SCADAPack E

357E Hardware Manual

Version: 8.14.3

Date: August 2017

Table of Contents

1 Legal Information

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

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.

Trademarks

Schneider Electric, ClearSCADA, SCADAPack, Trio, Modbus, and StruxureWare are trademarks and the property of Schneider Electric SE, its subsidiaries and affiliated companies. All other trademarks are the property of their respective owners.

Address

Schneider Electric

415 Legget Drive, Suite 101, Kanata, Ontario K2K 3R1 Canada
Direct Worldwide: +1 (613) 591-1943
Fax: +1 (613) 591-1022
Toll Free within North America: 1 (888) 267-2232
www.schneider-electric.com

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

⚠ WARNING

UNACCEPTABLE USE

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

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

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

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

Use only Schneider Electric software or approved software with Schneider Electric hardware products.

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

4 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.

Validity Note

This document is valid for the SCADAPack 357E.

Product Relation Information

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

Follow all local and national safety codes and standards.

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

Related Documents

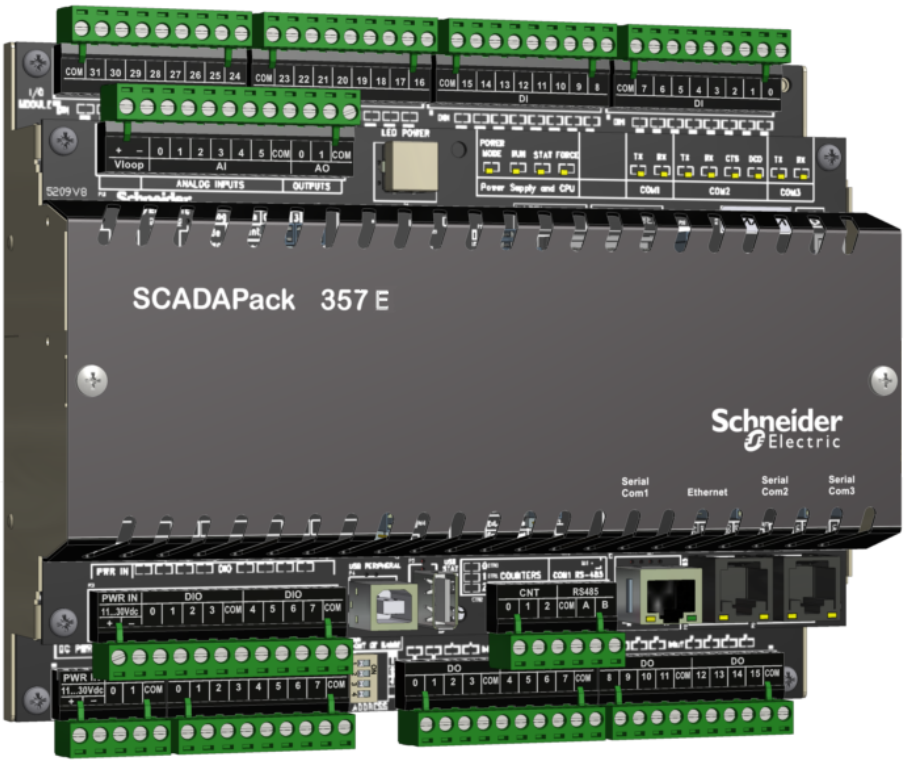
Use this manual with other manuals included in your SCADAPack E documentation set. The table below lists the main manuals for the tasks described. However, it is not a complete list of the manuals available to you. Please see the SCADAPack E Reference Manual set for a complete listing of manuals.

For Information About	See
The basic steps required to get your RTU up and running	• The Quick Start Guide for your RTU.
Configuring your RTU to communicate with other RTUs and with input and output (I/O) devices	• SCADAPack E Configurator User Manual • DNP3 Technical Manuals • Protocol Technical Manuals • Communication Interfaces Manual
Configuring security on your RTU	• Security Quick Start Guide • Security Administrator User Manual • Security Technical Reference Manual
Operating and troubleshooting your RTU	• SCADAPack E Operational Reference Manual
Installing SCADAPack E Target 5 Workbench, using it to build custom applications for the RTU and downloading the applications to the RTU	• SCADAPack Workbench Quick Start Guide • SCADAPack E Target 5 Technical Manuals
Installing ISaGRAF 3 Workbench, using it to build custom applications for the RTU and downloading the applications to the RTU	• ISaGRAF 3 Quick Start Guide • ISaGRAF 3 Technical Manuals
Adding I/O expansion modules	• SCADAPack E I/O Expansion Reference Manual • SCADAPack System Configuration Guide • I/O Expansion Module Hardware Manuals

5 Documentation Check

Before you begin installation, verify that you are viewing the correct documentation.

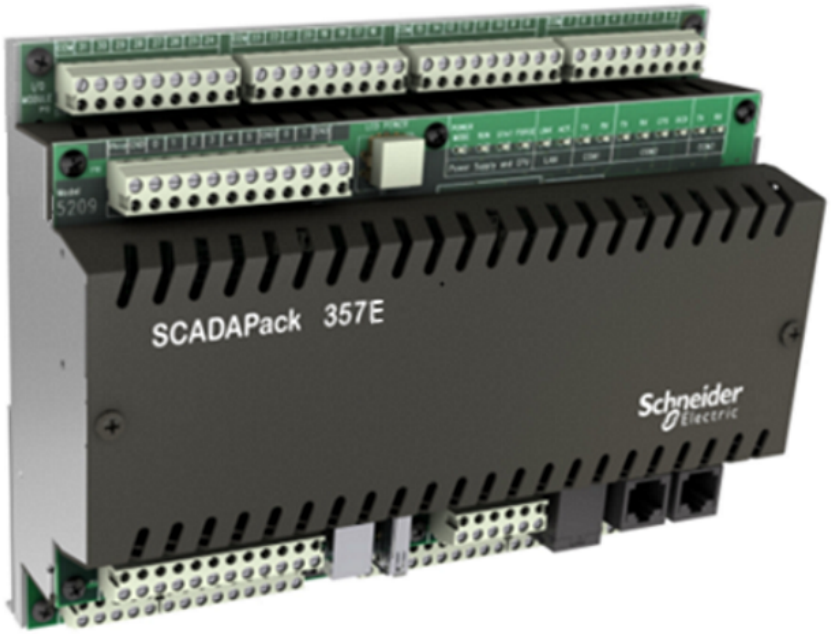
If your SCADAPack 357E looks like the figure below (green connectors and Ethernet and USB cables plug in at the front), continue to use this hardware manual.



SCADAPack 357E

If your SCADAPack E Smart RTU looks like this (with white connectors, green controller and I/O boards and the Ethernet port oriented such that you have to plug in the cable from below), you will need to get the SCADAPack 350 Hardware Manual (Legacy) and the SCADAPack 5606 Hardware Manual (Legacy).

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



SCADAPack 357E (previous version)

6 About the SCADAPack 357E

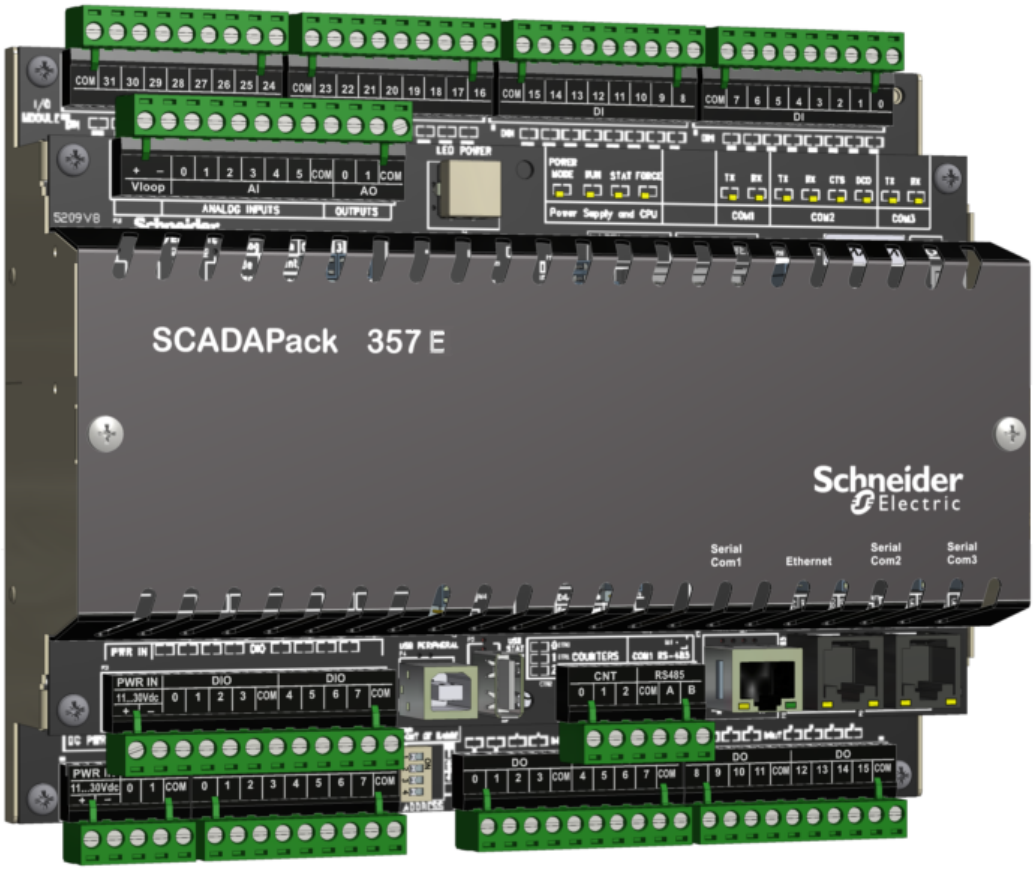
The SCADAPack E Smart RTU (Remote Terminal Unit) is an intelligent, microprocessor-based telemetry and control device. The SCADAPack 357E features extensive communications capabilities including Ethernet and USB interfaces and a powerful embedded micro-controller. Combined, these features provide the 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 SCADAPack 357E.

The SCADAPack 357E has an extensive on-board I/O capability. The on-board switch mode power supply allows a wide range of voltage operation from a single external voltage supply (11...30 Vdc).

The use of FLASH memory chips allows new firmware to be downloaded both locally and remotely via the interfaces of the SCADAPack 357E, without removing the SCADAPack 357E from its enclosure, or removing the cover.

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



SCADAPack 357E

Communications

The SCADAPack 357E includes three serial ports and one Ethernet port that are available for communications with:

- the SCADA master system
- other RTUs
- devices such as Programmable Logic Controllers (PLCs)
- the local configuration software

The SCADAPack 357E also includes a USB 2.0-compliant port (USB Peripheral Port) for local configuration.

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

The SCADAPack 357E provides the following DNP3 capabilities:

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

Inputs and Outputs

The SCADAPack 357E provides:

- 8 universal digital inputs/outputs
- 32 digital inputs
- 16 digital outputs
- 14 analog inputs
- 8 counter inputs

Up to four optional analog outputs are also available with the SCADAPack 357E. The analog outputs are ordered at the time of purchase. For further information, see Analog Outputs 52.

Configuration

You can configure the SCADAPack 357E using one of two methods:

- Locally or remotely using SCADAPack E Configuration, a software application that runs on a desktop or laptop computer that is connected to the RTU through the USB device port or through any of the available serial ports or Ethernet port.
- Locally using applications created in the SCADAPack Workbench or ISaGRAF 3 Workbench user programming tools. Typically, applications created in these tools extend and enhance the functionality provided by the RTU. However, you can also write applications that replace the

configuration functionality provided through the SCADAPack E Configuration software or the SCADA Expert ClearSCADA software.

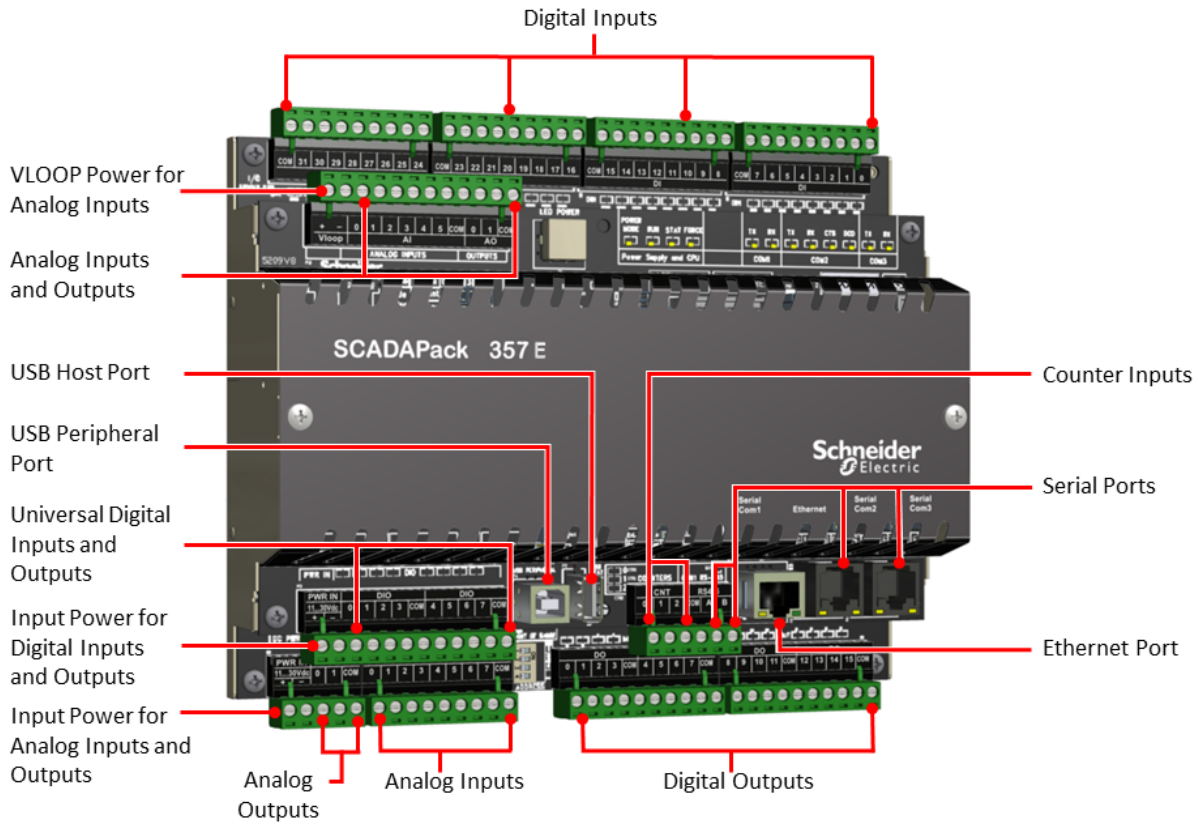
SCADAPack 357E configurations are maintained in the on-board battery backed RAM and can be modified locally or remotely.

Security

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

7 Hardware Overview

The figure below shows the location of the inputs, outputs and ports on the SCADAPack 357E.



SCADAPack 357E Input, Output and Port Locations

The SCADAPack 357E hardware is described in the following sections:

7.1 CPU, RAM and Storage

The SCADAPack 357E processing hardware includes the following components:

- CPU
- RAM

- Flash Storage

CPU

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

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

RAM

The onboard battery-backed RAM is used to store:

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

Flash Storage

The RTU provides internal flash storage as described by:

- Operating System Flash
- Boot Monitor Flash

Operating System Flash

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

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

Boot Monitor Flash

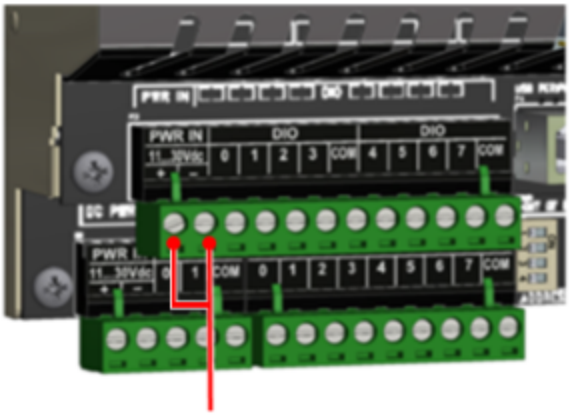
The boot monitor firmware resides in a separate flash memory chip on the RTU. The boot monitor firmware is the first code executed by the CPU when power is applied to the RTU. It configures the RTU hardware then verifies, loads and executes the operating system firmware.

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

7.2 Power Supply

The SCADAPack 357E is powered by an 11...30 Vdc power supply that is connected to the power input connectors on the RTU. The SCADAPack 357E generates sufficient power for the onboard circuitry, a SCADAPack Vision operator interface and a limited number of 5000 series I/O modules.

The figure below shows the location of the SCADAPack 357E power supply connections for the RTU.



Input Power Connectors for the RTU

SCADAPack 357E Power Supply Connections

For details about power supply requirements and wiring, see Power Supply Requirements 62.

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

Analog Input Wiring Example 105

Analog Output Wiring Example 112

Refer to Specifications 154 for the minimum and maximum operating voltages and input power requirements.

7.3 Back-Up Battery

A 3.6 V lithium battery provides back-up power to the real-time clock and RAM memory. The back-up battery provides power to the RAM to maintain the RTU configuration if a power-supply interruption occurs.

For information on how to replace the back-up battery, see:

Replacing the Battery 149

7.4 Serial Ports

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

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

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

- COM1 is a dedicated 2-wire RS485 port.
- COM2 can be configured for RS232 or 2-wire RS485.
- COM3 is a dedicated RS232 port.

The RTU provides the following DNP3 capabilities:

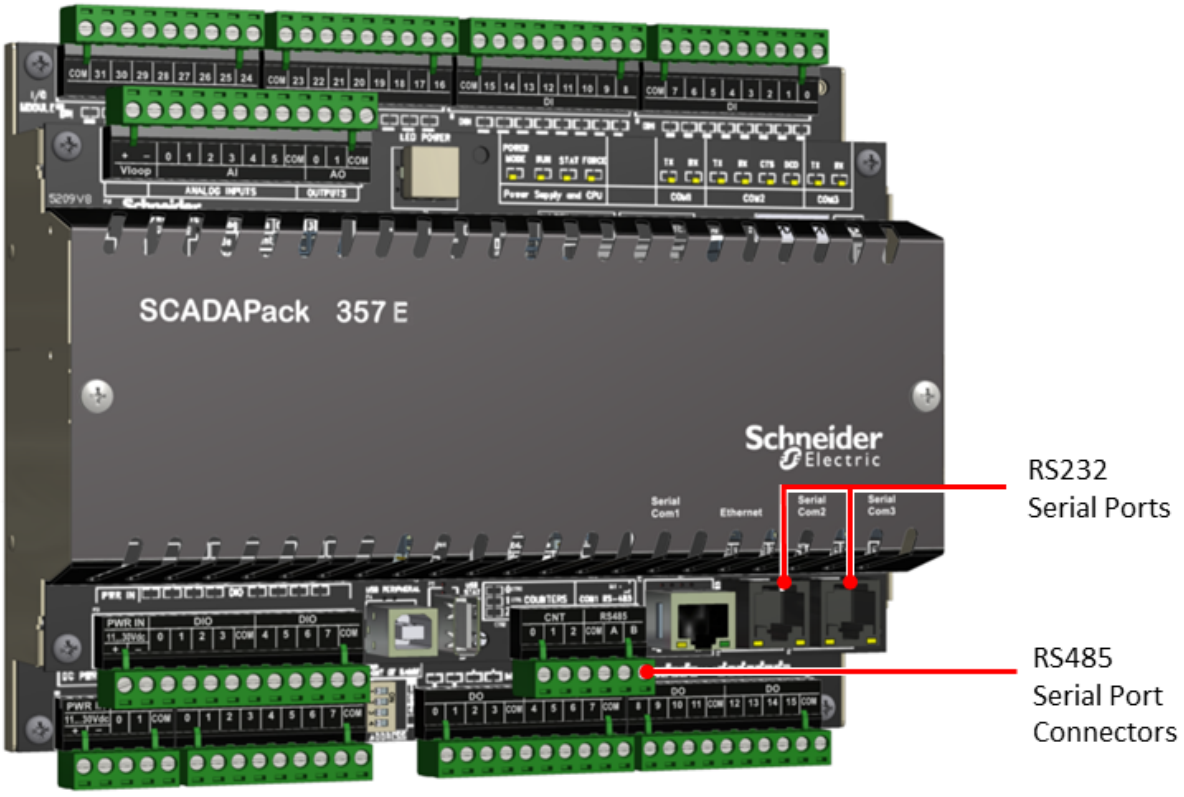
- SCADA data configuration
- Simultaneous DNP3 operation on multiple ports
- Networking DNP3 frames
- Peer-to-peer communication
- DNP3 over TCP/IP LAN and WAN networks

For more information, see the following:

RS232 Serial Communication Ports 23

RS485 Serial Communication Ports 31

The following figure shows the RS232 and RS485 port locations.



357E RS232 and RS485 Serial Port Locations

7.4.1 RS232 Serial Communication Ports

COM2 and COM3 support RS232 communication. RS232 wiring needs to use shielded cable. The shield should be connected to chassis ground at one point. Improperly shielding the cable may result in the installation not complying with Federal Communications Commission (FCC) or Department of Communications (DOC) radio interference regulations.

See the following for more information:

COM2 RS232 Serial Port 24

COM3 RS232 Serial Port 27

7.4.1.1 COM2 RS232 Serial Port

Serial port COM2 (Port 2) can be configured either as a six-line RS232 port or a two-wire RS485 serial communication port. For further information on RS485 operation, refer to: COM2 RS485 Serial Port 33.

To enable RS232 serial communication port operation, install the J13 header jumper link in position “RS-232” on the controller board.

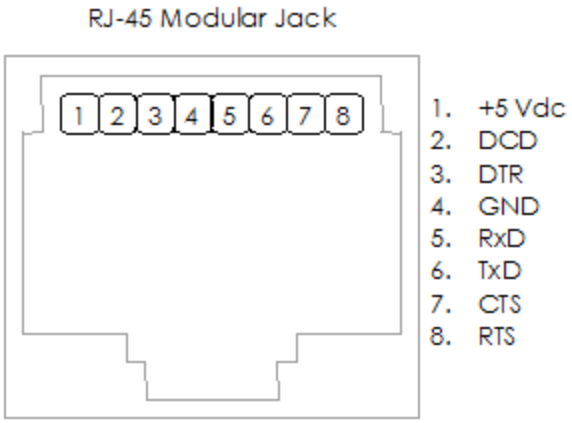
The following table shows the serial and protocol communication parameters supported by COM2. These parameters are set from SCADAPack E Configurator or from an application program running in the SCADAPack 357E controller. Default values are set when a **Factory Defaults Initialization** (Cold Boot) is performed on the SCADAPack 357E controller.

COM2 Serial and Protocol Communication Parameters

Parameter	Supported Values
Baud Rate	• 300 • 600 • 1200 • 2400 • 4800 • 9600 • 19200 • 38400 • 57600 • 115200 • Default: 9600
Duplex	• Full or Half depending on the Port Mode • Default: Full (RS232)
Data Mode	• 8-bit No Parity 1 Stop Bit • 8-bit Even Parity 1 Stop Bit • 8-bit Odd Parity 1 Stop Bit • 7-bit Even Parity 1 Stop Bit • 7-bit Odd Parity 1 Stop Bit • 8-bit No Parity 2 Stop Bits • Default: 8-bit No Parity 1 Stop Bit
Serial Port Control	• RS232 (RTS On)

Parameter	Supported Values
	• RS232 (RTS Off) • RS232 (RTS Keyed) • RS485 2-wire (Half Duplex)
Protocol	• None • ISaGRAF • DNP3 • Command Line • PLC Device • ISaGRAF-User • PPP/TCPIP • TCP service • Modbus RTU Slave • DNP VT service • IEC 60870-5-103 Master • IEC 60870-5-101 Slave or NTP GPS receiver
Configuration & Diagnostics	When referenced in SCADAPack E Configuration and Diagnostic facilities, this port is known as PORT2

Connections to COM2 are made through a RJ-45 modular connector. COM2 supports six signals plus ground and 5 V power. The following diagram shows the pin connections for the RS232 (RJ-45) port connector for COM2.



RJ-45 Connector Pinout

- The transmitters used in COM2 generate RS232 compatible ±5 Vdc levels. Cables should be limited to a maximum of 3 m (10 ft.)

- For RS232 operation, (RxD) J13 needs to have the jumper link in position RS-232.

The following table provides a description of the function of each pin of the RJ-45 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.

RJ-45 Connector Pin Description

Pin	Function	Description
1	5 Vdc (Output)	This pin can be connected to the 5 Vdc power supply by installing a jumper at J14 on the SCADAPack 357E. This 5 Vdc output is used to power Vision terminals and other Schneider Electric accessories. Check that cables connecting this pin have no voltage.
2	DCD (Input)	The DCD led is on for a **MARK** level.
3	DTR (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.

7.4.1.2 COM3 RS232 Serial Port

The following table shows the serial and protocol communication parameters supported by COM3. These parameters are set from SCADAPack E Configurator or from an application program running in the SCADAPack 357E controller. Default values are set when a **Factory Defaults Initialization** (Cold Boot) is performed on the SCADAPack 357E.

COM3 (Port 3) supports only the RS232 serial communications standard.

COM3 Serial and Protocol Communication Parameters

Parameter	Supported Values
Baud Rate	• 300 • 600 • 1200 • 2400 • 4800 • 9600 • 19200 • 38400 • 57600 • 115200 • Default: 9600
Duplex	Full or Half (protocol dependent)
Data Mode	• 8-bit No Parity 1 Stop Bit • 8-bit Even Parity 1 Stop Bit • 8-bit Odd Parity 1 Stop Bit • 7-bit Even Parity 1 Stop Bit • 7-bit Odd Parity 1 Stop Bit • 8-bit No Parity 2 Stop Bits • Default: 8-bit No Parity 1 Stop Bit
Serial Port Mode	RS232: DTR/DCD or VISION Display Mode (Jumper Selectable)
Serial Port Control	• RS232 (RTS On) • RS232 (RTS Off) • RS232 Keyed mode

Parameter	Supported Values
Protocol	• ISaGRAF • DNP3 • Command Line • PLC Device • ISaGRAF user • PPP/TCPIP • TCP service • Modbus RTU slave • DNP VT service • IEC 60870-5-103 Master • IEC 60870-5-101 Slave or NTP GPS receiver • None
Configuration & Diagnostics	When referenced in SCADAPack E Configuration and Diagnostic facilities, this port is known as PORT3

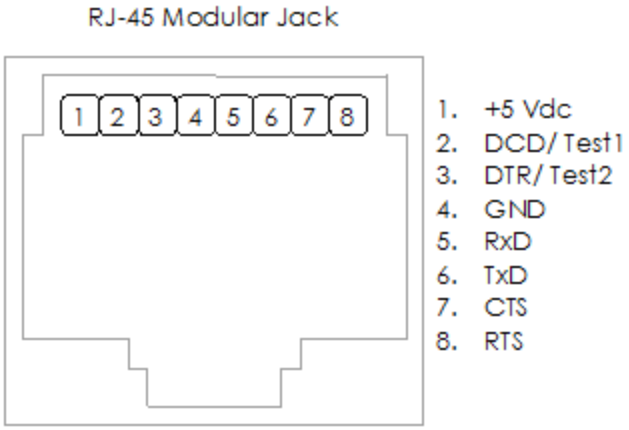
Connections to COM3 are made through an RJ-45 modular connector. COM3 supports six signals plus ground and 5 Vdc power. The SCADAPack 357E COM3 is designed to be able to operate with the SCADAPack Vision operator interface and has several special features noted below. Two of the signals (DTR and DCD) are shared with the test signals used to detect the **ON** switch closure on the Vision interface.

To use the signals as DTR, DCD jumpers J15 and J16 need to have their jumper links installed in position **Normal**.

To use the COM3 port with a Vision interface, jumpers J15 and J16 need to have their jumper links installed in position **Vision**. Refer to Jumper Functions 80 for the location of these jumpers.

For proper operation, both jumper links (J15 and J16) need to be installed in the same position, either **Vision** or **Normal**.

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



RJ-45 Connector Pinout

For COM3 RS232 serial port operation:

- +5 Vdc is available on Pin 1 when turned on by the user under program control or, provided J15 and J16 jumper links are in the **Vision** position, when the SCADAPack 357E detects the contact closure of the **ON** switch of the SCADAPack Vision or 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.
- The SCADAPack Vision **ON** switch is wired to Pins 2 and 3.

NOTICE
UNEXPECTED EQUIPMENT OPERATION If not using a SCADAPack Vision, ensure that J15 and J16 jumper links are in the **Normal** position to prevent a CPU interrupt due to a change in the state of the DCD signal. **Failure to follow these instructions can result in equipment damage.**

- The transmitters used in COM3 generate RS232 compatible ±5 Vdc levels. Cables should be limited to a maximum of 3 m (10 ft.)

The following table provides a description of the function of each pin of the RJ-45 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.

RJ-45 Connector Pin Description

Pin	Function	Description
1	5 Vdc (Output)	+5 Vdc power for the SCADAPack Vision. This 5 Vdc output is used to power Vision terminals and other Schneider Electric accessories. Check that cables connecting this pin have no voltage.

Pin	Function	Description
2	DCD / Test1 (Input)	With J15 and J16 jumper links in the **Normal** position, used as DCD signal. With J15 and J16 jumper links in the **Vision** position, used to detect SCADAPack Vision ON switch closure.
3	DTR / Test2 (Output)	With J15 and J16 jumper links in the **Normal** position, used as DTR signal. With J15 and J16 jumper links in the **Vision** position, used to detect SCADAPack Vision **ON** switch closure.
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.

7.4.2 RS485 Serial Communication Ports

Serial port COM1 on the SCADAPack 357E is configured as a two-wire RS485 serial communication port.

Serial port COM2 can be configured as either a two-wire RS485 port or as a six-line RS232 port.

RS485 wiring needs to use shielded cable. The shield should be connected to chassis ground at one point. Improperly shielding the cable may result in the installation not complying with Federal Communications Commission (FCC) or Department of Communications (DOC) radio interference regulations.

COM1 RS485 Serial Port 31

COM2 RS485 Serial Port 33

RS485 Bias and Termination Resistors 35

7.4.2.1 COM1 RS485 Serial Port

Serial port COM1 (Port 1) on the SCADAPack 357E controller is configured as a two-wire RS485 serial communication port.

COM1 transmits and receives differential voltages to other RS485 devices on a network. The RS485 communication specification allows a maximum of 32 devices connected on a single RS485 network. The specification for RS485 recommends that the cable length should not exceed 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. The SCADAPack 357E ground is connected to the chassis.

The following table shows the serial and protocol communication parameters supported by COM1. These parameters are set from SCADAPack E Configurator or from an application program running in the RTU. Default values are set when a **Factory Defaults Initialization** (Cold Boot) is performed on the SCADAPack 357E.

COM1 Serial and Protocol Communication Parameters

Parameter	Supported Values
Baud Rate	• 300 • 600 • 1200 • 2400 • 4800 • 9600 • 19200

Parameter	Supported Values
	• 38400 • 57600 • 115200 • Default: 9600
Duplex	Half
Data Mode	• 8-bit No Parity 1 Stop Bit • 8-bit Even Parity 1 Stop Bit • 8-bit Odd Parity 1 Stop Bit • 7-bit Even Parity 1 Stop Bit • 7-bit Odd Parity 1 Stop Bit • 8-bit No Parity 2 Stop Bits • Default: 8-bit No Parity 1 Stop Bit
Receive Flow Control	None
Transmit Flow Control	None
Protocol	• DNP3 • PLC Device • IEC 60870-5-103 Master • IEC 60870-5-101 Slave • Modbus RTU Slave • None • Default: None
Configuration & Diagnostics	When referenced in SCADAPack E Configuration and Diagnostic facilities, this port is known as PORT1

.

7.4.2.2 COM2 RS485 Serial Port

Serial port COM2 (Port 2) can be configured either as a six-line RS232 port or a two-wire RS485 serial communication port. For further information on RS232 operation, refer to: COM2 RS232 Serial Port 24.

To enable RS485 serial communication port operation, install the J13 header jumper link in position "RS485" on the controller board (see Jumper Functions) 79.

COM2 transmits to and receives differential voltages from other RS485 devices on a network. The RS485 specification allows a maximum of 32 devices connected on a single RS485 network. The RS485 specification recommends that the cable length should not exceed 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. Controller ground is connected to the chassis.

The following table shows the serial and protocol communication parameters supported by COM2. These parameters are set from SCADAPack E Configurator or from an application program running in the RTU. Default values are set when a **Factory Defaults Initialization** (Cold Boot) is performed on the SCADAPack 357E.

COM2 Serial and Protocol Communication Parameters

Parameter	Supported Values
Baud Rate	• 300 • 600 • 1200 • 2400 • 4800 • 9600 • 19200 • 38400 • 57600 • 115200 • Default: 9600
Duplex	• Half • Default: Half • Full or Half, depending on the Port Mode • Default: Half
Data Mode	• 8-bit No Parity 1 Stop Bit • 8-bit Even Parity 1 Stop Bit

Parameter	Supported Values
	• 8-bit Odd Parity 1 Stop Bit • 7-bit Even Parity 1 Stop Bit • 7-bit Odd Parity 1 Stop Bit • 8-bit No Parity 2 Stop Bits • Default: 8-bit No Parity 1 Stop Bit
Receive Flow Control	None
Transmit Flow Control	None
Protocol	• RS232 (RTS On) • RS232 (RTS Keyed) • RS485 2w • Hayes Modem • GPRS • 1xRTT • RS232 (RTS Off)
Port Function	• NONE • ISaGRAF • DNP3 • Command Line • PLC Device • ISaGRAF-User • PPP/TCPIP • TCP Service • Modbus Master (Modbus RTU) • Modbus Slave • DNP VT Service • IEC 60870-5-103 Master • IEC 60870-5-101 Slave • NTP GPS Receiver • SLIP • CSLIP

Parameter	Supported Values
Configuration & Diagnostics	When referenced in SCADAPack E Configuration and Diagnostic facilities, this port is known as PORT2

7.4.2.3 RS485 Bias and Termination Resistors

RS485 Bias Resistors

The RS485 receiver inputs on the controller are biased so that 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 in long networks operating at the highest baud rates. Networks as long 1200 m (4000 ft.) operating at 9600 baud will function without termination resistors. Terminations should only be considered if the baud rate is higher.

When termination resistors are required, they are installed on the first and last station on the RS485 wire pair. Other stations should not have termination resistors.

If required, RS485 networks are terminated with 120 ohm resistors on each end. The required 120 ohm resistor is 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 to generate at least 0.2 Vdc across 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. When J14 is installed, +5 Vdc is available on P8 pin 1.

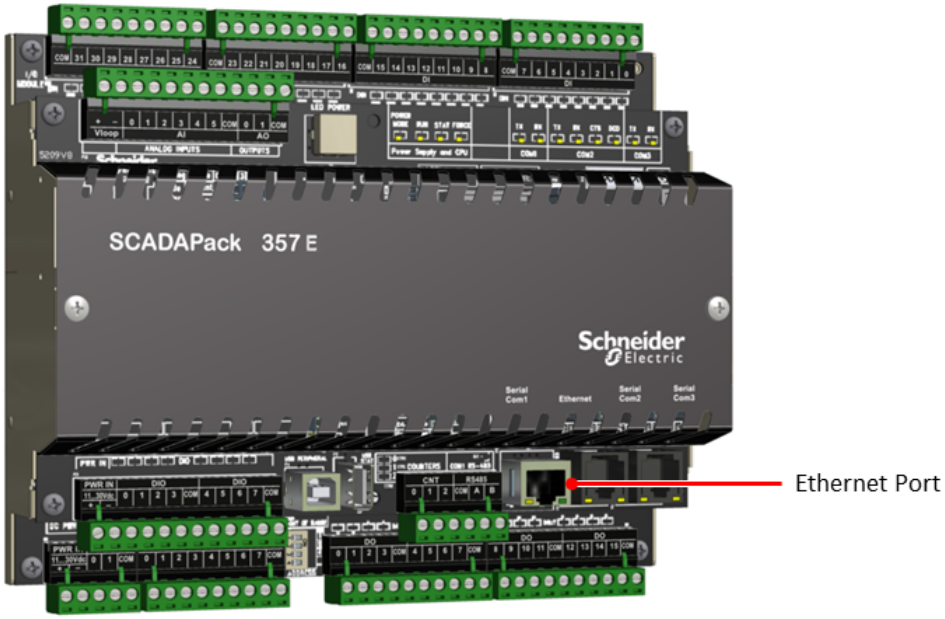
7.5 Ethernet Port

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

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

Connections to the Ethernet port are made through an RJ-45 modular connector. The wiring and pin connections for this connector are described in section RJ-45 Modular Connector for Ethernet 87.

The figure below shows the location of the Ethernet port.



SCADAPack 357E Ethernet Port

7.6 USB Ports

The SCADAPack 357E has two USB 2.0-compliant ports:

- USB Peripheral Port (Type B): Connects to a local peripheral such as a notebook computer and provides DNP3 communications for local connection to SCADAPack E Configurator. For further information, see USB Peripheral Port 37.
- USB Host Port (Type A): Not currently supported by SCADAPack E operating system.

⚠ WARNING

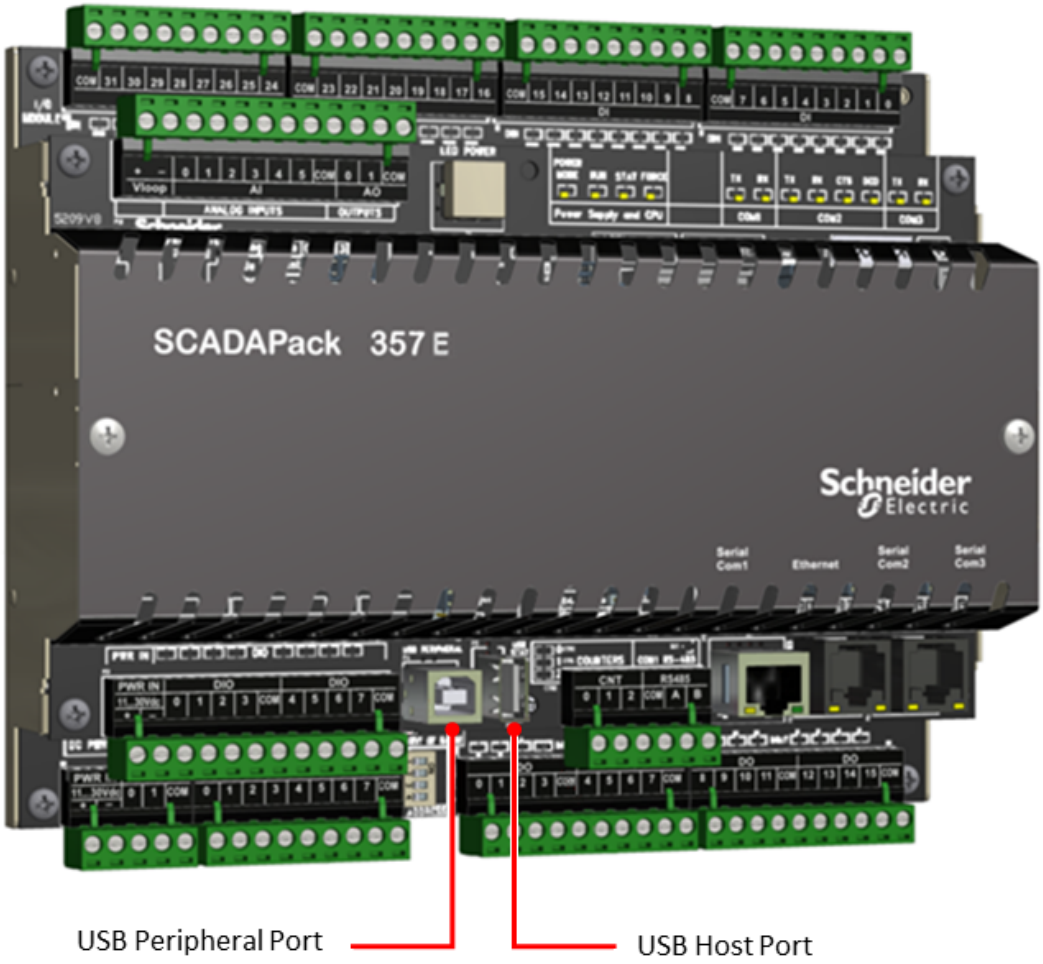
EXPLOSION RISK

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

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

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

The figure below shows the location of the two USB ports on the SCADAPack 357E.



SCADAPack 357E USB Ports

7.6.1 USB Peripheral Port

The peripheral port uses a USB series “Type-B” receptacle and supports both low-speed (1.5 Mb/s) and full-speed (12 Mb/s).

⚠ 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.

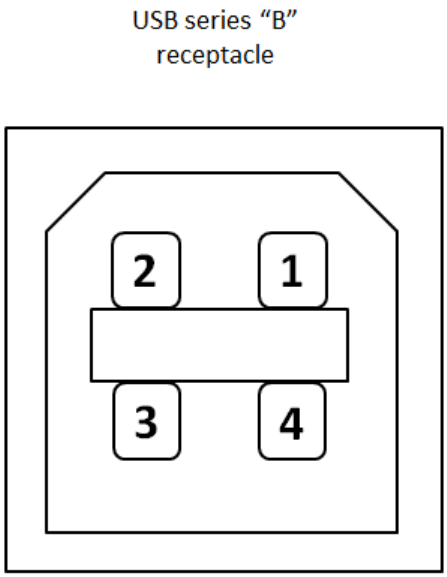
The peripheral port is used for local connection of SCADAPack E Configurator using DNP3 protocol.

A SCADAPack 357E will not draw any significant power from the host over the USB peripheral port.

USB Peripheral Port Communication Parameters

Parameter	Supported Values
USB	USB 2.0-compliant, Peripheral port
Data Rate	• Auto detect • Low-speed (1.5 Mb/s) and Full-speed (12 Mb/s)
Protocol	DNP3
Configuration & Diagnostics	When referenced in SCADAPack E Configuration and Diagnostic facilities, this port is known as PORT0

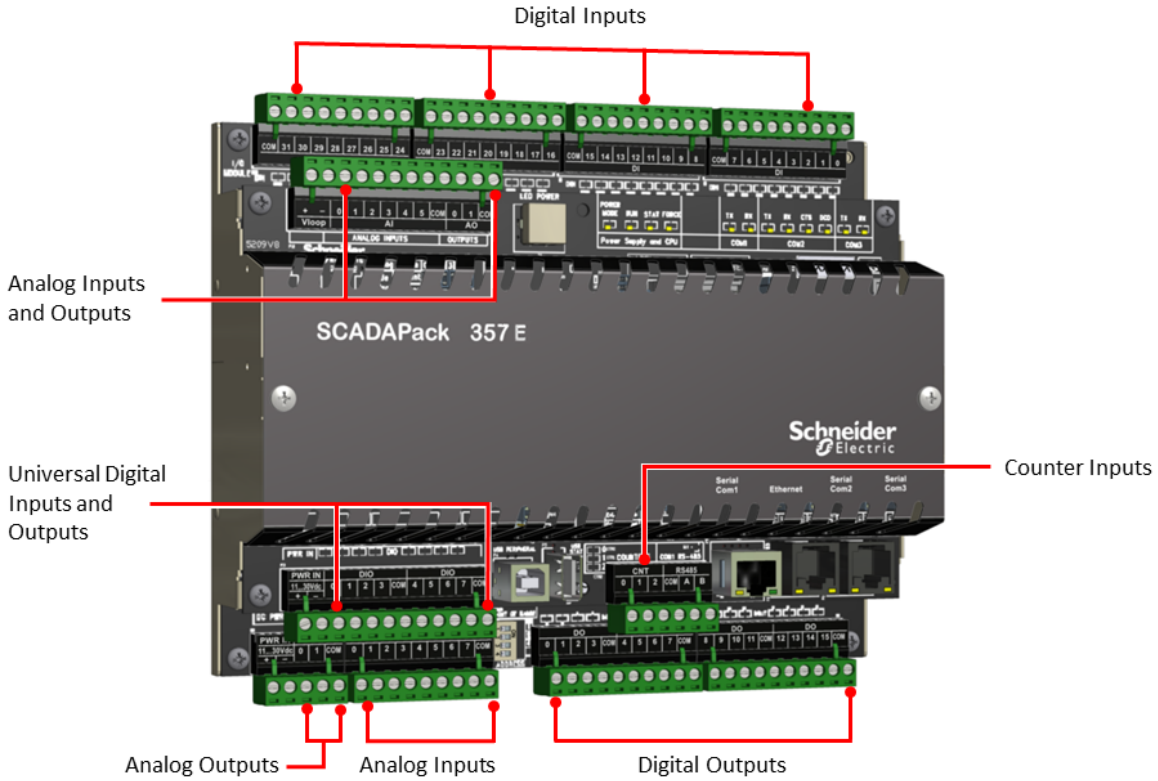
The following diagram shows the connections of the peripheral USB port.



Peripheral USB Port Connections

7.7 Inputs and Outputs

The figure below shows the location of the inputs and outputs on the SCADAPack 357E.



SCADAPack 357E Inputs and Outputs

The inputs and outputs on the RTU can be:

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

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

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

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

The following table describes the SCADAPack 357E input and output characteristics.

Name	RTU Label	Description
Counter Inputs 42 (0-2)	CNT 0	For use with open collector/drain output amplifiers
	CNT 1-2	For millivolt (mV) level turbine meters
Digital Inputs and Outputs 44 (0-7)	DIO 0-3 DIO 4-7	• Universal digital inputs/outputs • For use with dry contacts such as switches and relay contacts • Organized into two groups of four inputs. Each group shares a common return.
Digital Inputs 45 (0-31)	DI 0-7 DI 8-15 DI 16-23 DI 24-31	• Digital inputs • Optically isolated from logic power • Available in four standard voltage ranges • Organized into four groups of eight inputs. Each group shares a common return.
Digital Outputs 46 (0-15)	DO 0-7 DO 8-15	• Dry contact (mechanical) Form A or solid state relay (SSR) outputs • Organized into two groups of eight inputs. Each group shares two common returns.
Analog Inputs 47 (0-5)	AI 0-4	• Single-ended analog inputs • Jumper selectable for voltage inputs up to 10 Vdc or current inputs up to 40 mA. • For measurement of field data

Name	RTU Label	Description
	AI 5	• Single-ended analog input • For voltage mode only and will measure 0...32.768 Vdc • For battery monitoring
Analog Inputs 47 (0-7)	AI 0-7	• Single-ended analog inputs • Can be configured for current or voltage mode
Analog Outputs 52 (0-1 optional)	AO 0-1	Two 20 mA analog outputs on the top controller board
Analog Outputs 52 (0-1 optional)	AO 0-1	Two 20 mA analog outputs on the bottom I/O board

7.7.1 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.

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

- Assign RTU database point indexes to the counter In field(s) using the controller in **SCADAPack E Configurator's I/O > SCADAPack I/O** page.
- For Target 3 applications use an rtuXXctr Input Board or complex equipment type for the RTU to read the counters.
- For Target 5 applications use an RTU_COUNTER_READ I/O device for the RTU to read the counters.
- Use the counter input point directly by using a counter point in the RTU database for the assigned DNP Point Number.

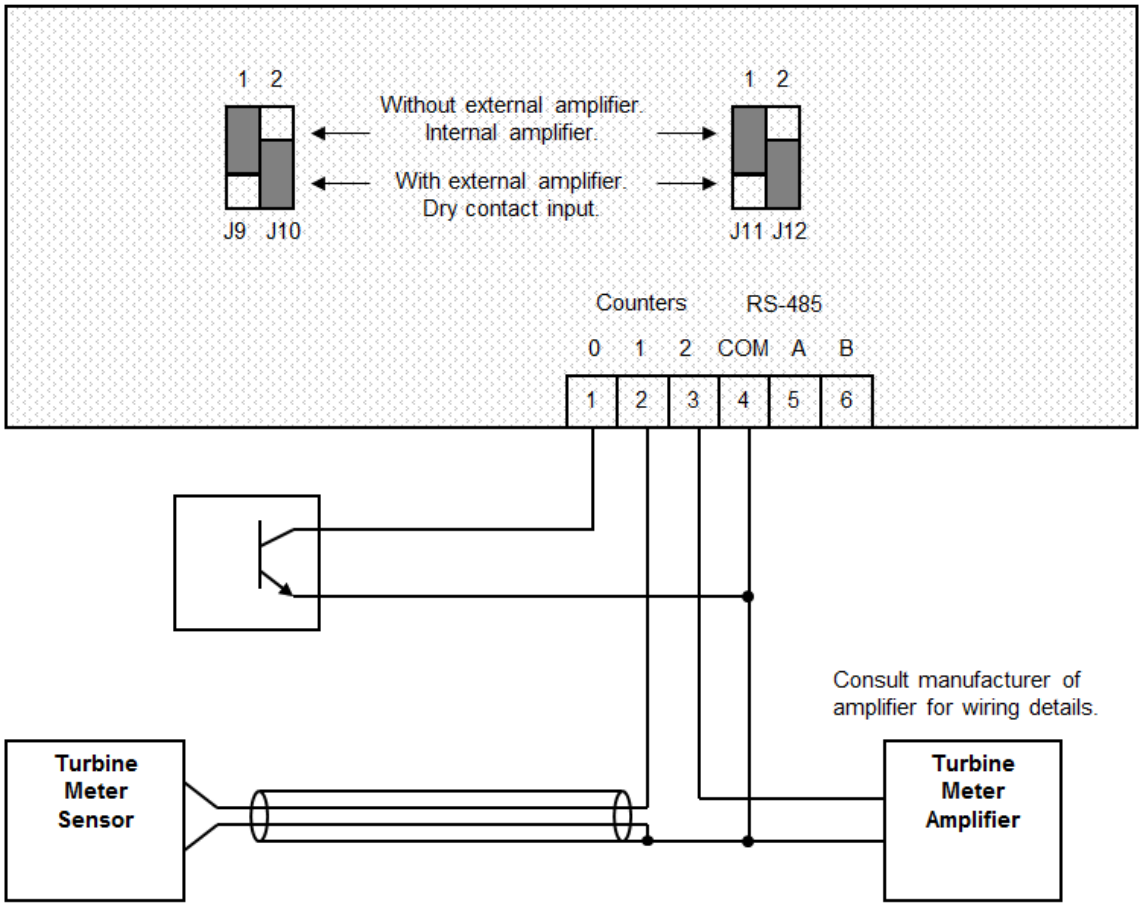
For more information on Counter Inputs, see:

Counter Input 0 42

Turbine Meter Counter Inputs 1 and 2 43

7.7.1.1 Counter Input 0

Counter Input 0 is used to count contact closures. The input circuitry includes a 1000 ohm resistor from the counter input to the 5 Vdc power supply. Refer to Counter Input Wiring 43 for an example of wiring to an open collector output.



Counter Input Wiring

Counter 1 is shown as a millivolt input with a direct connection to a turbine meter sensor. Shielded wiring is used and the shield is connected at one end only. Counter 2 is shown connected to an external turbine meter pre-amplifier.

See Turbine Meter Counter Inputs 1 and 2 43 for details on connecting to the turbine meter counter inputs.

7.7.1.2 Turbine Meter Counter Inputs 1 and 2

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

There are four jumper links positions: J9, J10, J11 and J12, 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.

Jumpers J9 and J11 enable the SCADAPack E Smart RTU pre-amplifier on turbine counter input 1.

Jumpers J10 and J12 enable the SCADAPack E Smart RTU pre-amplifier on turbine counter input 2.

7.7.2 Digital Inputs and Outputs

The SCADAPack 357E has the following digital inputs and outputs:

- 32 digital inputs
- 16 dry contact (mechanical) relay or solid state relay (SSR) outputs
- 8 universal, user configurable digital inputs and outputs. The inputs are for use with dry contacts such as switches and relay contacts. The RTU provides the wetting current for the contacts. Refer to SCADAPack 357E Inputs and Outputs 39 for the location of the digital inputs and outputs.

If LED power is enabled, the RTU continuously sources approximately 5 mA wetting current into each dry contact input. Indicator LEDs will be at their maximum brilliance if they are illuminated, which assists in field service and diagnostics.

If LED power is disabled, the wetting current is turned on only when the digital inputs are scanned by the RTU. Indicator LEDs are dim in this condition. This is normal.

Digital inputs and outputs can be used to monitor or control panel lamps, relays, motor starters, solenoid valves, and other devices.

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

The relay outputs are suited to applications that cannot tolerate any off-state leakage current, that require high load currents, or that involve non-standard voltages or current ranges.

Configuration

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

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

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

Specifications

For digital input and output specifications, see Specifications 154.

Wiring

Digital inputs and outputs support solid or stranded wires from 3.3...0.08 mm^2 (12...28 AWG).

For more information, see Wiring Screw-Termination Connectors 77.

Refer to the appropriate software manual for information on using the SCADAPack 357E digital inputs and outputs in application programs.

NOTICE
UNEXPECTED EQUIPMENT OPERATION External lightning protection is required if the device being controlled is outside the physical area (cubicle or building) in which the SCADAPack 357E is located. **Failure to follow these instructions can result in equipment damage.**

7.7.2.1 Digital Inputs

The RTU has 32 digital inputs. In addition, the RTU has eight, user configurable universal digital inputs/ outputs.

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

To simplify field wiring, the 32 inputs are organized into four 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. Inputs 16 to 23 are in a third group. Inputs 24 to 31 are in the final group.

The following digital inputs can be read from a user application:

User Application Digital Inputs

Input	Type	Description
0 to 7	external	Dry contact inputs These inputs are located on terminal P3 0 = contact open (associated LED is off) 1 = contact closed (associated LED is on)
8	internal (**50610**)	VLOOP output status 0 = off 1 = on See VLOOP Power Control 133 for details.
9	internal	DC/DC converter status

Input	Type	Description
	(**50751**)	This bit reports the true status of the DC/DC converter. If over-current causes the converter to be turned off, this bit will clear. 0 = off 1 = on See 12V to 24V DC/DC Converter Control 135 for details.
10	internal (**50760**)	VLOOP over-current status Indicates VLOOP over-current has been detected. This input clears when VLOOP output is off, or the over-current condition clears. 0 = off 1 = on See VLOOP Over-Current Protection 134 for details.
11	internal	Digital output mismatch Known outputs are compared to the corresponding inputs to detect incorrect outputs. A point is compared if it has been turned on at any time since RTU reset. This input indicates if one or more outputs mismatch. The source of the mismatch can be determined by comparing each digital input against the corresponding digital output. 0 = off 1 = on
12	Internal (**50750**)	COM3 (HMI) power 0 = off 1 = on See COM3 Serial Port Power Control 132 for details.

7.7.2.2 Digital Ouputs

The RTU has 16 digital outputs. In addition, the RTU has eight, user configurable universal digital inputs/ 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 16 digital outputs are either dry contact (mechanical) relay or solid state relay (SSR) outputs.

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

Digital outputs are open-collector/open drain type for use with sustained DC loads up to 1 ampere. Higher peak loads can be tolerated.

The negative side of the load is connected to the desired terminal on the controller board terminal block P3. The positive side of the load connects to a power supply. When the load is on, the load current is switched through the controller board to the terminal labeled GND. GND needs to be connected to the negative side of the power supply.

Inductive load transient suppression is built into each digital output point. It is not necessary to add additional inductive load transient suppression unless highly inductive loads (greater than 1 H) are operated continuously at greater than 0.5 Hz.

7.7.3 Analog Inputs

The SCADAPack 357E has 14 analog inputs as follows:

- 6 single-ended analog inputs. These inputs are available for external wiring to measure field data.
- 8 single-ended analog inputs on connector P4. These inputs can be configured for current or voltage mode.

The six single-ended analog inputs provide 15-bit resolution over the range of the input. Five inputs can be configured for voltage or current mode. The sixth input is available for voltage mode only and measures 0...32.768 Vdc. This input can be used to monitor the input power or a battery voltage.

The six analog inputs are identified as Channel 0 through Channel 5. These inputs are transient protected and share a common return (COM) that is connected to the chassis. Refer to the following table for the location of the analog inputs.

Controller Board Inputs	Type	Description
0 to 4	external	Jumper selectable for voltage inputs up to 10 Vdc or current inputs up to 40 mA. See Analog Input Mode Jumpers 49 for further information.
5	external	0...32.768 Vdc for battery monitoring

Access to the analog input points in a user application is achieved using an I/O connection in ISaGRAF. Refer to the SCADAPack E Target 3 Technical Reference Manual for more information.

When configured for current mode, a 250 ohm current sense resistor will produce a 5 Vdc input at 20 mA. See Analog Inputs Mode Jumpers and Data Format 49 for information on setting the range.

When assigning RTU database points to the SCADAPack 357E controller board channels using

SCADAPack E Configurator, the user is given an opportunity to select the mode of operation for each analog input channel. See Range and Resolution 50.

The SCADAPack 357E RTU provides an internal system point for monitoring the RTU input power supply. This is independent of AI Channel 5, allowing it to be used for other purposes. See Internal Supply Voltage 139 for more information.

Internal Analog Points are provided for monitoring of onboard controller variables. These can be used in a user application to monitor input voltage, RAM battery voltage, controller board ambient temperature and DC\DC converter voltage used for VLOOP. Access to the analog input points in a user application is achieved using an I/O connection in ISaGRAF. Refer to the SCADAPack E ISaGRAF Technical Reference manual for more information. For information on wiring of the external inputs, see Analog Output Wiring 110.

The eight analog inputs are identified as Channel 0 through Channel 7. These inputs are transient protected and share a common return (COM) that is connected to the chassis. Refer to the following table for the location of the analog inputs.

I/O Board Inputs		
0 to 7	external	Software configurable for Voltage or Current mode. Voltage mode: range is 0...5 Vdc or 0...10 Vdc Current mode: range is 0...20 mA or 4...20 mA

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 50 for information on how to choose input modes.

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

Configuration

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

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

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

Specifications

For analog input specifications, see Specifications 154.

Current or Voltage Mode 50

Range and Resolution 50

Wiring

Analog inputs support solid or stranded wires from 3.3...0.08 mm^2 (12...28 AWG).

For more information, see Wiring Screw-Termination Connectors 77.

7.7.3.1 Analog Input Mode Jumpers and Data Format

Analog Input Mode Jumpers

Channels 0 through 4 can be configured for either voltage or current operation using jumper links.

A sample illustration of the analog input mode selection using jumpers J1-J5 is provided in Analog Input Wiring 105. A jumper link installed in the **Current** position of the header results in a 250 ohm resistor across the appropriate analog input. A jumper link installed in the **Voltage** position of the header results in a high impedance analog input.

Refer to Jumper Functions 79 for the location of the analog input mode selection jumpers.

Analog Input Data Format

The analog inputs have a 16-bit, unipolar, analog to digital (A/D) converter that measures input voltages from 0...10 Vdc. The analog inputs are factory calibrated to scale the data and represent it with a 15-bit unsigned number.

The following Input Type ranges can be configured by SCADAPack E Configurator for each SCADAPack 350E analog input channel:

- 0...10 Vdc / 0...40 mA
- 0...5 Vdc / 0...20 mA
- 1...5 Vdc / 4...20 mA

To select **Voltage** or **Current** mode for each analog input channel, set the Analog Inputs Mode Jumpers on the controller board.

When an analog input is configured for a voltage mode, 10 Vdc input is represented with 15 bits of data. The input resolution is 0.305 mV per A/D count from the A/D converter. The Input Type voltage range selected is scaled to the **Raw Min**. to **Raw Max**. range configured for the individual analog input point when point integer values are used. The **Eng. Min. to Eng. Max.** range for the point is used to scale the analog input **Engineering Floating Point** database value.

When an analog input is configured for current mode, 40 mA input is represented with 15 bits of A/D data. The input resolution is 1.22 µA per A/D count. The **Input Type** current range selected is scaled to the **Raw Min. to Raw Max.** range configured for the individual analog input point when point integer values are used. The **Eng. Min. to Eng. Max.** range for the point is used to scale the analog input **Engineering Floating Point** database value.

For example, if a SCADAPack 350E analog input point's attributes are **RAW_MIN = 0, RAW_MAX = 10000** and the input channel is selected for 4...20 mA: a 20 mA input is 100% of the selected input signal range and corresponds to 10000 counts. a 4 mA input is 0% of the selected input signal range and corresponds to 0 counts.

See SCADAPack E **Data Processing Technical Reference** manual for more information on scaling.

Channel 5 analog input is configured for voltage mode only. 32.768 Vdc is represented with 15 bits of data. The input resolution is 0.001 Vdc/count.

7.7.3.2 Current or Voltage Mode

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

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

NOTICE
UNINTENDED EQUIPMENT OPERATION This module must be the only loop current measurement device in the loop when using the analog inputs in the 20 mA measurement mode. If power to the module is removed, the module reverts to voltage mode and results in an open current loop. Applications that cannot tolerate this possibility require external current sense resistors, with the module input range set to voltage. **Failure to follow these instructions can result in equipment damage.**

7.7.3.3 Range and Resolution

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

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

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

- 0...5 Vdc
- 0...10 Vdc
- 0...20 mA
- 4...20 mA

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

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

corresponds to 10000 counts. A 4 mA input is 0% of the selected input signal range and corresponds to 0 counts.

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

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

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

7.7.4 Analog Outputs

The SCADAPack 357E has up to four optional 20 mA analog output channels. These outputs are optional and are requested at the time of purchase.

Refer to the SCADAPack E Target 3 Manuals and the SCADAPack E Target 5 Manuals for information on how to use the SCADAPack 357E analog outputs in application programs. Use an I/O connection in ISaGRAF to access the analog output registers.

Analog output channels can be directly controlled from the following SCADAPack E communications protocols without the need of a SCADAPack Workbench or ISaGRAF 3 Workbench application:

- DNP3
- Modbus
- IEC 60870-5

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

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

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

Configuration

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

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

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

Specifications

For analog output specifications, see Specifications 154.

Current and Voltage Outputs 53

Range and Resolution 54

Wiring

Analog outputs support solid or stranded wires from 3.3...0.08 mm^2 (12...28 AWG).

For more information, see Wiring Screw-Termination Connectors 77.

7.7.4.1 Current and Voltage Outputs

Current Outputs

The optional analog outputs use a 12-bit, unipolar, digital to analog (D/A) converter. There are 4096 discretization steps in the output signal range. The 0...20 mA output range resolution is 4.88 µA per D/A count.

One of the following ranges can be configured on the **SCADAPack E Configurator I/O > SCADAPack I/O** page for either the controller board or the I/O board. Both analog output channels use the same range:

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

Configuration for points attached to the optional analog output channels uses the SCADAPack E **Raw Min. to Raw Max.** and **Eng. Min. to Eng. Max.** parameters for integer and engineering scaling, respectively. These scaling ranges automatically apply to the analog input signal range selected by SCADAPack E Configurator for the analog **Output Type** (0...20 mA or 4...20 mA).

The internal power supply powers the analog output circuits. The user can, under program control or by selection on SCADAPack E Configurator, boost the DC input power to 24 Vdc. Boosting the DC input power is required when generating current outputs into high resistance loads. Refer to 24 V DC/DC Converter Control 135 for more information on how to boost DC input power.

For example wiring of the analog outputs, see:

Analog Output Wiring 112

Voltage Outputs

To obtain voltage outputs, connect a load resistor in series with the current output channel and the voltage device across the load resistor.

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

Resistance Values and Output range Settings

Voltage Range	Resistance	Output Range
0...5 Vdc	250 ohms	0...20 mA
0...10 Vdc	500 ohms	0...20 mA

For example wiring of the analog outputs, see:

Analog Output Wiring 112

7.7.4.2 Range and Resolution

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

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

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

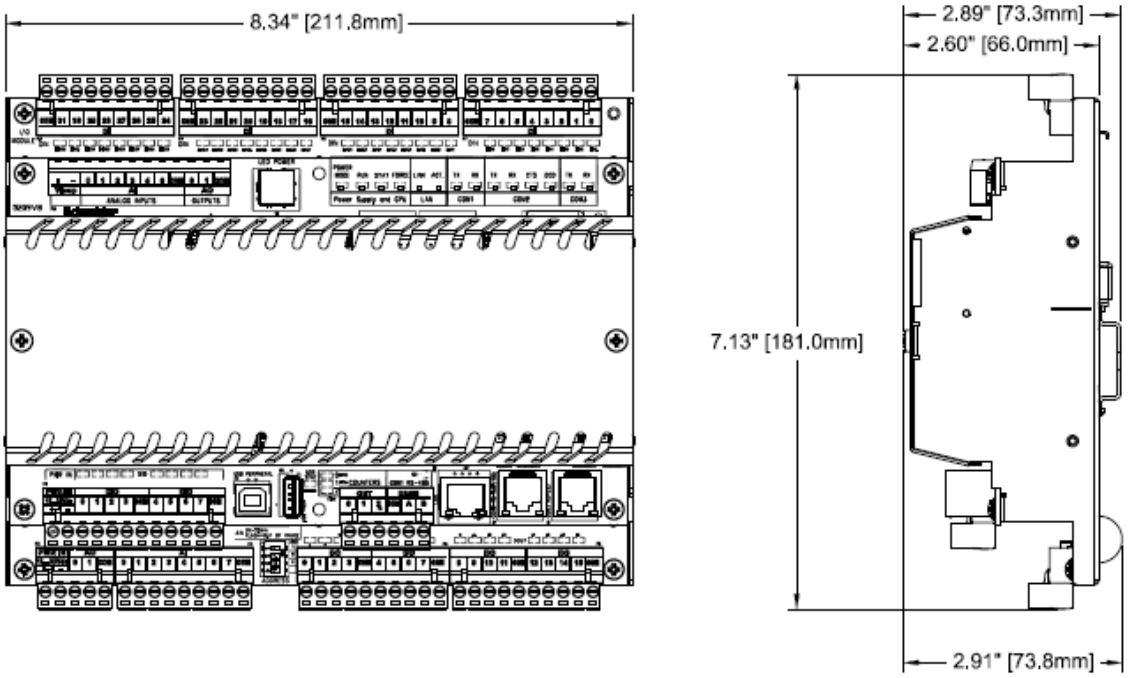
Configuration for points attached to the optional analog output channels uses the SCADAPack E **Raw Min.** to **Raw Max.** and **Eng. Min.** to **Eng. Max.** parameters for integer and engineering scaling, respectively.

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

8 Installation

The installation of the RTU requires mounting it on the 7.5 mm x 35 mm (0.30 in. x 1.38 in.) DIN rail and optionally connecting the RTU to a system I/O Bus.

The following diagram shows the dimensions of the SCADAPack 357E.



SCADAPack 357E Dimensions

For more information, see:

For ATEX and IECEx Applications Only 56

System Grounding 57

Mounting the SCADAPack 357E 59

Power Supply Overview and Requirements 21

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

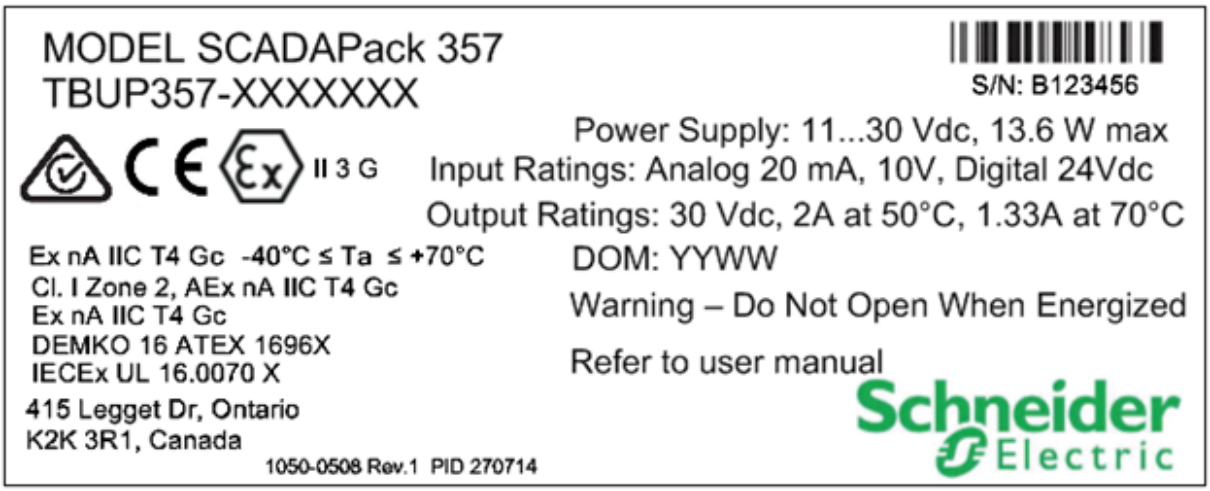
- Only install this equipment under the following conditions:

Conditions of Safe Use

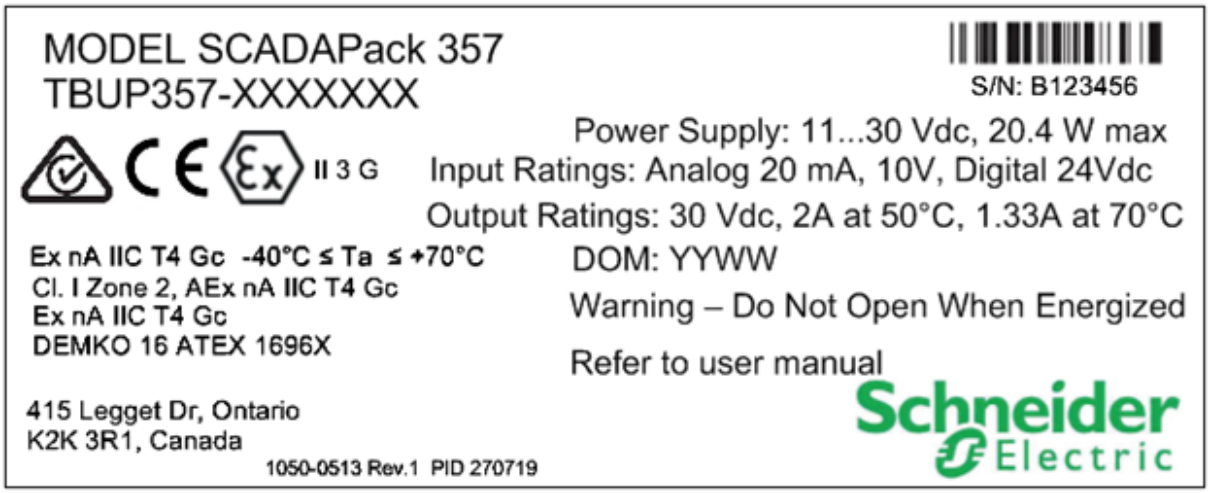
- Only use this equipment in an area not exceeding pollution degree 2, as defined in EN/IEC 60664-1.
- Install this equipment in an enclosure certified for use, that is tool accessible only and provides a degree of protection of IP54 or better, in accordance with EN 60079-15.
- Provide transient protection at a level that does not exceed 140% of the peak rated voltage value at the supply terminals to the equipment.
- The free internal volume of the enclosure must be dimensioned in order to keep the temperature rating.
- For products using solid state relays (5606 and 5607 I/O modules and RTUs using these modules), a T4 rating is acceptable for maximum loads of 1.33 A. When 2 A loads are connected to the solid state relays, the maximum ambient rating is lowered to 50 °C (122 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 SCADAPack 357E with no radio:



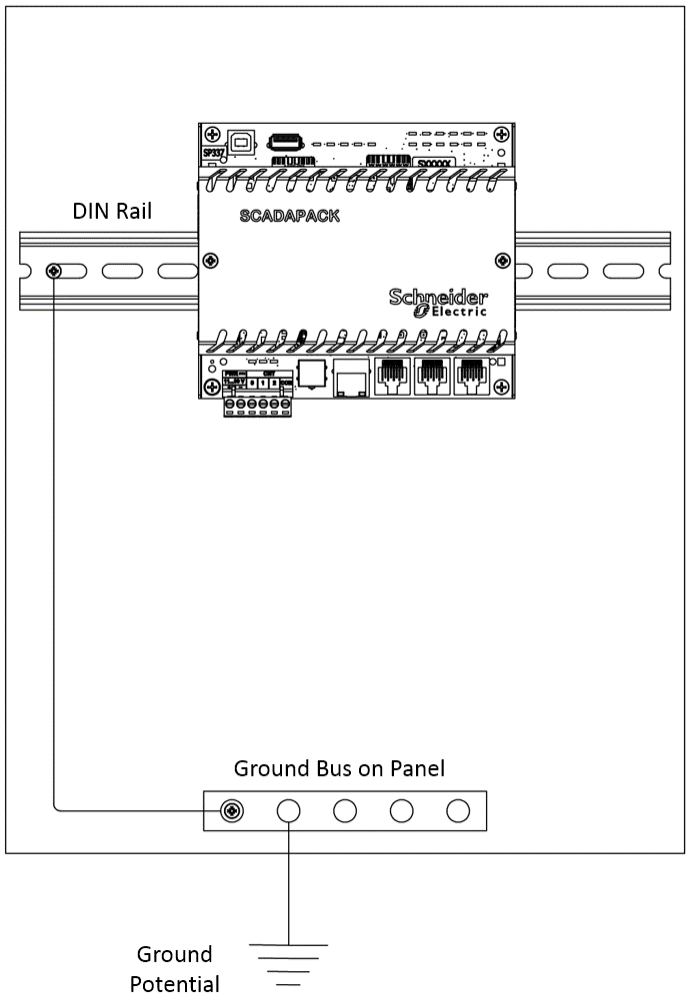
The following product label appears on SCADAPack 357E with a radio:



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 E RTU

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

⚠WARNING

ELECTRICAL HAZARD

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

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

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

NOTICE

UNINTENDED EQUIPMENT OPERATION

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

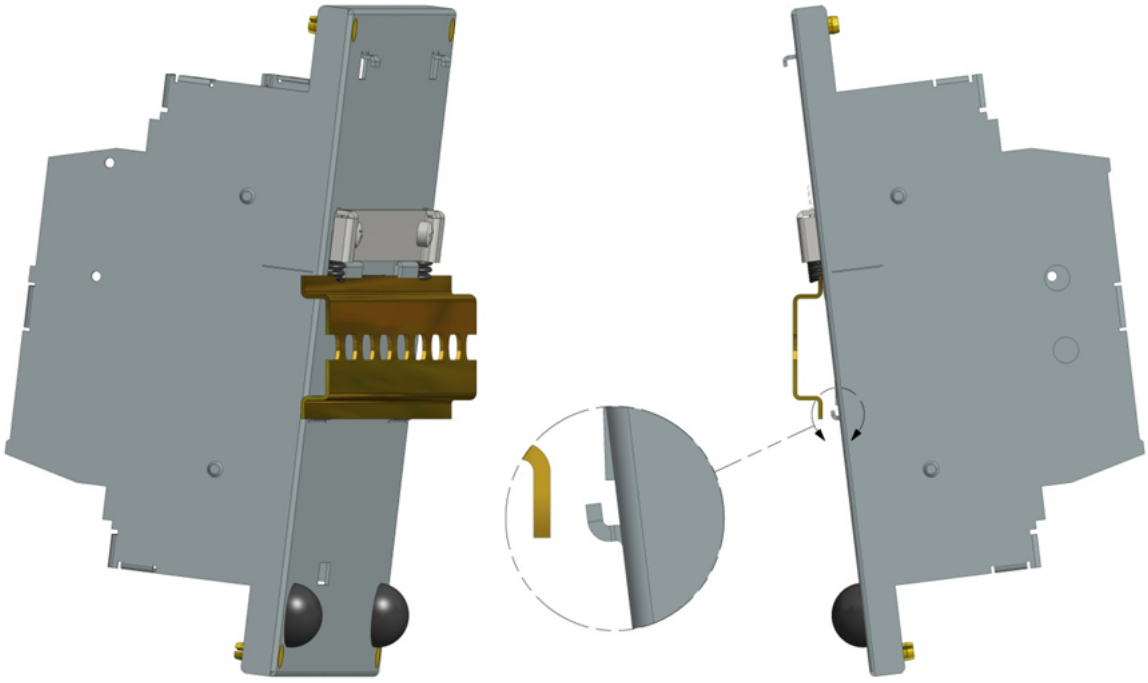
Failure to follow these instructions can result in equipment damage.

To Mount the SCADAPack E Smart RTU on a DIN Rail

The illustrations below show the correct way to mount the device on a horizontally oriented 7.5 mm by 35 mm (0.30 in. by 1.38 in.) 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.

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

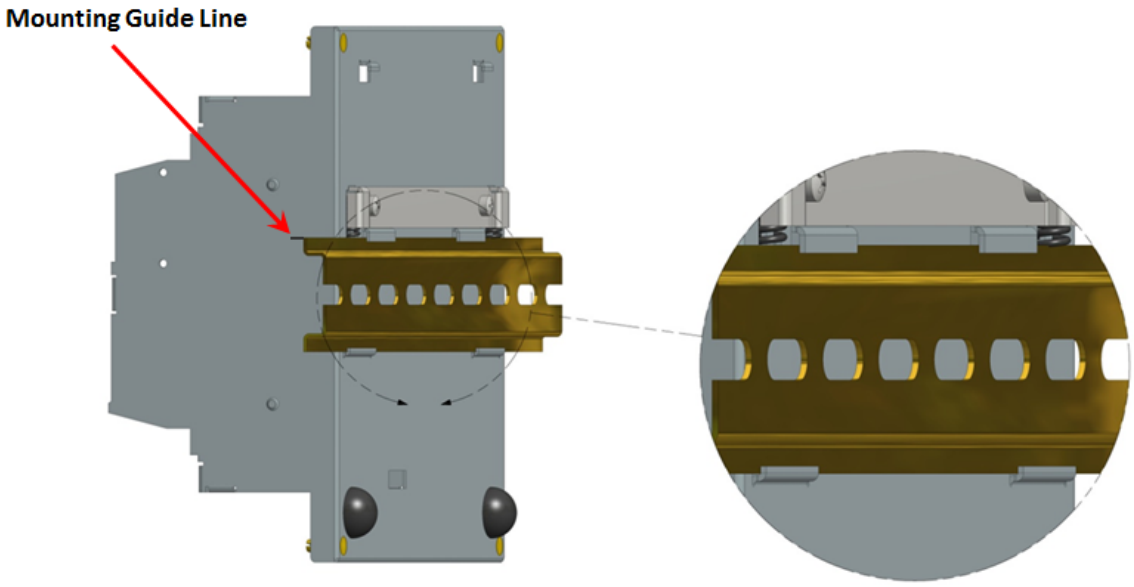


DIN Rail Alignment for RTU Mounting

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 should be aligned with the edge of the DIN rail.

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



Rear View of a Correctly Mounted SCADAPack 357E

The figure below shows the front view of a device that is mounted on a horizontally oriented DIN rail.

SCADAPack 357E Mounted on a Horizontally Oriented DIN Rail

8.4 Power Supply Requirements

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

- Input power is applied to the positive (+) and negative (-) terminals on connector P3.

  Refer to the Specifications 154 for the minimum and maximum operating voltages and input power requirements.

- When the input voltage is below the minimum recommended voltage the RTU will turn off.
- Exceeding the maximum input voltage or applying a reverse voltage will blow the input power fuse.

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

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

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

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

The input power supply must be a filtered DC supply.

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

NOTICE

UNEXPECTED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

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

The power available for any 5000 Series expansion I/O modules is limited. Refer to the Specifications 154.

For 12 Vdc input voltages, an onboard DC/DC converter with an output capacity of 3.36 W (24 Vdc at 140 mA) can be used to power five 20 mA analog inputs and two 20 mA output devices (loop-powered transmitters). The 24 V DC/DC converter is controlled by the user application program and may be turned on or off.

Refer to Section 24 V DC/DC Converter Control 135 for more information on DC/DC converter control.

8.4.1 Power Calculations

This topic describes power calculations for the SCADAPack 357E with no I/O expansion modules connected to the RTU. Power requirements depend on the number of connections used on a single RTU.

The power requirements specified are for operation at 25 °C (77 °F). For operation at the extremes of the temperature range, -40...70 °C (-40...158 °F), add 0.3 W. For information on power for compatible external I/O expansion modules and power output for expansion power supplies, see the appropriate I/O hardware manual specifications.

For information on power calculations, see:

Determining if an Expansion Power Supply is Required 63

Calculating the Total Power Supply Requirements 64

Calculating the Total Power Supply Requirements for Vloop 65

8.4.1.1 Determining if an Expansion Power Supply is Required

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

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

L1 + L2 + L3 + L4 = C

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

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

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

RTU	312E	313E, 314, 314E	330, 330E	333E, 334, 334E	337E	350E	357E
Capacity							

See Calculating the Total Power Supply Requirements 64 and Calculating the Total Power Supply Requirements for Vloop 65.

8.4.1.2 Calculating the Total Power Supply Requirements

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

To calculate the total power supply requirements

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

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

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

   1.2 – A + C = E

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

3. Determine the power required by the controller using:

   E x 5.9 = F

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

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

   F/D = G1

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

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

   G1 + G2 + G3 = H

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

8. Calculate the total power requirement using:

   D x H = J

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

8.4.1.3 Calculating the Total Power Supply Requirements for Vloop

You can calculate the additional power supply requirements for boosted or un-boosted Vloop on the 350E or 357E.

To determine the additional power supply requirements for Vloop

1. Determine the current required to support up to 7 analog inputs and outputs at 20 mA each to a maximum of 140 mA, (**K**), in Amps.
2. Calculate the power required by Vloop, if Vloop is boosted to 24 Vdc:

   K x 27 = L1

Value	Description	Units
K	Current required to support up to 7 analog inputs and outputs at 20 mA each to a maximum of 140 mA	A
L1	Power required by Vloop, if Vloop is boosted to 24 Vdc	W

3. Calculate the power required by Vloop, if Vloop is not boosted and follows Vdc In:

   D x K = L2

Value	Description	Units
D	System voltage	V
K	Current required to support up to 7 analog inputs and outputs at 20 mA each to a maximum of 140 mA	A
L2	Power required by Vloop, if Vloop is not boosted and follows Vdc In	W

4. Calculate the total power supply requirements with Vloop included using either of the following formulas:

   L1 + J = Total power supply requirement with Vloop included

   or

   L2 + J = Total power supply requirement with Vloop included

Value	Description	Units
L1	Power required by Vloop, if Vloop is boosted to 24 Vdc	W
L2	Power required by Vloop, if Vloop is not boosted and follows Vdc In	W
J	Total power requirement with Vloop included	W
	Total power supply requirement with Vloop included	W

8.4.2 Power Supply Wiring

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

For basic power supply wiring for the RTU, see Basic Wiring 68.

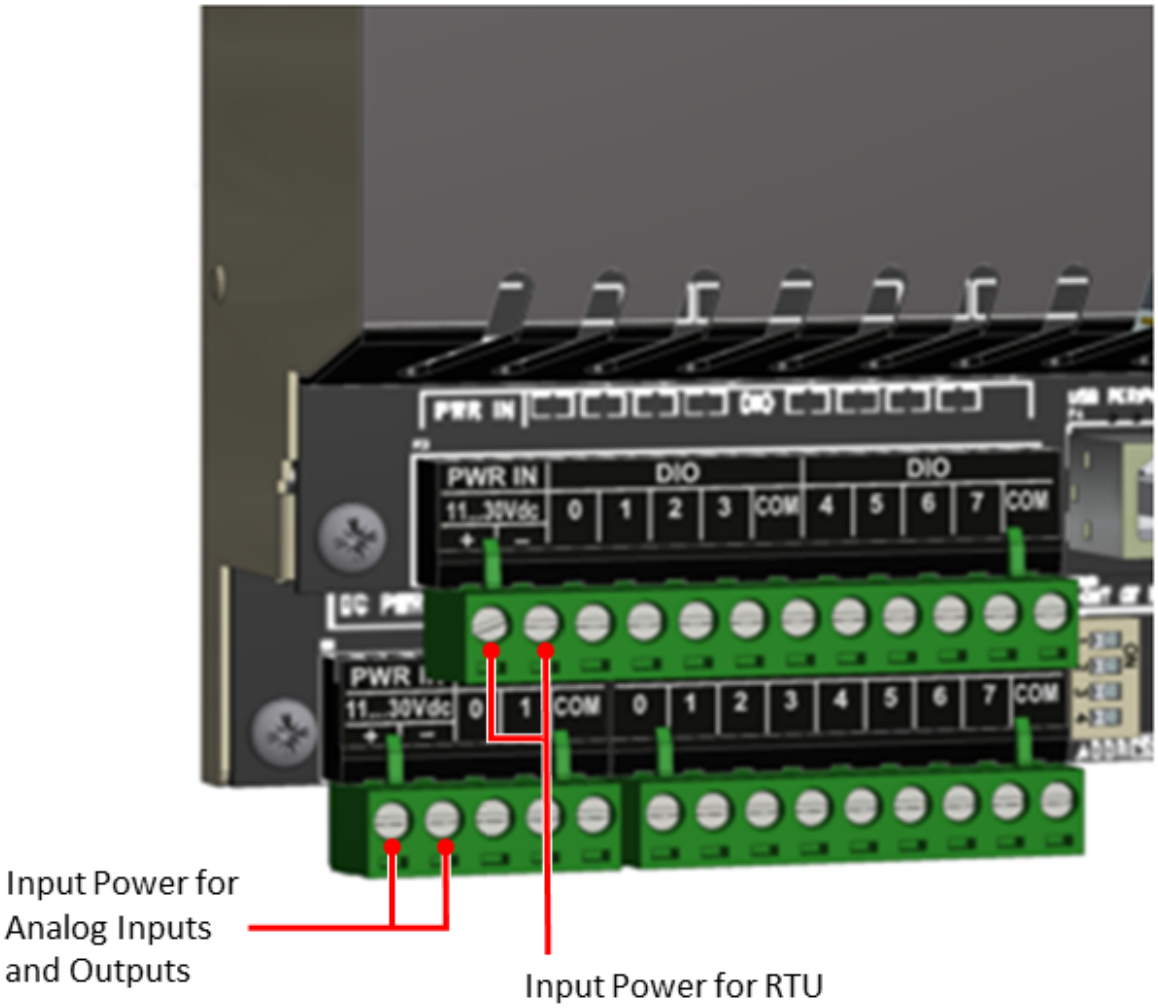
Power for the I/O board or I/O expansion module can be provided in several ways:

- With a 24 Vdc source connected to the PWR IN terminals on the controller board and on the I/O board or I/O expansion module, in a parallel configuration. See Recommended 24 Vdc Power Supply Configuration 69 for an example of this wiring configuration.

- With a 12 Vdc source connected to the PWR IN terminals on the controller board and on the I/O board or I/O expansion module, in a parallel configuration. See Recommended Battery Configuration 71 for an example of this wiring configuration.
- With an Uninterruptible Power Supply (UPS) providing 5 Vdc to the controller board through the IMC cable and 24 Vdc to the I/O board or I/O expansion module, through the 24 Vdc output. See Recommended 5103 Power Supply Configuration 72 for an example of this wiring configuration.

For information about grounding the system, see System Grounding 57.

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



SCADAPack 357E Power Supply Connections

See the following topics for details:

Basic Wiring 68

Recommended 24 Vdc Power Supply Configuration 69

Recommended Battery Configuration 71

Recommended 5103 Power Supply Configuration 72

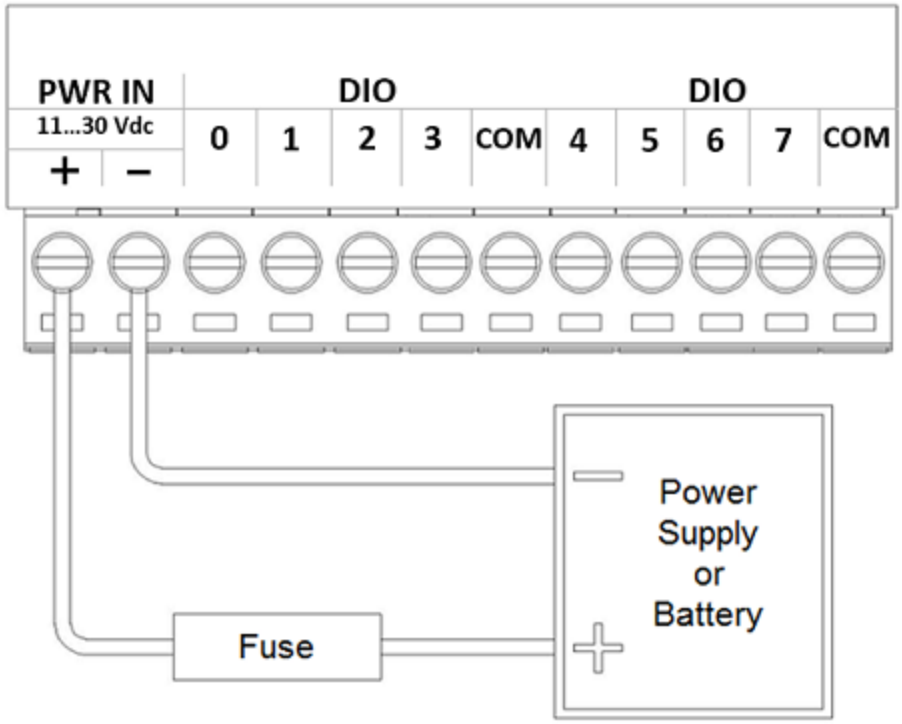
8.4.2.1 Basic Wiring

RTU Power Supply Wiring

This section describes power supply connections to the controller board.

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 77.



Controller Board Power Input Connectors

I/O Board Power Supply Wiring

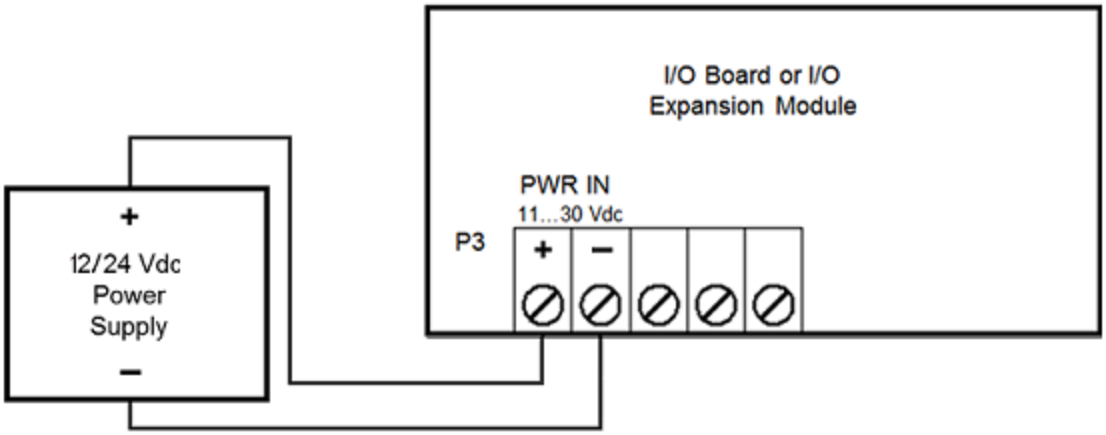
The I/O board requires a nominally 12 Vdc or 24 Vdc power supply applied to the terminals labeled

11...30 Vdc on connector P3 to power the analog input and optional analog output circuitry.

The current requirement of the analog portion (input and optional output circuitry) on the I/O board can vary from a minimum of 12 mA for basic operation of the analog circuitry plus an additional 40 mA for the optional analog outputs.

In addition, the system controller or power supply provides 5 Vdc through the I/O Bus cable. Refer to the Specifications 154 section of the RTU manual for its power capabilities. A sample power calculation for a SCADAPack RTU with an integrated I/O board can be found in the manual of the corresponding RTU.

See the image below for the location of the input power connection.

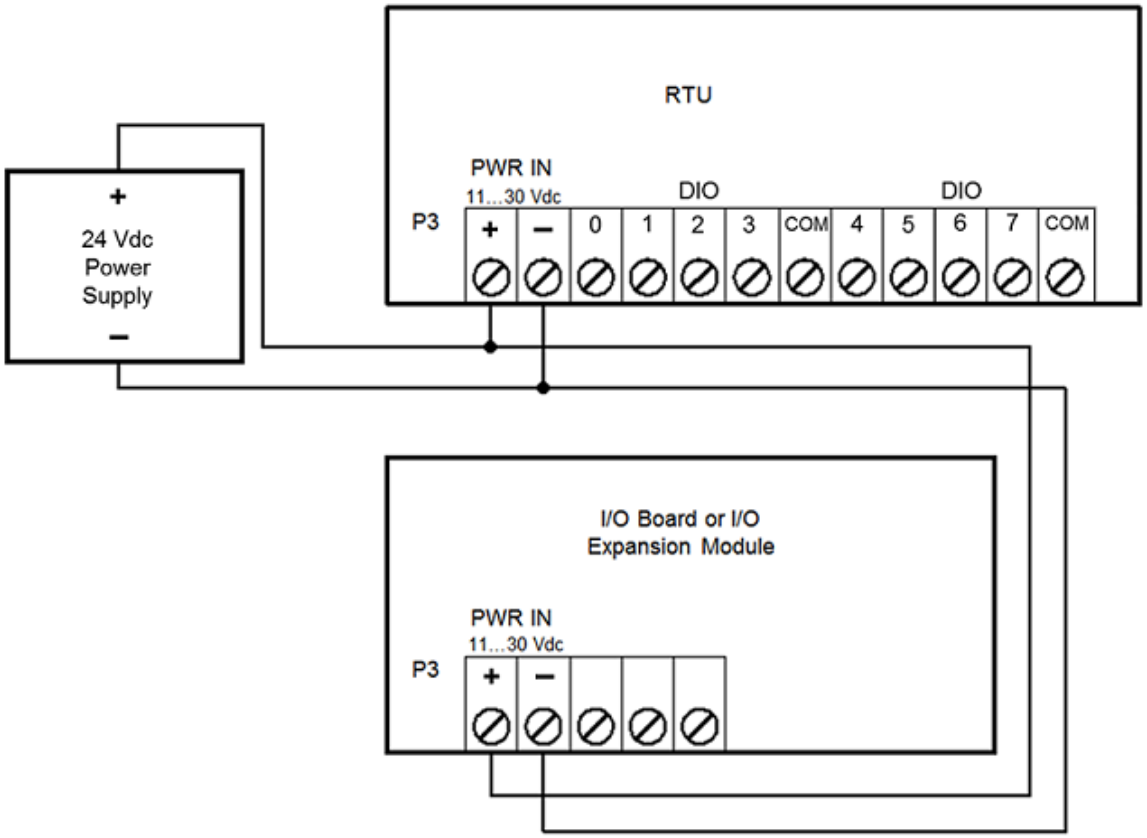


SCADAPack 357E I/O Board Power Input Connectors

8.4.2.2 Recommended 24 Vdc Power Supply Configuration

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

- This configuration is recommended when a large amount of current is required at 24 Vdc. Refer to the Specifications 154 section.
- Connect the controller board **PWR IN** terminal to the same power supply as the I/O board or I/O expansion module **PWR IN** terminal.

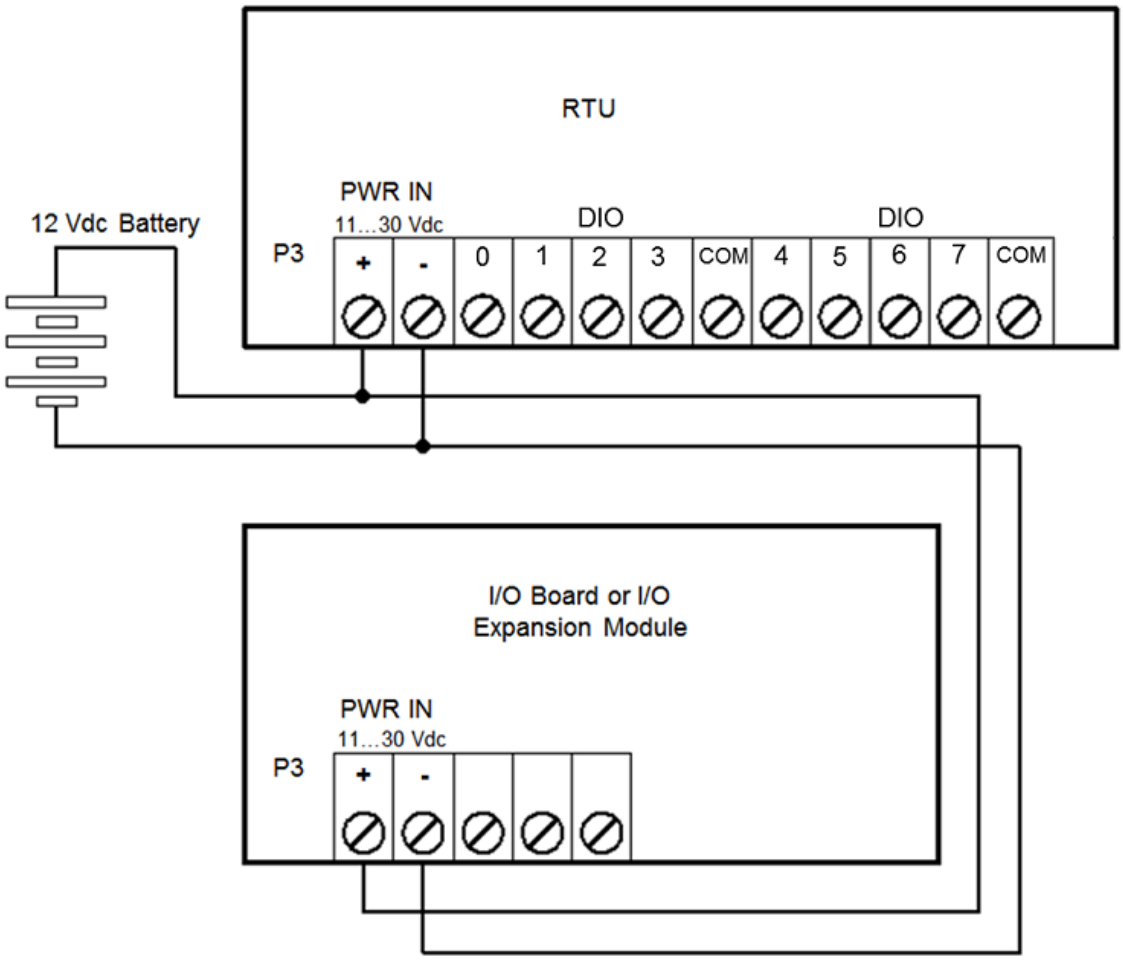


24 Vdc Power Supply Connection

8.4.2.3 Recommended Battery Configuration

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

- This configuration is recommended when a large amount of current is required at 12 Vdc. Refer to the Specifications 154 section for power requirements from a 12 V battery.
- Connect the controller board **PWR IN** terminal to the same power supply as the I/O board **PWR IN** terminal.



12 V Battery Power Supply Connection

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

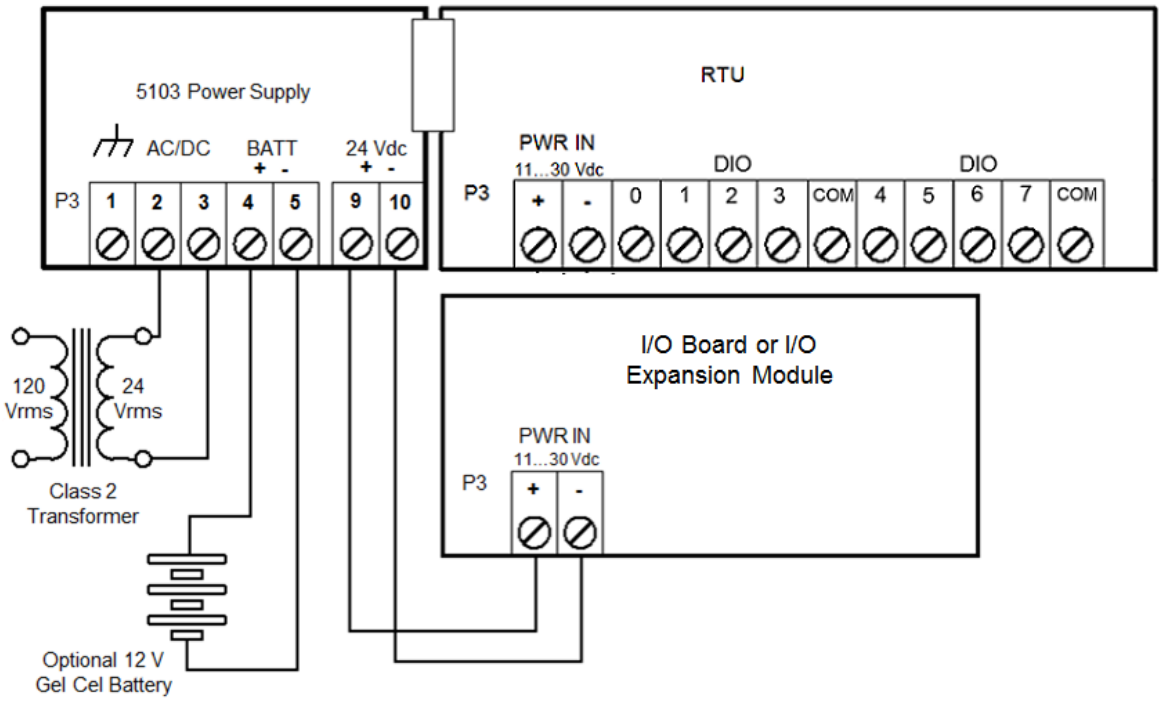
The 5103 power supply may also be connected upstream (to the left) of the RTU, but only if the following conditions are observed:

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

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

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

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



Universal Power Supply Configuration

The **Sleep Mode** feature of the controller applies only to those modules powered by the controller.

The 5103 power supply may also be connected upstream (to the left) of the SCADAPack 357E, but only if the following conditions are observed:

- No power is applied to the power inputs of the controller board.
- A jumper is installed at position J5. See Jumper Functions 79 for the location and use of this jumper.
- The sleep mode feature is not used.

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.

A maximum of 8 I/O modules can be added. Additional power supply modules may be required.

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

5000 Series Module	Type	I/O	
5304	Analog Out	4	Analog Outputs
5405	Digital In	32	Digital Inputs
5411	Digital Out	32	Digital Outputs
5414	Digital In	16	Digital Inputs
5415	Relay Output	12	Relay Outputs
5505	RTD	4	RTD (Temperature) Inputs
5506	Analog In	8	Analog Inputs
5606	Composite I/O	32 16 8 2	Digital Inputs Relay Digital Outputs Analog Inputs Analog Outputs (optional with 5305)
5607	Composite I/O	16 10 8 2	Digital Inputs Relay Digital Outputs Analog Inputs Analog Outputs (optional with 5305)

Power Requirements

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

If you are using an analog input or analog output module, you require an additional 24 Vdc power supply to power the field-side circuitry.

Each analog output module requires 50 mA current regardless of the system voltage.

For more information, see the I/O expansion module hardware manual.

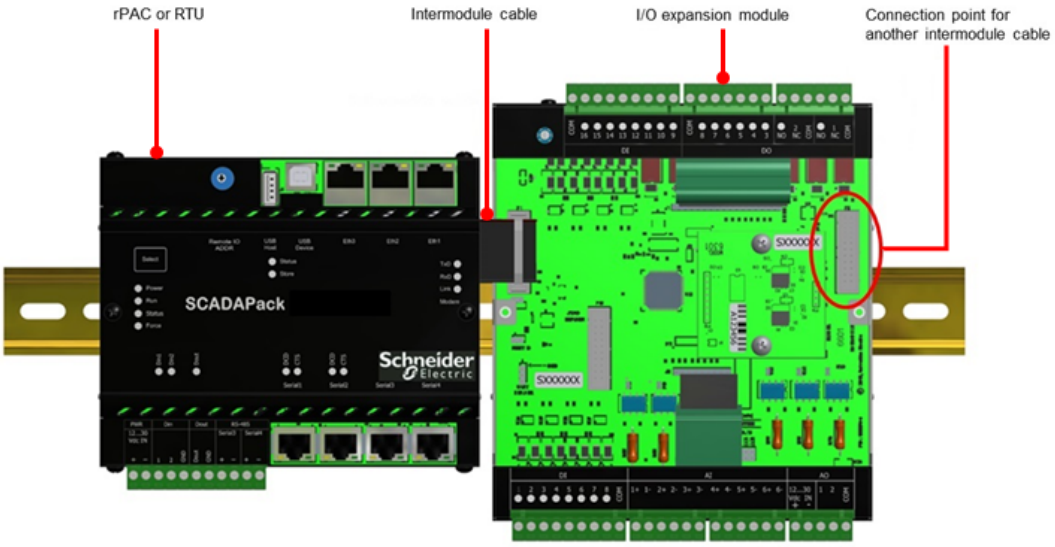
Mounting

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

Connecting

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

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



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

Precautions

Connection Rules

Attaching Intermodule Cables

Addressing

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

Addressing Rules

Configuring

Use SCADAPack E Configurator to configure the inputs and outputs on the I/O expansion module.

For more information, see:

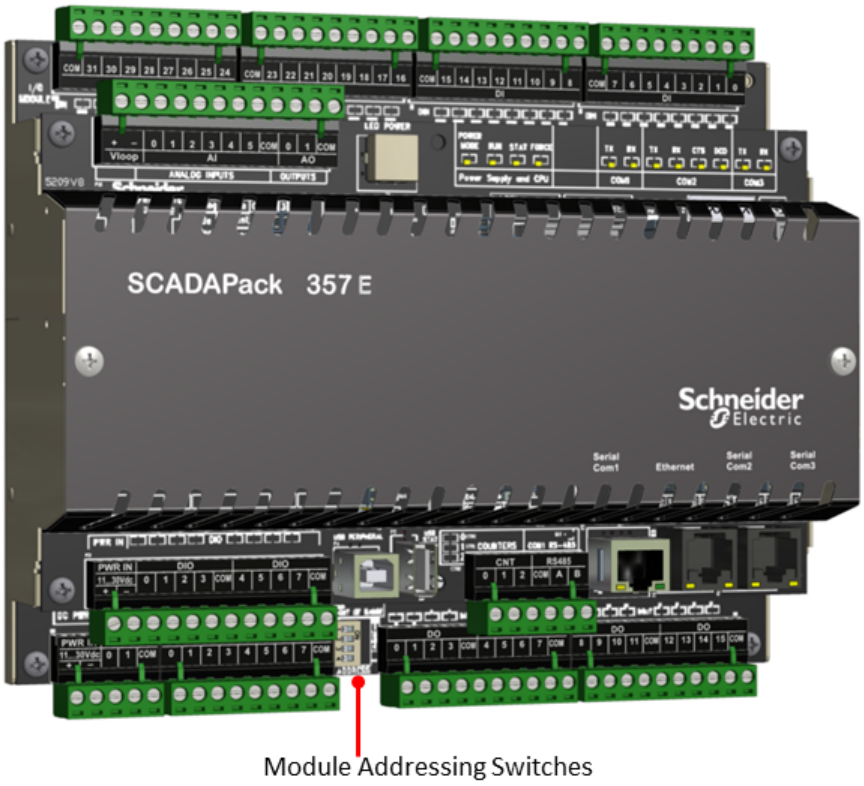
- SCADAPack E Configurator User Manual
- Configuration Technical Reference Manual
- SCADAPack E I/O Expansion Reference Manual

8.6 I/O Expansion Module Address Switch Settings

5000 Series I/O module types may be added and combined in any manner up to the maximum number that is supported by the RTU. See Specifications 154 to determine the power requirements for your I/O modules.

Each I/O module device operating in the system is identified by an address. Each I/O module address is set to 0 (zero) at the factory. The I/O module address may need to be changed when you add an I/O module to your system.

Set the I/O module address using the address switches as shown in the following figure.



SCADAPack 357E Address Switches

For more information on setting the I/O expansion module addresses, see the SCADAPack E I/O Expansion Technical Reference Manual.

9 Field Wiring

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

- RS232 serial communication ports, COM2 and COM3, connect to 8-pin modular jacks. Refer to RS232 Serial Communication Ports 23 for pinout details and wiring diagrams for these modular jacks.
- An Ethernet port connects to an 8-pin modular jack. Refer to RJ-45 Modular Connector for Ethernet 87 for pinout details.
- Removable screw termination style connectors. These connectors accommodate solid or stranded wires from 3.3...0.08 mm² (12...22 AWG).
- The USB ports use conventional USB-A and USB-B interface connectors. Refer to USB Ports 36 for details.

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

The I/O expansion modules 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 module 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 154 for the maximum voltages. **Failure to follow these instructions can result in equipment damage.**

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

See the following for more information:

Wiring Screw-Termination Connectors 77

Jumper Functions 79

Serial Port Wiring 81

Ethernet Port Wiring 87

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 mm^2 (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

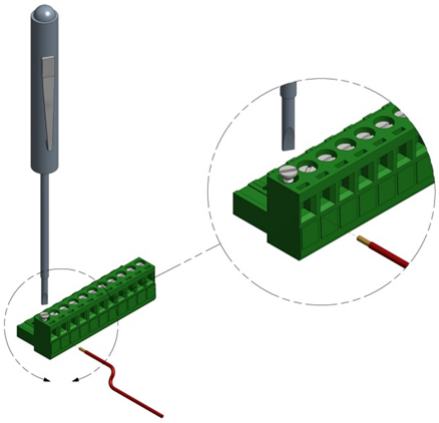
UNINTENDED EQUIPMENT OPERATION

Remove power from the device before servicing.

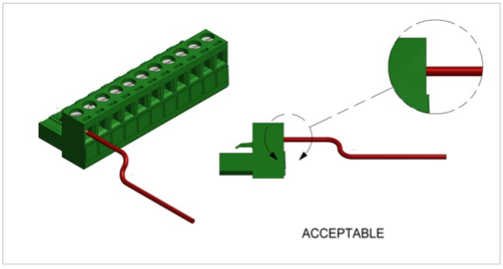
Failure to follow these instructions can result in equipment damage.

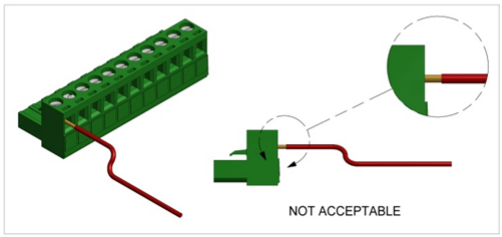
To wire a connector

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

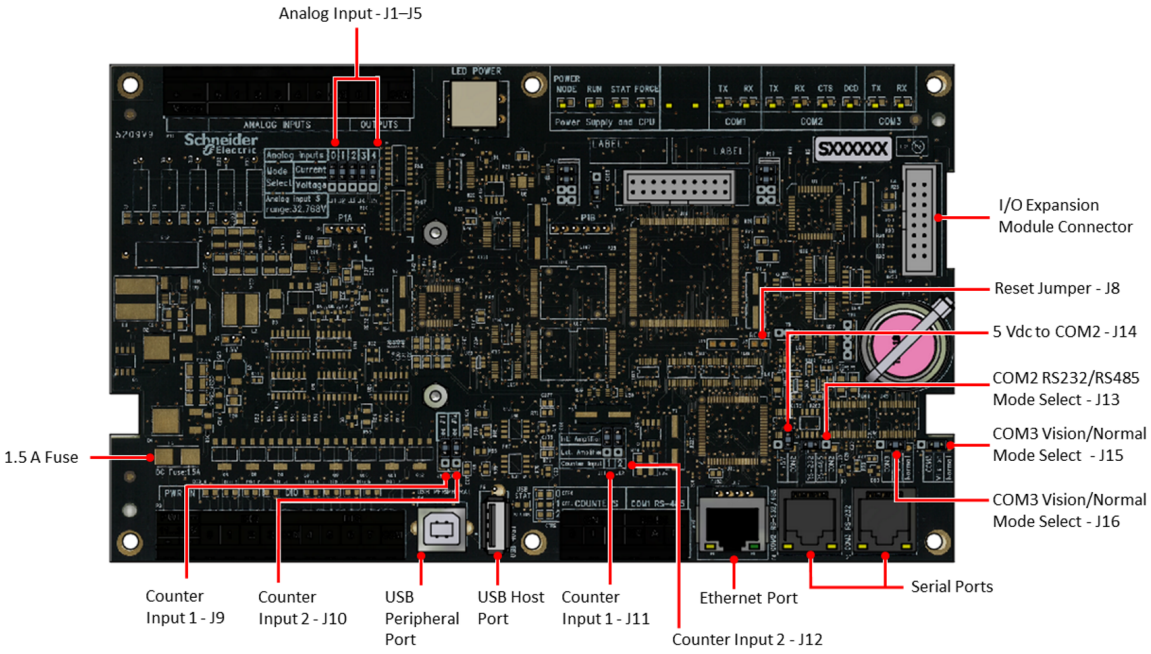
9.2 Jumper Functions

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	Manual Section
J1	Analog Input 0 Range	Analog Inputs 47
J2	Analog Input 1 Range	Analog Inputs 47
J3	Analog Input 2 Range	Analog Inputs 47
J4	Analog Input 3 Range	Analog Inputs 47
J5	Analog Input 4 Range	Analog Inputs 47
J8	Reset Jumper Performs a controller board reset similar to power cycle	
J9, J11	Counter Input 1 Type	Counter Inputs 42
J10, J12	Counter Input 2 Type	Counter Inputs 42
J13	COM2 RS232 / RS485 mode selection:	COM2 RS232 Serial Port 24
J14	COM2 5 Vdc on Pin 1	COM2 RS232 Serial Port 24
J15, J16	COM3 Vision / Normal mode select: Install both these jumpers in the same position, either Vision or Normal	COM3 RS232 Serial Port 27

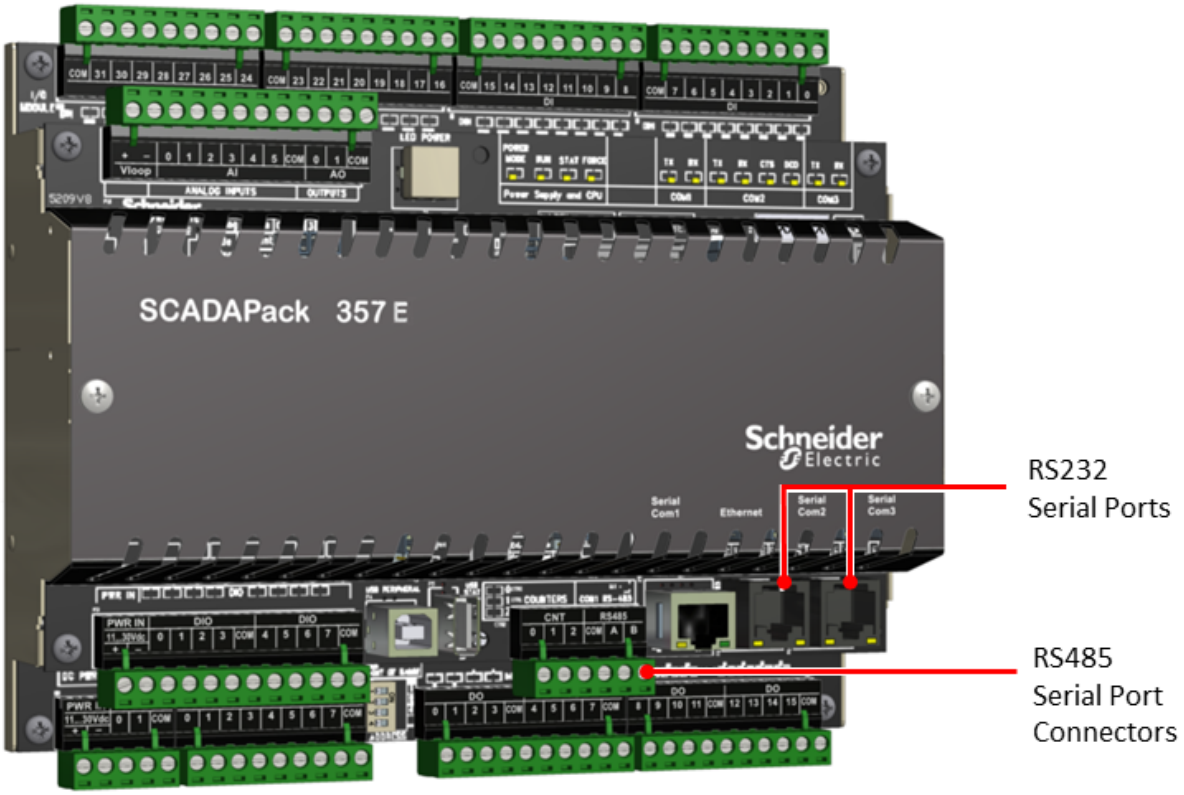
The following diagram shows the location of jumpers and connectors.



SCADAPack 357E Connector and Jumper locations

9.3 Serial Port Wiring

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



SCADAPack 357E RS232 and RS485 Serial Interfaces

For more information on RS232 and RS485 serial port connections, see:

RS232 Cable Description 81

RS232 Wiring Examples 84

RS485 Wiring Example 86

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

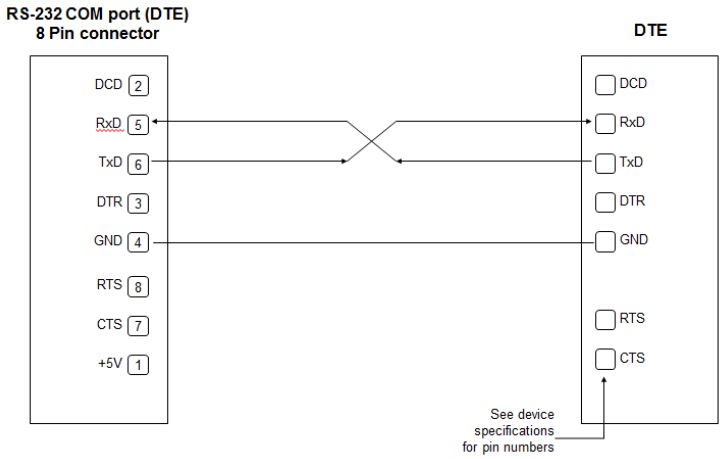
HAZARD OF ELECTRIC SHOCK

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.

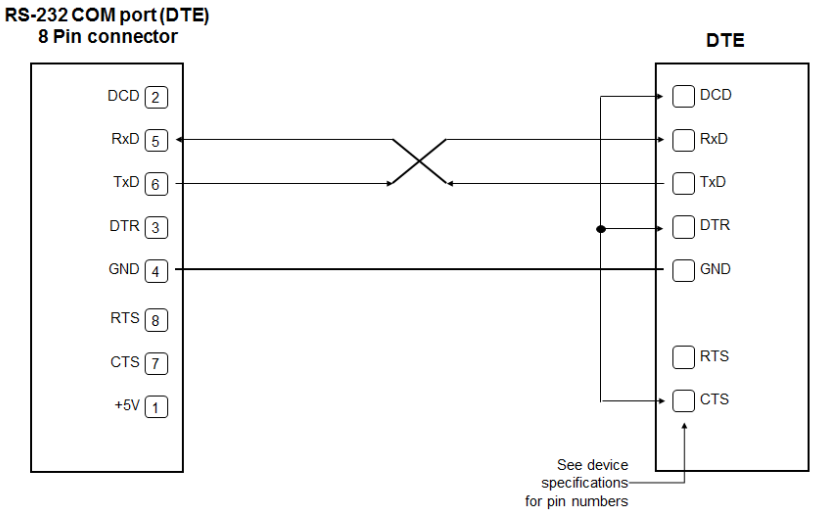
DTE to DTE Without Handshaking

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.



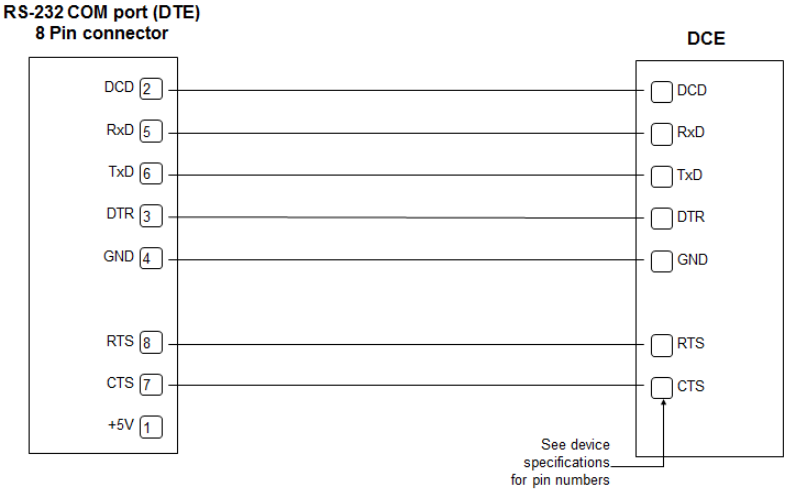
DTE to DTE with Handshaking

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.



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

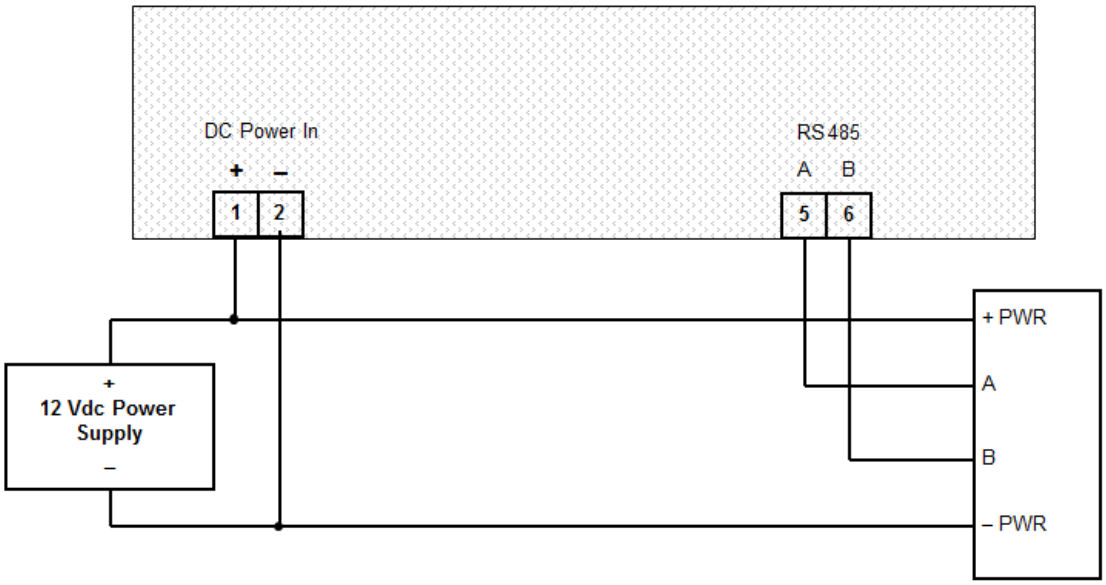
⚠WARNING

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.

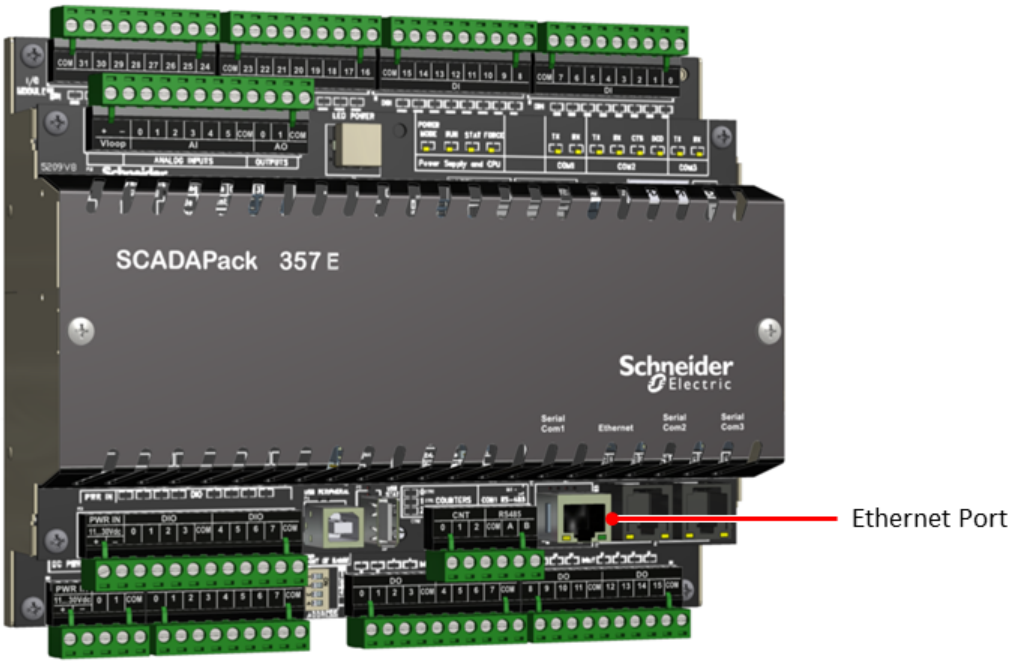
A typical RS485 wiring example is shown below. COM1 is shown connected to a multivariable transmitter such as a Schneider Electric 4000 series MVT. The power for the transmitter can come from the RTU power input source or can be obtained from the 24 Vdc VLOOP output for possible power savings.



Schneider Electric 4000 series MVT

9.4 Ethernet Port Wiring

This section describes the wiring for the Ethernet port on the SCADAPack 357E.

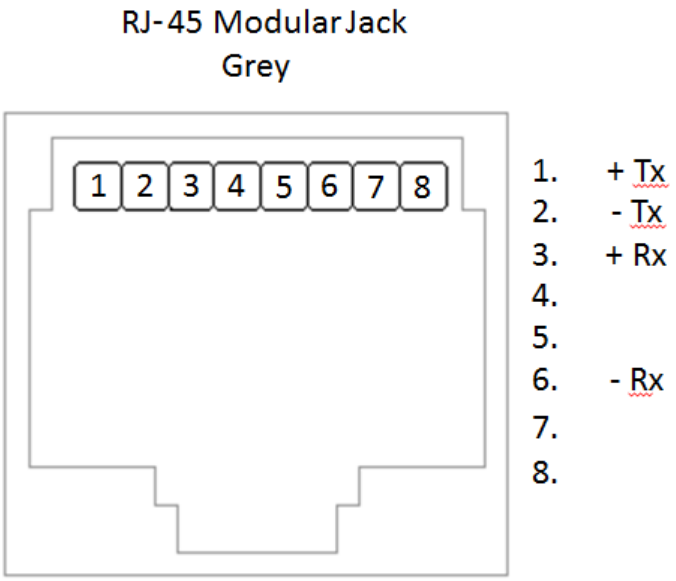


SCADAPack 357E Ethernet Port

RJ-45 Modular Connector for Ethernet 87

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 (328 ft), but the actual limit is based on signal loss and the noise in the environment. Running the Ethernet cables in parallel with power cables or any cables that generate noise will reduce the practical distance to less than 100 m (328 ft).

NOTICE
UNEXPECTED EQUIPMENT OPERATION The IEEE 802.3 10BASE-T specification requires that 10BASE-T and 100BASE-T devices support UTP 100-120 unshielded twisted pair cables of less than 100 m (328 ft.) in length. This requirement does not factor in losses due to connectors, patch panels, punch-down blocks, or other cable management hardware, which introduce additional loss. For each connector or other intrusive cable management device in the total link, subtract 12 m (39 ft.) from the total allowable link length. **Failure to follow these instructions can result in equipment damage.**

9.5 Counter Input Wiring

This section describes the wiring of counter inputs.

NOTICE
UNEXPECTED EQUIPMENT OPERATION Do not exceed the maximum voltage specified for each counter input. **Failure to follow these instructions can result in equipment damage.**

NOTICE
UNEXPECTED EQUIPMENT OPERATION Counter input signals must be shielded using Belden 9322 or equivalent, when the unit is operating in an electrically noisy environment or to meet the requirements of EN 61000-6-2. **Failure to follow these instructions can result in equipment damage.**

NOTICE
UNINTENDED EQUIPMENT OPERATION When wiring counter inputs: • Confirm that the connection to the counter input does not exceed the ratings for the input. See the Specifications section for details.

- Confirm that the polarity of the connection is correct with the two positive terminals wired together and the two negative terminals wired together.

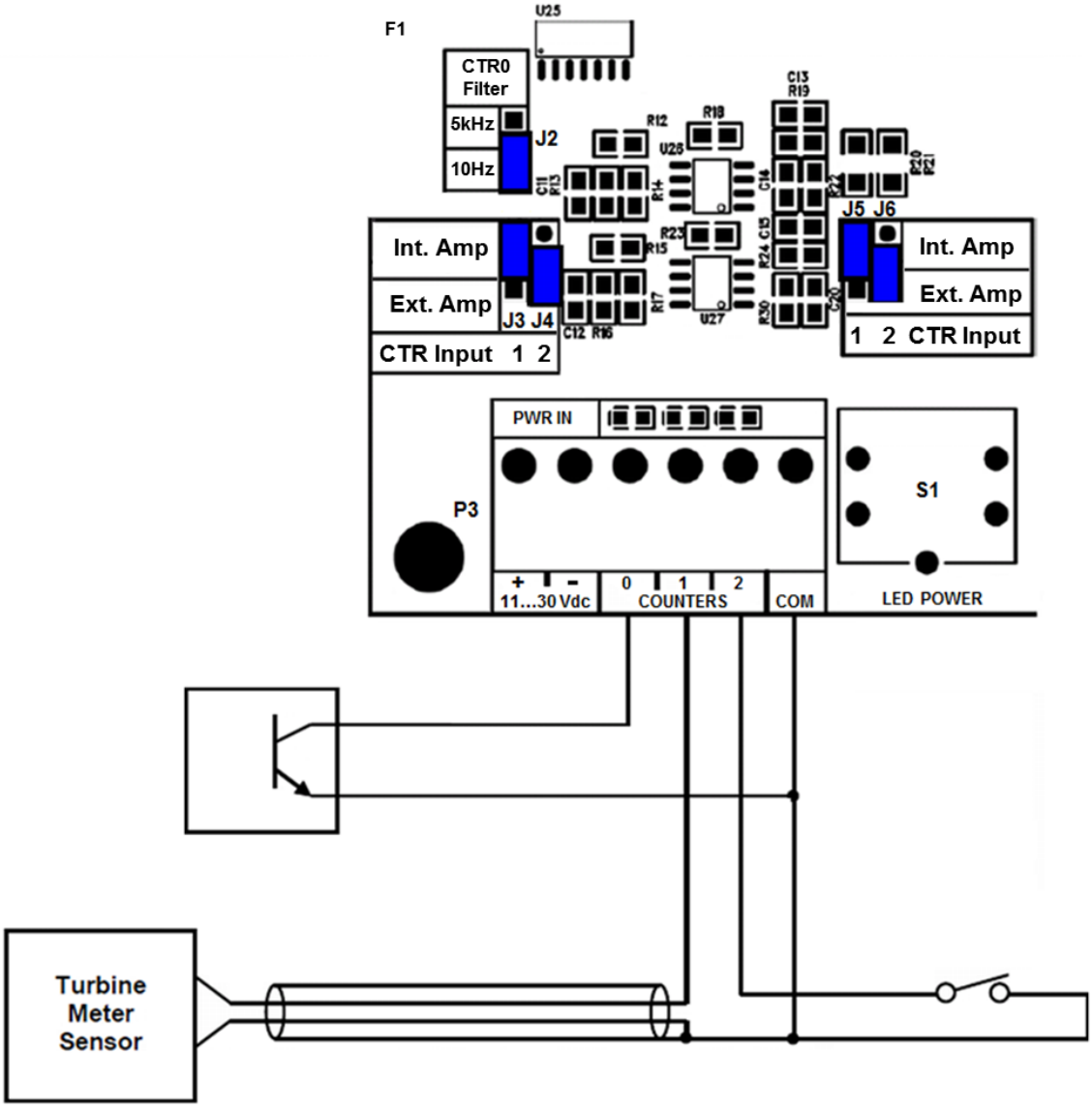
Failure to follow these instructions can result in equipment damage.

NOTICE

SIGNAL INTERFERENCE DUE TO NOISE

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

Failure to follow these instructions can result in equipment damage.



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

Counter 0 has a jumper selectable filter to set the maximum frequency of operation. The figure above

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

For information on counter input wiring, refer to:

Directly Connecting to Low Voltage Turbine Meters 93

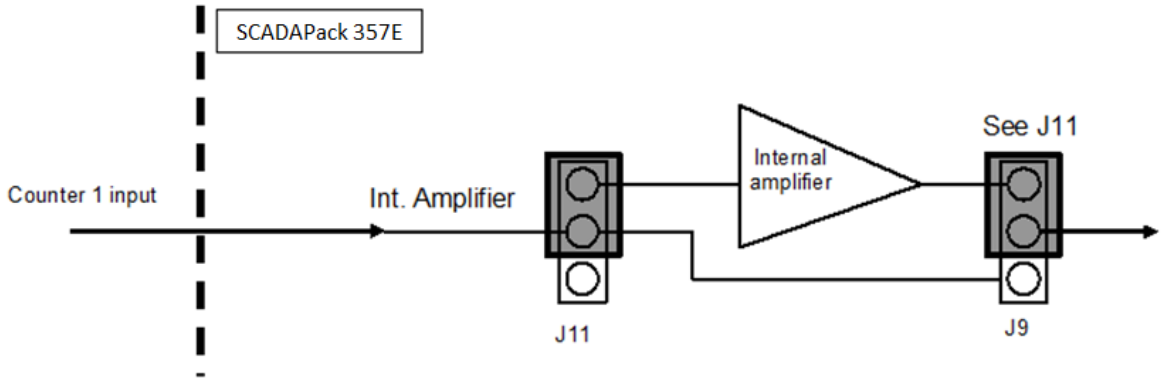
Connecting to Higher Voltage Turbine Meters 94

Connecting to Open Collector/Dry Contact Turbine Meters 95

9.5.1 Directly Connecting to Low Voltage Turbine Meters

When connecting a low voltage (mV) turbine meter directly to counter input 1, enable the SCADAPack 357E internal pre-amplifier on this input as follows:

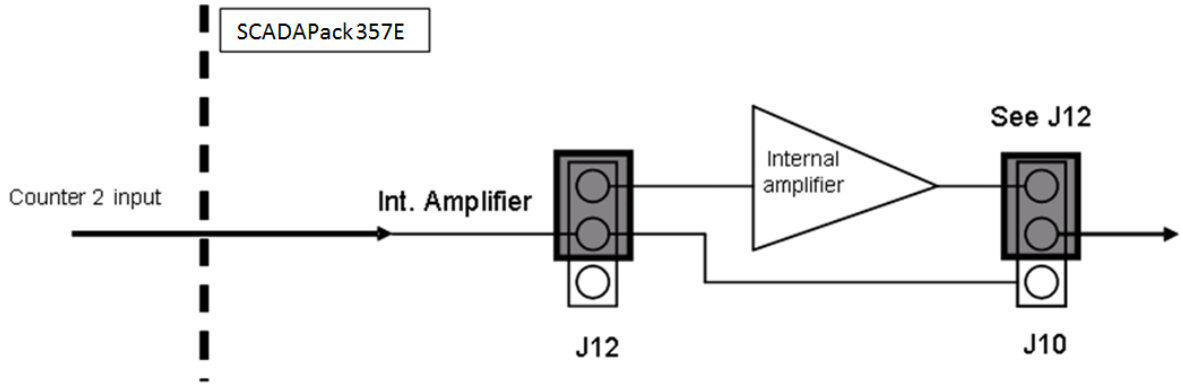
1. Install jumper J11 on the 'Int Amplifier' position.
2. Install jumper J9 on the 'See J11' position, as shown below.



Setting Jumpers on Counter Input 1 for Low Voltage Turbine Meters

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

1. Install jumper J12 on the 'Int Amplifier' position.
2. Install jumper J10 on the 'See J12' position, as shown below.



Setting Jumpers on Counter Input 2 for Low Voltage Turbine Meters

9.5.2 Connecting to Higher Voltage Turbine Meters

Counter inputs 1 and 2 inputs can also be configured for use with a turbine meter featuring an integrated or standalone amplifier. In this configuration, the SCADAPack's internal amplifiers need to be bypassed.

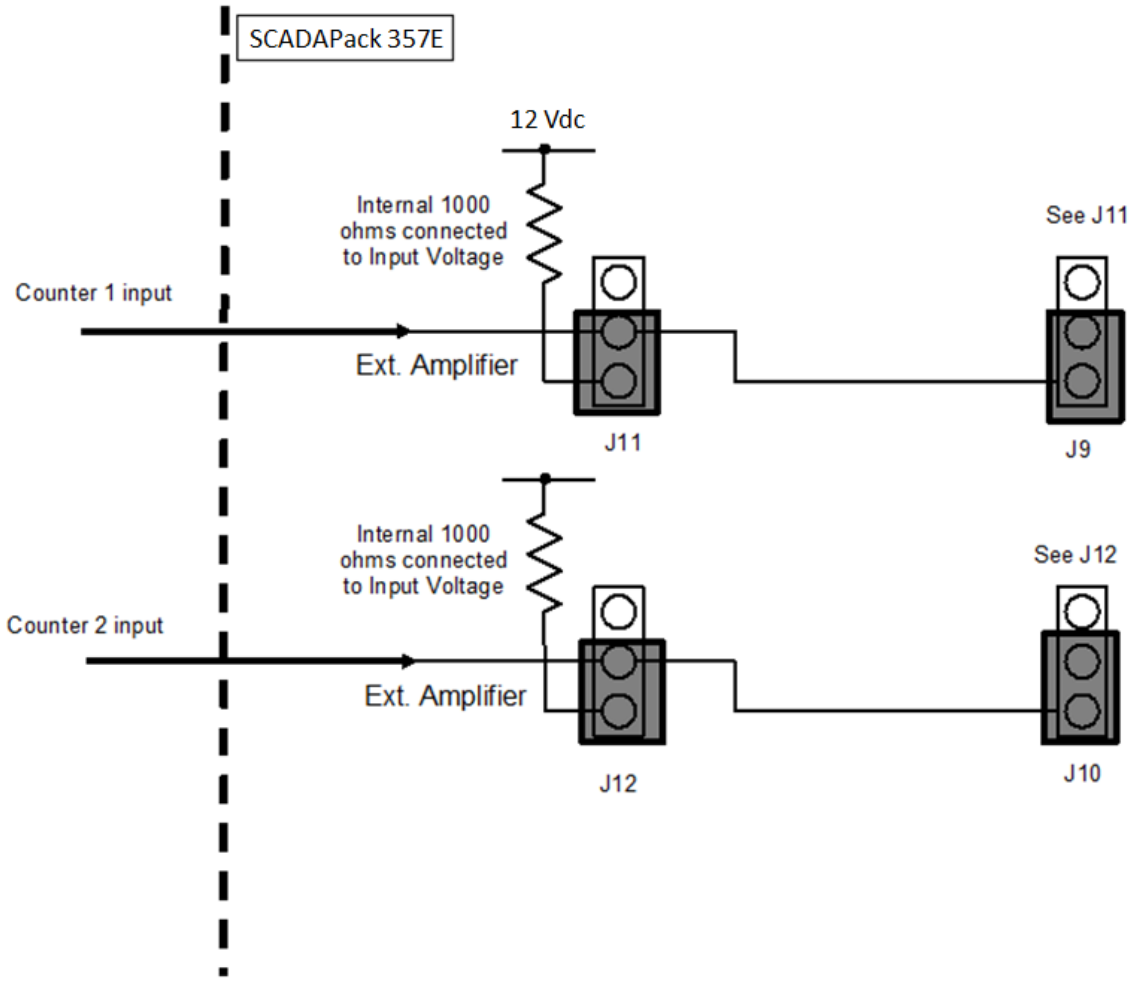
For Counter 1:

1. Install jumper J11 in the 'Ext Position'.
2. Remove jumpers J9 from the 'See J11' position and install on the other two pins.

For Counter 2:

1. Install jumper J12 in the 'Ext Position'.
2. Remove jumpers J10 from the 'See J12' position and install on the other two pins.

Refer to the figure below for an illustration.



Setting Counter Input 1 and 2 for Turbine Meters with Amplified Signals

Your standalone amplifier may have a specific current requirement as specified by the manufacturer. As shown in the figure above, the SCADAPack 357E includes a 1000 ohm resistor from the counter input to the DC input power source, when the jumpers J11 and J12 are installed in the **Ext Amplifier** position, as described above. The above configuration is the recommended wiring for a **Halliburton Low Power Pre-Amp**, when the SCADAPack 357E is powered from 12 Vdc.

On the other hand, if your amplifier requires a pull-up resistor greater than 1000 ohms, jumper J11 and J12 should not be installed in either position, while J9 and J10 should remain installed as shown in Connecting External Pull-Up Resistors to Counter Inputs 1 and 2 96. The appropriate external pull-up resistor should then be connected between the counter input and the positive terminal of your power supply, as shown in Connecting External Pull-Up Resistors to Counter Inputs 1 and 2 96.

9.5.3 Connecting to Open Collector/Dry Contact Turbine Meters

Counter Inputs 1 and 2 can also used with conventional sources such as open collector transistors and contacts. In this scenario, the 1000 ohm pull-up resistors described above can be used if the SCADAPack 357E is powered from 12 Vdc.

For Counter 1:

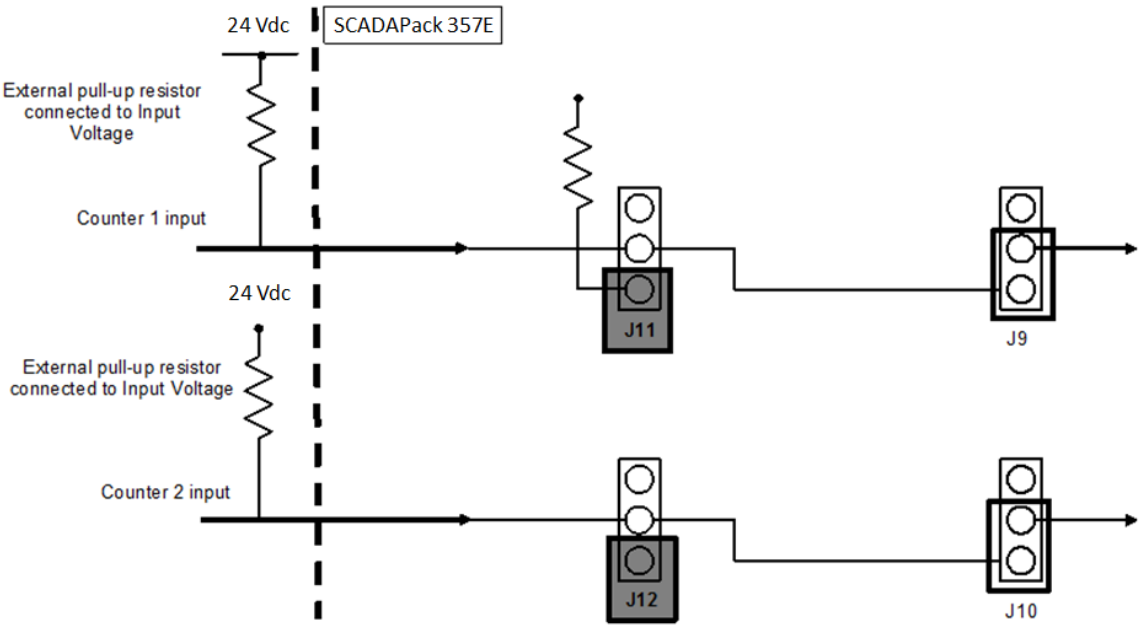
- Install jumper J11 in the ‘Ext Position’.
- Remove jumpers J9 from the ‘See J11’ position and install on the other two pins.

For Counter 2:

If 12 Vdc is used to power the controller, follow steps 1 and 2.

If 24 Vdc is used to power the controller, the internal 1000 ohm pull-up resistor should not be used; power dissipation can become excessive. In this case, wire an external pull-up resistor between the counter input and the positive side of your power supply, as illustrated in Connecting External Pull-Up Resistors to Counter Inputs 1 and 2 96. Also check that jumpers J11 and J12 are removed while J9 and J10 are installed.

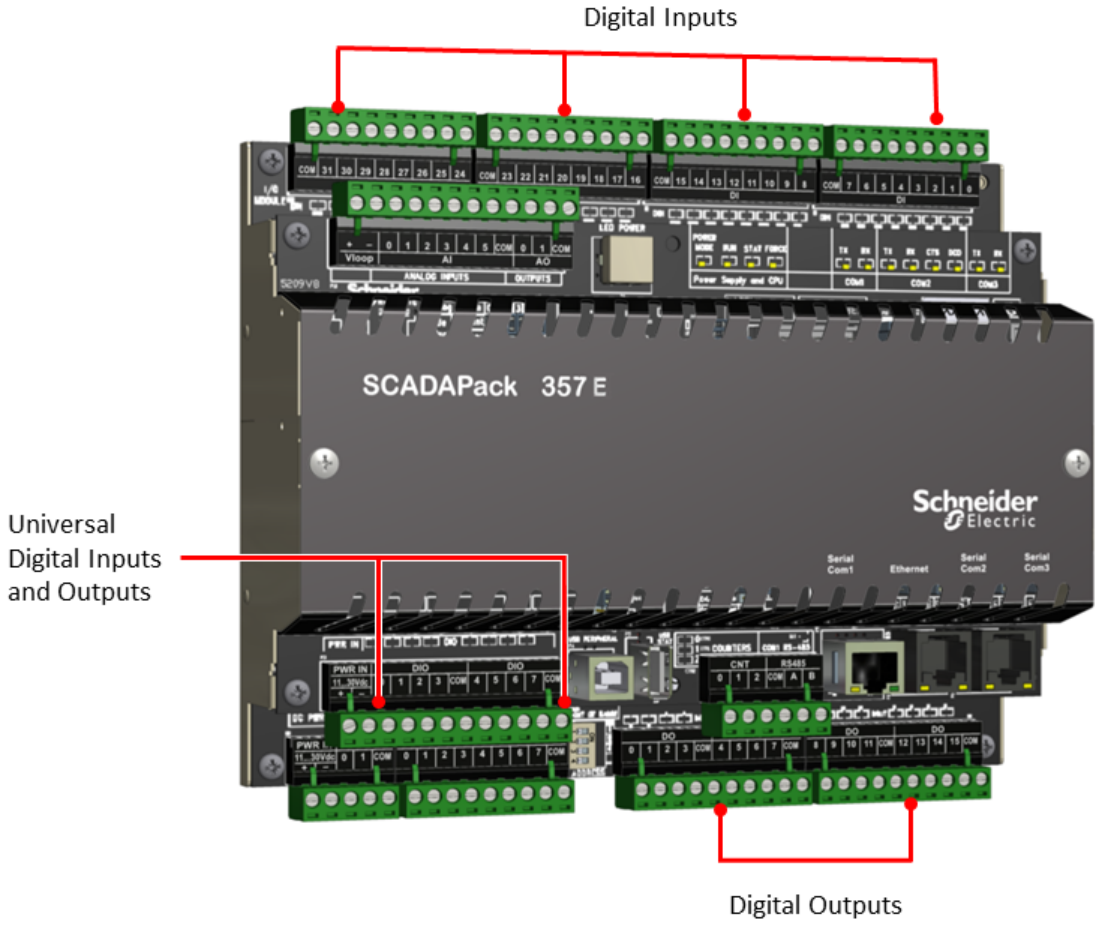
1. Install jumper J12 in the ‘Ext Position’.
2. Remove jumpers J10 from the ‘See J12’ position and install on the other two pins.



Connecting External Pull-Up Resistors to Counter Inputs 1 and 2

9.6 Digital Input and Output Wiring

This section describes the wiring for the digital inputs and outputs on the SCADAPack 357E.



SCADAPack 357E Digital Inputs and Outputs

For further information on digital inputs and outputs, refer to:

Universal Digital Input and Output Wiring 98

Digital Input Wiring 100

Digital Output Wiring 101

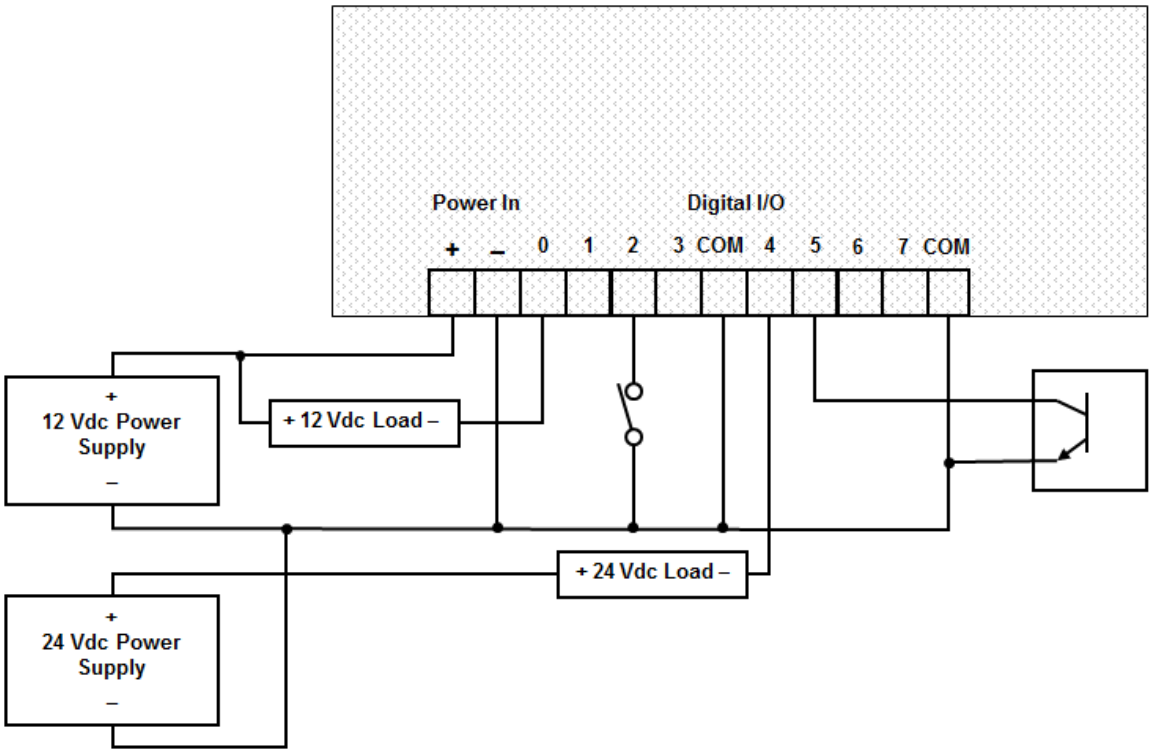
9.6.1 Universal Digital Input and Output Wiring

This section describes the wiring for universal digital input and output.

NOTICE
UNEXPECTED EQUIPMENT OPERATION When wiring digital inputs: • Confirm that the connection to the digital input does not exceed the ratings for the digital input. See Digital Inputs 164 for details. • Confirm that the polarity of the connection is correct with the two positive terminals wired together and the two negative terminals wired together. **Failure to follow these instructions can result in equipment damage.**

Various I/O point wiring examples are shown in the diagram, Digital Input/Output Wiring 99.

- Digital I/O point 0 is shown connected to a 12 Vdc load that uses the same 12 Vdc power supply that powers the SCADAPack 357E.
- Digital I/O point 4 is shown connected to a 24 Vdc load and external 24 Vdc power supply.
- Digital I/O point 2 is shown monitoring a dry contact.
- Digital I/O point 5 is shown monitoring an open collector contact. Transient voltage suppression is included on each I/O point.



Digital Input/Output Wiring

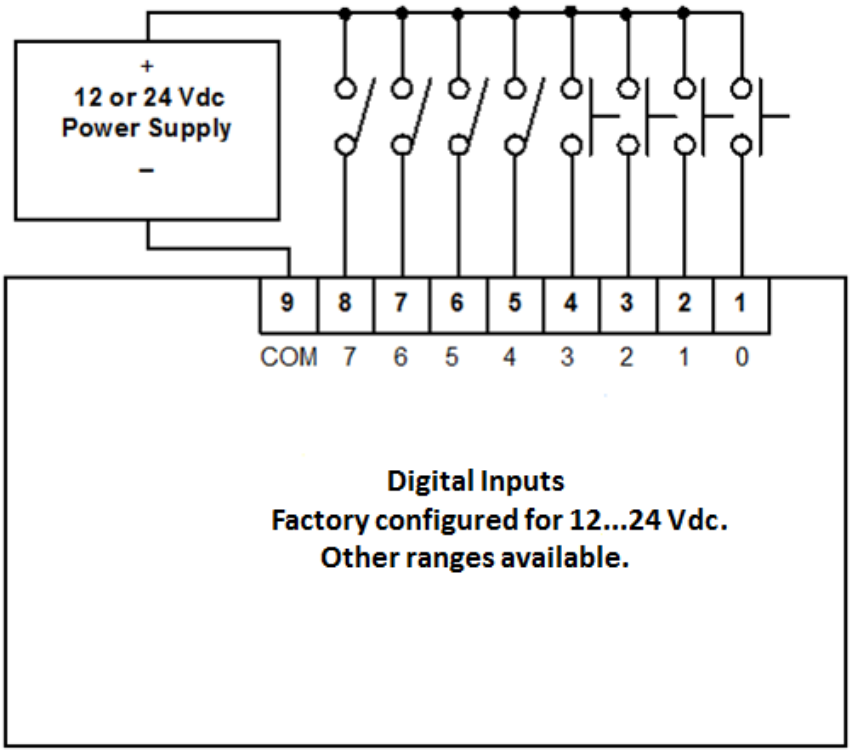
9.6.2 Digital Input Wiring

The SCADAPack 357E accommodates AC or DC inputs.

The voltage range is configured at the factory.

NOTICE
UNEXPECTED EQUIPMENT OPERATION When wiring digital inputs: • Confirm that the connection to the digital input does not exceed the ratings for the digital input. See Specifications 154 for details. • Confirm that the polarity of the connection is correct with the two positive terminals wired together and the two negative terminals wired together. **Failure to follow these instructions can result in equipment damage.**

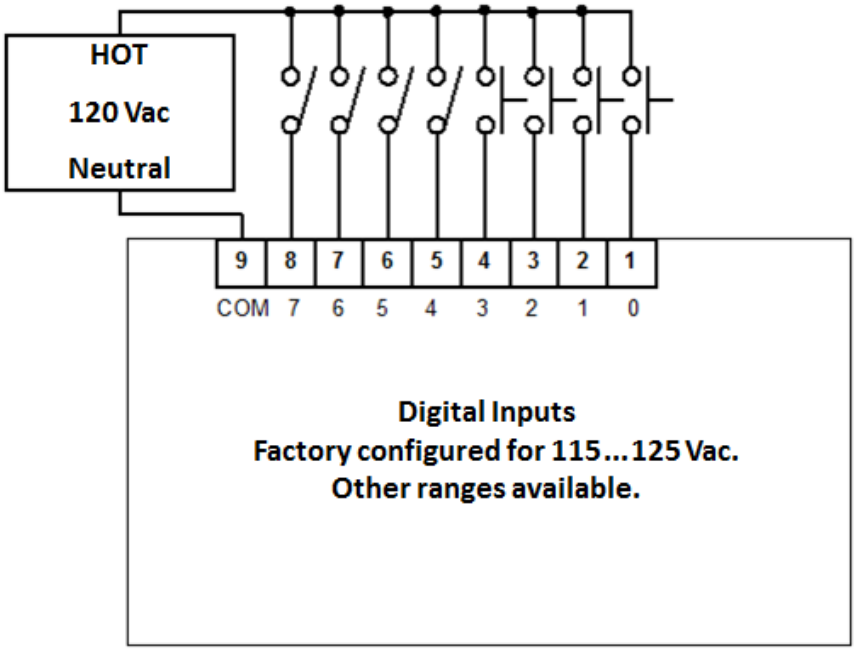
The following diagram shows typical wiring of DC signals to the digital input ports.



Digital Input Wiring of DC Signals

Digital Input Wiring of AC Signal 101 shows a typical wiring of AC signals to the digital input ports.

The signal polarity needs to be observed when using DC inputs. Connect the positive signal to the input. Connect the negative signal to the common.



Digital Input Wiring of AC Signals

9.6.3 Digital Output Wiring

NOTICE
UNEXPECTED EQUIPMENT OPERATION • When controlling inductive loads, the relay contacts on digital outputs must be protected. The energy stored in the coil can generate significant electrical noise when the relay contacts are opened. • To suppress the noise in DC circuits, place a diode across the coil. • To suppress the noise in AC circuits, place a metal-oxide varistor (MOV) across the coil. **Failure to follow these instructions can result in equipment damage.**

NOTICE

UNEXPECTED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

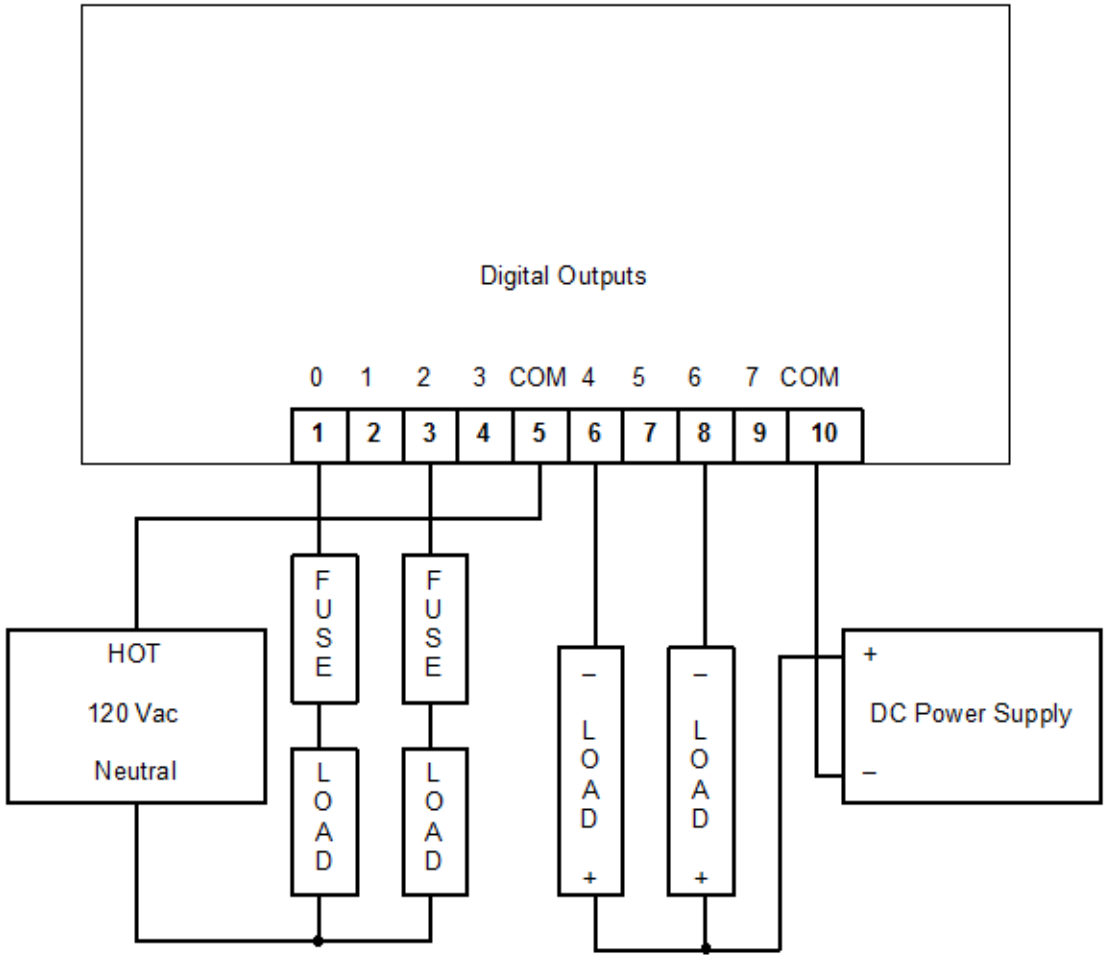
External lightning protection is required if the device being controlled is outside the physical area (cubicle or building) in which the module is located.

Failure to follow these instructions can result in equipment damage.

Refer to Digital Output Wiring 103 below for a digital output wiring example.

In this example 120 Vac is switched through the common of relays 0-3 through relays 0 and 2 to the loads. The loads share a common 120 Vac Neutral. The fuses shown are recommended.

Relays 4 and 6 are used to switch the DC power to two loads. In the DC example the negative side of the loads are switched through the common of relays 4 through 7 to the negative side of the DC power supply.



Digital Output Wiring

9.7 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.

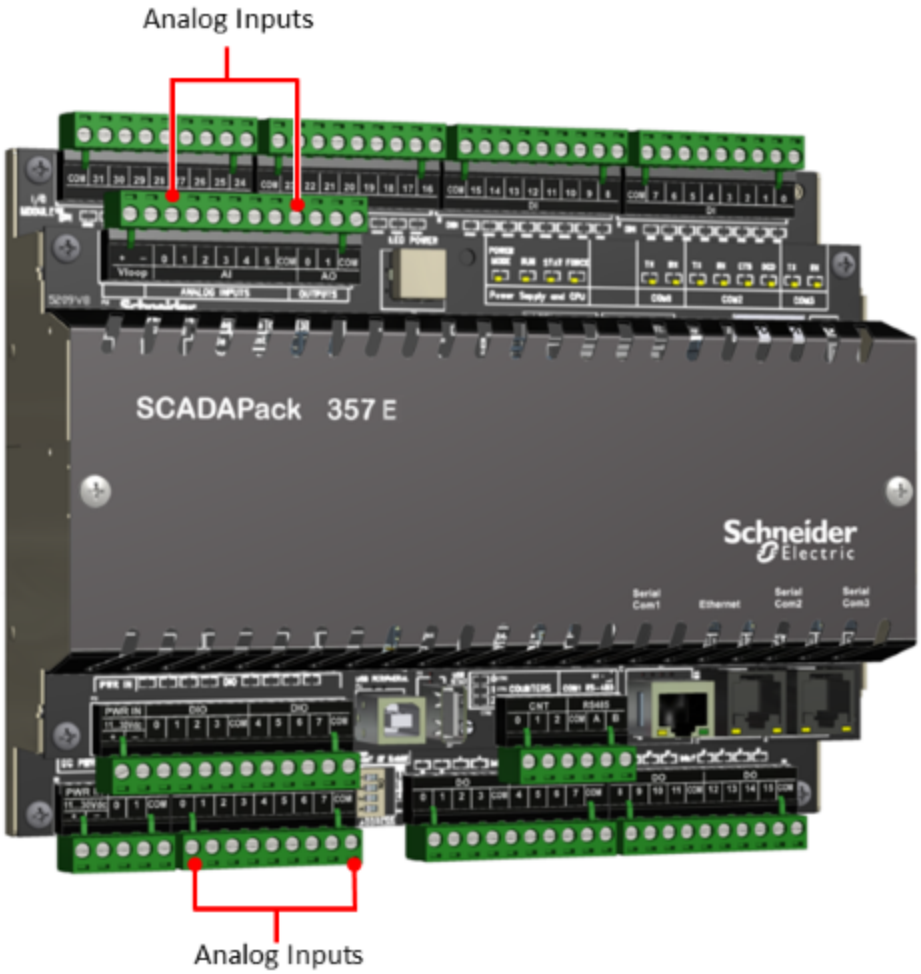
Self-powered transmitters can have a current or voltage output. Self-powered transmitters have three terminals: Power In, Signal Out and Common. Power In connects to a power supply; Signal Out connects to the analog input channel and Common connects to COM.

- **Power In** connects to a power supply
- **Signal Out** connects to the Analog Input Channel
- **Common** connects to COM

There are three options for the user when selecting the power source. In each case the user needs to confirm that the transmitter has enough voltage for proper operation. The transmitter manufacturer supplies the minimum operating voltage specification of the transmitter. The analog input requires a minimum of 5 Vdc.

- The first option is to use the SCADAPack 357E **VLOOP Supply** that steps up the input voltage to 24 Vdc. The stepped up voltage is available on the Analog Connector P10 and is labeled **VLOOP**. There is sufficient power available here for the five analog inputs and two analog outputs of the controller board, operating at 20 mA. Significant power saving is possible by switching the Loop Supply off.
- The second option is similar to the first except that the power supply is not stepped up to 24 Vdc. This can be used with low voltage transmitters or when then the input voltage is sufficiently high that further stepping up is not necessary. It is still possible to switch the supply off under program control. When the step up is turned off, **VLOOP** is approximately 0.5 Vdc less that the power input voltage.
- The third option is to power the transmitter from a power supply provided by the user.

The following figure shows the analog input connectors on the SCADAPack 357E.



Analog Input Connectors

For information on analog input wiring, see:

Analog Input Wiring Example 105

Configuring Analog Inputs as Current Inputs 109

Helping to Prevent Interruption of the Current Loop 109

9.7.1 Analog Input Wiring Example

This section describes the wiring for the analog inputs on the SCADAPack 357E.

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

NOTICE

UNEXPECTED EQUIPMENT OPERATION

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

UNEXPECTED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

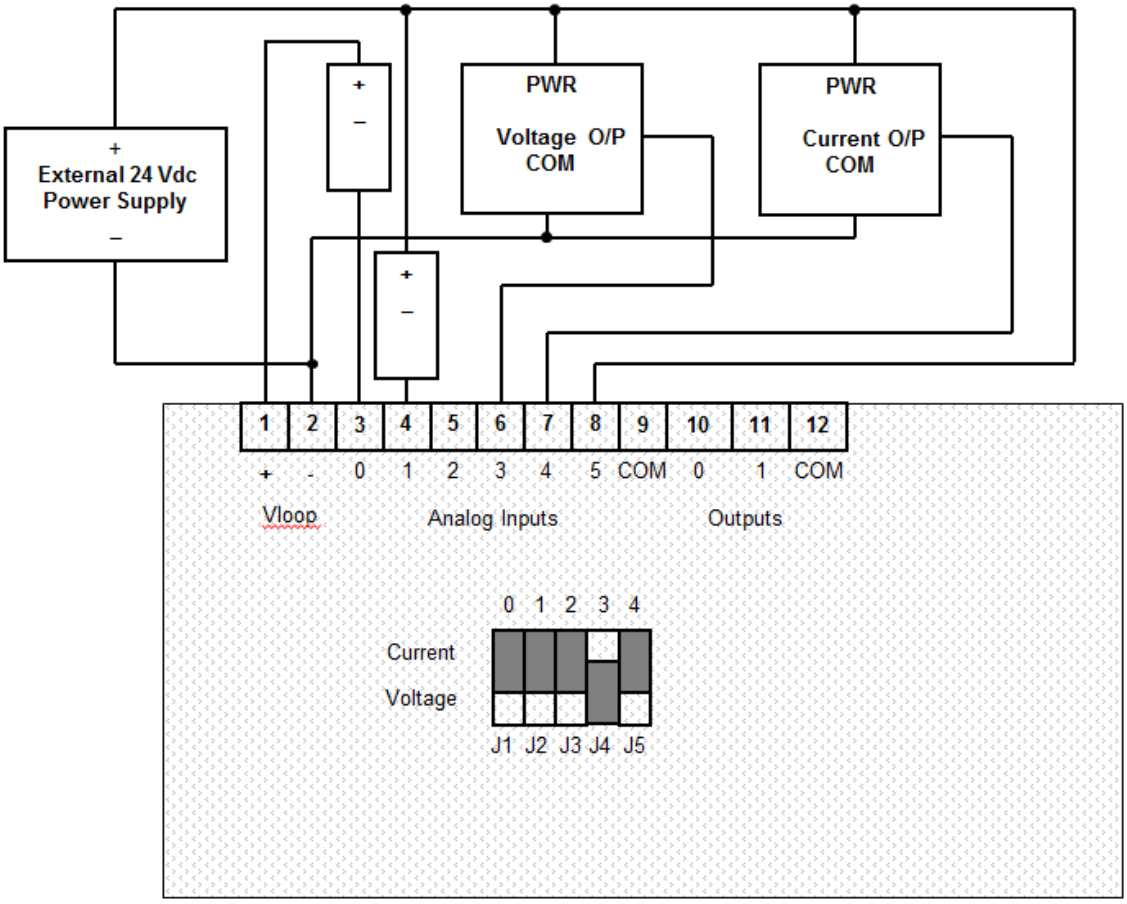
This module must be the only loop current measurement device in the loop when using the analog inputs in the 20 mA measurement mode. If power to the module is removed, the module reverts to voltage mode and results in an open current loop. Applications that cannot tolerate this possibility require external current sense resistors, with the module input range set to voltage.

Failure to follow these instructions can result in equipment damage.

Example wiring of several transmitters on the controller board is illustrated in Analog Input Wiring - Controller 107.

- Channel 0 has a loop powered current transmitter connected to VLOOP.
- Channel 1 has a loop powered current transmitter connected to an external 24 Vdc power supply.

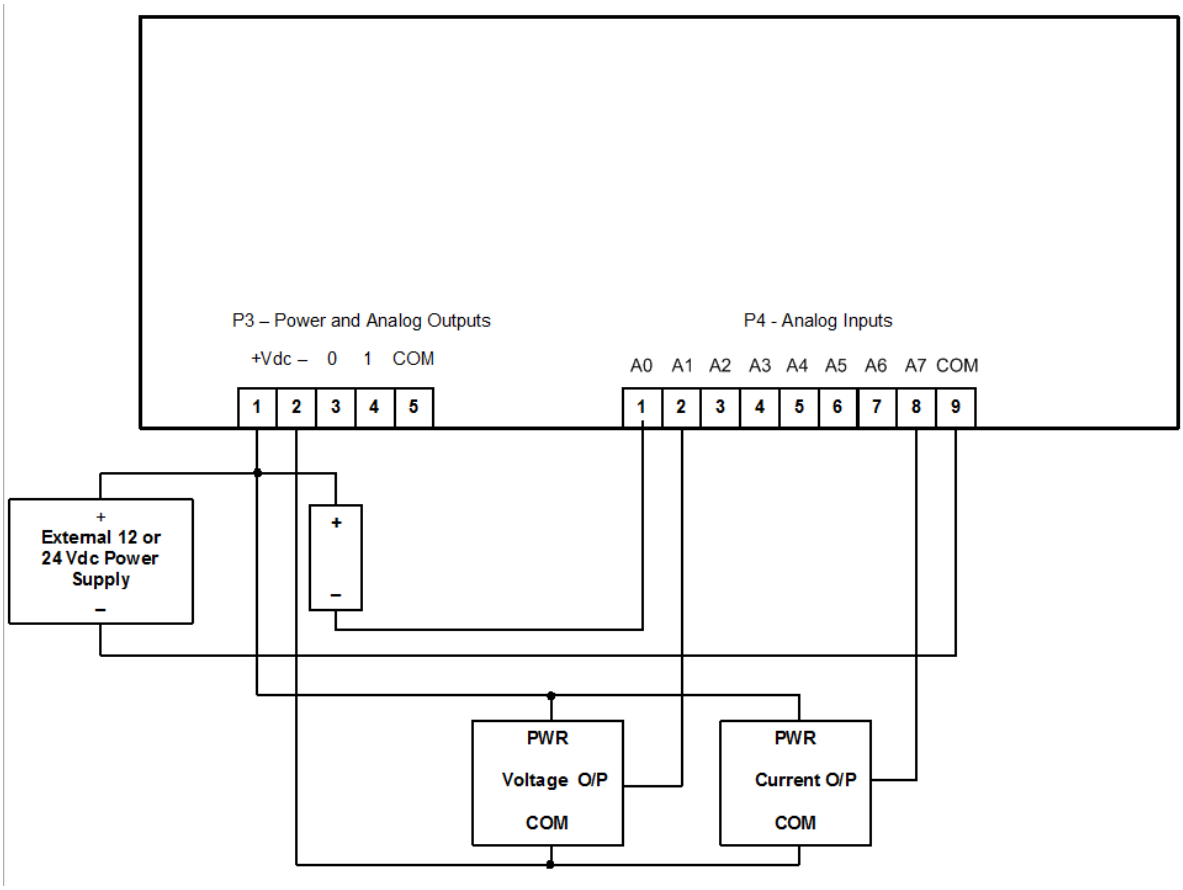
- Channel 2 is unused.
- Channel 3 has a self-powered voltage transmitter connected to an external 24 Vdc power supply.
- Channel 4 has a self-powered current transmitter connected to an external 24 Vdc power supply.
- Channel 5 is used to monitor the external 24 Vdc power supply.



Analog Input Wiring - Controller

Example wiring of several transmitters on the I/O module is illustrated in Analog Input Wiring - I/O Module 108.

- Channel A0 has a loop powered current transmitter connected to the external power supply.
- Channel A1 has a self-powered voltage transmitter connected to the external power supply.
- Channels A2 through A6 are unused.
- Channel A7 has a self-powered current transmitter connected to the external power supply.



Analog Input Wiring - I/O Module

9.7.2 Configuring Analog Inputs as Current Inputs

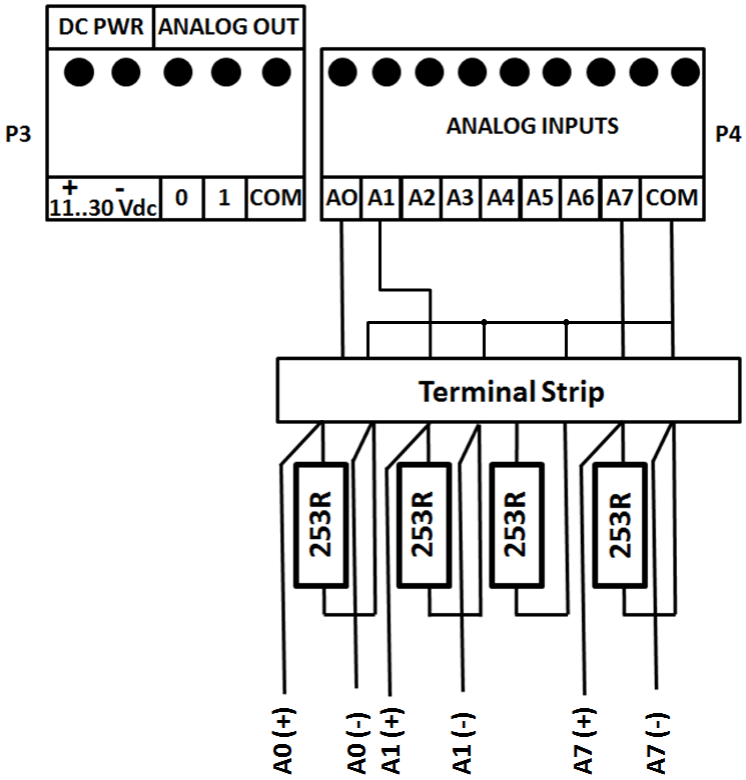
The analog inputs for the SCADAPack 357E RTU are configured in **Current Input** mode and have these possible operating conditions:

- The SCADAPack 357E is not the only transducer in a particular current loop
- The SCADAPack 357E is powered down, or reset

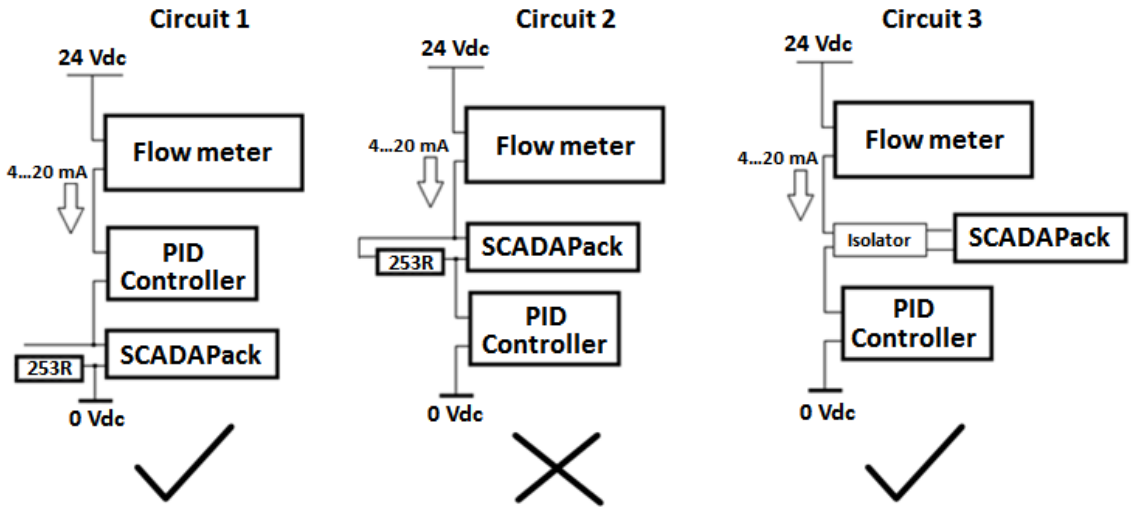
If you power down or reset the SCADAPack 357E in a multiple device loop, the analog inputs emulate voltage inputs that present a high impedance to the current loop, and effectively break the current loop of the system.

9.7.3 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:

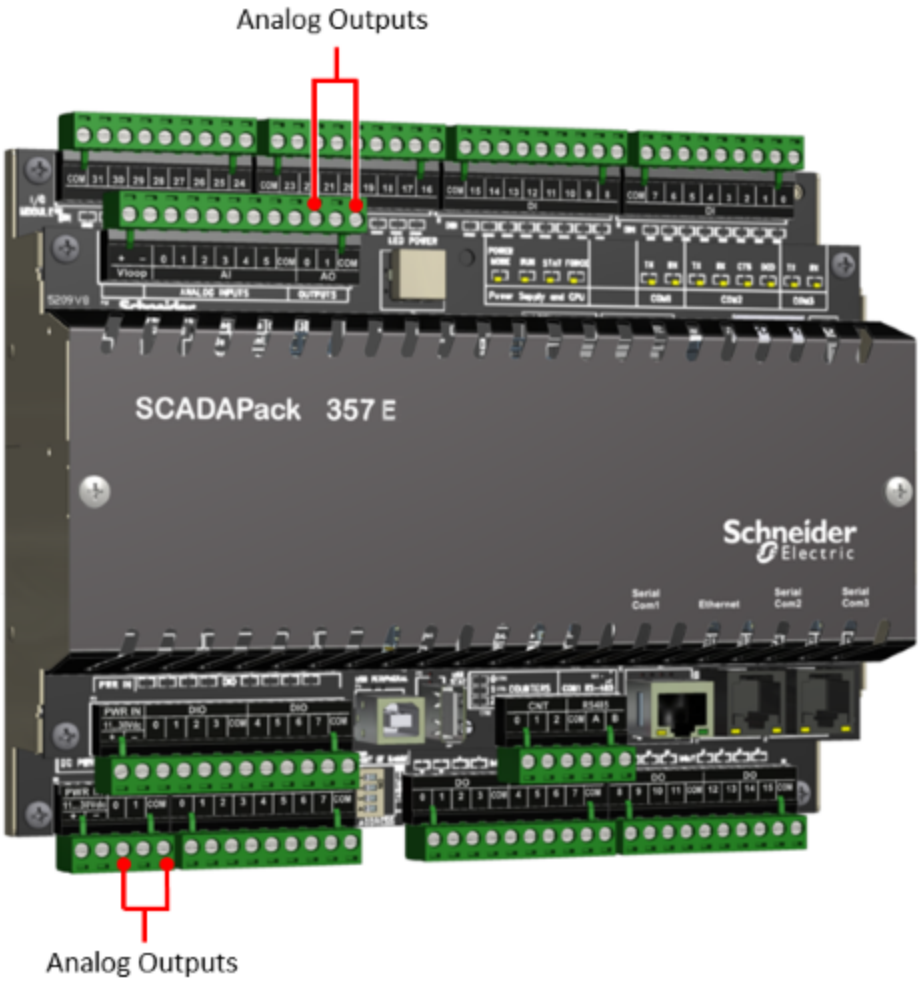


9.8 Analog Output Wiring

This section describes the analog output wiring

NOTICE
UNEXPECTED EQUIPMENT OPERATION Analog output signals must be shielded using Belden 9322 or equivalent, when the unit is operating in an electrically noisy environment or to meet the requirements of EN 61000-6-2. **Failure to follow these instructions can result in equipment damage.**

The following figure shows the location of the analog outputs.



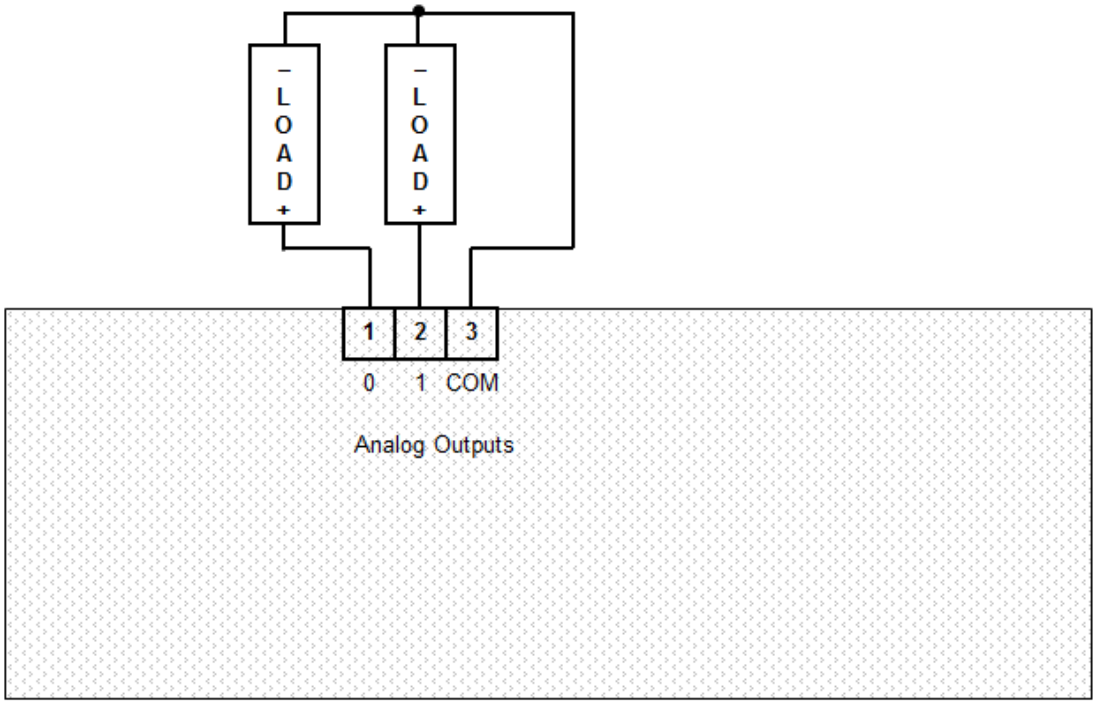
SCADAPack 357E Analog Outputs

For information on how to wire power to the analog outputs, see: Analog Output Wiring Example 112.

For information on configuration options for the analog output power supply, see: Analog Output Power Supply Configuration Options 113.

9.8.1 Analog Output Wiring Example

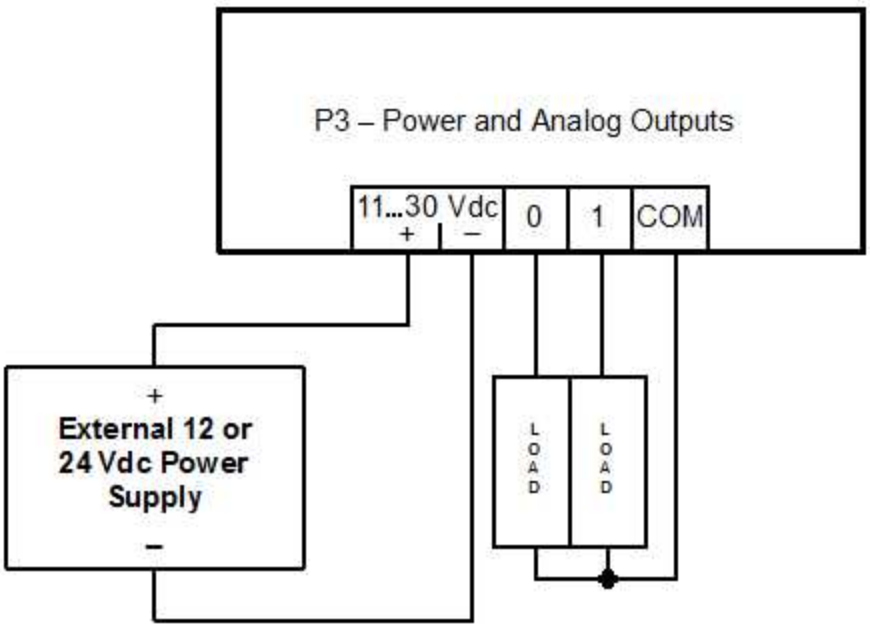
The figure below shows how to connect the analog outputs.



Analog Output Wiring - Controller Board

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

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



Analog Output Wiring - I/O Board

9.8.2 Analog Output Power Supply Configuration Options

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

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

NOTICE

UNINTENDED EQUIPMENT OPERATION

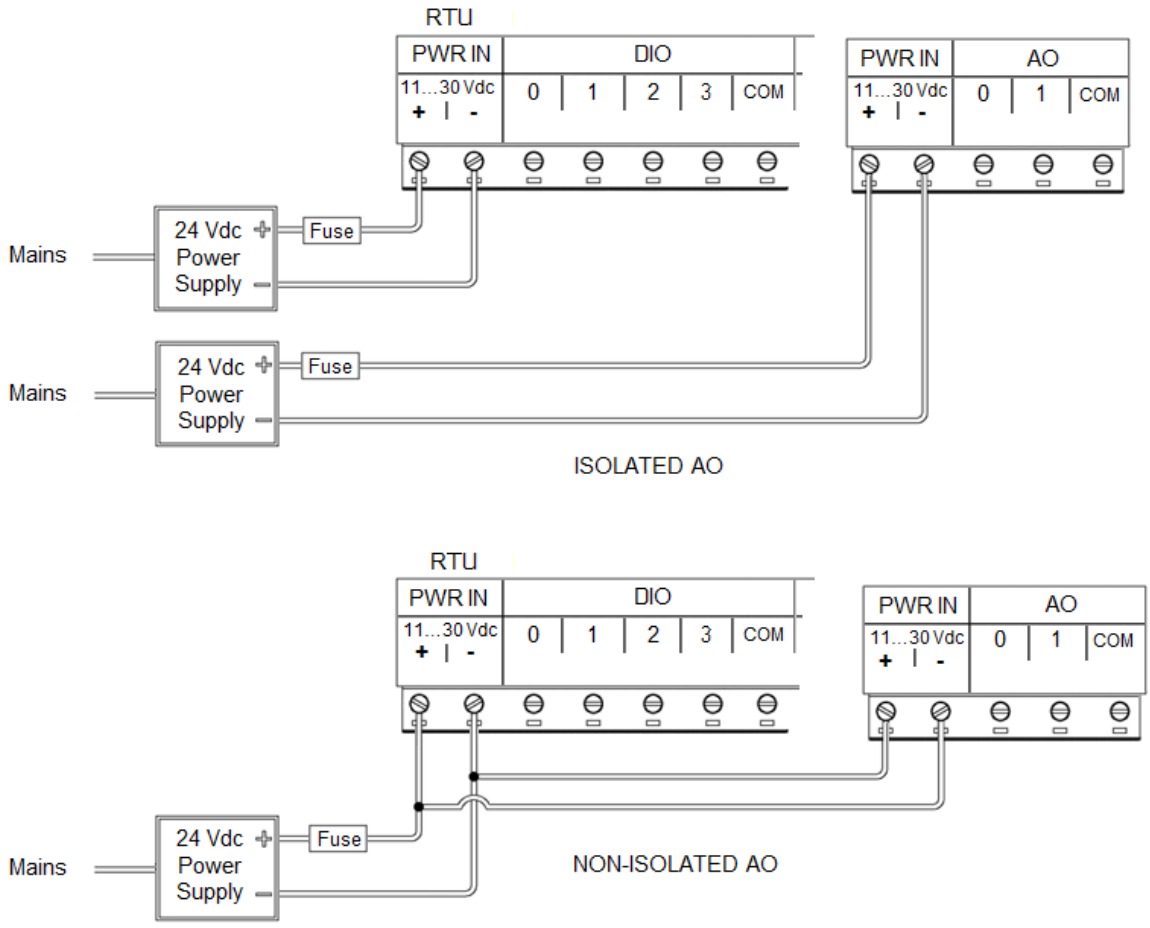
Install an external 1.6 A fast-acting fuse on the input voltage side of the RTU power supply connection.

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

Failure to follow these instructions can result in equipment damage.

Wiring Examples

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



Analog Output Power Supply Configuration

10 Startup Modes

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

- Run mode 117
- Service Boot mode 118
- Cold Boot mode 120
- Factory Boot mode 122

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

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

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

Startup Mode Actions

NOTICE

CONFIGURATION AND APPLICATION LOSS

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

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

Failure to follow these instructions can result in equipment damage.

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

10.1 Run Mode

Run mode is the normal operating mode for SCADAPack 300E RTUs. The RTU automatically starts in Run mode when power is applied or when a board reset occurs. No action is required to select Run mode.

When a SCADAPack 300E RTU starts in Run mode, it loads:

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

10.2 Service Boot Mode

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

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

- DNP3 node address zero (0) is set, enabling communication via SCADAPack E Configurator at a known DNP address. Connect SCADAPack E Configurator to USB, or serial Port 2 or Port 3.
- Any IEC 61131-3 applications that are running are stopped.
- Modbus Scanner operations are stopped.
- Applications and configurations are retained in non-volatile memory.
- Serial, USB, Ethernet, and IP Routing parameters are set to the values listed in the tables below. This allows you to connect to the RTU for configuration, programming, and maintenance tasks without knowing the port settings used for daily operations.

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

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

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

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

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

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

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

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 300E RTU in Service Boot Mode

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

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

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

10.3 Cold Boot Mode

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

Cold Boot mode does not format the flash file system. Start in Factory Boot 122 mode to do this.

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

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

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

Parameter	USB	COM1 (Port 1)	COM2 (Port 2)	COM3 [2] 118 (Port 3)
Function	DNP3	None	DNP3	ISaGRAF
Mode	USB	RS485 2w [1] 118	RS232 [1] 118	RS232
Baud	-	9600 bps	9600 bps	9600 bps
Data Mode	-	8-bit No Parity	8-bit No Parity	8-bit No Parity
Stop Bits	-	1	1	1
Duplex	-	Half	Full	Full

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

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

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

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

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

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 300E RTU in Cold Boot Mode

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

NOTICE

CONFIGURATION AND APPLICATION LOSS

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

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

Failure to follow these instructions can result in equipment damage.

1. Remove power from the RTU.
2. Hold down the LED POWER button.
3. Apply power to the RTU.
4. Continue holding the LED POWER button for 20 seconds until the STAT LED begins to flash on and off repeatedly.

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

   To cancel the startup mode selection, remove power from the RTU while the LED POWER button is depressed. This can be a useful tactic to avoid starting up in Factory Boot mode if you have held the LED POWER button down longer than 20 seconds.
5. Release the LED POWER button.
6. Reload the RTU configuration and user-created applications from backup.

10.4 Factory Boot Mode

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

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

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

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

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

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

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

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

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

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

Parameter	Address
Gateway IP	0.0.0.0

To Start a SCADAPack 300E RTU in Factory Boot Mode

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

NOTICE

CONFIGURATION AND APPLICATION LOSS

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

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

Failure to follow these instructions can result in equipment damage.

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

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

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

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

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

11 Configuration

The inputs and outputs on the RTU can be configured:

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

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

SCADAPack E Configurator 126

Reading and Writing Data with Logic Programs 128

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

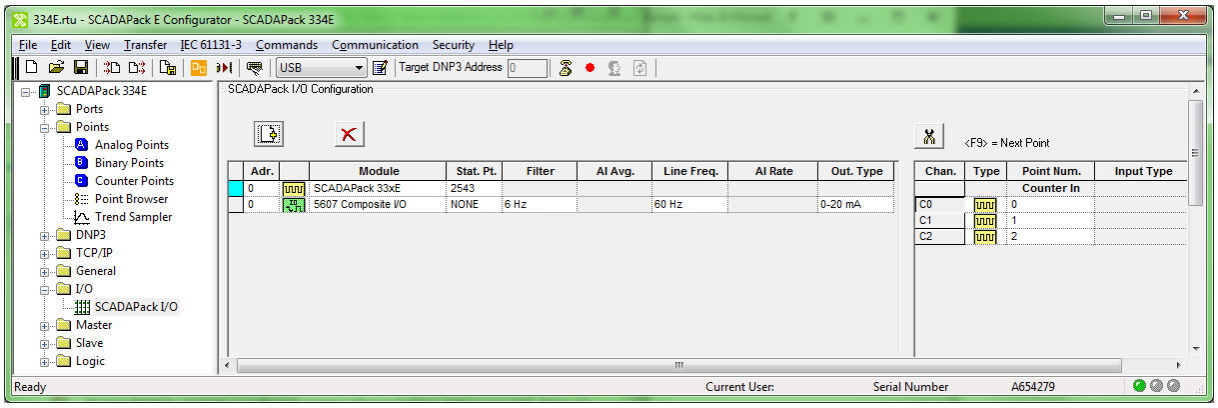
11.1 SCADAPack E Configurator

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

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

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

The figure below shows an example SCADAPack I/O property page in SCADAPack E Configurator and the location of the property pages listed in the table above. The I/O components listed on the SCADAPack I/O page depend on the RTU type. For details about using SCADAPack E Configurator, refer to the SCADAPack E Configurator User Manual.



11.2 Reading and Writing Data with Logic Programs

IEC 61131-3 applications use I/O connections to the SCADAPack E RTU points database to access physical I/O points and derived data. Use SCADAPack E Configurator to assign RTU database points to the I/O card channels.

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

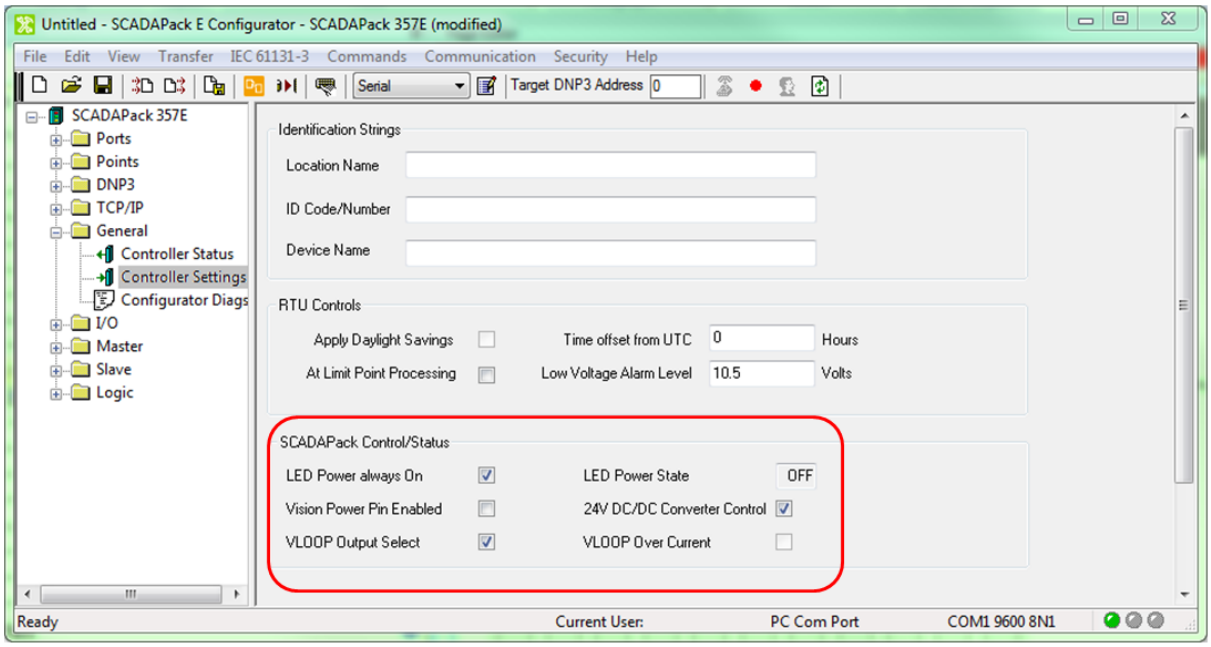
Data Type	SCADAPack Workbench	ISaGRAF 3 Workbench
Counter Input Data	• Use **RTU_COUNTER_READ** I/O device to read counter inputs.	• Use an **rtuXXctr** input board or complex equipment type to read counter inputs.
Digital I/O Data	• Use **RTU_BIN_READ** I/O devices to read data. • Use **RTU_BIN_READ_OUTPUT** I/O devices to read digital output point states. • Use **RTU_BIN_WRITE** I/O devices to write digital input or output points.	• Use **rtuxxdi**, **rtuxxdo** or **rtuxxdos** I/O boards to read or write to digital inputs or outputs.
Analog Input Data	Configuration for points attached to the analog input channels uses the SCADAPack E **RAW_MIN**, **RAW_MAX** and **ENG_MIN**, **ENG_MAX** parameters for integer and engineering scaling, respectively. These scaling ranges apply to the analog input signal range selected in SCADAPack E Configurator for each analog input channel. • Use **RTU_RAW_READ** or **RTU_ENG_READ** I/O devices to read analog input points • Use **RTU_RAW_WRITE** or **RTU_ENG_WRITE** I/O devices to write data to analog input points.	• Use **rtuxxai** I/O boards to read analog input points.
Analog Output Data	• Use **RTU_RAW_READ_OUTPUT** and **RTU_ENG_READ_OUTPUT** I/O devices to read analog output points. • Use **RTU_RAW_WRITE** or **RTU_ENG_WRITE** I/O devices to write data to analog output points.	• Use **rtuxxaos** I/O boards to read analog output points. • Use **rtuxxao** I/O boards to write data to analog output points.

More Information

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

11.3 Power Management Features

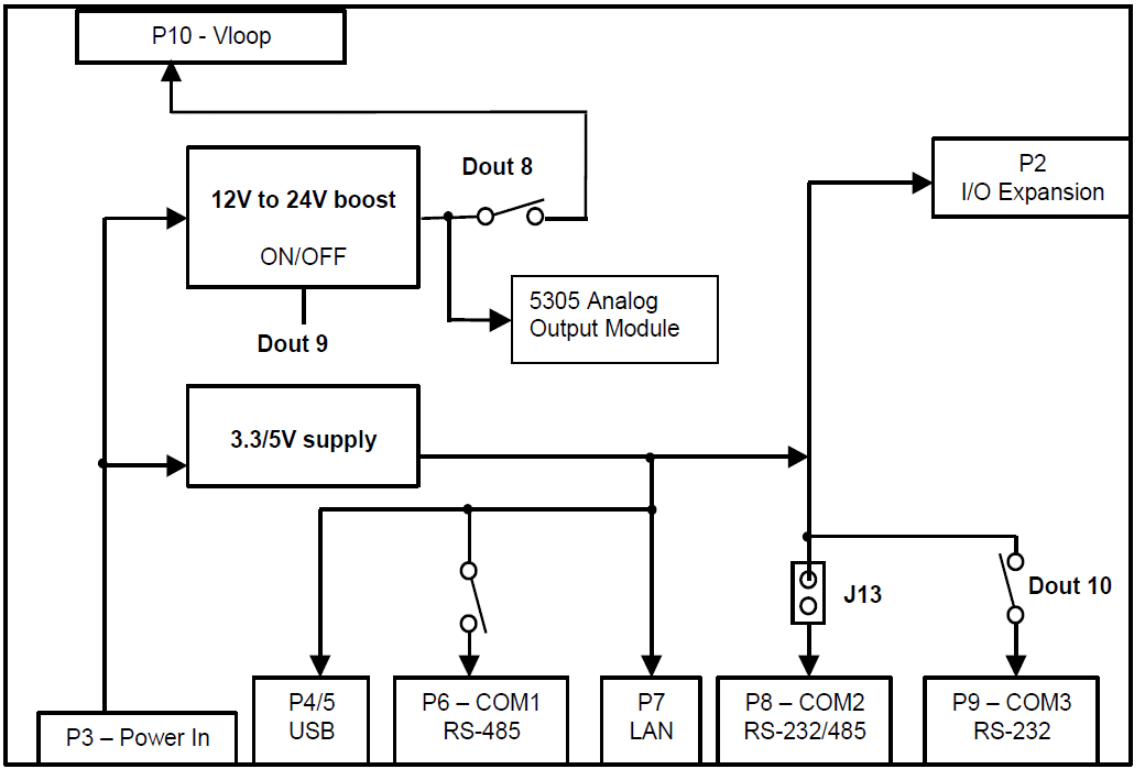
The SCADAPack 357E provides a number of special features to reduce power consumption. These features can be managed via binary system points that can be controlled in SCADAPack E Configurator or by the user application. SCADAPack E Configurator controls for the power management features are accessed from the **General > Controller Settings** page, shown in the image below.



The power management features with their associated binary system points are described in the following sections:

- COM3 Serial Port Power Control (50750) 132
- VLOOP Power Control (50610) 133
- VLOOP Over-Current Protection (50760) 134
- 24 V DC/DC Converter Control (50751) 135
- LED Power Control (50752) 136

See the diagram below for an overview of the power management features.



Power Management

11.3.1 COM3 Serial Port Power Control (50750)

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

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

Refer to COM3 RS232 Serial Port 27 for information on COM3 (and RS232 Wiring Examples 84 for wiring examples).

Binary System Point 50750

HMI power is controlled in the following ways.

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

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

HMI power is turned on whenever the LED power is enabled. This feature is provided for service and diagnostics.

Refer to LED Power Control 136 for further information on this feature.

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

11.3.2 VLOOP Power Control (50610)

Binary System Point 50610

The DC/DC converter output can be used to power analog input current loops or other instrumentation. This output, VLOOP, is controlled for intermittent or continuous operation. Turning the VLOOP output off when it is not required can save considerable electrical power.

The switched VLOOP power source is the output of the 24 V DC/DC Converter if it is turned on. See 24 V DC/DC Converter Control 135 for converter information. The VLOOP power source is the applied input power if the DC-DC converter is turned off.

- Turn on system **Binary System Point 50610** to turn ON the VLOOP Power Control (**SCADAPack E Configurator VLOOP Output Select ON**).
- Turn off system **Binary System Point 50610** to turn OFF the VLOOP Power Control (**SCADAPack E Configurator VLOOP Output Select OFF**)

Reading system **Binary System Point 50610** indicates the status of VLOOP power. It is set when VLOOP power is **ON** and is cleared when VLOOP power is **OFF**.

When VLOOP is first turned on, the user application program needs to wait some period of time for input readings to stabilize. This time period is dependent on the field sensors and transmitters connected. Documentation for these devices should be consulted.

The VLOOP output is turned **ON** when the LED power is enabled. This feature is provided for service and diagnostics. Refer to LED Power Control 136 for further information on this feature.

11.3.3 VLOOP Over-Current Protection (50760)

Binary System Point 50760

When **VLOOP Power Control** is **ON**, it is monitored for excessive current consumption caused by field wiring or instrumentation.

If sustained over-current is detected (for over 100 ms), the **VLOOP Power Control** is turned **OFF** even though **Binary System Point 50610** is **ON**. This helps to stop unnecessary fuse blowing, circuitry damage and rapid battery depletion.

When **VLOOP Power Control** is turned on using **Binary System Point 50610** (**SCADAPack E Configurator VLOOP Output Select ON**), and a short circuit or over-current is detected, VLOOP will turn off. VLOOP will turn on to try again 5 seconds after turning off. If the condition still exists, VLOOP will again turn off and retry after a 5 second delay.

While the condition exists, system **Binary System Point 50760** will be **ON** (**SCADAPack E Configurator > Controller Settings > VLOOP Over Current** indicator).

11.3.4 24 V DC/DC Converter Control (50751)

Binary System Point 50751

Internal **Binary System Point 50751** indicates the status of the 12 V to 24 V DC/DC converter. It is set when the 24 V DC/DC converter is on and is cleared when the 24 V DC/DC converter is off.

The 24 V DC/DC converter is used to provide 24 Vdc for VLOOP power and for the optional analog output module.

The converter should be turned on if the SCADAPack 357E is equipped with analog outputs for which 24 Vdc drive capability is required. Otherwise, the DC/DC converter can be turned off to conserve power.

- Turn on **Binary System Point 50751** to turn on the 24 V DC/DC converter (**SCADAPack E Configurator 24 V DC/DC Converter Control ON**). When the converter is turned on, 24 Vdc is provided to the VLOOP power and to the Analog Output module.
- Turn off **Binary System Point 50751** to turn off the 24 V DC/DC converter (**SCADAPack E Configurator 24 V DC/DC Converter Control OFF**). When the converter is turned off, VLOOP power and the Analog Output module use is the applied input power.

The 24 V DC/DC converter is turned on when the LED power is enabled. This feature is provided for service and diagnostics. See LED Power Control 136 for further information on this feature.

11.3.5 LED Power Control (50752)

The LEDs on the SCADAPack 357E can be disabled to conserve power. This is particularly useful in solar powered or unattended installations.

LED Power State - Binary System Point 50761

The **Power Mode LED** indicates the status of the LEDs. It is on when the **LED Power State** control (**50761**) is enabled in the **SCADAPack E Configurator General > Controllers Settings** page.

LED Power Always ON - Binary System Point 50752

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 SCADAPack E Configurator enables the LED power mode.

- If the **LED Power Always On** control (**50752**) in the **SCADAPack E Configurator General > Controller Settings** page is active, the **LED POWER** button has no effect and the SCADAPack 357E LEDs are on.
- If the **LED Power Always On** control (**50752**) in the **SCADAPack E Configurator General > Controller Settings** page is inactive, the state of LEDs at RTU startup is **Enabled**. 60 seconds after the controller has started the LEDs will be Disabled. While the controller is running, when the LED POWER button is pushed the LED displays are enabled for a period of 60 seconds. After this time the LED displays are again disabled.

The LED state is independent of the VLOOP, DC/DC Converter and Vision display controls on the SCADAPack 357E RTU. The user may programmatically relate these items together through IEC 61131-3 if required (for example, activate the DC/DC converter and Vision display when the LEDs are activated.)

12 Diagnostics

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

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

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

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.

To determine the cause of the STAT LED condition

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

To clear the status code and the STAT LED indicator

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

12.2 LED Indicators

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

LED	Function
Power Mode	On when operating and the LEDs are enabled. Off when the LEDs are disabled Off when powered off
RUN	Blinking every 1.5 secs when the RTU is operating normally
STAT	Blinking when there is a status code The status code and description can be viewed from the **SCADAPack E Configurator > General > Controller Status** page The status code is also available in SCADAPack E Analog System Point 50020 137
FORCE	On when I/O points are forced (LOCKED by ISaGRAF 3 Workbench and SCADAPack Workbench)
RX	On when receiving data on the corresponding serial port
TX	On when transmitting data on the corresponding serial port
CTS	On when the CTS input is asserted on the corresponding serial port
DCD	On when the DCD input is asserted on the corresponding serial port
Counter 0	On when the counter input is present and low
Counters 1 and 2	When the input is configured to use an external amplifier, the LED is on when the counter input is present and low When the input is configured to use the internal amplifier, the LED is on when input pulses are present
Digital I/O	On when the corresponding I/O point 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 Supply Voltage and Internal Temperature

Internal analog points measure the RTU input supply voltage and internal temperature. These can be accessed from a user application program or via remote RTU communications.

Supply Voltage

Analog System Point 50060

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

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

Internal Temperature

Internal Temperature °C

Analog System Point 50062

This analog system point measures the ambient temperature at the RTU circuit board in degrees Celsius. It is useful for measuring the operating environment of the RTU and returns an integer value in the range -40...75.

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

- Use the system point directly by assigning an analog point of this point number (50062) in the RTU database.
- Read the system point into a user-created SCADAPack Workbench or ISaGRAF 3 Workbench application as an integer or real variable from an input board connection.

Internal Temperature °F

Analog System Point 50063

This analog system point measures the ambient temperature at the RTU circuit board in degrees Fahrenheit. It is useful for measuring the operating environment of the RTU and returns an integer value in the range -40...167.

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

- Use the system point directly by assigning an analog point at this point number (50063) in the RTU database.
- Read the system point into a user-created SCADAPack Workbench or ISaGRAF 3 Workbench application as an integer or real variable from an input board.

12.4 Power Supply and Battery Status

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

Local Input Power Supply Low

Binary System Point 50206

This binary system point indicates the condition of the input power supply. It compares the Supply Voltage Analog System Point 50060 139 with the Low Voltage Alarm Level set on the SCADAPack E Configurator **General > Controller Settings** property page. If the input power supply is lower than the Low Voltage Alarm Level then this system point is activated.

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

Local On-Board Battery Low

Binary System Point 50207

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

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

12.5 Counter Inputs

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

12.6 Digital Inputs

Condition	Action
Input LED does not come on when input signal is applied.	Check the input signal at the termination block. It should be at least 50% of the digital input range. If this is a DC input, check the polarity of the signal.
Input is on when no signal is applied. The LED is off.	Check that the digital inputs are not forced on.
Input is off when a signal is applied. The LED is on.	Check that the digital inputs are not forced off.
Input is on when no signal is applied. The LED is on.	Check that the digital output at that point is off.
The LED is dim.	This is normal operation when the controller is in low power mode or sleep mode, or when the LEDs are turned off. Check the controller digital I/Os are in the register assignment.

12.7 Digital Outputs

Condition	Action
Output LED does not come on when output is turned on.	Check the LED POWER from the SCADAPack controller.
Output LED comes on and output is on, but the field device is not activated.	Check the field wiring. Check the external device.
Output LED and output are on when they should be off.	Check that the output is not forced on.
Output LED and output are off when they should be on.	Check that the output is not forced off.

Condition	Action
Output LED comes on but the output does not close.	Check if the relay is stuck. If so, return the board for repair.
The LED is dim.	This normal operation when the controller is in sleep mode, or when the LEDs are turned off. Check the controller digital I/Os are in the register assignment.

12.8 Analog Inputs

Condition	Action
20 mA inputs read 0.	Check transmitter power.
Reading is at or near 0 for every input signal.	Check if the input transient suppressors are damaged.
20 mA readings are not accurate.	Check for a damaged 250-ohm current sense resistor. Check that inputs are 0...20 mA, not 4...20 mA.
Reading is constant.	Check that the analog input is not forced.

12.9 Analog Outputs

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

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 149 for details.

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

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

⚠WARNING

HAZARD OF ELECTRIC SHOCK

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

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

For more information, see the following sections:

Calibration 144

Preventive Maintenance 144

Routine Maintenance 146

Replacing the Battery 149

Updating Firmware 152

Fuses 153

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 Preventative Maintenance

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

⚠WARNING

HAZARD OF ELECTRIC SHOCK

Remove power from the RTU before removing the RTU cover.

Remove power from the RTU before servicing.

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

Battery Handling Procedures

NOTICE

UNINTENDED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

Electrostatic Discharge (ESD) Procedures

NOTICE
UNINTENDED EQUIPMENT OPERATION The electronics inside the RTU can be damaged by static electricity. If you need to remove the RTU cover, wear an anti-static wrist strap that is connected to ground. Failing to follow this 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

UNINTENDED EQUIPMENT OPERATION

The electronics inside the RTU can be damaged by static electricity. If you need to remove the RTU cover, wear an anti-static wrist strap that is connected to ground. Failing to follow this 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.

NOTICE
DATA LOSS RTU memory contents are lost when: • The onboard RAM back-up battery goes flat. • The onboard RAM back-up battery is replaced while power to the RTU is disconnected. When memory contents are lost, RTU configuration information and user-created applications must be reloaded for correct RTU operation. **Failure to follow these instructions can result in equipment damage.**

NOTICE
UNINTENDED EQUIPMENT OPERATION Before replacing the onboard RAM back-up battery, save a copy of the RTU configuration information, user-created applications, logs and other data to an external drive so it can be reloaded when the procedure is complete. **Failure to follow these instructions can result in equipment damage.**

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

RAM back-up batteries are not rechargeable.

Power Supply Notifications

The RTU provides notifications for the following:

- Onboard lithium battery low
- Input power supply low

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

Cleaning

There are no special cleaning instructions for this product.

Routine Maintenance Schedule

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

- Every three years
- Every five years

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

Items requiring re-calibration may not be suitable for user servicing. Contact Schneider Electric Technical Support 8 for advice.

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

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 146 section:

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

The RAM battery status is provided on the Controller Status property page in the SCADAPack E Configurator software. Take care not to confuse this status with an external power supply low condition.

The following procedure requires the RTU to be powered off briefly. It also requires restarting the RTU in **Cold Boot** mode. Consider the following precautions before proceeding.

Back Up Data Before Replacing the Battery

RTU memory contents are lost when:

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

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

NOTICE

DATA LOSS

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

Failure to follow these instructions can result in equipment damage.

To replace the onboard RAM back-up battery

1. Back-up RTU configuration information, user-created applications, logs and other data to an external drive so it can be reloaded when the procedure is complete.

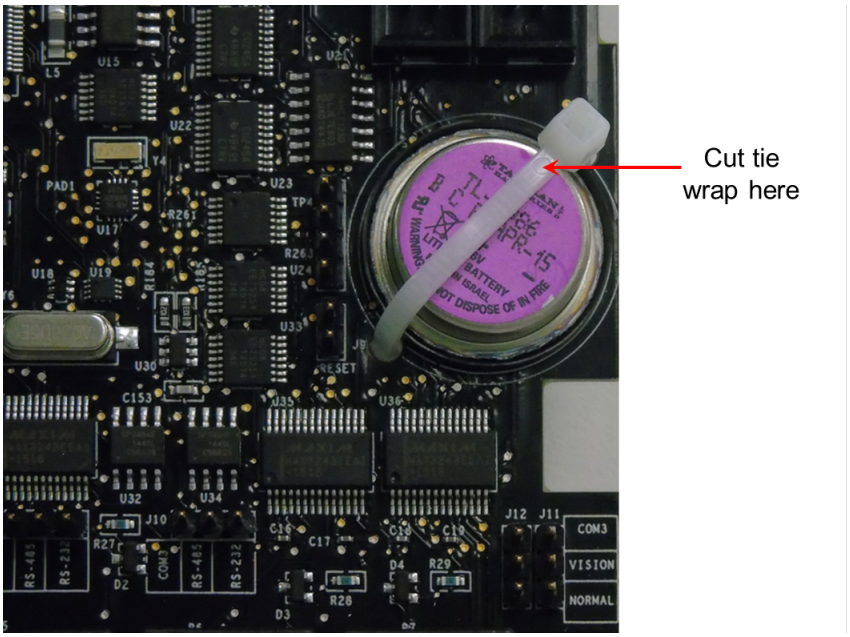
> **⚠WARNING**
>
> **UNINTENDED EQUIPMENT OPERATION**
>
> Evaluate the operational state of the equipment being monitored or controlled by the RTU before removing power.
>
> **Failure to follow these instructions can result in death or serious injury.**

2. Remove power from the RTU.

> ***NOTICE***
>
> **STATIC ELECTRICITY DAMAGE**
>
> The electronics inside the RTU can be damaged by static electricity. If you need to remove the RTU cover, wear an anti-static wrist strap that is connected to ground. Failing to follow this 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 Status LED begins blinking on and off.
10. In SCADAPack E Configurator, use the **Transfer > Set RTU** time to reset the time on the RTU.
11. Reload the RTU configuration and user-created applications from back-up.

13.5 Updating Firmware

On the SCADAPack E Smart RTU, you can update:

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

NOTICE
UNINTENDED EQUIPMENT OPERATION Before you install any firmware updates, check the Release Notes for the firmware update to determine the most suitable firmware versions for the functionality you are using and to confirm version compatibility. **Failure to follow these instructions can result in equipment damage.**

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

13.6 Fuses

A single 1.5 A fast-blow fuse provides protection for the power supply. The fuse is mounted under the cover.

Refer to Jumper Functions 79 for the fuse (F1) location.

⚠WARNING

RISK OF EXPLOSION

Before replacing the fuse:

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

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Replace the fuse with a fuse of the same rating. Under no circumstances should 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.

The following topics provide detailed hardware specifications for the SCADAPack 357E, its ports and its inputs and outputs:

14.1 General

Feature/Function	Detail
Terminations	• 5, 6, 9, 10 and 12-pin, removable terminal blocks • 3.31...0.08 mm^2 (12...28 AWG) • 15 A contacts • Screw termination - 0.5 N•m (4.5 lb-in) torque • Solid or stranded
Dimensions	• 211.8 mm (8.34 in) wide • 181.0 mm (7.13 in) high • 74.1 mm (2.92 in) deep
Packaging	Corrosion-resistant zinc-plated steel with black enamel paint
Environment	• Conformally coated • 5% RH to 95% RH, non-condensing • -40...70 °C (-40...158 °F) operation • -40...85 °C (-40...185 °F) storage
Shock and Vibration	• IEC 60068-2-27 (tested up to 15 g) • IEC 60068-2-6
Logic Control	IEC 61131-3 SCADAPack Workbench programming suite (LD, ST, FBD & SFC)
I/O Expansion	• Supported modules: 5606, 5607, 5608, 5610, 5304, 5404, 5411, 5414, 5415, 5505, and 5506 • Maximum number of modules: 8 (additional power supply modules may be required)
Platform	• SCADAPack E Firmware (Configuration software included). Excludes two IEC 61131 kernels • Workbench required
Security	• AGA-12 Encryption for DNP3 (Security Administrator application required) • DNP3 Secure Authentication SAv2 (Security Administrator application required) • DNP3 Secure Authentication with AGA-12 (Security Administrator application required)
Protocol Option	• DNP3 Serial/IP Master/Slave/peer-to-peer • IEC 60870-5-101/104 Slave

Feature/Function	Detail
	• Modbus RTU/TCP Master/Slave • TCP/IP • DF1 Master
License Option	• DNP3 Data concentrator license (limit of 500 points from 10 IEDS), supports multiple DNP3 Masters (up to 3) • Adds WITS protocol (available for SCADA security code C and certification code S only)

14.2 Power Supply

<table>
<tr><th>Feature/ Function</th><th>Detail</th></tr>
<tr><td>Rated Voltage</td><td>

11...30 Vdc
10...11.5 Vdc turn on voltage
9...10 Vdc turn off voltage
Limit voltage: 11.5...32 Vdc

</td></tr>
<tr><td>Maximum Power</td><td>12 W at 24 Vdc (internal 5 Vdc supply fully loaded and VLOOP on and boosted, fully loaded)</td></tr>
<tr><td>Power Requirements</td><td>Typical power consumption at 20 °C (68 °F):
<table>
<tr><th></th><th>Ethernet</th><th>LEDs</th><th>VLOOP fully loaded</th><th>12 Vdc</th><th>24 Vdc</th></tr>
<tr><td>Use case 1</td><td>ON</td><td>OFF</td><td>OFF</td><td>1.6 W</td><td>1.5 W</td></tr>
<tr><td>Use case 2</td><td>ON</td><td>OFF</td><td>ON</td><td>5.1 W</td><td>4.9 W</td></tr>
<tr><td>Use case 3</td><td>ON</td><td>ON</td><td>ON</td><td>5.2 W</td><td>5.0 W</td></tr>
</table>
Up to 8.9 W (with up to 7 analog input/output loops powered from VLOOP supply.
See Power Calculations 63.</td></tr>
<tr><td>Power Outputs</td><td>

Maximum 140 mA at 12 Vdc (booster turned off) or 24 Vdc (booster turned on)
Can power up to 7 analog input/output loops (20 mA per analog loop)

</td></tr>
<tr><td>Output Capacity</td><td>

5 Vdc at 1.2 A capacity
5 Vdc at 290 mA required by controller (LAN and USB enabled) in normal clock mode
5 Vdc at 1.1 A (current limited) for COM2 and I/O expansion
5 Vdc at 250 mA (current limited) on COM3 for Vision displays
5 Vdc at 100 mA (current limited) for USB downstream port loads

</td></tr>
</table>

14.3 Controller

Feature/Function	Detail
Processor	• 32-bit ARM7 microcontroller (32 MHz clock) • Integrated watchdog timer • Two microcontroller I/O co-processors (20 MHz clock)
Memory	• 16 MB FLASH ROM • 4 MB CMOS RAM • 4 kB EEPROM
Non-volatile RAM	CMOS SRAM with lithium battery retains contents for 2 years with no power
Clock calendar	±1 minute/month at 25 °C (77 °F) +1/-3 minutes/month 0...50 °C (32...122 °F)
Internal Temperature	• Measurement range -40...75 °C Accuracy ± 5 °C • Measurement range -40...167 °F Accuracy ± 9 °F
Lithium Battery Monitor	• Accuracy ± 0.2 Vdc • Status indicated by Internal Binary Points 140
Power Input Voltage Monitor	Accuracy ±0.4 Vdc

14.4 Data Capacity

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

14.5 Serial Ports

Feature/Function	Detail
Serial Port COM1	• RS485 compatible serial port • 2-pole removable terminal block • Two-wire half duplex
Serial Port COM2	**RS232 mode:** • RS232 compatible serial port • 8-pin modular RJ45 jack • Full or half duplex
	RS485 mode: • RS485 compatible serial port • Two-wire half duplex
Serial Port COM3	• Dedicated RS232 compatible serial port • 8-pin modular RJ45 jack • Full or half duplex with RTS/CTS control and operator interface power control
Baud Rates	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Embedded Wireless	The controller may embed an unlicensed radio module (different options in 900 MHz or 2.4 GHz) that uses one of the serial ports.
Serial Protocols	• DNP3 level 4 Master/Slave and peer-to-peer • IEC 60870-5-101 Slave • IEC 60870-5-103 Master • Modbus RTU Master/Slave • DF1 Master
Master - Slave Capability	• Can simultaneously report to multiple independent active masters: 3 in DNP3, 2 in IEC 60870-5-101/-104, 5 in Modbus TCP and 3 in Modbus RTU and connect to up to 100 remote devices in DNP3 peer-to-peer • As a data concentrator, it can manage up to 10 local or remote DNP3 slaves, and up to 100 local slaves communicating with Modbus RTU, Modbus TCP or DF1 serial.

14.6 Ethernet Port

Feature/Function	Detail
Terminations	• 8-pin RJ-45 modular connector • 10Base-T/100Base-T (twisted pair) • 10/100 Mbits per second • Transformer-isolated
Protocols Supported	• DNP3 level 4 in TCP Master/Slave • DNP3 in UDP Master/Slave and peer-to-peer • Modbus/TCP Client • Modbus RTU in TCP Client • Modbus/TCP Server • IEC 60870-5-104 Slave • NTP Client/Server • Telnet Server • FTP Server • BOOTP Server

14.7 USB Ports

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

14.8 Counter Inputs

Feature/Function	Detail
Counter Inputs	• Counter 0 (digital input) • Counter 1 (turbine meter inputs) • Counter 2 (turbine meter inputs)
Connectors	1 removable 6-pin terminal block
Counter 0	• Jumper selectable maximum frequency 10 Hz or 5 kHz • Dry contact input • Wetting current typically 5 mA • Contact closure to ground is ON • Open input is OFF
Counter 1 and 2	• Designed for use with low voltage, turbine meter outputs • Jumper link selectable for use with turbine meter amplifiers or dry contact closure
Counter 1 and 2 Turbine Meter Sensitivity	• Minimum input 30 mVp-p at 5...50 Hz • Minimum input 150 mVp-p at 150 Hz • Minimum input 650 mVp-p at 5 kHz • Minimum input 750 mVp-p at 10 kHz • Maximum input 4 Vp-p using internal amplifier
Counter 1 and 2 Dry Contact	• Maximum input 10 Vp-p without internal amplifier • Maximum frequency 10 kHz
Dry Contact Thresholds	• 0.9 Vdc typical turn on voltage • Less than 0.4 Vdc turn on input voltage • 1.5 Vdc typical turn off input voltage • Greater than 2.5 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

I/O Board Digital Inputs		
Feature/Function	**Detail**	
Quantity	32	
Connectors	4 removable 8-pin terminal blocks	
Indicators	Logic-powered LEDs that can be disabled to conserve power (see LED Power Control (50752)) 136	
Voltage	• Typical: 12...24 Vdc • Turn on voltage: 9 Vdc (minimum) • Turn off voltage: 4 Vdc (maximum) • Over-voltage Tolerance: 36 Vdc (150% sustained over-voltage without foreseeable damage)	
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 4 groups of 8 • Isolation from logic supply and chassis: 1500 Vac	
Controller Board Digital Inputs		
Feature/Function	**Detail**	
I/O Points	8 user-selectable as inputs or outputs (open drain)	
Connectors	1 removable 12-pin terminal block	
Digital Inputs	• Dry contact • Time stamping: 170 ms	
Input Rating	• Dry contact input • 60 ohms for 32.768 Vdc inputs	

I/O Board Digital Inputs	
	• 250 ohms for 20 mA inputs • Contact closure to ground is ON • Open input is OFF
Digital Input Thresholds	• 0.9 Vdc turn on input voltage • Less than 0.4 Vdc turn on input voltage • 1.5 Vdc typical turn off input voltage • Greater than 2.2 Vdc turn off input voltage
Contact Resistance	• ON input requires less than 100 ohms contact resistance • Off input requires greater than 50 kilohms contact resistance • Cable contact capacitance not to exceed 0.033 µF, typically 500 m (1600 ft)
Isolation	Common ground return connected to chassis ground

14.10 Digital Outputs

I/O Board Digital Outputs	
Feature/Function	**Detail**
Quantity	16
Connectors	2 removable 9-pin terminal blocks
Type	• Form A contacts (normally open) • 4 contacts share one common
Indicators	Logic-powered LEDs that can be disabled to conserve power (see LED Power Control (50752)) 136
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 I/O Board Digital Output Wiring 101 topic for further information)
Isolation	• Isolation is in 4 groups of 4 • Chassis to contact: 1500 Vac • Logic to contact: 1500 Vac
Operate Time	25 ms maximum (20 ms typical)
Release Time	30 ms maximum (25 ms typical)

I/O Board Digital Outputs	
Controls	• Direct operate • Select before operate • Trip/Close • Latch • Pulse
I/O Board - Digital Outputs (Dry contact relay version)	
Contact Rating	• 3 A or 30 Vdc • 12 A maximum per common
Switching Capacity	5 A, 30 Vdc (150 W resistive)
Service Life	• 2 x 10^7 mechanical • 1 x 10^5 at contact rating
Bounce Time	1 ms typical
I/O Board - Digital Outputs (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
Controller Board Digital Outputs	
Feature/Function	**Detail**
I/O Points	8 user-selectable as inputs or outputs (open drain)
Connectors	1 removable 12-pin terminal block
Digital Outputs	Sinking MOSFET output, rated 1 A
Output Rating	• 1.0 A maximum • 0.35 Vdc maximum drop at 1 A
Contact Resistance	• ON input requires less than 100 ohms contact resistance • Off input requires greater than 50 kilohms contact resistance • Cable contact capacitance not to exceed 0.033 µF, typically 500 m (1600 ft)
Isolation	Ground return connected to chassis ground

14.11 Analog Inputs

I/O Board Analog Inputs	
Feature/Function	**Detail**
Input Points	• 8 • Software-configurable • 0...20 mA or 4...20 mA • 0...5 V or 0...10 V
Connectors	1 removable 9 pin terminal block
Resolution	15 bit ADC (15 bits over the 10 Vdc measurement range, 14 bits over the 20 mA measurement range)
Accuracy	• ±0.1% of full scale at 25 °C (77 ºF) • ±0.2% over temperature range
Transient Protection	2.5 kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Input Resistance	250 ohms or 20 kilohms in 20 mA or 10 Vdc configurations
Normal Rejection Mode	27 dB at 60 Hz
Sampling Rate	170 ms
Isolation	500 Vac from logic and chassis
Controller Board Analog Inputs	
Feature/Function	**Detail**
Input Points	• 5 • User-selectable • 0...10 Vdc or 0...20 mA plus over range • 1, 0...32.7 Vdc (15-bit) for DC supply monitoring
Connectors	1 removable 12 pin terminal block
Resolution	15 bit ADC (15 bits over the 10 Vdc measurement range, 14 bits over the 20 mA measurement range)
Accuracy	• ±0.1% of full scale at 25 °C (77 ºF) • ±0.2% over temperature range

Transient Protection	2.5 kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Input Resistance	• 250 ohms or 200 kilohms in 20 mA or 10 Vdc configurations • 60 kilohms for 32.768 Vdc
Normal Rejection Mode	27 dB at 60 Hz
Sampling Rate	170 ms

14.12 Analog Outputs

I/O Board Analog Outputs	
Feature/Function	**Detail**
Output points	• 2 (optional) • 0...20 mA or 4...20 mA • 0...5 V or 0...10 V • Voltage output may be accomplished with external precision resistor.
Connectors	1 removable 5 pin terminal block
Resolution	12-bit over 0...20 mA range
Accuracy	Accuracy specified from 0.5...20 mA • ±0.15% at 25 °C (77 °F) • ±0.25% of full scale over temperature range
Response Time	Less than 10 µs for 10%...90% signal change
Power Supply	12...30 Vdc (External)
Power Requirements (current)	10 mA plus up to 20 mA per output
Load Range	• 12 Vdc: 0...375 ohms • 24 Vdc: 0...925 ohms
Latency	Typically 18...27 ms (end of scan to signal update)
Status/Reporting	Output value
Controls	• Direct operate • Select before operate
Isolation	Isolated from RTU logic and chassis
Controller Board Analog Outputs	
Feature/Function	**Detail**
Output points	• 2 (optional) • 0...20 mA or 4...20 mA • 0...5 V or 0...10 V (Voltage output may be accomplished with external precision

	resistor)
Connectors	1 removable 12 pin terminal block
Resolution	12-bit over 0...20 mA range
Accuracy	• ±0.15% at 25 °C (77 °F) • ±0.35% of full scale over temperature range
Response Time	Less than 10 µs for 10%...90% signal change
Power Supply	12...30 Vdc (External)
Power Requirements (current)	10 mA plus up to 20 mA per output
Load Range	• 12 Vdc: 0...375 ohms • 24 Vdc: 0...925 ohms
Latency	Typically 18...27 ms (end of scan to signal update)
Status/Reporting	Output value
Controls	• Direct operate • Select before operate

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. • 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.

Schneider Electric

415 Legget Drive, Suite 101, Kanata, Ontario K2K 3R1 Canada
Direct Worldwide: +1 (613) 591-1943
Fax: +1 (613) 591-1022
Toll Free within North America: 1 (888) 267-2232

www.schneider-electric.com