SCADAPack 350 Controller

Hardware Manual

2/24/2017

Schneider Electric

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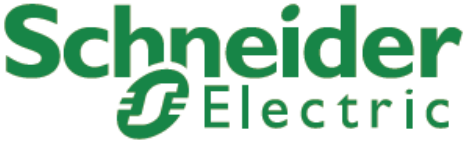


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Technical Support

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***

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 and operation of electrical equipment and the installation, and has received safety training to recognize and avoid the hazards involved.

Before You Begin

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

⚠ WARNING

EQUIPMENT OPERATION HAZARD

- Verify that all installation and setup 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.

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

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

Operation and Adjustments

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

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

Acceptable Use

SCADAPack controllers and expansion 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 controllers and expansion modules as an integral part of a safety system. These devices are not safety products.

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

⚠CAUTION

EQUIPMENT OPERATION HAZARD

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

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

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

About This Manual

Audience

This manual is written for people who need to install, troubleshoot or maintain the SCADAPack 350 hardware. These individuals are typically:

- Systems Engineers
- Commissioning Engineers
- Maintenance Technicians

Scope

This manual describes the SCADAPack 350.

Product Related Information

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

Follow all local and national safety codes and standards.

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

Document Validity

This document is valid for the SCADAPack 350.

Documentation Check

Before you begin installation, verify that you are viewing the correct documentation. If your SCADAPack 350 looks like this (with green connectors and the Ethernet and USB ports oriented such that you can plug in the cables from the front), continue with this manual.

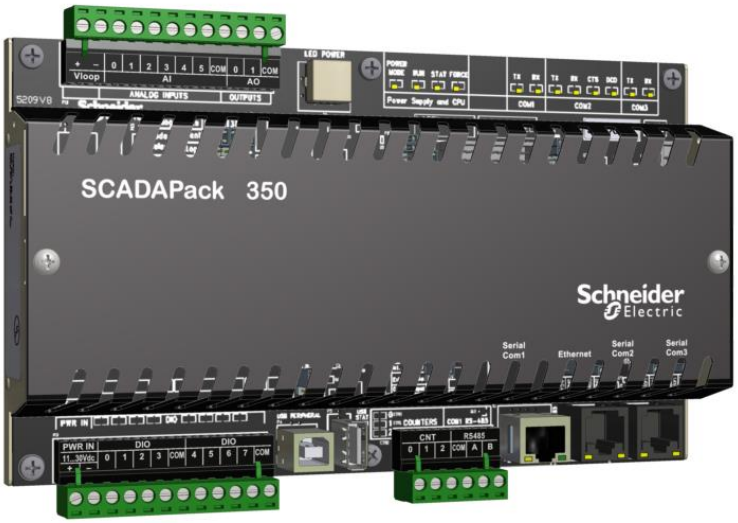


Figure 1: SCADAPack 350

If your SCADAPack 350 looks like this (with white connectors and Ethernet and USB ports oriented such that you need to plug in the cables from below), you will need to get the manual from **Start > All Programs > Schneider Electric > Hardware Manuals > Legacy**.



Figure 2: SCADAPack 350 (Previous Version)

Overview

A SCADAPack 350 is a low power RTU, complete with an integrated power supply, analog and digital I/O, serial communications, 10/100 Mb/s Ethernet, 12 Mb/s USB A and USB B ports and turbine flow meter counter inputs. Application programs can be written in Relay Ladder Logic, IEC 61131-3 and the C language.

Several power saving features are included in the SCADAPack 350. These power saving features include Sleep Mode, 24 Vdc power shutdown, Ethernet port shutdown, communication port power control, and SCADAPack Vision power down, USB disable and a reduced power mode that lowers the CPU clock.

The I/O capacity of the SCADAPack 350 can be expanded using 5000 I/O modules. A maximum of 8 5000 I/O modules may be used. Additional power supply modules may be required.

The SCADAPack 350 can be combined with a 5606 Integrated I/O module, forming a SCADAPack 357. For information on the 5606 I/O module, refer to the ***5606 Input/Output (I/O) Module Hardware Manual.***

SCADAPack 350 and SCADAPack 357

The SCADAPack 350 consists of the 5209 controller board.

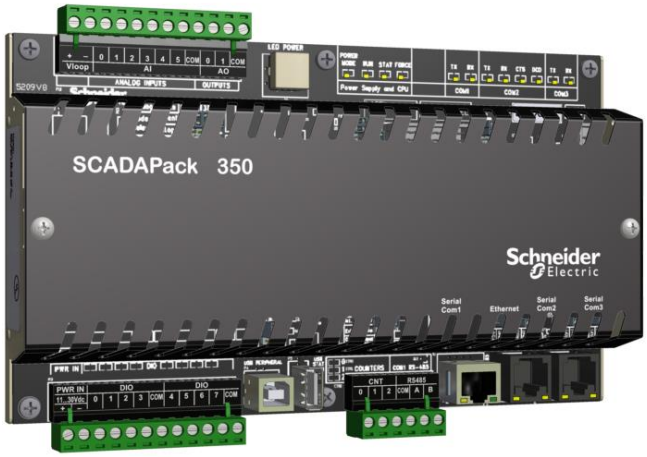


Figure 3: SCADAPack 350

The SCADAPack 357 consists of the 5209 controller board and a 5606 Input/Output Module.

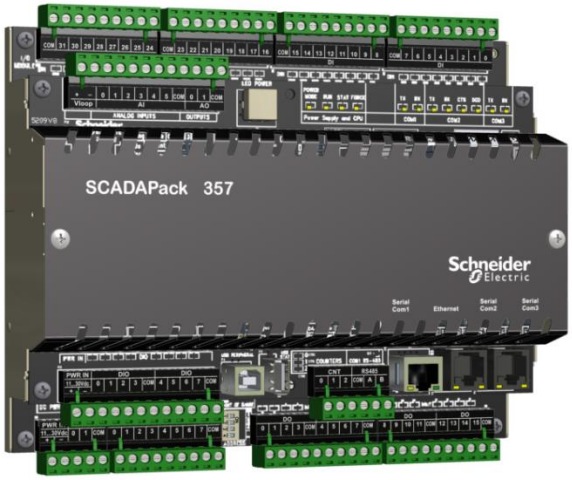


Figure 4: SCADAPack 357

The 5606 Input/Output Module adds eight analog inputs, 32 digital inputs, and 16 relay digital outputs to the 5000 input/output system. Refer to the ***5606 Input/Output Module*** hardware manual for details.

SCADAPack 350 and SCADAPack 357 controllers are equipped with one of:

- Trio KR20 spread spectrum radio.
- FreeWave spread spectrum radio.
- MDS spread spectrum radio.

Refer to the hardware user manual for the radio being used. These manuals are included on your SCADAPack DVD.

Installation

The following diagram shows the dimensions of the SCADAPack 350.

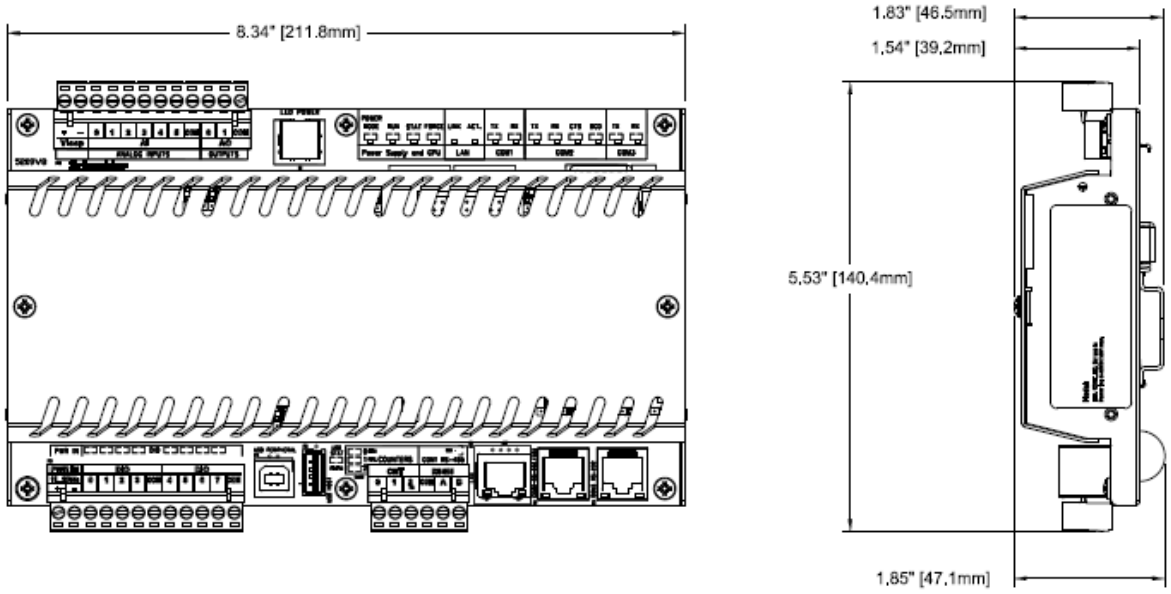


Figure 5: SCADAPack 350 Dimensions

The following diagram shows the dimensions of the SCADAPack 357.

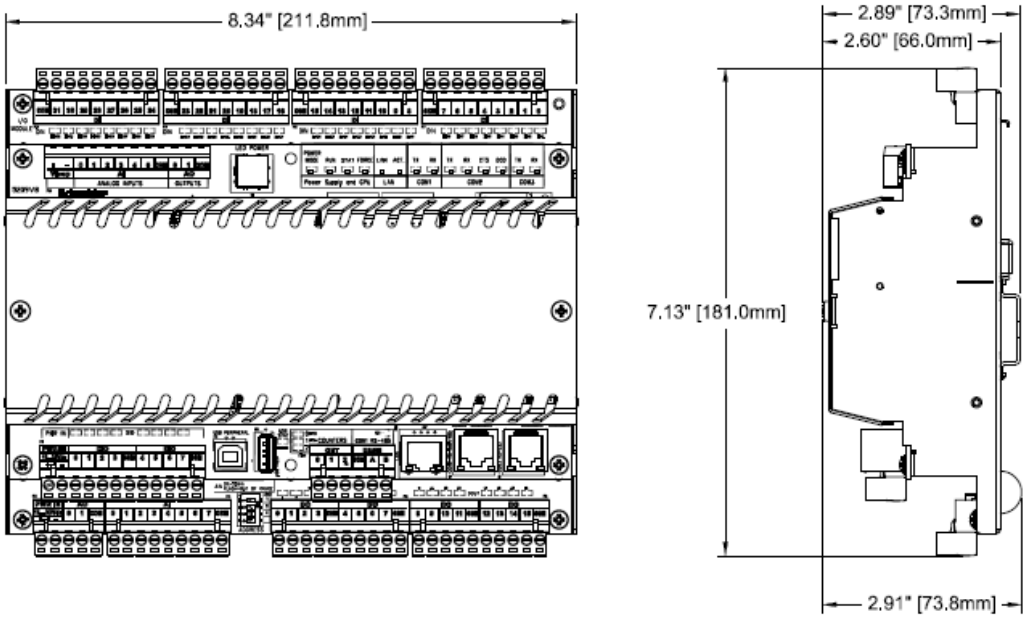


Figure 6: SCADAPack 357 Dimensions

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

For ATEX and IECEx Applications Only

Provide overvoltage protection external to the equipment.

The rated supply cable temperature is 105 °C.

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

⚠WARNING

EXPLOSION HAZARD

Only install this equipment under the following conditions:

Conditions of Safe Use

- Use this equipment in an area not exceeding pollution degree 2, as defined in EN 60664-1.
- Install this equipment in an enclosure that is only tool accessible and that provides a degree of protection not less than IP54 in accordance with EN 60079-15.
- Provide transient protection at a level not exceeding 140% of the peak rated voltage value at the supply terminals to the equipment.
- The free internal volume of the enclosure must be dimensioned in order to keep the temperature rating.
- For products using solid state relays (5606 and 5607 I/O modules and rPACs 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.

⚠WARNING

UNEXPECTED 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 the device before mounting it on a DIN rail.

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

CONFIGURATION DATA LOSS

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

Verify the voltage of the onboard RAM back-up battery before installing the device in the field.

Failure to follow these instructions can result in equipment damage.

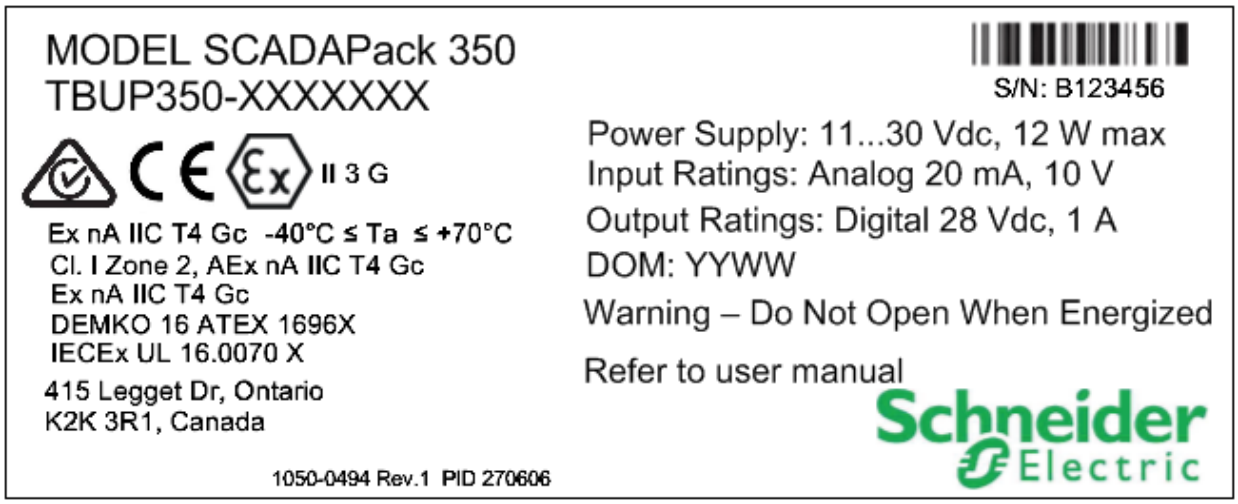
NOTICE

UNEXPECTED EQUIPMENT OPERATION

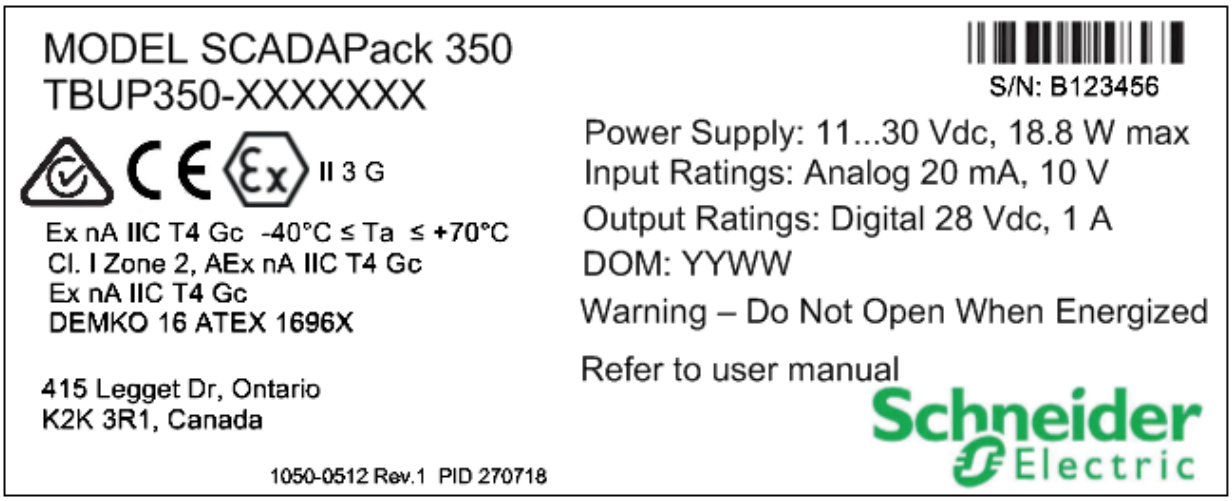
Do not install the device in an environment where the electromagnetic compatibility (EMC) rating exceeds the certified EMC rating for the device.

Failure to follow these instructions can result in equipment damage.

The following product label appears on a SCADAPack 350 with no radio:



The following product label appears on a SCADAPack 350 with a radio:



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 the 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.

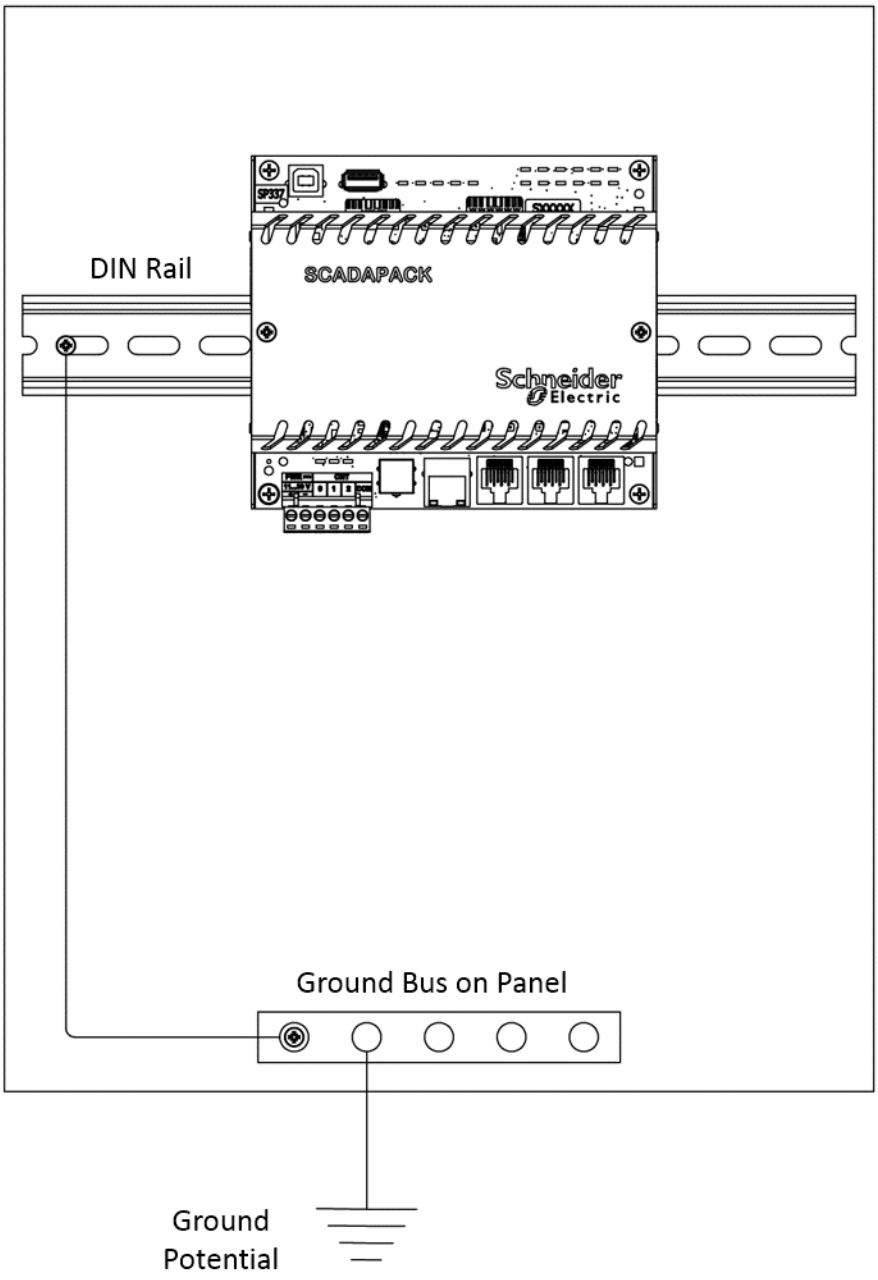


Figure 7: SCADAPack System Ground

To Mount the Device on a DIN Rail

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

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

   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.

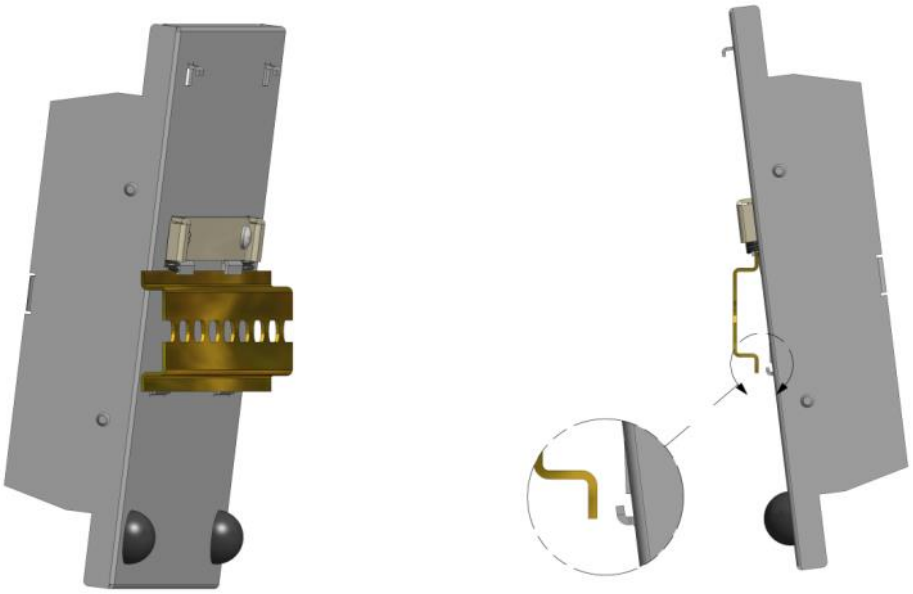


Figure 8: DIN Rail Alignment for Device Mounting

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.

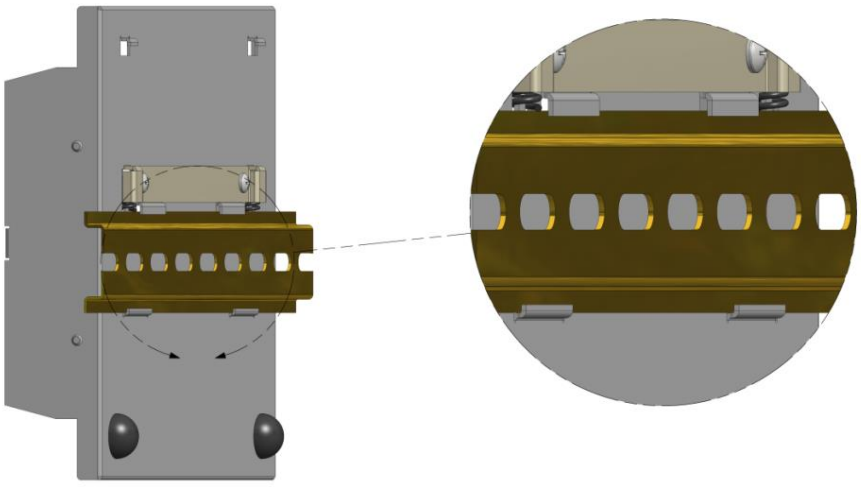


Figure 9: Rear View of a Correctly Mounted Device

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

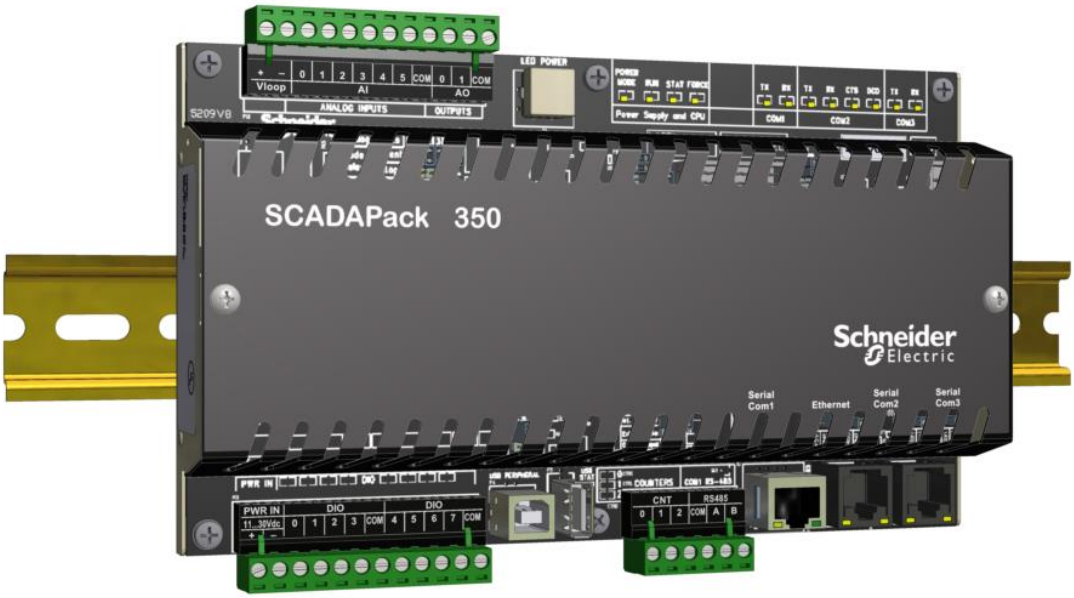


Figure 10: Device Mounted on a Horizontally Oriented DIN Rail

Field Wiring

SCADAPack RTUs use screw termination style connectors for termination of field wiring. These 5 mm (0.197 in.) pitch connectors support solid or stranded wires from 3.3…0.08 mm² (12…28 AWG).

The connectors are removable allowing replacement of the RTU without disturbing the field wiring. Leave enough slack in the field wiring for the connector to be removed.

- The two RS-232 communication ports, COM 2 and COM 3, connect to 8-pin modular jacks. Refer to section ***RS-232 Serial Communications Ports*** for pinout details and wiring diagrams for these modular jacks.
- One Ethernet port connects to an 8-pin modular jack. Refer to section ***Ethernet Communication*** for pinout details.
- The USB ports use conventional USB-A and USB-B interface connectors. Refer to section ***USB Ports*** for details.
- Other field wiring terminates in removable terminal connectors. Connector pinouts and wiring examples are described in each of the respective sections of this manual.

The locations of the connectors and ports are shown in Figure 8.

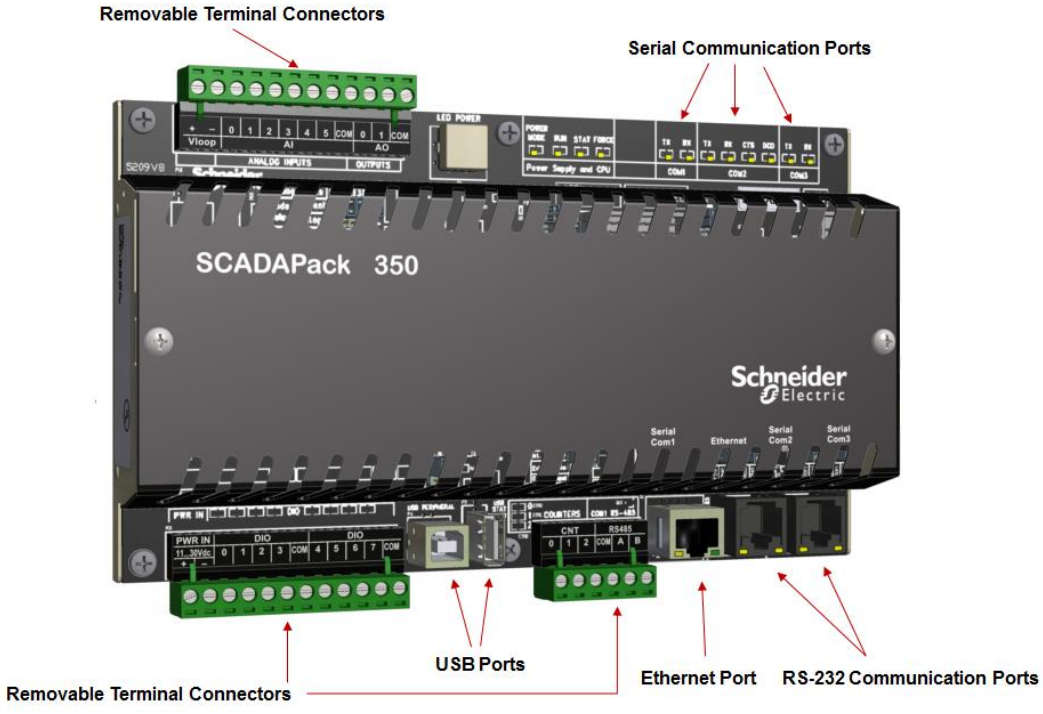


Figure 11: SCADAPack 350 Connector and Port Locations

To install the termination connector

1. Line up the pins on the module with the holes in the connector.
2. Push the connector onto the pins. Apply even pressure to both ends on the connector.

There are eight connectors for field wiring. Refer to ***Figure 10: SCADAPack 350 Connector and Port Locations*** for connector locations.

To remove the termination connector

⚠WARNING

UNEXPECTED 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.

NOTICE

UNEXPECTED EQUIPMENT OPERATION

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

Failure to follow these instructions can result in equipment damage.

Pull the connector upward from the board. Apply even pressure to both ends of the connector.

Power Supply

Overview and Power Requirements

The SCADAPack 350 is powered by an 11…30 Vdc input power source.

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

  Refer to the ***Specifications*** section of this manual for the minimum and maximum operating voltages and input power requirements.

- When the input voltage is below the minimum recommended voltage the SCADAPack 350 will turn off.

⚠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.

The following Schneider Electric power supply can be used:

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

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 onboard circuitry. The output capacity of 6 W is sufficient to power the SCADAPack 350 and a SCADAPack Vision operator interface with a limited number of 5000 I/O modules. Refer to the ***Specifications*** section of this manual for details.

The power available for any 5000 expansion I/O modules is limited to 5.5 W (5 Vdc at 1.1 A) and depends on the features enabled.

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 12…24 Vdc DC/DC converter is controlled by the user application program and may be turned on or off. Refer to section ***12…24 Vdc DC/DC Converter*** Control for more information on DC/DC converter control.

Understanding Power Requirements

In determining the power requirements for an application it is necessary to understand how the RTU and connected I/O modules use the input power. The terms used for calculating the power requirements for an application are discussed below:

Input Power

Input power, in the range 11…30 Vdc, is the power applied to the 11…30 Vdc input on the RTU.

Input Power Requirement

The input power requirement is the amount of voltage and current needed by the RTU and connected I/O modules for the application.

5 Vdc Requirements

The internal hardware in the RTU uses 5 Vdc to operate. The hardware that uses 5Vdc includes the board, USB ports, LAN port, serial ports, LEDs, I/O modules connected to P2 and processor power mode. The 5 Vdc is converted from the input power applied to the RTU.

12/24 Vdc Requirements

The only circuitry that requires 12 or 24 Vdc is the analog input loop. This requirement is added to the input power requirement to determine the overall input power requirement for the application.

Power Supply Efficiency

Some of the input power is not converted into 5 Vdc but is lost due to heat dissipation and other factors. The input power minus this loss is referred to as power supply efficiency. The SCADAPack 350 has an **85%** efficiency rating.

Power Units

The power unit used for requirements is Watts, or milliWatts (0.001 Watts). Watts are described as voltage x current (P=IV). Watts units are very useful in that power, current or voltage can be determined if two of the values are known. For example:

- An input of 24 Vdc at 500 mA equals 12 W (Watts)
- An input of 12 Vdc at 500 mA equals 6 W (Watts)
- An input of 12 Vdc at 1000 mA equals 12 W (Watts)

Much of the input power (12 or 24 Vdc) is needed for conversion to 5 Vdc. Examples of the relationship between the input power and 5 Vdc power follow.

The RTU can supply a maximum of 1200 mA at 5 Vdc. For applications that do not need the entire 1200 mA, a calculation is done to determine what 5 Vdc current is needed and convert this to the needed input power.

Assume a 12 or 24 Vdc input voltage and the 5 Vdc requirement is the maximum 1200 mA. To determine the input power for this example:

5 Vdc requirement = 1200 mA x 5 Vdc = 6 W

Power supply efficiency = 85%

Thus the input power times the power supply efficiency equals the requirement of 6 W.

Input Power = 6 W / 0.85 = 7 W (maximum)

For a 24 Vdc input power supply:	**For a 12 Vdc input power supply:**
P=IV	P=IV
7 W=I x 24 Vdc	7 W=I x 12 Vdc
I = 7 W / 24 Vdc = 290 mA	I = 6 W / 12 Vdc = 580 mA

Assume a 12 or 24 Vdc input voltage and the 5 Vdc requirement includes the board and LAN port only. To determine the input power for this example:

From the specifications section of this user manual it is seen that the board requires 85 mA at 5 Vdc and the LAN port requires 135 mA at 5 Vdc.

5 Vdc requirement = (85 mA + 135 mA) x 5 Vdc = 1100 mW

Power supply efficiency = 85%

Thus the input power times the power supply efficiency equals the requirement of 1100 mW.

Input Power = 1100 mW / 0.85 = 1300 mW

For a 24 Vdc input power supply:	For a 12 Vdc input power supply:
P=IV	P=IV
1300 mW=I x 24 Vdc	1300 mW=I x 12 Vdc
I = 1300 mW / 24 Vdc = 54mA	I = 1300 mW / 12 Vdc = 108 mA

The ***Specifications*** section at the end of this user manual must be used to determine how much power is required for each item used by the RTU for the application.

Power Management Features

The SCADAPack 350 provides a number of special features to reduce power consumption. Refer to **Error! Reference source not found.** for an overview of the power management features. These ower management features are:

- COM3 serial port power control for Vision Displays
- VLOOP power control.
- 12…24 Vdc DC/DC Converter Control.
- LED power control.
- Ethernet disable.
- USB disable.
- Lowering the CPU clock speed for reduced power mode.

The SCADAPack 350 provides three internal digital outputs that can be operated by the user application to manage the power saving features. Internal digital outputs 8, 9 and 10 and the power management functions they control are described in the following sections.

Disabling and enabling of the Ethernet and USB ports as well as a reduction of the clock speed can be done in Telepace using the CNFG Power Mode register assignment. The SETPMODE/ GETPMODE functions in IEC 61131-3 allow a user application to control these power management features.

For C applications, use the SetPowerMode and GetPowerMode functions. Refer to the appropriate software manual for information on using and controlling the internal digital outputs.

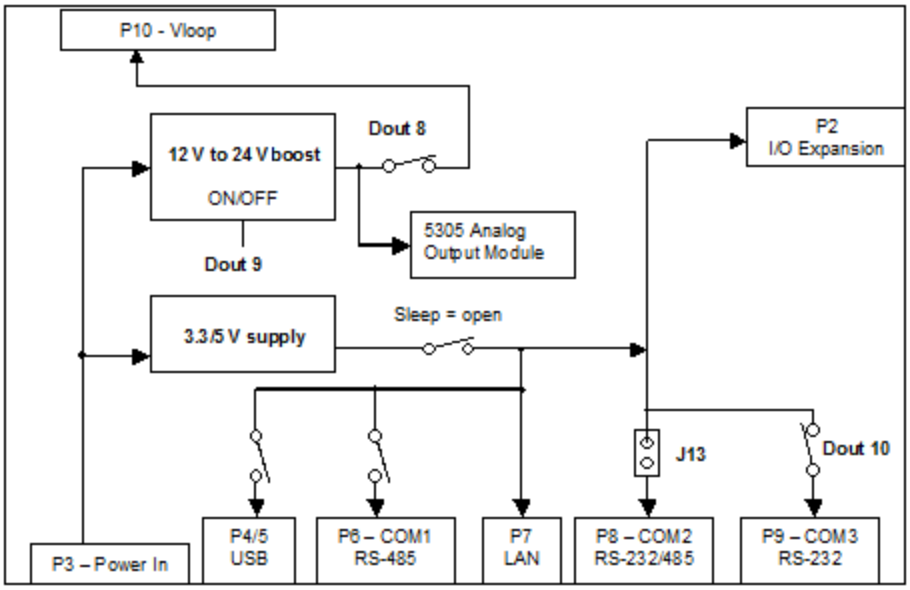


Figure 12: Power Management

COM3 Serial Port Power Control

The COM3 serial port is for use with the SCADAPack Vision or other Human Machine Interface (HMI). Pin 1 of the RJ-45 connector provides a switched 5-volt power for the SCADAPack Vision or other HMI.

Refer to section ***COM3 RS-232 Serial Port*** for information on COM3 and section ***RJ-45 to SCADAPack Vision*** for wiring examples. 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 internal **Digital Output 10** is **ON** HMI power is turned on.
- When the LED power is disabled and internal **Digital Output 10** is **OFF** HMI power is turned off.
- HMI power is turned on for five minutes when a momentary contact is made between pin 2 (DCD) and pin 3 (DTR) on the RJ-45 connector of COM3. This permits the SCADAPack Vision or an HMI pushbutton to control HMI power. At each momentary contact, the five-minute power timer is reloaded. If the five-minute power timer is maintaining the HMI power on, a momentary contact between DCD and DTR will turn off HMI power. Refer to section ***RJ-45 to SCADAPack Vision*** for more information.
- To make the HMI turn **OFF** when the five-minute power timer times out, configure one of the following for a default state of **OFF**:

  The **RTU LED Power Settings** register assignment

  OR

The IEC61131 "**settled**" function

- Internal **Digital Input 12** indicates the status of COM3 serial port power. **Digital Input 12** 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 section ***LED Power Control*** for further information on this feature.

VLOOP Power Control

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 DC-DC 12/24V converter if it is turned on. See section ***12…24 Vdc DC/DC Converter*** Control for converter information. The VLOOP power source is the applied input power if the DC-DC converter is turned off.

- To turn the VLOOP output **ON**, turn on **Digital Output 8.**
- To turn the VLOOP output **OFF,** turn off **Digital Output 8**.

Internal **Digital Input 8** indicates the status of VLOOP power. **Digital Input 8** 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 must 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 section ***LED Power Control*** for further information on this feature.

VLOOP Over-Current Protection

When VLOOP output is turned on, it is monitored for excessive current consumption caused by field wiring or instrumentation loops. If sustained over-current is detected (100 ms), VLOOP is turned off even though internal Digital Output 8 is turned on. This helps to prevent unnecessary fuse blowing, circuitry damage and rapid battery depletion.

When VLOOP output is turned on, using internal Digital Output 8, and a short circuit is detected VLOOP will turn off. VLOOP will turn on to try again 5 seconds after turning off. If the condition still exits VLOOP will again turn off and retry after a 5 second delay. While the condition exists internal **Digital Input 10** will be **ON**.

12…24 Vdc DC/DC Converter Control

The 12…24Vdc DC/DC converter is used to provide 24 Vdc for VLOOP power and for the 5305 Analog Output module. The converter should be turned on if the SCADAPack 350 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.

- To turn the 12…24Vdc DC/DC converter **ON**, turn on Digital Output 9. When the converter is turned on 24 Vdc is provided to the VLOOP power and to the 5305 Analog Output module.

- To turn the 12…24Vdc DC/DC converter **OFF**, turn off Digital Output 9. When the converter is turned off, VLOOP power and the 5305 Analog Output module use the input power.

Internal **Digital Input 9** indicates the status of the 12…24 Vdc DC/DC converter. Digital Input 9 is set when the 12…24 Vdc DC/DC converter is on and is cleared when the converter is off.

The 12…24 Vdc DC/DC converter is turned on when the LED power is enabled. This feature is provided for service and diagnostics. Refer to section ***LED Power Control*** for further information on this feature.

Analog Inputs

The SCADAPack 350 provides eight analog input channels as follows:

- Six single-ended analog inputs available for external wiring.

  The external inputs provide 15-bit resolution over the range of the input. Five external inputs can be configured for voltage or current mode. The sixth external input is configured for voltage mode only and will measure 0…32.768 Vdc. This input can be used to monitor the input power or a battery voltage. Wiring of the external outputs is covered in this section of the manual.

- Two internal analog inputs for monitoring of onboard variables.

  The two internal inputs can be used in a user application to monitor RAM battery voltage, board ambient temperature and DC\DC converter voltage used for VLOOP. See the following sections for details on how to access these points.

Input	Type	Description
0 to 4	external	Jumper selectable for 0…10 Vdc or 0…40 mA inputs.
5	external	0…32.768 Vdc for battery monitoring
6	internal	DC/DC converter output voltage
7	internal	Used internally by SCADAPack 350.

Refer to the Telepace or IEC 61131-3 software manuals for information on how to use the SCADAPack 350 Analog Inputs in application programs. Access to the analog input registers is achieved using a register assignment in Telepace or I/O connection in IEC 61131-3.

Internal Analog Inputs

There are three internal analog inputs which measure the input voltage, board ambient temperature and NV-RAM battery voltage. These internal analog inputs are accessed from a user application program.

Input Voltage

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

- For Telepace applications use the ***Controller Input Voltage*** register assignment to read the input voltage in millivolts.
- For IEC 61131-3 applications use the ***ainvolt*** I/O connection to read the input voltage in millivolts.

Controller Board Temperature

The ambient temperature internal analog input measures the temperature at the controller circuit board. It is useful for measuring the operating environment of the controller and returns an integer value in the range -40…75 °C (-40…167 °F.) The temperature reading represents temperatures in the range -40…75 °C(-40…167 °F.) Temperatures outside this range cannot be measured.

- For Telepace applications use the ***Controller Board Temperature*** register assignment to read the ambient temperature in degrees C and degrees F.
- For IEC 61131-3 applications use the ***aintemp*** I/O connection to read the ambient temperature in °C and °F.

Controller RAM Battery Voltage

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

- For Telepace applications use the ***Controller RAM Battery Voltage*** register assignment to read the lithium battery voltage.
- For IEC 61131-3 applications use the ***ainbatt*** I/O connection to read the lithium battery voltage.

Analog Inputs

Six single-ended analog inputs are available for measurement of field data. These analog inputs provide 15-bit resolution over the entire range of the input.

The six analog inputs are identified as Channel 0 through Channel 5.

The analog inputs share a common ground (GND) that is connected to the chassis.

The first five, identified as Channels 0 through 4, use range jumpers to select voltage or current mode. When set to voltage mode, the analog inputs are single ended and measure up to 10 Vdc. When configured for current mode a 250 ohm current sense resistor will produce a 5 Vdc input at 20 mA. See section ***Analog Input Mode Jumpers*** for information on setting the range.

The sixth analog input, identified as Channel 5, is configured for voltage mode only and measures up to 32.768 Vdc. This input is typically used to monitor the input supply or battery voltage.

Analog input channels 0 to 4 may be read using one of two Telepace register assignments or IEC 61131-3 complex equipment modules.

To report the analog input values as 0…10 Vdc or 0…40 mA use the following:

- For Telepace applications use the ***SCADAPack 350 10V/40mA I/O*** register assignment to read the analog inputs. The analog inputs are scaled internally by the SCADAPack 350 so that a 10 Vdc or 40 mA input will read full scale, 32767. See the ***Analog Inputs Data Format*** section for further details.

- For IEC 61131-3 applications use the ***sp350*** I/O connection to read the analog inputs. The analog inputs are scaled internally by the SCADAPack 350 so that a 10 Vdc or 40 mA input will read full scale, 32767. See ***Analog Inputs Data Format*** for further details.
- To report the analog input values as **0-5V or 0 to 20mA** use the following:
- For Telepace applications use the ***SCADAPack 350 5V/20mA I/O*** register assignment to read the analog inputs. The analog inputs are scaled internally by the SCADAPack 350 so that a 5 Vdc or 20 mA input will read full scale, 32767. See the ***Analog Inputs Data Format*** section for further details.
- For IEC 61131-3 applications use the ***sp350v1*** I/O connection to read the analog inputs. The analog inputs are scaled internally by the SCADAPack 350 so that a 5 Vdc or 20 mA input will read full scale, 32767. See the ***Analog Inputs Data Format*** section for further details.

Analog Input Wiring

The analog inputs support loop powered and self-powered transmitters. Loop powered transmitters are two terminal devices that connect between a power supply and the analog input. The loop current continues from the power supply, through the transmitter and to ground through a 250 ohm resistor built into the 20 mA input circuit. Self-powered transmitters have three terminals typically labeled *power in*, *signal out* and *common*. Self-powered transmitters can have a current or voltage output. The *power in* connects to a power supply, the *signal out* terminal connects to the Analog Input Channel, and the *common* connects to GND.

There are three options for the user when selecting the power source. The user is to ensure 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 350 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 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 supplied by the user.

Analog Input Wiring Examples

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.**

Example wiring of several transmitters is illustrated in ***Figure 13: Analog Input Wiring***.

- 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.

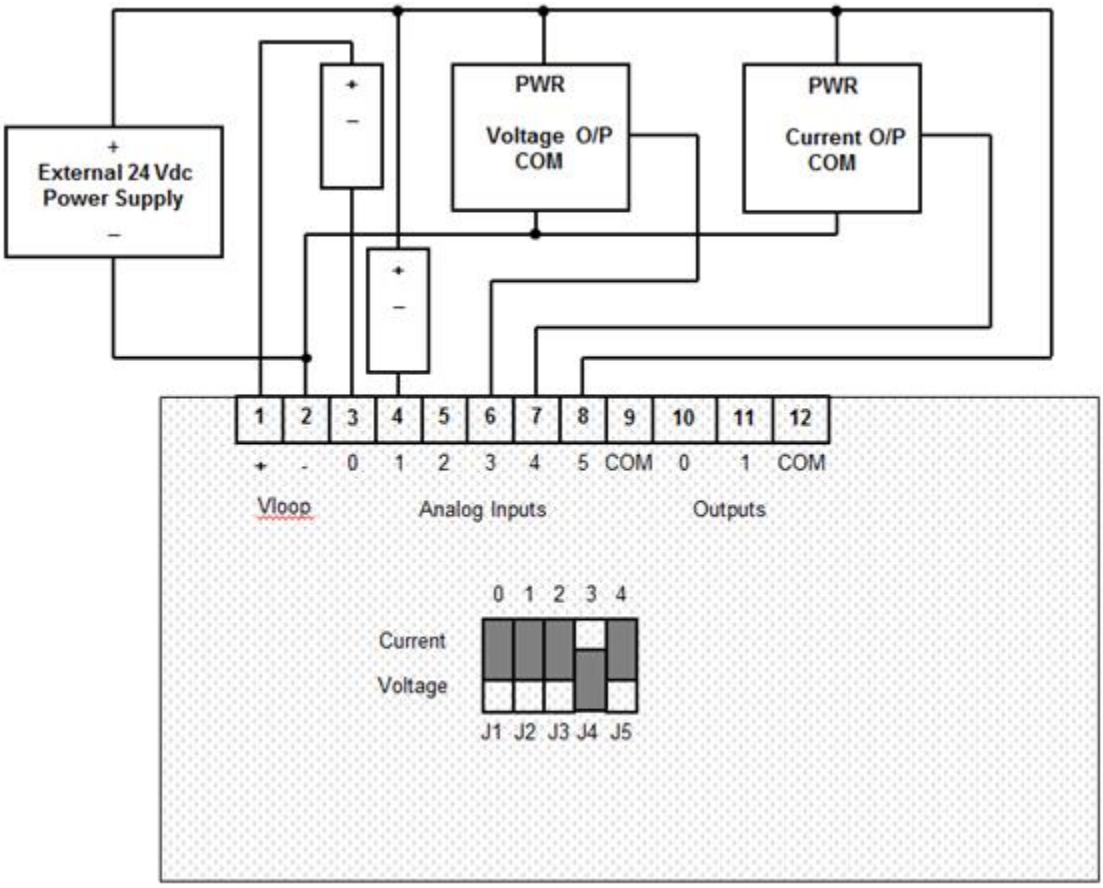


Figure 13: Analog Input Wiring

Analog Input Mode Jumpers

Channels 0 through 4 can be user configured for either voltage or current operation, using jumper links. Refer to ***Figure 13: Analog Input Wiring*** for the location of the analog input mode selection jumpers. A sample illustration of the analog input mode selection using jumpers J1-J5 is given in ***Figure 13: Analog Input Wiring***. 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.

Analog Inputs Data Format

The I/O 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.

When an analog input is configured for voltage mode, 10 Vdc input is represented with 15 bits of data. The input resolution is 0.305 mV/count.

When an analog input is configured for current mode, 20 mA input is represented with 14 bits of data. There is 100% over range. The input resolution is 1.22 µA/count.

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

The following table shows the A/D output value for several input signals. The A/D output is represented differently depending on the register assignment or IEC 61131-3 I/O module type.

Current Channel 0-4	**Voltage Channel 0-4**	**Voltage Channel 5**	**A/D Output 10 Vdc /40 mA**	**A/D Output 5 Vdc /20 mA**
0 mA	0 Vdc	0 Vdc	0	0
1.22 µA	0.305 mV	0.001 Vdc	1	1
4 mA	1.0 Vdc	3.277 Vdc	3277	6554
10 mA	2.5 Vdc	8.192 Vdc	8192	16384
20 mA	5.0 Vdc	16.384 Vdc	16384	32767
39.999 mA	9.9997 Vdc	32.767 Vdc	32767	NA

Analog Outputs

The SCADAPack 350 may include two analog output channels if this option was requested at time of purchase.

Refer to the Telepace or IEC 61131-3 software manuals for information on how to use the SCADAPack 350 analog outputs in application programs. Access to the analog output registers is achieved using a register assignment in Telepace or I/O connection in IEC 61131-3.

Current Outputs

The optional analog output module provides two 20 mA analog outputs.

The internal power supply powers the analog output circuits. The user can, under program control, boost the DC Input Power to 24 Vdc. This is required when generating current outputs into high resistance loads. Refer to section ***12…24 Vdc DC/DC Converter Control*** for further information.

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 EN61000-6-2. **Failure to follow these instructions can result in equipment damage.**

Figure 14: Analog Output Wiring shows example wiring of the analog outputs.

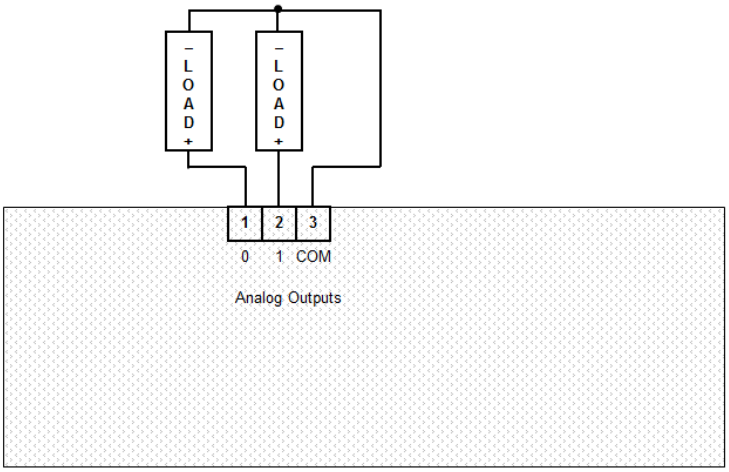


Figure 14: Analog Output Wiring

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.

Voltage Range	Resistance	Output Range
0 …5 Vdc	250 ohm	0…20 mA
0…10 Vdc	500 ohm	0…20 mA

Analog Outputs Data Format

The optional analog output module has a 12-bit, unipolar, digital to analog converter. There are 4096 discretization steps in the output signal range. The 0…20 mA output range resolution is 4.88 µA/count. The table below shows the output current for several data values.

Data	Current
0	0 mA
8	4.88 µA
6552	4 mA
16384	10 mA
24576	15 mA
32760	19.995 mA

Digital Inputs

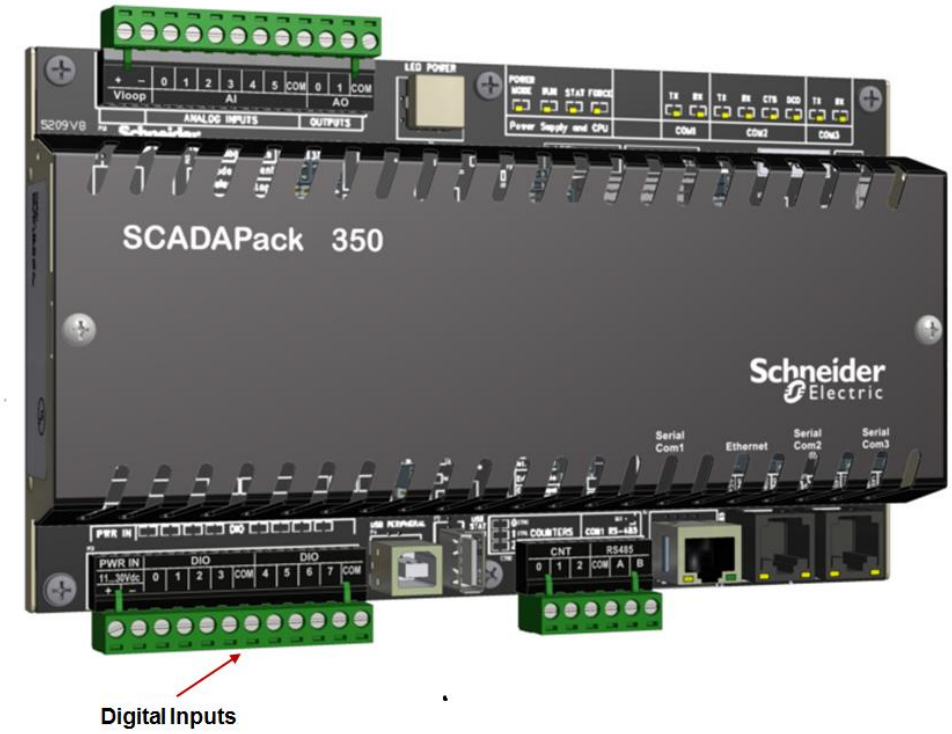


Figure 15: SCADAPack 350 Digital Inputs

The SCADAPack 350 provides eight universal digital inputs and outputs. The inputs are for use with dry contacts such as switches and relay contacts. The SCADAPack 350 provides the wetting current for the contacts.

If LED power is enabled, the SCADAPack 350 continuously sources approximately 5 mA wetting current into each dry contact input. Indicator LEDs will be at their maximum brilliance if on. This facilitates field service and diagnostics.

If LED power is disabled then the wetting current is turned on only when the digital inputs are scanned by the SCADAPack 350. Indicator LEDs are dim in this condition. This is normal.

Refer to the appropriate software manual for information on using the SCADAPack 350 Digital Inputs and Outputs in application programs. For Telepace applications refer to the register assignment for SCADAPack 350 I/O module and for IEC 61131-3 applications refer to the I/O Complex Equipment for SCADAPack 350 I/O.

The SCADAPack 350 provides the following digital inputs.

Input	Type	Description
0 to 7	external	Dry contact inputs. These inputs are located on terminal P3. 0 = contact open (associated is LED off) 1 = contact closed (associated is LED on)
8	internal	VLOOP output status 0 = off 1 = on See section ***VLOOP Power Control*** for details.
9	internal	**DC/DC converter status** 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 section ***12…24 Vdc DC/DC Converter*** Control for details.
10	internal	**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 section ***VLOOP Over-Current Protection*** 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

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

Input	Type	Description
0 to 7	external	Dry contact inputs. These inputs are located on terminal P3. 0 = contact open (associated is LED off) 1 = contact closed (associated is LED on)
8	internal	VLOOP output status 0 = off 1 = on See section ***VLOOP Power Control*** for details.
9	internal	**DC/DC converter status** 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 section ***12…24 Vdc DC/DC Converter Control*** for details.
10	internal	**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 section ***VLOOP Over-Current Protection*** 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. The SCADAPack 350 on board digital I/O can be inputs or outputs. There is no configuration for the type, the SCADAPack 350 accepts digital inputs on a point and will write a digital output if programmed. For example if D I/O point 0 is assigned registers 10001 as an input, it is also assigned as digital output 00001. If the application turns on 00001 then 10001 will be seen as ON. The internal DI 11 is turned ON if the SCADAPack 350 detects that a point has been turned on as an input and then turned on

Input	Type	Description
		as a digital output in the application. Each time the RTU is reset it begins the internal test again. 0 = off 1 = on
12	Internal	COM3 (HMI) power. 0 = off 1 = on See section ***Figure 12: Power Management*** COM3 Serial Port Power Control for details.

Wiring Digital Inputs

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 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.**

Digital Outputs

The SCADAPack 350 board provides eight universal digital inputs or outputs. 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 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 RTU to a terminal labeled COM. COM is 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 1H) are operated continuously at greater than 0.5 Hz.

The SCADAPack 350 also provides three internal digital outputs that can be controlled by the user application to manage power saving features unique to the SCADAPack 350.

Refer to the Telepace or IEC 61131-3 software manuals for information on how to use the SCADAPack 350 digital outputs in application programs. Access to the digital output registers is achieved using a register assignment in Telepace or I/O connection in IEC 61131-3.

The following table describes the SCADAPack 350 digital outputs.

Output	Type	Description
0 to 7	external	Open drain outputs. These outputs are located on terminal P3. 0 = output transistor off 1 = output transistor on
8	internal	VLOOP power control 0 = off 1 = on See section ***VLOOP Power Control*** for details.
9	internal	DC/DC converter control 0 = off 1 = on See section ***12…24 Vdc DC/DC Converter Control*** for details.
10	internal	com3 (HMI) power control 0 = off 1 = on See section ***Figure 12: Power Management*** COM3 Serial Port Power Control for details.

Wiring Digital Outputs

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 350 is located. **Failure to follow these instructions can result in equipment damage.**

Various I/O point wiring examples are shown in ***Figure 16: Digital Input/Output Wiring.***

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 350.

Digital I/O point 2 is shown monitoring a dry contact.

Digital I/O point 4 is shown connected to a 24 Vdc load and external 24 Vdc power supply.

Digital I/O point 5 is shown monitoring an open collector contact.

Transient voltage suppression is included on each I/O point.

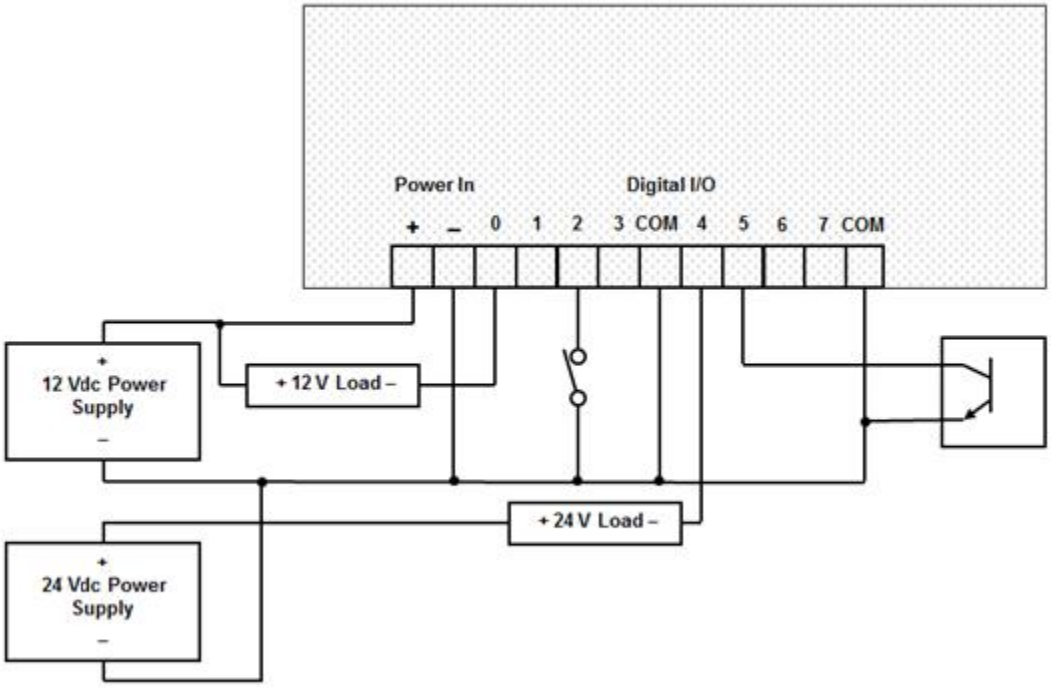


Figure 16: Digital Input/Output Wiring

Counter Inputs

The SCADAPack 350 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.
- Counter 1 and 2 are designed for millivolt level turbine meters.

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 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
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 EN61000-6-2. **Failure to follow these instructions can result in equipment damage.**

Refer to the appropriate software manual for information on using the SCADAPack 350 Counter Inputs in application programs.

- For Telepace applications use the **Counter Inputs** register assignment to read the counters.
- For IEC 61131-3 applications use the **cntrCtrl** I/O connection to read the board counters.
- For C applications use the **ioReadCounterSP2 function**.

Counter Input 0

Counter 0 is a self-powered input that requires a contact closure or open collector output to pull the input to ground. The wetting voltage is provided through a 1 kilohm resistor tied to the 5 Vdc power supply. Refer to ***Figure 17: Counter Input Wiring*** for an example of wiring to an open collector output.

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. Refer to the following sections for details on connecting to the turbine meter counter inputs.

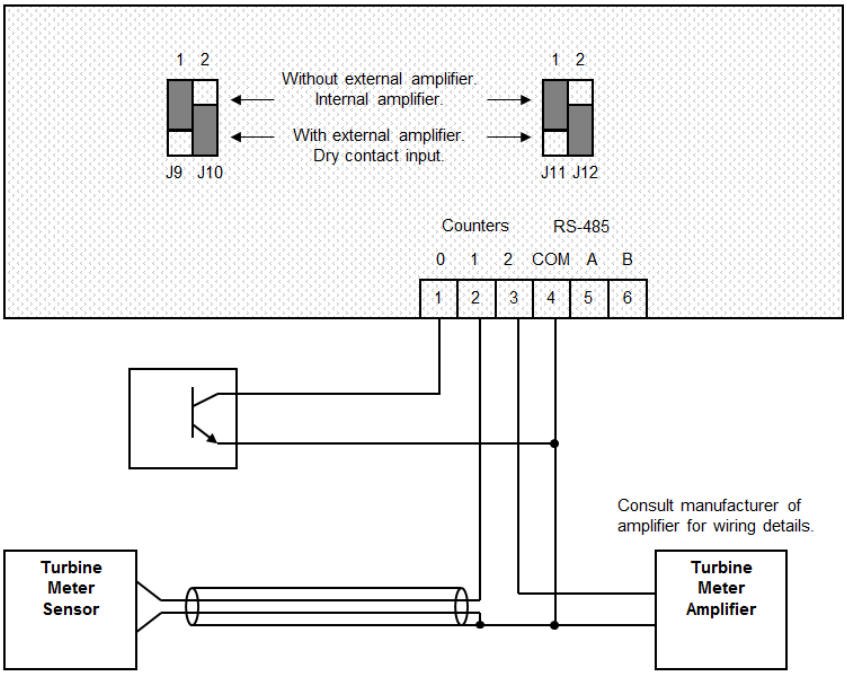


Figure 17: Counter Input Wiring

Turbine Meter Counter Inputs 1 and 2

The SCADAPack 350 allows for the direct connection of two turbine meter sensors. These sensors produce millivolt outputs and an additional pre-amplifier is not required when connecting to a SCADAPack 350. The turbine meter inputs should be used 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 pre-amplifier on turbine counter input 1.

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

Directly Connecting to Low Voltage Turbine Meters

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

- Install jumper J11 on the ‘Int Amplifier’ position.
- Install jumper J9 on the ‘See J11’ position, as shown below.

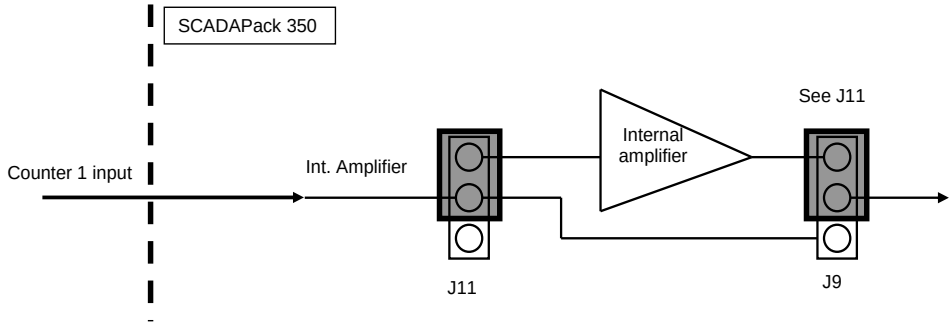


Figure 18: Setting Jumpers on Counter Input 1 for Low Voltage Turbine Meters

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

- Install jumper J12 on the ‘Int Amplifier’ position.
- Install jumper J10 on the ‘See J12’ position, as shown below.

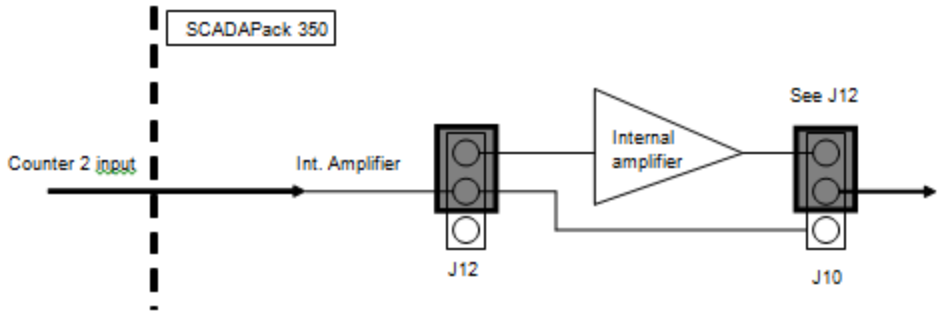


Figure 19: Setting Jumpers on Counter Input 2 for Low Voltage Turbine Meters

Connecting to Higher Voltage Turbine Meters

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

For Counter 1:

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

For Counter 2

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

Refer to the following figure for an illustration.

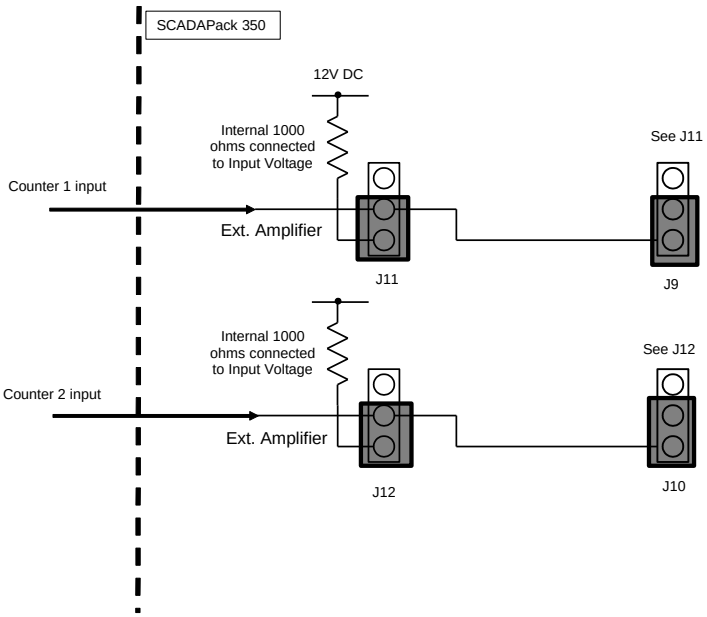


Figure 20: Setting Counter Inputs 1 and 2 for Turbine Meters with Amplified Signals

NOTICE
UNEXPECTED EQUIPMENT OPERATION Follow the current requirement specified by the manufacturer. **Failure to follow these instructions can result in equipment damage.**

As shown in ***Figure 20***, the SCADAPack 350 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 350 is ***powered from 12 Vdc***.

If your amplifier requires a pull-up resistor greater than 1000 ohms, jumpers J11 and J12 should not be installed in either position, while J9 and J10 should remain installed as shown in ***Figure 21***. 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 ***Figure 21***.

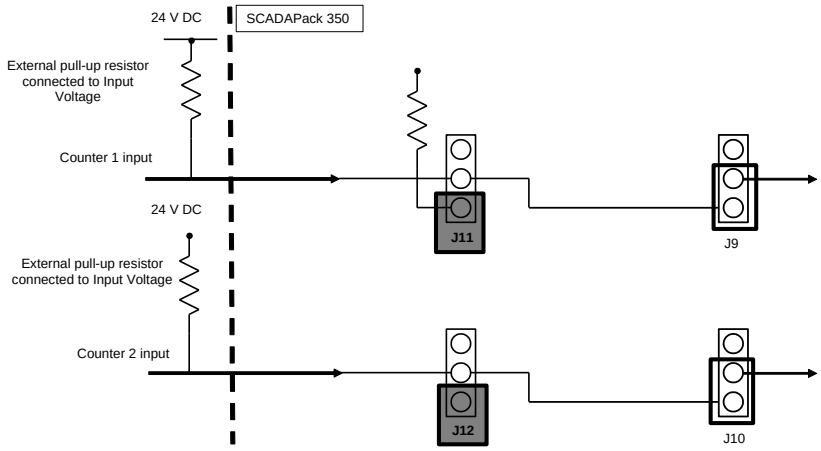


Figure 21: Connecting External Pull-Up Resistors to Counter Inputs 1 and 2

Connecting to Open Collector / Dry Contact Turbine Meters

Counter Inputs 1 and 2 can also be 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 350 is ***powered from 12V***.

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

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

The above configuration applies only when the RTU is being powered using 12 Vdc.

If 24 Vdc is used to power the RTU, do not use the internal 1000-Ohm pull-up resistor, as power dissipation can become excessive.

In this case, an external pull-up resistor is wired between the counter input and the positive side of your power supply, as illustrated in ***Figure 21***. Check that jumpers J11 and J12 are removed while J9 and J10 are installed.

Calculating the Size of the Pull-up Resistor

An input current of between 5 mA and 10 mA is suggested for the counter input sinking current.

Using a value of 7.5 mA and 24 Vdc:

24 Vdc / 7.5 mA = 3.3 k resistor.

24 Vdc / 7.5mA = 180 mW minimum 0.25 W resistor is needed.

Serial Communication

The SCADAPack 350 is equipped with three serial communication ports which support RS-232 and RS-485 communication. COM1 is a dedicated RS-485 port. The serial ports are labeled COM1, COM2 and COM3. Refer to ***Figure 10: SCADAPack 350 Connector and Port Locations*** for the location of the serial ports.

COM2 can be configured for RS-232 or RS-485 while COM3 is a dedicated RS-232 port. Details of the operation and properties of each serial port are described below.

RS-232 Serial Communications Ports

COM2 and COM3 support RS-232 communication. RS-232 wiring uses shielded cable. The shield should be connected to chassis ground at one point. Failure to properly shield the cable may result in the installation not complying with FCC or DOC radio interference regulations.

COM2 RS-232 Serial Port

Serial port COM2 can be configured as either a six-line RS-232 port or as a two-wire RS-485 port. For RS-232 operation J13 on the board has the jumper link installed in position “RS-232”. This section covers RS-232 operation. For RS-485 operation, refer to section ***COM2 RS-485 Serial Port.***

The following table shows the serial and protocol communication parameters supported by COM2. These parameters are set from Telepace, IEC 61131-3 or from an application program running in the SCADAPack 350. Default values are set when a Cold Boot or Service Boot is performed on the SCADAPack 350.

Parameter	Supported Values
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Default: 9600
Duplex	Full or Half duplex when RS-232 is selected. Default: Half
Parity	Odd, None or Even Default: None
Data Bits	7 or 8 Bits Default: 8 Bits
Stop Bits	1 Bit
Receive Flow Control	ModbusRTU or None Default: ModbusRTU
Transmit Flow Control	Ignore CTS or None Default: None

Parameter	Supported Values
Station	1 to 65534 Default: 1
Protocol	None, Modbus RTU, Modbus ASCII, DF1 and DNP Default: Modbus RTU
Addressing Mode	Standard or Extended Default: Standard

Connections to COM2 are made through a RJ-45 modular connector. COM2 supports six signals plus Ground and 5 Vdc power. The following diagram shows the pin connections for the RS-232 (RJ-45) port connector for COM2.

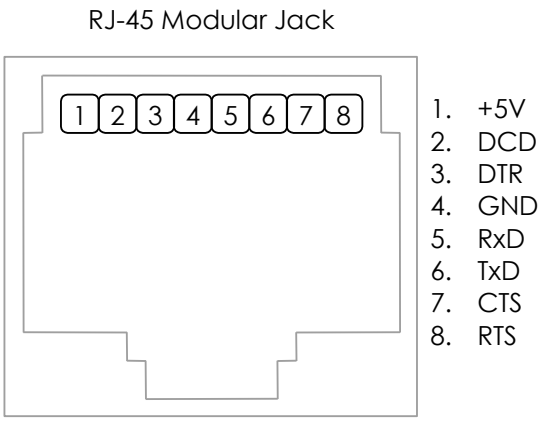


Figure 22: RJ-45 Connector Pinout

Notes:

- The transmitters used in COM2 generate RS-232 compatible ±5 Vdc levels. Cables should be limited to a maximum of 3 m (10 ft.)
- For RS-232 operation (RxD) J13 is in the 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.

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 350. 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 must be a MARK for the communication port to transmit data. When the attached device does not provide this signal, the RTU keeps the line at a MARK. When the attached device does provide this signal, it must set CTS to MARK to allow the RTU 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.

COM3 RS-232 Serial Port

The following table shows the serial and protocol communication parameters supported by COM3. These parameters are set from Telepace, IEC 61131-3 or from an application program running in the SCADAPack 350. Default values are set when a Cold Boot or Service Boot is performed on the SCADAPack 350.

Parameter	Supported Values
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Default: 9600
Duplex	Full or Half

Parameter	Supported Values
	Default: Full
Parity	Odd, None or Even Default: None
Data Bits	7 or 8 Bits Default: 8 Bits
Stop Bits	1 Bit
Receive Flow Control	ModbusRTU or None Default: ModbusRTU
Transmit Flow Control	Ignore CTS or None Default: None
Station	1 to 65534 Default: 1
Protocol	None, Modbus RTU, Modbus ASCII, DF1 and DNP Default: Modbus RTU
Addressing Mode	Standard or Extended Default: Standard

Connections to COM3 are made through a RJ-45 modular connector. COM3 supports six signals plus Ground and 5 Vdc power. The SCADAPack 350 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, in a manner similar to the SCADAPack LP.

In order to use the signals as DTR, DCD jumpers J15, J16 have their jumper links installed in position “Normal”. To use the COM3 port with a Vision interface, jumpers J15, J16 must have their jumper links installed in position “Vision”.

For proper operation, jumper links of J15, J16 are to be installed both in the same position, either “Vision” or “Normal”.

The following diagram shows the pin connections for the RS-232 (RJ-45) port connector for COM3.

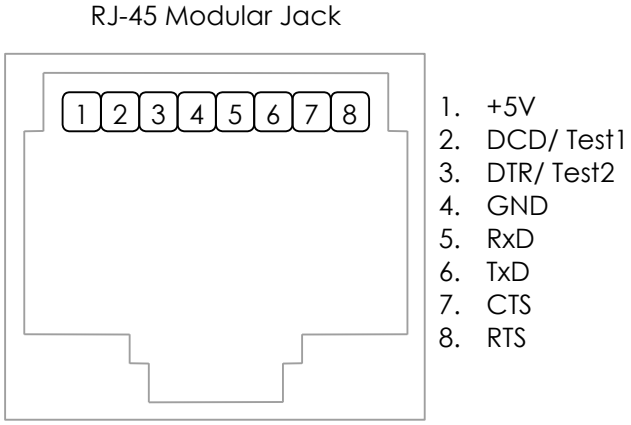


Figure 23: RJ-45 Connector Pinout

- +5 Vdc is available on Pin 1 when turned on by the user under program control or, provided jumpers J15, J16 have their jumper links in the “Vision” position, when the SCADAPack 350 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.

NOTICE
UNEXPECTED EQUIPMENT OPERATION If not using a SCADAPack Vision, ensure that jumpers J15 and J16 have their jumper links 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 RS-232 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 +3V or greater and a SPACE level is a voltage of –3 Vdc or lower.

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.
2	DCD /Test1 (Input)	With jumper links of J15, J16 in the “Norm.” position, used as DCD signal. With jumper links of J15, J16 in the “Vision” position, used to detect SCADAPack Vision ON switch closure.
3	DTR /Test2 (Output)	With jumper links of J15, J16 in the “Norm.” position, used as DTR signal. With jumper links of J15, J16 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 must be a MARK for the communication port to transmit data. When the attached device does not provide this signal, the RTU keeps the line at a MARK. When the attached device does provide this signal, it must set CTS to MARK to allow the RTU 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.

RS-232 Wiring Examples

⚠WARNING

HAZARD OF ELECTRIC SHOCK

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

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

DTE to DTE without Handshaking

There are several methods for wiring the RS-232 COM port to DTE (Data Terminal Equipment) and DCE (Data Communications Equipment) devices. The simplest connection requires only 3 wires: RxD, TxD and signal ground. The following diagram shows a common RS-232 COM port to DTE device.

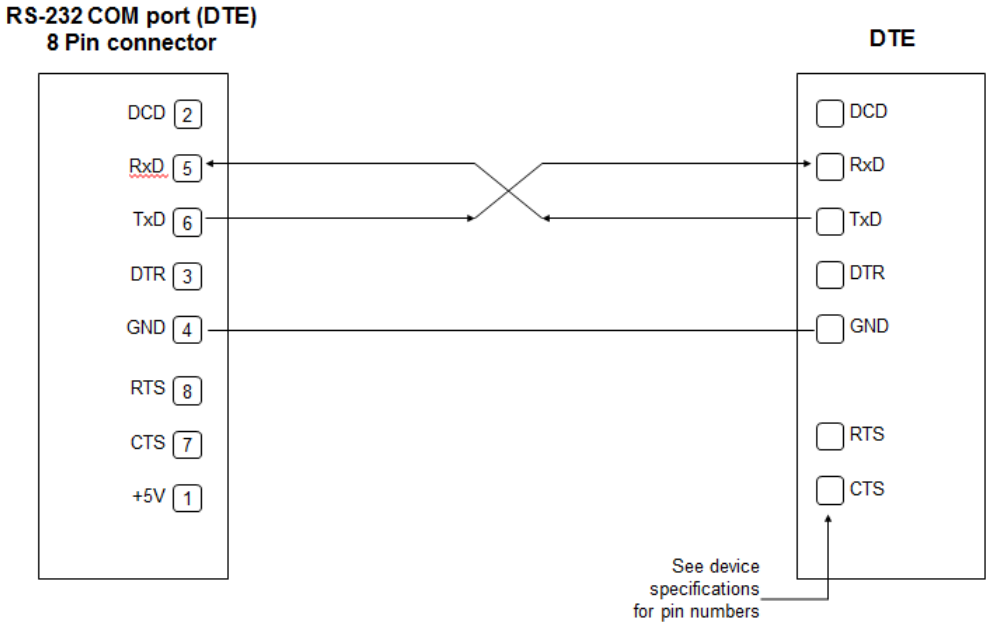


Figure 24: RS-232 DTE to RS-232 DTE without Handshaking

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 RS-232 COM port with a DTE device requiring handshaking lines.

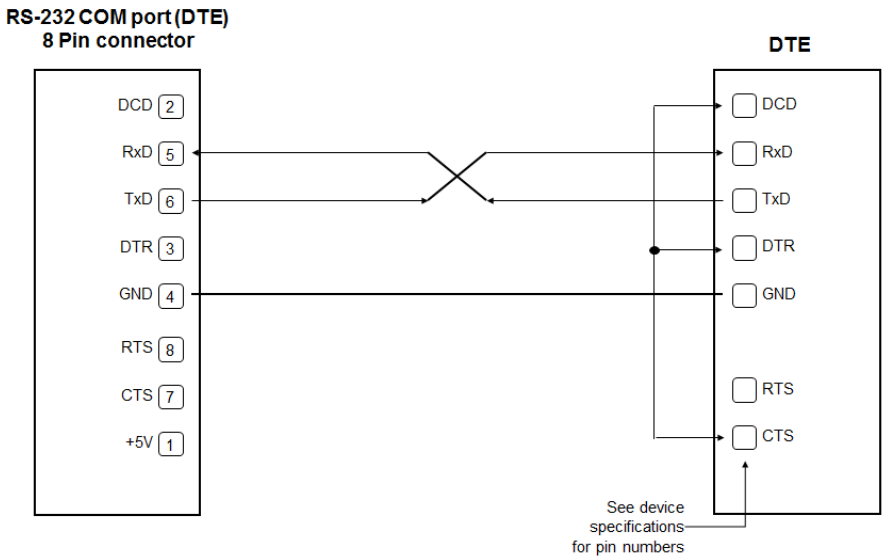


Figure 25: RS-232 DTE to RS-232 DTE with Handshaking

DTE to DCE with Handshaking

DCE devices require different wiring. The handshaking lines are connected in most cases. Many DCE devices are half-duplex. Select half-duplex operation with these devices. The diagram below shows common connection of a SCADAPack 350 with a DCE device requiring handshaking lines.

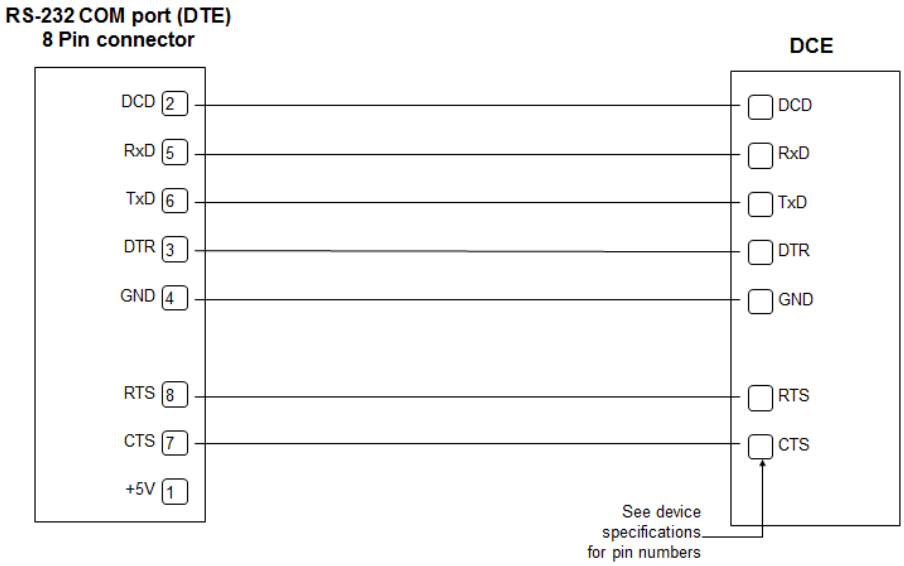


Figure 26: RS-232 DTE to RS-232 DCE With Handshaking

RS-232 Cables

RJ-45 to DE-9S DTE

This cable is used to connect from an RJ-45 based RS-232 port on the SCADAPack 350 to DE-9P connector on a DTE such as a PC. A 3 m (10 ft.) long cable is available from Schneider Electric as part number TBUM297217.

RJ-45 8 Pins	SCADAPack DTE Function	DE9S DTE Function	DE9S
			Shield connects to shell
6	TxD	RxD	2
5	RxD	TxD	3
4	COM	COM	5
1, 2, 3, 7 and 8 are not connected at this end.			Wires not connected at this end.

RJ-45 to SCADAPack Vision

This cable is used to connect from COM3 (RJ-45 based RS-232) port on the SCADAPack 350 to DE-9P connector on a SCADAPack Vision. A 1.5 m (5 ft.) long cable is available from Schneider Electric as part number TBUM297237.

RJ-45 8 Pins	SCADAPack 350 Function	SCADAPack Vision Function	DE9S
			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

This cable is used to connect from an RJ-45 based RS-232 port on the SCADAPack 350 to a DE-9S connector on a DCE such as a modem. A .38 m (15 in.) long cable is available from Schneider Electric as part number TBUM297218.

RJ45	SCADAPack 350 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

RS-485 Serial Communication Ports

COM1 RS-485 Serial Port

Serial port COM1 on the SCADAPack 350 is configured as a two-wire RS-485 serial communication port.

The following table shows the serial and protocol communication parameters supported by COM1. These parameters are set from Telepace, IEC 61131-3 or from an application program running in the SCADAPack 350. Default values are set when a Cold Boot or Service Boot is performed on the SCADAPack 350.

Parameter	Supported Values
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Default: 9600
Duplex	Half Default: Half
Parity	Odd, None or Even Default: None
Data Bits	7 or 8 Bits Default: 8 Bits
Stop Bits	1 Bit Default: 1 Bit

Receive Flow Control	None or Xon/Xoff Default: None
Transmit Flow Control	None or Xon/Xoff Default: None
Station	1 to 65534 Default: 1
Protocol	None, Modbus RTU or Modbus ASCII, DF1 or DNP. Default: Modbus RTU
Addressing Mode	Standard or Extended Default: Standard

COM1 transmits and receives differential voltages to other RS-485 devices on a network. The RS-485 specification allows a maximum of 32 devices connected on a single RS-485 network. The specification for RS-485 recommends that the cable length should not exceed a maximum of 1200 m (4000 ft.)

The signal grounds of the RS-485 devices in the network are not connected together but instead are referenced to their respective incoming electrical grounds. The grounds of the RS-485 devices on the network are wired to be within several volts of each other. The SCADAPack 350 ground is connected to the chassis.

COM2 RS-485 Serial Port

Serial port COM2 can be configured as either a six-line RS-232 port or as a two-wire RS-485 port. For RS-485 operation J13 is installed in position “RS-485”. This section covers RS-485 operation. For RS-232 operation, refer to section ***COM2 RS-232 Serial Port.***

The following table shows the serial and protocol communication parameters supported by COM2. These parameters are set from Telepace, IEC 61131-3 or from an application program running in the SCADAPack 350. Default values are set when a Cold Boot or Service Boot is performed on the SCADAPack 350.

Parameter	**Supported Values**
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Default: 9600
Duplex	Half Default: Half
Parity	Odd, None or Even Default: None
Data Bits	7 or 8 Bits Default: 8 Bits
Stop Bits	1 Bit Default: 1 Bit

Receive Flow Control	None or Xon/Xoff Default: None
Transmit Flow Control	None or Xon/Xoff Default: None
Station	1 to 65534 Default: 1
Protocol	None, Modbus RTU or Modbus ASCII, DF1 or DNP. Default: Modbus RTU
Addressing Mode	Standard or Extended Default: Standard

COM2 transmits and receives differential voltages to other RS-485 devices on a network. The RS-485 specification allows a maximum of 32 devices connected on a single RS-485 network. The specification for RS-485 recommends that the cable length should not exceed a maximum of 1200 m (4000 ft.)

The signal grounds of the RS-485 devices in the network are not connected together but instead are referenced to their respective incoming electrical grounds. The grounds of the RS-485 devices on the network are wired to be within several volts of each other. Controller ground is connected to the chassis.

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

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 350.
2	NC	Not used in RS-485 mode. Should be left open.
3	NC	Not used in RS-485 mode. Should be left open.
4	GND	This pin is connected to the system ground.
5	B (-) (Input/ Output)	For RS-485 operation J13 is in position “RS-485” This pin is the B signal of the RS-485 bus.
6	A (+) (Input/ Output)	For RS-485 operation J13 is in position “RS-485” This pin is the A signal of the RS-485 bus.
7	NC	Not used in RS-485 mode. Should be left open.
8	NC	Not used in RS-485 mode. Should be left open.

Connections to COM2 are made through a RJ-45 modular connector. COM2 supports two signals plus Ground and 5V power. The following diagram shows the pin connections for the RS-485 (RJ-45) port connector for COM2 operating in RS-485 mode.

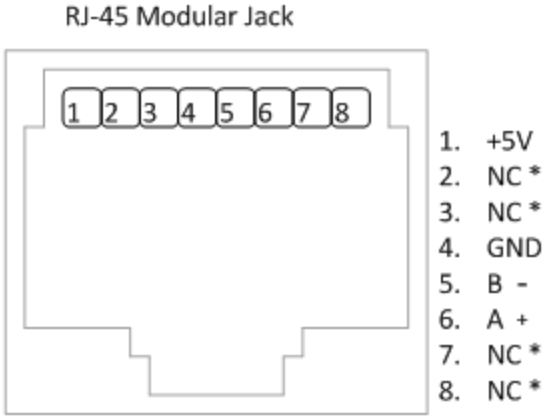


Figure 27: COM2 RJ-45 Connector

RS-485 Bias Resistors

The RS-485 receiver inputs on the RTU are biased so that 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.

RS-485 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 RS-485 wire pair. Other stations should not have termination resistors.

If required, RS-485 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 in order to generate at least 0.2 Vdc across RS-485 line. The suggested value of the bias resistors is 470 ohms. One bias resistor is installed from the B signal to COM. The second bias resistor is installed from the A signal to +5 Vdc. +5 Vdc is available on P8 pin 1 when J14 is installed.

RS-485 Wiring Examples

⚠WARNING

HAZARD OF ELECTRIC SHOCK

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

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

A typical RS-485 wiring example is shown below. COM1 is shown connected to a multivariable transmitter such as a Schneider Electric 4000 MVT. The power for the transmitter can come from the SCADAPack 350 power input source or can be obtained from the 24 Vdc VLOOP output for possible power savings.

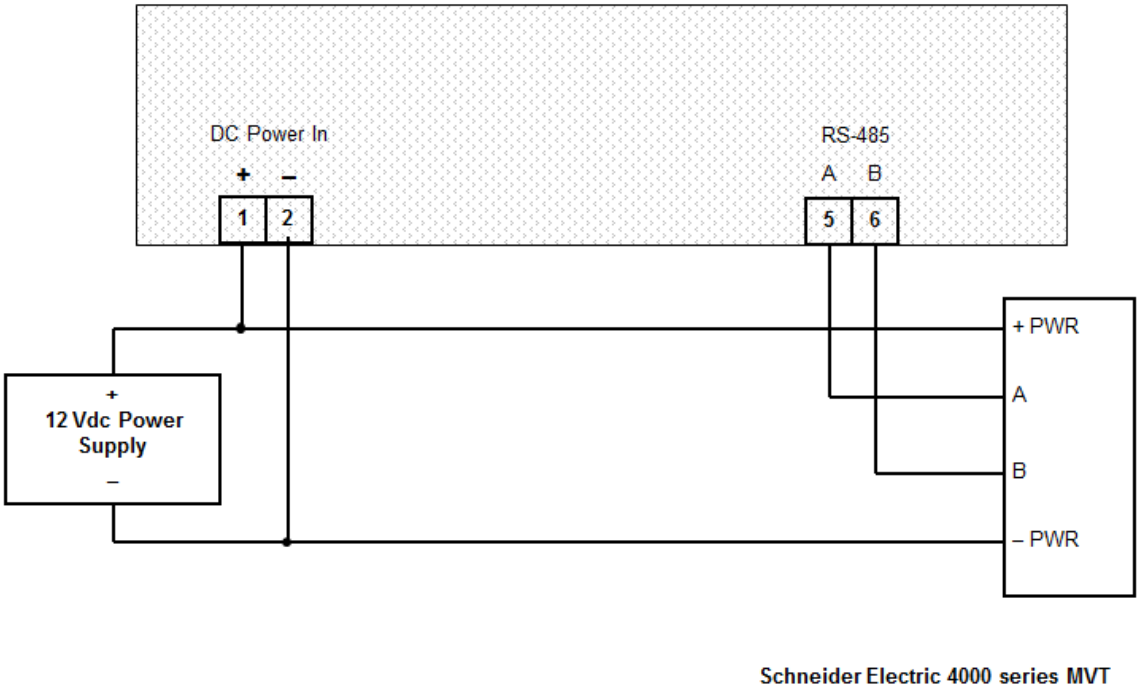


Figure 28: RS-485 Wiring

Ethernet Communication

The SCADAPack 350 has one 10/100Base-T Ethernet port. This is a single communications channel running at 10/100 Mb/s 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.

LAN Port Settings

Connections to the LAN 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***.

TCP/IP Settings

The following table shows the TCP/IP parameters supported by the LAN port. These parameters are set from the IEC 61131-3 or from an application program running in the RTU. Default values are set when a Cold Boot is performed on the RTU.

Parameter	Supported Values
IP Address	In the format 255.255.255.255 Default: 0.0.0.0
Subnet Mask	In the format 255.255.255.255 Default: 255.255.0.0
Gateway	In the format 255.255.255.255 Default: 0.0.0.0

The **IP Address** is the address of the RTU. The IP address is statically assigned. Contact your network administrator to obtain an IP address.

The **Subnet Mask** determines the subnet on which the RTU is located. The subnet mask is statically assigned. Contact your network administrator to obtain the subnet mask.

The **Gateway** determines how your RTU communicates with devices outside its subnet. Enter the IP address of the gateway. The gateway is statically assigned. Contact your network administrator to obtain the gateway IP address.

Modbus/TCP Settings

The following table shows the Modbus/TCP parameters supported by the LAN port. These parameters are set from the IEC 61131-3 or from an application program running in the RTU. Default values are set when a Cold Boot or Service Boot is performed.

Parameter	Supported Values
Master Idle Timeout	Any value in seconds. Default: 10 seconds
Server Receive Timeout	Any value in seconds.

Parameter	Supported Values
	Default: 10 seconds
Maximum Server Connections	Valid values are 1 to 20. Default: 20
TCP Port	Valid values are 1 to 65535 Default: 502
Modbus Addressing Type	Valid values are Standard or Extended Default: Standard
Modbus Station Address	Valid values are 1 to 65534. Default: 1
Store and Forward Messaging	Valid values are Enabled and disabled. Default: Disabled

The **Master Idle Timeout** parameter sets when connections to a slave controller are closed. Setting this value to zero disables the timeout; the connection will be closed only when your program closes it. Any other value sets the timeout in seconds. The connection will be closed if no messages are sent in that time. This allows the slave device to free unused connections.

The **Server Receive Timeout** parameter sets when connections from a remote device are closed. Setting this value to zero disables the timeout; the connection will be closed only when the remote device closes it. Any other value sets the timeout in seconds. The connection will be closed if no messages are received in that time. This allows the RTU to free unused connections.

The **Maximum Server Connections** parameter sets the number of incoming (server) connections that the RTU will allow. Incoming (server) connections are used when a remote device creates a connection to this RTU. Outgoing connections are used when this RTU creates a connection to a remote device (e.g. using a **masterip** function block from a Telepace or IEC 61131-3 program). Setting this value to the maximum allows the server to use all connections for incoming connections. Setting the value below the maximum limits the number of incoming connections from remote devices. This reserves the remaining connections for use by the RTU for outgoing connections.

The **TCP Port** parameter sets the port used by the Modbus/TCP protocol. This should be set to 502. This is the well-known port number for Modbus/TCP. Modbus/TCP devices use 502 by default, and on many devices the value cannot be changed. It is suggested that you change this value only if this port is used by another service on your network. Consult your network administrator to obtain a port if you are not using the default.

The **Addressing** parameter selects standard or extended Modbus addressing. Standard addressing allows 255 stations and is compatible with standard Modbus devices. Extended addressing allows 65534 stations, with stations 1 to 254 compatible with standard Modbus devices.

The **Station** parameter sets the station number of the RTU. The valid range is 1 to 255 if standard addressing is used and 1 to 65534 if extended addressing is used.

The **Store and Forward Messaging** parameter controls forwarding of messages on the Ethernet port. If this option is enabled, messages will be forwarded according to the settings in the store and forward routing table.

RJ-45 Modular Connector for Ethernet

The SCADAPack 350 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.

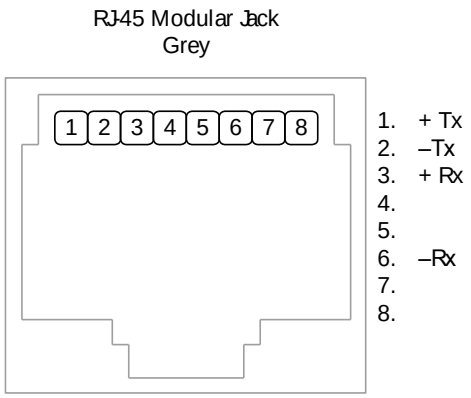


Figure 29: RJ-45 Connector for Ethernet

NOTICE
UNEXPECTED EQUIPMENT OPERATION The IEEE 802.3 10 BASE-T specification requires that 10 BASE-T and 100 BASE-T devices support UTP 100-120 unshielded twisted pair cables of not less than 100 m (325 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.**

10/100Base-T has a maximum run of 100 m (350 ft.) but the actual limit is based on signal loss and the noise in the environment. This may limit the practical distance to less than 100 m (350 ft.) The Ethernet cables should not be run in parallel with power or any cables that generate noise.

USB Ports

The SCADAPack 350 has two USB 2.0 compliant ports, supporting both low-speed (1.5 Mb/s) and full-speed (12 Mb/s). One of the ports allows the RTU to act as a host, while the second port allows connection to a USB host, such as a notebook computer. The two USB ports can be used simultaneously.

The USB interface circuitry can be disabled to save power. Refer to section ***Power Management Features*** for details to enable the power to the USB interface.

USB Connections

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

Host Port

⚠WARNING

EXPLOSION RISK

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

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

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

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

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

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

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

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

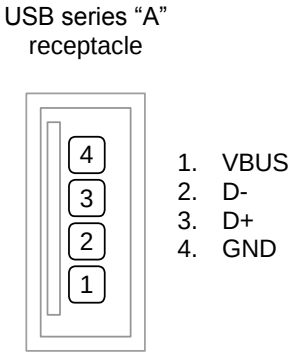


Figure 30: Host USB Port Connections

The host port supports memory stick type devices only; external USB drives are not supported.

The following USB devices are not supported:

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

For optimum performance, use your PC to format any new USB memory stick to FAT32 file format (Right click the USB drive and select Format – if you have a choice of FAT and FAT32, select FAT32.). This will remove any applications that may have been shipped pre-installed on your device.

Peripheral Port

⚠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 uses a USB series “B” receptacle. A SCADAPack 350 will not draw any significant power from the host over the USB peripheral port. The following diagram shows the connections of the peripheral USB port.

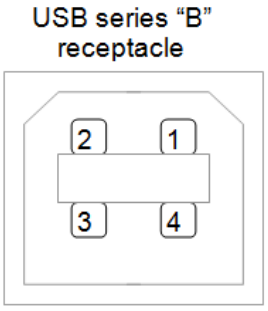


Figure 31: Peripheral USB Port Connections

Operation

Operating Modes

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Evaluate the operational state of the equipment monitored and controlled by the device before it is restarted.

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

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

Starting the RTU in COLD BOOT or FACTORY BOOT mode returns RTU configuration parameters to their default settings and erases application programs. This information must be reloaded into the RTU for correct RTU operation.

Before starting the RTU in COLD BOOT 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 death or serious injury.

A SCADAPack 350 may start up in RUN, SERVICE, COLD BOOT, FACTORY BOOT, or REENTRY BOOT modes.

- Start up in the RUN mode automatically executes Ladder Logic and C/C++ programs in the RTU memory.
- Start up in the SERVICE mode stops the programs to allow reprogramming and initialization.
- Start up in the COLD BOOT mode initializes the RTU and erases application programs.
- Start up in FACTORY boot reformats the Flash file system, initializes the RTU and erases application programs.
- REENTRY boot is performed as part of the firmware download process.

Each boot mode is determined by the amount of time that the LED power switch is depressed when power is applied or a board reset occurs.

The boot mode is not performed until the LED power switch is released. As such power can be removed prior to releasing the LED power switch without performing the selected boot mode.

The following sections describe in detail the selection of each operating mode.

RUN Mode

The RUN mode is the normal operating mode of the RTU. No action is required to select RUN mode. When power is applied to the RTU:

- The user defined serial communication parameters for COM ports are used.
- If a Telepace Ladder Logic or IEC 61131-3 application program is loaded in RAM, it is executed.
- C application programs are executed.
- If there is no application program in RAM and there is an application program in flash ROM, then the flash ROM program will be executed.
- The lock settings and password are used.

SERVICE Mode

SERVICE mode is used during application programming and maintenance work. When a SCADAPack 350 starts in SERVICE mode:

- The default serial communication parameters are used (see section ***Serial Communication*** for a description of the default parameters).
- The Telepace Ladder Logic or IEC 61131-3 program is stopped.
- The C program is stopped.
- Application programs are retained in non-volatile memory.
- The lock settings and password are used.

SERVICE mode is selected by performing a SERVICE BOOT using the following procedure:

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

If the LED POWER button is released before the STAT LED turns on, the SCADAPack 350 will start in RUN mode.

COLD BOOT Mode

COLD BOOT mode is used after installing new firmware. When a SCADAPack 350 starts in COLD BOOT mode:

The default serial and Ethernet communication parameters are used (see section ***Serial Communication*** and ***Ethernet Communication*** for a description of the default parameters.)

- The Telepace Ladder Logic or IEC 61131-3 and C Tools programs are erased.
- The C program is erased.
- The registers in the I/O database or I/O Connection are initialized to their default values.
- The Register Assignment is erased.
- The RTU is unlocked.

⚠WARNING

UNEXPECTED EQUIPMENT OPERATION

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

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

NOTICE

DATA LOSS

Starting the RTU in Cold Boot mode returns RTU configuration parameters to their default settings and erases applications created in 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 loss of files related to configuration and data collection.

COLD BOOT mode is selected by performing a COLD BOOT using the following procedure:

1. Remove power from the SCADAPack 350.
2. Hold down the LED POWER button.
3. Apply power to the SCADAPack 350.
4. Continue holding the LED POWER button for 25 seconds until the STAT LED begins to flash on and off continuously.
5. Release the LED POWER button.

If the LED POWER button is released before the STAT LED begins to flash, the SCADAPack 350 will start in SERVICE mode.

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

FACTORY BOOT Mode

FACTORY BOOT mode is used to reformat the Flash File system and initialize the SCADAPack 350 to factory default settings. When the RTU starts in FACTORY BOOT mode:

- The default serial and Ethernet communication parameters are used (see section ***Serial Communication*** and ***Ethernet Communication*** for a description of the default parameters).
- The Telepace Ladder Logic or IEC 61131-3 and C Tools programs are erased.
- The C program is erased.
- The registers in the I/O database or I/O Connection are initialized to their default values.
- The Register Assignment is erased.
- The RTU is unlocked.
- Flash File system is reformatted.

FACTORY BOOT mode is selected by performing the following procedure:

1. Remove power from the SCADAPack 350.
2. Hold down the LED POWER button.
3. Apply power to the SCADAPack 350.
4. Continue holding the LED POWER button for longer than 30 seconds until the STAT LED turns solid.
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. The STAT LED will remain on until the FACTORY boot has completed.

Low RAM Battery Voltage Effect

With Firmware version 1.58 and newer a feature is added to detect if the lithium RAM battery is at a very low level and to provide a modified RUN_BOOT or SERVICE_BOOT if that is the case. The Low RAM Battery Voltage effect occurs when a RUN_BOOT or SERVICE_BOOT is performed and the RAM battery voltage is detected at 1.0 Vdc or less or the battery is removed.

The special initialization with low voltage battery including following steps:

- The registers in the I/O database or I/O Connection are initialized to their default values.
- Ladder logic applications saved in RAM are erased.
- Ladder Logic programs, including DNP configurations and register assignments, saved to Flash memory will be restarted on a Run boot.
- IEC 61131-3 applications are erased.
- The DNP configuration is erased.

- The communication parameters for serial ports and LAN port are set to default values when a Service boot is performed and are returned to user defined values when a Run boot is performed.
- C applications are stopped during a Service boot and restarted fresh with the execution state set to first run during a Run boot condition. This enables C applications to re-initialize any “dynamic NVRAM” allocation that needs to occur when the application starts.
- Data Log and Data Log to File functions will return either Invalid ID or has not been created or Invalid logging mode errors.

Boot Mode Effects

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

Run Boot	Service Boot	Cold Boot	Factory Boot	Re-entry Boot	Action
		X	X		IP Address set to default
	X	X	X		Serial settings set to default
		X	X		Lock settings set to default
	X	X	X		S&F settings set to default
	X	X	X		Friendly IP Table set to default
		X	X		LED power set to default
		X	X		Register assignment erased
		X	X	IEC 61131-3- Yes Telepace if upgrading from firmware before 1.40	Database initialized
		X	X	IEC 61131-3 – Yes Telepace if upgrading from firmware before 1.40	Logic application erased
		X	X		C/C++ Applications Erased
		X	X		Application files are erased
			X		Flash File System reformatted
X					C/C++ Applications started
X					Logic application started
				X	Communication settings on active interface retained
		X	X	X	Settings saved to non-volatile memory
		X	X		Ladder logic in flash is erased
	X	X	X		Protocols are set to defaults

Sleep Mode

A SCADAPack 350 is capable of extremely low power operation when in sleep mode. The RTU enters the sleep mode under control of the application program. During sleep mode the following happens:

- Application programs stop executing.

- The 5 Vdc power to much of the RTU is switched off.
- The 5 Vdc power to the I/O bus is switched off.
- The three counter inputs on the board continue to function.
- The real-time clock and alarm continue to function.
- VLOOP will be turned off.

While in Sleep Mode, the processor uses a very slow speed clock.

The SCADAPack 350 wakes up from sleep mode under the following conditions:

- Hardware RESET caused by power removed and applied to the RTU.
- The LED POWER push-button is pressed.
- A real time clock alarm, defined by application program, occurs.
- Any of the board counters rolls over. This occurs every 65536 pulses on each input.
- Assertion of Digital Input 0.
- The COM3 Test1 to Test2 pins are connected together, indicating the SCADAPack Vision is to be turned on. This can only occur if COM3 is configured to operate with SCADAPack Vision operator interface.

Reduced Power Mode

A SCADAPack 350 is capable of lower power operation when in Reduced Power Mode. The RTU enters this mode under control of the application program. During in Reduced Power Mode the following happens:

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

A SCADAPack 350 exits from Reduced Power Mode under the following conditions:

- The user changes the corresponding register associated with the CNFG Power Mode register assignment in Telepace applications. Refer to the Telepace manual for more information on the CNFG Power Mode register assignment.
- For IEC 61131-3 applications, two functions can be used to change / check the power mode:
  - setpmode to set desired power mode
  - getpmode to request present power mode

Refer to the IEC 61131-3 manual for more information on these functions.

- For C applications, the user calls the SetPowerMode and GetPowerMode functions. Refer to the SCADAPack 350 C Tools manual.

Power Consumption

The power consumption of the SCADAPack 350 should be less than the values in the table below:

Power Mode	LAN Status	USB Status	Power Consumption (mW)
Normal	Enabled	Enabled	1750
Normal	Enabled	Disabled	1500
Normal	Disabled	Enabled	1000
Normal	Disabled	Disabled	750
Reduced	Enabled	Enabled	1500
Reduced	Enabled	Disabled	1250
Reduced	Disabled	Enabled	750
Reduced	Disabled	Disabled	500
Sleep	Any	Any	15

LED Indicators

There are 25 LEDs on SCADAPack 350. LEDs can be disabled to conserve power. The table below describes the LEDs.

LED	Function
Power Mode	On when operating and the LEDs are enabled. Off when the LEDs are disabled. Off when powered off or in Sleep Mode.
RUN	On when the ladder logic program is executing.
STAT	Blinking when an RTU condition exists.
FORCE	On when I/O points are forced.
USB STAT	Not currently used.
LINK	On when the LAN port has established a link
ACT.	On to signal activity on the LAN port
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 COM2.
DCD	On when the DCD input is asserted COM2.
Digital I/O	On when the corresponding I/O point is on. LEDs are dim in Sleep Mode when the corresponding I/O point is on.
Counter 0	On when the counter input is present and low.

Counters 1,2	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.

LED Power Control

The SCADAPack 350 can disable the LEDs on the controller board and the 5000 I/O modules to conserve power. This is particularly useful in solar powered or unattended installations.

The Power Mode LED on the RTU indicates the LED power state. It is on when the RTU enables LED power.

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

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

When the LED power state is ON power saving modes are disabled. The 24 Vdc power supply boost is on and VLOOP power is turned ON. The SCADAPack Vision operator interface is powered on as a result of 5 Vdc being available on COM3.

Jumpers

Headers on the SCADAPack 350 are user configurable and are described in the appropriate sections of this manual. Some headers and jumpers are reserved for manufacturing and test functions. Refer to ***Figure 13: Analog Input Wiring*** for the location of jumpers.

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

Jumper	Function
J1	Analog Input 0 Range ***Figure 13: Analog Input Wiring***
J2	Analog Input 1 Range ***Figure 13: Analog Input Wiring***
J3	Analog Input 2 Range ***Figure 13: Analog Input Wiring***
J4	Analog Input 3 Range ***Figure 13: Analog Input Wiring***
J5	Analog Input 4 Range ***Figure 13: Analog Input Wiring***
J8	Reset Jumper (Performs an RTU reset similar to power cycle)
J9	Counter Input 1 Type ***Figure 17: Counter Input Wiring***
J10	Counter Input 2 Type ***Figure 17: Counter Input Wiring***
J11	Counter Input 1 Type ***Figure 17: Counter Input Wiring***
J12	Counter Input 2 Type ***Figure 17: Counter Input Wiring***
J13	COM2 RS-232/ RS-485 mode selection ***COM2 RS-232 Serial Port***
J14	COM2 5 Volts on Pin 1 ***COM2 RS-232 Serial Port***
J15, J16	COM3 Vision/ Normal mode select ***COM3 RS-232 Serial Port***

	These jumpers are set to the same position, either Vision or Norm.

Status LED

The STAT LED indicates an RTU condition. The STAT LED blinks when a condition exists. The STAT LED turns off when the conditions are cleared.

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

The table below shows the meaning of the sequences.

Sequence	CONTROLLER STATUS CODE
Off	0 = Normal
1 Long	I/O Module Error Indication
1 Short, 1 Long	Register Assignment Checksum Error

I/O Module Indication

When the Status LED flashes the controller status code 1 (i.e. a long flash, once every second), an I/O module(s) is not communicating with the RTU. To correct do one of the following:

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

Register Assignment Checksum Indication

When the status LED flashes the controller status code 2 (i.e. a short flash then a long flash followed by a 1 second delay), this indicates the register assignment is not valid. To correct this, initialize the register assignment from the Telepace software, or alternatively, perform a COLD BOOT as described in section ***COLD BOOT Mode*** section of this manual. The status LED should stop flashing.

Firmware Loading

Periodically the firmware for an RTU is updated to add new features or provide bug fixes. As they become available new firmware versions may be downloaded from ***http://www.schneider-electric.com***.

Allowed connections for firmware loading for a **SCADAPack 350** are **com1, com2 or com3, Ethernet** or **USB** peripheral port.

Maintenance

This module requires no routine maintenance. If the module is not functioning correctly, contact Schneider Electric Technical Support for more information and instructions for returning the module for repair.

Calibration

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

There are no user calibration procedures.

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 the power.

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

⚠WARNING

HAZARD OF ELECTRIC SHOCK

Remove power from the RTU before removing the RTU cover.

Remove power from the RTU before servicing.

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

Battery Handling Procedures

NOTICE
UNINTENDED EQUIPMENT OPERATION • Treat batteries with care. • Follow the manufacturers' instructions concerning battery storage, use and disposal. • Keep batteries clean and free from contaminants or other materials that could short the terminals. • Connect new batteries using the correct polarity. • Replace batteries with new units of the same chemistry, capacity and make. • Observe the manufacturers' instructions regarding disposal of batteries. Considerable energy remains in the battery. Failure to follow these instructions can result in equipment damage.

Electrostatic Discharge (ESD) Procedures

NOTICE
STATIC ELECTRICITY DAMAGE The electronics inside the RTU can be damaged by static electricity. If you need to remove the RTU cover, wear an anti-static wrist strap that is connected to ground. Failing to follow this simple step can cause intermittent or total loss of RTU operation and will void the warranty. Failure to follow these instructions can result in equipment damage.

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 the 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 on-board RAM back-up battery is replaced while power to the RTU is disconnected.

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.

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*** 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.

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.

Replace this battery with one of the following 3.6 V batteries recommended by Schneider Electric as soon as possible after RTU reports that the RAM battery status is low and at the intervals recommended in the Routine Maintenance section:

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

For information on determining RAM battery status, refer to the documentation set provided with your configuration 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 the 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 following figure indicates where to cut the tie wrap.

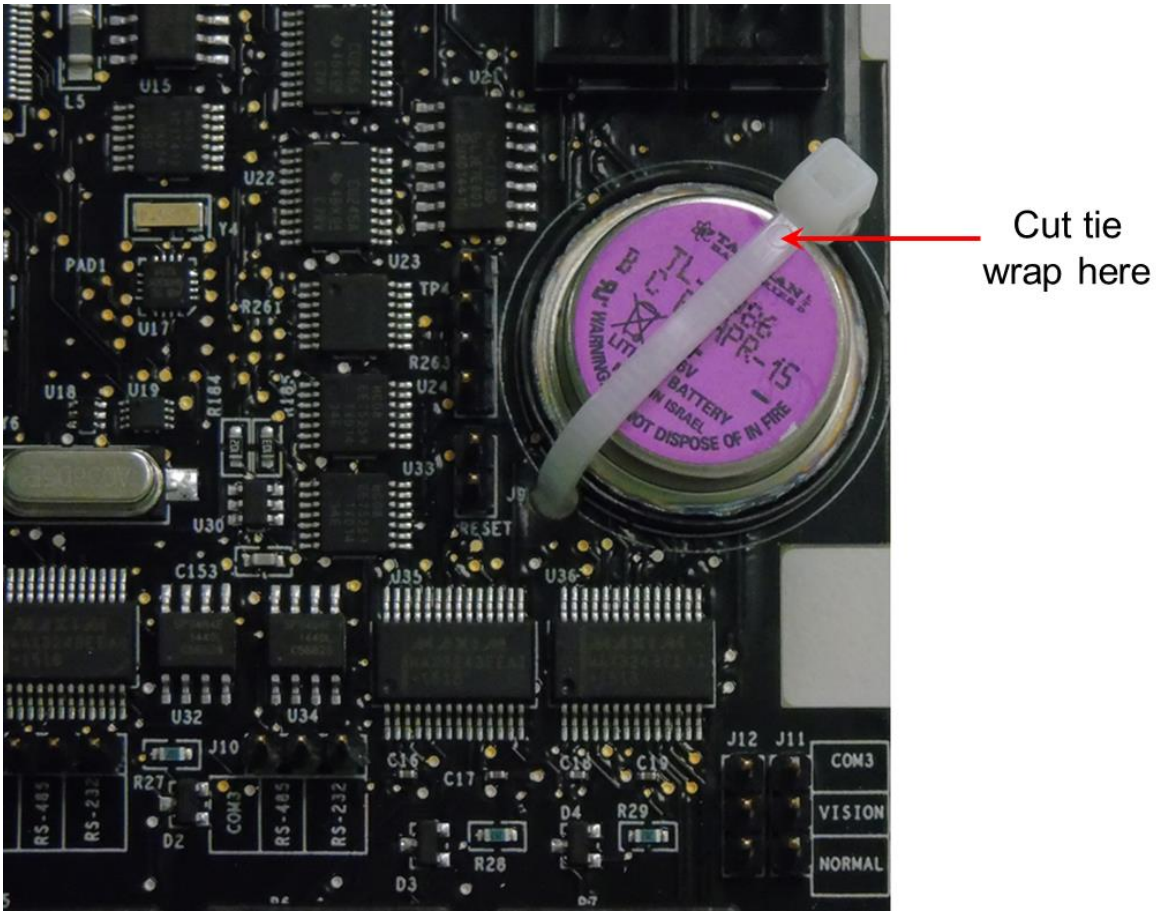


Figure 32: Battery Tie Wrap Location

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. Re-set the time on the RTU.
11. Reload the RTU configuration and user-created applications from back-up.

Updating Firmware

On the SCADAPack 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

For information on updating the firmware, refer to the manual for your configuration software.

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.**

Fuses

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

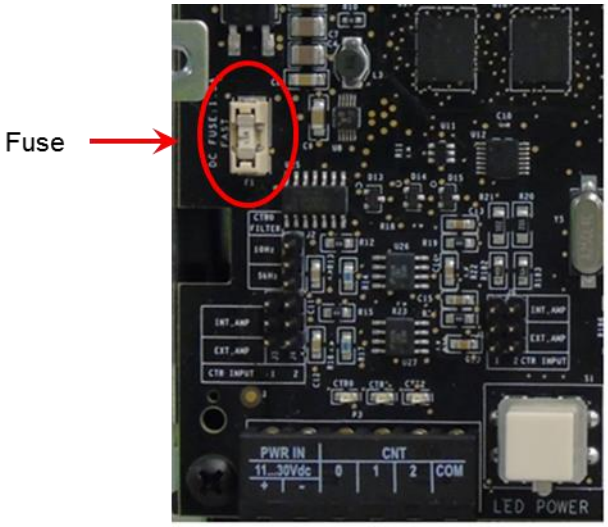


Figure 33: 1.5 Amp Fast-Blow Fuse Location

⚠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

UNEXPECTED EQUIPMENT OPERATION

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

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

⚠WARNING

UNEXPECTED 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.

Investigate and correct the cause of the blown fuse before replacing it. Common causes of blown fuses are short circuits and excessive input voltages.

Troubleshooting

Analog Inputs

Condition	Action
20 mA inputs read 0.	Check transmitter power.
Reading is at or near 0 for input signals.	Check if the input transient suppressers are damaged.
20 mA readings are not accurate.	Check for a damaged 250Ω current sense resistor. Inputs are 0…20 mA, not 4…20mA.
Reading is constant.	Check that the analog input is not forced.

Analog Outputs

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

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 RTU is in low power mode or sleep mode, or when the LEDs are turned off. Check that the digital I/Os are in the register assignment.

Digital Outputs

Condition	Action
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.
The LED is dim.	This is normal operation when the RTU is in sleep mode, or when the LEDs are turned off. Check that the digital I/Os are in the register assignment.

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.

Specifications

Disclaimer: Schneider Electric reserves the right to change product specifications. For more information, visit ***http://www.schneider-electric.com***.

General

Logic Control	SCADAPack Telepace Studio Ladder logic or IEC 61131-3 SCADAPack Workbench programming suite (LD, ST, FBD and SFC)
I/O Terminations	6 and 12-pole removable terminal blocks 3.31…0.0810 mm² (12…28 AWG) 15 A contacts Screw termination – 0.5 Nm (4.5 lb-in) torque Solid or stranded
Dimensions	211.8 mm (8.34 in.) wide 140.4 mm (5.53 in.) high 46.5 mm (1.83 in.) deep
Enclosure	Corrosion resistant zinc-plated steel with black enamel paint
Environment	Conformally coated -40…70 °C (-40…158 °F) operating -40…85 °C (-40…185 °F) storage 5% RH to 95% RH, non-condensing
Shock and Vibration	IEC 60068-2-27 (tested up to 15 g) IEC 60068-2-6
Warranty	3 years on parts and labor

Power Supply

Rated Voltage	11…30 Vdc Turn on Voltage: 10…11.5 Vdc Turn off Voltage: 9…10 Vdc
Maximum Power	12 W

Power Requirements

Typical power consumption at 20 °C (68 °F)

	Ethernet	LEDs	Vloop fully loaded	12 Vdc	24 Vdc
Use case 1	ON	OFF	OFF	1.6 W	1.5 W
Use case 2	ON	OFF	ON	5.1 W	4.9 W
Use case 3	ON	ON	ON	5.2 W	5.0 W

Power Outputs	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)
Output Capacity	5 Vdc at 1.2 A capacity 5 V 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

Controller

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
Internal Temperature	Measurement range -40…75 °C Accuracy ± 5 °C Measurement range -40…167 °F Accuracy ± 9 °F

Data Capacity

Maximum Database Points	Approx. 1,000
Maximum DNP3 Events	20,000
Maximum Data Concentrator Points	500
Maximum Data Concentrator Devices	Up to 10 in DNP3 Up to 100 in Modbus or DF1
File System Typical Storage	6 MB

Serial Ports

Serial Port: COM1	RS-485 serial port 2-wire half duplex
Serial Port: COM2	RS-232 Mode: RS-232 compatible serial port 8-pin modular RJ45 jack Full or half duplex OR RS-485 Mode: RS-485 compatible serial port 2-wire half duplex
Serial Port: COM3	Dedicated RS-232 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 Master/Slave IEC60870-5-101 Slave IEC60870-5-103 Master

	Modbus RTU Master/Slave DF1
Ethernet Port	8-pin modular RJ45 jack 10/100 Mb/s UTP (10/100Base-T) Transformer-isolated
IP Protocols	Modbus/TCP Server Modbus/TCP Client Modbus RTU in TCP Client DNP3 level 2 in TCP Slave FTP Server
Store and Forward	Stores and forwards frames between upstream and downstream SCADAPack 300 Smart RTUs
USB Device	USB 2.0 compliant "B"-type receptacle, for local configuration
USB Host	USB 2.0 compliant "A"-type receptacle, supports USB devices up to 32 GB (specific memory sticks supported)

Ethernet Port

Terminations	RJ-45 modular connector 10Base-T/100Base-T (twisted pair) 10/100 Mbits per second
Protocols Supported	DNP3 in TCP Master/Slave DNP3 in UDP Master/Slave Modbus/TCP Client IEC60870-5104 Slave NTP Server Telnet Server FTP Server BOOTP Server

USB Port

Port	USB Peripheral: One Port “B” connector

Speed	USB 2.0 compliant
Protocols Supported	DNP3

Counter Inputs

Counter Inputs	Counter 0: digital input counter Counter 1: turbine meter inputs Counter 2: turbine meter inputs
Digital Input Counter 0	Jumper selectable mmaximum 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 Input 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 Input 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 Input 1 and 2 Dry Contact	Maximum input 10 Vp-p without internal amplifier Maximum frequency 10 kHz
Dry Contact Input Thresholds	0.9 Vdc typical turn on input voltage Less than 0.4 Vdc turn on input voltage 1.5 V 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

Digital Inputs/Outputs

I/O points	8, user-selectable as inputs or outputs (open drain)
As Digital Inputs	Dry contact Time stamping: 170 ms
As Digital Outputs	Sinking MOSFET output, rated 30 Vdc, 1 A
Input Rating	Dry contact input 60 ohms for 32.768 Vdc inputs 250 ohms for 20 mA inputs Contact closure to ground is ON Open input is OFF
Output Rating	1.0 A maximum 0.35 Vdc maximum drop at 1 A
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 uF, typically 500 m (1600 ft.)
Isolation	Common ground return connected to chassis ground

Analog Inputs

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
Resolution	15-bit over the measurement range in 10 Vdc 14-bit over the measurement range in 20 mA
Accuracy	±0.1% of full scale at 25 ^{o}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 60 kilohms for 32.768 Vdc
Normal Rejection Mode	27 dB at 60 Hz

Analog Outputs

Output Points	2 (optional) 0…20 mA, 4…20 mA Voltage output may be accomplished with external precision resistor
Resolution	12 bits over 0…20 mA range
Accuracy	±0.15% at 25 ^{o}C (77 ^{o}F) ±0.35% of full scale over temperature range
Response Time	Less than 10 µs for 10% to 90% signal change
Power Supply	12…30 Vdc, external
Power (Current) Requirements	10 mA plus up to 20 mA per output
Isolation	Isolated from RTU logic and chassis
Load Range	12 Vdc: 0…375 ohms 24 Vdc: 0…925 ohms

Logic End-Of-Scan to Signal Update Latency	Typically, 18…27 ms

I/O Expansion Capacity

I/O Expansion	Maximum 8 I/O modules - to reach this limit, additional power supply modules (5103) are required Supported modules: Current 5000 modules (except 5608 and 5610 models)

Standards and Certifications

Hazardous Locations - North America	 Non-Incendive Electrical Equipment for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations. UL listed and CSA certified to the following standards: CSA Std. C22.2 No. 213-M1987 - Hazardous Locations. ANSI/ISA-12.12.01-2007 - 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.