SCADAPack LP

Hardware Manual

CONTROL MICROSYSTEMS

SCADA products... for the distance

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SCADAPack LP Hardware Manual

Trademarks

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1 Overview

The SCADAPack LP is a low power controller complete with an integrated power supply, analog and digital I/O, serial communications and turbine flow meter counter inputs. See

Figure 1: SCADAPack LP Controller. 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 LP. These power saving features include Sleep Mode, 24V-power shutdown, communication port power control and SCADAPack Vision power down.

The SCADAPack LP has six analog input channels. Five analog inputs are user configurable for either 10V or 20mA operation and one is a 32V analog input. Two optional 20mA analog outputs are available.

Eight digital I/O points, each capable of sinking 1A or monitoring a dry contact closure, provide flexible digital input and output configurations.

Three counter inputs, two of which are designed for direct connection to the millivolt output of turbine meter transducers, provide for a variety of connections to metering elements.

The I/O capacity of the SCADAPack LP can be expanded using 5000 Series I/O modules. A maximum of forty 5000 Series I/O modules may be used for a total expansion capacity of 512 digital inputs, 512 digital outputs, 128 analog inputs, 64 analog outputs and 64 counter inputs.

Three serial communication ports are provided. An RS-485 port is designed for use with multivariable transmitters. One of the two RS-232 ports is designed for use with the SCADAPack Vision operator interface. The SCADAPack LP supports direct wired, telephone and radio communication.

The primary microcontroller memory is 512KBytes flash ROM, and 1MBytes RAM. The CMOS RAM is non-volatile (battery backed). An EEPROM (1kBytes) stores configuration parameters. A real time clock calendar provides for time of day operations and alarms. A hardware watchdog timer protects against application program failures.

2 Important Safety Information

Power, input and output (i/o) wiring must be in accordance with Class I, Division 2 wiring methods Article 501-4 (b) of the National Electrical Code, NFPA 70 for installations in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations within Canada and in accordance with the authority having jurisdiction.

WARNING !
EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS 1, DIVISION 2.

WARNING !
EXPLOSION HAZARD – WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES.

WARNING !
EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NONHAZARDOUS.

Figure 1: SCADAPack LP Controller

3 Installation

The installation of SCADAPack controllers requires mounting the controller on the 7.5mm by 35mm DIN rail and connecting the SCADAPack controller to the system I/O Bus. Refer to the ***System Configuration Guide***, at the beginning of this manual, for complete information on system layout, I/O Bus cable routing and SCADAPack controller installation.

3.1 Field Wiring

SCADAPack controllers use screw termination style connectors for termination of field wiring. These connectors accommodate solid or stranded wires from 12 to 22 AWG. The connectors are removable allowing replacement of the SCADAPack Controller without disturbing the field wiring. Leave enough slack in the field wiring for the connector to be removed.

CAUTION:	Remove power before servicing unit.

To remove the termination connector:

- Pull the connector upward from the board. Apply even pressure to both ends of the connector.
- To install the termination connector:
- Line up the pins on the module with the holes in the connector. Make sure all the pins line up properly.
- Push the connector onto the pins. Apply even pressure to both ends on the connector.

There are six connectors for field wiring. Refer to ***Figure 2: SCADAPack LP Board Layout*** for connector locations.

- The two RS-232 communication ports, COM 2 and COM 3, connect to 8 pin modular jacks. Refer to section ***10.1-RS-232 Serial Communications Ports*** for pinout details and wiring diagrams for these modular jacks.
- All other field wiring terminates in removable terminal connectors. Connector pinouts and wiring examples are described in each of the respective sections of this manual.

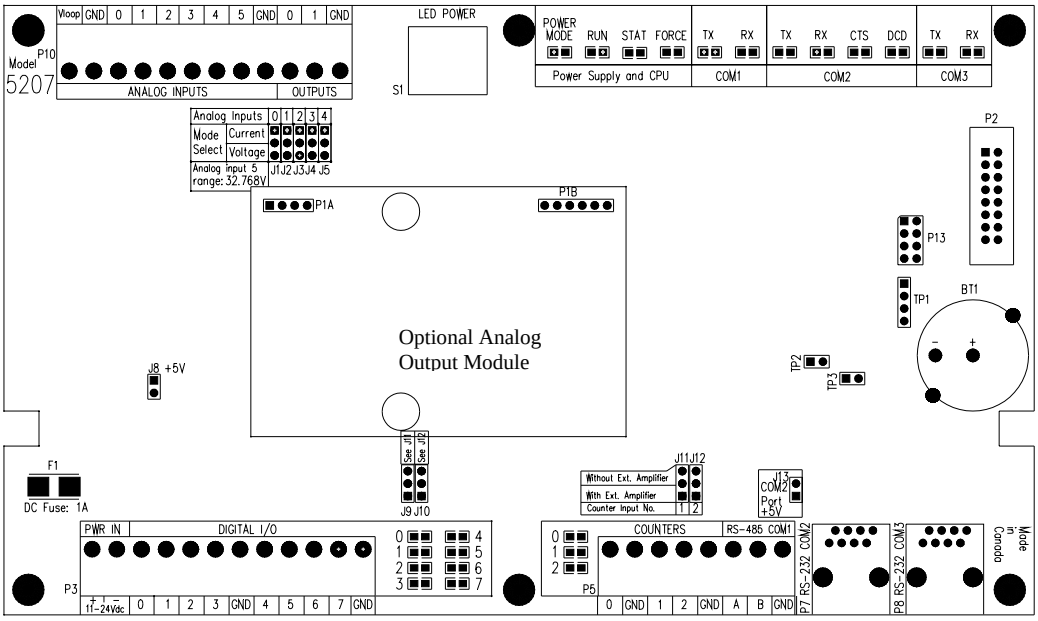


Figure 2: SCADAPack LP Board Layout

4 Power Supply

The SCADAPack LP is powered from an 11VDC to 24VDC input power source.

- Input power is applied to the 11-24Vdc positive (+) and negative (-) terminals on connector P3.

Refer to section ***14-Specifications*** 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 LP will turn off.
- Exceeding the maximum input voltage or applying a reverse voltage will blow the input power fuse.

Note: Unlike the other members of the SCADAPack family, the SCADAPack LP connects only to DC power sources. Connections to power sources such as 16Vac transformers will blow the fuse and may cause damage to the SCADAPack LP.

The DC power-input voltage is used to generate 5V for the SCADAPack LP circuitry. The output capacity of the 5V supply is sufficient to power the SCADAPack LP and a SCADAPack Vision operator interface with 100mA remaining capacity for a limited number of 5000 Series I/O modules.

For 12VDC power-input voltages a 12V to 24V DC/DC converter is used to power 20mA analog input and output devices. The DC/DC converter is controlled by the user application program and may turned on or off. Refer to section ***4.2.3-12V to 24V DC/DC Converter Control*** for more information on DC/DC converter control.

4.1 System Grounding

In most applications, it is desirable to ground the system by connecting the system power supply common, to the chassis or panel ground. The negative (–ve) side of the DC power input terminal as well as all I/O point terminals labeled GND are connected to chassis ground.

4.2 Power Management Features

The SCADAPack LP provides a number of special features to reduce power consumption. These power management features are:

- COM3 serial port power control.
- VLoop power control.
- 12V to 24V DC/DC Converter Control.

The SCADAPack LP provides three internal digital outputs that can be operated by the user application to manage the power saving features. Internal digital outputs 9, 10 and 11 and the power management functions they control are described in the following sections.

Refer to ***Figure 3: Power Management*** for an overview of the power management features. Refer to the appropriate software manual for information on using and controlling the internal Digital Outputs. For TelePACE applications refer to the Register Assignment for SCADAPack LP I/O module and for ISaGRAF applications refer to the I/O Complex Equipment for SCADAPack LP I/O.

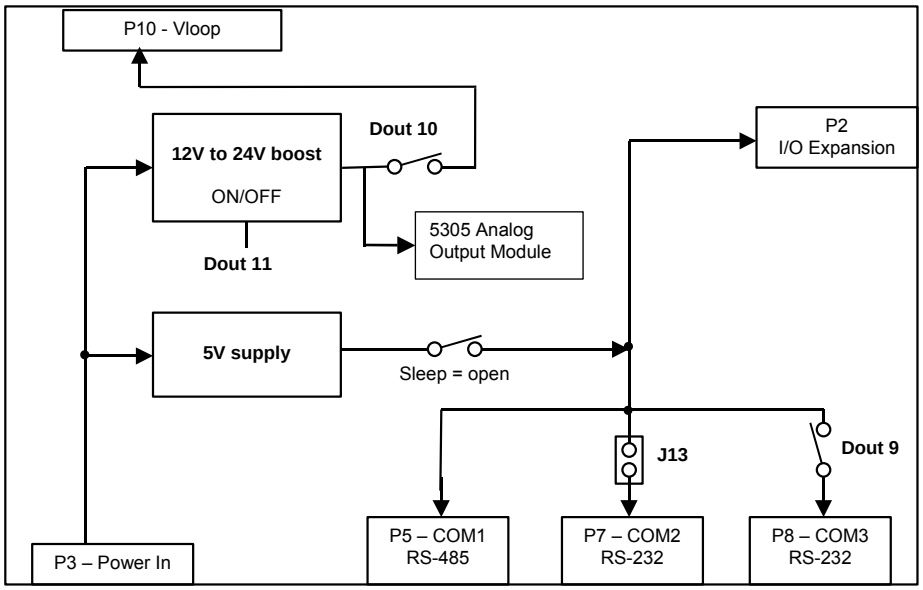


Figure 3: Power Management

4.2.1 COM3 Serial Port Power Control

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

Refer to section ***10.1.2-COM3 RS-232 Serial Port*** section for information on COM3 and section ***10.3.2-RJ-45 to SCADAPack Vision*** section for wiring examples. HMI power is controlled in the following ways.

- When internal **Digital Output 9** is **ON** HMI power is turned on.
- When internal **Digital Output 9** 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 COM3 RJ-45 connector. 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 sustained two-second or longer contact between DCD and DTR will turn off HMI power. Refer to section ***10.3.2-RJ-45 to SCADAPack Vision*** for more information.

Internal **Digital Input 9** indicates the status of COM3 serial port power. Digital Input 9 is set when COM3 serial port power is on and is cleared when COM1 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 ***11.3-LED Power Control*** for further information on this feature.

4.2.2 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 the section ***4.2.3-12V to 24V DC/DC Converter Control*** for converter information. The VLOOP power source is the applied input power if the DC-DC converter is turned off.

- Turn on **Digital Output 10** to turn **ON** the VLOOP output.
- Turn off **Digital Output 10** to turn **OFF** the VLOOP output.

Internal **Digital Input 10** indicates the status of VLOOP power. Digital Input 10 is set when VLOOP power is on and is cleared when VLOOP power is off.

Note:	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 ***11.3-LED Power Control*** for further information on this feature.

4.2.2.1 VLOOP Over-Current Protection

When VLOOP output is turned on, it is monitored for excessive current consumption caused by field wiring or instrumentation problems. If sustained over-current is detected (100 ms), VLOOP is turned off even though internal Digital Outputs 10 is turned on. This protection prevents unnecessary fuse blowing, circuitry damage and rapid battery depletion.

When VLOOP output is turned on, using internal Digital Output 10, and a short circuit is detected VLOOP will turn off. VLOOP will turn on to try again 5 seconds after turning off. If the fault condition still exits VLOOP will again turn off and retry after a 5 second delay. While the fault condition exists internal **Digital Input 12** will be ON.

4.2.3 12V to 24V DC/DC Converter Control

The 12V to 24V 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 LP is equipped with analog outputs for which 24V drive capability is required. Otherwise, the DC/DC converter can be turned off to conserve power.

- Turn on **Digital Output 11** to turn **ON** the 12V to 24V DC/DC converter. When the converter is turned on 24Vdc is provided to the VLOOP power and to the 5305 Analog Output module.
- Turn off **Digital Output 11** to turn **OFF** the 12V to 24V DC/DC converter. When the converter is turned off VLOOP power and the 5305 Analog Output module use is the applied input power.

Internal **Digital Input 11** indicates the status of the 12V to 24V DC/DC converter. Digital Input 11 is set when the 12V to 24V DC/DC converter is on and is cleared when the 12V to 24V DC/DC converter is off.

The 12V to 24V DC/DC converter is turned on when the LED power is enabled. This feature is provided for service and diagnostics. Refer to section ***11.3-LED Power Control*** for further information on this feature

5 Analog Inputs

There are six single ended analog inputs available to the user. These inputs provide 15-bit resolution over the range of the input. Five of these inputs are selectable for voltage or current inputs. One of these inputs is a 0 to 32.768-volt input and can be used to monitor battery voltage.

In addition to these analog inputs there are internal analog inputs available to the user. These analog inputs are used in application programs to monitor, RAM battery voltage, controller board ambient temperature and DC\DC converter voltage used for VLOOP.

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

Refer to the appropriate software manual for information on using the SCADAPack LP Analog Inputs in application programs. For TelePACE applications refer to the Register Assignment for SCADAPack LP I/O module and for ISaGRAF applications refer to the I/O Complex Equipment for SCADAPack LP I/O.

5.1 Internal Analog Inputs

SCADAPack LP Controllers have two internal analog inputs. These internal analog inputs are accessed from the user application program.

The ambient temperature 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 to 75 deg C or –40 to 167 deg F. The temperature reading represents temperatures in the range -40°C to 75°C or -40°F to 167°F. Temperatures outside this range cannot be measured.

- For TelePACE applications use the ***AIN Controller Temperature*** register assignment to read the ambient temperature in degrees C and degrees F.
- For ISaGRAF applications use the ***aintemp*** I/O connection to read the ambient temperature in degrees C and degrees F.

The lithium battery 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 3.6V lithium battery will return a typical value of 3600 or 3700. A reading less than 3000 (3.0V) indicates that the lithium battery requires replacement.

- For TelePACE applications use the ***AIN Controller RAM Battery V*** register assignment to read the lithium battery voltage.
- For ISaGRAF applications use the ***ainbatt*** I/O connection to read the lithium battery voltage.

5.2 I/O Analog Inputs

There are six single ended analog inputs available to the user. These analog inputs provide 15-bit resolution over the entire range of the input. The analog inputs are transient protected and share a common return (GND) that is connected to the chassis. Refer to ***Figure 2: SCADAPack LP Board Layout*** for the location of P9.

5.2.1 Analog Input Connections

The six external analog inputs connect to connector P10. The analog inputs are identified as Channel 0 through Channel 5. The first five, identified as Channels 0 through 4, use range jumpers to select either voltage inputs or current inputs. These analog inputs are single ended and measure voltages up to 10V. When configured as current inputs, the 250Ω current sense resistor will produce at 5V input at 20mA. See section ***5.3-Analog Input Range Jumpers*** for information on setting the range. See ***Figure 2: SCADAPack LP Board Layout*** section for the location of the range jumpers.

The sixth input, identified as Channel 5, is a 32.768V voltage input. This input is typically used to monitor the input power or battery voltage.

5.2.2 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 250Ω resistor built into the 20mA input circuit. Self-powered transmitters have three terminals called power in, signal out and common. Self-powered transmitters can have a current or voltage output. The signal out connects to the Analog Input Channel, the common connects to GND and the power in connects to a power supply.

There are three options for the user when selecting the power source. In all cases it is important for the user 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 5V.

The first option is to use the SCADAPack LP VLOOP Supply that steps up the input voltage to 24V. 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 all operating at 20mA. 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 24V. 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 0.5V less that the power input voltage.

The third option is to power the transmitter from a power supply supplied by the user.

5.2.3 Analog Input Wiring Examples

Figure 4: Analog Input Wiring shows example wiring of several transmitters.

- Channel 0 has a loop powered current transmitter connected to VLOOP.
- Channel 1 has a loop powered current transmitter connected to an external 24V power supply.
- Channel 2 is unused.
- Channel 3 has a self-powered voltage transmitter connected to an external 24V-power supply.
- Channel 4 has a self-powered current transmitter connected to an external 24V-power supply.
- Channel 5 is used to monitor the external 24V-power supply.

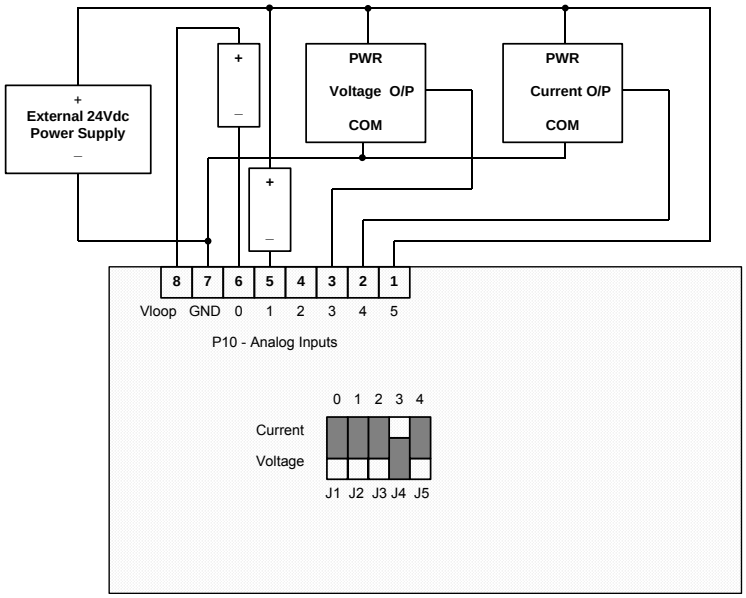


Figure 4: Analog Input Wiring

5.3 Analog Input Range Jumpers

Channels 0 through 4 can be user configured for either voltage or current operation with jumper links. Refer to ***Figure 4: Analog Input Wiring*** for examples of the how a jumper link is installed on J1 through J5. A jumper link installed in the Current position of the header results in a 250Ω resistor across the appropriate analog input. A jumper link installed in the Voltage position of the header results in high impedance analog input.

5.4 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 to 10V. 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, 10V input is represented with 15 bits of data. The input resolution is 0.305mV/count.

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

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

The following table shows the A/D output value for several input signals.

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

6 Analog Outputs

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

Refer to the appropriate software manual for information on using the SCADAPack LP Analog Outputs in application programs. For TelePACE applications refer to the Register Assignment for SCADAPack LP I/O module and for ISaGRAF applications refer to the I/O Complex Equipment for SCADAPack LP I/O.

6.1 Current Outputs

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

The internal power supply powers the analog output circuits. The user can, under program control, boost the DC Input Power to 24V. This is required when generating current outputs into high resistance loads. Refer to section ***4.2.3-12V to 24V DC/DC Converter Control*** for further information.

Figure 5: Analog Output Wiring shows example wiring of the analog outputs.

6.2 Voltage Outputs

To obtain voltage outputs, connect a load resistor in the current output. Connect the voltage device across the load resistor. The table below list 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 to 5V	250Ω	0-20mA
0 to 10V	500Ω	0-20mA

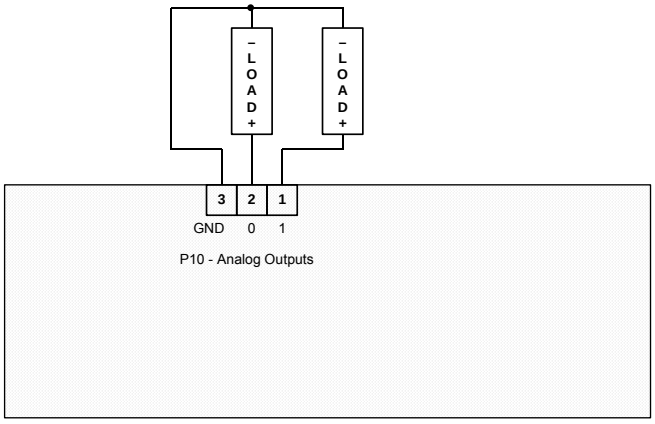


Figure 5: Analog Output Wiring

6.3 Analog Outputs Data Format

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

D/A Value	Current
0	0mA
8	4.88µA
6552	4mA
16384	10mA
24576	15mA
32760	19.995mA

7 Digital Outputs

The SCADAPack LP I/O Module 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 controller terminal block P3. The positive side of the load connects to a power supply. When the load is on the load current is switched through the controller to terminal labeled GND. GND must be connected to the negative side of the power supply.

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

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

Refer to the appropriate software manual for information on using the SCADAPack LP Digital Inputs and Outputs in application programs. For TelePACE applications refer to the Register Assignment for SCADAPack LP I/O module and for ISaGRAF applications refer to the I/O Complex Equipment for SCADAPack LP I/O.

The following table describes the SCADAPack LP 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	Not used for applications, internal use only.
9	internal	com3 (HMI) power control 0 = off 1 = on See section ***4.2.1-COM3 Serial Port Power Control*** for details.
10	internal	VLOOP power control 0 = off 1 = on See section ***4.2.2- VLOOP Power Control*** for details.
11	internal	DC/DC converter control 0 = off 1 = on See section ***4.2.3-12V to 24V DC/DC Converter Control*** for details.

8 Digital Inputs

The SCADAPack LP I/O Module provides eight universal digital inputs and outputs. The inputs are for use with dry contacts such as switches and relay contacts. The SCADAPack LP provides the wetting current for the contacts.

If LED power is enabled, the SCADAPack LP continuously sources approximately 5mA 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 LP. Power consumption is reduced as the inputs are scanned only once every millisecond. Indicator LEDs are dim in this condition. This is normal.

Refer to the appropriate software manual for information on using the SCADAPack LP Digital Inputs and Outputs in application programs. For TelePACE applications refer to the Register Assignment for SCADAPack LP I/O module and for ISaGRAF applications refer to the I/O Complex Equipment for SCADAPack LP I/O.

The SCADAPack LP I/O Module 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	Not for use in applications. Internal use only.
9	internal	Com3 (HMI) power output status 0 = off 1 = on See section ***4.2.1-COM3 Serial Port Power Control*** for details.
10	internal	VLOOP output status 0 = off 1 = on See section ***4.2.2- VLOOP Power Control*** for details.
11	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 ***4.2.3-12V to 24V DC/DC Converter Control*** for details.
12	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 ***4.2.2.1-VLOOP Over-Current Protection*** section for details.
13	internal	Digital output mismatch Known outputs are compared to the corresponding inputs to

Input	Type	Description
		detect incorrect outputs. A point is compared if it has been turned on at any time since controller 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
14	internal	If the SCADAPack Vision power key is pressed while DO 9 is off, digital input bit 14 will be set. DI 14 is cleared 5 minutes after the power key is pressed or immediately upon DO 9 turning on. See section ***4.2.1-COM3 Serial Port Power Control*** for details.
15	internal	reserved for future use

8.1 Digital I/O Connection Examples

Various I/O point wiring examples are shown in ***Figure 6: Digital Input/Output Wiring.*** Digital I/O point 0 is shown connected to a 12V load that uses the same 12V power supply that powers the SCADAPack LP. Digital I/O point 4 is shown connected to a 24V load and external 24V-power supply. Digital I/O point 2 is shown monitoring a dry contact. Digital I/O point 5 is shown monitoring an open collector contact. Transient voltage suppression is included on each I/O point.

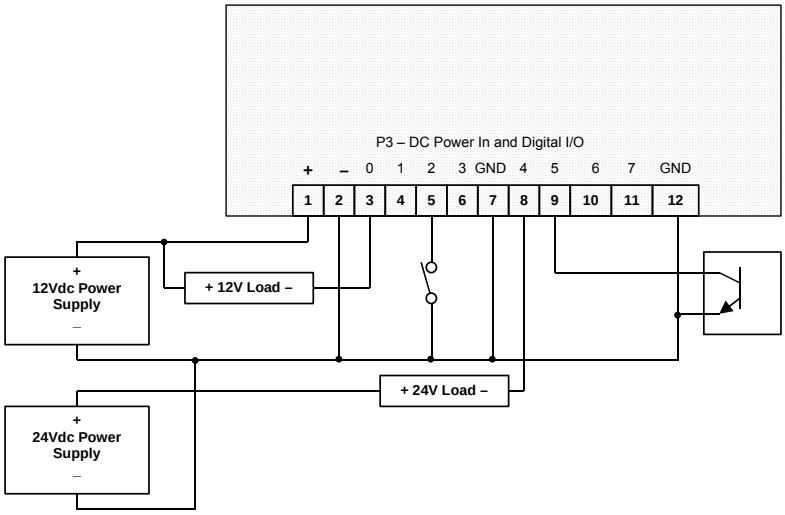


Figure 6: Digital Input/Output Wiring

9 Counter Inputs

The SCADAPack LP has three counter inputs, identified as Counter 0, 1 and 2. Two of the counter inputs, Counter 1 and 2, are designed for millivolt level turbine meters. The third, Counter 0, is a high level digital input for use with open collector/drain output amplifiers.

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

- For TelePACE applications refer to the Register Assignment for SCADAPack LP I/O module and
- For ISaGRAF applications refer to the I/O Complex Equipment for SCADAPack LP I/O.
- For C applications use the readCounter function.

9.1 Counter Input 0

Counter Input 0 is used to count contact closures. The input circuitry includes a 1000-ohm resistor from the counter input to the 5V power supply. Refer to ***Figure 7: Counter Input Wiring*** for an example of wiring to an open collector output.

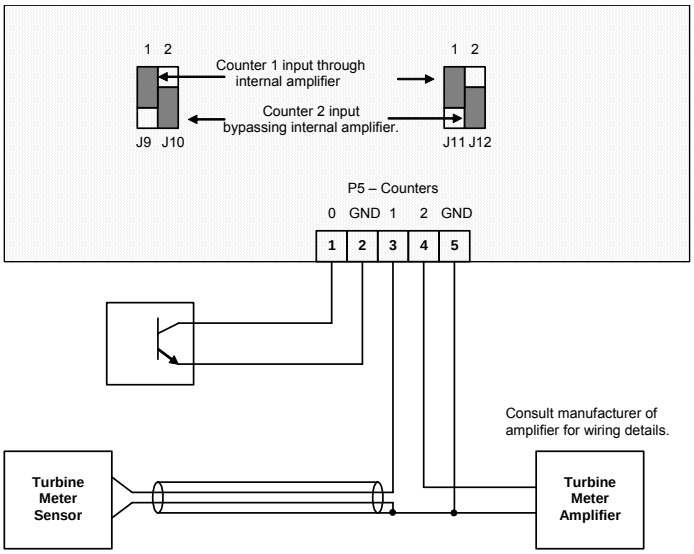


Figure 7: Counter Input Wiring

9.2 Turbine Meter Counter Inputs 1 and 2

The SCADAPack LP allows for the direct connection of two turbine meter sensors. These sensors produce millivolt outputs and do not require an external pre-amplifier when used with the SCADAPack LP. The turbine meter inputs should be used in low noise environments with shielded cabling.

There are four jumper links associated with configuring the inputs for either millivolt signals (direct to sensor) or high level signals such as external amplifiers, dry contacts or open collector outputs. Refer to ***Figure 7: Counter Input Wiring*** for examples of how to configure the jumper links and wire the inputs. Counter 1 is shown as a millivolt input with a direct connection to a turbine meter

sensor. Note the use of shielded wiring and that the shield is connected at one end only. Counter 2 is shown connected to an external turbine meter pre-amplifier.

When connecting to a turbine meter amplifier the manufacturer may have a specific current requirement to power the pre-amplifier. The SCADAPack LP includes a 1000-ohm resistor from the counter input to the DC input power source. This is the recommended wiring for a Halliburton Low Power Pre-Amp when the SCADAPack LP is powered from 12V. If this resistor is not suitable for your external amplifier then do not connect the jumper in either position. On Counter 1, the J11 jumper would be removed. On Counter 2, the J12 jumper would be removed. Wire the amplifier as per the manufacturers recommendations.

Counter Inputs 1 and 2 can be used with conventional sources such as open collector transistors and contacts. The SCADAPack LP includes a 1000-ohm resistor from the counter input to the DC input power source. This resistor can be used when the SCADAPack LP is powered from 12V. On Counter 1, J11 would be in the External Amplifier or bottom position. On Counter 2, J12 would be in the External Amplifier or bottom position. If a higher voltage is used or a pullup current other than 12V at 1000-ohms is required then the user must wire an external resistor to an appropriate power source. On Counter 1, the J11 jumper would be removed. On Counter 2, the J12 jumper would be removed.

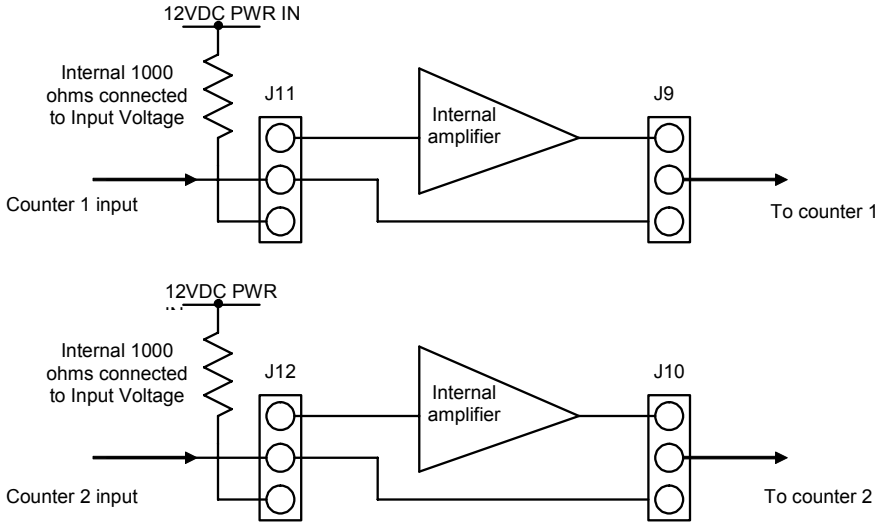


Figure 8: Counter Jumpers

10 Serial Communication

The SCADAPack LP controller is equipped with three serial communication ports. Two of the serial communication ports support RS-232 serial communication and one port supports RS-485 serial communication.

Serial ports on the SCADAPack LP controller are designated COM1, COM2 and COM3. Refer to ***Figure 2: SCADAPack LP Board Layout*** for the location of the serial ports.

10.1 RS-232 Serial Communications Ports

The two RS-232 serial ports are designated COM2 and COM3.

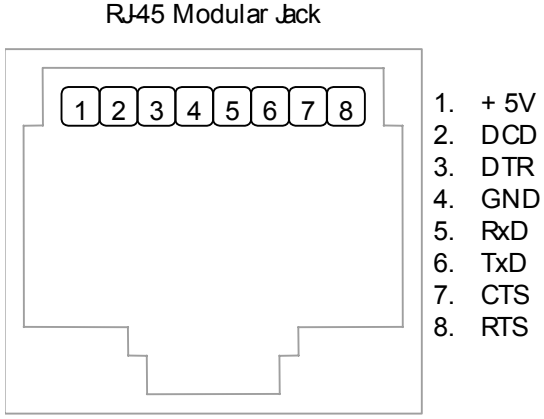
All RS-232 wiring must use shielded cable. The shield should be connected to chassis ground at one point. Failure to properly shield the cable may result in the installation not complying with FCC or DOC radio interference regulations.

10.1.1 COM2 RS-232 Serial Port

The following table shows the serial and protocol communication parameters supported by COM2. These parameters are set from TelePACE, ISaGRAF Workbench or from an application program running in the SCADAPack LP controller. Default values are set when a Cold Boot or Service Boot is performed on the SCADAPack LP controller.

Parameter	Supported Values
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200 and 38400 Default: 9600
Duplex	Full or Half Default: Full
Parity	Odd, None or Even Default: None
Data Bits	7 or 8 Bits Default: 8 Bits
Stop Bits	1 or 2 Bits Default: 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 or Modbus ASCII 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 5V power. The following diagram shows the pin connections for the RS-232 (RJ-45) port connector for COM2.



NOTES:

- +5V is only available on Pin 1 when a jumper is installed on J13. Refer to the ***Figure 2: SCADAPack LP Board Layout*** for the location of J13.
- The low power transmitters used in COM2 generate 0 to 5V levels. This is less than the RS-232 specification but still compatible with all RS-232 receivers. Cables should be limited to a maximum of 10 ft (3m).

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 0V.

Pin	Function	Description
1	5V (Output)	This pin can be connected to the 5V power supply by installing a jumper at J13 on the SCADAPack LP.
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 controller keeps the line at a MARK. When the attached device does provide this signal, it must set CTS to MARK to allow the controller to transmit data.
8	RTS (Output)	This pin is a MARK if full-duplex operation is selected for the port. This pin is set to a MARK just before and during transmission of data if half-duplex operation is selected.

Pin	Function	Description
		This pin is set to a SPACE when no data is being transmitted. The LED is ON for a MARK level.

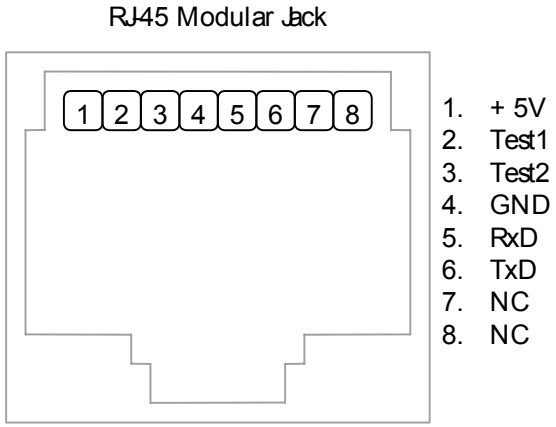
10.1.2 COM3 RS-232 Serial Port

The following table shows the serial and protocol communication parameters supported by COM3. These parameters are set from TelePACE, ISaGRAF Workbench or from an application program running in the SCADAPack LP controller. Default values are set when a Cold Boot or Service Boot is performed on the SCADAPack LP controller.

Parameter	Supported Values
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400, 57600 and 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 or 2 Bits Default: 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 or Modbus ASCII Default: Modbus RTU
Addressing Mode	Standard or Extended Default: Standard

Connections to COM3 are made through a RJ-45 modular connector. COM3 supports RxD and TxD plus Ground and 5V power. The following diagram shows the pin connections for the RS-232 (RJ-45) port connector for COM3.

The SCADAPack LP COM3 is designed to operate with the SCADAPack Vision operator interface and has several special features noted below.



NOTES:

- +5V is available on Pin 1 when turned on by the user under program control, when the SCADAPack LP detects the contact closure of the ON switch of the SCADAPack Vision or when the LED Power is ON.
- The SCADAPack Vision ON switch is wired to Pins 2 and 3. It is important that when a SCADAPack Vision is not used that only the TxD, RxD and GND pins are used.
- The low power transmitters used in COM3 generate 0 to 5V levels. This is less than the RS-232 specification but still compatible with all RS-232 receivers. Cables should be limited to a maximum of 10 ft (3m).

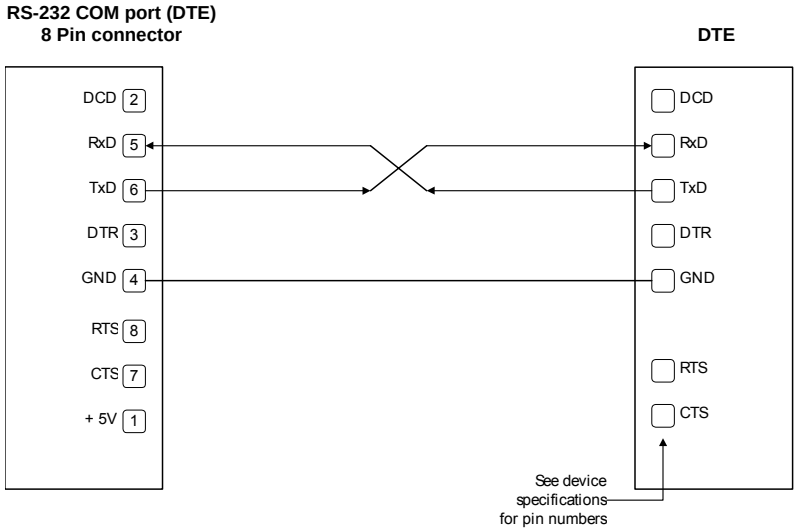
The following table provides a description of the function of each pin of the RJ-45 connector. In this table a MARK level is a voltage of +3V or greater and a SPACE level is a voltage of 0V.

Pin	Function	Description
1	5V (Output)	+5V power for the SCADAPack Vision.
2	Test1 (Input)	Used to detect SCADAPack Vision ON switch closure.
3	Test2 (Output)	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	NC	No connection.
8	NC	No connection.

10.2 RS-232 Wiring Examples

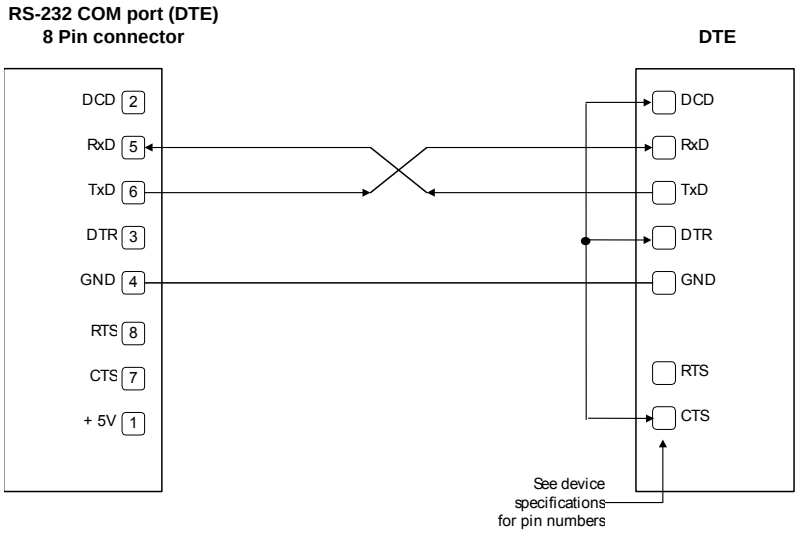
10.2.1 DTE to DTE without Handshaking

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.



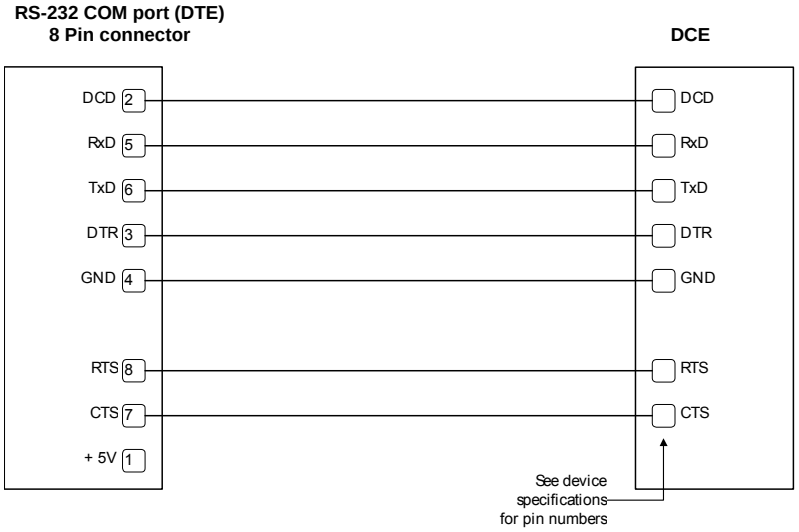
10.2.2 DTE to DTE with Handshaking

Some DTE devices may require hardware handshaking lines. The most common are the CTS and RTS lines. Less common are the DTR and DCD lines. The controller 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.



10.2.3 DTE to DCE with Handshaking

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



10.3 RS-232 Cables

10.3.1 RJ-45 to DE-9S DTE

This cable is used to connect from an RJ-45 based RS-232 port on the SCADAPack controller to DE-9P connector on a DTE such as a PC. A 10 ft. long cable is available from Control Microsystems as part number 297217.

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

10.3.2 RJ-45 to SCADAPack Vision

This cable is used to connect from an RJ-45 based RS-232 port on the SCADAPack LP controller to DE-9P connector on a SCADAPack Vision. A 5-ft. long cable is available from Control Microsystems as part number 297237.

RJ-45 8 Pins	SCADAPack LP Function	SCADAPack Vision Function	DE9S
			Shield connects to shell
6	TxD	RxD	2
5	RxD	TxD	3
4	GND	GND	5
3	Test 2	ON switch	1
2	Test 1	ON switch	4
1	+5V Out	+5V In	9

RJ-45 8 Pins	SCADAPack LP Function	SCADAPack Vision Function	DE9S
7 and 8 are not connected at this end.			Wires not connected at this end.

10.3.3 RJ-45 to DE-9P DCE

This cable is used to connect from an RJ-45 based RS-232 port on the SCADAPack controller to DE-9S connector on a DCE such as a modem. A 15-inch long cable is available from Control Microsystems as part number 297218.

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

10.4 COM1 RS-485 Serial Communication Port

Serial port COM1 on the SCADAPack LP controller 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, ISaGRAF Workbench or from an application program running in the SCADAPack LP controller. Default values are set when a Cold Boot or Service Boot is performed on the SCADAPack LP controller.

Parameter	Supported Values
Baud Rate	300, 600, 1200, 2400, 4800, 9600, 19200 and 38400 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 or 2 Bits 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

Parameter	Supported Values
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 4000 feet or 1200 meters. Termination resistors are required when using long cable lengths and high baud rates. Refer to section ***10.4.2-RS-485 Termination Resistors*** for information on termination resistors.

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 must be within several volts of each other. The SCADAPack LP ground is connected to the chassis.

10.4.1 RS-485 Bias Resistors

The RS-485 receiver inputs on the SCADAPack LP controller are biased to ensure 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 input and 5100 ohms from +5V to the A input.

10.4.2 RS-485 Termination Resistors

Termination resistors are required in long networks operating at the highest baud rates. Shorter networks in high noise environments may also benefit from terminations. Networks as long 1000 ft. operating at 9600 baud will function without termination resistors. Terminations should be considered if the baud rate is higher and the network is longer.

When termination resistors are required, they are installed on the first and last station on the RS-485 wire pair. All other stations should not have termination resistors.

RS-485 networks are generally terminated with 120-ohm resistors on each end. The required 120-ohm resistor must be supplied and installed by the user. When using termination resistors it is necessary to increase the line biasing by adding lower value bias resistors in order to generate at least 0.2V across RS-485 line. The suggested value of the bias resistors is 470 ohms. One bias resistor is installed from P5 terminal 7 (B) to P5 terminal 8 (COM). The second bias resistor is installed from P5 terminal 6 (A) to +5V. +5V is available on P7 pin 1 when J13 is installed.

10.5 RS-485 Wiring Examples

A typical RS-485 wiring example is shown below. COM1 is shown connected to a multivariable transmitter such as the Rosemount 3095. The power for the transmitter can come from the SCADAPack LP power input source or can be obtained from the 24V Vloop output for possible power savings.

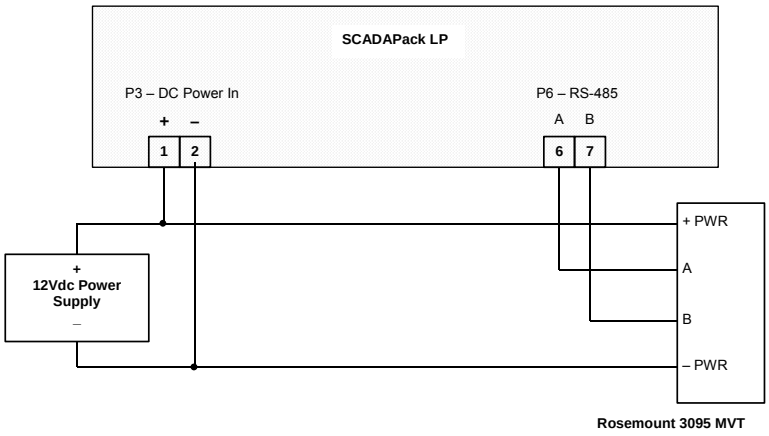


Figure 9: RS-485 Wiring

11 Operation

11.1 Operating Modes

SCADAPack LP Controllers may start up in RUN, SERVICE or COLD BOOT mode. Start up in the RUN mode automatically executes TelePACE Ladder Logic and TelePACE C programs in the controller memory. Start up in the SERVICE mode stops the programs to allow reprogramming and controller initialization. Start up in the COLD BOOT mode initializes the controller and erases all programs.

11.1.1 Run Mode

The RUN mode is the normal operating mode of the SCADAPack LP Controller. No action is required to select RUN mode. When power is applied to the controller board:

- The user defined serial communication parameters, for all COM ports are used.
- If a TelePACE Ladder Logic or ISaGRAF application program is loaded in RAM, it is executed.
- If a TelePACE or ISaGRAF C application program is loaded in RAM and the program checksum is correct, it is 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 controller lock settings and password are used.

11.1.2 Service Mode

SERVICE mode is used during application programming and maintenance work. When the SCADAPack LP controller starts in SERVICE mode:

- The default serial communication parameters are used (see section ***10-Serial Communication*** for a description of the default parameters).
- The TelePACE Ladder Logic or ISaGRAF program is stopped.
- The C program is stopped.
- All programs are retained in non-volatile memory.
- The controller lock settings and password are used.

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

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

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

11.1.3 Cold Boot Mode

COLD BOOT mode is used after installing new controller firmware. When the SCADAPack LP controller starts in COLD BOOT mode:

- The default serial communication parameters are used (see section ***10-Serial Communication*** for a description of the default parameters).
- The TelePACE Ladder Logic or ISaGRAF 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 controller is unlocked.

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

1. Remove power from the SCADAPack controller.
2. Hold down the LED POWER button.
3. Apply power to the SCADAPack controller.
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.

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

11.1.4 Sleep Mode

All SCADAPack LP Controllers are capable of extremely low power operation when in sleep mode. The user's TelePACE or ISaGRAF application program can enable and disable sleep mode by using the SLP or SLEEP functions respectively. During sleep mode the following happen:

- All programs stop executing.
- The 5V power to most of the circuit of the controller is switched off.
- The 5V power to the I/O bus is switched off.
- The three counter inputs on the controller board continue to function.
- The real-time clock and alarm continue to function.
- 24V DC power is not affected.

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

1. Hardware RESET caused by power removed and applied to the controller.
2. The LED POWER push-button is pressed.
3. A real time clock alarm, defined by application program, occurs.
4. Any of the controller board counters roll over. This occurs every 65536 pulses on each input.
5. A change in state of any of the Digital Inputs.
6. The COM3 Test1 to Test2 pins are connected together indicating the SCADAPack Vision is to be turned on.

11.2 LED Indicators

There are 23 LEDs on SCADAPack LP. All 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. Blinks once per second when the LEDs are disabled. Blinks once every two seconds when in Sleep Mode.
RUN	On when the ladder logic program is executing.
STAT	Blinking when an error exists.
FORCE	On when I/O points are forced.
RX	On when receiving data on the corresponding serial port.
TX	On when transmitting data on the corresponding serial port.
CTS	On when the CTS input is asserted 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.

11.3 LED Power Control

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

The Power Mode LED on the controller board indicates the LED power state. It is on when the controller board 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 all power saving modes are disabled. The 24V power supply boost is on and Vloop power is turned ON. The SCADAPack Vision operator interface is powered on as a result of 5V being available on COM3.

11.4 Jumpers

Most headers on the SCADAPack LP are user configurable and are described in the appropriate sections of this manual. Some headers and jumpers on the SCADAPack LP are reserved for manufacturing and test functions. Refer to ***Figure 2: SCADAPack LP Board Layout*** for the location of all jumpers.

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

Jumper	Function
J1	Analog Input 0 Range ***Figure 4: Analog Input Wiring***
J2	Analog Input 1 Range ***Figure 4: Analog Input Wiring***
J3	Analog Input 2 Range ***Figure 4: Analog Input Wiring***
J4	Analog Input 3 Range ***Figure 4: Analog Input Wiring***

J5	Analog Input 4 Range ***Figure 4: Analog Input Wiring***
J8	
J9	Counter Input 1 Type ***Figure 7: Counter Input Wiring***
J10	Counter Input 2 Type ***Figure 7: Counter Input Wiring***
J11	Counter Input 1 Type ***Figure 7: Counter Input Wiring***
J12	Counter Input 2 Type ***Figure 7: Counter Input Wiring***
J13	COM2 5 Volts on Pin 1 ***10.1.1-COM2 RS-232 Serial Port***

11.5 Status LED

The STAT LED indicates an alarm condition. The STAT LED blinks when an alarm occurs. The STAT LED turns off when all alarms clear.

The STAT LED blinks a binary sequence indicating alarm 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, all leading zeros are ignored. The application program defines the values of the alarm 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

11.5.1 I/O Module Error Indication

When the Status LED flashes the controller status code 1 (i.e. a long flash, once every second), there is a communication failure with one or more I/O module. To correct the problem, do one of the following:

1. Ensure that every module contained in the Register Assignment Table is connected to the controller. Check that the module address selected for each module agrees with the selection made in the Register Assignment Table.
2. If a module is still suspect of having failed, confirm the failure by removing the module from the Register Assignment Table. Download the changes to the controller. The Status LED should stop flashing.
3. If a module is currently not connected to the controller, delete it from the Register Assignment Table. Download the changes to the controller. The Status LED should stop flashing.
4. If unused modules must be intentionally left in the Register Assignment Table, the I/O error indication may be disabled from a selection box on the Register Assignment dialog.

11.5.2 Register Assignment Checksum Error

When the status LED flashes the controller status code 2 (i.e. a short flash then a long flash followed by a 1 second of delay), this indicates the register assignment is not valid. To correct this problem, initialize the register assignment from the TelePACE software, or alternatively, perform a COLD BOOT as described in section ***11.1.3-Cold Boot Mode*** of this manual. The status LED should stop flashing.

12 Maintenance

The SCADAPack LP controller requires little maintenance. The Power Mode LED indicates the status of the 5V supply. If the LED is off, the on board fuse F1 may require replacing. If the program is lost during power outages, the lithium battery may require replacement.

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

If the SCADAPack LP Controller is not functioning correctly, contact Control Microsystems Technical Support for information on returning the SCADAPack Controller for repair.

WARNING:	Do not connect or disconnect any field wiring, including the wiring to the RS-232 ports, unless the power is off or the area is know to be non-hazardous.

12.1 Fuses

A single 1.0 Amp fast-blow fuses protects the power supply. The fuse is mounted under the cover. Refer to ***Figure 2: SCADAPack LP Board Layout*** for the location.

CAUTION:	Remove power before servicing unit.

Always replace a defective 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.

The fuse is a Littelfuse Nano-SMF. Littelfuse part number LF R451 001. This fuse is available from Control Microsystems.

In all cases investigate and correct the cause of the fuse failure before replacement. Common causes of fuse failure are short circuits and excessive input voltages.

12.2 Lithium Battery

A small lithium battery powers the CMOS memory and real-time clock when input power is removed. The voltage of a functioning battery should be greater than 3.0V. An application program can monitor this voltage. Refer to the programming manual for details.

The battery should not require replacement under normal conditions. The shelf life of the battery is 10 years. The battery is rated to maintain the real-time clock and RAM data for two years with the power off. Accidental shorting or extreme temperatures may damage the battery.

12.2.1 Battery Replacement Procedure

The battery is plugged into the circuit board and secured with a tie-wrap. If necessary it can be replaced with an identical battery available from Control Microsystems.

1. Save the existing program running in the SCADAPack, if applicable.
2. Remove power from the SCADAPack.
3. Remove the SCADAPack top cover and locate the battery. It is found at the far right side of the circuit board.
4. The battery tie wrapped in place at the factory. This is to ensure the battery does not become disconnected during shipment. Cut the tie wrap using wire cutters.
5. Remove the battery by gently lifting it straight up from the circuit board. The battery has two pins that mate with two sockets on the circuit board.
6. Replace the battery. A replacement tie wrap is not necessary.

7. Cold boot the controller. (Refer to section ***11.1.3-Cold Boot Mode*** in of this manual for the Cold Boot procedure.)
   Warning: If a cold boot is not done the behavior of the controller is unpredictable.
8. The controller may now be programmed.

13 Troubleshooting

13.1 Analog Inputs

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

13.2 Analog Outputs

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

13.3 Digital Inputs

Problem	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 normal operation when the controller is in low power mode or sleep mode.

13.4 Digital Outputs

Problem	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.

Problem	Action
Output LED and output are off when they should be on.	Check that the output is not forced off.
The LED is dim.	This normal operation when the controller is in sleep mode.

13.5 Counter Inputs

Problem	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.
The LED is dim.	This normal operation when the controller is in low power mode or sleep mode.

14 Specifications

***Disclaimer**: Control Microsystems reserves the right to change product specifications without notice. For more information visit www.controlmicrosystems.com .*

14.1 General

I/O Terminations	8 and 10 pole, removable terminal blocks. 12 to 22 AWG 15A contacts
Dimensions	8.40 inch (213mm) wide 5.00 inch (127 mm) high 1.80 inch (45mm) deep
Packaging	Corrosion resistant zinc plated steel with black enamel paint
Environment	5% RH to 95% RH, non-condensing –40°C to 70°C –40°F to 158°F

14.2 Controller

Processors	16-bit CMOS microcontroller, 14.74MHz clock integrated watchdog timer microcontroller co-processor, 14.74MHz clock
Memory	1MBytes CMOS RAM 512kBytes flash ROM 1kBytes EEPROM
Non-volatile RAM	CMOS RAM with lithium battery retains contents for 2 years with no power
Clock calendar	±1 minute/month at 25°C +1/–3 minutes/month 0 to 50°C
Internal temperature	Measurement range -40°C to 75°C. Accuracy ±5°C. Measurement range -40°F to 167°F. Accuracy ±9°F.
Lithium battery monitor	Accuracy ±0.2V.

14.3 Communications

Communication Port COM1	RS-485 serial port removable terminal block 2 wire half duplex Bias resistors installed.
Communication Port COM2	RS-232 compatible serial port (CMOS) Data Terminal Equipment (DTE) 8 pin modular jack Full or half duplex with RTS/CTS control Implemented Td, Rd, CTS, RTS, DCD, DTR, 5V power with jumper link.

Communication Port COM3	RS-232 compatible serial port (CMOS) Data Terminal Equipment (DTE) 8 pin modular jack Half duplex Implemented Td, Rd, and 5V power under program control. Intended for use with SCADAPack Vision operator interface.
Baud Rates (COM1, COM2)	300, 600, 1200, 2400, 4800, 9600, 19200, 38400
Baud Rate (COM3)	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Parity	none, even, or odd
Word Length	7 or 8 bits
Stop Bits	1 or 2 bits
Transient Protection	COM1, COM2: 2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Common ground return connected to Chassis Ground.
Cable Length	RS-232 –maximum 10 ft (3 m) RS-485 –maximum 4000 ft (1200 m)
Protocol	TeleBUS (compatible with Modbus RTU and Modbus ASCII)
Protocol Modes	Slave, master, master/slave, store and forward

14.4 Visual Indicators

COM1	received data	(Rx) LED
	transmitted data	(Tx) LED
COM2	received data	(Rx) LED
	transmitted data	(Tx) LED
	clear to send	(CTS) LED
	data carrier detect	(DCD) LED
COM3	received data	(Rx) LED
	transmitted data	(Tx) LED
Status	Power Mode LED	
	Run LED	
	Status LED (shows functional status)	
	Forced I/O LED	
Digital Inputs / Outputs	8 LEDs	
Counters	3 LEDs	
Push-button	LED power toggle	

14.5 Power Supply

DC power Input	30V maximum 10.0 to 11.5V turn on 9.5V typical turn off

	Typically 125mW (at 12V) during sleep mode. Typically 360mW (at 12V) during normal operation. LEDs off, no expansion. 6.5W maximum.
Output capacity	5V at 0.4A capacity 5V at 55mA required by 5207 controller 5V at 0.35A (current limited) on COM2 and the I/O expansion 5V at 0.25A (current limited) on COM3 Vloop: 24V at 0.14A available for the 5 analog inputs and 2 optional analog outputs
Efficiency	85%, 12Vdc input, full load

14.6 I/O Capacity

5000 Series I/O Expansion Capacity	Maximum 40 I/O modules with a further limitation of 16 modules of any one type. 512 digital outputs using 32 point digital output modules 512 digital inputs using 32 point digital input modules 128 analog inputs using 8 point analog input modules 64 analog outputs using 4 point analog output modules 32 counter inputs using 4 point counter input modules Example: 16 of the 32 point digital output modules + 16 of the 32 point digital input modules + 8 of the 8 point analog input modules would yield an expansion of 1088 I/O points.

14.7 Analog Inputs

Input Points	5 at 10V/20mA: 250Ω resistance user configurable with jumper link. 1 at 32.768V
Resolution	15 bits over the 10V and 32.768V measurement range. 14 bits over the 20mA measurement range.
Input Resistance	20kΩ for 10V inputs 60kΩ for 32.768V inputs 250Ω for 20mA inputs
Converter type	16 bit successive approximation
Accuracy	±0.1% of full scale at 25°C (77ºF) ±0.2% over temperature range
Type	single ended
Calibration	Calibration constants stored in on board microcontroller EEPROM.
Normal mode rejection	27 dB at 60 Hz.
Over-scale Input Capacity (without damage)	10V/20mA inputs clamped at 12V. Transient: 2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989

Isolation	Analog common side connected to Chassis Ground.
Response Time	100ms typical for 10% to 90% signal change

14.8 Analog Outputs

Output Points	2 (when optional 5305 analog outputs installed)
Output Signal Range	0-20mA
Maximum Load Resistance	925Ω with 24Vdcinput voltage or when internal 24V power supply is on. 375Ω with 12Vdc input voltage 250Ω with input voltage at power supply turnoff
Output Type	Single ended regulation on positive side with common negative return
Isolation	Analog common side connected to Chassis Ground.
Resolution	12 bits
Accuracy	Specified from 0.5-20mA ±0.15% of full scale at 25°C (77°F) ±0.25% of full scale over temperature range
Noise and Ripple	0.04% maximum
Transient Protection	Transient: 2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Response Time	0.5ms to 2ms for 10% to 90% signal change
Power Requirements	24V boost power supply off: Vin X output current. 24V boost power supply on: 27 X output current.

14.9 Counter Inputs

Counter Inputs	Counter 0 Digital Input Counter Counter 1 Turbine Meter inputs Counter 2 Turbine Meter inputs
Digital Input Counter 0	Maximum frequency 10Hz. Dry contact input. Wetting current typically 5mA. Contact closure to ground is ON. Open input is OFF.
Counter 1 and 2	Designed for use with low voltage, turbine meter outputs. Jumper link selectable for use with turbine meter amplifiers or dry contact closure.
Counter 1 and 2 Turbine Meter Sensitivity	Minimum input 30mVp-p at 5-50Hz. Minimum input 150mVp-p at 150Hz. Minimum input 650mVp-p at 5kHz. Minimum input 750mVp-p at 10kHz. Maximum input 4Vp-p using internal amplifier.
Counter 1 and 2 Dry Contact	Maximum input 10Vp-p without internal amplifier. Maximum frequency 10KHz.

Transient Protection	2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Common ground return connected to Chassis Ground.

14.10 Digital Inputs/Outputs

I/O points	8 points Each point is an input and an output
Output Rating	1.0A maximum 0.35V maximum drop at 1.0A 0.05V maximum drop at 0.1A Open drain sinking when ON. 28V maximum when OFF.
Input Rating	Dry contact input. Wetting current typically 5mA, pulsed. Contact closure to ground is ON. Open input is OFF.
Digital Input Thresholds	0.9V typical turn on input voltage. Less than 0.4V guaranteed turn on input voltage. 1.5V typical turn off input voltage. Greater than 2.2V guaranteed turn off input voltage.
Contact Resistance	ON input requires less than 100Ω contact resistance. OFF input requires greater than 50kΩ contact resistance. Cable contact capacitance not to exceed 0.033uF, typically 1600ft (500m).
Transient Protection	2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Common ground return connected to Chassis Ground.

15 Approvals and Certifications

Safety	Non-Incendive Electrical Equipment for Use in Class I, Division 2 Groups A, B, C and D Hazardous Locations.
Digital Emissions	FCC Part 15, Subpart B, Class A Verification EN50081-2: 1993 Electromagnetic Compatibility Generic Emission Standard Part2: Industrial Environment
Immunity	EN61000-6-2: 1999 Electromagnetic Compatibility Generic Standards Immunity for Industrial Environments
Declaration	This product conforms to the above Emissions and Immunity Standards and therefore conforms with the requirements of Council Directive 89/336/EEC (as amended) relating to electromagnetic compatibility and is eligible to bear the CE mark. The Low Voltage Directive is not applicable to this product.