5604 Input/Output (I/O) Module

Installation, Operation and Maintenance Setup Manual

5/19/2011

Schneider Electric

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

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed. Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Safety Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, 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 an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠WARNING

WARNING indicates a potentially 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.

CAUTION

CAUTION used without the safety alert symbol, indicates a potentially

hazardous situation which, if not avoided, **can result** in equipment damage..

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.

⚠ CAUTION

EQUIPMENT OPERATION HAZARD

Verify that all installation and set up procedures have been completed.

Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.

Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in injury or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

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 prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove ground from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

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 prevent unauthorized changes in operating characteristics.

About The Book

At a Glance

Document Scope

This manual describes the 5604 Input/Output Module.

Validity Notes

This document is valid for all versions of the 5604 Input/Output module.

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, serious injury or equipment damage.

User Comments

We welcome your comments about this document. You can reach us by e-mail at technicalsupport@controlmicrosystems.com.

Overview

The 5604 I/O module is an integrated component of a SCADAPack controller and not available as a standalone unit. The following controllers support the 5604 I/O module:

- **SCADAPack P1A** A 520x controller board with an integrated 5604 I/O Module.
- SCADAPack P4A A 5232 controller board with an integrated 5604 I/O module.

The 5604 I/O module increases the I/O and communication capacity of a SCADAPack controller by providing 9 single ended analog inputs, 32 digital inputs/outputs, two analog outputs (optional) and one RS-232 serial communication port. This I/O module also has a 12V to 24V boost converter power supply capable of generating 24V at 0.25A for up to twelve 20mA transmitters or loads. This I/O module is not available as a standalone unit.

The analog inputs can be configured for current or voltage mode with a measurement ranges of 0-20mA or 0-10V respectively. Analog inputs can also be configured with a 20% offset in the measuring range. In current mode, a 250Ω current sense resistor appears across each analog input channel. The 250Ω resistor produces a voltage drop of 5V for a 20mA of current flow. Analog input channels are transient suppressed, optically isolated from the main logic supply and share a common return (COM) that is connected to the chassis.

This I/O module uses a 16-bit successive approximation A/D converter and provides 15 bit resolution over the range of the analog input. Analog Input 8 is a 0 to 32.768-volt input that measures with 10-bit resolution and can be used to monitor a power supply or battery voltage. There is one internal analog input that is used in application programs to monitor the DC/DC converter voltage used for VLOOP.

The 5604 I/O module can be equipped with an optional 5305 Analog Output Module that provides two 20mA outputs through a 12-bit D/A converter. The analog outputs are transient and over voltage suppressed. The output channels share a common return (GND) and with the analog input channels.

32 universal digital inputs/outputs are provided onboard this I/O module. Each digital I/O point can be used as an input or an output only. The inputs can be used to monitor the status of that output. In addition to the

32 universal digital input/outputs there are 3 internal digital inputs and 2 internal digital outputs that are used to monitor and control a DC/DC converter or VLOOP power supply as well as to monitor digital output mismatch status.

The inputs are for use with dry contacts such as switches, open collector transistors and relay contacts. Wetting current for the contacts is provided. GND terminals on the I/O module are connected internally to the SCADAPack chassis.

Outputs are open-collector/open drain type for use with sustained DC loads of up to 1 ampere. Loads with high in-rush currents may exceed the 1A rating. The output circuit will tolerate these higher peak currents. 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.

This manual covers the powering, wiring and configuration of a 5604 I/O module only. It is meant to be used with the hardware manual of the respective controller board to which the I/O module is attached.

Field Wiring Connectors

For ATEX and IECx applications only:

This equipment is to be installed in an enclosure certified for use, providing a degree of protection of IP54 or better. The free internal volume of the enclosure must be dimensioned in order to keep the temperature rating. A T4 rating is acceptable.

The 5604 I/O modules use screw termination style connectors for termination of field wiring. These connectors accommodate solid or stranded wires from 12 to 22 AWG.

Remove power before servicing unit.

The 5604 I/O module has seven connectors for field wiring. Refer to ***Figure 1: 5604 I/O Module Layout*** for connector locations.

- Primary power input connections, VLOOP output power connection and optional analog output connections are wired to a six-pole connector labeled P3. Refer to section ***Power Supply*** for details on wiring the power supply.
- The nine analog inputs are wired to a ten-pole connector labeled P4. Refer to section ***Analog Inputs*** for details on wiring analog input signals.
- The digital inputs and outputs are wired to four ten-pole connectors labeled P6, P7, P8 and P9. Refer to section ***Digital I/O*** for details on wiring digital input/output signals.
- The 5604 I/O Module has one RS-232 serial communication port that is wired to a black 8 pin modular RJ-45 connector labeled P5. Refer to section ***Serial Communication*** for details.

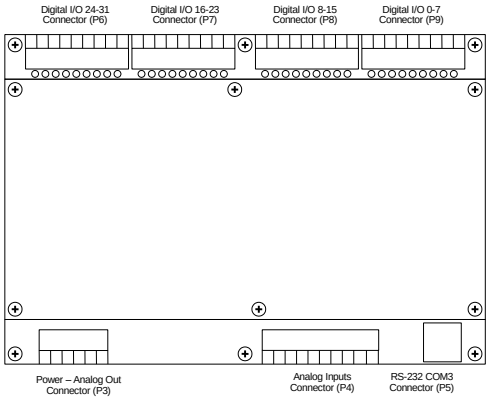

Figure 1: 5604 I/O Module Layout

Power Supply

Overview and Requirements

The 5604 I/O module requires 11-24Vdc applied to the AC/DC PWR IN terminals on connector P3 of the I/O board to power the analog input and optional analog output circuitry.

The current requirement of the analog portion (input and optional output circuitry) on the 5604 I/O board can vary from a minimum of 10mA for basic operation of the analog circuitry to a maximum of 550mA if every analog input, optional analog output and the 24V boost converter requires full power to provide 6W (250mA @24V) of power.

The user has three options to supply 11-24V to the I/O board as outlined below but should thoroughly examine the application and supply the 5604 I/O Module with a suitable power source.

Voltage referred to as Vrms (or VAC on some products) indicates AC power. Voltage referred to as V indicates DC power.

Power Supply Input Connections

Power to DC PWR on the I/O board can be provided in several ways:

- With a 16Vac source supplying power to the controller board, 24V is available on the DC PWR terminals on connector P5 of the controller board which can be used to power the lower I/O model. See the section ***Recommended AC Power Supply Configuration*** for details.
- A 24Vdc source connected to the DC PWR terminals on the controller board and on the 5604 I/O module in a parallel configuration. See section ***Recommended 24V Power Supply Configuration*** for details.
- With a 12Vdc source connected to the DC PWR terminals on the controller board and on the 5604 I/O module in a parallel configuration. See section ***Recommended Battery Configuration*** for a wiring example.
- A 5103 UPS Power Supply supplies 5Vdc to the controller board through the IMC cable and supplies 24Vdc to the 5604 I/O module through the 24Vdc output. See section ***Recommended 5103 Power Supply Configuration*** for an example of using the 5103 UPS Power Supply.

Power can be applied to either the AC/DC power input **OR** the DC power input. Damage to the power supply may result if both inputs are used.

Recommended AC Power Supply Configuration

This configuration uses a single Class 2 16vac transformer to power the controller board and the 5604 I/O Module. 24V is available on the controller module connector P3. This is used to power the analog circuitry for the analog input and output circuits on the 5604 I/O module.

Notes on this configuration:

- The 24V-boosted output (VLOOP) can be switched on and off under the control of the application program to save power to any loads connected to VLOOP.
- The DC output of the controller board is unregulated and can be boosted to 24Vdc on the 5604 I/O Module under the control of the application program.
- Only a limited amount of power is available from the controller. This configuration is not recommended when a large amount of current is required at 24V.
- The Controller Board DC Power terminal is to be connected to the same power supply as the 5604 I/O Module DC Power terminals.

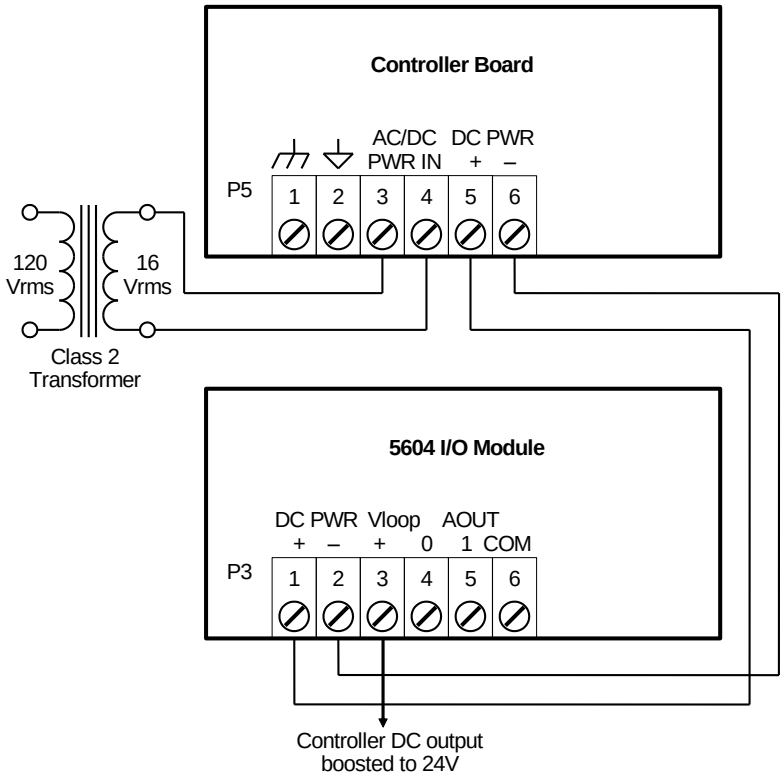

Figure 2: Recommended AC Power Supply Configuration

Recommended 24V Power Supply Configuration

This configuration uses a 24V power supply to power the controller board and the 5604 I/O module. This 24V is used to power the analog circuitry for the analog inputs and output circuits on the 5604 I/O module.

Notes on this configuration:

- The 24V output (VLOOP) can be switched on and off under the control of the application program to save power to any loads connected to VLOOP.
- It is unnecessary to boost the 24V power in the 5604 I/O Module. The 24V output (VLOOP) on the 5604 I/O Module can be switched under control of the application program.
- This configuration is recommended when a large amount of current is required at 24V. Refer to section ***Specifications*** and the section outlining sample power calculations in the manual of your respective controller board to determine the power required from the 24V power supply.
- The Controller Board DC Power terminal is to be connected to the same power supply as the 5604 I/O Module DC Power terminals.

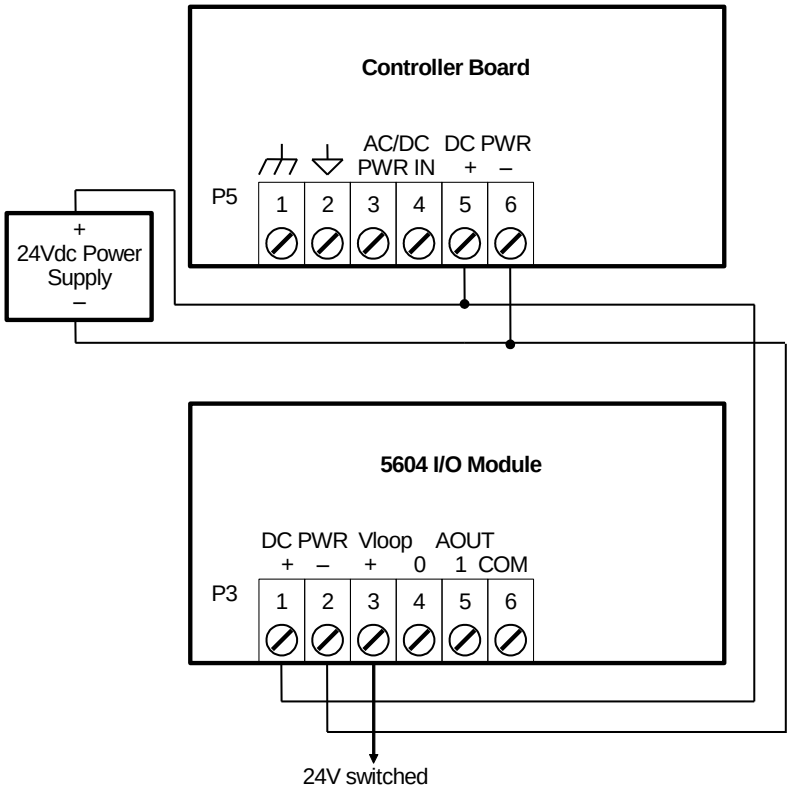

Figure 3: Recommended 24V Power Supply Configuration

Recommended Battery Configuration

This configuration uses a 12V battery to power the controller board and the 5604 I/O Module. This 12V is used to power the analog circuitry for the analog inputs and output circuits on the 5604 I/O Module.

Notes on this configuration:

- The 24V-boosted output (VLOOP) can be switched on and off under the control of the application program to save power to any loads connected to VLOOP.
- The DC input (battery voltage) to the 5604 I/O Module can be boosted to 24Vdc on the 5604 I/O Module under the control of the application program.
- This configuration is recommended when a large amount of current is required at 24V. Refer to the specifications and the sample calculations to determine the power required from the 12V battery.
- The 5232 Controller Board DC Power terminal is to be connected to the same power supply as the 5604 I/O Module DC Power terminals.

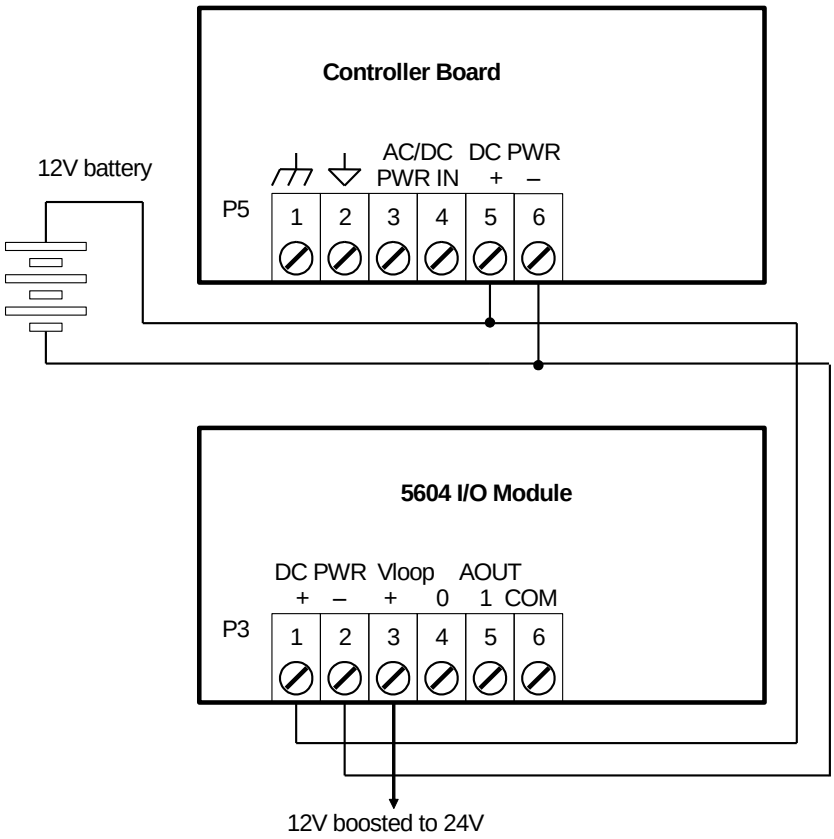

Figure 4: Recommended Battery Configuration

Recommended 5103 Power Supply Configuration

When additional power is required by the system, 5103 power supplies can be used in combination with the SCADAPack controllers. Refer to the ***System Configuration Guide*** for more information.

The 5103 power supplies can be connected anywhere *downstream* (to the right) of the controller. They will supply power to the modules downstream of them.

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

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

- No power is applied to the power inputs of the controller board.
- A jumper is installed at position J5 (see the user manual of your respective controller board for details.
- The sleep mode feature is not used.

This configuration uses a 5103 Power Supply module to power a SCADAPack controller. The 24VDC output from the 5103 powers the 5604 I/O module. The 5103 power supply provides a 5V output to power the 5604 I/O module, the controller board and 5000 modules through the IMC cables.

No connection is made to the AC/DC PWR IN or DC PWR terminals on the controller board.

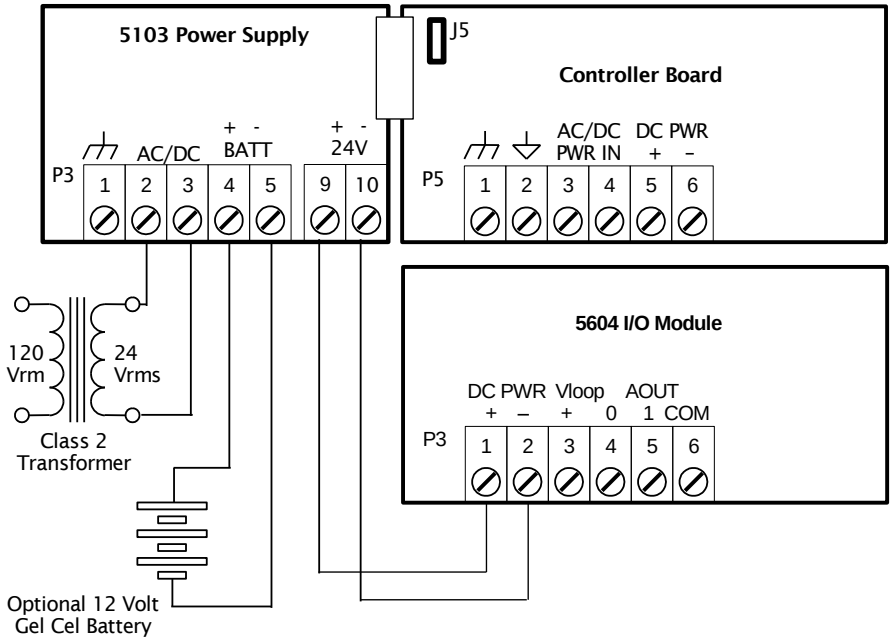

Figure 5: Recommended 5103 Power Supply Configuration

System Grounding

In applications, it is desirable to ground the system by connecting the system power supply common, to the chassis or panel ground.

On the 5604 I/O module, "-" terminal of the 24V supply(DC PWR "-") is already connected to the enclosure by the printed circuit board traces.

Power Management Features

The 5604 I/O board provides a number of special features to reduce power consumption. These power management features include:

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

The 5604 I/O module provides two internal digital outputs that can be operated by the user application to manage the power saving features. Internal digital outputs 32 and 33 and the power management functions they control are described in the following sections.

Refer to ***Figure 6: 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 the

SCADAPack 5604 I/O module and for IEC 61131-1 applications refer to the I/O Complex Equipment for SCADAPack 5604 I/O module.

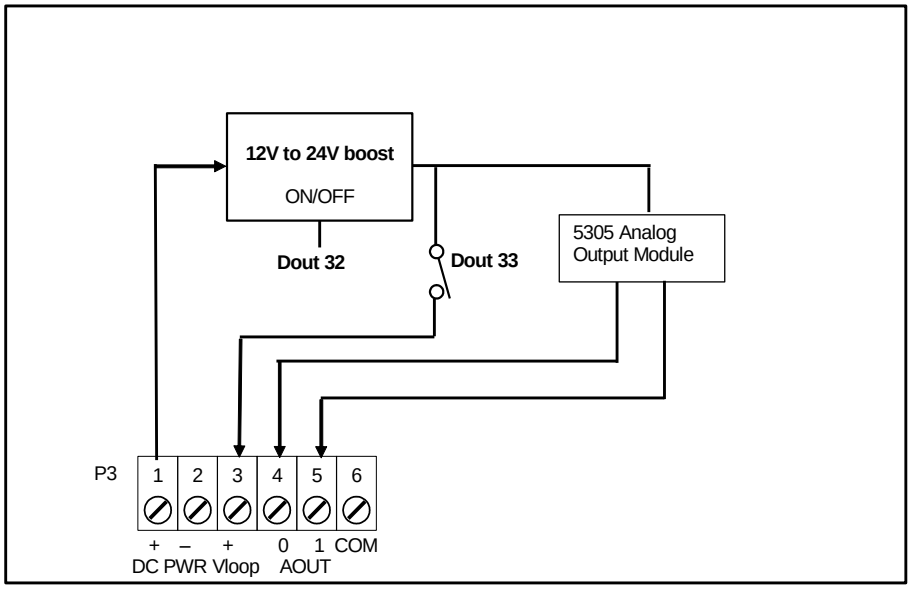

Figure 6: Power Management

DC/DC Converter Control

The 12V to 24V DC/DC converter is used to provide 24 VDC for VLoop power and for the Analog Output module. The converter should be turned on if the 5604 I/O Module 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 32** 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 Analog Output module.
- Turn off **Digital Output 32** to turn **OFF** the 12V to 24V DC/DC converter. When the converter is turned off VLoop power and the Analog Output module use is the applied input power.

Internal **Digital Input 32** 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 the ***LED Power Control*** section in the hardware manual of your respective controller board 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 the *DC/DC Converter Control* section for converter information. The VLoop power source is the applied input power if the DC-DC converter is turned off.

- Turn on **Digital Output 33** to turn **ON** the VLoop output.
- Turn off **Digital Output 33** to turn **OFF** the VLoop output.

When VLoop is first turned on, the user application program needs to wait at least one second for input readings to stabilize. This time may be increased depending on field sensors and transmitters. 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 the *LED Power Control* section in the hardware manual of your respective controller board for further information.

VLoop Over-Current Protection

When VLoop output is turned on, it is monitored for excessive current consumption. If sustained over-current is detected (100 ms), VLoop is turned off even though internal Digital Output 33 is turned on. When VLoop output is turned on, using internal Digital Output 33, and over current 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 34** will be ON.

Analog Inputs

The 5604 I/O module enhances the capacity of a SCADAPack controller by providing an additional nine single ended analog inputs on connector P4, that can be configured for current or voltage mode. Refer to ***Figure 1: 5604 I/O Module Layout*** for the location of this connector.

Analog Inputs 0-7 can be configured for current or voltage mode using jumper switches. Please refer to section ***Analog Inputs*** on how to select input modes.

- In voltage mode, these analog inputs are single ended and the measurement range is 0-10V. The range is selected via the configuration DIP switches. Refer to section ***Range and Resolution*** below for details.
- In current mode, a 250Ω current sense resistor appears across each analog input channel. Measurement range in current mode is 0-20mA or 4-20mA selectable via the configuration switches. The 250Ω resistor produces a voltage drop (input reading) of 5V for a 20mA of current flow.

Analog input channels are transient suppressed, optically isolated from the main logic supply and share a common return (COM) that is connected to the chassis.

The controller uses a 16-bit successive approximation analog to digital (A/D) converter and provides 15 bit resolution over the range of the analog input.

Analog Input 8 is a 0 to 32.768-volt input that measures with 10-bit resolution and can be used to monitor a power supply or battery voltage.

There is one internal analog input that is used in application programs to monitor the DC/DC converter voltage used for VLOOP.

- For Telepace applications use the ***SCADAPack 5604 I/O Module*** register assignment to read the nine external and the internal analog inputs.
- For IEC 61131-1 applications use the ***sp5604*** I/O connection to read the nine external and the internal analog inputs.

Please refer to the respective Telepace and IEC 61131-1 software manuals on how to assign the above registers to read these input ports.

Current or Voltage Mode

Analog Inputs 0-7on connector P4 can be configured for either voltage or current mode using jumper links. The jumper links reside on the lower I/O

board itself. To access the jumper links, the main cover and controller board will have to be taken off by removing the retaining screws.

Analog Input channels 0-7 are configured for current mode by default.

To select current mode, install the jumpers on the side labeled 20mA on the I/O board as shown in the figure below for analog inputs 0-5. In current mode a 250Ω resistor appears across the input channel.

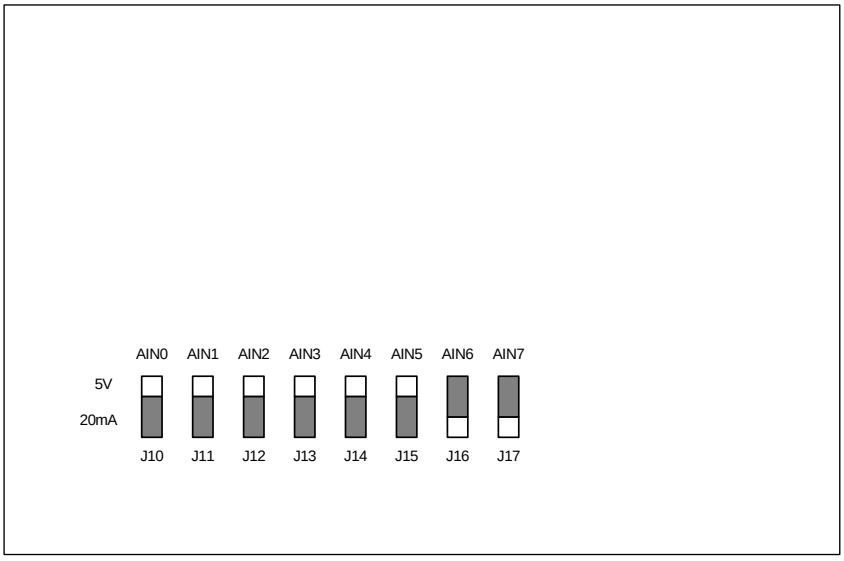

Figure 7: Analog Input Mode Settings

To select voltage mode, install the jumpers on the side labeled 5V. In the figure above, Analog inputs 6 and 7 are configured for voltage mode.

Range and Resolution

Analog inputs channels 0 – 7 use a16-bit, unipolar, analog to digital (A/D) converter that measures input voltages from 0 to 10V or currents from 0-20mA. In voltage mode, the input is represented by a 15 bit unsigned real number. In current mode, the input is represented by a 14 bits unsigned real number

Input resolution for channels 0-7 is:

- 0.305mV/count in voltage mode
- 1.22µA/count in current mode. There is 100% over range.

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

Current (mA) Channel 0-7	Voltage (V) Channel 0-7	Voltage (V) Channel 8	A/D Output
0	0V	0V	0
1.22mA	0.305mV	NA	1
4	1.0	3.277	3277
10	2.5	8.192	8192
20	5.0	16.38	16384
39.999	9.9997	32.767	32767

Analog input 8 is configured for voltage mode only. Voltage ranges of up to 32.768V are measurable using a 10 bit A/D converter and represented with 15 bits of data. The input resolution on this channel approximately 0.03V/count.

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.Tthe user to check 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 5604 I/O Module VLOOP Supply that boosts the input voltage to 24V with a 12V to 24V DC/DC converter. The stepped up voltage is available on connector P3 and is labeled VLOOP. There is sufficient power available for the eight analog inputs and four analog outputs each operating at 20mA. Significant power saving is possible by switching the VLOOP supply off when measurements are not being made.

The second option is similar to the first except that the power supply is not boosted up to 24V. This can be used with low voltage transmitters or when the input voltage is sufficiently high that further boosting 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.

Wiring Examples

Several wiring examples for loop and self powered transmitters are illustrated in ***Figure 8: Analog Input Wiring***. The transmitters are wired as follows:

- Channel 0 has a loop powered current transmitter connected to VLOOP.
- Channel 1 has a self-powered voltage transmitter connected to the external power supply.
- Channels 2 through 6 are unused.
- Channel 7 has a self-powered current transmitter connected to the external power supply.
- Channel 8 is used to monitor the external power supply.

If a 12V external power supply or battery is used the application can boost this voltage to 24V at VLOOP using the internal DC/DC converter. If a 24V external power supply is used it is unnecessary to boost this voltage.

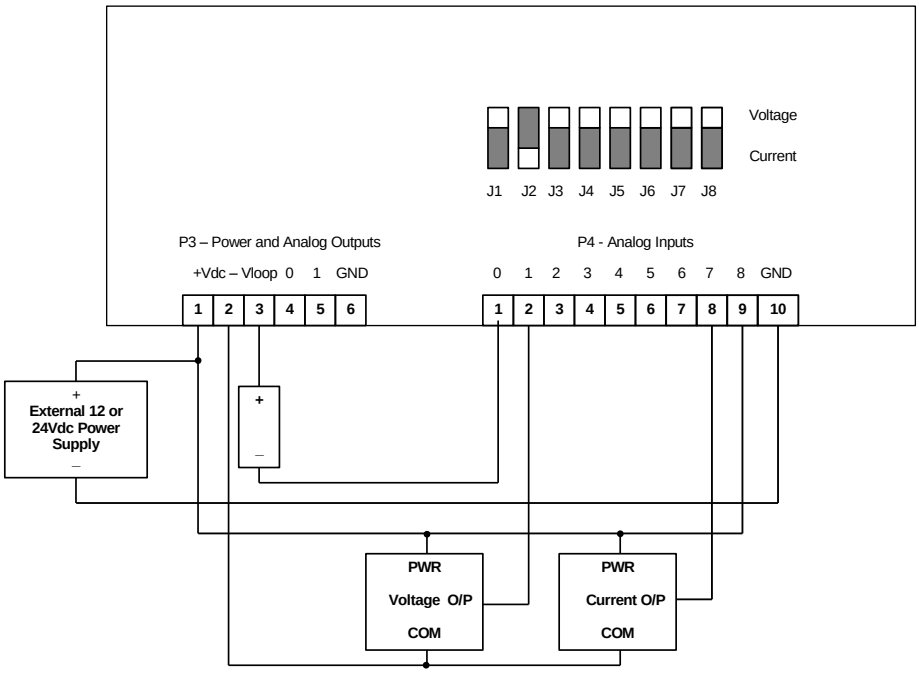

Figure 8: Analog Input Wiring

Filtering and Response Timing

The 5604 I/O Module also provides internal digital outputs to control the filtering and response times of the analog to digital conversion. Theses

digital outputs can be controlled by the user application to either maximize the filtering in noisy environments or minimize the filtering in applications that require the fastest response times.

The following chart shows the response timing for the selectable filter settings.

Internal digital outputs 34 and 35 control the filter setting.

The 5604 I/O module may select 50 or 60 Hz line frequency for digital and analog input processing. The Controller board Option Switch 3 selects the line frequency option.

Filter Setting	**Response Time**	**Digital Output 35**	**Digital Output 34**	
< 3 Hz	155ms at 60Hz 185ms at 50Hz	OFF	OFF	Maximum filter setting
6 Hz	85ms at 60Hz 85ms at 50Hz	OFF	ON	Medium filter setting
11 Hz	45ms at 60Hz 55ms at 50Hz	ON	OFF	Minimum filter setting
30 Hz	30ms at 60Hz 30ms at 50Hz	ON	ON	No filter

Analog Outputs

The 5604 I/O Module may include two channels of analog output if this option was requested at time of purchase.

- For Telepace applications use the ***SCADAPack AOUT I/O Module*** register assignment to write to the two analog outputs.
- For IEC 61131-1 applications use the ***aout2pt*** I/O connection to write to the two analog outputs.

Please refer to the respective Telepace and IEC 61131-1 software manuals on how to assign the above registers to read these input ports.

Current Outputs

The 5604 I/O Module can be equipped with an optional 5305 Analog Output Module that provides two 20mA analog outputs. Analog output resolution is 12 bits. The outputs are transient and over voltage suppressed. The outputs share a common return (GND) with each other and the 5604 I/O Module analog inputs.

The 12V to 24V DC/DC boost converter powers the analog outputs. The boost converter is used to boost the DC input power to 24V. The application program may control the boost converter.

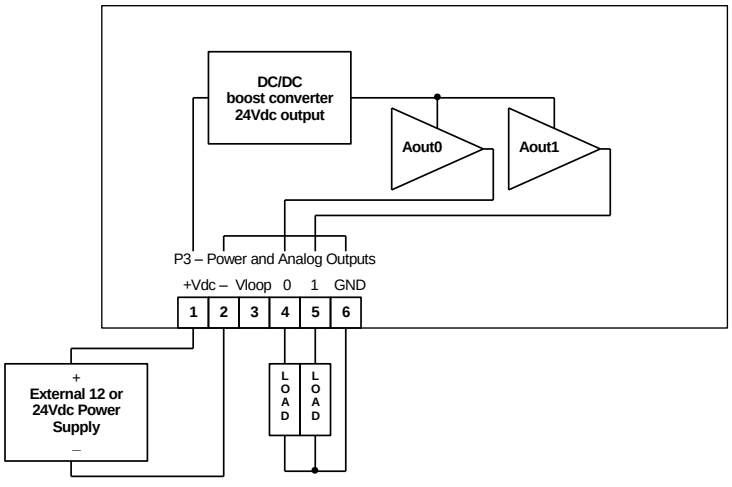

Figure 9: Analog Output Wiring

Voltage Outputs

To obtain voltage outputs, connect a load resistor as shown in ***Figure 9: Analog Output Wiring*** above. Connect the voltage device across the load resistor. The table below list resistance values and output range settings for common voltage ranges. The resistance value listed is the parallel resistance of the device and the load resistor.

Resistance	Output Range	Voltage Range
250Ω	0-20mA	0 to 5V
500Ω	0-20mA	0 to 10V

Range and Resolution

The optional analog output module installed on the 5604 I/O Module has a 12-bit, unipolar, digital to analog (D/A) converter. These analog outputs can be configured for a 0% (0-20mA) or 20% (4-20mA) range. There are 4096 D/A counts in the output signal range and one D/A count represents a value of 8 raw counts. Raw counts are displayed or issued from the application program.

The 0-20mA output range resolution is 4.88µA/count, such that 8 raw counts represent 4.88 µA. For a 0% offset, use the following relationship to determine the output current based on your raw counts:

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

For a 20% offset, use the following relationship:

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

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

Raw Count	Current (0% offset)	Current (20% offset)
0	0 mA	4 mA
8	4.88 µA	4 mA
1500	0.92 mA	4.73 mA
3200	1.95 mA	5.56mA
6552	4 mA	7.2 mA
7000	4.27 mA	7.42 mA
10000	6.11 mA	8.88 mA
16384	10 mA	12 mA
24576	15 mA	16 mA

32760	19.995 mA	19.995 mA

Digital I/O

The 5604 I/O module has 32 universal digital inputs/outputs. Each digital I/O point can be used as an input or an output only. The inputs can be used to monitor the status of that output.

The 32 I/O points are organized into four groups of eight. Four connectors are used for wiring the digital inputs/outputs. These connectors are identified as P6 through P9. Refer to ***Figure 1: 5604 I/O Module Layout*** for the location of these connectors.

In addition to the 32 universal digital input/outputs there are 3 internal digital inputs and 2 internal digital outputs that are used to monitor and control the DC/DC converter or VLOOP power supply as well as to monitor digital output mismatch status. Refer to section ***Internal DIO*** for information on these internal digital I/O.

- For Telepace applications use the ***SCADAPack 5604 I/O Module*** register assignment to read the digital inputs and write the digital outputs.
- For IEC 61131-1 applications use the ***sp5604*** I/O connection to read digital inputs and write the digital outputs.

Please refer to the respective Telepace and IEC 61131-1 software manuals on how to assign the above registers to read these input ports.

Digital Inputs

The inputs are for use with dry contacts such as switches, open collector transistors and relay contacts. Wetting current for the contacts is provided. The input is connected from the I/O terminal to the terminal labeled GND. GND terminals are connected internally to the SCADAPack chassis.

If LED power is enabled, there is a continuous 5mA wetting current for each input. Indicator LED's 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. Power consumption is reduced as the inputs are scanned only once every millisecond. Indicator LED's are dim in this condition. This is normal.

Digital Outputs

Outputs are open-collector/open drain type for use with sustained DC loads of up to 1 ampere. Loads with high in-rush currents may exceed the 1A rating. The output circuit will tolerate these higher peak currents. The load is connected between this output point and a +DC power source. The negative side of the DC power source is connected the terminal labeled GND. GND terminals are connected internally to the SCADAPack chassis. This is the return path from –DC to the load.

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.

Internal DIO

The 5604 I/O Module also provides internal digital outputs to enable the DC/DC boost converter, to switch on/off the boost converter output and control the analog input filtering. Theses digital outputs can be controlled by the user application to manage power savings and control the analog input response.

Digital input 32 returns the DC/DC converter status.
0 = DC/DC converter off
1 = DC/DC converter on

Digital input 33 returns the DC/DC converter over current status.
0 = Over current not detected
1 = Over current detected

Digital input 34 returns the digital output mismatch status.
0 = No mismatch
1 = One or more digital outputs mismatch

Digital Output 32 is used to control the DC/DC converter.
0 = DC/DC converter off
1 = DC/DC converter on
The 12V to 24V DC/DC converter is turned on when the LED power is enabled. This feature is provided for service and diagnostics.

Digital Output 33 is used to control the VLoop power supply.
0 = VLoop output off
1 = VLoop output on
The VLOOP output is turned on when the LED power is enabled. This feature is provided for service and diagnostics.

Digital Outputs 34 and 35 control the SCADAPack 5604 I/O Module Analog Input filters.

Filter Setting	Digital Output 35	Digital Output 34
< 3 Hz	OFF	OFF
6 Hz	OFF	**ON**
11 Hz	**ON**	OFF
30 Hz	**ON**	**ON**

Wiring Examples

Various I/O point wiring examples are shown in ***Figure 10: Digital Input/ Output Wiring*** below***.*** Inputs and outputs can be used on any of the I/O points.

- Digital I/O point 7 is shown connected to a 12V load and external 12V-power supply.
- Digital I/O point 6 is shown connected to a 24V load and external 24V-power supply.
- Digital I/O point 4 is shown monitoring a dry contact.
- Digital I/O point 1 is shown monitoring an open collector contact.

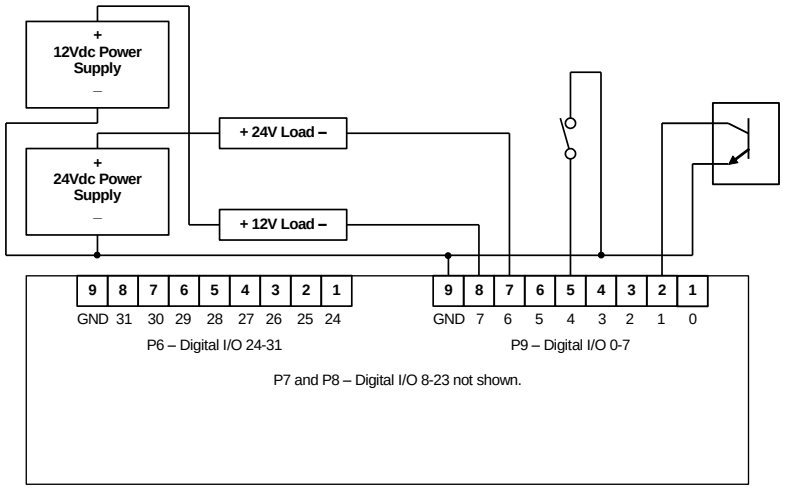

Figure 10: Digital Input/ Output Wiring

Serial Communication

The 5604 I/O module enhances the serial communication ability of a SCADAPack controller by providing an additional RS-232 serial port identified as COM3. The RS-232 port is an 8-pin female RJ-45 connector configured as Data Terminal Equipment (DTE) and only supports a half-duplex serial communication. The recommended specification for RS-232 cable length is a maximum of 50 feet or 15.2 meters. Shielded cable are used and the shield should be connected to chassis ground at one end.

Port	Type	Description
COM3	RS-232	RJ-45 connector designated P5 on the 5604 I/O Module.

COM3 RS-232 Serial Port

Connections to COM3 are made through a RJ-45. The wiring and pin connections for this connector are described in the section ***0- RJ-45 Modular Connector for RS-232***.

The following table shows the serial and protocol communication parameters supported by COM1. These parameters are set from Telepace, IEC 61131-1 Workbench or from an application program running in the controller. Default values are set when a Cold Boot or Service Boot is performed on the 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

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

RJ-45 Modular Connector for RS-232

Serial communication port COM3 on the 5604 I/O module uses an 8-pin female RJ-45 connectors configured as Data Terminal Equipment (DTE). The following diagram shows the pin connections for the RS-232 (RJ-45) port connector for COM3.

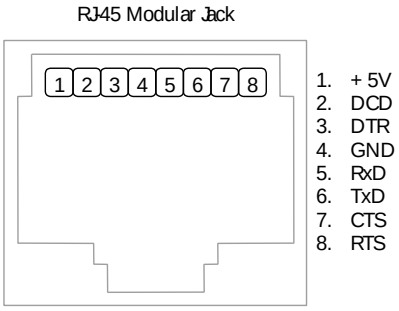

Figure 11: Front View of an RJ-45 Connector

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 –3V or less.

Pin	Function	Description
1	5V (Output)	This pin can be connected to the 5V power supply by installing a jumper at J4 on the SCADAPack controller board.
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	The level is SPACE on standby and MARK for transmitted

Pin	Function	Description
	(Output)	data. The LED is lit for a MARK level.
7	CTS (Input)	A MARK level is required 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 sets CTS to MARK to allow the controller to transmit data.
8	RTS (Output)	This pin is a MARK if full-duplex operation is selected for the port. This pin is set to a MARK just before and during transmission of data if half-duplex operation is selected. This pin is set to a SPACE when no data is being transmitted.

RS-232 Wiring Examples

See the chapter on ***Serial Communications*** in the hardware manual of your respective controller board for wiring examples.

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 5604 I/O module to a DE-9P connector on a DTE such as a PC. A 10 ft. long cable is available from Control Microsystems as part number TBUM297217.

RJ-45 8 Pins	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.	GND	GND	No wires 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 P1A 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 TBUM297218.

RJ-45	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

Operation

LED Indicators

This I/O module provides an additional 36 LEDs. LED's can be disabled by the controller board to conserve power. Refer to the chapter on ***LED Indicators*** in the hardware manual of your respective controller board for details**.** The table below describes some of the LEDs on the 5604 I/O module.

LED	Function
RX	On when receiving data COM3.
TX	On when transmitting data on COM3.
CTS	On when CTS is asserted on COM3.
DCD	On when DCD is asserted on COM3.
DI/O	On when the corresponding input is on. On when the corresponding output is on.

Specifications

Disclaimer: Control Microsystems reserves the right to change product specifications. For more information visit *www.controlmicrosystems.com* .

General

I/O Terminations	6,8,9 and 10 pole, removable terminal blocks. 12 to 22 AWG 15A contacts Screw termination - 6 lb.-in. (0.68 Nm) torque
Dimensions SCADAPack	8.40 inch (213mm) wide 6.13 inch (155mm) high 2.80 inch (72mm) 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

Communications

Communication Ports, 5203 controller board	2 RS-232 serial ports (COM1, COM2) Data Terminal Equipment (DTE) DE-9P male connector	
Communication Ports, 5204 controller board	One RS-232 serial port (COM2) Data Terminal Equipment (DTE) DE-9P male connector	
	One RS-485 serial port (COM1) 2 wire half duplex 4 wire full or half duplex optional termination resistors	
Communication Ports	5604 I/O Modulue	one RS-232 serial port (COM3) Data Terminal Equipment (DTE) DE-9P male connector

	5604 I/O Module	one RS-232 serial port (COM3) Data Terminal Equipment (DTE) 8 pin modular jack
Baud Rates (COM1, COM2)	300, 600, 1200, 2400, 4800, 9600, 19200, 38400 default: 9600	
Baud Rate (COM3) **Where applicable**	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Default: 9600	
Parity	none, even, or odd Default: none	
Word Length	7 or 8 bits Default: 8 bits	
Stop Bits	1 or 2 bits Default: 1 bit	
Duplex (COM1, COM2)	full or half with RTS/CTS control Default: full	
Duplex (COM3)	half with RTS/CTS control	
Cable Length	RS-232 –maximum 50 ft (15.2 m) RS-485 –maximum 4000 ft (1200 m)	
Protocol 5203 and 5204 Controller Boards	TeleBUS (compatible with Modbus RTU and Modbus ASCII) DF1 and DNP Protocols optional Default: Modbus RTU	
Protocol Modes 5203 and 5204 Controller Boards	slave, master, master/slave, store and forward	

Visual Indicators

Digital I/O (5604 I/O Module)	32 red LED's
Push-button	LED power toggle

Power Supply

DC power Input	30V maximum 11V minimum UL508 rated 13.75-28Vdc. Class 2. 12V at 5mA during Sleep Mode 12V at 10mA with no loading on the boosted 24V Vloop 12V at 550mA with 88% efficiency 23V/0.25A loading

24Vdc Power Output	22.5 to 25.2 Vdc with 0 to 0.25A load. Shutdown current limiting typically 0.36A. Efficiency 88-92%, 12V on DC PWR input
5V power required	170mA with LED's enabled and all I/O on 15mA with LED's enabled and all I/O off 15mA with LED's disabled

Analog Inputs

Inputs 0-7

Input Points	8 at 10V/20mA: 250Ω resistance, user configurable with jumper link	
Resolution	15 bits over the 10V measurement range 14 bits over the 20mA measurement range	
Input Resistance	20kΩ for 10V 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	26 dB at 50/60 Hz 21 dB at 50/60 Hz 14 dB at 50/60 Hz 5 dB at 50/60 Hz	Maximum filter setting Medium filter setting Minimum filter setting No filter
Over-scale Input Capacity	Measures up to 10V/40mA Inputs clamped between 12 and 17V Transient: 2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989	
Isolation	Analog common side connected to Chassis Ground	
Response Time	For 90% signal change, 60/50Hz. 155/185ms 85/ 95ms 45/ 55ms 30ms	 Maximum filter setting Medium filter setting Minimum filter setting No filter

Input 8

Input Points	1 at 0-32.768V
Resolution	10 bits over the 32.768V measurement range

Input Resistance	600kΩ for 32.768V inputs
Converter type	10 bit successive approximation
Accuracy	±0.25% of full scale at 25°C (77ºF) ±1% over temperature range
Type	single ended
Calibration	Calibration constants stored in on board microcontroller EEPROM
Over-scale Input Capacity (without damage)	Transient: 2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Analog common side connected to Chassis Ground
Response Time	30ms for 90% signal change.

Analog Outputs

Output Points	2 (when optional 5305 analog output module 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

Digital Inputs

I/O points	32 points in 4 group of 8. Each point is an input and an output.
Output Rating	1.0Adc 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.
Transient Protection	2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Common ground return connected to Chassis Ground.

Digital Outputs

I/O points	32 points in 4 group of 8. Each point is an input and an output.
Output Rating	1.0Adc 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 turn on input voltage. 1.5V typical turn off input voltage. Greater than 2.2V turn off input voltage.
Transient Protection	2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989
Isolation	Common ground return connected to Chassis Ground.

Approvals and Certifications

Hazardous Locations - North America	Suitable for use in Class I, Division 2, Groups A, B, C and D Hazardous Locations. Temperature Code T4 CSA certified to the requirements of: • CSA Std. C22.2 No. 213-M1987 - Hazardous Locations. • UL Std. No. 1604 - Hazardous (Classified) Locations.
Safety	CSA (cCSAus) certified to the requirements of: CSA C22.2 No. 142-M1987 and UL508. (Process Control Equipment, Industrial Control Equipment) UL (cULus) listed: UL508 (Industrial Control Equipment)
Digital Emissions	FCC Part 15, Subpart B, Class A Verification EN61000-6-4: 2007 Electromagnetic Compatibility Generic Emission Standard Part2: Industrial Environment C-Tick compliance. Registration number N15744.
Immunity	EN61000-6-2: 2005 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 2004/108/EEC (as amended) relating to electromagnetic compatibility. P1 (5604) and P1B (5606 Models with digital inputs configured below 30Vdc/60Vac are eligible to bear the CE mark. The Low Voltage Directive is not applicable to these products in applications below 30Vdc/60Vac. The Low Voltage Directive is not applicable to the P1A (5604) Model and is eligible to bear the CE mark.