Productivity 2000

HARDWARE USER MANUAL


AUTOMATIONDIRECT.com

Manual Number: P2-USER-M

**Notes:**

# WARNING

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To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and usually change with time. It is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation is in compliance with the latest revision of these codes.

At a minimum, you should follow all applicable sections of the National Fire Code, National Electrical Code, and the codes of the National Electrical Manufacturer's Association (NEMA). There may be local regulatory or government offices that can also help determine which codes and standards are necessary for safe installation and operation.

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Afin de réduire au minimum le risque d'éventuels problèmes de sécurité, vous devez respecter tous les codes locaux et nationaux applicables régissant l'installation et le fonctionnement de votre équipement. Ces codes diffèrent d'une région à l'autre et, habituellement, évoluent au fil du temps. Il vous incombe de déterminer les codes à respecter et de vous assurer que l'équipement, l'installation et le fonctionnement sont conformes aux exigences de la version la plus récente de ces codes.

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## Notes

# Productivity2000 User Manual

**Please include the Manual Number and the Manual Issue, both shown below, when communicating with Technical Support regarding this publication.**

| | |
|---|---|
| **Manual Number:** | **P2-USER-M** |
| **Issue:** | **1st Edition** |
| **Issue Date:** | **04/22** |

| Publication History | | |
|---|---|---|
| **Issue** | **Date** | **Description of Changes** |
| 1st Edition | 04/22 | Original |
| | | |

# Notes

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# GETTING STARTED

CHAPTER 1

## In This Chapter...

# Introduction

## Purpose of this Manual

Thank you for purchasing the AutomationDirect Productivity2000 Programmable Controller (CPU) family of products. This hardware user manual provides information that will help you install, set up, program, troubleshoot, and maintain your Productivity2000 CPU system. The manual includes information that is critical to the safety of the personnel who will install and use the controller and to the machinery, processes, and equipment controlled by the CPU.

The manual also includes important information about power and signal wiring, mounting of the CPU, and configuring the CPU system.

## About Getting Started

If you are familiar with Programmable Controllers in general, then following the simple steps in this first chapter may be all you require to start being productive using a Productivity2000 CPU system. After you have completed the steps, your Productivity2000 controller will be running the ladder logic project that you programmed.

## Online Help Files and Other Documentation

The Productivity2000 programming software, Productivity Suite, is available as a download from our website.

**See http://www.automationdirect.com/products/pseries.html.**

The Productivity Suite software includes searchable online help topics covering all aspects of the software, instruction set, module setup, and communications.

In addition, each base, power supply, CPU, and I/O module includes an installation insert.

## Technical Support

We strive to make our manuals the best in the industry. We rely on your feedback to let us know if we are reaching our goal. If you cannot find the solution to your particular application, or if for any reason you need technical assistance, please call us at:

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Our technical support group will work with you to answer your questions. They are available Monday through Friday from 9:00 A.M. to 6:00 P.M. Eastern Time. We also encourage you to visit our web site where you can find information about our company and specific technical information about a wide array of our products.

**http://www.automationdirect.com**

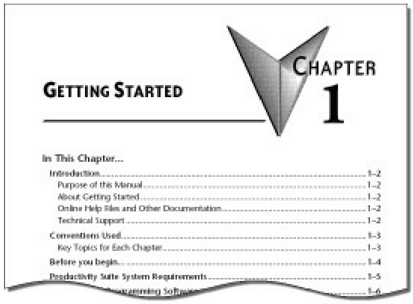
# Conventions Used

*When you see the "note pad" icon in the left-hand margin, the paragraph to its immediate right will be a special note. Notes represent information that may make your work quicker or more efficient. The word* ***NOTE:*** *in boldface will mark the beginning of the text.*

**When you see the "exclamation point" icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death in extreme cases. Any warning in this manual should be regarded as critical information that should be read in its entirety. The word WARNING in boldface will mark the beginning of the text.**

## Key Topics for Each Chapter

The beginning of each chapter will list the key topics that can be found in that chapter.


GETTING STARTED

CHAPTER 1

In This Chapter...

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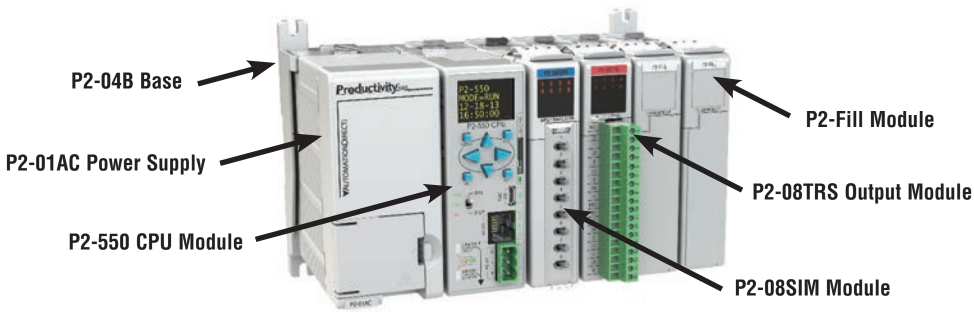
# Before you begin...

It is recommended that the following items be available to make this short step-by-step introduction to the Productivity2000 System go smoothly.

**Productivity2000 System Example**




**PC Running Windows 7, 8, 8.1**

Not available from Automationdirect.com

**Productivity Suite Programming Software PS-PGMSW**

Download software from our webste at: www.automationdirect.com under "Programmable Controllers".

**USB-A to Micro USB-B Programming Cable**

**Screwdriver TW-SD-VSL-2**

**Wire Strippers DN-WS**

**Hookup Wire**

**AC Power Cord**

Not available from Automationdirect.com.

# Productivity Suite System Requirements

Productivity Suite Windows-based programming software (CD-ROM or web download) works with Windows® XP (Home or Professional), Vista (Home, Basic, Premium, 32 or 64-bit) or Windows 7, 8, 8.1, (Home, Professional, Ultimate, 32 or 64-bit). Please check the following requirements when choosing your PC configuration:

- Windows XP Personal Computer with a 333 MHz or higher processor (CPU) clock speed recommended; Intel Pentium/Celeron family or AMD K6/Athlon/Duron family, or compatible processor recommended.
- Vista or Windows 7 or Windows 8, 8.1, Personal Computer with a 800 MHz or higher processor (CPU) clock speed recommended; Intel Pentium/Celeron family or AMD K6/Athlon/Duron family, or compatible processor recommended.
- SVGA 1024x768 pixels resolution. (1280x1024 pixels resolution recommended).
- 300MB free hard-disk space.
- RAM: Windows XP 2.0.0.x or higher; 1GB memory (2GB recommended).

  Windows XP 1.10 or lower; 128MB free RAM (512MB recommended).

  Windows 7, 8, 8.1 or Vista;

  Version 2.0.0.x or higher, 2GB memory (4GB recommended).

  Version 1.10 or lower, 512MB (1GB recommended)
- CD-ROM or DVD drive for installing software from the CD.
- USB or Ethernet Port for project transfer to CPU.

***NOTE:*** *USB or Ethernet cable is also required for communications between PC and CPU.*

# Step 1: Install Programming Software

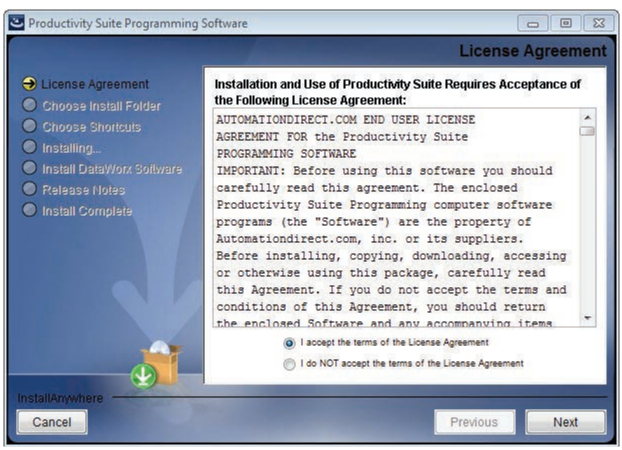
1. Download the latest version of the Productivity Suite Programming Software from the Automationdirect website.

   Or, if the Productivity Suite Programming Software CD is available, insert it into your PC CD drive. The splash screen should appear after a short time.
2. Click on the "Install" button at the splash screen and follow the dialog boxes.


3. If the CD does not auto-run, click your PC Start menu (bottom left corner of screen), and select Run.
   - In the Open: prompt text box, Type in "D: install.exe", where "D:" is the drive letter of the CD drive being used, or browse to the location of the "install.exe" file that was downloaded and select that file.
   - Select OK and follow the dialog boxes through the next pages.

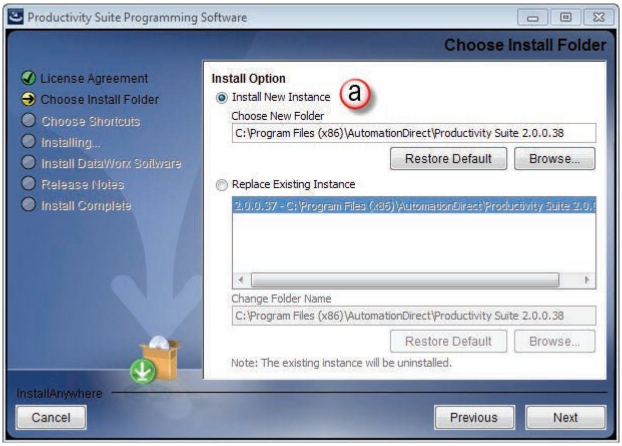
***NOTE:*** *See the Productivity Suite Installation and Productivity Suite Startup topics for additional details if needed.*

4. Carefully read the software license agreement. If you agree to the terms and conditions of this agreement, select the "I accept the terms of the License Agreement" and then the "Next" button.



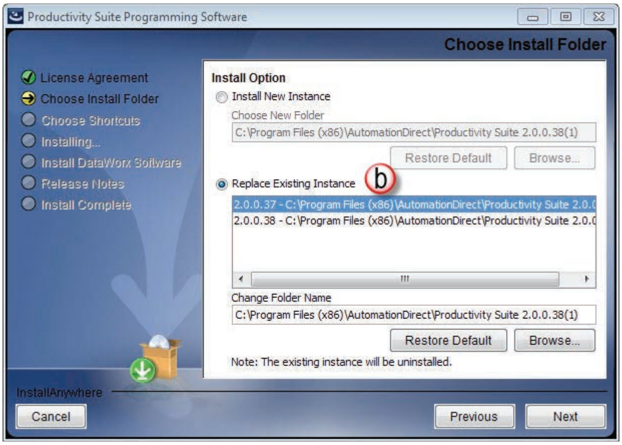
5. The “Choose Install Folder” window will open next. If this is the first installation of the Productivity Suite Software on your PC, choose

   (a) Install New Instance: This option will install a new instance of the Productivity Suite software in the default location, C:\Program Files\AutomationDirect\Productivity Suite

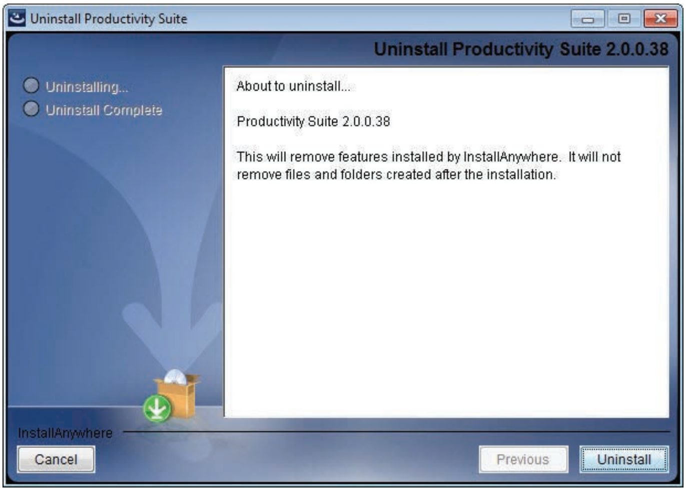


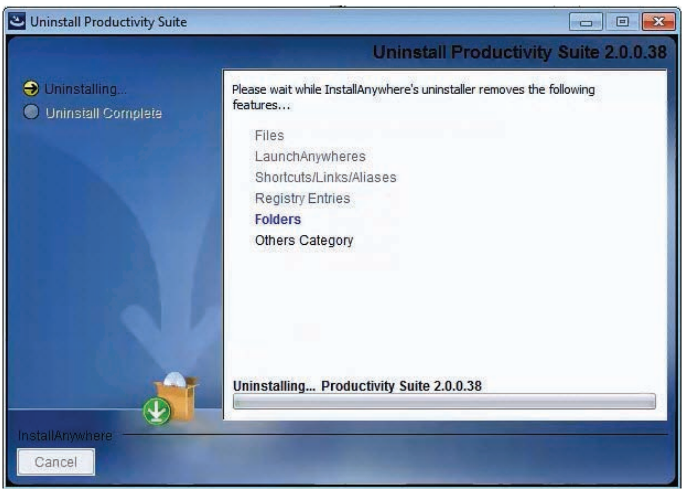

   <Software Version>; or choose a different one using the Browse button.

If the installer detects a previous version of Productivity Suite on your PC, there is another option available with this window:

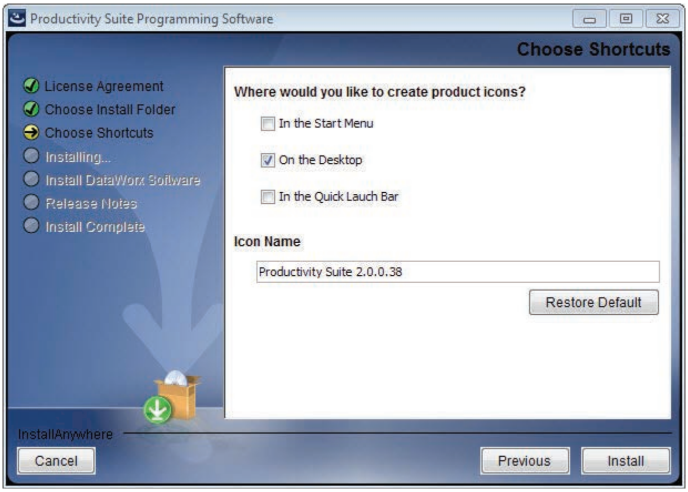



   (b) Replace Existing Instance: This option allows you to uninstall the previous version of the software and install the new version in its place. If this option is chosen the following window appears. Click “Uninstall” to continue.



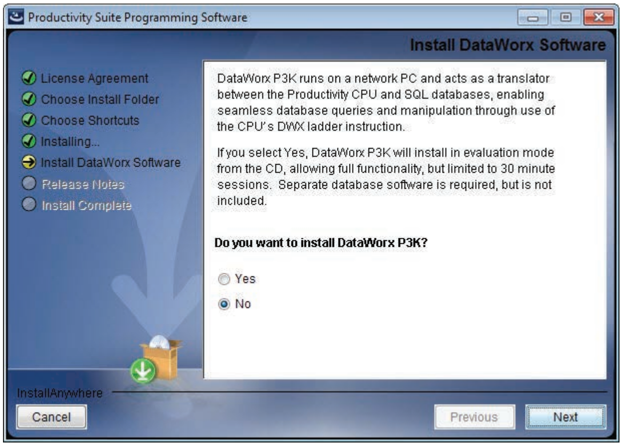

6. Once you have selected the install folder and whether or not to delete any previous instances, the “Choose Shortcuts” window will appear. If a Shortcut Icon is desired for the software select the location where the icon will be created. The default location is “On the Desktop”. Once all selections have been made, click “Install” to begin the installation. A status window will appear displaying the status of the installation.



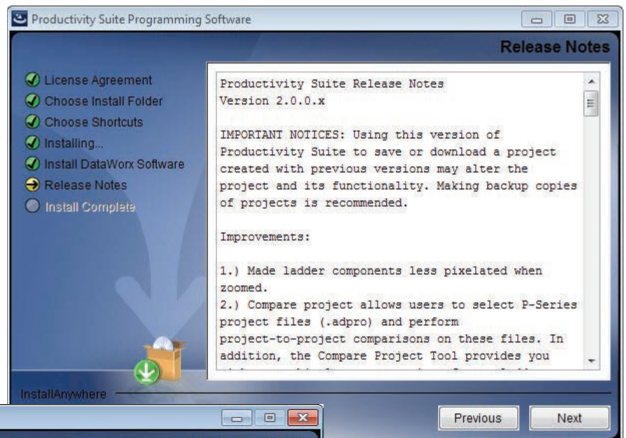


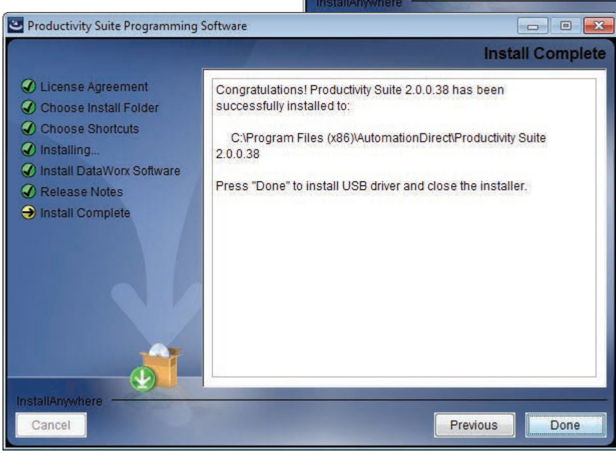
7. Do you want to install DataWorx P3K Software? (Following Dialog Box) DataWorx P3K runs on a network PC and acts as a translator between the Productivity2000 and SQL databases. If you select Yes, an evaluation version of DataWorx P3K will also install on your computer. The evaluation version allows full functionality, but is limited to 30 minute sessions. Separate database software is required, but is not included. See our website for more information on purchasing DataWorx P3K.

   Choose Yes or No and select “Next”.




8. The next screen to appear contains the Release Notes for this version of the Productivity Suite software. This is an opportunity to review the software version release notes. You may read these before selecting the "Next" button.

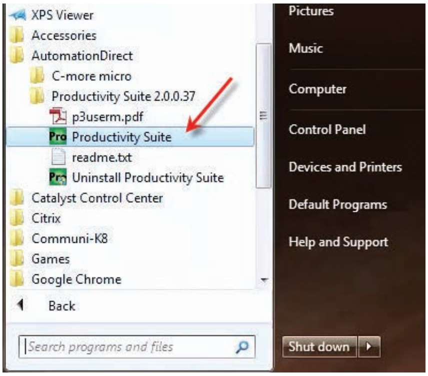



9. The Installation is now complete. Select "Done".

## Step 2: Launch Programming Software

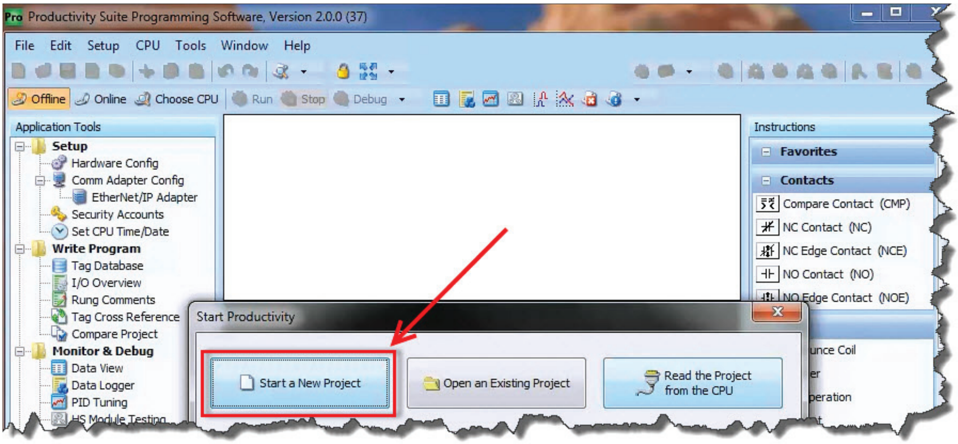
After installing the Productivity Suite Programming Software, PS-PGMSW, launch the software by double clicking the desktop Productivity Suite Icon. Or from the PC's 'Start' menu, slide the mouse pointer through the menus (start>All Programs>AutomationDirect>Productivity Suite x.x.x.x>Productivity Suite) to the Productivity Suite Programming Software selection, and use the left mouse button to click on it.



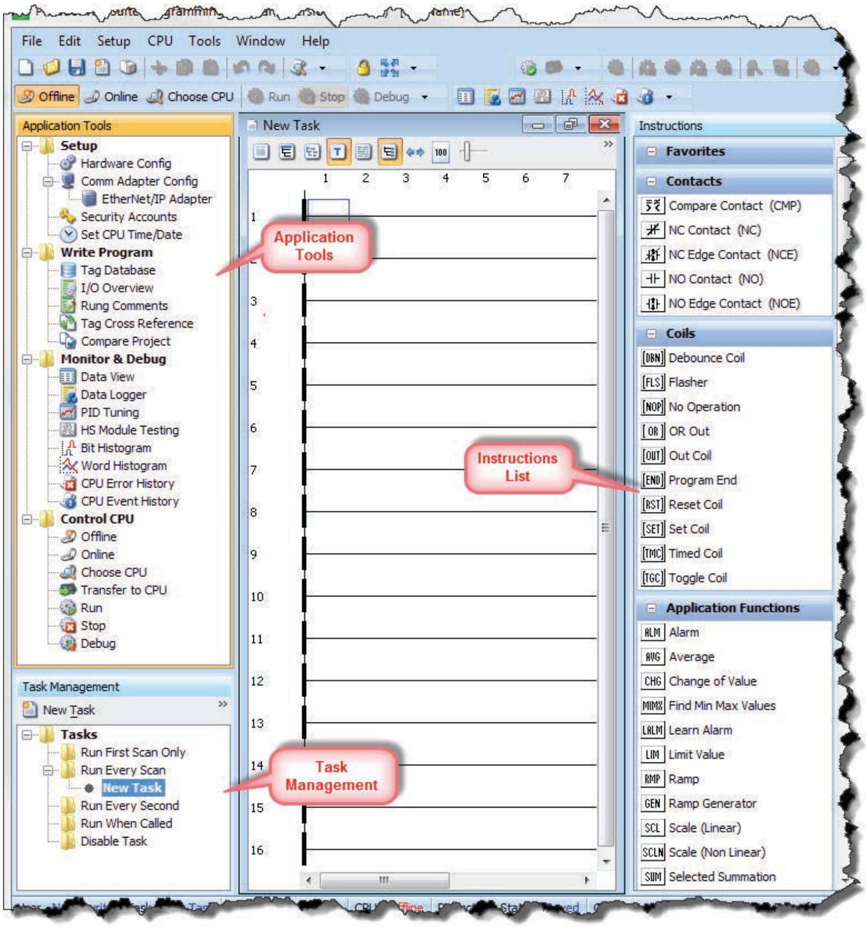

The Productivity Suite Programming Software will start up and display the Main Window as shown here.

***NOTE:*** *The recommended minimum screen size for the Productivity Suite Software is 1024 X 786 pixels.*

Click on the 'Start a New Project' in the Start Productivity dialog box to open a programming window.



The Programming Window is divided into menus and toolbars that work together to make project development as simple as possible.



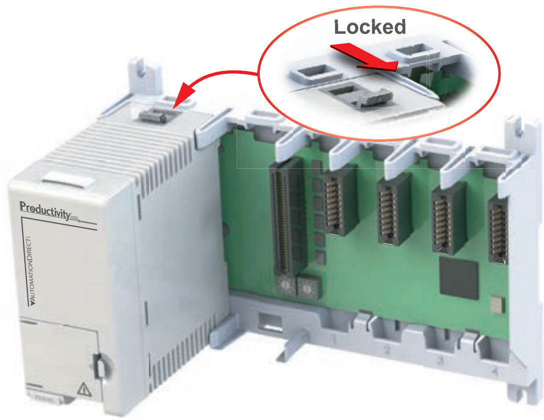

## Online Help

It is essential that you use the Productivity Suite online Help to familiarize yourself with the software. Keep it open on your desktop and refer to it frequently as you build your system. Click on the toolbar Help button to open the Help file.

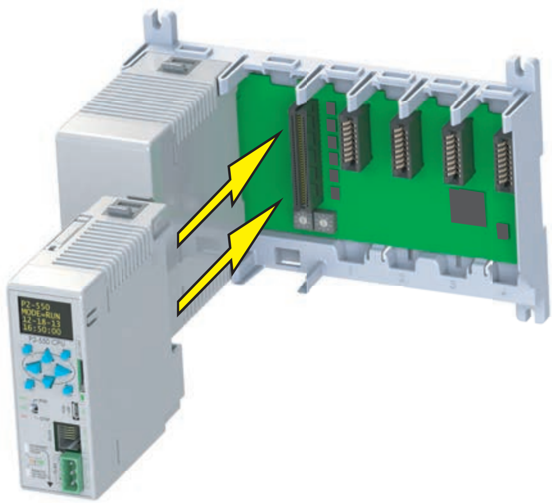
## Step 3: Install Hardware

The Productivity2000 CPU system components snap together to form a configured CPU in minutes. See Chapter 5, Installation and Wiring, for more detailed hardware installation information. What follows are the basic steps:

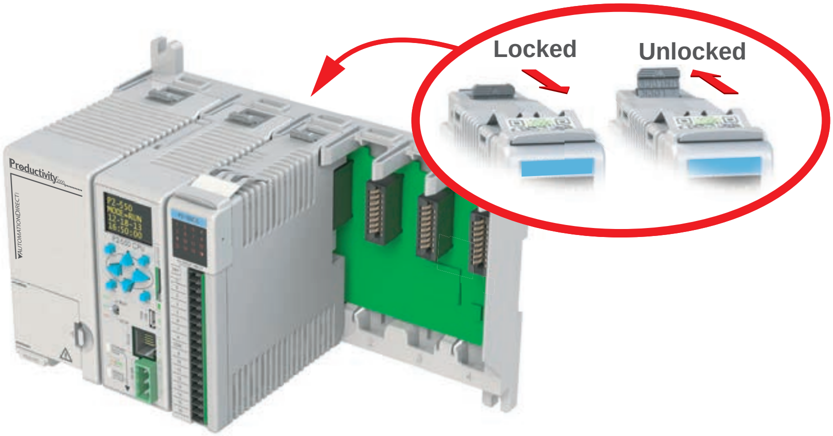
1. Install power supply in the base and engage locking tab.



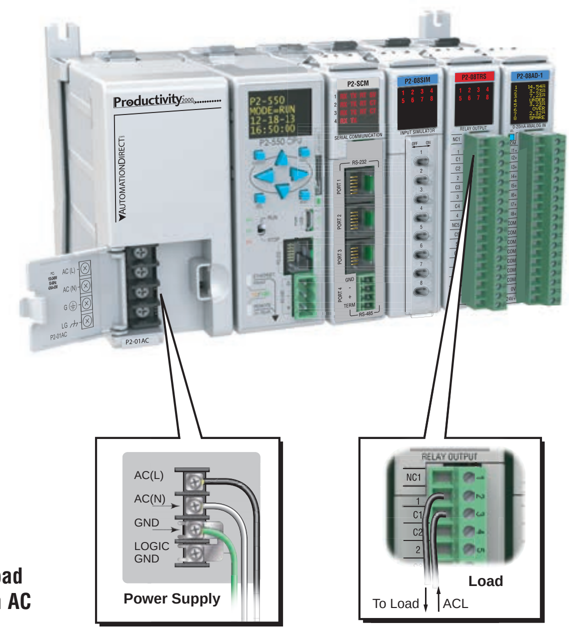

2. Install CPU in the base and engage locking tab.



3. Install I/O Modules and engage locking tabs.

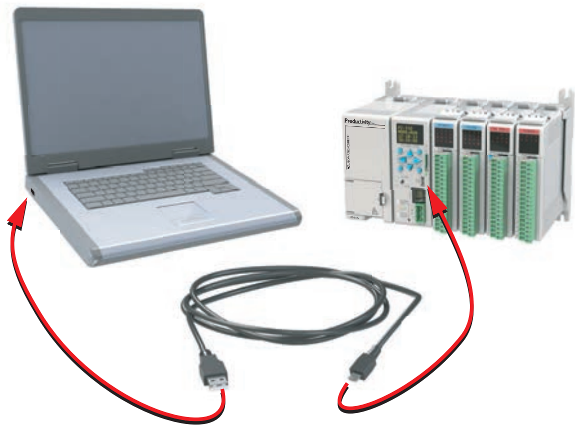



4..Connect appropriate wiring to the power supply (P2-01AC) and I/O (P2-08TRS module) in this example.




**The power supply and load are connected through an AC current source.**

5. Connect USB cable. Use a Micro USB cable with a Type A and Micro Type B connectors as shown below.

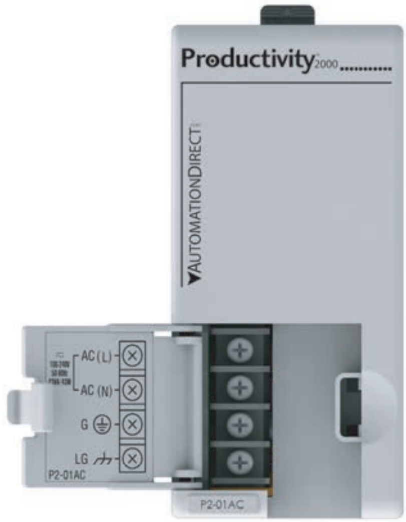


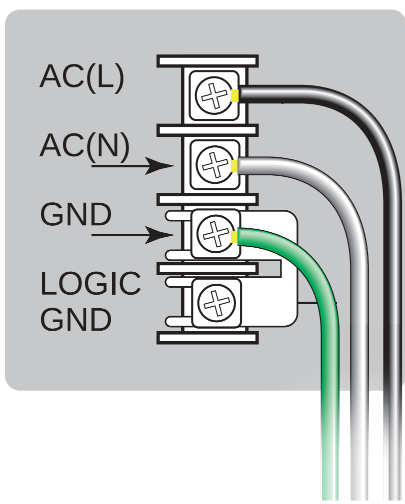
1

# Step 4: Apply Power to CPU

Ensure proper wiring and the correct voltage is available before connecting wiring to the power supply. Once this is verified, connect power to the power supply. Once power is applied, the CPU will perform a self evaluation and verification. See Chapters 2 and 5 of this manual for more power supply and input wiring information.

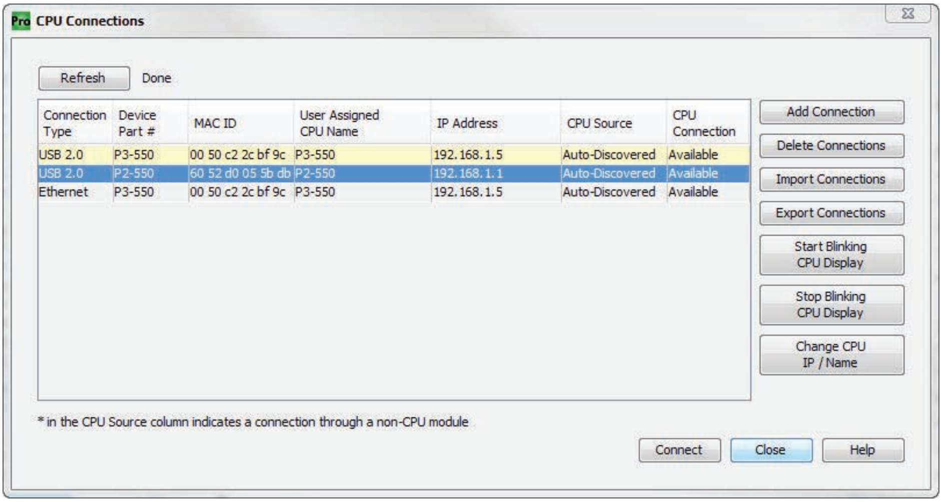
**P2-01AC**



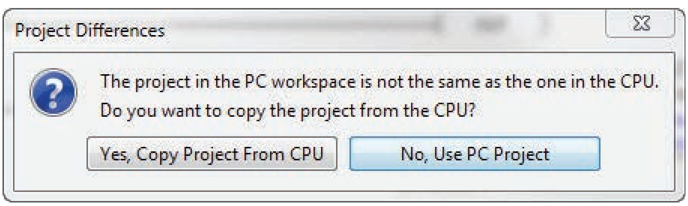



# Step 5: Establish PC to CPU Communications

Select “Choose CPU” icon on the CPU Toolbar and the dialog box shown below will appear. Highlight the installed CPU listed in the dialog box and select “Connect”.

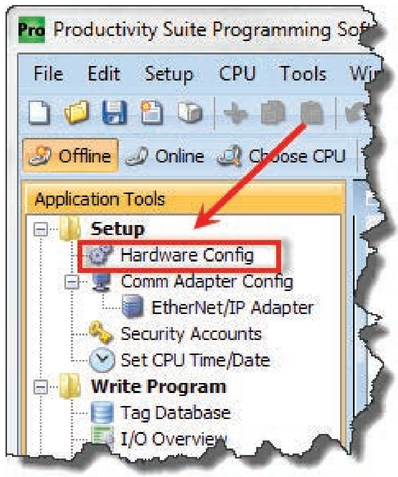


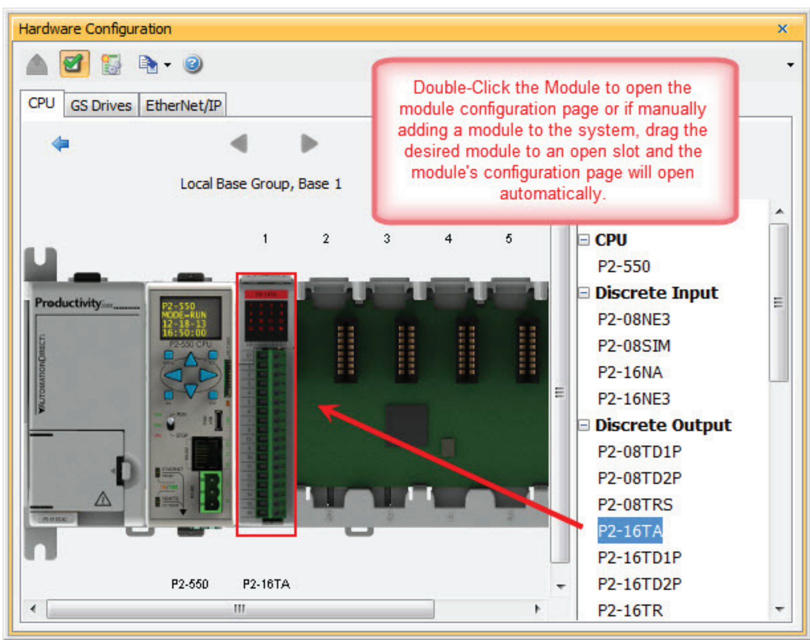

When initially going Online with the CPU, a popup window will notify you of a project difference between the CPU and the PC. Select “No, Use PC Project” command button.



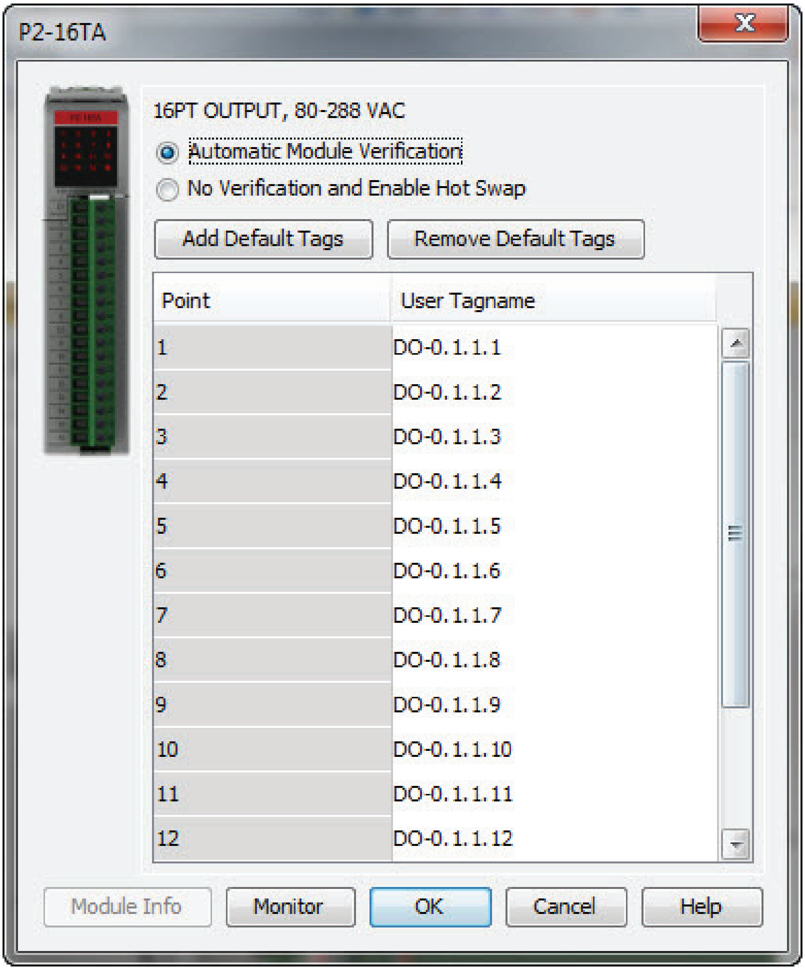
# Step 6: Open/Read Hardware Configuration

Before we create a project we must configure the hardware so we'll have default input and output tags for use in our project. With the CPU in "STOP" Mode, select Hardware Configuration under Application Tools and the following screen opens.



This screen shows the user tag names for all sixteen I/O points.  Select “OK”.



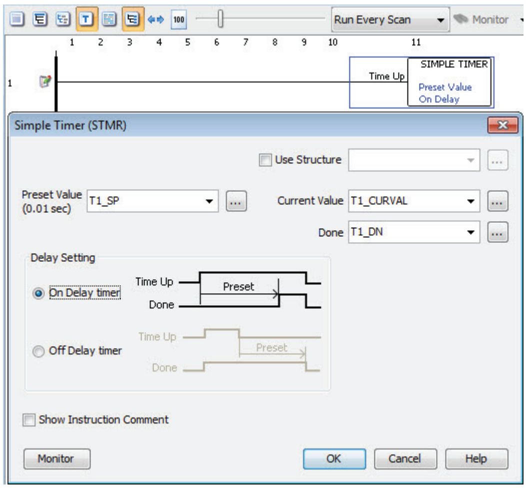
# Step 7: Create a Project

We’re going to start by entering a simple ladder logic program in the order that follows.

**Rung #1**

Select the “END” position on Rung #1 with your cursor. From the Instruction List on the right, scroll down to Counters/Timers section and double click on the Simple Timer (STMR) instruction. The “Simple Timer” instruction automatically is placed on the selected rung and the Simple Timer (STMR) dialog box pops up.

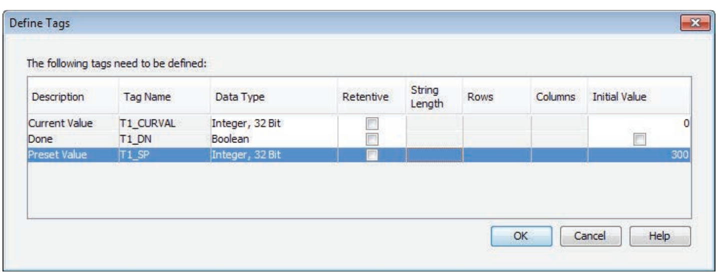
1. Enter ‘T1_SP’ into the Preset Value field.
2. Enter ‘T1_CURVAL’ into the Current Value field.
3. Enter ‘T1_DN’ into the Done field.




4. Select “OK”.

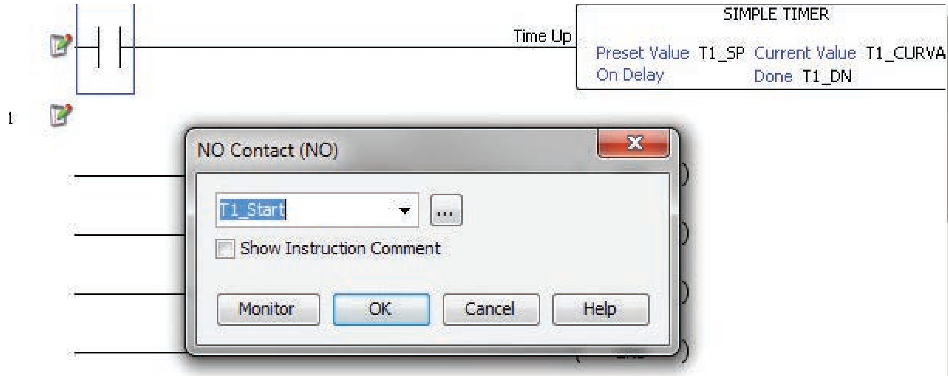
The Define Tags dialog box opens. Select OK.

5. Enter preset time value of 300ms into “Intial Value” field for Tag T1_SP.

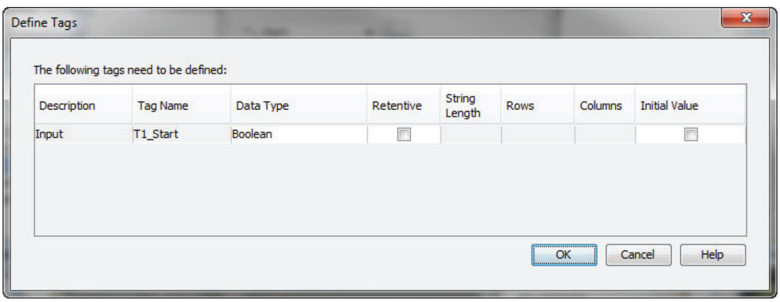


Place the cursor on the first position on Rung #1 as shown below. In the Instruction List on the right, scroll up to Contacts section and double click on "NO Contact (NO)". A NO Contact (NO) is placed at this rung position and a dialog box pops up.

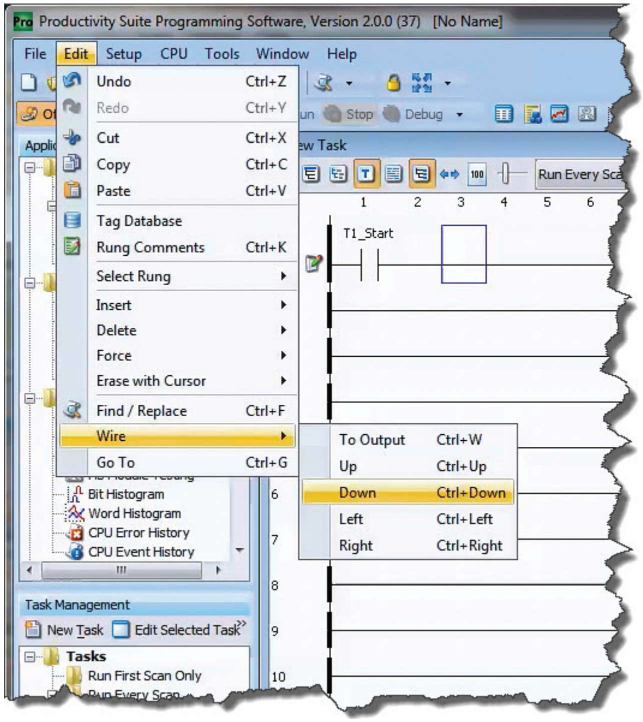
1. Enter 'T1_Start' into the text box.
2. Select OK.

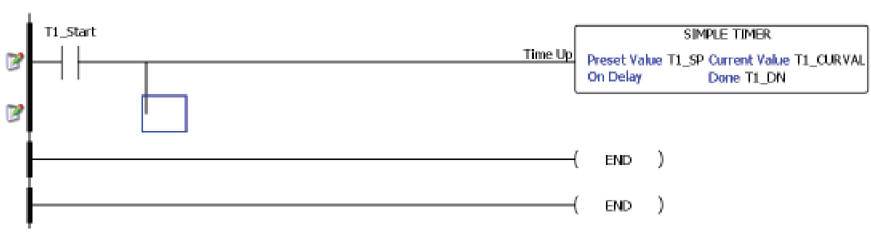



The Define Tags dialog box opens. Select "OK".



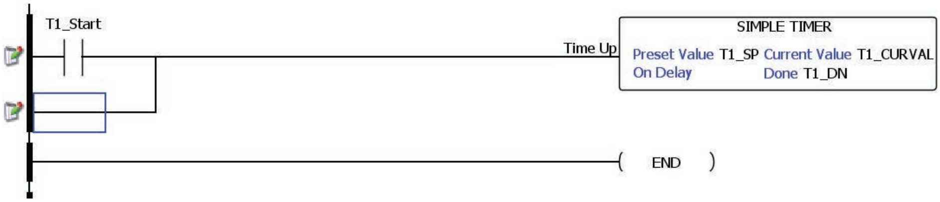
With the cursor on Rung #1, to the right of contact 'T1_Start', we are going to begin drawing a branch circuit. Under the Edit drop down menu, select "Wire", then select "Down". Notice that a wire has been added.



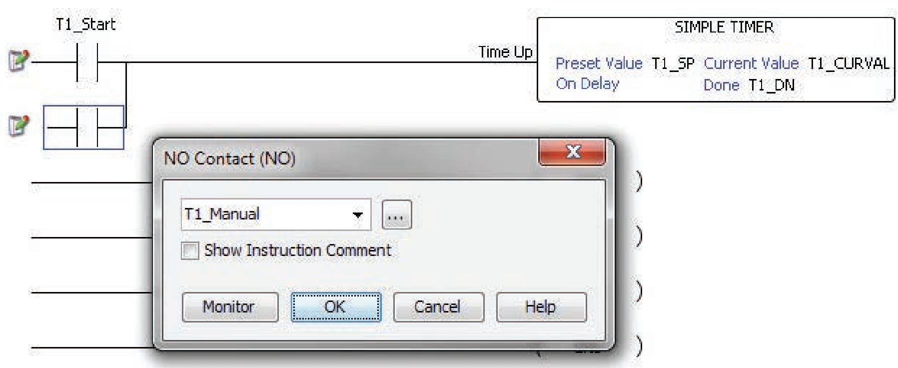

*__NOTE:__ There is also a wire Erase With Cursor tool in the Edit drop down menu that is used to erase any lines that were created using the Wire tools.*

Next we'll draw a wire to the left. Under the Edit drop down menu, select "Wire", then select "Left".

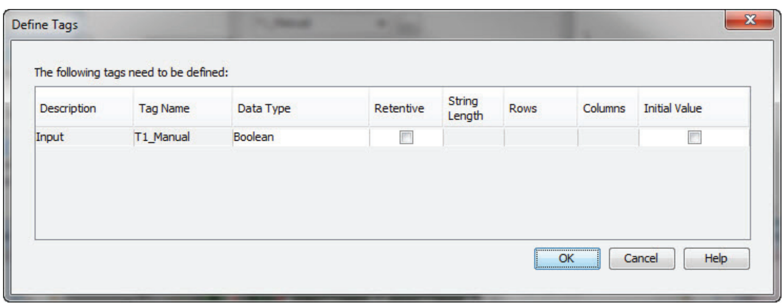



Next we'll add another normally-open contact. Place the box cursor on the first position on the newly created SubRung #1. From the Instruction List click & drag a Contact (NO) into this box. A NO Contact (NO) dialog box pops up.

1. Enter 'T1_Manual' into the field.
2. Select "OK".



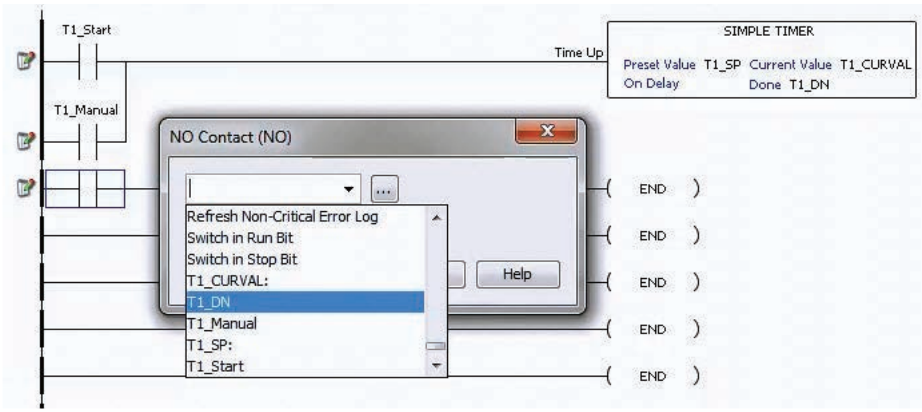

The Define Tags dialog box opens. Select "OK".



### Rung #2

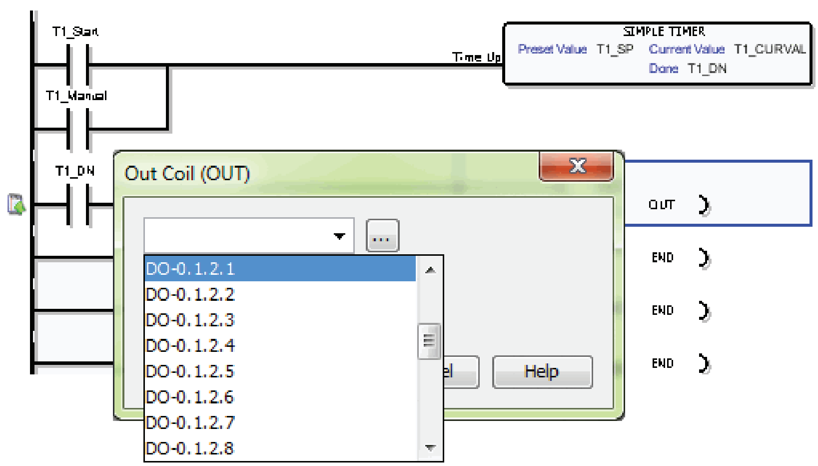
Next we'll add another normally-open contact at the start of Rung #2. Click & drag a "NO Contact (NO)" into this box. A NO Contact (NO) dialog box pops up.

1. In the empty tag field press the down arrow on the right to open a drop-down list; scroll down and select 'T1_DN'.
2. Select "OK".

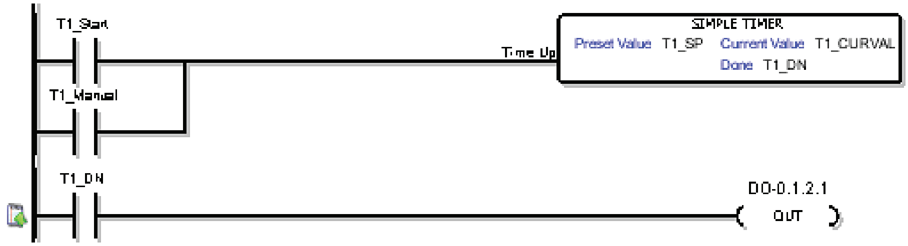



Next we'll add an Out coil at the end of the rung. Place the cursor at the end of the rung. From the Instructions list Coil section, double click on an "Out Coil (OUT)". An Out Coil (OUT) is placed on the rung and a dialog box pops up.

1. In the tag field press the down arrow on the right to open a drop-down list; scroll down and select 'DO-0.1.2.1'.
2. Select OK.

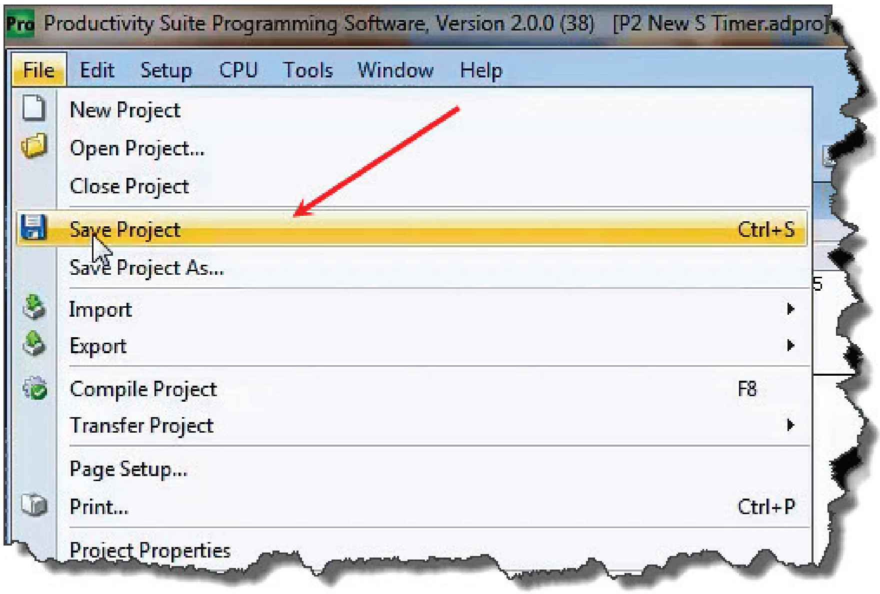


The ladder program now looks like this. When either of the T1 contacts are energized, the timer starts. When it times out, contact T1_DN energizes and turns on the rung 2 output.



## Step 8: Save Project

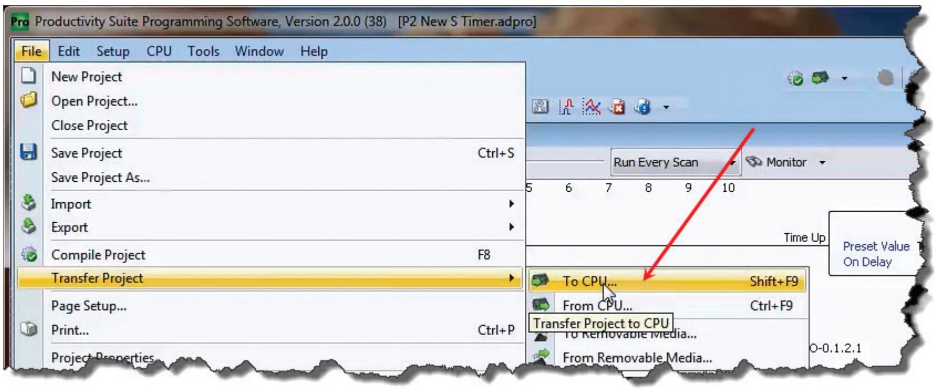
Save the project by opening the File drop-down menu and selecting Save Project.



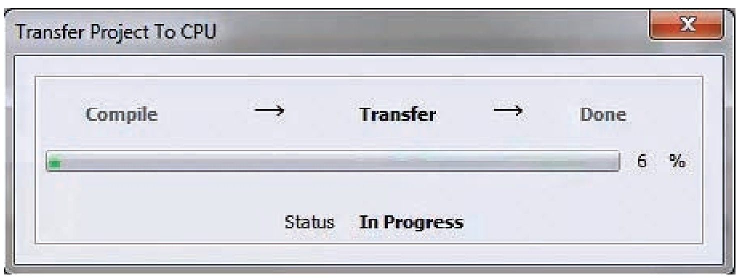
# Step 9: Write Project to CPU

Next we will transfer the project to the CPU. Transfer Project is accessed by selecting Transfer Project from the File Menu.

Select "To CPU" from the Transfer Project menu.

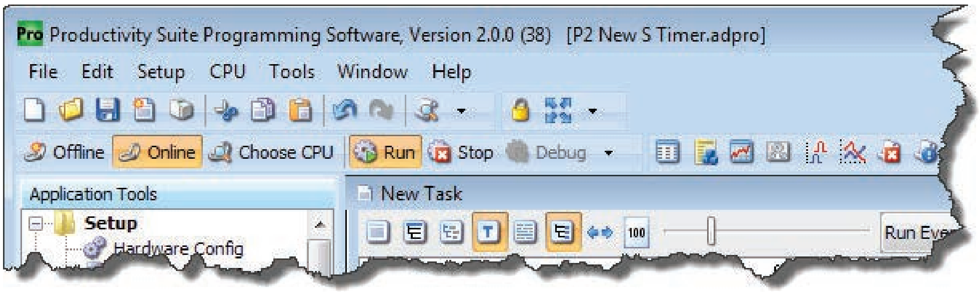



The project will then be Transferred to the CPU from the PC. During the transfer a status window will open displaying the process.



## Step 10: Place CPU in RUN Mode

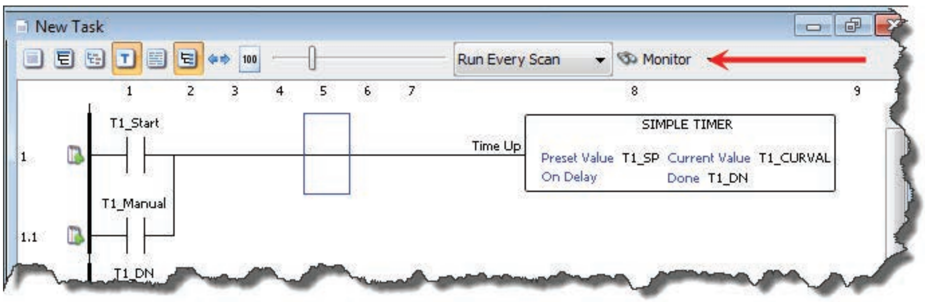
Next, verify the Run/Stop switch on the CPU faceplate is placed in the Run position and then place the CPU in RUN mode on the Productivity Software Toolbar so the ladder logic program executes.




***NOTE:*** *If the Run/Stop switch on the CPU is in the Stop position, the Run button on the Programming Software Toolbar will be disabled.*

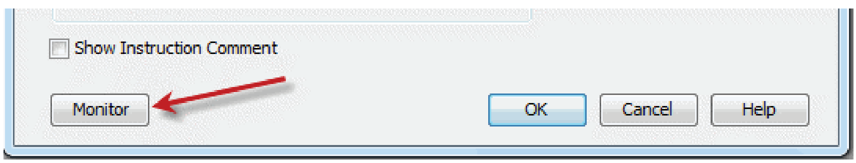
## Step 11: Test the Project Using Monitor Mode

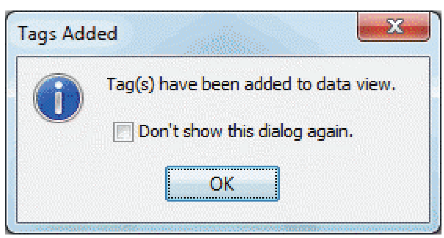
In this next step, use the Monitor Mode and Data View to test the ladder logic program. Select Monitor Mode from the top of the Ladder Logic screen to display the status of Boolean and Integer Tags.



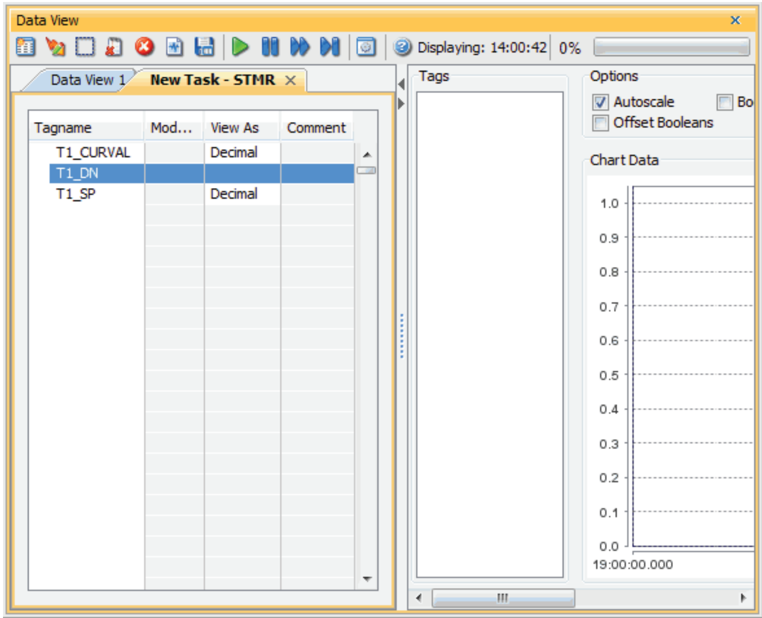

Using Data View, the Tag values can be viewed or manipulated for testing the project. The Data View window can be accessed by selecting Data View from the Tools Menu of the Main Menu.

For the Simple Timer Instruction, a Monitor button is provided that, when selected, will load the tags associated with the instruction into Data View.

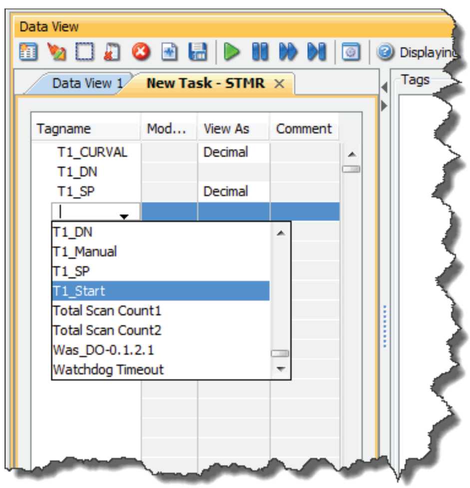


The tags will be placed in a separate Tab titled New Task - STMR as seen below.

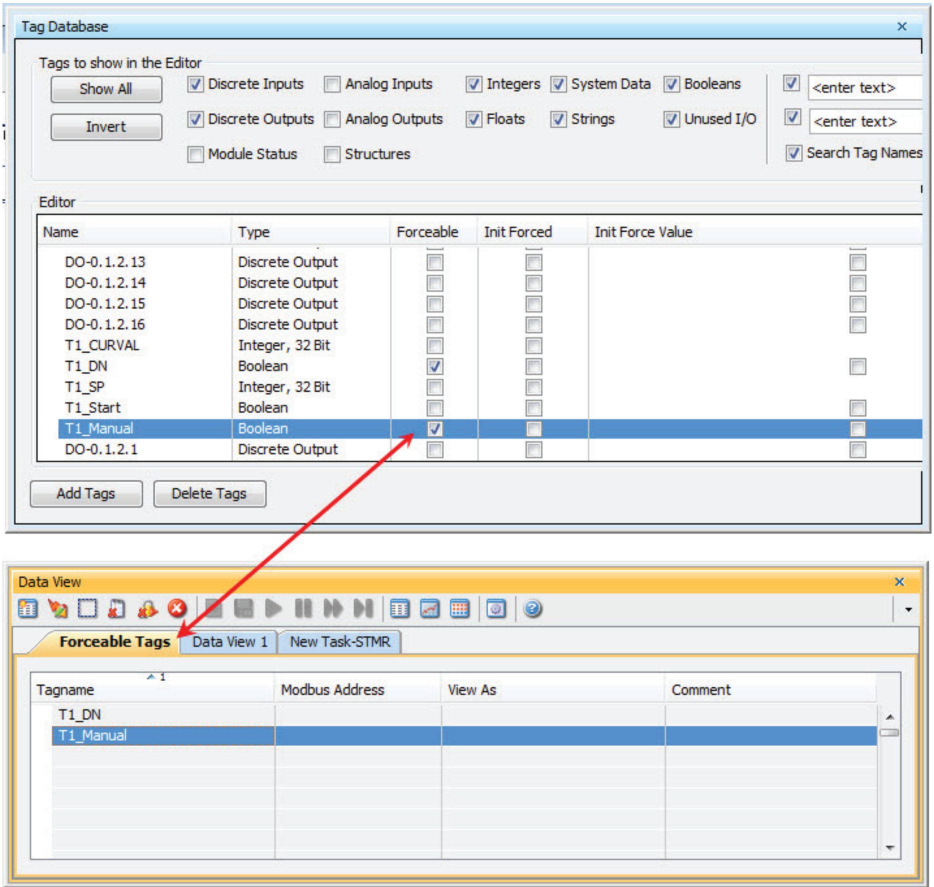



The remaining tagnames in the Ladder Logic can be added to the Data View window by clicking on a blank area in the Tagname column. This will display a drop down menu where the tags can be selected. Scroll down the list and select the tags to be added.



Once all of the tagnames have been added, they can now be monitored and manipulated. See the Data View help file topic for additional details if needed.

***NOTE:*** *Force must be enabled for a Tag in the Tag Database before Force can be used in Data View.*



## Notes

# SPECIFICATIONS

CHAPTER
2

## In This Chapter...

# Overview

## Base Hardware

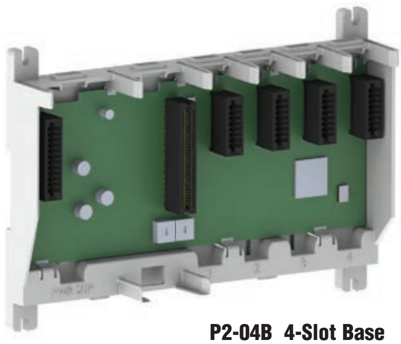
The Productivity2000 system is a modular system that requires a base to accommodate the various modules. Bases are available in sizes of 4, 7, 11 and 15 I/O module slots. The base contains additional dedicated slots for the power supply and the CPU unit. You can place any I/O module into any slot without power budget or module type restrictions.

The backplane incorporates a discrete and analog I/O processor which unloads the I/O module communication task from the CPU. This distributed processing architecture results in outstanding performance at a very low cost. The backplane includes a high-speed communication pathway directly from the CPU to specialty modules and to the discrete and analog module backplane processor.

The base supports hot swapping and has electronic module keying for each slot.

# P2-04B, P2-07B, P2-11B, P2-15B Bases

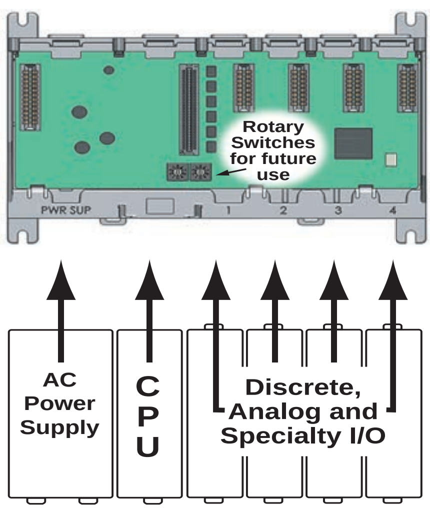
The P2-04B, P2-07B, P2-11B, and P2-15B are 4, 7, 11, and 15-slot, local, expansion, and remote I/O bases.

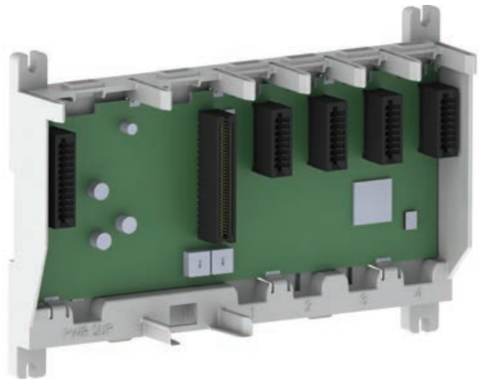


**P2-04B 4-Slot Base**

***NOTE:*** *See Chapter 5 for base dimensions.*

## Base Configuration





## Base Specifications

| | |
|---|---|
| Input or Output Modules per Base | 4, 7, 11, or 15 |
| Power Supply Slots | 1 (P2-01AC) |
| CPU Slots | 1 (P2-550) |
| Module Types Supported | Discrete, analog and specialty |
| Module Placement Restrictions | None. Any I/O module may be installed in any I/O slot without power supply budget or module type restrictions. |
| I/O Module Hot Swap Support | Yes. (All discrete, analog and specialty modules can be software enabled for Hot Swap operation) |
| Module Keying | Electronic to slot |
| Maximum Number of Local Bases | 1 |

## General Specifications

| | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Heat Dissipation | 3W |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Weight | P2-04B: 204g (7.2 oz) |
| | P2-07B: 294g (10.4 oz) |
| | P2-11B: 430g (15.2 oz) |
| | P2-15B: 521g (18.4 oz) |

*Meets EMC and Safety requirements. See the Declaration of Conformity for details.

# P2-01AC Power Supply

The power supply provides isolated 24VDC, and 3.3 VDC to the Productivity2000 bases.

The P2-01AC input power supply requires power from an external 100-240 VAC source.

## No Power Budgeting

No power budgeting is required with power supply. Any combination of I/O modules may be installed in any slot without power budget considerations.


P2-01AC

| Terminal Block Specifications | |
|---|---|
| Number of positions | 4 screw terminals |
| Wire Range | 22-12 AWG (0.324 to 3.31 mm²)<br>Solid / Stranded conductor<br>3/64 in (1.2 mm) insulation maximum<br>Use copper conductors, 75°C or equivalent |
| Screw Driver Width | 1/4 in (6.5 mm) maximum |
| Screw Size | M3 |
| Screw Torque | 7-9 lb·in (0.882 - 1.02 N·m) |

## P2-01AC Power Supply

P2-01AC


**IMPORTANT!**

| Hot-Swapping Information |
|---|
| **Note: This device cannot be Hot Swapped.** |

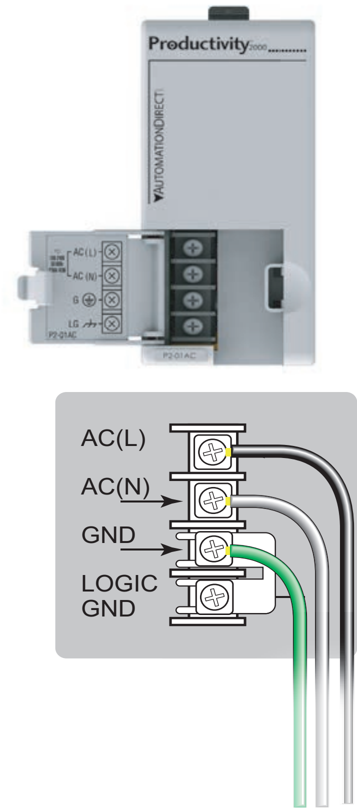
| User Specifications | |
|---|---|
| Input Voltage Range (Tolerance) | 100 to 240 VAC (-15% / +10%) |
| Rated Operating Frequency | 50 to 60Hz with ±5% tolerance |
| Maximum Input Power | 37.4 W |
| Cold Start Inrush Current | 23.6 A |
| Maximum Inrush Current (Hot Start) | 25.6 A |
| Input Fuse Protection (Internal) | Micro fuse 250V, 1A<br>Non-replaceable |
| Efficiency | 75% |
| Output | UL Rated:<br>24VDC, 0.85 A<br>3.3 VDC, 3.81 A |
| Maximum Output Power | 29W Combined |
| Heat Dissipation | 8.4 W |
| Isolated User 24VDC Output | None |
| Output Protection for Over Current, Over Voltage, and Over Temperature | Self resetting for both voltage outputs to base |
| Under Input Voltage Lock-out | 55-65 VAC |
| Over Input Voltage Lock-out | 265-280 VAC |
| Input Transient Protection | Varistor, plus input choke and filter |
| Operating Design Life | 10 years at full load at 40°C ambient and<br>5 years at 60°C ambient |

| General Specifications | |
|---|---|
| Operating Temperature | 0º to 60ºC (32º to 140ºF) |
| Storage Temperature | -20º to 70ºC (-4º to 158ºF) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Voltage Withstand (dielectric) | 2100VDC applied for 2 seconds |
| Insulation Resistance | >10MΩ @ 500VDC |
| Module Location | Power Supply slot in a Productivity2000 System. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Weight | 90g (3.2 oz) |

*Meets EMC and Safety requirements. See the D.O.C. for details.

## Power Connections

**P2-01AC**




# Grounding

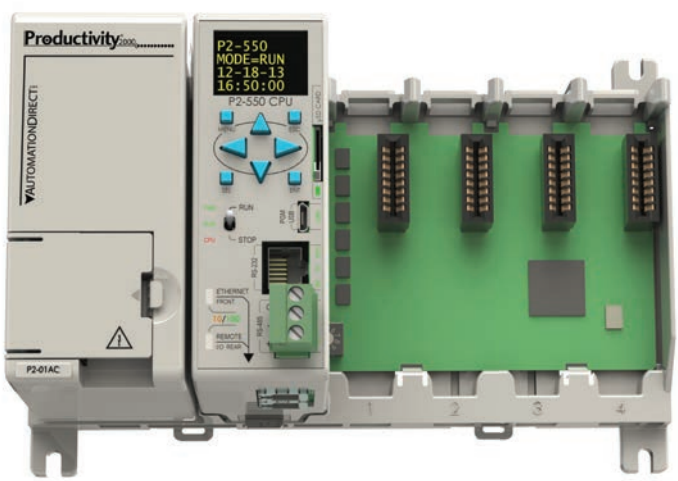
A good common ground reference (earth ground) is essential for proper operation of the Productivity2000 system. One side of all control circuits, power circuits and the ground lead must be properly connected to earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.

# Productivity2000 CPU Module

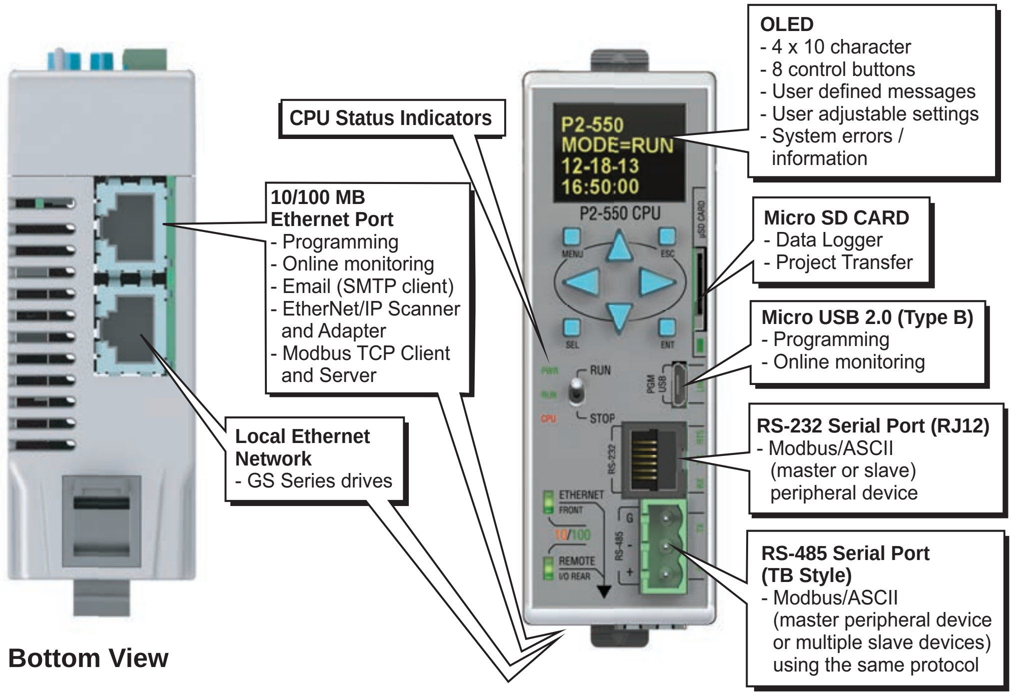
Each Productivity2000 system base requires one CPU module be mounted in the controller slot of the unit. The CPU stores and executes the user's program.



## P2-550

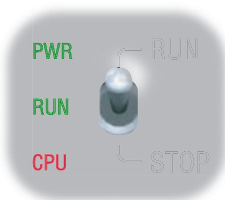



## P2-550 Specifications




| CPU Run/Stop Switch | |
|---|---|
| RUN position | Executes user program, run-time edits possible |
| STOP position | Does not execute user program, normal program load position |

| CPU Status Indicators | |
|---|---|
| PWR | Green LED is illuminated when power is ON |
| RUN | Green LED is illuminated when CPU is in RUN mode |
| CPU | Red LED is illuminated during power ON reset, power down, or watch-dog time-out. |



2

| CPU Specifications* | |
|---|---|
| User Memory | 50MB (Includes program, data and documention) |
| Memory Type | Flash and Battery Backed RAM |
| Retentive Memory | 500kB |
| Scan Time | 500µs (3K Boolean, 240 I/O) |
| Display | OLED, 4 x 10 characters, 8 control buttons;<br>OLED characters are 5 x 7 with a dot pitch of 0.45 mm; 2.25 mm x 3.15 mm |
| Communications;<br>5 Integrated Ports | **USB IN:** Programming, Monitoring, Debug, Firmware<br>**ETHERNET:** (10/100Mbps Ethernet) Programming, Monitoring, Debug, Firmware, Email SMTP Client, Modbus TCP Client (32 Servers) and Server (16 Clients), EtherNet/IP Scanner (32 Adaptors) and Adaptor (4 scanners) with 8 connections per device.<br>**Local Ethernet:** 16 GS-EDRV100 (GS Drives)<br>**RS-232:** (RJ12, 1200-115.2k Baud) ASCII, Modbus<br>**RS-485:** Removable Terminal Included, (1200-115.2k Baud) ASCII, Modbus RTU |
| Data Logging/Project Transfer | Micro SD card slot |
| Hardware Limits of System | **240 Hardware I/O Points:** All 16-point I/O Modules<br>**16 GS Series Drives** as Local Network I/O |
| Instruction Types | Application Functions<br>Array Functions<br>Counters/Timers<br>Communications<br>Data Handling<br>Drum Sequencers<br>Math Functions<br>PID<br>Program Control<br>String Functions<br>System Functions<br>Contacts<br>Coils |
| Real Time Clock Accuracy | +/- 5s per day typical at 25°C<br>+/- 15s per day maximum at 60°C |

* Meets EMC and Safety requirements. See the Declaration of Conformity for details.


**IMPORTANT!**

| Hot-Swapping Information |
|---|
| **Note: This device cannot be Hot Swapped.** |

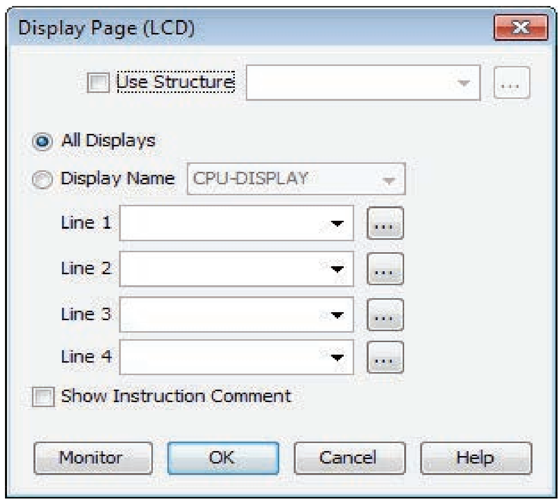
## OLED Message Display

The P2-550 CPU incorporates a 4 line by 10 character OLED for system alarms, information and for displaying user-defined messages. OLED characters are 5 x 7 (2.25 mm x3.15 mm) with a dot pitch of 0.45 mm.

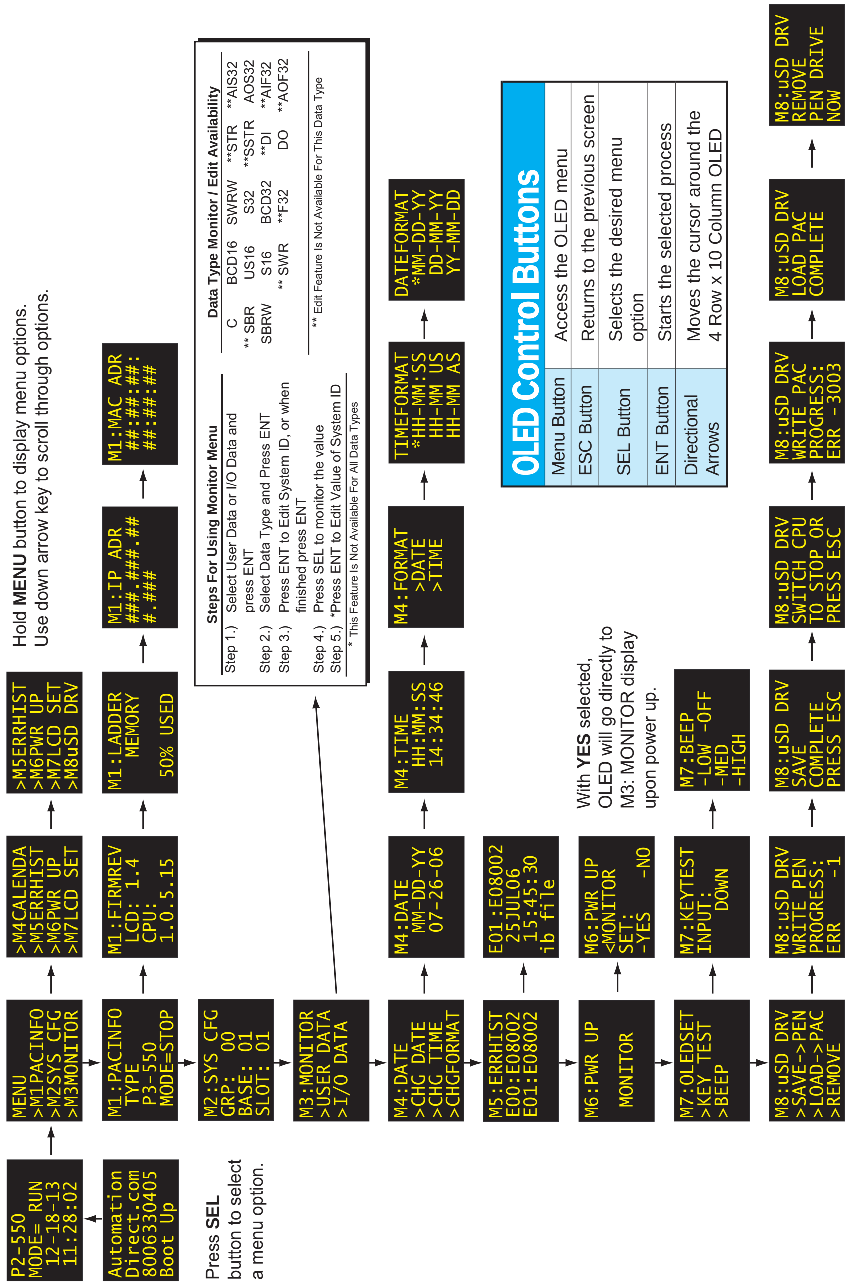
OLED control buttons located beneath the display allow the user to navigate through menu items. These buttons also permit local configuration of time and date settings.

For user defined messages, the display is configured using the Productivity Suite Programming Software. A “Display Page” instruction dialog box allows the user to program text into user-defined tags and display the messages based on the programmed ladder execution.


| OLED Control Buttons | |
|---|---|
| Menu Button | Access the OLED menu |
| ESC Button | Returns to the previous screen |
| SEL Button | Selects the desired menu option |
| ENT Button | Starts the selected process |
| Directional Arrows | Moves the cursor around the 4-Row x 10-Column OLED |



## Front Panel OLED Monitoring and Configuration




**Steps For Using Monitor Menu**

Step 1.) Select User Data or I/O Data and press ENT
Step 2.) Select Data Type and Press ENT
Step 3.) Press ENT to Edit System ID, or when finished press ENT
Step 4.) Press SEL to monitor the value
Step 5.) *Press ENT to Edit Value of System ID

* This Feature Is Not Available For All Data Types

**Data Type Monitor / Edit Availability**

| | | | | |
|---|---|---|---|---|
| C | BCD16 | SWRW | **STR | **AIS32 |
| ** SBR | US16 | S32 | **SSTR | AOS32 |
| SBRW | S16 | BCD32 | **DI | **AIF32 |
| | ** SWR | **F32 | DO | **AOF32 |

** Edit Feature Is Not Available For This Data Type

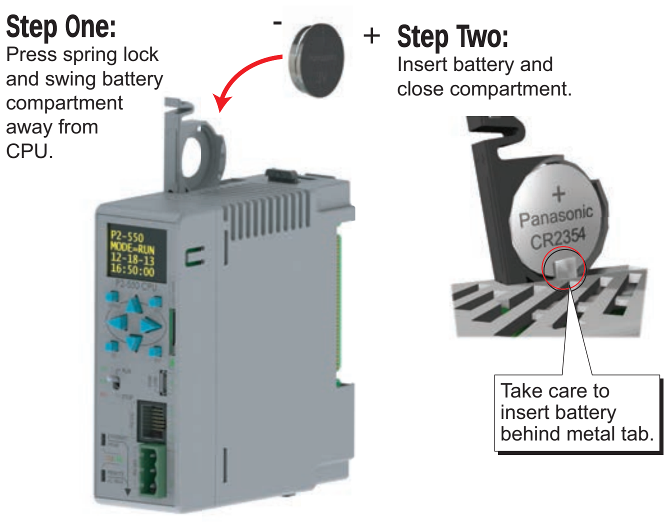
**OLED Control Buttons**

| | |
|---|---|
| Menu Button | Access the OLED menu |
| ESC Button | Returns to the previous screen |
| SEL Button | Selects the desired menu option |
| ENT Button | Starts the selected process |
| Directional Arrows | Moves the cursor around the 4 Row x 10 Column OLED |

## Battery (Optional)

A battery is included with the P2-550 CPU module, but is not installed. The battery may be installed in order to retain the Time and Date along with any Tagname values that are set up as retentive.

The battery is not needed for program backup.



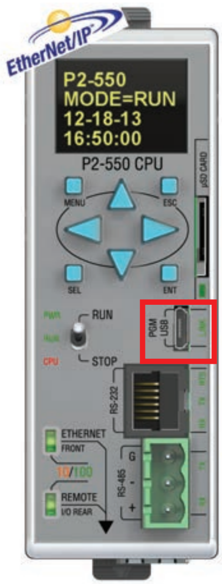

| Battery (Optional) | |
|---|---|
| D2-BAT-1 | Coin type, 3.0 V Lithium battery, 560mA, battery number CR2354 |
| **Note:** Although not needed for program backup, a battery is included with the P2-550. Install this battery if you want the CPU to retain the Time and Date along with any Tagname values that you have set up as retentive. | |

## Port Specifications

The P2-550 CPU has several communications ports and the following pages contain their specifications and pin-out diagrams.



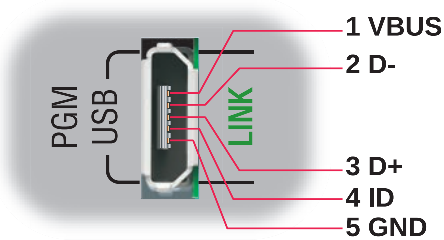
### P2-550



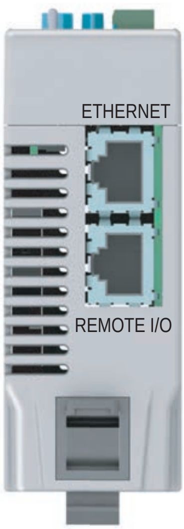

### MICRO USB Programming Port

Used exclusively for connecting to a PC running the ProductivitySuite programming software.

| Micro USB Input Specifications | |
|---|---|
| Port Name | MICRO USB |
| Description | Standard Micro USB Slave input for programming and on-line monitoring, with built-in surge protection. Not compatible with older full speed USB devices. |
| Transfer Rate | 480 Mbps |
| Port Status LED | Green LED is illuminated when LINK is established to programming software. |
| Cables | USB Type A to Micro USB Type B:<br>6ft cable part # USB-CBL-AMICB6<br>15ft cable part # USB-CBL-AMICB15 |



## P2-550


**P2-550 Bottom View**

## Ethernet Port (On bottom of CPU)

RJ-45 style connector used for:

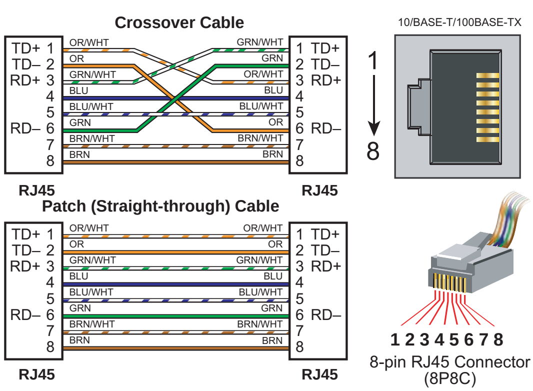
- Connection to a PC running the ProductivitySuite programming software
- Modbus TCP Client (32 Servers) connections (Modbus requests sent from the CPU)
- Modbus TCP Server (16 Clients) connections (Modbus requests received by the CPU)
- EtherNet/IP Scanner (32 Adaptors)
- EtherNet/IP Adapter (4 scanners) with 8 connections per device.
- Outgoing Email

## Remote I/O Port (On bottom of CPU)

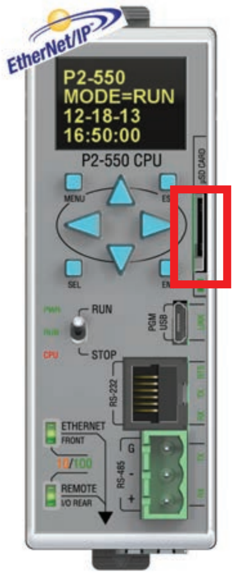
RJ-45 style connector used for connecting to a Remote I/O network consisting of GS-EDRV100 units with GS drives.

### Ethernet Specifications

| Port Name | ETHERNET | REMOTE I/O |
|---|---|---|
| Description | Standard transformer isolated Ethernet port with built-in surge protection for programming, online monitoring, Email (SMTP client), Modbus/TCP client/server connections (fixed IP or DHCP), and EtherNet/IP Scanner/Apapter connections. | Standard transformer isolated Ethernet port with built-in surge protection for connection to 16 GS Series Drives. |
| Transfer Rate | 10Mbps (Orange LED) and 100Mbps (Green LED) [Auto-MDIX (cross-over)]. | |
| Port Status LED | LED is solid when network LINK is established. LED flashes when port is active (ACT). | |



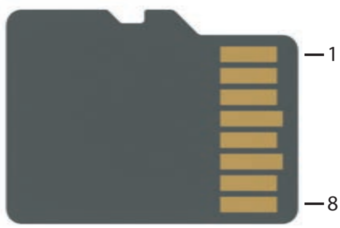
## P2-550




# MICRO SD SLOT

Used for data logging or project transfers.

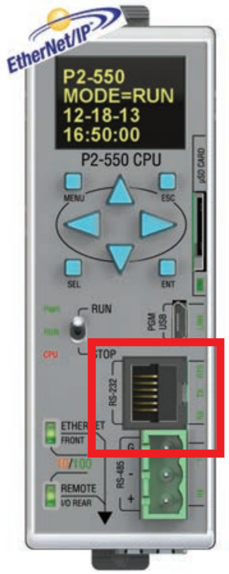
| Micro SD Specifications | | | | |
|---|---|---|---|---|
| Port Name | MICRO SD | | | |
| Description | Standard Micro SD socket for data logging or program transfer | | | |
| Maximum Card Capacity | 32GB | | | |
| Transfer Rate (ADATA microSDHC Class 4 memory card) | Mbps | Minimum | Typical | Maximum |
| | Read | 14.3 | 14.4 | 14.6 |
| | Write | 4.8 | 4.9 | 5.1 |
| Port Status LED | Green LED is illuminated when card is inserted/ detected | | | |




| Pin | SD |
|---|---|
| 1 | DAT2 |
| 2 | CD/DAT3 |
| 3 | CMD |
| 4 | VDD |
| 5 | CLK |
| 6 | VSS |
| 7 | DAT0 |
| 8 | DAT1 |

Note: Card not included with unit.

## P2-550

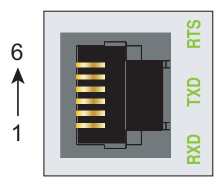



### RS-232 Port

RJ-12 style connector used for:

- Modbus RTU Master connections
- Modbus RTU Slave connections
- ASCII full or half duplex communications
- Custom Protocol Incoming and Outgoing communications

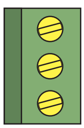
| RS-232 Specifications | |
|---|---|
| Port Name | RS-232 |
| Description | Non-isolated RS-232 DTE port connects the CPU as a Modbus/ASCII master or slave to a peripheral device. Includes ESD and built-in surge protection |
| Data Rates | Selectable,1200, 2400, 4800, 9600, 19200, 33600, 38400, 57600, and 115200 baud |
| +5V Cable Power Source | 210mA maximum at 5V, +/- 5%. Reverse polarity and overload protected |
| TXD | RS-232 Transmit output |
| RXD | RS-232 Receive input |
| RTS | Handshaking output for modem control |
| GND | Logic ground |
| Maximum Output Load (TXD/RTS) | 3kΩ, 1000pf |
| Minimum Output Voltage Swing | +/-5V |
| Output Short Circuit Protection | +/-15mA |
| Port Status LED | Green LED is illuminated when active for TXD, RXD and RTS |
| Cable Options | EA-MG-PGM-CBL<br>D2-DSCBL<br>USB-RS232 with D2-DSCBL<br>FA-CABKIT<br>FA-ISOCON for converting RS-232 to isolated RS-485 |



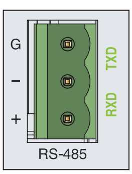

6-pin RJ12 Female Modular Connector

| Pin # | Signal | |
|---|---|---|
| 6 | GND | Logic Ground |
| 5 | RTS | RS-232 Output |
| 4 | TXD | RS-232 Output |
| 3 | RXD | RS-232 Input |
| 2 | +5V | 210mA Maximum |
| 1 | GND | Logic Ground |

## P2-550

Removable connector included.
Spare connectors available
(part no. P2-RS485CON).




| Pin # | Signal |
|---|---|
| G | GND |
| – | TXD-/RXD- |
| + | TXD+/RXD+ |

## RS-485 Port

A 3-pin removable terminal block used for:

- Modbus RTU Master connections
- Modbus RTU Slave connections
- ASCII Incoming and Outgoing communications
- Custom Protocol Incoming and Outgoing communications

| RS-485 Port Specifications | |
|---|---|
| Port Name | RS-485 |
| Description | Non-isolated RS-485 port connects the CPU as a Modbus/ASCII master or slave to a peripheral device. Includes ESD/EFT protection and automatic echo cancellation when transmitter is active |
| Data Rates | Selectable, 1200, 2400, 4800, 9600, 19200, 33600, 38400, 57600, and 115200 baud |
| TXD+/RXD+ | RS-485 transceiver high |
| TXD-/RXD- | RS-485 transceiver low |
| GND | Logic ground |
| Input Impedance | 19kΩ |
| Maximum Load | 50 transceivers, 19kΩ each, 60Ω termination |
| Output Short Circuit Protection | +/- 250mA, thermal shut-down protection |
| Electrostatic Discharge Protection | +/- 8KV per IEC1000-4-2 |
| Electrical Fast Transient Protection | +/- 2KV per IEC1000-4-4 |
| Minimum Differential Output Voltage | 1.5 V with 60Ω load |
| Fail Safe Inputs | Logic high input state if inputs are unconnected |
| Maximum Common Mode Voltage | -7.5 V to 12.5 V |
| Port Status LED | Green LED illuminated when active for TXD and RXD |
| Cable Options | Recommend L19827-XXX from AutomationDirect.com |

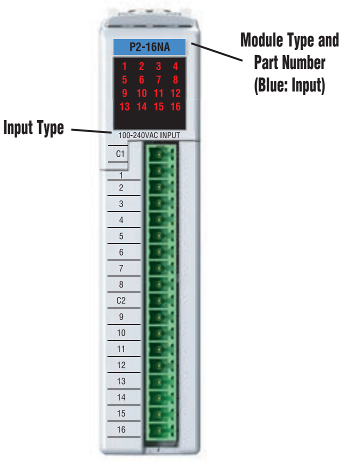
| Removable Terminal Block Specifications | |
|---|---|
| Part Number | P3-RS485CON |
| Number of Positions | 3 Screw Terminals |
| Pitch | 5mm |
| Wire Range | 28-12 AWG Solid Conductor<br>30-12 AWG Stranded Conductor |
| Screw Driver Width | 1/8 inch (3.175 mm) Maximum |
| Screw Size | M2.5 |
| Screw Torque | 4.5 lb·in (0.51 N·m) |

# I/O Modules Overview

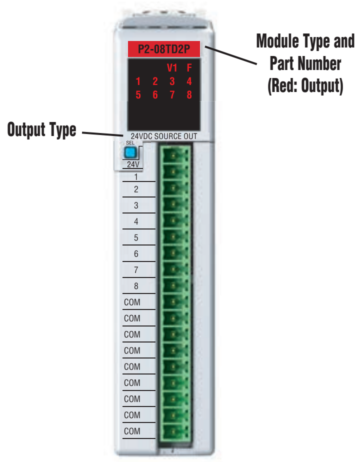
A variety of discrete and analog I/O modules are available for use in the P2000 System.

Each I/O module is identified as an "Input", "Output", or "Input/Output" module on its front panel using the color coding scheme listed below. See the following pages for discrete I/O module specifications, Chapter 3 for analog I/O module specifications and Chapter 4 for specialty module specifications.

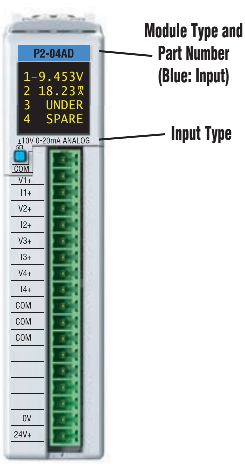
### *Discrete Input Modules*



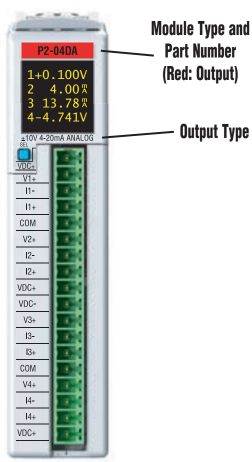

### *Discrete Output Modules*



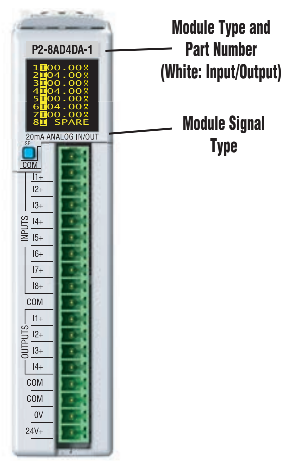

### *Analog Input Modules*



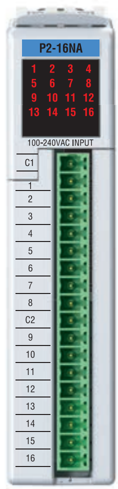

### *Analog Output Modules*




### *Analog Input/Output Modules*

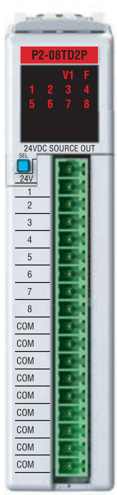


# Discrete I/O Modules




## Discrete Input Modules

| Productivity2000 Discrete Input Modules | | | |
|---|---|---|---|
| **Part Number** | **Number of Inputs** | **Description** | **See Page** |
| P2-8SIM | 8 | Input Simulator Module | 2-21 |
| P2-08NE3 | 8 | AC/DC Sinking/Sourcing Input | 2-22 |
| P2-16NE3 | 16 | AC/DC Sinking/ SourcingInput | 2-25 |
| P2-16NA | 16 | AC Input | 2-28 |




## Discrete Output Modules

| Productivity2000 Discrete Output Modules | | | |
|---|---|---|---|
| **Part Number** | **Number of Outputs** | **Description** | **See Page** |
| P2-08TD1P | 8 | Sinking Output | 2-31 |
| P2-08TD2P | 8 | Sourcing Output | 2-34 |
| P2-16TD1P | 16 | Sinking Output | 2-37 |
| P2-16TD2P | 16 | Sourcing Output | 2-40 |
| P2-16TA | 16 | AC Output | 2-43 |
| P2-08TRS | 8 | Isolated Relay Output | 2-45 |
| P2-16TR | 16 | Relay Output | 2-49 |

# P2-08SIM Input Simulator Module

The P2-08SIM Input Simulator Module provides 8 toggle switches to simulate input devices.


## Input Specifications

| | |
|---|---|
| Inputs per Module | 8 Internal switches |
| OFF to ON Response | Max. 20 ms |
| ON to OFF Response | Max. 20 ms |
| Status Indicators | Logic Side (8 points) |

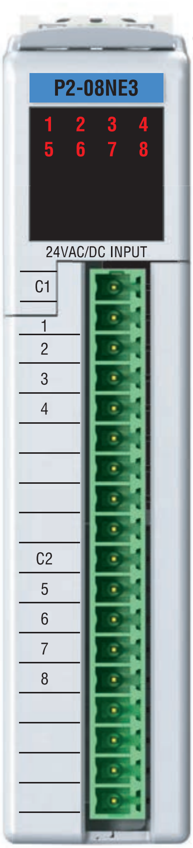
## General Specifications

| | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Heat Dissipation | 200mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Location | Any I/O slot in a Productivity2000 System. |
| EU Directive | See the "EU Directive" topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

# P2-08NE3 AC/DC Sinking/Sourcing Input

The P2-08NE3 AC/DC Input Module provides eight 24 VAC or DC sink/sourcing inputs for use with the Productivity2000 system.




| Input Specifications | |
|---|---|
| Inputs per Module | 8 (Sink/Source) |
| Voltage Range | 24 VAC /VDC |
| Input Voltage Range | 20.4 - 27.6 VAC /VDC |
| Peak Voltage | 27.6 VAC / 30VDC |
| AC Frequency | 47 - 63 Hz |
| Input Current (Typical) | 3.4 mA @ 24 VAC /VDC |
| Maximum Input Current @ Temp | 5.0 mA @ 27.6 VAC /VDC |
| ON Voltage Level | > 12VDC, >9VAC |
| OFF Voltage Level | < 10.5 VDC, <9VAC |
| Minimum ON Current | 2.5 mA |
| Maximum OFF Current | 0.5 mA |
| OFF to ON Response | DC: 6ms > max<br>AC: 10ms |
| ON to OFF Response | DC: 10ms > max<br>AC: 20ms |
| Status Indicators | Logic Side (8 points) |
| Commons | 2 Isolated (4 points/common) |

***Terminal blocks sold separately.**

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-08NE3 AC/DC Sinking/Sourcing Input, (continued)

## General Specifications

| | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F), |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800 VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500 VDC |
| Heat Dissipation | 325mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System. |
| Field Wiring | Removable terminal block (not included). Use ***ZIP***Link wiring system or optional terminal block. See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the Declaration of Conformity for details.

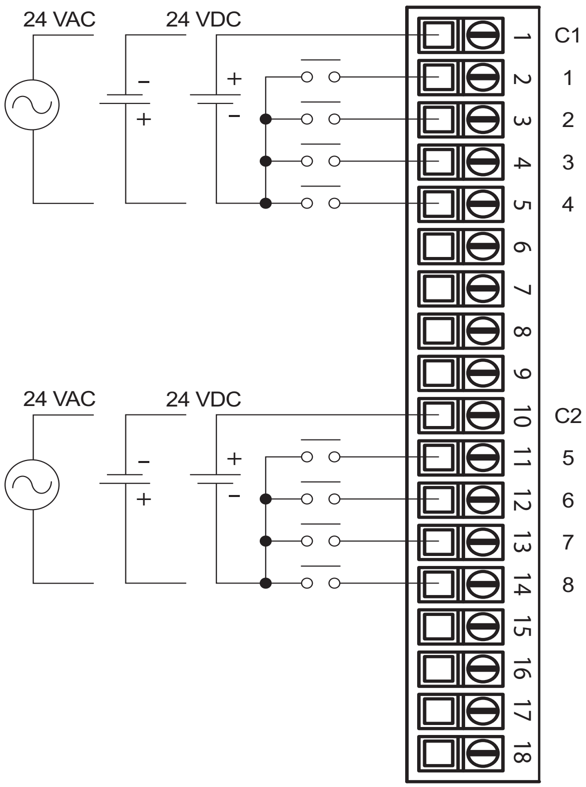
## Removable Terminal Block Specifications*

| Part Number | P2-RTB | P2-RTB-1 |
|---|---|---|
| Number of Positions | 18 screw terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 mm$^2$)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm$^2$)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | USE COPPER CONDUCTORS, 75°C” or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

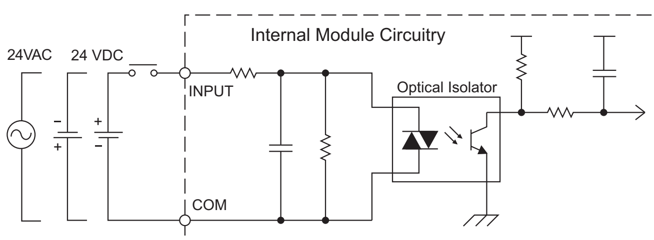
# P2-08NE3 AC/DC Sinking/Sourcing Input (continued)



## Wiring Diagrams

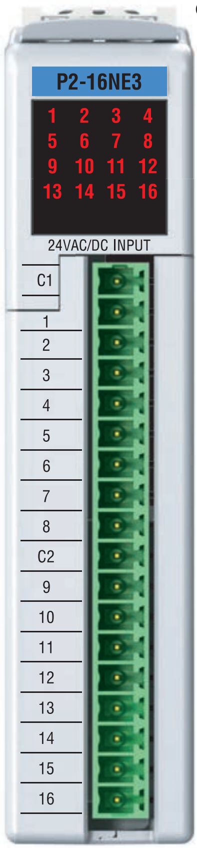



### Equivalent Input Circuit



# P2-16NE3 AC/DC Sinking/Sourcing Input

The P2-16NE3 AC/DC Input Module provides sixteen 24 VAC/VDC sinking or sourcing inputs with four isolated commons.




## Input Specifications

| | |
|---|---|
| Inputs per Module | 16 (Sink/Source) |
| Operating Voltage Range | 24 VAC/VDC |
| Input Voltage Range | 20.4 - 27.6 VAC/VDC |
| Peak Voltage Range | 27.6 VAC/ 30VDC |
| AC Frequency | 47 - 63 Hz |
| Input Current (typical) | 3.4 mA @ 24 VAC/VDC |
| Maximum Input Current | 5.0 mA @ 27.6 VAC/VDC |
| ON Voltage Level | > 12VDC, > 9VAC |
| OFF Voltage Level | < 10.5VDC, < 9VAC |
| Minimum ON Current | 2.5 mA |
| Maximum OFF Current | 0.5 mA |
| OFF to ON Response | DC: 6ms >max; AC: 10ms |
| ON to OFF Response | DC:10ms >max; AC: 20ms |
| Status Indicators | Logic Side (16 Points) |
| Commons per Module | 2 (8 points/common) Isolated |

## Removable Terminal Block Specifications*

| Part Number | P2-RTB* | P2-RTB-1* |
|---|---|---|
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 $mm^2$)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 $mm^2$)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75°C” or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-16NE3 AC/DC Sinking/Sourcing Input (continued)



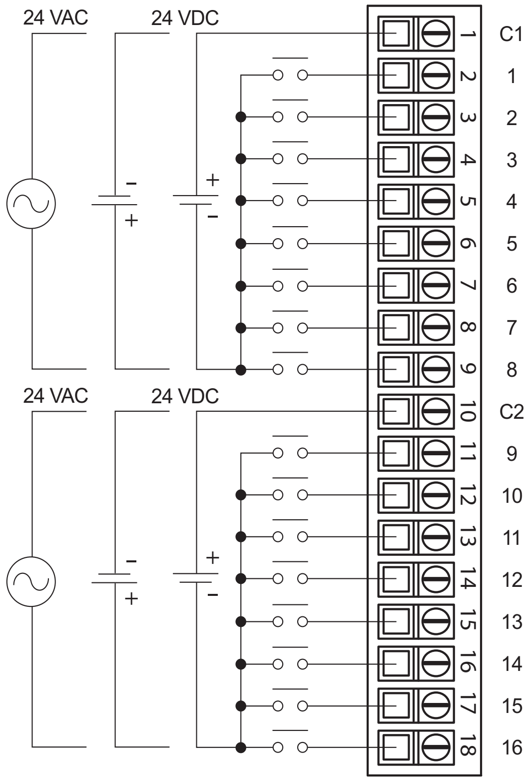
## General Specifications

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F), |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 400mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity 2000 Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

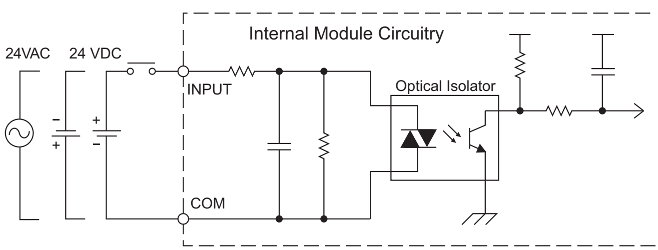
* Meets EMC and Safety requirements.  See the Declaration of Conformity for details.

# P2-16NE3 AC/DC Sinking/Sourcing Input (continued)

## Wiring Diagrams

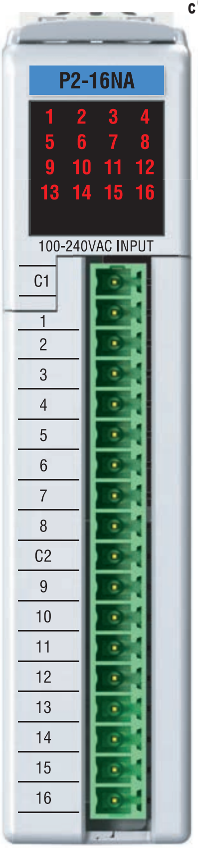



### Equivalent Input Circuit



# P2-16NA AC Input

The P2-16NA AC Input Module provides eight 100-240 VAC isolated inputs.




We recommend using pre-wired ***ZIP**Link* cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

## Input Specifications

| | | |
|---|---|---|
| Inputs per Module | | 16 |
| Operating Voltage Range (Tolerance) | CE | 100-240 VAC (± 20%) |
| | UL | 100-240 VAC (± 20%) |
| AC Frequency | | 47 - 63 Hz |
| Input Current (Typical) | | 8.5 mA @ 100VAC (50Hz)<br>10mA @ 100VAC (60Hz)<br>17mA @ 240VAC (50Hz)<br>20mA @ 240VAC (60Hz) |
| Maximum Input Current @ Temp | | 26mA @ 60°C (288VAC) |
| Input Impedance | | 15kΩ (50Hz), 12kΩ (60Hz) |
| ON Voltage Level | | > 70VAC |
| OFF Voltage Level | | < 20VAC |
| Minimum ON Current | | 5mA |
| Maximum OFF Current | | 2mA |
| OFF to ON Response | | < 10ms |
| ON to OFF Response | | < 25ms |
| Status Indicators | | Logic side (16 points) |
| Commons | | 2 Isolated for 120V<br>2 Non-Isolated for 240V (external jumper required) |

## Removable Terminal Block Specifications*

| Part Number | P2-RTB | P2-RTB-1 |
|---|---|---|
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75°C" or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

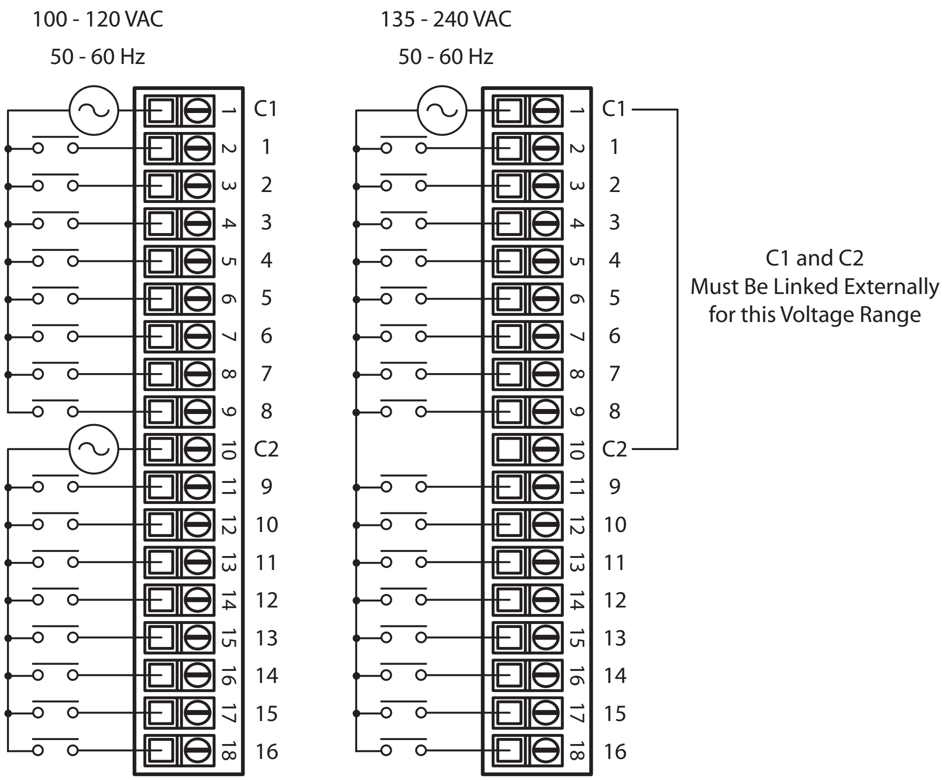
# P2-16NA AC Input (continued)

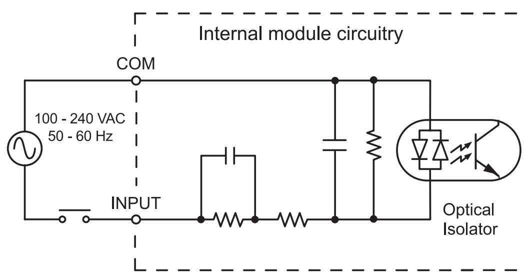
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 600mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the Declaration of Conformity for details.

# P2-16NA AC Input (continued)

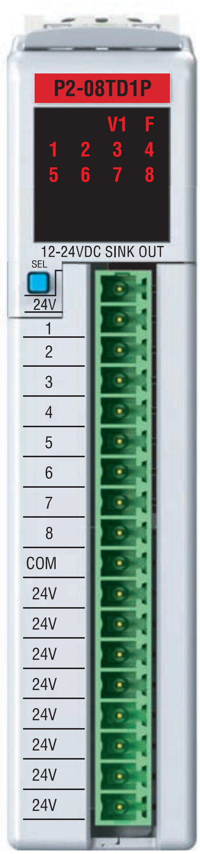
## Wiring Diagrams



# P2-08TD1P Sinking Protected DC Output

The P2-08TD1P Output Module provides eight 12-24 VDC sinking outputs with short-circuit and overload protection for use with the Productivity2000 System.




## Output Specifications

| | |
|---|---|
| Outputs per Module | 8 sinking |
| Rated Voltage | 12 - 24 VDC |
| Operating Voltage Range (Tolerance) | 10.2 - 26.4 VDC |
| Maximum Output Current | 0.25 A continuous |
| On Voltage Drop | 0.5 VDC |
| Maximum Inrush Current | Self-limited |
| OFF to ON Response | 0.5 ms |
| ON to OFF Response | 0.5 ms |
| Overcurrent Trip | 0.6 A min., 1.2 A max. |
| Minimum Load Current to Avoid Open Load Fault Detection | 113μA |
| Overtemperature Shutdown | Independent to each output |
| Load Resistance to Avoid Open Load Fault Detection | <58kΩ |
| Status Indicators | Logic Side (8 points) |
| External 24V Error Indicator | Logic Side (1 points) |
| Fault Condition Indicator | Logic Side (8 points) |
| Commons | 1 |
| Fuses | None |
| External DC Power Required | 24VDC @ 30mA |

## Removable Terminal Block Specifications*

| Part Number | P2-RTB | P2-RTB-1 |
|---|---|---|
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31mm²) Solid / Stranded Conductor 3/64 in. (1.2 mm) Insulation Maximum 1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²) Solid / Stranded Conductor 3/64 in. (1.2 mm) Insulation Maximum 19/64 in. (7-8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75°C" or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-08TD1P Sinking Protected DC Output (continued)



## General Specifications

| | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 1.8 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in any Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 5g (0.2 oz) |

* Meets EMC and Safety requirements.

## LED Status

| Fault Condition | Fault Status Indication | Operation to Reset Fault |
|---|---|---|
| Missing External 24VDC | “V1” LED is ON | Apply external 24 VDC |
| Open Load (Note 1) | “F” LED is ON (Note 2) | Connect the load |
| Over Temperature or Over Load Current | | Turn the output OFF or cycle power |

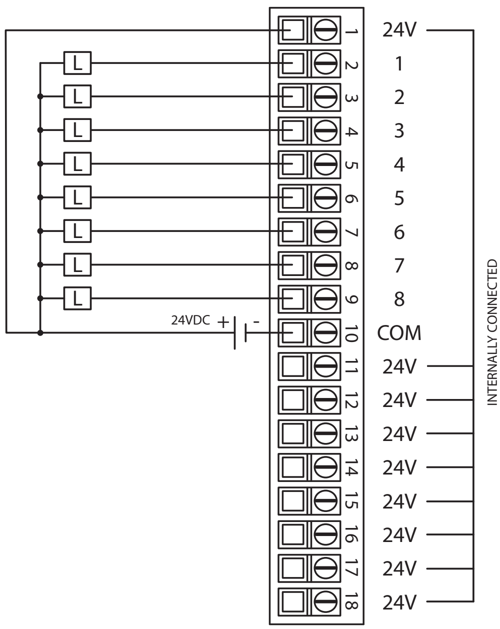
**Note 1:** Open Load Fault is always enabled, but is only valid when output is OFF. If Open Load Fault happens while output is ON, fault will not appear until you turn OFF output.

**Note 2:** The SEL button cycles between the output status and fault status. If the “F” LED is OFF the numbered LEDs are showing output status. If the “F” LED is ON the numbered LEDs are showing fault status of each output. The “V1” LED is independent of fault or output display.

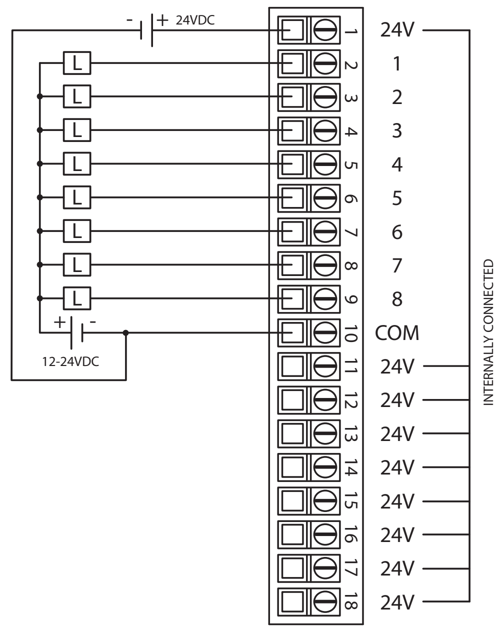
# P2-08TD1P Sinking Protected DC Output (continued)

## Wiring Diagrams

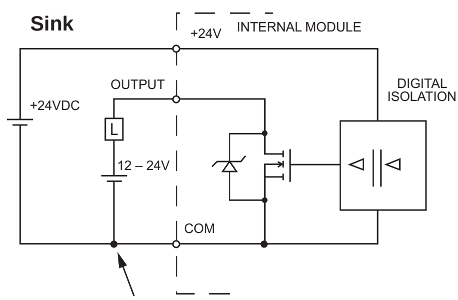
SINGLE POWER SOURCE




DUAL POWER SOURCE




***NOTE:*** *For testing purposes, to check the output point without a load attached, use DMM in current mode with a 1KΩ resistor in series with DMM lead; or use DMM in voltage mode with 1KΩ in parallel with DMM lead.*

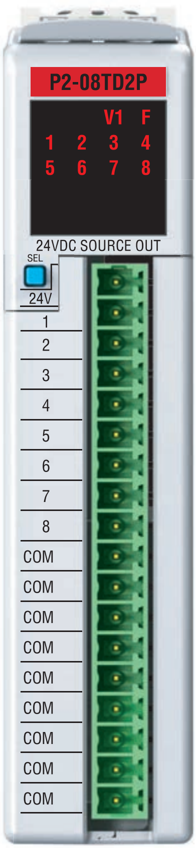



COMs of both Power Supplies are connected.

**NOTE:** If two separate power supplies are used to supply module control logic and output, grounds from both power supplies must be connected. For testing outputs, see note in P2-USER-M manual under P2-08TD1P wiring.

# P2-08TD2P Sourcing Protected DC Output

The P2-08TD2P DC Output Module provides eight 24VDC sourcing outputs with short circuit and overload protection for use with the Productivity2000 System.




## Output Specifications

| | |
|---|---|
| Outputs per Module | 8 sourcing |
| Voltage Rating | 24VDC |
| Operating Voltage Range | 24VDC±10% |
| Maximum Output Current | 0.25 A |
| On Voltage Drop | 0.7 VDC |
| Maximum Inrush Current | Self-limited |
| OFF to ON Response | 0.5 ms |
| ON to OFF Response | 0.5 ms |
| Overcurrent Trip | 0.6 A min., 1.2 A max. |
| Minimum Load Current to Avoid Open Load Fault Detection | 113μA |
| Over Temperature Shutdown | Independent to each output |
| Load Resistance to Avoid Open Load Fault Detection | <58kΩ |
| Status Indicators | Logic Side (8 points) |
| External 24V Error Indicator | Logic Side (1 points) |
| Fault Condition Indicator | Logic Side (8 points) |
| Commons | 9 (non-isolated) |
| Fuses | None |
| External DC Power Required | 24VDC @ 30mA |

## LED Status

| Fault Condition | Fault Status Indication | Operation to Reset Fault |
|---|---|---|
| Missing External 24VDC | V1 LED is ON | Apply external 24 VDC |
| Open Load (Note 1) | F LED is ON (Note 2) | Connect the load |
| Over Temperature or Over Load Current | | Turn the output OFF or cycle power |

**Note 1:** Open Load Fault is always enabled, but is only valid when output is OFF. If Open Load Fault happens while output is ON, fault will not appear until you turn OFF output.

**Note 2:** The SEL button cycles between the output status and fault status. If the “F” LED is OFF the numbered LEDs are showing output status. If the “F” LED is ON the numbered LEDs are showing fault status of each output. The “V1” LED is independent of fault or output display.

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1.

# P2-08TD2P Sourcing Protected DC Output (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 1.8 W |
| Enclosure Type | Open Equipment |
| Agency Approvals* | UL508 file E139594, Canada & USA<br>CE (EN61131-2) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

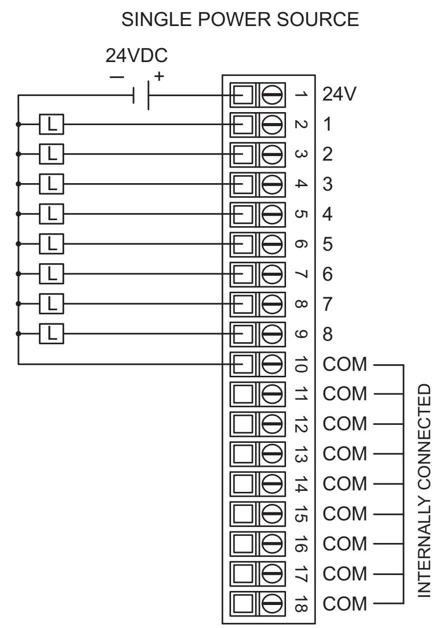
* Meets EMC and Safety requirements. See the Declaration of Conformity for details.

| Removable Terminal Block Specifications* | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75°C” or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

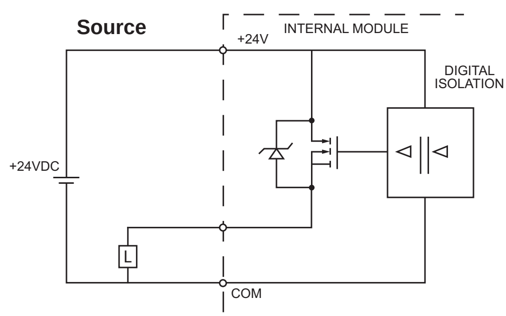
***Terminal blocks sold separately.**

# P2-08TD2P Sourcing Protected Output (continued)

## Wiring Diagrams

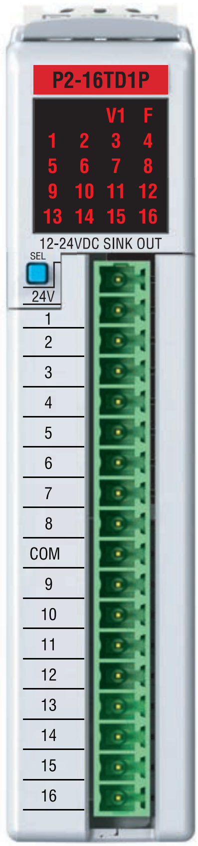



***NOTE:*** *For testing purposes, to check the output point without a load attached, use DMM in current mode with a 1KΩ resistor in series with DMM lead; or use DMM in voltage mode with 1KΩ in parallel with DMM lead.*



# P2-16TD1P Sinking Protected DC Output

The P2-16TD1P DC Output Module provides sixteen 12-24 VDC sinking outputs with short-circuit and overload protection for use with the Productivity2000 System.




## Output Specifications

| | |
|---|---|
| Outputs per Module | 16 sinking |
| Voltage Rating | 12 - 24 VDC |
| Operating Voltage Range | 10.2 - 26.4 VDC |
| Maximum Output Current | 0.25 A continuous |
| On Voltage Drop | 0.5 VDC |
| Maximum Inrush Current | Self-limited |
| OFF to ON Response | 0.5 ms |
| ON to OFF Response | 0.5 ms |
| Overcurrent Trip | 0.6 A min., 1.2 A max. |
| Minimum Load Current to Avoid Open Load Fault Detection | 113μA |
| Over Temperature Shutdown | Independent to each output |
| Load Resistance to Avoid Open Load Fault Detection | <58kΩ |
| Status Indicators | Logic Side (16 points) |
| External 24V Error Indicator | Logic Side (1 points) |
| Fault Condition Indicator | Logic Side (16 points) |
| Commons | 1 |
| Fuses | None |
| External DC Power Required | 24VDC @ 55mA |

## Removable Terminal Block Specifications*

| Part Number | P2-RTB | P2-RTB-1 |
|---|---|---|
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75°C" or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

We recommend using pre-wired ***ZIP**Link* cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1.

# P2-16TD1P Sinking Protected DC Output (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 1.8 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the Declaration of Conformity for details.

| LED Status | | |
|---|---|---|
| **Fault Condition** | **Fault Status Indication** | **Operation to Reset Fault** |
| Missing External 24VDC | “V1” LED is ON | Apply external 24VDC |
| Open Load (Note 1) | “F“ LED is ON (Note 2) | Connect the load |
| Over Temperature or Over Load Current | | Turn the output OFF or cycle power |

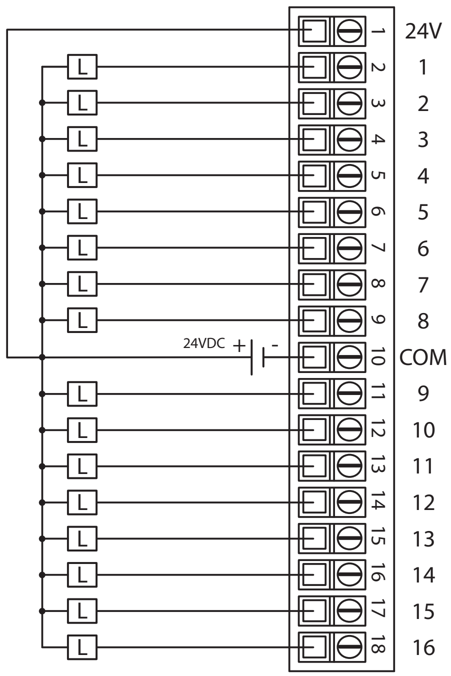
Note 1: Open Load Fault is always enabled, but is only valid when output is OFF. If Open Load Fault happens while output is ON, fault will not appear until you turn OFF output.

Note 2: The SEL button cycles between the output status and fault status. If the “F” LED is OFF the numbered LEDs are showing output status. If the “F” LED is ON the numbered LEDs are showing fault status of each output. The “V1” LED is independent of fault or output display.

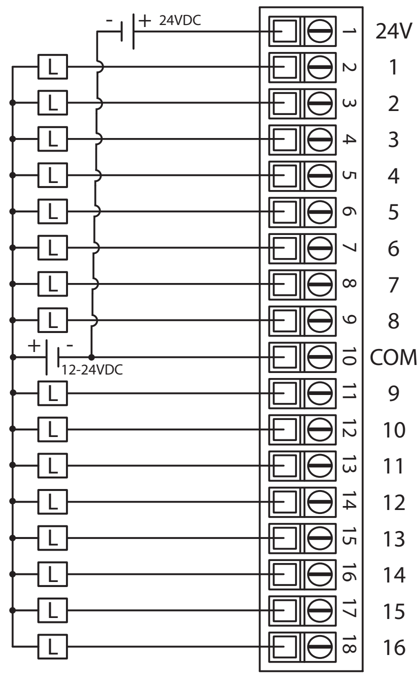
# P2-16TD1P Sinking Protected DC Output (continued)

## Wiring Diagrams

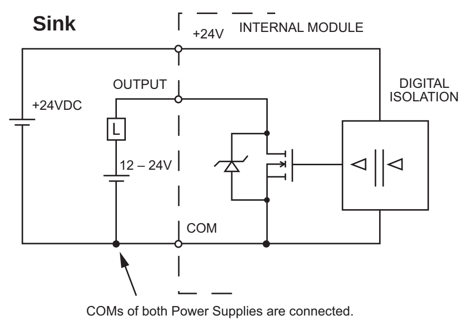
**Single Power Source**




**Dual Power Source**



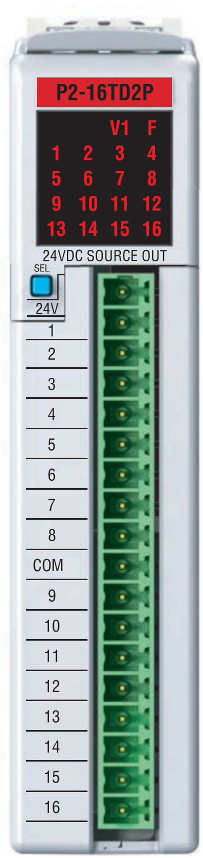

***NOTE:** For testing purposes, to check the output point without a load attached, use DMM in current mode with a 1KΩ resistor in series with DMM lead; or use DMM in voltage mode with 1KΩ in parallel with DMM lead.*




**NOTE:** If two separate power supplies are used to supply module control logic and output, common from both power supplies must be connected. For testing outputs, see note in P2-USER-M manual under P2-16TD1P wiring.

# P2-16TD2P Sourcing Protected DC Output

The P2-16TD2P DC Output Module provides sixteen 24VDC sourcing outputs with short-circuit and overload protection for use with the Productivity2000 System.




## Output Specifications

| | |
|---|---|
| Outputs per Module | 16 sourcing |
| Voltage Rating | 24VDC |
| Operating Voltage Range | 21.6-26.4 VDC |
| Maximum Output Current | 0.25 A continuous |
| On Voltage Drop | 0.7 VDC |
| Maximum Inrush Current | Self-limited |
| OFF to ON Response | 0.5 ms |
| ON to OFF Response | 0.5 ms |
| Overcurrent Trip | 0.6 A min., 1.2 A max. |
| Minimum Load Current to Avoid Open Load Fault Detection | 113μA |
| Overtemperature Shutdown | Independent to each output |
| Load Resistance to Avoid Open Load Fault Detection | <58kΩ |
| Status Indicators | Logic Side (16 points) |
| External 24V Error Indicator | Logic Side (1 point) |
| Fault Condition Indicator | Logic Side (16 points) |
| Commons | 1 |
| Fuses | None |
| External DC Power Required | 24VDC @ 55mA (not including 0.25 A per point) |

## LED Status

| Fault Condition | Fault Status Indication | Operation to Reset Fault |
|---|---|---|
| Missing External 24VDC | V1 LED is ON | Apply external 24 VDC |
| Open Load (Note 1) | F LED is ON (Note 2) | Connect the load |
| Over Temperature or Over Load Current | | Turn the output OFF or cycle power |

**Note 1:** Open Load Fault is always enabled, but is only valid when output is OFF. If Open Load Fault happens while output is ON, fault will not appear until you turn OFF output.

**Note 2:** The SEL button cycles between the output status and fault status. If the “F” LED is OFF the numbered LEDs are showing output status. If the “F” LED is ON the numbered LEDs are showing fault status of each output. The “V1” LED is independent of fault or output display.

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1.

# P2-16TD2P Sourcing Protected DC Output (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F), |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 2.6W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

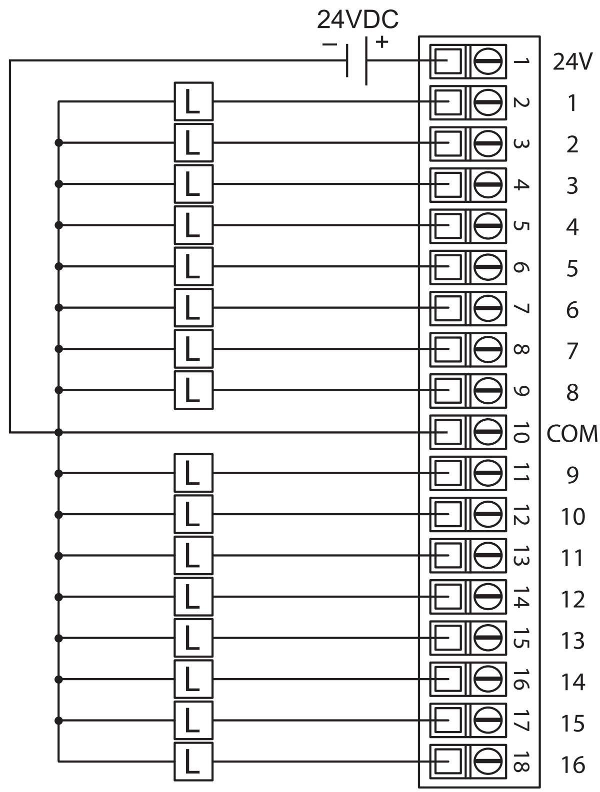
* Meets EMC and Safety requirements. See the Declaration of Conformity for details.

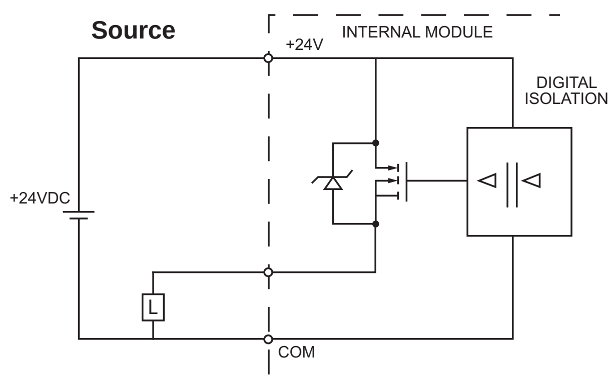
| Removable Terminal Block Specifications* | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75°C” or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

# P2-16TD2P Sourcing Protected DC Output (continued)

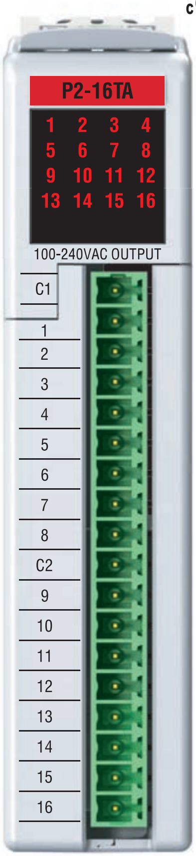
## Wiring Diagrams



# P2-16TA AC Output

The P2-16TA AC Output Module provides sixteen 100-240 VAC outputs for use with the Productivity2000 System.




## Output Specifications

| | |
|---|---|
| Outputs per Module | 16 |
| Voltage Rating | 100-240 VAC |
| Operating Voltage Range (Tolerance) (CE) | 100-240 VAC (-15% / +10%) |
| Operating Voltage Range (Tolerance) (UL) | 100-240 VAC (-20% / +20%) |
| AC Frequency | 47 - 63 Hz |
| Maximum Output Current @ Temp | 0.5 A / point , 4A / common @ 55°C<br>0.3 A / point , 2.4 A / common @ 60°C |
| Minimum Load | 10mA |
| Maximum Leakage Current | 4 mA @ 264 VDC |
| On Voltage Drop | 1.5 VAC @ > 50mA<br>4.0 VAC @ < 50mA |
| Maximum Inrush Current | 10A for 10ms |
| OFF to ON Response | 1ms + 1/2 cycle |
| ON to OFF Response | 1ms + 1/2 cycle |
| Status Indicators | Logic Side (16 points) |
| Commons | 2 Isolated Commons for 120V<br>2 Non-Isolated Commons for 240V (external jumper required) |
| Recommended External Fuse | 6.3 A Max<br>(Automation Direct P/N S5006-3-R) |

## Removable Terminal Block Specifications*

| Part Number | P2-RTB | P2-RTB-1 |
|---|---|---|
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75°C" or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1.

# P2-16TA AC Output (continued)

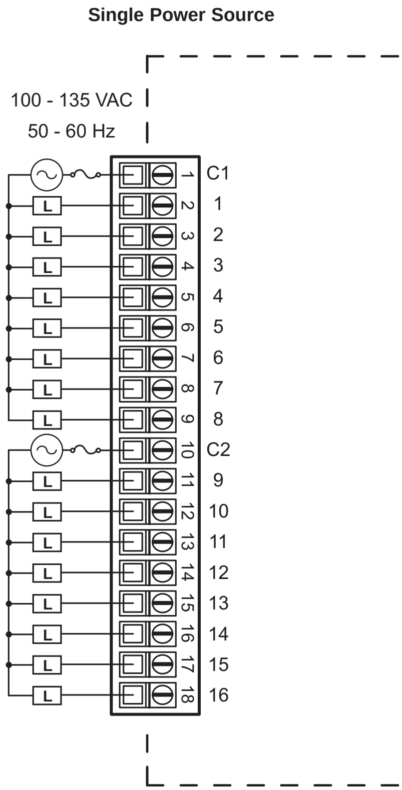


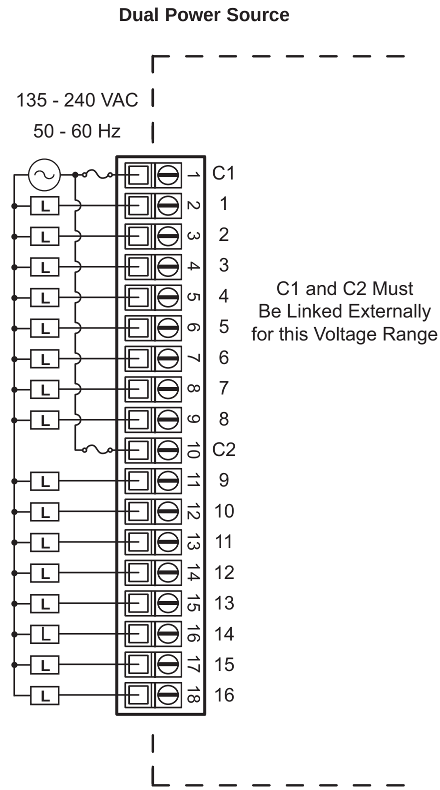
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F), |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 1.9 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in any local base in a Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5 |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

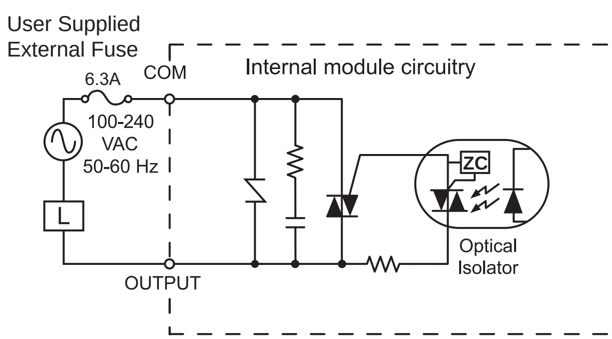
* Meets EMC and Safety requirements. See the D.O.C. for details.

# P2-16TA AC Output (continued)

## Wiring Diagrams

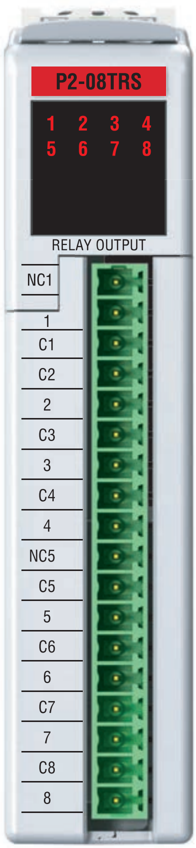


# P2-08TRS Isolated Relay Output

The P2-08TRS Isolated Relay Output Module provides eight 4A surge protected outputs for extended relay life. Module offers both normally open and normally closed relay contacts for use with the Productivity2000 system.




## Output Specifications

| | | |
|---|---|---|
| Outputs per Module | | 8 |
| Operating Voltage Range (Tolerance) | (CE) | 6.25 - 24 VDC (-15% / + 20%)<br>6 - 120 VAC (-15% / + 10%) |
| | (UL) | 120VAC / 30VDC, 4A / point |
| Output type | | 6 Relays, FORM A (SPST)<br>2 Relays, FORM C (SPDT) |
| AC Frequency | | 47 - 63 Hz |
| Maximum Output Current @ Temp | | 4A / point @ 60°C for both AC and DC<br>2A / point if used with ***ZIP***Link Cable |
| Minimum Load Current | | 5mA @ 5VDC |
| Maximum Inrush Current | | 4A for 10ms |
| OFF to ON Response | | ≤ 10ms |
| ON to OFF Response | | ≤ 10ms |
| Status Indicators | | Logic Side (8 points) |
| Commons | | 8 Isolated (1 point / common) |
| External Fuses (user supplied) | | 6.3 A Max |

## Removable Terminal Block Specifications*

| Part Number | P2-RTB | P2-RTB-1 |
|---|---|---|
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75°C" or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1.

# P2-08TRS Isolated Relay Output (continued)

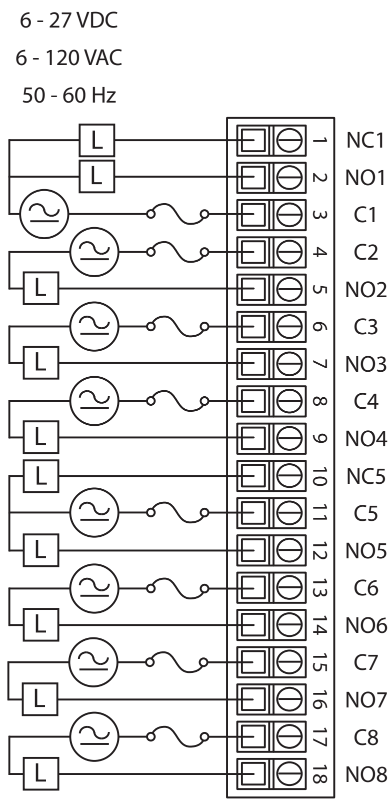
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F), |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 3W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 157g (5.54oz) |

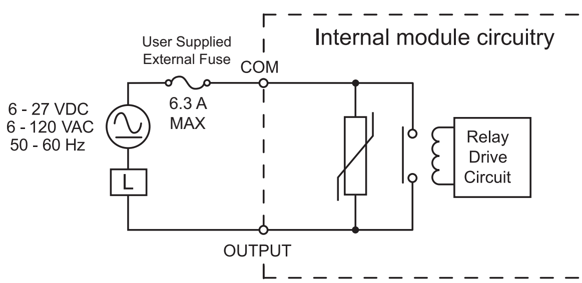
* Meets EMC and Safety requirements. See the D.O.C. for details.

| Typical Relay Life | |
|---|---|
| Voltage & Type of Load | Operations at 4A Load Current |
| 30VDC Resistive | 100,000 |
| 30VDC Solenoid | 100,000 |
| 120VAC Resistive | 100,000 |
| 120VAC Solenoid | 100,000 |

# P2-08TRS Isolated Relay Output (continued)

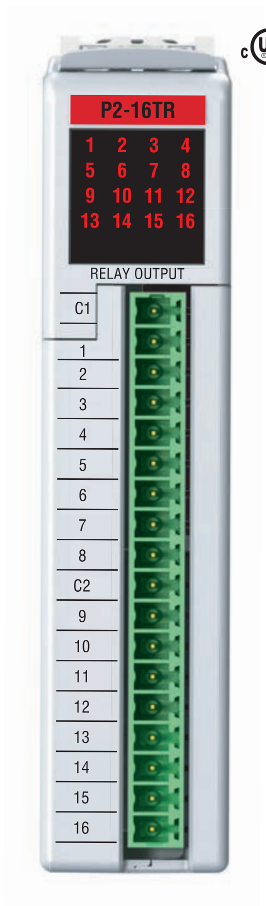
## Wiring Diagrams



# P2-16TR Relay Output

The P2-16TR Relay Output Module provides sixteen 1.0 amp surge protected outputs with two isolated commons for use with the Productivity2000 system.




## Output Specifications

| | | |
|---|---|---|
| Outputs per Module | | 16 |
| Operating Voltage Range | (CE) | 6.25-24 VDC (-15%/+20%)<br>6-240 VAC (-15%/+10%) |
| | (UL) | 6-27 VDC (-15%/+10%)<br>6-240 VAC (-10%/+10%) |
| Output Type | | Relay, form A (SPST) |
| AC Frequency | | 47 - 63 Hz |
| Maximum Output Current @ Temp | | 1A / point, 8A / common @ 60°C for both AC and DC |
| Minimum Load Current | | 5mA @ 5VDC |
| Maximum Inrush Current | | 4A for 10ms |
| OFF to ON Response | | ≤ 10ms |
| ON to OFF Response | | ≤ 10ms |
| Status Indicators | | Logic Side (16 points) |
| Commons | | 2 Isolated (8 point / common) |
| External Fuses (user supplied) | | 8A Max |

## Removable Terminal Block Specifications*

| Part Number | P2-RTB | P2-RTB-1 |
|---|---|---|
| Number of Positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30-16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in. (6-7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>19/64 in. (7-8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75°C" or Equivalent. | |
| Screw Driver Width | 1/8 inch (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1.

# P2-16TR Relay Output (continued)



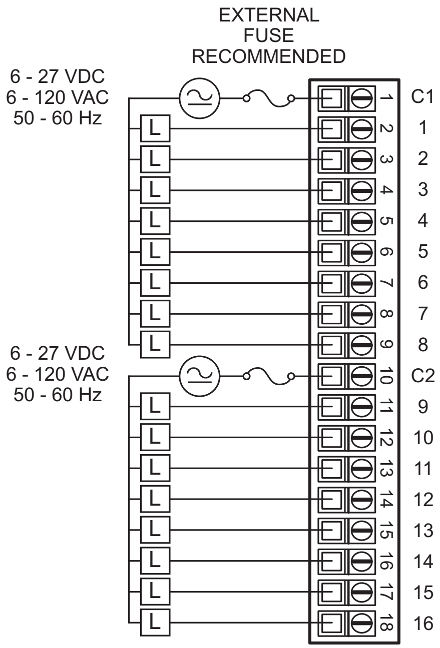
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 2.73 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 file E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System. |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 188g (6.64 oz) |

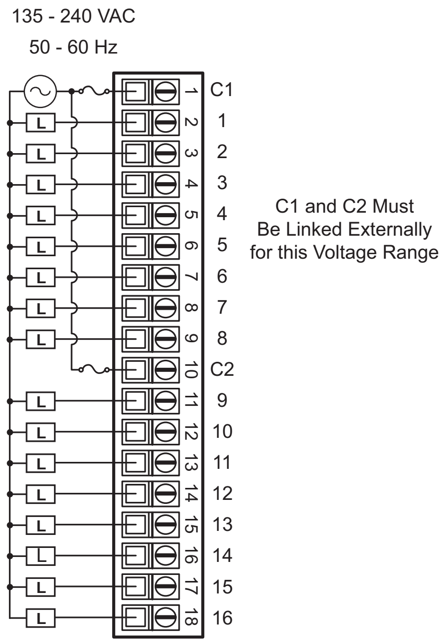
* Meets EMC and Safety requirements. See the D.O.C. for details.

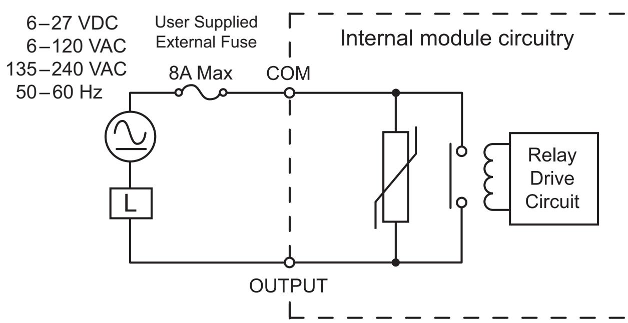
| Typical Relay Life | |
|---|---|
| Voltage & Type of Load | Operations at 1A load current |
| 30VDC Resistive | 100,000 |
| 30VDC Solenoid | 100,000 |
| 120VAC Resistive | 100,000 |
| 120VAC Solenoid | 100,000 |
| 240VAC Resistive | 100,000 |
| 240VAC Solenoid | 100,000 |

# P2-16TR Relay Output (continued)

## Wiring Diagrams



## Notes

# Analog I/O Specifications

# Chapter 3

## In This Chapter...

# Analog I/O Modules Overview

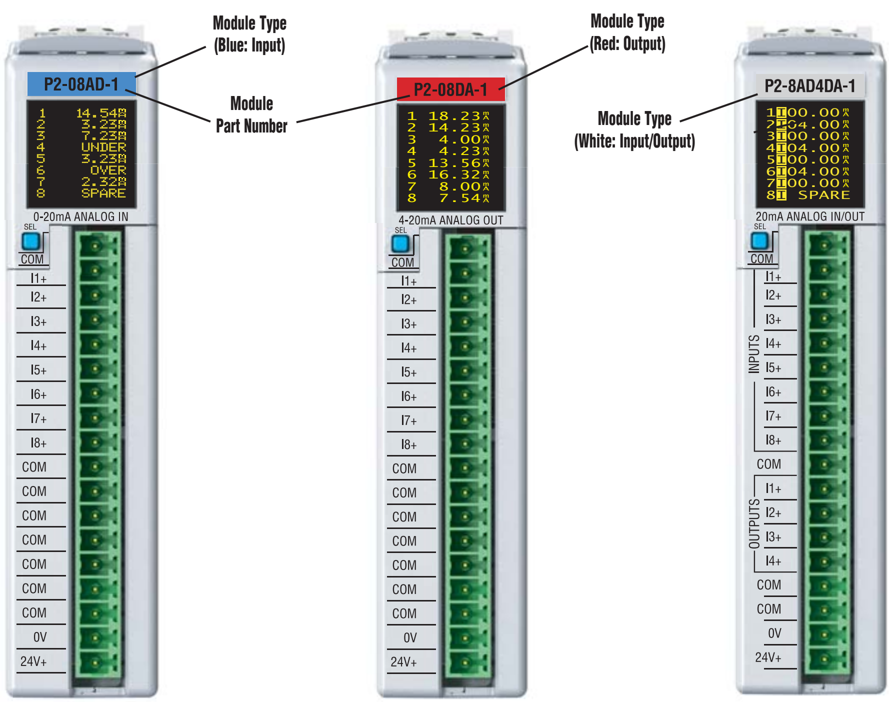
A variety of analog I/O modules are available for use in local I/O bases.

Each I/O module is identified as an "Input", "Output", or "Input/Output" module on its front panel using the color coding scheme listed below. See Chapter 2 for discrete I/O module specifications, Chapter 4 for specialty module specifications and Chapter 5 for module wiring and communications. The following pages contain the analog I/O module specifications.

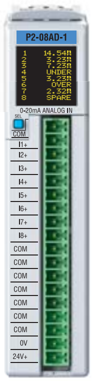
There are fourteen analog I/O modules available. The specifications and wiring diagrams, along with configuration and scaling information are in this chapter.

Use the hardware configuration tool in the Productivity Suite programming software to setup the I/O modules. See the Productivity Suite help file.

***Analog Input Modules*** ***Analog Output Modules*** ***Analog Input/Output Modules***

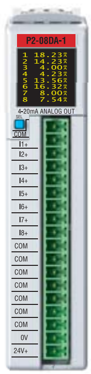


# Analog I/O Modules



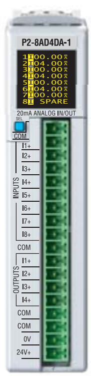

## Analog Input Modules

| Productivity2000 Analog Input Modules | | | |
|---|---|---|---|
| **Part Number** | **Number of Channels** | **Description** | **See Page** |
| ***P2-04AD*** | 4 | Isolated Analog Input | 3-4 |
| ***P2-08AD-1*** | 8 | Analog Input (Current) | 3-10 |
| ***P2-08AD-2*** | 8 | Analog Input (Voltage) | 3-15 |
| ***P2-16AD-1*** | 16 | Analog Input (Current) | 3-20 |
| ***P2-16AD-2*** | 16 | Analog Input (Voltage) | 3-25 |
| ***P2-06RTD*** | 6 | Analog RTD Input | 3-30 |
| ***P2-08THM*** | 8 | Analog Thermocouple Input | 3-37 |




## Analog Output Modules

| Productivity2000 Analog Output Modules | | | |
|---|---|---|---|
| **Part Number** | **Number of Channels** | **Description** | **See Page** |
| ***P2-04DA*** | 4 | Analog Output | 3-44 |
| ***P2-08DA-1*** | 8 | Analog Output (Current) | 3-50 |
| ***P2-08DA-2*** | 8 | Analog Output (Voltage) | 3-55 |
| ***P2-16DA-1*** | 16 | Analog Output (Current) | 3-60 |
| ***P2-16DA-2*** | 16 | Analog Output (Voltage) | 3-65 |

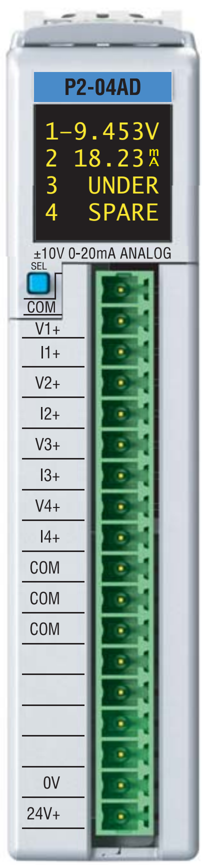



## Analog Input/Output Modules

| Productivity2000 Analog Input/Output Modules | | | |
|---|---|---|---|
| **Part Number** | **Number of Channels** | **Description** | **See Page** |
| ***P2-08AD4DA-1*** | 8/4 | Analog Input/Output (Current) | 3-70 |
| ***P2-8AD4DA-2*** | 8/4 | Analog Input/Output (Voltage) | 3-76 |

# P2-04AD Analog Input

The P2-04AD Voltage/Current Analog Input Module provides four channels for receiving ±10 VDC, ±5 VDC, 0-5 VDC, and 0 to 20mA signals for use with the Productivity2000 system.




| Input Specifications | |
|---|---|
| Input Channels | 4 |
| Module Signal Input Ranges | ±10 VDC, ±5 VDC, 0-5 VDC, 0-10 VDC, 0-20 mA |
| Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 1 LSB = 1 count<br>±10V = 305µV<br>±5V = 152µV<br>0-5 V = 76µV<br>0-10 V = 152µV<br>0-20 mA = 0.305µA |
| Data Range | 0-65535 counts unipolar<br>-32768 to +32767 counts bipolar |
| Maximum Continuous Overload | ±31 mA, current input<br>±100 V, voltage input |
| Input Impedance | 1MΩ±10% voltage input<br>250Ω±0.1% 1/4 W current input |
| Hardware Filter Characteristics | Low Pass 1st order, -3dB @ 48Hz |
| Sample Duration Time | 2ms per channel (does not include ladder scan time) |
| All Channel Update Rate | 8ms |
| Open Circuit Detection Time | Zero reading within 1s (current input only) |
| Conversion Method | Successive approximation |
| Accuracy vs. Temperature | ±10PPM / °C maximum |
| Maximum Inaccuracy | 0.1% of range voltage, 0.2% of range current (including temperature drift) |
| Linearity Error (end to end) | ±0.01% of range max., ±10 V & ±5 V<br>±0.015% of range max., 0-10 V, 0-5 V & 0-20 mA<br>Monotonic with no missing codes |
| Input Stability and Repeatability | ±0.035% of range (after 10 min. warmup) |
| Full Scale Calibration Error | ±0.2% of range maximum |
| Offset Calibration Error | ±0.065% of range maximum |
| Max Crosstalk | -96dB, 1 LSB |
| Recommended Fuse (external) | Edison S500-32-R, 0.032A fuse on current inputs only |
| External DC Power Required | 24VDC (-20% / +25%) 35mA |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-04AD Analog Input (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 1.4 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See "Wiring Options" in Chapter 5. |
| EU Directive | See the "EU Directive" topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

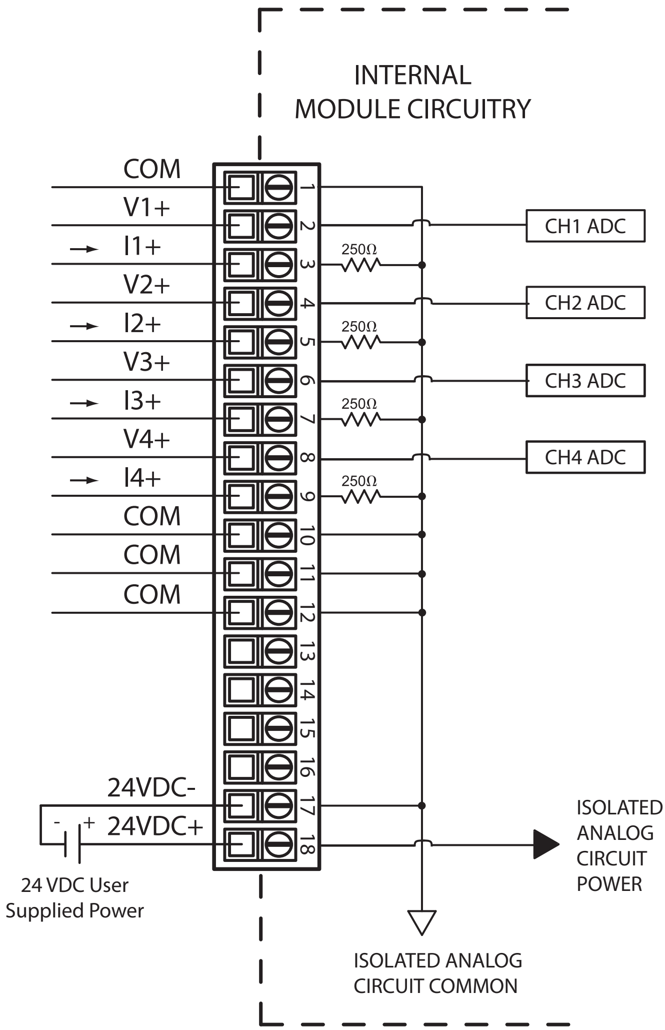
* Meets EMC and Safety requirements. See the D.O.C. for details.

| Removable Terminal Block Specifications* | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75°C" or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal blocks sold separately.**

# P2-04AD Analog Input (continued)

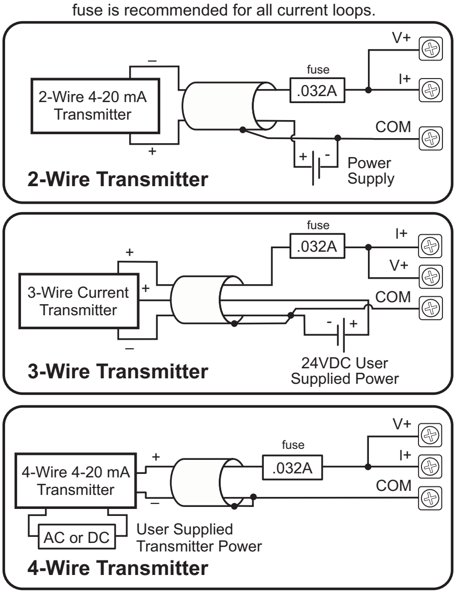
## Wiring Diagrams



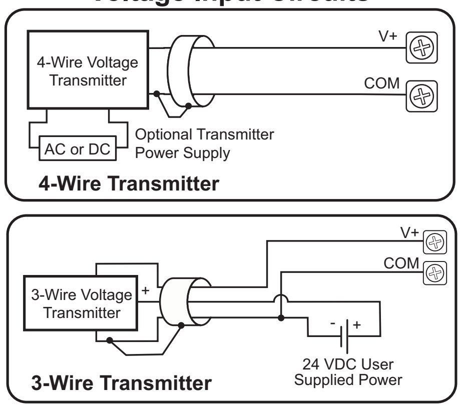
# P2-04AD Analog Input (continued)

## Current Sinking Input Circuits

An Edison S500-32-R 0.032A fast-acting
fuse is recommended for all current loops.




## Voltage Input Circuits




Notes:
1. Shield connected to signal source common.
2. If current is chosen, I-MUST be jumpered to V-. For example, when using 4-20mA source for Input 3, I3+ must be connected to V3+.

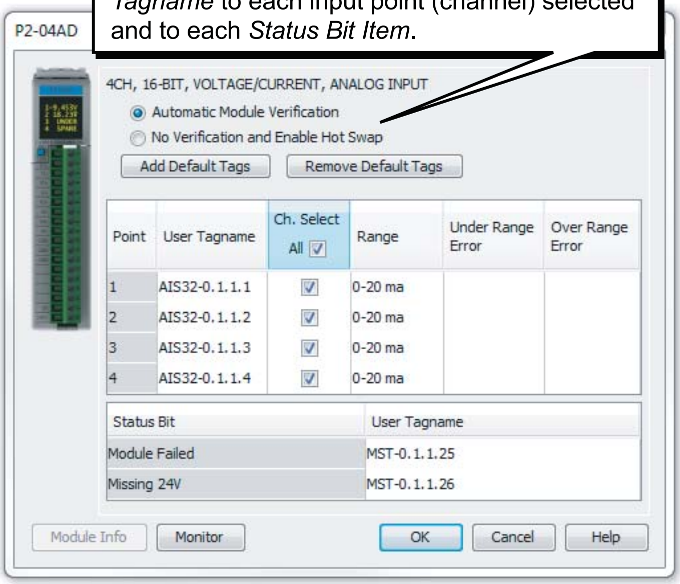
# P2-04AD Analog Input (continued)

## Module Configuration

3

Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-04AD module into the base configuration.

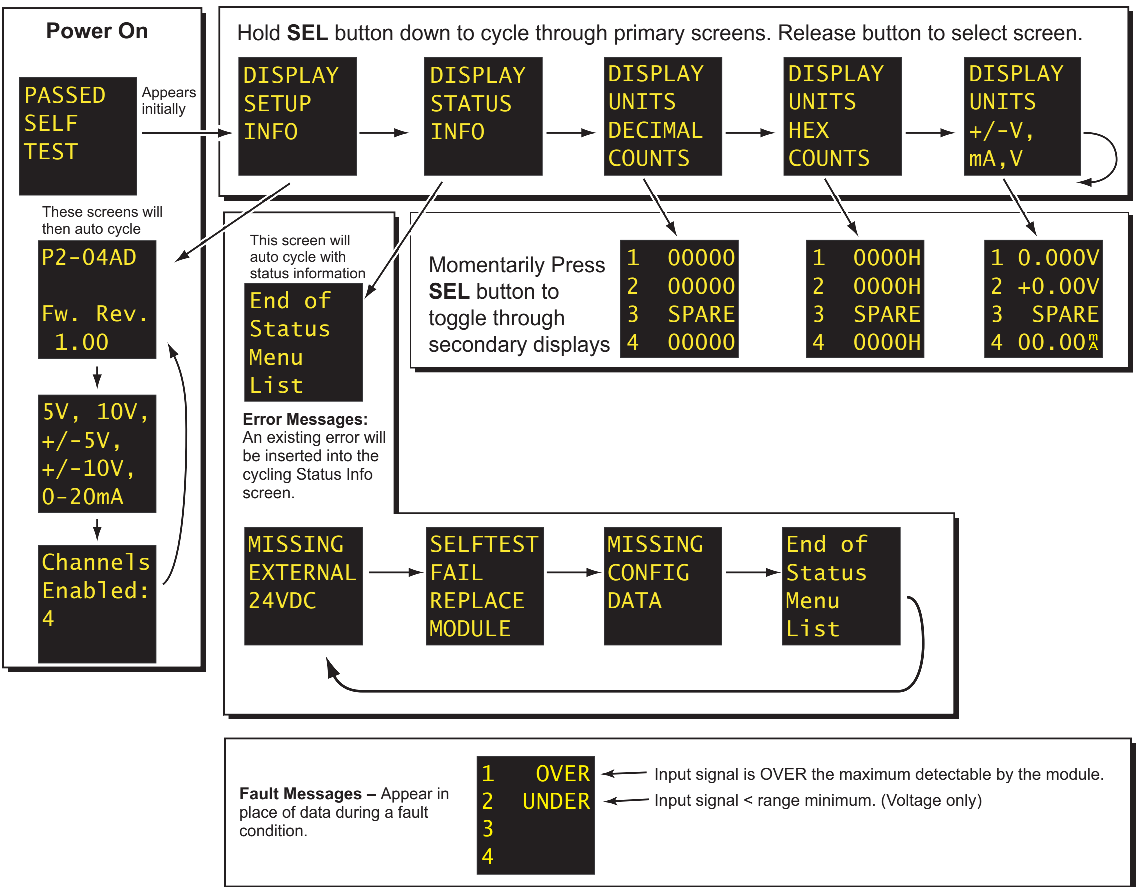
Select *Automatic Module Verification* or *No Verification and Enable Hot Swap.* Select *Range* type for each input. If desired, assign a *User Tagname* to each input point (channel) selected and to each *Status Bit Item*.



# P2-04AD Analog Input (continued)

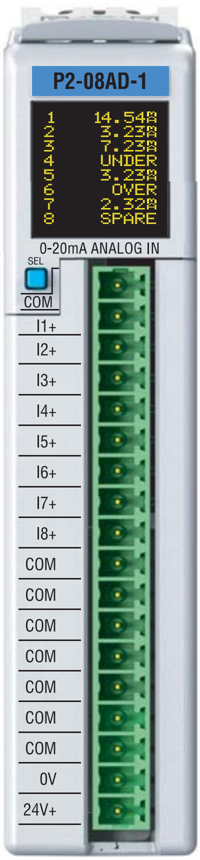
## LCD Panel Display





# P2-08AD-1 Analog Input

The P2-08AD-1 Current Analog Input Module provides 8 channels for receiving 0 to 20mA signals.




## Input Specifications

| Input Specifications | |
|---|---|
| Input Channels | 8 sinking |
| Module Signal Input Range | 0-20 mA |
| Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 0-20 mA = 0.305 μA per count (1 LSB = 1 count) |
| Data Range | 0 to 65535 counts |
| Input Type | Single-ended (1 common) |
| Maximum Continuous Overload | ±31mA |
| Input Impedance | 250Ω ±0.1% 1/4 W |
| Filter Characteristics | Low Pass, -3dB @ 100Hz |
| Sample Duration Time | 9ms per channel (does not include ladder scan time) |
| All Channel Update Rate | 80ms |
| Open Circuit Detection Time | Zero reading within 1s |
| Conversion Method | Successive approximation |
| Accuracy vs. Temperature | ±25PPM / ºC maximum |
| Maximum Inaccuracy | 0.1% of range (including temperature drift) |
| Linearity Error (end to end) | ±0.015% of range Monotonic with no missing codes |
| Input Stability and Repeatability | ±0.015% of range (after 10 min warmup) |
| Full Scale Calibration Error (not including offset) | ±0.015% of range maximum |
| Offset Calibration Error | ±0.015% of range maximum |
| Max Crosstalk | -76dB, ±10 LSB |
| Recommended Fuse (external) | Edison S500-32-R, 0.032A fuse |
| External DC Power Required | 24VDC (-20% / +25%) 35mA |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-08AD-1 Analog Input (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 800mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

*Meets EMC and Safety requirements. See the D.O.C. for details.

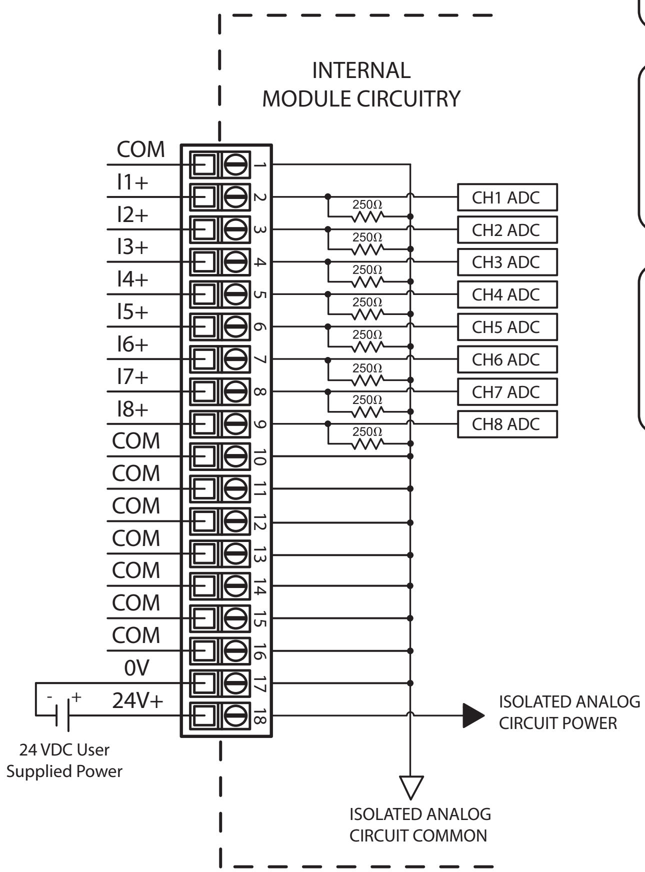
| Removable Terminal Block Specifications* | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75ºC” or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

***Terminal block sold separately.**

# P2-08AD-1 Analog Input (continued)

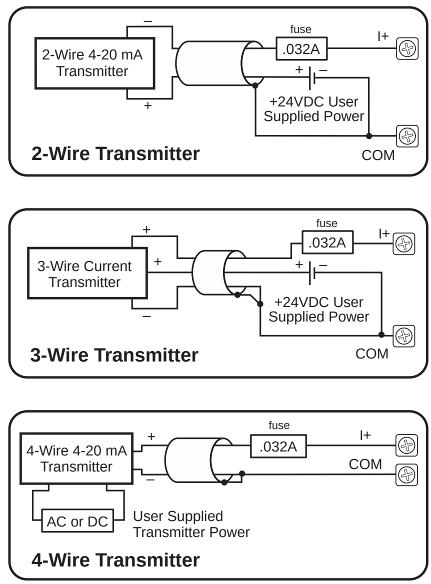
## Wiring Diagrams






**Current Input Circuits**

An Edison S500-32-R 0.032A fast-acting fuse is recommended for current loops.



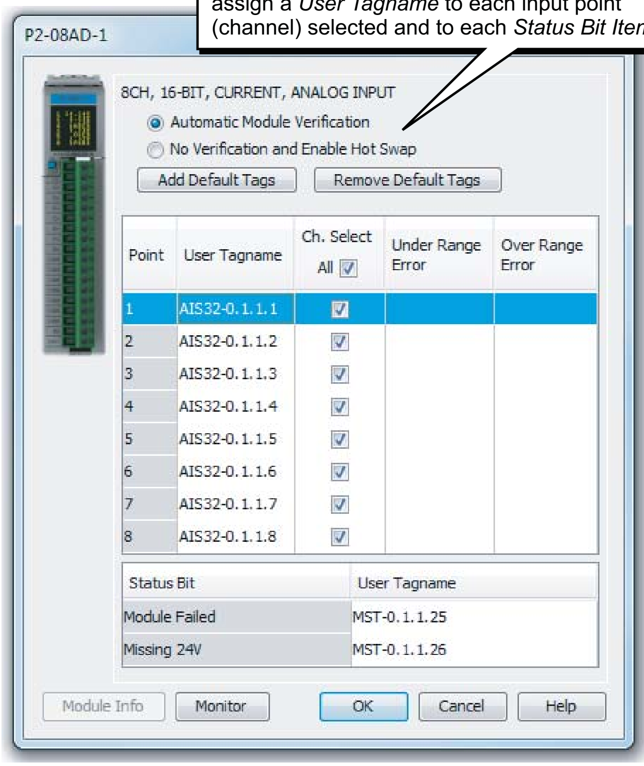

Note: Do not connect both ends of shield.

# P2-08AD-1 Analog Input (continued)

## Module Configuration

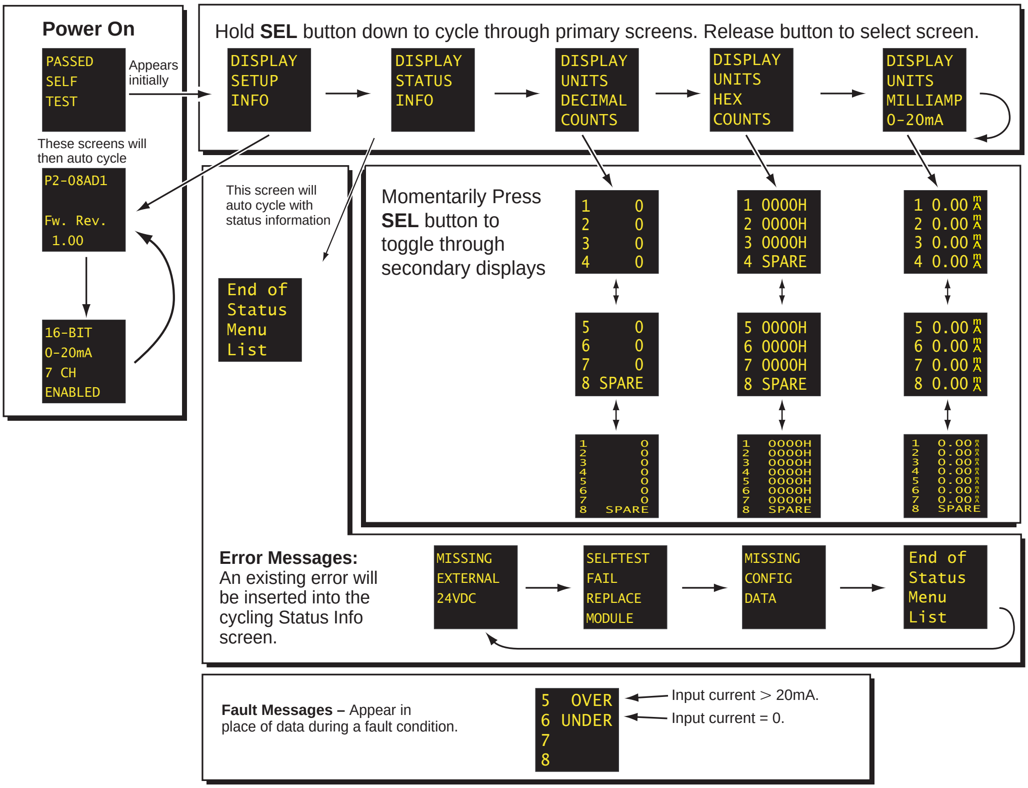
Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-08AD-1 module into the base configuration.

Select *Automatic Module Verification* or *No Verification and Enable Hot Swap*. If desired, assign a *User Tagname* to each input point (channel) selected and to each *Status Bit Item*.



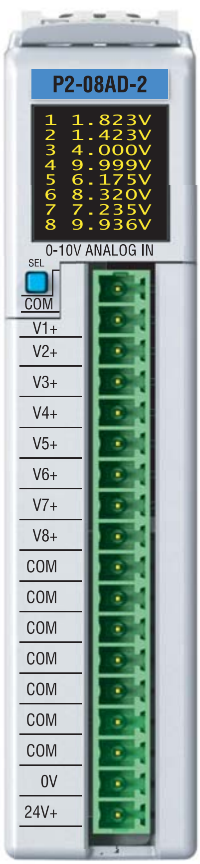
# P2-08AD-1 Analog Input (continued)

## LCD Panel Display



# P2-08AD-2 Analog Input

The P2-08AD-2 Voltage Analog Input Module provides eight channels for receiving 0-10 VDC signals for use with the Productivity2000 system.




| Input Specifications | |
|---|---|
| Input Channels | 8 |
| Module Signal Input Range | 0-10 VDC |
| Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 0-10 VDC = 152μV per count (1 LSB = 1 count) |
| Data Range | 0 to 65535 counts |
| Input Type | Single-ended (1 common) |
| Maximum Continuous Overload | ±100V |
| Input Impedance | 250Ω (typical) |
| Filter Characteristics | Low Pass, -3dB @ 100Hz |
| Sample Duration Time | 7ms per channel (does not include ladder scan time) |
| All Channel Update Rate | 80ms |
| Open Circuit Detection Time | Zero reading within 1s |
| Conversion Method | Successive approximation |
| Accuracy vs. Temperature | ±25PPM / °C maximum |
| Maximum Inaccuracy | 0.1% of range (including temperature drift) |
| Linearity Error (end to end) | ±0.015% of range Monotonic with no missing codes |
| Input Stability and Repeatability | ±0.015% of range (after 10 min warmup) |
| Full Scale Calibration Error (not including offset) | ±0.015% of range maximum |
| Offset Calibration Error | ±0.015% of range maximum |
| Max Crosstalk | -76dB, ±10 LSB |
| External DC Power Required | 24VDC (-20% / +25%) 35mA |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-08AD-2 Analog Input (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 82mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

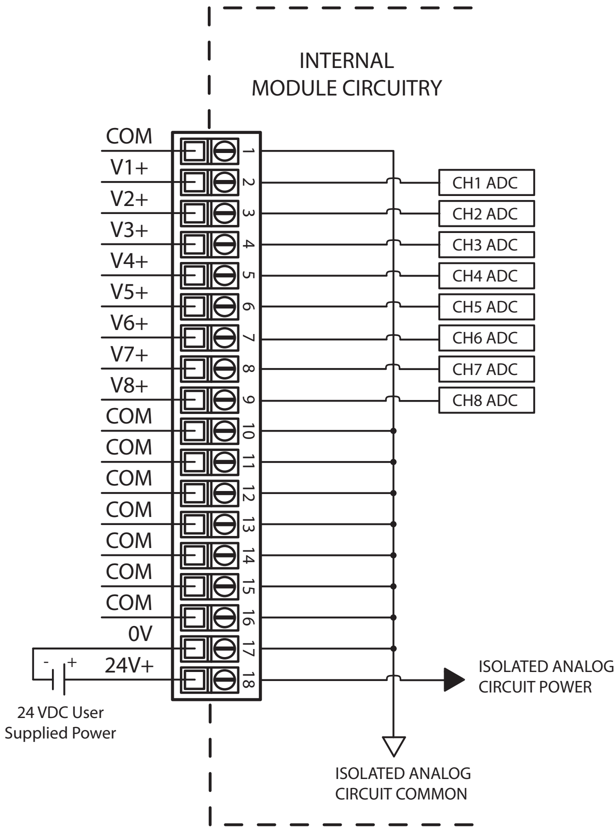
* Meets EMC and Safety requirements. See the D.O.C. for details.

| Removable Terminal Block Specifications* | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75°C” or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb in (0.28 N·m) | N/A |

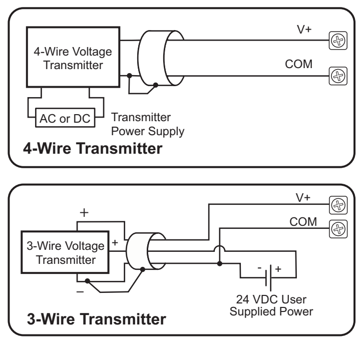
***Terminal block sold separately.**

# P2-08AD-2 Analog Input (continued)

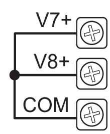
## Wiring Diagrams




**Voltage Input Circuits**




**Note:** For maximum accuracy jumper unused inputs to common.

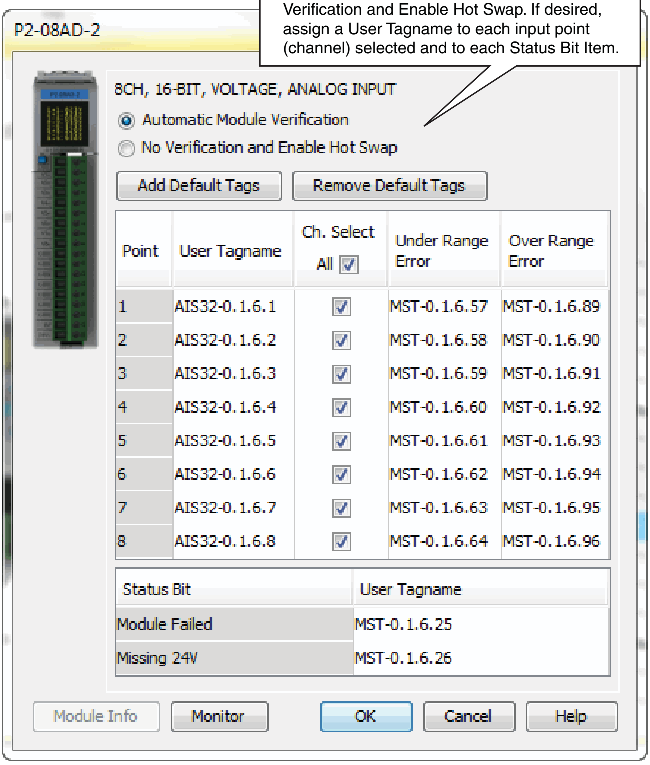


# P2-08AD-2 Analog Input (continued)

## Module Configuration

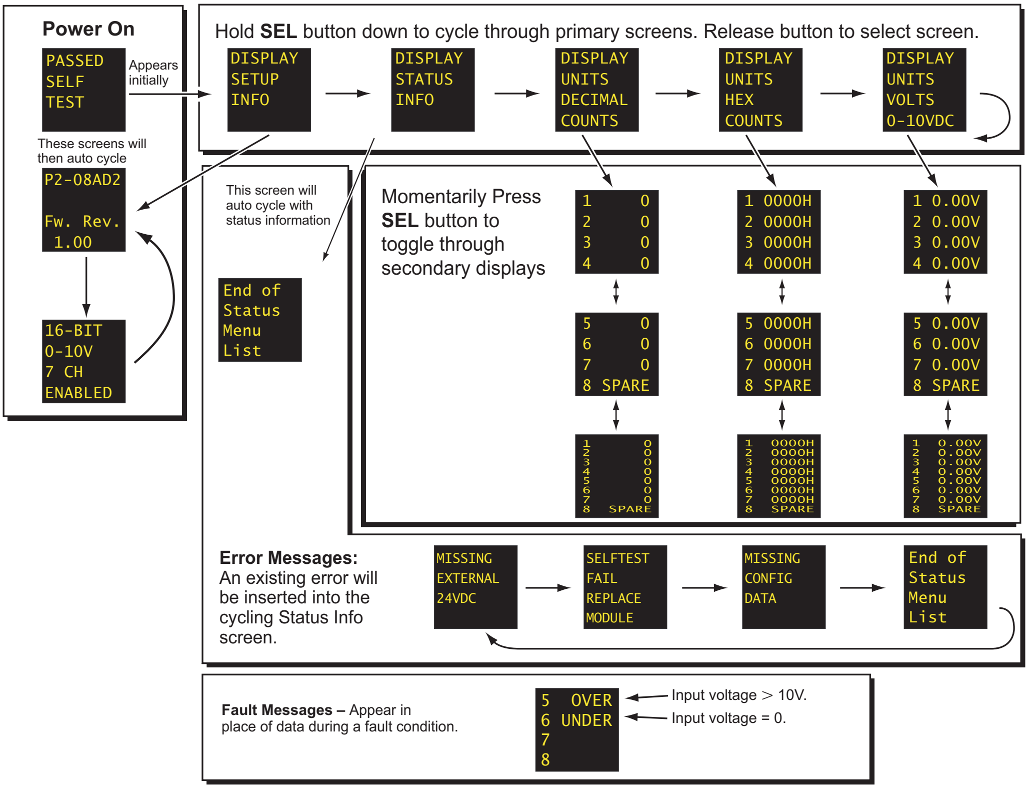


Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-08AD-2 module into the base configuration.
Select Automatic Module Verification or No Verification and Enable Hot Swap. If desired, assign a User Tagname to each input point (channel) selected and to each Status Bit Item.



# P2-08AD-2 Analog Input (continued)

## LCD Panel Display



# P2-16AD-1 Analog Input

The P2-16AD-1 Current Analog Input Module provides sixteen channels for receiving 0-20 mA input signals for use with the Productivity2000 System.


| Input Specifications | |
|---|---|
| Input Channels | 16 sinking |
| Module Signal Input Range | 0-20 mA |
| Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 0-20 mA = 305μA per count (1 LSB = 1 count) |
| Data Range | 0 to 65535 counts |
| Input Type | Single-ended (1 common) |
| Maximum Continuous Overload | ±31mA |
| Input Impedance | 250Ω ±0.1% 1/4W |
| Filter Characteristics | Low Pass, -3dB @ 100Hz |
| Sample Duration Time | 4ms per channel (does not include ladder scan time) |
| All Channel Update Rate | 112ms |
| Open Circuit Detection Time | Zero reading within 1s |
| Conversion Method | Successive approximation |
| Accuracy vs. Temperature | ±25PPM / ºC maximum |
| Maximum Inaccuracy | 0.1% of range (including temperature drift) |
| Linearity Error (end to end) | ±10 LSB maximum (±0.015% of range) Monotonic with no missing codes |
| Input Stability and Repeatability | ±0.015% of range (after 10 min warmup) |
| Full Scale Calibration Error (not including offset) | ±10 LSB |
| Offset Calibration Error | ±10 LSB maximum (±0.015% of range) |
| Max Crosstalk | -76dB, ±10 LSB |
| Recommended Fuse (external) | Edison S500-32-R, 0.032 A fuse |
| External DC Power Required | 24VDC (-20% / +25%) 35mA |

*Meets EMC and Safety requirements. See the Declaration of Conformity for details.

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

Module connector type is a 24-pin Molex Style 43025-2400.

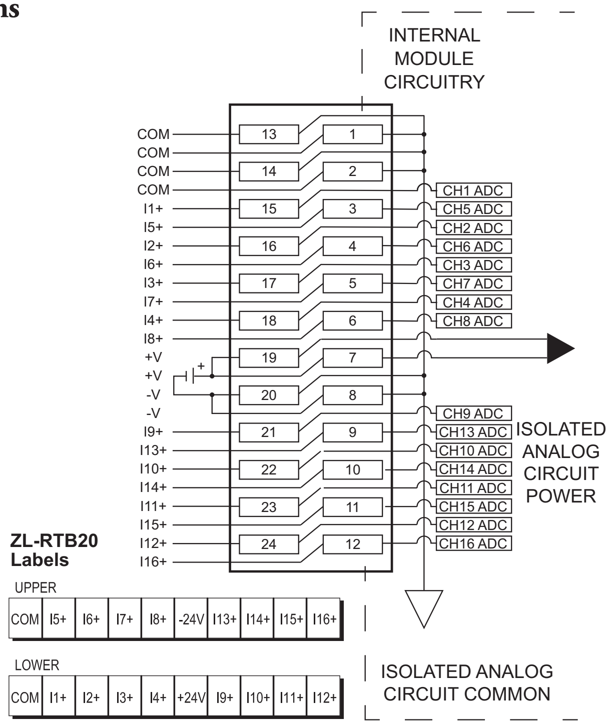
# P2-16AD-1 Analog Input (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 800mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | ***ZIP***Link Wiring System ONLY. See “Wiring Options” in Chapter 5. Must use copper conductors 75°C or equivalent. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type | 24-Pin Molex Style 43025-2400 |
| Weight | 90g (3.2 oz) |

| Connector Specifications | |
|---|---|
| Connector Type | 24-Pin Molex Style 43025-2400 |
| Number of Pins | 24 |
| Pin Spacing | 3x3 mm (0.118 x 0.118 in) |

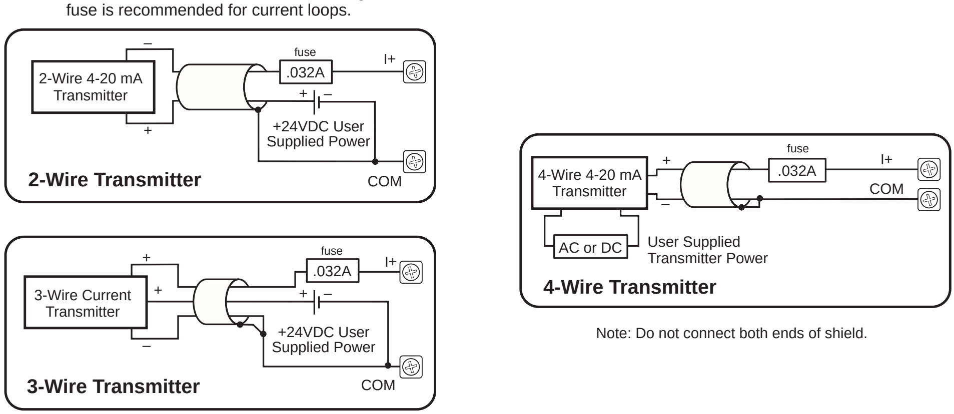
# P2-16AD-1 Analog Input (continued)

## Wiring Diagrams




### Current Input Circuits

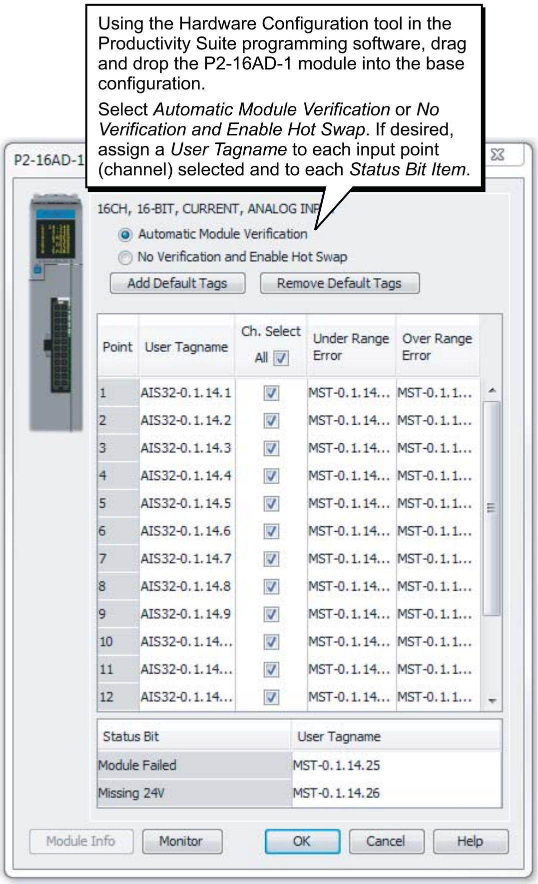
An Edison S500-32-R 0.032A fast-acting fuse is recommended for current loops.




Note: Do not connect both ends of shield.

# P2-16AD-1 Analog Input (continued)

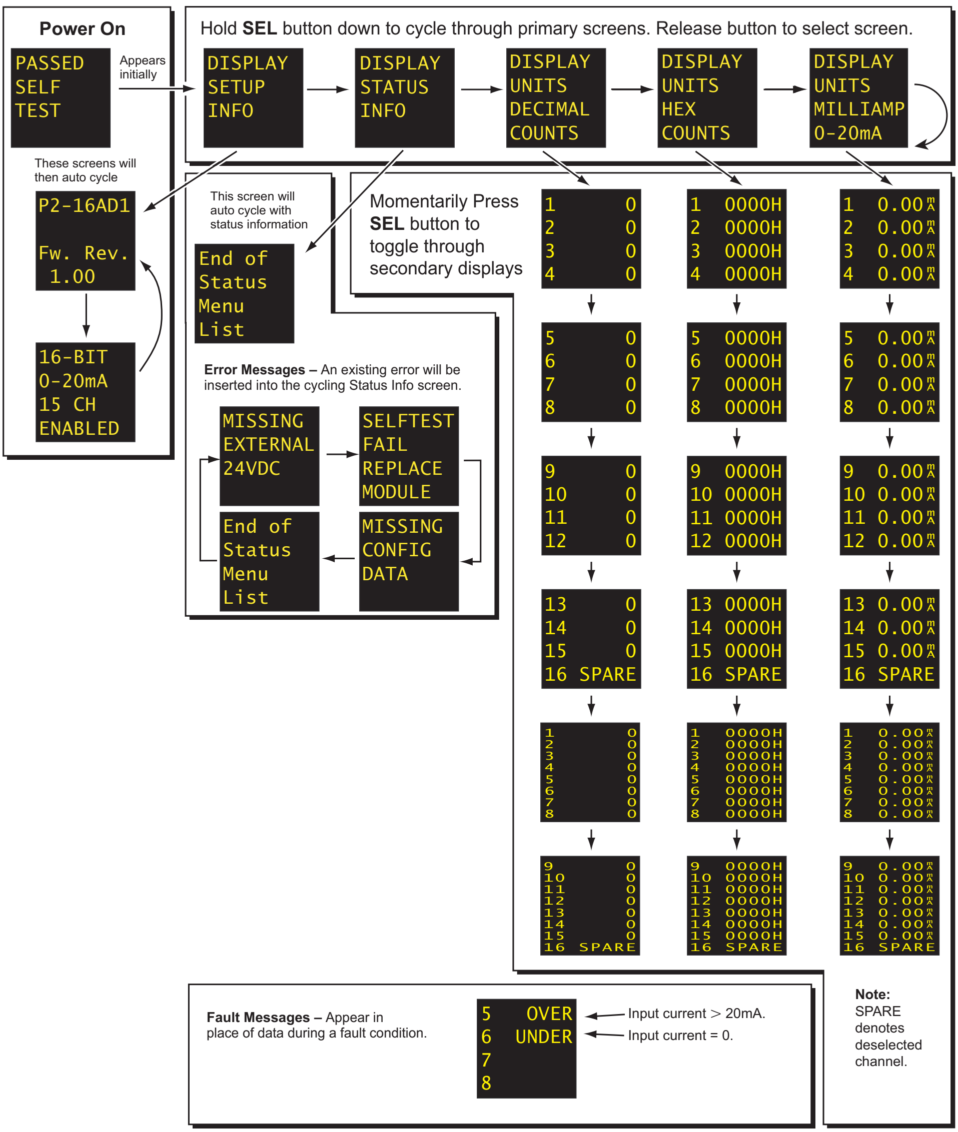
## Module Configuration



3

# P2-16AD-1 Analog Input (continued)

## LCD Panel Display



# P2-16AD-2 Analog Input

The P2-16AD-2 Voltage Analog Input Module provides sixteen channels for receiving 0 to 10 VDC signals.


| Input Specifications | |
|---|---|
| Input Channels | 16 |
| Module Signal Input Range | 0-10 VDC |
| Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 0-10 VDC = 152µV per count (1 LSB = 1 count) |
| Data Range | 0 to 65535 counts |
| Input Type | Single-ended (1 common) |
| Maximum Continuous Overload | ±100V |
| Input Impedance | 250kΩ (typical) |
| Filter Characteristics | Low Pass, -3dB @ 100Hz |
| Sample Duration Time | 4ms per channel (does not include ladder scan time) |
| All Channel Update Rate | 112ms |
| Open Circuit Detection Time | Zero reading within 1s |
| Conversion Method | Successive approximation |
| Accuracy vs. Temperature | ±25PPM / °C maximum |
| Maximum Inaccuracy | 0.1% of range (including temperature drift) |
| Linearity Error (end to end) | ±10 LSB maximum (±0.015% of range) Monotonic with no missing codes |
| Input Stability and Repeatability | ±10 LSB |
| Full Scale Calibration Error (not including offset) | ±10 LSB maximum (±0.015% of range) |
| Offset Calibration Error | ±10 LSB maximum |
| Max Crosstalk | -76dB, ±10 LSB |
| External DC Power Required | 24VDC (-20% / +25%) 35mA |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

Module connector type is a 24-pin Molex Style 43025-2400.

# P2-16AD-2 Analog Input (continued)

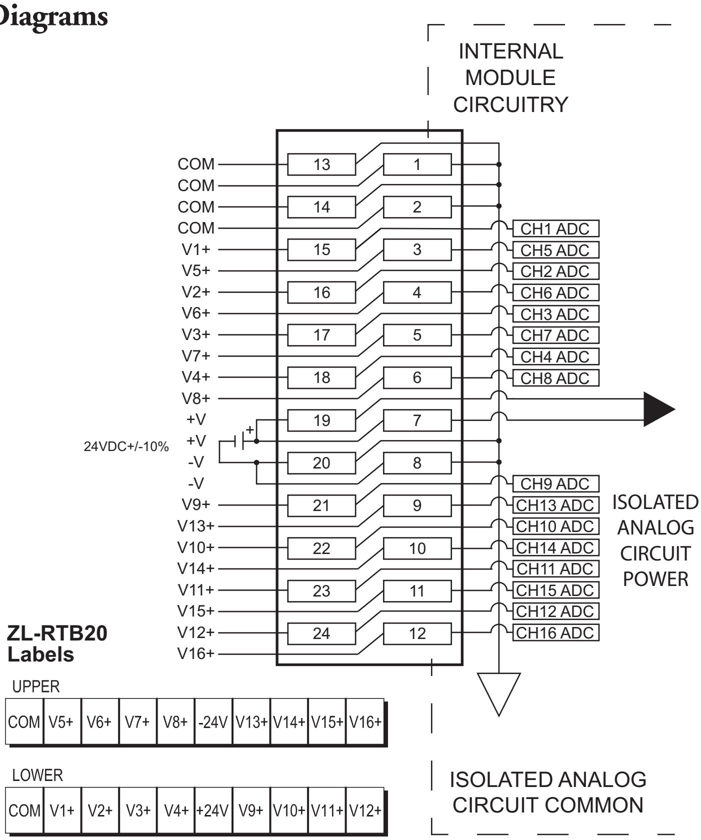
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 59mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | ***ZIP***Link Wiring System ONLY. See “Wiring Options” in Chapter 5. Must use copper conductors 75°C or equivalent. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type | 24-Pin Molex Style 43025-2400 |
| Weight | 90g (3.2 oz) |

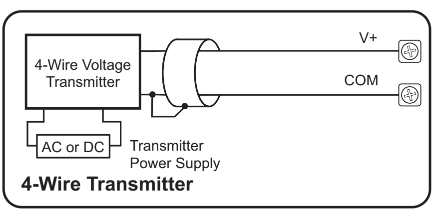
* Meets EMC and Safety requirements. See the Declaration of Conformity for details.

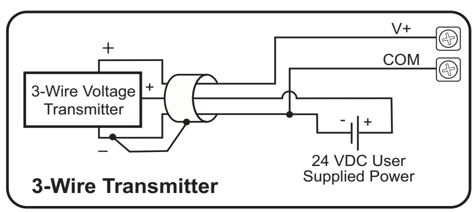
| Connector Specifications | |
|---|---|
| Connector Type | 24-Pin Molex Style 43025-2400 |
| Number of Pins | 24 |
| Pin Spacing | 3 x 3 mm (0.118 x 0.118 in) |

# P2-16AD-2 Analog Input (continued)

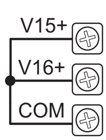
## Wiring Diagrams




**Note:** For maximum accuracy jumper unused inputs to common.

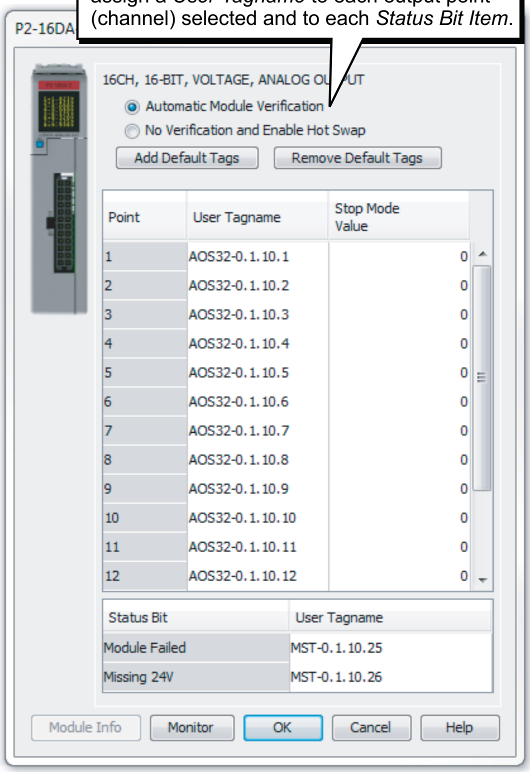


# P2-16AD-2 Analog Input (continued)

## Module Configuration

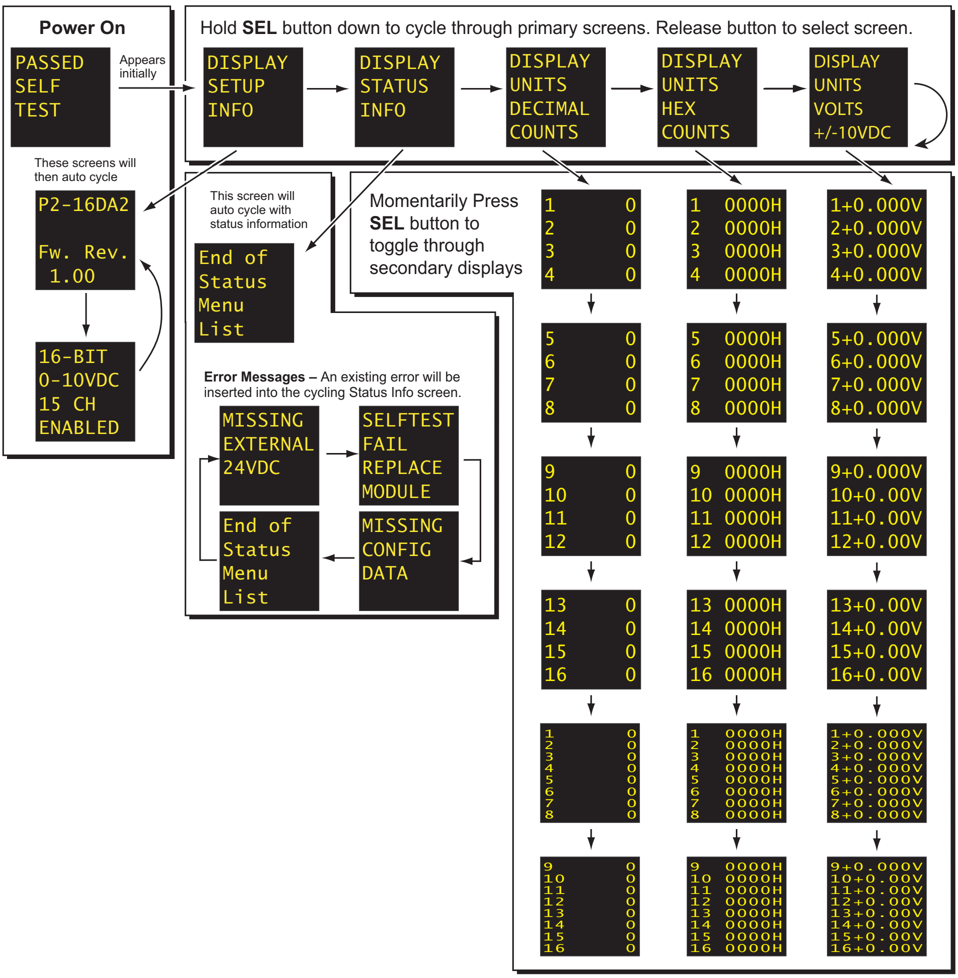
Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-16DA-2 module into the base configuration.

Select *Automatic Module Verification* or *No Verification and Enable Hot Swap*. If desired, assign a *User Tagname* to each output point (channel) selected and to each *Status Bit Item*.



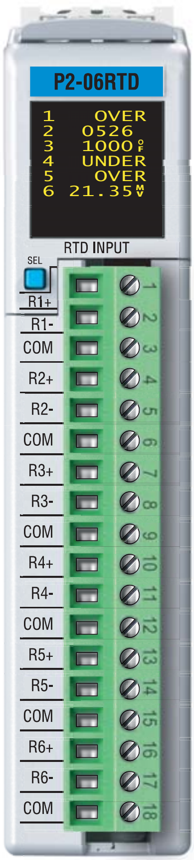
# P2-16AD-2 Analog Input (continued)

## LCD Panel Display



# P2-06RTD Analog Input

The P2-06RTD input module provides six differential channels for receiving RTD and resistance input signals for use with the Productivity2000 System.




## RTD Input Specifications

| | |
|---|---|
| Input Channels | 6 Differential |
| Max. Common Mode Voltage | 5VDC |
| Data Format | Floating Point |
| Common Mode Rejection | -90dB min. @ DC, -150dB min. @ 50/60 Hz |
| Absolute Maximum Ratings | Fault protected input, ±50V |
| Internal Resolution | 16-bit, ±0.1°C or °F (up to 100Hz filter) |
| Input Ranges (RTD Types) | Pt100 -200°C/850°C (-328°F/1562°F)<br>Pt1000 -200°C/595°C (-328°F/1103°F)<br>JPt100 -100°C/450°C (-148°F/842°F)<br>10Ω Cu. -200°C/260°C (-328°F/500°F)<br>25Ω Cu. -200°C/260°C (-328°F/500°F)<br>120Ω Ni. -80°C/260°C (-112°F/500°F) |
| RTD Linearization | Automatic |
| Excitation Current (all ranges) | 200µA |
| Accuracy vs. Temperature | ±5ppm per °C (maximum) |
| Full Scale Calibration | ±1°C |
| Offset Calibration Error | ±1 count (negligible) |
| Linearity Error (end to end) | ±0.5°C maximum, ±0.01°C typical, Monotonic with no missing codes |
| Maximum Inaccuracy | ±1°C maximum (excluding RTD error) (including temperature drift) |
| Warm-up Time | 2 minutes for ±0.2% repeatability |
| Sample Duration (Single channel update rate) | Dependent on digital Filter Settings – 488ms @ 10Hz, 88ms @ 50Hz, 75ms @ 60Hz, 56ms @ 100Hz, 48ms @ 250Hz |
| Filter Characteristics | Digital filter cutoff frequencies: 10Hz, 50Hz, 60Hz, 100Hz, or 250Hz |
| All Channel Update Rate | Single channel update rate times the number of enabled channels |
| Open Circuit Detection Time | Positive full scale reading within 2s |
| Conversion Method | Sigma-Delta |
| External DC Power Required | None |

* Meets EMC and Safety requirements. See the Declaration of Conformity for details.

**Terminal Block Included. Not Compatible with *ZIP*Link.**
**Warranty: Thirty-day money-back guarantee. Two-year limited replacement. (See www.productivity2000.com for details).**

# P2-06RTD Analog Input (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Heat Dissipation | 300mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Removable terminal block (included).<br>The P2-06RTD module is not compatible with the ***ZIP***Link wiring system. |
| EU Directive | See the "EU Directive" topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

## Removable Terminal Block Specifications

| Part Number | P2-RTB (included) | P2-RTB-1 |
|---|---|---|
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75°C" or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

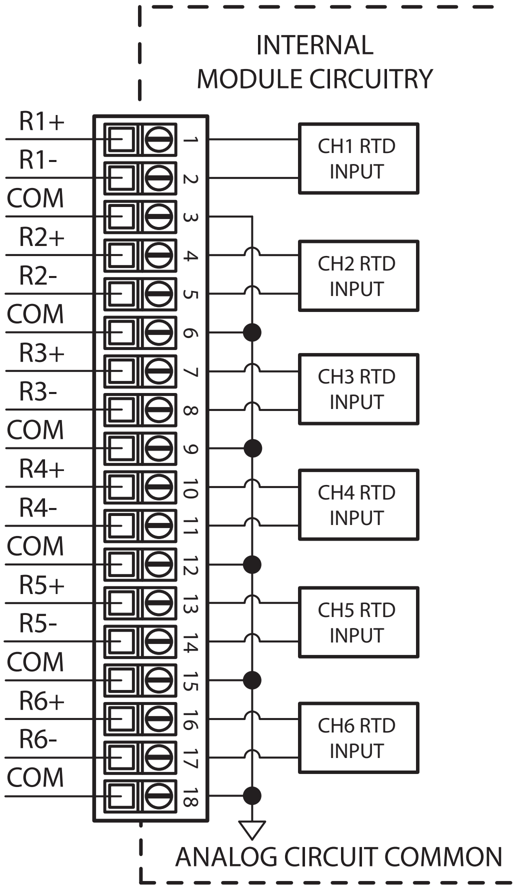
# P2-06RTD Analog Input (continued)

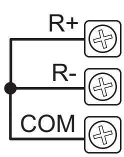
| Resistance Input Specifications | |
|---|---|
| Internal Resolution | 16 bit, .0015% of full scale range in ohms (up to 100Hz filter) |
| Resistance Input Ranges and CPU Resolution | 0-10,000Ω, Resolution 1Ω<br>0-6,250Ω, Resolution 0.1Ω<br>0-3,125Ω, Resolution 0.1Ω<br>0-1,562.5Ω, Resolution 0.1Ω<br>0-781.25Ω, Resolution 0.1Ω<br>0-390.625Ω, Resolution .01Ω<br>0-195.3125Ω, Resolution .01Ω |
| Accuracy vs. Temperature | ±25ppm per °C (maximum) |
| Full Scale Calibration | ± .02% of full scale range |
| Offset Calibration Error | ± .0015% of full scale range in ohms |
| Linearity Error (end to end) | ± .0015% of full scale range maximum at 25°C, Monotonic with no missing codes |
| Maximum Inaccuracy | ± 0.10% of full scale range |

| Diagnostics | |
|---|---|
| Module Diagnostics Failure | 1 bit per module |
| Module Not Ready | 1 bit per module |
| Channel Burn-out (RTD only) | 1 bit per channel |
| Under-range (RTD only) | 1 bit per channel |
| Over-range | 1 bit per channel |

# P2-06RTD Analog Input (continued)

## Wiring Diagrams

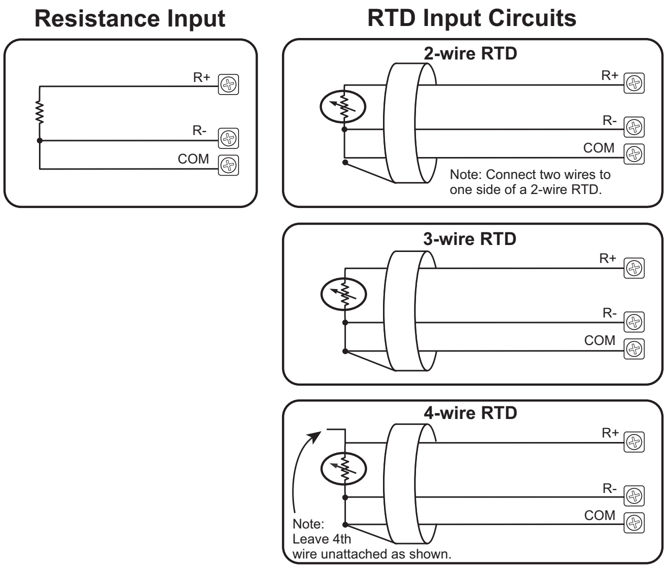



**Note:** Jumper unused inputs to common.

# P2-06RTD Analog Input (continued)

## Wiring Diagrams



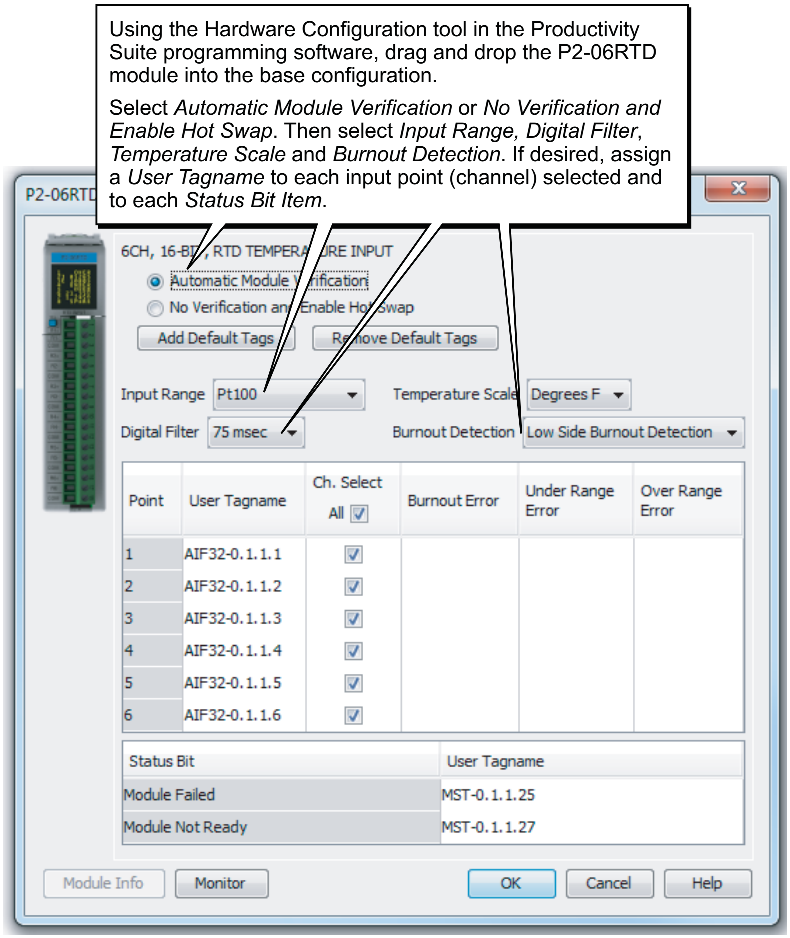

**Notes:**

For maximum accuracy follow these guidelines.

1. For 2-wire RTD, attach third wire to module common.
2. R+, R-, and COM wires to an RTD must be equal length and type. Refer to RTD manufacturer's recommendations.
3. Do not use cable shield as sensing wire.
4. When applicable, connect shield to RTD common only, otherwise connect to module common only. Do not connect shield at both ends.

# P2-06RTD Analog Input (continued)

## Module Configuration

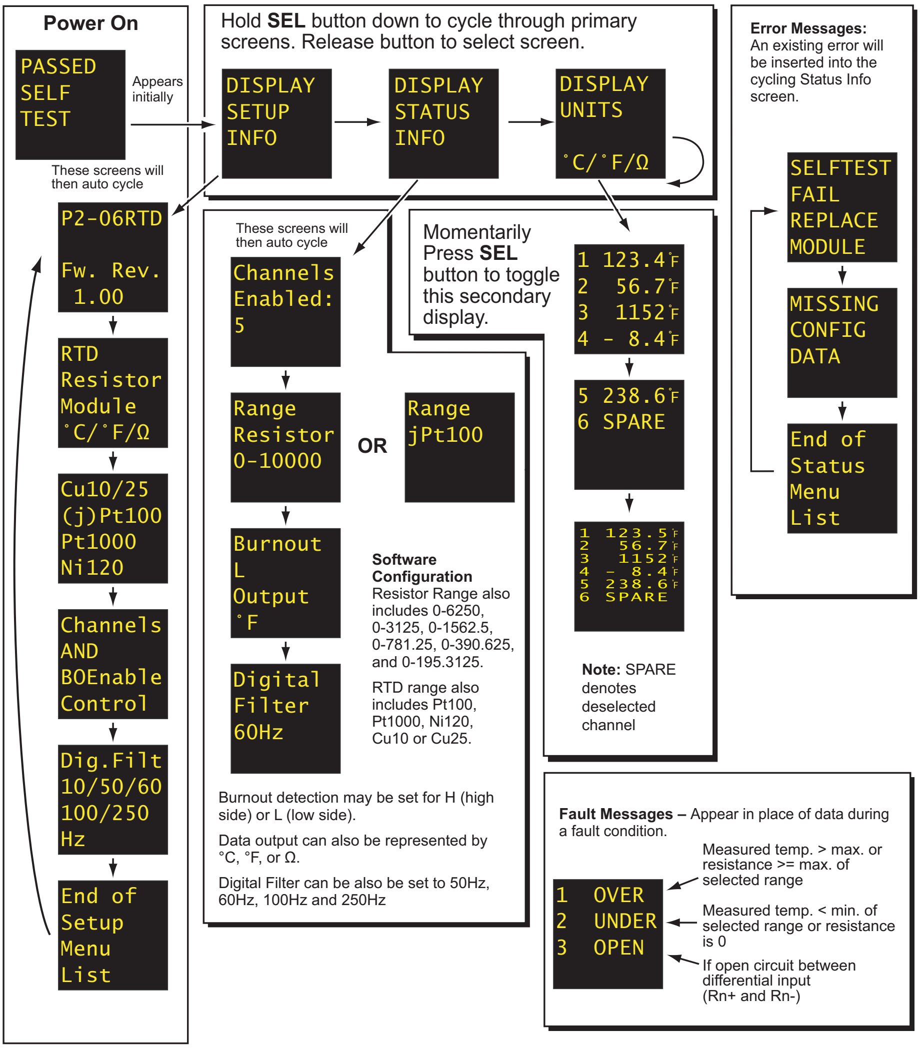





3

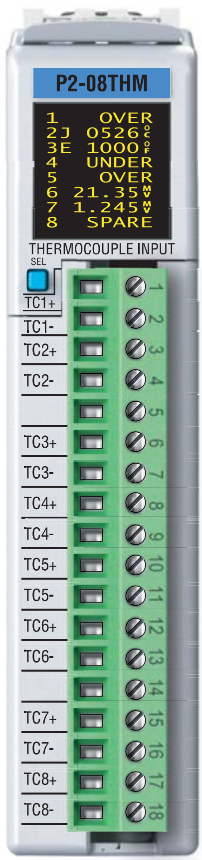
# P2-06RTD Analog Input (continued)

## LCD Panel Display



# P2-08THM Analog Input

The P2-08THM Thermocouple Input Module provides eight differential channels for receiving thermocouple and voltage input signals for use with the Productivity2000 System.




## Thermocouple Input Specifications

| | |
|---|---|
| Input Channels | 8 Differential |
| Data Format | Floating Point |
| Common Mode Range | ±1.25 V |
| Common Mode Rejection | 100dB @ DC and 130dB @ 60Hz |
| Input Impedance | >5MΩ |
| Maximum Ratings | Fault protected inputs to ±50V |
| Resolution | 16-bit, ±0.1°C or °F |
| Thermocouple Input Ranges | Type J -190° to 760°C (-310° to 1400°F);<br>Type E -210° to 1000°C (-346° to 1832°F);<br>Type K -150° to 1372°C (-238° to 2502°F);<br>Type R 65° to 1768°C (149° to 3214°F);<br>Type S 65° to 1768°C (149° to 3214°F);<br>Type T -230° to 400°C (-382° to 752°F);<br>Type B 529° to 1820°C (984° to 3308°F);<br>Type N -70° to 1300°C (-94° to 2372°F);<br>Type C 65° to 2320°C (149° to 4208°F); |
| Cold Junction Compensation | Automatic |
| Thermocouple Linearization | Automatic |
| Accuracy vs. Temperature | ±50ppm per °C (maximum) |
| Linearity Error | ±1°C maximum (±0.5°C typical)<br>Monotonic with no missing codes. |
| Maximum Inaccuracy | ±3°C maximum (including temperature drift but excluding thermocouple error). |
| Warm-up Time | 30 minutes for ±1% repeatability<br>2 minutes to reach voltage specifications |
| Sample Duration Time | 270ms |
| All Channel Update Rate | 2.16 s |
| Open Circuit Detection Time | Within 2s |
| Conversion Method | Sigma-Delta |
| External DC Power Required | None |

**Terminal Block Included. Not Compatible with *ZIP*Link.**
**Warranty: Thirty-day money-back guarantee. Two-year limited replacement. (See www.productivity2000.com for details).**

## Voltage Input Specifications

| | |
|---|---|
| Linear mV Device Input Ranges | 0-39.0625 mVDC,<br>+/-39.0625 mVDC,<br>+/-78.125 mVDC,<br>0-156.25 mVDC,<br>+/-156.25 mVDC,<br>0-1250 mVDC |
| Max Voltage Input Offset Error | 0.05% @ 0°- 60°C, typical 0.04% @ 25°C |
| Max Voltage Input Gain Error | 0.06% @ 25°C |
| Max Voltage Input Linearity Error | 0.05% @ 0°- 60°C, typical 0.03% @ 25°C |
| Max Voltage Input Impedance | 0.2% @ 0° - 60°C, typical 0.06% @ 25°C |

# P2-08THM Analog Input (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Heat Dissipation | 500mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Removable terminal block (included).<br>The P2-08THM module is not compatible with the ***ZIP***Link wiring system. |
| EU Directive | See the "EU Directive" topic in the Productivity Suite Help File. Information can also be obtained at:<br>www.productivity2000.com |
| Connector Type (Included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

| Configuration/Diagnostics | |
|---|---|
| Burn-out Detection: High Side/Disable | 1 bit per module |
| °C/°F (T/C Only) | 1 bit per module |
| Module Diagnostics Failure | 1 bit per module |
| Burn-out (on if T/C input is open – no connection between TCn+ and TCn-) | 1 bit per channel |
| Channel Under-range (T/C only) | 1 bit per channel |
| Channel Over-range (T/C only) | 1 bit per channel |

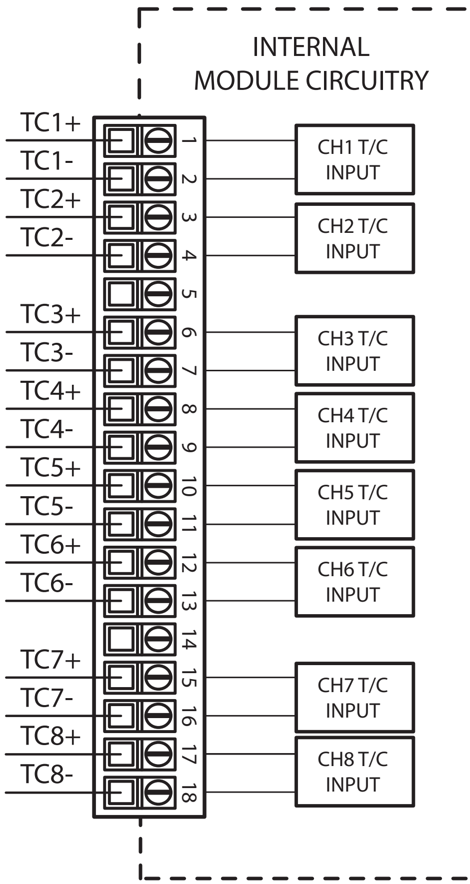
# P2-08THM Analog Input (continued)

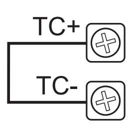
| Removable Terminal Block Specifications | | |
|---|---|---|
| **Part Number** | **P2-RTB (included)** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range* | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors* | Use Thermocouple Extension wire for thermocouples.<br>Use copper conductors, 75°C or equivalent for millivolt inputs. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

* Use shielded, twisted thermocouple wire that matches the thermocouple type.

# P2-08THM Analog Input (continued)

## Wiring Diagrams

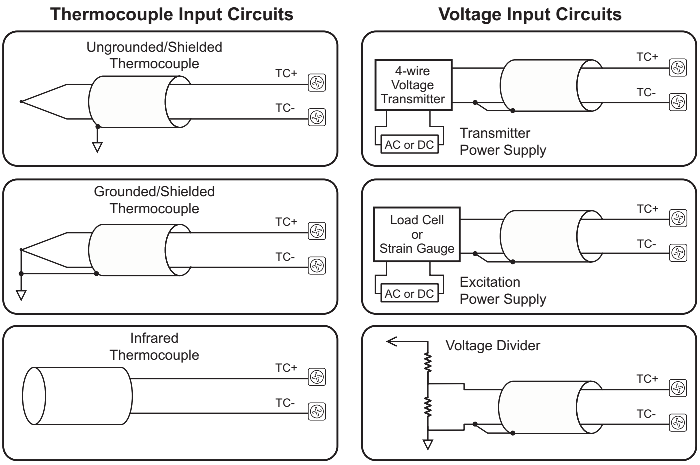


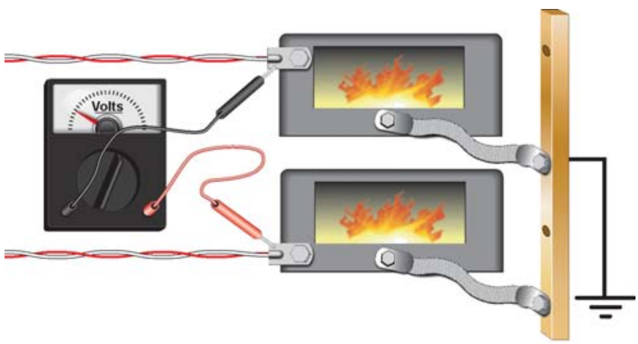




**NOTE:** Install jumper wire on each unused input; TC+ to TC-.

# P2-08THM Analog Input (continued)

## Wiring Diagrams




**NOTES:**

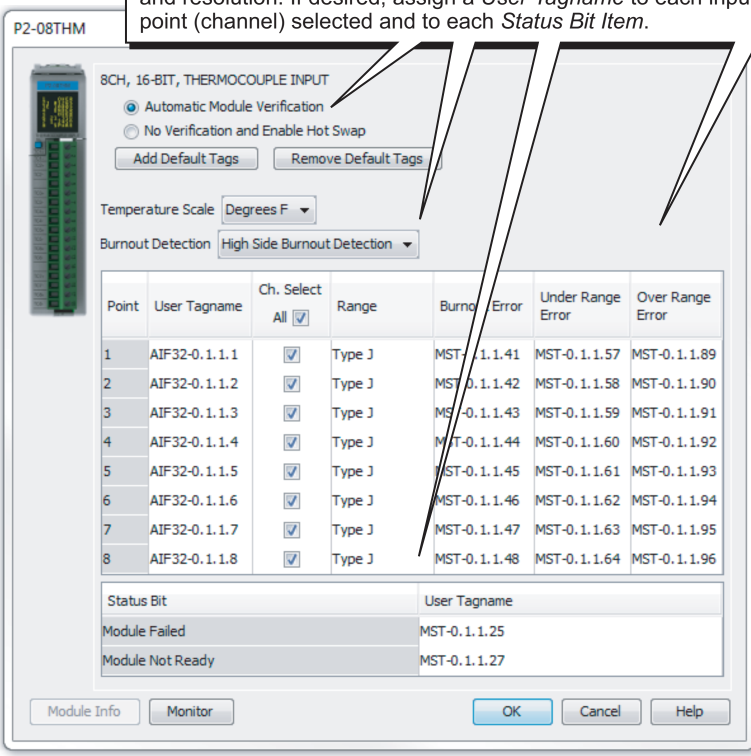
1. Connect shield to thermocouple signal/ground only. Do not connect to both ends.
2. With grounded thermocouples, take precautions to prevent having a voltage potential between thermocouple tips. A voltage of 1.25V or greater between tips will skew measurements.
3. Use shielded, twisted thermocouple extension wire that matches the thermocouple type. Use thermocouple-compatible junction blocks.

# P2-08THM Analog Input (continued)

## Module Configuration

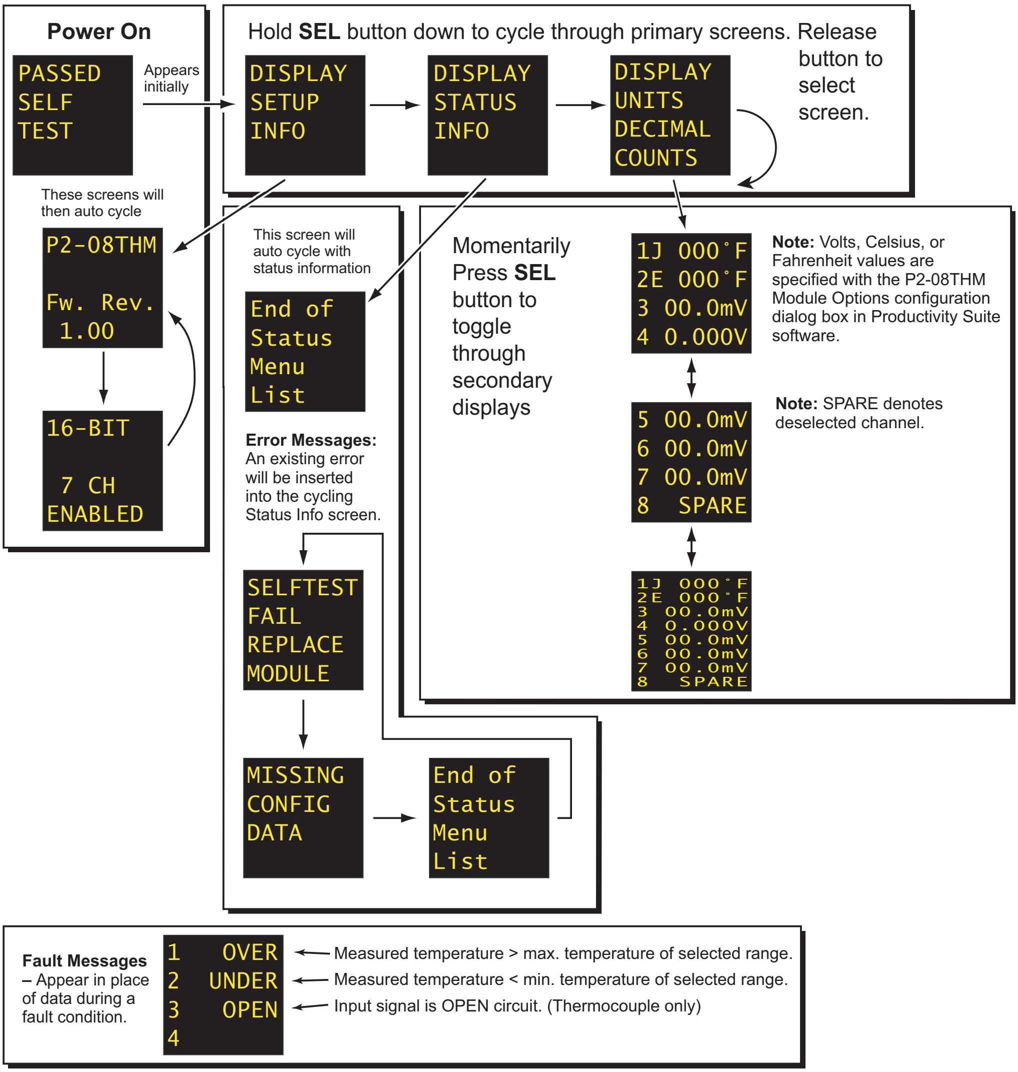
Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-08THM module into the base configuration.

Select *Automatic Module Verification* or *No Verification and Enable Hot Swap.* Specify *Temperature Scale* and *Burnout Detection*, and use the drop down menu to select module range and resolution. If desired, assign a *User Tagname* to each input point (channel) selected and to each *Status Bit Item*.



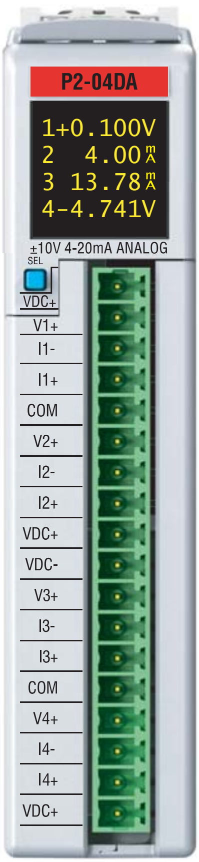
# P2-08THM Analog Input (continued)

## LCD Panel Display



# P2-04DA Analog Output

The P2-04DA Voltage/Current Analog Output Module provides four channels of ±10VDC or 4-20 mA sink/source selectable outputs.




| Output Specifications | |
|---|---|
| Output Channels | 4 |
| Module Signal Output Ranges | 1) ±10VDC<br>2) 4-20 mA (sink or source per channel) |
| Signal Resolution | 16-bit |
| Resolution Value of LSB<br>(least significant bit) | ±10V = 305μV/count<br>4-20 mA = 0.244 μA/count<br>1 LSB = 1 count |
| Data Range | 0 to 65535 counts uni-polar and<br>-32768 to +32767 counts bi-polar |
| Output Type | Voltage outputs sources/sinking at 10mA max, or<br>Current outputs sink or source at 20mA max. |
| Output Value in Fault Mode | Voltage outputs 0V or 0mA current outputs |
| Load Impedance<br>(Minimum External Power Supply) | >1000Ω voltage outputs (19.2 - 30 VDC)<br>0 - 755Ω Sinking, 0 - 600Ω Sourcing (19.2 VDC)<br>0 - 875Ω Sinking, 0 - 700Ω Sourcing (21.6 VDC)<br>0 - 1000Ω Sinking, 0 - 855Ω Sourcing (24VDC)<br>0 - 1110Ω Sinking, 0 - 970Ω Sourcing (26.4 VDC)<br>0 - 1350Ω Sinking, 0 - 1150Ω Sourcing (30VDC) |
| Maximum Capacitive Load | 0.01 μF maximum voltage outputs |
| Maximum Inductive Load | 1mH maximum current outputs |
| Allowed Load Type | Grounded |
| Maximum Inaccuracy (% of range) | 0.1% voltage, 0.1% current<br>(including temperature drift) |
| Maximum Full Scale Calibration Error (not including offset error) | ±0.025% of range maximum voltage outputs<br>±0.025% of range maximum current outputs |
| Maximum Offset Calibration Error | ±0.025% of range maximum |
| Accuracy vs. Temperature | ±25ppm/°C max f.s. calibration change<br>(±0.0025% of range/°C) |
| Max Crosstalk | -80dB, 6 LSB |
| Linearity Error (End to End) | ±16 LSB maximum (±0.025% of full scale)<br>Monotonic with no missing codes |
| Output Stability and Repeatability | ±10 LSB after 10 minute warm-up (typical) |
| Output Ripple | 0.05% of Full Scale |
| Output Setting Time | 0.3 ms max, 5μs min (full scale change) |
| All Channel Update Rate | 0.6 ms |
| Maximum Continuous Overload | Voltage Outputs current limited to 35mA typical<br>Current Outputs open circuit protected |
| Type of Output Protection | 15VDC Peak Output Voltage<br>Current outputs current limited to <=20mA |
| Output Signal (power-up,-down) | 0V voltage outputs, 0mA current outputs |
| External DC Power Required | 94mA voltage operation 4 channels<br>130mA current operation 4 channels<br>24VDC -20% / +25% |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-04DA Analog Output (continued)

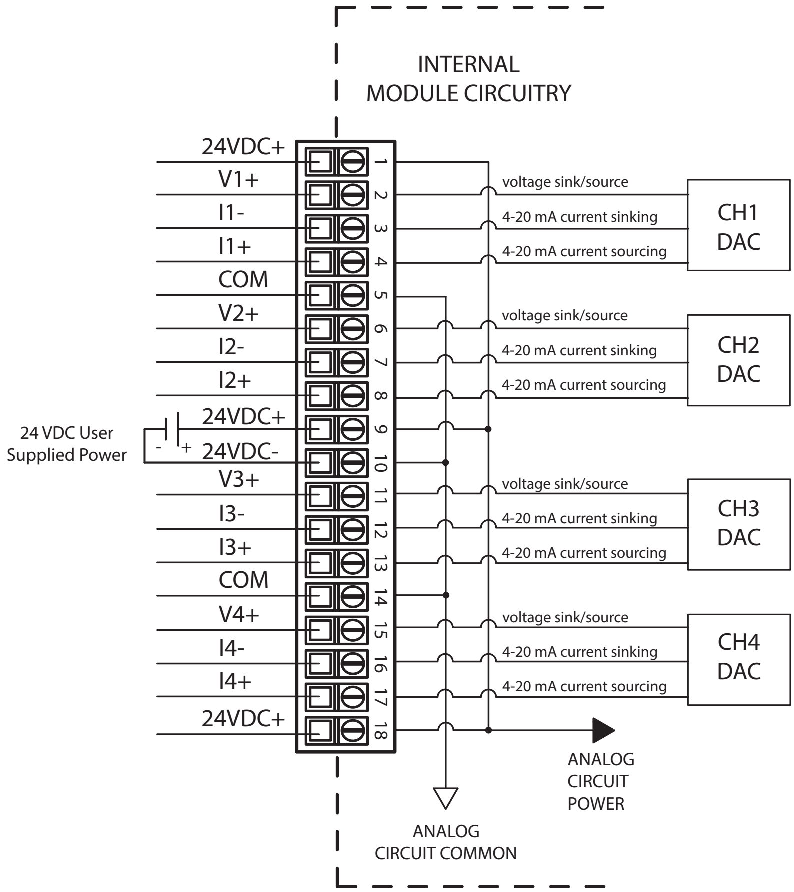
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 3.6 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

| Removable Terminal Block Specifications | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75°C” or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

# P2-04DA Analog Output (continued)

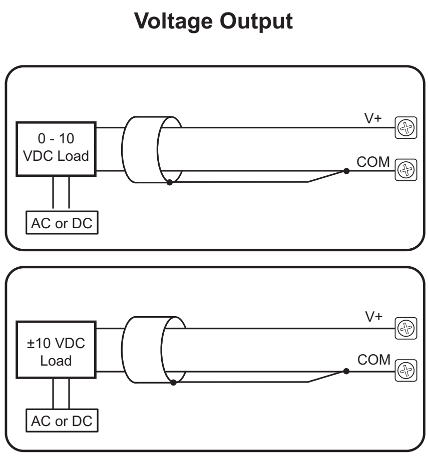
## Wiring Diagrams

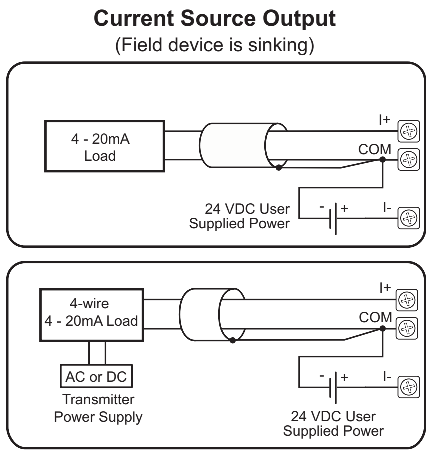


# P2-04DA Analog Output (continued)

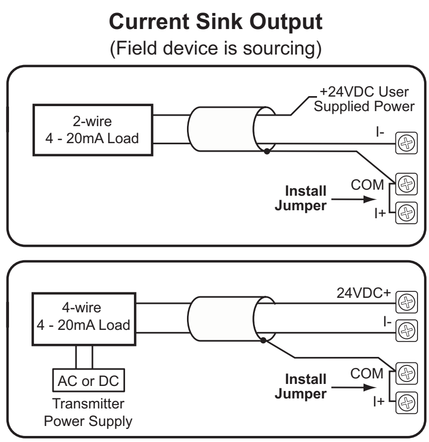
## Wiring Diagrams (continued)






NOTE: Shield is connected to common at the source device.

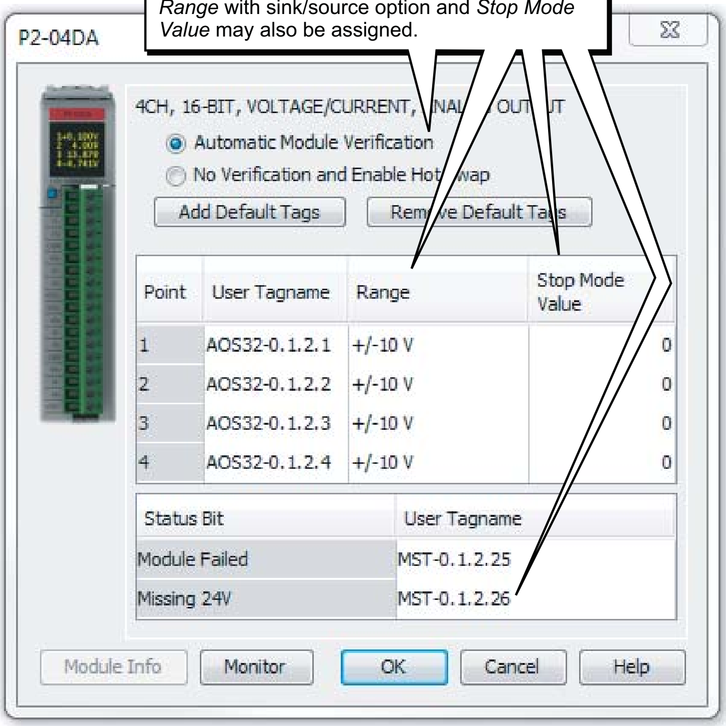


# P2-04DA Analog Output (continued)

## Configuration Settings

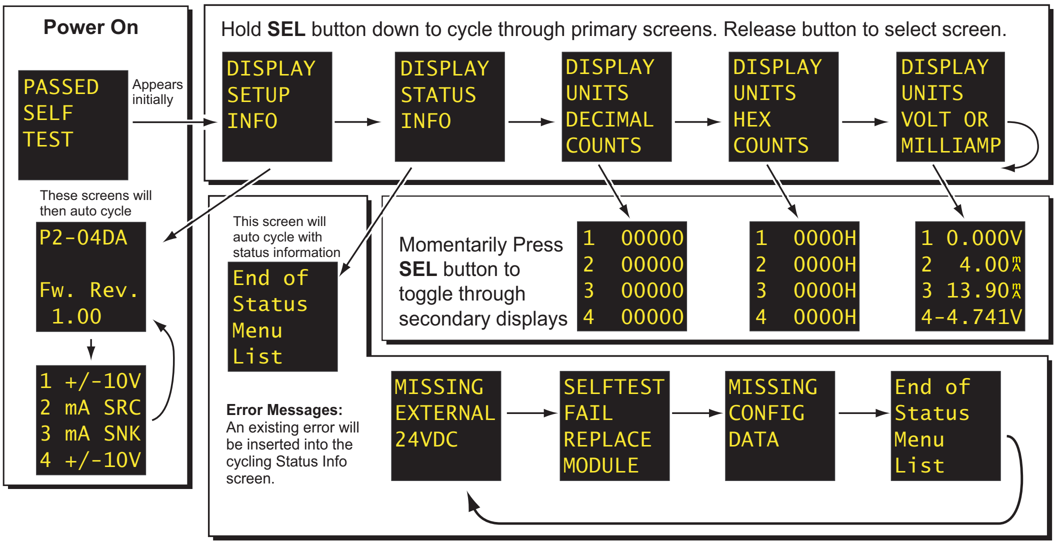
Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-04DA module into the base configuration.

Select *Automatic Module Verification* or *No Verification and Enable Hot Swap*. If desired, assign a *User Tagname* to each output point (channel) selected and to each *Status Bit Item*. *Range* with sink/source option and *Stop Mode Value* may also be assigned.



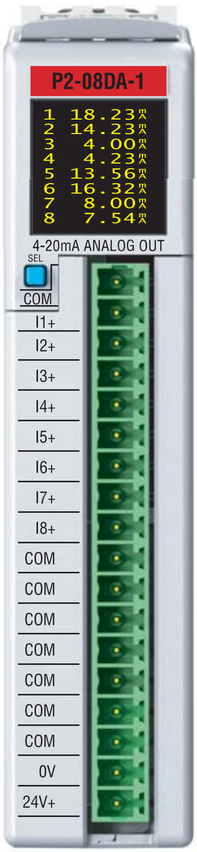
# P2-04DA Analog Output (continued)

## LCD Panel Display



# P2-08DA-1 Analog Output

The P2-08DA-1 Current Analog Output Module provides eight channels of 4 to 20 mA outputs for use with the Productivity2000 System.




| Output Specifications | |
|---|---|
| Output Channels (Commons) | 8 |
| Module Signal Output Range | 4-20 mA |
| Output Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 4-20 mA = 0.244 μA/count<br>1 LSB = 1 count |
| Data Range | 0 to 65535 counts |
| Output Type (sourcing) | Current: 20mA max |
| Output Value in Fault Mode | Near 0mA |
| Load Impedance (Minimum External Power Supply) | 0 - 570Ω (19.2 VDC)<br>0 - 690Ω (21.6 VDC)<br>0 - 810Ω (24VDC)<br>0 - 930Ω (26.4 VDC)<br>0 - 1100Ω (30VDC)<br>Minimum Load 0 - 125Ω @ 0 - 45°C<br>250 - 715Ω @ 0 - 60°C |
| Maximum Inductive Load | 1mH |
| Allowed Load Type | Grounded |
| Maximum Inaccuracy | 0.1% of range (Counts TBD)<br>(including temperature drift) |
| Maximum Full Scale Calibration Error (not including offset error) | ±0.025% of range maximum |
| Maximum Offset Calibration Error | ±0.025% of range maximum |
| Accuracy vs. Temperature | ±25ppm/°C max full scale calibration change<br>(±0.0025% of range/°C) |
| Max Crosstalk | -96dB, 1 LSB |
| Linearity Error (End to End) | ±16 LSB maximum (±0.025% of full scale)<br>Monotonic with no missing codes |
| Output Stability and Repeatability | ±10 count after 10 minute warm-up (typical) |
| Output Ripple | 0.05% of full scale |
| Output Setting Time | 300μs max, 5μs min (full scale change) |
| All Channel Update Rate | 600μs |
| Maximum Continuous Overload | Outputs open circuit protected |
| Type of Output Protection | Electronically current limited to 20mA or less |
| Output Signal (power-up,-down) | 4mA |
| External DC Power Required | 24VDC @ 220mA (Loop Power Included) |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-08DA-1 Analog Output (continued)

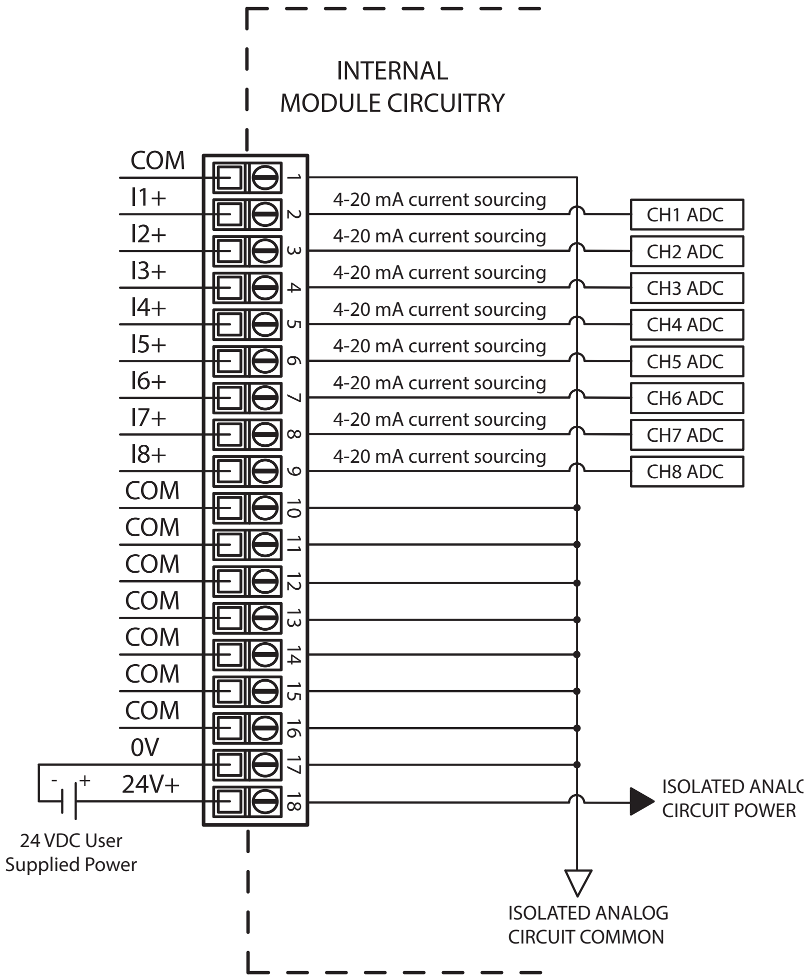
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 700mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

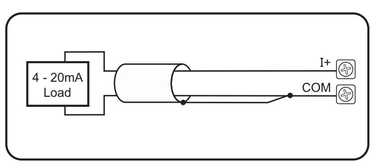
| Removable Terminal Block Specifications | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75°C” or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

# P2-08DA-1 Analog Output (continued)

## Wiring Diagrams



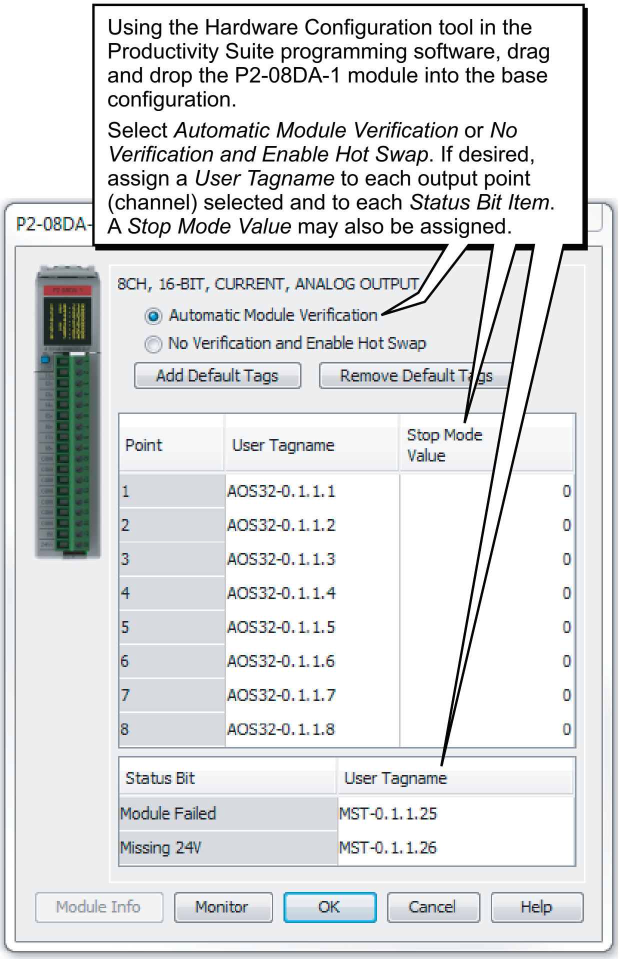

**Current Source Output Circuit**




Note: Shield is connected to common at the source device.

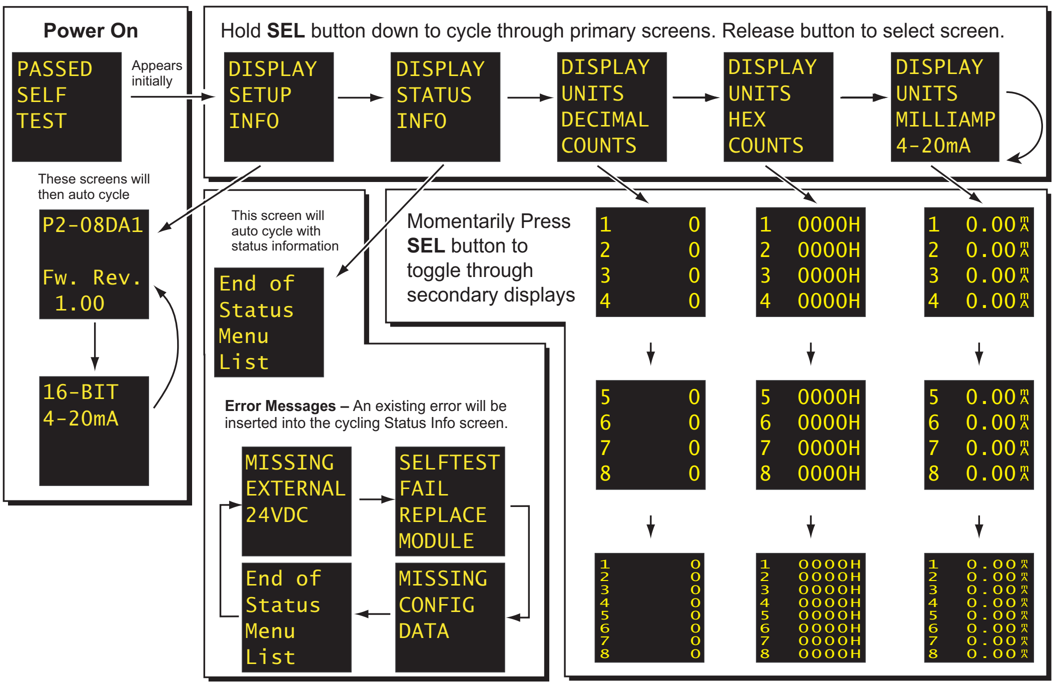
# P2-08DA-1 Analog Output (continued)

## Module Configuration



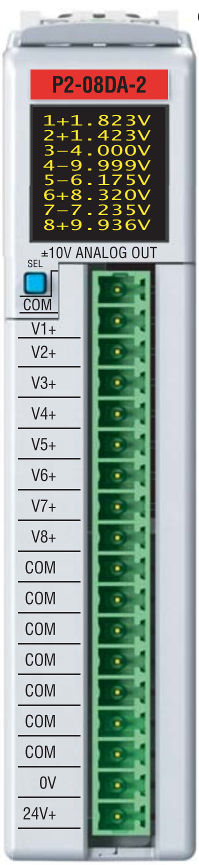
# P2-08DA-1 Analog Output (continued)

## LCD Panel Display



# P2-08DA-2 Analog Output

The P2-08DA-2 Voltage Analog Output Module provides eight channels of ±10 VDC outputs for use with the Productivity2000 Ssystem.




| Output Specifications | |
|---|---|
| Output Channels (Commons) | 8 |
| Module Signal Output Range | ±10VDC |
| Output Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | ±10V = 305µV/count<br>1 LSB = 1 count |
| Data Range | -32768 to +32767 counts |
| Output Type (sourcing/sinking) | Voltage: 10mA max |
| Output Value in Fault Mode | 0V |
| Load Impedance | ≤1000Ω |
| Maximum Capacitive Load | 0.01µF |
| Allowed Load Type | Grounded |
| Maximum Inaccuracy | 0.1% of range<br>(including temperature drift) |
| Maximum Full Scale Calibration Error (not including offset error) | ±0.025% of range maximum |
| Maximum Offset Calibration Error | ±0.025% of range maximum |
| Accuracy vs. Temperature | ±25ppm/°C max full scale calibration change<br>(±0.0025% of range/°C) |
| Max Crosstalk | -96dB, 1 LSB |
| Linearity Error (End to End) | ±16 LSB maximum (±0.025% of full scale)<br>Monotonic with no missing codes |
| Output Stability and Repeatability | ±10 LSB after 10 minute warm-up (typical) |
| Output Ripple | 0.05% of full scale |
| Output Setting Time | 300µs max, 5µs min (full scale change) |
| All Channel Update Rate | 1ms |
| Maximum Continuous Overload | Outputs current limited to 40mA typical<br>Continous overloads on multiple outputs can damage the module. |
| Type of Output Protection | 0.1µF Transient Suppressor |
| Output Signal (power-up,-down) | 0V |
| External DC Power Required | 24VDC @ 150mA |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-08DA-2 Analog Output (continued)

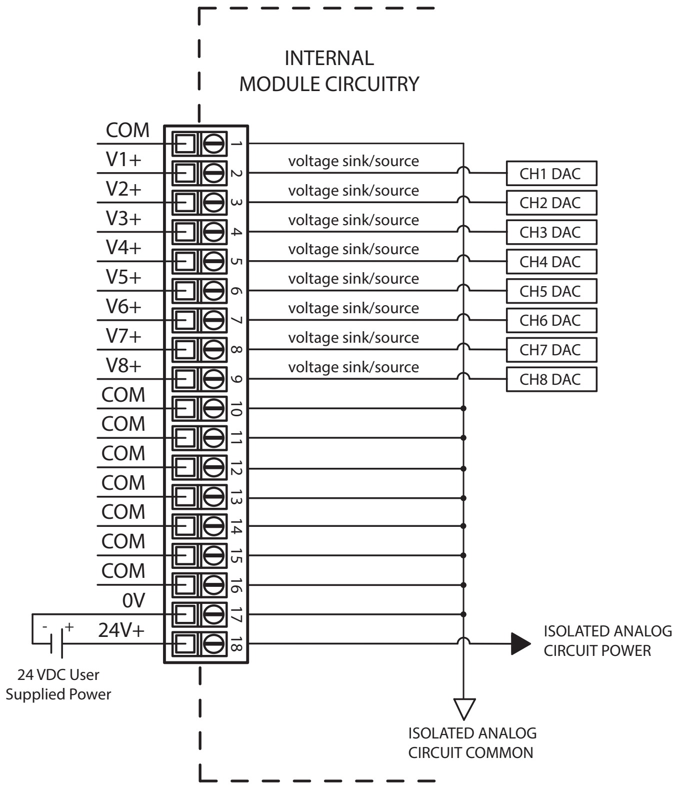
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 150mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

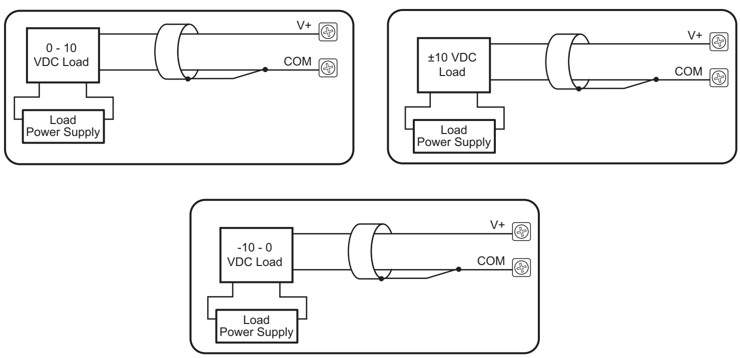
| Removable Terminal Block Specifications | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75°C” or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

# P2-08DA-2 Analog Output (continued)

## Wiring Diagrams

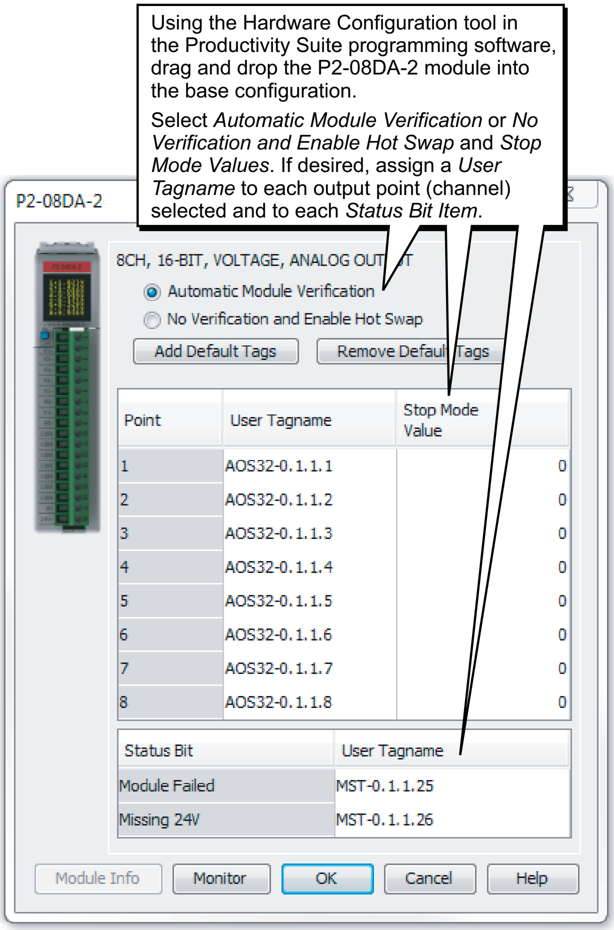



### Voltage Output Circuits



# P2-08DA-2 Analog Output (continued)

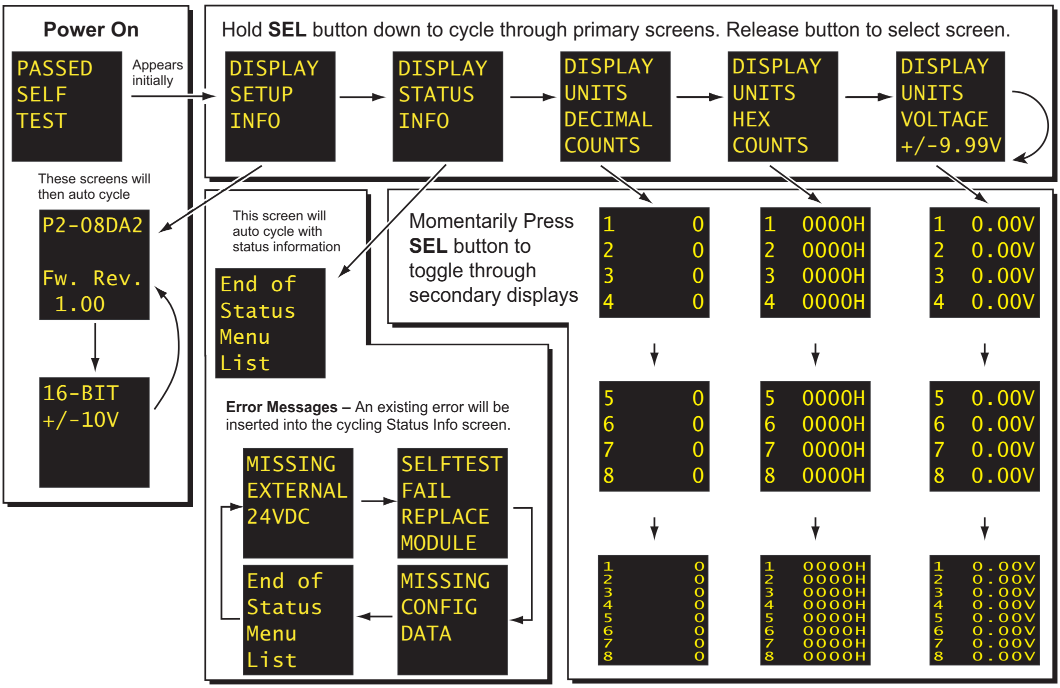
## Module Configuration



# P2-08DA-2 Analog Output (continued)



## LCD Panel Display



# P2-16DA-1 Analog Output

The P2-16DA-1 Current Analog Output Module provides sixteen channels of 4-20 mA sourcing output for use with the Productivity2000 System.


## Output Specifications

| | |
|---|---|
| Output Channels | 16 |
| Module Signal Output Range | 4-20 mA (Sourcing) |
| Output Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 4-20 mA = 0.244 μA/count<br>1 LSB = 1 count |
| Data Range | 0 to 65535 counts |
| Output Type (sourcing) | Current: 20mA max |
| Output Value in Fault Mode | Near 0mA |
| Load Impedance (Minimum External Power Supply) | 0 - 570Ω (19.2 VDC)<br>0 - 690Ω (21.6 VDC)<br>0 - 810Ω (24VDC)<br>0 - 930Ω (26.4 VDC)<br>0 - 1100Ω (30VDC)<br>Minimum Load 0Ω @ 0 - 45°C<br>125Ω @ 45 - 60°C |
| Maximum Inductive Load | 1mH |
| Allowed Load Type | Grounded |
| Maximum Inaccuracy | 0.1% of range<br>(including temperature drift) |
| Maximum Full Scale Calibration Error (not including offset error) | ±0.025% of range maximum |
| Maximum Offset Calibration Error | ±0.025% of range maximum |
| Accuracy vs. Temperature | ±25ppm/°C max full scale calibration change<br>(±0.0025% of range/°C) |
| Max Crosstalk | -96dB, 1 LSB |
| Linearity Error (End to End) | ±16 LSB maximum (±0.025% of full scale)<br>Monotonic with no missing codes |
| Output Stability and Repeatability | ±10 count after 10 minute warm-up (typical) |
| Output Ripple | 0.05% of full scale |
| Output Setting Time | 300μs max, 5μs min (full scale change) |
| All Channel Update Rate | 3ms |
| Maximum Continuous Overload | Outputs open circuit protected |
| Type of Output Protection | Electronically current limited to 20mA or less |
| Output Signal (power-up,-down) | 4mA |
| External DC Power Required | 24VDC @ 410mA (includes loop power) |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

Module connector type is a 24-pin Molex Style 43025-2400.

# P2-16DA-1 Analog Output (continued)

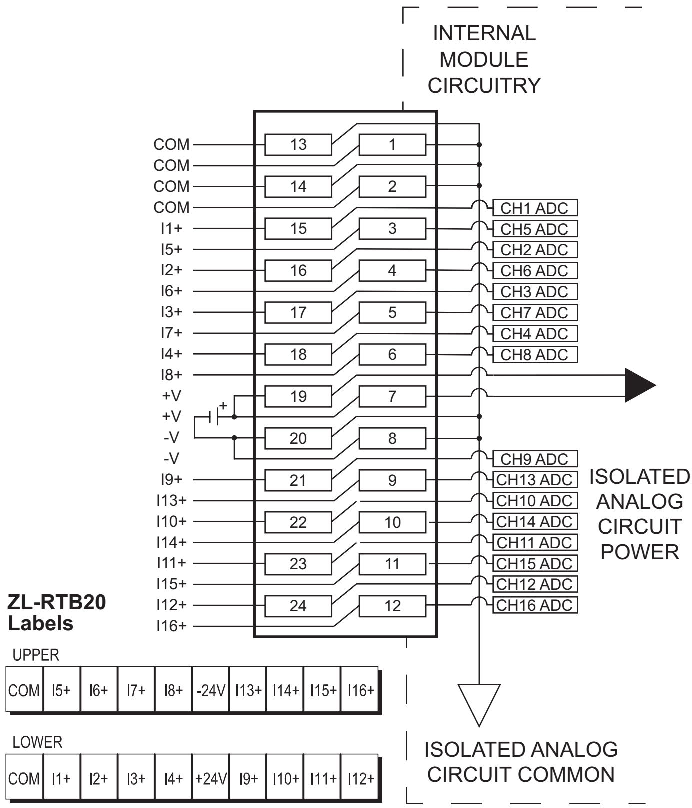
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 96mW |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System ONLY. See “Wiring Options” in Chapter 5. Must use copper conductors 75°C or equivalent. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type | 24-Pin Molex Style 43025-2400 |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

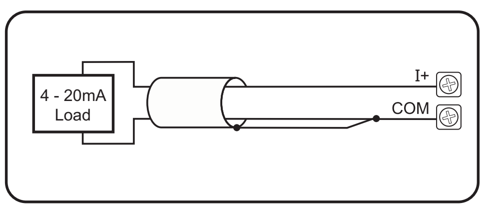
| Connector Specifications | |
|---|---|
| Connector Type | 24-Pin Molex Style 43025-2400 |
| Number of Pins | 24 |
| Pin Spacing | 3x3 mm (0.118 x 0.118 in) |

# P2-16DA-1 Analog Output (continued)

## Wiring Diagrams




**Current Sourcing Output Circuit**



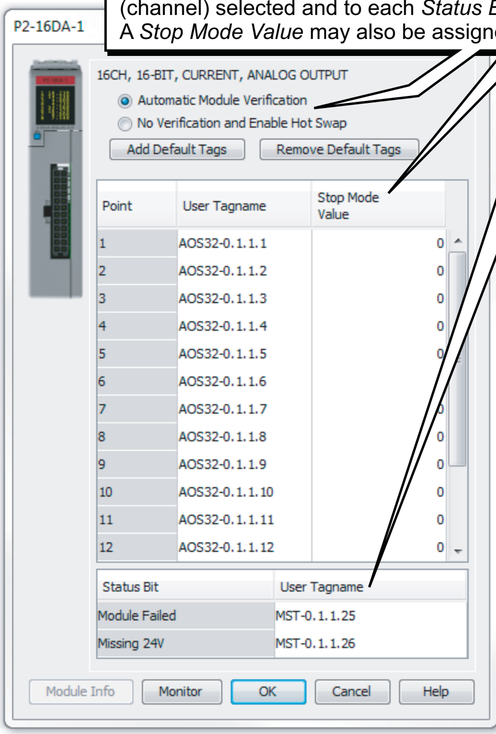

Note: Shield is connected to common at the source device.

# P2-16DA-1 Analog Output (continued)

## Module Configuration

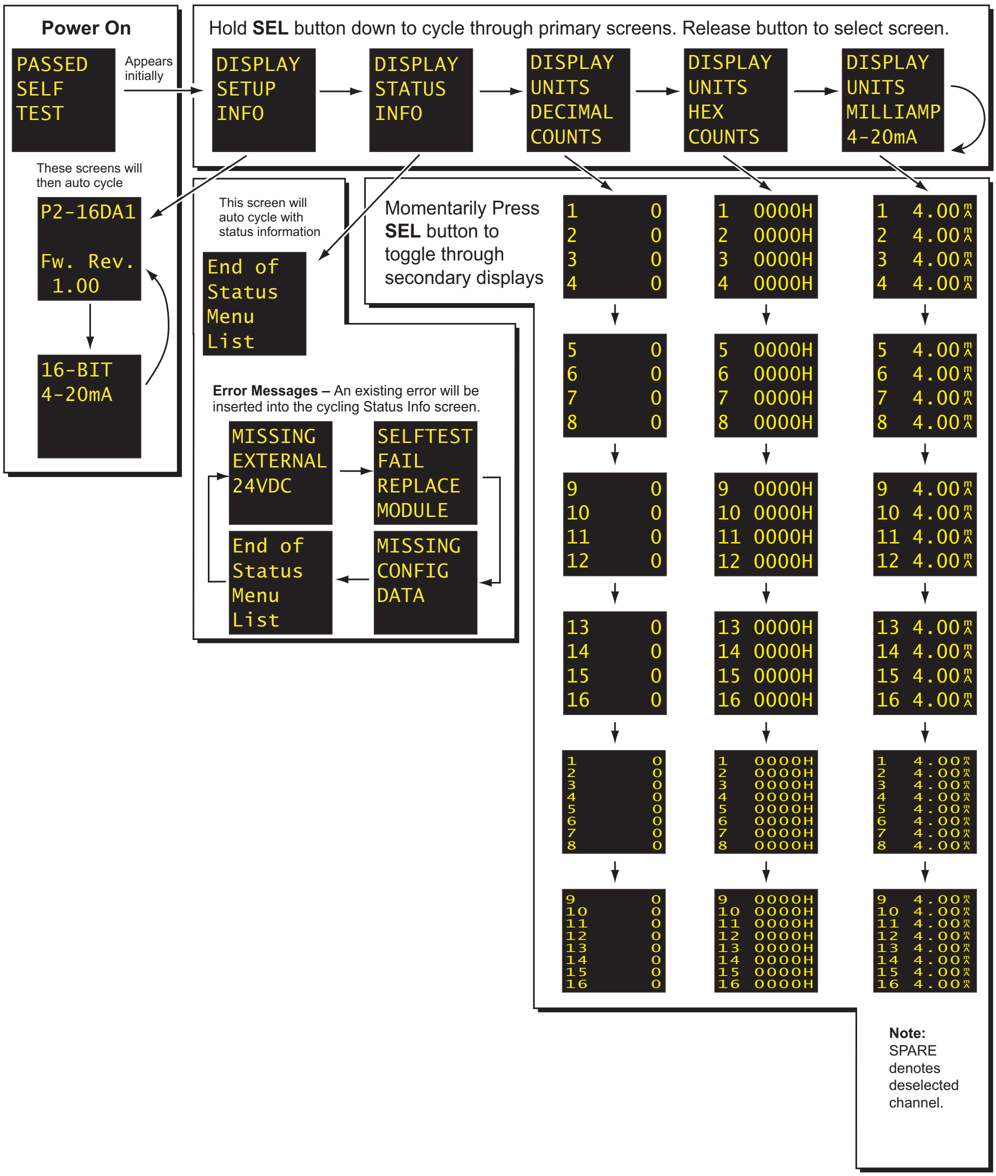
Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-16DA-1 module into the base configuration.

Select *Automatic Module Verification* or *No Verification and Enable Hot Swap*. If desired, assign a *User Tagname* to each output point (channel) selected and to each *Status Bit Item*. A *Stop Mode Value* may also be assigned.



# P2-16DA-1 Analog Output (continued)

## LCD Panel Display



# P2-16DA-2 Analog Output

The P2-16DA-2 Voltage Analog Output Module provides sixteen channels of ±10VDC outputs for use with the Productivity2000 System.


| Output Specifications | |
|---|---|
| Output Channels | 16 |
| Module Signal Output Range | ±10VDC |
| Output Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | ±10VDC = 305µV/count<br>1 LSB = 1 count |
| Data Range | -32768 to 32767 counts |
| Output Type (sourcing/sinking) | Voltage: 10mA max current |
| Output Value in Fault Mode | 0V |
| Load Impedance | ≥1000Ω |
| Maximum Capacitive Load | 0.01 µF maximum |
| Allowed Load Type | Grounded |
| Maximum Inaccuracy | 0.1% of range<br>(including temperature drift) |
| Maximum Full Scale Calibration Error (not including offset error) | ±0.025% of range maximum |
| Maximum Offset Calibration Error | ±0.025% of range maximum |
| Accuracy vs. Temperature | ±25ppm/°C max full scale calibration change<br>(±0.0025% of range/°C) |
| Max Crosstalk | -96dB, 1 LSB |
| Linearity Error (End to End) | ±16 LSB maximum (±0.025% of full scale)<br>Monotonic with no missing codes |
| Output Stability and Repeatability | ±10 LSB after 10 minute warm-up (typical) |
| Output Ripple | 0.05% of full scale |
| Output Setting Time | 300µs max, 5µs min (full scale change) |
| All Channel Update Rate | 3ms |
| Maximum Continuous Overload | Outputs current limited to 40mA typical. Continuous overloads on multiple output can damage the module. |
| Type of Output Protection | 0.1 µF Transient Suppressor |
| External DC Power Required | 24VDC (-20% / +25%), 265mA |

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

Module connector type is a 24-pin Molex Style 43025-2400.

# P2-16DA-2 Analog Output (continued)

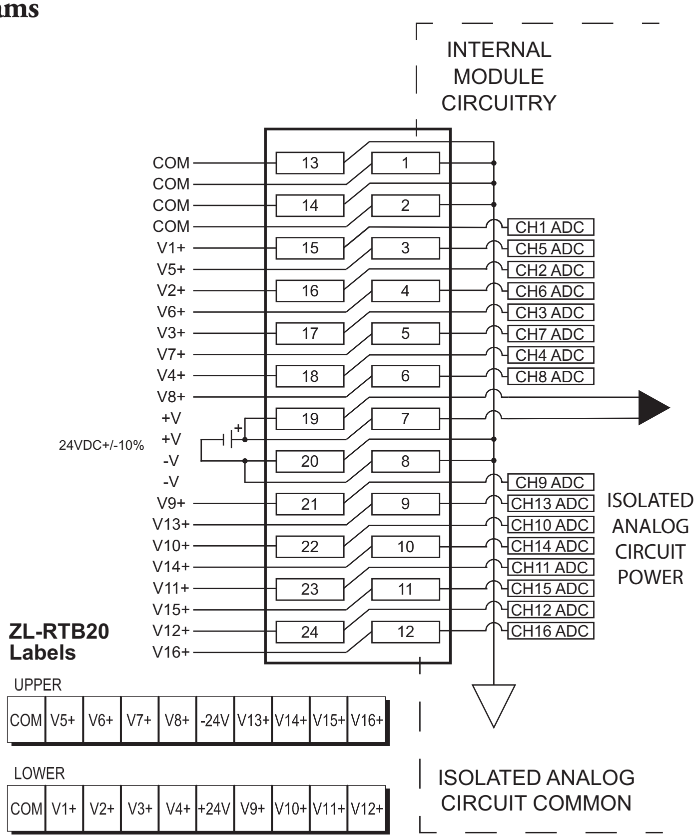
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 6.4 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System ONLY. See “Wiring Options” in Chapter 5. Must use copper conductors 75°C or equivalent. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type | 24-Pin Molex Style 43025-2400 |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

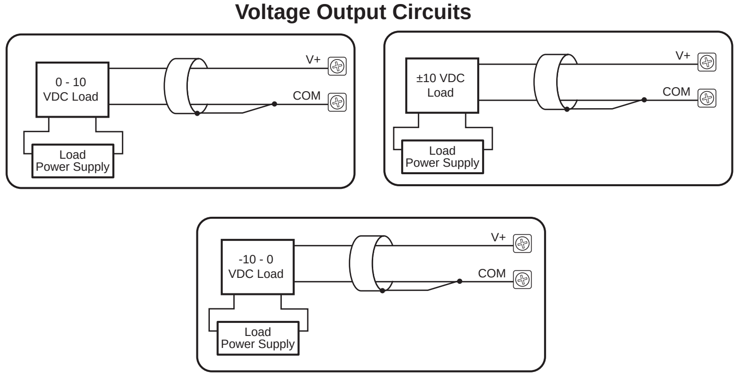
| Connector Specifications | |
|---|---|
| Connector Type | 24-Pin Molex Style 43025-2400 |
| Number of Pins | 24 |
| Pin Spacing | 3x3 mm (0.118 x 0.118 in) |

# P2-16DA-2 Analog Output (continued)

## Wiring Diagrams




**Voltage Output Circuits**



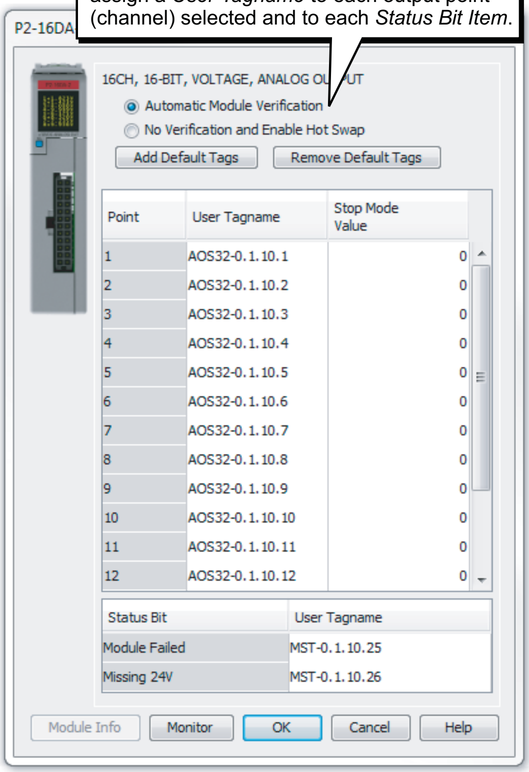
# P2-16DA-2 Analog Output (continued)

## Module Configuration



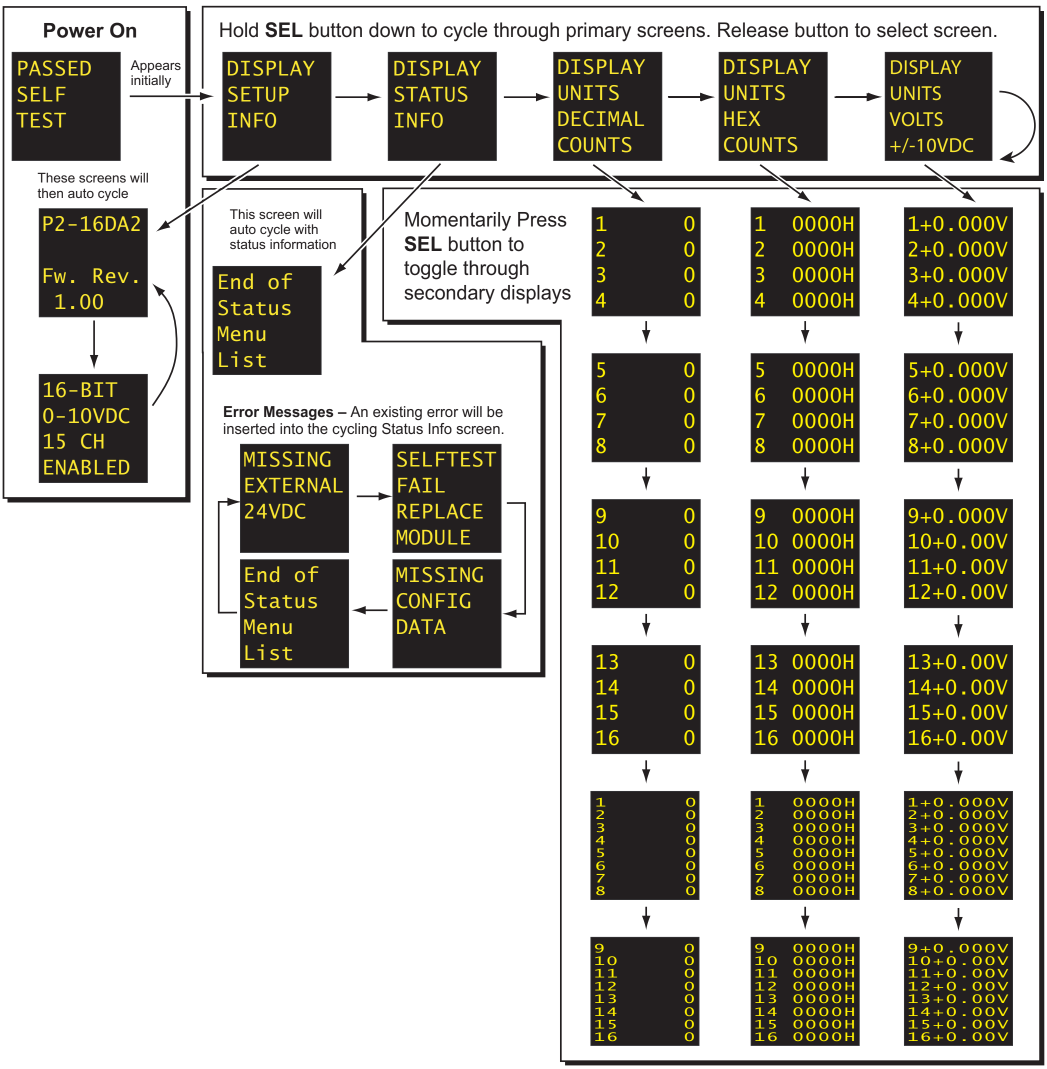
Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-16DA-2 module into the base configuration.

Select *Automatic Module Verification* or *No Verification and Enable Hot Swap*. If desired, assign a *User Tagname* to each output point (channel) selected and to each *Status Bit Item*.



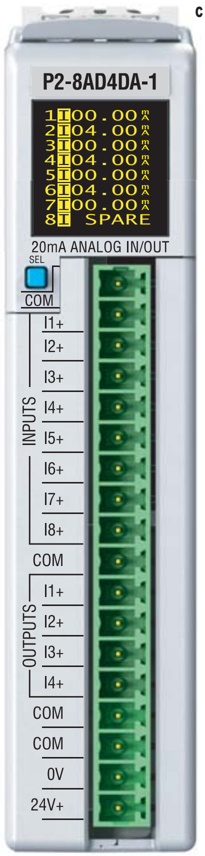
# P2-16DA-2 Analog Output (continued)

## LCD Panel Display



# P2-8AD4DA-1 Analog Input/Output

The P2-8AD4DA-1 Current Analog Input/Output Module provides eight channels of current sinking 0-20 mA inputs and four channels of current sourcing 4-20 mA outputs.




| Input Specifications | |
|---|---|
| Input Channels | 8 (1 common) |
| Module Signal Input Range | 0-20 mA (Sinking) |
| Signal Resolution | 12-16 bit, depending on input resolution |
| Input Resolution & Update Rate<br>(See Note 1) | Fine: 8ms, 0.305 µA, 16 bit<br>Medium: 2ms, 1.22 µA, 14 bit<br>Coarse: 700µs, 4.88 µA, 12 bit |
| Data Range | 0-65535 counts |
| Input Type | Single Ended (1 common) |
| Maximum Continuous Overload | ±31mA |
| Input Impedance | 250Ω ±0.1%, 1/4W |
| Hardware Filter Characteristics | Low pass 1st order, -3dB @ 48Hz |
| All Channel Update Rate<br>(See Note 2) | Fine 57ms<br>Medium: 17ms<br>Coarse: 7ms |
| Open Circuit Detection Time | Zero reading within 1s |
| Conversion Method | Successive approximation |
| Accuracy vs. Temperature | ±15ppm/°C maximum |
| Maximum Inaccuracy | 0.1% of range |
| Linearity Error (end to end) | 0.015% of range maximum<br>Monotonic with no missing codes |
| Input Stability and Repeatability | ±0.015% of range (after 10 minute warm-up) |
| Full Scale Calibration Error<br>(not including offset) | ±0.05% of range maximum |
| Offset Calibration Error | ±0.05% of range maximum |
| Maximum Crosstalk | -96dB ±1 -0.015% of full scale maximum |
| Recommended Fuse (external) | Edison S500-32-R, 0.032 A fuse |
| External DC Power Required | 24VDC (-20% / +25%), 145mA |

**NOTE 1:** The Input Resolution of Fine returns 16 bit resolution. Medium and Coarse are 14 and 12 bit respectively. The 12 and 14 bit input values are scaled to 0-65535.
**NOTE 2:** Valid when all channels are set for the same Input Resolution.

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-8AD4DA-1 Analog Input/Output (continued)

## Output Specifications

| | |
|---|---|
| Output Channels | 4 (1 common) |
| Module Signal Output Range | 4-20 mA |
| Output Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 0.244 µA / count<br>1 LSB = 1 count |
| Data Range | 0 - 65535 counts |
| Output Type | Current sourcing: 20mA max |
| Output Value in Fault Mode | ≤ 4mA |
| Load Impedance (Minimum External Power Supply) | 0 - 480Ω (19.2 VDC)<br>0 - 600Ω (21.6 VDC)<br>0 - 715Ω (24VDC)<br>0 - 840Ω (26.4 VDC)<br>0 - 1010Ω (30VDC) |
| Maximum Inductive Load | 1mH |
| Allowed Load Type | Grounded |
| Maximum Inaccuracy | 0.1% of range |
| Maximum Full Scale Calibration Error (not including offset error) | ±0.065% of full scale |
| Maximum Offset Calibration Error | ±0.065% of full scale |
| Accuracy vs. Temperature | ±15ppm/°C max full scale calibration change<br>(±0.0025% of range/°C) |
| Max Crosstalk | -96dB, 1 LSB |
| Linearity Error (End to End) | ±0.015% of range maximum<br>Monotonic with no missing codes |
| Output Stability and Repeatability | ±0.015% after 10 minute warm-up typical |
| Output Ripple | 0.01% of full scale at 50/60 Hz |
| Output Setting Time | Rising Time 200µs<br>Falling Time 135µs<br>(full scale change) |
| All Channel Update Rate | 3.55 ms |
| Maximum Continuous Overload | Outputs open circuit protected |
| Type of Output Protection | Electronically current limited to 20mA or less |
| Output Signal (power-up, -down) | ≤ 4mA |

## Removable Terminal Block Specifications

| Part Number | P2-RTB | P2-RTB-1 |
|---|---|---|
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75ºC" or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

# P2-8AD4DA-1 Analog Input/Output (continued)

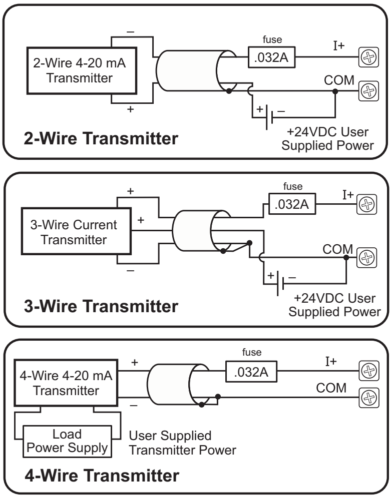
| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 2.47 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (Not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

# P2-8AD4DA-1 Analog Input/Output (continued)

## Wiring Diagrams

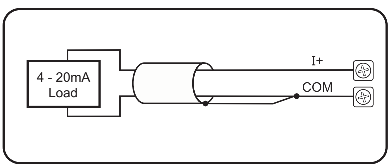
**Current Input Circuits**



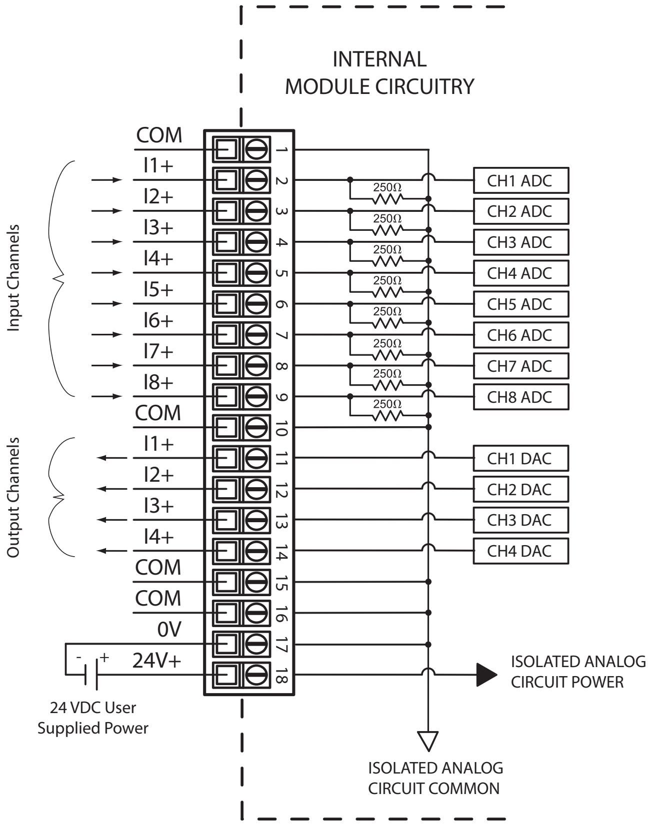

An Edison S500-32-R 0.032 A fast-acting fuse is recommended for all 4-20 mA current loops.

Note: Do not connect both ends of shield.

**Current Output Circuits**




Note: Shield is connected to common at the source device.




Note: This module includes input and output channels. Before connecting field wiring, verify that you are connecting to the appropriate terminals

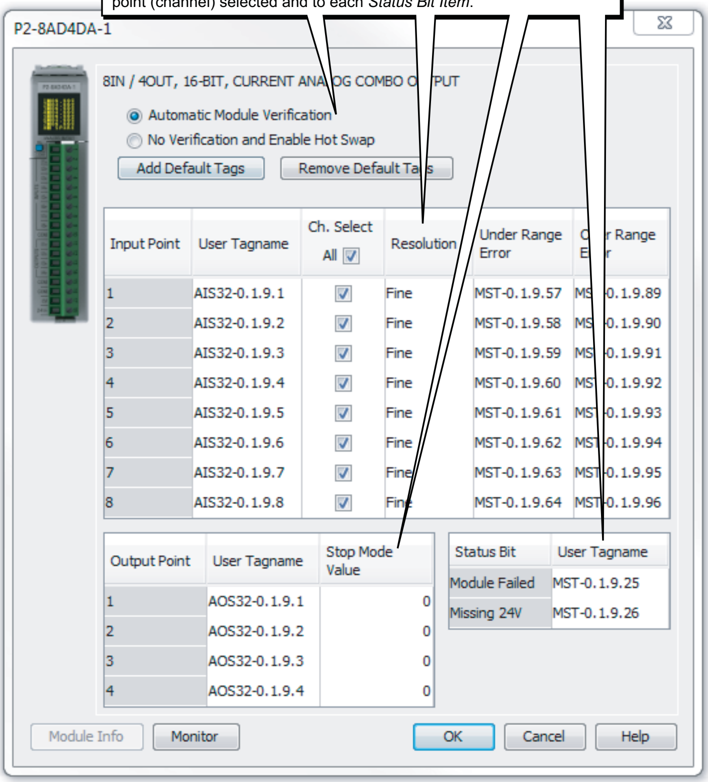
# P2-8AD4DA-1 Analog Input/Output (continued)

## Module Configuration



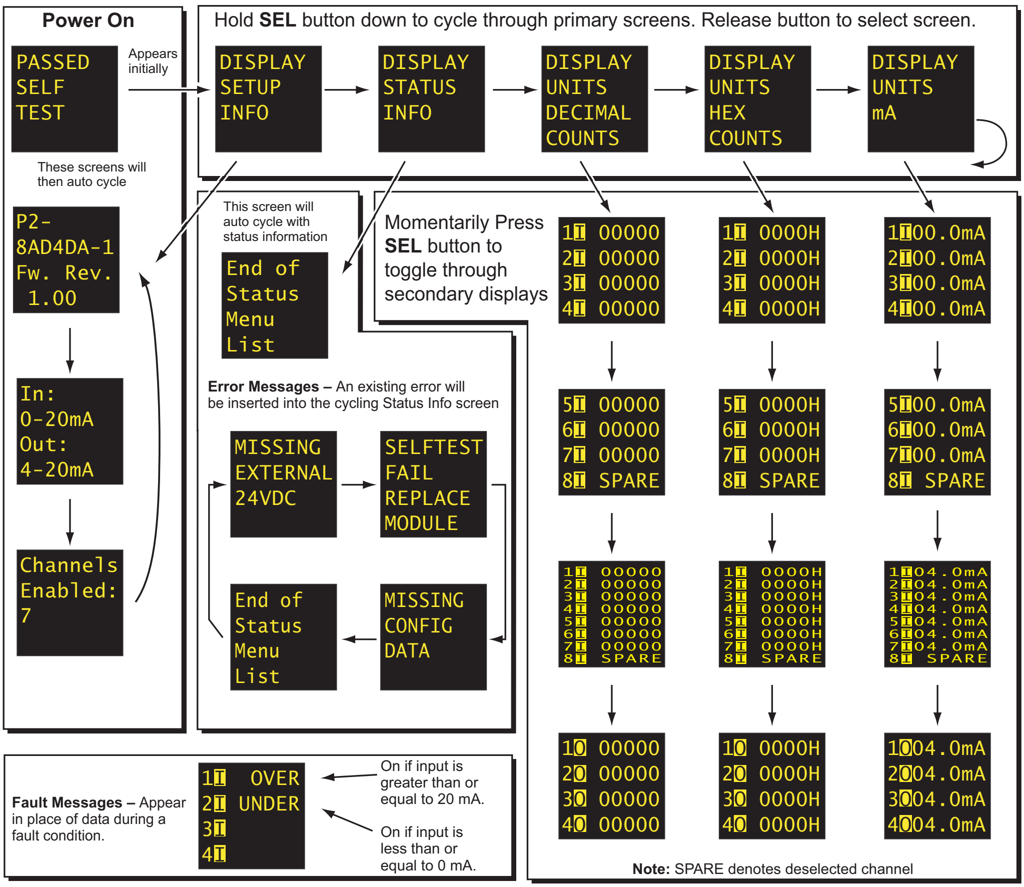
Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-8AD4DA-1 module into the base configuration.

Select *Automatic Module Verification* or *No Verification and Enable Hot Swap.* Also specify *Input Resolution* for inputs and *Stop Mode Value* for outputs. If desired, assign a *User Tagname* to each input and output point (channel) selected and to each *Status Bit Item*.



# P2-8AD4DA-1 Analog Input/Output (continued)

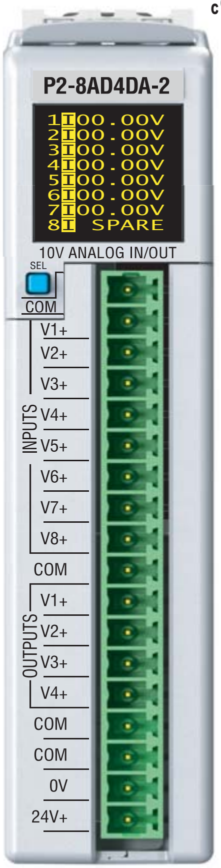
## LCD Panel Display



# P2-8AD4DA-2 Analog Input/Output

The P2-8AD4DA-2 Voltage Analog Input/Output Module provides eight channels of 0-10 VDC inputs and four channels of 0-10 VDC outputs for use with the Productivity2000 System.






| Input Specifications | |
|---|---|
| Input Channels | 8 inputs (1 common) |
| Input Ranges | 0 - 5 VDC, 0 - 10 VDC |
| Signal Resolution | 12-16 bit, depending on input resolution |
| 0 - 5V Input Resolution & Update Rate (See Note 1) | Fine: 7.1 ms, 76µV, 16 bit<br>Medium: 1.78 ms, 305µV, 14 bit<br>Coarse: 444µs, 1.22 mV, 12 bit |
| 0 - 10V Input Resolution & Update Rate (See Note 1) | Fine: 7.1 ms, 152µV, 16 bit<br>Medium: 1.78 ms, 610µV, 14 bit<br>Coarse: 444µs, 2.44 mV, 12 bit |
| Data Range | 0-65535 counts |
| Maximum Continuous Overload | ±100V, voltage input |
| Input Impedance | 1MΩ (±10%) voltage input |
| Hardware Filter Characteristics | Low pass 1st order, -3dB @ 80Hz |
| All Channel Update Rate (See Note 2) | Fine 56.8 ms<br>Medium: 14.24 ms<br>Coarse: 3.55 ms |
| Conversion Method | Successive approximation |
| Accuracy vs. Temperature | ±15ppm/°C maximum |
| Maximum Inaccuracy | 0.1% of range |
| Linearity Error (end to end) | ±0.015% of range maximum<br>Monotonic with no missing codes |
| Input Stability and Repeatability | ±0.025% of range (after 10 minute warm-up) |
| Full Scale Calibration Error (not including offset) | ±0.05% of range maximum |
| Offset Calibration Error | ±0.05% of range maximum |
| Maximum Crosstalk | -96dB, 1LSB |
| External DC Power Required | 24VDC (-20% / +25%), 130mA |

**NOTE 1:** The Input Resolution of Fine returns 16 bit resolution. Medium and Coarse are 14 and 12 bit respectively. The 12 and 14 bit input values are scaled to 0-65535.
**NOTE 2:** Valid when all channels are set for the same Input Resolution.

We recommend using pre-wired ***ZIP***Link cables and connection modules. See Chapter 5.

If you wish to hand-wire your module, removable terminal blocks are sold separately. Order part number P2-RTB or P2-RTB-1

# P2-8AD4DA-2 Analog Input/Output (continued)

| Output Specifications | |
|---|---|
| Output Channels | 4 (1 common) |
| Module Signal Output Range | 0 - 10 VDC, 0 - 5 VDC |
| Output Signal Resolution | 16-bit |
| Resolution Value of LSB (least significant bit) | 0 - 5V = 76µV/count<br>0 - 10V = 152µV/count<br>1 LSB = 1 count |
| Data Range | 0 - 65535 counts |
| Output Type | Voltage sourcing/sinking at 10mA maximum |
| Output Value in Fault Mode | 0V |
| Load Impedance | ≥1.5 kΩ |
| Maximum Capacitive Load | 0.01 µF |
| Allowed Load Type | Grounded |
| Maximum Inaccuracy | 0.1% of range |
| Maximum Full Scale Calibration Error (not including offset error) | ±0.065% of range maximum |
| Maximum Offset Calibration Error | ±0.065% of range maximum |
| Accuracy vs. Temperature | ±25ppm/°C max full scale calibration change (±0.0025% of range/°C) |
| Max Crosstalk | -96dB, 1 LSB |
| Linearity Error (End to End) | ±0.015% of full scale<br>Monotonic with no missing codes |
| Output Stability and Repeatability | ±0.015% after 10 minute warm-up typical |
| Output Ripple | 0.01% of full scale at 50/60 Hz |
| Output Setting Time | 500µs max, 5µs min (full scale change) |
| All Channel Update Rate | 5ms |
| Maximum Continuous Overload | Outputs current limited to 15mA typical |
| Type of Output Protection | 15VDC peak output voltage |
| Output Signal (power-up, -down) | 0V |

| Removable Terminal Block Specifications | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | "USE COPPER CONDUCTORS, 75ºC" or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

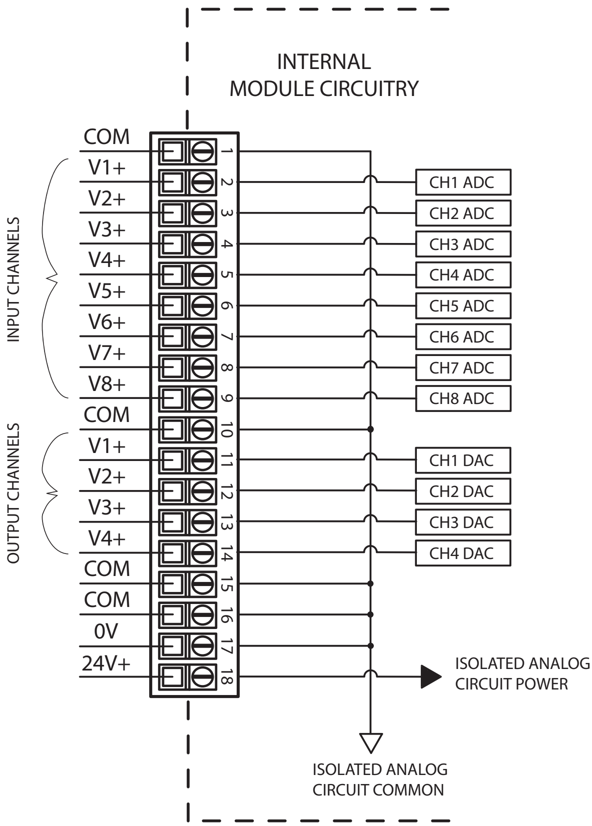
# P2-8AD4DA-2 Analog Input/Output (continued)

| General Specifications | |
|---|---|
| Operating Temperature | 0° to 60°C (32° to 140°F) |
| Storage Temperature | -20° to 70°C (-4° to 158°F) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC60068-2-6 (Test Fc) |
| Shock | IEC60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | > 10MΩ @ 500VDC |
| Heat Dissipation | 1.95 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System or removable terminal block (not included). See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Connector Type (not included) | 18-position removable terminal block |
| Weight | 90g (3.2 oz) |

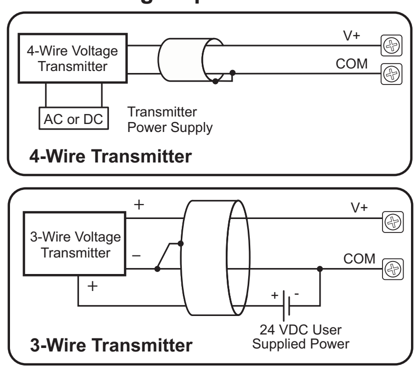
*Meets EMC and Safety requirements. See the D.O.C. for details.

# P2-8AD4DA-2 Analog Input/Output (continued)

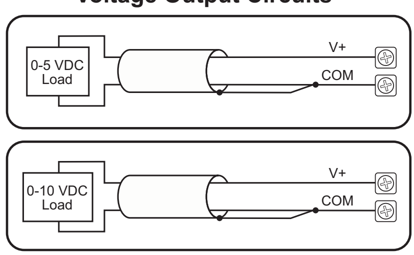
## Wiring Diagrams




### Voltage Input Circuits




### Voltage Output Circuits



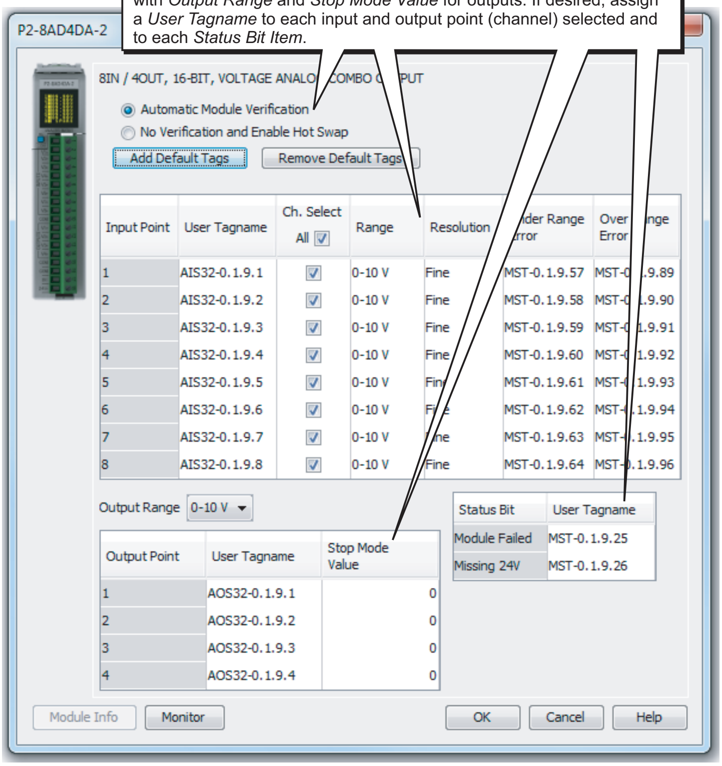

NOTE: This module includes input and output channels. Before connecting field wiring, verify that you are connecting to the appropriate terminals.

# P2-8AD4DA-2 Analog Input/Output (continued)

## Module Configuration

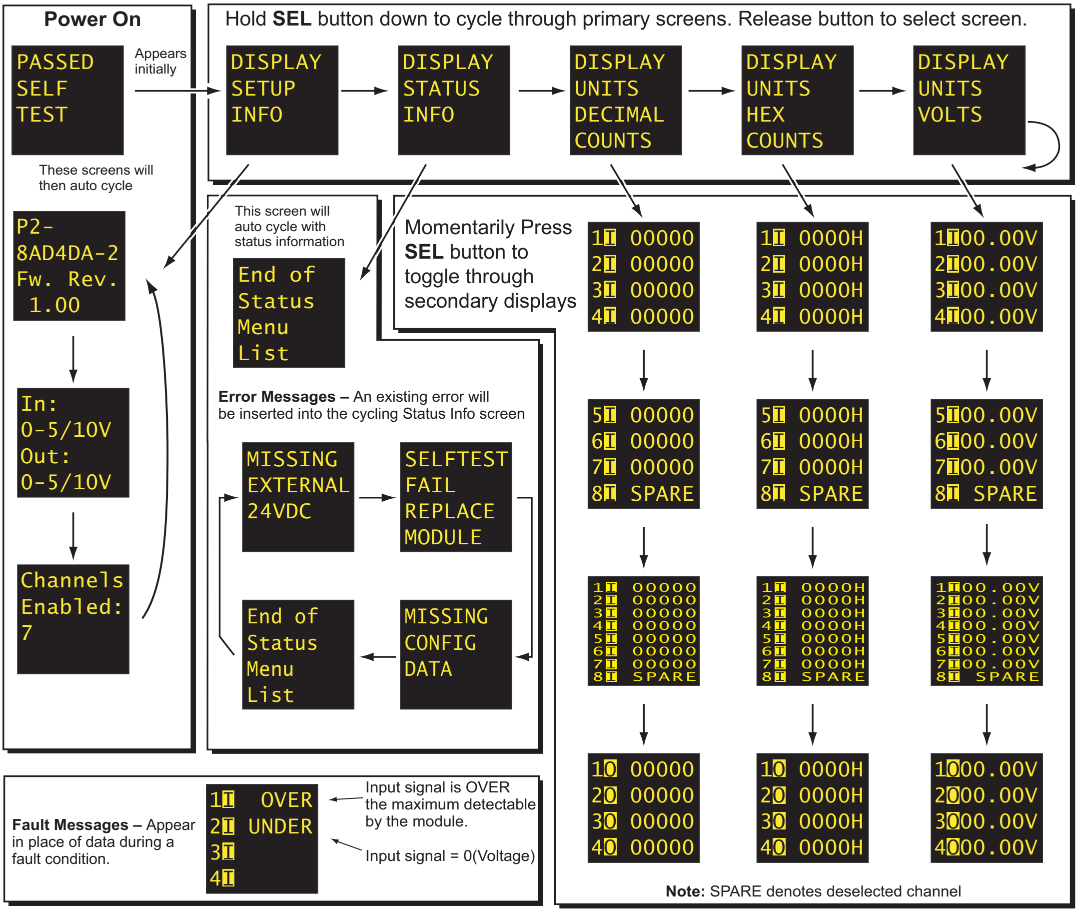
Using the Hardware Configuration tool in the Productivity Suite programming software, drag and drop the P2-8AD4DA-2 module into the base configuration.

Select *Automatic Module Verification* or *No Verification and Enable Hot Swap*. Also specify *Input Range* and *Input Resolution* for inputs along with *Output Range* and *Stop Mode Value* for outputs. If desired, assign a *User Tagname* to each input and output point (channel) selected and to each *Status Bit Item*.



# P2-8AD4DA-2 Analog Input/Output (continued)

## LCD Panel Display



## Notes:

# SPECIALTY MODULE SPECIFICATIONS

CHAPTER 4

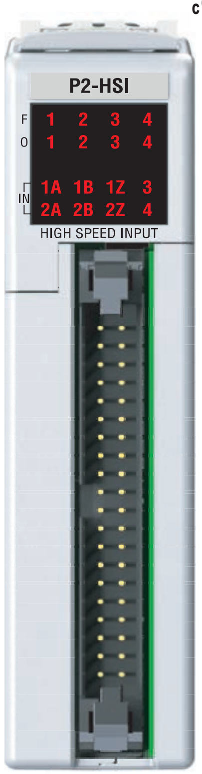
## In This Chapter...

# P2-HSI High-Speed Input Module Overview

The P2-HSI High-Speed (1MHz) Input Module provides differential (line receiver, 5V max) and single ended (5-24V) inputs that accept up to 1MHz of pulse/direction and quadrature signals on each of the two independent input channels. Additionally, four 5-24 VDC general purpose high-speed inputs and four general purpose, 5-24 VDC 0.5 amp, outputs are included for use with any Productivity2000 system.



Use the hardware configuration tool in the Productivity Suite programming software to setup the P2-HSI module. See the Productivity Suite help file.




| General Specifications | |
|---|---|
| Module Type | Intelligent |
| Modules per Base | 15 Maximum (See Note) |
| I/O Points Used | None, mapped directly to tags in CPU |
| Operating Temperature | 0º to 60ºC (32º to 140ºF) |
| Storage Temperature | -20º to 70ºC (-4º to 158ºF) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC 60068-2-6 (Test Fc) |
| Shock | IEC 60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 5.76 W |
| Enclosure Type | Open Equipment |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2)* |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System. See “Wiring Options” in Chapter 5. |
| EU Directive | See the “EU Directive” topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Weight | 90g (3.2 oz) |

* Meets EMC and Safety requirements. See the D.O.C. for details.

***NOTE:*** *For complete system limits, please refer to the “Hardware and Communication Limits” table in the Productivity Suite online “Help” file “Hardware Configuration”, topic P050.*

No terminal block sold for this module; ***ZIP***Link required. See Chapter 5 for part numbers of ***ZIP***Link cables and connection modules required with this module.

# P2-HSI High-Speed Input Module (continued)


4

| Status LEDs | |
|---|---|
| Fault Status LEDs | (F) 1, 2, 3 & 4 (one per status output) |
| Input LEDs | (IN) 1A, 1B, 1Z, 2A, 2B, 2Z, IN3 & IN4 (one per status input) |
| Output Status LEDs | (O) OUT1, OUT 2, OUT3 & OUT4 |

**Note:** All front panel fault LED's blinking indicates loss of external power.

| Connector Specifications | |
|---|---|
| Connector Type | IDC style header with latch, Omron XG4A-4034 |
| Number of Pins | 40 point |
| Pitch | 0.1 in (2.54 mm) |

| Power Specifications | |
|---|---|
| External Power | 24VDC -15% / +10%, Class 2 |
| Maximum Voltage | 26.4 VDC |
| Minimum Voltage | 20.4 VDC |
| Current Consumption Excluding Outputs | 50mA |
| Maximum Current Consumption Total of the 4 Status Outputs | 2A |

# P2-HSI High-Speed Input Module (cont'd)

## HSI Input Specifications

| Differential (5V) Input Specifications | |
|---|---|
| Pulse Inputs* | Differential inputs (6 pts: 1A, 1B, 1Z, 2A, 2B, 2Z) |
| Isolation | Each input is isolated from other circuits |
| Input Signal Type, per Channel Select | Differential |
| Input Volts | 5VDC |
| Input Volts Maximum | +/-5.6 VDC, limited by protection |
| Input Impedance | 200Ω minimum, 500Ω maximum |
| Input Rated Current | 5VDC, 15mA (8mA typical, 15mA maximum) |
| Input Minimum ON Voltage | 3.0 VDC |
| Input Maximum OFF Voltage | 1.0 VDC |
| Input Minimum ON Current | 5.0 mA |
| Input Maximum OFF Current | 2.0 mA |
| OFF to ON Response Time | 1A, 1B, 2A, 2B: 0.48 μs<br>1Z, 2Z, 3IN, 4IN: 6μs |
| ON to OFF Response Time | 1A, 1B, 2A, 2B: 0.48 μs<br>1Z, 2Z, 3IN, 4IN: 6μs |
| Max. Input Frequency | 1A, 1B, 2A, 2B: 1MHz<br>1Z, 2Z, 3IN, 4IN: 200kHz |

*The Z pulse input (1Z & 2Z) is capable of capturing a 1MHz wide pulse for the purpose of resetting an encoder count but a 3 microsecond pause (300kHz) is required between pulses.

**NOTE:** The voltage difference between the input pairs must be between 3 volts and 5.6 volts.

# P2-HSI High-Speed Input Module (cont'd)

## HSI Input Specifications

| Single Ended (5-24V) Input Specifications | |
|---|---|
| Status Input | Single ended inputs (8 pts: 1A, 1B, 1Z, 2A, 2B, 2Z, 3IN, 4IN) |
| Isolation | Each input is isolated from other circuits |
| Input Volts Range | 5-24VDC |
| Input Volts Maximum | ±34VDC, limited by protection |
| Input Impedance | 1kΩ minimum, 5kΩ maximum |
| Inputs Rated Current | 5-24 VDC, 16mA<br>5.2 mA typical @ 5VDC<br>22mA maximum @ 34VDC |
| Input Minimum ON Voltage | 4.5 VDC |
| Input Maximum OFF Voltage | 2.0 VDC |
| Input Minimum ON Current | 5.0 mA |
| Input Maximum OFF Current | 1.4 mA |
| OFF to ON Response Time | 1A, 1B, 2A, 2B: 0.48 µs<br>1Z, 2Z, 3IN, 4IN: 6µs |
| ON to OFF Response Time | 1A, 1B, 2A, 2B: 0.48 µs<br>1Z, 2Z, 3IN, 4IN: 6µs |
| Max. Input Frequency* | 1A, 1B, 2A, 2B: 1MHz<br>1Z, 2Z, 3IN, 4IN: 200kHz |

* Inputs are not limited to this speed however, single ended signals are not usually reliable above 200kHz due to cabling capacitance.

# P2-HSI High-Speed Input Module (cont'd)

## HSI Output Specifications

| Status Output Specifications | | |
|---|---|---|
| Status Outputs | 4 sink/source | |
| Output Signal Type, per Channel Select | Current Sinking | Current Sourcing |
| Operating Voltage[1] | 5-24 VDC | 5-24 VDC[1] |
| Output Volts Maximum | 36VDC | 26.4 VDC[1] |
| Output Current Maximum | 500mA | |
| Overcurrent Protection | Short circuit detect and current limit with automatic retry for each output | |
| Output Self Limiting Current | 1.2 to 2.4 A | |
| Max Inrush Current | Self limited | |
| Output Voltage Drop | 0.7 VDC @ 0.5 A | |
| Thermal Protection | Independent over temperature protection each output | |
| Output Voltage Clamp During Inductive Switching | +45VDC | -20VDC |
| Maximum OFF to ON Response | 25µs[2] | |
| Maximum ON to OFF Response | 25µs[2] | |

**NOTES:**
1. Operating voltage of current sourcing outputs must be no greater than external power.
2. Measured at 5 VDC operating voltage, 0.5A load curent.

## Frequency Response

| Inaccuracy of Frequency Measurements Due to Time Base Errors | |
|---|---|
| 25 MHz Crystal for Time Base | |
| Inaccuracy at 25°C, Maximum | ±30 PPM |
| Inaccuracy 0-60°C, Referenced to 25°C | ±30 PPM |
| Inaccuracy Due to Aging, Maximum | ±5 PPM/Year |
| Max. Time Base Inaccuracy 0-60°C and 10 Years Operation | 0.01% |

**Resolution of Frequency Measurements for "Fast Mode"**

| Input Frequency | Sampling Period | Resolution |
|---|---|---|
| 1 Hz to 1 MHz | 1000 ms | ±1 Hz |
| 10 Hz to 1 MHz | 100 ms | ±10 Hz |
| 100 Hz to 1 MHz | 10 ms | ±100 Hz |
| 1 MHz | 1 ms | ±1000 Hz |

# P2-HSI High-Speed Input Module (cont'd)

## Frequency Response

**Inaccuracy of Frequency Measurements[1,2] for "Slow Mode"**

| Input Frequency | Step/Dir | Quadrature 1X | Quadrature 4X |
|---|---|---|---|
| 1Hz | ±0.002 Hz | ±0.002 Hz | ±0.002 Hz |
| 10Hz | ±0.009 Hz | ±0.009 Hz | ±0.009 Hz |
| 100Hz | ±0.015 Hz | ±0.015 Hz | ±0.015 Hz |
| 1kHz | ±1 Hz | ±1 Hz | ±1 Hz |
| 10kHz | ±100 Hz | ±100 Hz | ±100 Hz |
| 100kHz | ±1000 Hz | ±1000 Hz | ±1000 Hz |
| 1MHz | ±40000 Hz | ±40000 Hz | ±40000 Hz |

**Inaccuracy of Frequency Measurements[1,2] for "Fast Mode"**

| Input Frequency | Sampling Period | Step/ Dir | Quadrature 1X | Quadrature 4X |
|---|---|---|---|---|
| 1Hz | ±1 Second | ±1 Hz | ±1 Hz | ±1 Hz |
| 10Hz | ±1 Second | ±1 Hz | ±1 Hz | ±1 Hz |
| 100Hz | ±1 Second | ±1 Hz | ±1 Hz | ±1 Hz |
| 1kHz | ±1 Second | ±1 Hz | ±1 Hz | ±1 Hz |
| 10kHz | ±1 Second | ±1 Hz | ±1 Hz | ±1 Hz |
| 100kHz | ±1 Second | ±1 Hz | ±1 Hz | ±1 Hz |
| 1MHz | ±1 Second | ±1 Hz | ±1 Hz | ±1 Hz |

**Inaccuracy of Frequency Measurements[1,2,3,4] for "Auto Mode"**

| Input Frequency | Step/Dir | Quadrature 1X | Quadrature 4X |
|---|---|---|---|
| 1Hz | ±1 Hz | ±1 Hz | ±1 Hz |
| 10Hz | ±1 Hz | ±1 Hz | ±1 Hz |
| 100Hz | ±1 Hz | ±1 Hz | ±1 Hz |
| 1kHz | ±1 Hz | ±1 Hz | ±1 Hz |
| 10kHz | ±100 Hz | ±100 Hz | ±100 Hz |
| 100kHz | ±1000 Hz | ±1000 Hz | ±1000 Hz |
| 1MHz | ±10000 Hz | ±10000 Hz | ±10000 Hz |

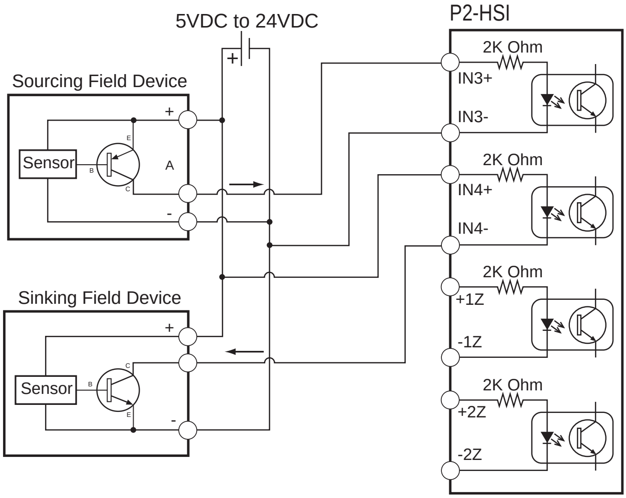
1. For stable input signal at given input frequency.
2. For total measurement error add the time base error to the tabulated error.
3. Maximum sample period: 1 second.
4. Minimum sample period: 0.001 seconds.

***NOTE:*** *Refer to the I/O Module Configuration Help file topic (P212) in the Productivity Suite Software for more information on Mode selections.*

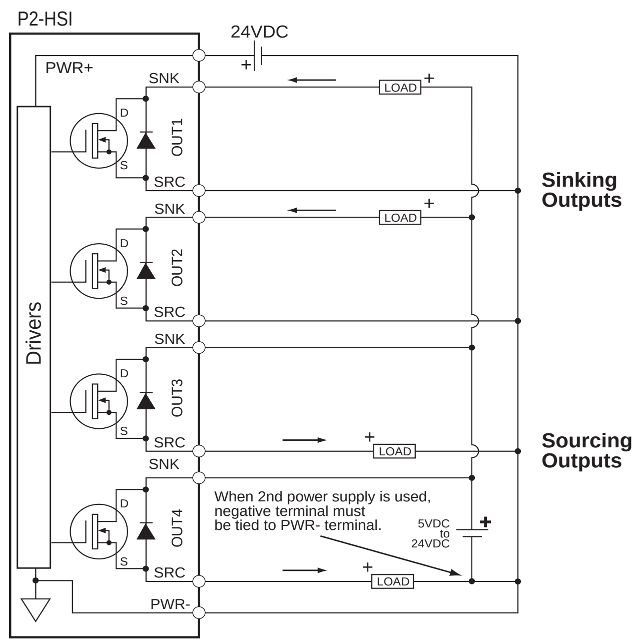
| Module Range: | Target position range ±2.147 billion (32-bit signed integer) |
|---|---|

# P2-HSI High-Speed Input Module (cont'd)

## Status Inputs Wiring Diagram

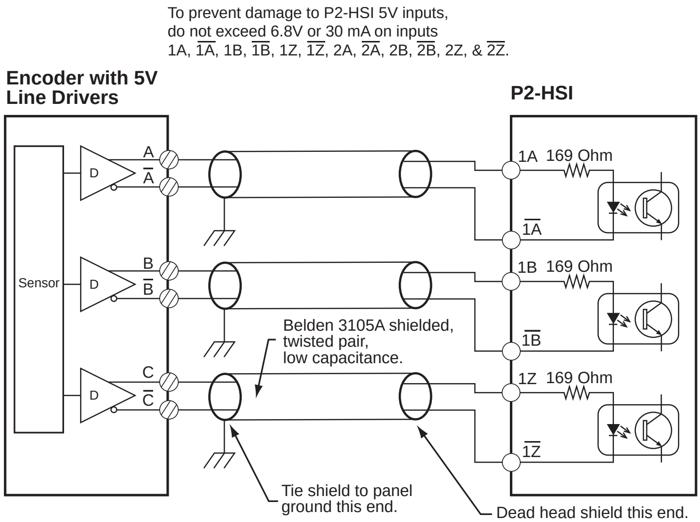



## Status Outputs Wiring Diagram

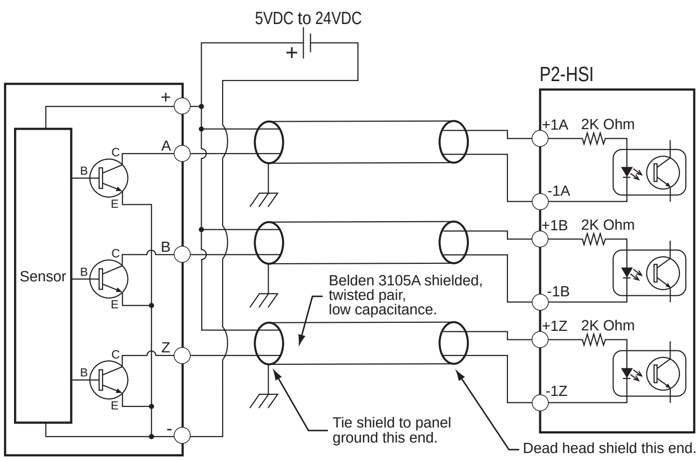


# P2-HSI High-Speed Input Module (cont'd)

## 5V Encoder Inputs Wiring Diagram

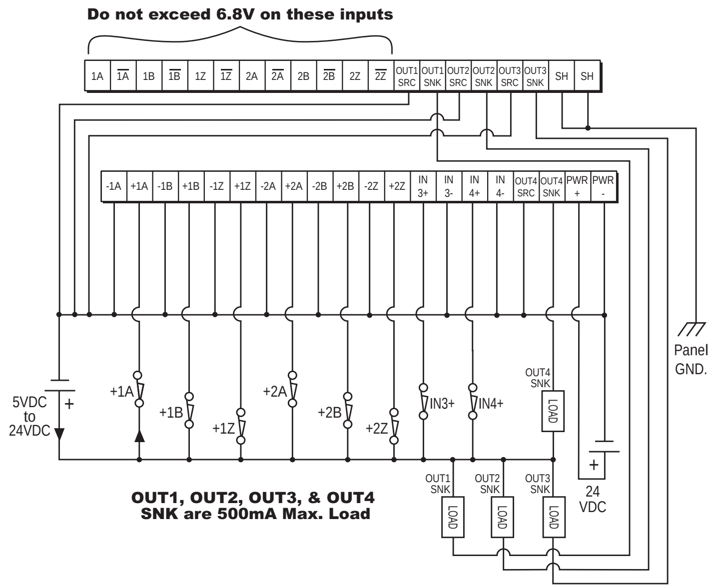



## 24V Encoder Inputs Wiring Diagram

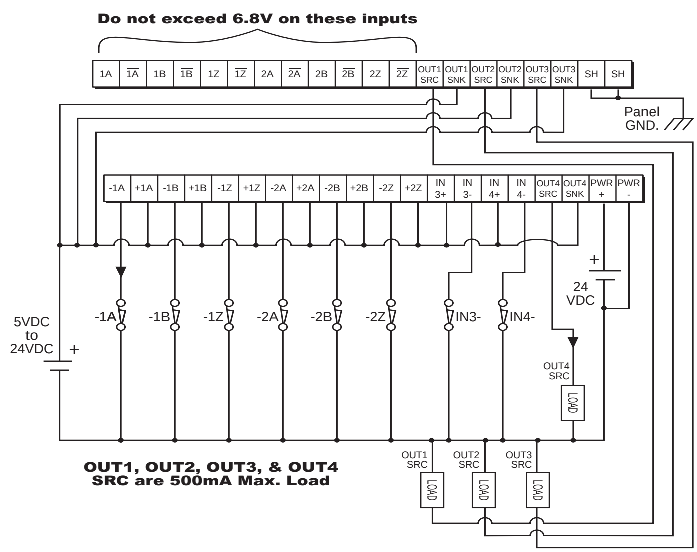


# P2-HSI High-Speed Input Module (cont'd)

## Sinking I/O Wiring Diagram




## Sourcing I/O Wiring Diagram



# P2-HSO High-Speed Output Module Overview

The P2-HSO High-Speed Output Module provides up to of (1MHz) pulse/direction, up/down and quadrature pulse output on each of two independent output channels. Additionally, six 5-24 VDC general purpose inputs and four 5-24 VDC general purpose outputs are included for use with the Productivity2000 System. Use the hardware configuration tool in the Productivity Suite programming software to setup the HSO module. See the Productivity Suite help file.


| General Specifications | |
|---|---|
| Module Type | Intelligent |
| Modules per Base | 15 Maximum (See Note) |
| I/O Points Used | None, mapped directly to tags in CPU |
| Operating Temperature | 0º to 60ºC (32º to 140ºF) |
| Storage Temperature | -20º to 70ºC (-4º to 158ºF) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC 60068-2-6 (Test Fc) |
| Shock | IEC 60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | 1800VAC applied for 1 second |
| Insulation Resistance | >10MΩ @ 500VDC |
| Heat Dissipation | 6.26 W |
| Enclosure Type | Open Equipment |
| Emissions | EN61000-6-4 (Conducted and Radiated RF Emissions) |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2*) |
| Module Keying to Backplane | Electronic |
| Module Location | Any I/O slot in a Productivity2000 System |
| Field Wiring | Use ***ZIP***Link Wiring System. See "Wiring Options" in Chapter 5. |
| EU Directive | See the "EU Directive" topic in the Productivity Suite Help File. Information can also be obtained at: www.productivity2000.com |
| Weight | 90g (3.2 oz) |

***NOTE:*** *For complete system limits, please refer to the "Hardware and Communication Limits" table in the Productivity Suite online "Help" file "Hardware Configuration", topic P050.*

No terminal block sold for this module; ***ZIP***Link required. See Chapter 5 for part numbers of ***ZIP***Link cables and connection modules required with this module.

# P2-HSO High-Speed Output Module (cont'd)


| Status LEDs | |
|---|---|
| Fault LEDs | (F) 1, 2, 3, 4, 5, 6 (one per pulse output and one per status output) |
| Input LEDs | (IN) 1, 2, 3, 4, 5, 6 (one per status input) |
| Output Status LEDs | (O) OUT 1A & 1B, OUT 2A & 2B, OUT 3, 4, 5, 6 |

Note: All front panel fault LED's blinking indicates loss of external power.

| Connector Specifications | |
|---|---|
| Connector Type | IDC style header with latch, Omron XG4A-4034 |
| Number of Pins | 40 point |
| Pitch | 0.1 in (2.54 mm) |

| Power Specifications | |
|---|---|
| External Power | 24VDC -15% / +10%, Class 2 |
| Maximum Voltage | 26.4 VDC |
| Minimum Voltage | 20.4 VDC |
| Current Consumption Excluding Outputs | 130mA |
| Maximum Current Consumption Total of the 4 Status Outputs | 2A |

# P2-HSO High-Speed Output Module (cont'd)

## Pulse Output Specifications

| | | |
|---|---|---|
| Pulse Outputs | 2 Channels | |
| Output Pulse Type, per Channel Select | Selectable for pulse & direction, up/down or quadrature | |
| Output Signal Type, per Channel Select | RS-422 Line Driver Current Sinking and Sourcing | Open Drain FET Outputs Current Sinking |
| Output Volts | RS-422 levels | 24VDC |
| Output Volts Maximum | 5VDC | 36VDC |
| Protection for Overcurrent and Short Circuit to Power | Current limit and thermal shutdown[2] | Current limit and thermal shutdown[1] |
| Protection Short to Ground | Yes | Yes |
| Overcurrent Trip Level | Output current limit ±200mA max[2] | 100mA minimum |
| Maximum Continuous Output Current | ±60mA | 40mA |
| Maximum Switching Frequency, 1m cable[3] | 1MHz | 500kHz |
| Maximum Switching Frequency, 10m cable[3] | 1MHz | 200kHz |

NOTES:
1. Any fault shuts off the output. Fault is indicated and output is kept off until a new move start is received.
2. RS-422 thermal faults auto reset after device cool down.
3. Outputs are not limited to these speeds but single ended signals produced by the FETs are not usually reliable above these speeds due to cabling capacitance.

## Status Input Specifications

| | |
|---|---|
| Status Input | 6 sink/source |
| Isolation | Each status input is individually isolated from all other circuits |
| Input Volts Range | 5-24 VDC |
| Input Volts Maximum | 34VDC, limited by protection |
| Input Impedance | 1kΩ minimum, 5kΩ maximum |
| Inputs Rated Current | 5-24 VDC, 16mA<br>5.2 mA typical @ 5VDC<br>22mA maximum @ 34VDC |
| Input Minimum ON Voltage | 4.5 VDC |
| Input Maximum OFF Voltage | 2.0 VDC |
| Input Minimum ON Current | 5.0 mA |
| Input Maximum OFF Current | 1.4 mA |
| OFF to ON Response Time | 4μs |
| ON to OFF Response Time | 4μs |

# P2-HSO High-Speed Output Module (cont'd)

| Status Output Specifications | | |
|---|---|---|
| Status Outputs | 4 sink/source | |
| Output Signal Type, per Channel Select | Current Sinking | Current Sourcing |
| Operating Voltage² | 5-24 VDC | 5-24 VDC² |
| Output Volts Maximum² | 36VDC | 26.4 VDC² |
| Output Current Maximum | 500mA | |
| Overcurrent Protection | Short circuit detect, overcurrent shutdown¹ | |
| Output Self Limiting Current | 1.2 to 2.4 A | |
| Max Inrush Current | Self limited | |
| Output Voltage Drop | 0.7 VDC @ 0.5 A | |
| Thermal Protection | Independent over temperature protection each output | |
| Output Voltage Clamp During Inductive Switching | +45VDC | -20VDC |
| Maximum OFF to ON Response | 25µs³ | |
| Maximum ON to OFF Response | 25µs³ | |

**NOTES:**
1. Any fault shuts off the output. Fault is indicated and output is kept off until a new move start is received.
2. Operating voltage for current sourcing outputs must be less or equal to the external power.
3. Measured at 5VDC operating voltage, 0.5 A load.

| Resolution of Frequency Output Measurements | |
|---|---|
| Output Frequency | Resolution |
| 1kHz | 0.01 Hz |
| 10kHz | 0.67 Hz |
| 100kHz | 67Hz |
| 1MHz | 6622Hz |

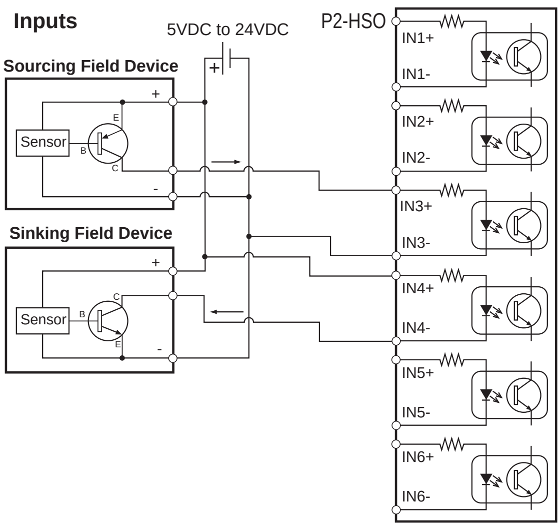
| Inaccuracy of Output Frequency Due to Time Base Errors | |
|---|---|
| 25 MHz Crystal for Time Base | |
| Inaccuracy at 25°C, Maximum | ±30 PPM |
| Inaccuracy 0-60°C, Referenced to 25°C | ±30 PPM |
| Inaccuracy Due to Aging, Maximum | ±5 PPM/Year |
| Max. Time Base Inaccuracy 0-60°C and 10 Years Operation | 0.01% |

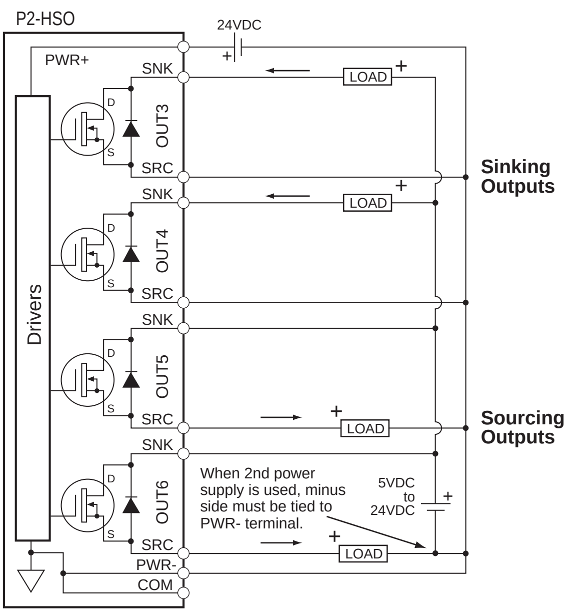
| Module Range: | Target position range ±2.147 billion (32-bit signed integer) |
|---|---|

# P2-HSO High-Speed Output Module (cont'd)

## HSO Wiring Examples

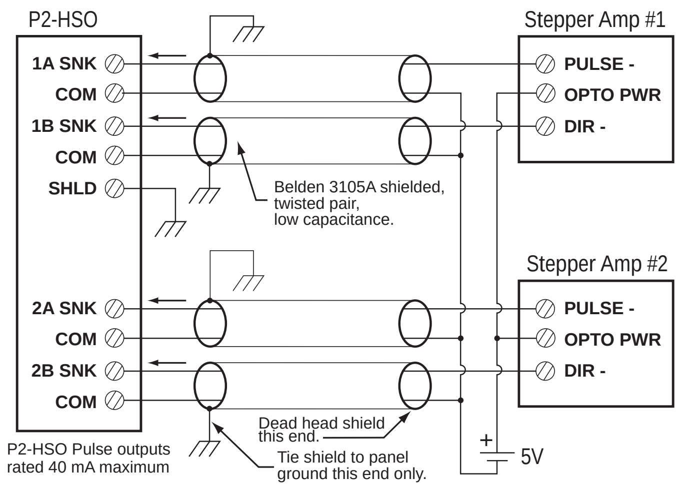
### Status Inputs and Outputs



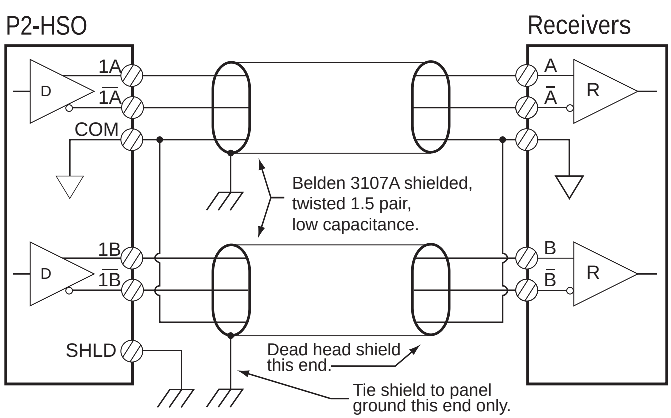



# P2-HSO High-Speed Output Module (cont'd)

## Sinking Pulse Output Wiring Diagram

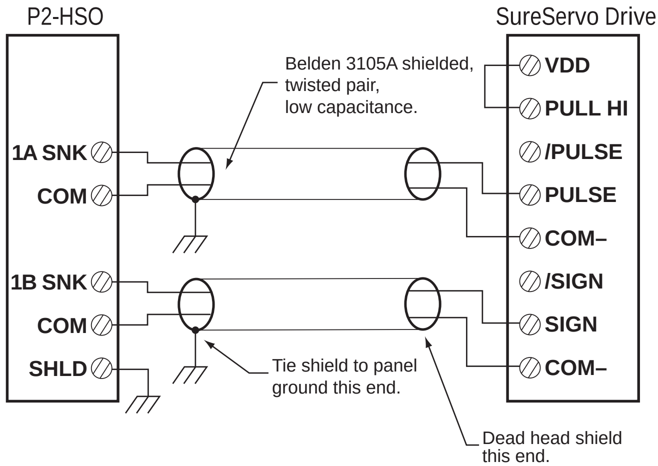



## Line Driver Pulse Output Wiring Diagram

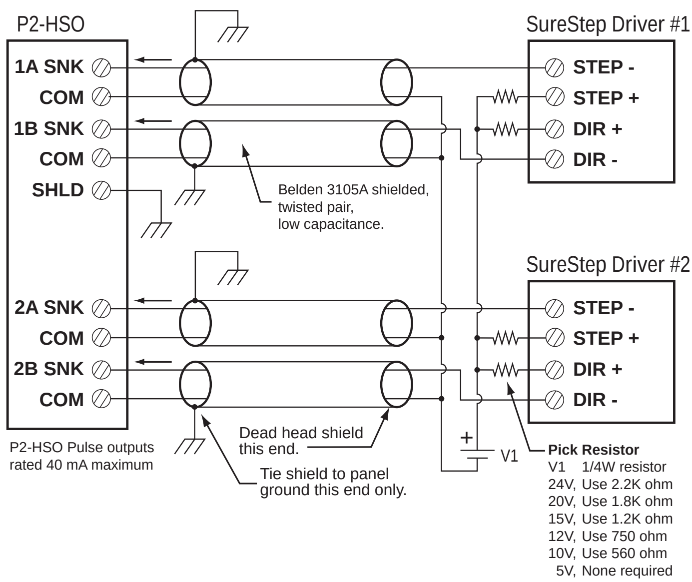


# P2-HSO High-Speed Output Module (cont'd)

## SureServo Wiring Diagram

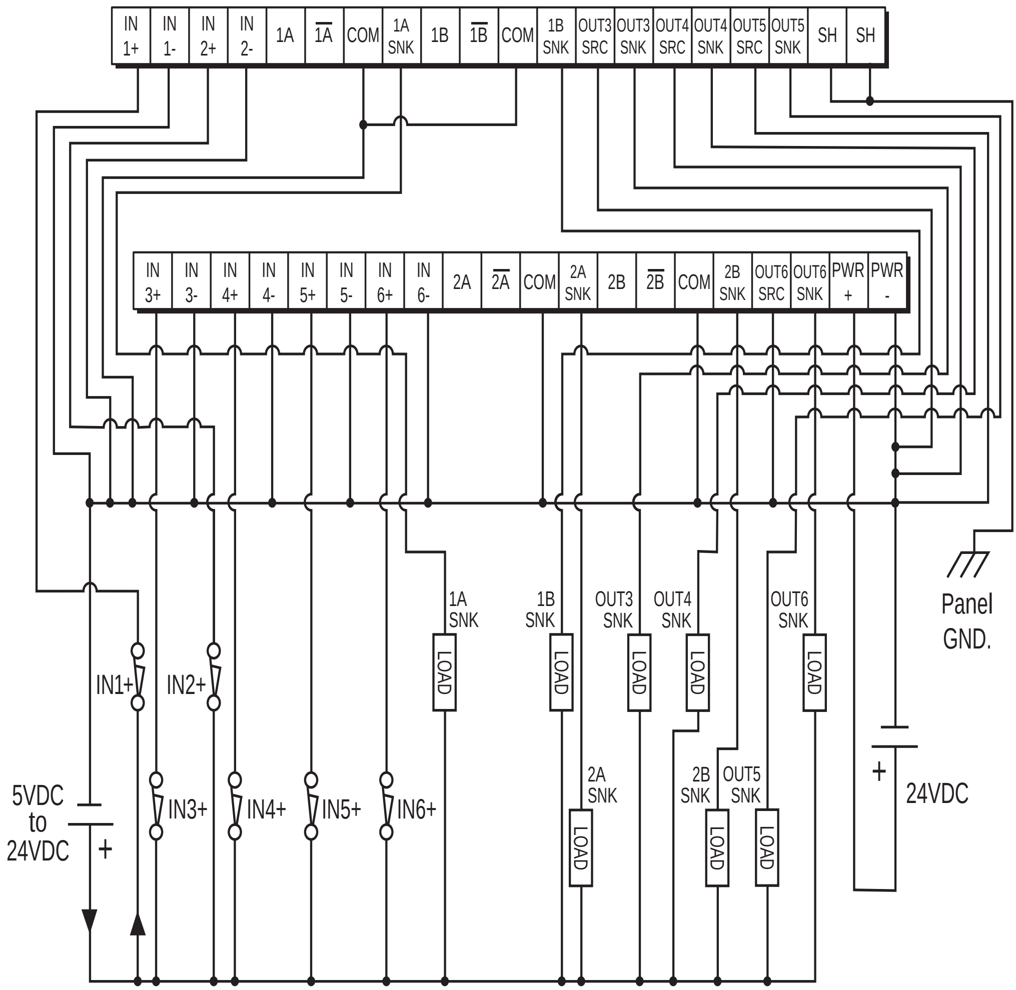



## SureStep Wiring Diagram



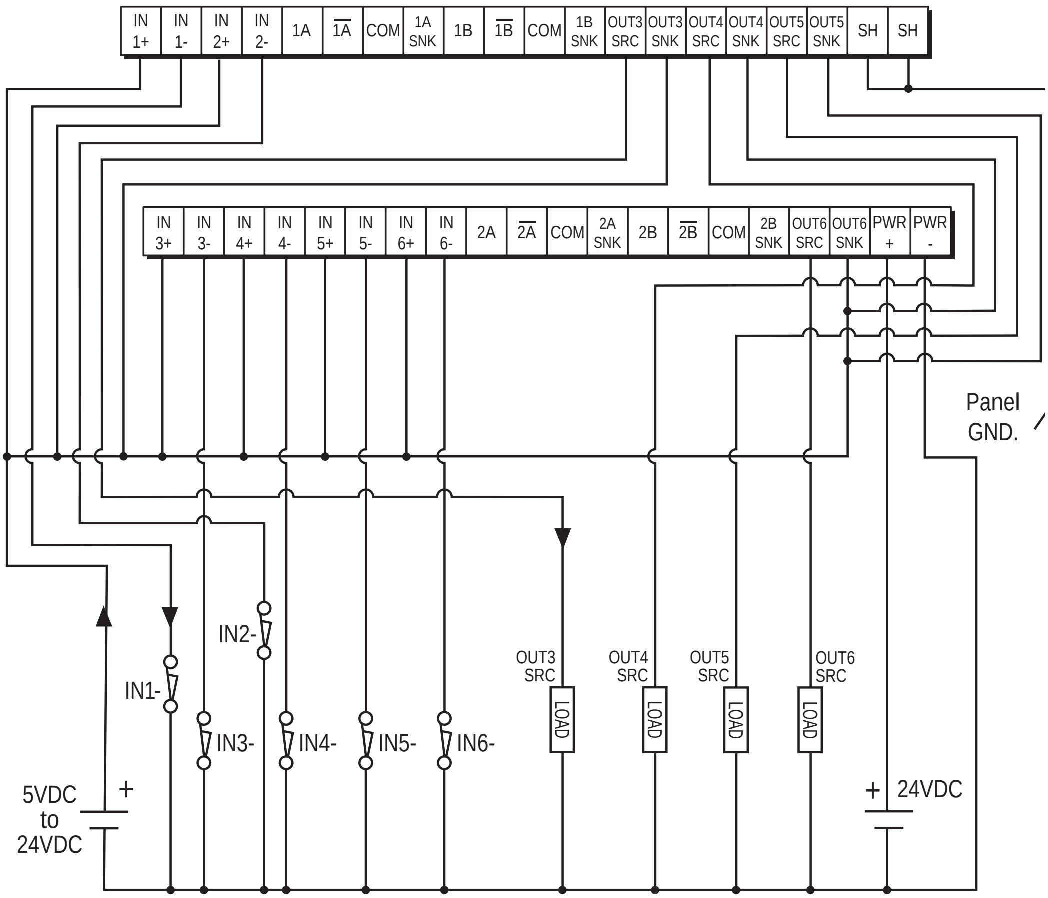
# P2-HSO High-Speed Output Module (cont'd)

## Sinking I/O Wiring Diagram



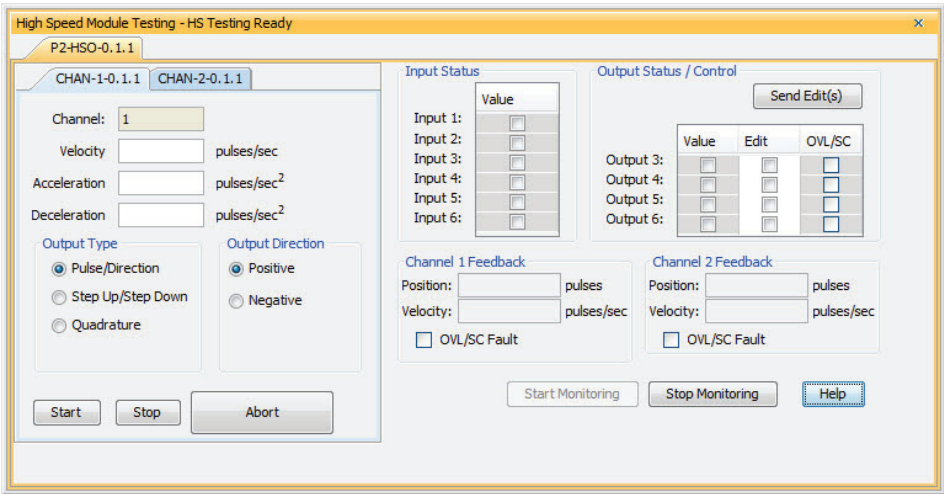
# P2-HSO High-Speed Output Module (cont'd)

## Sourcing I/O Wiring Diagram



# High-Speed Module Tester Utility

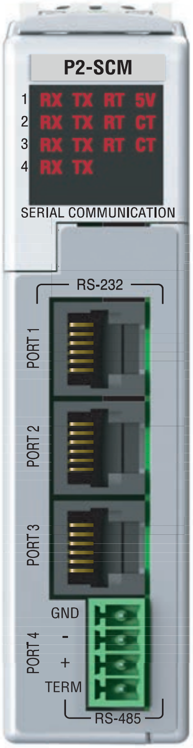
The High-Speed Module Tester is a software utility that allows a user to test the P2-HSO module's inputs and outputs. It is highly recommended that you simulate your P2-HSO functions before attempting to control the module from your CPU program. This software utility, seen below, can be useful with debugging, confirming field wiring and verifying external device operation.




Refer to the Productivity Suite Help file for more information on the High-Speed Module Tester Utility.

# P2-SCM Module Specifications

The P2-SCM Serial Communications Module provides three RS-232 ports and one RS-485 port for Modbus master/slave networking or connection to serial devices using ASCII or custom communication protocols. Port 1 only powers a C-More Micro when using an RJ-12 connector.



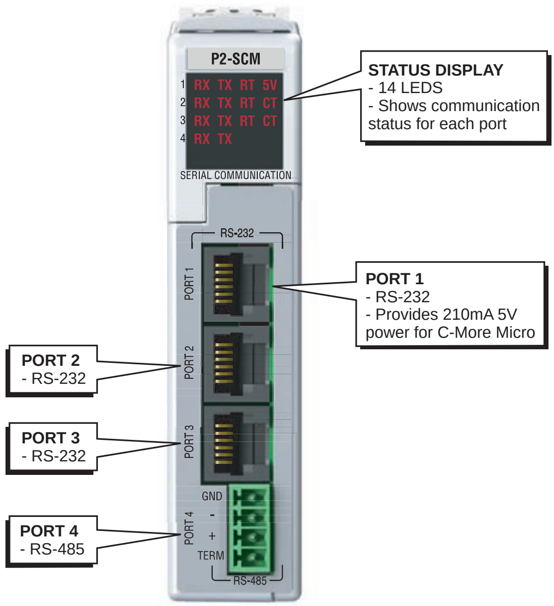

| General Specifications | |
|---|---|
| Module Type | Intelligent |
| Modules per Base | 15 maximum (See Note) |
| I/O Points Used | None, mapped directly to tags in CPU |
| Field Wiring Connector | 3 - RJ12, 1 - 4 Position Terminal Block |
| Operating Temperature | 0º to 60ºC (32º to 140ºF) |
| Storage Temperature | -20º to 70ºC (-4º to 158ºF) |
| Humidity | 5 to 95% (non-condensing) |
| Environmental Air | No corrosive gases permitted |
| Vibration | IEC 60068-2-6 (Test Fc) |
| Shock | IEC 60068-2-27 (Test Ea) |
| Field to Logic Side Isolation | None |
| Insulation Resistance | No isolation |
| Agency Approvals | UL508 File E139594, Canada & USA<br>CE (EN61131-2007) |
| Module Location | Any slot in any base in a Productivity2000 System |
| Weight | 90g (3.2 oz) |

| Removable Terminal Block Specifications | |
|---|---|
| Number of Positions | 4 Screw Terminals, 3.5 mm Pitch |
| Wire Range | 16-28 AWG<br>Solid/Stranded Conductor<br>“Use copper conductors, 75°C or equivalent” |
| Screwdriver Size | TW-SD-VSL-1 (recommended) |
| Screw Torque | 0.4 N-m |

Removable Terminal Connector included.
Spare connectors available,
(part no. P3-RS485CON-1).

***NOTE:*** *For complete system limits, please refer to the “Hardware and Communication Limits” table in the Productivity Suite online “Help” file “Hardware Configuration”, topic P050.*

# P2-SCM Specifications, (cont'd)



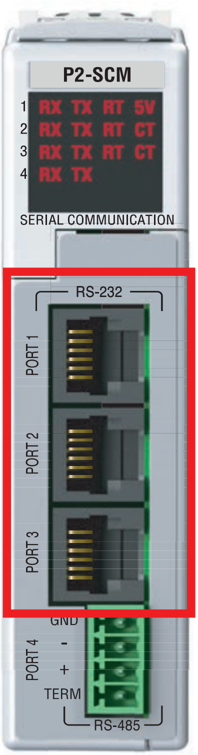

## Diagnostic LEDs

| LED | Port 1 | Port 2 | Port 3 | Port 4 |
|---|---|---|---|---|
| RXD | X | X | X | X |
| TXD | X | X | X | X |
| RTS | X | X | X | |
| CTS | | X | X | |
| 5V | X | | | |

1. All RS232 & RS485 LED's reflect the actual electrical level of the signal; there is no direct firmware control of LED's.
2. RS232 LED's RXD, TXD, RTS & CTS are turned ON when the voltage on the RS232 wire is positive:
   a. - This occurs when the UART I/O signal is low (GND).
   b. - They are turned OFF when the voltage on the RS232 wire is negative.
3. RS485 LED's RXD, TXD, are turned ON when the UART I/O signal is low (GND).
4. 5V LED is ON when 5V power is good, 5V LED is OFF when 5V is shorted to ground.

# P2-SCM Module Communications

## RS-232 Serial Ports




### RS-232 Ports 1, 2 & 3

| Electrical Specifications | Min | Typ | Max | Units |
|---|---|---|---|---|
| Output ON, Space Condition (3kΩ, 1000pF Load) | 5.0 | 5.2 | N/A | Volts |
| Output OFF, Mark Condition (3kΩ, 1000pF Load) | | -5.2 | -5.0 | Volts |
| Output Short-Circuit Current | N/A | 15 | N/A | mA |
| Short-Circuit Duration | | | No Limit | Seconds |
| Output Resistance | 300 | N/A | N/A | Ohm |
| Input ON Threshold | N/A | 1.6 | 2.4 | Volt |
| Input OFF Threshold | 0.6 | 1.2 | N/A | Volt |
| Input Resistance | 3k | 5k | 7k | Ohm |

### Line Specifications for RS-232 Ports

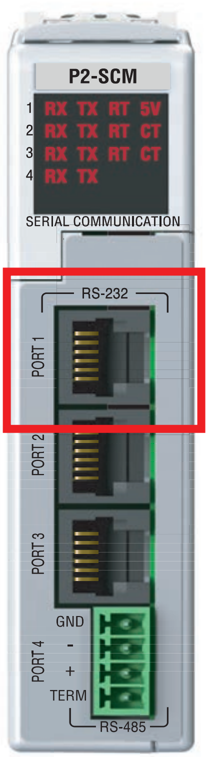
| RS-232 Line Specifications | Options | Units |
|---|---|---|
| Data Rate Setting | 1200, 2400, 4800, 9600, 19200, 33600, 38400 baud | Baud |
| Data Rate Error | ±2 | % |
| Data Bits Setting[1] | 7 or 8 | Bits |
| Stop Bits Setting | 1 | Bits |
| Parity Setting | None[1], Odd or Even | Parity |
| Data Transmission | Half duplex or full duplex | N/A |
| Network | Point-to-Point | |

1. 7-Bit data are only supported with odd or even parity.

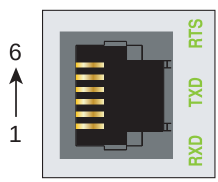
# P2-SCM Module Communications (cont'd)

## RS-232 Serial Port 1

Non-isolated RS-232 DTE port connects the CPU as a MODBUS/ASCII master or slave to a peripheral device. Includes ESD and built-in surge protection




| Port 1 | |
|---|---|
| Port Type | RS-232 |
| Description | Non-isolated RS-232 DTE port connects the CPU as a Modbus/ASCII master or slave to a peripheral device. Includes ESD and built-in surge protection. |
| Data Rates | Selectable, 1200, 2400, 4800, 9600, 19200, 33600, and 38400 baud |
| +5V Cable Power Source | 210mA maximum at 5V, ±5%. Reverse polarity and overload protected |
| TXD | RS-232 Transmit output |
| RX | RS-232 Receive input |
| RTS | Handshaking output for modem control |
| GND | Logic ground |
| Maximum Output Load (TXD/RTS) | 3kΩ, 1000pF |
| Minimum Output Voltage Swing | ±5V |
| Output Short Circuit Protection | ±15mA |
| Port Status LED | Red LED is illuminated when active for TXD, RXD and RTS |
| Cable Options | EA-MG-PGM-CBL<br>D2-DSCBL<br>USB-RS232 with D2-DSCBL<br>FA-CABKIT<br>FA-ISOCON for converting RS-232 to isolated RS-485 |



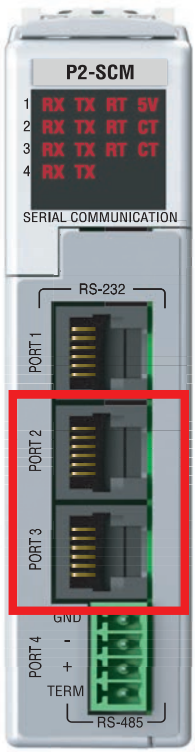

6-pin RJ12 Female Modular Connector

| Pin # | Signal | |
|---|---|---|
| 6 | GND | Logic Ground |
| 5 | RTS | RS-232 Output |
| 4 | TXD | RS-232 Output |
| 3 | RXD | RS-232 Input |
| 2 | +5V | 210mA Maximum |
| 1 | GND | Logic Ground |

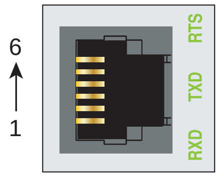
# P2-SCM Module Communications (cont'd)

## RS-232 Serial Port 2 and 3

Non-isolated RS-232 DTE port connects the CPU as a MODBUS/ASCII master or slave to a peripheral device.




| Port 2 and 3 | |
|---|---|
| Port Type | RS-232 |
| Description | Non-isolated RS-232 DTE port connects the CPU as a Modbus/ASCII master or slave to a peripheral device. Includes ESD and built-in surge protection. |
| Data Rates | Selectable, 1200, 2400, 4800, 9600, 19200, 33600, and 38400 baud |
| TXD | RS-232 Transmit output |
| RX | RS-232 Receive input |
| RTS | Handshaking output for modem control |
| GND | Logic ground |
| Maximum Output Load (TXD/RTS) | 3kΩ, 1000pF |
| Minimum Output Voltage Swing | ±5V |
| Output Short Circuit Protection | ±15mA |
| Port Status LED | Red LED is illuminated when active for TXD, RXD and RTS |
| Cable Options | D2-DSCBL<br>USB-RS232 with D2-DSCBL<br>FA-CABKIT<br>FA-ISOCON for converting RS-232 to isolated RS-485 |




6-pin RJ12 Female Modular Connector

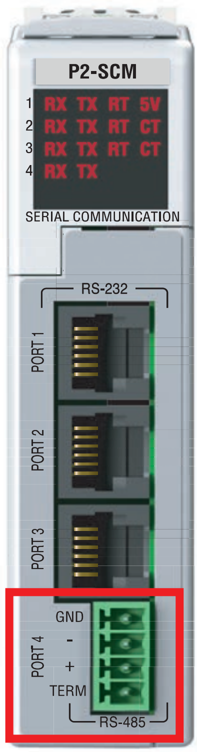
| Pin # | Signal | |
|---|---|---|
| 6 | GND | Logic Ground |
| 5 | RTS | RS-232 Output |
| 4 | TXD | RS-232 Output |
| 3 | RXD | RS-232 Input |
| 2 | +5V | 210mA Maximum |
| 1 | GND | Logic Ground |

# P2-SCM Module Communications (cont'd)

## RS-485 Port 4

Non-isolated RS-485 port connects the CPU as a MODBUS/ASCII master or slave to a peripheral device(s).






<table>
<tr><th colspan="5">Port 4</th></tr>
<tr><th>Electrical Specifications</th><th>Min</th><th>Typ</th><th>Max</th><th>Units</th></tr>
<tr><td>Driver Differential Output (54Ω Load)</td><td>1.5</td><td rowspan="7">N/A</td><td>N/A</td><td>Volts</td></tr>
<tr><td>Driver Common-Mode Output</td><td rowspan="3">N/A</td><td>3</td><td>Volts</td></tr>
<tr><td>Driver Short-Circuit Output Current</td><td>250</td><td>mA</td></tr>
<tr><td>Short-Circuit Duration (Thermal Shutdown)</td><td>No Limit</td><td>Seconds</td></tr>
<tr><td>Receiver Differential Input Threshold</td><td>200</td><td>N/A</td><td>mV</td></tr>
<tr><td>Receiver Common-Mode Input</td><td>-7</td><td>12</td><td>Volt</td></tr>
<tr><td>Input Resistance</td><td>12k</td><td rowspan="2">N/A</td><td>Ohm</td></tr>
<tr><td>Termination Resistance (TB Jumper wire 'T' to '+')</td><td>N/A</td><td>120</td><td>Ohm</td></tr>
<tr><td>Data Rate</td><td>1200</td><td>N/A</td><td>38400</td><td>Baud</td></tr>
<tr><td>Data Rate Error</td><td rowspan="2">N/A</td><td rowspan="2">N/A</td><td>±2</td><td>%</td></tr>
<tr><td>Cable Length (38400 baud maximum)</td><td>1200</td><td>Meter</td></tr>
</table>

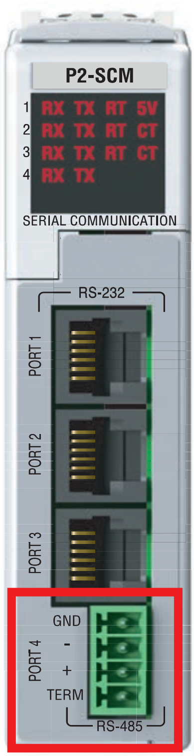
**Line Specifications for Port 4**

| RS-485 Line Specifications | Options | Units |
|---|---|---|
| Data Rate Setting | 1200, 2400, 4800, 9600, 19200, 33600, 38400 baud | Baud |
| Data Bits Setting[1] | 7 or 8 | Bits |
| Stop Bits Setting | 1 | Bits |
| Parity Setting | None[1], Odd or Even | Parity |
| Data Transmission | Half duplex | N/A |

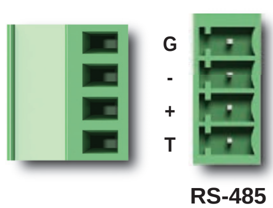
1. 7-Bit data are only supported with odd or even parity.

# P2-SCM Module Communications (cont'd)

## RS-485 Port 4




| Port 4 | |
|---|---|
| Port Type | RS-485 |
| Description | Non-isolated RS-485 port connects the CPU as a Modbus/ASCII master or slave to a peripheral device. Includes ESD/EFT protection and automatic echo cancellation when transmitter is active. |
| Data Rates | Selectable, 1200, 2400, 4800, 9600, 19200, 33600, 38400 baud |
| TXD+/RXD | RS-485 transceiver high |
| TXD-/RXD- | RS-485 transceiver low |
| GND | Logic Ground |
| Input Impedance | 19kΩ |
| Maximum Load | 50 transceivers, 19kΩ each, 60Ω termination |
| Output Short Circuit Protection | ±250mA, thermal shut-down protection |
| Electrostatic Discharge Protection | ±8kV per IEC1000-4-2 |
| Electrical Fast Transient Protection | ±2kV per IEC1000-4-4 |
| Minimum Differential Output Voltage | 1.5 V with 60Ω load |
| Fail Safe Inputs | Logic high input state if inputs are unconnected |
| Maximum Common Mode Voltage | -7.5 V to 12.5 V |
| Port Status LED | RED LED Illuminated when active for TXD and RXD |
| Cable Options | L19827-xx |




| Pin # | Signal |
|---|---|
| G | GND |
| – | TXD-/RXD- |
| + | TXD+/RXD+ |
| T | TERMINATION |

Notes

# INSTALLATION AND WIRING

CHAPTER 5

## In This Chapter...

# Safety Guidelines

***NOTE:*** *Products with CE marks perform their required functions safely and adhere to relevant standards as specified by CE directives provided they are used according to their intended purpose and that the instructions in this manual are adhered to. The protection provided by the equipment may be impaired if this equipment is used in a manner not specified in this manual. A listing of our international affiliates is available on our Web site at http://www.automationdirect.com.*



**WARNING: Providing a safe operating environment for personnel and equipment is your responsibility and should be your primary goal during system planning and installation. Automation systems can fail and may result in situations that can cause serious injury to personnel or damage to equipment. Do not rely on the automation system alone to provide a safe operating environment. You should use external electromechanical devices, such as relays or limit switches, that are independent of the CPU application to provide protection for any part of the system that may cause personal injury or damage. Every automation application is different, so there may be special requirements for your particular application. Make sure you follow all national, state, and local government requirements for the proper installation and use of your equipment.**

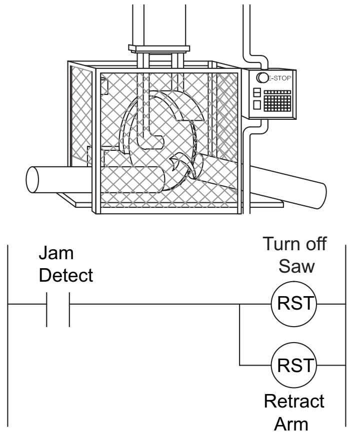
## Plan for Safety

The best way to provide a safe operating environment is to make personnel and equipment safety part of the planning process. You should examine every aspect of the system to determine which areas are critical to operator or machine safety. If you are not familiar with CPU system installation practices, or your company does not have established installation guidelines, you should obtain additional information from the following sources.

- NEMA — The National Electrical Manufacturers Association, located in Washington, D.C., publishes many different documents that discuss standards for industrial control systems. You can order these publications directly from NEMA. Some of these include:
  ICS 1, General Standards for Industrial Control and Systems
  ICS 3, Industrial Systems
  ICS 6, Enclosures for Industrial Control Systems
- NEC — The National Electrical Code provides regulations concerning the installation and use of various types of electrical equipment. Copies of the NEC Handbook can often be obtained from your local electrical equipment distributor or your local library.
- Local and State Agencies — many local governments and state governments have additional requirements above and beyond those described in the NEC Handbook. Check with your local Electrical Inspector or Fire Marshall office for information.

## Three Levels of Protection

**WARNING: The control program must not be the only form of protection for any problems that may result in a risk of personal injury or equipment damage.**




The publications mentioned provide many ideas and requirements for system safety. At a minimum, you should follow these regulations. Also, you should use the following techniques, which provide three levels of system control.

1. Orderly system shutdown sequence in the CPU control program.
2. Mechanical disconnect for output module power.
3. Emergency stop switch for disconnecting system power.



## Orderly System Shutdown

The first level of fault detection is ideally the CPU control program, which can identify machine problems. Certain shutdown sequences should be performed. These types of problems are usually things such as jammed parts, etc. that do not pose a risk of personal injury or equipment damage.

## System Power Disconnect

You should also use electromechanical devices, such as master control relays and/or limit switches, to prevent accidental equipment startup at an unexpected time. These devices should be installed in a manner that will prevent any machine operations from occurring.

For example, if the machine in the illustration has a jammed part, the CPU control program can turn off the saw blade and retract the arbor. If the operator must open the guard to remove the part, you should also include a bypass switch that disconnects all system power any time the guard is opened.

## Emergency Stop Circuits

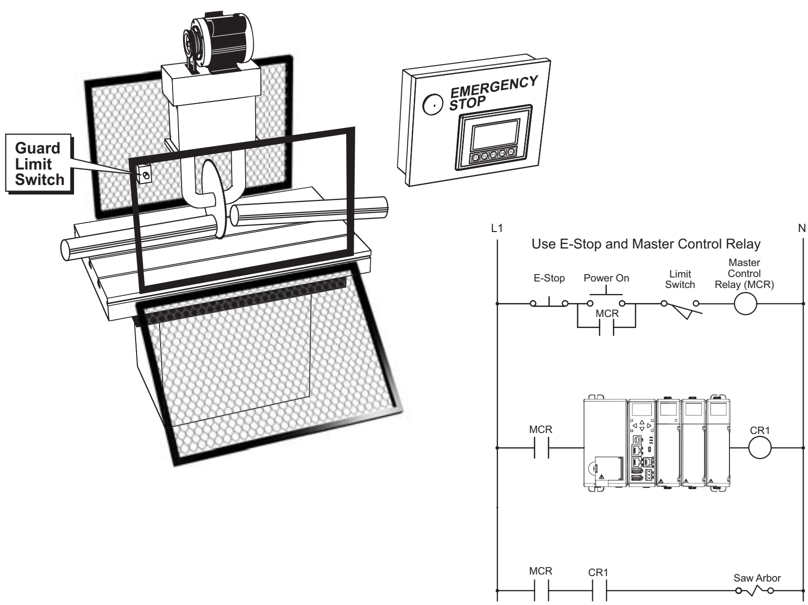
Emergency stop (E-Stop) circuits are a critical part of automation safety. For each machine controlled by a CPU, provide an emergency stop device that is wired outside the CPU and easily accessed by the machine operator.

E-stop devices are commonly wired through a master control relay (MCR) or a safety control relay (SCR) that will remove power from the CPU I/O system in an emergency.

MCRs and SCRs provide a convenient means for removing power from the I/O system during an emergency situation. By de-energizing an MCR (or SCR) coil, power to the input (optional) and output devices is removed. This event occurs when any emergency stop switch opens. However, the CPU continues to receive power and operate even though all its inputs and outputs are disabled.



The MCR circuit could be extended by placing a CPU fault relay (closed during normal CPU operation) in series with any other emergency stop conditions. This would cause the MCR circuit to drop the CPU I/O power in case of a CPU failure (memory error, I/O communications error, etc.).



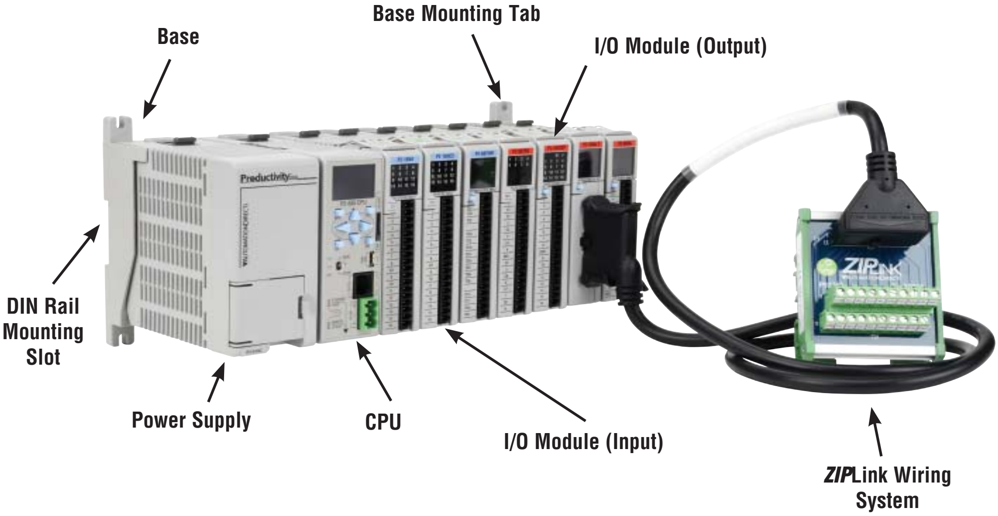

**WARNING: For some applications, field device power may still be present on the terminal block even though the CPU is turned off. To minimize the risk of electrical shock, remove all field device power before you expose or remove CPU wiring.**

# Introduction to the Productivity2000 Mechanical Design

The Productivity2000 is a modular system that requires a base to accommodate the various modules. Bases are available with 4, 7, 11 and 15 I/O module slots. The bases contain additional dedicated slots for the power supply and the CPU. Each Productivity2000 system requires one CPU module mounted in the controller slot. You can place any I/O module in any I/O slot without power budget or module type restrictions.



### Typical Productivity2000 System



# Dimensions and Installation

Before installing the CPU system you will need to know the dimensions of the components considered. These diagrams provide the base dimensions to use in defining your enclosure specifications. Remember to leave room for potential expansion. If you are using other components in your system, refer to the appropriate manual to determine how those units can affect mounting dimensions.

The height dimension is the same for all bases. The depth varies depending on your choice of I/O module. The Productivity2000 is designed to be mounted on standard 35mm DIN rail, or it can be surface mounted. Make sure you have followed the installation guidelines for proper spacing.

*NOTE: Dimensional drawings for the CPU, power supply and all modules are available on the AutomationDirect.com site.*

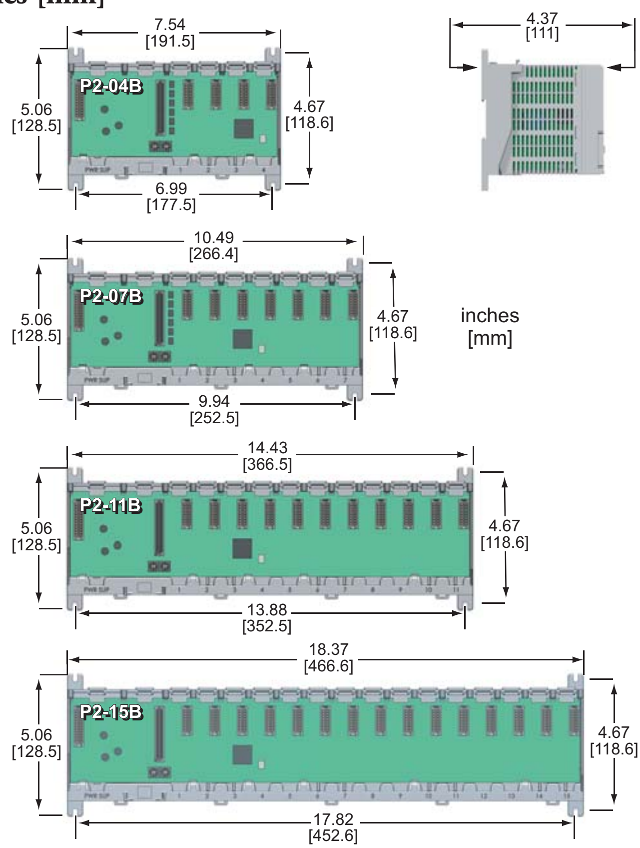
## Base Dimensions, inches [mm]

P2-04B

P2-07B

P2-11B

P2-15B



# Mounting Guidelines

## Enclosures

Your selection of a proper enclosure is important to ensure safe and proper operation of your Productivity2000 system. Applications for the Productivity2000 system vary and may require additional hardware considerations. The minimum considerations for enclosures include:

- Conformance to electrical standards
- Protection from the elements in an industrial environment
- Common ground reference
- Maintenance of specified ambient temperature
- Access to the equipment
- Security or restricted access
- Sufficient space for proper installation and maintenance of the equipment



## Mounting Position

Mount the bases horizontally, as shown in the illustration on the following page, to provide proper ventilation. Do not mount the bases vertically, upside down, or on a flat horizontal surface.

## Mounting Clearances

Provide a minimum clearance of 2 inches (50mm) between the bases and all sides of the enclosure. Allow extra door clearance for operator panels and other door mounted items. There should be a minimum of 3 inches (76mm) clearance between the base and any wire duct, and a minimum of 7.2 inches (183mm) from base to base in a multiple base installation.

## Grounding

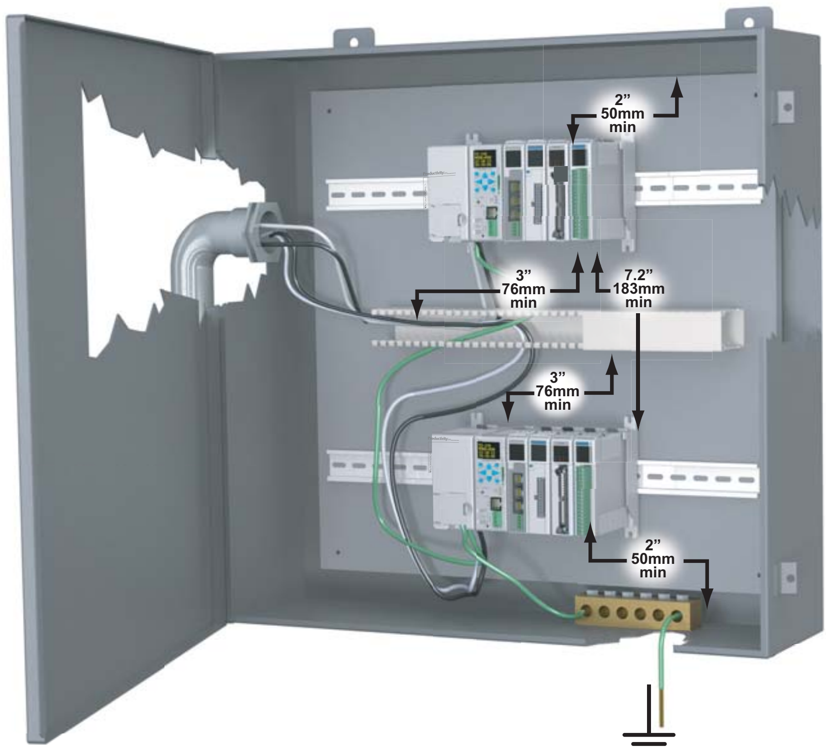
A good common ground reference (earth ground) is essential for proper operation of the Productivity2000 system. One side of all control circuits, power circuits and the ground lead must be properly connected to earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.

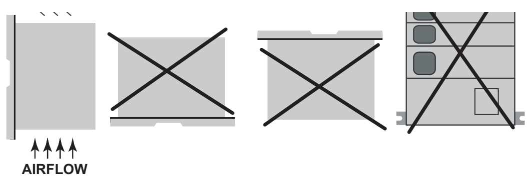
## Temperature Considerations

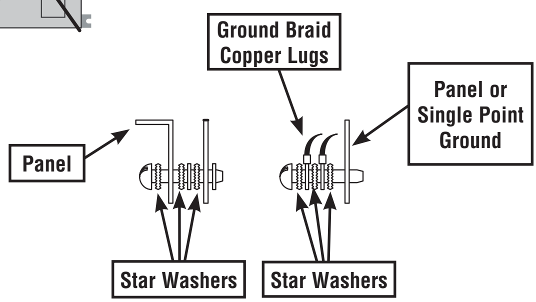
The Productivity2000 system should be installed in an environment operating within the equipment temperature specifications. If the temperature deviates above or below the specification, measures such as cooling or heating the enclosure should be taken to maintain the specification.

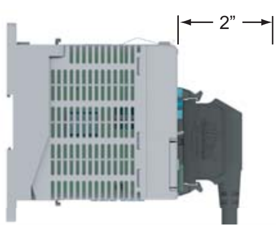
## Power Considerations

The Productivity2000 system is designed to be powered by 110/240 VAC the Productivity2000 power supply. The Productivity2000 has achieved CE certification without requiring EMF/RFI line noise filters on the AC power supply. Please review the European Union (CE) material in Appendix A for more information.




**NOTE:** Add 2" to mounting depth when using ZIPLink cable.

In addition to the panel layout guidelines, other specifications can affect the installation of a CPU system. Always consider the following:

- Environmental Specifications
- Power Requirements
- Agency Approvals
- Enclosure Selection and Component Dimensions

**WARNING: Do not disconnect equipment unless power has been switched off or the area is known to be non–hazardous.**

## Agency Approvals

Some applications require agency approvals for particular components. The Productivity2000 CPU agency approvals are listed below:

- UL (Underwriters' Laboratories, Inc.)
- CUL (Canadian Underwriters' Laboratories, Inc.)
- CE (European Economic Union)

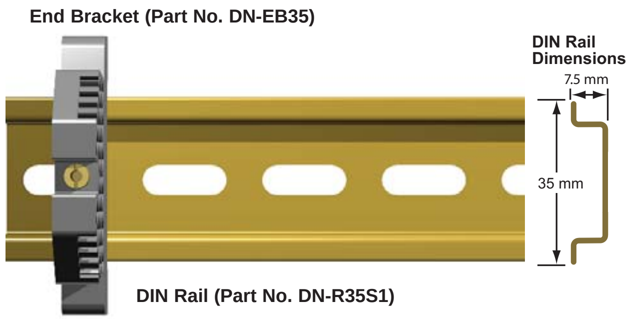
***NOTE:*** *See the "EU Directives(CE)" in Appendix A in this manual for more information.*

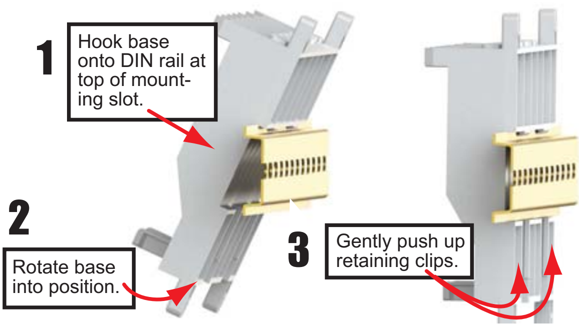
## Using Mounting Rails

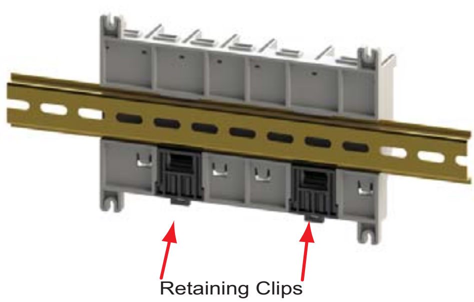
The Productivity2000 bases can be secured to the cabinet using mounting rails. You should use rails that conform to DIN EN standard 50 022. We offer a complete line of DIN rail, DINnectors and DIN rail mounted apparatus. These rails are approximately 35mm high, with a depth of 7.5mm. If you mount the base on a rail, you should also consider using end brackets on each side of the base. The end brackets keep the base from sliding horizontally along the rail. This minimizes the possibility of accidentally pulling the wiring loose.

If you examine the bottom of the base, you'll notice retaining clips. To secure the base to a DIN rail, place the base onto the rail and gently push up on the retaining clips. The clips lock the base onto the rail. To remove the base, pull down on the retaining clips, slightly lift up the base, and pull it away from the rail.

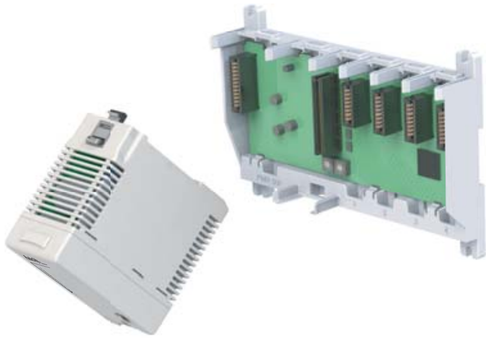




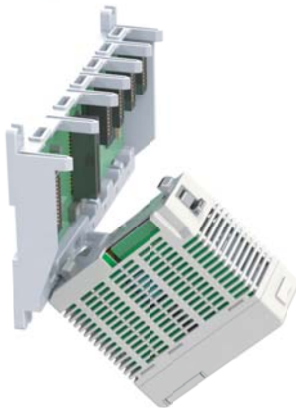



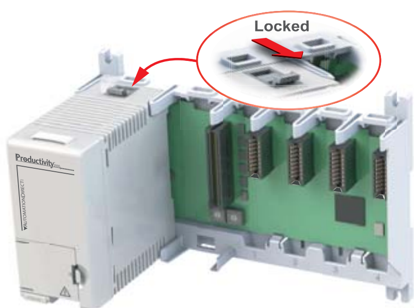
## Installing the Power Supply



**Step One:**
**Locate the left most socket in the base.**



**Step Two:**
**Insert the Power Supply at a 30° angle into the notch located at the bottom of the base and rotate up until seated in socket.**

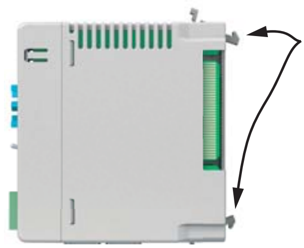



**Step Three:**
**Snap the retaining tab into the locked position.**

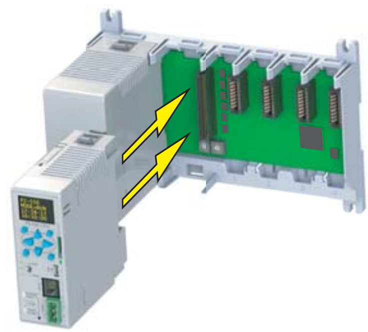
**WARNING:** **Explosion hazard – Do not connect, disconnect or operate switches while circuit is live unless the area is known to be non-hazardous. Do not hot swap.**

## Installing the CPU

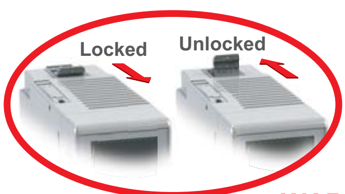
This installation procedure applies to the P2-550 CPU module assembled in any of the multi-slot bases.



**Step One:**
**Unlock both locking tabs**



**Step Two:**
**Seat CPU on support platform and push towards base until circuit board is fully engaged into connector.**



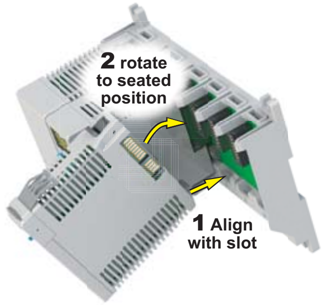

**Step Three:**
**Snap retaining tab into the locked position.**

**WARNING: Explosion hazard – Do not connect, disconnect or operate switches while circuit is live unless the area is known to be non-hazardous.**

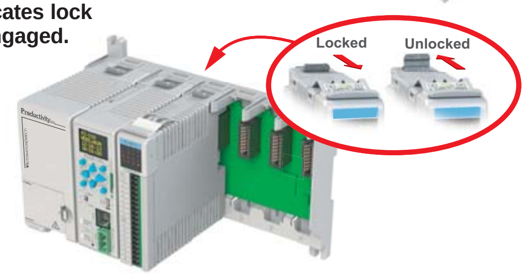
## Installing the I/O Modules

**WARNING: Do not apply field power until the following steps are completed. See hot-swapping procedure for exceptions.**

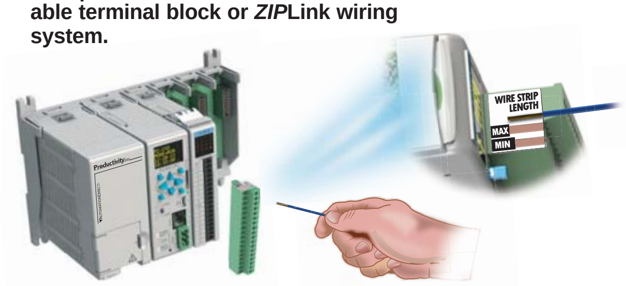
Step One: **Align module catch with base slot and rotate module into connector.**




Step Two: **Pull top locking tab toward module face. Click indicates lock is engaged.**




Step Three: **Attach field wiring using the removable terminal block or *ZIP*Link wiring system.**




**WARNING: Explosion hazard – Do not connect, disconnect or operate switches while circuit is live unless the area is known to be non-hazardous.**

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**WARNING: The Productivity2000 CPU supports Hot Swap. Individual modules can be taken offline, removed, and replaced while the rest of the CPU system continues controlling your process. Hot Swapping is performed with a HOT (powered) system. EXTREME care must be taken to prevent damage to components, terminal blocks, or even personal injury due to a short circuit from the live terminal block. Before attempting to use the hot swap feature, be sure to read the hot swap topic in the Productivity Suite Help file for details on how to plan your installation for use of this powerful feature.**

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# Wiring Guidelines

## Wiring to the Power Supply

Connect the AC power source input wiring to the power supply as shown. The power supply terminals can accept up to 14 AWG solid or stranded wire. Do not overtighten the terminal screws; the recommended torque is 7 to 9 inch-pounds (0.882 to 1.02 Nm).

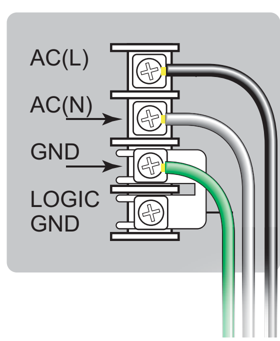
**WARNING: Once the power wiring is connected, secure the terminal block cover in the closed position. When the cover is open there is a risk of electrical shock if you accidentally touch the connection terminals or power wiring.**



## Grounding

A good common ground reference (earth ground) is essential for proper operation of the Productivity2000 system. One side of all control circuits, power circuits and the ground lead must be properly connected to earth ground by either installing a ground rod in close proximity to the enclosure or by connecting to the incoming power system ground. There must be a single-point ground (i.e. copper bus bar) for all devices in the enclosure that require an earth ground.

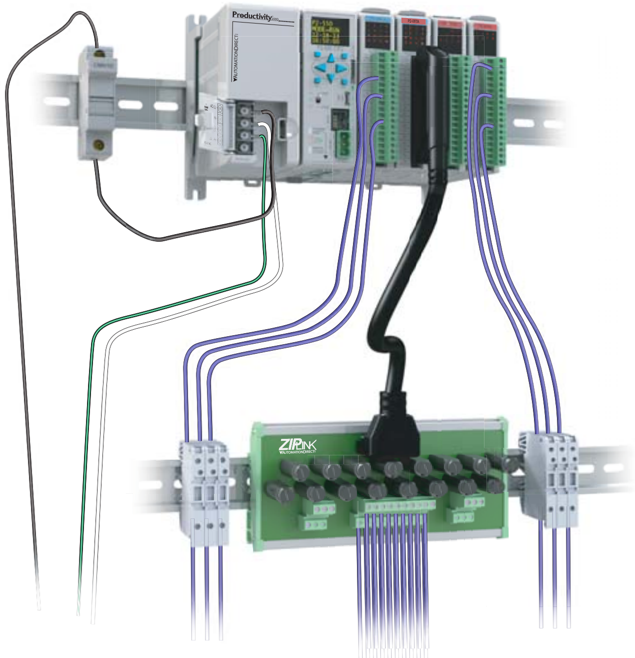
**P2-01AC**



## Fuse Protection

Some of the Input and Output I/O module circuits do not have internal fuses. In order to protect your modules, we suggest you add external fuses to your I/O wiring. A fast-blow fuse with a lower current rating than the I/O bank's common current rating can be wired to each common; or a fuse with a rating of slightly less than the maximum current per output point can be added to each output. Refer to the I/O module specifications in Chapter 2 to find the maximum current per output point or per output common. Adding the external fuse does not guarantee the prevention of CPU damage, but it will provide added protection.





# I/O Module Wiring Options

There are two available methods for wiring most I/O modules: The ***ZIP***Link wiring system or hand wiring to the optional removable I/O module terminal blocks.

***NOTE:** The high-density 16-point ANALOG I/O module design requires the use of a Molex style connector wiring system. Thermocouple and RTD modules are not compatible with the **ZIP**Link system and are shipped with the terminal blocks included.*



## *ZIP*Link Wiring System

The ***ZIP***Link wiring system is the recommended method, which allows quick and easy connection using cables that are prewired to the I/O module terminal blocks at one end and plug into a ***ZIP***Link connector module terminal block at the other end. Use the tables on the following page to specify your ***ZIP***Link wiring system.

***ZIP*Link Wiring System**

***ZIP*Link Pre-Wired Cable**

**Sample *ZIP*Link Module**

## Terminal Block With Pigtail Cable

For most I/O modules you can also purchase ***ZIP***Link pigtail cables.

***ZIP*Link Pigtail Cable**

## Input and Output Modules *ZIP*Link Selections

| Productivity2000 Input Module *ZIP*Link Selector | | | | |
|---|---|---|---|---|
| **Module** | | ***ZIP*Link** | | |
| **Input Module** | **# of Terms** | **Component** | **Module Part No.** | **Cable Part No.** |
| P2-08NE3 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16NE3 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16NA | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |

| Productivity2000 Output Module *ZIP*Link Selector | | | | |
|---|---|---|---|---|
| **PLC** | | ***ZIP*Link** | | |
| **Output Module** | **No. of Term's** | **Component** | **Module Part No.** | **Cable Part No.** |
| P2-08TD1P | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-08TD2P | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-08TRS[1] | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16TA | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16TD1P | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16TD2P | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16TR | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |

***** Select the cable length by replacing the * with: Blank = 0.5m, -1 = 1.0m, or -2 = 2.0m.

[1] The P2-08TRS-1 output module is derated not to exceed 2A per point maxiumum when used with the ***ZIP***Link wiring system.

5

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## Analog and Specialty Module *ZIP*Link Selections

| Productivity2000 Analog Module *ZIP*Link Selector | | | | |
|---|---|---|---|---|
| **Module** | | ***ZIP*Link** | | |
| **Analog Module** | **# of Terms** | **Component** | **Module** | **Cable** |
| P2-04AD | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-08AD-1 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-08AD-2 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16AD-1 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16AD-2 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-06RTD | Matched Only | See Note 1 | | |
| P2-08THM | T/C Wire Only | See Note 1 | | |
| P2-04DA | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-08DA-1 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-08DA-2 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16DA-1 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-16DA-2 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-08AD4DA-1 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |
| P2-08AD4DA-2 | 20 | Feedthrough | ZL-RTB20 | ZL-P2-CBL18* |

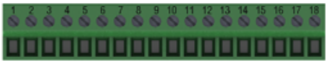
| Productivity2000 Specialty & Motion Modules *ZIP*Link Selector | | | | |
|---|---|---|---|---|
| **Module** | | ***ZIP*Link** | | |
| **Input Module** | **# of Terms** | **Component** | **Module Part No.** | **Cable Part No.** |
| P2-HSI | 40 | Feedthrough | ZL-RTB40 | ZL-CBL40*S |
| P2-HSO | 40 | Feedthrough | ZL-RTB40 | ZL-CBL40*S |
| P2-08SIM | See Note 1 | | | |
| P2-SCM | | | | |

* Select the cable length by replacing the * with: Blank = 0.5m, -1 = 1.0m, or -2 = 2.0m.

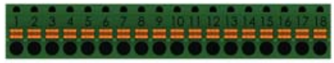
[1] These modules are not supported by the ZIPLink wiring system.

## Removable Terminal Blocks (Optional)

The hand wiring method consists of purchasing the removable I/O module terminal block (part no. P2-RTB or P2-RTB-1) and hand wiring from the I/O terminal block to a DIN rail mounted terminal block.



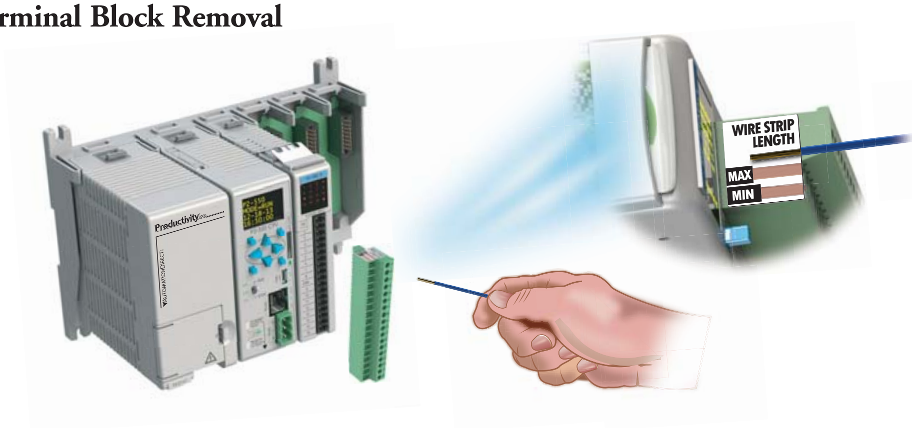
**Removable Terminal Block P2-RTB**



**Removable Terminal Block P2-RTB-1**



## Terminal Block Removal




| Removable Terminal Block Specifications | | |
|---|---|---|
| **Part Number** | **P2-RTB** | **P2-RTB-1** |
| Number of positions | 18 Screw Terminals | 18 Spring Clamp Terminals |
| Wire Range | 30 - 16 AWG (0.051 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in. (1.2 mm) Insulation Maximum<br>1/4 in (6 - 7 mm) Strip Length | 28-16 AWG (0.081 - 1.31 mm²)<br>Solid / Stranded Conductor<br>3/64 in (1.2 mm) Insulation Maximum<br>19/64 in (7 - 8 mm) Strip Length |
| Conductors | “USE COPPER CONDUCTORS, 75ºC” or equivalent. | |
| Screw Driver Width | 1/8 in (3.8 mm) Maximum | |
| Screw Size | M2 | N/A |
| Screw Torque | 2.5 lb·in (0.28 N·m) | N/A |

## Planning the I/O Wiring Routes

The following guidelines provide general information on how to wire the I/O connections to Productivity2000 modules. For specific information on wiring a particular I/O module refer to the module specifications in Chapter 2.

1. If using removable terminal blocks, follow the wire size guidelines in the I/O modules specifications in Chapter 2.
2. Always use a continuous length of wire. Do not splice wires to attain a needed length.
3. Use the shortest possible wire length.
4. Use wire trays for routing where possible.
5. Avoid running low voltage control wires near high voltage wiring.
6. Avoid confusion by laying input wiring separate from output wiring where possible.
7. To minimize voltage drops when wires must run a long distance, consider using multiple wires for the return line.
8. Avoid running DC wiring in close proximity to AC wiring where possible.
9. Avoid creating sharp bends in the wires; follow accepted Electrical Code standards.

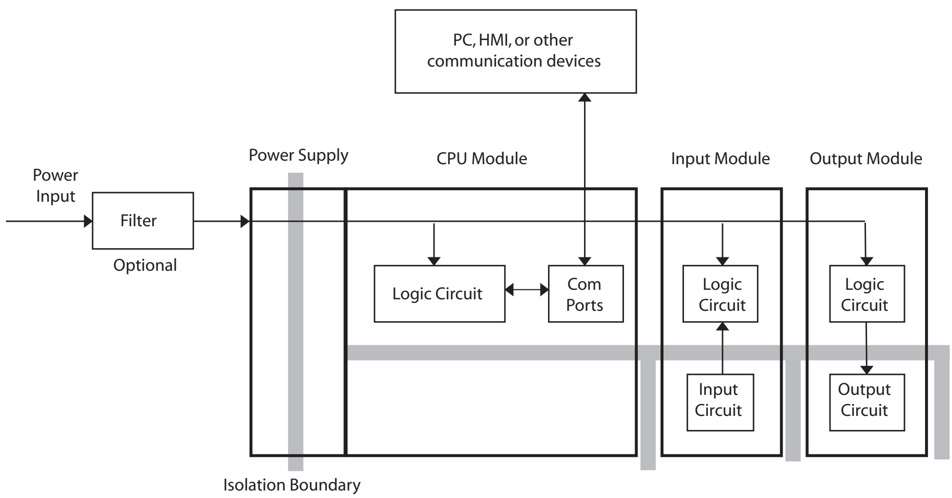
# System Wiring Strategies

The Productivity2000 system is very flexible and will work in many different wiring configurations. By studying this section before actual installation, you can find the best wiring strategy for your application. This will help to lower system cost and wiring errors, and avoid safety problems.

## CPU Isolation Boundaries

CPU circuitry is divided into three main regions separated by isolation boundaries, shown in the drawing below. Electrical isolation provides safety, so that a fault in one area does not damage another. The transformer in the power supply provides magnetic isolation between the primary and secondary sides. Optical isolators provide isolation in Input and Output circuits. This isolates logic circuitry from the field side, where factory machinery connects. The discrete inputs are isolated from the discrete outputs because each is isolated from the logic side. Isolation boundaries protect the devices which are connected to the communication ports, such as PCs and HMIs, from power input faults or field wiring faults. When wiring a CPU, it is extremely important to avoid making external connections that connect logic side circuits to any other.





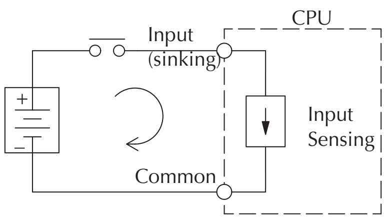
## Sinking/Sourcing Concepts

Before wiring field devices to the CPU I/O, it's necessary to have a basic understanding of "sinking" and "sourcing" concepts. Use of these terms occurs frequently in input or output circuit discussions. The purpose of this section is to explain the terms. The short definitions are as follows:

Sinking = Path to supply ground (–) or switching ground

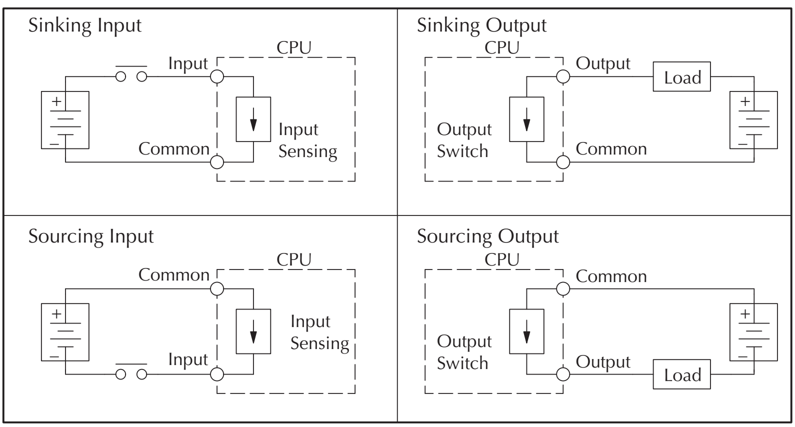
Sourcing = Path to supply source (+) or switching +V

These terms only apply to DC circuits, not AC circuits. Input and output points that are either sinking or sourcing can conduct current in only one direction. This means it is possible to wire the external supply and field device to the I/O point with current trying to flow in the wrong direction, in which case the circuit will not operate.




The diagram on the left shows a "sinking" CPU input. To properly connect the external supply, connect it so that the input provides a path to ground (–). Start at the CPU input terminal, follow through the input sensing circuit, exit at the common terminal, and connect the supply (–) to the common terminal.

The switch between the supply (+) and the input completes the circuit. Current flows in the direction of the arrow when the switch is closed. By applying the circuit principle above to the four possible combinations of input/output sinking/sourcing types, we have the four circuits as shown below.

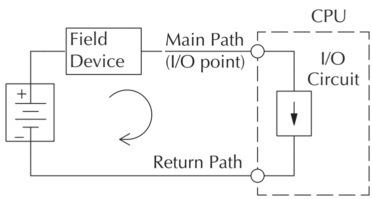


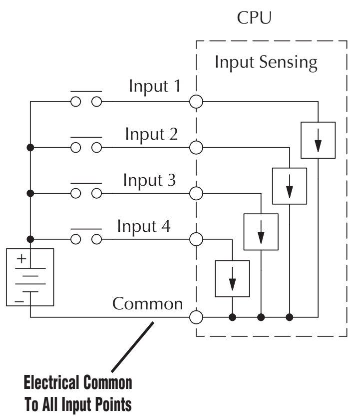
## I/O "Common Terminal" Concepts

In order for a CPU I/O circuit to operate, current must enter at one terminal and exit at another. This means at least two terminals are associated with every I/O point. In the figure below, the input or output terminal is the main path for the current. One additional terminal must provide the return path to the power supply.

If there was unlimited module space then every I/O point could have two dedicated terminals as the figure above shows. Providing this level of flexibility is not practical or necessary for most applications. Most I/O point groups share the return path (common) among two or more I/O points. The figure below shows a group (or bank) of four input points which share a common return path. In this way, the four inputs require only five terminals instead of eight.

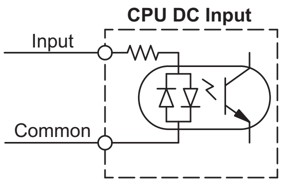





***NOTE:*** *In the circuit above, the current in the common path is equal to the sum of the energized channels. This is especially important in output circuits, where larger gauge wire is sometimes needed for the commons.*

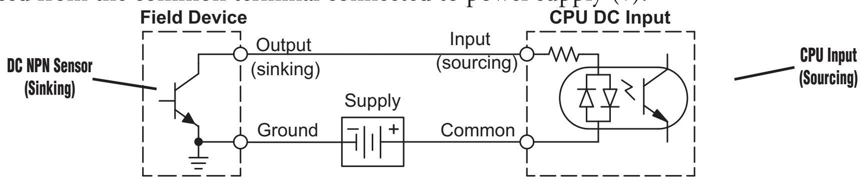
## DC Input Wiring Methods




I/O modules with DC inputs can be wired as either sinking or sourcing inputs. The dual diodes (shown in this diagram) allow current to flow in either direction. Inputs grouped by a common point must be either all sinking or all sourcing. DC inputs typically operate in the range of +12-24 VDC.

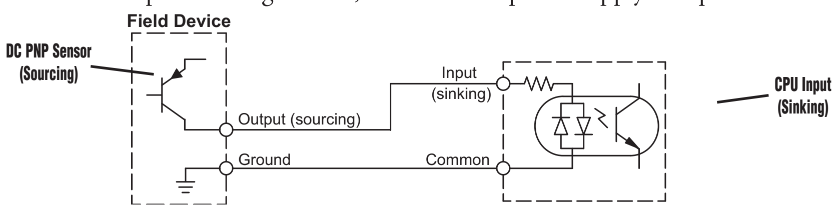
### Sinking Input Sensor (NPN Type) to CPU Sourcing Input

In the following example, a field device has an open-collector NPN transistor output. When energized, it sinks current to ground from the DC input point. The CPU input current is sourced from the common terminal connected to power supply (+).




### Sourcing Input Sensor (PNP Type) to CPU Sinking Input

In the following example, a field device has an open-emitter PNP transistor output. When energized, it sources current to the CPU input point, which sinks the current to ground. Since the field device loop is sourcing current, no additional power supply is required for the module.



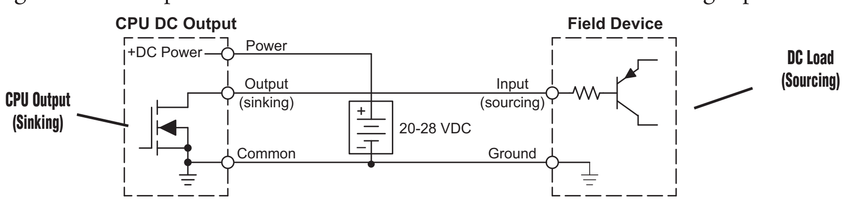

## DC Output Wiring Methods

I/O modules with DC output circuits are wired as all current sinking only or current sourcing only depending on which output module part number is used. DC outputs typically operate in the range of +5-24 VDC.

### CPU Sinking Output to Sourcing Load Device

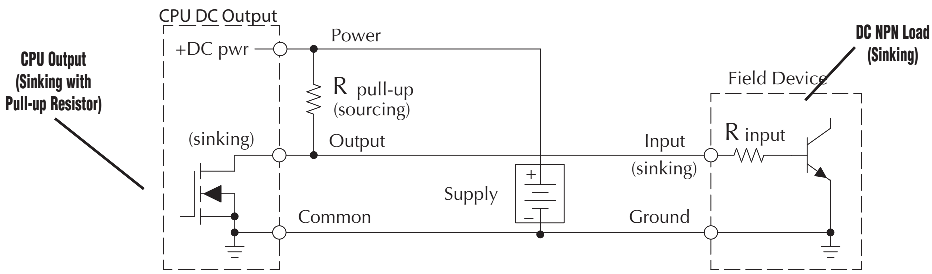
Many applications require connecting a CPU output point to a DC input on a field device load. This type of connection is made to carry a low-level DC signals.

In the following example, the CPU output point sinks current to ground (common) when energized. The output is connected to a field device load with a sourcing input.



### CPU DC Sinking Output to Sinking Load Device

In the example below, a sinking output point is connected to the sinking input of a field device load. In this case, both the CPU output and field device input are sinking type. Since the circuit must have one sourcing and one sinking device, we add sourcing capability to the CPU output by using a pull-up resistor. In the circuit below, we connect R pull-up from the output to the DC output circuit power input.




**NOTE:** *DO NOT attempt to drive a heavy load (>25 mA) with this pull-up method.*

**NOTE:** *Using the pull-up resistor to implement a sourcing output has the effect of inverting the output point logic. In other words, the field device input is energized when the CPU output is OFF, from a ladder logic point-of-view. Your ladder program must comprehend this and generate an inverted output. Or, you may choose to cancel the effect of the inversion elsewhere, such as in the field device.*

It is important to choose the correct value of $R_{pull\text{-}up}$. In order to do so, we need to know the nominal input current to the field device ($I_{input}$) when the input is energized. If this value is not known, it can be calculated as shown (a typical value is 15 mA). Then use $I_{input}$ and the voltage of the external supply to compute $R_{pull\text{-}up}$. Then calculate the power $P_{pull\text{-}up}$ (in watts), in order to size $R_{pull\text{-}up}$ properly.

$$I_{input} = \frac{V_{input\ (turn\text{-}on)}}{R_{input}}$$

$$R_{pull\text{-}up} = \frac{V_{supply} - 0.7}{I_{input}} - R_{input}$$

$$P_{pull\text{-}up} = \frac{V_{supply}^{2}}{R_{pull\text{-}up}}$$

## Relay Outputs - Wiring Methods

Relay outputs are available for the Productivity2000. Relays are best for the following applications:

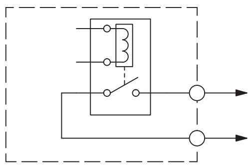
- Loads that require higher currents than the solid-state outputs can deliver
- Cost-sensitive applications
- Some output channels need isolation from other outputs (such as when some loads require different voltages than other loads)

Some applications in which NOT to use relays:

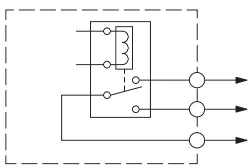
- Loads that require currents under 10 mA
- Loads which must be switched at high speed or heavy duty cycle.



Relay with Form A contacts



Relay with Form C contacts



Relay outputs are available in two contact arrangements. Form A type, or SPST (single pole, single throw) type. They are normally open and are the simplest to use. The Form C, or SPDT (single pole, double throw) type has a center contact which moves and a stationary contact on either side. This provides a normally closed contact and a normally open contact.

The relays in some relay output modules share common terminals, which connect to the wiper contact in each relay of the bank. Other relay modules have relays which are completely isolated from each other. In all cases, the module drives the relay coil when the corresponding output point is on.

## Relay Outputs – Transient Suppression for Inductive Loads in a Control System

The following pages are intended to give a quick overview of the negative effects of transient voltages on a control system and provide some simple advice on how to effectively minimize them. The need for transient suppression is often not apparent to the newcomers in the automation world. Many mysterious errors that can afflict an installation can be traced back to a lack of transient suppression.

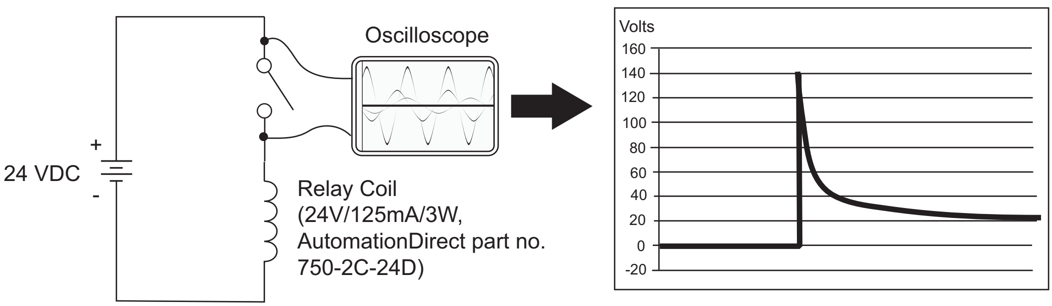
### What is a Transient Voltage and Why is it Bad?

Inductive loads (devices with a coil) generate transient voltages as they transition from being energized to being de-energized. If not suppressed, the transient can be many times greater than the voltage applied to the coil. These transient voltages can damage CPU outputs or other electronic devices connected to the circuit, and cause unreliable operation of other electronics in the general area. Transients must be managed with suppressors for long component life and reliable operation of the control system.



This example shows a simple circuit with a small 24V/125mA/3W relay. As you can see, when the switch is opened, thereby de-energizing the coil, the transient voltage generated across the switch contacts peaks at 140V!

**Example: Circuit with no Suppression**




In the same circuit, replacing the relay with a larger 24V/290mA/7W relay will generate a transient voltage exceeding 800V (not shown). Transient voltages like this can cause many problems, including:

- Relay contacts driving the coil may experience arcing, which can pit the contacts and reduce the relay's lifespan.
- Solid state (transistor) outputs driving the coil can be damaged if the transient voltage exceeds the transistor's ratings. In extreme cases, complete failure of the output can occur the very first time a coil is de-energized.
- Input circuits, which might be connected to monitor the coil or the output driver, can also be damaged by the transient voltage.

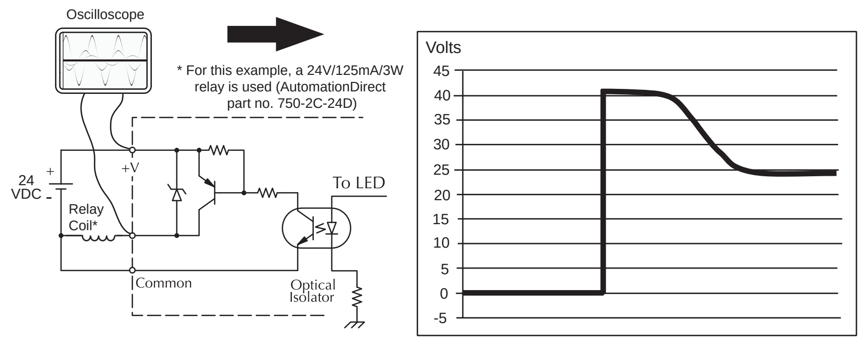
A very destructive side-effect of the arcing across relay contacts is the electromagnetic interference (EMI) it can cause. This occurs because the arcing causes a current surge, which releases RF energy. The entire length of wire between the relay contacts, the coil, and the power source carries the current surge and becomes an antenna that radiates the RF energy. It will readily couple into parallel wiring and may disrupt the CPU and other electronics in the area. This EMI can make an otherwise stable control system behave unpredictably at times.

### CPU's Integrated Transient Suppressors

Although the CPU outputs typically have integrated suppressors to protect against transients, they are not capable of handling them all. It is usually necessary to have some additional transient suppression for an inductive load.

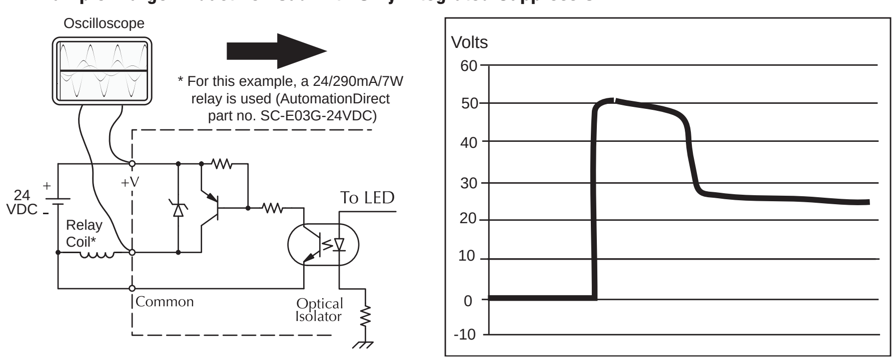
Here is another example using the same 24V/125mA/3W relay used earlier. This example measures the PNP transistor output of a typical CPU, which incorporates an integrated Zener diode for transient suppression. Instead of the 140V peak in the first example, the transient voltage here is limited to about 40V by the Zener diode. While the CPU will probably tolerate repeated transients in this range for some time, the 40V is still beyond the module's peak output voltage rating of 30V.

**Example: Small Inductive Load with Only Integrated Suppression**




The next example uses the same circuit as above, but with a larger 24V/290mA/7W relay, thereby creating a larger inductive load. As you can see, the transient voltage generated is much worse, peaking at over 50V. Driving an inductive load of this size without additional transient suppression is very likely to permanently damage the CPU output.

**Example: Larger Inductive Load with Only Integrated Suppression**

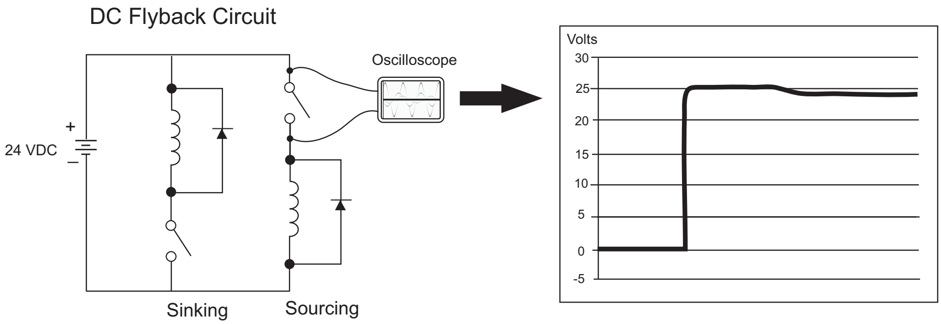



Additional transient suppression should be used in both these examples. If you are unable to measure the transients generated by the connected loads of your control system, using additional transient suppression on all inductive loads would be the safest practice.

### Types of Additional Transient Protection

### DC Coils:

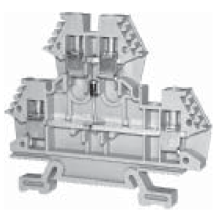
The most effective protection against transients from a DC coil is a flyback diode. A flyback diode can reduce the transient to roughly 1V over the supply voltage, as shown in this example.




Many AutomationDirect socketed relays and motor starters have add-on flyback diodes that plug or screw into the base, such as the AD-ASMD-250 protection diode module and 784-4C-SKT-1 socket module shown below. If an add-on flyback diode is not available for your inductive load, an easy way to add one is to use AutomationDirect's DN-D10DR-A diode terminal block, a 600VDC power diode mounted in a slim DIN rail housing.


**AD-ASMD-250**
**Protection Diode Module**

**784-4C-SKT-1**
**Relay Socket**



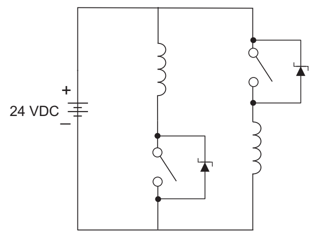
**DN-D10DR-A**
**Diode Terminal Block**

Two more common options for DC coils are Metal Oxide Varistors (MOV) or TVS diodes. These devices should be connected across the driver (CPU output) for best protection as shown below. The optimum voltage rating for the suppressor is the lowest rated voltage available that will NOT conduct at the supply voltage, while allowing a safe margin.

AutomationDirect's ZL-TSD8-24 transorb module is a good choice for 24VDC circuits. It is a bank of 8 uni-directional 30V TVS diodes. Since they are uni-directional, be sure to observe the polarity during installation. MOVs or bi-directional TVS diodes would install at the same location, but have no polarity concerns.

**ZL-TSD8-24**
**Transorb Module**

DC MOV or TVS Diode Circuit



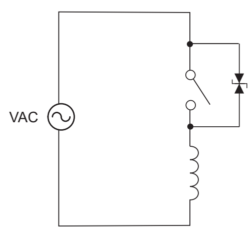

**AC Coils:**

Two options for AC coils are MOVs or bi-directional TVS diodes. These devices are most effective at protecting the driver from a transient voltage when connected across the driver (CPU output) but are also commonly connected across the coil. The optimum voltage rating for the suppressor is the lowest rated voltage available that will NOT conduct at the supply voltage, while allowing a safe margin.

AutomationDirect's ZL-TSD8-120 transorb module is a good choice for 120VAC circuits. It is a bank of eight bi-directional 180V TVS diodes.

**ZL-TSD8-120**
**Transorb Module**

AC MOV or Bi-Directional Diode Circuit




***NOTE:*** *Manufacturers of devices with coils frequently offer MOV or TVS diode suppressors as an add-on option which mount conveniently across the coil. Before using them, carefully check the suppressor's ratings. Just because the suppressor is made specifically for that part does not mean it will reduce the transient voltages to an acceptable level.*

For example, a MOV or TVS diode rated for use on 24-48 VDC coils would need to have a high enough voltage rating to NOT conduct at 48V. That suppressor might typically start conducting at roughly 60VDC. If it were mounted across a 24V coil, transients of roughly 84V (if sinking output) or -60V (if sourcing output) could reach the CPU output. Many semiconductor CPU outputs cannot tolerate such levels.

CHAPTER 6

# COMMUNICATIONS

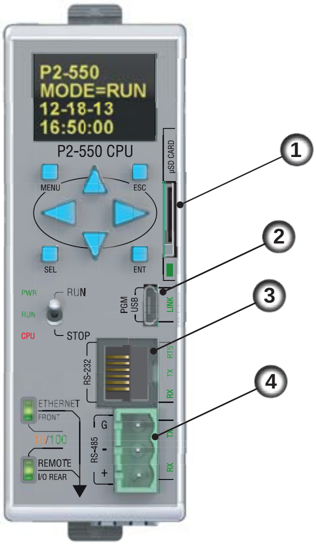
6

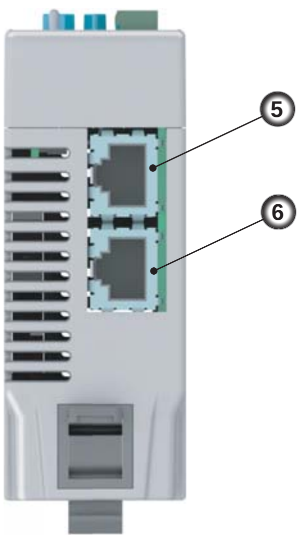
## In This Chapter...

# Communications

## Communication Ports

P2-550




P2-550 Bottom View

The AutomationDirect Productivity2000 CPU is provided with several Communications Ports. A detailed description of each of these ports are described in the sections below.

The Communication Ports are:

| General Specifications | |
|---|---|
| **Item #** | **Communication Port** |
| 1 | Micro SD Slot |
| 2 | Micro USB 2.0 Programming Port |
| 3 | RS232 Serial Port (RJ12) |
| 4 | RS485 Serial Port (TB Style) |
| 5 | 10/100 MB Ethernet Port |
| 6 | Local Ethernet Network Port |

1. Micro SD Card: The Micro SD Card slot is provided for data logging and project transfer capability. For Project Transfer security, this feature is disabled by default when creating a new project. It can be enabled in the Hardware Configuration panel. Once enabled, projects may be transferred from the Micro SD card to a CPU, or to a PC. Files stored on the Micro SD card by a P2-550 or the Productivity Suite programming software are stored under a default name, so only one project may be handled at a time on a Micro SD card. Existing projects on the Micro SD card will be overwritten without a prompt.

   Data Logging: The Data Logger tool allows setup of periodic or event-based data logging of tag and System Errors to the Micro SD card. Data Logger setup is accessed under the Monitor & Debug Menu. See Communications Connectivity section for more information.

2. Micro USB : The Micro USB 2.0 port uses a Type B connector. It is used for connection to a PC running the Productivity Suite programming software and Online monitoring of program.

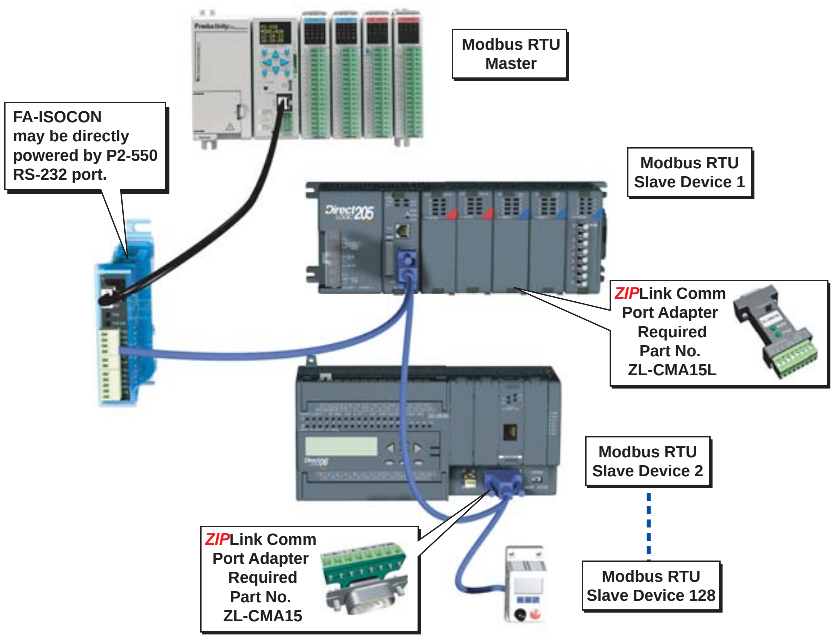
***Note:*** *The Micro USB port is NOT compatible with older 1.0/1.1 full speed USB devices.*

## P2-550 Communication Ports, cont'd

3. RS-232: The RS-232 port is an RJ-12 connector located on the lower right front of the CPU. This port can be used for:
   - Modbus RTU Master connections.
   - Modbus RTU Slave connections.
   - ASCII Incoming and Outgoing communications.
   - Custom Protocol Incoming and Outgoing communications.

Modbus RTU Master connections: The RS-232 port is intended to be used for point-to-point connections but it is possible to connect up to 128 devices on a network if an RS-232 to RS-485/422 converter is connected to the port (such as a FA-ISOCON). This is accomplished by using the communications instructions in the ladder project (MRX, MWX, RX, WX). If 4-wire RS-485 or RS-422 communications is needed, using this port with an FA-ISOCON is the best method. See Communications Connectivity section in this manual for more information.



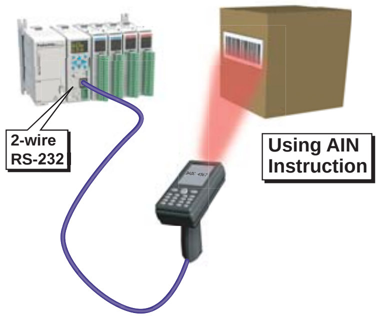



Modbus RTU Slave connections: The RS-232 port is intended to be used for point-to-point connections but it is possible for the RS-232 port to be used on a Modbus RTU network by using a RS-232 to RS-485/422 converter. The port is addressable in the Hardware Configuration in the Productivity Suite programming software. It is important to note that the RS-232 port cannot be a Modbus RTU master and slave concurrently. If the port is set to Modbus RTU and there are no communications instructions (MRX, MWX, RX, WX) in the project, the CPU will automatically respond to Modbus requests from a Modbus master. See Communications Connectivity section for more information.

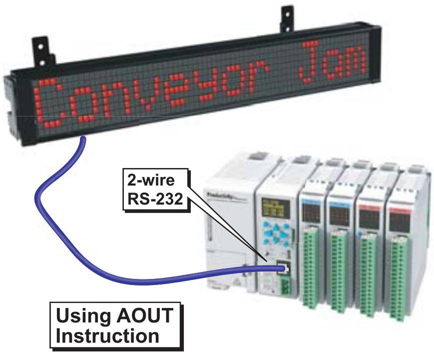
## P2-550 Communication Ports, cont'd

ASCII Incoming and Outgoing communications: The RS-232 port can be used for sending and receiving non-sequenced String data. This feature is typically used for receiving bar code strings from a scanner or sending statistical data to a terminal or serial printer using the ASCII IN and ASCII OUT instructions. See Communications Connectivity section for more information

**RS-232 ASCII In Communication**

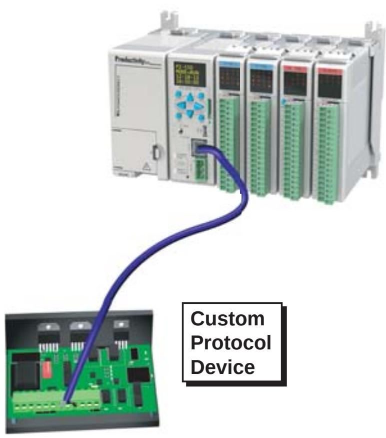



**RS-232 ASCII In Communication**




Custom Protocol Incoming and Outgoing communications: The RS-232 port can be used for sending and receiving non-sequenced byte arrays to various devices. This function is typically used for communicating with devices that don't support the Modbus protocol but have another serial communications protocol. This is accomplished by using the Custom Protocol In and Custom Protocol Out instructions. The RS-232 port is intended to be used for point-to-point connections but it is possible for the RS-232 port to be used on a multi-node network by using a RS-232 to RS-485/422 converter. See Communications Connectivity section for more information.

**RS-232 Custom Protocol In and Out**



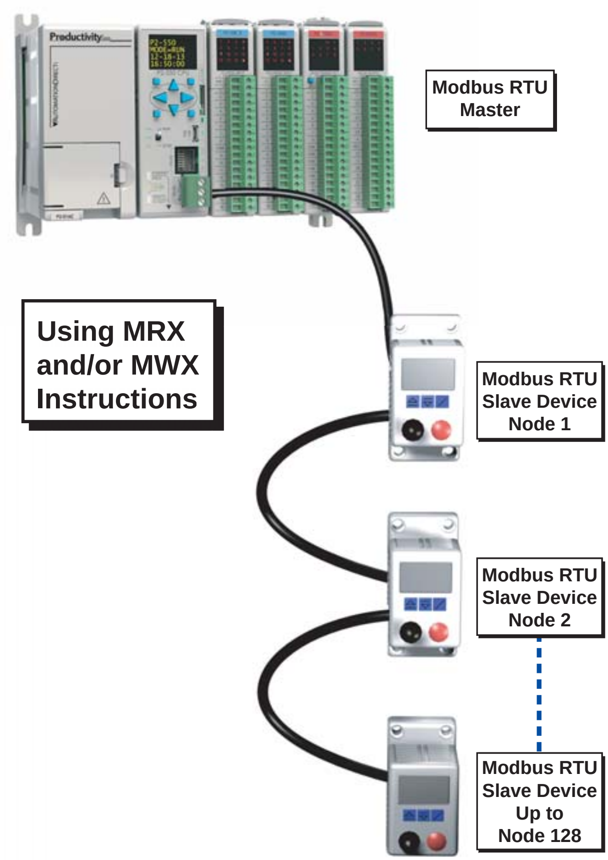
## P2-550 Communication Ports, cont'd

4. RS-485: The RS-485 port is a 3-pin removable terminal block. The RS-485 port can be used for:
   - Modbus RTU Master connections.
   - Modbus RTU Slave connections.
   - ASCII Incoming and Outgoing communications.
   - Custom Protocol Incoming and Outgoing communications.

   Modbus RTU Master connections: The RS-485 network port is used for multi-node networks. The CPU can connect to 128 Modbus RTU slave devices on a network. This is accomplished by using the communications instructions in the ladder project (MRX, MWX, RX, WX). See Communications Connectivity section for more information.

### RS-485 Modbus RTU Master Network Topology

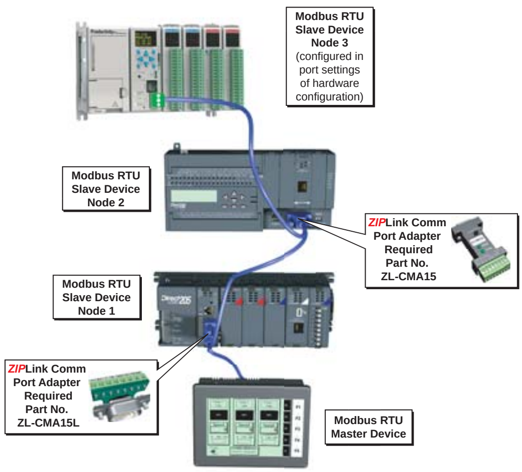
6



## P2-550 Communication Ports, cont'd

The Modbus RTU Slave connections: The RS-485 network port is used for multi-node networks. The port is addressable in the Hardware Configuration in the Productivity Suite programming software. If the port is set to Modbus RTU and there are no communications instructions (MRX, MWX, RX, WX) in the project, the CPU will automatically respond to Modbus requests from a Modbus master. See Communications Connectivity section for more information.

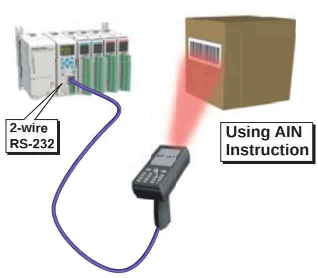
### RS-485 Modbus RTU Slave Network Topology



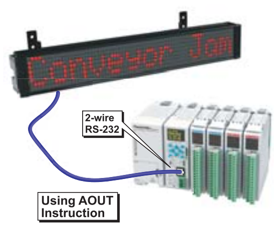

***Note:*** *See respective PLC Manual for communication port cable pinouts.*

ASCII Incoming and Outgoing communications: The RS-485 port can be used for sending and receiving non-sequenced String data. If long distances are required between the ASCII device and the CPU, the RS-485 port is the better selection because of its increased distance support (1,000 meters). ASCII communications are typically used for receiving bar code strings from a scanner or sending statistical data to a terminal or serial printer using the ASCII IN and ASCII OUT instructions. See Communications Connectivity section for more information.

### RS-232 ASCII In Communication




### RS-232 ASCII In Communication



## P2-550 Communication Ports, cont'd

5. External Ethernet: The Ethernet port is 10/100Base-T Ethernet with an RJ-45 style connector. It is used for:
   - Connection to a PC running the Productivity Suite programming software.
   - Modbus TCP Client connections (Modbus requests sent from the CPU).
   - Modbus TCP Server connections (Modbus requests received by the CPU).
   - EtherNet/IP Scanner (32 Adaptors)
   - EtherNet/IP Adapter (4 scanners) with 8 connections per device.
   - Outgoing Email.

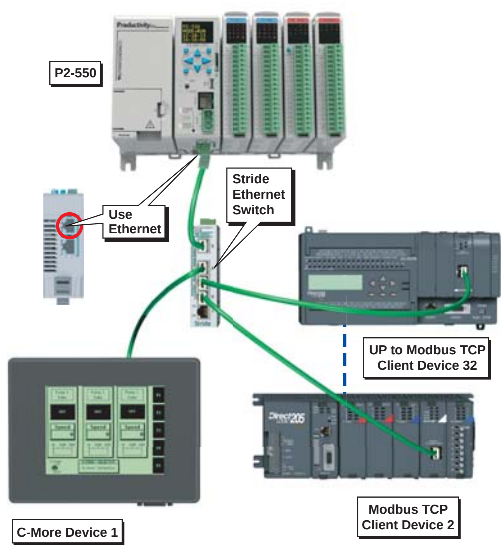
   Modbus TCP Client connections: The CPU can connect to 16 Modbus TCP server devices concurrently by means of communications instructions in the ladder program (MRX, MWX, RX, WX). It is possible to connect to more than 16 Modbus TCP server devices, but not concurrently.



   This is accomplished by having communications instructions for more than 16 devices in the ladder program and controlling the enabling and disabling of the instructions so that only 16 devices are enabled at a given time. To connect to non Productivity2000 devices, use the MRX (Modbus Read) and MWX (Modbus Write) instructions.

   The greatest difference in the RX versus the MRX is that with the RX, the Tag Name in the target CPU can be referenced directly and does not need a corresponding Modbus address. The way this is accomplished is by mapping local and remote tagnames together within the local CPU's RX instruction. Once the instruction is set up to read a remote project, the "Tags of Remote Project" or "Array Tags of Remote Project" drop down lists will be accessible. Map the Tag of the Remote project to a Tag in the Local project to read this data.

**Modbus TCP Client (RX-WX)**




   Modbus TCP Server connections: The CPU can serve data back to 16 Modbus TCP Client devices concurrently. If 16 Modbus TCP Client devices are connected to the CPU, then any new TCP connection requests will be denied until one of the existing 16 devices drops its connection. If the Client device connecting to the CPU is not a Productivity2000 device, then a Modbus address must be assigned to the tag that is being requested. This is done in the Tag Database window. If the device connecting to the CPU is another P2000 CPU or C-more panel, no Modbus address is required.

## P2-550 Communication Ports, cont'd

See Communications Port Configuration for port configuration, Communications Connectivity for connection information and Communications Ethernet for Ethernet set up.

6. Local Ethernet: This RJ45 Ethernet Port supports remote I/O. Located on the underside of the CPU, it is the rear port. The Remote I/O Out port is only used for connections to 16 GS Series Drives. Remote I/O is treated as local I/O by the CPU and is completely scan-synchronous. The I/O is automatically detected on power up.

7. GS Drive Devices: The P2-550 CPU can connect to 16 GS-EDRV100 Modules. The P2-550 will auto detect all GS-EDRV100 modules that have a unique address (configured by the bank of dipswitches on the module). The configuration can be managed in the Hardware Configuration in the Productivity Suite programming software. See Communications Remote I/O and GS Drives for configuration information and Communications Connectivity for connection information.

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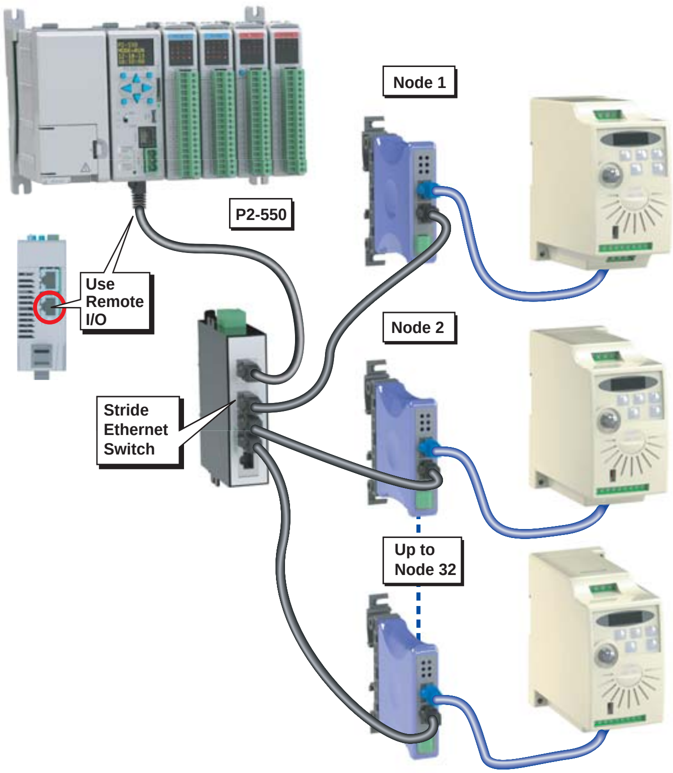
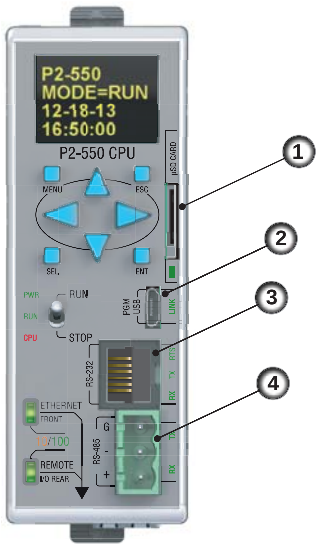
**Remote GS1 (GS-EDRV100)**



# Communications: Connectivity




## P2-550 Port Connections

The AutomationDirect Procuctivity2000 P2-550 CPU is provided with six communications ports. The Connectivity for each of these ports is described in the following sections. The Communication Ports available are:

### 1. Micro SD Card Slot

For program transfer and data logging. (Micro SD card not included with processor).

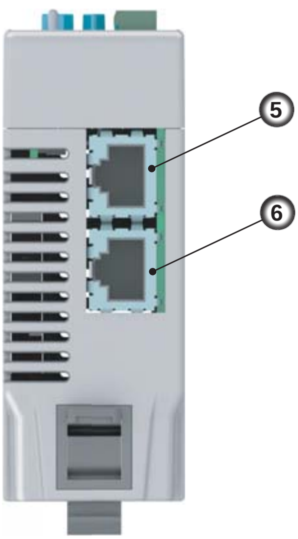
### 2. Micro USB Port

Programming port with a USB 2.0 Type Micro B female connector. This port requires a Micro USB Type A-Micro B cable (such as the USB-CBL-AMICB6 cable).

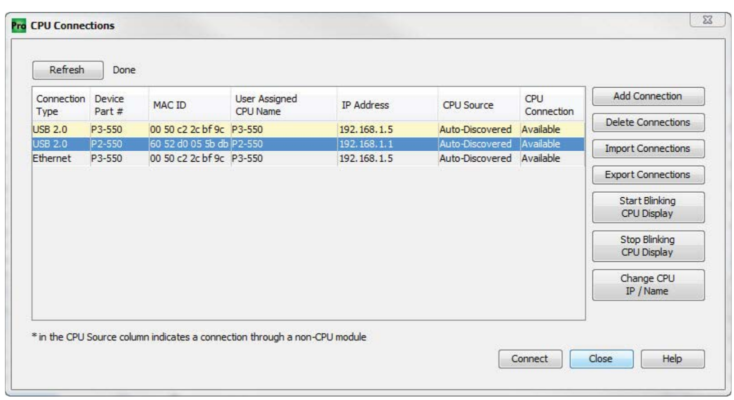
The Micro USB Port is the simplest method of connecting the Productivity Suite Programming Software to the P2-550 CPU. After the programming software has been installed, connect a USB A-Micro-B cable to the CPU and select the "Choose CPU" option. The dialog shown below will appear.

Highlight the CPU listed in the dialog box and click on "Connect". No configuration is required.

***Note:*** *The Micro USB port is NOT compatible with older 1.0/1.1 full speed USB devices.*




P2-550 Bottom View

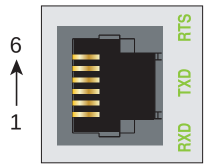


## 3. RS-232 Port:

Serial RS-232 multipurpose communications port with RJ12 connector.

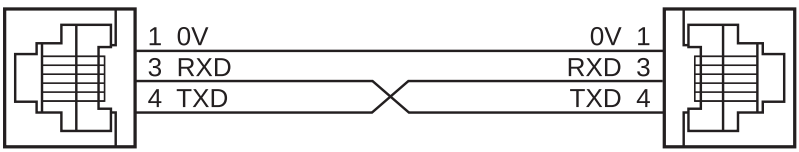
The RS-232 Port can be connected to Modbus RTU master or slave devices, as well as devices that output non-sequenced ASCII strings or characters. The manner in which these devices are wired to the CPU depends whether the device is considered to be Data Terminal Equipment (DTE) or Data Communications Equipment (DCE).

If two DTE devices are connected together, the RX and TX signals should cross or the RX of one device should go to the TX of the other device and the TX of one device should go to the RX of the other device (as shown below).




6-pin RJ12 Female Modular Connector

| Pin # | Signal | |
|---|---|---|
| 6 | GND | Logic Ground |
| 5 | RTS | RS-232 Output |
| 4 | TXD | RS-232 Output |
| 3 | RXD | RS-232 Input |
| 2 | +5V | 210mA Maximum |
| 1 | GND | Logic Ground |




The CPU is considered a DTE device. Most Modbus or ASCII devices being connected to the CPU will also be considered a DTE device and will need to swap TX and RX, but you should always consult the documentation of that device to verify. If a communication device, such as a Modem, is placed between the CPU and another Modbus or ASCII device it will most likely require connecting the signals straight across (TX to TX and RX to RX). Again, this can differ from manufacturer to manufacturer so always consult the documentation before wiring the devices together.

The RTS signal on pin 5 of the RS-232 Port will turn on when the TX signal is turned on and the RTS signal will turn off when the TX signal turns off. The amount of time that the RTS signal turns on before the TX signal turns on and the amount of time that the RTS signal waits before turning off after the TX signal turns off is adjustable in the P2-550 CPU Module Configuration for the RS-232 Port. The RTS signal is very often required for media converters, such as a RS-232 to RS-422/485 converter (much like the FA-ISOCON).

The RTS signal is sometimes required for use with radio modems as well (Key on and off control).

There is also +5VDC @ 210mA on pin 2 available for powering an external device such as the C-more Micro panel.

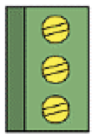
## 4. RS-485 Port

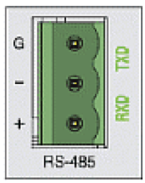
The RS-485 multipurpose serial communications port requires a removable 3-pin connector (See below). This port is useful for connecting multiple Modbus and ASCII devices on one network and/or connecting devices to the CPU at distances greater than 50 feet (RS-232 limit). The RS-485 standard supports distances of up to 1000 meters without requiring a repeater. The RS-485 Port on the CPU can support up to 50 devices, depending on each device's load (this assumes a 19K Ohm load for each device). This number can be increased by placing an RS-485 repeater on the network, if necessary.

This port only supports RS-485 2-wire connections. For 4-wire RS-485 or RS-422, a converter, such as an FA-ISOCON, should be used with the RS-232 Port.

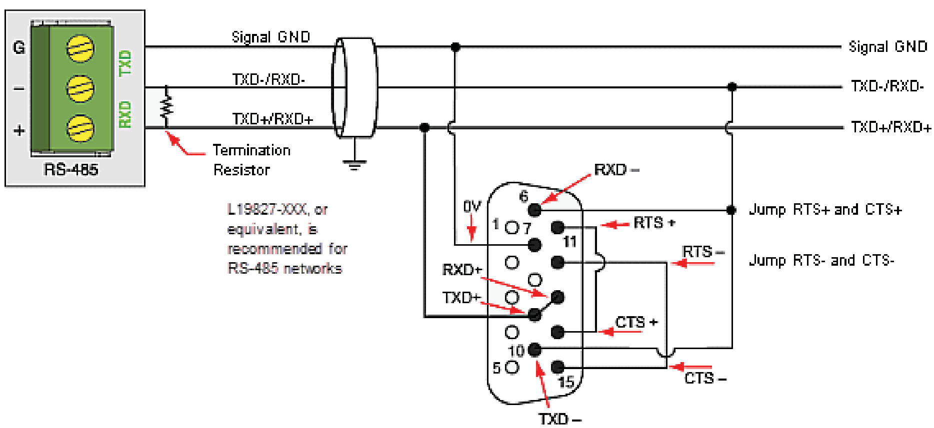


***Note:*** *A 120 Ohm resistor is required at each end of the network for termination.*






| Pin # | Signal |
|---|---|
| G | GND |
| – | TXD-/RXD- |
| + | TXD+/RXD+ |

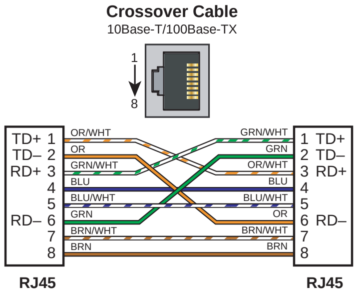


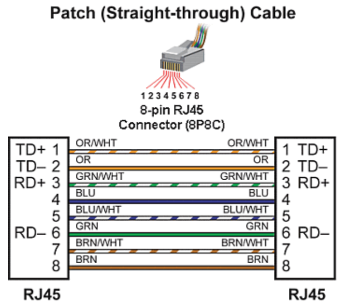

**DL06 CPU Port 2**

***Note: ZIP****Link Comm Port Adaptor Part No. ZL-CMA15 or ZL-CMA15L may be used to make the connection at DL06 or DL205 CPU Port 2.*

## 5. External Ethernet Port

The 10/100 Base-T Ethernet port with RJ45 connector is used for programming and Modbus TCP Client/Server functions.






### General Information

Crossover cables can be used to directly connect two endpoint Ethernet devices such as a PC network interface card and the CPU. Crossover or patch (or Straight-through) cables can be used to directly connect endpoint Ethernet devices and the CPU.

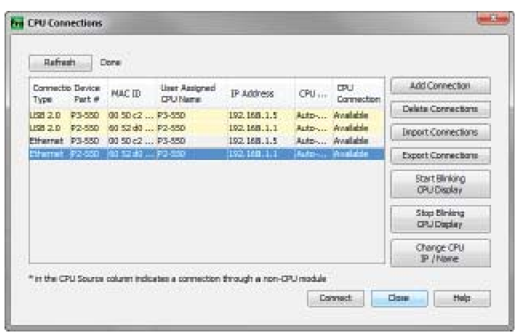
The maximum distance for one cable or segment is 100 meters (328 feet). If the distance required between 2 devices is greater than 100 meters, add an Ethernet switch to extend the distance. An Ethernet switch can be added every 100 meters (or less) almost indefinitely. Each Ethernet switch added will incur some latency (actual amount differs between switches and manufacturers). So if a very long distance is needed between 2 Ethernet devices, it may be better to convert to fiber optics.

The External Ethernet Port can be used as a programming port, a Modbus TCP Client port (32 Servers), a Modbus TCP Server port (16 Clients), or as EtherNet/IP Scanner (32 Adaptors) and Adaptor (4 scanners) with 8 connections per device.

The External Ethernet Port can also be used to send emails using the EMAIL instruction.

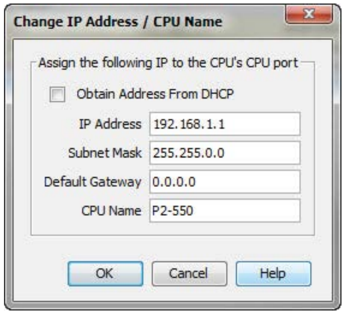
### Create a Connection

To communicate with the Productivity Suite programming software, connect an Ethernet cable from the PC to the CPU External Ethernet Port. Once the software has been opened, click on CPU and select the “Choose CPU” option. The dialog shown below will appear.



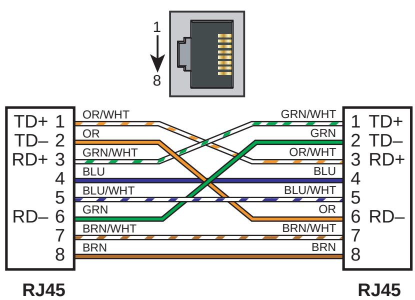
## 5. External Ethernet Port, cont'd

Highlight the CPU that you wish to connect to and press the "Connect" button. You may see in the CPU Connections dialog box CPU's that are not on the same subnet as your PC, but this does not mean you can connect to them. To connect to the CPU, you must configure either your PC or your CPU to be in the same subnet. You can easily change the Ethernet settings of the CPU by highlighting it and selecting the "Change CPU IP/Name" button (shown below). Or if you prefer, the PC Setup section of this chapter contains information on configuring the Ethernet settings of your PC.

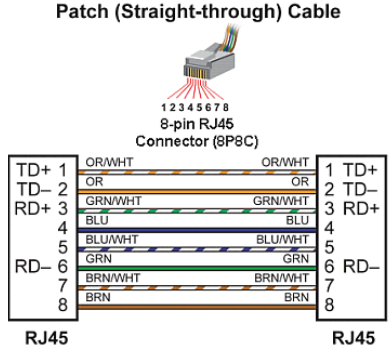



**Crossover Cable**

10Base-T/100Base-TX




**Patch (Straight-through) Cable**




## 6. Local Ethernet Port

Local Ethernet RJ45 connector supports communication with GS-EDRV100 Drive units. Crossover or patch (or Straight-through) cables can be used to directly connect endpoint Ethernet devices and the CPU.

The maximum distance for one cable or segment is 100 meters (328 feet). If the distance required between 2 devices is greater than 100 meters, add an Ethernet switch to extend the distance. An Ethernet switch can be added every 100 meters (or less) almost indefinitely. Each Ethernet switch added will incur some latency (actual amount differs between switches and manufacturers). So if a very long distance is needed between 2 Ethernet devices, it may be better to convert to a fiber optic system.

The Local Ethernet Port is used to communicate to the GS Drives with a GS-EDRV100 Ethernet module. It is highly recommended that the network attached to this port be isolated from other networks and it is imparitive that it be isolated from other Remote I/O networks. See GS Drives topic in this manual for details.

## ASCII and Custom Protocol Functionality

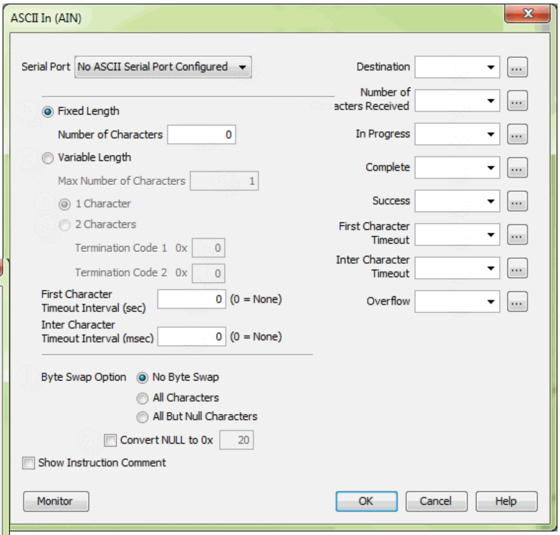
Besides Modbus RTU, there are two additional functions supported on the serial ports in the Productivity2000 system.

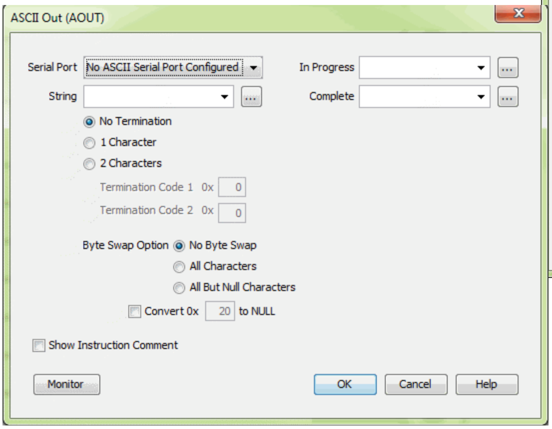
- The first function is the ability to send and receive text-based data with devices such as bar code readers and serial printers.
- The second function is the ability to communicate serially with other devices that do not support the Modbus protocol and lack a Productivity2000 driver.

## ASCII Instructions

The ASCII In/Out instructions use the String data type to send or recieve text-based data through the serial port. The String data type is only intended for use with the “printable character set”. This can include numbers, letters or special characters.

With the *ASCII In* instruction, the CPU can receive a fixed length of characters or a variable length of characters with a termination code (an ‘end of message’ character).




The *ASCII Out* instruction sends text-based data out of the serial port to various devices for control, printing or display.

## ASCII and Custom Protocol Functionality, cont'd

While the ASCII In instruction and the ASCII Out instruction can both be used in a project, they are not intended to be used in conjunction with one another. In other words, it is not advisable to use the ASCII Out instruction to send a String to a device that will respond (if the response is needed) and to use the ASCII In instruction to try to receive this data.

The ASCII instruction limitations are:

1. AIN and AOUT cannot be enabled at the same time on the same serial port.
2. When the AOUT completes, the AIN cannot be enabled until the next logic scan.
3. AIN does not buffer data received while the AIN is not active. If a device responds too quickly, some of the response may be lost before the AIN instruction can start receiving data.



## Custom Protocol Instructions

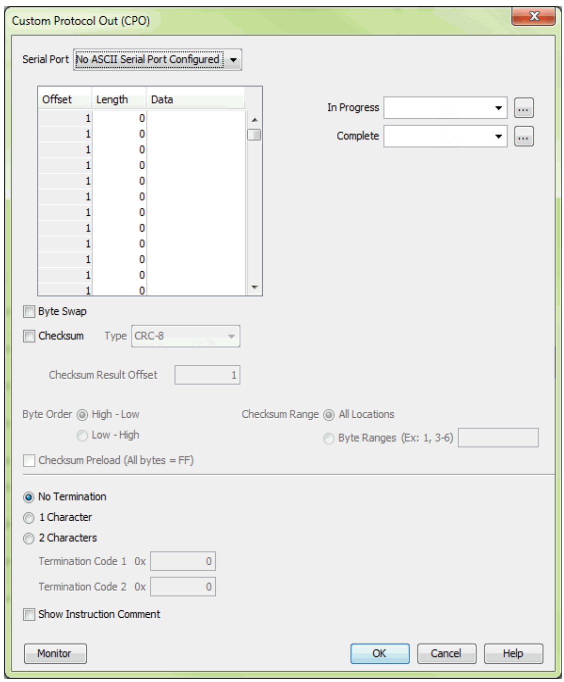
The Custom Protocol is a HEX based protocol used to communicate with devices that do not have the standard Modbus RTU Protocol. There are two instructions used with Custom Protocol communication:

- Custom Protocol Out (CPO)
- Custom Protocol In (CPI)

### Custom Protocol Out

The Custom Protocol Out instruction allows the user to send a 'byte formatted' packet of data out of the CPU serial port.

Constant values and/or Tag values can be used as the source for data transmitted. There are several formatting options including Byte Swap and Checksum.



## ASCII and Custom Protocol Functionality, cont'd

The Checksum option allows the user to select where in the packet the checksum should be inserted, what type of Checksum (CRC-8 bit, CRC-16 bit, CRC-32 bit, XOR-8 bit, XOR-16 bit and XOR 32 bit), which bytes of the data source should be used in the calculation of the checksum, what the byte order should be of the checksum (if greater than 8 bit) and how to preload the checksum calculation.

If the device requires a different Checksum calculation, this can be done outside of the instruction in other ladder code and the resulting Tag values can be inserted where appropriate in the packet.

Termination characters can also be specified when needed.

The Custom Protocol Out instruction is for transmission only. If information needs to be received from field devices, the Custom Protocol In instruction will have to be used. Unlike ASCII, the Custom Protocol will buffer the received data. When the Custom Protocol In instruction is executed, it will retrieve any data held in this buffer. Therefore, the lost responses found with ASCII communication do not occur with Custom Protocol communication.

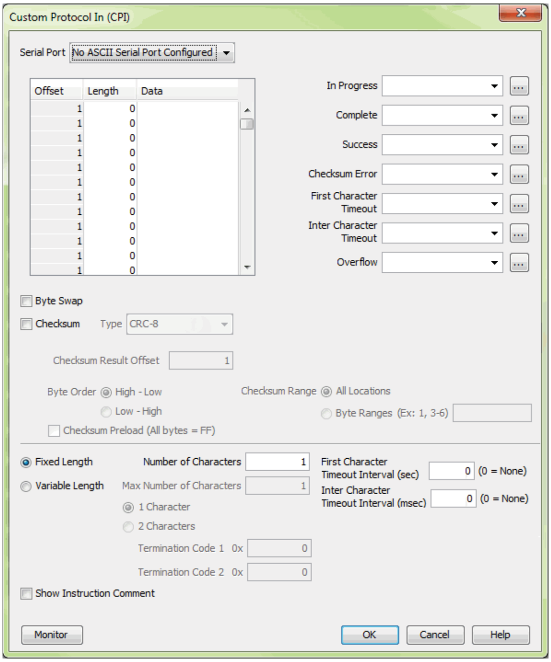


### Custom Protocol In

The Custom Protocol In instruction has similar formatting options to the Custom Protocol Out instruction.

The Custom Protocol In instruction will calculate the Checksum of the data packet received based on the criteria specified in the instruction and this will determine the state of the status bits assigned to the instruction. If the Checksum calculation passes based on the criteria specified in the instruction, the "Success" status bit will become true. If the Checksum calculation fails, the "Checksum Error" status bit will become true.

With the CPI instruction, the packet termination must be specified, either in terms of a termination character(s) or a packet length. If a Checksum is expected in the reply, be sure to include this in the Fixed Length value specified.



# Communications: Ethernet

## TCP and UDP Port Numbers

When doing TCP/IP and UDP/IP communications, there is a Source Port number and Destination Port number for every message. The Client device must be aware of the Destination Port Number(s) the Server device is expecting to see and the Server device must listen for this Destination Port number. After the Server device has received the message with the Destination Port Number it is listening on, it will formulate the return message (if the applications require this) with the Source Port Number from the message sent as its Destination Port Number.

It is important to understand a little about the Port numbering concept because many Ethernet devices, such as routers with firewalls, will block messages with Destination Port numbers that are not configured for that device. Listed below are the default Port Numbers used in the Productivity2000 system. Some of these are configurable, allowing more flexibility when going through routers in many applications.



| Port | Port Number (Decimal Format) | TCP or UDP | Configurable |
|---|---|---|---|
| Programming Software CPU Discovery | 8888 | UDP | No |
| Programming Software Connection and Project Transfer | 9999 | UDP | No |
| Modbus Client Connections (MRX, MWX, RX and WX instructions) | 502 | TCP | Yes |
| Modbus Server Connections | 502 | TCP | Yes |
| GS-Drive Discovery | 28784 | UDP | No |
| GS-Drive Connection | 502 | TCP | No |
| Email Instruction | 25 | TCP | No |
| EtherNet/IP | 44818 | TCP | Yes |
| EtherNet/IP | 2222 | UDP | No* |

***** *Adapters may choose to respond using another port number.***

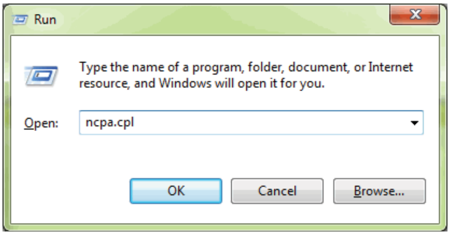
## IP Addressing and Subnetting

IP Addresses (used in conjunction with the Subnet Mask and Default Gateway address) are used for network routing. This allows for easy and logical separation of networks.

It is outside of the scope of this user manual to explain how IP Addresses and Subnet masks are configured for actual usage. There are many books, documents and tools (Subnet calculators) on the internet that provide this information. Each facility and network will incorporate their own rules and guidelines for how their networks are to be configured.

## PC Setup

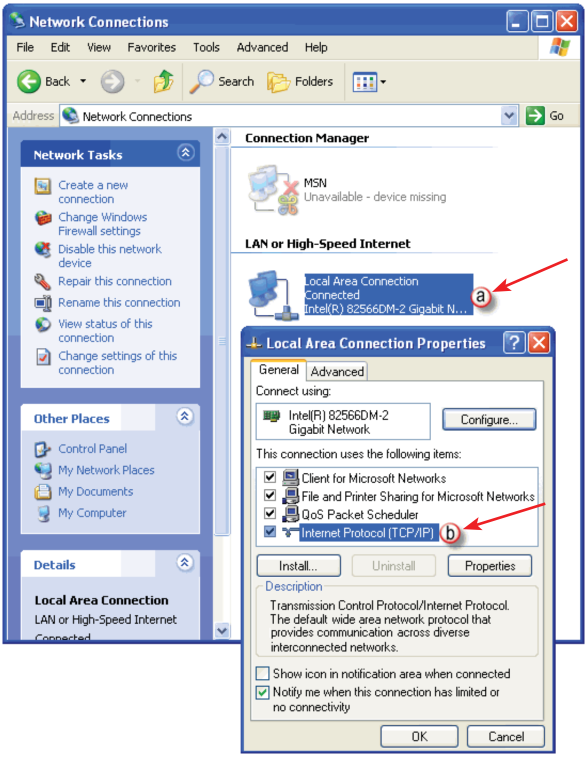
For testing and verification purpose, it is recommended that the PC and the CPU be on an isolated Ethernet switch. Configure the PC's network interface card setting as described below.




1. Go to Start, then Run, type ncpa.cpl in the Open field and click on OK to bring up the Network Connections dialog.

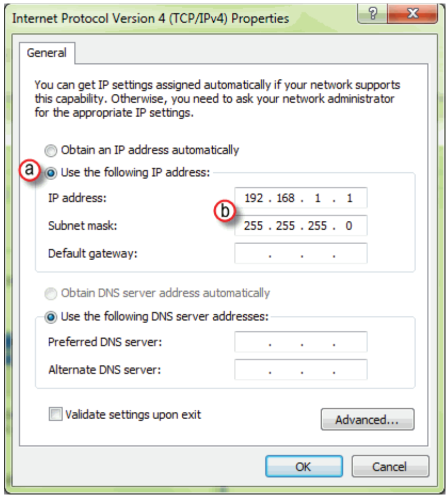
***Note:** Many system settings on your computer require Administrative privileges. Consult with your IT department for necessary privileges and approvals.*

***Note:** You should record initial settings prior to making any network configuration changes.*




2. Network Connections
   a. Right click on the Network interface shown in the Network Connections dialog and select Properties. If there is more than one Network Interface on the PC, be sure to choose the one connected to the Ethernet Switch with the CPU on it.
   b. From the Local Area Connection Properties window, highlight the Internet Protocol(TCP/IP) selection and click on Properties.

## PC Setup, cont'd

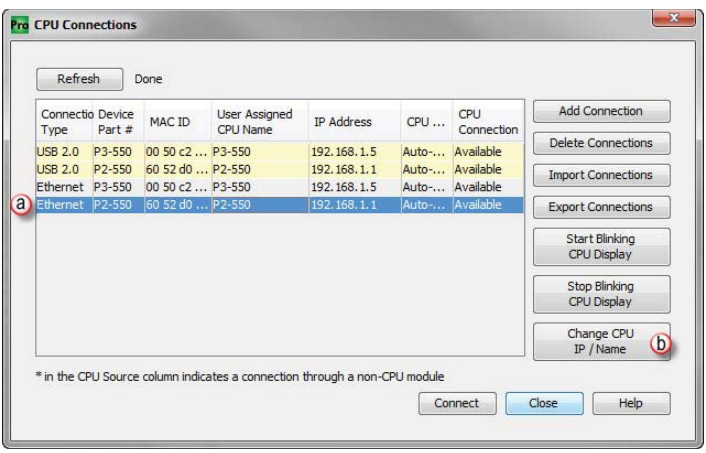



3. Internet Protocol (TCP/IP) Properties.
   a. In the Properties window, select Use the following IP address.
   b. Enter an IP Address of 192.168.1.1 and Subnet Mask 255.255.255.0 and select OK. Select OK again on the Local Area Connection Properties window.

## CPU Setup

Now configure the CPU's network IP setting as shown below.

1. Select CPU from the Productivity Suite Software Main Menu and then select Choose CPU from the drop down menu.
2. The CPU Connections window will open as shown below.

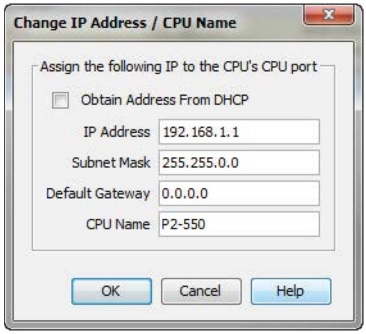


## CPU Setup, cont’d

a. Click to highlight the CPU connected to the Ethernet switch.

b. Select the “Change CPU IP/Name” button.

3. The Change IP Address/CPU Name window will open as shown below.




- Enter an IP Address of 192.168.1.2 and Subnet Mask 255.255.0.0 for the CPU’s network IP setting and select OK.

The CPU is now configured with the correct IP Address for connectivity with the PC. The IP Address and Subnet Mask settings will very likely differ from what will be used in the actual application. Consult the Network Administrator of the facility where the CPU will be installed to get the appropriate settings for that network.

## TCP Connection Behavior with Modbus TCP and Network Instructions

When performing communications over TCP, a Connection must be established before the applications can transfer data. The connection is typically maintained until the application decides that the connection is no longer needed and then the connection will be severed. Frequent connects and disconnects are not efficient for the Client or the Server and can add unnecessary network traffic. But maintaining connections needlessly is also costly to the Client and Server in terms of processing and memory so this should also be avoided.

The CPU allows user control of Client connections through enabling and disabling the rungs containing Modbus and Network instructions. The MRX, MWX, RX and WX instructions have two options for sending messages: Automatic Poll and Manual Poll.

Automatic Poll sends out messages at a specified rate. When enabled, the instruction performs a TCP connect with the Server device. Once the connection is established, the instruction messages are sent at the rate entered in the poll rate field. This continues until the instruction is disabled. The TCP connection will automatically be severed five seconds after the instruction is disabled.

Manual Poll sends out a message each time the instruction is enabled. Enabling the instruction performs a TCP connect with the Server device and sends the message one time. The TCP connection will automatically be severed five seconds after receiving the reply from the Server device. If the instruction gets another positive edge enable within the five seconds, the message will be sent and the disconnect of the TCP connection will be delayed by an additional five seconds.

# Communications Modbus Functionality

## Master/Client Function Code and Data Type Support

The following table lists the Modbus data type, the function code and the CPU source data type that is supported when the CPU is the Client or Master on a Modbus TCP or serial connection.

| Modbus Client/Master Support (Using MRX and MWX Instructions) | | | | |
|---|---|---|---|---|
| Function Code | Function Name | Modbus 984 Addressing (Zero Based) | Modbus 984 Addressing | Productivity2000 Tag Types (Data designation or source) |
| 01 | Read Coil Status | 000000 - 065535 | 000001 - 065536 | Discrete Output (DO) |
| | | | | Boolean (C ) |
| | | | | Boolean System (SBRW) |
| 02 | Read Coil Status | 100000 - 165535 | 100001 - 165536 | Discrete Input (DI) |
| | | | | Boolean (C ) |
| | | | | Boolean System (SBRW) |
| 03 | Read Holding Registers | 400000 - 465535 | 400001 - 465536 | Integer 8 bit Unsigned (U8) |
| | | | | Integer 16 bit (S16) |
| | | | | Integer 16 bit Unsigned (U16) |
| | | | | Integer 16 bit BCD (B16) |
| | | | | Integer 32 bit (S32) |
| | | | | Integer 32 bit BCD (B32) |
| | | | | Integer 32 bit Float (F32) |
| | | | | Integer 16 bit System (SWRW) |
| 04 | Read Input Registers | 300000 - 365535 | 300001 -365536 | Integer 8 bit Unsigned (U8) |
| | | | | Integer 16 bit (S16) |
| | | | | Integer 16 bit Unsigned (U16) |
| | | | | Integer 16 bit BCD (B16) |
| | | | | Integer 32 bit (S32) |
| | | | | Integer 32 bit BCD (B32) |
| | | | | Integer 32 bit Float (F32) |
| | | | | Integer 16 bit System (SWRW) |
| 05 | Write Single Coil | 000000 - 065535 | 000001 - 065536 | Discrete Input (DI) |
| | | | | Discrete Output (DO) |
| | | | | Boolean (C ) |
| | | | | Boolean System (SBRW) |
| | | | | Boolean System Read Only (SBR) |

| Modbus Client/Master Support (Using MRX and MWX Instructions) (continued) | | | | |
|---|---|---|---|---|
| Function Code | Function Name | Modbus 984 Addressing (Zero Based) | Modbus 984 Addressing | Productivity2000 Tag Types (Data designation or source) |
| 06 | Write Single Register | 400000 - 465535 | 400001 - 465536 | Integer 8 bit Unsigned (U8) |
| | | | | Integer 16 bit (S16) |
| | | | | Integer 16 bit Unsigned (U16) |
| | | | | Integer 16 bit BCD (B16) |
| | | | | Integer 32 bit (S32) |
| | | | | Integer 32 bit BCD (B32) |
| | | | | Integer 32 bit Float (F32) |
| | | | | Integer 16 bit System (SWRW) |
| | | | | Integer 16 bit System Read Only (SWR) |
| 15 | Write Multiple Coils | 000000 - 065535 | 000001 - 065536 | Discrete Input (DI) |
| | | | | Discrete Output (DO) |
| | | | | Boolean (C ) |
| | | | | Boolean System (SBRW) |
| | | | | Boolean System Read Only (SBR) |
| 16 | Write Multiple Registers | 400000 - 465535 | 400001 - 465536 | Integer 8 bit Unsigned (U8) |
| | | | | Integer 16 bit (S16) |
| | | | | Integer 16 bit Unsigned (U16) |
| | | | | Integer 16 bit BCD (B16) |
| | | | | Integer 32 bit (S32) |
| | | | | Integer 32 bit BCD (B32) |
| | | | | Integer 32 bit Float (F32) |
| | | | | Integer 16 bit System (SWRW) |
| | | | | Integer 16 bit System Read Only (SWR) |

## Slave/Server Function Code and Data Type Support

The following table lists the Modbus data type, the function code and the CPU source data type that is supported when the CPU is the Server or Slave on a Modbus TCP or serial connection.

| Modbus Server/Slave Support | | | |
|---|---|---|---|
| **Function Code** | **Function Name** | **Modbus 984 Addressing** | **Productivity2000 Tag Types (Data designation or source)** |
| 01 | Read Coil Status | 000001 - 065536 | Discrete Output (DO) |
| | | | Boolean (C ) |
| | | | Boolean System (SBRW) |
| 02 | Read Coil Status | 100001 - 165536 | Discrete Input (DI) |
| | | | Boolean System Read Only (SBR) |
| 03 | Read Holding Registers | 400001 - 465536 | Integer 8 bit Unsigned (U8) |
| | | | Integer 16 bit (S16) |
| | | | Integer 16 bit Unsigned (U16) |
| | | | Integer 16 bit BCD (B16) |
| | | | Integer 32 bit (S32) |
| | | | Integer 32 bit BCD (B32) |
| | | | Integer 32 bit Float (F32) |
| | | | Integer 16 bit System (SWRW) |
| | | | String |
| 04 | Read Input Registers | 300001 -365536 | Analog Input, Integer 32 bit (AIS32) |
| | | | Analog Input, Float 32 bit (AIF32) |
| | | | Integer 16 bit System Read Only (SWR) |
| 05 | Write Single Coil | 000001 - 065536 | Discrete Output (DO) |
| | | | Boolean (C) |
| | | | Boolean System (SBRW) |
| 06 | Write Single Register | 400001 - 465536 | Integer 8 bit Unsigned (U8) |
| | | | Integer 16 bit (S16) |
| | | | Integer 16 bit Unsigned (U16) |
| | | | Integer 16 bit BCD (B16) |
| | | | Integer 32 bit (S32) |
| | | | Integer 32 bit BCD (B32) |
| | | | Integer 32 bit Float (F32) |
| | | | Integer 16 bit System (SWRW) |
| | | | Integer 16 bit System Read Only (SBR) |
| | | | String |
| 15 | Write Multiple Coils | 000001 - 065536 | Discrete Output (DO) |
| | | | Boolean (C ) |
| | | | Boolean System (SBRW) |

| Modbus Server/Slave Support (continued) | | | |
|---|---|---|---|
| **Function Code** | **Function Name** | **Modbus 984 Addressing** | **Productivity2000 Tag Types (Data designation or source)** |
| 16 | Write Multiple Registers | 400001 - 465536 | Integer 8 bit Unsigned (U8) |
| | | | Integer 16 bit (S16) |
| | | | Integer 16 bit Unsigned (U16) |
| | | | Integer 16 bit BCD (B16) |
| | | | Integer 32 bit (S32) |
| | | | Integer 32 bit BCD (B32) |
| | | | Integer 32 bit Float (F32) |
| | | | Integer 16 bit System (SWRW) |
| | | | Integer 16 bit System Read Only (SBR) |
| | | | String |



## Assigning Modbus Addresses to Tags

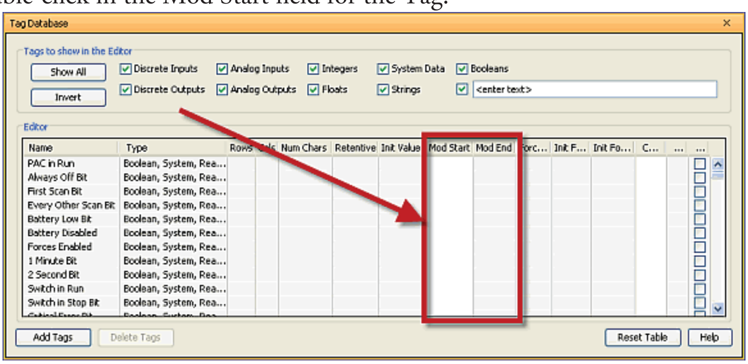
There are many different data types in the CPU. Because of this, the Modbus addresses need to be mapped to the various tag data types in the CPU.

There are two ways to map Modbus addresses to Tags in the Programming software:

- Modbus mapping in Tag Database window.
- Modbus mapping when creating Tags.

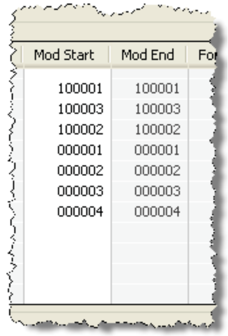
1. Modbus mapping in Tag Database window:

    - There are only two data sizes in the Modbus protocol: bits and words. In the CPU, there are multiple size types, so it is sometimes necessary to map multiple Modbus addresses to a single Tag entity. There are also array data structures in the CPU. When Modbus addresses are mapped to arrays, they will be mapped as a contiguous block of addresses. This is, in fact, the most efficient method to handle Modbus communications.
    - In the Tag Database window, there are two columns named “Mod Start” and “Mod End”. To map a Modbus address to a tag in the Tag Database window, simply double-click in the Mod Start field for the Tag.



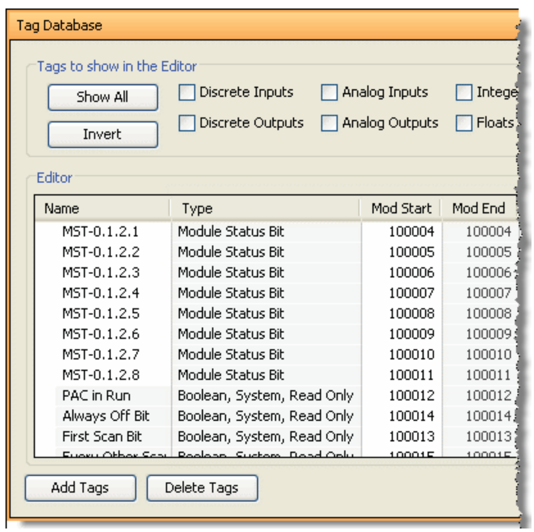
## Assigning Modbus Addresses, cont'd

- When this is done, two values will appear in the field The left most value is the Modbus data type. This is fixed based upon the tag data type. The chart below indicates the four different Modbus data types in the 984 addressing scheme.




| Address Identifier | Modbus 984 Address Type |
|---|---|
| 0xxxxx | **Coil (Read/Write bit)** |
| 1xxxxx | **Input (Read Only bit)** |
| 3xxxxx | **Input Register (Read Only 16 bit word)** |
| 4xxxxx | **Holding Register (Read/Write 16 bit word)** |

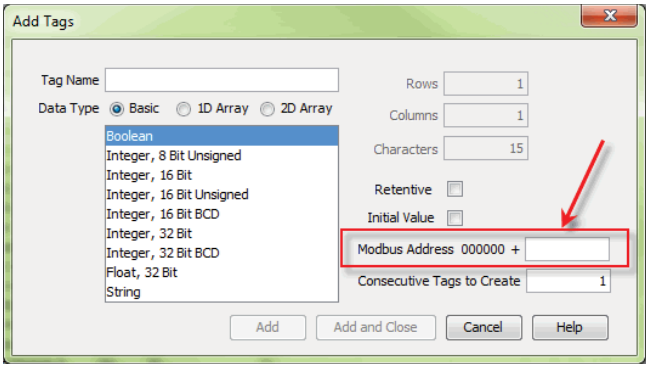
The right most value in the "Mod Start" field is the address offset (range is from 1 – 65535). You can accept the value that is pre-filled or the value can be changed. The software automatically pre-fills the address offset with the next available address.



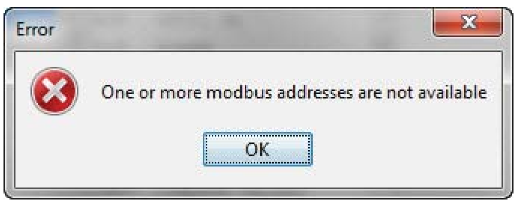
## Assigning Modbus Addresses, cont'd

2. Modbus mapping when creating Tags:

   Modbus addresses can be assigned to Tags as they are created in the Tag Database. Type in the Modbus offset value when entering the Tag Name and Data Type.



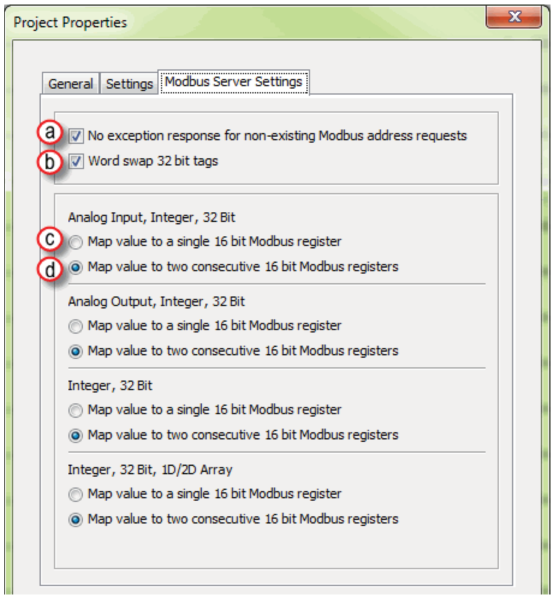

If the address is already assigned, a warning message will appear.



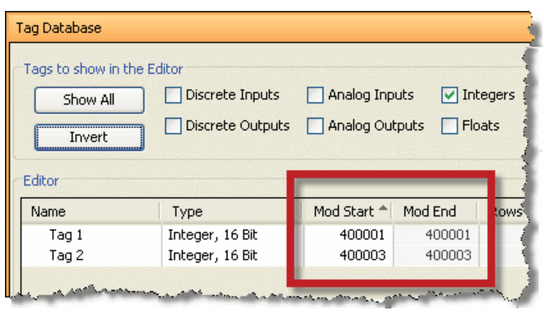
## Modbus Options

The Modbus protocol does not have a specific method outlined for data types outside of bits and 16-bit words. Most systems now have 32-bit data types. In order to transport 32-bit data types across Modbus, they must be placed into two Modbus 16-bit registers. Unfortunately, some devices do not support this method, so sometimes incompatibilities in the order in which the 16-bit high word and low word are handled between devices persist.

In order to alleviate this situation, there are some options for handling this in the programming software. To find the Modbus Address options, go to File and click on Project Properties and then click on the "Modbus Server Settings" tab.

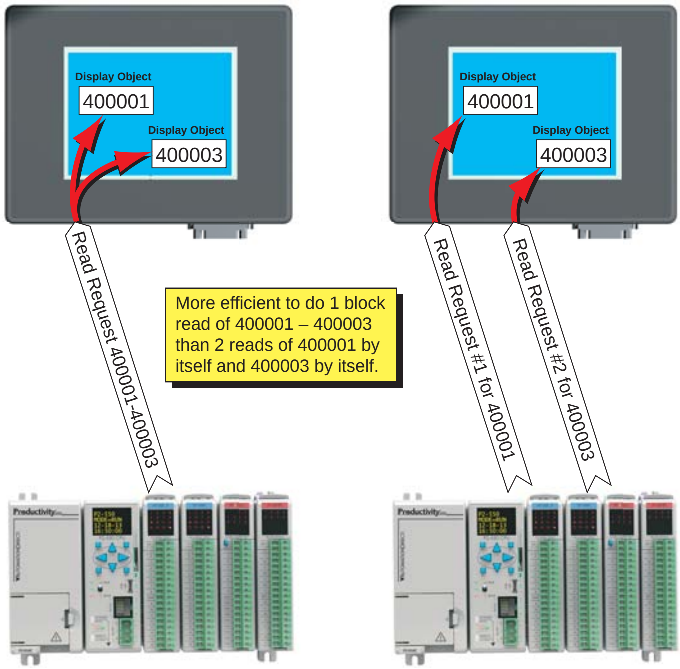



a. **No exception response for non-existing Modbus address requests:** Because the Modbus addresses can be manually assigned to tags, it is possible that gaps can occur in the Modbus address mapping. For example: Tag 1 has Modbus address 400001 assigned to it and Tag 2 has Modbus address 400003 assigned to it.



## Modbus Options, cont'd

Most Modbus Master/Client devices will attempt to optimize their data requests to a Modbus Slave/Server device by requesting blocks of data instead of individual registers. In the case mentioned previously, most Modbus masters would send one read request starting at 400001 and a size of three instead of sending two read requests starting at 400001 with size one and 400003 with size one as shown below.




In the example shown above on left, a Modbus Slave/Server device should give an exception response since there is no Modbus Address of 400002 in the device. This method can cause a lot of inefficiencies. By selecting the "No exception response for non-existing Modbus address requests" option, the CPU will not give an exception response to the request. Note that if Modbus address 400002 by itself were requested it would give an exception response.

**b. Word swap 32 bit tags:** (S-32, AIS-32, AOS-32, F-32, FI-32, FO-32):

Word swap allows the word order of 32-bit tags to be changed when sending the values across Modbus. The default selection is on, which returns the data low word first.

Tag 1 (Integer, 32-Bit) = 305,419,896 (hex = 0x12345678)

Tag1 Modbus address = 400001, 400002

| Low Word First | High Word Last |

Modbus reply for Tag 1 (Word Swap ON ) = 01 03 04 56 78 12 34

| High Word First | Low Word Last |

Modbus reply for Tag 1 (Word Swap OFF) = 01 03 04 12 34 56 78

## Modbus Options, cont'd

c. **Map value to a single 16 bit Modbus register:**

This option allows for compatibility with devices that do not support 32-bit Modbus functionality. This option can be selected individually for the Analog Input and Output Signed 32 data types and the Internal Signed 32 data types, including the array form of these data types. This function is only useful when the value contained in a 32-bit tag does not exceed a signed 15-bit value (32,765).

Tag 1 (Integer, 32-Bit) = 22136 (hex = 0x00005678)

With "Map value to a single 16 bit Modbus register" turned OFF =

Tag 1 Modbus address = 400001, 400002

Modbus reply for Tag1 (Word Swap ON) = 01 03 04 56 78 00 00

With "Map value to a single 16 bit Modbus register" turned ON =

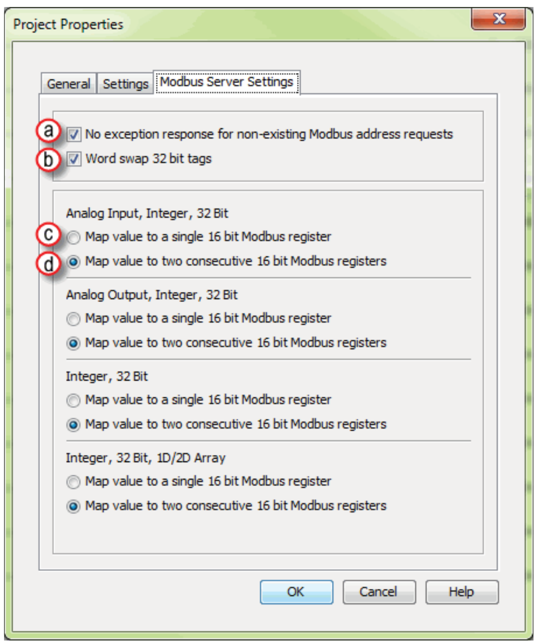
Tag 1 Modbus address = 400001

Modbus reply for Tag1 = 01 03 02 56 78

d. **Map value to two consecutive 16-bit Modbus registers:**

Allows for 32-bit data types to be mapped to two consecutive 16-bit registers. This option is selected as default.

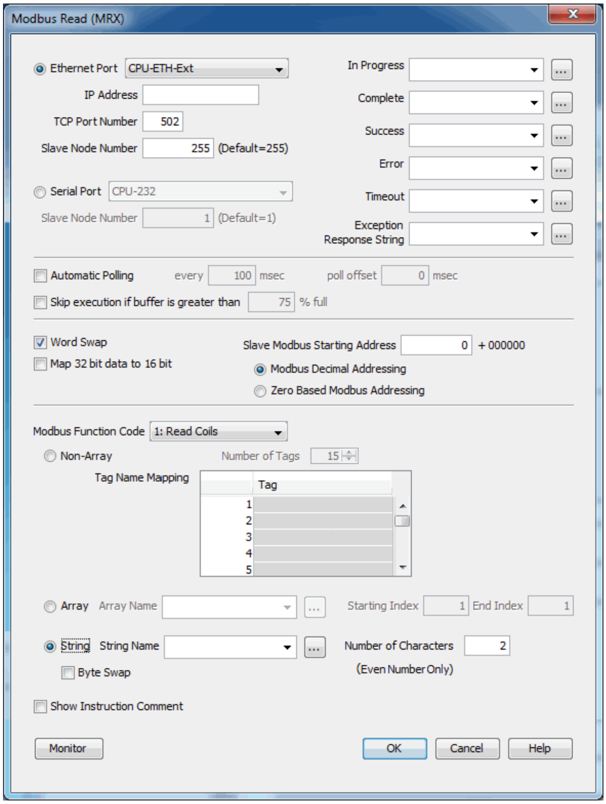
All of the options in the "Modbus Address" tab of the Project Properties only apply to the Modbus Slave/Server functionality. Similar options are available for the Modbus Master/Client functions as well and are available in the MRX and MWX Modbus instructions.



## Modbus Instructions

To read or set data in other Modbus Slave/Server devices, there are two instructions available in the programming software, Modbus Read and Modbus Write.

- The Modbus Read (MRX) instruction is used to read data from other Modbus devices into Tags of the CPU.

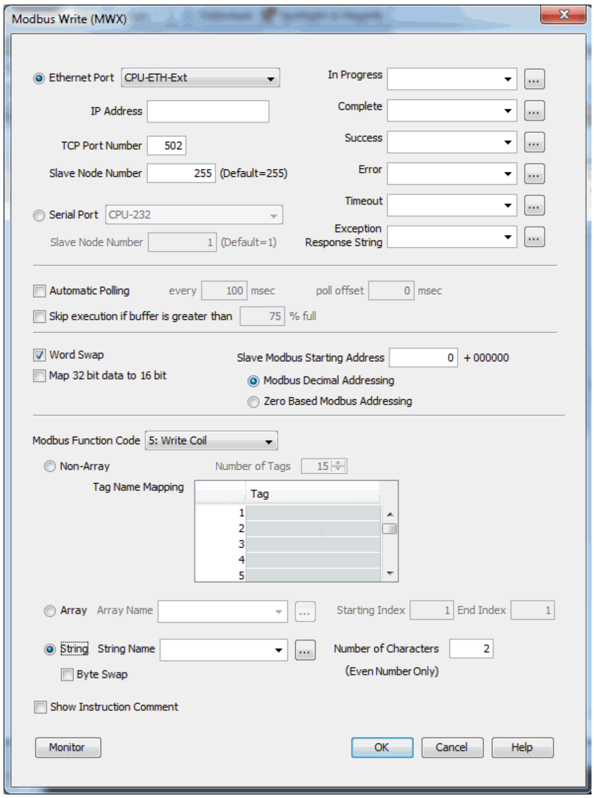



- The MRX instruction can be used for Modbus TCP or Modbus RTU. There are several status bits that can be used to determine whether the read message was successful and if it was not, the reason why.

## Modbus Instructions, cont'd

There is an "Automatic Polling" feature in the instruction to make it easier to read a device on a pre-determined poll rate. There is also a "poll offset" field that can be used when simultaneous instructions are enabled with the Automatic Polling feature to help stagger the flow of messages being sent to the network.

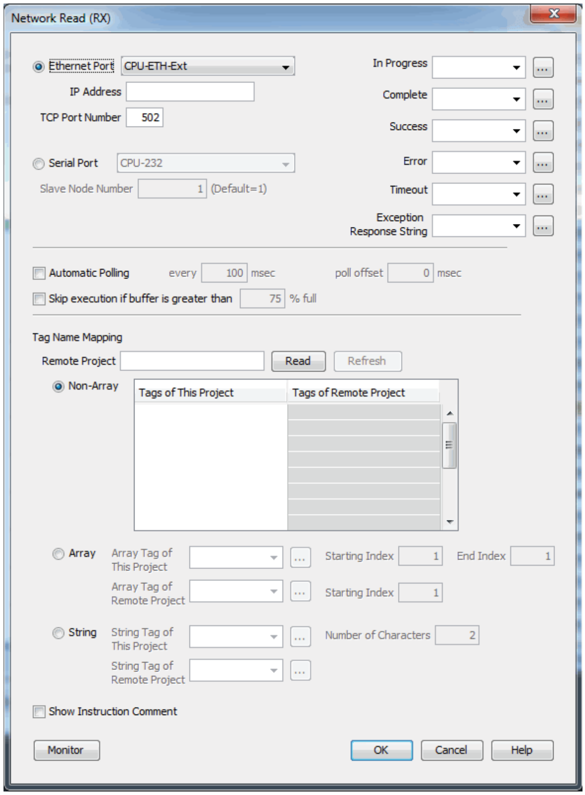
- The Modbus Write (MWX) instruction is very similar in layout and configuration to the MRX instruction. It is used to write values to a Modbus device from the tags in the CPU.
- The MWX operates very similarly to the MRX instruction. There are also many status bits to indicate the success or reason for failure when sending a message.
- The Automatic Polling option is also available to the MWX instruction, although greater care




should be taken when using this feature in this instruction. This is explained in better detail in the "Message Queue" section.

## Network Instructions

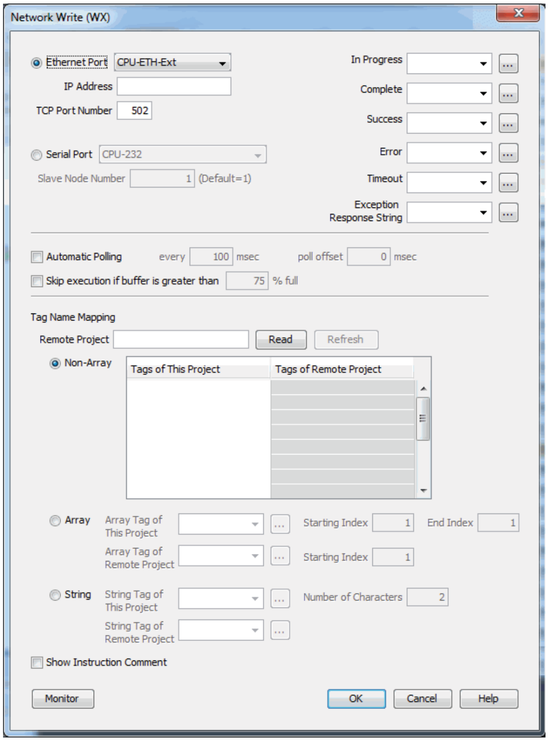
The Network Read (RX) and Network Write (WX) instructions are used to communicate to other CPU's. They are very similar in operation to the MRX and MWX instructions but they target Tag Names instead of Modbus addresses in the other CPU. There is also a significant performance gain in using the RX and WX instructions when communicating to other CPU's as opposed to using the MRX and MWX instructions.




The same status bits are available in the RX instruction as in the MRX instruction and operate in the same manner. The greatest difference in the RX versus the MRX is that with the RX, the Tag Name in the target CPU can be referenced directly and does not need a corresponding Modbus address. The way this is accomplished is by mapping local and remote tagnames together within the local CPU's RX instruction. Once the instruction is set up to read a remote project, the "Tags of Remote Project" or "Array Tags of Remote Project" drop down lists will be accessible. Map the Tag of the Remote project to a Tag in the Local project to read this data.

## Network Instructions, cont'd

The WX instruction operates in the same manner except that the data from the Local tags will be written into the Tags of the remote project. No Modbus mapping is required.




***Note:*** *The PC programming software project for the Remote CPU must be accessible by the PC running the programming software for the Local project.*

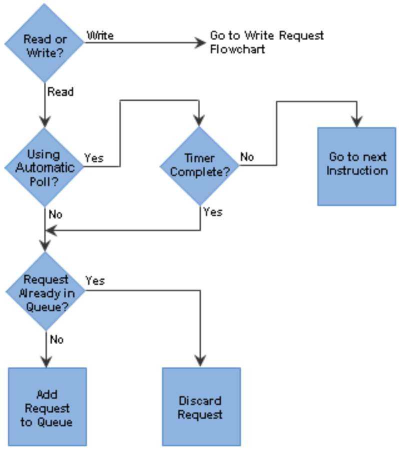
## Automatic Poll versus Manual Polling and Interlocking

In many cases when performing multiple communications requests to other devices, the message flow must be explicitly controlled in ladder code so that a message is not sent while another one is in operation. This usually requires writing 'interlocking' code between the instructions which typically involves the use of timers and shift registers, etc. Sometimes this is necessary because of the application but in other cases where the CPU just wants to read changing values from other devices and the frequency of that update is not critical it would be much more efficient to skip the unnecessary code complexity of interlocking.

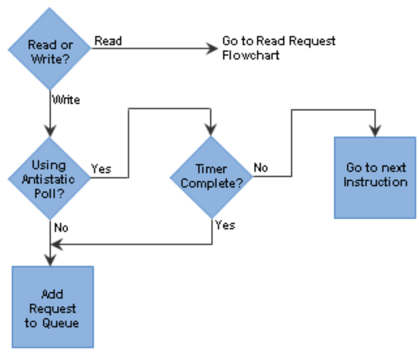
The desire to make it easier to communicate to other devices brought about the "Automatic Polling" feature and the "Message Queue" in the CPU. The Automatic Polling feature allows the user to choose the rate at which messages are sent without having to use a separate timer and enabling logic. The 'Message Queue' allows the user to stage the messages from the ladder code to go out to each physical communications port without requiring interlocking logic.

## Network Instructions, cont'd

Read Request Flowchart




Write Request Flowchart




The implementation of how the message queue works is slightly different based on whether the request is a read request or a write request.

Write requests will fill the queue much faster than read requests. That's why it is advisable to carefully choose when doing write requests whether to use the "Automatic Poll" feature or to manually send write requests only when needed (data to write has changed). When designing a system, it is important to know the total time it takes to send a request and get a reply for each target device. The Poll time should be longer than this time. The longer the poll time can be, within tolerance of the application, the better the overall network performance. So for efficiency in programming and for the best possible performance for the system, conservative poll rates should be used when utilizing the "Automatic Poll" feature.

There is also a "Poll offset" field in the communications instructions. This helps prevent the instructions from being queued all at the same time. When the CPU project starts, a master timer begins. The ladder scan will look to see if the instruction is enabled. If it is enabled, it will begin the Automatic Poll timer at the specified poll offset value from the master time clock.

## Message Queue

If the application requires more explicit, orderly control of each message sent to the devices, turn off the "Automatic Poll" feature. Using the instruction's status bits, logically control each message as required.

All of the above explains how messages get into the "queue". There are several factors involved with how each queue (1 for each physical port) is emptied.

- Serial port queues: The serial port queues empty slower than the Ethernet port queues, not just because of the hardware speed itself but because of the nature of serial communications. Each request sent must wait for a response or a timeout (whichever comes first). Once the reply is received for a request or a timeout has occurred, the next item in the list can be sent. So the response time of the slave devices on the network will largely affect the speed at which the queue fills and empties.
- Ethernet port queues: The Ethernet port queue can empty faster because when sending requests to multiple devices, the CPU does not have to wait on a response from one device before sending a request to another device due to the inherent nature of the Ethernet hardware. However, sending multiple requests to the same Ethernet device does necessitate that the CPU waits for a response from the first request before sending another request to that same device.

Another difference in the Ethernet port queue versus the Serial port queue spawns from the TCP 'connection' based behavior of Modbus TCP. If a TCP connection is lost to a device and there are still requests in the queue for that device, those requests will be dropped from the queue. There are three ways this can happen:

1. If a TCP timeout occurs (server device fails to respond within specified timeout value), the TCP connection is lost.
2. If the server device closes the connection, then all of the requests will be dropped.
3. And, finally, if all rungs with communications instructions to a device are disabled for five seconds, the CPU will drop the TCP connection for that device in order to free up valuable resources that could be used elsewhere in the system.

This is another factor that should be considered when designing the system. If it is imperative that no message be lost when communicating to a device, each instruction should be explicitly handled one by one (interlocking logic).

# EtherNet/IP for the Productivity Series

## Terminology Definitions

A lot of terminology associated with EtherNet/IP is not always clear. Some of these terms are listed below along with their respective definitions.

- Scanner: This is the term used to describe the device that initiates the EtherNet/IP sessions. The Scanner is sometimes referred to as the "Originator" as well. In more standard Ethernet terms, the Scanner would often be called the "Client".
- Adapter: This is the device that responds to the EtherNet/IP communications that are initiated by the Scanner. The Adapter is also known as the "Target" as well. Typically, the Adapter is an Ethernet "Server".
- Object: In EtherNet/IP, an Object is a representation of a defined set of Ethernet connections, behaviors, services and data attributes. There are standard objects and there are custom defined objects as well. See Object Modeling example below.
- Class: A Class is a set of Objects that are related in some fashion. See Object Modeling example below.
- Instance: An Instance is an actual, usable manifestation of an Object. See Object Modeling example below.
- Attributes: Attributes are the specific items within an Object Class. The category of Attributes should be the same for all Instances of an Object but the actual Attribute itself might vary. See Object Modeling example below.
- Connection Point: A Connection Point value is the "Class Code" reference for a data block. This value is required for access to input and output data in IO Messaging. It is typically defined for each input and output data block by the Adapter device manufacturer.
- IO Messaging: IO Messaging (also called "Implicit Messaging") is a method of reading and writing blocks of data without defining the Connection Point and size for each block transfer. The Connection Point, size and transfer rate (RPI) are defined at the beginning and then the data blocks are transferred at the specified intervals.
- Explicit Messaging: This method of reading or writing data requires that each message defines the type of data and size of data needed for each request.

**Object Modeling Example:**

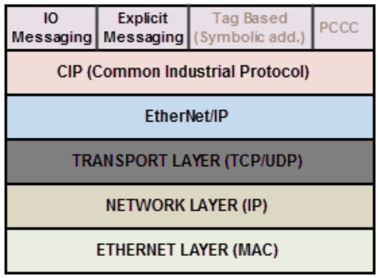
Class ------- Definition of Automobile

Attributes -- Make, Model, etc…

Object ------ A Ford Mustang

Instance ----Sally's Ford Mustang

## Network Layer Chart




The diagram above illustrates the OSI seven layer model and how EtherNet/IP fits into this model. In general, there are three basic layers for sending and receiving data in the EtherNet/IP protocol:



- EtherNet/IP layer (Register Session, etc…)
- CIP layer (CIP Forward Open, etc…)
- The uppermost layer,which contains several different types of messaging.

The ODVA (Open DeviceNet Vendor Association) specification defines many different types of messaging that reside on the CIP layer. Two types of messaging supported in the phase 1 release of the Productivity Series EtherNet/IP protocol are I/O Messaging and Explicit Messaging. I/O Messaging is accomplished through a Class 1 Connection and Explicit Messaging can be accomplished through a Class 3 Connection or an Unconnected Message.

Tag Based Messaging (used for reading and writing values to Allen Bradley Control and CompactLogix PLCs) and PCCC (used for reading and writing values to Allen Bradley MicroLogix and SLC PLCs) are planned for subsequent phases of this protocol.

## EtherNet/IP Data

When doing I/O Messaging, the data that is transported is defined as “Input” data and “Output” data. Don’t confuse this type of data with what most PLCs define as Input data and Output data. In most PLCs, Inputs are typically associated with an Input module that reads points from real word devices. Outputs are typically associated with an Output module that turns off and on real word devices.

In I/O Messaging, Input data is data that is sent from the target device back to the Originator or to multiple devices that are listening (multicast messages). Output data is data that is sent from the Target device. This data may or may not be connected to real word devices. That is completely dependent upon the Adapter device. For example: When the Productivity2000 is configured as an EtherNet/IP Adapter device, the Input data and Output data is defined in internal data arrays and does not directly tie to any Input and Output point to the real world. If it is desired to tie these array elements to real word devices, that must be accomplished in code by *Copy* commands (or other instructions).

***Note:*** *The Scanner (originator) in the P2000 will only accept messages from an Adapter (target) device with an established connection with a Scanner. The Adapter (target) in the P2000 will respond back to a Scanner (originator) in the method (Multicast or Unicast) that is sent in the forward open message from the Scanner (originator).*

## Class 1 and Class 3 Connections

What are they and how are they best used?

- Class 1 Connection is the transport mechanism that IO Messaging uses to send data. The basic concept is that data is sent in one direction: the Originator sends Output data in a Unicast UDP message to the Target and the Target sends Input data in either a Unicast message back to the Originator or Multicast UDP messages to multiple devices. The Input data and Output data messages have no relationship to each other. This method works well for Remote I/O type data and is very efficient due to little overhead and reduced handshaking messages on the wire. Class 3 Connection is one of the mechanisms that Explicit messaging uses. Class 3 messaging uses TCP messages unlike Class 1. Each Class 3 request has a header that defines the type of data requested as well as the size requested. It allows for more flexibility in messaging but does create additional overhead.

***Note:*** *Explicit messaging can be accomplished with unconnected messages as well for more infrequent requests. Explicit messaging is a slower performing method of communications but it typically allows for more flexibility and control when the situation requires it.*



When can the P2000 CPU use Class 1 or Class 3 Connections?

- Class 1 and Class 3 Connections can be accomplished with the Productivity2000 CPU as an Adapter or as a Scanner or both simultaneously.

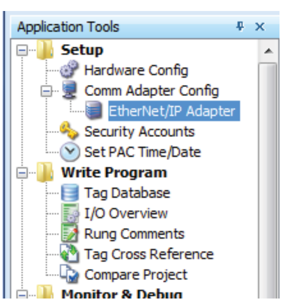
How many connections can the Productivity2000 support for EtherNet/IP?

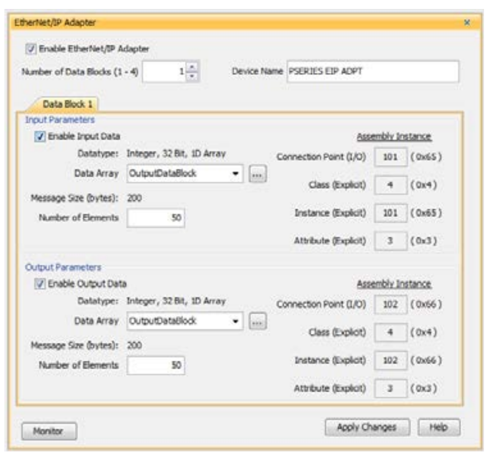
- 4 - TCP
- 4 - EtherNet IP
- 4 - CIP (Up to 4 CIP connections are allowed per EtherNet/IP connection. Therefore, if one device can support 4 CIP connections then you can have up to a total of 16 CIP connections using 4 devices)

## Setup Example: Productivity2000 as EtherNet/IP Adapter

The Adapter setup is accomplished through the EtherNet/IP Adapter setup under the Comm Adapter Config section of the Setup menu as seen on right.

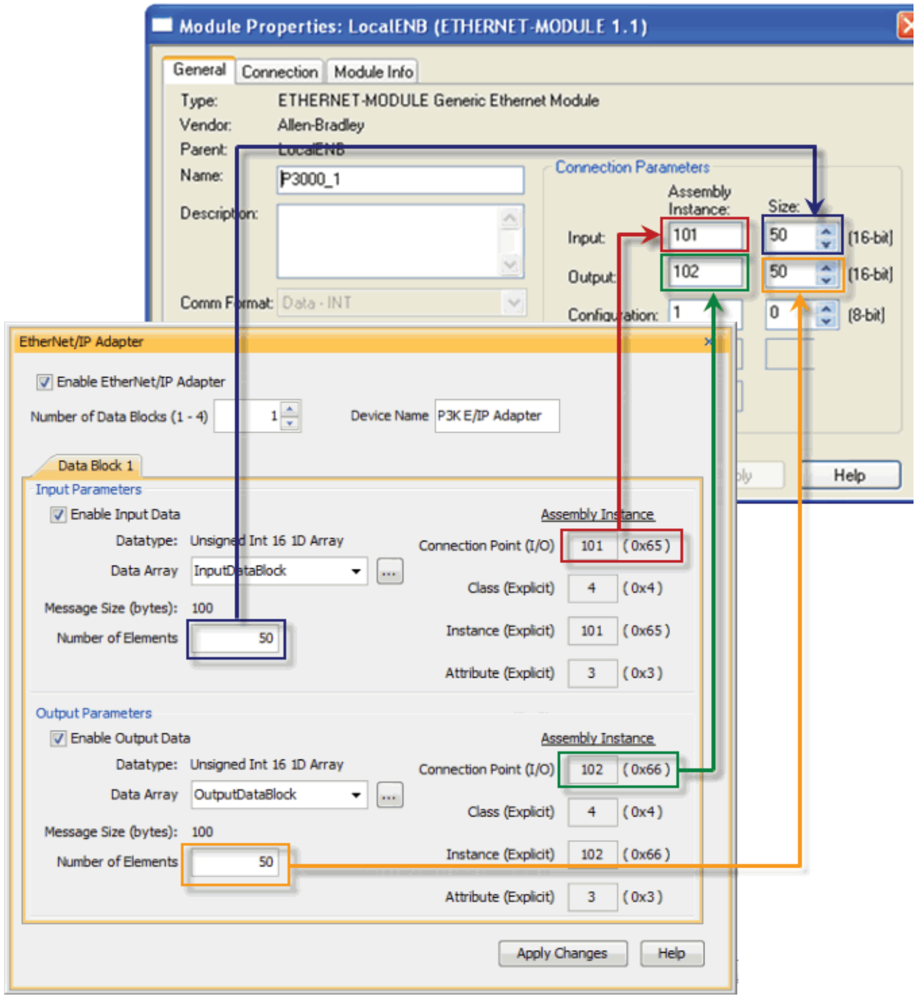
When the EtherNet/IP Adapter is selected from the menu the window shown here will open.



Fill in the required parameters and once configured these parameters will be used to configure the Scanner side as shown in the examples below. The first example shows how to setup a Class 1 IO Message connection from a 3rd party EtherNet/IP Scanner device (an Allen Bradley PLC).

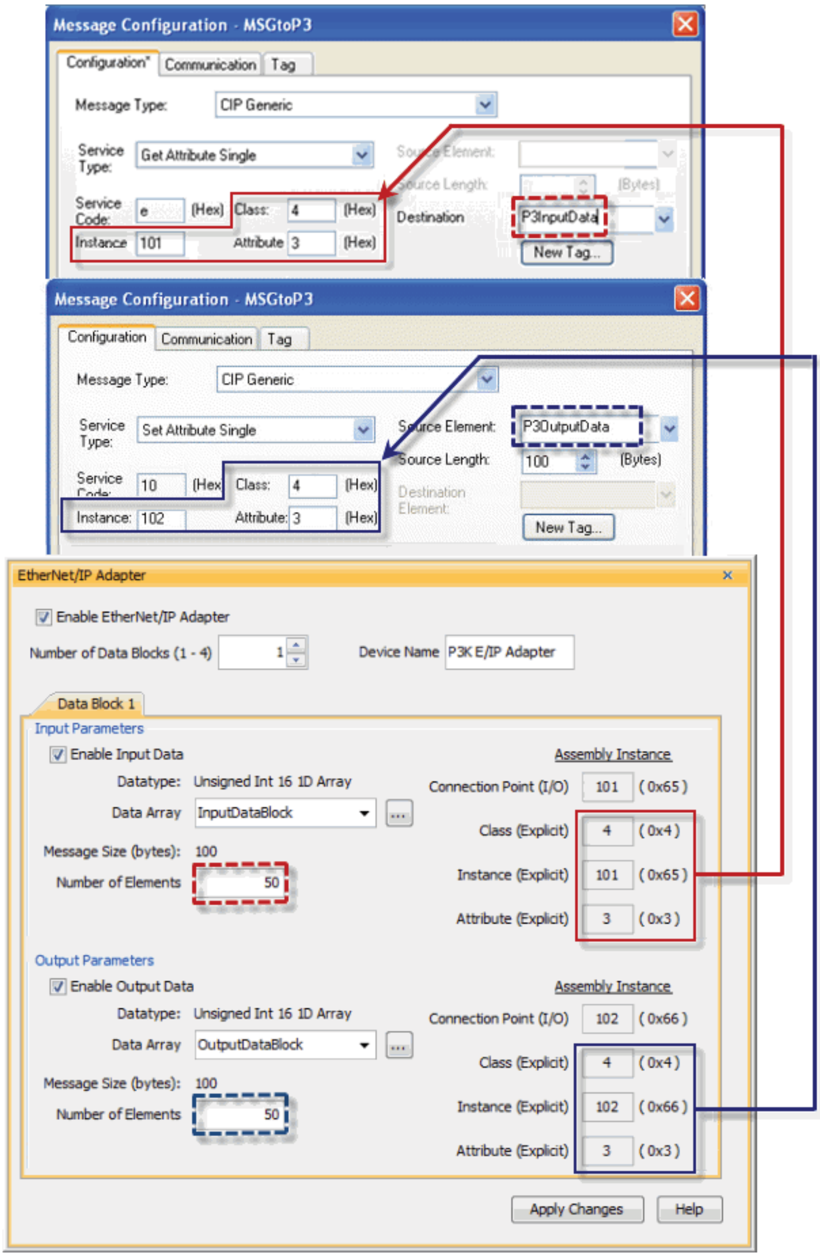
RS Logix5000 Control/CompactLogix Generic Ethernet Device Setup




The following example shows how a Class 3 Explicit Message might be accomplished from a 3rd party device (Allen Bradley PLC). As you can see the Input Data must be retrieved in one connection or message and the output data in another. Remember that Class 3 messaging is not as efficient in protocol messaging as Class 1 but it does allow for granular control.

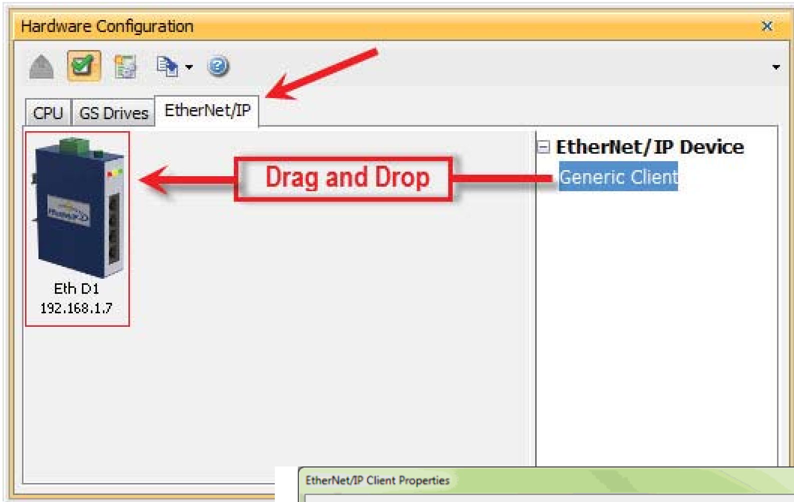
***Note:*** *In this example, size configuration is not shown on the Scanner side. The tag created for the Destination must be large enough to contain the data requested (shown with dashed boxes).*

RS Logix5000 MSG instruction for Control/CompactLogix



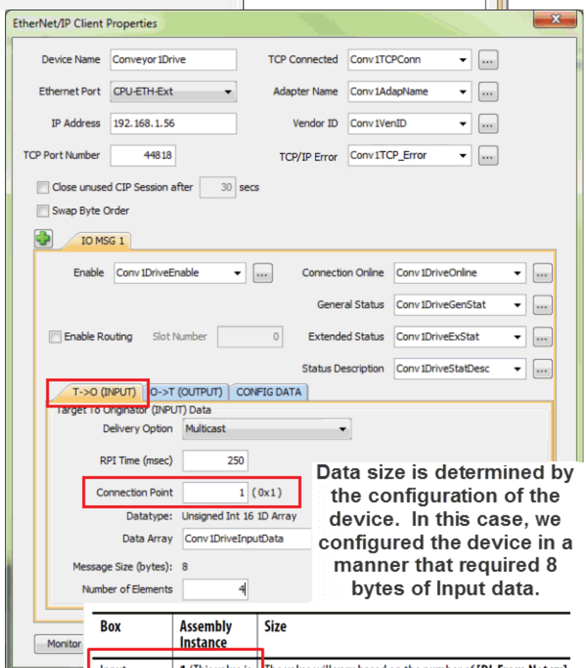
## Setup Example: Productivity2000 as EtherNet/IP Scanner

This example shows how to connect the Productivity2000 Scanner function to an EtherNet/IP adapter device using Class 1 I/O Messaging. First, create an EtherNet/IP device in the Hardware Configuration as seen below:




Configure the parameters to match the settings of the Adapter device. The image on right shows the setup of the Input data.

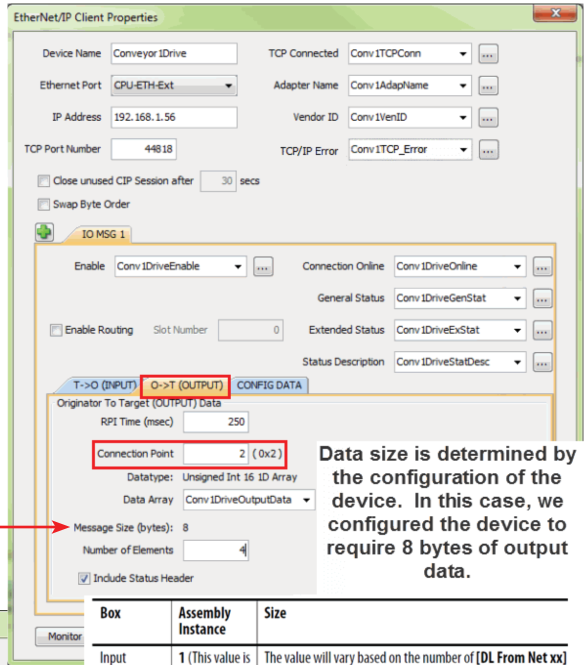
The size, in this case, is dynamic to the configuration of the device. For this particular example, we configured the device in a manner that allows it to publish 8 bytes of data for Input. Many devices will have a fixed configuration that should be published in the manufacturer's documentation.




Data size is determined by the configuration of the device. In this case, we configured the device in a manner that required 8 bytes of Input data.

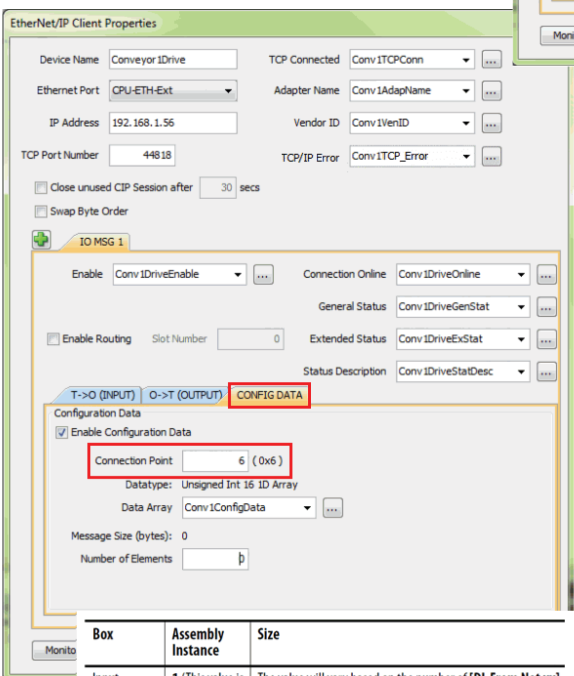
| Box | Assembly Instance | Size |
|---|---|---|
| Input | **1** (This value is required.) | The value will vary based on the number of **[DL From Net xx]** parameters used for your application (see details below). |
| Output | **2** (This value is required.) | The value will vary based on the number of **[DL To Net xx]** parameters used for your application (see details below). |
| Configuration | **6** (This value is required.) | **0** (This value is required.) |

The Output data must also be configured. Its data is also dynamic based upon the configuration. In our example, we configured the device in a manner that caused it to require 8 bytes of Output data.




| Box | Assembly Instance | Size |
|---|---|---|
| Input | **1** (This value is required.) | The value will vary based on the number of **[DL From Net xx]** parameters used for your application (see details below). |
| Output | **2** (This value is required.) | The value will vary based on the number of **[DL To Net xx]** parameters used for your application (see details below). |
| Configuration | **6** (This value is required.) | **0** (This value is required.) |

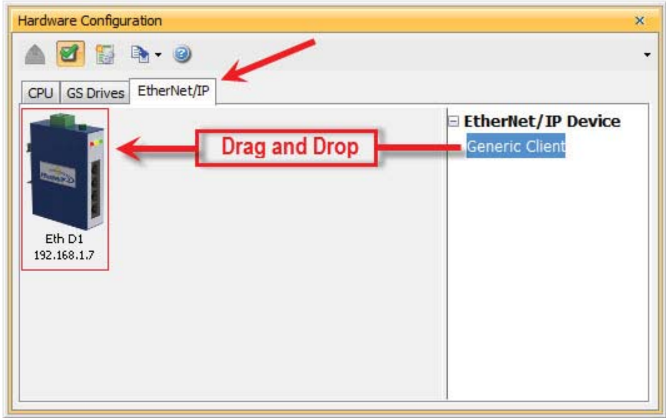




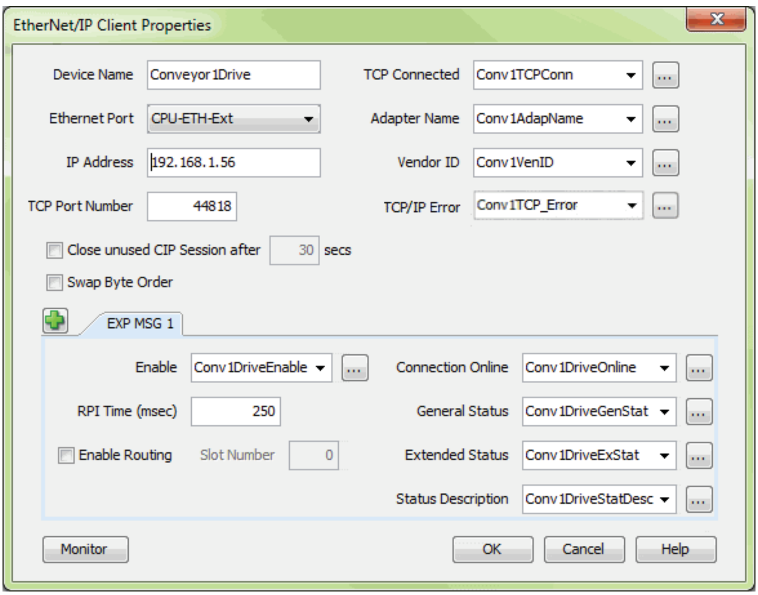

| Box | Assembly Instance | Size |
|---|---|---|
| Input | **1** (This value is required.) | The value will vary based on the number of **[DL From Net xx]** parameters used for your application (see details below). |
| Output | **2** (This value is required.) | The value will vary based on the number of **[DL To Net xx]** parameters used for your application (see details below). |
| Configuration | **6** (This value is required.) | **0** (This value is required.) |

The image on left shows the setup for the Configuration data. The Configuration data, for most devices, is a fixed size. Some devices will require that the Configuration data Connection Point be included in the Forward Open message (as shown on left) even if the size is 0. Some devices will require that the Configuration data Connection Point not be in the Forward Open and the checkbox option in the image below would need to be de-selected.

The following example shows how to connect the Productivity2000 Scanner function to an EtherNet/IP adapter device using Class 3 Explicit Messaging. As with IO Messaging, an EtherNet/IP device must be created in the Hardware Configuration as seen below:

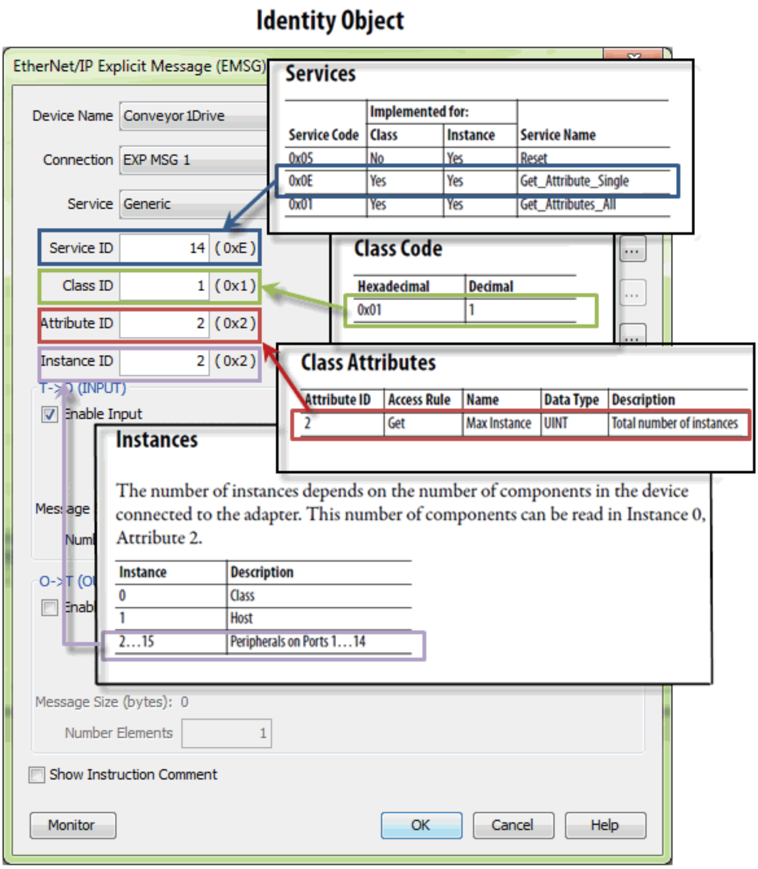





Explicit Messages can be performed in 2 ways: Unconnected or Connected (Class 3). The advantage of using Unconnected messaging is it allows more discrete control of each request. The disadvantage of Unconnected messaging is that Unconnected messages have a lower priority and will take longer to get serviced on some devices. Connected messages get serviced faster since there is a connection established to the device. If Connected messaging is desired, create an Explicit Message tab as shown in the image above. If Unconnected messaging is desired, do not create an Explicit Message tab. Only fill out the information in the upper portion of the EtherNet/IP Client Properties window.

Once the desired parameters have been entered, the device may now be referenced in the Explicit Message Instruction. If Unconnected messaging has been selected, choose the Unconnected MSG option in the Connection drop down box. If Connected messaging has been selected, choose the Explicit Message that was configured in the EtherNet/IP Client Properties window in the Connection drop down box. The rest of the settings should be matched to the specifications documented by the manufacturer. An example for requesting the Identity of a device is shown below. The data array configured for this function must be sufficient in size to hold the returned data from the device for this object. Data can also be written to the device if it supports an object for this purpose. If data is being written, enable the Output selection and specify the data array and size required by that device's object.




## Troubleshooting Tips:

1. Use the diagnostic tags in the Hardware Configuration and Explicit Message Instruction:

   As explained previously in the Network Layer Chart section, there are multiple layers of messaging involved with EtherNet/IP. If it appears that the Productivity2000 is not communicating with another EtherNet/IP device, there are diagnostic tags available to narrow down which layer of the protocol is preventing successful communications.

a. At the TCP layer, there is a TCP Connected field that will expose the status of the TCP/IP connection when a tag is populated in this field.

b. There is an Adapter Name field for a String tag and a Vendor ID field for an Integer tag. Both of these fields can help to identify whether the Productivity2000 is connected to the correct device or not.

c. At the CIP layer, there is a Connection Online field for a Boolean tag.

d. There are three additional fields to help determine why the CIP session might not be successful: General Status for an Integer tag, Extended Status for an Integer Data Array and Status Description for a String tag.

2. Use the TCP connected tag:

First check the TCP Connected tag. If the connection has been enabled (by turning on the tag configured in the Enable field or triggering an Explicit Message instruction with an Unconnected MSG specified) and the TCP Connected tag is not true, check the following items:

**a. Cabling.** Ensure that all of the cables are connected and in good shape. In most cases, the Ethernet port that the cable is connected to should indicate a Link Good LED. Ensure that any interim Ethernet switches are powered up and functioning and that the end device is powered up and functional.

**b. IP address and correct subnet.** Check that the IP address entered into the IP Address field is the correct address for the device that you are connecting to. Also check that the EtherNet/IP device's IP address and subnet mask is compatible with the IP address and subnet mask of the Productivity2000. If there are any routers in between the two, ensure that a proper default gateway that matches the router's IP address is configured. If you are unfamiliar with proper IP addressing and subnet configuration, consult with the network administrator for guidance.

**c. TCP Port number.** The default listening TCP port number for EtherNet/IP is 44818. Check that the target device is listening on this specific port number. If it is not, change the value in TCP Port Number field to the appropriate value. If there are interim router devices that are using port forwarding, ensure that the router is properly configured for this setup.

***Note:*** *Attempting to do IO Messaging across routers (different subnets) is unlikely to be successful. IO Messaging uses multicast messaging in many cases and the Port number is not necessarily fixed when the IO Messaging is established (the Forward Open message has the ability to 'negotiate' the port number used for the IO Messages).*

**d. Adapter Name and Vendor ID.** If the network contains many EtherNet/IP devices and these devices may not necessarily be connected to the Productivity2000, it may be a good safeguard to check the Adapter Name and Vendor ID returned and verify that these devices are the correct devices to which it is connected.

3. Use the Connection Online and Error tags:

If the TCP Connected tag is true and the Adapter Name and Vendor ID look correct, the next tags to look at are the Connection Online, the General Status, the Extended Status and the Status Description.

If the Enable tag is true and the Connection Online tag is not true, check the General Status value along with the Extended Status value(s) and the Status Description. If the General Status value and the Extended Status value(s) are part of the defined errors from the ODVA specification, the Status Description should also return a more descriptive String. Once these errors are known, it may be possible to very simply make the adjustment in the settings to correct the issue.

If it is not obvious from the description, first check the manufacturer's documentation for corrective action in this particular scenario.

If the manufacturer's documentation doesn't give corrective action, check the EtherNet/IP Error Code List in this chapter for possible solutions.

***Note:** This may not always solve the problem as each device manufacturer may publish the error for slightly different reasons.*

If the Connection Online tag is true and the data being received is different than what is expected, verify that the correct Connection Point values and/or Class, Instance, Attribute values are configured. There may be multiple areas of available data in that device. Verify that the correct data types are being used for both sides. If the data types are mismatched, this may make the data 'appear' to be incorrect.

Another great tool that can be used is Wireshark. Wireshark is a free network analyzer tool that can be downloaded from www.wireshark.com.



***Note:** Using this tool implies some knowledge of how networking protocols function. Using Wireshark will also require that you have a true Ethernet hub (not an unmanaged switch) or a managed switch with Port mirroring capability.*

You may also use the following basic steps to check your EtherNet/IP Setup.

## EtherNet/IP I/O Message Troubleshooting:

1. Does the IP Address set up in the Scanner match the Adapter IP Address?
2. Is the enable tag entered into the Scanner turned ON?
3. Does the connection point entered into the I/O Message Data Block match the connection point of the Adapter?
4. Does the number of elements match the Adapter?
5. Does the data type match the Adapter?

Steps 4 & 5 are important because the number of bytes being read from or written to the Adapter have to match the Adapter bytes allocated.

## EtherNet/IP Explicit Message Troubleshooting:

1. Does the IP Address set up in the Scanner match the Adapter IP Address?
2. Is the enable tag entered into the Scanner turned ON when not using the Unconnected MSG connection type?
3. Make sure the logic for the EtherNet/IP Explicit Message (EMSG) is TRUE so the instruction is enabled.
4. When using Get or Set single attributes in the Service field make sure the Instance ID matches the Instance ID of the Adapter.
5. When using Generic in the Service field make sure the Service ID, Class ID, Attribute ID and Instance ID match the Adapter settings.
6. Does the number of elements match the Adapter?
7. Does the data type match the Adapter?

Steps 6 & 7 are important because the number of bytes being read from or written to the Adapter have to match the Adapter bytes allocated.

# Communications: GS-Drives

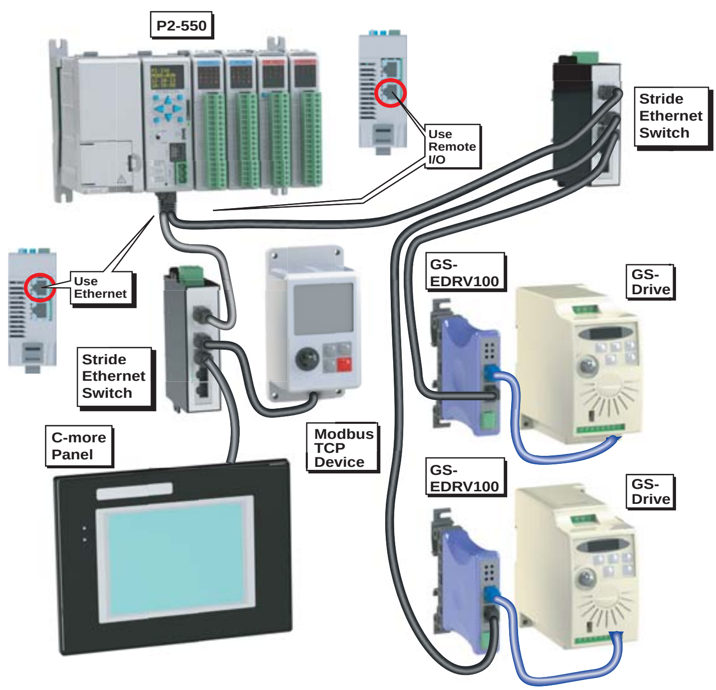
## Things To Consider for the design of Remote GS-Drives

It is important to understand that only one Remote I/O network can be on an unmanaged switch. If two or more Remote I/O networks are mixed into the same physical LAN (local area network), duplicate IP addressing will occur and the system will not function properly. Multiple Remote I/O networks can be used on a managed switch using the VLAN feature to create a virtual separation of the different networks, but multicasting messages are necessary for the network to function properly. Care must be taken when designing a system this way (using a managed switch).

Even if only one Remote I/O network is being used in a facility, it is strongly recommended to keep it on a dedicated network, physically isolated from other networks. As mentioned above, the Productivity2000 Remote I/O network makes use of multi-casting messages and many devices will not function properly in this situation.

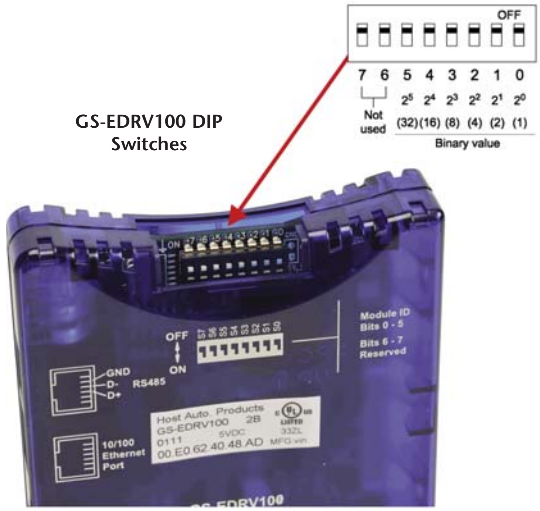
## Configuration of GS-Drive Connections

The GS Drive configuration does not use multicasting in its setup but there are some initial UDP broadcast messages that occur upon discovery when initiated from the software and at power up. This should be considered if installing the GS Drive network with other devices.



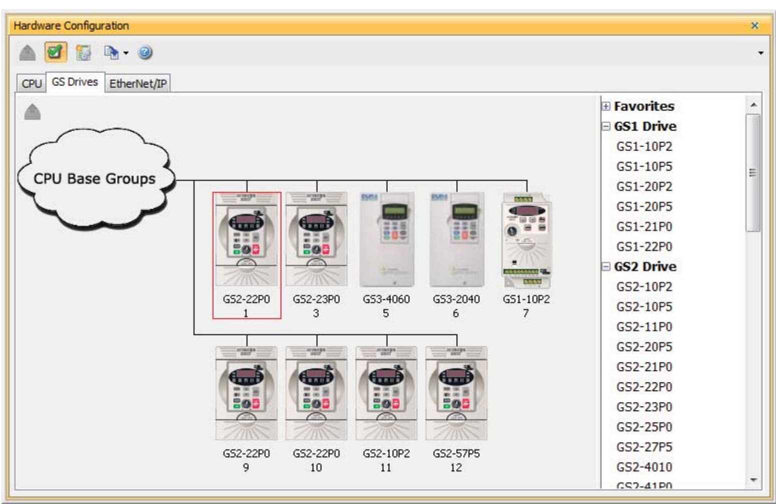
## Configuration of GS-Drive Connections, cont'd

GS Drive connections are set up in a similar manner. Set a unique address for each GS-EDRV100 using its DIP switches. Or set the DIP switches to 0 and select the address using NetEdit (free download at AutomationDirect.com). 01-64 are valid addresses for a GS-EDRV100 in a Productivity2000 system. Since the DIP switch settings can only represent 00-63, setting a GS-EDRV100 to address 64 must be done using NetEdit.

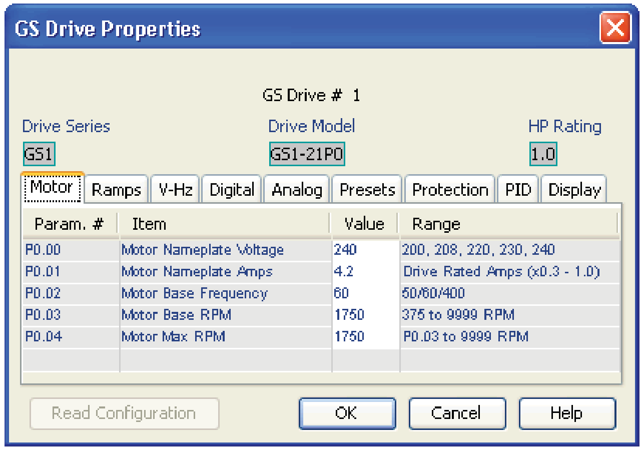



After the GS-EDRV100 modules' addresses have been set, be sure to connect the serial cable that comes with the GS-EDRV100 to the GS-Drive serial port. The GS-EDRV100 will automatically configure the GS-Drive serial port to the correct settings. Once the GS-EDRV100 is properly addressed and connected to the GS-Drive, connect a straight through (patch) Ethernet cable from the Ethernet port of the GS-EDRV100 to an Ethernet switch. Connect a straight through cable from the P2-550 Local Ethernet Port (Remote I/O) to the same switch.

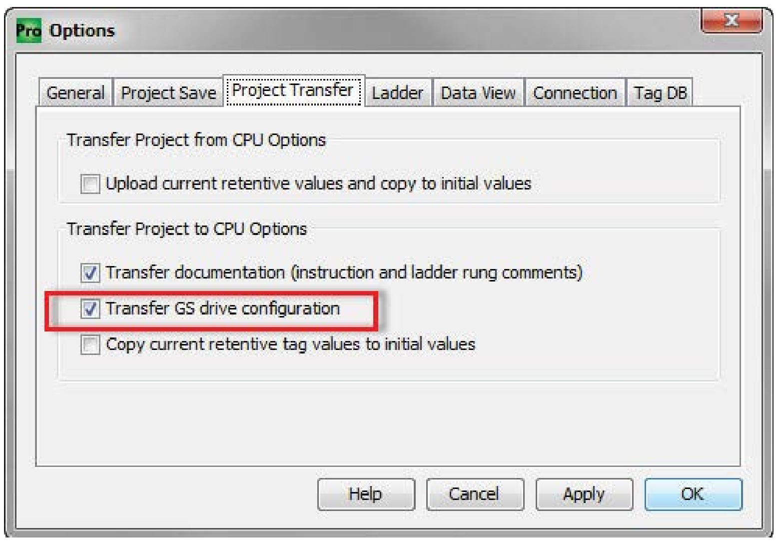
Open the Productivity Suite Programming software and go online with the P2-550. Select Setup and then Hardware Configuration. Select the "Read Configuration" button in the upper left hand corner of this dialog and the P2-550 will automatically discover all of the GS-EDRV100s connected to the switch and display all found GS-Drives.



## Configuration of GS-Drive Connections, cont'd



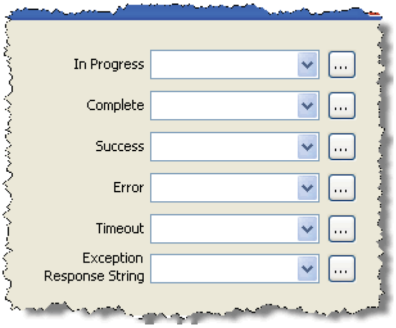

Once the drives have been discovered, the configuration of each drive can be read and written from the programming software.




To allow the P2-550 to automatically write the drive parameters on each CPU project transfer and when the CPU is powered up, a setting must be configured in the P2-550 project. Go to Tools and Options and select the "Project Transfer" tab. Select the "Transfer GS drive configuration" as shown above. Drive parameters are ONLY transferred to the GS Drive at project transfer or at boot up of the CPU.

## Configuration of GS-Drive Connections, cont'd

To monitor the status of the connection between the P2-550 and the GS-EDRV100 modules, use the status bits of the GS Read and GS Write instructions as shown below. If a Timeout occurs or an error is received, this can be monitored in the ladder code and appropriate action can be taken.






There is a Communications Heartbeat function that can be configured for the GS Drives. There are two possible communication paths that could be lost:

- P2-550 to GS-EDRV100.
- GS-EDRV100 to GS drive.

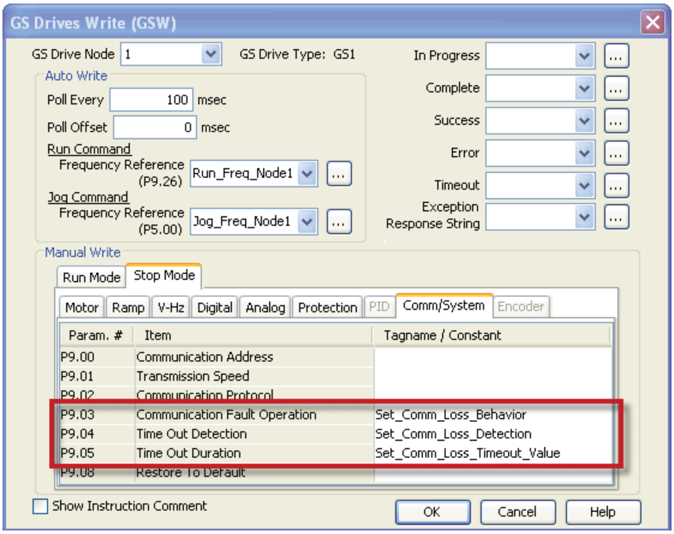
To configure the GS-EDRV100 and GS Drive to detect and react to loss of communications, three parameters should be configured appropriately in the drive.

As shown below, parameter P9.03 determines what the drive will do when it detects loss of communications. Parameter P9.04 enables the transmission loss detection feature. Parameter P9.05 determines the amount of time the drive will wait for a transmission before assuming that the link is lost and react according to how parameter P9.03 is configured.

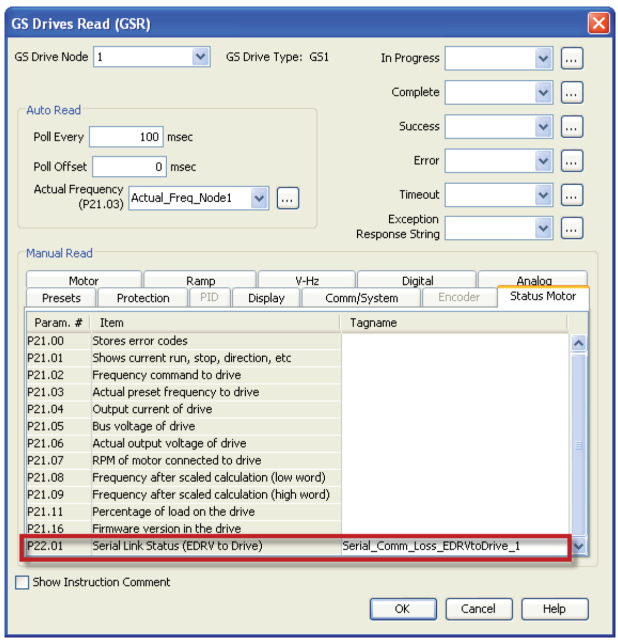
The GS-EDRV100 reads these configured parameters and if they are configured for detecting communications loss, it will also monitor for loss of communications on the Ethernet side. If communications are lost on the Ethernet side, the GS-EDRV100 will shut down the GS Drive.

| Communications Parameters | | | |
|---|---|---|---|
| GS2 Parameter | Description | Range | Default |
| P9.00 | Communication Address | 01 to 254 | 01 |
| P9.01 | Transmission Speed | 00: 4800 baud<br>01: 9600 baud<br>02: 19200 baud<br>03: 38400 baud | 01 |
| P9.02 | Communication Protocol | 00: Modbus ASCII mode<br>7 data bits,no parity,2 stop bits<br>01: Modbus ASCII mode<br>7 data bits,even parity,1 stop bit<br>02: Modbus ASCII mode<br>7 data bits,odd parity,1 stop bit<br>03: Modbus RTU mode<br>8 data bits,no parity,2 stop bits<br>04: Modbus RTU mode<br>8 data bits,even parity,1 stop bit<br>05: Modbus RTU mode<br>8 data bits,odd parity,1 stop bit | 00 |
| P9.03 | Transmission Fault Treatment | 00: Display fault and continue operating<br>01: Display fault and RAMP to stop<br>02: Display fault and COAST to stop<br>03: No fault displayed and continue operating | 00 |
| P9.04 | Time Out Detection | 00: Disable<br>01: Enable | 00 |
| P9.05 | Time Out Duration | 0.1 to 60.0 seconds | 0.5 |
| ◆ P9.07 | Parameter Lock | 00: All parameters can be set and read<br>01: All parameters are read-only | 00 |

## Configuration of GS-Drive Connections, cont'd



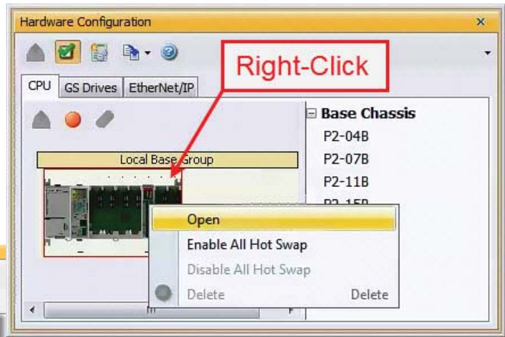

It is very important to note that if the communications loss feature is enabled; either a GS Drive Read or GS Drive Write instruction needs to be configured to communicate to the GS-EDRV100 and GS Drive at a poll rate that will prevent the GS-EDRV100 and GS Drive from detecting a loss of communication.

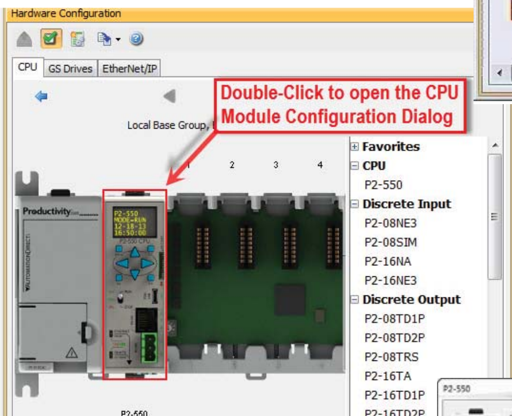



There is also a parameter (P22.01) that can be monitored to check the health of the serial connection between the GS-EDRV100 and the GS Drive. This parameter can be monitored in the ladder code and appropriate action taken if serial communications loss is detected.

# Communications: Port Configuration

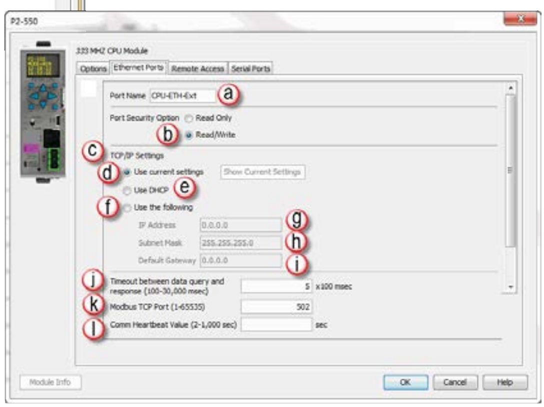
The Communications Port Configuration for any module containing comm ports is accessed from the Hardware Configuration window. For example, to access the P2-550 communications port configuration, first select the Local Base Group from the Hardware Configuration window by double left-clicking the Local Base Group or by right-clicking the Local Base Group and selecting Open from the drop down menu as seen above.




Then select the P2-550 by double left-clicking the CPU or by right-clicking the CPU and selecting Open from the drop down list as seen above. This will display the P2-550 configuration window seen here.

Although the following descriptions will focus on the P2-550 communications ports, the settings also apply to any other module containing these ports (P2-SCM).




## Ethernet Configuration

Ethernet Ports: There are two 10/100Base-T Ethernet ports on the P2-550 CPU.

- External Ethernet: The bottom front Ethernet port is referred to as the “External Ethernet Port”. This port can connect to Modbus TCP Client devices, Modbus TCP Server devices and PCs running the Productivity2000 programming software.

  The External Ethernet Port is configured with an IP Address, Subnet Mask and Default Gateway, allowing it to function seamlessly on a typical LAN network.

- Local Ethernet: The bottom rear Ethernet port is referred to as the “Local Ethernet Port”. This port functions as a Productivity2000 GS-Drive Client. The Local Ethernet Port is not configurable.

## External Ethernet Port Settings

***Note:** Two CPU Remote I/O networks cannot co-exist on the same LAN.*

a. Port Name: Allows the entry of a unique Name for the External Ethernet Port. This Name is referenced in the Communications instructions (MRX, MWX, RX, WX) to select the Port to send the request from.

b. Port Security Option: This Option can be used as a simple Security measure to prevent Modbus TCP write requests from being accepted by the CPU. To allow Reads and Writes, select Read/Write.

c. TCP/IP Settings: The IP Setting of this Port may be changed in several ways:

- The settings may be entered manually in the Choose CPU tool in the Productivity Suite programming software. This allows the user to make changes to the IP to allow connection by the computer running the Productivity Suite programming software. Changes are sent using Multicast Messages.
- The TCP/IP Settings can be saved as part of the project. This must be Enabled in the P2-550 Hardware Configuration Settings by selecting *Use the Following* (Item f below). If handled this way, the Settings stored in the project will take effect at Project Transfer and at boot up only. The Settings may be changed after boot up.



d. Use Current Settings: When selected, Project Transfer or boot up will not make changes to the TCP/IP Settings of the CPU.

e. Use DHCP: This specifies that the CPU should request its IP Settings from a DHCP Server on the network.

***Note:** If the CPU is set to use DHCP for it's IP Settings it cannot, in all likelihood, be used as a Modbus TCP Server.*

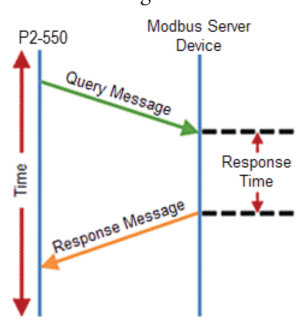
f. Use The Following: If this Option is selected, the CPU will set itself to the specified project Settings upon Project Transfer or at boot up.

g. IP Address: This field is where the IP Address is specified in Four Octets.

- For Example: 192.168.1.5

h. Subnet Mask: This field is where the Subnet Mask is specified in Four Octets (i.e., 255.255.255.0 ). The Subnet Mask is used in conjunction with the IP Address to configure a Logical Network.

i. Default Gateway: This field is where the Default Gateway Address is specified in Four Octets (i.e., 192.168.1.1). This is typically the IP Address of the router on the network. If a target IP Address is specified in an outgoing message from the CPU that is not in the Local Subnet, the Default Gateway Address is where this message will be sent.

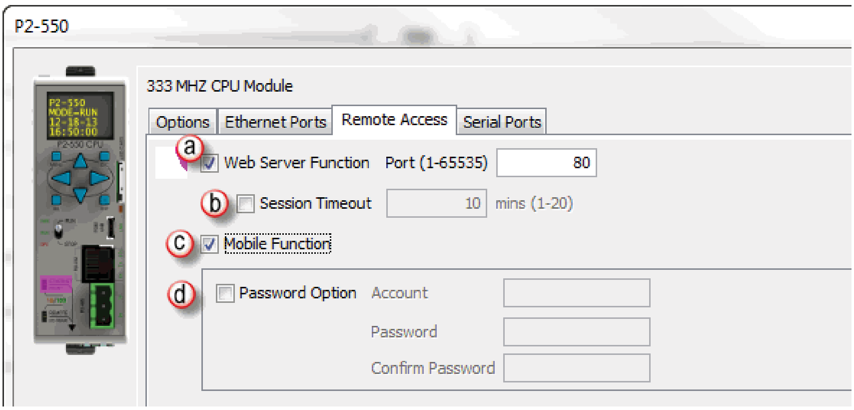



j. Timeout Between Data Query and Response: The Time period specified in this field is the Time between the queries sent from the CPU (via a Communication instruction, such as a MRX, MWX, RX or WX) and the Time a response from that device is received. If the Response takes longer to receive or is not received within the specified Time period, a Timeout Error will occur for the given instruction. Each instruction has a Timeout Status bit that can be assigned to it.

## External Ethernet Port Settings, cont'd

k. Modbus TCP Port: This is the listening TCP Port Number for Modbus TCP connections. If necessary, this value can be adjusted for advanced router access. In most situations, this Port Number should be left at 502.

l. Comm Heartbeat Value: This feature allows the ladder logic in the CPU to know if a device has stopped communicating to the CPU. If a value is placed in this field, the CPU will start a timer between each communication packet coming in to the CPU. If a communication packet fails to be received by the CPU within the specified time period, the System Bit Ethernet Heartbeat Timeout Bit will become true.






## Remote Access Configuration

a. Web Server Function: Allows the ability to make a non secure web connection to the P2-550 in order to access the USB pen drive and view read-only system tags. When enabled, a port number selection is required.

- Port: (Default 80) Allows user to set a port number ranging from 1-65535.

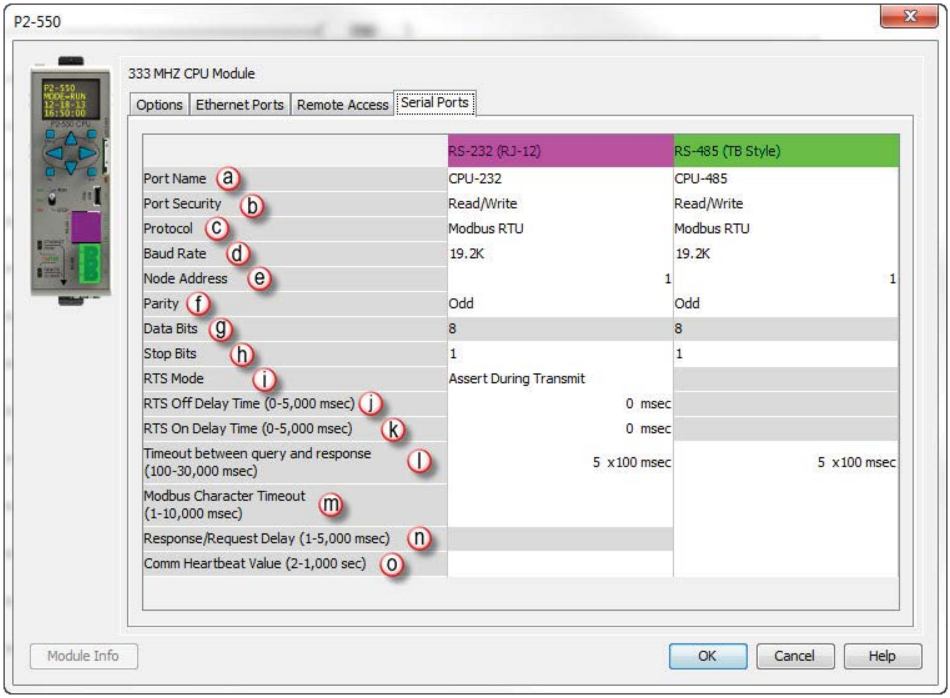
b. Session Timeout: Allows the user to set a specific time limit (1-20 mins.) on inactivity that will close the Web Server connection. If there is no activity between the PC and the Web Server for the specified time limit, the connection will close.

c. Mobile Function: Enables Remote Access which allows the CPU Data Remote Monitor App to monitor the selected tags.

d. Password Option: Allows the user to set a password for access to the Web Server.

- Enter an account name and password of up to a combination of 16 numbers and characters (can include special characters).

## Serial Configuration




When the Serial Ports Tab is selected, the Serial Ports settings are displayed as shown below.

There are two Serial Ports on the P2-550 CPU; an RS-232 Port with an RJ-12 connector and a 2-wire RS-485 Port with a removable three point terminal block. Both Ports are capable of Modbus RTU Client (device that initiates communications requests) and Server (device that responds to communications requests) communications. They are also capable of ASCII outgoing strings and incoming strings.

## RS-232 and RS-485 Port Settings

a. Port Name: Allows the entry of a unique name for the RS-232 and RS-485 Ports. This name is referenced inside of the Communications instructions (MRX, MWX, RX, WX) and ASCII instructions (AIN, AOUT, CPO, CPI) to select the Port to send or receive the request.

b. Port Security: This Option can be used as a simple Security measure to prevent Modbus TCP write requests from being accepted by the CPU. To allow Reads and Writes, select Read/Write.

c. Protocol: This field determines whether the Port is used for Modbus RTU communications, sending or receiving ASCII Strings or performing the Custom Protocol function.

d. Baud Rate: Choose the Baud Rate that your device and the CPU should communicate in this field. The appropriate choice will vary greatly with device, application and environment. The important point is that all devices communicating on the network need to be set to the same Baud Rate. The available Baud Rates are 1200, 2400, 9600, 19200, 33600, 38400, 57600 and 115200 bps.

## RS-232 and RS-485 Port Settings, cont'd

e. Node Address: This field is used only when the CPU is a Modbus RTU Server device. This field is used to uniquely identify the CPU on the network. This setting is also sometimes referred to as a Station Address. This field can be set from 1 to 247.

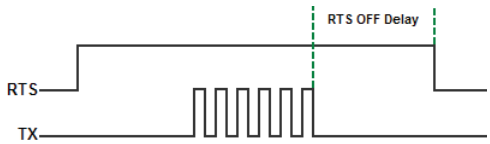
f. Parity: The Parity Bit is used as a simple, low-level form of Error Detection. All devices on the network need to be at the same Parity setting. The appropriate choice will vary with devices. Valid selections are None, Even and Odd.

g. Data Bits: This field determines whether the communications packet uses Seven Data Bits or Eight Data Bits. Eight Data Bits is the only valid selection for Modbus RTU. Either Seven or Eight Data Bits can be selected when using ASCII communications. Set this field to match the device that is connected to the CPU.

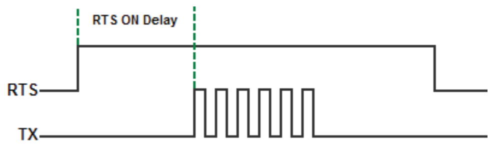
h. Stop Bits: This field determines whether the communications packet uses One or Two Stop Bits. Set this field to match the device that is connected to the CPU.

i. RTS Mode: This field allows selection of whether or not RTS is asserted during data transmition. Used for hardware handshaking in the standard way. You may need to manually configure RTS. Refer to your instrument documentation to determine its specific behavior.

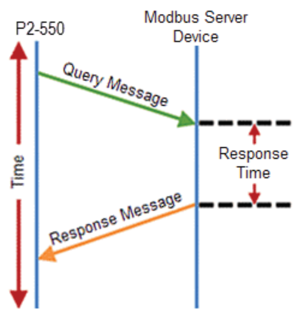





j. RTS Off Delay Time (RS-232 Only): This Time period is the amount of Time between the end of the data transmission to when the RTS signal is turned off. The diagram below illustrates this. This setting may be needed when using media converters (RS-232 to RS-422/485 converters) and/or radio modems. A delay may be needed at the end of the data transmission for processing time in the devices.



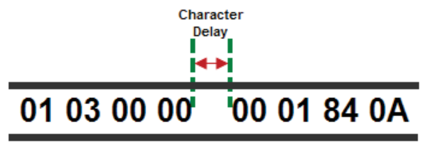

k. RTS On Delay Time (RS-232 Only): This Time period is the amount of Time between when the RTS Signal is turned ON and the data transmission begins. The diagram above illustrates this. This setting may be needed when using media converters (RS-232 to RS-485 converters) and/or radio modems. A delay may be needed after the assertion of the RTS Signal and when the data transmission begins for processing time in the device.




l. Timeout Between Query and Response: The Time period specified in this field is the Time between the queries sent from the CPU (via a Communication instruction, such as an MRX, MWX, RX, or WX) and the Time a Response from that device is Received. If the Response takes longer to receive (or is not received) than the specified Time period, a Timeout Error will occur for the given instruction. Each instruction has a Timeout Status bit that can be assigned to it.

## RS-232 and RS-485 Port Settings, cont'd

m. Modbus Character Timeout: The Modbus Character Delay Time is specified as the Time between two bytes (or characters) within a given Modbus Message. The Modbus RTU specification states that this time must be no more than 1.5 Character Times (real time based on Baud Rate). Sometimes delays do occur between bytes when using radio modems, media converters, etc. This setting allows some tolerance in these situations for the incoming Modbus Messages in the CPU. The CPU will wait for the amount of time specified in this field before discarding the incomplete packet. If the CPU does not receive the remainder of the Message within the specified Time Frame, it will discard the first portion of the Message and wait for a new Message.

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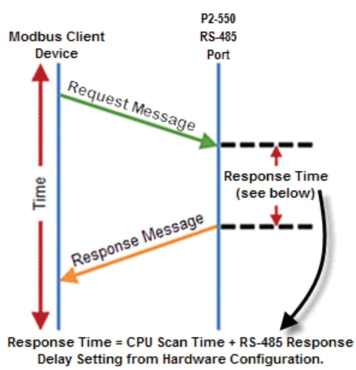
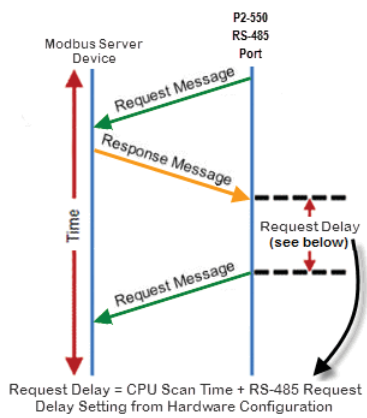
n. Response/Request Delay (RS-485 Only): This setting is used when the CPU is a Modbus RTU Server or Client on the RS-485 Port.

The total Response Time can be up to the Total CPU Scan Time + the Value specified in this field. When using 2-wire RS-485 communications, sometimes Echoes can occur since both devices use the same differential signal pair to send and receive.

- If acting as a Server (on left below), upon receiving a Modbus Request, the CPU will wait for the time period specified in this field before sending a Response. This can be used with slow clients that need extra time to change from sending to receiving.
- If acting as a Client (on right below), after receiving a Modbus Response, the CPU will wait for the time period specified in this field before sending another Request. This can be used to delay request messages in order to give extra time for slow server devices.



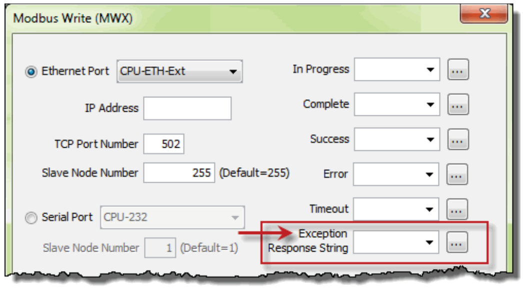




o. Comm Heartbeat Value: This feature allows the ladder logic in the CPU to know if a device has stopped communicating to the CPU. If a value is placed in this field, the CPU will start a timer between each communication packet coming in to the CPU. If a communication packet fails to be received by the CPU within the specified Time period, the System Bit RS-232 Heartbeat Timeout Bit or RS-485 Heartbeat Timeout Bit will become true.

# Communications: Error Codes

***Note:*** *The only time you will see Communications Error Codes is when the CPU is the Master of a Communications Network.*

To simplify the process of identifying a possible Error, the Productivity2000 CPU will automatically report to a specific memory location an Error Code that helps identify the existing issue. The Error Codes are reported in the Exception Response String Tag specified in the instruction as shown below.




The Exception Response String field is available on the following instructions:

- GS Drives Read
- GS Drives Write
- Modbus Read
- Modbus Write
- Network Read
- Network Write
- Dataworx Request

The Table shown below provides a list of Productivity2000 Communication Error Codes that may be reported by the Productivity CPU.

| Productivity2000 Communication Error Codes | | |
|---|---|---|
| **Error Code** | **Description** | **Suggested Fix** |
| 01 | Function Code not supported | Check instruction or connected device and correct Function code or address range selected. |
| 02 | Address out of range. This error is typically generated when a Modbus address has been requested that does not exist in the CPU. | Check instruction or connected device and correct Function code or address range selected. |
| 03 | Illegal Data Value. This error is typically generated when the Modbus request sent to the CPU is formed incorrectly. | Check the Modbus request against the Modbus protocol specification (www.modbus.org) to verify that it was formed correctly. |
| 04 | Device Failure | Check connected device |
| 06 | Slave Device is Busy. This error is typically due to excess communications to the EDRV. | Slow down the poll rate in the GS instruction. |

# P2000 EtherNet/IP Error Codes

✔ --- CPU server currently supported errors ✘ --- CPU server (will not generate error) Note: Other adapters may generate this error

| P2000 EtherNet/IP Error Codes | | | | |
|---|---|---|---|---|
| **General Status Error** | **Extended Status Error** | **Name** | **Description** | **P2000 Supported** |
| 0x01 | 0x0100 | Connection In Use/ Duplicate Forward Open | A connection is already established from the target device sending a Forward Open request or the target device has sent multiple forward open request. This could be caused by poor network traffic. Check the cabling, switches and connections. | ✔ |
| 0x01 | 0x0103 | Transport Class/ Trigger Combination not supported | The Transport class and trigger combination is not supported. The Productivity2000 CPU only supports Class 1 and Class 3 transports and triggers: Change of State and Cyclic. | ✔ |
| 0x01 | 0x0106 | Owner Conflict | An existing exclusive owner has already configured a connection to this Connection Point. Check to see if other Scanner devices are connected to this adapter or verify that Multicast is supported by adapter device if Multicast is selected for Forward Open. This could be caused by poor network traffic. Check the cabling, switches and connections. | ✔ |
| 0x01 | 0x0107 | Target Connection Not Found | This occurs if a device sends a Forward Close on a connection and the device can't find this connection. This could occur if one of these devices has powered down or if the connection timed out on a bad connection. This could be caused by poor network traffic. Check the cabling, switches and connections. | ✔ |
| 0x01 | 0x0108 | Invalid Network Connection Parameter | This error occurs when one of the parameters specified in the Forward Open message is not supported such as Connection Point, Connection type, Connection priority, redundant owner or exclusive owner. The Productivity2000 CPU does not return this error and will instead use errors 0x0120, 0x0121, 0x0122, 0x0123, 0x0124, 0x0125 or 0x0132 instead. | ✔ |
| 0x01 | 0x0109 | Invalid Connection Size | This error occurs when the target device doesn't support the requested connection size. Check the documentation of the manufacturer's device to verify the correct Connection size required by the device. Note that most devices specify this value in terms of bytes. The Productivity2000 CPU does not return this error and will instead use errors 0x0126, 0x0127 and 0x0128. | ✘ |
| 0x01 | 0x0110 | Target for Connection Not Configured | This error occurs when a message is received with a connection number that does not exist in the target device. This could occur if the target device has powered down or if the connection timed out. This could be caused by poor network traffic. Check the cabling, switches and connections. | ✘ |
| 0x01 | 0x0111 | RPI Not Supported | This error occurs if the Originator is specifying an RPI that is not supported. The Productivity2000 CPU will accept a minimum value of 10ms on a CIP Forward Open request. However, the CPU will produce at the specified rate up to the scan time of the installed project. The CPU cannot product any faster than the scan time of the running project. | ✔ |

| P2000 EtherNet/IP Error Codes | | | | |
|---|---|---|---|---|
| **General Status Error** | **Extended Status Error** | **Name** | **Description** | **P2000 Supported** |
| 0x01 | 0x0112 | RPI Value not acceptable | This error can be returned if the Originator is specifying an RPI value that is not acceptable. There may be six additional values following the extended error code with the acceptable values. An array can be defined for this field in order to view the extended error code attributes. If the Target device supports extended status, the format of the values will be as shown below:<br>• Unsigned Integer 16, Value = 0x0112, Explanation: Extended Status code<br>• Unsigned Integer 8, Value = variable, Explanation: Acceptable Originator to Target RPI type, values: 0 = The RPI specified in the forward open was acceptable (O -> T value is ignored), 1 = unspecified (use a different RPI), 2 = minimum acceptable RPI (too fast), 3 = maximum acceptable RPI (too slow), 4 = required RPI to corrected mismatch (data is already being consumed at a different RPI), 5 to 255 = reserved.<br>• Unsigned Integer 32, Value = variable, Explanation: Value of O -> T RPI that is within the acceptable range for the application.<br>• Unsigned Integer 32, Value = variable, Explanation: Value of T -> O RPI that is within the acceptable range for the application. | ✗ |
| 0x01 | 0x0113 | Out of Connections | The Productivity2000 EtherNet/IP Adapter connection limit of 4 when doing Class 3 connections has been reached. An existing connection must be dropped in order for a new one to be generated. | ✓ |
| 0x01 | 0x0114 | Vendor ID or Product Code Mismatch | The compatibility bit was set in the Forward Open message but the Vendor ID or Product Code did not match. | ✓ |
| 0x01 | 0x0115 | Device Type Mismatch | The compatibility bit was set in the Forward Open message but the Device Type did not match. | ✓ |
| 0x01 | 0x0116 | Revision Mismatch | The compatibility bit was set in the Forward Open message but the major and minor revision numbers were not a valid revision. | ✓ |
| 0x01 | 0x0117 | Invalid Produced or Consumed Application Path | This error is returned from the Target device when the Connection Point parameters specified for the O -> T (Output) or T -> O (Input) connection is incorrect or not supported. The Productivity2000 CPU does not return this error and uses the following error codes instead: 0x012A, 0x012B or 0x012F. | ✗ |
| 0x01 | 0x0118 | Invalid or Inconsistent Configuration Application Path | This error is returned from the Target device when the Connection Point parameter specified for the Configuration data is incorrect or not supported. The Productivity2000 CPU does not return this error and uses the following error codes instead: 0x0129 or 0x012F. | ✗ |
| 0x01 | 0x0119 | Non-listen Only Connection Not Opened | This error code is returned when an Originator device attempts to establish a listen only connection and there is no non-listen only connection established. The Productivity2000 CPU does not support listen only connections as Scanner or Adapter. | ✓ |

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| P2000 EtherNet/IP Error Codes | | | | |
|---|---|---|---|---|
| **General Status Error** | **Extended Status Error** | **Name** | **Description** | **P2000 Supported** |
| 0x01 | 0x011A | Target Object Out of Connections | The maximum number of connections supported by this instance of the object has been exceeded. | ✗ |
| 0x01 | 0x011B | RPI is smaller than the Production Inhibit Time | The Target to Originator RPI is smaller than the Target to Originator Production Inhibit Time. Consult the manufacturer's documentation as to the minimum rate that data can be produced and adjust the RPI to greater than this value. | ✗ |
| 0x01 | 0x011C | Transport Class Not Supported | The Transport Class requested in the Forward Open is not supported. Only Class 1 and Class 3 classes are supported in the Productivity2000 CPU. | ✗ |
| 0x01 | 0x011D | Production Trigger Not Supported | The Production Trigger requested in the Forward Open is not supported. In Class 1, only Cyclic and Change of state are supported in the Productivity2000 CPU. In Class 3, Application object is supported. | ✗ |
| 0x01 | 0x011E | Direction Not Supported | The Direction requested in the Forward Open is not supported. | ✗ |
| 0x01 | 0x011F | Invalid Originator to Target Network Connection Fixed/ Variable Flag | The Originator to Target fixed/variable flag specified in the Forward Open is not supported . Only Fixed is supported in the Productivity2000 CPU. | ✗ |
| 0x01 | 0x0120 | Invalid Target to Originator Network Connection Fixed/ Variable Flag | The Target to Originator fixed/variable flag specified in the Forward Open is not supported. Only Fixed is supported in the Productivity2000 CPU. | ✗ |
| 0x01 | 0x0121 | Invalid Originator to Target Network Connection Priority | The Originator to Target Network Connection Priority specified in the Forward Open is not supported. Low, High, Scheduled and Urgent are supported in the Productivity2000 CPU. | ✗ |
| 0x01 | 0x0122 | Invalid Target to Originator Network Connection Priority | The Target to Originator Network Connection Priority specified in the Forward Open is not supported. Low, High, Scheduled and Urgent are supported in the Productivity2000 CPU. | ✗ |
| 0x01 | 0x0123 | Invalid Originator to Target Network Connection Type | The Originator to Target Network Connection Type specified in the Forward Open is not supported. Only Unicast is supported for O -> T (Output) data in the Productivity2000 CPU. | ✓ |
| 0x01 | 0x0124 | Invalid Target to Originator Network Connection Type | The Target to Originator Network Connection Type specified in the Forward Open is not supported. Multicast and Unicast is supported in the Productivity2000 CPU. Some devices may not support one or the other so if this error is encountered try the other method. | ✓ |
| 0x01 | 0x0125 | Invalid Originator to Target Network Connection Redundant_Owner | The Originator to Target Network Connection Redundant_Owner flag specified in the Forward Open is not supported. Only Exclusive owner connections are supported in the Productivity2000 CPU. | ✓ |
| 0x01 | 0x0126 | Invalid Configuration Size | This error is returned when the Configuration data sent in the Forward Open does not match the size specified or is not supported by the Adapter. The Target device may return an additional Unsigned Integer 16 value that specifies the maximum size allowed for this data. An array can be defined for this field in order to view the extended error code attributes. | ✗ |

| P2000 EtherNet/IP Error Codes | | | | |
|---|---|---|---|---|
| **General Status Error** | **Extended Status Error** | **Name** | **Description** | **P2000 Supported** |
| 0x01 | 0x0127 | Invalid Originator to Target Size | This error is returned when the Originator to Target (Output data) size specified in the Forward Open does not match what is in the Target. Consult the documentation of the Adapter device to verify the required size. Note that if the Run/Idle header is requested, it will add 4 additional bytes and must be accounted for in the Forward Open calculation. The Productivity2000 CPU always requires the Run/Idle header so if the option doesn't exist in the Scanner device, you must add an additional 4 bytes to the O -> T (Output) setup. Some devices may publish the size that they are looking for as an additional attribute (Unsigned Integer 16 value) of the Extended Error Code. An array can be defined for this field in order to view the extended error code attributes.<br>Note:This error may also be generated when a Connection Point value that is invalid for IO Messaging (but valid for other cases such as Explicit Messaging) is specified, such as 0. Please verify if the Connection Point value is valid for IO Messaging in the target device. | ✓ |
| 0x01 | 0x0128 | Invalid Target to Originator Size | This error is returned when the Target to Originator (Input data) size specified in the Forward Open does not match what is in Target. Consult the documentation of the Adapter device to verify the required size. Note that if the Run/Idle header is requested, it will add 4 additional bytes and must be accounted for in the Forward Open calculation. The Productivity2000 CPU does not support a Run/Idle header for the T -> O (Input) data. Some devices may publish the size that they are looking for as an additional attribute (Unsigned Integer 16 value) of the Extended Error Code. An array can be defined for this field in order to view the extended error code attributes.<br>Note:This error may also be generated when a Connection Point value that is invalid for IO Messaging (but valid for other cases such as Explicit Messaging) is specified, such as 0. Please verify if the Connection Point value is valid for IO Messaging in the target device. | ✓ |
| 0x01 | 0x0129 | Invalid Configuration Application Path | This error will be returned by the Productivity2000 CPU if a Configuration Connection with a size other than 0 is sent to the CPU. The Configuration Connection size must always be zero if it this path is present in the Forward Open message coming from the Scanner device. | ✓ |
| 0x01 | 0x012A | Invalid Consuming Application Path | This error will be returned by the Productivity3000 CPU if the Consuming (O -> T) Application Path is not present in the Forward Open message coming from the Scanner device or if the specified Connection Point is incorrect. | ✓ |
| 0x01 | 0x012B | Invalid Producing Application Path | This error will be returned by the Productivity2000 CPU if the Producing (T -> O) Application Path is not present in the Forward Open message coming from the Scanner device or if the specified Connection Point is incorrect. | ✓ |
| 0x01 | 0x012C | Config. Symbol Does not Exist | The Originator attempted to connect to a configuration tag name that is not supported in the Target. | ✗ |
| 0x01 | 0x012D | Consuming Symbol Does not Exist | The Originator attempted to connect to a consuming tag name that is not supported in the Target. | ✗ |
| 0x01 | 0x012E | Producing Symbol Does not Exist | The Originator attempted to connect to a producing tag name that is not supported in the Target. | ✗ |
| 0x01 | 0x012F | Inconsistent Application Path Combination | The combination of Configuration, Consuming and Producing application paths specified are inconsistent. | ✗ |

| P2000 EtherNet/IP Error Codes | | | | |
|---|---|---|---|---|
| **General Status Error** | **Extended Status Error** | **Name** | **Description** | **P2000 Supported** |
| 0x01 | 0x0130 | Inconsistent Consume data format | Information in the data segment not consistent with the format of the data in the consumed data. | ✗ |
| 0x01 | 0x0131 | Inconsistent Product data format | Information in the data segment not consistent with the format of the data in the produced data. | ✗ |
| 0x01 | 0x0132 | Null Forward Open function not supported | The target device does not support the function requested in the NULL Forward Open request. The request could be such items as “Ping device”, “Configure device application”, etc. | ✗ |
| 0x01 | 0x0133 | Connection Timeout Multiplier not acceptable | The Connection Multiplier specified in the Forward Open request not acceptable by the Target device (once multiplied in conjunction with the specified timeout value). Consult the manufacturer device’s documentation on what the acceptable timeout and multiplier are for this device. | ✗ |
| 0x01 | 0x0203 | Connection Timed Out | This error will be returned by the Productivity2000 CPU if a message is sent to the CPU on a connection that has already timed out. Connections time out if no message is sent to the CPU in the time period specified by the RPI rate X Connection multiplier specified in the Forward Open message. | ✗ |
| 0x01 | 0x0204 | Unconnected Request Timed Out | This time out occurs when the device sends an Unconnected Request and no response is received within the specified time out period. In the Productivity2000 CPU, this value may be found in the hardware configuration under the Ethernet port settings for the P2-550. | ✓ |
| 0x01 | 0x0205 | Parameter Error in Unconnected Request Service | This error occurs when Connection Tick Time/ Connection time-out combination is specified in the Forward Open or Forward Close message this is not supported by the device. | ✗ |
| 0x01 | 0x0206 | Message Too Large for Unconnected_Send Service | Occurs when Unconnected_Send message is too large to be sent to the network. | ✗ |
| 0x01 | 0x0207 | Unconnected Acknowledge without Reply | This error occurs if an Acknowledge was received but no data response occurred. Verify that the message that was sent is supported by the Target device using the device manufacturer’s documentation. | ✗ |
| 0x01 | 0x0301 | No Buffer Memory Available | This error occurs if the Connection memory buffer in the target device is full. Correct this by reducing the frequency of the messages being sent to the device and/or reducing the number of connections to the device. Consult the manufacturer’s documentation for other means of correcting this. | ✗ |
| 0x01 | 0x0302 | Network Bandwidth not Available for Data | This error occurs if the Producer device cannot support the specified RPI rate when the connection has been configured with schedule priority. Reduce the RPI rate or consult the manufacturer’s documentation for other means to correct this. | ✗ |
| 0x01 | 0x0303 | No Consumed Connection ID Filter Available | This error occurs if a Consumer device doesn’t have an available consumed_connection_id filter. | ✗ |
| 0x01 | 0x0304 | Not Configured to Send Scheduled Priority Data | This error occurs if a device has been configured for a scheduled priority message and it cannot send the data at the scheduled time slot. | ✗ |

| P2000 EtherNet/IP Error Codes | | | | |
|---|---|---|---|---|
| **General Status Error** | **Extended Status Error** | **Name** | **Description** | **P2000 Supported** |
| 0x01 | 0x0305 | Schedule Signature Mismatch | This error occurs if the schedule priority information does not match between the Target and the Originator. | ✗ |
| 0x01 | 0x0306 | Schedule Signature Validation not Possible | This error occurs when the schedule priority information sent to the device is not validated. | ✗ |
| 0x01 | 0x0311 | Port Not Available | This error occurs when a port number specified in a port segment is not available. Consult the documentation of the device to verify the correct port number. | ✗ |
| 0x01 | 0x0312 | Link Address Not Valid | The Link address specified in the port segment is not correct. Consult the documentation of the device to verify the correct port number. | ✗ |
| 0x01 | 0x0315 | Invalid Segment in Connection Path | This error occurs when the target device cannot understand the segment type or segment value in the Connection Path. Consult the documentation of the device to verify the correct segment type and value. If a Connection Point greater than 255 is specified this error could occur. | ✓ |
| 0x01 | 0x0316 | Forward Close Service Connection Path Mismatch | This error occurs when the Connection path in the Forward Close message does not match the Connection Path configured in the connection. Contact Tech Support if this error persists. | ✗ |
| 0x01 | 0x0317 | Scheduling Not Specified | This error can occur if the Schedule network segment or value is invalid. | ✗ |
| 0x01 | 0x0318 | Link Address to Self Invalid | If the Link address points back to the originator device, this error will occur. | ✗ |
| 0x01 | 0x0319 | Secondary Resource Unavailable | This occurs in a redundant system when the secondary connection request is unable to duplicate the primary connection request. | ✗ |
| 0x01 | 0x031A | Rack Connection Already established | The connection to a module is refused because part or all of the data requested is already part of an existing rack connection. | ✗ |
| 0x01 | 0x031B | Module Connection Already established | The connection to a rack is refused because part or all of the data requested is already part of an existing module connection. | ✗ |
| 0x01 | 0x031C | Miscellaneous | This error is returned when there is no other applicable code for the error condition. Consult the manufacturer's documentation or contact Tech support if this error persist. | ✗ |
| 0x01 | 0x031D | Redundant Connection Mismatch | This error occurs when these parameters don't match when establishing a redundant owner connection: O -> T RPI, O -> T Connection Parameters, T -> O RPI, T -> O Connection Parameters and Transport Type and Trigger. | ✗ |
| 0x01 | 0x031E | No more User Configurable Link Resources Available in the Producing Module | This error is returned from the Target device when no more available Consumer connections available for a Producer. | ✗ |

| P2000 EtherNet/IP Error Codes | | | | |
|---|---|---|---|---|
| **General Status Error** | **Extended Status Error** | **Name** | **Description** | **P2000 Supported** |
| 0x01 | 0x031F | **No User Configurable Link Consumer Resources Configured in the Producing Module** | **This error is returned from the Target device when no Consumer connections have been configured for a Producer connection.** | ✗ |
| 0x01 | 0x0800 | **Network Link Offline** | **The Link path is invalid or not available.** | ✗ |
| 0x01 | 0x0810 | **No Target Application Data Available** | **This error is returned from the Target device when the application has no valid data to produce.** | ✗ |
| 0x01 | 0x0811 | **No Originator Application Data Available** | **This error is returned from the Originator device when the application has no valid data to produce.** | ✗ |
| 0x01 | 0x0812 | **Node Address has changed since the Network was scheduled** | **This specifies that the router has changed node addresses since the value configured in the original connection.** | ✗ |
| 0x01 | 0x0813 | **Not Configured for Off-subnet Multicast** | **The producer has been requested to support a Multicast connection for a consumer on a different subnet and does not support this functionality.** | ✗ |
| 0x01 | 0x0814 | **Invalid Produce/ Consume Data format** | **Information in the data segment not consistent with the format of the data in the consumed or produced data. Errors 0x0130 and 0x0131 are typically used for this situation in most devices now.** | ✗ |
| 0x02 | N/A | **Resource Unavailable for Unconnected Send** | **The Target device does not have the resources to process the Unconnected Send request.** | ✗ |
| 0x04 | N/A | **Path Segment Error in Unconnected Send** | **The Class, Instance or Attribute value specified in the Unconnected Explicit Message request is incorrect or not supported in the Target device. Check the manufacturer's documentation for the correct codes to use.** | ✗ |
| 0x09 | Index to error | **Error in Data Segment** | **This error code is returned when an error is encountered in the Data segment portion of a Forward Open message. The Extended Status value is the offset in the Data segment where the error was encountered.** | ✗ |
| 0x0C | Optional | **Object State Error** | **This error is returned from the Target device when the current state of the Object requested does not allow it to be returned. The current state can be specified in the Optional Extended Error status field.** | ✗ |
| 0x10 | Optional | **Device State Error** | **This error is returned from the Target device when the current state of the Device requested does not allow it to be returned. The current state can be specified in the Optional Extended Error status field.** | ✗ |
| 0x13 | N/A | **Not Enough Data** | **Not enough data was supplied in the service request specified.** | ✗ |
| 0x15 | N/A | **Too Much Data** | **Too much data was supplied in the service request specified.** | ✗ |

# MAINTENANCE AND TROUBLESHOOTING

CHAPTER 7

## In This Chapter...

# Hardware Maintenance

## Standard Maintenance

The Productivity2000 is a low maintenance system requiring only a few periodic checks to help reduce the risks of problems. Routine maintenance checks should be made regarding two key items.

- Air quality (cabinet temperature, airflow, etc.)
- CPU battery

## Air Quality Maintenance

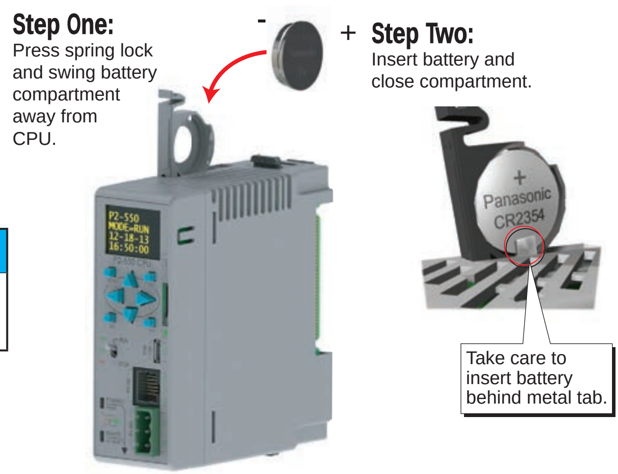
The quality of the air your system is exposed to can affect system performance. If you have placed your system in an enclosure, check to see that the ambient temperature is not exceeding the operating specifications. If there are filters in the enclosure, clean or replace them as necessary to ensure adequate airflow. A good rule of thumb is to check your system environment every one to two months. Make sure the Productivity2000 is operating within the system operating specifications.



## CPU Battery Replacement

A battery is included with the CPU, but is not installed. The battery can be installed to retain the Time and Date along with any Tagname values that are set up as retentive.

The battery is not needed for program backup.




| Battery (Optional) | |
|---|---|
| D2-BAT-1 | Coin type, 3.0V Lithium battery, 560mA, battery number CR2354 |

# Diagnostics

## Diagnostics

Your Productivity2000 system performs many pre-defined diagnostic routines with every CPU scan. The diagnostics have been designed to detect various types of failures for the CPU and I/O modules. There are two primary error classes, critical and non-critical.

## Critical Errors

Critical errors are errors the CPU has detected that offer a risk of the system not functioning safely or properly. If the CPU is in Run Mode when the critical error occurs, the CPU will switch to Stop Mode (Remember, in Stop Mode all outputs are turned off). If the critical error is detected while the CPU is in Stop Mode, the CPU will not enter Run Mode until the error has been corrected. Here are some examples of critical errors:

- Base power supply failure
- Parity error or CPU malfunction
- I/O configuration errors
- Certain programming errors.



## Non-Critical Errors

Non-critical errors are flagged by the CPU as requiring attention. They can neither cause the CPU to change from Run Mode to Stop Mode, nor do they prevent the CPU from entering Run Mode. There are system tags the application program can use to detect if a non-critical error has occurred. The application program can be used to take the system to an orderly shutdown or to switch the CPU to Stop Mode if necessary.

Some examples of non-fatal errors are:

- Backup battery voltage low
- All I/O module errors
- Certain programming errors.

## Finding Diagnostic Information

The CPU automatically logs critical and non-critical error codes. Logged errors can be found in the following places marked with a time and date stamp:

- Displayed on OLED of the CPU module by scrolling through the menu.
- Under the Monitor Debug tool of ProductivitySuite, in the CPU Error History window, the 20 most recent critical and non-critical errors are listed.

## Error Codes

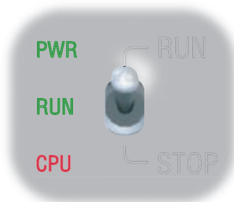
See Appendix B "Productivity2000 Error Codes" for a complete list of error messages sorted by error types.

# CPU Indicators

The Productivity2000 CPU has indicators on the faceplate to help diagnose problems with the system. The table below gives a quick reference of potential problems associated with each status indicator. The pages following the table contain a detailed analysis of each of these indicator problems.

| Indicator Status | Potential Problems |
|---|---|
| PWR (off) | 1. System voltage is incorrect. |
| | 2. Power supply/CPU is faulty. |
| | 3. Other components such as an I/O module has power supply shorted. |
| RUN (will not come on) | 1. CPU programming error |
| | 2. Switch in STOP position |
| CPU (blink) | CPU internal error |




| CPU Status Indicators | |
|---|---|
| PWR | Green LED is illuminated when power is on |
| RUN | Green LED is illuminated when CPU is in RUN mode |
| CPU | Red LED is illuminated during power on reset, power down, or watch-dog time-out. |

# PWR Indicator

There are three general reasons for the CPU power status LED (PWR) to be OFF:

1. Power to the base is incorrect or is not applied.
2. Base power supply is faulty.
3. Other component(s) have the power supply shut down.

## Incorrect Base Power

If the voltage to the power supply is not correct, the CPU and/or base may not operate properly or may not operate at all. Use the following guidelines to correct the problem.

**WARNING: To minimize the risk of electrical shock, always disconnect the system power before inspecting the physical wiring.**

1. First, disconnect the system power and check all incoming wiring for loose connections.
2. If you are using a separate termination panel, check those connections to make sure the wiring is connected to the proper location.
3. If the connections are acceptable, reconnect the system power and measure the voltage at the base terminal strip to ensure it is within specification. If the voltage is not correct, shut down the system and correct the problem.
4. If all wiring is connected correctly and the incoming power is within the specifications required, the base power supply should be returned for repair.

## Faulty CPU

There is no simple test for a faulty CPU other than substituting a known good one to see if this corrects the problem. If you have experienced major power surges, it is possible the CPU and power supply have been damaged. If you suspect this is the cause, a line conditioner should be installed on the incoming line. This will keep damaging voltage spikes from reaching the CPU.

# PWR Indicator, cont'd

## Device or Module Causes the Power Supply to Shutdown

Module:

If the PWR LED is operating normally but the power supply shuts down, check each module for a possible bent pin on the base connector as follows:

1. Turn off power to the base.
2. Remove a module from the base.
3. Reapply power to the base.
4. Check  for power supply normal operation.
5. Repeat procedure until defective module is found and replaced.



Device:

A 5V charge may be originating from the base or CPU communications port.

Test as follows:

1. Turn off power to the CPU.
2. Disconnect all external devices (i.e., communication cables) from the CPU.
3. Reapply power.
4. If power supply operates normally then check for a shorted device or shorted cable.

## Run Indicator

If the CPU will not enter the Run mode (the RUN indicator is off), the problem is usually in the application program, unless the CPU has a critical error. If a critical error has occurred, the CPU LED should be on. You can use a programming device to determine the cause of the error.

A complete list of error codes can be found in Appendix B.

## CPU Indicator

If the CPU indicator is on, a critical error has occurred in the CPU. Generally, this is not a programming problem but an actual hardware error. The CPU indicator should blink briefly and then do an automatic reboot.

If the error clears, you should monitor the system and determine what caused the problem. You will find this problem is sometimes caused by high frequency electrical noise introduced into the CPU from an outside source. Check your system grounding and install electrical noise filters if the grounding is suspected. If power cycling the system does not reset the error, or if the problem returns, you should replace the CPU.



## Communications Problems

If a communication error occurs, the indicator will come on and stay on until a successful communication has been completed. If you cannot establish communications with the CPU, check these items:

- The cable is disconnected.
- The cable has a broken wire or has been wired incorrectly.
- The cable is improperly terminated or grounded.
- The device connected is not operating at the correct baud rate.
- The device connected to the port is sending data incorrectly.
- A grounding difference exists between the two devices.
- Electrical noise is causing intermittent errors.
- The CPU has a bad communication port; the CPU should be replaced.

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# I/O Module Troubleshooting

## Things to Check

If you suspect an I/O error, there are several things that could be causing the problem.

- A blown fuse
- A loose terminal block
- The 24 VDC supply has failed
- The module has failed
- The I/O configuration check detects a change in the I/O configuration

## Error Codes

See Appendix B for Productivity2000 error code information.

Also, in the Productivity Suite programming software, you can go to:

Tools > CPU Error History, and

Tools > CPU Event History

Next, click on “CPU Error”or “Event History” tab to get an updated list of critical errors, non-critical errors and event history that should indicate problems or changes to the I/O. This list will give the “GBS” (group, base, slot numbers).

## Some Quick Steps

When troubleshooting the Productivity2000 I/O modules there are a few facts you should be aware of which may assist you in quickly correcting an I/O problem:

- The output modules cannot detect shorted or open output points. If you suspect one or more points on a output module to be faulty, you should measure the voltage drop from the common to the suspect point. Remember, when using a Digital Volt Meter, leakage current from an output device, such as a triac or a transistor, must be considered. A point which is off may appear to be ON if no load is connected to the point.
- The I/O point status indicators on the modules are logic side indicators. This means the LED which indicates the ON or OFF status reflects the status of the point in respect to the CPU. For an output module, the status indicators could be operating normally, while the actual output device (transistor, triac etc.) could be damaged. With an input module, if the indicator LED is ON, the input circuitry should be operating properly. To verify proper functionality, check to see that the LED goes off when the input signal is removed.
- Leakage current can be a problem when connecting field devices to I/O modules. False input signals can be generated when the leakage current of an output device is great enough to turn on the connected input device. To correct this, install a resistor in parallel with the input or output of the circuit. The value of this resistor will depend on the amount of leakage current and the voltage applied but usually a 10K to 20K resistor will work. Ensure the wattage rating of the resistor is correct for your application.
- The easiest method to determine if a module has failed is to replace it if you have a spare. However, if you suspect another device to have caused the failure in the module, that device may cause the same failure in the replacement module as well. As a point of caution, you may want to check devices or power supplies connected to the failed module before replacing it with a spare module.

## Testing Output Points

Output points can be set ON or OFF using the force function to override a point even while the program is running. However, this is not a recommended method to test the output points. If you want to do an I/O check independent of the application program, follow the procedure in the table below:

| Step | Action |
|---|---|
| 1. | Use Productivity Suite programming software to communicate online to the CPU. |
| 2. | Change to Program Mode. |
| 3. | Go to the first rung of the ladder. |
| 4. | Insert a rung with an "END" statement. (This will cause program execution to occur only at address 0 and prevent the application program from turning the I/O points on or off). |
| 5. | Change to Run Mode. |
| 6. | Use the programming device to set (turn) on or off the points you wish to test. |
| 7. | When you finish testing I/O points delete the "END" statement at the first rung. |



**WARNING: Depending on your application, forcing I/O points may cause unpredictable machine operation that can result in a risk of personal injury or equipment damage. Make sure you have taken all appropriate safety precautions prior to testing any I/O points.**

***NOTE:*** *The LED on Analog I/O modules displays actual voltage, current, and digital values without connecting a meter.*

# Noise Troubleshooting

## Electrical Noise Problems

Noise is one of the most difficult problems to diagnose. Electrical noise, whether conducted or radiated, can enter a system in many different ways. It may be difficult to determine how the noise is entering the system but the corrective actions for either type of noise problem are similar.

- Conducted noise is when the electrical interference is introduced into the system by way of an attached wire, panel connection, etc. It may enter through an I/O module, a power supply connection, the communication ground connection, or the chassis ground connection.
- Radiated noise is when the electrical interference is introduced into the system without a direct electrical connection, much in the same manner as radio waves.

## Reducing Electrical Noise

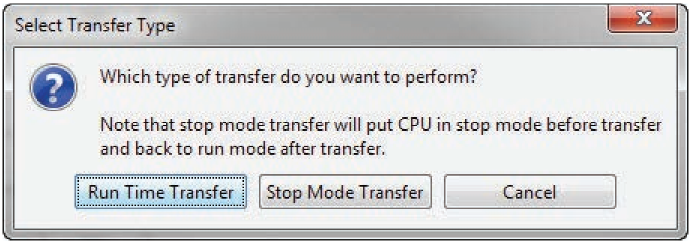
While electrical noise cannot be eliminated completely, it can be reduced to a level that will not affect system function. Proper grounding of components and signal wiring along with proper isolation of voltages can minimize noise in the system.



1. Grounding:
   - Most noise problems result from improper grounding of the system. A good earth ground can be the single most effective way to correct noise problems. If a ground is not available, install a ground rod as close to the system as possible.
   - Ensure all ground wires are single point grounds and are not daisy chained from one device to another. Ground metal enclosures around the system. A loose wire is no more than a large antenna waiting to introduce noise into the system; therefore, you should tighten all connections in your system. Loose ground wires are more susceptible to noise than the other wires in your system. Review Chapter 5, “Installation and Wiring”, if you have questions regarding how to ground your system.
2. Isolation:
   - Electrical noise can enter the system through the power source for the CPU and I/O. Installing an isolation transformer for all AC sources can correct this problem.
   - DC power sources should be well grounded, good quality power supplies. Switching DC power supplies commonly generate more noise than linear supplies.
   - Separate input wiring from output wiring. Never run I/O wiring close to high voltage wiring.

# Run Time vs. Stop Mode Transfer Instruction

Here we describe the actions and differences between Run Time & Stop Mode transfers as shown in this dialog box.



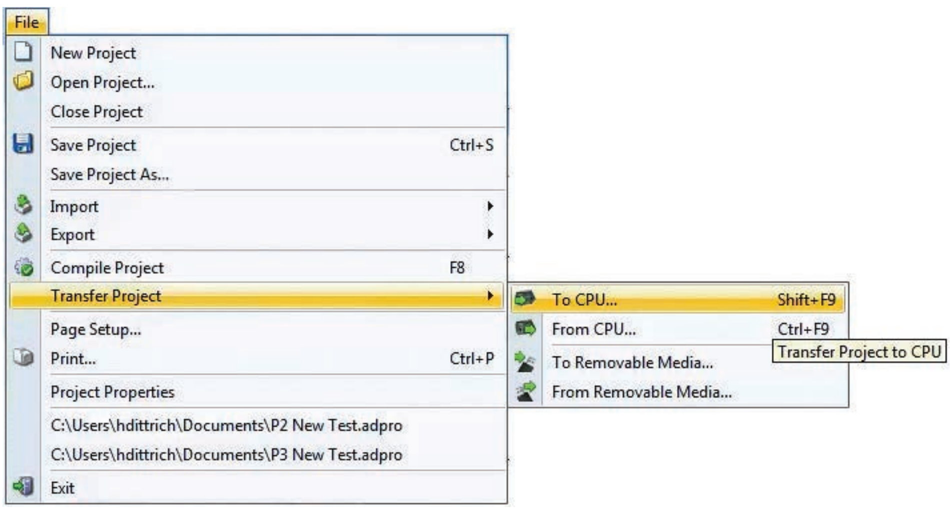

The above dialog is accessed two ways: (only when CPU is online AND in run mode)

Perform either of the following to transfer project to the CPU:

1. Click on the "To CPU" icon on the Tool Bar, or 


2. Click through from the File menu > Transfer Project > To CPU.





## Run Time Transfers

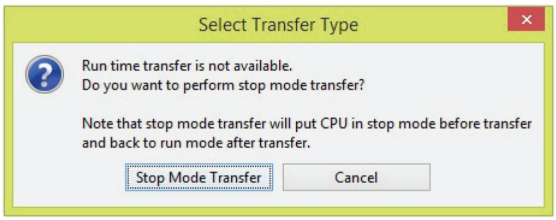
Run Time Transfer allows the user to transfer edits to a project in the CPU without stopping the CPU scan, therefore not stopping the process. Be aware that a Run Time Transfer will affect the length of your scan time, which should be considered if your process is susceptible to varying or lengthy scan times. The download time is longer compared to a Stop Mode transfer.

During a Run Time transfer, the current project file continues running until the entire project file is transferred to the CPU. Once downloaded, the ladder logic files swap and begin executing the new file. The Tag Database is shared between the two project files during a Run Time transfer, therefore current operating values will not be effected.

Because the Tag database is shared, any edits to the Tag database will force a Stop Mode transfer.

## Stop Mode Transfers






Stop Mode Transfers allows the user to transfer any and all ladder, Tag Database and configuration changes to the CPU.

Because the CPU is in stop mode, the project transfer is much faster than a Run Time Transfer and also loads all initial values to the tags once the project is switched from Stop to Run.

Following are conditions that will force the user to perform a **Stop Mode Transfer**:

1. Any changes to the hardware configuration, such as:
    A. Adding or removing hardware.
    B. Changing the configuration of a piece of hardware.
    - Ethernet or serial port configuration.
    - Hot swap enable or disable on any module or base.

    C. Adding an EhterNet/IP device and any configured changes
2. Adding > 5000 tags of any type (Excluding Strings and Structures).

***NOTE:** This limit is accumulated between each stop mode transfer.*

3. Adding >50,000 characters or changing the length of a **String** data type Tag.

***NOTE:** This limit is accumulated between each stop mode transfer.*

4. Changes to Data Logger.

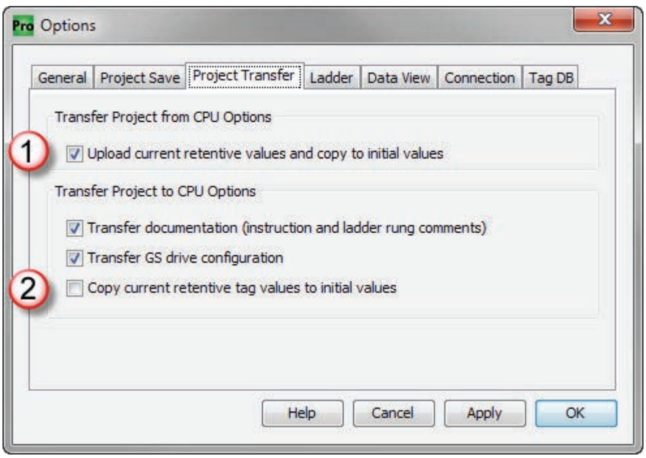
5. Changes to Modbus Server settings under **Project Properties**.
6. Changes to the buffer size for a FILI instruction.
7. Adding >5,000 elements of a **Structures** data type to **Tag Database**.

***NOTE:*** *This limit is accumulated between each stop mode transfer.*

8. Enabling **Bit of Word** under **Project Properties**.
9. Enabling Structures in **Project Properties**.
10. Enable and Disable of **EhterNet/IP Adapter**.

As the CPU goes from Stop to Run after a Stop Mode Transfer, tags are initialized as if the project is being executed for the first time. This includes Retentive Tags. If it's desirable that the values of Retentive Tags be retained through a Stop Mode Transfer, there are two methods available. Both options may be enabled and they can be found under Tools > Options > Project Transfer

1. Upload current retentive values and copy to initial values. This option works during program upload. When selected, place the CPU in Stop Mode so Retentive Tag values are stable, then upload the project. Productivity Suite will copy the current value of all Retentive Tags to their Initial Values in the Tag Database of the project. Perform your edits and transfer the project back to the CPU. When the CPU goes back to run, your Retentive Tags will be initialized with their old values. This is a simple process and is convenient for quick edits to the program, but the CPU must remain in Stop Mode while the project is edited to ensure that no retentive values have changed during editing.




2. Copy current retentive tag values to initial values. This option works during program download. This process is more involved, but the CPU will use the values from the project currently running as the initial values of the project being transferred. For more information refer to the Options topic in the help file.

# Forcing I/O Points

Following is a description of the actions, expectations and indications of forcing a value in the Productivity2000 controller.

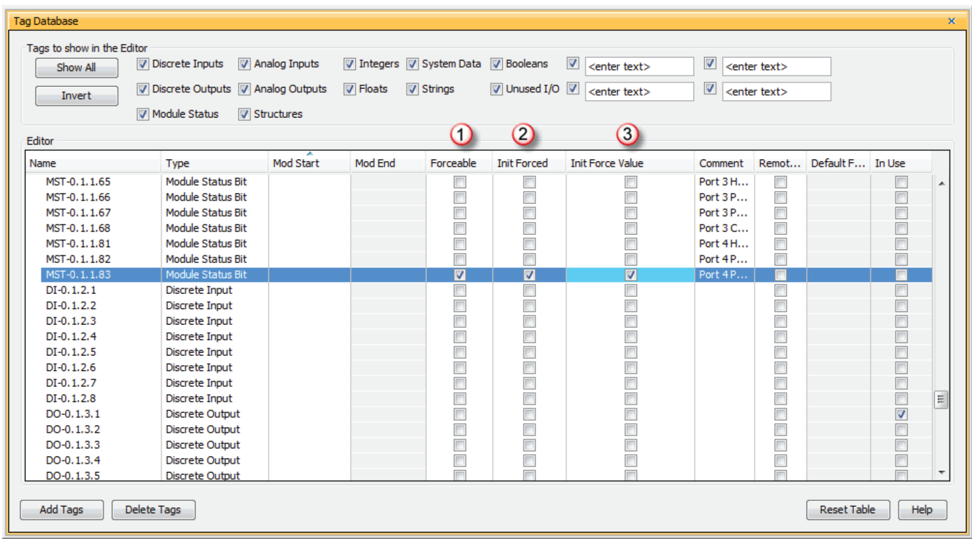
## Advantages of Forces

Almost all tags can be written to in the software without Forcing. However, if the ladder logic or an external device (operator interface panel, Modbus device, etc.) is connected to your controller and writing to those tags, the values you write from a Data View will be over-written. Conversely, if you write a Forced value, this will not be overwritten or reset until you manually remove the force or reset by means of a Stop to Run mode transition, a Stop Mode Transfer, or a controller power cycle.

## Enabling Forces

The Productivity2000 CPU is a Tag based controller where forcing a tag begins by identifying any tag you wish to be "Forceable" within the Tag database.



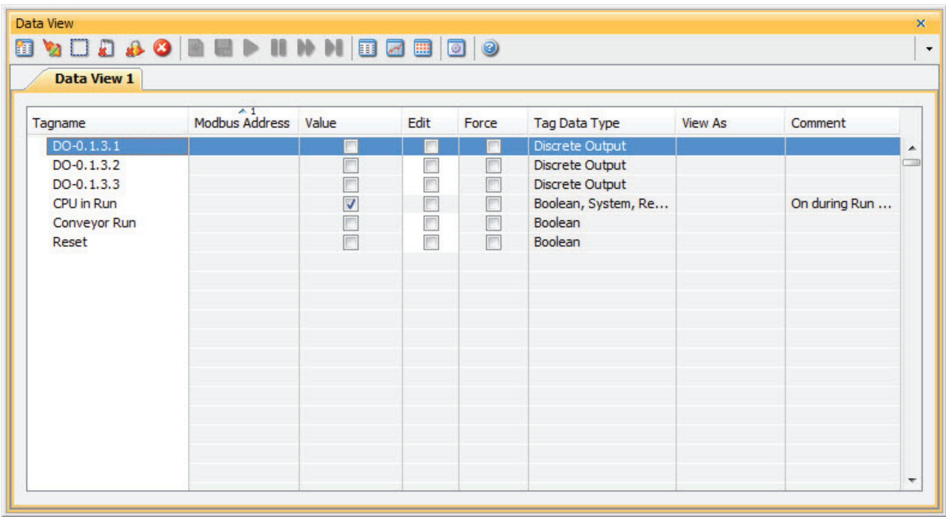


There are three columns within the Tag database that affect the forcing of all tags.

1. “Forceable” - Checking the box in this column identifies the corresponding tag as being able to be forced within the system.
2. “Init Forced” - Checking the box in this column identifies that corresponding tag as being forced as soon as the project is loaded and the processor is switched to Run mode.
3. “Init Force Value” - The state of the box in this column identifies the initial forced state of the Boolean tag:
    - A check mark in a box equates to a logical “1” or “ON”, and
    - An unchecked box equates to a logical ”0” or “OFF”. The value placed in this field for Integer or Floating point tags will be written into the tag.

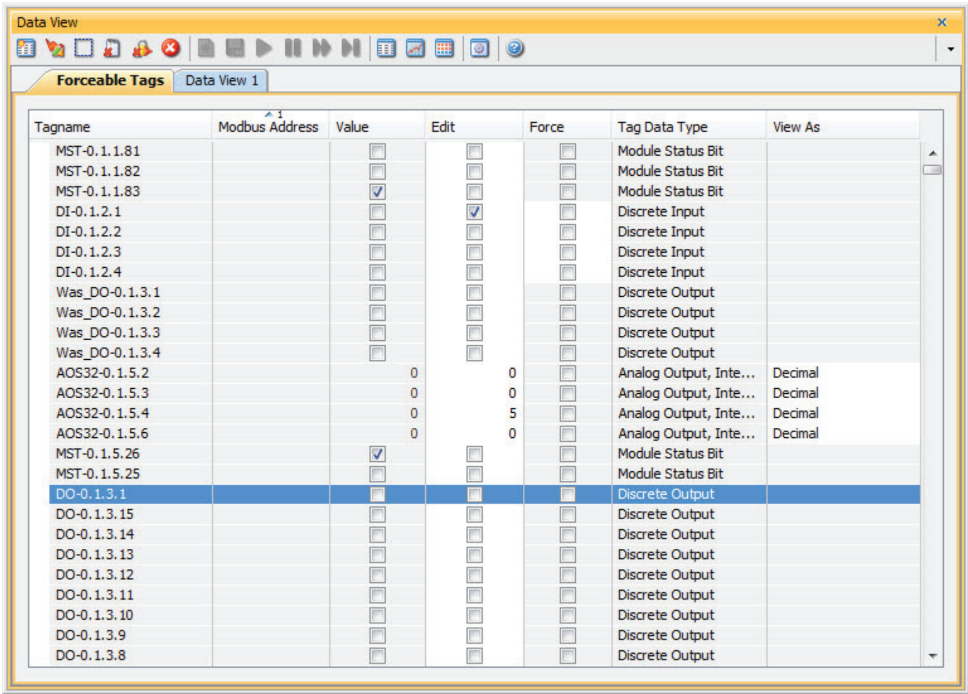
## Forcing Tags in Your System

All forcing of tags can be accomplished through the Data View window or directly in the




program interface while in “Monitor” mode, as long as the “Forceable” box has been checked in Tag Database. I/O may also be directly forced in I/O View by clicking on individual I/O points.

From the DataView Window, enter the tags you wish to force, or you can view all forceable tags from the “Forceable Tags” tab automatically created for you when you enable tags as forceable in the tag database.



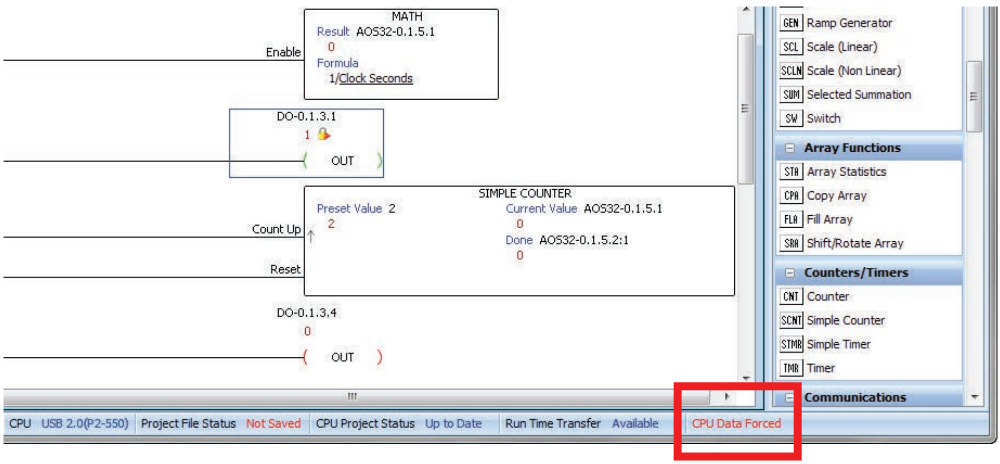

From either of these windows you have the option to select the check box in the Force column. When this box is checked and the row is selected (selected rows show high-lighted blue) and you select the Send Edit(s) button, the current row(s) will be forced.

***NOTE:*** *You can select multiple rows by clicking and holding down the left mouse button and dragging up or down. This selects consecutive rows. If you wish to select various rows, simple hold the “Ctrl” control key on your keyboard while left mouse clicking the rows.*

## Identifying Forced Values

There are two indications that forces are active on your controller.

1. All active forces will be shown in the Forceable tab of the Data View window as shown in the previous view.
2. You will also see “CPU Data Forced” in Red in the lower right of the Status bar of your software interface.



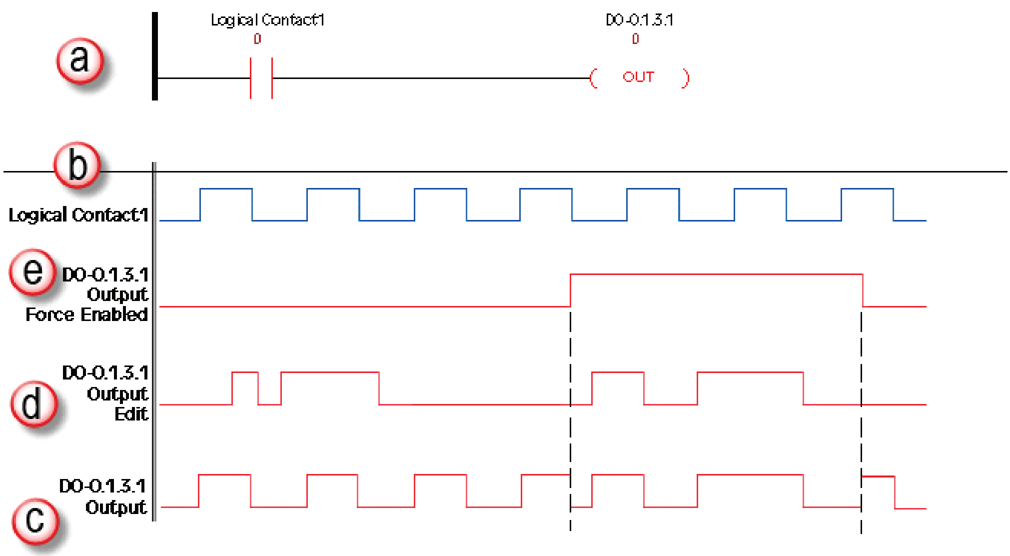

***NOTE:*** *Only Forced tags with an initial force value specified in the Tag database will be retained after a Stop to Run transition, Stop Mode transfer, or a power cycle. All forced values are retained during a Run Time transfer.*

## Force Value Timing Chart

The chart below shows how the states of a Digital Output are varied when forces and edits are applied. The ladder rung at the top of the chart (**a**) shows the logical arrangement of Logical Contact1 and Digital Output DO-0.1.3.1.

Under normal operation, Logical Contact1 (**b**) is driven by a clock pulse. This clock pulse is then fed to the Digital Output DO-0.1.3.1 (**c**). Edits written to the contact or the coil from the Data View window within the software will be written one time and will not be forced. With the clock pulse driving the contact, any software edits made to this contact will be allowed but will be overwritten by the logic on the very next scan. Any software edits made to the output will not be allowed and will not register. Edits can only change the state of the output if there are no other logistic or outside factors influencing the output.

In order to change the state of Logical Contact1 or Digital Output DO-0.1.3.1 while the clock pulse is driving it, a force must be introduced. The DO-0.1.3.1 Output Edit line (**d**) represents edits sent to the digital output from the Data View window. The DO-0.1.3.1 Output Force Enabled line (**e**) shows the point at which the software forces the output edit to take effect. The dotted lines represent the force being enabled and then disabled by the user. When the force is enabled, any edits made will register at the output regardless of Logical Contact1's state. When the force is disabled, all output edits will be ignored.



# European Union Directives (CE)

Appendix A

## In This Appendix...

# European Union (EU) Directives

***NOTE:*** *The information contained in this section is intended as a guideline and is based on our interpretation of the various standards and requirements. Since the actual standards are issued by other parties, and in some cases governmental agencies, the requirements can change over time without advance warning or notice. Changes or additions to the standards can possibly invalidate any part of the information provided in this section.*

This area of certification and approval is absolutely vital to anyone who wants to do business in Europe. One of the key tasks that faced the EU member countries and the European Economic Area (EEA) was the requirement to bring several similar yet distinct standards together into one common standard for all members. The primary purpose of a single standard was to make it easier to sell and transport goods between the various countries and to maintain a safe working and living environment. The Directives that resulted from this merging of standards are now legal requirements for doing business in Europe. Products that meet these Directives are required to have a CE mark to signify compliance.

## Member Countries

As of January 1, 2015, the members of the EU are Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithonia, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. Iceland, Liechtenstein, and Norway together with the EU members make up the European Economic Area (EEA) and all are covered by the Directives.

## Applicable Directives

There are several Directives that apply to our products. Directives may be amended, or added, as required.

- **Electromagnetic Compatibility Directive (EMC)** — this Directive attempts to ensure that devices, equipment, and systems have the ability to function satisfactorily in an electromagnetic environment without introducing intolerable electromagnetic disturbance to anything in that environment.
- **Machinery Safety Directive** — this Directive covers the safety aspects of the equipment, installation, etc. There are several areas involved, including testing standards covering both electrical noise immunity and noise generation.
- **Low Voltage Directive** — this Directive is also safety related and covers electrical equipment that has voltage ranges of 50–1000VAC and/or 75–1500VDC.
- **Battery Directive** — this Directive covers the production, recycling, and disposal of batteries.

## Compliance

Certain standards within each Directive already require mandatory compliance. The EMC Directive, which has gained the most attention, became mandatory as of January 1, 1996. The Low Voltage Directive became mandatory as of January 1, 1997.

Ultimately, we are all responsible for our various pieces of the puzzle. As manufacturers, we must test our products and document any test results and/or installation procedures that are necessary to comply with the Directives. As a machine builder, you are responsible for installing the products in a manner which will ensure compliance is maintained.

You are also responsible for testing any combinations of products that may (or may not) comply with the Directives when used together. The end user of the products must comply with any Directives that may cover maintenance, disposal, etc. of equipment or various components. *Although we strive to provide the best assistance available, it is impossible for us to test all possible configurations of our products with respect to any specific Directive. Because of this, it is ultimately your responsibility to ensure that your machinery (as a whole) complies with these Directives and to keep up with applicable Directives and/or practices that are required for compliance.*

Productivity2000 systems manufactured by Koyo Electronics Industries or FACTS Engineering, when properly installed and used, conform to the Electromagnetic Compatibility (EMC), Low Voltage Directive, and Machinery Directive requirements of the following standards:

- **Product Specific Standard for Programmable Controllers**
  EN61131–2:2003 Programmable controllers, equipment requirements and tests.
- **Warning on Electrostatic Discharge (ESD)**

| IEC 60068 | IEC 60417 | IEC 60664 | IEC 60695 | IEC 60707 | IEC 60947 | IEC 60950 | IEC 61000 | IEC 61010 |
|---|---|---|---|---|---|---|---|---|
| 2-1:1990 part 2 Test A | All Parts | 1:1992 Part 1 | 2-1 (all sheets) Part 2 | :1999 | 5-1:1997 Part 5-1 | 1:2001 Part 1 | 4-2:1995 Part 4-2 | 1:2001 Part 1 |
| 2-2:1974 part 2 Test B | | 3:1992 | | | 7-1:2002 Part 7-1 | | 4-3:2002 Part 4-3 | |
| 2-6:1995 Part 2: Test Fc | | | | | | | 4-4:1995 | |
| 2-6:1995 Part 2: Test Fc | | CISPR 11:1999 | | | | | 4-5:1995 Part 4-5 | |
| 2-14:1984 Part 2 Test N | | CISPR 16-1:1999 Part 1 | | | | | 4-6:1996 Part 4-6 | |
| 2-27:1987 Part 2 Test Ea | | CISPR 16-2:1999 Part 2 | | | | | 4-8:1993 Part 4-8 | |
| 2-30:1980 Part 2 Test Db | | | | | | | 4-12:1995 Part 4-12 | |
| 2-31:1969 Part Test Ec | | | | | | | | |
| 2-32:1975 Part 2 Test Ed | | | | | | | | |

For undated references, the latest edition of the referenced document (including any amendments) applies.

We recommend that all personnel take necessay precautions to avoid the risk of transferring static charges to inside the control cabinet, and clear warnings and instructions should be provided on the cabinet exterior. Such precautions may include the use of earth straps, grounding mats and similar static-control devices, or the powering off of the equipment inside the enclosure before the door is opened.

- **Warning on Radio Interference (RFI)**
  This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

## General Safety

- External switches, circuit breaker or external fusing, are required for these devices.
- The switch or circuit breaker should be mounted near the programmable controller equipment.

### Special Installation Manual

The installation requirements to comply with the requirements of the Machinery Directive, EMC Directive and Low Voltage Directive are slightly more complex than the normal installation requirements found in the United States. To help with this, we have published a special manual which you can order or download from our website:

- **DA–EU–M** – EU Installation Manual that covers special installation requirements to meet the EU Directive requirements. Refer to this manual for updated information.

### Other Sources of Information

Although the EMC Directive gets the most attention, other basic Directives, such as the Machinery Directive and the Low Voltage Directive, also place restrictions on the control panel builder. Because of these additional requirements it is recommended that the following publications be purchased and used as guidelines:

- BSI publication BS TH 42073: November 2000 – covers the safety and electrical aspects of the Machinery Directive
- EN 60204–1:2006 – Safety of Machinery; General electrical requirements for machinery, including Low Voltage and EMC considerations
- IEC 61000–5–2: EMC earthing and cabling requirements
- IEC 61000–5–1: EMC general considerations

It may be possible for you to obtain this information locally; however, the official source of applicable Directives and related standards is:

**The Office for Official Publications of the European Communities** L–2985 Luxembourg; quickest contact is via the web at http://publications.europa.eu

Another source is the British Standards Institution at:

British Standards Institution – Sales Department, Linford Wood:

Milton Keynes, MK14 6LE, United Kingdom.

The quickest contact is via the web at www.bsigroup.com

## Basic EMC Installation Guidelines

### Enclosures

The simplest way to meet the safety requirements of the Machinery and Low Voltage Directives is to house all control equipment in an industry standard lockable steel enclosure. This normally has an added benefit because it will also help to reduce EMC emissions. Although the RF emissions from the programmable controller equipment, when measured in the open air, are well below the EMC Directive limits, certain configurations can increase emission levels. Holes in the enclosure, for the passage of cables or to mount operator interfaces, can increase emissions.

## Mains Filters

Productivity2000 AC powered base power supplies do not require extra mains filtering to comply with the EMC Directive on conducted RF emissions.

## Suppression and Fusing

In order to comply with the fire risk requirements of the Low Voltage and Machinery Directive standards EN 61010–1 and EN 60204–1, it is necessary to fuse both sides of the power inputs (on both AC and DC units).

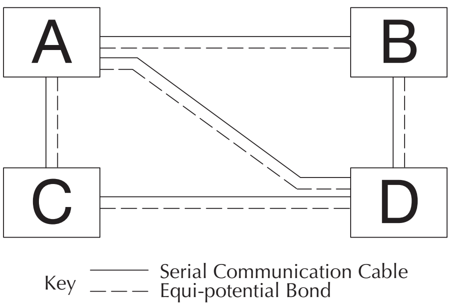
Transient suppressors must be protected by fuses and the capacity of the transient suppressor must be greater than the blow characteristics of the fuses or circuit breakers to avoid a fire risk. A recommended AC supply input arrangement for the Productivity2000 is to use twin 3 amp TT fused terminals with fuse blown indication, such as DINnectors DN–F10L terminals, or twin circuit breakers.

## Internal Enclosure Grounding

A heavy-duty star earth terminal block should be provided in every cubicle for the connection of all earth ground straps, protective earth ground connections, mains filter earth ground wires, and mechanical assembly earth ground connections. This should be installed to comply with safety and EMC requirements, local standards, and the requirements found in IEC 61000–5–2. The Machinery Directive also requires that the common terminals of the programmable controller input modules, and common supply side of loads driven from programmable controller output modules should be connected to the protective earth ground terminal.

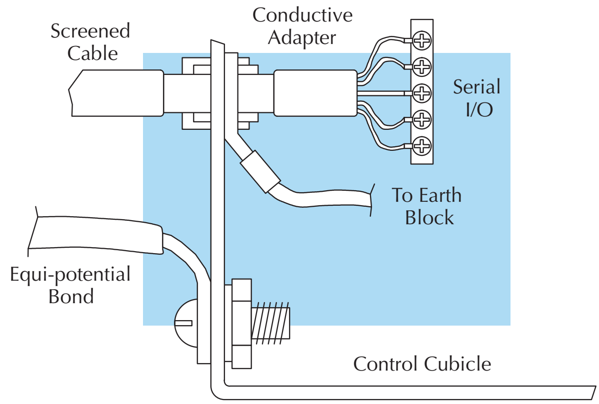
## Equi–potential Grounding

Adequate site earth grounding must be provided for equipment containing modern electronic




circuitry. The use of isolated earth electrodes for electronic systems is forbidden in some countries. Make sure you check any requirements for your particular destination. IEC 61000–5–2 covers equi-potential bonding of earth grids adequately, but special attention should be given to apparatus and control cubicles that contain I/O devices, remote I/O racks, or have inter-system communications with the primary CPU system enclosure. An equi-potential bond wire must be provided alongside all serial communications cables, and to any separate items of the plant which contain I/O devices connected to the programmable controller. The diagram shows an example of four physical locations connected by a communications cable.

## Communications and Shielded Cables

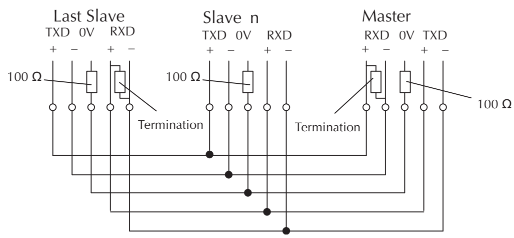



Good quality 24 AWG minimum twisted-pair shielded cables, with overall foil and braid shields are recommended for analog cabling and communications cabling outside of the programmable controller enclosure. To date it has been a common practice to only provide an earth ground for one end of the cable shield in order to minimize the risk of noise caused by earth ground loop currents between apparatus. The procedure of only grounding one end, which primarily originated as a result of trying to reduce hum in audio systems, is no longer applicable to the complex industrial environment. Shielded cables are also efficient emitters of RF noise from the CPU system, and can interact in a parasitic manner in networks and between multiple sources of interference.

The recommendation is to use shielded cables as electrostatic “pipes” between apparatus and systems, and to run heavy gauge equi-potential bond wires alongside all shielded cables. When a shielded cable runs through the metallic wall of an enclosure or machine, it is recommended in IEC 61000–5–2 that the shield should be connected over its full perimeter to the wall, preferably using a conducting adapter, and not via a pigtail wire connection to an earth ground bolt. Shields must be connected to every enclosure wall or machine cover that they pass through.

## Analog and RS232 Cables

Providing an earth ground for both ends of the shield for analog circuits provides the perfect electrical environment for the twisted pair cable as the loop consists of signal and return, in a perfectly balanced circuit arrangement, with connection to the common of the input circuitry made at the module terminals. RS232 cables are handled in the same way.




## Multidrop Cables

RS422 twin twisted pair, and RS485 single twisted pair cables also require a 0V link, which has often been provided in the past by the cable shield. It is now recommended that you use triple twisted pair cabling for RS422 links, and twin twisted pair cable for RS485 links. This is because the extra pair can be used as the 0V inter-system link. With loop DC power supplies earth grounded in both systems, earth loops are created in this manner via the inter-system 0v link. The installation guides encourage earth loops, which are maintained at a low impedance by using heavy equi-potential bond wires. To account for non–European installations using single-end earth grounds, and sites with far from ideal earth ground characteristics, we recommend the addition of 100 ohm resistors at each 0V link connection in network and communications cables.

## Shielded Cables Within Enclosures

When you run cables between programmable controller items within an enclosure which also contains susceptible electronic equipment from other manufacturers, remember that these cables may be a source of RF emissions. There are ways to minimize this risk. Standard data cables connecting CPUs and/or operator interfaces should be routed well away from other equipment and their associated cabling. You can make special serial cables where the cable shield is connected to the enclosure's earth ground at both ends, the same way as external cables are connected.

## Analog Modules and RF Interference

The readings from all analog modules will be affected by the use of devices that exhibit high field strengths, such as mobile phones and motor drives.

All AutomationDirect products are tested to withstand field strength levels up to 10V/m, which is the maximum required by the relevant EU standards. While all products passs this test, analog modules will typically exhibit deviations of their readings. This is quite normal, however, systems designers should be aware of this and plan accordingly.

When assembling a control system using analog modules, these issues must be adhered to and should be integrated into the system design. This is the responsibility of the system builder/ commissioner.

## Network Isolation

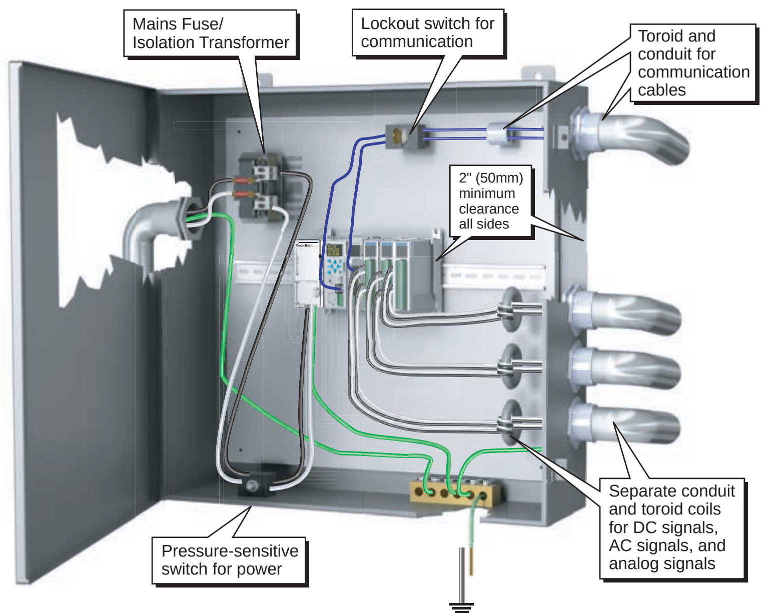
For safety reasons, it is a specific requirement of the Machinery Directive that a keyswitch must be provided that isolates any network input signal during maintenance, so that remote commands cannot be received that could result in the operation of the machinery. To avoid the introduction of noise into the system, any keyswitch assembly should be housed in its own earth grounded steel box and the integrity of the shielded cable must be maintained.

Again, for further information on EU directives we recommend that you get a copy of our EU Installation Manual (DA–EU–M) online. Also, you can check the EU Commision's official web site at:

http://publications.europa.eu.

It is good Engineering practice to install toroid inductors on the I/O wiring and the communications cables such as listed in the table below.

| Toroid Inductors | | | | |
|---|---|---|---|---|
| Manufacturer | Mfg. Part Number | Outside Diameter | Inside Diameter | Length |
| RS Online | 2606795 | 17.5 mm | 9.5 mm | 28.5 mm |
| Fair-Rite | 2643665702 | 17.45 mm | 9.5 mm | 28.6 mm |
| Wurth Elektronick | 7427009 | 17.5 mm | 9.5 mm | 28.5 mm |



## Items Specific to the Productivity2000

- The rating between all circuits in this product are rated **as basic insulation only**, as appropriate for single fault conditions.
- It is the responsibility of the system designer to earth one side of all control and power circuits, and to earth the braid of screened cables.
- This equipment must be properly installed while adhering to the guidelines of the in house CPU installation manual DA–EU–M, and the installation standards IEC 61000–5–1, IEC 61000–5–2 and IEC 61131–4.
- It is a requirement that all CPU equipment must be housed in a protective steel enclosure, which limits access to operators by a lock and power breaker. If access is required by operators or untrained personnel, the equipment must be installed inside an internal cover or secondary enclosure.
- It should be noted that the safety requirements of the machinery directive standard EN60204–1 state that all equipment power circuits must be wired through isolation transformers or isolating power supplies, and that one side of all AC or DC control circuits must be earthed.
- Both power input connections to the programmable controller must be separately fused using 3 amp T-type anti–surge fuses, and a transient suppressor fitted to limit supply overvoltages.
- If the equipment is used in a manner not specified by the manufacturer the protection provided by the equipment may be impaired.

## Notes

# PRODUCTIVITY2000 ERROR CODES

# APPENDIX B

## In This Appendix:

## Communications Error Codes

| Error Code | Description | Suggested Fix |
|---|---|---|
| 01 | Function Code not supported | Check instruction or connected device and correct Function code or address range selected. |
| 02 | Address out of range. This error is typically generated when a Modbus address has been requested that does not exist in the CPU. | Check instruction or connected device and correct Function code or address range selected. |
| 03 | Illegal Data Value. This error is typically generated when the Modbus request sent to the CPU is formed incorrectly. | Check the Modbus request against the Modbus protocol specification (www.modbus.org) to verify that it was formed correctly. |
| 04 | Device Failure | Check connected device |

## Module Error Codes

| Error Code | Cause | Solution |
|---|---|---|
| **E02101** | One or more module status bits are set. | Examine the individual module status bits for the module(s) in question to determine the cause of the error and appropriate action. |
| **E02110** | Module firmware is incompatible with project. | Recompile and transfer project to CPU. If problem persists, upgrade module firmware to latest version, then recompile and transfer project using latest Programming Software. |
| **E02111** | Module firmware is incompatible with project. | Recompile and transfer project to CPU. If problem persists, upgrade module firmware to latest version, then recompile and transfer project using latest Programming Software. |
| **E02112** | Module configuration data is invalid. | Recompile and transfer project to CPU. If problem persists, upgrade module firmware to latest version, then recompile and transfer project using latest Programming Software. |
| **E02113** | Module configuration data is invalid. | Recompile and transfer project to CPU. If problem persists, upgrade module firmware to latest version, then recompile and transfer project using latest Programming Software. |
| **E02114** | Unable to configure module. | Restart CPU. If problem persists, recompile and transfer project to CPU. If problem persists, upgrade module firmware to latest version, then recompile and transfer project using latest Programming Software. |
| **E02115** | Unable to configure module. | Restart CPU. If problem persists, recompile and transfer project to CPU. If problem persists, upgrade module firmware to latest version, then recompile and transfer project using latest Programming Software. |
| **E02201/ E02202** | Intelligent module is not communicating. | Remove and reinstall the module. If the problem persists, the module is defective and must be repaired or replaced. |

## Module Error Codes - Continued

| Error Code | Cause | Solution |
|---|---|---|
| **E02301** | Expected module is not installed, or the installed module is defective. Hot swap is enabled for the slot. | Install the correct module. |
| **E02302** | Expected module is not installed, or the installed module is defective. Hot swap is not enabled for the slot. | Install the correct module. |
| **E02401** | GS-Drive configuration cannot be transferred to GS-Drive due to communications error. | Make sure GS-Drive is in STOP mode and motor is not in motion, then either power-cycle CPU or re-transfer project to CPU. |
| **E02402** | GS-Drive configuration cannot be transferred to GS-Drive due to GS-Drive error. Number in parentheses is MODBUS exception code. | Verify E-Drive and GS-Drive are properly installed and functioning, then either power-cycle CPU or re-transfer project to CPU. |
| **E02403** | GS-Drive configuration cannot be transferred to GS-Drive while motor is in motion. | Make sure GS-Drive is in STOP mode and motor is not in motion, verify all Ethernet equipment is properly installed and configured, then either power-cycle CPU or re-transfer project to CPU. |
| **E02404** | GS-Drive configuration cannot be transferred to GS-Drive because GS drive type and model do not match project. | Correct GS drive type and model in project. |

## CPU Error Codes

| Error Code | Cause | Solution |
|---|---|---|
| **E05101** | The CPU battery is low. | Replace CPU's Battery. |
| **E05102** | The Base identifier (EPROM) is invalid. | Replace the unit. If unit is in warranty, call AutomationDirect for an RA number. |
| **E05103** | The P2-550 cannot communicate with the User Interface Module (LCD). | Replace the unit. If unit is in warranty, call AutomationDirect for an RA number. |
| **E05104** | Too many display messages were sent to the User Interface Module (LCD) in a short period of time. | Reduce the rate at which messages to the LCD are triggered. |
| **E05105** | The User Interface Module (LCD) did not receive firmware from the P2-550. | If error persists after power cycle, replace the unit. If unit is in warranty, call AutomationDirect for an RA number. |
| **E05106** | I2C bus has locked up. | Self-recoverable. If problem persists, restart system. |
| **E05107** | UIM Task Can not access File System. | Restart system, if reoccurs notify support. |
| **E05108** | Missing or improperly formatted Pen Drive. | Insert valid Pen Drive (FAT16 or FAT32). |
| **E05109** | Error Reading or Writing to the Pen Drive. | Replace Pen Drive. |
| **E05110** | CPU has an existing Connection to Productivity Suite, UIM Action can not be performed. | Wait until CPU Connection is closed or restart system. |
| **E05111** | One or more project files are missing from Pen Drive. | Transfer complete project to Pen Drive. |
| **E05120** | The module specified has a Firmware Error. | Replace the unit. If unit is in warranty, call AutomationDirect for an RA number. |
| **E05121** | The module specified has a Hardware Error. | Replace the unit. If unit is in warranty, call AutomationDirect for an RA number. |
| **E05122** | The module specified has an Internal Error. | Replace the unit. If unit is in warranty, call AutomationDirect for an RA number. |

## Project Error Codes

| Error Code | Cause | Solution |
|---|---|---|
| **E03000 - E03199** | Internal firmware file system error. | Power cycle CPU. If problem persists, contact AutomationDirect for repair or replacement. |
| **E03201 - E03299** | Internal firmware operating system error. | Power cycle CPU. If problem persists, contact AutomationDirect for repair or replacement. |
| **E03301** | Unable to exit RUN mode. | Power cycle CPU. If problem persists, contact AutomationDirect for repair or replacement. |
| **E03801 - E03899** | Internal firmware USB error. | Problem should self recover. If problem persists, power cycle CPU. |
| **E03901** | A scan exceeded the timeout specified in CPU CPU Hardware Configuration. | Verify that For/Next loops are handled properly. Adjust the timeout setting. |
| **E04101** | Scan attempted access beyond array limits. Txxxx is task ID. Rxxxx is rung number. | Correct problem in ladder logic or data that caused invalid access. |
| **E04201** | Internal firmware Data Logging error. | Problem should self recover. If problem persists, power cycle CPU. |
| **E04202** | Cannot create data logging folder. | Ensure a supported storage device is properly installed in USB OUT port on CPU. If problem persists, restart system. |
| **E04203** | Cannot write data to data logging storage device. | Ensure a supported storage device is properly installed in USB OUT port on CPU. If problem persists, restart system. |
| **E04204** | Internal firmware Data Logging buffer is greater than 50% full. | Problem should self recover. If problem persists, power cycle CPU. |
| **E04205** | Internal firmware Data Logging buffer overflow. | Problem should self recover. If problem persists, power cycle CPU. |
| **E04210** | Invalid system ID found while loading project. | Load new project. |
| **E04220** | Email instruction failed. | Problem should self recover. If problem persists, power cycle CPU. |
| **E04230** | Base firmware may be corrupt. | Power cycle base. If problem persists, power cycle CPU. If problem persists, reload firmware for the CPU. |
| **E04300 - E04302** | A project file is missing. | Load new project. |
| **E04303** | Internal firmware project loader failure. | Problem should self recover. If problem persists, power cycle CPU. |
| **E04304** | Project load failure limit exceeded. Project has been removed. | Load new project. |
| **E04305 - E04306** | Internal firmware project loader failure. | Problem should self recover. If problem persists, power cycle CPU. If problem persists, load new project. |
| **E04307** | Project file corrupt. | Load new project. |
| **E04308 - E04315** | Internal firmware project loader failure. | Load new project. |

## Project Error Codes - Continued

| Error Code | Cause | Solution |
|---|---|---|
| **E04316** | Project upload failed. | Retry the process. |
| **E04317** | Internal firmware project loader failure., | Load new project. |
| **E04318** | Modbus TCP connection limit exceeded. | Reduce the number of concurrently enabled MRX, MWX, RX and WX Instructions to no more than 64. |
| **E04319** | Internal error. | Self-recoverable, if problem persists restart CPU. |
| **E04320** | One or more RS232 parameters contain invalid values. | Verify that all RS232 parameters in project contain valid settings. |
| **E04321** | One or more RS485 parameters contain invalid values. | Verify that all RS485 parameters in project contain valid settings. |

## Project Error Messages



| Error Message | Cause | Solution |
|---|---|---|
| **Cannot create a task with the name ‘<taskname>’ because a task with that name already exists.** | The name of the new task already exists. | Create a unique task name. |
| **The help file ‘<helpfilename>’ cannot be found.** | The help file cannot be found in the location that it was installed. | Re-install the software.<br>The P2-HELP.chm file should be located in the following folder: C:\ProgramFiles\AutomationDirect\ProductivitySuite\data\help |
| **The topic ‘<topicname>’ does not exist.** | A referenced help topic has either been changed, moved, or deleted from the help file. | Re-install the software or download the Latest Help File version. |
| **Task name cannot be empty.** | An attempt was made to create a task without a task name. | Create a unique task name. |
| **The task name has an invalid character ‘<taskname>’.** | An attempt was made to create a task with an invalid character in the name. | Create a unique task name using valid characters only. |
| **The task name ‘<taskname>’ already exists.** | The name of the new task already exists. | Create a unique task name. |
| **Tagname cannot be all digits.** | A tagname that consists of only digits was entered. | There must be at least one letter in a tagname. |
| **Cannot complete the operation because the P2-550 folder already exists.** | The P3-550 folder already exists on the target removable USB drive and the create folder option is checked. | Uncheck the create folder option in the dialog and try transfer again. |
| **Cannot complete the operation because the P2-550 folder does not exist.** | The P3-550 folder does not exist on the target removable USB drive and the create option is not checked. | Check the create folder option in the dialog and try transfer again. |
| **Cannot complete the operation due to failure to create the P2-550 folder.** | System could not create the P3-550 folder. | This might be due to a read only drive. |
| **Failed to reboot CPU.** | CPU failed to reboot. | Reboot CPU again or cycle power. |
| **Failed to get CPU date & time from CPU.** | CPU failed to return date & time data. | Check CPU to PC connection. |
| **Failed to set CPU date & time.** | CPU failed to set date & time. | Check CPU to PC connection. |
| **CPU does not exist.** | A CPU does not exist in the configuration. | Add a CPU to the hardware configuration or connect to the CPU and select “read configuration” in the Hardware Configuration dialog. |
| **Rebooting the CPU failed.** | CPU failed to reboot. | Reboot CPU again or Cycle power |
| **The IP address ‘<IP Address>’ is already on the network. Please use a different address.** | The new CPU IP address is used by another entity on the network. | Select a unique IP address. You may need to contact your networks IT department to verify. |
| **Cannot change CPU name.** | Failed to change CPU name due to a CPU error or a network problem | Check CPU to PC connection. |

## Project Error Messages - Continued

| Error Message | Cause | Solution |
|---|---|---|
| **Cannot change IP configuration due to CPU error.** | CPU failed to change IP configuration. | Check CPU to PC connection and network configuration. Connections through a router may also cause conflicts. |
| **Cannot change IP configuration due to network problem.** | CPU failed to respond to the IP configuration request. | Check CPU to PC connection and network configuration. Connections through a router may also case conflicts. |
| **The project GS drive for address <GS Drive ID> has a type mismatch. The project configuration has a type of <GS Drive Model> while the physical configuration has a type of <GS Drive Model>.<br>Please correct the project configuration before continuing.** | The GS drive type in the software workspace is different from the physical configuration. | Check the Hardware Configuration or connect to the CPU and in the hardware configuration dialog select “Read Configuration”. |
| **The base found on group <CPU GroupId> base <CPU BaseId> is invalid.** | The base ID returned from CPU is invalid. | Check the hardware configuration or connect to the CPU and in the hardware configurations dialog select “Read Configuration”. |
| **Could not connect to the CPU.** | CPU is not able to be connected. | Check CPU to PC connection. |
| **Could not disconnect the CPU.** | CPU is not able to be disconnected. | Check CPU to PC connection. |
| **Could not connect to the selected CPU.** | Failed to validate security on connection. | Check CPU to PC connection and required security passwords. |
| **Cannot blink CPU due to CPU error.** | CPU failed to blink CPU run light. | Check CPU to PC connection and clear existing CPU errors. |
| **Cannot blink CPU due to network problem.** | CPU failed to respond to the blink request. | Check CPU to PC connection and network configuration. Connections through a router may also cause conflicts. |
| **Failed to retrieve I/O inventory from CPU ‘<CPU Name>’.** | CPU failed to respond to the inventory request. | Check CPU to PC connection and request again. |
| **Failed to put the CPU to run mode.** | CPU is not able to be put in run mode. | CPU mode switch must be in the Run position and errors cleared. |
| **Failed to put the CPU to stop mode.** | CPU is not able to be put in stop mode. | Check CPU to PC connection. |
| **Failed to put the CPU to debug mode.** | CPU is not able to be put in debug mode. | Check CPU to PC connection. CPU must be in STOP before entering debug mode. |
| **CPU has existing connection.** | CPU cannot be connected since it has already connected to another software. | Verify existing connections. |
| **Failed to put the CPU into <CPU Mode> mode because CPU connection is lost.** | CPU connection is lost while setting CPU mode. | Check CPU to PC connection. |

## Project Error Messages - Continued

| Error Message | Cause | Solution |
|---|---|---|
| **Failed to put the CPU into <CPU Mode> mode because CPU has existing critical error.** | Cannot set CPU mode due to critical errors on the CPU. | Check CPU to PC connection and clear errors. |
| **Failed to put the CPU into run mode because the CPU switch is set to the STOP position.** | Cannot set CPU to run mode since the run/stop switch is in the stop position. | Place the CPU switch in Run. |
| **Could not connect to the detected CPU.** | An unknown failure occurred on connection. | Check CPU to PC connection. |
| **You do not have permission to access this feature.** | The security setup does not allow the current user to perform this operation. | Check CPU to PC connection and required security passwords. |
| **You need to specify a user name.** | The name on a user account was deleted while editing the profile. | Specify the user name. |
| **You need to specify a password.** | The password on a user account was deleted while editing the profile. | Specify the password. |
| **The two passwords do not match.** | The password on a user account was changed and the verification does not match the new value. | Re-enter the password and check to make sure both are the same. |
| **At least one user needs to have "Project Transfer From CPU and Monitor Data" selected to enable the protection feature.** | Project Transfer from CPU and Data Monitor security was enabled without a user with these rights currently defined. | Define at least one user with the appropriate project transfer rights. |
| **At least one user needs to have "Project Transfer To CPU" selected to enable the protection feature.** | Project Transfer to CPU security was enabled without a user with these rights currently defined. | Define at least one user with the appropriate project transfer rights. |
| **You must connect to a CPU first.** | User tried to Set Factory Defaults, Reboot the CPU, Read the SRAM, or Clear CPU Memory without first being connected to the CPU. | Check CPU to PC connection. |
| **The current project does not contain a CPU in the configuration. Go to: Setup>Hardware Config to correct the problem.** | The user tried to download a project that does not contain a CPU to the CPU or USB Pen Drive. | Add a CPU to the hardware configuration or connect to the CPU and in the hardware configurations dialog select "read configuration". |
| **The CPU firmware is in service mode. The requested action is not available in this mode.** | The user tried to transfer a project to a CPU that is in Service Mode. | Check CPU to PC connection and upgrade firmware. |
| **Please select a search result first.** | In the Find dialog, User pressed the GoTo button before selecting an entry in the Search Results list. | Define your search criteria and try again. |
| **Incorrect Key Code.** | User entered an invalid license keycode. | Verify correct key code was entered. Pay close attention to capitalization, and mixture of letters and numbers. |