AMCI
ADVANCED MICRO CONTROLS INC.

4402

PWM Output Module
for POINT I/O™

User Manual

AMCI Specialty I/O Products
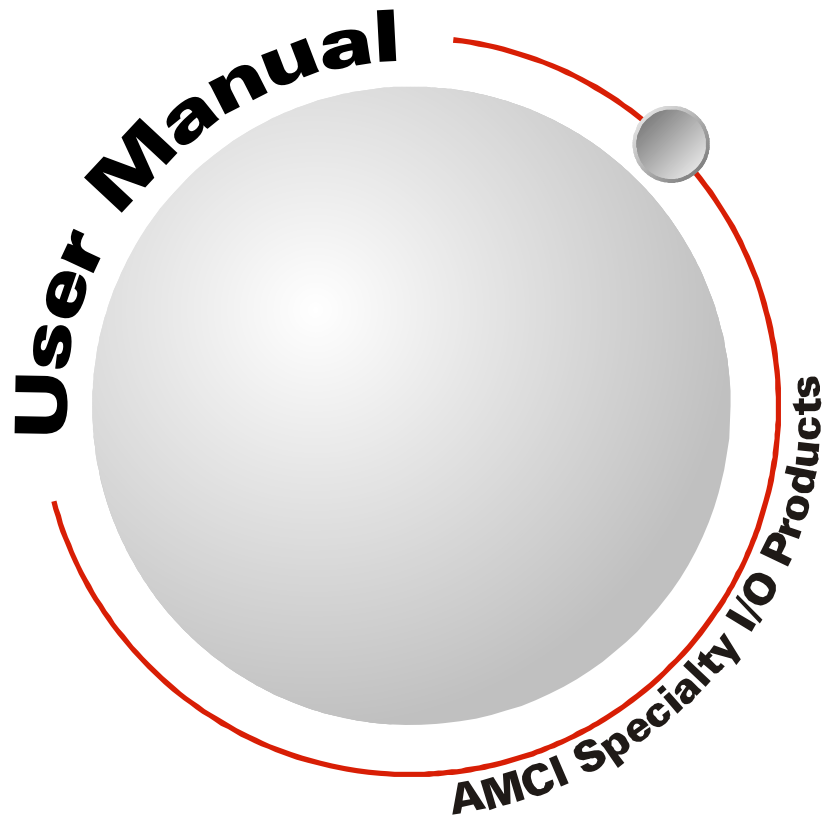
GENERAL INFORMATION

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Manuals at AMCI are constantly evolving entities. Your questions and comments on this manual are both welcomed and necessary if this manual is to be improved. Please direct all comments to: Technical Documentation, AMCI, 20 Gear Drive, Terryville CT 06786, or fax us at (860) 584-1973. You can also e-mail your questions and comments to *techsupport@amci.com*

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Notes

ABOUT THIS MANUAL

> Read this chapter to learn how to navigate through this manual and familiarize yourself with the conventions used in it. The last section of this chapter highlights the manual's remaining chapters and their target audience.

Audience

This manual explains the installation and operation of AMCI's 4402. It is written for the engineer responsible for incorporating the 4402 into a design as well as the individual responsible for its actual installation.

Applicable Units

This manual is applicable to all 4402 devices at the time of its release.

Navigating this Manual

This manual is designed to be used in both printed and on-line forms. Its on-line form is a PDF document, which requires Adobe Acrobat Reader version 7.0+ to open it. You are allowed to select and copy sections for use in other documents and, if you own Adobe Acrobat version 7.0 or later, you are allowed to add notes and annotations. If you decide to print out this manual, all sections contain an even number of pages which allows you to easily print out a single chapter on a duplex (two-sided) printer.

Manual Conventions

Three icons are used to highlight important information in the manual:

NOTE — **NOTES** highlight important concepts, decisions you must make, or the implications of those decisions.

CAUTION — **CAUTIONS** tell you when equipment may be damaged if the procedure is not followed properly.

WARNING — **WARNINGS** tell you when people may be hurt or equipment may be damaged if the procedure is not followed properly.

The following table shows the text formatting conventions:

Format	Description
Normal Font	Font used throughout this manual.
Emphasis Font	Font used for parameter names and the first time a new term is introduced.
Cross Reference	When viewing the PDF version of the manual, clicking on a blue cross reference jumps you to referenced section of the manual.
HTML Reference	When viewing the PDF version of the manual, clicking on a red cross reference opens your default web browser to the referenced section of the AMCI website if you have Internet access.

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Revision Record

This document, 940-04030, is the first release of this manual. It was first released on September 17th, 2015.

Revision History

940-04030:   09/17/2015   Initial Release

Manual Layout

You will most likely read this manual for one of two reasons:

➤ If you are curious about the 4402, this manual contains the information you need to determine if it is the right product for your application. Chapter 1, 4402 Specifications, was written for you. The chapter contains all of the information you will need to fully specify the 4402 product in your application.

➤ If you need to install and use the 4402, then the rest of the manual is written for you. To simplify installation and configuration, the rest of the manual is broken down into *tasks* and *references*. Using the 4402 requires you to complete four tasks, and the manual is broken down into sections that explain how to complete each one.

Chapter Title	Chapter Description
4402 Specifications	Complete specifications of the 4402.
Hardware Installation	Task instructions that give you the information and steps needed to physically install 4402 on your machine.
Software Installation	Task instructions that give you the information and steps needed to add the 4402 to your host controller.
Reading Data from the 4402	Task instructions that give you the information needed to read data from the 4402.
Writing Data to the 4402	Task instructions that give you the information needed to write programming data to the 4402.

ADVANCED MICRO CONTROLS INC.

4402 SPECIFICATIONS

Overview

The 4402 is the latest addition to a growing line of AMCI products for the Bulletin 1734 POINT™ I/O system from Rockwell Automation. The 4402 offers two channels of Pulse Width Modulated (PWM) outputs with variable frequency and duty cycle. The 4402 also offers dithering functionality for use with proportional control valves and other applications that must compensate for stiction in the system.

Designed around RA licensed technology, installation of the 4402 is the same as all other POINT I/O modules. The 4402 uses standard eight pin mounting bases, such as the 1734-TB, that are available from RA.

The 4402 is programmed and controlled with network data from a host controller. The operating status of the module is transmitted back to the host controller using six, 16-bit integer words. Programming the 4402 is accomplished with eight, 16-bit integer words.

The 4402 can be configured to change output states as soon as data is received from the host controller. This allows you to use the host to generate complex waveforms, such as S-Curve accelerations between output setpoints, and send this data to the 4402 in real time. Updates to a single module can occur as often as every five milliseconds. Worse case update time for a block of five modules (10 channels) on a single network drop is fifty milliseconds.

Figure 1 4402 PWM Output Module

PWM Outputs

Two outputs are available on the 4402. These outputs have independent PWM frequency and duty cycle settings. The PWM frequency settings are programmable over a 1 Hz to 20 kHz range with a resolution of 1 Hz. Duty cycle settings can range from 0% to 100% when the output frequency for the channel is programmed to be below 10 kHz. From 10 kHz and above, the duty cycle can be programmed to 0%, 100%, and in the range of 5% to 95%. In either case, the duty cycle resolution is 0.1%.

Dithering

Dithering is used to overcome problems associated with static friction, which is often referred to as "stiction". Static friction can cause errors when the valve is commanded to a new position, but the force generated by the coil is not great enough to overcome the static friction in the mechanical components. Stiction can also cause overshoot errors and dampened output oscillations when the static friction is finally overcome.

Dithering overcomes these errors by imposing an AC signal on top of the PWM signal. This AC signal keeps the valve core in constant motion. The average flow through the valve is unaffected because the average value of the AC signal is zero. When choosing a dithering frequency, system resonance points must be avoided.

Drivers

Outputs control high current DC drivers that can power many proportional control valves directly. Each output sources current and is rated to 1.5 A at 24 Vdc. Total output current for both channels is 2.5 A at 25°C.

Connector Pinout

Figure 2 shows the pin out of the module's eight pin connector. A standard Removable Terminal Block (RTM) is used in the picture.

➤ The 24 Vdc In and 24 Vdc Return pins are connected to the power supply pins of the POINT I/O power adapter to the left of the module. This supply is used to power the output drivers and must be capable of supplying the current needed by the loads. The 4402 can source up to 1.5 Adc per output, 2.5 Adc per module. See *Power and Output Wiring* on page 15 for additional information.

➤ Pins 0 and 1 are electrically connected in the module and either pin can be used to connect to the load.

➤ Pins 2 and 3 are electrically connected in the module and either pin can be used to connect to the load.

➤ Pins 6 and 7 are electrically connected in the module and connected to the POINT I/O power adapter.

➤ If shielded cable is used to wire to the loads, Pin 5 can be used to connect their shields to chassis ground.

4402

Pin 0 Output 0			Pin 1 Output 0
Pin 2 Output 1			Pin 3 Output 1
Pin 4 24 Vdc Return			Pin 5 Chassis Ground (Shields)
Pin 6 24 Vdc In			Pin 7 24 Vdc In
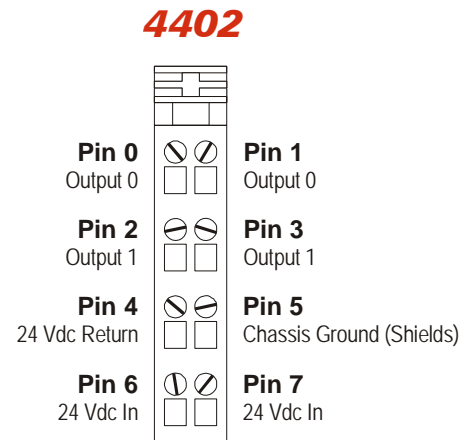
Figure 2 Connector Pin Out

Status LED's

The module has a total of four status LED's. Figure 3 shows the locations of these LED's.

Module LED

State	Description
Solid Green	Module OK
Blinking Red	Programming error
Solid Red	Save to Flash memory error

Network LED

State	Description
Off	No communications with scanner
Solid Green	Active communications with scanner
Solid Red	Communications error with scanner

Channel Status LED

State	Description
Off	Duty Cycle is equal to its default value
Solid Orange	Duty Cycle is not equal to its default value
Blinking Orange	Duty Cycle is not equal to its default value and Dithering is applied.

Figure 3 Status LED Locations

Electrical Specifications

Number of Channels

2. Channels are independent of each other.

Backplane Current Draw

200 mA max.
Maximum of five in a block without the use of an additional POINT I/O power supply

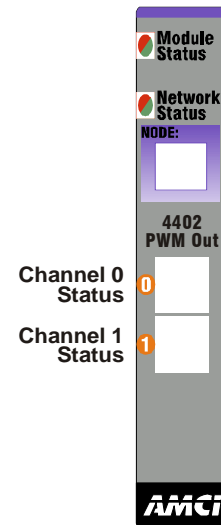### PWM Frequency Range

1 Hz to 20 kHz. Default of 250 Hz.
Programmable with 1 Hz resolution.

Duty Cycle Range

Programmable with 0.1% resolution. Default of 10.0% on.

PWM frequency < 10 kHz.
0.0% to 100.0%

PWM Frequency ≥ 10 kHz
0.0%, 5.0 to 95.0%, 100.0%

Dither Frequency

0 Hz to (PWM Frequency / 4) Hz
Programmable with 1 Hz resolution. Programming to 0 Hz disables Dither feature. Default of 0 Hz.

Dither Amplitude

0.0% to {Duty Cycle /2}%
Programmable with 0.1% resolution. Programming to 0.0% disables Dither feature. Default of 0.0%

Electrical Specifications (continued)

Output Drivers

24 Vdc Sourcing drivers. 1.5 A max. per output.

2.5 A max. per module at 25°C

Outputs derive power from the power supply attached to the communications adapter or the ±FB pins on the CompactLogix 5370 L1 family of PLC's.

Response Time

Greater of 5 milliseconds or 1 output period. Response time is the time between when the data is accepted and when it is acted upon. It does not include network transit time from the host to the module.

Mechanical Specifications

Package Style

Eight pin POINT I/O.
Compatible with eight pin mounting bases

Environmental Specifications

Operating Temperature

32°F to 140°F (0°C to 60°C)

Relative Humidity

5% to 95%, non-condensing

Storage Temperature

-40°F to +185°F (-40°C to +85°C)

PWM Output

The PWM output is controlled by two parameters.

PWM Frequency

The 4402 has two PWM Frequency parameters, one associated with each output. The PWM Frequency parameter defines the time period of the output. It is programmed in hertz, and is programmable from 1 to 20,000 Hz inclusive. This yields a time period between one second and fifty microseconds.

Duty Cycle

The 4402 has two Duty Cycle parameters, one associated with each channel. The Duty Cycle parameter defined the time the output is on as a percentage of the programmed time period. It is programmed as an integer with a range of 0 to 1,000, which corresponds to a percentage of 0.0 to 100.0%. The output is off when the Duty Cycle is set to 0 and the output is on all of the time when the Duty Cycle is set to 1000 (100.0%).

When the PWM Frequency parameter is programmed to be less than 10 kHz, the Duty Cycle can be programmed to any value within its 0.0 to 100.0% range.

When the PWM Frequency parameter is programmed to be greater than or equal to 10 kHz, the Duty Cycle can be programmed to 0.0%, 5.0% to 95.0%, and 100.0%. This corresponds to integer values of 0, 50 to 950, and 1,000. The Duty Cycle cannot be programmed to be between 0.1% and 4.9% or 95.1% to 99.9% if the PWM Frequency is 10 kHz or above.

Figure 4 PWM Output Examples

> **NOTE** ⟩ Changes to the Duty Cycle parameter will take a minimum of five milliseconds to occur. When the programmed PWM Frequency is 200 Hz (1/0.005 sec) or above, the changes will take five milliseconds to occur. At frequencies below 200 Hz, changes to Duty Cycle will occur at the beginning of the next time period. This means that the changes to the Duty Cycle will take up to 1/{PWM Frequency} seconds to occur. For example, if the PWM Frequency is set to 10 Hz, the any change to the Duty Cycle will take between 5 milliseconds and 100 milliseconds to occur.
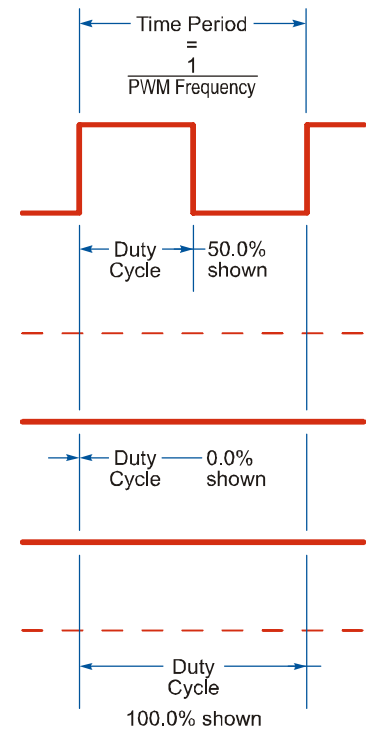
Dithering Control

Dithering imposes an AC signal within the PWM output. This is accomplished by varying the duty cycle of the output in a regular fashion. If the PWM signal were to be properly filtered and observed on an oscilloscope, the output would appear to be an AC signal riding on the DC value defined by the programmed Duty Cycle.

Dithering is controlled with two parameters.

Dither Frequency

The 4402 has two Dither Frequency parameters, one associated with each channel. This parameter sets the frequency of the imposed AC signal. It has a range of 0 Hz to {PWM Frequency}/4. If the Dither Frequency is set to zero, the dithering functionality is for that channel.

Dither Amplitude

The 4402 has two Dither Amplitude parameters, one for each channel. Like Duty Cycle, Dither Amplitude is programmed as an integer value that represents a percentage of the programmed time period. The value has a resolution of 0.1%. Each of these parameters has a range of 0 to {Duty Cycle}/2 and must equal zero if the Dither Frequency parameter for the channel is set to zero. Additionally, if the channel's Dither Amplitude is set to zero, the dithering functionality is disabled for that channel.

Dithering Control (continued)

As shown in figure 5 below, the Dithering Period is divided into eight segments, which represent the 45° points of a cycle. The duty cycle at each point is equal to:

$$\text{duty cycle} = \text{Duty Cycle} + \text{Dither Amplitude} \times \sin(\omega t)$$

Where:

➤ Duty Cycle = Present value of the Duty Cycle parameter for the channel
➤ Dither Amplitude = Present value of the Dither Amplitude parameter for the channel
➤ ω = Dither Frequency expressed in radians/second
➤ t = time in seconds
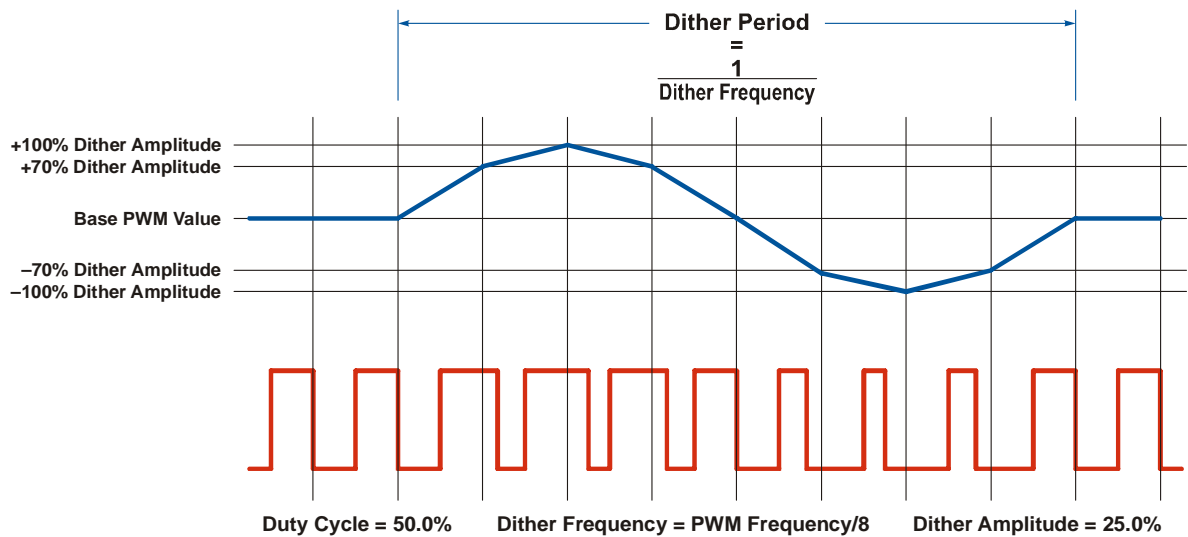
Figure 5 Dithering Output Example

If the Dither Frequency is greater than the PWM Frequency/8, the output will be a triangular wave instead of a sine wave, but the DC component will remain zero.

The only time dithering will add a DC component to the PWM output is when the programmed Duty Cycle + the programmed Dither Amplitude exceeds 100.0%. For example, if the Duty Cycle is programmed to 80.0%, the 4402 will accept a Dither Amplitude of 40.0%. The combined value of 120% exceeds the maximum 100.0% duty cycle.

If this condition is true, the output is limited at its 100.0% state. The dithering waveform will be distorted, and the DC component of the PWM output will be lowered.

Real Time Control

There are two additional parameters on the 4402. These parameters are called *CH0 RT Update Enable* and *CH1 RT Update Enable*. When real time updates are enabled on a channel, changes in Duty Cycle and Dither Amplitude parameter settings are made as soon as the network data changes. A programming cycle is not required. This allows changes to the channel outputs with a single network transfer instead of four.

Power On Behavior

The 4402 contains non-volatile Flash memory that stores the settings that will be used on power up.

Table 1 shows factory default settings for all of the parameters.

Parameter	Setting
Output State on Net Loss	Maintain Current Output
CH0 PWM Frequency	250 Hz
CH0 Duty Cycle	10.0% (Integer value of 100)
CH0 Dither Frequency	0 Hz (Disabled state)
CH0 Dither Amplitude	0.0% (Disabled state)
CH0 RT Update Enable	Disabled
CH1 PWM Frequency	250 Hz
CH1 Duty Cycle	10.0% (Integer value of 100)
CH1 Dither Frequency	0 Hz (Disabled state)
CH1 Dither Amplitude	0.0% (Disabled state)
CH1 RT Update Enable	Disabled

Table 1 Factory Default Settings

With these settings, the 4402 will output at 10% on both channels, with a maximum update time of forty milliseconds (1/250 Hz).

All of these parameters can be programmed through the network data and saved to the Flash memory on the 4402. Once changed, the stored values will be used on power up. Many platforms output data to the module at regular intervals. In order to prevent inadvertent changes, the 4402 employs a Transmit Bit in the output data and an Acknowledge Bit in the input data to implement a handshaking mechanism. Programming data is only accepted on a 0→1 transition on the Transmit Bit. The module acknowledges the transfer by making a 0→1 transition on the Acknowledge Bit.

> This section is intended for the engineer or technician responsible for physically installing the 4402 module.

1.1 Satisfy Environmental and Power Requirements

1.1.1 Module Location

The 4402 module is suitable for use in industrial environments that meet the following criteria:

➤ Only non-conductive pollutants normally exist in the environment, but an occasional temporary conductivity caused by condensation is expected.

➤ Transient voltages are controlled and do not exceed the impulse voltage capability of the product's insulation.

Note that these criteria apply to the system as a whole. These criteria are equivalent to the *Pollution Degree 2* and *Over Voltage Category II* designations of the International Electrotechnical Commission (IEC).

Refer to POINT I/O documentation from Rockwell Automation for information on environmental requirements for the POINT I/O system as a whole.

NOTE ➲ Because of their on board microprocessors, the 4402 modules will become warmer than most POINT I/O modules. Rockwell Automation defined spacing around the POINT I/O system to allow convection cooling is all that is required. Additional spacing or cooling is not required.

1.1.2 Power Requirements

➤ The 4402 requires 200 milliamperes at 5 Vdc from the POINT I/O system. Make sure your system's power supply has adequate reserve current capacity.

➤ A maximum of five 4402 modules can be installed in one network base. This limitation is caused by a small voltage drop across each of the 4402 modules. If you attempt to drive more than five modules, the voltage at the sixth module will be too low for the 4402 module to operate. It is possible to add more 4402 modules to the POINT I/O base by adding a 1734-EP24DC supply to the system.

1.1.3 Safe Handling Guidelines

Prevent Electrostatic Damage

⊙ CAUTION Electrostatic discharge can damage an 4402 module if you touch the rear bus connector pins. Follow these guidelines when handling the module.

1) Touch a grounded object to discharge static potential before handling the module.
2) Work in a static-safe environment whenever possible.
3) Wear an approved wrist-strap grounding device.
4) Do not touch the pins of the bus connector or the I/O connector.
5) Do not disassemble the module
6) Store the module in its anti-static bag and shipping box when it is not in use.

Prevent Debris From Entering the Module

⊙ WARNING During DIN rail mounting of all devices, be sure that all debris (metal chips, tapping liquid, etc.) is prevented from falling into the module. Debris may cause damage to the module or unintended machine operation with possible personal injury. The DIN rail for the modules should be securely installed and grounded before the modules are mounted on it.

Remove Power Before Servicing in a Hazardous Environment

⊙ WARNING Remove power before removing or installing any modules in a hazardous environment.

1.2 Install the Mounting Base

> **POINT I/O terminal base assemblies are Rockwell Automation products and RA literature should be considered the authority on installing these products. Steps are given here as a convenience. If you have any questions, refer to RA documentation for additional information.**

1.2.1 Installation

1) Verify that the DIN rail locking screw is in the horizontal position. The mounting base will not attach to the DIN rail if this screw is in the vertical position.
2) Position the mounting base vertically above any currently installed units, such as an adapter, power supply, or an existing module.
3) Slide the mounting base down allowing the interlocking side pieces to engage the adjacent module or adapter.
4) Press firmly until the mounting base snaps onto the DIN rail.
5) If this the last mounting base in the block, install the safety end cap to protect the exposed pins.

1.2.2 Removal

1) To remove the mounting base from the DIN rail, first remove the 4402 module and all mounting bases to the right of the base you wish to remove.
2) Using a small bladed screwdriver, rotate the base locking screw to the vertical position. This releases the locking mechanism holding the mounting base to DIN rail.
3) Lift the mounting base straight up to remove it from the block.

1.3 Install the 4402 Module

> **The 4402 installs into the selected wiring base in the same fashion as all other POINT I/O modules. The 4402 module can be installed in the mounting base before or after the mounting base is installed on the DIN rail.**

1.3.1 Remove Power

Power should be removed from the system before installing the 4402.

1.3.2 Installation

1) Verify that the wiring base is correctly keyed for the 4402 module. If it is not, use a small bladed screwdriver to rotate the keyswitch on the mounting base until it matches the keying on the 4402 module.
2) Install the 4402 module by inserting it into the mounting base and pressing straight down. The module will lock into place.

1.4 Install the Removable Terminal Block (as required)

The 1734-TB and 1734-TBS terminal bases require the use of a removable terminal block, part numbers 1734-RTB or 1734-RTBS respectively. The appropriate removable terminal block (RTB) is supplied with the mounting base assembly that is ordered through RA.

1.4.1 Remove Power

Power should be removed from the system before the RTB is installed or removed. This is to prevent the possibility of creating an electrical arc when the installation or removal is performed.

1.4.2 Installation

1) Insert the end opposite the handle into the base unit. This end has a curved section that engages with the wiring base.
2) Rotate the terminal block into the mounting base until it locks itself in place.
3) If a module is installed, snap the RTB handle into place on the module.

1.4.3 Removal

This procedure allows the mounting base to be removed and replaced as necessary without removing any of the wiring.

1) If need be, pull back on the terminal block handle to disengage it from the module.
2) Pull up on the RTB handle to remove.

1.5 Power and Output Wiring

Figure 1.1 below show that the 4402 obtains its 24 Vdc power from the 24 Vdc supply that is used to power the POINT I/O drop. The 4402 can source 1.5 A per output, 2.5 A per module @ 25°C. This current load must be considered when designing the system to assure that the 10 A maximum load on the internal bus is not exceeded. If this 10 A load limit is exceeded, an additional RA 1734 series power adapter must be added to the system.

Load 1 is shown attached to the 4402 with a shielded cable. Shielded cables are recommended if the load draws little current which makes the output susceptible to electrical noise. This decision is based on the electrical environment the system is placed in, and must be made on an individual basis.
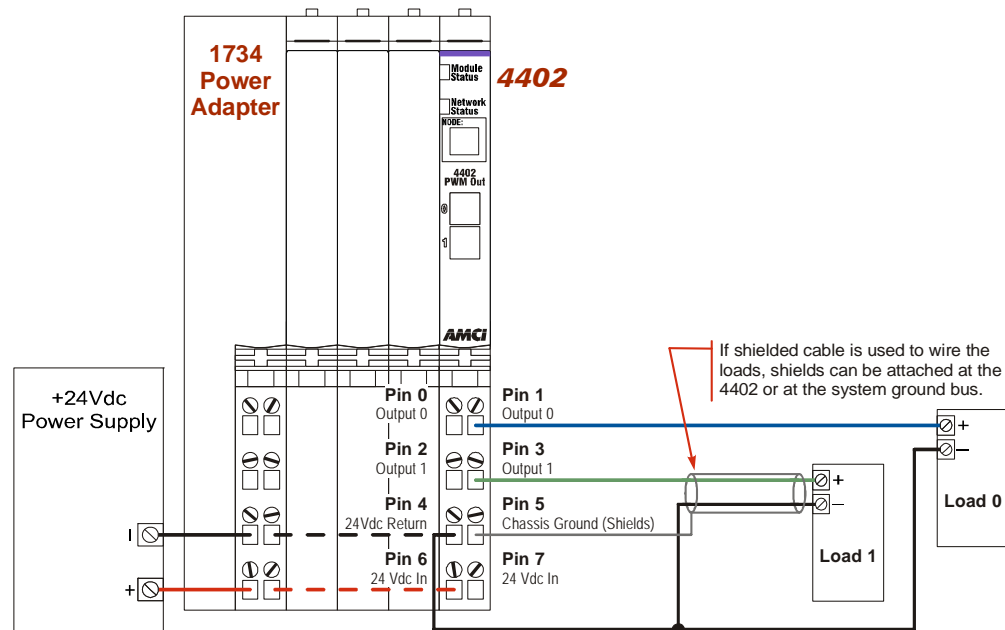

Figure 1.1 Power and Output Wiring

Notes

> **This section is intended for the engineer or technician responsible for adding the 4402 to a software project. The procedure used depends on the interface used to attach the 4402 to the PLC.**

2.1 Determine Which Procedure to Use

This task is broken down into different procedures based on the connection between the 4402 and the PLC. Use the table below to determine the correct procedure to use when adding the 4402 to the software project.

Connection	Procedure	Page #
CompactLogix 5370 L1 Local I/O	2.2a	see below
EtherNet/IP Adapters	2.2b	18
DeviceNet Adapters	2.2c	19
ControlNet Adapters	2.2d	20
RSNetWorx for ControlNet (optional)	2.2e	22

2.2a Procedure for CompactLogix 5370 L1 Local I/O

1) Open RSLogix 5000 and the project in which you want to install the AMCI 4402 module.

2) Right click on I/O Configuration in the Project Tree and select 'New Module' in the resulting pop up window.

3) In the new window that opens, select the following module type from the list that appears.
   ➤ Type = 1769-MODULE Description = Generic 1769 Module

4) Click the [OK] button. A Module Properties window will appear.

5) Set the following parameters in the Module Properties window. All parameters not listed here are optional.
   ➤ **Name:** A descriptive name for the module. The name must begin with a letter.
   ➤ **Description:** Your Choice
   ➤ **Comm Format:** Data-INT (The default is *Input Data-INT*. This must be changed to *Data-INT*)
   ➤ **Slot:** Location of 4402 module

6) Enter the Connection Parameters from the following table.

	Assembly Instance	Size
Input	101	6
Output	102	8
Configuration	103	0

Table 2.1 CompactLogix 5370 Connection Parameters

7) Click on Next and select the RPI time. The minimum RPI time for the 4402 is two milliseconds, with five milliseconds or above recommended.

The 4402 module will now appear in the project tree and three new data tags will have been created, Local:X.I.Data[Y], Local:X.O.Data[Y] and Local:X.C.Data[Y] where "X" is the slot number and "Y" is the word number. Module status and duty cycle values for the two channels appear in the Input tags. All commands are sent to the 4402 module through the Output tags. The 4402 does not use the Configuration tags.

Please note that the first two input words, Local:X.I.Data[0] and Local:X.I.Data[1] are not used and will always be equal to zero.

2.2b Procedure for EtherNet/IP Adapters

NOTE ▶ Being a speciality I/O module, the 4402 uses direct connections to communicate with the processor. In this procedure, you will set two RPI times. The RPI time for the adapter controls how quickly discrete I/O points attached to the adapter are updated. The RPI time of the 4402 controls the rate of its updates.

1) Create or open a new Ladder Logic program.
2) If the processor used in the project has a built-in Ethernet port, it must be configured. If the processor does not have a built in Ethernet port, a bridge module must be added to the project and it must be configured before you can continue. Refer to RA documentation if you need help performing this step.
3) Go to Project tree and right click on the configured Ethernet port. Select 'New Module' in the resulting pop up window.
4) In the new window that opens, select the POINT I/O EtherNet/IP adapter used to connect the 4402 to your processor. The 1734-AENT/A is used in this example.
5) Click the [OK] button. A new Module Properties window will open.
6) Set the following parameters in the Module Properties window.
   ➤ **Name:** A descriptive name for the EtherNet/IP adapter. The name must begin with a letter.
   ➤ **Description:** Your Choice
   ➤ **Comm Format:** *Rack Optimization* or *None*
   ➤ **IP Address:** The IP address of the EtherNet/IP adapter. For the 1734-AENT/A, the last octet of the address must match the node number set on the adapter.
   ➤ **Chassis Size:** One plus the number of Point I/O modules attached to the 1734-AENT/A.

NOTE ▶ If adding the 4402 module to an existing system, the Chassis Size parameter must also be modified on the Chassis Size tab of the 1734-AENT/A module. After changing and downloading the chassis size, go online, select the chassis tab, and click on "Set Chassis Size in Module."

7) If the Comm Format was set to *None*, click on the [Finish>>] button to accept the configuration. If the Comm Format above was set to *Rack Optimization*, click on [Next>] and set the RPI time for the discrete I/O modules in your system, and then click on [Finish>>] to accept the configuration.
8) Right click on the POINT I/O adapter in the Project tree. Select 'New Module' in the resulting pop up window.
9) In the new window that opens, select the following module type from the list that appears.
   ➤ Type = 1734-MODULE Description = Generic 1734 Module

10) Click the [OK] button. A Module Properties window will appear.
11) Set the following parameters in the Module Properties window. All parameters not listed here are optional.
   ➤ **Name:** A descriptive name for the 4402 module. The name must begin with a letter.
   ➤ **Description:** Your Choice
   ➤ **Comm Format:** Data-INT (This parameter *must* be *Data-INT*)
   ➤ **Slot:** Location of 4402 module. Slot 1 is directly to the right of the adapter.

2.2b Procedure for EtherNet/IP Adapters (continued)

12) Enter the Connection Parameters from the following table.

	Assembly Instance	Size
Input	101	6
Output	102	8
Configuration	103	0

Table 2.2 CompactLogix 5370 Connection Parameters

13) Click on the [Next] button and select the RPI time. Because the AMCI 4402 is a Specialty I/O module, it will only use direct connections to communicate with the scanner module. Although any value down to three milliseconds can be selected, AMCI does not recommend values below ten milliseconds. Additionally, refer to RA documentation to determine the recommended minimum RPI time to avoid overloading the adapter. For example, RA recommends an RPI time of fifty milliseconds or greater be used for all direct communication modules when using the 1734-AENT adapter.

NOTE ⚫ The other pages of the Module Properties window are not used by the 4402 module.

14) Click on the [Finish>>] button to complete the installation. You should now save the project and download the new configuration to the processor.

The following tags will have been created. The *adapter_name* shown here was the one selected for the POINT I/O network adapter in step 6 above. Also, X = slot number and Y = word number.

➢ *adapter_name***:X:I.data[Y]:** Input Data sent from the 4402 module to the PLC. Words 0 and 1 will always be zero.

➢ *adapter_name***:X:O.data[Y]:** Output Data sent from the PLC to the 4402 module.

➢ *adapter_name***:X:C.data[Y]:** Configuration Data, not used by the 4402 module.

2.2c Procedure for DeviceNet Adapters

NOTE ⚫ Before the 4402 can be attached to a network, it must be added to the RSNetWorx for DeviceNet software. The EDS file is available in the Driver File Download section of our website, *http://www.amci.com*. The following procedure is used to add the EDS file to RSNetWorx. It assumes that you have already downloaded this file and un-zipped it.

NOTE ⚫ Please note that the 4402 does not support ADR (Automatic Device Replacement).

1) Start RSNetWorx for DeviceNet.
2) In the RSNetWorx program, click on *Tools* in the menu bar.
3) Click on "EDS Wizard…" from the pull down menu that appears.
4) Click on the [Next>] button in the window that appears.
5) Select "Register an EDS file(s)" and click on [Next>].
6) Select *Register an EDS file*.
7) Click on the [Choose File…] button and navigate to the folder where you placed the EDS file.
8) Double click on 4402_r01.eds file.
9) Click on [Next>].
10) Click on 4402_r01.eds file name so that it is highlighted.
11) Click on [Next>] to assign an icon to the device.

2.2c Procedure for DeviceNet Adapters (continued)

12) Click on the 4402 and then click on the [Change icon…] button. Select one of the built in icons that Rockwell Automation offers.

13) Click on [Next>] and then click on [Finish] to complete the installation of the AMCI 4402 EDS file to the RSNetWorx system.

14) Open or create a network where a POINT I/O DeviceNet scanner module is present. (A 1734-ADN is used in the rest of this procedure.) In this network, the scanner module will have a node address of zero.

15) Add the 4402 to your network as you would any other POINT I/O module, including adding it to the scanlist configuration of the scanner module. The 4402 module has a default node address of 63.

16) Go online with the DeviceNet network and drill down to the subnet network.

17) Expand the POINT I/O network associated with the 1734-ADN POINT I/O DeviceNet Adapter module and select the *DeviceNet Subnet, DeviceNet* network.

18) If, after the network is scanned, the 4402 module has a different address from the desired one, right click on the module, select "Properties…" and change the address to the desired value. It will also be necessary to update the Scanlist in the Scanner module. Please note that to operate correctly, the lower numbered addresses must be located closer to the 1734-ADN Scanner module.

19) Once the network has been correctly configured, save it, and then download it to the scanner module.

20) Open or create a second network that will be reading the data from the POINT I/O network created above. In this network, the node number of the 1734-ADN adapter module must match what is physically set by the address switches on the 1734-ADN adapter module.

21) Right click on the 1734-ADN module and select "Properties…".

22) Click on the *Device Bridging* Tab

23) Click on *Associate File* and select the file that was created above.

24) Click on the [Apply] button.

25) Once the network has been correctly configured, save it, and then download it to the network's scanner module.

2.2d Procedure for ControlNet Adapters

1) Create or open a new Ladder Logic program.

2) If it does not already exist, add a ControlNet adapter module, such as the 1756-CNBR/D, to the rack configuration.

3) Right click on the ControlNet adapter module in the project tree. Select "New Module" in the pop up window that appears.

4) In the new window that opens, select the 1734-ACNR module from the list that appears.

5) Click the [OK] button. A Module Properties window will appear.

6) Set the following parameters in the Module Properties window. All parameters not listed here are optional.

  ➤ **Name:** A descriptive name for the module. The name must begin with a letter.
  ➤ **Description:** Your Choice
  ➤ **Comm Format:** *Rack Optimization* or *None*
  ➤ **Node:** Must match the address set on the 1734-ACNR adapter.
  ➤ **Chassis Size:** One plus the number of POINT I/O modules attached to the 1734-ACNR.

NOTE ▷ If adding the 4402 module to an existing system, the Chassis Size parameter must also be modified on the Chassis Size tab of the 1734-ACNR module. After changing and downloading the chassis size, go online, select the chassis tab, and click on "Set Chassis Size in Module."

2.2d Procedure for ControlNet Adapters (continued)

7) If the Comm Format was set to *None*, click on the [Finish>>] button to accept the configuration. If the Comm Format above was set to *Rack Optimization*, click on [Next>] and set the RPI time for the discrete I/O modules in your system, and then click on [Finish>>] to accept the configuration.

8) Right click on the 1734-ACNR module and then select "New Module..".

9) In the new window that opens, select the following module type from the list that appears.
   ➤ Type = 1734-MODULE Description = Generic 1734 Module

10) Click on the [OK] button. A Module Properties window will appear.

11) Set the following parameters in the Module Properties window. All parameters not listed here are optional.
   ➤ **Name:** A descriptive name for the module. The name must begin with a letter.
   ➤ **Description:** Your Choice
   ➤ **Comm Format:** Data-INT (This parameter ***must*** be *Data-INT*)
   ➤ **Slot:** Location of 4402 module. Slot 1 is directly to the right of the adapter.

12) Enter the Connection Parameters from the following table.

	Assembly Instance	Size
Input	101	6
Output	102	8
Configuration	103	0

Table 2.3 CompactLogix 5370 Connection Parameters

13) Click on the [Next] button and select the RPI time. Because the AMCI 4402 is a Specialty I/O module, it will only use direct connections to communicate with the scanner module. Although any value down to three milliseconds can be selected, AMCI does not recommend values below fifteen milliseconds. Additionally, to avoid overloading the 1734-ACNR adapter, RA recommends an RPI time of fifty milliseconds or greater be used for all direct communication modules when using the 1734-ACNR adapter.

NOTE ▷ The other pages of the Module Properties window are not used by the 4402 module.

14) Click on the [Finish>>] button to complete the installation. You should now save the project and download the new configuration to the processor.

The following tags will have been created. The *adapter_name* shown here was the one selected for the POINT I/O network adapter in step 6 above. Also, X = slot number and Y = word number.

   ➤ *adapter_name***:X:I.data[Y]:** Input Data sent from the 4402 module to the PLC. Words 0 and 1 will always be zero.

   ➤ *adapter_name***:X:O.data[Y]:** Output Data sent from the PLC to the 4402 module.

   ➤ *adapter_name***:X:C.data[Y]:** Configuration Data, not used by the 4402 module.

2.2e RSNetWorx for ControlNet Setup (optional)

Although not required to make the 4402 module operate in a ControlNet system, adding the 4402 module's EDS file to RSNetWorx will allow it to appear in your network. If the EDS file is not added to RSNetWorx, the 4402 module will appear as an *Unknown Device*.

The EDS file is available in the Driver File Download section of our website, *www.amci.com*. The following procedure, used to add the EDS file to RSNetWorx, assumes that you have already downloaded this file and un-zipped it.

1) Start RSNetWorx for ControlNet and either open an existing project or create a new one.
2) In the RSNetWorx program, click on *Tools* in the menu bar.
3) Click on "EDS Wizard…" from the pull down menu that appears.
4) Click on the [Next>] button in the window that appears.
5) Select "Register an EDS file(s)" and click on [Next>].
6) Select *Register an EDS file*.
7) Click on the [Choose File…] button and navigate to the folder where you placed the EDS file.
8) Double click on 4402_r01.eds file.
9) Click on [Next>].
10) Click on 4402_r01.eds file name so that it is highlighted.
11) Click on [Next>] to assign an icon to the device.
12) Click on the 4402 and then click on the [Change icon…] button. Select one of the built in icons that Rockwell Automation offers.
13) Click on [Next>] and then click on [Finish] to complete the installation of the AMCI 4402 EDS file to the RSNetWorx system.
14) Go Online. RSNetWorx will scan the ControlNet network and should discover both the 1734-ANCR adapter and the 4402 module at the node address that you set on the adapter.
15) Click on the Enable Edits checkbox and then save the project. You should now have a working network.

> **This section covers the data format of the tags assigned to the 4402 when it was created. Sample code for the 4402 is available on our website, www.amci.com.**

3.1 Buffering Data

Some of the platforms that are compatible with POINT I/O update data asynchronously to the program scan. Therefore, this data should be buffered by copying it to holding registers using a Synchronous Copy (CPS) instruction. The holding registers should then used by your PLC program. If the data is not buffered, it can change during a program scan, resulting in logical errors that may cause a machine malfunction.
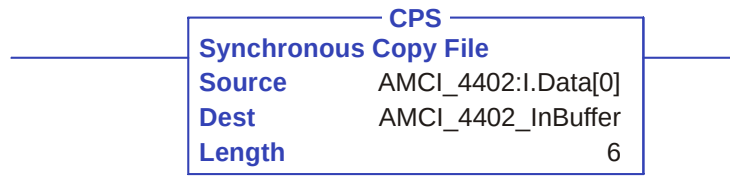
```
                    ┌──────── CPS ────────┐
                    Synchronous Copy File
                    Source        AMCI_4402:I.Data[0]
                    Dest          AMCI_4402_InBuffer
                    Length                          6
```

Figure 3.1 Sample CPS Instruction

3.2 Data Format

Table 3.1 below shows the format of the input data based on the communications platform used with the module.

Word	CompactLogix 5370 L1 EtherNet/IP ControlNet	DeviceNet
0	Reserved. Always 0000.	Module Status
1	Reserved. Always 0000.	Channel 0 Duty Cycle
2	Module Status	Channel 1 Duty Cycle
3	Channel 0 Duty Cycle	Reserved. Always 0000.
4	Channel 1 Duty Cycle	Reserved. Always 0000.
5	Reserved. Always 0000.	Reserved. Always 0000.

Table 3.1 Input Data Format

3.2.1 Duty Cycle Words

These words report the present duty cycle being output on the respective channel. Values range form 0 to 1,000, representing on times from 0.0% to 100.0%.

3.2 Data Format (continued)

3.2.2 Status Word

Figure 3.2 below shows the format of the Module Status bits.

Bit Number															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ACKnowledge	Save to Flash Error	0	Reserved Word Error	CH1 Dither Freq Error	CH1 PWM Freq Error	CH0 Dither Freq Error	CH0 PWM Freq Error	CH1 Dither Amplitude Error	CH0 Dither Amplitude Error	CH1 Duty Cycle Error	CH0 Duty Cycle Error	Control Word Error	0	CH1 RT Updates Enabled	CH0 RT Updates Enabled

Figure 3.2 Module Status Bits

Bit 0 - CH0 Real Time Updates Enabled: Set to '0' when the output on channel 0 is based on its default parameters. Set to '1' when the output on channel 1 is based on the last values written to the 4402 for the channel.

Bit 1 - CH1 Real Time Updates Enabled: Set to '0' when the output on channel 1 is based on its default parameters. Set to '1' when the output on channel 1 is based on the last values written to the 4402 for the channel.

Bit 2 - Reserved: Always equals '0'.

Bit 3 - Control Word Error: Set to '1' if any of the reserved bits in the Control Word are set to '1' when the Transmit bit makes a 0→1 transition.

Bit 4 - CH0 Duty Cycle Error: Set to '1' if the programmed Duty Cycle is outside its acceptable range. Range of 0 to 1,000 for programmed operating frequencies between 1 and 9,999 Hz. Range of 0, 50 to 950, and 1,000 for programmed operating frequencies between 10,000 and 20,000 Hz.

Bit 5 - CH1 Duty Cycle Error: Set to '1' if the programmed Duty Cycle is outside its acceptable range. Range of 0 to 1,000 for programmed operating frequencies between 1 and 9,999 Hz. Range of 0, 50 to 950, and 1,000 for programmed operating frequencies between 10,000 and 20,000 Hz.

Bit 6 - CH0 Dither Amplitude Error: Set to '1' if:
➢ the programmed Dither Deviation is outside its acceptable range of 0 to {programmed Duty Cycle / 2}.
➢ the Duty Cycle is changed to a value less than {programmed Dither Deviation * 2}
➢ this parameter is non-zero and the Dither Frequency is set to zero.

Bit 7 - CH1 Dither Amplitude Error: Set to '1' if:
➢ the programmed Dither Deviation is outside its acceptable range of 0 to {programmed Duty Cycle / 2}.
➢ the Duty Cycle is changed to a value less than {programmed Dither Deviation * 2}
➢ this parameter is non-zero and the Dither Frequency is set to zero.

Bit 8 - CH0 PWM Frequency Error: Set to '1' if the programmed frequency for channel 0 is outside its acceptable range of 0 to 20,000.

Bit 9 - CH0 Dither Frequency Error: Set to '1' if the programmed Dither Frequency for channel 0 is outside its acceptable range of 0 to {programmed PWM Frequency / 4).

Bit 10 - CH1 PWM Frequency Error: Set to '1' if the programmed frequency for channel 1 is outside its acceptable range of 0 to 20,000.

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3.2 Data Format (continued)

3.2.2 Status Word (continued)

Bit 11 - CH1 Dither Frequency Error: Set to '1' if the programmed Dither Frequency for channel 1 is outside its acceptable range of 0 to {programmed PWM Frequency / 4).

Bit 12 - Reserved Word Error: Set to '1' if word 7 of the output data is not equal to zero when the Transmit bit makes a 0→1 transition.

Bit 13 - Reserved: Always equals '0'.

Bit 14 - Save to Flash Error: Set to '1' if there was an error writing parameter data to Flash memory.

Bit 15 - Acknowledge Bit: Handshake protocol response bit. Used with the Transmit bit in the output data to control the data transfer to the 4402. This bit is set to '1' when the Transmit bit is '1' and the programming data has been accepted. This bit is set to '0' when the Transmit bit is '0'.

Notes

This section covers the data format you must use when writing to the 4402. This data must be written to the output tags assigned to the 4402 when it was added to the project tree. Sample code for the 4402 is available on our website, www.amci.com.

4.1 Data Format

Table 4.1 below shows the format of the input data based on the communications platform used with the module.

Word	Description	Range
0	Control Bits	See *Control Bits Description* starting on page 28.
1	Channel 0 Duty Cycle	0 to 1000 (0.0 to 100.0%) if PWM frequency between 0 to 9,999 Hz 0, 50 to 950, 1000 (0.0%, 5.0% to 95.0%, 100.0%) if PWM Frequency ≥ 10,000 Hz
2	Channel 1 Duty Cycle	0 to 1000 (0.0 to 100.0%) if PWM frequency between 0 to 9,999 Hz 0, 50 to 950, 1000 (0.0%, 5.0% to 95.0%, 100.0%) if PWM Frequency ≥ 10,000 Hz
3	Channel 0 Dither Deviation	0 to (*CH0 Duty Cycle* / 2) Programmed with the same units as Duty Cycle values, which is as a percentage of PWM period with a resolution of 0.1%.
4	Channel 1 Dither Deviation	0 to (*CH1 Duty Cycle* / 2) Programmed with the same units as Duty Cycle values, which is as a pre cent age of PWM period with a resolution of 0.1%.
5	PWM Frequency	0 to 20,000 Programmed in Hertz with a resolution of 1 Hz.
6	Dither Frequency	0 to (*PWM Frequency* / 2) Programmed in Hertz with a resolution of 1 Hz.
7	Reserved. Must be 0000.	0

Table 4.1 Output Data Format

4.1 Data Format (continued)

4.1.1 Control Bits Description

Figure 4.1 below shows the format of the Control Bits.

Bit Number															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Transmit	Clear Errors	0	0	0	0	0	0	Output State on Net Loss	PGM State on Net Loss	Save CH1 Defaults	Save CH0 Defaults	Program CH1	Program CH0	CH1 RT Update Enable	CH0 RT Update Enable

Figure 4.1 Module Status Bits

Bit 15 - Transmit Bit: Handshake protocol initialization bit. Used with the Acknowledge bit in the input data to control the data transfer to the 4402. The remaining bits in this word are only acted upon when the Transmit bit makes a 0→1 transition.

Bit 14 - Clear Errors: Set to '1' to clear any programming error that exist in the module.

Bits 8-13 - Reserved: These bits must always equal '0'.

Bit 7 - Output State On Network Loss: *Only acted upon when the Program Network Lost State (bit 6) is set to '1'.* When set to '0', the output will remain in its current state. When set to '1' the output state will be based on the last saved default values.

Bit 6 - Program Network Lost State: When set to '1', the state the outputs take when the network connection is lost is defined by (bit 7). When set to '0' the state the outputs take is left unchanged.

Bit 5 - Save Channel 1 Defaults: When set to '1', the present channel 1 parameter values are saved to flash memory. These values will now be used as power on defaults for channel 1. If the *Program Channel 1* bit (bit 3) is also set, the values saved in flash will be the values in output words 2, 4, 5, and 6 as well as the value of *CH 1 Real Time Update Enable* bit, which is bit 1 of this word.

Bit 4 - Save Channel 0 Defaults: When set to '1', the present channel 0 parameter values are saved to flash memory. These values will now be used as power on defaults for channel 0. If the *Program Channel 0* bit (bit 2) is also set, the values saved in flash will be the values in output words 1, 3, 5, and 6 as well as the value of *CH 0 Real Time Update Enable* bit, which is bit 0 of this word.

Bit 3 - Program Channel 1: When set to '0', the output on channel 1 is based on the last values programmed to the unit, or power on defaults if the 4402 has not been programmed since a power cycle. When set to '1', the output on channel 1 is based on the values in output words 2, 4, 5, and 6 as well as the value of *CH 1 Real Time Update Enable* bit, which is bit 1 of this word.

Bit 2 - Program Channel 0: When set to '0', the output on channel 0 is based on the last values programmed to the unit, or power on defaults if the 4402 has not been programmed since a power cycle. When set to '1', the output on channel 0 is based on the values in output words 1, 3, 5, and 6 as well as the value of *CH 0 Real Time Update Enable* bit, which is bit 0 of this word.

Bit 1 - CH 1 Real Time Update Enable: When set to '0', changes to the *CH 1 Duty Cycle* and *CH 1 Dither Amplitude* parameters for channel 1 will only be accepted when the *Program Channel 1* bit is set to '1' while the Transmit bit makes a 0→1 transition. When set to '1', the changes to these parameters, (Words 2 and 4 respectively), are acted upon immediately.

Bit 0 - CH 0 Real Time Update Enable: When set to '0', changes to the *CH 0 Duty Cycle* and *CH 0 Dither Amplitude* parameters for channel 0 will only be accepted when the *Program Channel 0* bit is set to '1' while the Transmit bit makes a 0→1 transition. When set to '1', the changes to these parameters, (Words 1 and 3 respectively), are acted upon immediately.

4.2 Programming Notes

Use the following values for the Control Bits word to enable or disable real time updates on the 4402 outputs. When enabled, changes to the Duty Cycle and Dither Amplitude parameters are acted upon as soon as they occur. These values assume that the Transmit bit is already equal to zero.

> ➤ 16#8000: Real time updates disabled on both channels.
> ➤ 16#8001: Real time updates enabled on channel 0, disabled on channel 1.
> ➤ 16#8002: Real time updates disabled on channel 0, enabled on channel 1.
> ➤ 16#8003: Real time updates enabled on both channels.

Use the following values for the Control Bits word to program the parameters of the 4402. These setting will program the PWM Frequency, Duty Cycle, Dither Frequency, Dither Amplitude, and Real Time Updates Enable for the associated channel. These values assume that the Transmit bit is already equal to zero.

> ➤ 16#8004: Program channel 0. Real time updates disabled on both channels.
> ➤ 16#8005: Program channel 0. Real time updates enabled on channel 0, disabled on channel 1.
> ➤ 16#8006: Program channel 0. Real time updates disabled on channel 0, enabled on channel 1.
> ➤ 16#8007: Program channel 0. Real time updates enabled on both channels.
> ➤ 16#8008: Program channel 1. Real time updates disabled on both channels.
> ➤ 16#8009: Program channel 1. Real time updates enabled on channel 0, disabled on channel 1.
> ➤ 16#800A: Program channel 1. Real time updates disabled on channel 0, enabled on channel 1.
> ➤ 16#800B: Program channel 1. Real time updates enabled on both channels.
> ➤ 16#800C: Program both channels. Real time updates disabled on both channels.
> ➤ 16#800D: Program both channels. Real time updates enabled on channel 0, disabled on channel 1.
> ➤ 16#800E: Program both channels. Real time updates disabled on channel 0, enabled on channel 1.
> ➤ 16#800F: Program both channels. Real time updates enabled on both channels.

NOTE ▶ If you program both channels at the same time, the PWM Frequency and Dither Frequency for both channels will be the same.

Data can be stored in flash memory with the following commands.

> ➤ 16#8010: Store data for channel 0.
> ➤ 16#8020: Store data for channel 1.
> ➤ 16#8030: Store data for both channels.

NOTE ▶ Programming errors can only be cleared by setting the Clear Errors bit to '1'. They cannot be cleared by attempting to program the parameters with corrected values. Setting the Clear Errors bit will change the Controls Bits word listed above to 16#C0xx where 'xx' are the values listed above.

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