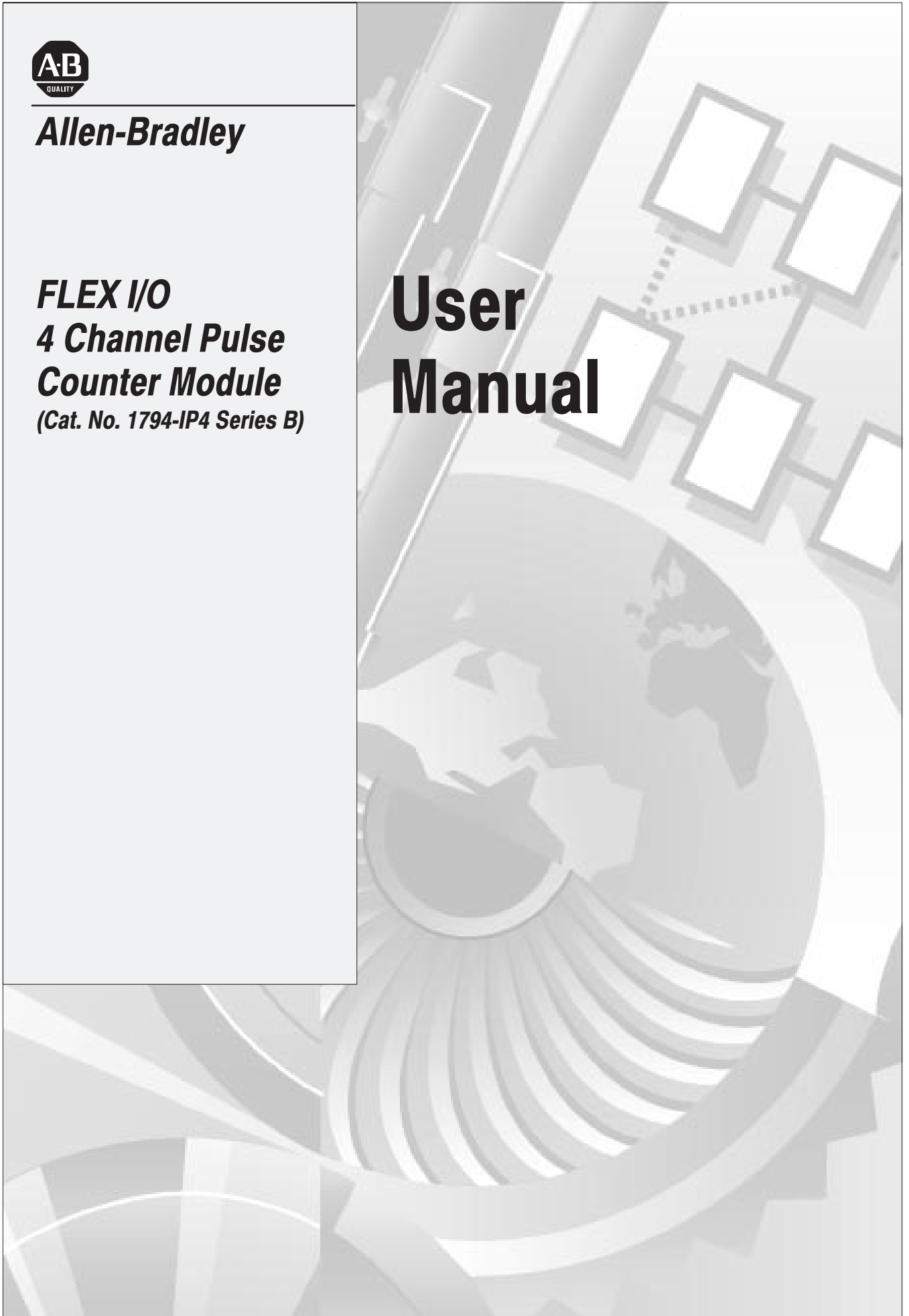




Allen-Bradley

***FLEX I/O
4 Channel Pulse
Counter Module
(Cat. No. 1794-IP4 Series B)***

User Manual



Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for example. Since there are many variables and requirements associated with any particular installation, Allen-Bradley does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Allen-Bradley publication SGI-1.1, “Safety Guidelines For The Application, Installation and Maintenance of Solid State Control” (available from your local Allen-Bradley office) describes some important differences between solid-state equipment and electromechanical devices which should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we make notes to alert you to possible injury to people or damage to equipment under specific circumstances.



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss.

Attention helps you:

- identify a hazard
- avoid the hazard
- recognize the consequences

Important: Identifies information that is especially important for successful application and understanding of the product.

Important: We recommend you frequently backup your application programs on appropriate storage medium to avoid possible data loss.

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Using This Manual

Purpose of this Manual

This manual shows you how to use your FLEX I/O pulse counter module with Allen-Bradley programmable controllers. The manual helps you install, program and troubleshoot your module.

Audience

You must be able to program and operate an Allen-Bradley programmable controller to make efficient use of your FLEX I/O module. In particular, you must know how to program block transfers.

We assume that you know how to do this in this manual. If you do not, refer to the appropriate programming and operations manual before you attempt to program your modules.

Vocabulary

In this manual, we refer to:

- the pulse counter module as the “input module”
- the Programmable Controller as the “controller”


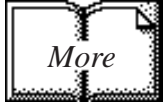
Manual Organization

This manual is divided into seven chapters. The following chart lists each chapter with its corresponding title and a brief overview of the topics covered in that chapter.

Chapter	Title	Contents
1	Overview of FLEX I/O and the Pulse Counter Module	Describes FLEX I/O pulse counter modules, features, and how they function
2	How to Install Your Pulse Counter Module	How to install and wire the module
3	Module Programming	Explains block transfer programming, sample programs
4	Writing Configuration to and Reading Status From with a Remote I/O Adapter	Explains how to configure your modules and read status information from your modules when using a remote I/O adapter
5	How Communication Takes Place and I/O Image Table Mapping with the DeviceNet Adapter	Explains how you communicate with your modules, and how the I/O image is mapped when using a DeviceNet adapter
6	Calibrating Your Pulse Counter Module	How to calibrate the module.
7	Troubleshoot Your Pulse Counter Module	How to use the indicators to troubleshoot your module.
Appendix	Title	Contents
A	Specifications	Specifications for the pulse counter module

Conventions

We use these conventions in this manual:

In this manual, we show:	Like this:
that there is more information about a topic in another chapter in this manual	
that there is more information about the topic in another manual	

For Additional Information

For additional information on FLEX I/O systems and modules, refer to the following documents:

Catalog Number	Voltage	Description	Publications	
			Installation Instructions	User Manual
1794		1794 FLEX I/O Product Data	1794-2.1	
1794-ACN	24V dc	ControlNet Adapter	1794-5.8	
1794-ACNR	24V dc	Redundant Media ControlNet Adapter	1794-5.18	
1794-ACN15	24V dc	ControlNet Adapter	1794-5.47	
1794-ACNR15	24V dc	Redundant Media ControlNet Adapter	1794-5.48	
1794-ADN	24V dc	DeviceNet Adapter	1794-5.14	1794-6.5.5
1794-ASB/C	24V dc	Remote I/O Adapter	1794-5.50	1794-6.5.9
1794-ASB2/B	24V dc	2-Slot Remote I/O Adapter	1794-5.44	1794-6.5.13
1794-APB	24V dc	Profibus Adapter	1794-5.40	1794-6.5.6
1794-IB8	24V dc	8 Sink Input Module	1794-5.30	
1794-OB8	24V dc	8 Source Output Module	1794-5.31	
1794-IB16	24V dc	16 Sink Input Module	1794-5.4	
1794-OB16	24V dc	16 Source Output Module	1794-5.3	
1794-IV16	24V dc	16 Source Input Module	1794-5.28	
1794-OV16	24V dc	16 Sink Output Module	1794-5.29	
1794-OB8EP	24V dc	8 Electronically Fused Output Module	1794-5.20	
1794-IB8S	24V dc	Sensor Input Module	1794-5.7	
1794-IB10XOB6	24V dc	10 Input/6 Output Module	1794-5.24	
1794-IE8	24V dc	Selectable Analog 8 Input Module	1794-5.6	
1794-OE4	24V dc	Selectable Analog 4 Output Module	1794-5.5	1794-6.5.2
1794-IE4XOE2	24V dc	4 Input/2 Output Analog Module	1794-5.15	

Table continued on next page

Catalog Number	Voltage	Description	Publications	
			Installation Instructions	User Manual
1794-OF4	24V dc	4 Output Isolated Analog Module	1794-5.37	1794-6.5.8
1794-IF4	24V dc	4 Input Isolated Analog Module	1794-5.38	
1794-IF2XOF2	24V dc	2 Input/2 Output Isolated Analog Module	1794-5.39	
1794-IR8	24V dc	8 RTD Input Analog Module	1794-5.22	1794-6.5.4
1794-IT8	24V dc	8 Thermocouple Input Module	1794-5.21	1794-6.5.7
1794-IRT8	24V dc	8 Thermocouple/RTD Input Module	1794-5.50	1794-6.5.12
1794-IJ2	24V dc	2 Frequency Input Module	1794-5.49	1794-6.5.11
1794-ID2	24V dc	2 Channel Pulse Counter Module	1794-5.63	1794-6.5.15
1794-IC16	48V dc	48V dc 16 Input Module	1794-5.53	
1794-OC16	48V dc	48V dc Output Module	1794-5.54	
1794-IA8	120V ac	8 Input Module	1794-5.9	
1794-OA8	120V ac	8 Output Module	1794-5.10	
1794-IA8I	120V ac	Isolated 8 Input Module	1794-5.55	
1794-OA8I	120V ac	Isolated Output Module	1794-5.56	
1794-IA16	120V ac	16 Input Module	1794-5.60	
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1794-TB3TS		Spring Clamp Temperature Base Unit	1794-5.43	
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1794-TB3GS		Spring Clamp Terminal Base Unit	1794-5.59	
1794-CE1, -CE3		Extender Cables	1794-5.12	
1794-NM1		Mounting Kit	1794-2.13	
1794-PS1		24V dc	Power Supply	1794-5.35

Summary

This preface gave you information on how to use this manual efficiently. The next chapter introduces you to the frequency module.

Overview of the Pulse Counter Module

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How to Install Your Pulse Counter Module

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Overview of the Pulse Counter Module

What This Chapter Contains

Read this chapter to familiarize yourself with the 1794-IP4 module.

For information on	See page
How You Use the Pulse Counter Module . .	1-1
What the Pulse Counter Module Does	1-3
Input Capabilities	1-4

How You Use the Pulse Counter Module

The 1794-IP4 module is an intelligent I/O module designed to perform high speed pulse counting. The module provides:

- 4 pulse transmitter interfaces, each with 2 optocoupled inputs. Each input has + and – inputs for connection to transmitters with complementary and noncomplementary signals.

The pulse inputs can accept frequencies up to 100KHz. The module accepts and returns binary data.

The module's primary use is accurate, high-speed counting of pulses from flow meters or density meters. This includes quantity counting and speed calculations.

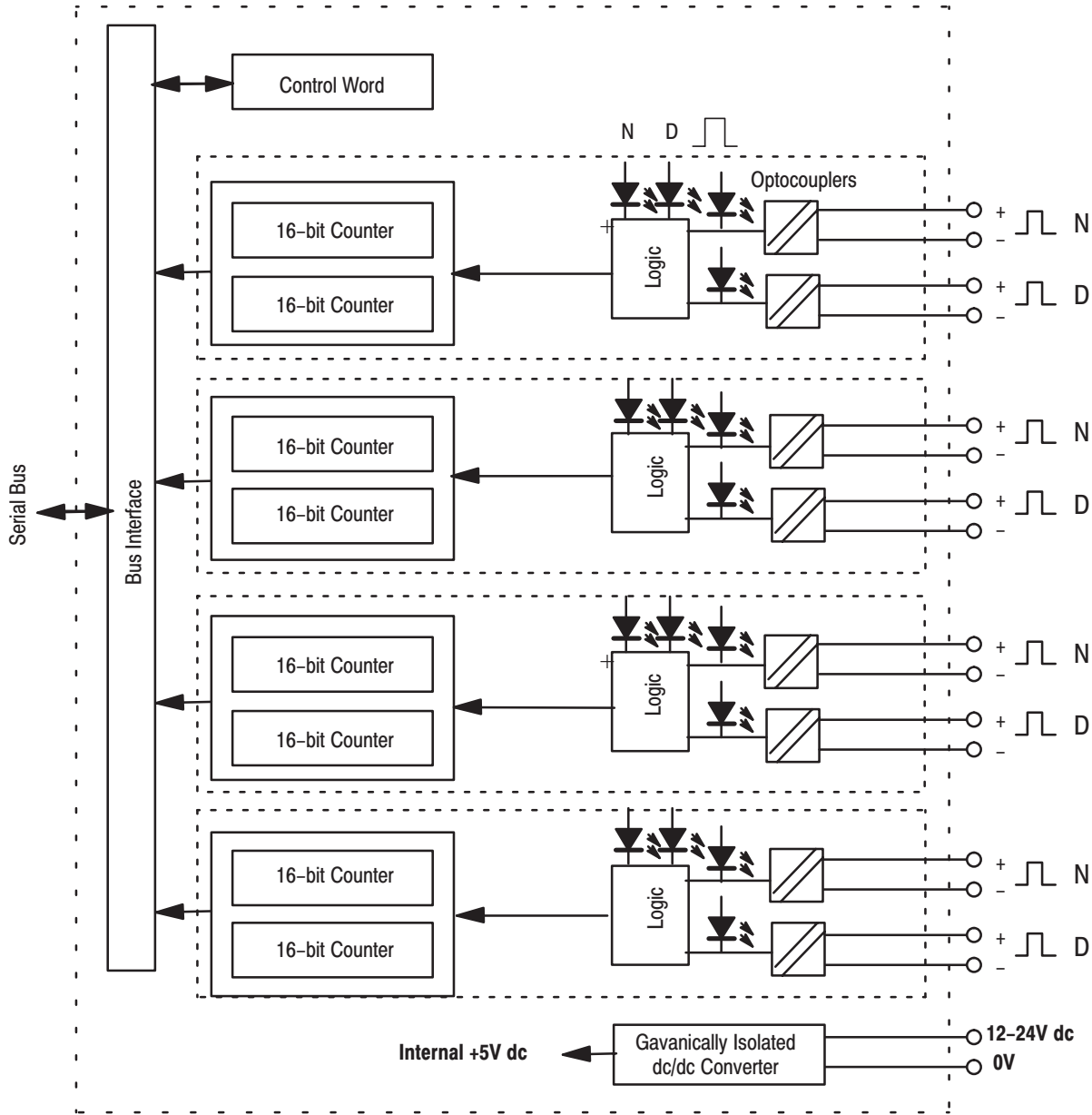
The module has 2 16-bit up/down counters per channel. Each of the 4 interfaces can be individually configured for:

- period time measurement using one 16-bit counter and accumulating pulse counting using the other 16-bit counter.
- period time measurement using a 32-bit counter.

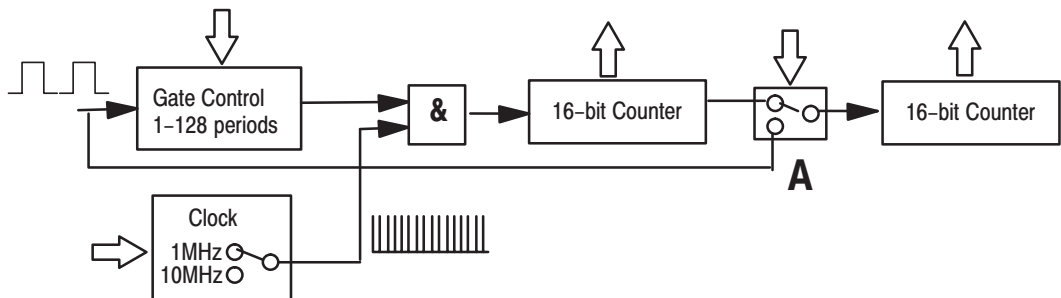
An internal clock (1 or 10MHz) is used for period time measurement.

The number of periods of the input signal to be measured is selectable (1, 2, 4, 8, 16, 32, 64 and 128 periods).

The Pulse Counter has 4 identical pulse transmitter interfaces (12–24V dc), each with 2 signal inputs (N and D). Each input has + and – connections to the pulse transmitter.



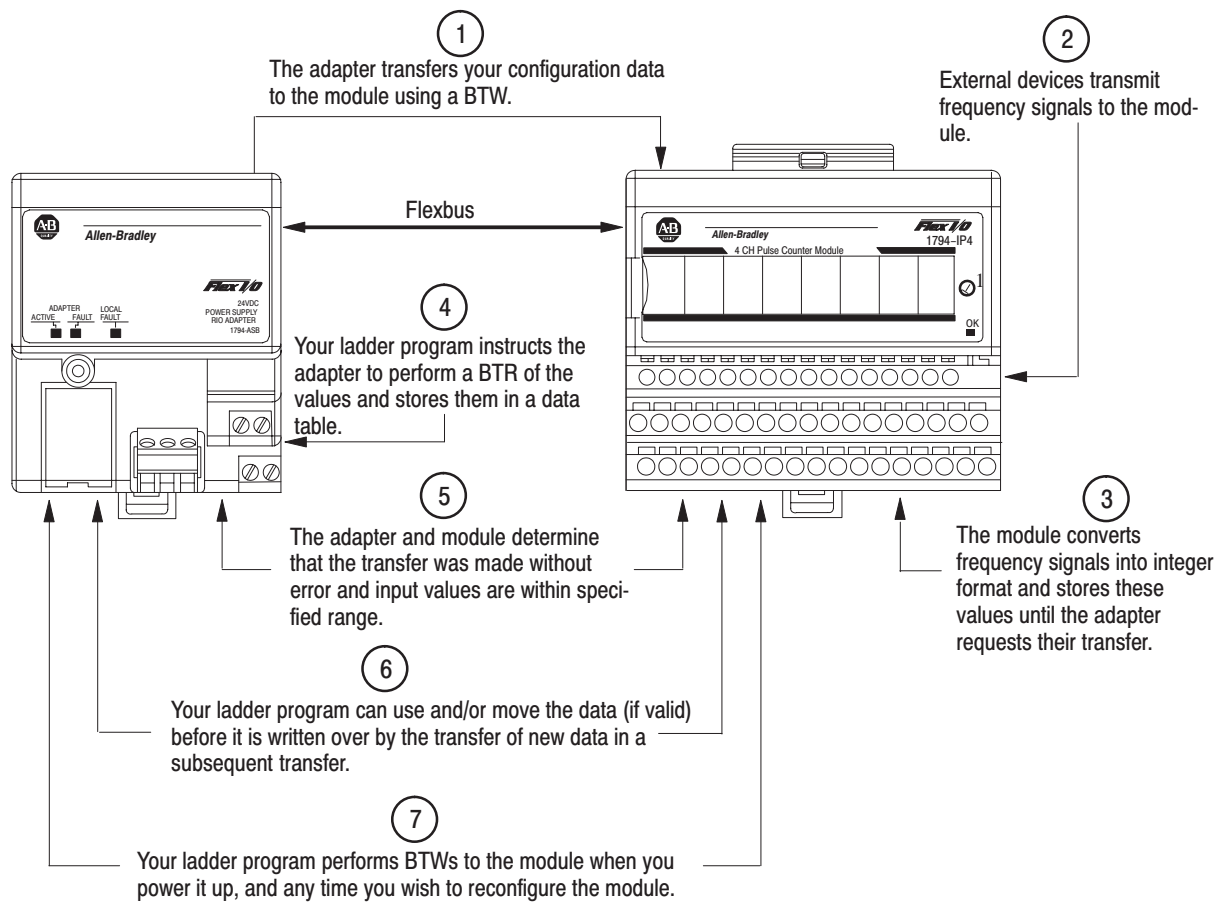
Configuration is selected by setting A (below) in the appropriate position (variable SelectMeasureType). The arrows show signals (control words and registers) controlled by the control system.



What the Pulse Counter Module Does

The Pulse Counter module performs high-speed scaling calculation operations for various industrial applications. The module interfaces with a FLEX I/O family adapter which then communicates with a programmable controller processor that has block-transfer capability and external I/O devices.

The adapter/power supply transfers data to the module (block transfer write) and from the module (block transfer read) using BTW and BTR instructions in your ladder diagram program. These instructions let the adapter read input values and status from the module, and let you write output values and configure the module's mode of operation. The following illustration describes the communication process.



Typical Applications

You can use the 1794-IP4 module in the power management, automotive, food and beverage, and oil and gas industries for various flow and/or turbine metering applications. Some sample applications include:

- quantity counting
- speed calculations
- brewery flow monitoring
- petrochemical flow and custody transfer

Input Capabilities

The Pulse Counter module has 4 identical input interfaces. Each of the input channels may accept + and – input signals:

- N+ and N–
- D+ and D–

The pulse inputs can accept frequencies up to 100KHz. The module accepts and returns binary data.

Each of the 4 counters has two 16-bit counter registers.

Variables

Communication between the Pulse Counter module and the control system take place using variables accessible in the control system program. Examples of variables are:

- selection of clock frequency (*ClockFrequency*)
- selection of measurement type (*SelectMeasureType*).

Control words are used to set parameters for configuration. Control words sent to the Pulse Counter module are read back to the control system to verify that at least 1 I/O scan has been performed since the control system cycle which initiated the frequency module command.

Select Type of Measurement

The module can be configured for 2 alternate functions using the variable *SelectMeasureType*. Each of the 4 inputs can be individually configured.

<i>SelectMeasureType</i>	Function
0	Period time measurement using a 16-bit counter register and the function of a 16-bit accumulating counter
1	Period time measurement using a 32-bit counter register

Start Period Time Measurement

The control bit *StartMeasurement* starts the measurement of the time period.

<i>StartMeasurement</i>	Function
0	Period time measurement stopped (not enabled)
1	Period time measurement starts on the positive edge of the variable

Check if the Measurement is Complete

After a complete measurement the flag *MeasurementReady* is set.

<i>MeasurementReady</i>	Function
0	The measurement is not complete
1	The positive edge of the flag indicates that the measurement is complete

MeasurementReady is reset by the module when a positive edge of *StartMeasurement* is received.

Select Clock Frequency

The clock period for the period time measurement resolution selection can be set to 1 or 10MHz using the variable *ClockFrequency*. 10MHz clock frequency is recommended at 32-bit period time measurement to provide the best accuracy and resolution. Use 1MHz clock frequency at 16-bit frequencies to avoid overflow in the counter at frequencies over 15Hz.

<i>ClockFrequency</i>	Function
0	Clock frequency = 10MHz
1	Clock frequency = 1MHz

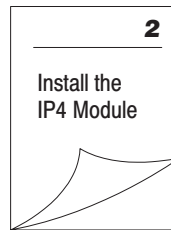
Select Number of Periods

The number of periods to be measured can be selected using the variable *NumberofPeriods*.

<i>NumberofPeriods</i>	Function
0	Measure during 1 period
1	Measure during 2 period
2	Measure during 4 period
3	Measure during 8 period
4	Measure during 16 period
5	Measure during 32 period
6	Measure during 64 period
7	Measure during 128 period

Chapter Summary

In this chapter, you learned about the Pulse Counter module, block transfer communication, and details of how the module functions. Now you can install the module.



How to Install Your Pulse Counter Module

What This Chapter Contains

In this chapter, we tell you about:

For information on	See page
Before You Install Your Module	2-1
European Union Directives	2-1
Power Requirements	2-2
Installing the Module	2-4
on a DIN rail	2-4
on a wall/panel	2-6
on the terminal base	2-7
Connecting Wiring	2-9
Module Indicators	2-15

Before You Install Your Input Module

Before installing your Pulse Counter module in the FLEX I/O system:

You need to:	As described under:
Calculate the power requirements of all modules in each FLEX system.	Power Requirements, page 2-2
Position the keyswitch on the terminal base	Installing the Module, page 2-4



ATTENTION: The Pulse Counter module does not receive power from the backplane. +24V dc power must be applied to your module before installation. If power is not applied, the module position will appear to the adapter as an empty slot in your chassis.

European Union Directive Compliance

If this product has the CE mark it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet Council Directive 89/336/EEC Electromagnetic Compatibility (EMC) and the following standards, in whole or in part, documented in a technical construction file:

- EN 50081-2EMC – Generic Emission Standard, Part 2 – Industrial Environment
- EN 50082-2EMC – Generic Immunity Standard, Part 2 – Industrial Environment

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61131-2 Programmable Controllers, Part 2 – Equipment Requirements and Tests.

For specific information required by EN 61131-2, see the appropriate sections in this publication, as well as the following Allen-Bradley publications:

- Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, publication 1770-4.1
- Guidelines for Handling Lithium Batteries, publication AG-5.4
- Automation Systems Catalog, publication B111

This equipment is classified as open equipment and must be mounted in an enclosure during operation to provide safety protection.

Power Requirements

The wiring of the terminal base unit is determined by the current draw through the terminal base. Make certain that the current draw does not exceed 10A.



ATTENTION: Total current draw through the terminal base unit is limited to 10A. Separate power connections may be necessary.

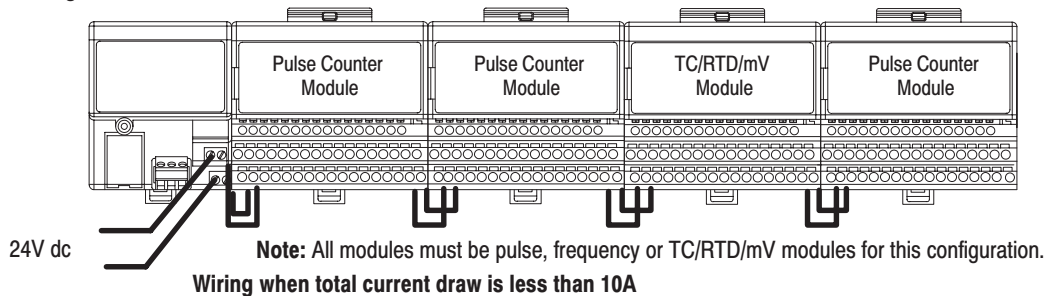
Methods of wiring the terminal base units are shown in the illustration below.

Wiring the Terminal Base Units (1794-TB3G shown)

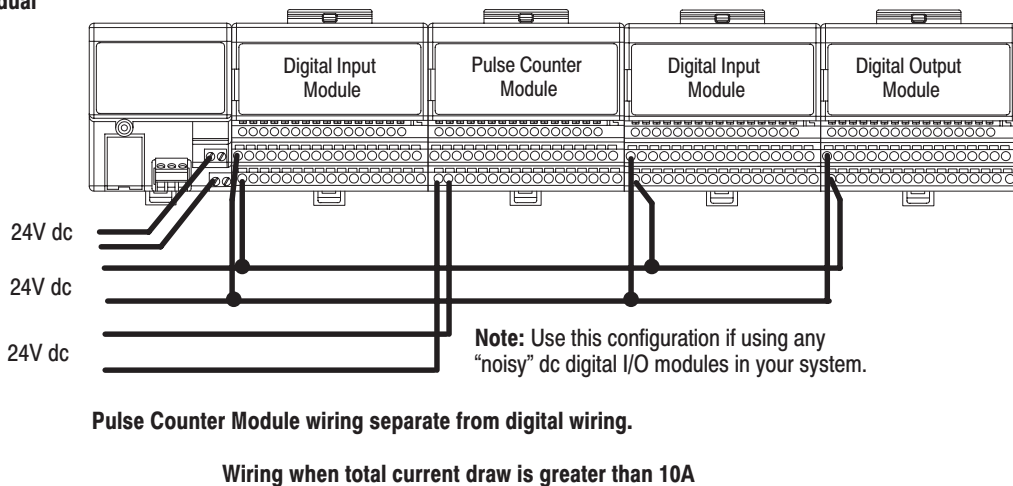


ATTENTION: Do not daisy chain power or ground from the terminal base unit to any ac or dc digital module terminal base unit.

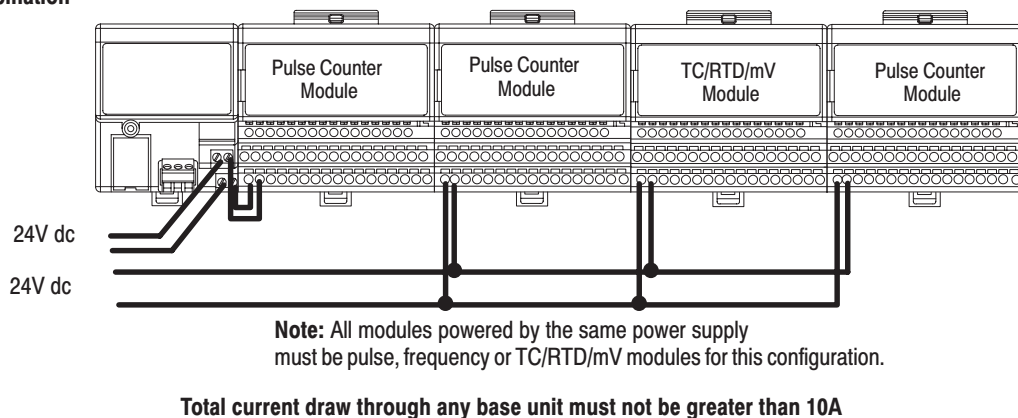
Daisy-chaining



Individual



Combination



Installing the Module

Installation of the Pulse Counter module consists of:

- mounting the terminal base unit
- installing the module into the terminal base unit
- installing the connecting wiring to the terminal base unit

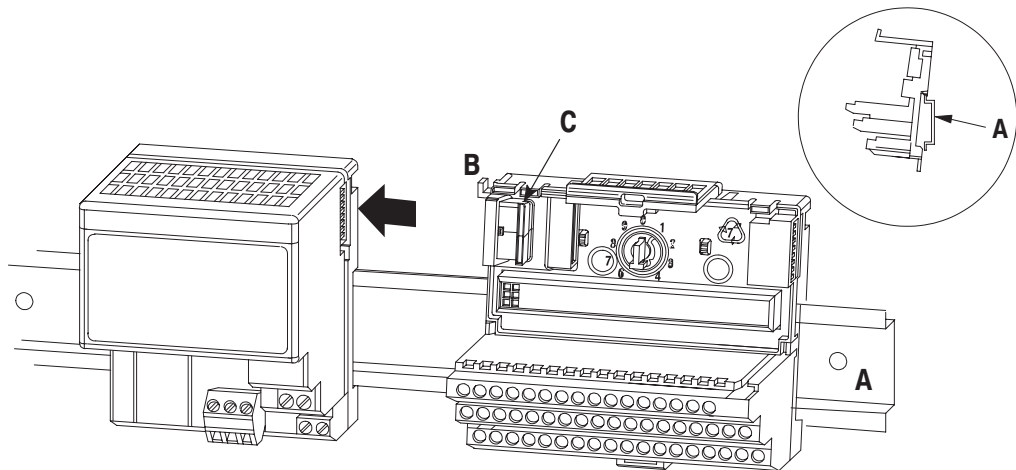
If you are installing your module into a terminal base unit that is already installed, proceed to “Mounting the Pulse Counter Module on the Terminal Base” on page 2-7.

Mounting the Terminal Base Unit on a DIN Rail



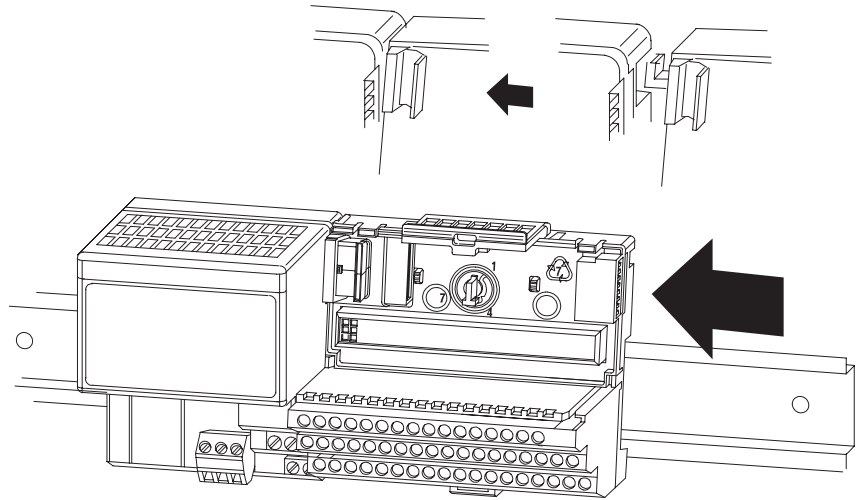
ATTENTION: Do not remove or replace a terminal base unit when power is applied. Interruption of the flexbus can result in unintended operation or machine motion.

1. Remove the cover plug (if used) in the male connector of the unit to which you are connecting this terminal base unit.
2. Check to make sure that the 16 pins in the male connector on the adjacent device are straight and in line so that the mating female connector on this terminal base unit will mate correctly.
3. Position the terminal base on the 35 x 7.5mm DIN rail **A** (A-B pt. no. 199-DR1; 46277-3). Proceed as follows:

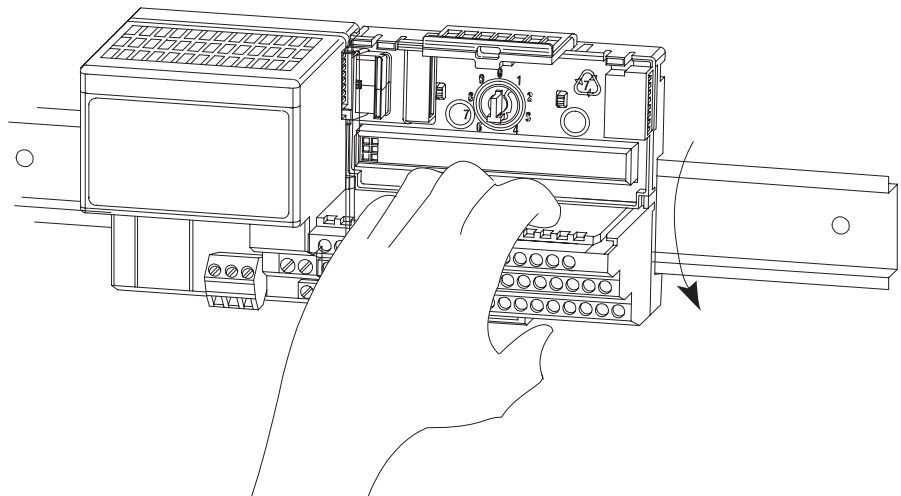


Position terminal base at a slight angle and hooked over the top of the DIN rail.

4. Make certain that the female flexbus connector **C** is **fully retracted** into the base unit.

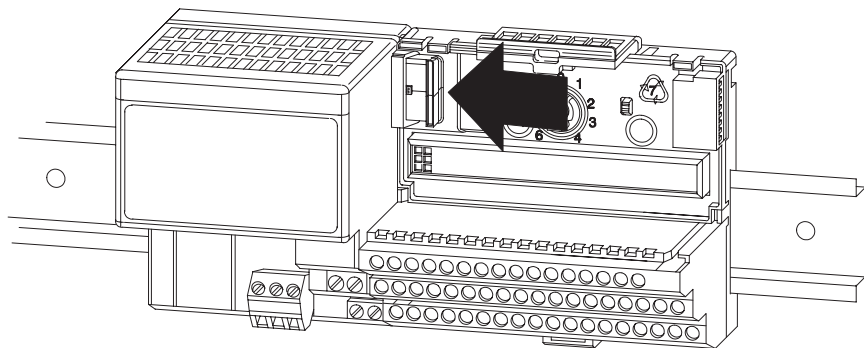


Slide the terminal base unit over tight against the adapter. Make sure the hook on the terminal base slides under the edge of the adapter and the flexbus connector is fully retracted.



Press down on the terminal base unit to lock the terminal base on the DIN rail. If the terminal base does not lock into place, use a screwdriver or similar device to open the locking tab, press down on the terminal base until flush with the DIN rail and release the locking tab to lock the base in place.

30077-M



Gently push the flexbus connector into the side of the adapter to complete the backplane connection.

5. Repeat the above steps to install the next terminal base.

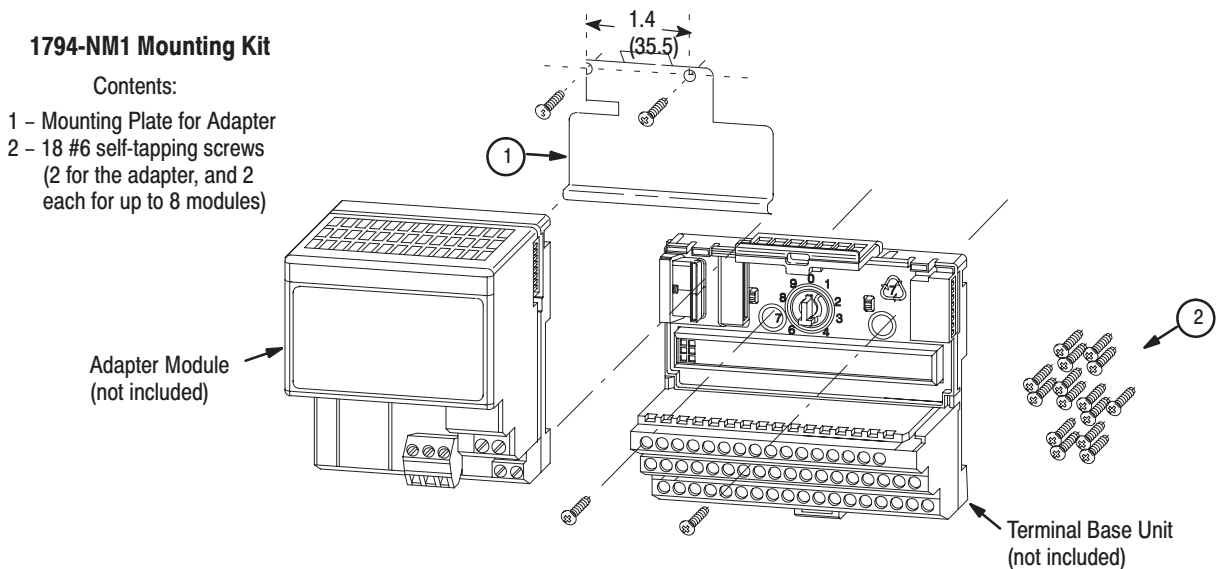
Panel/Wall Mounting

Installation on a wall or panel consists of:

- laying out the drilling points on the wall or panel
- drilling the pilot holes for the mounting screws
- mounting the adapter mounting plate
- installing the terminal base units and securing them to the wall or panel

If you are installing your module into a terminal base unit that is already installed, proceed to “Mounting the Pulse Counter Module on the Terminal Base” on page 2-7.

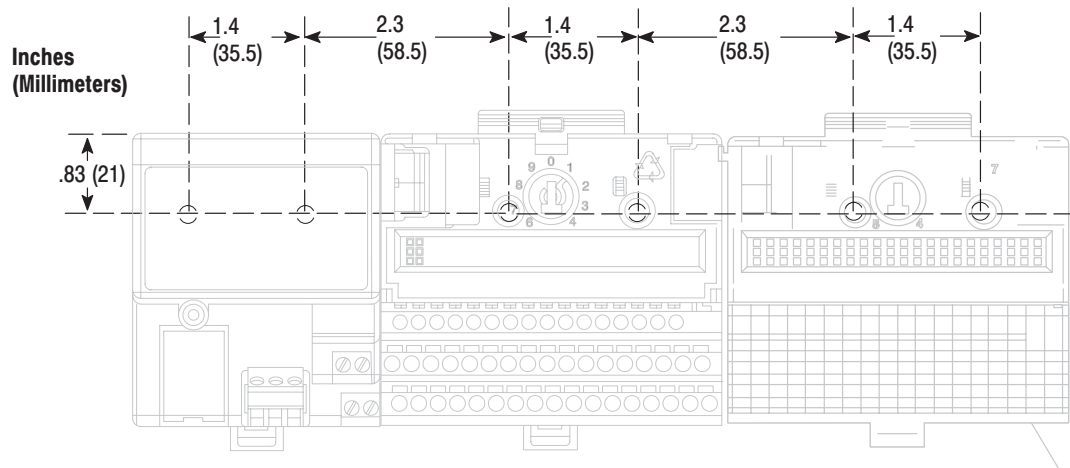
Use the mounting kit Cat. No. 1794-NM1 for panel/wall mounting.



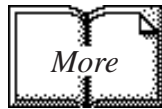
To install the mounting plate on a wall or panel:

1. Lay out the required points on the wall/panel as shown in the drilling dimension drawing.

Drilling Dimensions for Panel/Wall Mounting of FLEX I/O



2. Drill the necessary holes for the #6 self-tapping mounting screws.
3. Mount the mounting plate (1) for the adapter module using two #6 self-tapping screws (18 included for mounting up to 8 modules and the adapter).



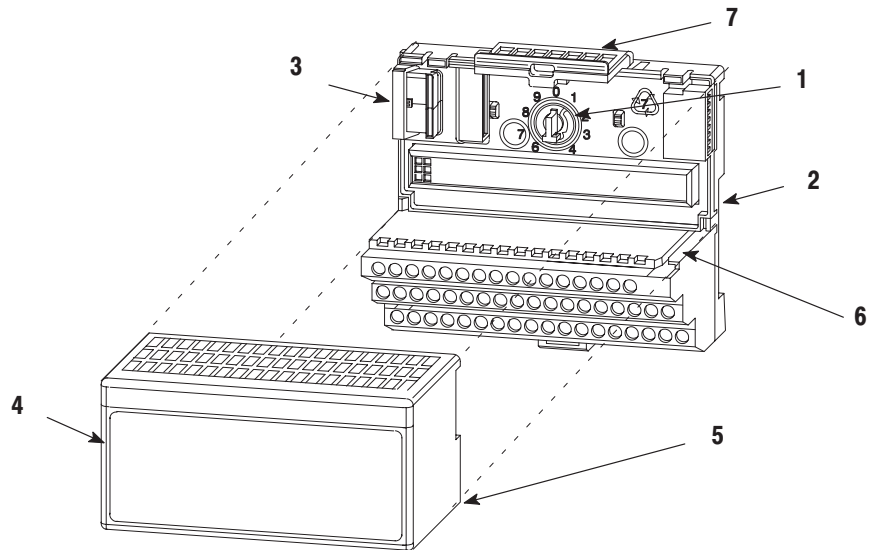
- Important:** Make certain that the mounting plate is properly grounded to the panel. Refer to “Industrial Automation Wiring and Grounding Guidelines,” publication 1770-4.1.
4. Hold the adapter (2) at a slight angle and engage the top of the mounting plate in the indentation on the rear of the adapter module.
 5. Press the adapter down flush with the panel until the locking lever locks.
 6. Position the terminal base unit up against the adapter and push the female bus connector into the adapter.
 7. Secure to the wall with two #6 self-tapping screws.
 8. Repeat for each remaining terminal base unit.

Note: The adapter is capable of addressing eight modules. Do not exceed a maximum of eight terminal base units in your system.

Mounting the Pulse Counter Module on the Terminal Base Unit

The Pulse Counter module mounts on a 1794-TB3, TB3S, -TBN or -TBNF terminal base unit.

1. Rotate the keyswitch (1) on the terminal base unit (2) clockwise to position 1 as required for the Pulse Counter module.



2. Make certain the flexbus connector (3) is pushed all the way to the left to connect with the neighboring terminal base/adaptor. **You cannot install the module unless the connector is fully extended.**
3. Make sure that the pins on the bottom of the module are straight so they will align properly with the connector in the terminal base unit.



ATTENTION: Remove field-side power before removing or inserting the module. This module is designed so **you can remove and insert it under backplane power**. When you remove or insert a module with field-side power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices causing unintended machine motion
 - causing an explosion in a hazardous environment
- Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

4. Position the module (4) with its alignment bar (5) aligned with the groove (6) on the terminal base.
5. Press firmly and evenly to seat the module in the terminal base unit. The module is seated when the latching mechanism (7) is locked into the module.
6. Repeat the above steps to install the next module in its terminal base unit.

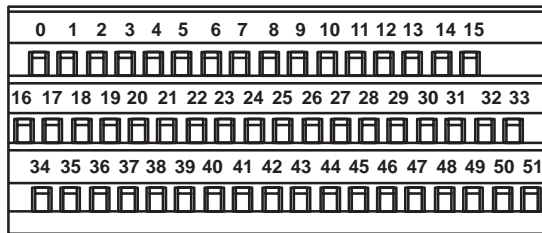
Connecting Wiring for Your Pulse Counter Module

Wiring to the module is made through the terminal base unit on which the module mounts.

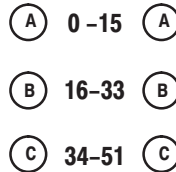
Compatible terminal base units are:

Module	1794-TB3	1794-TB3S	1794-TBN	1794-TBNF
1794-IP4	Yes	Yes	Yes	Yes

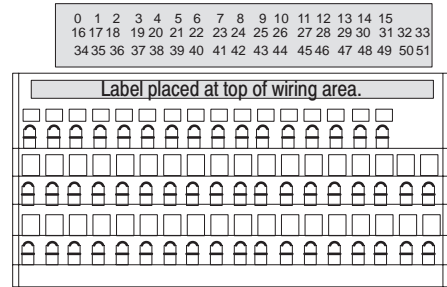
1794-TB3



34 and 50 = 24V dc
 35 and 51 = common
 16 and 33 = chassis ground
 40 thru 45 = chassis ground



1794-TB3S



34 and 50 = 24V dc
 35 and 51 = common
 16 and 33 = chassis ground
 40 thru 45 = chassis ground

Connecting Wiring using a 1794-TB3 and -TB3S Terminal Base Units

1. Connect individual input wiring (N+, N-) or (D+, D-) to numbered terminals on the **0-15** row (A) as indicated in the table below.



ATTENTION: Do not connect maximum input voltage simultaneously to all inputs if the module ambient temperature is expected to exceed 40°C.



ATTENTION: If the module ambient temperature is expected to continuously exceed 40°C, you must limit the input voltage using an external resistor on each input. A 1KΩ resistor effectively limits a 24V sensor signal to about 15V at the input. Do not limit the input to less than 6V.

2. Connect the associated input common to the corresponding terminal on the 16-33 row (B) for each input as indicated in the table below.

3. If using shielded cable, terminate the shield at the DIN rail (earth ground).
4. Connect +24V dc to terminal 34 on the **34-51** row (**C**).
5. Connect dc return to terminal 16 on the **16-33** row (**B**).



ATTENTION: To reduce susceptibility to noise, power frequency modules and digital modules from separate power supplies. Do not exceed a length of 33 ft (10m) for dc power cabling.

6. If continuing power to the next terminal base unit, connect a jumper from terminal 51 (+24V dc) on this base unit to terminal 34 on the next base unit.
7. If continuing common to the next terminal base unit, connect a jumper from terminal 33 (common) on this base unit to terminal 16 on the next base unit.



ATTENTION: Do not daisy chain power or ground from this terminal base unit to any ac or dc digital module terminal base unit.



ATTENTION: This module does not receive power from the backplane. +24V dc power must be applied to your module before operation. If power is not applied, the module position will appear to the adapter as an empty slot in your chassis. If the adapter does not recognize your module after installation is completed, cycle power to the adapter.

Wiring to a 1794-TBN or -TBNF Terminal Base Unit

1. Connect individual input wiring (N+, N-,) or (D+, D-) to the even numbered terminals on row (B) as indicated in the table below.

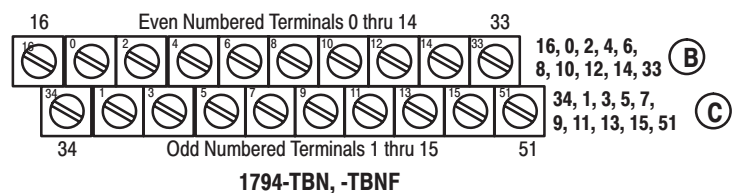


ATTENTION: Do not connect maximum input voltage simultaneously to all inputs if the module ambient temperature is expected to exceed 40°C.



ATTENTION: If the module ambient temperature is expected to continuously exceed 40°C, you must limit the input voltage using an external resistor on each input. A 1KΩ resistor effectively limits a 24V sensor signal to about 15V at the input. Do not limit the input to less than 6V.

2. Connect the associated input common to the corresponding odd numbered terminal on row (C) for each input as indicated in the table below.
3. Connect the associated input common to the corresponding terminal on the 16-33 row (B) for each input as indicated in the table below.
4. Connect 24V dc to terminal 34 on row (C).
5. Connect 24V dc common to terminal 16 on row (B).
6. If continuing power to the next terminal base unit, connect a jumper from terminal 51 (24V dc) on this base unit to terminal 34 on the next base unit.
7. If continuing common to the next terminal base unit, connect a jumper from terminal 33 (24V dc common) on this base unit to terminal 16 on the next base unit.



Wiring connections for the 1794-IP4 Pulse Counter Module

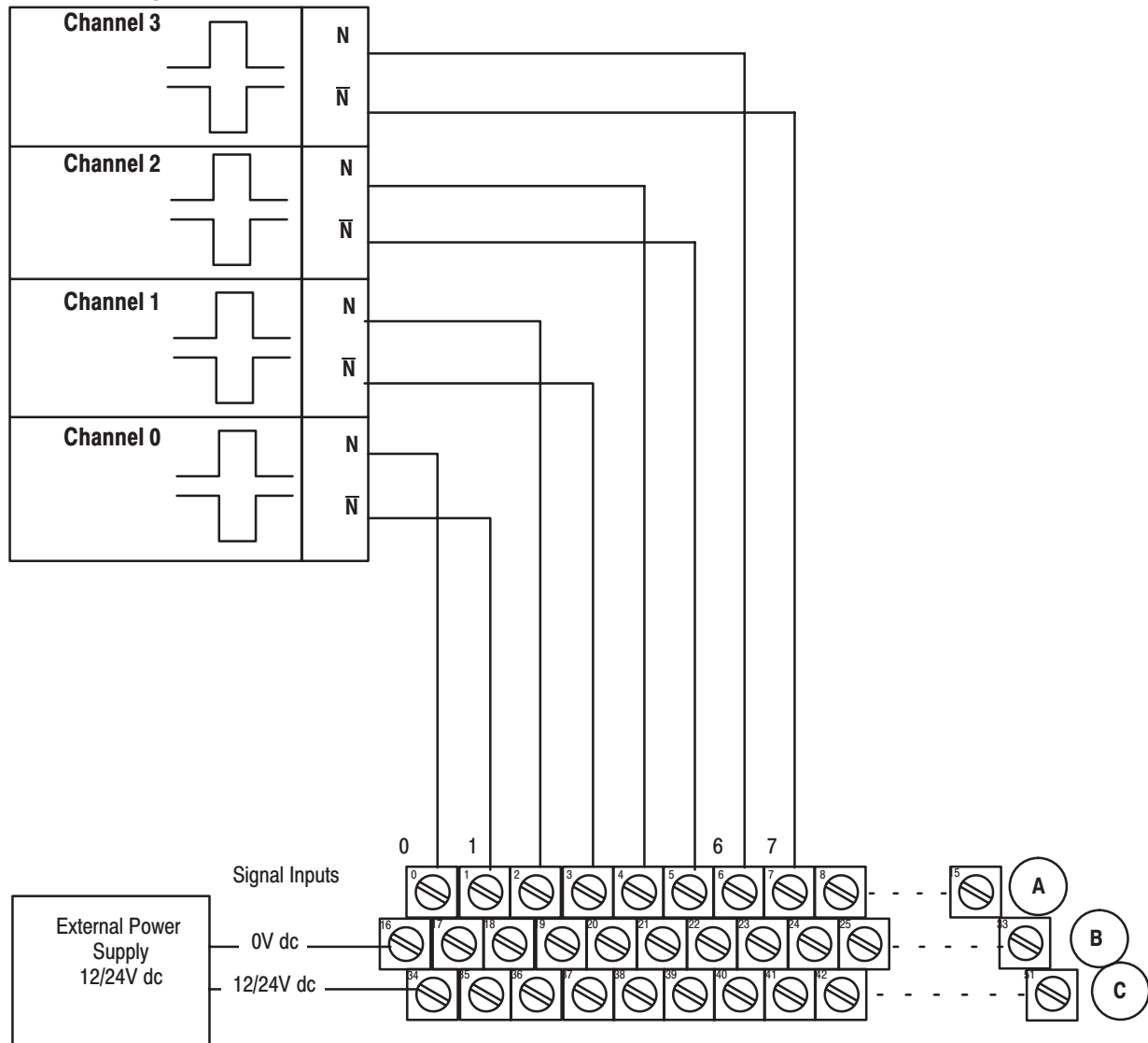
Channel	Signal Name ¹	Terminal Base Units 1794-TB2, -TB3, -TB3S			Terminal Base Units 1794-TBN, -TBNF ²	
		Signal	0V dc (Common)	12/24V dc	Signal	Input
16-bit Period Time Measurement						
0	N	0	17	35	0	
	\bar{N}	1	18	36	1	
1	N	2	19	37	2	
	\bar{N}	3	20	38	3	
2	N	4	21	39	4	
	\bar{N}	5	22	40	5	
3	N	6	23	41	6	
	\bar{N}	7	24	42	7	
32-bit Period Time Measurement						
0	D	8	25	43	8	
	\bar{D}	9	26	44	9	
1	D	10	27	45	10	
	\bar{D}	11	28	46	11	
2	D	12	29	47	12	
	\bar{D}	13	30	48	13	
3	D	14	31	49	14	
	\bar{D}	15	32	50	15	
	0V dc (Common)	Terminals 16 and 33 (1794-TB2) Terminals 16 thru 33 (1794-TB3, -TB3S)			Terminals 16 and 33	
	12/24V dc	Terminals 34 and 51 (1794-TB2) Terminals 34 thru 51 (1794-TB3)			Terminals 34 and 51	
¹ Any unused signals have to be connected to the associated common. ² Auxiliary terminal blocks are required when using these terminal base units. NOTE: If using shielded cable, terminate the shield at the DIN rail (earth ground).						



ATTENTION: Total current draw through the terminal base unit is limited to 10A. Separate power connections to the terminal base unit may be necessary.

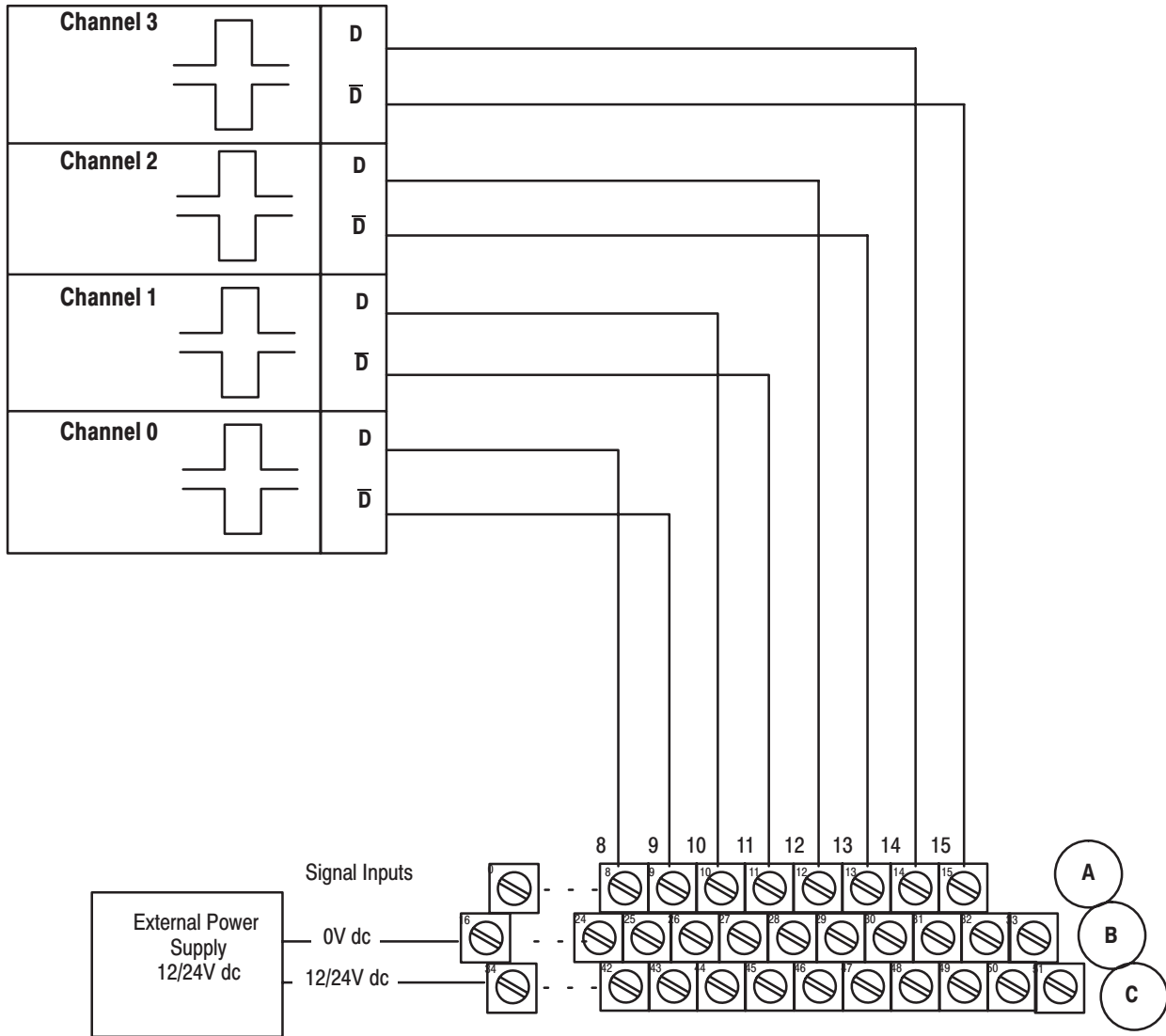
Example of 16-bit Period Time Measurement and 16-bit Accumulating Pulse Counter Wiring (4 channels)

Accumulating Pulse Counter



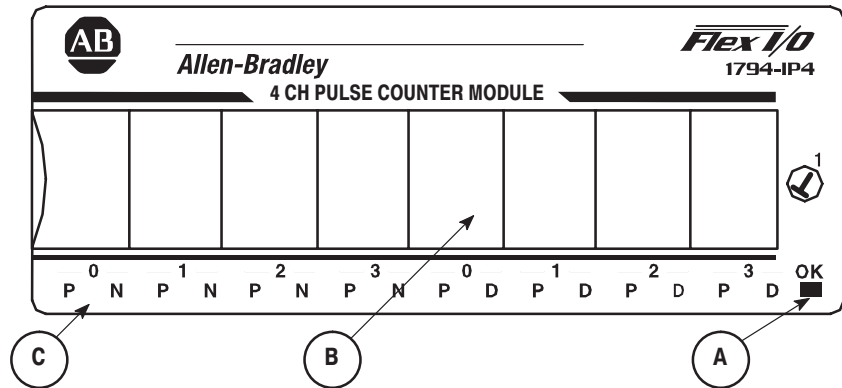
Example of 32-bit Period Time Measurement Wiring (4 channels)

32-bit period time measurement



Module Indicators

The Pulse Counter module has one status indicator (PWR) that is on when power is applied to the module, an input on indicator for each channel, and an input status indicator for each input (8 in all).



A = Power/status indicator –

Red – indicates initialization of internal logic at powerup

Green – indicates initialization of internal logic is complete and correct.

B = Insertable label for writing individual I/O assignments.

C = Status indicators – for each channel:

Indication	Color	Description
P	Yellow	When on, indicates the input is active
N	Yellow	When on, indicates the input is configured for 16-bit period time measurement and 16-bit accumulating pulse counter function
D	Yellow	When on, indicates the input is configured for 32-bit period time measurement

Chapter Summary

In this chapter, we told you how to install your Pulse Counter module in an existing programmable controller system and how to wire to the terminal base units.

Programming Your Pulse Counter Module

What This Chapter Contains

To initiate communication between the Pulse Counter module and your PLC processor, you must enter block transfer instructions into your ladder logic program. Use this chapter to enter the necessary block transfer instructions into your ladder logic program.

To edit your ladder logic you	See page
Enter Block Transfer Instructions	3-1
PLC-2 Family Processors	3-2
PLC-5 Family Processors	3-2
SLC-5 Processors	3-3

Enter Block Transfer Instructions

The Pulse Counter module communicates with the PLC processor through bidirectional block transfers. This is the sequential operation of both read and write block transfer instructions.

Before you configure the module, you need to enter block transfer instructions into your ladder logic. The following example programs illustrate the minimum programming required for communication to take place between the module and a PLC processor. These programs can be modified to suit your application requirements.

A configuration block transfer write (BTW) is initiated when the module is first powered up, and subsequently only when the programmer wants to enable or disable features of the module. The configuration BTW sets the bits which enable the programmable features of the module, such as scalars and alarm values, etc. Block transfer reads are performed to retrieve information from the module.

Block transfer read (BTR) programming moves status and data from the module to the processor's data table. The processor user program initiates the request to transfer data from the module to the processor. The transferred words contain module status, channel status and input data from the module.

Your program should monitor status bits, block transfer read and block transfer write activity.

PLC-2 Family Processor

The 1794 Pulse Counter module is not recommended for use with PLC-2 family programmable controllers due to the number of digits needed for high resolution.

Important: The Pulse Counter module functions with reduced performance in PLC-2 systems. Because the module does not support BCD and the PLC-2 processor is limited to values of 4095 (12 bit binary), many values returned in the BTR file may not provide meaningful data to the PLC-2 processor.

PLC-5 Family Processor

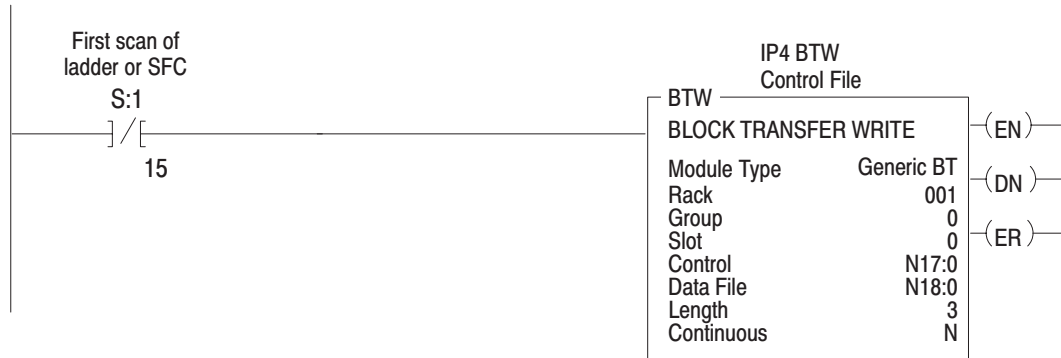
Block transfer instructions with the PLC-5 processor use a control file and a data file. The block transfer control file contains the data table section for module location, the address of the block transfer data file and other related data. The block transfer data file stores data that you want transferred to the module (when programming a BTW) or from the module (when programming a BTR).

The programming terminal prompts you to create a control file when a block transfer instruction is being programmed. **A different block transfer control file is used for the read and write instructions for your module.**

**PLC-5 Processor
Program Example**

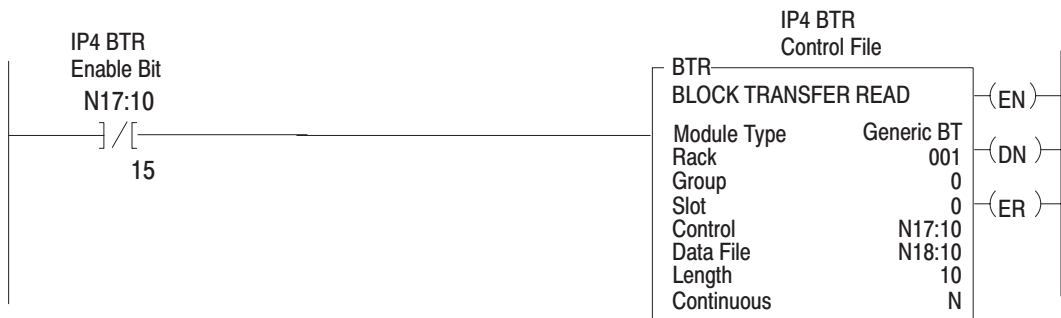
Rung 2:0

The IP4 module is located in rack 1, I/O group 0, slot 0. The integer control file starts at N17:0. The data sent by the PLC-5 processor to the IP4 module starts at N18:0 and is 3 words long. At power up in RUN mode, or when the processor is first switched from PROG to RUN, the user program enables a block transfer write to configure the module..



Rung 2:1

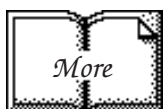
The IP4 module is located in rack 1, group 0, slot 0. The integer control file starts at N17:10,. The data obtained by the PLC-5 processor from the IP4 module is placed in memory starting at N18:10 and is 10 words long. IThe program continuously performs read block transfers to read data from the module.



SLC-5 Programming

The SLC-5 programs (using the 1747-SN scanner) follow the same logic as the PLC-5 family programs in the previous example. Differences occur in the implementation of block transfers due to the use of “M” files in the SLC system.

Configuration data for the FLEX I/O Pulse Counter module and the 1747-SN scanner must be in place before executing the following programs. Chapter 4 contains information on module configuration.



For more information on using the 1747-SN scanner module and block transfer programming, refer to publication 1747-6.6, “Remote I/O Scanner User Manual.”

Figure 3.1
SLC Programming for the 1794-IP4 Pulse Counter Module

The 1794-IP4 module is located in remote I/O rack 1, group 0, slot 0. The 1747-SN scanner module is located in slot 1 of the SLC chassis. This program enables 1 BTW to configure the 1794-IP4 module at power-up. Thereafter, BTRs will be performed continuously to obtain data from the 1794-IP4 module.

Program Action

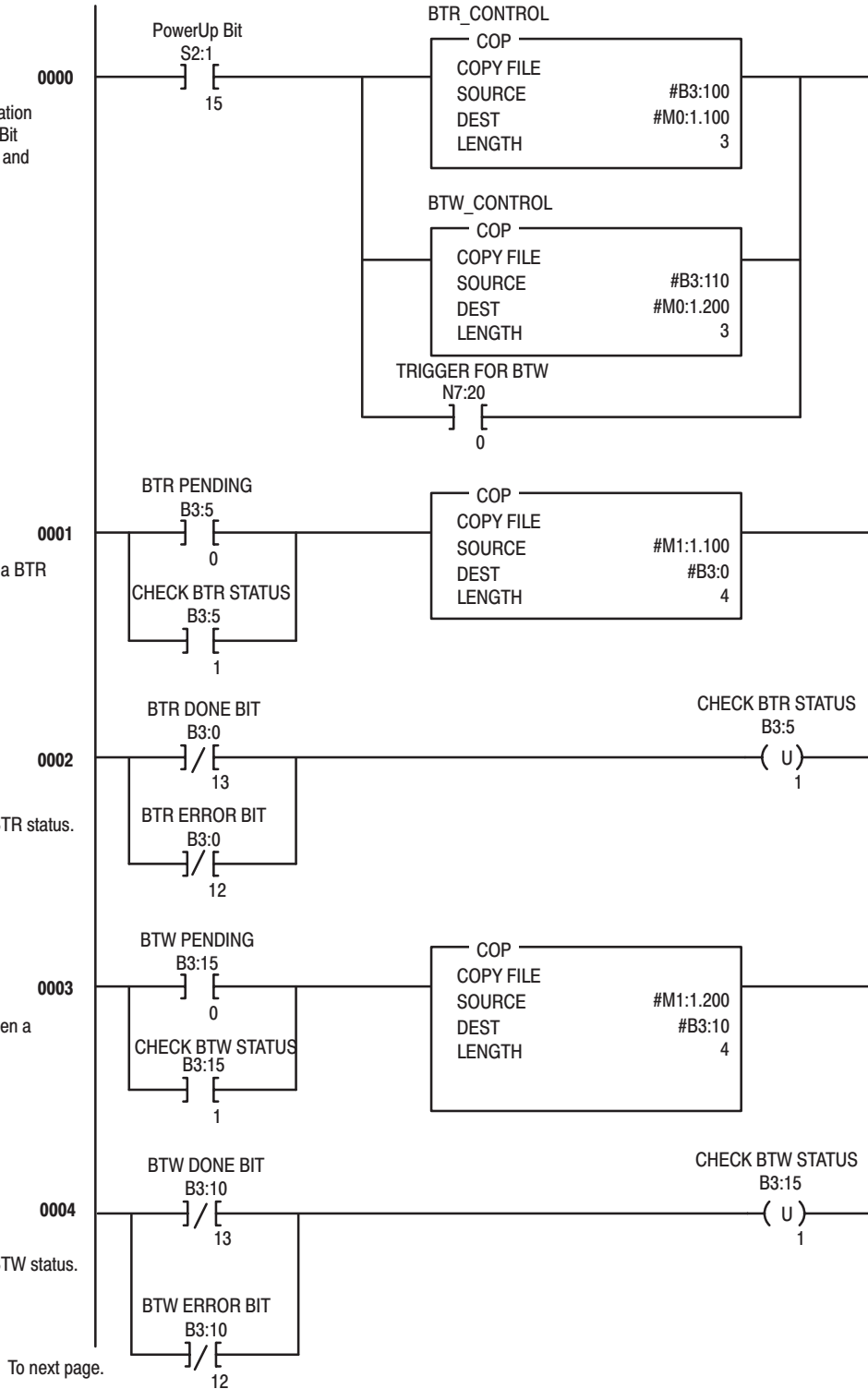
This rung configures the block transfer operation type, length, and RIO address at power-up. Bit B3:100/7 must be set to 1 to indicate a BTR and bit B3:110/7 must be 0 to indicate a BTW.

BTR status is copied to the B3:0 area when a BTR is in progress.

Unlatch the bit that continues to check the BTR status.

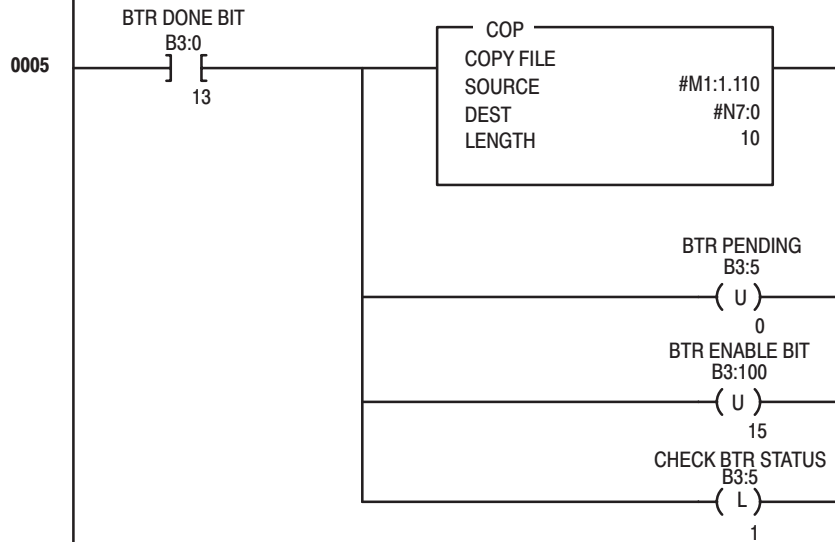
BTW status is copied to the B3:100 area when a BTW is in progress.

Unlatch the bit that continues to check the BTW status.

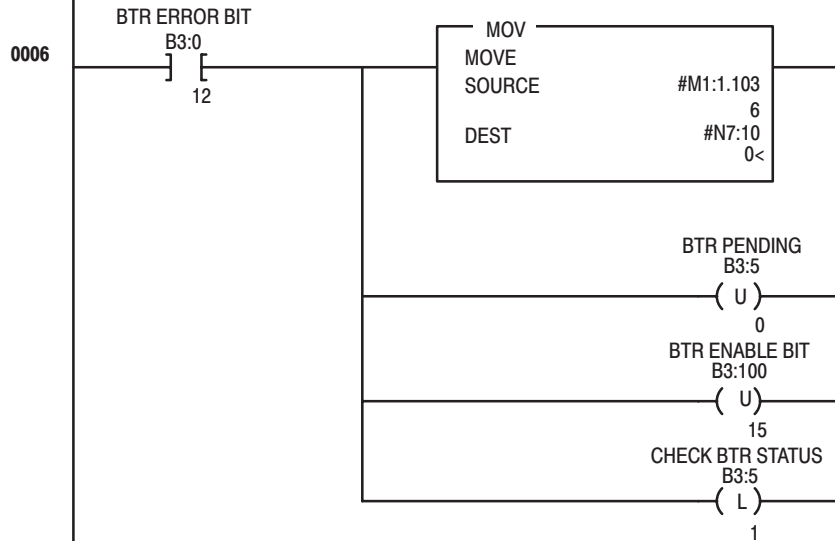


Program Action

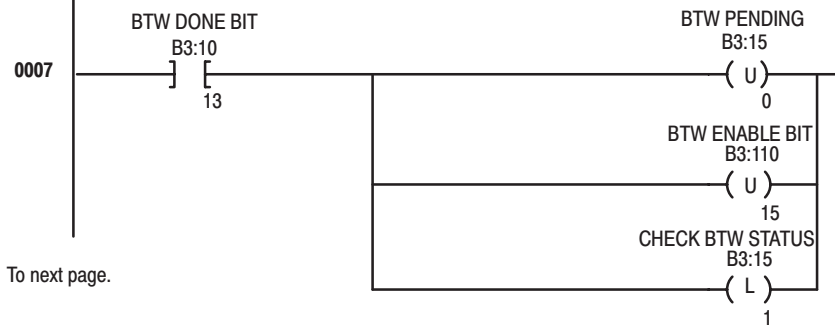
When a BTR successfully completes and the done bit is detected, the BTR data is copied into the N7:0 to N7:9 area.



When a BTR error occurs, the error code is moved to N7:10.



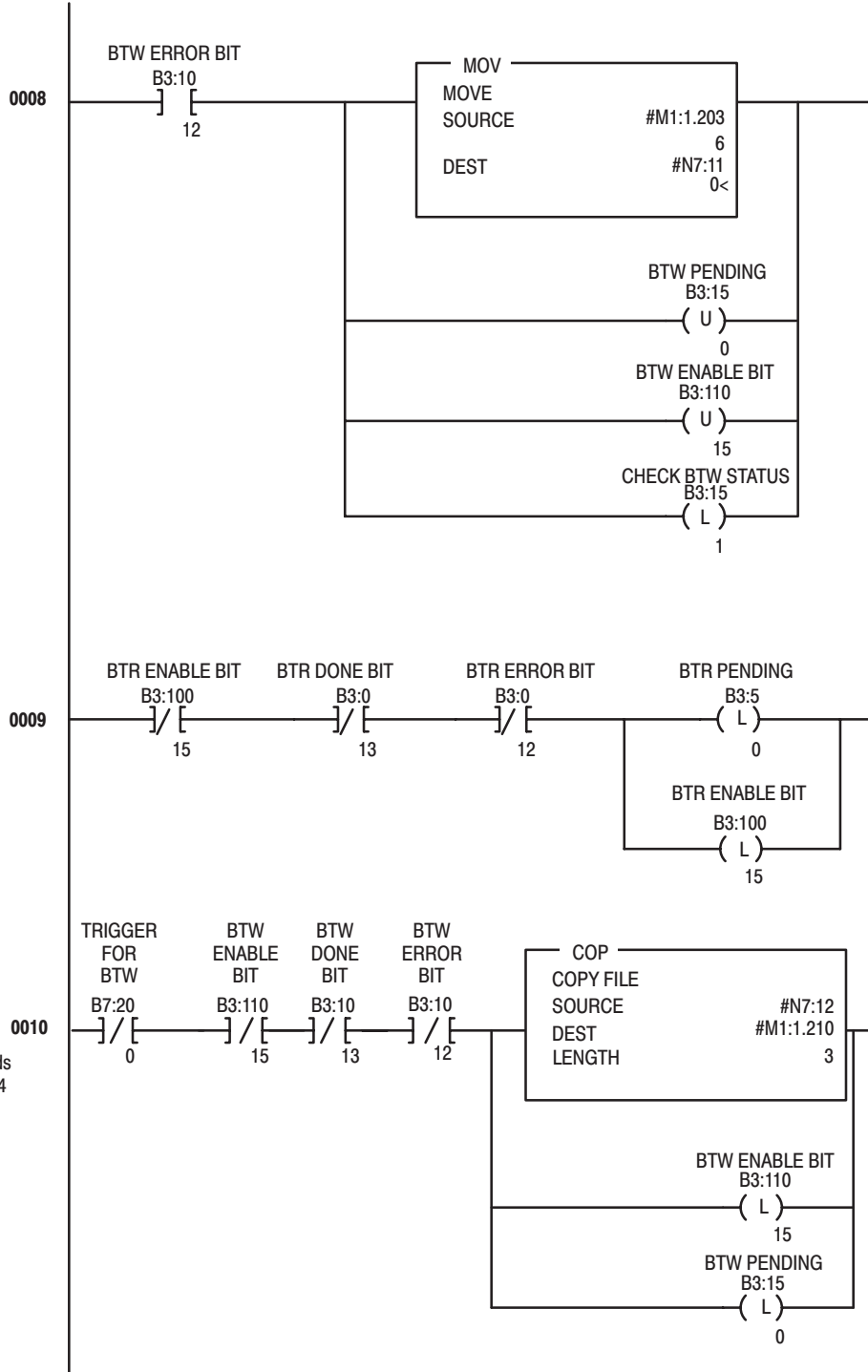
When a BTW successfully completes and the done bit is detected, all BTW flags are reset.



To next page.

Program Action

When a BTW occurs, the error code is moved to N7:11.



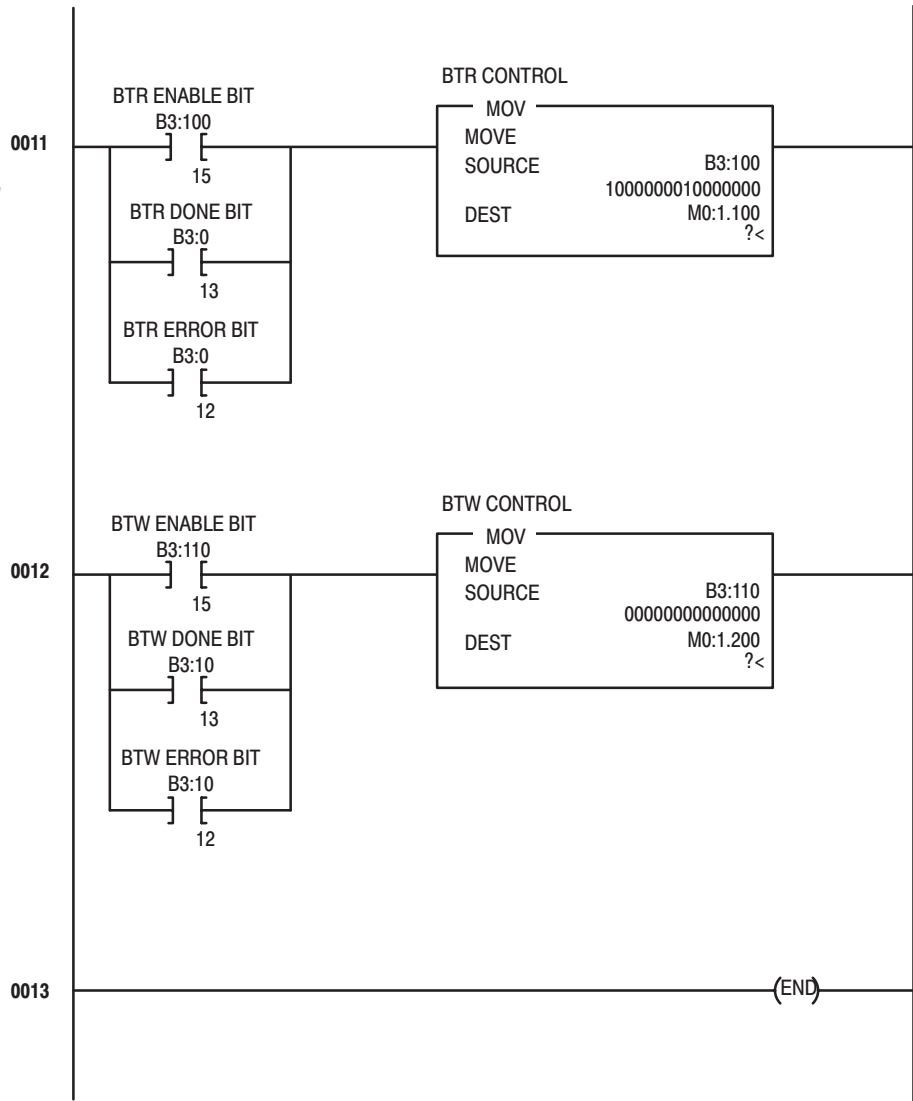
This rung executes BTRs continuously, as fast as possible.

One BTW is triggered at power up. Three words of data starting at N7:12 is sent to the 1794-IP4 module.

To next page.

Program Action

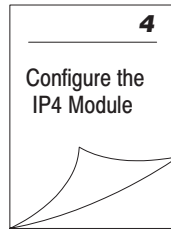
This BTR control word is moved to the M0 file for the scanner module while the BTR is in progress until the enable, done and error bits are turned off



This BTW control word is moved to the M0 file for the scanner module while the BTW is in progress until the enable, done and error bits are turned off.

Chapter Summary

In this chapter, you learned how to program your 1794-IP4 Pulse Counter module using block transfer instructions and ladder logic. Now, you can configure your module.



Writing Configuration to and Reading Status from Your Module with a Remote I/O Adapter

What This Chapter Contains

In this chapter, we tell you about:

For information on	See page
Configuring Your Module	4-1
Reading Data from Your Module	4-2
Mapping Data for the Module	4-2
Pulse Counter Module (1794-IP4) Image Table Mapping	4-2
Block Transfer Read Word Assignments	4-3
Bit/Word Definitions for Block Transfer Read Words	4-3
Block Transfer Write Word Assignments	4-4
Bit/Word Definitions for the Block Transfer Write Words	4-5

Configuring Your Pulse Counter Module

The Pulse Counter module is configured using a group of data table words that are transferred to the module using a block transfer write instruction.

Some of the software configurable features available are:

- number of inputs
- encoder multiplier
- gate function
- latch function
- rollover

Configure your module for its intended operation by means of your programming terminal and write block transfers.

Note: Programmable controllers that use 6200 software (release 4.2 or higher) programming tools can take advantage of the IOCONFIG Addendum utility to configure this module. IOCONFIG Addendum uses menu-based screens for configuration without having to set individual bits in particular locations. Refer to your 6200 software literature for details.

Important: It is strongly recommended that you use IOCONFIG Addendum to configure this module. The IOCONFIG Addendum utility greatly simplifies configuration. If the IOCONFIG Addendum is not available, you must enter data directly into the data table. Use this chapter as a reference when performing this task.

During normal operation, the processor transfers from 1 to 4 words to the module when you program a BTW instruction to the module's address.

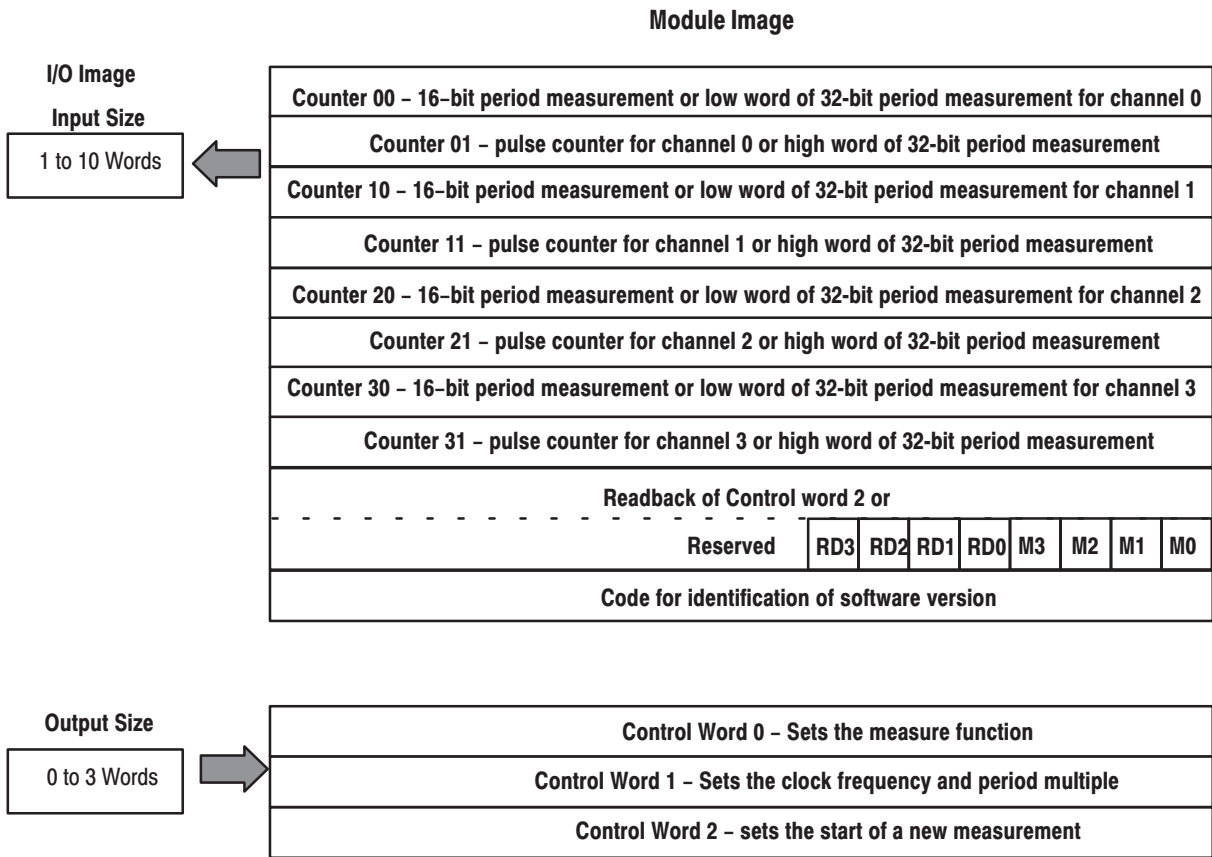
Reading Data From Your Module

Read programming moves status and data from the Pulse Counter module to the processor's data table in one I/O scan. The processor's user program initiates the request to transfer data from the Pulse Counter module to the processor.

Mapping Data for the Module

The following read and write words and bit/word descriptions describe the information written to and read from the Pulse Counter module. The module uses up to 11 words of input data and up to 3 words of output data. Each word is composed of 16 bits.

Pulse Counter Module (1794-IP4) Image Table Mapping



Block Transfer Read Word Assignments for the Pulse Counter Module (1794-IP4)

(Octal Bit⇒)	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Dec. Bit ⇒	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word↓	Read															
0	Counter 00 – 16-bit period measurement or low word of 32-bit period measurement for channel 0															
1	Counter 01 – pulse counter or high word of 32-bit period measurement for channel 0															
2	Counter 10 – 16-bit period measurement or low word of 32-bit period measurement for channel 1															
3	Counter 11 – pulse counter or high word of 32-bit period measurement for channel 1															
4	Counter 20 – 16-bit period measurement or low word of 32-bit period measurement for channel 2															
5	Counter 21 – pulse counter or high word of 32-bit period measurement for channel 2															
6	Counter 30 – 16-bit period measurement or low word of 32-bit period measurement for channel 3															
7	Counter 31 – pulse counter or high word of 32-bit period measurement for channel 3															
8	Readback of Control Word 2															
	Reserved								RD3	RD2	RD1	RD0	M3	M2	M1	M0
9	Revision read – software version code															

Where: M = positive edge measurement ready for the respective channel.
 RD = Reset Done for the respective channel.

Bit/Word Definitions for Block Transfer Read Words for the Pulse Counter Module

Read Word	Bit	Definition
0	Bits 00–15 (00–17)	Store Counter 00 – 16-bit period measurement or low word of 32-bit period measurement for channel 0.
1	Bits 00–15 (00–17)	Counter 01 – pulse counter or high word of 32-bit period measurement for channel 0
2	Bits 00–15 (00–17)	Counter 10 – 16-bit period measurement or low word of 32-bit period measurement for channel 1.
3	Bits 00–15 (00–17)	Counter 11 – pulse counter or high word of 32-bit period measurement for channel 1
4	Bits 00–15 (00–17)	Counter 20 – 16-bit period measurement or low word of 32-bit period measurement for channel 2.
5	Bits 00–15 (00–17)	Counter 21 – pulse counter or high word of 32-bit period measurement for channel 2
6	Bits 00–15 (00–17)	Counter 30 – 16-bit period measurement or low word of 32-bit period measurement for channel 3.
7	Bits 00–15 (00–17)	Counter 31 – pulse counter or high word of 32-bit period measurement for channel 3

Read Word	Bit	Definition
Word 8		Readback of Control Word 2
	Bit 00	Positive edge - Channel 0 - measurement ready
	Bit 01	Positive edge - Channel 1 - measurement ready
	Bit 02	Positive edge - Channel 2 - measurement ready
	Bit 03	Positive edge - Channel 3 - measurement ready
	Bit 04	Reset Done, Channel 0 - a positive edge on this bit indicates counter 01 reset done
	Bit 05	Reset Done, Channel 1 - a positive edge on this bit indicates counter 11 reset done
	Bit 06	Reset Done, Channel 2 - a positive edge on this bit indicates counter 21 reset done
	Bit 07	Reset Done, Channel 3 - a positive edge on this bit indicates counter 31 reset done
	Bit 08-15	Reserved for factory use
Word 9	Bits 00-15 (00-17)	Software revision - version code of software installed

Block Transfer Write Word Assignments for the Pulse Counter Module

(Octal Bit) ⇒	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Dec. Bit ⇒	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word ↓	Write															
0	Control Word 0 - selects the measure function															
1	Control Word 1 - sets the clock frequency and period multiple															
2	Control Word 2 - sets the start of a new measurement															
3-4	Not used															

Bit/Word Definitions for the Block Transfer Write Words for the Pulse Counter Module

Write Word	Bit	Definition			
Write Word 0		Control Word 0 – Control word for setting the function of counter 0.			
	Bits 00	Pulse counting and period time measurement selection for Channel 0 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected			
	Bits 01	Pulse counting and period time measurement selection for Channel 1 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected			
	Bits 02	Pulse counting and period time measurement selection for Channel 2 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected			
	Bits 03	Pulse counting and period time measurement selection for Channel 3 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected			
	Bits 04–15 (04–17)	Reserved			
Write Word 1		Control Word 1 – Control word for setting period measurement			
	Bit 00	Clock frequency for period time measurement – Channel 0 – 0 = period time measurement with 10MHz internal clock selected 1 = period time measurement with 1MHz internal clock selected			
	Bits 01–03	03	02	01	Number of periods for measurement – Channel 0
		0	0	0	1 period
		0	0	1	2 periods
		0	1	0	4 periods
		0	1	1	8 periods
		1	0	0	16 periods
		1	0	1	32 periods
		1	1	0	64 periods
	1	1	1	128 periods	
Bit 04	Clock frequency for period time measurement – Channel 1 – refer to bit 00.				
Bits 05–07	Selection of Number of periods for measurement – Channel 1 – see bits 01–03 above				
Bit 08 (10)	Clock frequency for period time measurement – Channel 2 – refer to bit 00.				
Bits 09–11 (11–13)	Selection of Number of periods for measurement – Channel 2 – see bits 01–03 above				
Bit 12 (14)	Clock frequency for period time measurement – Channel 1 – refer to bit 00.				
Bits 13–15 (15–17)	Selection of Number of periods for measurement – Channel 1 – see bits 01–03 above				
Write Word 2		Control Word 2 – starts new measurement			
	Bit 00	Start new measurement bit – Channel 0 – when set, start new measurement on positive edge			
	Bit 01	Start new measurement bit – Channel 1 – when set, start new measurement on positive edge			
	Bit 02	Start new measurement bit – Channel 2 – when set, start new measurement on positive edge			
	Bit 03	Start new measurement bit – Channel 3 – when set, start new measurement on positive edge			

Write Word	Bit	Definition
Write Word 2 cont.	Bit 04	Reset Counter, Channel 0 - a positive edge on this bit resets counter 01
	Bit 05	Reset Counter, Channel 1 - a positive edge on this bit resets counter 11
	Bit 06	Reset Counter, Channel 2 - a positive edge on this bit resets counter 21
	Bit 07	Reset Counter, Channel 3 - a positive edge on this bit resets counter 31
	Bit 08-15 (10-17)	Not used
Write Words 3 and 4	Bit 04-15 (04-17)	Not used

Chapter Summary

In this chapter, you learned how to configure your module's features and enter your data.

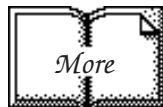
How Communication Takes Place and I/O Image Table Mapping with the DeviceNet Adapter

What This Chapter Contains

In this chapter, we tell you about:

For information on	See page
About DeviceNetManager Software	5-1
Polled I/O Structure	5-1
Adapter Input Status Word	5-2
System Throughput	5-3
Mapping Data into the Image Table	5-3
Pulse Counter Module (1794-ID2) Image Table Mapping	5-3
Pulse Counter Bit/Word Assignments	5-4
Defaults	5-7

About DeviceNetManager Software



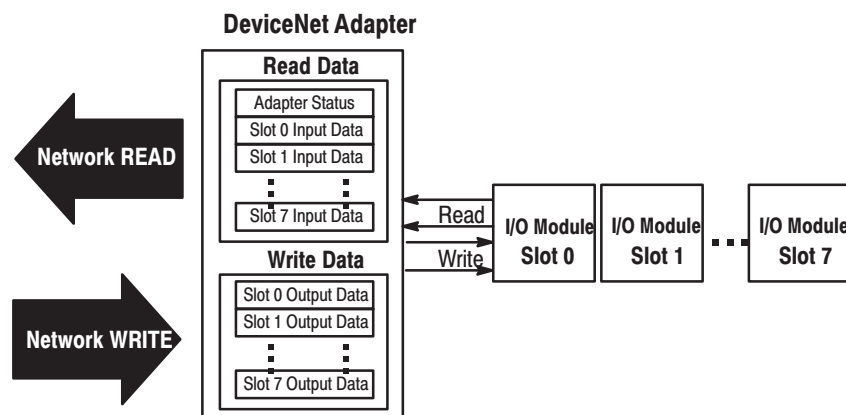
DeviceNetManager software is a tool used to configure your FLEX I/O DeviceNet adapter and its related modules. This software tool can be connected to the adapter via the DeviceNet network.

You must understand how DeviceNetManager software works in order to add a device to the network. Refer to the DeviceNetManager Software User Manual, publication 1787-6.5.3.

Polled I/O Structure

Output data is received by the adapter in the order of the installed I/O modules. The Output data for Slot 0 is received first, followed by the Output data for Slot 1, and so on up to slot 7.

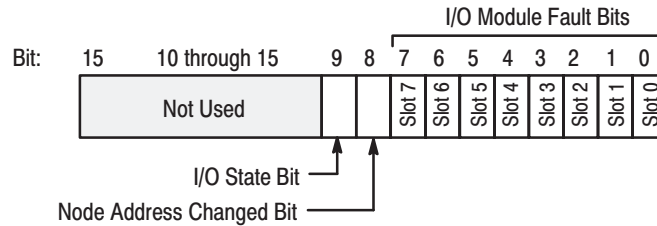
The first word of input data sent by the adapter is the Adapter Status Word. This is followed by the input data from each slot, in the order of the installed I/O modules. The Input data from Slot 0 is first after the status word, followed by Input data from Slot 2, and so on up to slot 7.



Adapter Input Status Word

The input status word consists of:

- I/O module fault bits – 1 status bit for each slot
- node address changed – 1 bit
- I/O status – 1 bit



The adapter input status word bit descriptions are shown in the following table.

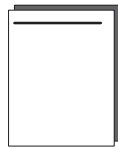
Bit Description	Bit	Explanation
I/O Module Fault	0	This bit is set (1) when an error is detected in slot position 0.
	1	This bit is set (1) when an error is detected in slot position 1.
	2	This bit is set (1) when an error is detected in slot position 2.
	3	This bit is set (1) when an error is detected in slot position 3.
	4	This bit is set (1) when an error is detected in slot position 4.
	5	This bit is set (1) when an error is detected in slot position 5.
	6	This bit is set (1) when an error is detected in slot position 6.
	7	This bit is set (1) when an error is detected in slot position 7.
Node Address Changed	8	This bit is set (1) when the node address switch setting has been changed since power up.
I/O State	9	Bit = 0 – idle Bit = 1 – run
	10 thru 15	Not used – sent as zeroes.

Possible causes for an **I/O Module Fault** are:

- transmission errors on the Flex I/O backplane
- a failed module
- a module removed from its terminal base
- incorrect module inserted in a slot position
- the slot is empty

The **node address changed** bit is set when the node address switch setting has been changed since power up. The new node address does not take effect until the adapter has been powered down and then powered back up.

System Throughput



System throughput, from Pulse Counter to backplane, is a function of:

- the configured minimum frequency sample time
- the number of channels actually configured for connection to a specific sensor (0 or 1)

You can set the minimum frequency time during module configuration. The selection influences the sample data rate, thus affecting system throughput.

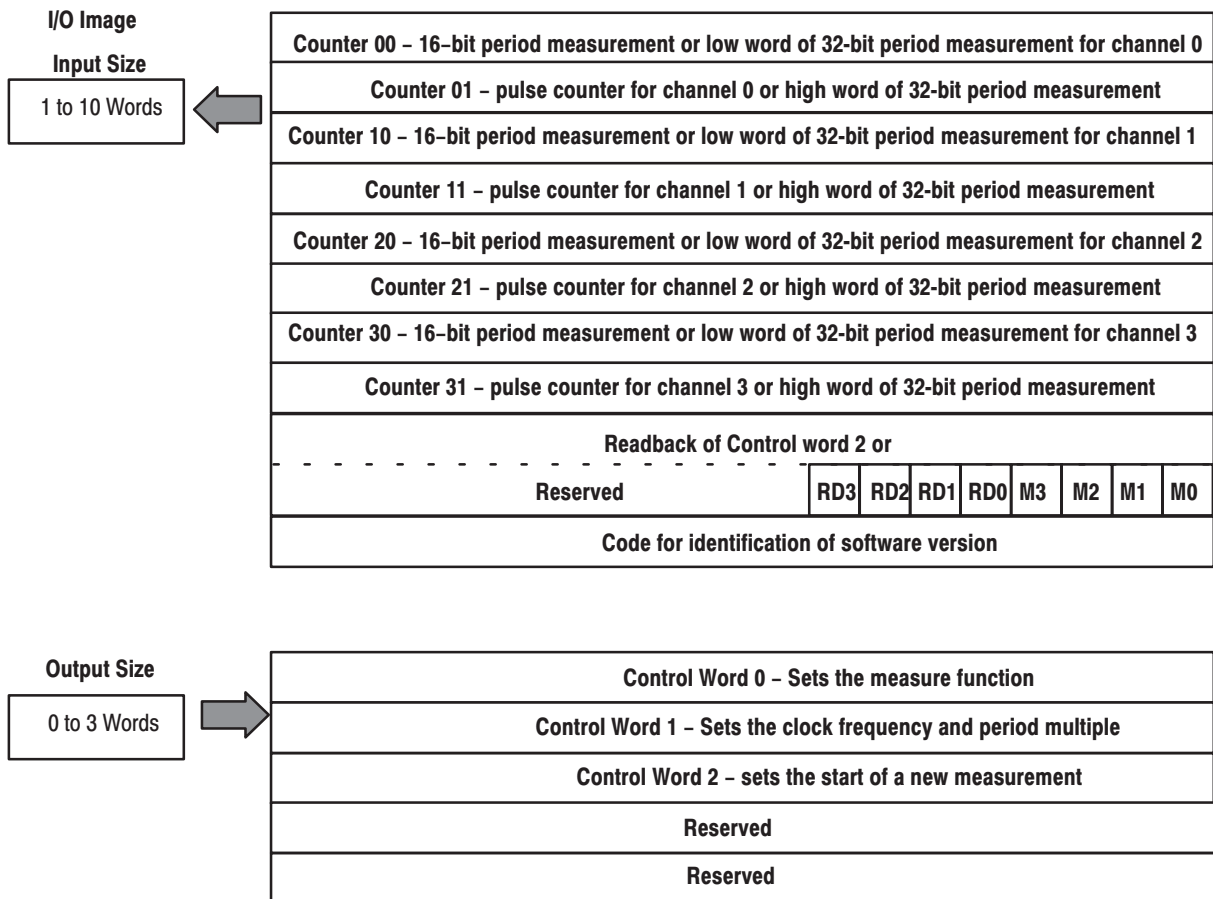
The number of channels included in each input scan also affects system throughput.

Mapping Data into the Image Table

FLEX I/O Pulse Counter module data table mapping is shown below.

Pulse Counter Module (1794-IP4) Image Table Mapping

Module Image



Block Transfer Read Word Assignments for the Pulse Counter Module (1794-IP4)

(Octal Bit⇒)	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Dec. Bit ⇒	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word↓	Read															
1	Counter 00 – 16-bit period measurement or low word of 32-bit period measurement for channel 0															
2	Counter 01 – pulse counter or high word of 32-bit period measurement for channel 0															
3	Counter 10 – 16-bit period measurement or low word of 32-bit period measurement for channel 1															
4	Counter 11 – pulse counter or high word of 32-bit period measurement for channel 1															
5	Counter 20 – 16-bit period measurement or low word of 32-bit period measurement for channel 2															
6	Counter 21 – pulse counter or high word of 32-bit period measurement for channel 2															
7	Counter 30 – 16-bit period measurement or low word of 32-bit period measurement for channel 3															
8	Counter 31 – pulse counter or high word of 32-bit period measurement for channel 3															
9	Readback of Control Word 2															
	Reserved								RD3	RD2	RD1	RD0	M3	M2	M1	M0
10	Revision read – software version code															

Where: M = positive edge measurement ready for the respective channel.
RD = Reset Done for respective channel.

Block Transfer Write Word Assignments for the Pulse Counter Module

(Octal Bit) ⇒	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00
Dec. Bit ⇒	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Word↓	Write															
1	Control Word 0 – selects the measure function															
2	Control Word 1 – sets the clock frequency and period multiple															
3	Control Word 2 – sets the start of a new measurement															
4-5	Reserved															

Bit/Word Definitions for the Pulse Counter Module

Word	Bit	Definition
Read Word 1	Bits 00–15 (00–17)	Store Counter 00 – 16-bit period measurement or low word of 32-bit period measurement for channel 0.
Read Word 2	Bits 00–15 (00–17)	Counter 01 – pulse counter or high word of 32-bit period measurement for channel 0
Read Word 3	Bits 00–15 (00–17)	Counter 10 – 16-bit period measurement or low word of 32-bit period measurement for channel 1.
Read Word 4	Bits 00–15 (00–17)	Counter 11 – pulse counter or high word of 32-bit period measurement for channel 1
Read Word 5	Bits 00–15 (00–17)	Counter 20 – 16-bit period measurement or low word of 32-bit period measurement for channel 2.

Word	Bit	Definition
Read Word 6	Bits 00-15 (00-17)	Counter 21 – pulse counter or high word of 32-bit period measurement for channel 2
Read Word 7	Bits 00-15 (00-17)	Counter 30 – 16-bit period measurement or low word of 32-bit period measurement for channel 3.
Read Word 8	Bits 00-15 (00-17)	Counter 31 – pulse counter or high word of 32-bit period measurement for channel 3
Read Word 9		Readback of Control Word 2
	Bit 00	Positive edge - Channel 0 – measurement ready
	Bit 01	Positive edge - Channel 1 – measurement ready
	Bit 02	Positive edge - Channel 2 – measurement ready
	Bit 03	Positive edge - Channel 3 – measurement ready
	Bit 04	Reset Done, Channel 0 – a positive edge on this bit indicates counter 01 reset done
	Bit 05	Reset Done, Channel 1 – a positive edge on this bit indicates counter 11 reset done
	Bit 06	Reset Done, Channel 2 – a positive edge on this bit indicates counter 21 reset done
	Bit 07	Reset Done, Channel 3 – a positive edge on this bit indicates counter 31 reset done
	Bit 08-15	Reserved for factory use
Read Word 10	Bits 00-15 (00-17)	Software revision – version code of software installed
Write Word 1		Control Word 0 – Control word for setting the function of counter 0.
	Bits 00	Pulse counting and period time measurement selection for Channel 0 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected
	Bits 01	Pulse counting and period time measurement selection for Channel 1 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected
	Bits 02	Pulse counting and period time measurement selection for Channel 2 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected
	Bits 03	Pulse counting and period time measurement selection for Channel 3 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected
	Bits 04-15 (04-17)	Reserved

Word	Bit	Definition			
Write Word 2	Bit 00	Clock frequency for period time measurement - Channel 0 - 0 = period time measurement with 10MHz internal clock selected 1 = period time measurement with 1MHz internal clock selected			
	Bits 01-03	03	02	01	Number of periods for measurement - Channel 0
		0	0	0	1 period
		0	0	1	2 periods
		0	1	0	4 periods
		0	1	1	8 periods
		1	0	0	16 periods
		1	0	1	32 periods
		1	1	0	64 periods
	1	1	1	128 periods	
	Bit 04	Clock frequency for period time measurement - Channel 1 - refer to bit 00.			
	Bits 05-07	Selection of Number of periods for measurement - Channel 1 - see bits 01-03 above			
Bit 08 (10)	Clock frequency for period time measurement - Channel 2 - refer to bit 00.				
Bits 09-11 (11-13)	Selection of Number of periods for measurement - Channel 2 - see bits 01-03 above				
Bit 12 (14)	Clock frequency for period time measurement - Channel 1 - refer to bit 00.				
Bits 13-15 (15-17)	Selection of Number of periods for measurement - Channel 1 - see bits 01-03 above				
Write Word 3	Bit 00	Start new measurement bit - Channel 0 - when set, start new measurement on positive edge			
	Bit 01	Start new measurement bit - Channel 1 - when set, start new measurement on positive edge			
	Bit 02	Start new measurement bit - Channel 2 - when set, start new measurement on positive edge			
	Bit 03	Start new measurement bit - Channel 3 - when set, start new measurement on positive edge			
	Bit 04	Reset Counter, Channel 0 - a positive edge on this bit resets counter 01			
	Bit 05	Reset Counter, Channel 1 - a positive edge on this bit resets counter 11			
	Bit 06	Reset Counter, Channel 2 - a positive edge on this bit resets counter 21			
	Bit 07	Reset Counter, Channel 3 - a positive edge on this bit resets counter 31			
	Bit 08-15 (10-17)	Reserved			
Write Words 4 and 5	Bit 0-15 (0-17)	Reserved			

Defaults

Each I/O module has default values associated with it. At default, each module will generate inputs/status and expect outputs/configuration.

Module Defaults for:		Factory Defaults		Real Time Size	
Catalog Number	Description	Input Default	Output Default	Input Default	Output Default
1794-IP4	Pulse Counter Module	10	5	4	0

Factory defaults are the values assigned by the adapter when you:

- first power up the system, and
- no previous stored settings have been applied.

For Pulse Counter modules, the defaults reflect the actual number of input words/output words. For example, for the Pulse Counter module, you have 10 input words, and 5 output words.

You can change the I/O data size for a module by reducing the number of words mapped into the adapter module, as shown in “real time sizes.”

Real time sizes are the settings that provide optimal real time data to the adapter module.

The Pulse Counter modules have 15 words assigned to them. This is divided into input words/output words. You can reduce the I/O data size to fewer words to increase data transfer over the backplane.



For information on using DeviceNetManager software to configure your adapter, refer to the DeviceNetManager Software User Manual, publication 1787-6.5.3.

Input, Output and Configuration Files for Analog Modules when used with ControlNet

Chapter Objectives

In this chapter you will learn about:

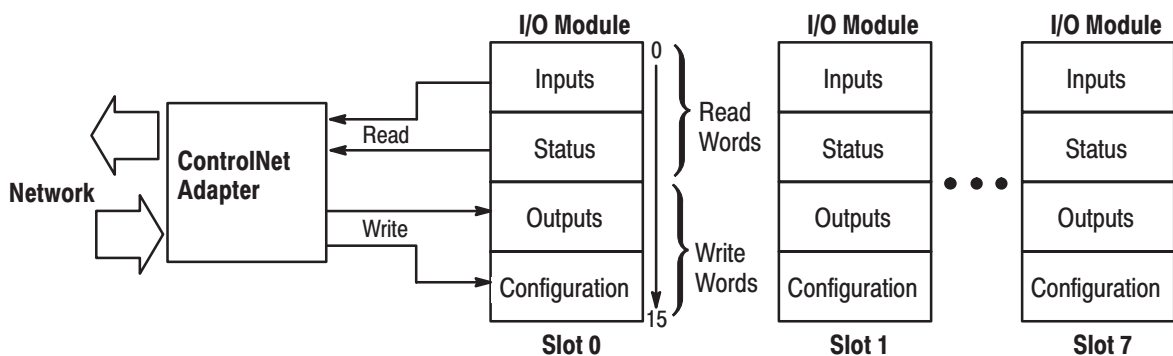
- ControlNet Adapter
- I/O structure
- safe state data
- communication fault data
- idle state behavior
- input data behavior upon module removal

About the ControlNet Adapter

The FLEX I/O ControlNet adapters (cat. no. 1794-ACN15 and -ACNR15) interfaces up to 8 FLEX I/O modules and a ControlNet processor or scanner. The adapter can support ControlNet real-time data connections to individual modules or module groups. Each connection is independent of the others and can be from different processors or scanners.

Communication Over the FLEX I/O Backplane

One 1794-ACN15 and -ACNR15 ControlNet adapter can interface up to eight terminal base units with installed FLEX I/O modules, forming a FLEX I/O system of up to eight slots. The adapter communicates to other network system components (typically one or more controllers or scanners, and/or programming terminals) over the ControlNet network. The adapter communicates with its I/O modules over the backplane.



Data is exchanged scheduled (when mapped) or unscheduled (using CIO instructions).

Scheduled Data-Transfer

Scheduled data transfer:

- is continuous
- is asynchronous to the ladder-logic program scan
- occurs at the actual rate displayed in the Actual Packet Interval field on the programming software ControlNet I/O mapping (monitor) screen

Unscheduled Data-Transfer

Unscheduled operations include:

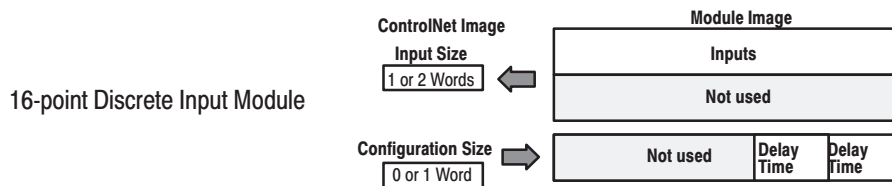
- unscheduled non-discrete I/O data transfers—through ControlNet I/O Transfer (CIO) instructions
- peer-to-peer messaging—through Message (MSG) instructions
- messaging from programming devices

Unscheduled messaging on a ControlNet network is non-deterministic. Your application and your configuration—number of nodes, application program, NUT, amount of scheduled bandwidth used, etc.—determine how much time there is for unscheduled messaging.

Module I/O Mapping

The I/O map for a module is divided into read words and write words. Read words consist of **input and status words**, and write words consist of **output and configuration words**. The number of read words or write words can be 0 or more. The length of each I/O module's read words and write words vary in size depending on module complexity. Each I/O module will support at least 1 input word or 1 output word. Status and configuration are optional, depending on the module.

For example, a 16 point discrete input module will have up to 2 read words and 1 write word.

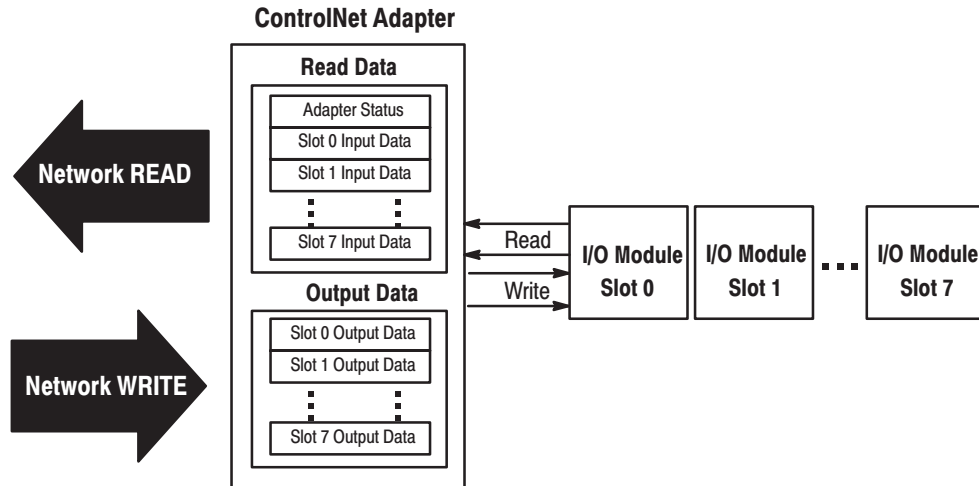


Check the I/O map for each module for the exact mapping.

I/O Structure

Output data is received by the adapter in the order of the installed I/O modules. The Output data for Slot 0 is received first, followed by the Output data for Slot 1, and so on up to slot 7.

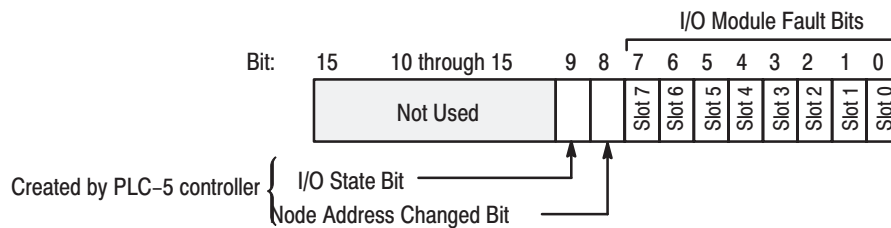
The first word of input data sent by the adapter is the Adapter Status Word. This is followed by the input data from each slot, in the order of the installed I/O modules. The Input data from Slot 0 is first after the status word, followed by Input data from Slot 2, and so on up to slot 7.



Adapter Input Status Word

The input status word consists of:

- I/O module fault bits – 1 status bit for each slot
- node address changed – 1 bit (created by PLC-5 controller)
- I/O status – 1 bit (created by PLC-5 controller)



The adapter input status word bit descriptions are shown in the following table.

Bit Description	Bit	Explanation
I/O Module Fault	0	This bit is set (1) when an error is detected in slot position 0.
	1	This bit is set (1) when an error is detected in slot position 1.
	2	This bit is set (1) when an error is detected in slot position 2.
	3	This bit is set (1) when an error is detected in slot position 3.
	4	This bit is set (1) when an error is detected in slot position 4.
	5	This bit is set (1) when an error is detected in slot position 5.
	6	This bit is set (1) when an error is detected in slot position 6.
	7	This bit is set (1) when an error is detected in slot position 7.
Node Address Changed (Created by PLC-5 controller.)	8	This bit is set (1) when the node address switch setting has been changed since power up.
I/O State (Created by PLC-5 controller.)	9	Bit = 0 - idle Bit = 1 - run
	10 thru 15	Not used - set to 0.

Possible causes for an **I/O Module Fault** are:

- transmission errors on the FLEX I/O backplane
- a failed module
- a module removed from its terminal base
- incorrect module inserted in a slot position
- the slot is empty
- the slot contains a non-discrete module

Safe State Data

The ControlNet adapter provides storage for alternate module output data during communication faults or processor idle state. This “safe state data” assures that a known output will be applied to the output devices to maintain a previously designated safe operating condition during the previously mentioned failure modes. The processor or scanner software must include the means to specify this safe state data for each module. If applicable, this data is sent in the configuration block (see Image Table Mapping later in this chapter).

Device Actions

Device actions include:

- communication fault behavior
- idle state behavior
- input data behavior upon module removal

Communication Fault Behavior

You can configure the adapter response to a communication fault for each I/O module in its system. Upon detection of a communication fault, the adapter can:

- leave the module output data in its last state (hold last state)
- reset the module output data to zero (reset)
- apply safe state data to the module output

Idle State Behavior

The ControlNet adapter can detect the state of the controlling processor or scanner. Only 2 states can be detected: run mode, or program mode (idle).

When run mode is detected, the adapter copies the output data received from the processor to the corresponding module output. When program mode is detected, the adapter can be configured to:

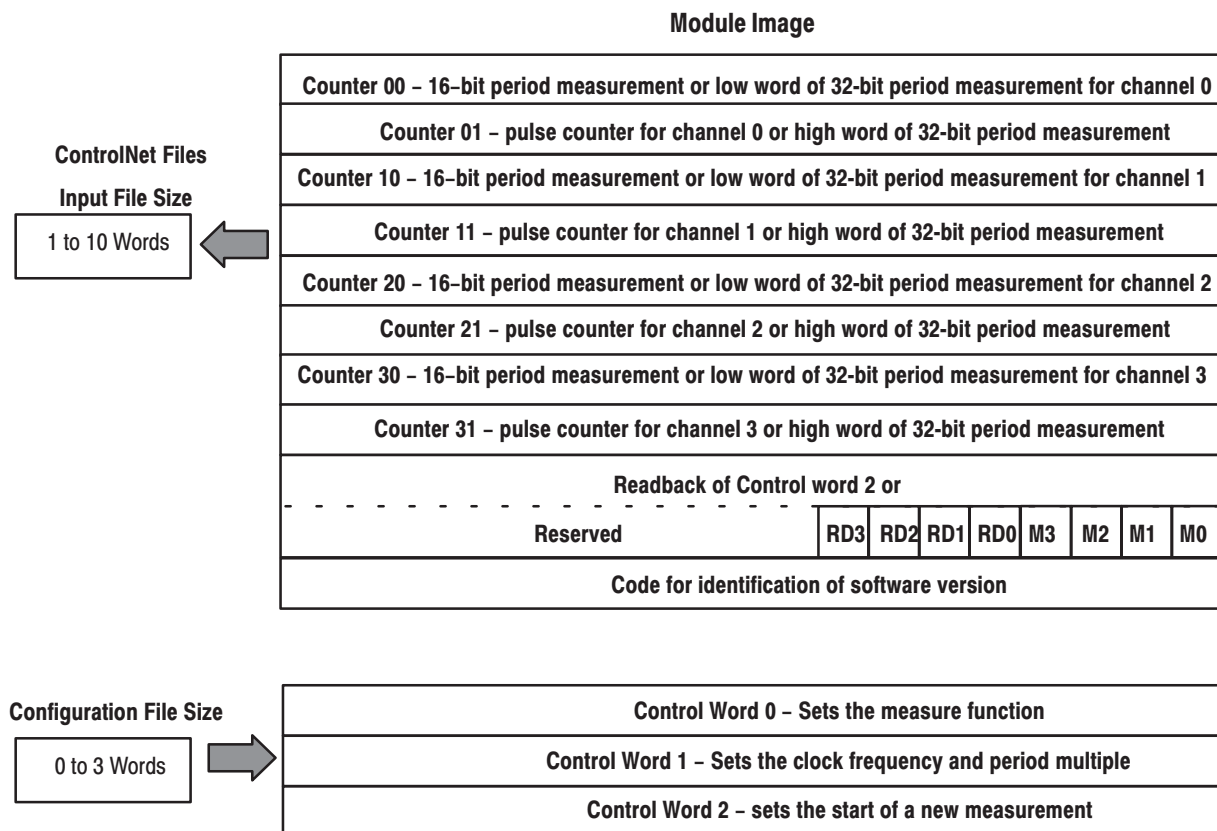
- leave the module output data in its last state (hold last state)
- reset the module output data to zero (reset)
- apply safe state data to the module output

Input Data Behavior upon Module Removal

I/O module input data sent by the adapter upon module removal is configurable. The adapter can:

- reset the module output data to zero (reset)
- leave the module output data in the last state before module removal (hold last state)

Pulse Counter Module (1794-IP4) Image Table Mapping



Bit/Word Definitions for Block Transfer Read Words for the Pulse Counter Module

Input Word	Bit	Definition
Input Word 0	Bits 00–15 (00–17)	Store Counter 00 – 16-bit period measurement or low word of 32-bit period measurement for channel 0.
1	Bits 00–15 (00–17)	Counter 01 – pulse counter or high word of 32-bit period measurement for channel 0
2	Bits 00–15 (00–17)	Counter 10 – 16-bit period measurement or low word of 32-bit period measurement for channel 1.
3	Bits 00–15 (00–17)	Counter 11 – pulse counter or high word of 32-bit period measurement for channel 1
4	Bits 00–15 (00–17)	Counter 20 – 16-bit period measurement or low word of 32-bit period measurement for channel 2.
5	Bits 00–15 (00–17)	Counter 21 – pulse counter or high word of 32-bit period measurement for channel 2
6	Bits 00–15 (00–17)	Counter 30 – 16-bit period measurement or low word of 32-bit period measurement for channel 3.

Input Word	Bit	Definition
7	Bits 00-15 (00-17)	Counter 31 – pulse counter or high word of 32-bit period measurement for channel 3
Read Word 8		Readback of Control Word 2
	Bit 00	Positive edge - Channel 0 – measurement ready
	Bit 01	Positive edge - Channel 1 – measurement ready
	Bit 02	Positive edge - Channel 2 – measurement ready
	Bit 03	Positive edge - Channel 3 – measurement ready
	Bit 04	Reset Done, Channel 0 – a positive edge on this bit indicates counter 01 reset done
	Bit 05	Reset Done, Channel 1 – a positive edge on this bit indicates counter 11 reset done
	Bit 06	Reset Done, Channel 2 – a positive edge on this bit indicates counter 21 reset done
	Bit 07	Reset Done, Channel 3 – a positive edge on this bit indicates counter 31 reset done
	Bit 08-15	Reserved for factory use
Word 9	Bits 00-15 (00-17)	Software revision – version code of software installed

Configuration Word	Bit	Definition
Configuration Word 0		Control Word 0 – Control word for setting the function of counter 0.
	Bits 00	Pulse counting and period time measurement selection for Channel 0 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected
	Bits 01	Pulse counting and period time measurement selection for Channel 1 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected
	Bits 02	Pulse counting and period time measurement selection for Channel 2 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected
	Bits 03	Pulse counting and period time measurement selection for Channel 3 – 0 = pulse counting and period time measurement selected 1 = period time measurement selected
		Bits 04-15 (04-17)

Configuration Word	Bit	Definition			
Word 1	Bit 00	Clock frequency for period time measurement – Channel 0 – 0 = period time measurement with 10MHz internal clock selected 1 = period time measurement with 1MHz internal clock selected			
	Bits 01–03	03	02	01	Number of periods for measurement – Channel 0
		0	0	0	1 period
		0	0	1	2 periods
		0	1	0	4 periods
		0	1	1	8 periods
		1	0	0	16 periods
		1	0	1	32 periods
		1	1	0	64 periods
	1	1	1	128 periods	
	Bit 04	Clock frequency for period time measurement – Channel 1 – refer to bit 00.			
	Bits 05–07	Selection of Number of periods for measurement – Channel 1 – see bits 01–03 above			
Bit 08 (10)	Clock frequency for period time measurement – Channel 2 – refer to bit 00.				
Bits 09–11 (11–13)	Selection of Number of periods for measurement – Channel 2 – see bits 01–03 above				
Bit 12 (14)	Clock frequency for period time measurement – Channel 3 – refer to bit 00.				
Bits 13–15 (15–17)	Selection of Number of periods for measurement – Channel 3 – see bits 01–03 above				
Word 2	Bit 00	Start new measurement bit – Channel 0 – when set, start new measurement on positive edge			
	Bit 01	Start new measurement bit – Channel 1 – when set, start new measurement on positive edge			
	Bit 02	Start new measurement bit – Channel 2 – when set, start new measurement on positive edge			
	Bit 03	Start new measurement bit – Channel 3 – when set, start new measurement on positive edge			
	Bit 04	Reset Counter, Channel 0 – a positive edge on this bit resets counter 01			
	Bit 05	Reset Counter, Channel 1 – a positive edge on this bit resets counter 11			
	Bit 06	Reset Counter, Channel 2 – a positive edge on this bit resets counter 21			
	Bit 07	Reset Counter, Channel 3 – a positive edge on this bit resets counter 31			
	Bit 08–15 (10–17)	Not used			

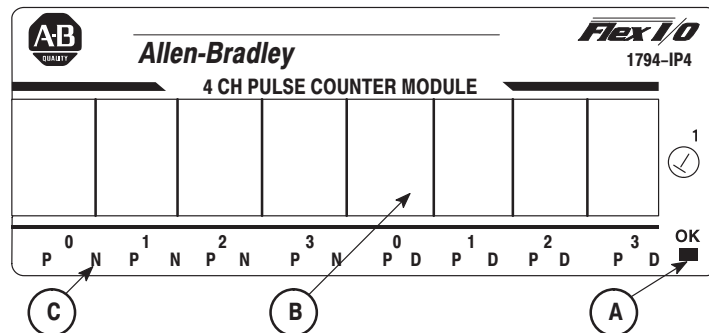
Troubleshoot the Pulse Counter Module

What This Chapter Contains

Use this chapter to troubleshoot the pulse counter module by interpreting the indicators.

Status Indicators

The module contains indicators for each of the following:



A = Power/status indicator – indicates power applied to module and status of module.

Red – indicates initialization of internal logic at powerup

Green – indicates initialization of internal logic is complete and correct

B = Insertable label for writing individual I/O assignments.

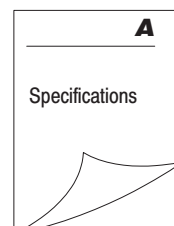
C = Status Indicators –

Indication	Color	Description
P	Yellow	When on, indicates the input is active
N	Yellow	When on, indicates the input is configured for 16-bit period time measurement and 16-bit accumulating pulse counter function
D	Yellow	When on, indicates the input is configured for 32-bit period time measurement

What's Next

To find out more about the IP4 module:

See appendix A



For specifications on the IP4 module

Specifications

Specifications – 4 Channel Pulse Counter Module (Cat. No. 1794-IP4)	
Number of Inputs	4 pulse counter interfaces – 2 inputs each
Counting Frequency	100KHz maximum. Each signal condition must be stable for at least 2 μ s to be recognized.
Input Range Input ON Input OFF	Maximum 26.4V dc (24V dc +10%) Minimum 6V dc Maximum 3V dc Minimum -26.4V dc
Input Current (typical)	3mA @ 6V dc 9mA @ 12V dc 15mA @ 24V dc
Module Location	Mounts on Cat. No. 1794-TB2, TB3, -TB3S, and -TBN Terminal Base Units
Isolation Voltage	Tested at 500V dc for 1s
Flexbus Current	5mA @ 5V dc
Power Supply (external)	12-24V dc (+10%)
Current consumption from external power supply	150mA @ 12V dc 75mA @ 24V dc
Power Dissipation	5W maximum @ 26.4V dc
Thermal Dissipation	Maximum 17.1 BTU/hr @ 26.4V dc
Indicators (field side driven, logic side indication)	1 green/red power/status indicator 8 yellow status indicators – logic side
Keyswitch Position	1
Dimensions Inches (Millimeters)	1.8H x 3.7W x 2.1D (45.7 x 94.0 x 53.3)
Environmental Conditions	
Operating Temperature	IEC 60068-2-1 (Test Ad, Operating Cold) IEC 60068-2-2 (Test Bd, Operating Dry Heat) IEC 60068-2-14 (Test Nb, Operating Thermal Shock) 32 to 131°F (0 to 55°C) Note: Do not connect maximum input voltage simultaneously to all inputs if the module ambient temperature is expected to exceed 40°C.
Storage Temperature	IEC 60068-2-1 (Test Ab, Unpackaged, Nonoperating Cold) IEC 60068-2-2 (Test Bb, Unpackaged, Nonoperating Dry Heat) IEC 60068-2-14 (Test Na, Unpackaged, Nonoperating Thermal Shock) -40 to 185°F (-40 to 85°C)
Relative Humidity	IEC 60068-2-30 (Test Db, Unpackaged, Nonoperating Damp Heat) 5 to 95%, noncondensing

Specifications continued on next page.

Specifications – 4 Channel Pulse Counter Module (Cat. No. 1794-IP4)

Shock Operating Nonoperating	IEC 60068-2-27 (Test Ea, Unpackaged Shock) 30g 50g
Vibration	IEC 60068-2-6 (Test Fc, Operating) 5g @ 10-500Hz
ESD Immunity	IEC 61000-4-2 4kV contact discharges 8kV air discharges
Radiated RF Immunity	IEC 61000-4-3 10V/m with 1kHz sine-wave 80%AM from 80MHz to 1000MHz
EFT/B Immunity	IEC 61000-4-4 +2kV @ 5kHz on signal ports _
Surge Transient Immunity	IEC 61000-4-5 +1kV line-earth (CM) on shielded ports _
Conducted RF Immunity	IEC 61000-4-6 10V rms with 1kHz sine wave 80% AM from 150kHz to 80MHz
Emissions	CISPR 11 Group 1, Class A (with appropriate enclosure)
Enclosure Type Rating	None (open-style)
Input Conductors Wire Category Length (max)	Belden 8761 2 ² 1000ft (304.8m)
Certifications (when product is marked)	UL UL Listed Industrial Control Equipment UL UL Listed for Class I, Division 2 Group A, B, C and D Hazardous Locations CE ³ European Union 89/336/EEC EMC Directive, compliant with: EN 61000-6-4, Industrial Emissions EN 50082-2, Industrial Immunity EN 61326, Meas./Control/Lab., Industrial Requirements EN 61000-6-2, Industrial Immunity C-Tick ³ Australian Radiocommunications Act, compliant with AS/NZS 2064, Industrial Emissions
Publications Installation Instructions User Manual	Publication 1794-IN064 Publication 1794-UM016

¹ Use 1794-TB2, -TB3, -TB3S, -TB3T or -TB3TS terminal base unit for millivolt inputs. You **must use** a 1794-TB3T or -TB3TS terminal base unit when using thermocouple inputs.

² You use this conductor category information for planning conductor routing as described in Allen-Bradley publication 1770-4.1, Industrial Automation Wiring and Grounding Guidelines.

³ See the Product Certification link at www.ab.com for Declarations of Conformity, Certificates and other certification details

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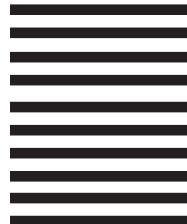
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