Allen-Bradley

Very High Speed Counter Module

(Cat. No. 1794-VHSC)

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.

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.

Summary of Changes

This publication contains new and revised information not included in the last release.

New Information

Information has been added to allow you to enhance frequency/resolution on smodules with firmware revision D or later.

Appendix B has been added to illustrate the criteria for CSA hazardous location approval.

Revised Information

Chapter 4 has been revised to include information on using the frequency/resolution feature included in later modules. In addition, the data table image has been revised to include the mode.

Change Bars

The areas in this manual which are different from previous editions are marked with change bars (as shown to the right of this paragraph) to indicate the addition of new or revised information.

Using This Manual

Purpose of This Manual

This manual shows you how to use the Very High Speed Counter module with an Allen-Bradley programmable controller. It helps you install, program, and troubleshoot your module.

Audience

You must be able to program and operate an Allen-Bradley programmable controller (PLC) to make efficient use of this module.

We assume that you know how to do this in this manual. If you do not, refer to the appropriate programming and operations manual for the associated programmable controller before you attempt to use this module.

Vocabulary

In this manual, we refer to:

- the Very High Speed Counter module as the “module,” the “1794-VHSC” or the “VHSC module.”
- the programmable controller as the “controller,” or the “PLC.”

Manual Organization

This manual is divided into 5 chapters. The following chart shows each chapter with its corresponding title and a brief description of the topics covered in that chapter.

Chapter	Title	Topics Covered
1	Overview of the Very High Speed Counter Module	Explanation of modes, outputs, and how the module communicates with the processor.
2	Installing the Very High Speed Counter Module	How to install, key, connect wiring, ground and an explanation of the indicators on the module.
3	Programming Your Very High Speed Counter Module	Use RSLogics to program this module.
4	Input, Output and Configuration Files for the Very High Speed Counter on ControlNet	Identification and description of bit/words for input, output and configuration.
5	Troubleshoot the Very High Speed Counter Module	Using the indicators for troubleshooting and diagnostic codes.
Appendices		
A	Specifications	Specifications for the 1794-VHSC module.
B	CSA Hazardous Location Approval	Approval criteria for the module.

Related Products

You can install your input module in any system that uses Allen-Bradley ControlNet programmable controllers and the 1794 I/O structure.

Contact your nearest Allen-Bradley office for more information about your programmable controllers.

Product Compatibility

This module can be used with 1794-ACN15 series B and -ACNR15 series B or later ControlNet Adapters. Communication between the module and the processor is bidirectional. The PLC sends module information using ControlNet messages to the adapter. The PLC receives module status information through ControlNet messages from the adapter.

Related Publications

For a list of publications with information on Allen-Bradley programmable controller products, consult our publication index SD499.

Overview of the Very High Speed Counter Module

Chapter 1

How to Install Your Very High Speed Counter Module

Chapter 2

Overview of the Very High Speed Counter Module

Chapter Objectives

This chapter gives you information on:

- features of the 1794-VHSC module
- how the module communicates with programmable controllers.
- how the module operates

Module Description

The VHSC module performs high speed counting for industrial applications. The module is an intelligent I/O module that interfaces signals with any Allen-Bradley programmable controller that has ControlNet capability.

The VHSC module, once configured for its intended purpose, can continue to operate without flexbus power. (**Note:** Customer power is required for the module, inputs and outputs.) After scanning the inputs and updating the outputs, the input data is converted to a specified data type in a digital format to be transferred to the processor's data table on request. Command and configuration data is sent from the programmable controller data tables to the module via ControlNet.

Features of the Module

The HSC module counts pulses from encoders (such as Allen-Bradley Bulletin 845), pulse generators or mechanical limit switches, proximity switches, etc. and returns either a count or frequency in binary format.

The module's features include:

- 2 counters configurable for 3 encoder modes, counter mode, period/rate mode, continuous/rate mode, rate measurement and pulse width modulation (PWM)
- 4 outputs, isolated in pairs
- outputs are current-sourcing at 5 or 12– 24V dc (0.5mA max. @ 5V; 1A max. @ 12–24V)
- single-ended or differential inputs
- 2-phase encoder inputs up to a frequency of 250KHz (X 4 mode)
- single-phase counter inputs up to a frequency of 1MHz
- input voltage range of 5 or 24V dc

- returns input as count or frequency in binary format
- input counts as high as 16,777,215
- up to 1MHz in period/rate or rate measurement frequency modes
- outputs can be tied to any or all counter windows
- each output has a user-selectable on-off value
- outputs can be tied back to an input for cascading
- each counter has a user-selectable preset and rollover value
- totalization is provided in period/rate, continuous/rate and rate measurement modes
- module can continue counting without flexbus power (after configuration)
- outputs have safe state values which can be applied when there is a network failure or the PLC is switched to PROGRAM mode
- pulse width modulation (PWM) mode is available

The 1794-VHSC module operates in the following modes:

- counter mode -
- encoder X1 mode
- encoder X2 mode
- encoder X4 mode
- period/rate mode
- continuous/rate mode
- rate measurement frequency mode
- pulse width modulation (PWM)

The operation of the module in these modes is described below.

Operation in Encoder or Counter Mode

The operation of encoder and counter modes is virtually identical. The only difference between the two modes is in the type of feedback used.

Use the counter mode if you need the module to read incoming pulses from a maximum of 2 encoders (single-ended or differential), counters, pulse generators, mechanical limit switches, etc. and return them to the programmable controller as a binary number (0-16,777,215).

Use the encoder modes if you need the module to read incoming quadrature pulses and return them to the programmable controller as a binary number (0-16,777,215). In these modes, the module accepts two-phase quadrature feedback and counts up or down depending upon the condition of the phase B input for each counter.

The operation of the module in the encoder/counter modes is as follows:

- counter mode - channel B is direction control (up or down). Channel A input is used for pulse. The count is bidirectional with the direction determined by channel B.
- encoder X1 - This is a bidirectional count mode; counting up or down, using quadrature input signals.
- encoder X2 - This is a bidirectional count mode, using quadrature input signals, with 2 times the resolution of X1.
- encoder X4 - This is a bidirectional count mode, using quadrature input signals, with 4 times the resolution of X1.

Each of the counters in encoder/counter mode has values associated with it. These are:

- preset value
- rollover value

Counter Mode

The counter mode allows the module to read incoming pulses and return them to the programmable controller processor as a binary number (0-16,777,215).

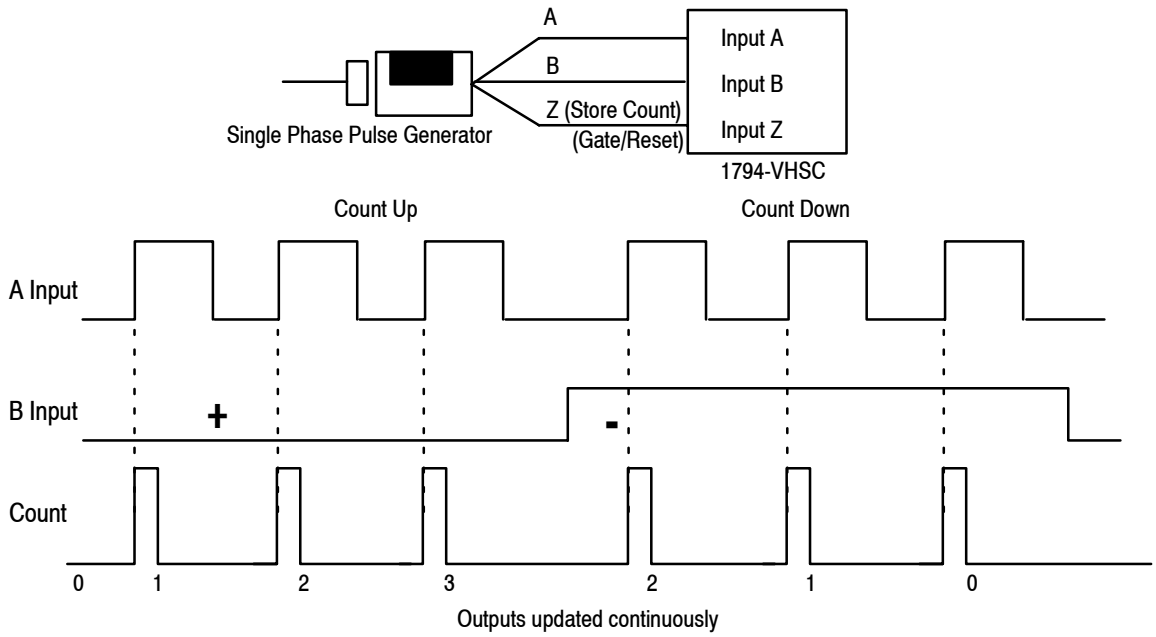
In the counter mode, direction (up counting or down counting) is determined by the phase B input, which can be a random signal. If Phase B is high, the counter will count down. If phase B is low or floating, (that is, not connected), the counter counts up.

If Phase B is:	Counter will count (direction):
High	Down
Low or floating (not connected)	Up

The module reads incoming pulses from a maximum of 2 encoders (single-ended or differential), counters, pulse generators, mechanical limit switches, and so forth and returns a count to the programmable controller processor in a binary number (0-16,777,215).

The counter mode accepts only one phase feedback. This relationship is shown in figure 1.1.

Figure 1.1
Block Diagram of Counter Mode



Encoder Mode

The encoder mode allows the module to read incoming pulses and return them to the programmable controller processor as a binary number (0-16,777,215).

In this mode, the module will accept two phase quadrature feedback. The module senses the relationship between the 2 phases and counts up or down accordingly.

Encoder X1 mode – quadrature input signals count on the leading edge or the trailing edge of channel A for a bidirectional count. The phase relationship between Channel A and Channel B determines direction – channel A leading, and channel B floating, the count direction is up; channel A lagging, and channel B high, the count direction is down.

Encoder X2 mode – quadrature input signals count on the leading edge **and** the trailing edge of channel A for a bidirectional count. Channel B determines direction – B low (floating), the count direction is up; B high, the count direction is down.

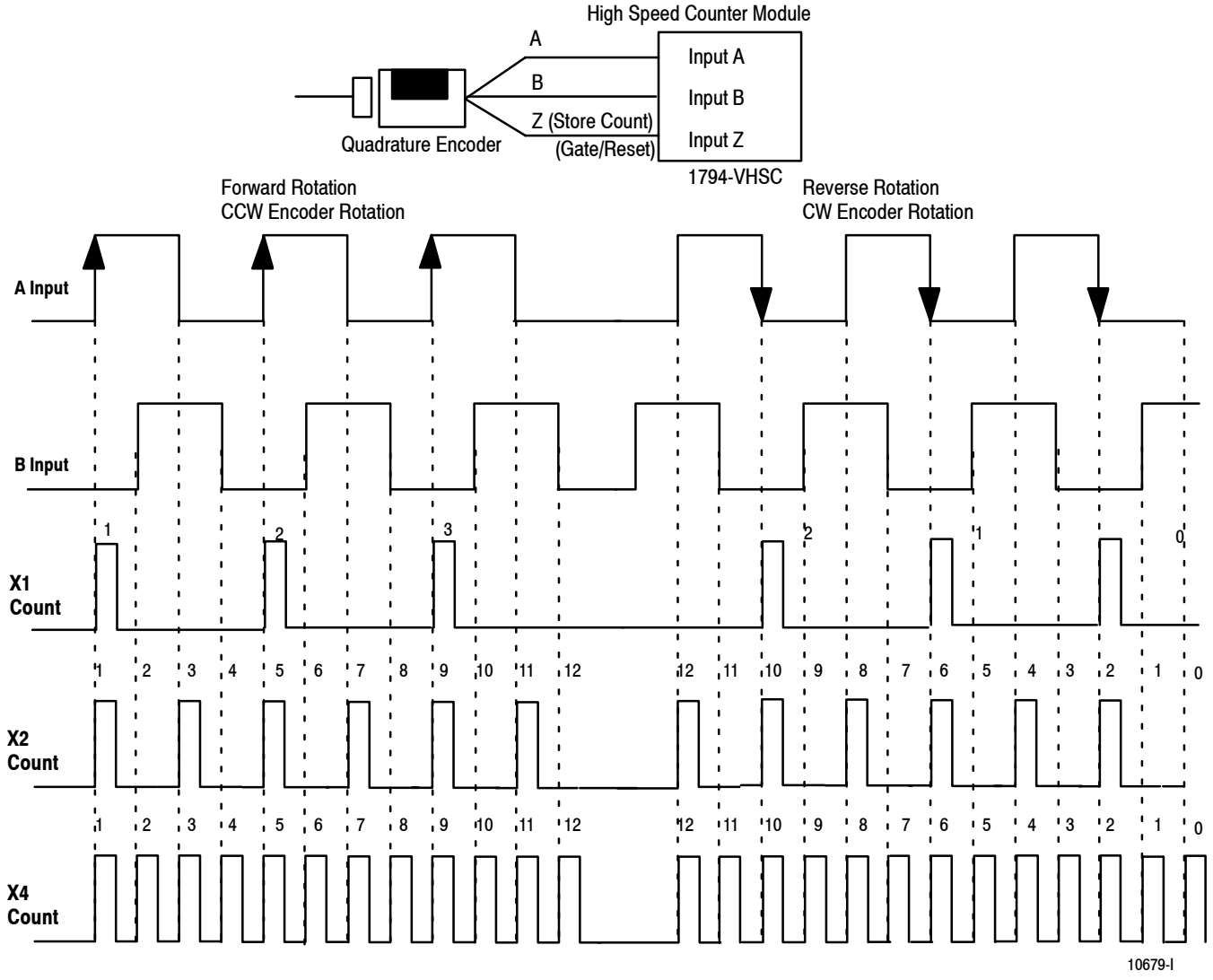
Encoder X4 mode – quadrature input signals count on the leading edge **and** the trailing edge of channel A and channel B for a bidirectional count. Channel B determines direction – B low (floating), the count direction is up; B high, the count direction is down.

Direction of Count

The module can count either up or down, depending upon the condition of the B input for each counter. In encoder applications, the counter will increment on the leading edge of input A, while input B determines the direction of the count.

You also have the option of X1, X2 and X4 multiplying of the input pulses. Figure 1.2 shows the relationships between inputs A and B for forward and reverse directions in encoder applications.

Figure 1.2 Phase Relationship for Forward or Reverse Directions



The following paragraphs apply to both encoders and counters.

Preset Value

Each of the 2 counters has one preset value associated with it. In the encoder or counter modes, the preset value represents a reference point (or count) from which the module begins counting. The module can count either up or down from the preset value. Preset values are loaded into the count registers through the preset count bits. Preset values can range from 0 to 16,777,215 binary.

Rollover Value

Each of the 2 counters has one rollover value associated with it. When the rollover value is reached by the encoder/counter, it resets to 0 and begins counting again. The rollover values range from 1 to 16,777,216 binary. The rollover value is circular (for example: if you program 360, the count will be from 358, 359, 0, 1 etc. in a positive direction and from 1, 0, 359, 358 etc. in a negative direction).

Software Reset

The counters can also be reset by the Reset Count bits found in Word 0, bits 0 and 4 of the Counter Control word. When one of these bits is set to 1, the associated counter is reset to zero and begins counting. The module can also be reset with the gate/reset as explained below. Refer to chapter 4 for further details.

Gate/Reset Input

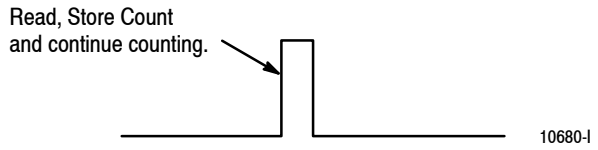
There is one gate/reset input for each of the 2 counters. The gate/reset input, when active, will function in one of the 4 store count modes outlined below.

Scaling Input Count at the Gate/Reset Terminal
You can scale the incoming count at the gate/reset terminal. Scaling allows the incoming pulses at gate/reset to be divided by a number in the range of 1, 2, 4, 8, 16, 32, 64 and 128.

Store Count
The store count feature allows the module to store the current count value of the associated counter. The store count feature is triggered by the state of the gate/reset terminal on the module. The stored count of each counter is placed in a separate word in the Read Data file. The stored count value will remain in the Read Data file until a new trigger pulse is received at the Gate/Reset terminal. When a new trigger pulse is received, the old count value will be overwritten by the new value.

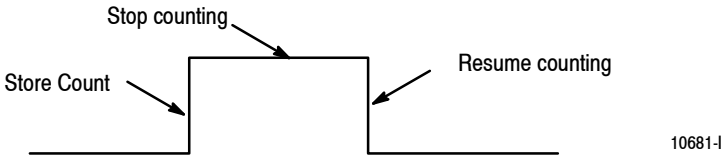
In **mode 1, store/continue** (figure 1.3), the leading edge of a pulse input on input Z (gate/reset) terminal causes the current value in the counter to be read and stored. The counter will continue counting. The stored count will be available in the Read Data file. The stored count information will remain in the block transfer read file until it is overwritten by new data.

Figure 1.3 Store/Continue



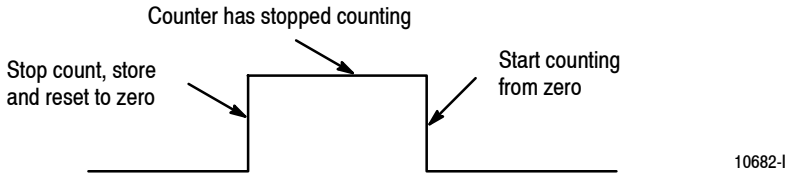
In **mode 2, store/wait/resume** (figure 1.4), a rising edge of a pulse input on the Z input (gate/reset) terminal reads and stores the current counter value in the Read Data file, and inhibits counting while the gate/reset input is high. Counting resumes when the input goes low. Mode 2 does not reset the counter, although it does store the count value. The stored count is available in the Read Data file. The stored count remains in the Read Data file until it is overwritten with new data.

Figure 1.4 Store/Wait/Resume



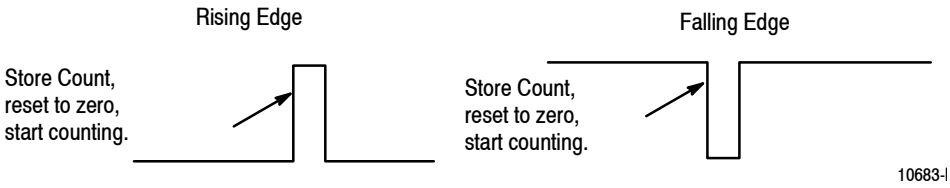
In mode 3, store-reset/wait/start (figure 1.5), the rising edge of the pulse on input Z (gate/reset) terminal causes the counter to stop counting, store the current count value in the Read Data file and reset the count to zero. The counter does not count while the Z input on the gate/reset terminal remains high. Counting resumes from zero on the falling edge of the pulse at the Z (gate/reset) terminal. The stored count is available in the Read Data file. The stored count remains in the Read Data file until it is overwritten with new data.

Figure 1.5 Store-Reset/Wait/Start



In **mode 4, store-reset/start** (figure 1.6), on the rising edge of a pulse input at the Z (gate/reset) terminal causes the counter to store the accumulated count value in the Read Data file, and reset the counter to zero. The counter continues counting while the Z gate/reset input is high. The stored count is available in the Read Data file. The stored count remains in the Read Data file until it is overwritten with new data.

Figure 1.6 Store-Reset/Start



Figures 1.3 through 1.6 show the store count feature operating on the rising edge of the gate/reset pulse. The user has the option of selecting these same features using the falling edge of the gate/reset pulse. The gate invert bit is active in the store count, continuous/rate and period/rate modes.

Operation in Period/Rate Mode

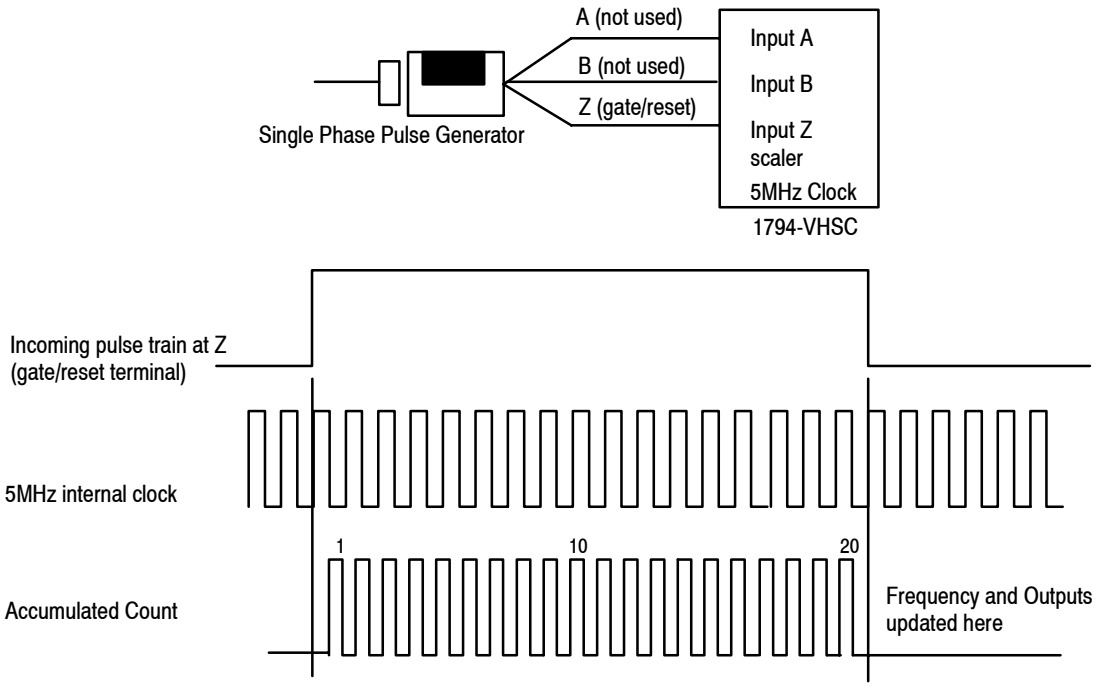
Use the period/rate mode to determine the frequency of input pulses by counting the number of internal 5MHz clock pulses over a user-specified number of input signal pulses. At the end of the specified number of pulses, the module returns the frequency and the total number of pulses received.

A channel configured for period/rate mode acts as a period rate counter. An internal 5MHz clock is used as a frequency reference. This clock is gated by the incoming pulse train at the gate/reset input. The results of this gating action are the number of pulses or a frequency. The frequency is returned in input file words 0 (LSW) and 1 (MSW) for channel 0 and word 2 (LSW) and 3 (MSW) for channel 1. The total pulses received is stored in input file words 4 (LSW) and 5 (MSW) for channel 0 and words 6 (LSW) and 7 (MSW) for channel 1. Select the period/rate mode by setting the appropriate bits in word 0 of the configuration block.

1794-VHSC modules count the total number of pulses occurring at the Z (gate/reset) pin. This function is frequency-limited to 200Hz X the scaler value. You can reset this count by setting the VR bit.

Figure 1.7 shows a diagram of the module used in the period/rate mode.

Figure 1.7 Period/Rate Mode



Assumes symmetrical pulse, 50% duty cycle, so period = sample time on X 2 (on and off)

Frequency = 1/period

If count = 25, scaler = 1, and clock period = (1/5MHz)

Frequency = 1 / [(25/1) X (1/5MHz) X 2] = 100KHz

In Figure 1.7, the incoming pulse train from the gate/reset terminal is used to sample pulses from the 5MHz internal clock. As the frequency of the incoming pulse train at the gate/reset terminal increases, the number of sampled pulses from the 5Mhz clock decreases. This relationship is shown in NO TAG. Since accuracy is related to the number of pulses received over the sample period, the accuracy will decrease with increasing input frequencies at the Gate/Reset terminal.

To some extent, the decrease in accuracy can be lessened by scaling the input frequency through the use of a scaler. A scaler value of 1 will only return an accurate input frequency if incoming pulses have a 50% duty cycle.

Table 1.A
Relationship Between Sampled Pulses and Input Frequency

Input Frequency at Z (Gate/Reset) Terminal in Hz	Sampled Pulses for 1/2 Cycle of Z (Gate/Reset) Pulse
2	1.25M
5	500K
10	250K
20	125K
50	50K
100	25K
200	12.5K
500	5K
1KHz	2.5K
2KHz	1.25K
5KHz	500
10KHz	250
20KHz	125
50KHz	50
100KHz	25

Operation of scaler

In period/rate mode, the scaler lets the incoming pulse train at the Z (gate/reset) terminal be divided by a user defined number. Acceptable values for the scaler are 1, 2, 4, 8, 16, 32, 64 and 128. There is one scaler value for each counter.

ATTENTION: Sample period times scaler must be less than 6.71 seconds in order to avoid a zero frequency detect indication.

Connection to Counter Inputs

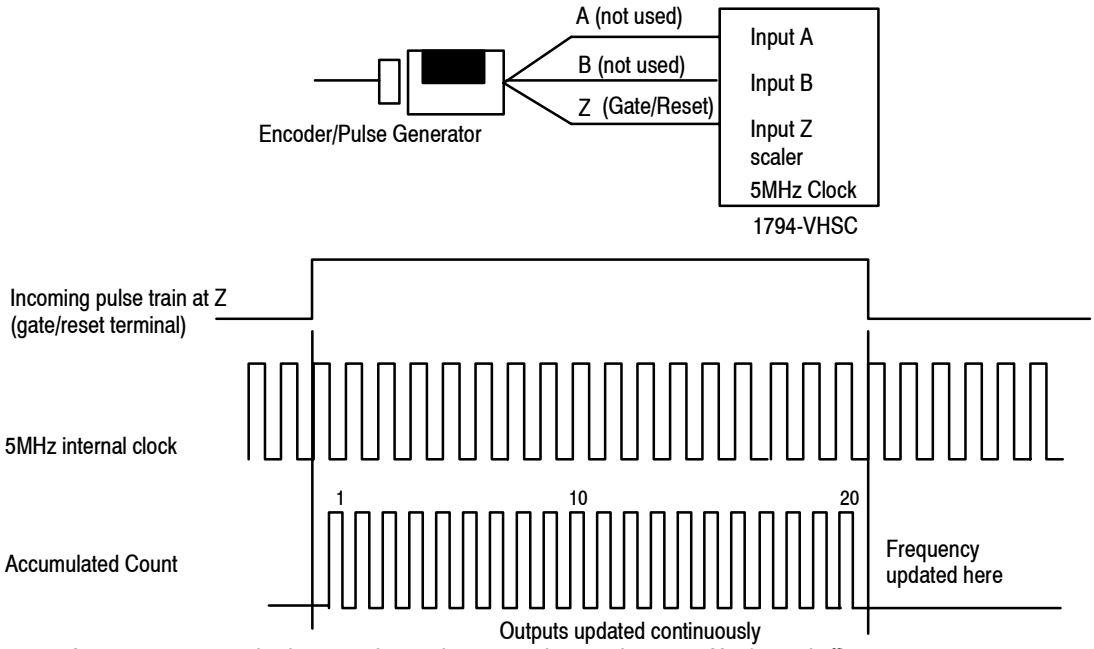
The only input to the module in the period/rate mode is made to the Z (gate/reset) terminal. The counter inputs (channel A and B) are not used in the period/rate mode.

Continuous/Rate Mode

The continuous/rate mode is similar to the period/rate mode previously described except the outputs in this mode are dynamic outputs. Use this mode to determine the frequency of input pulses by counting the number of internal 5MHz clock pulses over a user-specified number of input signal pulses. Each output is turned on as soon as the turn-on count is reached, and turned off as soon as the turn-off count is reached. As the internal 5MHz clock is counted, the outputs dynamically track the 5MHz count. This allows you to turn an output on a certain number of 5MHz counts after the gate/reset pin goes active, and turn it off a certain number of 5MHz counts later.

1794-VHSC modules count the total number of pulses occurring at the Z (gate/reset) terminal. This function is frequency-limited to 200Hz X the scaler value. This total count is returned in input file words 4 (LSW) and 5 (MSW) for channel 0 and 6 (LSW) and 7 (MSW) for channel 1. You can reset this count by setting the VR bit.

Figure 1.8 Period/Rate and Continuous/Rate Output Operation with Scaler of 1



Assumes symmetrical pulse, 50% duty cycle, so period = sample time on X 2 (on and off)

Frequency = 1/period

If count = 25, scaler = 1, and clock period = (1/5MHz)

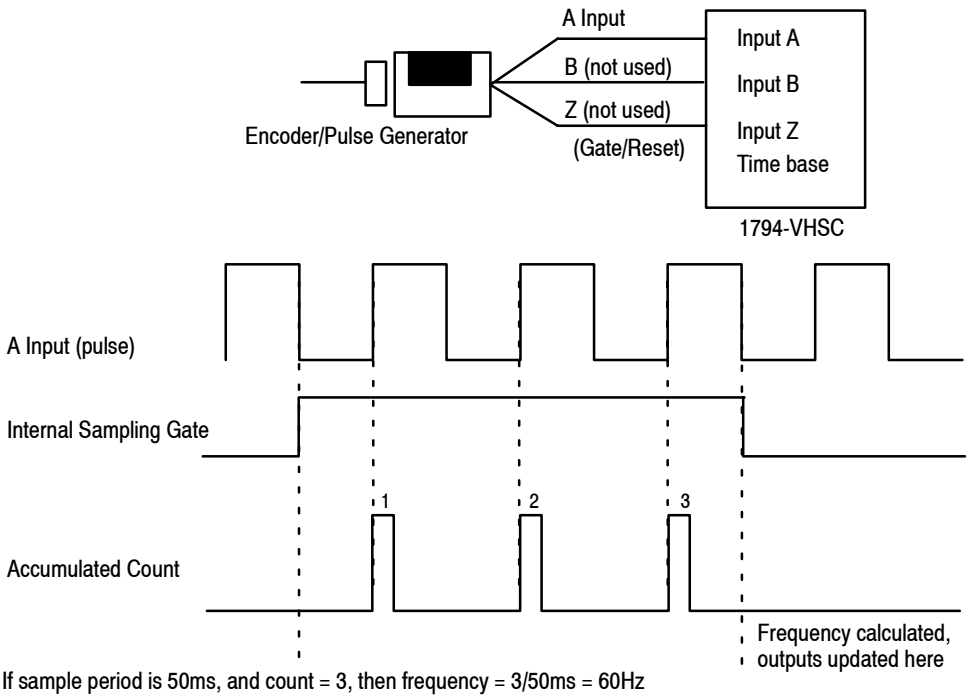
Frequency = 1 / [(25/1) X (1/5MHz) X 2] = 100KHz

Operation in Rate Measurement Mode

Use the rate measurement mode to count incoming pulses for a user-specified time interval. At the end of the interval, the module returns a value representing the sampled number of pulses and a value indicating the incoming frequency. When the count and frequency are updated, any associated outputs are checked against their associated presets.

The value representing the total number of pulses is returned in input file words 4 (LSW) and 5 (MSW) for channel 0 and 6 (LSW) and 7 (MSW) for channel 1, and the value indicating the incoming frequency is returned in words 0 (LSW) and 1 (MSW) and 2 (LSW) and 3 (MSW). The total count equals the running sum of the number of pulses received during the sample period. The operation of rate measurement mode is shown below in Figure 1.9.

Figure 1.9
Operation of the Rate Measurement Mode



Example:
In figure 1.9, three counts have been accumulated during the user-selected time period. If you had selected 50 milliseconds as the sample period, the frequency returned to the programmable controller processor would be:

Frequency = Counts/Sample period = 3 counts/50 milliseconds = 60Hz

Sample Period
You can set the sample period used in the frequency calculation in the rate measurement mode. Allowable values are 10 milliseconds to 3 seconds in 10 millisecond increments. The default value is 1 second.

Connection to Counter Inputs
The only user connections used in the rate measurement mode are to phase A of the module. The Z (gate/reset) and channel B terminals are not used in this mode.

Pulse Width Modulation

The module can generate a pulse width modulation signal that may be tied to any output. By specifying a period (configuration word 2) and gate interval (configuration word 2 or 3) together with the PWM configuration word 2 or 3, a counter and its first ON/OFF window comparator is assigned and the signal generated. The actual duty cycle is specified by output words 2 and 3.

Outputs

The VHSC module has 4 outputs, isolated in groups of 2. Each of the outputs is capable of sourcing current and will operate between 5 and 24 volts dc. You must connect an external power supply to each of the outputs. The outputs can source 1A dc alone or in combination. The outputs are hardware-driven and will turn on in about 25μs when the appropriate count value has been reached.

Enabling and Forcing Outputs

Outputs may be forced on or off independent of count or frequency value. To force the outputs, they must first be enabled. Enabling the outputs is done through a data table word 1, bits 1, 5, 9 and 13 (refer to chapter 4). Once the outputs have been enabled, they may be forced on by setting bits 0, 4, 8 or 12 in word 1. The outputs can be forced off by setting the enable bit to 0.

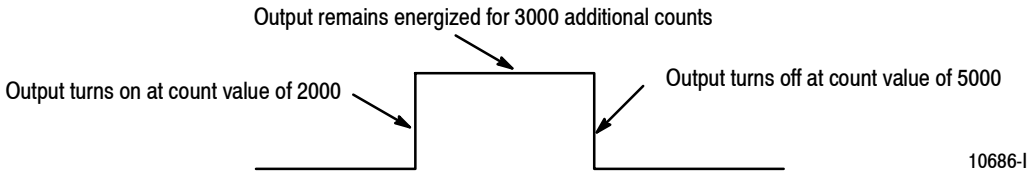
Assigning Outputs to Counter Windows

By setting bits in the configuration block, you can assign the outputs on the module to any of the various counter windows. You can assign any output to any count window with no restrictions.

Operation of Outputs

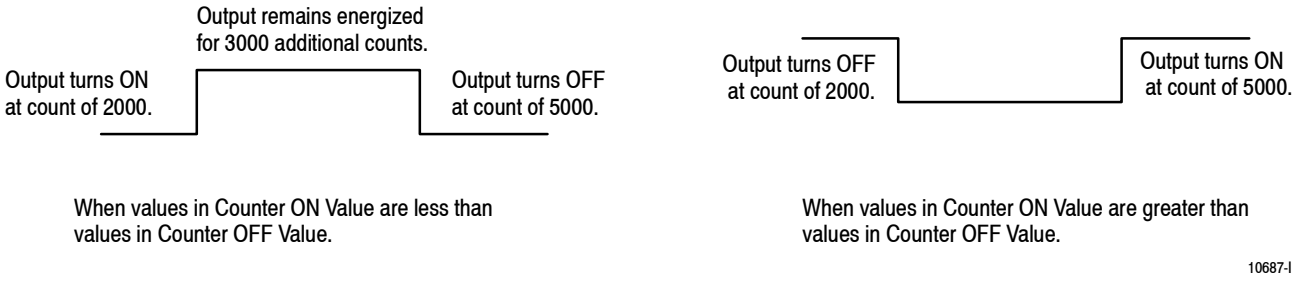
When the outputs for the VHSC module are enabled and assigned to a counter window they operate in an ON-OFF fashion. For example, assume that the module were programmed to turn ON an output when a count value of 2000 was reached. Further, assume that the user desired to have the output remain energized for a period of 3000 counts and then turn OFF. The end result would be that the outputs would turn ON at count of 2000, would remain energized for 3000 additional counts, and would turn OFF at 5000 counts. The ON and OFF values are circular around zero. Refer to figure 1.10.

Figure 1.10 On-Off Operation of Output



Refer to figure 1.11. Using output 0 as an example, when the value in Counter ON Value is less than the value in Counter OFF Value, the output turns on at 2000 and off at 5000. If the value in Counter ON Value is greater than the value in Counter OFF Value, the output turns off at 2000 and on at 5000.

Figure 1.11 Effect of Values in On/Off Operation



Isolation of Outputs

The module provides 850V dc isolation between each of the outputs and the flexbus.

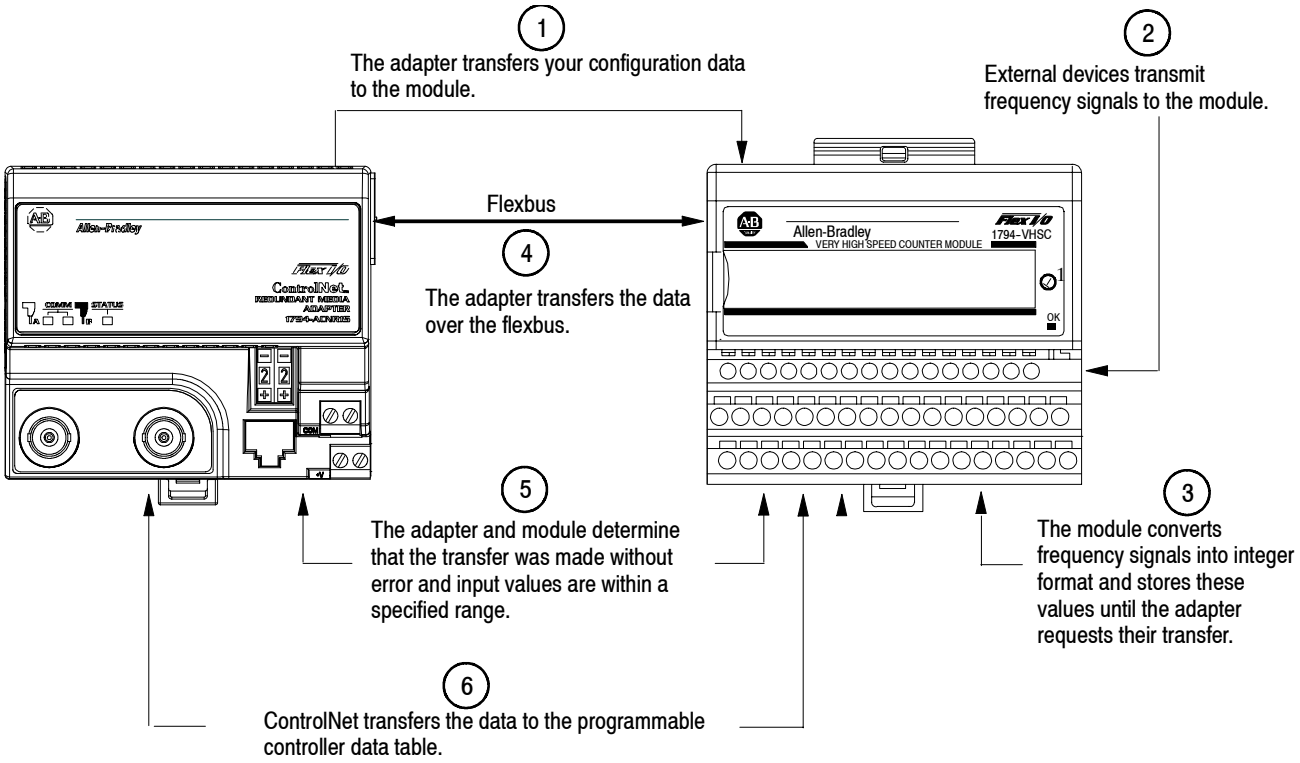
Connecting Outputs to Counters

You can connect any of the outputs to any of the counter inputs. In this way, it is possible to use the outputs to reset a counter or to cascade counters. If using the outputs this way, make certain that the output voltage is compatible with the chosen input.

What the Very High Speed Counter Module Does

The very high speed counter module performs high-speed scaling calculation operations for various industrial applications. The module interfaces with a FLEX I/O family ControlNet 1794-ACN15 series B or -ACNR15 series B or later adapter which then communicates with a programmable controller processor.

The adapter/power supply transfers data to and from the module over the flexbus. Instructions in the PLC facilitate this communication and let you write output values and configure the module's mode of operation. The following illustration describes the communication process.



1. The adapter transfers your configuration data and commands to the module.
2. External devices generate input signals that are transmitted to the module.
3. The module converts these signals into binary format, and stores these values and controls their output until the adapter requests their transfer.

4. The adapter transfers the data over the flexbus.
5. The adapter and module determine that the transfer was made without error and inputs values are within a specified range.
6. ControlNet transfers the data to the PLC data table.

Chapter Summary

In this chapter you learned how your module operates, and how your module communicates with the programmable controller.

How to Install Your Very High Speed Counter Module

What This Chapter Contains

In this chapter, we tell you:

Before You Install Your Input Module

Before installing your 1794-VHSC very high speed counter module:

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

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
- 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.

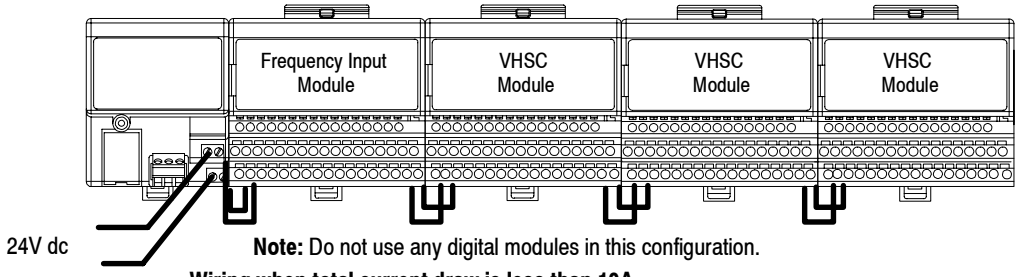
ATTENTION: Total current draw through the terminal base unit is limited to 10A. Separate power connections may be necessary.

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.

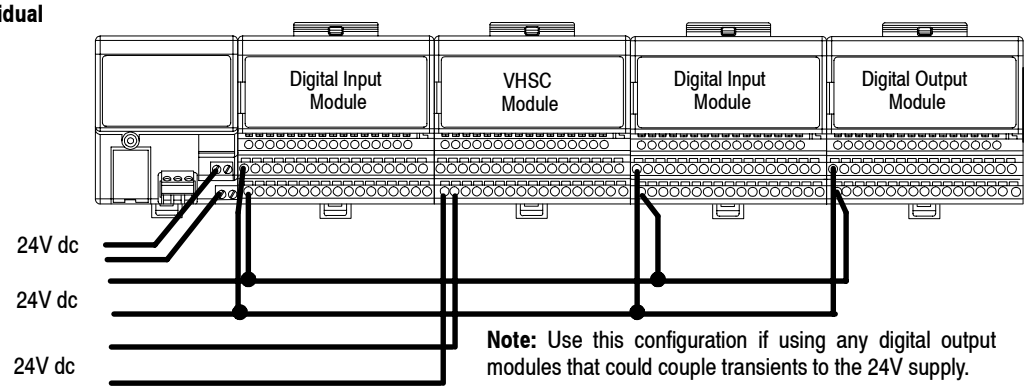
Daisy-chaining



Note: Do not use any digital modules in this configuration.

Wiring when total current draw is less than 10A

Individual



Note: Use this configuration if using any digital output modules that could couple transients to the 24V supply.

VHSC Module wiring separate from digital wiring.

Wiring when total current draw is greater than 10A

Installing the Module

Installation of the very high speed counter module consists of:

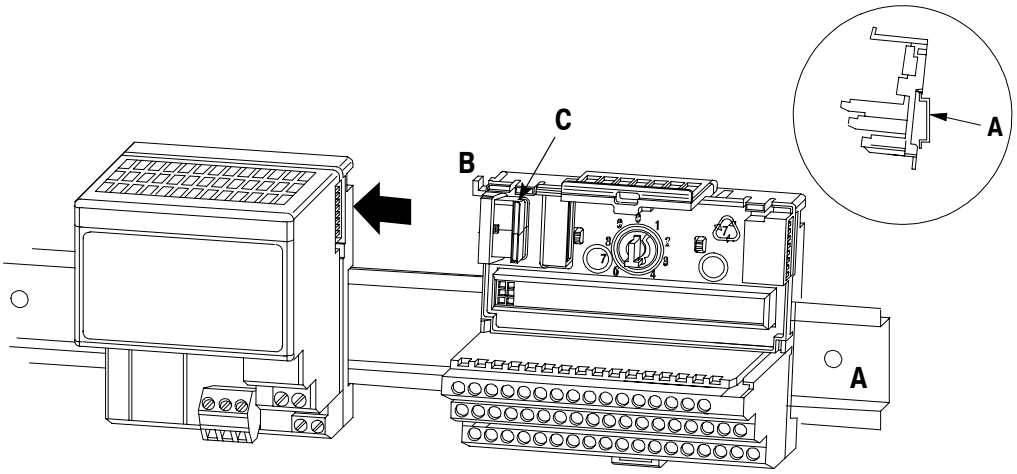
- mounting the terminal base unit
- installing the VHSC module into the terminal base unit
- installing the connecting wiring to the terminal base unit

If you are installing your module into a terminal base unit that is already installed, proceed to "Mounting the High Speed Counter Module on the Terminal Base" on page2-8.

Mounting the Terminal Base Unit on a DIN Rail

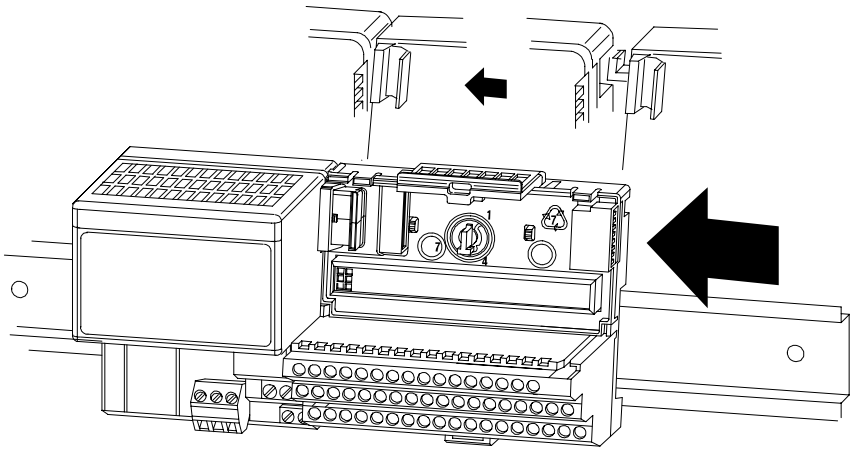
ATTENTION: Do not remove or replace a terminal base unit when power is applied. Interruption of the flexbus can result in unintended operation or machine motion.

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).

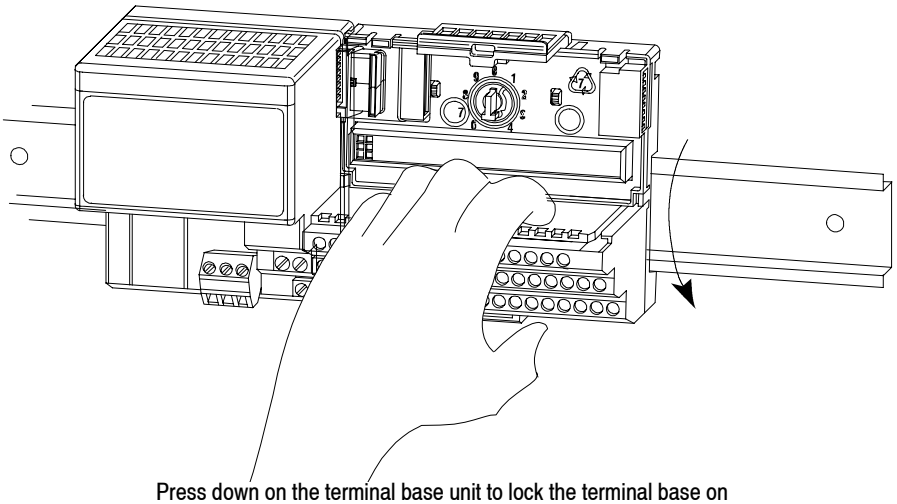


Position terminal base at a slight angle and hooked over the top of the DIN rail.

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

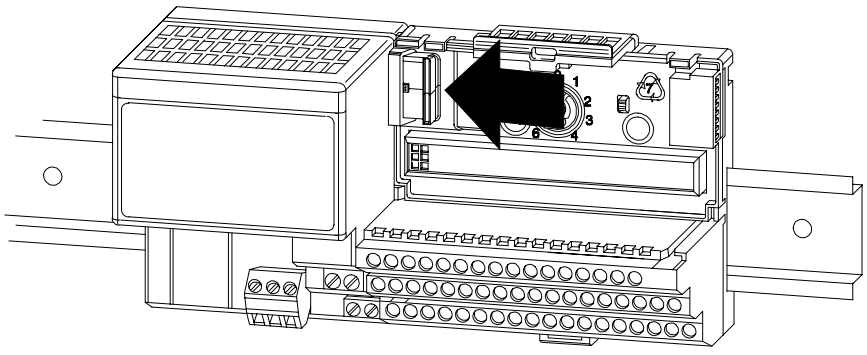


Slide the terminal base unit over tight against the adapter. Make sure the hook on the terminal base slides under the edge of the adapter and the flexbus connector is fully retracted.



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

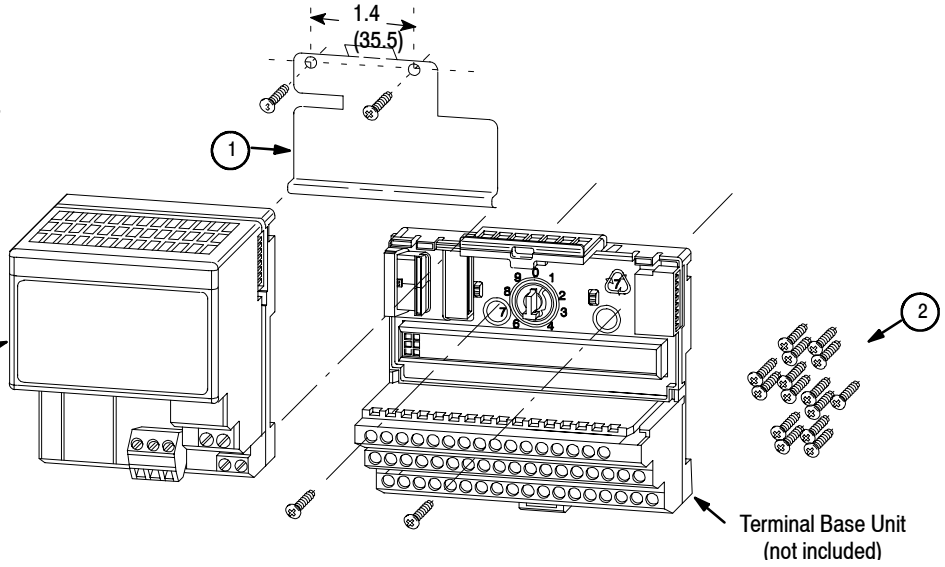
If you are installing your module into a terminal base unit that is already installed, proceed to "Mounting the High Speed Counter Module on the Terminal Base" on page2-8.

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

1794-NM1 Mounting Kit

Contents:

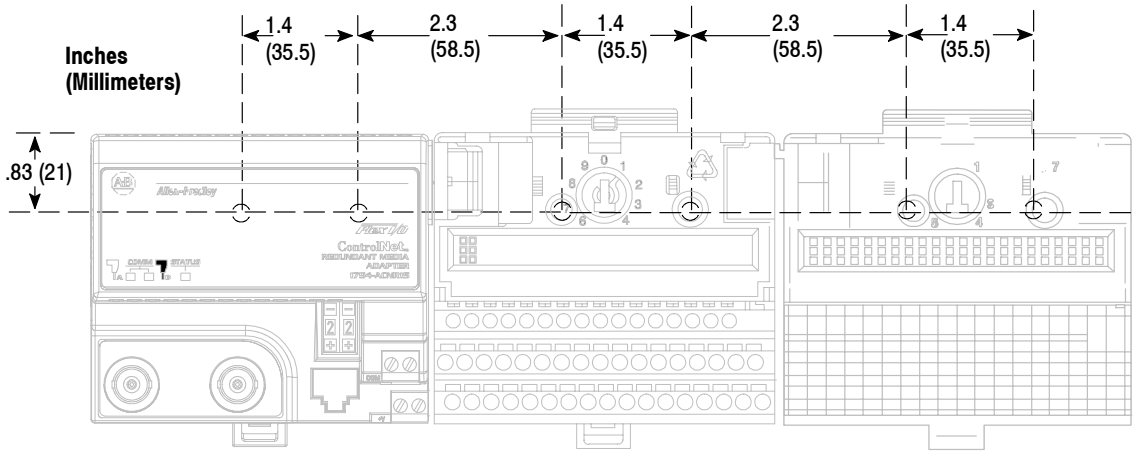
1 - Mounting Plate for Adapter
2 - 18 #6 self-tapping screws
(2 for the adapter, and 2 each for up to 8 modules)



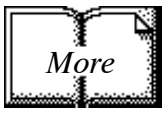
To install the mounting plate on a wall or panel:

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.

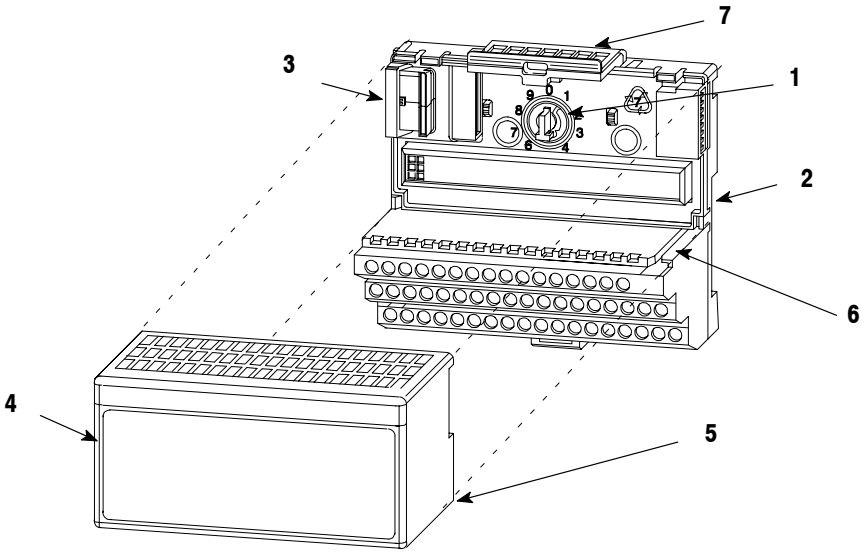
4. Hold the adapter (2) at a slight angle and engage the top of the mounting plate in the indention on the rear of the adapter module.
5. Press the adapter down flush with the panel until the locking lever locks.
6. Position the terminal base unit up against the adapter and push the female bus connector 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 High Speed Counter Module on the Terminal Base Unit

The 1794-VHSC module mounts on a 1794-TB3G or TB3GS terminal base unit.

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



2. Make certain the flexbus connector (3) is pushed all the way to the left to connect with the neighboring terminal base/adapter. **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.

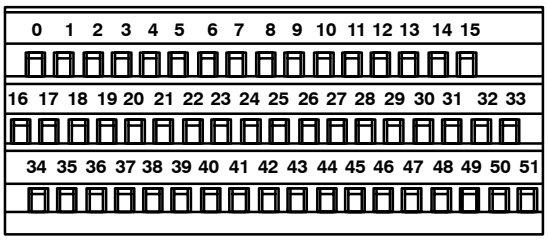
Connecting Wiring for the High Speed Counter Module

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

Compatible terminal base units are:

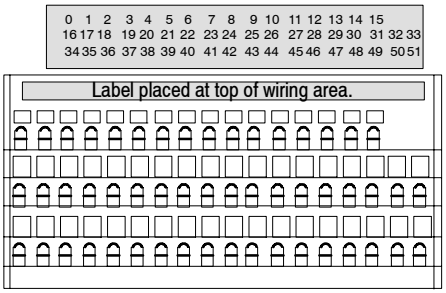
Module	1794-TB3G	1794-TB3GS
1794-VHSC	Yes	Yes

1794-TB3G



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

1794-TB3GS



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

Connecting Wiring using a 1794-TB3G and -TB3GS Terminal Base Units

1. Connect the individual signal wiring to numbered terminals on the **0-15** row **(A)** for +24V inputs (terminals 0-5 and 8-13) and **17-32** row **(B)** for +5V inputs (terminals 17-22 and 25-30).on the terminal base unit. Connect the input devices as shown in the wiring table on page 2-12.

ATTENTION: Do not connect 24V signals to the 5V input terminals. Permanent damage to the module will result.

2. Connect individual output wiring to terminals 6, 7 and 14, 15 on the **0-15** row **(A)** and terminals 23, 24 and 31, 32 on the **16-32** row **(B)** on the terminal base unit. Connect output return wiring for channels 0, 1, 2, and 3 to terminals 23, 24 31 and 32 respectively. Connect the output devices as shown in the wiring table on page 2-12.

3. Terminate any shield to terminals 16 or 33 on row **B**, or 40 through 45 on row **C**.

4. Connect +24V dc to terminal 34 on the **34-51** row (C), and 24V common to terminal 35 on the **34-51** row (C).

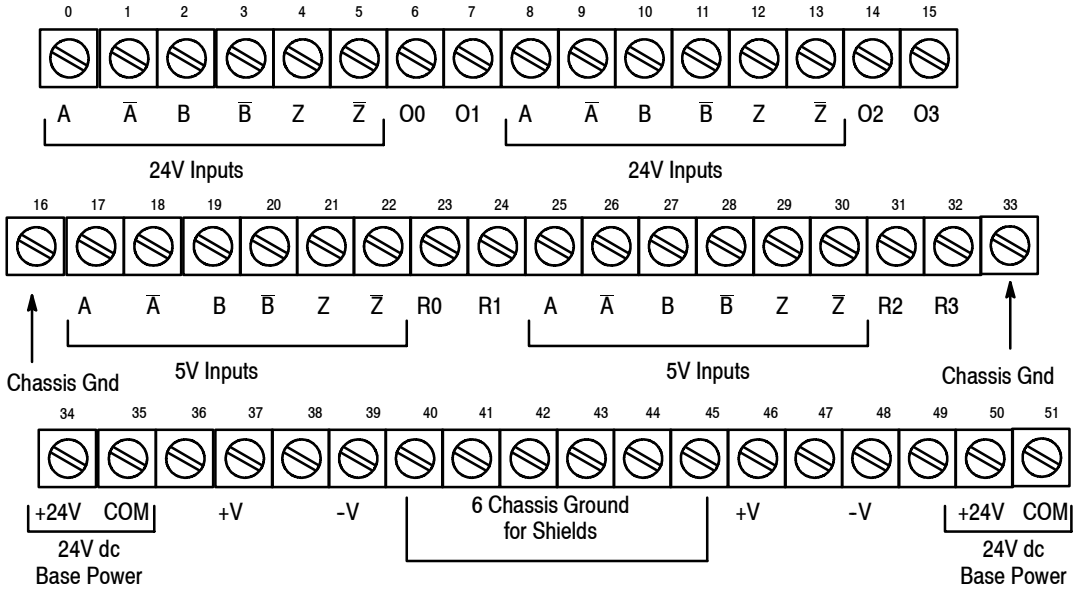
ATTENTION: To reduce susceptibility to noise, power VHSC modules and digital modules from separate power supplies. Do not exceed a length of 33 ft (10m) for dc power cabling.

5. If daisy chaining the +24V dc power to the next base unit, connect a jumper from terminal 50 (+24V) on this base unit to terminal 34 and from terminal 51 (24V dc common) to terminal 35 on the next base unit.

6. Connect output power wiring to terminals 37 (+) and 39 (-) for outputs 0 and 1, and terminals 46 (+) and 48 (-) for outputs 2 and 3.

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

Connections for Terminal Base 1794-TB3G shown



Where: A, $\overline{A}$ - incremental encoder input A (+5 or +24V dc)
B $\overline{B}$ - incremental encoder input B (+5 or +24V dc)
Z, $\overline{Z}$ - incremental encoder input Z (+5 or +24V dc)
O = sourcing outputs
R = returns for sourcing outputs
+V = +5 or +24V dc isolated power externally supplied for outputs (1A max.)
-V = negative isolated power connection (1A max.)
+24V dc = 24V dc terminal base power for module
COM = return for +24V dc terminal base power for module
Chassis Gnd = chassis ground for input or output cable shields

Wiring connections for the 1794-VHSC High Speed Counter Module

Incremental Encoder Input	Terminal Base Units 1794-TB3G, -TB3GS		
	Channel 0	Channel 1	
+24V Inputs			
Input A	0	8	
Input $\overline{A}$	1	9	
Input B	2	10	
Input $\overline{B}$	3	11	
Input Z	4	12	
Input $\overline{Z}$	5	13	
+5V Inputs			
	Channel 0	Channel 1	
Input A	17	25	
Input $\overline{A}$	18	26	
Input B	19	27	
Input $\overline{B}$	20	28	
Input Z	21	29	
Input $\overline{Z}$	22	30	

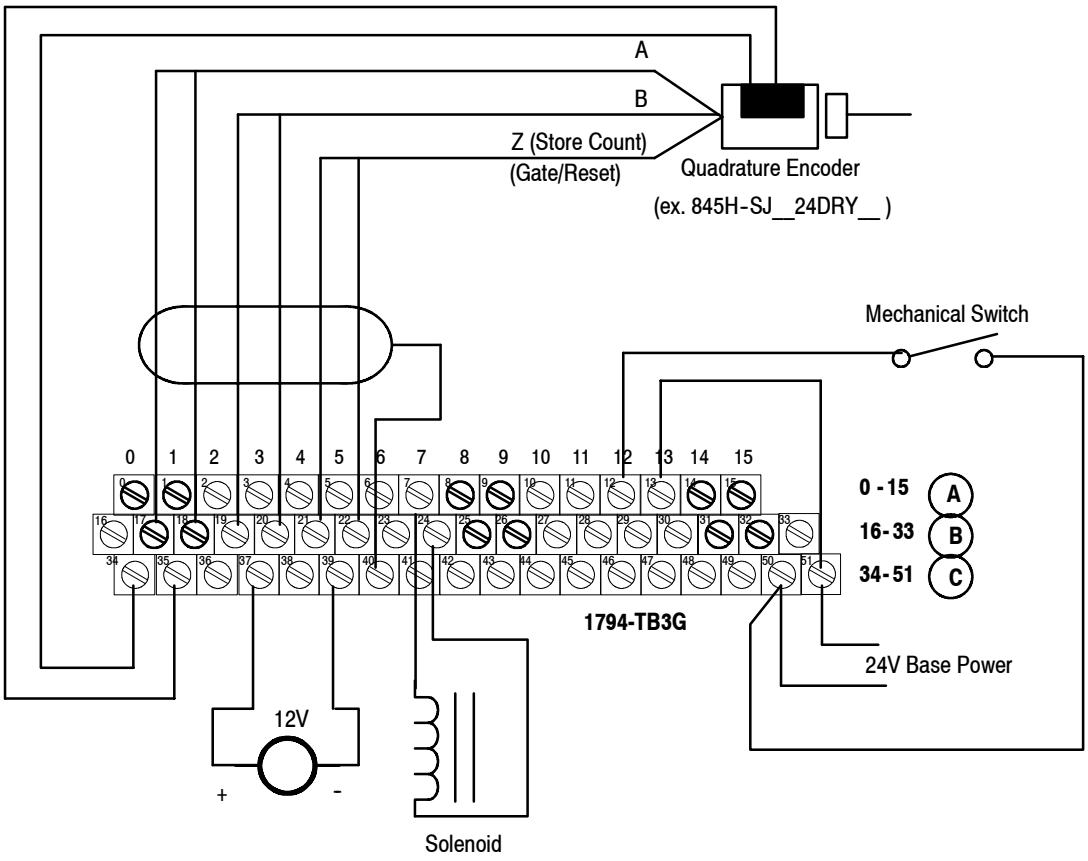
Outputs

Output	Sourcing Out	Return	Output	Sourcing Out	Return
O0	6	23	O1	7	24
O2	14	31	O3	15	32

+24V dc base power	Terminals 34 and 50
+24V dc COM	Terminals 35 and 51
+5V or +24V Output Pwr	Terminals 37 and 46
-V Output Pwr	Terminals 39 and 48
Chassis GND	Terminals 16, 33, and 40 thru 45

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

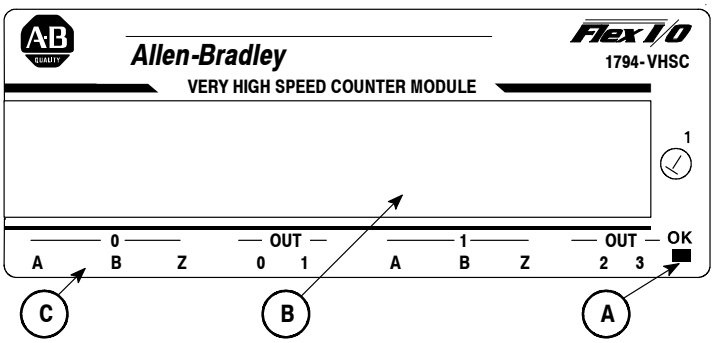
Example of Quadrature Encoder Differential Wiring to a 1794-TB3G Terminal Base Unit



Attention: Keep exposed area of inner conductor as short as possible.

Module Indicators

The high speed counter module has one red/green status indicator (OK) that is on when power is applied to the module and one yellow indicator for each input and output.



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

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

C = Status Indicators -

A = Status of input A

B = Status of input B

Z = Status of gate input Z

OUT = Output indicators, 1 for each output

Indicator	Indication	Explanation
A	**Yellow**	Input A active
	Off	Input A not active
B	**Yellow**	Input B active
	Off	Input B not active
Z	**Yellow**	Input Z active
	Off	Input Z not active
OUT 0, 1, 2, 3	**Yellow**	Output is on
	Off	Individual output is off

Indicator	Indication	Explanation
OK	**Red (solid)**	• Hardware diagnostic error, TF set to 1 and module/channel status contains error code. • Hardware runtime failure (i.e. watchdog timeout), module communication ceases.
	Red (flashing)	• Module is configuring hardware, NR is set to 1. • Module in test mode (bits 15-8 of counter control word are non-zero), TF set to 1
	Green (solid)	• Module is active and operating normally.
	Green (flashing)	• Module is not configured. • Programming error, PE is set to 1 and error code is supplied in bits 11-0 of module/channel status word. • Field power fault, FP set to 1. • Adapter powered down, and module local power still active. • ControlNet cable disconnected. • PLC in PROG mode.

When an input indicator (yellow) is lighted, it indicates that a valid signal (active high or active low) is present at one of the Input terminals.

Chapter Summary

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

Programming Your Very High Speed Counter Module

To initiate communication between the very high speed counter module and your PLC processor, you must use RSLogix 5 software. Refer to the RSLogix software manuals for information on communicating with this 1794-VHSC very high speed counter module.

Input, Output and Configuration Files for the Very High Speed Counter on ControlNet

Chapter Objectives

In this chapter you will learn about:

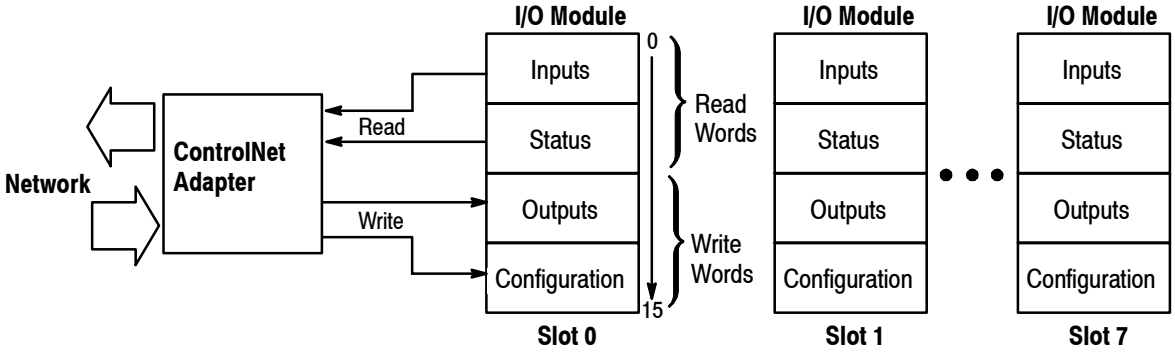
- ControlNet Adapter
- I/O structure
- safe state data
- communication fault data
- idle state behavior
- input data behavior upon module removal

About the ControlNet Adapter

This module must be used with the FLEX I/O ControlNet adapters (cat. no. 1794–ACN15 series B and –ACNR15 series B or later) which support extended data transfer (EDT). These adapters interface 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/B and -ACNR15/B 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 the VHSC 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. The VHSC module has 9 input words, no status words, 4 output words and 56 configuration words.

Application of New Configurations

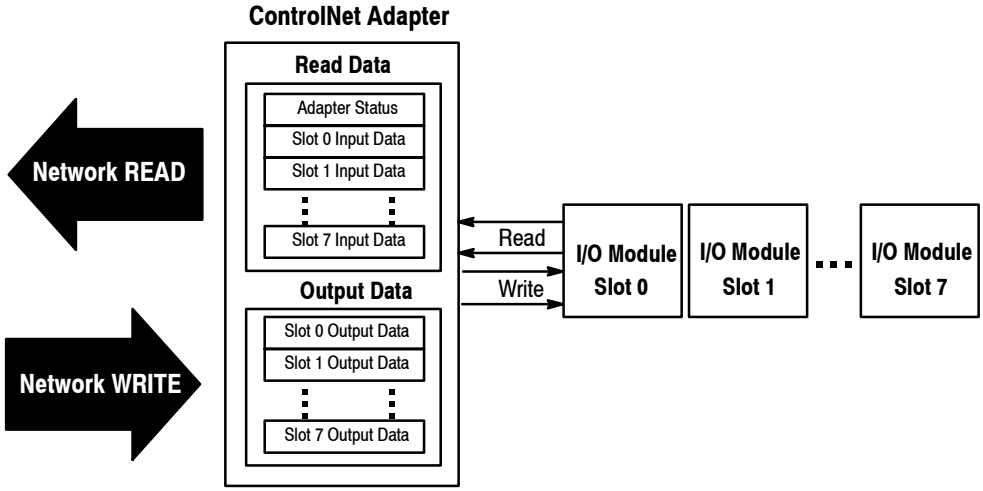
When a configuration is sent to the 1794-VHSC module, it is checked for consistency before being applied. If an error is found in the configuration, the PE bit (input word 8, bit 15) is asserted and the module locally retains its previous configuration. To isolate any problems an improperly configured module may have, the user application program (i.e. ladder program) should monitor this error.

If the configuration is considered acceptable, the counter application specific integrated circuit (ASIC) is disabled (i.e. counting is suspended and outputs are shut off), while the ASIC is loaded with the new operational parameters.

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.

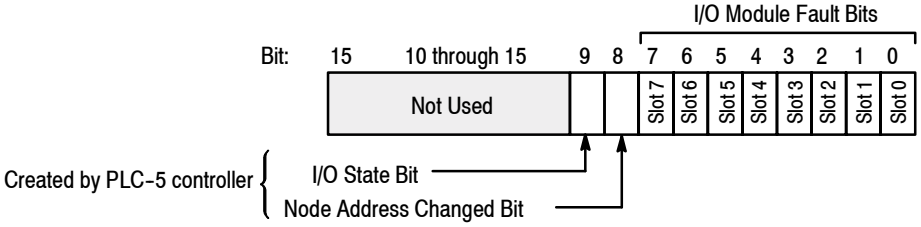
The first word of input data sent by the adapter is the Adapter Status Word. This is followed by the input data from each slot, in the order of the installed I/O modules. The Input data from Slot 0 is first after the status word, followed by Input data from Slot 2, and so on up to slot 7.



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 does not provide storage for alternate module output data during communication faults or processor idle state. This “safe state data” is stored in the VHSC module and may be defined using configuration software. 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. 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 VHSC response to a communication fault. Upon detection of a communication fault, the module 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 VHSC module responds to idle state (PLC in PROGRAM mode) according to the Communication Fault Behavior described above. The module 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

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)

Frequency/Resolution Enhancement

This mode is only for use in modules with firmware revision D or later.
The upper byte of the counter control word (output word 0) is reserved for special modes. Only mode 8, Enhancing Frequency/Resolution is available. In this mode, you can change significant digits of frequency display based on output word 3 for channel 0 and output word 4 for channel 1. Decimal point placement is absolute positioning. (-2 moves decimal point left 2 places dividing the frequency value by 100; +1 moves the decimal point 1 place, multiplying by 10, and so on). This allows frequency values to fit in a single word.

Applying the Frequency/Resolution Enhancement

To use this mode, proceed as follows

ATTENTION: Use this enhancement mode with caution since no checks are performed to verify data. Unintended operation can occur.

1. Power up the FLEX chassis, or put the PLC into RUN mode, or both. Let the 1794-VHSC module initialize as normal. Wait for the 'OK' indicator on the module to go solid green.
2. You must place ladder logic in your PLC that performs the following:.
   - **A.** Set a value between -4 and +2 into output word 2 and/or 3.
   - **B.** Then set (1) the M11 bit in the upper byte of control word 0.

     When the upper byte of the output word is not zero, the status indicator flashes red, and the TF bit (bit 12, input word 8) is asserted.
   - **C.** Next, reset (0) the M11 bit in the upper byte of output control word 0.

     Clearing the upper byte of output word 0 restores the module to an operational state, clears the TF bit in input word 8. and returns the indicator to green. The module is now in inhanced mode.
3. To turn this feature off:
   - **A.** Set output word 2 or 3 to zero (no value)
   - **B.** Set (1) the M11 bit
   - **C.** Then reset (0) the M11 bit

High Speed Counter Module (1794-VHSC) Image Table Mapping

Module Image

ControlNet Files

Input File Size

1 to 9 Words

0	**Channel 0 Current Count** (least significant word)															
1	**Channel 0 Current Count** (most significant word)															
2	**Channel 1 Current Count** (least significant word)															
3	**Channel 1 Current Count** (most significant word)															
4	**Channel 0 Stored/Accumulated Count** (least significant word)															
5	**Channel 0 Stored/Accumulated Count** (most significant word)															
6	**Channel 1 Stored/Accumulated Count** (least significant word)															
7	**Channel 1 Stored/Accumulated Count** (most significant word)															
8	PE	FP	NR	TF	OS	OS	OS	OS	C1	C0	ZF	ZS	C1	C0	ZF	ZS

Output File Size

0 to 4 Word

0	Reserved				M11	Reserved			0	VR	CP	CR	0	VR	CP	CR
1	0	LC	OE	FO	0	LC	OE	FO	0	LC	OE	FO	0	LC	OE	FO
2	**Channel 0 PWM Output Value (0-95.00%)**															
3	**Channel 1 PWM Output Value (0-95.00%)**															

Configuration File Size

56 Words

0	**Counter Configuration**
1	**Filter Selection**
2	**Time Base Value/PWM Period**
3	**Channel 0 Gate Interval**
4	**Channel 1 Gate Interval**
5	**Reserved**
6	**Channel 0 Rollover Value** (least significant word)
7	**Channel 0 Rollover Value** (most significant word)
8	**Channel 1 Rollover Value** (least significant word)
9	**Channel 1 Rollover Value** (most significant word)
10	**Channel 0 Preset Value** (least significant word)
11	**Channel 0 Preset Value** (most significant word)
12	**Channel 1 Preset Value** (least significant word)
13	**Channel 1 Preset Value** (most significant word)
14	**Channel 0 Scaler**
15	**Channel 1 Scaler**

Configuration File Size

56 Words

16	0	0	0	0	0	0	0	0	S4	S3	S2	S1	F4	F3	F2	F1
17	0	0	0	0	0	0	0	0	S4	S3	S2	S1	F4	F3	F2	F1
18	0	0	0	0	0	0	0	0	S4	S3	S2	S1	F4	F3	F2	F1
19	0	0	0	0	0	0	0	0	S4	S3	S2	S1	F4	F3	F2	F1
20	**First Counter 1st On Value** (least significant word)															
21	**First Counter 1st On Value** (most significant word)															
22	**First Counter 1st Off Value** (least significant word)															
23	**First Counter 1st Off Value** (most significant word)															
24	**First Counter 2nd On Value** (least significant word)															
25	**First Counter 2nd On Value** (most significant word)															
26	**First Counter 2nd Off Value** (least significant word)															
27	**First Counter 2nd Off Value** (most significant word)															
28	**First Counter 3rd On Value** (least significant word)															
29	**First Counter 3rd On Value** (most significant word)															
30	**First Counter 3rd Off Value** (least significant word)															
31	**First Counter 3rd Off Value** (most significant word)															
32	**First Counter 4th On Value** (least significant word)															
33	**First Counter 4th On Value** (most significant word)															
34	**First Counter 4th Off Value** (least significant word)															
35	**First Counter 4th Off Value** (most significant word)															
36	**Second Counter 1st On Value** (least significant word)															
37	**Second Counter 1st On Value** (most significant word)															
38	**Second Counter 1st Off Value** (least significant word)															
39	**Second Counter 1st Off Value** (most significant word)															
40	**Second Counter 2nd On Value** (least significant word)															
41	**Second Counter 2nd On Value** (most significant word)															
42	**Second Counter 2nd Off Value** (least significant word)															
43	**Second Counter 2nd Off Value** (most significant word)															

Configuration File Size (continued)

56 Words

44	**Second Counter 3rd On Value** (least significant word)
45	**Second Counter 3rd On Value** (most significant word)
46	**Second Counter 3rd Off Value** (least significant word)
47	**Second Counter 3rd Off Value** (most significant word)
48	**Second Counter 4th On Value** (least significant word)
49	**Second Counter 4th On Value** (most significant word)
50	**Second Counter 4th Off Value** (least significant word)
51	**Second Counter 4th Off Value** (most significant word)
52	**Counter Control Safe State**
53	**Output Control Safe State**
54	**Channel 0 PWM Safe State**
55	**Channel 1 PWM Safe State**

Input Word	Bit	Definition
Word 0	00-15 (00-17)	**Channel 0 current count -** The current count consists of 2 words (32 bits) representing the current count of the 24-bit counter (in encoder, X2 encoder, X4 encoder, PWM) or the frequency (in period/rate, continuous/rate, rate measurement.). The range of values is (0 ≤ value ≤ 16,777,215).
Word 1	00-15 (00-17)	
Word 2	00-15 (00-17)	**Channel 1 current count -** The current count consists of 2 words (32 bits) representing the current count of the 24-bit counter (in encoder, X2 encoder, X4 encoder, PWM) or the frequency (in period/rate, continuous/rate, rate measurement.). The range of values is (0 ≤ value ≤ 16,777,215).
Word 3	00-15 (00-17)	
Word 4	00-15 (00-17)	**Channel 0 stored/accumulated count -** These are 32-bit long word values representing the stored count of the counter at the time of some specified event. These words are not updated in counter modes (counter, X1 encoder, X2 encoder, X4 encoder) without store modes selected. With store modes selected, it is the counter value at the time of the specified Z input event. In PWM configuration, it is the counter value at the end of the period specified by the product of the time base times gate interval. In period/rate and continuous/rate, it is the total accumulation of unscaled Z pulses (i.e. if scaling is set to 128, the accumulator will increase by 128 counts). The maximum frequency that accumulation can follow is (200Hz X Scaler value). In rate measurement, it is the total number of pulses seen at the A input accumulated over each period as specified by the product of time base times gate interval. The range of values occupy the entire 32-bit size from 0 < value < 4,294,967,295. These words are not cleared by changing the configuration.
Word 5	00-15 (00-17)	

Input Word	Bit	Definition
Word 6	00–15 (00–17)	**Channel 1 stored/accumulated count -** These are 32–bit long word values representing the stored count of the counter at the time of some specified event. These words are not updated in counter modes (counter, X1 encoder, X2 encoder, X4 encoder) without store modes selected.With store modes selected, it is the counter value at the time of the specified Z input event. In PWM configuration, it is the counter value at the end of the period specified by the product of the time base times gate interval. In period/rate and continuous/rate, it is the total accumulation of unscaled Z pulses (i.e. if scaling is set to 128, the accumulator will increase by 128 counts). The maximum frequency that accumulation can follow is (200Hz X Scaler value). In rate measurement, it is the total number of pulses seen at the A input accumulated over each period as specified by the product of time base times gate interval. The range of values occupy the entire 32–bit size from 0 < value < 4,294,967,295. These words are not cleared by changing the configuration.
Word 7	00–15 (00–17)	
Words 8		**Module Channel Status Word**
	00	**Zero input status bit (ZS) for Channel 0-** This bit represents the present status of the Z input. 0 = Off 1 = Input on This bit is uneffected by Z invert, ZI, in the counter configuration word.
	01	**Zero frequency detected bit (ZF) for Channel 0 -** Only used during frequency configurations (period/rate, continuous/rate, and rate measurement). In period/rate and continuous/rate, counts are acquired during on state of the Z input. At very low frequencies, the counter saturates, indicating a zero frequency detect. The time it takes to determine a zero frequency in these 2 configurations can be as long as 6.7s (16,777,215 counts X 1/5MHz X 2 half cycles of Z). In rate measurement, pulses on Z are counted over a sample interval specified by the product of time base X gate interval. The time to detect a zero frequency is determined by the sample interval (example: time base = 0.100s, gate interval = 3 is 300ms to determine ZF).
	02, 03	**Stored/data count bit (C0, C1) for Channel 0 -** This count cycles thru 00, 01, 10, 11, 00... Each time the stored/accumulated count words are updated, C(0,1) is incremented. The PLC sample rate, including network delay and program scan, must be as fast or faster than the frequency of the event which updates.
	04	**Zero input status bit (ZS) for Channel 1 -** This bit represents the present status of the Z input. 0 = Off 1 = Input on
	05	**Zero frequency detected bit (ZF) for Channel 1 -** Only used during frequency configurations (period/rate, continuous/rate, and rate measurement). In period/rate and continuous/rate, counts are acquired during on state of the Z input. At very low frequencies, the counter saturates, indicating a zero frequency detect. The time it takes to determine a zero frequency in these 2 configurations can be as long as 6.7s (16,777,215 counts X 1/5MHz X 2 half cycles of Z). In rate measurement, pulses on Z are counted over a sample interval specified by the product of time base X gate interval. The time to detect a zero frequency is determined by the sample interval (example: time base = 0.100s, gate interval = 3 is 300ms to determine ZF).

Input Word	Bit	Definition
Word 8 continued	06, 07	**Stored/data count bit (C0, C1) for Channel 1 -** This count cycles thru 00, 01, 10, 11, 00... Each time the stored/accumulated count words are updated, C(0,1) is incremented. The PLC sample rate, including network delay and program scan, must be as fast or faster than the frequency of the event which updates.
	08–11 (10–13)	**Output status indicators (OS) -** Bit 08 corresponds to output 0, bit 09 to output 1, bit 10 to output 2, and bit 11 to output 3. 0 = output Off 1 = output On
	12 (14)	**Test/fail bit (TF) -** If the flexbus power or terminal base power is applied and the module fails during hardware tests, a fatal error occurs. The TF bit is asserted and the red module indicator turns on. An error code will be set in the module/channel status word which can be read using a CIO instruction. The TF bit is also asserted if the upper byte of the counter control word is not zero. The upper byte of the counter control word is reserved for special modes. Only mode 8, Enhancing Frequency/Resolution is available. To use this mode, set bit 11, and set a value in output woed 3 and/or 4. When the upper byte of word 12 is not zero, the red module status indicator will flash and the TF bit is asserted to indicate the module has entered a test–mode state. Clearing the upper byte of output word 0 restores the module to an operation state, clears the TF bit and returns the indicator to green.
		0x08 **This test mode is only for use in modules with firmware revision D or later.** Change significant digits of frequency display based on word 14 for channel 0 and word 15 for channel 1 (–2 moves decimal point left 2 places dividing the frequency value by 100; +1 moves the decimal point 1 place, multiplying by 10, and so on). This allows frequency values to fit in a single word. **CAUTION:** *Use this test mode with caution since no check is performed to assure that the returned frequency is meaningful.* Firmware revision D changed decimal point placement to absolute positioning. Revision D firmware also checks for placement to be in the range of –4 to +2. A value outside the range moves the decimal point to the zero position. Moving the decimal point to the left allows high frequencies, (commonly present in rate measurement) to fit within a single word. Moving the decimal point to the right allows low frequencies (commonly present in period and continuous rate modes) to have resolution displayed to 0.1Hz and 0.01Hz. Do not use scalars of Z/128, Z/64, Z/32 and Z/16 when using this test mode.
	13 (15)	**Not ready status bit (NR) -** Whenever 24V dc power is applied to the module, the hardware must be initialized. The NR bit will be asserted and the red module indicator will flash. If the red indicator continues flashing, and the green indicator momentarily turns on, the 24V dc power is below the module minimum.
	14 (16)	**Field power fault bit (FP) -** If the 24V dc module power drops, the FP bit is asserted, the green module indicator flashes, the module outputs turn off, and the module enters an idle state reporting status as it waits for power to be restored. **Note:** this bit does not indicate status of either output customer power supply.
	15 (17)	**Programming error bit (PE) -** This bit is asserted if incomplete, incorrect or conflicting set of configuration parameters are sent to the module. The green module status indicator will flash and an error code will be placed in bits 11:0 of the module/channel status word. The module will not enter a normal operating state. Bit definitions are shown in Chapter 5.

Output Word	Bit	Definition
Word 0	00–15 (00–17)	**Counter Control Word**
	00	**Channel 0 Counter reset bit (CR) -** A 0 to 1 transition of this bit clears the counter. Outputs are adjusted according to the window compare values.
	01	**Channel 0 Counter preset bit (CP) -** A 0 to 1 transition of this bit sets the counter to the value specified by the preset words. Outputs are adjusted according to the window compare values.
	02	**Channel 0 Value reset bit (VR) -** A 0 to 1 transition of this bit clears the stored/accumulated count words.
	03	This bit is always 0.
	04	**Channel 1 Counter reset bit (CR) -** A 0 to 1 transition of this bit clears the counter. Outputs are adjusted according to the window compare values.
	05	**Channel 1 Counter preset bit (CP) -** A 0 to 1 transition of this bit sets the counter to the value specified by the preset words. Outputs are adjusted according to the window compare values.
	06	**Channel 1 Value reset bit (VR) -** A 0 to 1 transition of this bit clears the stored/accumulated count words.
	07	This bit is always 0.
	08–10 (10–12)	Reserved for factory use.
	11 (13)	**Frequency/Resolution enhancement bit (M11) -** Refer to input word 8. Set this bit to 1 for enhancement. Note that you must place a value between -4 and +2 in output word 3 and/or 4.
	12–15 (14–17)	Reserved for factory use.

Output Word	Bit	Definition
Word 1	00–15 (00–17)	**Output Control Word**
	00	**Output 0 Force output bit (FO) -** When set to 1, output is turned on if OE is 1. When FO = 0, output can be controlled by a compare match or as directed by the PWM settings.
	01	**Output 0 Output enable bit (OE) -** When set to 1, output can be turned on from a force on, compare match or as directed by the PWM settings. When OE = 0, the associated output is turned off.
	02	**Output 0 Local control bit (LC) -** When set to 1, output is controlled the counter if the flexbus power is lost. (i.e. the module detects a flexbus reset signal). (Note: When flexbus power is lost, communication to the PC is lost.) When LC = 0, the module clears its OE bit at a loss of flexbus power. Set this bit as appropriate in the safe state word, since a communication fault occurs after adapter power is lost.
	03	Not used - set to 0.
	04	**Output 1 Force output bit (FO) -** When set to 1, output is turned on if OE is 1. When FO = 0, output can be controlled by a compare match or as directed by the PWM settings.
	05	**Output 1 Output enable bit (OE) -** When set to 1, output can be turned on from a force on, compare match or as directed by the PWM settings. When OE = 0, the associated output is turned off.
	06	**Output 1 Local control bit (LC) -** When set to 1, output is controlled the counter if the flexbus power is lost. (i.e. the module detects a flexbus reset signal). (Note: When flexbus power is lost, communication to the PC is lost.) When LC = 0, the module clears its OE bit at a loss of flexbus power. Set this bit as appropriate in the safe state word, since a communication fault occurs after adapter power is lost.

Output Word	Bit	Definition
Word 1 continued	07	Not used - set to 0.
	08 (10)	**Output 2 Force output bit (FO) -** When set to 1, output is turned on if OE is 1. When FO = 0, output can be controlled by a compare match or as directed by the PWM settings.
	09 (11)	**Output 2 Output enable bit (OE) -** When set to 1, output can be turned on from a force on, compare match or as directed by the PWM settings. When OE = 0, the associated output is turned off.
	10 (12)	**Output 2 Local control bit (LC) -** When set to 1, output is controlled the counter if the flexbus power is lost. (i.e. the module detects a flexbus reset signal). (Note: When flexbus power is lost, communication to the PC is lost.) When LC = 0, the module clears its OE bit at a loss of flexbus power. Set this bit as appropriate in the safe state word, since a communication fault occurs after adapter power is lost.
	11 (13)	Not used - set to 0.
	12 (14)	**Output 3 Force output bit (FO) -** When set to 1, output is turned on if OE is 1. When FO = 0, output can be controlled by a compare match or as directed by the PWM settings.
	13 (15)	**Output 3 Output enable bit (OE) -** When set to 1, output can be turned on from a force on, compare match or as directed by the PWM settings. When OE = 0, the associated output is turned off.
	14 (16)	**Output 3 Local control bit (LC) -** When set to 1, output is controlled the counter if the flexbus power is lost. (i.e. the module detects a flexbus reset signal). (Note: When flexbus power is lost, communication to the PC is lost.) When LC = 0, the module clears its OE bit at a loss of flexbus power. Set this bit as appropriate in the safe state word, since a communication fault occurs after adapter power is lost.
	15 (17)	Not used - set to 0.
Word 2	00–15 (00–17)	**Channel 0 PWM Output value -** When the module is configured for PWM, the time base is enabled, the counter for the respective channel, its gate interval, rollover and 1st on and 1st off value are used. Ties can be used to direct the PWM signal to any or all outputs. The range of the PWM values is 0 < value < 9500 decimal (i.e. 0.00% < value < 95.00%). The actual duty cycle at the output depends on the turn on and turn off times of the MOSFET, energy storage capability of the cable/load and the resistance from output to return.
Word 3	00–15 (00–17)	**Channel 1 PWM Output value -** When the module is configured for PWM, the time base is enabled, the counter for the respective channel, its gate interval, rollover and 1st on and 1st off value are used. Ties can be used to direct the PWM signal to any or all outputs. The range of the PWM values is 0 < value < 9500 decimal (i.e. 0.00% < value < 95.00%). The actual duty cycle at the output depends on the turn on and turn off times of the MOSFET, energy storage capability of the cable/load and the resistance from output to return.

Configuration Word	Bit	Definition				
Configuration Word 0		**Counter Configuration -** The upper byte of this word configures counter 1, the lower byte counter 0.				
	Bits 00–03	03	02	01	00	Counter 0
	Bits 08–11 (10–13)	11 (13)	10 (12)	09 (11)	08 (10)	Counter 1
		0	0	0	0	Counter
		0	0	0	1	Encoder
		0	0	1	0	Encoder X2
		0	0	1	1	PWM
		0	1	0	0	Encoder X4
		0	1	0	1	Period/Rate
		0	1	1	0	Continuous/Rate
		0	1	1	1	Rate Measurement
		Mode Selection				
	Bits 04–07	06	05	04	Counter 0	
	Bits 12–14 (14–16)	14 (16)	13 (15)	12 (14)	Counter 1	
		0	0	0	Store count disabled	
		0	0	1	Mode 1 – store/continue	
		0	1	0	Mode 2 – store/wait/resume	
		0	1	1	Mode 3 – store;reset/wait/start	
		1	0	0	Mode 4 – store;reset/start	
	Bit 15 (17)	Invert the Z signal – 0 = Z not inverted; 1 = Z inverted				

Configuration Word	Bit	Definition				
Word 1		**Filter Selection - Only 1 filter selection can be chosen at a time. Frequency = 50% duty cycle.**				
	Bits 00-03	**03**	**02**	**01**	**00**	**Counter 0**
	Bits 08-11 (10-13)	**11 (13)**	**10 (12)**	**09 (11)**	**08 (10)**	**Counter 1**
		0	0	0	0	No filter
		0	0	0	1	50kHz (10μs + 0μs/-1.6μs)
		0	0	1	0	5kHz (100μs + 0μs/-13.2μs)
		0	1	0	0	500Hz (1.0ms + 0ms/-1.25μs)
		1	0	0	0	50Hz (10.0ms + 0ms/-1.25ms)
	Bit 12 (14)	Input A filter bit (AF) - 0 = not filtered; 1 = apply filter to input				
	Bit 13 (15)	Input B filter bit (BF) - 0 = not filtered; 1 = apply filter to input				
	Bit 14 (16)	Input Z filter bit (ZF - 0 = not filtered; 1 = apply filter to input				
	Bit 15 (17)	Set to 0.				
Word 2	Bits 00-15 (00-17)	**Time base -** Sets the fundamental time base for both counters. Resolution in ms, with a minimum of 10ms intervals (10ms = 10; 1s = 1000). **Time base must be entered when PWM and rate measurement are configured. The maximum programmed value is 3000.**				
Word 3	Bits 00-15 (00-17)	**Channel 0 Gate interval -** Sets the individual counter gate interval using the time base setting as its time unit. Actual gate interval is time base X gate interval (i.e. time base of 10 X gate interval of 5 = 50ms). Maximum value is 3s. **Gate interval must be entered when PWM and rate measurement are configured.**				
Word 4	Bits 00-15 (00-17)	**Channel 1 Gate interval -** Sets the individual counter gate interval using the time base setting as its time unit. Actual gate interval is time base X gate interval (i.e. time base of 10 X gate interval of 5 = 50ms). Maximum value is 3s. **Gate interval must be entered when PWM and rate measurement are configured.**				
Word 5	Bits 00-15 (00-17)	Do not use - reserved.				
Word 6 and 7	Bits 00-15 (00-17)	**Channel 0 Rollover -** Sets the number of counts the counter accumulates before rolling over. For example, a setting of 1000 produces a count sequence of 998, 999, 0, 1, 2... while incrementing; and 2, 1, 0, 999, 998... while decrementing. Rollover is a 32-bit number with a usable range of 16,777,216. In PWM, this value is zero; in count, X1 encoder, X2 encoder and X4 encoder configurations, it must be some specified nonzero number. The value doesn't matter in period/rate, continuous/rate and rate measurement configurations.				
Word 8 and 9	Bits 00-15 (00-17)	**Channel 1 Rollover -** Sets the number of counts the counter accumulates before rolling over. For example, a setting of 1000 produces a count sequence of 998, 999, 0, 1, 2... while incrementing; and 2, 1, 0, 999, 998... while decrementing. Rollover is a 32-bit number with a usable range of 16,777,216. In PWM, this value is zero; in count, X1 encoder, X2 encoder and X4 encoder configurations, it must be some specified nonzero number. The value doesn't matter in period/rate, continuous/rate and rate measurement configurations.				
Word 10 and 11	Bits 00-15 (00-17)	**Channel 0 Preset -** This word sets the preset value the counter is loaded with when CP is asserted. This number has a range of 0 $\leq$ value $\leq$ 16,777,216.				
Word 12 and 13	Bits 00-15 (00-17)	**Channel 1 Preset -** This word sets the preset value the counter is loaded with when CP is asserted. This number has a range of 0 $\leq$ value $\leq$ 16,777,216.				

Configuration Word	Bit	Definition	
Word 14	Bits 00-15 (00-17)	**Channel 0 Scaler -** This word scales the Z signal **in period/rate and continuous/rate modes**. If the filter is applied, the filtered Z signal is scaled. **Set only 1 bit of the Scaler.** Selecting a Scaler causes accumulated counts to be adjusted accordingly (i.e. selecting a Scaler of 128 increases the accumulated count by 128 after 128 Z pulses have been received). **We recommend using the filter to reduce erroneous frequency readings any time you use the Scaler on the Z input.**	
	00	Z	Fmins (frequency at which the 24-bit counter overflows) = 0.149Hz
	01	Z/2	Fmins (frequency at which the 24-bit counter overflows) = 0.298Hz
	02	Z/4	Fmins (frequency at which the 24-bit counter overflows) = 0.596Hz
	03	Z/8	Fmins (frequency at which the 24-bit counter overflows) = 1.192Hz
	04	Z/16	Fmins (frequency at which the 24-bit counter overflows) = 2.384Hz
	05	Z/32	Fmins (frequency at which the 24-bit counter overflows) = 4.768Hz
	06	Z/64	Fmins (frequency at which the 24-bit counter overflows) = 9.537Hz
	07	Z/128	Fmins (frequency at which the 24-bit counter overflows) = 19.073Hz
Word 15	Bits 00-15 (00-17)	**Channel 1 Scaler -** This word scales the Z signal in **period/rate and continuous/rate modes**. If the filter is applied, the filtered Z signal is scaled. **Set only 1 bit of the Scaler.** Selecting a Scaler causes accumulated counts to be adjusted accordingly (i.e. selecting a Scaler of 128 increases the accumulated count by 128 after 128 Z pulses have been received). **We recommend using the filter to reduce erroneous frequency readings any time you use the Scaler on the Z input.**	
	00	Z	Fmins (frequency at which the 24-bit counter overflows) = 0.149Hz
	01	Z/2	Fmins (frequency at which the 24-bit counter overflows) = 0.298Hz
	02	Z/4	Fmins (frequency at which the 24-bit counter overflows) = 0.596Hz
	03	Z/8	Fmins (frequency at which the 24-bit counter overflows) = 1.192Hz
	04	Z/16	Fmins (frequency at which the 24-bit counter overflows) = 2.384Hz
	05	Z/32	Fmins (frequency at which the 24-bit counter overflows) = 4.768Hz
	06	Z/64	Fmins (frequency at which the 24-bit counter overflows) = 9.537Hz
	07	Z/128	Fmins (frequency at which the 24-bit counter overflows) = 19.073Hz
Words 16 to 19	Bits 00 01 02 03 04 05 06 07 Bits 08-15 (10-17)	**Output Ties -** These bits connect the specified output to the appropriate compare window. There are 8 windows, 4 per counter. Each output can be connected to any number of windows, from 1 ot 8. F1 = Tie output to first counter 1st window F2 = Tie output to first counter 2nd window F3 = Tie output to first counter 3rd window F4 = Tie output to first counter 4th window S1 = Tie output to second counter 1st window S2 = Tie output to second counter 2nd window S3 = Tie output to second counter 3rd window S4 = Tie output to second counter 4th window Set to 0.	

Configuration Word	Bit	Definition
Words 20 to 51	Bits 00–15 (00-17)	**Counter On and Off -** These words program each of the 4 counter's (first and second counter) on and off values. The first compare window for each counter is used in PWM, and when programmed for PWM, the associated compare window should remain at 0. The range of each entry is 0 < value < 16,777,215. When a tie is connected to a window comparator, that window must be specified. These windows are always interpreted as counts, regardless of the configuration setting, and can be computed as follows: counts = (Scaler X 2.5E6)/desired frequency (for period/rate and continuous/rate) counts = time base X desired frequency (for rate measurement)
Words 52 to 55	Bits 00–15 (00-17)	**Safe State Values -** When the PLC transitions to PROG mode or a communication fault occurs, the module copies the safe state words into its real time working buffer. The definitions are identical to the those in the counter control word, except entering a PWM safe state value outside the range 0–9500 results in a Hold Last State. Word 52 is Counter Control Safe State; word 53 is Output Control Safe State; word 54 is Channel 0 PWM Safe State word 55 is Channel 1 PWM Safe State.

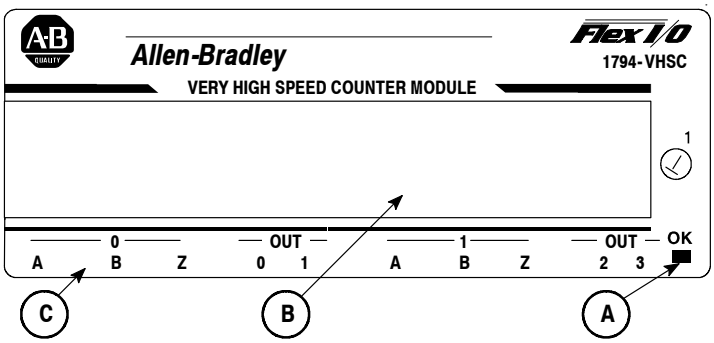
Troubleshoot the Very High Speed Counter Module

What This Chapter Contains

Use this chapter to troubleshoot the very high speed 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.

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

C = Status Indicators –

A = Status of input A
B = Status of input B
Z = Status of gate input Z

The indicators are multiplexed in 2 groups (A0, B0, Z0, O0/O1; and A1, B1, Z1, O2/O3) at a frequency of 488Hz. If inputs or outputs change at or near that frequency, the associated indicator will vary in brightness.

Indicator	Indication	Explanation
A	**Yellow**	Input A active
	Off	Input A not active
B	**Yellow**	Input B active
	Off	Input B not active
Z	**Yellow**	Input Z active
	Off	Input Z not active
OUT 0, 1, 2, 3	**Yellow**	Output is on
	Off	Individual output is off

Indicator	Indication	Explanation
OK	**Red (solid)**	• Hardware diagnostic error, TF set to 1 and module/channel status contains error code. • Hardware runtime failure (i.e. watchdog timeout), module communication ceases.
	Red (flashing)	• Module is configuring hardware, NR is set to 1. • Module in test mode (bits 15-8 of counter control word are non-zero), TF set to 1
	Red (flashing) with occasional flashing Green	• Module 24V power is below minimum rating.
	Green (solid)	• Module is active and operating normally.
	Green (flashing)	• Module is not configured. • Programming error, PE is set to 1 and error code is supplied in bits 11-0 of module/channel sttus word. • Field power fault, FP set to 1. • Adapter powered down, and module local power still active. • ControlNet cable disconnected. • PLC in PROG mode.

When an input indicator (yellow) is lighted, it indicates that a valid signal (active high or active low) is present at one of the Input terminals.

Diagnostic Codes Returned by the Module

If an incomplete, incorrect or conflicting set of configuration parameters are sent to the module, the PE bit is asserted, the green module status indicator flashes, and an error code is displayed in bits 0-11 of the module/channel status word. These codes are identified below. Use a CIO instruction to access this information.

Diagnostics Reported in Word 8 of the Data Input File

Read Word	Bit	Indication
Word 8	Bit 00	A reserved configuration or mode was programmed
	Bits 01	ZF/BF/AF were selected and no filter was programmed, **or** multiple filters were selected.
	Bits 02	A timebase was entered that was not a multiple of 10, **or** the timebase is out of range > 3000, i.e. 3s).
	Bit 03	A configuration requiring a timebase was selected and no gate interval was set, **or** the gate interval is out of range (> 3s) **or** the product of timebase and gate interval is greater than 3s.
	Bit 04	A rollover of zero was programmed though PWM was not selected; a rollover was programmed and PWM was selected; **or** the rollover is out of range ($1 \leq$ rollover $\leq$ 16,777,216)
	Bit 05	The preset ($0 \leq$ preset $\leq$ 16,777,215) is out of range.

Read Word	Bit	Indication
	Bit 06	A configuration was selected that requires a scalar, and no scalar was programmed **or** multiple scalars were selected
	Bit 07	A tie has been connected to an unprogrammed window
	Bit 08	Counter 0 window ON and OFF values are equal and not zero **or** counter 0 window ON and OFF value greater than 16,777,215.
	Bit 09	Counter 1 window ON and OFF values are equal and not zero **or** counter 1 window ON and OFF value greater than 16,777,215.
	Bit 10	Reserved
	Bit 11	

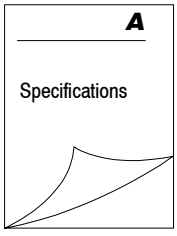
During hardware self-tests, when either flexbus power or terminal base power is first applied and a fatal error occurs, the TF bit is asserted and the red module status indicator turns on. An error code is placed in the lower byte of the module/channel status word to indicate the failed resource. Use a CIO instruction to access this information. When using a CIO instruction, this would be word 10.

Read Word	Bit	02	01	00	Dec.	Definition
Word 8	Bits 00-07	0	0	1	1	RAM test failed
		0	1	0	2	ROM checksum test failed
		0	1	1	3	EEPROM test failed
		1	0	0	4	Programmable Gate Array loading failed
		All other combinations not used				

What's Next

To find out more about the VHSC module:

See appendix A



For
specifications on the 1794-VHSC module

Specifications

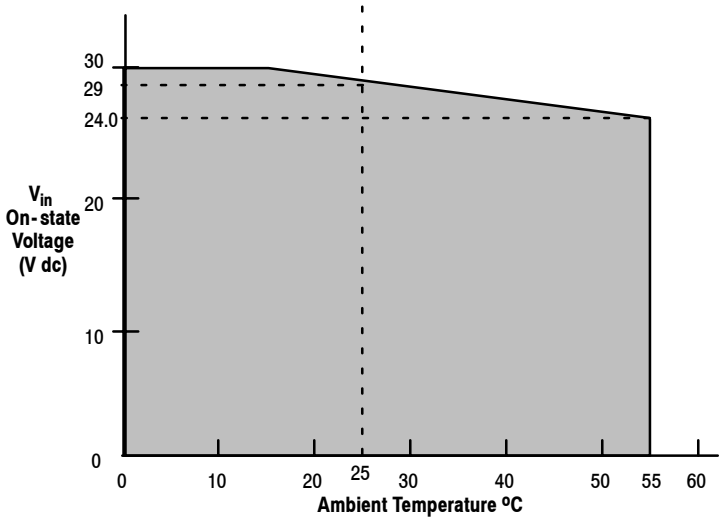
Specifications - 1794-VHSC Very High Speed Counter Module	
Input Specifications	
Number of Counters	2
Number of Inputs per Counter	2 groups of A/$\overline{A}$, B/$\overline{B}$, and Z/$\overline{Z}$ pairs with 5V dc or 15-24V dc terminations
Input Voltage	5V dc or 15-24V dc (determined on terminal base terminations)
Input Current (typical)	5V dc terminations: 19.1mA @ 5V dc 25.7mA @ 6V dc 15-24V dc terminations: 6.1mA @ 15V dc 10.2mA @ 24V dc
Input Off-State Voltage	5V dc terminations: <1.25V dc 15-24V dc terminations: <1.8V dc
Input Off-State Current	<0.250mA
Input On-State Voltage	5V dc terminations: >2.6V dc 15-24V dc terminations: >12.5V dc
Input On-State Current	>5mA
On-State Voltage Maximum	5V dc terminations: +6V 15-24V dc terminations: **Refer to 24V Input Derating curve below.**
Input Frequency Maximum	1.0MHz counter and encoder X1 (no filters) 500kHz encoder X2 (no filters) 250kHz encoder X4 (no filters)
Input Filter Selections	5: Off, 10μs, 100μs, 1.0ms, 10.0ms per A/B/Z group
Specifications continued on the next page.	

Specifications - 1794-VHSC Very High Speed Counter Module		
Output Specifications		
Number of Outputs		2 isolated groups of 2 (0.5A max. @ 5V dc; 1.0A max. @ 12-24V dc)
Output Control		Outputs can be tied to 8 compare windows
Output Supply Voltage Range		5-7V dc; 10-31V dc
Off-State Leakage Current		$\leq$0.3mA
On-State Voltage Drop		5V dc terminations: 0.9V dc @ 0.5A 12-24V dc terminations: 0.9V dc @ 1.0A
On-State Current Maximum		5V dc terminations: 0.5A 12-24V dc terminations: 1.0A
Maximum Current per Output pair		5V dc terminations: 0.5A 12-24V dc terminations: 1.0A
Short Circuit Current		5V dc terminations: 0.9A 12-24V dc terminations: 4.0A Outputs are short circuit protected and turn off until power is cycled.
Delay Time	Off to On On to Off	25μs (load dependent) 150μs (load dependent)
Isolation Voltage		100% tested @ 850V dc for 1s between six isolated areas, including; flexbus module 24V dc power A0/B0/Z0 inputs A1/B1/Z1 inputs O0/O1 and output power supply 1 O2/O3 and output power supply 2
Flexbus Current		75mA @ 5V dc (with terminal base power off)
Power Dissipation		5W maximum @ 31.2V dc
Thermal Dissipation		Maximum 17.1 BTU/hr @ 31.2V dc
Indicators		1 green/red power/status indicator 6 yellow input status indicators - logic side 4 yellow output status - logic side
Keyswitch Position		1
Specifications continued on the next page.		

Specifications - 1794-VHSC Very High Speed Counter Module	
General Specifications	
Module Location	Cat. No. 1794-TB3G or -TB3GS Terminal Base
Dimensions Inches (Millimeters)	1.8H x 3.7W x 2.1D (45.7 x 94.0 x 53.3)
External dc Power Supply Voltage Voltage Range Supply Current	**Refer to 24V Derating Curve below** 24V dc nominal 19.2 to 31.2V dc (includes 5% ac ripple) 100mA @ 24V dc
Environmental Conditions Operational Temperature Storage Temperature Relative Humidity Shock Operating Nonoperating Vibration	 0 to 55°C (32 to 131°F) -40 to 85°C (-40 to 185°F) 5 to 95% noncondensing (operating) 5 to 80% noncondensing (nonoperating) 30g peak acceleration, 11(±1)ms pulse width 50g peak acceleration, 11(±1)ms pulse width Tested 5g @ 10-500Hz per IEC 68-2-6
Conductors Wire Size Category	12 gauge (4mm^2) stranded maximum copper wire rated at 75°C or greater 3/64 inch (1.2mm) insulation maximum 2[1]
Agency Certification (when product is marked)	• CSA certified • CSA Class I, Division 2 Groups A, B, C, D certified • UL listed • UL Class I, Division 2 Groups A, B, C, D certified • CE marked for all applicable directives
User Manual Installation Instructions	Publication 1794-UM010❒-EN-P Publication 1794-IN067❒-EN-P

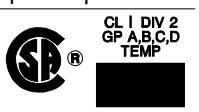
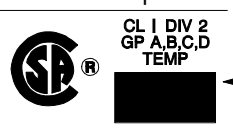
1 Use this conductor category information for planning conductor routing . Refer to publication 1770-4.1, "Industrial Automation Wiring and Grounding Guidelines for Noise Immunity."

24V Input Derating Curve



The area within the curve represents the safe operating range for the module under various conditions of user supplied 24V dc supply voltages and ambient temperatures. This includes all possible mounting positions, including inverted horizontal.

CSA Hazardous Location Approval

CSA Hazardous Location Approval	Approbation d'utilisation dans des emplacements dangereux par la CSA
CSA® certifies products for general use as well as for use in hazardous locations. **Actual CSA certification is indicated by the product label** as shown below, and not by statements in any user documentation.	La CSA® certifie les produits d'utilisation générale aussi bien que ceux qui s'utilisent dans des emplacements dangereux. **La certification CSA en vigueur est indiquée par l'étiquette du produit** et non par des affirmations dans la documentation à l'usage des utilisateurs.
Example of the CSA certification product label 	Exemple d'étiquette de certification d'un produit par la CSA 
To comply with CSA certification for use in hazardous locations, the following information becomes a part of the product literature for CSA-certified Allen-Bradley industrial control products. • This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D, or non-hazardous locations only. • The products having the appropriate CSA markings (that is, Class I Division 2, Groups A, B, C, D), are certified for use in other equipment where the suitability of combination (that is, application or use) is determined by the CSA or the local inspection office having jurisdiction.	Pour satisfaire à la certification de la CSA dans des endroits dangereux, les informations suivantes font partie intégrante de la documentation des produits industriels de contrôle Allen-Bradley certifiés par la CSA. • Cet équipement convient à l'utilisation dans des emplacements de Classe 1, Division 2, Groupes A, B, C, D, ou ne convient qu'à l'utilisation dans des endroits non dangereux. • Les produits portant le marquage approprié de la CSA (c'est à dire, Classe 1, Division 2, Groupes A, B, C, D) sont certifiés à l'utilisation pour d'autres équipements où la convenance de combinaison (application ou utilisation) est déterminée par la CSA ou le bureau local d'inspection qualifié.
Important: Due to the modular nature of a PLC® control system, the product with the highest temperature rating determines the overall temperature code rating of a PLC control system in a Class I, Division 2 location. The temperature code rating is marked on the product label as shown.	**Important:** Par suite de la nature modulaire du système de contrôle PLC®, le produit ayant le taux le plus élevé de température détermine le taux d'ensemble du code de température du système de contrôle d'un PLC dans un emplacement de Classe 1, Division 2. Le taux du code de température est indiqué sur l'étiquette du produit.
Temperature code rating  ← Look for temperature code rating here	Taux du code de température  ← Le taux du code de température est indiqué ici
The following warnings apply to products having CSA certification for use in hazardous locations.	Les avertissements suivants s'appliquent aux produits ayant la certification CSA pour leur utilisation dans des emplacements dangereux.
WARNING: Explosion hazard — • Substitution of components may impair suitability for Class I, Division 2. • Do not replace components unless power has been switched off or the area is known to be non-hazardous. • Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous. • Do not disconnect connectors unless power has been switched off or the area is known to be non-hazardous. Secure any user-supplied connectors that mate to external circuits on an Allen-Bradley product using screws, sliding latches, threaded connectors, or other means such that any connection can withstand a 15 Newton (3.4 lb.) separating force applied for a minimum of one minute.	**AVERTISSEMENT:** Risque d'explosion — • La substitution de composants peut rendre ce matériel inacceptable pour lesemplacements de Classe I, Division 2. • Couper le courant ou s'assurer quel'emplacement est désigné non dangereux avant de remplacer lescomposants. • Avant de débrancher l'équipement, couper le courant ou s'assurer que l'emplacement est désigné non dangereux. • Avant de débrancher les connecteurs, couper le courant ou s'assurer que l'emplacement est reconnu non dangereux. Attacher tous connecteurs fournis par l'utilisateur et reliés aux circuits externes d'un appareil Allen-Bradley à l 'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens permettant aux connexions de résister à une force de séparation de 15 newtons (3,4 lb. - 1,5 kg) appliquée pendant au moins une minute.
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