GFK-0293

GE Fanuc Manual Series 90-30

High Speed Counter

GE Fanuc Automation

Programmable Control Products

Series 90™-30
High Speed Counter

User's Manual

GFK–0293C *June 1995*

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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Preface

This manual provides the specifications, hardware interface requirements, and programming information needed to install and use the High Speed Counter module for the Series 90™-30 Programmable Logic Controller. The *Series 90-30 Programmable Controller Installation Manual*, GFK-0356, should be your primary reference for information about the Series 90-30 Programmable Logic Controller. It describes types of systems, system planning, installation procedures, and system components for the Series 90-30 PLC.

Revisions to This Manual

This version (GFK-0293C) of the Series 90-30 High Speed Counter User's Manual has several corrections to the prior version (GFK-0293B). These corrections and / or additions are listed below. Additionally, Appendix A, which was in the previous version was removed, since it does not apply to the current version of the High Speed Counter.

- Page 1-4, added "depending on counter type selected" to sentence under **Selectable counter operation.**
- Page 1-4, under **Accumulator for each counter,** changed third sentence and added sentence beginning with "When negative ... ".
- Page 1-5, under **Counts per Timebase ....** added sentence beginning with "The Counts per Timebase ..." .
- Page 2-2, sentence added at beginning of first paragraph regarding where High Speed Counter modules can be installed.
- Page 2-5, *Conformance to CE Mark Requirements* added.
- Page 2-7, added "single ended" before positive logic.
- Page 2–8, added DC+ to pin 14 description, and DC– to pin 20 description. Added footnotes at bottom of table.
- Page 3-10, new section added under Type C Counter Home Sequence.
- Page 4-4, status bits 7 and 8 corrected to read: *disable 1 status* and *disable 2 status*.
- Page 4-19, sentence added before Ladder Diagram noting that comments inside /*.....*/ are comments only.
- Page 4-21, added NOTE at bottom of page, and Status Word Fault Code table.
- Page A-7, in Example 2, .0001 corrected to read .001.
- Page B-1, under %I Return Data, bits 7 and 8 for Type B counter changed to read: *Disable 1 status* and *Disable 2 status*.
- Page B-2, under %Q Output data, bits 7 and 8 for Type B counter changed to read: *not used*.

Content of this Manual

This manual contains the following information:

Chapter 1. Introduction: provides an overview of High Speed Counter Module features.

Chapter 2. Installation and Wiring: explains installation and field wiring for the module.

Chapter 3. Counter Operation: describes operation of each counter type.

Chapter 4. CPU Interface: provides descriptions of data that is routinely transferred between a High Speed Counter and a CPU.

Chapter 5. Configuration Features: describes the configurable features of the High Speed Counter.

Chapter 6. Configuration Programming: provides information for programming or monitoring High Speed Counter data with a Workmaster® II computer or Series 90-30 Hand-Held Programmer.

Appendix A. Application Examples: provides a group of application examples using the various features of the High Speed Counter.

Appendix B. High Speed Counter Summary: provides a summary of return data, output data, data commands, error codes, and wiring information for the High Speed Counter.

Related Publications:

- *GFK-0356: Series 90™-30 Programmable Controller Installation Manual*. Provides information required for system planning and installation. Describes system hardware components system and system configuration, and provides installation and field wiring information for system planning and actual installation.
- *GFK-0402: Hand-Held Programmer, Series 90™-30 and 90-20 Programmable Controllers User's Manual*. Describes how to install and setup the Hand-Held Programmer, and how to use it to configure, program, and monitor operations of the Series 90-30 Programmable Logic Controller.
- *GFK-0466: Logicmaster™ 90 Series 90™-30 and 90-20 Programming Software User's Manual.* Explains use of Logicmaster™ 90 software to configure a Series 90-30 or 90-20 Programmable Logic Controller and create application programs.
- *GFK-0467: Series 90™-30/90-20 Programmable Controllers Reference Manual*. Describes the programming instructions used to create application programs for the Series 90-30 and 90-20 Programmable Logic Controllers.

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Henry A. Konat
Senior Technical Writer

Chapter 1 Introduction

This chapter describes:

- The High Speed Counter Module
- Basic module features
- The module's inputs and outputs
- Configurable counter types

High Speed Counter Module

The High Speed Counter module, catalog number IC693APU300, for the Series 90™-30 Programmable Logic Controller (PLC) provides direct processing of rapid pulse signals up to 80 kHz for industrial control applications such as:

- Turbine flowmeter
- Meter proving
- Velocity measurement
- Material handling
- Motion control
- Process control

Direct processing means that the module is able to sense inputs, process the input count information, and control the outputs without needing to communicate with a CPU.

The High Speed Counter uses 16 words of input memory. This consists of 16 bits of discrete input memory (%I) and 15 words of analog input memory (%AI). These inputs are updated once per CPU sweep. The High Speed Counter also uses 16 bits of discrete output memory (%Q) which are transferred once per sweep.

The High Speed Counter is configured using the Series 90™-30 Hand-Held Programmer or the Logicmaster™ 90-30 Programming Software Configurator function. Many features can be configured from the user's application program as well. Each feature is set to a factory default configuration which is suitable for many applications. There are no jumpers or DIP switches to set on the module. Two green LEDs at the top of the module indicate the operating status of the module and the status of configuration parameters.

Configurable Counter Types

When the module is configured, a counter type must first be selected. The choices are:

- Type A - selects 4 identical, independent simple counters
- Type B - selects 2 identical, independent more complex counters
- Type C - selects 1 complex counter

Type A Configuration

When used in this basic configuration, the module has four identical programmable up or down 16-bit counters. Each counter can be programmed to count either up or down. Each has three inputs: a Preload input, a Count Pulse input, and a Strobe input. In addition, each counter has one output, with programmable on and off Output Presets.

Type B Configuration

In its Type B configuration, the module has two identical bidirectional 32-bit counters. The count inputs may be configured to accept Up / Down, Pulse / Direction, or A Quad B signals. For a Type B counter configuration, each counter has two completely independent sets of Strobe inputs and Strobe registers. Each counter also has two outputs, with each output having programmable on / off Presets. A Disable input can be used to suspend counting.

Type C Configuration

In the Type C configuration, the module has one 32-bit counter with four outputs, each with programmable on / off output presets, three strobe registers with strobe inputs, and two Preload values with Preload inputs. In addition, the module has a Home Position register for preloading the Accumulator to the Home Position value. Two sets of bidirectional counter inputs can be connected to operate in a differential fashion. Each set of inputs can be configured for A Quad B, Up / Down, or Pulse / Directionoperation. The Type C configuration is suitable for applications requiring motion control, differential counting, or homing capability.

Description of Module

Additional module features include:

- 12 positive logic (source) inputs with input voltage range selection of either 5 VDC or 10 to 30 VDC
- 4 positive logic (source) outputs
- Counts per timebase register for each counter
- Software configuration
- Internal module diagnostics
- Individual LEDs that provide a visual indication of Module OK and Configured OK status
- A removable terminal board for connection of field wiring

Inputs can be used as count signals, direction, disable, edge-sensitive strobe, and preload inputs depending on the counter type selected by the user. Outputs can be used to drive indicating lights, solenoids, relays, and other devices.

Power to operate the module's logic circuitry is obtained from the baseplate backplane's 5 VDC bus. Power sources for input and output devices must be supplied by the user or by the +24 VDC Isolated output of the Model 30 power supply. The module also provides a selectable threshold voltage to allow the inputs to respond to either 5 VDC signal levels or 10 to 30 VDC signal levels. The 5 VDC threshold is selected by connecting a jumper between two terminals on the detachable terminal board connector. Leaving the threshold selection terminals unconnected places the inputs in the default 10 to 30 VDC voltage range. The detachable terminal board connector allows prewiring to the module or replacing the module without disturbing the field wiring. It is important to note that ***10 to 30 VDC must not be applied when the threshold terminals are jumpered to select 5 VDC.***

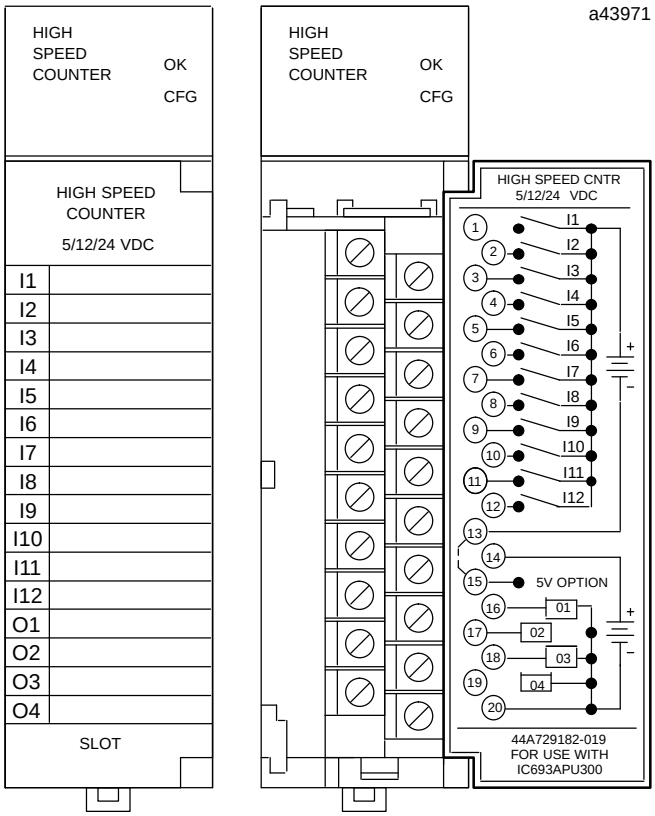


Figure 1-1. Series 90-30 High Speed Counter Module

For each counter, a Counts per Timebase register indicates the number of counts in a given time interval. The Counts per Timebase data is a 16-bit signed number. The sign indicates up counts (+) or down counts (–). The Timebase value is specified in milliseconds and ranges from 1 to 65535 milliseconds.

All configuration parameters for the module are downloaded from the PLC to the High Speed Counter after it passes its internal diagnostics and the MODULE OK indicator has turned on. An initial (default) set of configuration parameters is loaded during diagnostics. These default parameters may be used "as is" or modified through a download from the PLC, or the parameters may be changed by the user with the Hand-Held Programmer. When the user configuration is complete, the CONFIG OK LED will turn on.

Operation of the High Speed Counter module is monitored by a watchdog timer circuit which, if it detects a module failure, will force all outputs off and turn off the MODULE OK LED.

Basic Features

Oscillator:

The module also provides an internal square wave oscillator output that can be configured as a count input for the **first counter only** and used as a timing reference for measurement. The output is set for a default frequency of 1 kHz. A higher or lower frequency can be selected using the Hand-Held Programmer, or by the application program.

Direct Processing:

The module is able to sense inputs, count and respond with outputs without the need to communicate with a CPU.

Selectable number of counters per module:

The module provides 1, 2, or 4 counters of various complexity.

Selectable counter operation:

Counters can be configured to count either up or down, count both up and down, or count the difference between two changing values (*depending on counter type selected*).

Continuous or single-shot counting:

Each counter can be configured to operate in either continuous or single-shot mode:

Continuous Counter Mode: If either the upper or lower count limit is exceeded, the counter wraps around to the other limit and continues.

Single-Shot Counter Mode: The counter counts to either limit and stops. When the counter is at the limit, counts in the opposite direction back it off the limit. The Accumulator can also be changed by loading a new value from the CPU or by applying a Preset Input.

Accumulator for each counter:

Each counter's accumulated count is stored separately. The CPU can read the value in the accumulator, or set it from the application program. The accumulator value can be either positive or negative. When negative, the value is two's complement.

Accumulator adjust:

For each counter, the Accumulator may be adjusted. The adjustment is an 8-bit signed offset value that is sent from the CPU whenever an adjustment is required.

Selectable Input Filters:

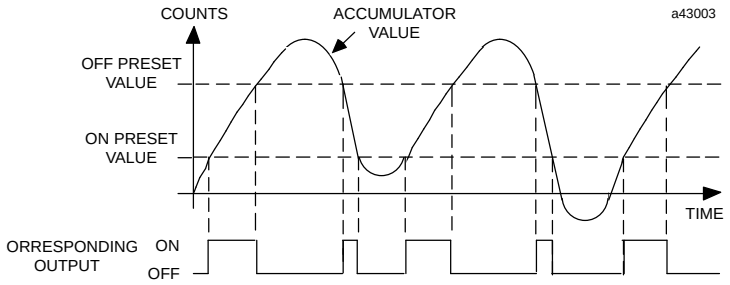
The Count and Control inputs for each counter can be configured for a high-frequency filter (2.5mS) or a low-frequency filter (12.5mS).

Count Rate:

Maximum count rates are 80 kHz with the high-frequency filter and 30 Hz with the low-frequency filter.

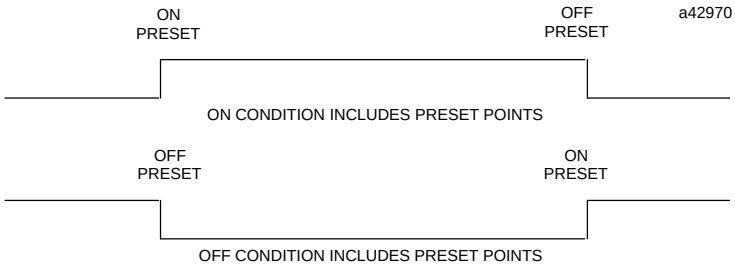
Selectable On/Off Output Presets:

Each counter output has two Preset points, ON and OFF. The output state indicates when the counter accumulator value lies between the defined points. For example:



The output polarity may be configured to be either on or off between points by the relative location of the ON / OFF presets as shown below.

Preset closest to low limit	Output ON	Output OFF
ON	> = ON Preset	> OFF Preset
	< = OFF Preset	< ON Preset
OFF	< OFF Preset	< = ON Preset
	> ON Preset	> = OFF Preset



Counts per Timebase can be used to measure the rate of counting:

Each counter stores the number of counts that have occurred in a specified period of time. A timebase value from 1 millisecond to 65535 milliseconds is configurable. The Counts per Timebase register value returned in the %AI will update at the timebase interval. Counts per Timebase values will be retrieved by the PLC I/O update during the normal PLC sweep.

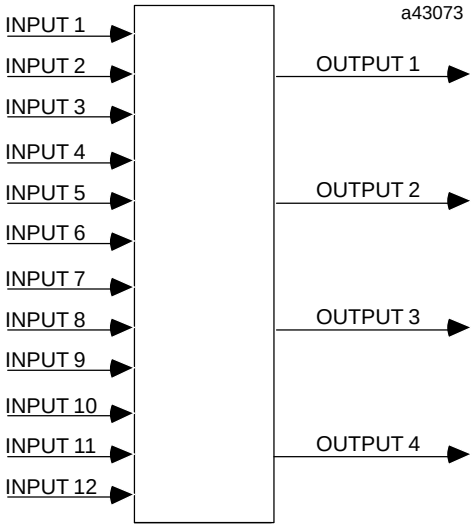
Strobe Register:

Each counter has one or more strobe registers that capture the current Accumulator value when a Strobe input transitions in the direction selected during the last

configuration of the module. It is recommended that the rising edge of the strobe input be used for best performance.

Module Inputs and Outputs

The High-Speed Counter Module accepts 12 input signals, and can provide 4 output signals.



Inputs

Inputs include count signals, Direction, Disable, edge-sensitive Strobe, and other inputs which can be configured for the application. Input filters can be configured for high frequency or low frequency operation.

Count Inputs:

A rising edge on a count input will increment or decrement its Count Accumulator. The method of counting depends upon the counter type and the count mode configuration.

The Count input is positive-edge sensitive. It may be configured to have either the high-frequency (2.5mS) or low-frequency filter (12.5mS). The default filter is high-frequency.

Preload Inputs:

Each counter has a configurable preload register. The contents of this register determine the value the counter resets to when the Preload input goes active. The default value of the Preload register is zero.

The Preload input is positive-edge sensitive. It may be configured to have either the high-frequency (2.5mS) or low-frequency filter (12.5mS). The default is high-frequency.

If Preload occurs during counting, preload data with a resolution of Ç 1 count is stored in the accumulator and a Preload flag is set to indicate to the CPU that a Preload occurred.

Strobe Inputs:

Strobe inputs are edge-sensitive. They may be configured to respond to either the positive or negative edge. Strobe inputs always have the 2.5mS high-frequency filter enabled. On counter types with multiple strobe inputs, the strobes may occur simultaneously without affecting the integrity of the data strobed. When the strobe signal goes active, count data with a resolution of one count is stored in the associated Strobe register and a Strobe flag is set to indicate to the CPU that a strobe value was captured. ***This value remains in the Strobe register until the Strobe signal goes active again, at which time it is overwritten.*** Each time the CPU acknowledges receipt of the Strobe flag, the application program should clear it.

If a Strobe input and Preload input both go active in the same 0.5mS interval, both the Accumulator and Strobe register will be set to the Preload value.

Other Inputs:

These are described under the discussion of operation for each counter type.

Outputs

The module's four outputs can be used to drive indicating lights, solenoids, relays, and other devices. The outputs are also capable of driving CMOS level loads. Each output is a positive logic (source) output, with power supplied from a user supplied power source. The outputs are protected against short circuits by a common 3 Amp pico fuse. Diodes protect outputs against transients going below output common. Each output can source a maximum of 500 mA at 10 to 30 VDC or 20 mA at 5 VDC.

The module's outputs can be programmed to turn on or off when the accumulated count reaches appropriate values. The count input-to-output delay is 1mS maximum (200mS minimum) plus the configured Input Filter Time.

Configuring the High Speed Counter

There are two schemes that may be followed for configuration of the High Speed Counter:

- When the High Speed Counter module is installed in its selected slot in a Series 90-30 PLC baseplate, the Hand-Held Programmer may be used for on-line configuration.
- Off-Line configuration can be accomplished using the Logicmaster 90 configurator software.

Configuration for Installed Module

When the High Speed Counter module is installed, configuration data entered by the user, in response to the Hand-Held Programmer screens, is stored in the configuration memory area of the PLC. When the configuration is complete, the PLC sends this configuration data to the High Speed Counter.

Screens for Configuration

The screens for configuring the %I, %AI, and %Q references are explained in detail in the Series 90-30 Hand-Held Programmer User's Manual, GFK-0402. *If the value input by*

the user is not an acceptable value for that configuration parameter, the High Speed Counter will respond with an error message. Error messages are also described in the Hand-Held Programmer User's Manual.

Module Specifications

General:		
Operating Temperature	0°C to 60°C (32° F to 140° F)	
Storage Temperature	–40 °C to +85°C (–40° F to 185° F)	
Humidity	5% to 95% (non-condensing)	
Module Operating Voltage	5 VDC (from backplane)	
Module Power Dissipation	1.25 watts (250 mA)	
Maximum Count Rate	200 kHz	
Output Points	Powered by user supplied 5V, or 10 to 30 VDC	
LEDs	BOARD OK and CONFIG OK	
Isolation	1500 volts between field inputs and logic side 1500 volts between field outputs and logic side 1500 volts between field inputs and field outputs	
Number of Modules per System		
Model 311 / 313, 5-slot	4	
Model 311 / 313, 10-slot	4	
Model 311 / 340 / 341 / 351	8	
Inputs		
Voltage Range	5 VDC (TSEL jumpered to INCOM)	
	10 to 30 VDC (TSEL open)	
Number of Positive Logic Outputs	12	
Input Thresholds (I1 to I12)	*5 VDC Range*	*10 to 30 VDC Range*
V_{on}	3.25 V Range	8.0 V minimum
I_{on}	3.2 mA minimum	3.2 mA minimum
V_{off}	1.5 V maximum	2.4 V maximum
I_{off}	0.8 mA maximum	0.8 mA maximum
Survivable Peak Voltage	± 500 V for 1µSec	
Transient Common Mode Noise Rejection	1000V / µSec minimum	
Input Impedance	See Figure 1-2 for V-Icharacteristics	
Outputs		
Voltage Range	10 to 30 VDC @ 500 mA maximum	
Voltage Range	4.75 to 6 VDC @ 20 mA maximum	
Off State Leakage Current	10 µA maximum per point	
Output Voltage Drop at 500 mA	0.5 V maximum	
CMOS Load Drive Capability	Yes	
Positive Logic Outputs	4	
Output protection	Outputs are short circuit protected by a 3A pico fuse common to all 4 outputs	

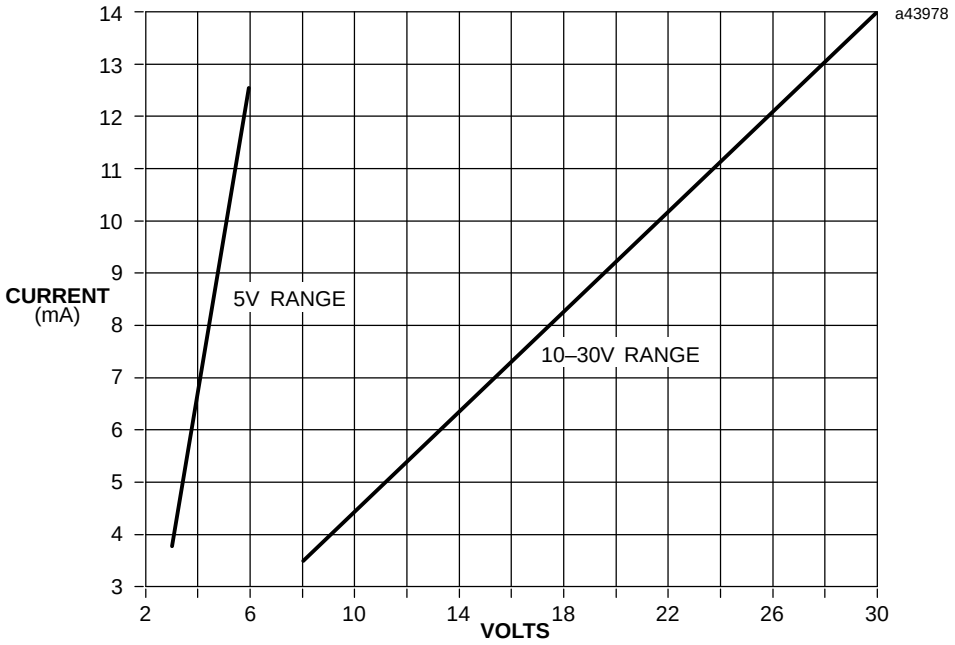


Figure 1-2. Input V-I Characteristics

I/O Performance Specifications

The time shown in Table 1-1 is the maximum delay in microseconds. All performance data specifications assume that the default high frequency filter is used on input points, unless otherwise stated.

Table 1-1. I/O Performance

Parameter	Timing Specification		
	Input Voltage		
INPUT POINTS	5 VDC	10 VDC	30 VDC
With High Frequency Filter Selected:			
Maximum Turn On Period (I1 - I4)	2 msec	3 µsec	3 µsec
Maximum Turn Off Period (I1 - I4)	5 µsec	4 µsec	6 µsec
Maximum Turn On Period (I5 - I12)	5 µsec	10 µsec	5 µsec
Maximum Turn Off Period (I5 - I12)	120 µsec	100 µsec	120 µsec
Maximum I1 - I4 Rate	80 Khz (50 Khz in A Quad B Mode)		
Maximum I5 - I12 Rate	4 Khz		
With Low Frequency Filter Selected:			
I1 - I8 Turn On Period	9 msec (min), 16.5 msec (max)		
I1 - I8 Turn Off Period	9 msec (min), 15.5 msec (max)		
Typical On / Off Period	12.5 msec		
Maximum I1 - I8 Rate	30 Hz		
OUTPUT POINTS			
Turn On Delay *	10 msec maximum		
Turn Off Delay *	150 msec maximum		
Maximum time between HSC output point updates	0.5 msec		

* Switch circuit delay only.

Total Input-to-Output delay = Input filter time + 200 µsec minimum

Total Input-to-Output delay = Input filter time + 1 msec maximum

Chapter 2

Installation and Wiring

I/O Module Installation and Wiring

This chapter contains information on installing the High Speed Counter module and information relevant to field wiring to and from the modules.

Installation and Removal of I/O Modules

The High Speed Counter module can be installed in any I/O slot in a CPU baseplate, expansion baseplate, or remote baseplate. The following procedures and recommendations should be followed when installing and removing Series 90-30 I/O modules.

Inserting a Module

Use the following instructions as a guide when inserting a module into its slot in a baseplate.

- Make sure that power to the PLC is turned off.
- Select the slot into which the module is to be inserted. Grasp the module firmly with terminal board toward you and with rear hook facing away from you.
- Align module with desired base slot and connector. Tilt module upwards so that top rear hook of module engages slot on baseplate.
- Swing module downward until connectors mate and lock-lever on bottom of module snaps into place engaging the baseplate notch.
- Visually inspect the module to be sure that it is properly seated.

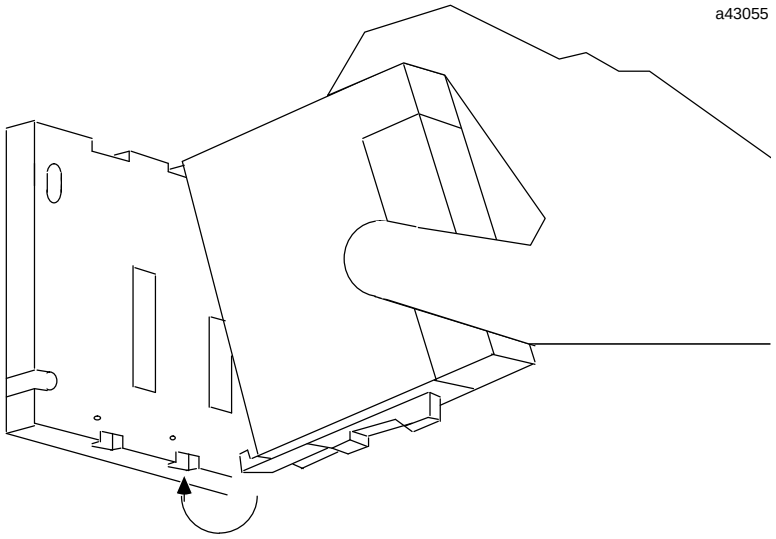


Figure 2-1. Inserting a Series 90-30 Module

Warning

Do not insert or remove modules with power applied. This could cause the PLC to Stop, damage may be incurred to the module, or may result in personal injury.

Removing a Module

Use the following procedure to remove a module from its slot.

- Locate release lever at bottom of the module and firmly press it up - towards the module.
- While holding the module firmly at top and fully depressing release lever, swing the module upward (release lever must be free of its retaining slot).
- Disengage hook at top rear of module by raising the module up and moving it away from faceplate.

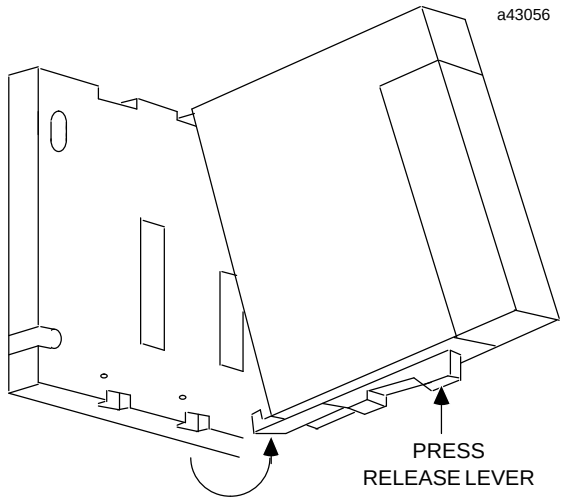


Figure 2-2. Removing a Series 90-30 Module

Warning

Voltages from user devices may be present on a module's screw terminals even though power to the rack is turned off. Care must be taken any time you are handling the module's removable terminal board or any wires connected to it.

Wiring to I/O Modules

Wiring connections to and from user supplied input and output field devices is made to the detachable terminal board supplied with each I/O module. This removable terminal board makes it easy to prewire field wiring to the user supplied input and output devices, and to replace modules in the field without disturbing existing field wiring.

The I/O terminal boards has 20 screw terminals. Each terminal accepts up to one AWG #14 wire using ring or lug type terminals. Minimum recommended wire size is AWG #22. These terminals require a flat or Phillips head screwdriver for installing field wiring. An Isolated 24 volt DC supply is available on the power supply. Wires are routed to and from the terminals out of the bottom of the terminal board cavity.

Installing a Terminal Board

To install a terminal board with no wires attached:

- Hook the hinge, located on the bottom of the terminal board, to the lower slot on the module.
- Push the terminal board towards the module until it snaps into place.
- Open the terminal board cover and ensure that the latch on the module is securely holding the terminal board in place.

When installing a terminal board that has wiring attached verify that the terminal board is connected to the proper module type.

Caution

Check the label on the hinged door and the label on the module to ensure that they match. If a wired terminal board is installed on the wrong module type, damage to the module may incur.

The following figure shows the recommended procedure for terminal board installation.

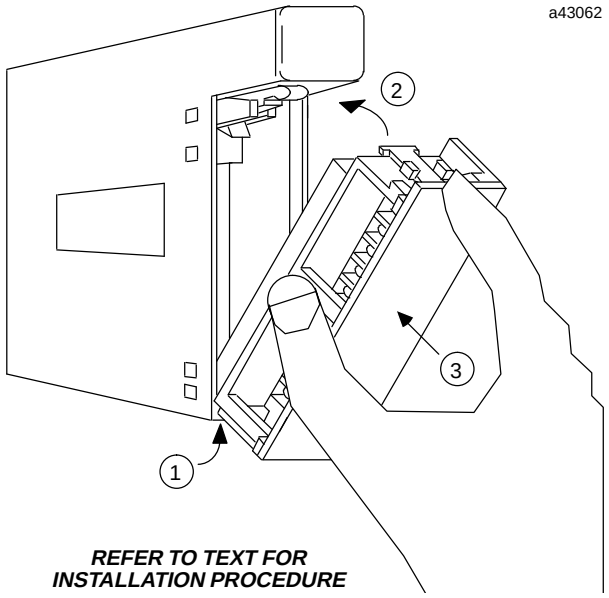
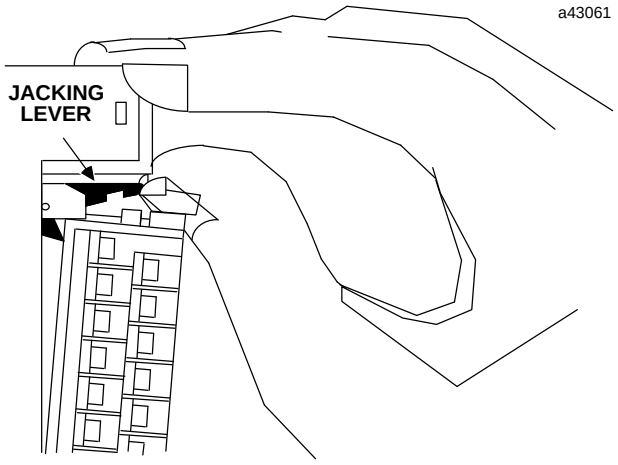


Figure 2-3. Installing a Terminal Board

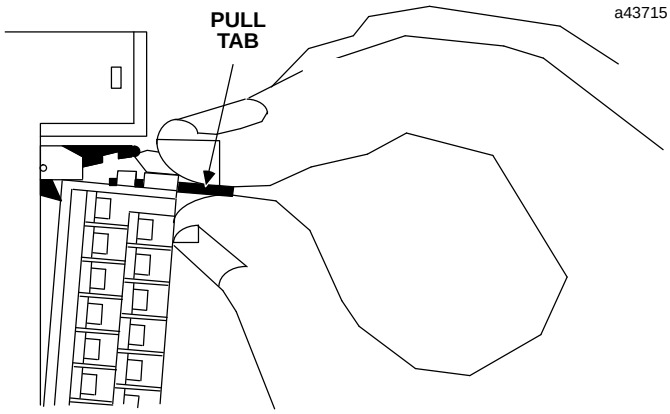
Removing a Terminal Board

To remove a terminal board:

- Open the plastic terminal board cover.
- Push up on jacking lever to release the terminal block.



- Grasp pull-tab towards you until contacts have separated from module housing and hook has disengaged for full removal.



Field Wiring Considerations

It is recommended that the following procedures be followed when routing and connecting field wiring from user devices to the PLC or to Output devices to be controlled by the PLC.

- All low level signal wires should be run separately from other field wiring.
- AC power wiring should be run separately from DC field wiring.

Warning

You should calculate the maximum current for each wire and observe proper wiring practices. Failure to do so may cause injury to personnel or damage to equipment.

- Field wiring should not be routed close to any device that could be a potential source of electrical interference.
- If severe noise problems are present, additional power supply filtering or an isolation transformer may be required.
- Ensure that proper grounding procedures, as previously described, are followed to minimize potential safety hazards to personnel.
- Label all wires to and from I/O devices. Record circuit identification numbers or other pertinent data on the inserts which go in the module's faceplate door.

Conformance to CE Mark Requirements

For installations that must conform to CE Mark requirements, the following procedures ***must be followed.*** For more information, refer to GFK-1179, *Installation Guidelines for Conformance to Standards.*

A. Input cable must be shielded.

B. Cable length must be no more than 30 meters (100 feet).

C. Cable must be clamped 127 mm (5 inches) from module.

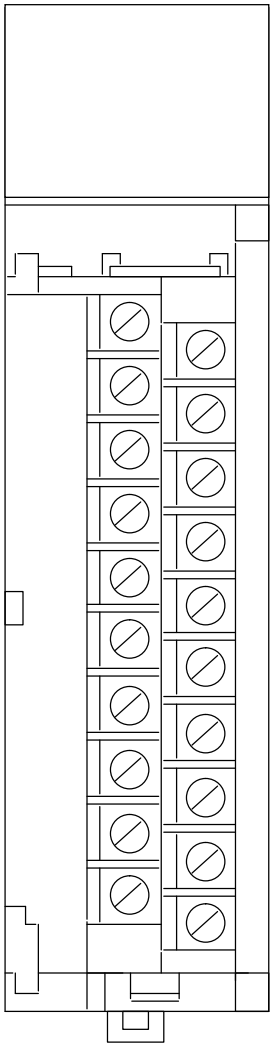
D. Cable shield must be wrapped 360 around its tie point before soldering in place.

Terminal Board Pin Assignments

The High Speed Counter Module has a removable terminal strip for connection to field devices. High Speed Counter terminal board pin assignments for field wiring connections are shown in the following figure.

Caution

Do not apply loads greater than 500 mA to the OUT1 through OUT4 outputs (terminals 16 through 19). Doing so may damage the module.



PIN	NAME
1	I1
2	I2
3	I3
4	I4
5	I5
6	I6
7	I7
8	I8
9	I9
10	I10
11	I11
12	I12
13	INCOM
14	OUTPWR
15	TSEL
16	O1
17	O2
18	O3
19	O4
20	OUTCOM

Figure 2-4. Terminal Board Pin Assignments

Field Wiring Information

The following figure provides wiring information for field connections to and from the High Speed Counter.

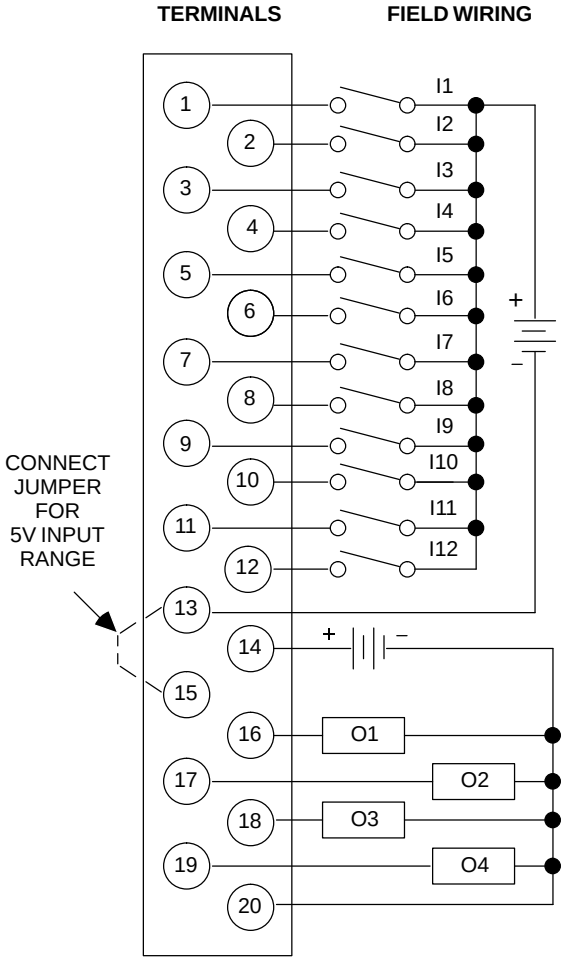


Figure 2-5. Field Wiring for the High Speed Counter

Note

All 12 High Speed Counter inputs are single-ended positive logic (source) type inputs.

Transducers with CMOS buffer outputs (74HC04 equivalent) can directly drive the High Speed Counter inputs using the 5V input range.

Transducers using TTL totem pole or open collector outputs must include a 470 ohm pullup resistor (to 5V) to guarantee compatibility with the High Speed Counter inputs.

Transducers using high voltage open collector (sink) type outputs must have a 1K pullup resistor to + 12V for compatibility with the High Speed Counter 10 to 30 volt input range.

Caution

Do not connect 10 to 30 VDC to the module inputs when the 5 VDC input range (pins 13 to 15 jumpered) is selected. Doing so will cause damage to the module.

Terminal Assignments for Counter Type

The following table defines which terminals to use for the type of counter selected during module configuration.

Table 2-1. Pin Assignments for Each Counter Type

Pin Number	Signal Name	Pin Definition	Use in Counter Type		
			Type A	Type B (1)	Type C (2)
1	I1	Positive Logic Input	A1	A1	A1
2	I2	Positive Logic Input	A2	B1	B1
3	I3	Positive Logic Input	A3	A2	A2
4	I4	Positive Logic Input	A4	B2	B2
5	I5	Positive Logic Input	PRELD1	PRELD1	PRELD1.1†
6	I6	Positive Logic Input	PRELD2	PRELD2	PRELD1.2
7	I7	Positive Logic Input	PRELD3	DISAB1	DISAB1
8	I8	Positive Logic Input	PRELD4	DISAB2	HOME
9	I9	Positive Logic Input	STRB1	STRB1.1†	STRB1.1†
10	I10	Positive Logic Input	STRB2	STRB1.2	STRB1.2
11	I11	Positive Logic Input	STRB3	STRB2.1	STRB1.3
12	I12	Positive Logic Input	STRB4	STRB2.2	MARKER
13	INCOM	Common for positive logic inputs	INCOM	INCOM	INCOM
14	OUTPWR (3)	DC+ Power for positive logic outputs	OUTPWR	OUTPWR	OUTPWR
15	TSEL	Threshold select, 5V or 10 to 30V	TSEL	TSEL	TSEL
16	O1	Positive Logic Output	OUT1	OUT1.1†	OUT1.1†
17	O2	Positive Logic Output	OUT2	OUT1.2	OUT1.2
18	O3	Positive Logic Output	OUT3	OUT2.1	OUT1.3
19	O4	Positive Logic Output	OUT4	OUT2.2	OUT1.4
20	OUTCOM	DC- Common for positive logic outputs	OUTCOM	OUTCOM	OUTCOM

(1). Type B counter:
A1, B1 are the A and B inputs for counter 1.
A2, B2 are the A and B inputs for counter 2.

(2) Type C Counter:
A1, B1 are the A and B count inputs for (+) loop
A2, B2 are the A and B count inputs for (–) loop

(3) OUTPWR ***doesnot*** source power for user loads. Output power ***mustbesupplied*** from an external supply.

† Inputs and outputs identified by two numbers separated by a decimal point indicate the counter number to the left of the decimal point and the element number on the right. For example, STRB1.2 indicates Counter 1, Strobe 2 input.

Chapter 3 Counter Operation

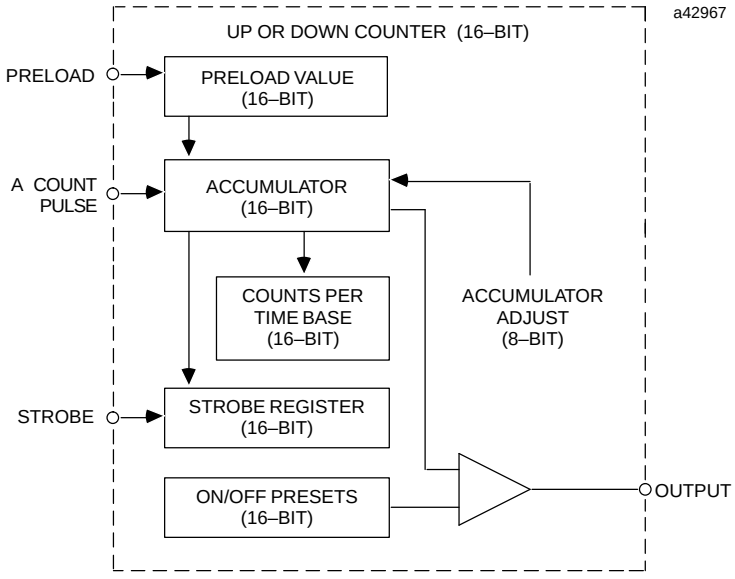
Each counter type (A, B, and C) is described on the following pages. Functionality of each type is described beginning with the simplest (Type A) and progressing to the most complex (Type C).

Operation of a Type A Counter

To operate as **four 16-bit unidirectional counters**, select Type A during module configuration.

When configured as Type A, each counter may be independently configured to count either up or down. Details of each counter are shown below. Each counter has an Accumulator register, Counts per Timebase register, one Strobe register and one set of on / offPreset values. Each counter has three inputs: Preload, Count Pulse, and Strobe, and one output.

Elements of a Type A Counter (4 per module)



Since the Preload input is normally used to perform the reset function for each counter, the Preload default value has been set to 0. However, the Preload may be configured to

any value within the counter's selected range. The Preload for each counter is edge-sensitive, and is active on the positive edge only. When a preload input occurs, the configured preload value is inserted into the Accumulator and a Preload flag is set to indicate this to the CPU. If the application program uses this flag indication, then it should clear the flag before the next preload occurs. **A rising edge on the Preload input always preloads the Accumulator regardless of the state of the Preload flag.**

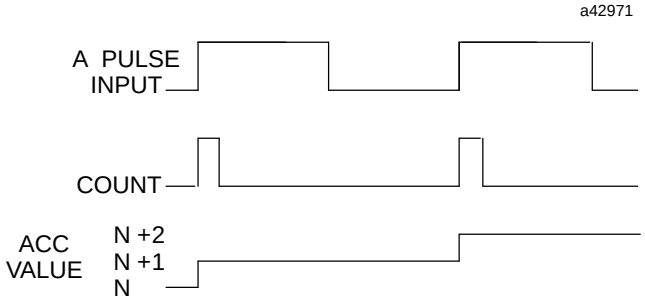
Each counter's Strobe input is also edge-sensitive, and can be configured to respond to either a positive edge or a negative edge. When the Strobe signal goes active, the current value in the accumulator is stored in the associated Strobe register and a Strobe flag is set to indicate to the CPU that a strobe value was captured. This value remains in the Strobe register until the Strobe signal goes active again and is overwritten. Each time the CPU acknowledges receipt of the Strobe flag, the application program should clear it. **The Strobe input always updates the Strobe register with the latest Accumulator value regardless of the state of the Strobe flag.**

The Strobe input always has a 2.5mS high-frequency filter. Preload inputs and Count inputs can be configured to use either the high-frequency filter, or a 12.5mS low-frequency filter. The low-frequency filter reduces the effect of signal noise. Maximum count rates are 80 kHz with the high-frequency filter and 30Hz with the low-frequency filter.

The value in the Accumulator may be adjusted by writing an offset adjustment value to the Accumulator. This adjustment may be any value between –128 and +127. The adjustment value is added to the contents of the accumulator.

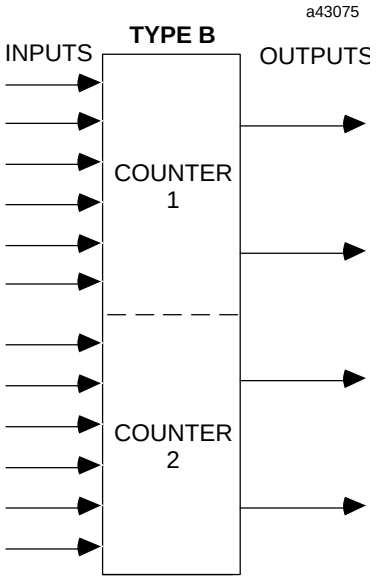
Timing for Type A Counter

The Count signal shown in the following illustration represents an internal signal that indicates where counting occurs with respect to the pulse input. Counting always occurs on the low-to-high transition of the Pulse input.



Operation of a Type B Counter

If the module is to operate as **two 32-bit bidirectional counters**, select Type B during module configuration.



Each Type B counter has six inputs and two outputs, and may be separately configured for Up / Down, Pulse / Direction, or A Quad B operation. Details of each Type B counter are shown below.

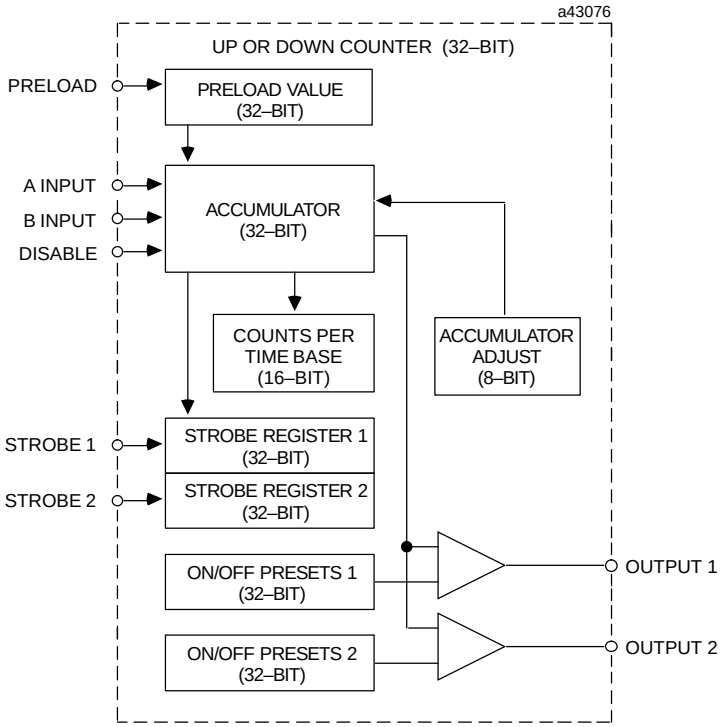
Each counter has one Preload input and two completely independent sets of Strobe inputs with storage registers and on / off Presets for each output. Refer to the Type A counter description in this chapter for details of the Preload and Strobe input operation. The Disable input, which is not available in the Type A configuration, can be used to inhibit counting. When the Disable input is applied, it will inhibit all counting and the Counts / Timebase register will go to zero. This also applies for Counter 1 when the internal oscillator is selected as its count source.

The Disable input is level sensitive, and active when high. All other inputs are positive edge-sensitive except Strobe input which can be configured to be active on either the rising or the falling edge. The Strobe inputs always use the 2.5mS high-frequency filter. A high-frequency filter or a 12.5mS low-frequency filter can be independently selected for each of the following signals:

- Preload input
- Disable input
- Both count inputs

The low-frequency filter reduces the effect of signal noise. Maximum count rates are 80 kHz with the high-frequency filter and 30 Hz with the low-frequency filter.

Elements of a Type B Counter (2 per module)

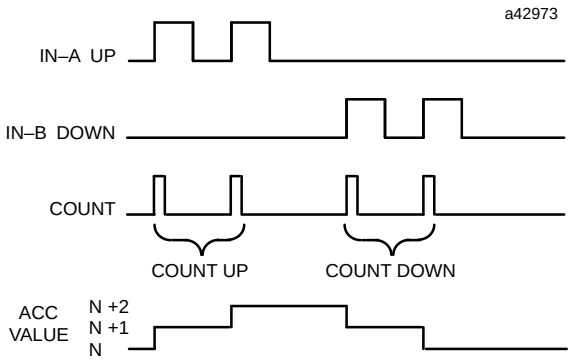


Timing for Type B Counter

The Count signal shown in these illustrations represents an internal signal that indicates where counting occurs with respect to the user inputs. In the Pulse / Direction mode, the direction input may be changed while in use, without affecting proper operation of the counter.

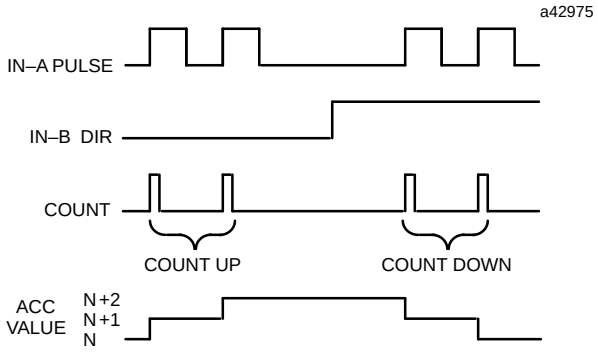
Operating in UP/DOWN Mode

Up-counting occurs on the low-to-high transition of the Up input. Down counting occurs on the low-to-high transition of the Down input. The accumulator automatically tracks the difference between the number of counts received by the Up channel and the Down channel. Simultaneous inputs on the up channel and down channel will cause a net accumulator change of zero.



Operating in Pulse/Direction Mode

Counting always occurs on the low-to-high transition of the Pulse input. Count direction is up for a low level on the Direction input and down for a high level on the Direction input. Avoid changing the DIR signal coincidentally with the rising edge of the Pulse input.

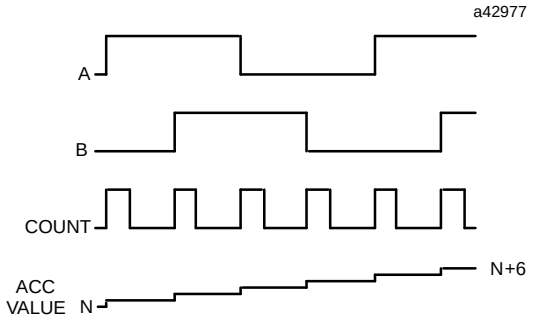


Operating in A Quad B Mode

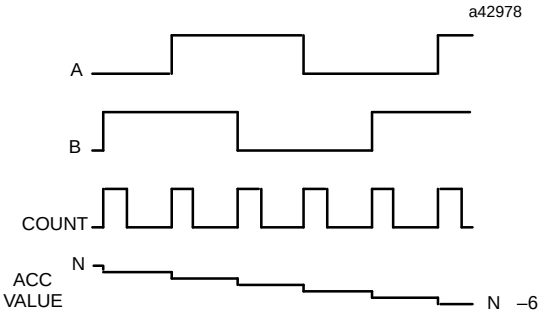
In A Quad B mode, there are four counts for each A Quad B cycle. A count occurs for each transition of either A or B. The counts will be evenly spaced with respect to the input waveforms when the phase relationship between A and B is shifted by 1/4 cycle.

The phase relationship between A and B determines count direction, as shown in the following timing diagrams.

The count direction is up if A leads B.

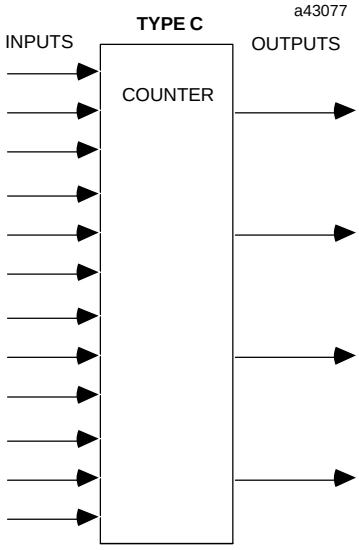


The count direction is down if A lags B.



Operation of a Type C Counter

If the module is to operate as **one 32-bit differential counter**, select Type C during module configuration. This configuration is suitable for applications requiring motion control, differential counting, or homing capability. The accumulator is the summing function of the + loop and the – loop. The + loop is made up of inputs A1 and B1, the – loop is made of inputs A2 and B2.



This counter uses all 12 of the module's inputs and all four outputs. Counter details are shown below. There are:

- four on / off Presets with outputs;
- three Strobe registers with corresponding Strobe inputs;
- two Preload inputs with separate Preload values.
- a Home Position register for preloading the accumulator to the Home Position value within 1 count period when the Enable Home input is active and the Marker pulse occurs;
- two sets of bidirectional Count inputs that can be connected to operate in a differential fashion. Each set can be configured for A Quad B, Up / Down, or Pulse / Direction mode.

All inputs are edge sensitive, except Enable Home and Disable. Either the rising or falling edge of each Strobe input can be configured as active.

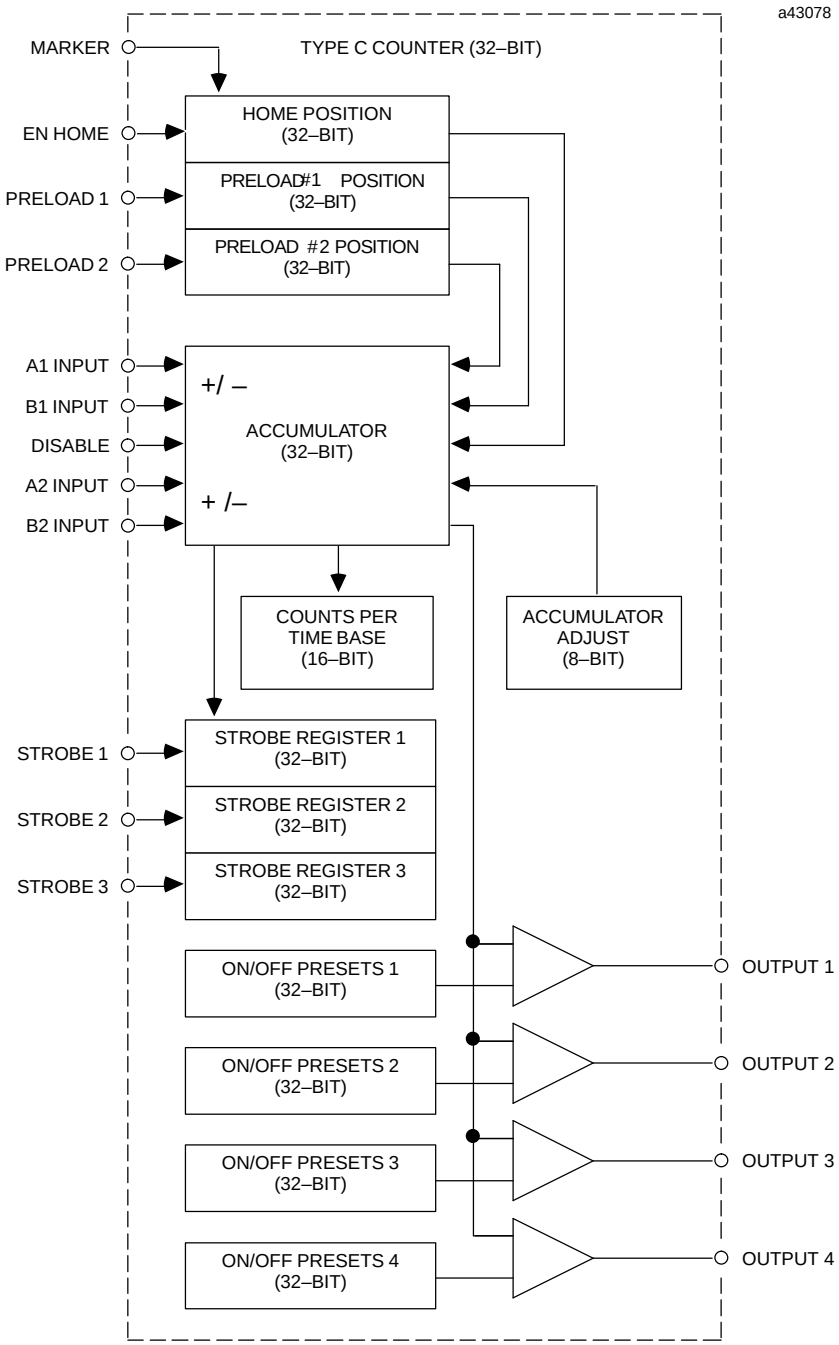
The Marker input and Strobe inputs always use the 2.5mS high-frequency filter. The Enable Home input always uses the 12.5mS low-frequency filter. The high- or low-frequency filter can be separately configured for each set of Count inputs, for the Disable input, and for both Preload inputs. Refer to the Type A counter description in this chapter for details of the Preload and Strobe input operation.

If any combination of Preload 1, Preload 2, or Home Found Marker inputs go active in the same 0.5mS interval, the Accumulator will be set to the value according to the following priority:

- Home Found
- Preload 1
- Preload 2

Each output turns on or off as determined by its own Preset values.

Elements of a Type C Counter (1 per module)

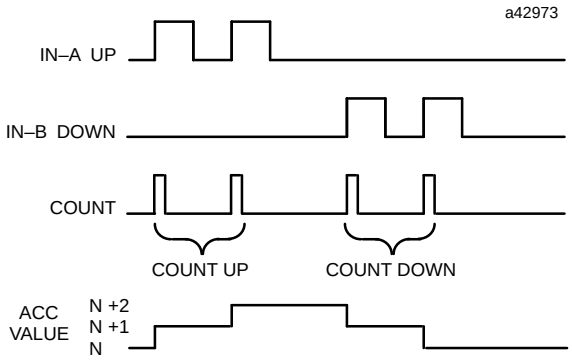


Timing for Type C Counter

The following information applies to the positive (+) loop of a type C counter. The relationship between the input signals and the internal count pulse remains the same in the negative (–) loop, but the effect of the pulse is opposite (i.e. count pulses that would result in an increment to the accumulator value on the (+) loop will result in a decrement on the (–) loop, and vice-versa).

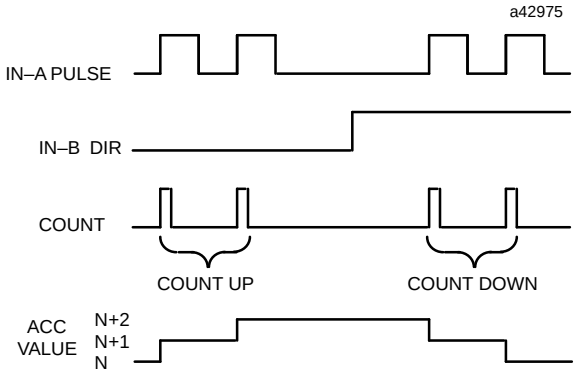
Operating in UP/DOWN Mode

Up-counting occurs on the low-to-high transition of the Up input. Down counting occurs on the low-to-high transition of the Down input.



Operating in Pulse/Direction Mode

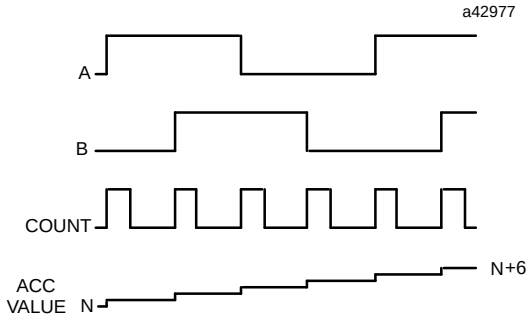
Counting always occurs on the low-to-high transition of the Pulse input. Count direction is up for a low level on the Direction input and down for a high level on the Direction input. Avoid changing the DIR signal coincidentally with the rising edge of the Pulse input.



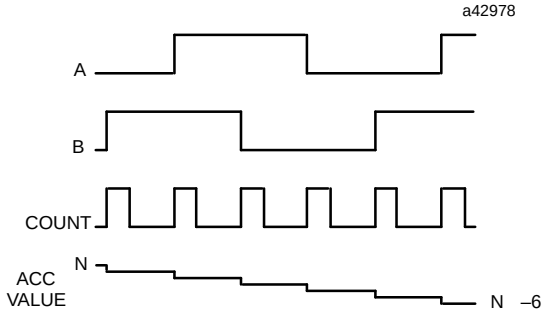
Operating in A Quad B Mode

In A Quad B mode, there are four counts for each A Quad B cycle. A count occurs for each transition of either A or B. The counts will be evenly spaced with respect to the input waveforms when the phase relationship between A and B is shifted by 1/4 cycle. The phase relationship between A and B determines count direction, as shown in the following timing diagrams.

The count direction is up if A leads B.



The count direction is down if A lags B.



Type C Counter Plus and Minus Loop

In the Type C counter configuration, the plus (+) and minus (–) loops may be set up to operate independently in any mode (Up / Down, Pulse Direction, or A Quad B).

Count Direction		ACCUMULATOR FUNCTION x = counts on (+) loop y = counts on (–) loop
(+) Loop A1, B1	(–) Loop A2, B2	
Up	Up	Differential (x–y)
Up	Down	Additive (x+y)
Down	Up	Additive –(x+y)
Down	Down	Differential (y–x)
Up	no connection	Counts Up (x)
Down	no connection	Counts Down (–x)
no connection	Up	Counts Down (–y)
no connection	Down	Counts Up (y)

Type C Counter Home Sequence

The following is a description of how to enable and use the Home cycle of a Type C counter.

The %Q14 bit (Home command) should be enabled before an input to the HOME terminal (pin 8) on the module is made. This Home command output is sent to the module at the PLC sweep rate.

An external event then causes the HOME input to go true, this enables the next event. The HOME input is always set to use the low frequency filter. Switching specifications can be found in Table 1-1 (I/O Performance) on page 1-9.

The next occurrence of the MARKER input after HOME (HOME input must be maintained on until the MARKER pulse occurs) will copy the contents of the Home Position Register to the counter accumulator; this event is called *Home Found*. This event has priority over the Preload events. The MARKER input always uses the High-Frequency filter. See Table 1-1 for specifications.

The Home Found (%I4) status is sent to the PLC and will be read at the PLC sweep rate.

For more information on the Home Position, refer to Page 5-6 of this manual.

Chapter 4

CPU Interface

Data Transfer Between High Speed Counter and CPU

During each I/O scan, the High Speed Counter module automatically sends 16 status bits (%I) and 15 words (%AI) of register data values to the CPU. The format of this input data depends on whether the counter is configured as Type A, Type B, or Type C. In return, during each I/O scan, the CPU sends 16 bits (%Q) of output data to the module. COMREQ function blocks in the user program can be used to send additional data commands to the module. For information about configuration, programming, and monitoring High Speed Counter operation using a Hand-Held Programmer, refer to Chapter 6 in this manual and the *Series 90-30 Hand-Held Programmer User's Manual* (GFK-0402).

Data Automatically Sent by the High Speed Counter

The 15 register data words (%AI) represent:

- latest Counts per Timebase value
- contents of the Accumulator(s)
- contents of the Strobe registers
- error code

The 16 status bits (%I) represent:

- Strobe flag status
- Preload flag status
- Disable status
- Output status
- Module ready status
- Home input status (Type C counter only)
- Error status

These status bits are sent to the CPU as inputs, and can influence outputs sent from the CPU to the module. Data formats for the High Speed Counter modules Type A, Type B, and Type C configurations are shown on the following pages.

Data Automatically Sent to the High Speed Counter

The 16 output bits (%Q) represent:

- Strobe flag reset
- Preload flag reset
- Clear error flag
- Output enable
- Home command (Type C counter only)

All of this data is transferred from the High Speed Counter to the CPU once per I/O scan. The I/O scan is active while the CPU is in the RUN mode or STOP ENABLED mode.

Additional Data Sent to the High Speed Counter Using a COMREQ Function Block

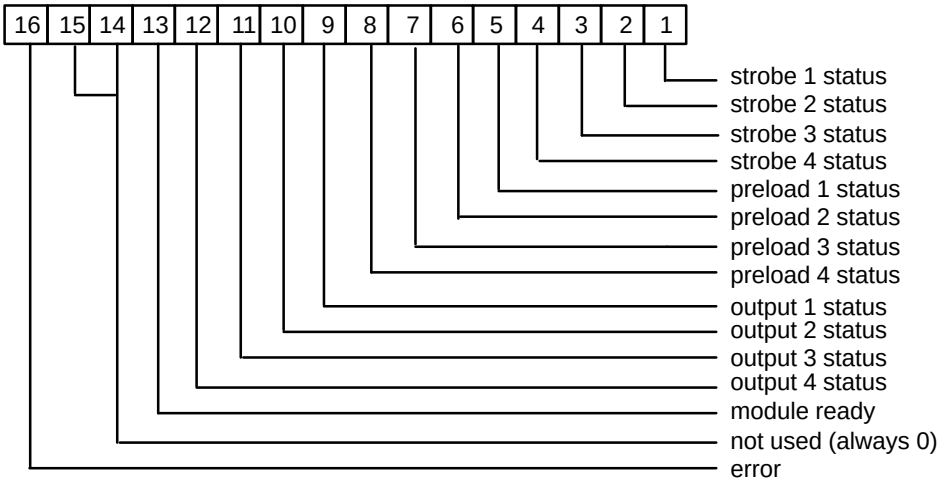
- Load Accumulator
- Load count limits
- Load Accumulator increment
- Load output presets
- Load Accumulator Preload
- Load time base
- Load Oscillator divider ratio
- Count Direction (Type A only)

%AI and %I Data Sent by a Module Configured as Type A

%AI Data - Type A Counter

Word	Description
01	Module Status code
02	Counts per timebase for counter 1
03	Counts per timebase for counter 2
04	Counts per timebase for counter 3
05	Counts per timebase for counter 4
06	Accumulator for counter 1
07	Strobe register for counter 1
08	Accumulator for counter 2
09	Strobe register for counter 2
10	Accumulator for counter 3
11	Strobe register for counter 3
12	Accumulator for counter 4
13	Strobe register for counter 4
14 - 15	Not used (set to 0)

Status bits (%I) - Type A Counter



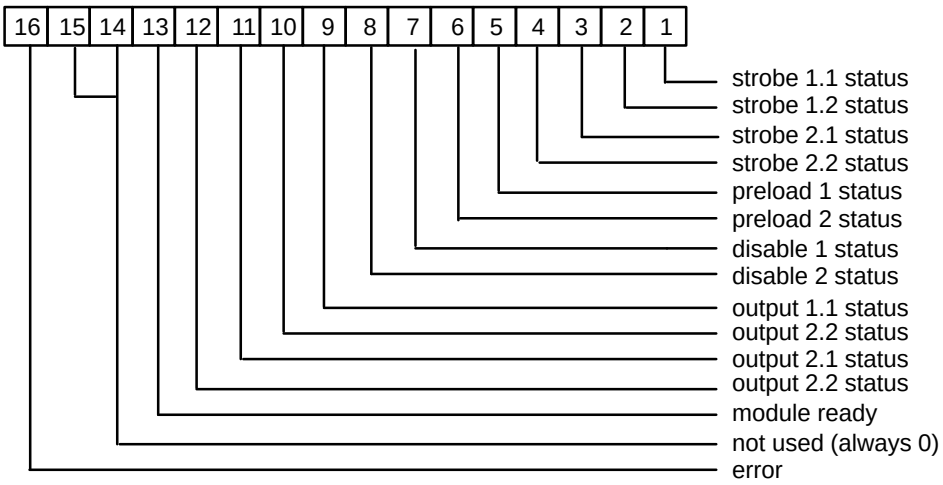
Strobe/Preload Status:	the module sets one of these bits when a strobe or preload occurs. The CPU must clear the bit using the corresponding Reset Strobe/Reset Preload output.
Output Status:	the module uses these four bits to indicate the ON or OFF commanded status of each output.
Module Ready:	the module sets this bit to 1 after successfully completing its power-up tests.
Error:	set to indicate an error condition. When this occurs, the error code is returned in the Module Status code (word 1). See page 4-9 for the definition of these module status codes. When the error is acknowledged by the CPU, it should be cleared by sending the Clear Error output.

%AI and %I Data Sent by a Module Configured as Type B

%AI Data - Type B Counter

Word	Description
01	Module Status code
02	Counts per timebase for counter 1
03	Counts per timebase for counter 2
04-05	Accumulator for counter 1
06-07	Strobe register 1 for counter 1
08-09	Strobe register 2 for counter 1
10-11	Accumulator for counter 2
12-13	Strobe register 1 for counter 2
14-15	Strobe register 2 for counter 2

Status bits (%I) - Type B Counter



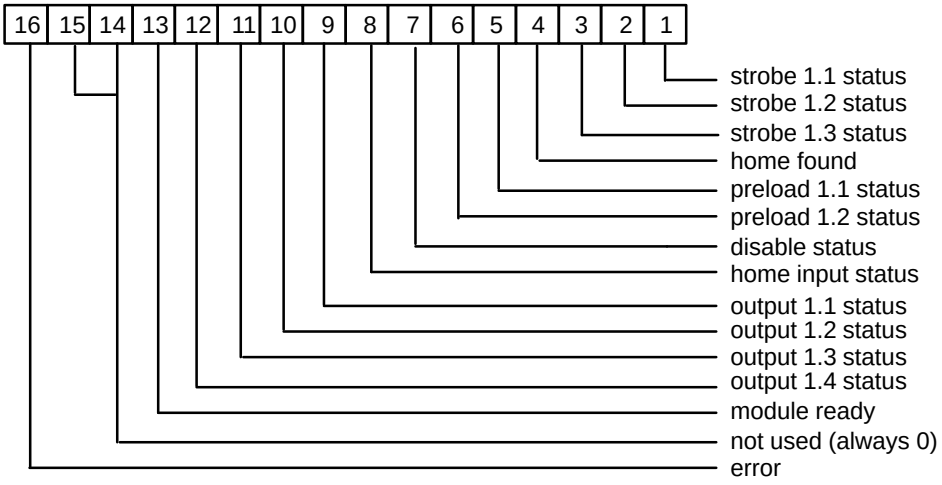
Strobe/Preload Status:	the module sets one of these bits when a strobe or preload occurs. The CPU must clear the bit using the corresponding Reset Strobe / Reset Preload output.
Disable Status:	the module uses these bits to indicate the present status of each Disable input.
Output Status:	the module uses these four bits to indicate ON or OFF commanded status of each output.
Module Ready:	the module sets this bit to 1 after successfully completing its power-up tests.
Error:	set to indicate an error condition. When this occurs, the error code is returned in the Module Status code (word 1). See page 4-9 for the definition of these module status codes. When the error is acknowledged by the CPU, it should be cleared by sending the Clear Error output.

%AI and %I Data Sent by a Module Configured as Type C

%AI Data - Type C Counter

Word	Description
01	Module Status code
02	Counts per timebase for counter 1
03	Not used (set to 0)
04-05	Accumulator for counter 1
06-07	Strobe register 1
08-09	Strobe register 2
10-11	Strobe register 3
12-15	Not used (set to 0)

Status bits (%I) - Type C Counter

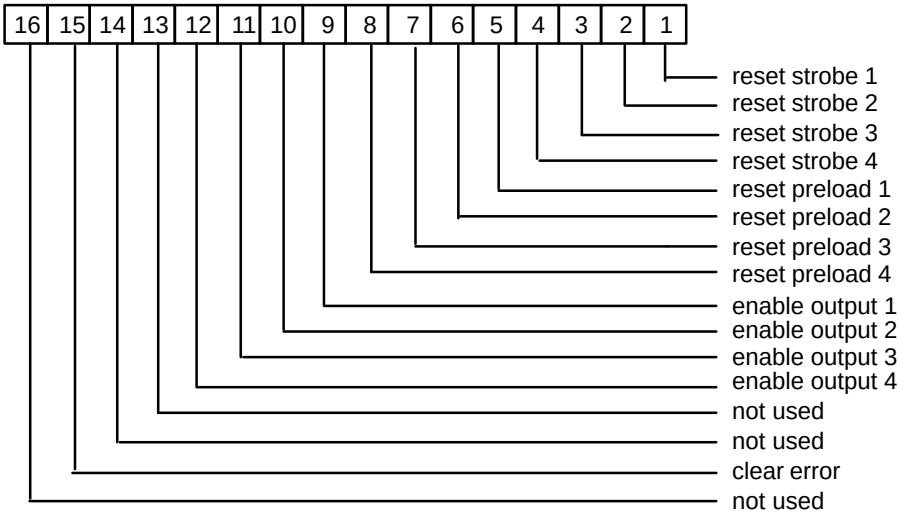


Strobe/Preload Status:	the module sets one of these bits when a strobe or preload occurs. The CPU must clear the bit using the corresponding Reset Strobe / Reset Preload output.
Disable Status:	indicates the present status of the Disable input.
Home Input Status:	indicates the present status of the Home Limit Switch input.
Home Found:	indicates the Home position has been reached.
Output Status:	these four bits indicate the on or off commanded status of each output.
Module Ready:	the module sets this bit to 1 after successfully completing its power-up tests.
Error:	set to indicate an error condition. When this occurs, the error code is returned in the Module Status code (word 1). See page 4-9 for the definition of these module status codes. When the error is acknowledged by the CPU, it should be cleared by sending the Clear Error output.

%Q Data Sent from CPU to High Speed Counter

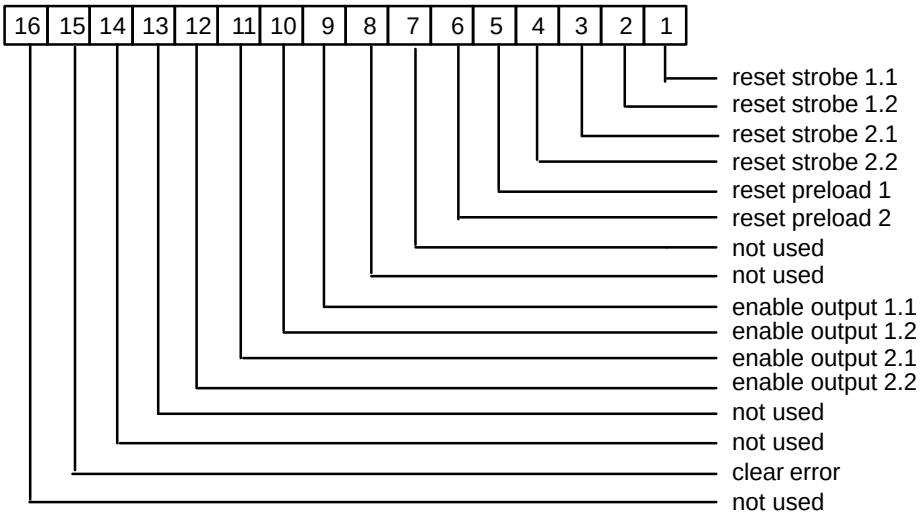
Once each I/O scan, the CPU sends 16 bits (%Q) of data to the High Speed Counter Module. The application program can use these outputs to send commands to the module. The %Q data formats for each counter type are shown om the following pages.

%Q Data - Type A Counter



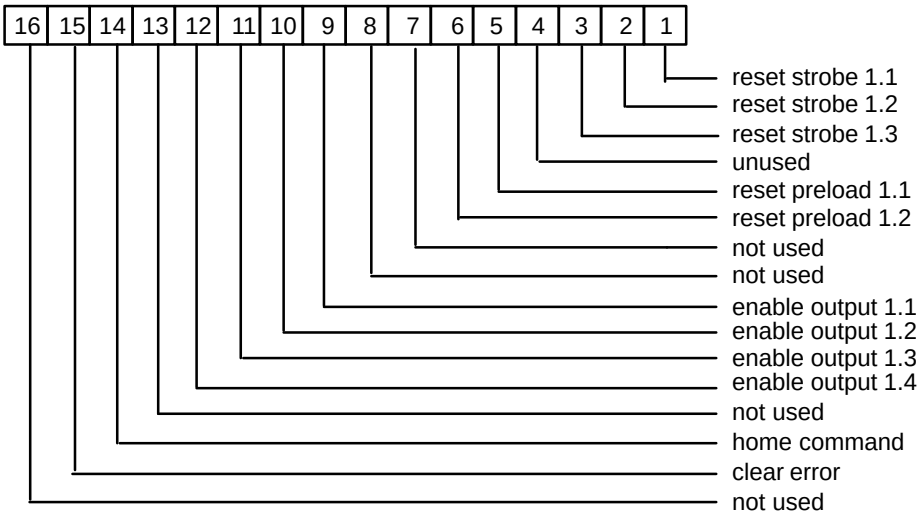
Reset Strobe:	clears the module's corresponding Strobe input status bit (as described on the previous pages). For example, Reset Strobe bit 2 is used to reset the module's Strobe status bit 2. If the corresponding Strobe input status changes to 1, the program logic should set this bit to 1 and then back to 0 on the next I/O scan.
Reset Preload:	clears the module's corresponding Preload input status bit. For example, reset Preload bit #5 is used to reset the module's Preload status bit 5. If the corresponding Preload input status changes to 1,the program logic should set this bit to 1 and then back to 0 on the next I/O scan.
Outputs En/Disable:	bits 9 to 12 are used to enable or disable the module's outputs. If these bits are 0, the corresponding output will not turn on.
Clear Error:	Set by the CPU to clear error after it has been acknowledged.

%Q Data - Type B Counter



Reset Strobe:	clears the module's corresponding Strobe input status bit (as described on the previous pages). For example, Reset Strobe bit 2 is used to reset the module's Strobe status bit 2. If the corresponding Strobe input status changes to 1, the program logic should set this bit to 1 and then back to 0 on the next I/O scan.
Reset Preload:	clears the module's corresponding Preload input status bit. For example, reset Preload bit #5 is used to reset the module's Preload status bit 5. If the corresponding Preload input status changes to 1,the program logic should set this bit to 1 and then back to 0 on the next I/O scan.
Outputs En/disable:	bits 9 to 12 are used to enable or disable the module's outputs. If these bits are 0, the corresponding output will not turn on.
Clear Error:	Set by the CPU to clear error after it has been acknowledged.

%Q Data - Type C Counter



Reset Strobe:	clears the module's corresponding Strobe input status bit (as described on the previous pages). For example, Reset Strobe bit 2 is used to reset the module's Strobe status bit 2. If the corresponding Strobe input status changes to 1, the program logic should set this bit to 1 and then back to 0 on the next I/O scan.
Reset Preload:	clears the module's corresponding Preload input status bit. For example, reset Preload bit #5 is used to reset the module's Preload status bit 5. If the corresponding Preload input status changes to 1,the program logic should set this bit to 1 and then back to 0 on the next I/O scan.
Outputs En/Disable:	bits 9 to 12 are used to enable or disable the module's outputs. If these bits are 0, the corresponding output will not turn on.
Home Command:	(module configured as type C only) for position monitoring and control applications, the program should set this bit before the Home limit switch is actuated. If this is done, when the Home limit switch is actuated,the next Marker input will cause the Home Count value to be loaded into the counter and the Home flag will be set.
Clear Error:	Set by the CPU to clear error after it has been acknowledged.

Module Status Codes

The Module Status Code in the %AI Input Data contains the error code returned to the PLC. These codes are set as a result of message or configuration command errors. To clear this code, the clear error bit in the discrete outputs (%Q) should be set. These codes are defined the same for counter types A, B and C. Note that fatal (RAM, EPROM) errors have no codes associated with them. These errors cause the watchdog timer to time out. Following is a list of error codes returned:

Table 4-1. Error Codes Received

Code	Description	Code	Description
0	No Errors	7-9	Reserved
1	Unused	10	Home Position Error
2	Unused	11	Counter 1 Limit Error
3	Invalid Command	12	Counter 2 Limit Error
4	Invalid Parameter	13	Counter 3 Limit Error
5	Invalid Sub-Command	14	Counter 4 Limit Error
6	Invalid Counter Number		

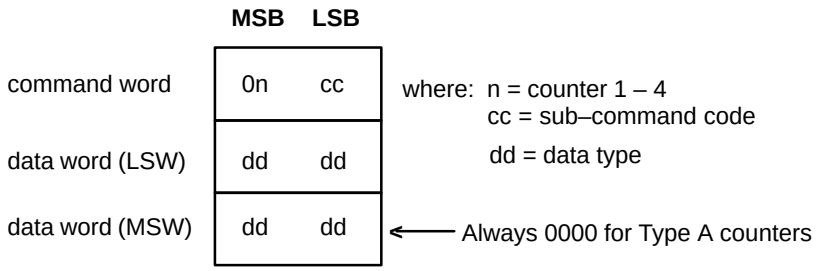
Error codes are defined as follows:

Invalid Command:	Command number received was invalid for the High Speed Counter module.
Invalid Parameter:	Configuration parameter received was invalid for the counter type selected.
Invalid Sub-Command:	Sub-Command code in the Data Command Word was invalid for the counter type selected.
Invalid Counter Number:	Counter number in the Data Command Word was invalid for the counter type selected.
Home Position Error:	Home Command was aborted (turned off) by the PLC before the Home Position was located (Type C counter only).
Counter_ Limit Error:	Counter configuration limit was rejected because the new limit set would be incompatible (High limit < Low limit).

Sending Data Commands to the High Speed Counter

In addition to the %Q discrete output data which is sent every sweep to the High Speed Counter, there are a series of commands which can be sent by the PLC (using the COMREQ function block) to change the various operating parameters of the counters. These commands are all 6 bytes in length.

The format for Data Commands is as follows:



The data commands must be placed in registers within the COMREQ command block before it is sent to the High Speed Counter. It is easier to correlate the data to register size by using hexadecimal data.

The following tables list the Data Command words for each of the 3 counter types in both decimal and hexadecimal numbers. Each table is immediately followed with a description of each command, as it applies to that counter Type, and a simple example.

Data Commands for Type A Counters

Table 4-2. Data Commands- Type A Counter

Command Name	Command Word	
	Decimal	Hexadecimal
Load Accumulator n	0n 01	0n 01
Load Hi Limit n	0n 02	0n 02
Load Lo Limit n	0n 03	0n 03
Load Acc n Increment	0n 04	0n 04
Set Cntr n Direction	0n 05	0n 05
Load Timebase n	0n 06	0n 06
Load ON Preset n	0n 11	0n 0B
Load OFF Preset n	0n 21	0n 15
Load Preload n	0n 31	0n 1F
Load Osc Freq Divisor	00 50	00 32

Note: n = Counter #1 - 4

The bytes in the command word are always treated as independent bytes - a counter ID byte and a command code byte.

Load Accumulator	Command Code = 01H Used to set any value within counter limits directly into the Accumulator. Example: To set Counter 3 to 1234H, load COMREQ command registers with: Command word: 0301 LS data word: 1234 MS data word: 0000
Load Hi Limit	Command Code = 02H
Load Lo Limit	Command Code = 03H Used to set the Hi and Lo limits to any value within the counter range. Example: To change the upper limit of counter 4 to 10000 (2710H), load registers with: Command word: 0402 LS data word: 2710 MS data word: 0000 Note: If the limits are loaded in the wrong order, they may be rejected and an error flag will be set. To avoid this, remember to always move the Lo Limit first when shifting the limits down or the Hi Limit first when shifting the limits up.
Load Acc Increment	Command Code = 04H Used to offset a counter accumulator by a small number of counts (up to +127 or -128). Only the least significant byte of data is used with this command. Example: To offset counter 3 by –7 counts, load: Command word: 0304 LS data word: 00F9 MS data word: 0000 This may be done at any time, even while the counter is counting at maximum rate. If the offset causes the counter to exceed its limits, the excess will be treated just like any other overflow , i.e., if the Continuous mode is selected, the counter will wraparound through the other limit, or if the Single-Shot mode is selected the counter will stop at the limit.

Set Cntr Direction	Command Code = 05H
	Used to change the count direction (up or down) of a Type A counter. Only the LSB of the first data word is used for this command (00 = up, 01 = down). Example: To set the direction of counter 4 to down, load: Command word: 0405 LS data word: 0001 MS data word: 0000
Load Timebase	Command Code = 06H Used to change the time interval referenced by the counter when computing its counts / timebase register data. Example: To change the timebase for counter 2 to 600 ms (258H), load: Command word: 0206 LS data word: 0258 MS data word: 0000 Note: The maximum range of the counts / timebase (CTB) register is +32767 and –32768 counts. The length of the timebase and the maximum count frequency should be coordinated so that these limits are not exceeded. The indication will roll over from (+) to (–) or (–) to (+) if exceeded.
Load ON Preset	Command Code = 0BH
Load OFF Preset	Command Code = 15H Used to set up the output turn on / off points within the counter range. For Type A, there is one output associated with each counter. Example: To set counter 3 output to turn on at 5000 (1388H) counts, load: Command Code: 030B LS data word: 1388 MS data word: 0000 and off at 12000 (2EE0H) counts, load: Command Code: 0315 LS data word: 2EE0 MS data word: 0000
Load Preload	Command Code = 1FH Used to change the count value that will be loaded into the counter accumulator when the preload input is activated.
	Example: Make counter 2 start at 2500 (09C4H) counts at its preload signal, load: Command word: 021F LS data word: 09C4 MS data word: 0000
Load Osc Freq Divisor	Command Code = 32H Used to change the frequency of the internal square wave oscillator signal that can be configured to drive the 1 counter input. The frequency (f) = 660 / d Khz, where d = the Osc Freq Divisor. Example: To change the frequency to 10 Khz (d = 66 decimal, 42H), load: Command word: 0032 LS data word: 0042 MS data word: 0000

Data Commands for Type B Counters

Table 4-3. Data Commands - Type B Counter

Command Name	Command Word	
	Decimal	Hexadecimal
Load Accumulator n	0n 01	0n 01
Load Hi Limit n	0n 02	0n 02
Load Lo Limit n	0n 03	0n 03
Load Acc n Increment	0n 04	0n 04
Load Timebase n	0n 06	0n 06
Load ON Preset n.1	0n 11	0n 0B
Load ON Preset n.2	0n 12	0n 0C
Load OFF Preset n.1	0n 21	0n 15
Load OFF Preset n.2	0n 22	0n 16
Load Preload n	0n 31	0n 1F
Load Osc Freq Divisor	00 50	00 32

Note: n = Counter #1 or 2

The bytes in the command word are always treated as independent bytes – a counter ID byte and a command code byte.

Load Accumulator	Command Code = 01H Used to set any value within counter limits directly into the Accumulator. Example: To set Counter 2 to 44332211H, load COMREQ command registers with: Command word: 0201 LS data word: 2211 MS data word: 4433
Load Hi Limit	Command Code = 02H
Load Lo Limit	Command Code = 03H Used to set the Hi and Lo limits to any value within the counter range. Example: To change the upper limit of counter 1 to 1000000 (F4240H), load registers with: Command word: 0102 LS data word: 4240 MS data word: 000F Note: If the limits are loaded in the wrong order, they may be rejected and an error flag will be set. To avoid this, remember to always move the Lo Limit first when shifting the limits down or the Hi Limit first when shifting the limits up.
Load Acc Increment	Command Code = 04H Used to offset a counter accumulator by a small number of counts (up to +127 or –128). Only the least significant byte of data is used with this command. Example: To offset counter 2 by 9 counts, load: Command word: 0204 LS data word: 0009 MS data word: 0000 This may be done at any time, even while the counter is counting at maximum rate. If the offset causes the counter to exceed its limits, the excess will be treated just like any other overflow, i.e., if the Continuous mode is selected, the counter will wraparound through the other limit, or if the Single-Shot mode is selected the counter will stop at the limit.
Load Timebase	Command Code = 06H

	Used to change the time interval referenced by the counter when computing its counts / timebase register data. Example: To change the timebase for counter 2 to 600 ms (258H), load: Command word: 0206 LS data word: 0258 MS data word: 0000 Note: The maximum range of the counts / timebase (CTB) register is +32767 and –32768 counts. The length of the timebase and the maximum count frequency should be coordinated so that these limits are not exceeded. The indication will roll over from (+) to (–) or (–) to (+) if exceeded.
Load ON Preset	Command Code = 0BH / 0CH
Load OFF Preset	Command Code = 15H / 16H Used to set up the output turn on / off points within the counter range. For Type B, there are two outputs associated with each counter. Example: To set counter 2 output 2 to turn on at 5000 (1388H) counts, load: Command word: 020C LS data word: 1388 MS data word: 0000 and off at 12000 (2EE0H) counts, load: Command word: 0216 LS data word: 2EE0 MS data word: 0000
Load Preload	Command Code = 1FH Used to change the count value that will be loaded into the counter accumulator when the preload input is activated. Example: Make counter 2 start at 2500000 (2625A0H) counts at its preload signal, load: Command word: 021F LS data word: 25A0 MS data word: 0026
Load Osc Freq Divisor	Used to change the frequency of the internal square wave oscillator signal that can be configured to drive the counter 1 input. The frequency (f) = 660 / d Khz, where d = the Osc Freq Divisor. Example: To change the frequency to 10 Khz (d = 66 decimal, 42H), load: Command word: 0032 LS data word: 0042 MS data word: 0000

Data Commands for Type C Counters

Table 4-4. Data Commands - Type C Counter

Command Name	Command Word	
	Decimal	Hexadecimal
Load Accumulator	01 01	01 01
Load Hi Limit	01 02	01 02
Load Lo Limit	01 03	01 03
Load Acc Increment	01 04	01 04
Load Timebase	01 06	01 06
Load Home Position	01 08	01 08
Load ON Preset 1.1	01 11	01 0B
Load ON Preset 1.2	01 12	01 0C
Load ON Preset 1.3	01 13	01 0D
Load ON Preset 1.4	01 14	01 0E
Load OFF Preset 1.1	01 21	01 15
Load OFF Preset 1.2	01 22	01 16
Load OFF Preset 1.3	01 23	01 17
Load OFF Preset 1.4	01 24	01 18
Load Preload 1.1	01 31	01 1F
Load Preload 1.2	01 32	01 20
Load Osc Freq Divisor	00 50	00 32

The bytes in the command word are always treated as independent bytes - a counter ID byte and a command code byte.

Load Accumulator	Command Code = 01H Used to set any value within counter limits directly into the Accumulator. Example: To set Counter to 44332211H, load COMREQ command registers with: Command word: 0101 LS data word: 2211 MS data word: 4433
Load Hi Limit	Command Code = 02H
Load Lo Limit	Command Code = 03H Used to set the Hi and Lo limits to any value within the counter range. Example: To change the lower limit of the counter to –50000 (FFFF3CB0H), load registers with: Command word: 0103 LS data word: 3CB0 MS data word: FFFF Note: If the limits are loaded in the wrong order, they may be rejected and an error flag will be set. To avoid this, remember to always move the Lo Limit first when shifting the limits down or the Hi Limit first when shifting the limits up.
Load Acc Increment	Command Code = 04H

	Used to offset a counter accumulator by a small number of counts (up to +127 or –128). Only the least significant byte of data is used with this command. Example: To offset the counter by 19 counts (13H), load: Command word: 0104 LS data word: 0013 MS data word: 0000 This may be done at any time, even while the counter is counting at maximum rate. If the offset causes the counter to exceed its limits, the excess will be treated just like any other overflow , i.e., if the Continuous mode is selected, the counter will wraparound through the other limit, or if the Single-Shot mode is selected the counter will stop at the limit.
Load Timebase	Command Code = 06H Used to change time interval referenced by counter when computing its counts / timebase register data. Example: To change the timebase for the counter to 600 ms (258H), load: Command word: 0106 LS data word: 0258 MS data word: 0000 Note: The maximum range of the counts / timebase (CTB) register is +32767 and –32768 counts. The length of the timebase and the maximum count frequency should be coordinated so that these limits are not exceeded. The indication will roll over from (+) to (–) or (–) to (+) if exceeded.
Load Home Position	Command Code = 08H Used to change the count value that will be loaded into the counter accumulator at the home position. Example: To assign the counter home position as 1000000 (0F4240H) counts, load: Command word: 0108 LS data word: 4240 MS data word: 000F
Load ON Preset	CommandCodes=0B / 0C / 0D / 0E
Load OFF Preset	CommandCodes=15 / 16 / 17 / 18 Used to set up the output turn on / off points within the counter range. For Type C, there are four outputs controlled by the counter. Example: To set counter output 4 to turn on at 5000 (1388H) counts, load: Command word: 010E LS data word: 1388 MS data word: 0000 and off at 12000 (2EE0H) counts, load: Command word: 0118 LS data word: 2EE0 MS data word: 0000
Load Preload	Command Codes = 1F / 20 Used to change the count value that will be loaded into the counter accumulator when the preload input is activated. The Type C counter has two preload inputs. Example: To make the counter start at 2500000 (2625A0H) counts at its preload 2 signal, load: Command word: 0120 LS data word: 25A0 MS data word: 0026
Load Osc Freq Divisor	Command Code = 32 Used to change the frequency of the internal square wave oscillator signal that can be configured to drive the counter input. The frequency (f) = 660 / d Khz, where d = the Osc Freq Divisor. Example: To change the frequency to 10 Khz (d = 66 decimal, 42H), load: Command word: 0032 LS data word: 0042 MS data word: 0000

Sending Data with the COMREQ Function

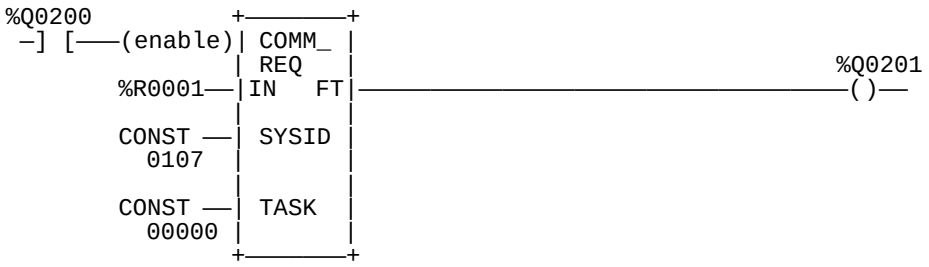
The PLC ladder program sends the Data Commands using the COMREQ (Communication Request) function. The COMREQ requires that all its command data be placed in the correct order in the CPU memory before it is executed. It should then be executed by a one-shot to prevent sending the data to the High Speed Counter multiple times. A description of the COMREQ function and its command block data follows along with a ladder example which uses registers %R0001 to %R0014 for the COMREQ command block & status register.

COMREQ Function Block Description

The Communications Request (COMREQ) function is a conditionally executed function that communicates a particular request, through the ladder logic program, to the High Speed Counter.

Communications Request Function Block Format

The ladder logic representation of the COMREQ is as follows:



The Communications Request function block has four inputs and one output. The first input is an enable input. Generally a one-shot coil is used to enable the COMREQ function. This prevents multiple messages from being sent. The second input (IN) is the starting location of the COMREQ command block. The SYSID input is used to indicate which rack and slot to send the message to (physical location of High Speed Counter module).

In the above example, the SYSID (0107 (in Hexadecimal)) points to rack 1, slot 7 and the COMREQ command block starts at Register 0001. The last input (TASK) is ignored during High Speed Counter communications and should be set to zero.

Command Block

The command block for DATA Commands is composed of 10 words of information arranged in the following fashion: (all values in hexadecimal unless otherwise indicated). Use the block move command to move these values to the Register tables (refer to the Logicmaster 90-30 Programmable Controller Reference Manual, GFK-0467, for information on using the block move function).

Location	Data	Description
%R0001	0004	Always0004 for this High Speed Counter application
%R0002	0000	Not used (Always zero)
%R0003	0008	COMREQ status data type (8 = registers), see Table 4-5
%R0004	000D	COMREQ status location –1 (%R0014)
%R0005	0000	Not used
%R0006	0000	Not used
%R0007	E201	Command type (E2 – message ID for 6 byte Data Command to High Speed Counter) and Command Parameter (1 = write)
%R0008	0006	Byte length of data to High Speed Counter
%R0009	0008	Data type (8 = registers), see Table 4.5
%R0010	000A	Start location of data –1 (%R0011)
%R0011	nnnn	Command word (Tables 4-2, 4-3, 4-4)
%R0012	nnnn	LS data word
%R0013	nnnn	MS data word

Table 4-5. COMREQ Data Type Codes

For This Data Type		Enter This Number	
		Decimal	Hexadecimal
%I	Discrete Input	28	1C
%Q	Discrete Output	30	1E
%R	Register	8	08
%AI	Analog Input	10	0A
%AQ	Analog Output	12	0C

Example - Sending Data Commands

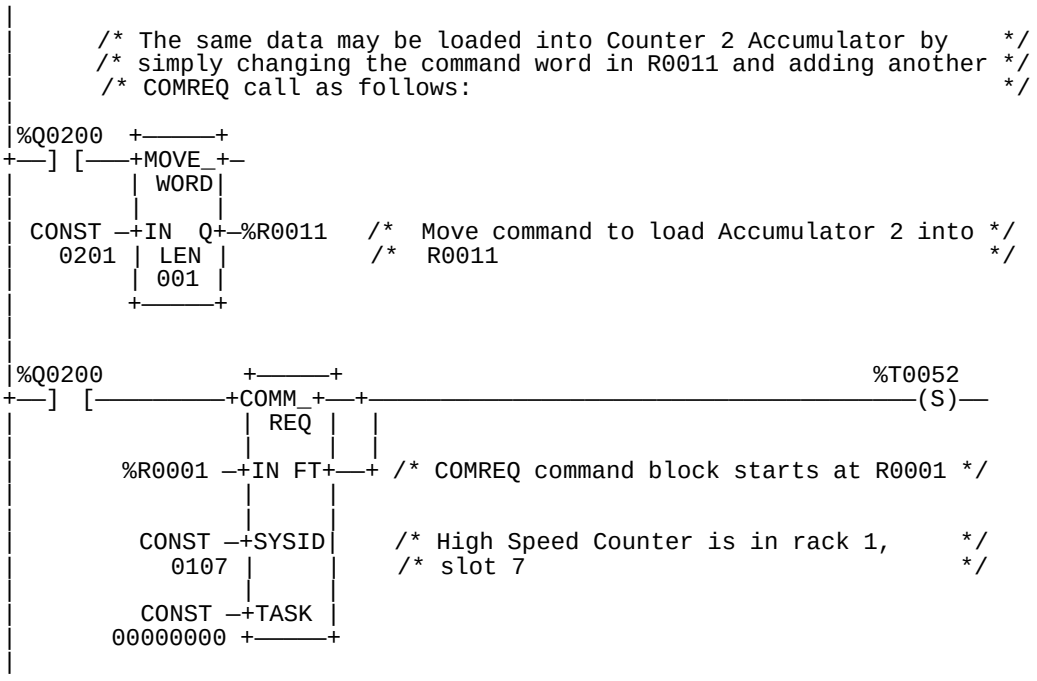
An example of ladder logic for sending data commands to the High Speed Counter using COMREQ function blocks is shown below. In this example, the COMREQ command block is located in registers %R0001 through %R0013 and the COMREQ status is returned in %R0014. The command to send the data is initiated by the conditional input %I0289 which sets output %Q0200 for one sweep. The High Speed Counter is located in Rack 1, slot 7.

Note that register reference pointers in the COMREQ command block are one less than the register number pointed to, e.g. 000D (13) indicates R0014 as the COMREQ status register.

Note that the comments within / . . . . */ have been included for information purposes only. They are not generated by the Logicmaster 90-30 software.*

```
|
|%I0289                                                          %Q0200
+--][-------------------------------------------------------------------(P)--
|
|
|%Q0200  +------+
+--] [---+BLKMV+-        /* Move Command block into Registers 1-7  */
|        | WORD|
|        |     |
| CONST -+IN1 Q+-%R0001   /* Command block data starts at %R0001    */
|   0004 |     |         /* Always starts with 0004 for this       */
|        |     |         /* application
| CONST -+IN2  |
|   0000 |     |         /* Not used (always 0000)                 */
|        |     |
| CONST -+IN3  |
|   0008 |     |         /* 8 indicates command block in register  */
|        |     |         /* reference
| CONST -+IN4  |
|   000D |     |         /* 0D (13 decimal) points to R0014 for    */
|        |     |         /* COMREQ status
| CONST -+IN5  |
|   0000 |     |         /* Not used (always 0000)                 */
|        |     |
| CONST -+IN6  |
|   0000 |     |         /* Not used (always 0000)                 */
|        |     |
| CONST -+IN7  |
|   E201 +------+         /* E2 Command code (01 = send data)       */
|
|
```

```
|
|
|%Q0200  +-————+
+——] [———+BLKMV+—       /* Move data into registers 8 through 14  */
|        | WORD|
|        |     |
| CONST —+IN1 Q+—%R0008
|   0006 |     |        /* Length of data sent by COMREQ to  HSC  */
|        |     |        /* (Always 6 for Data Commands)          */
| CONST —+IN2  |
|   0008 |     |        /* Data type (8 = registers)             */
|        |     |
| CONST —+IN3  |
|   000A |     |        /* Start location of data (R0011)        */
|        |     |
| CONST —+IN4  |
|   0101 |     |        /* First word (Command Word)             */
|        |     |        /* In this case, load Accumulator 1      */
| CONST —+IN5  |
|   2211 |     |        /* LSW of data. This and next  word will  */
|        |     |        /* load the Accumulator with 44332211H.   */
| CONST —+IN6  |
|   4433 |     |        /* MSW of data.                           */
|        |     |
| CONST —+IN7  |
|   0000 +————+         /* Zero the COMREQ status word (R0014)    */
|                       /* before the COMREQ is called.          */
|
|
|
|
|                         /* Now call the COMREQ to send the message */
|
|%Q0200       +————+                                          %T0051
+——][————————+COMM_+——+————————————————————————————————————(S)——
|            | REQ |  | /* COMREQ will set output %T0051 if failure */
|            |     |  | /* detected when sending message.          */
|     %R0001 —+IN FT+——+
|             |     |   /* Command block data starts in R0001      */
|             |     |
|      CONST —+SYSID|   /* High Speed Counter is in rack 1, slot 7  */
|        0107 |     |
|             |     |
|      CONST —+TASK |   /* Input not used (always 0)               */
|    00000000 +————+
|
|
```



Note

It is important when executing multiple COMMREQ functions to confirm successful status prior to executing successive COMMREQs. In the above example, communication failure is indicated if %T0051 or %T0052 is set.

Table 4-6. Status Word Fault Codes for High Speed Counter

Fault	Value	Description
IOB_BUSY	1	Module is reconfiguring
IOB_SUCCESS	0	All communications proceeded normally.
IOB_PARITY_ERR	–1	A parity error occurred while communicating with an expansion rack.
IOB_NOT_COMPL	–2	After the communication was over, the module did not indicate that it was complete.
IOB_MOD_ABORT	–3	For some reason, the module aborted the communication.
IOB_MOD_SYNTAX	–4	The module indicated that the data sent was not in the correct sequence.
IOB_NOT_RDY	–5	The RDY bit in the module's status was not active.
IOB_TIMEOUT	–6	The maximum response time elapsed without receiving a response from the module.
IOB_BAD_PARAM	–7	One of the parameters passed was invalid.
IOB_BAD_CSUM	–8	The checksum received from the DMA protocol module did not match the data received.
IOB_OUT_LEN_CHGD	–9	The output length for the module was changed, so normal processing of the reply record should not be performed.

Chapter 5 Configuration Features

This chapter describes the configurable features of the High Speed Counter, which are:

- Counter type (Type A, B, or C)
- Oscillator Reference Input
- Oscillator frequency
- Strobe edge active
- Disable, Preload, and Count input filters
- Count direction (Type A only)
- Count Signal mode (Types B and C only)
- Continuous or Single-Shot counting
- Timebase for measuring count rate
- Upper and lower count limits
- On and off presets for outputs
- Home position (Type C only)
- Preload counter value
- Output Fail Mode

Configurable Features

The following table summarizes all configuration features and default configuration values.

Features	Selections	Default
Counter Type	A, B, C	Type A
Oscillator Frequency Input	OFF, ON	OFF
Oscillator Frequency Divider (N)	4 to 65535	660 (1 kHz)
Strobe edge	positive / negative	positive
Disable Input filter **	high / low frequency	high frequency
Preload Input filter	high / low frequency	high frequency
Count input filter	high / low frequency	high frequency
Count Up or Down *	Up / down	up counter
Count input signals **	UP / DN, PUL / DIR, A QUAD B	PUL / DIR
Count mode	Continuous / single-shot	continuous
Counter timebase	1 - 65535 mS	1000 mS
Count limits	A: –32768 to +32767 B / C: –2147483648 to +2147483647	A: upper = +32767, lower = 0 B / C: upper = +8388607, lower = 0
Output Preset positions	select ON and OFF positions	A: ON = +32767, OFF = 0 B / C: ON = +8388607, OFF = 0
Home position value ***	enter home count value	0
Preload value	A: –32768 to +32767 B / C: –2147483648 to +2147483647	0
Output Fail mode	Normal, OFF, hold	Normal

* for Type A configuration only; ** for Type B or Type C configuration; *** for Type C configuration only

Counter Type

The module's counter type must be selected. Each type is represented by a letter, either A, B, or C:

Function	Counters	Counter Type
Unidirectional counters	4	A
Bidirectional counters	2	B
Differential counter	1	C

Oscillator Frequency Divider and Input

The High Speed Counter module generates an internal square wave signal which can be switched into the count input in place of I1 to be used as a timing reference for measurement applications. This is controlled by the Oscillator Frequency Input configuration option (***this is available only on Counter 1 and may not be used for Counter 2 - 4***). OFF allows the normal user input to drive I1. ON selects the internal reference frequency as the input.

The Oscillator output frequency is determined by the configured divider number (N) as indicated below:

Osc Freq = 660 / N kHz

The range for N is 4 to 65535. The default setting for N is 660 to provide 1 kHz.

Strobe Edge

Strobe inputs are edge sensitive. Each Strobe input on the module can be individually configured to have either the positive or the negative edge active. By default, they are positive-edge sensitive.

Input Filters

By default, each input has a built-in high-frequency (2.5µS) filter. For the following groups of inputs, this can be changed to a 12.5mS low-frequency filter (the Strobe input always uses a high-frequency filter). The low-frequency filter reduces the effect of signal noise. Maximum count rate for the low-frequency filter is 30Hz. Input Filter selections are grouped as follows:

- IN1, IN2 - Count Inputs
- IN3, IN4 - Count Inputs
- IN5, IN6 - Preload Inputs
- IN7 - Preload (A), or Disable (B & C)
- IN8 - Preload (A), or Disable (B)

(A), (B), and (C) above refer to the selected counter type. See Table 3-1 for input designations for each counter type. The Home input filter (IN8 for Type C) is always low frequency.

Counter Direction - Type A

If the module is used in its Type A configuration, it provides four individual unidirectional counters. Each of the four counters can be configured to count either up or down. The default is Up.

Count Signal Mode - Types B and C

For a Type B or Type C module configuration, select how each counter will be used; choices are:

- Up / Downmode
- Pulse / Directionmode
- A Quad B mode

Continuous or Single-Shot Counting

Each counter on a module has programmable count limits that define its range. The counter can either count continuously within these limits, or count to either limit, then stop.

Continuous Counting

In the continuous counting mode, if either the upper or lower limit is exceeded, the counter wraps around to the other limit and continues counting. Continuous counting is the default mode.

Single-Shot Counting

If single-shot is selected, the counter will count to its upper or lower limit, then stop. When the counter is at the limit, counts in the opposite direction will count it back off the limit. The Accumulator can also be changed by loading a new value from the CPU or by applying a Preset Input.

Note

For CPU firmware release, Version 1.02, the following configuration features are available when using the Series 90-30 Hand-Held Programmer - with these limitations:

1. The CPU - HHP firmware only allows display and entry of 16 bit data values. Therefore Types B & C counters (32 bits) are restricted to 16 bit data values using the HHP.

2. The CPU - HHP firmware does not save any of the configuration values on the following pages in non-volatile memory. If a default value is changed by the HHP, it will only be active as long as logic power remains ON in the backplane containing the High Speed Counter. Loss of logic power will result in the configuration values returning to their default states. BLKMOVE and COMREQ function blocks can be used to send non-default configuration values to the High Speed Counter after powerup. Refer to Appendix A for details.

These limitations will be removed in future releases of CPU firmware.

Counter Timebase

For each counter, the timebase represents a span of time which can be used to measure the rate of counting. For example, the program may be required to monitor the number of count pulses which are occurring every 30 seconds.

A timebase from 1 msec to 65535 msec can be selected for each counter. The counter timebase is set to 1 second (1000 msec) by default. The module stores the number of counts that occurred during the last-completed timebase interval in the Counts / Tmebase register. The range of the Counts / Timebase register is –32768 and +32767 counts. The timebase value selected should not allow the Counts / Timebase register to overflow at the maximum count frequency. If it does, the sign of the Counts / Tmebase will change from (+) to (–) or (–) to (+).

Count Limits

Each counter can be assigned upper and lower count limits. All Accumulator preload values and output on / off preset values must lie within these limits. The upper (high) limit is the most positive, and the lower limit is the most negative. Both can be positive, or both can be negative, but the high limit is always greater than the low limit.

If the Accumulator value is outside the new limits when the limits are changed it is automatically adjusted to the low limit value. If the new limits are incompatible, that is, (high < low or Low > high), then they will be rejected and the old limits retained. In

this case a counter limit error code will be returned. To avoid this situation when the limits are changed one at a time, a good rule to follow is: always move the high limit first when shifting the limits up and always move the low limit first when shifting them down.

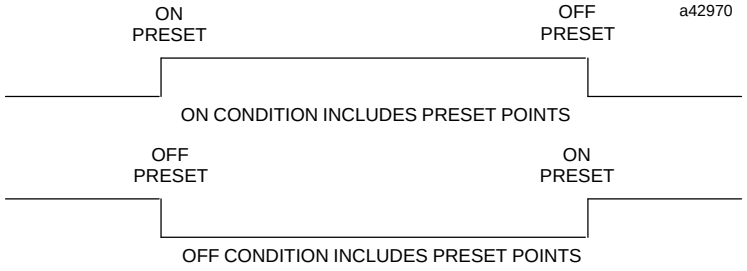
- For Type A (16-bit) counters, the limit range is –32,768 to +32,767.
- For Type B and C (32-bit) counters, the limit range is –2,147,483,648 to +2,147,483,647.

Output Preset Positions

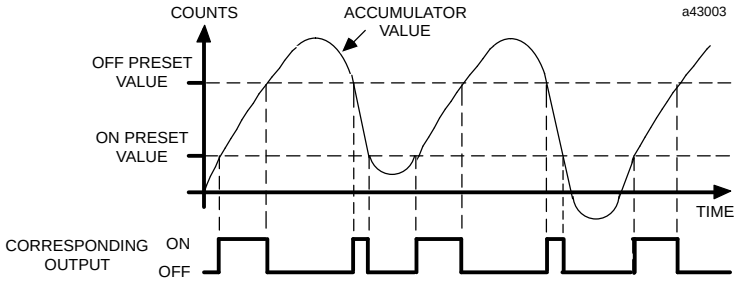
Each counter output has a preset ON and OFF position. The output state indicates when the counter accumulator value is between the ON and OFF points.

Preset closest to low limit	Output ON	Output OFF
ON	> = ON Preset < = OFF Preset	> OFF Preset < ON Preset
OFF	< OFF Preset > ON Preset	< = ON Preset > = OFF Preset

The output may be either on or off when the accumulator value lies between the Preset points.



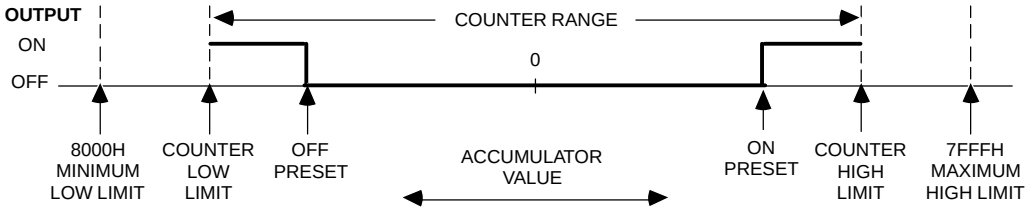
For example:



Location of Preset Points

The Preset points may be located anywhere within the counter range. When the accumulator value is between the Preset points, the output ON / OFF state will always be that of the lowest (most negative) Preset point. When the accumulator value is *not* between the Preset points, the output ON / OFF state will be that of the most positive preset. This is true regardless of the counter direction.

The following example compares the output state and accumulator value of a 16-bit counter.



If both preset points are within the counter range, the output always switches at the Preset points. If only one of the Preset points is programmed within the counter range, then the counter limits will function as the other Preset point. In the continuous mode, the output will switch when wraparound occurs.

If neither of the Preset points is in the counter range then the output state will not change; it will always be the state of the most positive Preset. If both Preset points are equal and out of range, the output will always be OFF. If both Preset points are equal and within the counter range, then the output will only be on for one count value - as defined by the Preset points.

Separation of Preset Points

The count accumulators are compared to the Presets at 0.5 msec intervals. Therefore, to guarantee that the outputs will always switch, the Preset points must be separated by at least the number of counts received in a 0.5 msec time period. For example:

If maximum count rate = 10kHz;
then minimum count separation = (10,000 Hz x .0005 sec) = 5 counts.

Home Position

If the module has been set up to operate as a Type C counter, a Home Position can be selected. The default for the Home Position is 0. The counter will be set to this value when all three of the following events occur:

1. Home command is given by the CPU;
2. Home Limit Switch input is present;
3. next Marker input pulse occurs.

Additional markers will be ineffective until the Home Command is removed and the Home Command sequence is repeated. If the Home Command is removed before the Home Position marker is found, a ***Home Position Error*** will be returned.

Preload Value

For each counter, a starting count value can be specified which will be used when the Preload input is activated. If the counter should be reset to 0, enter 0 as the Preload value; this is the default value. For a differential (Type C) counter module, two different Preload values can be selected for the same counter. For Type A (16-bit) counters, the preload range is –32,768 to +32,767. For Type B or C (32-bit) counters, the preload range is –2,147,483,648 to +2,147,483,647.

Preload values within the configured counter limits should always be used. When preload values outside the counter limits are used, a preload input will have the following effect:

- A preload value greater than the counter high limit initially sets the Accumulator to the preload value. If down counts are being received every 0.5 ms then the Accumulator is counted down from the preload value. Whenever a 0.5 ms period occurs during which no counts are received or up counts are received the Accumulator is immediately adjusted for overflow. The overflow adjustment depends on the counter mode selected (continuous or one-shot).
- A preload value less than the counter low limit initially sets the Accumulator to the preload value. If no counts are currently being received the Accumulator stays at the preload value. If up counts are currently being received the Accumulator is counted up from the preload value. When down counts are received the Accumulator is immediately adjusted for underflow according to the selected counter mode (continuous or one-shot).

Output Fail Mode

If the module detects a loss of the CPU, it can respond in three different ways:

- it can continue to operate normally, processing the inputs and controlling the outputs according to its configuration (NORMAL);
- it can force all four outputs to turn off (FRCOFF);
- the module can hold the outputs at the current state (HOLD).

These responses remain in effect until the CPU returns to operation or the module is power-cycled.

Chapter 6 Configuration Programming

This chapter defines the messages and actions required to configure the Series 90-30 High Speed Counter (HSC). If you want to use the High Speed Counter with a configuration different than the default configuration, you must change the configuration to suit your needs. Configuration of the High Speed Counter can be accomplished in three ways:

- by using the Series 90-30 Hand-Held Programmer;
- by using the configurator function in the Logicmaster 90 Software Programming package;
- by sending data via COMREQ command in ladder logic programs.

Power-up Condition and Defaults

When the High Speed Counter first powers up, it has default values for all the Counter parameters. To meet the requirements of most applications it will have to be configured before it can be used.

Configuration with Hand-Held Programmer

Configuration can be done using the Hand-Held Programmer. After powering up the Series 90-30 PLC with a High Speed Counter installed in the baseplate enter the Configuration mode by pressing the [MODE] [4] and [ENT] keys in sequence (the CPU must be in STOP mode). Using the Down Arrow key [–], sequence to the slot that contains the High Speed Counter. Press the [READ] key, then [ENT]. ENT is the Enter key and when pressed tells the system to invoke the operation specified by the keys pressed prior to ENT.

Parameters and Hand-Held Programmer Abbreviations

Tables 6-1 through 6-5 list all of the configuration parameters in the Series 90-30 High Speed Counter and the abbreviations for those parameters as they are displayed on the Hand-Held Programmer. Note that parameters 1 through 4 are common to all three types of counters.

Table 6-1. Common Parameter Abbreviations

Parameter Number	Abbreviation	Value 1	Value 2	Value 3	Actual Parameter	Default
1	CNTR TYPE	TYPE A	TYPE B	TYPE C	Counter Type	Type A
2	FAIL MODE	NORMAL	FRCOFF	HOLD	Output Failure Mode	NORMAL
3	REF INPUT	OFF	ON	-	Oscillator reference Input	OFF
4	OSC DIV	-	-	-	Oscillator Divider	660

Table 6-2. Counter Type A Abbreviations

Parameter Numberer	Abbreviation	Value 1	Value 2	Value 3	Actual Parameter	Default
5	CNT FIL 1-2	HIGH	LOW	-	Count Input Filter for Counters 1 and 2	HIGH
6	PLD FIL 1-2	HIGH	LOW	-	Preload Input Filter for Counters 1 and 2	HIGH
7	CNT FIL 3-4	HIGH	LOW	-	Count Input Filter for Counters 3 and 4	HIGH
8	PLD FIL 3	HIGH	LOW	-	Preload Input Filter for Counter 3	HIGH
9	PLD FIL 4	HIGH	LOW	-	Preload Filter for Counter 4	HIGH
10	CTR1 DIR	UP	DOWN	-	Counter 1 Direction	UP
11	CTR1 MODE	CONT	1 SHOT	-	Counter 1 Mode	CONT
12	CTR1 STB	POS	NEG	-	Counter 1 Strobe Edge	POS
13	CTR2 DIR	UP	DOWN	-	Counter 2 Direction	UP
14	CTR2 MODE	CONT	1 SHOT	-	Counter 2 Mode	CONT
15	CTR2 STB	POS	NEG	-	Counter 2 Strobe Edge	POS
16	CTR3 DIR	UP	DOWN	-	Counter 3 Direction	UP
17	CTR3 MODE	CONT	1 SHOT	-	Counter 3 Mode	CONT
18	CTR3 STB	POS	NEG	-	Counter 3 Strobe Edge	POS
19	CTR4 DIR	UP	DOWN	-	Counter 4 Direction	UP
20	CTR4 MODE	CONT	1 SHOT	-	Counter 4 Mode	CONT
21	CTR4 STB	POS	NEG	-	Counter 4 Strobe Edge	POS
22	TIME BS 1	-	-	-	Time Base 1	1000mS
23	HI LIM 1	-	-	-	High Limit 1	+32767
24	LO LIM 1	-	-	-	Low Limit 1	0
25	ON PST 1	-	-	-	ON Preset 1	+32767
26	OFF PST1	-	-	-	OFF Preset 1	0
27	PRELD 1	-	-	-	Preload 1	0
28	TIME BS 2	-	-	-	Time Base 2	1000mS
29	HI LIM 2	-	-	-	High Limit 2	+32767
30	LO LIM 2	-	-	-	Low Limit 2	0
31	ON PST 2	-	-	-	ON Preset 2	+32767
32	OFF PST2	-	-	-	OFF Preset 2	0
33	PRELD 2	-	-	-	Preload 2	0
34	TIME BS 3	-	-	-	Time Base 3	1000mS
35	HI LIM 3	-	-	-	High Limit 3	+32767
36	LO LIM 3	-	-	-	Low Limit 3	0
37	ON PST 3	-	-	-	ON Preset 3	+32767
38	OFF PST3	-	-	-	OFF Preset 3	0
39	PRELD 3	-	-	-	Preload 3	0
40	TIME BS 4	-	-	-	Time Base 4	1000
41	HI LIM 4	-	-	-	High Limit 4	+32767
42	LO LIM 4	-	-	-	Low Limit 4	0
43	ON PST 4	-	-	-	ON Preset 4	+32767
44	OFF PST4	-	-	-	OFF Preset 4	0
45	PRELD 4	-	-	-	Preload 4	0

Table 6-3. Counter Type B Abbreviations

Parameter Number	Abbreviation	Value 1	Value 2	Value 3	Actual Parameter	Default
5	CNT FIL1	HIGH	LOW	-	Counts Filter 1	HIGH
6	CNT FIL2	HIGH	LOW	-	Counts Filter 2	HIGH
7	PLD FIL	HIGH	LOW	-	Preloads 1&2 Filter	HIGH
8	CTR1 SIG	PUL / DIR	UP / DN	A QD B	Count Signals 1	PUL / DIR
9	CTR2 SIG	PUL / DIR	UP / DN	A QD B	Count Signals 2	PUL / DIR
10	CTR1 DISBL	HIGH	LOW	-	Disable-Input-Filter for Counter 1	HIGH
11	CTR2 DISBL	HIGH	LOW	-	Disable-Input-Filter for Counter 2	HIGH
12	CTR1 MODE	CONT	1 SHOT	-	Counter 1 Mode	CONT
13	CTR2 MODE	CONT	1 SHOT	-	Counter 2 Mode	CONT
14	CTR1 STB 1	POS	NEG	-	Strobe Edge 1.1	POS
15	CTR1 STB 2	POS	NEG	-	Strobe Edge 1.2	POS
16	CTR2 STB 1	POS	NEG	-	Strobe Edge 2.1	POS
17	CTR2 STB 2	POS	NEG	-	Strobe Edge 2.2	POS
18	TIME BS 1	-	-	-	Time Base 1	1000 mS
19	HI LIM 1	-	-	-	High Limit 1	+8388607
20	LO LIM 1	-	-	-	Low Limit 1	0
21	ON PS 11	-	-	-	ON Preset1.1	+8388607
22	OFF PS 11	-		-	OFF Preset 1.1	0
23	ON PS 12	-	-	-	ON Preset 1.2	+8388607
24	OFF PS 12	-	-	-	OFF preset 1.2	0
25	PRELD 1	-	-	-	Preload 1	0
26	TIME BS 2	-	-	-	Time Base 2	1000 mS
27	HI LIM 2	-	-	-	High Limit 2	+8388607
28	LO LIM 2	-	-	-	Low Limit 2	0
29	ON PS 21	-	-	-	ON Preset 2.1	+8388607
30	OFF PS 21	-	-	-	OFF Preset 2.1	0
31	ON PS 22	-	-	-	ON Preset 2.2	+8388607
32	OFF PS 22	-	-	-	OFF Preset 2.2	0
33	PRELD 2	-	-	-	Preload 2	0

Table 6-4. Counter Type C Abbreviations

Parameter Number	Abbreviation	Value 1	Value 2	Value 3	Actual Parameter	Default
5	CNT FIL1	HIGH	LOW	-	Count Filter Channel 1	HIGH
6	CNT FIL2	HIGH	LOW	-	Count Filter Channel 2	HIGH
7	PLD FIL	HIGH	LOW	-	Preload Inputs Filter	HIGH
8	DISABLE	HIGH	LOW	-	Disable Filter	HIGH
9	CNTR MODE	CONT	1 SHOT	-	Counter Mode	CONT
10	CTR1 SIG	PUL / DIR	UP / DN	A QD B	Count Signals 1	PUL / DIR
11	CTR2 SIG	PUL / DIR	UP / DN	A QD B	Count Signals 2	PUL / DIR
12	STB EDGE 1	POS	NEG	-	Strobe Edge 1	POS
13	STB EDGE 2	POS	NEG	-	Strobe Edge 2	POS
14	STB EDGE 3	POS	NEG	-	Strobe Edge 3	POS
15	TIME BS	-	-	-	Time Base	1000mS
16	HI LIM	-	-	-	High Limit	+8388607
17	LO LIM	-	-	-	Low Limit	0
18	HOME	-	-	-	Home Value	0
19	ON PST 1	-	-	-	ON Preset 1	+8388607
20	OFF PST1	-	-	-	OFF Preset 1	0
21	ON PST 2	-	-	-	ON Preset 2	+8388607
22	OFF PST2	-	-	-	OFF preset 2	0
23	ON PST 3	-	-	-	ON Preset 3	+8388607
24	OFF PST3	-	-	-	OFF Preset 3	0
25	ON PST 4	-	-	-	ON Preset 4	+8388607
26	OFF PST4	-	-	-	OFF Preset 4	0
27	PRELD 1	-	-	-	Preload 1	0
28	PRELD 2	-	-	-	Preload 2	0

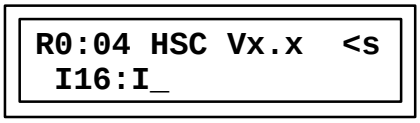
Table 6-5. Default Values for Counters

Parameter	Default Value	Parameter	Default Value
Counter Type	TYPE A	Time Bases	1000
Output Failure Mode	NORMAL	High Limits for Type A	32767
Oscillator reference Input	OFF	High Limits for Type B and C	8388607
Oscillator Divider	660	Low Limits	0
All Filters	High Frequency	ON Presets for type A	32767
All Counter Directions	Up	ON Presets for type B and C	8388607
All Counter Modes	Continuous	OFF Presets	0
All Strobe Edge	Positive	Preloads	0
Count Signals (B and C only)	Pulse / Direction		

PLC I/O Scanner Configuration

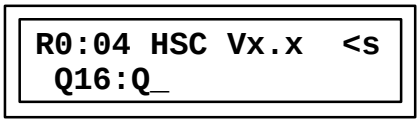
Before the PLC allows the High Speed Counter configuration screens to be viewed, it presents the following I/O Scanner Configuration screens.

%I Address



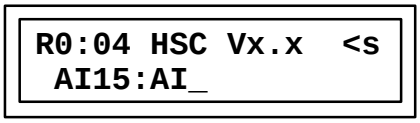
On the first line of the screen display, R0 indicates the RACK number, 04 is the slot number, and <S indicates that the CPU is in STOP mode. On the second line, I16 shows that this module has 16 bits of discrete Input data (%I). This is the data transferred from the High Speed Counter to the PLC each sweep. Enter a valid %I starting reference for this data and press the [ENT] key - or to have the reference assigned by the PLC, just press the [ENT] key. Note that at this point, when you press ENT, the LCD display will then display the next screen in sequence.

%Q address



This screen is prompting you for the %Q address. This is the starting reference for 16 discrete control bits sent to the High Speed Counter each PLC sweep. Enter a valid address and press [ENT], or just press [ENT] and the PLC will assign the next available address.

%AI address

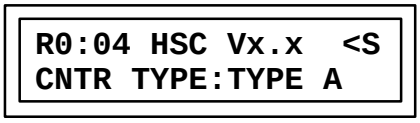


This screen is asking for the location where you want the 15 words of return data to be stored. This data is the count accumulators, the strobe registers and other pertinent data transferred from the High Speed Counter to the PLC each sweep. Enter a valid reference and press the [ENT] key, or just press [ENT] for the next available address.

The next series of screens are the actual count parameters for the High Speed Counter. For the filter times, count modes and count directions, press the [Ç] key to toggle the screen display, then press [ENT] to record the value. If you change your mind about a parameter, press the CLR key instead of ENT and the original value will be recalled. To get to the next screen in the series, simply press the right arrow [‡] key. To backup to previous parameters (screens), use the left arrow [z] key.

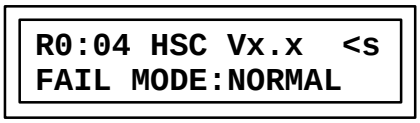
Configuration Screens Common to All Counter Types

Screen 1 - Counter Type



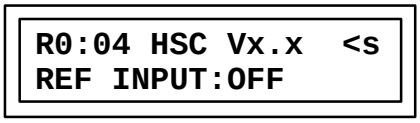
This screen allows you to select the counter type. Press the [Ç] key to select the type of counter you desire, then press the [ENT] key. The [CLR] key (before enter is pressed) will cancel the operation.

Screen 2 - Output Default/Module Failure Mode



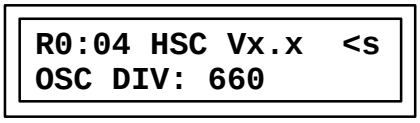
This screen selects the state the outputs will assume if communications with the PLC is lost. NORMAL indicates that the outputs will continue to operate under control of the counter. FRCOFF causes the outputs to be forced off if communications is lost, while HOLD causes the High Speed Counter to retain the last state of the output points before communication was lost.

Screen 3 - Oscillator Reference Input



This screen controls the Oscillator Reference. OFF means that the input to Counter 1 is fed from the normal input on the terminal strip. ON, when selected, causes the internal oscillator to be fed into Counter 1. When ON is selected for counter Types B or C, the counter signal for Counter 1 should be set for Pulse / Direction.

Screen 4 - Oscillator reference Divide Ratio



This value is a 16-bit number that controls the frequency of the internal reference oscillator. The frequency is determined by the configured divider number (N), where *Oscillator Frequency = 660/N = kHz*. The range for N is 4 -65535 and the default number is 660, which provides 1 kHz.

Type A Counter Specific Screens

The following screens will be displayed when TYPE A is selected in Screen 1.

Screen 5 - Count Filter Counters 1 and 2

```
R0:04 HSC Vx.x  <s
CNT FIL 1–2:HIGH
```

This screen allows you to specify the filters applied to the count inputs for counters 1 and 2. Both counters are affected by this parameter. The HIGH (2.5 microsecond) selection is used to filter out high frequency noise, while the LOW (12.5 millisecond) filter is used to remove additional low frequency interference.

Screen 6 - Preload Filter Counters 1 and 2

```
R0:04 HSC Vx.x  <s
PLD FIL 1–2:HIGH
```

This screen allows you to select high or low frequency filtering for the preload inputs for counters 1 and 2. As with the count inputs, these can only be set for both counters simultaneously.

Screen 7 - Count Filter Counters 3 and 4

```
R0:04 HSC Vx.x  <s
CNT FIL 3–4:HIGH
```

This screen allows you to specify either high or low frequency filtering for the count inputs for counters 3 and 4. Both counters are affected by this parameter and are also set simultaneously.

Screen 8 - Preload Filter Counter 3

```
R0:04 HSC Vx.x  <s
PLD FIL 3:HIGH
```

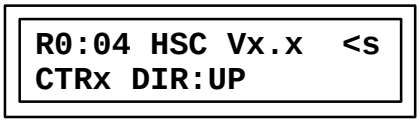
This screen allows you to specify high or low frequency filtering for the preload input for counter 3. Unlike counters 1 and 2, the preload filters for counters 3 and 4 can be set independently.

Screen 9 - Preload Filter Counter 4

```
R0:04 HSC Vx.x  <s
PLD FIL 4:HIGH
```

This screen allows you to specify high or low frequency filtering for the preload input for counter 4.

Screens 10, 13, 16, 19 - Counter Direction



This series of three screens (screen 13, screen 16, and screen 19) for setting the count direction, mode and strobe edge is repeated in the Hand-Held Programmer for counter 1 through counter 4. Only one set of the three screens is shown here. All of the other counters are configured in the same manner, only the counter number is different. Screen 13 allows you to specify the direction the counter will operate in - either up or down counting.

Screens 11, 14, 17, 20 - Counter Mode

These screens specify the Counter Mode - continuous or one shot. When configured in the continuous (CONT) mode, the counter will roll over to the low limit once the accumulator passes the high limit. In the one shot (1 SHOT) mode, the counter will stop when the high (or low - if counting down) limit is reached.

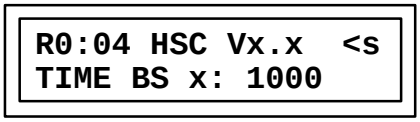
Screens 12, 15, 18, 21 - Counter Strobe Edge

These screens configure the strobe input edge to trigger on a positive or negative going signal.

Note

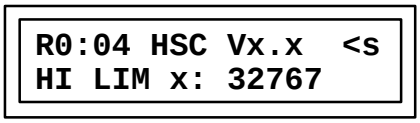
The parameters associated with screens 1 through 21 are retained by the PLC in battery-backed RAM memory and are downloaded to the High Speed Counter each time the PLC powers up. The next series of screens (22 through 45) show additional parameters that are NOT retained by PLC Version 1.02 in battery-backed RAM memory. These parameters can be sent to the High Speed Counter via a COMREQ command. Refer to Appendix A for details on using the COMREQ function. Future PLC Versions (2.0 and greater) will save ALL parameters in battery-backed RAM.

Screens 22, 28, 34, 40 - Time Base Value



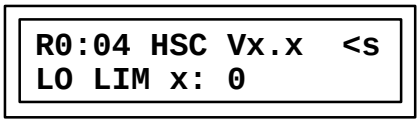
These screens allow you to enter the time base that is used to configure the counts per time base calculation. The default is 1000 milliseconds (1 second). To enter a new value, select the value using the numeric keys on the Hand-Held Programmer then press the [ENT] key to record the value.

Screens 23, 29, 35, 41 - High Limit



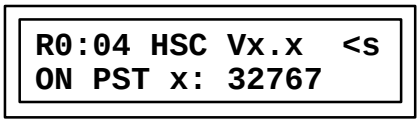
These screens are used to specify the highest (most positive) value the count accumulator can obtain. The default is 32767 which is the maximum value the Type A counters can handle. As with the time base, use the Hand-Held Programmer numeric keys to change the value, then press the [ENT] key to record it. Pressing [CLR] instead of [ENT] will cancel the entry.

Screens 24, 30, 36, 42 - Low Limit



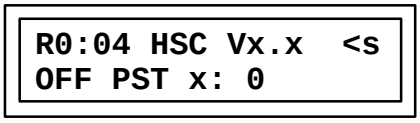
These screens specify the lowest (most negative) value for the count accumulator.

Screens 25, 31, 37, 43 - ON Preset Value



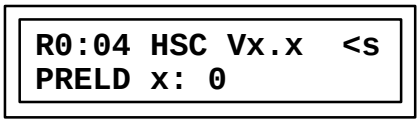
When the counter accumulator reaches this value (depending also on the value of the OFF preset) the appropriate output is turned on (depending on the state, either enabled or disabled, of the output control flags in the %Q data word).

Screens 26, 32, 38, 44 - OFF Preset Value



This value is used in conjunction with the ON preset to indicate at what accumulator value the associated output point will be turned off.

Screens 27, 33, 39, 45 - Preload Value



This parameter specifies the value that will be loaded into the accumulator when the appropriate preload input on the terminal strip is asserted.

Type B Counter Specific Screens

The following group of screens are specific to Type B counters and will be displayed when TYPE B is selected as the counter type in Screen 1.

Screen 5 - Counts Filter Counter 1

```
R0:04 HSC Vx.x  <s
CNT  FIL 1:HIGH
```

This screen allows you to specify the filters applied to the count inputs for counter 1. The HIGH (2.5 microsecond) selection is used to filter out high frequency noise, while the LOW (12.5 millisecond) filter is used to remove additional low frequency interference.

Screen 6 - Counts Filter Counter 2

```
R0:04 HSC Vx.x  <s
CNT  FIL:HIGH
```

This screen allows you to specify the filters applied to the count inputs for counter 2. The HIGH (2.5 microsecond) selection is used to filter out high frequency noise, while the LOW (12.5 millisecond) filter is used to remove additional low frequency interference.

Screen 7 - Preload Filter Counters 1 and 2

```
R0:04 HSC Vx.x  <s
PLD FIL:HIGH
```

This screen allows you to specify the preload filter, either HIGH or LOW, for counters 1 and 2.

Two screens numbers are referenced for the following groups of configuration parameters. The first is for counter 1 - the second for counter 2.

Screens 8, 9 - Counter Signal Definitions

```
R0:04 HSC Vx.x  <s
CTRx SIG:PUL/DIR
```

This screen allows you to select the type of input signals that counters 1 or 2 will accept. The available options are Pulse / Direction, Up / Down and A Quad B. As with previous screens, press the [Ç] key to toggle the display through the selections. When your choice is displayed, press the [ENT] key to record your selection.

Screens 10, 11 - Counter Disable Input Filter

```
R0:04 HSC Vx.x  <s
CTRx DISBL:HIGH
```

These screens allow you to select either the HIGH or LOW filter for the Counter Disable input.

Screens 12, 13 - Counter Mode

```
R0:04 HSC Vx.x  <s
CTRx STB x:POS
```

These screens allow you to select select the Counter Mode, either Continuous or One Shot, for each of the Type B counters.

Screens 14, 15, 16, 17 - Counter Strobe Edges

```
R0:04 HSC Vx.x  <s
CTRx STB x:POS
```

These screens configure the strobe input edge for the Type B counters to trigger on either a positive-going or a negative-going signal.

Note

The parameters associated with screens 1 to 17 are retained by the PLC in battery-backed RAM memory and are downloaded to the High Speed Counter each time the PLC powers up. The next series of screens (18 through 33) show additional parameters that are NOT retained by PLC Version 1.02 in battery-backed RAM memory. These parameters can be sent to the High Speed Counter via a COMREQ command. Refer to Appendix A for details on using the COMREQ function. Future PLC Versions (2.0 and greater) will save ALL parameters in battery-backed RAM.

Screens 18, 26 - Time Base Value

```
R0:04 HSC Vx.x  <s
TIME BS x: 1000
```

These screens allow you to enter the time base that is used to configure the counts per time base calculation. The default is 1000 milliseconds (1 second). To enter a new value, use the numeric keys on the Hand-Held Programmer then press the [ENT] key to record the value.

Screens 19, 27 - High Limit

```
R0:04 HSC Vx.x  <s
HI LIM x: OVRNGE
```

These screens are used to specify the highest (most positive) value that the count accumulator can obtain. As with the time base, use the Hand-Held Programmer numeric keys to change the value, then press the [ENT] key to record your entry. Pressing [CLR] instead of [ENT] will cancel the entry. Note that the Hand-Held Programmer imposes a 16 bit limitation on the numbers sent to the Type B and C counters for PLC firmware version 1.02. The Hand-Held Programmer can only display numeric values between –32768 and +32767. Any number outside of this range will cause **OVRNGE** to be displayed. The full 32 bit range can only be configured using the COMREQ function (refer to Appendix A).

Screens 20, 28 - Low Limit

```
R0:04 HSC Vx.x  <s
LO LIM x: 0
```

These screens specify the lowest (most negative) value for the count accumulator. As with the other numeric values, the Hand-Held Programmer limits this to a 16 bit integer (Ç 32767).

Screens 21, 23, 29, 31 - ON Presets for Counters 1 and 2

```
R0:04 HSC Vx.x  <s
ON PS  xx: OVRNGE
```

Type B counters have two groups of preset values. This series of screens allows you to enter 16 bit values for these ON presets. In the screen example shown here, x.x represents the preset inputs for both counters 1 and 2. The numbers 1.1 represent Counter 1 - preset 1; 1.2 represents Counter 1 - preset 1; 2.1 represents Counter 2 - preset 1, and 2.2 represents Counter 2 - preset 2.

Screens 22, 24, 30, 32 - OFF Presets for Counters 1 and 2

```
R0:04 HSC Vx.x  <s
OFF PS  xx: 0
```

These screens allow you to enter the OFF preset values that correspond to the ON values described for the previous screen.

Screens 25, 33 - Preload values

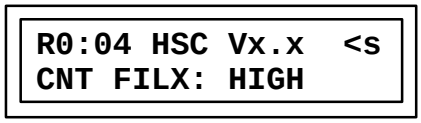
```
R0:04 HSC Vx.x  <s
PRELD x: 0
```

These screens are used to enter the preload values for the Type B counters.

Type C Counter Specific Screens

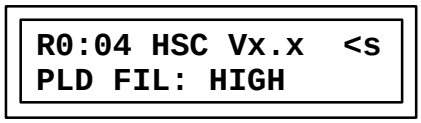
The following screens will be displayed when TYPE C is selected in Screen 1.

Screens 5, 6 - Count Filters Channel 1 and 2



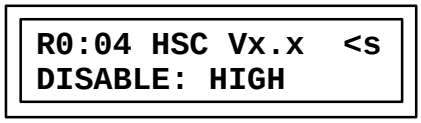
These screens allow you to specify the filters applied to the count inputs for the counter. The HIGH (2.5 microsecond) selection is used to filter out high frequency noise, while the LOW (12.5 millisecond) filter is used to remove additional low frequency noise.

Screen 7 - Preload Filters



This screen allows you to select the preload filters for the counter. As with the previous screens, the selection is either HIGH or LOW.

Screen 8 - Counter Disable Filter

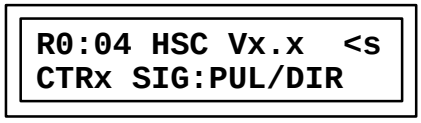


This screen allows you to select the disable input filter.

Screen 9 - Counter Mode

These screens allow you to select select the Counter Mode, either Continuous or One Shot, for the Type C counters.

Screens 10, 11 - Counter Signal Definitions



These screens allow you to select the type of input signals that channels 1 or 2 will accept. The available options are Pulse / Direction, Up / Down and A Quad B.

Screens 12, 13, 14 - Counter Strobe Edges

```
R0:04 HSC Vx.x  <s
STB EDGE x:POS
```

These screens to select the type of signal the counter strobe edges will respond to (Type C counters). This configuration selects whether the strobe edge will trigger on a positive-going or negative-going signal.

Note

Parameters associated with screens 1 to 14 are retained by the PLC in battery-backed RAM memory and are downloaded to the High Speed Counter each time the PLC powers up. The next series of screens (15 through 28) show additional parameters NOT retained by PLC Version 1.02 in battery-backed RAM memory. These parameters can be sent to the High Speed Counter via a COMREQ command. Refer to Appendix A for details on using the COMREQ function. Future PLC Versions (2.0 and greater) will save ALL parameters in battery-backed RAM.

Screen 15 - Time Base Value

```
R0:04 HSC Vx.x  <s
TIME BS: 1000
```

This screen allows you to enter the time base that is used to configure the counts per time base calculation. The default is 1000 milliseconds (1 second). To enter a new value, select the value using the numeric keys on the Hand-Held Programmer then press the [ENT] key to record the value.

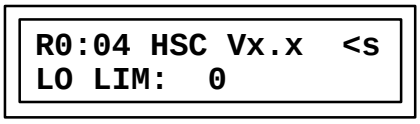
Screen 16 - High Limit

```
R0:04 HSC Vx.x  <s
HI LIM:   OVRNGE
```

This screen is used to specify the highest (most positive) value the count accumulator can reach. As with the time base, use the Hand-Held Programmer numeric keys to change the value, then press the [ENT] key to record it. Pressing [CLR] instead of [ENT] will cancel the entry. Note that the Hand-Held Programmer imposes a 16 bit limitation on the value sent to the Type B and C counters for PLC firmware version 1.02.

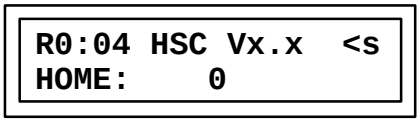
The Hand-Held Programmer can only display numeric values between –32768 and +32767. Any number outside of this range will cause **OVRNGE** to be displayed. The full 32 bit range can only be configured using the COMREQ function (refer to Appendix A).

Screen 17 - Low Limit



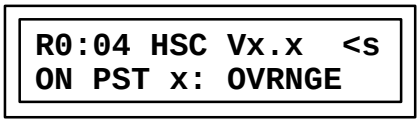
This screen specifies the lowest (most negative) value for the count accumulator. As with the other numeric values, the Hand-Held Programmer limits this value to a 16 bit integer (Ç 32767).

Screen 18 - Home Value



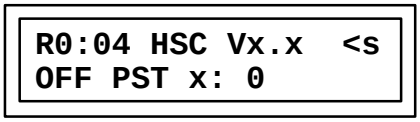
This screen specifies the Home position value. This value can be a 16-bit integer (Ç 32767) when using the Hand-Held Programmer. The default value for this parameter is 0. To achieve the full 32 bit range, configuration must be done using the COMREQ function.

Screens 19, 21, 23, 25 - ON Presets



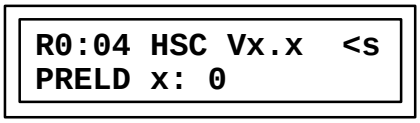
Type C counters have four groups of preset values. This series of screens prompts you to enter 16 bit values for each of the ON presets.

Screens 20, 22, 24, 26 - OFF Presets



These screens allow you to enter 16 bit values for the OFF preset values that correspond to the ON values described in the previous screen description.

Screens 27, 28 - Preload values



These screens are used to enter the preload values into the accumulator for the appropriate counter.

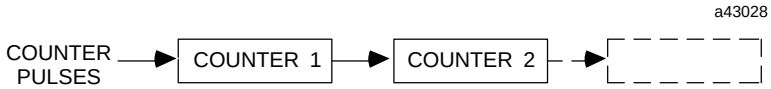
Appendix A Application Examples

This appendix contains descriptions of several typical applications using the Series 90-30 High Speed Counter. These application examples are:

- Counter Cascading
- Monitoring and Controlling Differential Speeds
- Direction-Dependent Positioning
- RPM Indicator
- Tolerance Checking
- Measuring Pulse Time
- Measuring Total Material Length
- Material Handling Conveyor Control
- Timing Pulse Generation
- Digital Velocity Control
- Dynamic Counter Preloading
- Carousel Tracking

Counter Cascading

Type A counters can be cascaded to accumulate greater count values than are possible with a single 2-byte counter. This can be accomplished by using the preset output of one counter for the count input of the next as shown below.

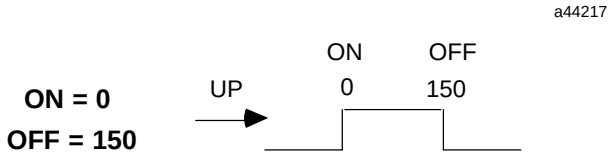


For example, if a 4-byte Up Counter is required, use two counters configured for the UP direction and:

1. Set the Count Limits for both counters at their maximum values:

   LOW = –32768 and HIGH = +32767

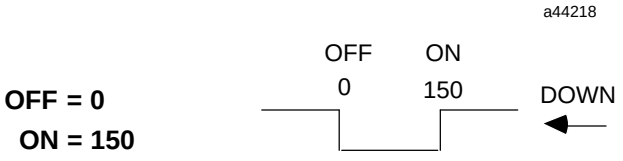
2. Set the output preset for counter 1 at:



3. Connect counter 1 output to the counter 2 input.

4. Connect the count pulse stream to the counter 1 input.

Similarly, Down Counters can be cascaded by configuring all counters for the Down direction, setting the limits at the maximum values and reversing the output presets. For example:



Monitoring and Controlling Differential Speeds

Many industrial applications require machines such as cutters, conveyors, or nip rolls to operate at precise differential speeds. The Type C counter, which could be used with a minimum of controller support is most suited for this application. Type A or Type B counters could also be used with the aid of a controller.

The pulses representing the speed of each machine can be separately fed into the plus and minus loops of the Type C counter. The accumulator will automatically track and indicate the difference in speed of the two machines. The sign of the accumulator value will indicate which pulse stream count is greater and the accumulator will indicate the total accumulated count difference. The Counts / Timebase register (CTB) will indicate the present rate difference and its sign indicates which is greater.

Depending on the count signal types, each channel of the counter can be independently programmed to operate in any of its three modes:

1. Pulse / Direction
2. Up / Down
3. A quad B

The sign (+ or –) and magnitude of the deviation from the desired difference can be used as feedback to provide automatic control for the speed regulation of the machines.

Direction-Dependent Positioning

Features Used :	Counter Type:
Single–Shot Mode	B
Preload Inputs	
Preset Outputs	

Some applications require direction-dependent positioning. An example is an operation where a crane on tracks has to perform certain maneuvers while traveling 100 feet in one direction and different ones while traveling 100 feet in the reverse direction.

This example uses the Type B configuration with two counters configured to operate in the A Quad B mode. Both counters should be driven by the same A Quad B signals and connected so they count in opposite directions when the crane is moving, as shown in Figure B-3 (Example of Terminal Connections).

The counter operating mode, limits and preload value can be set so that the preset outputs are direction sensitive. In this example, this is done by using the single-shot mode and preloading Counter 2 so that it only counts when the crane is moving in the reverse direction (right-to-left).

The counters are both preloaded at the start point and Counter 1 will count up from 0 to 100 for the left-to-right direction, and count down for travel in the right-to-left direction. Counter 2 will count up from (–100 to 0) only when the crane travels from right-to-left.

Table A-1. Counter Configurations

Parameter	Configuration
Counter Type	Type B (two counters)
Counter Operating Mode	A Quad B
Count Mode	one-shot (both counters), (non-continuous)
Counter 1 Preload	0
Counter 2 Preload	–100
Counter 1 Limits	0 to 100
Counter 2 Limits	–100 to 0

Table A-2. Operating Count Directions

Counter Number	Crane Direction	Count Direction
Counter 1	→	UP
Counter 2	→	Not counting
Counter 1	←	DOWN
Counter 2	←	UP

In this example, Counter 1 is configured with a preload value of 0. An ON condition for Preset 1 is selected which will turn on a loading device when the crane has traveled 75 feet to the right. Preset 2 (also for Counter 1) is selected to come on when the crane has traveled 100 feet to the right.

The direction of travel is reversed at the Stop point, and as the crane travels back from right-to-left, the ON Preset 1 of Counter 2 activates an unloading device when the crane has traveled 40 feet to the left (ON Preset is –60).

Finally, Preset 2 of Counter 2 turns its output on when the crane has traveled 75 feet to the left (ON Preset is –25).

The desired operation of the crane in this example is shown in the following figure.

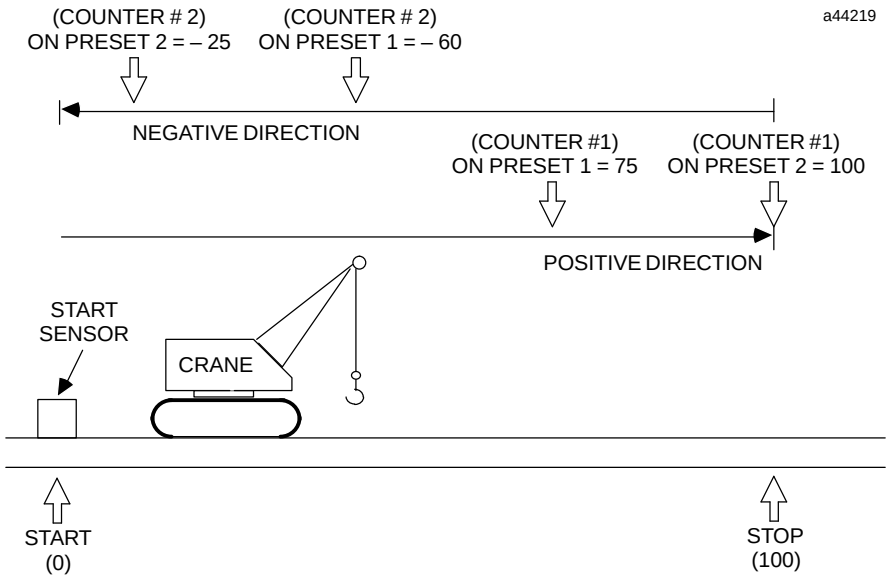


Figure A-1. Example of Direction-Dependent Sensing

OutputConditions

Counter1:	
Output 1	ON for Counter 1 y 75
	OFF for Counter 1 t 75
Output 2	ON for Counter 1 y 100
	OFF for Counter 1 <100
Counter2:	
Output 3	ON for Counter 2 v –60
	OFF for Counter 2 >–60
Output 4	ON for Counter 2 v –25
	OFF for Counter 2 >–25

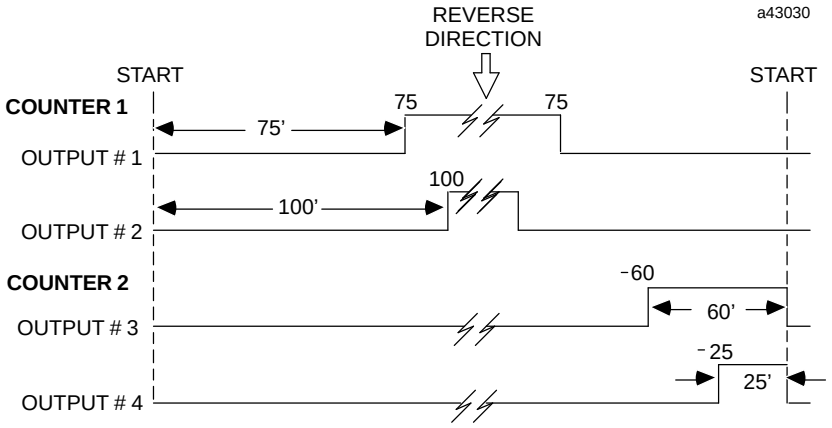


Figure A-2. Output Timing Conditions Example

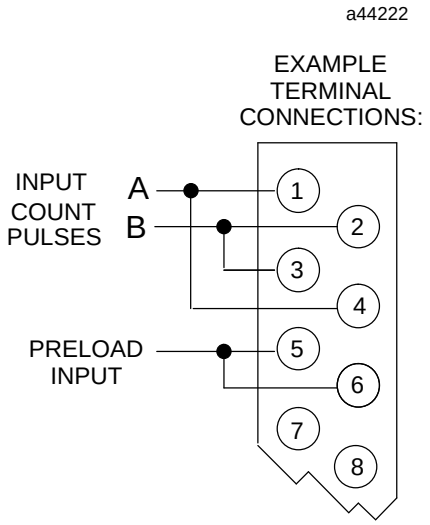


Figure A-3. Example of Terminal Connections

RPM Indicator

Feature Used:	Counter Types:
Counts/Timebase Register	A, B, C

The High Speed Counter can be used as a position / motion indicator when connected to a feedback device (such as an encoder) that is coupled to a rotary motion. RPM indication can be obtained directly from the counter's Counts / Timebase register (CTB) or derived from it by a simple calculation.

The RPM is given by:

$$RPM = \frac{CTB}{PPR} \times \frac{1}{T}$$

where: CTB = counts/timebase reading from the counter
PPR = pulses/revolution produced by the feedback device
T = timebase expressed in minutes

Note that if 1 / T divided by PPR is some integer power of 10, then the CTB register gives a direct reading of RPM with an assumed decimal placement. Longer timebase settings will give better RPM resolution. This is illustrated in the following examples.

Example 1

If feedback produces 1000 pulses / revolution, CTB reading = 5212, and the timebase is configured for 600 ms:

then T = 600 ms Ï 60000 ms / min = .01 and 1 / T = 100
RPM = 5212 Ï 1000 x 100 = 521.2

CTB reading is RPM with .1 RPM resolution.

Example 2

Assume the same conditions as example 1, except the timebase is now set to 60 ms, which gives

T = 60 Ï 60000 = .001 and 1 / T = 1000.

Since the motion is turning at the same speed as in example 1, the CTB reading now equals 521,

and RPM = 521 / 1000 x 1000 = 521.

CTB reading is now RPM with 1 RPM resolution.

Tolerance Checking

Features Used:	Counter Type:
Strobe Inputs with Positive/Negative Strobe Edge Configuration	B

Parts can be measured by a counter for tolerance checking. This can be accomplished by coupling a pulse feedback device to the transport conveyor to provide count inputs representing increments of movement to the measuring counter.

For this example, a Type B counter is used and the same part sensing signal is connected to both strobe inputs. The first strobe input is configured to be active on the leading edge and the second on the falling edge. Then as each part passes through the sensor, its length is indicated by the difference between the two strobe register readings. Multiplying the difference by the known distance represented by each pulse gives the length in measurement units for comparison against the allowable tolerance. Parts out of tolerance may be marked or diverted into a separate reject storage area.

An illustration of this application is shown below along with an example of field connections to the High Speed Counter's terminal board.

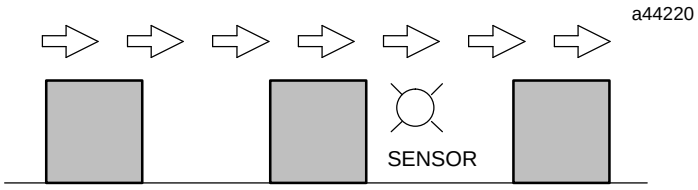


Figure A-4. Example of Tolerance Checking

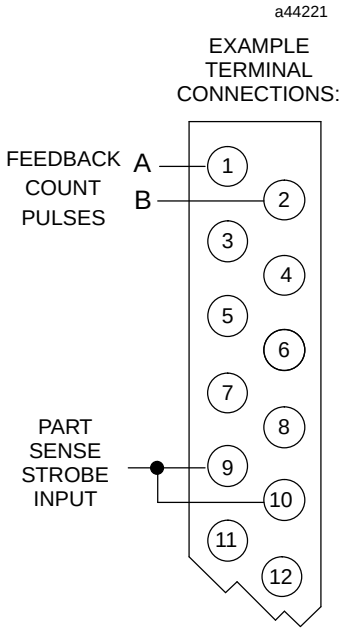


Figure A-5. Terminal Connections

Measuring Pulse Time

Features Used:	Counter Type:
Ref Osc Input	B
Strobe Inputs	

ON / OFFtime of input pulses can be accurately measured using the High Speed Counter. This can be done by configuring the Ref Osc input into Counter 1 and using the two Strobe inputs to capture the counter value on each of the input pulse edges.

For example, assume that an input pulse needs to be measured to the nearest 0.1 milliseconds; configure the High Speed Counter as follows:

```
Counter:  Type B
  Osc Freq Div = 66 (10 kHz)
  Osc IN 1 = ON (1)

For Counter 1:
  Mode = Continuous
  Strobe 1 Edge = Pos
  Strobe 2 Edge = Neg
```

Connect the pulse signal to both Strobe inputs. When the signal occurs, its duration (in tenths of ms) is now given by [Strobe Reg 2 – Strobe Reg 1] for positive going pulses or [Strobe Reg 1 – Strobe Reg 2] for negative going pulses.

Note that if the pulse spans the counter rollover point, the calculation becomes more complex, therefore it may be desirable to preload the counter to 0 shortly before the pulse is measured.

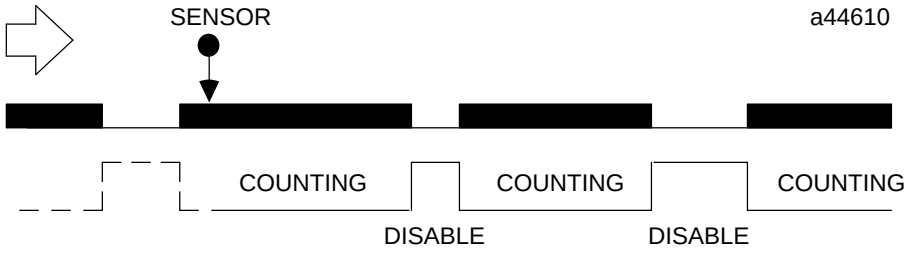
If only a positive-going pulse is measured, it could also be connected to the preload input. The Strobe Reg 2 reading would now give the pulse length directly.

Measuring Total Material Length

Features Used:	Counter Type:
Disable Input	B

The total length of multiple pieces of material, such as plate glass, plastic strips, or lumber, can be measured with the High Speed Counter.

This application uses an encoder geared to a transport conveyor to provide the count input increments, and a sensor to detect material as it passes.



The High Speed Counter should be configured for Type B counter operation.

Connect the encoder to the counter's Count Input. Connect the sensor to the Disable Input.

Count inputs from the encoder will increment the Accumulator only while a piece of material is passing through the sensor. The total length of all pieces will be accumulated until the counter is reset (Preloaded) for the start of a new batch. The application program can convert the count units from the accumulator to the actual units of length being measured.

Material Handling Conveyor Control

Features Used:	Counter Type:
Preset Outputs	B

When transported material must be stopped momentarily for inspection or modifications, the High Speed Counter's Preset outputs can control conveyor slowdown and stop points.

Use an encoder geared to the transport conveyor to provide the count input increments. Use a sensor to detect material as it passes on the conveyor.

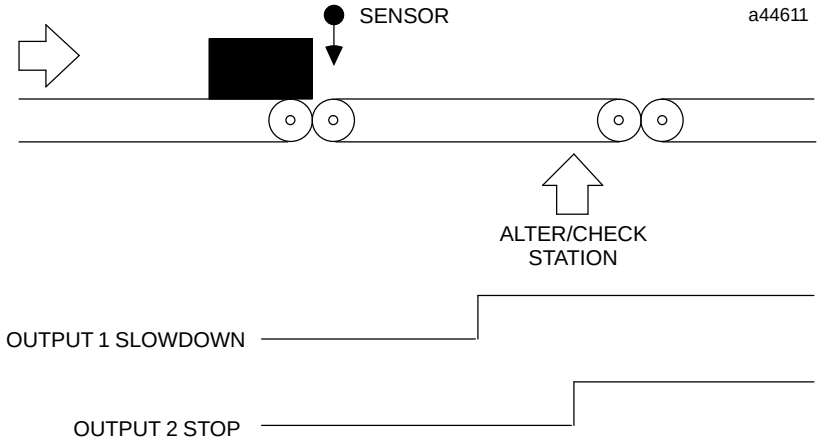
Determine where the material should begin to slow down, and where the material should stop. Find out how many encoder counts are equivalent to each of these two distances.

The High Speed Counter should be configured for Type B counter operation.

Configure Preset Output 1 to turn on at the slowdown point, by entering the number of counts from the sensor to the point where slowdown should begin.

Configure Preset Output 2 to turn on at the stop point, by entering the number of counts from the sensor to the inspection station.

Connect the sensor to the Preload Input of the counter to restart the counter at 0 for each piece of material that passes (only one piece can be between the sensor and the stop point in this configuration).



Timing Pulse Generation

Features Used:	Counter Type:
Ref Osc Input	A
Preset Output	

Applications requiring an accurate timing pulse can use the High Speed Counter to generate the pulse at the required frequency. The specified pulse width will be accurate to 0.5 msec of resolution.

Assume that a pulse of 50 msec duration is needed every 1/2 second. The High Speed Counter could be configured as follows to give the desired pulse output.

Counter type A

Oscillator Frequency Divider (N) =66 (10kHz)

Oscillator Frequency Input 1 = ON (1)

For counter 1:

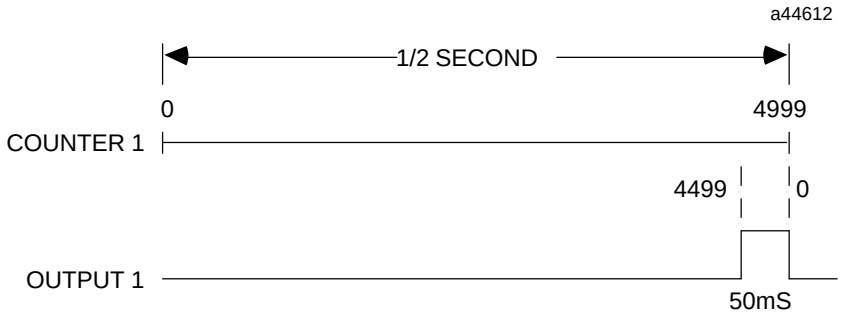
mode = continuous

high limit = 4999

low limit = 0

On Preset = 4499

Off Preset = 0



The counter's upper limit of 4999 represents 5000 counts, the number of counts in 1/2 second at 10kHz. (For this example, the Oscillator Frequency could also have been set to 1kHz. If that had been done, the upper limit would have been 499.)

Setting the lower limit to 0 establishes the counter start point for each output pulse period. The On Preset, 4499, determines that 4500 counts will pass before the beginning of the output pulse. Setting the Off Preset to 0 turns off the output pulse when the Accumulator reaches 5000 counts.

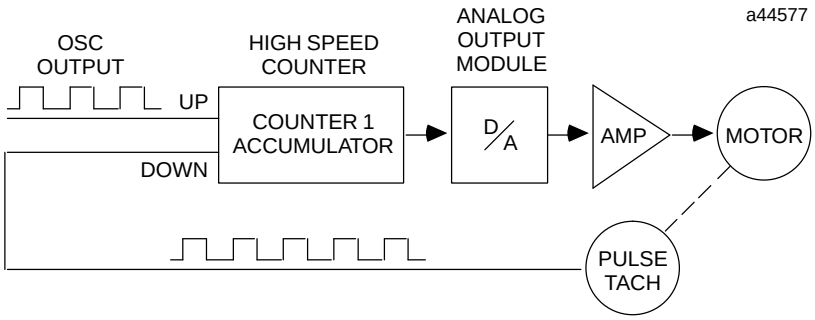
Digital Velocity Control

Features Used:	Counter Type:
Ref Osc Input	B
Up/Down Mode	

The High Speed Counter, together with an Analog Output module and a drive amplifier, can be used to provide accurate motor velocity control. The commanded velocity is generated by connecting the internal oscillator to the up count input of Counter 1.

The OSC input (or an external oscillator) provides a steady counting pulse to the up count input. The output of the counter provides the accumulator count value to the CPU. This data can be transferred by the CPU to an analog output module. An output from this module, in turn, controls the amplifier driving the motor.

During system operation, the motor's velocity can be changed by changing the frequency of the OSC output.



A pulse tachometer is connected to the block's down count input. This tachometer provides count pulses that are fed into the down count input of the same counter. As a result, the counter Accumulator reaches a stable value when the motor is turning at the commanded velocity.

Dynamic Counter Preloading

Feature Used:	Counter Type:
Home	C

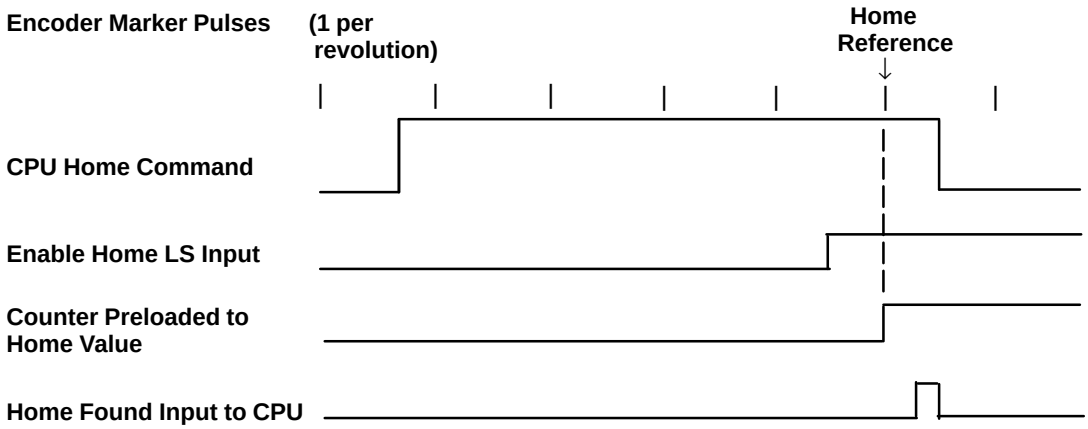
Applications using a High Speed Counter to track the position of a material conveyor or machine slide may need to be preloaded accurately at a given reference point while in motion. Simply connecting a limit switch to the counter's Preload Input does not give repeatable, accurate results because errors are introduced by:

1. Variations in the actuation point of the limit switch and
2. Preload Input Filter delay when actuated at different speeds.

For accurate repeatability, the Home feature of the Type C counter configuration should be used. This application requires a marker pulse (usually 1 per revolution) from the position feedback device (encoder). The limit switch should be placed so that it will be encountered approximately halfway between marker pulses. When the limit switch is reached, the next marker pulse causes the High Speed Counter to preload the Accumulator with the desired value. The limit switch should be connected to the High Speed Counter's Enable Home input.

The operation is as follows:

1. As the conveyor or slide moves toward the reference position, the CPU issues the Home Command (by setting output bit 14 to the High Speed Counter).
2. The Enable Home limit switch is actuated. This informs the High Speed Counter that the next marker pulse will be the reference marker.
3. When the next (reference) marker is reached, the High Speed Counter automatically transfers the Home value to the counter Accumulator.
4. The High Speed Counter informs the CPU that Home position has been found by setting input status bit 4.
5. The CPU may then clear the Home Command (output bit 14), causing the block to remove the Home Found indication.



Carousel Tracking

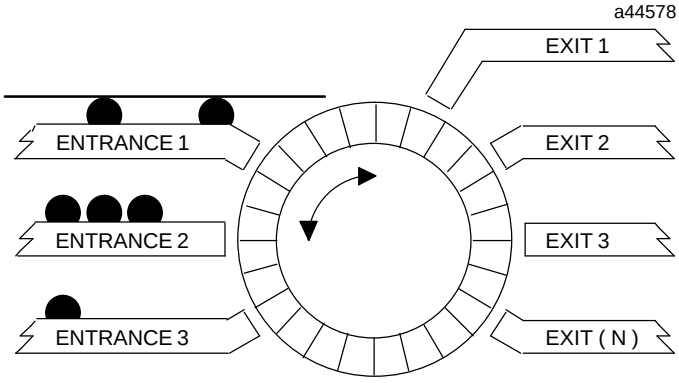
Features Used:	Counter Type:
Home Inputs	C
Strobe Inputs	
Continuous Mode	

Items stored in a rotating carousel can be tracked and retrieved using a High Speed Counter. A feedback device coupled to the carousel rotation can be used to provide up / down count inputs. The counter limits are configured so that the increments produced by one complete revolution of the carousel cause one full cycle of the counter.

Type C counter configuration is best for this application, since it provides a homing capability. The homing capability makes it possible to synchronize the counter with the carousel position at a defined home location after powerup. From then on, any rotation of the carousel is tracked by the counter. Since the relative location of all entrance and exit points to the home position is known, the CPU can record the pocket location of each item entering the carousel. It can command any pocket to any exit for item retrieval.

If there are up to 3 entrance points, a different Strobe Input can be used to indicate when a pocket is loaded from each entrance. When the CPU detects the Strobe Set flag, it can record the pocket position into a memory table and mark it full. (The CPU records the pocket position by reading the value from the Strobe Register, then adding or subtracting the entrance offset from the home location.)

To retrieve an item from a particular exit, the CPU can locate the nearest full pocket to that exit, and generate the required rotation command to the carousel.



Appendix B

High Speed Counter Summary

High Speed Counter %I Return Data

Bit	Type A	Type B	Type C
1	Strobe 1 flag	Strobe 1.1 flag	Strobe 1.1 flag
2	Strobe 2 flag	Strobe 1.2 flag	Strobe 1.2 flag
3	Strobe 3 flag	Strobe 2.1 flag	Strobe 1.3 flag
4	Strobe 4 flag	Strobe 2.2 flag	Home Found
5	Preload 1 flag	Preload 1 flag	Preload 1.1 flag
6	Preload 2 flag	Preload 2 flag	Preload 1.2 flag
7	Preload 3 flag	Disable 1 status	Disable status
8	Preload 4 flag	Disable 2 status	Home Input status
9	Output 1 status	Output 1.1 status	Output 1.1 status
10	Output 2 status	Output 1.2 status	Output 1.2 status
11	Output 3 status	Output 2.1 status	Output 1.3 status
12	Output 4 status	Output 2.2 status	Output 1.4 status
13	Module Ready	Module Ready	Module Ready
14	always off	always off	always off
15	always off	always off	always off
16	Error flag	Error flag	Error flag

High Speed Counter %AI Return Data

Word	Type A	Type B	Type C
1	Status Code	Status Code	Status Code
2	Cts/Tb 1	Cts/Tb 1	Cts/Tb 1
3	Cts/Tb 2	Cts/Tb 2	always 0000
4	Cts/Tb 3	Accumulator 1	Accumulator 1
5	Cts/Tb 4	Accumulator 1	Accumulator 1
6	Accumulator 1	Strobe Reg 1.1	Strobe Reg 1.1
7	Strobe Reg 1	Strobe Reg 1.1	Strobe Reg 1.1
8	Accumulator 2	Strobe Reg 1.2	Strobe Reg 1.2
9	Strobe Reg 2	Strobe Reg 1.2	Strobe Reg 1.2
10	Accumulator 3	Accumulator 2	Strobe Reg 1.3
11	Strobe Reg 3	Accumulator 2	Strobe Reg 1.3
12	Accumulator 4	Strobe Reg 2.1	always 0000
13	Strobe Reg 4	Strobe Reg 2.1	always 0000
14	always 0000	Strobe Reg 2.2	always 0000
15	always 0000	Strobe Reg 2.2	always 0000

High Speed Counter %Q Output Data

Bit	Type A	Type B	Type C
1	Reset Strobe 1 flag	Reset Strobe 1.1 flag	Reset Strobe 1.1 flag
2	Reset Strobe 2 flag	Reset Strobe 1.2 flag	Reset Strobe 1.2 flag
3	Reset Strobe 3 flag	Reset Strobe 2.1 flag	Reset Strobe 1.3 flag
4	Reset Strobe 4 flag	Reset Strobe 2.2 flag	not used
5	Reset Preload 1 flag	Reset Preload 1 flag	Reset Preload 1.1 flag
6	Reset Preload 2 flag	Reset Preload 2 flag	Reset Preload 1.2 flag
7	Reset Preload 3 flag	not used	not used
8	Reset Preload 4 flag	not used	not used
9	Enable Output 1	Enable Output 1.1	Enable Output 1.1 status
10	Enable Output 2	Enable Output 1.2	Enable Output 1.2 status
11	Enable Output 3	Enable Output 2.1	Enable Output 1.3 status
12	Enable Output 4	Enable Output 2.2	Enable Output 1.4 status
13	not used	not used	not used
14	not used	not used	Home Command
15	Clear Error	Clear Error	Clear Error
16	not used	not used	not used

High Speed Counter Data Commands

Command		Definition
Dec	Hex	
01	01	Load Accumulator n
02	02	Load Hi Limit n
03	03	Load Lo limit n
04	04	Load Acc Increment n
05	05	Set Ctr n Direction (A only)
06	06	Load Timebase n
08	08	Load Home Position (C only)
11	0B	Load ON Preset n.1
12	0C	Load ON Preset n.2 (B,C only)
13	0D	Load ON Preset n.3 (C only)
14	0E	Load ON Preset n.4 (C only)
21	15	Load OFF Preset n.1
22	16	Load OFF Preset n.2 (B,C only)
23	17	Load OFF Preset n.3 (C only)
24	18	Load OFF Preset n.4 (C only)
31	1F	Load Preload n.1
32	20	Load Preload n.2 (C only)
50	32	Load Osc Freq Div

Error Codes (%AI Word 1)

Code	Description
0	No errors
1	Unused
2	Unused
3	Invalid Command
4	Invalid Parameter
5	Invalid Sub–Command
6	Invalid Counter Number
7	Reserved
8	Reserved
9	Reserved
10	Home Position Error
11	Counter 1 Limit Error
12	Counter 2 Limit Error
13	Counter 3 Limit Error
14	Counter 4 Limit Error

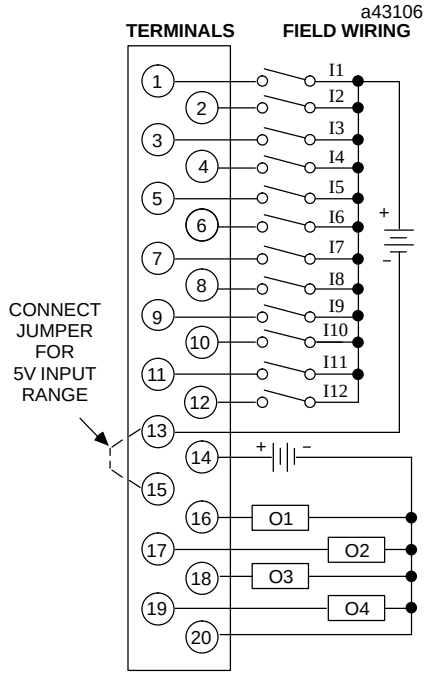


Figure B-1. Field Wiring for High Speed Counter

The following table defines which terminals to use for the type of counter selected during module configuration.

Table B-1. Pin Assignments for Each Counter Type

Pin Number	Signal Name	Pin Definition	Use in Counter Type		
			Type A	Type B	Type C
1	I1	Positive Logic Input	A1	A1	A1
2	I2	Positive Logic Input	A2	B1	B1
3	I3	Positive Logic Input	A3	A2	A2
4	I4	Positive Logic Input	A4	B2	B2
5	I5	Positive Logic Input	PRELD1	PRELD1	PRELD1.1
6	I6	Positive Logic Input	PRELD2	PRELD2	PRELD1.2
7	I7	Positive Logic Input	PRELD3	DISAB1	DISAB1
8	I8	Positive Logic Input	PRELD4	DISAB2	HOME
9	I9	Positive Logic Input	STRB1	STRB1.1	STRB1.1
10	I10	Positive Logic Input	STRB2	STRB1.2	STRB1.2
11	I11	Positive Logic Input	STRB3	STRB2.1	STRB1.3
12	I12	Positive Logic Input	STRB4	STRB2.2	MARKER
13	INCOM	Common for positive logic inputs	INCOM	INCOM	INCOM
14	OUTPWR	DC+ Power for positive logic outputs	OUTPWR	OUTPWR	OUTPWR
15	TSEL	Threshold select, 5V or 10 to 30V	TSEL	TSEL	TSEL
16	O1	Positive Logic Output	OUT1	OUT1.1	OUT1.1
17	O2	Positive Logic Output	OUT2	OUT1.2	OUT1.2
18	O3	DC– Positive Logic Output	OUT3	OUT2.1	OUT1.3
19	O4	Positive Logic Output	OUT4	OUT2.2	OUT1.4
20	OUTCOM	Common for positive logic outputs	OUCOM	OUTCOM	OUTCOM

A

B

C

D

E

F

H

U

V

W