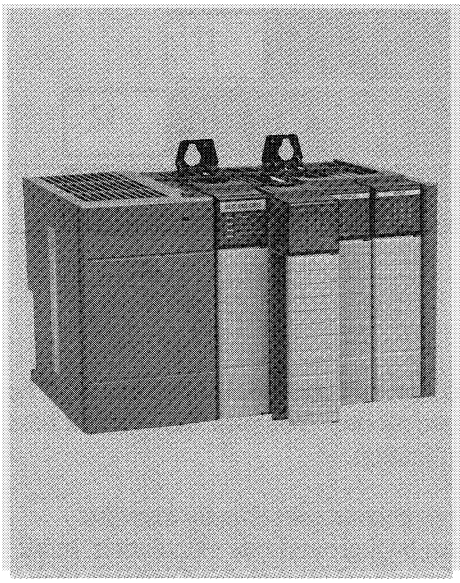
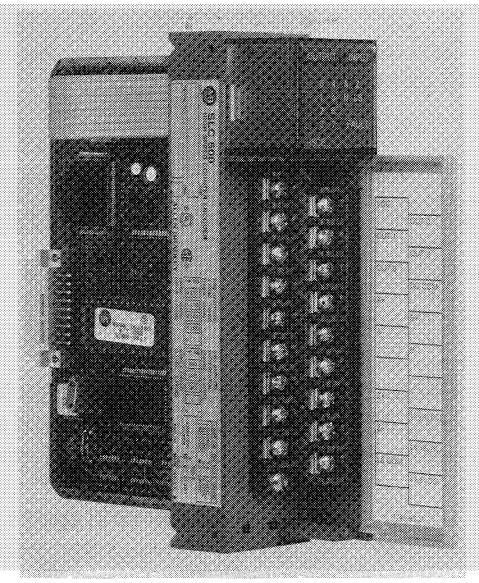
ALLEN-BRADLEY

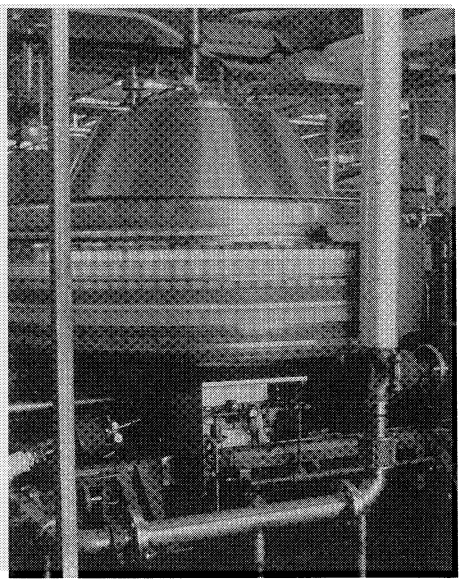
High-Speed Counter Module

(Catalog Number 1746-HSCE)

Product Data







Expand the application spectrum of the SLC 5/02 processor with high–speed counting. The High–Speed Counter Module, Catalog Number 1746–HSCE, is used in control applications where the ability to detect high–speed machine or process motion is critical. The 16–bit counter of the module can accept bidirectional input pulse frequencies of up to 50 kHz from encoders and other high–speed switching devices. Typical applications for the module include packaging, material handling, flow monitoring, cut–to–length, motor speed control and machining.

Realize high–speed counting performance with on–board output control. To perform the actual control, the module has 4 on–board open collector (current sink) outputs, which can be controlled independent of the SLC processor scan by the module. Translated into control applications, this means a faster throughput time, a more streamlined manufacturing process and — the bottom line — increased yield.

The module also has 4 "soft" outputs. A soft output refers to status bits within the module that can be examined by your user program and used as outputs.

Features and Benefits

Choose from three modes of operation. The module supports Range, Rate, and Sequencer Modes. You pick the one that best meets the requirements of your SLC application.

Obtain the rate of input pulses in cycles per second (Hz) directly from the module. The module provides transparent background rate calculation in all modes of operation. This feature saves processor memory and reduces scan time because the processor does not have to make calculations in the user program. Rate information is desirable when it is necessary to display this data for the operator, or take control action based on machine or process rate.

Change critical control parameters while the module is actively counting pulses. This feature lets you make control adjustments based on changing conditions. The result: improved system performance and reduced downtime.

Reset the accumulated counter of the module from multiple sources. You can reset the counter from any one, or any combination of three selectable sources: Limit Switch input, Z-pulse input, or Soft Reset (user program).

Use with a variety of incremental encoders and other input sensors. This capability provides system flexibility, plus saves application time and resources. The module can directly interface with 5V dc encoders or pulse elements having a single-count pulse train with direction control, quadrature (rotary pulse), or individual count up/count down pulse trains. In addition, x2 and x4 counting modes are provided to fully utilize the capabilities of high-resolution quadrature encoders.

The module also accepts several different wiring configurations, such as single-ended sinking, single-ended sourcing, or differential for improved electrical noise immunity. To interface with 12V dc or 24V dc devices, pull-up resistors are used.

For a complete solution, use the High-Speed Counter Module with the following Allen-Bradley encoders.

Compatible Allen-Bradley Encoders

Compatible Encoders	Power Supply Voltage	Differential (5V)	Source	Open Collector (Sinking)
845E	5V, 8–12V	•		•
845F	5V, 8–15V	•		•
845H	5V, 8–15V	•		•
845K	5V, 8–15V	•	•	•
845L	5V, 8–12V	•		•
845P	5V	•		
845T	5V, 11–30V	•	•	•

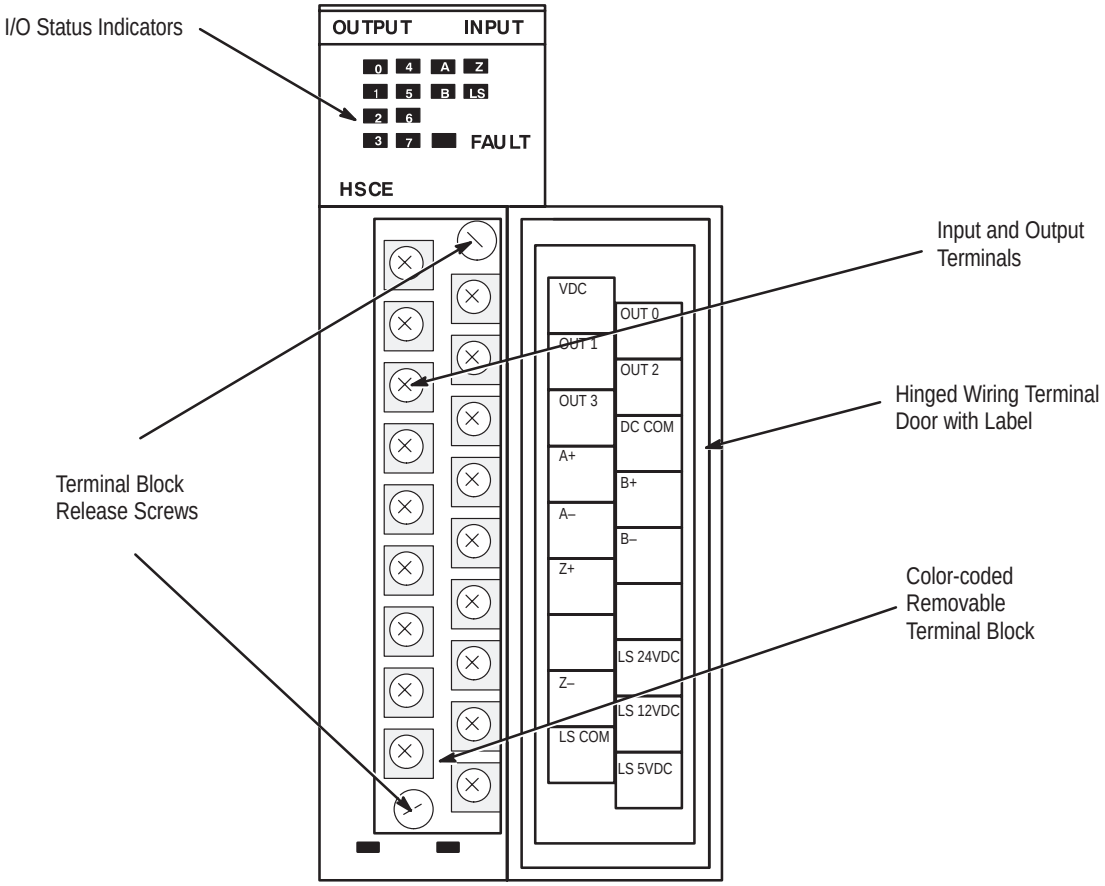
What's Inside ... **page**

Module Overview

The High-Speed Counter Module, Catalog Number 1746-HSCE, is an SLC 5/02™ processor (or later) compatible module. The following subsections detail the features and control capabilities of the module.

Hardware Features

Install the module like any other SLC 500™ discrete I/O or specialty module. Input and output wiring terminals are located on the front of the module, behind the terminal cover. The removable terminal wiring block eliminates the need to rewire a module if it is removed from the rack. Input and output diagnostic/status LEDs provide local indication of counter inputs and outputs for ease of troubleshooting.

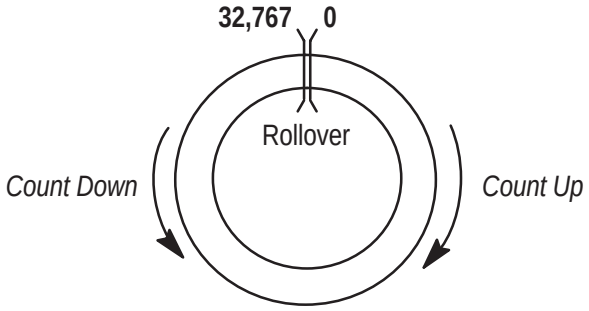


Counter Types

The High-Speed Counter Module supports two counter types: ring and linear.

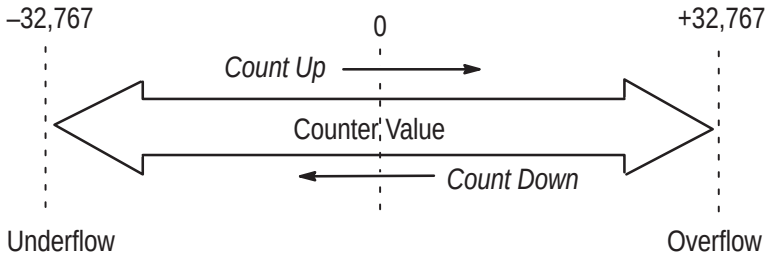
Ring Counter

The ring counter has a bidirectional count range of 0 to 32,767. Within this range you can set the rollover (maximum count value) for any point. Reset is possible from any combination of Limit Switch input, Z-input, and Soft Reset.



Linear Counter

The linear counter is a bidirectional counter with a count range between –32,767 to 32,767 counts. Overflow/underflow detection and indication is provided if the count value should go above or below the allowable range. It can be reset to zero or any user-defined value. Reset is possible from any combination of Limit Switch input, Z-input, and Soft Reset.



Counter Input Types

The High-Speed Counter Module supports three types of counter inputs.

- *Pulse and Direction:* Pulse inputs from channel A are counted. You can control the count direction by either the signal level at channel B, or by the user program.
- *Up/Down Pulse:* With this input type, the counter increments on the rising edge of pulses applied to channel A and decrements on the rising edge of pulses applied to channel B.
- *Quadrature:* Pulse inputs from channels A and B are counted. Phase angles between signals determine the count direction.

Programming and Monitoring Options

You can program and monitor the module using:

- SLC 500 A.I. Series Programming Software – Catalog Number 9323–S5300D, V6.06 or above
- Advanced Programming Software (APS) – Catalog Number 1747-PA2E, V2.01 or above
- a Hand-Held Terminal (HHT) – Catalog Number 1747-PT1 with 1747-PTA1E, V2.00 or above

Operating Modes

The High-Speed Counter Module provides 4 physical and 4 soft outputs that let you control your application in one of three modes:

Range Mode

In the Range Mode, you specify a group of count ranges and define the outputs that are to be active when the Accumulated Count value is within each range. (Ranges can overlap.) In this mode, the module offers:

- up to 12 ranges
- input rate calculation
- ring or linear counter operation
- dynamically configurable ranges

Rate Mode

In the Rate Mode, you define a group of rate ranges and corresponding outputs. When the Rate Measurement is within each defined range, the corresponding outputs are active. In this mode, the module offers:

- Rate Periods from 10 ms to 2.55 seconds
- input rates up to ±32,767 Hz
- up to 12 rate ranges
- ring or linear counter operation
- dynamically configurable Rate Period and range values

Sequencer Mode

In the Sequencer Mode, you define a sequence of presets and a series of corresponding output patterns. As the Accumulated Count passes the next preset, the outputs are updated to the corresponding pattern. In the Sequencer Mode, the module offers:

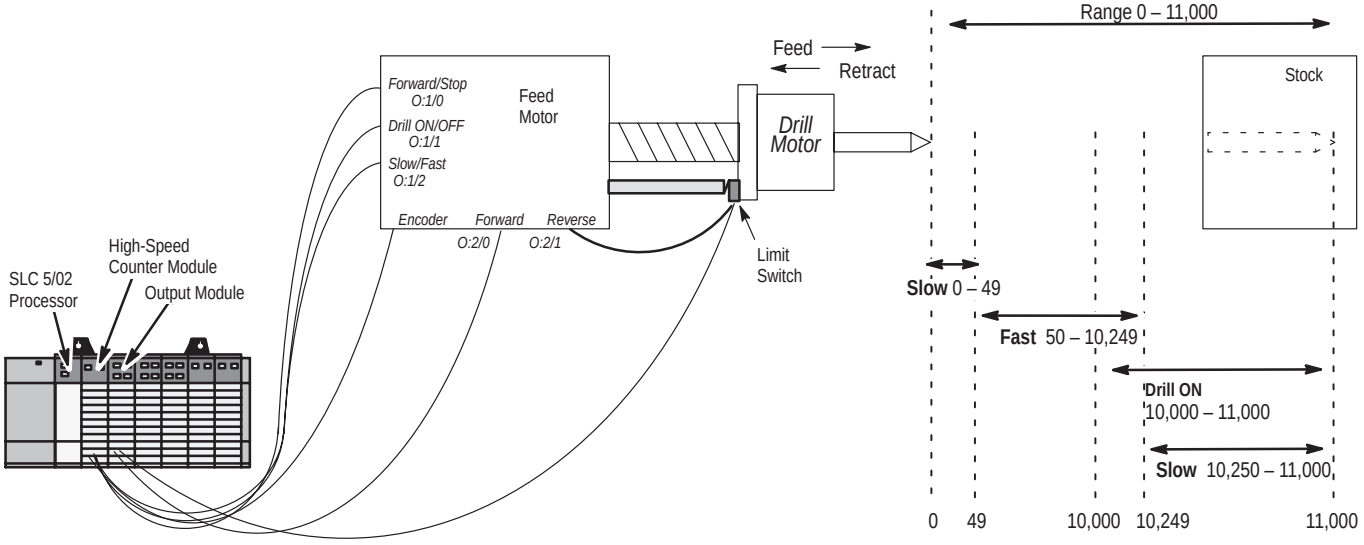
- up to 24 discrete steps
- automatic restart at the end of each sequence
- dynamically configurable steps
- ring or linear counter operation
- direct processor control of unused outputs
- input rate calculation

Typical Applications

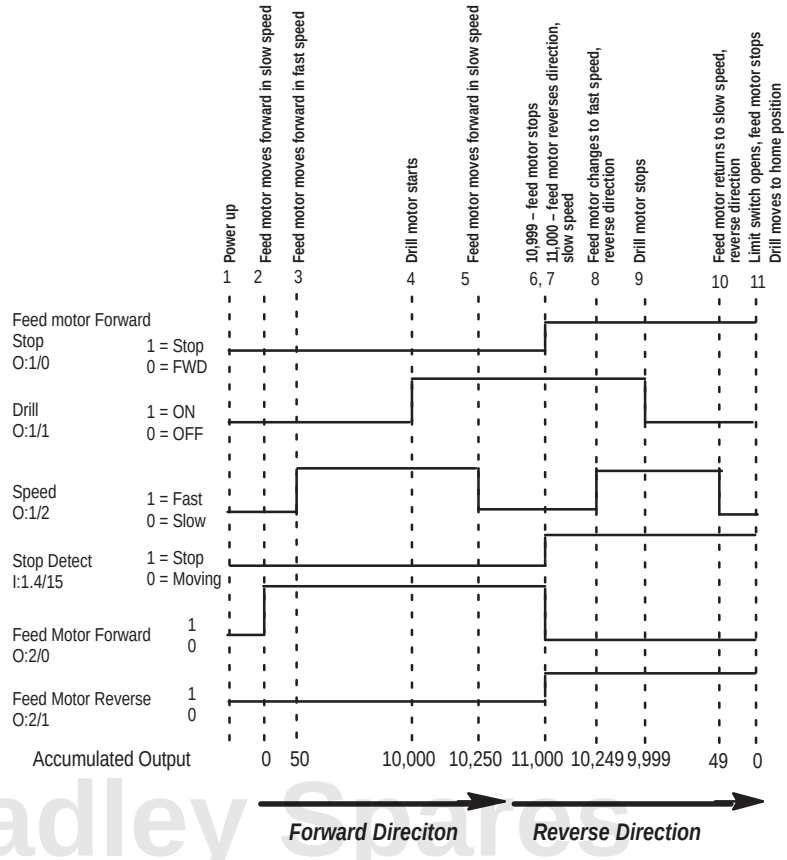
The following three pages show generic applications using each of the three modes of the module: range, rate, and sequencer.

Range Mode

Below is an example application using the Range Mode with linear counter function.

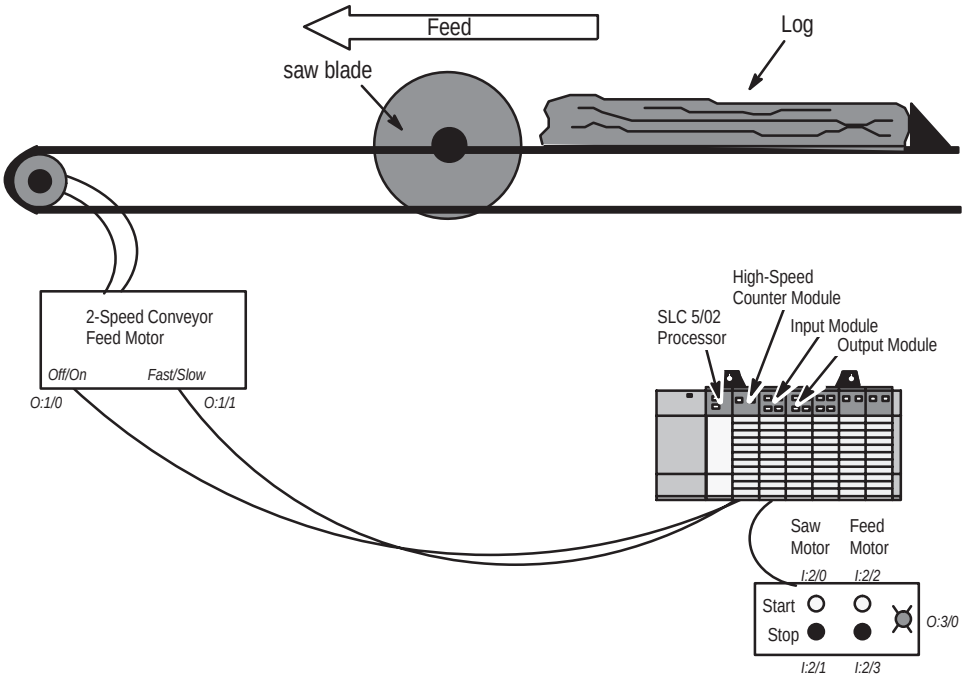


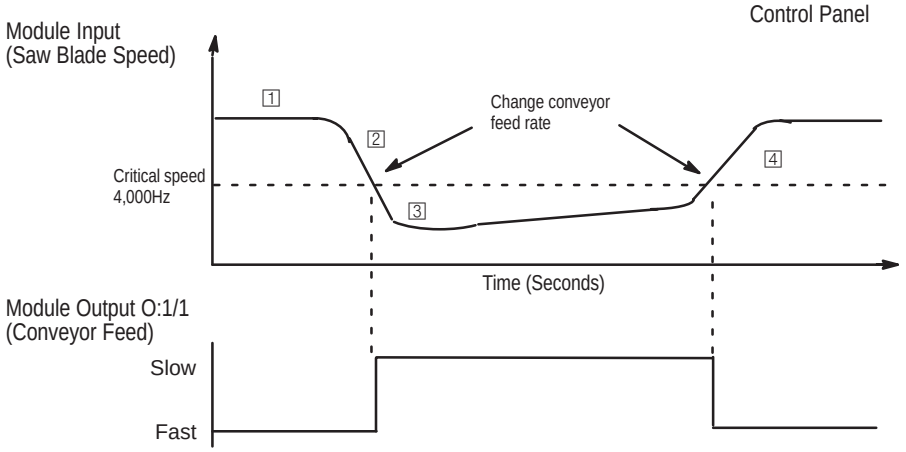
Range	Explanation
0	Drill is in the home position.
1–49	Feed motor moves forward at slow speed.
50–10,249	Drill moves forward at fast speed. At 10,000 counts, the drill rotates.
10,250	Feed motor returns to slow speed.
10,999	FWD stop output disables forward motion of the feed motor. Drill motor still rotates.
11,000	Feed motor is in slow speed, reverse direction.
10,249	Feed motor enters the fast speed.
9,999	Drill motor turns off.
1–49	Feed motor moves at slow speed.
0	Limit switch opens; feed motor stops; drill moves to its home position



Rate Mode

Below is an example application using the Rate Mode with linear counter function. This example uses two conveyor speeds. More steps can be added to slowly ramp the conveyor speed.



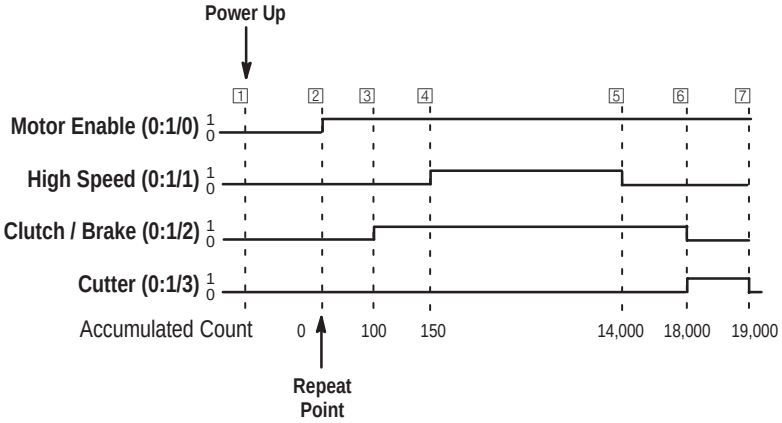


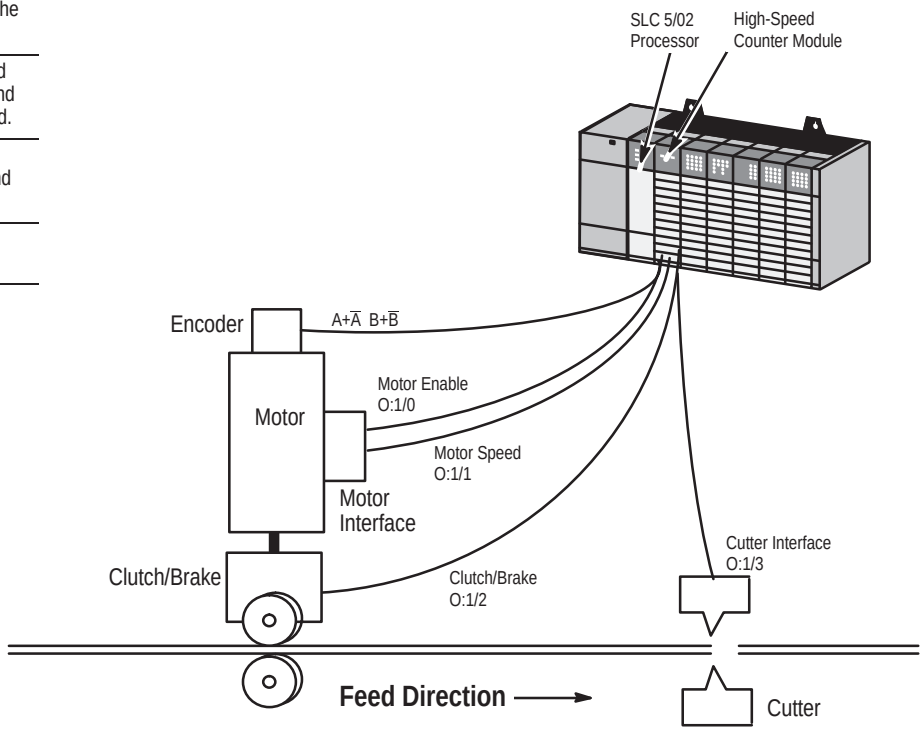
Rate	Explanation
1	The conveyor feeds a log into the saw blade at a fast rate.
2	The saw blade encounters an irregularity that causes the saw blade to slow down. The Slow Feed lamp illuminates.
3	The module detects the saw blades reduced speed and reduces the conveyor feed rate.
4	The saw blade clears the irregularity and returns to its normal cutting speed. The module increases the conveyor feed rate.

Sequencer Mode

Below is an example application using the Sequencer Mode with the linear counter function. The machine feeds a metal strip that is cut to a specific length by the saw. The initial outputs are set to 0.

Sequence	Explanation
1	The brake is enabled, the clutch is disengaged, and the cutter is retracted.
2	When the user program starts the motor, the encoder sends pulses to the high-speed module.
3	After 100 counts, the sequencer releases the brake which engages the clutch.
4	At count 150, the high-speed motor output is energized and the motor switches to high speed.
5	At count 14,000, the high-speed motor output is de-energized and the motor switches to low speed.
6	At count 18,000, the brake is enabled (clutch disengages) and the cutter is energized.
7	At 19,000 counts, the cutter is de-energized.





Operating Specifications

The following tables detail the operating specifications for the High-Speed Counter Module.

General

Description	Specification
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% without condensation
Backplane Current Consumption (power supply loading)	320 mA at +5V 0 mA at +24V
Maximum Cable Length①	305 m (1000 ft)
Agency Certification	• CSA certified • CSA Class I, Division 2 Groups A, B, C, D certified • UL listed • CE compliant for all applicable directives when product or packaging is marked

① Belden 9503 or equivalent

Inputs A, B, and Z

Specification	Differential (Switch 1 on)	Single Ended (Switch 1 off)
Input Voltage	±5V dc	0 to 5V dc①
On-State Voltage	2.8 to 4.5V dc	3.1 to 5.5V dc
Off-State Voltage	–5.5 to 0.8V dc	0 to 0.8V dc
Max Off-State Leakage Current	100 µA	600 µA
Input Current (mA)	2.5 mA at 2.8V dc 7.5 mA at 4.5V dc	2.5 mA at 3.1V dc 7.5 mA at 5.5V dc
Nominal Input Impedance	700Ω	825Ω
Min. Pulse Width	10 µs	
Min. Phase Separation②	4.5 µs	
Max. Input Frequency	Sequencer and Range Modes: 50k Hz, Rate Mode: 32.767k Hz	
Isolation (from backplane)	1500 volts	

① 12 and 24 volts must be used with a pullup resistor

② Channel A to channel B

Limit Switch Input

Specification	5V dc	12V dc	24V dc
On-State Voltage	3.8 to 5.4V dc	9.4 to 16.5V dc	16.5 to 30V dc
Off-State Voltage	0 to 1.2V dc	0 to 2.4V dc	0 to 3.9V dc
Input Current	4.6 mA (minimum) 6.8 mA (nominal) 9.2 mA (maximum)		
Max. Off-State Leakage Current	1 mA (all ranges)		
Isolation (from backplane)	1500 volts		

Outputs (Open Collector, Sinking)

Specification	4.5 to 10V dc (Switch 2 on)	10 to 30V dc (Switch 2 off)
Max. On-State Output Current	16 mA at 4.5V dc 40 mA at 10V dc	40 mA at 10V dc 125 mA at 30V dc
Max. On-State Voltage Drop	0.4V dc	1.0V dc
Max. Off-State Leakage Current	100 µA	
Isolation (from backplane)	1500 volts	

Timing Information

The following table provides the timing operations for the High-Speed Counter Module.

Operation	Description	Timing①		
		Range	Rate	Sequence
Throughput	The delay time between the module receiving a pulse and the updating of its physical outputs.	3.9 ms	70.0 ms + Rate Period	1.8 ms
Minimum wait time between range boundaries	Minimum amount of time (between range or step boundaries) required to ensure a range or sequencer step is not missed.	3.0 ms	70.0 ms + Rate Period	2.5 ms
Input file update time	The time required for the module to make a change of input status (I:e.0 to I:e.7) available to the user program.	60 ms	35 ms	45 ms
Physical output response time (under SLC control)	The time required for the module's Direct Outputs Field to respond to control commands from the user program.	60 ms	35 ms	45 ms
Z input reset response time. (reset to zero 0)	The time required for the module to respond to an external Z input event and reset the pulse counter to 0.	4.0 µs②		
Z input reset response time. (reset to a value other than 0)	The time required for the module to respond to an external Z input event and reset the pulse counter to a value other than 0.	500 µs②		
Limit switch reset response time. (reset to 0)	The time required for the module to respond to an external limit switch event and reset the pulse counter to 0.	1.0 ms with 300 µs filter② 15.0 ms with 10 ms filter②		
Limit switch reset response time. (reset to a value other than 0)	The time required for the module to respond to an external limit switch event and reset the pulse counter.	1.0 ms with 300 µs filter② 15.5 ms with 10 ms filter②		
Soft Reset response time (reset to 0 or value other than 0)	The time required for the module to respond to a soft reset event (i.e. issued from the user program) and reset the pulse counter to 0 or a value other than 0.	55 ms②	35 ms③	40 ms②
Counter Hold response time	The time required for the module to respond to a Counter Hold command issued from the user program.	50 ms	35 ms③	35 ms
Count Direction response time via user program	The time required for the module to respond to an Up/Down Count Direction change issued from the user program.	55 ms	35 ms	40 ms
Dynamic Parameter response time (worst case)	The amount of time the module needs to reconfigure data after its Dynamic Parameters have been changed.	110 ms	65 ms	110 ms
Module set up time (worst case)	The time required for the module to respond to counts received *after* the false-to-true transition of the Function Control bit.	200 ms		
Minimum time between resets via Z input	The minimum time between Z input resets to ensure a reset response.	3.5 ms	NA	2.0 ms
Minimum time between resets via limit switch with 300 µs filter	The minimum time between limit switch resets required to ensure a reset response using the 300 µs filter.	3.5 ms	NA	2.0 ms
Minimum time between resets via limit switch with 10 ms filter	The minimum time between limit switch resets required to ensure a reset response using the 10 ms filter.	17.5 ms	NA	14.0 ms

NA = Not Applicable

① Excludes SLC scan time.

② If counts occur at the module's inputs during a reset, they may be lost for the amount of time equal to the reset response time.

③ Rate counter not affected.

Allen-Bradley Support

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