Installation Instructions

High-Speed Counter Module

(Catalog Numbers 1746-HSCE)

Inside . . .

Publication 1746-IN011B-EN-P - April 2001

Hazardous Location Considerations

This equipment is suitable for use in Class I, Division 2, Groups A, B, C, D or non-hazardous locations only. The following WARNING statement applies to use in hazardous locations.

WARNING

EXPLOSION HAZARD

- Substitution of components may impair suitability for Class I, Division 2.
- Do not replace components or disconnect equipment unless power has been switched off or the area is known to be non-hazardous.
- Do not connect or disconnect components unless power has been switched off or the area is known to be non-hazardous.
- All wiring must comply with N.E.C. article 501-4(b).

Environnements dangereux

Cet équipement est conçu pour être utilisé dans des environnements de Classe I, Division 2, Groupes A, B, C, D ou non dangereux. La mise en garde suivante s'applique à une utilisation dans des environnements dangereux.

AVERTISSEMENT

DANGER D'EXPLOSION

- La substitution de composants peut rendre cet équipement impropre à une utilisation en environnement de Classe I, Division 2.
- Ne pas remplacer de composants ou déconnecter l'équipement sans s'être assuré que l'alimentation est coupée.
- Ne pas connecter ou déconnecter des composants sans s'être assuré que l'alimentation est coupée.

High-Speed Counter Module Overview

The High-Speed Counter Module, Catalog Number 1746-HSCE is an SLC 500 family compatible device. It can be used with SLC 5/02 (and above) processors.(1)

The module's bidirectional counting ability allows it to detect movement in either direction. In addition, x2 and x4 counting modes are provided to fully use the capabilities of high-resolution quadrature encoders.

High-speed inputs from quadrature encoders and various high-speed switches are supported. Accepting input pulse frequencies of up to 50k Hz allows precise control of fast motions.

In addition to providing an Accumulated Counter, the module provides a Rate Counter to determine Rate Measurement by indicating the pulse input frequency in Hz. (Refer to the block diagram on the following page.) The Rate Measurement is determined by accumulating input pulses over a fixed period of time. You set the Rate Period to best match your application requirements.

Background Rate calculation is provided in Sequencer and Range Modes. This operation accepts input rates up to 32,767 Hz. The dynamically configurable Rate Period ranges from 10 ms to 2.55 seconds.

The module's four current sink (open collector) outputs can be controlled from one of two sources:

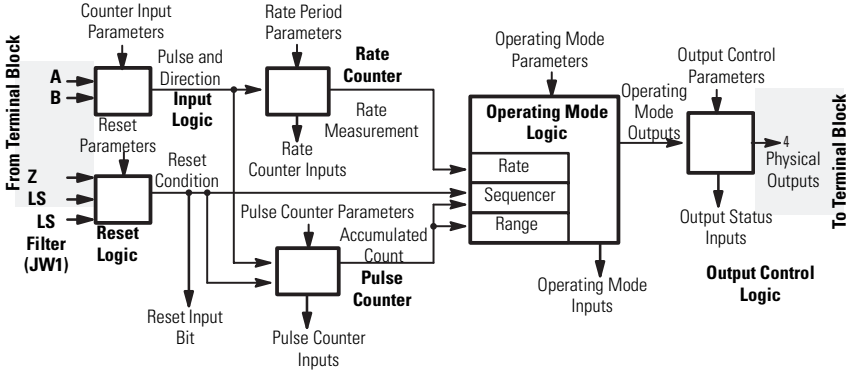
- the user program
- the module

Control of the counter reset is configured through user-set parameters. The counter can be reset from any combination of the Z input, Limit Switch input, or Soft Reset control bits.

Module operation is determined by selections made in the Setup and Control Word (M0:e.1). Setting the Function Control bit to 1 triggers the module to start the proper pulse counter, rate measurement, and output control functions. Many parameters are dynamic and can be changed without disrupting counter operation.

A block diagram of the module is shown below. Inputs from the terminal block enter the diagram at the left, outputs to the terminal block exit at the right. M0 and Output file parameters from the SLC enter the logic blocks from the top. Input file data to the SLC exit the logic blocks from the bottom.

(1) The 1746-HSCE High-Speed Counter Module is not compatible with the 1747-ASB Remote I/O Adapter Module.



Counter Input Parameters

Input Type (MO:e.1/9-11)
Up/Down Count Direction (MO:e 1/3) -d

Reset Parameters

Soft Reset bit (MO:e. 1/4) -d
Reset Mode (MO:e.1/5-7)

Rate Period Parameters

Rate Period (MO:e.9/0-7 or MO:e.16/0-7) -d

Operating Mode Parameters

Operating Mode (MO:e.1/14-15)
Function Control Bit (MO:e.1/12)
Range Definitions:
- Range Starting Values(MO:e.10-33) -d
- Range Ending Values (MO:e.10-33) -d
- Range Outputs (MO:e. 3-8) -d
- Valid Ranges (MO:e.2) -d

Sequencer Definitions
- Valid Steps (MO:e.2 and MO:e.3/0-7) -d
- Step Presets (MO:e.17-40)
- Step Outputs (MO:e.4-15)
- Initial Outputs (MO:e.3/8-15) -d
- Sequencer Reset (MO:e.1/0) -d

Critical Error (I:e.0/10)
Configuration Error bit (I:e.0/11)
Configuration Error Code (I:e.4/0-7)

Output Status Inputs (I:e.4/8-15)

Error Inputs

Critical Error (I:e.0/10)
Configuration Error Bit (I:e.0/11)
Configuration Error Code (I:e.4/0-7)

Pulse Counter Parameters

Reset Value (MO:e.34 or MO:e.41) -d
Max. Count Value (MO:e.34 or MO:e.41
Counter Hold bit (MO:e.1/2) -d
Counter Type bit (MO:e.1/13)

Output Control Parameters

Direct Outputs (O:e.0/0-7) -d
Output Source Select (MO:e.0/0-7) -d
Enable Outputs bit (MO:e.1/1) -d

Rate Counter Inputs

Rate Valid (I:e.0/3)
Rate Counter Overflow (I:e.0/4)
Rate Measurement Overflow (I"e.0/5)
Zero Rate Period Count (I:e.0/2)
Rate Period Count (I:e.2)
Rate Measurement (I:e.3)

Pulse Counter Inputs

Accumulated Count (I:e.1)
Overflow/Underflow (I:e.0/13)
Pulse Counter State (I:e.0/14-15)

Operating Mode Inputs

Sequencer Inputs
- Current Sequencer Step (I:e.5/0-7)
- Next Sequencer Step (I:e.5/8-15)
- Sequence Done (I:e.0/6)

Range inputs
- Ranges Active (I:e.6/0-11)

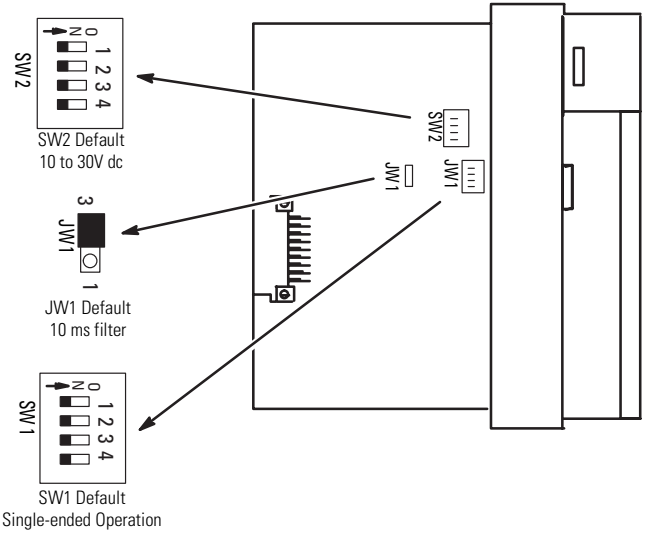
-d indicates a dynamic parameter

Dip Switch and Jumper Locations

Two dip switches (SW1 and SW2) and one jumper (JW1) are located on the side of the module.

- SW1 selects the type of input (single ended or differential).
- SW2 selects the output voltage range (4.5 to 10V dc or 10 to 30V dc).
- JW1 selects the filtering rate (300 µs or 10 ms) used to debounce the limit switch input.

Default settings are shown below:

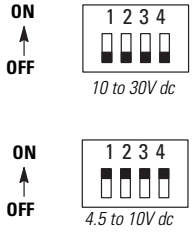


ATTENTION

Use a small screwdriver to change dip switch positions. Graphite from pencils will damage the switch.

SW2 Settings

Select an output voltage range that coincides with your supply voltage. The selections are 4.5 to 10V dc or 10 to 30V dc.



Switch	1	2	3	4
Output	0	1	2	3

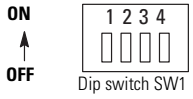
ATTENTION

All switches of SW2 must be ON or *all* switches must be OFF. Permanent damage may result if some are ON and some are OFF.

Operating in the 10 to 30V dc range with the switches set for the 4.5 to 10V dc range damages the module.

SW1 Settings

Select an input connection, single-ended or differential.



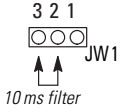
Switch	1	2	3	4
Channel	A	B	Z	not used

Position	Input Connection	Input ON Range
ON	differential	2.8 to 4.5V dc
OFF	single-ended	3.1 to 5.5V dc

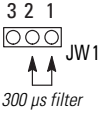
It is possible to configure different inputs in different modes. For example, input A (CHA) can be configured as differential and input Z (CHZ) can be configured as single-ended.

JW1 Settings

Select 300 µs or 10 ms filtering to debounce the limit switch input. Position the jumper as follows:



10 ms filter



300 µs filter

The LS input allows you to make a direct connection to nominal voltage levels of 5, 12, or 24V dc. The ON voltage ranges are as follows:

Wiring Terminal	ON range
LS (24V dc)	16.5 to 30V dc
LS (12V dc)	9.4 to 16.5V dc
LS (5V dc)	3.8 to 5.5V dc

See page 17 for limit switch wiring instructions.

ATTENTION

Connect only one LS input range at a time, or the module will be damaged.

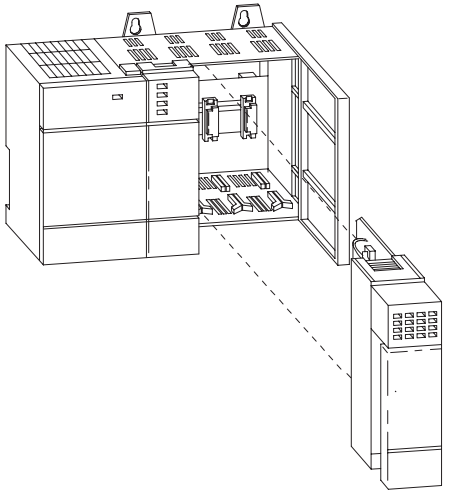
Installing the Module

Installation procedures for this module are the same as any other discrete I/O or specialty module.

IMPORTANT Set the dip switches before installing the module.

ATTENTION Disconnect power before attempting to install, remove, or wire the module.

Make sure your SLC power supply has adequate reserve current capacity. The module requires 320 mA at 5V dc.



1. Align the full-size circuit board with the chassis card guide. The first slot of the first chassis is reserved for the CPU.

2. Slide the module into the chassis until the top and bottom latches are latched. To remove the module, press the releases at the top and bottom of the module and slide it out.

3. Make sure the removable terminal wiring block is attached to the module and all wires are connected to the terminal block.

4. Insert the cable tie in the slots and secure the cable.

5. Cover all unused slots with the Card Slot Filler, Catalog Number 1746-N2.

Removing the Terminal Block

The removable terminal wiring block eliminates the need to rewire a module if it is removed from the chassis. Each terminal accepts two #14 AWG wires.

ATTENTION

Disconnect power before attempting to install, remove, or wire the removable terminal wiring block.

To avoid cracking the removable terminal block, alternate the removal of the slotted terminal block release screws.

Remove the terminal block by turning the slotted terminal block release screws counterclockwise. The screws are attached to the terminal block, so it will follow as the screws are turned out.

Wiring the Removable Terminal Block

The terminal screws can be turned with flat or cross slot screwdrivers. Each screw should be turned tight enough to immobilize the wire's end. Overtightening can strip the terminal screw. The torque applied to each screw should not exceed 0.7 to 0.9 Nm (6 to 8 in-lbs.).

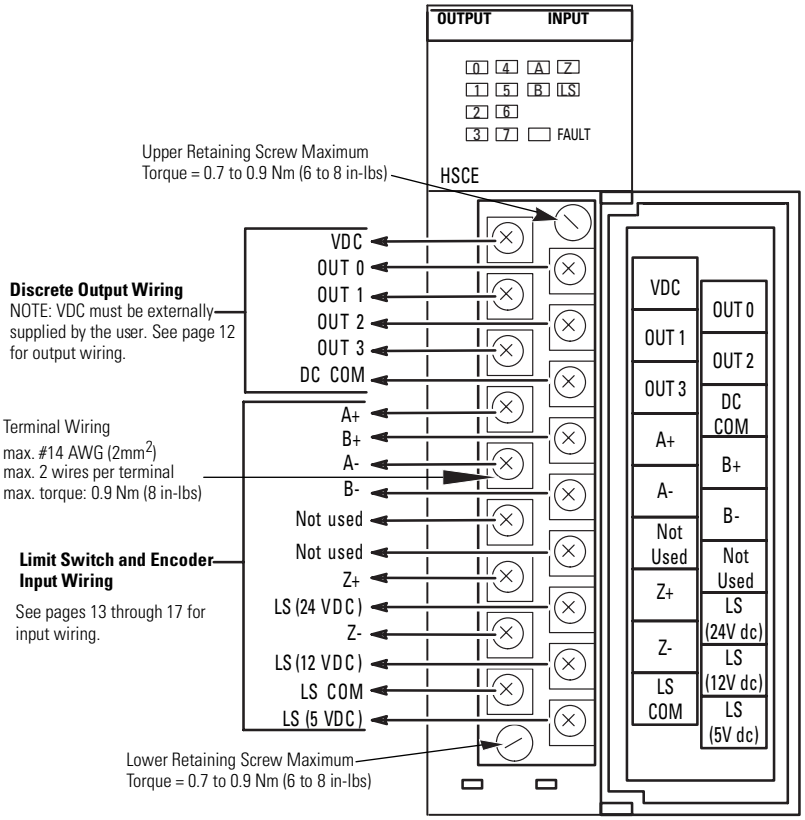
Important Wiring Considerations

Use the following guidelines when planning the system wiring for the module:

- Install the SLC 500 system in a NEMA-rated enclosure.
- Disconnect power to the SLC processor and the module before wiring.
- Make sure the SLC 500 system is properly grounded.
- Group this module and low-voltage DC modules away from AC I/O or high-voltage DC modules.
- Shielded cable is required for high-speed input signals A, B, and Z. We recommend Belden 9503 or equivalent for lengths up to 305 m (1000 ft).
- When the LS input is driven by an electromechanical device, route the wiring away from other inputs. In addition, JW1 should be set for the 10 ms filter.
- When the LS input is driven by a solid-state device, use a shielded cable. You *do not* have to route the cable away from other inputs.
- Shields should be grounded only at the end of the signal source end of the cable. Ground the shield to the case of the signal source, so energy coupled to the shield will not be delivered to signal source's electronics.

Input and Output Connections

Input and output wiring terminals are located on the front of the module, behind the terminal cover. When you connect input and output devices, you must also be concerned with the settings of dip switch SW1 (input connections), dip switch SW2 (output connections), and jumper JW1 (limit switch input connections). The location and description of these are shown on pages 5 through 7.



Outputs

The module provides four physical outputs. They can be controlled by the module when certain counter conditions are met, or they can be controlled from the user program (refer to *High-Speed Counter Module User Manual,* publication 1746-6.5 for M0:e.0 information).

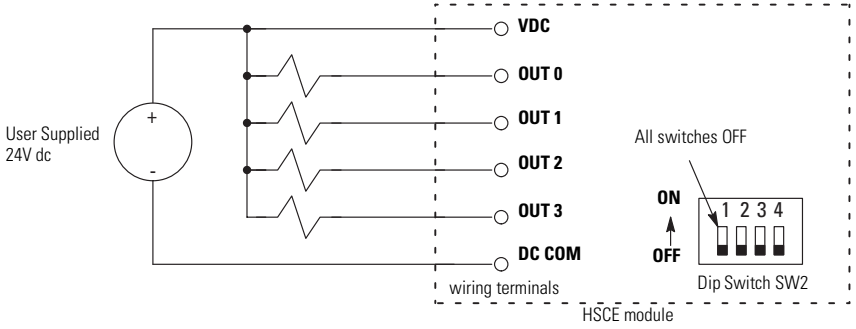
The outputs are bipolar transistors connected in a sinking (open collector sinking) configuration. When the output is energized, it sinks the current.

ATTENTION

Do not use incandescent lamps as output indicators. The high peak inrush current required to heat the filament can damage the module's output circuits. Use LED type indicators that satisfy the output circuit ratings, such as Allen-Bradley 800A and 800T LED indicators.

You can select an output voltage range of 4.5 to 10V dc or 10 to 30V dc. Refer to page 19 for the maximum current specifications for each voltage range. Dip switch SW2, located on the PC board, is used to select the voltage range. See pages 5 and 6 for switch SW2 location and settings.

The figure below indicates wiring connections for four 24V dc outputs. Switches of SW2 are OFF for this output voltage.

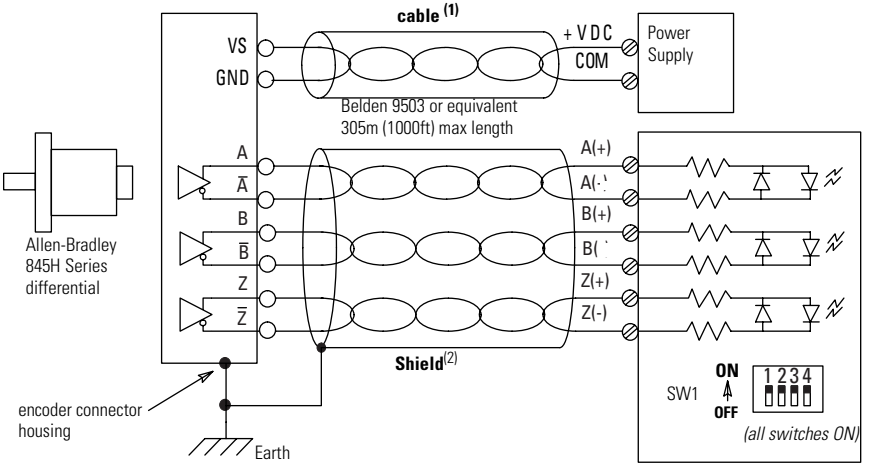


The outputs are *not* electrically isolated from each other. (They are referenced to the same output common terminal.) However, outputs are isolated from the rest of the circuitry to a level of 1500 volts.

Encoders

The wiring diagrams on the following pages are provided to support the Allen-Bradley encoders you may already have. Differential encoders provide the best immunity to electrical noise. We recommend, whenever possible, to use differential encoders.

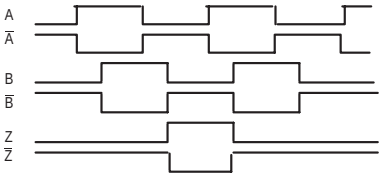
Differential Encoder Wiring



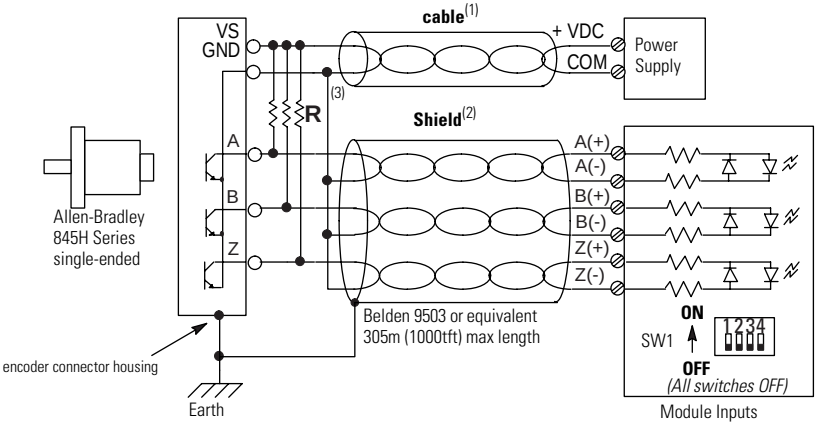
(1) Refer to your encoder manual for proper cable type and length.
(2) Due to the topology of the module's input circuits, terminating the shield at the encoder end provides the highest immunity to EMI interference. Connect EARTH ground directly to the encoder connector housing.

Differential Encoder Output Waveforms

The illustration below shows the different encoder output waveforms. If your encoder matches these waveforms, the encoder signals can be directly connected to the associated screw terminals on the module. For example, the A lead from the encoder is connected to the module's A+ screw. If your encoder does not match these waveforms, some wiring modifications may be necessary. Refer to the *High-Speed Counter Module User Manual*, publication 1746-6.5 for a description of these modifications.



Single-Ended Encoder Wiring (Open Collector)



(1) Refer to your encoder manual for proper cable type and length.

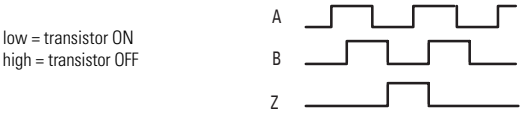
(2) Due to the topology of the module's input circuits, terminating the shield at the encoder end provides the highest immunity to EMI interference. Connect EARTH ground directly to the encoder connector housing.

(3) The pullup resistor (R) value depends on the power supply value (VS). The table below lists the resistor values for typical power supply values. These resistors must be located at the encoder end of the cable.

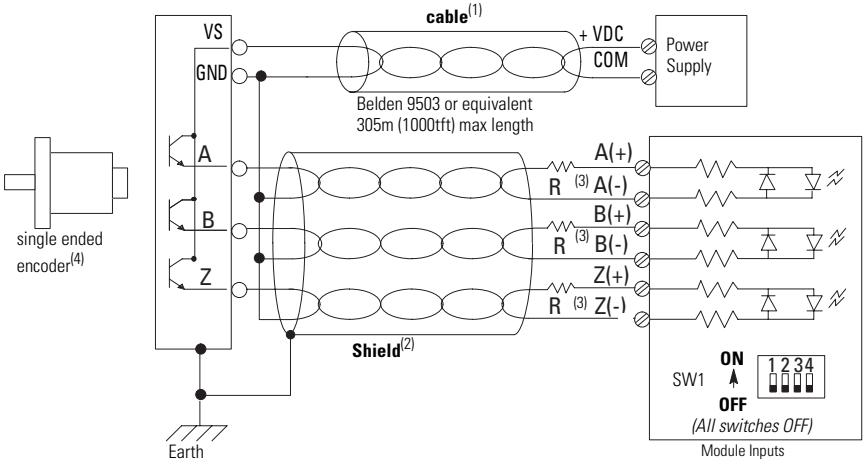
VS Value	R Value	Maximum Output Leakage
+5V dc	150 ohm 1/4W 5%	6.3 mA
+12V dc	1800 ohm 1/4W 5%	1.5 mA
+24V dc	4700 ohm 1/4W 5%	1.2 mA

Single-Ended Encoder Output Waveforms

The figure below shows the single-ended encoder output waveforms. When the waveform is low, the encoder output transistor is ON.



Single-Ended Encoder Wiring (Sourcing)



(1) Refer to your encoder manual for proper cable type and length.

(2) Due to the topology of the module's input circuits, terminating the shield at the encoder end provides the highest immunity to EMI interference. Connect EARTH ground directly to the encoder connector housing.

(3) The resistor (R) value depends on the power supply value (VS). The table below lists the resistor values for typical power supply values. These resistors must be located at the encoder end of the cable.

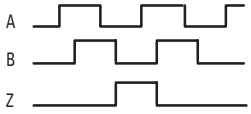
(4) The Allen-Bradley 845H sourcing encoder is not compatible with this module.

VS Value	R Value	Maximum Output Leakage
+5V dc	no resistor needed	6.3 µA
+12V dc	1800 ohm 1/4W 5%	1.5 µA
+24V dc	4700 ohm 1/4W 5%	1.2 µA

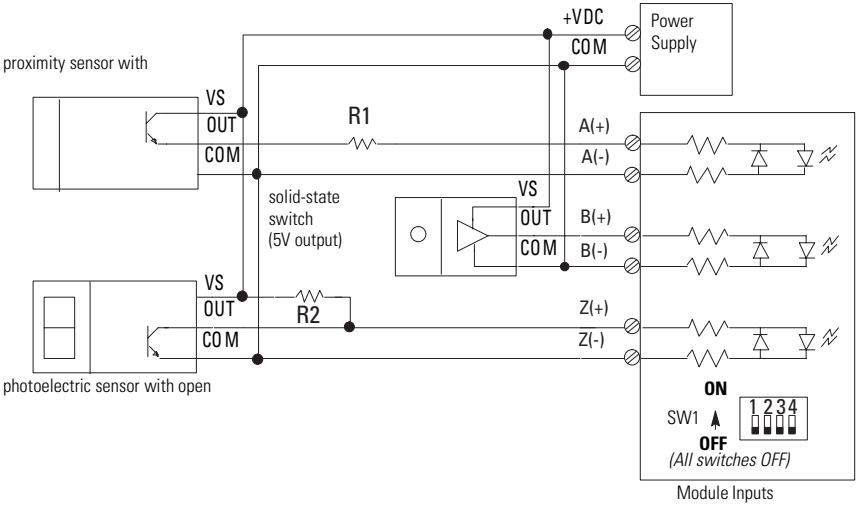
Single-Ended Encoder Output Waveforms (Sourcing)

The figure below shows the single-ended encoder output waveforms. When the waveform is low, the encoder output transistor is OFF.

low = transistor OFF
high = transistor ON



Single-Ended Wiring (Discrete Devices)



IMPORTANT

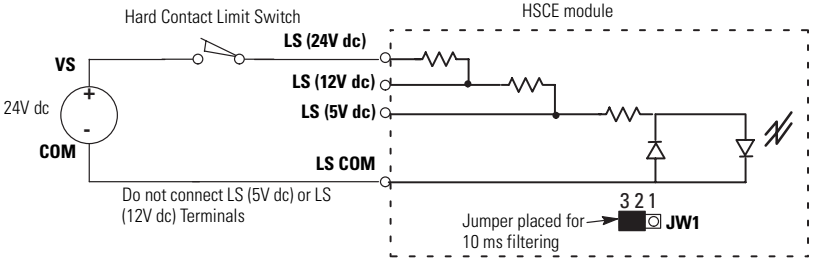
- This diagram shows the sensors operation from a common power supply. Separate power supplies for each circuit can be used.
- The resistor (R1) value depends on the power supply value (VS). The table below lists the resistor values for typical power supply values. These resistors must be located at the module end of the cable.
- The pullup resistor (R2) value depends on the power supply value (VS). The table below lists the resistor values for typical power supply values. These resistors must be located at the sensor end of the cable.

Limit Switch Wiring

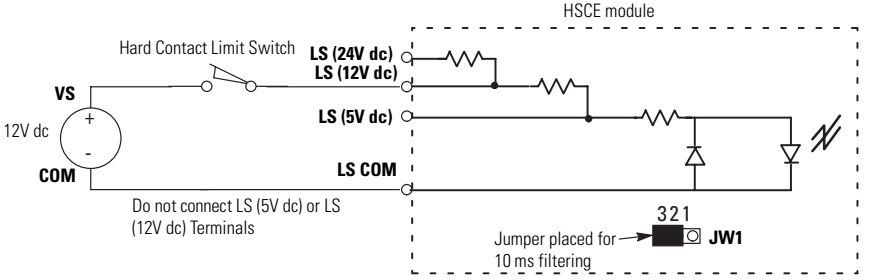
ATTENTION

Connect only one LS input range at a time, or the module will be damaged.

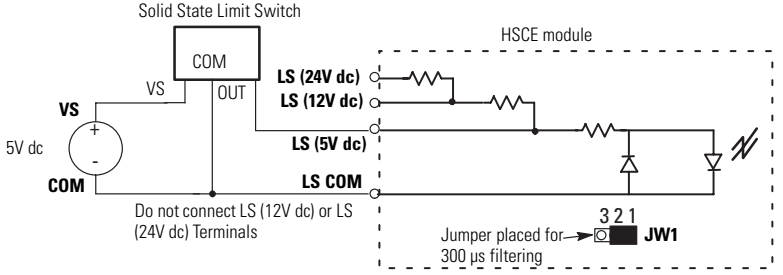
24V dc Hard Contact



12V dc Hard Contact



5V dc Solid State



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% without condensation
Backplane Current Consumption (power supply loading)	320 mA at +5V dc 0 mA at +24V dc
Maximum Cable Length(1)	305 m (1000 ft)
Agency Certification (when product or packaging is marked)	• CSA certified • CSA Class I, Division 2 Groups A, B, C, D • UL listed • CE marked for all applicable directives

(1) Belden 9503 or equivalent

Inputs A, B, and Z

	Differential (Switch 1 on)	**Single Ended (Switch 1 off)**
Input Voltage	±5V dc	0 to 5V dc(2)
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 Separation(1)	4.5 µs	
Max. Input Frequency **Sequencer and Range Rate**	 50k Hz 32.767k Hz	
Isolation (from backplane)	1500 volts	

(1) Channel A to channel B
(2) 12 and 24 volts must be used with a pull-up resistor.

Limit Switch Input

	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 **minimum** **nominal** **maximum**	 4.6 mA 6.8 mA 9.2 mA		
Max. Off-State Leakage Current	1 mA (all ranges)		
Isolation (from backplane)	1500 volts		

Outputs (Open Collector, Sinking)

	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	

For More Information

For	Refer to this Document	Pub. No.
A more detailed description on how to configure and program the High-Speed Counter Module.	High-Speed Counter Module User Manual	1746-6.5
A more detailed description on how to install and use your modular SLC 500 system.	SLC 500 Modular Hardware Style Installation and Operation Manual	1747-6.2
A reference manual that contains status file data, instruction set, and troubleshooting information.	SLC 500 Instruction Set Reference Manual	1747-6.15
A CD-ROM containing both of the manuals listed above, plus the: • SLC 500 Analog I/O Modules User Manual • Discrete I/O Modules Installation Instructions • Discrete I/O Modules Product Data	SLC 500 Literature Collection on CD-ROM	1747-CD1-1

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