



**S664**

**Frequency Counter  
Operation Manual**



## About this Manual

To the best of our knowledge and at the time written, the information contained in this document is technically correct and the procedures accurate and adequate to operate this instrument in compliance with its original advertised specifications.

## Notes and Safety Information

This Instruction Manual contains warning headings that alert the user to check for hazardous conditions. These appear throughout this manual where applicable, and are defined below. To ensure the safety of operating performance of this instrument, these instructions must be adhered to.



**Warning, refer to accompanying documents.**

**Attention, consulter les documents d'accompagnement.**



**Caution, risk of electric shock.**

**Attention, risque de choc électrique.**

## Technical Assistance

SIMPSON ELECTRIC COMPANY offers assistance Monday through Friday 8:00 am to 4:30 pm Central Time by contacting Technical Support or Customer Service at (715) 588-3311. Internet: <http://www.simpsonelectric.com>

## Warranty and Returns

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory or other article of equipment which shall within one (1) year after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service centers, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sales of its products.

This warranty shall not apply to any instrument or other article of equipment which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service centers, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

Under the normal field usage there is no need to remove the front bezel of this product. The front bezel of this product should only be removed by a qualified technician.

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# 1 Product Description



## 1.1 General Description

The S664 frequency counter fits a 1/8 DIN standard cutout and is perfect for tight spaces, extending only 3.24" (82mm) behind the panel.

The unit is UL listed. The unit is for indoor use at altitudes up to 2000m, temperatures between 0° and 40°C, and installation category III, pollution degree 2.

The counter is powered from 120 or 240 VAC.

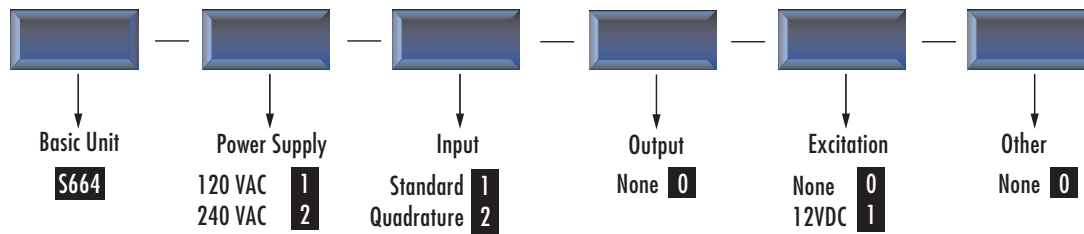
One of four frequency ranges may be selected to measure from 1Hz to 35KHz.

The counter accepts pulses from different types of sensors, including Quadrature, CMOS or TTL circuits and PNP or NPN devices.

An optional 12 VDC (100mA) excitation output module can provide power for external sensors.

## 1.2 Part Number Identification

The following matrix indicates the configuration of your S664 counter.



## 1.3 Option Module Summary

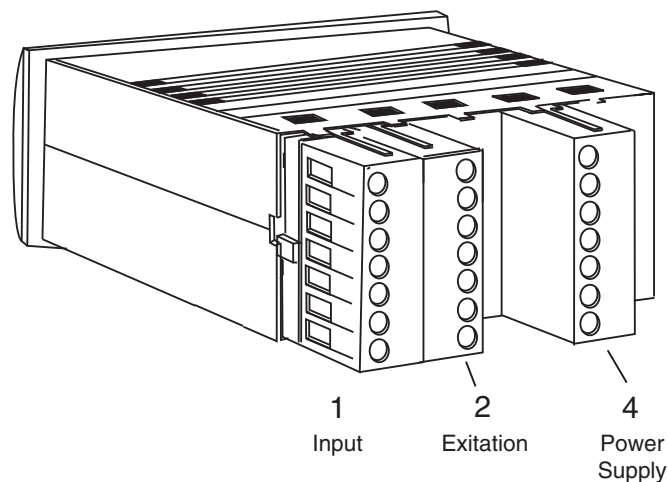


Figure 1. Option Module Slots (Rear View)

The S664 is a modular product that uses field configuring slide-in modules. The modules slide easily into the rear of the counter.

Figure 1 displays the functional assignments for each module position. Table 1 describes available option modules for the S664.

| Module slot | Type     | P/N   | Description                         | See Section |
|-------------|----------|-------|-------------------------------------|-------------|
| 1           | Input    |       | Standard Input Module               | 2.4         |
| 1           | Input    |       | Quadrature / Universal Input Module | 2.5         |
| 2           | Ext/Com. | 45064 | 12 VDC Excitation Module            | 2.6         |
| 4           | Power    |       | 120/220 VAC Power Module            | 2.3         |

Table 1. Option Module Summary

## 2 Hardware Setup

### 2.1 Panel Installation

The S664 1/8 DIN counter requires a standard 1/8 DIN panel cutout of 1.77" (45mm) high by 3.62" (92mm) wide. To install the counter into a panel cutout, remove the clips from the side of the counter. Slide the counter through your panel cutout, then slide the mounting clips back on. Press evenly to ensure a proper fit.

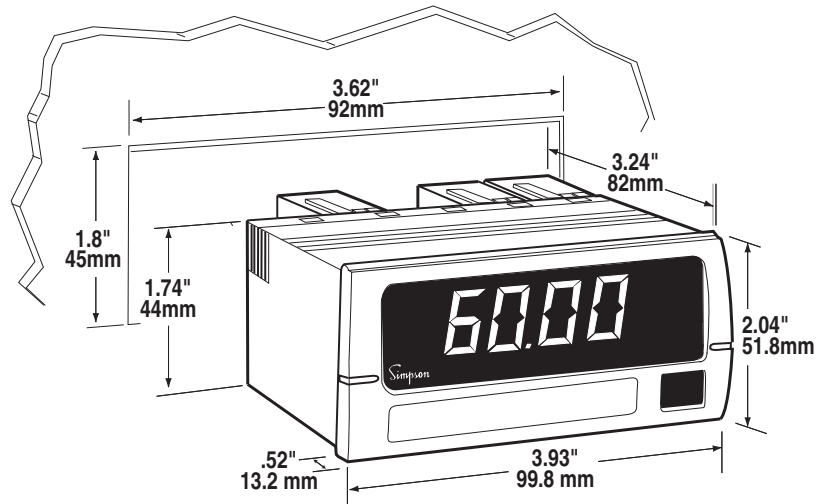


Figure 2. Counter and Panel Cut-Out Dimensions

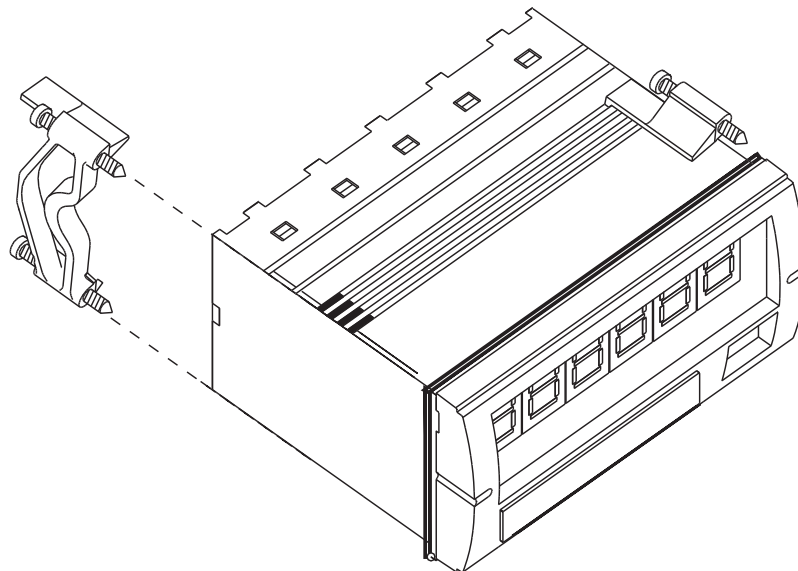
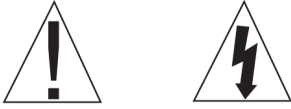


Figure 3. Panel Mounting Clips

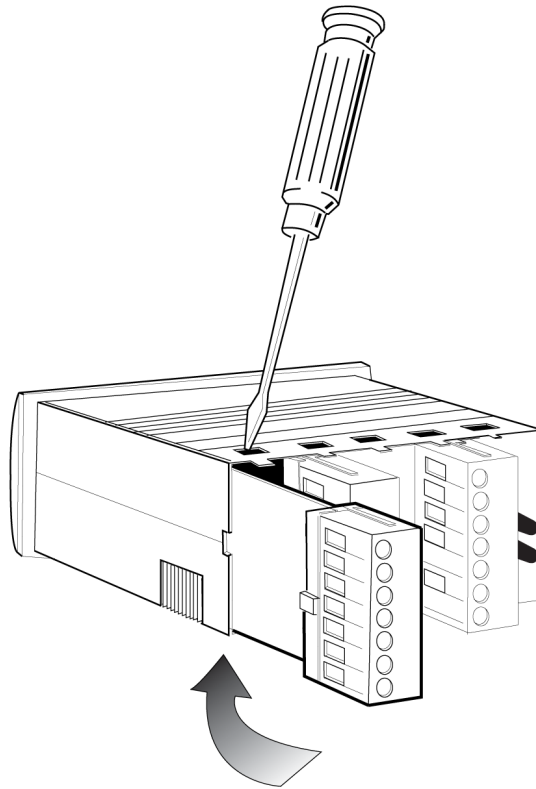
## 2.2 Removing / Installing Option Modules



**Shut power off before removing or installing any option modules**

**Couper le courant avant de retirer ou d'installer des modules optionnels**

1. Remove module from case by inserting a screwdriver into tab slot opening at top of input module. Apply pressure to release module from case. Repeat procedure for tab located on underside of module and then slide module away from the case.
2. Refer to appropriate sections to configure switches or jumpers for proper operation. Table 1 can be used to identify modules and their associated detail paragraph.
3. Install module by carefully aligning module edges with slots in case and pressing forward until tabs (on top and bottom) engage.



**Figure 4. Removing Option Module**

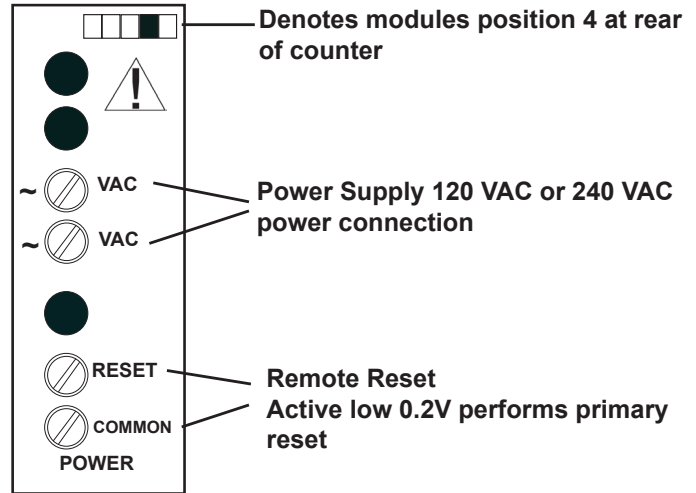
### 2.3 120/240 VAC Power Module



**Remove power before wiring option modules.**

**Coupez l'alimentation avant de raccorder les modules optionnels.**

The AC power module allows the S664 to be operated from standard 50/60 Hz line power. The power module will be configured as 120 VAC or 240 VAC per markings on the back panel. Ensure the input rating of the supply matches your line voltage. The power supply module has provisions for a hard-wire Range Select. This control can be a switch, relay contact or solid state device. Actuation is immediate upon an active Low for at least 2.5ms to this terminal. The reset circuit is independent of the power circuit.



**Figure 5. AC Power Module**

**NOTE: A fusible link is not provided on this module.**

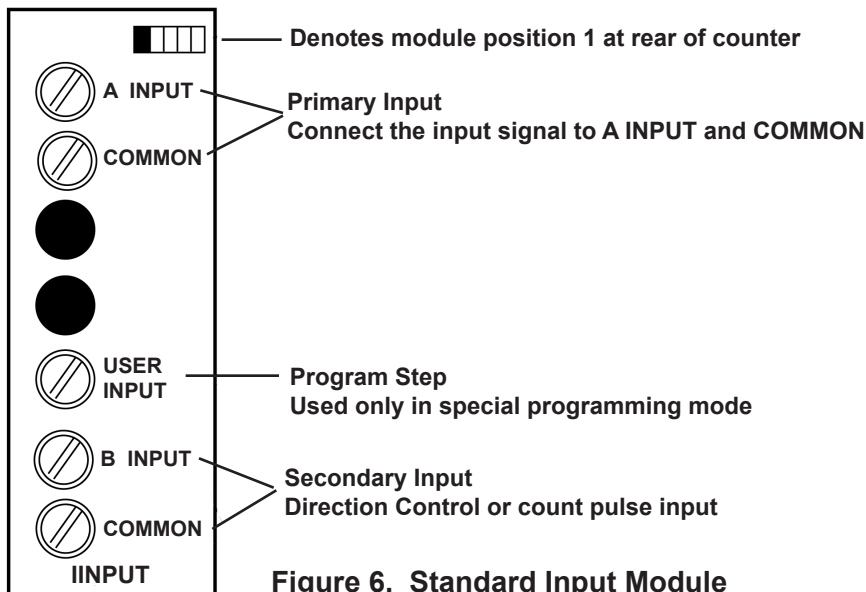
**A ½ Amp Time Delay fuse, Bussman MDL ½, or similar is required.**



**Never connect AC mains (hot or neutral) to the Reset or Common terminals!**

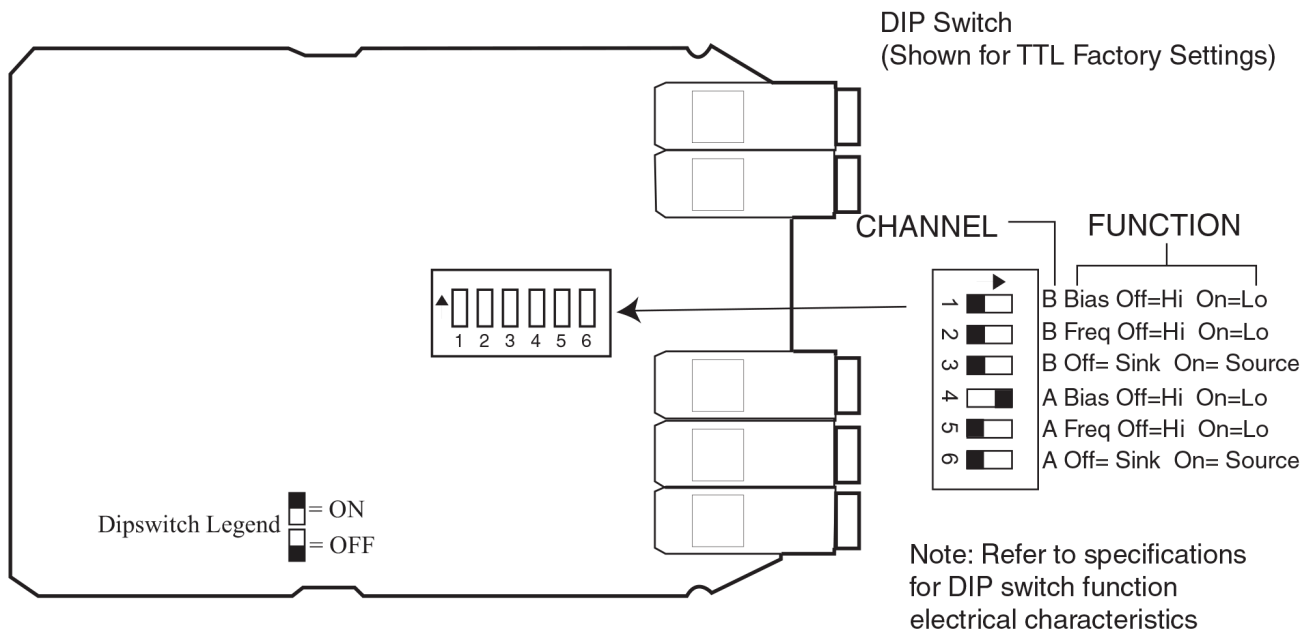
**Ne jamais brancher sur secteur (chaudes ou neutres) pour la réinitialisation ou terminaux communs!**

### 2.4 Standard Input Module



**Figure 6. Standard Input Module**





**Figure 7. Standard Input Module Default Settings**

DIP switch SW1, figure 7, is used to set up the counter to conform to the electrical characteristics of the sensor or signal being detected. Switch positions 1-3 configure channel B, while switches 4-6 configure channel A. These switches select bias (threshold voltages), low pass filter (enable/disable) and sensor type (Sink or Source). Refer to the documentation that accompanied the sensor for related information. The sensor can most likely be matched to one of the typical switch settings shown in figure 8 and figure 8a.

**Note: The input boards are designed so that selecting sourcing or sinking is based on the type of sensor that is being used. If a PNP (sinking) sensor is being used, set the input board for sinking also (switches 3 and 6 = OFF).**

If channel B is not used, default settings for switch positions 1 through 3 should be selected. Default settings are provided in Table 2.

The Input module also provides for a User input signal. On the S664, this input serves as a secondary channel (Rate) hard-wired reset. This may be used, for example, to reset latched alarm outputs that have been assigned to rate.

The S664 can accept inputs from many different sensors. The A and B channels may be configured independently as shown in Table 2. Figures 8 and 8a have examples of some typical sensors and the wiring connections that would be used.

Table 2. Standard Input Module DIP Switch Settings

\* = Factory Default setting

|                          |   |
|--------------------------|---|
| 1 B Channel Bias:        | OFF = Hi* VLT = 5.0 V VUT = 7.0V (+/- 10%)<br>ON = Low VLT = 1.6 V VUT = 3.6V (+/- 10%) |
| 2 B Channel Frequency:   | OFF = Hi* (low pass filter disabled)<br>ON = Lo (low pass filter enabled)               |
| 3 B Channel Sensor:      | OFF = Sinking* (internal pull-up enabled)<br>ON = Source (internal pull-down enabled)   |
| 4 A Channel Bias:        | OFF = Hi VLT = 5.0 V VUT = 7.0V (+/- 10%)<br>ON = Low* VLT = 1.6 V VUT = 3.6V (+/-10%)  |
| 5 A Channel Frequency:   | OFF = Hi* (low pass filter disabled)<br>ON = Lo (low pass filter enabled)               |
| 6 A Channel Sensor Type: | OFF = Sinking* (internal pull-up enabled)<br>ON = Source (internal pull-down enabled)   |

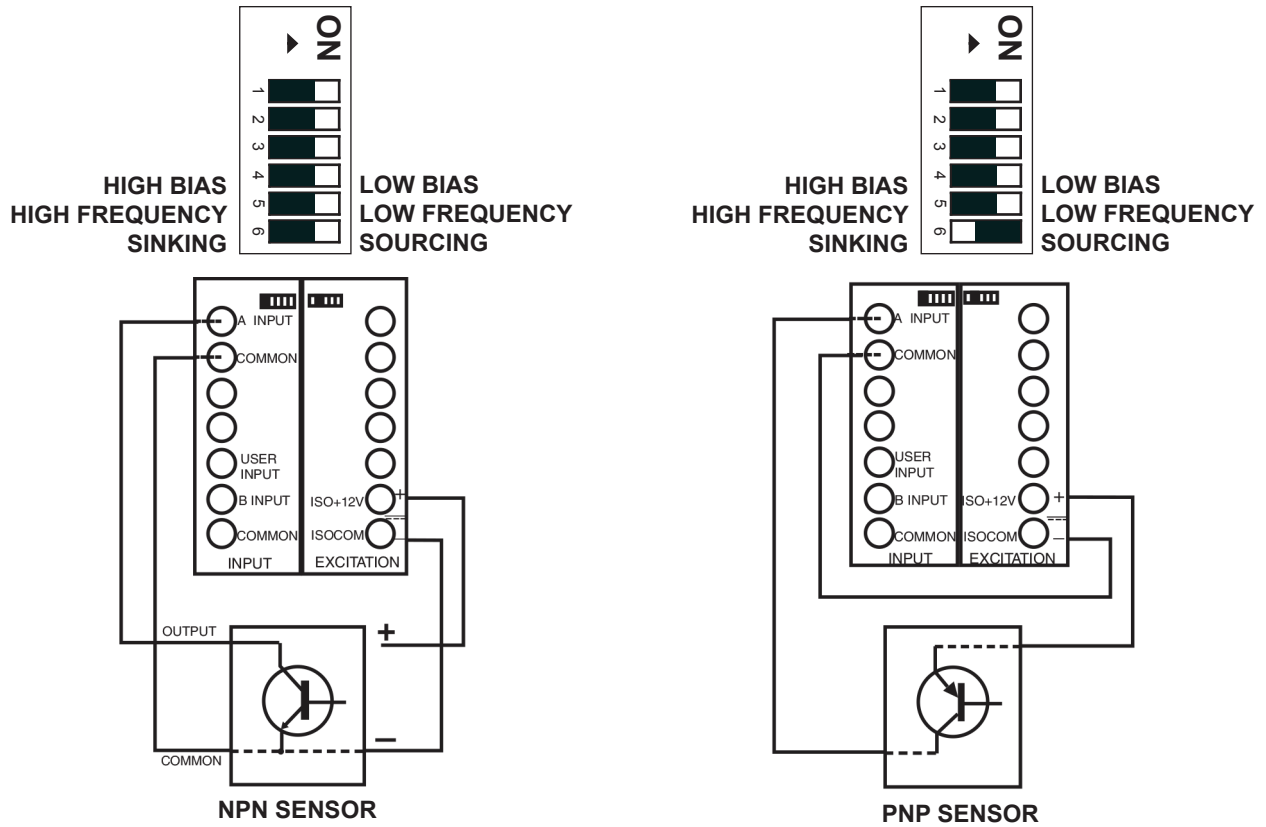


Figure 8. Sensor Connection Examples

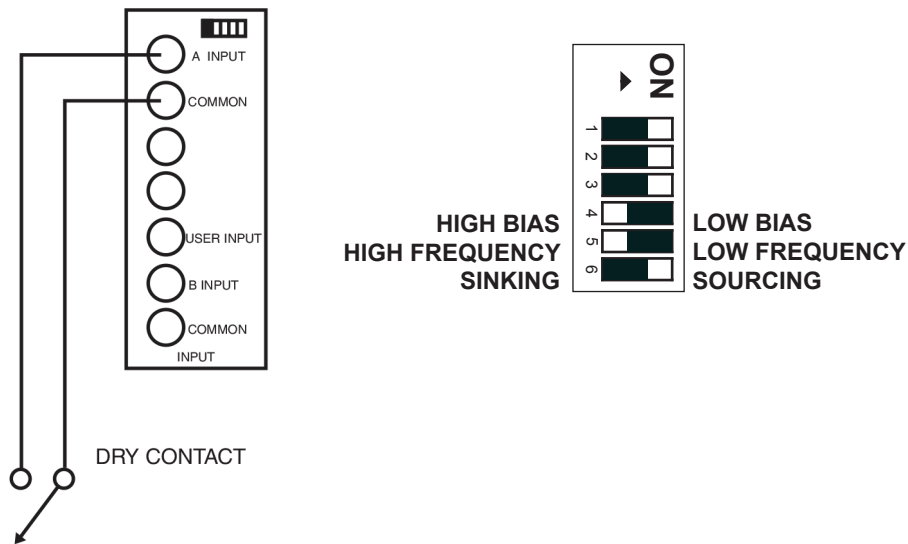


Figure 8a. Sensor Input Example

## 2.5 Quadrature Input Module

The Quadrature / Universal Input Module has two operational modes: Quadrature mode and Standard mode. Quadrature mode is selected by positioning JP1 and JP2 on pins 1 and 2. Standard mode is selected by placing JP1 and JP2 on pins 2 and 3 (see Figure 10 for details).

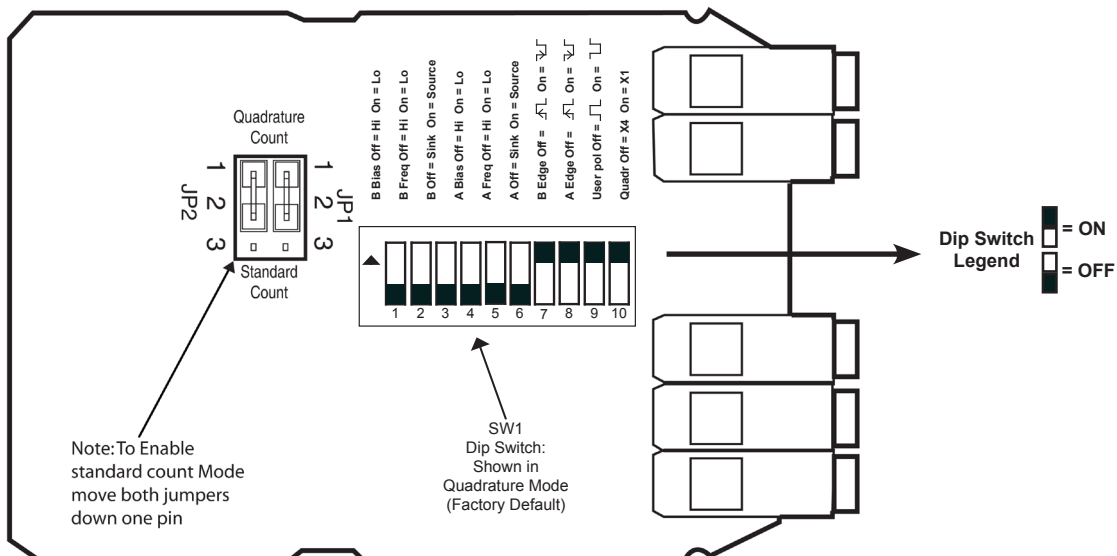
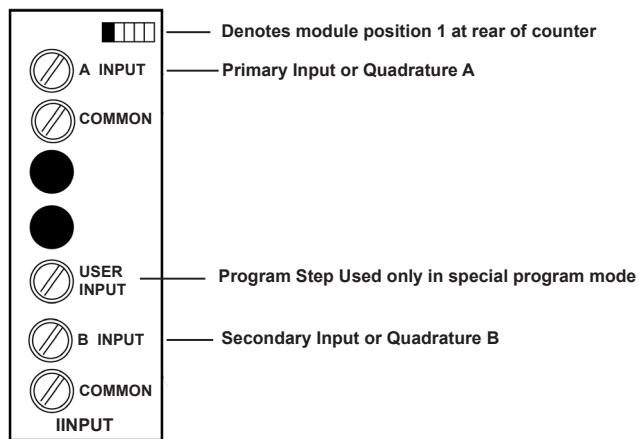
The Quadrature mode supports a wide range of encoders including the Simpson SE series.

While in Standard mode, this module works similarly to the Standard Input module, with the added capability to selectively invert the A, B, and User input signals.

**NOTE: If B channel is not going to be used, use the default switch settings for SW1 positions 1 through 3.**

Default settings are provided in Table 3. In both modes, the state of the User input signal can be selected as active high or active low. DIP switch SW1 configures the counter to match the specifications of the accompanying sensor. When shipped from the factory, the counter is set for X1 quadrature, as shown in Figure 10 and Table 3:

**Figure 9.**  
**Quadrature / Universal Input Module**



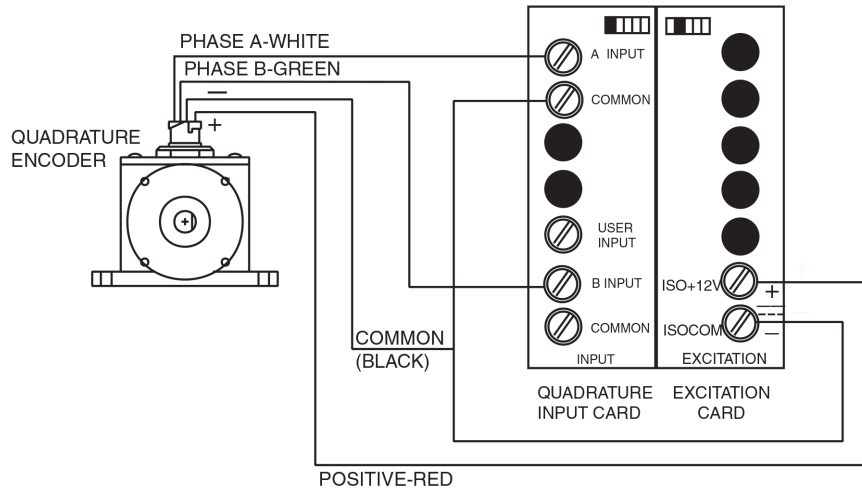
**Figure 10. Quadrature Input Module Default Settings**

**Table 3. Quadrature Module DIP Switch and Jumper Settings**

JP1/2: Count Mode Selector  
 Jumpered 1-2 = Quadrature mode  
 Jumpered 2-3 = Standard counter mode  
 SW1: 10 Position DIP Switch  
 \* = Factory Default setting

|           |                        |   |                            |  |
|-----------|------------------------|---|----------------------------|--|
| <b>1</b>  | B Channel Bias:        | OFF = Hi*<br>ON = Low   | VLT = 5.0V<br>VLT = 1.6V   | VUT = 7.0V (+/- 10%)<br>VUT = 3.6V (+/- 10%) |
| <b>2</b>  | B Channel Frequency:   | OFF = Hi* (low pass filter disabled)<br>ON = Low (low pass filter enabled)            |                            |  |
| <b>3</b>  | B Channel Sensor:      | OFF = Sinking* (internal pull-up enabled)<br>ON = Source (internal pull-down enabled) |                            |  |
| <b>4</b>  | A Channel Bias:        | OFF = Hi*<br>ON = Low   | VLT = 5.0 V<br>VLT = 1.6 V | VUT = 7.0V (+/- 10%)<br>VUT = 3.6V (+/- 10%) |
| <b>5</b>  | A Channel Frequency:   | OFF = Hi* (low pass filter disabled)<br>ON = Lo (low pass filter enabled)             |                            |  |
| <b>6</b>  | A Channel Sensor Type: | OFF = Sinking* (internal pull-up enabled)<br>ON = Source (internal pull-down enabled) |                            |  |
| <b>7</b>  | B Channel Count Edge:  | OFF = Rising (standard count mode only)<br>ON = Falling*                              |                            |  |
| <b>8</b>  | A Channel Count Edge:  | OFF = Rising (standard count mode only)<br>ON = Falling*                              |                            |  |
| <b>9</b>  | User Input Polarity:   | OFF = High/open circuit = Inhibit Count<br>ON* = Low/closed circuit = Inhibit Count   |                            |  |
| <b>10</b> | Quadrature Mode:       | OFF = X4 (quadrature mode only)<br>ON =X1*  |                            |  |

**Figure 2.6 Excitation Module**



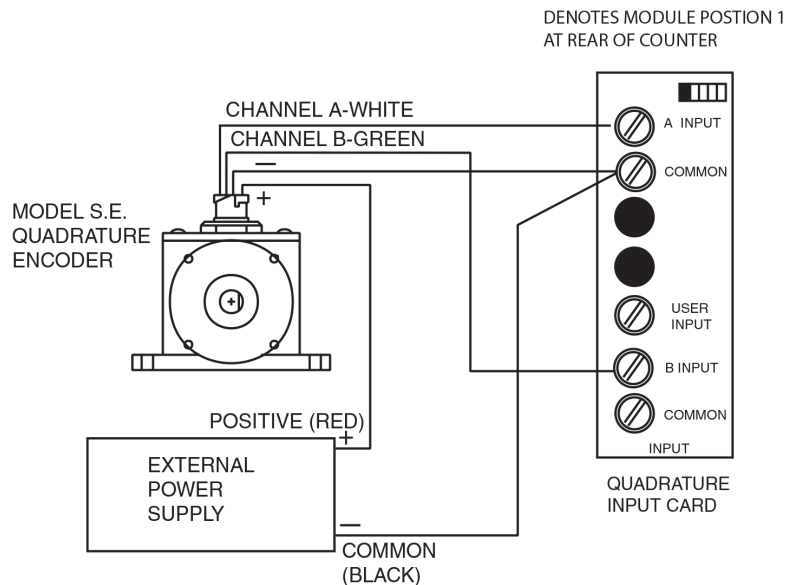
**Figure 11. Wiring Encoder w/Excitaion Supply**

**12 VDC Excitation Module**

The Excitation Module can supply 12 VDC at up to 100 mA for external sensors or encoders. This excitation is isolated from the counter internal logic supply.

When using sensors or encoders that do not have a signal return or imply a signal return that is in common with the supply voltage, a common attachment that ties the excitation supply to the logic input common may be required.

Examples of this appear in figures 8, 8a, 11 and 12.



**Figure 12. Wiring Encoder with External Supply**

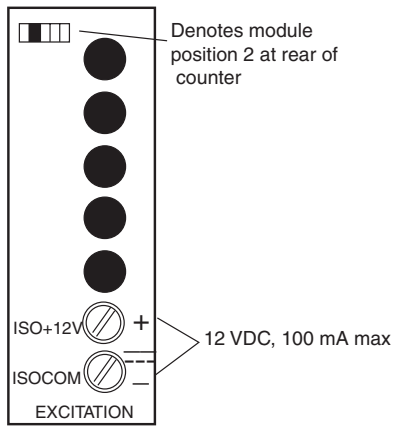


Figure 13. Excitation Module

### 3 Display & Rear Panel Controls

#### 3.1 Display

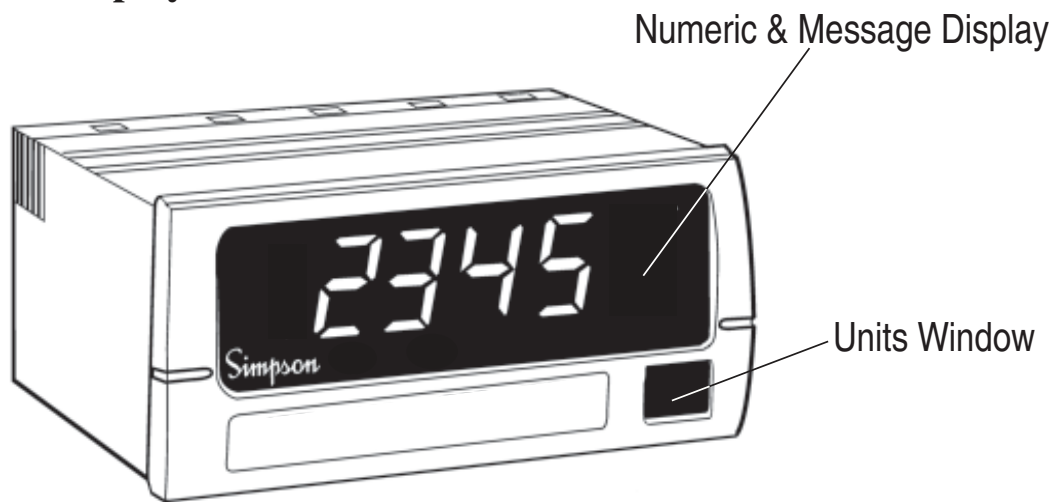


Figure 14. Display Layout

- 6-digit 0.56" high red LED display.
- Units Window for supplied label or legend.
- Upon power up, the S664 will identify its model and version.

## 3.2 Display Error Messages

| Display                                 | Description  | Action Required |
|---|--|-----------------|
| 9999 or<br>-999<br>(Flashing)           | <b>Display Over Range:</b> The displayed count is too large for the counter to display. Since the internal count buffer is much larger than the display, the counter will maintain accurate frequency well beyond the display value. | Reset Counter   |
| E3<br>(Outputs deactivate, count stops) | <b>Watchdog Fault:</b> The counter did not experience an orderly power-down. This can happen by exceeding the maximum allowable count speed for a sustained period of time.  | Reset Counter   |

## 3.3 Rate (Frequency) Scaling and Display

The S664 can measure frequencies ranging from 1.00 Hz to 35 KHz. The frequency scale is selected according to Table 4. The frequency range is selected by using a wire or switch across the RESET and COMMON terminals on the rear of the counter. The range prompt (scl 1) will toggle each time the contact is made.

| Range | Typical Update Period | Max Update Period | Min. Input Frequency | Max. Input Frequency | Comments / Typical Application                          |
|-------|-----------------------|-------------------|----------------------|----------------------|---|
| SCL1  | 1.0 sec               | 3.0 sec           | 1.00 Hz              | 99.99 Hz             | 1/100 Hz resolution / measure signals less than 100 Hz. |
| SCL2  | 1.0 sec               | 2.0 sec           | 1.6 Hz               | 999.9 Hz             | 1/10 Hz resolution / measure signals less than 1 KHz    |
| SCL3  | 0.5 sec               | 1.0 sec           | 4 Hz                 | 9999 Hz              | 1 Hz resolution / measure signals less than 10 KHz      |
| SCL4  | 0.5 sec               | 1.0 sec           | 0.01 KHz             | 35.00 KHz            | 0.01 KHz resolution / measure signals in KHz            |

Table 4. Frequency Scale Selection

Frequency can also be displayed as a signed entity and will be negative according to the direction control. (See section 3.4.)



### 3.4 A/B Channel Inputs

The A channel input is a pulse source. This signal must be limited to under 35 KHz. This corresponds to a minimum pulse width of 28.57 microseconds. The signal does not need an even duty cycle (On vs. Off time) as long as a minimum (high or low) of 1 microsecond is maintained (See figure 15).

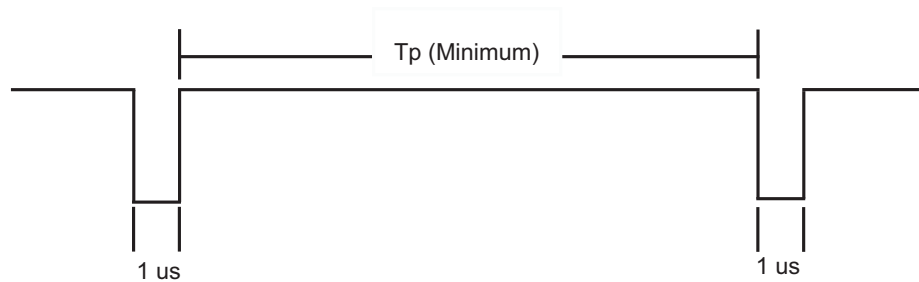


Figure 15. Input Pulse Definition

The B Channel acts as a direction control. If the B input is in the active state, frequency will be displayed as a negative number. When using the quadrature input card (in quadrature mode), A and B encoder signals are translated to Pulse and Direction signals internally.

## Appendix A: Technical Specifications

### A.1 Functional Specifications

|   |  |                   |                 |
|---|--|-------------------|-----------------|
| <b>Frequency modes</b>                    | Scale 1  | 1.00 to 99.99 Hz  | 1 update / sec  |
|   | Scale 2  | 2.0 to 999.99 Hz  | 1 update / sec  |
|   | Scale 3  | 4 to 9999 Hz      | 2 updates / sec |
|   | Scale 4  | 0.01 to 35.00 KHz | 2 updates / sec |
| <b>Frequency Inputs</b>                   | Channel A and Channel B  |                   |                 |
| <b>Miscellaneous inputs</b>               | Reset (Scale Select) and B (Direction Control)                             |                   |                 |
| <b>Maximum count rate</b>                 | 35 KHz (Standard and Quadrature X1 modes)<br>8.75 KHz (Quadrature X4 mode) |                   |                 |
| <b>Min pulse width</b>                    | 2 uS (Standard mode)   |                   |                 |
| <b>Frequency range (internal)</b>         | -2,147,483,648 Hz to +2,147,483,648  |                   |                 |
| <b>Frequency accuracy (instantaneous)</b> | > $\pm 0.001\%$ of reading   |                   |                 |
| <b>Frequency vs temperature</b>           | + 0.0001% of reading per °C  |                   |                 |
| <b>Frequency vs time (aging)</b>          | $\pm 0.001\%$ of reading per year  |                   |                 |
| <b>Display Digits</b>                     | 4-digit, 7-segment with leading zero blanking                              |                   |                 |
| <b>Display Decimal Point</b>              | Position according to selected scale                                       |                   |                 |
| <b>Display LEDs</b>                       | Red 0.56" (14.2mm), high efficiency  |                   |                 |
| <b>Display Range</b>                      | - 999 to + 9999<br>(Independent of decimal position)                       |                   |                 |

### A.2 Electrical, Environmental and Mechanical Specifications

|                              |  |
|------------------------------|--|
| <b>Power Requirements</b>    | AC Supply: 120 or 240 VAC, $\pm 10\%$  |
| <b>Power Consumption</b>     | 3VA  |
| <b>Reset Input Signal</b>    | Active Low: 0.2 VDC = active   |
| <b>Storage Temperature</b>   | -10 to 60°C  |
| <b>Operating Temperature</b> | 0 to 40°C  |
| <b>Relative Humidity</b>     | 0 to 80% for temperatures less than 32°C, decreasing linearly to 50% at 40°C. (Non-condensing) |
| <b>Bezel</b>                 | 3.93" x 2.04" x 0.52" (99.8 x 51.8 x 13.3mm)   |
| <b>Panel Cutout</b>          | 3.62" x 1.77" (92 x 45 mm) 1/8 DIN   |
| <b>Case Depth</b>            | 3.24" (82mm)   |
| <b>Weight</b>                | 9.0 oz. (255.1 g)  |

## Standard input module

|                        |   |
|------------------------|---|
| <b>Input Channels</b>  | A, B and User   |
| <b>Count edge</b>      | High to low transition (A and B channels)   |
| <b>Input Sources</b>   | Switch contact, CMOS or TTL logics, PNP or NPN devices  |
| <b>Input Impedance</b> | Sinking: 10K, 5% Res. Pull-up to (9.0 - 16 VDC) $\pm 10\%$<br>Sourcing: 5.1K, 5% Res. Pull-down to common |

### Input Thresholds

|                           |   |
|---------------------------|---|
| <b>A &amp; B channels</b> | Low Bias mode: VLT = 1.6V $\pm 10\%$ VUT = 3.6V $\pm 10\%$<br>High Bias mode: VLT = 5.0V $\pm 10\%$ VUT = 7.0V $\pm 10\%$ |
| <b>User Channel</b>       | VLT = 0.2V (min) VUT = 3.0V (max)   |
| <b>Low pass filter</b>    | Frequency < 200Hz (0 to 10V input square wave at 50% duty cycle)  |
| <b>Max voltage</b>        | A, B and User channels 30VDC maximum sustained  |

## Quadrature / Universal input module

|                        |   |
|------------------------|---|
| <b>Input Channels</b>  | A, B and User   |
| <b>Input Inversion</b> | User input polarity selectable. A and B channel polarity selective in standard mode only.                 |
| <b>Operation modes</b> | Standard, Quadrature X1 and Quadrature X4   |
| <b>Input Sources</b>   | Switch contact, CMOS or TTL logics, PNP or NPN devices quadrature (single-ended) encoders                 |
| <b>Input Impedance</b> | Sinking: 10K, 5% Res. Pull-up to (9.0 - 16 VDC) $\pm 10\%$<br>Sourcing: 5.1K, 5% Res. Pull-down to common |

### Input Thresholds

|                           |   |
|---------------------------|---|
| <b>A &amp; B channels</b> | Low Bias mode: VLT = 1.6V $\pm 10\%$ VUT = 3.6V $\pm 10\%$<br>High Bias mode: VLT = 5.0V $\pm 10\%$ VUT = 7.0V $\pm 10\%$ |
| <b>User Channel</b>       | VLT = 0.9V (min) VUT = 3.15V (max)  |
| <b>Low pass filter</b>    | Frequency < 200Hz (0 to 10V input square wave at 50% duty cycle)  |
| <b>Max voltage</b>        | A, B and User channels 30VDC maximum sustained  |

## Isolated 12V Excitation Module

|                             |                            |
|-----------------------------|----------------------------|
| <b>Excitation Output</b>    | 100 mA at 12 VDC $\pm 5\%$ |
| <b>Excitation Isolation</b> | 1500 V                     |

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