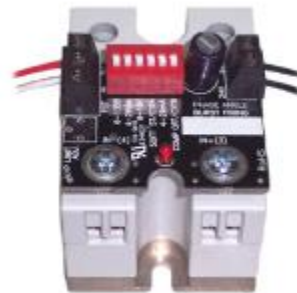


## **SSRMAN-1BFS SERIES USERS MANUAL**

### FAST SYNCHRONOUS BURST FIRING MODULE



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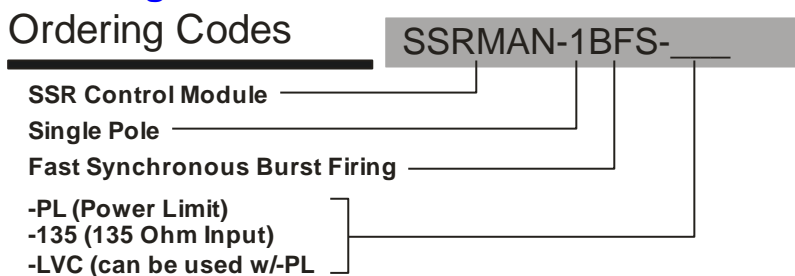
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**1. Ordering Codes**



**2. Description**

The SSRMAN-1BFS is a zero cross burst firing control module designed for use with standard footprint random fire SSRs (Solid State Relays). The module mounts directly on the SSR’s input screws. The module operates by varying duty cycle of SSR’s control input synchronous to the AC line. The power delivered to the load is proportional to the command input signal. The SSRMAN-1BFS is factory programmed for the desired cycle time. The cycle time is specified in the ordering code as the number of cycles, since it is synchronous to the AC power line.

## 2.1 Features

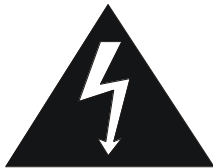
- Command input accepts 4-20mA, 0-10V, 0-5V, 0-135  $\Omega$ , Potentiometer
- Fast Synchronous Burst Algorithm provides true linear power at fast cycle times
- Drives multiple solid state relays (SSRs)
- Small (1.75x1.40") module mounts on the input terminals of an inexpensive SSR
- Fits under finger-safe covers
- LED output indicator
- Adjustable Power Limit (-PL) Option
- Single phase and three phase control

## 3. Installation / Safety Information

Responsibility for determining suitability for use in any application / equipment lies solely on the purchaser, OEM and end user. Suitability for use in your application is determined by applicable standards such as UL, cUL and CE and the completed system involving this component should be tested to those standards.

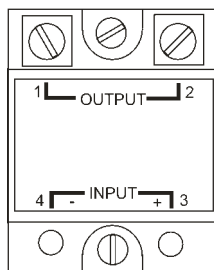


**WARNING: FIRE HAZARD!!** Even quality electronic components CAN FAIL KEEPING FULL POWER ON! Provide a SEPARATE (redundant) OVER TEMPERATURE SHUTDOWN DEVICE to switch the power off if safe temperatures are exceeded.



**WARNING: HIGH VOLTAGE!!** This control is installed on a Solid State Relay with high voltage on it. This control must be installed in a GROUNDED enclosure by a qualified electrician in accordance with applicable local and national codes including NEC and other applicable codes. Provide a safety interlock on the door to remove power before gaining access to the device.

### 3.1 Solid State Relay Installation

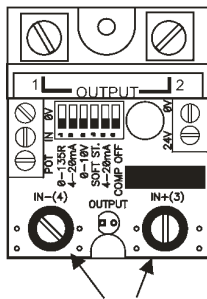


Make sure that the voltage and current ratings of the Solid State Relay (SSR) are sized correctly for the load, otherwise a hazardous condition such as over-heating, failure of the SSR, fire or explosion may result. Contact the SSR manufacturer for more details.



The SSR must be mounted to a heat sink as per the SSR manufacturers requirements otherwise a hazardous condition such as over-heating, failure of the SSR, fire or explosion may result. Contact the SSR manufacturer for more details.

### 3.2 Mounting Instructions

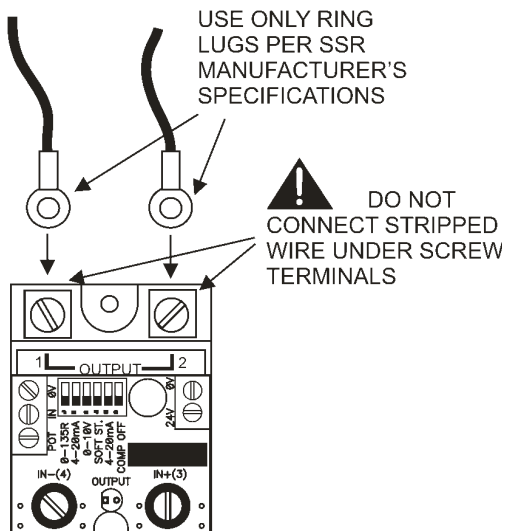


SSRMAN SHOULD BE ORIENTED AS SHOWN AND SCREWED TIGHT TO INPUT TERMINALS

The SSRMAN mounts directly to the control input terminals of an SSR using two #6-32 screws. Some relays have short input screws and longer screws will be required to reach through the contacts on the SSRMAN.

Be sure to observe the correct polarity when mounting the module (module should be positioned over the SSR). The module should sit firmly on top of the SSR when the screws are tightened.

### 3.3 Electrical Connections



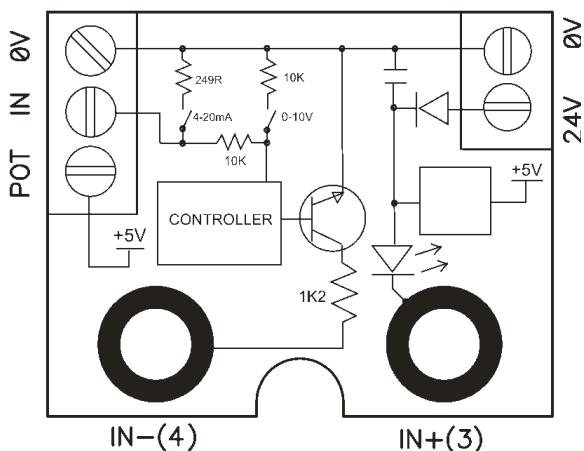
See the WIRING DIAGRAMS at the end of this document. Make sure the module ordered is the correct module for the application before wiring.

Before wiring the module all Dip Switch settings for the command input and special features should be setup properly per the Dipswitch Configuration Section.

The terminal blocks on the sides of the SSRMAN for connecting 24V Power and the command signal can accept 16-30 AWG wire.

#### 3.3.1 Internal Diagram

Please reference the internal diagram below to be absolutely sure that the system wiring will be compatible with the control module.



### 3.4 Limited Warranty

NuWave Technologies, Inc. warrant this product to be free from defect in workmanship and materials for a period of two (2) years from the date of purchase.

1. Should unit malfunction, return it to the factory. If defective it will be repaired or replaced at no charge.
2. There are no user serviceable parts on this unit. This warranty is void if the unit shows evidence of being tampered with or subjected to excessive heat, moisture, corrosion or other misuse / misapplication.
3. Components which wear or damage with misuse are excluded, e.g. relays.
4. NuWave Technologies, Inc. shall not be responsible for any damage or losses however caused, which may be experienced as a result of the installation or use of this product. NuWave Technologies, Inc. liability for any breach of this agreement shall not exceed the purchase price paid E. & O.E.

## 4. Operation

### 4.1 Power Supply

The SSRMAN-1BFS power requirement is 24V AC +/-15% 47-63Hz

### 4.2 24V Power Fusing

Fusing may be accomplished by fusing each module separately or fusing groups of the modules with either primary or secondary fusing. The current draw of each SSRMAN-1BFS is 65mA max.

### 4.3 Command Input

The SSRMAN-1BFS can accept 4-20mA, 0-10V, 0-5V, and Potentiometer. The SSRMAN-1BFS-135 can only accept a 0-135  $\Omega$  Input. All command inputs are not isolated from the 24V power input; they share a common ground. The type of command input can be configured via the dipswitch. The default setting is 0-5V/potentiometer.

When wiring multiple SSRMAN-1BFS units together, follow the guidelines in the Wiring Multiple SSRMAN-1BFS section.

Any leg of the command input can tolerate shorts to the (0V) input. Connecting the 24V power to the command input will cause damage to the unit.

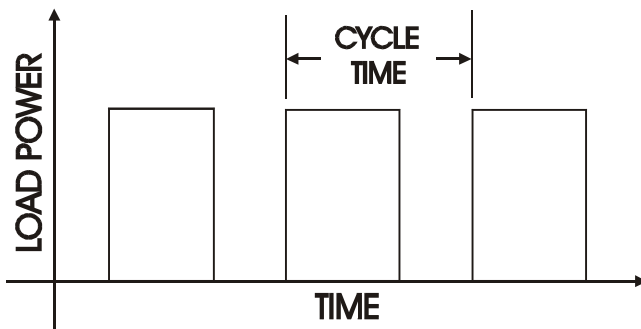
When 4-20mA is selected via the dipswitch, a 249 Ohm shunt resistor is present at the command input between the 0V and IN terminals. Be sure not to exceed 20mA DC on the input as damage to the unit may result. If the command input is wired to a 0-20mA or 4-20mA output of another device, the 0V terminal must remain at the same potential as the negative lead of the current output from the other device, otherwise damage to the SSRMAN may result.

#### 4.3.1 Input Fail-safe Protection

If the signal sent to the SSRMAN-1BFS' command input should become electrically open the control output will be forced to an off or less than 5% output power state.

### 4.4 Cycle Times

The cycle time refers to the total time between an on and off cycle.



The SSRMAN-1BFS has 4 available cycle times settable via the dipswitches.

The cycle times are specified below in # of cycles and can be correlated to their respective times using the table below for both 50 and 60 Hz Line frequencies (note that the -LVC option only has the fast burst firing cycle time and the dipswitch is disabled):

Dip Switch 6	Dip Switch 4	#of cycles	Cycle Time (60Hz)	Cycle Time (50Hz)	Resolution (% of FS)
*OFF	*OFF	~16	266mS	320mS	~1%
ON	OFF	60	1S	1.2S	1.66%
OFF	ON	600	10S	12S	0.166%
ON	ON	6000	100S	120S	0.0166%

#### \*Synchronous Firing Method

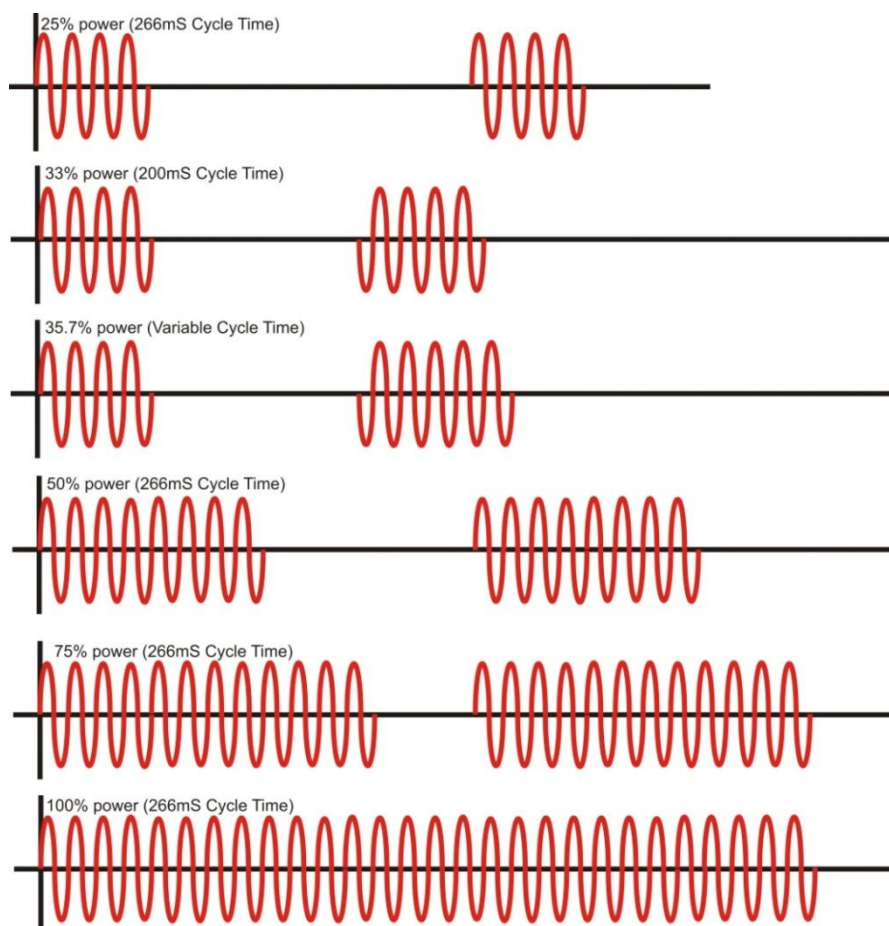
When burst firing AC with conventional PWM, there is a tradeoff between resolution and cycle time. Generally the cycle time should be chosen based on the mass of the load to be controlled; the larger the load mass, the longer the cycle time can be. For the best possible resolution, its standard practice to choose the longest cycle time that can be used without causing process ripple. Longer cycle times generally provide greater control resolution, but the Fast Synchronous Burst setting provides excellent resolution at a fast cycle time.

### 4.5 Cycle Times – 266mS Selection (Fast Synchronous Burst Firing)

When the SSRMAN-1BFS cycle time is set to 266mS (320mS @ 50Hz) the Fast Synchronous Burst Firing mode is turned on. The cycle time becomes longer near zero and full power levels to provide improved control resolution. For Example, since the SSRMAN-1BFS generally modulates 16 AC cycles, the lower limit in power that will maintain the cycle time is 1/16 or 6.25%. The SSRMAN-1BFS will use increased off periods below 6.25% power and above 94.75% power.

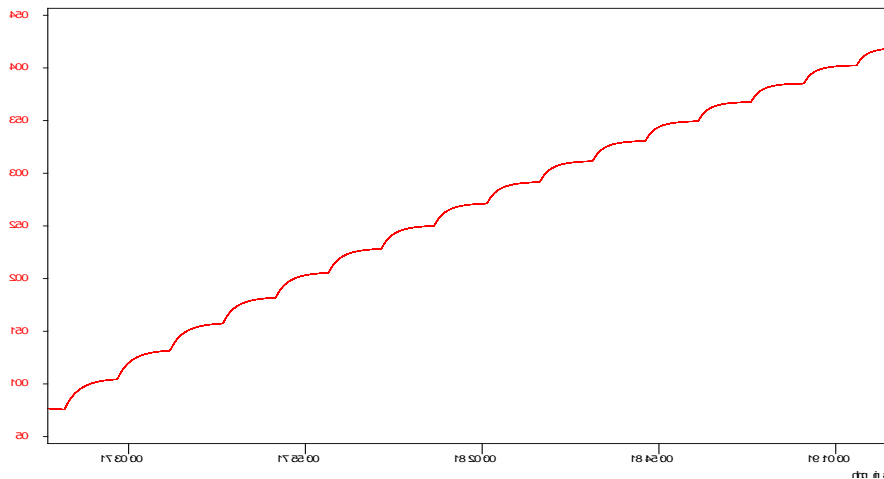
#### 4.5.1 Fast Synchronous Burst Firing Mode

As shown below, the SSRMAN-1BFS Fast Synchronous Burst Firing mode selectively fires fractional numbers of cycles. Since pulse width modulation alone would limit the resolution to 16 steps or 6.25% when modulating 16 AC cycles, a proprietary algorithm is employed to provide improved resolution of 0.5-1%. In this firing mode, the cycle time is varied as well as the on time. To select the Fast Synchronous Burst Firing Mode set Diswitches 1 and 3 to the off position.

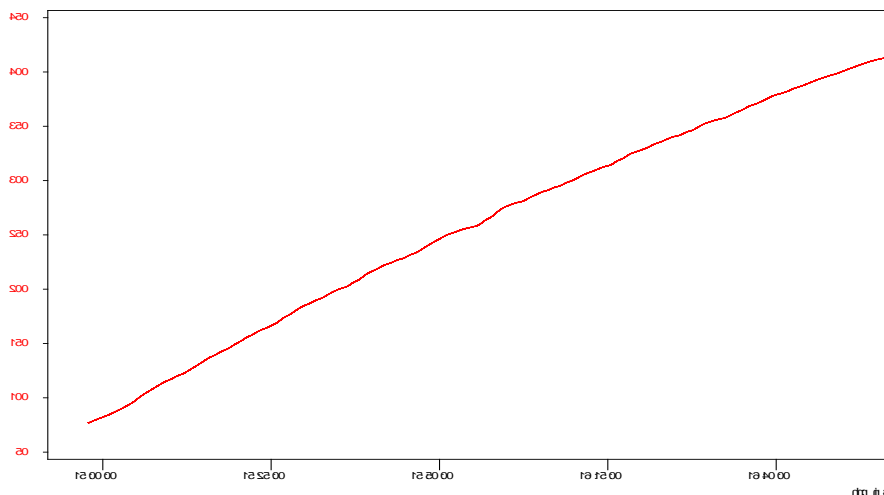


## 4.5.2 Fast Synchronous Burst Firing Advantages

The two plots below are actual data for a 425 degF capable 10KW resistive heater ramped from 0-100% power over two hours. The first plot shows straight 16 cycle, 266mS cycle time PWM. Note the nonlinearity humps due to poor resolution. The second plot shows the linearity improvement with the Fast Synchronous Burst. Any visible overall curvature is a normal heater characteristic.



*Fast PWM of zero cross fired loads can result in poor linearity / resolution (above)*



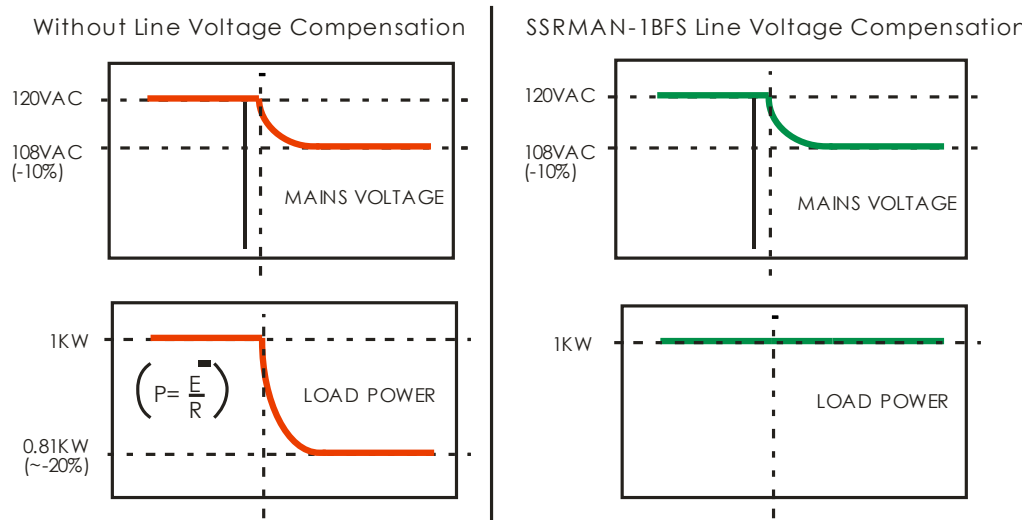
*NuWave Fast Synchronous Burst algorithm results in excellent linearity / resolution (above)*

## 4.6 Line Voltage Compensation (-LVC Option)

The SSRMAN-1BFS' line voltage compensation keeps the power constant on the load as the line voltage changes. The line voltage is measured via the 24VAC power applied to the SSRMAN-1BFS' module. To use the Line Voltage Compensation feature properly, a 24VAC power transformer should be fed from the same mains as the load circuit to be controlled as per the wiring diagrams at the end of this document. On the SSRMAN-1BFS, Line Voltage compensation can be ordered by adding -LVC to the suffix of the part #. When line voltage compensation is specified, only the fast synchronous burst cycle time is available (the dipswitch setting of cycle times is disabled).

With a 10% drop in line voltage, SSRMAN load power drops less than 2%

(120V, 1KW, 14.4 Ohm Load )



## 4.7 Power Limit

The Power Limit feature is used in conjunction with the Line Voltage Compensation feature to limit the power delivered to the load. The Power Limit is adjustable via a potentiometer located just below the input terminal block. For this feature to work properly Line Voltage Compensation (-LVC) must be ordered and the power transformer for the SSRMAN-1BFS must be connected to the same mains as the load power is connected to. This feature can be used without Line Voltage Compensation and will simply clip the command signal to a set level.

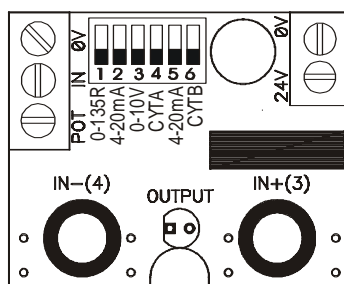
### 4.7.1 Power Limit Adjustment Procedure

The Power Limit is adjustable from 5% to 100% of the max power. Setting the Power Limit potentiometer half way corresponds to a Power limit of approximately 55%. With the command input set to approximately 100% (on startup) turn the pot fully CCW. Then just turn the pot CW until the desired maximum output power is achieved. For this feature to work as a true max limit, it is important that the Line Voltage Compensation version be ordered.

If the line voltage compensation is not present in the ordering code (-LVC), the max limit will act as a percentage of output limit and the absolute max limit will change with line voltage.

## 4.8 Configuration Dipswitch

The configuration dipswitch is used for setting up the command input and cycle times. Using a pen point gently push the switch up for on and down for off according to the setup outlined in the table below.

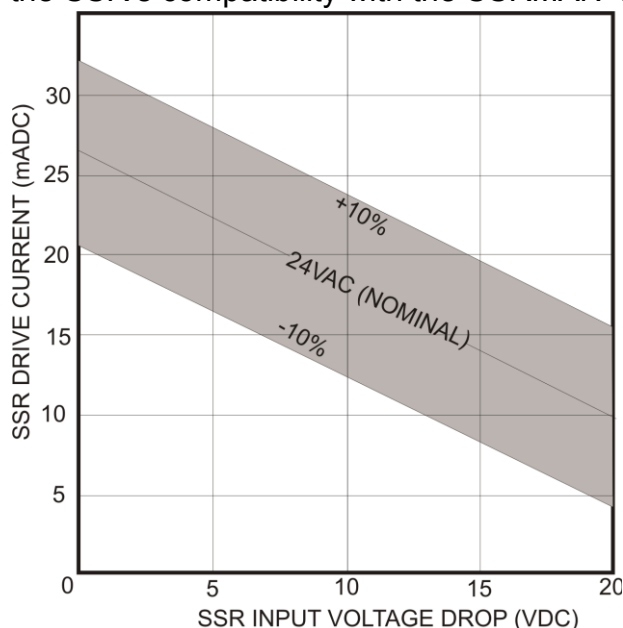


Command Input	1	2	3	5
<b>0-5V (Default)</b>	OFF	OFF	OFF	OFF
<b>Potentiometer</b>	OFF	OFF	OFF	OFF
<b>0-10V</b>	OFF	OFF	<b>ON</b>	OFF
<b>4-20mA</b>	OFF	<b>ON</b>	OFF	<b>ON</b>
<b>1-5V</b>	OFF	OFF	OFF	<b>ON</b>
<b>2-10V</b>	OFF	OFF	<b>ON</b>	<b>ON</b>
<b>0-135Ω*</b>	<b>ON</b>	OFF	OFF	OFF

\*Module must be ordered as SSRMAN-1BFS-135 for 0-135Ω input support.

### 4.9 Control Output

The SSRMAN-1BFS SSR output drive is a DC pulsed current limited drive signal of 10V/15mA (24VAC power). This is more than enough current for driving most 3-32V standard SSRs, however it is still important to review the data sheet for the SSR you would like to use for compatibility with the SSRMAN-1BFS's output drive. The control output can tolerate a momentary direct short. The following graph will allow you to verify the SSR's compatibility with the SSRMAN-1BFS over wide input voltage variations.



SSRMAN-1BFS Output Drive Current vs. SSR Input Voltage Drop

### 4.10 Output LED

The SSRMAN-1BFS' RED output LED will turn on when the output is on. The output LED is wired in series with the SSR's input. If there is a poor connection on the SSR input terminals or a problem with the SSR's input, the output LED will not become energized.

## 4.11 Three Phase Operation

Three SSRMAN-1BFSs can be used to control three poles of a three phase load for inside delta or grounded wye configurations. The Module should be wired as shown in the wiring diagrams, using one transformer for each leg to be controlled.

### 4.11.1 Three Phase Special Wiring Considerations

The SSRMAN-1BFS derives its AC synchronization from the applied 24VAC power. Each 24VAC transformer's primary must be connected to the corresponding leg power to be controlled by each SSRMAN-1BFS. See the wiring diagrams at the end of this document.

## 4.12 Wiring Multiple Units

If more than one SSRMAN-1BFS is to be used from a non-isolated or common command signals:

1. A common power transformer can be shared. If the input selected is 0-10V or 0-5V, the inputs should be wired in parallel.
2. If multiple units must be powered from one power transformer and 4-20mA input is selected, one module should be set for 4-20mA and the remaining modules should be set for 1-5V.
3. If the command is 4-20mA, and the command inputs are to be wired in series, a separate power transformer for each module is required to isolate the inputs.

### 4.12.1 Connecting Power & Commands in Parallel

When multiple SSRMAN-1BFS power inputs and commands are wired in parallel, all of the 0V terminals must be connected together follows:

Power:	Command:
0V----0V----0V---->	0V----0V----0V---->
24V---24V---24V--->	IN-----IN-----IN----->

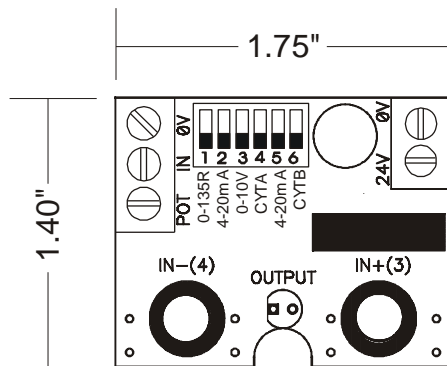
No crossing of the power input feed or command signal is permitted. If for some reason the power should become crossed, it will cause a direct short in the system. If properly fused, the fuse will blow and the SSRMAN-1BFS will not be damaged. If the command inputs are wired improperly, damage to SSRMAN-1BFS can result.

We do not guarantee operation of the SSRMAN-1BFS with any other manufacturer's SSR control module. Using them in the same circuit may cause either module to be damaged.

## 5. Electrical Specifications

Command Inputs	4-20mA, 0-10V, 0-5V, 0-135 $\Omega$ , Pot, 0-135 $\Omega$
Input Impedance	10K $\Omega$ (0-10V), 250 $\Omega$ (4-20mA), 100K $\Omega$ (0-5V)
0-135 $\Omega$ Excitation Current	13mA max
Control Output	SSR Drive, nominally 10V at 15mA (24VAC)
Output Resolution	0.5% for 4-20mA, 0-5V, pot and 0-10V; 1% for 0-135 $\Omega$
Output Linearity	1.5% for 4-20mA, 0-5V, pot and 0-10V; 5% for 0-135 $\Omega$
Power Limit Range	5-100% of max load power
External Potentiometer Res.	10K $\Omega$ -25K $\Omega$
Ambient Temperature Range	0 to 70 $^{\circ}$ C
Power Supply Voltage	24VAC +15/-15%.
Power Consumption	65mA (Power consumption 1.6W MAX).
Line Frequency Range	47-63 Hz.
Terminal Block wire Gauge	16-30 AWG
Terminal Block Material	Polyamide 6.6 UL 94 V-0, Black

## 6. Mechanical Dimensions



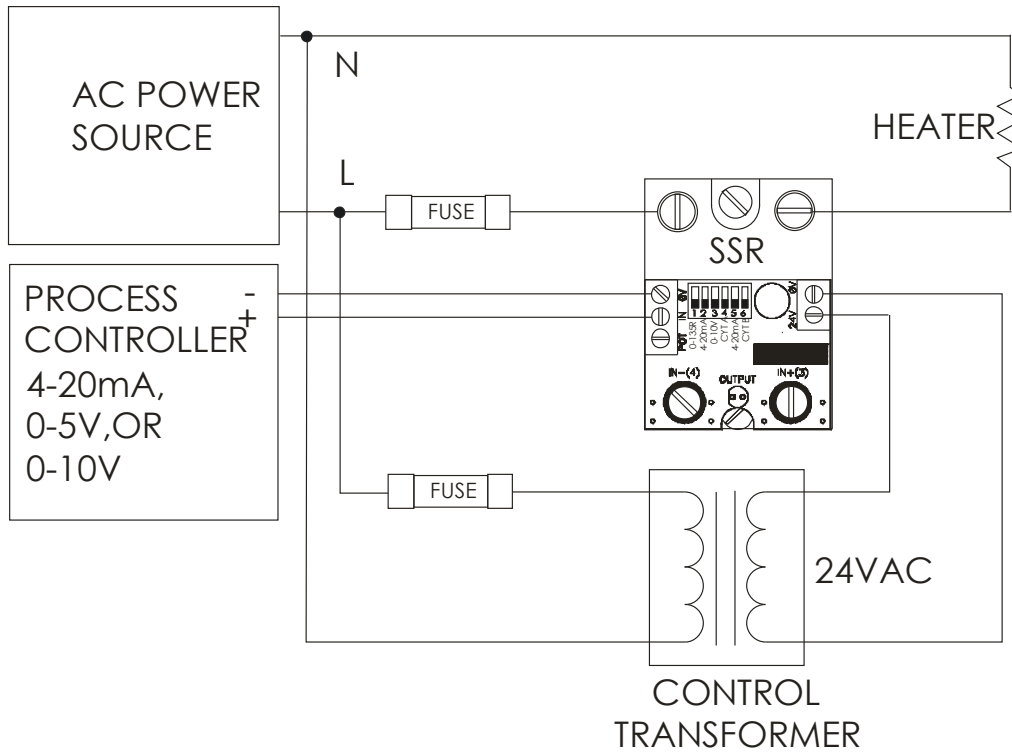
Max Height is 0.6"

## 7. Contact Information

NuWave Technologies, Inc  
 866-379-3597  
[www.nuwaveproducts.com](http://www.nuwaveproducts.com)

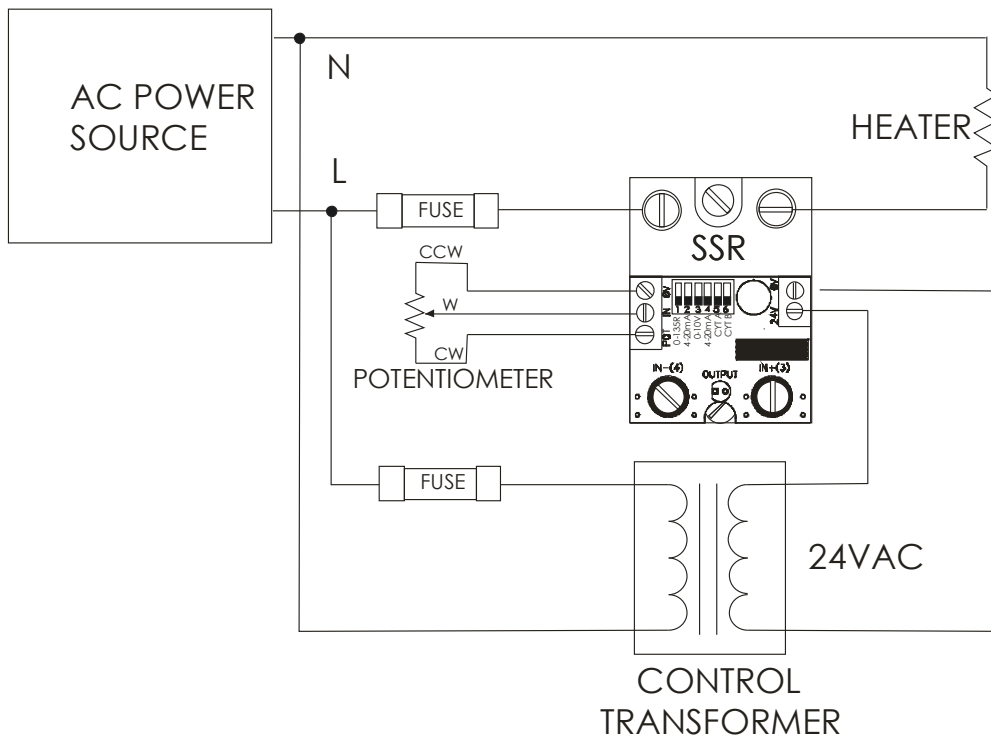
### 8. WIRING DIAGRAM (4-20mA, 0-5V, 0-10V Inputs)

SSRMAN-1BFS WIRING DIAGRAM (4-20mA, 0-5V, 0-10V INPUT)



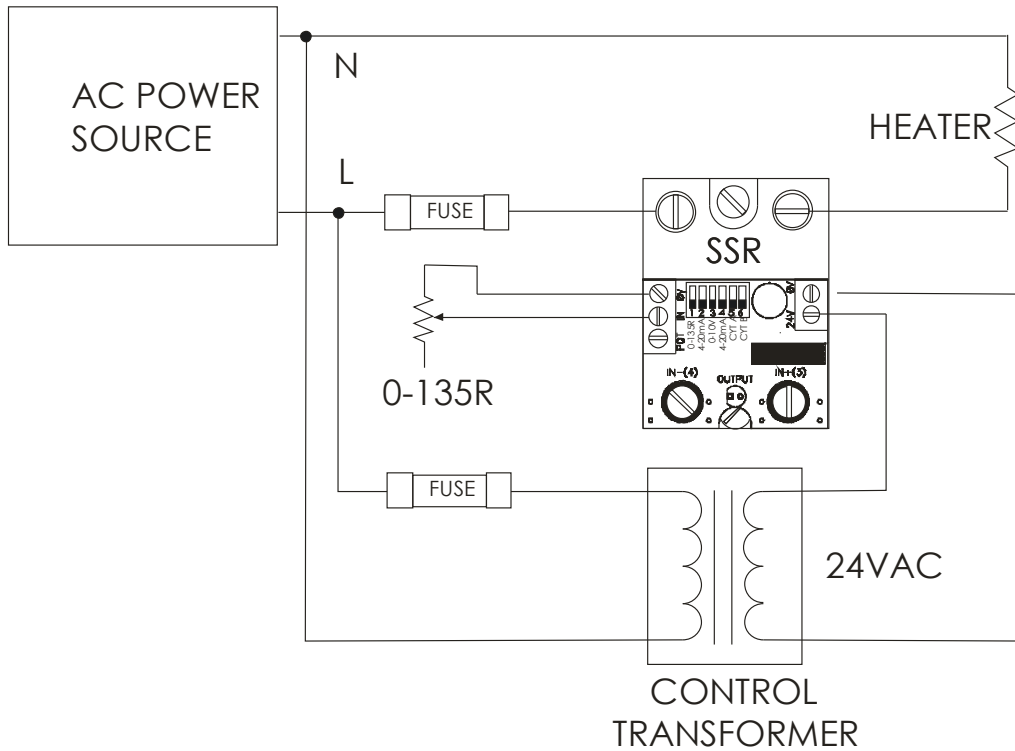
### 9. WIRING DIAGRAM (Potentiometer Input)

SSRMAN-1BFS WIRING DIAGRAM (POTENTIOMETER INPUT)



### 10. WIRING DIAGRAM (0-135 Ohm Input)

SSRMAN-1BFS WIRING DIAGRAM (0-135 Ohm)



### 11. WIRING DIAGRAM 3 PHASE DELTA – Zero Crossing

SSRMAN-1BFS WIRING DIAGRAM  
3 PHASE INSIDE DELTA CONNECTION

