



Switches in Series and Parallel Circuits

Switches in Series (“AND” operation)

Switches may be connected in series. Multiple switches in series must all be closed in order for the circuit to be closed, so we call this an “AND” operation (switch 1, 2, and all the others must be closed).

Circuit design considerations for series switch connection:

1. The load must receive the voltage it requires.
2. The switches must be supplied with a voltage within their operating range.
3. Each switch will cause a voltage drop as it absorbs power. The more switches in series, the more voltage consumed by the switches, and the less voltage available for operating the switches and the load. There will therefore be a limit on the number of switches which can be connected in series given the voltage applied to the circuit.
4. Current limiting resistors must be used in series with solid state switches connected in series to prevent a short circuit at the power supply output. If the power supply sees a short circuit, it will produce a very high current that will damage the switch.
5. Reed switches and sourcing switches can be connected in series.
6. Sinking switches cannot be connected in series. For a sinking configuration, use sourcing switches in series with a sinking switch as the last one in the chain.

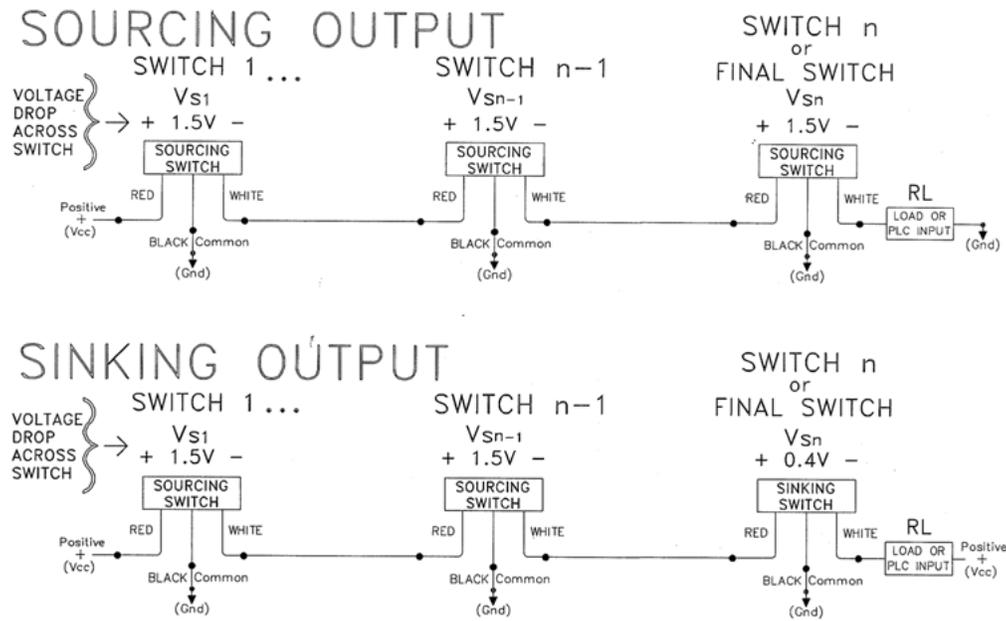
Calculation of voltage available to switches and the load: $V_{\text{POWER}} = V_{\text{LOAD}} + (V_{\text{SWITCH}} * N)$

The amount of voltage available to the circuit is fixed and constant: it's set by the output power supply, V_{POWER} . This voltage must be divided among the switches ($V_{\text{SWITCH}} * N$; where N is the number of switches) and the load (V_{LOAD}).

As more switches are placed in series, the voltage available for operation of the switches and load will decrease. It is possible for the switches and load to become inoperable as a result.

V_{SWITCH} includes the forward voltage drop of the LED or diode inside the switch, a constant value regardless of applied voltage, and the drop across the series resistor used to limit current to the LED if present, which varies with applied voltage, and the voltage drop across the internal switch electronics (operating voltage of the switch). The actual voltage drop due to the LED, diode, and internal resistor varies depending on the design of the switch. It is usually between 0 (no LED, diode, or resistor) and 1.5 volts. Operating voltages of switches vary widely.

Series Switch Connection Circuit Diagram (AND operation)



Switches in Parallel (“OR” operation)

Switches may be connected in parallel. If any one of multiple switches in parallel is closed, then the circuit is closed, so we call this an “OR” operation (switch 1 or 2 or any of the others can by itself close the circuit).

Parallel switch circuit design considerations:

1. Switches must not be mixed. Use all reed switches, or all sourcing switches, or all sinking switches.
2. When connecting many switches in parallel, if more than one switch is closed, the current draws from the power supply may be excessive, which may cause overheating and damage. Use an appropriately rated power supply.
3. Add blocking rectifier diodes on the output side of sourcing switches to prevent inadvertent LED activation by other switches.
 - The rectifier diode will lower the output voltage to the load. If this reduction presents a problem, use a Schottky barrier diode instead.
 - Choose a diode with a maximum average rectifier current greater than 0.3 Amps, and a maximum peak reverse voltage at least double the power supply voltage.
 - Typical forward voltage drops for diodes are 0.3 to 1.1 VDC.

The information presented is in Bimba’s best engineering opinion and should be used for reference only. Recommendations derived should be verified under actual operating conditions. Bimba reserves the right to change specifications without prior notice.

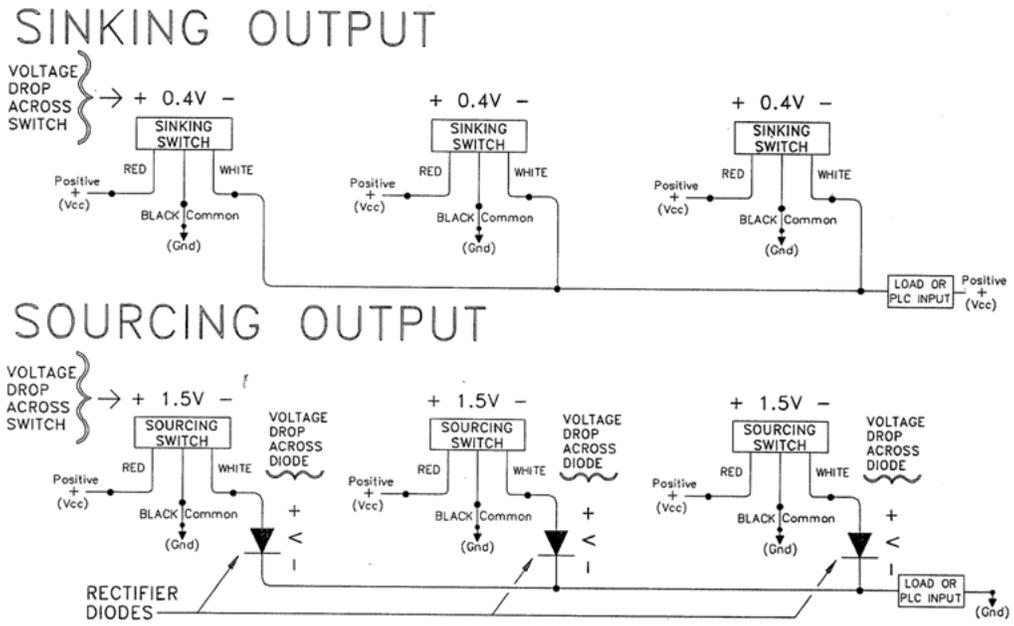
Bimba Manufacturing Company
 Monee, IL 60449-0068
 Telephone: 708.534.8544
 Email: cs@bimba.com
www.bimba.com
 Rev Level: 0

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Parallel Switch Connection Circuit Diagram (OR operation)



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