PIN Diode Microwave Switches

We can use PIN diodes to build microwave switches. There are two basic design configurations for a single pole switch. We first consider the series configuration.

Here the inductors are microwave chokes and the capacitors are DC blocking capacitors.

If the DC control voltage $V_c$ is set such that the PIN diode is forward biased, the equivalent microwave circuit becomes:
Note that $|S_{11}| \approx 0$ and $|S_{21}| \approx 1$ for this case, so that the switch has clearly connected the source to the load.

In contrast, consider the equivalent microwave circuit if the DC control voltage $V_C$ is set such that the PIN diode is reverse biased:

Note that $|S_{11}| \approx 1$ and $|S_{21}| \approx 0$ for this case, so that the switch has clearly disconnected the source from the load. Likewise, the input impedance of this switch has a very large magnitude—effectively an open circuit.
We now consider the \textbf{shunt} configuration:

![Microwave Switch Diagram]

where the inductors are \textit{microwave chokes} and the capacitors are \textit{DC blocking capacitors}.

If the DC control voltage $V_c$ is set such that the PIN diode is \textbf{forward biased}, the equivalent microwave circuit becomes:

![Equivalent Microwave Circuit Diagram]

Note that $|S_{11}| \approx 1$ and $|S_{21}| \approx 0$ for this case, so that the switch has clearly \textbf{disconnected} the source from the load. Likewise, the input impedance of this switch has a very small magnitude—effectively a \textbf{short} circuit.
In contrast, consider the equivalent microwave circuit if the DC control voltage $V_c$ is set such that the PIN diode is reverse biased:

![Microwave Circuit Diagram]

Note that $|S_{11}| \approx 0$ and $|S_{21}| \approx 1$ for this case, so that the switch has clearly connected the source to the load.

**Q:** But these are both SPST microwave switches. What about a (three-port) SPDT switch?

**A:** We can easily construct such a switch using the basic elements shown above. For example, a reflective switch would be (where DC bias elements have been ignored):
While an **absorptive switch** could be constructed as (where again the DC bias elements have been ignored):

![Diagram of an absorptive switch](image)

In this case, the port (1 or 2) **disconnected** from port 3 is connected to a **matched load**.