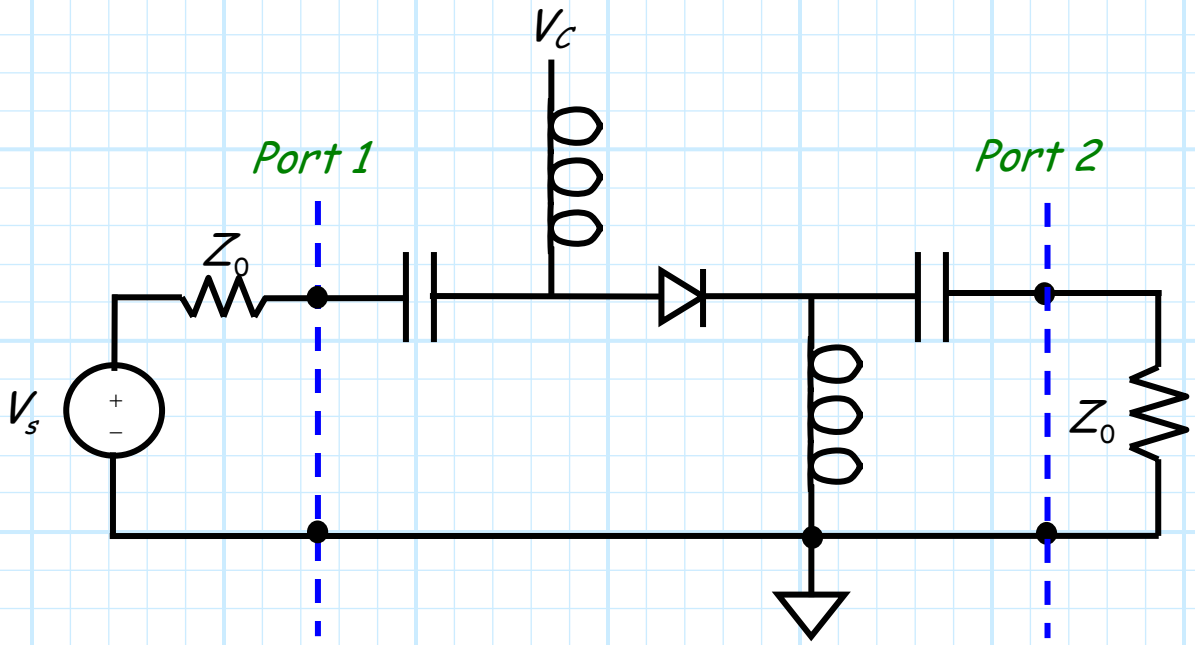
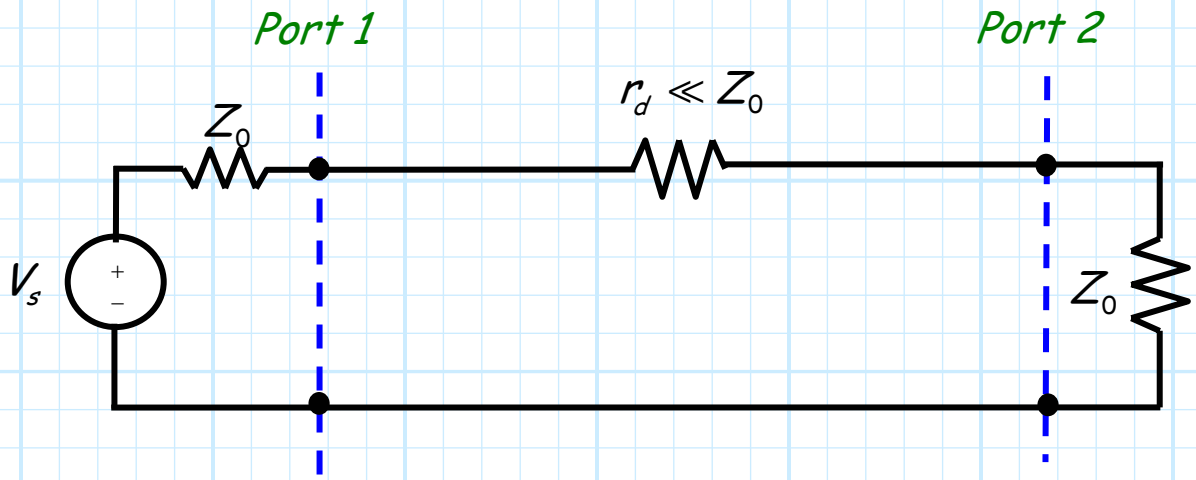
PIN Diode Microwave Switches

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.



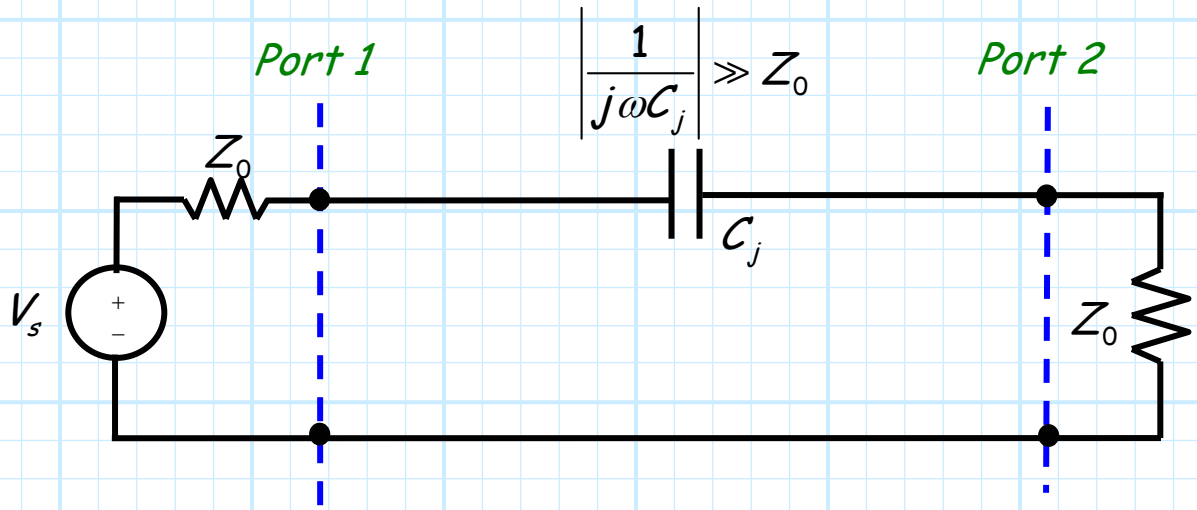
Here the inductors are **microwave chokes** and the capacitors are **DC blocking capacitors**.

If the DC control voltage V_C is set such that the PIN diode is **forward biased**, the equivalent microwave circuit becomes:



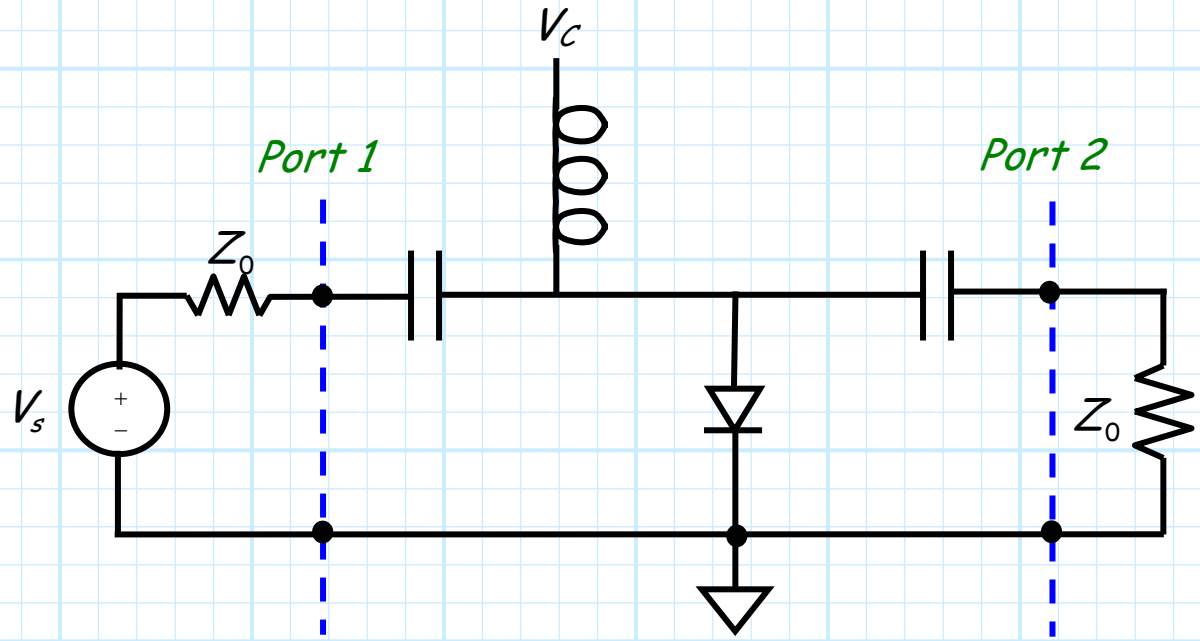
Note that $|S_{11}| \approx 0$ and $|S_{21}| \approx 1$ for this case, so that the switch has clearly **connected** the source to the load.

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



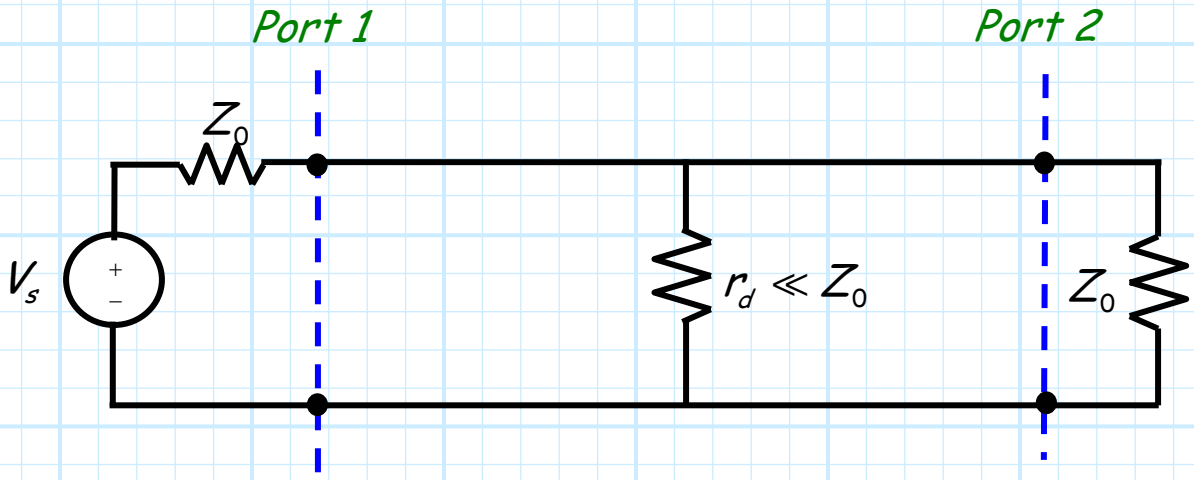
Note that $|S_{11}| \approx 1$ and $|S_{21}| \approx 0$ for this case, so that the switch has clearly **disconnected** the source from the load. Likewise, the input impedance of this switch has a very large magnitude—effectively an **open** circuit.

We now consider the **shunt** configuration:



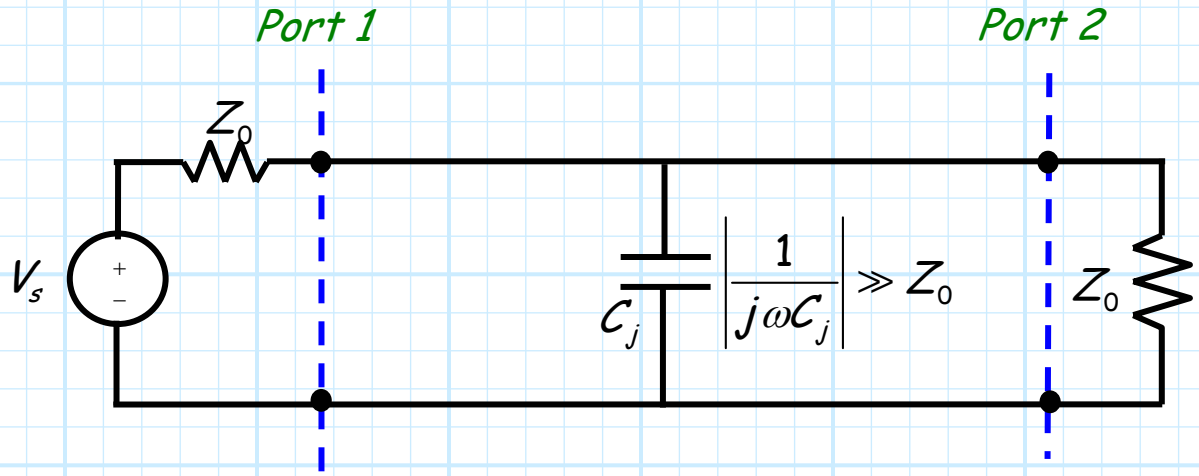
where the inductors are **microwave chokes** and the capacitors are **DC blocking capacitors**.

If the DC control voltage V_C is set such that the PIN diode is **forward biased**, the equivalent microwave circuit becomes:



Note that $|S_{11}| \approx 1$ 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 small magnitude—effectively a **short** circuit.

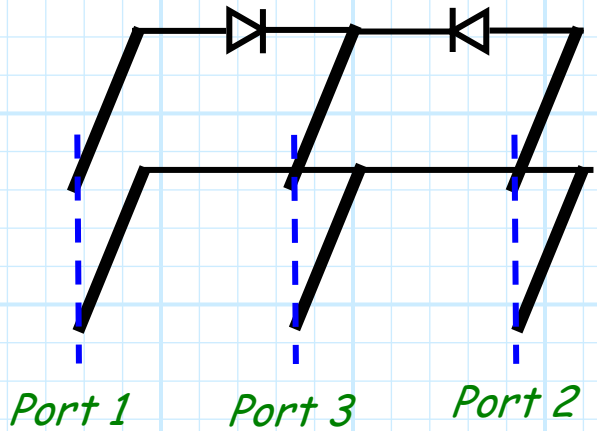
In contrast, consider the equivalent microwave circuit if the DC control voltage V_C is set such that the PIN diode is **reverse biased**:



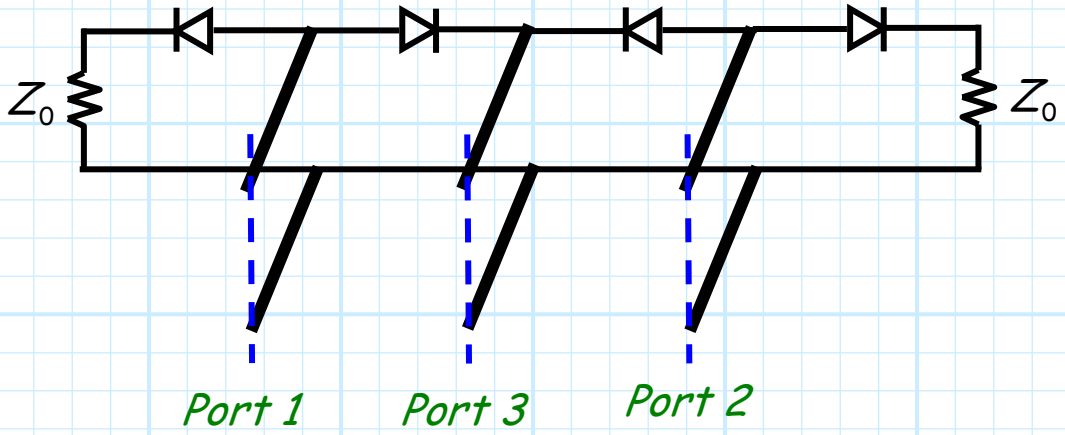
Note that $|S_{11}| \approx 0$ and $|S_{21}| \approx 1$ for this case, so that the switch has clearly **connected** the source to the load.

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):



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