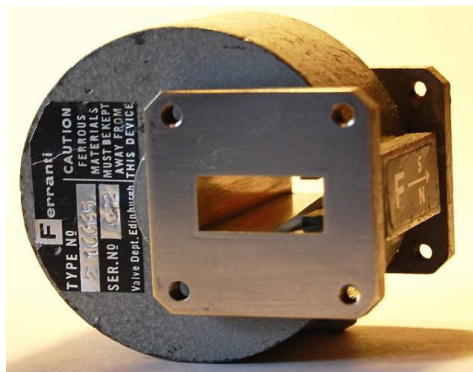


Applications of Circulators

➤ Isolator

When one port of a three-port circulator is terminated in a matched load, it can be used as an [isolator](#), since a signal can travel in only one direction between the remaining ports. An isolator is used to shield equipment on its input side from the effects of conditions on its output side; for example, to prevent a microwave source being detuned by a mismatched load.

Isolator is a microwave device which allows RF energy to pass through in one direction with very little loss, while RF power in the reverse direction is absorbed.

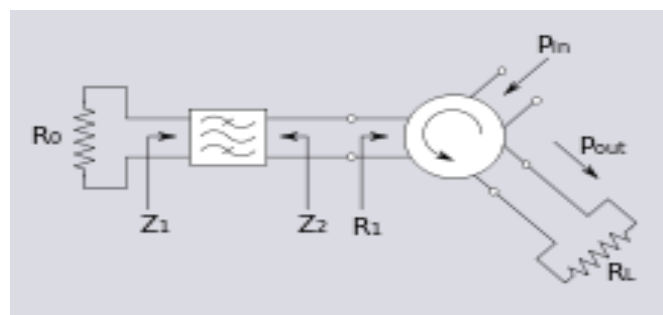


➤ Duplexer

In [radar](#), circulators are used as a type of [duplexer](#), to route signals from the [transmitter](#) to the [antenna](#) and from the antenna to the [receiver](#), without allowing signals to pass directly from transmitter to receiver. The alternative type of duplexer is a *transmit-receive switch (TR switch)* that alternates between connecting the antenna to the transmitter and to the receiver.

➤ Reflection amplifier

A *reflection amplifier* is a type of microwave amplifier circuit utilizing **negative resistance** diodes such as **tunnel diodes** and **Gunn diodes**. Negative resistance diodes can amplify signals, and often perform better at microwave frequencies than two-port devices. However since the diode is a one-port (two terminal) device, a nonreciprocal component is needed to separate the outgoing amplified signal from the incoming input signal. By using a 3-port circulator with the signal input connected to one port, the biased diode connected to a second, and the output load connected to the third, the output and input can be uncoupled.



Microwave diode reflection amplifier using a circulator

Microwave Transistors and Tunnel Diodes

Microwave solid-state devices are becoming increasingly important at microwave frequencies. These devices can be divided into four groups:

First group:

- Microwave bipolar junction transistor (BJT)
- Hetero junction bipolar transistor (HBT)
- Tunnel diode.

Second group:

- Microwave field effect transistor (FETs)
- Metal – semiconductor field effect transistor

