**What is a mixer?**

It's a device that performs the task of frequency conversion, by multiplying two Mixers are needed in most microwave systems because the RF signal is way too high to process its information



Schematic symbol for a mixer

A mixer can be as simple as one that uses a single diode, or it can get far more complicated for improved performance. Two broad categories of mixers commonly used in microwave applications are ***switching mixers*** and [***nonlinear***](http://www.microwaves101.com/encyclopedia/nonlineardevices.cfm) ***mixers***.

**Mixer ports**

There are three ports on a mixer

1. ,the radio frequency (RF) port,
2. the local oscillator port (LO), and
3. the intermediate frequency port (IF).

The RF port is where the high frequency signal is applied that you want to down convert it, or where the high-frequency signal is output in an upconverter.

The local oscillator (LO) port is where the "power" for the mixer is injected. In this case, the power that is applied is RF, not DC like it would be in an [amplifier.](http://www.microwaves101.com/encyclopedia/amplifiers.cfm) The LO signal is the strongest signal, and is used to turn the diodes on and off in a *switching* mixer (which is nine out of ten mixers). The switching action effectively reverses the path of the RF to the IF.

The IF port is where the RF signal that was modified by the LO signal is passed, and its waveform is filtered to become the IF signal.

**Active versus passive mixers**

Even though a fair amount of LO power is used to operate a mixer, a mixer is considered a [passive device](http://www.microwaves101.com/encyclopedia/Network_theory.cfm#passive) unless it contains a means of amplifying the converted signal using DC power. One type of active mixer that you might have heard of is a Gilbert cell mixer, which we promise to describe another time!

**Downconverters versus upconverters**

You can use a mixer to convert a signal down in frequency (as in a receiver) or up in frequency (as in an transmitter or exciter) because it is a reciprocal device.

**Conversion loss/gain**

This is the difference in amplitude of the available RF signal to the IF signal output (downconverter), or from the IF signal to the RF signal (up converter).

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**Mixer isolation measurements**

In a perfect mixer, the RF and LO signals would not be present at the IF port, and the LO would not be present at the RF port. There are three important isolations to consider:

RF to IF

LO to IF

LO to RF

The LO in particular presents a problem because it is usually a much stronger signal that the other two. The problem with LO (or RF) at the IF terminal is that these signals may cause other spurious products later in the chain, and perhaps saturate the IF amp if they are strong enough. The problem with LO at the RF port is that it can cause your receiver to radiate RF energy at the antenna port and get you in trouble with the FCC, or worse, get your fighter aircraft spotted by a surface-to-air missile.

**Spurs**

The word "spur" is an abbreviation for "spurious signal". These are unwanted products that can creep into your IF bandwidth. Any nonlinear device, when presented with two or more input frequencies, will output not only the input frequencies but harmonics and intermodulation products of the input frequencies as well. The expression normally used for the mixing products is:

FIF = M x FRF + N x FLO

**Detectors**

A detector is a two-terminal device that is used to rectify an RF signal (like a diode rectifies an alternating current signal in a power supply). Detectors are used as the receiving element in amplitude modulation schemes among other uses.

**Basic detector circuit and terminology**

Here is a schematic of a simple detector circuit. The heart of the circuit is the detector diode, whose non-linear behavior is what causes the "detectitation

|  |
| --- |
| http://www.microwaves101.com/encyclopedia/images/detectors/basicdetector.jpgBasic detector circuit |

**Detector diode**
The diode rectifies the incident power, providing a signal that is of one polarity (either all positive or all negative) to the bypass capacitor, with an amplitude proportional to the input power level. Typical detectors provide a negative voltage, which would occur by reversing the diode in the schematic.

**DC return**
In order for a detector to generate a DC voltage, a DC return must be supplied. This is typically done by placing an RF choke (shunt inductor) across the detector diode; at RF frequencies the inductor looks like an open circuit and has no effect, at video frequencies it provides a low-impedance path to ground.

**Input matching network**
An impedance transformer is used to match the impedance of network with detector

**Video Out**

 THE VIDEO OUT OF DETECTOR IS CONNECTED NORMALLY TO A COXIAL CABLE AND DATA IS COLLECTED FROM HERE

**Types of detector diodes**

Diodes used in detectors can be Schottky or Esaki tunnel diodes. Some of Example of diode used for diode are

**PIN DIODEN**

**Schottky diode**

**Planar-doped barrier diode**

**POWER DIODE**

# **CIRCULATOR**





A **circulator** is a [passive](http://en.wikipedia.org/wiki/Passivity_%28engineering%29) non-[reciprocal](http://en.wikipedia.org/wiki/Reciprocity_%28electromagnetism%29) three- or four-[port](http://en.wikipedia.org/wiki/Two-port_network) device, in which a [microwave](http://en.wikipedia.org/wiki/Microwave) or [radio frequency](http://en.wikipedia.org/wiki/Radio_frequency) signal entering any port is transmitted to the next port in rotation (only).

**Types**

## **Applications**

### Isolator

When one port of a three-port circulator is terminated in a matched load, it can be used as an [*isolator*](http://en.wikipedia.org/wiki/Isolator_%28microwave%29), since a signal can travel in only one direction between the remaining ports.[[4]](http://en.wikipedia.org/wiki/Circulator#cite_note-4) 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.



An **isolator** is a [two-port](http://en.wikipedia.org/wiki/Two-port_network) device that transmits [microwave](http://en.wikipedia.org/wiki/Microwave) or [radio frequency](http://en.wikipedia.org/wiki/Radio_frequency) power in one direction only. It 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.

## **Non-reciprocity**

An isolator is a non-[reciprocal](http://en.wikipedia.org/wiki/Reciprocity_%28electromagnetism%29) device, with a non-[symmetric](http://en.wikipedia.org/wiki/Symmetric_matrix) [scattering matrix](http://en.wikipedia.org/wiki/Scattering_parameters). An ideal isolator transmits all the power entering port 1 to port 2, while absorbing all the power entering port 2,





### ]Duplexer

In [radar](http://en.wikipedia.org/wiki/Radar), circulators are used as a type of [duplexer](http://en.wikipedia.org/wiki/Duplexer), to route signals from the [transmitter](http://en.wikipedia.org/wiki/Transmitter) to the [antenna](http://en.wikipedia.org/wiki/Antenna_%28electronics%29) and from the antenna to the [receiver](http://en.wikipedia.org/wiki/Receiver_%28radio%29), 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. The use of chirped pulses and a high dynamic range may lead to temporal overlap of the sent and received pulses, however, requiring a circulator for this function.