Isolator & Circulator Basics

An RF isolator is a two-port passive device made of magnets and ferrite material which is used to protect other RF components from excessive signal reflection, while an RF circulator is a three-port passive device used to control the direction of signal flow in a circuit.

To understand how these components control the signal flow, think of a cup of water into which you place a spoon and stir in a clockwise motion. If you sprinkle some pepper into the cup and continue to stir, you will notice that the pepper easily follows the circular motion of the water. You can also see that it would be impossible for the pepper to move in a counterclockwise direction because the water motion is just too strong. The interaction of the magnetic field to the ferrite material inside isolators and circulators create magnetic fields similar to the water flow in the cup. The rotary field is very strong and will cause any RF/microwave signal placed at one port to follow the magnetic flow to the adjacent port and not in the opposite direction.

Figure 1 shows the schematics for a circulator and an isolator. Notice how an isolator is a circulator with the third port terminated. The arrows represent the direction of the magnetic fields and the signal when applied to any port of these devices. Example: If a signal is placed at port A, and port B is well matched, the signal will exit at port B with very little loss (typically 0.4dB). If there is a mismatch at port B, the reflected signal from port B will be directed to port C.

FIGURE 1

Isolation

An important consideration when specifying an isolator or circulator is to ensure the device has adequate isolation between the ports for your given application. The amount of isolation is directly affected by the load at port 3.

If the match on port 3 is poor, you can expect isolation below 10 dB, but if the match is improved to 1.10:1 by using a good termination device in the circuit, then the isolation would improve to over 20 dB.

Source: www.e-meca.com

Level 14, 350 Collins Street, Melbourne 3000 Victoria Australia ACN 102 832 495
Tel +61 3 9604 6900 Fax +61 3 9604 6999 Email info@drawcom.com.au www.drawcom.com.au

Common Applications

A common application for a circulator is as a duplexer (a transmitter and receiver sharing one antenna). **Figure2** shows that when the transmitter at port A sends out a signal, the output goes directly to the antenna at port B and does not leak back into the receiver at port C due to the isolation of the circulator. Good isolation is key to ensure that a high-power transmitter output signal does not get back the receiver front end. In this configuration, all signals from the antenna go straight to the receiver and not the transmitter because of the circular signal flow (remember the cup of water).

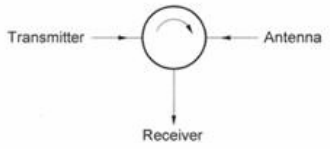

FIGURE 2 - Duplexor

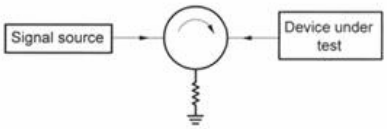

FIGURE 3

Figure 3 shows a common test bench application where an isolator is placed in a measurement path so that any variations in the device under test (DUT) will end up at the termination of the isolator and not back to the signal source.

Power Ratings

DrawCom isolators are designed with an internal 10w load capability. However, the recommended maximum power that our devices can sustain is 2w to allow for de-rating and heat transfer. Higher isolator power levels can be achieved utilizing our circulators with an external load. DrawCom offers an extensive selection of high power, low loss RF loads. Please consult with DrawCom to discuss your requirement.

Special Handling & Storage

Isolators and circulators have magnets that produce strong fields to control signal flow. As is the case with any magnet, when placed in close proximity to another these fields oppose one another and over time, will weaken the strength of the magnets. This is called degaussing. A similar effect can be seen when stored in close proximity to ferrous metals. Special care should be taken when storing any isolators/circulators and MECA recommends that the devices should be separated by 3 inches from each other & all ferrous surfaces to
reduce degaussing effects.

Ordering

DrawCom offers a broad range of isolators and circulators in both N, SMA and waveguide. The most "popular" frequency bands between 0.8 - 8.0 GHz are readily available and can ship from STOCK to 2 weeks after receipt of your order.

Source: www.e-meca.com