TECH BRIEF

Ferrite Series

Isolators and Circulators

150 MHz to 40 GHz

Mercury Systems designs and manufactures isolators and circulators ranging in frequency from 150 MHz to 40 GHz, with bandwidth variations from fixed frequency through octave band and even ultra bandwidths. Our ferrite products are used in telecommunication, multi-channel receivers and bi-phase/pulse modulation systems.

We are one of the leading designers and manufacturers of microwave receiving and signal processing components for military and commercial applications.

- Communication band coaxial isolators & circulators, with frequency ranges from 150 MHz to 26.5 GHz, 2 Watts average power handling.
- Broadband coaxial isolators & circulators, with frequency ranges from 500 MHz to 26.5+ GHz, 2 Watts average power handling.
- High frequency isolators & circulators, with frequency ranges from 17 MHz to 40 GHz, 1 Watt power handling.
- PAC isolators and circulators, with frequencies from 3.6 GHz to 23.6 GHz, forward power of 5 Watts and reverse power of 1 Watt.
- Drop-in isolators & circulators, covering frequency ranges up to 20GHz.
- Stripline drop-in isolators and virculators, with frequencies from 450 MHz to 14.5 GHz, low intermodulation distortion.
- Iso-adapters, designed for high vibration levels, rugged construction, offered in frequencies from 5.87 GHz to 23.6 GHz.

Choose from over 200 proven isolators and circulators in-stock or ready-to-build models or connect with our engineers to have a isolator/circulator designed to your specifications.

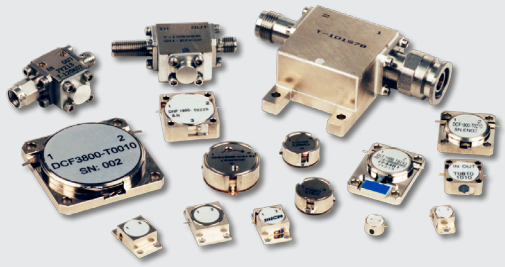
The Manteca facility is AS9100 Rev. C certified and is a qualified space components manufacturing facility.

OPERATING FREQUENCY: There are two types of stripline junction circulator/isolator designs, above resonance (AR) and below resonance (BR). AR designs fall into the 150 MHz to approximately 2.5 GHz range.

SIZE: The size of the circulator or isolator is a function of the frequency and/or bandwidth. Lower operating frequencies or units with greater operating bandwidths are usually larger than higher frequency or narrower bandwidth units.

BANDWIDTH: The AR junction is generally limited to 35% maximum bandwidth. The BR junctions allow for broader bandwidth designs up to 100% or more.

TEMPERATURE: Operating temperatures from -54°C to +95°C can be obtained on most models depending on the bandwidth and level of performance desired.



POWER:

Breakdown: The peak power breakdown value of a stripline junction is reduced by an increase in load mismatch, altitude, temperature or pulse width. A mismatch on the output port will reflect a percentage of the signal back into the junction causing a high internal voltage level. The peak power rating can be increased be filling the internal volume of the device with a high dielectric strength material. Hermetically sealed modules can be used to maintain pressurization for high altitude operation.

Stripline Junction Technology

Mercury divides its stripline junction circulators and isolators into two types, drop-in and coaxial (coax). Both the drop-in and coax use the same basic construction where the center conductor (called the circuit) is sandwiched between two ferrite disks or triangles (called the pucks). This circuit and puck assembly is then further sandwiched between two ground planes and magnetically biased using permanent magnets.

When the ferrite material is properly magnetized, ferri-magnetic resonance occurs when a rotating RF magnetic field has the same direction and frequency as the electrons in the ferrite material. The magnetic biasing of the circulator junction must be set so the operating region is either above or below the ferri-magnetic resonance. Extremely high insertion loss will occur at resonance. High insertion loss can also occur at very low biasing fields.

The ferrite and the intersection of the three transmission lines from the Y-junction circuit is where the actual circulation takes place. When an RF signal is applied at port 1, two counter-rotating waves are generated that will rotate at different velocities w+ and w-. The velocity of the wave as it propagates through the magnetically biased ferrite material will depend on its direction of rotation. With the proper ferrite material and biasing field, the phase velocity of the wave traveling in one direction will be greater than the wave velocity traveling in the other direction. With the signal applied to port 1, the signals will arrive in phase at port 2 for maximum power transfer and cancellation at port 3.

DROP-IN TYPE: The drop-in isolator or circulator is a non-connectorized unit, allowing the center conductor to be soldered or ribbon bonded directly to a stripline circuit board assembly, by the use of tabs. The tabs on the drop-in units are usually 5 mil thick beryllium copper and can be gold plated for ribbon bonding, silver or solder tin plated for better solderability or unplated for cost savings. The tabs may also be configured for flush mount or stress relief. Careful consideration should be given to the mounting and grounding of the unit housing as well as the geometry of the mating substrate. It is essential that MICA is supplied with as much information as possible on how the unit is to be integrated into the final assembly. The drop-in type isolators and circulators are of an open construction and are not recommended for applications in hostile environments.

Visit our website at http://rf.mrcy.com for more information regarding our proven ferrite solutions or to connect with our ferrite engineers for detailed engineering support.

Limiting: Another effect related to the peak power rating of a circulator is known as nonlinearity or peak power threshold. As the peak power level increases beyond a critical value, the loss versus magnetic field curve will show considerable changes in the BR region. The AR region will show little affect.

Average Power: The power dissipation in the junction is in proportion to the insertion loss. If the average power level is significant, the dissipated power will cause heating of the ferrite and degradation in performance. The average power rating is also dependent on the mismatch at the output port. For example, if a signal of 100 Watts average power were applied at the input with a mismatch of 6.00:1 on the output, 51 Watts would be reflected, requiring the junction to handle 151 Watts total. Note, that this will also affect the termination power rating requirement for isolators.

COAX TYPE: The coax isolators and circulator are connectorized units and can be supplied with various connector types. SMA female or male connectors are the most popular, cost effective and easiest to install. Other connector configurations include: K, 3.5mm, right angle, TYPE N, TNC, GPO, OSP and others.

The coax type isolators and circulators can be built to withstand high humidity up to 100%, salt atmospheres and pass EMI or RFI specifications through the use of sealing epoxies and paints. Other connector configurations may be used such as, mixed connector types, removable connectors, where one or more connections can have removable shells allowing the center conductor to be soldered to a circuit board much like the drop-in units. Waveguide adapters, called iso-adapters, are a circulator or isolator mounted to a waveguide flange and are particularly useful for connecting directly to a wave antenna with the waveguide port while the SMA connector port can be fed directly into a solid stale amplifier.

 2958.01E-1013-TB-Ferrite-Series

www.mrcy.com

MERCURY SYSTEMS™

Innovation That Matters™

Corporate Headquarters
201 Riverneck Road
Chelmsford, MA 01824-2820 USA
(978) 967-1401 • (866) 627-6951
Fax (978) 256-3599
www.mrcy.com

Mercury Commercial Electronics
RF Microwave Components
1096 Mellon Avenue
Manteca, CA 95337
(209) 825-3977
email: salesRF@mrcy.com
http://rf.mrcy.com