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ELECTRO TECHNIK

NOVA MICROWAVE

# MICROWAVE ISOLATORS & CIRCULATORS




- Antenna Systems
- Satellite Communications (SATCOM)
- Test and Measurement







- Transmit/Receive (T/R) Modules
- Reflection Amplifiers
- Radar (Duplexer)
- Switchable Circulator
- Phase Locked Injection Circuits

ISO 9001:2008 REGISTERED

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# INDEX


| | |
|---|---|
| Welcome; Mission; Vision | 1 |
| Facility; Management | 2 |
| Why NOVA: Quality Control; Inventory Control | 3 |
| Circulators: Types; Applications | 4 |
| Drop-In Circulators | 5-7 |
| SMA Coaxial Circulators | 8 |
| N Type Coaxial Circulators | 9-10 |
| Surface Mount Circulators | 11-12 |
| Isolators | 13 |
| Drop-In Isolators | 14-16 |
| SMA Isolators | 17-18 |
| N Type Coaxial Isolators | 19-20 |
| Surface Mount Isolators | 21-22 |
| Drop-In & Connectorized Multi-Port Junctions | 23 |
| Installation Procedures | 24 |
| Packages: | |
| A, B, C | 25 |
| CC, CI, CT | 26 |
| E, EC, F | 27 |
| FC, IT, M | 28 |
| N, NQ, NR | 29 |
| NS, NT, NY | 30 |
| NQC, NRC, NSC | 31 |
| NTC, NYC, O | 32 |



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OC, P, PC 33

Q, QC, R 34

RC, S, SC 35

T, TC, U 36

UC, V, VC 37

W, WC, X 38

XC, Y, YC 39

Specifying Isolators and Circulators: 40

VSWR; Isolation; Insertion Loss; Temperature Range 40

Magnetic Shielding; RFI Shielding; Termination Rating; Power Rating 41

Connectors; Insertion Phase 42

Understanding Circulators and Isolators: 43

Ferrite 43-44

Comparing; Operating Frequency; Bandwidth 45

Temperature; Junction Size; Magnetic Circuit; Impedance Transformation 46

Transmission Line Geometry 47

Connectors; Description of Operating Parameters; VSWR; 48

Insertion Loss; Isolation 48

Percentage Bandwidth; Temperature Range; Operating 49

Storage; Phase Tracking; Phase Linearity; Impedance Characteristics; 50

Peak Power: Breakdown; Limiting 50

Harmonics; Average Power 51

Isolator Termination Rating; RFI 52




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## Welcome

Nova Microwave specializes in design, development and manufacturing of high quality passive RF Microwave Circulators and Isolators. Available in single or multi-junction topographies, the Nova Microwave product line of Ferrite Circulators and Isolators are specifically designed for use in varied environmental and temperature extremes. We provide circulators and isolators spanning the frequency range of 380 MHz to 26.5 GHz in varying bandwidths, tailored to cover all standard and popular bands commonly used throughout the market place.

- Drop-In
- Surface Mount
- Magnetically Shielded Packages (Drop-In)
- SMA and N Type Coaxial Connectors
- Clockwise and Counter-Clockwise rotation (CCW)
- Reflected power from 1 Watt to 100 Watts pending on Model Number (contact factory) for your particular requirement

Nova Microwave is a World Wide Supplier for Commercial Applications, Military Applications, Cellular and Wireless Telecommunications.

Quality is a total commitment at Nova Microwave, **NOT JUST A SLOGAN**

## Nova Microwave Mission Statement

Nova Microwave's mission is to provide high reliability Circulators and Isolators on time at a competitive price. Nova Microwave is a company where the primary objective is to fulfill or exceed our customers' need and expectations. Quality is a total commitment at Nova Microwave, NOT JUST A SLOGAN.

Have our customers remember us as much for our friendly and professional staff and commitment to long-term relationships as they do for our Circulators and Isolators.

## Our Vision

Nova Microwave's vision is to be the preferred supplier for Circulators and Isolators for the Microwave Industry.



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## Facility

The Nova Microwave facility is located in Clearwater, Florida, with easy access to Interstate 275 and the Tampa International Airport.

The Nova facility is made up of departments consisting of manufacturing,raw material inventory, prototype shop, quality assurance, and management services. The design engineers have computer stations, software and test stations to develop and design state-of-the-art Ferrite Circulators and Isolators to the finished product.

Nova has state of the art test equipment that provides swept frequency response over the desired frequency band. Nova has a close working relationship with a number of machine shops in the area who specialize in the type of parts required for our Ferrite Circulator and Isolator designs. We are one of their major customers in this area and utilize them as part of our team to support all our customer requirements.

The Nova facility is equipped with an Automated CAD Integrated Circuit cutting machine which operates from the AutoCAD Program. This provides the ability to cut circuits in house for the prototype parts and optimization of the design process in a timely fashion. Nova's geographic location makes a large pool of potential employees available to meet anticipated growth requirements.

## Management

Nova Microwave Incorporated was started in 1994 and acquired by Electro Technik Industries in 2013. The success of this management has always relied on its ability to develop a customer-sensitive culture. The team members have mutual respect for their ability to satisfy the customer community we serve. The team understands that we must compete in this market place based on quality, reliability, product, technology, price and convenience with which our customer can use our Ferrite Circulators and Isolators. The team also understands that vendors are a unique part of our team and we must work with them to improve the quality of our Circulators and Isolators we supply. It is only with their support that we can meet our commitments to our customers. This can only be accomplished through effective communication and working closely with customers and vendors. The Nova team is very particular in selecting our vendors that can help to provide parts at the most competitive price. These advanced capabilities are generated as a result of integrating technological experience with our unique problem solving techniques to produce the most cost effective Ferrite Circulators and Isolators for our customers. The Nova team brings together the talented designers, experienced manufacturing engineers, quality assurance specialists, and program managers to develop a Ferrite Circulator and/or Isolator for any application.



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## Quality Control

Nova Microwave's mission is to become the primary source of high-quality, volume production for Ferrite Circulators and Isolators for wireless communication and military systems. Management understands this objective can only be achieved if Nova maintains a quality system compliant with MIL-I-45208 and registered to ISO 9001. Nova's staff has extensive experience with Ferrite Circulator and Isolator qualification, high reliability manufacturing, program documentation, program management, and environmental testing. We take pride in establishing company procedures which produce high-quality Ferrite Circulators and Isolators at competitive prices. Nova's manufacturing facility is equipped with all required testing equipment to ensure the compliance of Ferrite Circulators and Isolators manufactured. We process parts through temperature cycling on a 100% basis as part of our manufacturing process. Nova design engineers are required to stress test the Circulator and Isolator designs before releasing them to the production line. Nova management believes that quality has to be designed in the Circulators and Isolators at the design stage and not at final screening stage. Nova's primary objective is to fulfill or exceed our customers' needs and expectations. Quality and services are a total commitment of Nova, NOT JUST A SLOGAN.

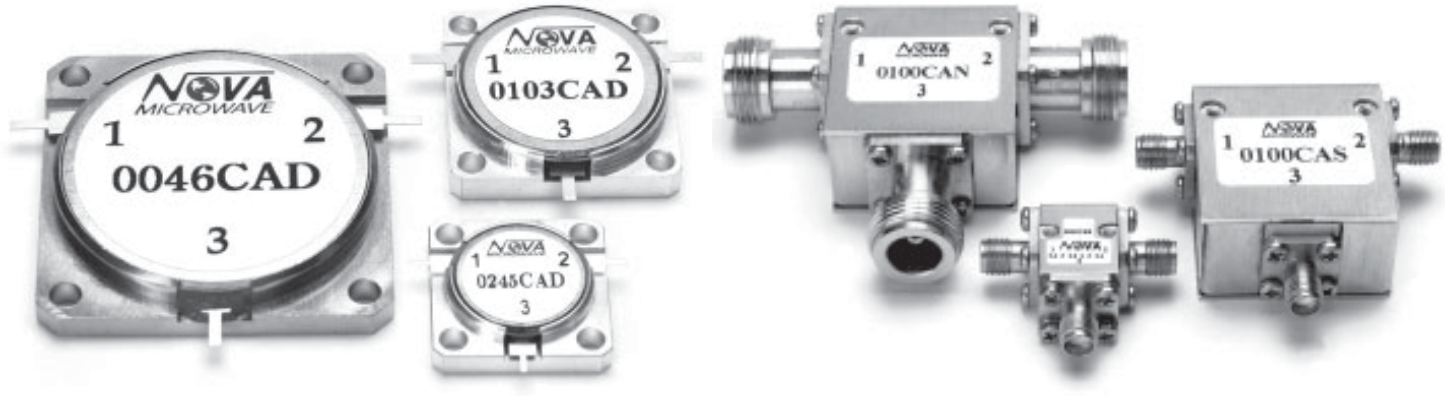
## Inventory Control

Nova Microwave maintains a large inventory of qualified parts. Our ability to support product on a just in time (JIT) delivery basis is dependent on maintaining a large inventory of raw materials. The inventory is managed to provide a competitive price to our customers, and our vendors understand the concept of functional evaluation of their products for consistent Ferrite Circulator and Isolator performance. All incoming material is inspected and samples issued to the line for functional testing before being received into inventory. The inventory area is physically separated from production with controlled access by production control personnel. The inspection dates are clearly marked on materials in their appropriate containers, and is controlled by lot numbers to keep inventory current. The inventory management is considered to be a key in meeting our slogan of fulfilling customers' needs and expectations with quality products and service.



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Nova Microwave designs and manufactures a comprehensive line of circulators for commercial applications, military applications, wireless and cellular markets. These devices are important for keeping signals flowing in one direction only. A circulator is a device that transports radio frequency or microwave signals from one port to another. They typically have three ports. They are made of magnets and ferrite materials with magnetic properties. Circulators can be made to circulate clockwise or counterclockwise. So the name "circulator" makes sense in that it transmits the signal around to the three ports. These devices are also referred to as duplexers because they allow the transmission of two signals over one channel. This allows a receiver and a transmitter to share the same antenna. This is the most common use for a circulator. When the transmitter sends a signal, the device directs the signal to the antenna port. So in summary, a circulator is a device that is designed to direct radio frequencies or microwave signals from Port 1 to Port 2 with a minimum loss.

**The Types of Circulators**
At Nova Microwave, we pride ourselves for being a source for quality circulators, all designed with customer satisfaction in mind at competitive prices. Nova Microwave produces a broad range of circulators from 380 MHz to 23.6 GHz as follows:

- **Drop-In Circulators**
- **Surface Mount Circulators**
- **SMA Coaxial Circulators**
- **N Type Coaxial Circulators**
- **Drop-In & Connectorized Multi-Port Junctions (Contact Factory)**

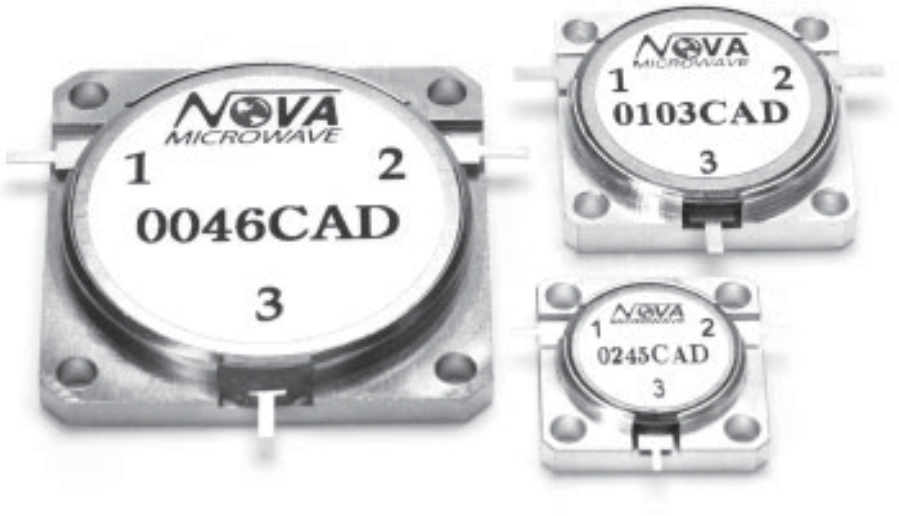
Each device is stress tested during production to ensure the performance over temperature extremes. The focus on quality and testing during manufacturing allows us to provide a reliable product to our customers. The material selected for manufacturing these devices has a significant effect on their performance as well as their cost. Our understanding of ferrite and magnetic materials allows us to manufacture devices that are reliable and cost effective. We also take temperature fluctuations into consideration at the design stage. Each device is temperature cycled from -50°C to +100°C in the design and testing process. This ensures that the magnets will provide the required magnetic field over the desired operating temperatures.

**Applications**
Typical application for circulators is the use of a common antenna for a transmitter and receiver. The transmitter is attached to Port 1 and the antenna to Port 2. The receiver is connected to Port 3 in clockwise biased circulators. Anytime there is a need to direct microwave signals in clockwise or counter-clockwise direction with a low insertion loss, circulators are utilized.

***For additional information, see the following sections below.***
- How to Specify Isolators And Circulators
- Understanding Circulators and Isolators
- Drop-In Installation Procedure
- Technical Information


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Nova Microwave offers a line of Drop-In Isolators in various package sizes and frequency bands, specifically designed for communications applications, military applications, cellular and wireless markets. Reliability, price and manufacturability are optimized at the design stage.




Drop-In Isolators are manufactured with high quality materials to ensure optimum performance over the temperature range. To ensure that the magnetic field is stabilized and will not fluctuate over temperature, all Drop-In Isolators are temperature cycled from -50°C to +100°C prior to final test. Drop-In Isolators with phase matching, counter clockwise rotation, higher reverse power capability along with required intermodulation specifications can be provided upon request.

Electrical specifications listed are over the operating temperature range. **If the frequency band of interest is not covered, please contact the factory.** Test fixtures are available for verification of data prior to integration and can be purchased from Nova Microwave.If you have any issues or questions regarding installation of our Drop-In Isolators, please refer to Nova Microwave Installation Procedure for Drop-In Circulators and Drop-In Isolatorson this website.



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# DROP-IN CIRCULATORS

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.450-0.470 | 0046CAD | 22 | 0.40 | 1.20 | -20+85 | 250 | 250 | 1.50 X 1.50 X 0.33 | M |
| 0.450-0.500 | 0048CAD | 20 | 0.50 | 1.25 | -20+85 | 250 | 250 | 1.50 X 1.50 X 0.33 | M |
| 0.470-0.512 | 0049CAD | 20 | 0.50 | 1.25 | -20+85 | 250 | 250 | 1.50 X 1.50 X 0.33 | M |
| 0.810-0.915 | 0086CAD | 20 | 0.35 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 0.810-0.826 | 0082CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 0.824-0.849 | 0084CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 0.860-0.904 | 0088CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 0.880-0.940 | 0091CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 0.890-0.960 | 0092CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 0.915-0.964 | 0094CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 0.980-1.020 | 0100CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.000-1.060 | 0103CAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.000-1.100 | 0105CAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.030-1.090 | 0106CAD | 22 | 0.30 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.250-1.350 | 0130CAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.400-1.600 | 0150CAD | 20 | 0.40 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.429-1.453 | 0144CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.429-1.501 | 0147CAD | 22 | 0.35 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.477-1.501 | 0149CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.500-1.660 | 0158CAD | 20 | 0.35 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | N |
| 1.710-1.785 | 0175CAD | 20 | 0.30 | 1.25 | -20+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 1.710-1.880 | 0179CAD | 20 | 0.35 | 1.25 | -20+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 1.805-1.880 | 0184CAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 1.850-1.990 | 0192CAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 1.930-1.990 | 0196CAD | 20 | 0.30 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 2.000-2.300 | 0215CAD | 20 | 0.50 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 2.000-2.400 | 0225CAD | 20 | 0.50 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 2.300-2.500 | 0240CAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |

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# DROP-IN CIRCULATORS

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 2.400-2.500 | 0245CAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 2.500-2.900 | 0270CAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 2.900-3.100 | 0300CAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 3.300-3.600 | 0345CAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | CC |
| 3.400-4.200 | 0380CED | 20 | 0.40 | 1.25 | -20+85 | 50 | 50 | 0.75 X 0.75 X 0.21 | CC |
| 3.600-4.300 | 0395CED | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 0.75 X 0.75 X 0.21 | CC |
| 4.200-4.400 | 0430CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 4.400-5.000 | 0470CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 5.000-6.500 | 0575CED | 17 | 0.50 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 5.400-5.900 | 0565CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 5.800-6.500 | 0615CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 6.400-7.200 | 0680CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 6.500-8.500 | 0750CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 7.100-7.900 | 0760CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 7.200-8.400 | 0780CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 7.800-8.500 | 0815CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 8.300-8.800 | 0855CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | OC |
| 8.500-11.500 | 1000CED | 17 | 0.50 | 1.35 | -40+85 | 30 | 30 | 0.35 X 0.475 X 0.16 | PC |
| 9.000-9.700 | 0935CED | 20 | 0.35 | 1.25 | -40+85 | 30 | 30 | 0.35 X 0.475 X 0.16 | PC |
| 9.500-12.750 | 1112CED | 20 | 0.40 | 1.25 | -40+85 | 30 | 30 | 0.35 X 0.475 X 0.16 | PC |
| 9.700-11.700 | 1070CED | 20 | 0.40 | 1.25 | -40+85 | 30 | 30 | 0.35 X 0.475 X 0.16 | PC |
| 11.100-13.700 | 1240CED | 20 | 0.40 | 1.25 | -40+85 | 25 | 25 | 0.35 X 0.475 X 0.16 | PC |
| 11.500-16.000 | 1375CED | 17 | 0.50 | 1.35 | -40+85 | 25 | 25 | 0.35 X 0.475 X 0.16 | PC |
| 12.700-14.500 | 1360CED | 20 | 0.35 | 1.25 | -40+85 | 25 | 25 | 0.35 X 0.475 X 0.16 | PC |
| 14.000-14.500 | 1425CED | 20 | 0.40 | 1.25 | -40+85 | 25 | 25 | 0.35 X 0.475 X 0.16 | PC |
| 14.500-19.700 | 1710CET | 18 | 0.50 | 1.30 | -40+85 | 20 | 20 | 0.35 X 0.475 X 0.18 | CT |
| 17.700-19.700 | 1870CET | 20 | 0.50 | 1.25 | -40+85 | 20 | 20 | 0.35 X 0.475 X 0.18 | CT |

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# SMA COAXIAL CIRCULATORS

Nova Microwave offers a line of SMA Coaxial Circulators in various packages sizes and frequency bands, specifically designed for communications applications, military applications, cellular and wireless markets. Reliability, price and maufacturability are optimized at the design stage. SMA Coaxial Circulators are designed to have some RFI and magnetic shielding with high quality materials to ensure optimum performance over the termperature range. To ensure that the magnetic field is stabilized and will not fluctuate over termperature, all SMA Coaxial Circulators are temperature cycled from -50°C to +100°C prior to final test. Standard SMA Coaxial Circulators are supplied with SMA Female connectors. SMA Coaxial Circulators with male connectors, phase matching, counter clockwise rotation, higher shielding along with required intermodulation specifications can be provided upon request. Electrical specifications listed are over the operating termperature range. If the frequency band of interest is not covered, please contact the factory.




| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.380-0.470 | 0042CAS | 20 | 0.40 | 1.25 | -20+85 | 250 | 250 | 2.25 X 2.25 X 1.00 | QC |
| 0.400-0.500 | 0045CAS | 20 | 0.40 | 1.25 | -20+85 | 250 | 250 | 2.25 X 2.25 X 1.00 | QC |
| 0.500-0.600 | 0055CAS | 20 | 0.40 | 1.25 | -40+85 | 250 | 250 | 2.00 X 2.00 X 1.00 | RC |
| 0.600-0.750 | 0067CAS | 20 | 0.40 | 1.25 | -40+85 | 250 | 250 | 1.75 X 1.75 X 1.00 | SC |
| 0.700-0.830 | 0076CAS | 20 | 0.40 | 1.25 | -40+85 | 250 | 250 | 1.50 X 1.50 X 0.75 | TC |
| 0.790-0.960 | 0088CAS | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | UC |
| 0.900-1.100 | 0100CAS | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | UC |
| 0.915-0.964 | 0094CAS | 23 | 0.35 | 1.20 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | UC |
| 0.960-1.215 | 0109CAS | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | UC |
| 1.100-1.300 | 0120CAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | UC |
| 1.200-1.400 | 0130CAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | UC |
| 1.400-1.600 | 0150CAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | UC |
| 1.500-1.800 | 0165CAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | UC |
| 1.700-2.000 | 0185CAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | VC |
| 1.700-2.300 | 0200CES | 20 | 0.40 | 1.25 | -10+70 | 50 | 50 | 1.63 X 1.63 X 0.75 | YC |
| 1.800-2.100 | 0195CAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | VC |
| 1.930-1.990 | 0196CAS | 23 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | VC |
| 2.000-2.300 | 0215CAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | VC |
| 2.100-2.400 | 0225CAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | VC |
| 2.300-2.700 | 0250CAS | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | VC |

**NOTES:** All models come standard with type SMA female connectors. Other connector configurations are available upon request.



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# N TYPE COAXIAL CIRCULATORS

Nova Microwave offers a line of N Type Coaxial Circulators in various package sizes and frequency bands. N Type Coaxial Circulators are specifically designed for communications applications, military applications, cellular and wireless markets. Reliability, price and manufacturability are optimized at the design stage. N Type Coaxial Circulators are designed to have some RFI and magnetic shielding. N Type Coaxial Circulators are manufactured with high quality materials to ensure optimum performance over the temperature range.




To ensure that the magnetic field is stabilized and will not fluctuate over temperature, all N Type Coaxial Circulators are temperature cycled from -50°C to +100°C prior to final test. Standard N Type Coaxial Circulators are supplied with N Type Female connectors. N Type Coaxial Circulators with N Type male connectors, phase matching, counter clockwise rotation, higher shielding along with required intermodulation specifications can be provided upon request. Electrical specifications listed are over the operating temperature range. **If the frequency band of interest is not covered, please contact the factory.**

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.380-0.470 | 0042CAN | 20 | 0.40 | 1.25 | -20+85 | 250 | 250 | 2.25 X 2.25 X 1.00 | NQC |
| 0.400-0.500 | 0045CAN | 20 | 0.40 | 1.25 | -20+85 | 250 | 250 | 2.25 X 2.25 X 1.00 | NQC |
| 0.500-0.600 | 0055CAN | 20 | 0.40 | 1.25 | -20+85 | 250 | 250 | 2.00 X 2.00 X 1.00 | NRC |
| 0.600-0.750 | 0067CAN | 20 | 0.40 | 1.25 | -40+85 | 250 | 250 | 1.75 X 1.75 X 1.00 | NSC |
| 0.700-0.830 | 0076CAN | 20 | 0.40 | 1.25 | -40+85 | 250 | 250 | 1.50 X 1.50 X 0.75 | NTC |
| 0.790-0.960 | 0088CAN | 20 | 0.40 | 1.25 | -40+85 | 250 | 250 | 1.25 X 1.25 X 0.75 | EC |



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| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.900-1.100 | 0100CAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | EC |
| 0.915-0.964 | 0094CAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | EC |
| 0.960-1.215 | 0109CAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | EC |
| 1.100-1.300 | 0120CAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | EC |
| 1.200-1.400 | 0130CAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | EC |
| 1.400-1.600 | 0150CAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | EC |
| 1.500-1.800 | 0165CAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.25 X 1.25 X 0.75 | EC |
| 1.700-2.000 | 0185CAN | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | FC |
| 1.700-2.300 | 0200CEN | 20 | 0.40 | 1.25 | -10+70 | 50 | 50 | 1.63 X 1.63 X 0.75 | NYC |
| 1.800-2.100 | 0195CAN | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | FC |
| 1.930-1.990 | 0196CAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | FC |
| 2.000-2.300 | 0215CAN | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | FC |
| 2.100-2.400 | 0225CAN | 20 | 0.35 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | FC |
| 2.300-2.700 | 0250CAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | FC |
| 2.400-2.500 | 0245CAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | FC |
| 2.500-2.900 | 0270CAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 150 | 1.00 X 1.00 X 0.75 | FC |
| 2.700-3.100 | 0290CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 2.800-3.300 | 0305CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 3.400-4.200 | 0380CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 3.600-4.300 | 0395CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 4.200-5.000 | 0460CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 4.600-5.400 | 0500CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 5.000-6.000 | 0550CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 5.400-5.900 | 0565CEN | 23 | 0.35 | 1.20 | -40+85 | 50 | 50 | 1.00 X 1.00 X 1.00 | FC |
| 5.700-6.800 | 0625CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 5.800-6.500 | 0615CEN | 23 | 0.35 | 1.20 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 6.000-8.000 | 0700CEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |
| 6.400-7.200 | 0680CEN | 23 | 0.35 | 1.20 | -40+85 | 50 | 50 | 1.00 X 1.00 X 0.75 | FC |

**NOTES:** All models come standard with type N female connectors. Other connector configurations are available upon request.



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# SURFACE MOUNT CIRCULATORS

Nova Microwave offers a line of Surface Mount Circulators in various package sizes and frequency bands, specifically designed for communications applications, military applications, cellular and wireless markets. Reliability, price and manufacturability are optimized at the design stage. Surface Mount Circulators are manufactured with high quality materials to ensure optimum performance over the temperature range. To ensure that the magnetic field is stabilized and will not fluctuate over temperature, all Surface Mount Circulators are temperature cycled from-50°C to +100°C prior to final test. Surface Mount Circulators with phase matching, counter clockwise rotation along with required intermodulation specifications can be provided upon request. Electrical specifications listed are over the operating temperature range. If the frequency band of interest is not covered, please contact the factory. Test fixtures are available for verification of data prior to integration and can be purchased from Nova Microwave.
If you have any issues or questions regarding installation of our Surface Mount Circulators, please refer to Nova Microwave Installation Procedure for Drop-In Circulators and Drop-In Isolators on this website.




| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.450-0.470 | S0046CAD | 22 | 0.40 | 1.20 | -20+85 | 250 | 250 | 1.50 X 1.50 X 0.33 | SM |
| 0.450-0.500 | S0048CAD | 20 | 0.50 | 1.25 | -20+85 | 250 | 250 | 1.50 X 1.50 X 0.33 | SM |
| 0.470-0.512 | S0049CAD | 20 | 0.50 | 1.25 | -20+85 | 250 | 250 | 1.50 X 1.50 X 0.33 | SM |
| 0.810-0.915 | S0086CAD | 20 | 0.35 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 0.810-0.826 | S0082CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 0.824-0.849 | S0084CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 0.860-0.904 | S0088CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 0.880-0.940 | S0091CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 0.890-0.960 | S0092CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 0.915-0.964 | S0094CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 0.980-1.020 | S0100CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.000-1.060 | S0103CAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.000-1.100 | S0105CAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.030-1.090 | S0106CAD | 22 | 0.30 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.250-1.350 | S0130CAD | 20 | 0.30 | 1.25 - | 20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.400-1.600 | S0150CAD | 20 | 0.40 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.429-1.453 | S0144CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.429-1.501 | S0147CAD | 22 | 0.35 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.477-1.501 | S0149CAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.500-1.660 | S0158CAD | 20 | 0.35 | 1.25 | -20+85 | 150 | 150 | 1.00 X 1.00 X 0.30 | SN |
| 1.710-1.785 | S0175CAD | 20 | 0.30 | 1.25 | -20+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 1.710-1.880 | S0179CAD | 20 | 0.35 | 1.25 | -20+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 1.805-1.880 | S0184CAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 1.850-1.990 | S0192CAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |

**NOTES:** All models come standard with type SMA female connectors. Other connector configurations are available upon request.



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# SURFACE MOUNT CIRCULATORS

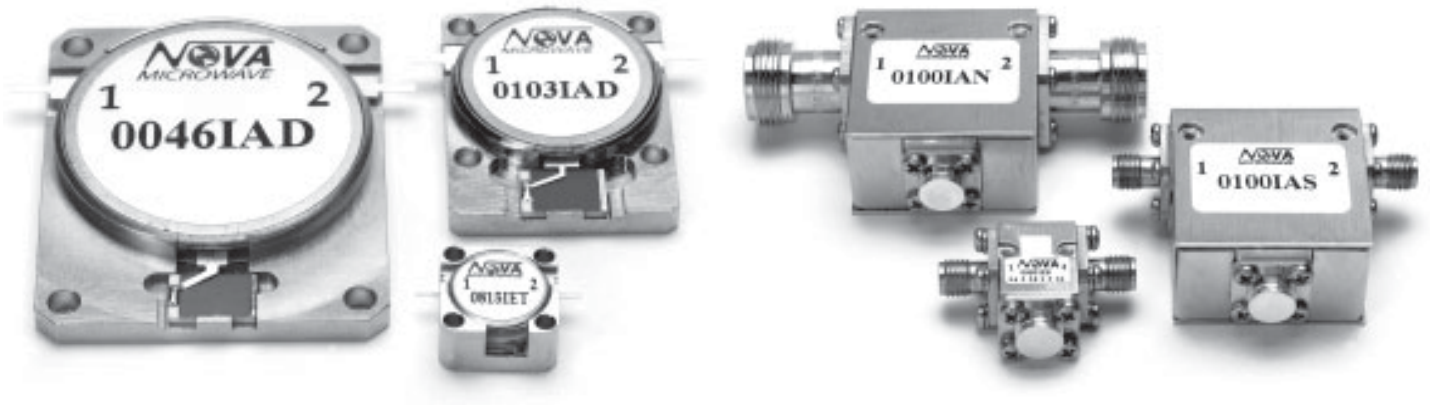
| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 1.930-1.990 | S0196CAD | 20 | 0.30 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 2.000-2.300 | S0215CAD | 20 | 0.50 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 2.000-2.400 | S0225CAD | 20 | 0.50 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 2.300-2.500 | S0240CAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 2.300-2.700 | S0250CAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 2.400-2.500 | S0245CAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 2.500-2.900 | S0270CAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 2.900-3.100 | S0300CAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 3.300-3.600 | S0345CAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 125 | 0.75 X 0.75 X 0.21 | SCC |
| 3.400-4.200 | S0380CED | 20 | 0.40 | 1.25 | -20+85 | 50 | 50 | 0.75 X 0.75 X 0.21 | SCC |
| 3.600-4.300 | S0395CED | 20 | 0.40 | 1.25 | -40+85 | 50 | 50 | 0.75 X 0.75 X 0.21 | SCC |
| 4.200-4.400 | S0430CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 4.400-5.000 | S0470CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 5.000-6.500 | S0575CED | 17 | 0.50 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 5.400-5.900 | S0565CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 5.800-6.500 | S0615CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 6.400-7.200 | S0680CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 6.500-8.500 | S0750CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 7.100-7.900 | S0760CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 7.200-8.400 | S0780CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 7.800-8.500 | S0815CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 8.300-8.800 | S0855CED | 20 | 0.40 | 1.25 | -40+85 | 35 | 35 | 0.50 X 0.575 X 0.16 | SOC |
| 8.500-11.500 | S1000CED | 17 | 0.50 | 1.35 | -40+85 | 30 | 30 | 0.35 X 0.475 X 0.16 | SPC |
| 9.000-9.700 | S0935CED | 20 | 0.35 | 1.25 | -40+85 | 30 | 30 | 0.35 X 0.475 X 0.16 | SPC |
| 9.500-12.750 | S1112CED | 20 | 0.40 | 1.25 | -40+85 | 30 | 30 | 0.35 X 0.475 X 0.16 | SPC |
| 9.700-11.700 | S1070CED | 20 | 0.40 | 1.25 | -40+85 | 30 | 30 | 0.35 X 0.475 X 0.16 | SPC |
| 11.100-13.700 | S1240CED | 20 | 0.40 | 1.25 | -40+85 | 25 | 25 | 0.35 X 0.475 X 0.16 | SPC |
| 11.500-16.000 | S1375CED | 17 | 0.50 | 1.35 | -40+85 | 25 | 25 | 0.35 X 0.475 X 0.16 | SPC |
| 12.700-14.500 | S1360CED | 20 | 0.35 | 1.25 | -40+85 | 25 | 25 | 0.35 X 0.475 X 0.16 | SPC |
| 14.000-14.500 | S1425CED | 20 | 0.40 | 1.25 | -40+85 | 25 | 25 | 0.35 X 0.475 X 0.16 | SPC |
| 14.500-19.700 | S1710CET | 18 | 0.50 | 1.30 | -40+85 | 20 | 20 | 0.35 X 0.475 X 0.18 | SCT |
| 17.700-19.700 | S1870CET | 20 | 0.50 | 1.25 | -40+85 | 20 | 20 | 0.35 X 0.475 X 0.18 | SCT |

**NOTES:** All models come standard with type SMA female connectors. Other connector configurations are available upon request.



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Nova Microwave designs and manufactures a comprehensive line of isolators for commercial applications, military applications, cellular and wireless markets. These devices are important to minimize the interence between incident and reflected signals. These devices provide a constant impedance to the transmitter, thus maximizing the power transfer by absorbing the reflected signal into the internal terminations. They are made of magnets and ferrite materials with magnetic properties. Isolators are also available in counter-clockwise rotation.

**Types of Isolators**
At Nova Microwave we pride ourselves for being a source of quality isolators, all designed with customer satisfaction in mind at competitive prices. Nova Microwave products a broad range or isolators from 380 MHz to 23.6 GHz as follows:

- Drop-In Isolators
- Surface Mount Isolators
- SMA Coaxial Isolators
- N Type Coaxial Isolators
- Drop-In & Connectorized Multi-Port Junctions (Contact Factory)

Each device is stress tested during production to ensure the performance over temperature extremes. The focus on quality and testing during manufacturing allows us to provide a reliable product to our customers. The material selected for manufacturing allows us to provide a reliable product to our customers, which has a significant effect on their performance as well as their cost. Our understanding of ferrite and magnetic materials allows us to manufacture devices that are reliable and cost effective. We also take temperature fluctuations into consideration at the design stage. Each device is temperature cycled from -50°C to +100°C in the design and testing process. This ensures that the magnets will provide the required magnetic field over the desired operating temperatures.

**Applications**
Typical application for isolators is to minimize the interference between two microwave components. The isolator provides a low loss in the forward direction and high isolation in the reverse direction. This properly separates the device connected to the input from the device connected to the output, like an amplifier and antenna.

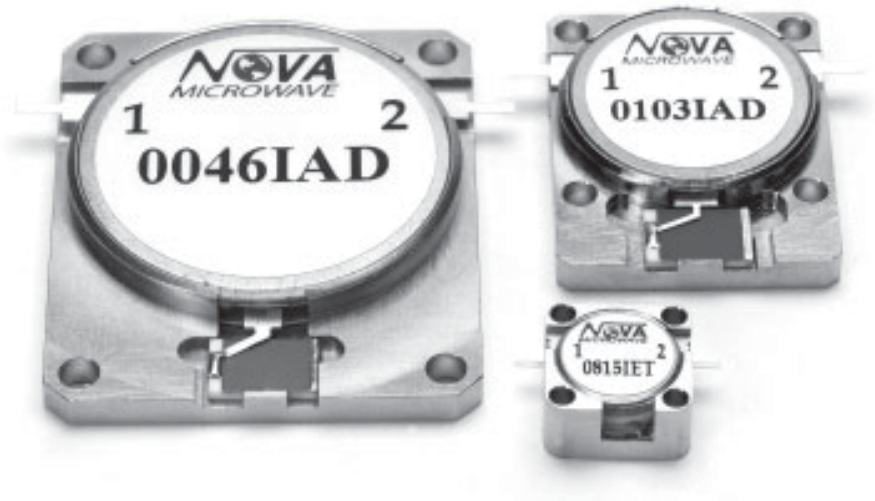
***For additional information, see the following sections below.***
- How to Specify Isolators And Circulators
- Understanding Circulators and Isolators
- Drop-In Installation Procedure
- Technical Information



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Nova Microwave offers a line of Drop-In Isolators in various package sizes and frequency bands, specifically designed for communications applications, military applications, cellular and wireless markets. Reliability, price and manufacturability are optimized at the design stage.




Drop-In Isolators are manufactured with high quality materials to ensure optimum performance over the temperature range. To ensure that the magnetic field is stabilized and will not fluctuate over temperature, all Drop-In Isolators are temperature cycled from -50°C to +100°C prior to final test. Drop-In Isolators with phase matching, counter clockwise rotation, higher reverse power capability along with required intermodulation specifications can be provided upon request.

Electrical specifications listed are over the operating temperature range. **If the frequency band of interest is not covered, please contact the factory.** Test fixtures are available for verification of data prior to integration and can be purchased from Nova Microwave.If you have any issues or questions regarding installation of our Drop-In Isolators, please refer to Nova Microwave Installation Procedure for Drop-In Circulators and Drop-In Isolatorson this website.



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# DROP-IN ISOLATORS

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.450-0.470 | 0046IAD | 20 | 0.40 | 1.25 | -20+85 | 250 | 65 | 1.50 X 1.80 X 0.30 | A |
| 0.450-0.500 | 0048IAD | 20 | 0.50 | 1.25 | -20+85 | 250 | 65 | 1.50 X 1.80 X 0.30 | A |
| 0.470-0.512 | 0049IAD | 20 | 0.50 | 1.25 | -20+85 | 250 | 65 | 1.50 X 1.80 X 0.30 | A |
| 0.810-0.915 | 0086IAD | 20 | 0.35 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 0.810-0.826 | 0082IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 0.824-0.849 | 0084IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 0.860-0.904 | 0088IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 0.880-0.940 | 0091IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 0.890-0.960 | 0092IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 0.915-0.964 | 0094IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 0.980-1.020 | 0100IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.000-1.060 | 0103IAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.000-1.100 | 0105IAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.030-1.090 | 0106IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.250-1.350 | 0130IAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.400-1.600 | 0150IAD | 20 | 0.40 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.429-1.453 | 0144IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.429-1.501 | 0147IAD | 22 | 0.35 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.477-1.501 | 0149IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.500-1.660 | 0158IAD | 20 | 0.35 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | B |
| 1.710-1.785 | 0175IAD | 20 | 0.30 | 1.25 | -20+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 1.710-1.880 | 0179IAD | 20 | 0.35 | 1.25 | -20+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 1.805-1.880 | 0184IAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 1.850-1.990 | 0192IAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 1.930-1.990 | 0196IAD | 20 | 0.30 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 2.000-2.300 | 0215IAD | 20 | 0.50 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 2.000-2.300 | 0225IAD | 20 | 0.50 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 2.300-2.500 | 0240IAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |

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# DROP-IN ISOLATORS

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 2.300-2.700 | 0250IAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 2.400-2.500 | 0245IAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 2.500-2.900 | 0270IAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 2.900-3.100 | 0300IAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 3.300-3.600 | 0345IAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | C |
| 3.400-4.200 | 0380IED | 20 | 0.40 | 1.25 | -20+85 | 50 | 2 | 0.75 X 0.75 X 0.21 | CI |
| 3.600-4.300 | 0395IED | 20 | 0.40 | 1.25 | -40+85 | 50 | 2 | 0.75 X 0.75 X 0.21 | CI |
| 4.200-4.400 | 0430IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 4.400-5.000 | 0470IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 5.000-6.500 | 0575IED | 17 | 0.60 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 5.400-5.900 | 0565IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 5.800-6.500 | 0615IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 6.400-7.200 | 0680IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 6.500-8.500 | 0750IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 7.100-7.900 | 0760IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 7.200-8.400 | 0780IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 7.800-8.500 | 0815IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 8.300-8.800 | 0855IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | O |
| 8.500-11.500 | 1000IED | 17 | 0.50 | 1.35 | -40+85 | 30 | 2 | 0.35 X 0.475 X 0.16 | P |
| 9.000-9.700 | 0935IED | 20 | 0.35 | 1.25 | -40+85 | 30 | 2 | 0.35 X 0.475 X 0.16 | P |
| 9.500-12.750 | 1112IED | 20 | 0.40 | 1.25 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | P |
| 9.700-11.700 | 1070IED | 20 | 0.40 | 1.25 | -40+85 | 30 | 2 | 0.35 X 0.475 X 0.16 | P |
| 11.100-13.700 | 1240IED | 20 | 0.40 | 1.25 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | P |
| 11.500-16.000 | 1375IED | 17 | 0.50 | 1.35 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | P |
| 12.700-14.500 | 1360IED | 20 | 0.35 | 1.25 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | P |
| 14.000-14.500 | 1425IED | 20 | 0.40 | 1.25 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | P |
| 14.500-19.700 | 1710IET | 18 | 0.50 | 1.30 | -40+85 | 20 | 2 | 0.35 X 0.475 X 0.18 | IT |
| 17.700-19.700 | 1870IET | 20 | 0.50 | 1.25 | -40+85 | 20 | 2 | 0.35 X 0.475 X 0.18 | IT |

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# SMA COAXIAL ISOLATORS

Nova Microwave offers a line of SMA Coaxial Isolators in various package sizes and frequency bands, specifically designed for communications applications, military applications, cellular and wireless markets. Reliability, price and manufacturability are optimized at the design stage. SMA Coaxial Isolators are designed to have some RFI and magnetic shielding with high quality materials to ensure optimum performance over the temperature range. To ensure that the magnetic field is stabilized and will not fluctuate over temperature, all SMA Coaxial Isolators are temperature cycled from -50°C to +100°C prior to final test. Standard SMA Coaxial Isolators are supplied with SMA Female Connectors and 10 watt terminations. SMA Coaxial Isolators with male connectors, phase matching, counter clockwise rotation, higher reverse power capability, higher shielding along with required intermodulation specifications can be provided upon request. Electrical specifications listed are over the operating temperature range. **If the frequency band of interest is not covered, please contact the factory.**




| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.380-0.470 | 0042IAS | 20 | 0.40 | 1.25 | -20+85 | 250 | 10 | 2.25 X 2.25 X 1.00 | Q |
| 0.400-0.500 | 0045IAS | 20 | 0.40 | 1.25 | -20+85 | 250 | 10 | 2.25 X 2.25 X 1.00 | Q |
| 0.500-0.600 | 0055IAS | 20 | 0.40 | 1.25 | -40+85 | 250 | 10 | 2.00 X 2.00 X 1.00 | R |
| 0.600-0.750 | 0067IAS | 20 | 0.40 | 1.25 | -40+85 | 250 | 10 | 1.75 X 1.75 X 1.00 | S |
| 0.700-0.830 | 0076IAS | 20 | 0.40 | 1.25 | -40+85 | 250 | 10 | 1.50 X 1.50 X 0.75 | T |
| 0.790-0.960 | 0088IAS | 20 | 0.40 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | U |
| 0.900-1.100 | 0100IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | U |
| 0.915-0.964 | 0094IAS | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | U |
| 0.960-1.215 | 0109IAS | 20 | 0.40 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | U |
| 1.100-1.300 | 0120IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | U |
| 1.200-1.400 | 0130IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | U |
| 1.400-1.600 | 0150IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | U |
| 1.500-1.800 | 0165IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | U |
| 1.700-2.000 | 0185IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | V |
| 1.700-2.300 | 0200IES | 20 | 0.40 | 1.25 | -10+70 | 50 | 10 | 1.63 X 1.63 X 0.75 | Y |
| 1.800-2.100 | 0195IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | V |
| 1.930-1.990 | 0196IAS | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | V |
| 2.000-2.300 | 0215IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | V |
| 2.100-2.400 | 0225IAS | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | V |
| 2.300-2.700 | 0250IAS | 20 | 0.40 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | V |
| 2.400-2.500 | 0245IAS | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | V |



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# SMA COAXIAL ISOLATORS

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 2.500-2.900 | 0270IAS | 20 | 0.40 | 1.20 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | V |
| 2.700-3.100 | 0290IES | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | V |
| 2.800-3.300 | 0305IES | 20 | 0.40 | 1.25 | -20+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 3.400-4.200 | 0380IES | 20 | 0.40 | 1.25 | -20+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 3.600-4.300 | 0395IES | 20 | 0.40 | 1.25 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 4.200-5.000 | 0460IES | 20 | 0.40 | 1.25 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 4.600-5.400 | 0500IES | 20 | 0.40 | 1.25 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 5.000-6.000 | 0550IES | 20 | 0.40 | 1.25 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 5.400-5.900 | 0565IES | 23 | 0.35 | 1.20 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 5.700-6.800 | 0625IES | 20 | 0.40 | 1.25 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 5.800-6.500 | 0615IES | 23 | 0.35 | 1.20 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 6.000-8.000 | 0700IES | 20 | 0.40 | 1.25 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 6.400-7.200 | 0680IES | 23 | 0.35 | 1.20 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 7.200-8.400 | 0780IES | 23 | 0.35 | 1.20 | -40+85 | 35 | 10 | 0.75 X 0.75 X 0.50 | W |
| 8.000-11.000 | 0950IES | 20 | 0.40 | 1.25 | -40+85 | 25 | 10 | 0.50 X 0.63 X 0.50 | X |
| 8.500-11.500 | 1000IES | 20 | 0.40 | 1.25 | -40+85 | 30 | 10 | 0.50 X 0.63 X 0.50 | X |
| 9.000-9.700 | 0935IES | 23 | 0.35 | 1.20 | -40+85 | 25 | 10 | 0.50 X 0.63 X 0.50 | X |
| 9.500-12.750 | 1112IES | 20 | 0.40 | 1.25 | -40+85 | 25 | 10 | 0.50 X 0.63 X 0.50 | X |
| 9.700-11.700 | 1070IES | 23 | 0.35 | 1.20 | -40+85 | 30 | 10 | 0.50 X 0.63 X 0.50 | X |
| 11.100-13.700 | 1240IES | 20 | 0.40 | 1.25 | -40+85 | 25 | 1 | 0.50 X 0.63 X 0.50 | X |
| 11.500-15.000 | 1325IES | 20 | 0.40 | 1.25 | -40+85 | 25 | 1 | 0.50 X 0.63 X 0.50 | X |
| 11.700-12.200 | 1195IES | 23 | 0.35 | 1.20 | -40+85 | 25 | 10 | 0.50 X 0.63 X 0.50 | X |
| 12.700-13.200 | 1295IES | 23 | 0.35 | 1.20 | -40+85 | 25 | 10 | 0.50 X 0.63 X 0.50 | X |
| 13.500-15.400 | 1445IES | 20 | 0.40 | 1.25 | -40+85 | 25 | 1 | 0.50 X 0.63 X 0.50 | X |
| 14.000-14.500 | 1425IES | 23 | 0.35 | 1.15 | -40+85 | 25 | 1 | 0.50 X 0.63 X 0.50 | X |
| 15.000-18.000 | 1650IES | 20 | 0.40 | 1.20 | -40+85 | 20 | 1 | 0.50 X 0.63 X 0.50 | X |
| 17.000-20.000 | 1850IES | 20 | 0.50 | 1.30 | -40+85 | 20 | 10 | 0.50 X 0.63 X 0.50 | X |
| 21.200-23.600 | 2240IES | 20 | 0.50 | 1.35 | -40+85 | 20 | 1 | 0.50 X 0.63 X 0.50 | X |



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# N TYPE COAXIAL ISOLATORS

Nova Microwave offers a line of N Type Coaxial Circulators in various package sizes and frequency bands. N Type Coaxial Circulators are specifically designed for communications applications, military applications, cellular and wireless markets. Reliability, price and manufacturability are optimized at the design stage. N Type Coaxial Circulators are designed to have some RFI and magnetic shielding. N Type Coaxial Circulators are manufactured with high quality materials to ensure optimum performance over the temperature range.




To ensure that the magnetic field is stabilized and will not fluctuate over temperature, all N Type Coaxial Circulators are temperature cycled from -50°C to +100°C prior to final test. Standard N Type Coaxial Circulators are supplied with N Type Female connectors. N Type Coaxial Circulators with N Type male connectors, phase matching, counter clockwise rotation, higher shielding along with required intermodulation specifications can be provided upon request. Electrical specifications listed are over the operating temperature range. **If the frequency band of interest is not covered, please contact the factory.**

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.380-0.470 | 0042IAN | 20 | 0.40 | 1.25 | -20+85 | 250 | 10 | 2.25 X 2.25 X 1.00 | NQ |
| 0.400-0.500 | 0045IAN | 20 | 0.40 | 1.25 | -20+85 | 250 | 10 | 2.25 X 2.25 X 1.00 | NQ |
| 0.500-0.600 | 0055IAN | 20 | 0.40 | 1.25 | -20+85 | 250 | 10 | 2.00 X 2.00 X 1.00 | NR |
| 0.600-0.750 | 0067IAN | 20 | 0.40 | 1.25 | -40+85 | 250 | 10 | 1.75 X 1.75 X 1.00 | NS |
| 0.700-0.830 | 0076IAN | 20 | 0.40 | 1.25 | -40+85 | 250 | 10 | 1.50 X 1.50 X 0.75 | NT |
| 0.790-0.960 | 0088IAN | 20 | 0.40 | 1.25 | -40+85 | 250 | 10 | 1.25 X 1.25 X 0.75 | E |

**NOTES:** All models come standard with type N female connectors. Other connector configurations are available upon request.



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# N TYPE COAXIAL ISOLATORS

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.900-1.100 | 0100IAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | E |
| 0.915-0.964 | 0094IAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | E |
| 0.960-1.215 | 0109IAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | E |
| 1.100-1.300 | 0120IAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | E |
| 1.200-1.400 | 0130IAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | E |
| 1.400-1.600 | 0150IAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | E |
| 1.500-1.800 | 0165IAN | 23 | 0.40 | 1.25 | -40+85 | 150 | 10 | 1.25 X 1.25 X 0.75 | E |
| 1.700-2.000 | 0185IAN | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | F |
| 1.700-2.300 | 0200IEN | 20 | 0.40 | 1.25 | -10+70 | 50 | 10 | 1.63 X 1.63 X 0.75 | NY |
| 1.800-2.100 | 0195IAN | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | F |
| 1.930-1.990 | 0196IAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | F |
| 2.000-2.300 | 0215IAN | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | F |
| 2.100-2.400 | 0225IAN | 20 | 0.35 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | F |
| 2.300-2.700 | 0250IAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | F |
| 2.400-2.500 | 0245IAN | 23 | 0.35 | 1.20 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | F |
| 2.500-2.900 | 0270IAN | 20 | 0.40 | 1.25 | -40+85 | 150 | 10 | 1.00 X 1.00 X 0.75 | F |
| 2.700-3.100 | 0290IEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 2.800-3.300 | 0305IEN | 20 | 0.40 | 1.25 | -20+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 3.400-4.200 | 0380IEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 3.600-4.300 | 0395IEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 4.200-5.000 | 0460IEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 4.600-5.400 | 0500IEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 5.000-6.000 | 0550IEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 5.400-5.900 | 0565IEN | 23 | 0.35 | 1.20 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 5.700-6.800 | 0625IEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 5.800-6.500 | 0615IEN | 23 | 0.35 | 1.20 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 6.000-8.000 | 0700IEN | 20 | 0.40 | 1.25 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |
| 6.400-7.200 | 0680IEN | 23 | 0.35 | 1.20 | -40+85 | 50 | 10 | 1.00 X 1.00 X 0.75 | F |

**NOTES:** All models come standard with type N female connectors. Other connector configurations are available upon request.

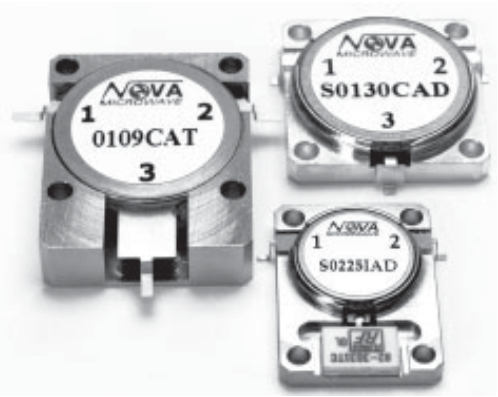


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# SURFACE MOUNT ISOLATORS

Nova Microwave offers a line of Surface Mount Isolators in various package sizes and frequency bands, specifically designed for communications applications, military applications, cellular and wireless markets. Reliability, price and manufacturability are optimized at the design stage. Surface Mount Isolators are manufactured with high quality materials to ensure optimum performance over the temperature range. To ensure that the magnetic field is stabilized and will not fluctuate over temperature, all Surface Mount Isolators are temperature cycled from-50°C to +100°C prior to final test. Surface Mount Isolators with phase matching, counter clockwise rotation, higher reverse power capability along with required intermodulation specifications can be provided upon request. Electrical specifications listed are over the operating temperature range. If the frequency band of interest is not covered, please contact the factory.Test fixtures are available for verification of data prior to integration and can be purchased from Nova Microwave.If you have any issues or questions regarding installation of our Drop-In Isolators, please refer to Nova Microwave Installation Procedure for Drop-In Circulators and Drop-In Isolators on this website.




| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 0.450-0.470 | S0046IAD | 20 | 0.40 | 1.25 | -20+85 | 250 | 65 | 1.50 X 1.80 X 0.30 | SA |
| 0.450-0.500 | S0048IAD | 20 | 0.50 | 1.25 | -20+85 | 250 | 65 | 1.50 X 1.80 X 0.30 | SA |
| 0.470-0.512 | S0049IAD | 20 | 0.50 | 1.25 | -20+85 | 250 | 65 | 1.50 X 1.80 X 0.30 | SA |
| 0.810-0.915 | S0086IAD | 20 | 0.35 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 0.810-0.826 | S0082IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 0.824-0.849 | S0084IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 0.860-0.904 | S0088IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 0.880-0.940 | S0091IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 0.890-0.960 | S0092IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 0.915-0.964 | S0094IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 0.980-1.020 | S0100IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.000-1.060 | S0103IAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.000-1.100 | S0105IAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.030-1.090 | S0106IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.250-1.350 | S0130IAD | 20 | 0.30 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.400-1.600 | S0150IAD | 20 | 0.40 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.429-1.453 | S0144IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.429-1.501 | S0147IAD | 22 | 0.35 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.477-1.501 | S0149IAD | 22 | 0.30 | 1.20 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.500-1.660 | S0158IAD | 20 | 0.35 | 1.25 | -20+85 | 150 | 65 | 1.00 X 1.25 X 0.30 | SB |
| 1.710-1.785 | S0175IAD | 20 | 0.30 | 1.25 | -20+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 1.710-1.880 | S0179IAD | 20 | 0.35 | 1.25 | -20+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 1.805-1.880 | S0184IAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 1.850-1.990 | S0192IAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |

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# SURFACE MOUNT ISOLATORS

| FREQUENCY GHZ | MODEL | ISOLATION dN (Min.) | INS. LOSS dB (Max.) | VSWR (Max.) | TEMP ( °C ) | POWER (WATTS) | | DIMENSIONS (INCHES) L X W X T | PACKAGE OUTLINE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FWD | REV | | |
| 1.930-1.990 | S0196IAD | 20 | 0.30 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 2.000-2.300 | S0215IAD | 20 | 0.50 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 2.000-2.300 | S0225IAD | 20 | 0.50 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 2.300-2.500 | S0240IAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 2.300-2.700 | S0250IAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 2.400-2.500 | S0245IAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 2.500-2.900 | S0270IAD | 20 | 0.35 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 2.900-3.100 | S0300IAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 3.300-3.600 | S0345IAD | 20 | 0.40 | 1.25 | -40+85 | 125 | 50 | 0.75 X 1.00 X 0.21 | SC |
| 3.400-4.200 | S0380IED | 20 | 0.40 | 1.25 | -20+85 | 50 | 2 | 0.75 X 0.75 X 0.21 | SCI |
| 3.600-4.300 | S0395IED | 20 | 0.40 | 1.25 | -40+85 | 50 | 2 | 0.75 X 0.75 X 0.21 | SCI |
| 4.200-4.400 | S0430IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 4.400-5.000 | S0470IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 5.000-6.500 | S0575IED | 17 | 0.60 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 5.400-5.900 | S0565IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 5.800-6.500 | S0615IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 6.400-7.200 | S0680IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 6.500-8.500 | S0750IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 7.100-7.900 | S0760IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 7.200-8.400 | S0780IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 7.800-8.500 | S0815IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 8.300-8.800 | S0855IED | 20 | 0.40 | 1.25 | -40+85 | 35 | 2 | 0.50 X 0.575 X 0.16 | SO |
| 8.500-11.500 | S1000IED | 17 | 0.50 | 1.35 | -40+85 | 30 | 2 | 0.35 X 0.475 X 0.16 | SP |
| 9.000-9.700 | S0935IED | 20 | 0.35 | 1.25 | -40+85 | 30 | 2 | 0.35 X 0.475 X 0.16 | SP |
| 9.500-12.750 | S1112IED | 20 | 0.40 | 1.25 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | SP |
| 9.700-11.700 | S1070IED | 20 | 0.40 | 1.25 | -40+85 | 30 | 2 | 0.35 X 0.475 X 0.16 | SP |
| 11.100-13.700 | S1240IED | 20 | 0.40 | 1.25 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | SP |
| 11.500-16.000 | S1375IED | 17 | 0.50 | 1.35 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | SP |
| 12.700-14.500 | S1360IED | 20 | 0.35 | 1.25 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | SP |
| 14.000-14.500 | S1425IED | 20 | 0.40 | 1.25 | -40+85 | 25 | 2 | 0.35 X 0.475 X 0.16 | SP |
| 14.500-19.700 | S1710IET | 18 | 0.50 | 1.30 | -40+85 | 20 | 2 | 0.35 X 0.475 X 0.18 | SIT |
| 17.700-19.700 | S1870IET | 20 | 0.50 | 1.25 | -40+85 | 20 | 2 | 0.35 X 0.475 X 0.18 | SIT |

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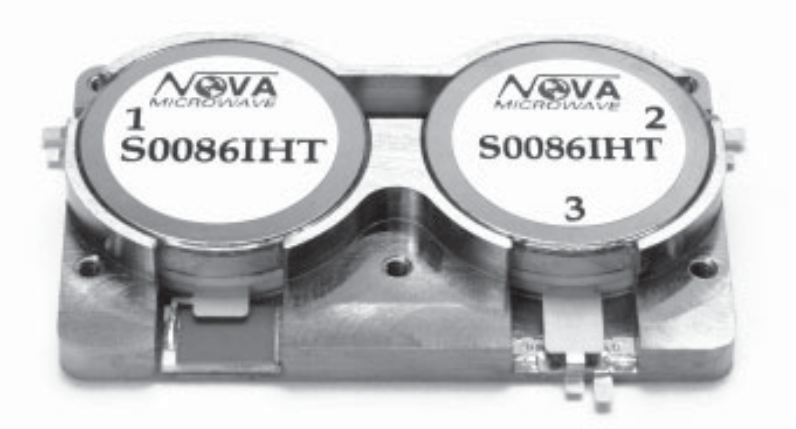
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# DROP-IN & CONNECTORIZED MULTI-PORT JUNCTIONS

For your particular requirement for multi-port circulators and isolators, *please contact the factory*.

| | |
|---|---|
| Frequency: | 0.825 to 0.925 GHz |
| Isolation: | 40dB Min |
| Insertion Loss 1-2: | 0.50dB Max |
| Insertion Loss 2-3: | 0.35dB Max |
| Return Loss: | 20dB Min |
| Op. Temp: | -200C to +85C |
| Storage Temp: | -500C to +100C |
| Package Outline: | 2.10 x 1.25 x 0.30 Inches |




| | |
|---|---|
| Frequency: | 0.243 to 0.270 GHz |
| Isolation: | 70dB Min |
| Insertion Loss 1-2: | 1.0dB Max |
| Return Loss: | 18dB Min (1.28:1 VSWR) ALL PORTS |
| Op. Temp: | 00C to +50C |
| Power Rating: | 100 Watts Forward40 Watts Reverse |
| Connectors: | N Female, 2 Places |
| Package Outline: | 8.20 x 2.85 x 1.10 Inches |





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## Installation Procedure for Drop-In Circulators/Isolators

### 1.0 SCOPE

The scope of this document is to provide general guidelines for the installation of Nova Microwave Drop-in Isolators and Circulators.

**2.0** Preperation to Installation- All isolator and/or circulator tabs shall be correctly positioned and free of debris and/or contaminants, which could inhibit the solderability to the user trace pad. Circuit tabs should be gently bent to align with the user's trace pad prior to soldering.

**2.1** Cleaning: Tabs can be cleaned using a cotton swab, pipe cleaner or non-abrasive absorbent cloth or pad and an appropriate cleaning solution/solvent. DO NOT submerse or spray the device with any cleaning solution or solvent. DO NOT use an ULTRA-SONIC device for cleaning. Remove any extraneous fibers prior to soldering.

**2.2** Mounting Surface: The mounting surface is generally the bottom of the device. It should be free of any contaminants. DO NOT submerse or spray the device with any cleaning solution or solvent. DO NOT use an ULTRA-SONIC device for cleaning. Apply the cleaning solution/solvent to the absorbent material being used then wipe the mounting surface.

**2.3** Mounting Area: The mounting area should be designed so that when the unit is mounted, the bottom of the tab leads contact the top of the user traces. Also, the bottom of the unit must make proper ground to mounting surface. Tapped holes in the mounting area are necessary for installing devices with mounting clearance holes. Use appropriate fasteners when installing the device.

**2.4** The mounting area cut-out should be kept minimal and the user trace as close as possible to the side walls of the device, without the risk of short-circuting the device. The mounting area should be designed so that no other part of the user's application will interefere with or block the installation of the device. The gap between the device's body and user's trace should not exceed 0.0053 .

**2.5** User Trace: The user trace should be tinned in close proximity to where the device tab will be located. A small amount of liquid flux should then be applied to the user trace, prior to installation of the device.

**3.0** Installation:Position the unit symmetrically in the base and align the input/output tabs over the soldering traces.

**3.1** Install appropriate fasteners when mounting the device to the user base. See Figure 1.

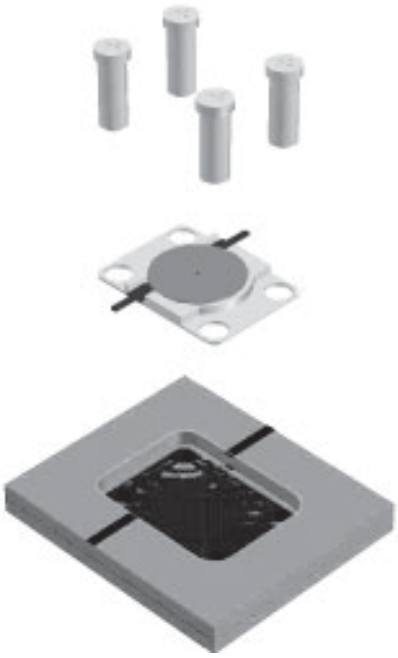
**3.2** Ensure that the circuit tabs make contact with the user traces.

**3.3** Apply a thin, even coating of liquid flux to the area of the user trace where the circuit tab makes contact. Methodology of flux application is discretionary. However, any flux, which may backflow into the device, can impair the electrical performance. Proper caution should be exercised when using any liquid flux.

**3.4** Heat the device tab lead in close proximity to the user trace using a soldering iron. Apply a small amount of cored solder, evenly, where the soldering iron contacts the circuit tab lead. Allow for sufficient wetting to occur and proper solder flow prior to removing the soldering iron. The process should not exceed 5-10 seconds due to potential damage to the magnets. Excessive heat can demagnetize the magnets causing degradation to the electrical performance. Do not allow flux or solder to splatter where internal parts of the isolator/circulator are exposed.

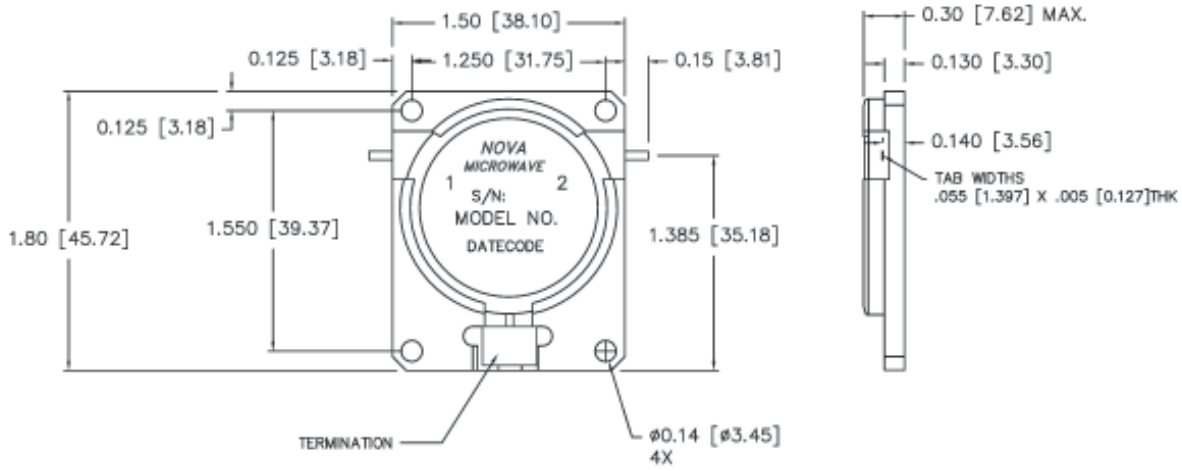
**3.5** Allow solder to cool. Clean solder joint with approved cleaning solvents.

**3.6** Installation is complete.

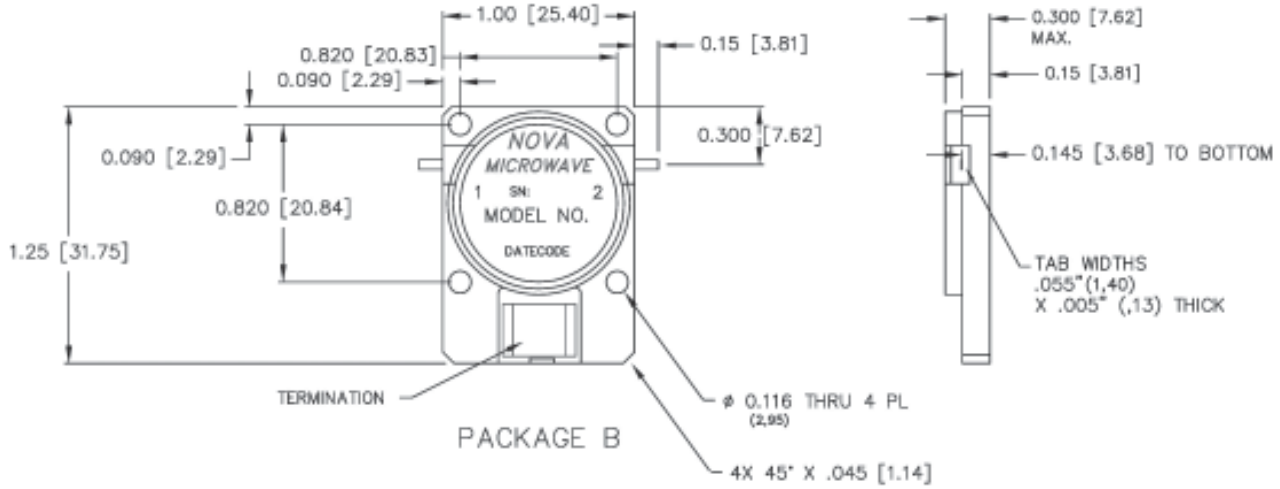




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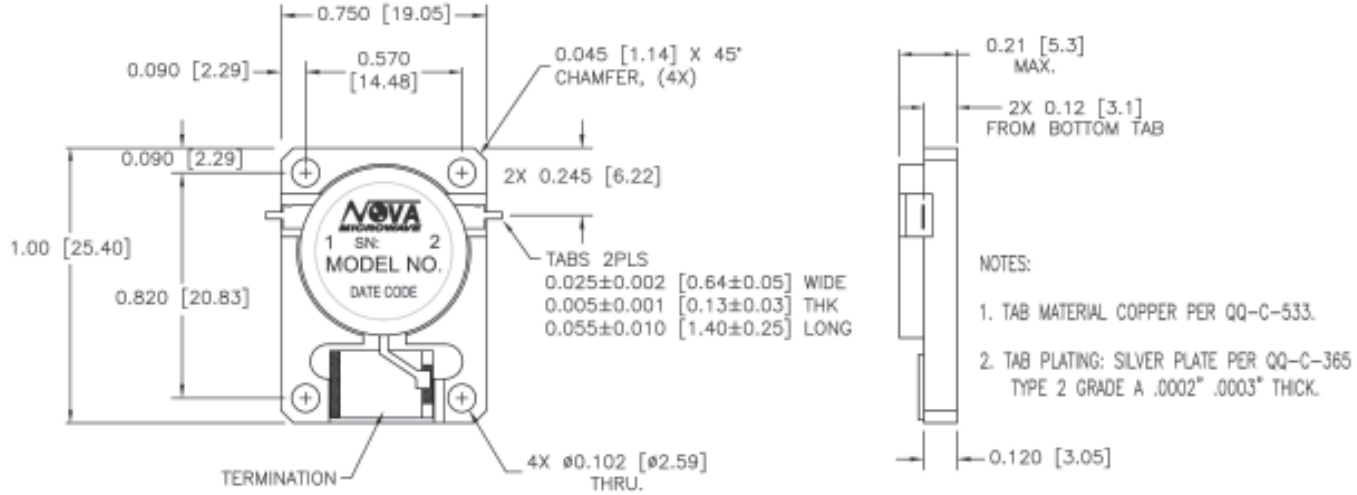



PACKAGE A




PACKAGE B

PACKAGE B

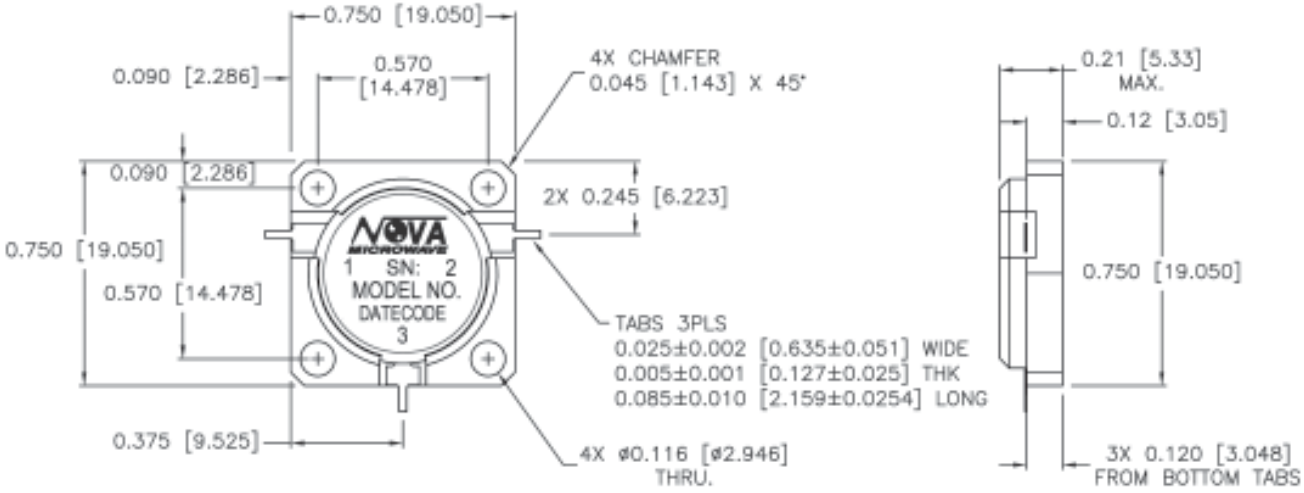



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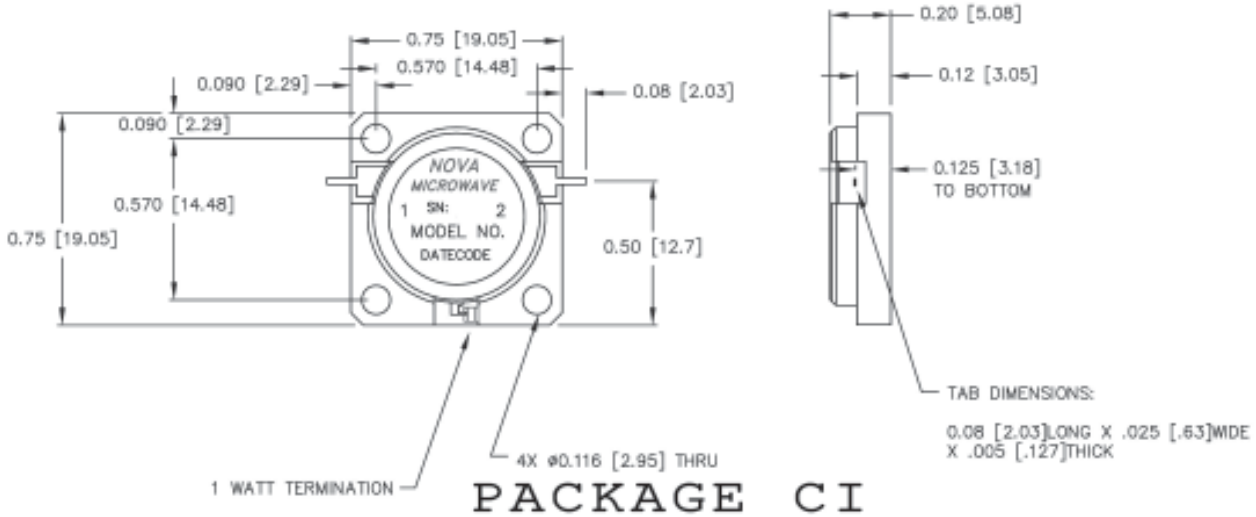


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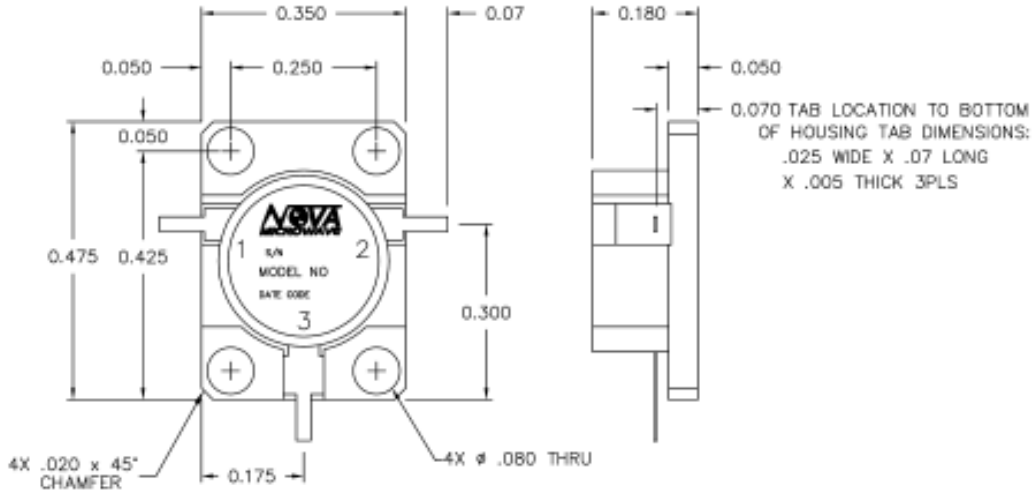
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PACKAGE CC




PACKAGE CI

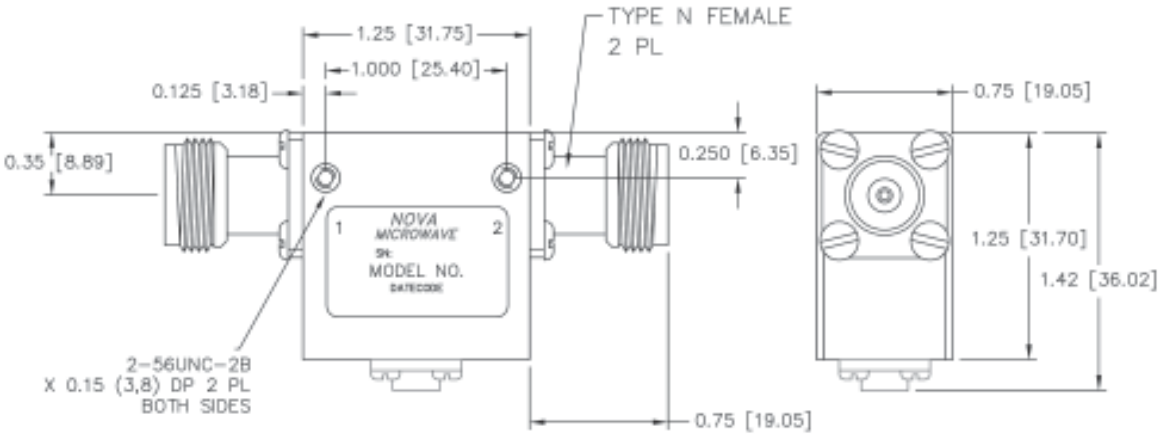



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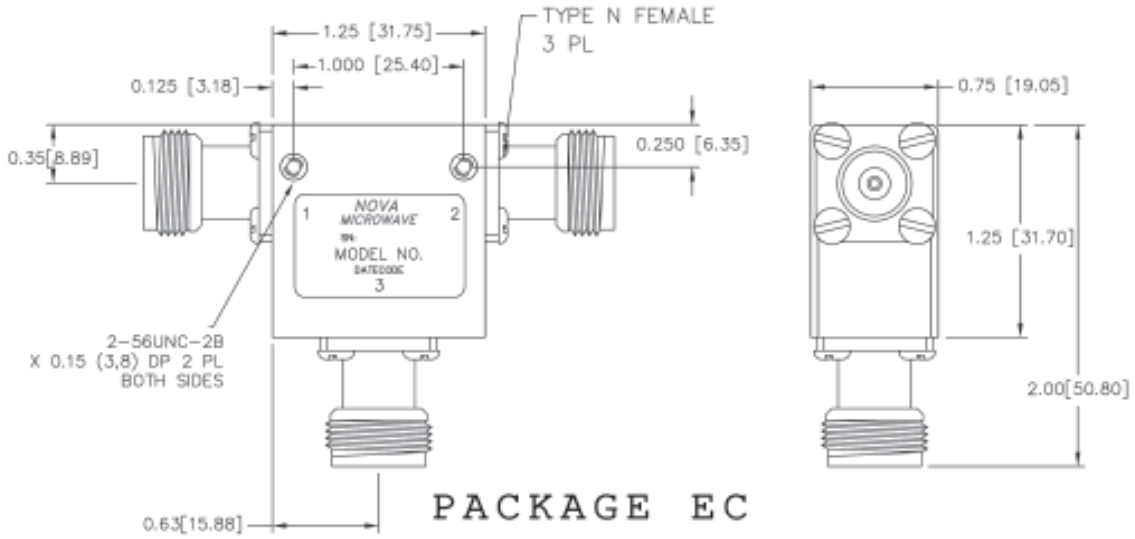


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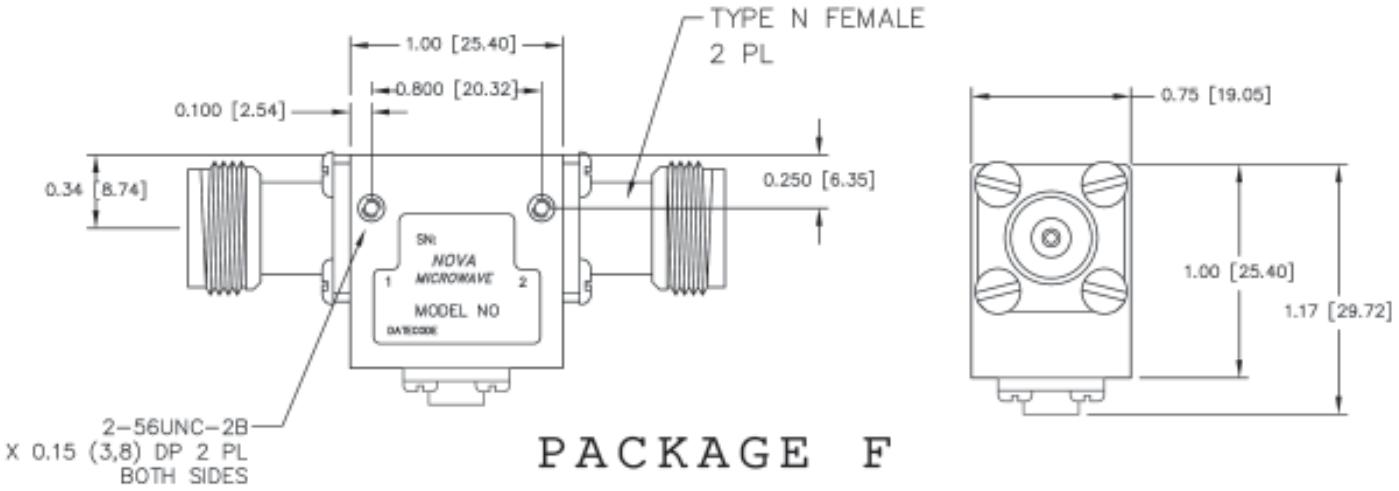
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PACKAGE E




PACKAGE EC

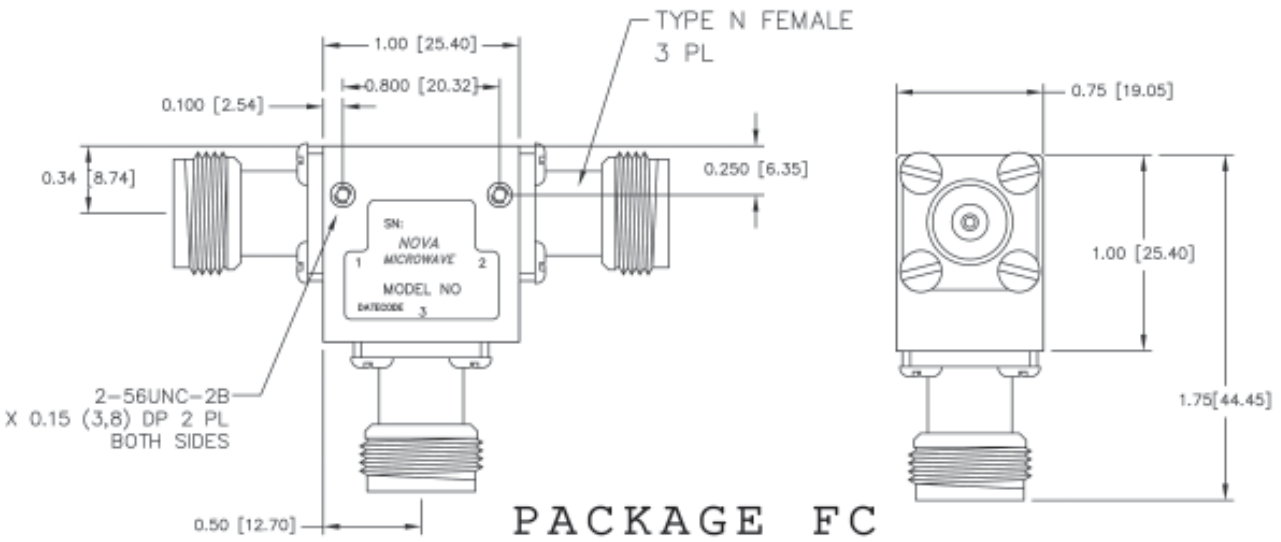



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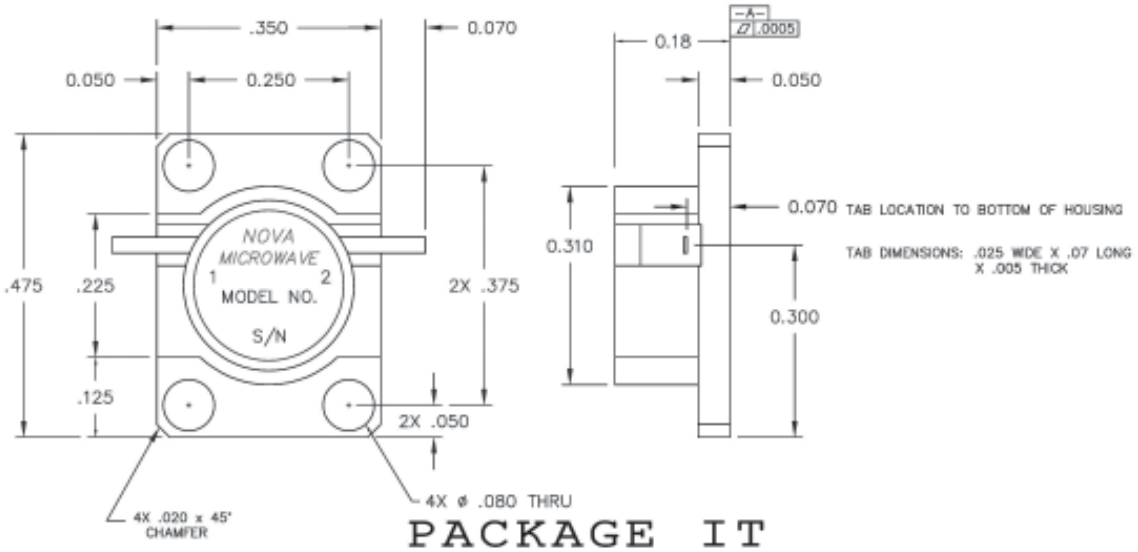


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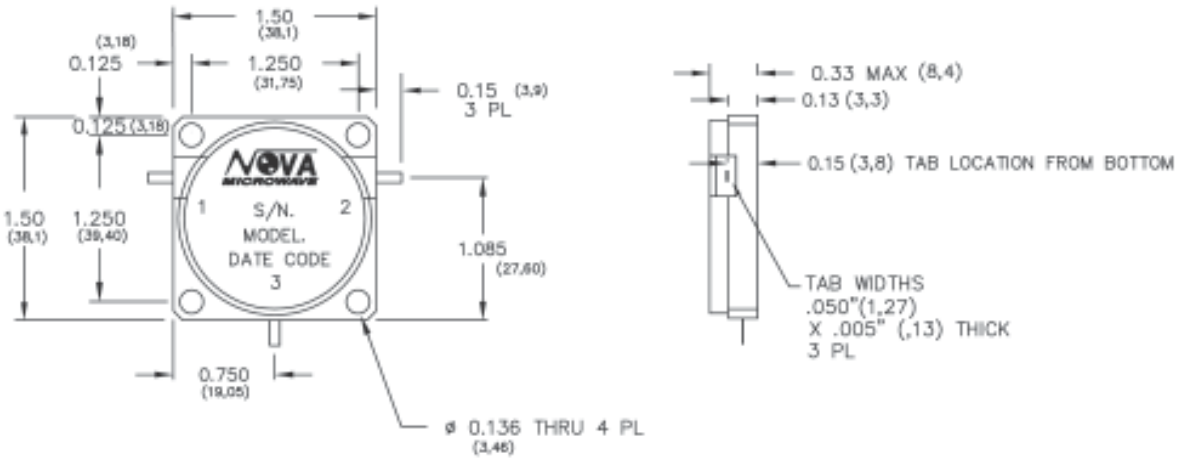
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PACKAGE FC




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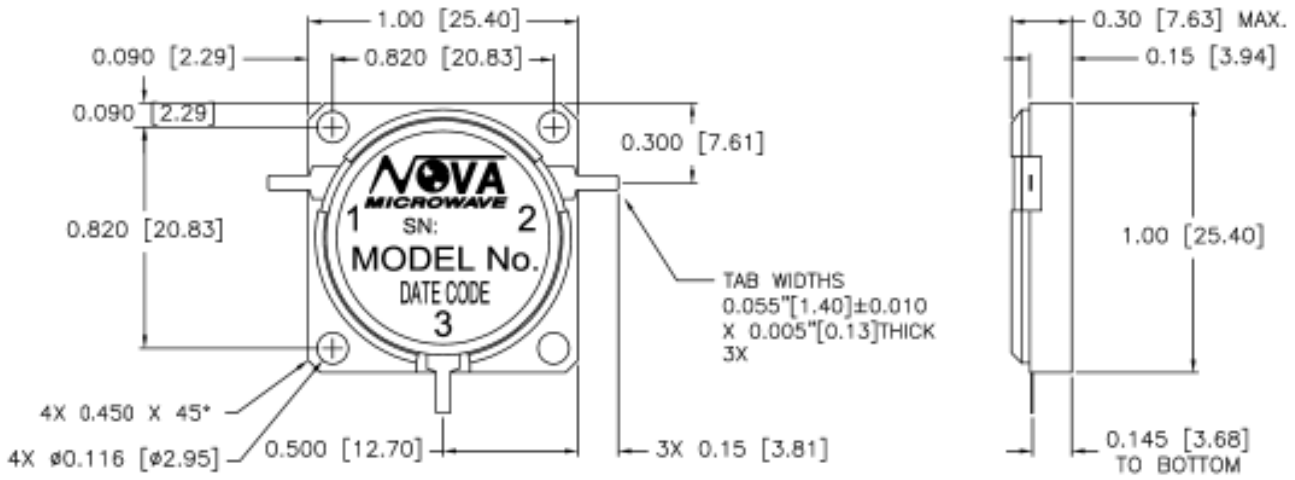



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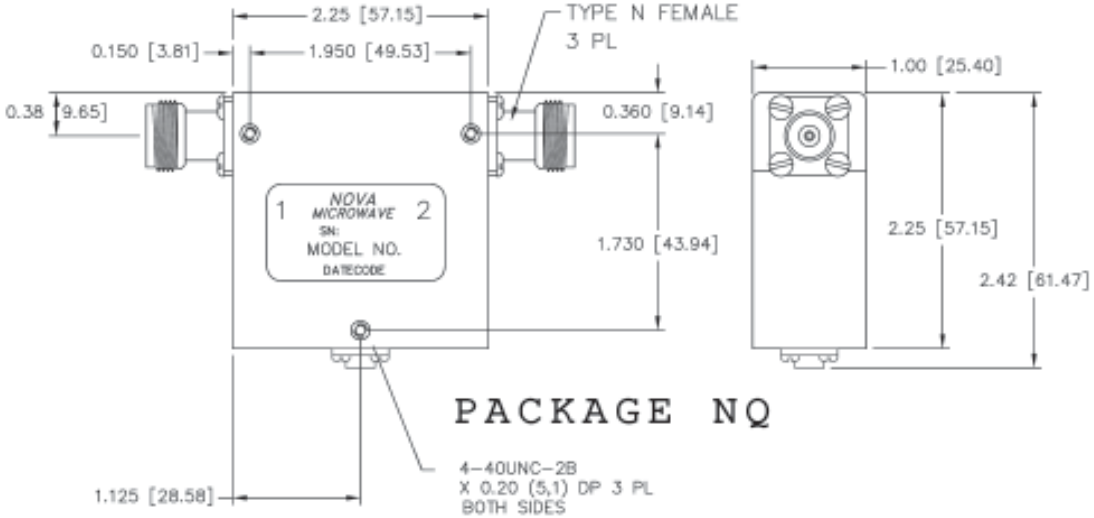


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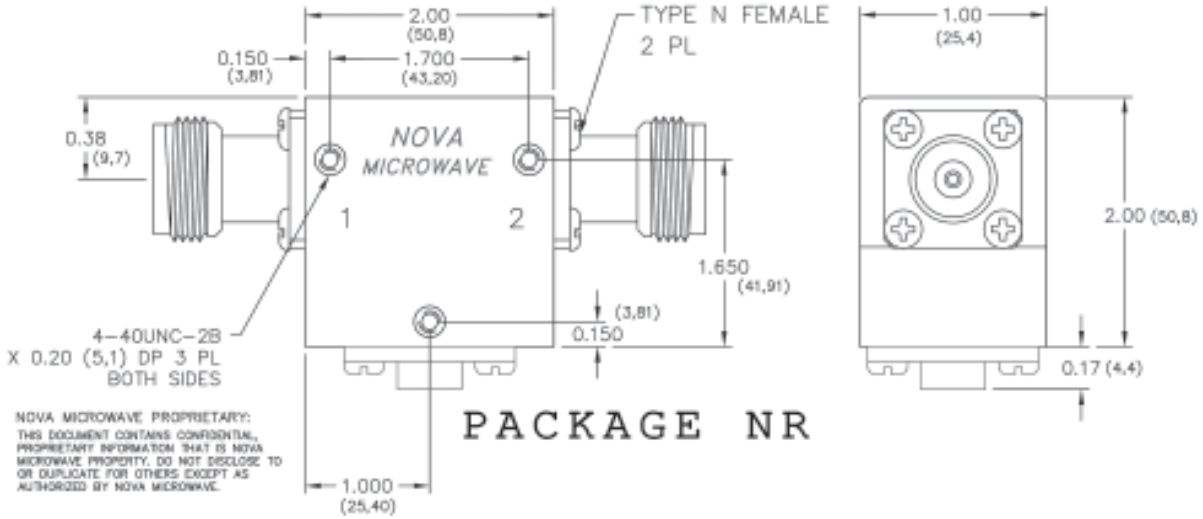
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PACKAGE N




PACKAGE NQ



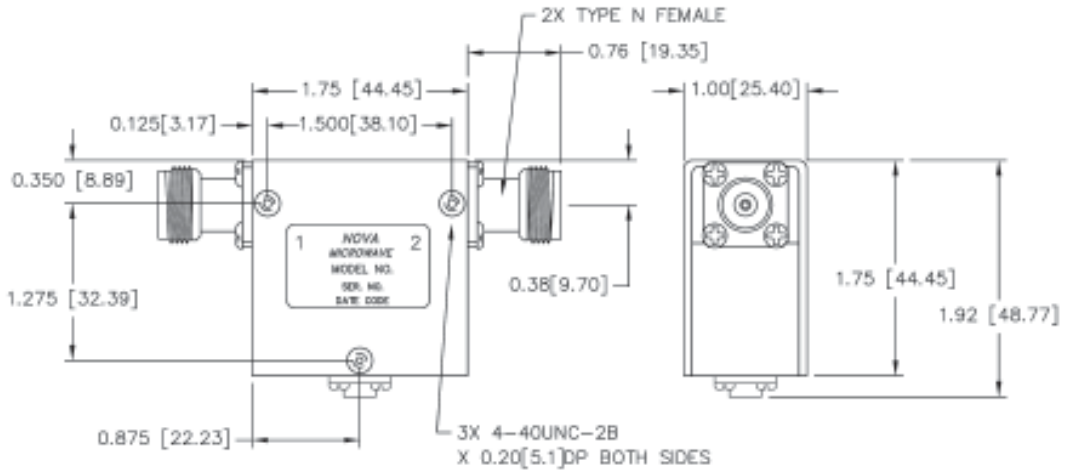

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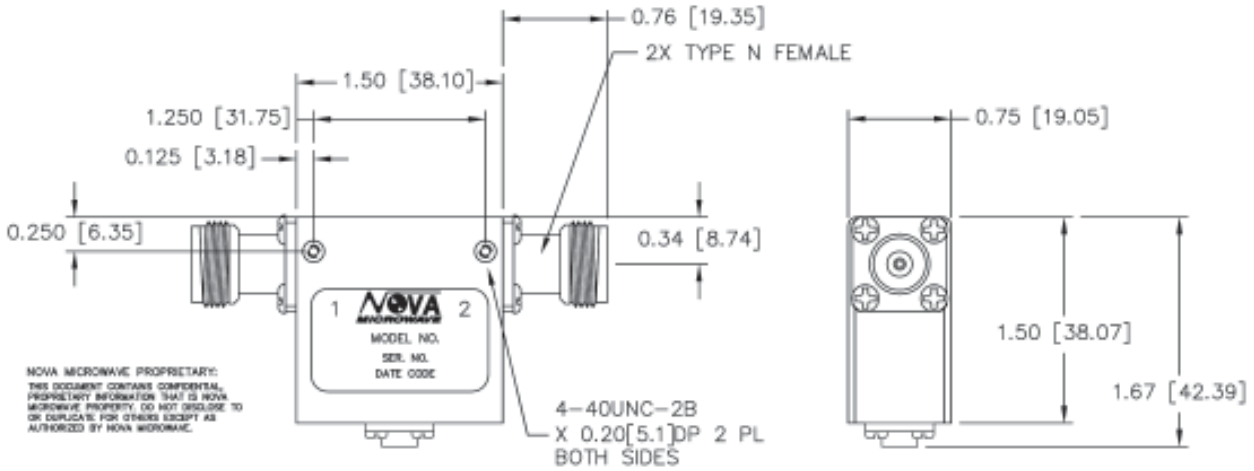


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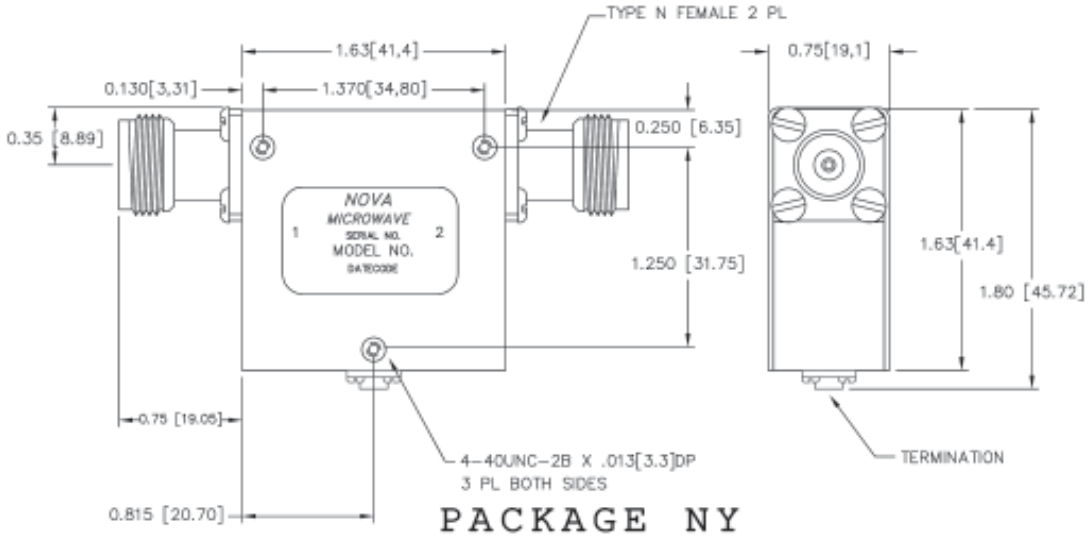



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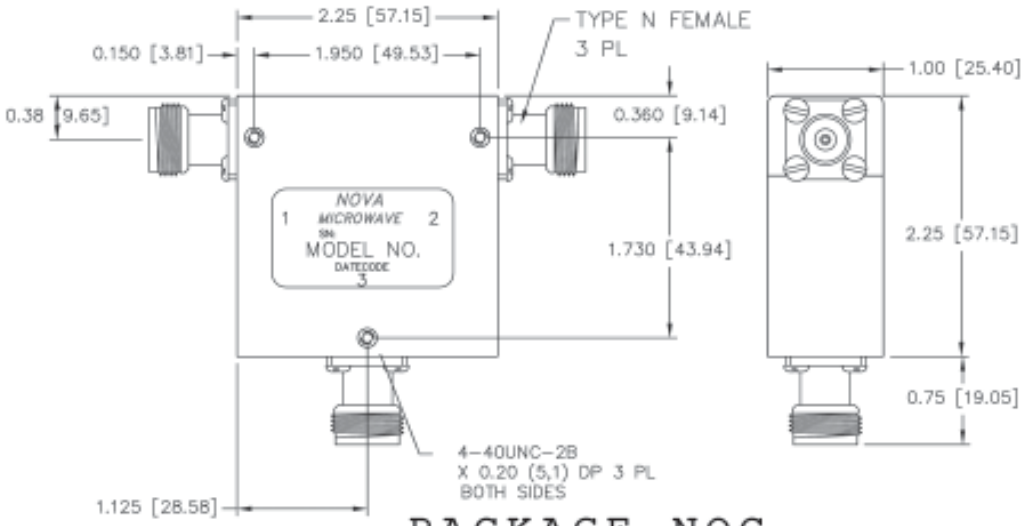



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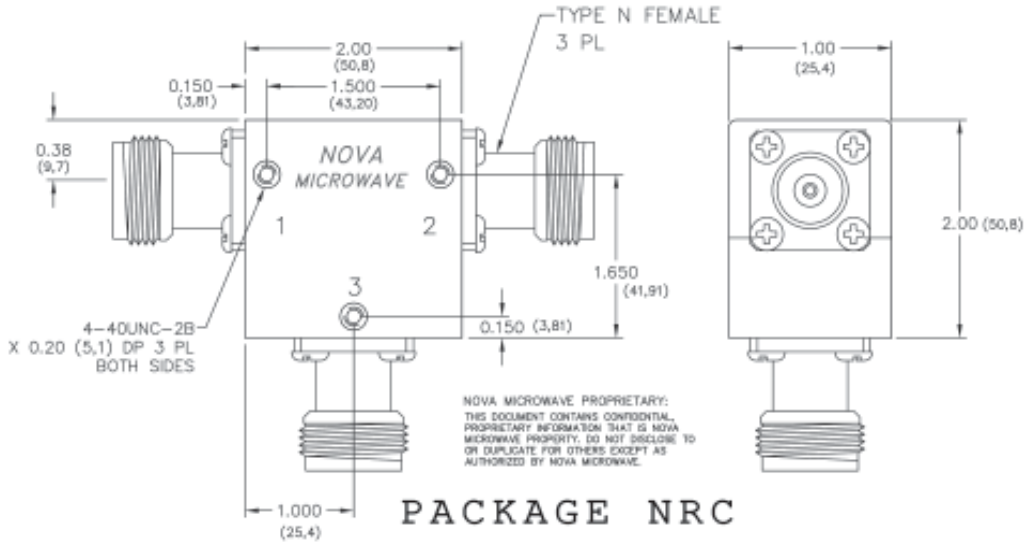


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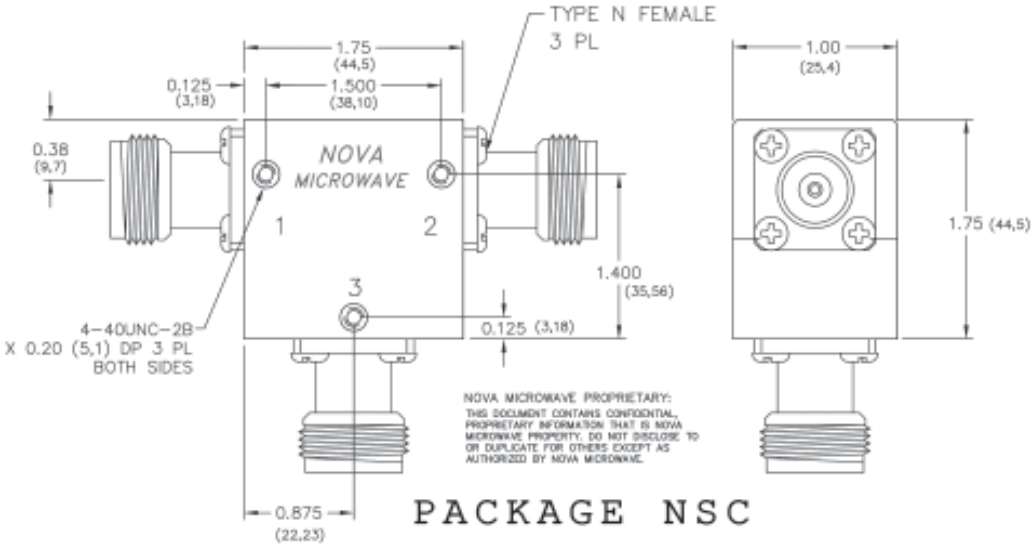
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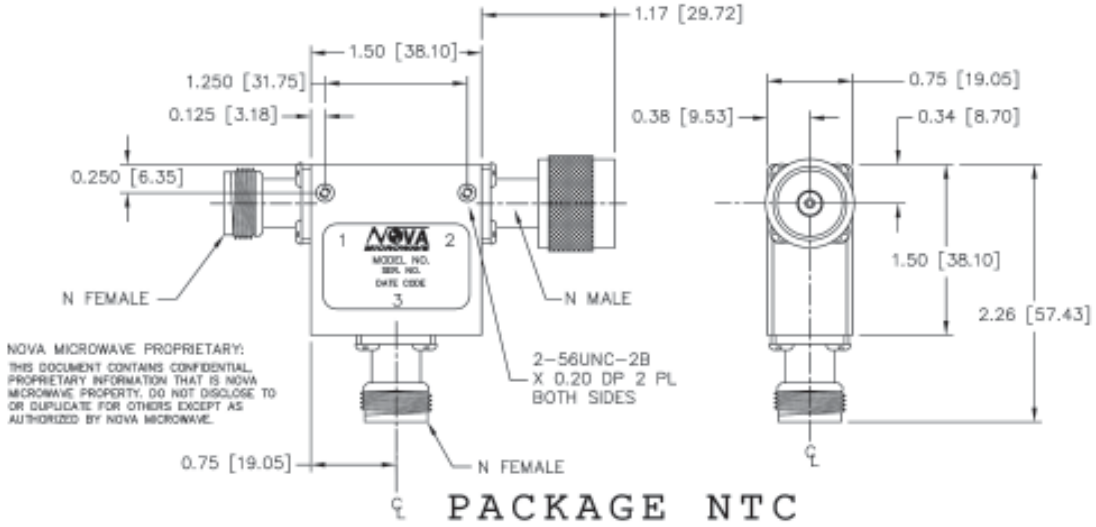



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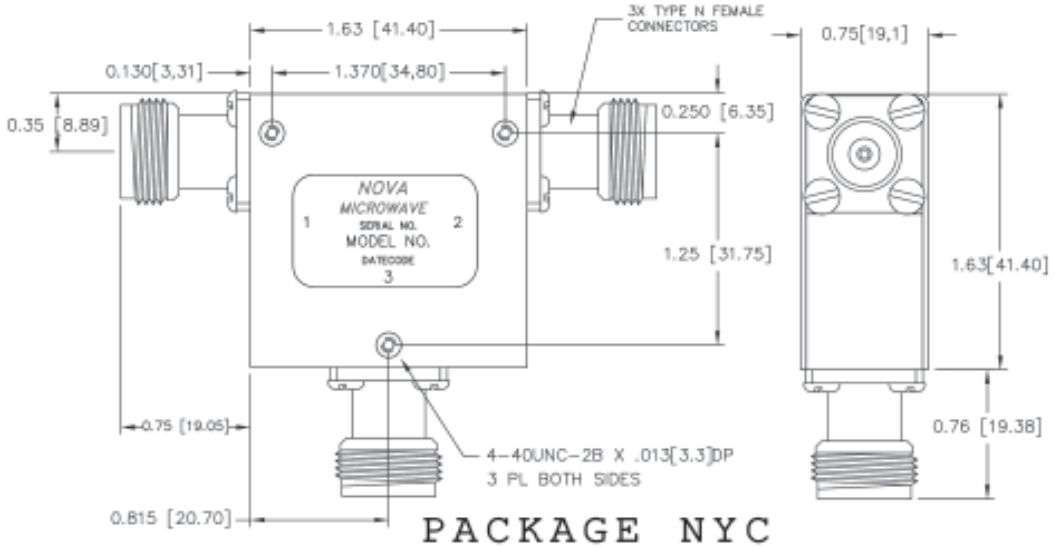


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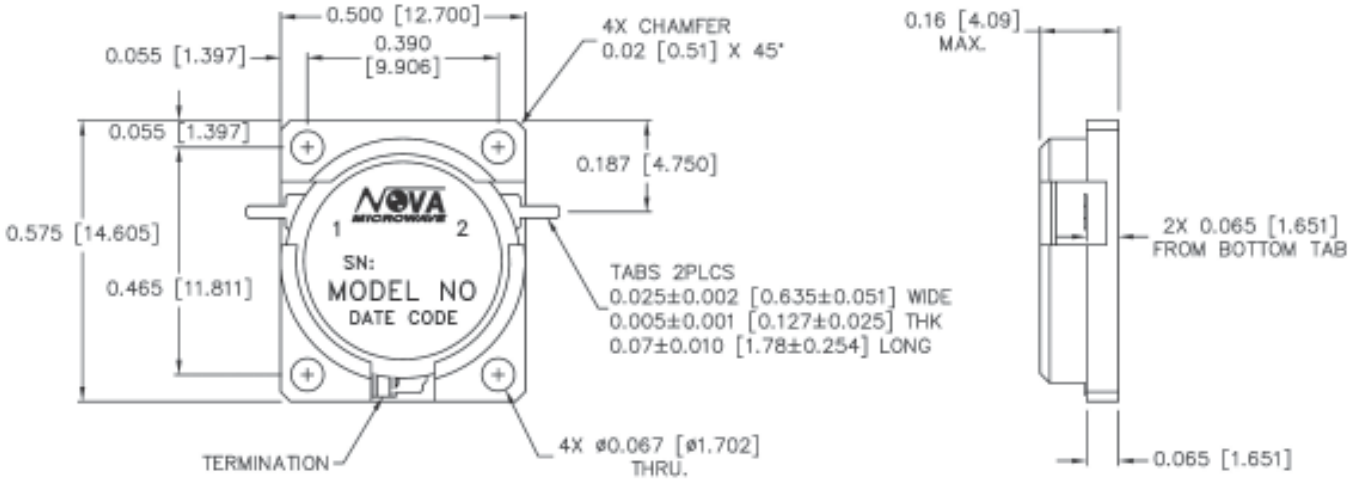
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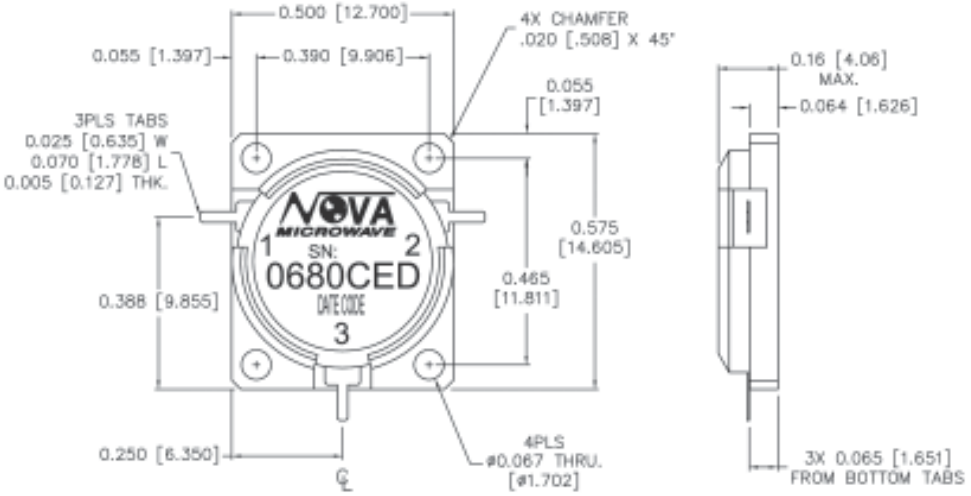



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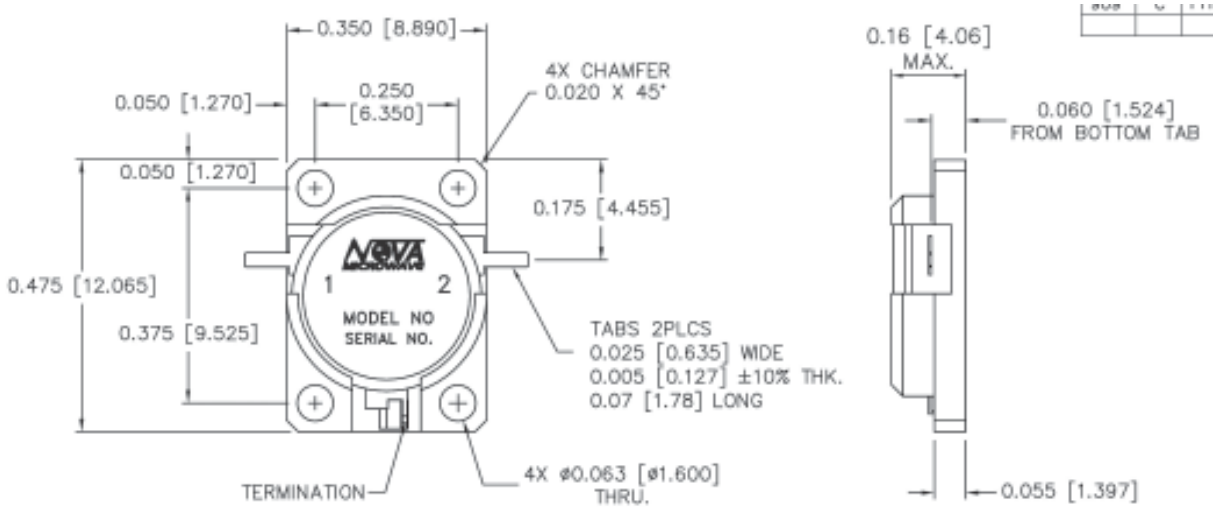


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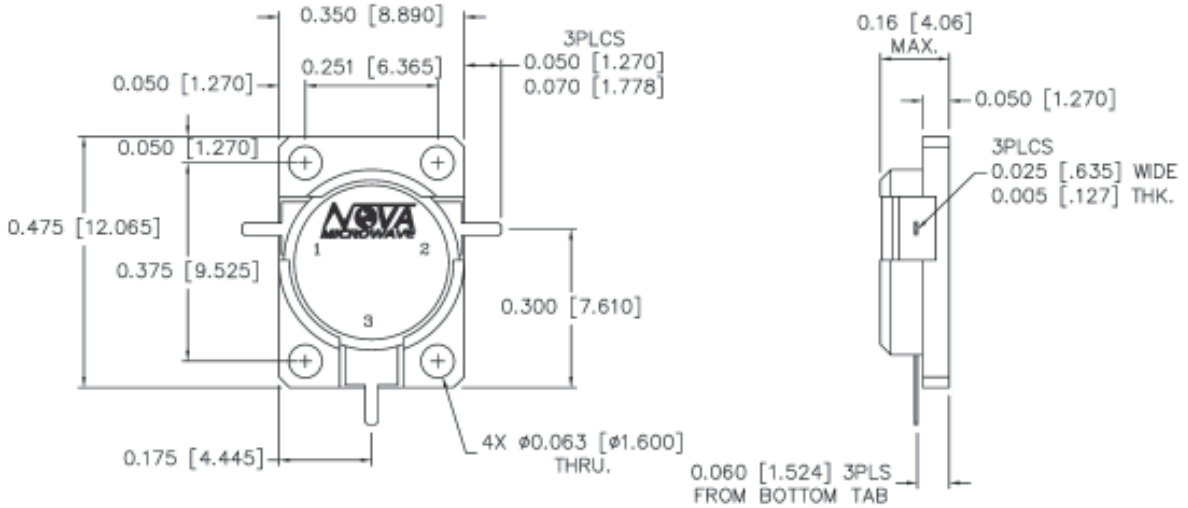
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PACKAGE P

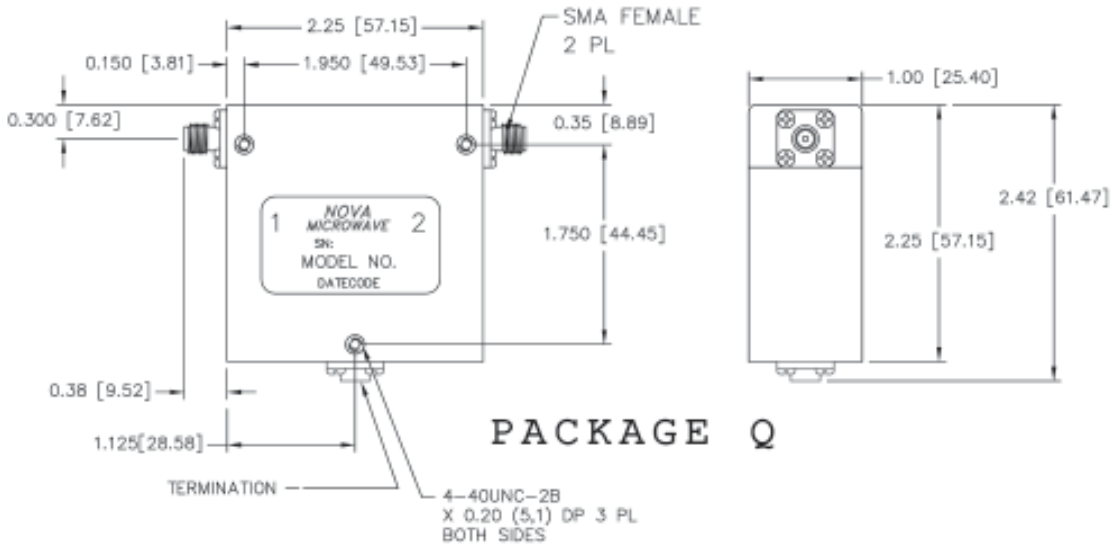



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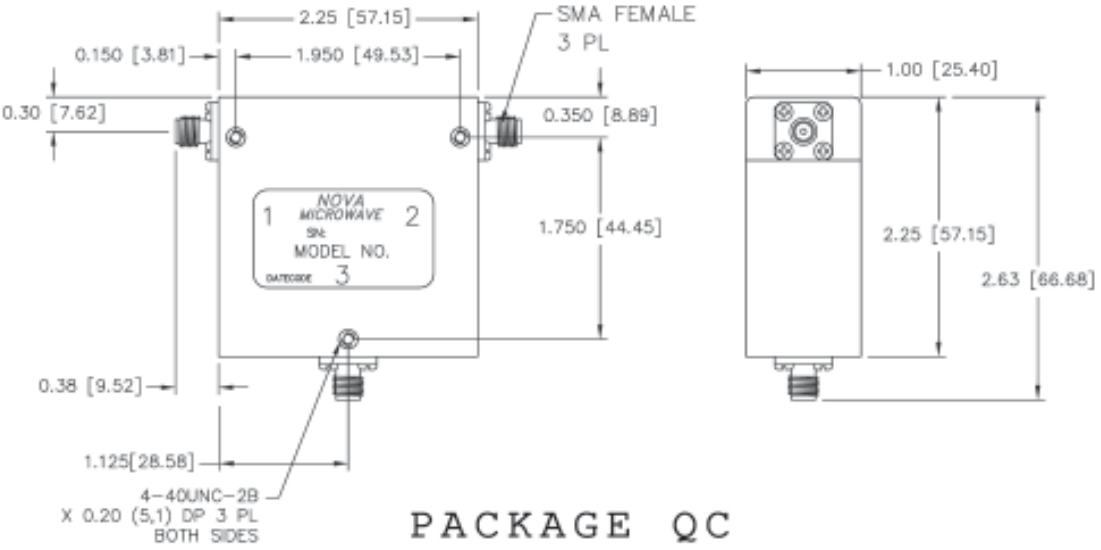


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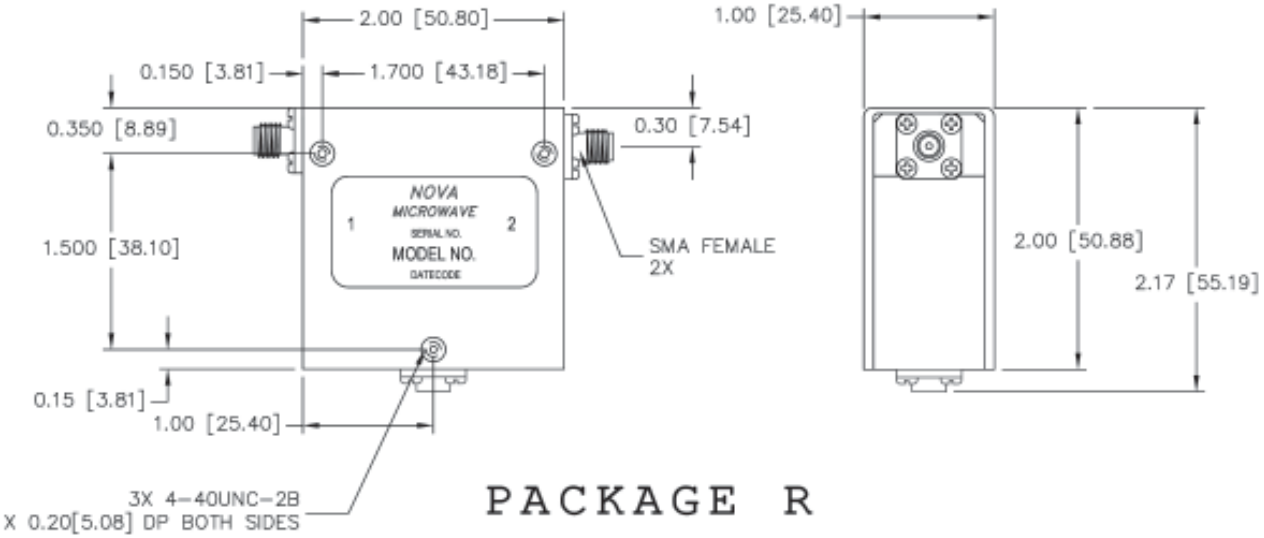
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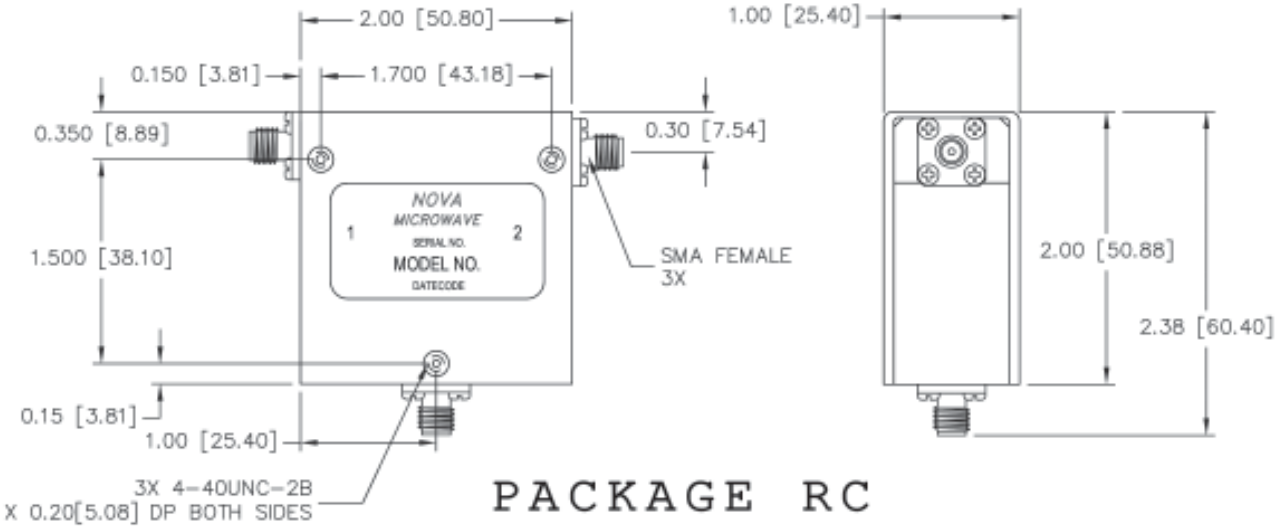



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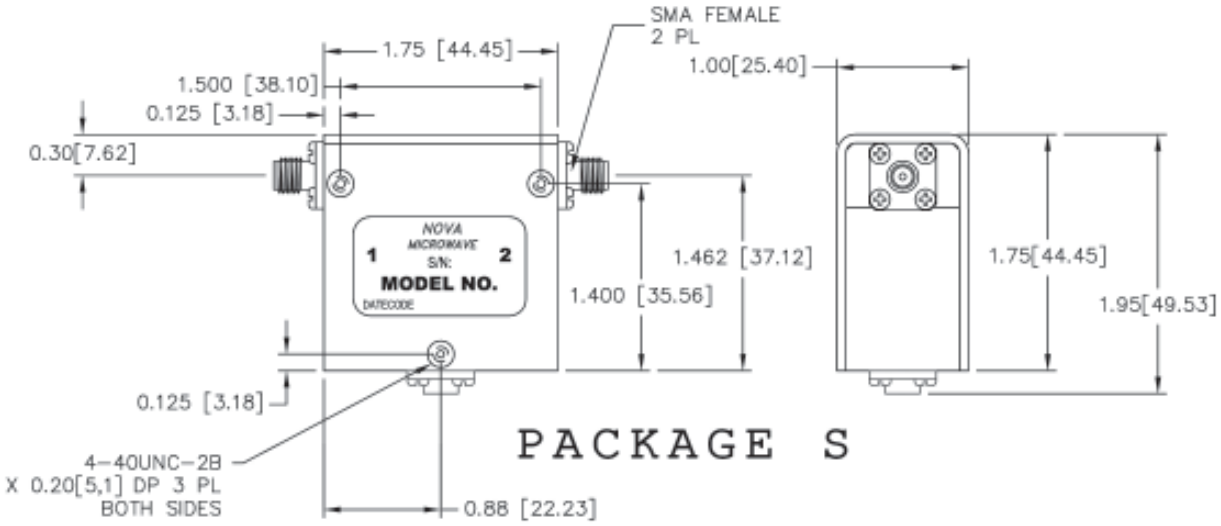


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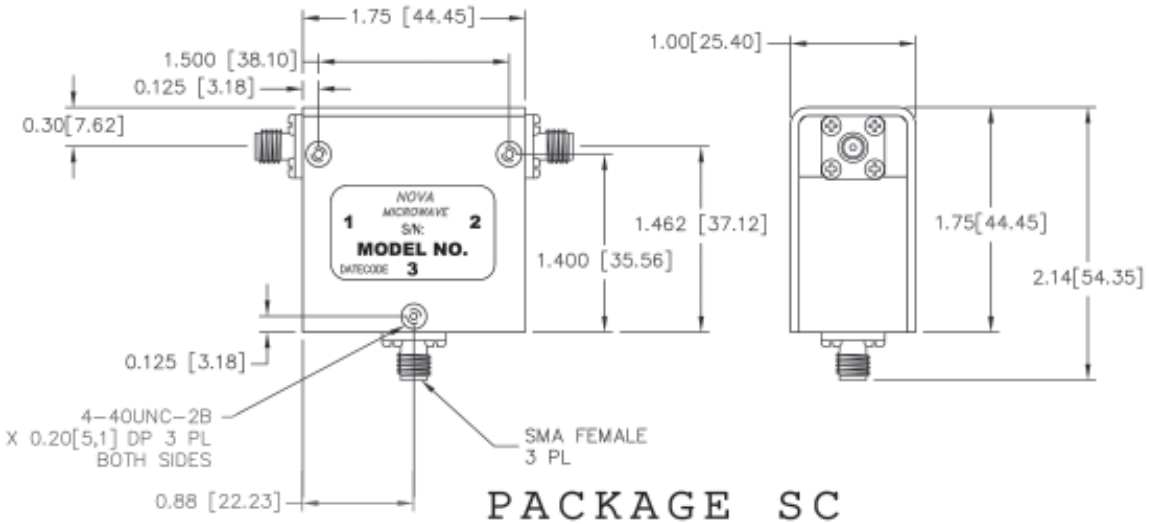
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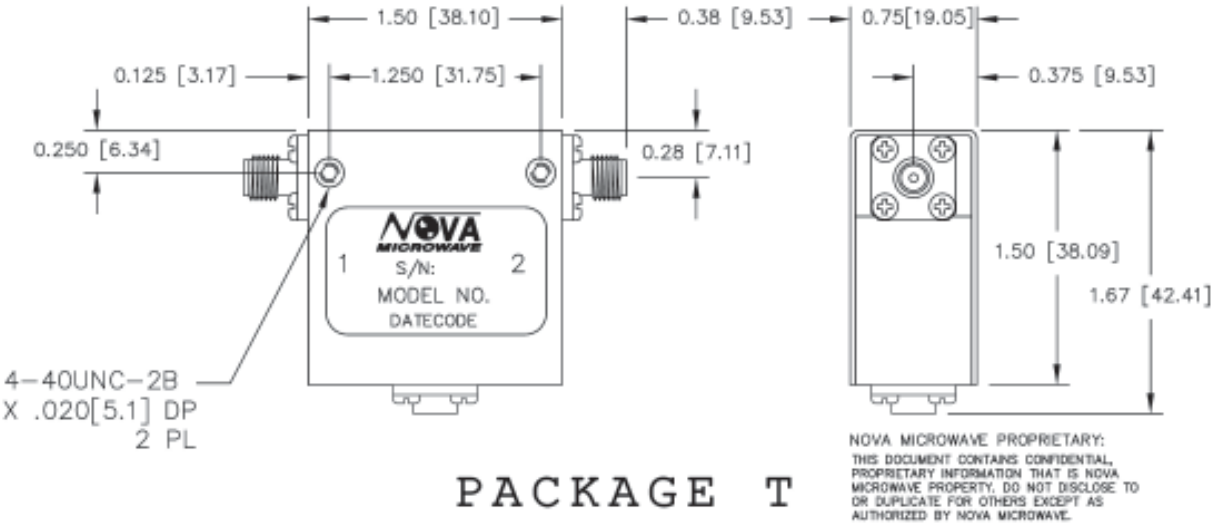



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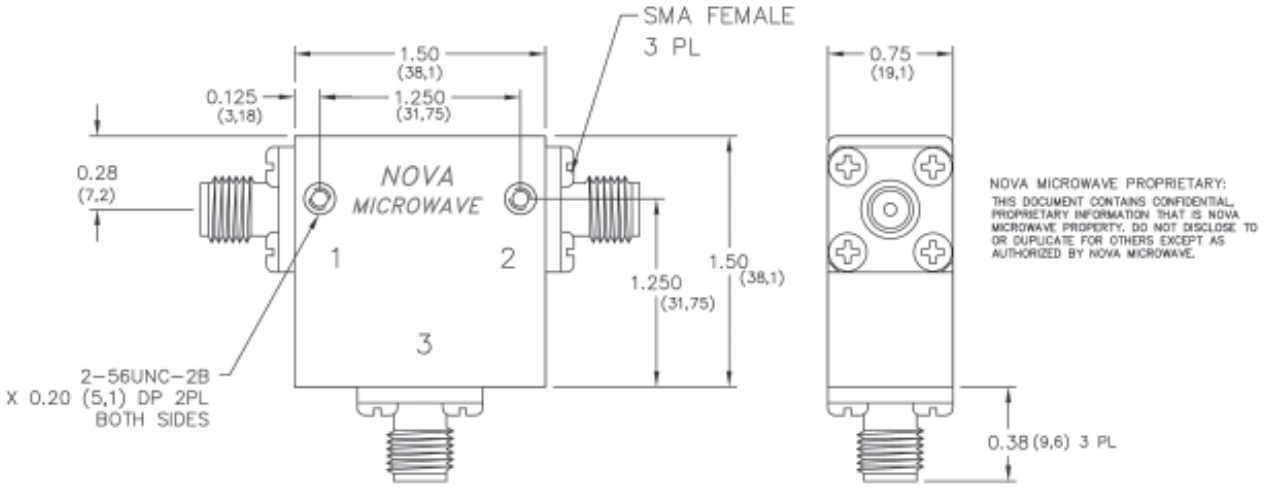


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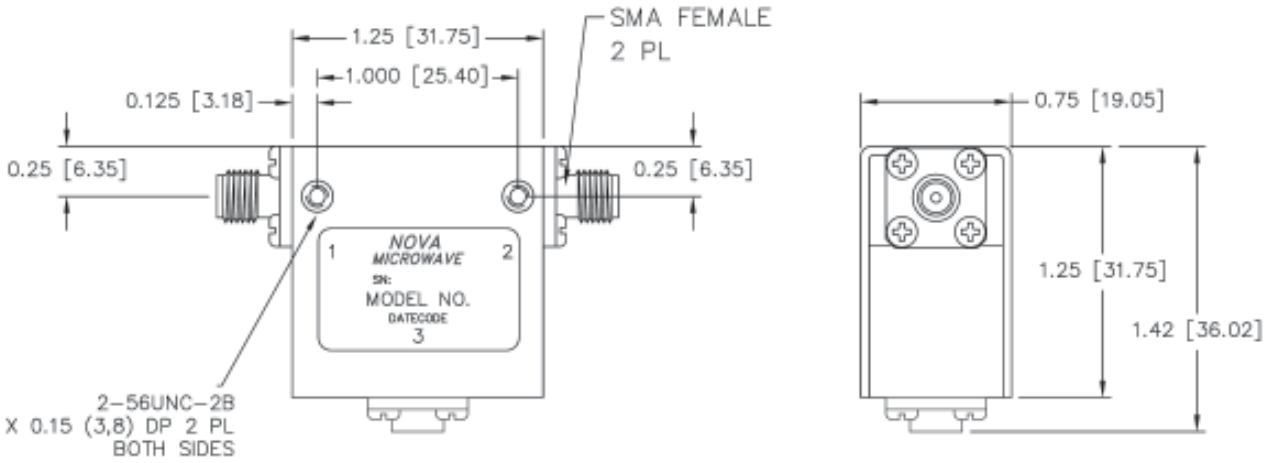
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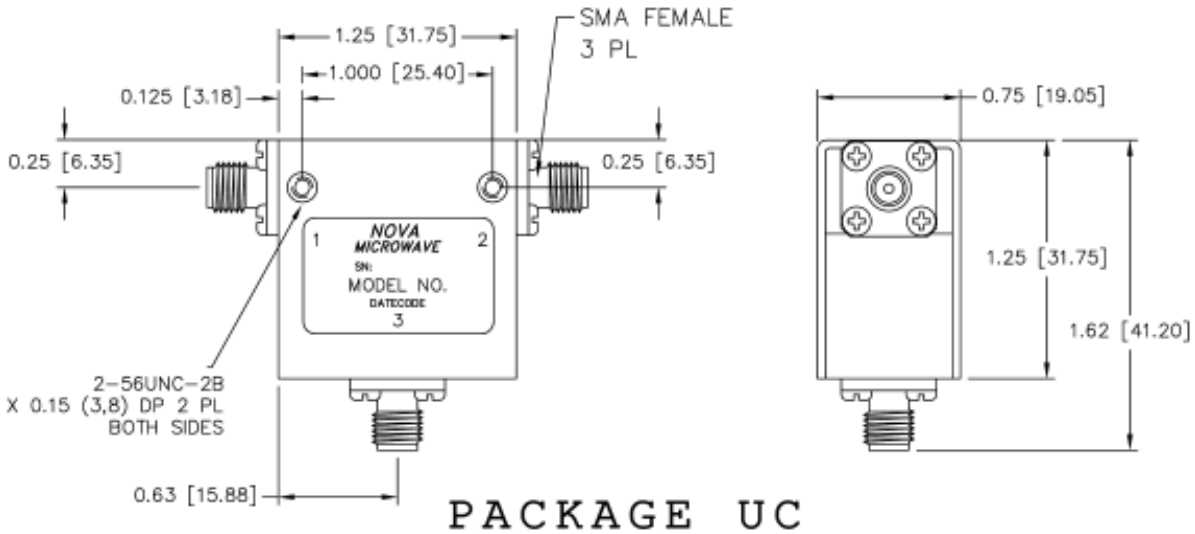

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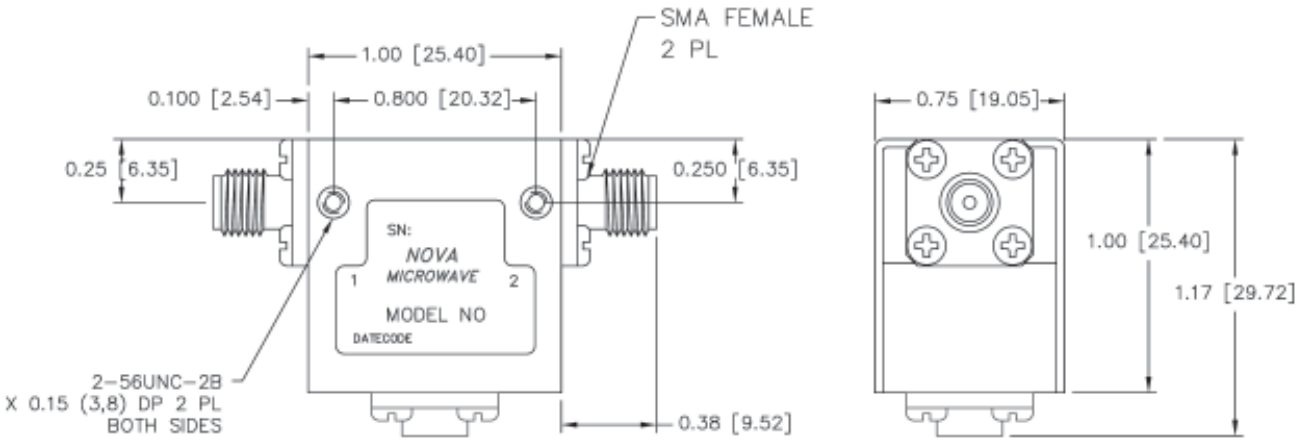
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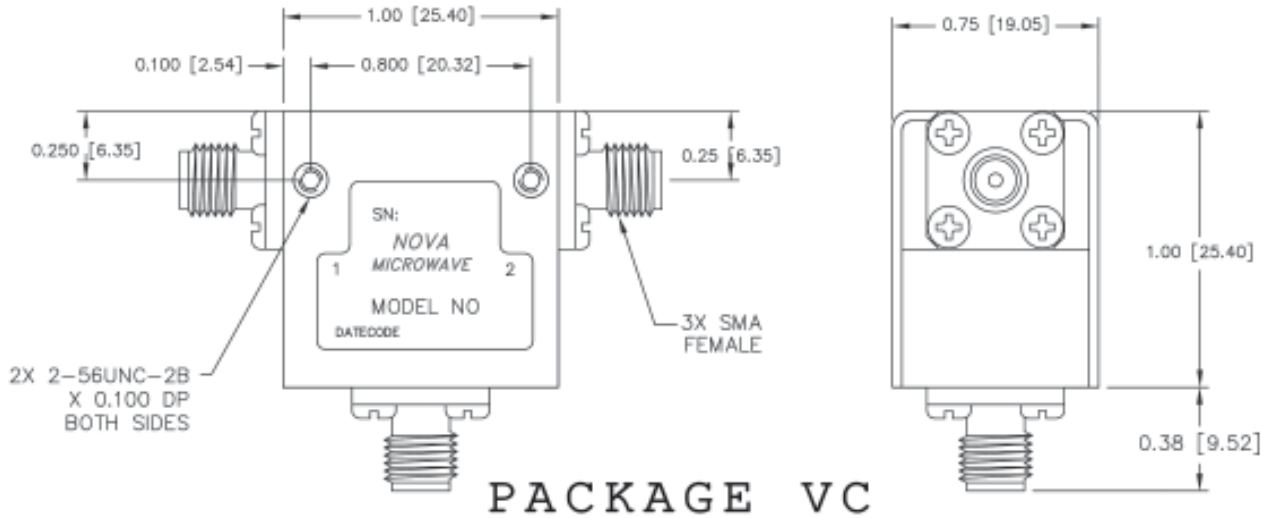
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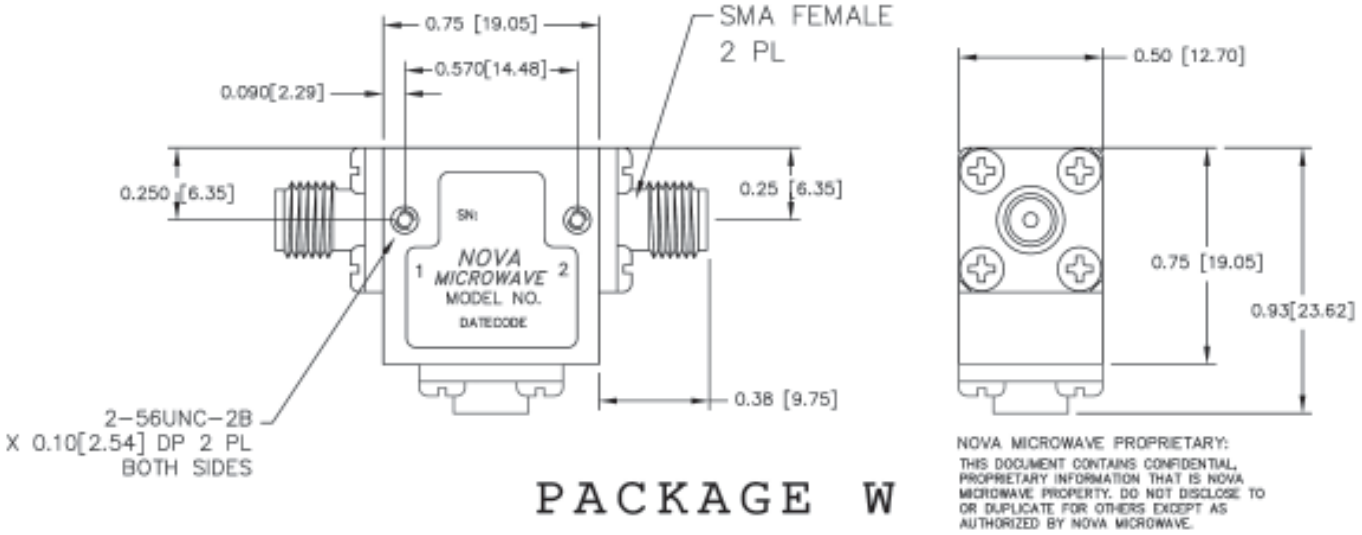



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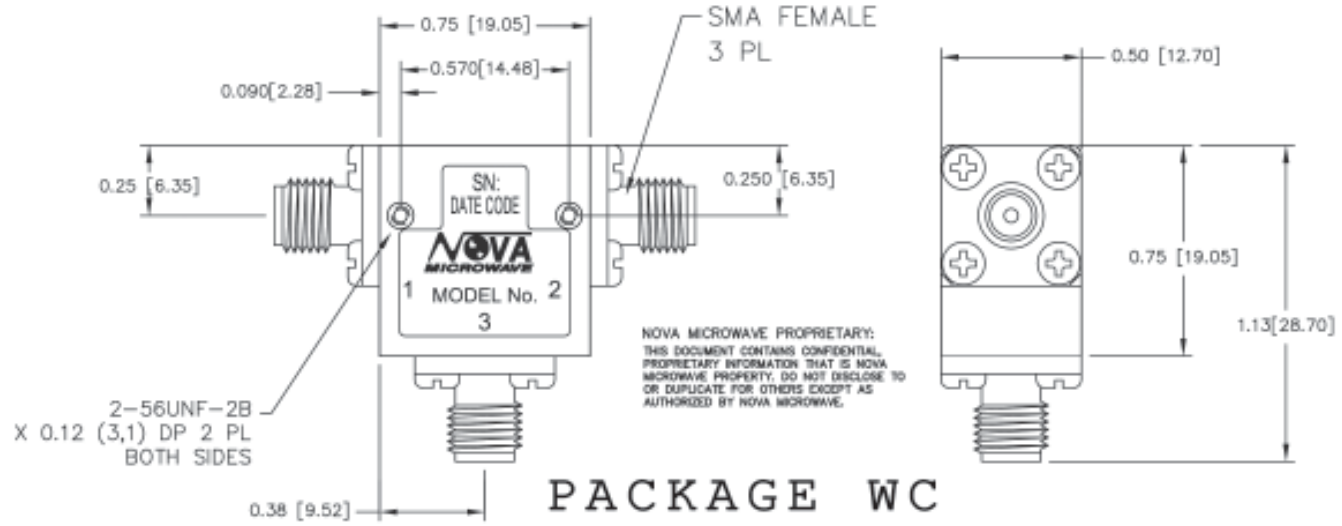


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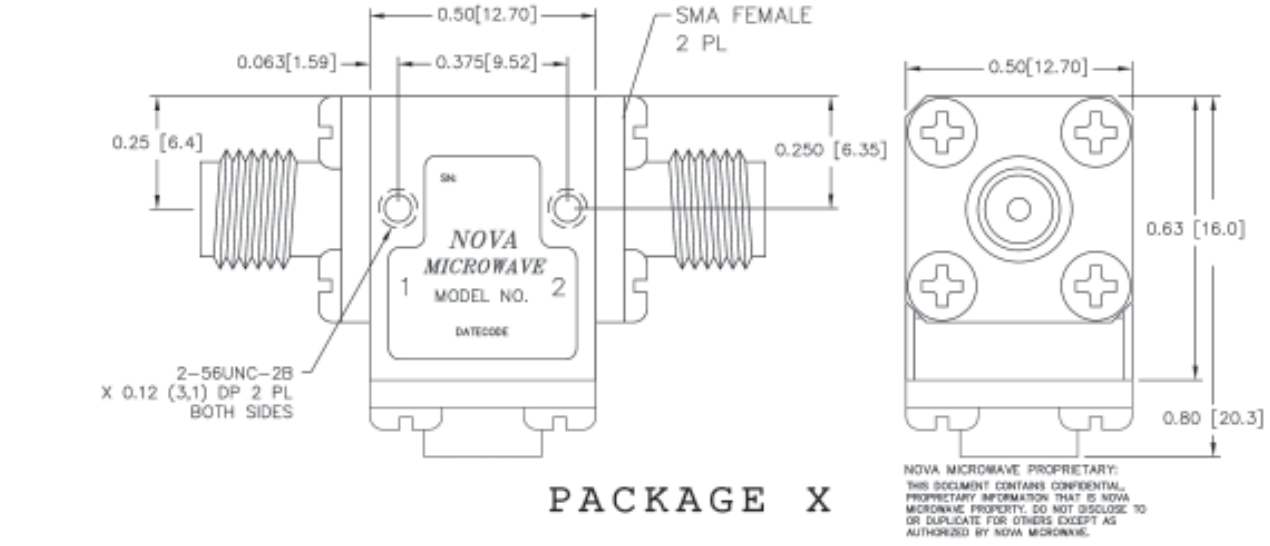
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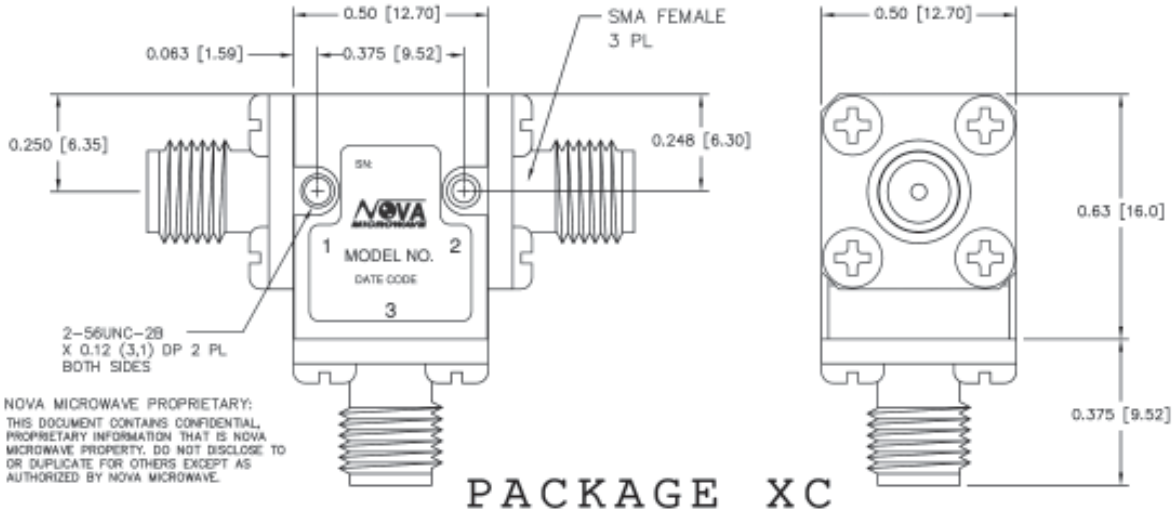

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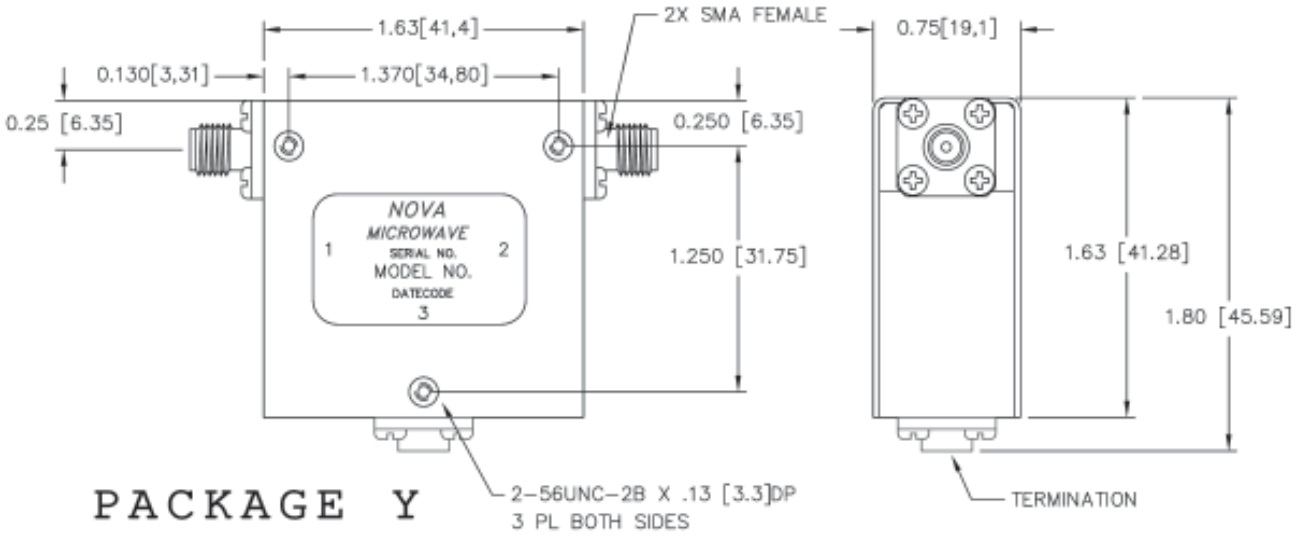

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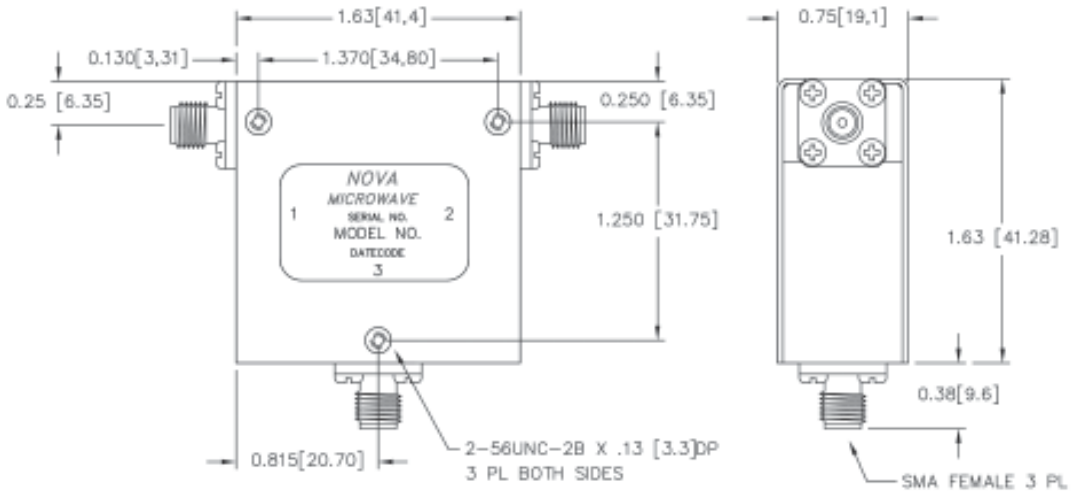

PACKAGE X




PACKAGE XC




PACKAGE Y




PACKAGE YC



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**VSWR:**
The reflective property of each port of a ferrite circulator or isolator is usually specified in terms of VSWR. For critical applications a Smith Chart, with an impedance plot recorded at a specified reference plane, can be provided. A typical specification for VSWR is 1.25. However, a value of 1.10 can be provided for narrow band applications.

**ISOLATION:**
This parameter is used to specify the reverse loss characteristics of an isolator.The parameters isolation, VSWR, and insertion loss are required to specify an isolator whereas a circulator is completely defined by only the VSWR of the three ports and insertion loss. Although a circulator can be made into an isolator by terminating one port, it does not have an intrinsic isolation value. The isolation measured would be dependent on the VSWR of both the termination and the circulator port. Most isolators are specified at 20dB but value of 26dB can be obtained for narrow band applications.

**Example:** A circulator has a measured VSWR of 1.22 for all three ports. If a perfect test termination with a VSWR equal to 1.00 were available to place on Port 3, the resulting isolation from Port 2 to Port 1 would be 20dB. If a test termination with a VSWR equal to 1.05 were placed on Port 3, the resulting isolation from Port 2 to Port 1 would vary between 18.2 and 22.5dB depending on the phasing between the two VSWR's. The resulting isolation value is a function of the VSWR of the test termination and how it may phase with the VSWR of the circulator port.

**INSERTION LOSS:**
This parameter is used to specify the forward loss characteristics of a circulator or isolator. Most catalog models have an insertion loss specification of 0.4dB to 0.5dB. Many low noise systems require an isolator with as low an insertion loss as possible. For these applications the insertion loss can be minimized by using low loss ferrite and dielectric materials. Losses as low as 0.1dB have been provided in large production quantities.

**TEMPERATURE RANGE:**
The operating temperature range of a circulator or isolator is limited by the ferrite materials available. In general the lower the operating frequency the greater the temperature sensitivity an isolator will have. Temperature compensation can be used at some operating frequencies. Catalog units make use of temperature compensation where possible.Operating temperatures from -20°C to +85°C are common although some models are limited to 0 to 50°C. The storage temperature is generally the military range of -20°C to +85°C. Although temperatures of -40°C to +85°C; can also be provided.



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**MAGNETIC SHIELDING:**
Catalog circulator and isolators all have sufficient magnetic shielding for general handling and mounting. These units can usually be mounted to within ½ inch of one another or from other magnetic materials without degrading electrical performance. For more stringent applications (mounting in direct contact with a magnetic plate) additional shielding may be required and necessitate a larger package size.

**RFI SHIELDING:**
Standard circulators and isolators have an RFI leakage measured at proximity of 30 to 40dB. Special packaging and sealing methods can improve the RFI shielding. Leakage values in excess of 60dB can be provided but require additional shielding to be incorporated during the initial design.

**TERMINATION RATING:**
The termination rating on isolators must be sufficient to safely dissipate the reverse power that is expected to occur under normal or anticipated fault conditions. The reverse power will be determined by the power applied to the input port of the isolator and the mismatch on the output port. This reverse power will be dissipated by the internal termination.

All units, except the drop-in and surface mount isolators have terminations rates at 100 watts peak and 2 watts average power. If frequency, bandwidth and size permit, higher peak and average power values can be specified. Average power ratings of less than 50 watts for the lower frequency standard isolators usually do not require cooling other than mounting to a heat sink. Higher power levels may require the termination be mounted directly to a heat sink or the use of other forms of cooling. Allowances must be made for some degradation in isolation for the higher power rated terminations.

**POWER RATING:**
The input power to a circulator or isolator can be supplied from a CW or a pulsed source. In the case of a pulsed source both the peak and average power components of the pulse train should be specified in order to determine an adequate safety margin for a particular circulator or isolator.

The peak power can be at a high enough level to cause breakdown or arcing. This generally results in permanent degradation of electrical performance. A proper connector selection and an optimized internal geometry are required to maximize the peak power capability of a particular circulator or isolator.

Contingent on the peak power level and other parameters, circulators or isolators can be provided that will operate to altitudes in excess of 100,000 feet.

The peak power level can also cause an increase in the insertion loss in a below resonance design, due to non-linearity effects of the ferrite material. This increase can occur at peak power levels considerably lower than that required for breakdown or arcing. The increased insertion loss will cause more power to be dissipated in the ferrite region of the device which will result in overheating. Higher peak power levels can be obtained by using a special ferrite material.



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Non-Linearity effects of the insertion loss do not occur in the above resonance circulators or isolators. All standard circulators and isolators that are above resonance will have the letter "A" as part of the assigned model number. Most circulators and isolators below 2 GHz center frequency are also above resonance.

The average power rating of a circulator or isolator is determined by the insertion loss, the internal geometry of the ferrite region, and the type of cooling available. The insertion loss of a circulator or isolator will cause some of the average power to be absorbed and dissipated in the ferrite region as heat. Adequate cooling is necessary to ensure the ferrite material does not reach an excessive temperature. Mounting to a heat sink for cooling is sufficient in many cases if the average power is moderate.

In high power applications, a component with a high VSWR connected to the output port of an isolator will reflect a substantial amount of power. The temperature of the ferrite region as well as the internal voltage will increase causing the performance to deteriorate or arcing to occur before full rated input power can be realized.

Circulators and isolators that must meet stringent peak and average power levels require design considerations of many parameters. The normal and worst case load VSWR conditions and the available cooling must be specified when ordering high power isolators or circulators.

**CONNECTORS:**
The connectors used on the standard SMA Coaxial Isolators and Circulators and N Type Coaxial Isolators and Circulators are female. Other connectors can be provided based on operating frequency and package size. However, certain types may cause electrical degradation. Most versions of the SMA and N Type connectors can be supplied for special applications.

**INSERTION PHASE:**
Many applications require circulators and isolators to be supplied as phase matched sets. Although the catalog circulator and isolators are not phase matched, this feature can be provided on a specified basis. The tolerance in phase matching will depend on the particular circulator and isolator model and size of the lot to be matched. Phase matched pairs can usually be provided to within ±5 degrees.

Linearity of the insertion phase can also be specified. It is usually defined as a deviation from a best fit straight line of insertion phase versus frequency.



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**Understanding Circulators & Isolators**

The Nova Microwave staff has a thorough understanding of the working of ferrite and magnet materials and their application to develop electronic microwave circulators and isolators. The selection of basic ferrite material and magnet material has a significant effect on the overall performance and cost of circulators and isolators. The power handling, insertion loss, and labor required to manufacture these circulators and isolators is very dependent on this material selection. The ferrite material and magnet material required for circulators and isolators; is a major cost contributor to the final circulator and isolator cost. Nova designers have developed custom programs to provide the optimum performance at the lowest cost. The detailed understanding of the circulators and isolators is as follows:

This section describes the basic operating principles of strip line junction circulators and isolators. The following information has been compiled from many technical papers. It has been summarized to present a simplified non-mathematical description that is used to highlight the operating characteristics of various circulator and isolator types. Although this paper is not intended to be a design guide it is hoped that the information presented will be useful to both the buyer and system engineers. A junction circulator is a 3-port device formed by a symmetrical Y-Junction strip line coupled to a magnetically biased ferrite material. When one of the ports is terminated, with either an internal or external termination, the device then becomes an isolator which isolates the incident and reflected signals.

Consideration of the following is necessary to understand the operation of a junction circulator or isolator.

- FERRITE REGION
- MAGNETIC CIRCUIT
- IMPEDANCE TRANSFORMATION
- TRANSMISSION LINE GEOMETRY
- CONNECTORS

**FERRITE REGION**

A ferrite disk and the intersection of 3 transmission lines from the Y-junction is where the actual circulation occurs. In order to have a better understanding of this region, it is necessary to briefly discuss the concept of circulation and ferromagnetic resonance. A simple model can be used to explain how a junction circulator operates as shown in **Figure 1.**

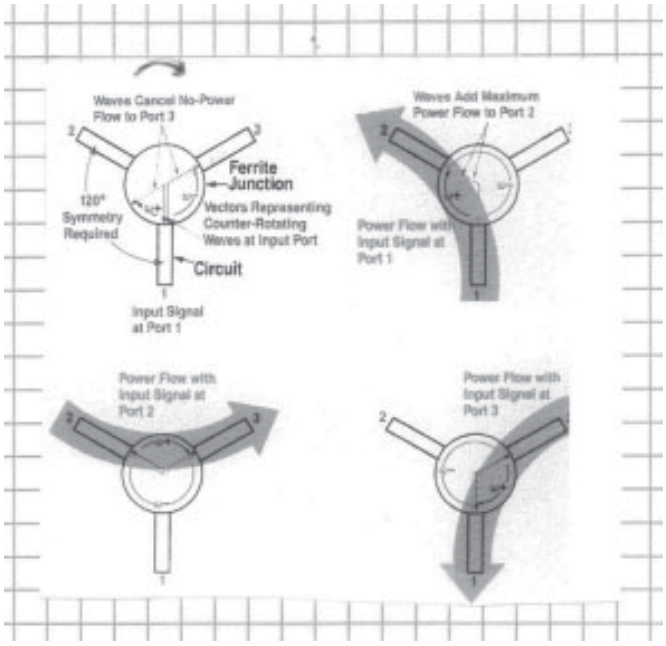



**Figure 1**

A Signal Entering the Circulator generates two counter-rotating waves. Each wave travels at a different velocity so that addition and cancellation occours at the appropriate ports.



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A signal applied to a ferrite disk will generate two equal, circularly polarized counter-rotating waves that will rotate at velocities É+ and É-. The velocity of a circularly polarized wave as it propagates through a magnetically biased microwave ferrite material will depend on its direction of rotation. By selecting the proper ferrite material and biasing magnetic field the phase velocity of the wave traveling in one direction can be made greater than the wave traveling in the opposite direction. If a signal were applied at Port 1 the two waves will arrive in phase at Port 2 and cancel at Port 3. Maximum power transfer will occur from Port 1 to 2 and minimum transfer from Port 1 to 3, depending on the direction of the applied magnetic field. Due to the symmetry of the Y-Junction, similar results can be obtained for other port combinations. Externally the circulator seem to direct the signal flow clockwise or counterclockwise depending on the polarization of the magnetic biasing field.

When the ferrite material is magnetized the magnetic moments of the electrons precess at a frequency proportional to the biasing magnetic field. Ferromagnetic resonance occurs when a rotating RF magnetic field has the same direction and frequency as the precessing electrons in the ferrite material. The maximum coupling of the energy from the RF signal to the ferrite material will occur at ferromagnetic resonance. If the direction of rotation or the frequency of the RF signal is changed, minimum coupling will occur. A simplistic analogy can be used to explain these phenomena. It is easier for a person to pass items to an individual riding on a merry-go-round if he is running in the same direction and at the same speed while it is more difficult to pass them if both are moving in opposite directions.

Biasing the junction circulator at ferromagnetic resonance is not desirable because the circulator would be extremely lossy. High insertion loss can also occur at very low biasing magnetic fields. This low field loss region arises from the fact that the applied magnetic field is not sufficient to fully saturate or align the individual magnetic domains of the ferrite material. Although high loss occurs in both the low field and ferromagnetic resonance areas low loss operation can still be obtained in the below and above resonance regions as shown in **Figure 2.**

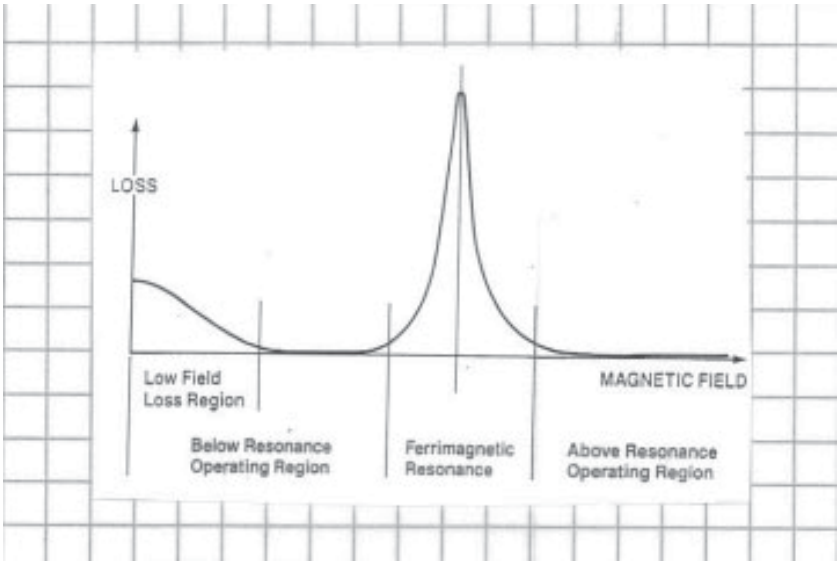



**Figure 2**
Resonance Curve Shows basic Regions of Circulator operation.


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## COMPARISON OF ABOVE AND BELOW RESONANCE CIRCULATOR AND ISOLATOR DESIGNS

It should be noted that the following comparison applies principally to strip line junction circulators and isolators and is intended as a guide only.

## OPERATING FREQUENCY

Above resonance (A/R) circulators and isolators can be designed to operate from 50 MHz to approximately 2.5 GHz. Although operation above this frequency can be achieved, impractical magnetic circuits are required in order to bias the ferrite material. Operation at frequencies below 50 MHz is difficult because the magnetic field the demagnetizing factors of the ferrite geometry do not allow proper biasing of the junction.

Below resonance (B/R) circulators and isolators are generally limited to operation above 500 MHz. Operation below this frequency is possible but generally more limited in performance. As the frequency is reduced the B/R region of operation diminishes as shown in **Figure 3.**

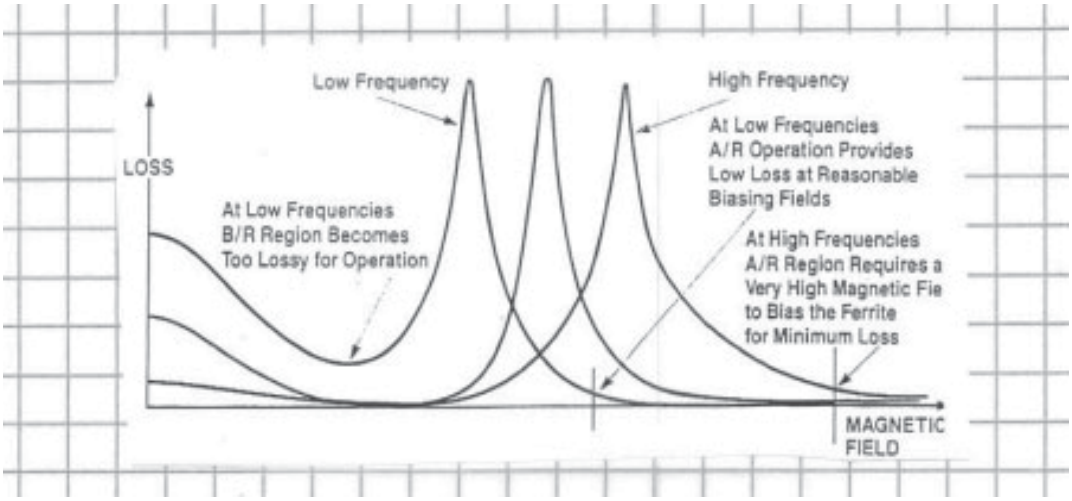



**Figure 3**
**Regions of Operations Vary with Frequency.**

The lower magnetic field required for operation of the B/R junction is not sufficient to fully saturate the ferrite material, resulting in the low field loss region. The low field loss and ferromagnetic resonance regions merge together, thereby reducing or eliminating entirely the B/R region for ferrite operation. The B/R junction can operate at frequencies to approximately 30 GHz. Operation above this frequency is limited mainly by the strip line geometry. Waveguide circulators can be designed to operate at frequencies greater than 100 GHz.

## BANDWIDTH

B/R junction characteristics allow broad bandwidth operation up to 100%. The A/R junction is generally limited to 40% maximum bandwidth.



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## TEMPERATURE

The A/R circulator or isolator can be temperature compensated using special magnetic materials. The magnetic properties of these materials change with temperature and are used to compensate for the ferrite junction temperature characteristics. Above 1 GHz, operation over a temperature range of -40°C to +85°C is common.

The B/R junction is virtually limited to room temperature operation below 1 GHz. The magnetic properties of the ferrite materials available to build circulators or isolators at these frequencies are extremely temperature sensitive. Available materials have Curie temperatures (Tc) less than 100°C. The Curie temperature is defined as the temperature at which the ferrite material's magnetic characteristics are reduced to zero. Circulation of the input signal cannot occur at this temperature. In general, ferrite materials used for the higher operating frequencies have greater temperature stability. Operation above 4 GHz, and from -40°C to +85°C can be obtained depending on the bandwidth and the level of performance desired.

The temperature performance of the B/R and A/R circulators can be improved by the use of temperature compensating material in the magnetic circuit.

## JUNCTION SIZE

The ferrite disk diameter is a function of the effective permeability, dielectric constant, and frequency of operation of the ferrite junction. The A/R junction has a greater effective permeability than the B/R junction because of the higher internal magnetic biasing field and ferrite saturation magnetization value. The ferrite disk in the A/R junction will therefore be smaller than the B/R junction for the same operating frequency. For narrow bandwidths in the 1.0 GHz to 2.5 GHz range the A/R junction circulator is usually smaller.

## MAGNETIC CIRCUIT

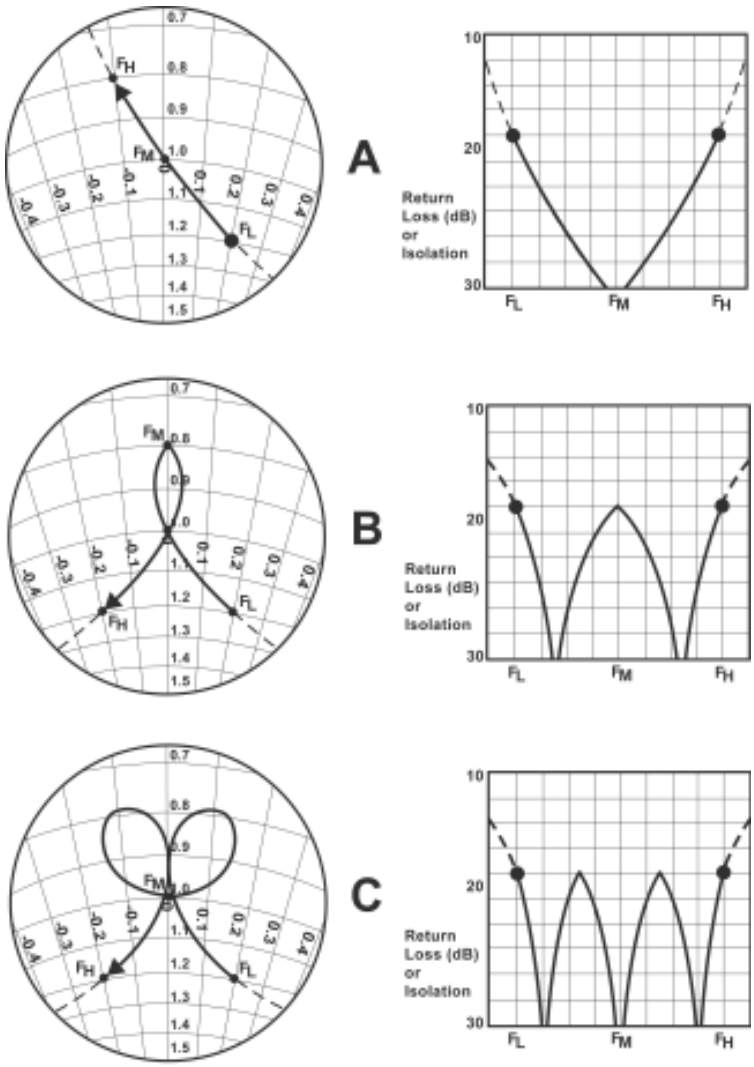
High energy product magnets which are now used to bias the ferrite junction have minimized the problem of irreversible change in the magnetic field due to temperature. Extensive temperature cycling is no longer required to stabilize the magnetic field against further permanent change. As previously discussed, the magnetic circuit will also include materials to compensate for the reversible changes with temperature. Optimization of the magnetic circuit can be done to provide additional magnetic shielding for critical applications where units are mounted in close proximity.

## IMPEDANCE TRANSFORMATION

Multiple quarter-wavelength sections of transmission line are commonly used to match the lower impedance of the ferrite disk to the 50 Ohm impedance of the connectors. The VSWR and bandwidth sections determine the number of transformer sections required. A typical VSWR specification for a circulator or isolator is a 1.25:1.
For narrow bandwidths (less than 5%) the ferrite junction impedance can be designed to be 50 Ohms. Matching transformers are not required for this type of design which allows a small package size to be obtained. The impedance characteristics; of this type of junction is shown in **Figure 4A.**


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**Figure 4**
**Circulator Impedance Characteristics**




Moderate bandwidths (less than 40%) can be obtained for both the A/R and B/R junctions by using a single section transformer external to the ferrite disk. The transformer length can be shorted by using high dielectric materials and optimizing the circuit. The single section transformer can also be designed to be included within the ferrite region. Although a more compact size can be obtained, the bandwidth using this technique will be on the order of 25%. The impedance characteristics of the single section design can be seen in **Figure 4B.**

Bandwidths greater than an octave, can be obtained for the B/R junction, by using two or three external transformer sections. Using more than three transformer sections provides little improvement in performance due to the limitations of the ferrite junction. The A/R ferrite characteristics limit its operation to the previously discussed
40%. The typical two section transformer impedance characteristics are shown in **Figure 4C.**

Lumped element circulator or isolator designs replace the quarter-wavelength transformer sections with discrete capacitors and inductors to achieve small package sizes in the frequency range of 50 MHz to 1.0 GHz. These devices are temperature sensitive and operate over narrow bandwidths at low power levels.

## TRANSMISSION LINE GEOMETRY

Balanced strip line is the most common transmission line geometry in use for the circulator junction. Other applications require the circulator to be constructed in micro strip. This configuration uses a deposited metal circuit and ground plane on a ferrite substrate. Magnets on one or both sides of the substrate provide the necessary biasing magnetic field. Micro strip designs are somewhat limited in performance when compared to strip line but can be easily integrated with other micro strip components.



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## CONNECTORS

Various connector types can be supplied on circulators and isolators. SMA Male or female connectors are the most popular and in general the easiest to install. Type N, TNC and right angle connectors of various types can be used. Some connectors can however cause limitations in the electrical performance of the high frequency and broad bandwidth circulators and isolators.

The package size may have to be increased to accommodate certain connector types. For example, a 0.50 inch thickness package will not accommodate a Type N connector without an increase to at least 0.63 inch. Circulators and isolators requiring the use of high voltage connectors such as HN or the larger EIA 7/8, 1-5/8 or 3-1/8 types use an intermediate adapter so that they can be installed on the circulator or isolator.

Another connector configuration can be obtained by mounting the circulator and isolators on a waveguide adapter. The large waveguide section provides a rigid base for the usually smaller coaxial circulator or isolator. These units are particularly used when both waveguide and coaxial connectors are required. For example, the waveguide port can accept a signal directly from a waveguide antenna, while the output for a SMA connector port can be fed directly into a solid state amplifier.

Circulators and isolators can be supplied with removable connectors. The connector shell can be removed to allow the center conductor to be directly soldered to a circuit board. High temperature solder is used for the internal solder joint so the pin will not move while being soldered.

The use of tabs in place of connectors is also an option as they allow strip line drop-in circulators and isolators to be mounted directly into a micro strip assembly. Careful consideration must be given to the grounding of the circulator or isolator housing as well as the geometry of the mating substrate. It is essential that the circulator or isolator manufacturer be supplied with as much information as possible on how the circulator or isolator will be integrated into the final assembly. The manufacturer's test fixture should be used to improve the correlation of measured data.

## DESCRIPTION OF OPERATING PARAMETERS

### VSWR:

This parameter specifies to what degree the input signal will be reflected back toward the source. For critical applications the magnitude and phase of the reflected signal can be provided as an impedance plot recorded on a Smith Chart.

### INSERTION LOSS:

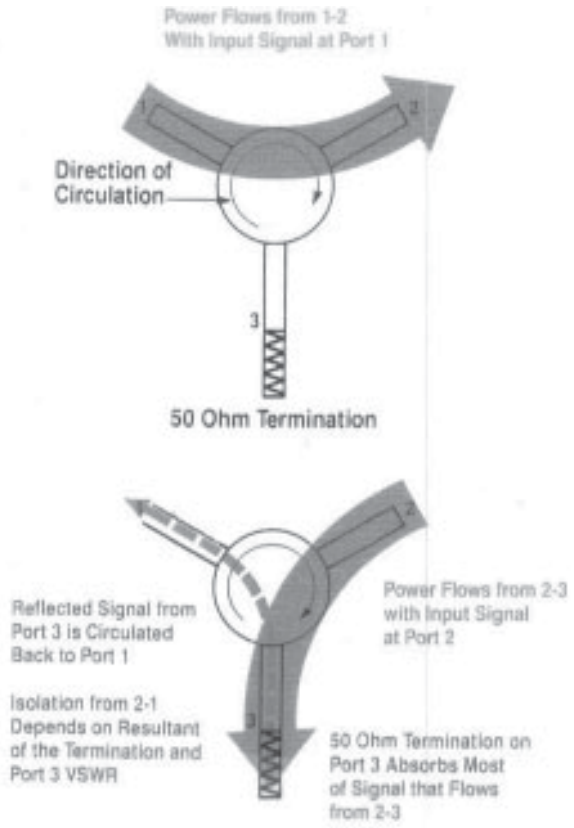
When a signal is applied in the low loss direction to the circulator or isolator the insertion loss will be the ratio of the output signal to the input signal expressed in dB.

### ISOLATION:

An isolator is a two port device made by internally or externally terminating one port of a circulator as shown in **Figure 5.**


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**Figure 5**
**Adding a Termination at Port 3 results in an Isolator**




When a signal is applied in the high loss direction to the isolator the isolation will be the ratio of the signal applied to the output port to the signal measured at the input port expressed in dB. It should also be noted that in the case of a circulator this parameter is not applicable.

The parameters isolation, VSWR, and insertion loss are required to specify an isolator whereas a circulator is completely defined by only the VSWR on the three ports and insertion loss. Although a circulator can be made into an isolator by terminating one port, it does not have an intrinsic isolation value. The isolation measured is dependent on the VSWR of both the termination and circulator port.

**Example:**
A circulator has a measured VSWR of 1.22 for all three ports. If a perfect test termination with a VSWR equal to 1.00 were available to place on Port 3, the resulting isolation from Port 2 to Port 1 would be 20dB. If a test termination with a VSWR equal to 1.05 were placed on Port 3, the resulting isolation from Port 2 to Port 1 would vary between 18.2 and 22.5dB depending on the phasing between the two VSWR's. The resulting isolation value is a function of the VSWR of the test termination and how it phases with the VSWR of the circulator port.

**PERCENTAGE BANDWIDTH:**
Expressed as the difference between the high and low operating frequencies divided by the center frequency multiplied by 100, this parameter is useful when comparing the relative performance of various circulators or isolators.

**TEMPERATURE RANGE:** -40°C to +85°C.

**OPERATING:**
The temperature range at which a circulator or isolator must meet all specifications.



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**STORAGE:**
The temperature range at which a circulator or isolator must survive without permanent degradation in specifications. Storage temperatures from -60°C to +125°C can usually be accommodated. All circulators and isolators at Nova Microwave are cycled over the storage temperature extremes for a minimum of 2 cycles to ensure the reliability of all solder joints, terminations and the magnetic circuit.

**PHASE TRACKING:**
Phase tracking is a measurement of the variation of the electrical length between the input and the output ports of two or more circulators or isolators. The insertion phase of the A/R circulator or isolator is very sensitive to changes in the magnetic biasing field. This effect can be used to magnetically trim the phase. Some degradation in VSWR or isolation may be required to allow this method of trimming to be used. The insertion phase of the B/R circulator or isolator cannot be easily adjusted.

**PHASE LINEARITY:**
This parameter is defined as a deviation from a best fit straight line of insertion phase versus frequency. For A/R and B/R circulators or isolators with less than 20% bandwidth the phase linearity will generally be within 2 degrees.

**IMPEDANCE CHARACTERISTICS:**
This parameter describes both the magnitude and phase of the reflected signal recorded as an impedance plot on a Smith Chart. Applications such as amplifiers and VCOs may require the reflected signal to have a minimum phase variation with frequency. These basic input impedance characteristics of a circulator or isolator will be one of the three types as shown in Figure 4. The phase change is proportional to the number of transformer sections used to obtain a given bandwidth. For moderate bandwidths it is possible to restrict the phase change to less than 360 degrees.

**PEAK POWER:**

**Breakdown:**
The peak power breakdown value of a circulator or isolator 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 circulator or isolator causing a higher internal voltage level which will reduce the power rating of the circulator or isolator. The peak power rating can be increased by filing the internal volume of a circulator or isolator with a high dielectric strength material. Hermetically sealed modules can be used to maintain pressurization for operation at high altitudes.

**Limiting:**
Another effect related to the peak power rating of a circulator or isolator is known as the non-linearity or peak power threshold of the circulator or isolator. As the peak power level increases beyond a critical value, the loss versus magnetic field curve will show considerable changes in the region below the main resonance as shown in **Figure 6.**


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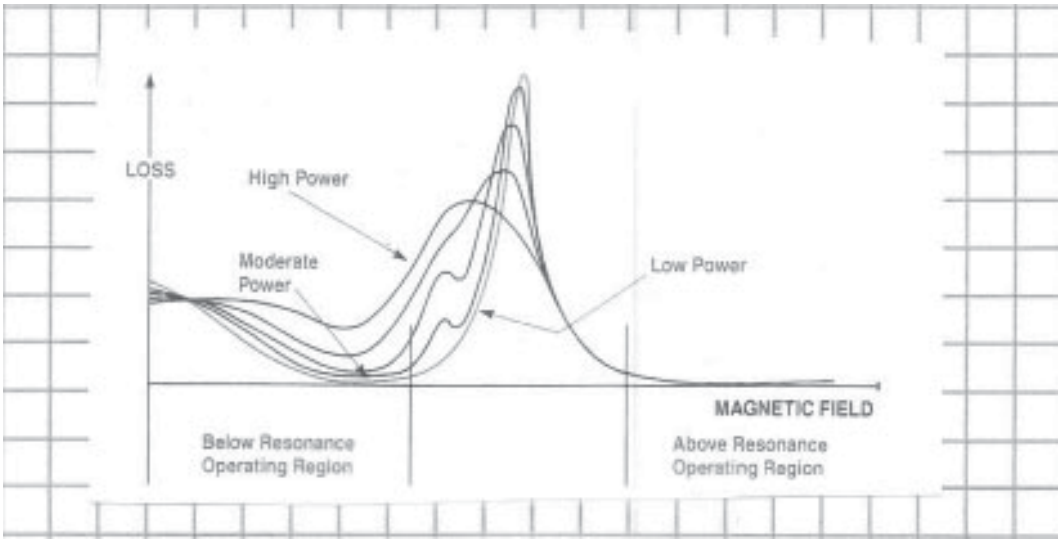



**Figure 6**
**Peak Power Effects On Resonance Curve**

The A/R region will remain essentially unaffected.

The peak power threshold is dependent on the junction geometry, bandwidth, and ferrite material properties. The threshold level can be improved by doping the ferrite material with elements such as holmium, which will cause a slight increase in the insertion loss at low powers.

**Harmonics:**
At high peak power levels the non-linearity of the circulator or isolator generates harmonic and intermodulation products within the ferrite junction. Because of design limitations imposed by other parameters it is difficult to eliminate this effect.

**AVERAGE POWER:**
The power dissipated in the circulator or isolator is in proportion to the insertion loss. If the average power level is significant, the dissipated power will cause heating of the ferrite junction and degradation in performance.

Conduction, convection or liquid cooling can increase the average power rating of a circulator or isolator. The connector type is also important when the average power is significant. Captured SMA and hermetic seal connectors are limited in power rating because of their internal losses.

The average power rating of a circulator or isolator will also depend on the resultant mismatch at the output port. For example if a signal of 100 Watts average power were applied at the input of a circulator terminated with a 6.00:1 mismatch, 51 watts would be reflected, requiring the circulator to handle 151 watts total.


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**ISOLATOR TERMINATION RATING:**

The power rating required for the termination of an isolator depends on the mismatch on the output port as shown below:

| Mismatch on Output port | % Power Reflected |
|---|---|
| 1.0 (perfect match) | 0 |
| 1.5 | 4 |
| 2.0 | 11 |
| 6.0 | 51 |
| Short or open circuit | 100 |

**RFI:**
RFI leakage values of 30dB or less are easily obtainable in a standard circulator or isolator. Internal plates bonded using conductive epoxy can be used so that values up to 60dB can be obtained. Additional RFI shielding can be provided by utilizing special packaging techniques.


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