narda MITEQ RF and Microwave Components

Catalog 32 *Commemorating 60 years of service*

Model Number Search

55 FIND

For a comprehensive search of this catalog, use the Acrobat® Find option (Edit/Find).

Use Acrobat® Navigational Aids

Make sure Bookmarks are enabled for optimal navigation through this catalog.

narda MITEQ

www.nardamiteq.com

TEL: 631.321.1700 FAX: 631.231.1711 E-MAIL: componentsnm@nardamiteq.com

RF and Microwave Components

Catalog 32

The New Narda-MITEQ Catalog

With nearly 60 years of experience in the design, development and production of high performance RF components, IMA's, RF Sub-Systems and Instruments, superior performance and long-term reliability has been and continues to be synonymous with our brand. Our complete and expanded product lines appear in this 2013 edition, collectively representing the world's most comprehensive RF and Microwave products catalog. In addition to full product specifications and outline drawings, our application notes and technical articles will help guide your product selections. As has always been the case, our local and factory based Sales Engineering and Customer Support Professionals are always available to provide the personalized assistance that you expect.

Table of Contents


narda
COAXIAL PHASE SHIFTER
MODEL 3752
1.0 - 5.0 GHz
narda
ATTENUATOR 4.0-8.0 GHz
MODEL 794 FM
narda
STANDARD GAIN HORN
FREQ. 5.40 - 8.2 GHz
MODEL 642
narda
LEVEL SET ATTENUATOR 0-45 dB
MODEL 4797
+V RTN 2

Ordering Information

The information in this catalog will, in most cases, be sufficient for you to select a particular Narda-MITEQ product. When additional technical information is required, or for pricing and delivery information, our website contains an actively updated list of our world wide local representative offices. Visit www.nardamiteq.com RF Safety Instruments) and click on the Reps or Contacts tabs as appropriate. While the factory can be contacted at 631-231-1700, or by email at componentsnm@nardamiteq.com, we very much appreciate the involvement of our local representation in meeting your needs. Please see the important note just below for our customers located outside the United States.

Note: For technical assistance and pricing and delivery for our customers residing outside the United States, our International Sales representatives are the single point of contact for our customers and all inquiries should be routed through those International Sales organizations accordingly. For those few regions where we are not represented, direct contact to the factory is acceptable, per the contact information above.

When placing your order, please include the Narda-MITEQ model number, the frequency range of operation and the name of the product as it appears in the catalog. For example: **Model Number 4779-10 DC-18 GHz 10dB Fixed Attenuator.** As Narda-MITEQ can only guarantee the performance stated in the catalog, for the purchase of a catalog part, any non-standard features that may be required should be clearly identified on the purchase order. When such non-standard features are required, a dialog with Narda-MITEQ Sales Engineering must take place to ensure that there are no misunderstandings as to what is being provided, and of course to find the best method of achieving the non-standard feature that is desired.

Submitting Purchase Orders

DOMESTIC UNITED STATES originated orders may be submitted on your Standard Purchase Order Form by phone, fax or email directly to the factory or to the attention of your local representative:

631-231-1700 (Phone)
631-231-1711 (by Fax)
nardamiteq.com (for components based products)
nardamiteq.com (for RF Safety Instruments)

In either case, all orders should show the Narda-MITEQ Factory information below as the formal supplier of the goods to be purchased:

Narda-MITEQ
435 Moreland Road
Hauppauge, NY 11788

INTERNATIONAL CUSTOMERS: For those purchase orders submitted from our International Customers, your order placement should be submitted to and in the name of the authorized Sales organization for your geographical area, or directly to the factory when Representation is not present in your area.

Domestic Terms

Net 30 days, Ex-works, subject to credit approval unless otherwise specified. Shipments shall be C.O.D. when made to unrated firms, unless a credit account has been established or when advance payment has been received.

All major credit cards are accepted.

Ordering Information

Export Terms

Full payment in advance of shipment by wire transfer, major credit card or via irrevocable Letter of Credit confirmed by a United States bank. All prices are Ex-works unless otherwise specified.

Shipping Information

All sales are considered Ex-works unless otherwise specified. Any damage incurred during shipment should be settled between the customer and the carrier. Shipments from the point of origin will normally be made by Parcel Post, UPS, Federal Express, or Air Freight. Narda-MITEQ will choose the most appropriate means of transportation when carrier or method has not been otherwise specified.

Additional Information

Delivery on all items quoted stock is subject to prior sale, a quotation indicating an IN STOCK status cannot guarantee that said STOCK is available at the time of order. Quotations, Pro Forma Invoices, Destination prices and shipping information required for Pro Forma invoices or FAS, CIF or C&F quotations or importation assistance can be quickly obtained from your local Sales Representative or from the factory directly as necessary.

Payment of Invoices

US CURRENCY PAYMENTS

Send check to (remittance address):

Narda-MITEQ
P.O. Box 7410604
Chicago, IL 60647-0604

Send Electronic Funds Transfer to:

Bank of America
222 Broadway
New York, NY 10038
Contact: 1-888-400-9009
Email: eservice@bankofamerica.com

Account Name

Narda Holdings Inc.,
D.B.A. Narda-MITEQ Inc.

Account No.

4451481753

Domestic ABA No.

026009593

Foreign ABA/Wire No.

026009593

SWIFT Code No.

BOFAUS3N

(Narda-MITEQ)

EURO PAYMENTS

Send check or wire to:

Bank of America (Branch 6008)
26 Elmfield Road
Bromley, Kent BR1 1WA
United Kingdom

Account No.

600825572018

Sort Code No.

165050

IBAN No.

GB36BOFA16505025572018

SWIFT Code No.

BOFAGB22

(Narda-MITEQ)

Certificate of Conformance

A Certificate of Conformance is supplied on our packing list for all shipments. This certification states the following:

"This material was produced in accordance with all applicable drawings and specifications and meets the contractually applicable quality specifications. All inspections and /or tests have been performed using equipment calibrated in accordance with the requirements of ANSI/NCSL Z540-1. Documentary evidence in the form of the test data and/or reports and inspection records are on file and available for examination. Narda-MITEQ components and instruments are mercury free. Mercury is neither utilized nor present in our component or instrument products, production processes or inventory locations."

Test Data Availability

Hard Copy test data as applicable and as available per device type and testing methods may be purchased for an additional $25.00 per unit. Test data requests must be requested at the time of order and an associated line item(s) with the applicable test data fee should be within the body of your ordering document. *After the fact requests for test data are normally not acceptable.*

Ordering Information

Change Orders and Cancellations

Change Orders regarding price, delivery or any conditions not specified on the original order will be considered in effect after mutual agreement has been affirmed in writing between the customer and Narda-MITEQ. Cancellation of any accepted order shall only be accepted with the written consent of the factory. All cancellations will be dependent upon customer's agreement to satisfy all charges incurred by Narda-MITEQ in the performance of the order. Narda-MITEQ will endeavor to promptly "stop work" upon written notification of a cancellation request.

Repairs / Returns and Calibration Services

Repairs and recalibration of Narda-MITEQ Components and Instruments require that the product is returned to the factory. ***Before returning any component or instrument, the Narda-MITEQ Customer Service Department must be contacted such that a Return Material Authorization (RMA) may be issued for the return and subsequent repair or recalibration of the goods.*** When requesting an RMA, you will be asked to provide the model number, serial number and as much information as possible about the nature of the difficulty or reason for return. Once the repair or return has been approved, an RMA number will be assigned, this RMA number should be clearly denoted on the shipping container for routing on arrival. Estimates of repair and/or calibration charges are provided to the customer before any work is done, unless otherwise directed.

Contact Information for RMA:
componentsnm@nardamiteq.com
631-231-1700 (Phone)

Returns must be shipped prepaid to:
Narda-MITEQ
435 Moreland Road
Hauppauge, NY 11788

PLEASE PLACE RMA REFERENCE NUMBER ON THE OUTSIDE SHIPPING PACKAGING

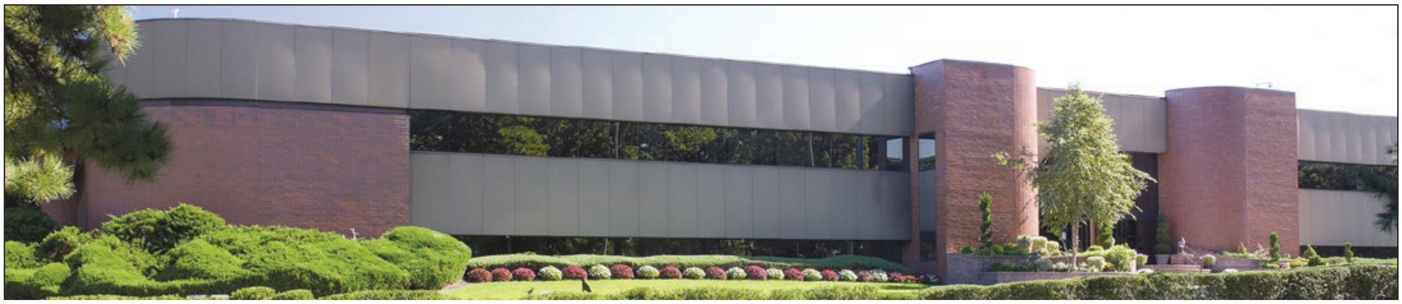
Application Engineering

Convenient local support is provided through Sales Representatives. They are well equipped to provide you with any product assistance you may require and to assist you with your special requirements and applications. In cases where special needs are to be met with special or catalog derivative solutions, the Narda-MITEQ factory shall assign special five digit model numbers so that variations on catalog performance or outline drawings may be properly documented. Additional costs and or lead times are normally associated with special product development and delivery.

Product and Price Changes

Although all information in this catalog was current at the time of publication, our continuing product improvement program requires that we must reserve the right to change specifications and/or pricing without notice. ***The minimum acceptable purchase order amount is $100.00.***

Narda-MITEQ Microwave East



About Us

Started in 1953, Narda-MITEQ is one of the ten original business units of Narda-MITEQ, an electronics company serving military and commercial markets. For nearly 60 years, Narda-MITEQ has developed and manufactured state-of-the-art RF and microwave components, integrated microwave assemblies, subsystems and RF Safety Instrumentation. The company has positioned itself and maintains its position as a technology leader by offering advanced products in the frequency range of DC to 60 GHz for both commercial and military applications.

We maintain the world's largest inventory of RF and microwave components and instruments for rapid delivery of our products to our customer base. Products manufactured in our production factories include PIN diode switches, switch filter banks, couplers, power dividers, attenuators and RF mechanical switches that are suitable for myriad RF applications.

Narda-MITEQ also offers custom developed Integrated Microwave Assemblies (IMAs) which integrate and combine active and passive components. These products are typically custom designs for specific customer functionality requirements and include the integration of switches, filters, oscillators, synthesizers, amplifiers and many other components as required.

In addition, to our custom and COTS components and IMAs, Narda-MITEQ manufactures our full line of RF Safety Instrumentation that characterizes RF levels for RF workers and the general public.

Facilities

With our Hauppauge, NY facility, and our dedicated team of engineering, sales, design, production and quality professionals, the Narda-MITEQ brand continues to be recognized as a trusted and field proven choice for custom or catalog off-the shelf RF components and instrumentation. All product design/protoyping, production control, procurement, manufacturing and test originate at the Hauppauge facility. In addition to its standard production and test environments, clean room manufacturing facilities are maintained at this manufacturing location. Additional combined capability highlights are described on the following page.

Engineering Design Tools

- Advanced Design and Simulation Software Packages
- High Frequency Structure Simulator
- Component Synthesis Software, Design and System Budget Calculators
- 40 and 60 GHz Vector Network Analyzers with converter group delay module

Special Process Manufacturing

- Automated Ribbon/Wire Bonding
- Automated Epoxy and Die Attach
- Photo Etch of Substrate Circuitry
- Laser Seal (NY facility)
- Sputtering (Gold Germanium)
- Vacuum Deposition
- Paint and Seal
- Environmental Testing Facilities

Test and Measurement Capabilities

- Production in Process Testing DC to 50 GHz
- ATE Suite for Instrument Calibration Services
- IM Test Capability
- Classified and Non-Classified Designated Test Areas

Quality Assurance Management

The Quality Assurance System at Narda-MITEQ is in full conformance with ISO 9001:2008. Originally certified in 1996 to ISO 9001:1994, Narda-MITEQ's registration was upgraded to the ISO 9001:2000 version of the standard in May 2003 and ISO 9001:2008 in 2009. We received our AS 9100 certification in the summer of 2009. Our Quality System's heritage is based upon MIL-Q-9858 and MIL-I-45208. The company also complies with the workmanship standards in MIL-STD-454, and maintains a calibration system to ANSI/NCSL Z540-1-1994. Narda-MITEQ's QA System is approved by over 100 companies including most of the major top tier defense and commercial equipment providers.

- ISO 9001:2008 Certified
- AS 9100:2009 Certified
- Reliability Engineering
- Over 50 Internal Audits Performed Annually by Trained Auditors
- Audit Results Reviewed by ISO Management
- Soldering is performed and inspected by IPC Certified Individuals
- Plating is verified by XRF Technology
- Product Conformance Testing
- Design Verification / Verification Testing
- Special Environmental Testing performed in house, or at approved external facilities
- First Article and Group B Services
- In Process Inspection
- Documentation ESD Control Plan

Design and Drafting

- Manufacturing Engineering
- Dedicated Design Center (CAD/CAM)
- Mechanical Design
- Layout

Material Control and Procurement Systems

Production and material is controlled by the Narda-MITEQ ERP System (Visual Manufacturing) and by a set of defined procedures maintained by department management. The Visual system allows traceability of material throughout the manufacturing process as well as providing historical data via the Visual Manufacturing database. The material flow sequence can be loosely broken up into (3) discrete sections; Front Office (Sales and Contracts), manufacturing operations, and back office (shipping and accounting).

RF and Microwave Components Overview

Catalog Products

We build our catalog products to an industry forecast and inventory over 1000 different models. Most models are in stock and if not, are available on a defined schedule.

Attenuators

- DC - 40 GHz
- Type N Fixed Coaxial
- SMA Fixed
- Type N High and Medium Power
- Thumbwheel and Panel Mount Step
- Commercial Use Step
- Variable

Couplers

- 0.05 - 40 GHz
- Millimeter Wave Ultra-Broadband
- SMA
- Type N Broadband Directional
- Type N Dual Directional Reflectometer
- High Power Directional
- Couplers for Commercial Use / Wireless Applications

Power Dividers and Hybrids

- 0.25 - 45 GHz
- Wireless Band
- SMA 2, 3, 4, 6, 8 and 16-way
- Multi-Octave Type N
- Ultra-Broadband SMA
- SMA and Type N Multi-Octave 90° and 180°
- Specialized Devices for High Power Dividing and Combining Operations

Terminations

- DC - 40 GHz
- Millimeter Wave Ultra-Broadband
- SMA Coaxial Fixed
- Type N Coaxial Fixed

Waveguide Products

- 1.70 - 40 GHz
- Standard Gain Horns
- Wideband Gain Horns
- SMA, 2.92mm, Type N Waveguide-to-Coaxial Adapters (right angle)
- SMA, 2.92mm, Type N Waveguide-to-Coaxial Adapters (end launch)
- Low and Medium Power Terminations
- Cross-Guide Coupers

Additional Passive Components

- Adapters
- Circulators and Isolators
- DC Blocks
- Detectors
- Phase Shifters

Mechanical Switches

- SEM Series - Stocked Electro-Mechanical
  - DC to 18 GHz
  - SPST to SP6T, transfer
- Standard Custom
  - DC to 26.5 GHz
  - SP2T to SP12T, transfer

Control Products

- 0.1 - 40 GHz
- PIN Switches
- High-Speed Switched Bit Attenuators
- Switched Filter Banks
- Custom Switches
- High Power Switches
- PIN Limiters - Narrowband and Wideband

Power Monitors and Sensors

- 0.01 - 26.5 GHz
- Thermocouple Based Power Monitors
- Broadband Power Sensors

About Narda-MITEQ Safety Test Solutions

Narda-MITEQ Safety Test Solutions is the name of the world leader in non-ionizing radiation safety equipment. In February 2000, Narda-MITEQ acquired the Safety Test Solutions business from Wavetek Wandel & Goltermann. To give more focus to the RF safety business and to separate it from Narda-MITEQ's business in components and networks, a new division was formed – Narda-MITEQ Safety Test Solutions – which combines the expertise and complementary product lines of both operations. Narda-MITEQ-STS holds more than 95% of the patents in the industry. Products are now available to accurately measure electromagnetic fields from a few Hertz to over 100 GHz as well as static magnetic fields. RF personal monitors cover 100 kHz to 100 GHz and area monitors detect energy from 50 Hz to 100 GHz.

User Support

Narda-MITEQ-STS User Support Includes:

- Equipment and application consultation by our worldwide sales network
- Repair and calibration service
- Expert advice on standards and recent developments
- Training and measurement services

Just Power-On and Measure

Simple operation is critical when you need dependable results. This requires device technology that simplifies the complex measurements found in EMF (Electro-Magnetic Field) applications. With any device you purchase from Narda-MITEQ-STS, the basic principle is: Just Power-On and Measure.

RF Radiation Safety Training

Narda-MITEQ-STS can provide unequaled educational materials and training for your company. You will find public seminars and courses that address different industries as well as custom corporate training programs using live instruction or CD, VCR, and DVD based content.

Contact Us for your Copy of the Full
RF Radiation Safety
Products and Services Catalog
at www.nardamiteq.com

Narda-MITEQ RF Safety Products

Low Frequency – DC Static Fields (0 Hz) to 400 kHz

Like all Narda-MITEQ-STS equipment, the low frequency product line delivers excellent measurement reliability. All instrument functions were designed for direct and reliable testing to domestic and international standards such as IEEE and ICNIRP.

THM1176-PDA

- Precision measurements of low frequency fields are required in the following industries:
- Power Generation and Delivery (50/60 Hz)
- Electric Railway Lines
- Smelting Furnaces
- Welding Systems
- Medical Systems (e.g., MRI)

THM1176-PDA - Our complete Magnetic Flux density measurement system including a full featured PDA computer. A Three-axis Hall Magnetometer is used to measure the magnetic flux density, from DC to 1 kHz. Its unique, extraordinarily compact design allows it to be used as a portable instrument or directly connected to a PC.

EHP-50D – High Precision measurement of E and β fields from 5 Hz to 100 kHz. This field analyzer can operate in a data logging mode or with the supplied software, through a 10m fiber optic cable to display real-time spectrum information on a PC. With it's wide dynamic range and exceptional accuracy, ELF/VLF fields are easily measured.

ELT-400 – The first low frequency measurement device that can be used by engineering and safety personnel. This new system measures the magnetic field required for certification of products destined for Europe. Safety personnel can use the ELT-400 to verify magnetic field limits recommended by the new IEEE C95.6 standard.

ELT-400

EFA-300 – The EFA-300 (Electric and Magnetic) Field Analyzer sets the testing standard for low frequency devices. These units offer exceptional accuracy and overall performance for testing occupational exposures to ELF/VLF frequencies.

EHP-200A – A stand-alone solution for measurements of fields from 9 kHz to 30 MHz is the new EHP-200. This fiber-optically isolated sensor measures both E and H fields over a wide dynamic range and displays them on a computer through a 10-meter cable. This design allows repeatable field measurements thanks to the supplied non-metallic stand, and the EHP-200 also features excellent accuracy.

EHP-50D with NBM-550

EFA-300

RF Safety Overview

Meters

SRM-3006 – The Selective Radiation Meter, covering 9 kHz to 6 GHz, is unlike any previous designs to detect RF and microwave fields. With its outstanding sensitivity and dynamic range added to simple operation, surveyors can now detect emitters separately in a multiple emitter field.

NIM Series – Features digital meters and dual-field probes. The NIM-513 is excellent for measurements on heat sealers and vinyl welders, while the NIM-511 covers a wider frequency range for testing most semiconductor systems.

NBM Series – Narda-MITEQ's new NBM series of meters and probes provide unequalled performance for broadband measurements. Either the NBM-520 or -550 meters can be used with 11 different E or H field probes.

NBM Series

Personal Monitors

Narda-MITEQ offers two families of RF/microwave personal monitors – The RadMan and Nardalert S3 series. These products perform similar tasks in different ways.

RadMan – The RadMan offers broad frequency coverage for both the electric (E) and magnetic (H) fields. Narda-MITEQ recommends the RadMan to technicians and engineers for off-body use.

Nardalert S3

NEW Nardalert S3 – The new Nardalert S3 (NS3) Series features an updated design with field replaceable sensors, color LCD display and comprehensive software. The NS3 is packaged in a new case with lanyard and belt clips, protective cover, USB charging/data connection port and rechargeable battery.

Area Monitors

Narda-MITEQ STS now offers our standard SMARTS II monitors and we also have the capability of supplying innovative NBM-580/NS3 and 8060 Series, broadband and narrowband monitors.

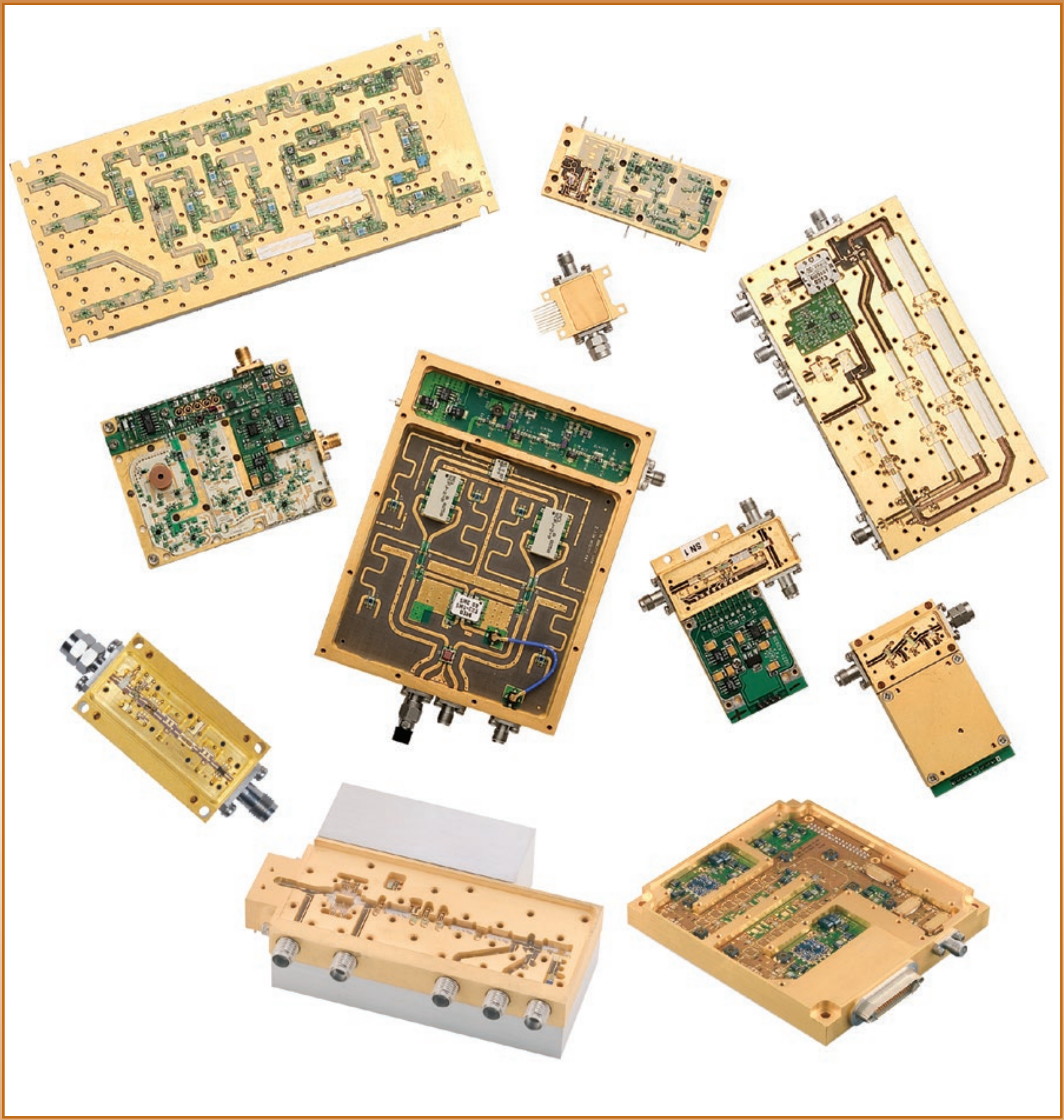
SMARTS II – The SMARTS II monitors feature wideband operation (2 MHz to 100 GHz) that is ideally suited to high power, indoor applications, such as satellite uplink amplifier rooms, industrial process machines employing high power RF, and military system test stands.

NBM-580/NS3 – Narda-MITEQ has updated and expanded area monitoring with a new system based on the NBM-580, that accepts inputs from up to 8 sensors which can be NBM meters / probes or NS3 monitors. Additionally, the NS3 monitors can be powered from AC/DC power for internal applications or solar power for outdoor installations.

Model 8061 Area Monitor – can be configured for indoor or outdoor applications, with a GSM communications modem built-in and narrowband detection to provide spectral plots.

Narrowband Systems – Narda-MITEQ-STS can also supply designs based on the upcoming 8060 Series of narrowband monitors. Contact the factory for more details.

NBM-580 / NS3 System: NS3 in solar powered outdoor enclosure (right) remotely connected to NBM-580 (left)



Integrated Microwave Assemblies

Quick Reference Guide

Narda-MITEQ Defense Technology Solutions

Narda-MITEQ Defense Technology Solutions is positioned as an industry leader that offers advanced integrated microwave assembly (IMA) products and subsystems to both the commercial and military markets. Every project we undertake benefits from our years of experience and world-class resources. Our strengths include:

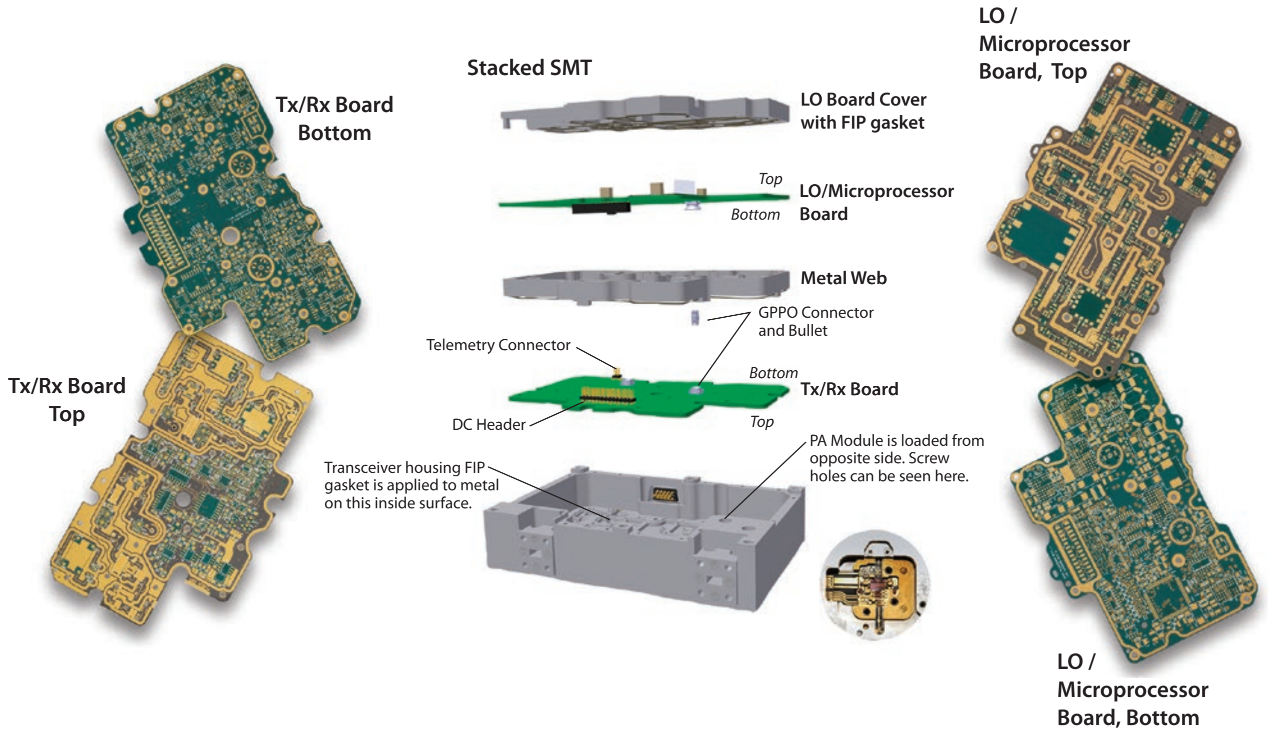
- Custom solutions incorporating leading edge technology from DC to 40 GHz
- Advanced technology that produces cost savings, reductions in size and weight and improvement in efficiency and performance
- Highly experienced, senior engineering staff, working at the forefront of integrated microwave assembly and sub-assembly development for over 30 years
- Applications include electronic warfare, communications, radar and Satcom
- Designs which meet or exceed requirements for rugged military sea, air and land platforms
- Financial backing and resources of Narda-MITEQ
- An experienced, dedicated senior program management staff to minimize risk and ensure efficient, successful achievement of project requirements
- 150,000 square-foot, state-of-the-art headquarters and design center, with two additional satellite locations

Facilities

Narda-MITEQ has a state-of-the-art facility dedicated to IMA products and a plant in Hauppauge, NY (design, development and production). Narda-MITEQ maintains two Class clean rooms.

From Classic MICs to State-of-the-Art MMC Technology

Narda-MITEQ has pioneered the design and manufacture of Integrated Microwave Assemblies (IMAs) for more than 30 years. The first IMAs manufactured by Narda-MITEQ, referred to as classic MICs, were realized by combining several alumina-on-carrier circuits within a single machined aluminum housing. These classic MIC multifunction assemblies provided high performance and longevity, yet the constraints of higher labor/ materials costs and larger footprints often became prohibitive. While enhanced versions of this technology continue to remain viable for certain applications, Narda-MITEQ Defense Technology Solutions has evolved new technologies to effectively eliminate the constraints of traditional chip and wire manufacture. Our new and continually evolving proprietary MMC (Multi-layer Microwave Circuitry) technology leverages commercially available multi-layer board materials with unique interconnection techniques, along with DSP/FPGA – enabled monitor/control functions, to allow for densely packaged IMA's and Subsystems in footprints previously unachievable.



Compact Ka-Band Transceiver with Stacked SMT Board MMC Technology

Narda-MITEQ's MMC Technology

MMC uses multi-layered printed circuit boards to interconnect microwave devices (MIC, SMT, or MMIC configurations) with bias, control and digital signal processing components. These complex IMAs and Compact Subsystems are constructed using single or stacked multi-layer boards with the microwave circuitry on the top side, and the control circuitry, conditioning, microprocessor, FPGA and DSP circuits, on the bottom. Connections from top to bottom are made with specially developed vias, as appropriate.

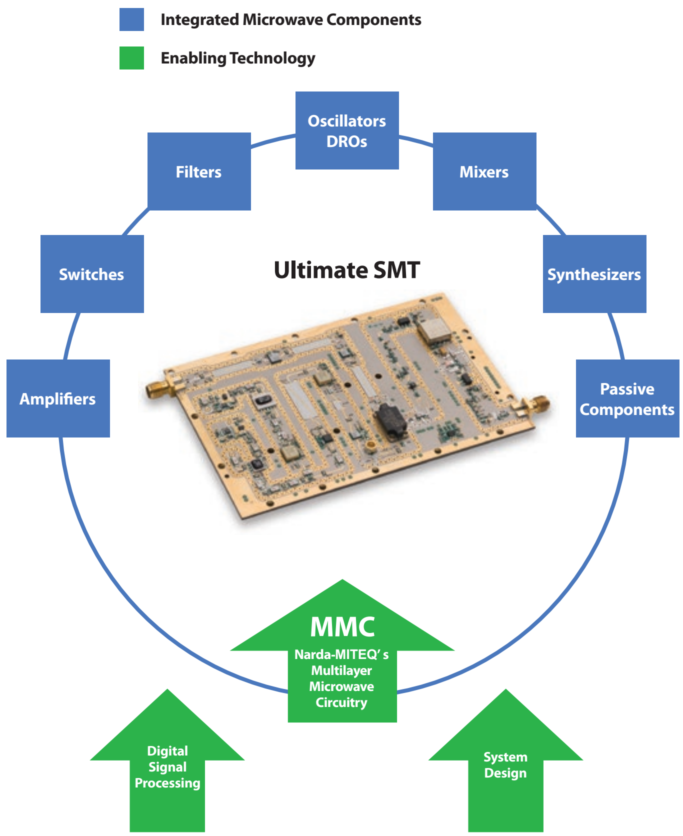
Narda-MITEQ's MMC technology allows the creation of highly complex IMA modules with unprecedented performance, flexibility and unusually small form factors that facilitate integration into complex next level assemblies.

Evolution of IMA Developments

The MMC technology utilized on our module and sub-system solutions consists of two major types of approaches, the **Ultimate MIC** and **Ultimate SMT**. The Ultimate MIC approach is utilized when the majority of the electrical components are bare die and chip, while Ultimate SMT technology is employed when there is a prevalence of surface mount devices. Each type of technology promotes the ability to combine traditional MIC chip and wire hybrid technology with high volume, low cost, surface mount assembly techniques. As a result our modules or compact subsystems demonstrate unrivaled and previously unachievable integration levels. The results are smaller, reduced cost, higher performance solutions that combine microwave, bias/control circuits, and DSP functions interconnected with high isolation promoting multi-layer signal routing.

Features of MMC enabled IMA modules and Subsystems:

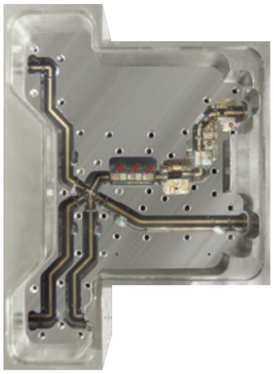
- A single multi-layer board construction integrates the RF/Microwave functions along with supporting bias, control and DSP needs, facilitating an unmatched level of integration
- "Stacked" multi-layer board topology allows for growth in height while preserving footprint
- Allows for the marriage of traditional MIC technology with SMT as may be required
- Dense packaging, reduced weight and lowered power consumption for SWaP considerations
- Custom solutions from DC to 40 GHz



Products

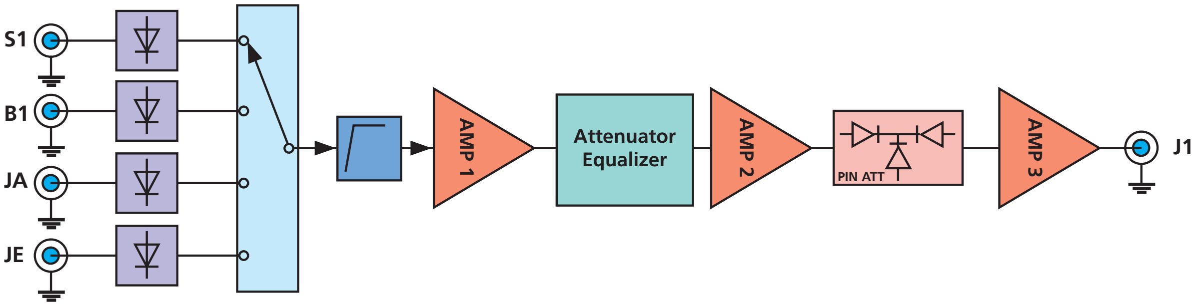
- High Dynamic Range Front End Assemblies
- Up and Down Converter Modules
- Waveform Generators
- LNA's and SSPA's
- Transceivers
- Pin Diode Switch Solutions
- Switched Filter Banks
- Frequency Sources

IMA Products



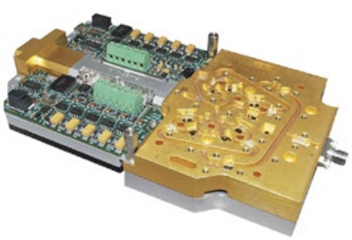
Simple IMA Modules

SImple IMA Modules integrate two or more microwave components into a functional assembly using conventional MIC technology.



Complex IMA Modules

Complex IMA Modules use MMC technology to create a much higher level of integration. These modules typically use the Ultimate MIC or Ultimate SMT topology.

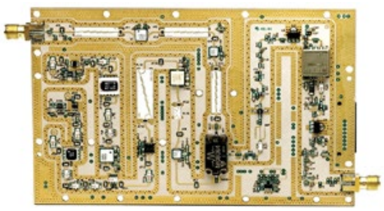


Ka-Band SSPA

Smart IMA using a microcontroller to provide maximum power output with minimum DC drive over temperature and system variations.

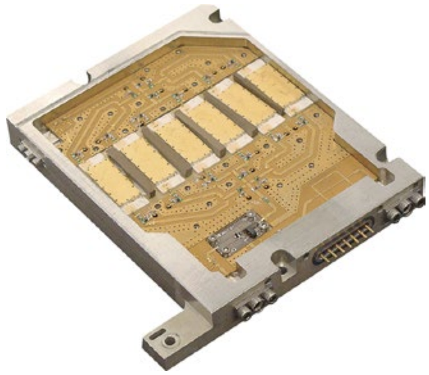
FPGA Programmable Source

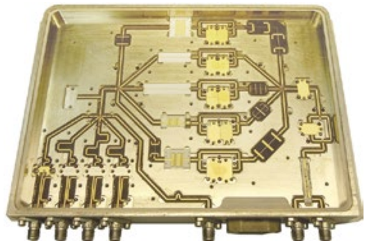
This Ultimate MIC incorporates a Field Programmable Gate Array (FPGA) to provide DSP-based arbitrary waveform modulation of microwave signals.



Ku-Band Block Upconverter

This IMA uses Ultimate SMT technology to provide a high performance, compact and efficient Ku-Band SATCOM block upconverter.





Switched Filter Bank

IMA utilizing high rejection PIN switches to select sharp cutoff channel filters.

X-Band DDS Synthesizer

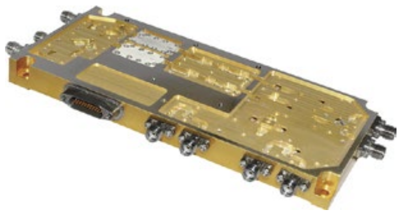
Ultimate SMT X-Band synthesizer provides stable signals with precision resolution.

EW Antenna Interface

Complex IMA routing single input to multiple outputs with variable gain, preselection filtering and high power limiting in each path.

Compact Microwave Subsystems (CMS)

Compact Microwave Subsystems (CMS) use IMA modules and support devices to build complete functional subsystems.



EW Receiver

Compact assembly of MMC (multilayer microwave circuitry) modules containing input and output switching networks, RF filters, and dual amplifier chains in a very small package.

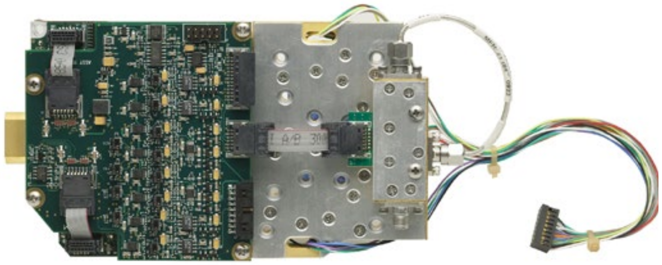
RF Distribution Network

Complex distribution network integrating two multiplexers with input and output switching networks.

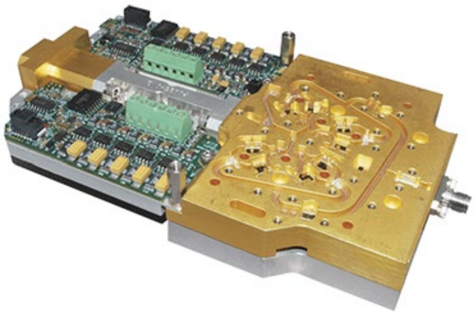
SATCOM Transceiver

Self contained transceiver for X, Ku or Ka-Band applications. High performance, low DC power and light weight.

Solid State Power Amplifiers

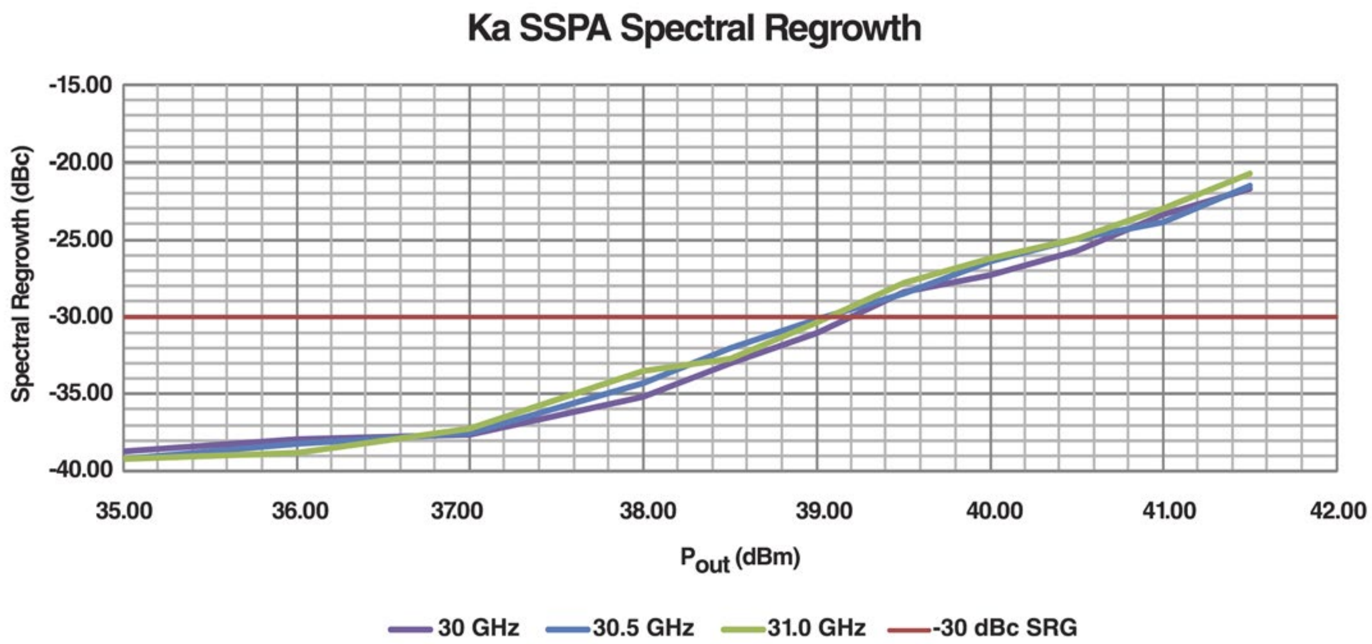


- Military SATCOM, COTM and ManPack Applications
- X-Band through Ka-Band
- Output Power Levels to 32W (P1dB)
- Ethernet, RS-485 (other standard interfaces available)
- High Linearity
- Very Small and Lightweight



Narda-MITEQ has developed and manufactured numerous reduced size, weight, and power (SWAP), high linearity, satellite communication (SATCOM) SSPA designs, spanning X-Band through Ka-Band, for use in earth terminal, Communications on the Move (COTM) and Man-Portable (Manpack) applications.

Narda-MITEQ possesses extensive experience developing Solid State Power Amplifiers (SSPAs) and holds a unique understanding of the electrical and mechanical design challenges confronted when developing high performance, producible power amplifiers. We have delivered hundreds of custom designs to a variety of SATCOM system providers for use in high data rate communication links operating under adverse environmental conditions and temperature extremes. Our present offering of amplifiers includes SSPAs that operate over standard SATCOM bands from X through Ka (including the 29-30 GHz commercial Ka-Band), many of which are currently in use on a number of programs including Ka-Band COTM for WIN-T and X, Ku and Ka-Band Manpack for USSOCOM and others. All of our SSPAs undergo extensive thermal analysis and many utilize custom designed housings made from high thermal conductivity, controlled expansion materials that allow for unprecedented reductions in size and weight. This careful selection of materials and innovative housing design also allows for improved electrical, thermal and reliability performance, making our SSPAs ideally suited for high temperature operation without the need for noisy and unreliable cooling fans.



SSPA Design Considerations

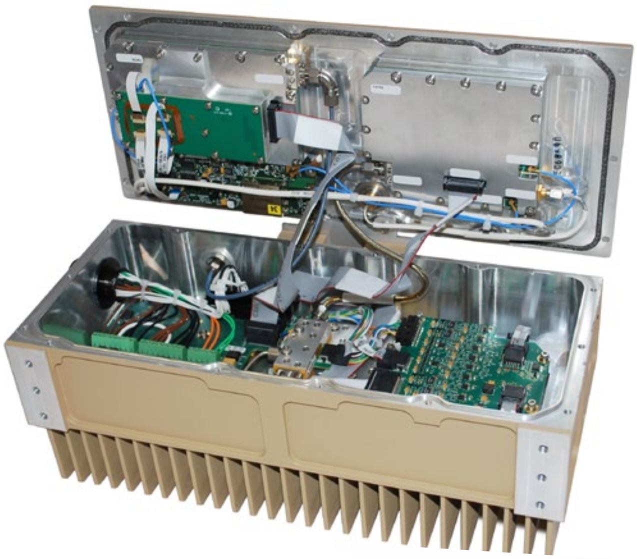
All of Narda-MITEQ's Ka-Band SSPAs are micro-processor (µP) controlled, utilize custom designed power supply circuitry containing both DC-to-DC converters and low drop-out linear regulators, employ high current HEXFET drain switches and ample bias line filtering. All key voltages are continuously monitored to denote power supply health. Voltage variable attenuators (VVAs), digital-to-analog (D/A) converters and I2C temperature sensors are used to control gain and DC bias points over temperature. Output power detectors allows the µP to automatically shut down the SSPA to protect against over-power or high VSWR conditions. We routinely work with customers to incorporate custom features into the µP firmware, offering the user unmatched control over amplifier operating parameters and yielding system level benefits not available from other suppliers. All standard digital interfaces are supported, including RS-485 and Ethernet. We specialize in designing application specific solutions that offer our customers the best electrical, thermal and mechanical performance with very competitive lead times and price points.

Narda-MITEQ's SSPA assemblies utilize both commercial off the shelf (COTS) and custom GaAs MESFET, pHEMT and InP HVHBT discrete and MMIC-based devices. All COTS devices have been carefully selected, charac-terized and specified to insure that only the best linearity and highest efficiency devices are utilized. This allows us to achieve linear operation much closer to the 1dB compression point than most SSPAs on the market, without the use of linearizers. We are currently designing a Ka-Band SSPA MMIC based on InP HVHBT technology to cover both commercial and military SATCOM operating bands. HVHBT technology offers exceptional linearity and efficiency performance compared to COTS pHEMT

Solid State Power Amplifiers

device and we plan to offer 12.5, 25, 45, and 90W P1dB versions in the very near future. These next generation amplifiers will demonstrate linearity and efficiency performance not currently achievable with FET-based technologies and will offer significant performance improvements to Ka-Band SATCOM system providers.

From our current SSPA offerings and our future development efforts, Narda-MITEQ continues to push the boundaries of SSPA performance. Please contact your local respresentative if you have further interest in this product area.



Ka-Band Outdoor Transceiver with 12.5W SSPA

Ka-Band BUC with 25W SSPA

Table of Contents

High Power Components

Directional Couplers, Hybrids, Terminations and Attenuators

Narda-MITEQ offers a broad range of high power passive products which are widely used in power test equipment and for military systems requirements. Many of the Narda-MITEQ high power passive products are available as catalog-stock items and are described in the appropriate section of this catalog. Special high power products are also available in which Narda-MITEQ has an established design it manufactures in reasonable quantity but, due to the unique or limited requirements, the product is only produced on a custom-order basis.

Important facets of Narda-MITEQ high power passive products are drawn from:

Power Test Facility: The high power test laboratory at Narda-MITEQ's Hauppauge facility provides the resources to perform both Narrowband and Broadband testing for new product development, our customers' special testing requirements, and our own total quality programs.

Environmental Testing and Quality Assurance: The Narda-MITEQ high power product can be tested on the premises under the rigors of most severe MIL-SPEC requirements. Routine in-house tests include temperature-cycling, thermal shock, and random vibration. As a supplement to our in-house capabilities, Narda-MITEQ has well established relationships with several local area certified Environmental Laboratories.

Narda-MITEQ's Quality Assurance Program meets the requirements of ISO 9001:2008 and AS 9100:2009. From a flight-qualified high power product for a complicated EW System, to an unconventional device to handle extraordinarily high microwave power for a commercial transmitter, Narda-MITEQ has the resources to meet your high power passive product requirements.

MODEL	FREQUENCY RANGE (GHz)	AVERAGE POWER RATING (W)	CONNECTOR
Attenuators			
752 Series	DC - 3	5	Type N
765A Series	DC - 5	50	Type N
769A Series	DC - 6	150	Type N
770A Series	DC - 18	100	Type N
776C Series	DC - 18	50	Type N
4776 Series	DC - 18	4.5	SMA
Directional Couplers			
3000-30	0.225 - 0.460	500	Type N
3001	0.460 - 0.950	up to 500	Type N
3002	0.950 - 2	up to 500	Type N
3003	2 - 4	up to 500	Type N
3004	4 - 10	up to 500	Type N
3020A	0.05 - 1	500	Type N
3022	1 - 4	500	Type N
3024	4 - 8	500	Type N
3045C	7 - 12.4	100	Type N
3060	2 - 18	200	Type N
4196-20	6 - 18	100	SMA
30300D	0.820 - 0.960	500 CW	Type N
30470	0.820 - 0.960	500 CW	Type N
30600	0.820 - 0.980	500	Type N
27000	2 - 18	400	Type N
27001A	6 - 18	400	Type N
27002	2 - 8	400	Type N
27003	2 - 18	400	TNC
27004A	6 - 18	400	TNC
27005	2 - 8	400	TNC
27002SC	2 - 8	1000	SC
27005SC	2 - 8	1000	SC
Power Dividers / Combiners			
4306-2	6 - 18	75	SMA
3306-2	6 - 18	100	Type N
2372A-2	0.5 - 2.5	250	Type N
2382-2	0.5 - 6	250	Type N
30402	0.820 - 0.915	80	Type N
30403	0.820 - 0.915	80	Type N
30373	0.820 - 0.915	100	Type N
2362-2	1.8 - 2	80	Type N
2362-3	1.8 - 2	80	Type N
2362-4	1.8 - 2	100	Type N
Quadrature Hybrids			
3322	0.82 - 0.98	500	Type N
3032	0.95 - 2	200	Type N
3033B	1.7 - 4.2	200	Type N
4096	6 - 18	125	SMA
Terminations			
369BNM	0.7 - 18	175	Type N
368BNM	2 - 18	500	Type N
366NM	DC-18	100	Type N
4366M	DC-18	100	SMA
366TNCM	DC-18	100	TNC

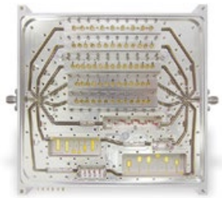
Narda-MITEQ is More Than Just Catalog Components

Custom Engineered Components and Networks

In addition to providing the finest off-the-shelf catalog products, Narda-MITEQ has been supporting military and commercial customers for decades with thousands of custom-engineered solutions. A Narda-MITEQ **"special"** passive product has been the solution of choice for decades—field proven in the harshest of environments.

While your selection of one of our rugged and reliable catalog devices remains the best, most efficient choice for all parties, we excel at meeting your additional needs with our special model catalog derivatives, or with completely unique multifunctional designs.

Please contact your local rep or the factory today for additional details.



Switched Filter Bank

Dual Hybrid Network

125 W 5-way Power Divider

200 W Combiner

Custom Butler Matrix

High Power Sampling Coupler

0.02-18 GHz Power Sensor

Environmental Performance for Selected Passive Products*

PARAMETER	SPECIFICATION
Operating Temperature	-54 to +105°C
Storage Temperature	-55 to +125°C
Humidity	Per MIL-STD-202F, method 103B, condition B (96 hours at 95% R.H.)
Shock	Per MIL-STD-202F, method 213B, condition J (30G, 11 msec)
Altitude	Per MIL-STD-202F, method 105G, condition B (50,000 feet)
Vibration	Per MIL-STD-202F, method 204D, condition B (.06" double amplitude or 15G, which ever is less)
Thermal Shock	Per MIL-STD-202F, method 107D, condition A (5 cycles)

* Applicable to Stripline Directional Couplers, Attenuators, Power Dividers

Note: This is an exclusive listing. Where otherwise noted in the catalog, the above environmental performance may not apply. Not applicable for those products designed for commercial applications. Many of our catalog off-the-shelf (COTS) products have the ability to withstand considerably more stringent environments. If you have special environmental requirements, please contact the Sales Department at Narda-MITEQ.

Adapters

narda MITEQ

Adapters

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	PAGE
DC-26.5	69	3.5mm-F to 3.5mm-F	31
DC-26.5	70	3.5mm-M to 3.5mm-M	31
DC-26.5	71	3.5mm-F to 3.5mm-M	31
DC-18	55	SMA-F to Type N-M	33
DC-18	56	SMA-M to Type N-M	33
DC-18	57	SMA-M to Type N-F	33
DC-18	58	SMA-F to Type N-F	33
DC-18	59	SMA-F to SMA-F	31
DC-18	60B	SMA-M to SMA-M	31
DC-18	61B	SMA-F to SMA-M	31
DC-18	76	Type N-M to Type N-M	33
DC-18	77	Type N-F to Type N-F	33

DC to 18 GHz, DC to 26.5 GHz

Coaxial Adapters SMA and 3.5 mm

- Low VSWR
- Stainless Steel Precision Connectors

Specifications

SMA (M/F) Gender Changing, DC to 18 GHz

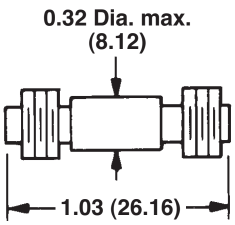
FREQUENCY RANGE (GHz)	MODEL	VSWR (max.)	WEIGHT (max.)		CONNECTORS
			oz.	gr.	
DC-18	**59**	1.25	0.5	14	SMA-F to SMA-F
	60B	1.25	0.5	14	SMA-M to SMA-M
	61B	1.25	0.5	14	SMA-F to SMA-M

3.5 mm (M/F) Gender Changing, DC to 26.5 GHz

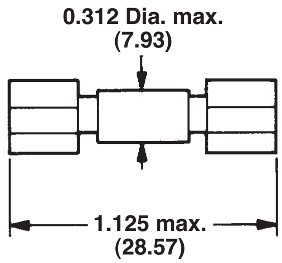
FREQUENCY RANGE (GHz)	MODEL	VSWR (max.)		WEIGHT (max.)		CONNECTORS
		DC-18	18-26.5	oz.	gr.	
DC-26.5	**69**	1.25	1.30	0.5	14	3.5mm-F to 3.5mm-F
	70	1.25	1.30	0.5	14	3.5mm-M to 3.5mm-M
	71	1.25	1.30	0.5	14	3.5mm-F to3.5mm-M

Adapters

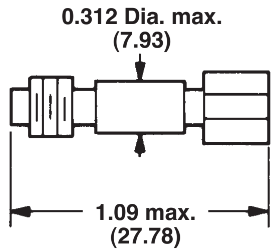
Outline Drawings



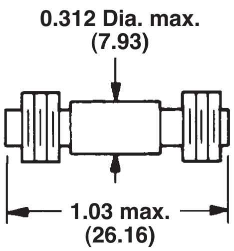
Model 59
SMA-F to SMA-F



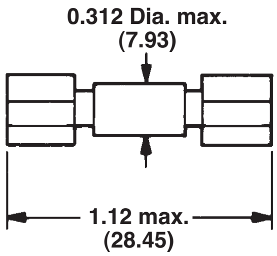
Model 60B
SMA-M to SMA-M



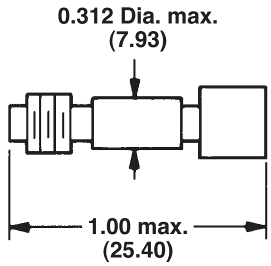
Model 61B
SMA-F to SMA-M



Model 69
3.5mm-F to 3.5mm-F

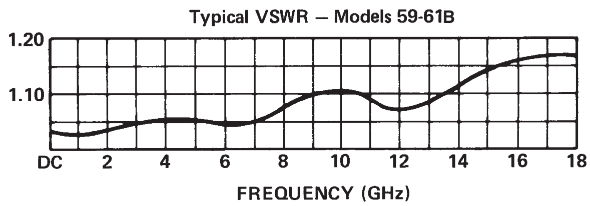


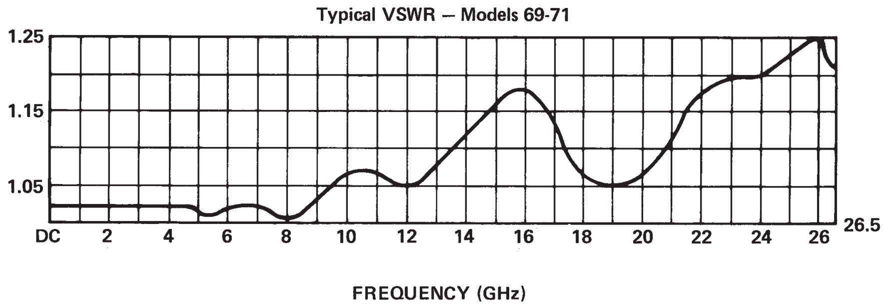
Model 70
3.5mm-M to 3.5mm-M



Model 71
3.5mm-F to 3.5mm-M

Dimensions in inches (mm in parentheses), unless otherwise specified.





DC-18 GHz

Coaxial Adapters Type N

- Low VSWR
- Stainless Steel Precision Connectors

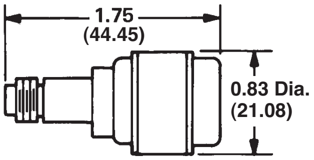
Specifications

Type N (M/F) to SMA (M/F) Gender Changing, DC to 18 GHz

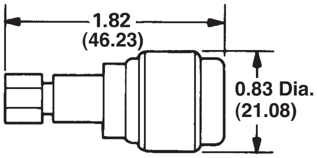
FREQUENCY RANGE (GHz)	MODEL	VSWR (max.)	WEIGHT (max.)		CONNECTORS
			oz.	gr.	
DC-18	**55**	1.25	1.5	43	SMA-F to N-M
	56	1.25	2.0	57	SMA-M to N-M
	57	1.25	1.5	43	SMA-M to N-F
	58	1.25	1.0	28	SMA-F to N-F
	76	1.20	2.0	57	N-M to N-M
	77	1.20	2.5	71	N-F to N-F

Adapters

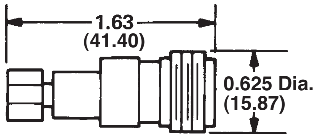
Outline Drawings



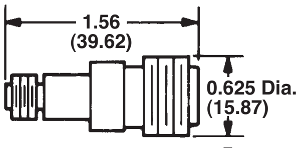
Model 55
SMA-F to N-M



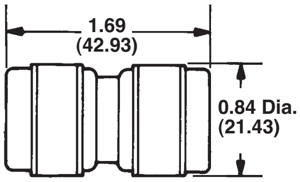
Model 56
SMA-M to N-M



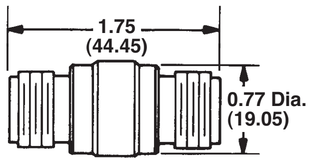
Model 57
SMA-M to N-F



Model 58
SMA-F to N-F



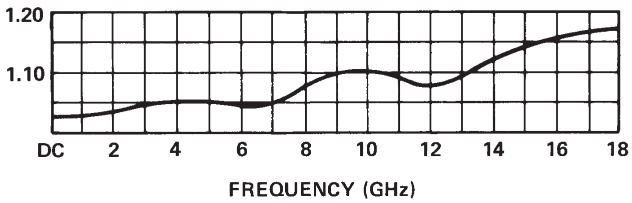
Model 76
N-M to N-M



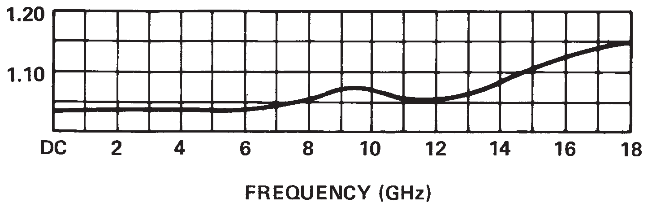
Model 77
N-F to N-F

Dimensions in inches (mm in parentheses), unless otherwise specified.

Typical VSWR – Models 55-58



Typical VSWR – Models 76 and 77



Attenuators

Attenuators

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL SERIES	TYPE	CONNECTOR	PAGE
Fixed				
DC-40	4768	Fixed	2.92 mm	44
DC-40	4777	Fixed	2.92 mm	48
DC-18	770	Fixed	Type N	54
DC-18	776	Fixed	Type N	50
DC-18	776C	Fixed	Type N	50
DC-18	779	Fixed	Type N	42
DC-18	4776	Fixed	SMA	48
DC-18	4779	Fixed	SMA	45
DC-18	4782	Fixed	SMA	47
DC-12.4	757C	Fixed	Type N	43
DC-12.4	777C	Fixed	Type N	42
DC-12.4	4775	Fixed	SMA	49
DC-12.4	4778	Fixed	SMA	46
DC-11	768A	Fixed	Type N	51
DC-6	769A	Fixed	Type N	54
DC-6	773	Fixed	Type N	43
DC-6	4772	Fixed	SMA	46
DC-6	4774	Fixed	SMA	49
DC-6	4780	Fixed	SMA	47
DC-5	765A	Fixed	Type N	52
DC-4	766A	Fixed	Type N	51
DC-3	752	Fixed	Type N	41

FREQUENCY RANGE (GHz)	MODEL SERIES	TYPE	CONNECTOR	PAGE
Attenuator Sets				
DC-18	120A/4	Fixed	Type N	56
DC-12.4	118A/4	Fixed	Type N	56
DC-12.4	119A/4	Fixed	Type N	56
Step				
DC-18	741	Step	Type N	57
DC-18	743-60	Step	Type N	57
DC-18	745-69	Step	Type N	57
DC-18	4741	Step	SMA	57
DC-18	4743-60	Step	SMA	57
DC-18	4745-69	Step	SMA	57
DC-2.5	AS-SMA	Step	SMA	60
Variable				
7-26.5	4796	Variable	3.5 mm	62
4-18	4791	Variable	SMA	62
8-18	4792	Variable	SMA	62
12.4-18	4793	Variable	SMA	62
2-12.4	787FF	Variable	Type N	64
4-8	788FF	Variable	Type N	65
2-4	796	Variable	Type N	66
0.8-2.5	4790	Variable	SMA	62
1-2	795	Variable	Type N	66

Environmental Performance for Selected Passive Products*

PARAMETER	SPECIFICATION
Operating Temperature	-54 to +105°C
Storage Temperature	-55 to +125°C
Humidity	Per MIL-STD-202F, method 103B, condition B (96 hours at 95% R.H.)
Shock	Per MIL-STD-202F, method 213B, condition J (30G, 11 msec)
Altitude	Per MIL-STD-202F, method 105G, condition B (50,000 feet)
Vibration	Per MIL-STD-202F, method 204D, condition B (.06" double amplitude or 15G, which ever is less)
Thermal Shock	Per MIL-STD-202F, method 107D, condition A (5 cycles)

* Applicable to Stripline Directional Couplers, Attenuators, Power Dividers

Note: This is an exclusive listing. Where otherwise noted in the catalog, the above environmental performance may not apply. Not applicable for those products designed for commercial applications. Many of our catalog off-the-shelf (COTS) products have the ability to withstand considerably more stringent environments. If you have special environmental requirements, please contact the Sales Department at Narda-MITEQ.

Introduction

Coaxial attenuators are used in every type of equipment involving the transmission, control or measurement of microwave energy. To meet the needs of system designers, original equipment manufacturers, and laboratory users, our variety of devices offers a broad combination of physical and electrical performance characteristics.

Narda-MITEQ offers attenuators for frequency bands from DC to 40 GHz, with a choice of attenuation values from 0 to 69 dB, average power ratings from 0.5 to 150 watts, and attenuation accuracy specifications to ±0.2 dB.

Variable attenuators encompassing many combinations of bandwidth, attenuation range, accuracy, power handling capability and physical dimensions are also available.

Attenuators for Systems Applications

The most common applications for coaxial attenuators in microwave systems are in transmitters and receivers. In these, and similar applications, the characteristics that are usually of principal concern are:

- **a.** amount or range of attenuation
- **b.** flatness over frequency
- **c.** average and peak power-handling capability
- **d.** temperature characteristics, and
- **e.** size and weight

Fixed Attenuators

Fixed attenuators are used in systems for two broad classes of service. One is in a calibration channel to establish a known signal level; flatness over the required frequency range is important here. In the second type of service, the device is used for impedance matching or as a buffer to prevent interaction between two devices. For this type of service, low VSWR is the important factor.

The variety of fixed attenuators for these applications is shown in this catalog. Although these attenuators cover most requirements for frequency range and flatness, the practical rule, where cost is a factor, is to specify only the range and tolerances that are required. Since these attenuators are manufactured by thin-film deposition, savings resulting from unique specifications will not be significant for single units or small quantities, but should be considered for large quantities.

Variable Attenuators

Variable attenuators for systems applications (and some OEM and laboratory applications) fall into two general categories: lossy wall attenuators and step (or turret) attenuators. The general operating principles and characteristics of each of these types are described below.

Lossy Wall Attenuators

Figure 1 shows a section of the lossy wall attenuator. The construction is basically stripline with a section of the outer conducting wall replaced by a section of lossy material with high dielectric and magnetic dissipation factors. Microwave power flowing through this dielectric material is attenuated as a result of loss, allowing low variation of attenuation with frequency. Attenuation is varied by mechanically varying the location of the lossy material with respect to the fixed center conductor. In practice, the outer walls are displaced in such a way that the physical length of the transmission line is constant. Various coaxial line geometries are employed to provide gradual variation of attenuation with mechanical movement and to achieve the required flatness with frequency.

Limitations of available lossy materials restrict the usefulness of these attenuators to above 2 GHz, although they can be used with degraded performance to 1 GHz. Because the dissipation of energy in these lossy materials tends to be frequency sensitive, selection of a lossy wall attenuator usually involves a tradeoff of attenuation, bandwidth and flatness versus frequency range and size. For example, assuming one available model provides 90 dB of attenuation at 16 GHz, with a design center from 15.7 to 16.3 GHz. The same unit can be used in X-band, but with attenuation reduced to about 50 dB. These units have moderate power-handling capability since attenuation is achieved through dissipation of power as heat in the walls. Narda-MITEQ lossy-wall attenuators can easily handle an average power of as much as 10 watts and peak power to 5 kW.

In general, lossy-wall attenuators have low insertion loss (usually less than 1 dB), low VSWR, and relatively flat attenuation characteristics over the design band. Attenuation is directly proportional to the length of the center conductor between the lossy material. Consequently, the designer concerned about space limitations can safely estimate that a 40 dB unit will be approximately twice the size of a 20 dB unit.

Attenuators

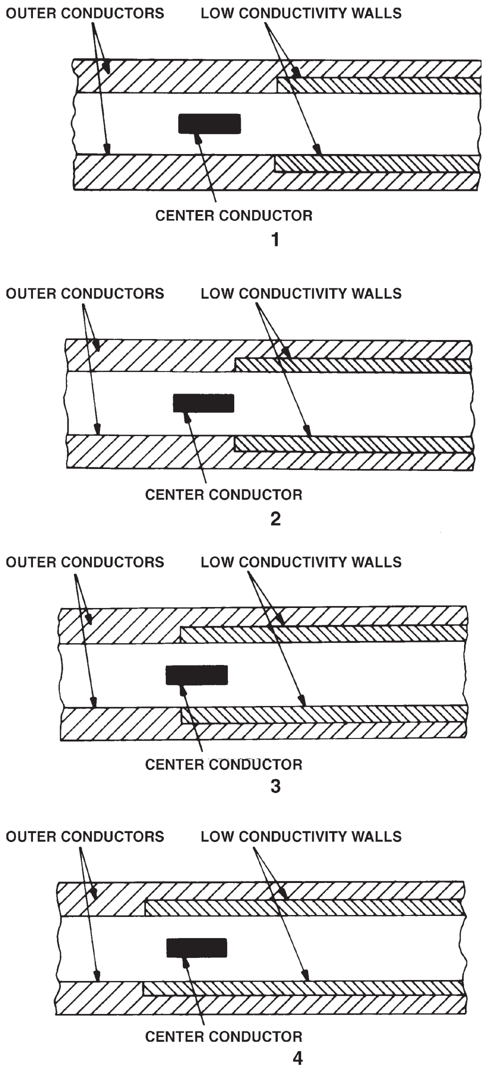


Figure 1. Transverse section of lossy wall attenuartor at various stages of attenuation: (1) minimum attentuation; (2) small attenuation; (3) high attenuation; (4) maximum attenuation.

Lossy wall attenuators are ideally suited for use as buffers in front of a local oscillator or power source, where the requirement is for a minimum of 10 dB of attenuation with capability for precise tuning. Common applications are in surveillance, and in radar reflection augmenters, where each of many local oscillators must be trimmed a few dB.

For these and similar applications, the lossy wall attenuator offers cost and size advantages over other types of variable attenuators.

Step (Or Turret) Attenuators

For applications demanding both broadband flatness and adjustability over ranges from 0 to 69 dB, Narda-MITEQ has a number of stepping-type attenuators that utilize the flatness characteristics of thin-film fixed attenuators. The turret attenuator, Narda-MITEQ Model 745/4745 Series, is a typical example, using fixed attenuators mechanically arranged to permit successive stepping in discrete increments. Typically, these units are offered with switching in 10 or 1 dB increments and may be cascaded to provide the desired attenuation range with resettability of better than 0.05 dB. Because of the inherent broadband characteristics of the thin-film, step attenuators afford excellent flatness from DC to above 18 GHz.

Narda-MITEQ turret attenuators have a specified repeatability of 0.05 dB; in practice this figure is usually better than 0.02 dB. Life of the Narda-MITEQ turret attenuators can be expected to be in excess of one million steps.

Original Equipment Applications

For the original equipment designer, the ideal attenuator is likely to be a panel-mountable unit continuously variable from 0 to 69 dB, with maximum flatness over a wide frequency range. Since the present state-of-the-art is unable to provide devices with this combination of characteristics, equipment designers must choose a practical alternative. A step attenuator with a continuously variable attenuator to serve as a fill-in vernier between incremental steps over restricted frequency ranges will usually suffice.

Laboratory Applications

The selection of attenuators for use in the development laboratory is generally the easiest of the specification tasks. Because bench testing requirements may vary considerably from project to project, the objective in specifying attenuators for these applications will normally be to provide for the broadest possible range of project requirements. Characteristics involved in this concept of versatility will be:

- **a.** broad bandwidth
- **b.** large attenuation range
- **c.** high accuracy
- **d.** longevity of connectors

Variable Attenuators for the Laboratory

The wide range of testing requirements usually dictates a selection of variable attenuators that remain flat over at least an octave, and frequently over several octaves. For this reason, the step attenuator represents a more practical choice than the low-loss, continuously-variable attenuator. Typical of step attenuators designed for bench test applications are the Narda-MITEQ Models 700/4700 Series. This series provides 0 to 60 dB attenuation in 10 dB steps; 0 to 9 and 0 to 69 dB attenuation in 1 dB steps. The series also includes effective zero-loss positions to permit full signal input to the load, providing convenient reference levels without removing the units from the setup. These units are usable as freestanding models, or in panel-mount configurations with behind-the-panel connectors. (Panel-mounting hardware is available as an accessory where applicable.)

Fixed Attenuators for Laboratory Setups

Fixed attenuators for laboratory service are available with various levels of calibration accuracy.

The Attenuator Series, Model 777C for example, is available in eight standard attenuation values from 3 to 60 dB and is calibrated at DC, 4, 8, 10 and 12.4 GHz. Model 779 is available in 15 (standard) attenuation values from 1 to 60 dB and is calibrated at DC, 4, 8, 12.4 and 18 GHz. Attenuation certification for this series of attenuators is recorded at each frequency to the nearest .05 dB.

The accuracy characteristics of these units are best suited to the standards laboratory, where they can be used under controlled conditions, rather than on the bench where other factors may cancel out the advantages to be gained from precise calibration and accuracy. For bench service, more practical choices include the Narda-MITEQ 757C (which covers the DC to 12.4 GHz band, has an average power capacity of 2 watts and is accurate to 0.3 dB), or the Narda-MITEQ 779 for DC to 18 GHz.

The design and performance of Narda-MITEQ attenuators are suited to many high-reliability applications. In such cases, economical selection of attenuators can be achieved with Narda-MITEQ's assistance when the customer defines the requirement and application. Application-specific qualification inspections can be performed. This applies to both fixed and variable attenuators.

Connector Longevity

This is especially important in laboratory use, as worn or damaged connectors cause errors in attenuation and high VSWR. While many manufacturers supply stainless steel connectors on their better quality attenuators to provide longer life, all Narda-MITEQ standard line attenuators have stainless steel connectors.

User-Manufacturer Consultation

Manufacturers of microwave components are often in a position to make recommendations regarding the selection of attenuators for particular applications.

Narda-MITEQ offers consultation on any systems, original equipment or laboratory requirements and is prepared to assist in evaluating or specifying either catalog-listed or custom-designed attenuators for all application requirements.

Theory and Practice of Attenuation Measurements

In the use and design of microwave components it is often necessary to consider their insertion loss or attenuation characteristics. Insertion loss is the ratio of the power delivered to a matched load by a matched generator before and after the insertion of a component into the line. Insertion loss is actually a combination of two losses: mismatch loss (reflective) and attenuation (dissipative).

Attenuators

Mismatch loss is the ratio of power that would be absorbed by the device if it were perfectly matched to the actual power absorbed by the device with its mismatch in impedance. Attenuation is the ratio of power into a component to the power out under matched conditions, and represents the actual power dissipated within the component. Where a component is perfectly matched to the line and load, the mismatch loss is zero and insertion loss is the same as attenuation.

The expression is the same for all three losses:

$$\alpha_{(dB)} = 10 \log \frac{P_1}{P_2}$$

However, the variables have different significance for each case. For insertion loss, P_1 is the power at the load before insertion of the component in the line and P_2 is the power after insertion. In the case of attenuation, P_1 is the power into the component and P_2 is the power out.

In practice, the insertion loss is usually of primary interest. It is good practice to provide a well matched generator and load. An attenuator with low VSWR is commonly used to obtain good source and load match.

Methods Of Measurement

Modern technique for measuring loss and return loss (or VSWR) on microwave attenuators utilizes two classes of network analyzers, scalar and vector. The choice depends upon the application and the form of data desired. Both are in use at Narda-MITEQ. Features of each are summarized:

Scalar Network Analyzer

- Provides magnitude, in dB, for example
- Interval microprocessor quickly plots graphs, automatically compensating for instrumentation frequency response
- Frequency range presently to 60 GHz

Vector Network Analyzer (also called Automatic Network Analyzer, or ANA)

- Provides magnitude and angle of all S-parameters
- Plots graphs or prints tabular data under software control
- High resolution error corrected measurements, against attenuation standards traceable to NIST
- Frequency range to 60 GHz

Data on individual attenuators can be supplied (for a nominal fee) upon request. For fixed attenuators, this is normally in tabular form as attenuation and two-ended VSWR vs. frequency, taken with an ANA. Resolution is 0.01 dB, and in hundredths for VSWR.

In addition to microwave measurement, insertion loss can be measured at DC. The attenuator under test is placed between precise resistive terminations, and the dB value calculated from the drop-in load voltage read on a high resolution digital voltmeter. Accuracy of DC attenuation is as follows:

Attenuation	Maximum Error
to 10 dB	0.009 dB
to 40 dB	0.015 dB
50 dB	0.035 dB
60 dB	0.090 dB

The DC attenuator measurement can be used as a check on ANA data; correlation with results at 45 MHz is typically within 0.03 dB.

Software utilized for tabulated data on the ANA extends dynamic range at high frequency through multiple measurement averaging. As a result, typical day to day repeatability of SMA-type attenuators up to 18 GHz is:

Attenuation Value	Repeatability
to 50 dB	0.05 dB
60 dB	0.33 dB

NOTE: For all applicable Narda-MITEQ Attenuators, Narda-MITEQ can supply **standard** test data for a nominal fee.

DC-18 GHz

Fixed Precision Coaxial Attenuators

- Extremely Low Frequency Sensitivity
- Very Low VSWR
- Designed to Meet Environmental Requirements of MIL-A-3933E
- Medium Power Rating

Specifications

Type N (M/F), DC to 3 GHz, 5 W

FREQUENCY RANGE (MHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)	WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE (W max.)	PEAK (kW max.)		oz.	gr.
DC-3	**752-3**	3	±0.3	5	0.3	1.20	3.7	105
	752-6	6	±0.3	5	0.3	1.20	3.7	105
	752-10	10	±0.3	5	0.3	1.20	3.7	105
	752-20	20	±0.3	5	0.3	1.20	3.7	105
	752-30	30	±0.3	5	0.3	1.20	3.7	105

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Fixed Attenuators

Specifications

Type N (M/F), DC to 18 GHz, 2 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB) NOMINAL	DEVIATION DC-12.4	DEVIATION 12.4-18	POWER INPUT AVERAGE (W max.)	POWER INPUT PEAK (kW max.)	VSWR (max.) DC-6	VSWR (max.) 6-12.4	VSWR (max.) 12.4-18	WEIGHT (max.) oz.	WEIGHT (max.) gr.
DC-18	779-1	1*	±0.3	±0.4	2	0.2	1.15	1.30	1.40	2.9	82
	779-2	2*	±0.3	±0.4	2	0.2	1.15	1.30	1.40	2.9	82
	779-3	3	±0.3	±0.3	2	0.2	1.15	1.30	1.40	2.9	82
	779-4	4*	±0.3	±0.4	2	0.2	1.15	1.30	1.40	2.9	82
	779-5	5*	±0.3	±0.4	2	0.2	1.15	1.30	1.40	2.9	82
	779-6	6	±0.3	±0.3	2	0.2	1.15	1.30	1.40	2.9	82
	779-7	7*	±0.4	±0.5	2	0.2	1.15	1.30	1.40	2.9	82
	779-8	8*	±0.4	±0.5	2	0.2	1.15	1.30	1.40	2.9	82
	779-9	9*	±0.4	±0.5	2	0.2	1.15	1.30	1.40	2.9	82
	779-10	10	±0.3	±0.5	2	0.2	1.15	1.30	1.40	2.9	82
	779-20	20	±0.5	±0.7	2	0.2	1.15	1.30	1.40	2.9	82
	779-30	30	±0.8	±1.0	2	0.2	1.15	1.30	1.40	2.9	82
	779-40	40	±1.25	±1.6	2	0.2	1.15	1.30	1.40	2.9	82
	779-50	50	±1.25	±1.6	2	0.2	1.15	1.30	1.40	2.9	82

* Non-standard attenuation values are available on a custom order basis. Minimum order quantity may apply. Consult factory for details

NOTES:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W
From DC-3 GHz, maximum frequency deviation is ± 0.5 dB for the 30, 40 and 50 dB models

Type N (M/F), DC to 12.4 GHz, 2 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB) NOMINAL	DEVIATION DC-6	DEVIATION 6-12.4	POWER INPUT AVERAGE (W max.)	POWER INPUT PEAK (kW max.)	VSWR (max.) DC-6	VSWR (max.) 6-12.4	WEIGHT (max.) oz.	WEIGHT (max.) gr.
DC-12.4	777C-3	3	±0.3	±0.3	2	0.2	1.15	1.20	2.9	82
	777C-6	6	±0.3	±0.3	2	0.2	1.15	1.20	2.9	82
	777C-10	10	±0.3	±0.3	2	0.2	1.15	1.20	2.9	82
	777C-20	20	±0.3	±0.3	2	0.2	1.15	1.20	2.9	82
	777C-30	30	±0.5	±0.75	2	0.2	1.15	1.25	2.9	82

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Specifications

Type N (M/F), DC to 12.4 GHz, 2 W

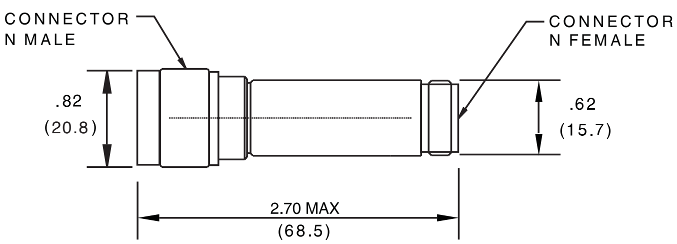
FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)			POWER INPUT		VSWR (max.)		WEIGHT (max.)	
		NOMINAL	DEVIATION		AVERAGE (W max.)	PEAK (kW max.)				
			DC-6	6-12.4			DC-6	6-12.4	oz.	gr.
DC-12.4	757C-3	3	±0.3	±0.3	2	0.3	1.20	1.25	2.9	82
	757C-6	6	±0.3	±0.3	2	0.3	1.20	1.25	2.9	82
	757C-10	10	±0.3	±0.5	2	0.3	1.20	1.25	2.9	82
	757C-20	20	±0.3	±0.5	2	0.3	1.20	1.25	2.9	82
	757C-30	30	±0.5	±1.0	2	0.3	1.20	1.25	2.9	82

Type N (M/F), DC to 6 GHz, 2 W

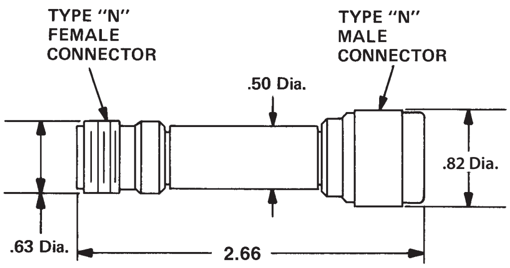
FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)			POWER INPUT		VSWR (max.)		WEIGHT (max.)	
		NOMINAL	DEVIATION		AVERAGE (W max.)	PEAK (kW max.)				
			DC-3	3-6			DC-3	3-6	oz.	gr.
DC-6	773-3	3	±0.3	±0.5	2	0.3	1.20	1.25	2.4	68
	773-6	6	±0.3	±0.5	2	0.3	1.20	1.25	2.4	68
	773-10	10	±0.3	±0.5	2	0.3	1.20	1.25	2.4	68
	773-20	20	±0.3	±0.5	2	0.3	1.20	1.25	2.4	68
	773-30	30	±0.3	±0.5	2	0.3	1.20	1.25	2.4	68
	773-40	40	±0.5	±1.0	2	0.3	1.20	1.25	2.7	77

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Outline Drawings



MODELS 752



MODELS 757C, 773, 777C, 779

Dimensions in inches (mm in parentheses), unless otherwise specified.

Fixed Attenuators

DC- 40 GHz

SMA and 2.92 mm
Miniature Fixed Attenuators

- Flat Frequency Response
- Low VSWR
- 2 Watt Rating
- Designed to Meet Environmental Requirements of MIL-A-3933
- Precision Stainless Steel SMA Connectors

Specifications

2.92 mm (M/F), DC to 40 GHz, 2 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)			POWER INPUT		VSWR (max.)	WEIGHT (max.)	
		NOMINAL	DEVIATION		AVERAGE (W max.)	PEAK (kW max.)		oz.	gr.
			DC-26.5	26.5-40					
DC-40	**4768-3**	3	±0.5	±0.8	2	0.2	1.40	0.25	7.5
	4768-6	6	±0.5	±0.8	2	0.2	1.40	0.25	7.5
	4768-10	10	±0.5	±0.8	2	0.2	1.40	0.25	7.5
	4768-20	20	±0.5	±0.8	2	0.2	1.40	0.25	7.5

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Specifications

SMA (M/F), DC to 18 GHz, 2 W

FREQUENCY RANGE (GHz)	MODEL*	ATTENUATION (dB) NOMINAL	DEVIATION DC-12.4	DEVIATION 12.4-18	POWER INPUT AVERAGE (W max.)	POWER INPUT PEAK (kW max.)	VSWR (max.) DC-4	VSWR (max.) 4-12.4	VSWR (max.) 12.4-18	WEIGHT (max.) oz.	WEIGHT (max.) gr.
DC-18	4779-0	0	±0.3	±0.4	2	0.2	1.15	1.30	1.35	0.5	14
	4779-1	1	±0.3	±0.4	2	0.2	1.15	1.30	1.35	0.5	14
	4779-2	2	±0.3	±0.4	2	0.2	1.15	1.30	1.35	0.5	14
	4779-3	3	±0.3	±0.3	2	0.2	1.15	1.25	1.35	0.5	14
	4779-4	4	±0.3	±0.3	2	0.2	1.15	1.30	1.35	0.5	14
	4779-5	5	±0.3	±0.3	2	0.2	1.15	1.30	1.35	0.5	14
	4779-6	6	±0.3	±0.3	2	0.2	1.15	1.25	1.35	0.5	14
	4779-7	7	±0.4	±0.5	2	0.2	1.15	1.30	1.35	0.5	14
	4779-8	8	±0.4	±0.5	2	0.2	1.15	1.30	1.35	0.5	14
	4779-9	9	±0.4	±0.5	2	0.2	1.15	1.30	1.35	0.5	14
	4779-10	10	±0.3	±0.5	2	0.2	1.15	1.25	1.35	0.5	14
	4779-11	11	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-12	12	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-13	13	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-14	14	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-15	15	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-16	16	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-17	17	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-18	18	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-19	19	±0.5	±0.6	2	0.2	1.15	1.30	1.35	0.5	14
	4779-20	20	±0.5	±0.6	2	0.2	1.15	1.25	1.35	0.5	14
	4779-30	30	±0.8	±1.0	2	0.2	1.15	1.35	1.40	0.5	14
	4779-40	40	±1.2	±1.5	2	0.2	1.15	1.35	1.40	0.5	14
	4779-50	50	±1.2	±1.5	2	0.2	1.15	1.35	1.40	0.5	14
	4779-60	60	±1.2	±1.5	2	0.2	1.15	1.35	1.40	0.5	14

* Standard attenuation values are typically available from stock in the following attenuation values: 3 dB, 6 dB, 10 dB, 20 dB, 30 db.
Non-standard attenuation values are available on a custom order basis. Minimum order quantity may apply. Consult factory for details.

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Fixed Attenuators

Specifications

SMA (M/F), DC to 12.4 GHz, 2 W

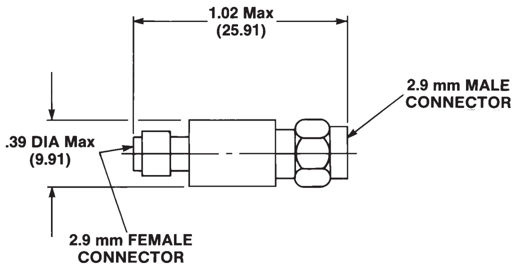
FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)		WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE (W max.)	PEAK (kW max.)	DC-4	4-12.4	oz.	gr.
DC-12.4	**4778-3**	3	±0.3	2	0.2	1.15	1.30	0.5	14
	4778-6	6	±0.3	2	0.2	1.15	1.30	0.5	14
	4778-10	10	±0.3	2	0.2	1.15	1.30	0.5	14
	4778-20	20	±0.5	2	0.2	1.15	1.30	0.5	14
	4778-30	30	±0.8	2	0.2	1.15	1.35	0.5	14

SMA (M/F), DC to 6 GHz, 2 W

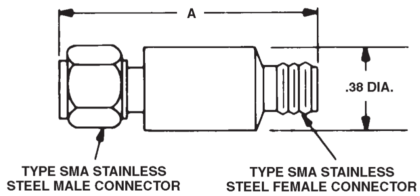
FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)		WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE (W max.)	PEAK (kW max.)	DC-4	4-6	oz.	gr.
DC-6	**4772-3**	3	±0.3	2	0.2	1.25	1.40	0.5	14
	4772-6	6	±0.3	2	0.2	1.25	1.40	0.5	14
	4772-10	10	±0.3	2	0.2	1.25	1.40	0.5	14
	4772-20	20	±0.3	2	0.2	1.25	1.40	0.5	14
	4772-30	30	±0.5	2	0.2	1.25	1.40	0.5	14

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Outline Drawings



MODEL 4768



MODEL	A 1-26 dB	A 30-60 dB
4772	1.24	1.49
4778	1.24	1.49
4779	1.24	1.49

Dimensions in inches (mm in parentheses), unless otherwise specified.

DC-18 GHz

SMA Miniature Fixed Attenuator

- Flat Frequency Response
- Low VSWR
- Precision Stainless Steel SMA Connectors
- 2 Watt Rating
- Smallest Size

Specifications

Miniature SMA (M/F), DC to 18 GHz, 2 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)			WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE (W max.)	PEAK (kW max.)	DC-4	4-12.4	12.4-18	oz.	gr.
DC-18	**4782-3**	3	±0.3	2	0.2	1.15	1.30	1.40	0.17	5.2
	4782-6	6	±0.3	2	0.2	1.15	1.30	1.40	0.17	5.2
	4782-10	10	±0.4	2	0.2	1.15	1.30	1.40	0.17	5.2
	4782-20	20	±0.5	2	0.2	1.15	1.30	1.40	0.21	6.3

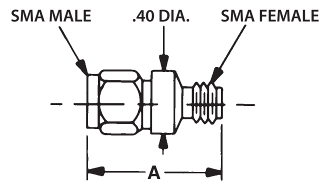
Miniature SMA (M/F), DC to 6 GHz, 2 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)	WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE (W max.)	PEAK (kW max.)		oz.	gr.
DC-6	**4780-3**	3	±0.4	2	0.2	1.20	0.17	5.2
	4780-6	6	±0.4	2	0.2	1.20	0.17	5.2
	4780-10	10	±0.4	2	0.2	1.20	0.17	5.2
	4780-20	20	±0.5	2	0.2	1.20	0.21	6.3

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Outline Drawing

MODEL	A 3, 6, 10 dB	A 20 dB
4780	.86	.93
4782	.86	.93



Dimensions in inches, unless otherwise specified.

Fixed Attenuators

DC- 40 GHz

2.92 mm and SMA Miniature Medium Power Attenuators

- Small Size and Light Weight
- Low VSWR
- Designed to Meet Environmental Requirements of MIL-A-3933E

Specifications

2.92 mm (M/F), DC to 40 GHz, 3 to 6 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)			POWER INPUT		VSWR (max.)	WEIGHT (max.)	
		NOMINAL	DEVIATION		AVERAGE (W max.)	PEAK (kW max.)			
			DC-26.5	26.5-40				oz.	gr.
DC-40	4777-3	3	±0.5	±0.8	6.0	0.2	1.4	0.53	15
	4777-6	6	±0.5	±0.8	4.0	0.2	1.4	0.53	15
	4777-10	10	±0.5	±0.8	3.3	0.2	1.4	0.53	15
	4777-20	20	±0.5	±0.8	3.0	0.2	1.4	0.53	15

SMA (M/F), DC to 18 GHz, 4.5 to 8 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)				WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE (W max.)	PEAK (kW max.)	DC-4	4-6	6-12.4	12.4-18	oz.	gr.
DC-18	4776-3	3	±0.3	8.0	0.2	1.15	1.25	1.30	1.35	0.9	25
	4776-6	6	±0.3	5.5	0.2	1.15	1.25	1.30	1.35	0.9	25
	4776-10	10	±0.5	4.5	0.2	1.15	1.25	1.30	1.35	0.9	25
	4776-20	20	±0.7	4.5	0.2	1.15	1.25	1.30	1.35	0.9	25
	4776-30	30	±1.0	4.5	0.2	1.15	1.25	1.30	1.35	0.9	25
	4776-40	40	±1.5	4.5	0.2	1.15	1.25	1.30	1.35	0.9	25
	4776-50	50	±1.5	4.5	0.2	1.15	1.25	1.30	1.35	0.9	25
	4776-60	60	±1.5	4.5	0.2	1.15	1.25	1.30	1.35	0.9	25

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Specifications

SMA (M/F), DC to 12.4 GHz, 4.5 to 8 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)		WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE (W max.)	PEAK (kW max.)	DC-6	6-12.4	oz.	gr.
DC-12.4	4775-3	3	±0.3	8.0	0.2	1.25	1.30	0.9	25
	4775-6	6	±0.3	5.5	0.2	1.25	1.30	0.9	25
	4775-10	10	±0.3	4.5	0.2	1.25	1.30	0.9	25
	4775-20	20	±0.5	4.5	0.2	1.25	1.30	0.9	25
	4775-30	30	±0.8	4.5	0.2	1.25	1.30	0.9	25

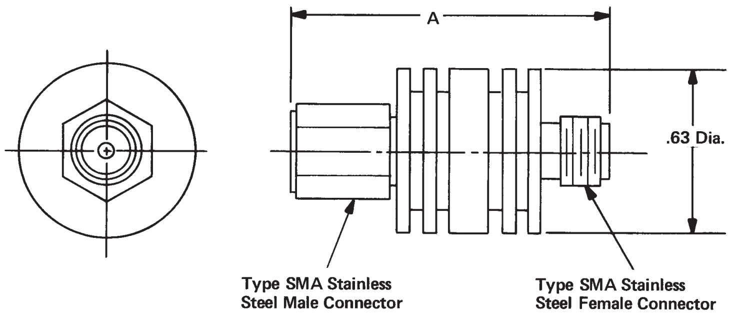
SMA (M/F), DC to 6 GHz, 4.5 to 8 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)		WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE (W max.)	PEAK (kW max.)	DC-4	4-6	oz.	gr.
DC-6	4774-3	3	±0.3	8.0	0.2	1.25	1.40	0.9	25
	4774-6	6	±0.3	5.5	0.2	1.25	1.40	0.9	25
	4774-10	10	±0.3	4.5	0.2	1.25	1.40	0.9	25
	4774-20	20	±0.3	4.5	0.2	1.25	1.40	0.9	25
	4774-30	30	±0.5	4.5	0.2	1.25	1.40	0.9	25

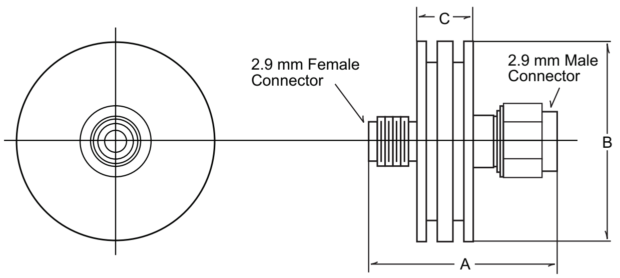
NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Outline Drawings

MODEL	ATTENUATOR (dB)	DIMENSION A
4776	3, 6, 10, 20	1.23
	30, 40, 50, 60	1.49
4775	3, 6, 10, 20	1.23
	30	1.49
4774	3, 6, 10, 20	1.23
	30	1.49



MODEL	A	B	C
4777-3 4777-6 4777-10 4777-20	1.02 (25.91)	1.00 (25.40)	0.29 (7.37)



Dimensions in inches, unless otherwise specified.

Fixed Attenuators

DC-18 GHz

Type N Medium Power Bi-Directional Fixed Coaxial Attenuators

- Excellent VSWR
- 50 Watts

Specifications

Type N (M/F), DC to 18 GHz, 50 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT (W max.)		VSWR (max.)				WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE*	PEAK	DC-4	4-12.4	12.4-15	15-18	oz.	gr.
DC-18	776C-10	10	±0.5	50	1000	1.30	1.40	1.50	1.50	12	340
	776C-20	20	±0.75	50	1000	1.30	1.35	1.40	1.50	12	340
	776C-30	30	±1.0	50	1000	1.30	1.35	1.40	1.50	12	340

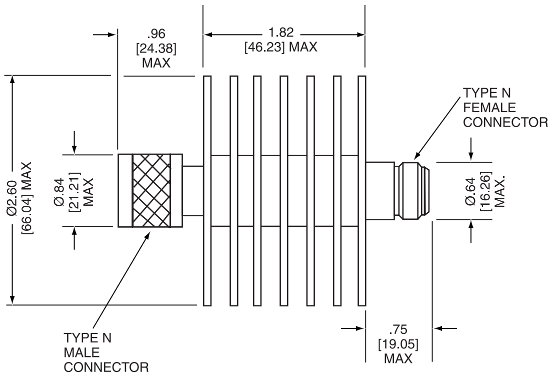
Type N (M/F), DC to 18 GHz, 50 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT (W max.)		VSWR (max.)			WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE*	PEAK	DC-8	8-12.4	12.4-18	oz.	gr.
DC-18	776-40	40	±2.0	50	1000	1.20	1.25	1.35	14	400
	776-50	50	±2.5	50	1000	1.20	1.25	1.35	14	400
	776-60	60	±3.0	50	1000	1.20	1.25	1.35	14	400

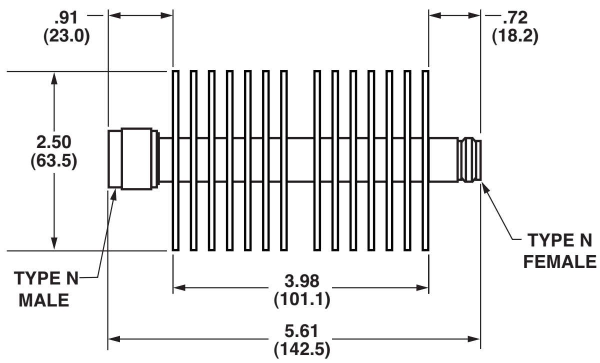
* Power ratings for horizontal operation at +25°C derate linearly to 5 watts at +125°C – see page 53 for derating curve

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Outline Drawings



Model 776C Series



Model 776 Series

Dimensions in inches (mm in parentheses), unless otherwise specified.

DC-11 GHz

Type N Medium Power Bi-Directional Fixed Coaxial Attenuators

- 20 and 50 Watts
- Small Size
- Stainless Steel Connectors

Specifications

Type N (M/F), DC to 5 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)			POWER INPUT		VSWR (max.)		WEIGHT (max.)	
		NOMINAL	DEVIATION		AVERAGE* (W max.)	PEAK (kW max.)				
			DC-3	3-4			DC-1	1-4	oz.	gr.
DC-4	766A-3	3	±0.25	±0.50	20	1	1.10	1.15	5.6	159
	766A-6	6	±0.25	±0.50	20	1	1.10	1.15	5.6	159
	766A-10	10	±0.25	±0.50	20	1	1.10	1.15	5.6	159
	766A-20	20	±0.25	±0.50	20	1	1.10	1.15	5.6	159
	766A-30	30	±0.75	±0.75	20	1	1.10	1.35	5.6	159

Type N (M/F), DC to 11 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)				POWER INPUT		VSWR (max.)				WEIGHT (max.)	
		NOMINAL	DEVIATION			AVERAGE* (W max.)	PEAK (kW max.)						
			DC-3	3-6	6-11			DC-1	1-4	4-6	6-11	oz.	gr.
DC-11	768A-3	3	±0.25	±0.50	±0.75	20	1	1.10	1.15	1.20	1.30	5.6	159
	768A-6	6	±0.25	±0.50	±0.75	20	1	1.10	1.15	1.20	1.30	5.6	159
	768A-10	10	±0.25	±0.50	±0.75	20	1	1.10	1.15	1.20	1.30	5.6	159
	768A-20	20	±0.25	±0.50	±0.75	20	1	1.10	1.15	1.20	1.30	5.6	159
	768A-30	30	±0.25	±0.50	±0.75	20	1	1.10	1.15	1.20	1.35	5.6	159

* Power ratings for horizontal operation at +25°C derate linearly to 5 W at +125°C

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Fixed Attenuators

Specifications

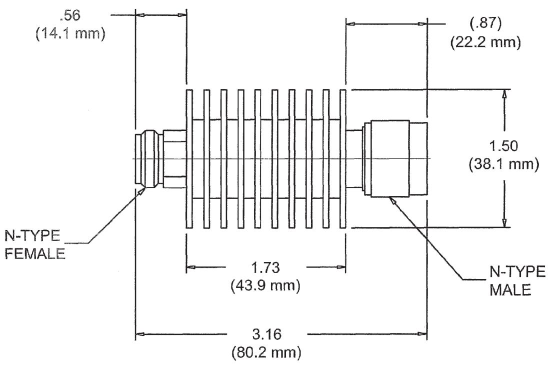
Type N (M/F), DC to 5 GHz, 50 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)			POWER INPUT		VSWR (max.)		WEIGHT (max.)	
		NOMINAL	DEVIATION		AVERAGE* (W max.)	PEAK (kW max.)				
			DC-3	3-5			DC-3	3-5	oz.	gr.
DC-5	**765A-3**	3	±0.30	±0.50	50	2	1.20	1.30	11	300
	765A-6	6	±0.30	±0.50	50	2	1.20	1.30	11	300
	765A-10	10	±0.30	±0.50	50	2	1.20	1.30	11	300
	765A-20	20	±0.30	±0.50	50	2	1.20	1.30	11	300
	765A-30	30	±0.50	±0.70	50	2	1.20	1.30	11	300

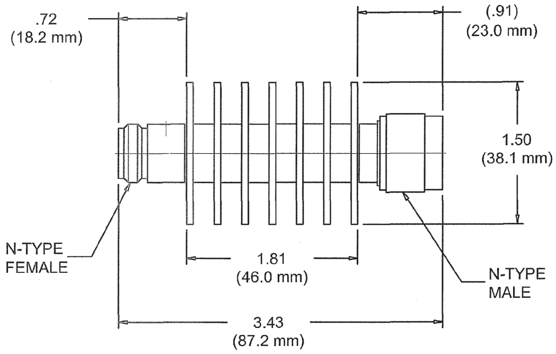
* Power ratings for horizontal operation at +25°C derate linearly to 5 W at +125°C

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

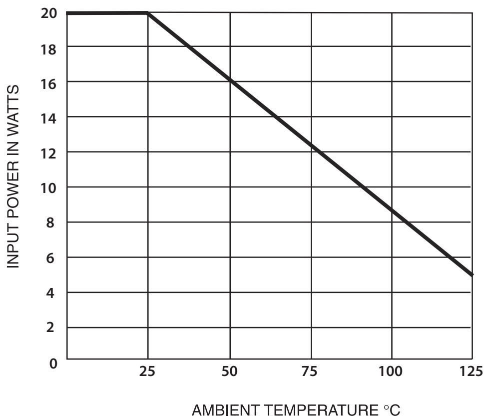
Outline Drawings



Model 766A Series



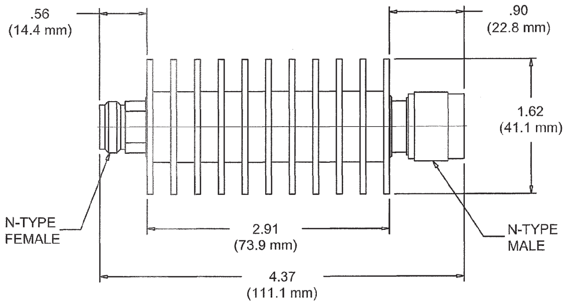
Model 768A Series



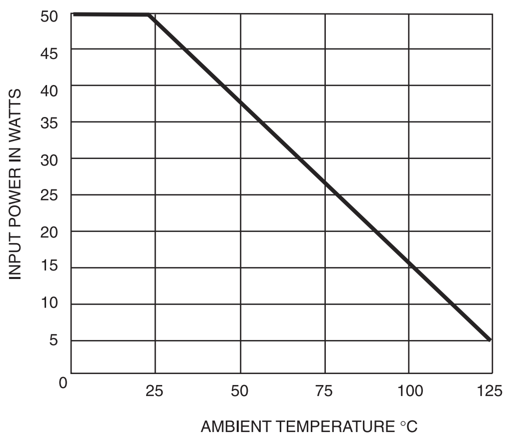
Derating Curve, Horizontal Operation
766A and 768A Series

Dimensions in inches (mm in parentheses), unless otherwise specified.

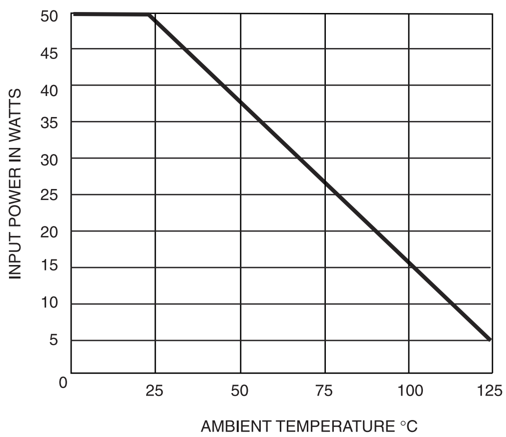
Fixed Attenuators



Model 765A Series



Derating Curve, Horizontal Operation
765A Series



Derating Curve, Horizontal Operation
Models 765A, 776 and 776C Series

Dimensions in inches (mm in parentheses), unless otherwise specified.

DC-18 GHz

Type N High Power Bi-Directional Fixed Coaxial Attenuators

- High Power
- 3, 6, 10, 20 and 30 dB at 150 W
- 10, 20, 30, 40, 50 and 60 dB at 100 W

Specifications

Type N (M/F), DC to 6 GHz, 150 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)			POWER INPUT		VSWR (max.)	WEIGHT (max.)	
		NOMINAL	DEVIATION		AVERAGE* (W max.)	PEAK (kW max.)			
			DC-2	2-6				lbs.	kg.
DC-6	769A-3	3	±0.4	±0.75	150	3	1.35	3.3	1.5
	769A-6	6	±0.4	±0.75	150	3	1.35	3.3	1.5
	769A-10	10	±0.4	±0.75	150	3	1.35	3.3	1.5
	769A-20	20	±0.5	±1.00	150	3	1.35	3.3	1.5
	769A-30	30	±0.5	±1.00	150	3	1.35	3.3	1.5

* Power ratings for horizontal operation at +25°C derate linearly to 5 W at +125°C

NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Type N (M/F), DC to 18 GHz, 100 W

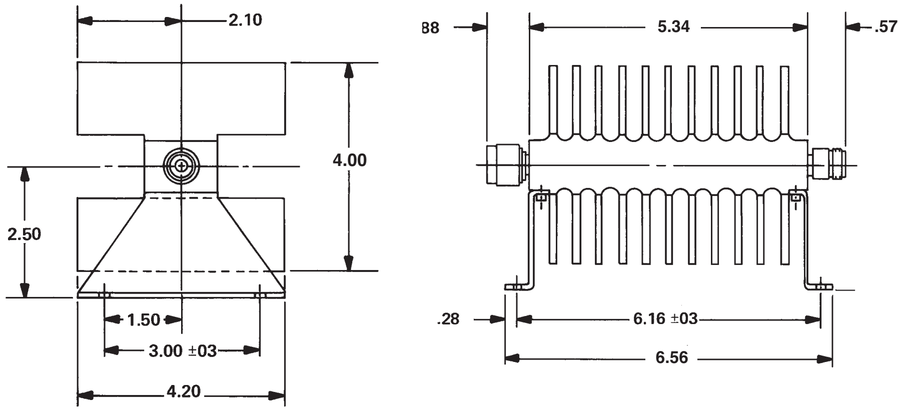
FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)		POWER INPUT		VSWR (max.)			WEIGHT (max.)	
		NOMINAL	DEVIATION	AVERAGE* (W max.)	PEAK (kW max.)	DC - 8	8 - 12.4	12.4 - 18	lbs.	kg.
DC - 18	770-10	10	±1.2	100	1	1.25	1.30	1.40	3.0	1.36
	770-20	20	±1.4	100	1	1.25	1.30	1.40	3.0	1.36
	770-30	30	±1.4	100	1	1.25	1.30	1.40	3.0	1.36
	770-40	40	±2.5	100	1	1.25	1.30	1.40	1.75	0.7
	770-50	50	±3.0	100	1	1.25	1.30	1.40	1.75	0.7
	770-60	60	±3.5	100	1	1.25	1.30	1.40	1.75	0.7

* Power ratings for horizontal operation at +25°C derate linearly to 10 W at +125°C

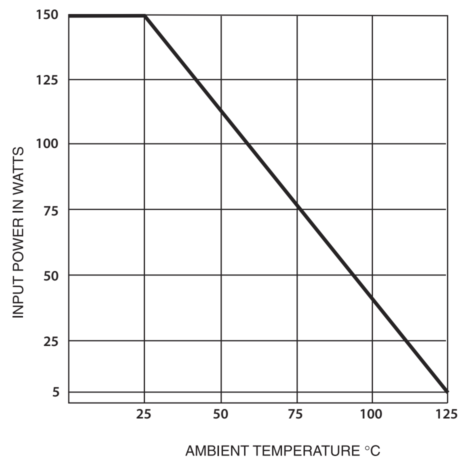
NOTE:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W

Fixed Attenuators

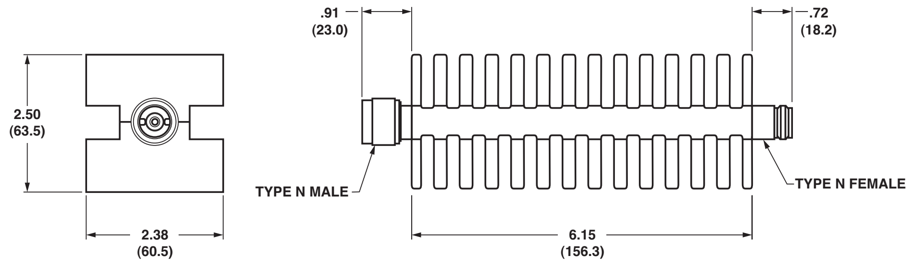
Outline Drawings



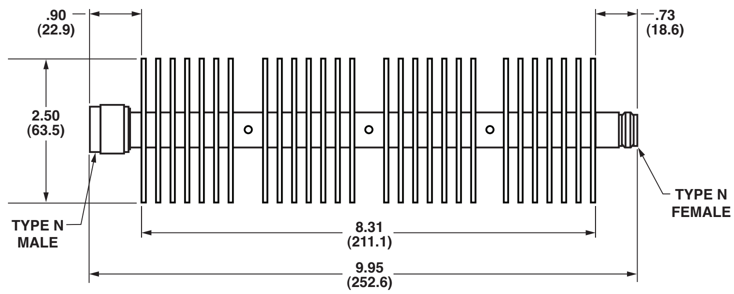
Model 769A Series



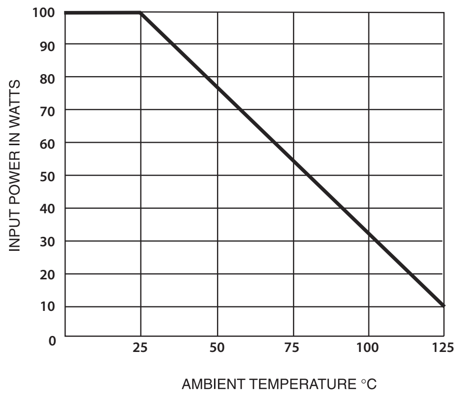
Derating Curve, 125° C - Horizontal Operation
769A Series



Model 770 -10, -20, -30



Model 770 -40, -50, -60



Derating Curve, Horizontal Operation
770 Series

Dimensions in inches (mm in parentheses), unless otherwise specified.

Fixed Attenuators

DC-18 GHz

Precision Fixed Attenuator Sets

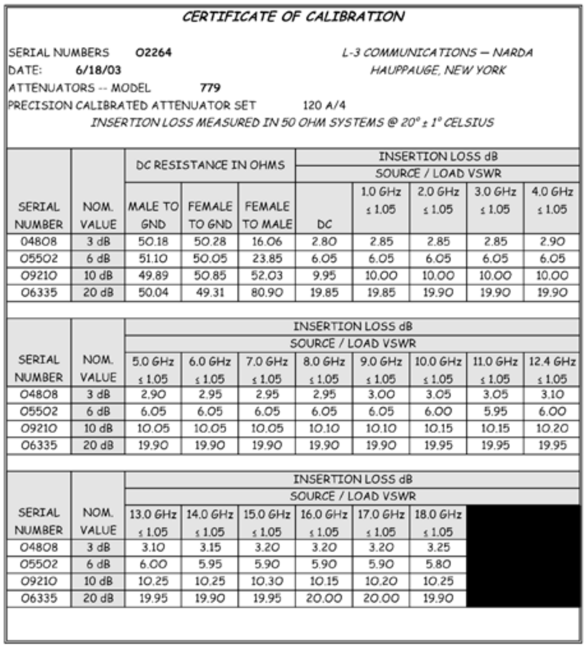
- Calibrations Traceable to NIST
- Extremely Low Frequency Sensitivity
- Designed to Meet Environmental Requirements of MIL-A-3933E

Specifications

Type N (M/F), DC to 18 GHz, 2 W

FREQUENCY RANGE (GHz)	MODEL	ATTENUATORS	ABSOUTE CALIBRATION ACCURACY (per 10 dB step)	AVERAGE POWER (W)
DC-12.4	118A/4	1 each of Models 777C-3, 777C-6, 777C-10, 777C-20	0.05	2
DC-12.4	119A/4	1 each of Models 757C-3, 757C-6, 757C-10, 757C-20	0.05	2
DC-18	120A/4	1 each of Models 779-3, 779-6, 779-10, 779-20	0.05	2

NOTES:
Temperature Coefficient: 0.0006 dB/dB/°C; Power Coefficient: 0.0005 dB/dB/W.
See Catalog pages 42-43 for the individual Attenuator RF specifications.



CERTIFICATE OF CALIBRATION

SERIAL NUMBERS 02264
DATE: 6/18/03
ATTENUATORS -- MODEL 779
PRECISION CALIBRATED ATTENUATOR SET 120 A/4

L-3 COMMUNICATIONS – NARDA
HAUPPAUGE, NEW YORK

INSERTION LOSS MEASURED IN 50 OHM SYSTEMS @ 20° ± 1° CELSIUS

SERIAL NUMBER	NOM. VALUE	DC RESISTANCE IN OHMS			INSERTION LOSS dB SOURCE / LOAD VSWR				
		MALE TO GND	FEMALE TO GND	FEMALE TO MALE	DC	1.0 GHz ≤ 1.05	2.0 GHz ≤ 1.05	3.0 GHz ≤ 1.05	4.0 GHz ≤ 1.05
04808	3 dB	50.18	50.28	16.06	2.80	2.85	2.85	2.85	2.90
05502	6 dB	51.10	50.05	23.85	6.05	6.05	6.05	6.05	6.05
09210	10 dB	49.89	50.85	52.03	9.95	10.00	10.00	10.00	10.00
06335	20 dB	50.04	49.31	80.90	19.85	19.85	19.90	19.90	19.90

SERIAL NUMBER	NOM. VALUE	INSERTION LOSS dB SOURCE / LOAD VSWR							
		5.0 GHz ≤ 1.05	6.0 GHz ≤ 1.05	7.0 GHz ≤ 1.05	8.0 GHz ≤ 1.05	9.0 GHz ≤ 1.05	10.0 GHz ≤ 1.05	11.0 GHz ≤ 1.05	12.4 GHz ≤ 1.05
04808	3 dB	2.90	2.95	2.95	2.95	3.00	3.05	3.05	3.10
05502	6 dB	6.05	6.05	6.05	6.05	6.05	6.00	5.95	6.00
09210	10 dB	10.05	10.05	10.05	10.10	10.10	10.15	10.15	10.20
06335	20 dB	19.90	19.90	19.90	19.90	19.90	19.95	19.95	19.95

SERIAL NUMBER	NOM. VALUE	INSERTION LOSS dB SOURCE / LOAD VSWR					
		13.0 GHz ≤ 1.05	14.0 GHz ≤ 1.05	15.0 GHz ≤ 1.05	16.0 GHz ≤ 1.05	17.0 GHz ≤ 1.05	18.0 GHz ≤ 1.05
04808	3 dB	3.10	3.15	3.20	3.20	3.20	3.25
05502	6 dB	6.00	5.95	5.90	5.90	5.90	5.80
09210	10 dB	10.25	10.25	10.30	10.15	10.20	10.25
06335	20 dB	19.95	19.90	19.95	20.00	20.00	19.90

Sample Certificate of Calibration

DC-18 GHz

Thumb Wheel and Panel Mount Step Attenuators

- Broadband DC-18 GHz
- Small Size
- Precision Construction/High Reliability
- Precision 1 dB or 10 dB steps, to 69 dB
- Panel Mount* or Stand Alone

Specifications

Type N (F), DC to 18 GHz

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	ATTENUATION (dB)	RESETTABILITY PER DRUM (dB)	POWER		VSWR (max.)	IMPEDANCE (ohms)	TEMPERATURE STABILITY (dB/dB/°C)
					AVERAGE (W)	PEAK (kW at duty cycle of 0.0001)			
DC-18	**741**	Type N (F)	0-9 in 1 dB steps	<0.05	2	0.2	1.50	50	0.0001
	4741	SMA (F)	0-9 in 1 dB steps	<0.05	2	0.2	1.50	50	0.0001
	743-60	Type N (F)	0-60 in 10 dB steps	<0.05	2	0.2	1.50	50	0.0001
	4743-60	SMA (F)	0-60 in 10 dB steps	<0.05	2	0.2	1.50	50	0.0001
	745-69	Type N (F)	0-69 in 1 dB steps	<0.05	2	0.2	DC-12.4 GHz: 1.50 12.4-18 GHz: 1.65	50	0.0001
	4745-69	SMA (F)	0-69 in 1 dB steps	<0.05	2	0.2	DC-12.4 GHz: 1.50 12.4-18 GHz: 1.65	50	0.0001

Relative Attenuation Deviation (dB)

MODEL 741, 4741		MODEL 743-60, 4743-60		MODEL 745-69, 4745-69	
STEP (dB)	DEVIATION	STEP (dB)	DEVIATION	STEP (dB)	DEVIATION
0	0.5	0	0.5	0	1.0
1	± 0.5	10	±0.5	1-9	±0.5
2	± 0.5	20	±0.7	10-19	±1.0
3	± 0.5	30	±0.9	20-29	±1.2
4	± 0.5	40	±1.0	30-39	±1.4
5	± 0.5	50	±1.3	40-49	±1.5
6	± 0.5	60	±1.5	50-59	±1.9
7	± 0.5			60-69	±2.0
8	± 0.5				
9	± 0.5				

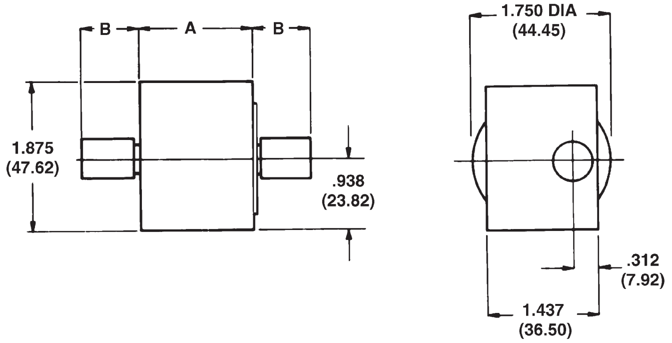
* Field-installable Mounting Kit must be purchased separately as Part No. **43017200**.
Rack Mounting Kit accommodates all attenuator series housings.

Step Attenuators

Ordering Information

1. Prefix "7" denotes Type N Stainless Steel Connectors (741, 743, 745).
   Prefix "47" denotes SMA Stainless Steel Connectors (4741, 4743, 4745).
2. All units are bidirectional.
3. Field-installable Mounting Kit must be purchased separately as Part No. 43017200.

Outline Drawing

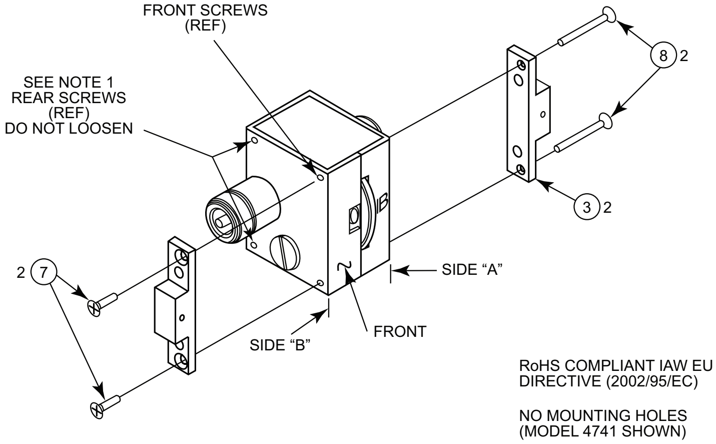


MODEL	A	B (max.)	CONNECTOR
741	1.125 (28.75)	.781 (19.83)	Type N (F)
743-60	1.437 (36.5)	.781 (19.83)	Type N (F)
745-69	2.250 (57.15)	.781 (19.83)	Type N (F)
4741	1.125 (28.75)	.437 (11.10)	Type SMA (F)
4743-60	1.437 (36.5)	.437 (11.10)	Type SMA (F)
4745-69	2.250 (57.15)	.437 (11.10)	Type SMA (F)

Dimensions in inches (mm in parentheses), unless otherwise specified.
Connectors made without interference per MIL-STD-348.

Panel Mounting Brackets Installation Instructions

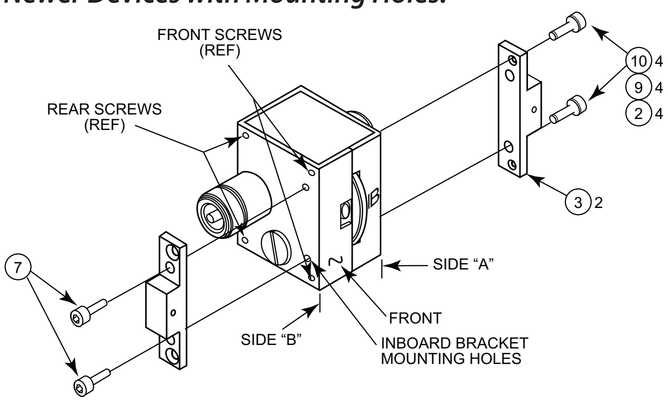
For Older Devices without Mounting Holes:



This drawing gives instructions for installation of panel mounting brackets on a model 741, 4741, 743, 4743, 745, 4745, thumbwheel turret attenuator.

1. Working: from the front of side "A", remove the two FRONT screws. **DO NOT loosen or otherwise disturb the two rear screws.**
2. Install mounting bracket (item 3) using two flat head screws (item 8) as shown on side "A".
3. Install mounting bracket (item 3) using two flat head screws (item 7) as shown on side "B".
4. Make sure mounting brackets are flush with front of unit.

For Newer Devices with Mounting Holes:



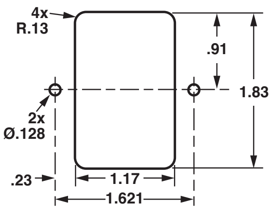
1. Working from the front of side "B", locate inboard bracket mounting holes.
2. Install bracket (item 3) using screw lock washer (item 10) and flat washer #6 (item 2). Carefully insert the screw assembly through the inboard mounting holes on the bracket and into the inboard screw holes on the housing.
3. Make sure the bracket is flush with the front of the unit and tighten the screws.
4. Repeat above steps for "A" side.

Materials Supplied with Mounting Kit Part Number 43017200

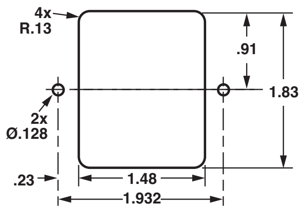
FIND NO.	IDENT. NO.	DESCRIPTION	QTY. FOR MODELS 741, 4741, 743 and 4743	QTY. FOR MODELS 744 and 4745
10	535338136	LOCKWASHER #6	4	4
9	70152019	SCR, SOCKET HD. #632 x 3/8 L.	4	4
8	551959020	SCR, FLAT #4-40 x 7/8 LG.	2	—
8	551959019	SCR, FLAT HD. #4-40 x 3/4 LG.	—	2
7	551959015	SCR, FLAT HD. #4-40 x 3/8 LG.	2	—
7	551959022	SCR, FLAT HD. #4-40 x 1-1/4 LG.	—	2
3	42452200	BRACKET MOUNTING	2	2
2	515795805	WASHER, FLAT #6	4	4

Suggested Cutouts

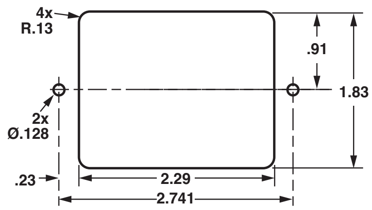
Dimensions in inches, unless otherwise specified.



741 and 4741



743-60 and 4743-60



745-69 and 4745-69

DC-2.5 GHz

Commercial Use Step Attenuators

- For Commercial Wireless Applications

Specifications

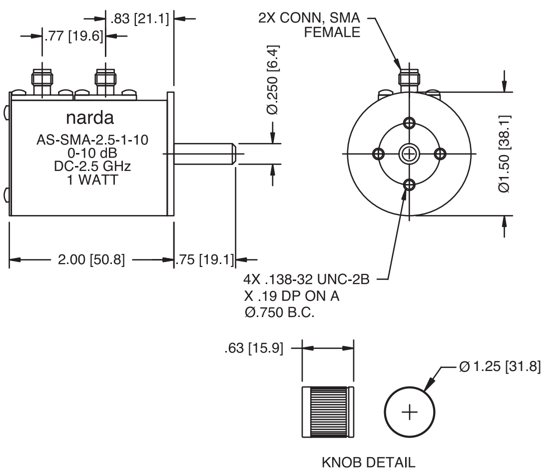
SMA (F), DC to 2.5 GHz

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	ATTENUATION ACCURACY (dB)	ATTENUATION RANGE	POWER AVERAGE (W)	POWER PEAK (kW)	INSERTION LOSS (dB max.)	VSWR (max.)
DC-2.5	**AS-SMA-2.5-1-10**	SMA(F)	DC-1.1: ±0.25 1.1-2.2: ±0.50 2.2-2.5: ±0.60	0-10 dB in 1 dB steps	1	1	DC-1.1: 0.25 1.1-2.5: 0.50	DC-1.1: 1.25 1.1-2.5: 1.50
	AS-SMA-2.5-1-50	SMA(F)	DC-0.5: ±0.2 or 1%* 0.5-1.0: ±0.3 or 3%* 1.0-2.5: ±0.4 or 3%*	0-50 dB in 1 dB steps	1	1	DC-1.0: 0.6 1.0-2.5: 1.1	DC-0.5: 1.2 0.5-1.0: 1.4 1.0-2.5: 1.5
	AS-SMA-2.5-1-70	SMA(F)	DC-0.5: ±0.5 or 1%* 0.5-1.0: ±0.5 or 2%* 1.0-2.5: ±0.5 or 3%*	0-70 dB in 10 dB steps	1	1	DC-1.0: 0.3 1.0-2.0: 0.5 2.0-2.5: 0.6	DC-1.0: 1.2 1.0-2.0: 1.4 2.0-2.5: 1.5
	AS-SMA-2.5-2-1	SMA(F)	±0.5	0-1 dB in 0.1 dB steps	2	1	1.0	DC-1.1: 1.2 1.1-2.5: 1.4

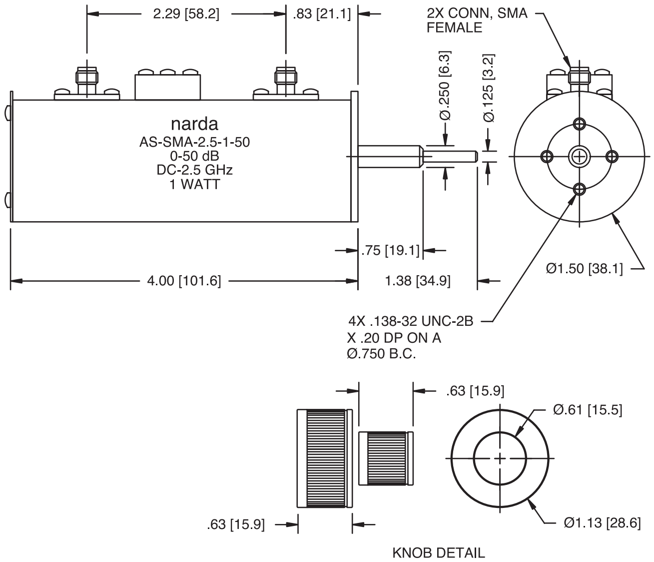
* Whichever is greater

NOTE:
Operational Temperature Range: -20°C to +85°C

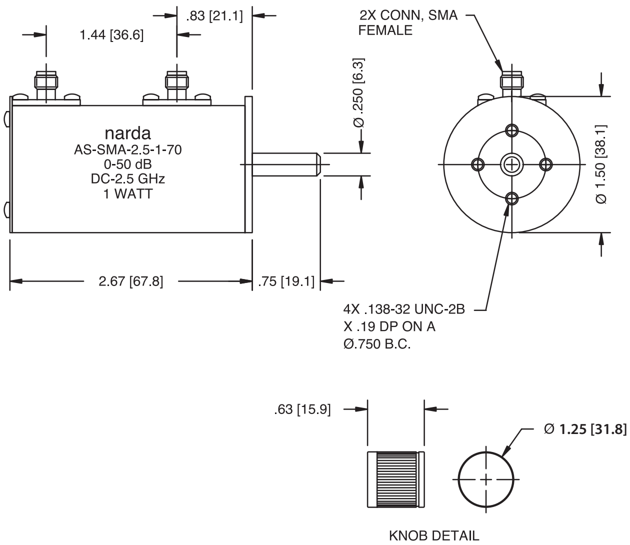
Outline Drawings



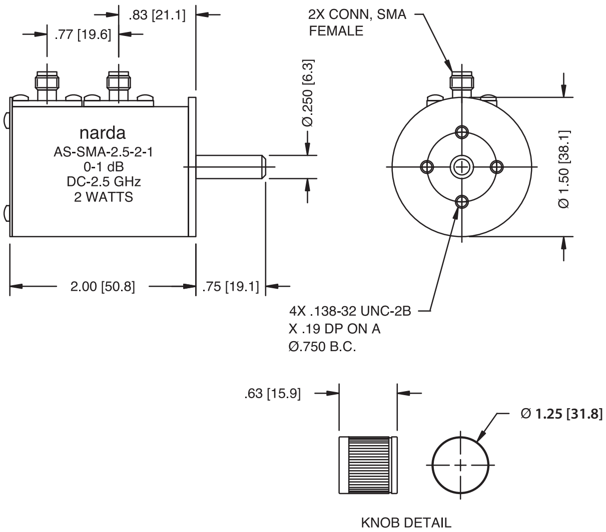
MODEL
AS-SMA-2.5-1-10



MODEL
AS-SMA-2.5-1-50



MODEL
AS-SMA-2.5-1-70



MODEL
AS-SMA-2.5-2-1

Dimensions in inches (mm in parentheses), unless otherwise specified.
Connectors made without interference per MIL-STD-348.

0.8-2.5, 4-26.5 GHz

Miniature Variable Attenuators

- Low Minimum Insertion Loss
- Small Size, Lightweight
- Operational to 105°C without Degradation (125°C storage)
- Excellent for Communications

Specifications

SMA (F), 0.8 to 18 GHz

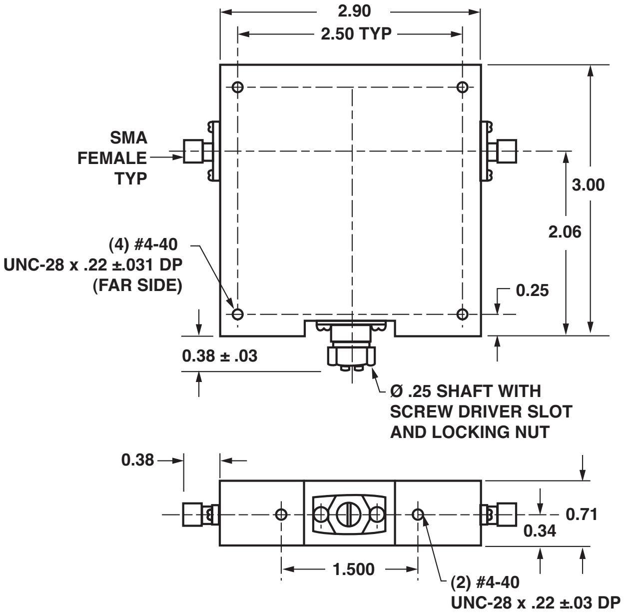
FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB min.)	POWER INPUT AVERAGE (W max.)	POWER INPUT PEAK (kW max.)	VSWR (max.)	INSERTION LOSS (dB max.)	FREQUENCY SENSITIVITY (dB)	WEIGHT (max) oz.	WEIGHT (max) gr.
0.8-2.5	**4790***	20	5	3	1.5	0.5	—	10.6	300
4-18	**4791**	15	5	3	4-11 GHz: 1.5 11-18 GHz: 1.7	1.0	±3.5	5.5	160
8-18	**4792**	30	5	3	8-11 GHz: 1.5 11-18 GHz: 1.7	8-12.4 GHz: 0.5 12.4-18 GHz: 1.0	±3.5	5.5	160
12.4-18	**4793**	30	5	3	1.7	1.0	±2.0	5.5	160

3.5 mm (F), 7 to 26.5 GHz

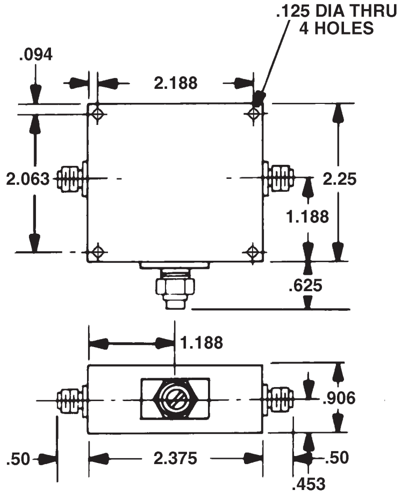
FREQUENCY RANGE** (GHz)	MODEL	ATTENUATION (dB min.)	POWER INPUT AVERAGE (W max.)	POWER INPUT PEAK (kW max.)	VSWR (max.)	INSERTION LOSS (dB max.) 7 - 12.4	INSERTION LOSS (dB max.) 12.4 - 26.5	FREQUENCY SENSITIVITY (dB)	WEIGHT oz.	WEIGHT gr.
7 - 26.5	**4796**	15	5	1.4	1.7 ‡	0.7	1.5	±3.0	7.5	213

* Due to the sensitivity of existing dielectric properties, this model does not exhibit flat frequency sensitivity.
** Usable to 33 GHz
‡ Maximum VSWR from 12.4 - 18 GHz is 1.6

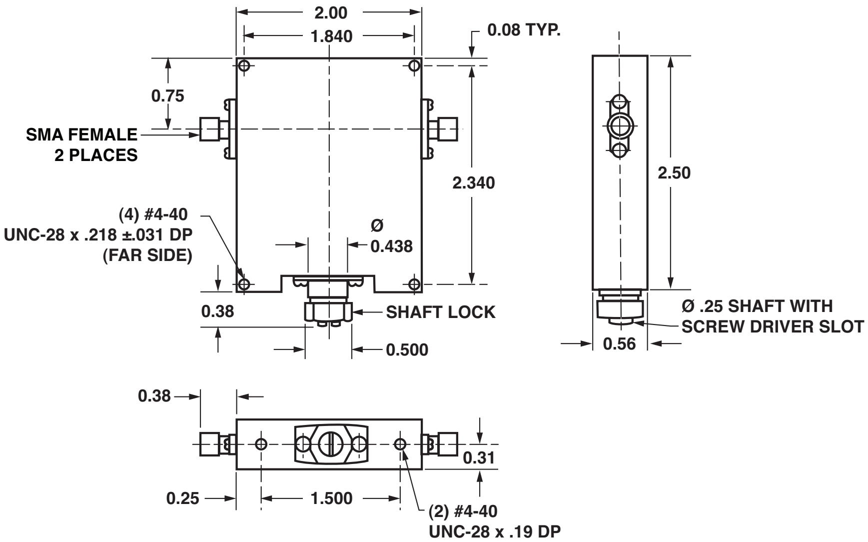
Outline Drawings



MODEL 4790



MODEL 4796



MODELS 4791, 4792, 4793

Dimensions in inches, unless otherwise specified.

Variable Attenuators

2-12.4 GHz

Broadband Variable Attenuator

- Smooth, Continuous Operation Over Full Range
- High Attenuation Over a Broad Frequency Range
- Small Size, Lightweight

Specifications

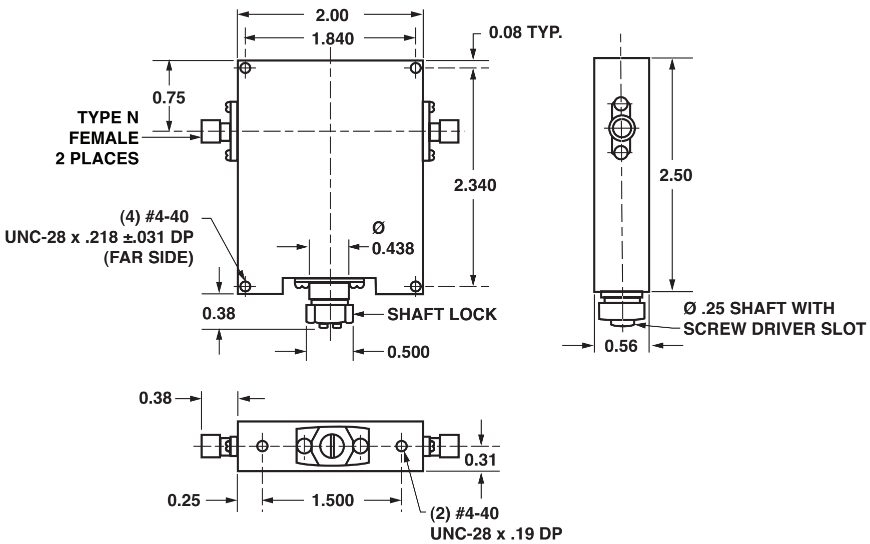
Type N, 2 to 12.4 GHz

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)	POWER INPUT		VSWR (max.)		INSERTION LOSS (dB max.)	FREQUENCY SENSITIVITY* (dB)	WEIGHT (max)	
			AVERAGE (W max.)	PEAK (kW max.)	2-11	11-12.4			oz.	gr.
2-12.4	**787FF**	20	5	3	1.5	1.7	1.0	—	6.1	170

* Due to the sensitivity of existing dielectric properties, this model does not exhibit flat frequency sensitivity.

NOTES:
Connectors are Type N stainless steel.
All units are supplied with female input and output connectors.
Type N male connector(s) available on a custom order basis.

Outline Drawing



Dimensions in inches, unless otherwise specified.

4-8 GHz

Broadband Variable Attenuator

- Flat Frequency Response
- Smooth Continuous Operation Over Full Frequency Range

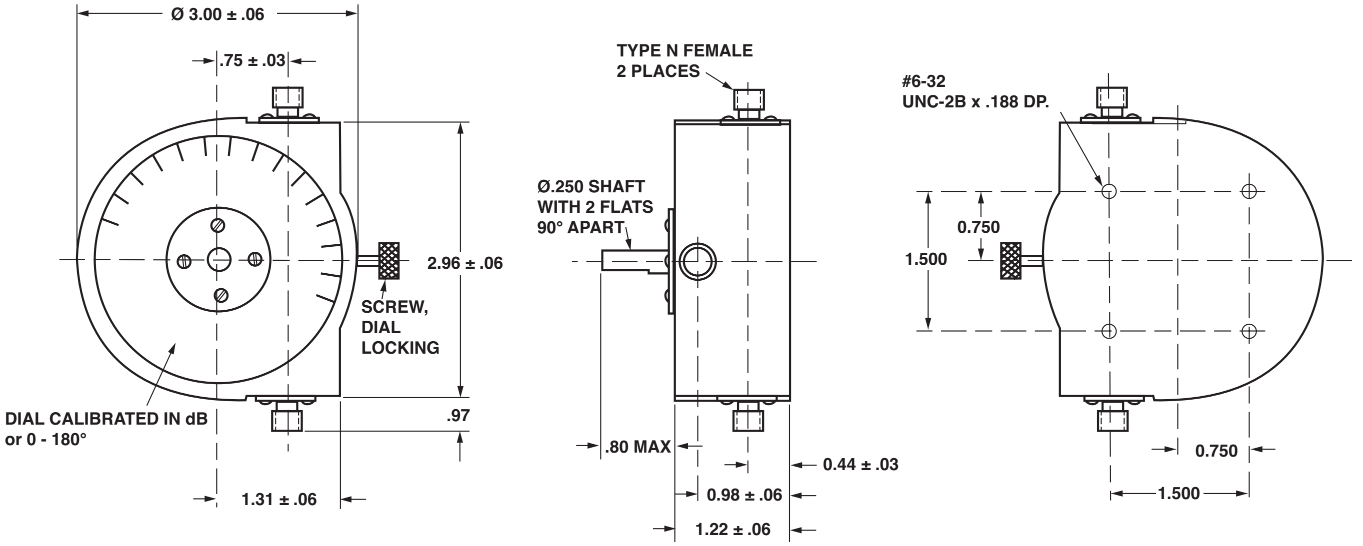
Specifications

Type N, 4 to 8 GHz

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)	POWER INPUT AVERAGE (W max.)	POWER INPUT PEAK (kW max.)	VSWR (max.)	INSERTION LOSS (dB max.)	FREQUENCY SENSITIVITY (dB)	WEIGHT (max.) oz.	WEIGHT (max.) gr.
4-8	**788FF**	20	10	5	1.5	0.5	±2.5	16	454

NOTES:
Connectors are Type N stainless steel.
All units are supplied with female input and output connectors.
Type N male connector(s) available on a custom order basis.

Outline Drawing



Dimensions in inches, unless otherwise specified.

1-4 GHz

High Power Variable Attenuators

- High power (500 W) Handling Capability
- Adjustable by Micrometer

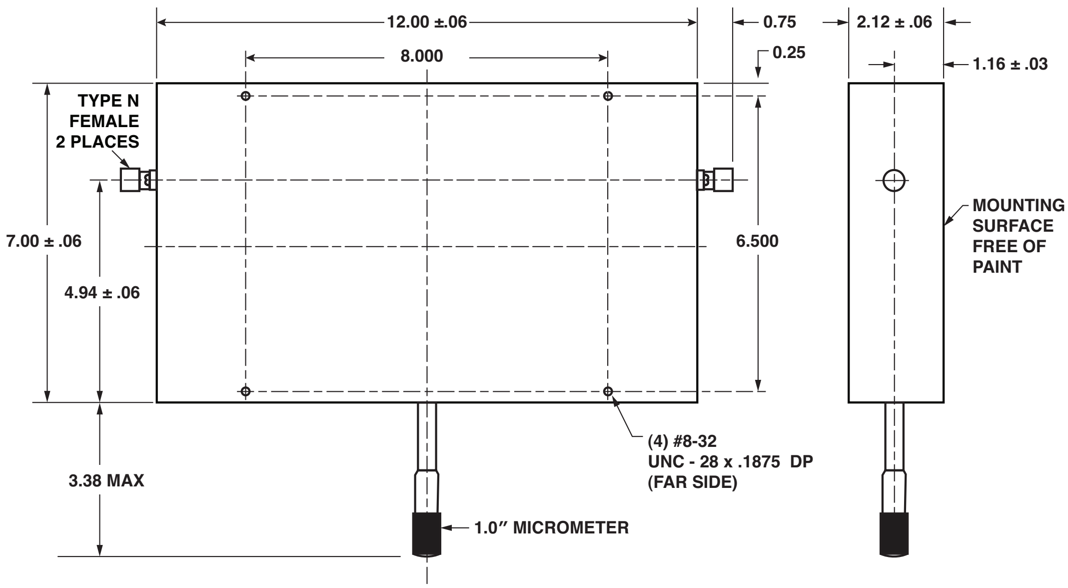
Specifications

Type N, 1 to 4 GHz

FREQUENCY RANGE (GHz)	MODEL	ATTENUATION (dB)	POWER INPUT		VSWR (max.)	INSERTION LOSS (dB max.)	FREQUENCY SENSITIVITY* (dB)	WEIGHT (max)	
			AVERAGE (W max.)	PEAK (kW max.)				lb.	kg.
1-2	**795**	10	500	10	1.5	0.5	—	7	3.18
2-4	**796**	20	500	10	1.5	1.0	—	7	3.18

* Due to the sensitivity of existing dielectric properties, these models do not exhibit flat frequency sensitivity.

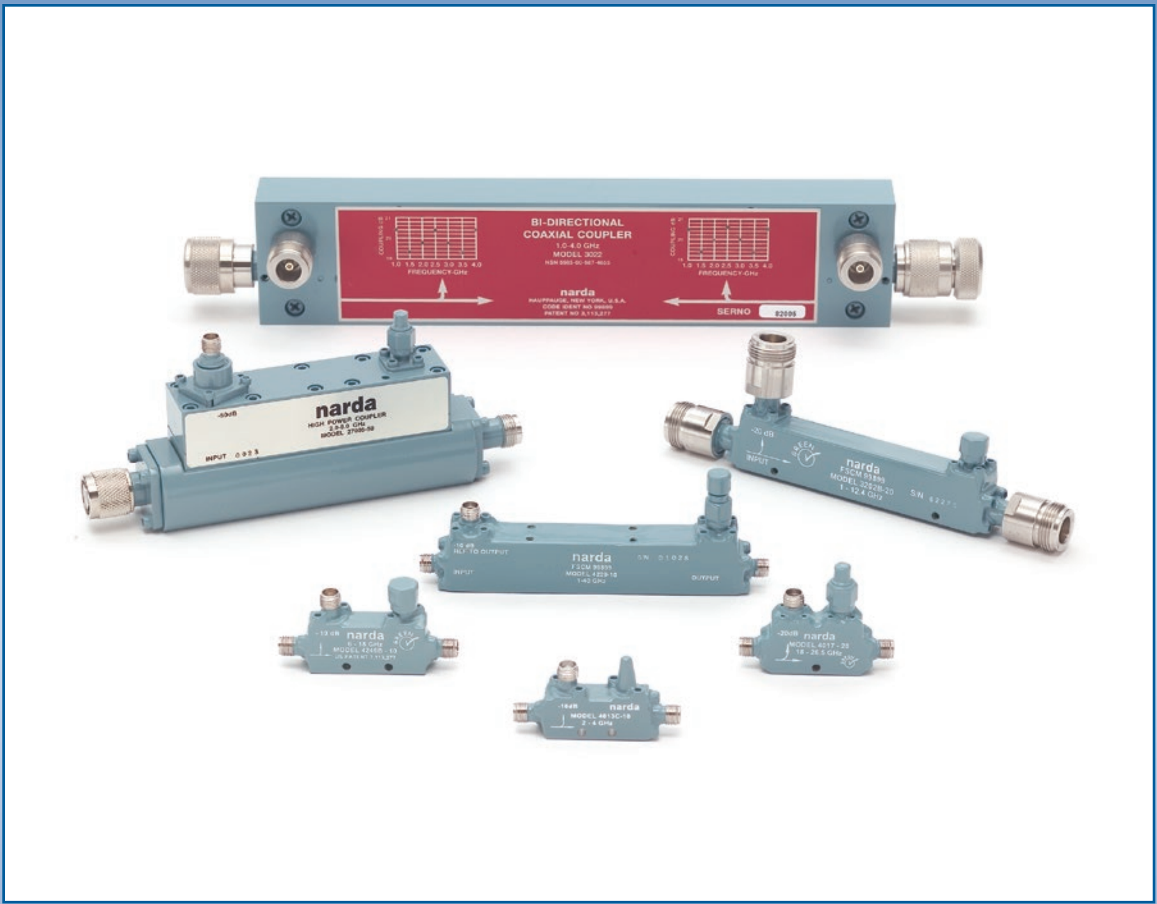
Outline Drawing



MODELS 795 and 796

Dimensions in inches, unless otherwise specified.

Couplers



narda MITEQ

Couplers

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL SERIES	CONNECTOR	PAGE
1-40	4229	2.92 mm	76
18-40	4018	2.92 mm	76
1.7-26.5	4227	2.92 mm	80
6-26.5	4247	2.92 mm	80
18-26.5	4017	2.92 mm	80
0.5 -18	4226	SMA	85
1-18	3222	Type N	84
1-18	3292	Type N	99
1-18	4222	SMA	84
1-18	5292	7 mm	99
2-18	3060	Type N	95
2-18	3203	Type N	84
2-18	4203	SMA	84
2-18	27000	Type N	87
2-18	27003	TNC	87
6-18	4196	SMA	86
6-18	4246B	SMA	82
6-18	27001A	Type N	87
6-18	27004A	TNC	87
7-18	3096	7 mm	97
12.4-18	4016C	SMA	78
12.4-18	4016D	SMA	78
7.5-16	4055	SMA	78
1-12.4	3202B	Type N	84
1-12.4	4202B	SMA	84
4-12.4	4245B	SMA	82
7-12.4	3045C	Type N	93
7-12.4	3095	7 mm	97
7-12.4	4015C	SMA	78
4-10	3004	Type N	91

FREQUENCY RANGE (GHz)	MODEL SERIES	CONNECTOR	PAGE
3.7-8.3	3094	7 mm	97
0.5-8	4216	SMA	78
2-8	4244	SMA	82
2-8	27002	Type N	87
2-8	27002SC	SC	89
2-8	27005	TNC	87
2-8	27005SC	SC	89
4-8	3024	Type N	95
4-8	4014C	SMA	78
1.7-4.2	3043B	Type N	93
1.7-4.2	3093	7 mm	97
2-4	3003	Type N	91
2-4	4013C	SMA	78
1-4	3022	Type N	95
1-3.5	4243	SMA	82
0.7-2.5	3171	Type N	101
0.92-2.2	3042B	Type N	93
0.95-2.2	3092	7 mm	97
1.7-2.1	3161	Type N	101
1.7-2.1	4161	SMA	101
0.5-2.0	4242	SMA	82
0.95-2.0	3002	Type N	91
1.0-2.0	4012C	SMA	78
0.05-1.0	3020A	Type N	95
0.5-1.0	4011C	SMA	78
0.82-0.98	3151	Type N	101
0.82-0.98	4151	SMA	101
0.46-0.95	3001	Type N	91
0.225-0.460	3000	Type N	91

Environmental Performance for Selected Passive Products*

PARAMETER	SPECIFICATION
Operating Temperature	-54 to +105°C
Storage Temperature	-55 to +125°C
Humidity	Per MIL-STD-202F, method 103B, condition B (96 hours at 95% R.H.)
Shock	Per MIL-STD-202F, method 213B, condition J (30G, 11 msec)
Altitude	Per MIL-STD-202F, method 105G, condition B (50,000 feet)
Vibration	Per MIL-STD-202F, method 204D, condition B (.06" double amplitude or 15G, which ever is less)
Thermal Shock	Per MIL-STD-202F, method 107D, condition A (5 cycles)

* Applicable to Stripline Directional Couplers, Attenuators, Power Dividers

NOTE: This is an exclusive listing. Where otherwise noted in the catalog, the above environmental performance may not apply. Not applicable for those products designed for commercial applications. Many of our catalog off-the-shelf (COTS) products have the ability to withstand considerably more stringent environments. If you have special environmental requirements, please contact the Sales Department at Narda-MITEQ.

Introduction

In today's microwave practice, the directional coupler is a virtually indispensable measurement tool. It provides a simple, convenient, and accurate means for sampling microwave energy without moving parts and without the need for adjustments. Unlike other methods of power sampling involving probes or coupling loops, the directional coupler also provides the important capability of separating forward from reflected power. By selecting energy traveling only in one direction, as a function of the device directivity, accurate VSWR measurements can be facilitated, eliminating the mechanical motion needed with a slotted line. Attenuation measurements also become more accurate when directional couplers are used since reflection errors are eliminated.

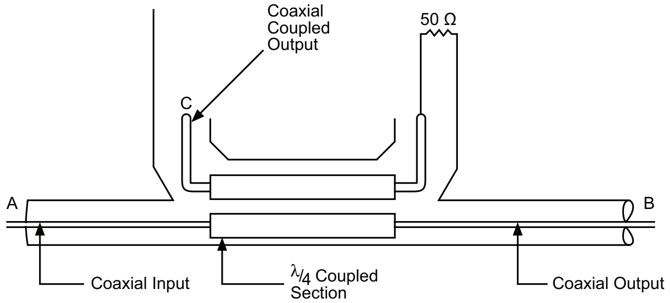


Figure 1. Diagram of a typical directional coupler

The basic construction of a coupled-line directional coupler can be seen in Figure 1, which illustrates a typical coaxial-line, microwave directional coupler such as might be used for microwave applications. It consists of two parallel striplines coupled over a length of approximately one-quarter wavelength. The mainline input (A) and output (B) coaxial lines are connected to one stripline; the other stripline is terminated in Z_o at one end, and is connected to the coupled output port through a coaxial line (C). The two sections, referred to respectively as the main and auxiliary lines, are separated from each other except for the coupling area, through which energy is unidirectionally coupled from the main line to the auxiliary line. An internal view of a typical Narda-MITEQ coaxial coupler is shown in Figure 2.

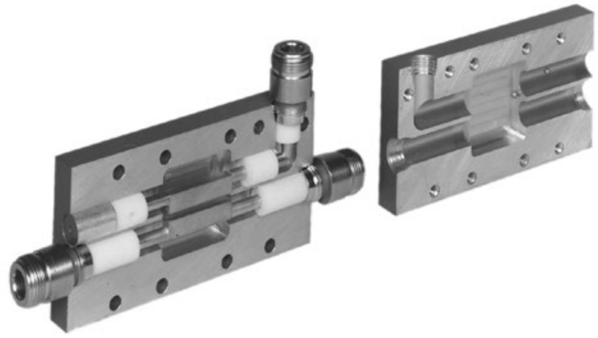


Figure 2. Internal view of a typical coaxial coupler

In operation, energy is fed into end A of the main line. Most of this energy will appear at the output end B. Some fraction of the energy, however, will appear at the output of the auxiliary line C, depending upon the amount of coupling provided in the design of the unit. Energy applied to end B of the main line will appear at A, but practically none of this energy will appear at the auxiliary output C. The degree of discrimination in the auxiliary line between energy flowing in the B to A direction and energy flowing in the A to B direction is the directivity of the coupler. Directivity is calculated as the ratio of the forward to reverse coupling, expressed in dB. Since the intention is to ensure that a minimum of reflected energy reaches the load on the auxiliary line, the ideal directional coupler will have an infinite value of directivity. The amount of coupling desired for forward power, however, will vary with the application. Consequently, coupling values from 6 dB to beyond 70 dB are frequently encountered.

Types Of Directional Couplers

Although a wide variety of configurations and packages have been built, most directional couplers fall into a relatively small number of well-defined types according to the intended service and sampling capabilities. Typical categories are: waveguide or coaxial, single- or dual-directional units, and combination types.

Coaxial directional couplers are offered for use at frequencies from 10 MHz to 40 GHz, and can be obtained with any of the standard or precision miniature coaxial connectors. Dual directional couplers, which permit simultaneous sampling of both forward and reflected energy, consist essentially of two directional couplers connected back to back in a single package and are available for coaxial systems. Figure 3 shows typical Narda-MITEQ directional coupler configurations.

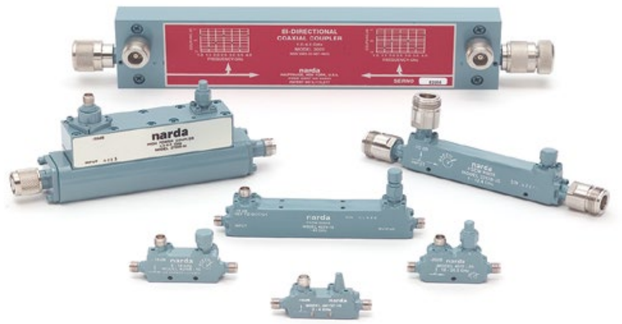


FIgure 3. High Directivity Directional Couplers

In addition, as special-order devices, a number of combination types are available, such as those which include couplers combined with detectors, referred to as directional detectors. For some applications, couplers are designed without the internal termination in the secondary line, permitting the user to terminate that line either with an absorbing load of his selection or with other RF instrumentation as desired.

Selection Features

Published specifications for directional couplers usually include coupling, directivity, insertion loss, main line and auxiliary line VSWR, bandwidth, frequency sensitivity and power handling capability. These and other terms commonly used in specifying coupler characteristics are defined below.

Coupling Coefficient - The ratio in dB of the incident power fed into the main port, to the coupled port power when all ports are terminated by reflectionless terminations. Some Narda-MITEQ couplers are principally used for power leveling, and the coupling coefficient of these couplers is expressed as the ratio in dB of the main-line power output to the power output at an auxiliary port.

Directivity - The ratio in dB of the power output at an auxiliary port, when power is transmitted in the preferred direction, to the power output at the same auxiliary port when the same amount of power is transmitted in the opposite direction. Reflectionless terminations are connected to all ports.

Insertion Loss - The change in load power, due to the insertion of a component in a transmission system, reflectionless terminations being connected to the ports of the inserted component.

Residual VSWR - The standing wave ratio measured by a reflectometer coupler terminated by a reflectionless termination, and fed from a nonreflecting generator. (Directivity or return loss expressed as a VSWR.)

Bandwidth - The range of frequencies within which performance, with respect to some characteristic, falls within specific limits.

Frequency Sensitivity (or Flatness) - The maximum peak-to-peak variation in coupling coefficient over a specified frequency band.

Tracking - The maximum change in the difference of the coupling coefficient ratio of two coupler paths.

The relative importance of each of these characteristics will, of course, vary with the particular application. It should be noted that some of these characteristics tend to conflict; for example, it is difficult to obtain both flatness over a broad bandwidth and high directivity. Selection of a coupler for each application thus requires evaluating the major performance parameters in terms of the intended service.

Coupling Coefficient

Narda-MITEQ directional couplers are offered in a choice of convenient standard and non-standard coupling values. While the standard coupling values of 6, 10, 20 and 30 dB are most common, several catalog models are available in alternative coupling values (13 or 16 dB, for example), including devices that provide up to 60 dB of coupling.

As is the case with the majority of our family of passive products, special models are available if they are required. Since our ability to provide a special coupler will be gated by the particulars of the requirement (volume factors, cost factors, etc.), we will often recommend the use of a standard-value coupler in conjunction with a fixed precision attenuator attached to the coupled port. With this configuration, any number of non-standard coupling values can be achieved very cost effectively.

The choice of the specific value of coupling coefficient will usually depend upon the power levels involved. Where auxiliary (coupled) output is used to feed a measuring device, the coupling must provide adequate signal levels without overloading the equipment. It must be remembered, also, that any coupler takes power out of the main line, the magnitude of this drain being dependent upon the amount of coupling between the main and auxiliary lines. For example a 20 dB coupler will reduce the transmitted power by 1%, while a 6 dB coupler will reduce the transmitted power by 25%. In specifying coupling coefficient, therefore, it may be necessary to consider the amount of power loss that can be tolerated in the portion of the system following the coupler.

Coupling coefficient is measured with an absolute accuracy of ±0.1 dB per 10 dB. Flatness is measured to an accuracy of ±0.05 dB relative to other points.

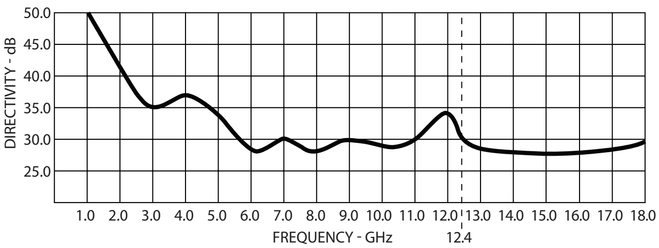


Figure 4. Typical directivity curve for Models 3292 and 5292 Broadband High Directivity Couplers

Directivity

In power measurements, the degree to which the auxiliary line is isolated from the load is of particular importance where high measurement accuracy is required. In power measuring application, where the absolute magnitude of the sample is the significant value, reverse coupling into the auxiliary line will alter the magnitude of this sample, with resulting measurement error. Errors from reflected power can be severe when the directivity is not adequate. In reflectometry, where the VSWR of a test piece is measured, accuracy is closely dependent upon the directivity of the coupler used. Here the effect of poor directivity is to introduce a residual reflection which adds to or subtracts from the reflected energy of the device. The graph in Figure 4 shows a typical directivity curve for Narda-MITEQ Models 3292 and 5292 Broadband High Directivity Couplers. These devices provide the hightest broadband directivity per-formance available.

Insertion Loss

The term "insertion loss" has the same significance with respect to directional couplers as for other components in a microwave system. That is, it describes the loss resulting from the insertion of the device into a transmission system.

Narda-MITEQ couplers now carry two insertion loss specifications: insertion loss, in accordance with the industry standard definition (see page 70); and insertion loss, excluding coupled power. This latter term allows for some ambiguity in characterizing couplers with coupling coefficients less than 15 dB. It is calculated value based on what the insertion loss would be if no power were coupled to the auxiliary port or ports. The insertion loss "excluding coupled power" specification is given in this catalog (where applicable) for reference only.

Voltage Standing Wave Ratio (VSWR)

In waveguide couplers, where coupling between main and auxiliary line is accomplished through holes or slots, VSWR can be held to very low levels, often no greater than that resulting from a typical flange mismatch. In coaxial couplers, the proximity effects, end effects and capacitive effects from the coupling bars employed generally result in higher values of VSWR. The major source of high VSWR in coaxial couplers, however, is usually found in the connectors employed. The particular structure of standard coaxial connectors introduces an appreciable amount of reflection. Consequently, where the application requires minimum reflection back into the main line, precision laboratory connectors are required.

Bandwidth

For laboratory applications, it is customary to select couplers with as broad a bandwidth as possible, simply because broad bandwidth affords greater flexibility in handling the changing day-to-day measurement tasks. Where bandwidth is under consideration it should be noted, however, that broad frequency range is usually accompanied by reduced directivity and increased VSWR. For very narrow bandwidths it is possible to maintain coupling coefficient to within 0.1 dB of nominal value and to achieve directivities over 40 dB. Where the coupler is required to operate over an octave frequency band the coupling tolerance may have to be increased. Thus, when a choice is possible, it is best to specify the narrowest bandwidth compatible with the application requirements.

Frequency Sensitivity

Directional couplers are available in single and multi-section design. Single (1/4 λ) section couplers exhibit frequency response similar to that shown in Figure 5, Curve A. The multi-section type couplers exhibit a flat frequency response over their frequency range as shown in Figure 5, Curve B.

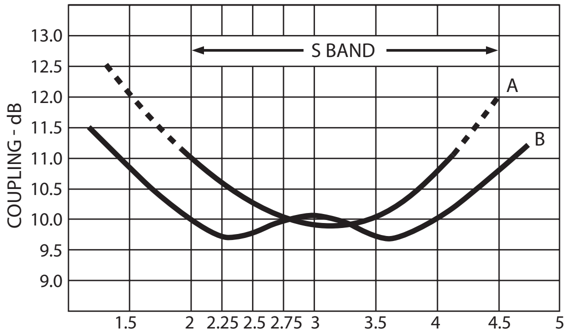


Figure 5. Typical response curves of single and multi-section directional couplers. Curve A represents 1/4λ; Curve B represents maximally flat response curve.

Where a band of frequencies must be sampled, as in swept-frequency measurements, the "flatness" or frequency sensitivity of the coupler is of major importance. Manufacturers differ in the method of specifying frequency sensitivity. In some instances, variation of coupling with frequency is expressed as the deviation from the nominal value; in others, as the excursion around the mean value of coupling over the range. Where couplers are to be used over a band of frequencies, manufacturers may provide a calibration chart showing the actual coupling as specified frequencies across the band. The Narda-MITEQ Model 3040 Series Maximally Flat Directional Couplers have a flatness specification of ±0.25 dB over an extended band and are, in addition, calibrated at five points within the octave.

Power Rating

Power ratings for directional couplers are usually specified for both CW power and peak pulse power, in both the forward and reverse directions. These ratings represent the maximum levels at which the unit can operate without altering its characteristics and/or cause irreversible damage to the device.

NOTE: For applicable Narda-MITEQ Couplers, Narda-MITEQ can supply standard test data for a nominal fee.

Applications

Power Measurements

Although the directional coupler finds a variety of uses as a power "splitter," in many applications it is used as a calibrated power sampler in a measurement system. Among its most common applications is the measuring or monitoring of microwave power. Because it can sample transmission line power by a definite known amount, accurate measurements can be conveniently made without interrupting operation of the system. The accuracy of measurement with a given detector-meter combination will depend upon the accuracy of sampling, that is, upon the absolute magnitude of the coupling. With the coupling coefficient known, the meter may be calibrated to provide a direct indication of power at the input to the coupler. Figure 6 is an example of such an application.

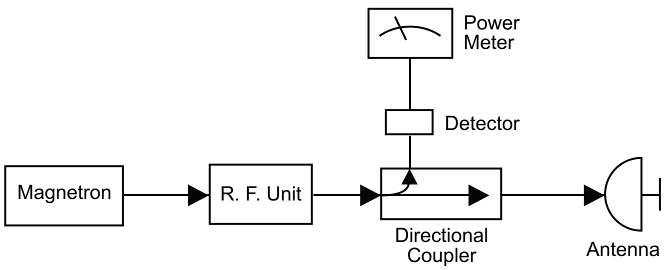


Figure 6. Directional couplers and power meters used for measuring power in the microwave portion of a radar system.

Frequency Measurements

The directional coupler is especially useful in measuring or monitoring frequency in operating systems since it permits measurements without disrupting operation. The requirement for uninterrupted operation, without interference from the measuring device, is met by using a resonant cavity wavemeter or a direct reading counter in conjunction with a directional coupler.

Signal Leveling

In swept frequency measurements, some form of signal leveling is virtually mandatory. Although sweep generators are available with leveled outputs, an external closed loop method of leveling is usually necessary to eliminate uncertainties introduced by cables and other components between the generator and the test piece.

Such a leveling loop can be conveniently arranged through the use of a directional coupler and detector.

Reflection Coefficient Measurements

The ability of swept-frequency techniques to provide broadband plots of microwave reflection characteristics (in a fraction of the time required for point-by-point measurements) affords obvious advantages. Speed and convenience are provided where testing time and costs are important considerations. Recognition of these advantages led to continuing refinement of swept-frequency reflectometer systems. As a result, a choice of swept-frequency techniques is now available for measuring reflection coefficient and VSWR in coaxial components, providing both the accuracy demanded for laboratory work and the speed and efficiency required for production-line testing. Improvements in coupler design and manufacturing techniques have significantly increased the accuracy of coaxial reflectometry. Today's reflectometer couplers provide directivities as much as an order of magnitude greater than previously obtainable.

In applications such as production-line testing, the reflectometer is a common method of measuring reflection coefficient, VSWR and impedance since this method offers advantages of speed and convenience, as the dual directional coupler (incorporating two auxiliary outputs) permits the simultaneous sampling of incident and reflected power.

Figure 7. Directional Coupler with SC Connectors

Purpose and Use of Equipment

Reflectometer couplers offer a significant cost savings over microwave vector network analyzers for production test stations and monitoring VSWR during environmental testing. The test set-up consists of a sweep generator, matching attenuator or isolator, scalar network analyzer, and a precision laboratory reflectometer coupler (Narda-MITEQ 3090 Series, 3020A, 3022, 3024 Dual Couplers and 3292 Broadband Couplers). Data can be stored in an electronic file or plotted for a paper copy. The reflectometer is excellent for detecting intermittent problems while a unit is under environmental test.

Principles of Reflectometer Operation

The reflectometer coupler consists of two precision air-line directional couplers, with rigid structure enclosing the two couplers to ensure protection for the critical parts of the coupling mechanism. The coupled line impedances have been perfectly balanced.

Discontinuities where the transmission line connects to the coupling mechanism and at bead supports are designed for broadband impedance match to achieve the desired high directivity. Since the twin couplers are effectively positioned back-to-back, a portion of the RF microwave power applied to the input port is coupled out of the incident power port at a level 10 dB down from the applied power level. The remainder of applied power appears at the main line output port and is applied to the load. Coupling variations (also referred to as frequency sensitivity) between the main line input and coupled incident output ports are calibrated at five discrete frequencies within the octave bandwidth and vary not more than ±1.0 dB from the nominal 20 dB coupling value.

Figure 8. Coaxial Dual Directional Coupler

The ability of a dual directional coupler to provide an accurate measure of incident or reflected power is enhanced by the tracking between the incident and reflected output ports. Therefore, the coupling variation of frequency sensitivity of the reflected output port should ideally be identical to that of the incident output port. RF power applied to the load is reflected to some degree depending on load characteristics, thereby resulting in a voltage standing wave ratio (VSWR) which is reflected back to the main line output port. This reflected power is coupled out of the reflected output port at a level 10 dB down from the reflected power level at the load. Since the tracking of the forward and reverse ports is held to a total of 0.3 dB, the coupling variation at the reflected output port closely follows that of the incident output port.

In addition to exhibiting excellent tracking characteristics, the dual directional coupler also features as high a directivity as possible. Directivity can be expressed as the ratio of power being coupled out of the reflected port, with the main line output terminated by a precision termination, to the power being coupled out of the incident port. If a portion of the incident power is coupled out of the reflected output port it essentially adds, randomly, to the reflected power from the load, thereby introducing an error. Likewise, if a portion of the reflected power appears at the incident output port, it adds to the normal incident coupled power. Therefore, a true measure of incident and reflected power for accurate determination of reflection coefficient and VSWR depends on coupler directivity; the higher the directivity, the more accurate the measurement. As previously mentioned, the reflectometer coupler exhibits a directivity of 45 dB minimum at L-band.

The single-ended coupler is a single air-line directional coupler for use in measuring transmission gain or loss characteristics in a swept measurement setup with the reflectometer coupler, or for use in RF power measurement setups. Besides exhibiting similar high directivity to the reflectometer coupler, in each of the five bands, the coupled output port (10 dB) of this device also provides tracking (0.3 dB) with respect to the incident port of the reflectometer set. As a result, simultaneous measurement of reflection coefficient and transmission gain or loss characteristics is possible in a single swept measurement system.

Design Theory

A coaxial directional coupler has the general appearance of a section of coaxial line, with the addition of a second parallel section of line and with one end terminated (see Figure 9).

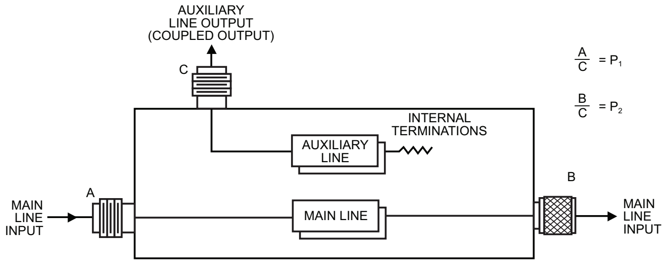


Figure 9. Single-Ended Coaxial Directional Coupler

These two sections are known as the main and auxiliary lines. The two lines are internally separated from each other; the amount of spacing between lines determines the amount of RF energy that may be transferred from the main line to the auxiliary line. In operation, assume that energy is fed into port A of the main line. Most of this energy will appear at output port B of the main line. However, a fraction of this energy (determined by coupling value) will also appear at the coupled port C, of the auxiliary line.

A dual-directional coaxial coupler, such as the reflectometer coupler, consists essentially of two single-ended couplers connected back-to-back. Perhaps the most important characteristic of the directional coupler (and the one from which its name originates) is its directivity.

Directivity and Coupling

Directivity means that energy entering output port B of the main line will appear at input port A, but practically none of the energy will appear at coupled output port C of the auxiliary line. This characteristic has wide application in the measurement of RF microwave power. The coupling of a directional coupler, therefore, is the ratio of the power fed into input port A of the main line to the power appearing at output port C of the auxiliary line; it is usually expressed in decibel (dB) and is calculated in the same manner as any other form of attenuation.

Directivity is a measure of isolation obtainable at coupled port C with power being fed into the main line at output port B. Directivity is calculated in the same manner as previously indicated, except that the values of P_1 and P_2 refer, respectively, to the power at the auxiliary line output port C with power at the main line input port A, and the power at auxiliary output port C with the same power input at main line output port B. Since the intention is to have as little reflected energy as possible coupled out of port C, the values of directivity are usually high (25 to 40 dB), while the coupling values may range from as low as 10 dB to more than 30 dB.

A directional coupler is a very useful device for ensuring that an absolute minimum of energy in the reverse direction (such as reflected energy due to a load mismatch) reaches the detector or other device at port C of the auxiliary line. In a dual-directional coupler, reflected energy should appear at coupled output port D.

Confusion exists in many quarters as to why a considerable main-line VSWR does not interfere with the ability of a reflectometer coupler to measure low reflections. The following explanation should end this confusion: Power flow into test port B (Figure 10) is coupled directly to auxiliary line output port D with minimal reflections.

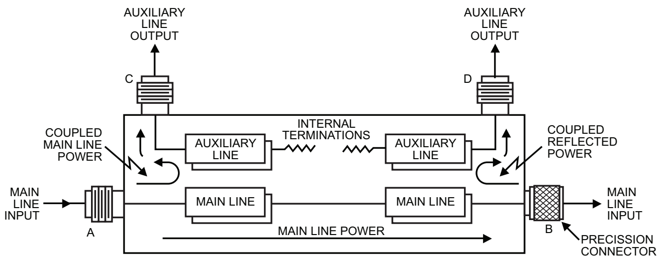


Figure 10. Dual Coaxial Directional Coupler

When using a coupler as a reflectometer, the directivity path includes only the connector and the transmission line to the decoupled port. When a signal is reflected from the test piece into port B, this reflected power will be coupled into the auxiliary line and will appear at the output port D. The VSWR of the reflected power is affected only by the output reflections on the main line.

Main-line VSWR is affected by the input connector, and by reflections all along the line, to the output connector. However, the main-line VSWR does not basically affect the above measurement at the coupled port because the major factors which contribute to the main line output VSWR are outside the path of the reflected power.

Main-line power is transmitted into the test port B direction towards the test piece. Ideally, any power that is coupled to the auxiliary line is absorbed by the internal termination. The main-line VSWR does not come into play when a measurement is made in the coupled direction. Thus, the main-line VSWR could be, for example, 1.20, but if the directivity is greater than 40 dB, a measurement can be made to better than 1.02 at the coupled port.

Millimeter Wave Couplers

1-40 GHz

Millimeter Wave Ultra-Broadband Directional Couplers

- Low Frequency Sensitivity
- High Directivity
- 2.92 mm Connectors

Applications

- EW Systems
- Radar
- Millimeter Wave Communications
- OEM Test Equipment

Specifications

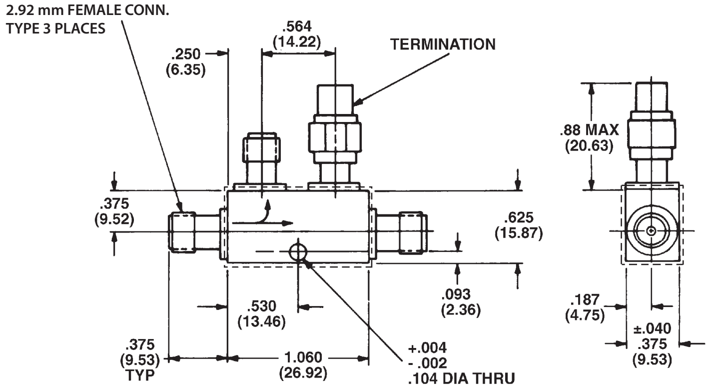
2.92 mm (F), 1 to 40 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	COUPLING (dB)	BAND SEGAMENTS (GHz)	DIRECTIVITY (dB)	INSERTION LOSS TRUE (dB)	VSWR		FREQUENCY SENSITIVITY (dB max.)	POWER		WEIGHT (max.)	
						PRIMARY LINE (max.)	SECONDARY LINE (max.)		AVG. (W)	PEAK (kW)	oz.	gr.
18-40	**4018-10**	10 ±1.25	18-40	12	2.0	1.9	1.9	±0.8	20	0.2	1	28
18-40	**4018-20**	20 ±1.25	18-40	12	1.45	1.9	1.9	±0.8	20	0.2	1	28
			1-20	15	1.5	1.4	1.6					
1-40	**4229-10**	10 ±1.50**	20-26	13	2.0	1.6	1.7	±1.0*	20	3	3.2	90
			26-40	12	2.4	1.7	1.75					

* Frequency Sensitivity included in coupling
** Referenced to output port

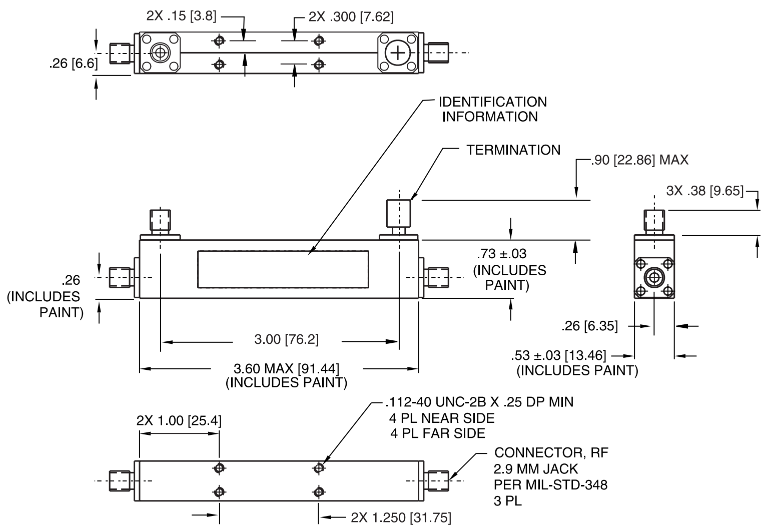
narda MITEQ www.nardamiteq.com **E-MAIL:** componentsnm@nardamiteq.com **TEL:** +1 631 231-1700

Outline Drawings



Dotted area represents .020 max. build-up of sealant per surface.

MODEL 4018



Allow .020 max. build-up of sealant per surface.

TOL:
XX ±.02[.51]
XXX ±.010 [.25]

MODEL 4229-10

Dimensions in inches (mm in parentheses), unless otherwise specified.

0.5-18 GHz

SMA Miniature Stripline Coaxial Couplers

- Smallest, Lightest Units Available from 0.5 to 18 GHz
- Highest Directivity, Lowest VSWR
- Excellent Frequency Flatness
- Operational to 105°C without Degradation (125°C Storage)

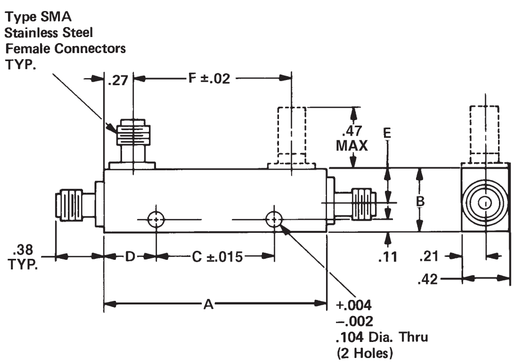
Specifications

SMA (F), 0.5 to 18 GHz, 50 W

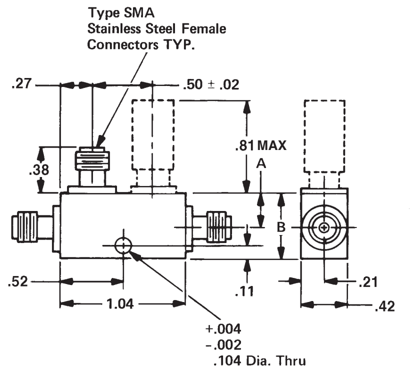
FREQUENCY RANGE (GHz)	MODEL	COUPLING (dB)	DIRECTIVITY (dB min.)	INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY * (dB max.)	POWER INPUT (W)	REFLECTED POWER		WEIGHT (max.)	
				EXCLUDING COUPLED POWER	TRUE	PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVG. (W)	PEAK (kW)	oz.	gr.
0.5-1	4011C-10	10 ±1.25	25	0.20	0.80	1.15	1.15	±0.75	50	5	3	1.3	37
	4011C-20	20 ±1.25	25	0.20	0.80	1.15	1.15	±0.75	50	50	3	1.2	34
1-2	4012C-6	6 ±1.00	25	0.20	1.80	1.15	1.15	±0.60	50	2	3	0.9	26
	4012C-10	10 ±1.25	25	0.20	0.90	1.10	1.10	±0.75	50	5	3	0.9	26
	4012C-20	20 ±1.25	27	0.20	0.20	1.10	1.10	±0.75	50	50	3	0.9	26
	4012C-30	30 ±1.25	27	0.20	0.20	1.10	1.10	±0.75	50	50	3	0.9	26
2-4	4013C-6	6 ±1.00	22	0.20	1.80	1.15	1.15	±0.60	50	2	3	0.6	18
	4013C-10	10 ±1.25	22	0.25	0.80	1.15	1.15	±0.75	50	5	3	0.6	18
	4013C-20	20 ±1.25	22	0.20	0.25	1.15	1.15	±0.75	50	50	3	0.6	18
	4013C-30	30 ±1.25	22	0.20	0.20	1.15	1.15	±0.75	50	50	3	0.6	18
0.5-8	4216-10	10 ±1.50	15	—	1.40	1.40	1.40	—	50	5	3	2.1	60
	4216-20	20 ±1.50	14	—	0.80	1.30	1.30	—	50	50	3	2.1	60
4-8	4014C-6	6 ±1.00	18	0.25	2.00	1.25	1.25	±0.60	50	2	3	0.6	18
	4014C-10	10 ±1.25	20	0.25	1.00	1.25	1.25	±0.75	50	5	3	0.6	18
	4014C-20	20 ±1.25	20	0.25	0.30	1.25	1.25	±0.75	50	50	3	0.6	18
	4014C-30	30 ±1.25	20	0.25	0.25	1.25	1.25	±0.75	50	50	3	0.6	18
7-12.4	4015C-6	6 ±1.00	15	0.40	2.00	1.30	1.30	±0.50	50	2	3	0.8	23
	4015C-10	10 ±1.25	17	0.40	1.00	1.30	1.30	±0.50	50	5	3	0.8	23
	4015C-20	20 ±1.00	17	0.30	0.35	1.25	1.25	±0.50	50	50	3	0.8	23
	4015C-30	30 ±1.00	17	0.30	0.30	1.25	1.25	±0.50	50	50	3	0.8	23
7.5-16	4055-6**	6 ±1.10	12	0.60	2.00	1.35	1.40	±0.60	50	2	2	0.8	23
	4055-10**	10 ±1.50	12	0.60	1.00	1.35	1.40	±0.75	50	5	2	0.8	23
	4055-20**	20 ±1.25	15	0.50	0.50	1.35	1.40	±0.75	50	50	2	0.8	23
	4055-30**	30 ±1.25	15	0.50	0.50	1.35	1.40	±0.75	50	50	2	0.8	23
12.4-18	4016D-6	6 ±1.00	15	0.30	2.00	1.35	1.40	±0.50	50	2	1	0.7	20
	4016D-10	10 ±1.00	15	0.30	0.85	1.30	1.40	±0.50	50	5	1	0.7	20
	4016C-20	20 ±1.00	15	0.50	0.55	1.30	1.40	±0.50	50	50	1	0.8	23
	4016C-30**	30 ±1.00	15	0.50	0.55	1.30	1.40	±0.50	50	50	1	0.8	23

* Frequency Sensitivity included in coupling
** Special order devices. Minimum quantity may apply.

Outline Drawings



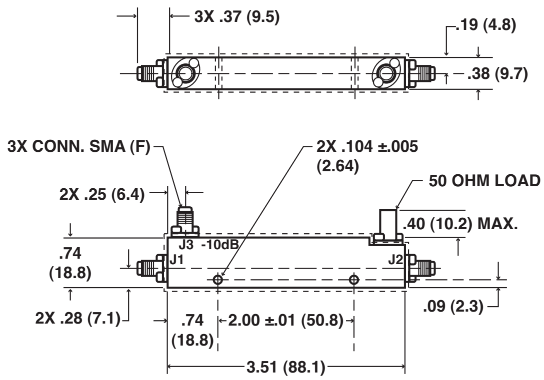
Allow .020 max. sealant build-up per surface.



Allow .020 max. sealant build-up per surface.

MODEL	A	B	C	D	E	F
4011C-10	3.06	.58	1.500	.78	.34	2.52
4011C-20	3.04	.55	1.750	.65	.30	2.50
4012C-6	1.82	.55	.938	.44	.30	1.28
4012C-10, -20	1.82	.55	.938	.44	.30	1.28
4012C-30	1.82	.58	.938	.44	.34	1.28
4013C-6	1.20	.55	.344	.43	.30	.66
4013C-10, -20	1.20	.55	.344	.43	.30	.66
4013C-30	1.20	.59	.344	.43	.35	.66

MODEL	Max. Dimensions	
	A	B
4014C-6, -10, -20	.30	.54
4014C-30	.34	.58
4015C-6, -10, -20	.30	.55
4015C-30	.43	.67
4016D-6, -10	.30	.55
4016C-20, -30	.43	.67
4055-6, -10	.30	.55
4055-20, -30	.43	.67



MODELS 4216-10, 4216-20

NOTES:

1. Dotted area represents .020 max. build-up of sealant per surface.
2. Connectors mate without interference per MIL-STD-348.

TOL:
XX ±.02 (.51)

Dimensions in inches (mm in parentheses), unless otherwise specified.

1.7-26.5 GHz

2.92 mm Connectors Ultra-Broadband Couplers

- Low Return Loss
- Excellent Flatness
- Superior Directivity
- Designed for MIL Environments

Specifications

2.92 mm (F), 6 to 26.5 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	COUPLING (dB)	DIRECTIVITY (dB min.)	INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY (dB max.)	POWER		WEIGHT (max.)	
				EXCLUDING COUPLED POWER	TRUE	PRIMARY LINE (max.)	SECONDARY LINE (max.)		AVERAGE (W)	PEAK (kW)	oz.	gr.
6-26.5	**4247B-10**	10 ±1	12	0.9	1.5	1.5	1.5	±0.75	20	0.2	1.0	28
6-26.5	**4247-20**	20 ±1*	13	0.7	0.8	1.45	1.45	±0.8	20	0.2	1.0	28

2.92 mm (F), 18 to 26.5 GHz, 30 W

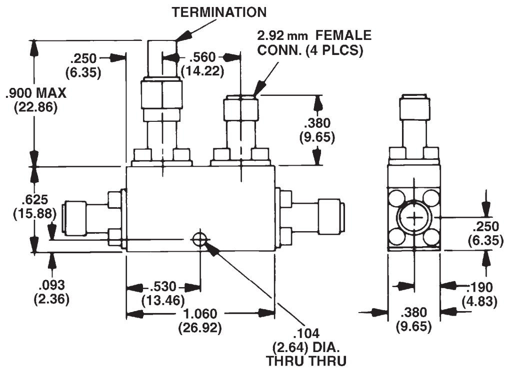
FREQUENCY RANGE (GHz)	MODEL	COUPLING (dB)	DIRECTIVITY (dB min.)	INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY (dB max.)	POWER		WEIGHT (max.)	
				EXCLUDING COUPLED POWER	TRUE	PRIMARY LINE (max.)	SECONDARY LINE (max.)		AVERAGE (W)	PEAK (kW)	oz.	gr.
18-26.5	**4017C-10**	10 ±1	12	0.9	1.5	1.5	1.5	±0.75	30	0.2	1.0	28
18-26.5	**4017-20**	20 ±1*	13	0.7	0.8	1.45	1.45	±0.8	30	0.2	1.0	28

2.92 mm (F), 1.7 to 26.5 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	COUPLING** (dB)	BAND SEGMENTS (GHz)	DIRECTIVITY (dB)	INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY** (dB max.)	POWER		WEIGHT (max.)	
					EXCLUDING COUPLED POWER	TRUE	PRIMARY LINE (max.)	SECONDARY LINE (max.)		AVERAGE (W)	PEAK (kW)	oz.	gr.
1.7-26.5	**4227-16**	16 ±1*	1.7-12.4 12.4-18.0 18.0-26.5	15 12 12	0.6 0.8 1.2	0.7 0.9 1.3	1.45	1.45	±1.0 ‡	20	0.2	1.9	54

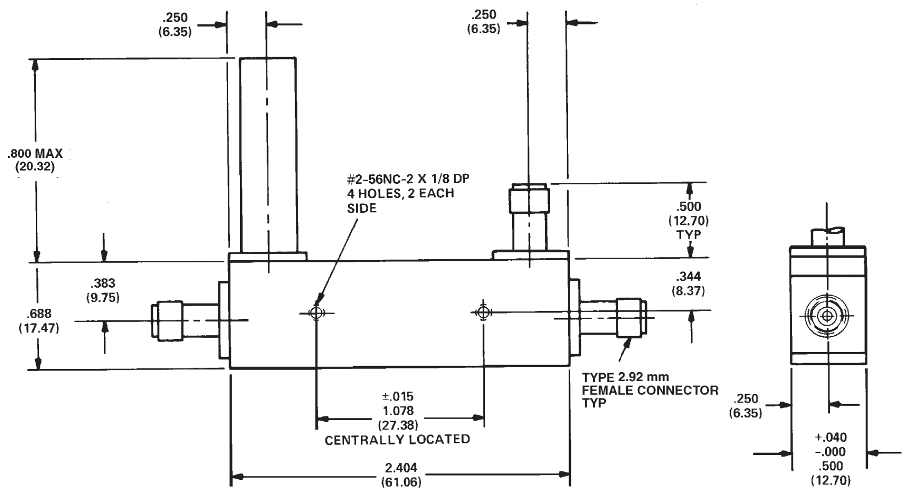
* Coupling is average value
** Referenced to output port
‡ Frequency sensitivity within 2-18 GHz band is ±0.5 dB

Outline Drawings



Allow .020 max. build-up of sealant per surface.

MODELS 4247B, 4247, 4017, 4017C



Allow .020 max. build-up of sealant per surface.

MODEL 4227-16

Dimensions in inches (mm in parentheses), unless otherwise specified.

Couplers

0.5-18 GHz

SMA Maximally Flat Miniature Stripline Coaxial Couplers

- Multi-Octave Frequency Coverage from 0.5 to 18 GHz
- Flat Frequency Response
- Small, Lightweight
- Operational to 105°C without Degradation (125°C storage)
- Designed for MIL Environments

Specifications

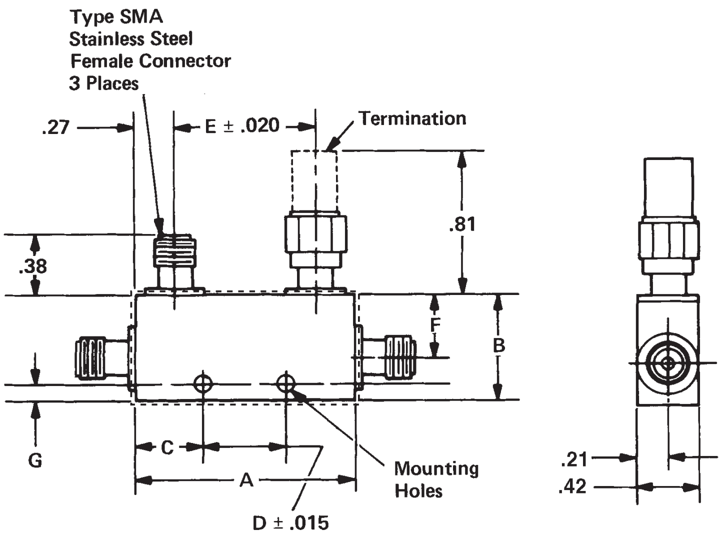
SMA (F), 0.5 to 18 GHz, 50 W

FREQUENCY RANGE (GHz)	MODEL	COUPLING (dB)	DIRECTIVITY (dB min.)	INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY* (dB max.)	MAXIMUM DEVIATION FROM NOMINAL (dB)	POWER		WEIGHT (max.)	
				EXCLUDING COUPLED POWER	TRUE‡	PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVERAGE FORWARD (W)	AVERAGE REFLECTED (W)	oz.	gr.
0.5-2	4242-6	6	22	0.35	2.00	1.20	1.20	±0.5	±1.0	50	2	2.5	71
	4242-10	10	22	0.35	0.90	1.20	1.20	±0.5	±1.0	50	5	2.5	71
	4242-20	20	22	0.35	0.40	1.20	1.20	±0.5	±1.0	50	50	2.8	80
1-3.5	4243-6	6	20	0.35	2.00	1.20	1.20	±0.3	±1.0	50	2	1.5	41
	4243B-10	10	23	0.35	0.90	1.20	1.20	±0.5	±1.0	50	5	1.5	41
	4243-20	20	23	0.35	0.40	1.20	1.20	±0.4	±1.0	50	50	1.8	50
2-8	4244-6	6	20	0.50	2.20	1.30	1.30	±0.4	±1.0	50	2	1.0	29
	4244-10	10	20	0.35	0.90	1.25	1.25	±0.5	±1.0	50	5	1.0	29
	4244-20	20	20	0.35	0.40	1.25	1.25	±0.4	±1.0	50	50	1.0	29
	4244-30	30	20	0.40	0.40	1.25	1.25	±0.5	±1.0	50	50	1.3	35
4-12.4	4245B-6**	6	16	0.50	2.20	1.30	1.30	±0.4	±1.0	50	2	0.7	21
	4245B-10	10	16	0.50	1.20	1.30	1.30	±0.4	±1.0	50	5	0.7	21
	4245B-20	20	15	0.50	0.60	1.30	1.30	±0.5	±1.0	50	50	0.8	24
	4245B-30**	30	15	0.50	0.50	1.30	1.30	±0.5	±1.0	50	50	0.8	24
6-18	4246B-6	6	15	0.80	2.50	1.40	1.40	±0.5	±1.0	50	2	0.9	25
	4246B-10	10	15	0.60	1.20	1.40	1.40	±0.5	±1.0	50	5	0.9	25
	4246B-20	20	15	0.60	0.70	1.40	1.40	±0.5	±1.0	50	50	0.9	25
	4246B-30	30	12	0.60	0.60	1.40	1.40	±0.5	±1.0	50	50	0.9	25

* Frequency Sensitivity included in coupling value.
** Special-order devices. Minimum quantity may apply.
‡ Typical true insertion loss at 5, 9, 19 and 29 dB

NOTE:
Peak Power for all models is 3 kW

Outline Drawing



MODEL	A	B	C	D	E	F	G	MOUNTING HOLES (THRU)
4242-6, -10	3.54	1.04	.85	1.843	3.000	.77	.36	.146 ±.005
4242-20	4.04	1.04	.77	2.500	3.500	.77	.16	.146 ±.005
4243-6, 4243B-10	2.92	.67	.48	1.968	2.384	.34	15	.146 ±.005
4243-20	2.92	.85	.59	1.750	2.384	.50	.16	.146 ±.005
4244-6, -10, -20	1.81	.67	.47	.875	1.274	.34	.15	.146 ±.005
4244-30	2.12	.82	.62	.875	1.584	.52	.11	.104 +.004/-.002
4245B-6, -10, -20, -30	1.26	.58	.44	.375	.719	.34	.11	.104 +.004/-.002
4246B-6, -10, -20, -30	1.40	.66	.45	.500	.860	.39	.11	.104 +.004/-.002

Allow .020 max. build-up of sealant per surface.
Dimensions in inches, unless otherwise specified.

0.5-18 GHz

SMA and Type N Broadband Coaxial Directional Couplers

- Flat Frequency Response
- Small Size, Lightweight
- Very Low, Fine Grain Ripple
- Designed for MIL Environments

Specifications

Type N (F) and SMA (F), 1 to 12.4 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	NOMINAL COUPLING** (dB)	DIRECTIVITY (dB)		INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY* (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	POWER		WEIGHT (max.)	
				1-8	8-12.4	EXCLUDING COUPLED POWER	TRUE (max.)	PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVERAGE (W)	PEAK (kW)	oz.	gr.
1-12.4	4202B-6	SMA	6	15	12	0.70	2.35	1.35	1.50	±0.5	±1.0	20	3	2.8	80
	4202B-10	SMA	10	15	12	0.70	1.30	1.35	1.50	±0.5	±1.5	20	3	2.7	77
	4202B-20	SMA	20	15	15	0.70	0.75	1.35	1.50	±0.5	±1.5	20	3	2.7	77
	3202B-10	N	10	15	12	0.70	1.30	1.45	1.50	±0.5	±1.5	20	3	4.5	128
	3202B-20	N	20	15	15	1.00	1.05	1.45	1.50	±0.5	±1.5	20	3	4.5	128

Type N (F) and SMA (F), 2 to 18 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	NOMINAL COUPLING** (dB)	DIRECTIVITY (dB)		INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY* (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	POWER		WEIGHT (max.)	
				2-12.4	12.4-18	EXCLUDING COUPLED POWER	TRUE (max.)	PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVERAGE (W)	PEAK (kW)	oz.	gr.
2-18	4203-6	SMA	6	15	12	0.90	2.00	1.40	1.40	±0.5	±1.0	20	3	2.0	59
	4203-10	SMA	10	15	12	0.90	1.40	1.35	1.50	±0.5	±1.0	20	3	2.2	65
	4203-16	SMA	16	15	12	0.65	0.80	1.35	1.40	±0.5	±1.0	20	3	1.8	51
	3203-16	N	16	15	12	0.85	1.00	1.40	1.40	±0.5	±1.0	20	3	3.4	96

Type N (F) and SMA (F), 1 to 18 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	NOMINAL COUPLING** (dB)	DIRECTIVITY (dB)		INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY* (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	POWER		WEIGHT (max.)	
				1-12.4	12.4-18	EXCLUDING COUPLED POWER	TRUE (max.)	PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVERAGE (W)	PEAK (kW)	oz.	gr.
1-18	4222-16	SMA	16	15	12	0.80	0.90	1.40	1.50	±0.5	±1.0	20	3	2.5	74
	3222-16	N	16	15	12	1.15	1.25	1.40	1.50	±0.5	±1.0	20	3	4.3	122

* Frequency sensitivity is included in coupling variation
** Coupling is referenced to the output port

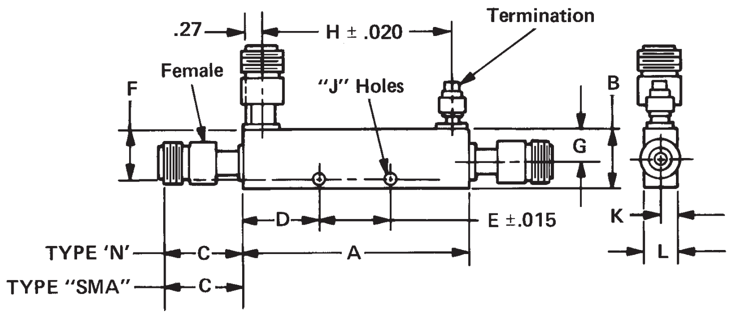
SMA (F), 0.5 to 18 GHz, 20 W

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	NOMINAL COUPLING* (dB)	DIRECTIVITY (dB)		INSERTION LOSS TRUE (dB max.)	VSWR		FREQUENCY SENSITIVITY (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	POWER		WEIGHT (max.)	
				0.5-12.4	12.4-18		PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVERAGE (W)	PEAK (kW)	oz.	gr.
0.5-18	4226-10	SMA	10	15	12	1.50	1.50	1.50	± 1.1	±1.0	20	3	3.9	110
	4226-20	SMA	20	15	12	0.90	1.50	1.50	± 1.1	±1.0	20	3	3.9	110

* 4226 Series coupling is average

$\left(\frac{C_{max.} + C_{min.}}{2}\right)$ and is referenced to the output port

Outline Drawing



Allow .020 max. build-up of sealant per surface.

MODEL	A	B	C	D	E	F	G	H	K	L	"J" HOLES
3202B-10	3.24	.88	1.10	1.12	1.000	.71	.48	2.717	.28	.57	. 104 +.004/-.002
4202B-6, -10	3.24	.88	.38	1.12	1.000	.71	.48	2.717	.28	.57	
3202B-20	3.48	.73	1.10	.58	2.319	.62	.44	2.943	.28	.57	
4202B-20	3.48	.73	.38	.58	2.319	.62	.44	2.943	.28	.57	
3203-16	2.12	.73	1.26	.58	.958	.36	.43	1.580	.28	.56	2-56 NC-2B Tapped Holes 1/8 DP Both Sides
4203-16	2.12	.73	.38	.58	.958	.36	.43	1.580	.28	.56	
3222-16	3.53	.75	1.18	.77	2.000	.38	.44	2.969	.27	.54	4-40 NC-2B Tapped Holes 1/8 DP Both Sides
4222-16	3.53	.75	.38	.77	2.000	.38	.44	2.969	.27	.54	
4203-6, -10	2.16	.89	.38	.52	1.125	.44	.50	1.620	.28	.56	
4226-10, -20	4.40	.77	.38	.77	2.906	.39	.50	3.900	.28	.57	

Dimensions in inches, unless otherwise specified.

6-18 GHz

High Power 100 Watt Directional Coupler

- Broadband – 6 to 18 GHz, High Directivity
- Excellent Frequency Flatness
- Operates at 85°C Ambient
- Designed for MIL Environments

Applications

- EW Systems, 100 Watt TWT Power Monitor Circuits, BIT Circuits, Jammers
- Test Equipment/ATE
- Power Amplifier Control
- Radar-Transmitter Circuits
- 100 Watt Miniature Stripline Design

Specifications

SMA (F), 6 to 18 GHz, 100 W

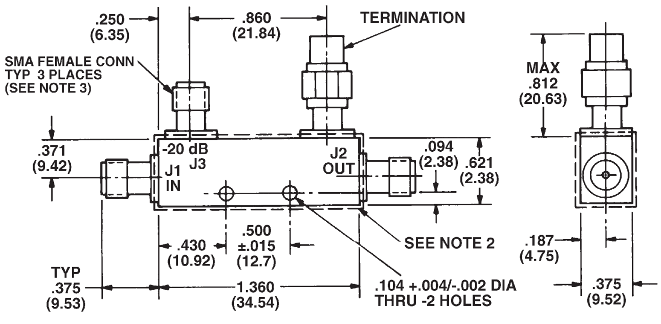
FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	DIRECTIVITY (dB min.)	TRUE INSERTION LOSS (dB max.)	VSWR PRIMARY LINE (max.)	VSWR SECONDARY LINE (max.)	FREQUENCY SENSITIVITY (dB max.)	POWER* AVERAGE (W)	POWER* PEAK (kW)	WEIGHT (max.) oz.	WEIGHT (max.) gr.
6-18	4196-20	20	±1.0	12	0.5	1.5	1.5	±0.5	100	3	.88	25

* Mounted to a Heat Sink (+85° C Max Housing Temperature). Power derates linearly from 100 watts at 85°C to 0 watts at 125°C housing temperature.

Outline Drawing

NOTES:

1. Dimensions in inches (mm in parentheses), unless otherwise specified.
2. Dotted area represents .020 max. build-up of sealant per surface.
3. Connectors mate without interference per MIL-STD-348.



2-18 GHz

High Power Directional Couplers

- High Performance Design
- 400 Watt Average, 3 to 5 kW Peak Rating
- Low Loss, Air Dielectric
- Operation to 85°C without Degradation
- TNC or Type N Connectors

Applications

- Measurement of High Power RF Signals
- Reliable Monitoring of TWT High Power Amplifiers
- Testing of EW Systems with High RF Power Outputs

Specifications

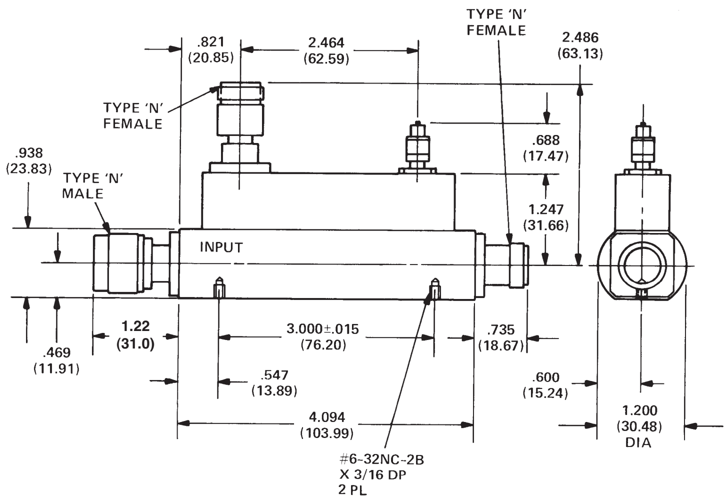
Type N, TNC and SMA, 2 to 18 GHz, 400 W

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	CONNECTORS			DIRECTIVITY (dB min.)			INSERTION LOSS (dB max.)	VSWR		FREQUENCY SENSITIVITY (dB max.)	POWER		WEIGHT (max.)	
				MAINLINE INPUT	MAINLINE OUTPUT	COUPLED OUTPUT	2-8 GHz	6-15 GHz	15-18 GHz		PRIMARY LINE (max.)	SECONDARY LINE (max.)		AVERAGE (W)	PEAK (kW)	oz.	gr.
2-18	**27000-30 27000-40 27000-50**	30 40 50	±1.4	Type N (M)	Type N (F)	Type N (F)	12	12	10	0.5	1.4	1.6	±1.0	400	3	15	425
2-18	**27003-30 27003-40 27003-50**	30 40 50	±1.4	TNC (M)	TNC (F)	SMA (F)	12	12	10	0.5	1.4	1.6	±1.0	400	3	15	425
6-18	**27001A-30 27001A-40 27001A-50**	30 40 50	±1.0	Type N (M)	Type N (F)	Type N (F)	—	12	10	0.5	1.4	1.6	±0.7	400	3	15	425
6-18	**27004A-30 27004A-40 27004A-50**	30 40 50	±1.0	TNC (M)	TNC (F)	SMA (F)	—	12	10	0.5	1.4	1.6	±0.7	400	5	15	425
2-8	**27002-30 27002-40 27002-50**	30 40 50	±1.0	Type N (M)	Type N (F)	Type N (F)	16	—	—	0.25	1.3	1.4	±0.5	400	5	15	425
2-8	**27005-30 27005-40 27005-50**	30 40 50	±1.0	TNC (M)	TNC (F)	SMA (F)	16	—	—	0.25	1.3	1.4	±0.5	400	5	15	425

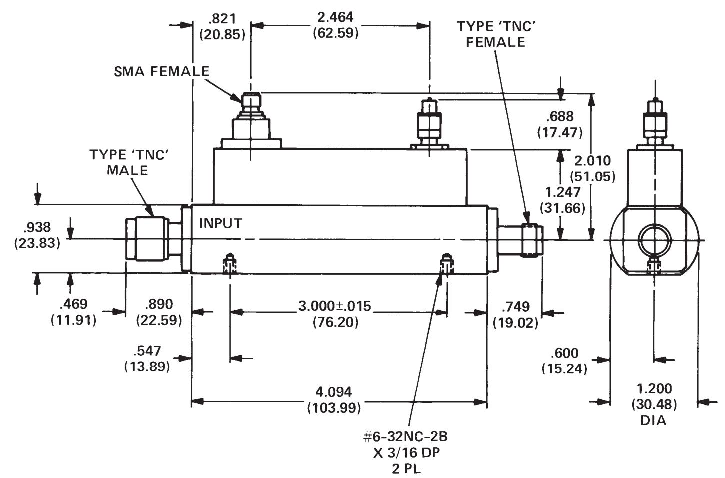
NOTES:
All units are available on a Custom-Order basis. Minimum quantities may apply.
See page 89 for 1 kW CW SC connector model.

Couplers

Outline Drawings



MODELS 27000, 27001A, 27002



MODELS 27003, 27004A, 27005

Dimensions in inches (mm in parentheses), unless otherwise specified.

2-8 GHz

High Power Directional Couplers With SC Connectors

- 1kW CW Operation
- SC Main Line Connectors
- 2-8 GHz Operation – Usable 1.5 to 10 GHz

Applications

- Power Tube Test Stands
- EW Systems
- Satellite Communication Transmitters
- Power Monitoring and Transmitter Protection Circuits

Specifications

SC, N and SMA, 2 to 8 GHz, 1 kW

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	DIRECTIVITY (dB min.)	INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY** (dB max.)	POWER		WEIGHT (max.)	
					EXCLUDING COUPLED POWER (max.)	TRUE	PRIMARY LINE (max.)	SECONDARY LINE (max.)		AVERAGE (kW)	PEAK (kW)	oz.	gr.
2-8	27002SC-40 27002SC-50 27002SC-60	40* 50* 60*	±1.5	14	0.25	0.25	1.5	1.5	±1.0	1.0	12.0	24	681
2-8	27005SC-40 27005SC-50 27005SC-60	40* 50* 60*	±1.5	14	0.25	0.25	1.5	1.5	±1.0	1.0	12.0	24	681

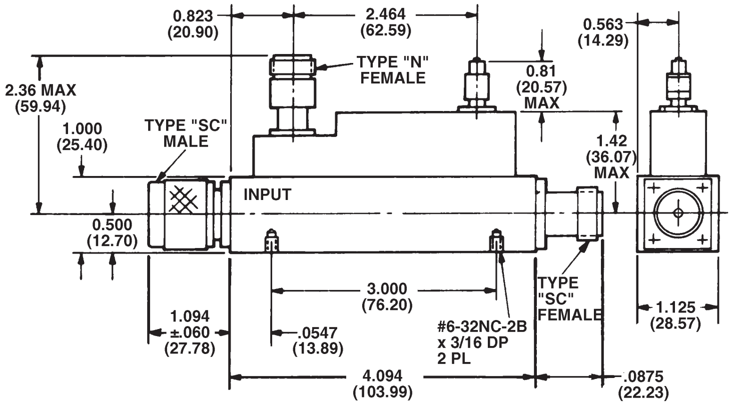
* Non-standard coupling values in the range of -40 dB to -60 dB are available, contact factory for details.
** Frequency sensitivity is included in coupling deviation specification

CONNECTORS:
Primary Line: Input - SC Male, Output - SC Female
Secondary Line: Model 27002SC - N Female, Model 27005SC - SMA Female

NOTES:
All units are available on a Custom-Order basis. Minimum quantities may apply.
See page 87 for type N and TNC versions High Power Couplers.

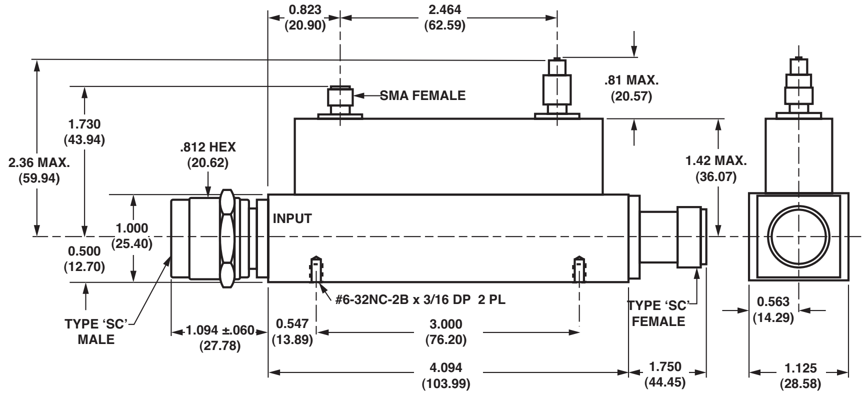
Couplers

Outline Drawings



TOL: ±.032 (.76)

MODEL 27002SC



TOL: ±.032 (.76)

CONNECTORS MATE WITHOUT INTERFERENCE PER MIL-C-39012

MODEL 27005SC

Dimensions in inches (mm in parentheses), unless otherwise specified.

0.225-10 GHz

Type N Coaxial Directional Couplers

- High Directivity
- Ruggedized Construction
- Low VSWR

Specifications

Type N (F), 0.225 - 10 GHz, 200 / 500 W

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	DIRECTIVITY (dB min.)	INSERTION LOSS (dB)		VSWR		CALIBRATION FREQUENCY (GHz)	ABSOLUTE CALIBRATION ACCURACY (dB per 10 dB step)	MAXIMUM DEVIATION FROM NOMINAL	INCIDENT POWER (W)		REFLECTED POWER (W)		PEAK (kW)	WEIGHT (max)	
				EXCLUDING COUPLED POWER	TRUE	PRIMARY LINE (max.)	SECONDARY LINE (max.)				10 dB	20, 30 dB	10 dB	20, 30 dB		lb.	kg.
0.225-0.460	**3000-10**	10	30	0.20	0.70	1.10	1.15	0.225, 0.280, 0.350, 0.410, 0.460	±0.1	±1.2	200	500	50	500	10	2.0	0.91
	3000-20	20			0.20												
	3000-30	30			0.20												
0.46-0.95	**3001-10**	10	30	0.20	0.70	1.15	1.15	0.460, 0.580, 0.700, 0.825, 0.950	±0.1	±1.2	200	500	50	500	10	1.5	0.70
	3001-20	20			0.20												
	3001-30	30			0.20												
0.95-2	**3002-10**	10	30	0.20	0.70	1.15	1.15	0.950, 1.21, 1.47, 1.73, 2.00	±0.1	±1.2	200	500	50	500	10	1.0	0.45
	3002-20	20			0.20												
	3002-30	30			0.20												
2-4	**3003-10**	10	25	0.20	0.70	1.15	1.20	2.0, 2.5, 3.0, 3.5, 4.0	±0.1	±1.2	200	500	50	500	10	1.0	0.45
	3003-20	20	27		0.20												
	3003-30	30	27		0.20												
4-10	**3004-10**	10	20/17**	0.20	0.85	1.20	1.30	4.0, 5.5, 7.0, 8.5, 10.0	±0.1	±1.6*	200	500	50	500	10	1.0	0.45
	3004-20	20	20/17**		0.25												
	3004-30	30	20/17**		0.20												

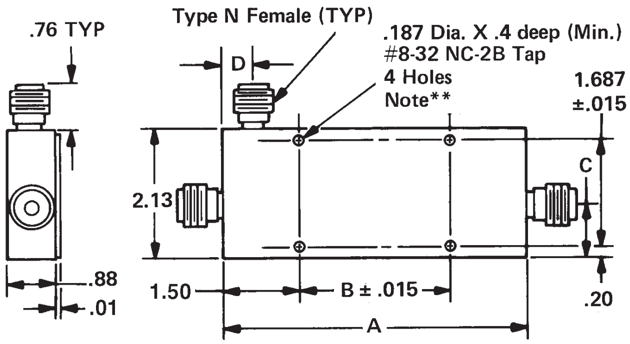
* Model 3004 has frequency sensitivity of ±1.2 dB from mean coupling. The mean coupling may deviate from the nominal by ±0.4 dB.

** Directivity at 4-8 GHz: 20 dB; from 8-10 GHz: 17dB

NOTE:
Model 3004 Series is available on a special order basis. Minimum quantities may apply.

Couplers

Outline Drawing



**Holes covered by nameplate this side.

MODEL	A	B	C	D
3000-10	10.68	3.000 ±.015	.87	.50
3000-20	10.68		.87	.50
3000-30	10.68		.69	.50
3001-10	6.25	3.000 ±.015	.87	.50
3001-20	6.25		.87	.50
3001-30	6.25		.69	.50
3002-10	4.10	1.090 ±.015	.87	.50
3002-20	4.10		.87	.50
3002-30	4.10		.69	.50
3003-10	4.10	1.090 ±.015	.87	.50
3003-20	4.10		.87	.50
3003-30	4.20		.69	.50
3004-10	5.00	2.000 ±.015	.57	.66
3004-20	5.00		.69	.57
3004-30	5.00		.69	.57

Dimensions in inches, unless otherwise specified.

0.92-12.4 GHz

Type N Maximally Flat Coaxial Couplers

- High Power Capability
- Low Loss, Superior Directivity
- ±0.25 dB Frequency Sensitivity
- Permanent Nameplate Calibrations

Specifications

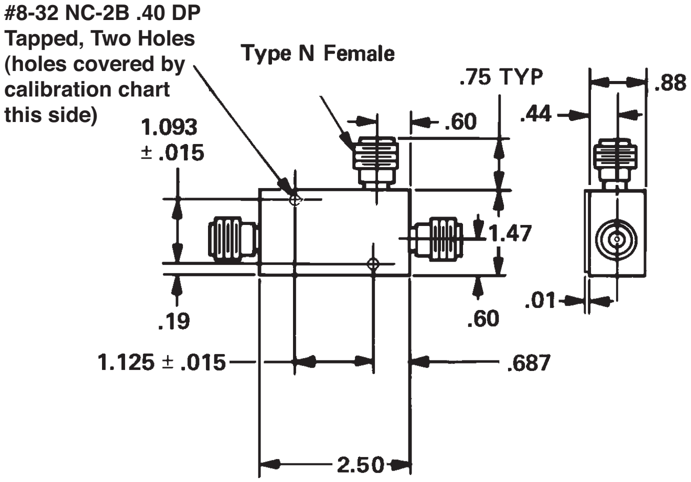
Type N (M/F), 0.92 to 12.4 GHz

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	DIRECTIVITY (dB min.)	INSERTION LOSS (dB)		VSWR		FREQUENCY SENSITIVITY* (dB max.)	MAXIMUM DEVIATION FROM NOMINAL (dB)	CALIBRATION FREQUENCY (GHz per 5 dB step)	ABSOLUTE CALIBRATION ACCURACY (per 10 dB step)	AVERAGE POWER (W)		REFLECTED POWER (W)		PEAK (kW)	WEIGHT (max.)	
				EXCLUDING COUPLED POWER	TRUE	PRIMARY LINE (max.)	SECONDARY LINE (max.)					10 dB	20, 30 dB	10 dB	20, 30 dB		lb.	kg.
	3042B-10	10			0.70					0.92, 1.24,								
0.92-2.2	**3042B-20**	20	20	0.20	0.25	1.10	1.20	±0.25	±0.5	1.56, 1.88,	±0.1	200	500	50	500	10	1.25	0.60
	3042B-30	30			0.20					2.2								
	3043B-10	10			0.70					1.7, 2.325,								
1.7-4.2	**3043B-20**	20	20	0.20	0.25	1.15	1.20	±0.25	±0.5	2.95, 3.575,	±0.1	200	500	50	500	10	1.0	0.45
	3043B-30	30			0.20					4.2								
	3045C-10	10			0.95					7.0, 8.0,								
7-12.4	**3045C-20**	20	15	0.35	0.35	1.25	1.30	±0.25	±0.5	9.0, 10.0,	±0.1	100	100	10	100	2	0.8	0.40
	3045C-30	30			0.35					11.0, 12.4								

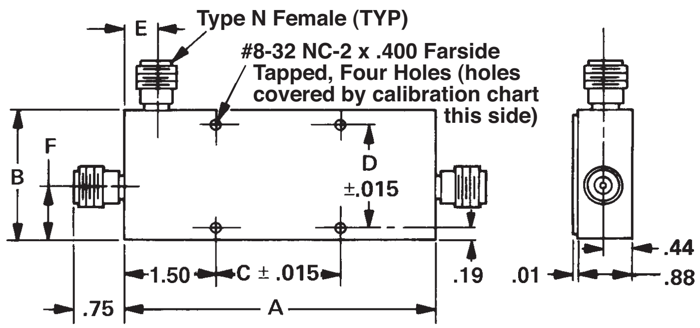
* Frequency sensitivity included in coupling value

Couplers

Outline Drawings



MODEL 3045C



MODEL	A	B	C	D	E	F
3042B-10	6.12	2.12	3.000	1.688	.50	.86
3042B-20	6.12	2.12	3.000	1.688	.50	.86
3042B-30	6.12	2.12	3.000	1.688	.50	.68
3043B-10	4.09	2.12	1.090	1.688	.50	.86
3043B-20	4.09	2.12	1.090	1.688	.50	.86
3043B-30	4.09	2.12	1.090	1.688	.50	.68

Dimensions in inches, unless otherwise specified.

0.05-18 GHz

Type N Dual Coaxial Reflectometer Couplers

- **Exceptionally High Directivity for Reflectometry Measurements**
- **Broadband Frequency Coverage**
- **Bilateral Male and Female Output Ports**
- **Low VSWR**
- **High Power**

Specifications

Type N (M/F), 0.05 to 8 GHz, 500 W

FREQUENCY RANGE (GHZ)	MODEL	NOMINAL COUPLING (dB)	DIRECTIVITY (dB min.)	VSWR		EQUIVALENT RESIDUAL VSWR (max.)	ABSOLUTE CALIBRATION ACCURACY (per 10 dB)	TRUE INSERTION LOSS (dB max.)	TRACKING (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	POWER AVERAGE			WEIGHT (max.)	
				PRIMARY LINE	SECONDARY LINE						INCIDENT (W)	REFLECTED (W)	PEAK (kW)	lb.	kg.
0.05-1	**3020A**	20*	35	1.05	1.10	104	±0.1	0.2	0.3	±1.0 from 250-1000 MHz	500	500	10	2.4	1.1
1-4	**3022**	20	1-3 GHz: 30 3-4 GHz: 27	1.15	1.15	1.09	±0.1	0.3	0.3	±1.0	500	500	10	1.9	0.9
4-8	**3024**	20	25	1.15	1.20	1.12	±0.1	0.6	0.3	±1.0	500	500	10	1.5	0.7

* Coupling from 250 MHz to 50 MHz increases from 20 dB to 33 dB

CONNECTORS: Primary Connectors 1 female, 1 male, Type N; Secondary Connectors 2 female, Type N

NOTES:
Model 3020A is usable down to 10 MHz; coupling will typically be 42-46 dB at this frequency.
Accessories supplied with all units above: 1 male short, 1 female short

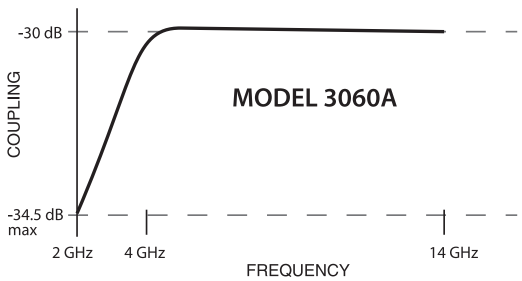
CALIBRATION FREQUENCIES		
3020A (MHz)	3022 (GHz)	3024 (GHz)
50, 150, 250, 300, 400, 500, 600, 700, 800, 900, 1000	1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0	4.0, 5.0, 6.0, 7.0, 8.0

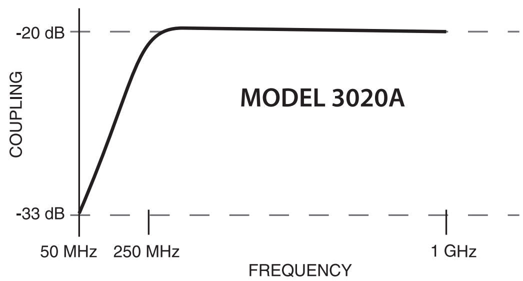
Type N (M/F), 2 to 18 GHz, 200 W

FREQUENCY RANGE (GHZ)	MODEL	NOMINAL COUPLING* (dB)	MAXIMUM DEVIATION FROM NOMINAL (dB)	DIRECTIVITY (dB min.)	INSERTION LOSS (dB max.)	VSWR		FREQUENCY SENSITIVITY (dB max.)	POWER		WEIGHT (max.)	
						PRIMARY LINE	SECONDARY LINE		AVERAGE (W)	PEAK (kW)	oz.	gr.
2-18	**3060A**	30	4-14 GHz: ±1.4	2-14 GHz: 11 14-18 GHz: 9	2-14 GHz: 0.80 14-18 GHz: 1.25	1.60	2-14 GHz: 1.75 14-18 GHz: 2.00	4-14 GHz: ±1.5 14-18 GHz: ±2.0	200	3	15	425

CONNECTORS: Primary Connectors Type N - female (Type N - male optional); Secondary Connectors Type N - female (SMA - female optional)

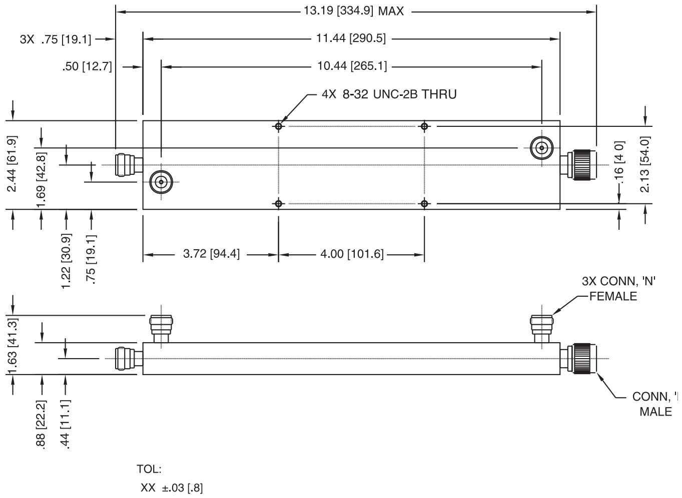
*Nominal coupling is defined as $\frac{(C_{max} + C_{min})}{2}$, in the range from 4 GHz to 14 GHz. Frequency Sensitivity is applied to the nominal coupling.



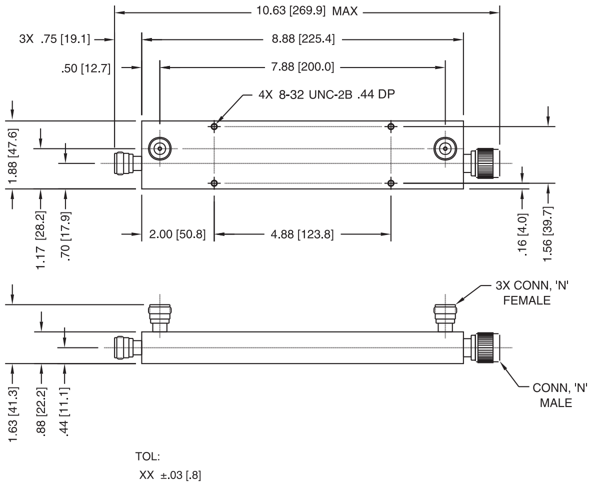


Couplers

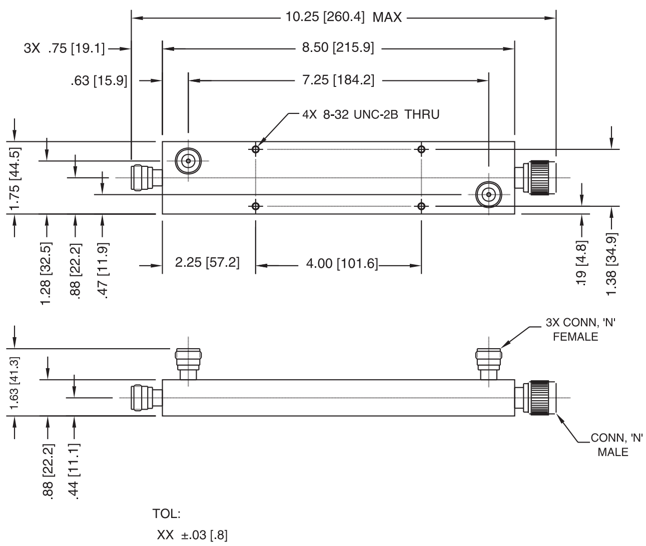
Outline Drawings



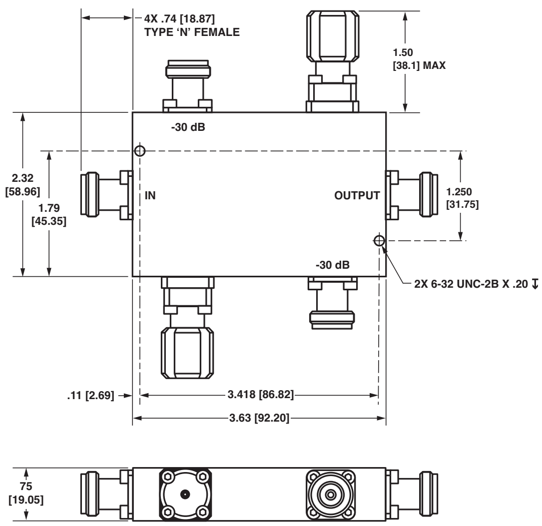
MODEL 3020A



MODEL 3022

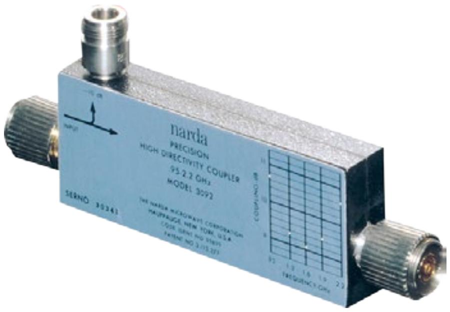


MODEL 3024



MODEL 3060A

Dimensions in inches (mm in parentheses), unless otherwise specified.



0.95-18 GHz

7 mm Precision High-Directivity Directional Couplers

- Exceptionally High Directivity
- Extended Octaves
- Precision Connectors
- Increased Dynamic Range
- Allows Swept Measurements with High Accuracy

Specifications

7mm , 0.95 to 18 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	DIRECTIVITY (dB min.)	VSWR		FREQUENCY SENSITIVITY (dB max.)	ABSOLUTE CALIBRATION ACCURACY (dB)	POWER AVERAGE* (W)	WEIGHT (max.)	
				PRIMARY LINE (max.)	SECONDARY LINE (max.)				oz.	gr.
0.95-2.2	**3092**	10	45	1.10	1.10	±1.2	±0.1	30	13	369
1.7-4.2	**3093**	10	42	1.10	1.10	±1.2	±0.1	30	11	312
3.7-8.3	**3094**	10	37	1.20	1.20	±1.2	±0.1	30	20	567
7-12.4	**3095**	10	33	1.20	1.25	±1.2	±0.1	30	14	397
7-18	**3096**	10	25	1.25	1.30	±1.5	±0.1	30	15	425

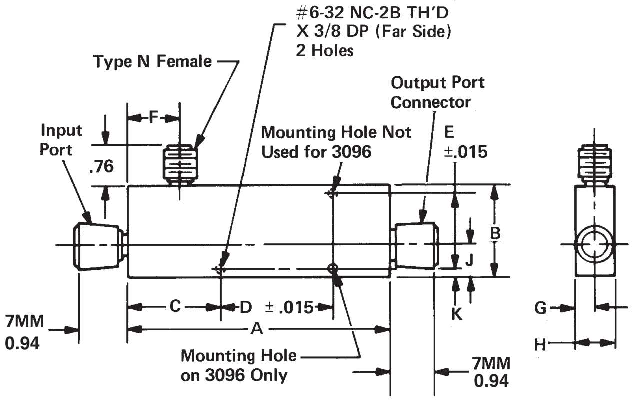
* Maximum reflected power into output port is 5 W average

CONNECTORS:
Primary input and output connectors are 7 mm.
Secondary line connectors are Type N female.

NOTE:
All units are available on a Custom-Order basis. Minimum quantities may apply.

Couplers

Outline Drawings



MODEL	A	B	C	D	E	F	G	H	J	K	MOUNTING HOLES DIAMETER OR THREAD
3092	4.69	1.75	.50	3.000	1.375	.50	.38	.76	.63	.19	6-32 NC-2B Tapped Holes 3/8 DP 2 Places
3093	3.97	1.60	.50	3.000	1.218	.50	.38	.76	.63	.19	
3094	7.58	1.75	.88	5.000	1.375	.50	.38	.76	.63	.19	
3095	5.05	1.44	.88	3.000	1.062	.63	.44	.88	.63	.19	
3096	5.24	1.51	.76	3.732	—	.91	.44	.88	.70	.22	8-32 NC-2B Tapped Holes 1/4 DP 2 Places

Dimensions in inches, unless otherwise specified.

1-18 GHz

Broadband High Directivity Couplers

- Broadband Frequency Coverage from 1 to 18 GHz in a Single Unit
- High Directivity
- Increased Dynamic Range
- Flat Frequency Response

Specifications

Type N and 7 mm, 1 to 18 GHz, 5 W

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING* (dB)	DIRECTIVITY (dB min.)		VSWR		FREQUENCY SENSITIVITY (dB max.)		CONNECTORS		TRUE INSERTION LOSS (dB max.)	OPTIONS AVAILABLE	WEIGHT (max.)	
		1.5-18 GHz	1-8 GHz	8-18 GHz	PRIMARY LINE (max.)	SECONDARY LINE (max.)	1-1.5 GHz	1.5-18 GHz	PRIMARY LINE INPUT	PRIMARY LINE OUTPUT			oz.	gr.
1-18	**3292-1**	13 ±1	27	25	1.35	1.40	±2	±1.5	Type N Male	Type N Female	1.0	-02	12	340
	3292-2	13 ±1	27	25	1.35	1.40	±2	±1.5	Type N Female	Type N Male	1.0	-02	12	340
	5292	13 ±1	28	26	1.35	1.40	±2	±1.5	Precision 7 mm	Precision 7 mm	1.0	-01 -02	12	340

* Nominal Coupling is defined as average coupling over the designated frequency range

$$\left(\frac{C_{max.} + C_{min.}}{2} \right)$$

Refer to Typical Coupling Curve on page 100 for 1-1.5 GHz.

NOTES:

Standard Version (all models) has N Female, Coupled-Output Port.
All units are available on a Custom-Order basis. Minimum quantities may apply.

OPTIONS:

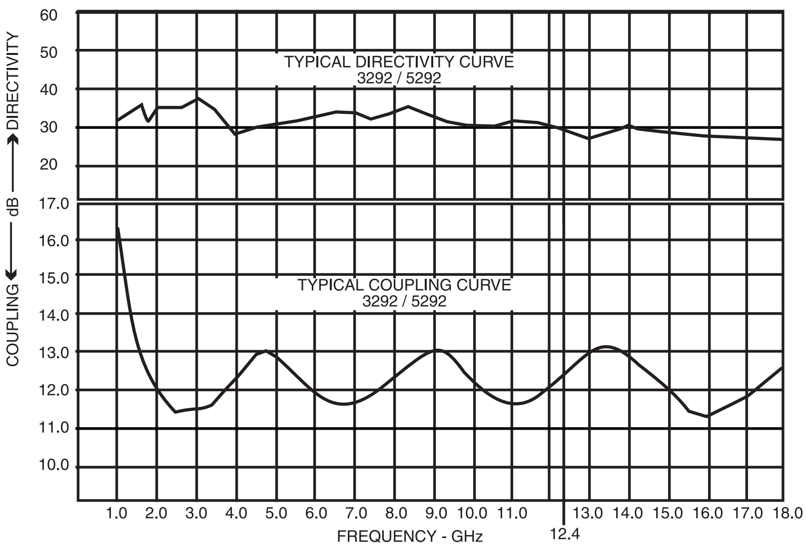
-01 Precision Stainless Steel Type N Female Connector on the secondary line (Example: 3292-1-01).
-02 Precision Stainless Steel SMA Female Connector on the secondary line (Example: 3292-1-02).

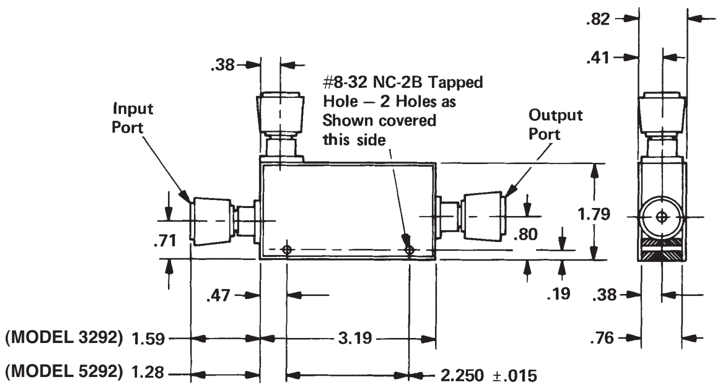
POWER RATING:

5 W average, 100 W peak

Couplers

Outline Drawings





MODELS 3292, 5292

Dimensions in inches, unless otherwise specified.

0.82-2.5 GHz

Commercial Use Directional Couplers

- Complete Series: 10 dB, 20 dB, 30 dB Coupling Values
- High Directivity 25 dB Typical
- SMA and N Connector Models Available

Specifications

Type N (F), 0.82 to 2.1 GHz, 100 W to 500 W

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	DIRECTIVITY (dB min.)	VSWR		FREQUENCY SENSITIVITY (dB max.)	INSERTION LOSS (dB max.)	POWER			WEIGHT (max.)	
				PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVERAGE (W)	REFLECTED (W)	PEAK (kW)	lb.	gr.
	3151-10	10 ±1.0	20	1.15	1.15	±0.15	0.9	100	5	3	1.12	510
0.82-0.98	3151-20	20 ±1.0	30	1.07	1.10	±0.20	0.2	500	50	3	1.12	510
	3151-30	30 ±1.0	30	1.07	1.10	±0.20	0.15	500	500	3	1.12	510
	3161-10	10 ±1.0	20	1.15	1.20	±0.30	0.7	100	5	3	.86	390
1.7-2.1	3161-20	20 ±1.0	20	1.15	1.20	±0.30	0.2	500	50	3	.86	390
	3161-30	30 ±1.0	20	1.15	1.20	±0.30	0.15	500	500	3	.86	390

Type N (F), 0.7 to 2.5 GHz, 500 W

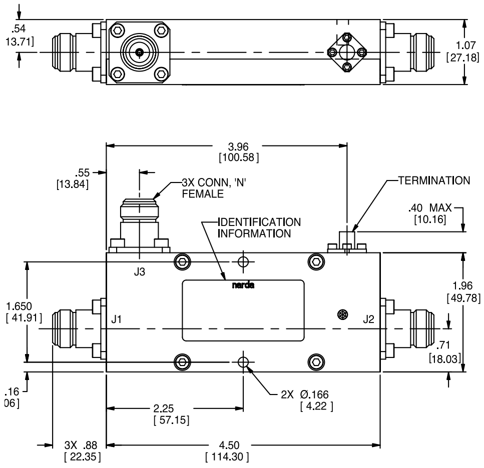
FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)			DIRECTIVITY (dB min.)	VSWR		FREQUENCY SENSITIVITY (dB max.)	INSERTION LOSS (dB max.)	POWER			WEIGHT (max.)	
		0.7-2.5 GHz	0.82-0.98 GHz	1.8-2.2 GHz		PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVERAGE (W)	REFLECTED (W)	PEAK (kW)	lb.	gr.
0.7-2.5	3171-30	32 ±3.0	33 ±1.6	30 ±1.0	20	1.15	1.20	—	0.15	500	500	3	.88	400

SMA (F), 0.82 to 2.1 GHz, 50 W

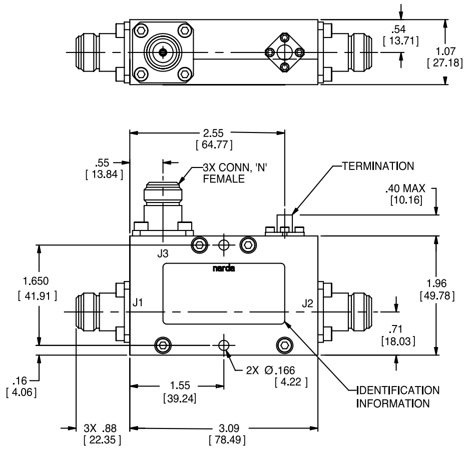
FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	DIRECTIVITY (dB min.)	VSWR		FREQUENCY SENSITIVITY (dB max.)	INSERTION LOSS (dB max.)	POWER			WEIGHT (max.)	
				PRIMARY LINE (max.)	SECONDARY LINE (max.)			AVERAGE (W)	REFLECTED (W)	PEAK (kW)	oz.	gr.
	4151-10	10 ±1.0	20	1.15	1.15	±0.15	0.9	50	5	3	14.8	420
0.82-0.98	4151-20	20 ±1.0	25	1.12	1.12	±0.15	0.2	50	50	3	14.8	420
	4151-30	30 ±1.0	25	1.12	1.12	±0.15	0.15	50	50	3	14.8	420
	4161-10	10 ±1.0	20	1.15	1.20	±0.30	0.7	50	5	3	9.9	280
1.7-2.1	4161-20	20 ±1.0	20	1.15	1.20	±0.30	0.2	50	50	3	9.9	280
	4161-30	30 ±1.0	20	1.15	1.20	±0.30	0.15	50	50	3	9.9	280

Couplers

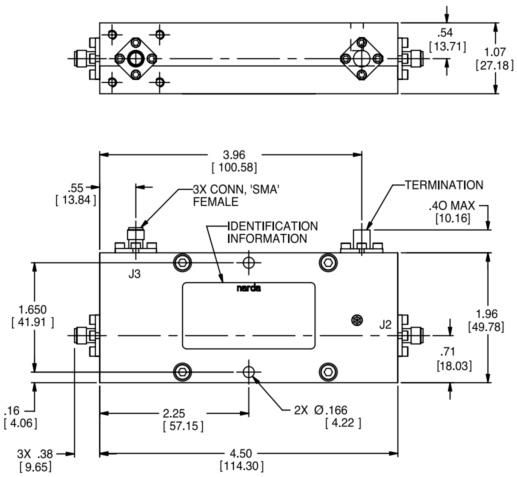
Outline Drawings



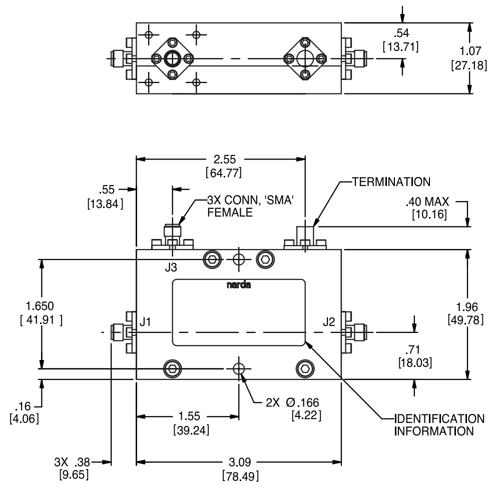
MODELS 3151-10, 3151-20, 3151-30



MODELS 3161-10, 3161-20, 3161-30, 3171-30



MODELS 4151-10, 4151-20, 4151-30



MODELS 4161-10, 4161-20, 4161-30

Dimensions in inches (mm in parentheses), unless otherwise specified.

DC Blocks

DC Blocks

Quick Reference Guide

DC Blocks and Audio Interference Suppressors

FREQUENCY RANGE (GHz)	MODEL	TYPE	CONNECTOR	PAGE
0.01 - 12.4	**562**	INSIDE/ OUTSIDE	Type N	105
0.50 - 18.0	**4563**	INSIDE/ OUTSIDE	SMA	105
0.15 - 18.0	**4564**	INSIDE	SMA	105

narda MITEQ www.nardamiteq.com **E-MAIL:** componentsnm@nardamiteq.com **TEL:** +1 631 231-1700

0.01-18 GHz

DC Blocks

(Audio Interference Suppressors)

- Broadband Frequency Ranges
- Suppresses DC thru 100 kHz Leakage from External Signal Sources
- Low Insertion Loss
- Small Size, Light Weight

Specifications

Inside/Outside Block, Type N, 0.01 - 12.4 GHz

FREQUENCY RANGE (GHz)	MODEL	VSWR (max.)		INSERTION LOSS (dB max.)		VOLTAGE BREAKDOWN (Vdc)	RF INPUT POWER (Watts, max. CW)	CONNECTORS	WEIGHT (max.) grams
		10-20 MHz	0.02-12.4 GHz	0.01-11.0 GHz	11.0-12.4 GHz				
0.01-12.4	**562**	1.5	1.3	0.5	1.0	100	10	Type N M/F	125

Inside/Outside Block, SMA, 0.50 - 18.0 GHz

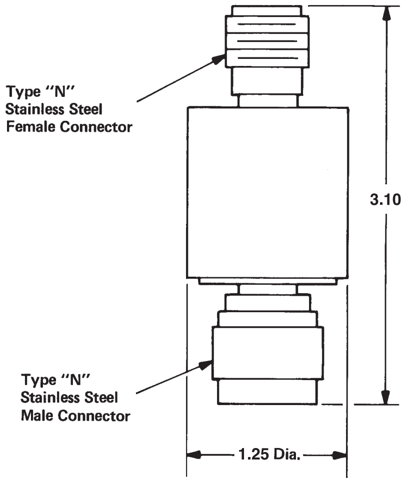
FREQUENCY RANGE (GHz)	MODEL	VSWR (max.)	INSERTION LOSS (dB max.)		VOLTAGE BREAKDOWN (Vdc)	RF INPUT POWER (Watts, max. CW)	CONNECTORS	WEIGHT (max.) grams
			0.5-1.5 GHz	1.5-18.0 GHz				
0.50-18.0	**4563**	1.35	1.5	0.5	150	10	SMA M/F	10

Inside Block, SMA, 0.15 - 18.0 GHz

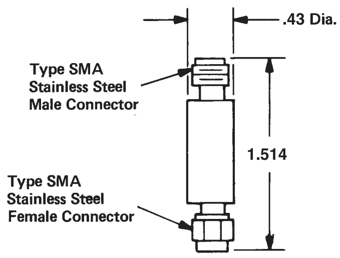
FREQUENCY RANGE (GHz)	MODEL	VSWR (max.)	INSERTION LOSS (dB max.)	VOLTAGE BREAKDOWN (Vdc)	RF INPUT POWER (Watts, max. CW)	CONNECTORS	WEIGHT (max.) grams
0.15-18.0	**4564**	1.35	0.35	150	10	SMA M/F	10

DC Blocks

Outline Drawings



MODEL 562



MODELS 4563 and 4564

Dimensions in inches, unless otherwise specified.

Detectors

narda MITEQ

Detectors

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	PAGE
0.01-18	**4506**	SMA	109
0.01-18	**503A**	N, BNC	110
0.01-18	**503A-03**	N, BNC	110
0.01-18	**4503A**	SMA, BNC	110
0.01-18	**4503A-03**	SMA, BNC	110

For detailed detector output performance vs. RF power and temperature, please contact the factory, or visit:
www.nardamiteq.com

0.01-18 GHz

Ultra Broadband Schottky Detectors

- Zero Biased Detectors
- Excellent Sensitivity, Rugged
- Matched Detector; Good VSWR Characteristics

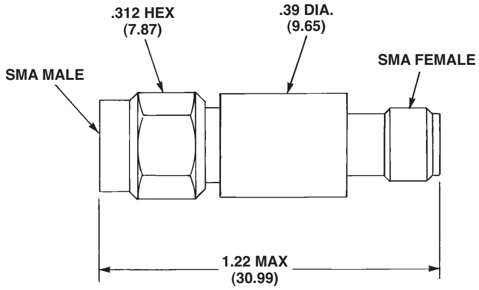
Specifications

SMA (M/F), 0.01 to 18 GHz

FREQUENCY RANGE (GHz)	MODEL	FLATNESS (dB) 0.01-18 GHz	VSWR 0.01-18 GHz	SENSITIVITY* (mV/µW)	CAPACITANCE	POLARITY	INPUT POWER (mW max)	CONNECTORS INPUT MALE	CONNECTORS INPUT FEMALE
0.01-18	**4506**	±0.5	1.5	0.5	30pf	Neg.	100	SMA	SMA

* Referenced to -20 dBm maximum at 25°C

Outline Drawing



Dimensions in inches (mm in parentheses), unless otherwise specified.

Detectors

0.01-18 GHz

Miniature Flat, Zero-Biased Schottky Detectors

- Broadband Coverage
- Flat Frequency Response
- High Sensitivity
- Field-Replaceable Diode
- Negative or Positive Output Available

Specifications

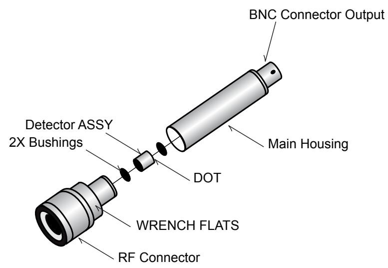
Type N (M) and SMA (M) to BNC (F), 0.01 to 18 GHz

FREQUENCY RANGE (GHz)	MODEL	FLATNESS (dB)	SENSITIVITY* (mV/µW)	VSWR (max)	INPUT POWER (mW max)	POLARITY	CONNECTORS INPUT	CONNECTORS OUTPUT
0.01-18	**503A**	±0.6	0.5	<1.6	100	Neg.	Type N-M	BNC-F
	503A-03	±0.6	0.5	<1.6	100	Pos.	Type N-M	BNC-F
	4503A	±0.6	0.5	<1.6	100	Neg.	SMA-M	BNC-F
	4503A-03	±0.6	0.5	<1.6	100	Pos.	SMA-M	BNC-F

* Referenced to -20 dBm maximum at 25°C

REPLACEMENT DIODES	
Detector	Replacement Diode
503A, 4503A	4829
503A-03, 4503A-03	4829-03

NOTE: Not to be used for 4506 series.



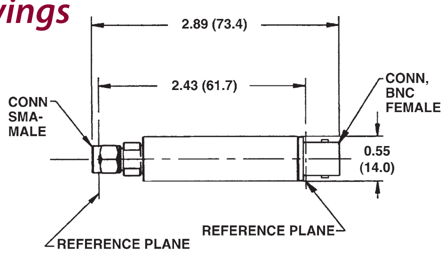
Field Diode Replacement Procedure

Using approved ESD guidelines:

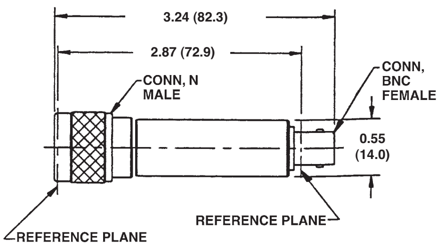
1. Hold Detector by main housing (side with BNC connector). Unscrew RF Input connector by applying a wrench to flats provided.
2. Remove detector assembly.
3. Insert bushings into each assembly.
4. Insert replacement diode into RF connector side – dot should be facing out.
5. Reassemble the connector and hand tighten.

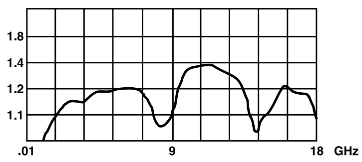
Outline Drawings

Models 4503A, 4503A-03

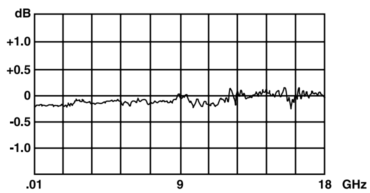


Models 503A, 4503A-0

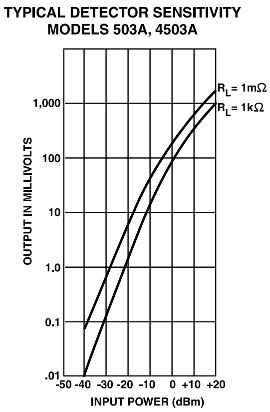




TYPICAL VSWR CURVE

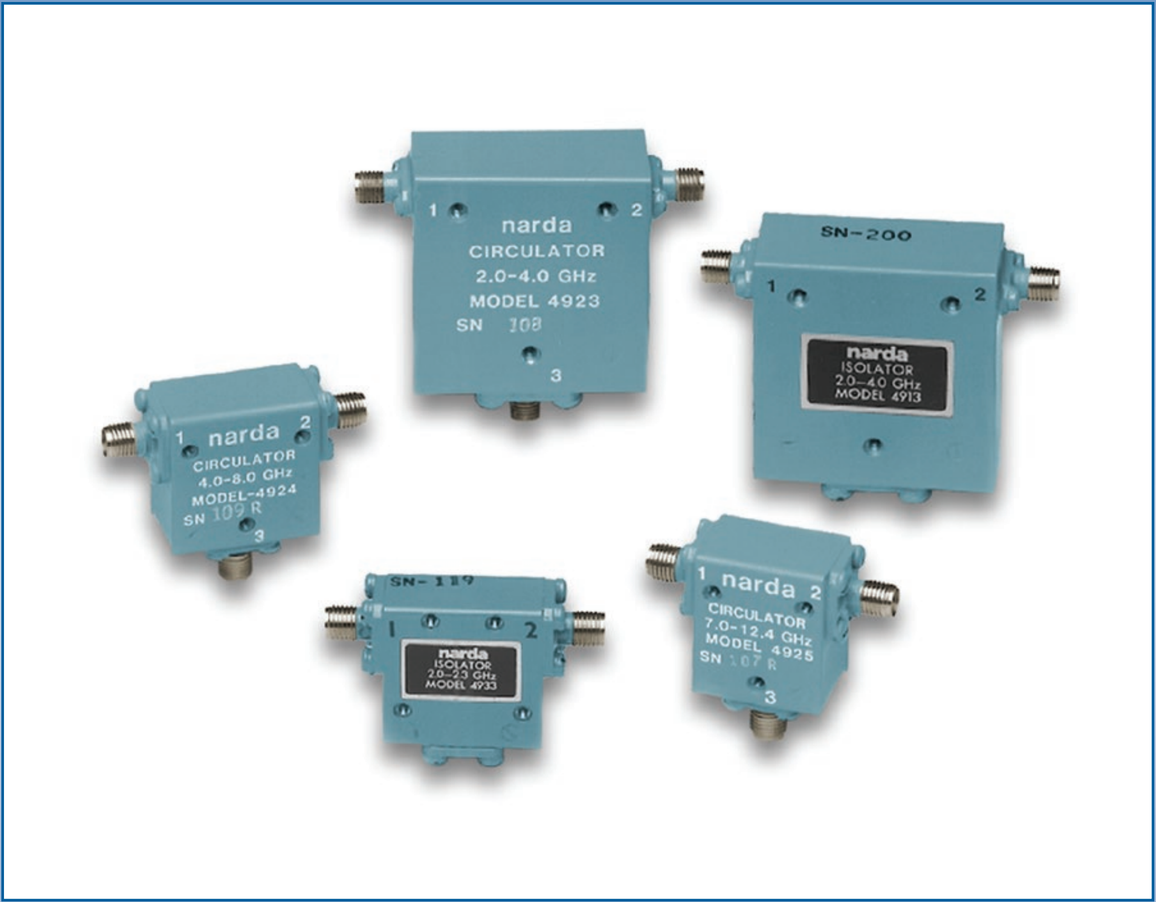


TYPICAL RESPONSE CURVE



Dimensions in inches (mm in parentheses), unless otherwise specified.

Isolators and Circulators



Isolators and Circulators

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	PAGE
Isolators			
18-26.5	4917	SMA	113
8-18	4946	SMA	113
11-18	4916	SMA	113
7-10	4915	SMA	113
4-8	4914	SMA	113
2-4	4913	SMA	113
Circulators			
7-12.4	4925	SMA	115
4-8	4924	SMA	115
2-4	4923	SMA	115

2-26.5 GHz

Ferrite Isolators

Specifications

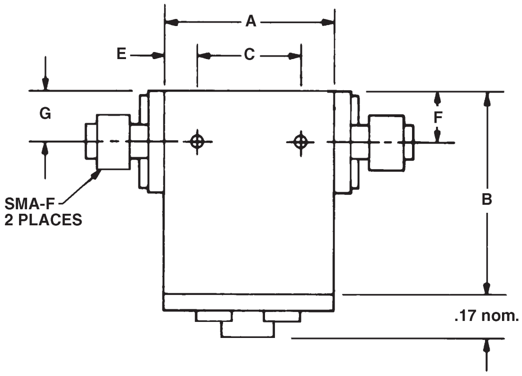
SMA (F), 2 to 26.5 GHz

FREQUENCY (GHz)	MODEL	ISOLATION (dB min.)	INSERTION LOSS (dB max.)	VSWR (max.)	PEAK POWER Fwd & Rev (watts)	AVERAGE POWER Forward (watts)	AVERAGE POWER Reverse* (watts)	TEMPERATURE RANGE (°C)
2-4	**4913**	18	0.5	1.30	50	25	1	0 to +55
4-8	**4914**	18	0.5	1.30	50	15	1	-20 to +65
7-10	**4915**	20	0.5	1.25	10	5	1	-20 to +55
8-18	**4946**	16	0.6	1.45	15	5	1	-20 to +65
11-18	**4916**	20	0.5	1.25	20	5	1	-20 to +65
18-26.5	**4917**	17	0.6	1.40	10	3	1	-20 to +65

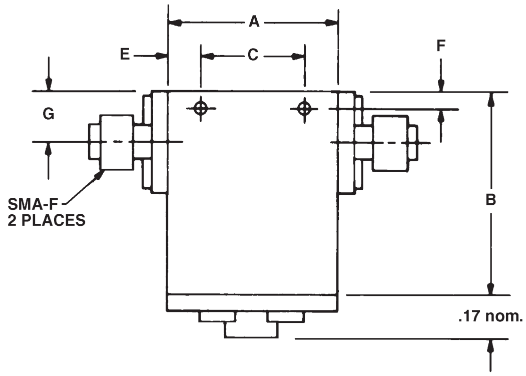
* Limited by termination power handling capacity

Isolators and Circulators

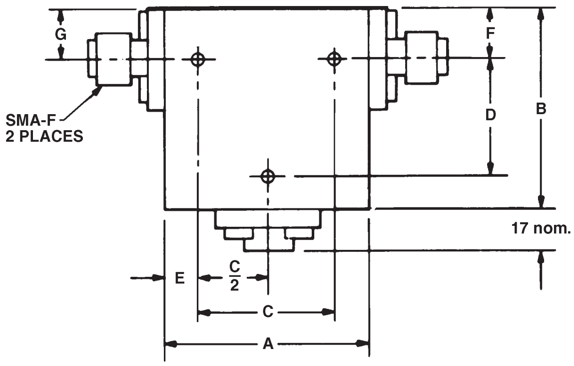
Outline Drawings



OUTLINE I



OUTLINE II



OUTLINE III

NOTES:
TOL: .xx ± .02
.xxx ± .010

*Mounting holes both sides
a = 2-56 UNC-2B
b = 4-40 UNC-2B

MODEL	OUTLINE DRAWING	MOUNTING DEPTH	HOLE SIZE*	THICKNESS	A	B	C	D	E	F	G
4913	III	.18	b	.75	1.60	1.65	1.000	1.10	.30	.25	.25
4914	III	.15	a	.60	1.00	1.00	.750	1.60	.13	.25	.25
4915	II	.15	a	.50	.50	.63	.375	—	.06	.16	.25
4946	I	.13	a	.55	.63	.80	.500	—	.07	.25	.25
4916	I	.13	a	.55	.63	.80	.500	—	.07	.25	.25
4917	II	.18	a	.50	.50	.66	.380	—	.06	.18	.25

Dimensions in inches, unless otherwise specified.

2-12.4 GHz

Ferrite Circulators

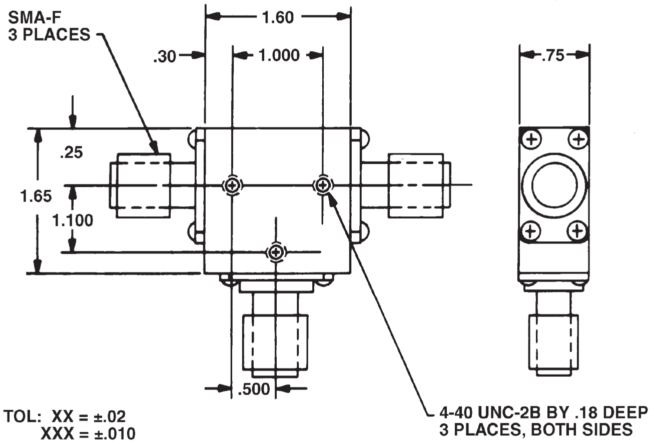
Specifications

3 Port SMA (F), 2 to 12.4 GHz

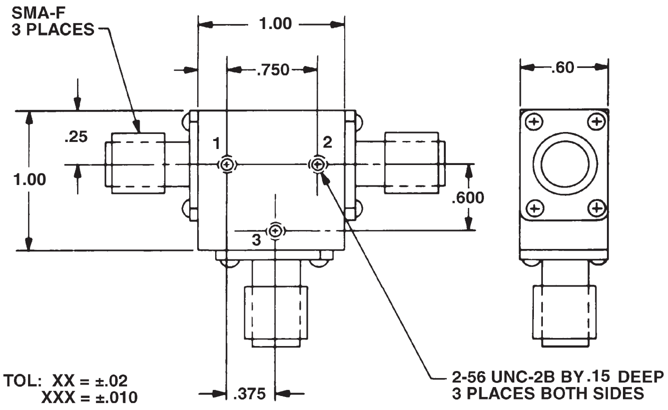
FREQUENCY (GHz)	MODEL	ISOLATION (dB min.)	LOSS (dB max.)	VSWR (max.)	PEAK POWER Fwd & Rev (watts)	AVERAGE POWER		TEMP RANGE (°C)
						Forward (watts)	Reverse (watts)	
2-4	**4923**	18	0.5	1.30	50	25	25	0 to +55
4-8	**4924**	18	0.5	1.30	50	15	15	-20 to +55
7-12.4	**4925**	18	0.5	1.30	50	15	15	-20 to +65

Isolators and Circulators

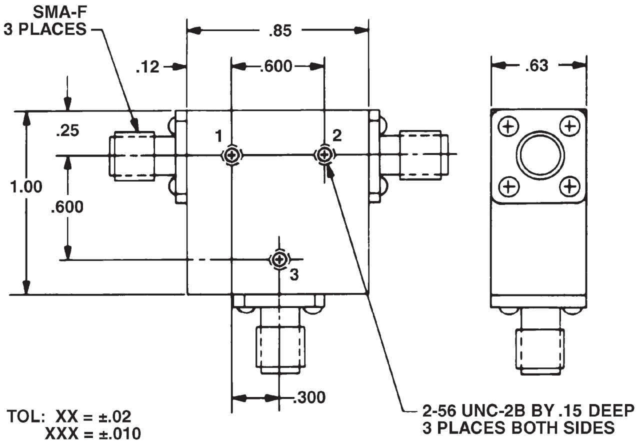
Outline Drawings



MODEL 4923



MODEL 4924



MODEL 4925

Dimensions in inches, unless otherwise specified.

Phase Shifters

Phase Shifters

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	PAGE
18-40	4582	2.92 mm	121
DC-26.5	4580	SMA	121
18-26.5	4581	SMA	121
18-26	4590	SMA	122
DC-18.6	4579	SMA	121
DC-18.6	4589	SMA	122
DC-18	4754	SMA	123
DC-18	4755	SMA	123
3-18	4572B	SMA	120
3.5-12.4	3753B	Type N	119
1-5	3752	Type N	119

1-12.4 GHz

Precision Coaxial Phase Shifters

- Broadband Coverage – 180° Phase Shift at Minimum Frequency
- Low VSWR
- ±0.5°/GHz Accuracy with Digital Dial Readout

Specifications

Type N (F), 1 to 5 GHz

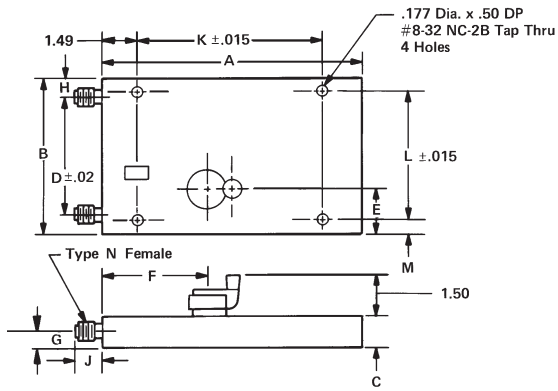
FREQUENCY RANGE (GHz)	MODEL	MINIMUM PHASE SHIFT	POWER		INSERTION LOSS (dB max.)	VSWR (max.)	ACCURACY*	CONNECTORS	WEIGHT (max.)	
			AVERAGE (W)	PEAK (kW)					lbs.	kg.
1-5	**3752**	180° at 1 GHz	200	5	0.5	1.25	±0.5°/GHz	Type N (F)	4.5	2.05

Type N (F), 3.5 to 12.4 GHz

FREQUENCY RANGE (GHz)	MODEL	MINIMUM PHASE SHIFT	POWER		INSERTION LOSS (dB max.)	VSWR (max.)		ACCURACY*	CONNECTORS	WEIGHT (max.)	
			AVERAGE (W)	PEAK (kW)		3.5-10	10-12.4			lbs.	kg.
3.5-12.4	**3753B**	180° at 3.5 GHz	200	5	0.7	1.35	1.4	±0.5°/GHz	Type N (F)	4.0	1.8

* Phase must be measured in one rotational direction so as to maintain phase accuracy

Outline Drawing



MODEL	A	B	C	D ±.02	E	F	G	H	J	K ±.015	L ±.015	M
3752	9.03	5.53	1.12	4.13	1.56	3.75	0.56	0.68	0.75	6.00	5.13	0.18
3753B	6.72	4.69	1.28	3.50	1.59	1.13	0.75	0.58	1.23	4.50	4.31	0.17

Dimensions in inches, unless otherwise specified.

3-18 GHz

Phase Trimmer

- Broadband Frequency Coverage from 3 to 18 GHz
- Extremely Small Size and Lightweight
- Ruggedized Construction
- Operational from -54° to +100°C
- Fixed Length Phase Shifter

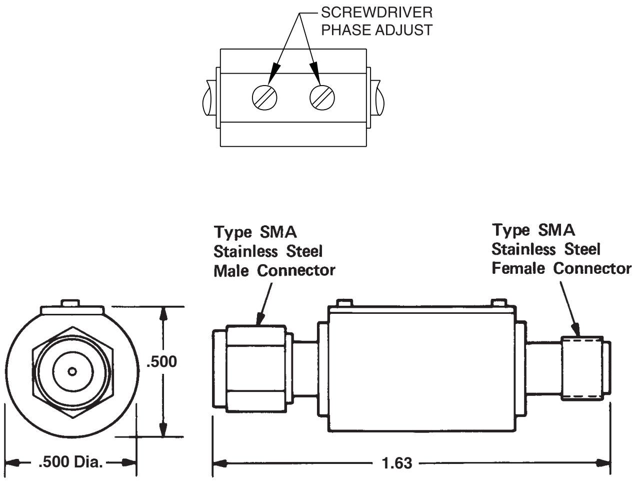
Specifications

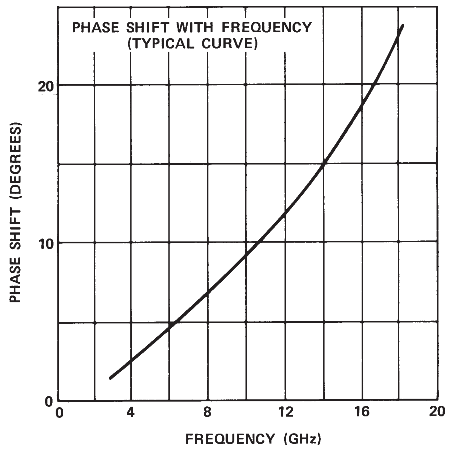
SMA, 3 to 18 GHz

FREQUENCY RANGE (GHz)	MODEL	INSERTION LOSS (dB max.)	PHASE SHIFT ADJUSTMENT RANGE	LINEARITY	VSWR (max.)	WEIGHT (max.)	
						oz.	gr.
3-18	**4572B**	0.4	±2°@ 3 GHz >20°@ 18 GHz	3-12.4 GHz: ±2° 12.4-18 GHz: ±5°	1.35	0.64	19

Note:
Input Power: 30 watts CW max. at 25° C; derates linearly to 0 W at +125°C.

Outline Drawing





Dimensions in inches, unless otherwise specified.

DC-40 GHz

Broadband Phase Shifters

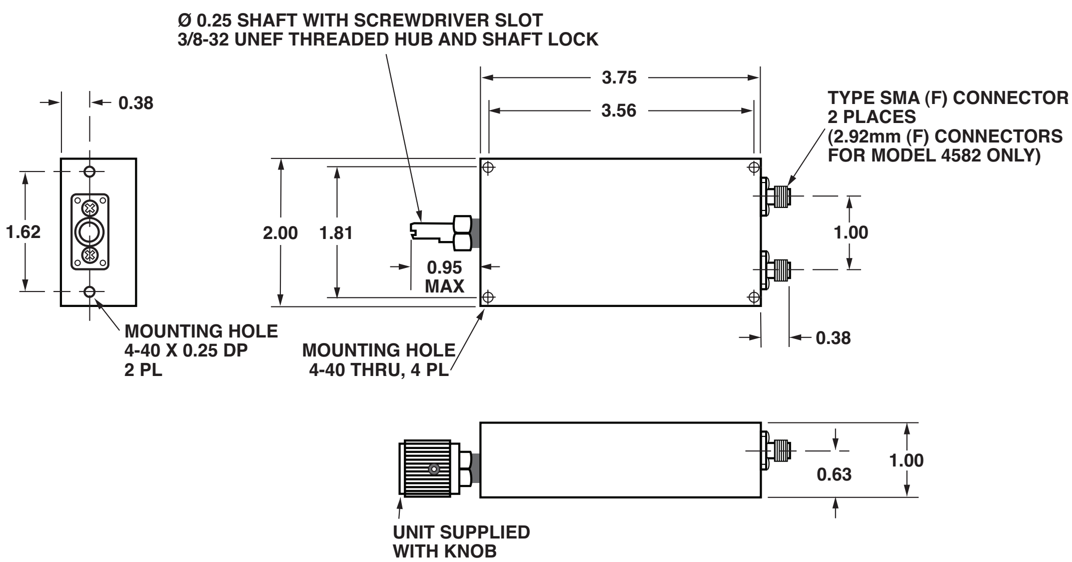
- Broadband Coverage
- Low VSWR
- Adjustable via Knob with Lock Nut

Specifications

SMA (F) and 2.92 mm (F), DC to 40 GHz

FREQUENCY RANGE (GHz)	MODEL	ADJUSTABLE PHASE SHIFT	POWER		INSERTION LOSS (dB max.)	VSWR (max.)	CONNECTORS	WEIGHT (max.)	
			AVERAGE (W)	PEAK (kW)				oz.	gr.
DC-18.6	**4579**	0-30° / GHz	100	3	1.0	1.6	SMA (F)	10.8	306
DC-26.5	**4580**	0-30° / GHz	100	3	1.5	2.0	SMA (F)	10.8	306
18.0-26.5	**4581**	0-360°	100	3	1.5	1.8	SMA (F)	10.8	306
18.0-40.0	**4582**	0-360°	100	3	2.5	2.0	2.92 mm (F)	10.8	306

Outline Drawing



Dimensions in inches, unless otherwise specified.

Phase Shifters

DC-26 GHz

Broadband 60° Phase Shifters

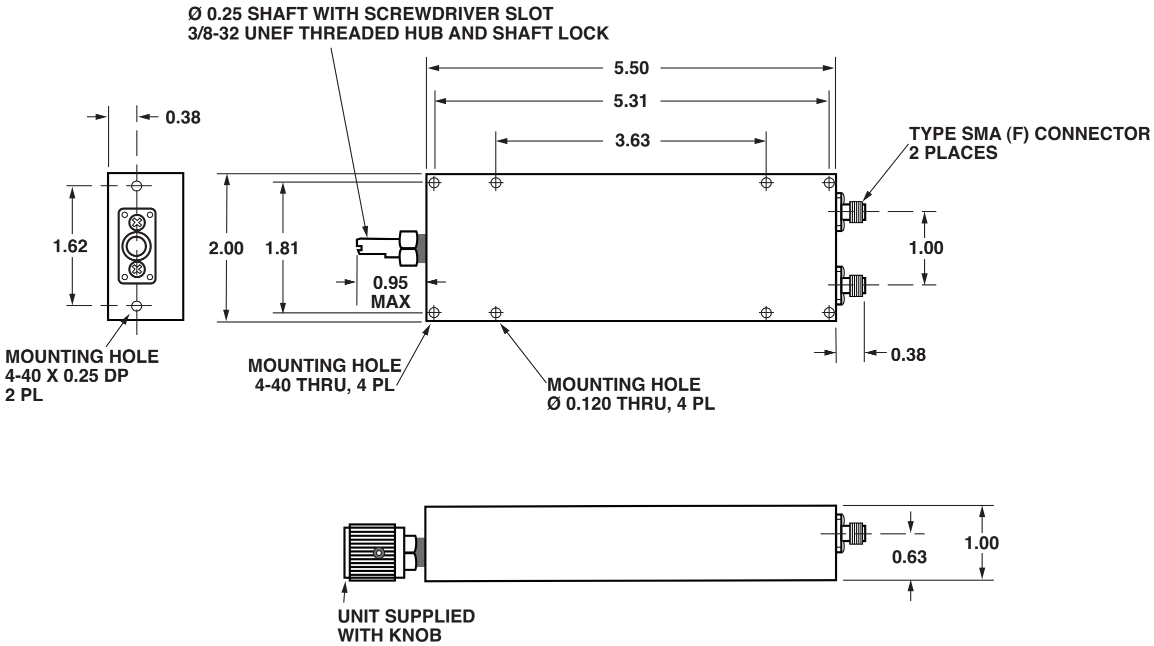
- Broadband Coverage
- Low VSWR
- Adjustable via Knob with Lock Nut

Specifications

SMA (F), DC to 26 GHz

FREQUENCY RANGE (GHz)	MODEL	ADJUSTABLE PHASE SHIFT	POWER		INSERTION LOSS (dB max.)	VSWR (max.)	CONNECTORS	WEIGHT (max.)	
			AVERAGE (W)	PEAK (kW)				oz.	gr.
DC-18.6	**4589**	0-60° / GHz	100	3	1.0	1.6	SMA (F)	15.4	437
18.0-26.0	**4590**	0-60° / GHz	100	3	1.5	2.0	SMA (F)	15.4	437

Outline Drawing



Dimensions in inches, unless otherwise specified.

DC-18 GHz

Broadband Phase Shifters

- Broadband Coverage
- Low VSWR
- Adjustable via Micrometer Drive or Knob with Lock Nut (model-dependent)

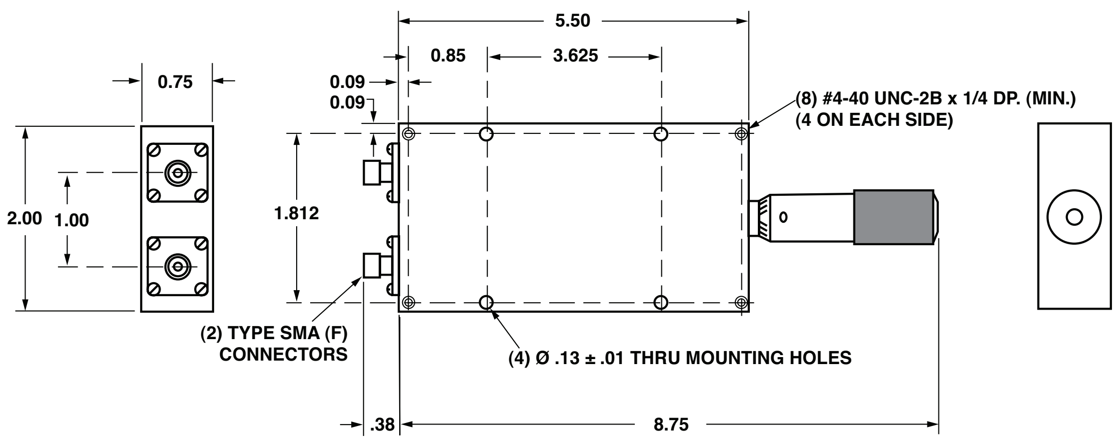
Specifications

SMA (F), DC to 18 GHz

FREQUENCY RANGE (GHz)	MODEL	MINIMUM PHASE SHIFT	POWER AVERAGE (W)	POWER PEAK (kW)	INSERTION LOSS (dB max.)	VSWR (max.)	CONNECTORS	WEIGHT (max.) oz.	WEIGHT (max.) gr.
DC-18	**4754***	60° / GHz 360° at 6 GHz	100	5	DC-8 GHz: 0.50 8-12 GHz: 0.75 12-18 GHz: 1.00	DC-4 GHz: 1.3 4-12 GHz: 1.5 12-18 GHz: 1.6	SMA (F)	15.4	437
DC-18	**4755****	60° / GHz 360° at 6 GHz	100	5	DC-8 GHz: 0.50 8-12 GHz: 0.75 12-18 GHz: 1.00	DC-4 GHz: 1.3 4-12 GHz: 1.5 12-18 GHz: 1.6	SMA (F)	13.4	380

* Micrometer Drive
** Knob

Outline Drawing

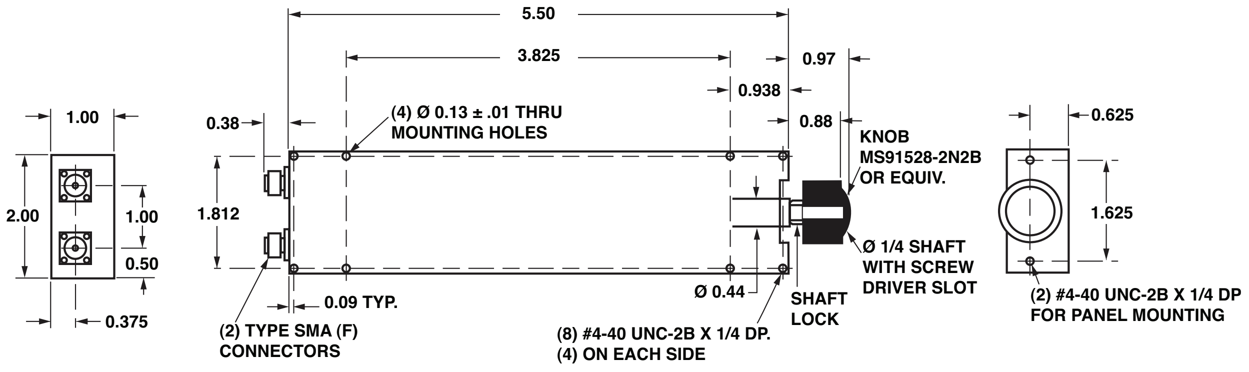


MODEL 4754

Dimensions in inches, unless otherwise specified.

Phase Shifters

Outline Drawing



MODEL 4755

Dimensions in inches, unless otherwise specified.

Power Dividers and Hybrids

Power Dividers and Hybrids

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL SERIES	CONNECTOR	PAGE
POWER DIVIDERS			
10-45	4428C	2.92 mm	137
18-40	4318	2.92 mm	137
10-33	4328B	2.92 mm	138
1.7-26.5	4327C	2.92 mm	138
18-26.5	4317C	2.92 mm	141
0.5-18	4426	SMA	145
2-18	3456B	Type N	143
2-18	4456	SMA	138
5-18	3326B	Type N	143
5-18	4326B	SMA	138
6-18	3306	Type N	155
6-18	4306	SMA	155
6-18	4326	SMA	135
12-18	4316	SMA	141
8-12.4	4315	SMA	141
0.5-8	4436	SMA	147
2-8	3324	Type N	143
2-8	4324	SMA	138
4-8	4314B	SMA	141
0.5-6	2382	Type N	154
0.5-6	4426LB	SMA	145
2-6	4323	SMA	135
2-4	4313B	SMA	141
2-4	4313C	SMA	141
0.5-2.5	4322	SMA	138
0.7-2.5	2372A	Type N	154
0.8-2.5	3372A	Type N	131
0.8-2.5	4372A	SMA	131
1.9-2.5	4162	SMA	131
0.8-2.2	4325	SMA	138
0.5-2	4321B	SMA	138
0.5-2	4321C	SMA	138
1-2	4312B	SMA	141
1-2	4312C	SMA	141
1.8-2	2362	Type N	152
0.5-1	4311B	SMA	141
0.5-1	4311C	SMA	141
0.8-1	4152	SMA	131
0.820-0.915	30373	Type N	150
0.820-0.915	30402	Type N	150
0.820-0.915	30403	Type N	150
HYBRIDS			
2-18	4346	SMA	158
2-18	4356B	SMA	158
6-18	4096	SMA	157
6-18	4336	SMA	160
7.5-16	4065	SMA	165
0.5-8	4358	SMA	162
2-8	4333	SMA	160
2-8	4343	SMA	160
4-8	4034C	SMA	165
1.7-4.2	3033B	Type N	163
2-4	4033C	SMA	165
0.95-2	3032	Type N	163
1-2	4032C	SMA	165
0.5-1	4031C	SMA	165
0.82-0.98	3322	Type N	163
0.25-0.5	4030C	SMA	165

narda MITEQ www.nardamiteq.com E-MAIL: componentsnm@nardamiteq.com TEL: +1 631 231-1700

Introduction

Traditionally, both coupled-line 3 dB couplers and in-phase Wilkinson dividers have been used for power dividing and combining. For a given application, however, the differences between the two make one type more desirable than the other.

90° Hybrids

A 90° Hybrid (Hybrid Junction) is a network having the electrical characteristics of a 3 dB directional coupler whose branch line is not terminated. The four terminal network can be considered to have two pairs of terminals called conjugate pairs. In most packages, each conjugate pair is located on either side of the device (Figure 1). The two terminals that make up the conjugate pair are isolated from each other. Therefore, power flowing into one terminal of the pair does not appear at its conjugate, but is equally divided between the terminals of the opposite conjugate pair. When used as a power divider, any one of the four terminals can be used as the input. With the conjugate port of the input terminated in 50 ohms, the two outputs at the opposite conjugate pair will be of equal amplitude and in quadrature (90° apart in phase).

The primary advantage of the hybrid junction is its power handling capability. Since the isolated port (conjugate of the input port) is terminated externally, the only limitations to power handling are heat generated by the internal dissipation losses and the power handling capability of the external termination. As stripline losses are typically low, hybrid junctions can be designed to handle up to 500 watts average power in special versions. Another advantage of the hybrid junction is that it maintains its quadrature relationship over the full operating frequency range of the device. This characteristic is highly desirable in Polar Frequency Discrimination and Circularly Polarized antenna circuits.

180° Hybrids

A signal applied to the sum port of the 180° hybrid provides output signals of equal amplitude and phase at the output ports. A signal applied to the delta port provides output signals of equal amplitude but 180° out of phase with each other (Figure 2). Narda-MITEQ Broadband 180° Hybrids are ideal for use as power dividers, combiners, balanced mixers, image rejection mixers, antenna feed networks, matrix amplifiers and switching networks.

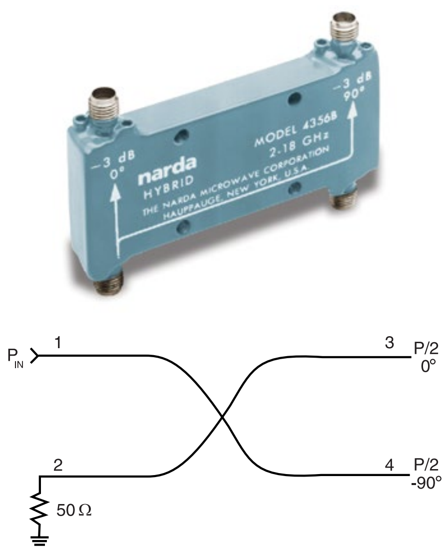


Figure 1 Multi-Octave Hybrid
Ports 1 & 2 Comprise a Conjugate Pair
Ports 3 & 4 Comprise a Conjugate Pair

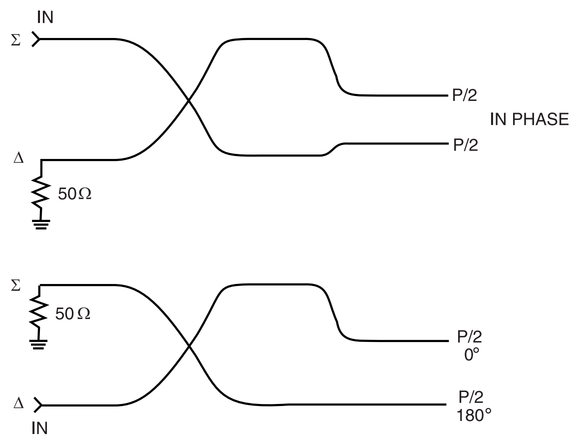


Figure 2 Signal Flow Diagram 180° Hybrid

Power Dividers and Hybrids

In-Phase Power Divider

The in-phase Wilkinson power divider is a network with one input and N outputs equal in amplitude whose phase relationship is zero degrees. In some applications, such as phased arrays and certain EMC interferometer receiving systems, this characteristic is a necessity.

A distinct advantage of the in-phase power divider is its superior amplitude balance when compared to the amplitude balance of a hybrid junction. Examples which take advantage of this superior performance are illustrated in Figures 3 and 4. Since the output ports track so closely, one port of the divider is fed back to the swept signal generator to provide a very flat amplitude response at the point of measurement.

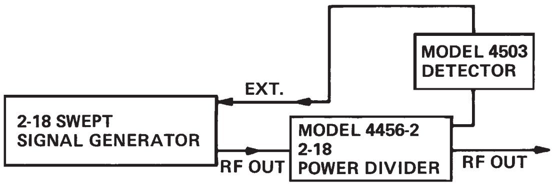


Figure 3 - An example using a power divider in a leveling loop application requiring superior amplitude and phase balance.

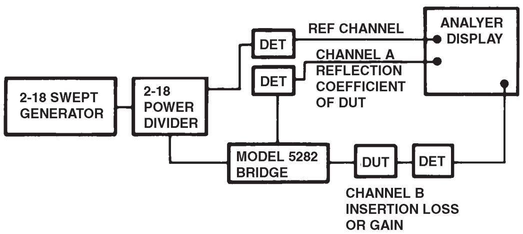


Figure 4 - A ratio measurement system is an example in the use of the excellent tracking characteristics of the divider

As the output ports of the divider are identical, and one of these outputs is used to provide amplitude correction information to the swept generator, the ideal case provides a constant RF output level to the unit under test. When this is the case, measurement of reflection coefficient and insertion loss of a device may be made with a swept signal generator in the unleveled mode. Any inadvertent variation of the power output control of the swept signal generator would have no effect on the measurement. It should be noted, however, that in both of the cases depicted in Figures 3 and 4, there is a nominal 3dB power loss of the input signal.

Using Hybrids and In-Phase Power Dividers as Power Combiners

Both the in-phase power divider and the hybrid junction can be used as power combiners. If the relationship of the input signals when the device is used as a combiner is the same as the relationship of the output signals present when the device is used as a divider, there is a minimal power loss through the device. For example, a 90° hybrid with equal amplitude signals in quadrature placed on the inputs to one conjugate pair will result in no signal at one of the terminals of the opposite conjugate pair and the sum of the signals at the other terminal. Due to the fact that the inputs, when used as a combiner, were at the same relationship as the outputs would have been if the device was used as a divider (one signal in, two signals out at equal amplitude 90° apart) the power loss is minimal. In other cases, the combination losses will vary with the relationship of the signals, and the combined power level achieved in combination will be degraded.

In a similar manner, the in-phase power divider can be used as a power combiner. In this case, however, as the power handling capability of the in-phase power divider is limited by the power handling capability of the internal resistor(s) of the device, the input power level of each of the combined signals must not exceed 1W/N watts (where N is the number of inputs). For example, when using a 4-way power divider as a combiner, the maximum power level into each of the output ports of the divider cannot exceed 0.25 watts or 1W/N=4. If, however, the input signals are phase and amplitude coherent (same frequency, equal amplitude), the internal resistor of the in-phase power divider does not dissipate energy, and the power level of the inputs can be as high as the full-rated power used as a divider, divided by N. In this example, a 4-way device rated as a divider at 50 watts, could handle 4 signals of 12.5 watts if the signals were *perfectly* frequency- and amplitude-coherent.

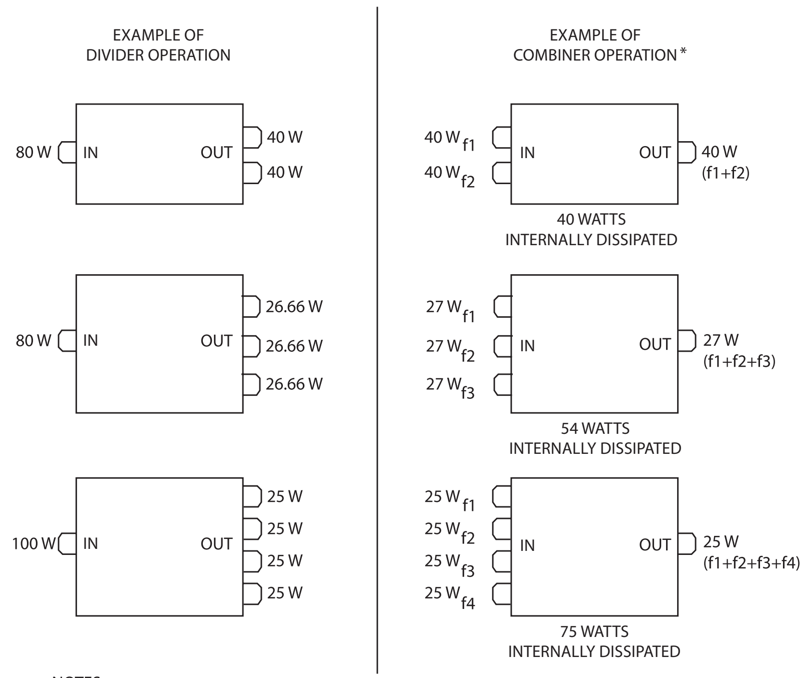
In applications for the combination of 2 or more transmit signals into single antenna communications networks, Narda-MITEQ does provide designs that can handle multiple signal inputs at elevated RF power levels. Power level handling, where the sum of the input signal power of each of the input ports closely matches the maximum forward power when used as a divider, is readily achievable with the proper resistor selection. Using this design approach, custom broadband high frequency devices, as well as narrow band products geared toward the cellular markets, are available.

When a signal is applied to the input of a Wilkinson power divider, it results in signals at the output that are equal in amplitude and phase (with respect to each other). Ignoring the effects of insertion loss (that loss above and beyond the theoretical or split loss), the output signals are at an amplitude that is half the amplitude of the input signal. This concept can be expanded for devices with more than two outputs: i.e., the output power is equal to the input power, divided by "N" the number of outputs ($P_{OUT} = P_{IN} / N$). In dB, the relationship would be $Out_{dB} = 10 \log (1 / N)$.

When non-coherent (other than matched in phase and amplitude) signals are introduced into the outputs as a combiner however, the device will dissipate a considerable amount of energy and as such, special consideration must be taken in the management of that dissipated power. For example, with traditional low-power designs, a two-way divider rated for 30 watts (30 watts in, two 15 watt signals out) would produce catastrophic results if two non-coherent 15 watt signals were applied (P_{IN} / N or 30 W / 2 = 15 W). In a two-way device, half of the energy of each signal to be combined would need to be dissipated in the internal resistors. If special provisions were not taken to handle this power, the device would be destroyed. With non-coherent signal inputs, the loss of each signal will be identical to the loss of the device when used as a divider. In the combiner case, that loss is dissapated in the internal resistors.

With the utilization of proprietary thermal-management techniques and special material / assembly methods, Narda-MITEQ provides a series of Wilkinson-style devices that have the capability of handling elevated RF power levels as a non-coherent signal combiner. For example, our 80 watt, 2-way device (Narda-MITEQ Model 2362-2) handles 2 x 40 W signals (80 W / 2 = 40 W), and the 80 watt, 3-way device (Narda-MITEQ Model 2362-3) handles 3 x 27 W signals (80 W / 3 = 26.66 W). The diagram in Figure 5 illustrates the general function for 2, 3, and 4-way devices, in terms of their use as non-coherent signal combiners.

Figure 5



NOTES:
CONSIDERS THEORETICAL LOSSES ONLY.
ADDITIONAL I^2R LOSSES ARE NOT INCLUDED IN THIS ANALYSIS.
* CASE TEMPERATURE MUST BE MAINTAINED AT 85° MAX.
COOLING FAN MAY BE REQUIRED.

Power Dividers and Hybrids

Glossary

Since performance characteristics of in-phase power dividers are specified in a number of ways, the following definitions of terms are applicable to all Narda-MITEQ in-phase power dividers that appear in this catalog.

Frequency - The frequency range over which the power divider must meet specifications listed.

Amplitude Balance - The maximum peak-to-peak amplitude difference in dB between the output ports of the power divider over the specified frequency range.

Phase Balance - The maximum peak-to-peak difference in phase, in degrees, between the output ports of the power divider over the specified frequency range.

Isolation - The difference in dB that the signal level measured at one output port is below the signal level into the adjacent output port, with the input port terminated in 50 ohms. Isolation is measured between adjacent ports since this is the most severe condition.

VSWR, Input - The maximum VSWR of the power divider over its specified frequency range, looking into the common port, with all other ports terminated in 50 ohms.

VSWR, Output - The maximum VSWR of the power divider over its specified frequency range, looking into any one of the output ports with all other ports terminated in 50 ohms.

Insertion Loss - The ratio in dB of the net difference between the power input and the sum of the output power expressed as:

$$\text{Insertion Loss} = 10 \log \left[\frac{P_1 + P_2 + \ldots.. P_n}{P_{input}} \right]$$

Average Power - The maximum power that may be applied to the common or input port with the output ports terminated in a load with the VSWRs listed.

NOTE: For Applicable Narda-MITEQ Power Dividers and Hybrids, Narda-MITEQ can supply **standard** test data for a nominal fee.

Environmental Performance for Selected Passive Products*

PARAMETER	SPECIFICATION
Operating Temperature	-54 to +105°C
Storage Temperature	-55 to +125°C
Humidity	Per MIL-STD-202F, method 103B, condition B (96 hours at 95% R.H.)
Shock	Per MIL-STD-202F, method 213B, condition J (30G, 11 ms)
Altitude	Per MIL-STD-202F, method 105G, condition B (50,000 feet)
Vibration	Per MIL-STD-202F, method 204D, condition B (.06" double amplitude or 15G, which ever is less)
Thermal Shock	Per MIL-STD-202F, method 107D, condition A (5 cycles)

* Applicable to Stripline Directional Couplers, Attenuators, Power Dividers

Note:
This is an exclusive listing. Where otherwise noted in the catalog, the above environmental performance may not apply. Not applicable for those products designed for commercial applications. Many of our catalog off-the-shelf (COTS) products have the ability to withstand considerably more stringent environments. If you have special environmental requirements, please contact the Sales Department at Narda-MITEQ.

0.8-2.5 GHz

Wireless Band Power Combiners / Dividers

- Wireless Communications PCS and Cellular Coverage
- Broadband – 0.8 to 2.5 GHz
- Complete Series – 2-Way thru 16-Way Models
- Sealed Versions Available
- High Isolation ≥ 20 dB, Typical ≥ 26 dB Isolation
- Excellent Phase and Amplitude Balance

Specifications

Type N (F), 0.8 to 2.5 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	CONNECTORS	BAND SEGMENTS (GHz)	VSWR (max.)		INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	AVERAGE POWER* (W max.)			WEIGHT	
				INPUT	OUTPUT					A	B	C	oz.	gr.
0.8-2.5	**3372A-2**	TYPE N (F)	0.8-1	1.35	1.30	0.3	22	0.2	3°	30	5	0.5	7.8	220
			1-2.5	1.35	1.30	0.5	22	0.2	3°	30	5	0.5		
0.8-2.5	**3372A-3**	TYPE N (F)	0.8-2.5	1.60	1.50	0.8	15	0.5	8°	30	5	0.5	20.1	570
0.8-2.5	**3372A-4**	TYPE N (F)	0.8-2.5	1.40	1.35	0.8	22	0.3	6°	30	5	0.5	22.9	650
0.8-2.5	**3372A-6**	TYPE N (F)	0.8-1	1.70	1.50	0.8	18	0.5	8°	30	5	0.5	60	1700
			1-2.5	1.80	1.60	1.0	18	0.7	10°	30	5	0.5		

* Average Power Rating into a load VSWR of (A) 1.2 to 1, (B) 2 to 1 and (C) ∞VSWR

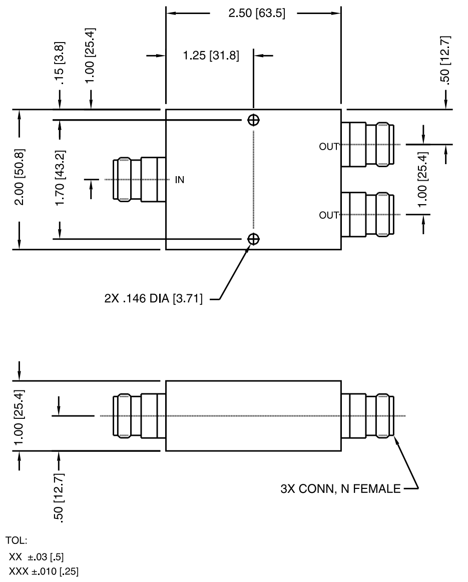
SMA (F), 0.8 to 2.5 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	CONNECTORS	BAND SEGMENTS (GHz)	VSWR (max.)		INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	AVERAGE POWER* (W max.)			WEIGHT	
				INPUT	OUTPUT					A	B	C	oz.	gr.
0.8-2.5	**4372-2**	SMA (F)	0.8-1	1.35	1.30	0.3	25	0.2	3°	30	5	0.5	3.5	100
			1-2.5	1.35	1.30	0.5	25	0.2	3°	30	5	0.5		
0.8-2.5	**4372A-3**	SMA (F)	0.8-2.5	1.60	1.50	0.8	15	0.5	8°	30	5	0.5	6	170
0.8-2.5	**4372A-4**	SMA (F)	0.8-2.5	1.40	1.35	0.8	22	0.3	6°	30	5	0.5	8.8	250
0.8-2.5	**4372A-6**	SMA (F)	0.8-1	1.70	1.50	0.8	18	0.5	8°	30	5	0.5	17	482
			1-2.5	1.80	1.60	1.0	18	0.7	10°	30	5	0.5		
1.9-2.5	**4162-8**	SMA (F)	1.9-2.5	1.50	1.40	1.1	22	0.5	6°	30	5	0.5	17.6	500
1.9-2.5	**4162-16**	SMA (F)	1.9-2.5	1.60	1.40	1.2	19	0.8	10°	30	5	0.5	19.4	550
0.8-1	**4152-8**	SMA (F)	0.8-1	1.30	1.30	0.8	20	0.4	6°	30	5	0.5	22.9	650
0.8-1	**4152-16**	SMA (F)	0.8-1	1.30	1.30	1.5	20	0.6	10°	30	5	0.5	30	850

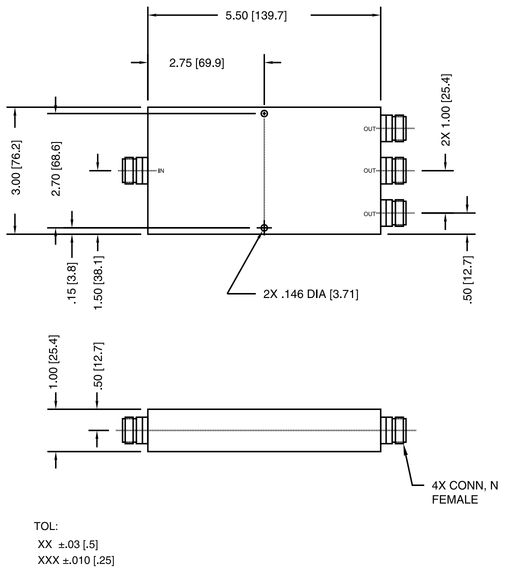
* Average Power Rating into a load VSWR of (A) 1.2 to 1, (B) 2 to 1 and (C) ∞VSWR

Power Dividers

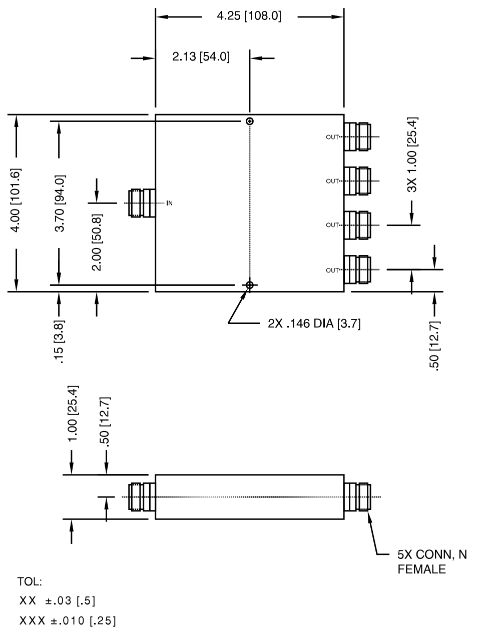
Outline Drawings



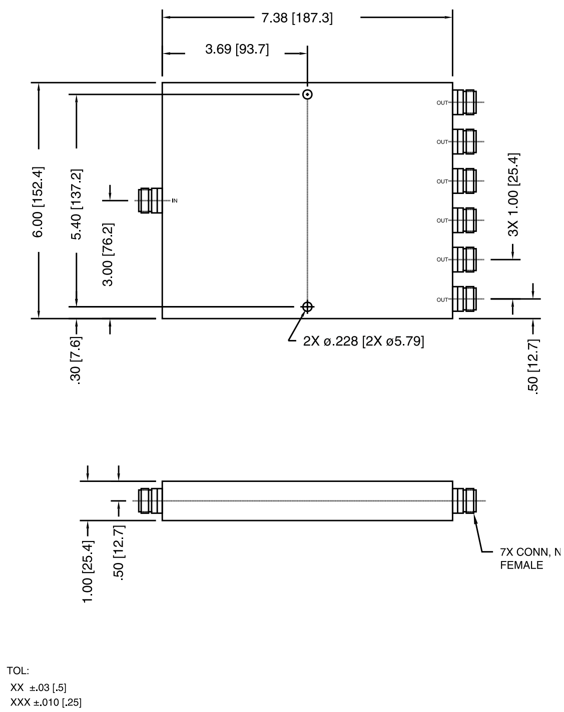
MODEL 3372A-2



MODEL 3372A-3



MODEL 3372A-4

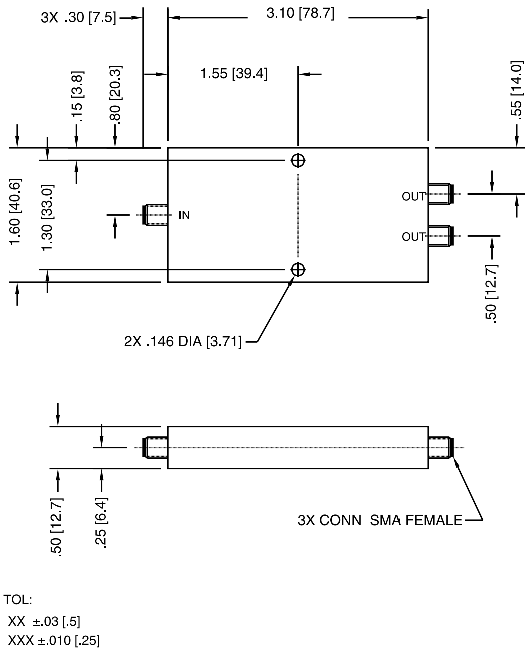


MODEL 3372A-6

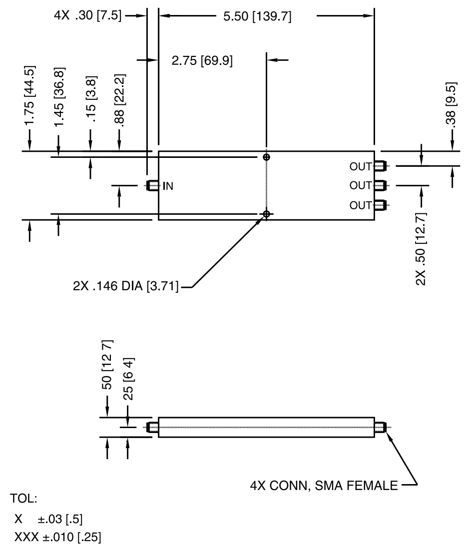
Dimensions in inches (mm in parentheses), unless otherwise specified.
Connectors mate without interference per MIL-STD-348.

Power Dividers

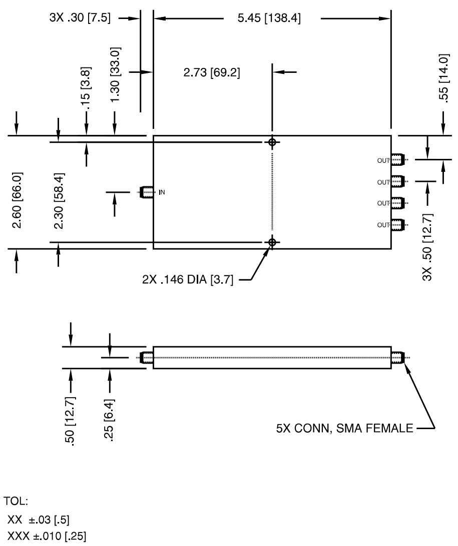
Outline Drawings



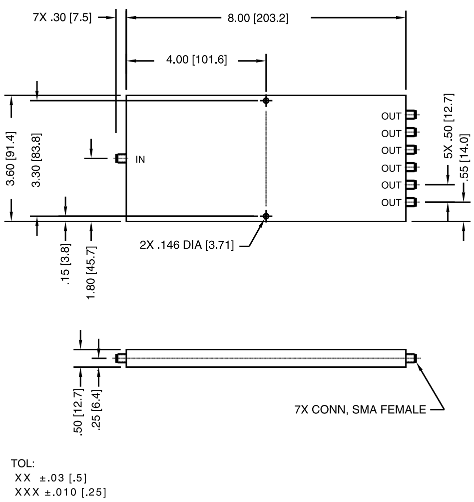
MODEL 4372-2



MODEL 4372A-3



MODEL 4372A-4

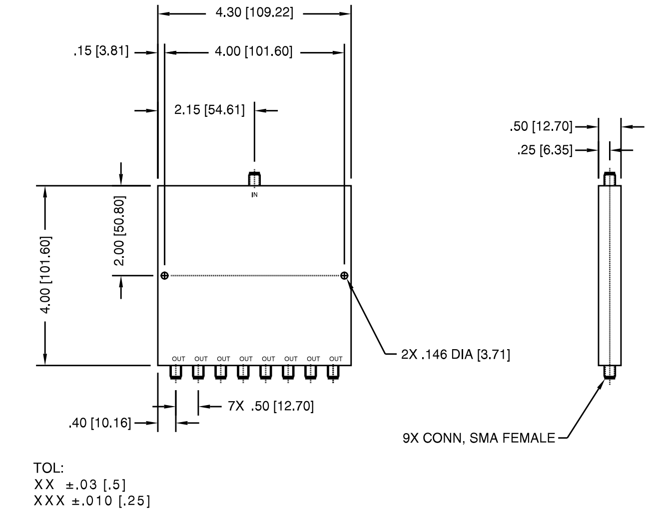


MODEL 4372A-6

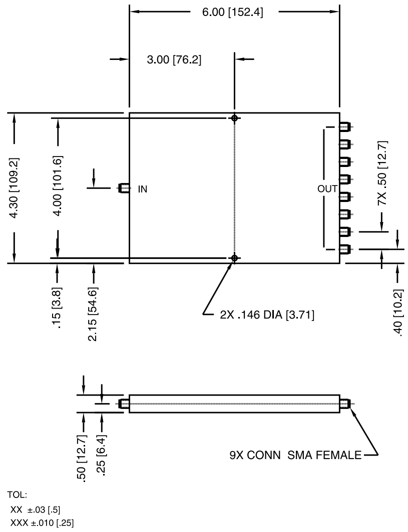
Dimensions in inches (mm in parentheses), unless otherwise specified.
Connectors mate without interference per MIL-STD-348.

Power Dividers

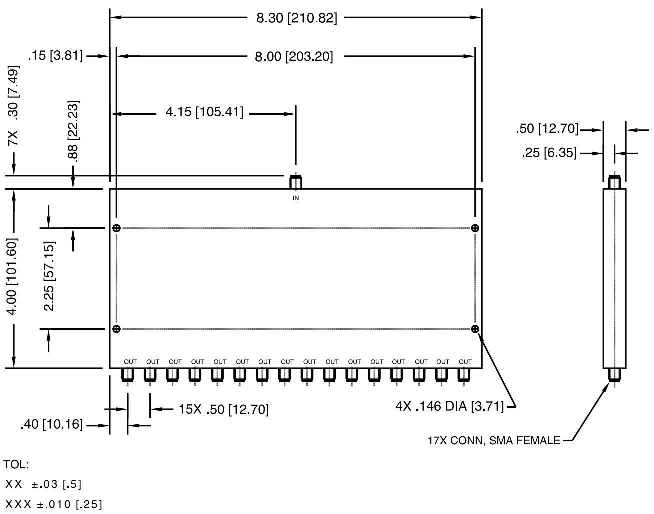
Outline Drawings



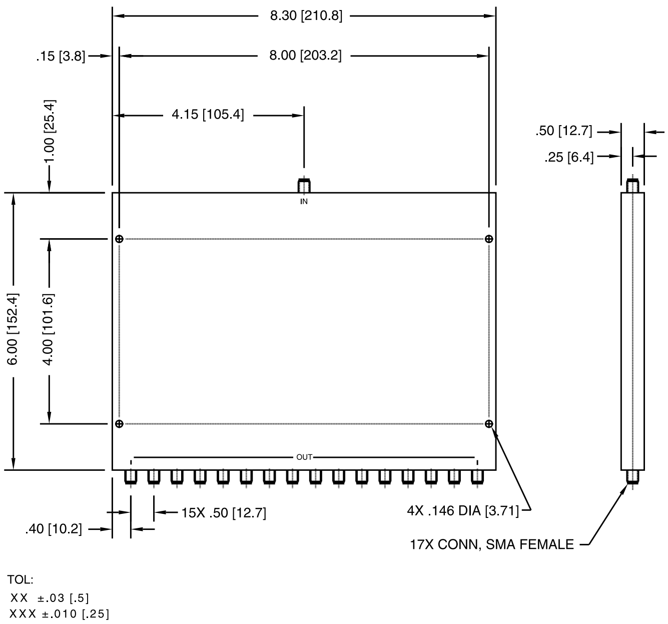
MODEL 4162-8



MODEL 4152-8



MODEL 4162-16



MODEL 4152-16

Dimensions in inches (mm in parentheses), unless otherwise specified.
Connectors mate without interference per MIL-STD-348.

2-18 GHz

3-Way Power Dividers

- True 3-Way Power Dividers
- Octave Band Frequency Coverage
- Small Size
- High Isolation Between Output Ports

Specifications

SMA (F), 3-Way, 2 to 6 GHz, 1W

FREQUENCY RANGE (GHz)	MODEL	VSWR INPUT (max.)			VSWR OUTPUT (max.)	INSERTION LOSS (dB)			ISOLATION (dB min.)			AMPLITUDE BALANCE (dB)	PHASE BALANCE (max.)	AVERAGE* POWER (W)	WEIGHT	
		2-3	3-5	5-6		2-3	3-5	5-6	2-3	3-5	5-6				oz.	gr.
2-6	**4323-3**	2.0	1.5	2.0	1.5	0.9	0.5	0.9	13	15	13	0.4	8°	1	.96	27

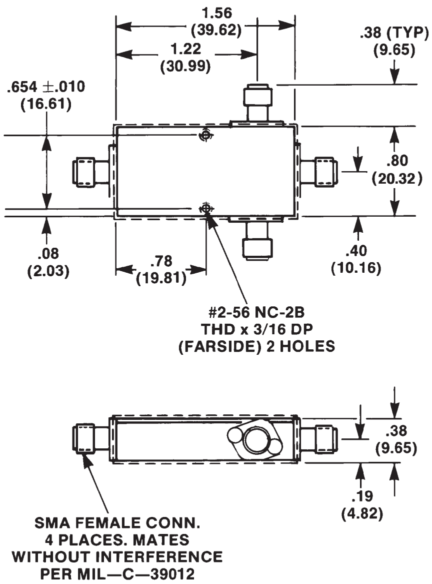
SMA (F), 3-Way, 6 to 18 GHz, 1W

FREQUENCY RANGE (GHz)	MODEL	VSWR INPUT (max.)			VSWR OUTPUT (max.)		INSERTION LOSS (dB)		ISOLATION (dB min.)			AMPLITUDE BALANCE (dB)		PHASE BALANCE (max.)	AVERAGE POWER (W)	WEIGHT	
		6-7.5	7.5-15.6	15.6-18	6-17	17-18	6-17	17-18	6-7	7-16	16-18	6-17	17-18			oz.	gr.
6-18	**4326-3**	2.0	1.5	2.0	1.5	2.0	0.9	1.2	14	15	12	0.4	0.5	9°	1	.63	18

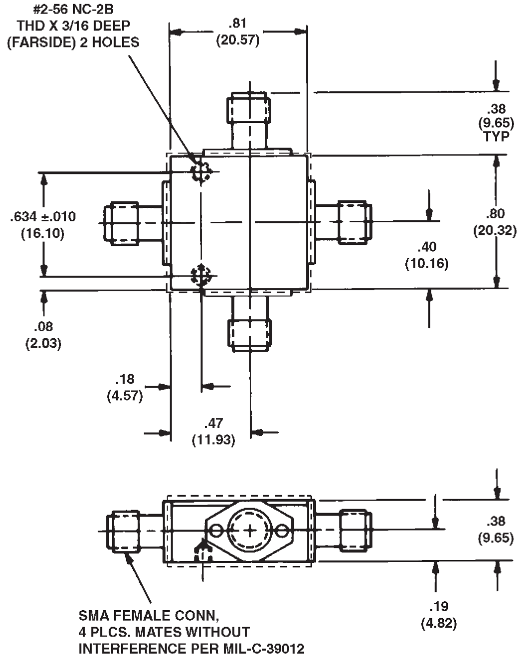
* Power Rating into 2 to 1 VSWR Load

Power Dividers

Outline Drawings



MODEL 4323-3



MODEL 4326-3

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

10-45 GHz

Millimeter Wave 2- and 4-Way Power Dividers

- 40 GHz, 2.92 mm Coaxial Connector Power Divider
- Ultra Broadband, Multi-Octave
- Superior Phase & Amplitude Balance

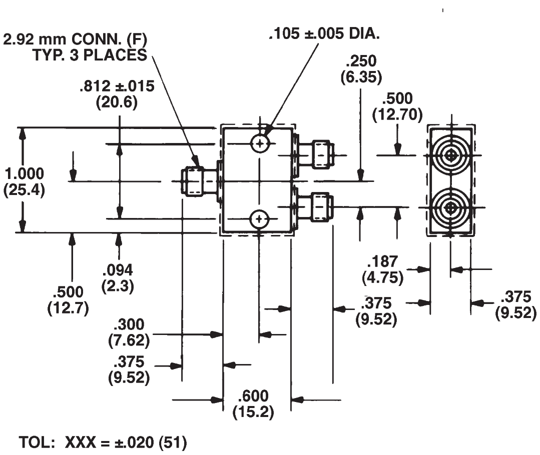
Specifications

2.92 mm (F), 2-Way / 4-Way, 10 to 45 GHz

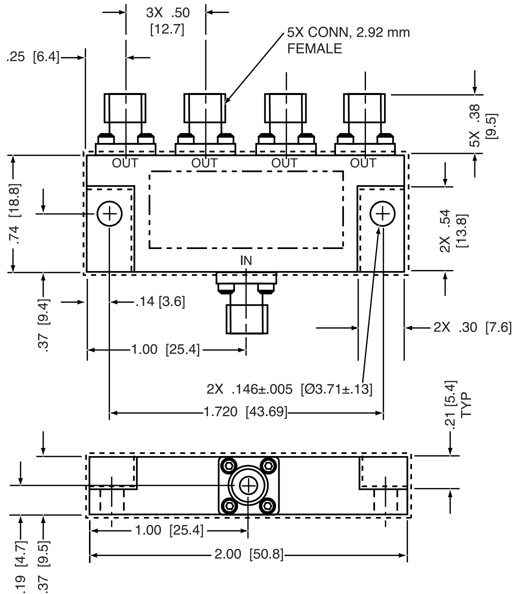
FREQUENCY RANGE (GHz)	MODEL	BAND SEGMENTS (GHz)	VSWR (max.)		INSERTION LOSS (dB min.)	ISOLATION (dB)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	AVERAGE POWER* (W max.)			WEIGHT (max.)	
			INPUT	OUTPUT					A	B	C	oz.	gr.
10-45	4428C-2	10-18	1.5	1.5	0.6	20	0.3	5°	20	5	1	0.71	20
		18-26.5	1.7	1.7	0.9	17	0.5	6°					
		26.5-40	1.9	1.9	1.6	14	0.8	12°					
		40-45	1.9	1.9	1.9	13	0.8	12°					
18-40	4318-4	18-40	1.9	1.7	2.2	16	1.0	10°	30	5	0.5	1.41	40

* Average Power Rating into a load VSWR of (A) 1.2 to 1, (B) 2 to 1 and (C) ∞VSWR

Outline Drawings



MODEL 4428C-2



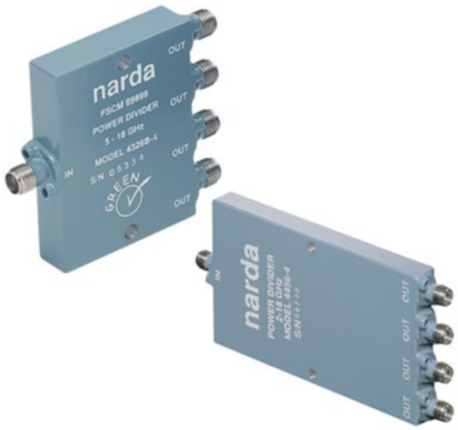
MODEL 4318-4

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

Power Dividers

0.5-33 GHz

Multi-Octave 2- and 4-Way Power Dividers



- Broadband Frequency Coverage from 0.5 to 33 GHz
- Excellent Phase and Amplitude Tracking
- Low Input VSWR
- High Isolation Between Output Ports
- Precision SMA or 2.92 mm Connectors

Specifications

SMA (F) and 2.92 mm (F), 2-Way, 0.5 to 33 GHz, 30 W

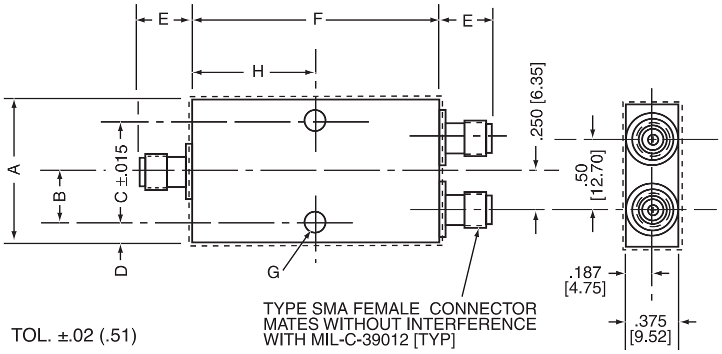
FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	BAND SEGMENTS (GHz)	VSWR (max.) INPUT	VSWR (max.) OUTPUT	INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB)	PHASE BALANCE	AVERAGE POWER* (W) A	B	C	WEIGHT oz.	gr.
0.5-2.0	4321B-2	SMA (F)	0.5-2.0	1.25	1.15	0.6	22	0.2	2°	30	20	3	1.1	30
0.5-2.5	4322-2	SMA (F)	0.5-2.5	1.35	1.15	0.3	18	0.2	2°	30	20	3	2.0	55
0.8-2.2	4325-2	SMA (F)	0.8-2.2	1.25	1.15	0.6	23	0.2	2°	30	10	1	1.1	30
2-8	4324-2	SMA (F)	2-4 4-8	1.35 1.35	1.25 1.25	0.2 0.5	20 20	0.2 0.3	2° 4°	30	10	1	1.2	35
5-18	4326B-2	SMA (F)	5-12.4 12.4-18	1.35 1.40	1.30 1.35	0.4 0.6	19 19	0.2 0.3	3° 6°	30	10	1	0.7	20
2-18	4456-2	SMA (F)	2-8 8-18	1.30 1.40	1.25 1.40	0.5 1.2	20 19	0.2 0.3	3° 6°	30	10	1	1.4	38
1.7-26.5	4327C-2	2.92 mm (F)	1.7-2 2-18 18-26.5	1.50 1.40 1.70	1.50 1.35 1.50	1.1 1.4 2.4	19 21 16	0.3 0.3 0.5	6° 6° 10°	2	—	—	1.8	50
10-33	4328B-2**	2.92 mm (F)	10-18 18-33	1.50 2.00	1.50 2.00	1.5 1.5	15 15	0.5 0.5	6° 12°	30	10	1	0.8	22

SMA (F) and 2.92 mm (F), 4- Way, 0.5 to 18 GHz, 30 W

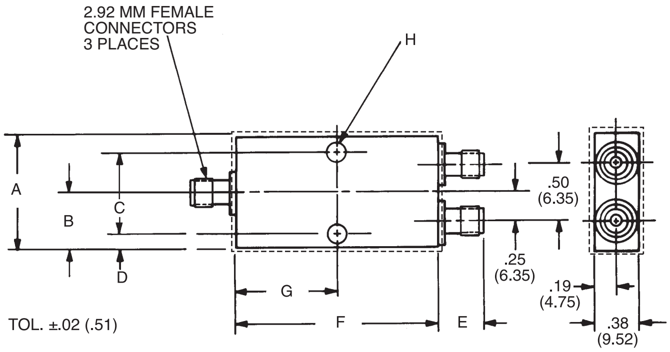
FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	BAND SEGMENTS (GHz)	VSWR (max.) INPUT	VSWR (max.) OUTPUT	INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB)	PHASE BALANCE	AVERAGE POWER* (W) A	B	C	WEIGHT oz.	gr.
0.5-2	4321C-4	SMA (F)	0.5-2	1.45	1.30	1.3	20	0.3	4°	30	10	3	2.9	80
0.5-2.5	4322-4	SMA (F)	0.5-2.5	1.45	1.25	0.7	20	0.3	4°	30	10	1	5.8	165
0.8-2.2	4325-4**	SMA (F)	0.8-2.2	1.25	1.20	0.9	22	0.3	3°	30	20	3	2.9	80
2-8	4324-4	SMA (F)	2-8	1.45	1.35	0.9	18	0.4	4°	30	10	1	4.3	120
5-18	4326B-4	SMA (F)	5-6 6-18	1.60 1.50	1.40 1.40	0.5 0.9	18 19	0.3 0.5	3° 6°	30	10	1	2.2	60
2-18	4456-4	SMA (F)	2-8 8-18	1.40 1.50	1.40 1.40	1.0 1.8	20 18	0.4 0.8	6° 10°	30	10	1	4.4	125

* Average Power Rating into a load VSWR of (A) 1.2 to 1, (B) 2 to 1 and (C) ∞VSWR
** Custom-order basis: minimum quantity may apply

Outline Drawings, 2-Way



MODEL	A	B	C ±.015	D	E	F	G (Thru 2 Holes)	H
4321B-2	1.338 (33.98)	.669 (16.99)	1.146 (29.11)	.096 (2.44)	.375 (9.52)	1.204 (30.58)	. 104 +.004/-.002	.602 (15.29)
4322-2	1.70 (43.18)	.85 (21.59)	1.512 (32.40)	.09 (2.38)	.375 (9.52)	1.56 (39.69)	. 104 +.004/-.002	.78 (19.84)
4324-2	1.000 (25.40)	.500 (12.70)	.812 (20.62)	.094 (2.39)	.375 (9.52)	1.688 (42.87)	. 104 +.004/-.002	.844 (21.44)
4326B-2	1.000 (25.40)	.500 (12.70)	.812 (20.62)	.094 (2.39)	.375 (9.52)	.750 (19.05)	. 104 +.004/-.002	.375 (9.52)
4325-2	1.338 (33.98)	.669 (16.99)	1.146 (29.11)	.096 (2.44)	.375 (9.52)	1.204 (30.58)	. 104 +.004/-.002	.602 (15.29)
4456-2	1.000 (25.40)	.500 (12.70)	.700 (17.78)	.150 (3.81)	.375 (9.52)	1.750 (44.45)	.146 ±.003	.875 (22.22)

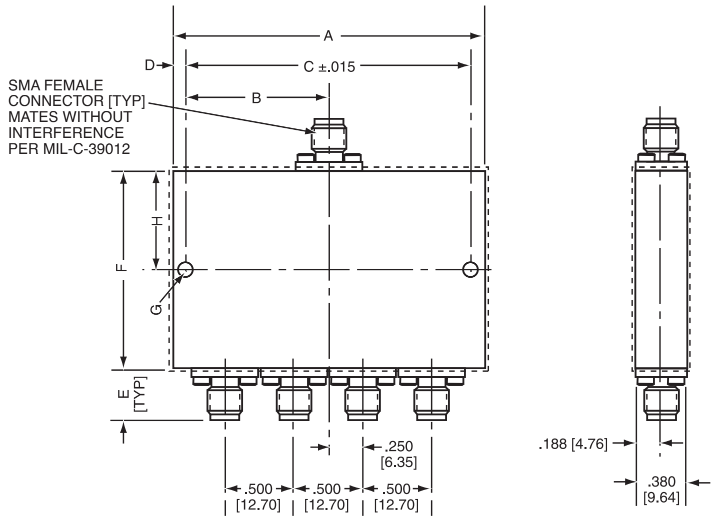


MODEL	A	B	C ±.015	D	E	F	G	H (2 Holes)
4327C-2	1.00 (25.4)	.50 (12.7)	.700 (17.78)	.15 (3.81)	.38 (9.52)	1.40 (35.56)	.70 (17.78)	.146 ±.005
4328B-2	1.00 (25.4)	.50 (12.7)	.812 (20.62)	.09 (2.39)	.38 (9.52)	.75 (19.05)	.38 (9.65)	. 104 +.004/-.002

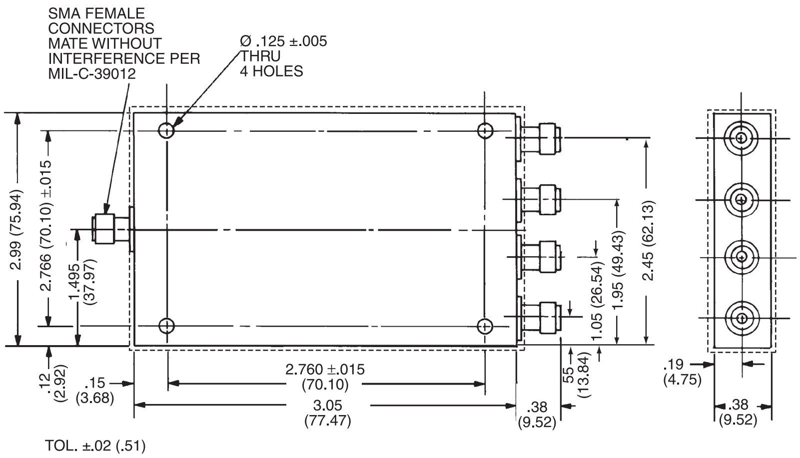
Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

Power Dividers

Outline Drawings, 4-Way



MODEL	A	B	C ±.015	D	E	F	G (Thru 2 Holes)	H
4321C-4	2.343 (59.51)	1.171 (29.74)	2.153 (54.68)	.095 (2.41)	.375 (9.52)	2.11 (53.62)	. 104 +.004/-.002	1.055 (26.79)
4324-4	1.940 (49.27)	.970 (24.63)	1.688 (42.87)	.126 (3.20)	.375 (9.52)	3.448 (87.57)	.146	1.740 (44.20)
4325-4	2.343 (59.51)	1.171 (29.74)	2.153 (54.68)	.095 (2.41)	.380 (9.65)	2.110 (53.62)	. 104 +.004/-.002	1.055 (26.79)
4326B-4	1.940 (49.27)	.970 (24.63)	1.688 (42.87)	.126 (3.20)	.375 (9.52)	1.418 (36.01)	.146	.709 (18.00)
4456-4	1.940 (49.27)	.970 (24.63)	1.688 (42.87)	.126 (3.20)	.375 (9.52)	3.448 (87.57)	.146	1.724 (43.78)



MODEL 4322-4

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

0.5-26.5 GHz

Octave Band 2- and 4-Way SMA Power Dividers

- Operation to 26.5 GHz
- Excellent Phase and Amplitude Tracking
- High Isolation Between Output Ports
- Small Size
- Operational Temperature Range: -55° to +85°C

Specifications

SMA (F) and 2.92 mm (F), 2-Way, 0.5 to 26.5 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	VSWR (max.)		INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	AVERAGE POWER* (W)			WEIGHT	
			INPUT	OUTPUT					A	B	C	oz.	gr.
0.5-1.0	**4311B-2**	SMA (F)	1.25	1.15	0.45	22	0.2	2°	30	20	3	1.1	30
1-2	**4312B-2**	SMA (F)	1.25	1.15	0.35	20	0.2	2°	30	20	3	0.9	23
2-4	**4313B-2**	SMA (F)	1.30	1.20	0.40	20	0.2	2°	30	20	3	0.8	20
4-8	**4314B-2**	SMA (F)	1.35	1.25	0.60	20	0.2	2°	30	20	3	0.8	20
8-12.4	**4315-2**	SMA (F)	1.35	1.30	0.50	20	0.2	3°	30	10	1	0.8	20
12-18	**4316-2**	SMA (F)	1.40	1.35	0.70	19	0.3	6°	30	10	1	0.8	20
18-26.5	**4317C-2**	2.92 mm (F)	2.00	2.00	1.00	15	0.5	12°	30	10	1	0.8	20

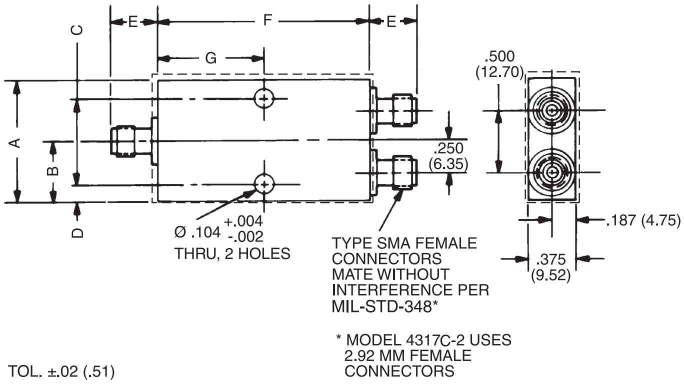
SMA (F), 4-Way, 0.5 to 18 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	VSWR (max.)		INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	AVERAGE POWER* (W)			WEIGHT	
			INPUT	OUTPUT					A	B	C	oz.	gr.
0.5-1.0	**4311C-4**	SMA (F)	1.45	1.30	0.90	22	0.3	3°	30	10	1	2.9	80
1-2	**4312C-4**	SMA (F)	1.40	1.25	0.80	20	0.3	3°	30	10	3	2.0	56
2-4	**4313C-4**	SMA (F)	1.35	1.35	0.60	20	0.3	3°	30	10	1	2.0	56
4-8	**4314B-4**	SMA (F)	1.45	1.35	0.50	20	0.3	3°	30	20	3	2.7	75
8-12.4	**4315-4**	SMA (F)	1.45	1.35	0.80	18	0.4	4°	30	10	1	2.2	60
12-18	**4316-4**	SMA (F)	1.50	1.40	1.50	18	0.5	6°	30	10	1	2.2	60

* Average Power Rating into a load VSWR of (A) 1.2 to 1, (B) 2 to 1 and (C) ∞VSWR

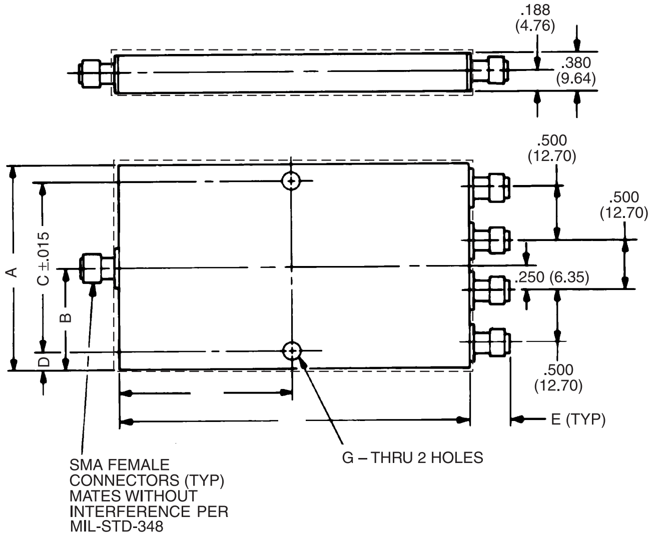
Power Dividers

Outline Drawings



OCTAVE 2-WAY POWER DIVIDERS

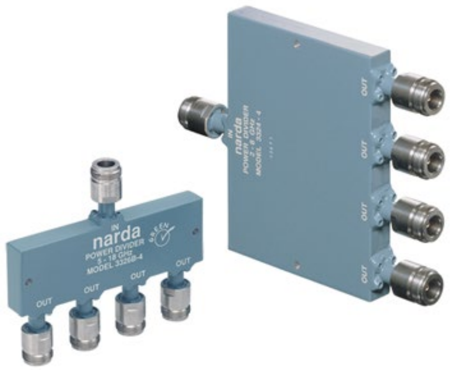
MODEL	A	B	C ±.015	D	E	F	G
4311B-2	1.338 (33.98)	.669 (16.99)	1.146 (29.11)	.096 (2.44)	.375 (9.52)	1.204 (30.58)	.602 (15.29)
4312B-2	1.260 (32.00)	.630 (16.00)	1.068 (27.13)	.096 (2.44)	.375 (9.52)	.875 (22.22)	.437 (11.10)
4313B-2	1.010 (25.65)	.505 (12.83)	.818 (20.78)	.096 (2.44)	.375 (9.52)	.875 (22.22)	.437 (11.10)
4314B-2	1.010 (25.65)	.505 (12.83)	.818 (20.78)	.096 (2.44)	.375 (9.52)	.875 (22.22)	.437 (11.10)
4315-2	1.000 (25.40)	.500 (12.70)	.812 (20.62)	.094 (2.39)	.375 (9.52)	.750 (19.05)	.375 (9.52)
4316-2	1.000 (25.40)	.500 (12.70)	.812 (20.62)	.094 (2.39)	.375 (9.52)	.750 (19.05)	.375 (9.52)
4317C-2	1.000 (25.40)	.500 (12.70)	.812 (20.62)	.094 (2.39)	.375 (9.52)	.600 (15.24)	.300 (7.62)



OCTAVE 4-WAY POWER DIVIDERS

MODE;	A	B	C	D	E	F	G	H
4311C-4	2.343 (59.51)	1.171 (29.74)	2.153 (54.68)	.095 (2.41)	.375 (9.52)	2.111 (53.62)	. 104 +.004/-.002	1.055 (26.79)
4312C-4	2.260 (57.40)	1.130 (28.70)	2.070 (52.57)	.095 (2.41)	.375 (9.52)	1.439 (36.55)	. 104 +.004/-.002	.719 (18.26)
4313C-4	2.260 (57.40)	1.130 (28.70)	2.070 (52.57)	.095 (2.41)	.375 (9.52)	1.439 (36.55)	. 104 +.004/-.002	.719 (18.26)
4314B-4	2.260 (57.40)	1.130 (28.70)	2.070 (52.57)	.095 (2.41)	.375 (9.52)	1.500 (38.10)	. 104 +.004/-.002	.750 (19.05)
4315-4	1.940 (49.27)	.970 (24.63)	1.688 (42.87)	.126 (3.20)	.375 (9.52)	1.418 (36.01)	.146	.709 (18.00)
4316-4	1.940 (49.27)	.970 (24.63)	1.688 (42.87)	.126 (3.20)	.375 (9.52)	1.418 (36.01)	.146	.709 (18.00)

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.



2-18 GHz

Multi-Octave Type N 2- and 4-Way Power Dividers

- Precision, Multi-Octave Units Covering 2 to 18 GHz
- Excellent Phase and Amplitude Tracking
- Low Input VSWR
- High Isolation Between Output Ports

Specifications

Type N (F), 2-Way, 2 to 18 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	BAND SEGMENTS (GHz)	VSWR (max.) INPUT	VSWR (max.) OUTPUT	INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	AVERAGE POWER* (W max.) A	B	C	WEIGHT oz.	gr.
2-8	**3324-2**	2-4	1.35	1.25	0.7	20	0.2	3°	30	10	1	5.0	140
		4-8	1.35	1.25	0.7	20	0.3	4°	30	10	1		
6-18	**3326B-2****	6-12.4	1.60	1.50	0.6	20	0.2	3°	30	10	1	4.8	135
		12.4-18	1.60	1.50	1.1	17	0.3	6°	30	10	1		
2-18	**3456B-2**	2-8	1.50	1.40	0.7	20	0.3	6°	30	10	1	7.1	200
		8-18	1.50	1.40	1.5	19	0.5	9°	30	10	1		

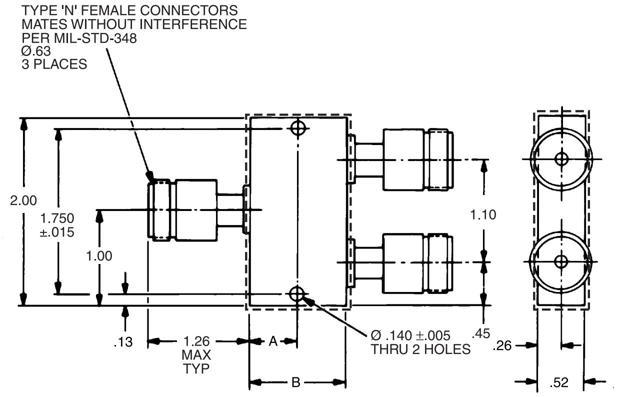
Type N (F), 4-Way, 2 to 18 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	BAND SEGMENTS (GHz)	VSWR (max.) INPUT	VSWR (max.) OUTPUT	INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	AVERAGE POWER* (W max.) A	B	C	WEIGHT oz.	gr.
2-8	**3324-4**	2-8	1.45	1.35	0.9	18	0.4	7°	30	10	1	9.7	275
5-18	**3326B-4****	5-12.4	1.50	1.45	1.4	18	0.5	7°	30	20	1	8.9	250
		12.4-18	1.65	1.45	1.4	18	0.5	7°	30	20	1		

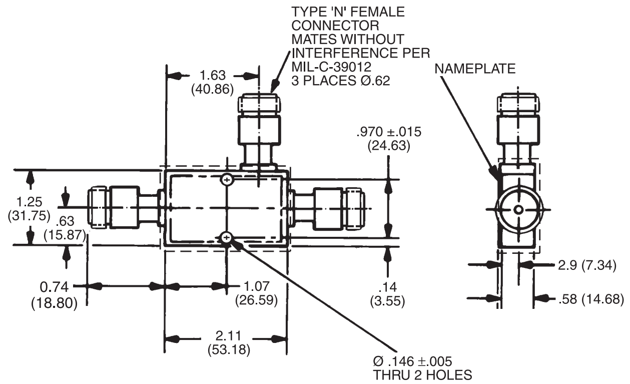
* Average Power Rating into a load VSWR of (A) 1.2 to 1, (B) 2 to 1 and (C) ∞VSWR
** Custom-order basis: minimum quantity may apply

Power Dividers

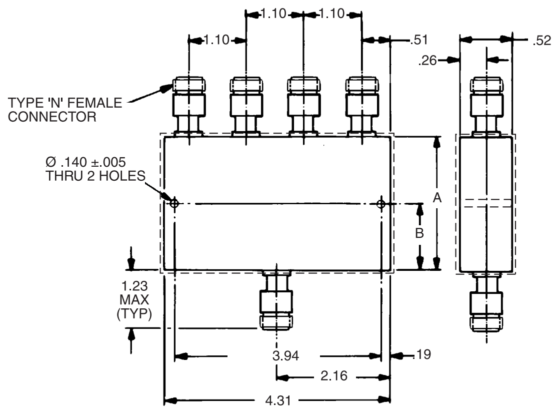
Outline Drawings



MODEL	A	B
3324-2	.84	1.69
3326B-2	.50	1.00



MODEL 3456B-2



MODEL	A	B
3324-4	3.44	1.72
3326B-4	1.42	0.71

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

0.5-18 GHz

SMA Ultra-Broadband Power Dividers

- Low Input VSWR
- High Isolation Between Output Ports
- Temperature Range: -54 to +85°C (Operational at 105°C)
- Designed for MIL Environments

Specifications

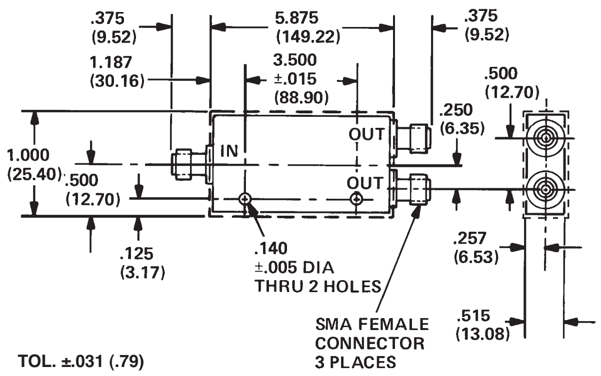
SMA (F), 2-Way / 4-Way / 8-Way, 0.5 to 18 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	VSWR (max.)		INSERTION LOSS (dB)		ISOLATION (dB min.)	AMPLITUDE BALANCE (dB)		PHASE BALANCE (max.)		AVERAGE POWER* (W max.)			WEIGHT (max.)	
		INPUT	OUTPUT	0.5-8	8-18		0.5-8	8-18	0.5-8	8-18	A	B	C	oz.	kg.
0.5-18	**4426-2**	1.50	1.45	0.8	1.7	19	0.3	0.6	4°	8°	30	10	1	6.4	.18
	4426-4	1.60	1.45	1.8	3.8	16	0.5	1.2	8°	14°	30	10	1	20	.55
	4426-8	1.70	1.50	3.5	6.5	18**	0.8	1.4	10°	18°	30	10	1	38	1.1
0.5-6	**4426LB-2**	1.50	1.40	0.9‡	—	19	0.3‡	—	4° ‡	—	30	10	1	6.4	.18
	4426LB-4	1.60	1.45	1.8‡	—	16	0.5‡	—	8° ‡	—	30	10	1	20	.55
	4426LB-8	1.70	1.50	3.5‡	—	14	0.8‡	—	10° ‡	—	30	10	1	38	1.1

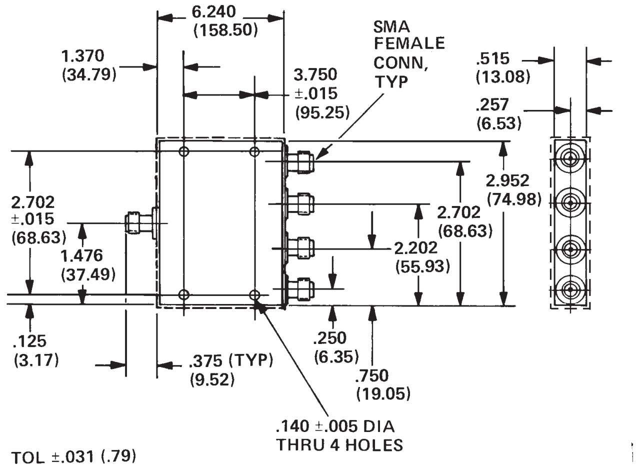
* Average Power Rating into a load VSWR of (A) 1.2 to 1, (B) 2 to 1 and (C) ∞VSWR
** Isolation between 0.5-2.0 GHz is 14 dB min.
‡ 0.5-6.0 GHz

Power Dividers

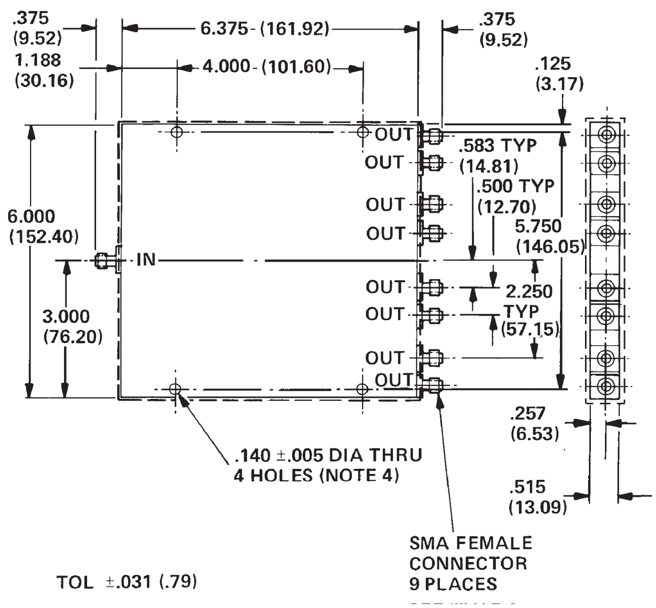
Outline Drawings



MODEL 4426-2, 4426LB-2



MODEL 4426-4, 4426LB-4



MODEL 4426-8, 4426LB-8

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

0.5-8 GHz

Commercial Broadband Power Dividers

- 0°C to +70°C Operation
- Microstrip Construction
- Humidity 95% Non-Condensing
- Suitable for Commercial Applications

Specifications

SMA (F), 2-Way / 3-Way / 4-Way / 8-Way, 0.5 to 8 GHz, 0.5 W

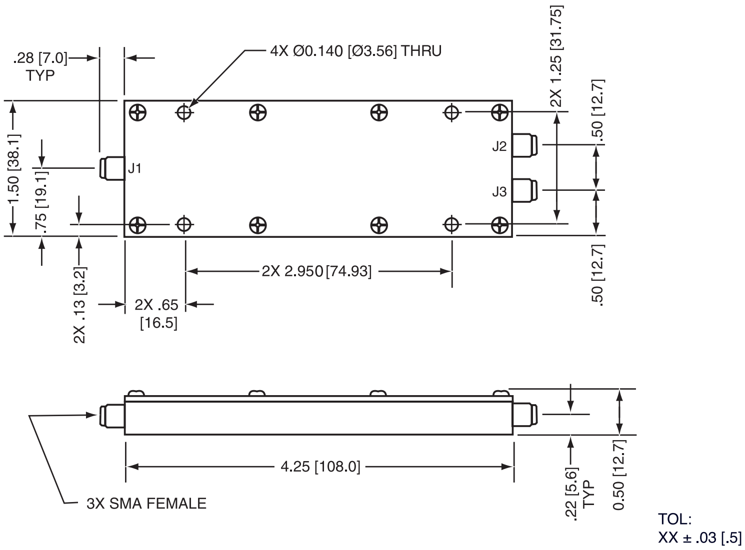
FREQUENCY RANGE (GHz)	MODEL	BAND SEGMENTS (GHz)	VSWR (max.)		INSERTION LOSS* (dB max.)	ISOLATION (dB min.)	PHASE BALANCE (max.)	POWER (max.)		WEIGHT	
			INPUT	OUTPUT				INPUT (W)	PEAK (kW)	oz.	gr.
0.5-8**	**4436-2**	0.5-0.7	1.80	1.50	1.30	12	10°	0.5	1.5	3.9	110
		0.7-6	1.35	1.25	1.00	20	6°	0.5	1.5		
		6-8	1.50	1.35	1.50	18	10°	0.5	1.5		
0.5-8**	**4436-3**	0.5-0.7	2.00	1.60	0.75‡	12	12°	0.5	1.5	4.8	135
		0.7-6	1.85	1.50	1.70‡	15	10°	0.5	1.5		
		6-8	2.00	1.50	2.20‡	15	12°	0.5	1.5		
0.5-8**	**4436-4**	0.5-0.7	2.50	1.50	1.50	12	10°	0.5	1.5	10.2	290
		0.7-6	1.60	1.40	3.00	17	8°	0.5	1.5		
		6-8	1.80	1.50	4.50	15	10°	0.5	1.5		
0.5-8**	4436-8	0.5-0.7	2.60	1.75	2.00	12	15°	0.5	1.5	22.9	650
		0.7-6	1.75	1.50	5.00	17	13°	0.5	1.5		
		6-8	2.25	1.85	8.00	15	16°	0.5	1.5		

* Insertion loss is in addition to the theoretical (ideal) split loss
** Model 4436 Series is designed to operate in 0.7-8 GHz frequency ranges
Specifications from 0.5-0.7 GHz are provided for reference only
‡ Model 4436-3 insertion loss is specified as the average of all three outputs

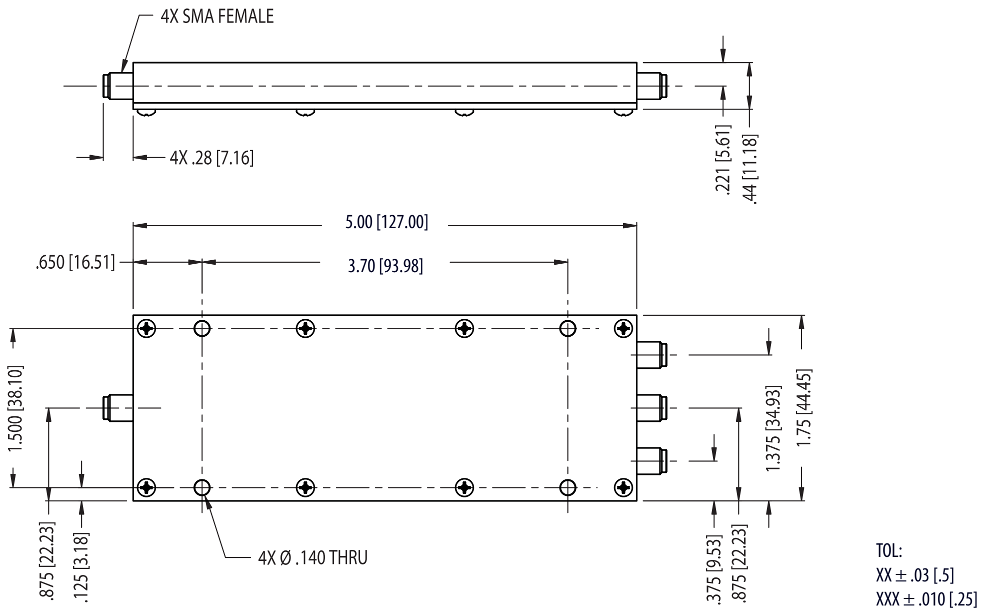
Note:
All ports are terminated in 50 ohms when not in use.

Power Dividers

Outline Drawings



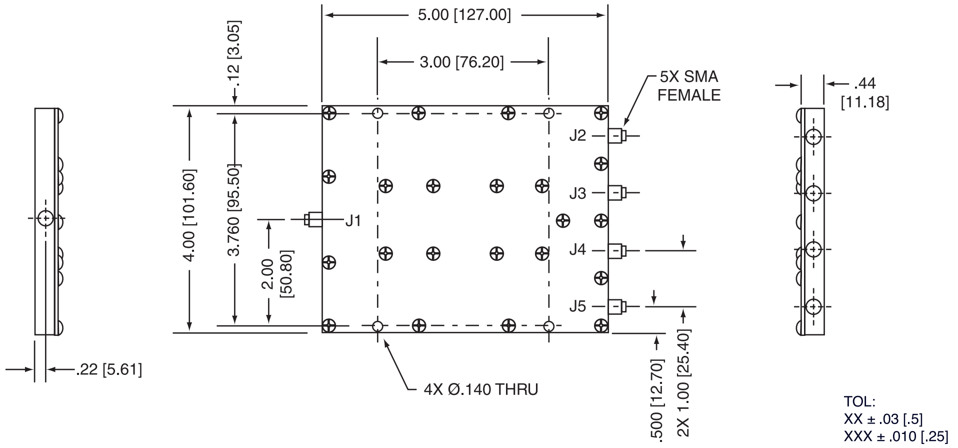
MODEL 4436-2



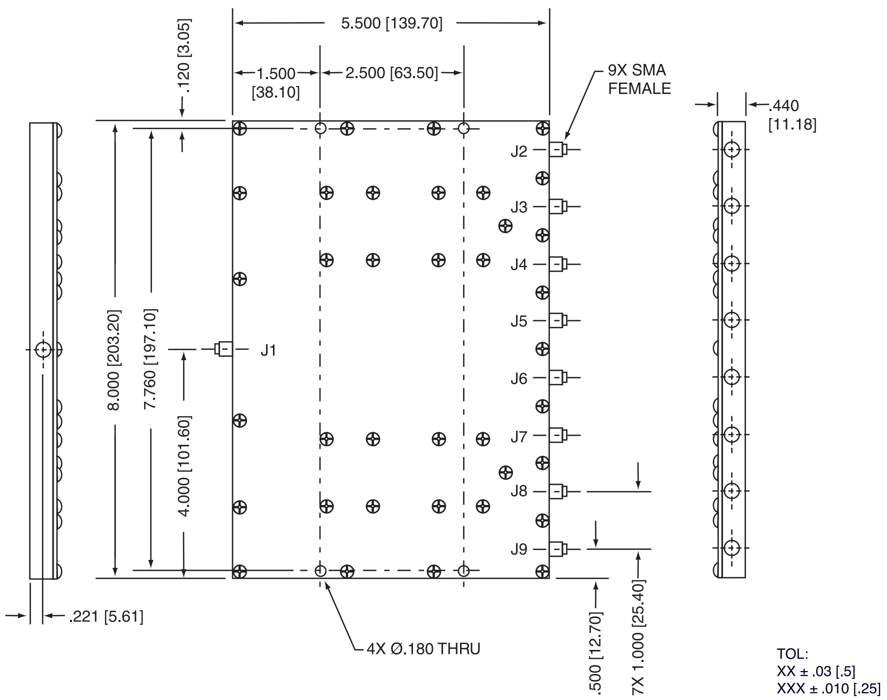
MODEL 4436-3

Dimensions in inches (mm in parentheses), unless otherwise specified.
Connectors mate without interference per MIL-STD-348.
FINISH: Chemical film per MIL-C-5541, CL 3, CLR

Outline Drawings



MODEL 4436-4



MODEL 4436-8

Dimensions in inches (mm in parentheses), unless otherwise specified.
Connectors mate without interference per MIL-STD-348.
FINISH: Chemical film per MIL-C-5541, CL 3, CLR

820-915 MHz

Power Combiners / Dividers: Cellular Tx

- Wireless Coverage
- Can Combine Very High Power Non-Coherent Signals

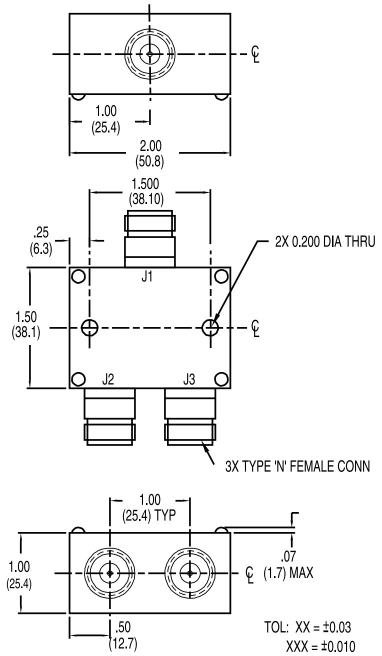
Specifications

Type N, 2-, 3- and 4-Way, 820 to 915 MHz

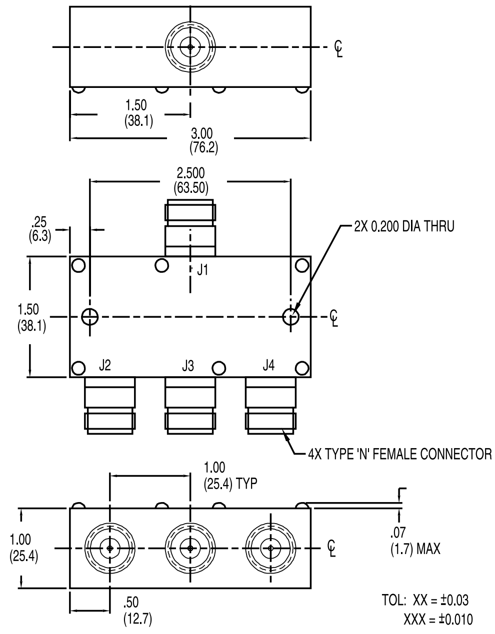
FREQUENCY RANGE (MHz)	MODEL	N-WAY	VSWR (max.) INPUT	VSWR (max.) OUTPUT	INSERTION LOSS (dB max.) EXCLUDING COUPLED POWER	INSERTION LOSS (dB max.) INCLUDING COUPLED	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	TOTAL INPUT POWER* POWER DIVIDER OPERATION PORT J1 AVERAGE (W)	TOTAL INPUT POWER* POWER DIVIDER OPERATION PORT J1 PEAK (kW)	TOTAL INPUT POWER* POWER COMBINER OPERATION MAX POWER PER PORT AVERAGE (W)	TOTAL INPUT POWER* POWER COMBINER OPERATION MAX POWER PER PORT PEAK (kW)	WEIGHT oz.	WEIGHT gr.
820-915	**30402**	2-way	1.3	1.2	0.5	3.5	20	0.2	±3°	80	3	40	1.5	4.9	140
820-915	**30403**	3-way	1.3	1.2	0.6	5.4	20	0.2	±5°	80	3	27	1	8.1	230
820-915	**30373**	4-way	1.3	1.2	0.6	6.6	20	0.2	±3°	100	3	25	.75	10.9	310

* Case Temperature must be limited to 85° C maximum, cooling fan may be required

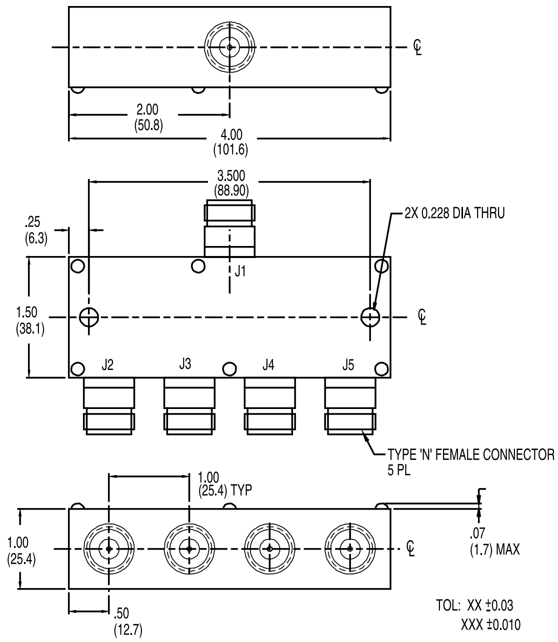
Outline Drawings



MODEL 30402



MODEL 30403



MODEL 30373

Dimensions in inches (mm in parentheses), unless otherwise specified.

1800-2000 MHz

Power Combiners / Dividers: PCS and DCS

- Wireless Coverage
- Can Combine Very High Power Non-Coherent Signals

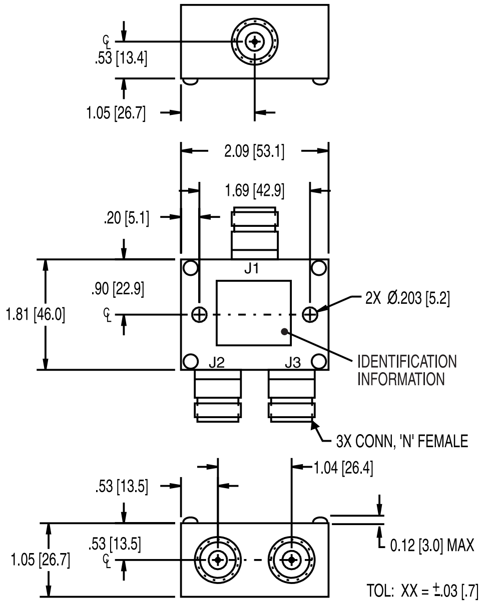
Specifications

Type N, 2-, 3- and 4-Way, 1800 to 2000 MHz

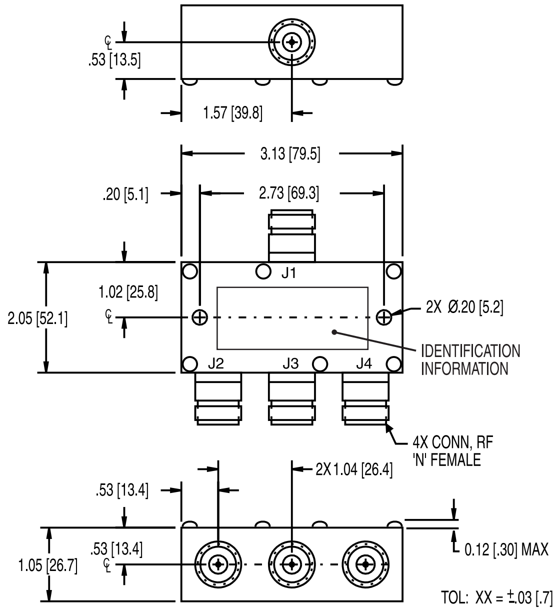
FREQUENCY RANGE (MHz)	MODEL	VSWR (max.)		INSERTION LOSS (dB max.)		ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (max.)	TOTAL INPUT POWER*				WEIGHT	
									POWER DIVIDER OPERATION PORT J1		POWER COMBINER OPERATION MAX POWER PER PORT			
		INPUT	OUTPUT	EXCLUDING COUPLED POWER	INCLUDING COUPLED				AVERAGE (W)	PEAK (kW)	AVERAGE (W)	PEAK (kW)	oz.	gr.
1800-2000	**2362-2**	1.3	1.2	0.5	3.5	20	0.2	±6°	80	3	40	1.5	4.9	140
1800-2000	**2362-3**	1.3	1.2	0.6	5.4	20	0.2	±10°	80	3	27	1	8.1	230
1800-2000	**2362-4**	1.3	1.2	0.8	6.9	20	0.2	±6°	100	3	25	.75	10.9	310

* Case Temperature must be limited to 85° C maximum, cooling fan may be required

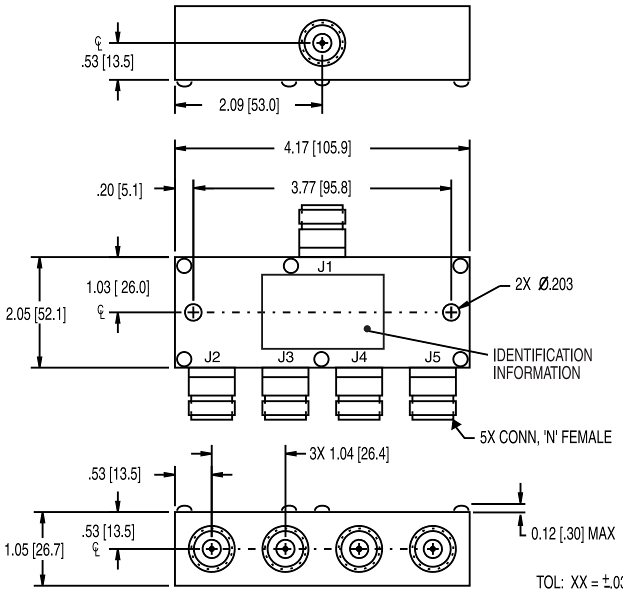
Outline Drawings



MODEL 2362-2



MODEL 2362-3



MODEL 2362-4

Dimensions in inches (mm in parentheses), unless otherwise specified.

0.5-6 GHz

Power Combiners / Dividers: 0.5 to 6 GHz

- Can Combine Very High Power Non-Coherent Signals

Specifications

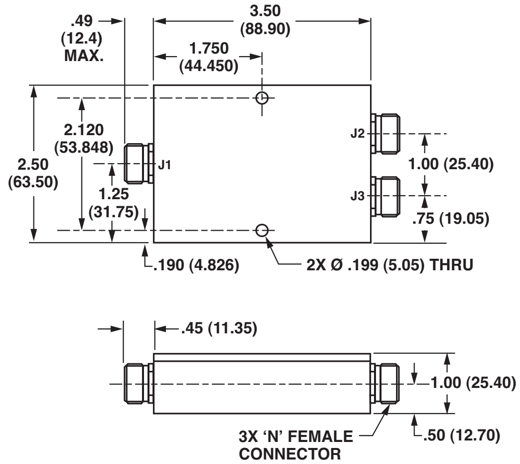
Type N, 2-Way, 0.5 to 6 GHz

FREQUENCY RANGE (GHz)	MODEL	VSWR (max.) INPUT (into 50Ω)	VSWR (max.) OUTPUT (into 50Ω)	INSERTION LOSS* (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB max.)	PHASE BALANCE (typical)	TOTAL CW INPUT POWER** (W max.) ANY LOAD	TOTAL CW INPUT POWER** (W max.) 2:1 MATCH	TOTAL CW INPUT POWER** (W max.) 1.2:1 MATCH	PEAK POWER (kW max.)	WEIGHT (MAX.) oz.	WEIGHT (MAX.) gr.
0.7-2.5	2372A-2	0.7-0.8 GHz: 1.5 0.8-2.4 GHz: 1.3 2.4-2.5 GHz: 1.5	1.3	0.45	18	0.25	±5°	100	175	300	2	14.0	396
0.5-6.0	2382-2	0.5-1 GHz: 2.2 1-6 GHz: 1.5	1.5	0.5-4.5 GHz: 1 4.5-6 GHz: 1.5	0.5-1 GHz: 9 1-6 GHz: 17	0.40	±7°	100	220	250	2	14.0	396

* Insertion Loss does not include the ideal 2-way split of 3.01 dB
** Full Power Handling (as divider or combiner) with case temperature limited to +85° C max., power derated to 0% of full rated power at +125° C case temperature

NOTES:
Power input at combiner (non-coherent signals) is limited to 125 W per signal (all VSWR conditions) with case temperature maintained at +85° C max.

Outline Drawing



MODELS 2372A-2 and 2382-2

Dimensions in inches (mm in parentheses), unless otherwise specified.

6-18 GHz

High Power (up to 100 W CW) In-Phase Power Divider

- Up to 100 W CW Capability into Mismatch
- Up to 100 W CW Capability at Elevated Ambient Temperatures of 85°C
- Flight Qualified, MIL Environment Qualified Versions Available

Specifications

SMA (F), 2-Way, 6 to 18 GHz

FREQUENCY RANGE (GHz)	MODEL	INSERTION LOSS (dB max.)		ISOLATION (dB min.)	VSWR (max.)		AMPLITUDE BALANCE (dB)	PHASE BALANCE	AVERAGE POWER* (W)		WEIGHT	
		6-14	14-18		INPUT	OUTPUT			A	B	oz.	gr.
6-18	**4306-2**	0.8	1.0	17	1.75	1.65	0.4	10°	100	75	1.5	43

* Average Power Rating into a load VSWR of (A) 1.25 to 1 and (B) 2 to 1
Power Rating is based upon maximum case temperature of the power divider not exceeding 85°C

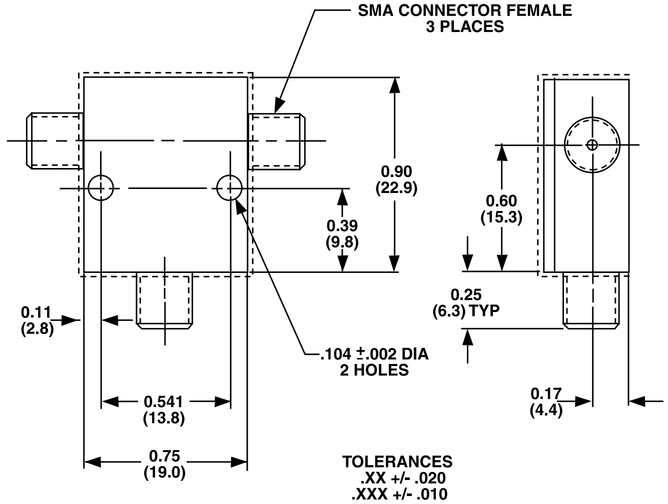
Type N (F), 2-Way, 6 to 18 GHz

FREQUENCY RANGE (GHz)	MODEL	INSERTION LOSS (dB max.)		ISOLATION (dB min.)	VSWR (max.)		AMPLITUDE BALANCE (dB)	PHASE BALANCE	AVERAGE POWER* (W)	WEIGHT	
		6-10	10-18		INPUT	OUTPUT				oz.	gr.
6-18	**3306-2**	1.2	1.5	15	1.80	1.70	0.5	12°	100	13.0	369

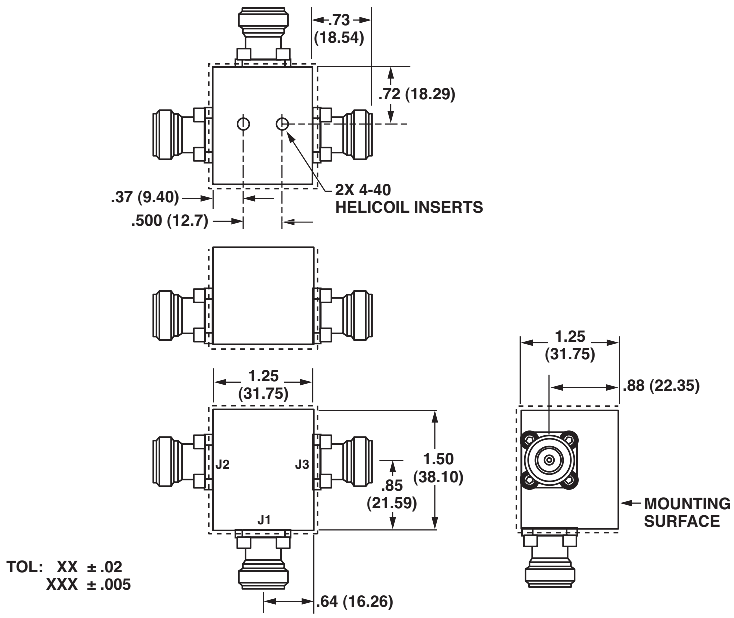
* Max. input power handling requires the outputs to be loaded by no greater that 1.5 VSWR,
and the case temperature of the power divider must not exceed 85°C

Power Dividers

Outline Drawings



MODEL 4306-2



MODEL 3306-2

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

6-18 GHz

125 W CW Power 90° Hybrid

- Broadband – 6 to 18 GHz
- 125 W Average Power Handling at 85°C
- Superior Phase Balance
- Small, Lightweight Package

Applications

- EW Systems
- Radars
- Communications

Specifications

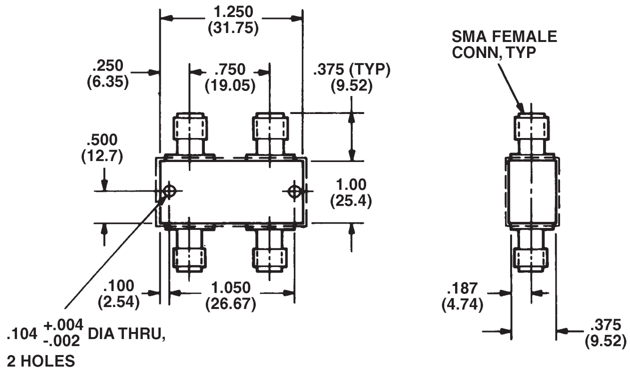
90°, SMA (F), 6 to 18 GHz, 125 W

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	VSWR (max.)	INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB)	PHASE BALANCE	POWER**		WEIGHT	
								AVERAGE (W max.)	PEAK (kW max.)	oz.	gr.
6-18	**4096***	3.0	1.4	0.75	17	±0.6	±7°	125	3	1.1	32

* Special-order unit, minimum quantity may apply
** Mounted to a heat sink (+85° C max. housing temperature)

NOTE:
Also refer to Model 4196-20 High Power Coupler on page 86.

Outline Drawing



Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

Hybrids

2-18 GHz

Ultra-Broadband 180° and 90° Hybrids

- Smallest Size and Weight
- Multi-Octave Bandwidth
- Excellent Phase Balance
- Low VSWR
- High Isolation
- Rigid Construction Resists Shock and Vibration
- Operational to 105°C without Degradation (125°C storage)

Specifications

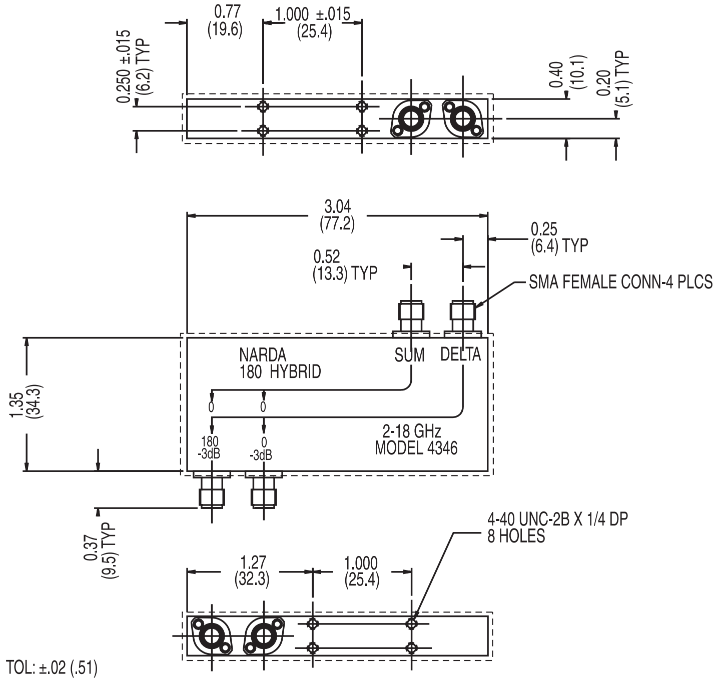
180°, SMA (F), 2 to 18 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	VSWR (max.)	INSERTION LOSS (max.)	ISOLATION (dB min.)	AMLITUDE BALANCE (dB)	PHASE BALANCE		POWER		WEIGHT	
							2.0-2.5	2.5-18	AVERAGE (W)	PEAK (kW)	oz.	gr.
2-18	**4346**	3	1.6	2.3	18	±0.8	±15°	±12°	30	3	2.89	82

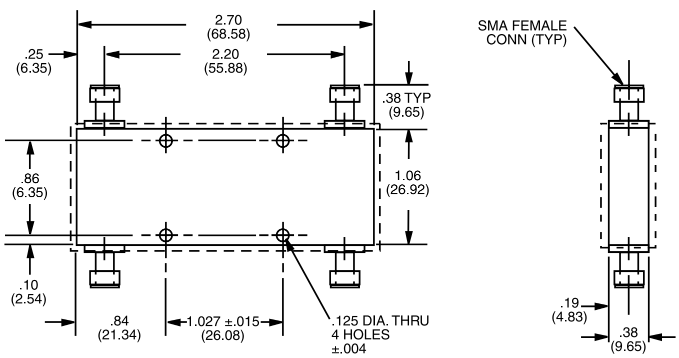
90°, SMA (F), 2 to 18 GHz, 30 W

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	VSWR (max.)	INSERTION LOSS (max.)		ISOLATION (dB min.)		AMLITUDE BALANCE (dB)	PHASE BALANCE	POWER		WEIGHT	
				2-8	8-18	2-8	8-18			AVERAGE (W)	PEAK (kW)	oz.	gr.
2-18	**4356B**	3	1.5	0.6	1.0	20	17	±0.75	±7°	30	3	2.3	65

Outline Drawings



MODEL 4346



MODEL 4356B

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

Hybrids

2-18 GHz

SMA Multi-Octave 90° and 180° Hybrids

- Smallest Size and Weight
- Multi-Octave Bandwidth
- Excellent Phase Balance
- Low VSWR
- High Isolation
- Rigid Construction Resists Shock and Vibration
- Operational to 105°C without Degradation (125°C storage)

Specifications

90°, SMA (F), 2 to 18 GHz, 30 W

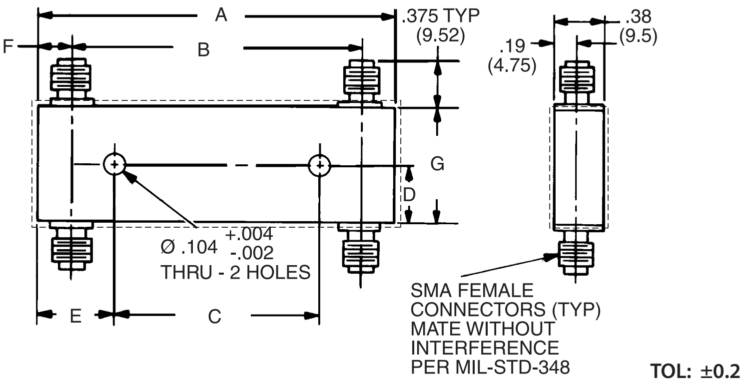
FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	VSWR (max.)	INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB)	PHASE BALANCE	POWER		WEIGHT	
								AVERAGE (W)	PEAK (kW)	oz.	gr.
2-8	**4333**	3	1.4	0.75	24	±0.5	±5°	30	3	2.7	75
6-18	**4336**	3	1.5	0.85	14	±0.7	±6°	30	3	1.0	28

180°, SMA (F), 2 to 18 GHz, 30 W

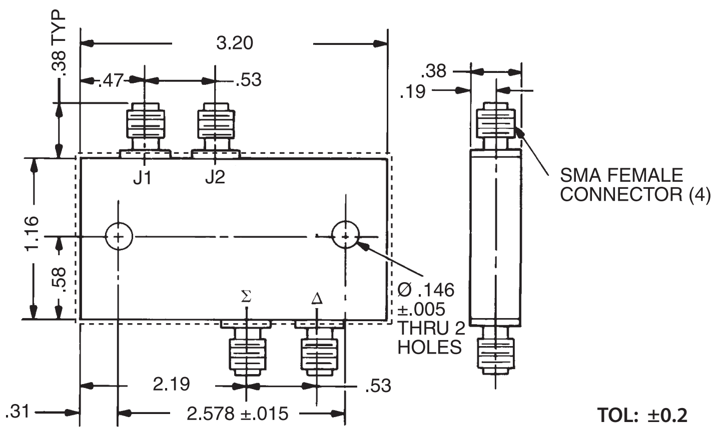
FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	VSWR (max.)	INSERTION LOSS (dB max.)	ISOLATION (dB min.)	AMPLITUDE BALANCE (dB)	PHASE BALANCE	POWER		WEIGHT	
								AVERAGE (W)	PEAK (kW)	oz.	gr.
2-8	**4343***	3	1.5	1.30	17	±0.5	±13°	30	3	2.2	62

* Special-order unit, minimum quantity may apply

Outline Drawings



MODEL	A	B	C ±0.015	D	E	F	G
4333	2.71 (68.71)	2.20 (56.01)	1.561 (39.65)	.43 (10.95)	.57 (14.53)	.25 (6.35)	.860 (21.89)
4336	1.25 (31.75)	0.80 (20.32)	0.375 (9.52)	.40 (10.21)	.44 (11.10)	.23 (5.71)	.804 (20.42)



MODEL 4343

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

Hybrids

0.5-8 GHz

SMA Multi-Octave 90° Hybrid

- Excellent Phase Balance
- High Isolation
- Low Insertion Loss

Specifications

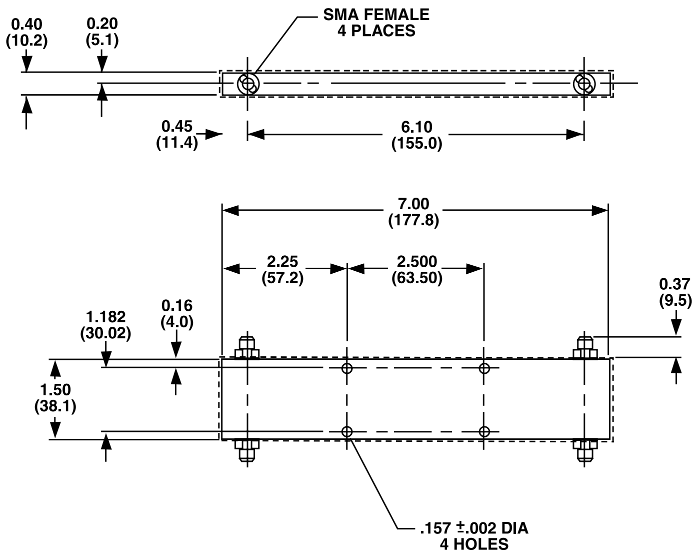
90°, SMA (F), 0.5 to 8 GHz, 30 W

FREQUENCY RANGE (dB)	MODEL	NOMINAL COUPLING (dB)	VSWR (max.)	INSERTION LOSS		ISOLATION (dB min.)	AMPLITUDE BALANCE (dB)	PHASE BALANCE	POWER		WEIGHT	
				0.5-5	5-8				AVERAGE (W)	PEAK (kW)	oz.	gr.
0.5-8	4358*	3	1.5	1.0	1.2	15	±0.75	±12°	30	3	8	227

* Special-order unit, minimum quantity may apply

NOTE:
Custom order models are available upon request. Consult the factory.

Outline Drawing



Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

narda MITEQ www.nardamiteq.com **E-MAIL:** componentsnm@nardamiteq.com **TEL:** +1 631 231-1700

0.82-4.2 GHz

Type N Coaxial 90° Hybrids

- Broadband Coverage
- Signal Isolation Over a Complete Band
- Low VSWR
- Flat Frequency Response
- Up to 500 W Power Handling

Specifications

90°, Type N (F), 0.82 to 4.2 GHz, High Power

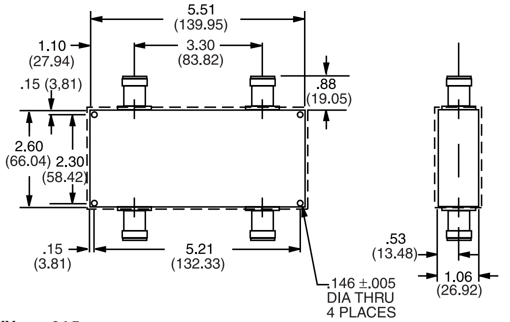
FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	VSWR (max.)	INSERTION LOSS (dB max.)	ISOLATION (dB max.)	AMPLITUDE BALANCE (dB)	PHASE BALANCE	POWER		WEIGHT	
								AVERAGE (W)	PEAK (kW)	lb.	gr.
0.82-0.98	**3322**	3	1.25	0.20	20	±0.25	±5°	500	10	1.30	600
0.95-2.00	**3032**	3	1.20	0.30	20	±0.25	±5°	200	5	1.55	700
1.70-4.20	**3033B***	3	1.25	0.35	20	±0.25	±5°	200	5	1.10	500

* Custom order models available upon request, consult the factory

NOTE:
See page 175 for High Power Type N (M) Termination, normally required for typical dividing or combining function.

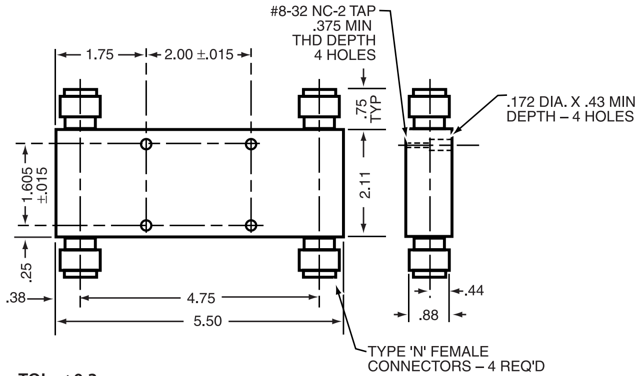
Hybrids

Outline Drawings



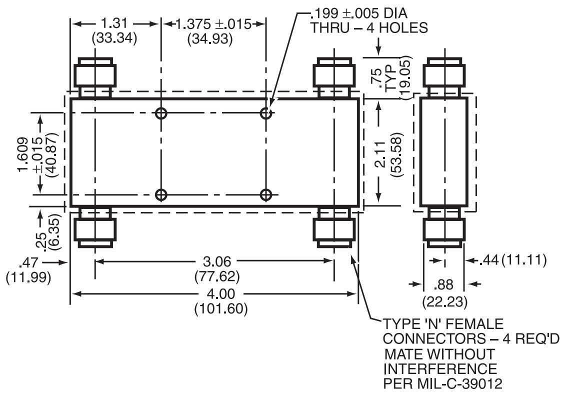
TOL: XXX = ±.015
XX = ±.02

MODEL 3322*



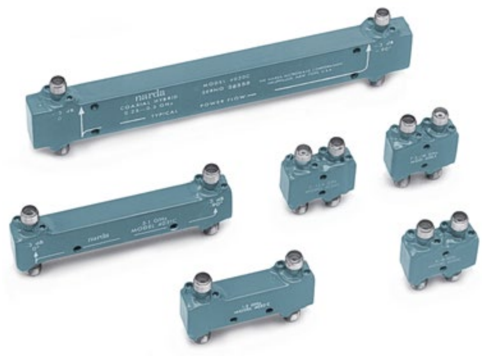
TOL: ±0.3

MODEL 3032



MODEL 3033B*

*Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.



0.25-16 GHz

SMA Miniature Stripline 90° Coaxial Mini-Hybrids

- Frequency Range
  0.25 to 16 GHz
- Smallest Units Available
- Isolation to 30 dB
- Rigid Construction
  Resists Shock and Vibration
- Operational to 105°C without
  Degradation (125°C storage)

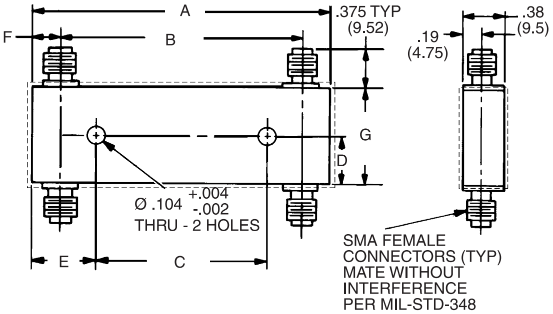
Specifications

90°, SMA (F), 0.25 to 16 GHz

FREQUENCY RANGE (GHz)	MODEL	NOMINAL COUPLING (dB)	VSWR (max.)	INSERTION LOSS (dB max.)	ISOLATION (dB max.)	AMPLITUDE BALANCE (dB)	PHASE BALANCE	POWER		WEIGHT	
								AVERAGE (W)	PEAK (kW)	oz.	gr.
0.25-0.5	**4030C**	3	1.25	0.2	25	±0.6	±5°	50	5	3.00	85
0.50-1.0	**4031C**	3	1.25	0.2	20	±0.6	±5°	50	5	1.40	40
1.00-2.0	**4032C**	3	1.10	0.2	30	±0.6	±5°	50	5	0.85	24
2.00-4.0	**4033C**	3	1.20	0.2	22	±0.6	±5°	50	5	0.53	16
4.00-8.0	**4034C**	3	1.25	0.3	20	±0.6	±10°	50	5	0.60	17
7.50-16	**4065**	3	1.35	0.6	15	±0.6	±10°	30	5	0.70	20

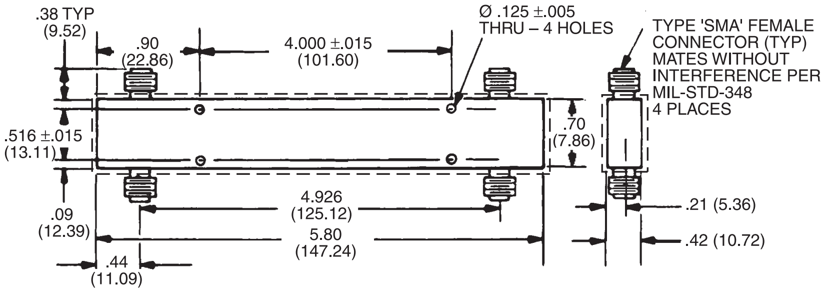
Hybrids

Outline Drawings

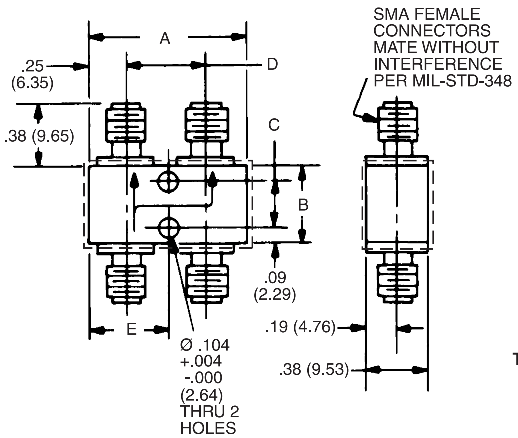


TOL: ±0.2

MODEL	MAXIMUM DIMENSIONS							
	A	B	C	D	E	F	G	H THRU 2 HOLES
4031C	3.06 (77.75)	.51 (12.87)	2.56 (65.07)	.25 (6.35)	.10 (2.46)	.84 (21.40)	1.375 ± .010 (34.93)	Ø.125 +.004/-.002
4032C	1.78 (45.21)	.50 (12.70)	1.28 (32.51)	.25 (6.35)	.09 (2.29)	.64 (16.25)	.500 ± .015 (12.70)	Ø.104 +.004/-.002



MODEL 4030C



MODEL	A	B	C	D	E
4033C	1.16 (29.46)	.51 (12.88)	.312 (7.92)	.66 (16.76)	.58 (14.75)
4034C	1.00 (25.40)	.50 (12.70)	.31 (7.87)	.50 (12.70)	.50 (12.70)
4065	1.00 (25.40)	.58 (14.68)	.390 ± .010 (9.91)	.50 (12.70)	.50 (12.70)

TOL: ±0.2

Allow .020 for sealant build-up per surface.
Dimensions in inches (mm in parentheses), unless otherwise specified.

Terminations

Terminations

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	PAGE
DC-40	4388M	2.92 mm	170
DC-26.5	4380M	3.5 mm	171
DC-18	366NM	Type N	175
DC-18	366TNCM	TNC	175
DC-18	370BNM	Type N	173
DC-18	374BNM	Type N	173
DC-18	375BNM	Type N	173
DC-18	377BNM	Type N	173
DC-18	378NM	Type N	173
DC-18	379BNM	Type N	173
DC-18	4366M	SMA	175
DC-18	4370DM	SMA	171
DC-18	4375GM	SMA	171
DC-18	4378BM	SMA	171

FREQUENCY RANGE (GHz)	MODEL	CONNECTOR	PAGE
DC-18	4379BM	SMA	171
DC-18	T-SMA-17-18-1	SMA	178
2-18	367NM	Type N	173
2-18	368BNM	Type N	175
0.7-18	369BNM	Type N	175
DC-12.4	376BNM	Type N	173
DC-8	4377BM	SMA	171
DC-6	T-N-17-6-1	Type N	178
DC-6	T-N-17-6-2	Type N	178
DC-6	T-N-17-6-5	Type N	178
DC-6	T-N-17-6-35	Type N	178
DC-6	T-N-17-6-50	Type N	178
DC-6	T-N-17-6-100	Type N	178

NOTE:
Female connector **may** be available on applicable models. Please contact the factory should female connectors be required.

Types of Terminations

Narda-MITEQ offers a large variety of coaxial and waveguide terminations and dummy loads which meet the requirements of all microwave measurement systems and most other applications for high quality loads. The many types of coaxial fixed terminations range from small ½ watt instrument loads to 500 watt loads to terminate high power transmitters. Medium power loads (10 to 40 watts with low VSWR) are used in many system and measurement applications. High power dummy loads with cooling fins of unique design provide optimum dissipation of large amounts of microwave power.

Criteria for Selecting Terminations

Criteria which should be evaluated for selecting terminations, whether fixed or tuneable, are frequency range, power handling capabilities, reflection coefficient, connectors and cost.

Frequency Range

Narda-MITEQ coaxial terminations are generally available in two types: a resistive matched load which offers an excellent impedance match to 50 ohms over the DC, 12.4, 18, 26.5 or 40 GHz range; and an absorptive load which offers superior VSWR performance in the 0.7 or 2 to 18 GHz range but does not operate down to DC.

Power Handling

Terminations are rated according to the amount of power they can dissipate at a specific ambient temperature. These parameters are included in the basic electrical specifications. A termination which is used at a higher power level or higher ambient temperature than it is rated may either burn out or suffer irreversible changes from excessive heat which it fails to dissipate. When terminations are to be used at higher ambient temperatures than specified, the maximum power handling capability must be decreased in accordance with a derating curve. Derating curves are available for most series of terminations.

In most applications, heat leaves the termination by convection and/or radiation. Low and medium power loads (up to 200 W) do not rise to a temperature for which radiation is the major factor. Terminations in this power range, therefore, are designed with appropriate fin surfaces, in a manner to pass air freely around and through the fins. For higher power levels, up to the kilowatt range, radiation is predominant. Fins and external surfaces are designed to radiate heat away from the load. All high power loads and many medium power loads rise to a temperature too hot to touch, and may rise to a level where special safety precautions are required. Above these power levels, liquid cooling is used.

Terminations Used with Adapters

It would seem simple enough to select a termination for either waveguide or coaxial use and to add an adapter, but this is a practice which should be discouraged. The introduction of an adapter between the main transmission line and the termination adds physical discontinuities and, therefore, increases the reflections of main line power. Also, many adapters cannot handle power in the 100-500 watt range.

The type of connector should be suitable to mate with the transmission line or device to be terminated. Narda-MITEQ offers a complete line of terminations in SMA, N, 2.92, and 3.5 mm, with average power ratings from 0.5 to 500 watts. Terminations with the popular N and SMA connectors are widely used in commercial and military systems as well as in bench test applications.

Reflection Coefficient (VSWR)

Reflection, as measured in VSWR (voltage standing wave ratio), is a measure of the return loss, or proportion of incident power that is reflected. The value required for a particular application is determined by the maximum allowable load VSWR of a generator, or by the accuracy required for a measurement.

DC-40 GHz

Millimeter Wave Fixed Terminations

with 2.92 mm Connectors

- DC-40 GHz
- Miniature Size
- Low VSWR
- SMA Compatible

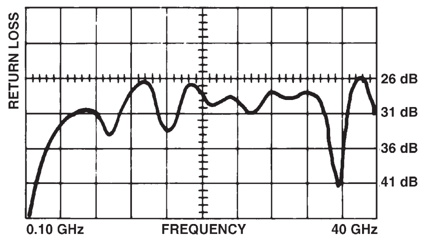
Specifications

2.92 mm (M), DC to 40 GHz, 2 W (Low Power)

FREQUENCY RANGE (GHz)	MODEL	POWER		VSWR (max.)	IMPEDANCE (ohms)	WEIGHT (max.)	
		AVERAGE (W)	PEAK (kW)			oz.	gr.
DC-40	4388M	1.0	0.2	1.20	50	0.16	4.5

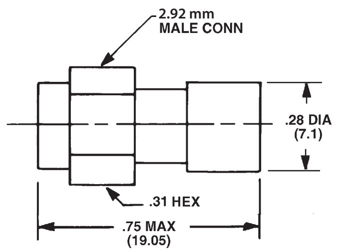
Typical Performance Curve

MODEL
4388M



Outline Drawing

MODEL
4388M



TOL: XX = ± .02 (.50)

Dimensions in inches (mm in parentheses), unless otherwise specified.

DC-26.5 GHz

SMA and 3.5 mm Coaxial Fixed Terminations

- Low VSWR
- Operation to 26.5 GHz
- 10W, 5W and .5W models

Specifications

SMA (M), DC to 18 GHz (Low / Medium Power)

FREQUENCY RANGE (GHz)	MODEL	POWER		VSWR* (max.)	WEIGHT	
		AVERAGE (W)	PEAK (kW)		oz.	gr.
DC-8	**4377BM**	5.0	2	1.05 + .015f	3.0	85
DC-18	**4370DM**	0.5	1	1.05 + .010f	0.1	3
	4379BM	0.5	1	1.05 + .005f	0.1	3
	4378BM	5.0	2	1.05 + .015f	3.0	85
	4375GM	10.0	2	1.05 + .015f	4.0	115

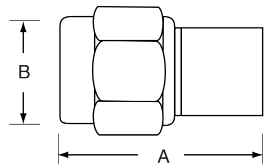
3.5 mm (M), DC to 26.5 GHz (Low / Medium Power)

FREQUENCY RANGE (GHz)	MODEL	POWER		VSWR* (max.)		WEIGHT	
		AVERAGE (W)	PEAK (kW)	DC-18	18-26.5	oz.	gr.
DC-26.5	**4380M**	0.5	1	1.05 +.0075f	<1.25	0.2	6

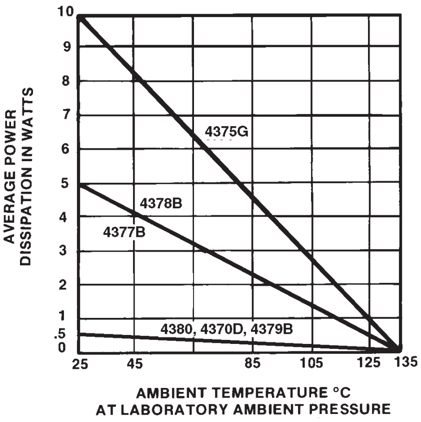
* f represents frequency in GHz

Terminations

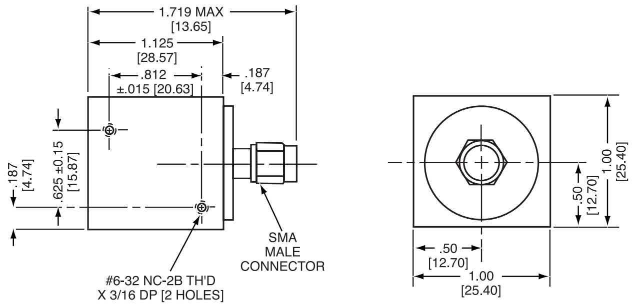
Outline Drawings



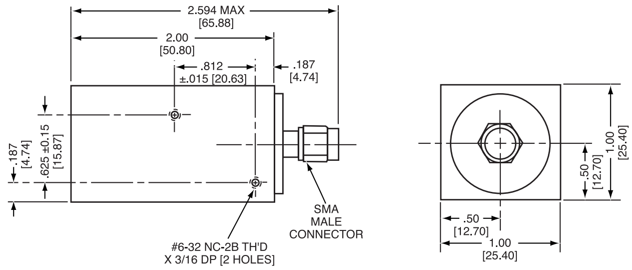
MODEL	A (max.)	B DIAMETER (max.)
4370DM	.75	.31
4379BM	.75	.31
4380M	1.02	.40



DERATING CURVE



MODEL 4377 and 4378



MODEL 4375

Dimensions in inches (mm in parentheses), unless otherwise specified.

DC-18 GHz

Type N Coaxial Fixed Terminations

- Low VSWR
- Broadband
- Medium Power, Superior Performance
  40 W, 20 W, 10 W, 5 W and 1 W Models

Specifications

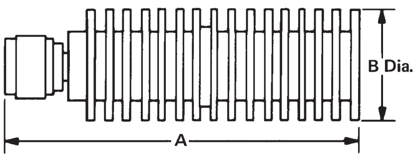
Type N (M), DC to 18 GHz (Medium Power)

FREQUENCY RANGE (GHz)	MODEL	POWER**		VSWR* (max.)	WEIGHT	
		AVERAGE (W)	PEAK (kW)		oz.	gr.
DC-12.4	**376BNM**	40	7.5	1.10 + .025f	10	283
DC-18	**378NM**	1	1	1.04 + .003f	3	85
	370BNM	5	2	1.05 + .015f	3	85
	379BNM	5	2	1.05 + .010f	3	85
	377BNM	5	2	1.05 + .005f	3	85
	375BNM	10	5	1.05 + .015f	3	85
	374BNM	20	5	1.05 + .015f	5	142
2-18	**367NM**	40	5	1.07 + .005f	9	255

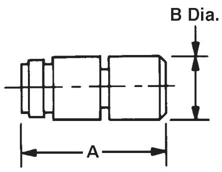
* f denotes frequency in GHz.

** **IMPORTANT NOTE:** Power rating is specified at 25° and free air convection at atmospheric (760 mm) pressure. Derate power capability linearly from stated value at 25°C to 0 watts at 135°C.

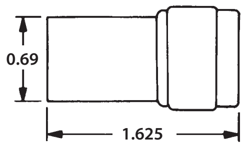
Outline Drawings



MODEL	A	B
367NM	7.57	1.75
374BNM	2.44	1.25
376BNM	5.06	1.63



MODEL	A	B
370BNM	1.67	.72
377BNM	1.67	.72
378NM	1.88	.72
379BNM	1.67	.72



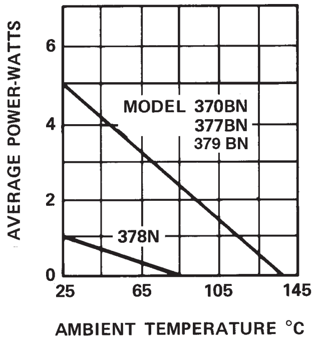
MODEL 375BNM

Dimensions in inches, unless otherwise specified.

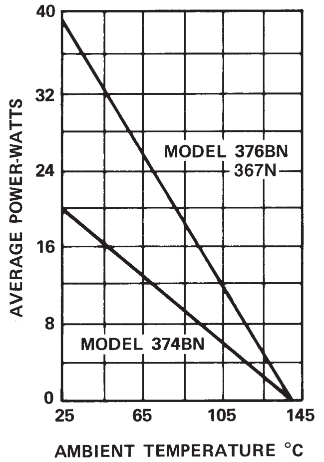
Terminations

Typical Performance Curves

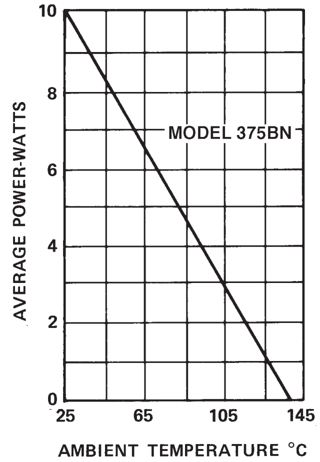
DERATING CURVE IN FREE AIR



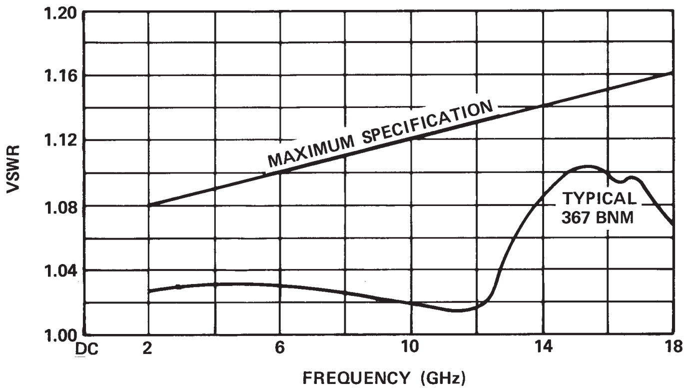
DERATING CURVE IN FREE AIR



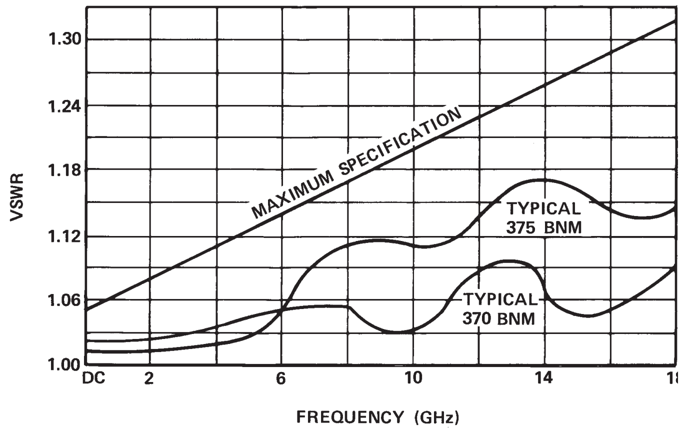
DERATING CURVE IN FREE AIR



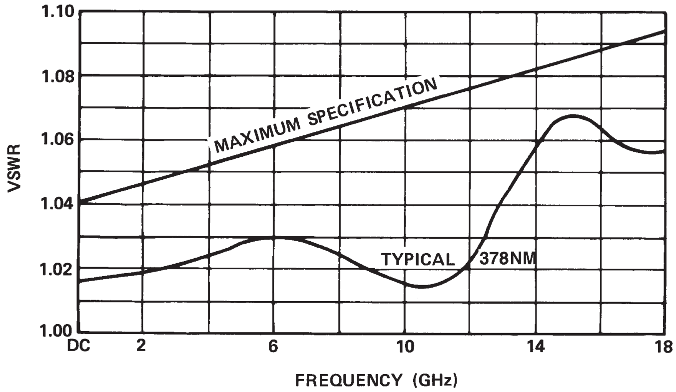
VSWR VS FREQUENCY



VSWR VS FREQUENCY
MODELS 370BNM, 375BNM



VSWR VS FREQUENCY
MODEL 378NM



DC-18 GHz

High Power Coaxial Terminations

- Low VSWR
- Broadband
- High Power, 500 Watts Capability
- SMA, Type N and TNC Connectors

Specifications

SMA, Type N, TNC, DC to 18 GHz (High Power)

FREQUENCY RANGE (GHz)	MODEL	POWER*		VSWR (max.)			CONNECTOR	WEIGHT (max.)	
		AVERAGE (W)	PEAK (kW)	DC-8 GHz	8-12.4 GHz	12.4-18 GHz		oz.	kg.
DC-18	**4366M**	100	1	1.20	1.25	1.35	SMA (M)	10.25	0.29
	366NM	100	1	1.20	1.25	1.35	Type N (M)	11.25	0.31
	366TNCM	100	1	1.20	1.25	1.35	TNC (M)	10.75	0.30

Type N, 0.7 to 18 GHz (High Power)

FREQUENCY RANGE (GHz)	MODEL	POWER**		VSWR (max.)			WEIGHT (max.)	
		AVERAGE (W)	PEAK (kW)	0.7-1 GHz	1-9 GHz	9-18 GHz	lbs.	kg.
0.7-18	**369BNM**	175	10	1.20	1.10	1.20	2.5	1.1

Type N, 2 to 18 GHz (High Power)

FREQUENCY RANGE (GHz)	MODEL	POWER**		VSWR (max.)			WEIGHT (max.)	
		AVERAGE (W)	PEAK (kW)	2-10 GHz	10-14 GHz	14-18 GHz	lbs.	kg.
2-18	**368BNM**	500	5	1.35	1.45	1.40	6.5	3

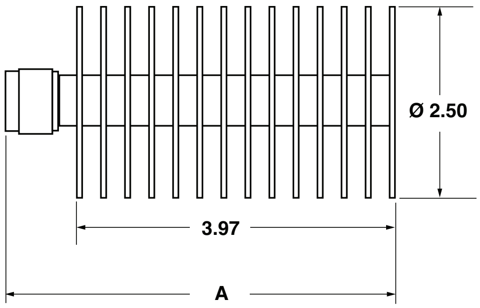
CONNECTORS:
Type N; other connector configurations on special order.

* **IMPORTANT NOTE**: Power rating is specified at 25° and free air convection at atmospheric (760 mm) pressure. Derate power capability linearly from stated value at 25°C to 10 watts at 125°C for **Model 4366M, 366NM and 366TNCM.**

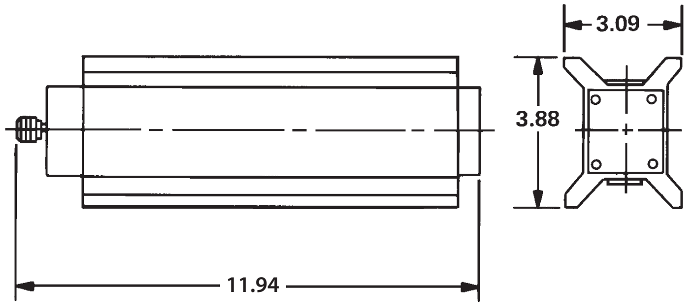
** **IMPORTANT NOTE**: Power rating is specified at 25° and free air convection at atmospheric (760 mm) pressure. Derate power capability linearly from stated value at 25°C to 0 watts at 170°C for **Model 369** and 200°C for **Model 368** Series.

Terminations

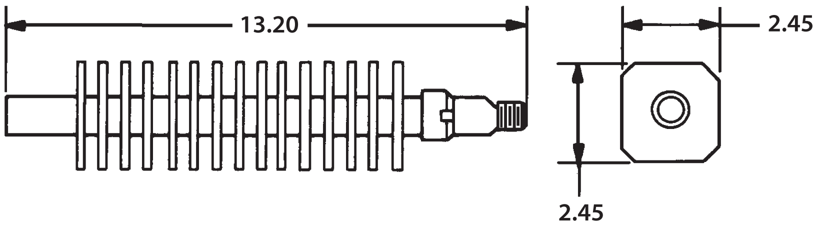
Outline Drawings



MODEL	A
4366M	4.42
366NM	4.89
366TNCM	4.73



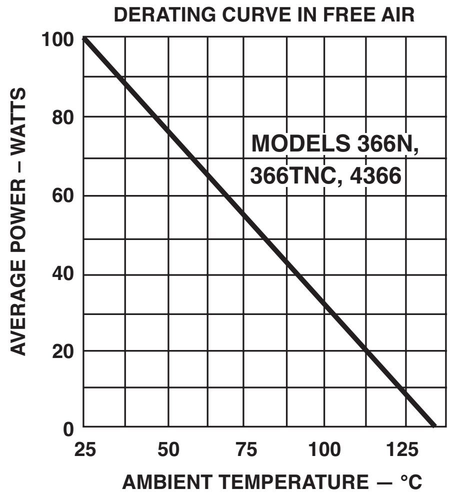
MODEL 368BNM

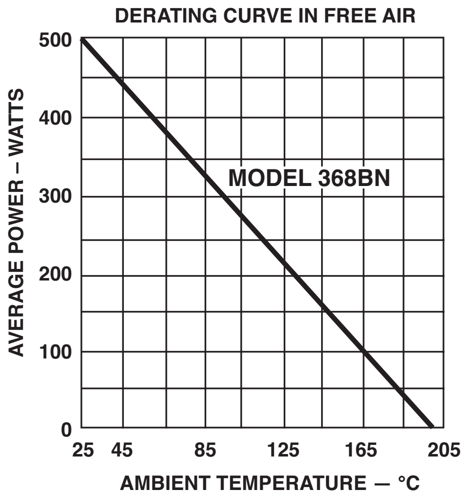


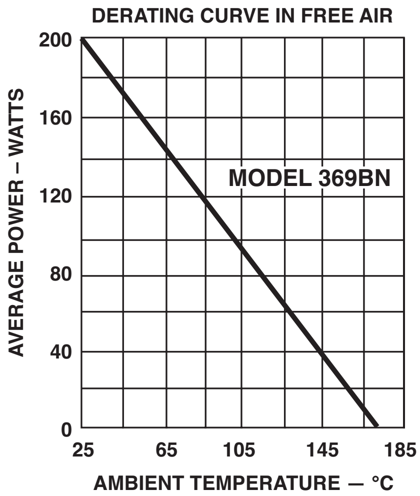
MODEL 369BNM

Dimensions in inches, unless otherwise specified.

Typical Performance Curves







Terminations

DC-18 GHz

Commercial Use
50 Ohm Terminations

- For Commercial Wireless Applications
- Excellent VSWR Performance

Specifications

SMA (M), DC to 18 GHz, 1 W Average Power

FREQUENCY RANGE (GHz)	MODEL	RF CONNECTOR	RF INPUT POWER*	PEAK POWER (kW)	VSWR (max.)			IMPEDANCE (ohms nominal)	WEIGHT (max.)	
					DC-8 GHz	8-12 GHz	12-18 GHz		oz.	gr.
DC-18	**T-SMA-17-18-1**	SMA (M)	1 W average @ +25°C	1	1.05:1	1.10:1	1.20:1	50	0.14	4

Type N (M), DC to 6 GHz, 1 W Average Power

FREQUENCY RANGE (GHz)	MODEL	RF CONNECTOR	RF INPUT POWER**	PEAK POWER (kW)	VSWR (max.)				IMPEDANCE (ohms)	WEIGHT (max.)	
					DC-1 (GHz)	1-2 GHz	2-4 GHz	4-6 GHz		oz.	gr.
DC-6	**T-N-17-6-1**	Type N (M)	1 W average @ +25°C	1	1.05:1	1.10:1	1.20:1	1.25:1	50	1.1	31

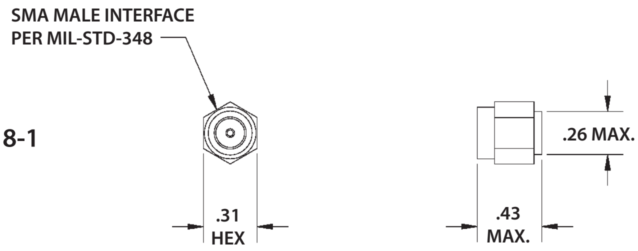
Type N (M), DC to 6 GHz, 2 to 100 W Average Power

FREQUENCY RANGE (GHz)	MODEL	RF CONNECTOR	RF INPUT POWER**	PEAK POWER (kW)	VSWR (max.)		IMPEDANCE (ohms nominal)	WEIGHT (max.)	
					DC-3 GHz	3-6 GHz		oz.	gr.
DC-6	**T-N-17-6-2**	Type N (M)	2 W average @ +25°C	1	1.1:1	1.2:1	50	1.6	45
	T-N-17-6-5	Type N (M)	5 W average @ +25°C	1	1.1:1	1.2:1	50	1.7	48
	T-N-17-6-35	Type N (M)	35 W average @ +25°C	1	1.1:1	1.55:1	50	5.3	150
	T-N-17-6-50	Type N (M)	50 W average @ +25°C	1	1.1:1	1.55:1	50	5.6	160
	T-N-17-6-100	Type N (M)	100 W average @ +25°C	1	1.2:1	1.35:1	50	9.4	265

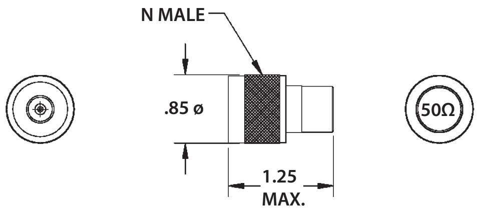
* Derates to 0 W at 125°C
** Derates to 0 W at 100°C

Outline Drawings

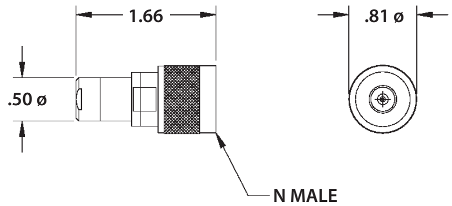
MODEL
T-SMA-17-18-1



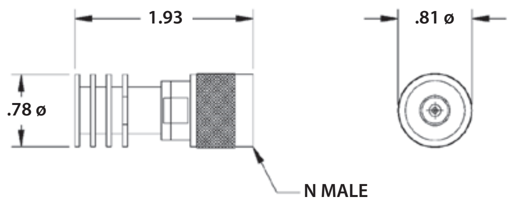
MODEL
T-N-17-6-1



MODEL
T-N-17-6-2



MODEL
T-N-17-6-5

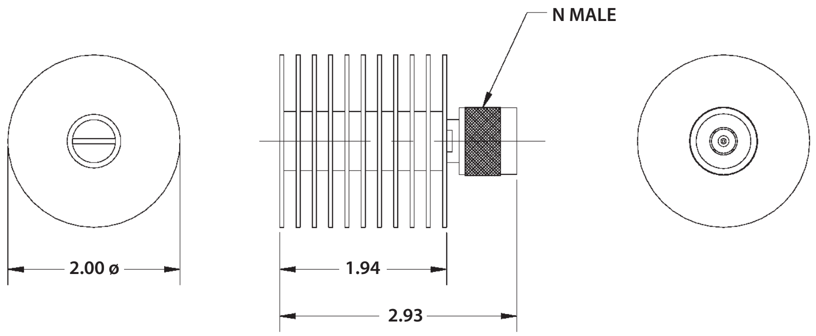


Dimensions in inches, unless otherwise specified.

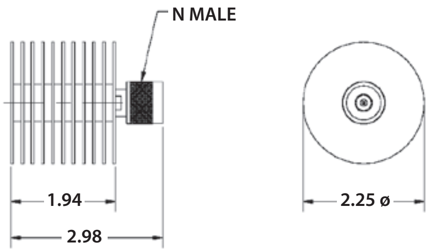
Terminations

Outline Drawings

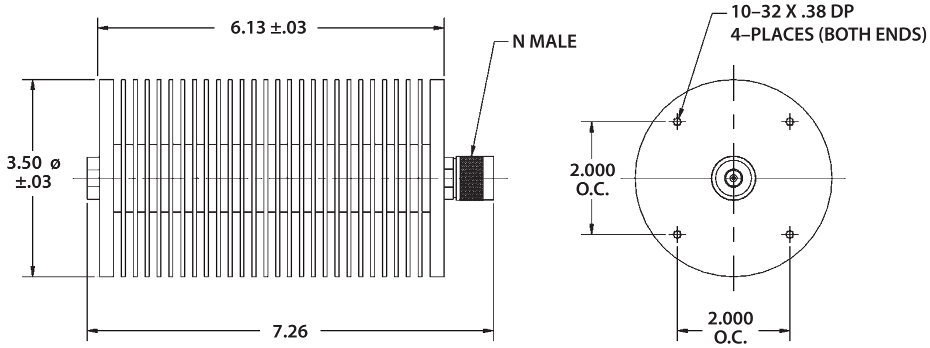
MODEL
T-N-17-6-35



MODEL
T-N-17-6-50

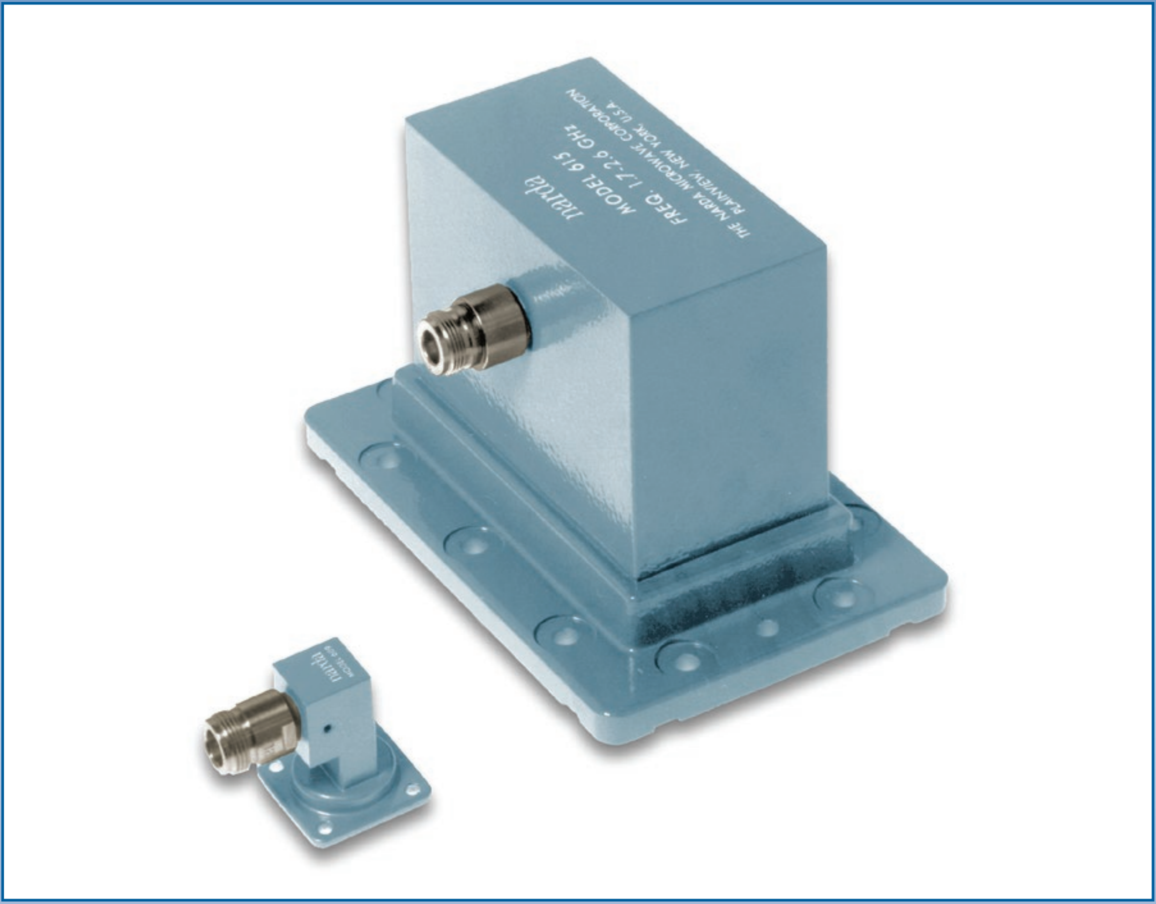


MODEL
T-N-17-6-100



Dimensions in inches, unless otherwise specified.

Waveguide



narda MITEQ

Waveguide

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL	PAGE
Waveguide to Coaxial Right Angle Adapters, Type N		
1.70 - 2.60	617	184
2.60 - 3.95	618	184
3.30 - 4.90	619	184
3.95 - 5.85	620	184
4.90 - 7.05	621	184
5.85 - 8.20	622	184
7.05 - 10.0	623	184
7.00 - 11.0	624	184
8.20 - 12.4	625	184
10.0 - 15.0	626	184
12.4 - 18.0	627	184
Miniature Waveguide to Coaxial Right Angle Adapters, SMA, 2.92mm		
1.70 - 2.60	4617A	185
2.60 - 3.95	4618	185
3.30 - 4.90	4619	185
3.95 - 5.85	4620	185
4.90 - 7.05	4621	185
5.85 - 8.20	4622	185
7.05 -10.0	4623	185
7.00 - 11.0	4624	185
8.20 - 12.4	4625	185
10.0 - 15.0	4626	185
12.4 - 18.0	4627	185
15.0 - 22.0	4628	185
18.0 - 26.5	4629	185
22.0 - 33.0	4630	185
26.5 - 40.0	4631	185
Waveguide to Coaxial End Launch Adapters, Type N		
1.70 - 2.60	617E	187
2.60 - 3.95	618E	187
3.30 - 4.90	619E	187
3.95 - 5.85	620E	187
4.90 - 7.05	621E	187
5.85 - 8.20	622E	187
7.05 - 10.0	623E	187
7.00 - 11.0	624E	187
8.20 - 12.4	625E	187
10.0 - 15.0	626E	187
12.4 - 18.0	627E	187

FREQUENCY RANGE (GHz)	MODEL	PAGE
Waveguide to Coaxial End Launch Adapters, SMA, 2.92mm		
2.60 - 3.95	4618E	188
3.30 - 4.90	4619E	188
3.95 - 5.85	4620E	188
4.90 - 7.05	4621E	188
5.85 - 8.20	4622E	188
7.05 -10.0	4623E	188
7.00 - 11.0	4624E	188
8.20 - 12.4	4625E	188
10.0 - 15.0	4626E	188
12.4 - 18.0	4627E	188
15.0 - 22.0	4628E	188
18.0 - 26.5	4629E	188
22.0 - 33.0	4630E	188
26.5 - 40.0	4631E	188
Standard Gain Horns		
1.70 - 2.60	651 Series	190
2.60 - 3.95	652 Series	190
3.30 - 4.90	653 Series	190
3.95 - 5.85	654 Series	190
4.90 - 7.05	655 Series	190
5.85 - 8.20	656 Series	190
7.05 - 10.0	657 Series	190
7.00 - 11.0	658 Series	190
8.20 - 12.4	659 Series	190
10.0 - 15.0	660 Series	190
12.4 - 18.0	661 Series	190
15.0 - 22.0	662 Series	191
18.0 - 26.5	663 Series	191
22.0 - 33.0	664 Series	191
26.5 - 40.0	665 Series	191
7.50 - 18.0	667	191
18.0 - 40.0	668	191
7.50 - 18.0	667A	191
18.0 - 40.0	668A	191
Rectangular Waveguide Terminations, Low Power		
1.70 - 2.60	305L	194
2.60 - 3.95	306L	194
3.30 - 4.90	307L	194
3.95 - 5.85	308L	194
4.90 - 7.05	309L	194

FREQUENCY RANGE (GHz)	MODEL	PAGE
5.85 - 8.20	310L	194
7.05 - 10.0	311L	194
7.00 - 11.0	312L	194
8.20 - 12.4	313L	194
10.0 - 15.0	314L	194
12.4 - 18.0	315L	194
15.0 - 22.0	316L	194
18.0 - 26.5	317L	194
22.0 - 33.0	318L	194
26.5 - 40.0	319L	194
Rectangular Waveguide Terminations, Medium Power		
2.60 - 3.95	306M	195
3.30 - 4.90	307M	195
3.95 - 5.85	308M	195
4.90 - 7.05	309M	195
5.85 - 8.20	310M	195
7.05 - 10.0	311M	195
7.00 - 11.0	312M	195
8.20 - 12.4	313M	195
10.0 - 15.0	314M	195
12.4 - 18.0	315M	195
15.0 - 22.0	316M	195
18.0 - 26.5	317M	195
22.0 - 33.0	318M	195
26.5 - 40.0	319M	195
Crossguide Directional Couplers, Type N		
2.60 - 3.95	852	196
5.85 - 8.20	856	196
7.05 - 10.0	857	196
10.0 - 15.0	859	196
Crossguide Directional Couplers, SMA, 2.92mm		
7.05 - 10.0	4857	196
8.20 - 12.4	4858	196
10.0 - 15.0	4859	196
18.0 - 26.5	4862	196
26.5 - 40.0	4864	196

All waveguide products are made of iridite-treated aluminum, with painted exterior surfaces.

Waveguide Band Designation Table and Reference Guide

FREQUENCY RANGE (GHz)	WAVEGUIDE DESIGNATION			WAVEGUIDE TO COAXIAL ADAPTERS FOR STANDARD GAIN HORNS				
	EIA (WR)	IEC (R)	BRITISH (WG)	GAIN HORN SERIES	W/G TO COAX SMA / 2.92mm (F)	W/G TO COAX TYPE N (F)	W/G TO COAX END LAUNCH SMA / 2.92mm (F)	W/G TO COAX END LAUNCH TYPE N (F)
1.70 - 2.60	WR430	R22	WG8	651-Series	4617A	617	—	617E
2.60 - 3.95	WR284	R32	WG10	652-Series	4618	618	4618E	618E
3.30 - 4.90	WR229	R40	WG11A	653-Series	4619	619	4619E	619E
3.95 - 5.85	WR187	R48	WG12	654-Series	4620	620	4620E	620E
4.90 - 7.05	WR159	R58	WG13	655-Series	4621	621	4621E	621E
5.85 - 8.20	WR137	R70	WG14	656-Series	4622	622	4622E	622E
7.05 - 10.0	WR112	R84	WG15	657-Series	4623	623	4623E	623E
7.00 - 11.0	WR102	—	—	658-Series	4624	624	4624E	624E
8.20 - 12.4	WR90	R100	WG16	659-Series	4625	625	4625E	625E
10.0 - 15.0	WR75	R120	WG17	660-Series	4626	626	4626E	626E
12.4 - 18.0	WR62	R140	WG18	661-Series	4627	627	4627E	627E
15.0 - 22.0	WR51	R180	WG19	662-Series	4628	—	4628E	—
18.0 - 26.5	WR42	R220	WG20	663-Series	4629	—	4629E	—
22.0 - 33.0	WR34	R260	WG21	664-Series	4630	—	4630E	—
26.5 - 40.0	WR28	R320	WG22	665-Series	4631	—	4631E	—

All waveguide products are made of iridite-treated aluminum, with painted exterior surfaces.

1.7-18 GHz

Waveguide to Coaxial Right Angle Adapters, Type N

- Low VSWR
- Low Insertion Loss
- Lightweight

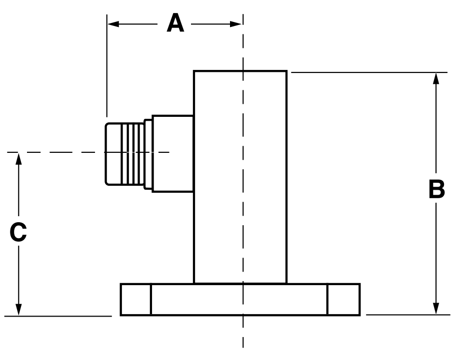
Specifications

Waveguide to Type N (F), 1.7 to 18 GHz

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	VSWR (max.)	CW POWER (W)	PEAK POWER (kW)	WEIGHT (max.)	
								lb.	kg.
1.70 - 2.60	**617**	WR430	CPRF	UG-1711/U	1.25	200	3	1.40	0.64
2.60 - 3.95	**618**	WR284	Cover	UG-584/U	1.25	200	3	0.80	0.36
3.30 - 4.90	**619**	WR229	CPRF	UG-1727/U	1.25	200	3	0.45	0.20
3.95 - 5.85	**620**	WR187	Cover	UG-407/U	1.25	200	3	0.38	0.17
4.90 - 7.05	**621**	WR159	CPRF	UG-1731/U	1.25	200	3	0.30	0.14
5.85 - 8.20	**622**	WR137	CPRF	UG-441/U	1.25	200	3	0.25	0.11
7.05 - 10.0	**623**	WR112	Cover	UG-138/U	1.25	200	3	0.21	0.10
7.00 - 11.0	**624**	WR102	Cover	MIL-F-3922/70-014	1.25	200	3	0.16	0.07
8.20 - 12.4	**625**	WR90	Cover	UG-135/U	1.25	150	2	0.15	0.07
10.0 - 15.0	**626**	WR75	Cover	MIL-F-3922/70-017	1.25	150	2	0.13	0.06
12.4 - 18.0	**627**	WR62	Cover	UG-1665/U	1.25	150	2	0.12	0.05

NOTE:
For a complete listing of all band letters and codes in use, refer to Band Designation Table on Page 183.

Outline Drawing



MODEL	DIMENSIONS (inches)		
	A	B	C
617	1.89	4.00	2.30
618	1.49	2.50	1.51
619	1.37	2.25	1.35
620	1.24	2.60	1.90
621	1.20	2.33	1.70
622	1.11	2.00	1.47
623	1.15	1.14	0.68
624	1.18	1.64	1.14
625	1.10	1.00	0.63
626	1.09	1.00	0.63
627	1.08	1.00	0.65

Dimensions in inches, unless otherwise specified.

1.7-40 GHz

Miniature Waveguide to Coaxial Right Angle Adapters SMA and 2.92 mm Types

- Low VSWR
- Low Insertion Loss
- Lightweight
- Precision Coaxial Connectors Either SMA or 2.92 mm

Specifications

Waveguide to SMA (F) , 1.7 to 22 GHz

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	VSWR (max.)	CW POWER (W)	PEAK POWER (kW)	WEIGHT (max.)	
								lb.	kg.
1.70 - 2.60	**4617A**	WR430	CPRF	UG-1711/U	1.25	50	3	1.30	0.59
2.60 - 3.95	**4618**	WR284	Cover	UG-584/U	1.25	50	3	0.90	0.41
3.30 - 4.90	**4619**	WR229	CPRF	UG-1727/U	1.25	50	3	0.35	0.16
3.95 - 5.85	**4620**	WR187	Cover	UG-407/U	1.25	50	3	0.45	0.20
4.90 - 7.05	**4621**	WR159	CPRF	UG-1731/U	1.25	50	3	0.30	0.14
5.85 - 8.20	**4622**	WR137	CPRF	UG-441/U	1.25	50	3	0.25	0.11
7.05 -10.0	**4623**	WR112	Cover	UG-138/U	1.25	50	3	0.17	0.08
7.00 - 11.0	**4624**	WR102	Cover	MIL-F-3922/70-014	1.25	50	3	0.15	0.07
8.20 - 12.4	**4625**	WR90	Cover	UG-135/U	1.25	50	3	0.12	0.05
10.0 - 15.0	**4626**	WR75	Cover	MIL-F-3922/70-017	1.25	50	3	0.10	0.05
12.4 - 18.0	**4627**	WR62	Cover	UG-1665/U	1.25	50	3	0.08	0.04
15.0 - 22.0	**4628**	WR51	Cover	MIL-F-3922/70-023	1.25	50	3	0.05	0.02

Waveguide to 2.92 mm (F), 18 to 40 GHz

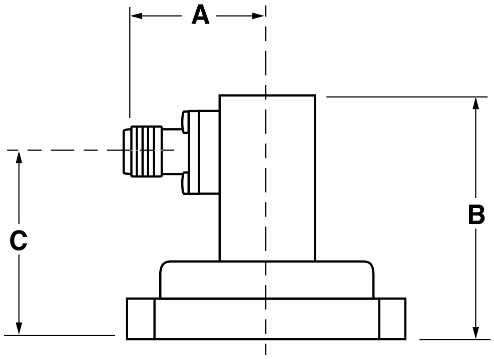
FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	VSWR (max.)	CW POWER (W)	PEAK POWER (kW)	WEIGHT (max.)	
								lb.	kg.
18.0 - 26.5	**4629**	WR42	Cover	UG-597/U	1.25	50	3	0.04	0.02
22.0 - 33.0	**4630**	WR34	Cover	UG-1530/U	1.25	10	3	0.03	0.01
26.5 - 40.0	**4631**	WR28	Cover	UG-599/U	1.25	10	3	0.03	0.01

NOTE:

For a complete listing of all band letters and codes in use, refer to Band Designation Table on Page 183.

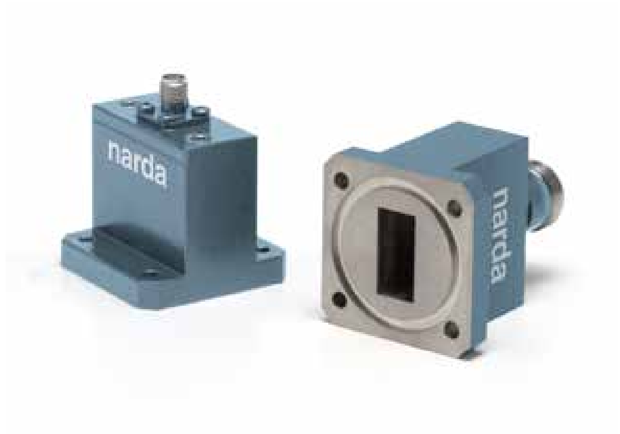
Waveguide Adapters

Outline Drawing



MODEL	DIMENSIONS (inches)		
	A	B	C
4617A	1.53	4.00	2.34
4618	1.13	2.95	1.90
4619	1.01	2.28	1.44
4620	0.88	2.60	1.96
4621	0.84	1.83	1.21
4622	0.75	1.70	1.23
4623	0.80	1.14	0.67
4624	0.77	1.50	1.12
4625	0.75	1.00	0.63
4626	0.74	1.00	0.63
4627	0.73	1.00	0.65
4628	0.73	1.00	0.65
4629	0.65	1.00	0.75
4630	0.66	0.56	0.36
4631	0.60	0.95	0.76

Dimensions in inches, unless otherwise specified.



1.7-18 GHz

Waveguide to Type N Coaxial End Launch Adapters

- Low VSWR
- Lightweight
- Higher Power Handling Capability

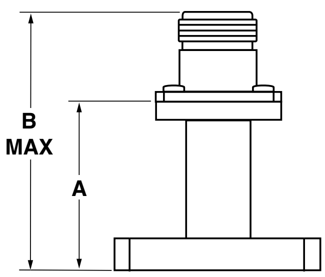
Specifications

Waveguide to Type N (F) , 1.7 to 18 GHz, End Launch

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	VSWR (max.)	CW POWER (W)	PEAK POWER (kW)	WEIGHT (max.)	
								lb.	kg.
1.70 - 2.60	**617E**	WR430	CPRF	UG-1711/U	1.25	1000	20	1.70	0.77
2.60 - 3.95	**618E**	WR284	Cover	UG-584/U	1.25	1000	20	1.15	0.52
3.30 - 4.90	**619E**	WR229	CPRF	UG-1727/U	1.25	1000	20	0.51	0.23
3.95 - 5.85	**620E**	WR187	Cover	UG-407/U	1.25	1000	20	0.53	0.24
4.90 - 7.05	**621E**	WR159	CPRF	UG-1731/U	1.25	1000	15	0.42	0.19
5.85 - 8.20	**622E**	WR137	CPRF	UG-441/U	1.25	750	14	0.35	0.16
7.05 - 10.0	**623E**	WR112	Cover	UG-138/U	1.25	500	11	0.25	0.11
7.00 - 11.0	**624E**	WR102	Cover	MIL-F-3922/70-014	1.25	500	11	0.23	0.10
8.20 - 12.4	**625E**	WR90	Cover	UG-135/U	1.25	450	11	0.22	0.10
10.0 - 15.0	**626E**	WR75	Cover	MIL-F-3922/70-017	1.25	500	10	0.20	0.09
12.4 - 18.0	**627E**	WR62	Cover	UG-1665/U	1.25	500	8	0.17	0.08

NOTE:
For a complete listing of all band letters and codes in use, refer to Band Designation Table on Page 183.

Outline Drawing



MODEL	DIMENSIONS (inches)	
	A	B
617E	4.00	4.74
618E	2.75	3.49
619E	2.25	2.99
620E	2.07	2.81
621E	2.00	2.77
622E	1.83	2.60
623E	1.56	2.30
624E	1.50	2.24
625E	1.46	2.20
626E	1.38	2.11
627E	1.25	1.99

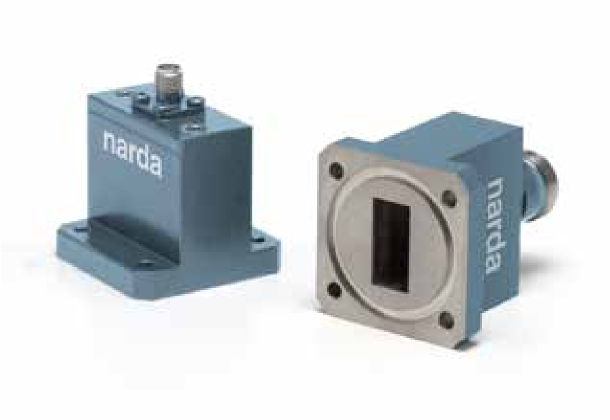
Dimensions in inches, unless otherwise specified.

Waveguide Adapters

2.6-40 GHz

Miniature Waveguide to Coaxial End Launch Adapters SMA and 2.92 mm Types

- Low VSWR
- Higher Power Handling Capability
- Lightweight
- Precision Coaxial Connectors Either SMA or 2.92 mm



Specifications

Waveguide to SMA (F), 2.6 to 22 GHz, End Launch

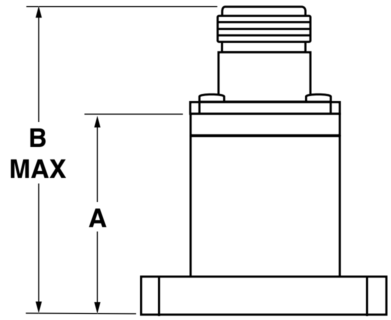
FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	VSWR (max.)	CW POWER (W)	PEAK POWER (kW)	WEIGHT (max.)	
								lb.	kg.
2.60 - 3.95	**4618E**	WR284	Cover	UG-584/U	1.25	100	3	1.00	0.45
3.30 - 4.90	**4619E**	WR229	CPRF	UG-1727/U	1.25	100	3	0.42	0.19
3.95 - 5.85	**4620E**	WR187	Cover	UG-407/U	1.25	100	3	0.53	0.24
4.90 - 7.05	**4621E**	WR159	CPRF	UG-1731/U	1.25	100	3	0.40	0.18
5.85 - 8.20	**4622E**	WR137	CPRF	UG-441/U	1.25	100	3	0.35	0.16
7.05 -10.0	**4623E**	WR112	Cover	UG-138/U	1.25	100	3	0.24	0.11
7.00 - 11.0	**4624E**	WR102	Cover	MIL-F-3922/70-014	1.25	100	3	0.21	0.10
8.20 - 12.4	**4625E**	WR90	Cover	UG-135/U	1.25	100	3	0.17	0.08
10.0 - 15.0	**4626E**	WR75	Cover	MIL-F-3922/70-017	1.25	100	3	0.12	0.05
12.4 - 18.0	**4627E**	WR62	Cover	UG-1665/U	1.25	100	3	0.10	0.05
15.0 - 22.0	**4628E**	WR51	Cover	MIL-F-3922/70-023	1.25	100	3	0.07	0.03

Waveguide to 2.92 mm (F), 18 to 40 GHz, End Launch

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	VSWR (max.)	CW POWER (W)	PEAK POWER (kW)	WEIGHT (max.)	
								lb.	kg.
18.0 - 26.5	**4629E**	WR42	Cover	UG-597/U	1.25	50	3	0.06	0.03
22.0 - 33.0	**4630E**	WR34	Cover	UG-1530/U	1.25	10	1	0.04	0.02
26.5 - 40.0	**4631E**	WR28	Cover	UG-599/U	1.25	10	1	0.04	0.02

NOTE:
For a complete listing of all band letters and codes in use, refer to Band Designation Table on Page 183.

Outline Drawing



MODEL	DIMENSIONS (inches)	
	A	B
4618E	2.75	3.13
4619E	2.25	2.63
4620E	2.07	2.45
4621E	2.00	2.38
4622E	1.83	2.21
4623E	1.56	1.94
4624E	1.50	1.88
4625E	1.46	1.84
4626E	1.38	1.75
4627E	1.25	1.63
4628E	1.09	1.47
4629E	0.88	1.25
4630E	0.88	1.25
4631E	0.86	1.23

Dimensions in inches, unless otherwise specified.

Waveguide Horns

1.7-40 GHz

Standard Gain Horns

- 10, 15, 20 dB Versions
- Wideband Versions Available

Specifications

Standard Gain Horns , 1.7 to 40 GHz

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	GAIN (dB)	VSWR (typ.)	WEIGHT (max.)	
							lb.	kg.
1.70 - 2.60	**651-10**	WR430	CPRF	UG-1711/U	10	1.25	2.30	1.04
2.60 - 3.95	**652-10** **652-15**	WR284	Cover	UG-584/U	10 15	1.25 1.18	1.00 2.80	0.45 1.27
3.30 - 4.90	**653-10** **653-15**	WR229	CPRF	UG-1727/U	10 15	1.25 1.18	0.75 2.80	0.34 1.27
3.95 - 5.85	**654-10** **654-15** **654-20**	WR187	Cover	UG-407/U	10 15 20	1.25 1.18 1.15	0.45 1.00 2.50	0.20 0.45 1.13
4.90 - 7.05	**655-10** **655-15** **655-20**	WR159	CPRF	UG-1731/U	10 15 20	1.25 1.18 1.15	1.20 1.50 2.40	0.54 0.68 1.09
5.85 - 8.20	**656-10** **656-15** **656-20**	WR137	Cover	UG-441/U	10 15 20	1.25 1.18 1.15	0.25 0.45 1.50	0.11 0.20 0.68
7.05 - 10.0	**657-10** **657-15** **657-20**	WR112	Cover	UG-138/U	10 15 20	1.25 1.18 1.15	0.15 0.35 0.75	0.07 0.16 0.34
7.00 - 11.0	**658-10** **658-15** **658-20**	WR102	Cover	MIL-F-3922/70-014	10 15 20	1.25 1.18 1.15	0.14 0.28 0.70	0.06 0.13 0.32
8.20 - 12.4	**659-10** **659-15** **659-20**	WR90	Cover	UG-135/U	10 15 20	1.25 1.18 1.15	0.18 0.25 0.75	0.08 0.11 0.34
10.0 - 15.0	**660-10** **660-15** **660-20**	WR75	Cover	MIL-F-3922/70-017	10 15 20	1.25 1.18 1.15	0.10 0.19 0.60	0.05 0.09 0.27
12.4 - 18.0	**661-10** **661-15** **661-20**	WR62	Cover	UG-1665/U	10 15 20	1.25 1.18 1.15	0.15 0.25 0.50	0.07 0.11 0.23

Waveguide Horns

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	GAIN (dB)	VSWR (typ.)	WEIGHT (max.)	
							lb.	kg.
15.0 - 22.0	662-10 662-15 662-20	WR51	Cover	MIL-F-3922/70-024	10 15 20	1.25 1.18 1.15	0.06 0.12 0.35	0.03 0.05 0.16
18.0 - 26.5	663-10 663-15 663-20	WR42	Cover	UG-597/U	10 15 20	1.25 1.18 1.15	0.02 0.04 0.13	0.01 0.02 0.06
22.0 - 33.0	664-10 664-15 664-20	WR34	Cover	UG-1530/U	10 15 20	1.25 1.18 1.15	0.02 0.03 0.07	0.01 0.01 0.03
26.5 - 40.0	665-10 665-15 665-20	WR28	Cover	UG-599/U	10 15 20	1.25 1.18 1.15	0.01 0.02 0.04	0.01 0.01 0.02

Wideband Horns, Horns Only, 7.5 to 40 GHz

FREQUENCY RANGE (GHz)	MODEL	INPUT WAVEGUIDE SIZE	FLANGE TYPE	GAIN (dB) LOW TO HIGH FREQUENCY
7.50 - 18.0	667	WRD750	Square Cover	20.5-24.0
18.0 - 40.0	668	WRD180	Square Cover	14.0-19.0

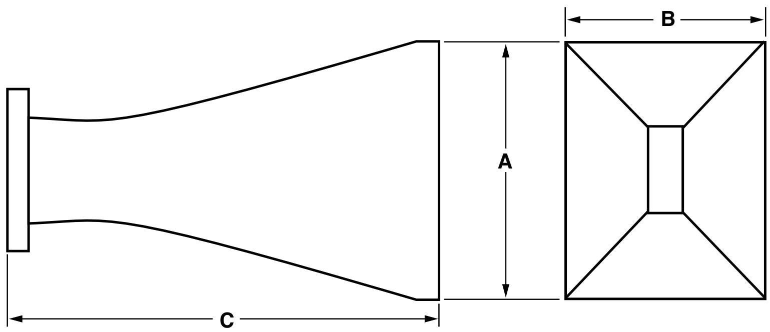
Wideband Horns, 7.5 to 40 GHz, Horns with Adapter

FREQUENCY RANGE (GHz)	MODEL	COAXIAL CONNECTOR TYPE	FLANGE TYPE	GAIN (dB) LOW TO HIGH FREQUENCY
7.50 - 18.0	667A	N-Female	—	20.5-24.0
18.0 - 40.0	668A	2.92mm-Female	—	14.0-19.0

NOTE:
For a complete listing of all band letters and codes in use, refer to Band Designation Table on Page 183.

Waveguide Horns

Outline Drawings

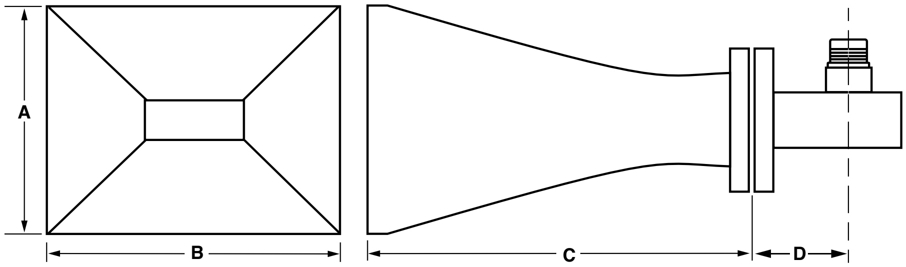


Standard Gain Horns

MODEL	DIMENSIONS (inches)		
	A	B	C
651-10	8.00	4.00	10.50
652-10	4.33	3.46	7.50
652-15	7.96	5.83	15.34
653-10	3.62	2.36	6.45
653-15	6.00	4.41	10.40
654-10	2.89	2.12	5.50
654-15	4.88	3.57	9.40
654-20	8.92	6.53	14.93
655-10	2.68	1.58	4.28
655-15	4.33	3.15	8.00
655-20	9.80	7.64	11.73
656-10	2.02	1.48	3.15
656-15	3.42	2.50	6.51
656-20	6.26	4.57	12.19
657-10	1.63	1.18	2.55
657-15	2.93	2.15	6.65
657-20	4.97	3.64	10.78
658-10	1.58	1.14	3.00
658-15	3.04	2.23	6.00
658-20	5.57	3.94	11.13

MODEL	DIMENSIONS (inches)		
	A	B	C
659-10	1.58	1.15	2.01
659-15	2.66	1.95	5.46
659-20	4.87	3.62	10.06
660-10	1.26	0.92	1.94
660-15	2.25	1.33	4.69
660-20	3.88	2.98	8.00
661-10	1.00	0.68	1.00
661-15	1.69	1.30	2.46
661-20	2.88	2.11	5.75
662-10	0.77	0.56	1.43
662-15	1.36	1.00	2.84
662-20	2.51	1.93	4.88
663-10	0.60	0.44	1.25
663-15	1.14	0.85	2.37
663-20	2.13	1.56	4.00
664-10	0.53	0.39	1.13
664-15	0.95	0.70	2.12
664-20	1.76	1.29	3.56
665-10	0.42	0.32	1.00
665-15	0.76	0.55	1.87
665-20	1.38	1.01	3.12

Dimensions in inches, unless otherwise specified.



Wideband Horns

MODEL	DIMENSIONS (inches) A	B	C	D
667	5.00	7.00	12.13	—
668	1.05	1.47	2.47	—
667A	5.00	7.00	12.13	1.42
668A	1.05	1.47	2.47	0.76

Dimensions in inches, unless otherwise specified.

Waveguide Band Designation Table and Reference Guide

FREQUENCY RANGE (GHz)	WAVEGUIDE DESIGNATION EIA (WR)	IEC (R)	BRITISH (WG)	WAVEGUIDE TO COAXIAL ADAPTERS FOR STANDARD GAIN HORNS GAIN HORN SERIES	W/G TO COAX SMA / 2.92mm (F)	W/G TO COAX TYPE N (F)	W/G TO COAX END LAUNCH SMA / 2.92mm (F)	W/G TO COAX END LAUNCH TYPE N (F)
1.70 - 2.60	WR430	R22	WG8	651-Series	4617A	617	—	617E
2.60 - 3.95	WR284	R32	WG10	652-Series	4618	618	4618E	618E
3.30 - 4.90	WR229	R40	WG11A	653-Series	4619	619	4619E	619E
3.95 - 5.85	WR187	R48	WG12	654-Series	4620	620	4620E	620E
4.90 - 7.05	WR159	R58	WG13	655-Series	4621	621	4621E	621E
5.85 - 8.20	WR137	R70	WG14	656-Series	4622	622	4622E	622E
7.05 - 10.0	WR112	R84	WG15	657-Series	4623	623	4623E	623E
7.00 - 11.0	WR102	—	—	658-Series	4624	624	4624E	624E
8.20 - 12.4	WR90	R100	WG16	659-Series	4625	625	4625E	625E
10.0 - 15.0	WR75	R120	WG17	660-Series	4626	626	4626E	626E
12.4 - 18.0	WR62	R140	WG18	661-Series	4627	627	4627E	627E
15.0 - 22.0	WR51	R180	WG19	662-Series	4628	—	4628E	—
18.0 - 26.5	WR42	R220	WG20	663-Series	4629	—	4629E	—
22.0 - 33.0	WR34	R260	WG21	664-Series	4630	—	4630E	—
26.5 - 40.0	WR28	R320	WG22	665-Series	4631	—	4631E	—

Waveguide Terminations

1.7-40 GHz

Rectangular Waveguide Terminations

- Low and Medium Power Handling Versions
- Standard Waveguide Sizes

Specifications

Low Power, 1.7 to 40 GHz

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	VSWR (max.)	POWER	
						AVERAGE (W)	PEAK (kW)
1.70 - 2.60	**305L**	WR430	CPRF	UG-1711/U	1.04	15.0	15.0
2.60 - 3.95	**306L**	WR284	Cover	UG-584/U	1.04	10.0	10.0
3.30 - 4.90	**307L**	WR229	CPRF	UG-1727/U	1.04	10.0	10.0
3.95 - 5.85	**308L**	WR187	Cover	UG-407/U	1.04	8.0	8.0
4.90 - 7.05	**309L**	WR159	CPRF	UG-1731/U	1.04	7.0	7.0
5.85 - 8.20	**310L**	WR137	Cover	UG-1733/U	1.04	6.0	6.0
7.05 - 10.0	**311L**	WR112	Cover	UG-138/U	1.04	4.0	4.0
7.00 - 11.0	**312L**	WR102	Cover	MIL-F-3922/70-014	1.04	3.0	3.0
8.20 - 12.4	**313L**	WR90	Cover	UG-135/U	1.04	4.0	7.0
10.0 - 15.0	**314L**	WR75	Cover	MIL-F-3922/70-017	1.04	2.0	2.0
12.4 - 18.0	**315L**	WR62	Cover	UG-1665/U	1.04	1.5	1.5
15.0 - 22.0	**316L**	WR51	Cover	MIL-F-3922/70-024	1.04	1.0	1.0
18.0 - 26.5	**317L**	WR42	Cover	UG-597/U	1.04	0.5	0.5
22.0 - 33.0	**318L**	WR34	Cover	UG-1530/U	1.04	0.5	0.5
26.5 - 40.0	**319L**	WR28	Cover	UG-599/U	1.04	0.5	0.5

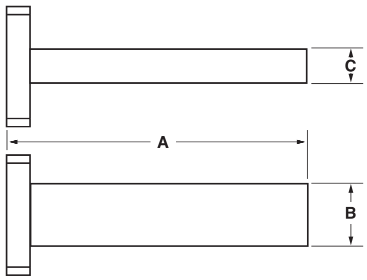
Waveguide Terminations

Medium Power, 2.6 to 40 GHz

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	VSWR (max.)	POWER AVERAGE (W)	POWER PEAK (kW)
2.60 - 3.95	**306M**	WR284	Cover	UG-584/U	1.15	1200	800
3.30 - 4.90	**307M**	WR229	CPRF	UG-1727/U	1.15	1000	800
3.95 - 5.85	**308M**	WR187	Cover	UG-407/U	1.15	750	750
4.90 - 7.05	**309M**	WR159	CPRF	UG-1731/U	1.15	625	625
5.85 - 8.20	**310M**	WR137	Cover	UG-441/U	1.15	500	400
7.05 - 10.0	**311M**	WR112	Cover	UG-138/U	1.15	425	400
7.00 - 11.0	**312M**	WR102	Cover	MIL-F-3922/70-014	1.15	325	300
8.20 - 12.4	**313M**	WR90	Cover	UG-135/U	1.15	225	225
10.0 - 15.0	**314M**	WR75	Cover	MIL-F-3922/70-017	1.15	200	200
12.4 - 18.0	**315M**	WR62	Cover	UG-1665/U	1.15	100	200
15.0 - 22.0	**316M**	WR51	Cover	MIL-F-3922/70-024	1.15	100	120
18.0 - 26.5	**317M**	WR42	Cover	UG-597/U	1.15	100	120
22.0 - 33.0	**318M**	WR34	Cover	UG-1530/U	1.15	75	80
26.5 - 40.0	**319M**	WR28	Cover	UG-599/U	1.15	75	50

NOTE:
For a complete listing of all band letters and codes in use, refer to Band Designation Table on Page 183.

Outline Drawings



Low Power

MODEL	DIMENSIONS (inches) A	B	C
305L	11.00	4.46	2.31
306L	10.80	3.00	1.50
307L	7.50	2.42	1.27
308L	6.30	2.00	1.00
309L	6.00	1.72	0.92
310L	5.50	1.50	0.75
311L	5.00	1.25	0.63
312L	4.00	1.12	0.61
313L	4.00	1.00	0.50
314L	4.00	0.85	0.48
315L	4.00	0.70	0.39
316L	4.00	0.59	0.34
317L	2.50	0.50	0.25
318L	2.50	0.42	0.25
319L	2.00	0.36	0.22

Medium Power

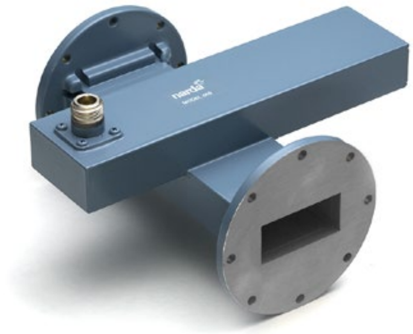
MODEL	DIMENSIONS (inches) A	B	C
306M	11.00	3.00	1.50
307M	9.75	2.42	1.27
308M	8.38	2.00	1.00
309M	8.00	1.72	0.92
310M	8.00	1.50	0.75
311M	7.00	1.25	0.63
312M	6.50	1.12	0.61
313M	5.50	1.00	0.50
314M	4.50	0.85	0.48
315M	3.25	0.70	0.39
316M	3.25	0.59	0.34
317M	3.50	0.50	0.25
318M	3.25	0.42	0.25
319M	4.00	0.36	0.22

Waveguide Couplers

2.6-40 GHz

Crossguide Directional Couplers

- SMA, 2.92 mm and Type N Connectors
- Standard Waveguide Sizes



Specifications

SMA and 2.92 mm, 7.05 to 40 GHz

FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	COUPLING (dB)	DEVIATION FROM NOMINAL (dB max.)	FREQUENCY SENSITIVITY (dB max.)	DIRECTIVITY (dB min.)	VSWR	
									PRIMARY (max.)	SECONDARY (max.)
7.05 - 10.0	**4857**	WR112	Cover	UG-138/U	30	±0.5	±1.00	20	1.05	1.25
8.20 - 12.4	**4858**	WR90	Cover	UG-135/U	30	±0.5	±1.00	20	1.05	1.25
10.0 - 15.0	**4859**	WR75	Cover	MIL-F-3922/70-017	30	±0.5	±1.00	20	1.05	1.25
18.0 - 26.5	**4862**	WR42	Cover	UG-597/U	30	±0.5	±1.00	20	1.05	1.25
26.5 - 40.0	**4864***	WR28	Cover	UG-599/U	30	±0.5	±1.00	20	1.05	1.25

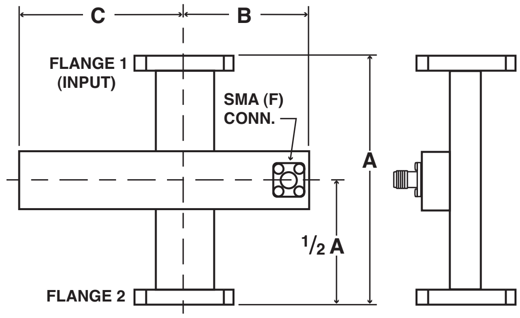
* Connectors are 2.92 mm

Type N, 2.6 to 15 GHz

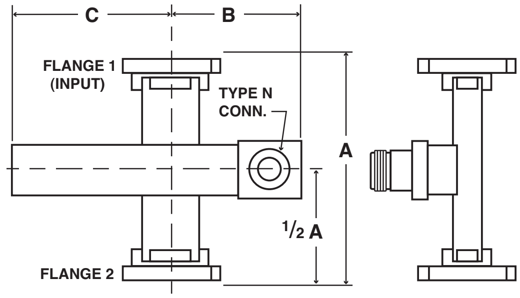
FREQUENCY RANGE (GHz)	MODEL	WAVEGUIDE SIZE	FLANGE TYPE	FLANGE EQUIVALENT	COUPLING (dB)	DEVIATION FROM NOMINAL (dB max.)	FREQUENCY SENSITIVITY (dB max.)	DIRECTIVITY (dB min.)	VSWR	
									PRIMARY (max.)	SECONDARY (max.)
2.60 - 3.95	**852**	WR284	Cover	UG-584/U	30	±0.5	±1.00	20	1.05	1.25
5.85 - 8.20	**856**	WR137	Cover	UG-441/U	30	±0.5	±1.00	20	1.05	1.25
7.05 - 10.0	**857**	WR112	Cover	UG-138/U	30	±0.5	±1.00	20	1.05	1.25
10.0 - 15.0	**859**	WR75	Cover	MIL-F-3922/70-017	30	±0.5	±1.00	20	1.05	1.25

Outline Drawings

MODEL	DIMENSIONS (inches)		
	A	B	C
4857	4.20	2.10	3.00
4858	4.00	2.00	2.75
4859	3.75	1.87	2.50
4862	2.20	1.10	1.50
4864	2.00	1.00	2.50

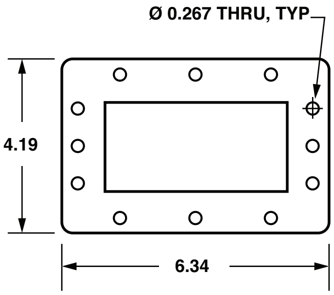


MODEL	DIMENSIONS (inches)		
	A	B	C
852	7.50	3.75	5.00
856	6.00	3.00	4.00
857	4.20	2.10	3.00
859	3.75	1.87	2.50

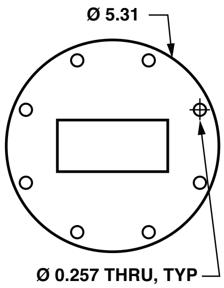


Dimensions in inches, unless otherwise specified.

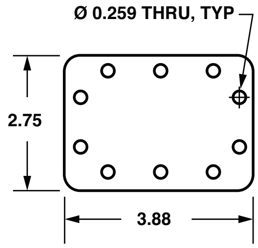
Waveguide Flange Data



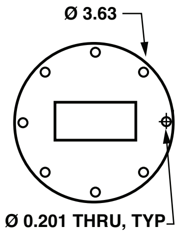
WR430
(UG-1711/U)



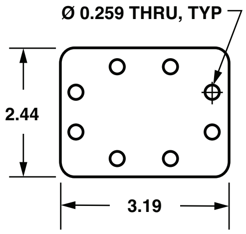
WR284
(UG-584/U)



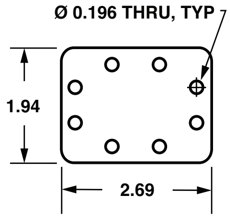
WR229
(UG-1727/U)



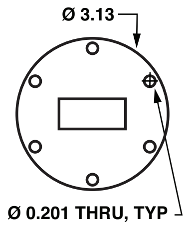
WR187
(UG-407/U)



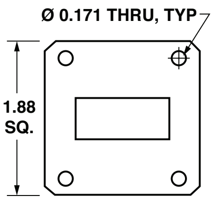
WR159
(UG-1731/U)



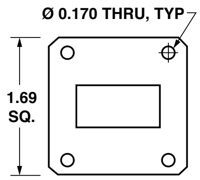
WR137
(UG-1733/U)



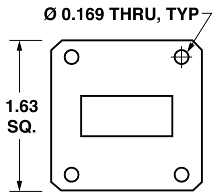
WR137
(UG-441/U)



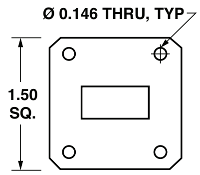
WR112
(UG-138/U)



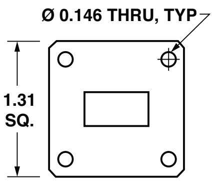
WR102
(MIL-F-3922/70-014)



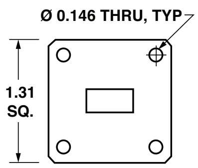
WR90
(UG-135/U)



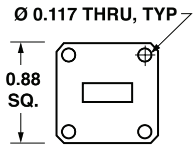
WR75
(MIL-F-3922/70-017)



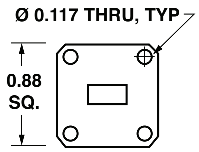
WR62
(UG-1665/U)



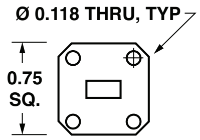
WR51
(MIL-F-3922/70-024)



WR42
(UG-597/U)



WR34
(UG-1530/U)



WR28
(UG-599/U)

For a complete listing of all band letters and codes in use, refer to Band Designation Table on page 183.

Dimensions in inches, unless otherwise specified.


+V RTN 2
narda
SWITCH, RF COAXIAL
MS-SMA-020
VOLTAGE 28 VDC
SERNO 3104 0621
1 IN 2
narda
FSCM 99899
SWITCH, RF COAXIAL
SEM020-12
VOLTAGE 12VDC
S/N 2716 D/C 0723
1 IN 2
COM
narda
99899
SP5T
SS153DHS
2-18 GHz
COM
narda
99899
SP3T
SS133DHS
2-18 GHz

narda MITEQ

Table of Contents

Electro-Mechanical Switches

Electro-Mechanical Switches

Narda-MITEQ offers a complete line of RF/microwave electro-mechanical switches: stocked SEMs, standard custom part, and one of a kind custom.

All Narda-MITEQ switches offer exceptional reliability and performance. A unique actuator design enables Narda-MITEQ to guarantee operation of one million to two million cycles per switch position without noticeable performance degradation. This means:

No intermittent contacts in RF or indicator circuits

Operating reliability is complemented by RF specifications that equal or exceed industry standards.

The unique design of the coil and solenoid allows the solenoid to be actuated more than one million cycles.

These switches can also include a self-termination technique that does not require a separate RF cavity. All switches are designed to meet MIL-S-3928 and are fully compatible with both military and commercial logic integrated circuits.

After assembly, switches are tested for VSWR, insertion loss, and isolation. Individual switches are then cycled in each position in accordance with Narda-MITEQ's comprehensive test procedures to assure trouble-free operation. Before shipping, final testing is performed. In addition to electrical and mechanical testing, the switches are tested at greater than 10 megohms, 500 volts for DC resistance between the switch body, the terminal, and indicator circuitry.

Narda-MITEQ electro-mechanical switches are available in single pole double throw (SP2T) through single pole twelve throw (SP12T), as well as transfer switch configurations. Standard options include four activation modes, 50 ohm terminations, and TTL logic circuits.

SEM models have either SMA or Type N connectors, indicator circuitry, solder-control terminals, 12, 24 or 28 Vdc actuating voltage, and a typical switching speed of 15 ms. TTL models include suppression diodes. Polarity is common positive for all pulse-latching models.

Custom part switches and one-of-a-kind switches designed and manufactured to your specific requirements benefit from the same rigorous standards and environment maintained for our SEM switch line.

SEMs - Standard, Stocked Switches

Narda-MITEQ has brought its most popular custom switches into the mainstream by making them standard, stocked catalog products that are always available when you need them. These Stocked Electro-Mechanical switches – or SEM switches – are the definitive answer to most switch requirements.

With nearly forty distinct models, Narda-MITEQ's SEM switches address applications in many industries: ATE, satellite communications, wireless communications, avionics, and military (Radar/EW/communications and commercial test equipment).

Standard, Custom Switches

Narda-MITEQ custom switches range from single pole, double throw configurations (SP2T) to single pole, twelve throw (SP12T) units, plus transfer switches.

Options include four different activation modes, all popular RF connector types, all common operating voltages, frequencies up to 26.5 GHz, and such special options as built-in 50-ohm terminations, self de-energizing circuits, indicator circuits, TTL logic circuits, MOSFET drivers and BCD decoders.

With this wide assortment of options, almost all requirements can be satisfied without resorting to the development of one-of-a-kind switches. If you have unique specifications, however, Narda-MITEQ is ready to design a switch that will precisely meet each of your parameters.

Extensive implementation of manufacturing and quality procedures, along with shop flow travelers, ensure that each step of the manufacturing process is completed correctly. Registration to ISO9001: 2008 reflects our commitment to serving customers throughout the world.

Assemblies

In many instances, it may be advantageous to have Narda-MITEQ incorporate a specified switch into a Narda-MITEQ designed assembly of high performance products, such as filters, amplifiers, power dividers, and couplers.

Like Narda-MITEQ switches, these assemblies will satisfy your most rigid performance requirements and will be manufactured, assembled, inspected and tested under the guidance and regulation of a quality assurance organization without industry equal.

Stocked Electro-Mechanical Switches

Quick Reference Guide – SEM Series Index

SEM	TYPE	FREQUENCY RANGE (GHz)	CONNECTOR	ACTUATION	TERMINATION 50 ohms	INDICATOR CIRCUITRY	SUPPRESSION DIODES	TTL LOGIC	SELF DE-ENERGIZING CIRCUIT	PAGE
020	SP2T	DC TO 18	SMA	FAILSAFE, 28V						206
020-12	SP2T	DC TO 18	SMA	FAILSAFE, 12V						206
020-24	SP2T	DC TO 18	SMA	FAILSAFE, 24V						206
020L	SP2T	DC TO 18	SMA	LATCHING, 28V						206
123	SP2T	DC TO 18	SMA	FAILSAFE, 28V		✔				206
123D	SP2T	DC TO 18	SMA	FAILSAFE, 28V		✔	✔	✔		206
123T	SP2T	DC TO 18	SMA	FAILSAFE, 28V	✔	✔				206
123L	SP2T	DC TO 18	SMA	LATCHING, 28V		✔	✔			206
123LT	SP2T	DC TO 18	SMA	LATCHING, 28V	✔	✔	✔			206
123LD	SP2T	DC TO 18	SMA	LATCHING, 28V		✔	✔	✔		207
123DT	SP2T	DC TO 18	SMA	FAILSAFE, 28V	✔	✔	✔	✔		207
123LDT	SP2T	DC TO 18	SMA	LATCHING, 28V	✔	✔	✔	✔	✔	207
123LDT-24	SP2T	DC TO 18	SMA	LATCHING, 24V	✔	✔	✔	✔	✔	207
123N	SP2T	DC TO 12.4	N	FAILSAFE, 28V		✔				207
123DN	SP2T	DC TO 12.4	N	FAILSAFE, 28V		✔	✔	✔		207
124	SP2T	DC TO 26.5	SMA	FAILSAFE, 28V		✔				207
133	SP3T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔				213
133D	SP3T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔	✔	✔		213
133DT	SP3T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔	✔	✔		213
133LT	SP3T	DC TO 18	SMA	LATCHING, 28V	✔	✔				213
133T	SP3T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔				213
143	SP4T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔				216
143D	SP4T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔	✔	✔		216
143DT	SP4T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔	✔	✔		216
143DT-24	SP4T	DC TO 18	SMA	NORMALLY OPEN, 24V	✔	✔	✔	✔		216
143T	SP4T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔				216
153	SP5T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔				218
066	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V						219
163	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔				219
163D	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔	✔	✔		219
163DT	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔	✔	✔		219
163LD	SP6T	DC TO 18	SMA	LATCHING, 28V		✔	✔	✔	✔	219
163LDT-24	SP6T	DC TO 18	SMA	LATCHING, 24V	✔	✔	✔	✔	✔	219
163T	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔				219
XSEM323	TRANSFER	DC TO 18	SMA	FAILSAFE, 28V		✔				223
XSEM323D	TRANSFER	DC TO 18	SMA	FAILSAFE, 28V		✔	✔	✔		223
XSEM323L	TRANSFER	DC TO 18	SMA	LATCHING, 28V		✔				223
XSEM323LD	TRANSFER	DC TO 18	SMA	LATCHING, 28V		✔	✔	✔		223
XSEM323LD-24	TRANSFER	DC TO 18	SMA	LATCHING, 24V		✔	✔	✔		223

Stocked Electro-Mechanical Switches

Quick Reference Guide – Commercial Use Index

MODEL	TYPE	FREQUENCY RANGE (GHz)	CONNECTOR	PAGE
MS-SMA-020	SP2T	DC TO 3	SMA	226
MS-SMA-020-12	SP2T	DC TO 3	SMA	226
MS-SMA-020L	SP2T	DC TO 3	SMA	226
MS-N-023	SP2T	DC TO 3	N	226
MS-SMA-223	DP2T	DC TO 3	SMA	226
MS-SMA-223L	DP2T	DC TO 3	SMA	226
MS-SMA-033	SP3T	DC TO 3	SMA	226
MS-SMA-063	SP6T	DC TO 3	SMA	226

Glossary

All switches are bi-directional. Inputs and Outputs are interchangeable.

SP2T – A single pole, double throw switch has one input port and two selectable output ports.

Multiposition Switch – A multiposition switch has one input port and more than two selectable output ports. Unlike some switches, Narda-MITEQ models can be switched directly to any one of the available output positions without sequencing through intervening positions.

Transfer Switch – A transfer switch has two independent paths that operate simultaneously in one of two selected positions.

Failsafe – The switch moves to the closed position when the actuating voltage is applied and always returns to a predetermined position when the voltage is removed.

Latching – Also called Pulse Latching, the switch remains in a preselected position whenever the actuating voltage is removed or interrupted and holds that preselected position until a voltage is applied to another position. This configuration must be pulse controlled with a pulse width of 20 ms to 100 ms duration. Standard polarity is common positive.

Normally Open – All output ports of the switch are disconnected from the input port until a voltage is applied to a selected position.

Terminated Units – Each unused or open output RF port is internally terminated in a 50-ohm resistive load (1W CW max.).

TTL – Selected position of the switch is controlled by a TTL Logic High. The switch requires only nominal +28 Vdc (additional 5 Vdc is not required).

TTL Logic Voltage Level:
Low 0 to 0.8 Vdc
High 2.5 to 5.0 Vdc
TTL Logic Input Current:
Low 0 mA
High 1.6 mA max. @ 3.85 Vdc

TTL Units – Transistor-Transistor-Logic circuitry enables the status of the switch to be controlled by the level of TTL logic input.

Suppression Diodes – Fast recovery silicon rectifiers (diodes) connected in parallel with the coils of the switch to suppress any transient voltage that may be generated by the coils.

Indicator Circuitry – A set of internally mounted contacts that allows external monitoring of switch RF status. Some switch series include a steering diode drive due to the electronic indicator.

Solder Terminal – A turret terminal is standard on all switches.

Self De-energizing Circuitry – With this option, a set of internally mounted contacts or electronically generated pulses disconnects the driver voltage as soon as RF contact has been made. This option is only available with latching type switches. Suppression diodes must be specified with this option.

Common Specifications

RF Impedance.. 50 ohms nominal

Actuating Voltage.. 28 Vdc ± 2 V

Switching Time.. 15 ms (max.)

Switching Sequence.. Break Before Make

Operating Ambient Temp.. -35°C to +70°C

Operating Life.. 1 million cycles/position

Designed to meet MIL-S-3928

Stocked Electro-Mechanical Switches

DC-26.5 GHz

SP2T SEM Series

- Standard Features Include:
  Latching Models, Failsafe Models,
  TTL Logic Control, Indicator Circuits

Specifications

SP2T, SMA (F), DC to 18 GHz

MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
SEM020 **SEM020-12** **SEM020-24**	FAILSAFE	160 275 @ 12V 200 @ 24V	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM020L	PULSE LATCHING	200	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM123	FAILSAFE / INDICATOR CKT	160	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM123D	FAILSAFE / INDICATOR CKT / TTL* / SUPPRESSION DIODE	160	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM123L	PULSE LATCHING / INDICATOR CKT	200	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM123T	FAILSAFE / INDICATOR CKT / TERMINATED	280	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM123LT	PULSE LATCHING / TERMINATED / INDICATOR CKT	280	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.4	1.2 1.3 1.4 1.4	80 70 60 60

SP2T, SMA (F), DC to 18 GHz (con't)

MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
SEM123LD	PULSE LATCHING / INDICATOR CKT / TTL*	200	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM123DT	FAILSAFE / TERMINATED / INDICATOR CKT / SUPPRESSION DIODE / TTL*	280	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM123LDT **SEM123LDT-24**	PULSE LATCHING / INDICATOR CKT / TERMINATED / TTL* / SELF DE-ENERGIZING	280 325 @ 24V	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.5 0.5	1.2 1.3 1.4 1.5	80 70 60 60

SP2T, Type N (F), DC to 12.4 GHz

MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
SEM123N	FAILSAFE / INDICATOR CKT	180	DC-3 3-8 8-12.4	0.2 0.35 0.5	1.2 1.35 1.5	80 70 60
SEM123DN	FAILSAFE / INDICATOR CKT / TTL* / SUPPRESSION DIODE	180	DC-3 3-8 8-12.4	0.2 0.35 0.5	1.2 1.35 1.5	80 70 60

SP2T, SMA (F), DC to 26.5 GHz

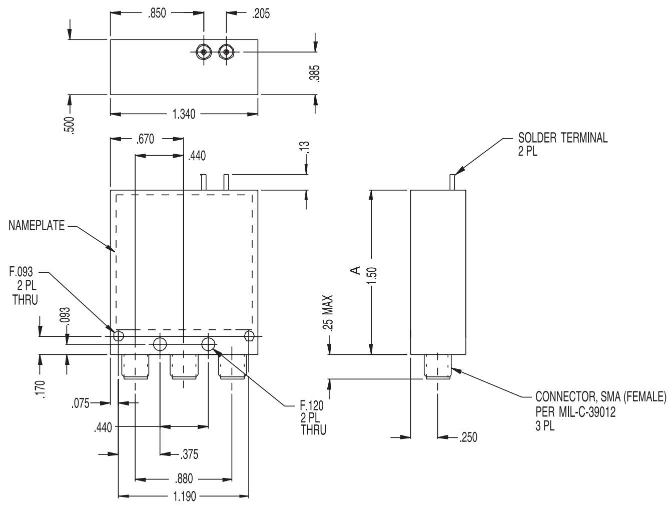
MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
SEM124	FAILSAFE / INDICATOR CKT	160	DC-3 3-8 8-12.4 12.4-18 18-26.5	0.2 0.3 0.4 0.5 0.7	1.2 1.3 1.4 1.5 1.7	80 70 60 60 50

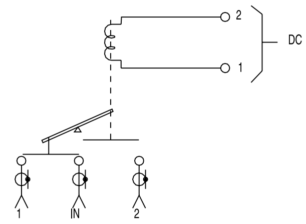
* APPLIES TO ALL SWITCHES WITH TTL:
1. Selected position of the switch is controlled by TTL Logic
2. Switch requires only nominal +28 Vdc for coils (additional 5 Vdc is not required)
3. TTL LOGIC LEVEL: Low 0 to .8 Vdcx High 2.5 to 5.0 Vdc
4. TTL LOGIC INPUT CURRENT: Low 0 mA High 1.6 mA max @ 3.85 Vdc

Stocked Electro-Mechanical Switches

Outline Drawings and Schematics

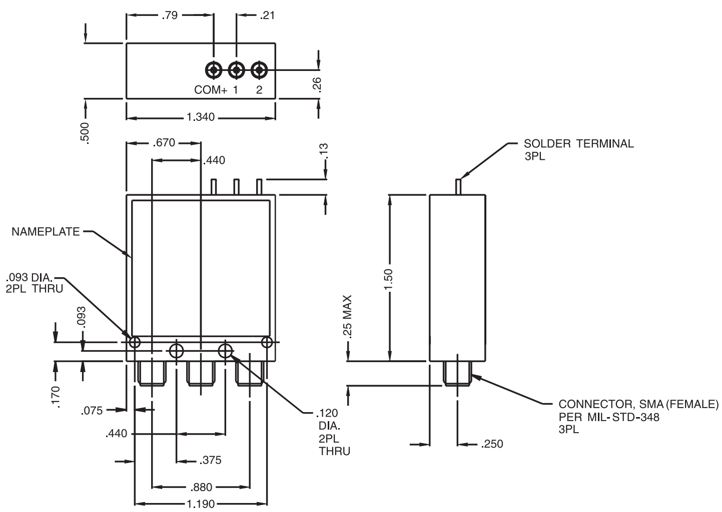
Dimensions in inches, unless otherwise specified.

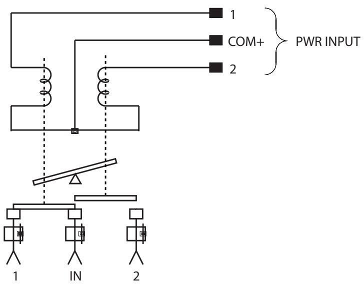




SCHEMATIC SHOWN IN FAILSAFE POSITION

SEM020, SEM020-12, SEM020-24

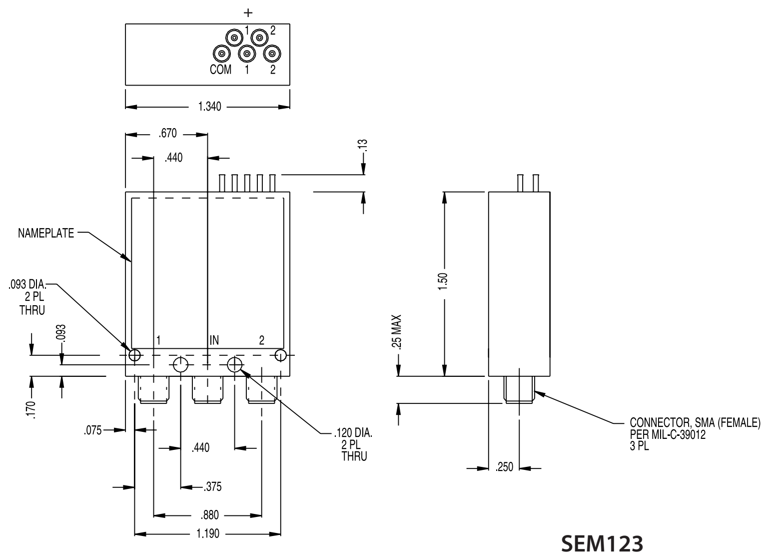


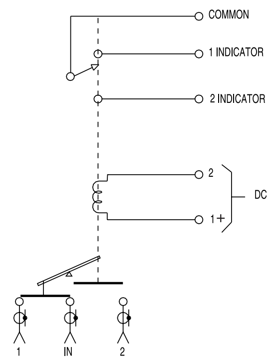


SCHEMATIC SHOWN WITH POSITION 1 CLOSED

SEM020L

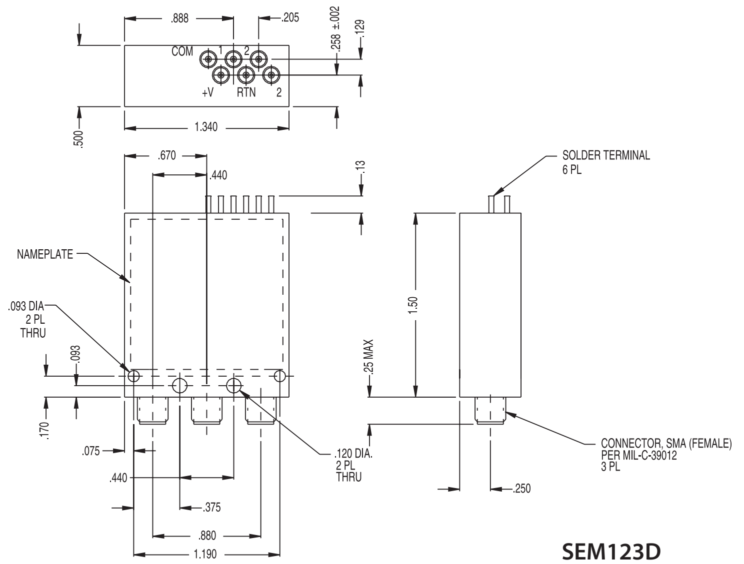
Stocked Electro-Mechanical Switches

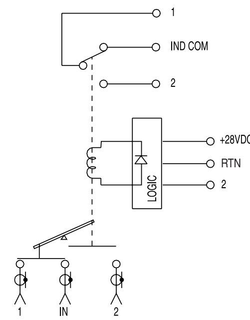




SCHEMATIC SHOWN IN FAILSAFE POSITION

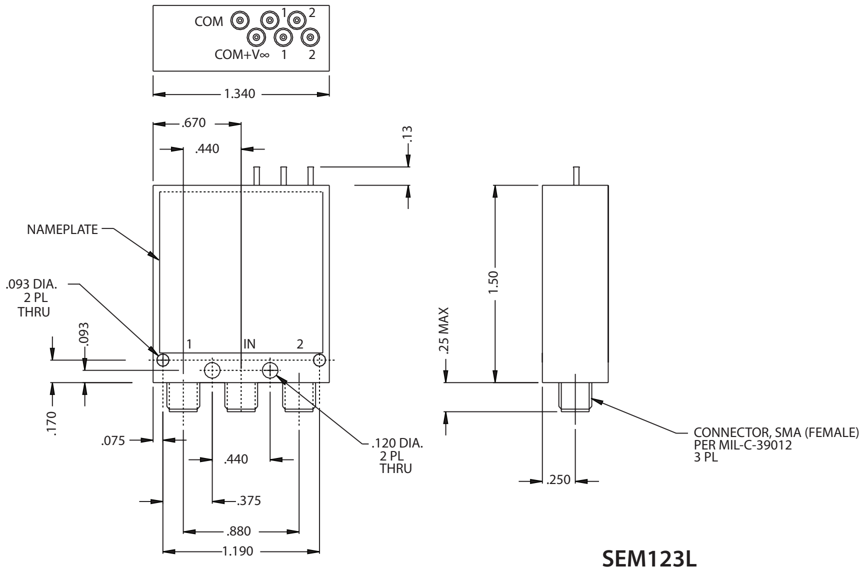
SEM123

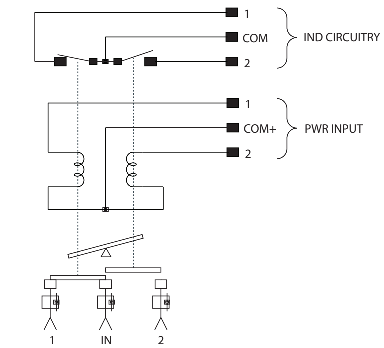




SCHEMATIC SHOWN IN FAILSAFE POSITION

SEM123D





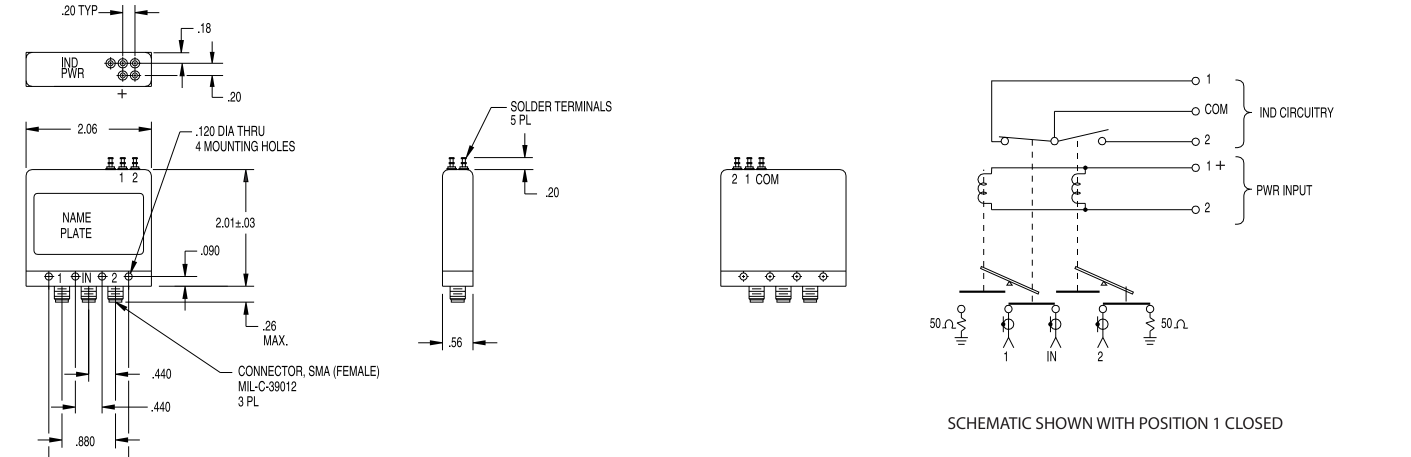
SCHEMATIC SHOWN WITH POSITION 1 CLOSED

SEM123L

Stocked Electro-Mechanical Switches

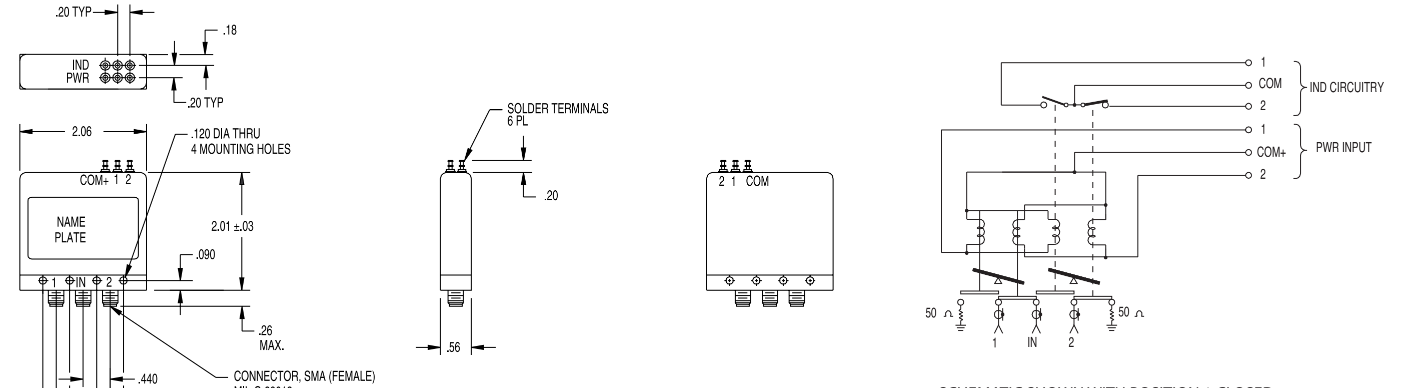
Outline Drawings and Schematics

Dimensions in inches, unless otherwise specified.



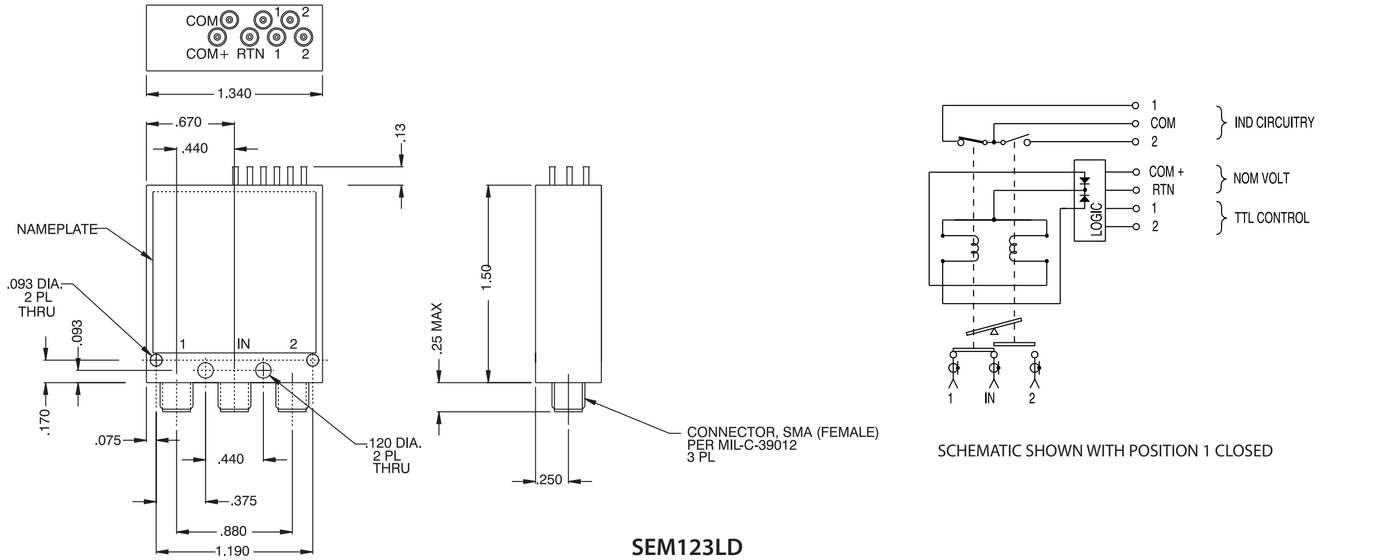
SCHEMATIC SHOWN WITH POSITION 1 CLOSED

SEM123T



SCHEMATIC SHOWN WITH POSITION 1 CLOSED

SEM123LT

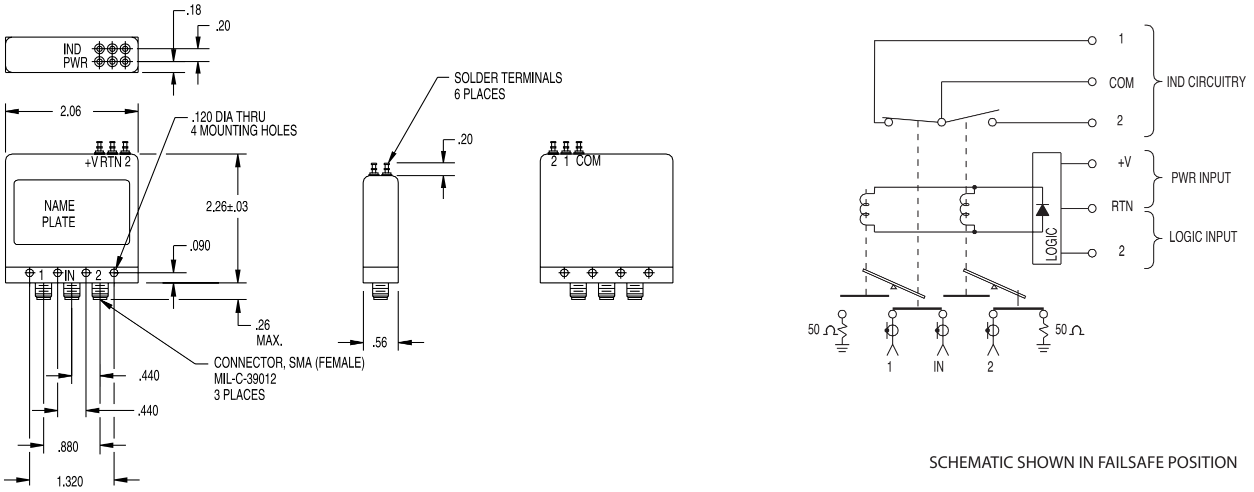


SCHEMATIC SHOWN WITH POSITION 1 CLOSED

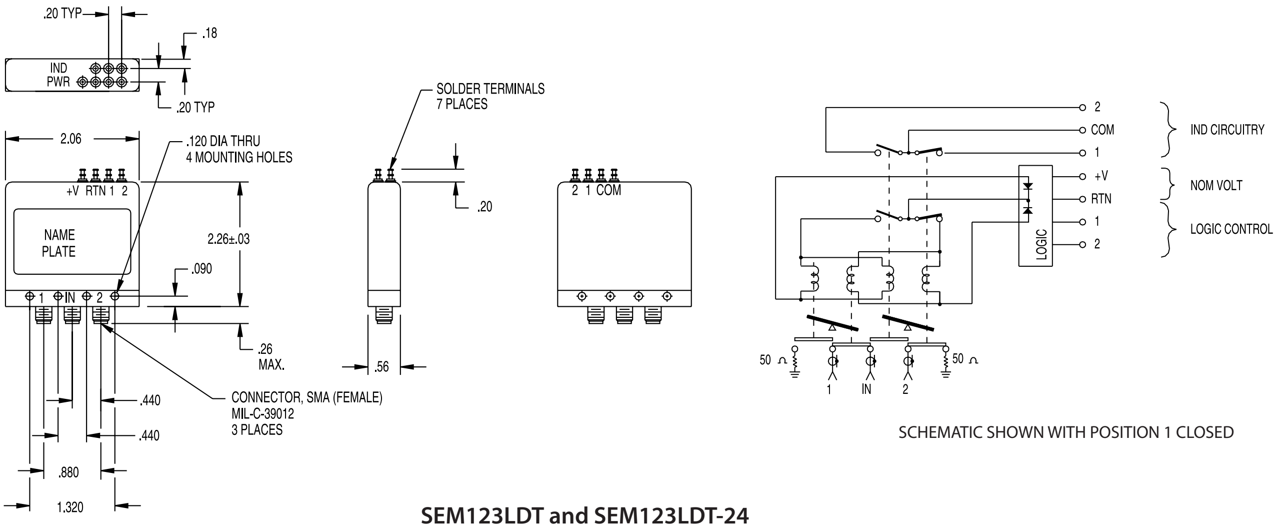
SEM123LD

narda MITEQ www.nardamiteq.com E-MAIL: componentsnm@nardamiteq.com TEL: +1 631 231-1700

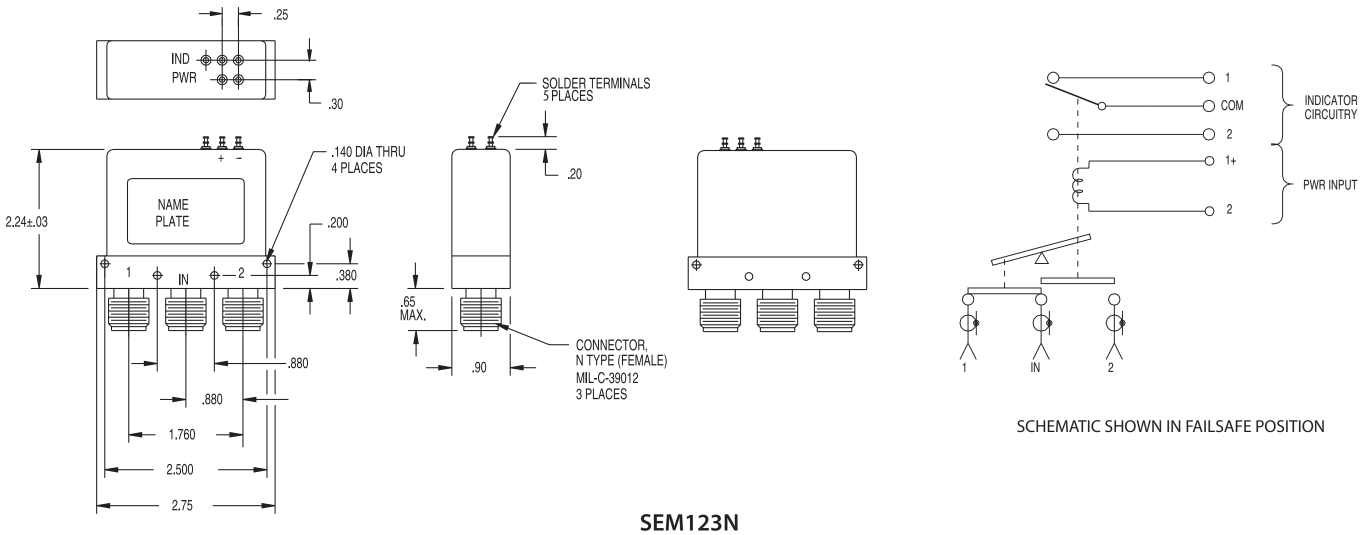
Stocked Electro-Mechanical Switches



SEM123DT



SEM123LDT and SEM123LDT-24

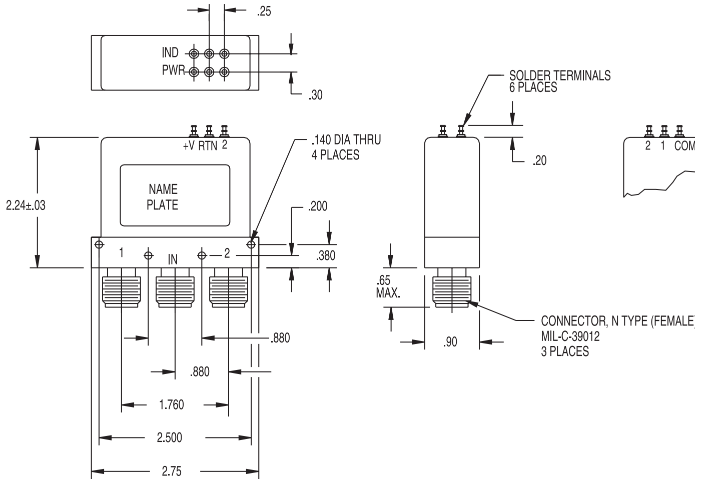


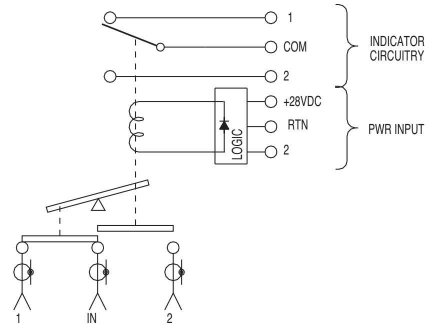
SEM123N

Stocked Electro-Mechanical Switches

Outline Drawings and Schematics

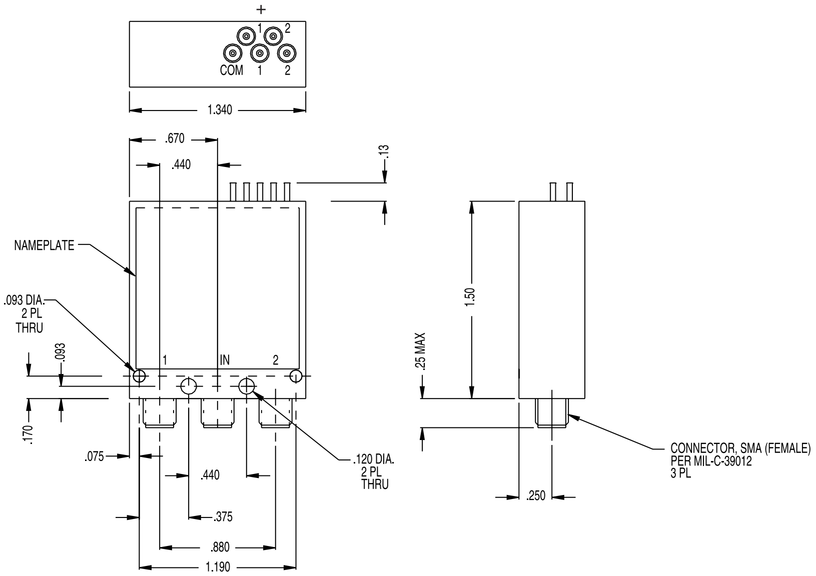
Dimensions in inches, unless otherwise specified.

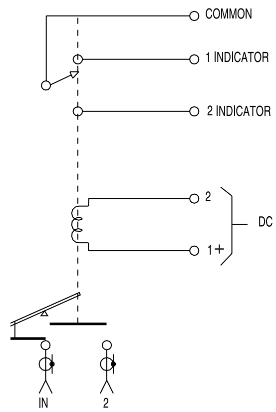




SCHEMATIC SHOWN IN FAILSAFE POSITION

SEM123DN





SCHEMATIC SHOWN IN FAILSAFE POSITION

SEM124

DC-18 GHz

SP3T SEM Series

- Standard Features Include:
  Normally Open and Latching Models
  TTL Logic Control, Suppression Diodes
- All Models Supplied with Indicator Circuits

Specifications

SP3T, SMA (F), DC to 18 GHz

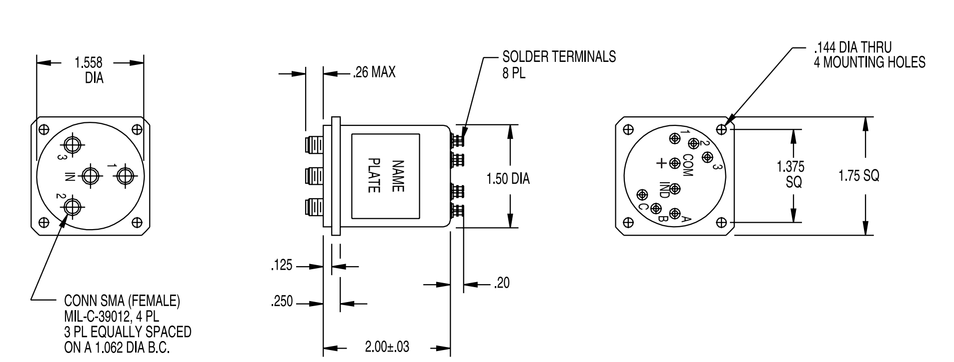
MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
SEM133	NORMALLY OPEN / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM133D	NORMALLY OPEN / TTL* / SUPPRESSION DIODE / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM133T	NORMALLY OPEN / TERMINATED / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM133DT	NORMALLY OPEN / TERMINATED / TTL* / SUPPRESSION DIODE / INDICATOR CKT	180	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM133LT	PULSE LATCHING / TERMINATED / INDICATOR CKT	300	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60

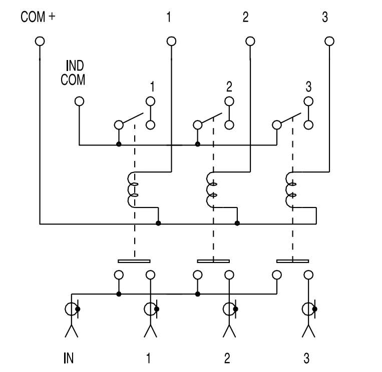
* APPLIES TO ALL SWITCHES WITH TTL:
1. Selected position of the switch is controlled by TTL Logic
2. Switch requires only nominal +28 Vdc for coils (additional 5 Vdc is not required)
3. TTL LOGIC LEVEL: Low 0 to .8 Vdc High 2.5 to 5.0 Vdc
4. TTL LOGIC INPUT CURRENT: Low 0 mA High 1.6 mA max @ 3.85 Vdc

Stocked Electro-Mechanical Switches

Outline Drawings and Schematics

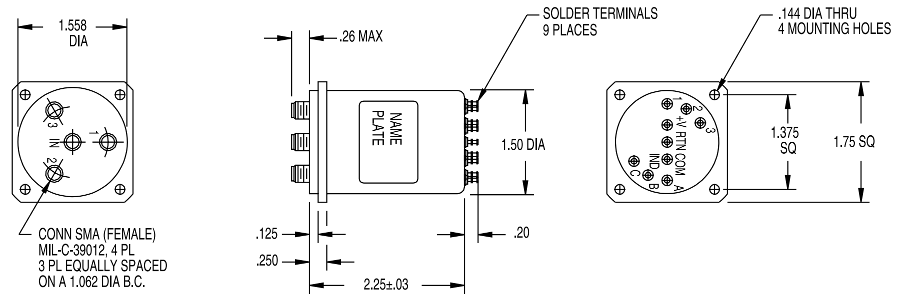
Dimensions in inches, unless otherwise specified.

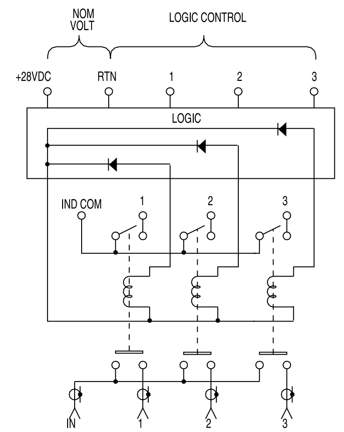




SCHEMATIC SHOWN IN NORMALLY OPEN POSITION

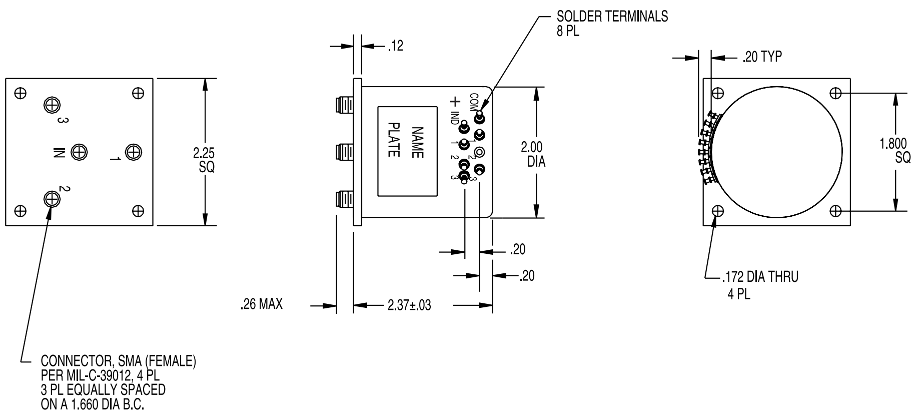
SEM133

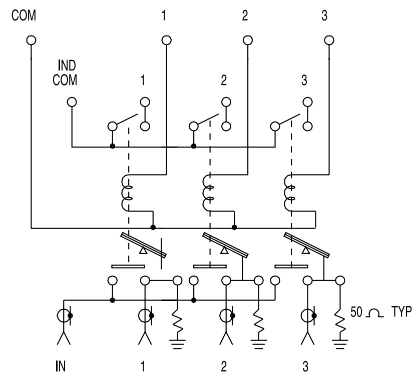




SCHEMATIC SHOWN IN NORMALLY OPEN POSITION

SEM133D

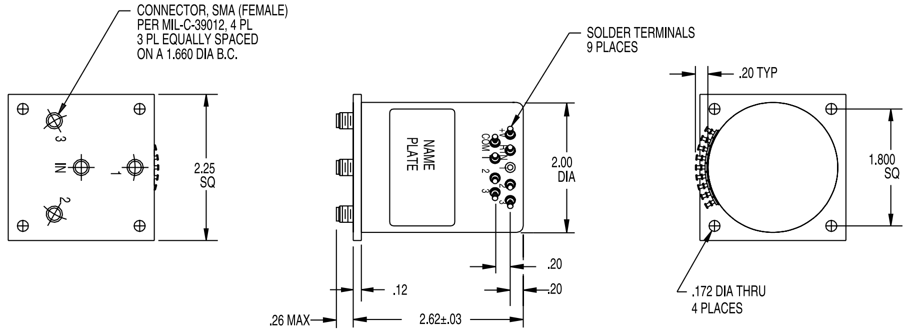


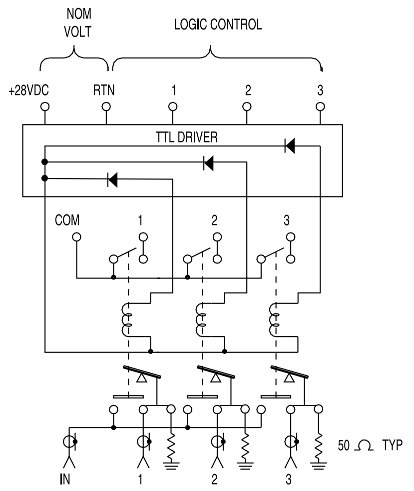


SCHEMATIC SHOWN WITH POSITION 1 CLOSED

SEM133T

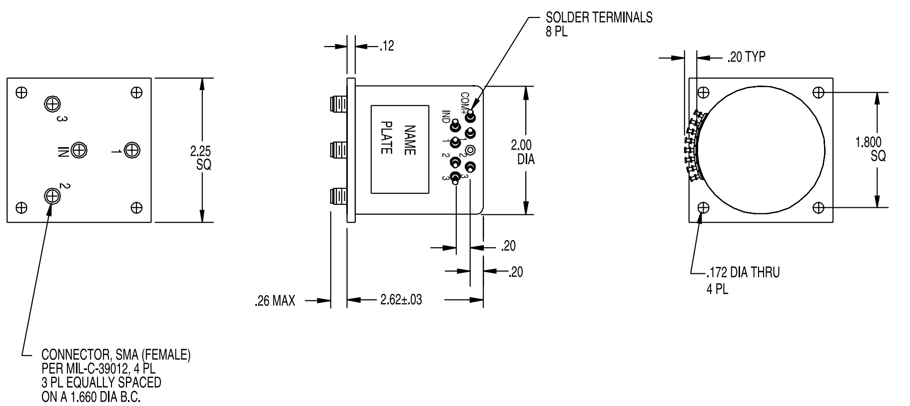
Stocked Electro-Mechanical Switches

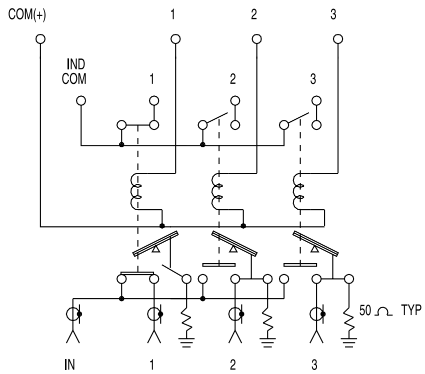




SCHEMATIC SHOWN IN 50 Ω TERMINATED POSITION

SEM133DT





SCHEMATIC SHOWN WITH POSITION 1 CLOSED

SEM133LT

DC-18 GHz

SP4T SEM Series

- Standard Features Include:
  Normally Open and Latching Models
  TTL Logic Control, Suppression Diodes,
  Indicator Circuits

Specifications

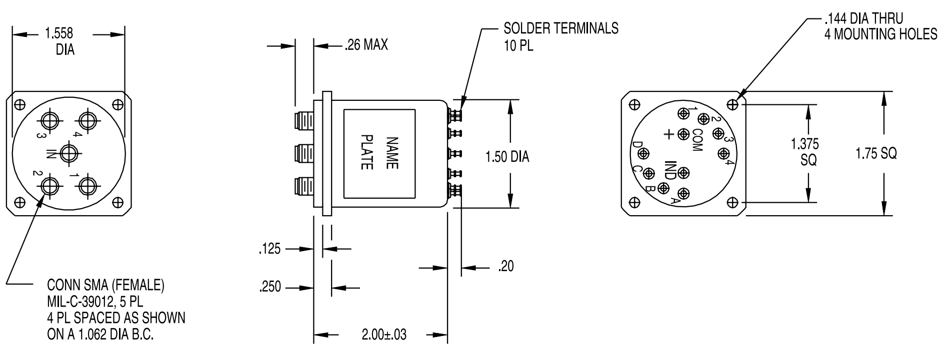
SP4T, SMA (F), DC to 18 GHz

MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
SEM143	NORMALLY OPEN / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM143D	NORMALLY OPEN / TTL* / INDICATOR CKT / SUPPRESSION DIODE	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM143T	NORMALLY OPEN / TERMINATED / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM143DT **SEM143DT-24**	NORMALLY OPEN / TERMINATED / TTL* / SUPPRESSION DIODE / INDICATOR CKT	140 225 @24V	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60

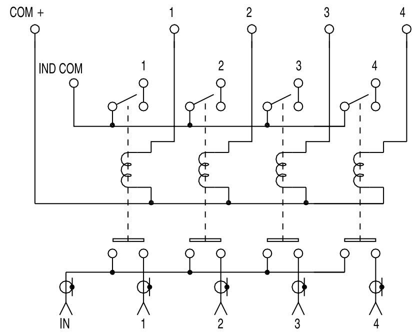
* APPLIES TO ALL SWITCHES WITH TTL:
1. Selected position of the switch is controlled by TTL Logic
2. Switch requires only nominal +28 Vdc for coils (additional 5 Vdc is not required)
3. TTL LOGIC LEVEL: Low 0 to .8 Vdc High 2.5 to 5.0 Vdc
4. TTL LOGIC INPUT CURRENT: Low 0 mA High 1.6 mA max @ 3.85 Vdc

Outline Drawings and Schematics

Dimensions in inches, unless otherwise specified.

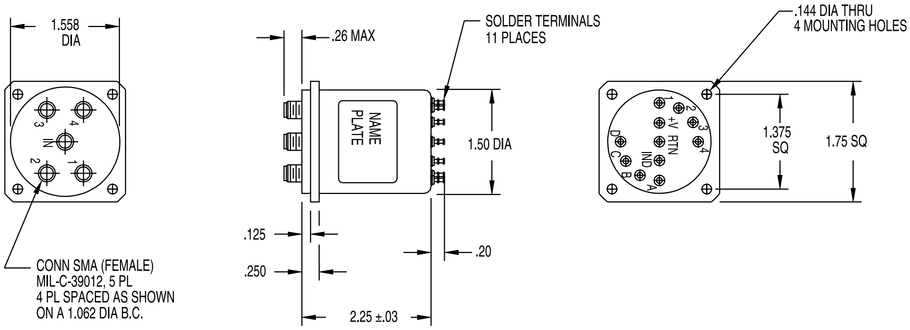


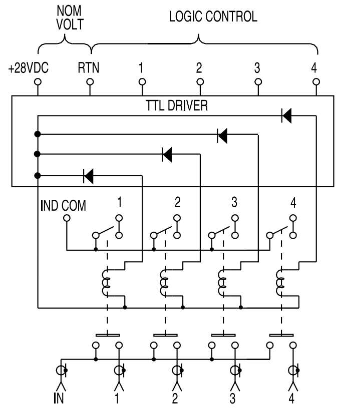
SEM143



SCHEMATIC SHOWN IN NORMALLY OPEN POSITION

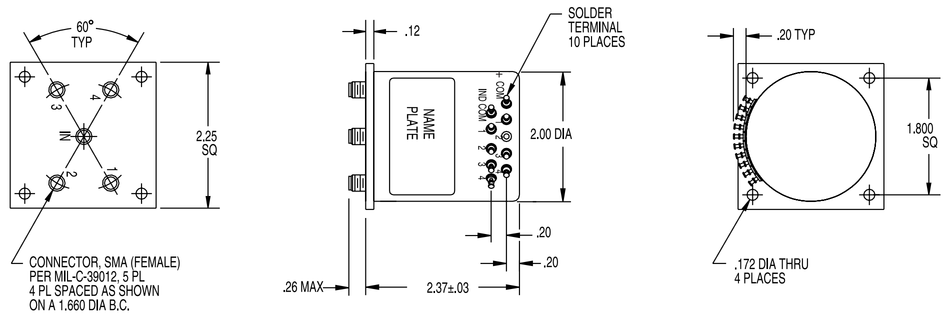
Stocked Electro-Mechanical Switches

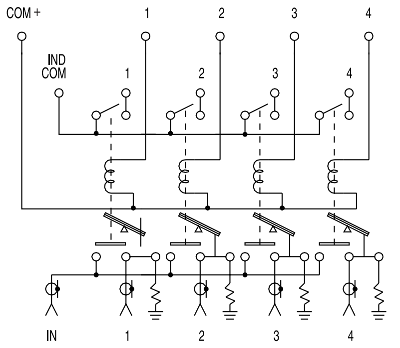




SCHEMATIC SHOWN IN NORMALLY OPEN POSITION

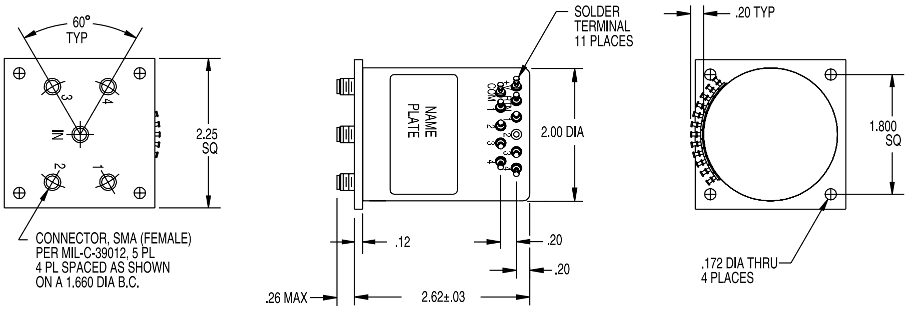
SEM143D

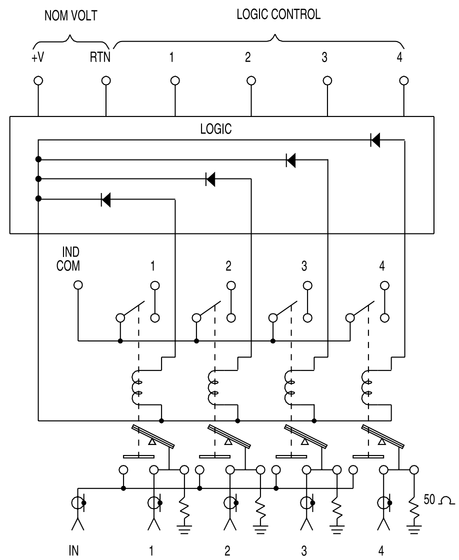




SCHEMATIC SHOWN IN 50 Ω TERMINATED POSITION

SEM143T





SCHEMATIC SHOWN IN 50 Ω TERMINATED POSITION

SEM143DT and SEM143DT-24

Stocked Electro-Mechanical Switches

DC-18 GHz

SP5T SEM Series

- Normally Open Version with Indicator Circuits
- SMA Connectors

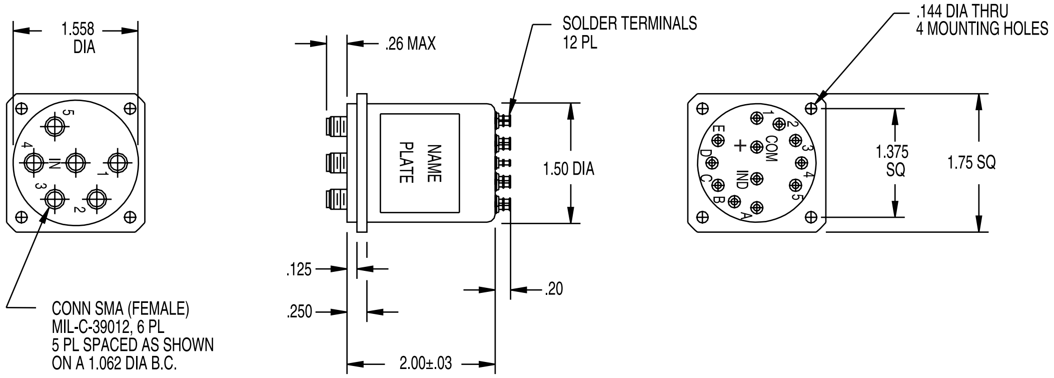
Specifications

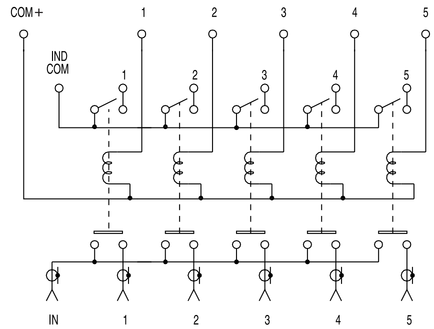
SP5T, SMA (F), DC to 18 GHz

MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
SEM153	NORMALLY OPEN / INDICATOR CKT	140	DC-3	0.2	1.2	80
			3-8	0.3	1.3	70
			8-12.4	0.4	1.4	60
			12.4-18	0.5	1.5	60

Outline Drawing and Schematic

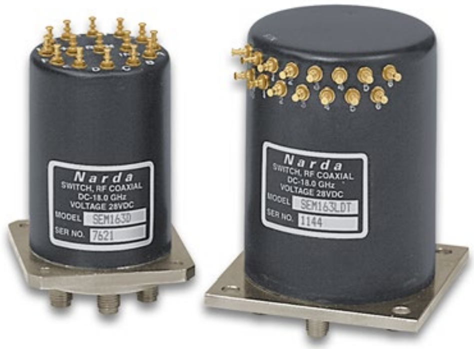
Dimensions in inches, unless otherwise specified.





SCHEMATIC SHOWN IN NORMALLY OPEN POSITION

SEM153



DC-18 GHz

SP6T SEM Series

- Standard Features Include:
  TTL Logic Control, Latching Models, Terminated, Normally Open Models

Specifications

SP6T, SMA (F), DC to 18 GHz

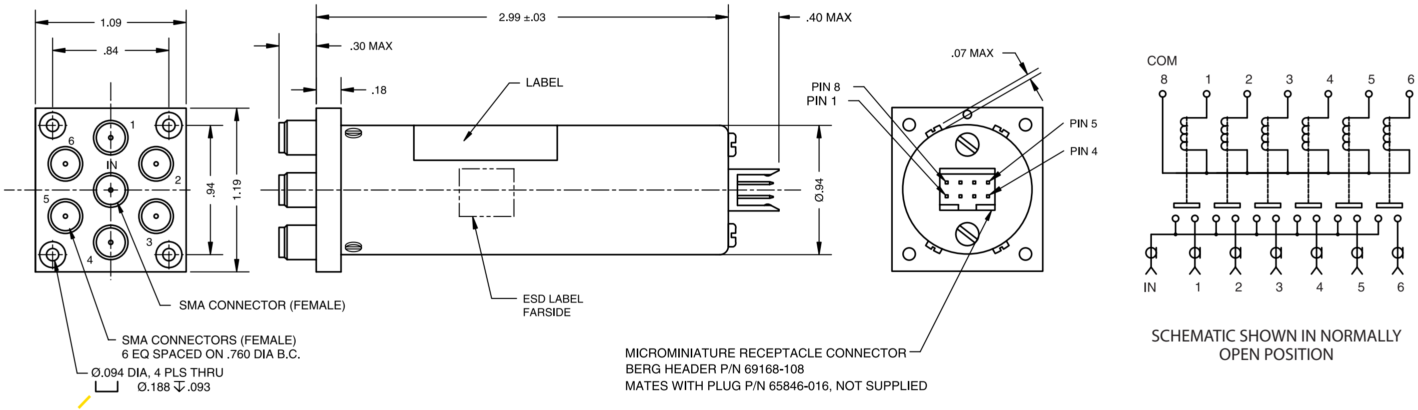
MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
SEM066	NORMALLY OPEN / MINIATURE	160	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM163	NORMALLY OPEN / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM163D	NORMALLY OPEN / TTL* / SUPPRESSION DIODE / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM163T	NORMALLY OPEN / TERMINATED / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM163DT	NORMALLY OPEN / TERMINATED / TTL* / SUPPRESSION DIODE / INDICATOR CKT	140	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM163LD	LATCHING / TTL* / SUPPRESSION DIODE / SELF DE-ENERGIZING / INDICATOR CKT	600	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
SEM163LDT-24	LATCHING / INDICATOR CKT / SELF DE-ENERGIZING / TTL* / SUPPRESSION DIODE	800	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60

* APPLIES TO ALL SWITCHES WITH TTL:
1. Selected position of the switch is controlled by TTL Logic
2. Switch requires only nominal +28 Vdc for coils (additional 5 Vdc is not required)
3. TTL LOGIC LEVEL: Low 0 to .8 Vdc High 2.5 to 5.0 Vdc
4. TTL LOGIC INPUT CURRENT: Low 0 mA High 1.6 mA max @ 3.85 Vdc

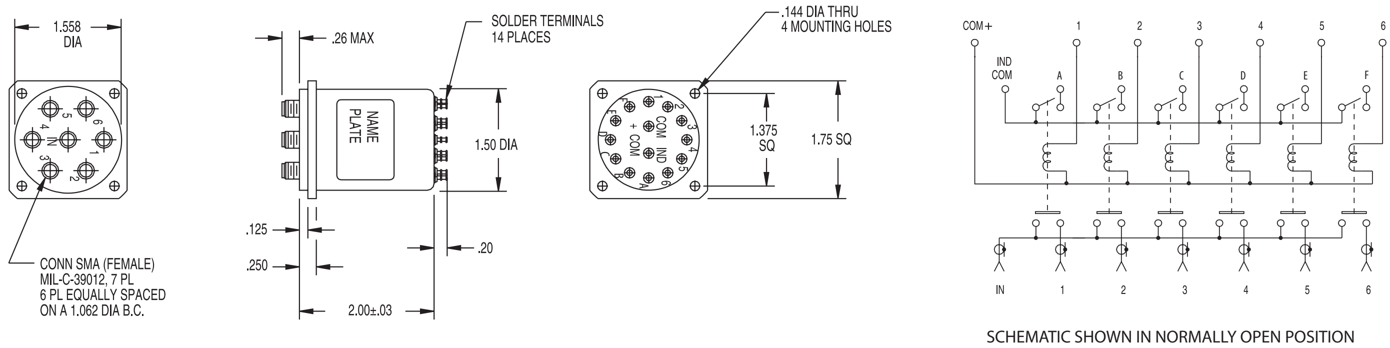
Stocked Electro-Mechanical Switches

Outline Drawings and Schematics

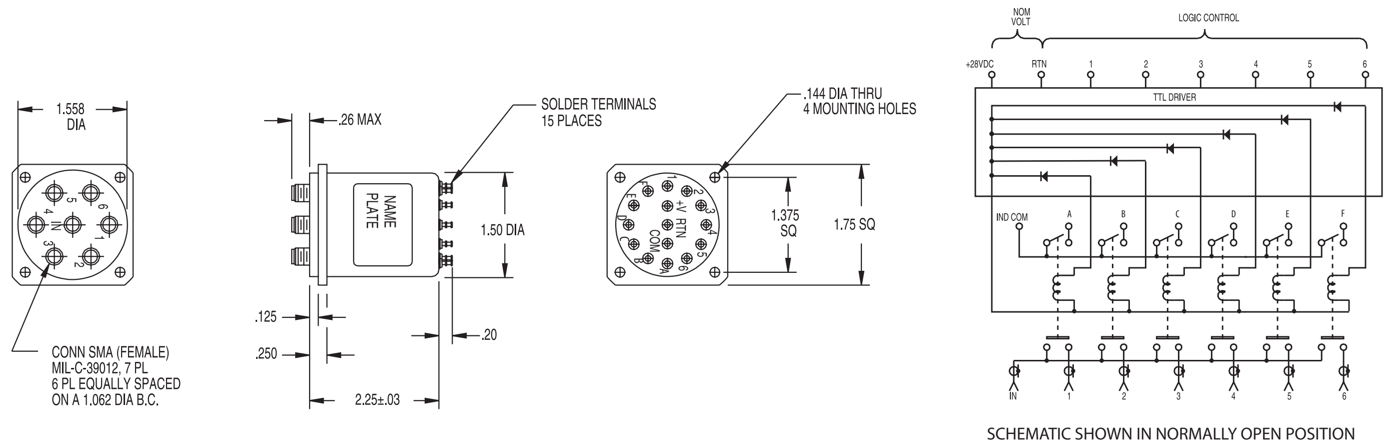
Dimensions in inches, unless otherwise specified.



SEM066

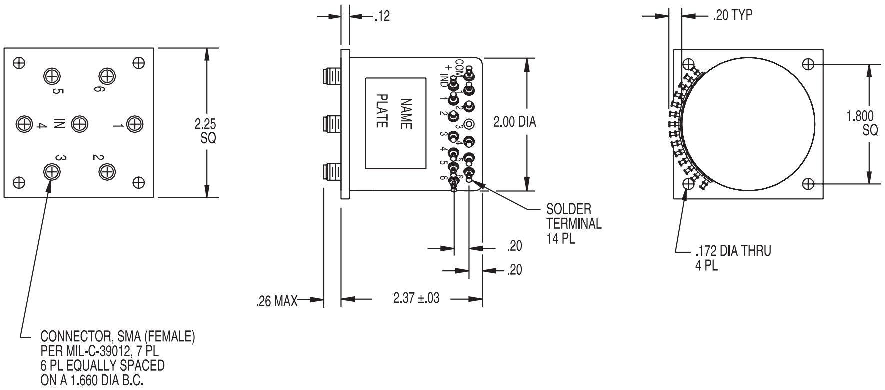


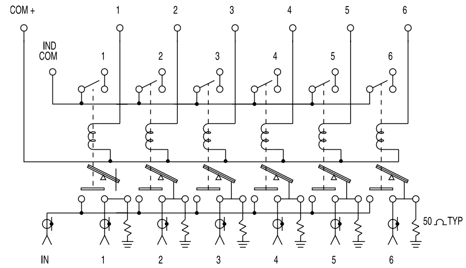
SEM163



SEM163D

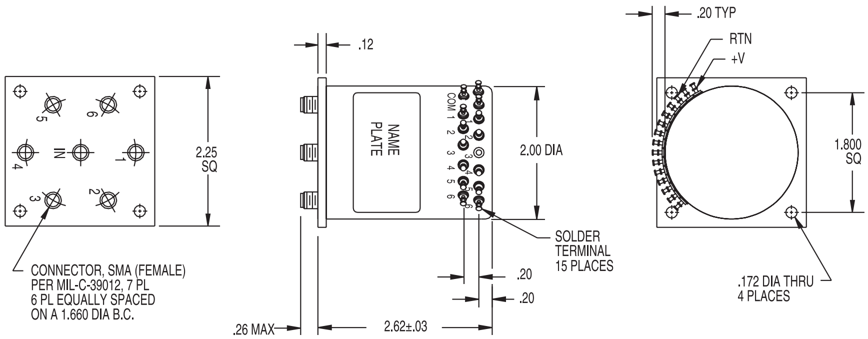
Stocked Electro-Mechanical Switches

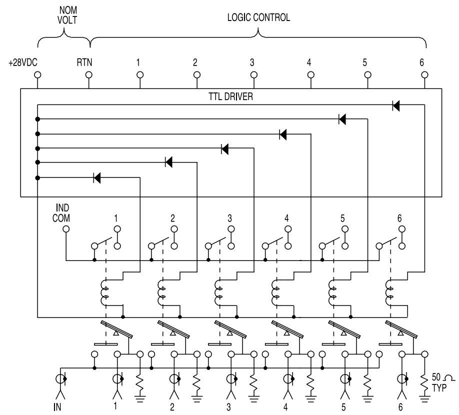




SCHEMATIC SHOWN IN 50 Ω TERMINATED POSITION

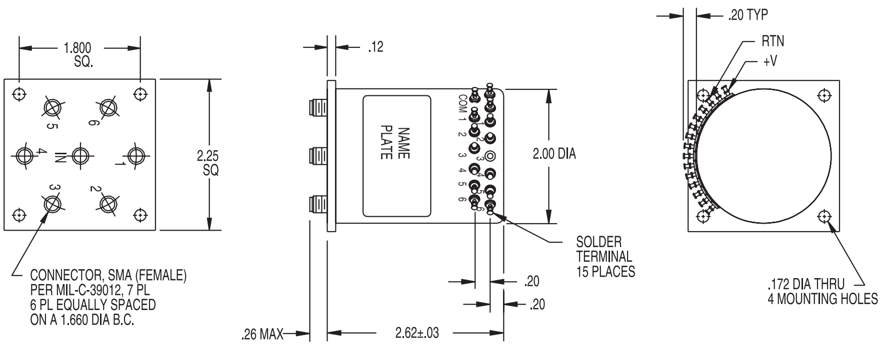
SEM163T

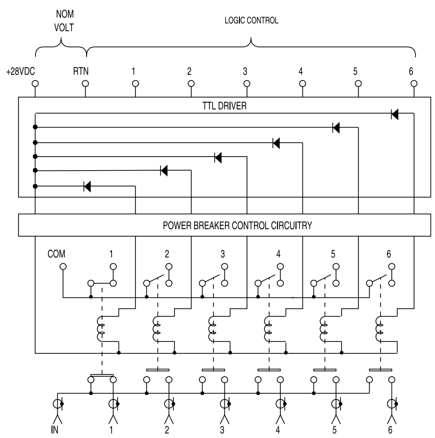




SCHEMATIC SHOWN IN NORMALLY OPEN POSITION

SEM163DT





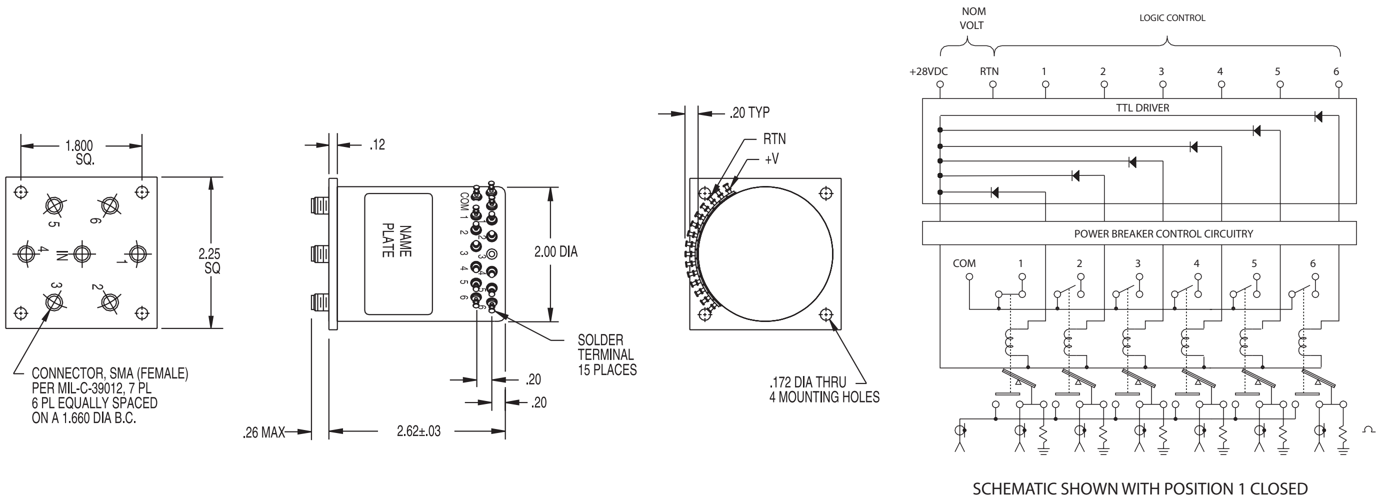
SCHEMATIC SHOWN WITH POSITION 1 CLOSED

SEM163LD

Stocked Electro-Mechanical Switches

Outline Drawings and Schematics

Dimensions in inches, unless otherwise specified.



SEM163LDT-24

DC-18 GHz

XSEM Series Transfer Switches

- Standard Features Include:
  Failsafe and Latching Models
  TTL Logic Control, Suppression Diodes
- Indicator Circuits Provided With All Models

Specifications

2P2T (Transfer), SMA (F), DC to 18 GHz

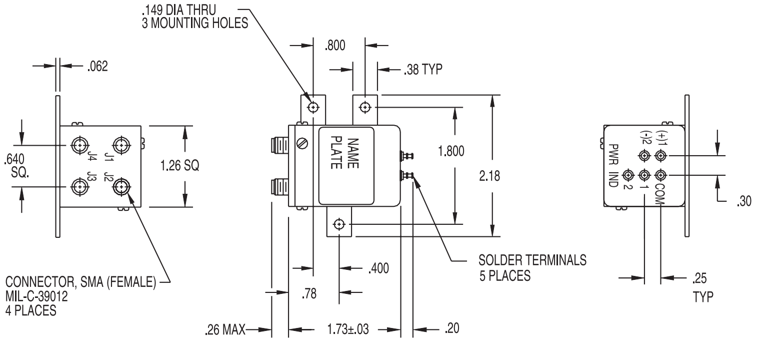
MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)
XSEM323	FAILSAFE / INDICATOR CKT	280	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
XSEM323D	FAILSAFE / TTL* / SUPPRESSION DIODE / INDICATOR CKT	280	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
XSEM323L	PULSE LATCHING / INDICATOR CKT	320	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60
XSEM323LD **XSEM323LD-24**	PULSE LATCHING / TTL*	320 375 @ 24V	DC-3 3-8 8-12.4 12.4-18	0.2 0.3 0.4 0.5	1.2 1.3 1.4 1.5	80 70 60 60

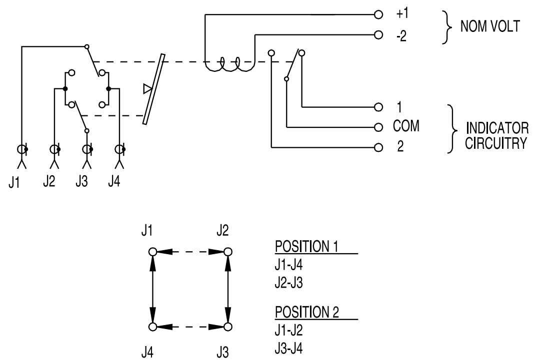
* APPLIES TO ALL SWITCHES WITH TTL:
1. Selected position of the switch is controlled by TTL Logic
2. Switch requires only nominal +28 Vdc for coils (additional 5 Vdc is not required)
3. TTL LOGIC LEVEL: Low 0 to .8 Vdc High 2.5 to 5.0 Vdc
4. TTL LOGIC INPUT CURRENT: Low 0 mA High 1.6 mA max @ 3.85 Vdc

Stocked Electro-Mechanical Switches

Outline Drawings and Schematics

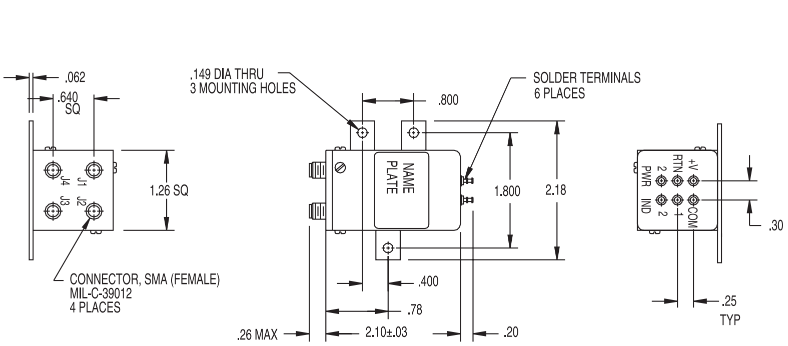
Dimensions in inches, unless otherwise specified.

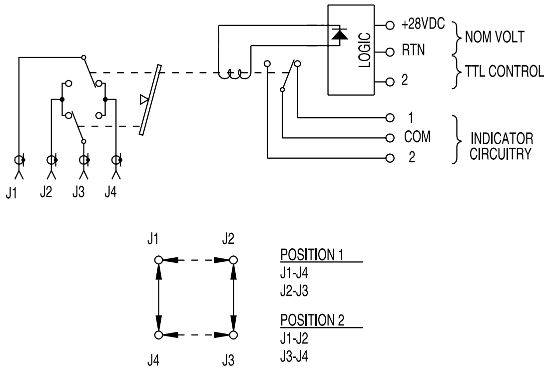




SCHEMATIC SHOWN IN FAILSAFE POSITION

XSEM323

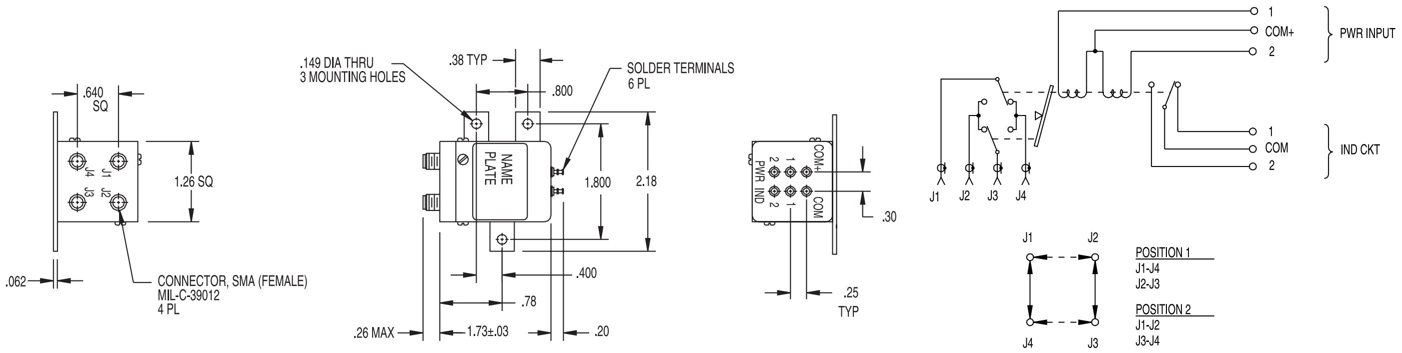




SCHEMATIC SHOWN IN FAILSAFE POSITION

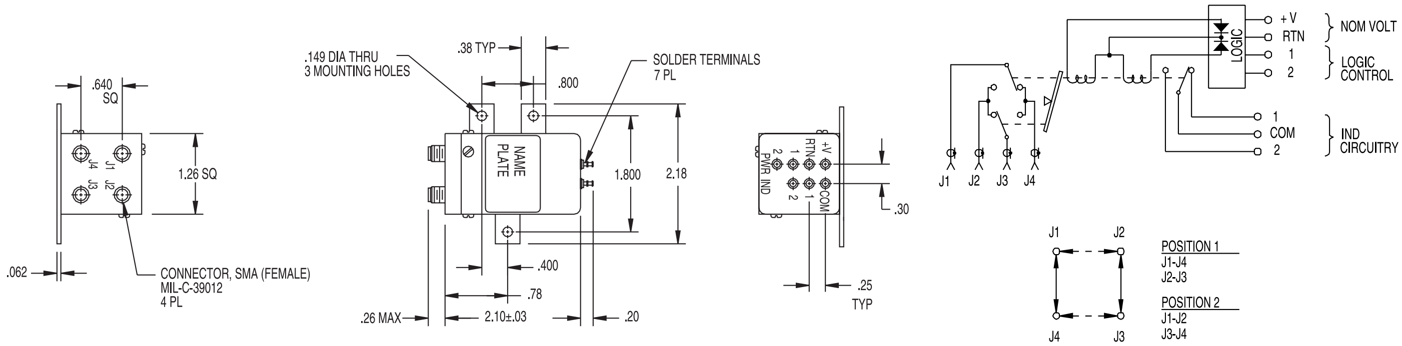
XSEM323D

Stocked Electro-Mechanical Switches



SCHEMATIC SHOWN WITH POSITION 1 CLOSED

XSEM323L



SCHEMATIC SHOWN WITH POSITION 1 CLOSED

XSEM323LD and XSEM323LD-24

Stocked Electro-Mechanical Switches

DC-3 GHz

Commercial Use RF Mechanical Switches

- High Performance
- Optimized for Cellular and PCS Requirements
- Used in Cell Site Systems, Production ATE and Field Test Equipment
- SP2T, Multithrow and Transfer Models Available from Stock

Specifications

SP2T, SMA (F) and Type N (F), DC to 3 GHz

MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	TEMPERATURE RANGE (C)
MS-SMA-020	SMA (F) / FAILSAFE / 2 MILLION OPERATIONS	160	DC-3	0.2	1.2	80	-10° to +60°
MS-SMA-020-12	SMA (F) / FAILSAFE / 2 MILLION OPERATIONS	275	DC-3	0.2	1.2	80	-10° to +60°
MS-SMA-020L	SMA (F) / LATCHING / 2 MILLION OPERATIONS	200	DC-3	0.2	1.2	80	-10° to +60°
MS-N-023	TYPE N (F) / FAILSAFE / 1 MILLION OPERATIONS	180	DC-3	0.2	1.2	80	-10° to +60°

DP2T (Transfer), SMA (F), DC to 3 GHz

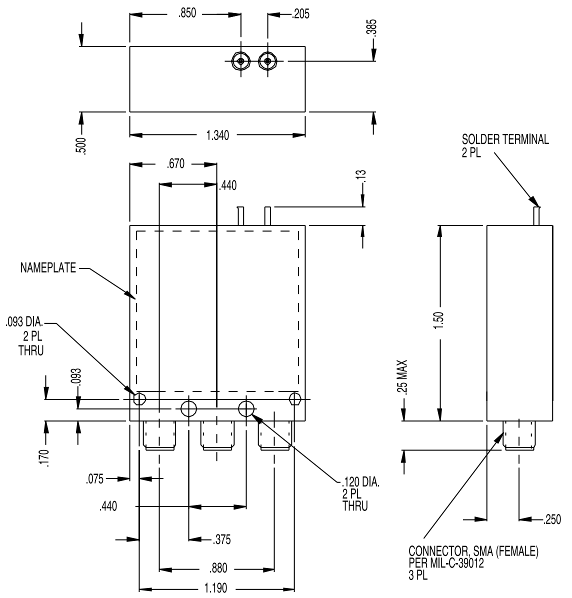
MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	TEMPERATURE RANGE (C)
MS-SMA-223	FAILSAFE / 1 MILLION OPERATIONS	280	DC-3	0.2	1.2	80	-10° to +60°
MS-SMA-223L	LATCHING / 1 MILLION OPERATIONS	375	DC-3	0.2	1.2	80	-10° to +60°

SP3T and SP6T, SMA (F), DC to 3 GHz

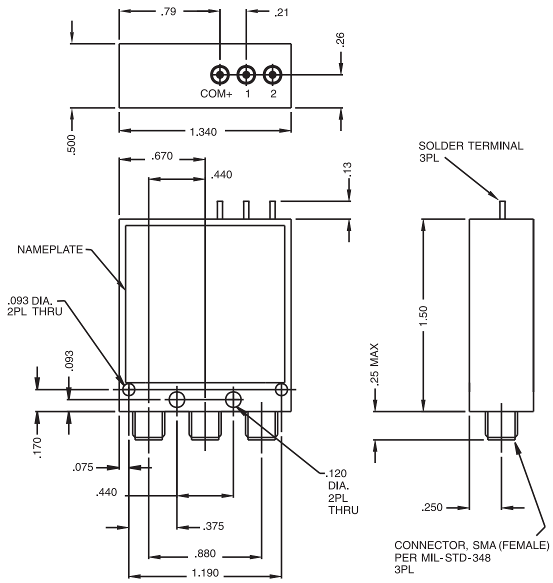
MODEL	FEATURES	ACTUATING CURRENT (mA @28Vdc & 25°C)	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	TEMPERATURE RANGE (C)
MS-SMA-033	FAILSAFE / 1 MILLION OPERATIONS	140	DC-3	0.2	1.2	80	-10° to +60°
MS-SMA-063	FAILSAFE / 1 MILLION OPERATIONS	140	DC-3	0.2	1.2	80	-10° to +60°

Outline Drawings

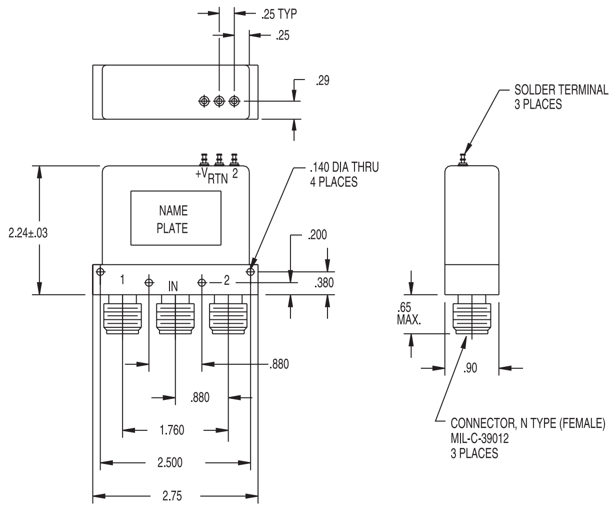
Dimensions in inches, unless otherwise specified.



MS-SMA-020 and MS-SMA-020-12



MS-SMA-020L

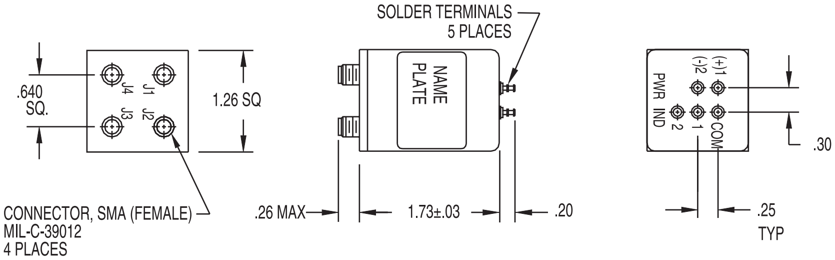


MS-N-023

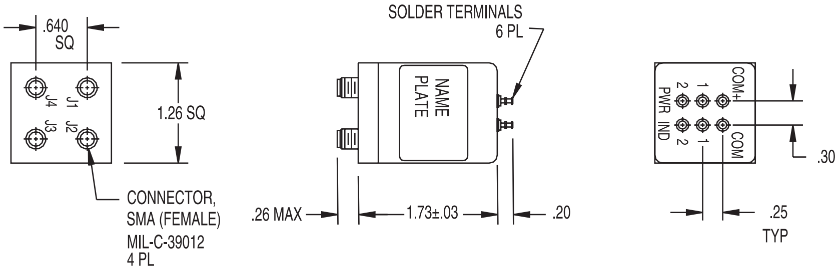
Stocked Electro-Mechanical Switches

Outline Drawings

Dimensions in inches, unless otherwise specified.

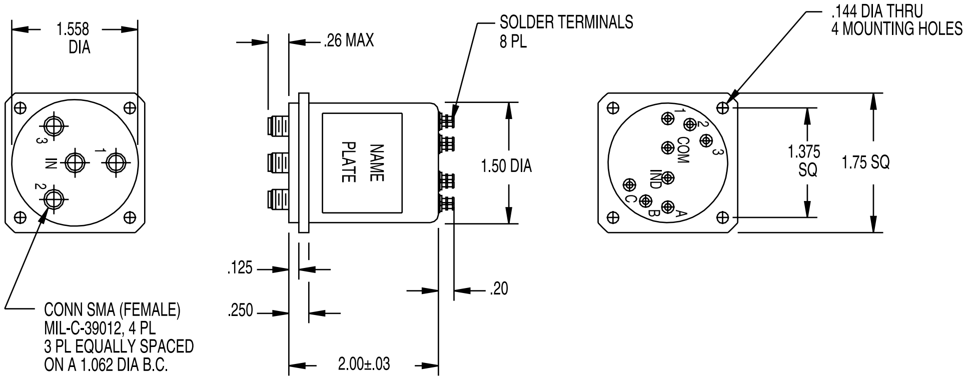


MS-SMA-223

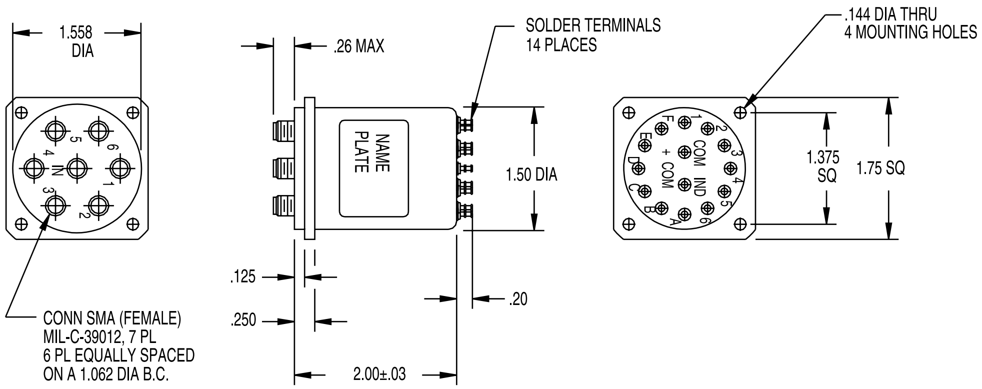


MS-SMA-223L

Stocked Electro-Mechanical Switches



MS-SMA-033



MS-SMA-063

Standard Custom Electro-Mechanical Switches

Custom Part Number and SEM (Stocked) Cross Reference

CUSTOM PART NUMBER	SEM NUMBER	TYPE	FREQUENCY RANGE (GHz)	CONNECTOR	ACTUATION	TERMINATION 50 ohms	INDICATOR CIRCUITRY	SUPPRESSION DIODES	TTL LOGIC	SELF DE-ENERGIZING CIRCUIT	PAGE
025-A0-A1D-4C0	020	SP2T	DC TO 18	SMA	FAILSAFE, 28V						206
025-A0-A1B-4C0	020-12	SP2T	DC TO 18	SMA	FAILSAFE, 12V						206
025-A0-A1C-4C0	020-24	SP2T	DC TO 18	SMA	FAILSAFE, 24V						206
025-B0-A1D-4A0	020L	SP2T	DC TO 18	SMA	LATCHING, 28V						206
025-A2-A1D-4C0	123	SP2T	DC TO 18	SMA	FAILSAFE, 28V		✔				206
025-A234-A1D-4C0	123D	SP2T	DC TO 18	SMA	FAILSAFE, 28V		✔	✔	✔		206
026-A12-A1D-4C0	123T	SP2T	DC TO 18	SMA	FAILSAFE, 28V	✔	✔				206
025-B23-A1D-4A0	123L	SP2T	DC TO 18	SMA	LATCHING, 28V		✔	✔			206
026-B123-A1D-4A0	123LT	SP2T	DC TO 18	SMA	LATCHING, 28V	✔	✔	✔			206
025-B234-A1D-4C0	123LD	SP2T	DC TO 18	SMA	LATCHING, 28V		✔	✔	✔		207
026-A1234-A1D-4C0	123DT	SP2T	DC TO 18	SMA	FAILSAFE, 28V	✔	✔	✔	✔		207
026-B12347-A1D-4C0	123LDT	SP2T	DC TO 18	SMA	LATCHING, 28V	✔	✔	✔	✔	✔	207
026-B12347-A1C-4C0	123LDT-24	SP2T	DC TO 18	SMA	LATCHING, 24V	✔	✔	✔	✔	✔	207
023-A2-D1D-3A0	123N	SP2T	DC TO 12.4	N	FAILSAFE, 28V		✔				207
023-A234-D1D-3C0	123DN	SP2T	DC TO 12.4	N	FAILSAFE, 28V		✔	✔	✔		207
025-A2-A1D-6C0	124	SP2T	DC TO 26.5	SMA	FAILSAFE, 28V		✔				207
030-D2-A1D-4A2	133	SP3T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔				213
030-D234-A1D-4C2	133D	SP3T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔	✔	✔		213
032-D1234-A1D-4C2	133DT	SP3T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔	✔	✔		213
032-B12-A1D-4A2	133LT	SP3T	DC TO 18	SMA	LATCHING, 28V	✔	✔				213
032-D12-A1D-4A2	133T	SP3T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔				213
040-D2-A1D-4A2	143	SP4T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔				216
040-D234-A1D-4C2	143D	SP4T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔	✔	✔		216
042-D1234-A1D-4C2	143DT	SP4T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔	✔	✔		216
042-D1234-A1C-4C2	143DT-24	SP4T	DC TO 18	SMA	NORMALLY OPEN, 24V	✔	✔	✔	✔		216
042-D12-A1D-4A2	143T	SP4T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔				216
050-D2-A1D-4A2	153	SP5T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔				218
066-D0-A2D-4C2	066	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V						219
060-D2-A1D-4A2	163	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔				219
060-D234-A1D-4C2	163D	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V		✔	✔	✔		219
062-D1234-A1D-4C2	163DT	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔	✔	✔		219
062-B2347-A1D-4C2	163LD	SP6T	DC TO 18	SMA	LATCHING, 28V		✔	✔	✔	✔	219
062-B12347-A1C-4C2	163LDT-24	SP6T	DC TO 18	SMA	LATCHING, 24V	✔	✔	✔	✔	✔	219
062-D12-A1D-4A2	163T	SP6T	DC TO 18	SMA	NORMALLY OPEN, 28V	✔	✔				219
130-A2-A1D-4A1	XSEM323	TRANSFER	DC TO 18	SMA	FAILSAFE, 28V		✔				223
130-A234-A1D-4C1	XSEM323D	TRANSFER	DC TO 18	SMA	FAILSAFE, 28V		✔	✔	✔		223
130-B23-A1D-4A1	XSEM323L	TRANSFER	DC TO 18	SMA	LATCHING, 28V		✔	✔			223
130-B234-A1D-4C1	XSEM323LD	TRANSFER	DC TO 18	SMA	LATCHING, 28V		✔	✔	✔		223
130-B234-A1C-4C1	XSEM323LD-24	TRANSFER	DC TO 18	SMA	LATCHING, 24V		✔	✔	✔		223

Custom may now be Standard

We believe your first choice should be Narda-MITEQ's standard SEM switch series – even if you have always ordered custom-part switches. Narda-MITEQ has more standard switches than any company in the industry. If you haven't reviewed this expanded line of stocked SEM switches, please refer to the cross reference at the left.

But, if standard still won't do...

It's easy to determine the number of a custom pick Narda-MITEQ switch that will correctly satisfy your intended application. Simply use the Part Number Chart on the next page. Referring to this chart, sequentially select the desired switch characteristics and options from Group 1 through Group 9. (The terms used here are defined in the Glossary on page 233.)

Within each group, select the number or letter representing the desired configuration or feature and record it in the manner shown by the "typical part number" on the chart. (The open boxes below are provided to assist you in using the part numbering process.)

Note that the last digit in part number Group 1 is indicative of envelope size and requires reference to the individual specifications and drawings in this catalog.

Select only one character from each part number group except for the Group 3 options. In Group 3, you many select as many options as applicable.

In Group 1, four items identified as "series number modifiers" call for further explanation:

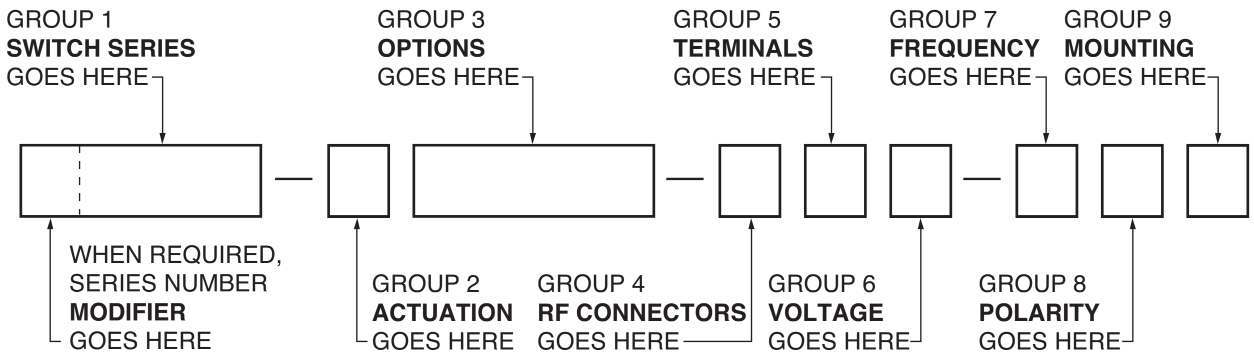
6XXX - If a matrix type switch is required, precede the selected series number with modifier number "6" (for example, specify 6080 for an eight position matrix switch).

8XXX - If you are able to configure a required switch from the features and options listed here, but will be imposing your own design or test specification, precede the selected series number with modifier number "8" to indicate to us that our standard switch may require special treatment.

9XXX - When a deviation from a standard design is required (for example, painted housing instead of black anodized), precede the selected series number with the number "9." Then contact your Narda-MITEQ Regional Sales Manager (see Sales Representatives listing on page 354).

To confirm that desired options are available for the selected switch series, please refer to the individual switch specifications in this catalog. Any other question that may arise in determining the proper part number should be addressed to your Narda-MITEQ Regional Sales Manager.

Part Number Grouping *(see next page for part number charts)*



Standard Custom Electro-Mechanical Switches

Part Number Charts

GROUP 1
SWITCH SERIES

022 - SP2T	063 - SP6T
023 - SP2T	073 - SP7T
025 - SP2T	075 - SP7T
026 - SP2T	083 - SP8T
030 - SP3T	085 - SP8T
032 - SP3T	091 - SP9T
033 - SP3T	093 - SP9T
036 - SP3T	100 - SP10T
040 - SP4T	101 - SP10T
042 - SP4T	103 - SP10T
043 - SP4T	110 - SP11T
046 - SP4T	120 - SP12T
050 - SP5T	130 - Transfer
052 - ST5T	132 - Transfer
053 - SP5T	136 - Transfer
056 - SP5T	150 - 2-SP2T
060 - SP6T	156 - 2-SP2T
062 - SP6T	

MODIFIERS:
6XXX - Matrix Switches
8XXX - Customer Specification
9XXX - Modified Standard

GROUP 3
OPTIONS

0 - None
1 - 50 Ohm Terminations
2 - Indicator Circuitry
3 - Suppression Diodes
4 - TTL Logic High*
5 - Other (Specify)‡‡
7 - Self De-energizing Circuitry*
V - MOSFET Driver*
Y - BCD TTL Decoder*

GROUP 5
TERMINALS

1 - Solder (Standard)
2 - Power Connector/ Fast Disconnect (Standard MIL)
3 - Power Connector/ Fast Disconnect (Sub Min. "D")
4 - Solder (Loop)
5 - Other (Specify)‡‡
S - Side Mounted Terminals

GROUP 7
FREQUENCY

0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
4 DC - 18 GHz
5 - DC - 18.5 GHz
6 - DC - 26.5 GHz
8 - DC - 6 GHz
7 - Other (Specify)‡‡

GROUP 9
MOUNTING

0 - Standard Mounting Holes
1 - Bracket
2 - Flange
3 - Other (Specify)‡‡

TYPICAL PART NUMBER‡:

022	–	B	1234	–	A	1	C	–	6	C	0

GROUP 2
ACTUATION

A - Failsafe
B - Latching**
C - Latching Reset
D - Normally Open
DA - Normally Open Failsafe to Position 1

GROUP 4
RF CONNECTORS

A - SMA
E - TNC
D - Type N
G - Other (Specify)‡‡

GROUP 6
VOLTAGE

B - 12 Vdc
C - 24 Vdc
D - 28 Vdc
E - 48 Vdc
G - Other (Specify)‡‡
H - 15 Vdc
I - 18 Vdc

GROUP 8
POLARITY

A - Common Plus
B - Common Minus
C - Not Relevant to Application for Switches with Logic

* If this option is selected, suppression diodes (option 3) must also be selected

** Requires pulse control of duration 30 to 100 ms unless self de-energizing circuitry option is chosen; Self de-energizing circuitry is recommended for multi-throw switches

‡ Sample Part Number identifies: SP2T switch, latching, 50 ohm termination, indicator circuitry, suppression diodes, TTL logic, SMA connectors, solder terminals, 24 Vdc, DC-26.5 GHz, polarity not relevant

‡‡ Consult the factory if "Other" is specified in any field

Glossary

The following glossary defines the various options and features available on Narda-MITEQ switches. All Switches are bi-directional. Inputs and Outputs are interchangeable.

SP2T Switch - A single pole, double throw switch has one input port and two selectable output ports.

Multiposition Switch - A multiposition switch has one input port and more than two selectable output ports. Standard Narda-MITEQ switches offer up to 12 outputs operating from a single input. Unlike some switch designs, Narda-MITEQ multiposition models can be switched directly to any one of the available output positions without sequencing through any intervening positions.

Transfer Switch (DP2T) - A transfer switch has two independent paths that operate simultaneously in either of two selected positions.

Failsafe - A mode of operation in which the switch moves to the closed position when the actuating voltage is applied and always returns to a predetermined position when the voltage is removed.

Hot Switching - A mode of operation where a high power RF signal is continually applied to the RF contacts while the switch is changing positions. It must be noted that switch life is a factor in this type of operation (1 Watt max.).

Latching - Also called pulsed latching, a mode of operation in which the switch remains in a preselected position whenever the actuating voltage is removed or interrupted and holds that preselected position until a voltage is applied to another position. *Latching switches specified without self de-energizing circuitry require pulse control, with pulse duration of 30 to 100 ms.*

Latching Reset - A mode of operation in which the switch remains in the pre-selected position whenever the actuating voltage is removed or interrupted. However, switching to a new position cannot occur until a voltage has been applied to the reset terminal to open all closed switching positions. This reset mode then permits random selection of any desired switch position and guarantees clean break before make switching.

Normally Open - A mode of operation in which all output ports of the switch are disconnected from the input port until a voltage is applied to maintain a selected position. The switch returns to its open position with the removal of voltage.

Normally Open Failsafe to Position 1 - In this mode of operation, (available only on multiposition switches), Position 1 is always closed until another switch position has been selected.

50 Ohm Termination - With this option, each unused or open output RF port is internally terminated in a 50 ohm resistive load. 1 W CW per position max.; 5 W CW max. input total per switch.

Indicator Circuitry - With the indicator circuitry option, a set of internally mounted contacts allow external monitoring of switch RF status.

Suppression Diodes - With this option, fast-recovery silicon recitifiers (diodes) are connected in parallel with the coils of the switch to suppress any transient voltage generated by the coils.

TTL - Selected position of the switch is controlled by a TTL Logic High. The switch requires only nominal +28 Vdc (additional 5 Vdc is not required).

TTL Logic Voltage Level:
Low 0 to 0.8 Vdc
High 2.5 to 5.0 Vdc
TTL Logic Input Current:
Low 0 mA
High 1.6 mA max. @ 3.85 Vdc

TTL Logic, High Input - Completely contained within the switch housing, this Transistor-Transistor-Logic driver circuitry enables the status of the switch to be controlled by the high level of the TTL logic input.

Self De-energizing Circuitry - With this option, a set of internally mounted contacts or electronically generated pulses disconnects the driver voltage as soon as RF contact has been made. This option is only available with latching type switches. Suppression diodes must be specified with this option.

Power Handling Capability (Watts CW) - Several factors determine the power handling capability of a given switch design. A general indication of power capability versus frequency is shown on the next page.

Standard Custom Electro-Mechanical Switches

BCD TTL Decoder - Completely contained within the switch housing, BCD logic circuitry establishes compatibility of the switch with binary logic inputs.

MOSFET Driver - Completely contained within the switch housing, the MOSFET driver establishes compatibility of the switch with external CMOS (15 Vdc) control logic. This type of driver can be controlled by any DC voltage from 3 Vdc up to 15 Vdc. A MOSFET circuit is switched with voltage and requires virtually no current. Also, it does not require a separate +5 Vdc power supply.

Standard Solder Terminal - The standard solder terminal offered with switches is a gold plated, double turret terminal, as shown in Figure 1.

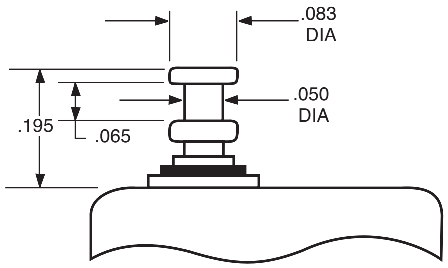


Figure 1. Standard Solder Terminal

Solder (Loop) Terminal - As an option, Narda-MITEQ offers a glass to metal loop type solder terminal, as shown in Figure 2.

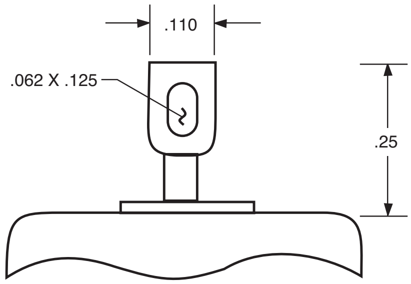


Figure 2. Optional Loop Type Solder Terminal

Power Connector / Fast Disconnect - The standard power connectors offered with Narda-MITEQ switches switches are specified on the individual data sheets in this catalog Narda-MITEQ switches can also be supplied with other power connectors specified by the customer.

Polarity - Either common plus polarity or common minus polarity must always be specified when ordering the following switches:

Latching

Latching Reset

Latching with Self De-energizing Circuitry

Latching Reset with Self De-energizing Circuitry

Make Before Break

Normally Open with Suppression Diodes

Failsafe with Suppression Diodes

Normally Open Failsafe to Position 1 with Suppression Diodes

Indicators

Polarity is not relevant to application for switches listed as follows:

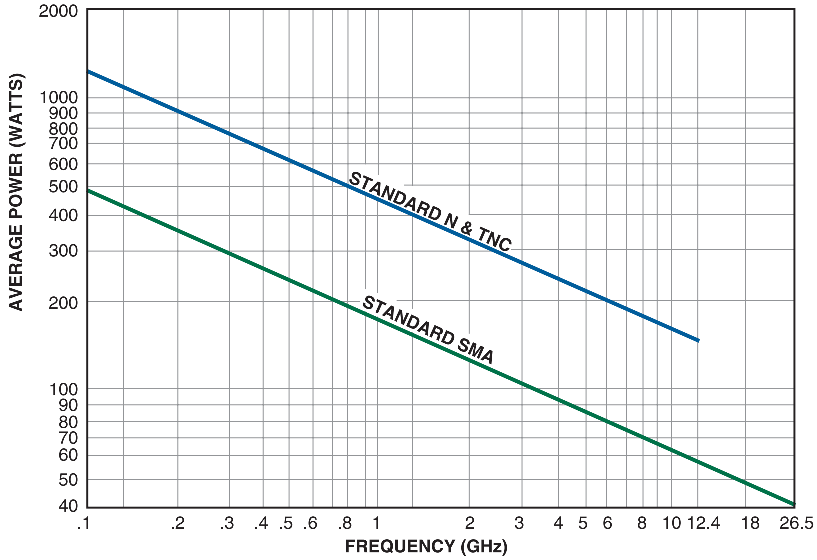
Normally Open – No Options

Failsafe – No Options,
except for XSEM323 or 130 Series

Switches with TTL logic driver,
BCD decoder or MOSFET driver

Actuator Voltage - Standard Narda-MITEQ DC actuating voltages are 12, 15, 18, 24, 28 and 48. When other voltages are required, contact your Narda-MITEQ Regional Sales Manager for instructions (page 354).

Power Handling Capability



Power Handling Capability of Narda-MITEQ Switches vs. Frequency for Common RF Connectors
(for 25°C ambient temperature, matched 50ohm systems, sea level and cold switching)

For VSWR above 1.1, Derate Power Handling Capability as shown:

VSWR	Derating Factor
1.5	.94
2.0	.88
2.5	.83
3.0	.78
3.5	.73
4.0	.70

Standard Custom Electro-Mechanical Switches

Quick Reference Guide

FREQUENCY RANGE (GHz)	SERIES	TYPE	CONNECTOR	PAGE
SP2T SWITCHES				237
DC-26.5	**022**	SP2T	SMA	238
DC-12.4	**023**	SP2T	TYPE N, TNC	240
DC-26.5	**025**	SP2T	SMA	242
DC-26.5	**026**	SP2T	SMA	244
DC-26.5	**150**	2-SP2T	SMA	246
DC.26.5	**156**	2-SP2T	SMA	248
MULTIPOSITION SWITCHES				250
DC-26.5	**030-060**	SP3T-SP6T	SMA	252
DC-18	**032-062**	SP3T-SP6T	SMA	254
DC-12.4	**033-063**	SP3T-SP6T	TYPE N, TNC	257
DC-26.5	**036-066**	SP3T-SP6T	SMA	260
DC-10	**073-083**	SP7T-SP8T	TYPE N, TNC	262
DC-18	**075-085**	SP7T-SP8T	SMA	265
DC-18	**091-101**	SP9T-SP10T	SMA	268
DC-8	**093-103**	SP9T-SP10T	TYPE N, TNC	274
DC-12.4	**110-120**	SP11T-SP12T	SMA	277
TRANSFER SWITCHES				280
DC-26.5	**130**	DP2T	SMA	281
DC-12.4	**132**	DP2T	TYPE N, TNC	284
DC-26.5	**136**	DP2T	SMA	287

Selecting a SP2T Switch

The following pages describe a wide range of SP2T and 2-SP2T switches, presenting specifications, outline drawings and typical schematics for each model in this group. Important distinctions among these models are noted here to help the user select the correct switch for a specific application:

Series 022 & 026

Two different SP2T switches with terminations. Frequency range up to 26.5 GHz with SMA connectors. Series 022 offers two externally mounted terminations. Series 026 is available with two internal terminations (refer to outline drawings for details).

Series 023

A SP2T switch available with TNC, and Type N connectors. Frequency range up to 12.4 GHz.

Series 023 with termination

Similar to standard 023 switch, but also offers internal 50 ohm terminations.

Series 025

High performance, high reliability, low cost SP2T switch. Frequency range up to 26.5 GHz.

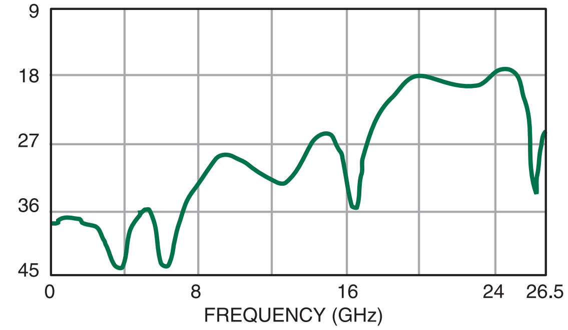
Series 150

Two SP2T switches in a single package. Frequency range up to 26.5 GHz with SMA connectors.

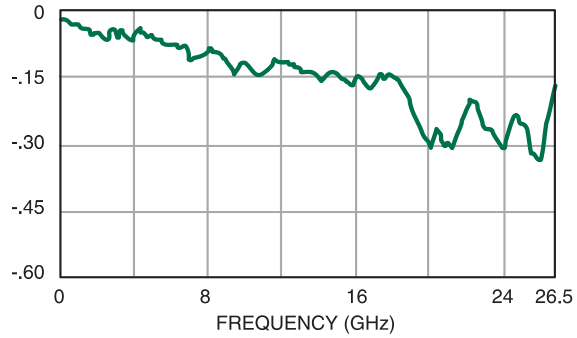
156 Miniature

Two independent SP2T switches in a single package. Frequency range up to 26.5 GHz with SMA connectors.

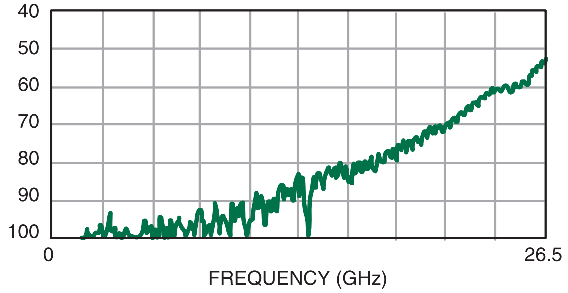
TYPICAL RETURN LOSS (dB)
025 SERIES SMA CONNECTORS



TYPICAL INSERTION LOSS (dB)
025 SERIES SMA CONNECTORS



TYPICAL ISOLATION (dB)
025 SERIES SMA CONNECTORS



Standard Custom Electro-Mechanical Switches

DC-26.5 GHz, SMA

SP2T Series 022
(External Termination)

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-24	24-26.5
VSWR (max.)	1.2	1.3	1.4	1.5	1.6	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.6	0.7
Isolation (dB min.)	80	70	60	60	50	45

Additional Specifications

RF Impedance.................. 50 ohms nominal
Actuating Voltage*.................. 28 Vdc
Actuating Current*.................. 280 mA (max.)
Switching Time.................. 15 ms (max.)
Switching Sequence.................. Break Before Make
Operating Mode*.................. Failsafe
Operating Ambient Temperature.................. -35°C to +70°C
Operating Life.................. 1 Million Cycles per Position

* Specifications for 28 Vdc. Failsafe configuration

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.
Series 026 is offered with internal terminations (see page 244).

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
A - FAILSAFE
B - LATCHING
D - NORM OPEN

GROUP 3 OPTIONS
1 - 50 OHM TERMINATION
2 - INDICATOR CIRCUITRY
3 - SUPPRESSION DIODES
4 - TTL LOGIC HIGH
7 - SELF DE-ENERGIZING CIRCUITRY
9 - OTHER (SPECIFY)
V - MOSFET DRIVER

GROUP 4 RF CONNECTORS
A - SMA
G - OTHER (SPECIFY)

GROUP 5 TERMINALS
1 - SOLDER (STANDARD)
2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
4 - SOLDER (LOOP)
5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
E - 48 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

GROUP 7 FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
4 - DC - 18 GHz
5 - DC - 18.5 GHz
6 - DC - 26.5 GHz
7 - OTHER (SPECIFY)

GROUP 8 POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

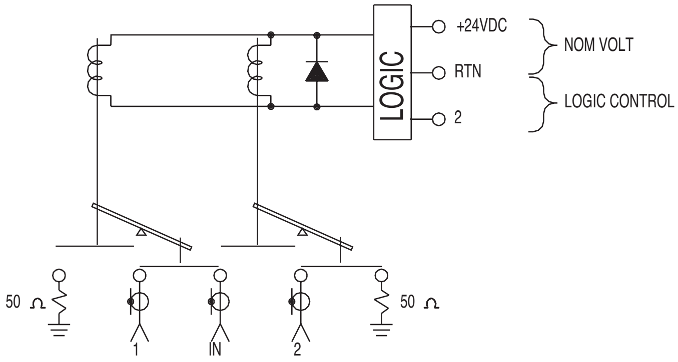
GROUP 9 MOUNTING
0 - STANDARD MOUNTING HOLES
3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

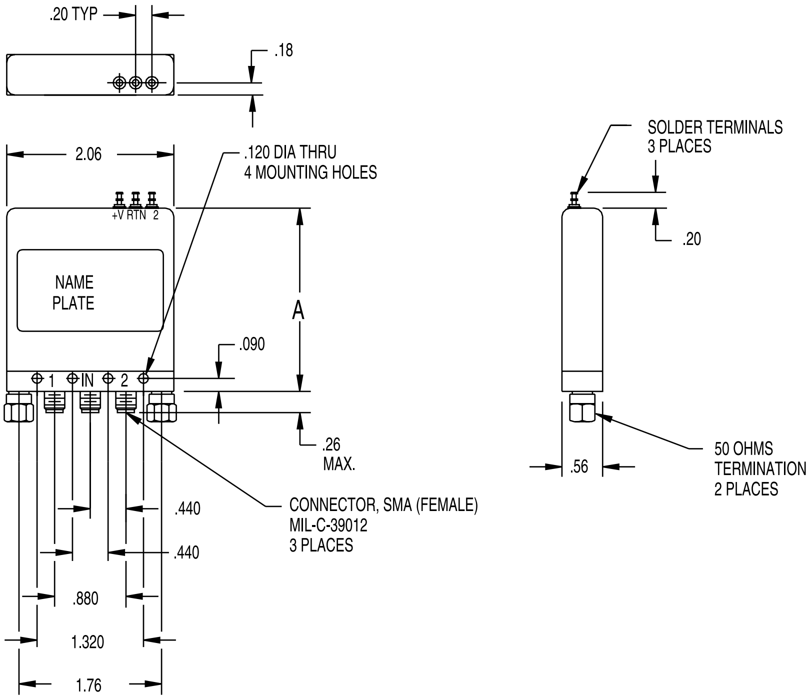
DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
1.67	A, B, D	1,3
2.01	A, D	1,2,3
2.01	B	1,2,3,7
2.26	A, D	1,2,3,4 or 5,V
2.26	B	1,2,3,4 or 5,7,V
2.26**	A, D	1,2,3,4 or 5,V
2.26**	B	1,2,3,4 or 5,7,V

** Dimension for switches with Standard Narda-MITEQ Power Connector M24308/3-1 mating with M24308/2-1

Typical Schematic and Outline Drawing



SCHEMATIC SHOWN IN FAILSAFE POSITION



Series 022 Switch with External Terminations

Dimensions in inches, unless otherwise specified.

Standard Custom Electro-Mechanical Switches

DC-12.4 GHz, Type N and TNC

SP2T Series 023

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4
VSWR (max.)	1.2	1.35	1.5
Insertion Loss (dB max.)	0.2	0.35	0.5
Isolation (dB min.)	80	70	60

Additional Specifications

RF Impedance........ 50 ohms nominal
Actuating Voltage*........ 28 Vdc
Actuating Current*........ Failsafe: 180 mA (max.)
.... Latching: 200 mA (max.)
Switching Time........ 15 ms (max.)
Switching Sequence........ Break Before Make
Operating Mode*........ Failsafe
Operating Ambient Temperature........ -35°C to +70°C
Operating Life........ 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Options Available *(refer to pages 231-232)*

GROUP 2
ACTUATION
A - FAILSAFE
B - LATCHING
D - NORM OPEN

GROUP 3
OPTIONS
0 - NONE
1 - 50 OHM TE MINATION
2 - INDICATOR CIRCUITRY
3 - SUPPRESSION DIODES
4 - TTL LOGIC HIGH
7 - SELF DE-ENERGIZING CIRCUITRY
9 - OTHER (SPECIFY)
V - MOSFET DRIVER

GROUP 4
RF CONNECTORS
D - TYPE N
E - TNC
G - OTHER (SPECIFY)

GROUP 5
TERMINALS
1 - SOLDER (STANDARD)
2 - POWER CON-NECTOR, FAST DISCONNECT (STANDARD MIL)
3 - POWER CON-NECTOR, FAST DISCONNECT (SUB MIN. "D")
4 - SOLDER (LOOP)
5 - OTHER (SPECIFY)

GROUP 6
VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
E - 48 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

GROUP 7
FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
7 - OTHER (SPECIFY)

GROUP 8
POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

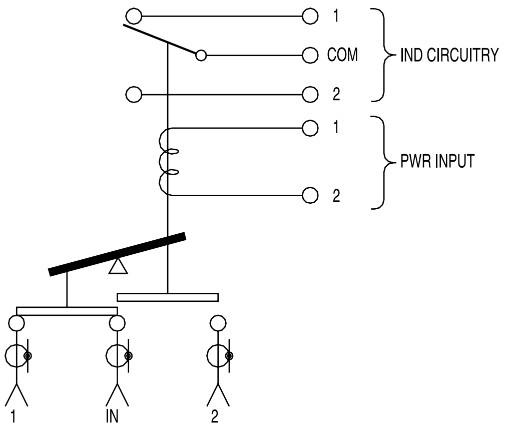
GROUP 9
MOUNTING
0 - STANDARD MOUNTING HOLES
3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.00	A, D	0,3,4 or 5,V
2.00	B	0,3,4 or 5,V
2.24**	B	2,3,4 or 5,7,V
2.24**	A, D	2,3,4 or 5,V

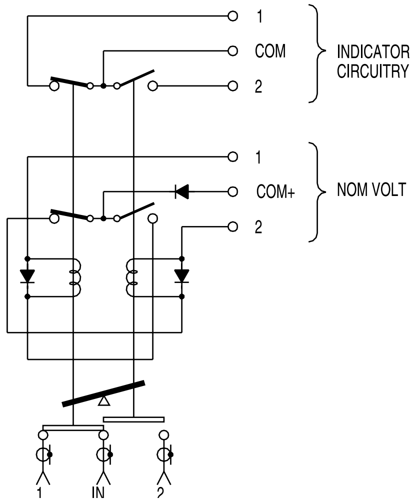
** Dimension for switches with Standard Narda-MITEQ Power Connector MS3113H-10-6P mating with MS3116E-10-6S

Typical Schematics and Outline Drawing



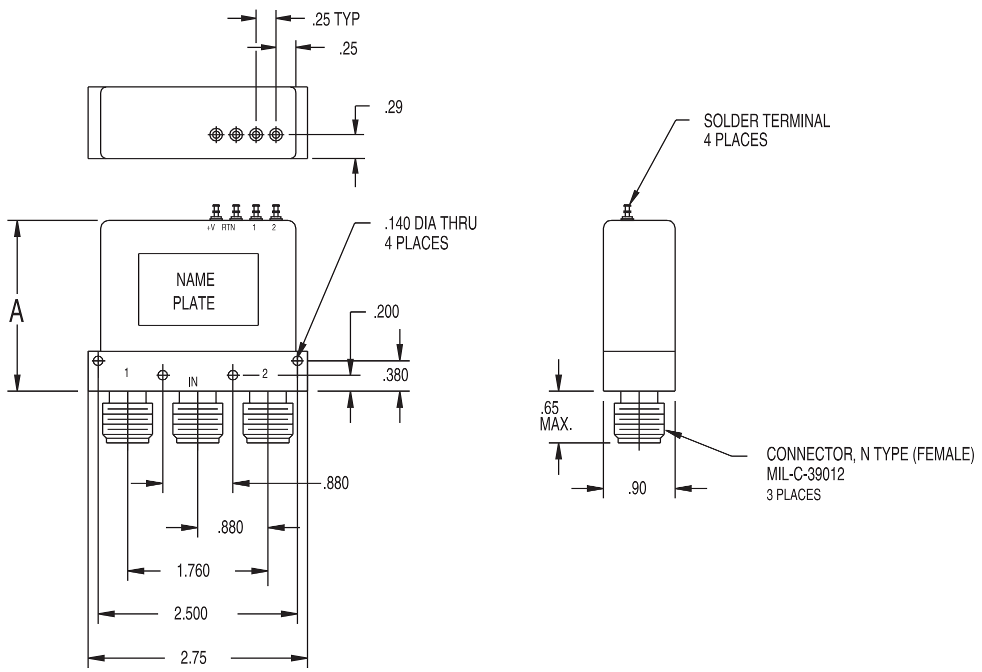
SCHEMATIC SHOWN IN FAILSAFE POSITION

Failsafe SP2T Switch
with indicator circuitry (A2)



SCHEMATIC SHOWN WITH POSITION 1 CLOSED

Latching, Common Plus SP2T Switch
with indicator circuitry, self de-energizing circuitry and suppression diodes (B237)



NOTE: Switches with side-mounted terminals must have the letter "S" added to the terminal designation in Group 5.
EXAMPLE: "1 S" means switch with solder terminals located on the side of the can.

Dimensions in inches, unless otherwise specified.

Standard Custom Electro-Mechanical Switches

DC-26.5 GHz, SMA

SP2T Series 025

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-26.5
VSWR (max.)	1.2	1.3	1.4	1.5	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.7
Isolation (dB min.)	80	70	60	60	50

Additional Specifications

RF Impedance........ 50 ohms nominal
Actuating Voltage*........ 28 Vdc
Actuating Current* ....Failsafe: 160 mA (max.)
........Latching: 200 mA (max.)
Switching Time........ 15 ms (max.)
Switching Sequence........ Break Before Make
Operating Mode* .... Failsafe and Latching
Operating Ambient Temperature........ -35°C to +70°C
Operating Life........ 2 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
- A - FAILSAFE
- B - LATCHING

GROUP 3 OPTIONS
- 0 - NONE
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 7 - SELF DE-ENERGIZING CIRCUITRY
- 9 - OTHER (SPECIFY)

GROUP 4 RF CONNECTORS
- A - SMA
- G - OTHER (SPECIFY)

GROUP 5 TERMINALS
- 1 - SOLDER (STANDARD)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC - 12.4 GHz
- 4 - DC - 18 GHz
- 6 - DC - 26.5 GHz
- 7 - OTHER (SPECIFY)

GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

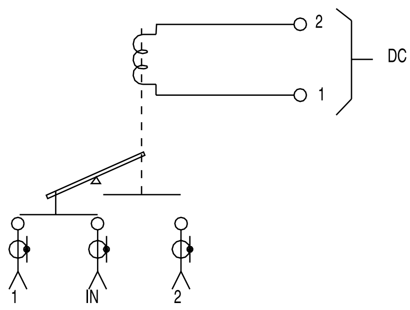
GROUP 9 MOUNTING
- 0 - STANDARD MOUNTING HOLES
- 3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

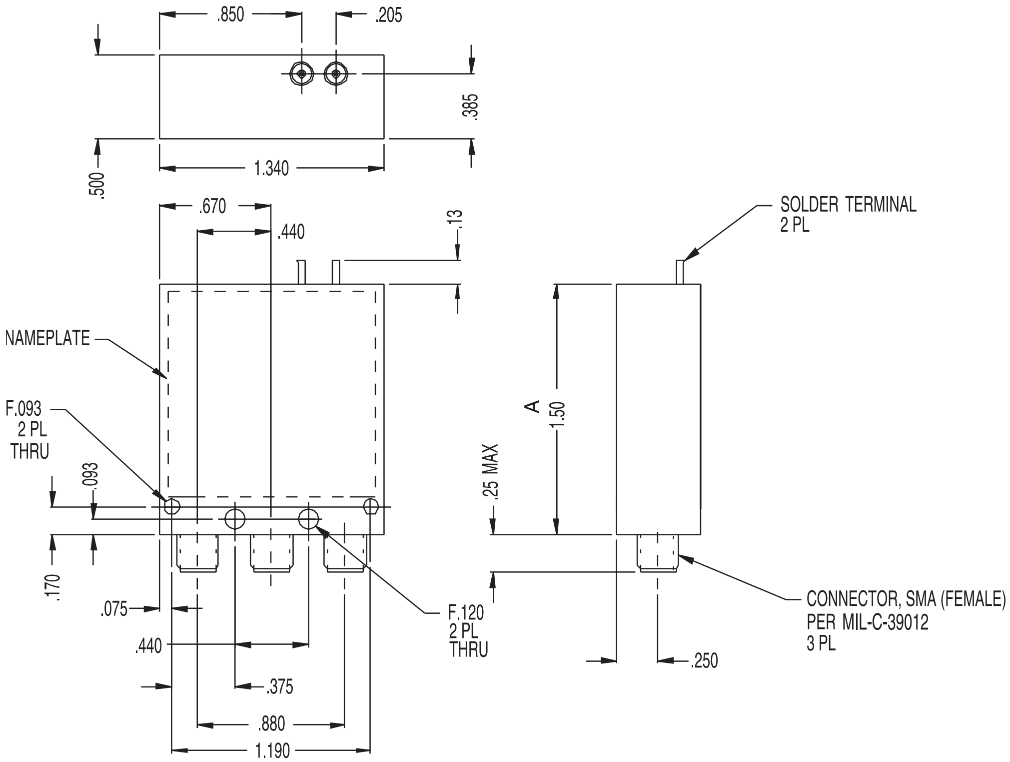
DIM A ±.03	GROUP 5 TERMINAL
1.5	1
2.1**	3

** Dimension for switches with Standard Narda-MITEQ Power Connector M24308/3-1 mating with M24308/1-1

Typical Schematic and Outline Drawing



SCHEMATIC SHOWN IN FAILSAFE POSITION



Dimensions in inches, unless otherwise specified.

Standard Custom Electro-Mechanical Switches

DC-26.5 GHz, SMA

SP2T Series 026

(Internal Termination)

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-24	24-26.5
VSWR (max.)	1.2	1.3	1.4	1.5	1.6	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.6	0.7
Isolation (dB min.)	80	70	60	60	50	45

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage .... 28 Vdc
Actuating Current .... Failsafe: 280 mA (max.)
.... Latching: 200 mA (max.)
Switching Time .... 15 ms (max.)
Switching Sequence .... Break Before Make
Operating Mode .... Failsafe
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Options Available *(refer to pages 231-232)*

GROUP 2
ACTUATION
- A - FAILSAFE
- B - LATCHING
- D - NORM OPEN

GROUP 3
OPTIONS
- 1 - 50 OHM TERMINATION
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 7 - SELF DE-ENERGIZING CIRCUITRY
- 9 - OTHER (SPECIFY)
- V - MOSFET DRIVER

GROUP 4
RF CONNECTORS
- A - SMA
- G - OTHER (SPECIFY)

GROUP 5
TERMINALS
- 1 - SOLDER (STANDARD)
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6
VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

GROUP 7
FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC - 12.4 GHz
- 4 - DC - 18 GHz
- 5 - DC - 18.5 GHz
- 6 - DC - 26.5 GHz
- 7 - OTHER (SPECIFY)

GROUP 8
POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

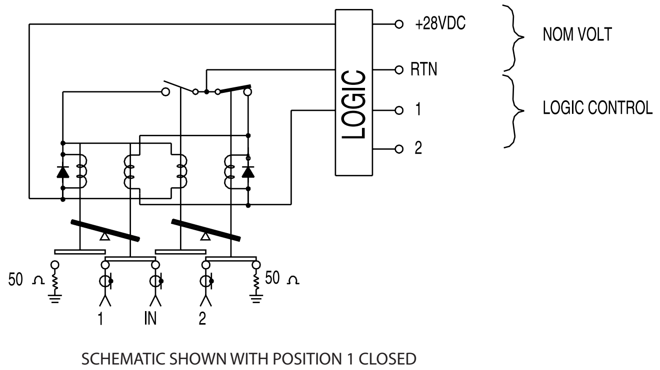
GROUP 9
MOUNTING
- 0 - STANDARD MOUNTING HOLES
- 3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

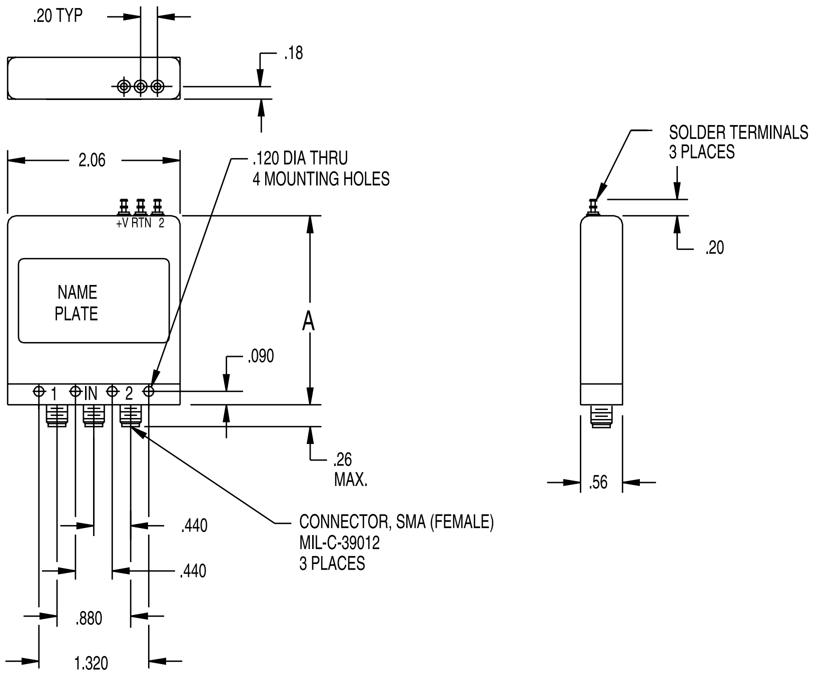
DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
1.67	A, B, D	1,3
2.01	A, D	1,2,3
2.01	B	1,2,3,7
2.26	A, D	1,2,3,4 or 5,V
2.26	B	1,2,3,4 or 5,7,V
2.26*	A, D	1,2,3,4 or 5,V
2.26*	B	1,2,3,4 or 5,7,V

* Dimension for switches with Standard Narda-MITEQ Power Connector M24308/3-1 mating with M24308/2-1

Typical Schematic and Outline Drawing



Series 026 with Pulse Latching Coil



Series 026 Switch with Internal Terminations

Dimensions in inches, unless otherwise specified.

DC-26.5 GHz, SMA

2-SP2T Series 150

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-24	24-26.5
VSWR (max.)	1.2	1.3	1.4	1.5	1.6	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.6	0.7
Isolation (dB min.)	80	70	60	60	50	45

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Failsafe: 280 mA (max.)
.... Latching: 400 mA (max.)
Switching Time .... 15 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
A - FAILSAFE
B - LATCHING
D - NORM OPEN

GROUP 3 OPTIONS
0 - NONE
2 - INDICATOR CIRCUITRY
3 - SUPPRESSION DIODES
4 - TTL LOGIC HIGH
7 - SELF DE-ENERGIZING CIRCUITRY
9 - OTHER (SPECIFY)
V - MOSFET DRIVER

GROUP 4 RF CONNECTORS
A - SMA
G - OTHER (SPECIFY)

GROUP 5 TERMINALS
1 - SOLDER (STANDARD)
2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
4 - SOLDER (LOOP)
5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
E - 48 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

GROUP 7 FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
4 - DC - 18 GHz
5 - DC - 18.5 GHz
6 - DC - 26.5 GHz
7 - OTHER (SPECIFY)

GROUP 8 POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

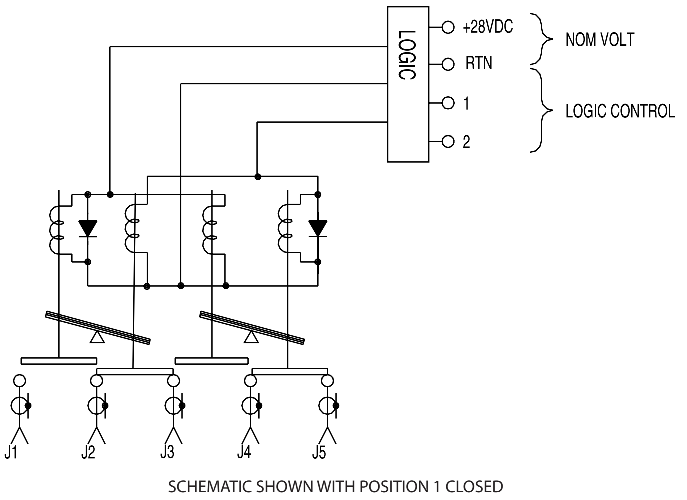
GROUP 9 MOUNTING
0 - STANDARD MOUNTING HOLES
1 - BRACKET
2 - FLANGE
3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

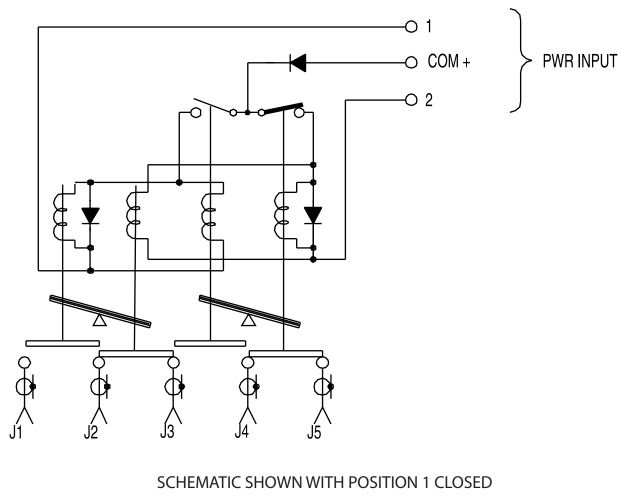
DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
1.67	A, B, D	3
2.01	A, D	2,3
2.01	B	2,3,7
2.26**	A, D	2,3,4 or 5,V
2.26**	B	2,3,4, or 5,7,V

** Dimension for switches with Standard Narda-MITEQ Power Connector M24308/3-1 mating with M24308/2-1

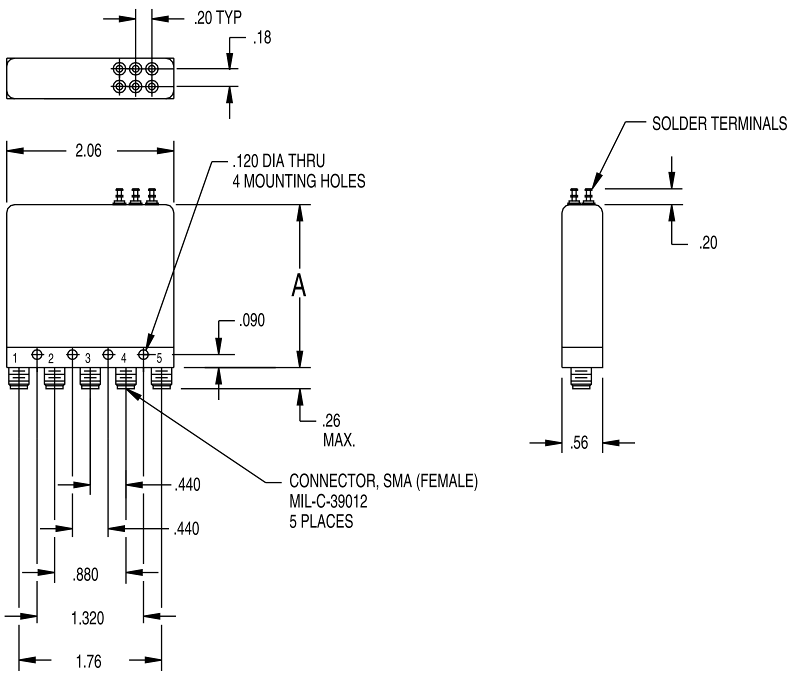
Typical Schematics and Outline Drawing



Latching 2-SP2T Switch
with TTL logic high and suppression diodes (B34)



Latching 2-SP2T Switch
with suppresion diodes and self cutoff (B37)

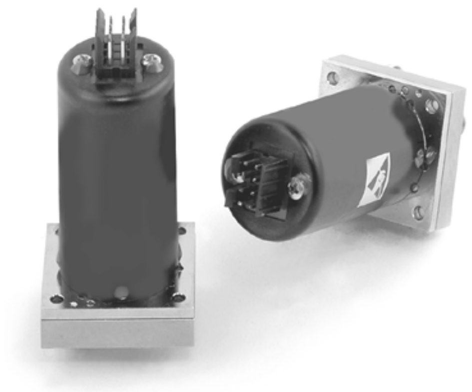


Dimensions in inches, unless otherwise specified.

Standard Custom Electro-Mechanical Switches

DC-26.5 GHz, SMA

2-SP2T Series 156



RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-26.5
VSWR (max.)	1.2	1.3	1.4	1.5	1.9
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.8
Isolation (dB min.)	80	70	60	60	45

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage .... 12 Vdc
Actuating Current .... Failsafe: 420 mA (max.)/switch
.... 840 mA (max.) @ 12 Vdc and 25°C
Switching Time .... 30 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Options Available *(refer to pages 231-232)*

GROUP 2
ACTUATION
A - FAILSAFE

GROUP 3
OPTIONS
0 - NONE
3 - SUPPRESSION DIODES
9 - OTHER (SPECIFY)

GROUP 4
RF CONNECTORS
A - SMA
G - OTHER (SPECIFY)

GROUP 5
TERMINALS
2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)

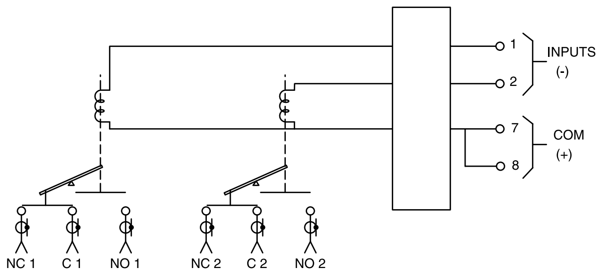
GROUP 6
VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

GROUP 7
FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
4 - DC - 18 GHz
6 - DC - 26.5 GHz
7 - OTHER (SPECIFY)

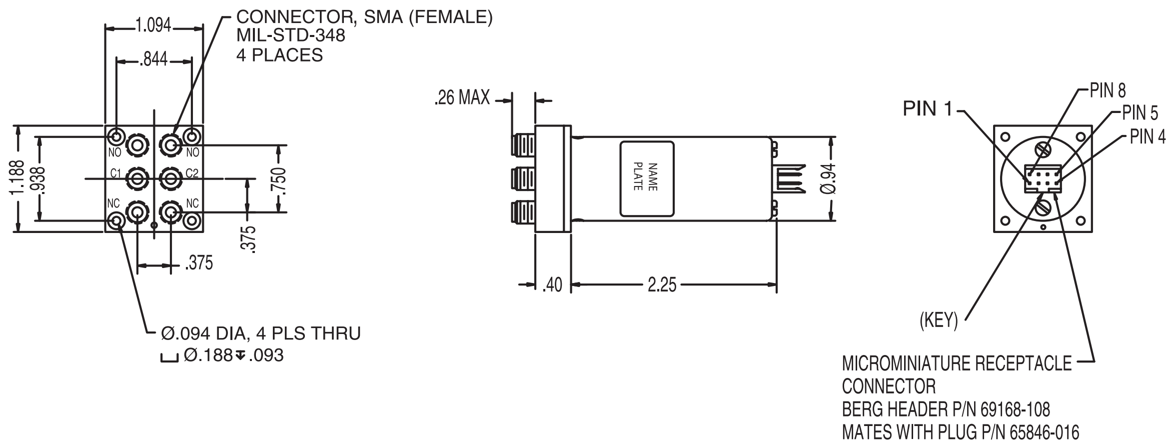
GROUP 8
POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

GROUP 9
MOUNTING
2 - FLANGE

Typical Schematic and Outline Drawing



SCHEMATIC SHOWN IN FAILSAFE POSITION



Dimensions in inches, unless otherwise specified.

Selecting a Multiposition Switch

The following pages describe a wide range of multiposition switches (SP3T-SP12T), presenting outline drawings, specifications and typical schematics for each model in the group. Important distinctions among these models are noted here to help you select the correct switch for a specific application.

3 - 6 Position

Series 030-060

Small SP3T-SP6T switches offering frequency range up to 26.5 GHz with SMA connectors. Normally open actuation. Termination option not available.

Series 032-062

Smallest available multiposition (SP3T-SP6T) switches offering latching actuation and termination option. Slightly larger than 030-060 series. Frequency range up to 18 GHz with SMA connectors.

Series 033-063

SP3T-SP6T switches to be specified when Type N or TNC connectors are required. Frequency range up to 12.4 GHz. Available with terminations.

Series 036-066

Miniature SP3T-SP6T switches offering frequency range up to 26.5 GHz with SMA connectors. Normally open only. No terminations.

7-8 Position

Series 073-083

SP7T-SP8T switch to be specified when Type N or TNC connectors are required. Frequency range up to 10 GHz. Available with terminations.

Series 075-085

SP7T-SP8T with frequency range up to 18 GHz and SMA connectors. Available with terminations.

9 -10 Position

Series 091-101

The switch to specify when the application requires 9 or 10 positions and frequency range up to 18 GHz with SMA connectors. Available with terminations.

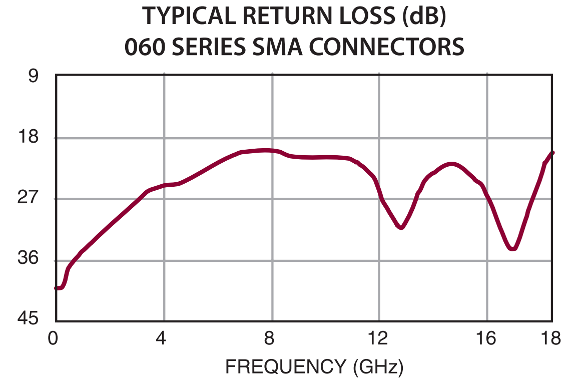
Series 093-103

SP9T-SP10T switch to be specified when Type N or TNC connectors are required. Frequency range up to 12.4 GHz. Available with terminations.

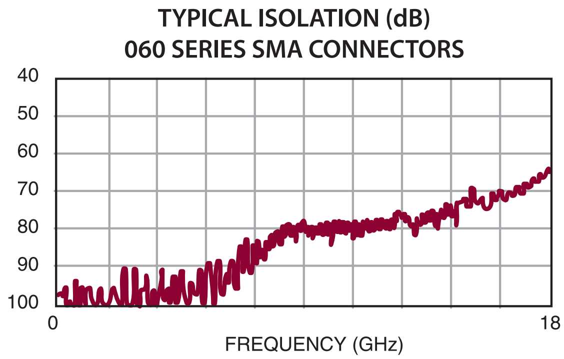
11-12 Position

Series 110-120

The switch to order when 11 or 12 positions are required. Frequency range up to 12.4 GHz with SMA connectors. Available with terminations.


TYPICAL RETURN LOSS (dB)
060 SERIES SMA CONNECTORS
9
18
27
36
45
0
4
8
12
16
18
FREQUENCY (GHz)


TYPICAL INSERTION LOSS (dB)
060 SERIES SMA CONNECTORS
0
.15
.30
.45
.60
0
4
8
12
16
18
FREQUENCY (GHz)


TYPICAL ISOLATION (dB)
060 SERIES SMA CONNECTORS
40
50
60
70
80
90
100
0
18
FREQUENCY (GHz)

DC-26.5 GHz, SMA

SP3T-SP6T Series 030-060

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-26.5
VSWR (max.)	1.2	1.3	1.4	1.5	1.8
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.8
Isolation (dB min.)	80	70	60	60	45

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Normally Open: 140 mA (max.)
.... DA: 280 mA (max.)
Switching Time .... 15 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
- D - NORM OPEN
- DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
- 0 - NONE
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 9 - OTHER (SPECIFY)
- V - MOSFET DRIVER
- Y - BCD TTL DECODER

GROUP 4 RF CONNECTORS
- A - SMA
- G - OTHER (SPECIFY)

GROUP 5 TERMINALS
- 1 - SOLDER (STANDARD)
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC - 12.4 GHz
- 4 - DC - 18 GHz
- 6 - DC - 26.5 GHz
- 7 - OTHER (SPECIFY)

GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

GROUP 9 MOUNTING
- 2 - FLANGE
- 3 - OTHER (SPECIFY)

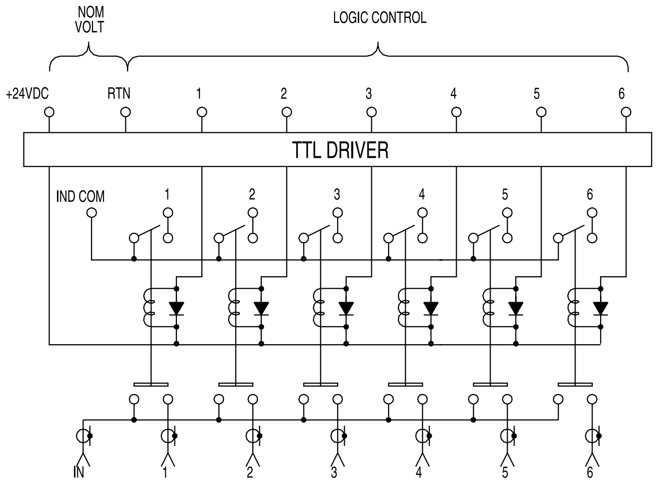
Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
1.56	D	0
2.00	D, DA	2,3
2.25	D, DA	2,3,4 OR 5,Y,V
2.50**	D, DA	2,3,4 OR 5,Y,V

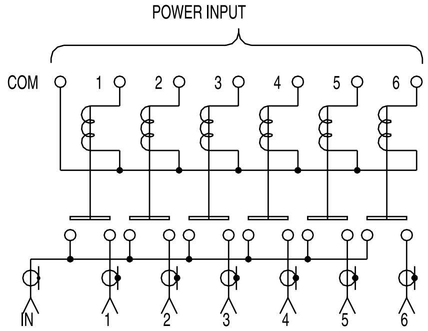
** Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-14-15P mating with MS3116E-14-15S

Exception: switches with options: 4-TTL Logic High, V-MOSFET Driver, Y-BCD Decoder use Power Connector MS3112E-14-18P mating with MS3116E-14-18S.

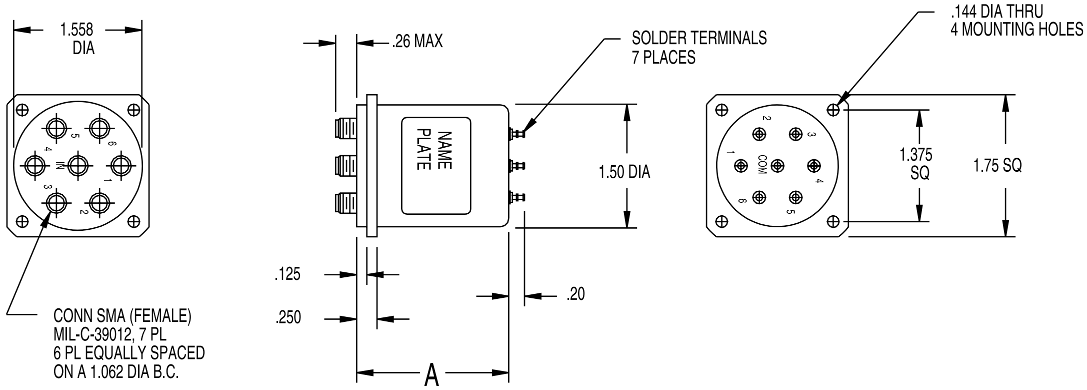
Typical Schematics and Outline Drawing

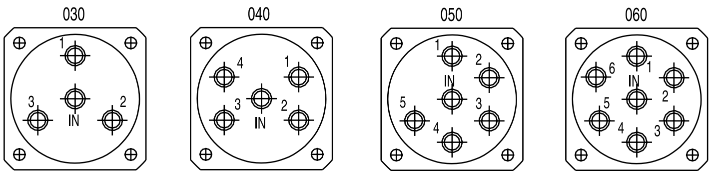


Normally Open SP6T Switch
with indicator circuitry, suppression diodes
and TTL high logic driver (D234)



Normally Open SP6T Switch (D0)





Dimensions in inches, unless otherwise specified.

Standard Custom Electro-Mechanical Switches

DC-18 GHz, SMA

SP3T-SP6T Series 032-062

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18
VSWR (max.)	1.2	1.3	1.4	1.5
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5
Isolation (dB min.)	80	70	60	60

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Normally Open: 160 mA
.... Latching: (n)** X 100 mA
.... DA: 2 x 160 mA
Switching Time .... 15 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C
** n = number of positions

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
- B - LATCHING
- C - LATCHING RESET
- D - NORM OPEN
- DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
- 0 - NONE
- 1 - 50 OHM TERMINATION
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 7 - SELF DE-ENERGIZING CIRCUITRY
- 9 - OTHER (SPECIFY)
- V - MOSFET DRIVER
- Y - BCD TTL DECODER

GROUP 4 RF CONNECTORS
- A - SMA
- G - OTHER (SPECIFY)

GROUP 5 TERMINALS
- 1 - SOLDER (STANDARD)
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC - 12.4 GHz
- 4 - DC - 18 GHz
- 7 - OTHER (SPECIFY)

GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

GROUP 9 MOUNTING
- 0 - STANDARD MOUNTING HOLES
- 1 - BRACKET
- 2 - FLANGE
- 3 - OTHER (SPECIFY)

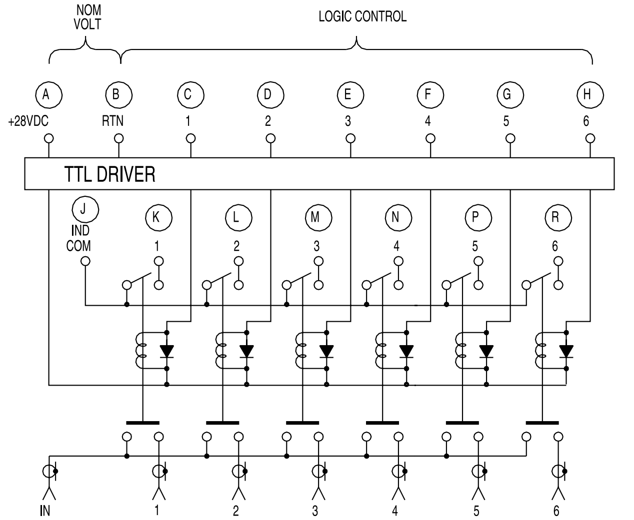
Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.12	D, DA	0,3
2.37	B, C	3,7
2.37	D, DA	2,3
2.62	B, C	2,3,4 OR 5,7,Y,V
2.62	D, DA	2,3,4 OR 5,Y,V
2.96‡	B, C	2,3,4 OR 5,7,Y,V
2.96‡	D, DA	2,3,4 OR 5,Y,V

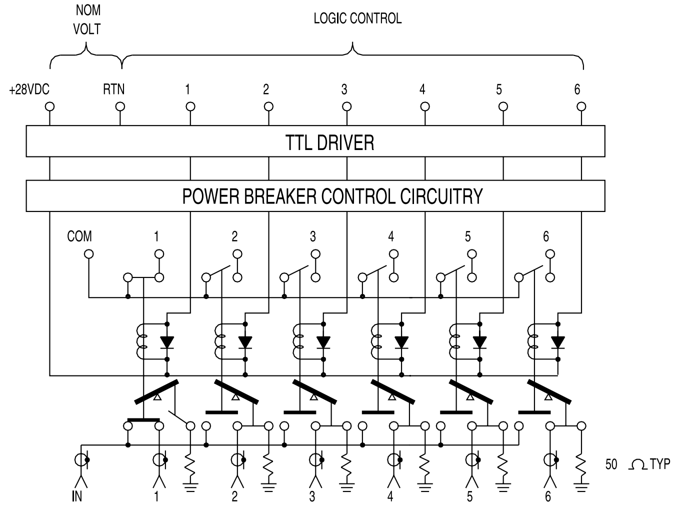
‡ Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-14-15P mating with MS3112E-14-15S

Exception: switches with options: 4-TTL Logic High, V-MOSFET Driver, Y-BCD Decoder use Power Connector MS3112E-14-18P mating with MS3116E-14-18S.

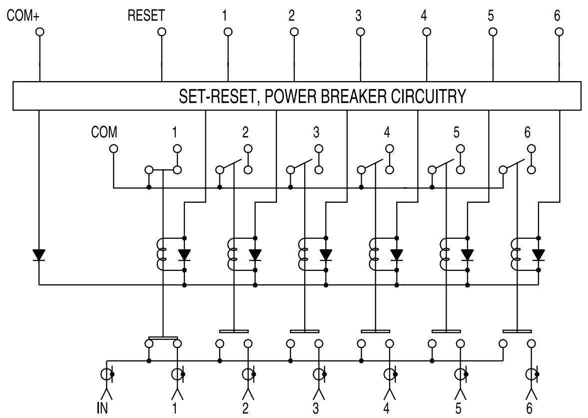
Typical Schematics



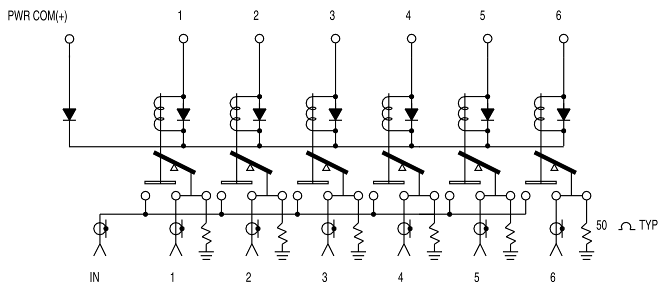
Normally Open SP6T Switch
with TTL driver, indicator circuitry and suppression diodes (D234)



Latching SP6T Switch
with TTL driver, indicator circuitry, self de-energizing circuitry, suppresion diodes and 50ohm termination, shown in position 1 (B12347)



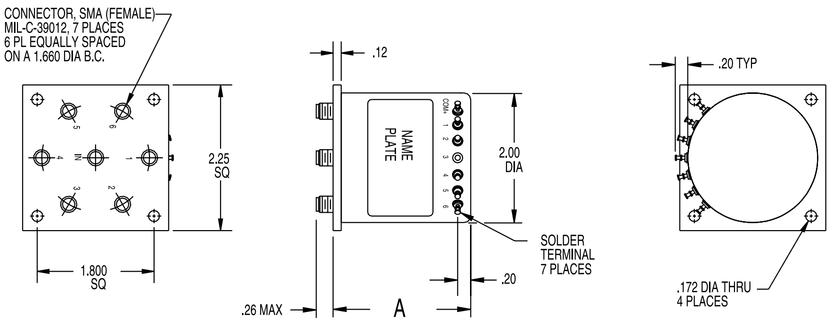
Latching, Common Plus SP6T Switch
with self de-energizing circuitry, reset function, indicator circuitry and suppression diodes, shown in postition 1 (C237)

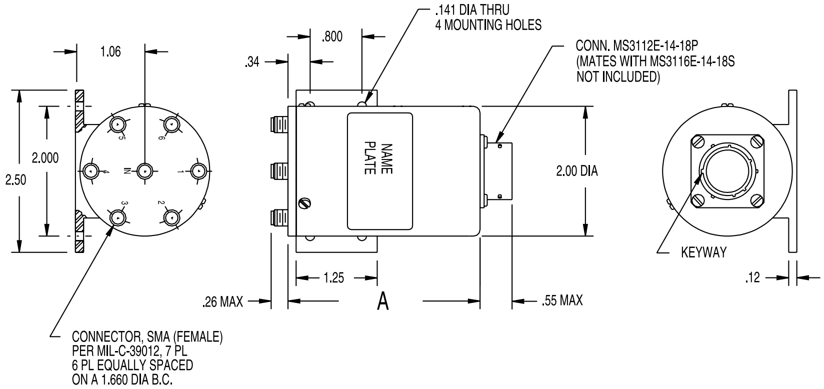


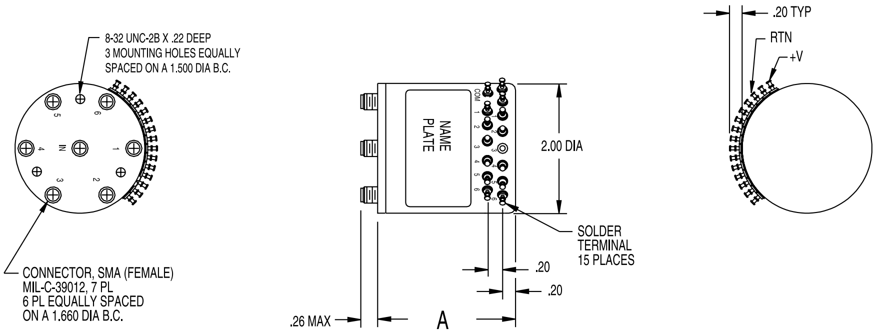
Normally Open, Common Plus SP6T Switch
with suppression diodes and 50 ohm termination on each unused position (D13)

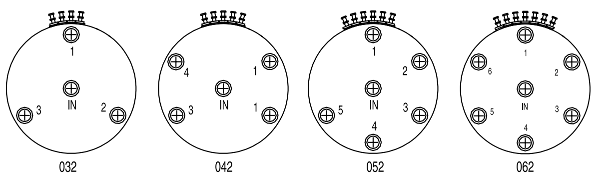
Standard Custom Electro-Mechanical Switches

Typical Outline Drawings









Dimensions in inches, unless otherwise specified.

DC-12.4 GHz, Type N and TNC

SP3T-SP6T Series 033-063

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4
VSWR (max.)	1.2	1.35	1.5
Insertion Loss (dB max.)	0.2	0.35	0.5
Isolation (dB min.)	80	70	60

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Normally Open: 140 mA (max.)
.... Latching: (n)** x 100 mA
.... DA: 350 mA
Switching Time .... 20 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C
** n = number of positions

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.20	D, DA	0,3
2.46	B, C	3,7
2.46	D, DA	2,3
2.88	B, C	2,3,7
3.08‡	B, C	2,3,4 OR 5,7,Y
3.08‡	D, DA	2,3,4 OR 5,Y

‡ Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-14-15P mating with MS3112E-14-15S

Exception: switches with options: 4-TTL Logic High, V-MOSFET Driver, Y-BCD Decoder use Power Connector MS3112E-14-18P mating with MS3116E-14-18S.

Options Available (refer to pages 231-232)

GROUP 2 ACTUATION
- B - LATCHING
- C - LATCHING RESET
- D - NORM OPEN
- DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
- 0 - NONE
- 1 - 50 OHM TERMINATION
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 7 - SELF DE-ENERGIZING CIRCUITRY
- 9 - OTHER (SPECIFY)
- V - MOSFET DRIVER
- Y - BCD TTL DECODER

GROUP 4 RF CONNECTORS
- D - TYPE N
- E - TNC
- G - OTHER (SPECIFY)

GROUP 5 TERMINALS
- 1 - SOLDER (STANDARD)
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

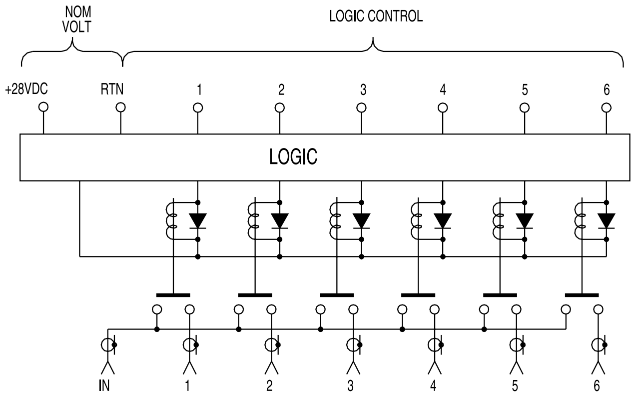
GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC - 12.4 GHz
- 7 - OTHER (SPECIFY)

GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

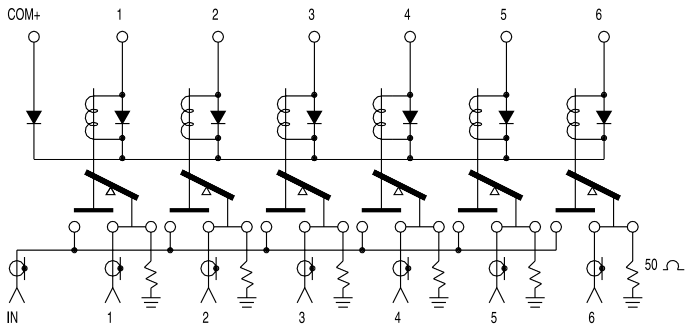
GROUP 9 MOUNTING
- 0 - STANDARD MOUNTING HOLES
- 1 - BRACKET
- 2 - FLANGE
- 3 - OTHER (SPECIFY)

Standard Custom Electro-Mechanical Switches

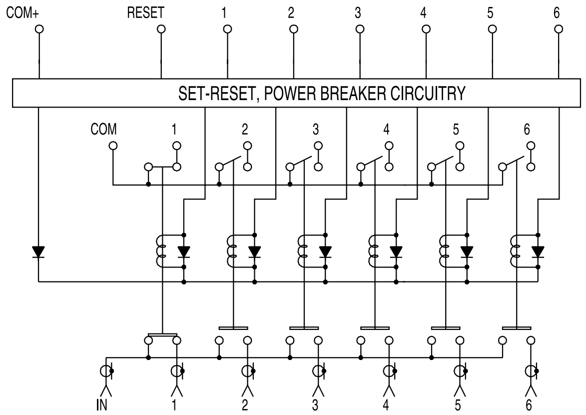
Typical Schematics



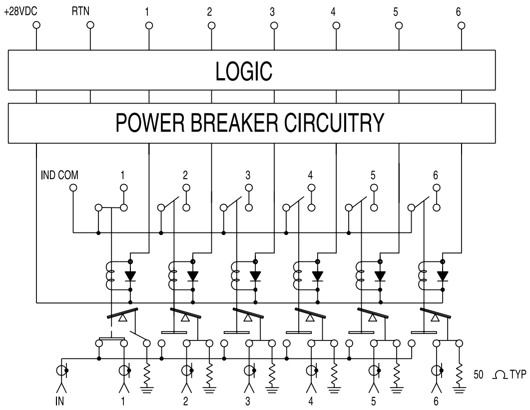
Normally Open SP6T Switch
with TTL driver and suppression diodes (D34)



Normally Open, Common Plus SP6T Switch
with suppresion diodes and 50 ohm termination (D13)



Latching, Common Plus SP6T Switch
with self de-energizing circuitry, reset function, indicator circuitry and suppression diodes, shown in postition 1 (C237)

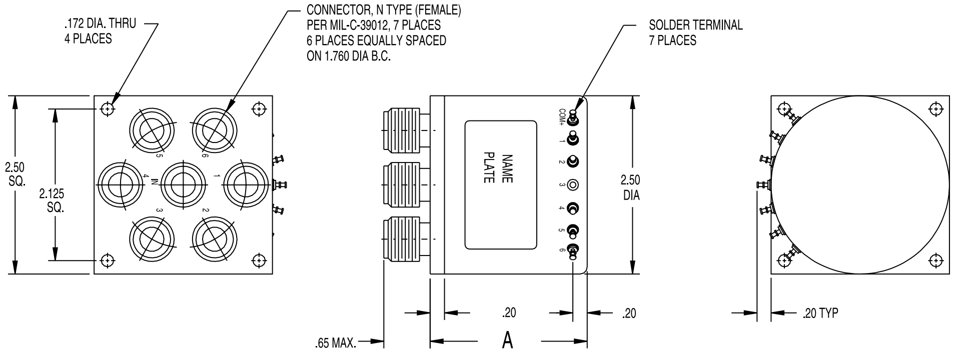


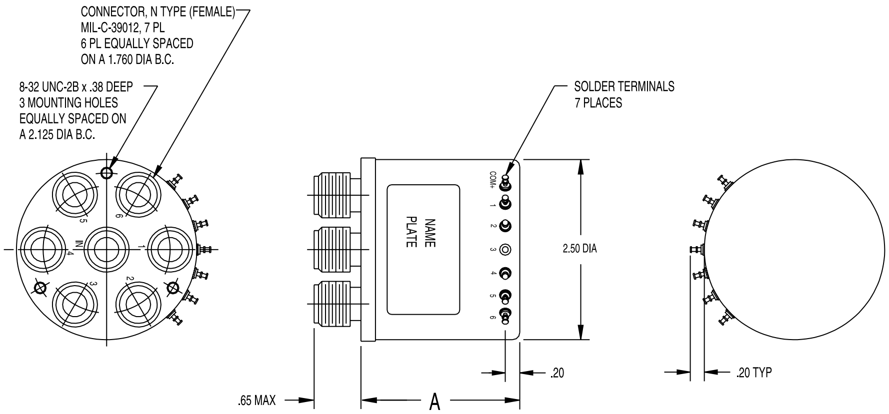
Latching SP6T Switch
with TTL driver, indicator circuitry, self de-energizing circuitry, suppression diodes and 50 ohm termination, shown in position 1 (B12347)

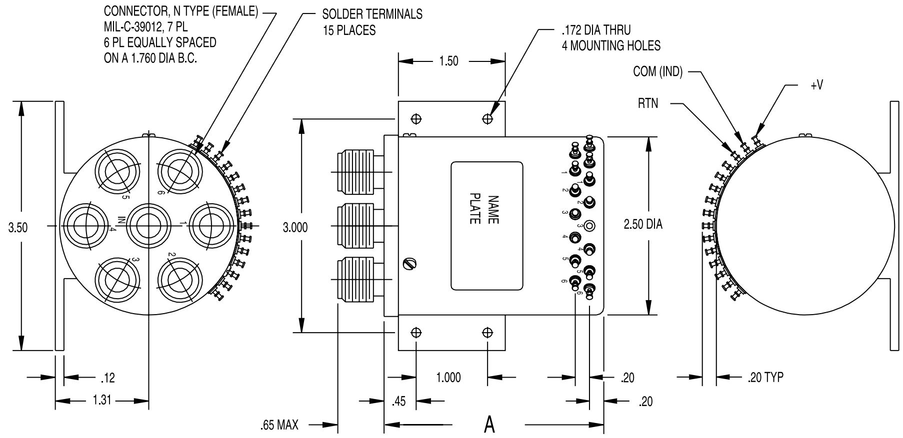
narda MITEQ www.nardamiteq.com E-MAIL: componentsnm@nardamiteq.com TEL: +1 631 231-1700

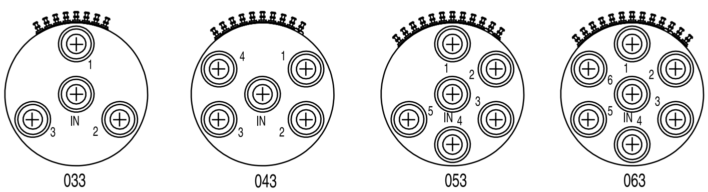
Standard Custom Electro-Mechanical Switches

Typical Outline Drawings





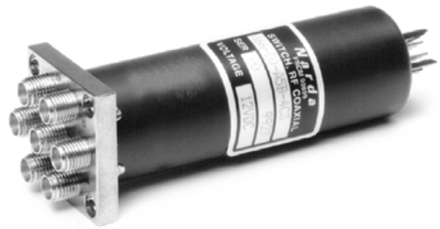




Dimensions in inches, unless otherwise specified.

DC-26.5 GHz, SMA

SP3T-SP6T Series 036-066



RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-26.5
VSWR (max.)	1.15	1.25	1.35	1.45	1.9
Insertion Loss (dB max.)	0.15	0.25	0.35	0.45	0.9
Isolation (dB min.)	85	75	65	65	45

Additional Specifications

RF Impedance...50 ohms nominal
Actuating Voltage*...28 Vdc
Actuating Current* ....Normally Open: 160 mA (max.)
Switching Time...15 ms (max.)
Switching Sequence...Break Before Make
Operating Ambient Temperature.......................................-35°C to +70°C
Operating Life..1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Standard Power Connector is Berg P/N 69168-108, mates with P/N 65846-016 (not supplied).
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
- D - NORM OPEN
- DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
- 0 - NONE
- 3 - SUPPRESSION DIODES
- 9 - OTHER (SPECIFY)

GROUP 4 RF CONNECTORS
- A - SMA
- G - OTHER (SPECIFY)

GROUP 5 TERMINALS
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

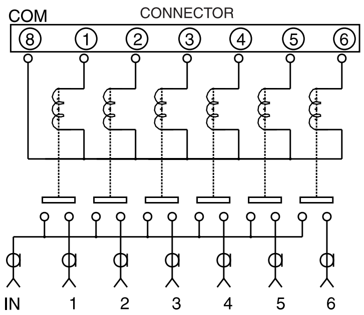
GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC - 12.4 GHz
- 4 - DC - 18 GHz
- 6 - DC - 26.5 GHz
- 7 - OTHER (SPECIFY)

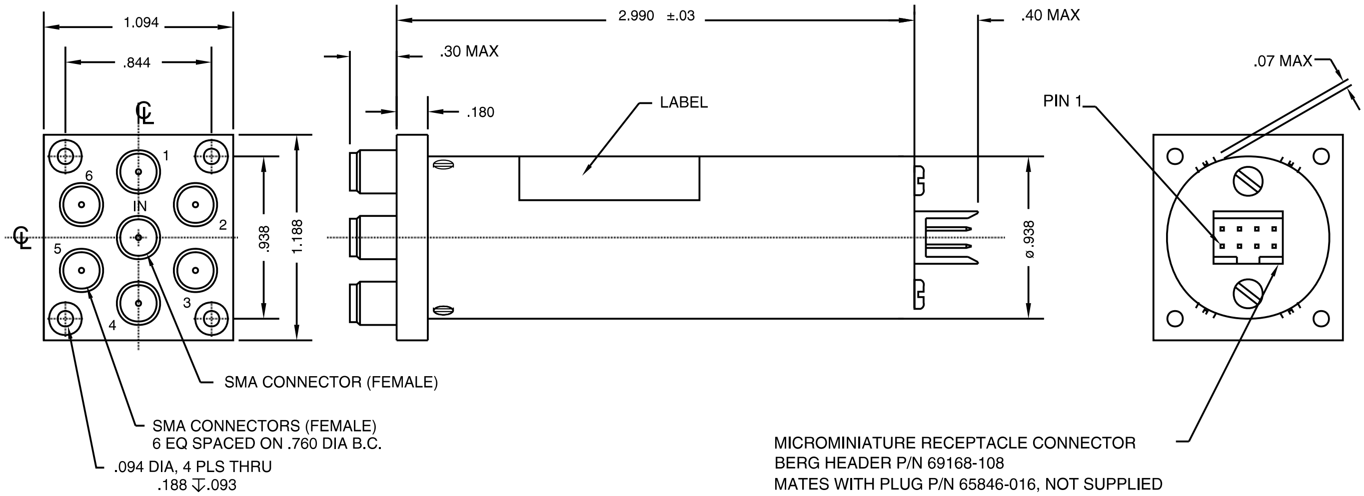
GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

GROUP 9 MOUNTING
- 2 - FLANGE

Standard Custom Electro-Mechanical Switches

Typical Schematic and Outline Drawing





Dimensions in inches, unless otherwise specified.

Standard Custom Electro-Mechanical Switches

DC-10 GHz, Type N and TNC

SP7T-SP8T Series 073-083

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-10
VSWR (max.)	1.2	1.35	1.5
Insertion Loss (dB max.)	0.2	0.35	0.5
Isolation (dB min.)	80	70	60

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Normally Open: 160 mA (max.)
.... Latching: (n)** x 100 mA
.... DA: 350 mA
Switching Time .... 20 ms (max.)
Switching Sequence .... Break Before Make
Operating Mode* .... Normally Open
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C
** n = number of positions

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
- B - LATCHING
- C - LATCHING RESET
- D - NORM OPEN
- DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
- 0 - NONE
- 1 - 50 OHM TERMINATION
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 7 - SELF DE-ENERGIZING CIRCUITRY
- 9 - OTHER (SPECIFY)
- V - MOSFET DRIVER
- Y - BCD TTL DECODER

GROUP 4 RF CONNECTORS
- D - TYPE N
- E - TNC
- G - OTHER (SPECIFY)

GROUP 5 TERMINALS
- 1 - SOLDER (STANDARD)
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC - 12.4 GHz
- 7 - OTHER (SPECIFY)

GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

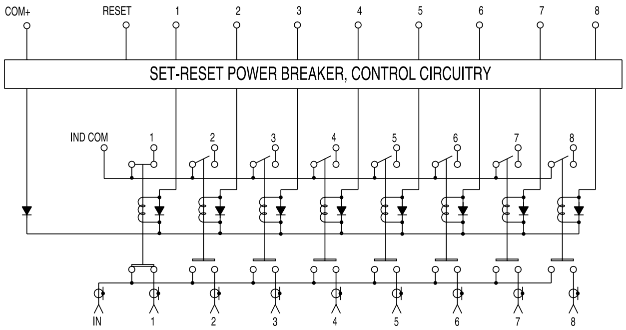
GROUP 9 MOUNTING
- 0 - STANDARD MOUNTING HOLES
- 1 - BRACKET
- 2 - FLANGE
- 3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

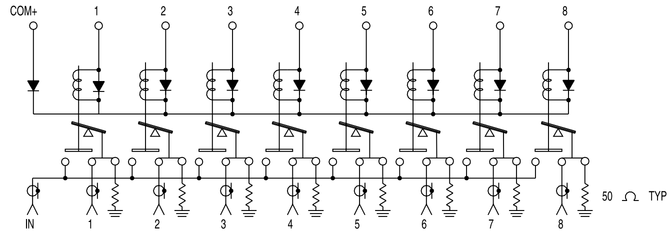
DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.20	D, DA	0,3
3.07	B, C	2,3,7
3.07	D, DA	2,3
3.07‡	B, C	1,2,3,4 OR 5,7,Y
3.07‡	D, DA	1,2,3,4 OR 5,Y

‡ Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-16-26P mating with MS3112E-16-26S

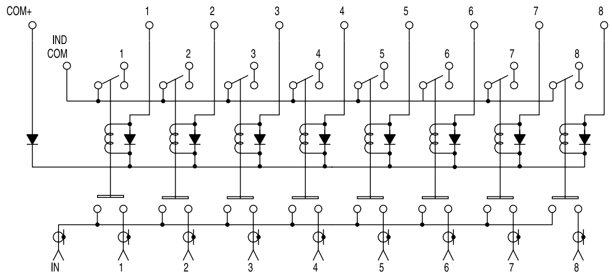
Typical Schematics



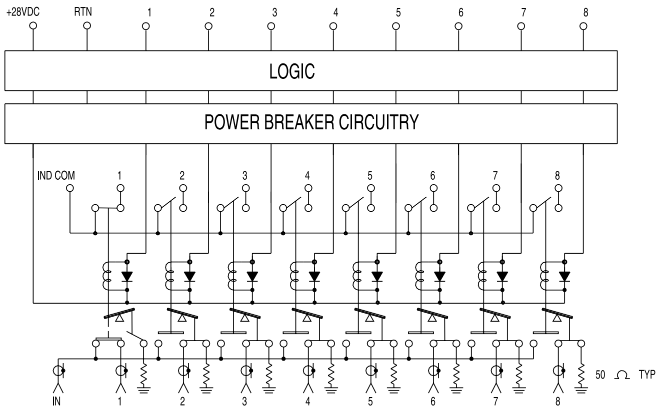
Latching, Common Plus SP8T Switch
with self de-energizing circuitry, reset function, indicator circuitry and suppression diodes, shown in position 1 (B237)



Normally Open SP8T Switch
with suppression diodes and 50-ohm termination on each unused position (D13)



Normally Open, Common Plus SP8T Switch
with indicator circuitry and suppression diodes (D23)

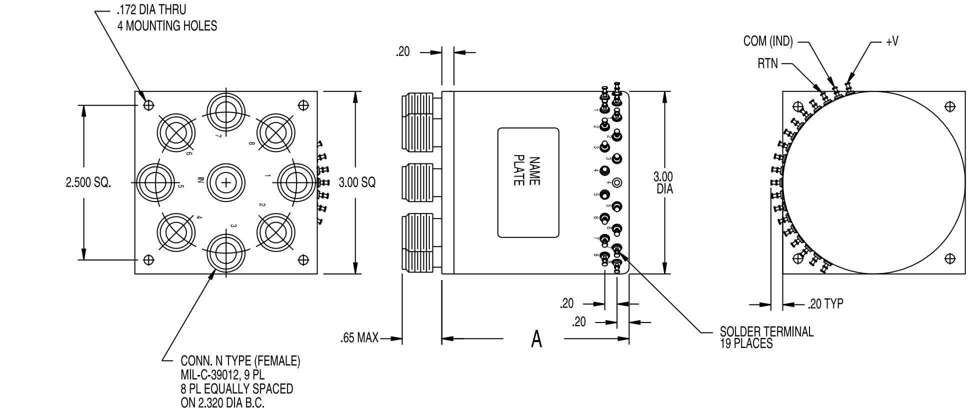


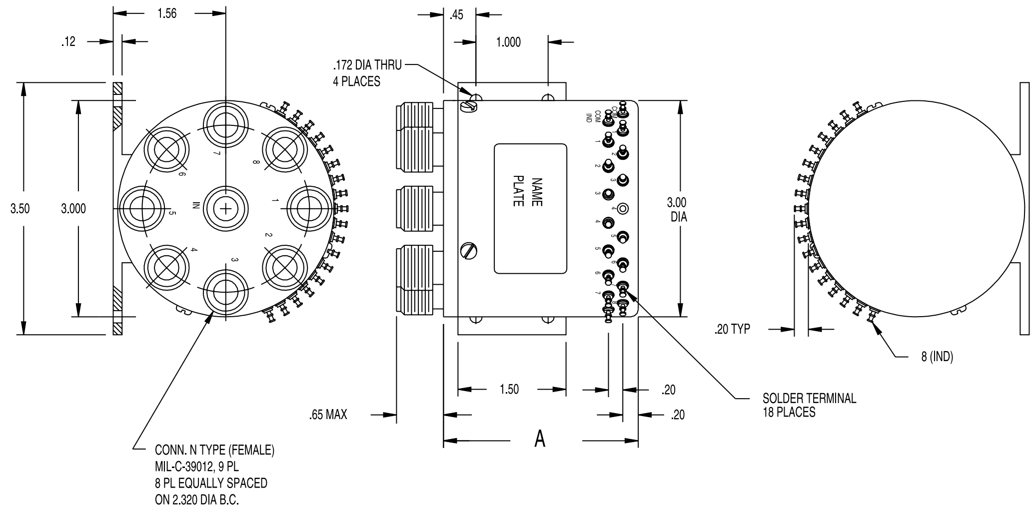
Latching SP8T Switch
with TTL driver, indicator circuitry, suppression diodes and 50 ohm termination, shown in position 1 (B12347)

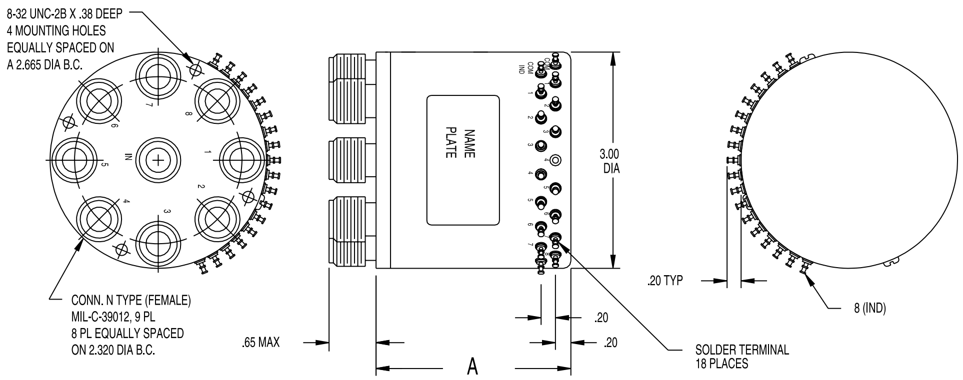
NOTE: for 073 series switches eliminate position 8.

Standard Custom Electro-Mechanical Switches

Typical Outline Drawings







NOTE: for 073 series switches eliminate position 8.

Dimensions in inches, unless otherwise specified.

DC-18 GHz, SMA

SP7T-SP8T Series 075-085

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-16	16-18
VSWR (max.)	1.2	1.3	1.4	1.5	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.55	0.7
Isolation (dB min.)	80	70	60	60	55

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Normally Open: 160 mA (max.)
.... Latching: (n)** x 100 mA
.... DA: 350 mA
Switching Time .... 15 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C
** n = number of positions

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.10	D, DA	0,3
2.50	B, C	2,3,7
2.50	D, DA	2,3
2.91‡	B, C	1,2,3,4 OR 5,7,Y,V
2.91‡	D, DA	1,2,3,4 OR 5,Y,V

‡ Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-16-26P mating with MS3116E-16-26S

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
B - LATCHING
C - LATCHING RESET
D - NORM OPEN
DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
0 - NONE
1 - 50 OHM TERMINATION
2 - INDICATOR CIRCUITRY
3 - SUPPRESSION DIODES
4 - TTL LOGIC HIGH
7 - SELF DE-ENERGIZING CIRCUITRY
9 - OTHER (SPECIFY)
V - MOSFET DRIVER
Y - BCD TTL DECODER

GROUP 4 RF CONNECTORS
A - SMA
G - OTHER (SPECIFY)

GROUP 5 TERMINALS
1 - SOLDER (STANDARD)
2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
4 - SOLDER (LOOP)
5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
E - 48 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

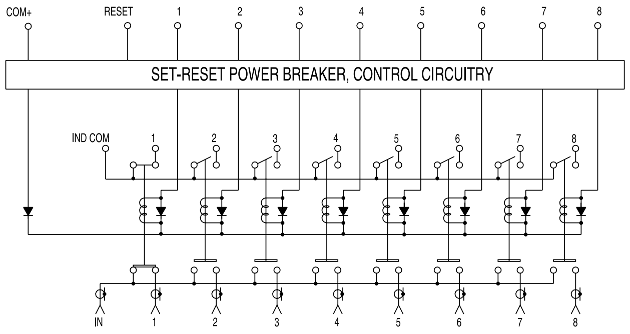
GROUP 7 FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
4 - DC - 18 GHz
7 - OTHER (SPECIFY)

GROUP 8 POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

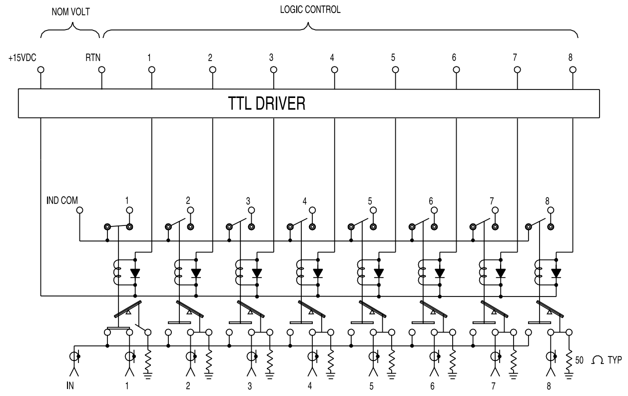
GROUP 9 MOUNTING
0 - STANDARD MOUNTING HOLES
1 - BRACKET
2 - FLANGE
3 - OTHER (SPECIFY)

Standard Custom Electro-Mechanical Switches

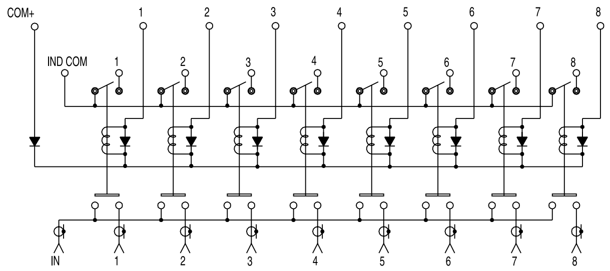
Typical Schematics



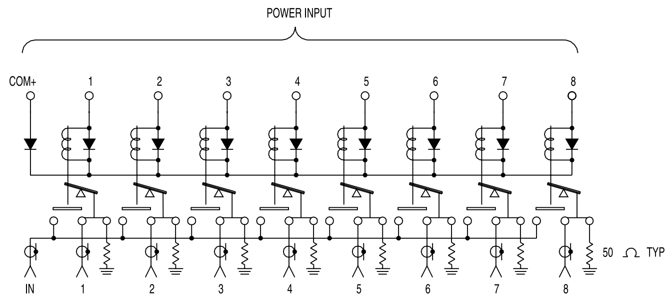
Latching, Common Plus SP8T Switch
with self de-energizing circuitry, indicator circuitry and suppression diodes, shown in position 1 (B237)



Pulse Latching SP8T Switch
with TTL driver, indicator circuitry, suppression diodes and 50 ohm termination, shown in position 1 (B1234)



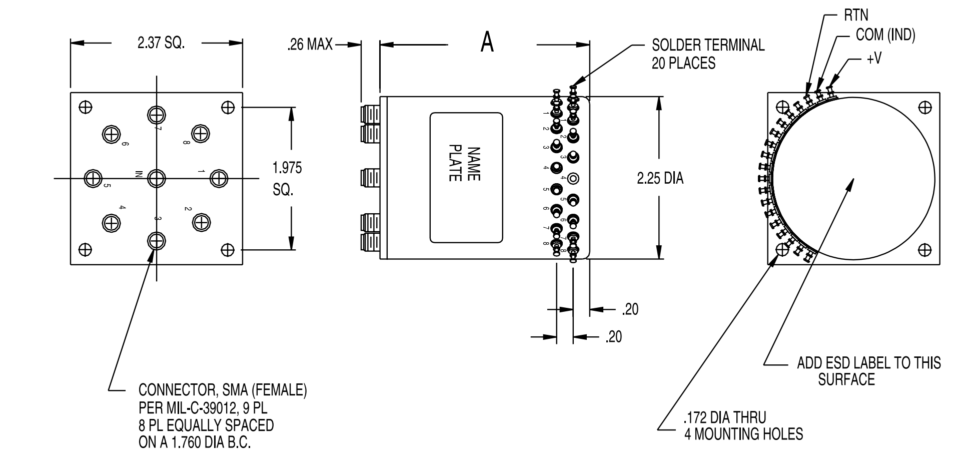
Normally Open, Common Plus SP8T Switch
with indicator circuitry and suppression diodes (D23)

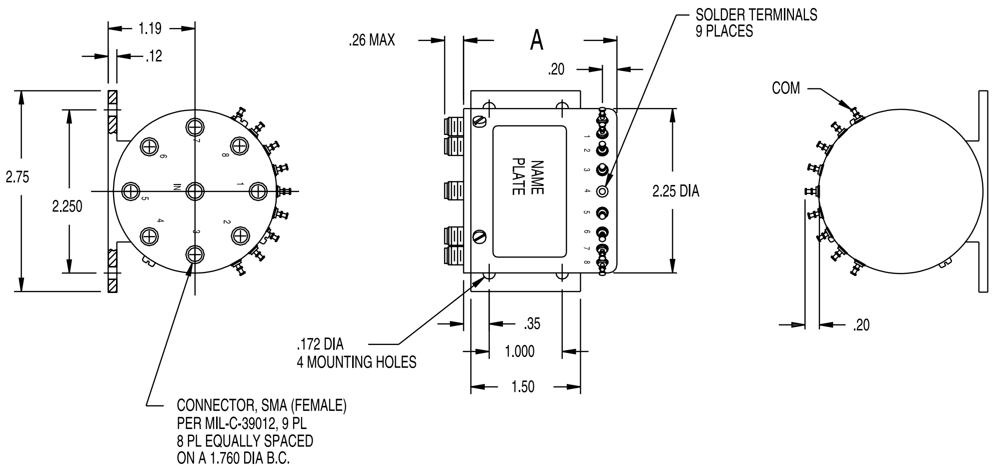


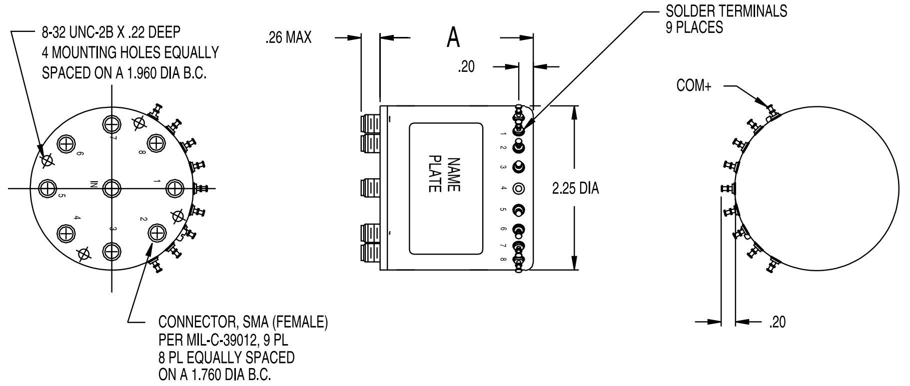
Normally Open, Common Plus SP8T Switch
with suppression diodes and 50 ohm termination on each unused position (D13)

NOTE: for 075 series switches eliminate position 8.

Typical Outline Drawings







NOTE: for 075 series switches eliminate position 8.

Dimensions in inches, unless otherwise specified.

DC-18 GHz, SMA

SP9T-SP10T Series 091-101

Normally Open and Normally Open with Termination

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-15.5	15.5-18
VSWR (max.)	1.2	1.3	1.4	1.5	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.7
Isolation (dB min.)	80	70	60	60	55

Additional Specifications

RF Impedance........ 50 ohms nominal
Actuating Voltage*........ 28 Vdc
Actuating Current* ....Normally Open: 160 mA (max.)
........DA: 350 mA
Switching Time........ 15 ms (max.)
Switching Sequence........ Break Before Make
Operating Ambient Temperature........ -35°C to +70°C
Operating Life........ 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
- D - NORM OPEN
- DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
- 0 - NONE
- 1 - 50 OHM TERMINATION
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 9 - OTHER (SPECIFY)
- V - MOSFET DRIVER
- Y - BCD TTL DECODER

GROUP 4 RF CONNECTORS
- A - SMA
- G - OTHER (SPECIFY)

GROUP 5 TERMINALS
- 1 - SOLDER (STANDARD)
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC - 12.4 GHz
- 4 - DC - 18 GHz
- 7 - OTHER (SPECIFY)

GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

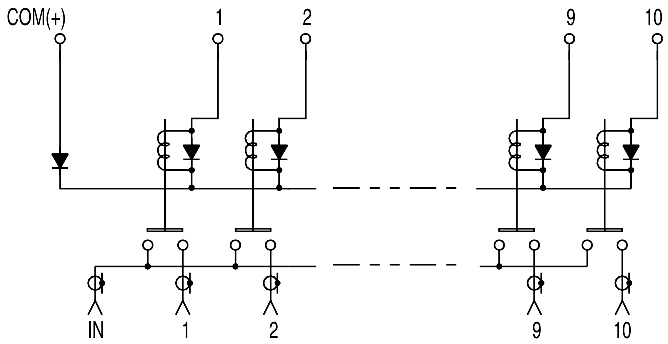
GROUP 9 MOUNTING
- 0 - STANDARD MOUNTING HOLES
- 1 - BRACKET
- 2 - FLANGE
- 3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

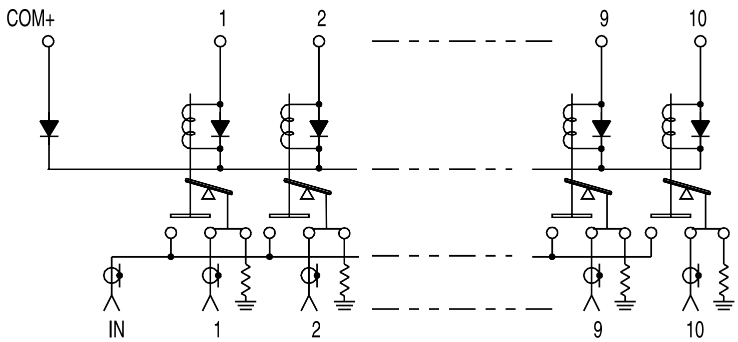
DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.10	D, DA	1,3
2.50	D, DA	1,2,3
2.91**	D, DA	1,2,3,4 OR 5,Y,V

** Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-16-26P mating with MS3116E-16-26S.

Typical Schematics



Normally Open, Common Plus SP10T Switch
with suppression diodes, shown in position 1 (D3)

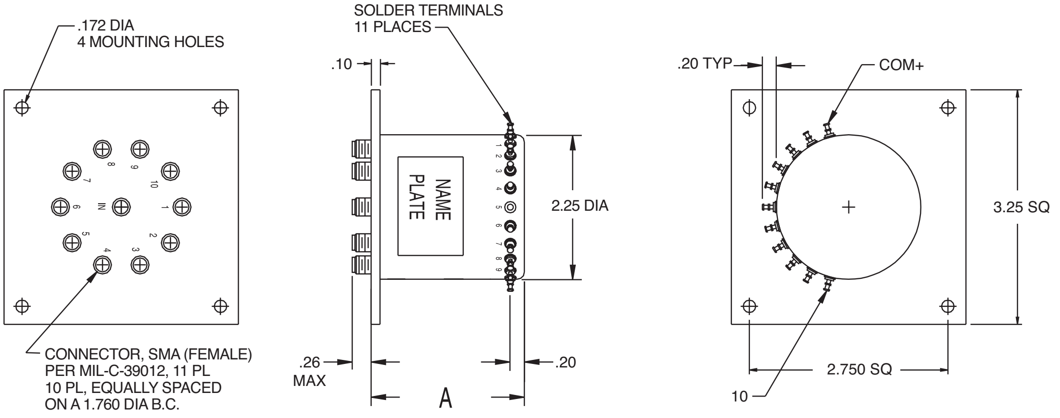


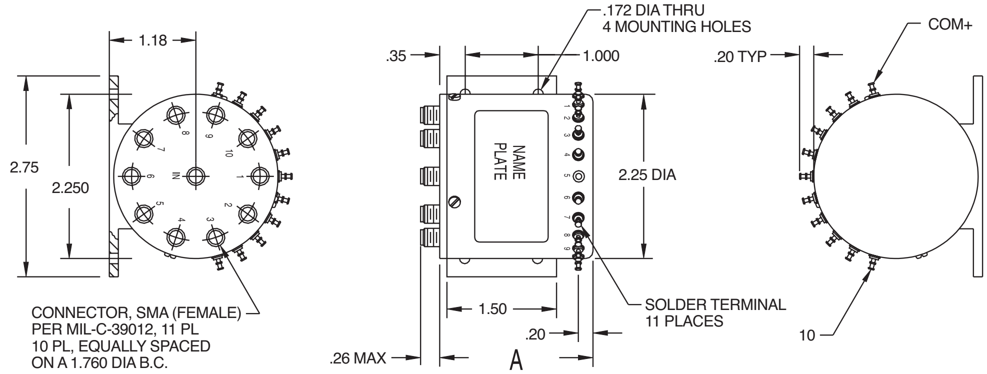
Normally Open, Common Plus SP10T Switch
with suppression diodes and 50 ohm termination
on each unused position (D13)

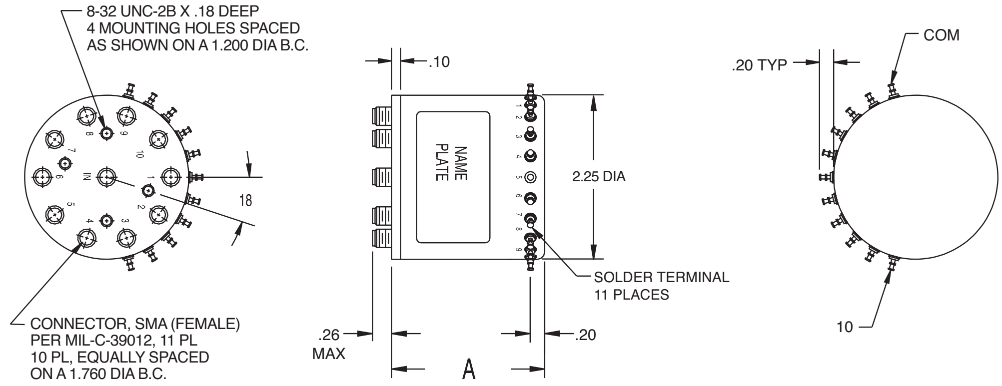
NOTE: for 091 series switches eliminate position 10.

Standard Custom Electro-Mechanical Switches

Typical Outline Drawings







NOTE: for 091 series switches eliminate position 10.

Dimensions in inches, unless otherwise specified.

DC-18 GHz, SMA

SP9T-SP10T Series 091-101

Latching and Latching with Termination

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-15.5	15.5-18
VSWR (max.)	1.2	1.3	1.4	1.5	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.7
Isolation (dB min.)	80	70	60	60	55

Additional Specifications

RF Impedance.......50 ohms nominal
Actuating Voltage*.......28 Vdc
Actuating Current*.......Latching: (n)** x 100 mA (max.)
Switching Time.......15 ms (max.)
Switching Sequence.......Break Before Make
Operating Ambient Temperature.......-35°C to +70°C
Operating Life.......1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C
** n = number of positions

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.10	D, DA	1,3
2.60	B, C	1,2,3,7
2.60	D, DA	1,2,3
2.98‡	B, C	1,2,3,4 OR 5,7,Y
2.98‡	D, DA	1,2,3,4 OR 5,Y

‡ Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-16-26P mating with MS3116E-16-26S

Options Available *(refer to pages 231-232)*

GROUP 2
ACTUATION
B - LATCHING
C - LATCHING RESET

GROUP 3
OPTIONS
0 - NONE
1 - 50 OHM TERMINATION
2 - INDICATOR CIRCUITRY
3 - SUPPRESSION DIODES
4 - TTL LOGIC HIGH
7 - SELF DE-ENERGIZING CIRCUITRY
9 - OTHER (SPECIFY)
V - MOSFET DRIVER
Y - BCD TTL DECODER

GROUP 4
RF CONNECTORS
A - SMA
G - OTHER (SPECIFY)

GROUP 5
TERMINALS
1 - SOLDER (STANDARD)
2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
4 - SOLDER (LOOP)
5 - OTHER (SPECIFY)

GROUP 6
VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
E - 48 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

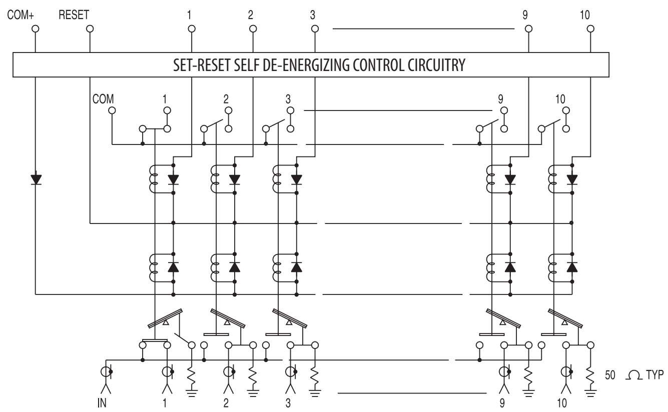
GROUP 7
FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
4 - DC - 18 GHz
7 - OTHER (SPECIFY)

GROUP 8
POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

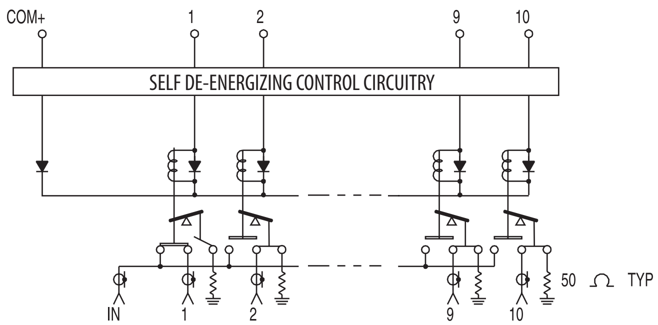
GROUP 9
MOUNTING
0 - STANDARD MOUNTING HOLES
1 - BRACKET
2 - FLANGE
3 - OTHER (SPECIFY)

Standard Custom Electro-Mechanical Switches

Typical Schematics



Latching, Common Plus SP10T Switch
with reset function, self de-energizing circuitry and suppression diodes, shown in position 1 (C1237)

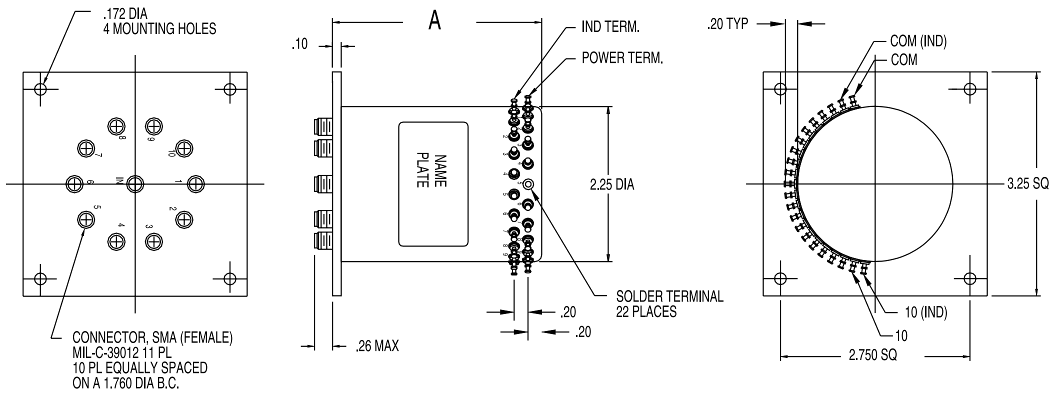


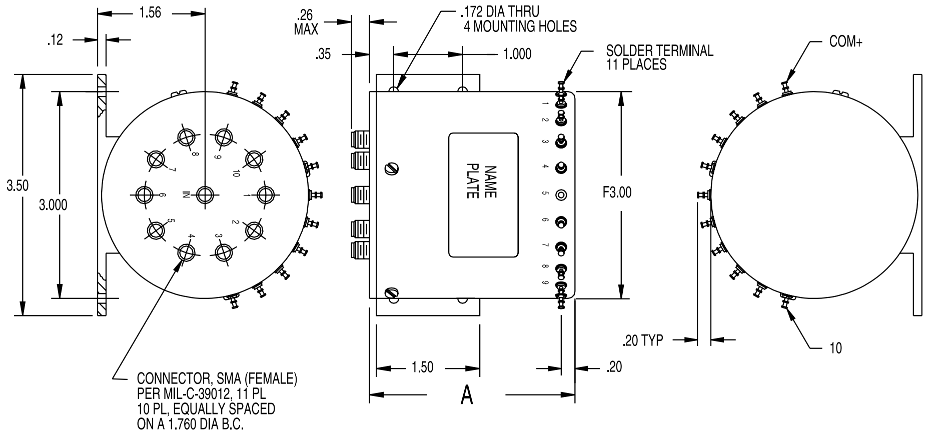
Latching, Common Plus SP10T Switch
with reset functions, self de-energizing circuitry, suppression diodes and 50 ohm termination on each unused position, shown in position 1 (B137)

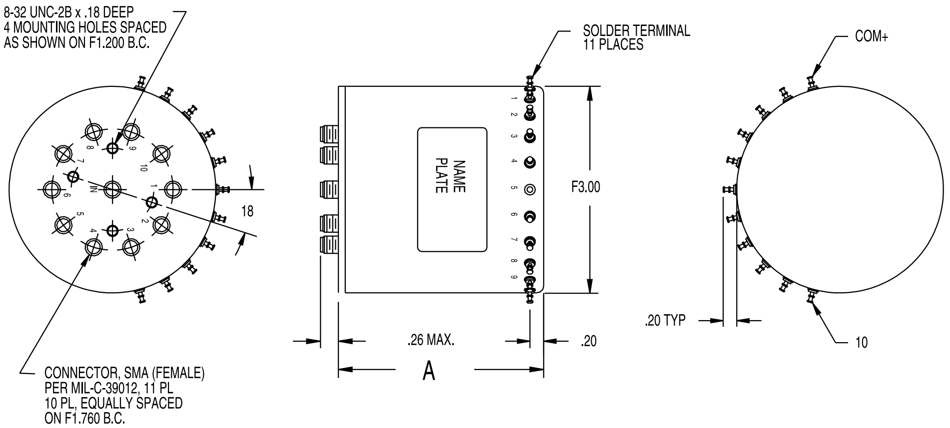
NOTE: for 091 series switches eliminate position 10.

Standard Custom Electro-Mechanical Switches

Typical Outline Drawings







NOTE: for 091 series switches eliminate position 10.

Dimensions in inches, unless otherwise specified.

Standard Custom Electro-Mechanical Switches

DC-8 GHz, Type N and TNC

SP9T-SP10T Series 093-103

RF Performance

Freq. Range (GHz)	DC-3	3-8
VSWR (max.)	1.3	1.5
Insertion Loss (dB max.)	0.3	0.5
Isolation (dB min.)	80	70

Additional Specifications

RF Impedance........ 50 ohms nominal
Actuating Voltage*........ 28 Vdc
Actuating Current*........ Normally Open: 180 mA (max.)
.... Latching: (n)** x 100 mA
.... DA: 400 mA
Switching Time........ 20 ms (max.)
Switching Sequence........ Break Before Make
Operating Ambient Temperature........ -35°C to +70°C
Operating Life........ 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C
** n = number of positions

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
- B - LATCHING
- C - LATCHING RESET
- D - NORM OPEN
- DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
- 0 - NONE
- 1 - 50 OHM TERMINATION
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 7 - SELF DE-ENERGIZING CIRCUITRY
- 9 - OTHER (SPECIFY)
- V - MOSFET DRIVER
- Y - BCD TTL DECODER

GROUP 4 RF CONNECTORS
- D - TYPE N
- E - TNC
- G - OTHER (SPECIFY)

GROUP 5 TERMINALS
- 1 - SOLDER (STANDARD)
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 7 - OTHER (SPECIFY)

GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

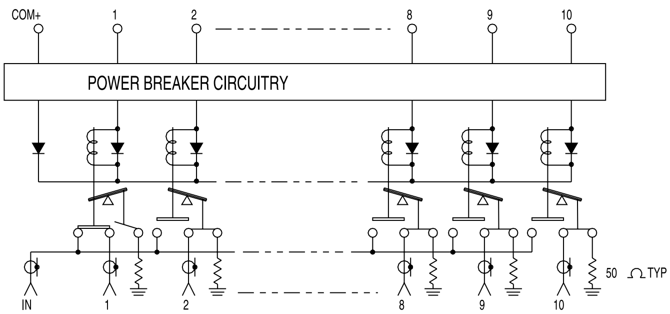
GROUP 9 MOUNTING
- 0 - STANDARD MOUNTING HOLES
- 1 - BRACKET
- 2 - FLANGE
- 3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

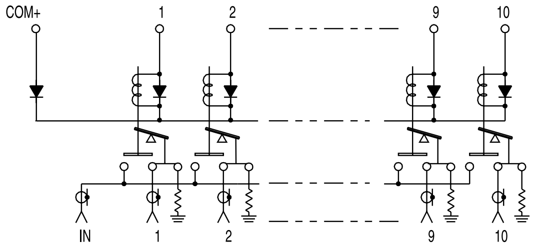
DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.40	D, DA	0,3
3.28	B, C	2,3,7
3.28	D, DA	2,3
3.28‡	B, C	2,3,4 OR 5,7,Y
3.28‡	D, DA	2,3,4 OR 5,Y

‡ Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-16-26P mating with MS3116E-16-26S.

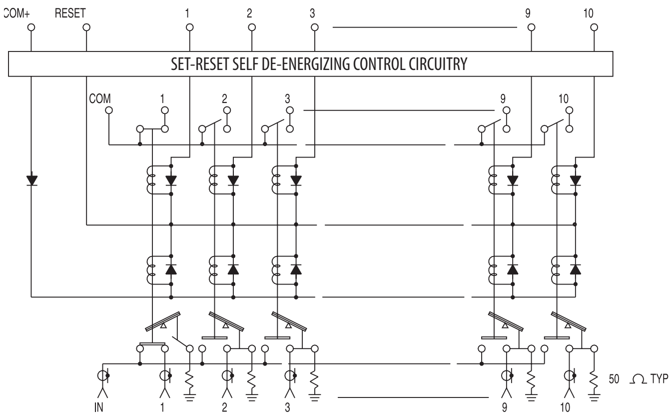
Typical Schematics



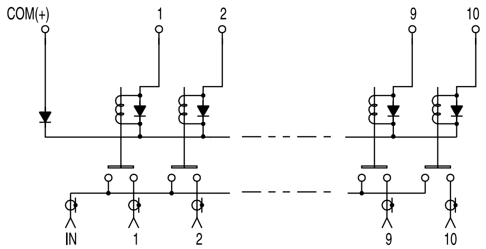
Latching, Common Plus SP10T Switch
with self de-energizing circuitry, control circuitry, suppression diodes and 50 ohm termination, shown in position 1 (B137)



Normally Open, Common Plus SP10T Switch
with suppression diodes and 50 ohm termination on each unused position (D13)



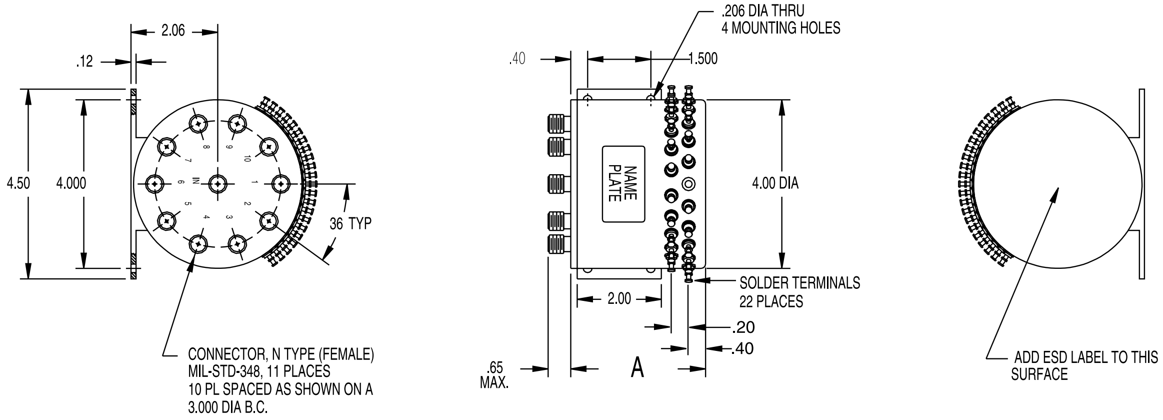
Latching, Common Plus SP10T Switch
with self de-energizing circuitry, indicator circuitry and suppression diodes, shown in position 1 (B1237)

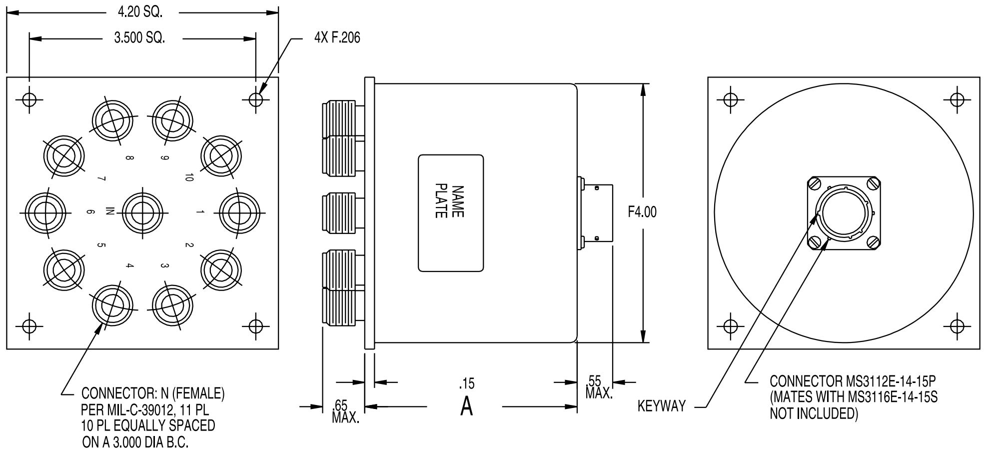


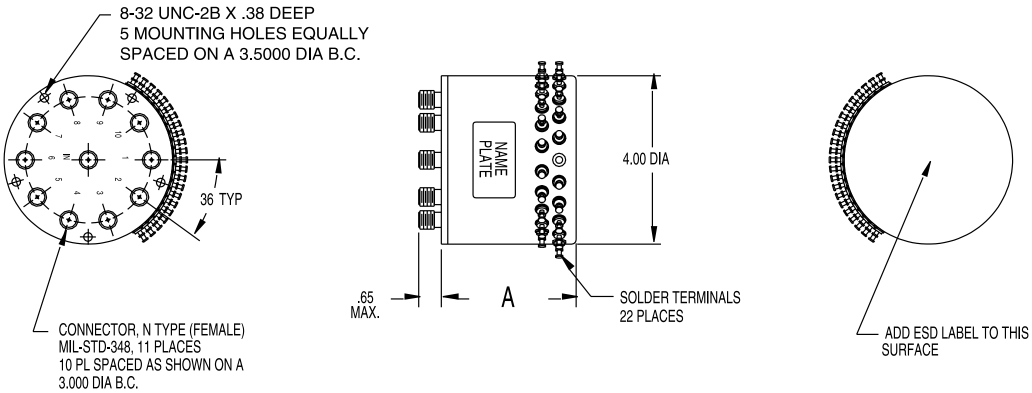
Normally Open, Common Plus SP10T Switch
with suppression diodes (D3)

NOTE: for 093 series switches eliminate position 10.

Typical Outline Drawings

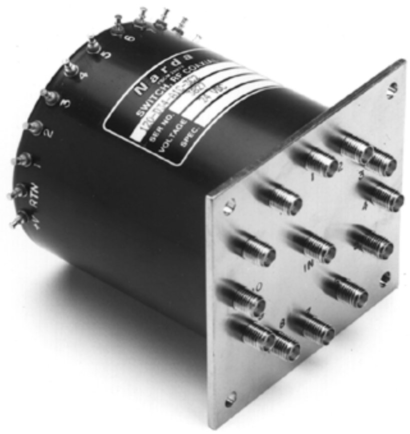






NOTE: for 093 series switches eliminate position 10.

Dimensions in inches, unless otherwise specified.



DC-12.4 GHz, SMA

SP11T-SP12T Series 110-120

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4
VSWR (max.)	1.2	1.4	1.8
Insertion Loss (dB max.)	0.2	0.35	0.7
Isolation (dB min.)	80	70	60

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Normally Open: 180 mA (max.)
.... Latching: (n)** x 100 mA
.... DA: 400 mA
Switching Time .... 15 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C
** n = number of positions

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.35	D, DA	0,3
2.70	B, C	2,3,7
2.70	D, DA	2,3
2.91‡	B, C	2,3,4 OR 5,7,Y
2.91‡	D, DA	2,3,4 OR 5,Y

‡ Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-16-26P mating with MS3116E-16-26S.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
- B - LATCHING
- C - LATCHING RESET
- D - NORM OPEN
- DA - NORM OPEN FAILSAFE TO POSITION 1

GROUP 3 OPTIONS
- 0 - NONE
- 1 - 50 OHM TERMINATION
- 2 - INDICATOR CIRCUITRY
- 3 - SUPPRESSION DIODES
- 4 - TTL LOGIC HIGH
- 7 - SELF DE-ENERGIZING CIRCUITRY
- 9 - OTHER (SPECIFY)
- V - MOSFET DRIVER
- Y - BCD TTL DECODER

GROUP 4 RF CONNECTORS
- A - SMA

GROUP 5 TERMINALS
- 1 - SOLDER (STANDARD)
- 2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
- 3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
- 4 - SOLDER (LOOP)
- 5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
- B - 12 VDC
- C - 24 VDC
- D - 28 VDC
- E - 48 VDC
- G - OTHER (SPECIFY)
- H - 15 VDC
- I - 18 VDC

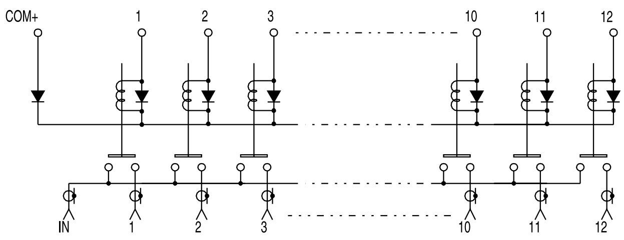
GROUP 7 FREQUENCY
- 0 - DC - 1 GHz
- 1 - DC - 3 GHz
- 2 - DC - 8 GHz
- 3 - DC -12.4 GHz
- 7 - OTHER (SPECIFY)

GROUP 8 POLARITY
- A - COMMON PLUS
- B - COMMON MINUS
- C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

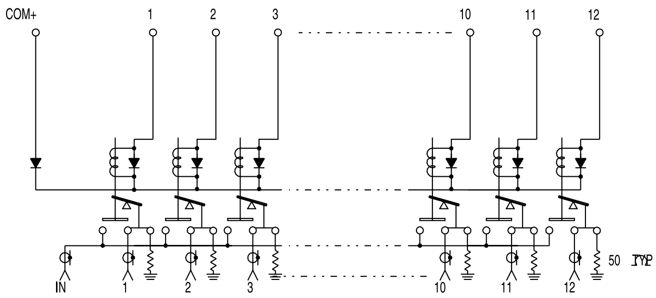
GROUP 9 MOUNTING
- 0 - STANDARD MOUNTING HOLES
- 1 - BRACKET
- 2 - FLANGE
- 3 - OTHER (SPECIFY)

Standard Custom Electro-Mechanical Switches

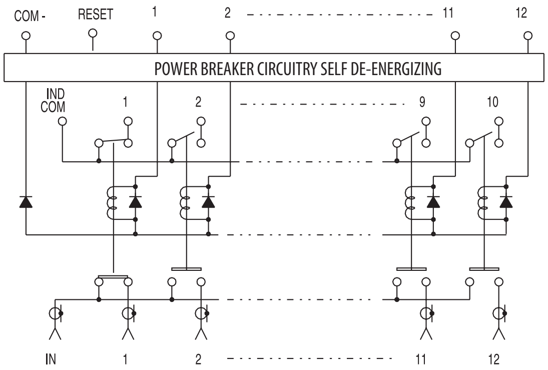
Typical Schematics



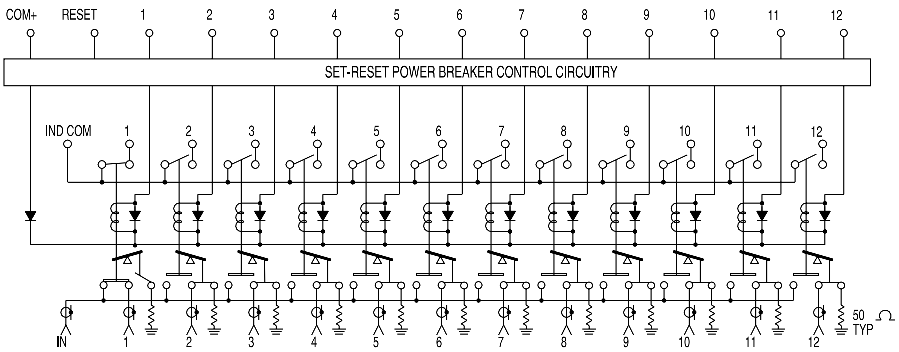
Normally Open, Common Plus SP12T Switch
with suppression diodes (D3)



Normally Open, Common Plus SP12T Switch
with suppression diodes and 50 ohm termination
on each unused position (D13)



Latching, Common Negative SP12T Switch
with self de-energizing circuitry, reset function, indicator circuitry
and suppression diodes, shown in position 1 (C237)

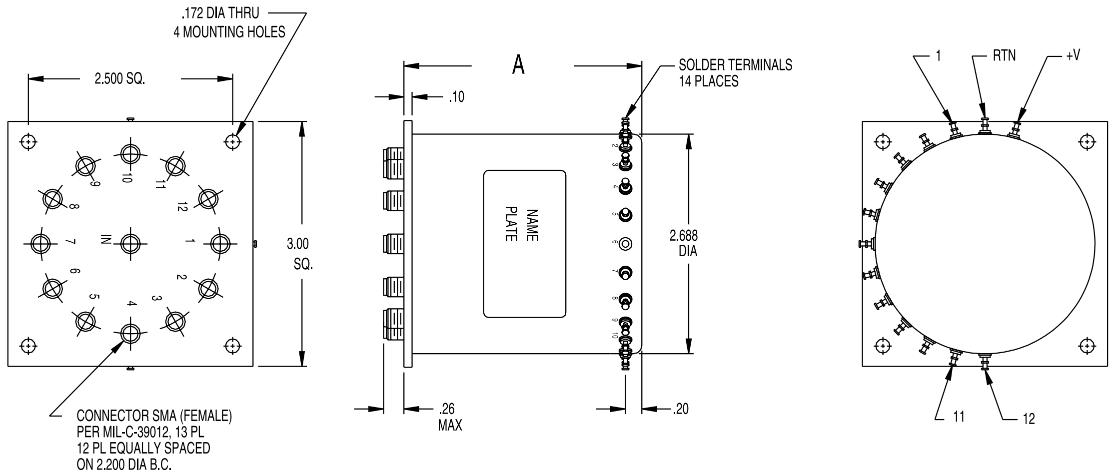


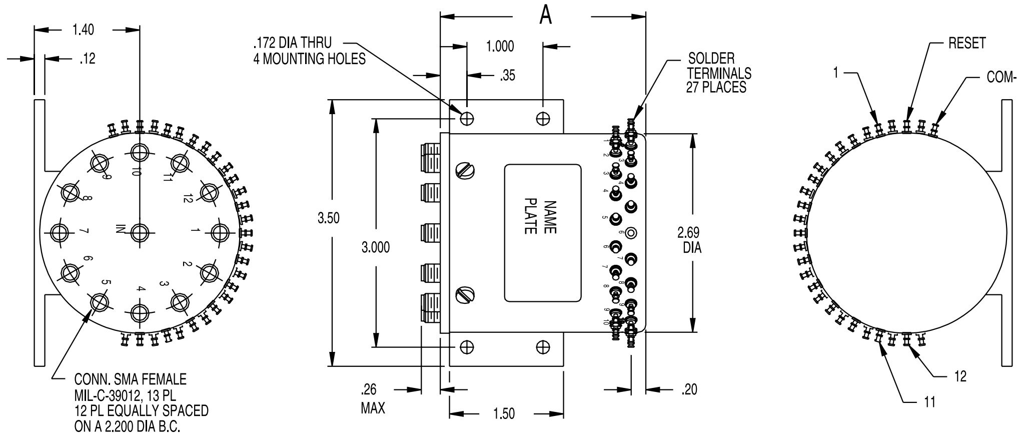
Latching, Common Plus SP12T Switch
with self de-energizing circuitry, reset function,
indicator circuitry, suppression diodes and 50-ohm termination,
shown in position 1 (C1237)

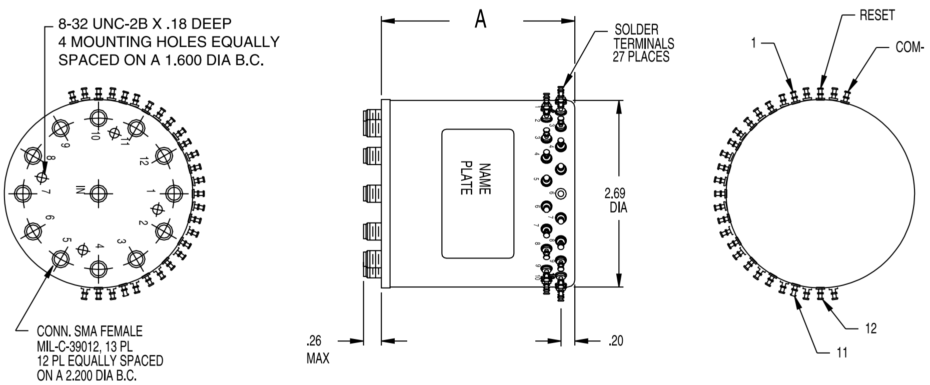
NOTE: for 110 series switches eliminate position 12.

Standard Custom Electro-Mechanical Switches

Typical Outline Drawings







NOTE: for 110 series switches eliminate position 12.

Dimensions in inches, unless otherwise specified.

Selecting a Transfer Switch

The following pages describe several types of transfer switches (DP2T) offered by Narda-MITEQ. Important distinc-tions among these models are noted here to help the user select the correct switch for a specific application:

Series 130

Basic high performance DP2T transfer switch. Frequency range up to 26.5 GHz with SMA connectors.

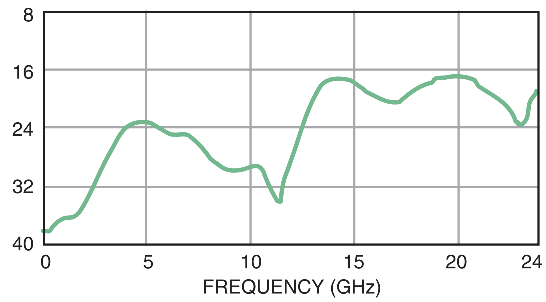
Series 132

DP2T switch available with either TNC or Type N con-nectors. Handles greater RF power than the 130 series. Frequency range up to 12.4 GHz.

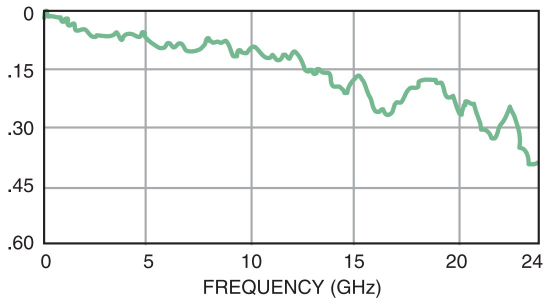
Series 136

Smallest DP2T switch available. Frequency range up to 26.5 GHz with SMA connectors.

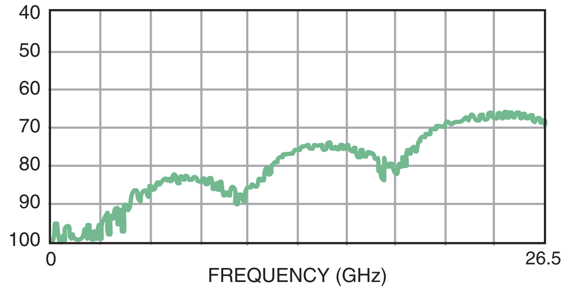
TYPICAL RETURN LOSS (dB)
130 SERIES SMA CONNECTORS

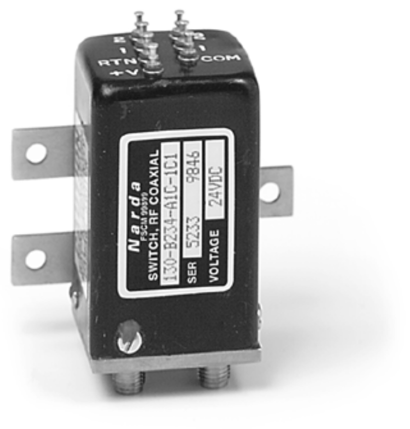


TYPICAL INSERTION LOSS (dB)
130 SERIES SMA CONNECTORS



TYPICAL ISOLATION (dB)
130 SERIES SMA CONNECTORS





DC-26.5 GHz, SMA

DP2T Series 130 Transfer Switch

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-26.5
VSWR (max.)	1.2	1.3	1.4	1.5	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.7
Isolation (dB min.)	80	70	60	60	50

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Failsafe: 280 mA (max.)
.... Latching: 350 mA (max.)
Switching Time .... 15 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Standard SEM models from this series are available from stock. See page 230 for a complete listing of stock switches, XSEM series.

Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
1.73	A, D	0,2,3
1.73	B	0,2
2.10	A, D	2,3,4 or 5,V
2.10	B	2,3,4 OR 5,7,V
2.50**	B	2,3,4 OR 5,7,V
2.50**	A, D	2,3,4 OR 5,V

** Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-12-8P mating with MS3116E-12-8S

Options Available (refer to pages 231-232)

GROUP 2 ACTUATION
A - FAILSAFE
B - LATCHING

GROUP 3 OPTIONS
0 - NONE
2 - INDICATOR CIRCUITRY
3 - SUPPRESSION DIODES
4 - TTL LOGIC HIGH
7 - SELF DE-ENERGIZING CIRCUITRY
9 - OTHER (SPECIFY)
V - MOSFET DRIVER

GROUP 4 RF CONNECTORS
A - SMA
G - OTHER (SPECIFY)

GROUP 5 TERMINALS
1 - SOLDER (STANDARD)
2 - POWER CON-NECTOR, FAST DISCONNECT (STANDARD MIL)
3 - POWER CON-NECTOR, FAST DISCONNECT (SUB MIN. "D")
4 - SOLDER (LOOP)
5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
E - 48 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

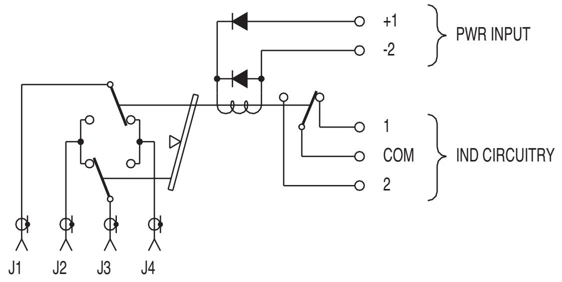
GROUP 7 FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
4 - DC - 18 GHz
5 - DC - 18.5 GHz
6 - DC - 26.5 GHz
7 - OTHER (SPECIFY)

GROUP 8 POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

GROUP 9 MOUNTING
0 - STANDARD MOUNTING HOLES
1 - BRACKET
3 - OTHER (SPECIFY)

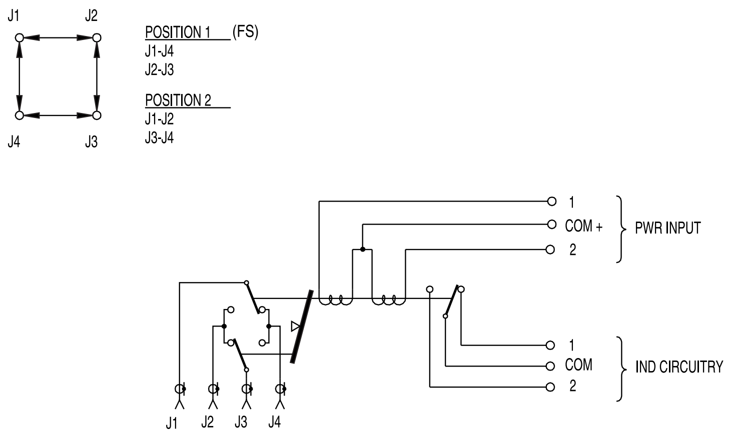
Standard Custom Electro-Mechanical Switches

Typical Schematics



SCHEMATIC SHOWN IN FAILSAFE POSITION

Failsafe, Common Plus DP2T Switch
with indicator circuitry and suppression diodes (A23)

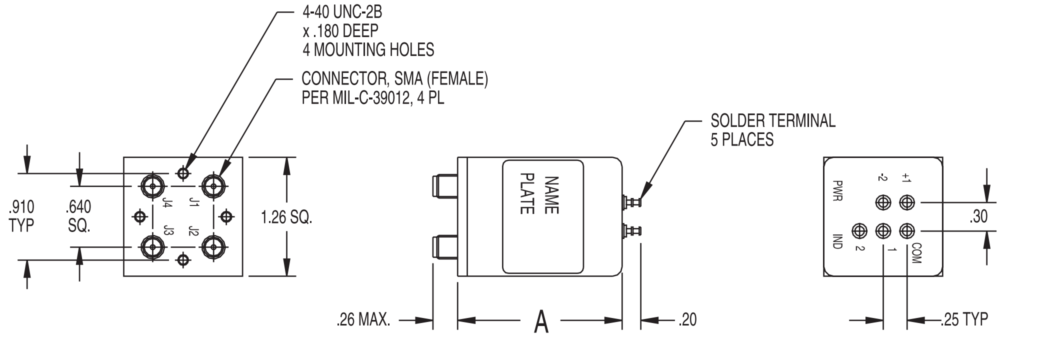


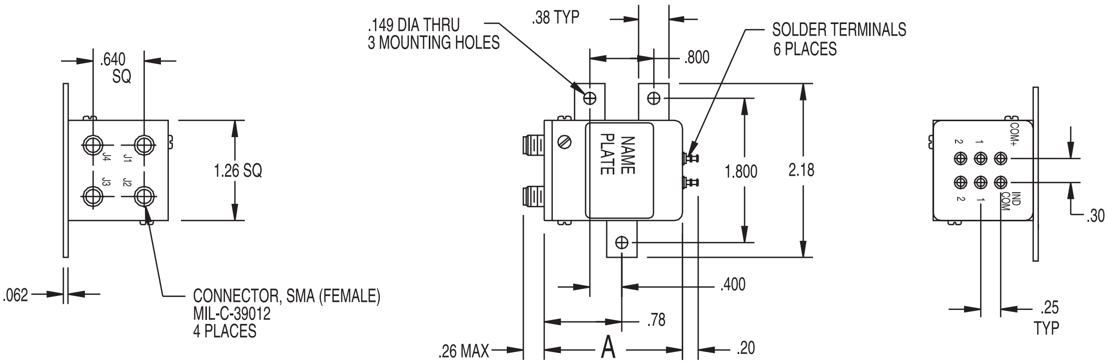
SCHEMATIC SHOWN WITH POSITION 1 CLOSED

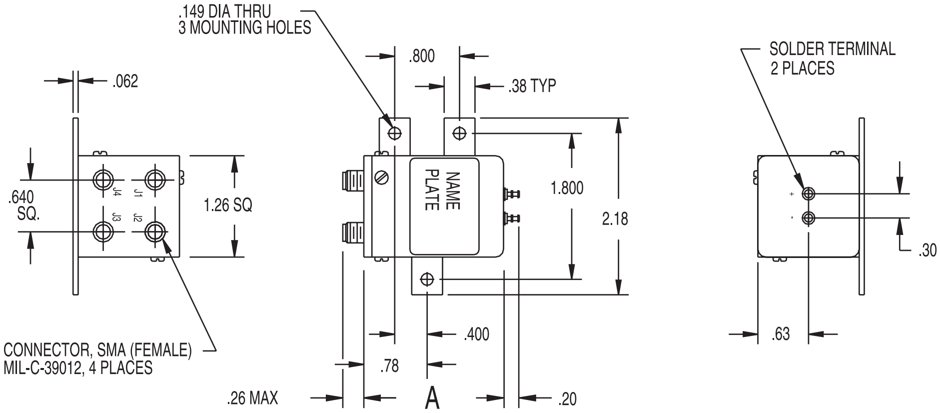
Latching, Common Plus DP2T Switch
with indicator circuitry (B2)

Standard Custom Electro-Mechanical Switches

Typical Outline Drawings







Dimensions in inches, unless otherwise specified.

Standard Custom Electro-Mechanical Switches

DC-12.4 GHz, Type N and TNC

DP2T Series 132 Transfer Switch

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4
VSWR (max.)	1.2	1.35	1.5
Insertion Loss (dB max.)	0.2	0.35	0.5
Isolation (dB min.)	80	70	60

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 28 Vdc
Actuating Current* .... Failsafe: 360 mA (max.)
.... Latching: 360 mA (max.)
Switching Time .... 20 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
A - FAILSAFE
B - LATCHING

GROUP 3 OPTIONS
0 - NONE
2 - INDICATOR CIRCUITRY
3 - SUPPRESSION DIODES
4 - TTL LOGIC HIGH
7 - SELF DE-ENERGIZING CIRCUITRY
9 - OTHER (SPECIFY)
V - MOSFET DRIVER

GROUP 4 RF CONNECTORS
D - TYPE N
E - TNC
G - OTHER (SPECIFY)

GROUP 5 TERMINALS
1 - SOLDER (STANDARD)
2 - POWER CONNECTOR, FAST DISCONNECT (STANDARD MIL)
3 - POWER CONNECTOR, FAST DISCONNECT (SUB MIN. "D")
4 - SOLDER (LOOP)
5 - OTHER (SPECIFY)

GROUP 6 VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
E - 48 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

GROUP 7 FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
7 - OTHER (SPECIFY)

GROUP 8 POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

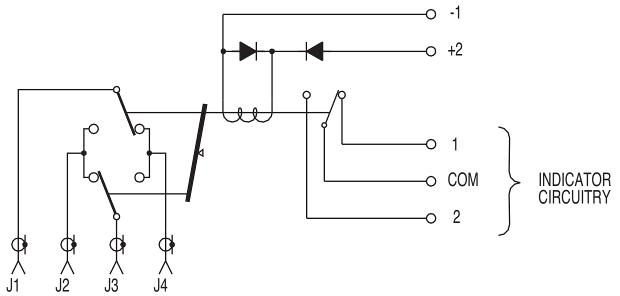
GROUP 9 MOUNTING
0 - STANDARD MOUNTING HOLES
1 - BRACKET
3 - OTHER (SPECIFY)

Switch Height (A) for Selected Options

DIM A ±.03	GROUP 2 ACTUATION	GROUP 3 OPTIONS
2.13	A, D	0,2,3,4 or 5,V
2.13	B	0,2,3,4 OR 5,7,V
2.63**	B	0,2,3,4 OR 5,7,V
2.63**	A, D	0,2,3,4 OR 5,V

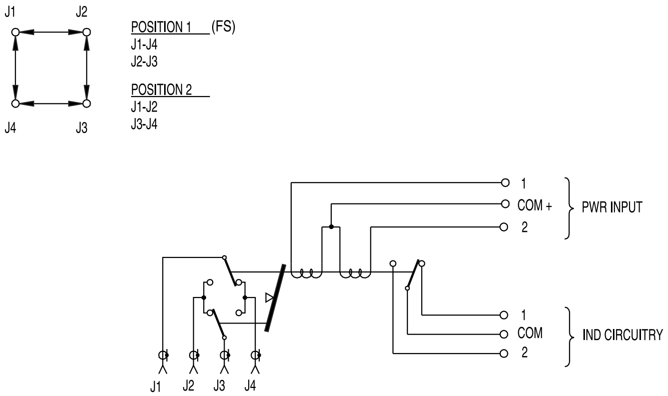
** Dimension for switches with Standard Narda-MITEQ Power Connector MS3112E-12-8P mating with MS3116E-12-8S

Typical Schematics



SCHEMATIC SHOWN IN FAILSAFE POSITION

Failsafe, Common Plus DP2T Switch
with indicator circuitry and suppression diodes (A23)

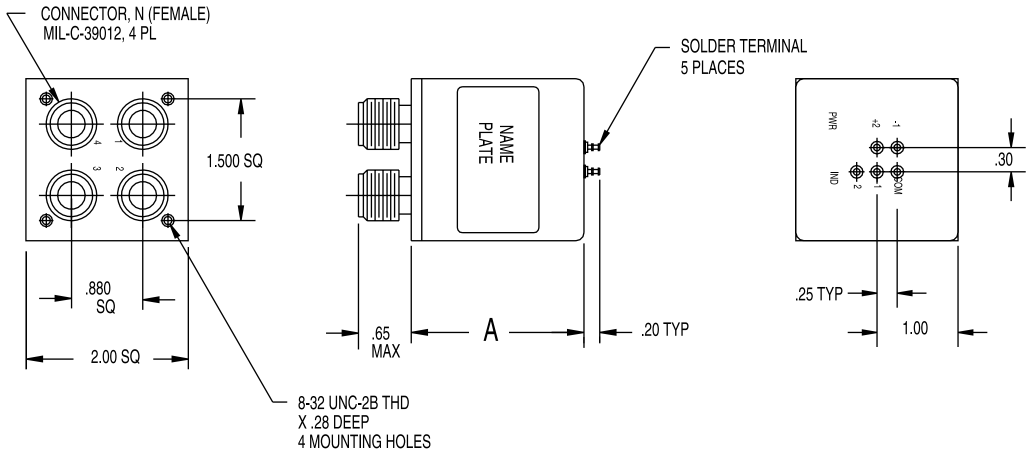


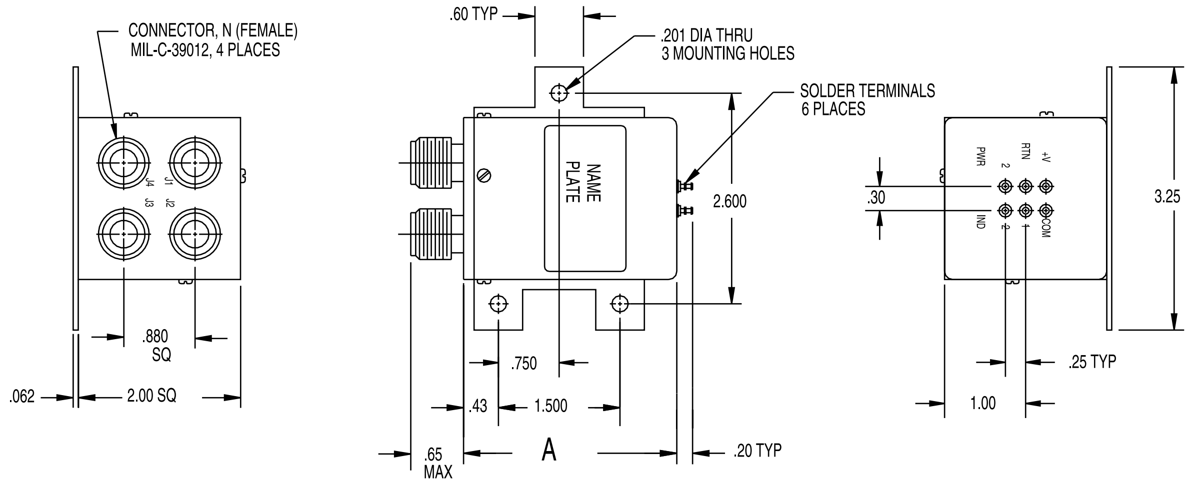
SCHEMATIC SHOWN WITH POSITION 1 CLOSED

Latching, Common Plus DP2T Switch
with indicator circuitry (B2)

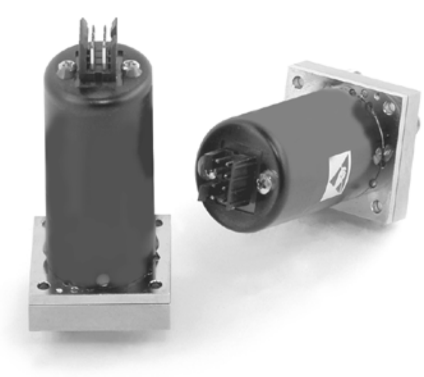
Standard Custom Electro-Mechanical Switches

Outline Drawings





Dimensions in inches, unless otherwise specified.



DC-26.5 GHz, SMA

DP2T Series 136 Transfer Switch

RF Performance

Freq. Range (GHz)	DC-3	3-8	8-12.4	12.4-18	18-26.5
VSWR (max.)	1.2	1.3	1.4	1.5	1.7
Insertion Loss (dB max.)	0.2	0.3	0.4	0.5	0.7
Isolation (dB min.)	80	70	60	60	50

Additional Specifications

RF Impedance .... 50 ohms nominal
Actuating Voltage* .... 12 Vdc
Actuating Current* .... Failsafe: 650 mA (max.)
.... Latching: 775 mA (max.)
Switching Time .... 20 ms (max.)
Switching Sequence .... Break Before Make
Operating Ambient Temperature .... -35°C to +70°C
Operating Life .... 1 Million Cycles per Position

* Specifications for 28 Vdc, 25°C

NOTES:
Designed to meet MIL-S-3928.
Power Handling shown on page 235.

Switch Height (A) for Selected Options

DIM A ±.03	GROUP 5 TERMINAL
1.5	1
2.1**	3

** Dimension for switches with Standard Narda-MITEQ Power Connector M24308/3-1 mating with M24308/1-1

Options Available *(refer to pages 231-232)*

GROUP 2 ACTUATION
A - FAILSAFE
B - LATCHING

GROUP 3 OPTIONS
0 - NONE
3 - SUPPRESSION DIODES
9 - OTHER (SPECIFY)

GROUP 4 RF CONNECTORS
A - SMA
G - OTHER (SPECIFY)

GROUP 5 TERMINALS
1 - STANDARD POWER CONNECTOR

GROUP 6 VOLTAGE
B - 12 VDC
C - 24 VDC
D - 28 VDC
E - 48 VDC
G - OTHER (SPECIFY)
H - 15 VDC
I - 18 VDC

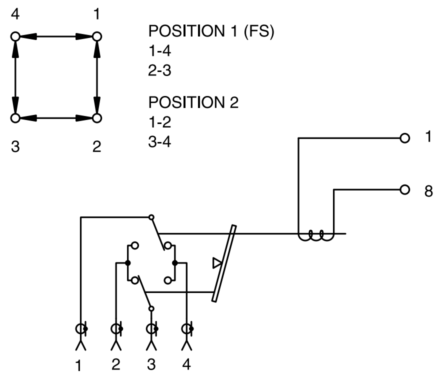
GROUP 7 FREQUENCY
0 - DC - 1 GHz
1 - DC - 3 GHz
2 - DC - 8 GHz
3 - DC - 12.4 GHz
4 - DC - 18 GHz
6 - DC - 26.5 GHz
7 - OTHER (SPECIFY)

GROUP 8 POLARITY
A - COMMON PLUS
B - COMMON MINUS
C - NOT RELEVANT TO APPLICATION OR SWITCHES WITH LOGIC

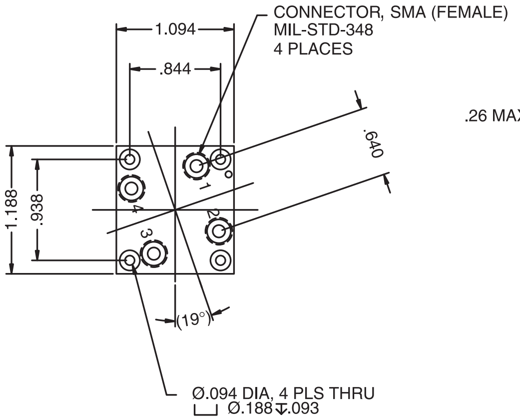
GROUP 9 MOUNTING
2 - FLANGE

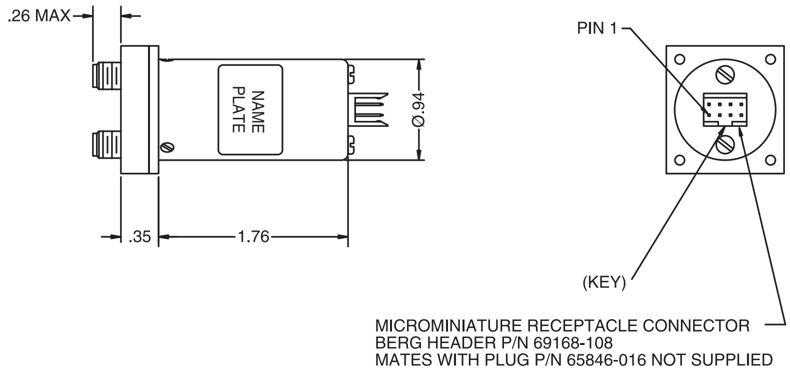
Standard Custom Electro-Mechanical Switches

Typical Schematics and Outline Drawings



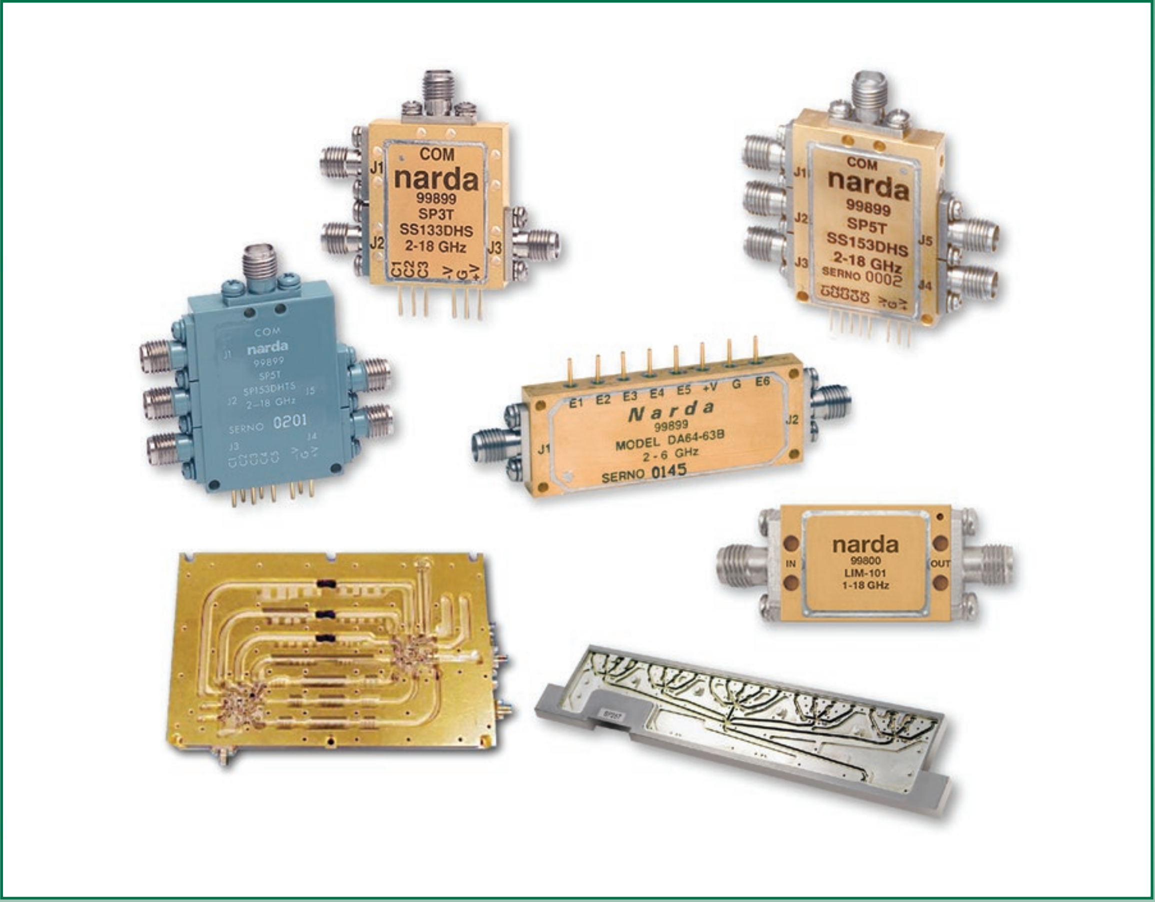
SCHEMATIC SHOWN IN FAILSAFE POSITION





Dimensions in inches, unless otherwise specified.

Solid State PIN Control Products



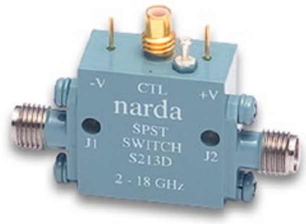
narda MITEQ

Solid State PIN Control Products

Quick Reference Guide

RF and Microwave PIN Control Products Application and Selection

A Guide to Help Designers Make the Best Selection When Specifying Switches, Attenuators and Limiters



- Fundamental PIN Diode Principles
- Primary Design Parameters
- Application Specific Considerations
- A Glossary of Key PIN Diode Terms

Introduction

RF and microwave components based on PIN diodes have been essential tools in the designer's toolkit for decades, and with good reason: their unique characteristics make them the best choice for a wide variety of control applications, such as switches, attenuators, phase shifters, limiters and modulators.

PIN diodes are fundamentally similar to standard diodes, but have an RF impedance that is determined by an externally supplied bias current. Their versatility makes them excellent building blocks in a wide variety of configurations within each product category, which allows diverse system requirements to be served. In short, the PIN diode enables all systems – from the least complex to the most sophisticated – to achieve their intended missions, while requiring very little space, power or cost.

There are many resources that provide both practical and theoretical information about PIN diode theory, characteristics and incorporation in modules and subsystem designs. However, practical information about choosing the proper PIN-diode-based product for a specific application is conspicuously absent. "RF and Microwave PIN Control Product Application and Selection" has been created to fill this void. It includes basic discussions of PIN diode characteristics, the most commonly used PIN-diode-based products, and the trade-offs encountered in designing products around them. The merits of various types of control products within a specific category (analog and digital attenuators, for example) are discussed as well.

PIN Diode Switches

Switches that control the path of RF power from very low frequencies through the low millimeter-wave range are the most common application for PIN diodes. The level of DC bias applied to the diode determines its impedance. In the case of a PIN diode mounted in series with a transmission line, when the bias changes the impedance from a low value to a high value, the circuit acts as a switch. That is, the switch is in the "on" state when forward biased (low impedance), and in the "off" state when zero or reverse biased (high impedance). The attenuation produced by the diode switch is called insertion loss (IL) when the switch is in the "on" state, and isolation when in the "off" state.

In a simple SPST PIN diode switch (Figure 1), the diode can be either series or shunt connected. The series-connected PIN diode configuration can provide reasonably low insertion loss over a multi-octave frequency range, but with lower power-handling capability. Design and fabrication are also simpler because no holes are required in the circuit board to mount shunt diodes.

In series diode switches, insertion loss is dependent on the series resistance of the PIN diode while isolation is primarily dependent on the junction capacitance. These parameters are determined by the forward bias current and reverse bias voltage, respectively.

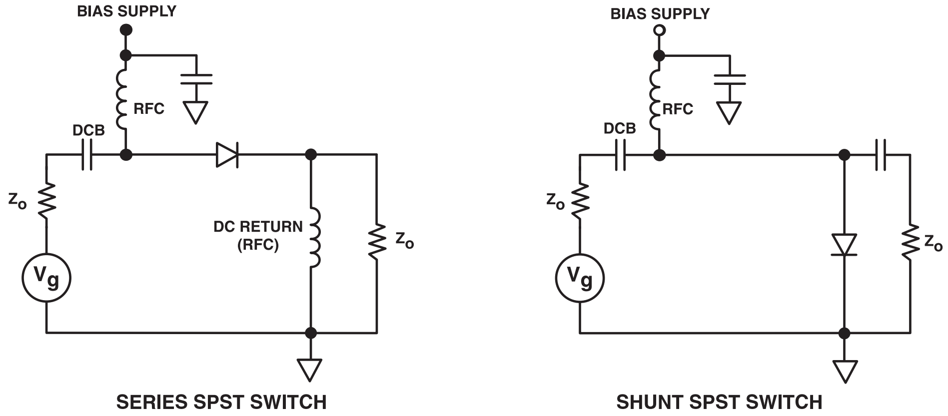


Figure 1

The shunt-connected PIN diode configuration optimizes high isolation and low loss across a wide frequency range (up to several octaves), and can handle higher power levels because the diodes are mounted directly to the housing. The shunt switch is "on" when the diode is zero or reversed biased, and off when forward biased (the opposite of the series switch).

The insertion loss of a shunt-connected diode at a given frequency is primarily dependent on its junction capacitance (C_j), while the isolation provided by the diode is dependent on its series resistance (R_s) when the diode is forward biased. A combination series-shunt topology is also used and provides very wideband performance, high speed and moderate power-handling ability and insertion loss.

Multi-throw switches can be configured in two ways to achieve improved performance. In the first method (Figure 2a), PIN diodes series-connected to the common junction and the diodes in the "on" port are forward-biased while the remaining diodes are reverse-biased. The result is a low-loss path for the "on" port and minimal loading by the "off" ports.

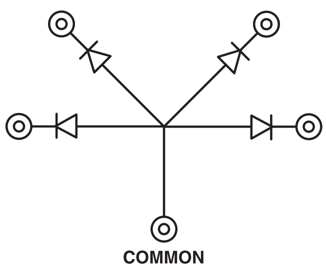


Figure 2a - Shunt Diodes Located Quarter Wave Length from Common Junction

In the second method (Figure 2b), shunt-connected PIN diodes are placed one-quarter wavelength from the common junction, and the selected diodes of the "on" port are reverse-biased while the "off" ports are forward-biased. The result in this case is an electrical short across each "off" transmission line, and the quarter-wavelength spacing transforms the shorts to open circuits at the junction. These techniques are optimized through prudent choice of transmission line impedances while keeping stray reactance low, resulting in a switch with acceptably low insertion loss and VSWR, and a 3:1 bandwidth.

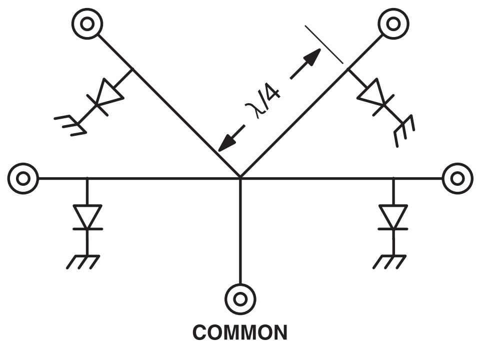


Figure 2b - Series Diodes at Common Junction

While it is possible to achieve isolation somewhat greater than 40 dB with a single PIN diode (either series or shunt-connected) at lower microwave frequencies, it is typically necessary at higher frequencies to increase the number of switch elements by using additional series-mounted and shunt-connected PIN diodes in each arm.

The isolation elements of a switch (series or shunt diodes) are usually spaced a quarter-wavelength apart. This results in a value of isolation 6 dB greater than the sum of the isolation that is provided by each pair of diodes. This structure can be repeated several times to achieve greater than 90 dB isolation.

Key PIN Diode Switch Parameters

Insertion loss, isolation, switching speed and power handling ability are typically the parameters used to describe switch performance. However, there are other key parameters.

Video Leakage

The spurious signals at the switch's RF ports when there is no RF signal present are collectively called video leakage. The switch driver produces these signals, specifically at the leading edge of the voltage spike provided for high-speed switching. There can actually be video spikes of ±10 Vdc present in a system with a 50 ohm impedance, although ±1.5 to ±3.0 Vdc is more common. Most of the RF energy in the video spike is below 200 MHz but in very high speed, broadband switches, there can be appreciable RF energy (-60 to -50 dBm) produced – as high as 1 GHz. High-pass filters can reduce the level of low-band video leakage components, but signals within the passband of the switch (in-band video leakage) cannot be filtered out. In-band video leakage can be reduced only by using a switch with a slower switching speed or by very carefully tailoring the drive waveform to suit the particular type of PIN diode being used.

Harmonics and Distortion

PIN diodes, like all diodes, are nonlinear in their response characteristics, and as a result produce harmonics and intermodulation distortion (IMD) products. Fortunately, these products are usually at very low levels in a PIN diode switch because the diodes themselves are either in a saturated, forward-biased condition or are reversed-biased. The minority carrier lifetime of the diode determines the level of IMD. A PIN diode switch's IMD performance is usually described by its third-order output intercept point (OIP). Good OIP performance for typical PIN switches ranges from +35 dBm to +45 dBm. The level of harmonics and IMD varies widely among devices, so it is important to read the manufacturer's specifications for these parameters for every model considered.

Minority Carrier Lifetime

This specification is very important from the perspective of both diode and circuit design. Carrier lifetime (T_L) is a property of the semiconductor material, and when the PIN diode is forward biased, injection of electrons and holes occurs from the N+ and P+ contacts respectively. These carriers have a finite lifetime, and the average time before they recombine is the carrier lifetime. Recombination takes place through interaction between the crystal lattice and impurities in the "I" region and P+ and N+ regions of the diode. The carrier lifetime in a PIN diode controls the switching speed, i.e., the time required to switch the diode from a low-impedance forward bias state to a high-impedance reverse bias state. This transition is the slower of the two transitions in a switching application since the driver circuit is attempting to remove stored charge from the PIN diode.

Switching speed and minority carrier lifetime are directly related. To visualize their interaction, it helps to examine the relationship of minority carrier lifetime and its forward and reverse current ratio (I_f/I_r) in the following equation:

$$T_{rr}=T_L \log (1 + I_f / I_r)$$

where

T_{rr} is the diode's switching speed (commonly referred to as "reverse recovery time"), and

T_L is the minority carrier lifetime

This equation describes the dependence of switching time on the minority carrier lifetime and the "I_f / I_r" ratio.

Switching Speed

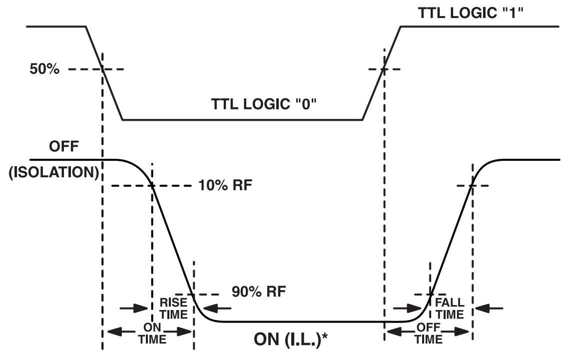


Figure 3 - Detected RF Power

a) Rise Time And Fall Time: These parameters, fundamental to many designs, are actually composed of several subsets, each one defining the time required for switching to take place between two states in the switch response (Figure 3). Rise time is defined as the period between full "off" and full "on," specifically from 10 percent of this condition to 90 percent of the square-law-detected RF power. Conversely, fall time is the period between 90 percent of full "on" to 10 percent of full "off." Rise time and fall time do not include driver propagation delays.

b) Switching Time (On Time and Off Time): The time lapse between 50 percent of the input control signal from the driver to 90 percent of the square-law-detected RF power when the device is switched from full "off" to full "on" is called the "on" time. The "off" time begins when the 50 percent point of control signal occurs, to the point when it achieves 10 percent of its square-law detected RF power and the unit is switched from full "on" to full "off." On and off times include driver propagation delays.

c) Modulating Switching Mode in Multichannel Switch: Mode when all the channels are in the isolation state and one of the channels is switching from "on" to "off."

d) Commutating Switching Mode in Multichannel Switch (Port-to-Port): Mode when two channels are switching simultaneously: one from "on" to "off" and another from "off" to "on." Switching time is the larger of the time for 1 port to go to 10 percent RF, and the other port to go to 90 percent RF.

For reflective switches, the switching time in the Commutation mode is typically slightly longer than in the modulation mode (5-10 ns).

For absorptive switches, Commutation time is dependent on switch topology. All series switches, and some series shunt switches, have Commutation times that are signigicantly longer than the Modulation Time. If Commutation switching time is required, please contact the factory.

ALL SPECIFICATIONS FOR SWITCHING SPEED IN THE NARDA-MITEQ CATALOG ARE FOR MODULATION SWITCHING SPEED.

Performance Trade-Offs

The design of any subsystem invariably requires trade-offs in one or more areas of performance. Optimizing a design for one performance parameter often occurs at the expense of another. Such is the case with PIN diode switches.

Power vs. Frequency

Junction capacitance can be reduced in order to ensure low loss at higher operating frequencies. For a given switching speed, junction capacitance can be lowered by decreasing the area of the diode. This increases the diode's thermal impedance, producing a reduction in power-handling ability.

Power vs. Switching Speed

To optimize power-handling ability, the diode's junction area must be large (hence lower thermal impedance). This increases the diode's junction capacitance, resulting in higher insertion loss, lower isolation (in a series switch configuration), and usually smaller bandwidths. To maintain low capacitance, the diode's "I" region thickness must be increased to compensate for the increase in capacitance caused by the increased junction area. The increased length of the "I" region raises the minority carrier lifetime, which increases switching speed. An added benefit of increasing the diode's junction area is a reduction in its forward-biased resistance, improving isolation in a shunt switch.

Frequency and Bandwidth

For a shunt configuration, the insertion loss (in dB) caused by the diode is given by:

$$10 \log [1 + 2 (Z_0 \pi F C_j) 2] \quad \textbf{for reverse bias}$$

As the diode's capacitance increases, the switch's insertion loss increases dramatically.

For a shunt configuration, the switch isolation in dB is given by:

$$20 \log \left[1 + \frac{Z_0}{2 R_s}\right] \quad \textbf{for forward bias}$$

where

Z_0 is the circuit's characteristic impedance

F is the RF frequency of interest

C_j is the diode's junction capacitance

R_s is the diode's forward-biased resistance

Reflective Switches

A reflective switch is one in which the incident power at the "off" port is reflected back to the source as a result of the impedance mismatch presented by the PIN diode. In contrast, an absorptive switch is designed to present a 50 ohm impedance in the "off" state, and to absorb incident power.

Typical reflective switches (Figure 4) include the previously described SPST series configuration, and an all-shunt arrangement, with its inherently higher power-handling ability and switching speed. The operating bandwidth of the switch is determined by the blocking capacitors selected, the bias circuitry and the diode's reverse-bias capacitance. Reducing the diode's shunt resistance increases isolation in this type of switch. This reduction is achieved either by increasing the current or decreasing the diode's overall resistance. In addition, by adding a fourth shunt diode, isolation can be increased, which is accompanied by an increase in insertion loss, but with little impact on power handling and switching speed.

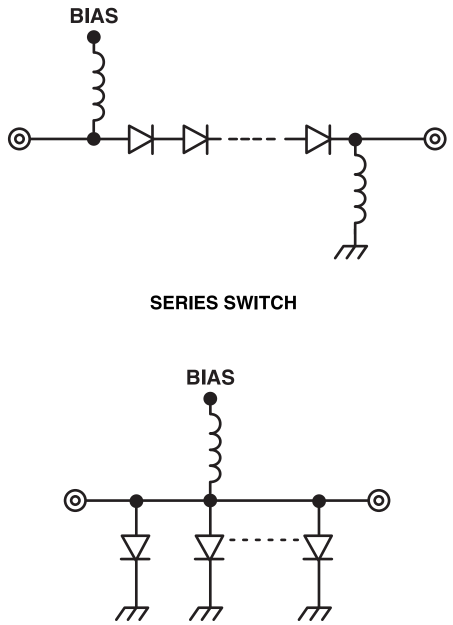


Figure 4 - Reflective SPST switch

Multi-Throw Reflective Switches

Taking this design to a multi-throw configuration (Figure 5), the low insertion loss at the "on" port must be isolated from the high insertion loss at the "off" port with a series PIN diode. Isolation at the "off" port is a function of frequency and diode capacitance, and isolation will increase as the capacitance of the series diode decreases. However, increased bandwidth (lower capacitance) comes at the expense of reduced power-handling ability. The number of throws can be extended in this type of switch, limited only by the diode's junction capacitance and the physical size limitations of the switch.

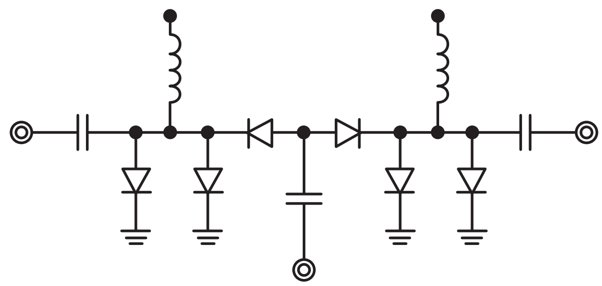
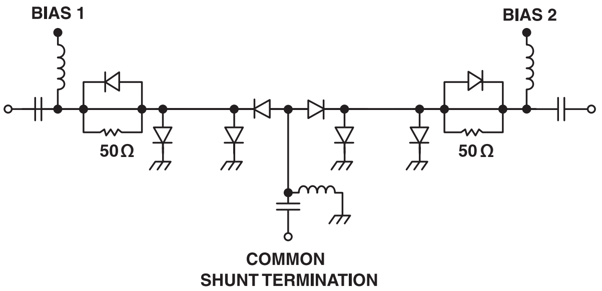


Figure 5 - Reflective SP2T Switch

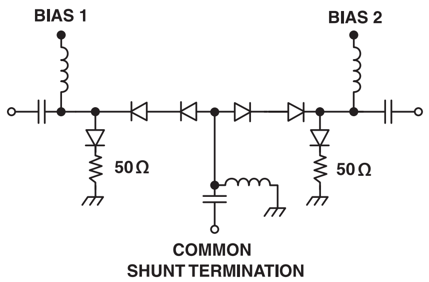
Absorptive Switches

Multi-throw absorptive switches either employ the series-shunt or series with shunt termination approach (Figure 6). The required 50 ohm terminating impedance is achieved by the series combination of the diode and terminating resistance to ground. This type of termination has good high-frequency characteristics, but power-handling ability is limited by the ability of the diodes and resistors to dissipate RF power. In addition, absorptive switches typically exhibit somewhat slower switching speeds. These types of switches are usually not absorptive at their common port (in the "all-off" state) but can be made absorptive for special applications.

Solid State PIN Control Products



Series-Shunt SP2T, Absorptive



Series SPDT with Shunt Termination

Figure 6

Transmit/Receive (T/R) Switches

T/R switches are used to switch a single feedline between a transmitter and receiver and can benefit greatly from PIN diode switch technology. They are more reliable, faster and more rugged than their electro-mechanical counterparts. The basic T/R switch consists of a PIN diode connected in series with the transmitter and a shunt diode connected one-quarter wavelength away from the antenna in the direction of the receiver section (Figure 7). Of course, quarter-wavelength spacing is not practical at low frequencies, so quarter-wavelength lumped elements can be used instead. In T/R switches, the trade-off is between achieving low loss for the receiver path and high power-handling ability for the transmitter path.

When the switch transfers the feedline to the transmitter, each diode becomes forward biased. The series diode appears as a low impedance to the signal approaching the antenna, and the shunt diode shorts the receiver's antenna terminals to prevent overload. Transmitter insertion loss and receiver isolation are dependent on the diode resistance. In the receive condition, the diodes are zero or reverse-biased, and present a low (shunt) capacitance which creates a low-loss path between the antenna and receiver. The "off" (transmitter) port is isolated from this path by the high-impedance series diode.

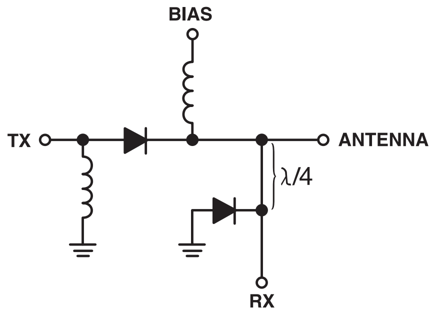


Figure 7 - T/R Switch

A Word on Drivers

A PIN diode switch will perform only as well as its driver allows. The driver must be capable of supplying the necessary reverse-bias voltage in order to achieve the desired diode capacitance, and must source or sink the bias currents required to drive the diodes to their rated forward-bias resistance. In addition, fast switching requires the transition time between driver output levels to be as short as possible. Relatively high voltage "spikes" are also required to remove charge from forward-biased diodes and speed up their switching time.

From the user's perspective, the important parameters are:

- Switching speed and repetition rate
- Number of switch throws
- Number of control lines (i.e., one line per throw or integral switch logic decoders)
- Logic sense (Ø = low-loss state is typical)
- Driver integral to switch assembly or mounted separately. High-speed switch driver circuits are usually built as hybrid (chip and wire) circuits to reduce size and increase speed, and are mounted next to the RF section.

PIN Diode Attenuators

Introduction

PIN diode attenuators range from simple series connected or shunt-connected diodes acting as a lossy reflective switch to more complex structures that maintain a good input match across the full dynamic range of the attenuator. PIN diode attenuator circuits are used extensively in automatic gain control (AGC) and RF leveling applications.

Although other methods are available for providing AGC, such as varying the gain of the RF amplifier, the PIN diode approach results in lower power drain, less frequency pulling, and lower RF signal distortion. Lower attenuator distortion is achieved using diodes with thicker "I" regions and long carrier lifetimes.

In an attenuator, the resistance characteristics of the diode are exploited not only at their extreme high and low values as switches, but also at values in between. Thus, PIN diode attenuators tend to produce less distortion than amplifiers but more than switches. The resistance characteristic of a PIN diode when forward-biased depends on the "I" region thickness, carrier lifetime, and hole and electron mobilities. A PIN diode with a thin "I" region will operate at lower forward-bias currents than a PIN diode with a thick "I" region, but the latter diode will generate less distortion. Careful selection of diode "I" layer thickness can yield a good compromise between attenuator speed, distortion, linearity, and power-handling ability. In addition, it is easier to linearize the driver for thicker diodes.

Notes on Attenuator Performance

Understanding how the following parameters affect performance makes it easier to choose the best type of attenuator for a particular application.

Phase Shift and Attenuation

A PIN diode attenuator's phase shift varies as the attenuation level changes. This is a result of stray PIN diode reactance vs. bias level, or (in the case of a switched-bit attenuator) the different lengths of the transmission paths connecting the diodes that are being switched in or out. It can never be entirely eliminated. However, attenuators can be designed to reduce phase shift to a very low level, especially over narrow bandwidths.

IMD and Harmonics

Every PIN diode-based device generates some level of harmonics and intermodulation products because diodes are non-linear devices. In this regard, switched-bit attenuators outperform analog voltage variable attenuators (VVAs) because switched-bit attenuators are basically just PIN diode switches. That is, their diodes are biased either fully on or fully off.

Power-Handling Ability

An attenuator's power-handling ability is dictated by its design, bias conditions, and switching speed. Generally speaking, faster VVAs handle less power, especially at low frequencies. An attenuator's maximum operating power level is defined as the amount of power required to cause 1 dB attenuation compression. At or near the 1 dB compression point, the attenuator will produce its highest levels of IMD and harmonics. Generally, the faster diodes will handle less power at lower frequencies because of the compression point's dependence on "I" layer thickness. The attenuator's survival rating is dictated by the diodes' survival rating. As might be expected, attenuator power-handling specifications vary considerably and can be tailored to the needs of a specific application.

Monotonicity

This is a required attribute of any type of attenuator, regardless of the application. Without a monotonic attenuation relationship to the analog or digital control commands, the attenuator's accuracy and other characteristics can never be optimal. Non-monotonic behavior can be exhibited by switched-bit attenuators as a result of uncompensated internal VSWR interaction, and in digitally-controlled analog attenuators with errors in digital calibration toward the band edges.

Mean Attenuation

This parameter is the average of maximum and minimum values of attenuation over a given frequency range for a given control signal. It is of particular importance in wideband analog VVAs, as they typically have a parabolic attenuation vs. frequency response, and the minimum-to-maximum attenuation vs. frequency at higher levels can be as large as 5 dB in multi-octave designs.

Attenuation Flatness

The attenuation variation from the mean attenuation over a given frequency range for a given attenuation value is called attenuation flatness, and is expressed in dB.

Attenuation Accuracy

This parameter is the maximum deviation of the mean attenuation from the nominal value of the programmed attenuation, expressed in dB.

Total Attenuation Accuracy

This is the sum of the effects that together produce deviation from the set attenuation value, including the contribution of attenuation accuracy, frequency variation, and temperature.

Comparison of Attenuator Characteristics

Parameter	Switched-Bit	Digitally-Linearized Analog
Switching Speed	Very high (20 ns)	Moderate (>100 ns)
Attenuation Accuracy	High	Highest
Attenuation Flatness with Frequency	Best	Moderate
Power Handling	High	Moderate
Operating Frequency Bandwidth	Broad (2-3 octaves)	Moderate (1 octave)
Resolution	High (1 dB)	Highest (0.25 dB)
Calibration	Fixed	Selectable within unit
Cost	High	Moderate
Survival and Compression Power	High	Moderate

Digitally-Linearized Analog Attenuators vs Switched-Bit Attenuators

There are dozens of possible attenuator configurations, each one with its own unique characteristics that make it better suited for one application over another.

Digitally-Linearized Analog Attenuators

Other than switched-bit types, all attenuators are essentially analog devices. There are as many analog attenuator configurations as there are system applications that require them. This guide covers only digitally-linearized analog attenuators, shunt-mounted diode arrays, and switched-bit attenuators, because they are the most common and versatile types.

Typical VVAs contain from one to four shunt-mounted diodes (Figure 8a). Adjusting the bias current changes the resistance of the PIN diodes, reflecting more of the RF signal, which produces the desired attenuation.

This approach is similar to a reflective switch because it presents a poor match at the input and output ports. Most VVAs of this type are built in pairs and mounted between 3 dB hybrids (Figure 8b). The reflected RF power is absorbed by the termination at the hybrid's isolated port, presenting a good match at the VVA's input and output ports.

An analog driver/linearizer or a digital driver (D/A converter with EPROM) can then be used to calibrate and linearize the VVA's attenuation vs. control signal response.

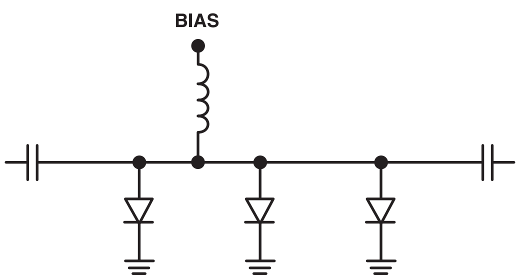


Figure 8a - Reflective

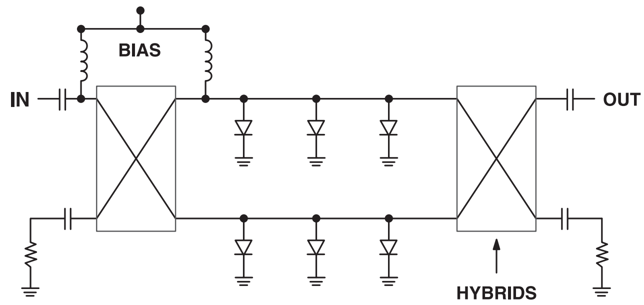


Figure 8b - Non-Reflective

Digitally-Controlled Switched-Bit Attenuators

When broadband, ultra-fast switching performance is needed, the digitally-controlled switched-bit attenuator is the only solution. It excels in attenuation accuracy and flatness over broad frequency ranges, and its switching speed is equivalent to a high-speed PIN diode switch (25 ns or better). Its only disadvantages are higher insertion loss and higher cost.

The digitally-controlled attenuator's topology is based on switching fixed attenuator pads in or out of the RF path using PIN diode SP2T switches. It uses one control bit per attenuator pad, and attenuation step size is determined by the lowest attenuator pad value. The total attenuation range is the sum of all the attenuator pads.

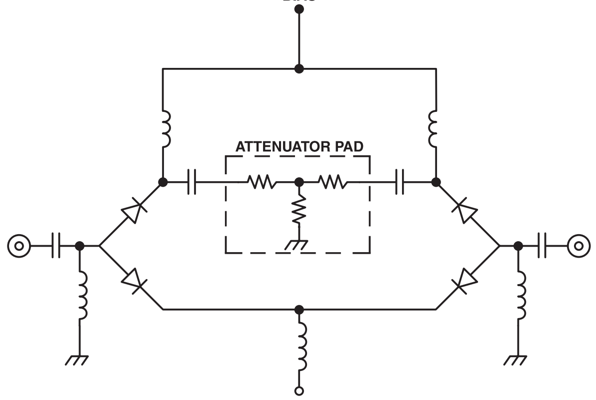


Figure 9

As stated earlier, attenuators are designed to match the requirements of specific applications. When the application requires fast switching speed combined with high power-handling ability (as in electronic warfare systems, for example), the switched-bit attenuator is the optimum choice (Figure 9). It employs one or more pairs of SP2T switches, with a low-loss connection between one pair of outputs, and a fixed attenuator between the other outputs. The diodes are switched between their forward-biased and reverse-biased states, which gives the attenuator higher switching speed.

The switched-bit attenuator achieves low, consistent VSWR performance throughout its dynamic range, and its power-handling ability (i.e., compression point and IMD) is also higher than that of an analog VVA because it uses PIN diode switches.

Of course, like all attenuator types, the switched-bit attenuator has some disadvantages. Its smallest attenuation step size at microwave frequencies is limited to about 0.5 dB because of VSWR interaction among the various high-loss and low-loss transmission paths and their associated bias circuits. This interaction also causes attenuation ripple, which can cause slight degradations in monotonicity. These errors are usually less than about ±0.5 dB.

Finally, the switched-bit attenuator is a comparatively complex RF circuit with more components, and is usually more expensive. These considerations aside, the high speed and power handling abilities of the switched-bit attenuator make it appealing for demanding applications.

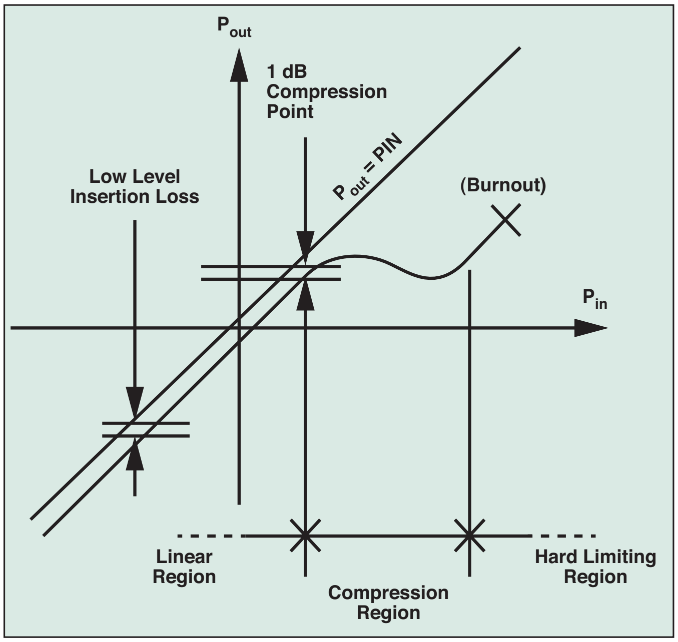
Limiters

Narda-MITEQ offers PIN diode based limiters supporting up to 500 W of pulsed power. The limiters can be supplied as stand alone devices, or as integrated assemblies that include the limiter and other microwave components such as: switches, attenuators, filters, amplifiers, etc.

Definition of Parameters

Input 1 dB Compression Point:

At the Input 1 dB compression point, the output power will start to compress and be 1dB below the value if it was linear.



Recovery Time:

The time period from the end of a high power pulse to the point where the insertion loss value has returned to within 3 dB of the quiescent loss state.

Spike Leakage:

After pulsed high power is applied, the limiter will momentarily pass significantly more power than when it is totally saturated. This power rise is seen as a spike on the leading edge of the leakage pulse. The rise time of the high power pulse and the turn-on time of the diode determine the spike's amplitude. The spike is defined by its energy content, i.e., in ergs.

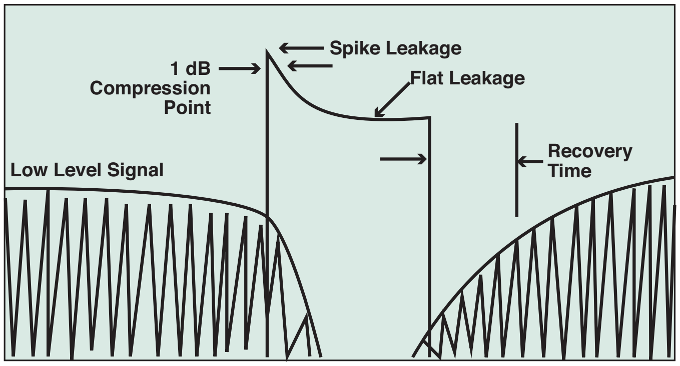
The formula for calculating the spike leakage is as follows:

$$\text{SPIKE LEAKAGE (ERGS)} = t_S \times P_S \times 10^7$$

where:

t_s = spike width at the half-power point in seconds

P_s = maximum spike amplitude in watts



Flat Leakage

The output signal that bleeds through a limiter under high input power conditons.

Power Handling

Two important considerations for defining the required power handling of a limiter are:

1. Peak Pulsed Power: for narrow pulses, equated to an equivalent CW power by multiplying the Peak Power by the Duty Cycle. For pulses exceeding 10 microseconds, Peak Power is considered CW.
2. Source VSWR: When it is fully turned on, the Limiter short circuits across the transmission line, and 90% incident power is reflected back towards the source.

Any mismatch at the source reflects power back toward the limiter, resulting in standing waves. In a correct limiter-source phase relationship, the maximum current point occurs at the input diode, causing the diode to dissipate a greater level of power than incident power. For a source VSWR of up to 2.0, an approximate maximum effective power can be achieved by multiplying the source VSWR by the incident power.

The following formula applies for source VSWRs over 2.0:

$$P_A = \frac{P_S}{[1 \pm (P_{FL} \times P_{FS})]^2}$$

where:

P_A = actual power

P_S = source power

P_{FL} = load (limiter) power factor 0.96 typical

P_{FS} = source power factor

Considerations in Using Limiters

- The difference between the flat leakage and the 0.1 dB compression point is typically between 10 and 13 dB, but may vary according to limiter type.
- There is usually noise generated following the point at which the limiter starts into compression, which can be at -10dBm. However, limiters can and usually do exhibit signs of compression at 0 dBm.
- Limiters dissipate approximately 8% of incident power as heat. Therefore, all limiters should be attached to a heatsink whose temperature does not exceed the maximum rated ambient temperature.
- Limiters are inherently broadband components. Band limitation results from DC return are required by some limiter designs. Limiters with bandwidths of up to 10:1 are relatively simple, while those with bandwidths exceeding 10:1 are progressively more complex and costly.

CAUTION! Limiters are NOT bidirectional components! They have a defined input and output; reverse installation will damage the component.

Glossary

Absorptive Device – A device in which the specified VSWR is maintained and all power is absorbed in the device during the high-loss state.

Accuracy/Linearity – In voltage-variable attenuators, the variation of the mean attenuation from the best straight line of attenuation vs. control signal transfer function.

Analog Attenuator – A unit in which attenuation level is controlled either by an applied current in a driverless unit or by a voltage in a unit with a driver. Attenuation level is continuously variable.

Attenuation Accuracy – The deviation of mean attenuation from the nominal attenuation value at a specified temperature (usually room temperature).

Bias – The control voltage or current signals supplied to a unit that provide proper operation for devices without integral drivers.

Carrier Suppression – The minimum ratio of carrier output power to the translated carrier output power in a phase shifter operated as a frequency translator.

Commutation – With all other ports set to isolation, one port is switched from insertion loss to isolation, while another port is switched from isolation to insertion loss. This specification applies only to multi-throw switches.

Digitally Controlled Voltage Variable Attenuator (VVA) – An analog attenuator with an integral driver in which control inputs are logic bits. Attenuation is not continuously adjusted, but is selected in steps. The steps are defined by the number of bits employed by the device, the maximum attenuation of the unit, and the logic levels applied to it.

Driver – The circuit used to convert analog or logic command signals to the bias conditions needed to execute control of active devices.

Fall Time – A measure of switching speed represented by the time between the 90 percent and 10 percent points of the detected RF power, when the unit is switched from insertion loss (on) to isolation (off).

Insertion Loss – The difference, measured in dB, between input power level and output power level when the unit is in a low-loss condition.

Solid State PIN Control Products

Isolation – The difference, measured in dB, between input power level and output power level when a unit is in a high-loss condition.

Mean Attenuation – The average attenuation over an attenuator's range of operating frequencies.

Modulation – With all other ports set to isolation, one port is repeatedly switched on and off.

Modulation Bandwidth – The maximum repetition rate at which a device can be switched.

Monotonicity – As the control input level is increased, the attenuation level continuously increases.

Off Time – A measure of switching speed represented by the time between the 50 percent point of input control pulse to the 10 percent point of detected RF power, when the unit is switched from insertion loss (on) to isolation (off).

On Time – A measure of switching speed represented by the time between the 50 percent point of input control pulse to the 90 percent point of detected RF power, when the unit is switched from isolation (off) to insertion loss (on).

Operating Frequency Range – The band of frequencies over which the product must operate and deliver specified performance.

Operating Power (Power Handling) – The maximum power over which a unit will achieve specified performance.

Operating Temperature Range – The temperature range over which a unit will achieve specified performance.

Phase and Amplitude Matching – The maximum range of values within which all phase or amplitudes are controlled over a specified frequency range. Usually referenced to one port and measured from port-to-port or unit-to-unit.

Phase Shift – The difference in electrical phase of a signal from the input of the device to its output. Measured as absolute insertion phase, or with respect to a given state.

Reflective Device – A device in which the incident power is reflected back to the source when the port is in the high-loss state.

Rise Time – A measure of switching speed represented by the time between the 10 percent and 90 percent points of the detected RF power, when the unit is switched from isolation (off) to insertion loss (on).

Sideband Suppression – The minimum ratio of any sideband output power to the translated carrier output power when a phase shifter is operated as a frequency translator.

Survival Power – The maximum RF power level to which a unit can be subjected without permanent performance degradation or failure. ***Cold switching only.***

Switching Speed – Either Modulation or Commutation. All specifications, unless otherwise noted, in the Narda-MITEQ catalog, are Modulation Switching Speed. See page 294.

Temperature Coefficient – The average rate of change in phase shift (degree phase shift/°C) or attenuation change (dB/°C) over the entire operating temperature range of the unit.

VVA Linearity – In a voltage-variable attenuator, the variation from straight-line attenuation vs. control signal level.

0.5-18 GHz and 2-18 GHz

Super-Slim High Performance Drop-In PIN Switches

- Reflective and Absorptive
- SPST thru SP6T and Transfer (Standard)
- High Speed
- High Isolation – up to 80 dB
- Low Insertion Loss
- Drop-In Applications
- Integral TTL Drivers
- Hermetically Sealed
- Full MIL Specifications

Description

The super-slim series of broadband, hermetically sealed switches offers fast switching speed and low insertion loss in very compact packages. Both 0.5 to 18 GHz and 2 to 18 GHz models are available. The switches are gold plated and have removable SMA connectors for use in drop-in applications. Superior RF performance is achieved over the entire bandwidth due to the use of selected PIN diodes and optimum RF circuit designs.

All models include integral drivers with reverse voltage protection. The drivers are TTL compatible and are tailored to each RF circuit to give optimum switching performance.

The small size, high speed, broad bandwidth and low insertion loss make these switches ideal for EW systems, automatic test equipment and simulators.

Solid State PIN Control Products

Specifications

Reflective Switches, SMA (F), 0.5 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
SS212DHS	SPST	15	0.5-2 2-4 4-8 8-12 12-18	1.1 1.3 1.6 2.1 2.6	1.6 1.7 1.8 1.9 2.0	70 70 70 70 70	200	50	50
SS122DHS	SP2T	20	0.5-2 2-4 4-8 8-12 12-18	1.5 1.5 2.0 2.4 2.9	1.8 1.9 1.9 2.0 2.0	70 75 70 65 60	200	90	60
SS132DHS	SP3T	20	0.5-2 2-4 4-8 8-12 12-18	1.5 1.5 2.0 2.5 3.0	1.8 1.9 1.9 2.0 2.0	70 75 70 65 60	200	90	60
SS142DHS	SP4T	20	0.5-2 2-4 4-8 8-12 12-18	1.6 1.6 2.1 2.6 3.2	1.8 1.9 1.9 2.0 2.0	70 75 70 65 60	200	110	70
SS152DHS	SP5T	20	0.5-2 2-4 4-8 8-12 12-18	2.0 2.0 2.5 3.0 3.6	1.8 1.9 2.0 2.0 2.0	70 70 70 65 60	200	220	90
SS162DHS	SP6T	20	0.5-2 2-4 4-8 8-12 12-18	2.0 2.0 2.5 3.0 3.6	1.8 1.9 2.0 2.0 2.0	70 70 70 65 60	200	260	100

Absorptive Switches, SMA (F), 0.5 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
SS212DHTS	SPST	30	0.5-12 12-18	2.4 2.8	1.9 2.0	55 50	200	50	60
SS212DHTS-80	SPST	30	0.5-12 12-18	2.4 2.8	1.9 2.0	70 80	200	60	60
SS122DHTS	SP2T	30	0.5-12 12-18	2.7 3.1	1.9 2.0	60 55	200	60	60
SS122DHTS-80	SP2T	30	0.5-12 12-18	2.2 2.9	2.0 2.0	80 80	200	90	60
SS132DHTS	SP3T	30	0.5-12 12-18	2.9 3.4	1.9 2.0	60 45	200	105	75
SS142DHTS	SP4T	30	0.5-12 12-18	2.9 3.4	1.9 2.0	60 45	200	110	80
SS152DHTS	SP5T	30	0.5-12 12-18	3.3 4.0	2.0 2.0	60 50	200	220	90
SS162DHTS	SP6T	30	0.5-12 12-18	3.3 4.0	2.0 2.0	60 50	200	250	100

Solid State PIN Control Products

Specifications

Reflective Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
SS213DHS	SPST	15	2-4 4-8 8-12 12-18	1.2 1.4 1.9 2.4	1.8 1.9 1.9 2.0	50 65 60 60	500	50	50
SS213DHS-80	SPST	15	2-4 4-8 8-12 12-18	1.3 1.5 1.9 2.5	1.8 1.9 2.0 2.0	80 80 80 80	500	60	40
SS123DHS	SP2T	15	2-4 4-8 8-12 12-18	1.5 2.0 2.4 2.9	1.9 1.9 2.0 2.0	75 70 65 60	200	90	60
SS123DHS-80	SP2T	15	2-4 4-8 8-12 12-18	1.5 1.9 2.2 2.9	1.8 1.9 2.0 2.0	80 80 80 80	200	90	60
SS133DHS	SP3T	15	2-4 4-8 8-12 12-18	1.5 2.0 2.5 3.0	1.9 1.9 2.0 2.0	75 70 65 60	200	90	60
SS143DHS	SP4T	15	2-4 4-8 8-12 12-18	1.6 2.1 2.6 3.0	1.9 1.9 2.0 2.0	75 70 65 60	200	110	70
SS153DHS	SP5T	20	2-4 4-8 8-12 12-18	2.0 2.5 3.0 3.6	1.9 2.0 2.0 2.0	70 70 65 60	200	220	90
SS163DHS	SP6T	20	2-4 4-8 8-12 12-18	2.0 2.5 3.0 3.6	1.9 2.0 2.0 2.0	70 70 65 60	200	250	100

Transfer Switch, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
XSS323CDHS	XFER	50	2-4 4-8 8-12 12-18	1.8 2.2 2.1 2.6	1.8 1.9 2.0 2.0	70 70 60 55	200	80	80

Absorptive Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
SS213BDHTS	SPST	20 20 20 25 25	2-4 4-8 8-12 12-16 16-18	1.5 1.7 2.1 2.5 2.5	1.9 1.9 1.9 2.0 2.0	65 60 55 50 50	200	40	60
SS123BDHTS	SP2T	20 20 20 25 25	2-4 4-8 8-12 12-16 16-18	1.6 1.8 2.5 2.9 2.9	1.9 1.9 1.9 2.0 2.0	65 65 60 55 55	200	60	60
SS133BDHTS	SP3T	20 20 20 25 25	2-4 4-8 8-12 12-16 16-18	1.8 2.0 2.7 3.2 3.2	1.9 1.9 1.9 2.0 2.0	65 65 60 50 45	200	105	75
SS143BDHTS	SP4T	20 20 20 25 25	2-4 4-8 8-12 12-16 16-18	1.8 2.0 2.7 3.2 3.2	1.9 1.9 1.9 2.0 2.0	65 65 60 50 45	200	105	75
SS153BDHTS	SP5T	25 25 25 25 25	2-4 4-8 8-12 12-16 16-18	2.2 2.7 3.2 3.8 3.8	1.9 2.0 2.0 2.0 2.0	65 65 60 50 50	200	220	90
SS163BDHTS	SP6T	25 25 25 25 25	2-4 4-8 8-12 12-16 16-18	2.2 2.7 3.2 3.8 3.8	1.9 2.0 2.0 2.0 2.0	65 65 60 50 50	200	250	100

Solid State PIN Control Products

Electrical Specifications

TTL CONTROL LOGIC
Logic 0 (0-0.8 V, 1.6 mA max. sink @ 0.4 V) = Insertion Loss
Logic 1 (2.0-5.5 V, 40 µA max. source @ 2.4 V) = Isolation

FOR TRANSFER SWITCH (XSS323CDHS)
Logic 0: J1-J4 and J2-J3 at Insertion Loss
Logic 1: J1-J2 and J4-J3 at Insertion Loss

SWITCHING TIME
T on = 50% TTL to 90% of RF voltage
T off = 50% TTL to 10% of RF voltage

SWITCHING RATE
5 MHz max. PRF @50% duty cycle

DRIVER
Reverse voltage protected

SURVIVAL POWER at 25°C (Cold Switching)
1.0 W CW, 20W Peak (1µs max. pulse width, 5% duty cycle)
Derate linearly to 50% at +95°C

Environmental Specifications

TEMPERATURE
Operating -54°C to +95°C
Storage -65°C to +125°C

HUMIDITY
Per MIL-STD-202F, method 103B, condition B
(96 hours at 95% R.H.)

SHOCK
Per MIL-STD-202F, method 213B, condition B
(75 G, 6 ms)

ALTITUDE
Per MIL-STD-202F, method 105C, condition B
(50,000 feet)

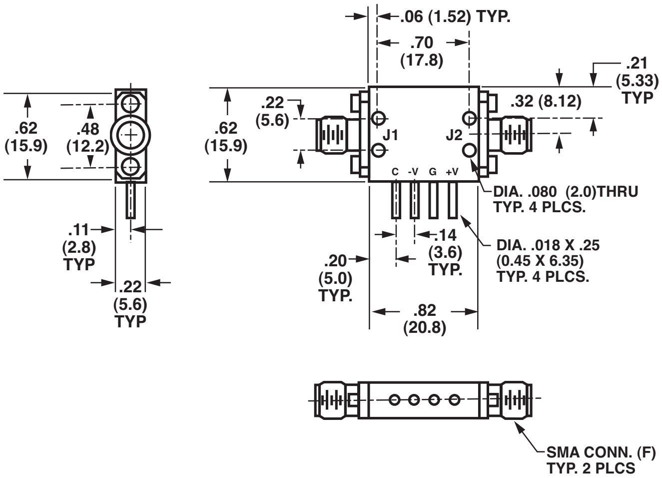
VIBRATION
Per MIL-STD-202F, method 204D, condition B
(.06" double amplitude or 15 G, whichever is less)

THERMAL SHOCK
Per MIL-STD-202F, method 107D, condition A (5 cycles)

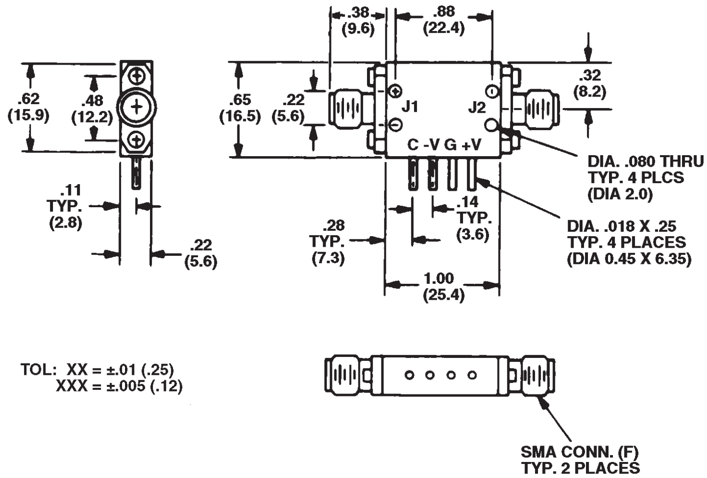
Options

- Very Low Loss Video Leakage
- Inverted TTL Logic Control
- BCD Decoder Driver
- Package Configuration
- Over Voltage Protection

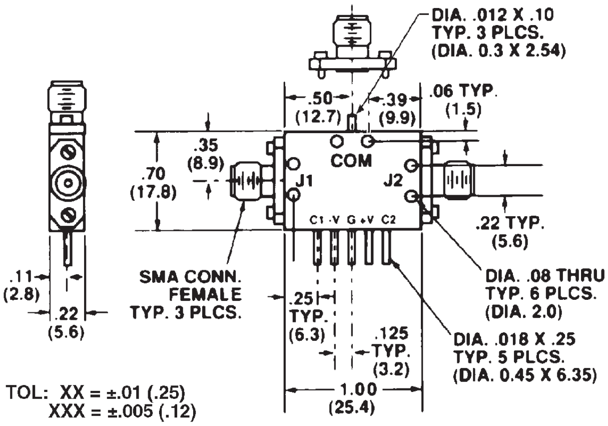
Outline Drawings



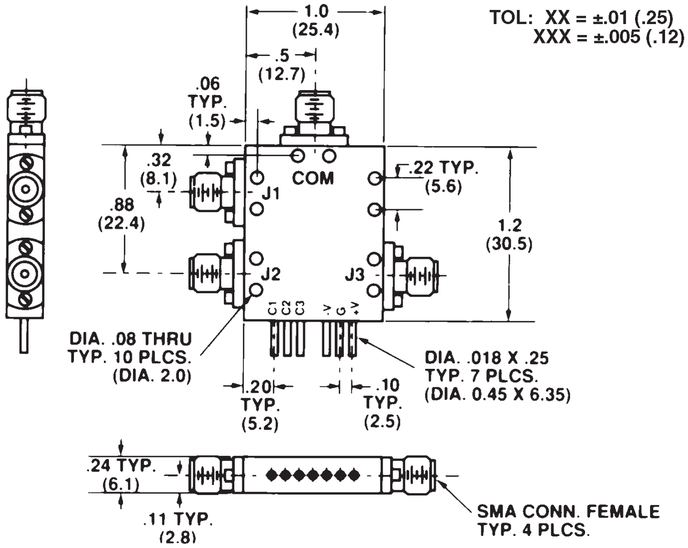
SS213DHS, SS213BDHTS



SS213DHS-80, SS212DHS, SS212DHTS



SS123DHS, SS123BDHTS, SS122DHS,
SS123DHS-80, SS122DHTS

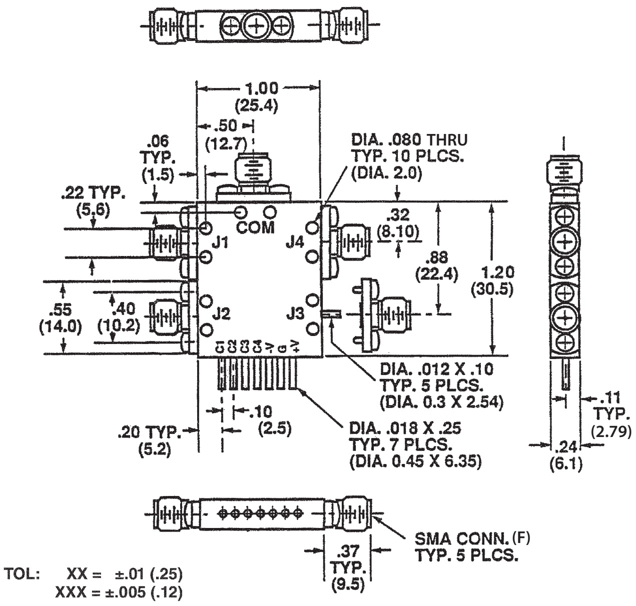


SS133DHS, SS133BDHTS, SS132DHS,
SS132DHTS

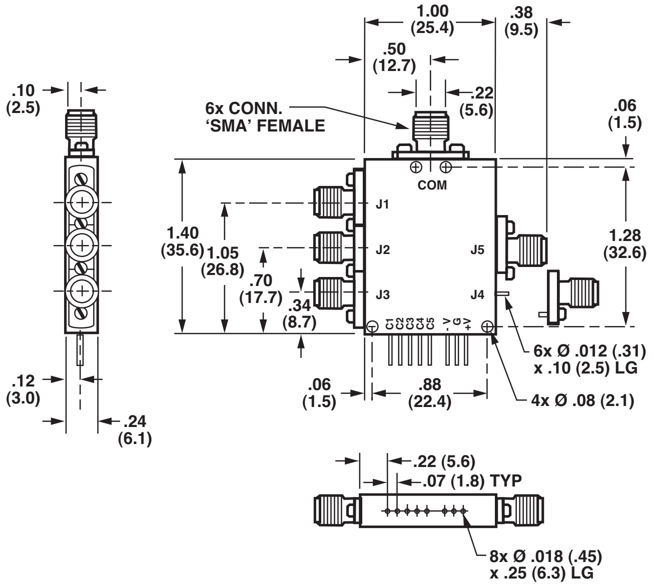
Dimensions in inches (mm in parentheses), unless otherwise specified.

Solid State PIN Control Products

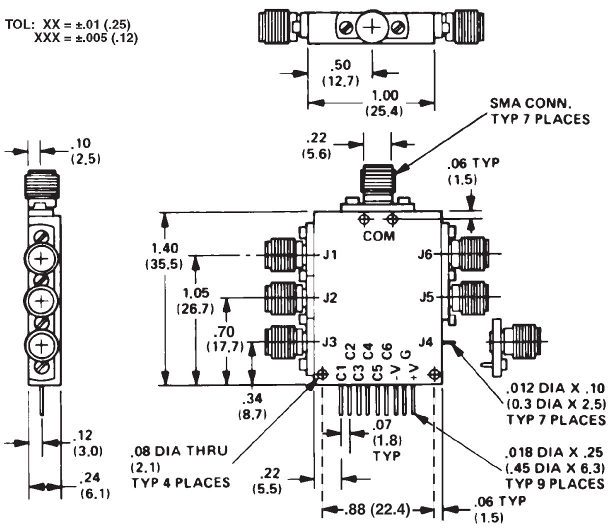
Outline Drawings



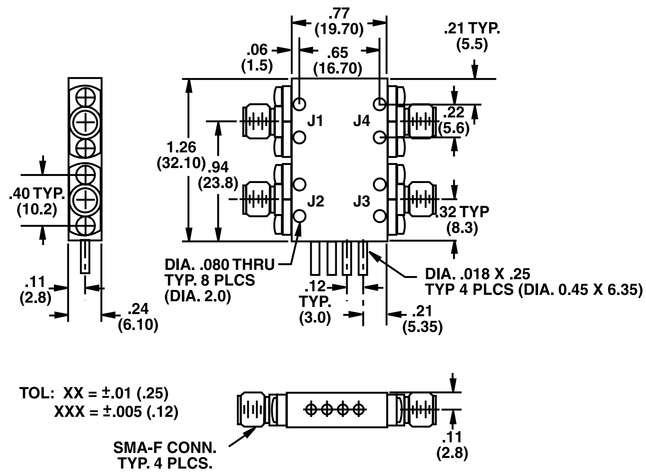
SS143DHS, SS143BDHTS, SS142DHS, SS142DHTS



SS153DHS, SS153BDHTS, SS152DHTS, SS152DHS

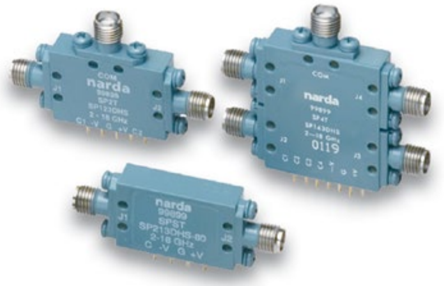


SS163DHS, SS163BDHTS, SS162DHS, SS162DHTS



XSS323CDHS

Dimensions in inches (mm in parentheses), unless otherwise specified.



0.5-18 GHz and 2-18 GHz

High Performance PIN Switches

- Reflective and Absorptive
- SPST thru SP6T and Transfer (Standard)
- High Speed – 15 ns
- High Isolation – up to 80 dB
- Low Insertion Loss
- Small Package Size
- Integral TTL Drivers
- Hermetically Sealed

Description

The performance series of 0.5 to 18 GHz and 2 to 18 GHz hermetically sealed switches offers fast switching speed and low insertion loss in compact packages. These switches use the identical circuits employed in Narda-MITEQ's top-of-the-line Super Slim Series. They are ideal for connectorized applications where the absolutely thinnest profile is not required.

All models include integral drivers with reverse voltage protection. The drivers are TTL compatible and are tailored to each RF circuit to give optimum switching performance.

The small size, high speed, broad bandwidth and low insertion loss make these switches ideal for EW systems, automatic test equipment, and simulators.

Solid State PIN Control Products

Specifications

Reflective Switches, SMA (F), 0.5 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
SP212DHS	SPST	15	0.5-2 2-12 12-18	1.2 2.1 2.6	1.6 1.9 2.0	70 70 70	200	50	50
SP212DHS-80	SPST	15	0.5-2 2-12 12-18	1.2 2.2 2.7	1.6 1.9 2.0	80 80 80	200	50	50
SP122DHS	SP2T	20	0.5-2 2-12 12-18	1.5 2.4 2.9	1.8 2.0 2.0	70 65 60	200	90	60
SP132DHS	SP3T	20	0.5-2 2-12 12-18	1.5 2.5 3.0	1.8 2.0 2.0	70 65 60	200	90	60
SP142DHS	SP4T	20	0.5-2 2-12 12-18	1.6 2.6 3.2	1.8 2.0 2.0	70 65 60	200	110	70
SP152DHS	SP5T	20	0.5-2 2-12 12-18	2.0 3.0 3.6	1.8 2.0 2.0	70 65 60	200	220	90
SP162DHS	SP6T	20	0.5-2 2-12 12-18	2.0 3.0 3.6	1.8 2.0 2.0	70 65 60	200	220	100

Absorptive Switches, SMA (F), 0.5 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V to -15 V
SP212DHTS	SPST	30	0.5-12 12-18	2.4 2.8	1.9 2.0	55 50	200	50	60
SP122DHTS	SP2T	30	0.5-12 12-18	2.7 3.1	1.9 2.0	60 55	200	60	60
SP132DHTS	SP3T	30	0.5-12 12-18	2.9 3.4	1.9 2.0	60 45	200	105	75
SP142DHTS	SP4T	30	0.5-12 12-18	2.9 3.4	1.9 2.0	60 45	200	110	80
SP152DHTS	SP5T	30	0.5-12 12-18	3.3 4.0	2.0 2.0	60 50	200	220	90
SP162DHTS	SP6T	30	0.5-12 12-18	3.3 4.0	2.0 2.0	60 50	200	250	100

Reflective Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS mA @+5 V	mA @-12 V
SP213DHS	SPST	15	2-12 12-18	1.9 2.4	1.9 2.0	50 60	500	50	60
SP213DHS-80	SPST	15	2-12 12-18	1.9 2.5	1.9 2.0	70 80	500	50	50
SP123DHS	SP2T	15	2-12 12-18	2.4 2.9	1.9 2.0	65 60	200	90	60
SP123DHS-80	SP2T	15	2-12 12-18	2.2 2.9	2.0 2.0	80 80	200	90	60
SP133DHS	SP3T	15	2-12 12-18	2.6 3.0	1.9 2.0	65 60	200	110	70
SP143DHS	SP4T	15	2-12 12-18	2.6 3.0	1.9 2.0	65 60	200	110	70
SP153DHS	SP5T	20	2-12 12-18	3.0 3.6	2.0 2.0	65 60	200	220	90
SP163DHS	SP6T	20	2-12 12-18	3.0 3.6	2.0 2.0	65 60	200	250	100

Transfer Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS mA @+5 V	mA @-12 V
XSP323DHS	XFER	50	2-12 12-18	2.8 3.4	2.0 2.0	60 65	200	90	80

Absorptive Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS mA @+5 V	mA @-12 V
SP213DHTS	SPST	25	2-12 12-18	2.1 2.5	1.9 2.0	55 50	200	40	60
SP213DHTS-80	SPST	25	2-12 12-18	2.1 2.6	1.9 2.0	70 80	200	50	60
SP123DHTS	SP2T	25	2-12 12-18	2.5 2.9	1.9 2.0	60 55	200	60	60
SP133DHTS	SP3T	25	2-12 12-18	2.7 3.2	1.9 2.0	60 45	200	105	75
SP143DHTS	SP4T	25	2-12 12-18	2.7 3.2	1.9 2.0	60 45	200	105	75
SP153DHTS	SP5T	25	2-12 12-18	3.2 3.8	2.0 2.0	60 50	200	220	90
SP163DHTS	SP6T	25	2-12 12-18	3.2 3.8	2.0 2.0	60 50	200	250	100

Solid State PIN Control Products

Electrical Specifications

TTL CONTROL LOGIC
Logic 0 (0-0.8 V, 1.6 mA max. sink @ 0.4 V) = Insertion Loss
Logic 1 (2.0-5.5 V, 40 µA max. source @ 2.4 V) = Isolation

FOR TRANSFER SWITCH (XSP323DHS)
Logic 0: J1-J4 and J2-J3 at Insertion Loss
Logic 1: J2-J2 and J4-J3 at Insertion Loss

SWITCHING TIME
T on = 50% TTL to 90% of RF voltage
T off = 50% TTL to 10% of RF voltage

SWITCHING RATE
Reflective Models 5 MHz max. PRF @50% duty cycle
Absorptive Models 2 MHz max. PRF @50% duty cycle

DRIVER
Reverse voltage protected

SURVIVAL POWER at 25°C (Cold Switching)
Models SP213DHS
and SP213DHS-80 .... 1.5 W CW, 20 W Peak
(1µs max. pulse width, 7½% duty cycle)
All other 2 to 18 GHz models .... 1.0 W CW, 20 W Peak
(1µs max. pulse width, 5% duty cycle)
All 0.5 to 18 GHz models..............500 mW CW, 10 W Peak
(1µs max. pulse width, 5% duty cycle)
Derate linearly to 50% at +95°C

Environmental Specifications

TEMPERATURE
Operating -54°C to +95°C
Storage -65°C to +125°C

HUMIDITY
Per MIL-STD-202F, method 103B, condition B
(96 hours at 95% R.H.)

SHOCK
Per MIL-STD-202F, method 213B, condition B
(75 G, 6 ms)

ALTITUDE
Per MIL-STD-202F, method 105C, condition B
(50,000 feet)

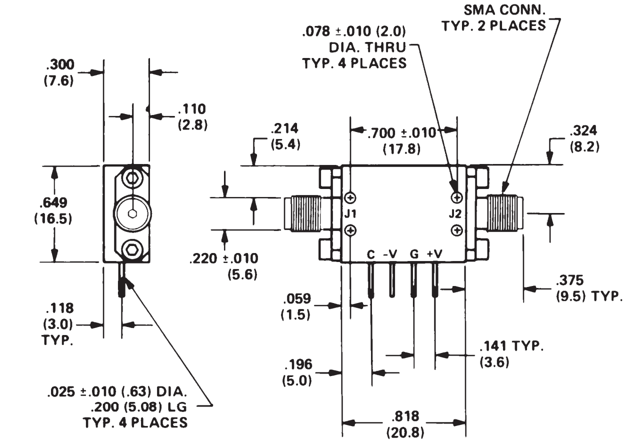
VIBRATION
Per MIL-STD-202F, method 204D, condition B
(.06" double amplitude or 15 G, whichever is less)

THERMAL SHOCK
Per MIL-STD-202F, method 107D, condition A (5 cycles)

Options

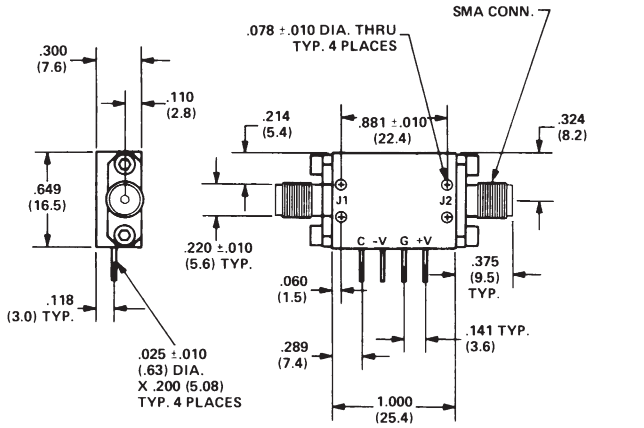
- Very Low Loss Video Leakage
- Inverted TTL Logic Control
- BCD Decoder Driver
- Package Configuration
- Over Voltage Protection

Outline Drawings



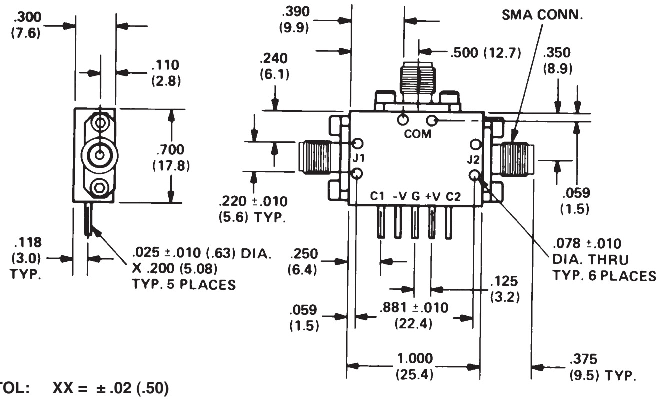
TOL: XX = ± .02 (.50)
XXX = ± .005 (.12)

SP213DHS, SP213DHTS, SP212DHTS, SP212DHS



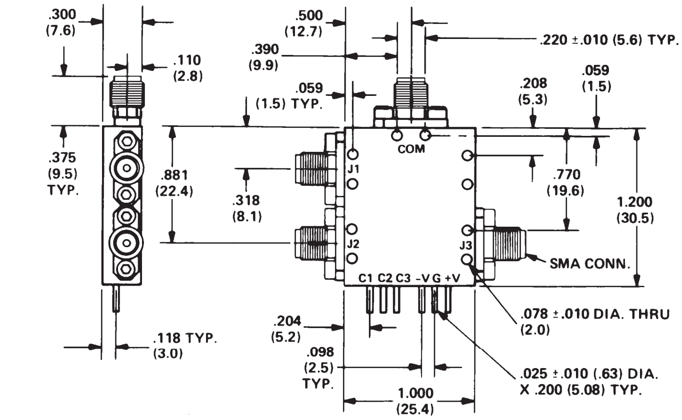
TOL: XX = ± .02 (.50)
XXX = ± .005 (.12)

SP213DHS-80, SP213DHTS-80, SP212DHS-80



TOL: XX = ± .02 (.50)
XXX = ± .005 (.12)

SP123DHS, SP123DHTS, SP122DHTS, SP122DHS



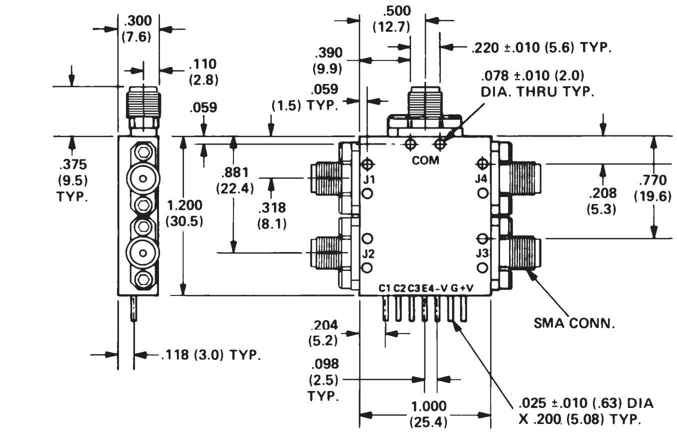
TOL: XX = ± .02 (.50)
XXX = ± .005 (.12)

SP133DHS, SP133DHTS, SP132DHTS, SP132DHS

Dimensions in inches (mm in parentheses), unless otherwise specified.

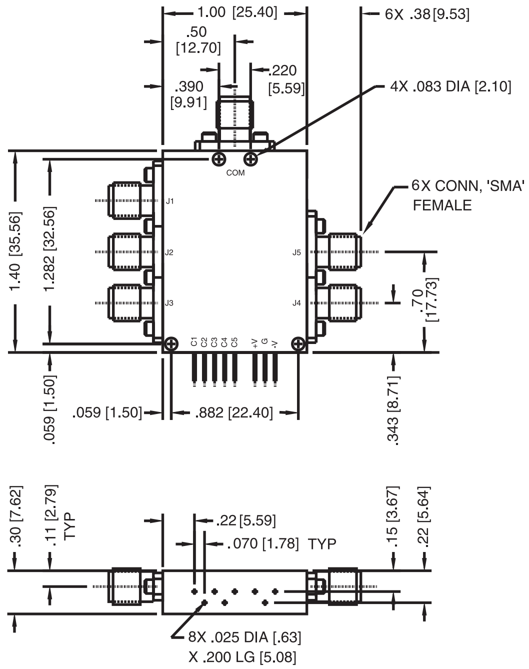
Solid State PIN Control Products

Outline Drawings



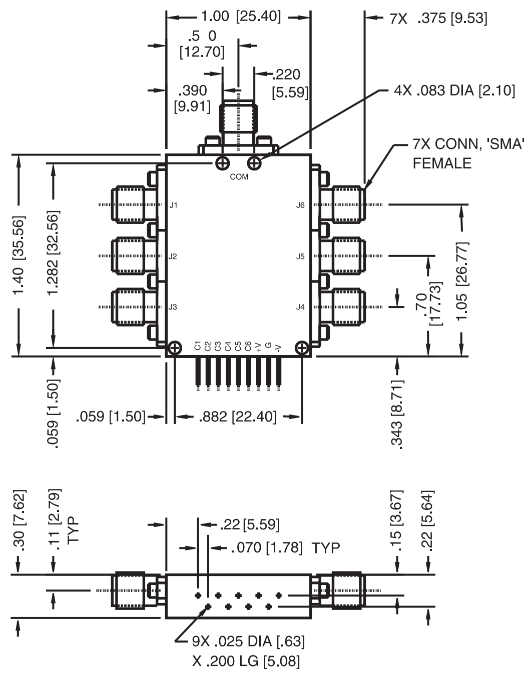
TOL: XX = ± .02 (.50)
XXX = ± .005 (.12)

SP143DHS, SP143DHTS, SP142DHTS, SP142DHS



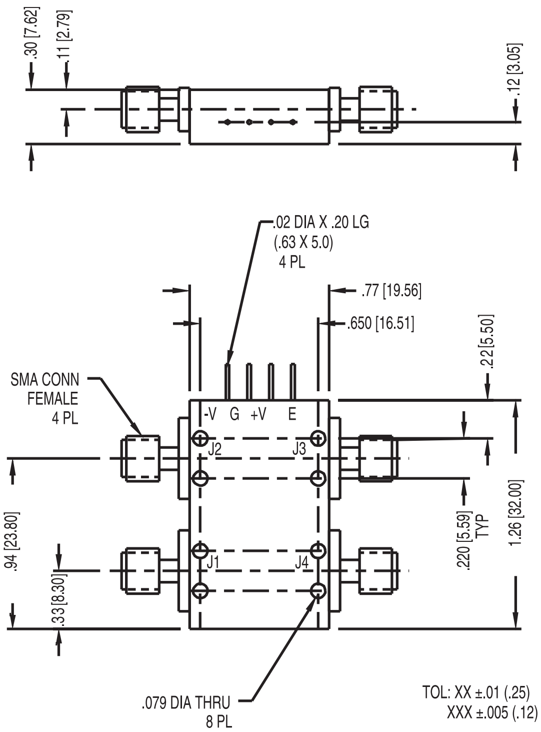
TOL: XX ±.02 [.51]
XXX ±.005 [.12]

SP153DHS, SP153DHTS, SP152DHTS, SP152DHS



TOL: XX ±.02 [.51]
XXX ±.005 [.12]

SP163DHS, SP163DHTS, SP162DHTS, SP162DHS



TOL: XX ±.01 (.25)
XXX ±.005 (.12)

XSP323DHS

Dimensions in inches (mm in parentheses), unless otherwise specified.

2-18 GHz

Value Series PIN Switches

- SPST through SP4T and Transfer
- Integral TTL Drivers
- Hermetically Sealed

Description

Narda-MITEQ Value Series PIN switches provide a lower cost alternative to the super slim and performance series. They are ideal for many applications where miniature size and state-of-the-art performance are not required. The circuits are well proven since they are derived from and similar to those used in the Super Slim Series.

Specifications

Reflective Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
SV213DS	SPST	50	2-12 12-18	2.0 2.5	2.0 2.0	50 50	500	50	60
SV123DS	SP2T	50	2-12 12-18	2.5 3.0	2.0 2.0	50 50	200	90	60
SV133DS	SP3T	50	2-12 12-18	2.7 3.1	2.0 2.0	50 50	200	105	75
SV143DS	SP4T	50	2-12 12-18	2.7 3.1	2.0 2.0	50 50	200	105	75
XSV323DS	XFER	50	2-12 12-18	3.0 3.4	2.0 2.0	50 50	200	80	80

Solid State PIN Control Products

Specifications

Absorptive Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
SV213DTS	SPST	50	2-12 12-18	2.3 2.8	2.0 2.0	60 45	200	40	60
SV123DTS	SP2T	50	2-12 12-18	2.7 3.0	2.0 2.0	60 50	200	60	60
SV133DTS	SP3T	50	2-12 12-18	2.8 3.3	2.0 2.0	60 45	200	105	75
SV143DTS	SP4T	50	2-12 12-18	2.8 3.3	2.0 2.0	60 45	200	105	75

Electrical Specifications

TTL CONTROL LOGIC
Logic 0 (0-0.8 V, 1.6 mA max. sink @ 0.4 V) = Insertion Loss
Logic 1 (2.0-5.5 V, 40 µA max. source @ 2.4 V) = Isolation

FOR TRANSFER SWITCH (XSV323DS)
Logic 0: J1-J2 and J3-J4 at Insertion Loss
Logic 1: J1-J4 and J2-J3 at Insertion Loss

SWITCHING TIME
T on = 50% TTL to 90% of RF voltage
T off = 50% TTL to 10% of RF voltage

SWITCHING RATE
1 MHz max. PRF @50% duty cycle

DRIVER
Reverse voltage protected

***SURVIVAL POWER at 25°C* (Cold Switching)**
1.0 W CW, 20 W Peak (1µs max. pulse width, 5% duty cycle)
Derate linearly to 50% at +95°C

Environmental Specifications

TEMPERATURE
Operating -54°C to +95°C
Storage -65°C to +125°C

HUMIDITY
Per MIL-STD-202F, method 103B, condition B
(96 hours at 95% R.H.)

SHOCK
Per MIL-STD-202F, method 213B, condition B
(75 G, 6 ms)

ALTITUDE
Per MIL-STD-202F, method 105C, condition B
(50,000 feet)

VIBRATION
Per MIL-STD-202F, method 204D, condition B
(.06" double amplitude or 15 G, whichever is less)

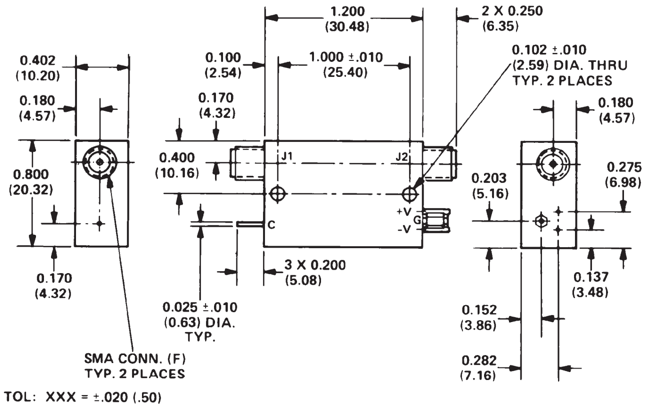
THERMAL SHOCK
Per MIL-STD-202F, method 107D, condition A (5 cycles)

Options

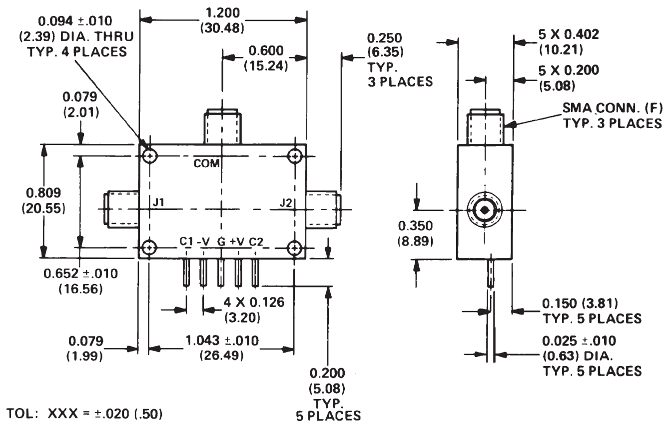
- Very Low Loss Video Leakage
- Inverted TTL Logic Control
- BCD Decoder Driver
- Package Configuration
- Over Voltage Protection

narda MITEQ www.nardamiteq.com E-MAIL: componentsnm@nardamiteq.com TEL: +1 631 231-1700

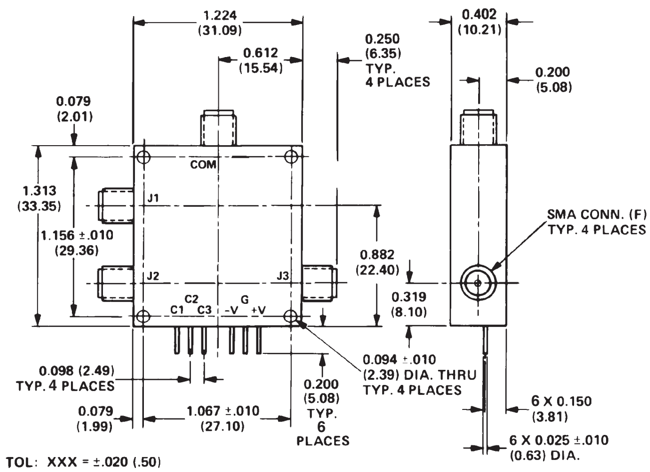
Outline Drawings



SV213DS, SV213DTS



SV123DS, SV123DTS

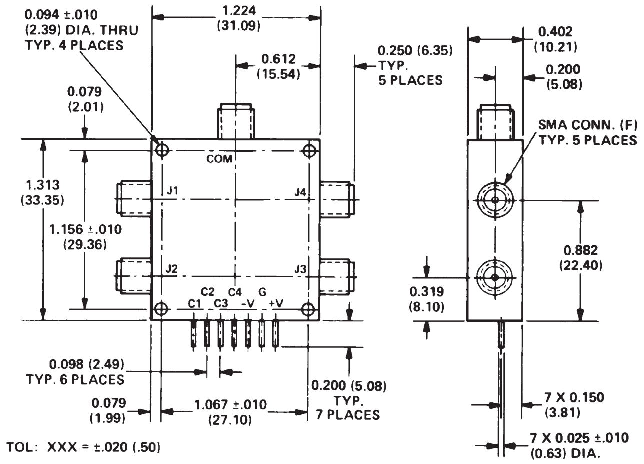


SV133DS, SV133DTS

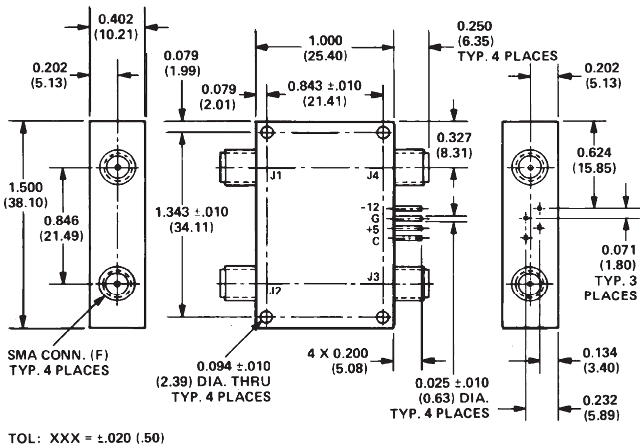
Dimensions in inches (mm in parentheses), unless otherwise specified.

Solid State PIN Control Products

Outline Drawings



SV143DS, SV143DTS



XSV323DS

Dimensions in inches (mm in parentheses), unless otherwise specified.

2-18 GHz

High Performance Miniature Switches

- Very Small Package Size
- AVANPAK equivalents
- Reflective
- SPST and SP2T
- Low Insertion Loss
- Integral TTL Drivers
- Hermetically Sealed

Description

These miniature switches are ideal for applications where size is critical. They are direct replacements for AVANPAK™ Models* with equal or better specifications.

Specifications

Reflective Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
SM213DHS	SPST	25	2-12 12-18	1.7 2.1	1.8 1.8	45 45	500	50	40
SM213DHS-60	SPST	25	2-12 12-18	1.9 2.4	1.8 1.8	60 60	500	50	40
SM123DHS	SP2T	25	2-12 12-18	2.3 2.9	1.8 1.8	50 50	200	60	40

* AVANPAK is a trademark of Avanteck, Inc.

Solid State PIN Control Products

Electrical Specifications

TTL CONTROL LOGIC
Logic 0 (0-0.8 V, 1.6 mA max. sink @ 0.4 V) = Insertion Loss
Logic 1 (2.0-5.5 V, 40 µA max. source @ 2.4 V) = Isolation

SWITCHING TIME
T on = 50% TTL to 90% of RF voltage
T off = 50% TTL to 10% of RF voltage

SWITCHING RATE
5 MHz max. PRF @ 50% duty cycle

DRIVER
Reverse voltage protected

***SURVIVAL POWER at 25°C* (Cold Switching)**
1.0W CW, 20W Peak (1 µs max. pulse width, 5% duty cycle)
Derate Linearly to 50% at +95°C

Enviromental Specifications

TEMPERATURE
Operating -54°C to +95°C
Storage -65°C to +125°C

HUMIDITY
Per MIL-STD-202F, method 103B, condition B
(96 hours @ 95% R.H.)

SHOCK
Per MIL-STD-202F, method 213B, condition B
(75 G, 6 ms)

ALTITUDE
Per MIL-STD-202F, method 105C, condition B
(50,000 feet)

VIBRATION
Per MIL-STD-202F, method 204D, condition B
(.06" double amplitude or 15 G, whichever is less)

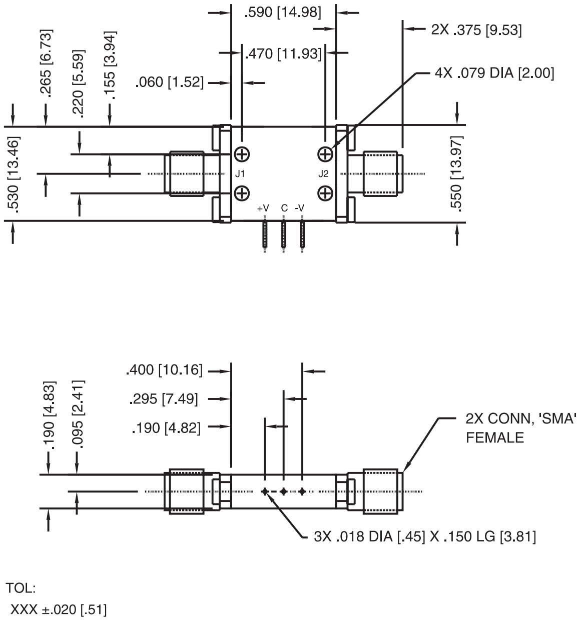
THERMAL SHOCK
Per MIL-STD-202F, method 107D, condition A (5 cycles)

Narda-MITEQ SM Series To AVANPAK™ Model Cross Reference

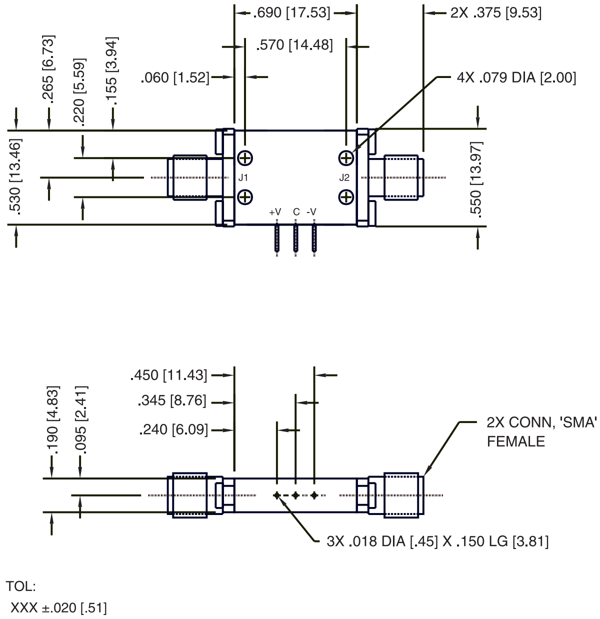
NARDA-MITEQ MODEL	AVANPAK™ MODEL*
SM213DHS	AHS-1802-0
SM213DHS-60	AHS-1802-1
SM123DHS	AHD-1802-0

* AVANPAK is a trademark of Avantek, Inc.

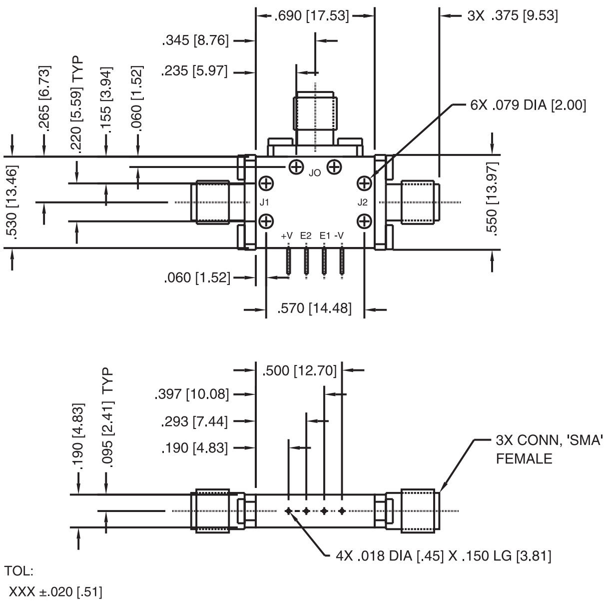
Outline Drawings



SM213DHS



SM213DHS-60



SM123DHS

Dimensions in inches (mm in parentheses), unless otherwise specified.

0.1-40 GHz

SPST / SP2T PIN Switches

- Reflective
- Hermetically Sealed
- Full MIL Specifications

Specifications

Reflective Switches, K (F), 0.1 to 40 GHz

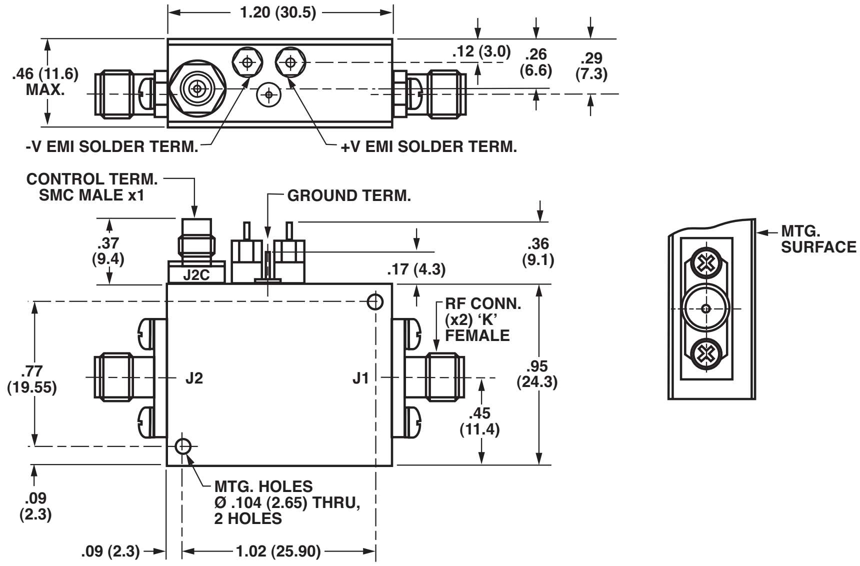
MODEL	TYPE	SWITCHING TIME MODULATION (ns max)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V ±2%	mA @-15 V
S125	SPST	500	0.1-4 4-18 18-26.5 26.5-40	2.3 2.9 3.5 5.0	2.0 2.0 2.5 2.5	60 50 35 30	200	60	50
S126	SP2T	500	0.1-4 4-18 18-26.5 26.5-40	2.6 3.2 3.8 5.3	2.0 2.0 2.5 2.5	60 50 35 30	200	75	50

Control Characteristics

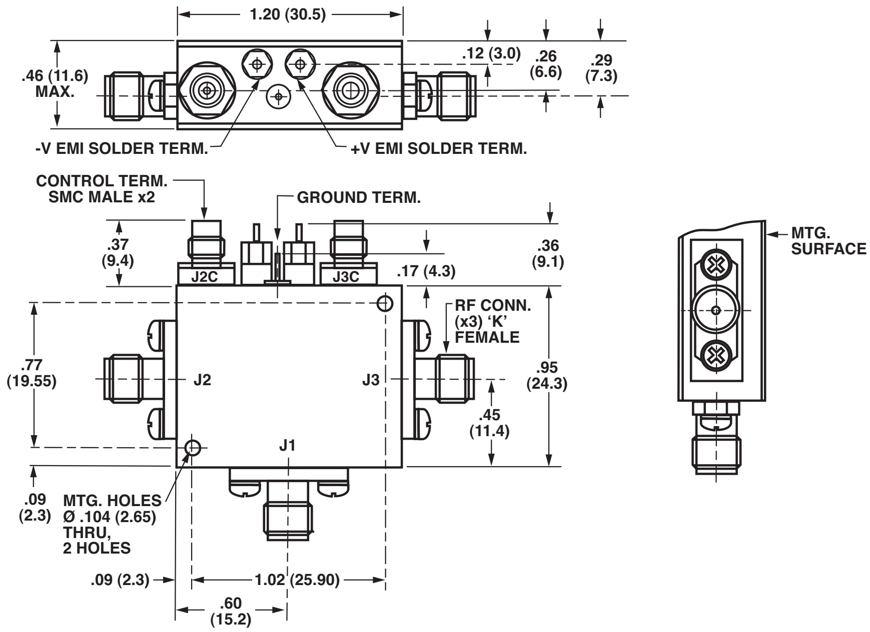
CONTROL INPUT IMPEDANCE
TTL advanced Schottky, one unit load. (A unit load is 0.6 mA sink current and 20 µA source current.)

CONTROL LOGIC
Logic 0 (-0.3 to 0.8 V) for switch "ON"
Logic 1 (2 to 5 V) for switch "OFF"

Outline Drawings



S125



S126

Dimensions in inches (mm in parentheses), unless otherwise specified.

2-18 GHz

3 Watt PIN Switches

- 3 Watt CW
- High Speed
- Low Insertion Loss
- High Isolation
- Small Size
- Hermetically Sealed

Description

These SPST and SP2T switches are hermetically sealed high speed PIN switches that provide high isolation, low VSWR and Insertion Loss. Special attention has been given to high packaging density for military environments.

Specifications

Reflective Switches, SMA (F), 2 to 18 GHz

MODEL	TYPE	SWITCHING TIME MODULATION (ns)	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (W)	POWER SUPPLY REQUIREMENTS	
								mA @+5 V	mA @-12 V
S213D	SPST	10	2-4 4-8 8-12 12-18	1.0 1.2 1.5 2.0	1.70 1.70 1.70 1.70	55 60 60 60	3.0	100	50
S213D-04*	SPST	10	2-4 4-8 8-12 12-18	1.0 1.2 1.5 2.0	1.70 1.70 1.70 1.70	55 60 60 60	3.0	100	50
S123BD	SP2T	50	2-4 4-8 8-12 12-18	1.5 1.7 2.0 2.5	1.75 1.75 1.75 2.00	60 60 60 55	1.0	100	50

* Suffix "-04" denotes solder control terminals instead of SMC connectors

Electrical Spcifications

TTL CONTROL LOGIC (Models with Driver)
Logic 0 (-0.3 to 0.8 V, 1.6 mA max. sink @ 0.4 V) = Insertion Loss
Logic 1 (2.4 to 5.0 V, 40 µA max. source @2.4 V) = Isolation

SWITCHING SPEED
Rise Time = 10% to 90% of detected RF power
Fall Time = 90% to 10% of detected RF power

***SURVIVAL POWER at 25*°C (Cold Switching)**
3 W CW, 75 W Peak (1 µs max. pulse width, 1% duty cycle)
Derate linearly to 50% at +95°C

INPUT VOLTAGES
+5 V ±2%
-5V to -15V

CONNECTORS
RF .... SMA Female
Control........ SMC Male
Power Supply .... Solder Terminal

Environmental Specifications

TEMPERATURE
Operating .... -54°C to +95°C
Storage .... -65°C to +125°C

HUMIDITY
Per MIL-STD-202F, method 103B, condition B
(96 hours at 95% R.H.)

SHOCK
Per MIL-STD-202F, method 213B, condition B
(75 G, 6 ms)

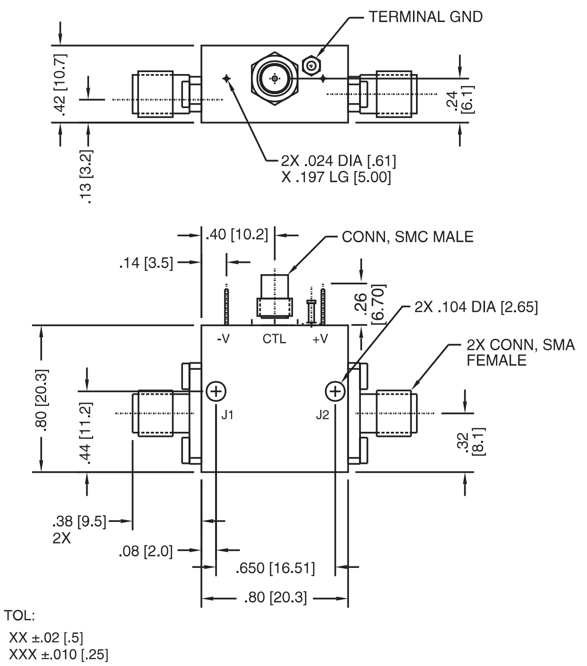
ALTITUDE
Per MIL-STD-202F, method 105C, condition B
(50,000 feet)

VIBRATION
Per MIL-STD-202F, method 204D, condition B
(.06" double amplitude or 15 G, whichever is less)

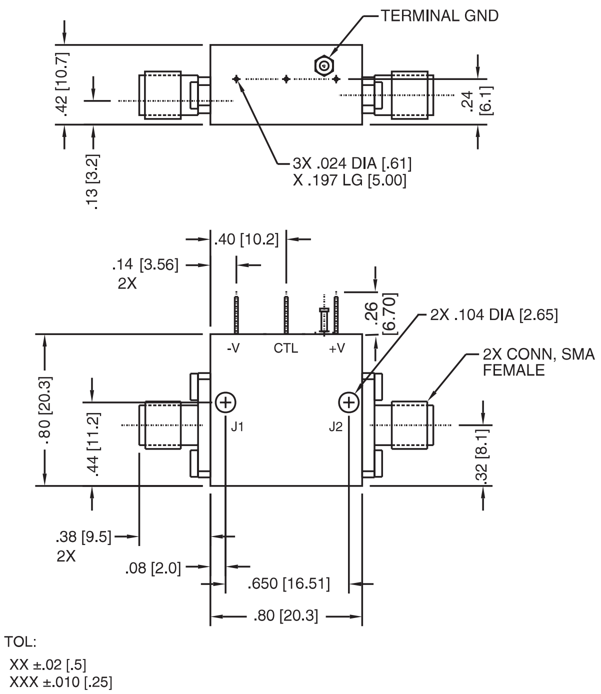
THERMAL SHOCK
Per MIL-STD-202F, method 107G, condition B (5 cycles)

Solid State PIN Control Products

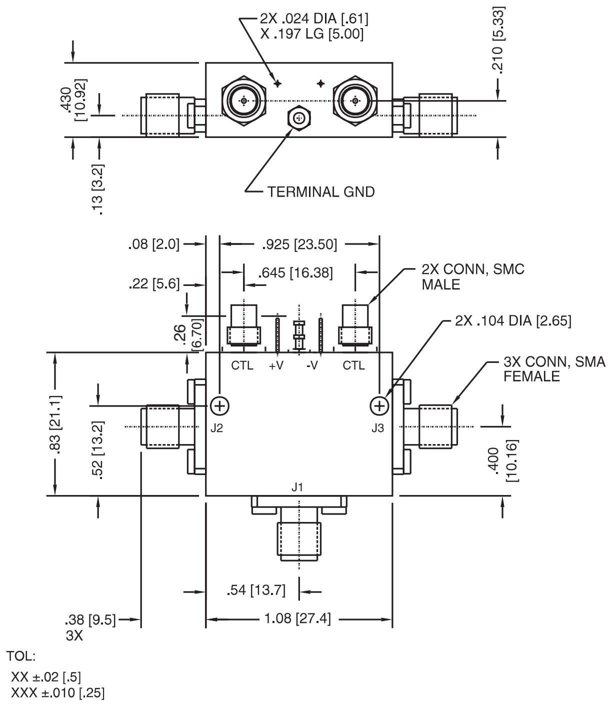
Outline Drawings



S213D



S213D-04



S123BD

Dimensions in inches (mm in parentheses), unless otherwise specified.

0.1-2.0 GHz

Custom Low Frequency Switches

- Custom Designs
- Reflective and Absorptive
- High Isolation – up to 80 dB
- SPST through SP6T

Description

Narda-MITEQ's low frequency switch line offers outstanding performance in small packages. Several package styles are available – the most popular is a drop-in package with removable connectors.

The following are examples of the many switches that have been supplied.

Typical Specifications

0.1 - 2.0 GHz

FUNCTION	TYPE	FREQUENCY RANGE (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	ISOLATION (dB min.)	SWITCHING TIME MODULATION (ns)
SPST	Reflective	**0.1-2.0**	1.0	1.8	60	35
SP2T	Absorptive	**0.1-2.0**	1.3	1.8	60	35
SP3T	Absorptive	**0.1-2.0**	1.4	1.8	60	35
SP6T	Absorptive	**0.1-2.0**	1.6	2.0	60	35

0.2-5.0 GHz

Custom High Power Switches

- Custom Designs
- High CW Power - up to 50 W
- High Peak Power - up to 500 W
- Reflective
- SPST through SP6T

Description

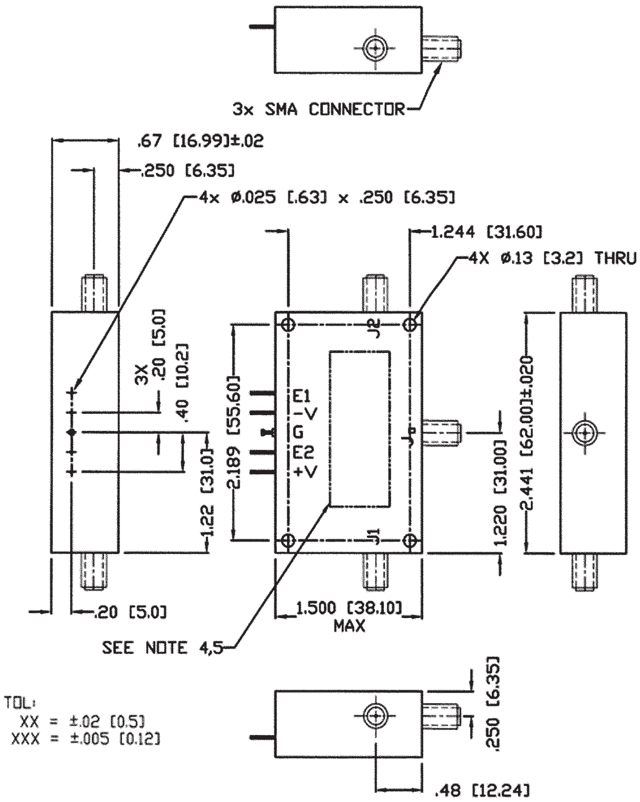
Narda-MITEQ High Power switches are custom designed units utilizing materials selected for power dissipation. These switches feature a special driver with TTL control. The driver is capable of supplying reverse-bias of up to -100 V and forward current of 150 mA.

Examples of Custom Designs

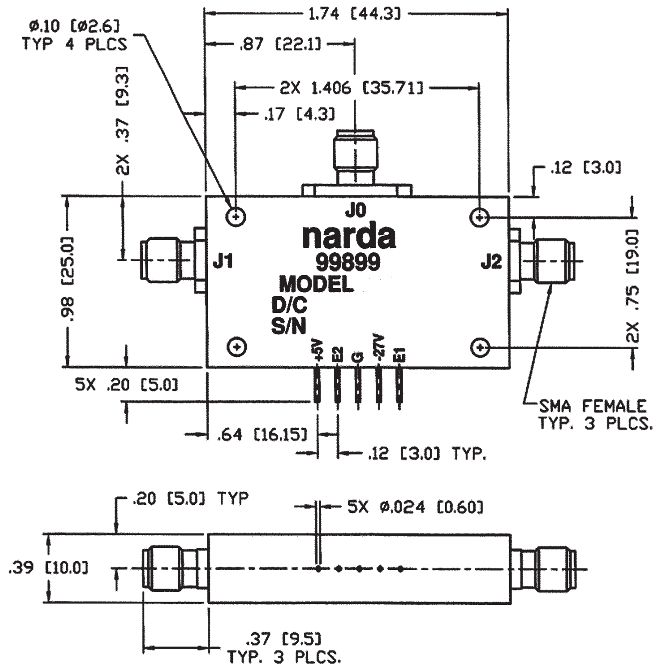
FUNCTION	FREQUENCY RANGE (GHz)	SWITCHING TIME MODULATION* (µs)	CW POWER (W)	PEAK POWER* (W)	PULSE WIDTH (µ)	OUTLINE DRAWING
SP2T	**1-6****	3	50	500	100‡	1
SP2T	**3.1-3.5**	400	25	250	100	2
SP3T	**0.2-0.8**	3	2	10	50	3
SP6T	**4.4-5.0**	0.1	5	15	10	4

* Cold switching
** Bandwidth is up to 25% within the frequency range
‡ The maximum pulse width depends on the maximum input power and duty cycle Bandwidth is up to 25% within the frequency range

Typical Outline Drawings



Outline Drawing 1
SP2T 1.0-6.0 GHz PIN Switch

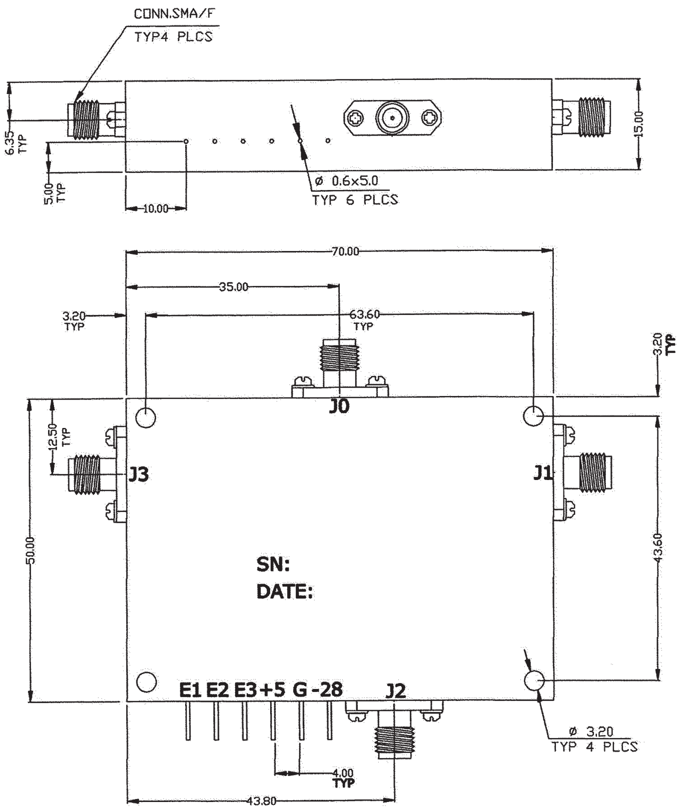


Outline Drawing 2
SP2T 3.1-3.5 GHz PIN Switch

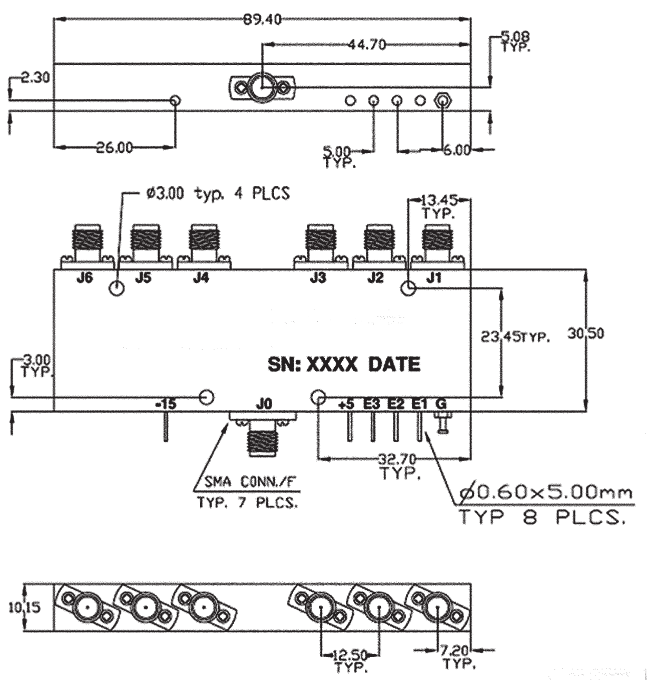
Dimensions in inches (mm in parentheses), unless otherwise specified.

Solid State PIN Control Products

Typical Outline Drawings



Outline Drawing 3
SP3T 0.2-0.8 GHz PIN Switch



Outline Drawing 4
SP6T 4.4-5.0 GHz PIN Switch

Dimensions in inches, unless otherwise specified.

0.5-18 GHz

Custom Multi-Throw Absorptive PIN Diode Switches

- Custom Capability
- Reflective and Absorptive
- Couplers, Power Dividers and Amplifiers included
- Hermetically Sealed
- Full MIL Specifications

Specifications

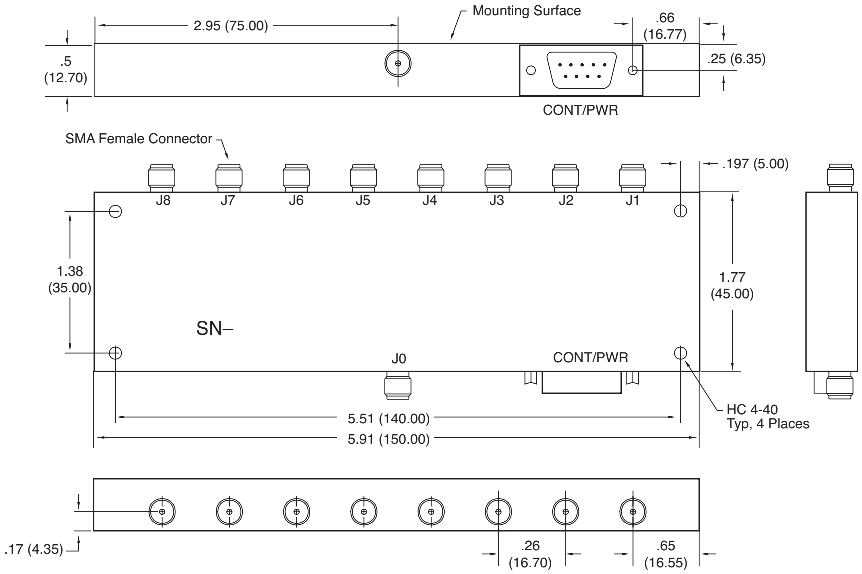
SMA (F), 0.5 to 18 GHz

FREQUENCY RANGE (GHz)	TYPE	SWITCHING TIME COMMUTATION* (ns)	INSERTION LOSS (dB max.)		VSWR (max.)	ISOLATION (dB min.)	POWER HANDLING (mW)	POWER SUPPLY REQUIREMENTS	
			1-12 GHz	12-18 GHz				mA @+5 V	mA @-12 V
1-18	SP8T	50	4.5	5	2.20	60	200	250	150
1-18	SP10T	500	4.3	5.6	2.20	60	500	270	150
6-18	SP12T**	700	5	7	2.20	60	200	300	150
0.02-4	SP16T ‡	3500	4 @ 4 GHz	—	2.00	60	200	300	50
0.5-18	SP25T ‡‡	2000	3.5 @ 0.5 GHz	7.5 @ 18 GHz	2.25	60	200	220	50

* 50% TTL to 10% or 90% RF:
Port X ON to OFF, Port Y OFF to ON
OR
Port X OFF to ON, Port Y ON to OFF
** Amplitude matched
‡ Built in coupler and amplifier
‡‡ Built in output coupler

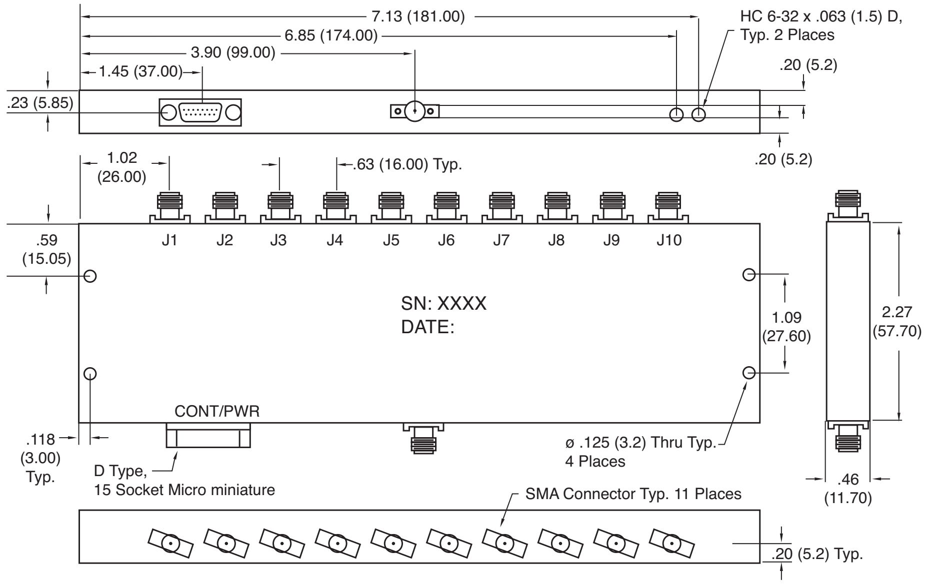
Solid State PIN Control Products

Outline Drawings



PIN	1	2	3	
	0	0	0	J0 TO J1
	0	0	1	J0 TO J2
	0	1	0	J0 TO J3
	0	1	1	J0 TO J4
	1	0	0	J0 TO J5
	1	0	0	J0 TO J6
	1	1	0	J0 TO J7
	1	1	1	J0 TO J8
6	-12			
7	GND			
8	+5V			

SP8T

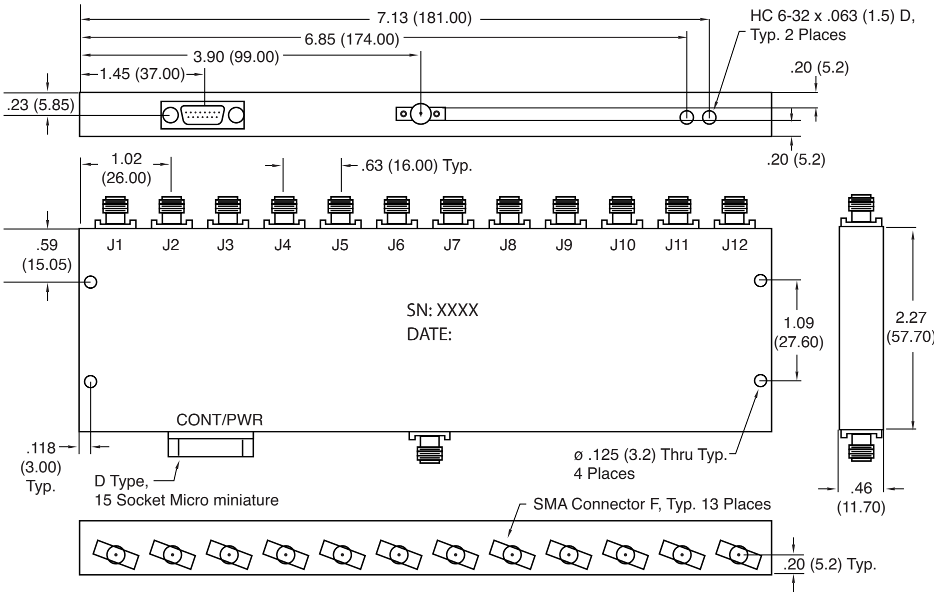


PIN NO.	Function
1	+5V
2	GND
3	-12V
4	NC
5	J1
6	J2
7	J3
8	J4
9	J5
10	J6
11	J7
12	J8
13	J9
14	J10
15	N.C.

SP10T

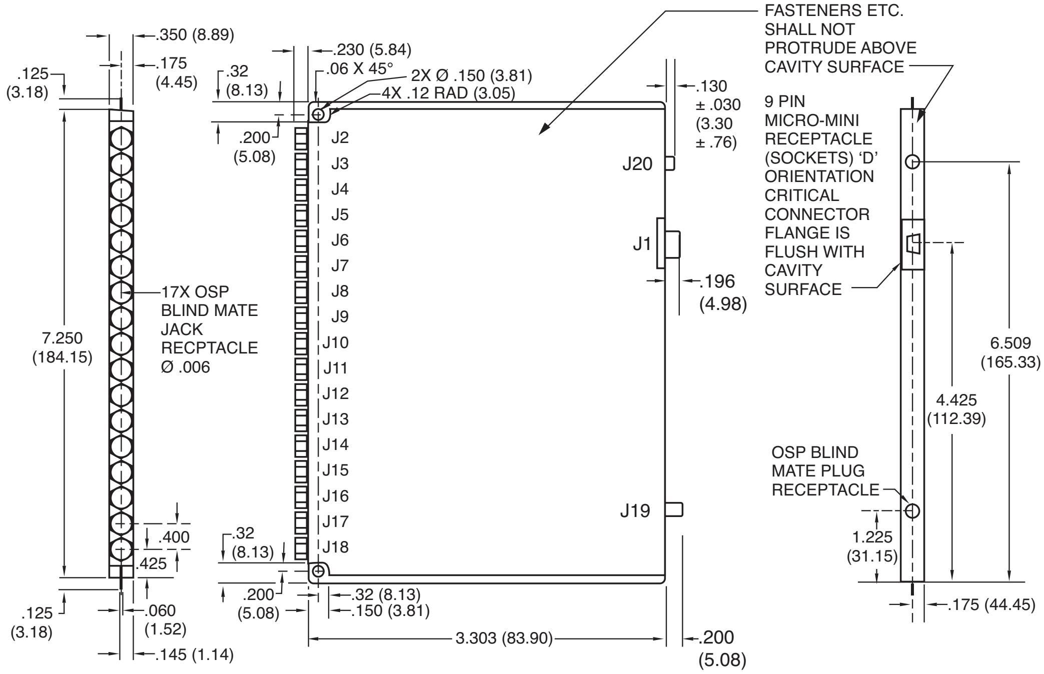
Dimensions in inches (mm in parentheses), unless otherwise specified.

Solid State PIN Control Products



PIN NO.	Function
1	+0V
2	GNC
3	-12V
4	J1
5	J2
6	J3
7	J4
8	J5
9	J6
10	J7
11	J8
12	J9
13	J10
14	J11
15	J12

SP12T



SP18T

Dimensions in inches (mm in parentheses), unless otherwise specified.

2-18 GHz

High Speed Switched-Bit Attenuators

- Very High Speed
- Precise Attenuation over Frequency Band
- Small Package Size
- Low Insertion Loss
- Hermetically Sealed

Options Available Based On Standard Designs

- Different Attenuation Range
- Performance Optimized over a Narrower Bandwidth
- Reverse Logic Control

These miniature, high speed digitally controlled switched-bit attenuators are designed for operation over multi-octave bandwidths. Attenuation levels are guaranteed to be monotonic and selectable using standard TTL logic circuitry. All models are hermetically sealed and are specified to operate over the full temperature range. All attenuators are equipped with removable RF connectors and are suitable for drop-in applications.

Digitally Controlled Attenuators (DCAs) vs Voltage Variable Attenuators (VVAs)

A VVA allows the user to select any value within its rated attenuation range – the user has full analog control. Most VVAs operate by changing the bias current of the series and shunt PIN diodes that form attenuator pads. This design approach leads to significant errors in attenuation level over the operating bandwidth. The most demanding system requirements can only be met by using a look-up table to correct for these errors.

DCAs provide very precise attenuation levels in digital (binary) increments. They have extremely fast switching speeds compared to VVAs – typically ten to twenty times faster. These switched-bit attenuators combine one or more tandem pairs of SP2T PIN diode switches with a zero loss connection between one pair of outputs and a fixed attenuator inserted in the other. The PIN diodes are simply switched between their forward and reverse states, rather than being used as variable attenuators. Very high speed PIN diodes and control circuitry are used to operate all the bits in parallel.

The major disadvantages of DCAs versus VVAs are: the minimum practical attenuation level, higher cost due to more complex circuits, somewhat higher insertion loss, and the potential for video leakage due to the high speed switches. The smallest practical Least Significant Bit (LSB) is about 0.5 dB. Video filters can often be incorporated into the DCA to satisfy specific leakage requirements.

Specifications

SMA (F), 2-6 GHz

MODEL	DA14-25	DA24-15	DA34-7
FREQUENCY RANGE (GHz)	2-6	2-6	2-6
ATTENUATION RANGE (dB)	25	15	7
INSERTION LOSS (dB max.)	2.0	2.5	3.2
VSWR (max.)	1.8	1.8	1.8
NUMBER OF BITS	1	2	3
LSB - LEAST SIGNIFICANT BIT (dB)	25	5	1
ACCURACY OF MEAN ATTENUATION	±0.5 dB	±0.3 dB	±0.3 dB
ATTENUATION FLATNESS	±1.0 dB	±0.3 dB: 0 to 10 dB ±0.9 dB:10 to 15 dB	±0.4 dB
POWER HANDLING	+23 dBm	+23 dBm	+23 dBm
SWITCHING TIME	30 ns (50% TTL to 10%/90% RF)	30 ns (50% TTL to 10%/90% RF)	30 ns (50% TTL to 10%/90% RF)
RISE AND FALL TIME (ns)	15	15	15
SWITCH RATE (MHz)	4.0	4.0	4.0
CONTROL LOGIC	'1' = I.L. '0' = ATTEN.	'1' = I.L. '0' = ATTEN.	'1' = I.L. '0' = ATTEN.
CONTROL INPUT	TRUE TTL GATE	TRUE TTL GATE	TRUE TTL GATE
POWER SUPPLY	+5 V ±2% @ 60 mA -12 V ±5% @ 60 mA	+5 V ±2% @ 110 mA -12 V ±5% @ 75 mA	+5V ±2% @ 180 mA -12V ±2% @ 130 mA
PIN DESIGNATIONS:			
E1	25 dB	5 dB	1 dB
E2	—	10 dB	2 dB
E3	—	—	4 dB
E4	—	—	—
E5	—	—	—
E6	—	—	—
E7	—	—	—
+V	+5V	+5V	+5V
-V	-12V	-12V	—
G	GROUND	GROUND	GROUND

NOTE:
Monotonicity Guaranteed

Solid State PIN Control Products

Specifications (con't.)

SMA (F), 2-6 GHz

MODEL	DA64-63B	DA74-81	DA84-64
FREQUENCY RANGE (GHz)	2-6	2-6	2-6
ATTENUATION RANGE (dB)	63	81	63.75
INSERTION LOSS (dB max.)	4.3	5.5	6.5
VSWR (max.)	2.0	2.0	2.0
NUMBER OF BITS	6	7	8
LSB - LEAST SIGNIFICANT BIT (dB)	1	1	0.25
ACCURACY OF MEAN ATTENUATION	±0.5 dB : 0 to 31 dB ±1.0 dB : 31 to 63 dB	±0.5 dB : 0 to 21 dB ±1.0 d : 22 to 41 dB ±1.5 dB : 42 to 81 dB	±0.5 dB : 0 to 21 dB ±1.0 dB : 22 to 41 dB ±1.5 dB : 42 to 63.75 dB
ATTENUATION FLATNESS	±0.5 dB : 0 to 15 dB ±0.75 dB : 15 to 32 dB ±1.0 dB : 32 to 63 dB	±0.5 dB : 0 to 21 dB ±0.75 dB : 22 to 41 dB ±1.0 dB : 42 to 81 dB	±0.5 dB : 0 to 21 dB ±0.75 dB : 22 to 41 dB ±1.0 dB : 42 to 63.75 dB
POWER HANDLING	+23 dBm	+23 dBm	+23 dBm
SWITCHING TIME	30 ns (50% TTL to 10%/90% RF)	500 ns	500 ns
RISE AND FALL TIME (ns)	10	—	—
SWITCH RATE (MHz)	4.0	0.5	0.4
CONTROL LOGIC*	'0' = I.L. '1' = ATTEN.	'1' = I.L. '0' = ATTEN.	'1' = I.L. '0' = ATTEN.
CONTROL INPUT	TRUE TTL GATE	TRUE TTL GATE	TRUE TTL GATE
POWER SUPPLY	+5 V ±2% @ 350 mA	+5 V ±2% @ 400 mA	+5V ±2% @ 450 mA
PIN DESIGNATIONS:			
E1	1 dB	1 dB	0.25 dB
E2	2 dB	2 dB	0.5 dB
E3	4 dB	4 dB	1 dB
E4	8 dB	8 dB	2 dB
E5	16 dB	10 dB	4 dB
E6	32 dB	20 dB	8 dB
E7	—	40 dB	16 dB
E8	—	—	32 dB
+V	+5V	+5V	—
-V	—	—	—
G	GROUND	GROUND	GROUND

* Reverse Logic available

NOTE:
Monotonicity Guaranteed

SMA (F), 2-18 GHz

MODEL	DA13-25	DA26-15	DA36-7	DA66-63
FREQUENCY RANGE (GHz)	2-18	6-18	6-18	6-18
ATTENUATION RANGE (dB)	25	15	7.0	63
INSERTION LOSS (dB max.)	2.6	4.5	6.5	13
VSWR (max.)	2.0	2.0	2.0	2.0
NUMBER OF BITS	1	2	3	6
LSB - LEAST SIGNIFICANT BIT (dB)	25	5	1	1
ACCURACY OF MEAN ATTENUATION	±0.5 dB	±1 dB	±0.5 dB	±0.6 dB 0 to 15 dB ±1.0 dB 16 to 32 dB ±1.5 dB 33 to 63 dB
ATTENUATION FLATNESS	±1.5 dB	±0.6 dB @ 5 dB ±1.0 dB @ 10 dB ±1.5 dB @ 15 dB	±0.75 dB	±1.5 dB
POWER HANDLING	+23 dBm	+23 dBm	+23 dBm	+23 dBm
SWITCHING TIME	30 ns	30 ns (50% TTL to 10%/90% RF)	30 ns max.	30 ns
RISE AND FALL TIME (ns)	15	15	15	15
SWITCH RATE (MHz)	4.0	4.0	4.0	4.0
CONTROL LOGIC*	'1' = I.L. '0' = ATTEN.	'1' = I.L. '0' = ATTEN.	'1' = I.L. '0' = ATTEN.	'1' = I.L. '0' = ATTEN.
CONTROL INPUT	TRUE TTL GATE	TRUE TTL GATE	TRUE TTL GATE	TRUE TTL GATE
POWER SUPPLY	+5 V ±2% @ 60 mA -12 V ±5% @ 60 mA	+5 V ±2% @ 110 mA -12 V ±5% @ 75 mA	+5V ±2% @ 200 mA -12V ±2% @ 150 mA	+5V ±2% @ 450 mA -12V ±2% @ 300 mA
PIN DESIGNATIONS:				
E1	25 dB	5 dB	1 dB	1 dB
E2	—	10 dB	2 dB	2 dB
E3	—	—	4 dB	4 dB
E4	—	—	—	8 dB
E5	—	—	—	10 dB
E6	—	—	—	32 dB
+V	+5V	+5V	+5V	+5V
-V	-12V	-12V	-12V	-12V
G	GROUND	GROUND	GROUND	GROUND

* Reverse Logic available

NOTE:
Monotonicity Guaranteed

Environmental Specifications

TEMPERATURE
Operating .... -54°C to +95°C
Storage .... -65°C to +125°C

HUMIDITY

Per MIL-STD-202F, method 103B, condition B
(96 hours at 95% R.H.)

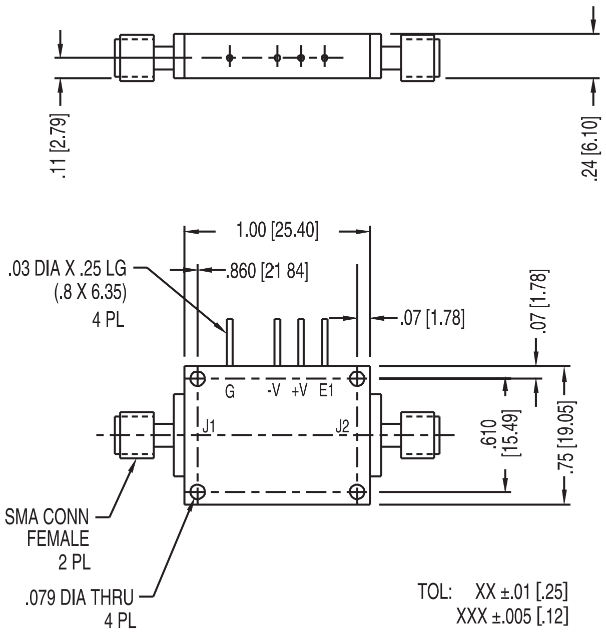
SHOCK
Per MIL-STD-202F, method 213B, condition B
(75 G, 6 msec)

ALTITUDE
Per MIL-STD-202F, method 105C, condition B
(50,000 feet)

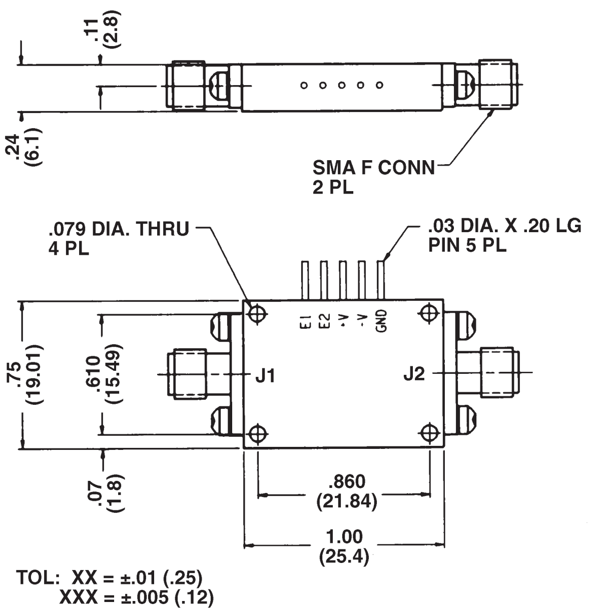
VIBRATION
Per MIL-STD-202F, method 204D, condition B
(.06" double amplitude or 15 G, whichever is less)

THERMAL SHOCK
Per MIL-STD-202F, method 107D, condition A (5 cycles)

Outline Drawings

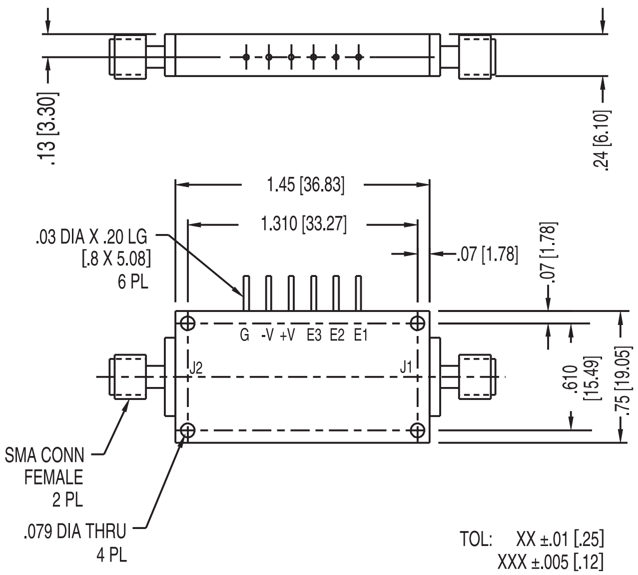


DA14-25, DA13-25

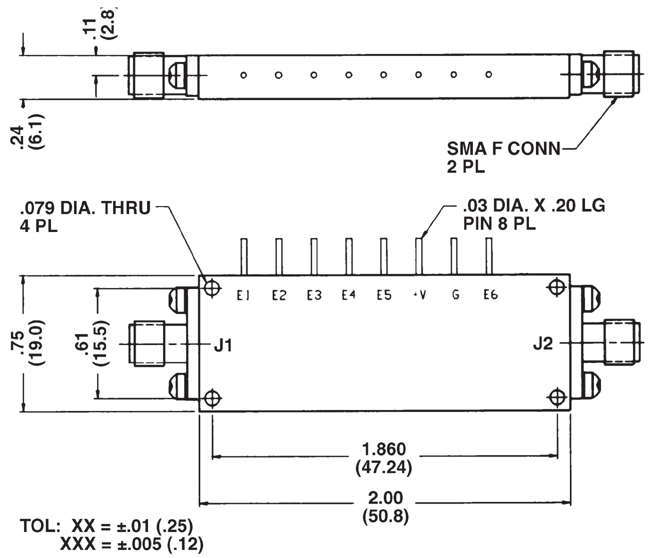


DA24-15, DA26-15

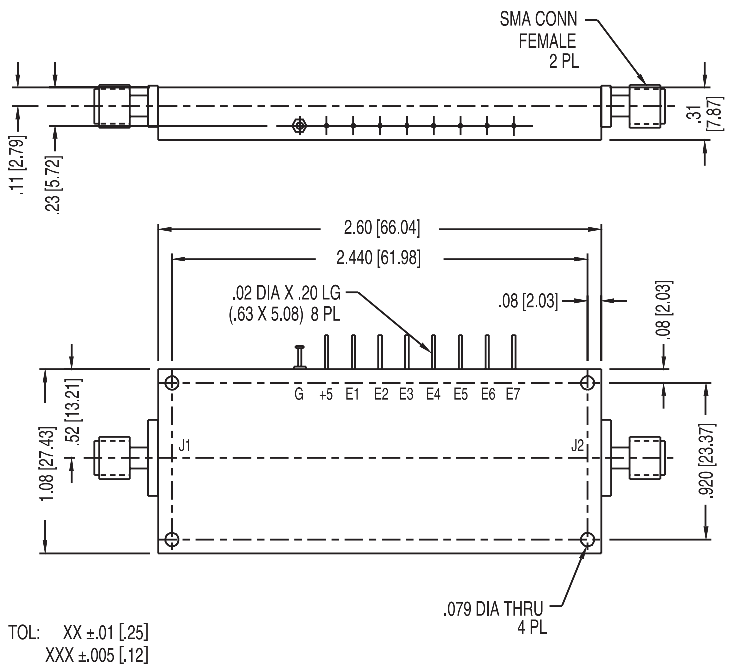
Dimensions in inches (mm in parentheses), unless otherwise specified.



DA34-7, DA36-7



DA64-63B

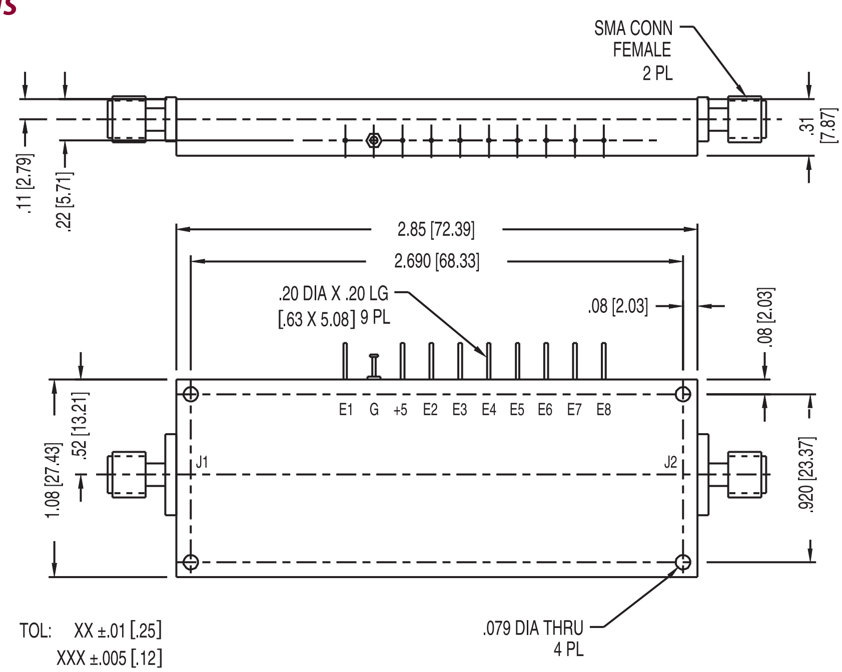


DA74-81

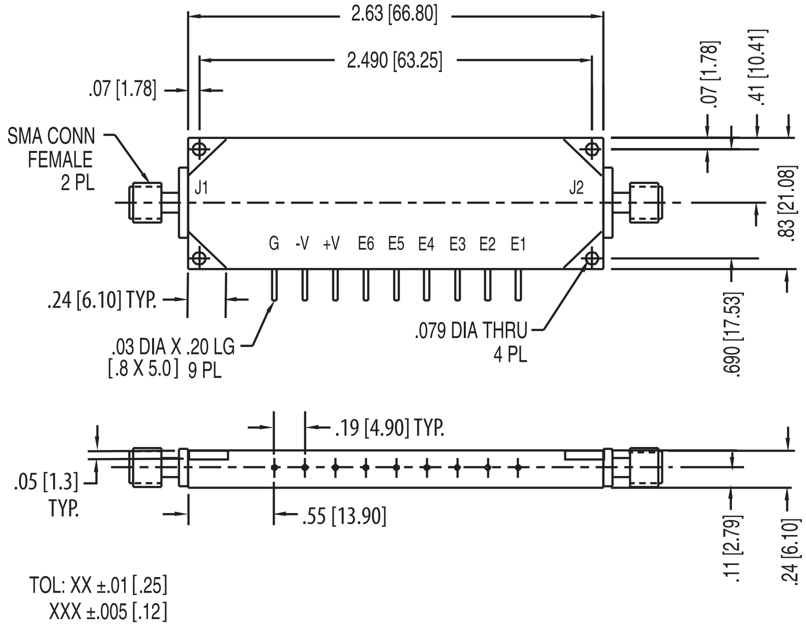
Dimensions in inches (mm in parentheses), unless otherwise specified.

Solid State PIN Control Products

Outline Drawings

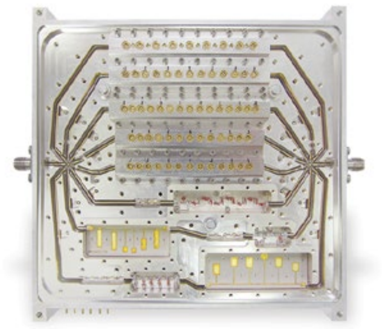


DA84-64



DA66-63

Dimensions in inches (mm in parentheses), unless otherwise specified.



1-18 GHz

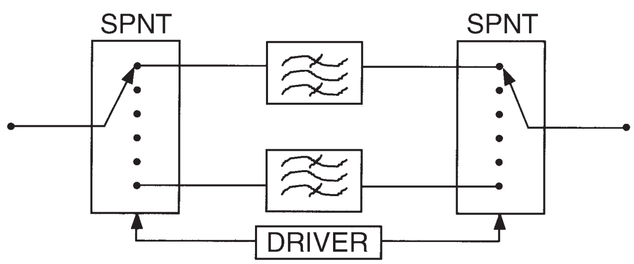
Switched Filter Banks

- Custom Designs
- Fast Switching Speed
- Low Insertion Loss
- Small Size
- Cavity, Lumped Element and Printed Filters available

Description

A switched filter bank is comprised of SPNT input and output switches together with a series of filters for every channel. Narda-MITEQ's switched filter banks are built as an integral unit of switches, filters and drivers.

These switched filter banks are custom designed to customer specifications, including the package configuration. The following are some examples of units that have been designed and manufactured.



Solid State PIN Control Products

Switched Filter Banks

1 to 6 GHz, 8 Channels

CHANNEL	PASS BAND (GHz)	INSERTION LOSS (dB)	REJECTION (GHz)			
			25 dB	35 dB	40 dB	50 dB
1	**0.95-1.55**	6	0-0.77	—	1.85-1.95	2.90-3.50
2	**1.45-2.35**	6	0-1.00	2.5-2.59	2.60-3.40	1.05-1.15
3	**2.25-3.15**	6	0-1.00	—	3.40-4.20	1.05-1.15
4	**3.05-3.95**	6	0-1.00	—	4.20-4.50	1.05-1.15
5	**3.85-4.25**	6	0-1.00	4.45-5.15	2.80-3.10	1.05-1.15
6	**4.15-4.85**	6	0-1.00	5.05-5.55	5.05-5.55	1.05-1.15
7	**4.75-5.45**	6	0-1.00	6.00-18.0	6.00-18.0	1.05-1.15
8	**5.35-6.05**	6	0-1.00	7.50-18.0	7.50-18.0	1.05-1.15

Switched Filter Banks

6 to 18 GHz, 6 Channels

CHANNEL	PASS BAND (GHz)	INSERTION LOSS (dB)	REJECTION (GHz)	
			60 dB	20 dB
1	**5.75-8.25**	6.5	0.5-4.2 & 11.5-18.0	9.0-11.0
2	**7.75-10.25**	6.5	0.5-5.2 & 13.4-22.0	11.0-13.0
3	**9.75-12.25**	6.5	0.5-6.2 & 15.4-22.0	13.0-15.0
4	**11.75-14.25**	6.5	0.5-8.6 & 16.4-22.0	9.0-11.0 & 15.0-16.4
5	**13.75-16.20**	6.5	0.5-10.6 & 18.4-22.0	11.0-13.0
6	**15.75-18.25**	7.0	0.5-12.6	13.0-15.0

Cavity Type Switched Filter Banks

6 to 18 GHz, 4 Channels

CHANNEL	PASS BAND (GHz)	INSERTION LOSS (dB)	REJECTION (dBc)	
			± 2 GHz	± 1 GHz
1	**6.6-9.8**	4.6	45-50	28-32
2	**9.4-12.6**	4.6	45-50	28-32
3	**12.2-15.4**	4.6	45-50	28-32
4	**14.8-18.0**	4.6	45-50	28-32

1-18 GHz

Limiters

- Connectorized and Drop-In Modules
- High-Power Ratings
- Fast Recovery Time
- Small Size

Description

Narda-MITEQ offers a wide range line of PIN diode based limiters designed to meet severe environmental conditions for airborne as well as other applications. Broadband limiters cover up to 1 to 18 GHz in one band and support power handling of up to 500 watts of pulsed power. The Narrowband limiters cover typically 25% frequency band within the frequency range of up to 18 GHz. They support power handling of up to 400 watts of pulsed power.

Specifications

Broadband , SMA (F), 1 to 18 GHz

FREQUENCY RANGE (GHz)*	MODEL	BAND SEGMENTS (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	INPUT POWER* (W max.)		PULSE WIDTH (µs max.)	DUTY CYCLE (max.)	INPUT 1 dB COMPRESSION POINT (dBm min.)	FLAT LEAKAGE (mW max.)	RECOVERY TIME (ns max.)	OPERATING TEMPERATURE RANGE (°C max.)
					CW	PEAK						
1-18	**LIM101**	1-18	2.5	2.0	2	150	1	1.0%	+5	100	200	-55 to +95
2-18	**LIM201**	2-4 4-8 8-12 12-18	1.0 1.4 1.8 2.3	1.7 1.9 1.9 2.0	1	150	1	0.1%	+5	150 130 130 130	100	-30 to +85
2-18	**LIM301**	2-4 4-8 8-12 12-18	1.3 1.8 2.2 2.7	1.7 1.9 1.9 2.0	3	500	1	0.1%	+5	150 130 130 130	200	-30 to +85

* Maximum pulsed (CW power) at 25°C derate linearly to 0 W at 175°C

Solid State PIN Control Products

Examples of Custom Designs

Narrowband , SMA (F), 1 to 12 GHz

FREQUENCY RANGE* (GHz)	INSERTION LOSS (dB max.)	VSWR (max.)	INPUT POWER (W max.)		PULSE WIDTH (µs max.)	DUTY CYCLE (max.)	INPUT 1 dB COMPRESSION POINT (dBm min.)	FLAT LEAKAGE (mW max.)	RECOVERY TIME (ns max.)	OPERATING TEMPERATURE RANGE (°C max.)
			CW	PEAK						
1-2	0.8	1.5	40	400	10	10%	+7	100	400	-30 to +75
1.2-1.4	0.7	1.3	30	300	20	10%	+7	100	400	-30 to +85
3.1-3.5	1.0	1.3	25	250	50	10%	+7	50	350	-40 to +75
8.4-9.6	2.0	2.0	15	50	20	5%	+5	64	500	-20 to +70
8-12	2.2	1.8	5	50	10	10%	+5	100	500	-40 to +85
1.28-1.4	0.6	1.5	30	300	25	13%	+7	32	200**	-30 to +85

* = 25% Bandwidth
** from 50 W input peak power of 1 dB of small signal gain

Environmental Specifications

TEMPERATURE
Operating .... See Examples of Custom Designs
Storage .... -55°C to +85°C

HUMIDITY

RTCA/DO-160D, Category B Section 6.3.2
R.H. Operating 95% @ 60°C

SHOCK

RTCA/DO-160D, Category B Section 7

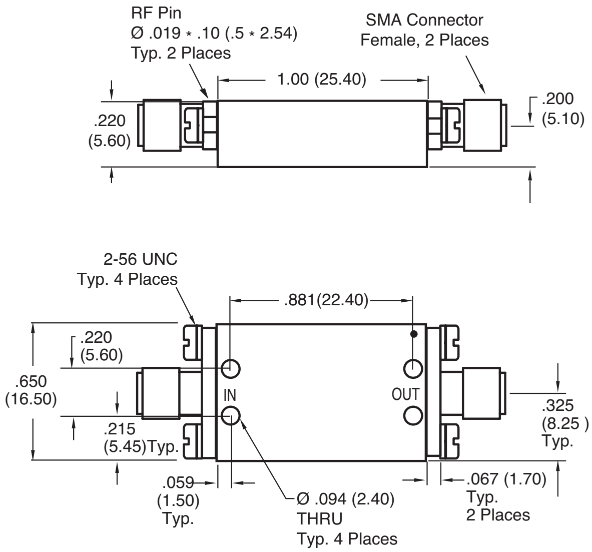
ALTITUDE
(70,000 feet)

VIBRATION

RTCV/DO-160D Category R or R2, Section 8, Par. 8.7.2
Fig 8-1 & 8-4, Curve C & C1, G rms 4.12 & 5.83
Random 30 min at performance level and 3 hours at endurance level for each axis

THERMAL SHOCK
Per MIL-STD-202F, method 107D, condition A (5 cycles)

Outline Drawing



Dimensions in inches (mm in parentheses), unless otherwise specified.


narda MODEL 462B
INTEGRATED THERMOCOUPLE
POWER MONITOR
10 MHz TO 12.4 GHz
RANGE .1-100 mW (30 dB)
MAX RATED PWR 100 mW
CAL ADJ
US PAT NO 3,668,521
S/N 40011

Power Monitors and Sensors

Quick Reference Guide

FREQUENCY RANGE (GHz)	MODEL	PAGE
Power Monitors		
0.01-12.4	426B	350
0.01-12.4	427B	350
0.01-12.4	460B	350
0.01-12.4	462B	350
0.01-12.4	466B	350
0.1-26.5	4491	350
Power Sensors		
0.01-18.5	8423	353

0.01-26.5 GHz

Integrated Thermocouple Based Power Monitors

- Broadband Frequency Coverage
- High Level Outputs
- Simplifies System Designs
- Excellent Stability, Accuracy
- Low Cost

Description

Narda-MITEQ integrated power monitors are complete, integrated power measurement subsystems which provide an output signal proportional to their RF input level. A system designer need only supply DC power to the RF power monitor for it to measure RMS average power levels. Measurements can be made over the designer's choice of 20 or 30 dB dynamic range with repeatable, accurate performance. All units are designed to operate in hostile RF environments and are sealed to reduce emissions of, and susceptibility to, stray RF signals. Input connectors are precision Type N or 3.5 mm connectors that comply with MIL-C-39012, and output connections are through a MIL-C-26284 type connector for environmental and EMC considerations. This design feature allows these units to be mounted close to high power output stages while maintaining accurate output readings. These power monitors operate from a wide range of supply voltages. Single ended supplies of either ±24 to 36 VDC unregulated, or dual supply voltages of ±12 to ±18 VDC regulated are acceptable for all thermocouple monitors However special versions are available to match system supply voltages. These devices may be used as either constant current or constant voltage devices. In a system where variations of the resistance of the DC wiring may be encountered (such as through the slip rings of a rotating antenna system), or where the length of wire would cause a voltage reduction, a constant current source is desirable since any resistance, or resistance fluctuation would not affect the accuracy of the remote readout. In a system where the remote readout might be a high impedance device, such as a PC based data acquisition card the most desirable configuration is a constant voltage source. The choice of either a constant current or constant voltage configuration does not require any change or modification of the internal circuitry of the power monitor. Either configuration is obtained by proper wiring of the external circuitry. The supplied operation and maintenance manual contains numerous examples of external wiring configurations that may be employed.

Power Monitors

Specifications

0.01 - 26.5 GHz

FREQUENCY RANGE	MODEL	DETECTION	DYNAMIC RANGE* (dB)	MEASUREMENT RANGE	OVERLOAD CW (mW)	OVERLOAD PEAK (W)	REPLACEMENT ELEMENT	OUTPUT CONNECTOR	INPUT CONNECTOR	INPUT VSWR (max.)
10 MHz-12.4 GHz	**426B**	True RMS Average	30	100 µW to 100 mW	300	30	820A	15 PIN**	Type N (M)	10-50 MHz: 2.0 50 MHz-12.4 GHz: 1.5
	427B	True RMS Average	30	1.0 µW to 1.0 mW	3.0	0.1	818A	15 PIN**	Type N (M)	10-50 MHz: 2.0 50 MHz-12.4 GHz: 1.5
	460B	True RMS Average	30	1.0 µW to 1.0 mW	3.0	0.1	818A	18 PIN‡	Type N (M)	10-50 MHz: 2.0 50 MHz-12.4 GHz: 1.5
	462B	True RMS Average	30	100 µW to 100 mW	300	30	820A	18 PIN‡	Type N (M)	10-50 MHz: 2.0 50 MHz-12.4 GHz: 1.5
	466B	True RMS Average	20	1 mW to 100 mW	300	30	820A	18 PIN‡	Type N (M)	10-50 MHz: 2.0 50 MHz-12.4 GHz: 1.5
0.1-26.5 GHz	**4491**	True RMS Average	30	10 µW to 10 mW	30	5.0	Contact Factory	18 PIN‡	3.5 mm (M)	0.1-22 GHz: 1.5 22-26.5 GHz: 2.0

* Units can be configured for two or three 10 dB ranges or for a single 20 dB or 30 dB range
** MS3116A-14-15P (mates with MS3116A-14-15S, Narda-MITEQ P/N 30931302)
‡ MS3116A-14-18P (mates with MS3116A-14-18S, Narda-MITEQ P/N 30931301)

NOTES:
ZERO OFFSET (typ): 0.005%/C° on least sensitive range, 10dB higher on each lower range
LINEARITY: ±2% of full scale

Environmental Specifications

TEMPERATURE

Operating .... -55°C to +85°C
Non-operating .... -55°C to +125°C

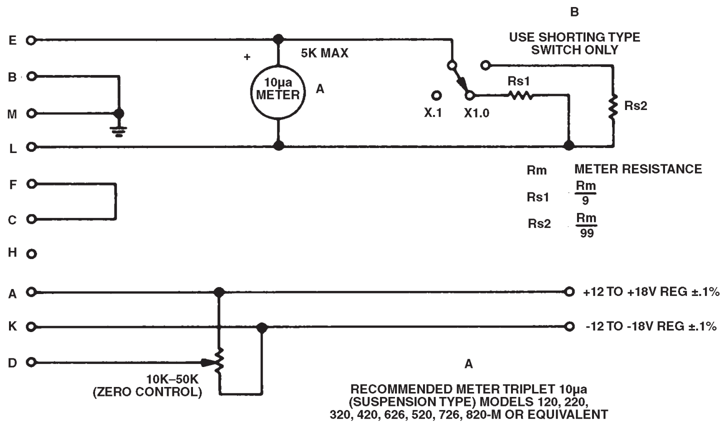
HUMIDITY .... 0 to 99% (Non-condensing)

ALTITUDE .... 0 to 30,000 ft.

Typical Interconnection Diagrams

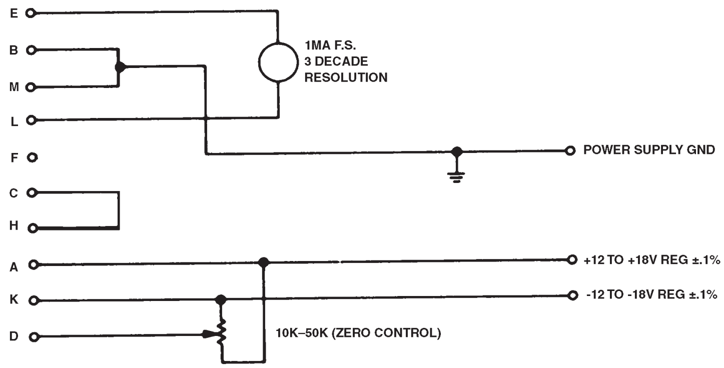
In this external wiring configuration, the RMS power monitors will generate a 0 to 100 mV output for each 10 dB range (x.1, x1, x10).

If the switch is left in the x.1 range, the RMS monitors will generate 0 to 1V and 0 to 10 V if operated in the x1 and x10 power ranges, respectively.



Constant Current Dual Supply, 3 Ranges

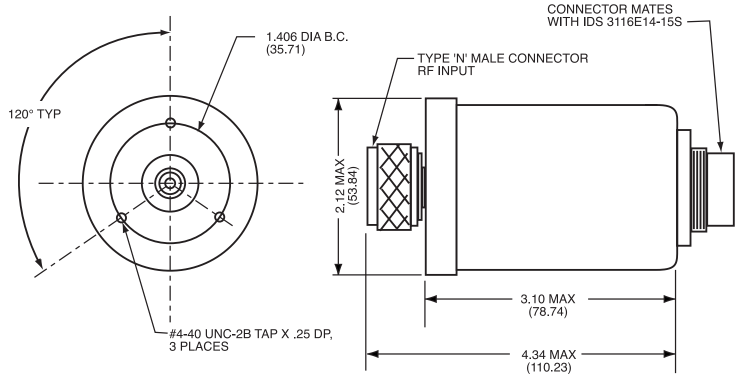
In this external wiring configuration, the RMS power monitor will generate up to 1 mA of current. When operated in the most sensitive range it will generate 0 to 10 µA, mid range; 0 to 100 µA and in the least sensitive range; 0 to 1 mA.



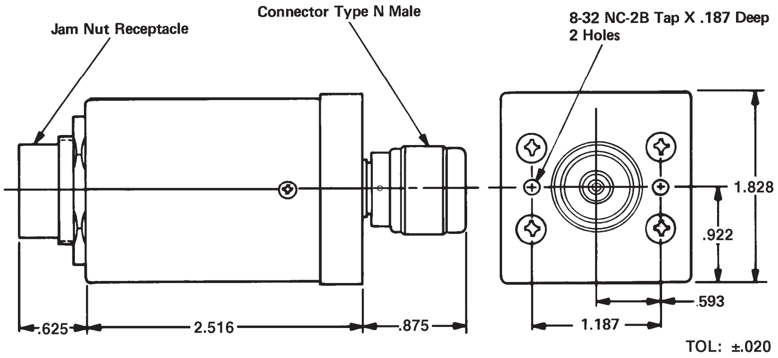
Constant Current Dual Supply Connection, Single Range

Power Monitors

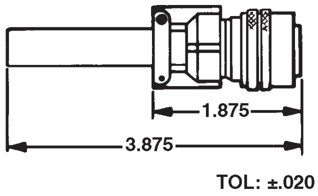
Outline Drawings



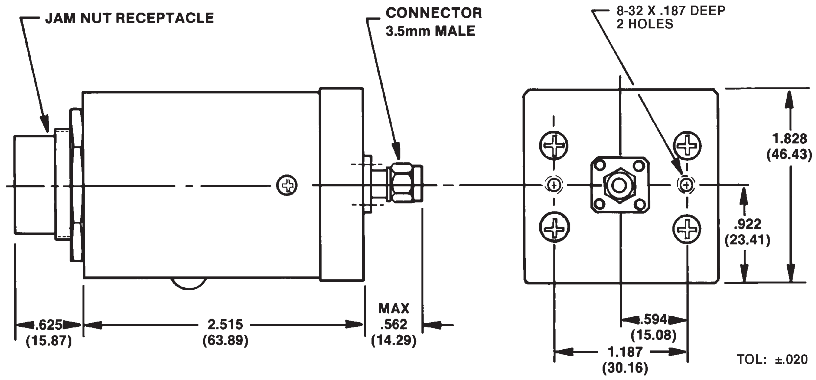
MODELS 426B AND 427B



MODEL 460B, 462B, 466B



MATING CONNECTOR
PART NO. 309313
(Accessory)



MODEL 4491

Dimensions in inches (mm in parentheses), unless otherwise specified.

0.01-18.5 GHz

Broadband Power Sensor

- RF Input and DC Voltage Outputs
- The Impedance of the RF Input is matched into 50 ohms
- Power conversion is accomplished with a pair of thermocouple elements

Specifications

0.01 to 18.5 GHz

FREQUENCY RANGE (GHz)	MODEL	TYPICAL POWER (mW)	MAXIMUM POWER* (mW)	PULSE POWER** (W max.)	TYPICAL SENSITIVITY (mV/mW)	DYNAMIC RANGE (dB)	TEMPERATURE COEFFICIENT	OPERATING TEMPERATURE (°C)	VSWR (max.)	CONNECTOR
0.01-18.5	**8423**	10	30	1	0.32	30	<±0.1%/°C	-40 to +80	1.75 (0.01-0.02 GHz) 1.5 (0.02-10 GHz) 1.6 (10-18.5 GHz)	SMA Male (input) 4 Pin Female (output)

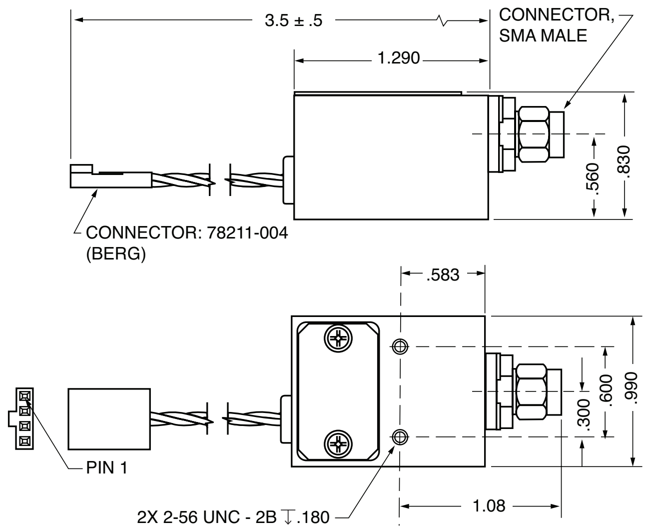
* Must be handled for 1 second minimum
** With shape of 5 W/µsec must be handled for a duration of 5 µsec (at 25° C)

NOTES:
Output range is based on an RF input level of +10 mW, and a temperature of 20° C.
The allowable voltage range at a constant input level for any single unit must be held within 2.2 dB.
Linearity must be verified at 9.5 GHz, over the input power range from + 10 dBm to -10 dBm at 20° C.
Output Connector Berg 78211-004. Pin 1: Positive Polarity, Pin 2: Ground, Pin 3: Negative Polarity, Pin 4: Not Used.
Input Connector per MIL-C-39012D.

Outline Drawing

PINS		
No.	FUNCTION	COLOR
1	POS	RED
2	GND	GREEN
3	NEG	BLACK

MODEL 4491
Connector mates without interference per MIL-STD-348
Finish: Gold Plate over Nickel
Tolerances ± .005



Dimensions in inches, unless otherwise specified.

Warranty

Narda-MITEQ warrants each product of its manufacture to be free from any defect in material and workmanship for a period of one year from date of shipment to, and return by, the original purchaser. In the case of electromechanical RF switches, the aforementioned warranty covers one year or the number of operations, whichever comes first. All warranty returns, how- ever, must first be authorized by a factory office representative.

The limit of liability under this warranty shall be to repair or replace any product, or part thereof, which proves to be defective after inspection by Narda-MITEQ. This warranty shall not apply to any Narda-MITEQ product that has been disassembled, modified, physically or electrically damaged or any product that has been subjected to conditions exceeding the applicable specifications or ratings.

Narda-MITEQ shall not be liable for any direct or consequential injury, loss or damage incurred through the use, or the inability to use, any Narda-MITEQ product.

Narda-MITEQ reserves the right to make design changes to any Narda-MITEQ product without incurring any obligation to make the same changes to previously purchased units.

This warranty is the full extent of obligation and liability assumed by Narda-MITEQ with respect to any and all Narda-MITEQ products. Narda-MITEQ neither makes, nor authorizes any person to make, any other guarantee or warranty concerning Narda-MITEQ products.

Sales Representatives

For Domestic and International Sales Representatives visit the Narda-MITEQ website at:

www.nardamiteq.com

Click **Narda-MITEQ**, go to the **"REP"** icon and select your area.

(www.nardamiteq.com)

If you need additional information or assistance please contact the factory direct at **631-231-1700**.

Alphabetical Index

Alphabetical Index

Model Number Index

Model Number Index

Model Number Index

Model Number Index

VSWR vs Return Loss

VSWR	RETURN LOSS (dB)	VSWR	RETURN LOSS (dB)	VSWR	RETURN LOSS (dB)
17.391	1.0	1.208	20.5	1.020	40.0
11.610	1.5	1.196	21.0	1.019	40.5
8.724	2.0	1.184	21.5	1.018	41.0
6.997	2.5	1.173	22.0	1.017	41.5
5.848	3.0	1.162	22.5	1.016	42.0
5.030	3.5	1.152	23.0	1.015	42.5
4.419	4.0	1.143	23.5	1.014	43.0
3.946	4.5	1.135	24.0	1.013	43.5
3.570	5.0	1.127	24.5	1.013	44.0
3.263	5.5	1.119	25.0	1.012	44.5
3.010	6.0	1.112	25.5	1.011	45.0
2.796	6.5	1.106	26.0	1.011	45.5
2.615	7.0	1.099	26.5	1.010	46.0
2.458	7.5	1.094	27.0	1.010	46.5
2.323	8.0	1.088	27.5	1.009	47.0
2.204	8.5	1.083	28.0	1.008	47.5
2.100	9.0	1.078	28.5	1.008	48.0
2.007	9.5	1.074	29.0	1.008	48.5
1.925	10.0	1.069	29.5	1.007	49.0
1.851	10.5	1.065	30.0	1.007	49.5
1.785	11.0	1.062	30.5	1.006	50.0
1.725	11.5	1.058	31.0	1.006	50.5
1.671	12.0	1.055	31.5	1.006	51.0
1.622	12.5	1.052	32.0	1.005	51.5
1.577	13.0	1.049	32.5	1.005	52.0
1.536	13.5	1.046	33.0	1.005	52.5
1.499	14.0	1.043	33.5	1.004	53.0
1.464	14.5	1.041	34.0	1.004	53.5
1.433	15.0	1.038	34.5	1.004	54.0
1.404	15.5	1.036	35.0	1.004	54.5
1.377	16.0	1.034	35.5	1.004	55.0
1.352	16.5	1.032	36.0	1.003	55.5
1.329	17.0	1.030	36.5	1.003	56.0
1.308	17.5	1.029	37.0	1.003	56.5
1.288	18.0	1.027	37.5	1.003	57.0
1.270	18.5	1.025	38.0	1.003	57.5
1.253	19.0	1.024	38.5	1.003	58.0
1.237	19.5	1.023	39.0	1.002	58.5
1.222	20.0	1.021	39.5	1.002	59.0

435 Moreland Road
Hauppauge, NY 11788
TEL: 631.321.1700
FAX: 631.231.1711
E-MAIL: componentsnm@nardamiteq.com
www.nardamiteq.com