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## General Information

### How To Order Maury Products

Orders may be placed directly with the factory or in care of your nearest Maury sales representative. For orders originating outside the United States, we recommend placing the order through your local Maury sales representative. Maury maintains an extensive network of sales representatives throughout the world. To find your local Maury sales representative use the interactive index on our web site at [maurymw.com/Support/find-sales-rep.php](http://maurymw.com/Support/find-sales-rep.php).

### Pricing and Quotations

Prices for Maury products are those prevailing when an order is placed except when the price is established by formal quotation. Maury Microwave reserves the right to change prices at any time without notice. Price and availability of products with custom or special features must be verified by a valid, formal factory quotation. Maury quotations are valid for a maximum of 30 days. Extensions beyond 30 days can be granted only by the factory.

### Terms of Sale

Domestic terms are net 30 days from the date of invoice for customers with established credit F.O.B. Ontario, California. Please refer to Maury Form 228 for complete terms and conditions. For International sales, please refer to Maury Form 250. Sales to Canada are covered by Maury Form 251. These forms are available on request, or may be found on our web site in PDF format.

### Shipment

All shipments are at the buyer's expense. Shipments are normally made using methods and carriers specified by the customer. In the absence of specific instructions, Maury will ship at our discretion by the most advantageous method. All shipments are F.O.B. the Maury factory in Ontario, California (U.S.A.) and, unless otherwise specified, will be insured at full value at the customer's expense. Shipments are packed to provide ample safety margin against transit damage, and there is no charge for regular packing requirements. Additional charges apply to MILSPEC preservation, packaging, packing and marking.

### Product and Specifications Changes

The information, illustrations and specifications contained in this catalog were current at the time of publication. Maury Microwave is continually striving to upgrade and improve our product offering and therefore, reserves the right to change specifications, designs and models without notice and without incurring any obligation to incorporate new features on products previously sold.

Because products are changed or improved with time, please consult your local Maury representative, or our Sales Department, for current pricing and product information before placing orders.

### Product Selection

Maury representatives and sales office personnel are well qualified to provide assistance in product selection, and current pricing and availability. Our factory applications engineers are ready to assist you with any technical or applications questions you may have.

### Service and Support

#### Warranty

Maury Microwave is highly confident that our products will perform to the high levels that our customers have come to expect. As an expression of that confidence, our products are warranted as noted in the abbreviated warranty statements below. (For a complete statement of the hardware warranty, please see Form 228, Terms and Conditions of Sales. For a complete statement of the software warranty, please see Form 273, Maury License Agreement.)

Maury Microwave hardware products are warranted against defects in material and workmanship for a period of one year after delivery to the original purchaser. If a Maury manufactured hardware product is returned to the factory with transportation prepaid and it is determined by Maury that the product is defective and under warranty, Maury will service the product, including repair or replacement of any defective parts thereof. This constitutes Maury's entire obligation under this warranty.

Maury warrants that, for a period of ninety (90) days following purchase, software products, including firmware for use with and properly installed on a Maury designated hardware product, will operate substantially in accordance with published specifications, and that the media on which the product is supplied is free from defects in material and workmanship. Maury's sole obligation under this warranty is to repair or replace a nonconforming product and/or media, provided Maury is notified of nonconformance during the warranty period. Maury does not warrant that the operation of the product shall be uninterrupted or error-free, nor that the product will meet the needs of your specific application.

The warranty does not apply to defects arising from unauthorized modifications, misuse or improper maintenance of the product. Warranty service is available at our facility in Ontario, California.

#### Service Returns

Repair and calibration services are available for Maury products for as long as replacement parts are available. On some instruments, support services may be available for up to ten years.

### Quality Profile

Maury Microwave Corporation enjoys a well-earned reputation for excellent, technically advanced products that are reliable, meet specifications, and provide a quality appearance. Maintaining and improving this reputation requires adherence to strict quality standards that are set forth in a formal Quality Department Manual. This manual is distributed to all Maury managers, inspectors, and technicians. The Quality Manual can be reviewed by our customers at our facility in Ontario, California.

Our inspection and calibration systems are in accord with MIL-I-45208A and MIL-STD-45662A, respectively. Our overall quality system has been approved through in-house surveys by many of our customers including the U.S. Government. Our laboratory is ANSI/NCSL Z540-1 compliant with traceability to NIST.

**MAURY MICROWAVE CORPORATION IS AN  
ISO 9001:2008/AS9100C CERTIFIED COMPANY.**

# About Maury Microwave

## Corporate Profile

Maury and Associates was founded by Mario A. Maury, in Montclair, California on October 15, 1957. With the help of his sons, Mario A. Maury, Jr. and Marc A. Maury, the company earned a solid reputation in the microwave test, measurement and calibration industry. Today, after more than 54 years, we serve our customers as Maury Microwave Corporation. We have are dedicated to the pursuit of quality, and committed to providing the very best in customer service.

## Markets Served

Maury Microwave serves all areas of the RF and microwave industry, providing a comprehensive line of automated tuners, microwave components and accessories that operate from DC to 110 GHz. This includes a wide range of test and measurement products used extensively by the wireless communication industry for power and noise characterization of transistors and amplifiers. Our precision calibration solutions are used for test and measurement applications and production testing. Maury also produces system components for ground based and airborne applications such as communications, EW/ECM systems, and radar.

## Manufacturing Technologies

Our factory is equipped with the latest 7-axis CNC machines and can handle high volume production as well as high precision, small-quantity manufacturing. We maintain a state-of-the-art microwave laboratory using the latest test equipment and vector network analyzers to support our test and calibration operations. Our in-house manufacturing and testing capabilities allow us to provide products tailored to our customers' specific requirements.

## Technical Services

Our extensive knowledge and experience with calibration and measurement requirements provides the expertise necessary for producing high quality products. Maury Calibration and Repair Services are available for every product we make, and are performed in a temperature-controlled environment with the latest in measurement and verification equipment.

## Products & Technologies

Maury makes RF and microwave devices that cover a range from DC to 110 GHz, primarily addressing test and measurement applications. Coaxial components are available DC to 67 GHz in most popular line sizes and we also manufacture waveguide components from WR284 (2.60 GHz) to WR10 (110 GHz).



## Facilities

Located in the City of Ontario, California, about 40 miles due east of Los Angeles and just north of the San Bernardino Freeway (Interstate 10), our 96,000 square foot facility is within minutes of the Ontario International Airport (ONT). Here, we make the best microwave products in the market.





## Maury's Strategic Alliances

### In The Test & Measurement Industry

Working Together To Provide The Right Solutions For Your Applications

#### Keysight Technologies, Inc.



Keysight's electronic measurement products provide standard and customized electronic measurement instruments and systems, monitoring, management and optimization tools for communications networks and services, software design tools and related services that are used in the design, development, manufacture, installation, deployment and operation of electronics equipment and communications networks and services.

Keysight RF & Microwave test equipment allow Maury's Engineering Experts to provide customer needs with high precision and advanced services (pulsed IV/RF measurements, Load-Pull characterization — CW and pulsed, two-tones, etc.), and are used to support the R&D engineers developing new characterization techniques.

Moreover, as Keysight's solutions partner Maury works closely with Keysight on the development of new applications for the PNA-X which take advantage of its advanced features and extend and enhance its capabilities into high-power, high-speed and 50 ohm environments.

#### Anteverta Microwave



Anteverta-mw is pioneer of large signal device characterization methodologies and systems, and high efficiency/linearity PA design. Anteverta's patented IP allows non-50Ω characterization at speeds up to 100x faster than traditional systems, and is unique in its capability of wideband impedance control for realistic modulated signals.

Anteverta microwave was launched in March 2010 as a spin-off from the Delft University of Technology in The Netherlands. Anteverta microwave was born as the development of a decade of successful research in the fields of large signal device characterization and high efficiency/linearity PA design. In May 2010 Anteverta microwave licensed its products to Maury Microwave Corporation to merge its innovative side with the strengths of the most reliable provider of non-linear characterization systems. Maury Microwave acquired Anteverta in full in March 2015.

#### AMCAD Engineering



AMCAD is a provider of new RF & Microwave solutions. Founded in 2004 with Headquarters and Lab in Limoges, France, its founders have brought together a multi-disciplinary and high skilled team.

#### Core Activities:

Development and provision of solutions and tools for semiconductor professionals, with emphasis on Component Measurements and Modeling, Circuit Design and Systems Behavioral Modeling. AMCAD Products include Advanced Pulsed IV / RF systems and IVCAD data management software. AMCAD's Pulsed IV/RF System is an advanced components characterization system that is essential to semiconductor technology development, device reliability and lifetime testing, and semiconductor device modeling. Its key features include 10A-240V pulse generation, pulse widths down to 200ns, high precision current and voltage measurement, synchronized S2P capabilities to 40 GHz, and self-heating and trapping phenomena characterization; all of which makes it the idea system for modeling a wide range of devices



# Maury Microwave Corporation

## ISO 9001:2008 – AS9100C Documentation

Maury Microwave Corporation is registered as conforming to ISO 9001:2008 with AS9100C for Design, Manufacturing and Servicing of Microwave Based Measuring and Testing Equipment for the Aerospace, Defense and Wireless Telecom Industries.



## Calibration and Repair Services



### Calibration Services

At Maury Microwave, our commitment to quality doesn't end with the sale of a product. In our state-of-the-art microwave laboratory, we offer both ANSI/NCSS Z540-1 (MIL-STD-45662A) calibration and commercial level calibration services for every product we produce. Our laboratory is ANSI/NCSS Z540-1 ISO 10012-1 compliant with traceability to NIST (National Institute of Standards and Technology).

Each Maury Microwave product is shipped with a certificate of conformance which assures that it has been tested and found to be within operational tolerances. As these products are used, changes can occur which may result in an out of tolerance condition. Periodic calibrations are therefore recommended to maintain functional integrity. We are happy to perform the calibrations you need at a reasonable cost.

Please contact our Calibration and Repair – Measurement Services Department to obtain quotations for the specific calibration services you require. Quoted prices will cover the cost of all applicable measurements and include written calibration reports documenting the mechanical and electrical data. If parts are out of tolerance, the cost of repair or replacement will be quoted for your approval prior to the start of any additional work.

**It is recommended that the following items be placed on a 12-month re-calibration cycle:**

- > Calibration Kits
- > Coaxial Components for Laboratory Use
- > Waveguide Components for Laboratory Use
- > Automated Tuner Systems
- > Noise Calibration Systems (Cryogenic, Thermal and Ambient Terminations) Mechanical Products
- > Torque Wrenches
- > Connector Gages

### Repair Services

We recommend annual re-calibration and refurbishment of your Maury products to ensure continuous measurement accuracy. Because we are the original equipment manufacturer and users of Maury products, we understand the critical performance criteria of your measurement equipment. Therefore, we will always give you an honest evaluation of each and every Maury part when repairs are required. We will also provide you with options and our best recommendation for optimum performance.

#### Annual re-calibration and servicing guarantees:

- > Accuracy and Confidence in your Network Analyzer Measurements
- > Precision Connector Mating
- > Verification of Critical Mechanical and Electrical Specifications
- > All Interfaces meet "As New" Mechanical Specifications to Ensure Predictable S-Parameter Performance
- > Prolonged Life of Both Maury Measurement Standards and Your Network Analyzers
- > Confidence That Your Maury Product Will Be As Precise As When First Delivered
- > Refurbishment Done Right and Done Here In Our Factory
- > Guaranteed Genuine Maury Parts and Quality
- > We Design It, We Build It, We Calibrate It, We Repair It.

#### Benefits of Maury Calibration and Repair:

- > Calibration and Repairs Performed Directly By The OEM (No Middleman Delays or Mark-Ups!)
- > Complete Confidence In Your Measurements
- > Protects Your Costly Network Analyzer Investment
- > Maintains Your ANSI/ISO Compliance and NIST Traceability

# Maury Precision Calibration Standards

## Your Calibration, Measurement & Modeling Solutions Partner!

### In This Volume:

#### Calibration Kits for Vector Network Analyzers

For precise, accurate calibration of Keysight, Anritsu, Rohde & Schwarz, and other network analyzers from DC to 67 GHz, Maury offers calibration-grade (metrology) cal kits in all popular connector types, in fixed load, sliding load and TRL/LRL configurations.

#### Coaxial & Waveguide Calibration Standards

The calibration standards provided in Maury calibration-grade cal kits are also available for separate purchase as spares or replacement parts. Maury also makes the world's finest precision and reference air lines, fixed and sliding loads, shorts, opens and precision mismatches.

#### Coaxial Connector Gage Kits

Maury's analog and digital connector gage kits are offered in 10 gage types and more than 20 kit configurations. These kits provide everything needed to verify the critical interface dimensions of each connector in your test setup. Proper use of these gage kits prevents damage to your test set ports and DUT connectors, while ensuring the best possible electrical performance and most accurate measurements from your test setups.

#### Maury Coax & Waveguide-to-Coax Adapter Solutions

Maury now offers three lines of precision adapters including **Test Essentials™ Lab Adapters**, offered at one of the industry's best price/performance ratios, are tailored for daily use in lab or field; **ColorConnect™ Precision Adapters**, which take advantage of new manufacturing techniques to improved VSWR, thus bridging the gap between laboratory-grade and calibration-grade (metrology) adapters. ColorConnect™ adapters employ the proposed IEEE high-frequency connector/adaptor color convention, becoming the first commercially available products to offer immediate and clear indication of mating compatibility; and **Maury Calibration-Grade (Metrology) Adapters**. Maury calibration-grade (metrology) adapters are known for their quality, durability and repeatability. From 1.85mm to Type N, and from WR280 to WR22. With the widest variety of precision coaxial and waveguide adapters of any supplier, world-wide, we have the adapter you need, no matter what test setup or application you use.

#### Maury Microwave/RF Cable Assembly Solutions

Maury's expanded Microwave/RF Cable Assemblies Solutions now include Maury **Test Port Cable Assemblies** designed specifically for use with commercial Vector Network Analyzers (VNAs) equipped with calibration-grade metrology NMD connectors; Maury's **Stability™ Cable Assemblies** designed specifically for phase-stable and amplitude-stable applications, where excellent measurement repeatability –even after cable flexure– is critical; **Utility™ Cable Assemblies**, designed for general testing applications, Utility™ cables offer excellent value with their low cost, low insertion loss, excellent return loss, flexibility, and amplitude and phase stability.

#### Thermal and Cryogenic Noise Calibration Systems and Components

Maury Noise Calibration Systems (NCS) are self-contained, highly accurate sources of RF and microwave noise power that are used wherever noise source accuracy is critical, such as in noise figure and effective input noise temperature measurement, calibration of solid state noise sources, evaluation and verification of earth station receivers, and as radiometer reference sources.





## Maury Precision VNA Calibration Kits

For Fixed Load, Sliding Load and TRL Calibration of Keysight, Rhode & Schwarz and Anritsu VNAs





# Network Analyzer Calibration Methodologies

## Why do we need to calibrate?

Systematic errors that are present in any measurement equipment and setup must be removed in order to measure a DUT accurately. The basis of network analyzer error correction is the measurement of known electrical standards, such as a through, open circuit, short circuit, and precision load impedance. By calibrating your network analyzer with these known standards, you can correct for systematic errors that are a result of the VNA itself along with errors due to measurement setup (cables, adapters, fixtures, etc). The information below addresses some of the most critical factors in VNA calibration, ending with a brief survey of the more widely used calibration methodologies that can be performed with Maury Precision VNA Calibration Kits.

## Calibration Procedures

Calibration procedures include the popular Short-Open-Load or Short-Open-Load-Thru (SOLT) calibration technique, SSLT for waveguide, and Thru-Reflect-Line (TRL).

## Sources and Types of Errors

All measurement systems, including those employing network analyzers, have three types of measurement errors:

- > Systematic errors
- > Random errors
- > Drift errors

Systematic errors are caused by imperfections in the test equipment and test setup. As the name suggests, systematic errors are non random in nature and hence can be characterized through calibration and removed during device measurements. Random and drift errors cannot be systematically be characterized and can affect measurement accuracy if the measurement setup and equipment are not validated prior to device measurement.

## Error Correction

Vector error correction is the more thorough method of removing systematic errors. This type of error correction requires a network analyzer capable of measuring (but not necessarily displaying) phase as well as magnitude, and a set of calibration standards with known, precise electrical characteristics.

The vector-correction process requires the open, short, load, and sometimes thru calibration standards. The two main types of vector error correction are the one-port and two-port calibrations.

## One-Port Calibration

A one-port calibration can measure and minimize three systematic error terms (directivity, source match, and reflection tracking) from reflection measurements. Three known calibration standards must be measured, such as a Short, Open, and a Load (the load value is usually the same as the characteristic impedance of the test system, generally either 50 or 75 ohm). One-port calibration makes it possible to derive the DUT's actual reflection S-parameters.

## Two-Port Error Correction

Two-port error correction yields the most complete calibration because it accounts for the three major sources of systematic error addressed by one-port calibration at both ports of a two-port DUT. Traditional full two-port calibrations utilize three impedance standards and one transmission standard to define the calibrated reference plane. These standards, typically a Short, Open, Load, and Thru, make up the SOLT calibration

kit. The most common Thru used is the test ports connected directly together.

## TRL Calibration

Following SOLT in popularity, the next most common form of two-port calibration is called a Thru-Reflect-Line (TRL) calibration. TRL corrects the same error terms as a SOLT calibration, although it uses different calibration standards.

Other variations of TRL are Line-Reflect-Line (LRL), (LRM) based on Line-Reflect-Match (load) calibration standards or Thru-Reflect-Match (TRM) calibration standards.

In non-coaxial applications such as waveguide, TRL usually achieves better source match and load match corrections than SOLT. While not as commonly used, coaxial TRL can also provide more accuracy than SOLT, but only if very-high quality coaxial transmission lines (such as beadless airlines) are used.

Maury Microwave includes precision beadless air lines in our coaxial TRL calibration kits providing the capability to perform the most accurate calibration possible.

## Why use Sliding Loads?

When performing a SOL, SOLT, or SSLT (waveguide) calibration the impedance standard is the Load. At frequencies above 2 GHz (4 GHz for 2.4mm) sliding loads are more accurate impedance standards. Therefore Sliding Loads will provide a better calibration at higher frequencies. (Reduced directivity error)

A summary of these calibrations is shown below:

## One-port calibration methods

(SOL) Short-Open-Load calibration

- Response calibration for measuring VSWR/Return Loss.

(SSL) Short-Short-Load calibration

- Calibration for measuring VSWR/Return Loss in waveguide applications

## Two-Port full calibration methods

(SOLT) Short-Open-Load-Thru

- Full two-port calibration for performing forward and reverse transmission and reflections measurements.

(SSLT) Short-Short-Load-Thru

- Full two-port calibration for performing forward and reverse transmission and reflections measurements.

(TRL) Thru-Reflect-Line

- Full two-port calibration for performing forward and reverse transmission and reflections measurements.

# 1.85mm VNA Calibration Kits from Maury Microwave

## 7850CK30/31 series

### Features

- > 1.85mm Connectors
- > DC to 67 GHz (Operates to 70 GHz)
- > Keysight, Rhode & Schwarz and Anritsu VNAs Supported

### Calibration Methods Supported

- > TRM – Thru-Reflect-Match (DC to 800 MHz)
- > TRL – Thru-Reflect-Line (800 MHz to 13.0 GHz)
- > LRL – Line-Reflect-Line (13.0 to 67.0 GHz)

### The Importance of VNA Calibration

Imperfections exist in even the finest test equipment. If uncorrected these systematic imperfections cause the equipment to yield less accurate measurements. The basis of network analyzer error correction is referred to as “calibration” of which multiple methods exist.

### Calibration Method

TRL calibration, using Thru, Reflect and Line standards, relies on the characteristic impedance of the air lines (Line). TRL calibration is the most accurate method of measuring devices at low (typically better than 40 dB return loss) and high reflection coefficients.

### TRL, LRL & TRM Calibration

TRL is typically used as a general term to represent any of these three specific types of calibration (TRM/TRL/LRL). Specifically, these three types of calibration are:

- TRM – Thru, Reflect, Match
- TRL – Thru, Reflect, Line
- LRL – Line, Reflect, Line

TRM is used for low frequencies where a very long air line would be required for the line standard. TRL is used for mid-frequencies where the appropriate line lengths are achievable to reach the 30°–150° phase delay over the frequency band. LRL is used for high frequencies where air line standards become too short to be practical, so the desired delay is achieved as the delta between a reference air line and a longer air line.

7850CK30/31 kits provide all of the calibration standards needed to perform TRL, TRM and LRL calibrations and are specifically configured for use under these three calibration methods. Source match can also be measured using the 3.00cm air line with the short circuit provided.

### Recommended Accessories

#### A048A Digital Connector Gage Kit:

Contains two “thread-on” type, digital gages for measuring female and male contact pin location. They provide an easy and accurate way to measure critical linear interface dimensions of 1.85mm and 2.4mm coaxial connectors.

#### 8799A1 5/16-inch Precision Torque Wrench (8.0 inch lbs):

For proper torquing of 1.85mm, 2.4mm, 2.92mm and 3.5mm connections. Factory preset to 8.0 inch lbs to ensure the precise torque needed for optimum repeatability. Employs a “break” design that makes it impossible to over-torque your connections. These torque wrenches are provided with 7850CK20/21 and 7850CK30/31 kits, and are highly recommended for use with 7850CK10/11 kits.

#### 7821A/B/C 1.85mm in-series adapters (specifications on page 18)

Recommended for the 7850CK30 kits; included in the 7850CK31 kits.

#### 7809A1 & 7809A2 1.85mm NMD test port adapters:

Precision 1.85mm to NMD1.85mm; DC–67.0 GHz. Saves unnecessary wear and tear on your VNA test port connectors.



See page 58-59 to see all Maury 1.85mm in-series and between series adapters.

## Kit Description

These precision 1.85mm TRL/LRL calibration kits are designed for use with a broad range of vector network analyzers (VNAs) and are used to make error-corrected measurements, from DC to 67 GHz, for devices supplied with 1.85mm connectors. Each kit includes a full complement of calibration standards (shorts, fixed

loads and air lines). Three 1.85mm in-series, calibration-grade (metrology), adapters are included in the 7850CK31 kits but are not included in the 7850CK30 kits. All kit components are provided in an attractive foam-lined, wood instrument case.

### 7850CK30



### Components Included in 7850CK30 Kits

QUANTITY	DESCRIPTION	MODEL
1	1.85mm female fixed short circuit (0.5cm)	7846A
1	1.85mm male fixed short circuit (0.5cm)	7847A
1	1.85mm female fixed termination	7831A1
1	1.85mm male fixed termination	7831B1
1	1.85mm female to male air line (0.96cm)	7843S0.96
1	1.85mm female to male air line (1.15cm)	7843S1.15
1	1.85mm female to male air line (3.00)	7843S3.00
1	Torque wrench (8 in. lbs)	8799A1
1	5/16-inch double end wrench	8770Z6
1	3/16-inch double end wrench	7960Z1
1	Foam-lined wood instrument case	—

### 7850CK31



### Components Included in 7850CK31 Kits

QUANTITY	DESCRIPTION	MODEL
1	1.85mm female fixed short circuit (0.5cm)	7846A
1	1.85mm male fixed short circuit (0.5cm)	7847A
1	1.85mm female fixed termination	7831A1
1	1.85mm male fixed termination	7831B1
1	1.85mm female to male air line (0.96cm)	7843S0.96
1	1.85mm female to male air line (1.15cm)	7843S1.15
1	1.85mm female to male air line (3.00)	7843S3.00
1	1.85mm female to 1.85mm female	7821A
1	1.85mm male to 1.85mm male	7821B
1	1.85mm female to 1.85mm male	7821C
1	Torque wrench (8 in. lbs)	8799A1
1	5/16-inch double end wrench	8770Z6
1	3/16-inch double end wrench	7960Z1
1	Foam-lined wood instrument case	—



## COMPONENT SPECIFICATIONS

### Air Lines – Models 7843S0.96, 7843S1.15 & 7843S3.00



Frequency Range	DC to 67.0 GHz
Electrical Length:	
7843S0.96	0.96cm
7843S1.15	1.15cm
7843S3.00	3.00cm
Electrical Length Accuracy	0.0005cm
Minimum Return Loss (excluding connector interface)	48 dB
Nominal Impedance	50 ohm

### Fixed Shorts - Models 7846A & 7847A



Frequency Range	DC to 67.0 GHz
Minimum Reflection Coefficient	0.98
Nominal Impedance	50 ohm
Phase Accuracy	±2.0 degrees

### Fixed Terminations - Models 7831A1 & 7831B1



Frequency Range	DC to 50.0 GHz
Maximum VSWR:	
DC to 1 GHz	1.02
1 to 10 GHz	1.07
10 to 26.5 GHz	1.10
26.5 to 50 GHz	1.20
Power Handling	0.5 watt CW, 0.25 kW peak
Nominal Impedance	50 ohm

### Precision 1.85mm In-series Adapters



#### Models 7821A/B/C (1.85mm to 1.85mm)

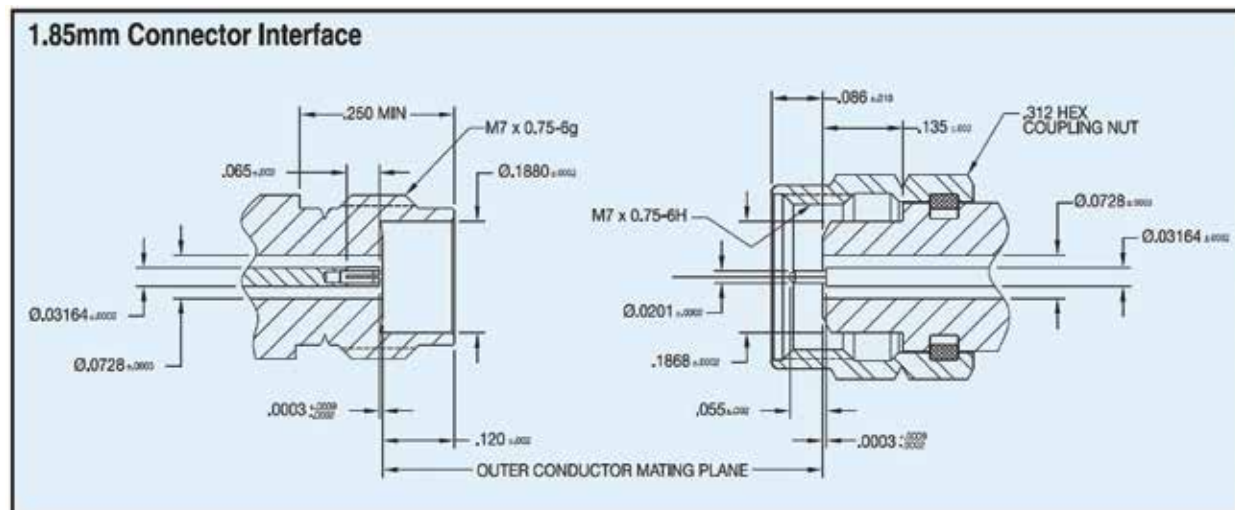
Frequency Range	DC to 67.0 GHz
Maximum VSWR:	
DC to 26.5 GHz	1.06
26.5 to 40.0 GHz	1.10
40.0 to 67.0 GHz	1.15
Nominal Impedance	50 ohm

(Note: These adapters are included in the 7850CK31 kits, but are not included in the 7850CK30 kits)

## Connector Description

The precision 1.85mm connectors on the components in this kit are miniature, instrument grade, air-interface connectors that operate mode free up to 67 GHz, and comply with IEEE standard

287 general precision connector, instrument grade GPC1.85. For detailed interface specifications please refer to Maury data sheet 5E-089.





## 2.4mm VNA Calibration Kits from Maury Microwave

7950CK10/11 series, 7950CK20/21 series and 7950CK30/31 series

### Features

- > 2.4mm Connectors
- > DC to 50 GHz
- > Keysight, Rhode & Schwarz and Anritsu VNAs Supported

### Calibration Methods Supported

- > 7950CK10/11 – Fixed Load SOLT (DC–50 GHz)
- > 7950CK20/21 – Sliding Load SOLT (DC–50 GHz)
- > 7950CK30/31 – TRM/TRL/LRL (DC–50 GHz)

### The Importance of VNA Calibration

Imperfections exist in even the finest test equipment. If uncorrected these systematic imperfections cause the equipment to yield less accurate measurements. The basis of network analyzer error correction is referred to as “calibration” of which multiple methods exist.

### Calibration Methods

SOLT calibration, which uses Short, Open and Load standards, requires precise models of the standards’ electrical performance. Fixed load SOLT uses fixed terminations and is adequate for measuring devices with mid-range reflection coefficients. The lowest return loss is limited by the reflection coefficient of the fixed load standard (typically better than 20 dB return loss\*).

The sliding load SOLT kit can accurately measure lower reflection coefficients due to the improved termination performance provided by the sliding load (typically better than 30 dB return loss).

TRL calibration, using Thru, Reflect and Line standards, relies on the characteristic impedance of the air lines (Line). TRL calibration is the most accurate method of measuring devices at low (typically better than 40 dB return loss) and high reflection coefficients.

\*Refer to specifications on page 21.

7950CK10/11/20/21 kits are configured for use in performing one-port SOL (Short-Open-Load) response calibrations (a method used for measuring VSWR/ Return Loss), and full two-port SOLT (Short-Open-Load-Thru) calibration (for performing forward and reverse transmission and reflections measurement).

7950CK30/31 TRL/LRL calibration kits contain the components needed to perform TRM, TRL and LRL calibrations. Source match can also be measured using the 6.25cm air line with the short circuit provided.

7950CK11/21/31 kits include three 2.4mm in-series adapters for applications that require female/female, male/male, or male/female connections. A wide range of between-series adapters in 2.4mm to other types and special VNA test port adapters (NMD type) are also available by separate order.

### Recommended Accessories

#### A048A Digital Connector Gage Kit:

Contains two “thread-on” type, digital gages for measuring female and male contact pin location. They provide an easy and accurate way to measure critical linear interface dimensions of 1.85mm and 2.4mm coaxial connectors.

#### 8799A1 5/16-inch Precision Torque Wrench (8.0 inch lbs):

For proper torquing of 1.85mm, 2.4mm, 2.92mm and 3.5mm connections. Factory preset to 8.0 inch lbs to ensure the precise torque needed for optimum repeatability. Employs a “break” design that makes it impossible to over-torque your connections. These torque wrenches are provided with 7950CK20/21 and 7950CK30/31 kits, and are highly recommended for use with 7950CK10/11 kits.

#### 7909A1 & 7909A2 2.4mm NMD test port adapters:

Precision 2.4mm to NMD2.4mm; DC–50.0 GHz. Saves unnecessary wear and tear on your VNA test ports.



See page 60-61 to see all Maury 2.4mm in-series and between series adapters.

## Maury 2.4mm VNA Calibration Kits

Maury precision 2.4mm VNA calibration kits include each of the calibration standards and tools shown in the tables at the right. The 7950CK10/20/30 kits do not include adapters; the 7950CK11/21/31 kits include one each of the in-series adapters shown. Other in-series and between series adapters are sold separately.



7950CK10

7950CK11



7950CK20

7950CK21



7950CK30

7950CK31

## Components Included in 7950CK10/11 Kits

QUANTITY	DESCRIPTION	MODEL
1	2.4mm female fixed short circuit	7946A
1	2.4mm male fixed short circuit	7946B
1	2.4mm female open circuit termination	7948A1
1	2.4mm male open circuit termination	7948B1
1	2.4mm female fixed termination	7931A1
1	2.4mm male fixed termination	7931B1
1*	2.4mm female to 2.4mm female adapter	7921A
1*	2.4mm male to 2.4mm male adapter	7921B
1*	2.4mm female to 2.4mm male adapter	7921C
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 7950CK11 kits, but are not included in the 7950CK10 kits.

## Components Included in 7950CK20/21 Kits

QUANTITY	DESCRIPTION	MODEL
1	2.4mm female fixed short circuit	7946A
1	2.4mm male fixed short circuit	7946B
1	2.4mm female open circuit termination	7948A1
1	2.4mm male open circuit termination	7948B1
1	2.4mm female fixed termination	7931A1
1	2.4mm male fixed termination	7931B1
1*	2.4mm female to 2.4mm female adapter	7921A
1*	2.4mm male to 2.4mm male adapter	7921B
1*	2.4mm female to 2.4mm male adapter	7921C
1	2.4mm female sliding termination	7935A
1	2.4mm male sliding termination	7935B
1	Pin depth adjusting tool	8777S02
1	5/16-inch torque wrench — 8 in. lbs.	8799A1
1	5/16-inch double end wrench	8770Z6
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 7950CK21 kits, but are not included in the 7950CK20 kits.

## Components Included in 7950CK30/31 Kits

QUANTITY	DESCRIPTION	MODEL
1	2.4mm female fixed short circuit	7946A
1	2.4mm male fixed short circuit	7946B
1	2.4mm female fixed termination	7931A1
1	2.4mm male fixed termination	7931B1
1*	2.4mm female to 2.4mm female adapter	7921A
1*	2.4mm male to 2.4mm male adapter	7921B
1*	2.4mm female to 2.4mm male adapter	7921C
1	2.4mm female to male air line (1.25cm)	7943S1.25
1	2.4mm female to male air line (1.50cm)	7943S1.50
1	2.4mm female to male air line (6.25cm)	7943S6.25
1	5/16-inch torque wrench — 8 in. lbs.	8799A1
1	3/16-inch double end wrench	7960Z1
1	5/16-inch double end wrench	8770Z6
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 7950CK31 kits, but are not included in the 7950CK30 kits.





## 2.92mm VNA Calibration Kits from Maury Microwave

8770CK10/11 series, 8770CK20/21 series, and 8770CK30/31 series

### Features

- > 2.92mm Connectors
- > DC to 40 GHz
- > Keysight, Rhode & Schwarz and Anritsu VNAs Supported

### Calibration Methods Supported

- > 8770CK10/11 – Fixed Load SOLT (DC–40 GHz)
- > 8770CK20/21 – Sliding/Fixed Load SOLT (DC–40 GHz)
- > 8760CK30/31 – TRM/TRL/LRL (DC–40 GHz)

### The Importance of VNA Calibration

Imperfections exist in even the finest test equipment. If uncorrected these systematic imperfections cause the equipment to yield less accurate measurements. The basis of network analyzer error correction is referred to as “calibration” of which multiple methods exist.

### Calibration Methods

SOLT calibration, which uses Short, Open and Load standards, requires precise models of the standards’ electrical performance. Fixed load SOLT uses fixed terminations and is adequate for measuring devices with mid-range reflection coefficients. The lowest return loss is limited by the reflection coefficient of the fixed load standard (typically better than 20 dB return loss\*).

The sliding load SOLT kit can accurately measure lower reflection coefficients due to the improved termination performance provided by the sliding load (typically better than 30 dB return loss).

TRL calibration, using Thru, Reflect and Line standards, relies on the characteristic impedance of the air lines (Line). TRL calibration is the most accurate method of measuring devices at low (typically better than 40 dB return loss) and high reflection coefficients.

\*Refer to specifications on page 24.

8770CK10/11/20/21 kits are configured for use in performing one-port SOL (Short-Open-Load) response calibrations (a method used for measuring VSWR/ Return Loss), and full two-port SOLT (Short-Open-Load-Thru) calibration (for performing forward and reverse transmission and reflections measurement).

8770CK30/31 TRL/LRL calibration kits contain the components needed to perform TRM, TRL and LRL calibrations. Source match can also be measured using the 15cm air line with the short circuit provided.

8770CK11/21/31 kits include three 2.92mm in-series adapters for applications that require female/female, male/male, or male/female connections. A wide range of between-series adapters in 2.92mm to other types are also available by separate order.

### Recommended Accessories

#### A050A Digital Connector Gage Kit:

Contains two “Thread-on” type, digital gages for measuring female and male contact pin location. They provide an easy and accurate way to measure critical linear interface dimensions of 2.92mm and 3.5mm coaxial connectors.

#### 8799A1 5/16-inch Precision Torque Wrench (8.0 inch lbs):

For proper torquing of 1.85mm, 2.92mm, 2.92mm and 3.5mm connections. Factory preset to 8.0 inch lbs to ensure the precise torque needed for optimum repeatability. Employs a “break” design that makes it impossible to over-torque your connections. These torque wrenches are provided with 8770CK20/21 and 8770CK30/31 kits, and are highly recommended for use with 8770CK10/11 kits.

#### 8719A & 8719B 2.92mm NMD test port adapters:

Precision 2.92mm to NMD2.92mm; DC–40.0 GHz. Saves unnecessary wear and tear on your VNA test port connectors.

#### 7909F1 & 7909F2 2.4mm NMD test port adapters:

Precision NMD2.4mm to 2.92mm; DC–40.0 GHz. Saves unnecessary wear and tear on your VNA test port connectors.

See page 62-63 to see all Maury 2.92mm in-series and between series adapters.





## Maury 2.92mm VNA Calibration Kits

Maury precision 2.92mm VNA calibration kits include each of the calibration standards and tools shown in the tables at the right. The 8770CK10/20/30 kits do not include adapters; the 8770CK11/21/31 kits include one each of the in-series adapters shown. Other in-series and between-series adapters are sold separately.



## Components Included in 8770CK10/11 Kits

QUANTITY	DESCRIPTION	MODEL
1	2.92mm female fixed short circuit	8771F2
1	2.92mm male fixed short circuit	8772F2
1	2.92mm female open circuit termination	8773A2
1	2.92mm male open circuit termination	8773B2
1	2.92mm female fixed termination	8775A3
1	2.92mm male fixed termination	8775B3
1*	2.92mm female to 2.92mm female adapter	8714A2
1*	2.92mm male to 2.92mm male adapter	8714B2
1*	2.92mm female to 2.92mm male adapter	8714C2
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8770CK11 kits, but are not included in the 8770CK10 kits.

## Components Included in 8770CK20/21 Kits

QUANTITY	DESCRIPTION	MODEL
1	2.92mm female fixed short circuit	8771F2
1	2.92mm male fixed short circuit	8772F2
1	2.92mm female open circuit termination	8773A2
1	2.92mm male open circuit termination	8773B2
1	2.92mm female fixed termination	8775A3
1	2.92mm male fixed termination	8775B3
1*	2.92mm female to 2.92mm female adapter	8714A2
1*	2.92mm male to 2.92mm male adapter	8714B2
1*	2.92mm female to 2.92mm male adapter	8714C2
1	2.92mm female sliding termination	8777A2
1	2.92mm male sliding termination	8777B2
1	Pin depth adjusting tool	8777S02
1	5/16-inch torque wrench — 8 in. lbs.	8799A1
1	5/16-inch double end wrench	8770Z6
1	7/16-inch double end wrench	8770Z7
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8770CK21 kits, but are not included in the 8770CK20 kits.

## Components Included in 8770CK30/31 Kits

QUANTITY	DESCRIPTION	MODEL
1	2.92mm female fixed short circuit	8771F2
1	2.92mm male fixed short circuit	8772F2
1	2.92mm female fixed termination	8775A3
1	2.92mm male fixed termination	8775B3
1*	2.92mm female to 2.92mm female adapter	8714A2
1*	2.92mm male to 2.92mm male adapter	8714B2
1*	2.92mm female to 2.92mm male adapter	8714C2
1	2.92mm female to male air line (5cm)	8774C5
1	2.92mm female to male air line (5.25cm)	8774C5.25
1	2.92mm female to male air line (6cm)	8774C6
1	2.92mm female to male air line (15cm)	8774C15
1	5/16-inch torque wrench — 8 in. lbs.	8799A1
1	5/16-inch double end wrench	8770Z6
1	7/16-inch double end wrench	8770Z7
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8770CK31 kits, but are not included in the 8770CK30 kits.

## COMPONENT SPECIFICATIONS

### Air Lines – Models 8774C15, 8774C6, 8774C5.25 & 8774C5



Frequency Range . . . . . DC to 40.0 GHz  
 Electrical Length:  
     8774C15 . . . . . 15cm  
     8774C5 . . . . . 5cm  
     8774C6 . . . . . 6cm  
     8774C5.25 . . . . . 5.25cm  
 Electrical Length Accuracy . . . . .  $\pm 0.0025$ cm  
 Minimum Return Loss (excluding connector interface) . . 48 dB  
 Nominal Impedance . . . . . 50 ohm

### Sliding Terminations – Models 8777A2 & 8777B2



Frequency Range . . . . . 4.0 to 40.0 GHz  
 Air Line Accuracy . . . . . 46 dB min, 4.0 to 40.0 GHz  
     (equivalent return loss of air line impedance)  
 Maximum VSWR of Terminating Element:  
     4.0 to 10.0 GHz . . . . . 1.10  
     10.0 to 40.0 GHz . . . . . 1.05  
 Nominal Impedance . . . . . 50 ohm  
 Power Handling . . . . . 0.5 watt CW, 0.5 kW peak  
 Travel . . . . . Greater than 1/2 wavelength at 4 GHz

### Fixed Terminations – Models 8775A3 & 8775B3



Frequency Range . . . . . DC to 40.0 GHz  
 Maximum VSWR:  
     DC to 4.0 GHz . . . . . 1.016  
     4.0 to 40.0 GHz . . . . . 1.12  
 Power Handling . . . . . 0.5 watt CW, 0.25 kW peak  
 Nominal Impedance . . . . . 50 ohm

### Fixed Shorts – Models 8771F2 & 8772F2



Frequency Range . . . . . DC to 40.0 GHz  
 Minimum Reflection Coefficient . . . . . 0.98  
 Phase Accuracy . . . . .  $\pm 2.0$  degrees  
 Nominal Impedance . . . . . 50 ohm

### Open Circuits – Models 8773A2 & 8773B2



Frequency Range . . . . . DC to 40.0 GHz  
 Minimum Reflection Coefficient . . . . . 0.98  
 Phase Accuracy . . . . .  $\pm 1.5$  degrees  
 Nominal Impedance . . . . . 50 ohm

### Precision 2.92mm Adapters – Models 8714A2/B2/C2



Frequency Range . . . . . DC to 40.0 GHz  
 Maximum VSWR:  
     DC to 4.0 GHz . . . . . 1.05  
     4.0 to 20.0 GHz . . . . . 1.08  
     20.0 to 40.0 GHz . . . . . 1.12  
 Nominal Impedance . . . . . 50 ohm

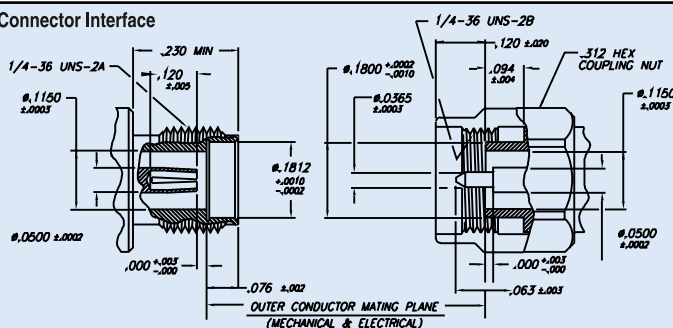
(Note: These adapters are included in the 8770CK11/21/31 kits, but are not included in the 8770CK10/20/30 kits.)

## Connector Description

The precision 2.92mm connectors on the components in these kits are miniature, instrument grade, air-interface connectors that operate mode free up to 40 GHz, and comply with IEEE standard 287 general precision connector, instrument grade GPC2.92.

For detailed interface specifications please refer to Maury data sheet 5E-063.

2.92mm Connector Interface



## 3.5mm VNA Calibration Kits from Maury Microwave

8050CK10/11 series, 8050CK20/21 series, and 8050CK30/31 series

### Features

- > 3.5mm Connectors
- > DC to 26.5 GHz
- > Keysight, Rhode & Schwarz and Anritsu VNAs Supported

### Calibration Methods Supported

- > 8050CK10/11 – Fixed Load SOLT (DC–26.5 GHz)
- > 8050CK20/21 – Fixed/Sliding Load SOLT (DC–26.5 GHz)
- > 8050CK30/31 – TRM/TRL/LRL (DC–26.5 GHz)

### The Importance of VNA Calibration

Imperfections exist in even the finest test equipment. If uncorrected these systematic imperfections cause the equipment to yield less accurate measurements. The basis of network analyzer error correction is referred to as “calibration” of which multiple methods exist.

### Calibration Methods

SOLT calibration, which uses Short, Open and Load standards, requires precise models of the standards’ electrical performance. Fixed load SOLT uses fixed terminations and is adequate for measuring devices with mid-range reflection coefficients. The lowest return loss is limited by the reflection coefficient of the fixed load standard (typically better than 20 dB return loss\*).

The sliding load SOLT kit can accurately measure lower reflection coefficients due to the improved termination performance provided by the sliding load (typically better than 30 dB return loss).

TRL calibration, using Thru, Reflect and Line standards, relies on the characteristic impedance of the air lines (Line). TRL calibration is the most accurate method of measuring devices at low (typically better than 40 dB return loss) and high reflection coefficients.

\*Refer to specifications on page 27.

8050CK10/11/20/21 kits are configured for use in performing one-port SOL (Short-Open-Load) response calibrations (a method used for measuring VSWR/ Return Loss), and full two-port SOLT (Short-Open-Load-Thru) calibration (for performing forward and reverse transmission and reflections measurement).

8050CK30/31 TRL/LRL calibration kits contain the components needed to perform TRM, TRL and LRL calibrations. Source match can also be measured using the 15cm air line with the short circuit provided.

8050CK11/21/31 kits include three 3.5mm in-series adapters for applications that require female/female, male/male, or male/female connections. A wide range of between-series adapters in 3.5mm to other types are also available by separate order.

### Recommended Accessories

#### A050A Digital Connector Gage Kit:

Contains two “thread-on” type, digital gages for measuring female and male contact pin location. They provide an easy and accurate way to measure critical linear interface dimensions of 2.92mm and 3.5mm coaxial connectors.

#### 8799A1 5/16-inch Precision Torque Wrench (8.0 inch lbs):

For proper torquing of 1.85mm, 3.5mm, 2.92mm and 3.5mm connections. Factory preset to 8.0 inch lbs to ensure the precise torque needed for optimum repeatability. Employs a “break” design that makes it impossible to over-torque your connections. These torque wrenches are provided with 8050CK20/21 and 8050CK30/31 kits, and are highly recommended for use with 8050CK10/11 kits.

#### 8009A & 8009B 3.5mm NMD test port adapters:

Precision 3.5mm to NMD3.5mm; DC–26.5 GHz. Saves unnecessary wear and tear on your VNA test ports.

#### 7909B1 & 7909B2 2.4mm NMD test port adapters:

Precision NMD2.4mm to 3.5mm; DC–34.0 GHz. Saves unnecessary wear and tear on your VNA test port connectors.

See page 64-65 to see all Maury 3.5mm in-series and between series adapters.





## Maury 3.5mm VNA Calibration Kits

Maury precision 3.5mm VNA calibration kits include each of the calibration standards and tools shown in the tables at the right. The 8050CK10/20/30 kits do not include adapters; the 8050CK11/21/31 kits include one each of the in-series adapters shown. Other in-series and between-series adapters are sold separately.



## Components Included in 8050CK10/11 Kits

QUANTITY	DESCRIPTION	MODEL
1	3.5mm female fixed short circuit	8046F
1	3.5mm male fixed short circuit	8047F
1	3.5mm female open circuit termination	8048A1
1	3.5mm male open circuit termination	8048B1
1	3.5mm female fixed termination	8031A4
1	3.5mm male fixed termination	8031B5
1*	3.5mm female to 3.5mm female adapter	8021A5
1*	3.5mm male to 3.5mm male adapter	8021B2
1*	3.5mm female to 3.5mm male adapter	8021C2
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8050CK11 kits, but are not included in the 8050CK10 kits.

## Components Included in 8050CK20/21 Kits

QUANTITY	DESCRIPTION	MODEL
1	3.5mm female fixed short circuit	8046F
1	3.5mm male fixed short circuit	8047F
1	3.5mm female open circuit termination	8048A1
1	3.5mm male open circuit termination	8048B1
1	3.5mm female fixed termination	8031A5
1	3.5mm male fixed termination	8031B5
1*	3.5mm female to 3.5mm female adapter	8021A2
1*	3.5mm male to 3.5mm male adapter	8021B2
1*	3.5mm female to 3.5mm male adapter	8021C2
1	3.5mm female sliding termination	8037A
1	3.5mm male sliding termination	8037B
1	Pin depth adjusting tool	8777S02
1	5/16-inch torque wrench — 8 in. lbs.	8799A1
1	7/16-inch double end wrench	8770Z7
1	5/16-inch double end wrench	8770Z6
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8050CK21 kits, but are not included in the 8050CK20 kits.

## Components Included in 8050CK30/31 Kits

QUANTITY	DESCRIPTION	MODEL
1	3.5mm female fixed short circuit	8046F
1	3.5mm male fixed short circuit	8047F
1	3.5mm female fixed termination	8031A5
1	3.5mm male fixed termination	8031B5
1*	3.5mm female to 3.5mm female adapter	8021A2
1*	3.5mm male to 3.5mm male adapter	8021B2
1*	3.5mm female to 3.5mm male adapter	8021C2
1	3.5mm female to male air line (5cm)	8043S5
1	3.5mm female to male air line (5.25cm)	8043S5.3
1	3.5mm female to male air line (6cm)	8043S6
1	3.5mm female to male air line (15cm)	8043S15
1	5/16-inch torque wrench — 8 in. lbs.	8799A1
1	7/16-inch double end wrench	8770Z7
1	5/16-inch double end wrench	8770Z6
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8050CK31 kits, but are not included in the 8050CK30 kits.



## COMPONENT SPECIFICATIONS

### Air Lines – Models 8043S15, 8043S6, 8043S5.3 & 8043S5



Frequency Range	DC to 26.5 GHz
Electrical Length:	
8043S15	15cm
8043S6	6cm
8043S5.3	5.3cm
8043S5	5cm
Electrical Length Accuracy	±0.0025cm
Minimum Return Loss (excluding connector interface)	48 dB
Nominal Impedance	50 ohm

### Sliding Terminations – Models 8037A & 8037B



Frequency Range	2.0 to 34.0 GHz
Maximum VSWR of Terminating Element:	
2.0 to 4.0 GHz	1.09
4.0 to 34.0 GHz	1.05
Air Line Accuracy	50 dB min return loss (equivalent return loss of air line impedance)
Nominal Impedance	50 ohm
Power Handling	1.0 watt CW, 1.0 kW peak
Travel	Greater than 1/2 wavelength at 2.0 GHz

### Fixed Terminations – Models 8031A5 & 8031B5



Frequency Range	DC to 26.5 GHz
Maximum VSWR:	
DC to 3.0 GHz	1.020
3.0 to 6.0 GHz	1.032
6.0 to 20.0 GHz	1.052
20.0 to 26.5 GHz	1.083
Power Handling	0.25 watt CW, 0.5 kW peak
Nominal Impedance	50 ohm

### Fixed Shorts – Models 8046F & 8047F



Frequency Range	DC to 26.5 GHz
Minimum Reflection Coefficient	0.98
Phase Accuracy	±2.0 degrees
Nominal Impedance	50 ohm

### Open Circuits – Models 8048A1 & 8048B1



Frequency Range	DC to 26.5 GHz
Minimum Reflection Coefficient	0.98
Phase Accuracy	±1.4 degrees
Nominal Impedance	50 ohm

### Precision 3.5mm Adapters – Models 8021A2/B2/C2



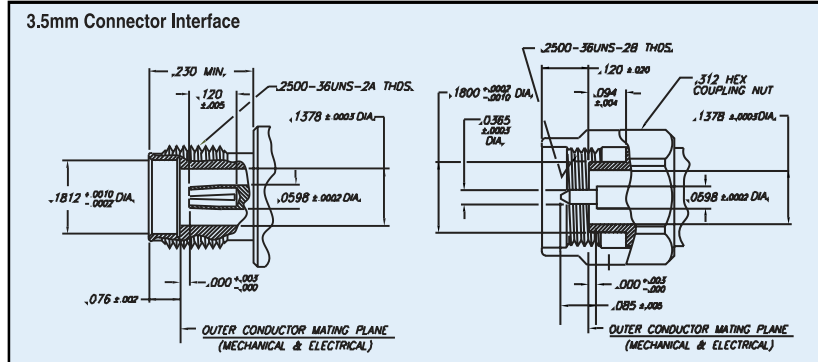
Frequency Range	DC to 34.0 GHz
Maximum VSWR:	
DC to 18.0 GHz	1.05
18.0 to 26.5 GHz	1.08
26.5 to 34.0 GHz	1.12
Nominal Impedance	50 ohm

(Note: These adapters are included in the 8050CK11/21/31 kits, but are not included in the 8050CK10/20/30 kits.)

## Connector Description

The precision 3.5mm connectors on the components in these kits are miniature, instrument grade, air-interface connectors that operate mode free up to 34 GHz, and comply with IEEE standard 287 general precision connector, instrument grade GPC3.5.

For detailed interface specifications please refer to Maury data sheet 5E-062.



# 7mm VNA Calibration Kits from Maury Microwave

## Models 2650CK10, 2650CK20 and 2650CK30

### Features

- > 7mm Connectors
- > DC to 18 GHz
- > Keysight, Rhode & Schwarz and Anritsu VNAs Supported

### Calibration Methods Supported

- > 2650CK10 – Fixed Load SOLT (DC–18.0 GHz)
- > 2650CK20 – Sliding/Fixed Load SOLT (DC–18.0 GHz)
- > 2650CK30 (TRL Kit) – TRM/TRL/LRL (DC–18.0 GHz)

### The Importance of VNA Calibration

Imperfections exist in even the finest test equipment. If uncorrected these systematic imperfections cause the equipment to yield less accurate measurements. The basis of network analyzer error correction is referred to as “calibration” of which multiple methods exist.

### Calibration Methods

SOLT calibration, which uses Short, Open and Load standards, requires precise models of the standards’ electrical performance. Fixed load SOLT uses fixed terminations and is adequate for measuring devices with mid-range reflection coefficients. The lowest return loss is limited by the reflection coefficient of the fixed load standard (typically better than 20 dB return loss\*).

The sliding load SOLT kit can accurately measure lower reflection coefficients due to the improved termination performance provided by the sliding load (typically better than 30 dB return loss).

TRL calibration, using Thru, Reflect and Line standards, relies on the characteristic impedance of the air lines (Line). TRL calibration is the most accurate method of measuring devices at low (typically better than 40 dB return loss) and high reflection coefficients.

\*Refer to specifications on page 30.

2650CK10/20 kits are configured for performing one-port SOL (Short-Open-Load) response calibrations (for measuring VSWR/ Return Loss), and full two-port SOLT (Short-Open-Load-Thru) calibration (for performing forward and reverse transmission and reflections measurement).

2650CK30 TRL/LRL calibration kits contain the components needed to perform TRM, TRL and LRL calibrations. Source match can also be measured using the 15cm air line with the short circuit provided.

2650CK10/20/30 kits do not include adapters. Maury offers a wide range of between-series adapters in 7mm to other types that can be ordered separately.

### Recommended Accessories

#### A028D Connector Gage Kit:

Contains one metrology-grade “Thread-on” type, dial indicator style gage for measuring the planar contact location. This provides an easy and accurate way to measure critical linear interface dimensions of 7mm coaxial connectors.

#### 2698C2 3/4-inch Precision Torque Wrench (12.0 inch lbs):

For proper torquing of 7mm, LPC7, Type N, NMD3.5, NMD2.92 NMD2.4 connections. Factory preset to 12.0 inch lbs to ensure the precise torque needed for optimum repeatability. Employs a “break” design that makes it impossible to over-torque your connections. These torque wrenches are provided with 2650CK20/30 kits, and are highly recommended for use with 2650CK10 kits.

#### Ruggedized Test Port Adapters (Available Models):

Model 2633C – NMD3.5mm female to 7mm

Model 7909C – NMD2.4mm female to 7mm

These adapters save wear and tear on your VNA test ports.

See page 67 to see all Maury 7mm in-series and between series adapters.



## Maury 7mm VNA Calibration Kits

Maury precision 7mm VNA calibration kits include each of the calibration standards and tools shown in the tables at the right. The 2650CK10/20/30 kits do not include adapters; in-series and between-series adapters are sold separately. (See Maury's Precision Calibration & Interconnect Solutions catalog for adapter specifications. This catalog is available online at [maurymw.com](http://maurymw.com).)



2650CK10



2650CK20



2650CK30



## Components Included in 2650CK10 Kits

QUANTITY	DESCRIPTION	MODEL
1	7mm fixed short circuit	2615D3
1	7mm open circuit termination	2616D3
1	7mm fixed termination	2610F
1	Foam-lined wood Instrument case	—

## Components Included in 2650CK20 Kits

QUANTITY	DESCRIPTION	MODEL
1	7mm fixed short circuit	2615D3
1	7mm open circuit termination	2616D3
1	7mm fixed termination	2610F
1	7mm sliding termination	2608C
1	3/4-inch torque wrench — 12 in. lbs.	2698C2
1	Foam-lined wood Instrument case	—

## Components Included in 2650CK30 Kits

QUANTITY	DESCRIPTION	MODEL
1	7mm fixed short circuit	2615D3
1	7mm fixed termination	2610F
1	7mm air line (0.6cm)	2653L
1	7mm air line (3.12cm)	2653S3.12
1	7mm air line (15cm)	2653S15
1	3/4-inch torque wrench — 12 in. lbs.	2698C2
1	Foam-lined wood Instrument case	—

## COMPONENT SPECIFICATIONS

### Air Lines – Models 2653S3.12, 2653L & 2653S15



Frequency Range .....	DC to 18.0 GHz
Electrical Length:	
2653S3.12 .....	3.12cm
2653L .....	0.69cm
2653S15 .....	14.983cm
Electrical Length Accuracy .....	±0.006cm
Return Loss (Min.) – excluding connector interface....	52 dB
Nominal Impedance .....	50 ohm

### Sliding Termination – Model 2608C



Frequency Range .....	2.0 to 18.0 GHz
Maximum VSWR of Terminating Element .....	1.04
Air Line Accuracy.....	62 dB min return loss (equivalent return loss of air line impedance)
Nominal Impedance .....	50 ohm
Power Handling .....	1.0 watt CW, 5.0 kW peak
Travel .....	Greater than 1/2 wavelength at 2.0 GHz

### Fixed Termination – Model 2610F



Frequency Range .....	DC to 18.0 GHz
Maximum VSWR:	
DC — 1.0 GHz .....	1.005
1.0 — 2.0 GHz .....	1.01
2.0 — 8.0 GHz .....	1.03
8.0 — 18.0 GHz .....	1.06
Nominal Impedance.....	50 ohm
Power Handling .....	1 watt CW 1 kW peak

### Fixed Short – Model 2615D3



Frequency Range .....	DC to 18.0 GHz
Minimum Reflection Coefficient .....	0.995
Phase Accuracy .....	±0.3 degrees
Nominal Impedance .....	50 ohm

### Open Circuit – Model 2616D3

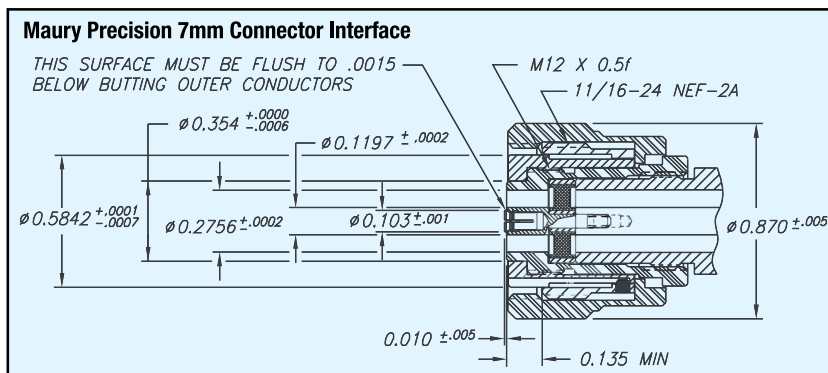


Frequency Range .....	DC to 18.0 GHz
Minimum Reflection Coefficient .....	0.995
Phase Accuracy .....	±0.3 degrees
Nominal Impedance .....	50 ohm

## Connector Description

7mm connectors are precision air interface hermaphroditic connectors that are rated from DC to 18 GHz. They have an air line size of 0.1197 inner conductor diameter and a 0.2756 outer conductor diameter. There are basically two configurations;

1) GPC7 (commonly referred to as APC7), which incorporates a bead support and, 2) LPC7A, which is a beadless connector. They comply with IEEE standard 287 for instrument grade general precision connectors (GPC7). See Maury data sheet 5E-060 for complete interface dimensions.





# Type N VNA Calibration Kits from Maury Microwave

## 8850CK10/11 series, 8850CK20/21 series and 8850CK30/31 series

### Features

- > Type N Connectors
- > DC to 18 GHz
- > Keysight, Rhode & Schwarz and Anritsu VNAs Supported

### The Importance of VNA Calibration

Imperfections exist in even the finest test equipment. If uncorrected these systematic imperfections cause the equipment to yield less accurate measurements. The basis of network analyzer error correction is referred to as “calibration” of which multiple methods exist.

### Calibration Methods

SOLT calibration, which uses Short, Open and Load standards, requires precise models of the standards’ electrical performance. Fixed load SOLT uses fixed terminations and is adequate for measuring devices with mid-range reflection coefficients. The lowest return loss is limited by the reflection coefficient of the fixed load standard (typically better than 20 dB return loss\*).

The sliding load SOLT kit can accurately measure lower reflection coefficients due to the improved termination performance provided by the sliding load (typically better than 30 dB return loss).

TRL calibration, using Thru, Reflect and Line standards, relies on the characteristic impedance of the air lines (Line). TRL calibration is the most accurate method of measuring devices at low (typically better than 40 dB return loss) and high reflection coefficients.

\*Refer to specifications on page 33.

### Calibration Methods Supported

- > 8850CK10/11 – Fixed Load SOLT (DC–18.0 GHz)
- > 8850CK20/21 – Fixed/Sliding Load SOLT (DC–18.0 GHz)
- > 8850CK30/31 – TRM/TRL/LRL (DC–18.0 GHz)

8850CK10/11/20/21 kits are configured for use in performing one-port SOL (Short-Open-Load) response calibrations (a method used for measuring VSWR/ Return Loss), and full two-port SOLT (Short-Open-Load-Thru) calibration (for performing forward and reverse transmission and reflections measurement).

8850CK30/31 TRL/LRL calibration kits contain the components needed to perform TRM, TRL and LRL calibrations. Source match can also be measured using the 15cm air line with the short circuit provided.

8850CK11/21/31 kits include three Type N in-series adapters for applications that require female/female, male/male, or male/female connections. A wide range of between-series adapters in Type N to other types are also available by separate order.

### Recommended Accessories

#### A020K Digital Connector Gage Kit:

Contains two “Thread-on” type, digital gages for measuring female and male contact pin location. They provide an easy and accurate way to measure critical linear interface dimensions of Type N coaxial connectors.

#### 2698C2 3/4-inch Precision Torque Wrench (12.0 inch lbs):

For proper torquing of 7mm, LPC7, Type N, NMD3.5, NMD2.92 NMD2.4 connections. Factory preset to 12.0 inch lbs to ensure the precise torque needed for optimum repeatability. Employs a “break” design that makes it impossible to over-torque your connections. These torque wrenches are provided with 8850CK20/21 and 8850CK30/31 kits, and are highly recommended for use with 8850CK10/11 kits.

#### 8829A & 8829B Type N to 3.5mm NMD test port adapters:

Precision Type N to NMD3.5mm; DC–18.0 GHz. Saves unnecessary wear and tear on your VNA test ports.

#### 7909D1 & 7909D2 Type N to 2.4mm NMD test port adapters:

Precision Type N to NMD2.4mm; DC–18.0 GHz. Saves unnecessary wear and tear on your VNA test ports.

See page 68-69 to see all Maury Type N in-series and between series adapters.



## Maury Type N VNA Calibration Kits

Maury precision Type N VNA calibration kits include each of the calibration standards and tools shown in the tables at the right. The 8850CK10/20/30 kits do not include adapters; the 8850CK11/21/31 kits include one each of the in-series adapters shown. Other in-series and between-series adapters are sold separately.



## Components Included in 8850CK10/11 Kits

QUANTITY	DESCRIPTION	MODEL
1	Type N female fixed short circuit	8806C
1	Type N male fixed short circuit	8807C
1	Type N female open circuit termination	8809B1
1	Type N male open circuit termination	8810B1
1	Type N female fixed termination	2510A6
1	Type N male fixed termination	2510B6
1*	Type N female to Type N female adapter	8828A
1*	Type N male to Type N male adapter	8828B
1*	Type N female to Type N male adapter	8828C
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8850CK11 kits, but are not included in the 8850CK10 kits.

## Components Included in 8850CK20/21 Kits

QUANTITY	DESCRIPTION	MODEL
1	Type N female fixed short circuit	8806C
1	Type N male fixed short circuit	8807C
1	Type N female open circuit termination	8809B1
1	Type N male open circuit termination	8810B1
1	Type N female fixed termination	2510A7
1	Type N male fixed termination	2510B7
1*	Type N female to Type N female adapter	8828A
1*	Type N male to Type N male adapter	8828B
1*	Type N female to Type N male adapter	8828C
1	Type N female sliding termination	8834A
1	Type N male sliding termination	8834B
1	3/4-inch torque wrench — 12.0 in. lbs.	2698C2
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8850CK21 kits, but are not included in the 8850CK20 kits.

## Components Included in 8850CK30/31 Kits

QUANTITY	DESCRIPTION	MODEL
1	Type N female fixed short circuit	8806G
1	Type N male offset short circuit	8807C
1	Type N female fixed termination	2510A7
1	Type N male fixed termination	2510B7
1*	Type N female to Type N female adapter	8828A
1*	Type N male to Type N male adapter	8828B
1*	Type N female to Type N male adapter	8828C
1	Type N female to Type N male air line (3.12cm)	2553T3.12
1	Type N female to Type N male air line (3.82cm)	2553T3.82
1	Type N female to Type N male air line (15cm)	2553T15
1	3/4-inch torque wrench — 12.0 in. lbs.	2698C2
1	Foam-lined wood Instrument case	—

\* These adapters are provided in the 8850CK31 kits, but are not included in the 8850CK30 kits.

## COMPONENT SPECIFICATIONS

### Air Lines – Models 2553T3.12, 2553T3.82 & 2653T15



Frequency Range	DC to 18.0 GHz
Electrical Length:	
2553T3.12	3.12cm
2553T3.82	3.816cm
2553T15	14.983cm
Electrical Length Accuracy	±0.01cm
Minimum Return Loss (excluding connector interfaces)	52 dB
Characteristic Impedance (where skin depth is negligible)	50 ohm + 0.2 ohm

### Sliding Termination – Model 8834A/B



Frequency Range	1.8 to 18.0 GHz
Maximum VSWR of Terminating Element	1.05
Air Line Accuracy	54 dB min return loss (equivalent return loss of air line impedance)
Nominal Impedance	50 ohm
Power Handling	1.0 watt CW, 1.0 kW peak
Travel	Greater than 1/2 wavelength at 1.8 GHz

### Fixed Terminations – Model 2510A6 & 2510B6



Frequency Range	DC to 18.0 GHz
Maximum VSWR:	
DC to 2.0 GHz	1.02
2.0 to 4.0 GHz	1.04
4.0 to 18.0 GHz	1.06
Nominal Impedance	50 ohm
Power Handling	1 watt CW, 1 kW peak

### Fixed Terminations – Model 2510A7 & 2510B7



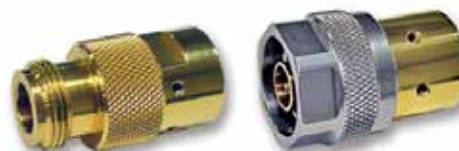
Frequency Range	DC to 18.0 GHz
Maximum VSWR:	
DC to 2.0 GHz	1.01
2.0 to 4.0 GHz	1.04
4.0 to 18.0 GHz	1.12
Nominal Impedance	50 ohm
Power Handling	1 watt CW, 1 kW peak

### Fixed Shorts – Models 8806G, 8806C & 8807C



Frequency Range	DC to 18.0 GHz
Minimum Reflection Coefficient	0.98
Nominal Impedance	50 ohm
Phase Accuracy	± 2.0°

### Open Circuits – Models 8809B1 & 8810B1



Frequency Range	DC to 18.0 GHz
Minimum Reflection Coefficient	0.99
Phase Accuracy	±2.0°
Nominal Impedance	50 ohm

### Precision Type N Adapters – Models 8828A/B/C



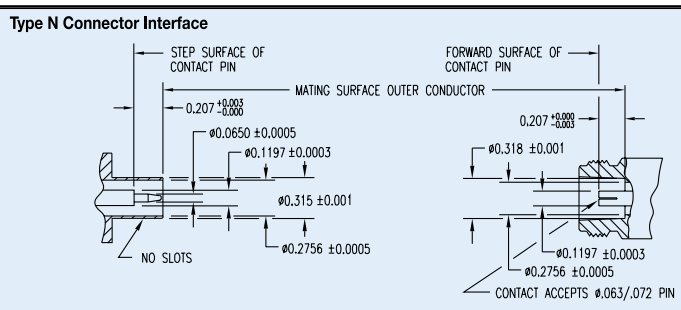
Frequency Range	DC to 18.0 GHz
Maximum VSWR:	
DC to 4.0 GHz	1.03
4.0 to 10.0 GHz	1.05
10.0 to 18.0 GHz	1.09
Nominal Impedance	50 ohm

(Note: These adapters are included in the 8850CK11/21/31 kits, but are not included in the 8850CK10/20/30 kits.)

## Connector Description

The precision Type N connectors on the components in these kits are instrument grade, air-interface connectors that are rated for operation from DC to 18.0 GHz, and comply with IEEE standard 287 for instrument grade general precision connectors (GPC Type N).

The connectors are normally made with stainless steel bodies with heat-treated gold-plated beryllium copper contacts. For detailed interface specifications please refer to Maury data sheet 5E-049.





# TNC VNA Calibration Kits from Maury Microwave

## Models 8650CK10/11 and 8650CK20/21

### Features

- > TNC Connectors
- > DC to 18 GHz
- > High Performance
- > Keysight, Rhode & Schwarz and Anritsu VNAs Supported

### Calibration Methods Supported

- > 8650CK10 & 8650CK11 – Fixed Load SOLT (DC–18.0 GHz)
- > 8650CK20 & 8650CK21 – Sliding/Fixed Load SOLT (DC–18.0 GHz)

### The Importance of VNA Calibration

Imperfections exist in even the finest test equipment. If uncorrected these systematic imperfections cause the equipment to yield less accurate measurements. The basis of network analyzer error correction is referred to as “calibration” of which multiple methods exist.

### Calibration Methods

SOLT calibration, which uses Short, Open and Load standards, requires precise models of the standards’ electrical performance. Fixed load SOLT uses fixed terminations and is adequate for measuring devices with mid-range reflection coefficients. The lowest return loss is limited by the reflection coefficient of the fixed load standard (typically better than 20 dB return loss\*).

The sliding load SOLT kit can accurately measure lower reflection coefficients due to the improved termination performance provided by the sliding load (typically better than 30 dB return loss).

8650CK10/11/20/21 kits are configured for use in performing one-port SOL (Short-Open-Load) response calibrations (a method used for measuring VSWR/ Return Loss), and full two-port SOLT (Short-Open-Load-Thru) calibration (for performing forward and reverse transmission and reflections measurement).

### Recommended Accessories

#### A012E TNC, TNCA, and AFTNC Connector Gage Kit:

Contains Six metrology-grade “push-on” “universal” type, dial indicator style gage for measuring the contact pin and dielectric interface locations of MIL-STD, IEC and commercial TNC connectors. This provides an easy and accurate way to measure these critical linear interface dimensions.

#### 2698G1 9/16-inch Torque Wrench — 12.0 Inch lbs:

For proper torquing of TNCA and MP6 connections. Factory preset to 12.0 inch lbs to ensure the precise torque needed for optimum repeatability. Employs a “break” design that makes it impossible to over-torque your connections. These torque wrenches are provided with 8650CK20/21 and are highly recommended for use with 8650CK10/11 kits.

#### 8619A & 8619B TNC to 3.5mm NMD test port adapters:

Precision TNC to NMD3.5mm; DC–18.0 GHz. Saves unnecessary wear and tear on your VNA test ports.

See page 70 to see all Maury TNC in-series and between series adapters.



A012E



2698G1



8619A



8619B

## Maury TNC VNA Calibration Kits

Maury precision TNC VNA calibration kits include each of the calibration standards and tools shown in the tables at the right. The 8650CK10/20 kits do not include adapters; the 8650CK11/21 kits include one each of the in-series adapters shown. Other in-series and between-series adapters are sold separately.



8650CK10



8650CK11



8650CK20



8650CK21

## Components Included in 8650CK10/11 Kits

QUANTITY	DESCRIPTION	MODEL
1	TNC female fixed short circuit	8615A
1	TNC male fixed short circuit	8615B
1	TNC female open circuit	8609B
1	TNC male open circuit	8610B
1	TNC female fixed termination	332E
1	TNC male fixed termination	332F
1*	TNC female to TNC female adapter	232A11
1*	TNC male to TNC male adapter	232B11
1*	TNC female to TNC male adapter	232C11
1	Foam-lined wood instrument case	—

\* These adapters are provided in the 8650CK11 kits, but are not included in the 8650CK10 kits.

## Components Included in 8650CK20/21 Kits

QUANTITY	DESCRIPTION	MODEL
1	TNC female fixed short circuit	8615A
1	TNC male fixed short circuit	8615B
1	TNC female open circuit	8609B
1	TNC male open circuit	8610B
1	TNC female fixed termination	332E
1	TNC male fixed termination	332F
1*	TNC female to TNC female adapter	232A11
1*	TNC male to TNC male adapter	232B11
1*	TNC female to TNC male adapter	232C11
1	TNC female sliding termination	452A1
1	TNC male sliding termination	452B1
1	9/16-inch torque wrench — 12 in. lbs.	2698G1
1	7/16-inch open end wrench	8770Z7
1	Foam-lined wood instrument case	—

\* These adapters are provided in the 8650CK21 kits, but are not included in the 8650CK20 kits.

## COMPONENT SPECIFICATIONS

### Sliding Terminations – Models 452A1 & 452B1



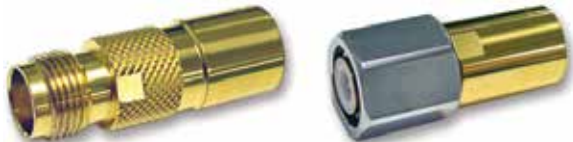
Frequency Range . . . . . 1.8 to 18.0 GHz  
 Maximum VSWR of Terminating Element . . . . . 1.05  
 Air Line Accuracy . . . . . 56 dB min return loss  
 (equivalent return loss of air line impedance)  
 Nominal Impedance . . . . . 50 ohm  
 Power Handling . . . . . 5.0 watt CW, 1.0 kW peak  
 Travel . . . . . Greater than 1/2 wavelength at 2.0 GHz

### Fixed Terminations – Models 332E & 332F



Frequency Range . . . . . DC — 18.0 GHz  
 Maximum VSWR:  
     DC — 4.0 GHz . . . . . 1.06  
     4.0 — 12.0 GHz . . . . . 1.10  
     12.0 — 18.0 GHz . . . . . 1.15  
 Nominal Impedance . . . . . 50 ohm  
 Power Handling . . . . . 1.0 watt CW 1.0 kW peak

### Fixed Short – Models 8615A & 8615B



Frequency Range . . . . . DC to 18.0 GHz  
 Minimum Reflection Coefficient . . . . . 0.98  
 Phase Accuracy . . . . .  $\pm 5.0^\circ$   
 Nominal Impedance . . . . . 50 ohm

### Open Circuits – Models 8609B & 8610B



Frequency Range . . . . . DC to 18.0 GHz  
 Minimum Reflection Coefficient . . . . . 0.98  
 Phase Accuracy . . . . .  $\pm 5.0^\circ$   
 Nominal Impedance . . . . . 50 ohm

### Precision TNC Adapters – Models 232A11/B11/C11



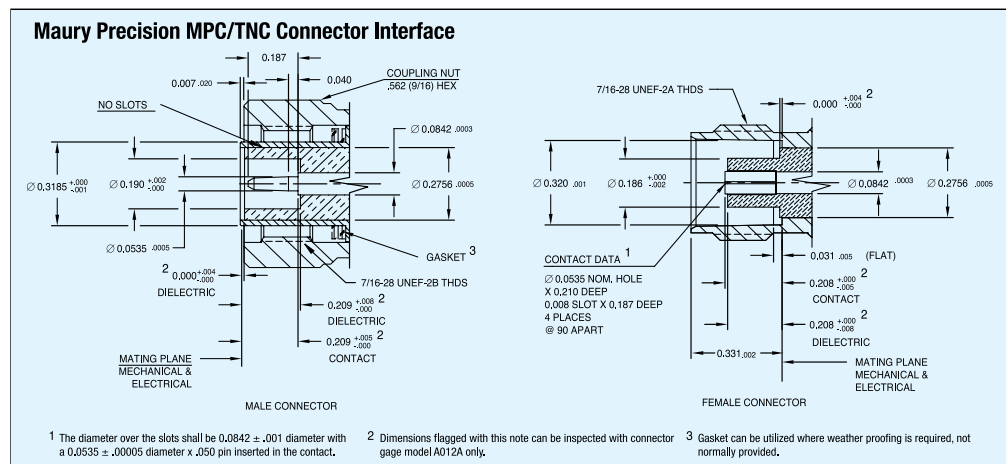
Frequency Range . . . . . DC to 18.0 GHz  
 Maximum VSWR:  
     DC to 4.0 GHz . . . . . 1.06  
     4.0 to 7.0 GHz . . . . . 1.10  
     7.0 to 18.0 GHz . . . . . 1.14  
 Nominal Impedance . . . . . 50 ohm

(Note: These adapters are included in the 8650CK11/21 kits, but are not included in the 8650CK10/20 kits.)

## Connector Description

The TNC connectors (MPC/TNC) on the components in this kit are precision stainless steel connectors that mate with most commercially available TNC connectors, and especially with those conforming to MIL-C-39012 and MIL-T-81490. They are low VSWR connectors rated from DC to 18.0 GHz.

For interface specifications see Maury data sheet 5E-053.





# BNC VNA Calibration Kits from Maury Microwave

## 8550CK10 & 8580CK10 models

### Features

- > 50Ω or 75Ω BNC Connectors
- > DC to 10.0 GHz & DC to 12.0 GHz
- > Simple Fixed Load Calibration
- > Keysight, Rhode & Schwarz and Anritsu VNAs Supported

### Calibration Methods Supported

- > 8550CK10 (50Ω) – Fixed Load SOLT (DC–10.0 GHz)
- > 8580CK10 (75Ω) – Fixed Load SOLT (DC–12.0 GHz)

### The Importance of VNA Calibration

Imperfections exist in even the finest test equipment. If uncorrected these systematic imperfections cause the equipment to yield less accurate measurements. The basis of network analyzer error correction is referred to as “calibration” of which multiple methods exist.

### Calibration Method

SOLT calibration, which uses Short, Open and Load standards, requires precise models of the standards’ electrical performance. Fixed load SOLT uses fixed terminations and is adequate for measuring devices with mid-range reflection coefficients. The lowest return loss is limited by the reflection coefficient of the fixed load standard (typically better than 20 dB return loss\*).

8550CK10 calibration kits are designed for calibrating Vector Network Analyzers (VNAs) from DC to 10.0 GHz for making 50 ohm measurements of devices with BNC connectors. The

8580CK10 kits are likewise designed for calibrating VNAs that will be used to make measurements of devices with 75Ω BNC connector measurements, from DC to 12 GHz.

A full complement of calibration standards (opens, shorts and fixed terminations, female and male) are included in both the 8550CK10 and 8580CK10 kits. All components are housed in a foam-lined wooden instrument case. Operating instructions with the calibration standard constants can be downloaded from the Maury website. The instruction manual explains how the calibration constants can be keyed in from the VNA’s front panel. Optional VNA software, specific to your VNA make and model, is sold separately.

### Recommended Accessories

#### A012A 50Ω/75Ω Dial Indicator Style Connector Gage Kit:

This kit contains one (1) “push-on” type gage for measuring the female and male contact pin and dielectric interface locations for 50Ω and 75Ω BNC connectors.

#### 8582D3/D4 Series Phase Matched 75Ω BNC Adapters:

These between series adapters are designed to adapt 75Ω BNC to 7mm. Visit [maurymw.com](http://maurymw.com) for detailed information.

#### 2621A1/B1 Series Phase Matched 50Ω BNC Adapters:

These between series adapters are designed to adapt 50Ω BNC to 7mm. Visit [maurymw.com](http://maurymw.com) for detailed information.



See page 71 to see all Maury 50Ω and 75Ω BNC between series adapters.

## Maury BNC VNA Calibration Kits

Maury precision BNC VNA calibration kits include each of the calibration standards and tools shown in the tables at the right. In-series and between-series adapters are sold separately.

### 8550CK10



### 8580CK10



## Components Included in 8550CK10 Kits

QUANTITY	DESCRIPTION	MODEL
1	50Ω BNC female fixed short circuit	361N2
1	50Ω BNC male fixed short circuit	361P2
1	50Ω BNC female open circuit	371N2
1	50Ω BNC male open circuit	371P2
1	50Ω BNC female fixed termination	351A2
1	50Ω BNC male fixed termination	351B2
1	Foam-lined wood instrument case	—

Between series adapters are available by separate order.  
See page 71 for more information.

## Components Included in 8580CK10 Kits

QUANTITY	DESCRIPTION	MODEL
1	75Ω BNC female fixed short circuit	8584A1
1	75Ω BNC male fixed short circuit	8584B1
1	75Ω BNC female open circuit	8585A1
1	75Ω BNC male open circuit	8585B1
1	75Ω BNC female fixed termination	8583A1
1	75Ω BNC male fixed termination	8583B1
1	Foam-lined wood instrument case	—

Between series adapters are available by separate order.  
See page 71 for more information.

## 50Ω BNC COMPONENT SPECIFICATIONS

### 50Ω Fixed Terminations – Models 351A2 and 351B2



Frequency Range	DC to 10.0 GHz
Maximum VSWR:	
DC to 2.0 GHz	1.04
2.0 to 4.0 GHz	1.10
4.0 to 10.0 GHz	1.20
Nominal Impedance	50 ohm
Power Handling	2.0 watt CW, 1.0 kW peak

### 50Ω Fixed Shorts – Models 361N2 and 361P2



Frequency Range	DC to 10.0 GHz
Reflection Coefficient	0.98 minimum
Phase Accuracy	± 5.0 degrees
Nominal Impedance	50 ohm

### 50Ω Open Circuits – Models 371N2 and 371P2



Frequency Range	DC to 10 GHz
Reflection Coefficient	0.98 minimum
Phase Accuracy	± 5.0 degrees
Nominal Impedance	50 ohm

## 50Ω BNC Connector Description

Maury BNC series connectors are 50-ohm impedance connectors with two-stud bayonet coupling. These connectors conform to MIL-PRF-39012 (formerly MIL-C-39012). The connectors are normally made with stainless steel bodies and with heat treated gold-plated beryllium copper contacts.

## 75Ω BNC COMPONENT SPECIFICATIONS

### 75Ω Fixed Terminations – Models 8583A1 & 8583B1



Frequency Range	DC to 12.0 GHz
Maximum VSWR:	
DC to 2.0 GHz	1.02
2.0 to 4.0 GHz	1.04
4.0 to 12.0 GHz	1.10
Nominal Impedance	75 ohm
Power Handling	1 watt CW

### 75Ω Fixed Shorts – Models 8584A1 & 8584B1



Frequency Range	DC to 12.0 GHz
Reflection Coefficient	0.98 minimum
Phase Accuracy:	
DC to 2.0 GHz	± 1.0°
2.0 to 3.0 GHz	± 2.0°
3.0 to 12.0 GHz	± 6.0°
Nominal Impedance	75 ohm

### 75Ω Open Circuits – Models 8585A1 and 8585B1



Frequency Range	DC to 12.0 GHz
Reflection Coefficient	0.98 minimum
Phase Accuracy:	
DC to 2.0 GHz	± 1.0°
2.0 to 3.0 GHz	± 2.0°
3.0 to 12.0 GHz	± 6.0°
Nominal Impedance	75 ohm

## 75Ω BNC Connector Description

Maury BNC series connectors are 75-ohm impedance connectors with two-stud bayonet coupling. These connectors conform to MIL-PRF-39012 (formerly MIL-C-39012). The connectors are normally made with stainless steel bodies and with heat treated gold-plated beryllium copper contacts.



# Waveguide VNA Calibration Kits

## CK10/12 & CK30/32 models

### Features

- > 2.6 to 50 GHz
- > WR284 Through WR22
- > SSLT and TRL calibration
- > Keysight, Anritsu and Rohde & Schwarz VNAs Supported

### The Importance of VNA Calibration

Any uncalibrated test setup has systematic errors inherent in the equipment used. The ability to obtain an accurate measurement of a device under test. The basis of network analyzer error correction is the measurement of known electrical standards, such as a thru, open circuit, short circuit, and precision load impedance. By calibrating your network analyzer with these standards, you can compensate for the inherent imperfections.

### Description

**CK10/12** - The CK10/12 SSLT Waveguide Calibration Kits are designed to provide accurate calibration of vector network analyzers (VNAs) that are used for measurements in standard rectangular waveguide from 2.6 to 50 GHz (WR284–WR22). Each kit includes all the components needed for accurate calibration of most VNAs to ensure high effective directivity after calibration.

**CK30/32** - Maury CK30/32 calibration kits are designed to provide accurate Thru-Reflect-Line (TRL), Short-Short-Load-Thru (SSLT) and Offset Load calibrations of vector network analyzers (VNAs) for measurements in rectangular waveguide from 2.6 to 50 GHz (WR284 to WR22). Each kit includes all the components needed for accurate TRL, SSLT or Offset Load calibration of supported VNA models.

\*Precision straight sections and a fixed (reference plane) short are also provide as verification standards in the CK12 or CK32 options.

### Flange Description

The components in these kits are equipped with Maury Precision Flanges (MPF) which conform to EIA WR standards for rectangular or round waveguide flanges. MPF flanges have precision indexing holes and corresponding indexing pins for precise alignment when mating, which ensures excellent measurement repeatability. Flange diagrams and other details can be found at <http://www.maurymw.com>. (Use the search feature with search term "MPF".)

### Calibration Methods

**CK10/12** - These kits are configured for use in performing one-port SSL (Short-Short-Load) calibrations for measuring VSWR/ Return Loss, or full two-port SSLT (Short-Short-Load-Thru) calibrations to perform forward and reverse transmission and reflection measurements.

**CK30/32** - These kits are configured for use in performing full two-port TRL (Thru-Reflect-Line) and SSLT (Short-Short-Load-Thru) calibrations; two standard methods for measuring forward



and reverse transmission and reflection measurements). They can also be used to perform Offset Load calibrations on VNAs that support that calibration method.

### Components Included in CK10/12 Kits

QUANTITY	DESCRIPTION	MODEL
1**	Fixed flush (reference plane) short	344 series
1	1/8- $\lambda$ fixed offset short	340 series
1	3/8- $\lambda$ fixed offset short	340 series
1	Precision fixed termination	301 series
1**	Straight section (rectangular)	102/3/6 series
1*	3/32-in. hex ball driver *	J998T2
1	Flange hardware (including the indexing pin set)	—
1	Instrument case	—

### Components Included in CK30/32 Kits

QUANTITY	DESCRIPTION	MODEL
1	Fixed flush (reference plane) short	344 series
1	1/4- $\lambda$ straight section (shim)	322 series
1	Precision fixed termination	301 series
1**	Straight section (rectangular)	102/3/6 series
1*	3/32-in. hex ball driver *	J998T2
1	Flange hardware (including the indexing pin set)	—
1	Instrument case	—

\* Included in the K, Q, U and J band kits only.

\*\* Included in CK12/32 kits.

## Component Specifications

### CK10/12 SSLT & CK30/32 TRL Kits

#### Fixed Flush Shorts – Model Series 344

These machined fixed shorts are flat-face/flat-plane shorts designed to terminate round or rectangular waveguide connectors at the mating plane, over a frequency range from 2.6 to 50 GHz. They are used to establish a reference plane in systems and in making loss measurements.

#### 1/8λ & 3/8λ Fixed Offset Shorts

##### – Model Series 340

These fixed offset shorts are considered one of the more accurate means of obtaining a 180° phase difference in waveguide. Using these single-piece devices reduces the number of flange interfaces during calibration; helping to maintain an essentially constant magnitude of current flow across the calibration plane. Those in rectangular waveguide are nominally 1/8λ and 3/8λ offset at frequencies near the waveguide band centers. These frequencies are chosen to equalize phase differences at band edges, and thus are not at the exact band centers.

Offset delay ranges from 50.835 – 4.007 ps for the 1/8λ shorts and 152.506 – 12.002 for the 3/8λ shorts; calculated without consideration for the dispersive effect of waveguide if the short is in air dielectric coaxial line. This conforms to the convention established for Agilent network analyzers. Anritsu analyzers use the actual mechanical offset in centimeters.

#### 1/4λ Precision Straight Sections

##### – Model Series 322B

These 322B series 1/4λ straight sections are reduced height spacers or shims which provide an accurately known VSWR which is directly calculable from their mechanical dimensions. The shims are designed for a theoretical VSWR of 1.00. The shims are fabricated from aluminum and are provided with precision indexing holes for excellent flange alignment. Their simple geometry allows direct calculation of reflection, loss, transfer and group delay characteristics and makes them ideally suited for quickly checking the performance and accuracy of automated network analyzers.

#### Precision Fixed Terminations – Model Series 301

These low power fixed terminations feature low VSWR (1.025 – 1.040 max up to 50.0 GHz; typically <1.02 from 3.95 to 18.0 GHz). Power handling is rated from 25W (avg)/10kW (peak) to 0.2W (avg)/0.03kW (peak) depending on frequency range.

#### Verification Stds – Precision Straight Sections

These precision straight sections exhibit low VSWR (1.025 max) across the frequency range of operation. These precision stds can be used along with the fixed flush shorts as verification stds to validate accuracy of calibration.

## Available Models

Waveguide Designation (EIA WR NO.)	FREQUENCY RANGE (GHz)	MMC WAVEGUIDE BAND	SSLT CALIBRATION KIT	SSLT CALIBRATION KIT w\ VERIFICATION STD.	TRL CALIBRATION KIT	TRL CALIBRATION KIT w\ VERIFICATION STD.
WR284	2.60 - 3.95	S	WR284CK10	WR284CK12	WR284CK30	WR284CK32
WR229	3.30 - 4.90	E	WR229CK10	WR229CK12	WR229CK30	WR229CK32
WR187	3.95 - 5.85	G	WR187CK10	WR187CK12	WR187CK30	WR187CK32
WR159	4.90 - 7.05	F	WR159CK10	WR159CK12	WR159CK30	WR159CK32
WR137	5.85 - 8.20	C	WR137CK10	WR137CK12	WR137CK30	WR137CK32
WR112	7.05 - 10.0	H	WR112CK10	WR112CK12	WR112CK30	WR112CK32
WR90	8.20 - 12.4	X	WR90CK10	WR90CK12	WR90CK30	WR90CK32
WR75	10.0 - 15.0	M	WR75CK10	WR75CK12	WR75CK30	WR75CK32
WR62	12.4 - 18.0	P	WR62CK10	WR62CK12	WR62CK30	WR62CK32
WR51	15.0 - 22.0	N	WR51CK10	WR51CK12	WR51CK30	WR51CK32
WR42	18.0 - 26.5	K	WR42CK10	WR42CK12	WR42CK30	WR42CK32
WR34	22.0 - 33.0	Q	WR34CK10	WR34CK12	WR34CK30	WR34CK32
WR28	26.5 - 40.0	U	WR28CK10	WR28CK12	WR28CK30	WR28CK32
WR22	33.0 - 50.0	J	WR22CK10	WR22CK12	WR22CK30	WR22CK32

# Precision Fixed Terminations

## General Information



## Fixed Terminations

A precision fixed termination (or load) consists of an immovable, (fixed) termination which, when mated to the end of a transmission line or cable, absorbs nearly all of the signal energy traveling toward it. An ideal “matched” condition exists when a termination with an impedance value of  $Z_0$ , is connected to the end of a transmission line or cable that also has a characteristic impedance of  $Z_0$ . Such an ideal “matched” condition (one with no mismatch between the termination and its mated line or cable) is critical if a voltage standing wave ratio (VSWR) of 1.0:1 is to be achieved in a system with a 50 or 75 ohm impedance value. Simply put, the more closely the 1.0:1 ratio is approached, the more accurate the measurements that can be made from a system.

Maury precision fixed terminations are designed to exacting specifications and are as close to the ideal impedance as it is mechanically possible to make them. The following pages provide detailed information about the various types of precision fixed terminations offered by Maury. Most are normally sold as components of Maury VNA calibration kits, but may also be purchased separately as replacement parts or spares.



## Precision Fixed Terminations Available Models

Model	Sex	Connector Type	Frequency Range (GHz)	VSWR	Power Rating
7831A1	Female	1.85mm	DC - 1.0	1.02	0.5 watt CW 0.25 kW peak
7831B1	Male		1.0 - 10.0	1.07	
			10.0 - 26.5	1.10	
			26.5 - 50	1.20	
7832A	Female	1.85mm	10.0 - 67.0	1.10	
7832B	Male				
7931A1	Female	2.4mm	DC - 4.0	1.016	0.5 watt CW 0.25 kW peak
7931B1	Male		4.0 - 50.0	1.15	
8775A3	Female	2.92mm	DC - 4.0	1.016	0.5 watt CW 0.25 kW peak
8775B3	Male		4.0 - 40.0	1.15	
8031A5	Female	3.5mm	DC - 3.0	1.02	0.5 watt CW 0.25 kW peak
			3.0 - 6.0	1.032	
8031B5	Male		6.0 - 20.0	1.052	
			20.0 - 26.5	1.083	
2610D	-	7mm	DC - 18.0	1.04	1 watt CW 1 kW peak
			DC - 1.0	1.005	
2610F	-		1.0 - 2.0	1.01	
			2.0 - 8.0	1.03	
			8.0 - 18.0	1.06	
2510A6	Female	Type N	DC - 2.0	1.02	1 watt CW 1 kW peak
			2.0 - 4.0	1.04	
2510B6	Male		4.0 - 18.0	1.06	
2510A7	Female	Type N	DC - 2.0	1.01	
			2.0 - 4.0	1.04	
2510B7	Male		4.0 - 18.0	1.12	
8583A	Female	BNC 75Ω	DC - 2.0	1.02	1 watt CW
			2.0 - 4.0	1.04	
8583B	Male	BNC 75Ω	4.0 - 12.0	1.10	
351A2	Female	BNC 50Ω	DC - 2.0	1.04	2 watt CW 1 kW peak
			2.0 - 4.0	1.10	
351B2	Male	BNC 50Ω	4.0 - 10.0	1.20	
332E	Female	TNC	DC - 4.0	1.06	1 watt CW 1 kW peak
			4.0 - 12.0	1.10	
332F	Male	TNC	12.0 - 18.0	1.15	

# Precision Fixed Terminations

## Waveguide (301 series)

### Features

- > Low VSWR
- > 2.6 to 50 GHz
- > Moderate Power Handling

### Description

The 301 series low power waveguide fixed terminations are precision, low VSWR terminations suited to a wide variety of general purpose and precision laboratory applications. They can be used for full band one-port calibration and full two-port, isolation calibration.

### Waveguide Flange Description

The waveguide flanges used on these terminations are Maury Precision Flanges (MPF) in rectangular, or round configurations. MPF flanges have precision indexing holes and removable indexing pins for excellent measurement repeatability. The millimeter waveguide flanges in the WR22 and smaller sizes are of a unique Maury-pioneered design featuring a raised outer rim to prevent the flanges from cocking during connection. These flanges will mate with corresponding UG ( )/U flanges. (See pages 78-80 for flange details.)



### Available Models

MODEL	FREQUENCY RANGE (GHz)			VSWR (Maximum)	EIA WR NUMBER	EQUIVALENT FLANGE	POWER RATING		LENGTH	
							Ave. (W)	PEAK (kW)	inches	(cm)
S301A	2.60	—	3.95	1.025	284	UG584/U	5.0	2.0	10.4	(26.4)
E301F	3.30	—	4.90	1.020	229	CPR229F	5.0	2.0	7.4	(18.8)
G301	3.95	—	5.85	1.020	187	UG149A/U	5.0	2.0	6.4	(16.3)
F301C	4.90	—	7.05	1.020	159	CPR159F	3.0	1.0	5.8	(14.7)
C301	5.85	—	8.20	1.020	137	UG344/U	2.5	1.0	5.2	(13.2)
H301A	7.05	—	10.00	1.015	112	UG51/U	2.0	1.0	5.0	(12.7)
X301A	8.20	—	12.40	1.015	90	UG39/U	1.0	1.0	5.0	(12.7)
M301A	10.00	—	15.00	1.020	75	MPF75	1.0	1.0	5.0	(12.7)
P301A	12.40	—	18.00	1.020	62	UG419/U	1.0	1.0	4.0	(10.2)
N301	15.00	—	22.00	1.025	51	MPF51	0.5	0.2	3.1	(07.9)
K301	18.00	—	26.50	1.025	42	UG595/U	0.5	0.2	2.8	(07.1)
U301	26.50	—	40.00	1.025	28	UG599/U	0.5	0.2	2.2	(05.6)
J301A	33.00	—	50.00	1.040	22	UG383 <sup>1</sup>	0.5	0.1	1.6	(04.1)

<sup>1</sup> Units are supplied with Maury precision flanges (MPF) which mate with the UG flanges shown.

# Sliding Terminations

## General Information



A sliding termination (or sliding load) consists of a precision, movable, tapered termination in a highly accurate, air dielectric transmission line. These instruments are basic tools for making precision microwave measurements, and are particularly useful in the following applications:

**Load Separation:** A general application measurement in which the reflection from the terminating element can be separated from that of the test device. Load separation using sliding loads is a key element in the calibration of vector network analyzers (VNAs). The technique is also used in the measurement of the reflection from two-port devices, particularly “non-insertable”, (e.g., waveguide-to-coax adapters, and the directivity of directional couplers). Maury sliding terminations make it possible to measure test device reflection in extremely small increments that would normally be masked by the reflections from the termination.

**50 ohm Fixed Termination:** The low VSWR inherent in Maury sliding terminations make them excellent for use as fixed terminations in 50 ohm systems.

Maury manufactures sliding terminations which offer a range of performance and convenience features. These include metrology grade, high precision units with integral, dedicated connectors; precision units which permit the sex of the connector to be changed within the same connector series; and true, modular instruments which permit changing the connector type or sex.

**Metrology grade sliding terminations** provide the highest level of accuracy, stability and repeatability when used as impedance standards for calibrating vector network analyzers. They feature integral connectors, flush set adjustment, and thermal isolation.

**Dedicated connector sliding terminations** are capable of handling higher power than is typical of metrology grade sliding terminations. Their defining characteristic is that they feature connectors of a single type, and (in sexed connectors) of a single, non-interchangeable, sex.

Most Maury sliding termination VNA calibration kits include metrology grade sliding terminations. These sliding terminations are also available individually as replacement parts for the calibration kits. Dedicated connector and Modular models are likewise available as individual instruments, and in some cases as boxed sets. The following pages (45-46) provide detailed descriptions and specifications for all of the coaxial and waveguide sliding terminations offered by Maury.



# Sliding Terminations

## 2.4mm, 2.92mm, 3.5mm, 7mm, Type N, and TNC

### Features

- > Integral Connectors
- > "Flush Set" Adjustment<sup>4</sup>
- > "Pull Back" Mechanism & Lock<sup>5</sup>
- > Thermal Isolation
- > Enhanced Air Line Accuracy

### Description

These metrology grade sliding terminations achieve a high level of accuracy, stability and repeatability when used as impedance standards for calibrating vector network analyzers (VNAs) and in other critical, precision measurement applications.

They feature seamless, integral, beadless (air dielectric) connectors that provide an extremely accurate impedance reference, and an external jacket that enhances thermal stability by insulating the transmission line.

When used with "thread-on" connector gages, a "flush set"<sup>4</sup> mechanism allows users to adjust the center conductor to achieve a coplanar inner and outer conductor interface at the connector mating plane.

A "pull back"<sup>5</sup> mechanism automatically locks the center conductor to a previously set flush condition, making it easy to return to flush condition from any other position. These terminations are available individually, with female or male connectors, or in boxed sets with one each of both sexes, per the **Specifications** chart (below).

TNC terminations are precision air lines with low-reflection transformers to the dielectrically loaded connectors. Their air dielectric connectors and movable center conductors permit precision setting of the connector interface condition, using an appropriate connector gage.

### Specifications

MODEL	CONNECTOR TYPE	FREQUENCY RANGE & MAXIMUM VSWR <sup>1</sup>	AIR LINE ACCURACY <sup>2</sup>	POWER HANDLING
7935A	2.4mm female	4.0 GHz — 10.0 GHz, 1.10 10.0 GHz — 50.0 GHz, 1.05	42 dB (4.0 — 50.0 GHz)	0.5 watts CW, 0.5 kW peak
7935B	2.4mm male			
7935C	2.4mm boxed set (1 ea. 7935A female and 7935B male) <sup>3</sup>			
8777A2	2.92mm (K) female	4.0 GHz — 10.0 GHz, 1.10 10.0 GHz — 40.0 GHz, 1.05	46 dB (4.0 — 40.0 GHz)	0.5 watts CW, 0.5 kW peak
8777B2	2.92mm (K) male			
8777C2	2.92mm (K) boxed set (1 ea. 8777A2 female and 8777B2 male) <sup>3</sup>			
8037A	3.5mm female	2.0 GHz — 4.0 GHz, 1.09 4.0 GHz — 34.0 GHz, 1.05	50 dB (4.0 — 34.0 GHz)	1.0 watts CW, 1.0 kW peak
8037B	3.5mm male			
8037C	3.5mm boxed set (1 ea. 8037A female and 8037B male) <sup>3</sup>			
2608C	7mm (LPC7)	1.8 GHz — 18.0 GHz, 1.035	62 dB	1.0 watt CW, 1.0 kW peak
8834A	Type N female	2.0 GHz — 18.0 GHz, 1.04	54 dB	
8834B	Type N male			
8834C	Type N boxed set (1 ea. 8834A female and 8834B male) <sup>3</sup>			
452A1	TNC female <sup>6</sup>	1.8 GHz — 18.0 GHz, 1.05	56 dB	5.0 watt CW, 1.0 kW peak
452B1	TNC male <sup>6</sup>			

<sup>1</sup> Maximum VSWR (50 ohm reference) of the terminating element alone.

<sup>2</sup> Equivalent return loss of the air line impedance (50 ohm reference).

<sup>3</sup> Supplied in a foam-lined wood instrument case.

<sup>4</sup> Does not apply to TNC.

<sup>5</sup> Does not apply to TNC or 7mm.

<sup>6</sup> Precision stainless steel TNC per ES-2047.

# Fixed Flush and Fixed Offset Shorts

## General Information

Fixed flush and fixed offset short circuit terminations (shorts) are used to establish reference planes in transmission systems and as key elements in the calibration of vector network analyzers (VNAs). Offset shorts can be used for banded calibrations of VNA. Those with the longest offset are often used to evaluate the calibration effectiveness of a VNA by measuring the effective source match after calibration.

In general, the shorting plane of fixed flush shorts is at the connector reference plane, and at some predetermined offset in offset shorts.

Many of the shorts listed in this section are components of the Maury VNA calibration kits described on pages 16-39 of this catalog. Others are available as supplements to the components in these kits. In all cases, the specification "Phase Accuracy" is defined in this section as phase deviation from a nominal unit.



## Available Models

Model	Sex	Connector Type	Frequency Range (GHz)	Phase Accuracy	Reflection Coefficient	Offset Length (Inches)
7846A	Female	1.85mm	DC - 67.0	± 4.0°	0.98	0.1968
7847A	Male					
7946A	Female	2.4mm	DC - 50.0	± 2.0°	0.98	0.2000
7946B	Male					
8771F2	Female	2.92mm	DC - 40.0	± 2.0°	0.98	0.1970
8772F2	Male					
8046F	Female	3.5mm	DC - 26.5	± 2.0°	0.98	0.1970
8047F	Male					
360D	Female	3.5mm\SMA*	DC - 40.0	± 2.0°	0.99	0.0000
360B	Male					
2615D3	-	7mm	DC - 18.0	± 0.3°	0.995	0.0000
8806C	Female	Type N	DC - 18.0	± 2.0°	0.98	0.2892
8806G						0.4972
8807C	Male					0.4972
8584A1	Female	BNC 75Ω	DC - 2.0	± 1.0°	0.98	0.3937
8584B1	Male		2.0 - 3.0 3.0 - 12.0	± 2.0° ± 6.0°		
351A2	Female	BNC 50Ω	DC - 12.4	± 5.0°	0.98	0.1410
351B2	Male					
8615A	Female	TNC	DC - 18.0	± 5.0°	0.98	0.5000
8615B	Male					0.7000

\* Flush shorts that can be used with SMA, 3.5mm and 2.92mm

# Waveguide Fixed Flush Shorts

## Model Series 344

### Description

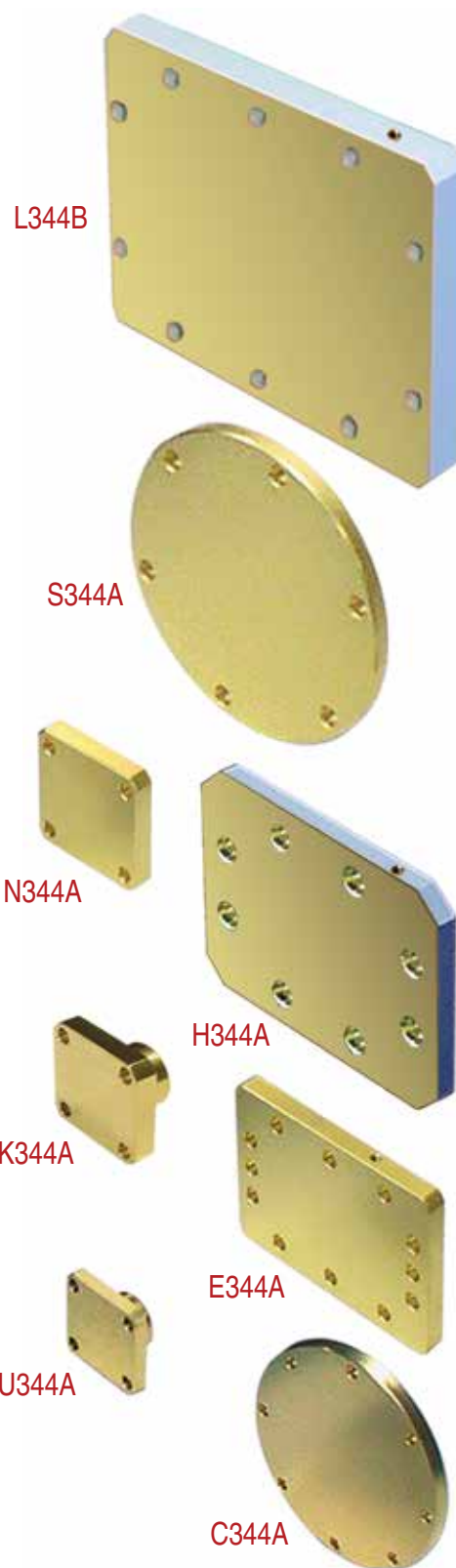
These machined fixed shorts are designed to terminate round or rectangular waveguide connectors at the mating plane. They are used to establish a reference plane in systems and in making loss measurements. They are flat face/flat plane shorts that cover frequencies from 2.6 to 50.0 GHz. They may be ordered with user-specified flanges; with or without Maury precision indexing holes. These shorts are included as components of Maury's CK12/30/32 series VNA calibration kits as listed on pages 40-41. They may also be purchased separately as spare or replacement parts for these kits.

### Available Models

MODEL	MATES WITH EQUIVALENT FLANGE	EIA WR NUMBER	FREQUENCY RANGE (GHz)		
S344A	UG53/U	284	2.6	—	3.95
S344B	CPR284F				
S344C	CMR284				
E344B	CPR229F	229	3.3	—	4.9
E344C	CMR229				
G344A	UG149A/U	187	3.95	—	5.85
G344B	CPR187F				
G344C	CMR187				
F344B	CPR159F	159	4.9	—	7.05
F344C	CMR159				
C344A	UG344/U	137	5.85	—	8.2
C344B	CPR137F				
C344C	CMR137				
H344A	UG51/U	112	7.05	—	10.0
H344B	CPR112F				
H344C	CMR112				
X344A	UG39/U	90	8.2	—	12.4
X344B	CPR90F				
X344C	CMR90				
M344A	MPF75	75	10.0	—	15.0
P344A	UG419U	62	12.4	—	18.0
N344A	MPF51	51	15.0	—	22.0
K344A	UG595/U	42	18.0	—	26.5
K344D	UG425/U				
K344E	UG595/U <sup>1</sup>	42	18.0	—	26.5
2	—	34	22.0	—	33.0
U344A	UG599/U	28	26.5	—	40.0
2	UG381/U				
2	UG383/U	22	33.0	—	50.0

<sup>1</sup> Same as K344D with index holes.

<sup>2</sup> Use K344D.





# Waveguide Fixed Offset Shorts

## Model Series 340

### Description

Offset shorts with 1/8 and 3/8 wavelength offsets are considered one of the more accurate means of obtaining a 180° phase difference in waveguide. Using these single-piece devices will reduce the number of flange interfaces during calibration. This helps to maintain an essentially constant magnitude of current flow across the calibration plane.

The chart below lists the offset shorts available from Maury. Those in rectangular guide are nominally 1/8 and 3/8 wavelength offset at a frequency near the waveguide band center. These will not be the exact band center as the frequency is chosen to equalize the phase differences at the band edges.



### Available Models

BAND	EIA WR NUMBER	FREQUENCY RANGE (GHz)	MODEL	OFFSET (cm)	DELAY (ps) <sup>1</sup>
S	WR284	2.6 — 3.95	S340B1	1.524	50.852
			S340B2	4.572	152.555
E	WR229	3.3 — 4.9	E340B3	1.359	45.346
			E340B4	4.077	136.038
G	WR187	3.95 — 5.85	G340B1	1.026	34.235
			G340B3	3.078	102.704
F	WR159	4.9 — 7.05	F340C1	0.815	27.194
			F340C3	2.446	81.616
C	WR137	5.85 — 8.2	C340F1	0.686	22.890
			C340F3	2.058	68.670
H	WR112	7.05 — 10.0	H340B1	0.571	19.067
			H340B3	1.714	57.191
X	WR90	8.2 — 12.4	X340B1	0.483	16.116
			X340B3	1.448	48.316
M	WR75	10.0 — 15.0	M340C1	0.396	13.213
			M340C3	1.189	39.674
P	WR62	12.4 — 18.0	P340A1	0.352	11.745
			P340A2	1.055	35.202
N	WR51	15.0 — 22.0	N340A	0.267	8.909
			N340B	0.800	26.694
K	WR42	18.0 — 26.5	K340A1	0.251	8.365
			K340A2	0.752	25.095
U	WR28	26.5 — 40.0	U340B	0.150	5.005
			U340C	0.450	15.015
J	WR22	33.0 — 50.0	J340A1	0.120	4.007
			J340B1	0.360	12.022

<sup>1</sup> Offset delay is calculated without consideration for the dispersive effect of waveguide, that is, assuming the short is in air dielectric coaxial line. This conforms to the convention established for Keysight network analyzers. Anritsu analyzers use the actual mechanical offset in centimeters.

# Opens

## General Information

Shielded, coaxial opens are used in the calibration of vector network analyzers to provide a nominal 180° phase offset from a compatible reference short over a wide range of frequencies.

At these frequencies, open circuit terminations are inherently imperfect. Shielding the open essentially eliminates radiation loss, but creates a residual frequency-sensitive capacitance. An accurate knowledge of the open's effective capacitance is essential to an accurate calibration of the analyzer.

Maury opens are characterized for effective capacitance versus frequency by means of a fourth order polynomial curve fit, and the nominal capacitance coefficients are provided with each unit. We offer several innovative designs that improve the consistency and repeatability of the open's capacitance coefficients resulting in improved effective source match of the calibrated VNA <sup>1</sup>.

One design (seen in the 7mm models shown below) uses a beadless captivated dielectric rod in place of the center conductor contact. This rod depresses the spring-loaded contact of the test port connector so that it is flush with the outer conductor mating plane. This creates highly accurate, precisely repeatable open circuit conditions which improve the calibration effectiveness and measurement accuracy of the open.



Another design (seen in most of the sexed models listed below) uses a center contact that is captivated and set at the factory to be essentially flush with the outer conductor mating plane, thereby eliminating dependence on test port connector tolerances and adding a high degree of performance consistency to the open.

The 371N2/P2 and 8585A1/B1 models are designed for limited frequency ranges as determined by their connector types.

In all cases, the specification "Phase Accuracy" is defined as phase deviation from a nominal unit.

## Available Models

MODEL	SEX	CONNECTOR TYPE	FREQUENCY RANGE (GHZ)	PHASE ACCURACY	MINIMUM REFLECTION COEFFICIENT
7948A1 7948B1	female male	2.4mm	DC – 50.0	±2.0°	0.98
8773A2 8773B2	female male	2.92mm (K)	DC – 40.0	±1.5°	0.98
8048A1 8048B1	female male	3.5mm	DC – 26.5	±1.4°	0.98
2616D3	—	7mm	DC – 18.0	±0.3°	0.995
8809B1 8810B1	female male	Type N	DC – 18.0	±2.0°	0.99
8609B 8610B	female male	TNC	DC – 18.0	±5.0°	0.98
371N2 371P2	female male	BNC 50Ω	DC – 12.4	±5.0°	0.98
8585A1 8585B1	female male	BNC 75Ω	DC – 12.0	DC – 2.0 = ±1.0° 2.0 – 3.0 = ±2.0° 3.0 – 12.0 = ±6.0°	0.98

<sup>1</sup> See Maury data sheet 5C-027.

## Precision Air Lines

### General Information

Coaxial air lines are air-dielectric transmission lines with highly accurate dimensions that can be used as fundamental impedance standards in measurement and calibration applications, and may also be used to establish reference positions for measurements.

Maury offers air lines with bead supported and/or beadless connectors in a variety of popular types including, 1.85mm, 2.4mm, 2.92mm (K), 3.5mm, 7mm and type N.

Bead supported air lines offer greater convenience and easier connections (the center conductor is automatically aligned by the dielectric bead for easy connection); beadless air lines offer better impedance and electrical length accuracies, as well as lower VSWR (the center conductor floats free in the air line body, and the male connector nut is retractable to facilitate insertion of the center conductor contact before the thread- on connection tightened).

The photos at the right (above) show end views of two type N air lines. On the left is a model 2503A (representing Maury's bead supported design) and on the right is a model 2553T5 (representing Maury's beadless design). The low-loss dielectric bead in the 2503A keeps the center conductor precisely centered in the body of the air line. The photo on the right shows how the unsupported center conductor of the 2553T5 has shifted to the left, and floats freely in the air line body until it is connected at both ends. The beadless design is a true "air" line in that it does not include any discontinuities caused by having the center conductor supported by dielectric beads.

Beadless air lines are often used as "sample holders" where samples of various materials can be inserted in the air line and measured to determine the material's dielectric properties.

Specifications given for the air line models in this section include the odd  $1/4\lambda$  frequency rating. This rating indicates the frequencies at which the electrical length is an odd multiple of a  $1/4$  wavelength where  $n = \text{zero or an integer}$ .



Bead-Supported



Unsupported (air dielectric)



8043S15



## Precision Air Lines Available Models

Model	Connector Type	Frequency Range (GHz)	Electrical Length (cm)	Electrical Length Accuracy	Minimum Return Loss	Odd 1/4 Wavelength Frequency (GHz)
7843S0.96	1.85mm	DC - 67.0	0.960	±0.0025	48dB	(2n + 1) 7.8
7843S1.15			1.150			(2n + 1) 6.5
7843S3.00			3.000			(2n + 1) 2.5
7943G	2.4mm	DC - 50.0	4.997	±0.0025	48dB	(2n + 1) 1.5
7943H			2.997			(2n + 1) 2.5
7943S1.25			1.250			(2n + 1) 6.0
7943S1.50			1.500			(2n + 1) 5.0
7943S6.25			6.250			(2n + 1) 1.2
8774C15	2.92mm	DC - 40.0	14.990	±0.0025	48dB	(2n + 1) 0.50
8774C6			6.000			(2n + 1) 1.25
8774C5.25			5.250			(2n + 1) 1.43
8774C5			4.997			(2n + 1) 1.50
8043S15	3.5mm	DC - 26.5	14.990	±0.0025	48dB	(2n + 1) 0.50
8043S6			6.000			(2n + 1) 1.25
8043S5.3			5.298			(2n + 1) 1.41
8043S5			4.997			(2n + 1) 1.50
8042C	3.5mm*	DC - 18.0	14.990	±0.02	<1.004 + 0.0035f(GHz)	(2n + 1) 0.50
8042D			9.993			(2n + 1) 0.75
2653S15	7mm	DC - 18.0	14.983	±0.005	<1.005	(2n + 1) 0.50
2653S3.12			3.120			(2n + 1) 1.50
2653L			0.693			(2n + 1) 10.81
2603A	7mm*	DC - 18.0	29.979	±0.015	<1.004 + 0.003f(GHz)	(2n + 1) 0.25
2603B			19.986			(2n + 1) 0.375
2553T15	Type N	DC - 18.0	14.983	±0.01	<1.004 + 0.001f(GHz)	(2n + 1) 0.50
2553T5			4.994			(2n + 1) 1.50
2553T3.82			3.816			(2n + 1) 1.96
2553T3.12			3.123			(2n + 1) 2.40
2503A	Type N*	DC - 18.0	29.979	±0.02	<1.03 + 0.003f(GHz)	(2n + 1) 0.83
2503B			19.986			(2n + 1) 0.84

\* Indicates Bead Supported Airlines

# Precision Mismatches

## General Information

Precision standard mismatches are fixed coaxial terminations, which are used to introduce a known VSWR into a 50 ohm transmission system. These mismatches are extremely useful in a wide variety of applications and are quick and easy to use. They can be used to calibrate swept reflectometers, verify network analyzer calibration, establish impedance references in TDR measurements, etc.

Maury standard mismatches are quality constructed using thin film resistors and a unique grounding method that ensures stable operation. For ease of identification, the VSWR value of the mismatch is engraved on the end cap. Calibration data is provided for all units.

The standard units in this section are fitted with 2.4mm, 2.92mm, 3.5mm, 7mm and type N connectors. Please consult with our sales



staff for application assistance. The units are also available as sets or kits packaged in foam-lined wood instrument cases.

## Available Models

Model		Connector Type	Frequency Range (GHz)	Nominal VSWR	Accuracy (GHz)	
Female	Male				DC - 12.0	12.0 - 50.0
7933A1.20	7933B1.20	2.4mm	DC - 50.0	1.20	±0.09	±0.13
7933A1.50	7933B1.50			1.50	±0.10	±0.20
7933A2.00	7933B2.00			2.00	±0.14	±0.25

Model		Connector Type	Frequency Range (GHz)	Nominal VSWR	Accuracy (GHz)	
Female	Male				DC - 12.0	12.0 - 40.0
8774A1.20	8774B1.20	2.92mm	DC - 40.0	1.20	±0.08	±0.13
8774A1.50	8774B1.50			1.50	±0.10	±0.20
8774A2.00	8774B2.00			2.00	±0.14	±0.25

Model		Connector Type	Frequency Range (GHz)	Nominal VSWR	Accuracy (GHz)	
Female	Male				DC - 12.0	12.0 - 26.5
8033A1.20	8033B1.20	3.5mm	DC - 26.5	1.20	±0.07	±0.10
8033A1.50	8033B1.50			1.50	±0.09	±0.17
8033A2.00	8033B2.00			2.00	±0.12	±0.22

Model		Connector Type	Frequency Range (GHz)	Nominal VSWR	Accuracy (GHz)		
Female	Male				DC - 8.0	8.0 - 12.4	12.4 - 18.0
2611C		7mm	DC - 18.0	1.20	±0.05	±0.06	±0.10
2611E				1.50	±0.06	±0.08	±0.17
2611G				2.00	±0.10	±0.12	±0.22

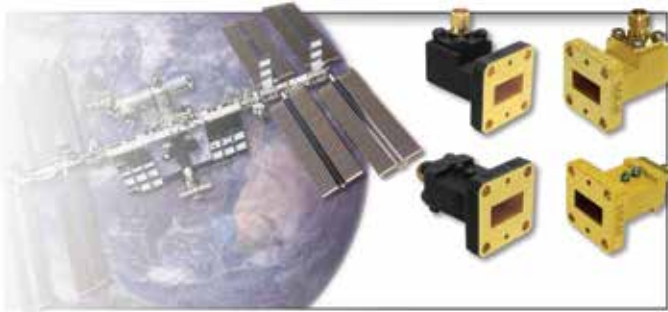
Model		Connector Type	Frequency Range (GHz)	Nominal VSWR	Accuracy (GHz)		
Female	Male				DC - 8.0	8.0 - 12.4	12.4 - 18.0
2561C	2562C	Type N	DC - 18.0	1.20	±0.06	±0.07	±0.07
2561E	2562E			1.50	±0.08	±0.09	±0.07
2561G	2562G			2.00	±0.12	±0.12	±0.07

# Precision Adapters, Cables, Connectors, Waveguide Components and Noise Calibration Systems

## General Information

### Coaxial Adapters

Maury Microwave produces three lines of in-series and between-series coax-to-coax adapters including industry-standard **Calibration-Grade (Metrology) Adapters**, available in all precision laboratory measurement connector types (1.85mm, 2.4mm, 2.92mm (K), 3.5mm, 7mm, 14mm, etc.) and all common systems connectors (type N, TNC, etc.); with two new **Test Essentials™** lines of **Laboratory Adapters** and **ColorConnect™ Adapters**. Maury also manufactures coaxial adapters in other less common connector series not shown in this catalog. For specific configurations not covered in these pages, please contact our Sales Department for assistance.



Maury produces waveguide-to-waveguide adapters, transitions, and straight transmission line sections in all popular EIA waveguide sizes. Units from R through P bands are normally aluminum construction with irridite finish; K band and above are copper alloy with a plated finish. All units are painted with highly durable paint.

Maury also produces waveguide devices in millimeter sizes from 26.5 through 110 GHz (WR28 to WR10), large waveguides (WR430), and in many less common configurations such as: flat guide, reduced height, round, etc. Maury can provide waveguide to waveguide adapters with any flange type, material or finish you require. Consult us on your specific requirement.



### Waveguide-to-Coaxial Adapters

Maury's comprehensive line of precision end launch and right-angle launch waveguide-to-coaxial adapters provide a convenient and reliable transition between most popular EIA waveguide sizes and a wide range of precision coaxial connector types. In most cases the waveguide flanges used are Maury Precision Flanges (MPF) that incorporate a pattern of precision index holes and matching pins to ensure proper mating alignment and connection repeatability. Space qualified adapters with specialized coatings or for Aerospace applications are also available.

### Waveguide-to-Waveguide Adapters



### Test Port Adapters

Maury Test port adapters are specifically designed to mate with the special ruggedized connectors used on commercial VNA test sets, such as those used on Keysight PNA series VNAs and Anritsu 37000 series VNAs. Maury's test port adapters can convert those connectors to other coaxial connector or waveguide types. Using Maury test port adapters as connector savers can yield significant cost savings in terms of reduced VNA down time and lower repair costs.

### Precision Connectors

All of the connectors used on Maury adapters are mating compatible with connectors conforming to the applicable MIL-C or MIL-T and industry-standard specifications. However, most Maury connectors are manufactured to even more exacting requirements.

Maury also offers a limited selection of precision connectors with integral or removable panel mount flanges, a series of micro-strip connectors designed for mounting on miniature micro-strip packages, and tool kits for use in performing precision assembly or disassembly of Maury precision connectors.



# Calibration-Grade (Metrology) Adapters

## General Information



## Connecting With Confidence

Test and measurement data is only as good as the system used to generate it. Good test and measurement systems rely on high-performance precision adapters to ensure proper connection between system components – connections that ensure the accuracy, repeatability, and reliability of component performance. Over the last four-and-a-half decades, Maury has earned a reputation as a leading producer of high quality, precision adapters. Today, Maury offers adapters with a wider variety of connector types and combinations than any other manufacturer.

Maury adapters feature low reflection at the interface and dielectric support, negligible electromagnetic interference, excellent connection repeatability, rugged durability, and are guaranteed to perform reliably within their specifications even after multiple connection/disconnection cycles.

When you consider the relative ease of incorporation into system designs and applications, and the value versus life-cycle cost inherent in every Maury adapter, it is easy to understand their popularity. Engineers, designers and technicians alike know that with Maury adapters they can have the highest confidence in their component connections.

The following paragraphs describe the major categories of Maury's precision adapter line.

## In-Series and Between-Series Adapters

Maury Microwave's comprehensive line of in-series and between-series coaxial adapters are available for all precision laboratory measurement connectors – 1.85mm, 2.4mm, 2.92mm (K), 3.5mm, 7mm, etc.; all common systems connectors – type N, TNC, etc.

Maury also manufactures adapters in other less common connector series not shown in this catalog. If you have a specific need and don't find a solution in these pages, please contact our Sales Department for assistance.

## Phase Matched Adapters

Phase matched adapters are used in two-port VNA calibrations when the devices have same sex input and output connectors that must be tested. Through connection for calibration is made using adapters with female and male connectors. One adapter is then replaced to permit mating to the test device. With phase matched adapters, this can be done without significantly degrading the VNA error correction capability. Phase matched in-series and between-series adapters are noted as such in the following pages.

## Ruggedized Test Port Adapters

Maury Test port adapters are specifically designed to mate with the special ruggedized connectors used on commercial VNA test sets, such as those used on Keysight PNA series VNAs and Anritsu 37000 series VNAs. Maury's test port adapters can convert those connectors to other coaxial or waveguide connector types. Using Maury test port adapters as connector savers can yield significant cost savings in terms of less VNA down time and repair costs.

# NMD1.85mm/2.4mm/2.92mm/3.5mm Test Port Adapters

## 2633, 7809, 7909, 8719, 8009, and 8829 Series

### Features

- > Low VSWR
- > DC to 67 GHz (Usable to 70 GHz)
- > Protects VNA Test Ports
- > Ruggedized for Long Life

### Description

Maury's NMD adapters are precision, low VSWR adapters designed to connect directly to the NMD-style test ports on certain Keysight test sets and VNA models (including those in the PNA series). They are fully compatible with the VNA test ports, and adapt to precision 1.85mm, 2.4mm, 2.92mm, 3.5mm, 7mm, and type N connectors. Maury test port adapters provide the best possible connection between the VNA and other precision cables and devices. Their rugged construction provides for long life and highly stable, highly repeatable connections. They also act as test port savers, by absorbing the wear and tear that would otherwise affect the test port; preventing costly repairs and eliminating downtime.

### Connector Description

The NMD1.85mm female connectors on Maury 7809 series adapters are miniature, instrument grade, air-interface connectors. Rated for operate up to 67 GHz, they are usable up to 70 GHz. They comply with IEEE standard 287 general precision connector, instrument grade GPC1.85. For interface specifications please refer to Maury data sheet 5E-089.

The NMD2.4mm female connectors on Maury 7909 series adapters are miniature, instrument grade, air-interface connectors., rated for operate up to 50 GHz. They comply with IEEE standard 287 general precision connector, instrument grade GPC2.4.) For interface specifications please refer to Maury data sheet 5E-082. The NMD male connectors are mateable to NMD female connectors via external threads, and can also mate to non-NMD connectors via internal threads.

The NMD2.92mm connectors on Maury 8719 series adapters are ruggedized test-port connectors used for stable connection to a network analyzer. The female connector is only mateable to NMD male connectors via external threads on the male nut. The NMD male connectors are mateable to NMD female connectors via external threads, and can also mate to non-NMD connectors (2.92mm, SMA, or 3.5mm) via internal threads.

The NMD3.5mm female connectors on Maury test port adapters are miniature, instrument grade, air-interface connectors., rated for operate up to 18, 20 or 26.5 GHz, according to the range of the adapted connector type. For interface specifications please refer to Maury data sheet 5E-084. The NMD male connectors on 8009F units are mateable to NMD female connectors via external threads, and can also mate to non-NMD connectors via internal threads.

7809A1



7809A2



7809B1



7809B2



7809F1



7809F2



7809K



7809H



7809G



7809C



8719E



8719F



7809D1



7809D2



**NMD1.85mm/2.4mm/2.92mm/3.5mm Test Port Adapters Available Models**

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
7809A1	NMD1.85mm female	1.85mm female	DC - $26.5 \leq 1.10$ $26.5 - 40.0 \leq 1.15$ $40.0 - 67.0 \leq 1.20$	0.993	(2.52)
7809A2	NMD1.85mm female	1.85mm male		0.993	(2.52)
7809K	NMD1.85mm female	NMD1.85mm male		1.133	(2.88)
7809F1	NMD1.85mm female	2.92mm female	DC - $20.0 \leq 1.10$ $20.0 - 40.0 \leq 1.16$	1.072	(2.72)
7809F2	NMD1.85mm female	2.92mm male		1.072	(2.72)
7809B1	NMD1.85mm female	3.5mm female	DC - $10.0 \leq 1.06$ $10.0 - 20.0 \leq 1.10$ $20.0 - 34.0 \leq 1.12$	1.085	(2.76)
7809B2	NMD1.85mm female	3.5mm male		1.085	(2.76)
7809C	NMD1.85mm female	7mm	DC - $4.0 \leq 1.05$ $4.0 - 12.0 \leq 1.07$ $12.0 - 18.0 \leq 1.10$	1.206	(3.06)
7809D1	NMD1.85mm female	Type N female	DC - $4.0 \leq 1.08$ $4.0 - 12.0 \leq 1.12$ $12.0 - 18.0 \leq 1.14$	1.145	(2.91)
7809D2	NMD1.85mm female	Type N male		1.504	(3.82)
7909A1	NMD2.4mm female	2.4mm female	DC - $26.5 \leq 1.10$ $26.5 - 40.0 \leq 1.15$ $40.0 - 50.0 \leq 1.20$	1.240	(3.15)
7909A2	NMD2.4mm female	2.4mm male		1.270	(3.23)
7909K	NMD2.4mm female	NMD2.4mm male		1.317	(3.35)
7909F1	NMD2.4mm female	2.92mm female	DC - $20.0 \leq 1.10$ $20.0 - 40.0 \leq 1.16$	1.291	(3.279)
7909F2	NMD2.4mm female	2.92mm male		1.291	(3.279)
7909J	NMD2.4mm female	NMD2.92mm male		1.247	(3.17)
7909B1	NMD2.4mm female	3.5mm female	DC - $10.0 \leq 1.06$ $10.0 - 20.0 \leq 1.10$ $20.0 - 34.0 \leq 1.12$	1.060	(2.7)
7909B2	NMD2.4mm female	3.5mm male		1.020	(2.6)
7909H	NMD2.4mm female	NMD3.5mm male		1.317	(3.35)
7909C	NMD2.4mm female	7mm	DC - $4.0 \leq 1.05$ $4.0 - 12.0 \leq 1.07$ $12.0 - 18.0 \leq 1.10$	2.040	(5.18)
7909D1	NMD2.4mm female	Type N female	DC - $4.0 \leq 1.08$ $4.0 - 12.0 \leq 1.12$ $12.0 - 18.0 \leq 1.14$	1.280	(3.25)
7909D2	NMD2.4mm female	Type N male		1.640	(4.17)
8719A	NMD2.92mm female	2.92mm female	DC - $4.0 \leq 1.05$ $4.0 - 20.0 \leq 1.08$ $20.0 - 40.0 \leq 1.12$	1.230	(3.12)
8719B	NMD2.92mm female	2.92mm male		1.230	(3.12)
8009A	NMD3.5mm female	3.5mm female	DC - $18.0 \leq 1.08$ $18.0 - 26.5 \leq 1.12$	1.450	(3.68)
8009B	NMD3.5mm female	3.5mm male		1.490	(3.79)
8009F	NMD3.5mm female	NMD3.5mm male		1.490	(3.79)
2633C	NMD3.5mm female	7mm	DC - $18.0 \leq 1.018 + 0.003f$	1.780	(4.53)
8829A	NMD3.5mm female	Type N female	DC - $6.0 \leq 1.04$ $6.0 - 18.0 \leq 1.08$	2.040	(5.18)
8829B	NMD3.5mm female	Type N male		2.200	(5.59)

# 1.85mm Adapters

## In-Series and Between-Series

### Description

The precision adapters in these model series are designed to allow devices with 1.85mm connectors to mate with devices and cables bearing 2.4mm, 2.92mm, or 3.5mm connectors. When properly mated, they provide a low VSWR connection with low insertion loss and high repeatability. Made of highly durable materials, these adapters are ideal for use in laboratory and production environments where frequent connect/ disconnect cycles occur.

These adapters are phase matched within each model series, so that they may be easily interchanged for VNA measurement of non-insertable devices.

### 1.85mm Connector Description

The precision 1.85mm connectors on these adapters are miniature, instrument grade, air-interface connectors that are rated for operation from DC to 67 GHz, but may be used up to 70 GHz. They comply with IEEE standard 287 for instrument grade general precision connectors (GPC1.85).

1.85mm



7821A

7821B

7821C

2.4mm



7824A

7824B

7824C

7824D

2.92mm



7826A

7826B

7826C

7826D

3.5mm



7827A

7827B

7827C

7827D



## 1.85mm Adapters Available Models

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
7821A <sup>1</sup>	1.85mm female	1.85mm female	DC - $26.5 \leq 1.06$ 26.5 - 40.0 $\leq 1.10$ 40.0 - 67.0 $\leq 1.15$	0.750	(1.905)
7821B <sup>1</sup>	1.85mm male	1.85mm male		0.750	(1.905)
7821C <sup>1</sup>	1.85mm female	1.85mm male		0.750	(1.905)
7824A <sup>2</sup>	1.85mm female	2.4mm female	DC - $26.5 \leq 1.06$ 26.5 - 40.0 $\leq 1.10$ 40.0 - 50.0 $\leq 1.15$	0.750	(1.905)
7824B <sup>2</sup>	1.85mm female	2.4mm male		0.750	(1.905)
7824C <sup>2</sup>	1.85mm male	2.4mm female		0.750	(1.905)
7824D <sup>2</sup>	1.85mm male	2.4mm male		0.750	(1.905)
7826A <sup>3</sup>	1.85mm female	2.92mm female	DC - $4.0 \leq 1.05$ 4.0 - 20.0 $\leq 1.08$ 20.0 - 40.0 $\leq 1.12$	0.657	(1.669)
7826B <sup>3</sup>	1.85mm female	2.92mm male		0.657	(1.669)
7826C <sup>3</sup>	1.85mm male	2.92mm female		0.657	(1.669)
7826D <sup>3</sup>	1.85mm male	2.92mm male		0.657	(1.669)
7827A <sup>4</sup>	1.85mm female	3.5mm female	DC - $4.0 \leq 1.05$ 4.0 - 26.5 $\leq 1.08$ 26.5 - 34.0 $\leq 1.12$	0.657	(1.669)
7827B <sup>4</sup>	1.85mm female	3.5mm male		0.657	(1.669)
7827C <sup>4</sup>	1.85mm male	3.5mm female		0.657	(1.669)
7827D <sup>4</sup>	1.85mm male	3.5mm male		0.657	(1.669)

<sup>1-4</sup> References to families that are phase matched.

## 2.4mm Adapters

### In-Series and Between-Series

#### Description

**In-Series Description** - Maury precision 2.4mm in-series adapters are low VSWR and low loss devices that operate from DC to 50 GHz. The models 7921A, B and C offer combinations for in-series adapting and are phase matched, making them ideal for use in precision measurement applications. These adapters are minimum length and feature a square-flanged body for ease of connecting that also prevents them from rolling off flat surfaces. They are useful as “test port savers” when used with automated network analyzers such as the Keysight 8510, etc. The models 7921D and E are bulk-head and panel mount feed-thru adapters respectively, and are designed for instrumentation applications.

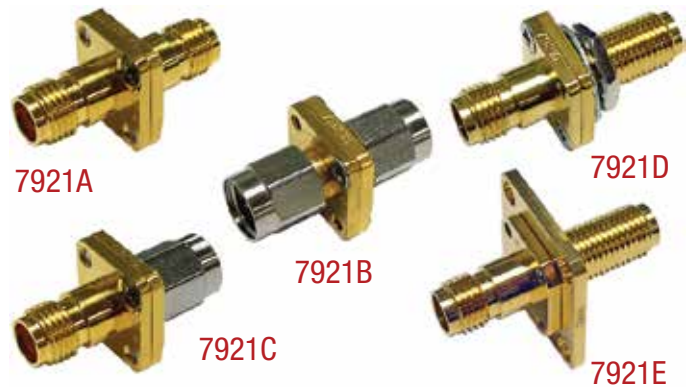
**Between-Series Description** -The precision adapters in these model series are designed to allow devices with 2.4mm connectors to mate with devices and cables bearing 2.92mm, 3.5mm, 7mm or Type N connectors. When properly mated, they provide a low VSWR connection with low insertion loss and high repeatability. Made of highly durable materials, these adapters are ideal for use in laboratory and production environments where frequent connect/ disconnect cycles occur.

Except for the 7923 series, these adapters are phase matched within each model series, so that they may be easily inter-changed for VNA measurement of non-insertable devices.

#### 2.4mm Connector Description

The precision 2.4mm connectors on these adapters are miniature, instrument grade, air-interface connectors that are rated for operation from DC to 50 GHz. They comply with IEEE standard 287 for instrument grade general precision connectors (GPC2.4).

2.4mm



2.92mm



3.5mm



7mm



Type N



## 2.4mm Adapters Available Models

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
7921A <sup>1</sup>	2.4mm female	2.4mm female	DC - 26.5 $\leq$ 1.06 26.5 - 40.0 $\leq$ 1.10 40.0 - 67.0 $\leq$ 1.15	0.750	(1.905)
7921B <sup>1</sup>	2.4mm male	2.4mm male		0.750	(1.905)
7921C <sup>1</sup>	2.4mm female	2.4mm male		0.750	(1.905)
7921D <sup>2</sup>	2.4mm female	2.4mm female		0.860	(2.18)
7921E <sup>2</sup>	2.4mm female	2.4mm female		0.860	(2.18)
7824A <sup>3</sup>	1.85mm female	2.4mm female	DC - 26.5 $\leq$ 1.06 26.5 - 40.0 $\leq$ 1.10 40.0 - 50.0 $\leq$ 1.15	0.750	(1.905)
7824B <sup>3</sup>	1.85mm female	2.4mm male		0.750	(1.905)
7824C <sup>3</sup>	1.85mm male	2.4mm female		0.750	(1.905)
7824D <sup>3</sup>	1.85mm male	2.4mm male		0.750	(1.905)
7926A <sup>4</sup>	2.4mm female	2.92mm female	DC - 4.0 $\leq$ 1.05 4.0 - 20.0 $\leq$ 1.08 20.0 - 40.0 $\leq$ 1.12	0.650	(1.65)
7926B <sup>4</sup>	2.4mm female	2.92mm male		0.650	(1.65)
7926C <sup>4</sup>	2.4mm male	2.92mm female		0.650	(1.65)
7926D <sup>4</sup>	2.4mm male	2.92mm male		0.650	(1.65)
7927A <sup>5</sup>	2.4mm female	3.5mm female	DC - 18.0 $\leq$ 1.06 18.0 - 26.5 $\leq$ 1.08 26.5 - 34.0 $\leq$ 1.12	0.657	(1.669)
7927B <sup>5</sup>	2.4mm female	3.5mm male		0.657	(1.669)
7927C <sup>5</sup>	2.4mm male	3.5mm female		0.657	(1.669)
7927D <sup>5</sup>	2.4mm male	3.5mm male		0.657	(1.669)
7922A <sup>6</sup>	2.4mm female	7mm	DC - 4.0 $\leq$ 1.03 4.0 - 12.0 $\leq$ 1.07 12.0 - 18.0 $\leq$ 1.08	1.280	(3.25)
7922B <sup>6</sup>	2.4mm male	7mm		1.280	(3.25)
7923A <sup>7</sup>	2.4mm female	Type N female	DC - 4.0 $\leq$ 1.07 4.0 - 18.0 $\leq$ 1.12	1.220	(3.10)
7923B <sup>8</sup>	2.4mm female	Type N male		1.580	(4.02)
7923C <sup>7</sup>	2.4mm male	Type N female		1.200	(3.05)
7923D <sup>8</sup>	2.4mm male	Type N male		1.560	(3.96)

<sup>1-8</sup> References to families that are phase matched.

## 2.92mm Adapters

### In-Series and Between-Series

#### Description

**In-Series Description** - Maury precision 2.92mm (K) in-series adapters are low VSWR and low loss devices that operate from DC to 40 GHz. The models 8714A2, B2 and C2 offer all combinations for adapting and are ideal for using with precision measurement applications. These adapters are minimum length, phase matched and feature a square-flange body for ease of connecting and prevents rolling off tables. They are useful as “test port savers” when used with vector network analyzers such as the Keysight 8510, etc. The 8714D1 and 8714E1 are bulkhead and panel mount feedthru adapters respectively, designed for instrumentation applications.

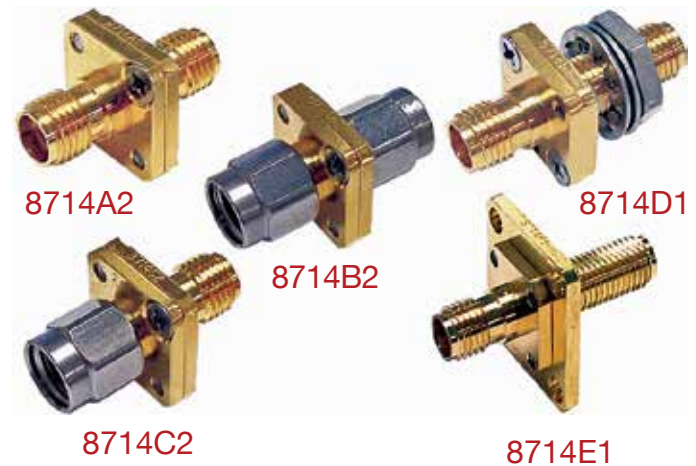
**Between-Series Description** - The precision adapters in these model series are designed to allow devices with 2.92mm connectors to mate with devices and cables bearing 7mm or Type N connectors. When properly mated, they provide a low VSWR connection with low insertion loss and high repeatability. Made of highly durable materials, these adapters are ideal for use in laboratory and production environments where frequent connect/disconnect cycles occur.

The 8725A and 8725B adapters are phase matched to each other so that they may be easily interchanged for network analyzer measurement of non-insertable devices.

#### 2.92mm Connector Description

The K connectors on 8719A/B adapters are precision miniature 2.92mm air-interface connectors that are rated for operation from DC to 40 GHz. They have a mechanically compatible interface that mates with SMA and 3.5mm connectors. The K connector was originally introduced by Maury in 1974 as the MPC3 connector and re-introduced by Wiltron in 1984 as the K connector. They comply with IEEE standard 287 general precision connector, instrument grade (GPC2.92).

2.92mm



Type N



7mm





## 2.92mm Adapters Available Models

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
8714A2 <sup>1</sup>	2.92mm female	2.92mm female	DC - 4.0 $\leq$ 1.05 4.0 - 20.0 $\leq$ 1.08 20.0 - 40.0 $\leq$ 1.12	0.650	(1.65)
8714B2 <sup>1</sup>	2.92mm male	2.92mm male		0.650	(1.65)
8714C2 <sup>1</sup>	2.92mm female	2.92mm male		0.650	(1.65)
8714D1 <sup>2</sup>	2.92mm female	2.92mm female		0.850	(2.15)
8714E1 <sup>2</sup>	2.92mm female	2.92mm female		0.850	(2.15)
7826A <sup>3</sup>	1.85mm female	2.92mm female	DC - 4.0 $\leq$ 1.05 4.0 - 20.0 $\leq$ 1.08 20.0 - 40.0 $\leq$ 1.12	0.657	(1.669)
7826B <sup>3</sup>	1.85mm female	2.92mm male		0.657	(1.669)
7826C <sup>3</sup>	1.85mm male	2.92mm female		0.657	(1.669)
7826D <sup>3</sup>	1.85mm male	2.92mm male		0.657	(1.669)
7926A <sup>4</sup>	2.4mm female	2.92mm female	DC - 4.0 $\leq$ 1.05 4.0 - 20.0 $\leq$ 1.08 20.0 - 40.0 $\leq$ 1.12	0.650	(1.65)
7926B <sup>4</sup>	2.4mm female	2.92mm male		0.650	(1.65)
7926C <sup>4</sup>	2.4mm male	2.92mm female		0.650	(1.65)
7926D <sup>4</sup>	2.4mm male	2.92mm male		0.650	(1.65)
8725A <sup>5</sup>	2.92mm female	7mm	DC - 4.0 $\leq$ 1.05 4.0 - 12.0 $\leq$ 1.07 12.0 - 18.0 $\leq$ 1.10	1.670	(4.24)
8725B <sup>5</sup>	2.92mm male	7mm		1.670	(4.24)
8723A <sup>6</sup>	2.92mm female	Type N female	DC - 4.0 $\leq$ 1.07 4.0 - 12.0 $\leq$ 1.10 12.0 - 18.0 $\leq$ 1.15	1.614	(4.099)
8723B <sup>7</sup>	2.92mm female	Type N male		1.914	(5.014)
8723C <sup>6</sup>	2.92mm male	Type N female		1.614	(4.099)
8723D <sup>7</sup>	2.92mm male	Type N male		1.914	(5.014)

<sup>1-7</sup> References to families that are phase matched.

## 3.5mm Adapters

### In-Series and Between-Series

#### Description

**In-Series Description** - These precision 3.5mm adapters are low VSWR and low loss models that operate from DC to 34 GHz. The 8021A2/B2/C2 series are designed for in-series adapting and are phase matched, making them ideal for use in precision measurement applications. They are minimum length and feature a square-flanged body to prevent them from rolling off flat surfaces. They serve as “test port savers” when used with network analyzers such as the Keysight PNA-X, etc.

Several designs are available for instrumentation applications: 8021D1 is a bulkhead feedthru model, 8021E1 is a panel mount model.

**Between-Series Description** - These precision adapters are used to connect 3.5mm devices to cables or devices with the connector types listed below. Low VSWR, low insertion loss and high repeatability, make these rugged, highly durable adapters ideal for use wherever frequent connect/disconnect cycles occur. Most are phase matched within their model series.

#### 3.5mm Connector Description

Rated from DC to 34 GHz, the precision 3.5mm miniature, air-interface connectors on these adapters comply with IEEE standard 287 for instrument grade general precision connectors (GPC3.5). See Maury data sheet 5E-062 for interface dimensions.

3.5mm



8021A2



8021B2



8021C2



8021D1



8021E1

TNC



8025A1



8025C1

BNC



8023A



8028B

Type N



8023C



8023B1

## 3.5mm Adapters Available Models

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
8021A2 <sup>1</sup>	3.5mm female	3.5mm female	DC - 18.0 $\leq$ 1.05 18.0 - 26.5 $\leq$ 1.08 26.5 - 34.0 $\leq$ 1.12	0.650	(1.65)
8021B2 <sup>1</sup>	3.5mm male	3.5mm male		0.650	(1.65)
8021C2 <sup>1</sup>	3.5mm female	3.5mm male		0.650	(1.65)
8021D1 <sup>2</sup>	3.5mm female	3.5mm female	DC - 18.0 $\leq$ 1.07 18.0 - 26.5 $\leq$ 1.10 26.5 - 34.0 $\leq$ 1.14	0.850	(2.15)
8021E1 <sup>2</sup>	3.5mm female	3.5mm female		0.850	(2.15)
7827A <sup>3</sup>	1.85mm female	3.5mm female	DC - 4.0 $\leq$ 1.05 4.0 - 26.5 $\leq$ 1.08 26.5 - 34.0 $\leq$ 1.12	0.657	(1.669)
7827B <sup>3</sup>	1.85mm female	3.5mm male		0.657	(1.669)
7827C <sup>3</sup>	1.85mm male	3.5mm female		0.657	(1.669)
7827D <sup>3</sup>	1.85mm male	3.5mm male		0.657	(1.669)
7927A <sup>4</sup>	2.4mm female	3.5mm female	DC - 18.0 $\leq$ 1.06 18.0 - 26.5 $\leq$ 1.08 26.5 - 34.0 $\leq$ 1.12	0.657	(1.669)
7927B <sup>4</sup>	2.4mm female	3.5mm male		0.657	(1.669)
7927C <sup>4</sup>	2.4mm male	3.5mm female		0.657	(1.669)
7927D <sup>4</sup>	2.4mm male	3.5mm male		0.657	(1.669)
8022S <sup>5</sup>	3.5mm female	7mm	DC - 4.0 $\leq$ 1.04 4.0 - 18.0 $\leq$ 1.08	1.220	(3.10)
8022T <sup>5</sup>	3.5mm male	7mm		1.220	(3.10)
8023A <sup>6</sup>	3.5mm female	Type N female	DC - 4.0 $\leq$ 1.065 4.0 - 18.0 $\leq$ 1.13	1.620	(4.11)
8023B1 <sup>6</sup>	3.5mm female	Type N male		1.620	(4.11)
8023C <sup>6</sup>	3.5mm male	Type N female		1.620	(4.11)
8023D1 <sup>6</sup>	3.5mm male	Type N male		1.620	(4.11)
8025A1 <sup>7</sup>	3.5mm female	TNC female	DC - 4.0 $\leq$ 1.04 4.0 - 8.0 $\leq$ 1.14 8.0 - 18.0 $\leq$ 1.20	1.610	(4.10)
8025B1 <sup>7</sup>	3.5mm female	TNC male		1.610	(4.10)
8025C1 <sup>7</sup>	3.5mm male	TNC female		1.610	(4.10)
8025D1 <sup>7</sup>	3.5mm male	TNC male		1.610	(4.10)
8028A <sup>8</sup>	3.5mm female	BNC female	DC - 4.0 $\leq$ 1.10 4.0 - 10.0 $\leq$ 1.20	2.000	(5.08)
8028B <sup>9</sup>	3.5mm female	BNC male		1.910	(4.85)
8028C <sup>8</sup>	3.5mm male	BNC female		2.000	(5.08)
8028D <sup>9</sup>	3.5mm male	BNC male		1.910	(4.85)

<sup>1-9</sup> References to families that are phase matched.

# 3.5mm (QT3.5mm™) Quick Test Adapters

8006 Series (U.S. Patent No. 6,210,221)

## Features

- > Quick, Easy Push-On/Pull-Off Design
- > Designed for Durability and Long Life (3,000 Connect/Disconnect Cycles)
- > Excellent Repeatability/Low VSWR
- > Guide Sleeve Design for Automated applications

## Description

The QT3.5mm™ male connector incorporates a quick connect design that provides for a push-on/pull-off capability that mates with any commercially available 3.5mm connectors. The optional quick 1-1/2 turn twist nut combines the best of both worlds allowing quick connect or disconnect with the increased accuracy of a thread-on connector. In addition to the no nut and quick turn nut designs, a guide sleeve configuration is available to provide a self-aligning capability required in automated test stations.

The push-on connector offers excellent repeatability and long life making these adapters ideal for use in a production environment. The nut can also be torqued to 8 in. lbs making them suitable for test port applications where a calibration is required. The connectors come in four configurations: no nut, a 3/8" diameter nut, a 9/16" diameter nut, and a guide sleeve configuration.



8006E1  
No Nut

8006E11  
3/8" Nut

8006E21  
9/16" Nut

8006Q1  
Guide Sleeve

## Repeatability\*

MODE	DC — 18 GHz	18 — 26.5 GHz
Push-On	> 40 dB	> 40 dB
Torqued to 8 in. lbs	> 50 dB	> 50 dB
Hand Torqued	> 50 dB	> 50 dB

\*Repeatability is based on a minimum of 3,000 connect/disconnect cycles.

## Available Models

MODEL	ADAPTS		FREQUENCY RANGE (GHz)	MAXIMUM VSWR (GHz)
	SIDE A	SIDE B		
8006E1	QT3.5mm™ (m) with no nut	3.5mm (f)	DC — 26.5 <sup>1</sup>	DC — 16.0 ≤ 1.05 16.0 — 26.5 ≤ 1.08
8006E11	QT3.5mm™ (m) with 3/8" diameter nut			
8006E21	QT3.5mm™ (m) with 9/16" diameter nut			
8006Q1	QT3.5mm™ (m) guide sleeve			

<sup>1</sup> Slightly reduced VSWR specifications to 34 GHz.



# 7mm Adapters

## Between-Series

### Description

Maury offers an extensive line of precision 7mm adapters in all common laboratory and systems connector types. 7mm adapters are also available for special purpose connections such as EIA rigid line connectors. Female and male adapters in the same connector series are phase matched for VNA applications. See pages 60-65 for 2.4mm, 2.92mm, and 3.5mm adapters.

### 7mm Connector Description

Maury precision 7mm connectors are miniature, instrument grade, air-interface connectors rated for operation from DC to 18 GHz. They comply with IEEE standard 287 for instrument grade general precision connectors (GPC7). They are normally made with gold-plated beryllium copper bodies and have a six-slot heat treated gold-plated beryllium copper center conductor contact for improved repeatability and durability. See Maury data sheet 5E-060 for interface dimensions.



### Available Models

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
7922A <sup>1</sup>	2.4mm female	7mm	DC - 4.0 $\leq$ 1.03 4.0 - 12.0 $\leq$ 1.07 12.0 - 18.0 $\leq$ 1.08	1.280	(3.25)
7922B <sup>1</sup>	2.4mm male	7mm		1.280	(3.25)
8725A <sup>2</sup>	2.92mm female	7mm	DC - 4.0 $\leq$ 1.05 4.0 - 12.0 $\leq$ 1.07 12.0 - 18.0 $\leq$ 1.10	1.670	(4.24)
8725B <sup>2</sup>	2.92mm male	7mm		1.670	(4.24)
8022S <sup>3</sup>	3.5mm female	7mm	DC - 4.0 $\leq$ 1.04 4.0 - 18.0 $\leq$ 1.08	1.220	(3.10)
8022T <sup>3</sup>	3.5mm male	7mm		1.220	(3.10)
2606C <sup>4</sup>	7mm	Type N female	DC - 4.0 $\leq$ 1.03 4.0 - 9.0 $\leq$ 1.04 9.0 - 18.0 $\leq$ 1.07	1.510	(3.84)
2606D <sup>4</sup>	7mm	Type N male		1.510	(3.84)
2622A1	7mm	TNC female	DC - 4.0 $\leq$ 1.05 4.0 - 18.0 $\leq$ 1.15	1.680	(4.26)
2622B	7mm	TNC male		1.550	(3.94)
2625A <sup>5</sup>	7mm	SMA female	DC - 4.0 $\leq$ 1.05 4.0 - 10.0 $\leq$ 1.08 10.0 - 18.0 $\leq$ 1.16	1.670	(4.24)
2625B <sup>5</sup>	7mm	SMA male		1.670	(4.24)
8582D3 <sup>6</sup>	7mm	BNC 75 $\Omega$ female	DC - 12.0 $\leq$ 1.60	2.060	(5.23)
8582D4 <sup>6</sup>	7mm	BNC 75 $\Omega$ male		2.060	(5.23)

<sup>1-6</sup> References to families that are phase matched.

 Key Literature: Maury data sheets 2B-030, 2Z-001, 2Z-025P and 2Z-069.

# Type N Adapters

## In-Series and Between-Series

### Description

**In-Series Description** - The 8828 precision type N in-series adapters feature extremely low VSWR with low insertion loss, and are phase matched (having the same electrical insertion length) so they may be readily interchanged in network analyzer measurement applications. They are constructed with aluminum bodies. Connector bodies are made from stainless steel, and the center conductors are made from gold plated, heat treated beryllium.

**Between-Series Description** -Maury precision type N between-series adapters are designed for general purpose laboratory use and high precision measurement applications. They exhibit low VSWR and low insertion loss across the frequency range of the adapted connector, and are built to the same rigorous quality standards as the type N in-series adapters.

### Type N Connector Description

The Maury type N connectors on these adapters are precision, miniature, instrument grade, air-interface connectors, rated for operation from DC to 18 GHz. They comply with IEEE standard 287 for instrument grade general precision connectors (GPC Type N), and meet most applicable interface requirements of MIL-C-39012/1 (see footnote 2, in Figure 1 below) and they meet all applicable interface requirements of MIL-C-39012/2. The connectors will mate properly with MIL-C-71, MIL-C-39012, MIL-T-81490 and most other semi-precision type N connectors. The male connectors are provided with a 0.75-inch hex coupling nut so they can be properly torqued to 12 in. lbs. The connectors have stainless steel bodies with heat treated gold-plated beryllium copper contacts.

SMA



8816A

TNC



8817B



8816C

Type N



8828A



8828C



8828B

BNC



8821A1



8821B1

## Type N Adapters Available Models

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
8828A <sup>1</sup>	Type N female	Type N female	DC - 4.0 $\leq$ 1.03 4.0 - 10.0 $\leq$ 1.05 10.0 - 18.0 $\leq$ 1.09	2.500	(6.35)
8828B <sup>1</sup>	Type N male	Type N male		2.500	(6.35)
8828C <sup>1</sup>	Type N female	Type N male		2.500	(6.35)
7923A	2.4mm female	Type N female	DC - 4.0 $\leq$ 1.07 4.0 - 18.0 $\leq$ 1.12	1.220	(3.10)
7923B	2.4mm female	Type N male		1.580	(4.02)
7923C	2.4mm male	Type N female		1.200	(3.05)
7923D	2.4mm male	Type N male		1.560	(3.96)
8723A <sup>2</sup>	2.92mm female	Type N female	DC - 4.0 $\leq$ 1.07 4.0 - 12.0 $\leq$ 1.10 12.0 - 18.0 $\leq$ 1.15	1.614	(4.099)
8723B <sup>3</sup>	2.92mm female	Type N male		1.914	(5.014)
8723C <sup>2</sup>	2.92mm male	Type N female		1.614	(4.099)
8723D <sup>3</sup>	2.92mm male	Type N male		1.914	(5.014)
8023A <sup>4</sup>	3.5mm female	Type N female	DC - 4.0 $\leq$ 1.065 4.0 - 18.0 $\leq$ 1.13	1.620	(4.11)
8023B <sup>14</sup>	3.5mm female	Type N male		1.620	(4.11)
8023C <sup>4</sup>	3.5mm male	Type N female		1.620	(4.11)
8023D <sup>14</sup>	3.5mm male	Type N male		1.620	(4.11)
2606C <sup>5</sup>	7mm	Type N female	DC - 4.0 $\leq$ 1.03 4.0 - 9.0 $\leq$ 1.04 9.0 - 18.0 $\leq$ 1.07	1.510	(3.84)
2606D <sup>5</sup>	7mm	Type N male		1.510	(3.84)
8816A <sup>6</sup>	Type N female	SMA female	DC - 4.0 $\leq$ 1.05 4.0 - 10.0 $\leq$ 1.10 10.0 - 18.0 $\leq$ 1.16	1.590	(4.04)
8816B <sup>6</sup>	Type N female	SMA male		1.590	(4.04)
8816C <sup>7</sup>	Type N male	SMA female		1.950	(4.95)
8816D <sup>7</sup>	Type N male	SMA male		1.950	(4.95)
8817A	Type N female	TNC female	DC - 4.0 $\leq$ 1.065 4.0 - 8.0 $\leq$ 1.10 8.0 - 12.0 $\leq$ 1.12 12.0 - 18.0 $\leq$ 1.14	1.170	(2.97)
8817B	Type N female	TNC male		1.500	(3.81)
8817C	Type N male	TNC female		1.530	(3.89)
8817D	Type N male	TNC male		0.186	(4.72)
8821A1	Type N female	BNC female	DC - 4.0 $\leq$ 1.08 4.0 - 10.0 $\leq$ 1.20	2.100	(5.33)
8821B1	Type N female	BNC male		2.010	(5.11)
8821C1	Type N male	BNC female		2.460	(6.25)
8821D1	Type N male	BNC male		2.370	(6.02)

<sup>1-7</sup> References to families that are phase matched.

# TNC Adapters

## In-Series and Between-Series



### Description

Because TNC interfaces vary from maker to maker, compatibility must be verified before connectors of different specification types are mated. Mating different specification types degrades electrical performance and risks damage to connector interfaces. Maury application note 5A-031 discusses the most common TNC connectors and compatibility issues that arise if specification types are mixed. See also Maury data sheet 5E-057A to check the compatibility of your TNC connectors.

### TNC Connector Descriptions

**Maury offers two precision TNC connector designs:**

**MPC/TNC** – Precision TNC connectors that mate with most commercially available TNC connectors and specifically with MIL-C-39012/26/27 test connectors or MIL-T-81490 connectors. This design is used in the 232A11/B11/C11 models and – with some modifications – in the 232A2/B2/C2 models.

Models 232A11/B11/C11 are designed per the Maury 5E-053 interface standard and are intended for general purpose precision test applications. These adapters are recommended for use with dielectrically loaded TNC interfaces. Because they are ideal for use in VNA application these adapters are provided in Maury 8650CK series VNA calibration kits (see pages 34-36).

Models 232A2/B2/C2 are designed per the Maury 5E-053A interface standard; an improved MPC/TNC version that is mating compatible with all common military and IEC specification TNC connectors. This includes MIL-STD-348A standard and test connectors (which replace MIL-C-39012 connectors), MIL-T-81490, and IEC 169-17 G0 and G2 connectors.

All 232 series adapters exhibit low VSWR when properly mated and are usable to 18 GHz.

### Available Models

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
232A11	TNC female	TNC female	DC - $4.0 \leq 1.06$ $4.0 - 7.0 \leq 1.10$ $7.0 - 18.0 \leq 1.14$	1.350	(3.43)
232B11	TNC male	TNC male		1.350	(3.43)
232C11	TNC female	TNC male		1.350	(3.43)
232A2	TNC female	TNC female	DC - $4.0 \leq 1.06$ $4.0 - 7.0 \leq 1.10$ $7.0 - 18.0 \leq 1.14$	1.350	(3.43)
232B2	TNC male	TNC male		1.350	(3.43)
232C2	TNC female	TNC male		1.350	(3.43)
8025A1	3.5mm female	TNC female	DC - $4.0 \leq 1.04$ $4.0 - 8.0 \leq 1.14$ $8.0 - 18.0 \leq 1.20$	1.610	(4.10)
8025B1	3.5mm female	TNC male		1.610	(4.10)
8025C1	3.5mm male	TNC female		1.610	(4.10)
8025D1	3.5mm male	TNC male		1.610	(4.10)
2622A1	7mm	TNC female	DC - $4.0 \leq 1.05$ $4.0 - 18.0 \leq 1.15$	1.680	(4.26)
2622B	7mm	TNC male		1.550	(3.94)
8817A	Type N female	TNC female	DC - $4.0 \leq 1.065$ $4.0 - 8.0 \leq 1.10$ $8.0 - 12.0 \leq 1.12$ $12.0 - 18.0 \leq 1.14$	1.170	(2.97)
8817B	Type N female	TNC male		1.500	(3.81)
8817C	Type N male	TNC female		1.530	(3.89)
8817D	Type N male	TNC male		0.186	(4.72)



# BNC & SMA Adapters

## BNC Connector Description

Maury BNC series connectors are 75-ohm or 50-ohm impedance connectors with two-stud bayonet coupling. These connectors conform to MIL-C-39012. The connectors are normally made with stainless steel bodies with heat treated gold plated beryllium copper contacts

## SMA Connector Description

The Maury SMA connectors are miniature, instrument grade, dielectric loaded interface connectors that are rated for operation from DC to 18 GHz. They comply with MIL-C-39012. NOTE: SMA connectors, 3.5mm connectors, and 2.92mm connectors are mateable

## Available Models

MODEL	CONNECTORS		FREQUENCY RANGE (GHz) AND MAXIMUM VSWR	INSERTION LENGTH	
	SIDE A	SIDE B		INCHES	(CM)
8028A <sup>1</sup>	3.5mm female	BNC 50Ω female	DC - 4.0 ≤ 1.10 4.0 - 10.0 ≤ 1.20	2.000	(5.08)
8028B <sup>2</sup>	3.5mm female	BNC 50Ω male		1.910	(4.85)
8028C <sup>1</sup>	3.5mm male	BNC 50Ω female		2.000	(5.08)
8028D <sup>2</sup>	3.5mm male	BNC 50Ω male		1.910	(4.85)
2625A <sup>3</sup>	7mm	SMA female	DC - 4.0 ≤ 1.05 4.0 - 10.0 ≤ 1.08 10.0 - 18.0 ≤ 1.16	1.670	(4.24)
2625B <sup>3</sup>	7mm	SMA male		1.670	(4.24)
8582D3 <sup>4</sup>	7mm	BNC 75Ω female	DC - 12.0 ≤ 1.60	2.060	(5.23)
8582D4 <sup>4</sup>	7mm	BNC 75Ω male		2.060	(5.23)
8816A <sup>5</sup>	Type N female	SMA female	DC - 4.0 ≤ 1.05 4.0 - 10.0 ≤ 1.10 10.0 - 18.0 ≤ 1.16	1.590	(4.04)
8816B <sup>5</sup>	Type N female	SMA male		1.590	(4.04)
8816C <sup>6</sup>	Type N male	SMA female		1.950	(4.95)
8816D <sup>6</sup>	Type N male	SMA male		1.950	(4.95)
8821A1	Type N female	BNC 50Ω female	DC - 4.0 ≤ 1.08 4.0 - 10.0 ≤ 1.20	2.100	(5.33)
8821B1	Type N female	BNC 50Ω male		2.010	(5.11)
8821C1	Type N male	BNC 50Ω female		2.460	(6.25)
8821D1	Type N male	BNC 50Ω male		2.370	(6.02)

<sup>1-6</sup> References to families that are phase matched.

# Waveguide-To-Coaxial Adapters — Right Angle Launch

WR90–WR22 to 2.4mm, 2.92mm, 3.5mm, 7mm, and Type N

## General Information

Maury produces a comprehensive lines of waveguide to coaxial adapters. Our adapters set the standards for high precision laboratory test and measurement applications, and for systems applications where accuracy and durability are important. These adapters feature precision index holes and lapped flanges to facilitate proper mating; ensuring that your system will deliver the critical performance demanded by the most exacting measurement tasks.

Maury waveguide to coaxial adapters include right angle and end launch configurations. They are available in all common waveguide sizes, covering frequencies from 8.2 to 50 GHz. They adapt to 2.4mm, 2.92mm, 3.5mm, 7mm, and type N coaxial connector types.

## Description

Maury right angle launch adapters feature low VSWR and low insertion loss. Except where noted, flanges are in accordance with the listing on page 78. Most of the adapters shown incorporate precision index holes in the flange for precise mating alignment and connection repeatability. Please consult the factory for detailed flange interface information.

## Specifications

Frequency Range . . . . . 8.2 – 50.0 GHz  
(in waveguide bands)

Flanges . . . . . Cover Type, see page 78



## VSWR Options

Improved VSWR is provided on adapters with a numeric suffix to the model number (e.g., X200A2).

Model Suffix	Maximum VSWR
2	1.05
1	1.10
6	1.15
3	1.20

Many adapters can be provided with improved VSWR over their full or partial waveguide bands. Our Sales Department will gladly assist you with this and other application specific requirements. Information on specific models such as loss, power handling and dimensions will be provided on request.

# Waveguide-To-Coaxial Adapters — Right Angle Launch

## Available Models

### Right Angle Launch EIA WR to 2.4mm, 2.92mm and 3.5mm Connectors

FREQUENCY RANGE (GHz)	EIA WR NUMBER	MODEL (BY COAXIAL CONNECTOR TYPE)					
		2.4mm female	2.4mm male	2.92mm female	2.92mm male	3.5mm female	3.5mm male
8.20 – 12.40	90	—	—	—	—	X200A2	X200B2
10.00 – 15.00	75	—	—	—	—	M200A2	M200B2
12.40 – 18.00	62	—	—	—	—	P200A2	P200B2
15.00 – 22.00	51	—	—	—	—	N200A2	N200B2
18.00 – 26.50	42	K236A1	K236B1	—	—	K200A2	K200B2
22.00 – 33.00	34	Q236A1	Q236B1	—	—	Q200A3	Q200B3
26.50 – 40.00	28	U236A6	U236B6	U210C6	U211C6	—	—
33.00 – 50.00	22	J236A3	J236B3	—	—	—	—

### Right Angle Launch EIA WR to 7mm and Type N Connectors

FREQUENCY RANGE (GHz)	EIA WR NUMBER	MODEL (BY COAXIAL CONNECTOR TYPE)		
		7mm	Type N female	Type N male
8.20 – 12.40	90	X209D2	X213D2	X214D2
10.00 – 15.00	75	M209D2	M213D2	M214D2
12.40 – 18.00	62	P209D2	P213D2	P214D2

## Waveguide-To-Coaxial Adapters — End Launch

WR430–WR22 to 2.4mm, 2.92mm, 3.5mm, 7mm, and Type N

### General Information

Maury produces a comprehensive lines of waveguide to coaxial adapters. Our adapters set the standards for high precision laboratory test and measurement applications, and for systems applications where accuracy and durability are important. These adapters feature precision index holes and lapped flanges to facilitate proper mating; ensuring that your system will deliver the critical performance demanded by the most exacting measurement tasks.

Maury waveguide to coaxial adapters include right angle and end launch configurations. They are available in all common rectangular waveguide sizes, covering frequencies from 8.2 to 50 GHz. They adapt to 2.4mm, 2.92mm, 3.5mm, 7mm, type N and SMA coaxial connector types.

### Description

Maury end launch adapters feature low VSWR and low insertion loss. Except where noted, flanges are in accordance with the listing on page 78. Most of the adapters shown incorporate precision index holes in the flange for precise mating alignment and connection repeatability. Please contact us for detailed flange interface information.

### Specifications

Frequency Range . . . . . 2.8 – 50.0 GHz  
(in waveguide bands)

Flanges . . . . . Cover Type, see page 78



**K233B8**  
WR42 -to-2.92mm  
Male



**U237A1**  
WR28 -to-2.4mm  
Female

### VSWR Options

Improved VSWR is provided on adapters with a numeric suffix to the model number (e.g., X230A1).

Model Suffix	Maximum VSWR
2	1.05
8	1.07
1	1.10
6	1.15
3	1.20

Many adapters can be provided with improved VSWR over their full or partial waveguide bands. Our Sales Department will gladly assist you with this and other application specific requirements. Information on specific models such as loss, power handling and dimensions will be provided on request.

## Waveguide-To-Coaxial Adapters — End Launch

### Available Models

#### End Launch EIA WR to 2.4mm, 2.92mm, and 3.5mm Connectors

FREQUENCY RANGE (GHz)	EIA WR NUMBER	MODEL (BY COAXIAL CONNECTOR TYPE)					
		2.4mm female	2.4mm male	2.92mm female	2.92mm male	3.5mm female	3.5mm male
8.20 – 12.40	90	—	—	—	—	X230A1	X230B1
10.00 – 15.00	75	—	—	—	—	M230A1	M230B1
12.40 – 18.00	62	—	—	—	—	P230A2	P230B2
15.00 – 22.00	51	—	—	—	—	N230A3	N230B3
18.00 – 26.50	42	K237A2	K237B2	K233A8	K233B8	K230A6	K230B6
22.00 – 33.00	34	Q237A2	Q237B2	—	—	—	—
26.50 – 40.00	28	U237A1	Q237B2	U233A1	U233B1	—	—
33.00 – 50.00	22	J237A6	J237B6	—	—	—	—

#### End Launch EIA WR to 7mm and Type N Connectors

FREQUENCY RANGE (GHz)	EIA WR NUMBER	MODEL (BY COAXIAL CONNECTOR TYPE)		
		7mm	Type N female	Type N male
8.20 – 12.40	90	X229A2	X221A2	X221B2
10.00 – 15.00	75	M229A2	M221A2	M221B2
12.40 – 18.00	62	P229A2	P221A2	P221B2

## Space Qualified Adapters

Maury Microwave offers an extensive line of precision Space Qualified waveguide-to-coaxial adapters for use in satellite communications and other space applications. Our unique designs, special materials, plating and coating processes, enable us to produce adapters that operate with optimum performance and reliability under the extreme conditions encountered in space. Maury Space Qualified adapters are available in right angle and end launch versions and can be provided in many

waveguide size and connector configurations. Weight-saving designs, custom flanges and beadless versions for harsh radiation exposure are also available, with full band or optimized narrow band performance ranges. These adapters can be qualified under Group A/B/C environmental testing, including Thermal Shock, Vibration, Operating Temperature Extremes, and EMI — all tailored to your exact specifications. Please call our Sales Department for more information.





# Waveguide Transmission Lines and Test Port Adapters

## Straight Sections and Transitions

### Description

Maury produces waveguide components in many EIA WR sizes. A comprehensive line of standard rectangular products is available in the sizes shown below. They are generally supplied with cover flanges. Units from S through P bands are normally aluminum construction with irridite finish; K band and above are copper alloy with a plated finish. All units are painted with highly durable paint, or other special order finishes.



### Available Models

MODEL	FREQUENCY RANGE (GHz)	LENGTH	
		INCHES	(CM)
S102C5	2.60 - 3.95	5.0	(12.7)
E102G5	3.30 - 4.90	5.0	(12.7)
G102C5	3.95 - 5.85	5.0	(12.7)
F102C5	4.90 - 7.50	5.0	(12.7)
C103C5	5.85 - 8.20	5.0	(12.7)
H103A5	7.05 - 10.0	5.0	(12.7)
X103A5	8.20 - 12.4	5.0	(12.7)
M103A5	10.0 - 15.0	5.0	(12.7)
P103A5	12.4 - 18.0	5.0	(12.7)
N102F4	15.0 - 22.0	4.0	(10.2)
K103A4	18.0 - 26.5	4.0	(10.2)
Q106D	22.0 - 33.0	4.0	(10.2)
U103A4	26.5 - 40.0	4.0	(10.2)
J106B1	33.0 - 50.0	2.2	(5.6)



**Shop Online for Test Essentials™ Lab Adapters & ColorConnect™ Precision Adapters Online at the Maury Store:**

**(<http://www.maurymw.com/store>)**

## At-A-Glance Performance Comparison

### Test Essentials™ Lab Adapters

Test Essentials™ Lab Adapters have been designed for daily use in microwave/RF labs and production facilities and offer one of the industry's best price/performance ratios. Test Essentials™ Lab Adapters feature excellent electrical performance, rugged construction for durability, repeatable mating and high reliability. Test Essentials™ Lab Adapters are available in SMA, N, 3.5mm, 2.92mm, 2.4mm and 1.85mm in-series and between-series configurations.

### ColorConnect™ Precision Adapters

ColorConnect™ Precision Adapters have been designed for lab and field use where quality, performance, ease-of-identification and ease-of-use are critical. New manufacturing techniques have given ColorConnect™ Precision Adapters improved VSWR specifications bridging the gap between calibration-grade metrology adapters and daily-use lab adapters. Following the proposed IEEE high-frequency connector/adaptor color convention, ColorConnect™ Precision Adapters are the first commercially available products to offer clear indications of compatibility and intermatability. ColorConnect™ makes it a simple matter to avoid and eliminate damaged equipment, degraded equipment reliability, degraded performance and lengthy maintenance times due to improper mating (and attempted mating) of incompatible adapters. ColorConnect™ Precision Adapters are available in N Type, 3.5mm, 2.92mm, 2.4mm and 1.85mm in-series and between-series.

### Calibration-Grade (Metrology) Adapters

Maury Microwave's comprehensive line of calibration-grade (metrology) adapters (see page 55) have been designed as an integral part of its renowned Vector Network Analyzer (VNA) Calibration Kits and are also available separately where calibration-grade precision is demanded. In-series and between series coaxial adapters are available for all precision laboratory measurement connectors – 1.85mm, 2.4mm, 2.92mm (K), 3.5mm, 7mm, 14mm, 7-16, etc.; all common systems connectors – type N, TNC, etc.; and several special purpose connector series such as EIA 7/8 rigid line connectors.

## Maury Coaxial Adapter Solutions

Connector 1	Connector 2	VSWR		
		Test Essentials™		Metrology
		Lab Adapters	ColorConnect™ Precision Adapters	Calibration-Grade Adapters
SMA (F)	SMA (F)	1.15	1.15	—
SMA (M)	SMA (M)	1.15	1.15	—
SMA (M)	SMA (F)	1.15	1.15	—
SMA (F)	N (F)	1.15	1.15	—
SMA (M)	N (M)	1.15	1.15	—
SMA (F)	N (M)	1.15	1.15	—
SMA (M)	N (F)	1.15	1.15	—
N (F)	N (F)	1.20	1.15	1.09
N (M)	N (M)	1.20	1.15	1.09
N (M)	N (F)	1.20	1.15	1.09
3.5mm (F)	N (F)	1.15	1.14	1.13
3.5mm (M)	N (M)	1.15	1.14	1.13
3.5mm (F)	N (M)	1.15	1.14	1.13
3.5mm (M)	N (F)	1.15	1.14	1.13
3.5mm (F)	3.5mm (F)	1.20	1.12	1.08
3.5mm (M)	3.5mm (M)	1.20	1.12	1.08
3.5mm (M)	3.5mm (F)	1.20	1.12	1.08
2.4mm (F)	3.5mm (F)	1.15	1.10	1.08
2.4mm (M)	3.5mm (M)	1.15	1.10	1.08
2.4mm (F)	3.5mm (M)	1.15	1.10	1.08
2.4mm (M)	3.5mm (F)	1.15	1.10	1.08
2.92mm (F)	2.92mm (F)	1.17	1.14	1.12
2.92mm (M)	2.92mm (M)	1.17	1.14	1.12
2.92mm (M)	2.92mm (F)	1.17	1.14	1.12
2.4mm (F)	2.92mm (F)	1.17	1.14	1.12
2.4mm (M)	2.92mm (M)	1.17	1.14	1.12
2.4mm (F)	2.92mm (M)	1.17	1.14	1.12
2.4mm (M)	2.92mm (F)	1.17	1.14	1.12
2.4mm (F)	2.4mm (F)	1.22	1.17	1.15
2.4mm (M)	2.4mm (M)	1.22	1.17	1.15
2.4mm (M)	2.4mm (F)	1.22	1.17	1.15
1.85mm (F)	1.85mm (F)	1.30	1.20	1.15
1.85mm (M)	1.85mm (M)	1.30	1.20	1.15
1.85mm (M)	1.85mm (F)	1.30	1.20	1.15

# Two New Maury Coaxial Adapter Solutions

## Test Essentials™ Lab Adapters – In-Series



### Available Models

Test Essentials™ Lab Adapters

Model	Connector 1	Connector 2	Frequency	VSWR
TE-A-SMA-FF	SMA Female	SMA Female	DC – 18.0	1.15
TE-A-SMA-MM	SMA Male	SMA Male	DC – 18.0	1.15
TE-A-SMA-MF	SMA Male	SMA Female	DC – 18.0	1.15
TE-A-SMAN-FF	SMA Female	N Female	DC – 18.0	1.15
TE-A-SMAN-MM	SMA Male	N Male	DC – 18.0	1.15
TE-A-SMAN-FM	SMA Female	N Male	DC – 18.0	1.15
TE-A-SMAN-MF	SMA Male	N Female	DC – 18.0	1.15
TE-A-N-FF	N Female	N Female	DC – 18.0	1.20
TE-A-N-MM	N Male	N Male	DC – 18.0	1.20
TE-A-N-MF	N Male	N Female	DC – 18.0	1.20
TE-A-35N-FF	3.5mm Female	N Female	DC – 18.0	1.15
TE-A-35N-MM	3.5mm Male	N Male	DC – 18.0	1.15
TE-A-35N-FM	3.5mm Female	N Male	DC – 18.0	1.15
TE-A-35N-MF	3.5mm Male	N Female	DC – 18.0	1.15
TE-A-35-FF	3.5mm Female	3.5mm Female	DC – 26.5	1.20
TE-A-35-MM	3.5mm Male	3.5mm Male	DC – 26.5	1.20
TE-A-35-MF	3.5mm Male	3.5mm Female	DC – 26.5	1.20
TE-A-2435-FF	2.4mm Female	3.5mm Female	DC – 26.5	1.15
TE-A-2435-MM	2.4mm Male	3.5mm Male	DC – 26.5	1.15
TE-A-2435-FM	2.4mm Female	3.5mm Male	DC – 26.5	1.15
TE-A-2435-MF	2.4mm Male	3.5mm Female	DC – 26.5	1.15
TE-A-292-FF	2.92mm Female	2.92mm Female	DC – 40.0	1.17
TE-A-292-MM	2.92mm Male	2.92mm Male	DC – 40.0	1.17
TE-A-292-MF	2.92mm Male	2.92mm Female	DC – 40.0	1.17
TE-A-24292-FF	2.4mm Female	2.92mm Female	DC – 40.0	1.17
TE-A-24292-MM	2.4mm Male	2.92mm Male	DC – 40.0	1.17
TE-A-24292-FM	2.4mm Female	2.92mm Male	DC – 40.0	1.17
TE-A-24292-MF	2.4mm Male	2.92mm Female	DC – 40.0	1.17
TE-A-24-FF	2.4mm Female	2.4mm Female	DC – 50.0	1.22
TE-A-24-MM	2.4mm Male	2.4mm Male	DC – 50.0	1.22
TE-A-24-MF	2.4mm Male	2.4mm Female	DC – 50.0	1.22
TE-A-185-FF	1.85mm Female	1.85mm Female	DC – 65.0	1.30
TE-A-185-MM	1.85mm Male	1.85mm Male	DC – 65.0	1.30
TE-A-185-MF	1.85mm Male	1.85mm Female	DC – 65.0	1.30

## Test Essentials™ ColorConnect™ Adapters – In-Series



### Available Models

ColorConnect™ Precision Adapters

Model	Connector 1	Connector 2	Frequency	VSWR
CC-A-SMA-FF	SMA Female	SMA Female	DC – 18.0	1.15
CC-A-SMA-MF	SMA Male	SMA Female	DC – 18.0	1.15
CC-A-SMA-MM	SMA Male	SMA Male	DC – 18.0	1.15
CC-A-N-FF	N Female	N Female	DC – 18.0	1.15
CC-A-N-MM	N Male	N Male	DC – 18.0	1.15
CC-A-N-MF	N Male	N Female	DC – 18.0	1.15
CC-A-35N-FF	3.5mm Female	N Female	DC – 18.0	1.14
CC-A-35N-MM	3.5mm Male	N Male	DC – 18.0	1.14
CC-A-35N-FM	3.5mm Female	N Male	DC – 18.0	1.14
CC-A-35N-MF	3.5mm Male	N Female	DC – 18.0	1.14
CC-A-35-FF	3.5mm Female	3.5mm Female	DC – 26.5	1.12
CC-A-35-MM	3.5mm Male	3.5mm Male	DC – 26.5	1.12
CC-A-35-MF	3.5mm Male	3.5mm Female	DC – 26.5	1.12
CC-A-2435-FF	2.4mm Female	3.5mm Female	DC – 26.5	1.10
CC-A-2435-MM	2.4mm Male	3.5mm Male	DC – 26.5	1.10
CC-A-2435-FM	2.4mm Female	3.5mm Male	DC – 26.5	1.10
CC-A-2435-MF	2.4mm Male	3.5mm Fem	DC – 26.5	1.10
CC-A-292-FF	2.92mm Female	2.92mm Female	DC – 40.0	1.14
CC-A-292-MM	2.92mm Male	2.92mm Male	DC – 40.0	1.14
CC-A-292-MF	2.92mm Male	2.92mm Female	DC – 40.0	1.14
CC-A-24292-FF	2.4mm Female	2.92mm Female	DC – 40.0	1.14
CC-A-24292-MM	2.4mm Male	2.92mm Male	DC – 40.0	1.14
CC-A-24292-FM	2.4mm Female	2.92mm Male	DC – 40.0	1.14
CC-A-24292-MF	2.4mm Male	2.92mm Female	DC – 40.0	1.14
CC-A-24-FF	2.4mm Female	2.4mm Female	DC – 50.0	1.17
CC-A-24-MM	2.4mm Male	2.4mm Male	DC – 50.0	1.17
CC-A-24-MF	2.4mm Male	2.4mm Female	DC – 50.0	1.17
CC-A-185-FF	1.85mm Female	1.85mm Female	DC – 65.0	1.20
CC-A-185-MM	1.85mm Male	1.85mm Male	DC – 65.0	1.20
CC-A-185-MF	1.85mm Male	1.85mm Female	DC – 65.0	1.20

### Proposed IEEE High-Frequency Connector/Adapter Color Convention (Available with Maury ColorConnect™ Precision Adapters)

BROWN		SMA
RED		TYPE N
ORANGE		3.5mm
YELLOW		2.92mm (K)
GREEN		2.4mm
BLUE		1.85mm (V)

# Waveguide Flange Information

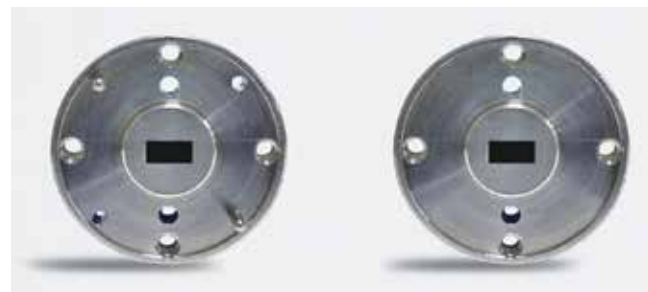
## Maury Precision Flanges (MPF)

### Description

Maury MPF flanges are designed to provide precise mating of flanges when repeated connections are required or in systems where optimum waveguide alignment is critical. Some MPF series flanges also allow mating to more than one type of flange interface, which amplifies their versatility and economy when mating different flange types within a band. Please refer to the "mates with" column in the chart below to see the possible combinations.

MPF flanges are provided on components used in Maury calibration kits or on low VSWR components such as waveguide to coax adapters with VSWR of 1.10 or better.

MPF flanges in WR22 waveguide (millimeter wave sizes) provide dramatic improvements in connection consistency, repeatability and serviceability versus standard UG flanges, while still maintaining mating compatibility with these older designs (see Maury data sheet 5E-030). As in larger waveguide sizes, these flanges have two precision index holes and slip-fit alignment pins. (Threaded pins may also be installed in the standard four-pin pattern when mating to standard UG flanges. Both types



of pins are removable, making the flange face available for servicing.)

MPF flanges also have a raised outer ring which prevents the mating surfaces from cocking due to uneven torque applied to the flange bolts. To obtain complete technical descriptions, please request the data sheets shown in the Maury Data Sheet column.

NOTE: All Maury MPF flanges have precision index holes. Corresponding slip-fit alignment pins are also available. Together, these ensure precise alignment and repeatable mating in waveguide connections. All Maury waveguide VNA calibration kit components come with MPF flanges. Alignment pins are available separately. See Maury data sheet 3A-996 for details.

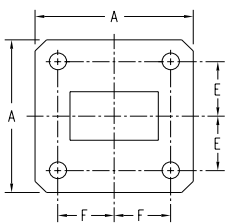
### Maury Precision Flange Reference Chart

BAND	EIA WR NUMBER	MPF DESIGNATION	MATES WITH	MAURY DATA SHEET
S	284	MPF284	UG53/U, UG54A/U, CPR284	5E-002
S	284	MPF284B	UG53/U, UG54A/U, CPR284, CMR284	5E-002A
S	284	MPF284C	UG53/U, UG54A/U	5E-002B
E	229	MPF229	CPR229, CMR229	5E-003
E	229	MPF229B	CPR229	5E-003A
G	187	MPF187	UG149A/U, UG148B/U, CPR187	5E-004
G	187	MPF187C	UG149A/U, UG148B/U	5E-004A
F	159	MPF159	CPR159, CMR159	5E-011
F	159	MPF159B	CPR159	5E-011A
C	137	MPF137	UG344/U, UG343A/U, CPR137	5E-005
C	137	MPF137C	UG344/U, UG343A/U	5E-005A
H	112	MPF112	UG51/U, UG138/U, CPR112F & G	5E-001
H	112	MPF112B	UG51/U, UG52/U	5E-001A
H	112	MPF112C	UG51/U, UG52/U, CMR112	5E-001C
HS	102	MPF102	UG1493	5E-014
X	90	MPF90	UG39/U, UG40A/U, CPR90	5E-006
X	90	MPF90A	UG39/U, UG40A/U, CMR90	5E-006
X	90	MPF90B	UG39/U, UG40A/U	5E-006A
M	75	MPF75A & B	M3922/70-004 & -005	5E-007
P	62	MPF62	UG419/U, UG541A/U	5E-008
N	51	MPF51A & B	M3922/70-010, -011, -012, -022, -023, -024	5E-012
N	51	MPF51C	Keysight Type, UBR180	5E-013
K	42	MPF42	UG595/U, UG596/U	5E-009
Q	34	MPF34	UG595U, UG596/U, UG1530/U	5E-019
U	28	MPF28	UG599/U, UG600/U	5E-010
J	22	MPF22	UG383/U	5E-030

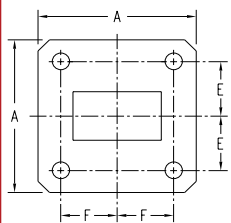


# Standard Waveguide Flange Specifications

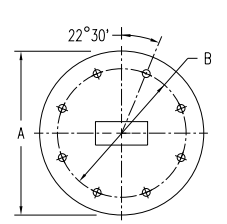
WR112	WG15	R84
UG51/U	UBR84	
Dimensions	inches	mm
A	1.875 <sup>1</sup>	47.90
E	0.737	18.72
F	0.676	17.17
Hole Dia.	0.169 <sup>2</sup>	4.255



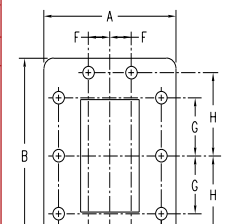
WR90	WG16	R100
UG39/U	UBR100	
Dimensions	inches	mm
A	1.625 <sup>1</sup>	41.40
E	0.640	16.26
F	0.610	15.49
Hole Dia.	0.169 <sup>2</sup>	4.255



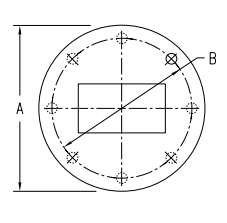
WR284	WG10	R32
UG53/U		
Dimensions	inches	mm
A	5.31	134.87
B	4.75	120.65
Hole Dia.	0.257 <sup>1</sup>	6.50



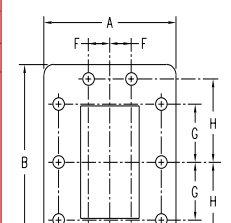
WR229	WG11A	R40
CPR229F	UDR40	
Dimensions	inches	mm
A	2.76	70.20
B	3.89	98.73
E	1.05	26.67
F	0.50	12.70
G	1.07	27.18
H	1.62	41.15
Hole Dia.	0.257 <sup>1</sup>	6.50



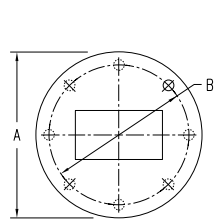
WR187	WG12	R48
UG149/U	UAR48	
Dimensions	inches	mm
A	3.64	92.33
B	3.25	82.55
Hole Dia.	0.330 <sup>1</sup>	5.13



WR159	WG13	R58
CPR159	UDR58	
Dimensions	inches	mm
A	2.44	61.98
B	3.18	80.77
E	0.88	22.35
F	0.38	9.53
G	0.50	12.70
H	1.27	32.26
Hole Dia.	0.257 <sup>1</sup>	6.50



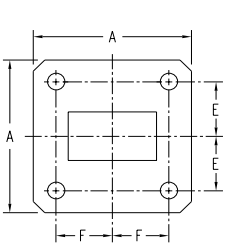
WR137	WG14	R70
UG344/U	UAR70	
Dimensions	inches	mm
A	3.13	79.50
B	2.75	69.85
Hole Dia.	0.199 <sup>1</sup>	5.16



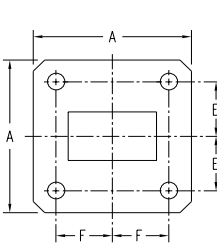
<sup>1</sup> English and metric hole sizes may differ slightly.

# Standard Waveguide Flange Specifications

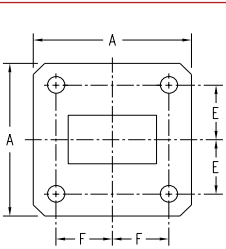
WR75	WG17	R120
COM'L UBR120		
Dimensions	inches	mm
A	1.50 <sup>1</sup>	38.83
E	0.561	14.25
F	0.520	13.21
Hole Dia.	0.144 <sup>2</sup>	4.085



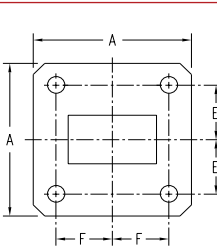
WR62	WG18	R140
UG419/U UBR140		
Dimensions	inches	mm
A	1.31 <sup>1</sup>	33.30
E	0.478	12.14
F	0.497	12.63
Hole Dia.	0.144 <sup>2</sup>	4.085



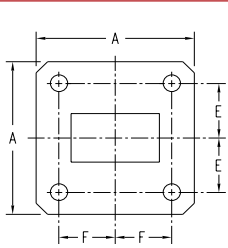
WR51	WG19	R180
COM'L		
Dimensions	inches	mm
A	1.31 <sup>1</sup>	33.27
E	0.497 <sup>1</sup>	12.62
F	0.478 <sup>1</sup>	12.14
Hole Dia.	0.144 <sup>2</sup>	3.658



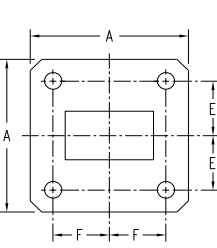
WR42	WG20	R220
UG595/U UBR220		
Dimensions	inches	mm
A	0.875 <sup>1</sup>	22.23
E	0.335	8.51
F	0.320	8.13
Hole Dia.	0.116 <sup>2</sup>	3.07



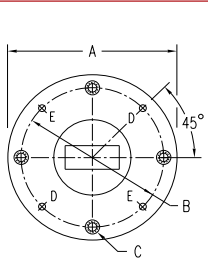
WR34	WG21	R260
UG1530		
Dimensions	inches	mm
A	0.875 <sup>1</sup>	22.41
E	0.335 <sup>1</sup>	8.51
F	0.320 <sup>1</sup>	8.13
Hole Dia.	0.116 <sup>2</sup>	3.07



WR28	WG22	R320
UG599/U		
Dimensions	inches	mm
A	0.75	19.05
E	0.265	6.73
F	0.250	6.35
Hole Dia.	0.116	2.98



WR22	WG23	R400
UG383/U		
Dimensions	inches	mm
A	1.13	28.85
B	0.94	23.81
C Holes	4-40 UNC-2B	
D Holes	0.063	1.613
E Dowels	0.061	1.555



<sup>1</sup> CAUTION: U.S. MIL and commercial flange dimensions differ from IEC flanges.

<sup>2</sup> English and metric hole sizes may differ slightly.

# Additional Maury Microwave Products

## General Information

### Stability™ and Utility™ Microwave/RF Cable Assemblies



Maury Microwave's Stability™ series sets the standard for high-performance ruggedized microwave/RF cable assemblies. For phase-stable and amplitude-stable applications, these cables offer excellent measurement repeatability even after cable flexure. With a ruggedized, durable construction, Stability™ will outlast and outperform other assemblies resulting in a reduced total cost-of-test. Stability's™ light weight, superior flexibility and small form factor make it ideal for daily use with VNAs, test instruments, bench-top testing and ATE systems. Stability™, the phase stable cable of choice.

Maury Microwave's Utility™ series sets the standard for high-end all-purpose test and measurement cable assemblies. Designed for general testing applications, Utility™ offers excellent value with its low cost, low insertion loss, excellent return loss, flexibility, and amplitude and phase stability. Utility™ is the ideal interconnection for reliable and repeatable measurements when mated with test instruments including bench-top testing, on-wafer characterization and ATE systems.

Both Maury's Stability™ and Utility™ cable assemblies are now part of the ColorConnect™ family! Complete product details available in Maury data sheet 2Z-004 and 2Z-005.

### Attenuators

Maury Microwave's AT-series of fixed coaxial attenuators are used to reduce the power of a RF, MW or mmW signal without distorting its signal quality/waveform. Attenuators are often used to lower the amplitude of a signal to a measurable level or to protect a measurement instrument from damage. Attenuators are also used to improve matching between components by improving the return loss (twice insertion loss) and effectively reducing the VSWR seen by adjacent components. Key attenuator parameters include attenuation, frequency bandwidth, power handling, VSWR and quality/repeatability of connector.

Maury AT-series attenuators are part of the ColorConnect™ family. Following the proposed IEEE high-frequency connector/adaptor color convention, AT-series attenuators are the first commercially available attenuators to offer clear indications of compatibility and intermatability. ColorConnect™ makes it a simple matter to avoid and eliminate damaged equipment, degraded equipment reliability, degraded performance and lengthy maintenance times due to improper mating (and attempted mating) of incompatible interconnects.

### Torque Wrenches

Maury's torque wrenches are recommended for tightening coaxial connectors in order to obtain optimum repeatability and prolong connector life. They employ a "break" design so it is impossible to over-torque a coupled junction, and torque can be applied in either direction. Each Maury torque wrench is factory preset to the proper in/lbs for tightening its coaxial connector type, and the color coded handles make it easy to select the correct wrench from your toolbox at a glance.

Maury torque wrenches are included in many of our VNA calibration kits, and accessory kits, and can be ordered separately by the model numbers listed below. If this list doesn't include the right kit for your application, please contact our Sales Department or your local Maury representative for assistance.

### Connector Gage Kits

Maury's connector gage kits provide an easy to use, direct reading, self-checking, and accurate way to measure the critical linear interface dimensions of most coaxial connectors. Their use helps ensure the best electrical performance and accuracy of your test instruments and DUTs, and allows you to avoid serious damage to their connectors.

### Stub Tuners

Stub tuners are basic laboratory tools used for matching load impedances to provide for maximum power transfer between a generator and a load, and introducing a mismatch into an otherwise matched system. Typical applications include power and attenuation measurements, tuned reflectometer systems and providing a DC return for single-ended mixers and detectors.

Stub tuners are impedance transformers that are designed to introduce a variable shunt susceptance into a coaxial transmission line. They consist of one or more short-circuited, variable length lines (stubs) connected at right angles to the primary transmission line. Each stub must be movable over one-half wavelength at the lowest frequency of operation in order to provide all possible shunt susceptances; therefore, the low frequency limit of a tuner is determined by the frequency at which the maximum stub travel equals one-half wavelength. Tuners, particularly multiple-stub models, are still usable below this limit. Other than the limitation of the connectors, there is no higher frequency limit; however, various models are offered for size convenience.

The spacing between the stubs of multiple-stub tuners determines the range of impedances that can be matched and the ease of tuning. The stub spacing of Maury double- and triple-stub tuners has been selected for general broadband applications. Triple-stub tuners are more convenient to use since tuning sensitivity is relatively independent of stub spacing.

Maury produces a comprehensive line of broadband stub tuners designed to satisfy the majority of applications. These tuners are available in double- and triple-stub configurations with frequency ranges extending from 0.2 to 18.0 GHz.

## Noise Calibration Systems



Maury Noise Calibration Systems (NCS) are self-contained, highly accurate sources of RF and microwave noise power that are used wherever noise source accuracy is critical. Examples are: receiver noise measurements, such as noise figure and effective input noise temperature; calibration of solid state noise sources; evaluation and verification of earth station receivers; and as radiometer reference sources.

## Cryogenic Terminations (Cold Loads)



Maury cryogenic terminations are liquid nitrogen cooled loads which provide accurately known noise power at a well matched output port. Used with ambient and/or thermal terminations and a noise figure meter, these terminations provide cold reference temperatures needed for highly accurate noise figure or effective input noise temperature measurements. Because of the accuracy of their noise output, cryogenic terminations are often used as a noise standard for calibration of solid state noise generators.

## Thermal Terminations (Hot Loads)



Maury thermal terminations are low-mismatch, heated loads in a precisely controlled thermal environment, which provide and accurately known noise power. Used with ambient and/or cryogenic terminations and a noise figure meter, these terminations provide the hot termination temperature needed for highly accurate noise figure or effective input noise temperature measurements. Because of the accuracy of the noise output, thermal terminations are often used as a noise standard for calibration of solid state noise generators.

## Coaxial and Waveguide Ambient Terminations

Maury ambient terminations are room temperature noise sources consisting of stable terminations in massive copper housings that provide thermal stability and reduce the effects of thermal transients.

## Noise Components & Accessories

Maury offers a wide range of calibrated adapters and adapter sets that are used with the MT7118J cryogenic termination and the MT7108B thermal termination to adapt the precision 7mm output port to other coaxial series or to waveguide at specific frequencies. They are calibrated for VSWR and insertion loss to allow their input noise temperature to be calculated.



# Test Port Cable Assemblies

## Series 8944C, 8946C and 8948C

### Features

- > For VNA Applications
- > Ruggedized Test Port Connectors
- > For Use with 2.4mm, 2.92mm, 3.5mm, and 7mm Test Ports
- > Coaxial Test Port to Waveguide Adapters Available



### Description

Maury 8944, 8946 and 8948 series test port cable assemblies and test port adapters replace multiple cables in various connector types with versatile and cost-effective alternatives. These cable assemblies extend the test ports of network analyzers, and have a rugged female and male test port connector at each end. They come in standard lengths of 25 or 38 inches and are extremely flexible while maintaining excellent phase and amplitude stability.

### 8946C25

The adapters also have a rugged test port connector on one side with a precision 2.4mm, 2.92mm, 3.5mm, 7mm, N, TNC or waveguide connector (EIA WR229 to WR28) on the other side. NMD to NMD adapters are also available. The adapters are sold separately.

### Available Models – Cable Assemblies

KIT MODEL	TYPE	CABLE LENGTH		FREQUENCY RANGE (GHz)			CABLE O.D. (NOMINAL)		BEND RADIUS (MINIMUM)		NOMINAL IMPEDANCE
		INCHES	(CM)				INCHES	(CM)	INCHES	(CM)	
8946C25	NMD2.4mm	25.0	(63.5)	DC	—	50.0	0.6	(1.524)	2.5	(6.35)	50 ohm
8946C38	NMD2.4mm	38.0	(96.5)								
8944C25	NMD3.5mm	25.0	(63.5)	DC	—	26.5	0.6	(1.524)	2.5	(6.35)	50 ohm
8944C38	NMD3.5mm	38.0	(96.5)								
8948C25	7mm	25.0	(63.5)	DC	—	18.0	0.6	(1.524)	2.5	(6.35)	50 ohm
8948C38	7mm	38.0	(96.5)								

### Specifications (25-in. Length Cables)

Maury 8944, 8946 and 8948 series 25-inch test port cables have the following specifications:

#### Frequency Range:

8946 series	DC – 50.0 GHz
8944 series	DC – 26.5 GHz
8948 series	DC – 18.0 GHz

#### Insertion Loss (dB)\*

8946 series	Typical: $0.02 + 0.34\sqrt{f} + 0.004f$ Guaranteed: $0.65 + 0.38\sqrt{f} + 0.006f$
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8944 & 8948 series	Typical: $0.02 + 0.19\sqrt{f} + 0.005f$ Guaranteed: $0.39 + 0.19\sqrt{f} + 0.007f$
--------------------	---

#### Return Loss (dB):

8946 series	15
8944 & 8948 series	18

Overall Phase Stability (degrees):*	Typical: 0.05(f) Guaranteed: $0.5 + 0.08(f)$
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Overall Amplitude Stability (dB):	Typical: $\leq 0.03$ Guaranteed: $\leq 0.08$
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Return Loss Stability (dB):	$\geq 40$
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### Specifications (38-in. Length Cables)

Maury 8944, 8946 and 8948 series 38-inch test port cables have the following specifications:

#### Frequency Range:

8946 series	DC – 50.0 GHz
8944 series	DC – 26.5 GHz
8948 series	DC – 18.0 GHz

#### Insertion Loss (dB):\*

8946 series	Typical: $0.02 + 0.52\sqrt{f} + 0.006f$ Guaranteed: $0.65 + 0.57\sqrt{f} + 0.009f$
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8944 & 8948 series	Typical: $0.02 + 0.29\sqrt{f} + 0.007f$ Guaranteed: $0.39 + 0.29\sqrt{f} + 0.011f$
--------------------	---

#### Return Loss (dB):

8946 series	15
8944 & 8948 series	18

Overall Phase Stability (degrees):*	Typical: 0.10(f) Guaranteed: $0.5 + 0.17(f)$
-------------------------------------	---

Overall Amplitude Stability (dB):	Typical: $\leq 0.05$ Guaranteed: $\leq 0.15$
-----------------------------------	---

Return Loss Stability (dB):	$\geq 40$
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\*  $f$  = frequency in GHz.



## Microwave/RF Cable Assemblies

Series SC-24, SC-292, SC-35 and SC-N

### Features and Benefits

- > Amplitude and phase stable with flexure
- > Reliable and repeatable measurements
- > Durable, ruggedized, crush-resistant
- > Longer flex life
- > Also available in 2.92mm or 3.5mm Low-Profile and Thermal Vacuum configurations.
- > Available in 90° Swept Angle configurations.

### Description

Maury Microwave's Stability™ series sets the standard for high-performance ruggedized cable assemblies. Designed specifically for phase-stable and amplitude-stable applications, Stability™ offers excellent measurement repeatability even after cable flexure. With a ruggedized, durable construction, Stability™ will outlast and outperform other assemblies resulting in a reduced total cost-of-test. Stability's™ light weight, superior flexibility and small form factor make it ideal for daily use with VNAs, test instruments, bench-top testing and ATE systems.

Stability™ cable assemblies are now part of the ColorConnect™ family! Following the proposed IEEE high-frequency connector/adaptor color convention, Stability™ cable assemblies are the first commercially available assemblies to offer clear indications of compatibility and intermatability. ColorConnect™ makes it a simple matter to avoid and eliminate damaged equipment, degraded equipment reliability, degraded performance and lengthy maintenance times due to improper mating (and attempted mating) of incompatible interconnects.

### Stability™ Specifications

STABILITY™ Cable Type	Frequency	Typical Phase Stability with Flexure	Typical Amplitude Stability with Flexure
SC-185	67 GHz	±8.0°	±0.08 dB
SC-24	50 GHz	±6.0°	±0.05 dB
SC-292	40 GHz	±5.0°	±0.05 dB
SC-35	26.5 GHz	±3.5°	±0.02 dB
SC-N	18.0 GHz	±2.0°	±0.015 dB

### Typical Applications

- > Vector network analyzers (VNAs)
- > RF and microwave instruments
- > Bench-top testing
- > Probe station integrations
- > RF production testing
- > ATE systems

### Typical Configurations

Part Number	Length*	Connector 1	Connector 2	Frequency
SC-185-MM-24	24 in.	1.85mm male	1.85mm male	67 GHz
SC-185-MM-36	36 in.			
SC-185-MM-48	48 in.			
SC-24-MM-24	24 in.	2.4mm male	2.4mm male	50 GHz
SC-24-MM-36	36 in.			
SC-24-MM-48	48 in.			
SC-292-MM-24	24 in.	2.92mm male	2.92mm male	40 GHz
SC-292-MM-36	36 in.			
SC-292-MM-48	48 in.			
SC-292-MM-60	60 in.			
SC-292-MM-78	78 in.			
SC-35-MM-24	24 in.	3.5mm male	3.5mm male	26.5 GHz
SC-35-MM-36	36 in.			
SC-35-MM-48	48 in.			
SC-35-MM-60	60 in.			
SC-35-MM-78	78 in.			
SC-N-MM-24	24 in.	N male	N male	18 GHz
SC-N-MM-36	36 in.			
SC-N-MM-48	48 in.			
SC-N-MM-60	60 in.			
SC-N-MM-78	78 in.			

\* Custom lengths are available by special order.



STABILITY™ SC-292-MM-36  
Microwave/RF Cable Assembly

## CABLE ASSEMBLY SPECIFICATIONS

### Electrical Properties<sup>1</sup>

STABILITY™ Cable Type	SC-185	SC-24	SC-292	SC-35	SC-N
Maximum Frequency	67 GHz	50 GHz	40 GHz	26.5 GHz	18.0 GHz
VSWR	1.40 typ/ 1.50 max	1.30 typ/ 1.43 max	1.25 typ/ 1.40 max	1.25 typ/ 1.35 max	1.25 typ/ 1.30 max
Typical Insertion Loss (cable only)	1.79 dB/ft	1.52 dB/ft	0.84 dB/ft	0.67 dB/ft	0.54 dB/ft
Impedance (nominal)	50 ohm	50 ohm	50 ohm	50 ohm	50 ohm
Phase Stability vs Bending <sup>2</sup>	±8° typ/ ±15.6° max	±6° typ/ ±11.8° max	±5° typ/ ±9.5° max	±3.5° typ/ ±7.0° max	±2.0° typ/ ±4.5° max
Amplitude Stability vs Bending <sup>3</sup>	±0.08 dB typ/ ±0.10 dB max	±0.05 dB typ/ ±0.08 dB max	±0.05 dB typ/ ±0.10 dB max	±0.02 dB typ/ ±0.04 dB max	±0.015 dB typ/ ±0.02 dB max
Phase Stability vs Temp	<4°/m/GHz (–55 ~+125°C)				
Velocity of Propagation	76% (nominal)				
Shielding Effectiveness	>90 dB (DC –18.0 GHz)				
Time Delay (nominal)	1.3ns/ft (4.4ns/m)				

<sup>1</sup> These specifications also apply to Stability™ Low-Profile (-LP) and Thermal Vacuum (-TVAC) cable assemblies (see page 87).

<sup>2</sup> Per IEC 60966-1, section 8.6, method 1.

<sup>3</sup> Per IEC 60966-1, section 8.4.

### Mechanical/Environmental Properties

STABILITY™ Cable Type	SC-185, SC-24, SC-292, SC-35 and SC-N	
Center Conductor Material	Silver-Plated Copper-Clad Steel	
Maximum Outer Diameter	SC-292/SC-35/SC-N 0.277 in (7.04mm)	SC-185/SC-24 0.244 (6.20mm)
Nominal Weight	1.61 oz/ft (150g/m)	1.02 oz/ft (95g/m)
Min. Static Bend Radius / Min. Dynamic Bend Radius	1.0 in. (25.4mm) / 2.0 in. (50.8mm)	
Flex Life Cycles <sup>4</sup>	>20,000	
Crush Resistance	>254 lb/inch (44 kN/m)	
Operating Temperature Range	–67 ~ +257°F (–55 ~ +125°C)	
Fire Resistance <sup>5</sup>	Yes	
Abrasion Resistance <sup>6</sup>	Yes	
RoHS/REACH	Yes	

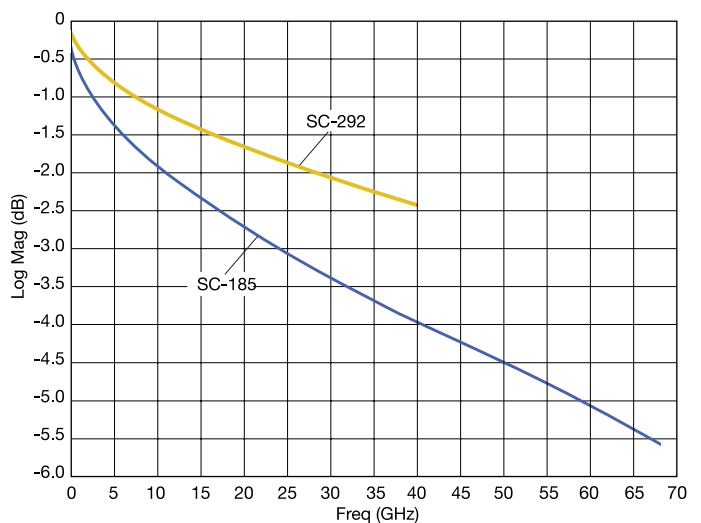
<sup>4</sup> Per IEC 60966-1, section 9.3.

<sup>6</sup> Per SAE AS5756.

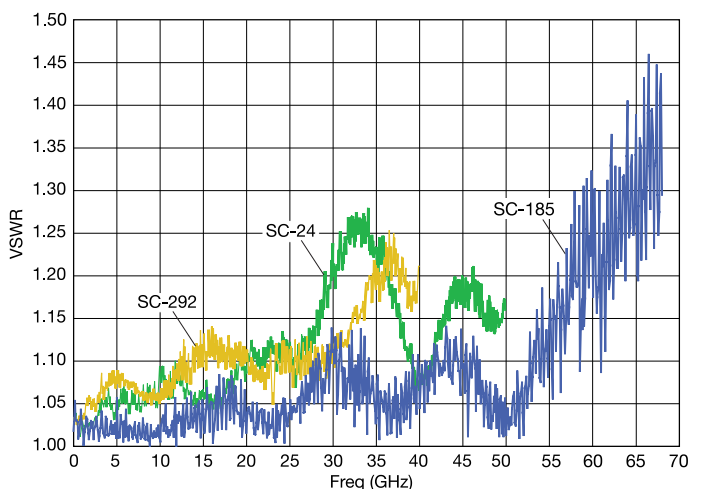
<sup>5</sup> Per MIL-C-87104.



### Maury Stability™ 36" Cable Assembly Typical Insertion Loss



### Maury Stability™ 36" Cable Assembly Typical VSWR

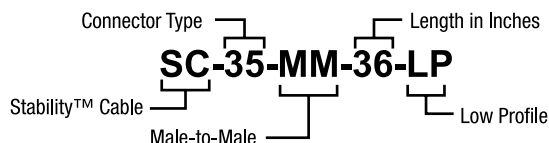


## Stability™ Low-Profile Cable Assemblies (-LP)

Stability™ Low-Profile Cable Assemblies are designed for high-density applications such as switch matrices and PXI/PXIe/AXIe cards, as well as wafer-probe applications where traditional cable assemblies might cause interference due to cable and connector size. Stability™ Low-Profile Cable Assemblies offer the same electrical performance as Stability™ Microwave/RF Cable Assemblies in a configuration that is 44% smaller and 66% lighter, and are available with 3.5mm and 2.92mm connectors.

## Ordering Instructions for Stability™ Low Profile (-LP) Cable Assemblies

To specify a Stability™ Low Profile Cable Assembly, add "-LP" at the end of the SC model number, as shown in the example below. Available with 3.5mm, 2.92mm and 2.4mm connectors.



## Mechanical/Environmental Properties (-LP)

STABILITY™ Cable Type	SC-292 and SC-35
Center Conductor Material	Silver-Plated Copper-Clad Steel
Maximum Outer Diameter	0.156 in (3.95mm)
Nominal Weight	0.54 oz/ft (50g/m)
Minimum Bend Radius	1.0 in. (25.4mm)
Flex Life Cycles <sup>4</sup>	>20,000
Crush Resistance	>23 lb/inch (4kN/m)
Operating Temperature Range	-67 ~ +257°F (-55 ~ +125°C)
Fire Resistance <sup>5</sup>	Yes
RoHS/REACH	Yes

<sup>4</sup> Per IEC 60966-1, section 9.3. <sup>5</sup> Per MIL-C-87104.

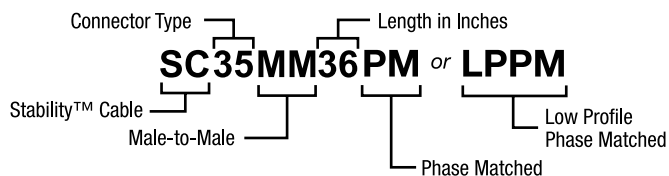


## Stability™ Phase-Matched (PM) Cable Assembly Sets

Stability™ Phase-Matched Cable Assemblies have been designed for applications where strict phase equality between multiple paths are required. Stability™ PM Cable Assemblies are matched within  $\pm 0.63$  °/GHz and available as sets of two or more assemblies. Stability™ PM Cable Assemblies are offered in both standard and low-profile formats and maintain the mechanical and electrical characteristics of the original assembly. Phase matched assemblies are available with 2.4mm, 2.92mm, 3.5mm and Type-N connectors and in all lengths.

## Ordering Instructions for Stability™ Phase-Matched (PM) Cable Assembly Sets

To specify a Stability™ Phase-Matched Cable Assembly set, add "PM" or "LPPM" at the end of the SC model number, as shown in the example below. "PM" indicates standard configuration Phase-Matched sets; "LPPM" indicates Low Profile configuration, Phase-Matched sets.





## Stability™ Swept 90° Cable Assemblies (-RT)

Stability™ Swept 90° Cable Assemblies are designed for applications requiring a fixed and stable bend where traditional cable assemblies may be inconvenient. With a bend radius of 1.43 inches and a cable-to-connector length of 3.3 inches, Stability™

Swept 90° Cable Assemblies retain the electrical and mechanical specifications of the traditional assembly while removing stresses related to hand-formed bends. Stability™ Swept 90° Cable Assemblies are built on demand and are available with 2.92mm, 3.5mm and Type-N connectors.

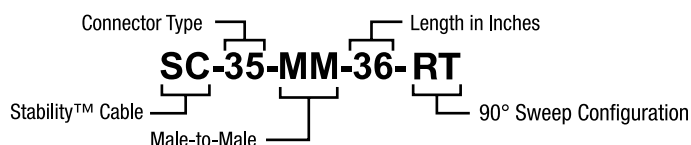


Stability™ Swept 90° Cable Assemblies are available in all the lengths offered for the standard Stability™ Microwave/RF Cable Assemblies.



## Ordering Instructions for Stability™ Swept 90° Cable Assemblies (-RT)

To specify a Stability™ Swept 90° Cable Assembly, add "-RT" at the end of the SC model number, as shown in the example at the right.



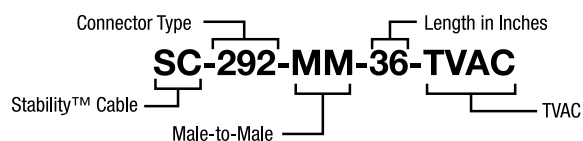
## Stability™ Thermal Vacuum Cable Assemblies (-TV)

Stability™ TVAC Cable Assemblies have been designed for measurements in a thermal vacuum environment for space product testing. TVAC cable assemblies connect components or satellites located in thermal test chambers to systems and instruments outside. Stability™ TVAC Cable Assemblies offer the

same electrical and mechanical performance as Stability™ Microwave/RF Cable Assemblies with specialized vented 2.92mm connectors that meet low outgassing requirements of ESA-PSS-01-702 with a TML < 1% and CVCM < 0.1%.

## Ordering Instructions for Stability™ Thermal Vacuum (-TV) Cable Assemblies

To specify a Stability™ Thermal Vacuum Cable Assembly, add "-TV" at the end of the SC model number, as shown in the example at the right.



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ONLINE AT [MAURYMW.COM](http://MAURYMW.COM)



ORDER THESE AND OTHER IN-STOCK PRODUCTS  
ONLINE AT [MAURYMW.COM](http://MAURYMW.COM)

## Utility™ Microwave/RF Cable Assemblies

### Series UC-N and UC-SMA

#### Typical Applications

- > RF and microwave instruments
- > Bench-top testing
- > Probe station integrations
- > RF production testing
- > Component/module testing
- > ATE systems

#### Features and Benefits

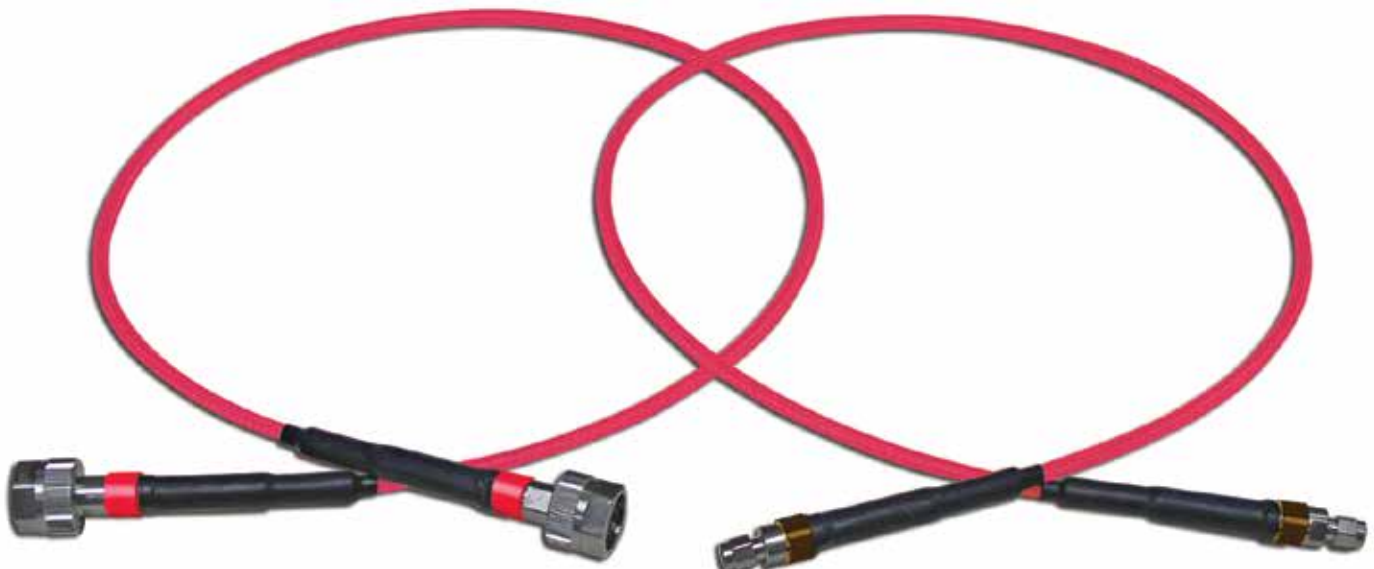
- > Excellent Value
- > Low insertion loss
- > Reliable and repeatable measurements
- > Amplitude and phase stable with flexure
- > High mating-cycle durability

#### Description

Maury Microwave's Utility™ series sets the standard for high-end all-purpose test and measurement cable assemblies. Designed for general testing applications, Utility™ offers excellent value with its low cost, low insertion loss, excellent return loss, flexibility, and amplitude and phase stability. Utility™ is the ideal interconnection for reliable and repeatable measurements when mated with test instruments including bench-top testing, on-wafer characterization and ATE systems.

Utility™ cable assemblies are now part of the ColorConnect™ family! Following the proposed IEEE high-frequency connector/

adapter color convention, Utility™ cable assemblies are the first commercially available assemblies to offer clear indications of compatibility and intermatability. ColorConnect™ makes it a simple matter to avoid and eliminate damaged equipment, degraded equipment reliability, degraded performance and lengthy maintenance times due to improper mating (and attempted mating) of incompatible interconnects.



Utility™ UC-N-MM-24 (Left) and UC-SMA-MM-24  
(Right) Microwave/RF Cable Assemblies

## CABLE ASSEMBLY SPECIFICATIONS

### Electrical Properties

Utility™ Cable Type	Type N	SMA
Maximum Frequency	18.0 GHz	20.0 GHz
VSWR	1.30 max	1.25 max
Typical Insertion Loss (cable only)	0.64 dB/ft	
Impedance (nominal)	50 ohm	
Phase Stability vs Bending <sup>1</sup>	±3.0° typ	
Amplitude Stability vs Bending <sup>2</sup>	±0.015 dB typ	
Velocity of Propagation	71% (nominal)	
Shielding Effectiveness	>100 dB (DC –18.0 GHz)	
Time Delay (nominal)	1.45ns/ft (4.75ns/m)	

<sup>1</sup> Per IEC 60966-1, section 8.6, method 1.

<sup>2</sup> Per IEC 60966-1, section 8.4.

### Mechanical/Environmental Properties

Utility™ Cable Type	Type N and SMA
Center Conductor Material	Silver-Plated Copper-Clad Steel
Maximum Outer Diameter	0.190 in (4.81mm)
Nominal Weight	0.65 oz/ft (60g/m)
Min. Static Bend Radius/ Min. Dynamic Bend Radius	1.0 in. (25.4mm)/ 2.0 in. (50.8mm)
Flex Life Cycles <sup>3</sup>	>10,000
Crush Resistance	>131 lb/inch (23 kN/m)
Operating Temperature Range	–67 ~ +221°F (–55 ~ +105°C)
Fire Resistance <sup>4</sup>	Yes
RoHS/REACH	Yes

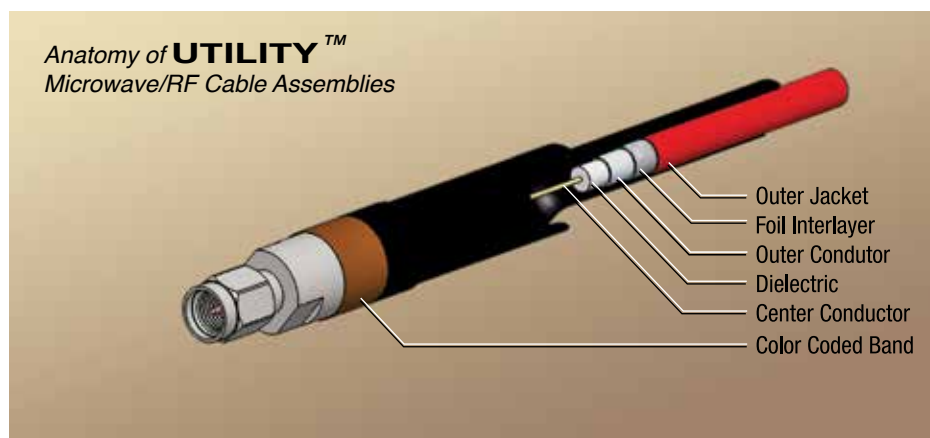
<sup>3</sup> Per IEC 60966-1, section 9.3.

<sup>4</sup> Per MIL-C-87104.

### Available Models

Part Number	Length <sup>5</sup>	Connector 1	Connector 2	Frequency
UC-N-MM-24	24 in.	N male	N male	18 GHz
UC-N-MM-36	36 in.			
UC-N-MM-48	48 in.			
UC-N-MM-60	60 in.			
UC-N-MM-78	78 in.			
UC-SMA-MM-24	24 in.	SMA male	SMA male	20 GHz
UC-SMA-MM-36	36 in.			
UC-SMA-MM-48	48 in.			
UC-SMA-MM-60	60 in.			
UC-SMA-MM-78	78 in.			

<sup>5</sup> Custom lengths are available by special order.



# ColorConnect™ Precision Attenuators

## AT-Series



AT-24-01-03



AT-292-01-03



AT-SMA-01-03

AT-Series Attenuators

### Features

- > Fixed Coaxial Attenuators
- > Precision 2.4mm, 2.92mm & SMA Male/Female Connectors
- > Color Coded For Easy Identification

### Description

Maury Microwave's AT-series of fixed coaxial attenuators are used to reduce the power of a RF, MW or mmW signal without distorting its signal quality/waveform. Attenuators are often used to lower the amplitude of a signal to a measurable level or to protect a measurement instrument from damage. Attenuators are also used to improve matching between components by improving the return loss (twice insertion loss) and effectively reducing the VSWR seen by adjacent components. Key attenuator parameters include attenuation, frequency bandwidth, power handling, VSWR and quality/repeatability of connector.

### ColorConnect™ Color Coding

Maury AT-Series attenuators are part of the ColorConnect™ family. Following the proposed IEEE high-frequency connector/adaptor color convention, AT-Series attenuators are the first commercially available attenuators to offer clear indications of compatibility and intermatability. ColorConnect™ makes it a simple matter to avoid and eliminate damaged equipment, degraded equipment reliability, degraded performance and lengthy maintenance times due to improper mating (and attempted mating) of incompatible interconnects.

#### Proposed IEEE High-Frequency Connector/Adapter Color Convention

(Available with Maury ColorConnect™ Precision Adapters)

BROWN		SMA
RED		TYPE N
ORANGE		3.5mm
YELLOW		2.92mm (K)
GREEN		2.4mm
BLUE		1.85mm (V)

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ONLINE AT [MAURYMW.COM](http://MAURYMW.COM)



**ColorConnect™ Precision Attenuators Available Models**

Model	Connector 1	Connector 2	Frequency Range	Power Handling (W)	Attenuation (dB)	VSWR (max)
AT-SMA-02-03	SMA male	SMA female	DC – 26.5	2	3	1.5:1
AT-SMA-02-06	SMA male	SMA female	DC – 26.5	2	6	1.5:1
AT-SMA-02-10	SMA male	SMA female	DC – 26.5	2	10	1.5:1
AT-SMA-02-20	SMA male	SMA female	DC – 26.5	2	20	1.5:1
AT-292-01-03	2.92mm male	2.92mm female	DC – 40.0	1	3	1.4:1
AT-292-01-06	2.92mm male	2.92mm female	DC – 40.0	1	6	1.4:1
AT-292-01-10	2.92mm male	2.92mm female	DC – 40.0	1	10	1.4:1
AT-292-01-20	2.92mm male	2.92mm female	DC – 40.0	1	20	1.4:1
AT-24-01-03	2.4mm male	2.4mm female	DC – 50.0	1	3	1.75:1
AT-24-01-06	2.4mm male	2.4mm female	DC – 50.0	1	6	1.75:1
AT-24-01-10	2.4mm male	2.4mm female	DC – 50.0	1	10	1.75:1
AT-24-01-20	2.4mm male	2.4mm female	DC – 50.0	1	20	1.75:1

# Torque Wrenches

## All Models

### Description

Maury's torque wrenches are recommended for tightening coaxial connectors in order to obtain optimum repeatability and prolong connector life. They employ a "break" design so it is impossible to over-torque a coupled junction, and torque can be applied in either direction. Each Maury torque wrench is factory preset to the proper in. lbs for tightening its coaxial connector type, and the color coded handles make it easy to select the correct wrench from your toolbox at a glance. The "TW" series has color coded bands corresponding to the Color Connect series identification.

Maury torque wrenches are included in many of our VNA calibration kits, and can be ordered separately by the model numbers listed in the chart below.

Note: The models shown are delivered in a non-calibrated state unless calibration is requested at the time they are ordered. Maury highly recommends annual re-calibration of these torque wrenches to ensure their continued ability to properly tighten connections. Torque wrenches that are subject to heavy use should have their calibration checked more frequent.



### Available Models

Model	For Use With Connector	Wrench Size (Inches)	Preset Torque (in.lbs.)	Handle Color <sup>6</sup>
2498T1	MPC14, LPC14 <sup>1</sup>	1.0 HEX	12 ±0.8	BLUE
2698C2	7mm, N <sup>2</sup> , NMD3.5, NMD2.92, NMD2.4, NMD1.85	0.75 HEX	12 ±0.8	BLUE
2698G1	TNC <sup>3</sup>	0.562 HEX	12 ±0.8	BLUE
2698H1	LPC/OSP™ <sup>4</sup>	0.562 HEX	8±0.5	RED
2698K1	7-16	1.062 HEX	20 ±1.2	GREEN
8799A1 <sup>5</sup>	3.5mm, 2.92mm, 2.4mm, 1.85mm	0.312 HEX	8 ±0.5	RED
8799D1	SMA	0.312 HEX	5 ±0.3	BLACK
TW-5	SMA	0.312 HEX	5 ±0.5	BROWN <sup>7</sup>
TW-8	3.5mm, 2.92mm, 2.4mm, 1.85mm,	0.312 HEX	8 ±0.8	BLUE, GREEN, YELLOW, ORANGE <sup>7</sup>
TW-12	7mm, N <sup>2</sup> , NMD3.5, NMD2.92, NMD2.4, NMD1.85	0.750 HEX	12 ±1.2	RED <sup>7</sup>

<sup>1</sup> MPC14 and LPC14 connectors are precision 14mm connectors that are essentially the same as GR900 connectors and are supplied with 1.0 hex nuts.

<sup>2</sup> Precision N connectors supplied with 3/4 hex nuts.

<sup>3</sup> Precision TNC connectors supplied with 9/16 hex nuts.

<sup>4</sup> Precision LPC/OSP™ per Maury data sheet 5E-065. OSP is a M/A Com Omni-Spectra designation.

<sup>5</sup> WARNING: Do Not Use on SMA connectors. Damage can result.

<sup>6</sup> Unless otherwise marked on nameplate, handle color represents torque value: blue = 12 in. lbs., red = 8 in. lbs., black = 5 in. lbs., gold = 20 in. lbs.

<sup>7</sup> Has color coded bands corresponding to the Color Connect series identification.

# Connector Gages and Connector Gage Kits

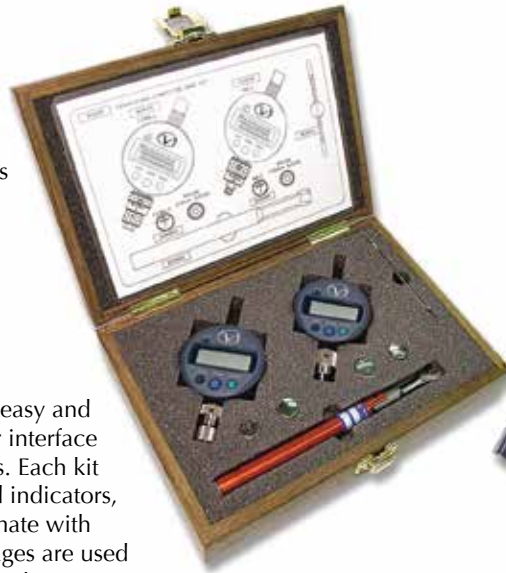
## General Information

### Features

- > Direct Reading, Self-Checking
- > Accurate, Easy to Use
- > Digital and/or Dial Indicator Styles

### Description

Maury connector gage kits provide an easy and accurate way to measure critical linear interface dimensions of most coaxial connectors. Each kit consist of gages with specially adapted indicators, and the bushings and pins needed to mate with specified connectors. Master setting gages are used to adjust the dial indicators (or digital indicators) to zero, before push-on or thread-on gages are mated with connectors to measure the distance from a given interface (male shoulder, etc.) to the outer conductor mating plane. The table below lists available models. Additional information is found in the referenced data sheets.



A048A 1.85mm/2.4mm  
Digital Connector Gage Kit



A048A (Female) and  
A048B (Male) Digital  
Gages with Master Blocks  
(Enlarged)

## Why You Need Connector Gages

The Importance of checking the critical mechanical dimensions of your coaxial connectors before mating cannot be overstated. Superior electrical performance depends on making sure all the coaxial connectors in you test setup are operating within their specified tolerances. Pin depth and position of the center conductors are especially critical in that regard.

If the male and female contacts are recessed beyond tolerance they will exhibit a "gap-fit" connection when mated. This causes significant reduction of electrical performance.

If the male and female contacts protrude beyond their specified tolerances they will exhibit an "interference-fit" when mated. This will also degrade electrical performance, with adverse effects on measurement accuracy, and may result in catastrophic damage to the center connectors and contacts.

Since 1962 Maury Microwave has been designing connector gage kits that provide the best method of checking pin depth and position in all the most popular coaxial connector types. Today these include digital gage kits in 1.85mm/2.4mm and 2.92mm/3.5mm connector types, and dial-indicator gage kits in 1.85mm/2.4mm, 2.92mm/3.5mm, 7mm, type N (in 50 ohm and 75 ohm models), BNC, TNC, SMA, OSP™<sup>1</sup>, 7-16 and SMP/GPO™<sup>2</sup> connector types.

All Maury connector gage kits are designed for superior durability, stability and repeatability. Each kit includes at least one connector gage with the master gage block or blocks necessary to ensure the accuracy of the gages. Kits are available as metrology-grade thread-on designs or hand-held push-on designs.

## Available Models - Digital Indicator Style

CONNECTOR TYPE	DIAL RESOLUTION (INCHES)	MODEL	DESCRIPTION	DATA SHEET
1.85mm/2.4mm	0.001mm/ 0.00004 in.	A048A	Two "thread-on" metrology grade digital gages measure female and male contact pin locations.	2Y-048
2.92mm (K) or 3.5mm	0.001mm/ 0.00004 in.	A050A	Two "thread-on" metrology grade digital gages measure female and male contact pin locations.	2Y-049
Type N	0.0001mm/ 0.00004 in.	A020K	Two "thread-on" metrology grade digital gages measure type N female and male connectors, sliding loads, airlines, two-port standards, VNA test port adapters, etc.	2Y-032

<sup>1</sup> OSP™ (the Omni-Spectra designation) is a trademark of M/A-Com.

<sup>2</sup> GPO™ is a trademark of the Gilbert Engineering Co., Inc.



A007A Type N Push-On Connector Gage Kit



A020D Type N Thread-On Connector Gage Kit

### Available Models - Dial Indicator Style

CONNECTOR TYPE	DIAL RESOLUTION (INCHES)	MODEL	DESCRIPTION	DATA SHEET
2.92mm (K) or 3.5mm	0.00025	A034B	Two "push-on" gages measure female and male contact pin interface locations.	2Y-020
2.92mm (K) or 3.5mm	0.0001	A034E	Two metrology grade "thread-on" gages measure female and male contact pin interface locations.	2Y-020A
2.4mm/1.85mm	0.0001	A035E	Two metrology grade "thread-on" gages measure female and male contact pin interface locations.	2Y-022A
7mm	0.0001	A028D	One "thread-on" metrology grade gage measures planar contact location.	2Y-005A
N	0.001	A007A	One "push-on" gage measures female and male contact pin location.	2Y-002
N	0.00025	A020A	One "push-on" gage measures female and male contact pin location.	2Y-003
N	0.0001	A020D	Two metrology grade "thread-on" gages measure female and male contact pin interface locations.	2Y-003A
N (75 ohms)	0.0001	A020G	One "push-on" gage measures female and male contact pin location of 75 ohm type N connectors.	2Y-003G
BNC or TNC	0.0005	A012A	One "push-on" gage measures female and male contact pin and dielectric interface locations.	2Y-009
SMA	0.0005	A027	Two "push-on" gages measure female and male contact pin interface locations.	2Y-004
SMA	0.0005	A027A	Four "push-on" gages measure female and male contact pin and dielectric interface locations.	2Y-004
SMA	0.0005	A027G	Two "push-on" gages measure female contact pin and dielectric interface locations.	2Y-004
SMA	0.0005	A027M	Three "push-on" gages measure standard male contact pin and dielectric interface locations, and the stepless 0.085-inch male pin dimension.	2Y-004
7-16	0.0001	A041A	One "push-on" gage measures female and male contact pin location.	2Y-027
SMP/GPO™ 1	0.0005	A042A	Three "push-on" gages measures SMP connectors' contact pin and dielectric interface locations.	2Y-031

<sup>1</sup> GPO™ is a trademark of the Gilbert Engineering Co., Inc.



# Coaxial Stub Tuners

## Description

Maury stub tuners are basic laboratory tools used for matching load impedances to provide for maximum power transfer between a generator and a load, and for introducing a mismatch into an otherwise matched system. Typical applications include power and attenuation measurements, tuned reflectometer systems and providing a DC return for single-ended mixers and detectors. Maury stub tuners are available in double- and triple-stub configurations with frequency ranges extending from 0.2 to 18.0 GHz.

Stub tuners work as impedance transformers to introduce a variable shunt susceptance into a coaxial transmission line. They consist of one or more short-circuited, variable length lines

(stubs) connected at right angles to the primary transmission line. To provide all possible shunt susceptances, each stub must be movable over 1/2 wavelength at the lowest frequency of operation; therefore, the lower frequency limit of a tuner is determined by the frequency at which the maximum stub travel equals 1/2 wavelength. The upper frequency limit for a stub tuner is established by its connectors.

The inter-stub spacing of multiple-stub tuners determines the range of impedances that can be matched and the ease of tuning. Triple-stub tuners are more convenient to use since tuning sensitivity is relatively independent of stub spacing.



## Available Models

STUB CONFIGURATION	FREQUENCY RANGE (GHz)	MODEL (BY CONNECTOR TYPE)			STUB TRAVEL		STUB SPACING			
		TYPE N	7mm	SMA	INCHES	(cm)	INCHES		(cm)	
DOUBLE-STUB	0.2 — 0.5	1778G	2612B7	—	30.0	(76.2)	4.6		(11.7)	
	0.4 — 1.0	1778A	2612B1	1719A	15.0	(38.1)	4.6		(11.7)	
	0.8 — 4.0	1778B	2612B2	1719B	7.5	(19.1)	2.0		( 5.1)	
	2.0 — 12.0	1778C	2612B3	1719C	3.0	( 7.6)	0.75		( 1.9)	
	2.0 — 18.0	1778E	—	—	3.0	( 7.6)	0.5		( 1.3)	
	4.0 — 18.0	1778D	2612B4	1719D	1.75	( 4.4)	0.5		( 1.3)	
TRIPLE-STUB	0.2 — 0.5	1878G	2612C7	—	30.0	(76.2)	4.6	(11.7)	/	2.0 ( 5.1)
	0.4 — 1.0	1878A	2612C1	1819A	15.0	(38.1)	4.6	(11.7)	/	2.0 ( 5.1)
	0.8 — 4.0	1878B	2612C2	1819B	7.5	(19.1)	1.0	( 2.5)	/	0.75 ( 1.9)
	2.0 — 18.0	1878C	2612C3	1819C	3.0	( 7.6)	0.75	( 1.9)	/	0.5 ( 1.3)
	4.0 — 18.0	1878D	2612C4	1819D	1.75	( 4.4)	0.75	( 1.9)	/	0.5 ( 1.3)

# Noise Calibration Systems and Components



MT7149D12  
WR10 75–110 GHz  
Noise Calibration System

## Introduction

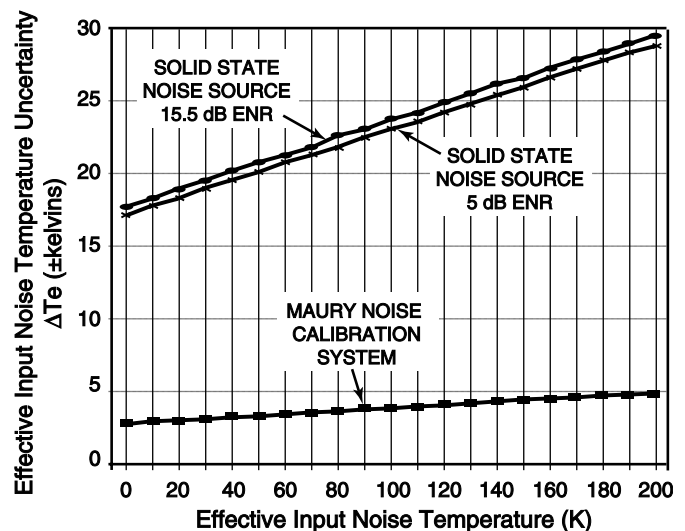
The Maury Noise Calibration Systems (NCS) are self-contained, highly accurate sources of RF and microwave noise power. These systems are used wherever noise source accuracy is critical. Examples are: receiver noise measurements such as noise figure and effective input noise temperature; calibration of solid state noise sources; evaluation and verification of earth station receivers; and as radiometer reference sources.

Each NCS consists of two (hot/cold) or three (hot/ambient/cold) thermal noise sources whose outputs can be conveniently switched into a single calibrated output port. This capability makes for a unique combination of accuracy and convenience. The incorporation of the output switch makes the operation of the NCS in a noise performance measurement as convenient as a solid state noise generator – without the accuracy penalty associated with the latter. The plot shown at right illustrates the improvement in accuracy that can be gained by the use of an NCS in a typical measurement application (effective input noise temperature).

The cold noise source is a liquid nitrogen ( $\text{LN}_2$ ) cooled termination. A liquid nitrogen level sensor and an automatic fill system maintains the proper nitrogen level. The user must provide a suitable liquid nitrogen reservoir. The cold termination is also pressurized with helium at 2 psi. Pressure is maintained by a regulator that requires 20 psi maximum from an external user-supplied source. Since most helium

bottles are pressurized to about 1,000 psi or more, the MT152C pressurizing system is included.

The hot noise source is a heated termination whose temperature is maintained by proportional control to better than  $\pm 0.2\text{K}$  by the MT155J controller. Actual temperature is indicated by a digital readout on the controller front panel.



# Maury Noise Calibration Systems and Components

**True Thermal Noise Sources That Provide High Accuracy in a Conceptually Simple Package.**

**In This Section:**

## Maury MT7000 Series Noise Calibration Systems

These Maury Noise Calibration Systems (NCS) are self-contained, highly accurate sources of RF and microwave noise power that are used wherever noise source accuracy is critical. Examples are: receiver noise measurements, such as noise figure and effective input noise temperature; calibration of solid state noise sources; evaluation and verification of earth station receivers; and as radiometer reference sources. (See page 98).

## Maury MT7000 Series Waveguide Cryogenic Terminations (Cold Loads) and

## Maury MT7100 Series Coaxial Cryogenic Terminations (Cold Loads)

Maury cryogenic terminations are liquid nitrogen cooled loads which provide accurately known noise power at a well matched output port. Used with ambient and/or thermal terminations and a noise figure meter, these terminations provide cold reference temperatures needed for highly accurate noise figure or effective input noise temperature measurements. Because of the accuracy of their noise output, cryogenic terminations are often used as a noise standard for calibration of solid state noise generators. (See pages 100-101.)

## Maury MT7000 Series Waveguide Thermal Terminations (Hot Loads) and

## Maury MT7100 Series Coaxial Thermal Terminations (Hot Loads)

Maury thermal terminations are low-mismatch, heated loads in a precisely controlled thermal environment, which provide and accurately known noise power. Used with ambient and/or cryogenic terminations and a noise figure meter, these terminations provide the hot termination temperature needed for highly accurate noise figure or effective input noise temperature measurements. Because of the accuracy of the noise output, thermal terminations are often used as a noise standard for calibration of solid state noise generators. (See pages 106-109.)

## Maury Coaxial and Waveguide Ambient Terminations

Maury ambient terminations are room temperature noise sources consisting of a stable termination in a massive copper housing to provide thermal stability and to reduce the effects of thermal transients. (See page 105.)

## Noise Components & Accessories

Maury offers a number of accessories to support your Maury Noise Calibration System including a wide range of calibrated adapters and adapter sets that are used with the MT7118J cryogenic termination and the MT7108B thermal termination to adapt the precision 7mm output port to other coaxial series or to waveguide at specific frequencies. They are calibrated for VSWR and insertion loss to allow their input noise temperature to be calculated. (See pages 102 and 109.)





# Noise Calibration Systems and Components

(Continued)

The NCS consists of three assemblies:

- A. A component mounting plate which holds the cryogenic and heated termination assemblies, the hot/cold or hot/ambient/cold remotely controlled relay(s) and output assembly, and the helium pressure regulator. The LN<sub>2</sub> level sensor and fill solenoid are mounted on the cover of the dewar flask.
- B. The MT155J controller (shown at right) which contains the temperature control circuitry and a digital temperature readout for the thermal termination, the automatic or manual LN<sub>2</sub> fill control circuitry and the remote noise temperature output switch.
- C. The MT155L control cable, 25 feet in length, which connects the controller to the mounting plate.

Calibration of the hot/cold noise temperatures at the output connector of the NCS is provided at a number of frequencies. Each NCS model is calibrated at specific standard frequencies. Typically, waveguide units will be calibrated at the band edges and the arithmetic center frequency of the waveguide. Coaxial units are generally calibrated at four data points within the frequency range of the connector type. For example, the



MT155J

The MT155J controller can be located up to 25 feet (7.6 meters) away from the mounting plate.

MT7098J is a dual-load model equipped with a 7mm connectors and transmission lines. Calibration for this unit is provided at 3.95 GHz, 7.5 GHz, 12.4 GHz and 18.0 GHz. (Maury also offers the MT7250 series Noise Calibration Swept Data Module as a tool that allows users to work with other non-standard data points in addition to, or in place of the factory standards.<sup>1</sup>) Note that these noise temperatures are not critical as long as they are accurately known.

## Typical NCS Models

The table below shows a some of the more popular NCS available from Maury. Each model is a complete system made up of the appropriate terminations assembled on a mounting plate, the MT155J controller and the interconnecting cable. All dual-load systems shown consist of cold (LN<sub>2</sub>) and heated terminations. The tri-load system (MT7208J) includes an

ambient termination as well. Please consult our Sales Department if you do not see a noise calibration system in this table suitable for your application or if you would like more detailed information on any of these systems.

Model	Frequency Range (GHz)	Transmission Line	Output Connector Or Flange	Type
MT7091B	10.0 — 12.4	WR90	MPF90 <sup>2</sup>	Dual-load
MT7093B	10.0 — 15.0	WR75	MPF75B <sup>3</sup>	Dual-load
MT7094B	15.0 — 22.0	WR51	MPF51B <sup>3</sup>	Dual-load
MT7095J	18.0 — 26.5	WR42	UG595/U	Dual-load
MT7096J	26.5 — 40.0	WR28	UG599/U	Dual-load
MT7097	33.0 — 50.0	WR22	UG383/U	Dual-load
MT7100J	50.0 — 75.0	WR15	UG385/U	Dual-load
MT7149D	75.0 — 110.0	WR10	UG385/U	Dual-load
MT7098J	DC — 18.0	Coaxial	7mm	Dual-load
MT7208J <sup>4</sup>	DC — 18.0	Coaxial	7mm	Tri-load

<sup>1</sup> Maury data sheet 4E-020 provides specifics on the MT7250 series.

<sup>2</sup> Mates with the appropriate military (UG) and CPR flanges.

<sup>3</sup> Mates with most standard military and industrial flanges in this band.

<sup>4</sup> CE certified.



## Cryogenic Noise Terminations (Cold Loads)



MT7025J with Power Supply and Foam-lined Wood Carrying Case.

### Introduction

Maury cryogenic terminations are liquid nitrogen cooled loads which provide accurately known noise power at a well matched output port. Used with ambient and/or thermal terminations and a noise figure meter, these terminations provide cold reference temperatures needed for highly accurate noise figure or effective input noise temperature measurements. Because of the accuracy of their noise output, cryogenic terminations are often used as a noise standard for calibration of solid state noise generators.

The accuracy achieved by these terminations is possible because they utilize the known temperature of boiling liquid nitrogen as a constant for calculating noise temperature. Because of this, measurements made with these terminations are traceable to the fundamental quantity, temperature and NIST via temperature and network calibration standards.

Each unit is provided with a calibration report which includes VSWR and available output noise temperature data at standard frequencies. Options for additional user-selected frequencies are available (see Maury data sheet 4E-020, which provides specifics for the MT7250 series Noise Calibration Swept Data Module, a software tool that allows users to work with non-standard data points in addition to, or in place of the factory standards).

The cryogenic terminations require user-provided liquid nitrogen and dry helium gas at 2 psi. Maury's MT152A pressurization system is available as an optional accessory to regulate the helium pressure (see page 98). The terminations include a heater circuit to prevent frosting on the output connector and to prevent the heat load of the device under test from affecting the output noise temperature.

# MT7118J 7mm Coaxial Cryogenic Terminations

## DC to 18.0 GHz

### Features

- > Accurate Noise Temperature at Specified Calibration Frequencies
- > Low VSWR Across the Full Frequency Range
- > Liquid Nitrogen Cooled
- > Metrology Grade Calibration for Solid State Noise Generators
- > Low Noise Figure/Temperature Measurements



### Description

The MT7118J cryogenic termination is a liquid nitrogen cooled noise source that provides accurately known noise temperatures at specified calibration frequencies and low VSWR over the full frequency range. It is used for performing accurate noise temperature measurements in 7mm applications such as certification of the noise performance of low noise earth stations. It is also used for general purpose, low noise figure/temperature measurements and calibration of solid state noise generators.

The MT7118J comes with a linear power supply that operates on line voltages of 120 VAC/60 Hz or 240 VAC/50 Hz, while supplying 48 VDC to the device power input.

The MT7118J can be packaged with an extensive complement of options and accessories, including calibrated adapters to other coaxial connector series and waveguide, and user specified calibration frequencies. Our sales staff will be happy to assist in tailoring the best package for your application.

The MT7118J can be optimized for VSWR and input noise temperature over other bandwidths, or with additional calibration points. For calibration at additional or other frequencies see Maury data sheet 4E-020, which covers the maury MT7250 series Noise Calibration Swept Data Module; a software tool that works with Microsoft® Excel® 2003 (or later) to provide an Effective Noise Temperature Interpolator. Please contact our Sales Department for additional information.

Maury also produces an extensive line of precision hot, cold and ambient terminations in both coaxial and waveguide configurations. Our sales staff is ready to assist you in ordering the right noise calibration solution for your applications.

### Pressurizing System

Maury cryogenic terminations require helium gas pressurization at 2 psi. The optional MT152A pressurizing system (see page 102) provides the valves, gages, and hardware necessary to connect an external helium gas supply to Maury cryogenic terminations (helium gas supply is not provided).

### Specifications

Frequency Range.....	DC to 18.0 GHz
Maximum VSWR: .....	1.06, DC to 4.0 GHz
	1.10, 4.0 to 12.0 GHz
	1.15, 12.0 to 18.0 GHz
Operating Temperature (Load) .....	77.36°K (liquid N cooled)
Calibration Frequencies & Noise Temperature	
Uncertainty .....	±1.5 K
Connector .....	7mm
Operating Orientation .....	Horizontal
Operating Life .....	2 hours minimum (one fill)
Dewar Capacity.....	1 liter
Weight .....	7 lbs approximate (empty)
Pressurization.....	2 psi helium gas (external supply)
AC Power .....	100 to 240 VAC, 47 to 63 Hz
	6.0 amps maximum
Accessories (provided).....	One (1) two meter power cord and a wooden instrument case

Note: For calibration at additional or other frequencies, see the information on Maury's MT7250 series Noise Calibration Swept Data Module software (pages 103 –104), or consult our Sales Department.

# Waveguide Cryogenic Terminations

## MT70xx Series

### Features

- > Accurate Noise Temperature at Specified Calibration Frequencies
- > Low VSWR Across the Full Frequency Range
- > Liquid Nitrogen Cooled
- > Metrology Grade Calibration for Solid State Noise Generators
- > Low Noise Figure/Temperature Measurements



### Description

Maury offers waveguide cryogenic terminations in several styles and a wide range of waveguide sizes from WR430 through WR15. The table below represents a typical sample of the available terminations.

Waveguide terminations are generally calibrated at three frequencies – high, low and arithmetic center – within the applicable frequency range; however, they can be calibrated at any user-specified frequency within the waveguide band (using Maury MT7250 Noise Calibration Swept Data Module (see pages 103-104). Additional user-

specified calibration frequencies are also available as an option.

In addition to liquid nitrogen, these terminations require pressurization with helium gas (not provided) at 2 psi. The MT152A pressurizing system (see page 102) is available to provide proper regulation of the helium supply.

The MT70xx series units come with a universal input power supply that operates on line voltages of 100–240 VAC and 47–63 Hz, while supplying 48 VDC to the device power input.

### Available Model Series (Typical)

Model	Frequency Range (GHz)	EIA Waveguide Size	VSWR (maximum)
MT7040H	7.05 — 10.0	WR112 <sup>1, 2</sup>	1.08
MT7041X	10.0 — 12.4	WR90 <sup>2</sup>	1.10
MT7042M	10.0 — 15.5	WR75 <sup>3</sup>	1.08
MT7043P	13.0 — 15.0	WR62 <sup>2</sup>	1.10
MT7044N	15.0 — 22.0	WR51 <sup>3</sup>	1.10
MT7021K	18.0 — 26.5	WR42 <sup>2</sup>	1.08
MT7022U	26.5 — 40.0	WR28 <sup>2</sup>	1.10
MT7023J	33.0 — 50.0	WR22 <sup>2</sup>	1.10
MT7025V	50.0 — 75.0	WR15 <sup>2</sup>	1.15
MT7027Z	75.0 — 110.0	WR10 <sup>2</sup>	1.20

### Calibration Uncertainty

Frequency Range (GHz)	Calibration Uncertainty
< 18.0	±1.5 K
18.0 — 40.0	±1.5 K
40.0 — 50.0	±1.8 K
50.0 — 110.0	±2.6 K

<sup>1</sup> Flange mates with the applicable CPR flange.

<sup>2</sup> Flange mates with the applicable CMR flange.

<sup>3</sup> Flange mates with the applicable military (UG) flange.

## Cryogenic Termination Accessories

### MT152A/C Helium Pressurizing Systems

Maury cryogenic terminations must be supplied with helium gas at about 2 psi to purge contaminants (air, carbon dioxide, etc.) from the coaxial or waveguide transmission line (connecting the cooled termination to the output connector) before the dewar is filled with liquid nitrogen. For stand-alone cryogenic terminations, the MT152A regulates the helium supply by use of a two-stage pressure regulator preset to provide 2 to 3 psi output pressure and a safety pressure relief valve set to 4 psi. These are included with an 8 foot hose and CGA-580 fittings for connecting your helium supply to the termination.

Maury dual-load and tri-load noise calibration systems are provided with the MT152C helium pressurizing system, a modified version of the MT152A, which serves the same purpose.



### Calibrated Adapters Sets

Maury offers a wide range of calibrated adapters and adapter sets that are used with the MT7118J cryogenic termination and the MT7108B thermal termination to adapt the precision 7mm output port to other coaxial series or to waveguide at specific frequencies. They are calibrated for VSWR and insertion loss to allow their input noise temperature to be calculated.

The table below lists the available models and calibrated adapter sets. These are also available separately; however, since the use of adapters affects measurement accuracy and limits stability

or repeatability in waveguide applications, better accuracy is achieved (and operation of the termination is simpler) when they are purchased and calibrated with your instrument. Maury recommends purchase of your instrument with the connector type or waveguide flange needed. (See also page 109.)

Maury also offers cryogenic and thermal terminations calibrated at user-specified or standard frequencies. Please consult our Sales Department for more information.

### Available Models

Model	Connector Type	Description <sup>1</sup>	
8022M	3.5mm	One (1) each female and male adapter calibrated at 3.95, 7.5, 12.4, and 18.0 GHz.	DC – 4.0 GHz, 1.04 4.0 – 18.0 GHz, 1.08
2606M	Type N	One (1) each female and male adapter calibrated at 3.95, 7.5, 12.4, and 18.0 GHz.	DC – 4.0 GHz, 1.03 4.0 – 9.0 GHz, 1.04 9.0 – 18.0 GHz, 1.07
2607M	GR900	One (1) adapter calibrated at 3.95, 7.5, 12.4, and 18.0 GHz.	DC – 8.5 GHz, 1.04
R229E	WR430	One (1) w/g to 7mm end launch adapter calibrated at 2.25, 2.295 and 2.388 GHz.	1.7 – 2.6 GHz, 1.10
E229D	WR229	One (1) w/g to 7mm end launch adapter calibrated at 3.7, 3.95 and 4.2 GHz.	3.7 – 4.2 GHz, 1.05
F229D	WR159	One (1) w/g to 7mm end launch adapter calibrated at 4.9, 6.0 and 7.05 GHz.	4.9 – 7.05 GHz, 1.10
H229D	WR112	One (1) w/g to 7mm end launch adapter calibrated at 7.5, 8.0, 8.212 and 8.4 GHz.	7.05 – 10.0 GHz, 1.05
X229D	WR90	One (1) w/g to 7mm end launch adapter calibrated at 11.7, 11.95 and 12.2 GHz.	8.2 – 12.4 GHz, 1.05
M229D	WR75	One (1) w/g to 7mm end launch adapter calibrated at 14.0, 14.25 and 14.5 GHz.	10.0 – 15.0 GHz, 1.05
P229D	WR62	One (1) w/g to 7mm end launch adapter calibrated at 12.4, 15.0 and 18.0 GHz.	12.4 – 18.0 GHz, 1.05

Key literature – Maury data sheet 4A-008A and 4A-008B.



# Noise Calibration Swept Data Module

## MT7250 SERIES

### Features

- > Multiple Data Points
- > Effective Noise Temperature Calculator
- > Effective Noise Temperature Interpolator
- > Certified Calibration Report Generator
- > Standard and User-Defined Frequencies



### Description

Maury cryogenic and thermal terminations, whether stand-alone models or components of Maury noise calibration systems, are calibrated for hot/cold noise temperatures at their output connectors for a number of frequencies. Waveguide units are typically calibrated at specific standard frequencies or data points at the band edges and the arithmetic center frequency of the waveguide. Coaxial units are generally calibrated at four data points within the frequency range the connector type is rated for. Maury offers the MT7250 series Noise Calibration Swept Data Module as a tool that allows users to work with other, non-standard, data points in addition to, or in place of, the factory standards.

The MT7250 series Swept Data Module Software works with Microsoft® Excel® 2003<sup>1</sup> (or later) to give users the ability to generate standardized, or customized, Maury-certified calibration reports for any Maury cryogenic termination, thermal termination or noise calibration system. The data module can be supplied with a new unit at time of purchase, or with a re-certified unit.

<sup>1</sup> Not provided.

### The Effective Noise Temperature Calculator

The Effective Noise Temperature Calculator uses measured loss and actual temperature data to produce Maury-certified calibration reports. These reports are based on a) pre-measured data points (as shown in the table on the page 104), or b) a user-defined or customized set of measured data points, or c) a combination of both.

### The Effective Noise Temperature Interpolator

For use as a reference tool, the built-in Effective Noise Temperature Interpolator can be used to generate noise temperatures for non-measured data points within the data band of interest.

Microsoft Excel - NOISE TEMP CALCULATOR.xls

**Maury Microwave** **NOISE TEMPERATURE DATA CALCULATOR**  
www.maurycorp.com

CRYOTERM MODEL # BTXXXX  
S/N

JP BAROMETRIC PRESSURE 0  
(T<sub>0</sub>) PLATE TEMP deg. C 26.47  
(T<sub>0</sub>) AMBIENT TEMP deg. C 22.5

FREQUENCY IN GHz	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
ISOLATION SECT. IL (dB) IN dB	17.75	18.15	20.55							
WINDOW & INPUT SECTION IL (dB) IN dB	0.0055	0.0050	0.0050							
FINAL VSWR @ 1.5L	1.000	1.000	1.001							
T <sub>0</sub> (EQUIV. NOISE TEMP) deg. K	88.69	88.81	87.71							

**NOISE TEMPERATURE INTERPOLATOR**

Frequency below interpolation Freq.   
 Frequency of Interest (Interpolation)   
 Frequency above interpolation Freq.   
 ISOLATION SECT. IL (dB) IN dB   
 WINDOW & INPUT SECTION IL (dB) IN dB   
 FINAL VSWR @ 1.5L   
 T<sub>0</sub> (EQUIV. NOISE TEMP) deg. K

GO TO FREQ LIST  
PRINT REPORT  
READ ME - HELP

Typical Excel® spreadsheet showing the MT7250 Swept Data Module user interface (above) and a sample Maury-Certified Calibration Report (at right).

**CRYOGENIC TERMINATION**

ION. LIQUID NITROGEN COOLED  
Calibrator Part No.  Customer Spec. No.

	Input Noise Temp. T <sub>0</sub> (°K)	Input VSWR	Customer Spec. No.
• 0.00978 T <sub>0</sub>	86.63	1.03	
• 0.00995 T <sub>0</sub>	86.72	1.03	
• 0.00995 T <sub>0</sub>	86.45	1.02	
• 0.00875 T <sub>0</sub>	86.07	1.02	
• 0.01044 T <sub>0</sub>	86.6	1.02	
• 0.00951 T <sub>0</sub>	86.53	1.02	
• 0.00951 T <sub>0</sub>	86.53	1.02	
• 0.01000 T <sub>0</sub>	86.97	1.02	
• 0.01000 T <sub>0</sub>	87.20	1.02	
• 0.01000 T <sub>0</sub>	87.22	1.02	

**Notes:**

- For a complete description and specifications, the instrument refers to Technical Data Sheet \_\_\_\_\_.
- Prior to operating this instrument refer to operating instructions No. \_\_\_\_\_.
- For additional information relative to the calibration theory and equations refer to Technical Note \_\_\_\_\_.

To determine T<sub>0</sub> under the prevailing environmental conditions substitute in equations as follows (420 273.15 to convert from °C to °K):  
 T<sub>0</sub> = Temperature of Mounting Plate = 295.5 °K (actual calibration with heater current applied and deuter feed).

T<sub>0</sub> = Actual Ambient Temperature (°K)  
 Input Noise Temperature based on standard environmental conditions where ΔP = 0 (barometric pressure is 753mm Hg).  
 T<sub>0</sub> = 295.5 °K and ambient temperature T<sub>0</sub> = 295.65 °K  
 Cryogenic termination fully operational, deuter feed, heater current and 2 PSI Argon gas preparation applied. (note sheet)

Project  Prepared by and Date  Approved by and Date   
 Valid for 2 years from Approval Date

Model No. 7050 (HAC)

**MAURY MICROWAVE CORPORATION**  
10000 W. 10th St., Suite 100, Lincoln, NE 68504, USA  
Tel: 402-426-1100 Fax: 402-426-1101  
www.maurycorp.com

## Standard Pre-Measured Data Points

Waveguide or Line	Frequency Band (GHz)	Step Size
WR51	15.0—22.0	0.10
WR42	18.0—26.5	0.10
WR28	26.5—40.0	0.25
WR22	33.0—50.0	0.25
WR15	50.0—75.0	0.50
WR10	75.0—110.0	0.50
7mm	0.2—18.0	0.20

## Ambient Terminations



2659A



J309A

### Description

Maury ambient terminations are room temperature noise sources consisting of a stable termination in a massive copper housing to provide thermal stability and to reduce the effects of thermal transients.

These terminations are used as a reference temperature noise source for highly accurate noise figure or effective input noise temperature measurements, as an “on-line” standard for calibrating the operating noise temperature of low noise receiving systems, and in the calibration of solid state noise generators.

Each unit is provided with a direct reading dial thermometer calibrated from -5° to 45°C with better than 0.5° resolution and accuracy. The thermometer receptacle in the housing will also accept a quartz thermometer probe which, when connected to an appropriate unit, will provide for a remote temperature readout.

The units listed below are typical of those available. Please consult the factory for terminations in waveguide sizes, connector types or frequency ranges not shown here.

### Available Models

Model	Frequency Range (GHz)	VSWR (maximum)	Connector or EIA Waveguide Size
2459A	DC — 8.5	1.02, DC — 1.0 1.04, 1.0 — 4.0 1.06, 4.0 — 8.5	14mm (GR900)
2659A	DC — 18.0	1.04, DC — 4.0 1.08, 4.0 — 12.0 1.10, 12.0 — 18.0	7mm
R309B	2.2 — 2.3	1.05	WR430 <sup>1</sup>
E309A	3.7 — 4.2	1.05	WR229 <sup>1</sup>
X309A	8.2 — 12.4	1.05	WR90 <sup>2</sup>
M309A	10.0 — 15.0	1.05	WR75 <sup>3</sup>
P309A	12.4 — 18.0	1.05	WR62 <sup>2</sup>
K309B	21.0 — 23.0	1.05	WR42 <sup>2</sup>
J309A	33.0 — 50.0	1.05	WR22 <sup>2</sup>
U309B	36.0 — 38.0	1.05	WR28 <sup>2</sup>

<sup>1</sup> Flange mates with the applicable CPR flange.

<sup>2</sup> Flange mates with the applicable military (UG) flange.

<sup>3</sup> Flange mates with most applicable standard military and industrial flanges.

## Thermal Noise Terminations (Hot Loads)



### Introduction

Maury thermal terminations are low-mismatch, heated loads in a precisely controlled thermal environment which provide an accurately known noise power. Used with ambient and/or cryogenic terminations and a noise figure meter, these terminations provide the hot termination temperature needed for highly accurate noise figure or effective input noise temperature measurements. Because of the accuracy of the noise output, thermal terminations are often used as a noise standard for calibration of solid state noise generators.

The accuracy achieved by these terminations is possible because they utilize the proven concept of thermal (Johnson) noise operating in a precision thermal environment provided by the MT151C temperature controller. (The MT151C is a highly stable, proportional temperature controller that is accurately calibrated against NIST-traceable temperature measuring equipment.) This is the same concept used in several national standards laboratories

and NIST at the higher microwave frequencies.

The termination and the controller are matched during calibration; therefore, the two instruments must be purchased as a unit. In addition, a line voltage option must be specified. Each unit is provided with a calibration report which includes VSWR and available output noise temperature at specific frequencies.

Options for additional or alternative user-selected frequencies are available. Maury also offers the MT7250 series Noise Calibration Swept Data Module as a tool that allows users to work with non-standard data points in addition to, or in place of the factory standards<sup>1</sup>.) Other accessories such as special instrument cases and calibrated adapters to other coaxial series or waveguide are also available.

<sup>1</sup> See Maury Data Sheet 4E-020. See also pages 103-104.



# Coaxial Thermal Termination

## MT7108B



MT151C

MT7108B

### Description

Maury offers a single thermal noise termination model (the MT7108B), which is equipped with a precision 7mm coaxial output connector, and operates from DC to 18 GHz. This compact, reliable instrument is equally suited for both field measurements and laboratory use. It is generally used to make accurate low noise figure/temperature measurements and for calibration of solid state noise generators. The flexibility and versatility of the MT7108B are enhanced by an extensive selection of options and accessories. These include calibrated adapters to other coaxial connector series and waveguide flanges, and factory calibration at user-specified frequencies. (Maury's MT7250 series Noise Calibration Swept Data Module is offered as a tool that allows users to work with non-standard data points in addition to, or in place of the factory standards<sup>1</sup>.)

The MT7108B comes with a MT151C controller, with which it is precisely matched during the initial factory calibration. For accurate performance, these units must be used together. The MT151C's internal proportional controller responds to sensors in physical proximity to the termination and directs the MT7108B's heater circuit to maintain the physical temperature of the termination at 373.1 kelvins (100°C). Heavy insulation of the entire termination assembly minimizes the effects of the external environment. The MT151C's line voltage must be specified at the time of order. This ensures that the MT151C will be properly fused and shipped with the appropriate power cable (AC power option 22 for 100/120 VAC, 50/60 Hz, or option 32 for 220/240 VAC, 50/60 Hz).

VSWR and noise temperature data are provided at four frequencies (3.95 GHz, 7.5 GHz, 12.4 GHz and 18.0 GHz). A certified calibration report with traceability to NIST is provided with each unit.

### Specifications

Frequency Range ..... DC to 18 GHz  
 Nominal Physical Load Temperature ..... 373.1 K  
 Load Temperature Stability .....  $\pm 0.2$  K

#### VSWR (maximum):

DC to 4 GHz ..... 1.06  
 4 to 12 GHz ..... 1.10  
 12 to 18 GHz ..... 1.15

#### AC Power (User specifies one of two options):

Option 22 ..... 100/120 VAC, 50/60 Hz  
 Option 32 ..... 220/240 VAC, 50/60 Hz

Noise Temperature Uncertainty .....  $\pm 0.7$  K

Connector ..... Precision 7mm <sup>2</sup>

### Accessories Provided

- > One (1) MT151C controller
- > One (1) MT151P controller cable
- > One (1) Instrument case

<sup>1</sup> See Maury data sheet 4E-020 for details, and pages 103-104 in this volume.

<sup>2</sup> Precision 7mm per Maury data sheet 5E-060.

# Waveguide Thermal Terminations

## MT70xx Series



MT151C



MT7090J

### Description

Maury offers waveguide thermal terminations in several styles and a wide range of waveguide sizes, from WR430 through WR10. The chart below represents a typical sample of the available terminations.

Waveguide terminations are generally calibrated at three frequencies – high, low, and arithmetic center – within the applicable frequency range; however, they can be calibrated at any user-specified frequency within the waveguide band. Additional user-specified calibration frequencies are also available as an option. (Maury's MT7250 series Noise Calibration

Swept Data Module is offered as a tool that allows users to work with non-standard data points in addition to, or in place of the factory standards<sup>1</sup>.) Please contact our Sales Department for more information.

The physical temperature of the waveguide terminations is 350 kelvins with a stability of  $\pm 0.2$  kelvins. These terminations are calibrated with a specific temperature controller, and the two instruments are provided as a unit. A line voltage option must be specified at the time of order.

### Available Models

Model	Frequency Range (GHz)	EIA Waveguide Size	Maximum VSWR
MT7005A	3.7 – 4.2	WR229 <sup>2</sup>	1.07
MT7081A	10.0 – 12.4	WR90 <sup>3</sup>	1.10
MT7082A	10.0 – 15.0	WR75 <sup>3</sup>	1.08
MT7009B	15.0 – 22.0	WR51	1.10
MT7084A	18.0 – 26.5	WR42 <sup>3</sup>	1.08
MT7085A	26.5 – 40.0	WR28 <sup>3</sup>	1.10
MT7086A	33.0 – 50.0	WR22 <sup>3</sup>	1.10
MT7088B	50.0 – 75.0	WR15 <sup>3</sup>	1.20
MT7090J	75.0 – 110.0	WR10 <sup>3</sup>	1.15

### Calibration Uncertainty

Frequency Band (GHz)	Uncertainty (Kelvins)
< 18.0	$\pm 0.70$ K
18.0 – 40.0	$\pm 0.60$ K
40.0 – 50.0	$\pm 0.65$ K
50.0 – 110.0	$\pm 1.00$ K

### Accessories Provided

- > One (1) MT151C controller
- > One (1) MT151P controller cable
- > One (1) Instrument case

<sup>1</sup> See Maury data sheet 4E-020 and pages 103-104 in this volume.

<sup>2</sup> Flange mates with applicable CPR and CMR flanges.

<sup>3</sup> Flange mates with the applicable military (UG) flange.

## Thermal Terminations – Options and Accessories

### Temperature Controller, MT151C

A temperature controller is provided with each thermal termination. The controller and the termination are calibrated together and are sold as a unit. A line voltage must be specified at the time of order:

- > Option 22 ..... 100/120 VAC
- > Option 32 ..... 220.240 VAC



MT151C

### Instrument Case

Most Maury heated terminations are supplied in a foam-lined instrument case (like the one shown at below) for convenient handling and storage. Please contact our Sales Department for details.



A typical foam-lined Instrument case with one (1) model **MT7090J**, one (1) calibrated **MT151C** Controller and one (1) Operating Manual.

### Calibrated Adapters For Your 7mm Hot and Cold Loads

You can increase the utility of your Maury Cryogenic and Thermal Terminations by using precision adapters to connect the 7mm output port on the termination to other coaxial and waveguide connectors. However, as in any microwave measurement system, adding adapters degrades the accuracy of the data that can be obtained. In the case of waveguide measurement, stability and repeatability will also be degraded by the use of adapters. Therefore, for optimum performance, it is always recommended that a thermal termination with the appropriate output port be used for specific measurement applications.

In situations where adapters must be used, it is critical that the adapters are calibrated so that the critical performance parameters are known and can be calculated into the measurements. Adapters can be calibrated separately, but better accuracy is achieved and operation of the termination is simpler when they are purchased and calibrated with the thermal termination they will be used with.

The table at right shows the adapters and adapter sets that are available from Maury. If you don't see the adapter you need in this table, please contact our Sales Department for assistance.

All of these adapters are calibrated for VSWR and insertion loss so that their input noise temperature can be calculated using Maury technical note TN-011. The adapters are shipped with a test report and operating note. When purchased with a thermal termination, Maury can provide VSWR calibration of these adapters for an additional cost (quoted on request). Please contact our Sales Department for further details.

See page 102 for descriptions of the calibrated adapter sets.



### Typical 7mm between-series adapters.

Model	Maximum VSWR (GHz)	Adapts 7mm to
2606M	1.03, DC–4.0	Type N (F & M)
	1.04, 4.0–9.0	
	1.07, 9.0–18.0	
8022M	1.04, DC–4.0 1.08, 4.0–18.0	3.5mm (F & M)
2607M	1.004 + 0.004f	14mm
R229E	1.10, 1.7–2.6	WR430
E229D	1.05, 3.7–4.2	WR229
F229D	1.10, 4.9–7.05	WR159
H229D	1.05, 7.05–10.0	WR112
X229D	1.05, 8.2–12.4	WR90
M229D	1.05, 10.0–15.0	WR75
P229D	1.05, 12.4–18.0	WR62

# THANK YOU

We want to take the opportunity to thank you for your interest in Maury Microwave products and services. We realize that we must earn your business on each and every requirement by providing the highest quality products at a fair price with delivery per commitment.

This is what you expect and this is what Maury Microwave strives to provide.



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