MAURY

Noise Calibration Systems & Components

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• Thermal Terminations (Hot Loads)
• Ambient Terminations
• Helium Pressurizing Systems
• Calibrated Adapter Sets

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Maury Noise Calibration Systems and Components

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

In This Volume:

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.

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.

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.

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.

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.
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 53 years we serve our customers as Maury Microwave Corporation. We are proud of our company and the products we make, we are dedicated to the pursuit of quality, and we are committed to providing the very best in customer service.

Markets Served
Maury Microwave serves all areas of the RF and microwave industry, producing a comprehensive line of automated tuners, microwave components and accessories that operate from DC to 110 GHz. Our offering includes a wide range of test and measurement products that are used extensively by the wireless communication industry for power and noise characterization of transistors and amplifiers. Our precision calibration standards 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 custom products tailored to our customers’ specific requirements.

Business Alliances
As a leader in the RF and microwave calibration and measurement field, Maury has long been recognized for the accuracy, repeatability, and stability of our products. Agilent Technologies acknowledged this in September, 2001 by inviting Maury Microwave to become a Channel Partner for device characterization solutions. The ongoing success of that relationship led to Maury’s current recognition as an Agilent Global Solutions Partner. We also enjoy close business ties with Cascade Microtech of Beaverton, Oregon and Inter-Continental Microwave of Chandler, Arizona.

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.

New 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 to 67 GHz in most popular line sizes and we also manufacture waveguide components from WR650 to WR10.

Maury’s extensive line of VNA calibration kits also supports Agilent’s PNA and ENA series, as well as Rohde and Schwarz ZV series and Anritsu 37000 series network analyzers. Also, new digital connector gage kits are now available in 3.5mm/2.92mm and 2.4mm/1.85mm combination models.

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.
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/srx.htm.

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 MIL-SPEC 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 ANSI/NCSL Z540-1 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 ISO 9001:2000/AS9100:2004 REGISTERED COMPANY.
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/NCSL Z540-1 (MIL-STD-45662A) calibration and commercial level calibration services for every product we produce. Our laboratory is ANSI/NCSL 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
- Verification 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
**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 (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 ±0.2K by the MT155J controller. Actual temperature is indicated by a digital readout on the controller front panel.
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\textsubscript{2} 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\textsubscript{2} 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 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.)

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\textsubscript{2}) 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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range (GHz)</th>
<th>Transmission Line</th>
<th>Output Connector Or Flange</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT7091B</td>
<td>10.0 — 12.4</td>
<td>WR90</td>
<td>MPF90</td>
<td>Dual-load</td>
</tr>
<tr>
<td>MT7093B</td>
<td>10.0 — 15.0</td>
<td>WR75</td>
<td>MPF75B</td>
<td>Dual-load</td>
</tr>
<tr>
<td>MT7094B</td>
<td>15.0 — 22.0</td>
<td>WR51</td>
<td>MPF51B</td>
<td>Dual-load</td>
</tr>
<tr>
<td>MT7095J</td>
<td>18.0 — 26.5</td>
<td>WR42</td>
<td>UG595/U</td>
<td>Dual-load</td>
</tr>
<tr>
<td>MT7096J</td>
<td>26.5 — 40.0</td>
<td>WR28</td>
<td>UG599/U</td>
<td>Dual-load</td>
</tr>
<tr>
<td>MT7097</td>
<td>33.0 — 50.0</td>
<td>WR22</td>
<td>UG383/U</td>
<td>Dual-load</td>
</tr>
<tr>
<td>MT7149J</td>
<td>75.0 — 110.0</td>
<td>WR10</td>
<td>UG385/U</td>
<td>Dual-load</td>
</tr>
<tr>
<td>MT7098J</td>
<td>DC — 18.0</td>
<td>Coaxial</td>
<td>7mm</td>
<td>Tri-load</td>
</tr>
<tr>
<td>(MT7208J)</td>
<td>DC — 18.0</td>
<td>Coaxial</td>
<td>7mm</td>
<td>Tri-load</td>
</tr>
</tbody>
</table>

1 Maury data sheet 4E-020 provides specifics on the MT7250 series.
2 Mates with the appropriate military (UG) and CPR flanges.
3 Mates with most standard military and industrial flanges in this band.
4 CE certified.
Cryogenic Noise Terminations

**General**

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 heated 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. This mirrors the conceptual foundation of the noise standards used in virtually all national standards laboratories worldwide (e.g.: NIST). 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 specific frequencies. Options for additional user-selected frequencies are available.

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 13). The terminations include a heater circuit which operates on 115 VAC to prevent ice from forming on the output connector and to prevent the heat load of the device under test from affecting the output temperature. On some models, operation at 230 VAC requires the addition of the Maury MT154A power adapter.
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
- CE Approved

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 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.

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, additional calibration points or with calibrated bends for other operating orientations.

Pressurizing System

Maury cryogenic terminations require helium gas pressurization at 2 psi. The optional MT152A pressurizing system (see page 13) 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 14 – 15), 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
- CE Approved

Description

Maury offers waveguide cryogenic terminations in several styles and a wide range of waveguide sizes from WR430 through WR15. 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 (using Maury MT7250 Noise Calibration Swept Data Module (see pages 14-15). 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 13) 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)

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range (GHz)</th>
<th>EIA Waveguide Size</th>
<th>VSWR (maximum)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT7040( )</td>
<td>7.05 — 10.0</td>
<td>WR112 1, 2</td>
<td>1.08</td>
</tr>
<tr>
<td>MT7041( )</td>
<td>10.0 — 12.4</td>
<td>WR90 2</td>
<td>1.10</td>
</tr>
<tr>
<td>MT7042( )</td>
<td>10.0 — 15.5</td>
<td>WR75 3</td>
<td>1.08</td>
</tr>
<tr>
<td>MT7043( )</td>
<td>13.0 — 15.0</td>
<td>WR62 2</td>
<td>1.10</td>
</tr>
<tr>
<td>MT7044( )</td>
<td>15.0 — 22.0</td>
<td>WR51 3</td>
<td>1.10</td>
</tr>
<tr>
<td>MT7021( )</td>
<td>18.0 — 26.5</td>
<td>WR42 2</td>
<td>1.08</td>
</tr>
<tr>
<td>MT7022( )</td>
<td>26.5 — 40.0</td>
<td>WR28 2</td>
<td>1.10</td>
</tr>
<tr>
<td>MT7023( )</td>
<td>33.0 — 50.0</td>
<td>WR22 2</td>
<td>1.10</td>
</tr>
<tr>
<td>MT7025( )</td>
<td>50.0 — 75.0</td>
<td>WR15 2</td>
<td>1.15</td>
</tr>
<tr>
<td>MT7027( )</td>
<td>75.0 — 110.0</td>
<td>WR10 2</td>
<td>1.20</td>
</tr>
</tbody>
</table>

1 Flange mates with the applicable CPR flange.
2 Flange mates with the applicable CMR flange.
3 Flange mates with the applicable military (UG) flange.
4 Flange mates with most applicable military and industrial flanges.

Calibration Uncertainty

<table>
<thead>
<tr>
<th>Frequency Range (GHz)</th>
<th>Calibration Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18.0</td>
<td>±1.5 K</td>
</tr>
<tr>
<td>18.0 — 40.0</td>
<td>±1.5 K</td>
</tr>
<tr>
<td>40.0 — 50.0</td>
<td>±1.8 K</td>
</tr>
<tr>
<td>50.0 — 110.0</td>
<td>±2.6 K</td>
</tr>
</tbody>
</table>
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 chart at right lists the available models and 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.)

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

**Available Models**

<table>
<thead>
<tr>
<th>Model</th>
<th>Connector Type</th>
<th>Description ¹</th>
<th>Maximum VSWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8022M</td>
<td>3.5mm</td>
<td>One (1) each female and male adapter calibrated at 3.95, 7.5, 12.4, and 18.0 GHz.</td>
<td>DC – 4.0 GHz, 1.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.0 – 18.0 GHz, 1.08</td>
</tr>
<tr>
<td>2606M</td>
<td>Type N</td>
<td>One (1) each female and male adapter calibrated at 3.95, 7.5, 12.4, and 18.0 GHz.</td>
<td>DC – 18.0 GHz, 1.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4.0 – 9.0 GHz, 1.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9.0 – 18.0 GHz, 1.07</td>
</tr>
<tr>
<td>2607M</td>
<td>GR900</td>
<td>One (1) adapter calibrated at 3.95, 7.5, 12.4, and 18.0 GHz.</td>
<td>DC – 8.5 GHz, 1.04</td>
</tr>
<tr>
<td>R229E</td>
<td>WR430</td>
<td>One (1) w/g to 7mm end launch adapter calibrated at 2.25, 2.295 and 2.388 GHz.</td>
<td>1.7 – 2.6 GHz, 1.10</td>
</tr>
<tr>
<td>E229D</td>
<td>WR229</td>
<td>One (1) w/g to 7mm end launch adapter calibrated at 3.7, 3.95 and 4.2 GHz.</td>
<td>3.3 – 4.9 GHz, 1.10</td>
</tr>
<tr>
<td>F229D</td>
<td>WR159</td>
<td>One (1) w/g to 7mm end launch adapter calibrated at 4.9, 6.0 and 7.05 GHz.</td>
<td>4.9 – 7.02 GHz, 1.10</td>
</tr>
<tr>
<td>H229D</td>
<td>WR112</td>
<td>One (1) w/g to 7mm end launch adapter calibrated at 7.5, 8.0, 8.212 and 8.4 GHz.</td>
<td>7.05 – 10.0 GHz, 1.05</td>
</tr>
<tr>
<td>X229D</td>
<td>WR90</td>
<td>One (1) w/g to 7mm end launch adapter calibrated at 11.7, 11.95 and 12.2 GHz.</td>
<td>8.2 – 12.4 GHz, 1.05</td>
</tr>
<tr>
<td>M229D</td>
<td>WR75</td>
<td>One (1) w/g to 7mm end launch adapter calibrated at 14.0, 14.25 and 14.5 GHz.</td>
<td>10.0 – 15.0 GHz, 1.05</td>
</tr>
<tr>
<td>P229D</td>
<td>WR62</td>
<td>One (1) w/g to 7mm end launch adapter calibrated at 12.4, 15.0 and 18.0 GHz.</td>
<td>12.4 – 18.0 GHz, 1.05</td>
</tr>
</tbody>
</table>

¹ Calibration and VSWR at other frequencies is available upon request. Contact our sales department for assistance.

Key literature – Maury data sheet 4A-008A and 4A-008B.
Noise Calibration Systems and Components

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\(^1\) (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.

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 15), 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.

\(^1\) Not provided.
Typical Excel® spreadsheet showing the MT7250 Swept Data Module user interface (above) and a sample Maury-Certified Calibration Report (at right).

### Standard Pre-Measured Data Points

<table>
<thead>
<tr>
<th>Waveguide or Line</th>
<th>Frequency Band (GHz)</th>
<th>Step Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>WR51</td>
<td>15.0—22.0</td>
<td>0.10</td>
</tr>
<tr>
<td>WR42</td>
<td>18.0—26.5</td>
<td>0.10</td>
</tr>
<tr>
<td>WR28</td>
<td>26.5—40.0</td>
<td>0.25</td>
</tr>
<tr>
<td>WR22</td>
<td>33.0—50.0</td>
<td>0.25</td>
</tr>
<tr>
<td>WR15</td>
<td>50.0—75.0</td>
<td>0.50</td>
</tr>
<tr>
<td>WR10</td>
<td>75.0—110.0</td>
<td>0.50</td>
</tr>
<tr>
<td>7mm</td>
<td>0.2—18.0</td>
<td>0.20</td>
</tr>
</tbody>
</table>
Ambient Terminations

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°C to 45°C with better than 0.5°C 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

<table>
<thead>
<tr>
<th>Model</th>
<th>Frequency Range (GHz)</th>
<th>VSWR (maximum)</th>
<th>Connector or EIA Waveguide Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2459A</td>
<td>DC — 8.5</td>
<td>1.02, DC — 1.0</td>
<td>14mm (GR900)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.04, 1.0 — 4.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.06, 4.0 — 8.5</td>
<td></td>
</tr>
<tr>
<td>2659A</td>
<td>DC — 18.0</td>
<td>1.04, DC — 4.0</td>
<td>7mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.08, 4.0 — 12.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.10, 12.0 — 18.0</td>
<td></td>
</tr>
<tr>
<td>R309B</td>
<td>2.2 — 2.3</td>
<td>1.05</td>
<td>WR430 1</td>
</tr>
<tr>
<td>E309A</td>
<td>3.7 — 4.2</td>
<td>1.05</td>
<td>WR229 1</td>
</tr>
<tr>
<td>X309A</td>
<td>8.2 — 12.4</td>
<td>1.05</td>
<td>WR90 2</td>
</tr>
<tr>
<td>M309A</td>
<td>10.0 — 15.0</td>
<td>1.05</td>
<td>WR75 3</td>
</tr>
<tr>
<td>P309A</td>
<td>12.4 — 18.0</td>
<td>1.05</td>
<td>WR62 2</td>
</tr>
<tr>
<td>K309B</td>
<td>21.0 — 23.0</td>
<td>1.05</td>
<td>WR42 2</td>
</tr>
<tr>
<td>J309B</td>
<td>33.0 — 50.0</td>
<td>1.05</td>
<td>WR22 2</td>
</tr>
<tr>
<td>U309B</td>
<td>36.0 — 38.0</td>
<td>1.05</td>
<td>WR28 2</td>
</tr>
</tbody>
</table>

1 Flange mates with the applicable CPR flange.
2 Flange mates with the applicable military (UG) flange.
3 Flange mates with most applicable standard military and industrial flanges.
Noise Calibration Systems and Components

HOT THERMAL NOISE TERMINATIONS

General

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. Other accessories such as special instrument cases and calibrated adapters to other coaxial series or waveguide are also available.

1 See Maury Data Sheet 4E-020. See also pages 14-15.
### 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 standards1.)

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.

1 See Maury data sheet 4E-020 for details, and pages 14-15 in this volume.

### Specifications

- **Frequency Range**.......................... DC to 18 GHz
- **Nominal Physical Load Temperature**.................... 373.1 K
- **Load Temperature Stability**.......................... ±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** .................................. ±0.7 K

### Accessories Provided

- One (1) MT151C controller
- One (1) MT7005P controller cable
- One (1) Instrument case

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Precision 7mm per Maury data sheet 5E-060.
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.) Please contact our Sales Department for more information.

The physical temperature of the waveguide terminations is 350 kelvins with a stability of ±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

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

### Calibration Uncertainty

<table>
<thead>
<tr>
<th>Frequency Band (GHz)</th>
<th>Uncertainty (Kelvins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18.0</td>
<td>±0.70 K</td>
</tr>
<tr>
<td>18.0 – 40.0</td>
<td>±0.60 K</td>
</tr>
<tr>
<td>40.0 – 50.0</td>
<td>±0.65 K</td>
</tr>
<tr>
<td>50.0 – 110.0</td>
<td>±1.00 K</td>
</tr>
</tbody>
</table>

### Accessories Provided

- One (1) MT151C controller
- One (1) MT7005P controller cable
- One (1) Instrument case

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2. Flange mates with applicable CPR and CMR flanges.
3. 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

Calibrated Adapters

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 13 for descriptions of the calibrated adapter sets.

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.

### Table of 7mm Adapter Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum VSWR (GHz)</th>
<th>Adapts 7mm to</th>
</tr>
</thead>
<tbody>
<tr>
<td>2606M</td>
<td>1.03, DC–4.0</td>
<td>Type N (F &amp; M)</td>
</tr>
<tr>
<td></td>
<td>1.04, 4.0–9.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.07, 9.0–18.0</td>
<td></td>
</tr>
<tr>
<td>8022M</td>
<td>1.04, DC–4.0</td>
<td>3.5mm (F &amp; M)</td>
</tr>
<tr>
<td></td>
<td>1.08, 4.0–18.0</td>
<td></td>
</tr>
<tr>
<td>2607M</td>
<td>1.004 + 0.004f</td>
<td>14mm</td>
</tr>
<tr>
<td>R229E</td>
<td>1.05, 1.7–2.6</td>
<td>WR430</td>
</tr>
<tr>
<td>E229D</td>
<td>1.05, 3.3–4.9</td>
<td>WR229</td>
</tr>
<tr>
<td>F229D</td>
<td>1.05, 4.9–7.02</td>
<td>WR159</td>
</tr>
<tr>
<td>H229D</td>
<td>1.05, 7.05–10.0</td>
<td>WR112</td>
</tr>
<tr>
<td>X229D</td>
<td>1.05, 8.2–12.4</td>
<td>WR90</td>
</tr>
<tr>
<td>M229D</td>
<td>1.05, 10.0–15.0</td>
<td>WR75</td>
</tr>
<tr>
<td>P229D</td>
<td>1.05, 12.4–18.0</td>
<td>WR62</td>
</tr>
</tbody>
</table>

MT7090J and calibrated MT151C Controller and Operating Manual in a typical foam-lined instrument case.
Thank You!

We want to take the opportunity to thank you for your interest in Maury Microwave products. 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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