

NOISE CALIBRATION SYSTEM

7mm COAXIAL - DUAL LOAD SYSTEM

Features

- *Highly Accurate Noise Source*
- *Hot Load and Cold Load in One Unit*
- *Excellent for Receiver Noise Measurements (Noise Figure and Effective Input Noise Temperature)*
- *Excellent for Solid State Noise Source Calibration*

Description

The Maury MT7098J is an automatic, self-contained system that provides two accurately known, switched thermal noise sources at a single precision 7mm coaxial output port. It is designed for highly accurate noise figure or effective input noise temperature measurements, calibration of less accurate solid state noise generators, and performance evaluation and verification of satellite earth station receivers. Maury application note 5C-028 provides more details on these measurement procedures.

In many critical, low-noise measurement applications, solid state noise generators do not provide the degree of accuracy that is required to meet metrology standards. The typical solid state general purpose laboratory unit will exhibit hot temperature uncertainties in the order of ± 200 to ± 700 kelvins (K). The worst case temperature uncertainty of the MT7098J is better than ± 2 K. In a measurement of an amplifier with an effective input noise temperature of 100K, this can reduce measurement uncertainty due to temperature errors by about 30%.

The accuracy of the MT7098J derives from the use of true thermal noise sources — the fundamental principle of noise generation — and highly accurate insertion loss measurements of the interconnecting transmission structure (primarily the hot/cold selector relays).

The cold noise temperature is provided by a liquid nitrogen (LN_2) cooled termination (MT7118J series). An automatic level sensing/fill system maintains the proper operating level of user-provided liquid nitrogen. The termination is pressurized to 2 pounds per square inch (PSI) using helium gas. Pressurization purges the termination of air, moisture



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vapor, carbon dioxide and other contaminants, which if allowed to freeze would alter the microwave characteristics of the termination structure. Pressure is maintained by a regulator, which requires 20 PSI maximum from a user-provided external helium supply.

The hot noise source is a heated termination (MT7108B series) providing an operating temperature approximately that of boiling water (373.1K), which is maintained by proportional control to better than ± 0.2 K by the MT155J controller. Actual temperature is indicated by a digital readout on the controller front panel.

The MT7098J is comprised of three assemblies:

- A component mounting plate, which holds the cryogenic termination, the thermal termination, the hot/cold remotely controlled relays and the output assembly, and the helium pressure regulator. The LN_2 level sensor and fill solenoid are mounted on the cover of the LN_2 container.
- The MT155J controller, which contains the proportional temperature control circuitry for the thermal termination, a digital temperature readout (heated termination only), the liquid nitrogen automatic or manual fill control circuitry, and the remote hot/cold switch. The controller is described in detail in Maury data sheet 4F-003.
- The MT155L cable (25 feet/7.6 meters), which connects the controller to the component mounting plate.



Calibration of the hot and cold noise temperatures *at the output connector* is provided at four frequencies as shown in the **Specifications**. Additional or alternate calibration frequencies can be provided at additional cost (consult our Sales Department for calibration charges). Note that the noise temperatures themselves are not critical as long as they are accurately known.

Maury also offers the MT7250 series Noise Calibration Swept Data Module as a software tool that allows users to work with other non-standard data points in addition to, or in place of the factory standards. See Maury data sheet 4E-020 for MT7250 technical data.

Each MT7098J noise calibration system is provided with a calibration report, operating instructions, and three technical notes describing the calibration procedure and error analysis.

Maury also manufactures tri-load systems (with hot, ambient, and cold loads) as well as stand-alone cold, ambient and hot loads with 7mm coaxial or various popular waveguide connectors.

Specifications

Frequency Range DC to 18.0 GHz

VSWR (maximum):

DC to 10 GHz $1.10 + 0.01f(\text{GHz})$

10.0 to 18.0 GHz 1.20

Physical Termination Temperature:

Cold Termination 77.36K

Hot Termination 373.1K

Hot Temperature Stability $\pm 0.2\text{K}$ ($\pm 0.1\text{K}$ typical)

Available Output Noise Temperatures See Table I

Calibration Accuracy See Table II¹

Output Connector Precision 7mm²

Pressurization Helium at 20 PSI maximum

LN₂ Dewar Capacity 1 liter

LN₂ Operating Life 3 hours³

Operating Orientation Horizontal

Mounting Plate Dimensions See Figure 1

Power Requirements⁴:

Option 03 120 VAC/60 Hz

Option 04 240 VAC/50 Hz

¹ Other frequencies available at additional cost.

² 7mm male connector that is mating compatible with standard 7mm precision un-sexed connectors, per Maury data sheet 5E-060.

TABLE I
Typical Noise Temperatures at the MT7098J Output Connector

Frequency Range (GHz)	Hot Temperature (K)	Cold Temperature (K)
3.95	371	83
7.50	369	88
12.40	366	95
18.00	365	98

TABLE II
Noise temperature Calibration Accuracy

Frequency Range (GHz)	Temperature Uncertainty (\pm K)
DC – 18	1.5

Dimensions in Inches/(cm)

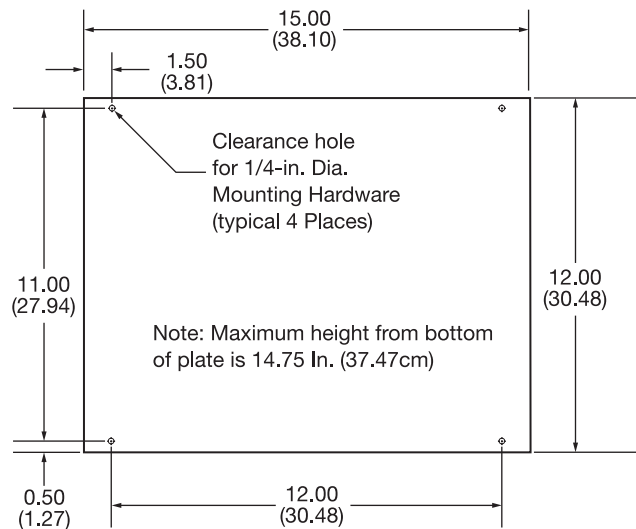


Figure 1. Component Mounting Plate Dimensions⁵

³ Single fill only. Operation is continuous with automatic fill as long as the LN₂ supply lasts.

⁴ Appropriate option must be specified at time of order.

⁵ Outline and layout available upon request.