06 Jun 2006

FULLY INTEGRATED MILLIMETER-WAVE DEVICE CHARACTERIZATION SYSTEMS

Maury Microwave Corporation
Ontario, California

This Article First Appeared in an RF Globalnet Newsletter, March 30, 2006

FULLY INTEGRATED MILLIMETER-WAVE DEVICE CHARACTERIZATION SYSTEMS

Author: Dr. Ali Boudiaf, Maury Microwave Corporation

The wireless communications market has grown dramatically in the last several years. As a result, frequency usage and commercial wireless applications have continued to move rapidly toward the millimeter-wave range. The emergence of millimeter-wave wireless applications including LMDS, WLAN, and automotive anticollision radar has brought with it new demands for device characterization systems that address the operation of transistors at millimeter-wave frequencies.

The new MT900N family of millimeter-wave device characterization systems was developed to provide customers with a set of state-of-the-art characterization tools for the development of circuit design methodologies that extract increased performance from a given fabrication process by enhancing transistor operating range and linearity. MT900N millimeter-wave noise parameter and load-pull measurement systems encompass a wide range of high-performance component test tools to address the growing needs of new millimeter-wave applications. Specific models and added options offer higher levels of measurement capability, including noise parameters, gain compression, harmonic, IMD, output power contours, and many other measurement features, in addition to fast and accurate S-parameter measurements. Complete measurement solutions to 50, 75, 90, and 110 GHz are available.

Maury Microwave offers noise parameters and large-signal test systems for both on-wafer and packaged device measurements. Measurement setups have been developed for V band (50 to 75 GHz), E band (60 to 90 GHz) and W band (75 o 110 GHz). Noise parameters are measured as functions of frequency or bias conditions and are based on the commonly used cold-noise source method. They are determined from measured noise figure versus source impedance data. Large-signal characterization is performed versus source and load impedance using tuners at the input and output of the device under test.

These systems use automated electro-mechanical tuners that are described in the following tables:

Model	Frequency Range	EIA WR Number	Designation	Mates With
MT979A	75.0 GHz — 110.0 GHz	10	MPF10	UG385/U
MT978A	60.0 GHz — 90.0 GHz	12	MPF12	UG385/U
MT977A	50.0 GHz — 75.0 GHz	15	MPF15	UG385/U
MT976A	40.0 GHz — 60.0 GHz	19	MPF19	UG385/U

Specifications	
Minimum matching range	20:1
Maximum VSWR	1.06
Maximum insertion loss	0.65 dB
Worst-case repeatability	> 50 dB
Step size (probes)	0.5 micron
Step size (carriage)	0.5 micron
Power handling	20W CW, 200W peak

2900 Inland Empire Blvd. • Ontario, California 91764-4804
Tel: 909-987-4715 • Fax: 909-987-1112 • http://www.maurymw.com

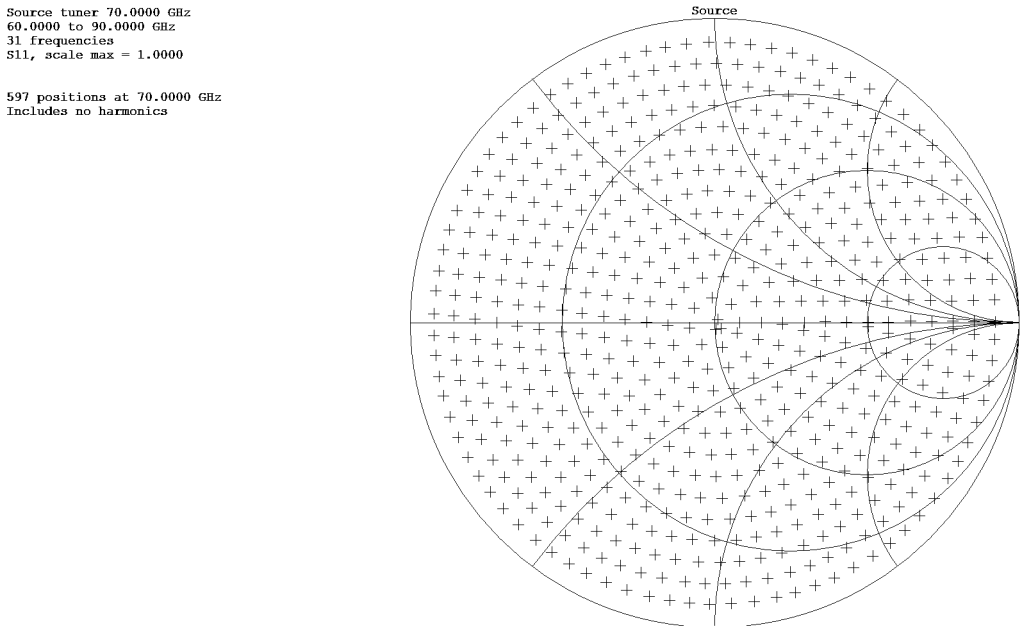

Figure 1. Typical Tuner Impedance Spread at 70 GHz

For example, the MT900N15 system, shown in the picture below, is a fully integrated on-wafer, S-parameter, noise parameter, and large signal device characterization system built on the Cascade Microtech automated probe station S300. It is a fully automated system through GPIB bus, and includes a millimeter-wave Agilent PNA network analyzer, spectrum analyzer, power meter, and noise figure meter associated with a Maury Microwave 60 to 90 GHz noise downconverter.

Figure 2. MT900N15 RF Device Characterization System

To demonstrate the measurement capability of the system, the measured minimum noise figure, associated gain, and optimum source reflection coefficient of a 3 dB pad device are shown in **Figure 3**. In these measurements, the frequency range was from 60 to 85 GHz. The measured minimum noise figure (Fmin) is compared to the calculated Fmin (Fmin_v) from measured S-parameters to assess the accuracy of the measurements. The results show that the predicted and the measured minimum noise figure are within a few tenths of a dB.

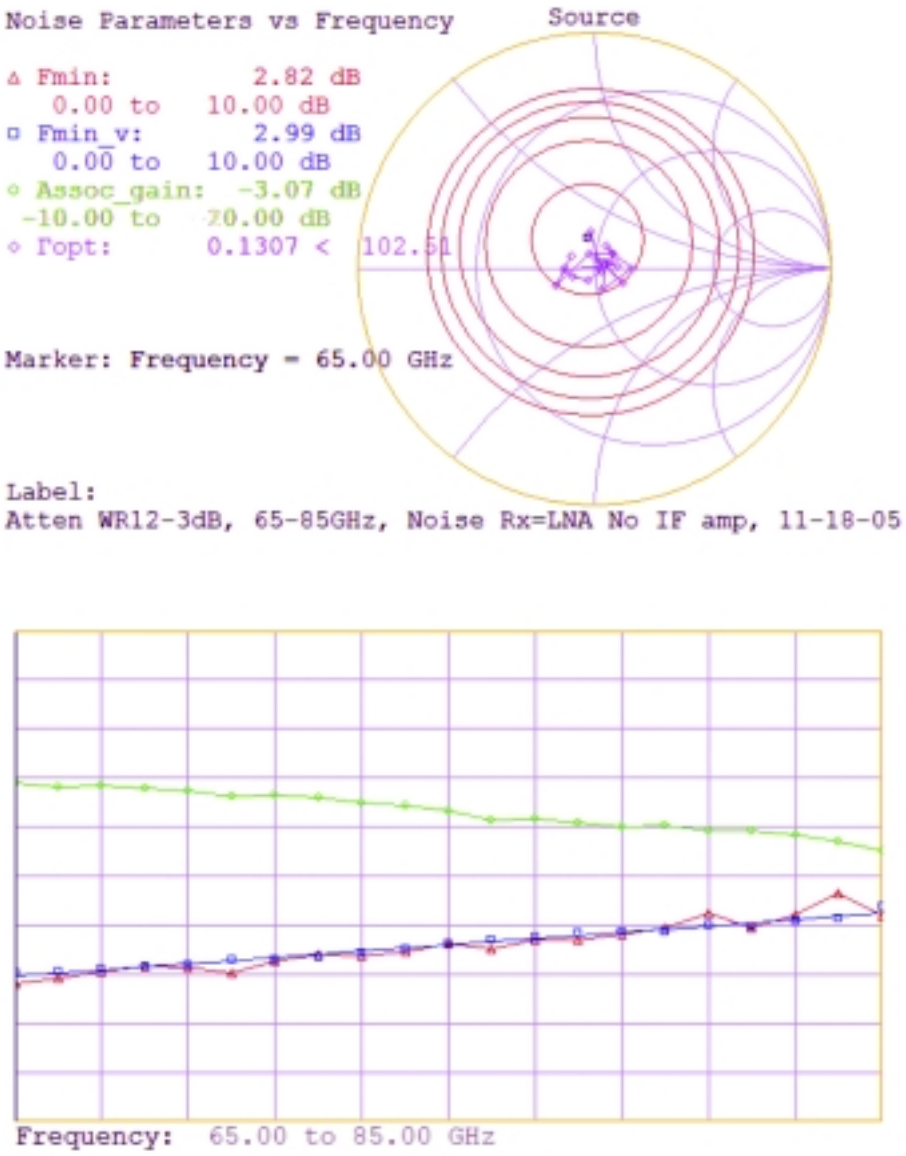

Figure 3. Measured Noise Parameters of a 3 dB Pad From 60 to 85 GHz.

For large signal characterization, the system has been configured to perform single-tone and two-tone measurements from 60 to 65 GHz and from 76 to 78 GHz. The system features more than 20 dB of dynamic range with a maximum available power at the input probe tip of 14 dBm.

Specific customer needs and specifications can be addressed through customization. For further information about these integrated measurement systems, please contac the factory at **maury@maurymw.com**.

2900 Inland Empire Blvd. • Ontario, California 91764-4804
Tel: 909-987-4715 • Fax: 909-987-1112 • http://www.maurymw.com