Microwave & RF Device Characterization Solutions

ATSv5 Automated Tuner System Software

From

Maury Microwave

Your Calibration, Measurement & Modeling Solutions Partner!

ATS v5

Models:
MT993 Series

Maury Microwave is ISO: 9001:2008/AS9100C Certified.

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ATSv5 Automated Tuner System Software

MT993 Series

Introduction

The Maury Automated Tuner System Software (ATSv5) is the easiest-to-use, yet most advanced, and most powerful device characterization software in the world. It brings together a comprehensive suite of software tools that greatly simplifies device characterization applications. The advanced development of this software has made it a must-have part of any modern test and measurement lab. For a growing community of RF and Microwave engineers and designers, ATS software has truly become the brain behind their device characterization operations.

What ATSv5 Software Can Do For You

Maury ATSv5 makes it possible to accurately measure power, gain, efficiency, IMD, ACPR, EVM, harmonics, noise parameters and many other characteristics of a device under test (DUT). Measured data from the ATSv5 software can be imported with ease into Keysight's ADS software environment for simulation of device models or PA/LNA designs. Optionally, using ATSv5 with the Maury dll library gives users the accuracy and repeatability of the Maury ATS hardware with the flexibility to write their own custom test and measurement applications.

ATSv5 builds upon the legendary reliability and robustness of ATSv4 which was the most comprehensive upgrade and improvement to ATS since the Windows™ release in 2000. The central features include an all new and significantly improved GUI API for direct tuner control (eliminating the need for the legacy tuner controller object) and the availability of a comprehensive dll kit.

But perhaps the most exciting feature of ATSv5 is the addition of a powerful new method of cascaded harmonic load pull that eliminates the need for diplexers/triplexers.

In addition, this release of ATS has undergone extensive QA testing, including comprehensive regression analysis for algorithmic integrity evaluation, a rigorous automated analysis to identify, document and correct defects, and live hardware evaluation in Maury's device characterization laboratory. ATSv5 is designed to run under Microsoft® Windows™ XP, and Windows™ 7.

ATSv5 Software Suite Models

- **MT993A –** Power Parameters, Power Measurement Mode, Swept Power Display, Load/Source Pull Contour Display
- **MT993B –** Noise Parameters, Interactive Noise Measurement Mode, Swept Noise Display, Noise Statistics Display
- **MT993B01 –** Ultra-Fast Noise Characterization Using PNA-X
- **MT993D –** Intermod Distortion (IMD), Adjacent Channel Power (ACP), and Error Vector Magnitude (EVM)
- **MT993E –** Programmers Edition
- **MT993F –** System Control Option
- **MT993G –** DC IV Curve Option
- **MT993H –** Harmonic Source/Load Pull Option (Supports Triplexer/Diplexer and Cascaded Tuner Techniques)
- **MT993J –** Fixture Characterization Option

MT993A

Power Characterization Application Software

General

The MT993A power characterization application software is designed to operate with the Maury Automated Tuner System (ATS) to determine the optimum load and source termination conditions for improving device performance. This software is provided as part of an ATS system specified for power characterization; either separately as model MT993A, or combined with the MT993B noise characterization software as model MT993C.

Power Parameters

In large signal amplifier design, power output is a complex function of the input power level, terminating impedances, and DC bias conditions.

A load pull bench, operating with the Maury power application software can provide fast accurate measurements of power output, transducer gain, power gain, power-added efficiency and measured input and output voltages and currents. The program also permits display of up to 10 harmonic source and load impedances simultaneously. A unique feature of the Maury software allows the user to define up to 35 user functions. These functions can be used to develop specific output parameters (e.g., simple efficiency, VSWR), or to control instruments (e.g., to control the turn-on/ turn-off sequence of a high power signal source). The program also has a built-in general purpose S-parameter measurement program that allows for fixed or swept bias conditions. The software provides for both data and graphical hard copy outputs.

Power Measurement Mode

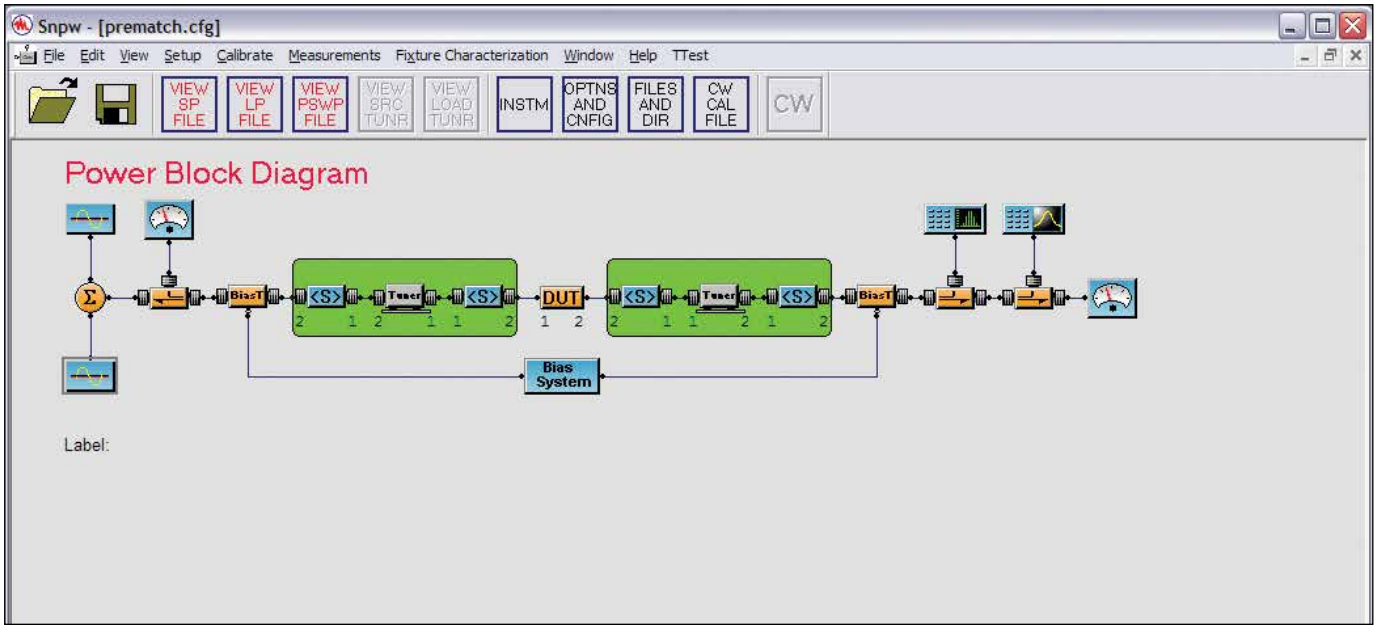
This is a single frequency display that permits the user to select the measured device parameters at a single input power or over a range of powers at any available source or load impedance. The frequency and impedances for load or source pull and sweep plan measurements can also be selected from this display. This is an active measurement screen which allows the operator to move the source and/or load tuners to any available position, and measure all active parameters. If the S-parameter option is exercised, stability circles S11* and S22* are also displayed.

Swept Power Display

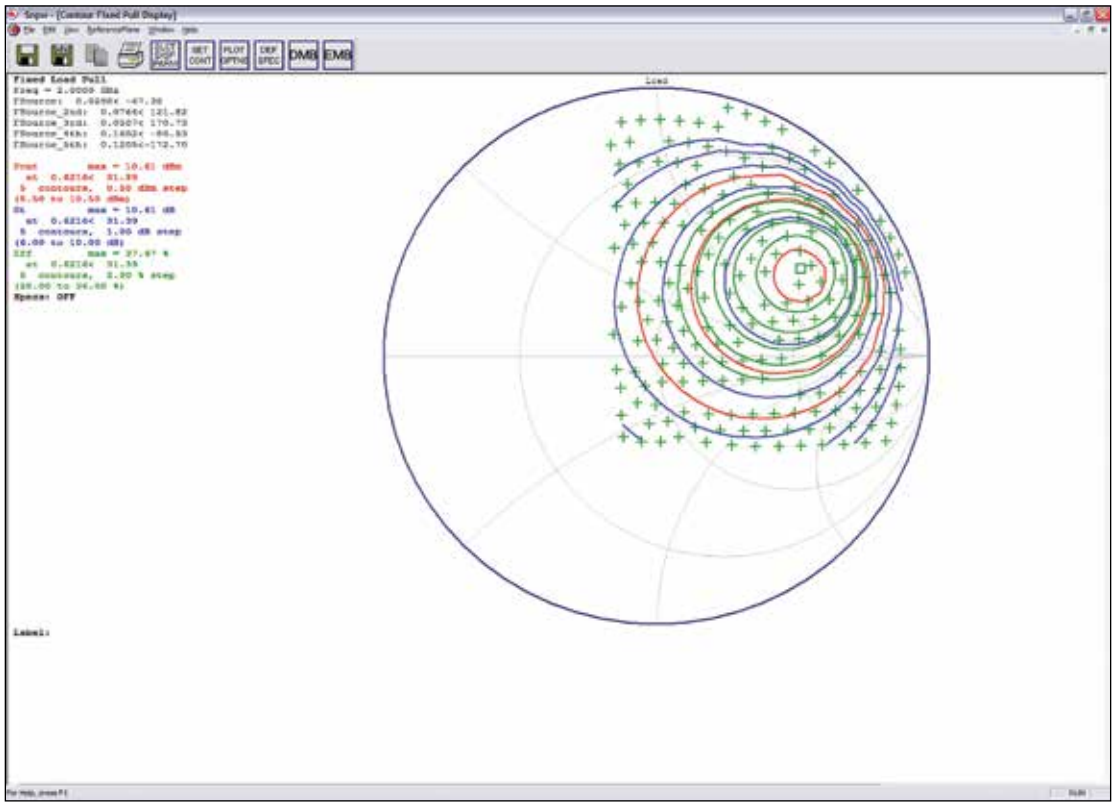
Up to five of the measured parameters can be simultaneously displayed versus available input power. A mouse or cursor key controlled marker provides for readouts at measured or interpolated points. Graphics scales are user-controlled. All measured parameters are tabulated below the plots and are available for printout.

Load/Source Pull Contour Display

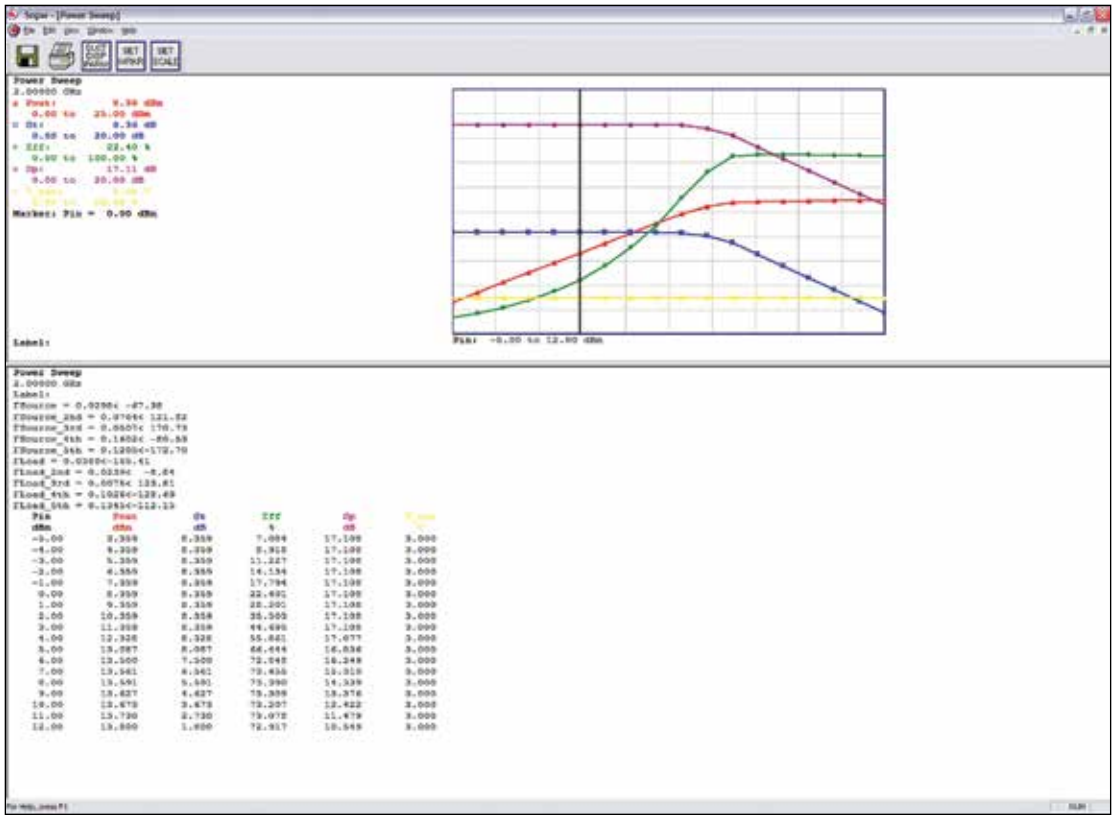
This single frequency display plots constant measured parameter contours on the impedance plane and the impedance(s) for maximum or minimum values. Contours of up to three parameters can be simultaneously displayed. The number of contours displayed, as well as the increment between contours, are user controlled. Output data at any tuner position can also be user controlled. The contour data can be converted to spreadsheet format with a single keystroke.



Typical setup for performing simultaneous load pull and source pull measurements.



Typical load pull contour display



Typical swept power display

MT993B

Noise Characterization Application Software

General

The MT993B noise characterization application software is designed to operate with ATS tuners and determine the noise parameters of a linear device, module or sub-assembly. The program is provided as part of an ATS system specified for noise characterization separately as model MT993B, or combined with the power characterization software as model MT993C.

Noise Parameters

Good noise performance is a critical element of most receiving systems. Knowledge of the noise parameters which define the noise performance of a device can be an invaluable aid to the receiver/amplifier designer by saving hours of design time and reducing, or even eliminating "cut-and-try" iterations.

An ATS system, operating with the Maury noise application software, can provide fast accurate measurements of minimum noise figure, optimum source reflection coefficient, and equivalent noise resistance. The program will also provide the gain parameters of the device and has a built-in general purpose S-parameter measurement program. All measurements can be de-embedded to the device input and output planes. The software provides for both data and graphical hard copy outputs.

Interactive Measurement Mode

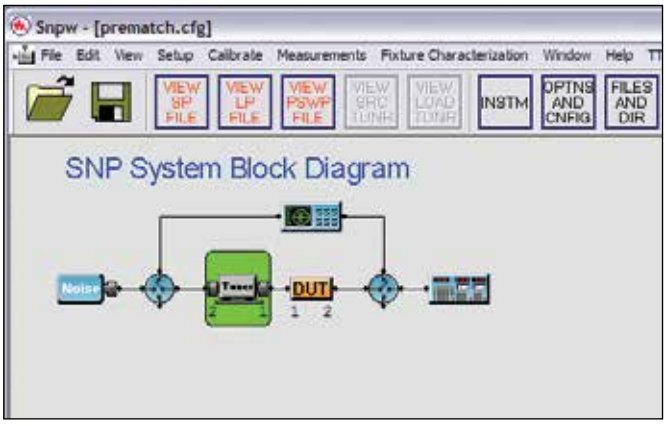
This is a single frequency display that permits the user to: a) measure the device noise parameters; b) measure noise figure and gain at any available source impedance; c) select the noise parameter measurement method; and, d) select the impedances used in the noise parameter determination or let the software determine these automatically. Constant noise figure and gain circles can also be plotted on the source impedance Smith chart. An advanced sweep plan is available to define fully-automated, multi-frequency, multi-bias noise characterization projects.

Swept Noise Display

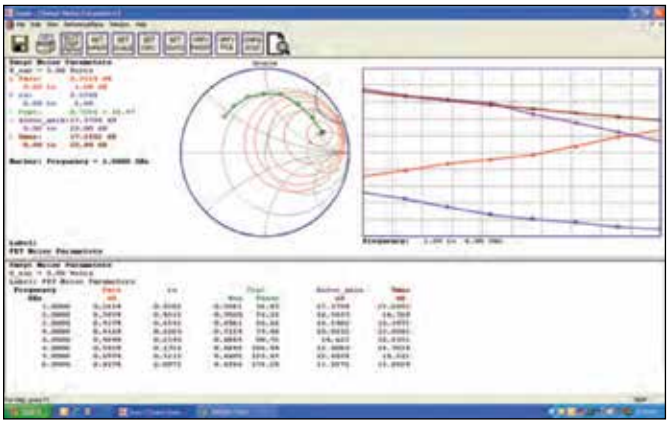
The measured parameters can be simultaneously displayed versus frequency and bias. A mouse or cursor key controlled marker provides for readouts at measured or interpolated points. Data smoothing (1st or 2nd order) is available, and graphics scales are user-controlled. Noise parameters as well as maximum gain, associated gain and stability factor (k) are tabulated and available for printout below the plots.

Noise Statistics Display

This is a statistics window screen which shows agreement between the noise parameter solution and individual points. The noise parameter solution is also displayed so the effect of changing options can be immediately seen. This display may be toggled between calibration and DUT measurement data so the effect of calibration options can be seen on the measured DUT data.



Typical setup for performing noise characterization measurements.



Typical swept noise display.

MT993B01

High Speed Noise Parameter Measurement Option

General

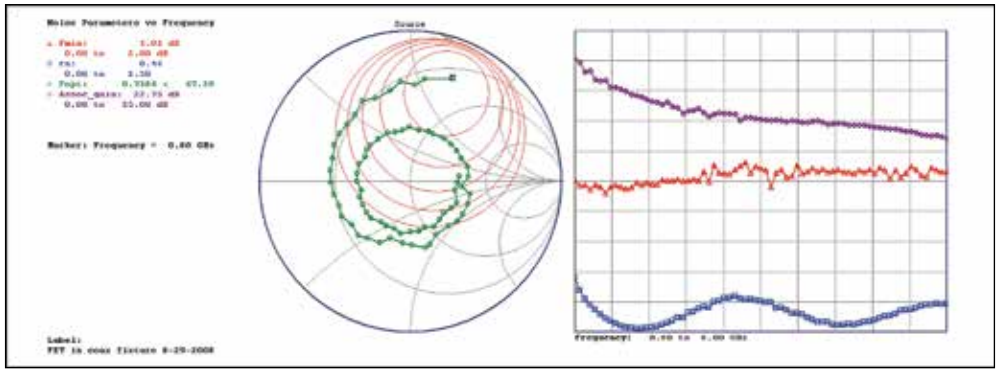
The MT993B01 high speed noise parameter measurement option (patent pending) operates with the MT993B noise characterization application software and Keysight's PNA-X to take advantage of the built-in noise receiver and fast sweep capability of the analyzer. This typically speeds up the calibration and measurement time by 200X – 400X; making it practical to sweep a much larger frequency set. Typical test bench setups are simplified (as shown in the photograph below), which reduces the number of cables and connections, thus helping to stabilize the setup. This setup produces data that is smoother and has less scatter than traditional methods of noise measurement. The fast measurement speed eliminates temperature drift, and using a VNA with an internal noise receiver simplifies the setup and makes it much more stable and consistent.

Benefits and Features

The MT993B01 option includes two key features that contribute to the breakthrough speed improvement: 1) The ATS tuner is characterized with one set of states (physical tuner positions) that are selected to give a reasonable impedance spread over the frequency band of interest; and 2) the noise power measurement is swept over the frequency range at each state, so that the tuner only moves to each position once; thereby minimizing tuner movement.

The much higher speed makes it practical to always do a full in-situ calibration to minimize errors, and to measure more frequencies to get a better view of scatter and cyclical errors, and to be able to use smoothing with more confidence. The higher frequency density also enhances accuracy by reducing shifts due to aliasing.

Typical setup for performing high speed noise parameter measurements.



Measured noise parameter data using MT993B01 (no smoothing).

MT993D

Intermod Distortion (IMD), Adjacent Channel Power (ACP) and Error Vector Magnitude (EVM) Application Software

General

The MT993D IMD/ACP/EVM application software requires the MT993A power characterization application software or MT993C power and noise characterization application software to operate with the Maury automated tuner system (ATS).

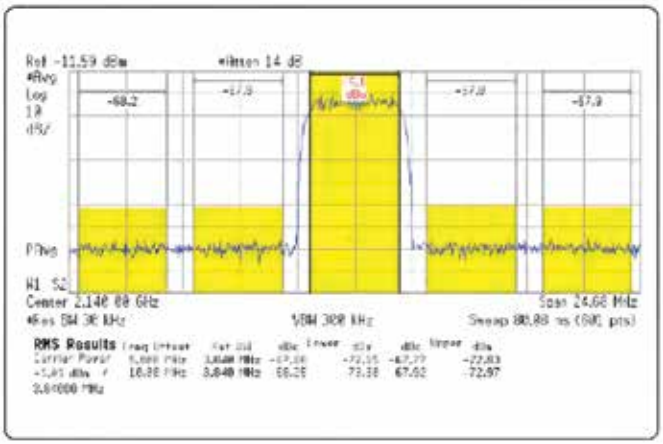
IMD/ACP/EVM Parameters

When two signals are simultaneously present, device non-linearity can cause frequency mixing. Odd order mixing (e.g., the fundamental of one signal mixing with the second harmonic of the other) results in a pair of mixing products which straddle the original pair and are displaced by the separation between the two tones. The magnitude of these products is a measure of the device non-linearity.

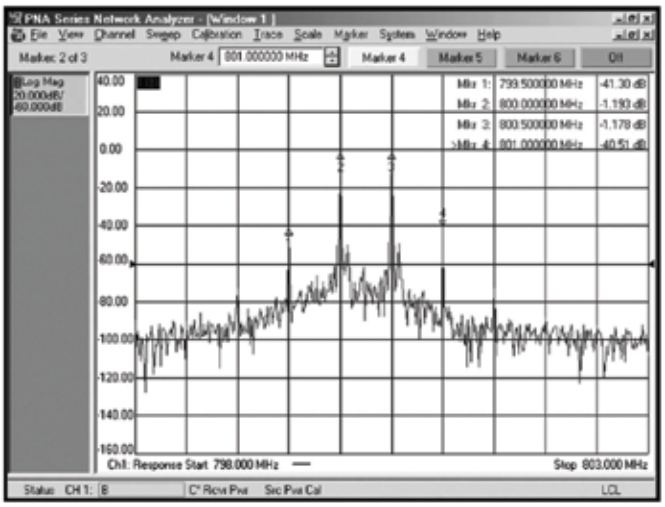
An ATS, operating with the Maury power and IMD/ACP/EVM application software, can provide fast, accurate measurements of the power parameters and the additional functions: 3rd through 7th order IMD power, carrier power, C/I ratio, intercept point, and first and second upper and lower adjacent channel power.

Adjacent channel power usually refers to the "spill-over" of a signal – typically, digitally modulated – into the adjacent or next adjacent communications channel. Knowledge of the magnitude of these products and other related parameters, as well as the termination conditions for minimizing or maximizing them, can be of significant help to the amplifier and system designer.

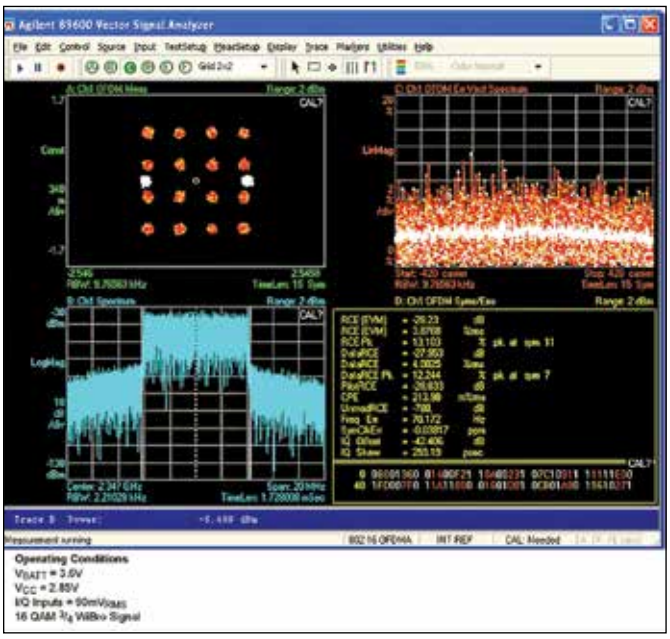
Error Vector Magnitude (EVM) is a reference of in-band distortion, which can prevent the proper reconstitution of a digital modulated signal. Often represented by an IQ constellation diagram, EVM compares the received signal to an ideal signal and can be represented in percentage and dB. EVM parameter is often used for WAN and mobile communication modulated signals.



Typical ACP measurement data.



Typical IMD measurement data.



Typical EVM measurement data.

Optional Software Features

System Control Option (MT993F)

MT993F is an option that extends the capability of the MT993A or MT993C power measurement application software to provide automated switching between noise, power, Intermod Distortion (IMD), Adjacent Channel Power (ACP), DC I-V curves, and S-parameter measurements from a single setup. A special S-parameters, noise, and power (SNP) calibration is also possible with this option.

A further advantage of this option is that the RF switching reduces system cost by allowing sharing of equipment. This can save the cost of up to two RF sources.

DC I-V Curve Option (MT993G)

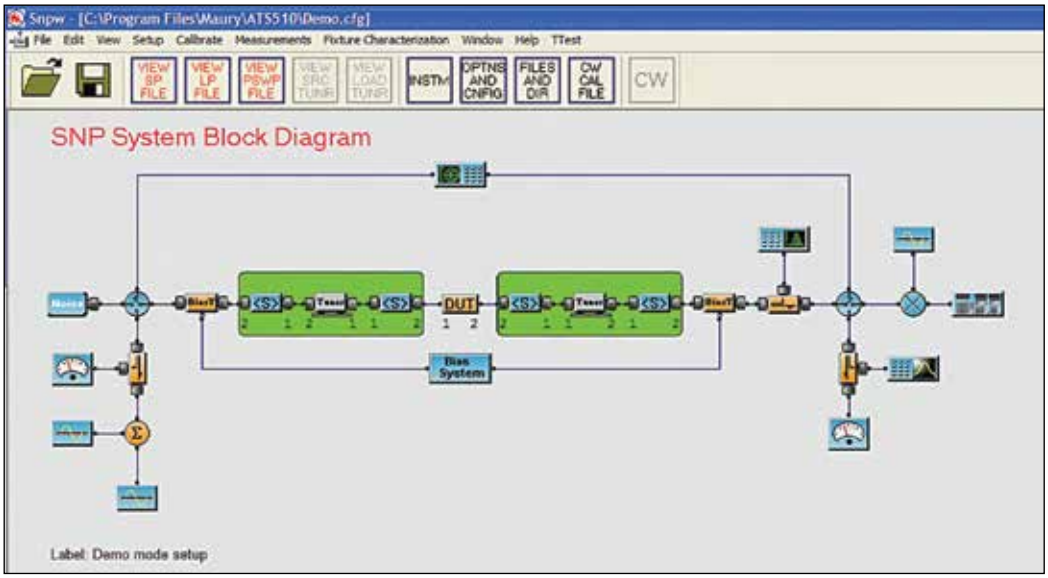
MT993G is an option that extends the capability of MT993A, MT993B or MT993C power measurement application software to provide for automatic measurement and display of device DC current-voltage curves. For FET devices, the measurement display is a family of output current versus output voltage curves with input voltage as the parameter. For bipolar devices, the measured display is a family of output current versus output voltage curves with input current as the parameter. A maximum dissipation value can be entered which will cause each sweep to terminate when that condition is reached.

Harmonic Source/Load Pull Option (MT993H)

MT993H is an option that extends the capability of the MT993A or MT993C power measurement application software to allow load/source pull measurements to be done independently at the fundamental, 2nd harmonic, and 3rd harmonic frequencies. Harmonic load pull is achieved by using a diplexer/triplexer to separate tuned frequencies, or by cascading tuners in-series and using advanced algorithms to set tuner positions. Harmonic tuning will generally improve power-added efficiency (PAE) for compressed amplifiers and lower error-vector magnitude (EVM) for modulated signals.

Fixture Characterization Option (MT993J)

MT993J is a standalone option that enables the S-Parameters of a test fixture or probe setup to be determined from two network analyzer calibrations. First, a 2-port calibration at the coaxial cable reference plane (or similar) is performed; second, a 2-port calibration at the DUT reference plane is performed. The resulting calibrations are mathematically compared and two separate S-Parameter files, each one representing a fixture half, are generated.



Typical setup for performing SNP measurements.