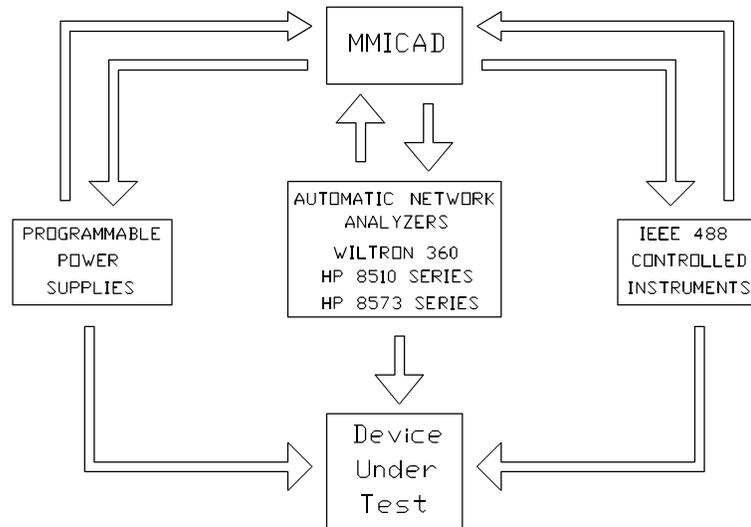


Computer Aided Testing with MMICAD

Series #2: Data Acquisition from an Automatic Network Analyzer (ANA)



The control of data acquisition can be done within MMICAD in two ways: (1) under user control with the Computer-Aided Test (CAT) Menu, where data are acquired and stored in files on disk for later use, and (2) under automatic control using circuit files, where analysis, tuning, and optimization are done in-situ with data acquisition. This application note describes both data acquisition techniques. The user should refer to application note #24 for configuration and setup of MMICAD for CAT.

I DATA ACQUISITION UNDER USER CONTROL

Step #1: Customizing frequency units, directories & filenames

This step is optional. Navigate to the "E:Defaults" of the **Settings** menu in MMICAD and press enter. To customize the frequency units for the data files, select the "Default Units for Frequency" and type 1E+9 for GHZ units, 1E+6 for MHZ units, etc. To customize the directory where the data files will be stored, select the "Default MMICAD Data File Directory" and type the desired drive and path names. MMICAD generates auto-incrementing default file names for file storage, they are also customized by selecting prefix, extension, and the start

number for the increment. Select the "Prefix for Sequential Text (ASCII) Files" and choose a convenient prefix. Select the "Extension for Sequential Text (ASCII) Files" and choose, for example, S2P for a two-port data file or S1P for a one-port data file. Finally, select the "Starting Value for Sequential Text (ASCII) Files" and choose a number from which the filenames will increment. Select "Save Values and Exit" and press enter.

Step #2: S-Parameters Measurement

Navigate to "B:Measure" of the "CAT" menu in MMICAD and press enter. MMICAD users will be given the options of performing one or two port measurements. The user is prompted next for a filename and a one-line comment which will be added to the beginning of the data file. MMICAD then pauses to allow the user to connect the jig or probe the Device Under Test (DUT), after which the S-Parameter data will be acquired and stored into the file in Magnitude-Angle format. The data will also appear in the screen. The user can scroll vertically with the PgUp and PgDn keys, and horizontally with CTRL + arrow keys.

Step #3: Customizing the Header File

The user has the option of adding "Header" information which will be displayed along with the S-Parameter results. This Header information might include lot description, calibration data, etc. The supplied Header file information may be changed by selecting Option "E:Edit Header File" from the "CAT" menu.

Step #4: Sending Codes Manually to the ANA

A complete list of valid GPIB codes can be viewed by pressing <F2> for the Wiltron 360 and <F3> for the HP ANA series. The user may use these codes to send commands to the ANA by selecting "C:Send Codes (F2,F3)" in the "CAT" menu. The list of GPIB codes are comprehensive enough to allow the user to bypass the ANA's control panel and use MMICAD for manually controlling the ANAs.

II DATA ACQUISITION UNDER AUTOMATIC CONTROL

MMICAD can acquire data during circuit analysis and store them into a wide variety of standard and user defined data file formats. This is accomplished by setting up the circuit file as follows:

Step #1: FILES Block Syntax

<ANAcode> <Network> <# of Data Points> <nP>

<ANAcode> is one of two special code words recognized by MMICAD, they are **WILTRON** for Wiltron 360 ANA, and **HPANA** for HP 8510, 8720, 8753, or 8702 ANAs.

<Network> is any valid network name

<# of Data Points> should be equal or larger than number of frequencies swept by the ANA

<nP> specifies the number of ports for the data

Step #2: FREQ Block Syntax

SWEEP <Start> <STOP> <STEP>
ESWEEP <START> <STOP> <N>
FIXED <F1>
STEP <F1> <F2> ... <Fn>

SWEEP is used to create a linear sweep, **ESWEEP** is used to create an exponential sweep, **FIXED** is used to specify the frequency for Parameter mode analysis, and **STEP** is used to specify a list of discrete frequency points.

Step #3: OUT Block Syntax

<Network> <Measurement> <Frame> <Control>

<Network> is a the network name defined in the FILES blocks

<Measurement> can be both a tabular or non-tabular measurement.

The format for tabular measurement is one of

SPAR for S-Parameters in Magnitude-Angle format
YPAR for Y-Parameters in Magnitude-Angle format
ZPAR for Z-Parameters in Magnitude-Angle format

The format of non-tabular measurement is

<FORMAT> [<Parameter>]

where <FORMAT> is one of

ANG for angle
DB for Decibels

DBN for inverted sign Decibels
IM for imaginary
INTGR for integration
MAG for magnitude
PHA for phase
POL for polar charts
RAD for angle in radians
RE for real part
SLOPE for derivative
SMI for smith charts
VSWR for voltage standing wave ratio
TD for group delay

and <Parameter> is one of

GMAX for maximum available gain
GM1 for simultaneous match reflection coefficient on the input
GM2 for simultaneous match reflection coefficient on the output
K for Rollet's stability factor
Sij S-Parameters of the n-port
Yij Y-Parameters of the n-port
Zij Z-Parameters of the n-port

<Frame> is an arbitrary output frame name. MMICAD allows several measurements to be displayed in the same output frame by using multiple OUT statements. This enables users to store data files with arbitrary formats.

<Control> is optional, and can be **T** to force an output frame to be tabular, or **S** to save an output frame into a data file.

These steps are best illustrated in the circuit file of Figure 1. When analyzed in MMICAD, a list of output frames (Frame1, Frame2, Frame3, Frame4, and Frame5) will be displayed. Upon selection of any of them, MMICAD will prompt the user for a filename to store the data.

Note that for **SPAR**, **YPAR**, and **ZPAR** tabular measurements, for example, Frame1, Frame2, and Frame3, MMICAD automatically inserts a specification line in the data files. The specification line identifies the format and thus enables MMICAD to read the data files. However, the user must manually insert the specification line for data files composed of user defined non-tabular measurements, for example, Frame4 and Frame5. The format of the specification line is:

<UNITS> <PARAM> <FORMAT> <R=ZO>

where:

indicates the start of the specification line
 <UNITS> are **GHZ**, **MHZ**, **KHZ**, **HZ**
 <PARAM> are **S**, **Y** or **Z**
 <FORMAT> are **DB** for DB-Angle format
 MA for Magnitude-Angle format
 RI for Real-Imaginary format
 <R=ZO> is the reference value where ZO is a positive number, for example, R=50

The user may supply the specification line to user defined data formats in the **LABEL** block of a circuit file. MMICAD inserts the label in the data file but it also precedes it with the ! symbol. This must be edited out afterwards.

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MMICAD 5.0   LINEAR ANALYSIS AND CIRCUIT DESIGN   OPTOTEK LTD
FILE NAME: APP25.CKT   AUTHOR: MMICAD Authors   04/28/1992

NOTES: Automatic Data Acquisition of a Device Under Test (DUT) from an HP Automatic Network Analyzer (ANA)

FILES
  HPANA DUT 502 2P
FREQ
  SWEEP .1 26.0 .1
OUT
  DUT SPAR Frame1 S   ! S-Parameters in Magnitude-Angle format
  DUT ZPAR Frame2 S   ! Z-Parameters in Magnitude-Angle format
  DUT YPAR Frame3 S   ! Y-Parameters in Magnitude-Angle format
!
  DUT DB[S11] Frame4 T S   ! S-Parameters User Defined in DB-Angle format
  DUT ANG[S11] Frame4
  DUT DB[S21] Frame4
  DUT ANG[S21] Frame4
  DUT DB[S12] Frame4
  DUT ANG[S12] Frame4
  DUT DB[S22] Frame4
  DUT ANG[S22] Frame4
!
  DUT RE[S11] Frame5 T S   ! S-Parameters User Defined in Real-Imaginary format
  DUT IM[S11] Frame5
  DUT RE[S21] Frame5
  DUT IM[S21] Frame5
  DUT RE[S12] Frame5
  DUT IM[S12] Frame5

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Figure 1