



Automated Calibration for NETWORK ANALYZER

Calibration Abstract Calibration is the process of comparing a measuring instrument with a measurement standard to establish the relationship between the values indicated by the instrument and those of the standard. To provide confidence in the accuracy of calibration results, the measurement must have demonstrable traceability. This means that all results associated with a calibration – including those relating to the calibration of the measurement standard used- must be traceable back to standards. Instruments usually need to be calibrated, whether they are simple devices with modest performance or instruments of Network analyzer caliber. Imperfections exist in even the finest test equipment and, if uncorrected, these imperfections will cause the equipment to yield less than ideal measurements.

uCal – The Automated Calibration Software In today's instrumentation environment there is no point using test and measurement equipment unless you can be absolutely confident that its results are accurate. Calibration has become a standard activity for any instrumentation lab and the efficiency of calibration depends on the accuracy of the standard used and the skill level of the person calibrating. Access has introduced uCal software that dramatically reduces the time and skill required for automating calibration tests for testing hysteresis and uncertainty of different types of instruments. uCal, is one of the milestones achieved by a team of professionals looking for a continual growth in automated test solutions.

Maintaining inventory of all the instruments, ease of retrieving data, configuring test procedures and automating them using standards requires a sophisticated and an easy to use system.

uCal's base module is built with a flexible utility to configure user defined test procedures, customized calibration test reports and the maintenance of historical test data.

The base module is also integrated with various utilities such as:

- Automatic email reminders for calibration of instruments belonging to different departments for release for calibration
- Easy configuration of calibration procedures by the user using simple keywords
- Defining report data and template modification for reports.
- Encrypted data storage for additional security.
- Automatic data backup at specified intervals.

The communication module is built with a library of standards and instruments for building test clusters to calibrate various types of instruments.

Clusters are the test schemes under which an instrument under calibration requires to be calibrated using different standards for implementing various calibration tests.

uCal database consists of various clusters to calibrate instruments of different caliber starting from the lower end instruments like multimeters to the higher end ones like network analyzer, spectrum analyzer and communication test sets. uCal supports all the communication connectivity available for an instrument.

Features of uCal : Flexible Instrument and standard configuration
Easy generation of user defined calibration procedures using a set of standard keywords

- Automatic instrument and standards detection
- Instrument connectivity diagram for users

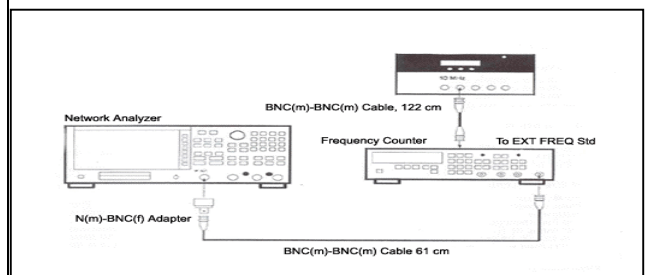
- Automatic calibration test
- Data storage and security
- Customized report generation
- Report access on the organization LAN.

Calibration for Network Analyzer using uCal Network Analyzer has various tests to be followed for calibration. Few of the standard tests as per the test manual is as follows:

Calibrating for Frequency Accuracy This is the measure of the actual frequency of the RF output signal of the network analyzer when the analyzer is tuned to a particular frequency. It is the measure for frequency accuracy of the internal frequency reference or the high stability frequency reference.

The procedure uses a frequency counter and a frequency standard to measure the actual frequency of the analyzer RF OUT signal when it is tuned to 100MHz.

The center frequency of the analyzer is set to 100MHz and the frequency span is set to zero. Record the frequency counter reading to a resolution of 1Hz.



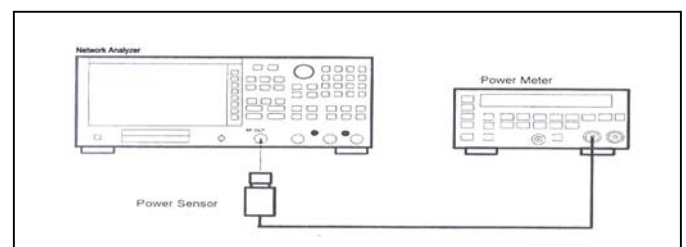
Measurement of Source Level Accuracy/Flatness This measures the actual power level of the RF output signal of the analyzer for various frequencies and the amplitude of the analyzer set to a particular level (normally 0 dbm). The level accuracy is checked at a particular frequency (reference frequency). The level flatness is calculated as power deviation from the power reading taken at the reference frequency.

This uses a power meter and a power sensor to measure the actual power level of the RF OUT signal at several frequencies from 10 Hz to 500 MHz when the signal amplitude is set to 0 dBm.

The level of accuracy is checked at a frequency 50 MHz. The level flatness is calculated as power deviation from the power reading taken at 50 MHz

The center frequency of the analyzer is set to 50MHz and the frequency span is set to zero and the power meter reading is recorded.

To test for Source Level Flatness, set the center frequency of the analyzer to the flatness test frequency varying between 1MHz to 500MHz and then the power meter reading is recorded.



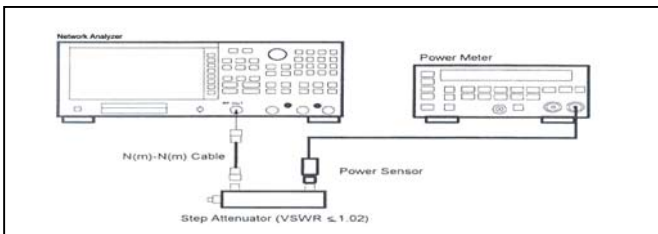


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Non Sweep Power Linearity Measurement The procedure uses a power meter to measure the actual power of the analyzer RF OUT signal at several power settings and then calculates the power linearity. The power linearity is referenced to a power level of 0 dBm. For the calibration procedure, the input power to the power sensor is maintained between -60 dBm and -30 dBm using the step attenuator.

This reduces measurement uncertainty caused by the power sensor's non-linearity and noise. The actual power of the RF OUT signal is calculated by adding the attenuation used and the power meter reading. The level of accuracy is checked at a frequency 50 MHz. The step attenuator is set for 30dB, 50dB, 40dB, 20dB, 10dB in steps and the power meter reading is recorded.

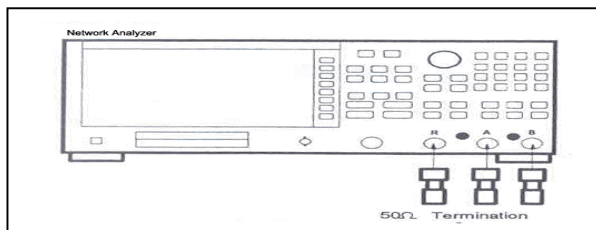
The source power setting is changed in accordance with the step attenuator values and the power meter reading is recorded



Receiver Noise level Measurement The test measures the receiver noise levels in the network analyzer mode at 1F BW 10 Hz and the noise level using the marker statistics function when the inputs are terminated.

The noise level is measured in linear format. Then the measured values are converted to log magnitude format. This is done to avoid skewing the data with the marker statistics function.

The center frequencies are varied from 100Hz to 499 MHz and the trace mean value is recorded



Input Crosstalk Measurement This test measures the crosstalk (Signal leakage interference) between any two of the analyzer's inputs when RF output signal is supplied to one input and the other is terminated.

Harmonics Spurious Measurement The analyzer's RF output signal power is set to 10 dBm. The second, third and non harmonic spurious levels are measured at several frequencies using a spectrum analyzer. The RF out signal frequency is set to values where harmonics and non-harmonic spurious are most likely to be observed.

Magnitude Ratio Phase Frequency Response This test applies the RF output signal from one input of analyzer and to either of the other 2 inputs using a power splitter. The magnitude ratio frequency

response is measured as the deviation from the ideal magnitude ratio value of 0 dB. The phase frequency response is measured as the deviation from linear phase.

Power Sweep Linearity Measurement This test sets the analyzer to power sweep mode and then makes a power sweep between start and stop power in specified steps. Here the actual power of the RF output signal of the analyzer is measured at each sweep point and then the power sweep linearity for a sweep span is calculated. The power linearity is specified as values relative to the stop power.

For calibration of Agilent 4395A Network Analyzer instrument includes the following:

Model No	Name
HP 53132A	Frequency counter
HP 34401A	Digital Multimeter
HP 437B	Power Meter
RS DPSP	Step Attenuator
HP 8484A	Power Sensor
HP 8566B	Spectrum Analyzer
HP 83752B	Synthesized Sweeper
HP 85027C	Directional Bridge
HP 8757D	Scalar Network Analyzer
IFR 2023A	Signal Generator
Agilent 33120A	Function Generator

Other Calibration Software Solutions

Different versions of uCal are the following :

eCalPharma – for Pharmaceutical Industries has been developed to take care of data handling and quality standards as required by the pharmaceutical industry.

eCalPharma is a 21 CFR PART11 compliant.

eCal for Refineries and manufacturing industry finds application in calibration of Pneumatic, Electrical and Temperature equipments.

Functional Test Solutions

SATMON – Satellite channel monitoring system, useful for satellite service providers to monitor the strength of various satellite channels.

Automation of Testing of RF Component using Programmable Network Analyzer