

# Current Acquisition and Analysis Routine

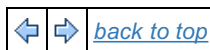
## Introduction

The sparmeter and impedance project currently supplies calibration services to outside customers. This document outlines the procedure for the data acquisition and analysis for the one port and two port impedance services.

## Overview

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- I. **Instrument Setup**  
Requires user control of the VNA. No setup information is recorded except on paper.
- II. **VNA Calibration**  
Uses a modified version of the HP Basic Program MultiCAL. No record of calibration coefficients is kept, the data is written to the VNA directly.
- III. **Calibration Verification**  
Uses versions of the HP Basic Programs MeasLP and Calrep. Generates a series of BDAT files saved on a shared drive, does not normally record the analysis of these files. We typically print the plots that show the calibration is good.
- IV. **Acquiring DUT Data**  
Uses versions of the HP Basic Program MeasLP. Generates BDAT files that are also saved with the Check Standard raw files.
- V. **DUT analysis**  
Uses a version of the HP Basic Program Calrep. Generates a series of tables in ascii format.
- VI. **Report Generation**  
Uses the data from Calrep, which is hand ported to a Microsoft Access Database which in turns fills out a Microsoft Word document through mail-merge. The database also includes other information including BII.
- VII. **Summary of the improvements needed to the current method**



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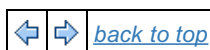
## Instrument Setup

Current Method:

The instrument setup requires setting the frequency points on the front-panel of the VNA (or PNA). In addition, the IFBW and averaging should be chosen. These parameters are typically chosen by convention and not recorded in any manner.

Desired Method:

All parameters on the VNA (or PNA) should be settable with the software used to acquire data. The parameters should either be user entered (or modified from an earlier state) or loaded from a file saved locally or on a server.



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## VNA Calibration

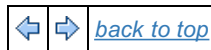
Current Method:

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A calibration set for the connector type of the measurement is chosen. The calibration kit is normally a set of air-lines and a high reflect standard. The uncalibrated s-parameters of these standards are measured using a modified version of the HP Basic program MultiCAL. The data is saved to temp files that are overwritten each time. The setup is predefined by the internal software modifications and the user is required to enter some data as to the line lengths. Once the calibration set is measured a series of correction coefficients is calculated and written to the VNA (or PNA) using MultiCAL. MultiCAL uses the LRL calibration method. Internal to MultiCAL are several checks to see if the calibration looks as expected. If the calibration looks strange to the user then the process is repeated or lines are dropped from the LRL calibration.

Desired Method:

We would prefer given a file that defines the standards to be measured, the line lengths and calibration standards would be automatically filled out. In addition, the raw measurements should be stored in a recoverable manner so that the calibration could be calculated using different methods in post processing. The coefficients could be written to the VNA or kept for later application to raw data.



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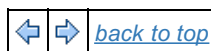
## Calibration Verification

Current Method:

A set of internally maintained check standards that are normally composed of an attenuator, high reflect, and/or a load are chosen and measured using repeated connects (typically 3 by convention) and potentially a reversal of device direction. These are measured using the HP Basic Program MeasLP (or a modified version) with the VNA in a calibrated state. The data from each of these measurements are stored in the HP Binary format known as BDAT with file extensions that represent the date, system used and an iterator. Currently the files are written to common location that is chosen in the MeasLP program. The data is then loaded to the HP Basic Program Calrep. Calrep assigns errors and given a file directory compares the data to a previously calculated standard curve saved as a result file (Ascii) in common folder. This comparison along with some of the calculated errors are then used as a series of graphical comparisons for the user to determine if the calibration and machine state is sufficiently good to proceed to the DUT. The raw data in BDAT format is retained, but it is atypical to output the analyzed results to a file at this point.

Desired Method:

We would prefer given a file that defines the check standards to be measured, the check standard definitions would be automatically filled out and measured with a single program. In addition, the raw measurements should be stored in a recoverable manner so that the check standard could be calculated using different methods in post processing (the raw measurements should be stored without the calibration correction). The comparison of the check standard s-parameters with the accepted curve should be achieved through calculation using the previous history of the device and/or a single definition file. In addition, the measurement history of each of the check standards should be findable to determine if the check standards have changed through time. This is the step that the Check Standard Database project was designed to streamline and assist. Currently, we have ~20-30 years of measurements of these check standard measurements in BDAT format and the Standard Curve for comparison was calculated using a SAS program in the early 2000's. The standard curve is saved in a folder on a shared drive and accessed with the Calrep program.



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## DUT Measurement

Current Method:

Once the calibration has been verified, the DUT is measured using the HP Basic Program MeasLP. The DUT is measured using repeated connects and potential reversal of direction of measurement. This data is stored as BDAT on a shared drive using a device id in the file name to identify the file.

Desired Method:

Since this method is no different in concept to the check standard measurement method we would want it to work the same including the possibility to compare the measurement with device history.

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## DUT Analysis

Current Method:

The raw data from the DUT measurement step is loaded into the Calrep program and analyzed. The analysis adds uncertainty to the files, but removes all the metadata from the raw files. This data is saved as a series of Ascii formatted tables (currently there are several different types). These tables are saved to a shared drive.

Desired Method:

We would like these files to retain the metadata so that we can look at historical records including their uncertainty. In addition, if we change the analysis from the calibration step, we would like this analysis to be recalculated.

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## Report Generation

Current Method:

Currently the table created by Calrep is imported into a Microsoft Access database by hand. This database has other data including BII in it. The database is then used to populate a Microsoft Word template through mail-merge. This report is the final product that is returned to the customer.

Desired Method:

We would want the report to be automatically generated from the results in the previous steps. It is desirable to have the report web compliant and searchable.

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## Summary of the improvements needed to the current method

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### Obsolete or non-existing data that needs to be replaced

1. All flavors of MultiCAL
2. All flavors of MeasLP
3. All flavors of Calrep
4. Check standard database
5. Automatic Report Generation

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Current Method	Issues	Replacement Strategy
Calibration of the instrument using MultiCAL	HP Basic is obsolete. The data used to correct the raw measurements is lost. New methods of calibration cannot be added easily. The lack of transfer standards to make calibration easier (requires correlated uncertainties)	The replacement of this step requires a program capable of acquiring data, calculating a correction, and storing data persistently in a searchable manner. Currently StatistiCAL and the MUF can calculate the correction, PNA grabber can acquire the data in some cases (does not have all possible VNA and PNAs) and there is no data management software option. Our approach is to create data management tools in Python (not obsolete) use the MUF or StatistiCAL through Python wrappers to calculate the correction and then integrate this with a Python based web frontend. Data acquisition can either be accomplished by using PNA grabber wrapper or a new Python acquisition program.
Tracking and comparison of check standard data	HP Basic is obsolete. The measurement data is stored in an obsolete binary format. There is no central repository that is updated. History is not tracked or analyzed. The analysis of the check standard data is not typically saved, and when it is saved important metadata is lost. No user control or web compliance.	Initially convert the data to a non-obsolete format, create an analysis routine in Python that saves the metadata. Create a central database of previous measurements that is managed and analyzed through a web based frontend. Currently we have the basics of this process are finished. By rewriting the analysis routines in Python we have made the code modern and provided both a web based frontend and the ability to link this analysis with data acquisition and data management.
Report Generation	Requires a human to connect the measurement data with the final report, also requires understading in at least 3 different programs. Not tied to a central database, no ability to provide real-time report generation for staff or customers.	Create a path to fill html templates with measurement data using Python library. These html reports can be tied to history and analysis for internal use.