Tutorial Document

Spectral Measurements

Reference: TU00005

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Author: Jonathan W. Kimball

Principal Investigator: Philip T. Krein

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Abstract:

This document describes the basic procedure for measuring a transfer function of a converter. In particular, the focus is on reference-to-output type measurements.

Document Revision History

Issue	Date	Comments
000		First pass.

Contents

1. Introduction

1.1 Scope

This document is predicated on the use of an HP4195A spectrum analyzer. The objective is to measure simple transfer functions. The HP4195A is a 50 Ω-type instrument, so applications like input-voltage-to-output-current transfer functions cannot be measured. The description has been determined based on reference-to-output measurements.

Also, the author has been unsuccessful in getting good measurements below 10 kHz.

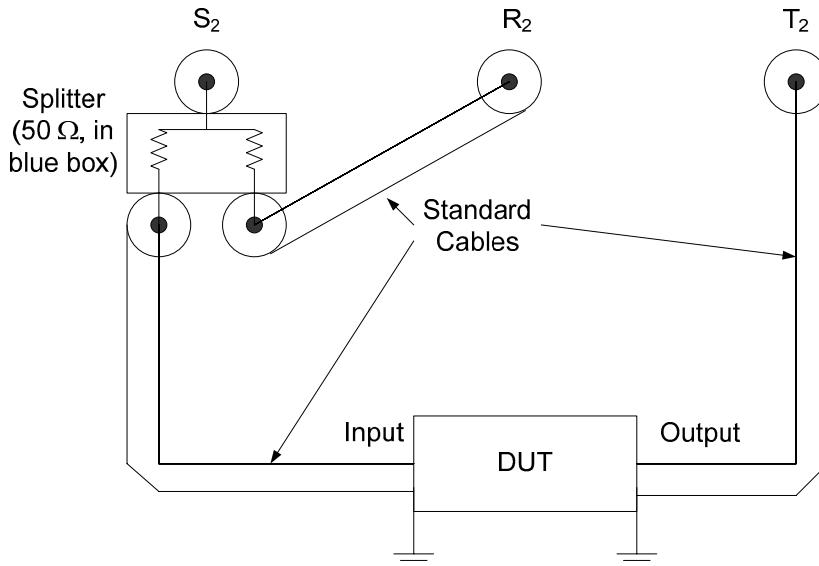## 1.2 Definitions

1.3 References

SW0039: Includes test4195.vee, which is needed to capture the measurement to a text file.
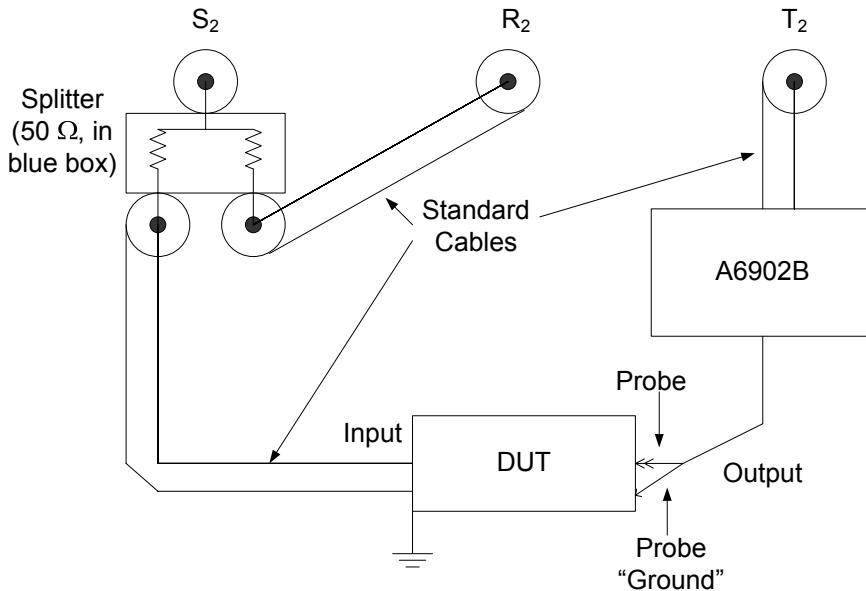
2. Taking a Measurement

2.1 Basic Setup

Spectral measurements have been taken successfully a number of ways. The first follows the instructions provided by HP (now Agilent). Throughout this document, we will assume that port 2 is used, since the instrument in room 50 Everitt Lab has an impedance fixture on port 1.

Notice that the input and output must be ground-referenced. The T_2 terminal can tolerate a few volts of dc offset, but it is still a good idea to capacitively couple both connections (e.g. 2.2 µF monolithic). A splitter has been built in a small blue aluminum box.

In some situations, the input and output grounds are different. Probe isolators can be helpful (A6902B—the old isolated probes, not the new ones).
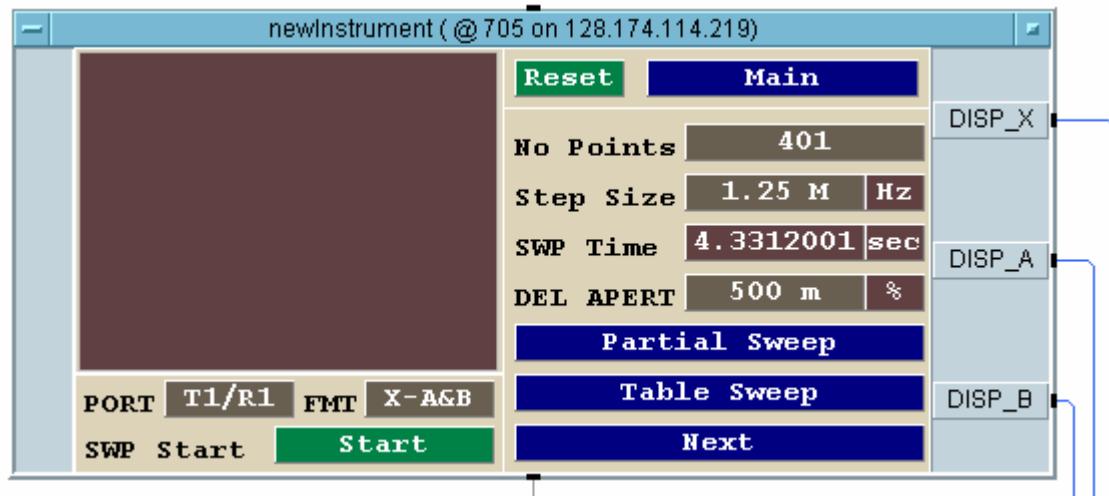
Typically, set the A6902B on ac coupling and 100 mV/div (1X). This method is effective for low-voltage systems.

In principle, the sensed output could be a current instead of a voltage, if you use the old-style Hall sensors with separate amplifiers. This application has not been tested.

2.2 Running the Test

First, get a local copy of test4195.vee, which is in SW0039. You may need to configure the HP4195A, which is connected to a GPIB-to-Ethernet bridge. Then follow this procedure. Do NOT try to set anything up from the physical HP4195A—do everything from the VEE virtual instrument.
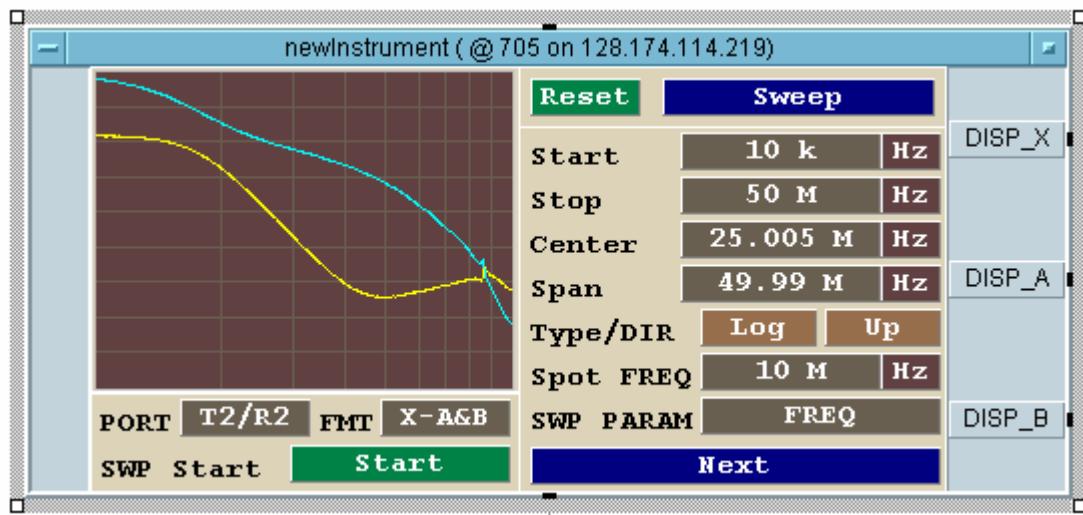
1. Start VEE and open test4195.vee. The instrument is controlled from the portion that looks like this:
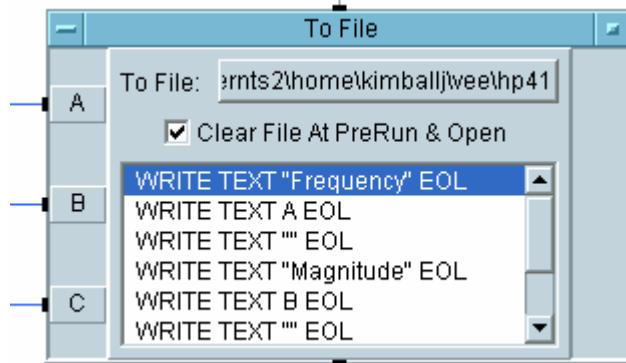

2. Turn on the HP4195A.

3. Connect according to one of the above methods, with the DUT replaced with a short for calibration.

4. On VEE, go to the "Sweep" menu by clicking on "Main" and selecting "Sweep" from the pop-up. It should look like this:

Click on the Start frequency and enter the new start. Click on the Stop frequency and enter the new stop. So in the image above, the range has been set to 10 kHz – 50 MHz. Click on the "Type" until it again says "Log."

5. Make sure the PORT is set to T2/R2, as in the above image.

6. Go to the calibration menu by clicking "Sweep" and selecting "Calibration" from the pop-up. Click "Normal & Thru."

7. When the calibration run is complete, replace the short with your DUT.

8. Press the big "START" button in the lower left quadrant of the panel.

9. If the traces are off screen, go to "Scale/Reference" and auto scale.

10. Repeat calibration and DUT sweeps as necessary until you are happy with the traces on the HP4195A screen.

11. Set the output file name on this portion of the VEE file:

By default, it will write in Jonathan Kimball's home directory, which is not appropriate. Set it to your own home directory, the exchange server, or someplace else convenient.
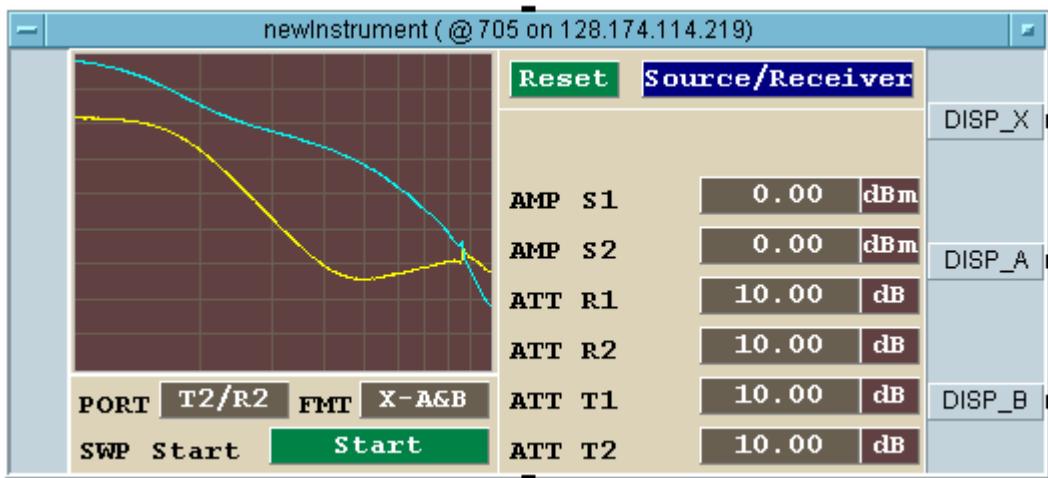
12. Press VEE's "►" button. This will capture the data, display it on the lower graph, and save it to "test.txt."

13. Check that "test.txt" contains the data. Rename the file to something descriptive so it does not get overwritten with the next sweep.

2.3 Troubleshooting

For error 17, the only known fix is to power-cycle the HP4195A.

If you get overloads (errors 182 and 183), try going into the port setup and reducing the source power. By default, it is set to 0 dBm. Try reducing it to -10 dBm. Also, set the T2 attenuation higher (e.g. 20 dB). One theory is that the switching frequency harmonics overload the test input.

Some errors result from not following the setup procedure properly or the instrument somehow getting in a strange mode. Just because the VEE panel looks right, the HP4195A might not be in the right mode. For example, VEE might say the sweep is in LOG mode, but the HP4195A might be in linear. Toggle a couple times to make sure the instrument is actually in LOG mode.

Similarly, sometimes the calibration method is not set up properly. You may need to click on "NORMAL_ISN". You may also need to click on the "Done" or "Not Done" buttons.

If all else fails, click the "RESET" button on the VEE panel and start over.