

From: [Clemens Paul](#)

To: [walter Maxwell](#)

Sent: Friday, December 28, 2007 2:15 PM

Subject: Re: Reflections 2

Dear Walt,

first of all I'm very pleased to find you still in good shape at the age of 87 and that you take the time and effort to write a reply to somebody unknown to you so far.

I'm looking forward to get a copy of Reflections 3 in 2008.

You write:

Consequently, the generator still delivers its original amount of power to the pad, regardless of the mismatch appears at the input of the device and at the output of the pad. The result is that the generator is not aware of any mismatch the device presents to the output of the pad, and continues to deliver a constant voltage to the device, regardless of any changes in the input impedance of the device during the measurement.

I think the crucial point is the red highlighted part of your statement.

In the case of a mismatch at the output terminals the generator still delivers a constant voltage **to the pad**

but not to the device!

So at the output terminals of the pad voltage changes and consequently the amount of power **which is**

delivered to the device also changes depending on the degree of mismatch.

(That's why output power of today's generators is always specified in dBm **into 50Ohm**.

Former generators used to specify only open circuit output voltage (EMF) so there was no need to specify the load's impedance.)

This can easily be proved by some simple measurements which I have done, see attached photos.

I was using a HP8640B and a R&S HF Millivoltmeter with a high impedance passive probe (>80kOhm // 2,5pF, accuracy ~3%).

The generator was set to -13dBm.

When the adapter T-pad is terminated in 50Ohm the R&S reads about 50mV.

When the T-pad is left open the voltage reading is 100mV.

As I said in my last email, for the reflected power it makes no difference if there's e.g. a +7dBm generator

with a 20dB pad or a -13dBm generator without a resistive pad.

The reflected wave always sees an active 50Ohm source in either case and hence in either case a total re-reflection occurs.

Just like in the case of a generator without a pad the reflected wave never gets a chance to see the resistive pad because the pad presents itself to the reflected power as **active 50Ohm source**.

I have six different signal generators (HP and R&S) here and all of them show the same results.

Furthermore in the highest output settings the generators have no resistive pad between generator and

output terminals (for instance according to the manual the HP8640B has no attenuator inserted at +10dBm and at +20dBm).

Looking forward to your comments

73

Clemens

DL4RAJ

----- Original Message -----

From: [walter Maxwell](#)

To: [Clemens Paul](#)

Sent: Thursday, December 27, 2007 8:34 PM

Subject: Re: Reflections 2

Hello Paul,

I'm pleased that you find my book Reflections has helped you in understanding what is going on on mismatched lines. However, it is apparent that you are misinterpreting the function of the pad between the source generator and device under test. So please let me explain.

In general, when making measurements on a device that is fed with energy from a signal generator, it is essential that the voltage applied to the device be constant, regardless of the input impedance of the device. If the input impedance of the device is equal to the output resistance of the generator and there is no isolation pad between the generator and the device, the voltage applied to the device will be correct to obtain accurate measurements of the device.

However, if the input impedance of the device presents a mismatch to the generator in the absence of a dissipative pad, the generator will reduce its power delivery in the amount of the mismatch. For example, if the generator sees a 2:1 mismatch it will reduce the power by 11.11 percent; if it sees a mismatch of 3:1 it will reduce the power by 25 percent.

Consequently, to avoid the reduction in power delivered to the device under test, the pad is inserted to isolate the device from the generator. This how it works: If a 20 dB pad having a 50-ohm impedance in both directions is inserted between the generator and the device, any power reflected from the device will be dissipated in the pad, such that the generator sees only 1/100th of the reflected power. This means that the generator will reduce its power by only 1/100th of the amount that it would reduce if it saw the entire amount of the reflected power.

Here's another example: Let's assume the output of the 20 dB pad (attenuator) is open circuited, resulting in total reflection. In this case the voltage reflected from the open terminals reaching the source in the generator would be 40 dB lower than the forward voltage supplied to the pad by the generator. In other words, the mismatch seen by the generator would be 1.005:1, which is negligible, meaning that the generator sees an almost perfect match even though the pad is terminated in an open circuit. Consequently, the generator still delivers its original amount of power to the pad, regardless of the mismatch appears at the input of the device and at the output of the pad. The result is that the generator is not aware of any mismatch the device presents to the output of the pad, and continues to deliver a constant voltage to the device, regardless of any changes in the input impedance of the device during the measurement.

Does this help in interpreting the function of the pad?

Concerning Reflections 3, the ARRL is going to publish it sometime in 2008.

Walt, W2DU

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Version: 7.5.516 / Virus Database: 269.17.11/1200 - Release Date: 27.12.2007 13:34