50dB Tap for Monitoring your RF Signal
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I have a HAMMEG spectrum analyzer that I like to use for measuring harmonic content and distortion of my transmitters and amplifiers. The maximum input level into this spectrum analyzer is +20dBm (100 milliwatts). As I have a 600 watt amplifier (Ameritron ALS-600), I decided that a 50dB tap would give me a comfortable level for monitoring my maximum signal without overloading the spectrum analyzer. 50dB down from 600 watts is 6-milliwatts or about +8dBm.

Referring to Figure 1 below, you can determine the tap coupling level using the normal voltage divider equation:

Vout = Vin x R2 ÷ (R1 + R2), where Rload is a high impedance load such as an oscilloscope probe.

For a 50 ohm load, like you may have with a power meter of spectrum analyzer, a finite R load must be considered in the voltage divider equation, as R load is in parallel with R2:

Vout = Vin x R2//R load ÷ (R1 + R2//R load)

To determine the level in dB: Tap (db) = 20 $\log_{10}$ (Vout)

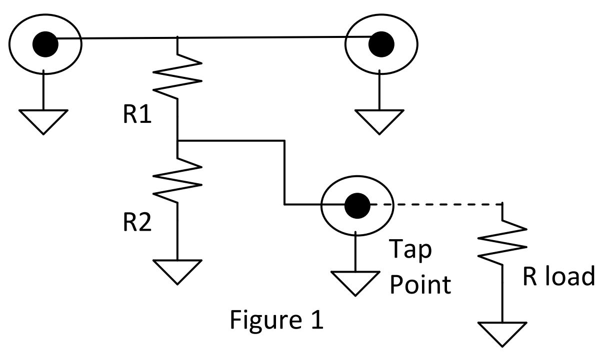

Figure 1

For my 50dB tap, I wanted to use commonly available resistors. It turns out that 8K ohms and 25 ohms will give you the desired 50dB tap point:

50 dB = 20 log (8000/25)

I realized the circuit using two 16K 2-watt resistors in parallel, and a 51 ohm ½-watt resistor as shown in Figure 2 below. I needed the 2-watt resistors due to the power that is dissipated in these resistors at 600 watts. Assuming your through line is terminated by a 50 ohm dummy load, the voltage across the voltage divider can be easily determined:

RF Pwr = V^2/R, so
V^2 = PwrxR = 600x50 = 30,000

So power dissipated in the resistors (neglecting the 51 ohm resistor as this is negligible)

Pres = V^2/R = 30,000/8000 = 3.75 watts, hence the two 2-watt resistors.

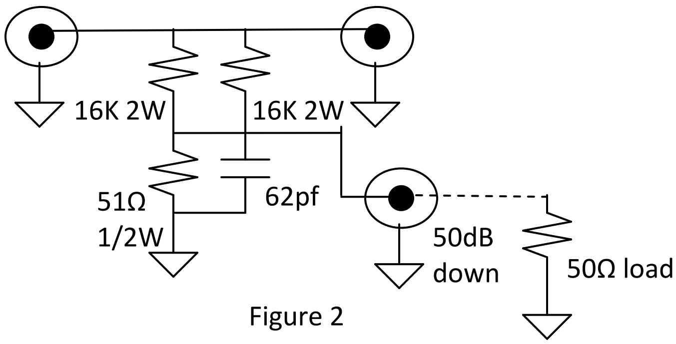

Figure 2

You'll also note the 62pf capacitor. I found that the 51 ohm resistor is slightly more inductive than the two parallel 16K resistors, resulting in peaking of the detected power as the frequency was increased. The 62pf capacitor helps compensate this at the higher frequencies.

Figure 3 below shows the swept coupling response of the 50dB tap point. You can see that the coupling starts to reduce due to the 51 ohm resistor inductance, but then decreases as the 62pf capacitor begins to compensate for this inductance. The tap point is very close to 50dB at HF and 2-meters, and about 49 dB on 6-meters.

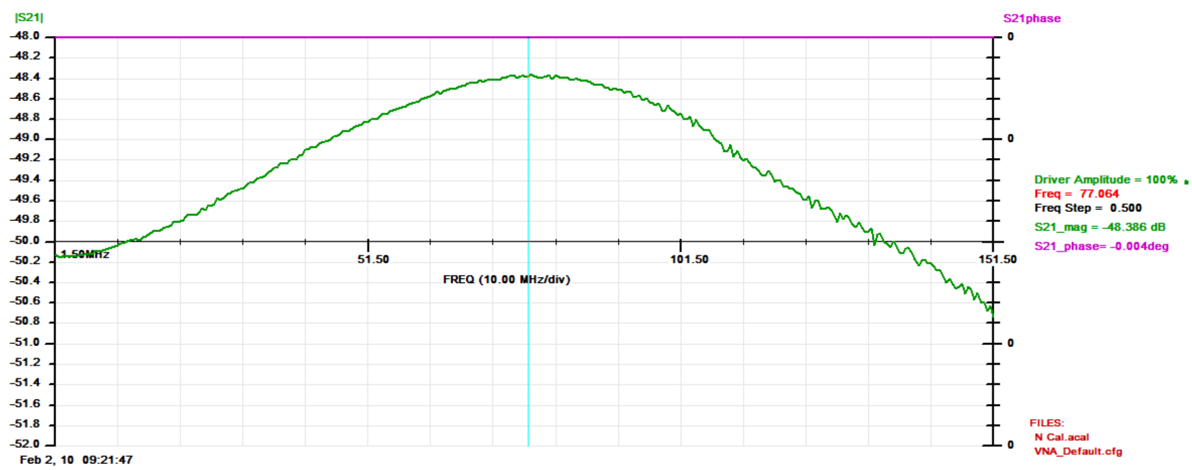

Figure 3 – Swept coupling response from 1.5-150 MHz

Remember, if you use a high impedance measuring device such as an oscilloscope, the coupling will be 6dB less (approximately 44 dB) unless you also terminate the tap output port in 50 ohms.

Photo 1 shows the internal wiring, and Photo 2 shows the external view of the finished product.

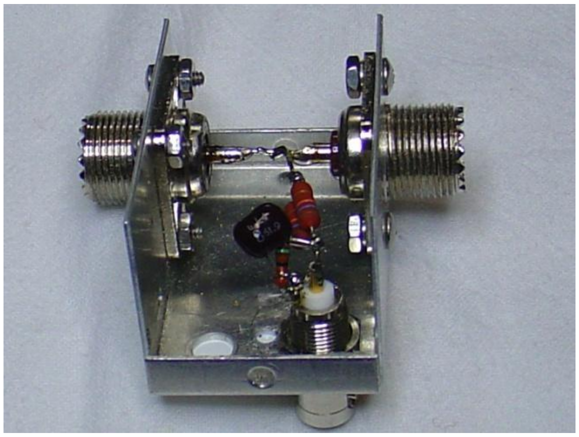

Photo 1: Internal view of the 50dB tap

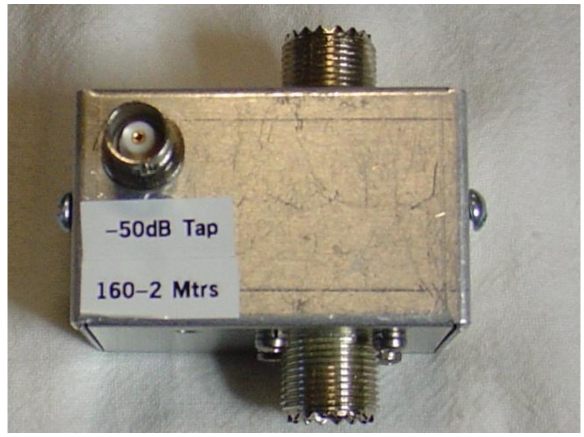

Photo 2: The final product

All necessary parts are listed in the Part List of Table 1. All components were obtained from Mouser Electronics (www.mouser.com).

Table 1 – 50dB Tap Bill of Materials

QTY	Description	Mouser PN	Price ea.
2	UHF connectors	601-25-7350	$1.33
1	BNC connector	530-CP-1094-AST	$2.67
2	16K 2W resistors	262-16K-RC	$0.19
1	51Ω ½-watt resistor	293-51-RC	$0.05
1	2.25x1.5x1.38" AL box	537-M00-P	$4.37