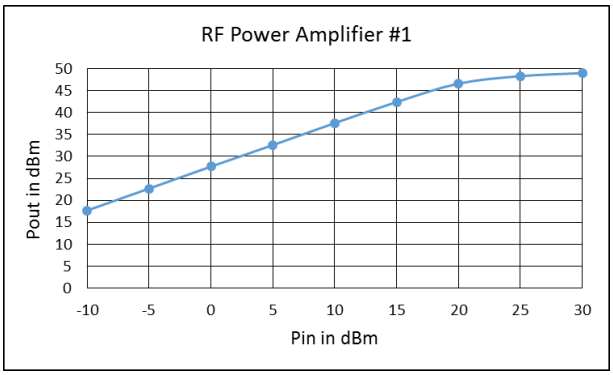
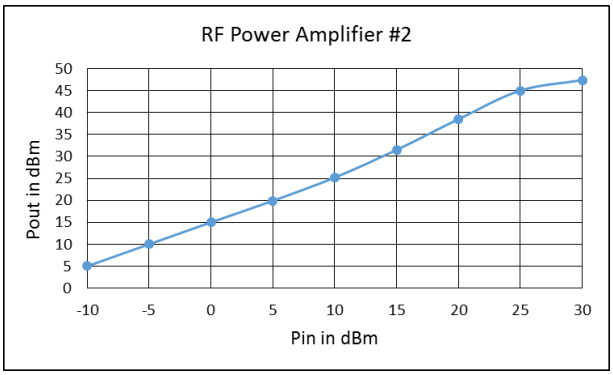
Characterizing an RF Power Amplifier with Pin and Pout data
Carl Luetzelschwab K9LA June 2017

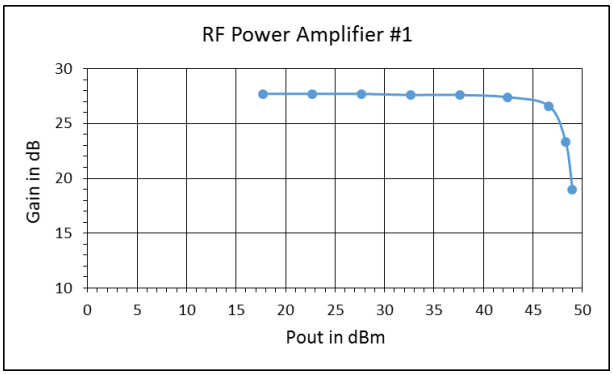
Most of the reviews of RF power amplifiers that I've seen plot the output power (Pout) versus the input power (Pin). The following Pout vs Pin curves are for two power amplifiers.

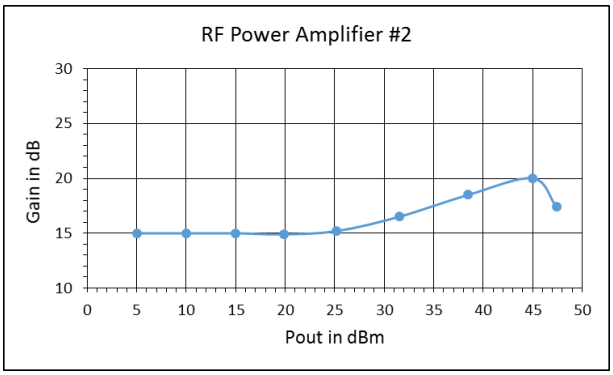




One of the power amplifiers is biased in light Class AB, while the other is biased Class A. It's not real obvious which one is which, but if you carefully study the shape of the curves you might be able to figure it out.

There's a better way to plot the data to easier tell how the power amplifiers is biased – and thus a better indication of its linearity (and other performance characteristics, too). All you have to do is use the same data but plot Gain versus Pout. The following Gain vs Pout curves are for the same power amplifiers as above.





Power amplifier #1 has a very flat gain until compression (roll-off in gain) starts. This is the Class A power amplifier. This power amplifier should have excellent linearity (two-tone IMD, for example). But being Class A, it should also be a compromise in efficiency (how much DC power needed to give the desired RF output power). From a physically larger plot for better resolution, the 1 dB compression point (P1dB – where the gain decreases 1 dB referenced to the gain at low Pout values) of this amplifier is easily determined to be +46.5 dBm (45 Watts).

Power amplifier #2 has flat gain for a while, but then the gain increases to a peak right before compression starts. This is the power amplifier biased into light Class AB, and this gain increase (commonly referred to as gain expansion) is a tell-tale characteristic of a Class AB power

amplifier. This amplifier should have decent linearity while still having decent efficiency. In other words, it's an acceptable compromise between linearity and efficiency, and is usually what is used for Amateur Radio SSB operation. But determining the 1 dB compression point is tough – what is the reference point? Is the reference point the gain at the low Pout values or is it the peak gain before compression starts? I've never seen an official definition for P1dB for a Class AB amplifier, but it seems sensible to reference it to the peak gain. Using this definition, P1dB is about +46 dBm (40 Watts)

In summary, plotting Gain vs Pout instead of Pout vs Pin will give you more insight into the performance of the RF power amplifier in question.