

A Broadband HF Amplifier Using Low-Cost Power MOSFETs



Part 1—With only 1 W of drive, you'll get over 40 W out—from 160 through 10 meters!

Many articles have been written encouraging experimenters to use power MOSFETs to build HF RF amplifiers. That's because power MOSFETs—popular in the design of switching power supplies—cost as little as \$1 each, whereas RF MOSFET prices start at about \$35 each!

Over the years, I tucked away several of these articles, waiting for an opportunity to experiment with them. That opportunity came when I received a call from Al, W2OHJ. Al wanted a low-cost linear amplifier to use with his 5 W QRP transmitter when band conditions got poor. Ideally, the amplifier would generate at least 25 W on all the HF bands. Al's inquiry renewed my interest in the topic and provided the motivation I needed to get my project underway.

Al provided me with an extensive list of RF-amplifier construction articles that use power MOSFETs.¹⁻⁴ These articles provided useful information about MOSFETs and general guidelines for working with them, including biasing, parasitic-oscillation suppression, broadband impedance-matching techniques and typical amplifier performance data. It was clear from the performance data that Al's desire to get 25 W output from power MOSFETs on 1.8 to 30 MHz was going to be a challenge! The RF output power of most of the amplifiers described in the articles drops off to 10 W or less as frequency increases just to 14 MHz.

An Idea Brews

After hundreds of hours of experimentation, I came up with a design that exceeds our original objective: One watt of input power produces over 40 W of output (after harmonic

filtering) from 160 through 10 meters. To the basic amplifier, I added an RF-sensed TR relay and a set of low-pass filters designed to suppress harmonic output and comply with FCC requirements. The amplifier is built on double-sided PC board and requires no tuning. Another PC board contains the low-pass filters. Power-supply requirements are 28 V dc at 5 A, although the amplifier performs well at 13.8 V dc.

Several of these amplifiers have been built and exhibit similar performance. Al has been using his amplifier on each of the HF bands, logging well over 500 contacts in 18 months. Signal reports indicate a noticeable improvement in readability (about two S units on average) over his 5 W rig. No indications of instability, CW key clicks or distortion on SSB have been reported. To make it easy for you to duplicate this project, PC boards and parts kits are available, all at a cost of about \$100!*

An Overview of MOSFETs

MOSFETs operate very differently from bipolar transistors. MOSFETs are voltage-controlled devices and exhibit a very high input impedance at dc, whereas bipolar transistors are current-controlled devices and have a relatively low input impedance. Biasing a MOSFET for linear operation only requires applying a fixed voltage to its gate via a resistor. With MOSFETs, no special bias or feedback circuitry is required to maintain the bias point over temperature as is required with bipolar transistors to prevent thermal runaway.¹⁰ With MOSFETs, the gate-threshold voltage increases with increased drain current. This works to turn off the device, especially at elevated temperatures as transconductance decreases and $R_{DS(on)}$ (static drain-to-source on resistance) increases. These built-in self-regulating actions prevent MOSFETs from being affected

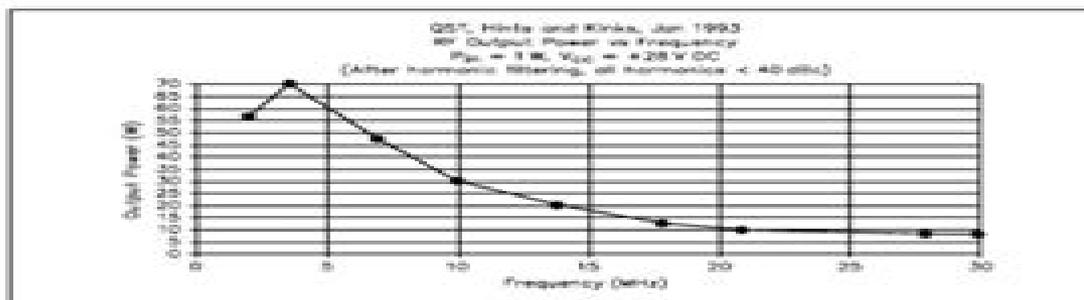


Figure 1—Jim Wyckoff, AA3X, "1 W In, 30 W Out With Power MOSFETs at 80 M," Hints and Kinks, QST, Jan 1993, pp 50-51.

*Notes appear on page 43.

A Broadband Hf Amplifier Using Low Cost

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