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ECEN 2420
On-Site Homework 10
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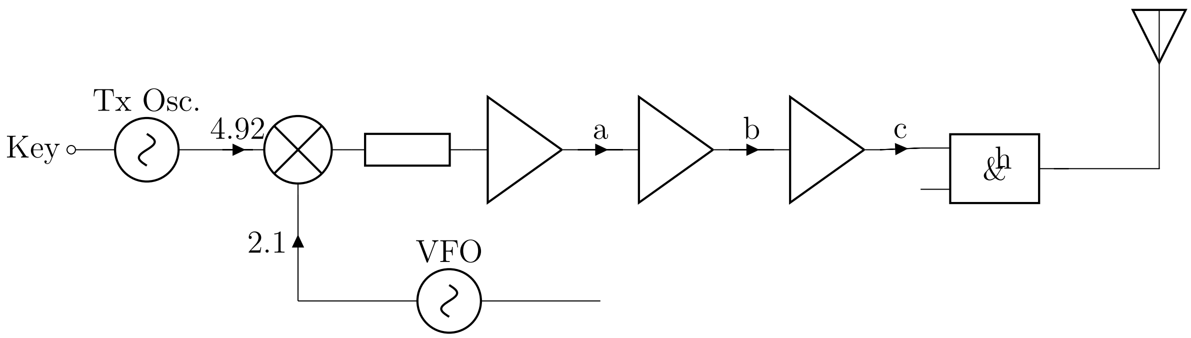
Introduction

The power amplifier and transmit mixer were constructed and analyzed. The power amplifier is the final amplification stage prior to the Harmonic filter, with an output designed to be around 2 Watts. The Transmit mixer is designed to combine the signal from the VFO and the Transmit oscillator.



1 Power Amplifier

1.1 Receiver Switch

Before building the power amplifier itself, a receiver switch was installed in order to protect the receiver circuitry for when the transmitter will be active. The schematic of the protective switch is shown in Figure 1.

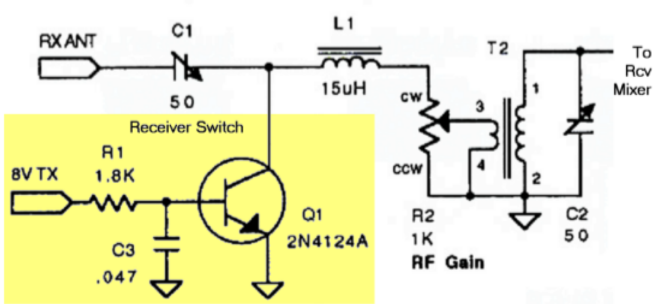


Figure 1: Receiver Switch

After the installation of the switching circuitry, the power amplifier was then build according to the schematic shown in Figure 2.

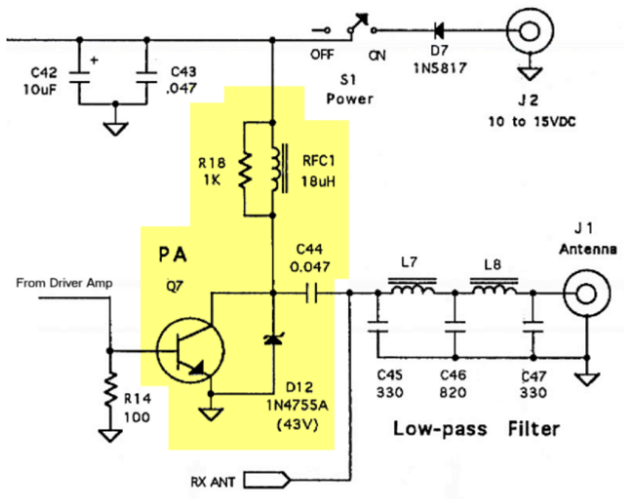


Figure 2: Power Amplifier

1.2 Measurements and Analysis

In order to prevent cooking the oscilloscope prematurely, a 40dB attenuator was connected between the antenna terminal and the coaxial cable. After this, the function generator was connected across R_{14} and set initially to $1V_{pp}$ at $7.04MHz$.

The following aspects of the circuit were the subject of analysis, and for the purpose of calculation had the following variable names:

$$\text{Input Voltage} \equiv V_0[V_{pp}]$$
$$\text{Output Voltage} \equiv V[V_{pp}]$$
$$\text{Supplied Current} \equiv i_0[mA]$$
$$\text{Supplied Power} \equiv P_0[mW]$$
$$\text{Output Power} \equiv P[mW]$$
$$\text{Gain} \equiv G$$
$$\text{Efficiency} \equiv \eta$$

The measurable values are V_0, V, and i_0. The remaining values were calculated using the following equations:

$$\text{Let } R_L = 50\Omega;\ V_{DC} = 12V$$
$$P_0 = V_{DC} \cdot i_0$$
$$P = \frac{V^2}{16 \cdot R_L}$$
$$\eta = \frac{P}{P_0}$$
$$G = 20log\left(\frac{V}{V_0}\right)$$

Next, V_0 was adjusted such that the output V was measured to be $5V_{pp}$. By adjusting the supplied voltage V_0, the measured output V was increased in intervals of $2.5V_{pp}$ until V was measured to be $30V_{pp}$. The relevant values found on each iteration were recorded into the following table. It should be noted that in order to compensate for the 40dB attenuation, the scope's values were multiplied by 100x (fortunately, the Agilent scope had this functionality built-in).

$V_0[V_{pp}]$	$V[V_{pp}]$	i_0[mA]	P_0[mW]	P[mW]	G[db]	η
1.712	5.12	41.0	492	32.7	9.52	6.70%
1.803	7.52	49.0	588	70.6	12.4	12.0%
1.866	10.0	56.0	672	125	14.6	18.6%
1.922	12.5	63.0	756	195	16.4	25.8%
1.965	15.0	71.0	852	281	17.7	33.3%
2.012	17.5	79.0	948	383	18.8	40.4%
2.053	20.0	86.0	1.03[W]	500	19.8	48.4%
2.094	22.5	94.0	1.13[W]	633	20.6	56.1%
2.168	25.0	102	1.22[W]	781	21.2	63.8%
2.189	27.5	111	1.33[W]	945	22.0	70.9%
2.229	30.0	119	1.43[W]	1.13[W]	22.6	78.8%

1.3 Plotting η v.s. P

Taking the values from the table, plots can be made that demonstrate the circuit's properties. In Figure 3, the efficiency η is plotted against the output power P. In Figure 4, the gain of the power amplifier was plotted against the input RF Voltage.

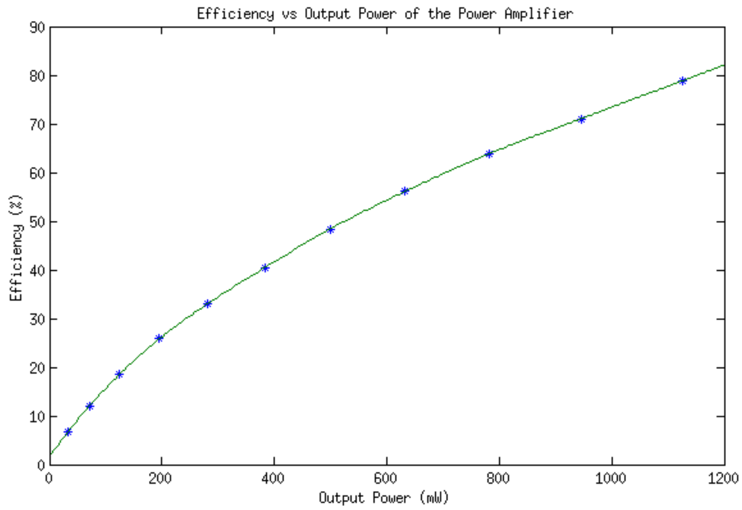


Figure 3: Plot of Efficiency η v.s. Output Power P

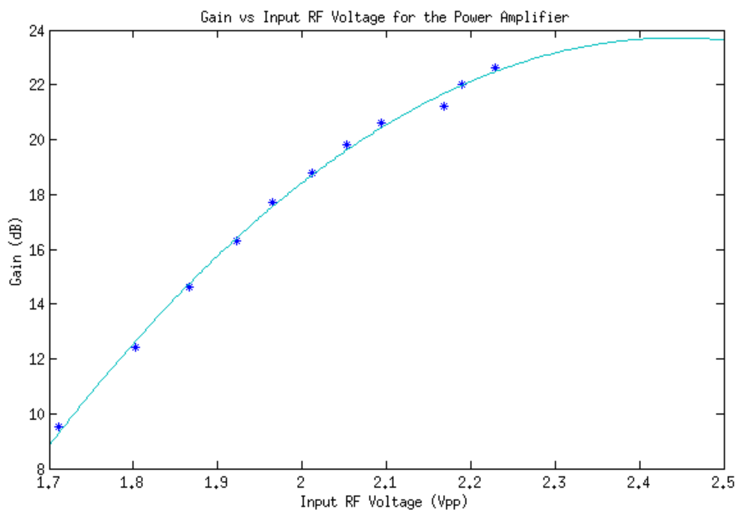


Figure 4: Plot of Gain v.s. input RF Voltage

2 Transmit Mixer

Next, the Transmit Mixer was build and tested. Its schematic is shown in the following Figure.

2.1 Initial Set of Measurements

All components except C_{31} were soldered. Next, C_{34} was adjusted to get a max voltage Next, the resonant frequency was measured across the crystal and inductor and found to be $\boxed{4.9MHz}$

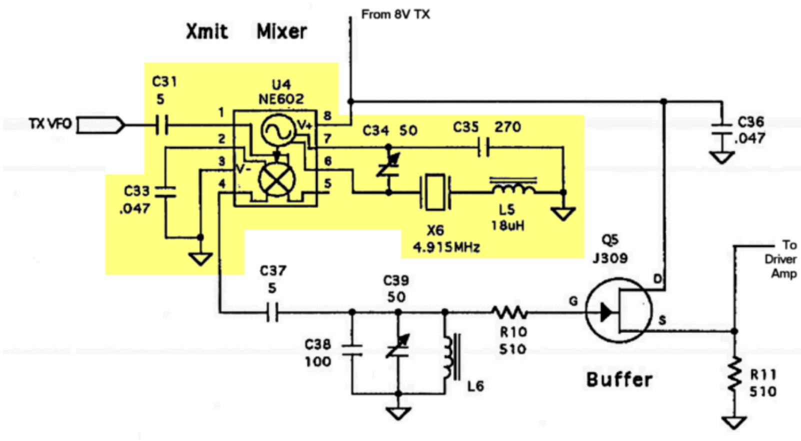


Figure 5: Transmitter Mixer

After these final measurements, C_{31} was soldered in.