

# On Site Homework #10

## ECEN 2420: Wireless Electronics for Communication

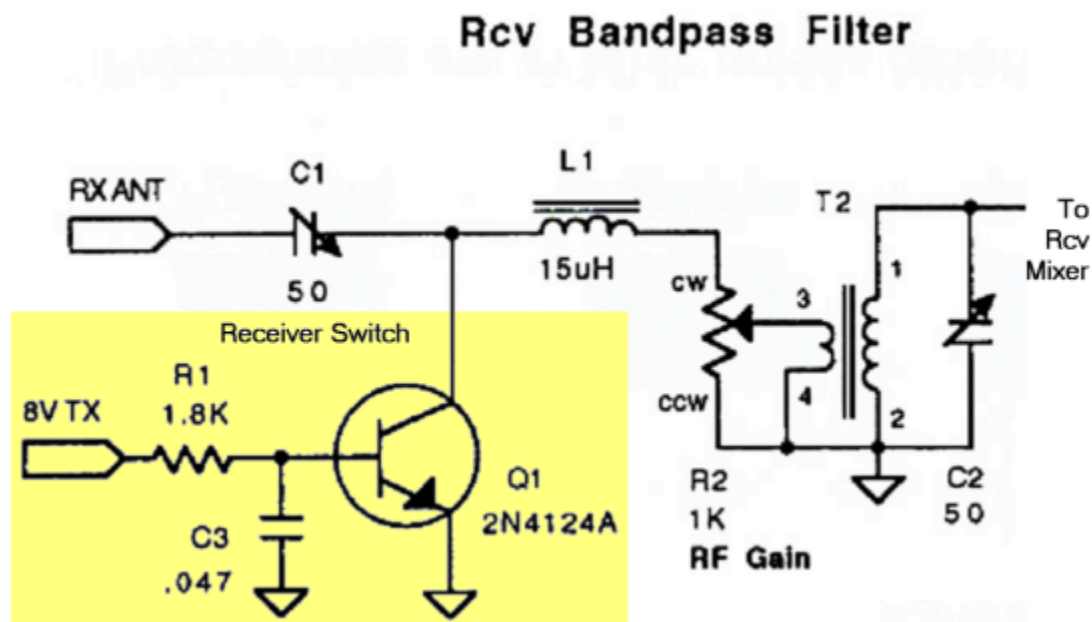
### Goals

- Build and measure the Power Amplifier of the NorCal 40A transmitter
- Implement and measure the Transmit Mixer of the NorCal 40A transmitter

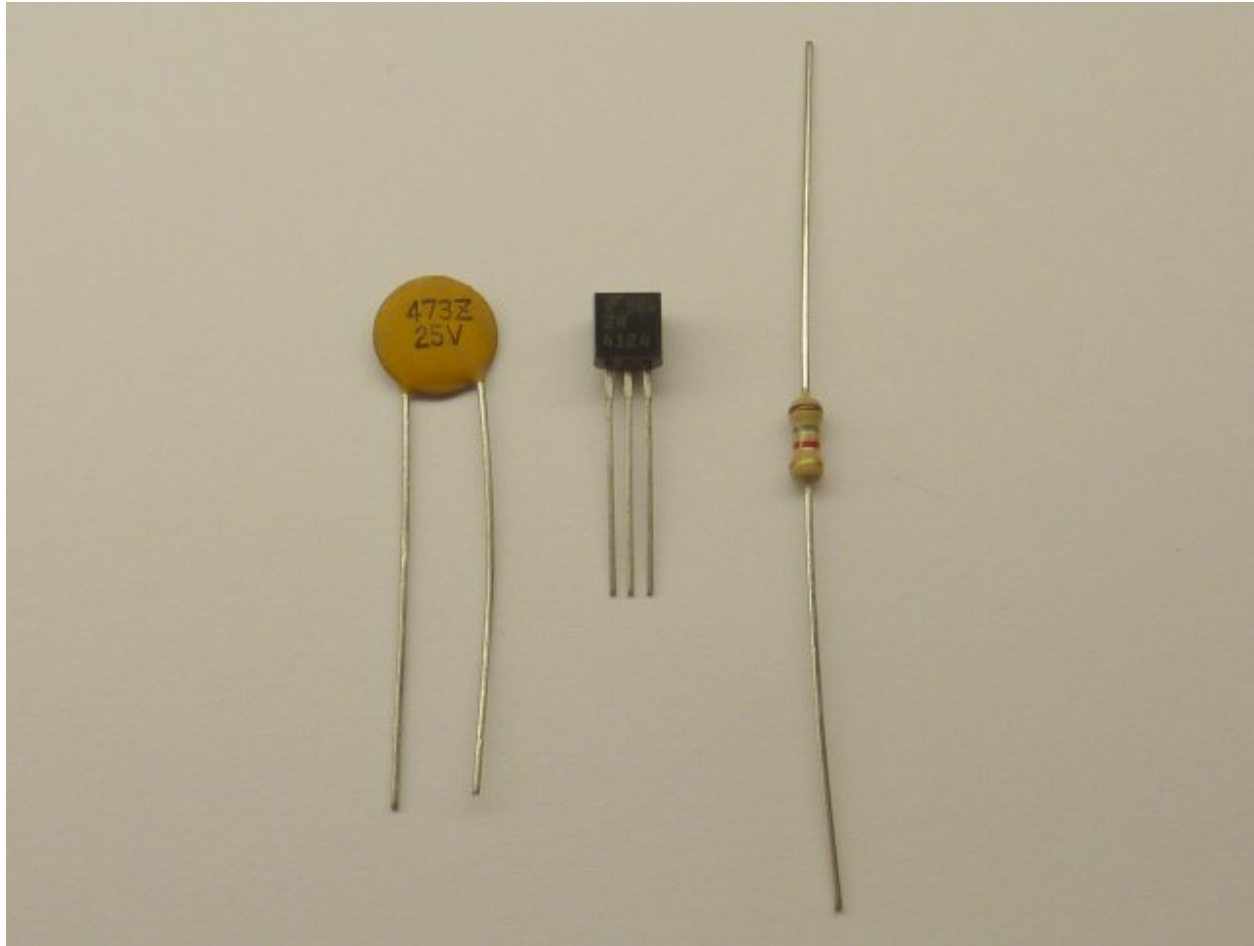
### Problems

#### Problem 1.


The goal of this problem is to put in the receiver switch that protects the receiver circuitry when the transmitter is on. The schematic of the transistor switch is shown below.

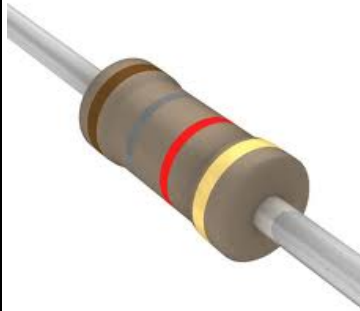



The parts needed are shown below



The parts are listed below

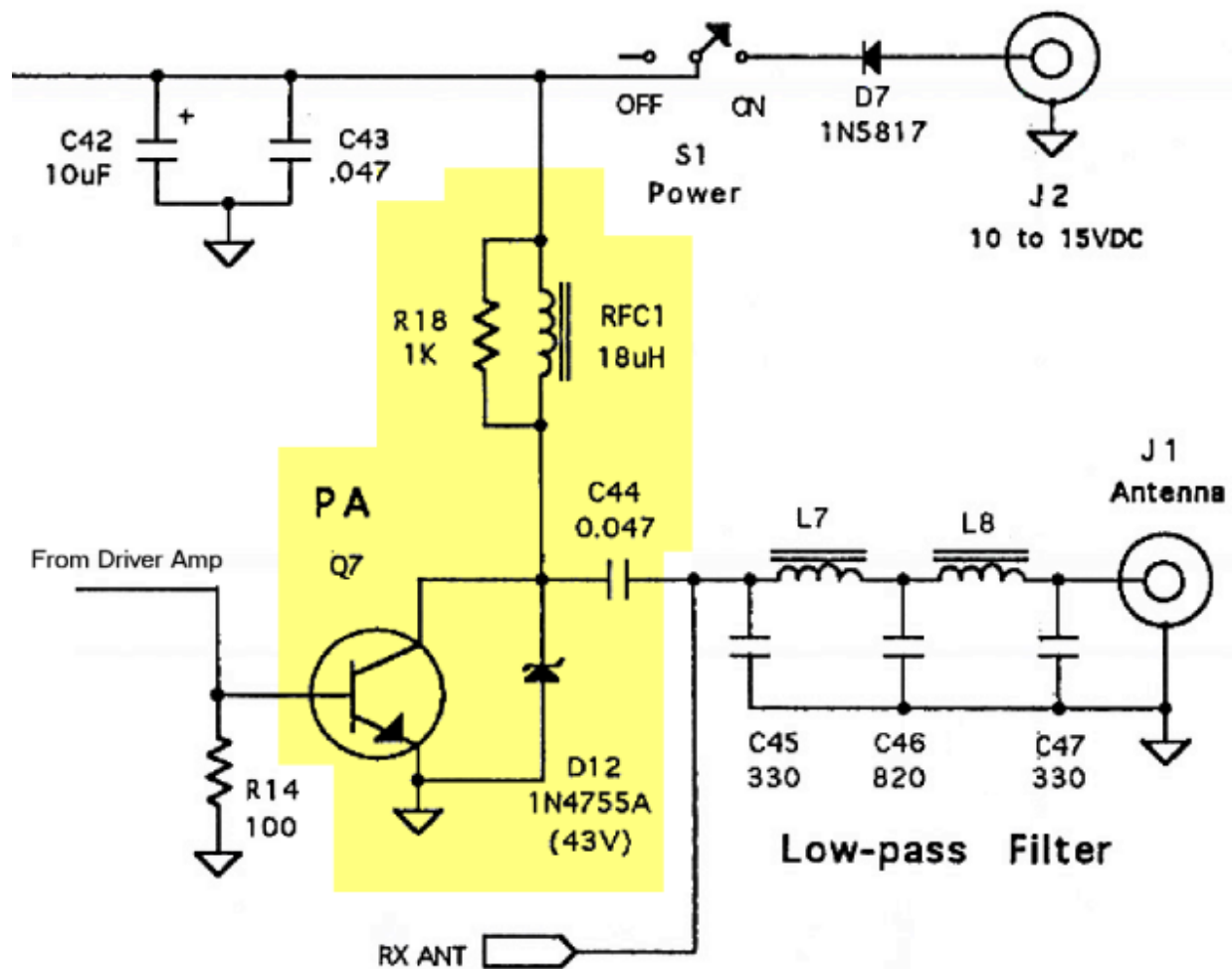
Picture	Reference	Description	Part Number	Quantity
	Q19	Transistor, 2N4124-A		1

	R1	Resistor, 1.8 kOhm		1
	C3	Cap. Disc or Mono, 0.047 uF, 20%, 25 V		1

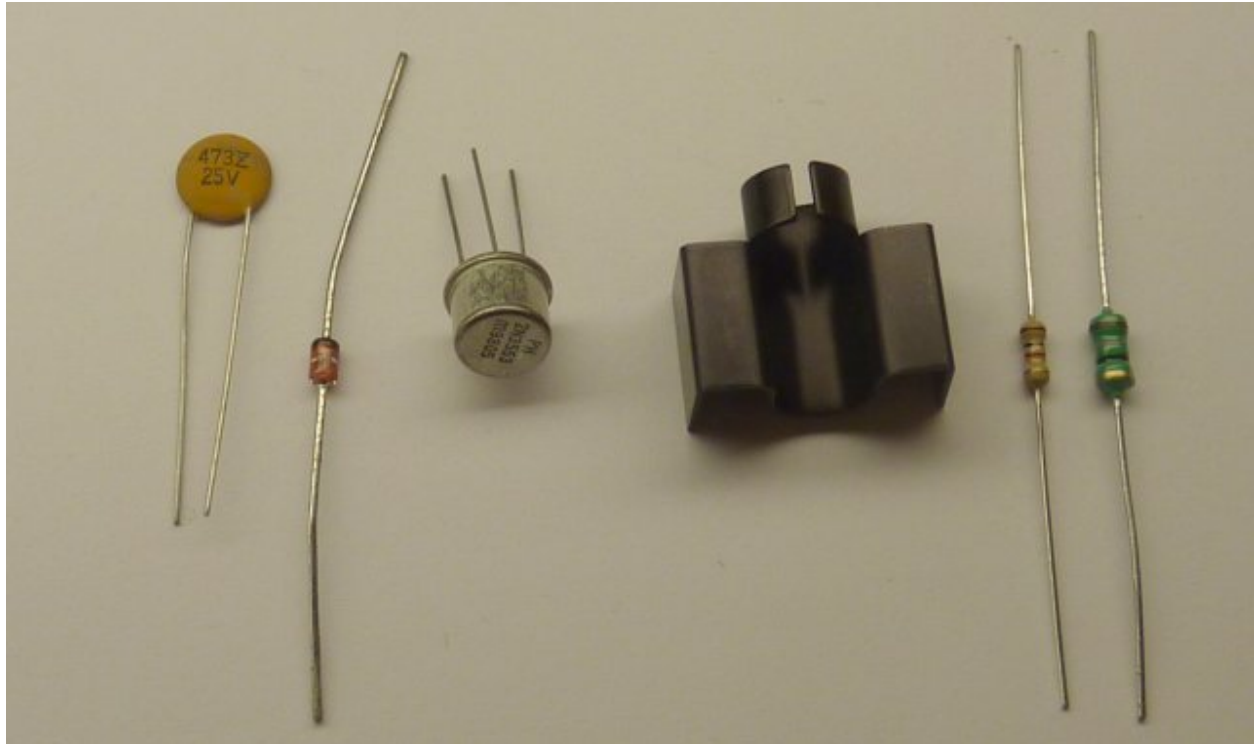
## Problem 2

The goal of this problem is to build and measure the Power Amplifier of the transmitter.



The transistor used for the power amplifier is the 2N3553, and the manufacturer's data sheet specifies that the maximum collector voltage as 40 V. The circuit schematic is shown below.



D12 is a Zener diode across the output that conducts at 36 V to prevent excessive collector voltages. R14, which was installed previously, limits the reverse voltage on the base-emitter diode, which should not exceed 4 V. The parts needed for the Power Amplifier are shown below.



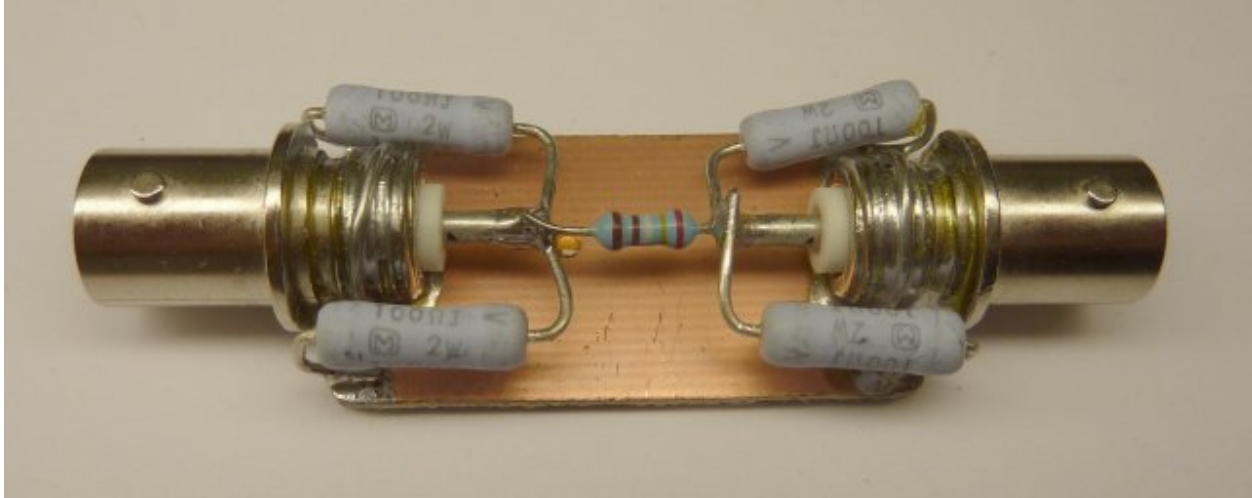
The parts are listed below.

Picture	Reference	Description	Part Number	Quantity
	RFC1	Inductor, 18 uH		1
	D12	IN4755A		1

	C44	Cap. Disc or Mono, 0.047 $\mu$ F, 20%, 25 V		1
	Q7	NPN Transistor, 2SC799		1
	R18	1 kOhm resistor		1

Go ahead and solder all components into the board.

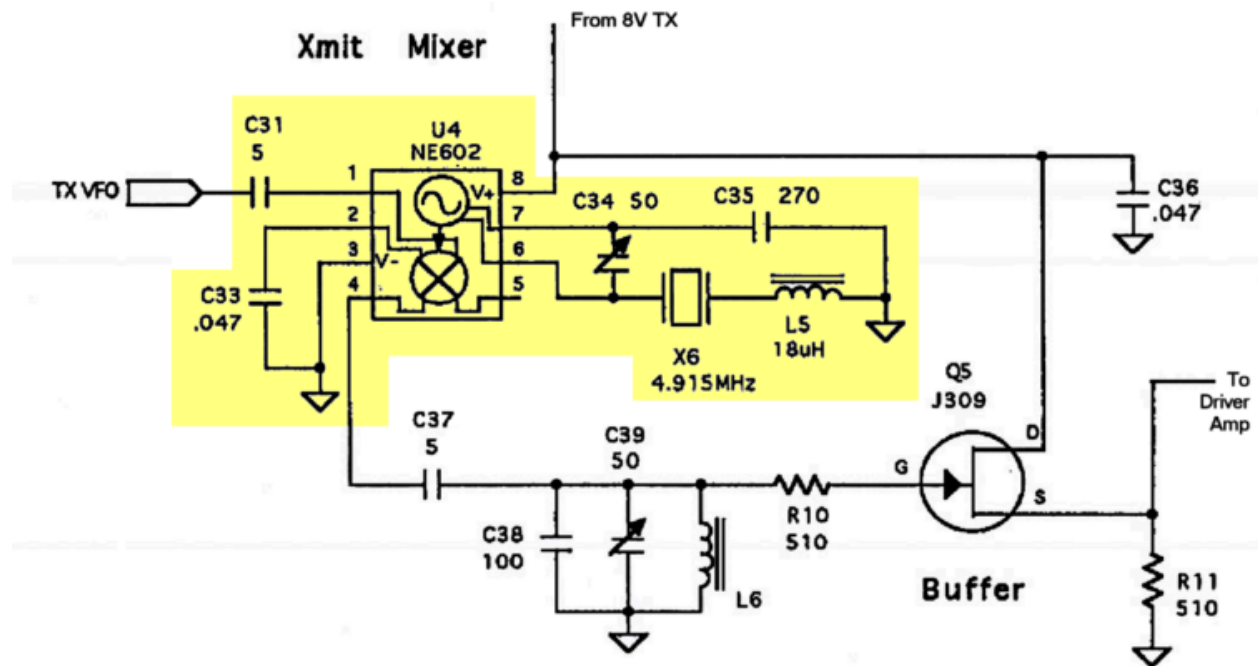
- The output of the NorCal 40A is ideally about 2 W. Using our power equation, we can calculate that this corresponds to an output voltage of approximately 28 V. This is a rather high voltage to measure using the oscilloscope, and even more so because we connect the scope right to the antenna output jack and not through a 10x scope probe. Thus, the output power must be reduced for measurements. You can use a 40 dB attenuator shown below for this purpose.



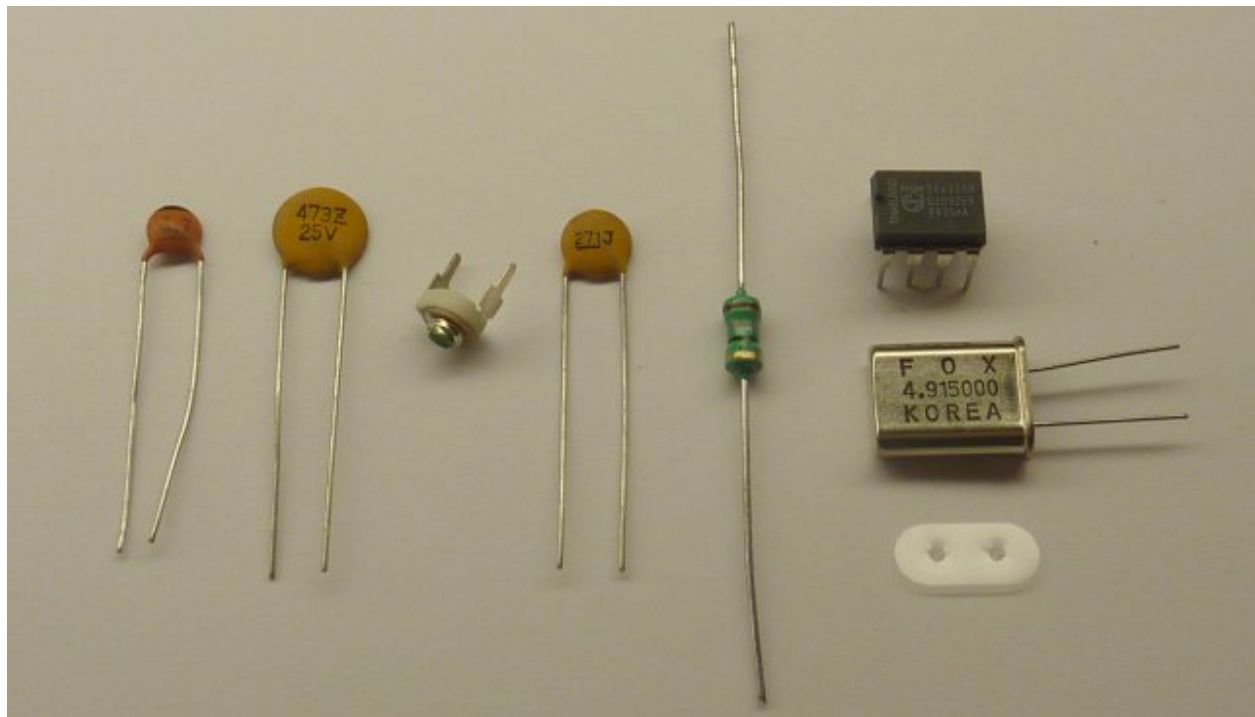
- Connect the function generator across R14, initially set at 1 V<sub>pp</sub> and 7.04 MHz. Connect the scope to the antenna jack after the attenuator. You will need to utilize a male – male BNC adapter for this.
- You may not see an output voltage right away because you are at the wrong bias point for this transistor. Increase the function generator voltage as necessary to see the sinusoidal output. Make a series of measurement for peak-to-peak output voltages of 5 V through 30 V. Make sure to take into account the 40 dB attenuator. For each output voltage, make note of the supply current required as well.
- For each of the measurements, record the output voltage, remembering that you have a 40 dB attenuator at the antenna jack. Calculate the output power for each output voltage. Also calculate the supply power at each output voltage. Use this to calculate the efficiency, and plot it vs. the output power P. Also plot the gain of the power amplifier vs. the input RF voltage.

### Problem 3

The goal of the last problem is to build and measure the Transmit Mixer. The transmit mixer takes the signal from the VFO and mixes it with the Transit Oscillator. Its output is a low-level signal that is amplified by the transmit amplifier chain. In the receiver mixer, we take differential outputs, but in the transmit mixer, we only use one. If we do this, we cut the output voltage and resistance in half. Thus, our available power drops by a factor of 2. The circuit diagram is shown below.




The parts needed are shown below.



A list of the parts needed is shown below.

Picture	Reference	Description	Part Number	Quantity
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	C35	270 pF		1
	C31	4.7 pF		1
	C37	Cap. Disc or Mono, 0.047 uF, 20%, 25 V		1
	C34	Cap., Var., 8-50 pF, Mica		1
	L5	18 uH inductor		1
	X6	Crystal, 4.915 MHz, HC-49		1
	U4	IC, Mixer/Oscillator	SA602AN	1

**Do not solder in C31 yet. This leaves the VFO disconnected initially, which we need for the first set of measurements.**

Solder in every component except for C31.

- Adjust C34 with a plastic tool to get a maximum voltage level. What is the resonant frequency? Measure this across the crystal and inductor.

Now you may solder C31 in.