On Site Homework #11

ECEN 2420: Wireless Electronics for Communication

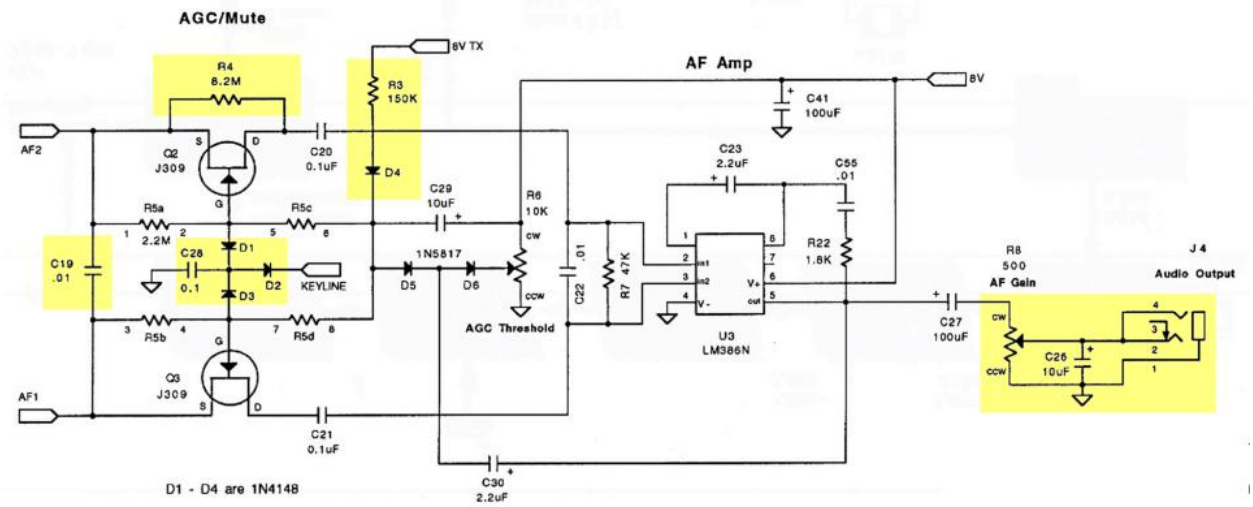
Goals

- **Finish the NorCal 40A and do final alignment**
    - **Make sure to bring a pair of headphones for final alignment!**

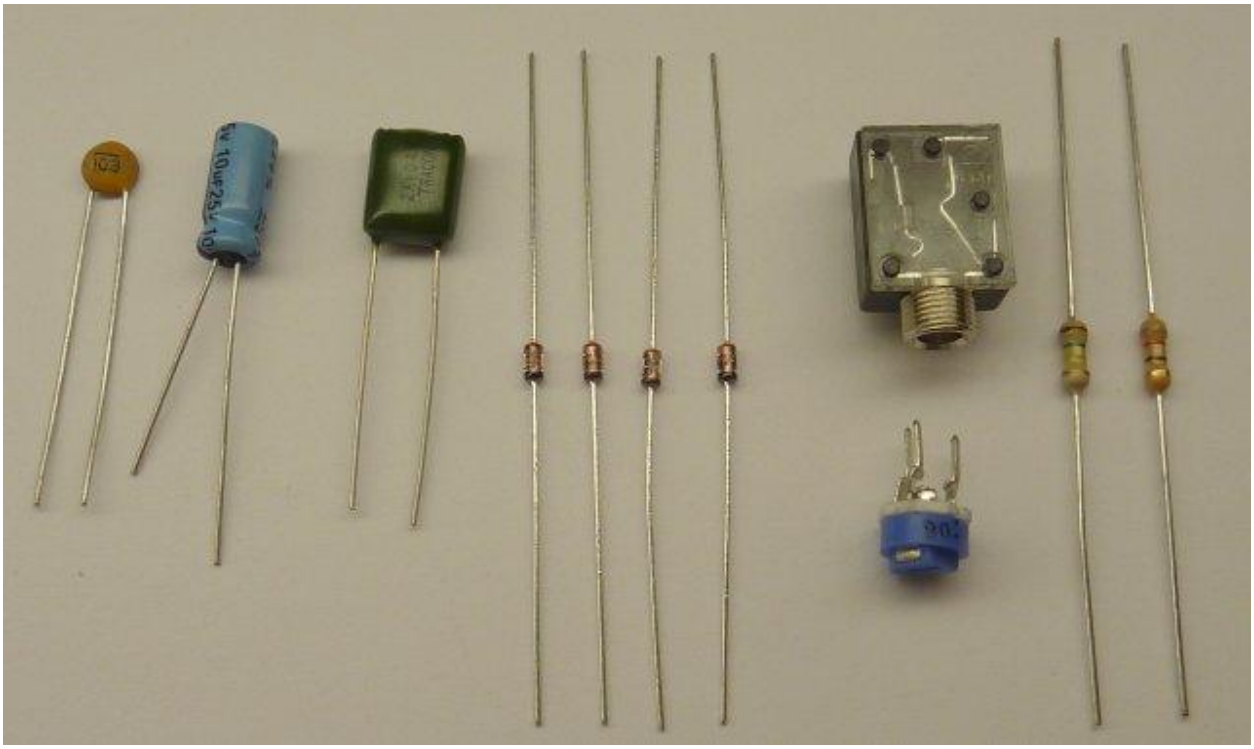
Problems

Problem 1.

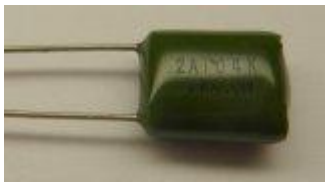
The goal of this problem is to finish installing remaining components and do final alignment. We will be closely following Problem 33 in the book. The parts that we still need to install are shown below.



The parts needed are shown below



The parts are listed below

Picture	Reference	Description	Quantity
	C19	10 nF Disc Capacitor	1
	D1,D2,D3,D4	Cap. Disc or Mono, 0.047 uF, 20%, 25 V	4
	C28	100 nF Mylar Capacitor	1
	C26	10 uF Capacitor	1

	J4	3.5 mm stereo jack	1
	R8	10 kOhm Resistor Trimmer	1
	R3	150 kOhm	1
	R4	8.2 MOhm	1

C19 and C26 provides additional high frequency roll-off for the audio filter. The potentiometer allows us to adjust the output volume. The remaining parts are for muting the audio output while transmitting. Even with the receiver switch on, the transmitter gives a larger voltage in the receiver mixers than any signal that would be received by the antenna – therefore, we cannot rely on the AGC alone. Solder these additional parts to the board. Also, remove all temporary resistors and wires.

We will now do final calibration of your NorCal 40A in preparation for the final board exam next week. Please print out a copy of the final calibration to hand in, 1 per group. Also, please bring your own headphones to listen for the audio signal output.

Initial Settings

1. Familiarize yourself with the location of the jacks (J1, J2, J3, & J4), the switches (S1 & S2), the trimpots (R6, R8, & R13), the trimmer capacitors (C1, C2, C17, C34, C39, & C50), and the potentiometers (R2, R16, R17). **Accidentally adjusting a previously adjusted component may force you to start the entire procedure over!**
2. Do NOT plug anything into J3 (key jack).
3. Plug a bare 3.5mm stereo jack into J4 (audio jack).
4. Set the trim-pots. as follows:
    a. R6 (AGC) fully clockwise (100%) = AGC disabled
    b. R8 (Audio) fully clockwise (100%) = maximum audio volume
    c. R13 (Drive) fully counter-clockwise (0%) = minimum transmitter drive
5. Set the potentiometers. with knobs as follows:
    a. R2 (RF gain) fully clockwise (100%)= maximum RF gain
6. Set S1 (Power) lever down = power off
7. Set S2 (RIT enable) lever down = RIT disabled
8. Do not connect anything to J1 (antenna jack) yet

Checkout

All steps must be completed successfully before proceeding to the next step!

1. Set the DC power supply to 12.0V and the current limit to 100mA.
2. Connect the power cable to the Norcal 40A and turn on S1. The DC current draw should be~15-18mA.
    a. Measured DC current draw = _____
3. Plug a 3.5mm stereo plug into J3 (key jack) and short tip to sleeve on the plug or plug in the "Key" and press down. The DC current draw should be ~25-55mA. Radio is now in the transmit mode at minimum power.
    a. Measured DC current draw = _____
4. **Remove the plug from J3 returning the radio to receive mode.**

Calibration

The radio will be calibrated at 7.040MHz which will be the center of the VFO range. Again all steps must be completed successfully before proceeding to the next step!

1. Preliminary setup:
    a. Set the signal generator for 4mVpp into 50 ohms at 7.040MHz and turn on the generator output.
    b. Connect the signal generator to a 40dB attenuator and connect that to the Norcal 40A.
    c. Set the oscilloscope amplitude to 200mV per division and the time base to 200nS per division. Set the channel for a X10 probe and **AC coupling.** Have the scope measure frequency and Vpp. The next step requires a X10 scope probe. Connect the scope probe to the test point wire near S2 and the scope ground to the ground loop near J1.

2. Turn on the Norcal 40A (Switch S1= up) and adjust C50 with a plastic tool until the VFO frequency is correct.
    a. With a 10:1 probe the signal is ~600-800mVpp.
    b. **You may have already done this tuning previously, check your VFO frequency before changing anything.**
    c. Adjust C50 (with R17 at 50%) until the VFO frequency is 2.125MHz.
    d. Measured frequency (to +/-100Hz) with R17 fully counterclockwise = _____
    e. Measured frequency (to within +/-100Hz) with R17 fully clockwise = _____
    f. Return R17 until frequency = 2.125MHz exactly.
    g. What freq. range would you expect the radio to tune? _____

3. Receiver alignment
    a. Set the scope amplitude for 200mV per division (should already be there) and the time base to 2ms per division. Connect the scope to tip and sleeve (ground on sleeve) on the plug connected to J4 (audio)
    b. **You may have already done this tuning previously, check your Audio frequency before changing anything.**

c. Adjust C17 for an audio frequency of 575 +/- 10Hz.
d. What is the measured audio voltage? _____ (should be >1 Vpp)
e. Adjust the RF signal generator frequency up and down looking for a 6dB change in amplitude (amplitude is 0.5 times the maximum @ -6dB).
f. Measure the audio frequency at both 6dB points.
g. What is the measured 6dB bandwidth of the crystal filter? _____
h. Adjust the RF signal generator frequency until the audio frequency is back to ~575Hz.
i. Turn on the Receiver Incremental Tuning (RIT) by turning switch S2 = up and turn potentiometer R16 throughout its range. The audio frequency should vary several hundred Hz and you should see the amplitude change as the receiver's passband is tuned above and below the frequency of the signal generator. What is the range of frequencies you see? _____
j. Turn off the RIT (switch S2 = down) which will return the audio frequency to ~575Hz.
k. Adjust R6 (AGC) until the voltage at the scope drops by about 30%. Pot should be at ~60% of clockwise rotation.
l. Disconnect the function generator from the 40dB attenuator while leaving the pad connected to J1.

4. Transmitter alignment
   a. Set the scope amplitude for 50mV per division and the time base to 2ms per division (should already be there). Leave the scope connected to J4.
   b. Adjust the DC power supply to current limit at 200mA.
   c. Adjust R13 to the 50% point.
   d. Connect either a shorted plug to J3 (key jack) or the key.
   e. Adjust C39 (transmit filter) for maximum voltage at the scope. This is at audio frequency. Make sure C39 is not at either the minimum or maximum capacitance setting.
   f. Measure the DC current draw from the power supply which must be less than 200mA. What value was measured? _____
   g. Adjust C34 (transmit frequency) for 575Hz +/- 10Hz as measured by the scope.
   h. Set the scope amplitude for 2V per division and the time base to 200ns per division and connect the scope to the <u>transmitter end</u> of the 40dB attenuator (not the open end).
   i. A 40dB attenuator reduces the <u>power</u> by what factor? _____
   j. Measure the RF voltage at the scope and convert to transmitter power remembering that there is a 40dB pad prior to the scope. What is the measured power? _____
   k. Remove the short on the plug connected to J3.
   l. Adjust the DC power supply to current limit at 600mA.
   m. Set the scope amplitude for 5V per division.
   n. For the next step the transmitter will be run at maximum power so do not key the transmitter for more than 10 seconds continuously.

o. Adjust R13 fully clockwise, short the plug at J3 or use the key, and quickly measure the RF voltage on the scope. Quickly remove the short and set R13 to the 50% point.
p. Using the just measured voltage what is the maximum power the transmitter can provide? _____

This completes the Norcal 40A calibration!