

Errata for Hands on Radio Experiments #1 through #10

Experiment #1 - The Common-Emitter Amplifier

Under "Key Equations", in equation #2 of experiment #1, the last term is "Vcc". It should be "Vce".

Experiment #2 - The Emitter-Follower Amplifier

In Experiment #2, "The Emitter Follower", the caption for Figure 1 should state that the circuit is a common-collector amplifier, not a common-emitter. Thanks, Dave AD5TU

Experiment #4 - Active Filters

The text uses the phrase "The reactance of C_f ($X = 1/2\pi f C_f$) gets smaller with frequency. That means the impedance of the feedback path between the op-amp's inverting terminal and output also gets smaller with frequency." This is intended to mean that capacitive reactance gets smaller as frequency increases. As reactance decreases, the circuit's gain also decreases, creating a low-pass filter.

A couple of readers have written with questions about their measured frequency response versus what the equations predicted. First and foremost - it is Good Practice to compare predicted versus observed performance and question discrepancies! Don't blindly accept what a model or equation says! If you use software tools to evaluate measurements, you should be sure to understand their output, as well. After all, as Isaac Asimov said, "The most exciting phrase to hear in science, the one that heralds new discoveries, is not 'Eureka!' (I've found it!), but 'That's funny...'"

Gain must be calculated from the actual input and output voltages for each frequency, since the input voltage is likely to change due to changes in circuit input impedance or signal source variation. Performance will also vary from the predicted value if the component's nominal (labeled) values are used instead of the actual values, which can be several percent different.

Avoid very high or very low values of resistance (>100 kohms or <100 ohms) and capacitance (>0.1 uF or less than 100 pF) because the parasitic effects of the way the circuit is constructed or the characteristics of the op amp will affect circuit performance. The simple design equations ignore these effects.

Experiment #7--Voltage Multipliers

Ron WD8SBB asks, "Could you please refresh my memory about voltage doublers and the potential that they place across the insulation of the transformer? This is of little issue for low voltages, but for something like a high power tube supply, it would be an engineering issue."

Actually, the voltage stress is the same for both types of multipliers. The peak voltage on the secondary is $1.4 \times V_{rms}$ in either case because the secondary is never connected across more than one of the capacitors in the charge-pump string. What does increase in the transformer secondary is the current load. The current requirement (versus output current) doubles for a doubler, triples for a tripler, and so forth.

From the ARRL Handbook - "When a doubler is employed, the secondary winding of the power transformer need only be half the voltage that would be required for a bridge rectifier. This reduces voltage stress in the windings and decreases the transformer insulation requirements. It also reduces the chance of corona in the winding, prolonging the life of the transformer. This is not without cost, however, because the transformer-secondary current rating has to be correspondingly doubled."

Experiment #10 - SCRs

The instructions for this experiment failed to indicate where the ground clip for the oscilloscope probe was to be connected. For all of the measurements in this experiment, the ground clip should be connected to the SCR's cathode or any lead connected to it.

This brings up an important point about using 'scopes to measure signals in AC circuits. The ground clips are generally connected together, so if they are placed at different points in a circuit, those points are then shorted together through the 'scope ground. The oscilloscope requires a "single-point" ground and will place the circuit at ground potential wherever the ground clip is attached.

This can be a problem - how can you make measurements between two ungrounded points? This is where the 'scope's "ADD" and "INVERT" functions are used. ADD causes the voltages from the two vertical channels to be added together. INVERT causes one channel's voltage to be inverted around ground. The result is that one channel is subtracted from the other. This allows you to measure the voltage between two ungrounded points in the circuit. This is also called a "Differential" voltage measurement.

- Attach the tip of the scope probes to the two ungrounded points.
- Connect the ground clips together.
- If there is a ground point in the circuit, connect the ground clips to that point. If not, connect the ground clips to a safety ground.
- Set both channels to the same Volts/division vertical sensitivity.
- Select the "ADD" function - usually on the same switch or menu as "CHOP" or "ALT"
- Select "INVERT" on one of the channels.

SAFETY NOTE - when using an oscilloscope to measure voltages on a circuit connected directly to the AC line, you **MUST** use an isolation transformer on the circuit or on the 'scope. Not doing so can put the full line voltage on circuit ground points, causing short circuits and damage to the circuit or scope, or creating a major shock hazard.