Analysis of A Transistor-Amplified Radio  
Written December 1992 by D. E. Mook

Introduction

In this laboratory session you will use the oscilloscope to study the amplified radio circuit you constructed in Project 15. You should have constructed the circuit before the lab period and bring the working circuit with you to the lab room.

The process you will be carrying out is called "tracing the signal" through a circuit. When you are designing a circuit or trying to diagnose a problem with a circuit signal tracing can be an excellent technique. You begin "at the beginning" of the circuit where the signal originates, and then trace its path along until you reach the "output" of the circuit. along the way you can observe how various components alter the signal and so determine if they are working as you want them to work.

Procedure

1) Turn on the HP 54600A oscilloscope. Re-set all of the controls of the oscilloscope to their initial values by pressing the Setup button and then the button below Default Setup that appears on the menu line at the bottom of the screen. Next press the 1 button in the Vertical Channel 1 portion of the oscilloscope controls. In the second menu item at the bottom of the screen, press the button for Coupling until AC is highlighted.

Here is the schematic diagram for your radio:

![Schematic Diagram]

The origin of the signal in the radio is clearly the antenna. Remember in the oscilloscope lab that you connected a wire to the input of the oscilloscope and saw the WDCR signal. that is the signal we will be tracing through the radio.

2) Tune the radio to receive WDCR as loudly as possible.

Connect the black plastic-covered clip to spring 49 and the probe of Channel 1 to spring 47. You will now be displaying the signal going to the earphone. Adjust the Volts/Div and Time/Div controls until you see a reasonable display of the sound you are hearing. The signal display should not go outside the top or bottom boundaries of the screen and
there should be few enough cycles present that you can see the shape of the signal wave 
your most humble and obedient Prof. decided to use a **Time/Div** setting of 2.00ms)

While you are watching the oscilloscope, disconnect the wire from spring 44. This 
disconnects the battery from the circuit and turns off the transistor. This test tells you 
that, in fact, the transistor is doing something to the circuit. Re-connect the wire to spring 44.

3) Connect the black clip to spring 55. We will now measure the signal with respect to 
the potential in this spring. Disconnect the battery from the circuit by removing the wire 
from spring 44. Next remove the crystal radio portion of the circuit from the amplifier 
portion by disconnecting the wire from spring 61.

Connect the probe of the scope to spring 60. You will have to change the **Volts/Div** 
setting to see the signal. This is the signal from the antenna after it has passed through 
the LC tuner circuit. Change the **Time/Div** setting to about 200ns and measure the 
frequency of the waves you see. Return the **Time/Div** setting to 2.00ms.

4) Now connect the probe to spring 61. You will have to change the **Volts/Div** setting to 
see the signal. Compare the appearance of the signal as it appears at spring 60 with that 
as it appears at spring 61. It is clear from the schematic that it is the signal at spring 61 that is sent on to the amplifier. **Why?**

5) Re-connect the wire from spring 15 to spring 61 to connect the crystal radio to the 
amplifier again. Next remove the wire from the 0.022µf capacitor to the base of the 
transistor (this wire runs from spring 22 to spring 29). Connect the probe to spring 21 
and look at the signal now. How does this signal differ from the signal at spring 61? 
What is causing this difference and why do you suppose the signal has been altered in 
this way? Before going on to the next step, make a note of the rough amplitude of the 
signal in volts.

6) Re-connect the wire between springs 22 and 29 to re-connect the input of the transistor 
amplifier to the signal. Re-connect the wire between springs 45 and 44 to supply power 
to the amplifier. Connect the probe to spring 30 and observe the signal after it has passed 
through the amplifier. Measure the amplitude of the signal. The **GAIN** of an amplifier is 
defined as the ratio of the signal output to the signal input. What is the gain of your 
transistor amplifier?

7) Is there any evidence that the act of amplifying the signal has distorted the signal in 
any way besides increasing its amplitude?

**This completes the required portion of this laboratory.**