MP212
Principles of Audio Technology II

Audio Signals, Measurement and Oscilloscopes

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Acrobat Reader 6.0 or higher required

http://classes.berklee.edu/mpe
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Introduction

The purpose of this assignment is for you to gain familiarity with simple audio signals, measurement procedures, and use of the oscilloscope. The assignment utilizes two “Black Box Analysis Workstations” in the A79 (L12) Audio Lab, located in the rear corridor around the corner from the Music Synthesis Department offices. Get the key to the room from the Studio Supervisor in the Studio Office (B08). Don’t forget to sign out headphones.

You should schedule lab time for this assignment in advance. This will ensure that you have an opportunity to get time on a workstation. See the Studio Booking Manager, in B08, to schedule a one-hour slot (booking hours are posted). Keep in mind that there are many students using these stations, so if you miss your time, you may not be able to find an open slot before the assignment is due. A79 is open and available every day, whenever the MP&E studios are open. You should try to do this as early as possible, since an hour may not be sufficient to complete the exercises. LATE ASSIGMENTS WILL NOT BE ACCEPTED.

Please follow the directions below carefully; it’s easy to get confused trying to get test equipment working if you’ve never used the gear before. Be prepared—you may want to review this handout in advance of your actual lab time.

This assignment is due in class one week from the date it is assigned. Submit a typed or word-processed lab report with illustrations as required. Use graph paper for illustrating audio signals. Your grade for all MP212 assignments will be based partly on the quality of the presentation.

Set-up:

For this assignment, you will use the Loftech digital meter/audio signal tone generator, pink noise generator, VU meter, dual-trace oscilloscope, and patch bay. Before you begin, verify that the power is on for the meter/tone generator and oscilloscope (on the front panels of the units) and for the noise generator and VU meter (in the rack below the test equipment, near the floor).

Using the 1/4” patch cables, connect the output of the tone generator (located on the front panel of the unit) to one of the jacks in any of the four “MULTs” on the patch bay. Each MULT has four jacks; you can plug a signal into any of the four and use the others to split that signal to three destinations. Patch from another jack in the same MULT to the VU meter jack. Also patch from that MULT to the channel 1 oscilloscope input (the left jack labeled “SCOPE”).

Set the Loftech digital meter to read frequency (the button below the meter should be set to “FREQU” – the LED to the right of the display should indicate Hz or kHz), and set the large knob on the right labeled “Course Frequency” to approximately A440 (almost completely counterclockwise). Now set the Loftech meter to read level (“dB” button; again the status is indicated by the LED).
Set the Hitachi scope inputs to read the two patch bay jacks by selecting “PB” on both of the rotary switches to the left of the scope. Adjust the scope controls as follows:

- TIME/DIV: Neither fully clockwise nor fully counterclockwise
- SWP VAR: Fully clockwise to the CAL position.
- MODE (top right switch): AUTO
- LEVEL: Approximately centered
- SOURCE: INT
- CH 1 VOLTS/DIVISION: the red knob in the center fully clockwise to the CAL position.
- CH 1 AC/GND/DC: GND
- MODE: CH 1
- INT TRIG: CH 1
- CH 2 VOLTS/DIVISION: the red knob in the center fully clockwise to the CAL position.
- CH 2 AC/GND/DC: GND

Using the switch near the VU meter, calibrate it so that 0 VU is equivalent to +4 dBm, the professional standard (the switch should be in the up position).

**Calibrate the scope inputs:**

In order to measure audio signal levels with the scope, it is helpful to calibrate the display so that a 0 volt signal corresponds to the central horizontal (x) axis, although you don’t need to do this if you only need to measure peak-to-peak values. With the CH 1 AC/GND/DC switch in the ground position, adjust the CH 1 vertical POSITION control so that the scope trace lines up with the x axis. Use the FOCUS and INTENSITY controls if necessary to zero in the display. Afterwards, set the CH 1 AC/GND/DC switch to the DC position. Repeat this process later with the CH 2 switch when you need to calibrate channel 2.

**Exercise 1:**

Adjust the level control on the Loftech so that the VU meter reads EXACTLY 0 VU.

Q1: What is the reading on the Loftech digital meter?

Q2: If the VU meter and Loftech display different values, what might explain this difference?
Using the CH 1 VOLTS/DIV selector, choose a setting convenient for measuring the sine wave (the waveform should be as large as possible without exceeding the full scale). Note the position of this switch; each vertical division on the scale corresponds to the voltage selected. Set the main TIME/DIV control so that at least one full cycle of the sine wave is visible. If the display is not stable, adjust the trigger LEVEL control. Also note the position of this control; each horizontal division corresponds to the time value selected.

Q3: Draw the display on the scope.

Q4: What is the amplitude of the sine wave?

Q5: What is its peak-to-peak value?

Q6: What is its RMS value?

Exercise 2:
Adjust the level control on the Loftech so that the VU meter reads EXACTLY -6 VU.
Q7: What is the peak-to-peak value of the -6 VU sine wave?

Adjust the level control on the Loftech so that the VU meter reads EXACTLY -12 VU (or as close as you can get). An easier way to accomplish this is to set the VU meter so that 0 VU is calibrated to -6 dBm, and adjust the VU meter to read -2 VU.
Q8: What is the peak-to-peak value of the -12 VU sine wave?

Q9: Based upon the measurements you made, how could you describe the relationship between a sine wave's level in VU and its level in peak-to-peak amplitude?
**Exercise 3:**

Q10: What is the period of the sine wave?

Q11: Based upon its period, what is the frequency of the sine wave? Show your calculation.

Set the Loftech to read frequency rather than level.
Q12: What is the reading on the Loftech digital meter?

Q13: If the scope and Loftech give different values, what might explain this difference?

**Exercise 4:**

Using the 1/4” patch cables, connect the output of the noise generator (located in the patch bay) to one of the jacks in another MULT on the patch bay. Patch from another jack in that MULT to the VU meter jack (You’ll have to remove the sine wave first; and make sure the VU meter is set back to its +4dBm calibrated setting.) Also patch from that MULT to the channel two oscilloscope input (the right jack labeled “SCOPE”).

Adjust the level control on the noise generator so that the VU meter reads APPROXIMATELY 0 VU (it won’t be steady, so get as close as you can).

Set the MODE and INT TRIG switches on the scope to CH 2. Calibrate the channel 2 input the same way you set up channel 1. Don’t forget to switch the CH 2 AC/GND/DC switch to the DC position.

Q14: Draw the display on the scope.

Q15: What is the approximate peak-to-peak value of the noise?

Q16: If the peak-to-peak values of the noise and sine wave are different, how would you explain the difference?