Purpose: In this demo, a picture of the MOSFET amplifier behavior is presented by displaying a load line over a set of (premade) MOSFET i-v curves. The load line crosses the family of MOSFET curves in the saturation region, and ends in the ohmic region. By using music as the amplifier input, and by sending the output to a speaker, distortion can be heard when the signal is outside the saturation region. This is seen on the scope as the (partial) load line being in the saturation region (no distortion), in the ohmic region (distortion), or near the cutoff region (distortion/low volume). As a fun and interesting aside, we can show that classical music suffers much more perceptually than does, say, heavy metal.

Steps:
1. Having previously aligned the load line with the stored MOSFET curves, use the sinusoid input to show the entire load line.
2. With the input sinusoid set to a small value, turn on the speaker and adjust the bias of the input to show the amplifier behavior for the different MOSFET regions.
3. Repeat the previous step using a classical music signal from the CD player, noting the audio distortion.
4. Switch to heavy metal music, and point out this type of music does not perceptually distort much. (in showing this demo, we have observed that the output to the speaker system of the class loads the circuit and makes it behave strangely. Add a buffer to fix the problem).

Description: Small signal circuit models and analysis

Load IVCURVE5.WFM from WAVEFORM MEMORY

Connect CD output to the input of to EXT2 (Red) cable.

Connect CH3 output of MOSFET Amplifier, using a Tee BNC to Mac Amp/Speaker

*******************************Make sure the FG1 is OFF (Very important! )*******************************

For music use CD1 #10 for the first music; later we play AC/DC (the razor edge) #1 to show that Doesn’t matter where you have the load line it sounds the same!

Note: see Fg1 next page schematic diagram and pins being used
Note: For Prof. Agarwal load Demo#10AA.set he starting with ONLY a dot by pressing FG2 offset bottom to zero

Oscilloscope Setup

<table>
<thead>
<tr>
<th>CH</th>
<th>V/DIV</th>
<th>OFFSET</th>
<th>MODE</th>
<th>FUNC</th>
<th>MATH</th>
<th>VERTICAL</th>
<th>HORIZONTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>off</td>
<td>1</td>
<td>3</td>
<td>DC</td>
<td>off</td>
<td>CH2 – CH3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>on</td>
<td>1</td>
<td>4.451</td>
<td>DC</td>
<td>off</td>
<td>F1 + 1k</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>on</td>
<td>2</td>
<td>-670mV</td>
<td>DC</td>
<td>on</td>
<td>F2 vs CH3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>off</td>
<td>200 mV</td>
<td>611 mV</td>
<td>DC</td>
<td>off</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Horizontal: 1 m Acquisition: Trigger: CH4

Waveform Generator Setup

<table>
<thead>
<tr>
<th>UNIT</th>
<th>WAVE</th>
<th>AMP</th>
<th>OFFSET</th>
<th>FREQ</th>
<th>+6</th>
<th>+25</th>
<th>-25</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>FG2</td>
<td>SIN</td>
<td>50m ~ 100m</td>
<td>1 k</td>
<td>2.08</td>
<td>6</td>
<td>on</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Trigger: INT

Note: We had to use our amplifier and speaker set up because the 10-250 system stop working and also caused our amplifier (MOSFET) on demo board to go bad.

Note: Use CD#1 Piano music instead violin for Prof. Lang
IDS vsVDS
Load Line

6 Vdc from +25
(1)*

2 K
(2)*

1 K
+6 Vdc
(2)*

2N7000

To Amp/Speaker

100 uF

7
(7)*

22
(22)*

FG2

13
(13)*

14

CD Player

(2)*

Note: We don’t need pre-amp for this demo.

* Note: # of pins on the PC board and BNC connectors

Make sure FG1 is OFF!

BNC

Pins

Cite as: Anant Agarwal and Jeffrey Lang, course materials for 6.002 Circuits and Electronics, Spring 2007. MIT OpenCourseWare (http://ocw.mit.edu/), Massachusetts Institute of Technology. Downloaded on [DD Month YYYY].