Lab 6 EXTRA: D-to-A and (Wireless) Synthesizer with Volume Control

OBJECTIVES
- To understand and use D/A devices. You will use an external D/A. The D/A will be used to control the volume of tones/scales/songs played via the remote control.

MATERIALS
- 5532 Dual Op-amp (8-pin device)
- DAC0800 D/A Converter (16-pin device)
- Piezo Speaker (buzzer)
- 2 capacitors (0.1 µF)
- 9V Battery (you must supply this battery)
- 9V Battery Connector (given to you in lab)

PROGRAM INTRODUCTION
Generate a triangle waveform with period controlled by the keypad. Keys 0-9 should give periods ranging from 1ms (for 0) to 10ms (for 9). Use 10 values going up the triangle and 10 values going down. This section of the lab may be deleted or delayed since some of the required circuit components are not available. Leave this section for last.

Output compare interrupts should still be used to produce the delay between outputs, with 19 outputs for one period. The output port will drive the DAC.

PROGRAM REQUIREMENTS

DAC:
1. Obtain and read the DAC0800 data sheet from our web site (or National Semiconductor's web site).
2. Wire in the DAC0800 as shown below in Figure 1.

<table>
<thead>
<tr>
<th>+5V</th>
<th>-9V</th>
</tr>
</thead>
<tbody>
<tr>
<td>10K</td>
<td>10K</td>
</tr>
<tr>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>+5V</td>
</tr>
<tr>
<td>4</td>
<td>-V</td>
</tr>
<tr>
<td>1</td>
<td>+V</td>
</tr>
<tr>
<td>0</td>
<td>-V</td>
</tr>
<tr>
<td>2</td>
<td>Vref</td>
</tr>
<tr>
<td>5</td>
<td>-Vref</td>
</tr>
<tr>
<td>6</td>
<td>+IOUT</td>
</tr>
</tbody>
</table>

Output Port

<table>
<thead>
<tr>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>D7</td>
<td>D6</td>
<td>D5</td>
<td>D4</td>
<td>D3</td>
<td>D2</td>
<td>D1</td>
<td>D0</td>
<td>Vref</td>
</tr>
</tbody>
</table>

Comp

+IOUT

Note: See Figure 2. The -9V can be -6V. Generate this negative voltage via a battery with the positive terminal tied to GND and the negative terminal as -V.

3. Run the output of the DAC0800 (+IOUT) to the current to voltage converter op-amp circuit shown in Figure 3. The second stage is a simple gain stage that increases the output span of the first op-amp current to voltage stage by a factor of two. The 5k resistor can be two 10k’s in parallel.

4. Connect the OUT signal to an oscilloscope and monitor the different waveforms. (You might also want to try outputting to your speaker.)

5. Change the waveform to another shape (other than triangle).

IN-LAB REQUIREMENTS (NONE)
1. Test the DAC circuit by writing values to the output port via D-bug4744. When you write $00, you should see 0V. When you write $80, you should see about -2V. And $FF should produce around -4V.
2. Make the required triangle waveforms at the 10 different frequencies and display the result on the oscilloscope (and speaker).
3. Change the waveform and display the results on the oscilloscope (and speaker).

WIRELESS?
This device can be made wireless by controlling the volume with the remote control system you will design in the next lab.

Figure 1: DAC0800 wiring diagram.

Figure 2: Power.

Figure 3: Amplifiers.