Telephone Tone Ringer
Bipolar Linear/\textit{l}^2\textit{L}

Features

- Complete Telephone Bell Replacement Circuit with Minimum External Components
- On-Chip Diode Bridge and Transient Protection
- Direct Drive for Piezoelectric Transducers
- Push Pull Output Stage for Greater Output Power Capability
- Base Frequency Options
  - 34017A-1: 1.0 kHz
  - 34017A-2: 2.0 kHz
  - 34017A-3: 500 Hz
- Input Impedance Signature Meets Bell and EIA Standards
- Rejects Rotary Dial Transient

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Temperature Range (T\textsubscript{A})</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC34017AD/DR2</td>
<td>-20°C to 60°C</td>
<td>8 SOIC</td>
</tr>
<tr>
<td>MC34017AP</td>
<td>-20°C to 60°C</td>
<td>8 Plastic DIP</td>
</tr>
</tbody>
</table>

Figure 1. 34017A Simplified Application Diagram

This device contains 97 active transistors and 79 gates

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Figure 2. 34017A Simplified Internal Block Diagram
TERMINAL CONNECTIONS

Table 1. 34017A Terminal Definitions

<table>
<thead>
<tr>
<th>Terminal Number</th>
<th>Terminal Name</th>
<th>Terminal Function</th>
<th>Formal Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 8</td>
<td>AC1, AC2</td>
<td></td>
<td></td>
<td>The input terminals to the full-wave diode bridge. The AC ringing signal from the telephone line energizes the ringer through this bridge.</td>
</tr>
<tr>
<td>5</td>
<td>RS</td>
<td></td>
<td></td>
<td>The input of the threshold comparator to which diode bridge current is mirrored and sensed through an external resistor (R3). Nominal threshold is 1.2 V. This Terminal internally clamps at 1.5 V.</td>
</tr>
<tr>
<td>4</td>
<td>RI</td>
<td></td>
<td></td>
<td>The positive supply terminal for the oscillator, frequency divider, and output buffer circuits.</td>
</tr>
<tr>
<td>2, 3</td>
<td>RO1, RO2</td>
<td></td>
<td></td>
<td>The tone ringer output terminals through which the sound element is driven.</td>
</tr>
<tr>
<td>7</td>
<td>RG</td>
<td></td>
<td></td>
<td>The negative terminal of the diode bridge and the negative supply terminal of the tone generating circuitry.</td>
</tr>
<tr>
<td>6</td>
<td>RC</td>
<td></td>
<td></td>
<td>The oscillator terminal for the external resistor and capacitor which control the tone ringer frequencies (R2, C2).</td>
</tr>
</tbody>
</table>
### MAXIMUM RATINGS

#### Table 2. Maximum Ratings

All voltages are with respect to RG, Terminal 7, unless otherwise noted. ESD voltage data is available upon request.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating AC Input Current (Terminals 1, 8)</td>
<td>–</td>
<td>20</td>
<td>mA, RMS</td>
</tr>
<tr>
<td>Transient Input Current (Terminals 1, 8) (T &lt; 2.0 ms)</td>
<td>$V_{IN}$</td>
<td>±300</td>
<td>mA, peak</td>
</tr>
<tr>
<td>Voltage Applied at RC (Terminal 6)</td>
<td>$V_{RC}$</td>
<td>5.0</td>
<td>V</td>
</tr>
<tr>
<td>Voltage Applied at RS (Terminal 5)</td>
<td>$V_{RS}$</td>
<td>5.0</td>
<td>V</td>
</tr>
<tr>
<td>Voltage Applied to Outputs (Terminals 2, 3)</td>
<td>$V_O$</td>
<td>-2.0 to $V_{RI}$</td>
<td>V</td>
</tr>
<tr>
<td>Power Dissipation (@ 25°C)</td>
<td>$P_D$</td>
<td>1.0</td>
<td>W</td>
</tr>
<tr>
<td>Operating Ambient Temperature</td>
<td>$T_A$</td>
<td>-20 to 60</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$T_{STG}$</td>
<td>-65 to 150</td>
<td>°C</td>
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# Table 3. Static Electrical Characteristics

Typical values noted reflect the approximate parameter mean at $T_A = 25^\circ C$ under nominal conditions unless otherwise noted.

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<th>Characteristic</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
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<tr>
<td>Ringing Start Voltage</td>
<td>$V_{\text{START}}$</td>
<td>$V_{\text{START}}^{(+)}$</td>
<td>34</td>
<td>37.5</td>
<td>41</td>
</tr>
<tr>
<td>$V_{\text{START}}^{(-)}$</td>
<td>-34</td>
<td>-37.5</td>
<td>-41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{\text{DC}}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ringing Stop Voltage</td>
<td>$V_{\text{STOP}}$</td>
<td>14</td>
<td>16</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>(Test 1c)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{\text{STOP}}$</td>
<td>34017A-1</td>
<td>12</td>
<td>14</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>34017A-2</td>
<td>14</td>
<td>16</td>
<td>22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>34017A-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{\text{DC}}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Frequencies ($V_I = 50$ V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(Test 1d)</td>
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<td></td>
</tr>
<tr>
<td>34017A-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Tone</td>
<td>$f_H$</td>
<td>937</td>
<td>1010</td>
<td>1083</td>
<td></td>
</tr>
<tr>
<td>Low Tone</td>
<td>$f_L$</td>
<td>752</td>
<td>808</td>
<td>868</td>
<td></td>
</tr>
<tr>
<td>Warble Tone</td>
<td>$f_W$</td>
<td>11.5</td>
<td>12.5</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>34017A-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Tone</td>
<td>$f_H$</td>
<td>1874</td>
<td>2020</td>
<td>2166</td>
<td></td>
</tr>
<tr>
<td>Low Tone</td>
<td>$f_L$</td>
<td>1504</td>
<td>1616</td>
<td>1736</td>
<td></td>
</tr>
<tr>
<td>Warble Tone</td>
<td>$f_W$</td>
<td>11.5</td>
<td>12.5</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>34017A-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Tone</td>
<td>$f_H$</td>
<td>937</td>
<td>1010</td>
<td>1083</td>
<td></td>
</tr>
<tr>
<td>Low Tone</td>
<td>$f_L$</td>
<td>752</td>
<td>808</td>
<td>868</td>
<td></td>
</tr>
<tr>
<td>Warble Tone</td>
<td>$f_W$</td>
<td>23</td>
<td>25</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>$Hz$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Voltage ($V_I = 50$ V)</td>
<td>$V_O$</td>
<td>34</td>
<td>37</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>(Test 6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Short – Circuit Current</td>
<td>$I_{\text{RO1}}, I_{\text{RO2}}$</td>
<td>35</td>
<td>60</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>(Test 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Diode Voltage ($I_I = 5.0$ mA)</td>
<td>$V_D$</td>
<td>5.4</td>
<td>6.2</td>
<td>6.8</td>
<td></td>
</tr>
<tr>
<td>(Test 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage – SCR OFF ($I_I = 30$ mA)</td>
<td>$V_{\text{OFF}}$</td>
<td>30</td>
<td>38</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>(Test 4a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltage – SCR ON ($I_I = 100$ mA)</td>
<td>$V_{\text{ON}}$</td>
<td>3.2</td>
<td>4.1</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>(Test 4b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS Clamp Voltage ($V_I = 50$ V)</td>
<td>$V_{\text{CLAMP}}$</td>
<td>1.3</td>
<td>1.5</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>(Test 5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{\text{DC}}$</td>
<td></td>
<td></td>
<td></td>
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</table>
### APPLICATION CIRCUIT PERFORMANCE
Refer to Typical Application.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Typ</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Tone Frequencies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34017A-1</td>
<td>808/1010</td>
<td>Hz</td>
</tr>
<tr>
<td>34017A-2</td>
<td>1616/2020</td>
<td></td>
</tr>
<tr>
<td>34017A-3</td>
<td>404/505</td>
<td></td>
</tr>
<tr>
<td><strong>Warble Frequencies</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td><strong>Output Voltage (V_i ≥ 60 V_{RMS}, 20 Hz)</strong></td>
<td>37</td>
<td>VPP</td>
</tr>
<tr>
<td><strong>Output Duty Cycle</strong></td>
<td>50</td>
<td>%</td>
</tr>
<tr>
<td><strong>Ringing Start Input Voltage (20 Hz)</strong></td>
<td>36</td>
<td>V_{RMS}</td>
</tr>
<tr>
<td><strong>Ringing Stop Input Voltage (20 Hz)</strong></td>
<td>21</td>
<td>V_{RMS}</td>
</tr>
<tr>
<td><strong>Maximum AC Input Voltage (≤ 68 Hz)</strong></td>
<td>150</td>
<td>V_{RMS}</td>
</tr>
<tr>
<td><strong>Impedance When Ringing</strong></td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>V_i = 40 V_{RMS}, 15 Hz</td>
<td>&gt;16</td>
<td></td>
</tr>
<tr>
<td>V_i = 130 V_{RMS}, 23 Hz</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td><strong>Impedance When Not Ringing</strong></td>
<td></td>
<td>kΩ</td>
</tr>
<tr>
<td>V_i = 10 V_{RMS}, 24 Hz</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>V_i = 2.5 V_{RMS}, 24 Hz</td>
<td>&gt;1.0</td>
<td>MΩ</td>
</tr>
<tr>
<td>V_i = 10 V_{RMS}, 3.0 Hz</td>
<td>55</td>
<td>kΩ</td>
</tr>
<tr>
<td>V_i = 3.0 V_{RMS}, 200 to 3200 Hz</td>
<td>&gt;200</td>
<td>kΩ</td>
</tr>
<tr>
<td><strong>Maximum Transient Input Voltage (T ≤ 2.0 ms)</strong></td>
<td>1500</td>
<td>V</td>
</tr>
<tr>
<td><strong>Ringer Equivalence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class A</td>
<td>0.5</td>
<td>–</td>
</tr>
<tr>
<td>Class B</td>
<td>0.9</td>
<td>–</td>
</tr>
</tbody>
</table>
TYPICAL APPLICATIONS

INTRODUCTION

The 34017A Tone Ringer derives its power supply by rectifying the AC ringing signal. It uses this power to activate a tone generator and drive a piezo-ceramic transducer. The tone generation circuitry includes a relaxation oscillator and frequency dividers which produce high and low frequency tones as well as the tone warble frequency. The relaxation oscillator frequency $f_o$ is set by resistor $R_2$ and capacitor $C_2$ connected to Terminal RC. The oscillator will operate with $f_o$ from 1.0 kHz to 10 kHz with the proper choice of external components (see Figure 2).

The frequency of the tone ringer output signal at RO1 and RO2 alternates between $f_o/4$ to $f_o/5$. The warble rate at which the frequency changes is $f_o/320$ for the 34017A-1, $f_o/640$ for the 34017A-2 and $f_o/160$ for the 34017A-3. With a 4.0 kHz oscillator frequency, the 34017A-1 produces 800 Hz and 1000 Hz tones with a 12.5 Hz warble rate. The 34017A-2 generates 1600 Hz and 2000 Hz tones with a similar 12.5 Hz warble frequency from an 8.0 kHz oscillator frequency. The 34017A-3 will produce 400 Hz and 500 Hz tones with a 12.5 Hz warble rate from a 2.0 kHz oscillator frequency. The tone ringer output circuit can source or sink 20 mA with an output voltage swing of 37 V peak-to-peak. Volume control is readily implemented by adding a variable resistance in series with the piezo transducer.

Input signal detection circuitry activates the tone ringer output when the AC line voltage exceeds programmed threshold level. Resistor $R_3$ determines the ringing signal amplitude at which an output signal at RO1 and RO2 will be generated. The AC ringing signal is rectified by the internal diode bridge. The rectified input signal produces a voltage across $R_3$ which is referenced to RG. The voltage across resistor $R_3$ is filtered by capacitor $C_3$ at the input to the threshold circuit.

When the voltage on capacitor $C_3$ exceeds 1.2 V, the threshold comparitor enables the tone ringer output. Line transients produced by pulse dialing telephones do not charge capacitor $C_3$ sufficiently to activate the tone ringer output.

Capacitors $C_1$ and $C_4$ and resistor $R_1$ determine the 10 V, 24 Hz signature test impedance. $C_4$ also provides filtering for the output stage power supply to prevent droop in the square wave output signal. Six diodes in series with the rectifying bridge provide the necessary non-linearity for the 2.5 V, 24 Hz signature tests.

An internal shunt voltage regulator between the RI and RG terminals provides DC voltage to power the output stage, oscillator, and frequency dividers. The DC voltage at RI is limited to approximately 22 V in regulation. To protect the IC from telephone line transients, an SCR is triggered when the regulator current exceeds 50 mA. The SCR diverts current from the shunt regulator and reduces the power dissipation within the IC.

External Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_1$</td>
<td>Line Input Register</td>
</tr>
<tr>
<td>$C_1$</td>
<td>Line Input Capacitor</td>
</tr>
<tr>
<td>$R_2$</td>
<td>Oscillator Resistor</td>
</tr>
<tr>
<td>$C_2$</td>
<td>Oscillator Capacitor</td>
</tr>
<tr>
<td>$R_3$</td>
<td>Input Current Sense Resistor</td>
</tr>
<tr>
<td>$C_3$</td>
<td>Ringing Threshold Filter Capacitor</td>
</tr>
<tr>
<td>$C_4$</td>
<td>Ringer Supply Capacitor</td>
</tr>
</tbody>
</table>

Figure 4. Oscillator Period ($1/f_o$) versus Oscillator $R_2$ $C_2$ Product
Figure 5. Test One
Figure 6. Test Two

Figure 7. Test Three
**Figure 8. Test Four**

- 34017A-1: C = 1000 pF
- 34017A-2: C = 500 pF
- 34017A-3: C = 1000 pF

*Indicates 1% tolerance (5% otherwise)

- a. Set I1 to 30 mA. Measure voltage at Pin 1 (V1).
- b. Set I1 to 100 mA. Measure voltage at Pin 1 (V1).

(Each test < 30 ms)

**Figure 9. Test Five**

- 34017A-1: C = 1000 pF
- 34017A-2: C = 500 pF
- 34017A-3: C = 1000 pF

*Indicates 1% tolerance (5% otherwise)

Measure voltage at Pin 5 (Vclamp).
34017A-1: C = 1000 µF
34017A-2: C = 500 µF
34017A-3: C = 1000 µF
*indicates 1% tolerance (99% otherwise)

With \( V_{NC} = 4.0 \) V, close S1. Measure dc voltage between Pins 2 and 3 (\( V_{O1} \)). Repeatedly switch \( V_{RC} \) between 4.0 V and 0 V until Pins 2 and 3 change state. Measure the new voltage between Pins 2 and 3 (\( V_{O2} \)).

Calculate: \( V_{O} = |V_{O1}| + |V_{O2}| \).

Figure 10. Test Six
PACKAGING

PACKAGING DIMENSIONS

For the most current package revision, visit www.freescale.com and perform a keyword search using the 98A42420B listed below.

D SUFFIX
8-LEAD SOIC
98A42420B
ISSUE N

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<tr>
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<td>STANDARD: NON-JEDEC</td>
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<td>19 MAY 2005</td>
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D SUFFIX
8-LEAD SOIC
98A42420B
ISSUE N

DETAIL "D"

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PACKAGING DIMENSIONS

For the most current package revision, visit www.freescale.com and perform a keyword search using the 98A42564B listed below.

D SUFFIX
8-LEAD SOIC
98A42564B
ISSUE U

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TITLE: 8LD SOIC NARROW BODY

DOCUMENT NO: 98ASB42564B  REV: U
CASE NUMBER: 751-07  07 APR 2005
STANDARD: JEDEC MS-012AA
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<th>DESCRIPTION OF CHANGES</th>
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<td>3.0</td>
<td>3/2006</td>
<td>• Implemented Revision History page</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Converted to Freescale format</td>
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