

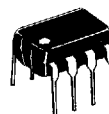
MC34012-1
MC34012-2
MC34012-3

TELEPHONE TONE RINGER

- Complete Telephone Bell Replacement Circuit with Minimum External Components
- On-Chip Diode Bridge and Transient Protection
- Direct Drive for Piezoelectric Transducers
- Base Frequency Options—MC34012-1: 1.0 kHz
MC34012-2: 2.0 kHz
MC34012-3: 500 Hz
- Input Impedance Signature Meets Bell and EIA Standards
- Rejects Rotary Dial Transients

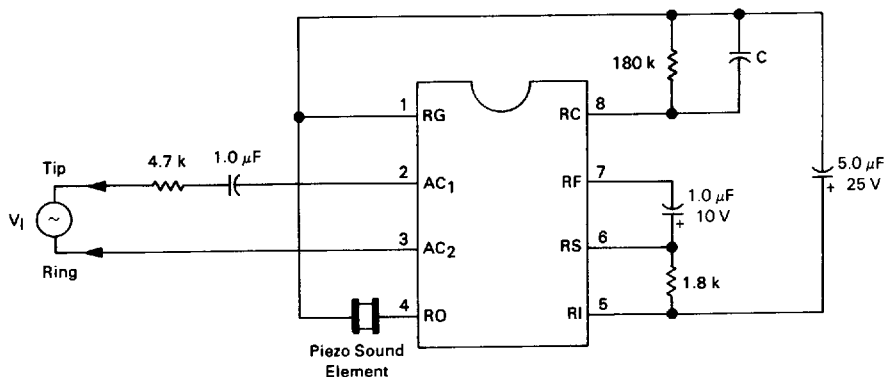
**TELEPHONE
TONE RINGER**

BIPOLAR LINEAR/12L



**PLASTIC PACKAGE
CASE 626**

APPLICATION CIRCUIT



MC34012-1: C = 1000 pF
MC34012-2: C = 500 pF
MC34012-3: C = 2000 pF

APPLICATION CIRCUIT PERFORMANCE

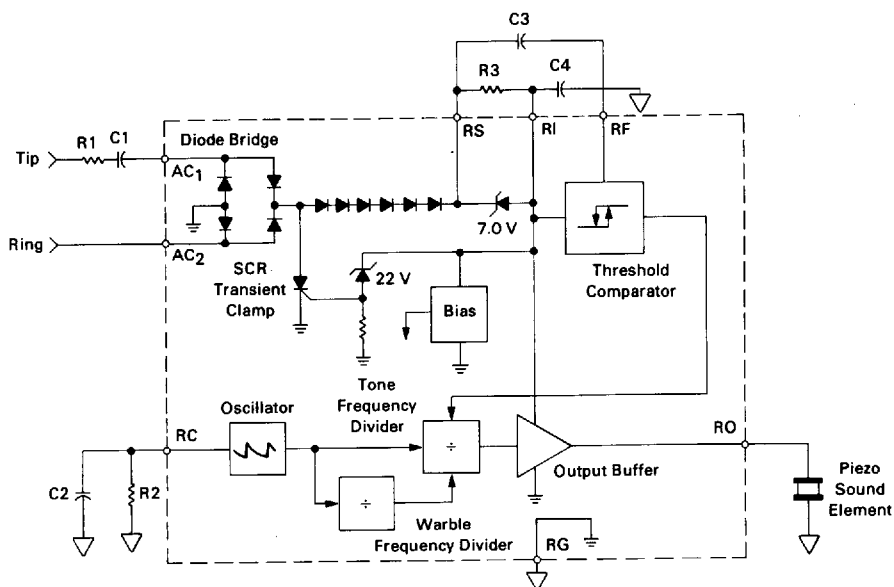
Characteristic	Typical Value	Units
Output Tone Frequencies MC34012-1 MC34012-2 MC34012-3	832/1040 1664/2080 416/520	Hz
Warble Frequency	13	
Output Voltage ($V_I \geq 60 V_{rms}$, 20 Hz)	20	V_{p-p}
Output Duty Cycle	50	%
Ringing Start Input Voltage (20 Hz)	36	V_{rms}
Ringing Stop Input Voltage (20 Hz)	28	V_{rms}
Maximum ac Input Voltage (≤ 68 Hz)	150	V_{rms}
Impedance When Ringing $V_I = 40 V_{rms}$, 15 Hz $V_I = 130 V_{rms}$, 23 Hz	20 10	$k\Omega$
Impedance When Not Ringing $V_I = 10 V_{rms}$, 24 Hz $V_I = 2.5 V_{rms}$, 24 Hz $V_I = 10 V_{rms}$, 5.0 Hz $V_I = 3.0 V_{rms}$, 200-3200 Hz	28 >1.0 55 >1.0	$k\Omega$ $M\Omega$ $k\Omega$ $M\Omega$
Maximum Transient Input Voltage ($T \leq 2.0$ ms)	1500	V

PIN DESCRIPTIONS

Name	Description
AC ₁ , AC ₂	The input terminals to the full-wave diode bridge. The ac ringing signal from the telephone line energizes the ringer through this bridge.
RS	The positive output of diode bridge to which an external current sense resistor is connected.
RI	The positive supply terminal for the oscillator, frequency divider and output buffer circuits.
RF	The terminal for the filter capacitor used in detection of ringing input signals.
RO	The tone ringer output terminal through which the sound element is driven.
RG	The negative output of the diode bridge and the negative supply terminal of the tone generating circuitry.
RC	The oscillator terminal for the external resistor and capacitor which control the tone ringer frequencies.

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

Characteristic	Test	Symbol	Min	Typ	Max	Units
Ringing Start Voltage ($V_{\text{Start}} = V_I$ @ Ring Start) $V_I > 0$ $V_I < 0$	1a 1b	$V_{\text{Start}(+)}$ $V_{\text{Start}(-)}$	31 -31	34.5 -34.5	38 -38	Vdc
Ringing Stop Voltage ($V_{\text{Stop}} = V_I$ @ Ring Stop) MC34012-1 MC34012-2 MC34012-3	1c	V_{Stop}	16 13 16	20 18 20	25 22 25	Vdc
Output Frequencies ($V_I = 50\text{ V}$) MC34012-1 High Tone MC34012-1 Low Tone MC34012-1 Warble Tone MC34012-2 High Tone MC34012-2 Low Tone MC34012-2 Warble Tone MC34012-3 High Tone MC34012-3 Low Tone MC34012-3 Warble Tone	1d	f_H f_L f_W f_H f_L f_W f_H f_L f_W	967 774 12 1934 1548 12 967 774 24	1040 832 13 2080 1664 13 1040 832 26	1113 890 14 2226 1780 14 1113 890 28	Hz
Output Voltage ($V_I = 50\text{ V}$)	6	V_O	19	20	23	V _{p-p}
Output Short-Circuit Current	2	I_O	35	50	80	mA _{p-p}
Input Diode Voltage ($I_I = 1.0\text{ mA}$)	3	V_D	4.6	5.1	5.6	Vdc
Input Voltage—SCR Off ($I_I = 30\text{ mA}$)	4a	V_{off}	37	42	47	Vdc
Input Voltage—SCR On ($I_I = 100\text{ mA}$)	4b	V_{on}	3.2	4.2	6.0	Vdc
Threshold Filter Resistance $R_{\text{RF}} = 2.0\text{ V}/I_{\text{RF}}$	5	R_{RF}	30	50	80	k Ω

BLOCK DIAGRAM


CIRCUIT DESCRIPTION

The MC34012 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_0 is set by resistor R2 and capacitor C2 connected to pin RC. The oscillator will operate with f_0 from 1.0 kHz to 10 kHz with the proper choice of external components (See Figure 1).

The frequency of the tone ringer output signal at pin RO alternates between $f_0/4$ to $f_0/5$. The warble rate at which the frequency changes is $f_0/320$ for the MC34012-1, $f_0/640$ for the MC34012-2, or $f_0/160$ for the MC34012-3. With a 4.0 kHz oscillator frequency, the MC34012-1 produces 800 Hz and 1000 Hz tones with a 12.5 Hz warble rate. The MC34012-2 generates 1600 Hz and 2000 Hz tones with a similar 12.5 Hz warble frequency from an 8.0 Hz oscillator frequency. The MC34012-3 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 20 volts 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 R3 determines the ringing signal amplitude at which an output signal will be generated at RO. The ac ringing signal is rectified by the internal diode bridge. The rectified input signal

produces a current through R3 which is input at terminal RI. The voltage across resistor R3 is filtered by capacitor C3 at the input to the threshold circuit. When the voltage on capacitor C3 exceeds 1.7 volts, the threshold comparator enables the tone ringer output. Line transients produced by pulse dialing telephones do not charge capacitor C3 sufficiently to activate the tone ringer output.

Capacitors C1 and C4 and resistor R1 determine the 10 volt, 24 Hz signature test impedance. C4 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 volt, 24 Hz signature tests.

An internal shunt voltage regulator between the RI and RG terminals provides dc voltage to power output stage, oscillator, and frequency dividers. The dc voltage at RI is limited to approximately 22 volts 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

R1	Line input resistor. R1 controls the tone ringer input impedance. It also influences ringing threshold voltage and limits current from line transients. (Range: 2.0 k Ω to 10 k Ω).
C1	Line input capacitor. C1 ac couples the tone ringer to the telephone line and controls ringer input impedance at low frequencies. (Range: 0.4 μ F to 2.0 μ F).
R2	Oscillator resistor. (Range: 150 k Ω to 300 k Ω).
C2	Oscillator capacitor. (Range: 400 pF to 2000 pF).
R3	Input current sense resistor. R3 controls the ringing threshold voltage. Increasing R3 decreases the ring-start voltage. (Range: 0.8 k Ω to 2.0 k Ω).
C3	Ringing threshold filter capacitor. C3 filters the ac voltage across R3 at the input of the ringing threshold comparator. It also provides dialer transient rejection. (Range: 0.5 μ F to 5.0 μ F).
C4	Ringer supply capacitor. C4 filters supply voltage for the tone generating circuits. It also provides an ac current path for the 10 V _{rms} ringer signature impedance. (Range: 1.0 μ F to 10 μ F).

FIGURE 1 — OSCILLATOR PERIOD ($1/f_0$) versus OSCILLATOR R2 C2 PRODUCT

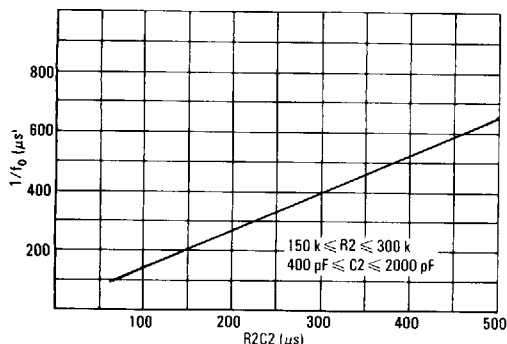
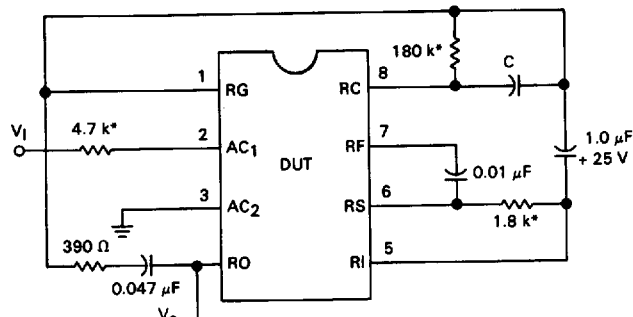
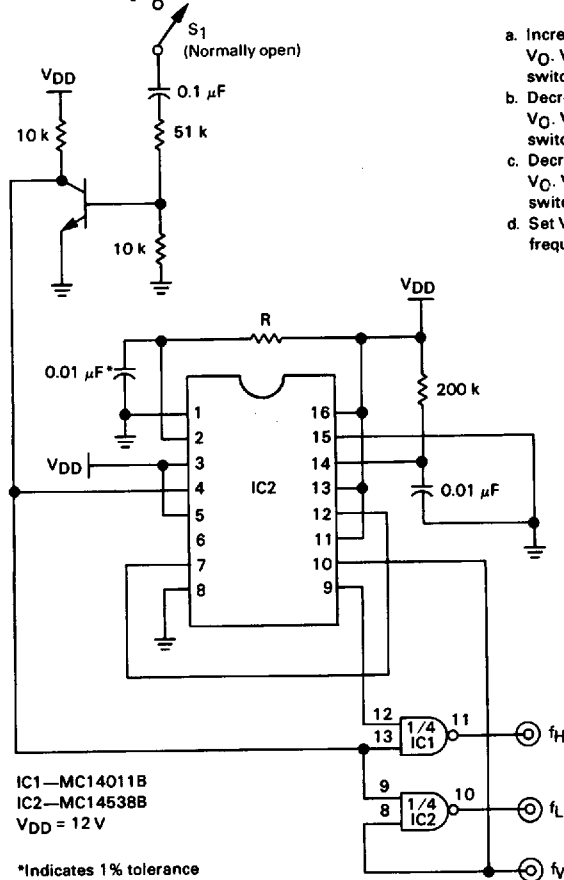


FIGURE 2 — TEST ONE



MC34012-1: C = 1000 pF*
MC34012-2: C = 500 pF*
MC34012-3: C = 1000 pF*



- Increase V_I from +30 volts while monitoring V_O . $V_{Start}(+)$ equals V_I when V_O commences switching.
- Decrease V_I from -30 volts while monitoring V_O . $V_{Start}(-)$ equals V_I when V_O commences switching.
- Decrease V_I from +40 volts while monitoring V_O . V_{Stop} equals V_I when V_O ceases switching.
- Set V_I to +50 volts. Close S1. Measure frequencies f_H , f_L , and f_W .

IC1—MC14011B
IC2—MC14538B
 $V_{DD} = 12\text{ V}$

*Indicates 1% tolerance
(5% otherwise)

MC34012-1: R = 110 kΩ*
MC34012-2: R = 55 kΩ*
MC34012-3: R = 110 kΩ*

FIGURE 3 — TEST TWO

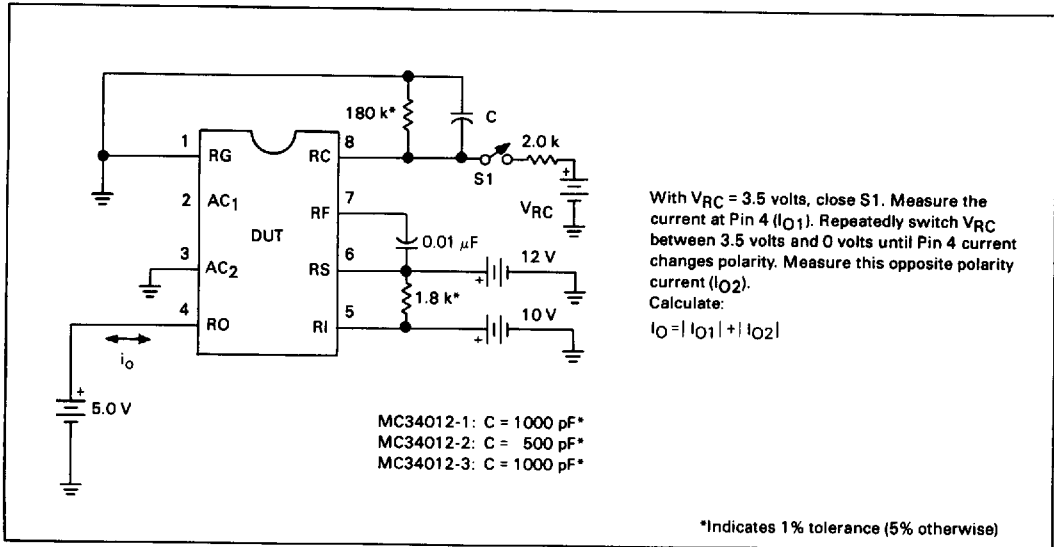


FIGURE 4 — TEST THREE

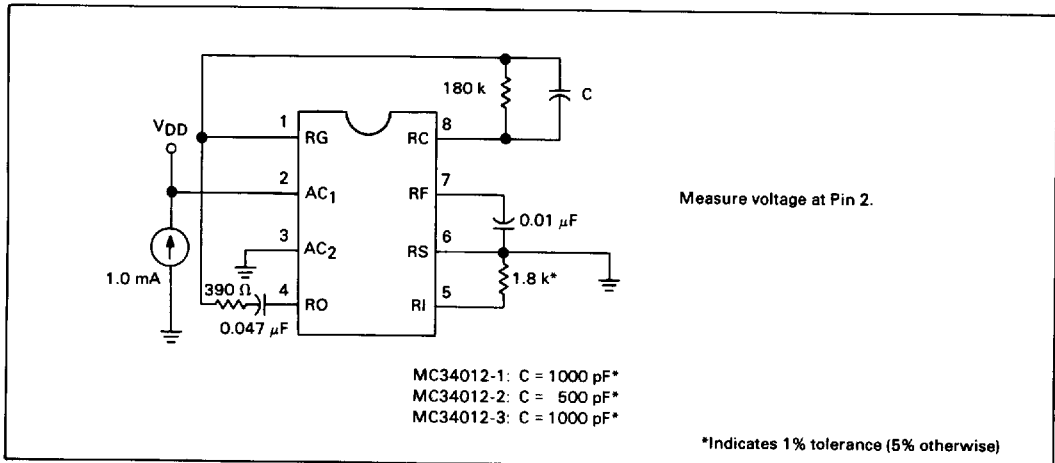
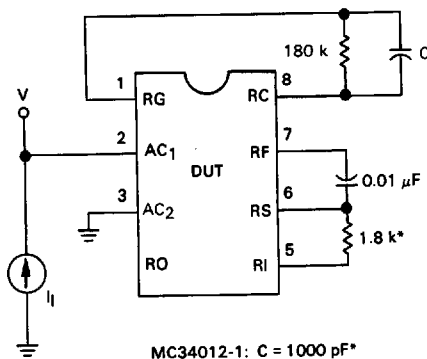


FIGURE 5 — TEST FOUR

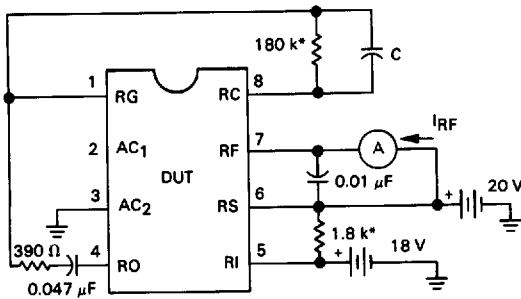


- Set I_i to 30 mA. Measure voltage at Pin 2 (V_{off}).
- Set I_i to 100 mA. Measure voltage at Pin 2 (V_{on}).

MC34012-1: C = 1000 pF*
 MC34012-2: C = 500 pF*
 MC34012-3: C = 1000 pF*

*Indicates 1% tolerance (5% otherwise)

FIGURE 6 — TEST FIVE



Measure current into Pin 7 (I_{RF}).
 Calculate:

$$R_{RF} = 2 \text{ volts} \div I_{RF}$$

MC34012-1: C = 1000 pF*
 MC34012-2: C = 500 pF*
 MC34012-3: C = 1000 pF*

*Indicates 1% tolerance (5% otherwise)

FIGURE 7 — TEST SIX

