

# MC34017

## Telephone Tone Ringer Bipolar Linear/I<sup>2</sup>L

- 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 – MC34017–1: 1.0 kHz  
– MC34017–2: 2.0 kHz  
– MC34017–3: 500 Hz
- Input Impedance Signature Meets Bell and EIA Standards
- Rejects Rotary Dial Transients

### TELEPHONE TONE RINGER BIPOlar LINEAR/I<sup>2</sup>L

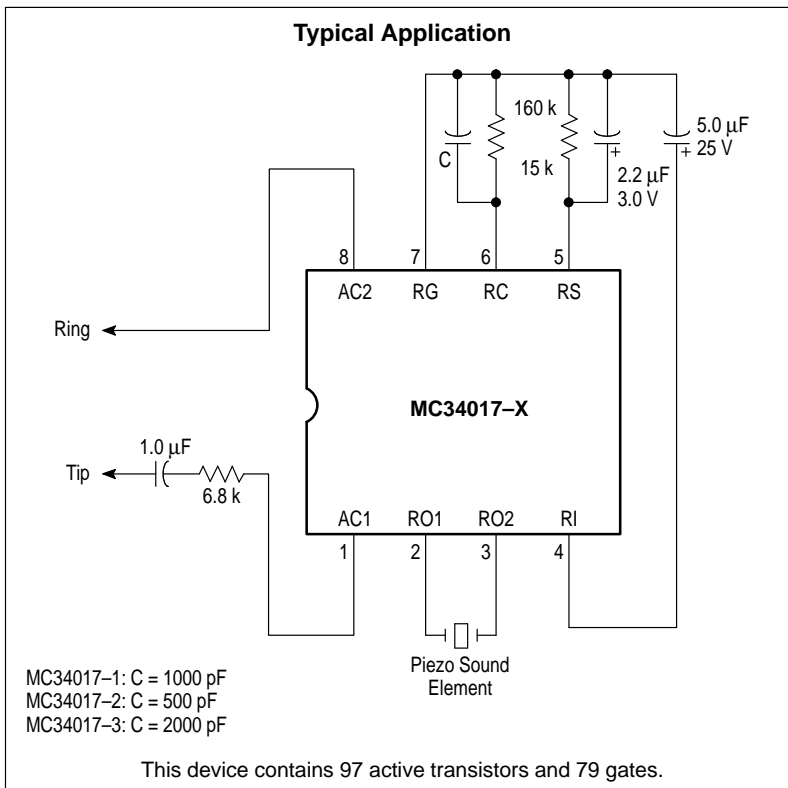
#### SEMICONDUCTOR TECHNICAL DATA



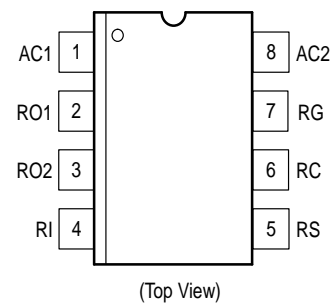
**D SUFFIX**  
PLASTIC PACKAGE  
CASE 751



**P SUFFIX**  
PLASTIC PACKAGE  
CASE 626



#### PIN CONNECTIONS



#### ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC34017D	T <sub>A</sub> = -20° to +60°C	SOIC
MC34017P		Plastic DIP

# MC34017

## MAXIMUM RATINGS (Voltages Referenced to RG, Pin 7)

Rating	Symbol	Value	Unit
Operating AC Input Current (Pins 1, 8)	–	20	mA, RMS
Transient Input Current (Pins 1, 8) (T<2.0 ms)	V <sub>in</sub>	±300	mA, peak
Voltage Applied at RC (Pin 6)	V <sub>RC</sub>	5.0	V
Voltage Applied at RS (Pin 5)	V <sub>RS</sub>	5.0	V
Voltage Applied to Outputs (Pins 2, 3)	V <sub>O</sub>	–2.0 to V <sub>RI</sub>	V
Power Dissipation (@ 25°C)	P <sub>D</sub>	1.0	W
Operating Ambient Temperature	T <sub>A</sub>	–20 to +60	°C
Storage Temperature	T <sub>stg</sub>	–65 to +150	°C

NOTE: ESD data available upon request.

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C)

Characteristic	Test	Symbol	Min	Typ	Max	Unit
Ringing Start Voltage V <sub>Start</sub> = V <sub>I</sub> at Ring Start V <sub>I</sub> > 0 V <sub>I</sub> < 0	1a 1b	V <sub>Start</sub> (+) V <sub>Start</sub> (–)	34 –34	37.5 –37.5	41 –41	Vdc
Ringing Stop Voltage V <sub>Stop</sub> = V <sub>I</sub> at Ring Stop MC34017–1 MC34017–2 MC34017–3	1c	V <sub>Stop</sub>	14 12 14	16 14 16	22 20 22	Vdc
Output Frequencies (V <sub>I</sub> = 50 V) MC34017–1 High Tone Low Tone Warble Tone MC34017–2 High Tone Low Tone Warble Tone MC34017–3 High Tone Low Tone Warble Tone	1d	f <sub>H</sub> f <sub>L</sub> f <sub>W</sub> f <sub>H</sub> f <sub>L</sub> f <sub>W</sub> f <sub>H</sub> f <sub>L</sub> f <sub>W</sub>	937 752 11.5 1874 1504 11.5 937 752 23	1010 808 12.5 2020 1616 12.5 1010 808 25	1083 868 14 2166 1736 14 1083 868 28	Hz
Output Voltage (V <sub>I</sub> = 50 V)	6	V <sub>O</sub>	34	37	43	V <sub>pp</sub>
Output Short–Circuit Current	2	I <sub>RO1</sub> , I <sub>RO2</sub>	35	60	80	mApp
Input Diode Voltage (I <sub>I</sub> = 5.0 mA)	3	V <sub>D</sub>	5.4	6.2	6.8	Vdc
Input Voltage – SCR “Off” (I <sub>I</sub> = 30 mA)	4a	V <sub>off</sub>	30	38	43	Vdc
Input Voltage – SCR “On” (I <sub>I</sub> = 100 mA)	4b	V <sub>on</sub>	3.2	4.1	6.0	Vdc
RS Clamp Voltage (V <sub>I</sub> = 50 V)	5	V <sub>clamp</sub>	1.3	1.5	1.8	Vdc

## PIN FUNCTION DESCRIPTION

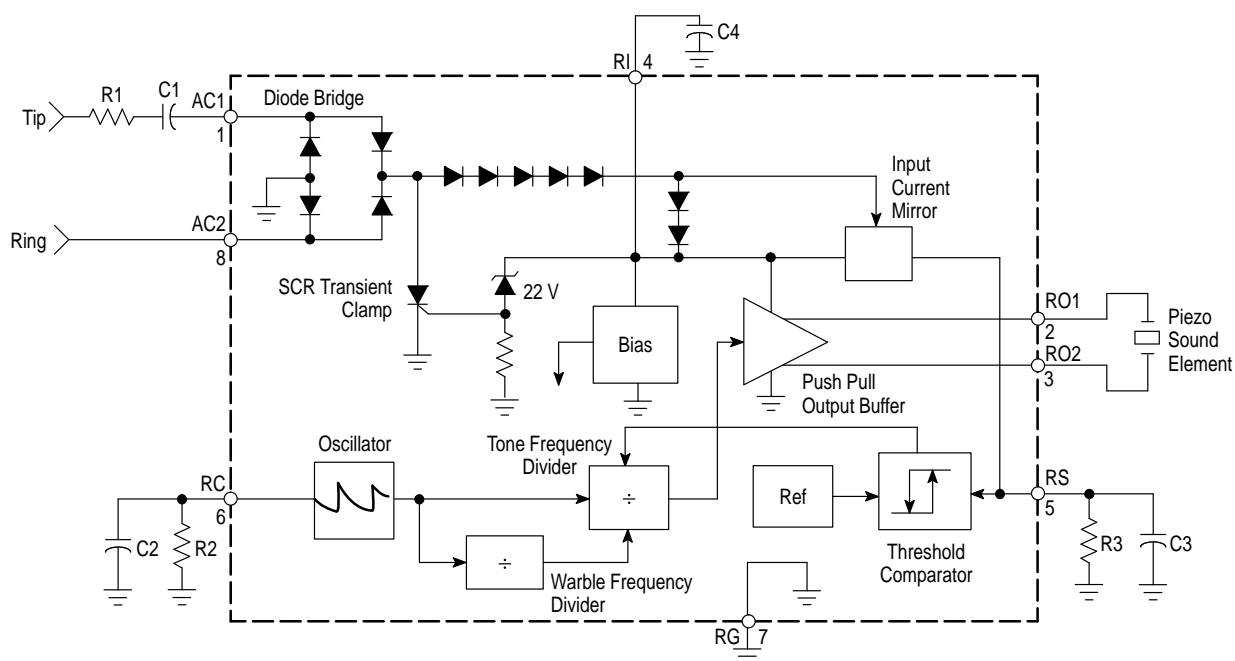
Pin	Symbol	Description
1, 8	AC1, AC2	The input terminals to the full–wave diode bridge. The ac ringing signal from the telephone line energizes the ringer through this bridge.
5	RS	The input of the threshold comparator to which diode bridge current is mirrored and sensed through an external resistor (R3). Nominal threshold is 1.2 V. This pin internally clamps at 1.5 V.
4	RI	The positive supply terminal for the oscillator, frequency divider and output buffer circuits.
2, 3	RO1, RO2	The tone ringer output terminals through which the sound element is driven.
7	RG	The negative terminal of the diode bridge and the negative supply terminal of the tone generating circuitry.
6	RC	The oscillator terminal for the external resistor and capacitor which control the tone ringer frequencies (R2, C2).

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## APPLICATION CIRCUIT PERFORMANCE (Refer to Typical Application)

Characteristic	Typical Value	Units
Output Tone Frequencies		Hz
MC34017-1	808/1010	
MC34017-2	1616/2020	
MC34017-3	404/505	
Warble Frequencies	12.5	
Output Voltage ( $V_I \geq 60$ Vrms, 20 Hz)	37	Vpp
Output Duty Cycle	50	%
Ringing Start Input Voltage (20 Hz)	36	Vrms
Ringing Stop Input Voltage (20 Hz)	21	Vrms
Maximum AC Input Voltage ( $\leq 68$ Hz)	150	Vrms
Impedance When Ringing		k $\Omega$
$V_I = 40$ Vrms, 15 Hz	>16	
$V_I = 130$ Vrms, 23 Hz	12	
Impedance When Not Ringing		
$V_I = 10$ Vrms, 24 Hz	28	k $\Omega$
$V_I = 2.5$ Vrms, 24 Hz	>1.0	M $\Omega$
$V_I = 10$ Vrms, 5.0 Hz	55	k $\Omega$
$V_I = 3.0$ Vrms, 200 - 3200 Hz	>200	k $\Omega$
Maximum Transient Input Voltage ( $T \leq 2.0$ ms)	1500	V
Ringer Equivalence: Class A	0.5	-
Class B	0.9	-

## Block Diagram



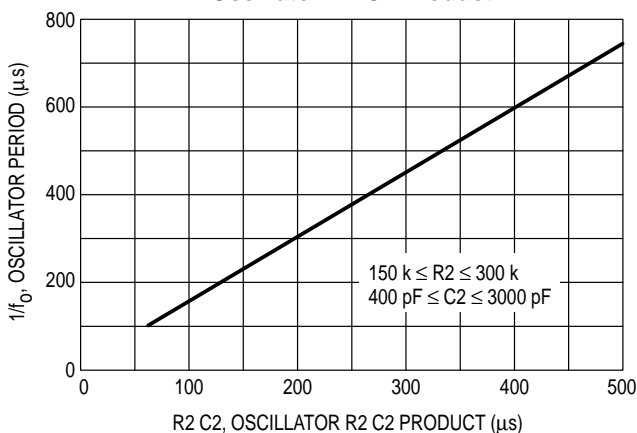
## CIRCUIT DESCRIPTION

The MC34017 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 R2 and capacitor C2 connected to Pin RC. The oscillator will operate with  $f_O$  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 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 MC34017-1,  $f_O/640$  for the MC34017-2 and  $f_O/160$  for the MC34017-3. With a 4.0 kHz oscillator frequency, the MC34017-1 produces 800 Hz and 1000 Hz tones with a 12.5 Hz warble rate. The MC34017-2 generates 1600 Hz and 2000 Hz tones with a similar 12.5 Hz warble frequency from an 8.0 kHz oscillator frequency. The MC34017-3 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 R3 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 R3 which is referenced to RG. The voltage across resistor R3 is filtered by capacitor C3 at the input to the threshold circuit.

Figure 1. Oscillator Period ( $1/f_O$ ) versus Oscillator R2 C2 Product



$$(1/f_O = 1.45 R2 C2 + 10 \mu s)$$

When the voltage on capacitor C3 exceeds 1.2 V, 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 V, 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 V, 24 Hz signature tests.

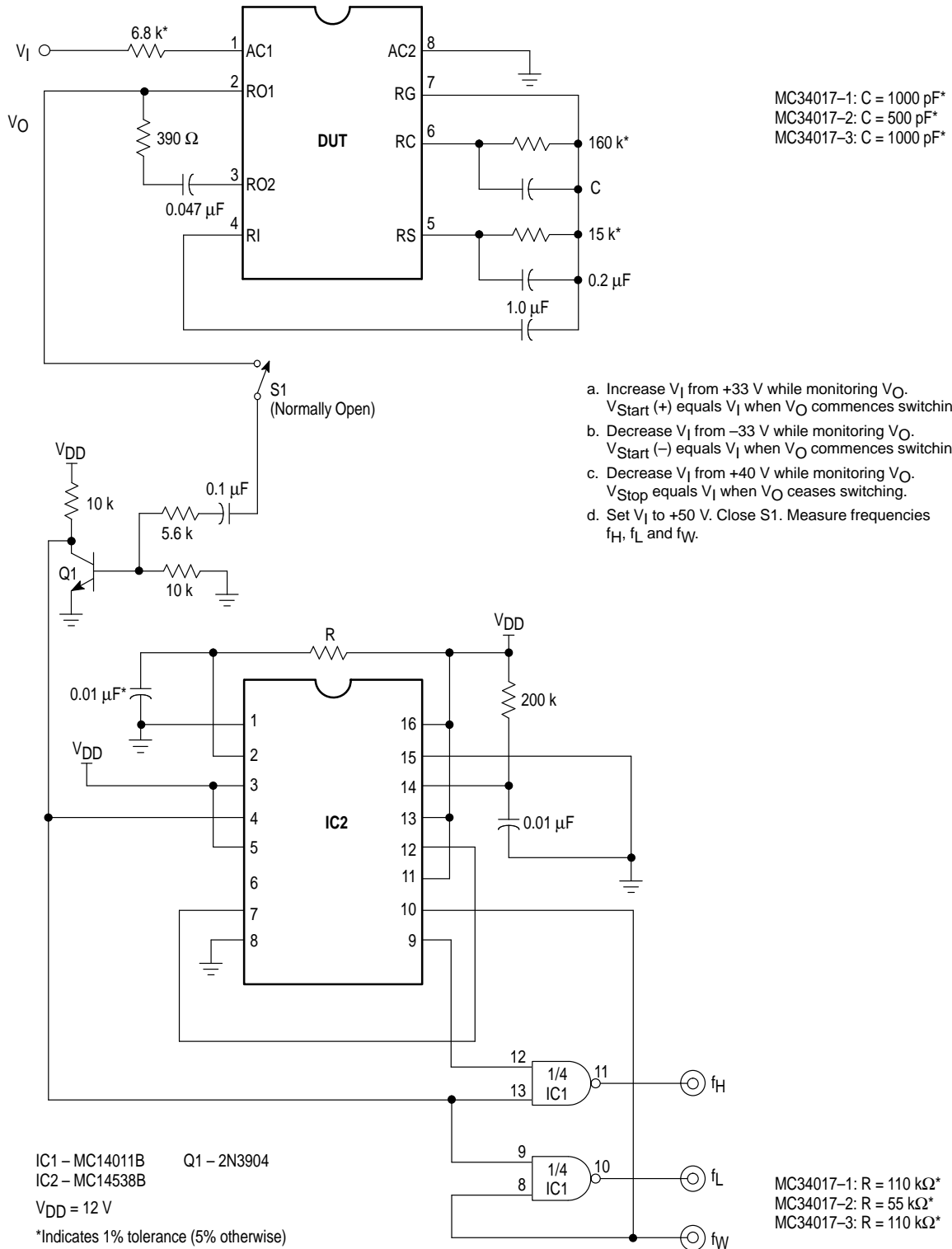
An internal shunt voltage regulator between the RI and RG terminals provides dc voltage to power the output stage, oscillator and frequency dividers. The dc voltage at RI is limited to approximately 22 V in regulation. To protect the IC from telephone line transients, an SCR is triggered when the regulator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

## EXTERNAL COMPONENTS

R1	<b>Line Input Resistor</b> R1 affects the tone ringer input impedance. It also influences ringing threshold voltage and limits current from line transients. (Range: 2.0 to 10 kΩ).
C1	<b>Line Input Capacitor</b> C1 ac couples the tone ringer to the telephone line and controls ringer input impedance at low frequencies. (Range: 0.4 to 2.0 μF).
R2	<b>Oscillator Resistor</b> (Range: 150 to 300 kΩ).
C2	<b>Oscillator Capacitor</b> (Range: 400 to 3000 pF).
R3	<b>Input Current Sense Resistor</b> R3 controls the ringing threshold voltage. Increasing R3 decreases the ring-start voltage. (Range: 5.0 to 18 kΩ).
C3	<b>Ringing Threshold Filter Capacitor</b> C3 filters the ac voltage across R3 at the input of the ringing threshold comparator. It also provides dialer transient rejection. (Range: 0.5 to 5.0 μF).
C4	<b>Ringer Supply Capacitor</b> C4 filters supply voltage for the tone generating circuits. It also provides an ac current path for the 10 Vrms ringer signature impedance. (Range: 1.0 to 10 μF).

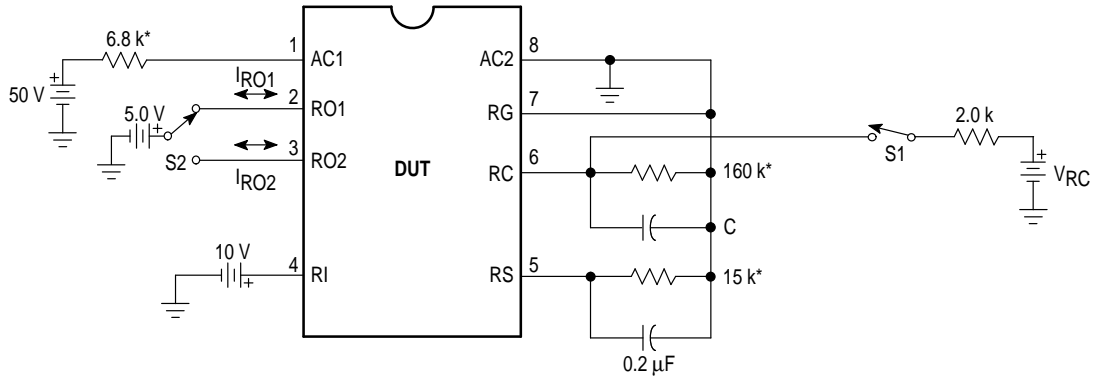
# MC34017

Figure 2. Test One



# MC34017

Figure 3. Test Two



MC34017-1: C = 1000 pF\*  
 MC34017-2: C = 500 pF\*  
 MC34017-3: C = 1000 pF\*

\*Indicates 1% tolerance (5% otherwise)

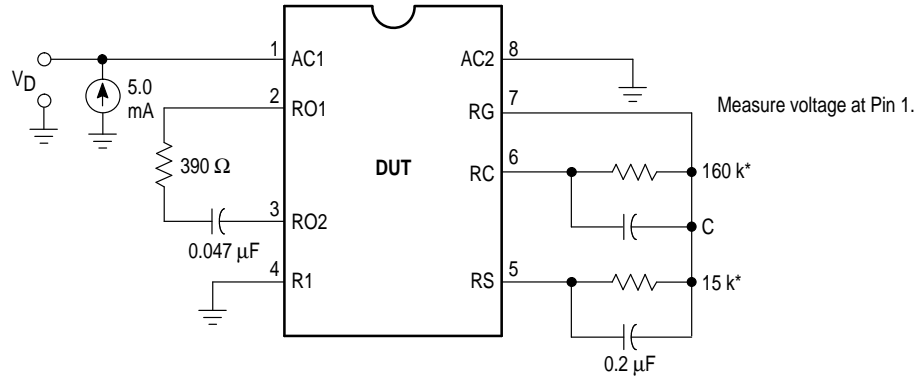
With  $V_{RC} = 4.0\text{ V}$ , close S1. Switch S2 to Pin 2 and measure current at Pin 2 ( $I_{O1}$ ). Repeatedly switch  $V_{RC}$  between 4.0 V and 0 V until Pin 2 current changes polarity. Measure the opposite polarity current ( $I_{O2}$ ).

Calculate:  $I_{RO1} = |I_{O1}| + |I_{O2}|$ .

Switch S2 to Pin 3 and repeat.

Calculate:  $I_{RO2} = |I_{O1}| + |I_{O2}|$ .

Figure 4. Test Three

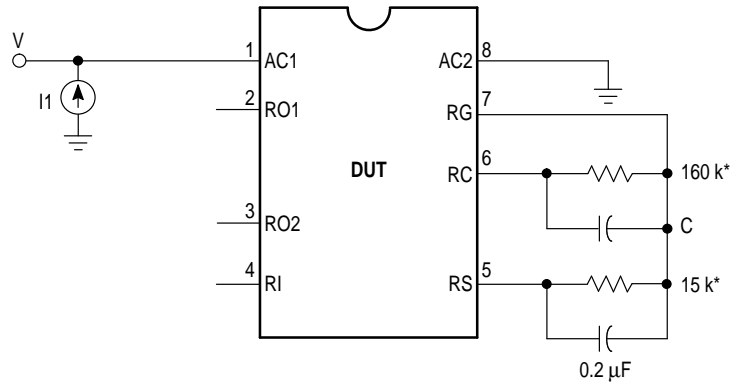


\*Indicates 1% tolerance (5% otherwise)

MC34017-1: C = 1000 pF\*  
 MC34017-2: C = 500 pF\*  
 MC34017-3: C = 1000 pF\*

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Figure 5. Test Four

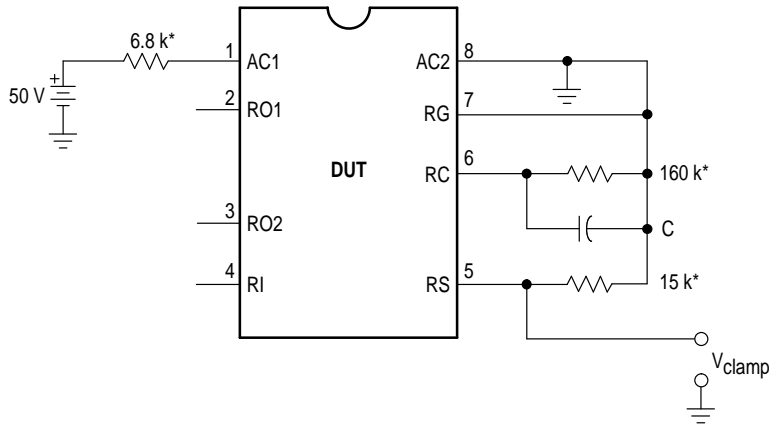


MC34017-1: C = 1000 pF\*  
 MC34017-2: C = 500 pF\*  
 MC34017-3: C = 1000 pF\*

\*Indicates 1% tolerance (5% otherwise)

- Set I1 to 30 mA. Measure voltage at Pin 1 ( $V_{Off}$ ).
  - Set I1 to 100 mA. Measure voltage at Pin 1 ( $V_{On}$ ).
- (Each test < 30 ms)

Figure 6. Test Five

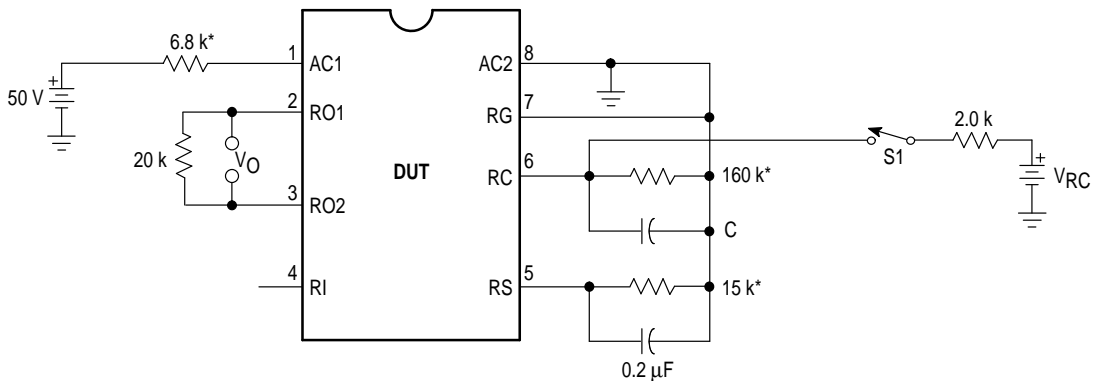


MC34017-1: C = 1000 pF\*  
 MC34017-2: C = 500 pF\*  
 MC34017-3: C = 1000 pF\*

\*Indicates 1% tolerance (5% otherwise)

Measure voltage at Pin 5 ( $V_{clamp}$ ).

Figure 7. Test Six



MC34017-1: C = 1000 pF\*  
 MC34017-2: C = 500 pF\*  
 MC34017-3: C = 1000 pF\*

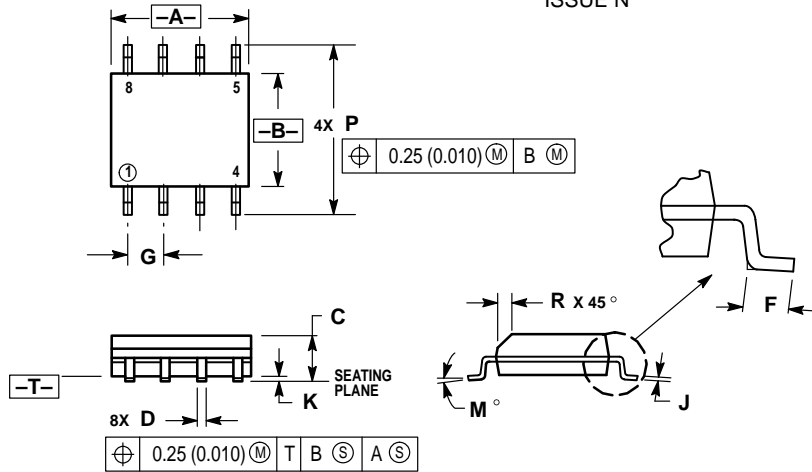
\*Indicates 1% tolerance (5% otherwise)

With  $V_{RC} = 4.0$  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:  $V_O = |V_{O1}| + |V_{O2}|$ .

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## OUTLINE DIMENSIONS

### D SUFFIX PLASTIC PACKAGE CASE 751-05 ISSUE N

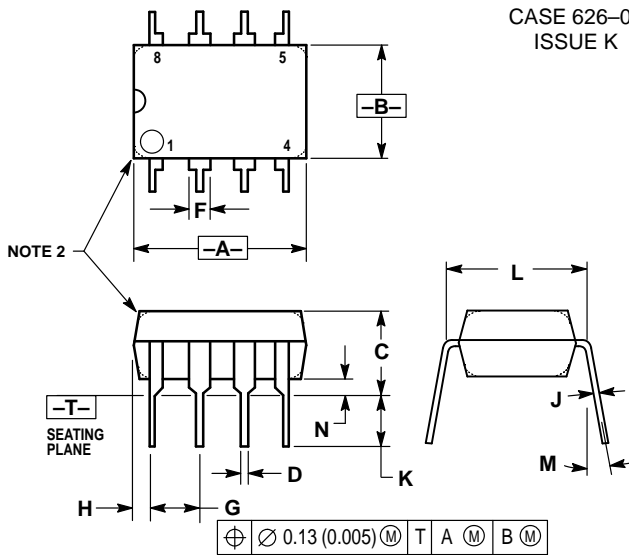


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.18	0.25	0.007	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

### P SUFFIX PLASTIC PACKAGE CASE 626-05 ISSUE K



NOTES:

1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	—		10°	
N	0.76	1.01	0.030	0.040

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MC34017/D

