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MOTOROLA

MC34017

Telephone Tone Ringer

Bipolar Linear/I²L

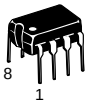
- Complete Telephone Bell Replacement Circuit with Minimum External Components
- On–Chip Diode Bridge and Transient Protection
- Direct Drive for Piezoelectric Transducers
- Push Pull Output Stage for Greater Output Power Capability
- Base Frequency Options – MC34017–1: 1.0 kHz
  – MC34017–2: 2.0 kHz
  – MC34017–3: 500 Hz
- Input Impedance Signature Meets Bell and EIA Standards
- Rejects Rotary Dial Transients

TELEPHONE TONE RINGER

BIPOLAR LINEAR/I²L

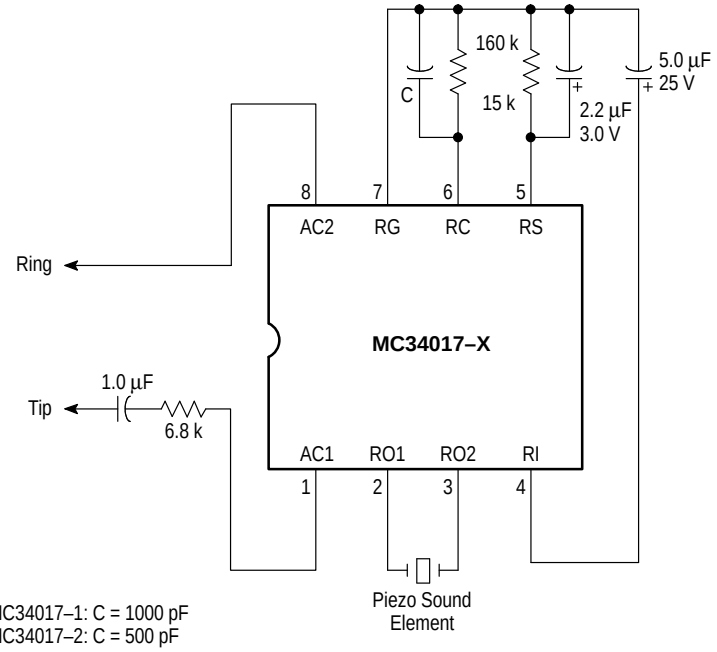
SEMICONDUCTOR TECHNICAL DATA

D SUFFIX
PLASTIC PACKAGE
CASE 751



P SUFFIX
PLASTIC PACKAGE
CASE 626

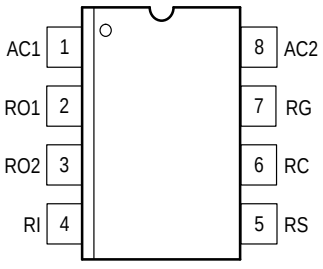
Typical Application



MC34017–1: C = 1000 pF
MC34017–2: C = 500 pF
MC34017–3: C = 2000 pF

This device contains 97 active transistors and 79 gates.

PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC34017D	T_A = –20° to +60°C	SOIC
MC34017P		Plastic DIP

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_{in}	±300	mA, peak
Voltage Applied at RC (Pin 6)	V_{RC}	5.0	V
Voltage Applied at RS (Pin 5)	V_{RS}	5.0	V
Voltage Applied to Outputs (Pins 2, 3)	V_O	–2.0 to V_{RI}	V
Power Dissipation (@ 25°C)	P_D	1.0	W
Operating Ambient Temperature	T_A	–20 to +60	°C
Storage Temperature	T_{stg}	–65 to +150	°C

NOTE: ESD data available upon request.

ELECTRICAL CHARACTERISTICS (T_A = 25°C)

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

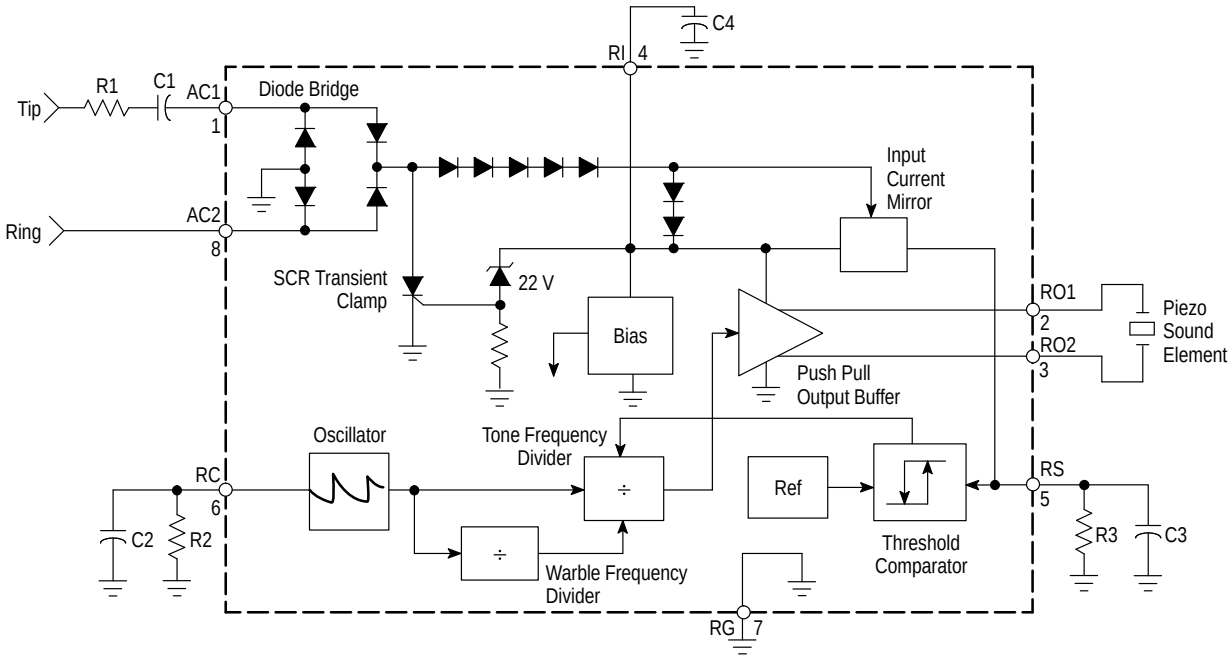
PIN FUNCTION DESCRIPTION

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).

APPLICATION CIRCUIT PERFORMANCE (Refer to Typical Application)

Characteristic	Typical Value	Units
Output Tone Frequencies MC34017–1 MC34017–2 MC34017–3 Warble Frequencies	 808/1010 1616/2020 404/505 12.5	Hz
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 (≤ 68 Hz)	150	Vrms
Impedance When Ringing V_I = 40 Vrms, 15 Hz V_I = 130 Vrms, 23 Hz	 >16 12	kΩ
Impedance When Not Ringing V_I = 10 Vrms, 24 Hz V_I = 2.5 Vrms, 24 Hz V_I = 10 Vrms, 5.0 Hz V_I = 3.0 Vrms, 200 – 3200 Hz	 28 >1.0 55 >200	 kΩ MΩ kΩ kΩ
Maximum Transient Input Voltage (T ≤ 2.0 ms)	1500	V
Ringer Equivalence: Class A Class B	0.5 0.9	– –

Block Diagram



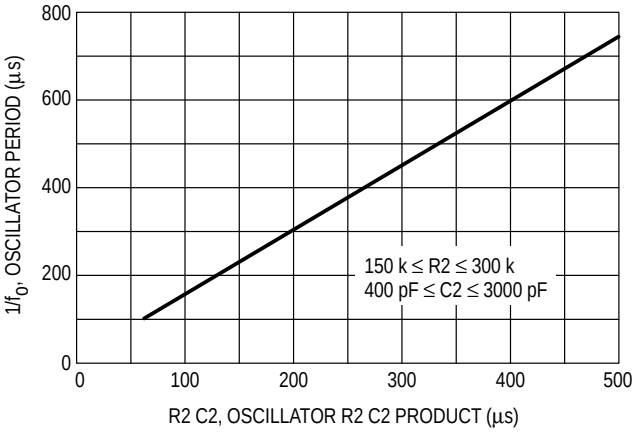
CIRCUIT DESCRIPTION

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 μs)

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.

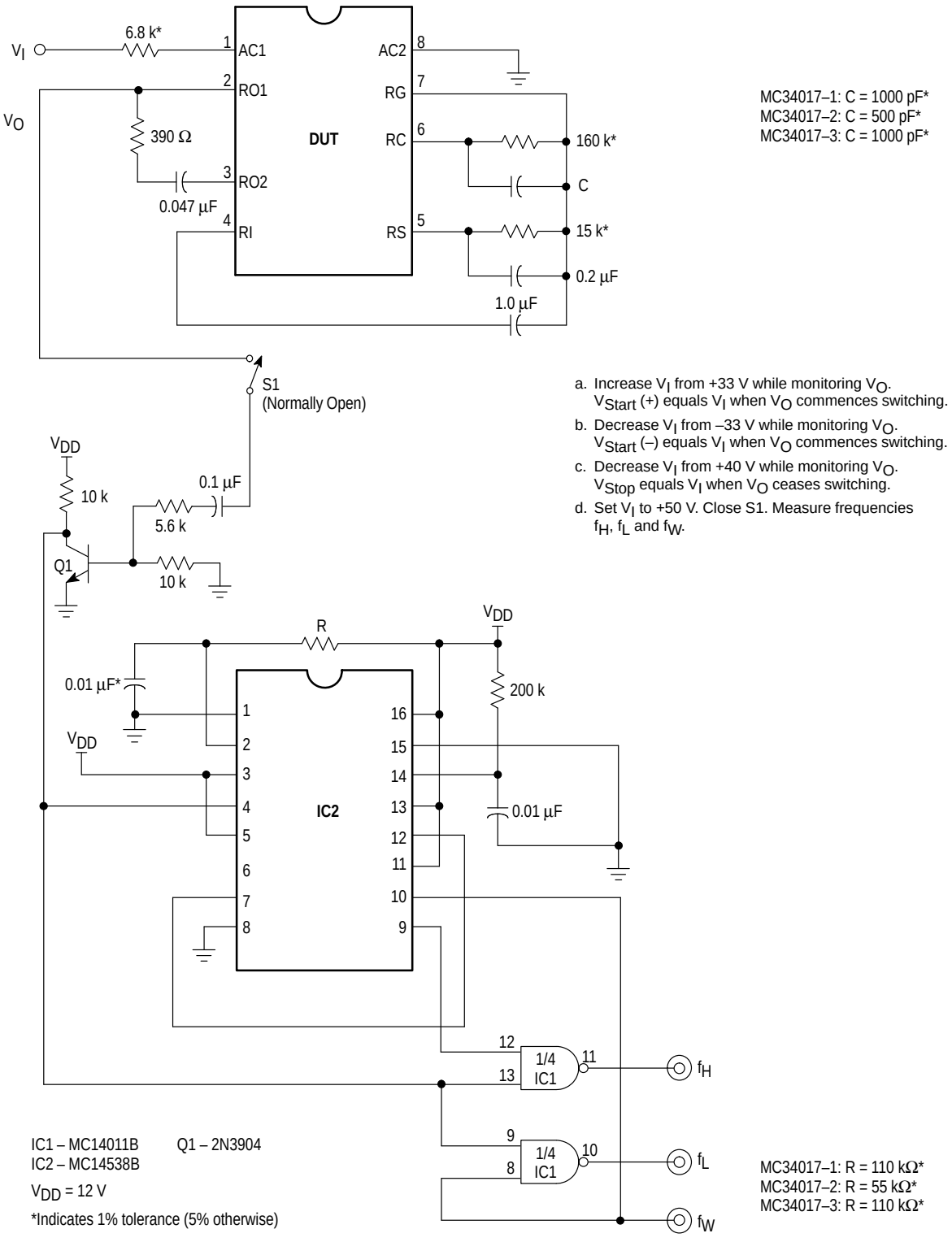
Capacitors C1 and C4 and resistor R1 determine the 10 V, 24 Hz signature test impedance. C4 also provides filtering for the output stage power supply to prevent droop in the square wave output signal. Six diodes in series with the rectifying bridge provide the necessary non–linearity for the 2.5 V, 24 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	**Line Input Resistor** 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	**Line Input Capacitor** 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	**Oscillator Resistor** (Range: 150 to 300 kΩ).
C2	**Oscillator Capacitor** (Range: 400 to 3000 pF).
R3	**Input Current Sense Resistor** R3 controls the ringing threshold voltage. Increasing R3 decreases the ring–start voltage. (Range: 5.0 to 18 kΩ).
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 to 5.0 μF).
C4	**Ringer Supply Capacitor** 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).

Figure 2. Test One



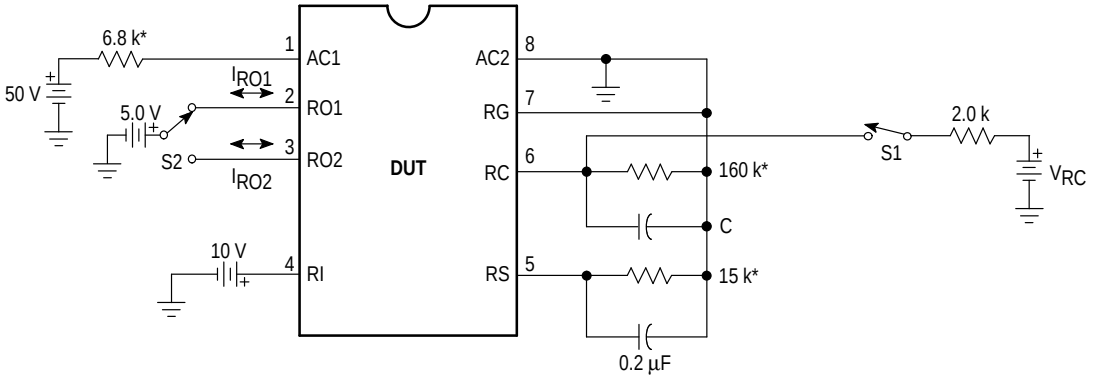
MC34017–1: C = 1000 pF*
MC34017–2: C = 500 pF*
MC34017–3: C = 1000 pF*

a. Increase V_I from +33 V while monitoring V_O. V_{Start} (+) equals V_I when V_O commences switching.
b. Decrease V_I from –33 V while monitoring V_O. V_{Start} (–) equals V_I when V_O commences switching.
c. Decrease V_I from +40 V while monitoring V_O. V_{Stop} equals V_I when V_O ceases switching.
d. Set V_I to +50 V. Close S1. Measure frequencies f_H, f_L and f_W.

IC1 – MC14011B Q1 – 2N3904
IC2 – MC14538B
V_{DD} = 12 V
*Indicates 1% tolerance (5% otherwise)

MC34017–1: R = 110 kΩ*
MC34017–2: R = 55 kΩ*
MC34017–3: R = 110 kΩ*

Figure 3. Test Two

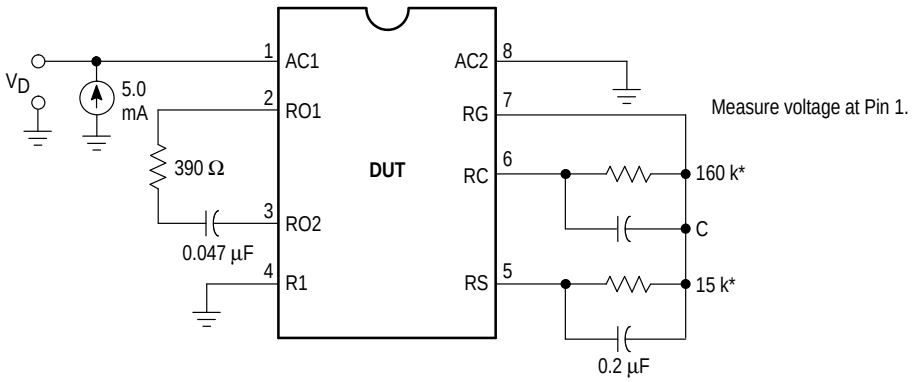


MC34017–1: C = 1000 pF*
MC34017–2: C = 500 pF*
MC34017–3: C = 1000 pF*

*Indicates 1% tolerance (5% otherwise)

With V_{RC} = 4.0 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: $I_{RO2} = |I_{O1}| + |I_{O2}|$.

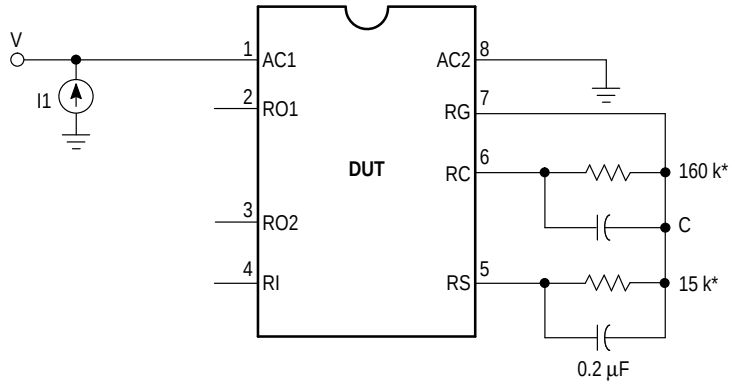
Figure 4. Test Three



MC34017–1: C = 1000 pF*
MC34017–2: C = 500 pF*
MC34017–3: C = 1000 pF*

*Indicates 1% tolerance (5% otherwise)

Figure 5. Test Four

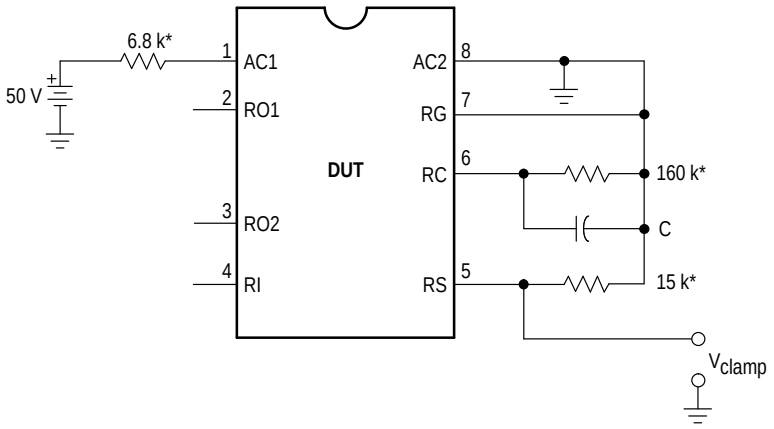


MC34017–1: C = 1000 pF*
MC34017–2: C = 500 pF*
MC34017–3: C = 1000 pF*

*Indicates 1% tolerance (5% otherwise)

a. Set I1 to 30 mA. Measure voltage at Pin 1 (V_{off}).
b. Set I1 to 100 mA. Measure voltage at Pin 1 (V_{on}).
(Each test < 30 ms)

Figure 6. Test Five

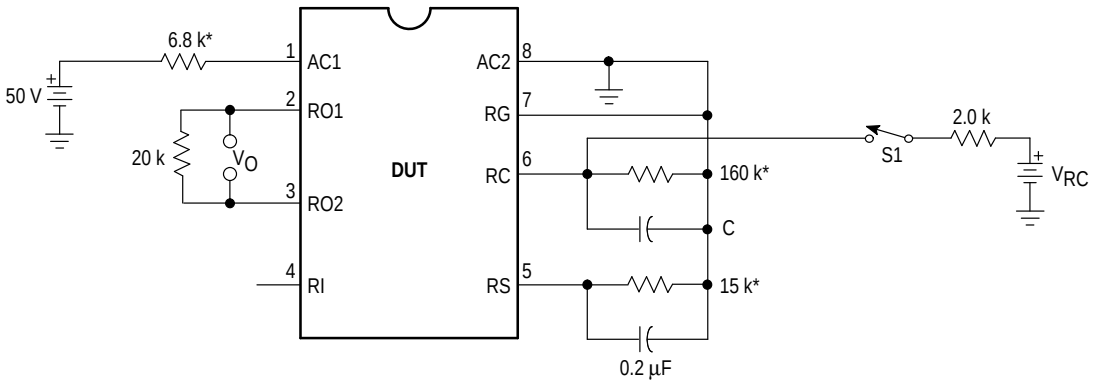


MC34017–1: C = 1000 pF*
MC34017–2: C = 500 pF*
MC34017–3: C = 1000 pF*

*Indicates 1% tolerance (5% otherwise)

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

Figure 7. Test Six



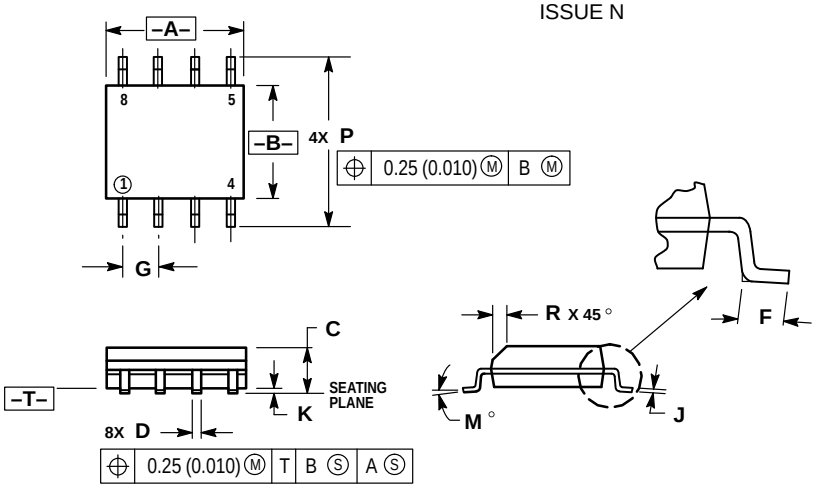
MC34017–1: C = 1000 pF*
MC34017–2: C = 500 pF*
MC34017–3: C = 1000 pF*

*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: $V_O = |V_{O1}| + |V_{O2}|$.

OUTLINE DIMENSIONS

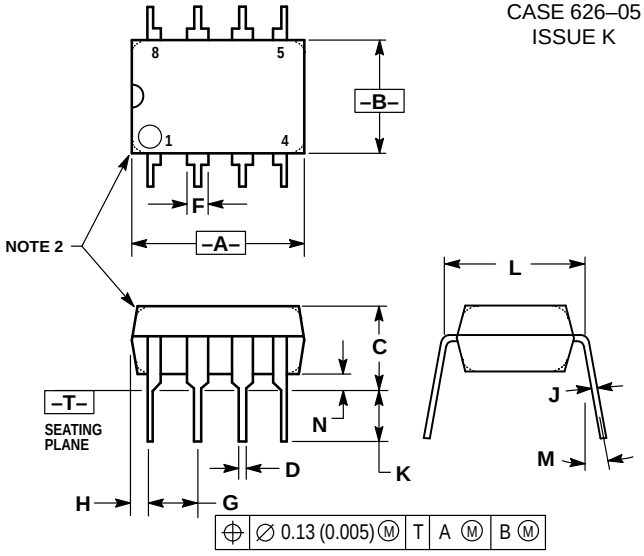
D SUFFIX
PLASTIC PACKAGE
CASE 751–05
ISSUE N



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.

	MILLIMETERS		INCHES	
DIM	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.

	MILLIMETERS		INCHES	
DIM	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°	—	10°
N	0.76	1.01	0.030	0.040

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