

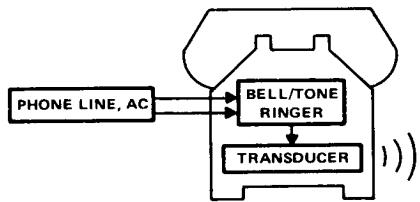
- Electronic Replacement for Electromechanical Telephone Bell When Used with Transducer
- Designed to Meet or Exceed FCC Part 68 Class B Ringer Requirements
- Low-Cost External Component Requirements
- Low External Component Count
- High Standby Input Impedance . . . 1 MΩ Typ
- Low Ringer Equivalency Number . . . < 1 Typ
- Single-Ended High-Voltage Output Compatible with Piezo Transducer or Transformer-Coupled Speaker
- Reliable BIDFET[†] Process Technology Provides Efficient High-Voltage Operation
- On-Chip High-Voltage Full-Wave Diode Bridge Rectifier and Output Voltage Regulator
- On-Chip Circuitry Provides Ring Rejection of Rotary Dial Transients, Lightning, and Induced High-Voltage Transients
- Improved Direct Replacements for TCM1501, TCM1506, and TCM1512

P DUAL-IN-LINE PACKAGE

(TOP VIEW)

AC INPUT	1	8	AC INPUT
DRIVER OUTPUT	2	7	COMMON
NC	3	6	C FILTER
ROSC	4	5	INTERNAL ZENER BYPASS

NC—No internal connection



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TYPICAL CHARACTERISTICS
TELEPHONE TONE RINGER DRIVER FAMILY

PART NO.	NOMINAL OUTPUT CENTER FREQUENCY (Hz)	WARBLE RATIO (f _H :f _L)	NOMINAL WARBLE FREQ. (Hz)
TCM1501A	2000	8:7	7.8
TCM1506A	500	5:4	7.8
TCM1512A	1250	8:7	9.8

description

The TCM1501A, TCM1506A, and TCM1512A are monolithic integrated circuit telephone tone ringer drivers that, when coupled with an appropriate transducer, replace the electromechanical bell. These devices are designed, using BIDFET[†] technology, for use with either a Piezo transducer or an inexpensive transformer-coupled speaker to produce a pleasing tone composed of a high frequency (f_H) alternating with a low frequency (f_L) resulting in a warble frequency. Each device is powered and activated by the telephone line ring voltage, which may vary from 40 volts to 150 volts rms at frequencies from 15.3 hertz to 68 hertz.

During low voltage (off-hook) standby, typical input impedance is greater than 1 megohm; this prevents interference with telephone DTMF or voice signals without the use of expensive mechanical switches. This high standby impedance is achieved with an on-chip series zener diode that is activated by a differential input voltage of typically 8.9 volts at pins 1 and 8. A voltage level of typically 17 volts differential at pins 1 and 8 deactivates the internal zener diode, allowing for more efficient power transfer to the load when the device is in the operating mode. During ringing, the impedance of the applied circuit (see Figures 4 and 5) varies from 30 kilohms to 8 kilohms over the Class B ring signal, and is reasonably independent of the output load.



Caution. These devices have limited built-in gate protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

[†]BIDFET — Bipolar, double-diffused, N-channel and P-channel, MOS transistors on the same chip—patented process.

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TEXAS
INSTRUMENTS

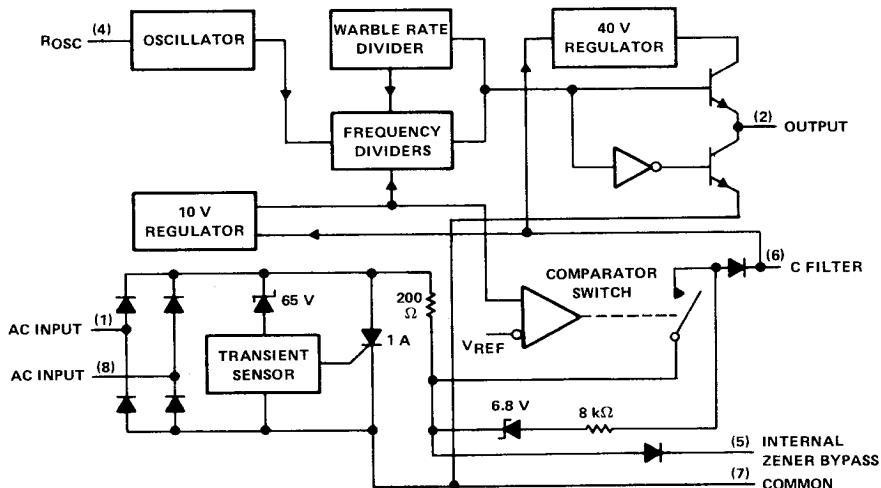
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description (continued)

When used with the proper external circuitry (see Figures 4 and 5), these devices feature lightning and transient protection circuitry designed to withstand lightning strikes of 1.5 kilovolts for up to 200 microseconds duration. In addition, internal circuitry will reject dial pulses from parallel telephones so that false ringing (tapping) will not occur.

These telephone tone ringer drivers may be used in nontelephone communications applications. For example, the devices can be used, with few external components, to produce an inexpensive and highly efficient alarm (see Figure 6).

functional block diagram



absolute maximum ratings

Continuous peak-to-peak input voltage, pin 1 to pin 8 (see Note 1)	65 V
Continuous dc input voltage at pin 6	65 V
Continuous output current, I_O , at pin 2	12 mA
Continuous output current, pin 5 and pin 6	30 mA
Continuous SCR on-state input current, pin 1 to pin 8	200 mA
SCR on-state input current, pin 1 to pin 8 (duration $\leq 200 \mu\text{s}$)	900 mA
Continuous total dissipation at (or below) 25°C free-air temperature (see Note 2)	1000 mW
Operating free-air temperature range	-40°C to 85°C
Storage temperature range	-40°C to 125°C

NOTES: 1. For applications requiring ≥ 45 Vrms, an external resistor and capacitor are required to prevent damage to the device (see Note 3). Tip and ring may be connected interchangeably to either pin 1 or pin 8.
2. For operation above 25°C free-air temperature, derate linearly at the rate of $8\text{ mW}/^\circ\text{C}$.

recommended operating conditions

		MIN	MAX	UNIT
RMS input voltage, V_I (f = 15.3 Hz to 68 Hz) (see Note 3)		40	150	V
Output frequency (MIN applies to f_L , MAX applies to f_H)	TCM1501A	1700	2500	Hz
	TCM1506A	425	575	
	TCM1512A	1062	1438	
Operating free-air temperature, T_A		-20	70	°C

NOTE 3: Input voltage is applied to pins 1 and 8 through a series $2.2\text{ k}\Omega \pm 10\%$ resistor and a $0.47\text{ }\mu\text{F} \pm 10\%$ capacitor (see Figures 4 and 5).

electrical characteristics at 25°C free-air temperature, $R_L = \text{open}$, $C(\text{filtr}) = 10\text{ }\mu\text{F}$, $f = 20\text{ Hz}$ (unless otherwise noted), see Figure 2

detector section

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Ringing start threshold voltage	Pin 5 open, $R_L = 4\text{ k}\Omega$		19	28	V
Ringing start threshold rms voltage	Pin 5 open, $R_L = 4\text{ k}\Omega$, $f = 15.3\text{ Hz}$		40		V
Ringing stop threshold voltage	Pin 5 open, $R_L = 4\text{ k}\Omega$	7	11		V
	$V_I = 3\text{ V}$, $f \leq 20\text{ kHz}$	0.1	1		MΩ
Standby input impedance	$V_I = 3\text{ V}$, $f \leq 20\text{ kHz}$ (see Note 5)		10		kΩ
Impedance when ringing	$V_I = 40\text{ V}$, $R_L = 4\text{ k}\Omega$, $f = 15.3\text{ Hz}$		25		kΩ
	$V_I = 130\text{ V}$, $R_L = 4\text{ k}\Omega$		22		
Operating current	Pin 2 open, $V_I = 40\text{ V}$			1.1	
	Pin 2 open, $V_I = 55\text{ V}$			4	mA
Low level input current	$V_I = 5\text{ V}$		20		μA
SCR trigger voltage (pin 1 to pin 8)	All pins open, $I_J \leq 125\text{ mA}$ (see Note 4)	65	75	100	V
SCR trigger current (pin 1 to pin 8)	All pins open, $V_I \leq 100\text{ V}$ (see Note 4)	55	90	110	mA
SCR input hold current	(see Note 4)		100		μA

NOTES: 4. These parameters are measured using pulse techniques ($t_W \leq 200\text{ }\mu\text{s}$, duty cycle $\leq 5\%$).

5. Pin 5 connected to pin 6, and pin 6 connected to pin 7 through a $100\text{ }\Omega$ resistor.

TCM1501A, TCM1506A, TCM1512A TELEPHONE TONE RINGER DRIVERS

electrical characteristics at 25 °C free-air temperature, $C_{(fltr)} = 10 \mu F$, $f = 20 \text{ Hz}$ (unless otherwise noted), see Figure 2

output section

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage, pin 2	$V_I = 17 \text{ V}$, $I_O = 2 \text{ mA}$, See Note 6	6			V
	$V_I = 65 \text{ V}$, $I_O = 5 \text{ mA}$, See Note 6	36	40		
	$V_I = 40 \text{ V}$, $f = 16 \text{ Hz}$, $I_O = 2 \text{ mA}$	8			
	$V_I = 150 \text{ V}$, $f = 15.3 \text{ Hz}$, $I_O = 2 \text{ mA}$	22	30		
Output voltage, pin 6 (see Note 7)	$V_I = 150 \text{ V}$, $f = 15.3 \text{ to } 68 \text{ Hz}$			100	V
High-level output current	$V_I = 65 \text{ V}$, $V_O = 36 \text{ V}$, See Note 6	-5	-10		mA
Low-level output current	$V_I = 65 \text{ V}$, $V_O = 5 \text{ V}$, See Note 6	5	6		mA

NOTES: 6. Devices must be forced to the required output state by taking pin 4 to 10 V and toggling to 0 V as required. This stops the on-chip oscillator.
7. Normal device operation requires that a capacitor be connected from pin 6 to common (pin 7). A 10 μF capacitor is recommended for optimum antitapping vs turn-off-time performance of the circuit. Increasing or decreasing the value of this capacitor will respectively increase or decrease the antitapping capabilities of the circuit.

oscillator section

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output tone frequency High tone frequency/Low tone frequency	See Note 8	$TCM1501A$	2142/1874		Hz
		$TCM1506A$	562/450		
		$TCM1512A$	1339/1172		
Warble frequency	See Note 8	$TCM1501A$	7.41	7.8	8.3
		$TCM1506A$	7.41	7.8	8.3
		$TCM1512A$	9.3	9.8	10.4
Temperature coefficient of frequency	$T_A = -20^\circ\text{C}$ to 70°C		± 0.05		$^\circ\text{C}$

NOTE 8: Normal device operation requires that a resistor ($\pm 1\%$) be connected from pin 4 to common (pin 7). Texas Instruments separates the devices during final test to match one of the resistor values listed in Table 1 below. Each device is then symbolized, as shown in Figure 1, with the appropriate recommended resistor value of R_{OSC} required to guarantee specified output frequencies. For oscillator stability, it is recommended that R_{OSC} be located on the printed-circuit board as close as possible to pin 4 of the integrated circuit and be surrounded by the ground plane.

TABLE I. STANDARD RESISTOR VALUES
(See Note 8)

DEVICE NO.	RESISTOR VALUES (k Ω)				
TCM1501A	130	140	150	158	165
TCM1506A	130	140	150	158	165
TCM1512A	130	140	150	158	165

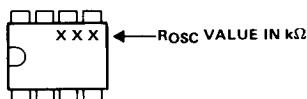


FIGURE 1. TELEPHONE TONE RINGER DRIVER SYMBOLIZATION

PARAMETER MEASUREMENT INFORMATION

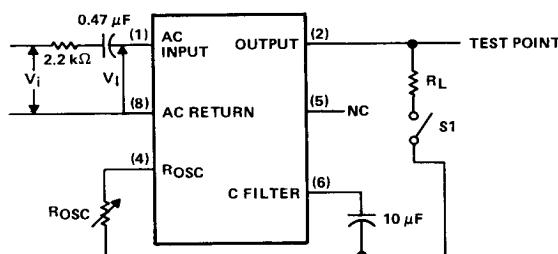


FIGURE 2. TEST CIRCUIT

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TYPICAL CHARACTERISTICS

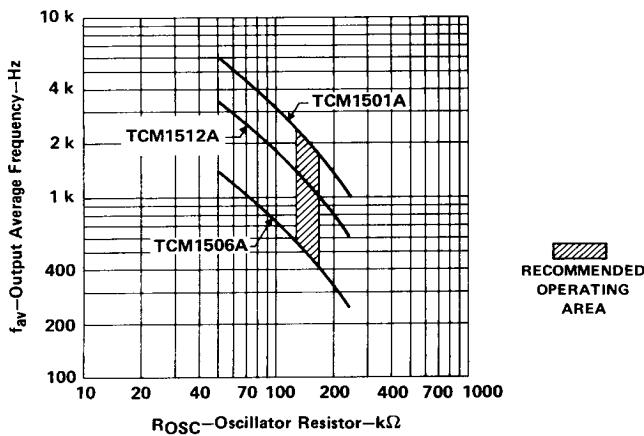


FIGURE 3. OSCILLATOR RESISTOR vs OUTPUT AVERAGE FREQUENCY

TYPICAL APPLICATIONS

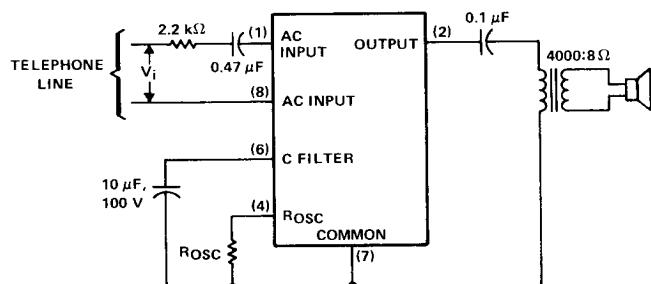


FIGURE 4. TELEPHONE APPLICATION—SPEAKER DRIVE

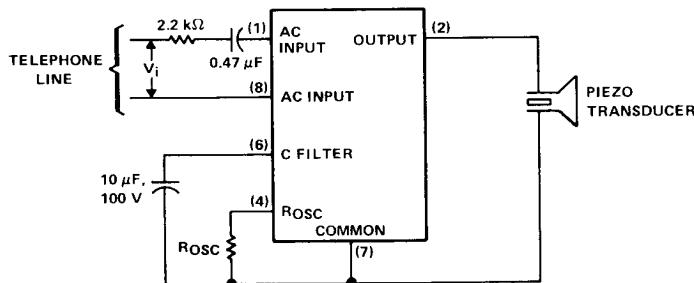
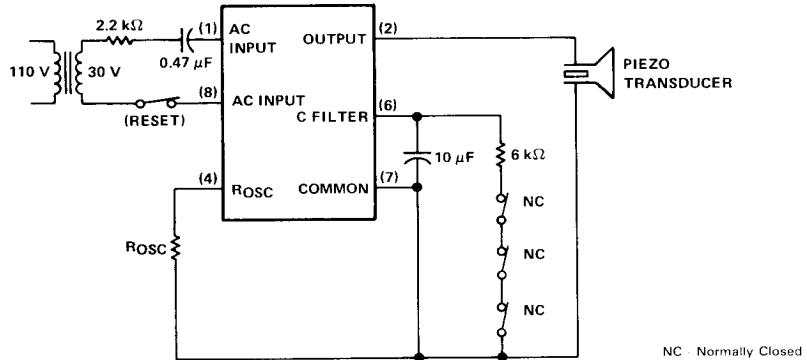


FIGURE 5. TELEPHONE APPLICATION—PIEZO DRIVE



NC - Normally Closed

FIGURE 6. ALARM SYSTEM CONFIGURATION

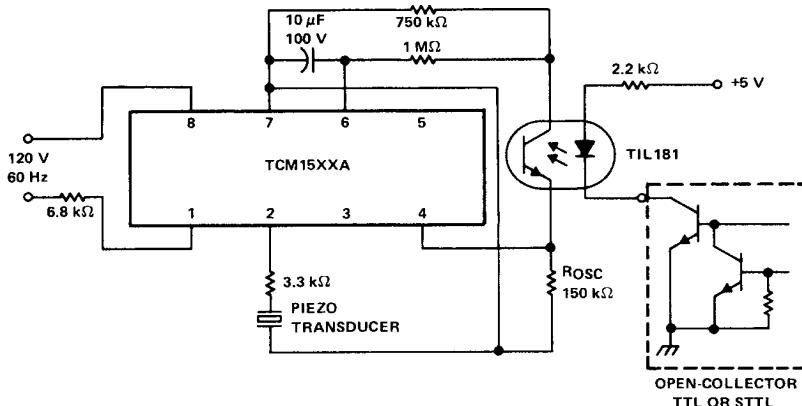


FIGURE 7. NONTELEPHONE APPLICATION

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Telecommunications Circuits

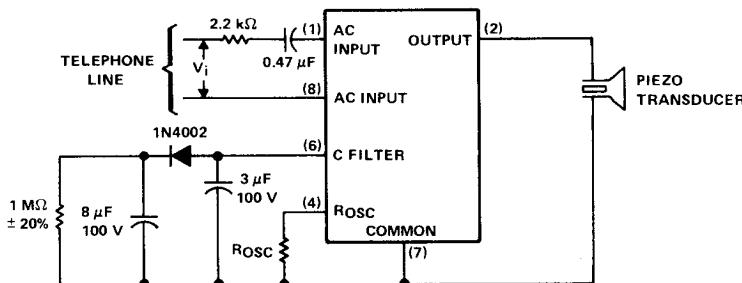


FIGURE 8. TELEPHONE APPLICATION—PIEZO DRIVE FAST RING SIGNAL CUTOFF