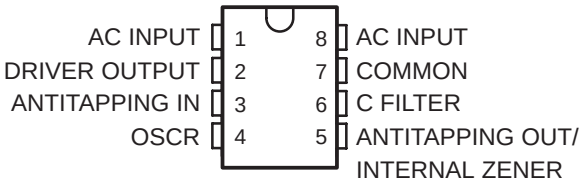
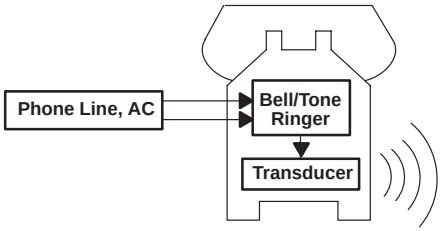
- **Electronic Replacement for Electromechanical Telephone Bell When Used With Transducer**
- **Designed to Meet or Exceed FCC Part 68 Class B Ringer Requirements**
- **Low-Cost External Component Requirements**
- **Low External Component Count**
- **High Standby Input Impedance 1 MΩ Typ**
- **Low Ringer 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**
- **On-Chip Thyristor Coupled With Additional External Components Provides Enhanced Rejection of Dial Pulses**
- **TCM1501B, TCM1512B, and TCM1506B Are Improved Direct Replacements for TCM1501A, TCM1512A, and TCM1506A, Respectively**
- **Requires Only a Single-Value Oscillator Resistor (Eliminates Binning Codes of the TCM15xxA Series)**

P PACKAGE
(TOP VIEW)



† Antitapping output for TCM1531, TCM1532, TCM1536, and TCM1539. Internal zener bypass for B-suffix versions.



TYPICAL CHARACTERISTICS
TELEPHONE TONE RINGER DRIVER FAMILY

PART NO.	NORMAL OUTPUT CENTER FREQUENCY (Hz)	WARBLE RATIO (f_H:f_L)	NORMAL WARBLE FREQ. (Hz)
TCM1501B, TCM1531	2000	8:7	7.8
TCM1512B, TCM1532	1250	8:7	9.8
TCM1506B, TCM1536	500	5:4	7.8
TCM1539	2000	5:4	31.2

description

The TCM1501B, TCM1506B, TCM1512B, TCM1531, TCM1532, TCM1536, and TCM1539 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 tone. Each device is powered and activated by the telephone line ring voltage, which may vary from 40 Vrms to 150 Vrms at frequencies from 15.3 Hz to 68 Hz.

Caution. These devices have limited built-in ESD 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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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description (continued)

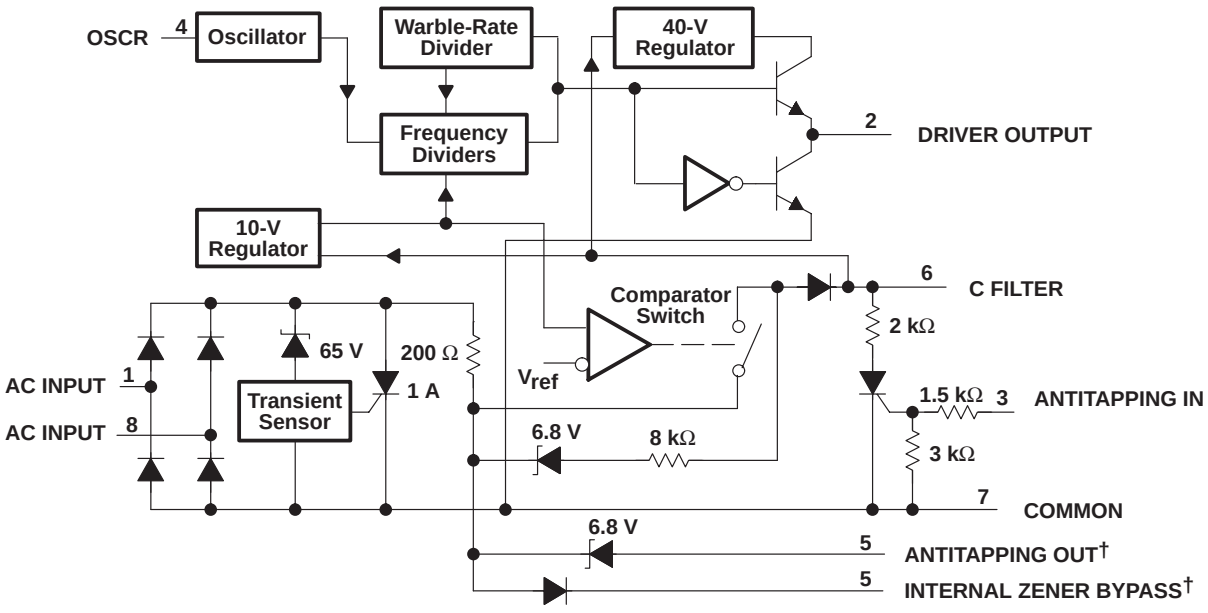
During low-voltage (off-hook) standby, typical input impedance is greater than 1 MΩ; this prevents interference with telephone DTMF or voice signals without the use of expensive mechanical switches. This high standby impedance is achieved with an on-chip series zener diode that is activated by a differential input voltage of typically 8.9 V at AC INPUT (pins 1 and 8). A voltage level of typically 17 V differential at AC INPUT 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, 5, and 6) varies from 30 kΩ to 8 kΩ over the Class B ring signal and is reasonably independent of the output load.

These devices feature lightning and transient protection circuitry designed to withstand transients of 1.5 kV for up to 200 ms duration when used with the proper external circuitry (see Figures 4 and 5). In addition, an on-chip thyristor coupled with an external resistor and capacitor circuit reject dial pulses from parallel telephones so that false ringing (tapping) does not occur (see application information section).

The TCM1501B, TCM1506B, TCM1521B have a provision for bypassing the internal series diode with one of lower voltage, thereby lowering the turn-on threshold of the devices. If the antitapping thyristor is used with these devices, an external zener diode must be added in series with ANTITAPPING OUT/INTERNAL ZENER BYPASS.

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

functional block diagram



† Antitapping output for TCM1531, TCM1532, TCM1536, and TCM1539. Internal zener bypass for B-suffix versions

absolute maximum ratings over free-air temperature range (unless otherwise noted)†

Continuous peak-to-peak input voltage, AC INPUT (pin 1 to pin 8) (see Note 1) . . . . . 110 V
Continuous dc input voltage at C FILTER . . . . . 55 V
Negative dc voltage, any pin . . . . . −1.2 V
Continuous output current, I_O, at DRIVER OUTPUT . . . . . 12 mA
Continuous output current, ANTITAPPING OUT/INTERNAL ZERNER BYPASS and C FILTER . . . . . 30 mA
Continuous SCR on-state input current, AC INPUT . . . . . 200 mA
SCR on-state input current, AC INPUT (pin 1 to pin 8) (duration ≤ 200 µs) . . . . . 900 mA
Continuous total dissipation at (or below) 25°C free-air temperature (see Note 2) . . . . . 1000 mW
Operating free-air temperature range, T_A . . . . . −40°C to 85°C
Storage temperature range . . . . . −40°C to 125°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. For applications requiring ≥ 38 Vrms, an external resistor and capacitor are required to prevent damage to the device (see Note 3). Tip and ring can 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 mW/°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
Resistor between OSCR and COMMON, R_{OSC}	120	180	kΩ
Operating free-air temperature, T_A	−20	70	°C

NOTE 3: Input voltage is applied to AC INPUT through a series 2.2-kΩ ± 10% resistor and a 0.47-µF ± 10% capacitor (see Figures 4, 5, and 6).

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

detector section

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Ringing start threshold voltage	ANTITAPPING OUT/INTERNAL ZENER BYPASS open, R_L = 4 kΩ		19	28	V
Ringing start threshold rms voltage	ANTITAPPING OUT/INTERNAL ZENER BYPASS open, R_L = 4 kΩ, f = 15.3 Hz			40	V
Ringing stop threshold voltage	ANTITAPPING OUT/INTERNAL ZENER BYPASS open, R_L = 4 kΩ	7	11		V
Ringing start threshold voltage	Antitapping thyristor activated		40		V
ANTITAPPING IN voltage required to activate antitapping thyristor			1		V
ANTITAPPING IN input current required to activate antitapping thyristor			0.2		mA
Standby input impedance	V_I = 3 V, f ≤ 20 kHz	0.1	1		MΩ
	V_I = 3 V, f ≤ 20 kHz, See Note 5		10		kΩ
Impedance when ringing	V_I = 40 V, R_L = 4 kΩ, f = 15.3 Hz		25		kΩ
	V_I = 130 V, R_L = 4 kΩ		22		
Operating current	DRIVER OUTPUT open, V_I = 40 V			1.3	mA
Low-level input current	V_I = 5 V			20	μA
SCR trigger voltage (AC INPUT)	All pins open, I_I ≤ 125 mA (see Note 4)	50	60	100	V
SCR trigger current (AC INPUT)	All pins open, I_I ≤ 100 V (see Note 4)	55	80	110	mA
SCR input hold current	See Note 4		10		mA

NOTES: 4. These parameters are measured using pulse techniques (t_w ≤ 200 μs, duty cycle ≤ 5%).
5. ANTITAPPING OUT/INTERNAL ZENER BYPASS connected to C FILTER, and C FILTER connected to COMMON through a 100-Ω resistor.

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

output section

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage, DRIVER OUTPUT	V_I = 17 V, I_O = 2 mA, See Note 6		10		V
	V_I = 50 V, I_O = 5 mA, See Note 6		44		
	V_I = 40 V, I_O = 2 mA, f = 16 Hz		8		
	V_I = 150 V, I_O = 2 mA, f = 15.3 Hz		40		
Output voltage, C FILTER (see Note 7)	V_I = 150 V, f = 15.3 to 68 Hz			55	V
High-level output current	V_I = 50 V, V_{OH} = 43 V		−15		mA
Low-power output current	V_I = 50 V, V_{OL} = 1.5 V, See Note 6		11		mA

NOTES: 6. Devices must be forced to the required output state by taking OSCR to 8 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 C FILTER to COMMON. 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	R_{OSC} = 150 kΩ ± 1%	TCM1501B, TCM1531	1983/1736	2133/1876	2283/1998	Hz
		TCM1512B, TCM1532	1239/1085	1333/1167	1427/1249	
		TCM1506B, TCM1536	516/414	555.5/445.5	595/477	
		TCM1539	2066/1653	2222/1776	2378/1903	
Warble frequency	R_{OSC} = 150 kΩ ± 1%	TCM1501B, TCM1531		7.8		Hz
		TCM1512B, TCM1532		9.8		
		TCM1506B, TCM1536		7.8		
		TCM1539		31.2		
Temperature coefficient of frequency	T_A = −20°C to 70°C			±0.05		%/°C

PARAMETER MEASUREMENT INFORMATION

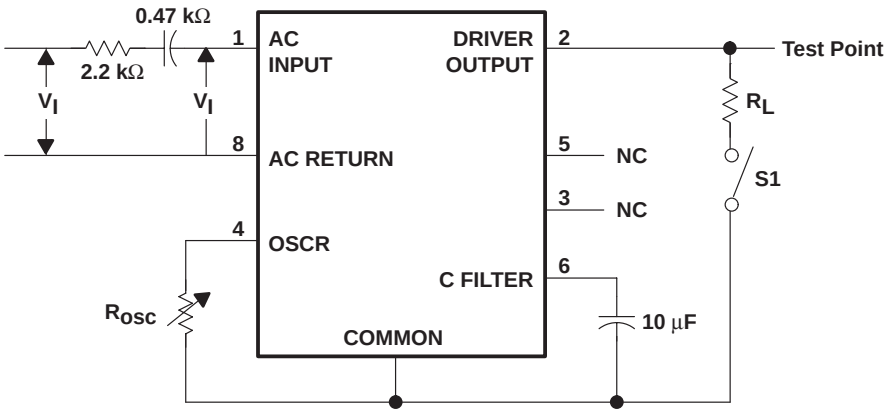


Figure 1. Test Circuit

TYPICAL CHARACTERISTICS

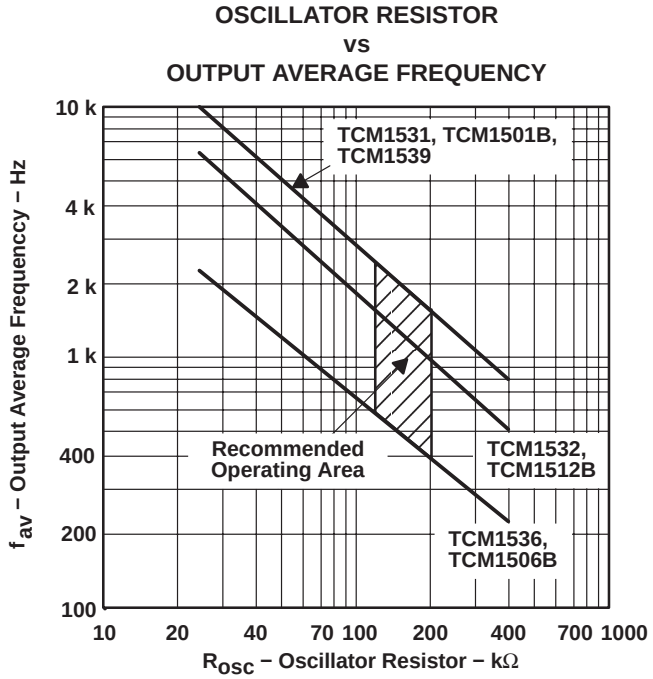


Figure 2

APPLICATION INFORMATION

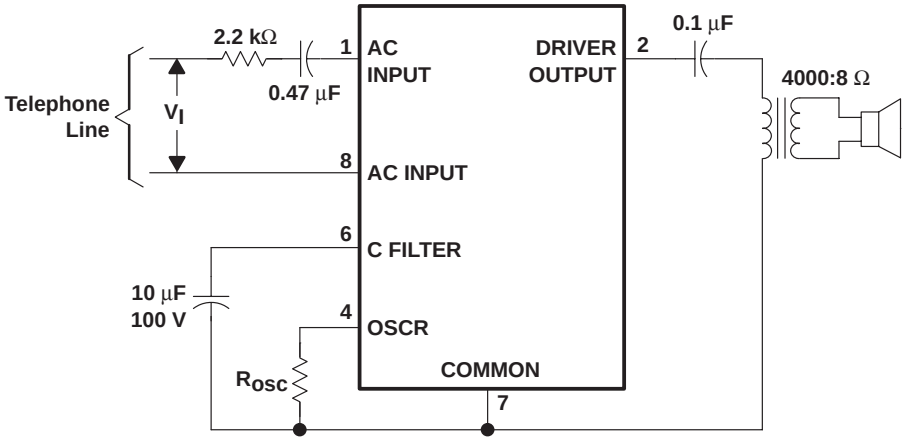


Figure 3. Telephone Application − Speaker Drive

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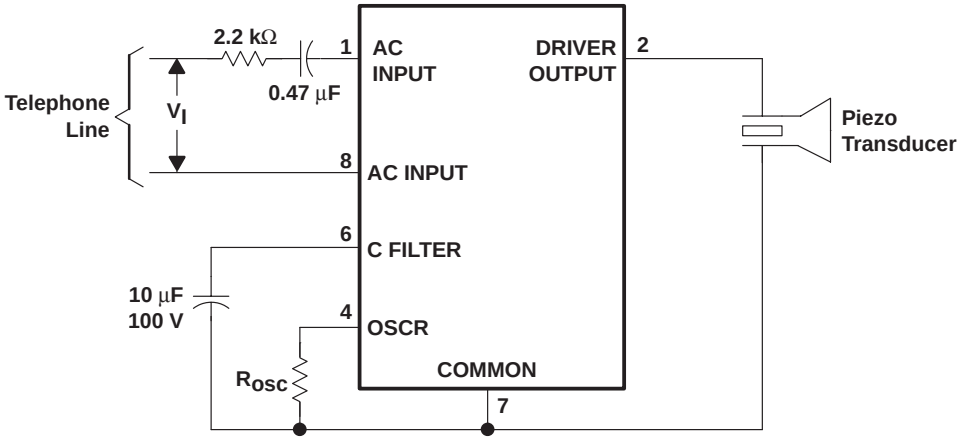
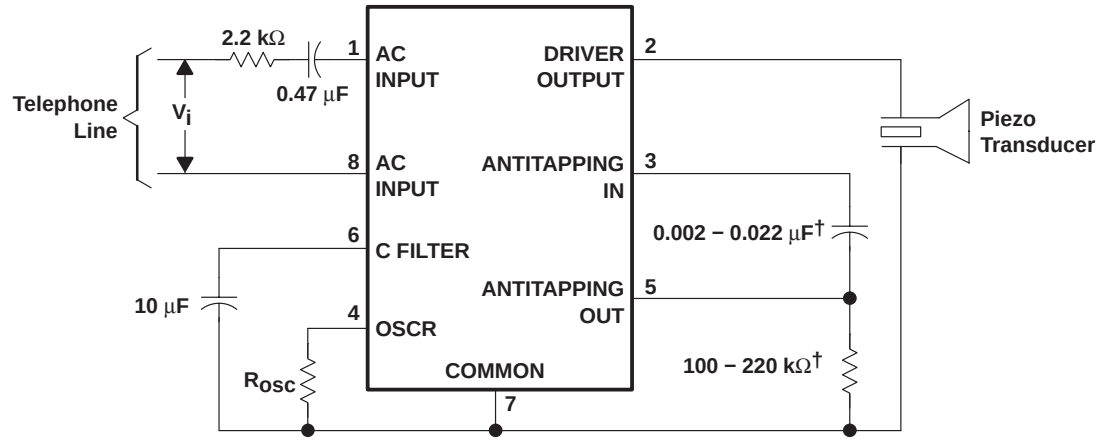


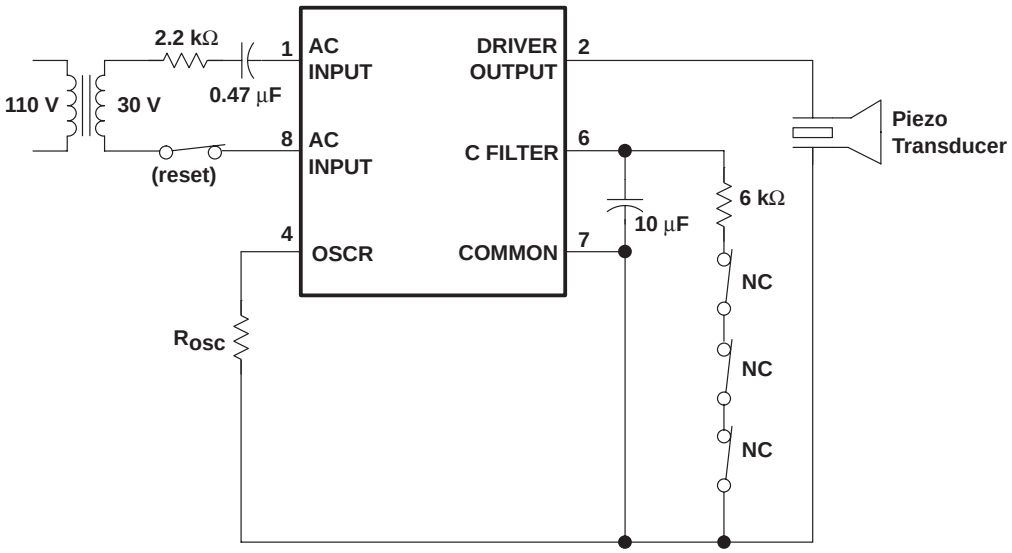
Figure 4. Telephone Application − Piezo Drive



† Optimum values to be determined by specific antitapping requirements.

Figure 5. Telephone Application, Improved Antitapping Circuit

APPLICATION INFORMATION



NC − Normally Closed

Figure 6. Alarm-System Configuration

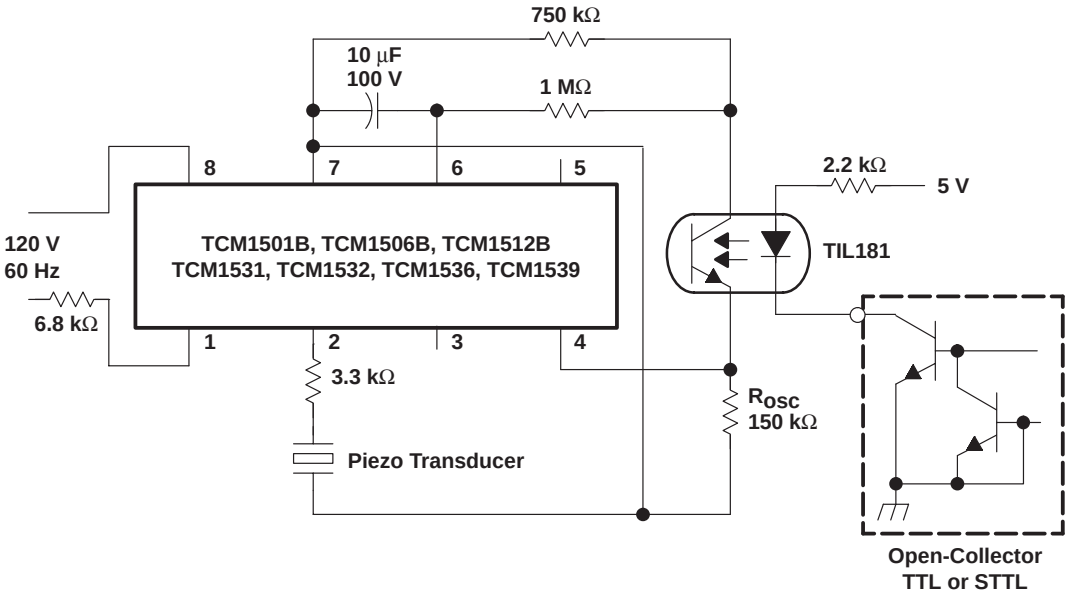


Figure 7. Nontelephone Application

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APPLICATION INFORMATION

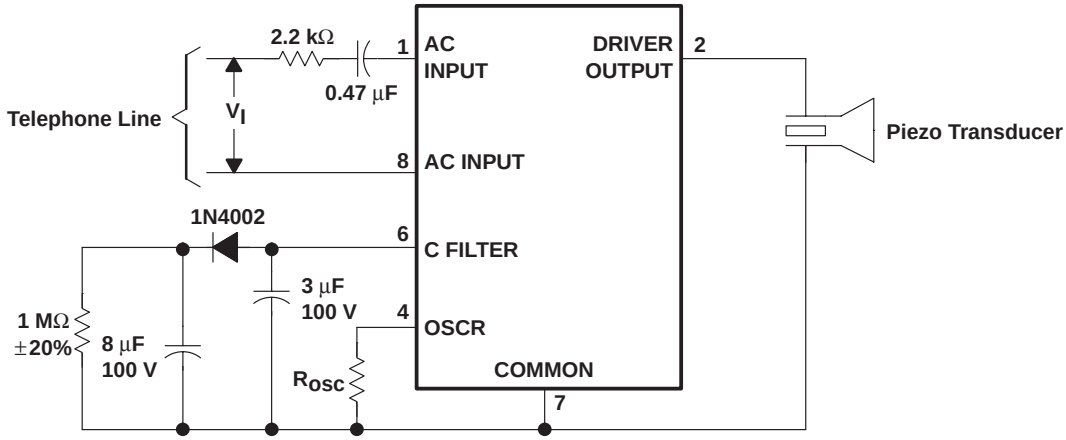

Figure 8. Telephone Application − Piezo-Drive Fast-Ring Signal Cutoff

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