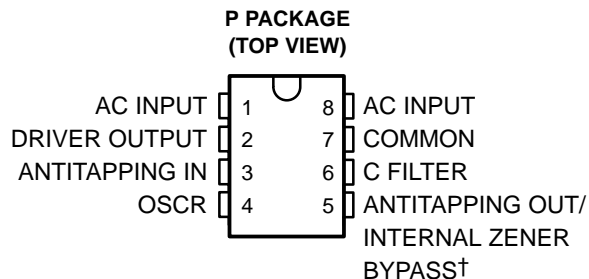


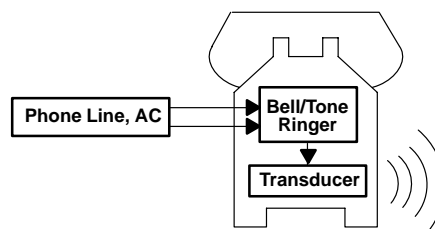
TCM1501B, TCM1506B, TCM1512B TCM1531, TCM1532, TCM1536, TCM1539 TELEPHONE TONE-RINGER DRIVERS

SCTS020 – MARCH 1986 – REVISED APRIL 1987

- 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 M Ω 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)



† 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 V_{rms} to 150 V_{rms} 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.

**TEXAS
INSTRUMENTS**

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TCM1501B, TCM1506B, TCM1512B TCM1531, TCM1532, TCM1536, TCM1539 TELEPHONE TONE-RINGER DRIVER

SCTS020 – MARCH 1986 – REVISED APRIL 1987

description (continued)

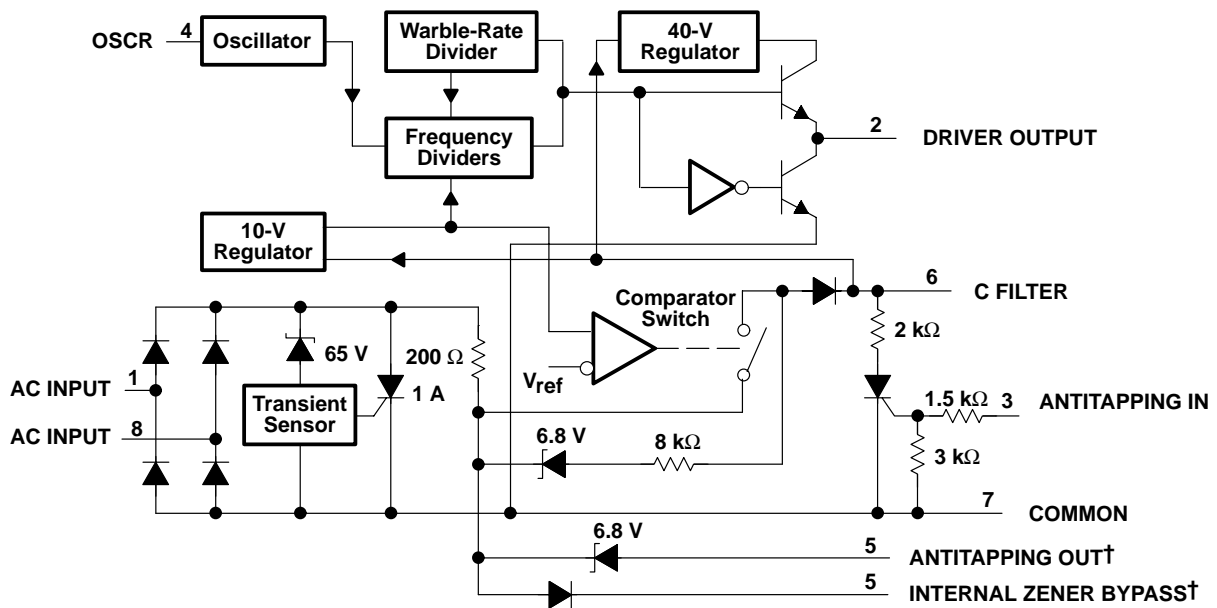
During low-voltage (off-hook) standby, typical input impedance is greater than 1 M Ω ; this prevents interference with telephone DTMF or voice signals without the use of expensive mechanical switches. This high standby impedance is achieved with an on-chip series zener diode that is activated by a differential 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 k Ω to 8 k Ω 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

**TCM1501B, TCM1506B, TCM1512B
TCM1531, TCM1532, TCM1536, TCM1539
TELEPHONE TONE-RINGER DRIVERS**

SCTS020 – MARCH 1986 – REVISED APRIL 1987

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 ZENER 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 $\leq 200 \mu\text{s}$) | 900 mA |
| Continuous total dissipation at (or below) 25°C free-air temperature (see Note 2) | 1000 mW |
| Operating free-air temperature range, 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 ($f = 15.3 \text{ Hz to } 68 \text{ Hz}$) (see Note 3) | 40 | 150 | V |
| Resistor between OSCR and COMMON, R_{OSC} | 120 | 180 | k Ω |
| Operating free-air temperature, T_A | –20 | 70 | °C |

NOTE 3: Input voltage is applied to AC INPUT through a series 2.2-k $\Omega \pm 10\%$ resistor and a 0.47- $\mu\text{F} \pm 10\%$ capacitor (see Figures 4, 5, and 6).



**TCM1501B, TCM1506B, TCM1512B
TCM1531, TCM1532, TCM1536, TCM1539
TELEPHONE TONE-RINGER DRIVER**

SCTS020 – MARCH 1986 – REVISED APRIL 1987

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

detector section

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|--|-----|-----|-----|---------------|
| Ringing start threshold voltage | ANTITAPPING OUT/INTERNAL ZENER BYPASS open, $R_L = 4 \text{ k}\Omega$ | | 19 | 28 | V |
| Ringing start threshold rms voltage | ANTITAPPING OUT/INTERNAL ZENER BYPASS open, $R_L = 4 \text{ k}\Omega$, $f = 15.3 \text{ Hz}$ | | | 40 | V |
| Ringing stop threshold voltage | ANTITAPPING OUT/INTERNAL ZENER BYPASS open, $R_L = 4 \text{ k}\Omega$ | 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 | $V_I = 3 \text{ V}$, $f \leq 20 \text{ kHz}$ | 0.1 | 1 | | M Ω |
| | $V_I = 3 \text{ V}$, $f \leq 20 \text{ kHz}$, See Note 5 | | 10 | | k Ω |
| Impedance when ringing | $V_I = 40 \text{ V}$, $R_L = 4 \text{ k}\Omega$, $f = 15.3 \text{ Hz}$ | | 25 | | k Ω |
| | $V_I = 130 \text{ V}$, $R_L = 4 \text{ k}\Omega$ | | 22 | | |
| Operating current | DRIVER OUTPUT open, $V_I = 40 \text{ V}$ | | | 1.3 | mA |
| Low-level input current | $V_I = 5 \text{ V}$ | | | 20 | μA |
| SCR trigger voltage (AC INPUT) | All pins open, $I_I \leq 125 \text{ mA}$ (see Note 4) | 50 | 60 | 100 | V |
| SCR trigger current (AC INPUT) | All pins open, $I_I \leq 100 \text{ V}$ (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 ($t_w \leq 200 \mu\text{s}$, duty cycle $\leq 5\%$).

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, $C_{(\text{fltr})} = 10 \mu\text{F}$, $f = 20 \text{ Hz}$ (unless otherwise noted) (see Figure 2)

output section

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

NOTES: 6. Devices must be forced to the required output state by taking OSC R 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.



**TCM1501B, TCM1506B, TCM1512B
TCM1531, TCM1532, TCM1536, TCM1539
TELEPHONE TONE-RINGER DRIVERS**

SCTS020 – MARCH 1986 – REVISED APRIL 1987

oscillator section

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT | |
|--|--|-------------------|-----------|-------------|-----------|----|
| Output tone frequency High tone frequency Low tone frequency | $R_{osc} = 150\text{ k}\Omega \pm 1\%$ | 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 | $R_{osc} = 150\text{ k}\Omega \pm 1\%$ | TCM1501B, TCM1531 | 7.8 | | Hz | |
| | | TCM1512B, TCM1532 | 9.8 | | | |
| | | TCM1506B, TCM1536 | 7.8 | | | |
| | | TCM1539 | 31.2 | | | |
| Temperature coefficient of frequency | $T_A = -20^\circ\text{C to } 70^\circ\text{C}$ | ± 0.05 | | | %/°C | |

PARAMETER MEASUREMENT INFORMATION

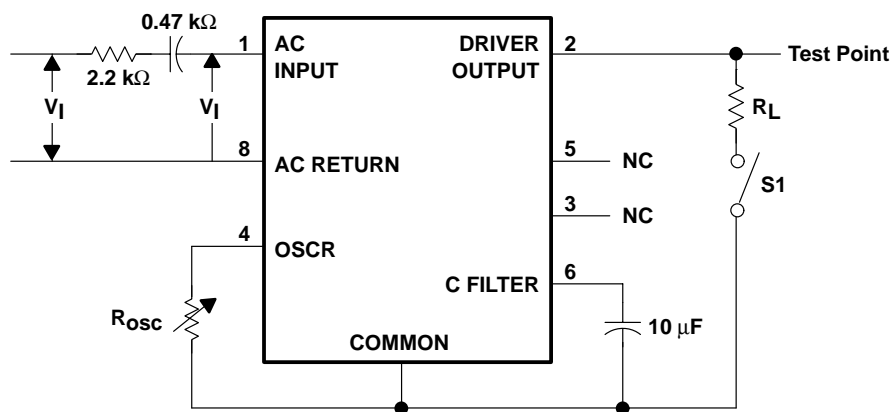
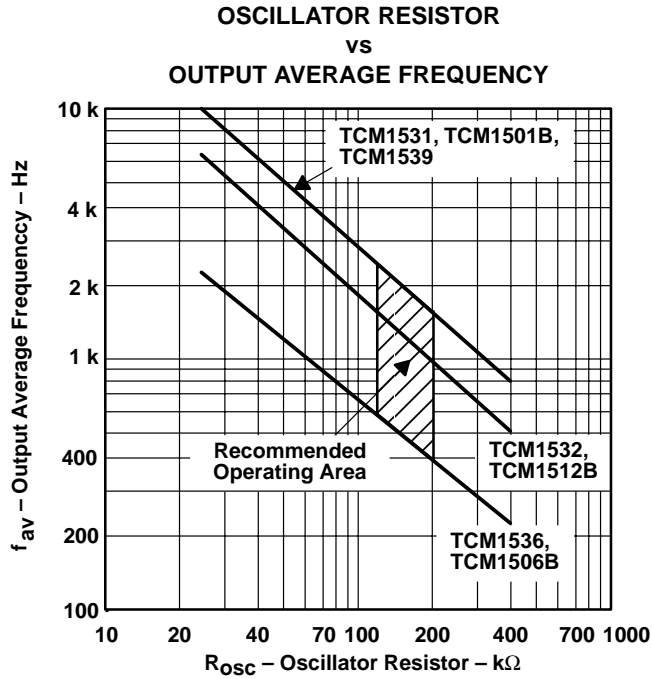


Figure 1. Test Circuit

**TCM1501B, TCM1506B, TCM1512B
TCM1531, TCM1532, TCM1536, TCM1539
TELEPHONE TONE-RINGER DRIVER**

SCTS020 – MARCH 1986 – REVISED APRIL 1987

TYPICAL CHARACTERISTICS



APPLICATION INFORMATION

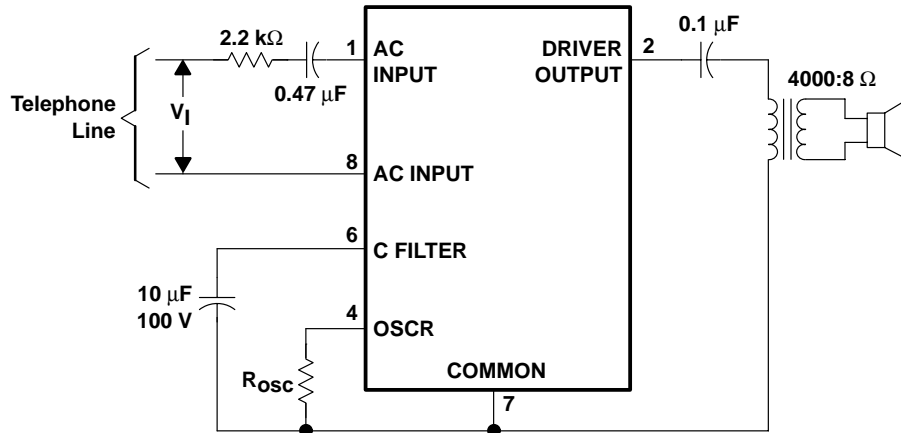


Figure 3. Telephone Application – Speaker Drive

APPLICATION INFORMATION

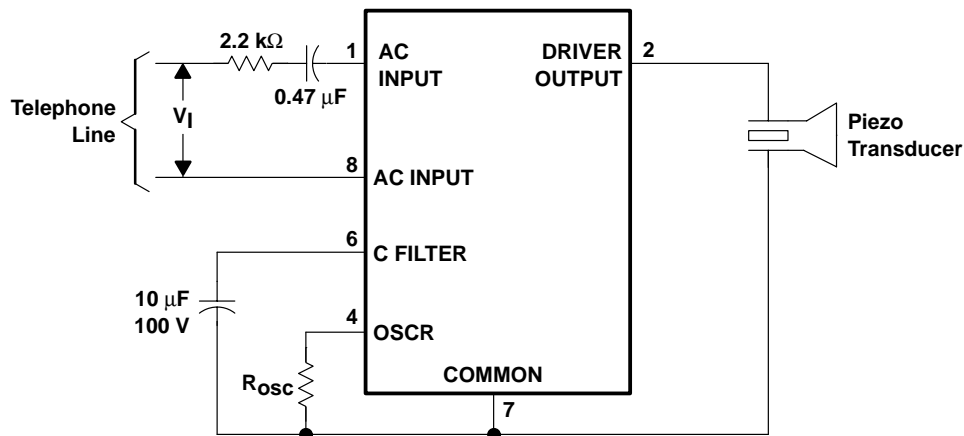
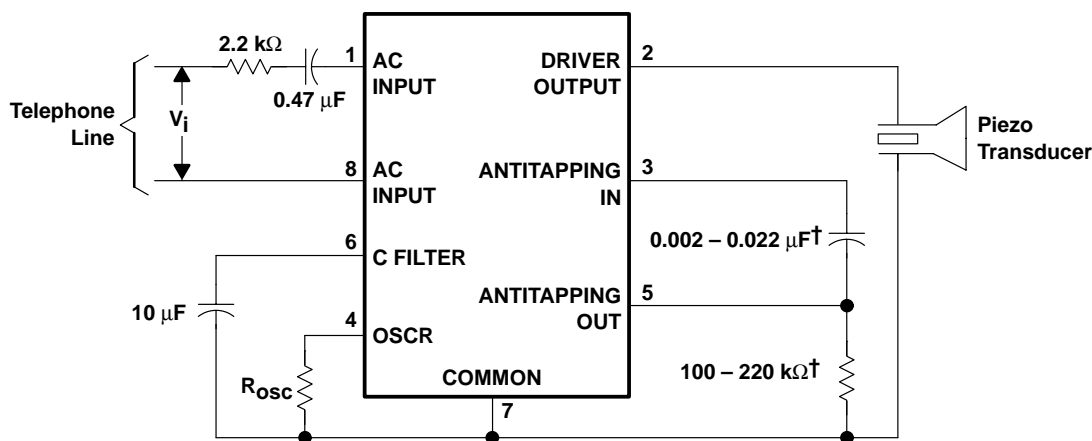


Figure 4. Telephone Application – Piezo Drive



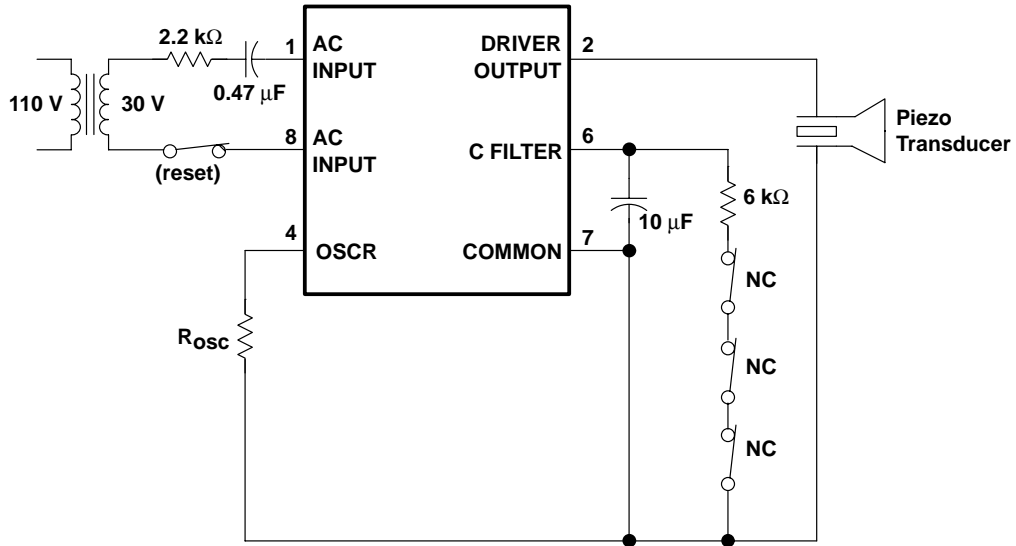
† Optimum values to be determined by specific antitapping requirements.

Figure 5. Telephone Application, Improved Antitapping Circuit

**TCM1501B, TCM1506B, TCM1512B
TCM1531, TCM1532, TCM1536, TCM1539
TELEPHONE TONE-RINGER DRIVER**

SCTS020 – MARCH 1986 – REVISED APRIL 1987

APPLICATION INFORMATION



NC – Normally Closed

Figure 6. Alarm-System Configuration

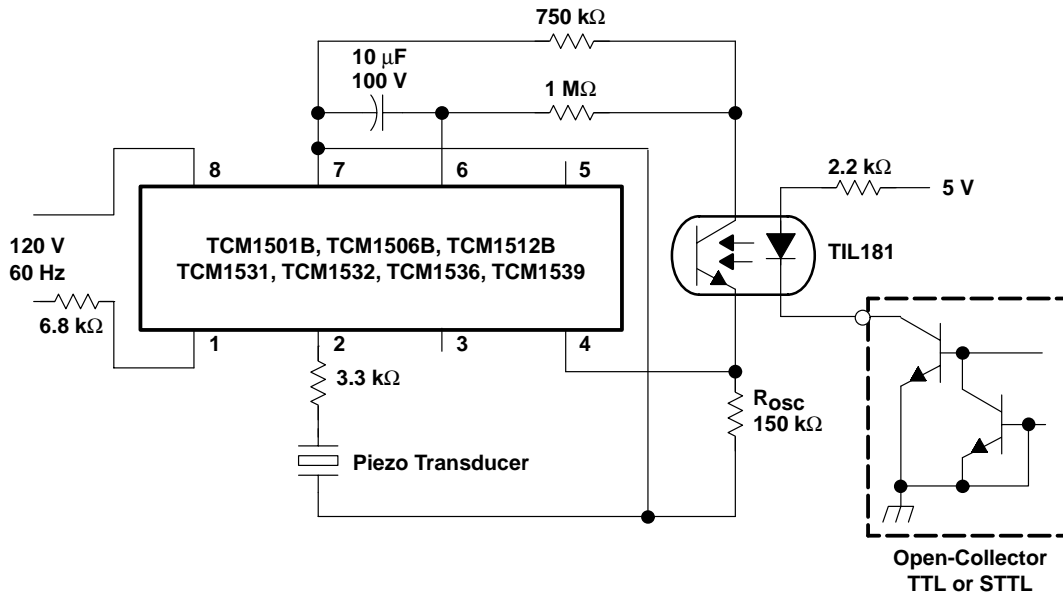


Figure 7. Nontelephone Application

APPLICATION INFORMATION

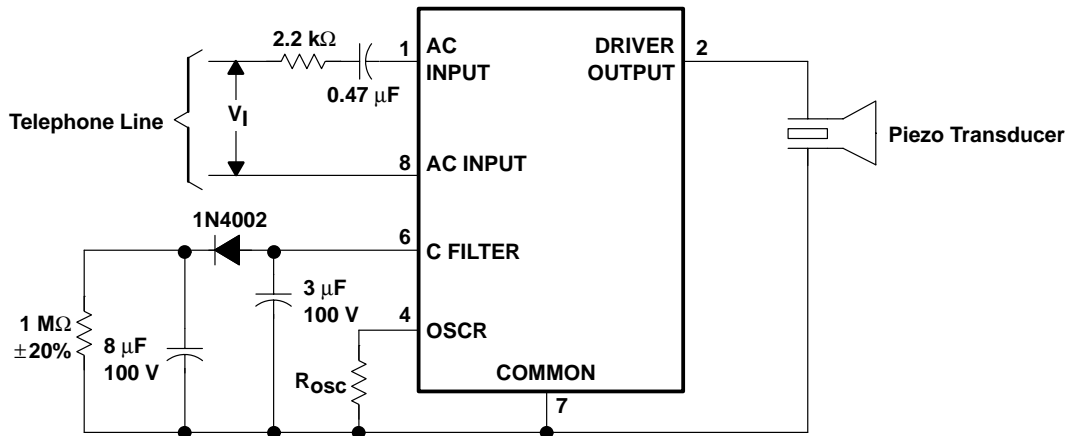


Figure 8. Telephone Application – Piezo-Drive Fast-Ring Signal Cutoff

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