**TAIWAN SEMICONDUCTOR**

**Pb** **RoHS** COMPLIANCE

# TS31002
## Tong Ringer

**SOP-8**

**DIP-8**

**Pin Definition:**
1. VCC          5. Gnd
2. Rsl           6. Hfo
3. Lfi            7. Hfi
4. Lfo           8. Out

## General Description

The TS31002 is a bipolar integrated circuit designed for telephone bell replacement.

## Features

- Designed for Telephone Bell Replacement
- Low Current Drain
- Adjustable 2-frequency Tone
- Adjustable Warbling Rate
- Extension Tone Ringer Modules
- Alarms or Other Alerting Devices
- Adjustable for Reduced Supply Initiation Current.
- Built-in hysteresis prevents false triggering and rotary dial 'Chirps'.

## Ordering Information

| Part No. | Package | Packing |
|---|---|---|
| TS31002CD C3 | DIP-8 | 50pcs / Tube |
| TS31002CS RL | SOP-8 | 2.5Kpcs / 13" Reel |

## Block Diagram

Version: A07
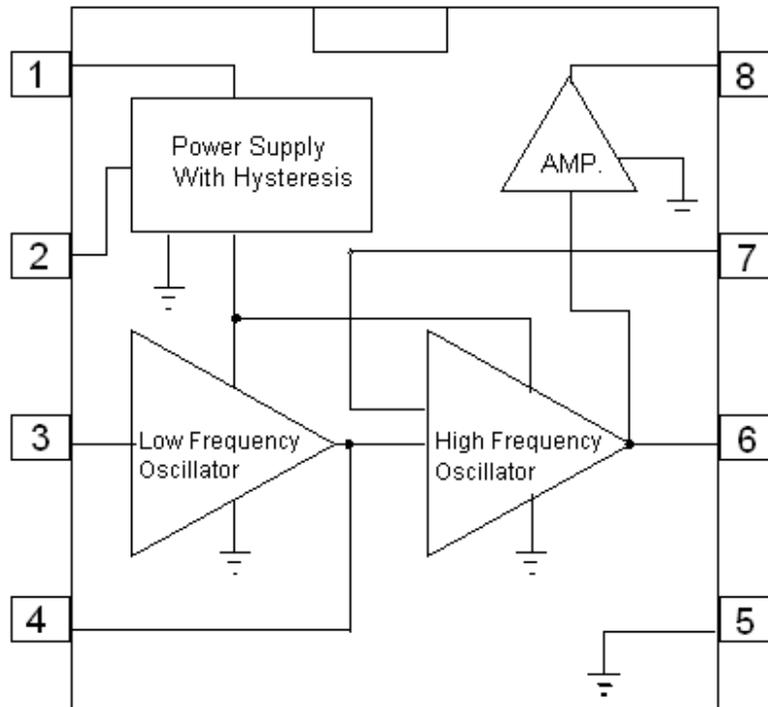
## Absolute Maximum Rating

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| DC Supply Voltage (Referenced to GND) | VCC | + 36 | V |
| Power Dissipation in Still Air Plastic DIP | PD | 400 | mW |
| Switch Collector Voltage | Tstg | -65 to +150 | $^o$C |

Note: a. Maximum Ratings are those values beyond which damage to the device may occur.

b. Functional operation should be restricted to the Recommended Operating Conditions.

## Recommended Operating Conditions

| Description | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Operating Voltage | Vopr | 13 | 36 | V |
| Operating Temperature | $T_A$ | -45 | +65 | $^o$C |

Note: This device contains protection circuitry circuitry to guard against damage due to high static voltages or electric fidlds. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, $V_{IN}$ and $V_{OUT}$ should be constrained to the range

$$GND \leq (V_{IN} \text{ or } V_{OUT)} \leq Vcc.$$

Unused inputs must always be tied to an appropriate logic voltage level (e.g.,either GND or Vcc). Unused outputs must be left open.

## Electrical Specifications (Voltages Referenced to GND,TA=-0 to +70 $^o$C)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Initiation Supply Voltage (1) | $V_{SI}$ | See Figure 2 | 16.8 | -- | 21.2 | V |
| Initiation Supply Current (1) | $I_{SI}$ | See Figure 2 | 1.4 | -- | 4.2 | mA |
| Sustaining Voltage (1) | $V_{SUS}$ | See Figure 2 | 9.5 | -- | 12.2 | V |
| Sustaining Current | $I_{SUS}$ | See Figure 2 | 0.7 | -- | 2.5 | mA |
| High-Level Output Voltage | $V_{OH}$ | Vcc=21V,$I_{OH}$=-15mA, Pin6=6V, Pin7=GND | 16.7 | -- | 21.0 | V |
| Low-Level Output Voltage | $V_{OL}$ | Vcc=21V,$I_{OL}$=15mA, Pin6= GND, Pin7=6V | -- | -- | 1.8 | V |
| Maximin Input Leakage Current | $I_{IN}$ | Pin3 =6V, Pin4 =GND, Vcc=21V | -- | -- | 1.0 | $\mu$A |
| | | Pin7 =6V, Pin6 =GND, Vcc=21V | -- | -- | 1.0 | $\mu$A |
| High Frequency 1 | $F_{H1}$ | $R_3$ =191K$\Omega$,$C_3$ =6800pF | 461 | -- | 563 | $H_Z$ |
| High Frequency 2 | $F_{H2}$ | $R_3$ =191K$\Omega$,$C_3$ =6800pF | 576 | -- | 704 | $H_Z$ |
| Low Frequency | $F_L$ | $R_2$ =165K$\Omega$,$C_2$ =0.47uF | 9.0 | -- | 11.0 | $H_Z$ |
| Ringing Start Voltage (4) | Vtr | See Figure 1 | -- | -- | 36 | V |

Notes :

a. Initiation supply voltage ($V_{SI}$) is the supply voltage required to start the tone ringer oscillating.

b. Sustaining voltage ($V_{SUS}$) is the supply voltage required to maintain oscillation.

c. Ringing start voltage is the value of AC supply voltage required to start the tone ringer ringing in FIG.3

d. This product is not designed for protection against radioactive rays.

e. All data and specifications are subject to change without notice.
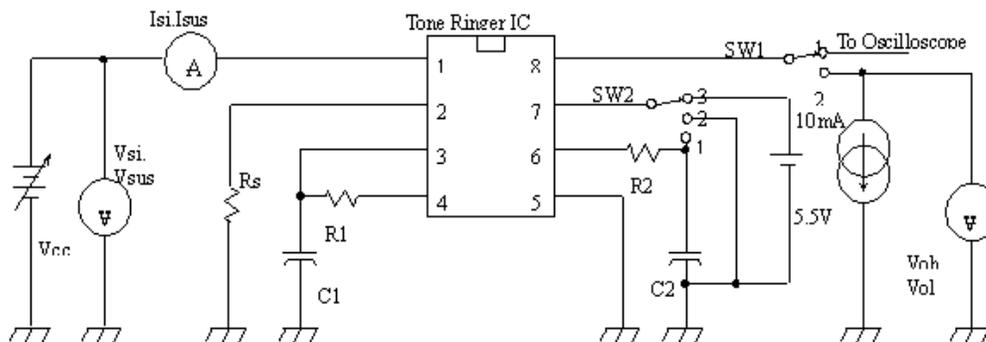
## Application Circuit

### HOW TO USE THE RSL PIN

In the IC, the supply initiation current (Isi) can be changed using the RSL Pin. As show is the diagram, the RSL (Pin 2) is grounded through resistor Rs. By changing the Rs value, supply initiation current can be changed.

Supply voltage (Vcc) vs. supply current (Icc) characteristics resulting from changes in the value of Rs are shown in the following diagram.
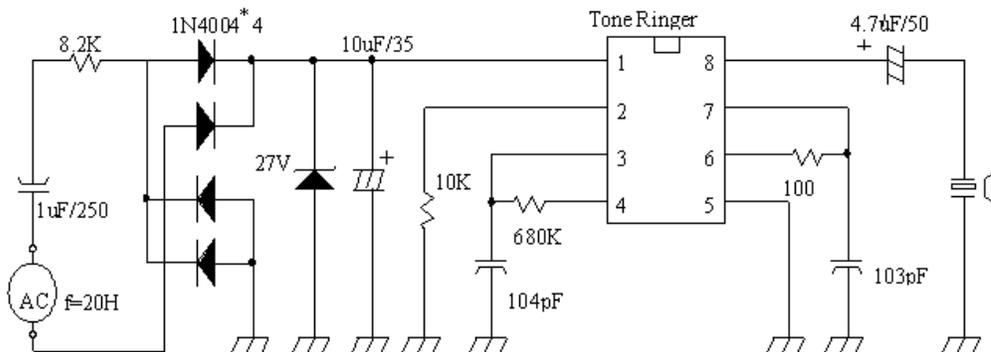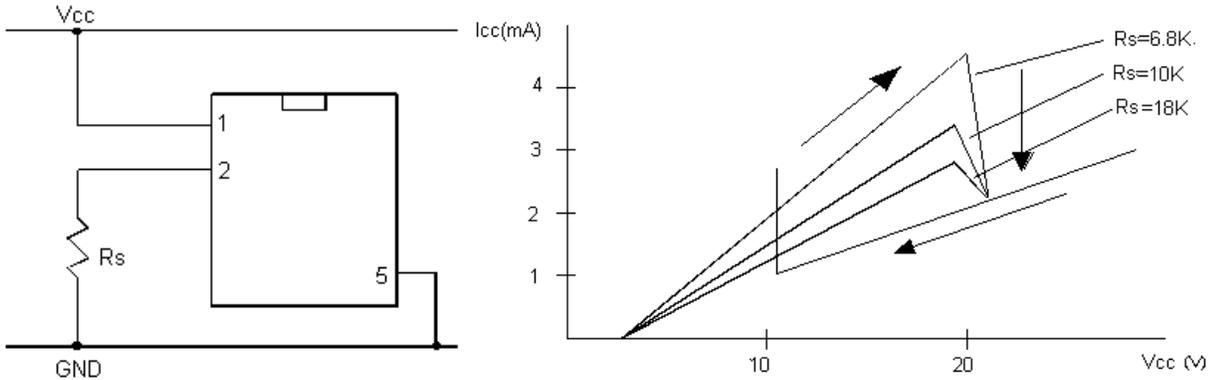




**Figure 1. Ringing Start Voltage Test Circuit**



**Figure 2. Test Circuit (1)**

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## Application Circuit

**SWITCH POSITION IS THE FOLLOWING TABLE: :**

| PARAMETER | SW1 | SW2 |
|---|---|---|
| Vsi , Isi | 1 | 1 |
| Vsus , Isus | 1 | 1 |
| Voh | 2 | 2 |
| Vol | 2 | 3 |

R1 = 165 K (+/-)    1%
R2 = 191 K (+/-)    1%
C1 = 0.47 $\mu$F (+/-)   5%
C2 = 0.0068 $\mu$F (+/-)  5%
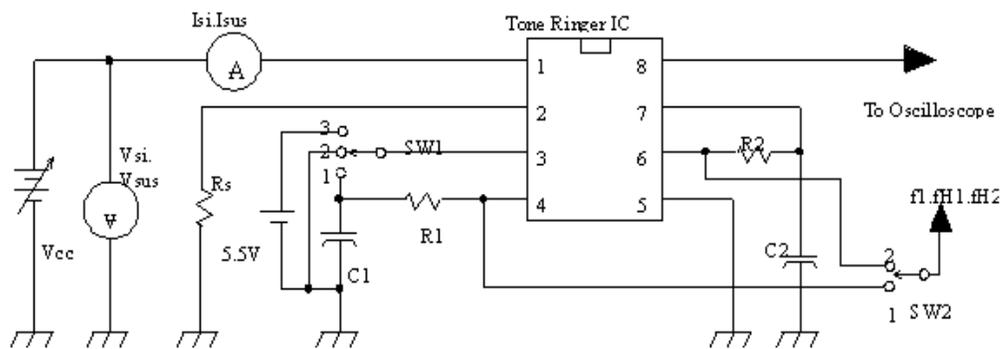


**Figure 3. Test Circuit (2)**

**SWITCH POSITION IS THE FOLLOWING TABLE:**

| PARAMETER | SW1 | SW2 |
|---|---|---|
| FL | 1 | 1 |
| fH1 | 3 | 2 |
| fH2 | 2 | 2 |

R1 = 165 K (+/-)   1%
R2 = 191 K (+/-)   1%
C1 = 0.47 $\mu$F (+/-)   5%
C2 = 0.0068 $\mu$F (+/-)  5%

## Application Note

The application circuit illustrates the use of the TS31002 devices in typical telephone or extension tone ringer application.

The AC ringer signal voltage appears across the TIP and RING inputs of the circuit and is attenuated by capacitorC1 and resistor R1.

C1 also provides isolation from DC voltages (48V) on the exchange line.

After full wave rectification by the bridge diode, the waveform is filtered by capacitor C4 to provide a DC supply for the tone ringer chip. As this voltage exceeds the initiation voltage (VSI), oscillation starts.

With the components shown, the output frequency chops between 512(fh1) and 640Hz(fh2) at a 10Hz(fL) rate.

The loudspeaker load is coupled through a 1300W to 8W transformer.

The output coupling capacitor C5 is required with transformer coupled loads.

When driving a piezo-ceramic transducer type load, the coupling C5 and transformer (1300W:8W) are not required. However, a current limiting resistor is required.

The low frequency oscillator oscillates at a rate (fL) controlled by an external resistor (R2) and capacitor (C2).

The frequency can be determined using the relation fL=1/1.289R2*C2. The high frequency oscillates at a fH1, fH2 controlled by an external resistor (R3) and capacitor (C3). The frequency can be determined using the relation H1=1/1.504R3*C3, fH2=1/1.203R3*C3.

## Application Note

Pin 2 allows connection of an external resistor RSL, which is used to program the slope of the supply current vs supply voltage characteristics (see Fig2), and hence the supply current up to the initiation voltage ( VSI ). This initiation voltage remains constant independent of RSL.

The supply current drawn prior to triggering varies inversely with RSL, decreasing for increasing value of resistance. Thus, increasing the value of RSL will decrease the amount of AC ringing current required to trigger the device. As such, longer sucribser loops are possible since less voltage is dropped per unit length of loop wire due to the lower current level. RSL can also be used to compensate for smaller AC couplin capacitors (C5 on Fig 3) (higher impedance) to the line which can be used to alter the ringer equivalence number of a tone ringer circuit.

The graph in Fig2 illustrates the variation of supply current with supply voltage. Three curves are drawn to show the variation of initiation current with RSL. Curve B( RSL=6.8K$\Omega$) shows the I-V characteristic for the TS31002 tone ringer. Curve A is a plot with RSL<6.8KW and shows an increase in the current drawn up to the initiation voltage VSI. The I-V characteristic after initiation remains unchanged. Curve C illustrates the effect of increasing RSL above 6.8KW initiation current decreases but again current after triggering is unchanged.
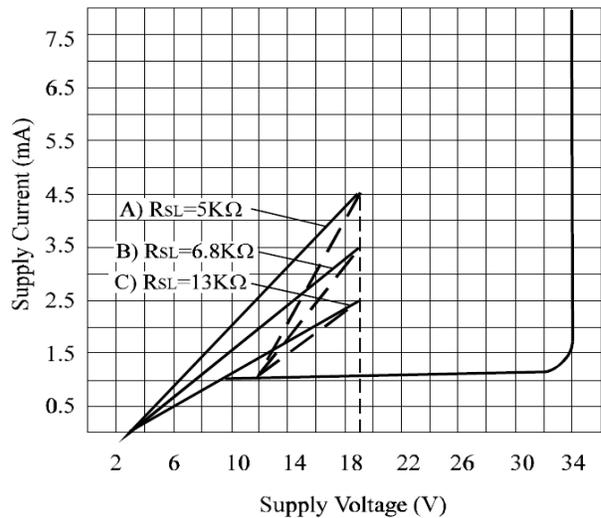
## Characteristics Curve

CIRCUIT CURRENT-SUPPLY VOLTAGE (NO LOAD)
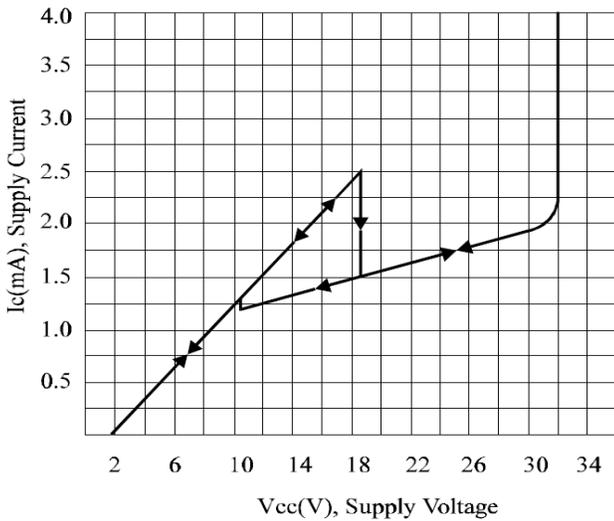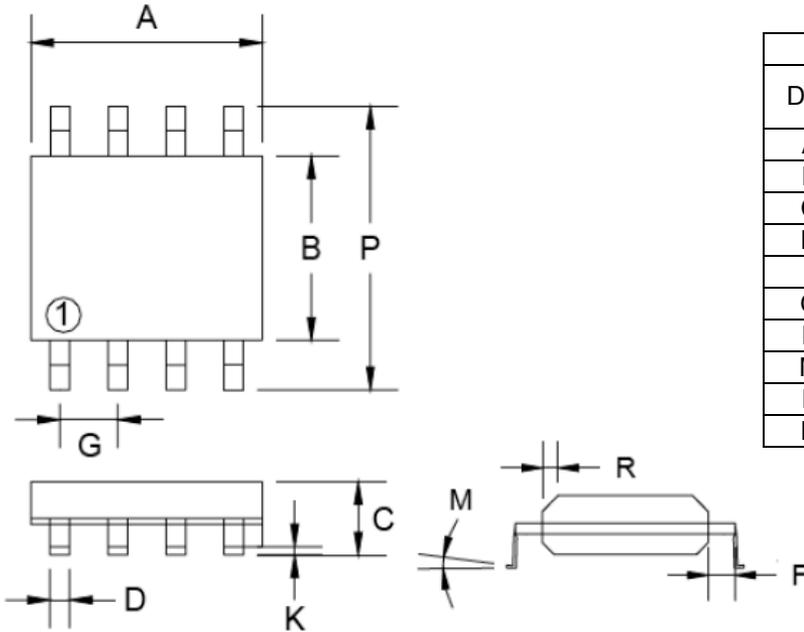

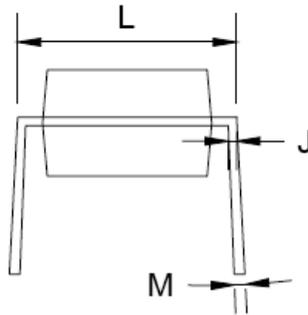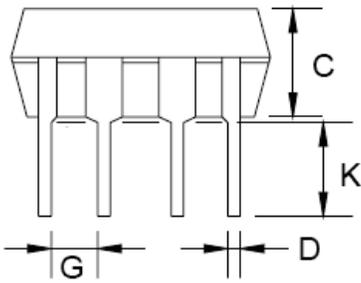
**Figure 4.**

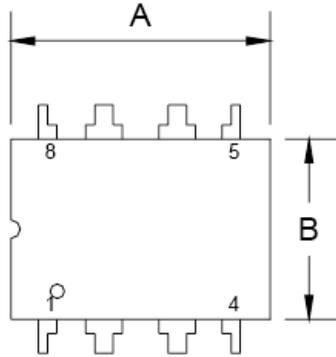SUPPLY CURRENT (NO LOAD) VC. SUPPLY VOLTAGE



**Figure 5.**

# SOP-8 Mechanical Drawing



| SOP-8 DIMENSION | | | | |
|---|---|---|---|---|
| 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 | 1.27BSC | | 0.05BSC | |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0º | 7º | 0º | 7º |
| P | 5.80 | 6.20 | 0.229 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

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# DIP-8 Mechanical Drawing

| DIP-8 DIMENSION | | | | |
|---|---|---|---|---|
| DIM | MILLIMETERS | | INCHES | |
| | MIN | MAX | MIN | MAX |
| A | 9.07 | 9.32 | 0.357 | 0.367 |
| B | 6.22 | 6.48 | 0.245 | 0.255 |
| C | 3.18 | 4.45 | 0.125 | 0.135 |
| D | 0.35 | 0.55 | 0.019 | 0.020 |
| G | 2.54 (typ) | | 0.10 (typ) | |
| J | 0.29 | 0.31 | 0.011 | 0.012 |
| K | 3.25 | 3.35 | 0.128 | 0.132 |
| L | 7.75 | 8.00 | 0.305 | 0.315 |
| M | - | 10° | - | 10° |

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