# *0.8Ω Low-Voltage SPDT Analog Switch*

## UM4157 *SOT363*

### General Description

The UM4157 is a low on resistance, low-power, Single Pole Double Throw (SPDT) analog switch. This product has been designed for switching audio signals in applications such as cell phones and portable media players. The ultra-low 0.8Ω impedance, sub μA current consumption, and 1.65V to 4.3V operating voltage range make this product ideal for battery-powered applications. The UM4157 also features bidirectional operation and break-before-make functionality. This device is fully specified for operation at 1.8V, 2.5V, and 3.3V.

### Applications

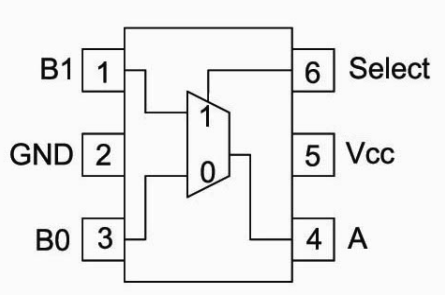
- Cellular Phone
- PDA
- Portable Media Player

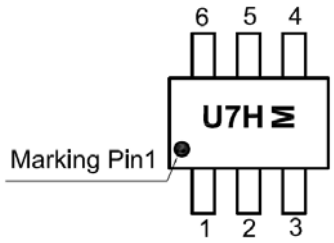
### Features

- Typical 0.8Ω On Resistance ($R_{ON}$) for 2.7V Supply
- 0.23Ω Typical $R_{ON}$ Flatness for 2.7V Supply
- Broad $V_{CC}$ Operating Range: 1.65V to 4.3V
- Low THD (0.02% Typical for 32Ω Load)
- Control Logic is 1.8V CMOS Logic Compatible

### Pin Configurations

### Top View




**M: Month Code**
**UM4157**
**SOT363**

### Ordering Information

| Part Number | Packaging Type | Marking Code | Shipping Qty |
|---|---|---|---|
| UM4157 | SOT363 | U7H | 3000pcs/7 Inch Tape & Reel |

### Function Table

| Select Input | Function |
|---|---|
| L | B0 Connected to A |
| H | B1 Connected to A |

## Absolute Maximum Ratings

| Symbol | Parameter | Limit | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage | -0.5 to +5.5 | V |
| $V_S$ | DC Switch Voltage (Note 1) | -0.5 to ($V_{CC}$+0.3) | |
| $V_{IN}$ | DC IN Voltage (Note 1) | -0.5 to +$V_{CC}$ | |
| $I_{IK}$ | DC Input Diode Current | -50 | mA |
| $I_{SW}$ | DC Switch Current | 100 | |
| $I_{SWPEAK}$ | Peak Switch Current<br>(Pulsed at 1ms Duration, <10% Duty Cycle) | 150 | |
| $T_J$ | Junction Temperature Under Bias | +150 | °C |
| $T_{STG}$ | Storage Temperature Range | -65 to +150 | |
| $T_L$ | Junction Lead Temperature (Soldering, 10 Seconds) | +260 | |
| ESD | Human Body Model | 2000 | V |
| $P_D$ | SOT363 Package | 180 | mW |

Note 1: The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

## Recommended Ratings

| Symbol | Parameter | Limit | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply Voltage Operating | 1.65 to 4.3 | V |
| $V_{IN}$ | Control Input Voltage (Note 2) | 0 to $V_{CC}$ | |
| $V_{IN}$ | Switch Input Voltage | 0 to $V_{CC}$ | |
| $T_A$ | Operating Temperature | -45 to +85 | °C |

Note 2: Unused inputs must be held HIGH or LOW, it must not float.

## Electrical Characteristics

| Symbol | Parameter | Test Conditions | $V_{CC}$ (V) | Temp | Limits (-40°C to 85°C) | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | |
| **DC Electrical Characteristics** | | | | | | | | |
| $I_{IN}$ | Control Leakage Current | $0 \le V_{IN} \le Vcc$ | 1.65 to 4.3 | Full | -0.5 | | +0.5 | μA |
| $I_{OFF(NO/NC)}$ | OFF State Leakage Current | A=0.3V, $V_{CC}$-0.3V, $B_0$ or $B_1$=0.3V, $V_{CC}$-0.3V or Floating | 1.95 to 4.3 | Room<br>Full | -10<br>-50 | | +10<br>+50 | nA |
| $I_{ON(A)}$ | On State Leakage Current | A=0.3V, $V_{CC}$-0.3V, $B_0$ or $B_1$=0.3V, $V_{CC}$-0.3V or Floating | 1.95 to 4.3 | Room<br>Full | -20<br>-100 | | +20<br>+100 | nA |
| $V_{IH}$ | Input High Voltage | | 3.6 to 4.3 | Full | 1.4 | | | V |
| | | | 2.7 to 3.6 | | 1.3 | | | |
| | | | 2.3 to 2.7 | | 1.1 | | | |
| | | | 1.65 to 1.95 | | 0.9 | | | |
| $V_{IL}$ | Input Low Voltage | | 3.6 to 4.3 | Full | | | 0.7 | V |
| | | | 2.7 to 3.6 | | | | 0.5 | |
| | | | 2.3 to 2.7 | | | | 0.4 | |
| | | | 1.65 to 1.95 | | | | 0.4 | |
| $I_{CC}$ | Quiescent Supply Current | $V_{IN}$ =$V_{CC}$ or GND<br>$I_O$=0 | 4.3 | Full | -3 | | 3 | μA |
| $R_{ON}$ | On-Resistance (Note 3) | $I_{OUT}$=100mA, $B_0$ or $B_1$=0V,0.7V,3.6V,4.3V | 4.3 | Full | | 0.6 | 1.0 | Ω |
| | | $I_{OUT}$=100mA, $B_0$ or $B_1$=0V,0.7V,2.0V,2.7V | 2.7 | Full | | 0.8 | 1.2 | |
| | | $I_{OUT}$=100mA, $B_0$ or $B_1$=0V, 0.7V, 2.0V,2.3V | 2.3 | Full | | 0.9 | 1.3 | |
| | | $I_{OUT}$=100mA, $B_0$ or $B_1$=0.7V | 1.65 | Room<br>Full | | 1.5 | 2.5<br>3.0 | |
| $\Delta R_{ON}$ | On Resistance Match Between Channels (Note 4) | $I_{OUT}$=100mA, $B_0$ or $B_1$=0.7V | 4.3 | Full | | 0.04 | 0.75 | Ω |
| | | | 2.7 | Full | | 0.06 | 0.13 | |
| | | | 2.3 | Full | | 0.12 | 0.20 | |
| | | | 1.65 | Full | | 1.0 | | |
| $R_{FLAT}$ | On Resistance Flatness (Note 5) | $I_{OUT}$=100mA, $B_0$ or $B_1$=0V to $V_{CC}$ | 4.3 | Full | | 0.18 | 0.5 | Ω |
| | | | 2.7 | Full | | 0.23 | 0.5 | |
| | | | 2.3 | Full | | 0.28 | 0.6 | |
| | | | 1.65 | Room | | 0.3 | | |

Note 3: Measured by the voltage drop between A and B pins at the indicated current through the switch. On Resistance is determined by the lower of the voltages on the two (A or B Ports).

Note 4: $\Delta R_{ON} = | R_{ON(B0)} - R_{ON(B1)} |$ measured at identical $V_{CC}$, temperature and voltage levels.

Note 5: Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of input voltage.

## Electrical Characteristics (Continued)

| Symbol | Parameter | Test Conditions | $V_{CC}$ (V) | Temp | Limits (-40°C to 85°C) | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | |
| **AC Electrical Characteristics** | | | | | | | | |
| $t_{ON}$ | Turn-On Time | $B_0$ or $B_1$=1.5V, $R_L$=50Ω, $C_L$=35pF | 3.6 to 4.3 | Room<br>Full | | | 55<br>60 | ns |
| | | | 2.7 to 3.6 | Room<br>Full | | | 60<br>65 | |
| | | | 2.3 to 2.7 | Room<br>Full | | | 65<br>70 | |
| | | | 1.65 to 1.95 | Full | | 70 | 90 | |
| $t_{OFF}$ | Turn-Off Time | $B_0$ or $B_1$=1.5V, $R_L$=50Ω, $C_L$=35pF | 3.6 to 4.3 | Room<br>Full | | | 30<br>35 | ns |
| | | | 2.7 to 3.6 | Room<br>Full | | | 35<br>40 | |
| | | | 2.3 to 2.7 | Room<br>Full | | | 40<br>45 | |
| | | | 1.65 to 1.95 | Full | | 40 | 55 | |
| $t_{BBM}$ | Break Before Make Time | $B_0$ or $B_1$=1.5V, $R_L$=50Ω, $C_L$=35pF | 1.65 to 4.3 | Full | 5 | | | ns |
| $Q_{INJ}$ | Charge Injection | $C_L$=1.0nF, $V_{GEN}$=0V $R_{GEN}$=0Ω | 3.6 to 4.3 | Room | | 6 | | pC |
| | | | 2.7 to 3.6 | Room | | 6 | | |
| | | | 2.3 to 2.7 | Room | | 6 | | |
| | | | 1.65 to 1.95 | Room | | | | |
| $O_{IRR}$ | Off Isolation | f=100kHz, $R_L$=50Ω, $C_L$=5pF (Stray) | 1.65 to 4.3 | Room | | -75 | | dB |
| Xtalk | Crosstalk | f=100kHz, $R_L$=50Ω, $C_L$=5pF (Stray) | 3.6 to 4.3 | Room | | -75 | | dB |
| | | | 2.7 to 3.6 | Room | | -75 | | |
| | | | 2.3 to 2.7 | Room | | -75 | | |
| | | | 1.65 to 1.95 | Room | | -70 | | |
| BW | -3dB Bandwidth | $R_L$=50Ω | 1.65 to 4.3 | Room | | 70 | | MHz |
| THD | Total Harmonic Distortion | | 3.6 to 4.3 | | | | | % |
| | | $R_L$=32Ω, $V_{IN}$=2$V_{P-P}$ f=20Hz to 20kHz | 2.7 to 3.6 | Room | | 0.02 | | |
| | | $R_L$=32Ω,$V_{IN}$=1.5$V_{P-P}$ f=20Hz to 20kHz | 2.3 to 2.7 | Room | | 0.036 | | |
| | | $R_L$=32Ω, $V_{IN}$=1.2$V_{P-P}$ f=20Hz to 20kHz | 1.65 to 1.95 | Room | | 0.01 | | |
| **Capacitance** | | | | | | | | |
| $C_{IN}$ | Control Pin Input Capacitance | f=1MHz | 0.0 | Room | | 1.5 | | pF |
| $C_{IO-B}$ | B Port Off Capacitance | f=1MHz | 4.5 | Room | | 21.0 | | pF |
| $C_{IOA-ON}$ | A Port Capacitance when Switch is Enabled | f=1MHz | 4.5 | Room | | 90.0 | | pF |

## Typical Operating Characteristics

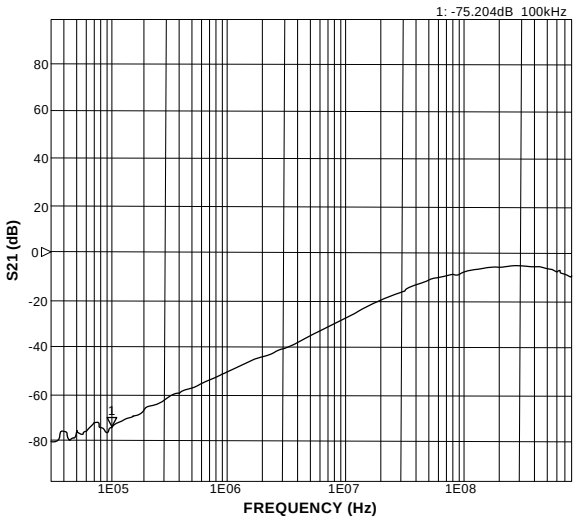



**Figure 1. Off-Isolation at $V_{CC}$=3.3V**

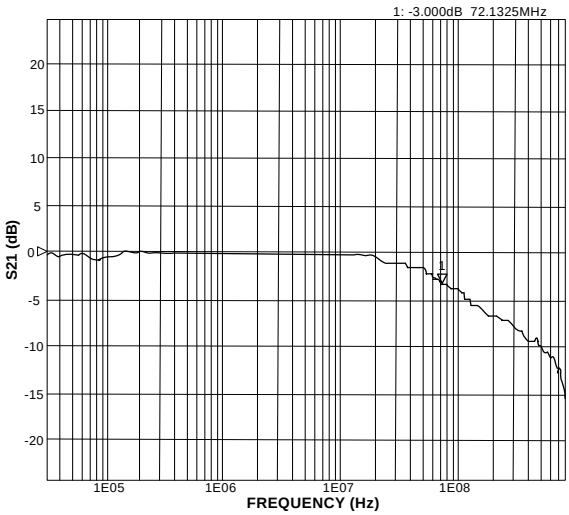



**Figure 2. Bandwidth at $V_{CC}$=-3.3V**

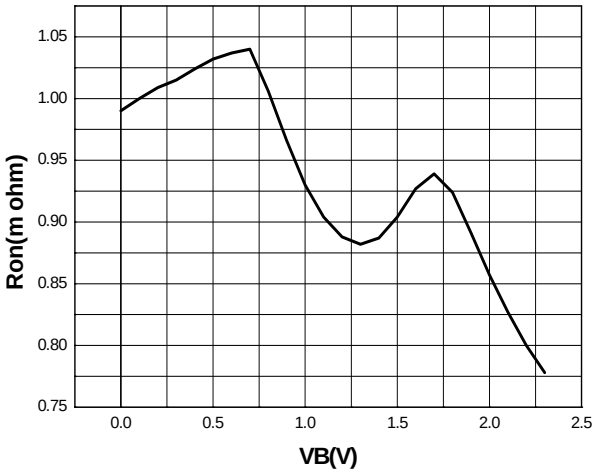



**Figure 3. Switch On Resistance, Ion=100mA, $V_{CC}$=2.3V, B1**

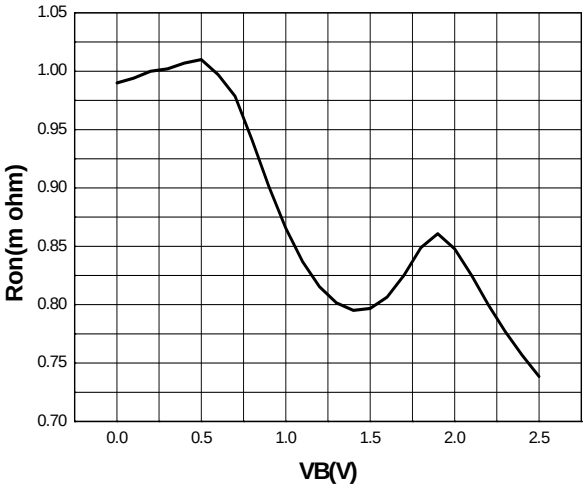



**Figure 4. Switch On Resistance, Ion=100mA, $V_{CC}$=2.5V, B1**

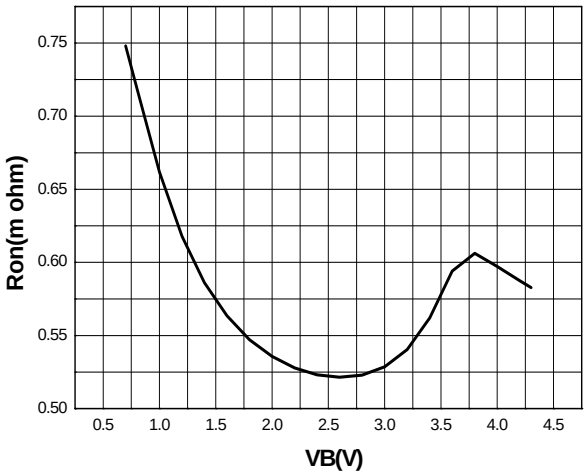
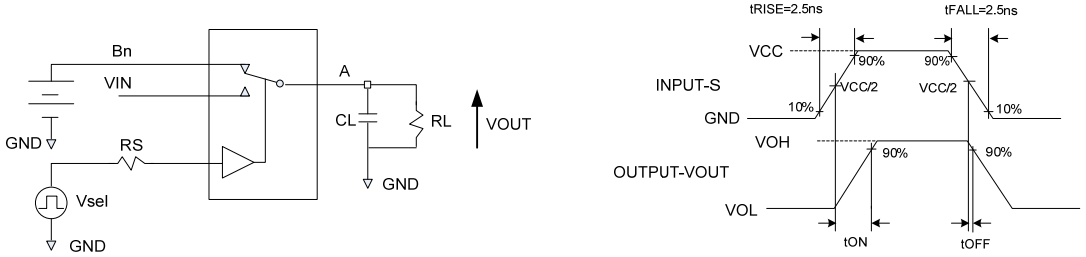



**Figure 5. Switch On Resistance, Ion=100mA, Vcc=4.3V, B1**

## Test Circuits/Timing Diagrams




Note 6: RL, RS and CL are functions of the application environment. (see AC Electrical table for specific values)

Note 7: CL includes test fixture and stray capacitance.

**Figure 6. Turn-Off Timing**

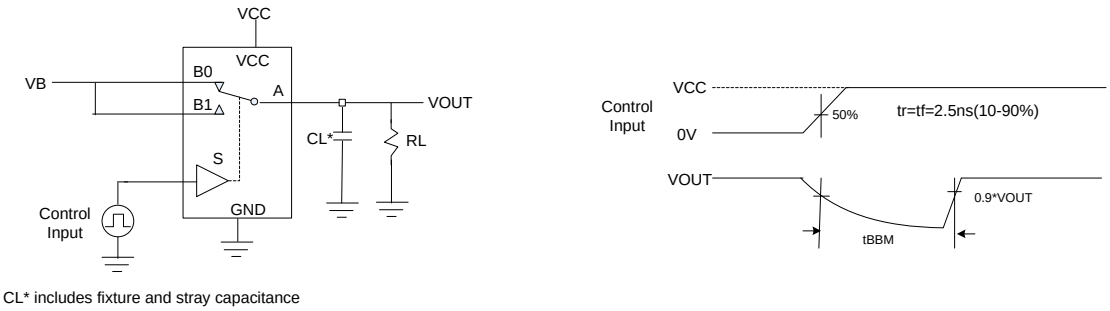



**Figure 7. Break-Before-Make Timing**

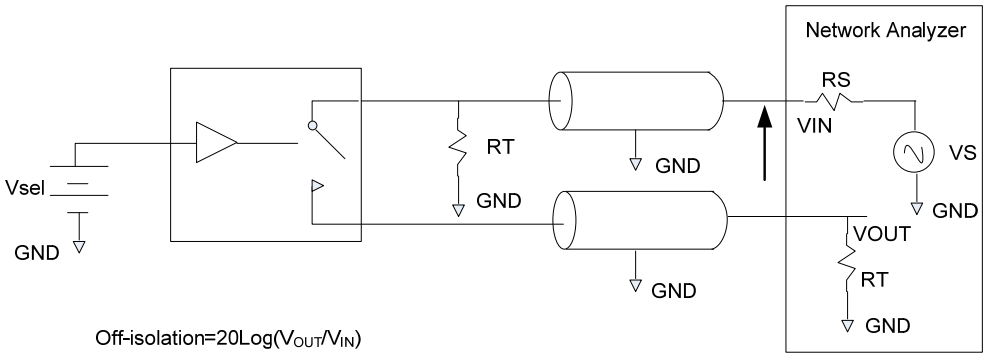



**Figure 8. Off-Isolation**

## Test Circuits/Timing Diagrams (Continued)

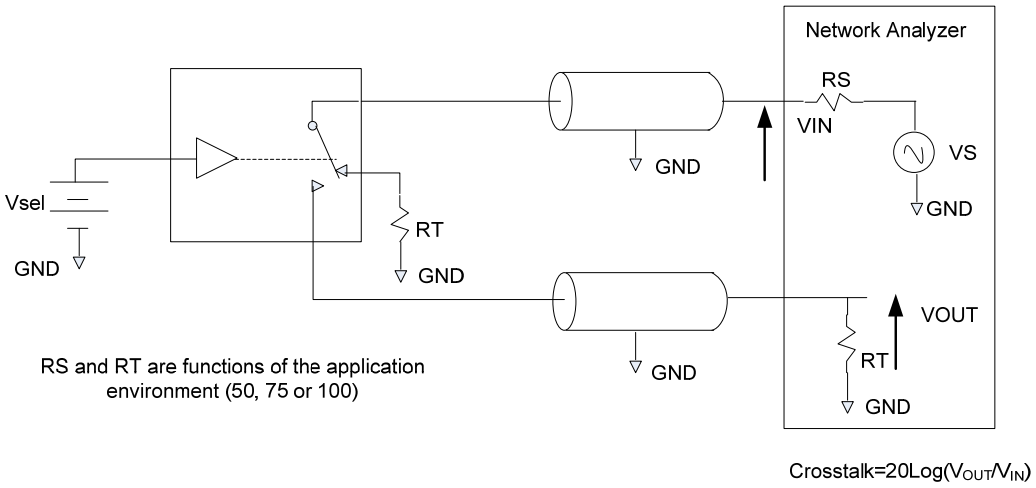



**Figure 9. Non-Adjacent Channel-to-Channel Crosstalk**

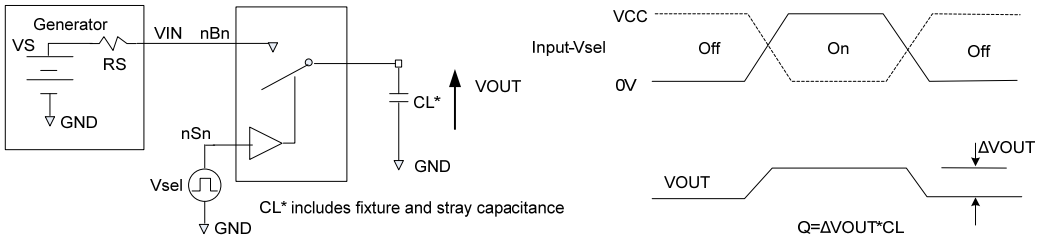



**Figure 10. Charge Injection Test**

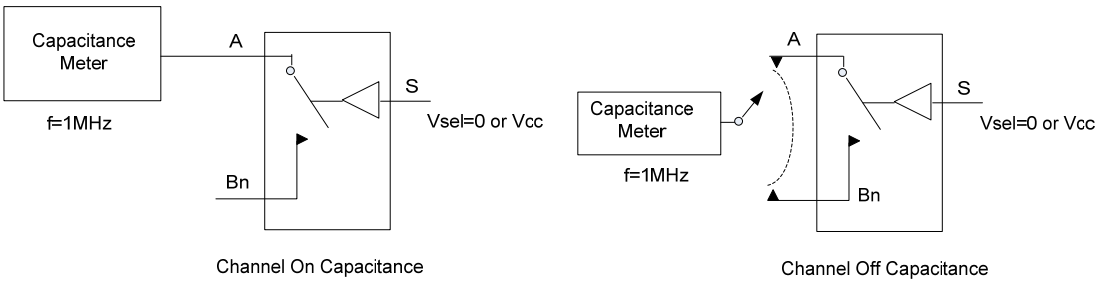



**Figure 11. On/Off Capacitance Measurement Setup**

## Test Circuits/Timing Diagrams (Continued)

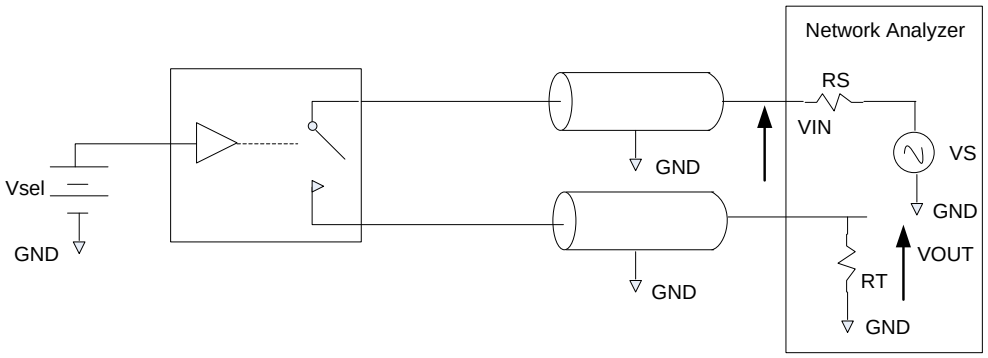



**Figure 12. Bandwidth**

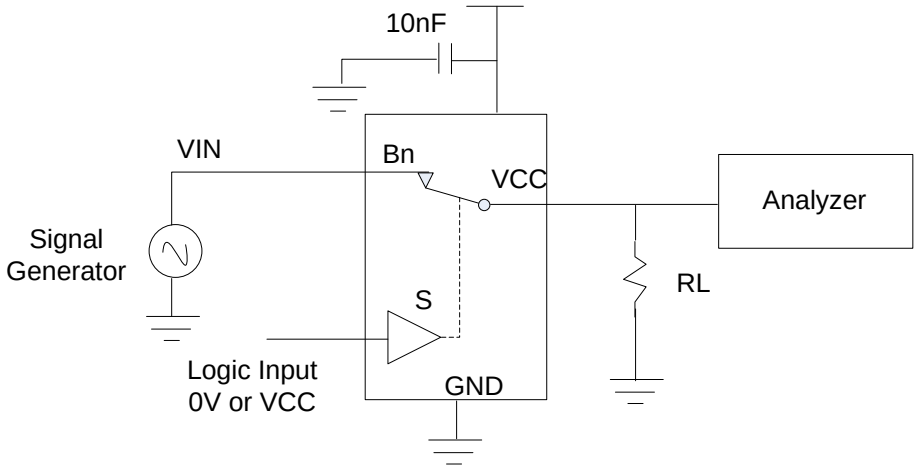
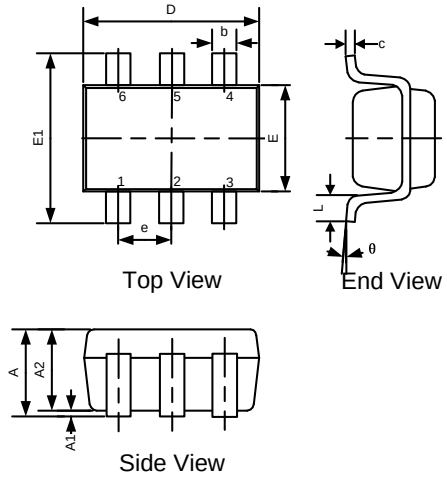



**Figure 13. Harmonic Distortion**

## Package Information

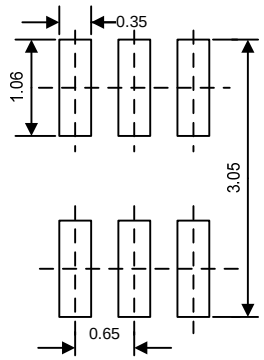
### UM4157 SOT363

**Outline Drawing**



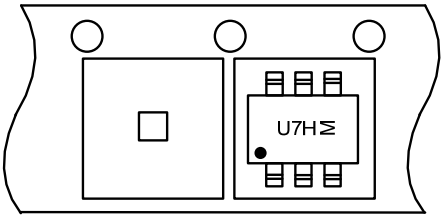

| DIMENSIONS | | | | | | |
|---|---|---|---|---|---|---|
| Symbol | MILLIMETERS | | | INCHES | | |
| | Min | Typ | Max | Min | Typ | Max |
| A | 0.90 | - | 1.10 | 0.035 | - | 0.043 |
| A1 | 0.00 | 0.05 | 0.10 | 0.000 | 0.002 | 0.004 |
| A2 | 0.90 | - | 1.00 | 0.035 | - | 0.039 |
| b | 0.10 | 0.25 | 0.35 | 0.004 | 0.010 | 0.014 |
| c | 0.08 | 0.11 | 0.22 | 0.003 | 0.004 | 0.009 |
| D | 1.80 | 2.15 | 2.20 | 0.071 | 0.085 | 0.087 |
| E | 1.15 | 1.30 | 1.35 | 0.045 | 0.051 | 0.053 |
| E1 | 2.00 | - | 2.45 | 0.079 | - | 0.096 |
| e | 0.65BSC | | | 0.026BSC | | |
| L | 0.25 | - | 0.46 | 0.010 | - | 0.018 |
| θ | 0° | - | 8° | 0° | - | 8° |

**Land Pattern**




NOTES:
1. Compound dimension: 2.15×1.30;
2. Unit: mm;
3. General tolerance ±0.05mm unless otherwise specified;
4. The layout is just for reference.

**Tape and Reel Orientation**



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