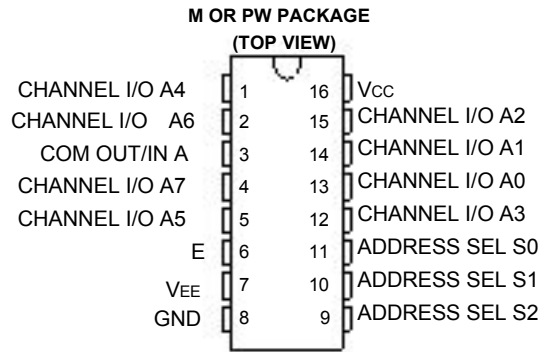


- ※ **Qualified for Automotive Applications**
- ※ **Wide Analog Input Voltage Range of  $\pm 5$  V Max**
- ※ **Low ON Resistance**
  - **70  $\Omega$  Typical ( $V_{CC} - V_{EE} = 4.5$  V)**
  - **40  $\Omega$  Typical ( $V_{CC} - V_{EE} = 9$  V)**
- ※ **Low Crosstalk Between Switches**
- ※ **Fast Switching and Propagation Speeds**
- ※ **Break-Before-Make Switching**
- ※ **Operation Control Voltage = 2 V to 6 V**
- ※ **Switch Voltage = 0 V to 10 V**
- ※ **High Noise Immunity  $N_{IL} = 30\%$ ,  $N_{IH} = 30\%$  of  $V_{CC}$ ,  $V_{CC} = 5$  V**



## description

SOP-16

This device is a digitally controlled analog switch that utilizes silicon-gate CMOS technology to achieve operating speeds similar to LSTTL, with the low power consumption of standard CMOS integrated circuits.

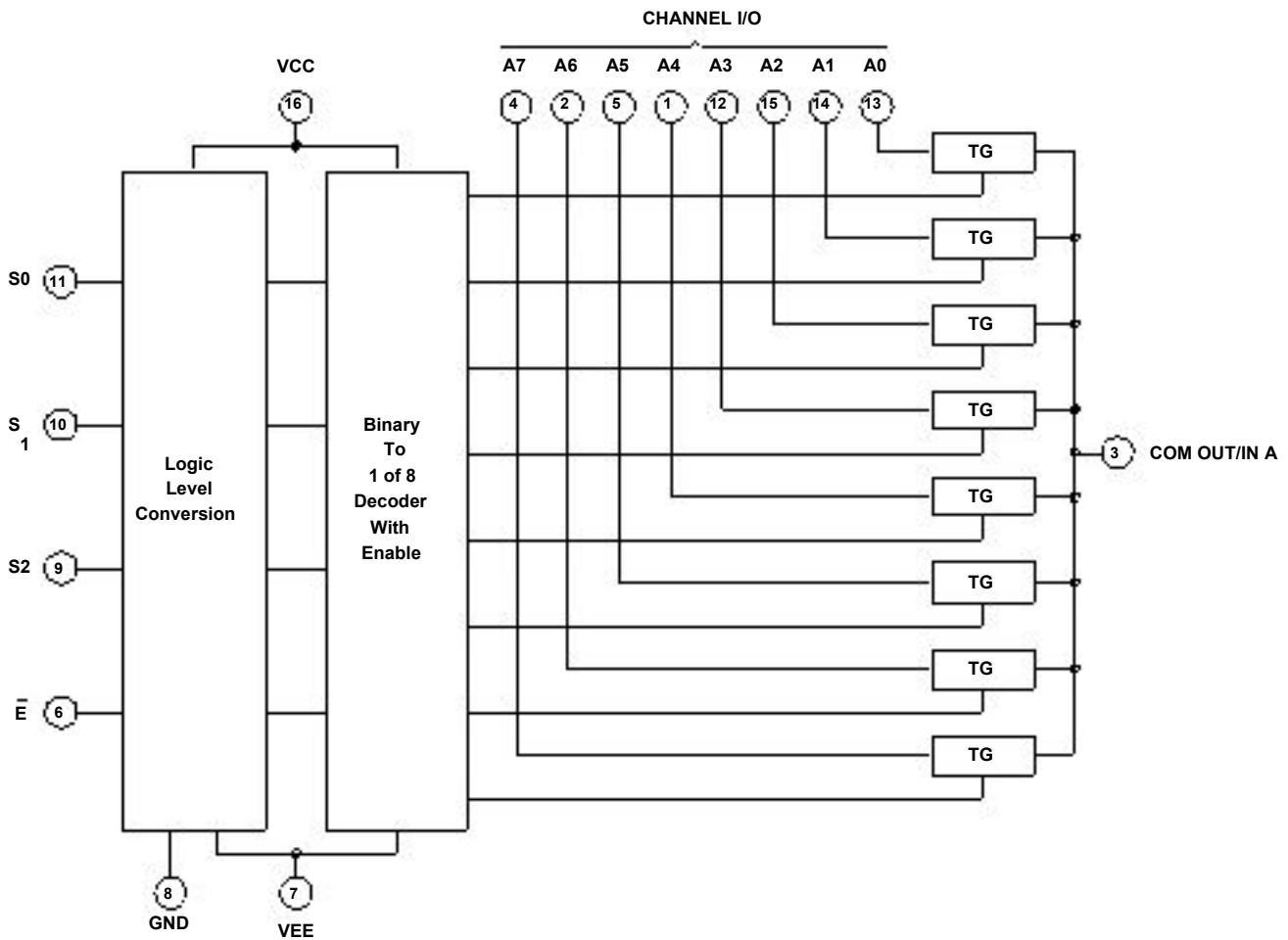
This analog multiplexer/demultiplexer controls analog voltages that may vary across the voltage supply range (i.e.,  $V_{CC}$  to  $V_{EE}$ ). These bidirectional switches allow any analog input to be used as an output and vice versa. The switches have low ON resistance and low OFF leakages. In addition, the device has an enable control (E) that, when high, disables all switches to their OFF state.

FUNCTION TABLE

| INPUTS    |                |                |                | ON CHANNEL(S) |
|-----------|----------------|----------------|----------------|---------------|
| $\bar{E}$ | S <sub>2</sub> | S <sub>1</sub> | S <sub>0</sub> |               |
| L         | L              | L              | L              | A0            |
| L         | L              | L              | H              | A1            |
| L         | L              | H              | L              | A2            |
| L         | L              | H              | H              | A3            |
| L         | H              | L              | L              | A4            |
| L         | H              | L              | H              | A5            |
| L         | H              | H              | L              | A6            |
| L         | H              | H              | H              | A7            |
| H         | X              | X              | X              | None          |

X = Don't care

logic diagram (positive logic)



### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>‡</sup>

|  |            |                  |
|--|------------|------------------|
| Supply voltage range, $V_{CC} - V_{EE}$ (see Note 1)                               | .....      | -0.5 V to 10.5 V |
| Supply voltage range, $V_{CC}$   | .....      | -0.5 V to 7 V    |
| Supply voltage range, $V_{EE}$   | .....      | +0.5 V to -7 V   |
| Input clamp current, $I_{IK}$ ( $V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V)          | .....      | $\pm 20$ mA      |
| Output clamp current, $I_{OK}$ ( $V_O < V_{EE} - 0.5$ V or $V_O > V_{CC} + 0.5$ V) | .....      | $\pm 20$ mA      |
| Switch current ( $V_I > V_{EE} - 0.5$ V or $V_I < V_{CC} + 0.5$ V)                 | .....      | $\pm 25$ mA      |
| Continuous current through $V_{CC}$ or GND   | .....      | $\pm 50$ mA      |
| $V_{EE}$ current, $I_{EE}$   | .....      | -20 mA           |
| Package thermal impedance, $\theta_{JA}$ (see Note 2):                             | M package  | 73°C/W           |
|  | PW package | 108°C/W          |
| Maximum junction temperature, $T_J$  | .....      | 50°C             |
| Lead temperature (during soldering):   |            |                  |
| At distance $1/16 \pm 1/32$ inch ( $1.59 \pm 0.79$ mm) from case for 10 s max      | .....      | 300°C            |
| Storage temperature range, $T_{stg}$   | .....      | -65°C to 150°C   |

<sup>‡</sup> 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. All voltages referenced to GND unless otherwise specified.
  2. The package thermal impedance is calculated in accordance with JESD 51-7.

### recommended operating conditions (see Note 3)

|          |  | MIN              | MAX      | UNIT |    |
|----------|--|------------------|----------|------|----|
| $V_{CC}$ | Supply voltage (see Note 4)                      | 2                | 6        | V    |    |
|          | Supply voltage, $V_{CC} - V_{EE}$ (see Figure 1) | 2                | 10       | V    |    |
| $V_{EE}$ | Supply voltage, (see Note 4 and Figure 2)        | 0                | -6       | V    |    |
| $V_{IH}$ | High-level input voltage<br>High level           | $V_{CC} = 2$ V   | 1.5      | V    |    |
|          |  | $V_{CC} = 4.5$ V | 3.15     |      |    |
|          |  | $V_{CC} = 6$ V   | 4.2      |      |    |
| $V_{IL}$ | Low-level input voltage<br>Low level             | $V_{CC} = 2$ V   | 0.5      | V    |    |
|          |  | $V_{CC} = 4.5$ V | 1.35     |      |    |
|          |  | $V_{CC} = 6$ V   | 1.8      |      |    |
| $V_I$    | Input control voltage                            | 0                | $V_{CC}$ | V    |    |
| $V_{ic}$ | Analog switch I/O voltage                        | $V_{EE}$         | $V_{CC}$ | V    |    |
| $t_t$    | Input transition (rise and fall) time            | $V_{CC} = 2$ V   | 0        | 1000 | ns |
|          |  | $V_{CC} = 4.5$ V | 0        | 500  |    |
|          |  | $V_{CC} = 6$ V   | 0        | 400  |    |
| $T_A$    | Operating free-air temperature                   | -40              | 125      | °C   |    |

- NOTES:
3. All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
  4. In certain applications, the external load resistor current may include both  $V_{CC}$  and signal-line components. To avoid drawing  $V_{CC}$  current when switch current flows into the transmission gate inputs, the voltage drop across the bidirectional switch must not exceed 0.6 V (calculated from  $r_{on}$  values shown in electrical characteristics table). No  $V_{CC}$  current flows through  $R_L$  if the switch current flows into the COM OUT/IN A terminal.

recommended operating area as a function of supply voltages

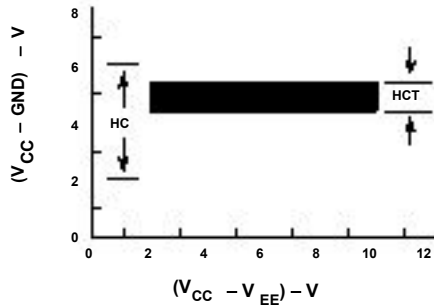


Figure 1

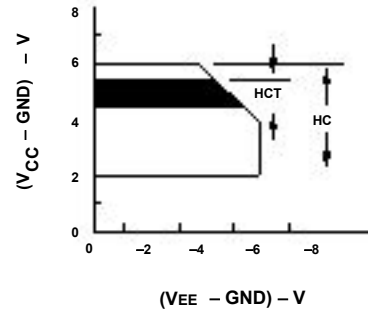


Figure 2

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER         | TEST CONDITIONS   | VEE   | Vcc    | T <sub>A</sub> = 25°C |     |     | T <sub>A</sub> = -40°C TO 125°C |     | UNIT |    |
|-------------------|---|---|--------|-----------------------|-----|-----|---------------------------------|-----|------|----|
|                   |   |   |        | MIN                   | TYP | MAX | MIN                             | MAX |      |    |
| R <sub>On</sub>   | I <sub>O</sub> = 1 mA,<br>V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br>See Figure 8   | V <sub>IS</sub> = V <sub>CC</sub> or V <sub>EE</sub>                          | 0 V    | 4.5 V                 | 70  | 160 | 240                             |     | Ω    |    |
|                   |   |   | 0 V    | 6 V                   | 60  | 140 | 210                             |     |      |    |
|                   |   |   | -4.5 V | 4.5 V                 | 40  | 120 | 180                             |     |      |    |
|                   |   | V <sub>IS</sub> = V <sub>CC</sub> to V <sub>EE</sub>                          | 0 V    | 4.5 V                 | 90  | 180 | 270                             |     |      |    |
|                   |   |   | 0 V    | 6 V                   | 80  | 160 | 240                             |     |      |    |
|                   |   |   | -4.5 V | 4.5 V                 | 45  | 130 | 195                             |     |      |    |
| Δ R <sub>On</sub> | Between any two channels  | 0 V   | 4.5 V  | 10                    |     |     |                                 |     | Ω    |    |
|                   |   | 0 V   | 6 V    | 8.5                   |     |     |                                 |     |      |    |
|                   |   | -4.5 V  | 4.5 V  | 5                     |     |     |                                 |     |      |    |
| I <sub>Iz</sub>   | For switch OFF:<br>When V <sub>IS</sub> = V <sub>CC</sub> , V <sub>OS</sub> = V <sub>EE</sub> ;<br>When V <sub>IS</sub> = V <sub>EE</sub> , V <sub>OS</sub> = V <sub>CC</sub> .<br>For switch ON:<br>All applicable combinations of V <sub>IS</sub> and V <sub>OS</sub><br>voltage levels,<br>V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> | 0 V   | 6 V    | ±0.2                  |     |     | ±2                              |     | αA   |    |
|                   |   | -5 V  | 5 V    | ±0.4                  |     |     | ±4                              |     |      |    |
| I <sub>IL</sub>   | V <sub>I</sub> = V <sub>CC</sub> or GND   | 0 V   | 6 V    | ±0.1                  |     |     | ±1                              |     | αA   |    |
| I <sub>CC</sub>   | I <sub>O</sub> = 0,<br>V <sub>I</sub> = 0, or GND<br>= V <sub>CC</sub> .  | When V <sub>IS</sub> = V <sub>EE</sub> ,<br>V <sub>OS</sub> = V <sub>CC</sub> | 0 V    | 6 V                   | 8   |     |                                 | 160 |      | αA |
|                   |   | When V <sub>IS</sub> = V <sub>CC</sub> ,<br>V <sub>OS</sub> = V <sub>EE</sub> | -5 V   | 5 V                   | 16  |     |                                 | 320 |      |    |

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 7)

| PARAMETER       | FROM (INPUT)                  | TO (OUTPUT) | LOAD CAPACITANCE       | V <sub>EE</sub> | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |     | T <sub>A</sub> = -40°C TO 125°C | UNIT |
|-----------------|-------------------------------|-------------|------------------------|-----------------|-----------------|-----------------------|-----|-----|---------------------------------|------|
|                 |                               |             |                        |                 |                 | MIN                   | TYP | MAX | MIN                             |      |
| t <sub>pd</sub> | IN                            | OUT         | C <sub>L</sub> = 15 pF |                 | 5 V             | 4                     |     |     | MAX                             | ns   |
|                 |                               |             | C <sub>L</sub> = 50 pF | 0 V             | 2 V             | 60                    |     |     | 90                              | ns   |
|                 |                               |             |                        |                 | 4.5 V           | 12                    |     |     | 18                              |      |
|                 |                               |             |                        |                 | 6 V             | 10                    |     |     | 15                              |      |
|                 |                               |             |                        |                 | -4.5 V          | 4.5 V                 |     |     | 8                               |      |
| ten             | ADDRESS SEL or E <sup>+</sup> | OUT         | C <sub>L</sub> = 15 pF |                 | 5 V             | 19                    |     |     |                                 | ns   |
|                 |                               |             | C <sub>L</sub> = 50 pF | 0 V             | 2 V             | 225                   |     |     | 340                             |      |
|                 |                               |             |                        |                 | 4.5 V           | 45                    |     |     | 68                              |      |
|                 |                               |             |                        |                 | 6 V             | 38                    |     |     | 57                              |      |
|                 |                               |             |                        |                 | -4.5 V          | 4.5 V                 |     |     | 32                              |      |
| tdis            | ADDRESS SEL or E <sup>+</sup> | OUT         | C <sub>L</sub> = 15 pF |                 | 5 V             | 19                    |     |     |                                 | ns   |
|                 |                               |             | C <sub>L</sub> = 50 pF | 0 V             | 2 V             | 225                   |     |     | 340                             |      |
|                 |                               |             |                        |                 | 4.5 V           | 45                    |     |     | 68                              |      |
|                 |                               |             |                        |                 | 6 V             | 38                    |     |     | 57                              |      |
|                 |                               |             |                        |                 | -4.5 V          | 4.5 V                 |     |     | 32                              |      |
| C <sub>I</sub>  | Control                       |             | C <sub>L</sub> = 50 pF |                 |                 |                       | 10  | 10  | pF                              |      |

operating characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, Input t<sub>r</sub>, t<sub>f</sub> = 6 ns

| PARAMETER  | TYP | UNIT |
|--|-----|------|
| C <sub>pd</sub> Power dissipation capacitance (see Note 5) | 50  | pF   |

NOTE 5: C<sub>pd</sub> is used to determine the dynamic power consumption, per package.

$$P_D = C_{pd} V_{CC}^2 f_i + \sum (C_L + C_S) V_{CC}^2 f_O$$

f<sub>O</sub> = output frequency

f<sub>I</sub> = input frequency

C<sub>L</sub> = output load capacitance

C<sub>S</sub> = switch capacitance

V<sub>CC</sub> = supply voltage

## analog channel characteristics, $T_A = 25^\circ\text{C}$

| PARAMETER                                     | TEST CONDITIONS                               | VEE  | Vcc     | MIN    | TYP   | MAX | UNIT |
|---|---|--|---------|--------|-------|-----|------|
| $C_I$   | Switch input capacitance                      |  |         |        | 5     |     | pF   |
| $C_{COM}$                                     | Common output capacitance                     |  |         |        | 25    |     | pF   |
| $f_{max}$                                     | Minimum switch frequency response at -3 dB    | See Figure 3 and Figure 9, and Notes 6 and 7 | -2.25 V | 2.25 V | 145   |     | MHz  |
|   |   |  | -4.5 V  | 4.5 V  | 180   |     |      |
|   | Sine wave distortion Sine-wave                | See Figure 4                                 | -2.25 V | 2.25 V | 0.035 |     | %    |
|   |   |  | -4.5 V  | 4.5 V  | 0.018 |     |      |
| E or ADDRESS SEL to switch feed-through noise | See Figure 55, and Notes 7 and 8              |  | -2.25 V | 2.25 V | (TBD) |     | mV   |
|   |   |  | -4.5 V  | 4.5 V  | (TBD) |     |      |
| Switch OFF signal feed through                | See Figure 6 and Figure 10, and Notes 7 and 8 |  | -2.25 V | 2.25 V | -73   |     | dB   |
|   |   |  | -4.5 V  | 4.5 V  | -75   |     |      |

- NOTES:
- Adjust input voltage to obtain 0 dBm at  $V_{OS}$  for  $f_{IN} = 1$  MHz.
  - $V_{IS}$  is centered at  $(V_{CC} - V_{EE})/2$ .
  - Adjust input for 0 dBm.

### PARAMETER MEASUREMENT INFORMATION

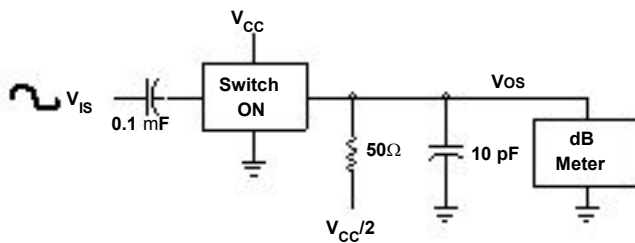


Figure 3. Frequency-Response Test Circuit

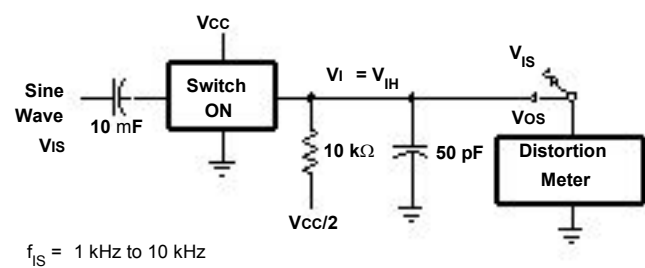
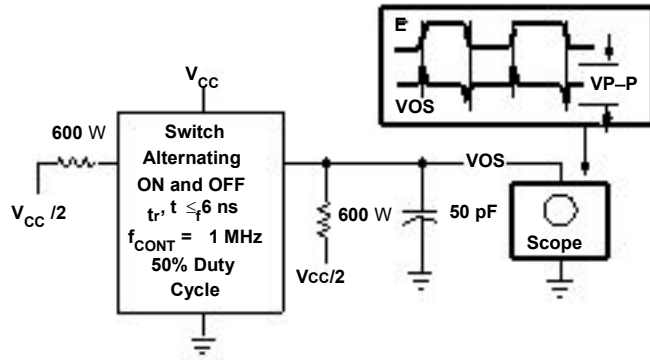
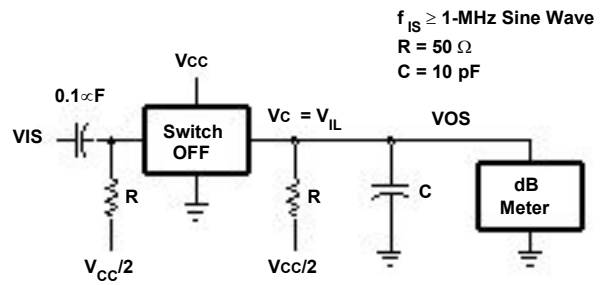


Figure 4. Sine-Wave Distortion Test Circuit

**PARAMETER MEASUREMENT INFORMATION**



**Figure 5. Control to Switch Feedthrough Noise Test Circuit**



**Figure 6. Switch OFF Signal Feedthrough Test Circuit**





Figure 7. Load Circuit and Voltage Wavefor

### TYPICAL CHARACTERISTICS

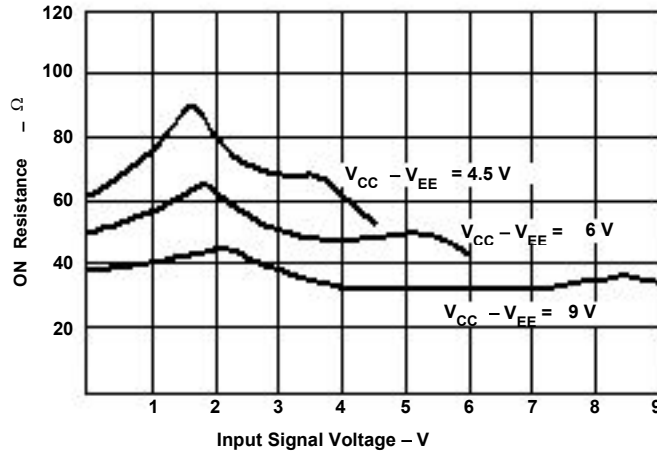


Figure 8. Typical ON Resistance vs Input Signal Voltage

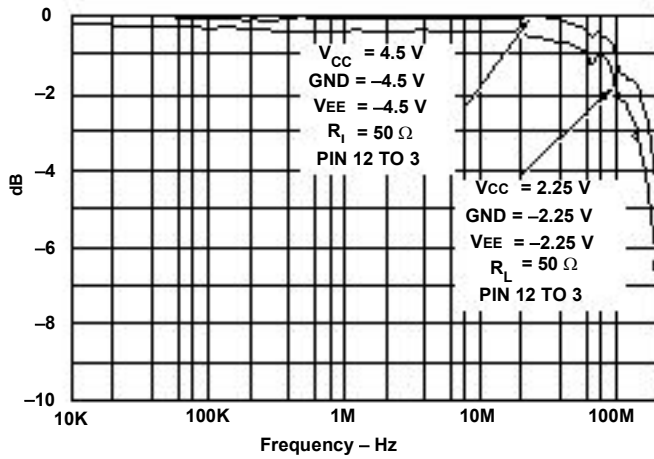


Figure 9. Channel ON Bandwidth

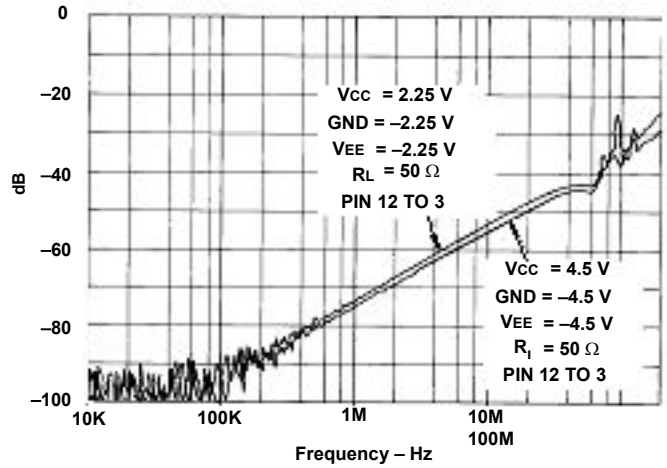
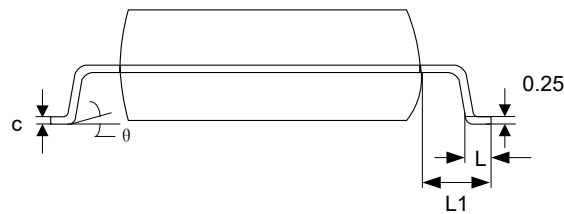
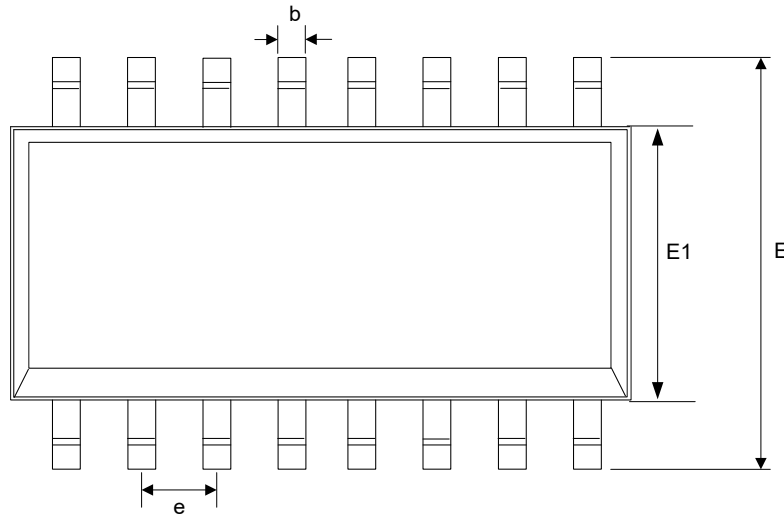
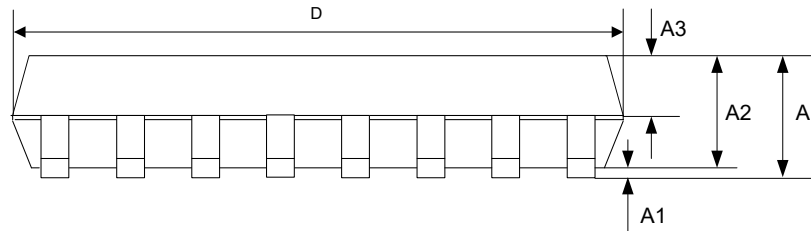


Figure 10. Channel OFF Feedthrough

## SOP-16 Package Outline Dimensions



| SYMBOL   | MILLIMETER |      |      |
|----------|------------|------|------|
|          | MIN        | NOM  | MAX  |
| A        | -          | -    | 1.75 |
| A1       | 0.10       | -    | 0.25 |
| A2       |            |      | 1.60 |
| A3       | 0.97       | 1.02 | 1.07 |
| b        | 0.35       | -    | 0.46 |
| c        | 0.19       | -    | 0.25 |
| D        | 9.80       |      | 10.0 |
| E        | 5.80       | 6.00 | 6.20 |
| E1       | 3.80       |      | 4.00 |
| e        | 1.27BSC    |      |      |
| L        | 0.70       | 0.5  | 1.00 |
| L1       | 1.40BSC    |      |      |
| $\theta$ | 0          | -    | 8°   |