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5 Ω SPDT Switch

NL5S4257B, NL5S4257C

The NL5S4257B and NL5S4257C are 5 Ω SPDT analog switches with soft-start feature. The devices are designed for a wide operating voltage range.

Features

- Wide V_{CC} Operating Range: 1.65 V to 5.5 V
- OVT up to +5.5 V for Control pin
- R_{ON} : Typically < 5 Ω at $V_{CC} = 4.5$ V
- Rail-to-Rail Input/Output
- This Device is Pb-Free, Halogen Free/BFR Free and is RoHS Compliant

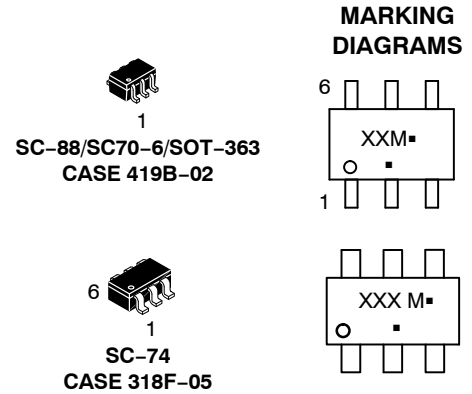
Typical Applications

- Cell Phone Speaker/Microphone Switching
- RF PA Routing



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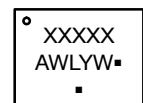


XX = Specific Device Code
M = Date Code*
▪ = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing location.

WDFN8 2x3, 0.5P
CASE 511EE



XXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information on page 6 of this data sheet.

NL5S4257B, NL5S4257C

PIN ASSIGNMENTS

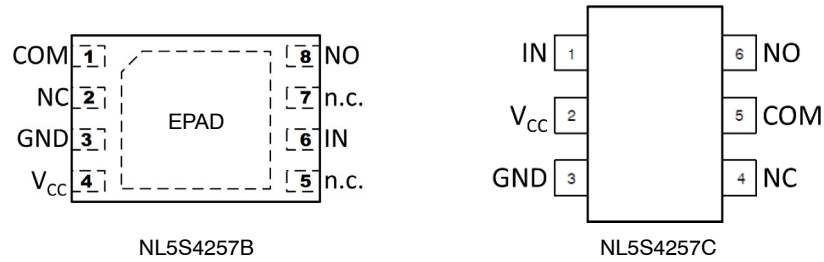


Figure 1. Pin Assignments (Top View)

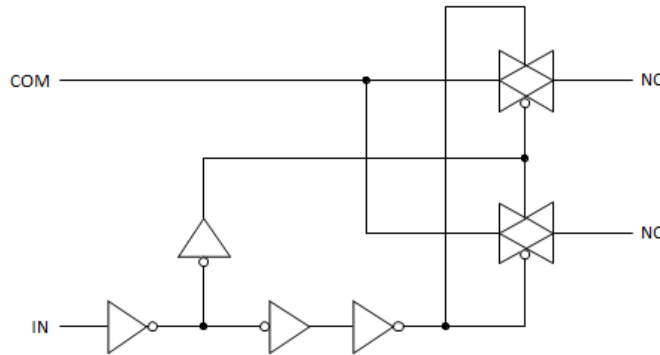


Figure 2. Analog Symbol

PIN DESCRIPTIONS

| NL5S4257B | NL5S4257C | Name | Description |
|-----------|-----------|-----------------|------------------------|
| 8 | 6 | NO | Normally-Open Port |
| 4 | 2 | V _{CC} | Supply |
| 2 | 4 | NC | Normally-Closed Port |
| 1 | 5 | COM | Common Port |
| 3, EPAD | 3 | GND | Supply Ground |
| 6 | 1 | IN | Switch Select Input |
| 5, 7 | | n.c. | No Internal Connection |

FUNCTION TABLE

| IN | Switch |
|----|-----------|
| L | NC to COM |
| H | NO to COM |

NL5S4257B, NL5S4257C

MAXIMUM RATINGS

| Symbol | Rating | Value | Unit |
|--------------|--|----------------------|-------------|
| V_{CC} | Positive DC Supply Voltage | -0.5 to +6.0 | V |
| V_{IS} | Switch Input / Output Voltage | -0.5 to $V_{CC}+0.5$ | V |
| V_{IN} | Digital Select Input Voltage | -0.5 to +6.0 | V |
| I_{OK} | I/O Port Diode Current | ± 50 | mA |
| I_{IK} | Select Input Diode Current | -50 | mA |
| $I_{I/O}$ | Continuous DC Current Through Analog Switch | ± 50 | mA |
| $I_{I/O-pk}$ | Peak Current Through Analog Switch, 10% Duty Cycle | ± 100 | mA |
| T_s | Storage Temperature | -65 to +150 | $^{\circ}C$ |
| ESD | Human Body Model (HBM) | 2 | kV |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit | |
|------------|--|---------------------|----------|-------------|------|
| V_{CC} | Positive DC Supply Voltage | 1.65 | 5.5 | V | |
| V_{IS} | Switch Input / Output Voltage | GND | V_{CC} | V | |
| V_{IN} | Digital Select Input Voltage | GND | 5.5 | V | |
| T_A | Operating Temperature Range | -40 | +125 | $^{\circ}C$ | |
| t_r, t_f | Input Transition Rise or Fall Time (Select Input IN) | $V_{CC} \leq 3.0$ V | 0 | 20 | ns/V |
| | | $V_{CC} > 3.0$ V | 0 | 10 | |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

NL5S4257B, NL5S4257C

ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Condition | V _{CC} (V) | Guaranteed Limit | | | | | | Unit | |
|---------------------|----------------------------------|--|---------------------|------------------|-----|------|---------------|-----|----------------|------|-----|
| | | | | 25°C | | | -40°C to 85°C | | -40°C to 125°C | | |
| | | | | Min | Typ | Max | Min | Max | Min | | Max |
| V _{IH} | Input High Voltage | | 2.7 | 1.1 | | | 1.1 | | 1.1 | | V |
| | | | 5.0 | 1.42 | | | 1.42 | | 1.42 | | |
| V _{IL} | Input Low Voltage | | 2.7 | | | 0.4 | | 0.4 | | 0.4 | V |
| | | | 5.0 | | | 0.7 | | 0.7 | | 0.7 | |
| I _{IN} | Input Leakage Current | V _{IN} = 0 V to 5.5 V | 1.65 – 5.5 | | | ±0.1 | | ±1 | | ±1 | μA |
| I _{OFF} | Input Leakage Current | V _{IN} = 0 to 5.5 V | 0 | | | 0.05 | | 1 | | 1 | μA |
| I _{S(ON)} | ON-State Switch Leakage Current | V _{IS} = GND to V _{CC} , V _{OS} = Open | 5.5 | | | ±4.0 | | ±40 | | ±200 | nA |
| I _{S(OFF)} | OFF-State Switch Leakage Current | V _{IS} = V _{CC} and V _{OS} = GND, or I _S = GND and V _{OS} = V _{CC} | 5.5 | | | ±4.0 | | ±20 | | ±200 | nA |
| I _{CC} | Quiescent Supply Current | V _{IN} = V _{CC} or GND, I _{OS} = 0 mA | 5.5 | | | 0.5 | | 5 | | 5 | μA |

NL5S4257B, NL5S4257C

ANALOG SWITCH CHARACTERISTICS

| Symbol | Parameter | Condition | V _{CC} (V) | Guaranteed Limit | | | | | Unit |
|--------------------------------------|---|--|---------------------|------------------|-------|------|----------------|------|------|
| | | | | 25°C | | | -40°C to 125°C | | |
| | | | | Min | Typ | Max | Min | Max | |
| R _{ON} (Note 1) | Switch ON Resistance | V _{IS} = 0 to V _{CC} , I _O = 15 mA | 2.7 | | 8.0 | 15.0 | | 16.0 | Ω |
| | | | 4.5 | | 5.0 | 6.0 | | 7.5 | |
| ΔR _{ON} (Notes 1, 2, 3) | ON Resistance Match Between Channels | V _{IS} = 1.5 V, I _A = 15 mA | 2.7 | | 0.1 | 0.5 | | 0.5 | Ω |
| | | V _{IS} = 2.5 V, I _A = 15 mA | 4.5 | | 0.08 | 0.5 | | 0.5 | |
| R _{FLAT} (Notes 1, 2, 4) | ON Resistance Flatness | V _{IS} = 0 to V _{CC} , I _O = 15 mA | 2.7 | | 3.7 | | | | Ω |
| | | | 4.5 | | 1.2 | | | | |
| Q (Note 5) | Charge Injection | C _L = 1 nF, V _{GEN} = 0 V, R _{GEN} = 0 Ω | 2.7 | | 26 | | | | pC |
| | | | 4.5 | | 48 | | | | |
| V _{ISO} (Note 6) | Off-Isolation | R _L = 50 Ω, f = 1 MHz | 2.7 – 5.5 | | -65 | | | | dB |
| V _{CT} | Crosstalk | R _L = 50 Ω, f = 1 MHz | 2.7 – 5.5 | | -70 | | | | dB |
| BW | -3 dB Bandwidth | R _L = 50 Ω | 2.7 – 5.5 | | 130 | | | | MHz |
| THD (Note 5) | Total Harmonic Distortion | R _L = 600 Ω, V _{IS} = 0.5 V _{P-P} , f = 20 Hz to 20 kHz | 2.7 – 5.5 | | 0.019 | | | | % |
| C _I | Select Input Capacitance | f = 1 MHz | 0 | | 4.5 | | | | pF |
| C _{OFF} | NC/NO Port Off Capacitance | f = 1 MHz | 4.5 | | 14 | | | | pF |
| C _{ON} | COM Port ON Capacitance | f = 1 MHz | 4.5 | | 35 | | | | pF |

1. Measured by the voltage drop between NC/NO and COM pins at the indicated current through the switch. On Resistance is determined by the lower of the voltages on the two (NO, NC, COM).
2. Parameter is characterized but not tested in production.
3. ΔR_{ON} = R_{ON} max – R_{ON} min measured at identical V_{CC}, temperature and voltage levels.
4. Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of conditions.
5. Guaranteed by Design.
6. V_{ISO} = 20 log₁₀ [V_{COM}/V_{NO,NC}].

NL5S4257B, NL5S4257C

SWITCHING CHARACTERISTICS

| Symbol | Parameter | Condition | V _{CC} (V) | Guaranteed Limit | | | | | Unit |
|------------------------------|-------------------------------------|--|---------------------|------------------|-----|-----|----------------|-----|------|
| | | | | 25°C | | | -40°C to 125°C | | |
| | | | | Min | Typ | Max | Min | Max | |
| t _{PD} (Note 7) | Propagation Delay | V _{IN} = V _{IH} or V _{IL} | 2.7 | | | 1.0 | | 1.0 | ns |
| | | | 4.5 | | | 0.5 | | 0.5 | |
| t _{ON} | Turn-on Time, (COM to NO or NC) | R _L = 50 Ω, C _L = 100 pF | | | | | | | ns |
| | | V _{IS} = 1.5 V | 2.7 | | | 300 | | 300 | |
| | | V _{IS} = 3.0 V | 4.5 | | | 300 | | 300 | |
| | | R _L = 50 Ω, C _L = 100 pF | | | | | | | |
| t _{OFF} | Turn-off Time, (COM to NO or NC) | R _L = 50 Ω, C _L = 100 pF | | | | | | | ns |
| | | V _{IS} = 1.5 V | 2.7 | | | 300 | | 300 | |
| | | V _{IS} = 3.0 V | 4.5 | | | 300 | | 300 | |
| | | R _L = 50 Ω, C _L = 100 pF | | | | | | | |
| t _{BBM} (Note 5) | Break Before Make Time | R _L = 50 Ω, C _L = 100 pF | 2.7 | 15 | | | 15 | | ns |
| | | | 4.5 | 10 | | | 10 | | |

7. This parameter is guaranteed by design but not tested. The bus switch contributes no propagation delay other than the RC delay of the On Resistance of the switch and the 50 pF load capacitance, when driven by an ideal voltage source (zero output impedance).

ORDERING INFORMATION

| Device | Package | Marking | Pin 1 Orientation (See below) | Shipping [†] |
|---|----------------------|---------|----------------------------------|-----------------------|
| NL5S4257BMT1TAG (Contact ON Semiconductor) | WDFN8 2x3, 0.5P | AA | Q1 | 3000 / Tape & Reel |
| NL5S4257CDFT2G | SC-88/SC70-6/SOT-363 | AV | Q4 | 3000 / Tape & Reel |
| NL5S4257CDBVT1G (Contact ON Semiconductor) | SC-74 | TBD | Q4 | 3000 / Tape & Reel |

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

Pin 1 Orientation in Tape and Reel

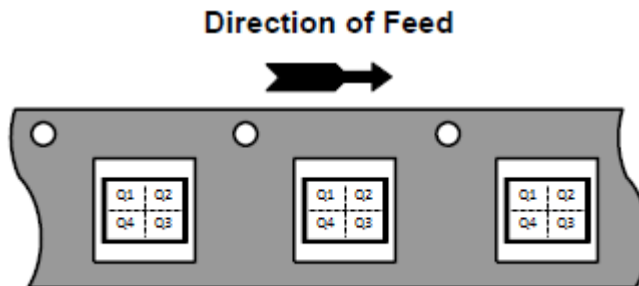


Figure 3.

Test Setups

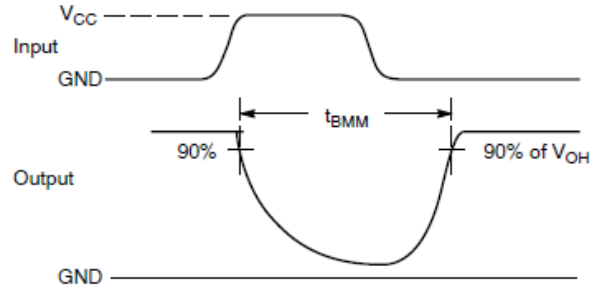
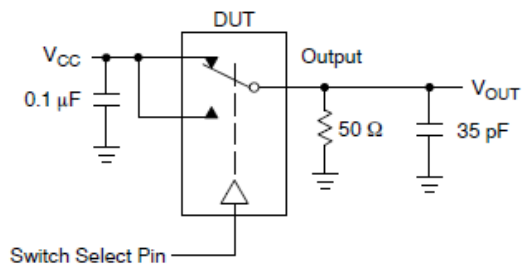


Figure 4. t_{BMM} (Time Break-Before-Make)

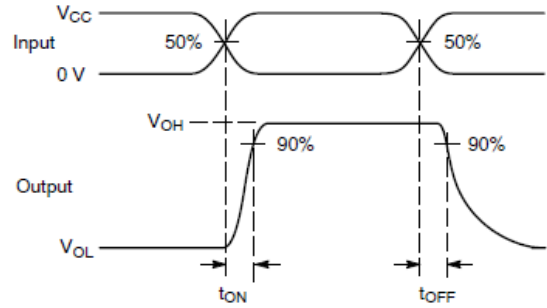
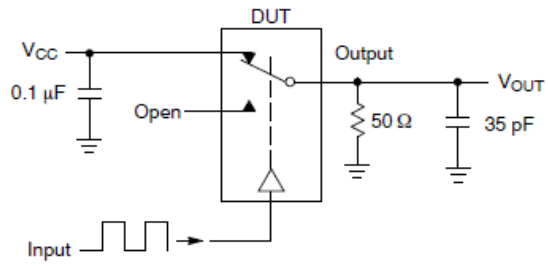


Figure 5. t_{ON}/t_{OFF}

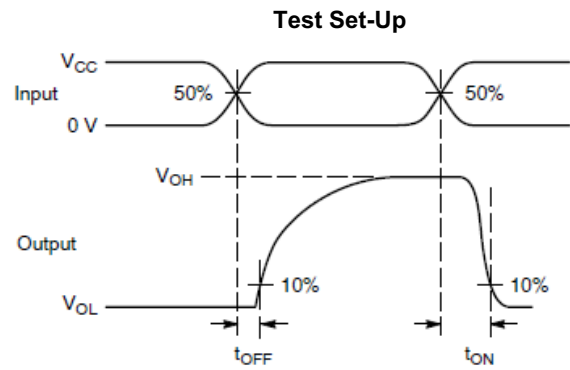
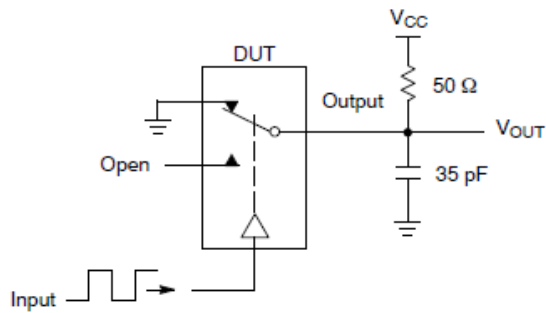
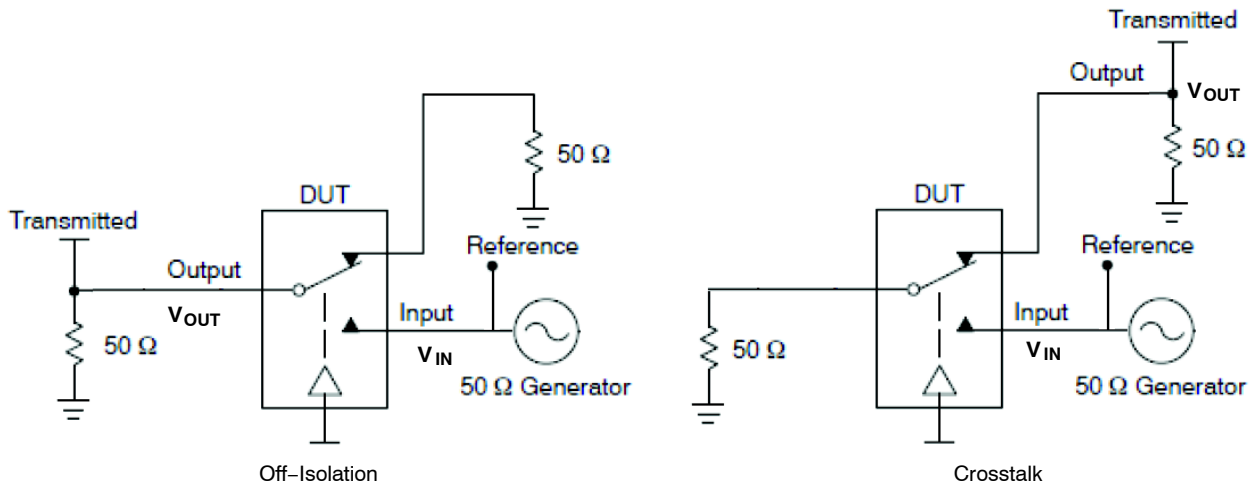


Figure 6. t_{ON}/t_{OFF}



Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. Crosstalk is measured from an off channel to an on channel. On loss is the bandwidth of an On switch. V_{ISO} , V_{CT} , Bandwidth and V_{ONL} are independent of the input signal direction.

$$V_{ISO} \text{ or } V_{CT} = \text{Off Channel Isolation or crosstalk} = 20 \text{ Log for } V_{OUT} / V_{IN}$$

$$V_{ONL} = \text{On Channel Loss} = 20 \text{ Log for } V_{OUT} / V_{IN} \text{ at } 100 \text{ kHz to } 50 \text{ MHz}$$

Bandwidth (BW) = the frequency 3 dB below V_{ONL}

Figure 7. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/ V_{ONL}

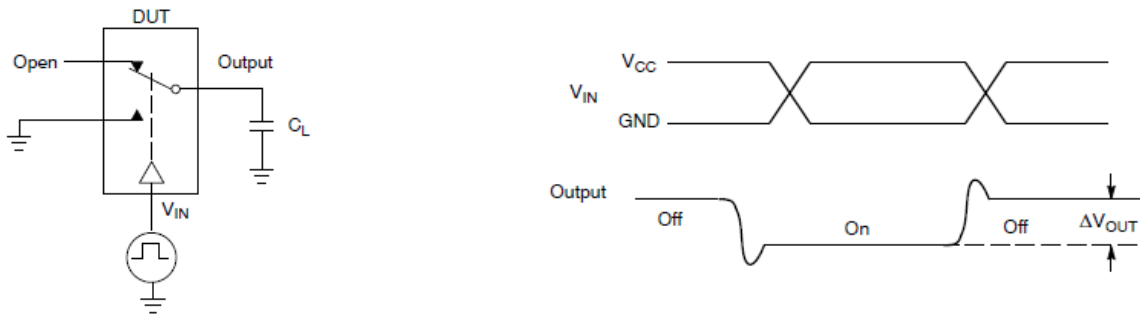


Figure 8. Charge Injection: (Q)

NL5S4257B, NL5S4257C

TYPICAL CHARACTERISTICS

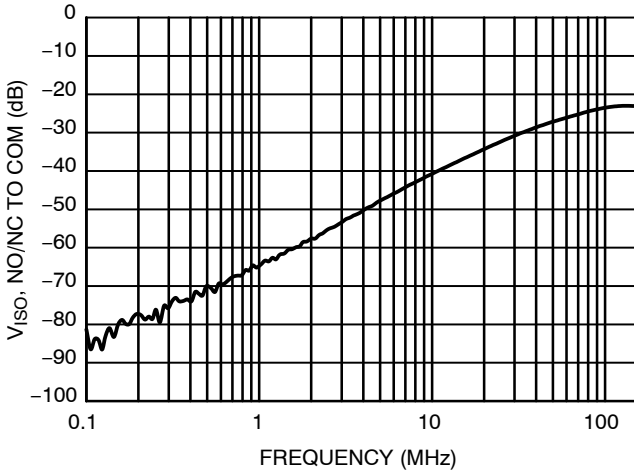


Figure 9. V_{ISO} vs. Frequency
@ $V_{CC} = 4.5$ V

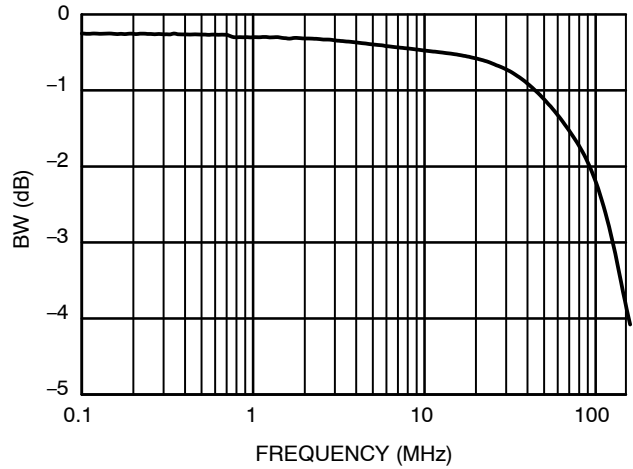


Figure 10. Bandwidth vs. Frequency

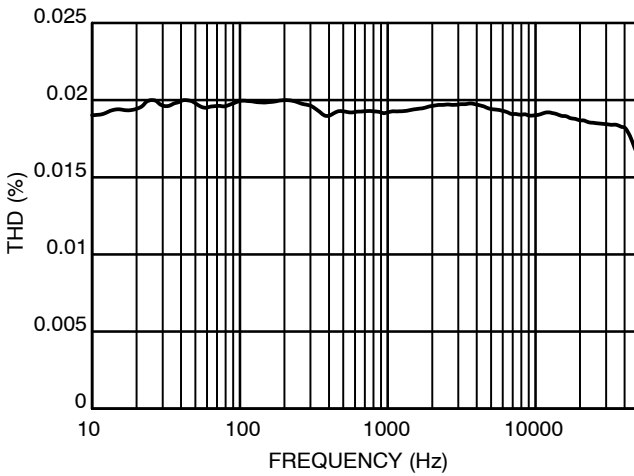


Figure 11. Total Harmonic Distortion

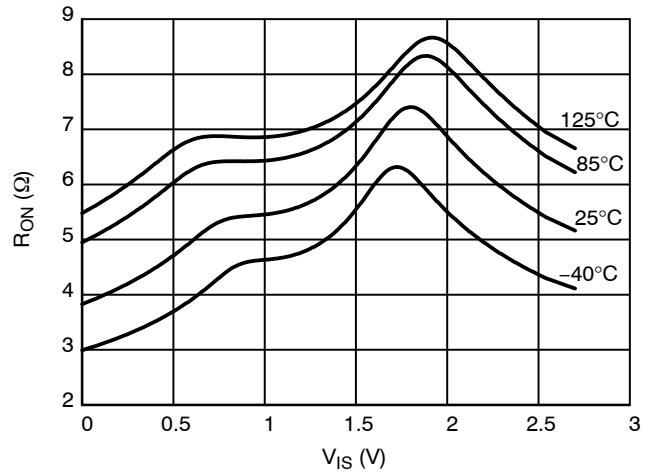


Figure 12. ON Resistance vs. Switch Voltage
@ $V_{CC} = 2.7$ V

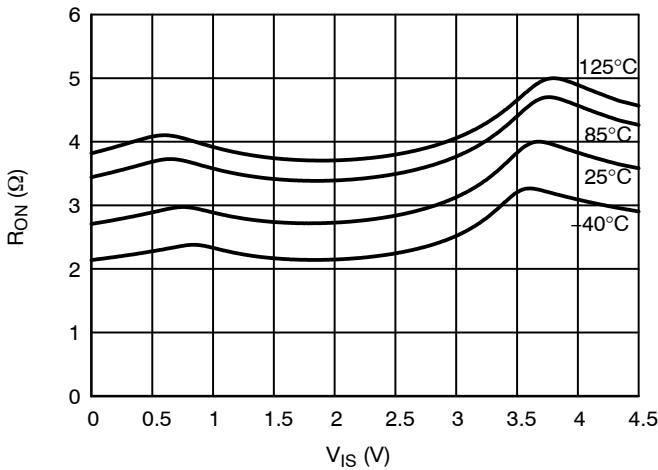


Figure 13. ON Resistance vs. Switch Voltage
@ $V_{CC} = 4.5$ V

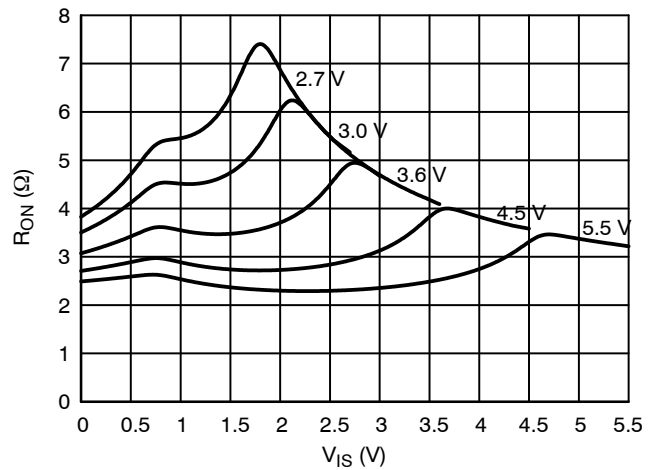
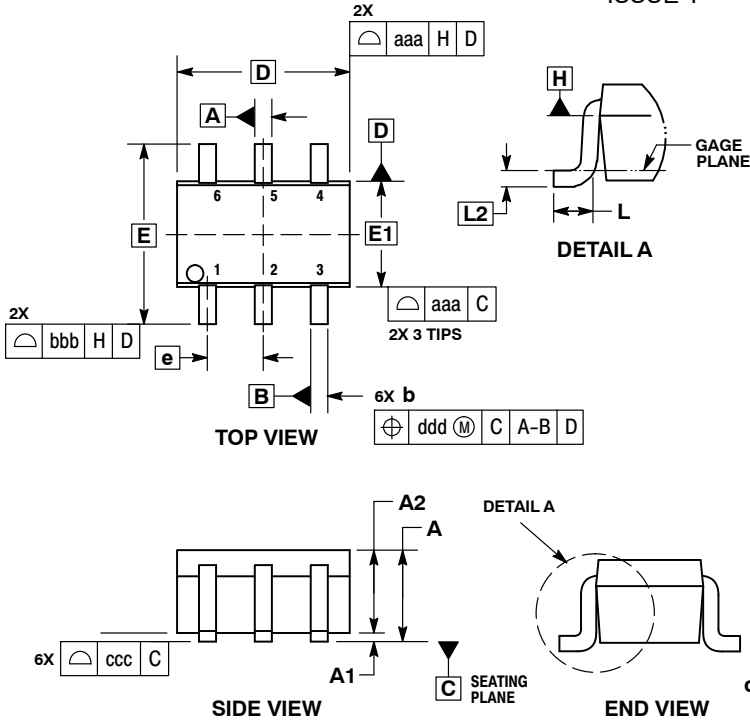


Figure 14. ON Resistance vs. Switch Voltage

NL5S4257B, NL5S4257C

PACKAGE DIMENSIONS

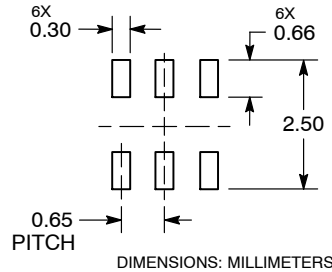
SC-88/SC70-6/SOT-363
CASE 419B-02
ISSUE Y



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 2. CONTROLLING DIMENSION: MILLIMETERS.
 3. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.20 PER END.
 4. DIMENSIONS D AND E1 AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY AND DATUM H.
 5. DATUMS A AND B ARE DETERMINED AT DATUM H.
 6. DIMENSIONS b AND c APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08 AND 0.15 FROM THE TIP.
 7. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 TOTAL IN EXCESS OF DIMENSION b AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|-----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | --- | --- | 1.10 | --- | --- | 0.043 |
| A1 | 0.00 | --- | 0.10 | 0.000 | --- | 0.004 |
| A2 | 0.70 | 0.90 | 1.00 | 0.027 | 0.035 | 0.039 |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| C | 0.08 | 0.15 | 0.22 | 0.003 | 0.006 | 0.009 |
| D | 1.80 | 2.00 | 2.20 | 0.070 | 0.078 | 0.086 |
| E | 2.00 | 2.10 | 2.20 | 0.078 | 0.082 | 0.086 |
| E1 | 1.15 | 1.25 | 1.35 | 0.045 | 0.049 | 0.053 |
| e | 0.65 BSC | | | 0.026 BSC | | |
| L | 0.26 | 0.36 | 0.46 | 0.010 | 0.014 | 0.018 |
| L2 | 0.15 BSC | | | 0.006 BSC | | |
| aaa | 0.15 | | | 0.006 | | |
| bbb | 0.30 | | | 0.012 | | |
| ccc | 0.10 | | | 0.004 | | |
| ddd | 0.10 | | | 0.004 | | |

RECOMMENDED SOLDERING FOOTPRINT*

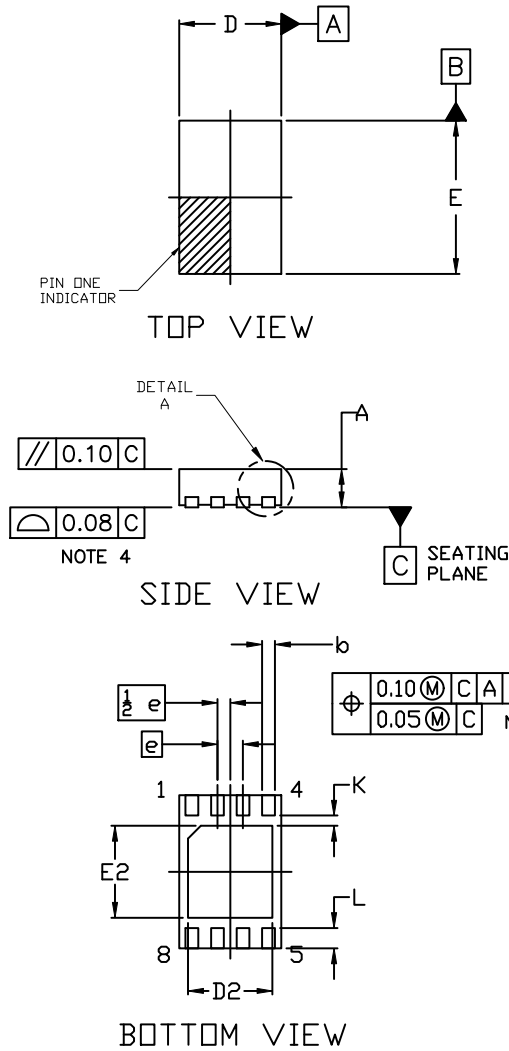


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NL5S4257B, NL5S4257C

PACKAGE DIMENSIONS

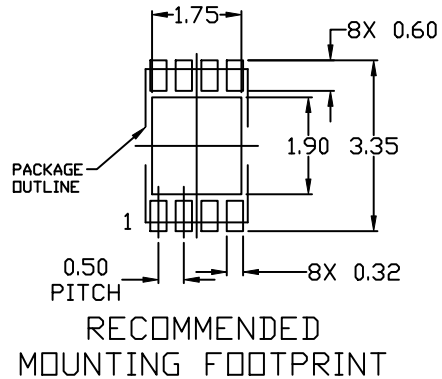
WDFN8 2x3, 0.5P
CASE 511EE
ISSUE O



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION *b* APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.25MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. POSITIONAL TOLERANCE APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| DIM | MILLIMETERS | | |
|----------|-------------|------|------|
| | MIN | NDM | MAX |
| A | 0.70 | 0.75 | 0.80 |
| A1 | 0.00 | --- | 0.05 |
| A3 | 0.20 REF | | |
| <i>b</i> | 0.20 | 0.25 | 0.30 |
| D | 1.90 | 2.00 | 2.10 |
| D2 | 1.55 | 1.65 | 1.75 |
| E | 2.90 | 3.00 | 3.10 |
| E2 | 1.70 | 1.80 | 1.90 |
| <i>e</i> | 0.50 BSC | | |
| K | 0.20 REF | | |
| L | 0.30 | 0.40 | 0.50 |

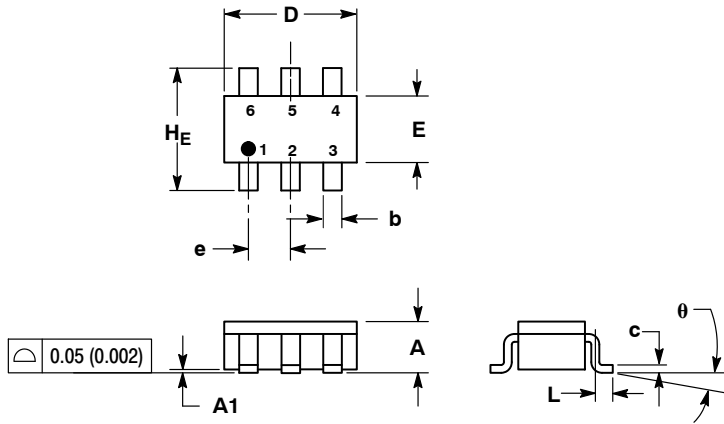


* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NL5S4257B, NL5S4257C

PACKAGE DIMENSIONS

SC-74
CASE 318F-05
ISSUE N

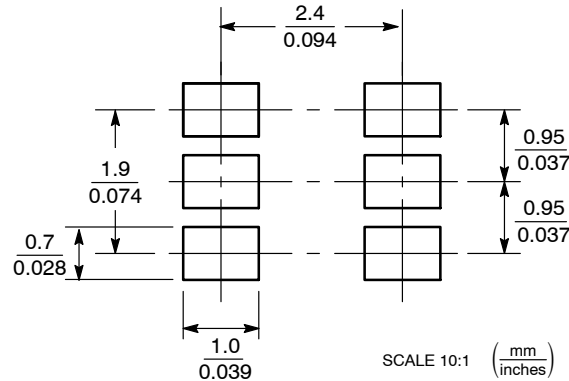


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F-01, -02, -03, -04 OBSOLETE. NEW STANDARD 318F-05.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|--------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.90 | 1.00 | 1.10 | 0.035 | 0.039 | 0.043 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.25 | 0.37 | 0.50 | 0.010 | 0.015 | 0.020 |
| c | 0.10 | 0.18 | 0.26 | 0.004 | 0.007 | 0.010 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 1.30 | 1.50 | 1.70 | 0.051 | 0.059 | 0.067 |
| e | 0.85 | 0.95 | 1.05 | 0.034 | 0.037 | 0.041 |
| L | 0.20 | 0.40 | 0.60 | 0.008 | 0.016 | 0.024 |
| HE | 2.50 | 2.75 | 3.00 | 0.099 | 0.108 | 0.118 |
| θ | 0° | - | 10° | 0° | - | 10° |

SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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