

NLAS9031

SPDT, 3 Ω R_{ON} Switch

The NLAS9031 is an advanced CMOS analog switch fabricated with silicon gate CMOS technology. It achieves very low propagation delay and RDS_(on) resistances while maintaining CMOS low power dissipation. Analog and digital voltages that may vary across the full power-supply range (from V_{CC} to GND). This device is a drop in replacement for the NC7S9031.

The select pin has overvoltage protection that allows voltages above V_{CC}, up to 7.0 V to be present on the pin without damage or disruption of operation of the part, regardless of the operating voltage.

Features

- High Speed: t_{PD} = 1.0 ns (Typ) at V_{CC} = 5.0 V
- Low Power Dissipation: I_{CC} = 2.0 μA (Max) at T_A = 25°C
- Standard CMOS Logic Levels
- High Bandwidth, Improved Linearity
- Switches Standard NTSC/PAL Video, Audio, SPDIF and HDTV
- May be used for Clock Switching, Data Multiplexing, etc.
- R_{ON} Typical = 3 Ω @ V_{CC} = 4.5 V
- Break Before Make Circuitry, Prevents Inadvertent Shorts
- 2 Devices can Switch Balanced Signal Pairs, e.g. LVDS > 200 Mb/s
- Latchup Performance Exceeds 300 mA
- Pin for Pin Drop in for NC7S9031
- Tiny SC88 and WDFN6 Packages
- ESD Performance:
 - ♦ Human Body Model; > 2000 V;
 - ♦ Machine Model; > 200 V
- Extended Automotive Temperature Range -55°C to +125°C (See Appendix)
- Pb-Free Packages are Available



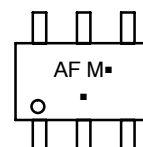
ON Semiconductor®

<http://onsemi.com>

MARKING DIAGRAMS



SC-88
DF SUFFIX
CASE 419B



WDFN6
MT SUFFIX
CASE 506AS



AF, F = Specific Device Code
M = Date Code*
▪ = Pb-Free Package

(Note: Microdot may be in either location)

*Date Code orientation may vary depending upon manufacturing location.

FUNCTION TABLE

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

ORDERING INFORMATION

| Device | Package | Shipping† |
|---------------|--------------------|------------------|
| NLAS9031DFT2G | SC-88 (Pb-Free) | 3000 Tape & Reel |
| NLAS9031MTR2G | WDFN6 (Pb-Free) | 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.

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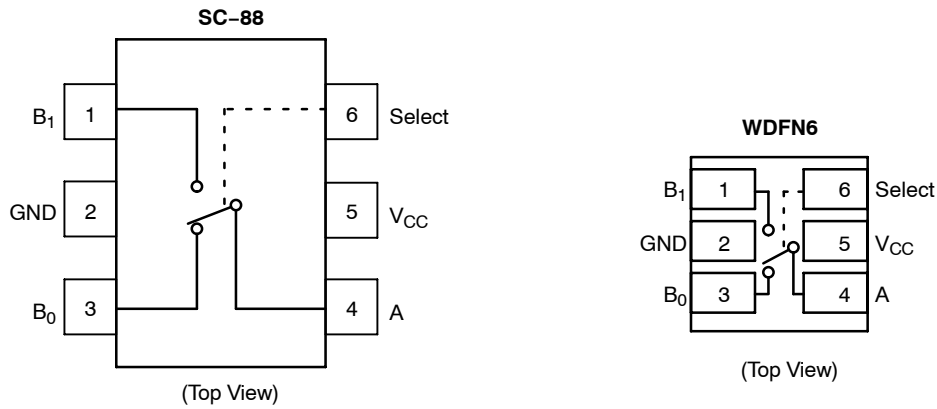


Figure 1. Pin Assignment & Logic Diagram

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|------------------|------------------------|------|
| Supply Voltage | V_{CC} | -0.5 to +7.0 | V |
| DC Switch Voltage (Note 1) | V_S | -0.5 to $V_{CC} + 0.5$ | V |
| DC Input Voltage (Note 1) | V_{IN} | -0.5 to + 7.0 | V |
| DC Input Diode Current @ $V_{IN} < 0$ V | I_{IK} | -50 | mA |
| DC Output Current | I_{OUT} | 128 | mA |
| DC V_{CC} or Ground Current | I_{CC}/I_{GND} | +100 | mA |
| Storage Temperature Range | T_{stg} | -65 to +150 | °C |
| Junction Temperature Under Bias | T_J | 150 | °C |
| Junction Lead Temperature (Soldering, 10 Seconds) | T_L | 260 | °C |
| Power Dissipation @ +85°C | P_D | 180 | mW |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

RECOMMENDED OPERATING CONDITIONS (Note 2)

| Characteristic | Symbol | Min | Max | Unit |
|--|---------------|--------|-----------|------|
| Supply Voltage Operating | V_{CC} | 1.65 | 5.5 | V |
| Select Input Voltage | V_{IN} | 0 | V_{CC} | V |
| Switch Input Voltage | V_{IN} | 0 | V_{CC} | V |
| Output Voltage | V_{OUT} | 0 | V_{CC} | V |
| Operating Temperature | T_A | -55 | +125 | °C |
| Input Rise and Fall Time Control Input $V_{CC} = 2.3$ V–3.6 V Control Input $V_{CC} = 4.5$ V–5.5 V | t_r, t_f | 0 0 | 10 5.0 | ns/V |
| Thermal Resistance | θ_{JA} | - | 350 | °C/W |

2. Select input must be held HIGH or LOW, it must not float.

DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V _{CC} (V) | T _A = +25°C | | | T _A = -40°C to +85°C | | Unit |
|--------------------|---|--|------------------------|------------------------|-------|-----------------|---|---|------|
| | | | | Min | Typ | Max | Min | Max | |
| V _{IH} | HIGH Level Input Voltage | | 1.65–1.95 2.3–5.5 | | | | 0.75 V _{CC} 0.7 V _{CC} | | V |
| V _{IL} | LOW Level Input Voltage | | 1.65–1.95 2.3–5.5 | | | | | 0.25 V _{CC} 0.3 V _{CC} | V |
| I _{IN} | Input Leakage Current | 0 ≤ V _{IN} ≤ 5.5 V | 0–5.5 | | ±0.05 | ±0.1 | | ±1 | μA |
| I _{OFF} | OFF State Leakage Current | 0 ≤ A, B ≤ V _{CC} | 1.65–5.5 | | ±0.05 | ±0.1 | | ±1 | μA |
| R _{ON} | Switch On Resistance (Note 3) | V _{IN} = 0 V, I _O = 30 mA | 4.5 | | 3.0 | | | 7.0 | Ω |
| | | V _{IN} = 2.4 V, I _O = -30 mA | | | 5.0 | | | 12 | |
| | | V _{IN} = 4.5 V, I _O = -30 mA | | | 7.0 | | | 15 | |
| | | V _{IN} = 0 V, I _O = 24 mA | 3.0 | | 4.0 | | | 9.0 | Ω |
| | | V _{IN} = 3 V, I _O = -24 mA | | | 10 | | | 20 | |
| | | V _{IN} = 0 V, I _O = 8 mA | 2.3 | | 5.0 | | | 12 | Ω |
| | | V _{IN} = 2.3 V, I _O = -8 mA | | | 13 | | | 30 | |
| | | V _{IN} = 0 V, I _O = 4 mA | 1.65 | | 6.5 | | | 20 | Ω |
| | | V _{IN} = 1.65 V, I _O = -4 mA | | | 17 | | | 50 | |
| I _{CC} | Quiescent Supply Current All Channels ON or OFF | V _{IN} = V _{CC} or GND I _{OUT} = 0 | 5.5 | | | 1.0 | | 10 | μA |
| | Analog Signal Range | | V _{CC} | 0 | | V _{CC} | 0 | V _{CC} | V |
| R _{RANGE} | On Resistance Over Signal Range (Note 3) (Note 7) | I _A = -30 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 4.5 | | | | | 25 | Ω |
| | | I _A = -24 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 3.0 | | | | | 50 | |
| | | I _A = -8 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 2.3 | | | | | 100 | |
| | | I _A = -4 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 1.65 | | | | | 300 | |
| ΔR _{ON} | On Resistance Match Between Channels (Note 3) (Note 4) (Note 5) | I _A = -30 mA, V _{Bn} = 3.15 | 4.5 | | 0.15 | | | | Ω |
| | | I _A = -24 mA, V _{Bn} = 2.1 | 3.0 | | 0.2 | | | | |
| | | I _A = -8 mA, V _{Bn} = 1.6 | 2.3 | | 0.5 | | | | |
| | | I _A = -4 mA, V _{Bn} = 1.15 | 1.65 | | 0.5 | | | | |
| R _{flat} | On Resistance Flatness (Note 3) (Note 4) (Note 6) | I _A = -30 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 5.0 | | 6.0 | | | | Ω |
| | | I _A = -24 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 3.3 | | 12 | | | | |
| | | I _A = -8 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 2.5 | | 28 | | | | |
| | | I _A = -4 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 1.8 | | 125 | | | | |

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).
4. Parameter is characterized but not tested in production.
5. ΔR_{ON} = R_{ON} max – R_{ON} min measured at identical V_{CC}, temperature and voltage levels.
6. Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of conditions.
7. Guaranteed by Design.

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AC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V _{CC} (V) | T _A = +25°C | | | T _A = -40°C to +85°C | | Unit | Figure Number |
|--------------------------------------|--|--|--|------------------------|------------|---------------------------|---------------------------------|-------------------------|------|---------------|
| | | | | Min | Typ | Max | Min | Max | | |
| t _{PHL} t _{PLH} | Propagation Delay Bus to Bus (Note 9) | V _I = OPEN | 1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5 | | | | | 1.2 0.8 0.3 | ns | Figures 2, 3 |
| t _{PZL} t _{PZH} | Output Enable Time Turn On Time (A to B _n) | V _I = 2 × V _{CC} for t _{PZL} V _I = 0 V for t _{PZH} | 1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5 | | | 23 13 6.9 5.2 | 7.0 3.5 2.5 1.7 | 24 14 7.6 5.7 | ns | Figures 2, 3 |
| t _{PLZ} t _{PHZ} | Output Disable Time Turn Off Time (A Port to B Port) | V _I = 2 × V _{CC} for t _{PLZ} V _I = 0 V for t _{PHZ} | 1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5 | | | 12.5 7.0 5.0 3.5 | 3.0 2.0 1.5 0.8 | 13 7.5 5.3 3.8 | ns | Figures 2, 3 |
| t _{B-M} | Break Before Make Time (Note 8) | | 1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5 | | | | 0.5 0.5 0.5 0.5 | | ns | Figure 4 |
| Q | Charge Injection (Note 8) | C _L = 0.1 nF, V _{GEN} = 0 V R _{GEN} = 0 Ω | 5.0 3.3 | | 7.0 3.0 | | | | pC | Figure 5 |
| OIRR | Off Isolation (Note 10) | R _L = 50 Ω f = 10 MHz | 1.65–5.5 | | -57 | | | | dB | Figure 6 |
| Xtalk | Crosstalk | R _L = 50 Ω f = 10 MHz | 1.65–5.5 | | -54 | | | | dB | Figure 7 |
| BW | -3 dB Bandwidth | R _L = 50 Ω | 1.65–5.5 | | 250 | | | | MHz | Figure 10 |
| THD | Total Harmonic Distortion (Note 8) | R _L = 600 Ω 0.5 V _{P-P} f = 600 Hz to 20 kHz | 5.0 | | 0.011 | | | | % | |

CAPACITANCE (Note 11)

| Symbol | Parameter | Test Conditions | Typ | Max | Unit | Figure Number |
|---------------------|---|-------------------------|------|-----|------|---------------|
| C _{IN} | Select Pin Input Capacitance | V _{CC} = 0 V | 2.3 | | pF | |
| C _{IO-B} | B Port Off Capacitance | V _{CC} = 5.0 V | 6.5 | | pF | Figure 8 |
| C _{IOA-ON} | A Port Capacitance when Switch is Enabled | V _{CC} = 5.0 V | 18.5 | | pF | Figure 9 |

8. Guaranteed by Design.

9. 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).

10. Off Isolation = 20 log₁₀ [V_A/V_{Bn}].

11. T_A = +25°C, f = 1 MHz, Capacitance is characterized but not tested in production.

APPENDIX A

DC ELECTRICAL EXTENDED AUTOMOTIVE TEMPERATURE RANGE CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V _{CC} (V) | T _A = +25°C | | | T _A = -55°C to +125°C | | Unit |
|--------------------|---|--|------------------------|------------------------|-------|-----------------|---|---|------|
| | | | | Min | Typ | Max | Min | Max | |
| V _{IH} | HIGH Level Input Voltage | | 1.65–1.95 2.3–5.5 | | | | 0.75 V _{CC} 0.7 V _{CC} | | V |
| V _{IL} | LOW Level Input Voltage | | 1.65–1.95 2.3–5.5 | | | | | 0.25 V _{CC} 0.3 V _{CC} | V |
| I _{IN} | Input Leakage Current | 0 ≤ V _{IN} ≤ 5.5 V | 0–5.5 | | ±0.05 | ±0.1 | | ±1 | μA |
| I _{OFF} | OFF State Leakage Current | 0 ≤ A, B ≤ V _{CC} | 1.65–5.5 | | ±0.05 | ±0.1 | | ±1 | μA |
| R _{ON} | Switch On Resistance (Note 12) | V _{IN} = 0 V, I _O = 30 mA | 4.5 | | 3.0 | | | 8.5 | Ω |
| | | V _{IN} = 2.4 V, I _O = -30 mA | | | 5.0 | | | 13.0 | |
| | | V _{IN} = 4.5 V, I _O = -30 mA | | | 7.0 | | | 15.0 | |
| | | V _{IN} = 0 V, I _O = 24 mA | 3.0 | | 4.0 | | | 11 | |
| | | V _{IN} = 3 V, I _O = -24 mA | | | 10 | | | 20 | |
| | | V _{IN} = 0 V, I _O = 8 mA | 2.3 | | 5.0 | | | 12 | |
| | | V _{IN} = 2.3 V, I _O = -8 mA | | | 13 | | | 30 | |
| | | V _{IN} = 0 V, I _O = 4 mA | 1.65 | | 6.5 | | | 20 | |
| | | V _{IN} = 1.65 V, I _O = -4 mA | | | 17 | | | 50 | |
| I _{CC} | Quiescent Supply Current All Channels ON or OFF | V _{IN} = V _{CC} or GND I _{OUT} = 0 | 5.5 | | | 1.0 | | 10 | μA |
| | Analog Signal Range | | V _{CC} | 0 | | V _{CC} | 0 | V _{CC} | V |
| R _{RANGE} | On Resistance Over Signal Range (Note 12) (Note 14) | I _A = -30 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 4.5 | | | | | 25 | Ω |
| | | I _A = -24 mA, 0 ≤ V _{Bn} ≤ V _{CC} | | | | | | 50 | |
| | | I _A = -8 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 3.0 | | | | | 100 | |
| | | I _A = -4 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 2.3 | | | | | 300 | |
| | | I _A = -4 mA, 0 ≤ V _{Bn} ≤ V _{CC} | 1.65 | | | | | 300 | |

12. 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).

13. Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of conditions.

14. Guaranteed by Design.

* For ΔR_{ON}, R_{FLAT}, Q, OIRR, Xtalk, BW, THD, and CIN see -40°C to 85°C section.

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APPENDIX A

AC ELECTRICAL EXTENDED AUTOMOTIVE TEMPERATURE RANGE CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V _{CC} (V) | T _A = +25°C | | | T _A = -55°C to +125°C | | Unit | Figure Number |
|--------------------------------------|--|--|--|------------------------|-----|---------------------------|----------------------------------|-------------------------|------|-----------------|
| | | | | Min | Typ | Max | Min | Max | | |
| t _{PHL} t _{PLH} | Propagation Delay Bus to Bus (Note 16) | V _I = OPEN | 1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5 | | | | | 1.2 0.8 0.3 | ns | Figures 2, 3 |
| t _{PZL} t _{PZH} | Output Enable Time Turn On Time (A to B _n) | V _I = 2 × V _{CC} for t _{PZL} V _I = 0 V for t _{PZH} | 1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5 | | | 23 13 6.9 5.2 | 7.0 3.5 2.5 1.7 | 24 14 9.0 7.0 | ns | Figures 2, 3 |
| t _{PLZ} t _{PHZ} | Output Disable Time Turn Off Time (A Port to B Port) | V _I = 2 × V _{CC} for t _{PLZ} V _I = 0 V for t _{PHZ} | 1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5 | | | 12.5 7.0 5.0 3.5 | 3.0 2.0 1.5 0.8 | 13 7.5 6.5 5.0 | ns | Figures 2, 3 |
| t _{B-M} | Break Before Make Time (Note 15) | | 1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5 | | | | 0.5 0.5 0.5 0.5 | | ns | Figure 4 |

15. Guaranteed by Design.

16. 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).

* For ΔR_{ON}, R_{FLAT}, Q, OIRR, Xtalk, BW, THD, and CIN see -40°C to 85°C section.

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AC LOADING AND WAVEFORMS

NOTE: Input driven by 50 Ω source terminated in 50 Ω
 NOTE: C_L includes load and stray capacitance
 NOTE: Input PRR = 1.0 MHz; t_W = 500 ns

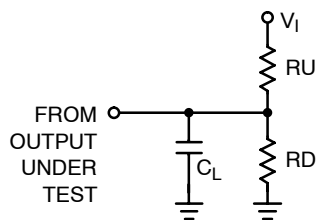


Figure 2. AC Test Circuit

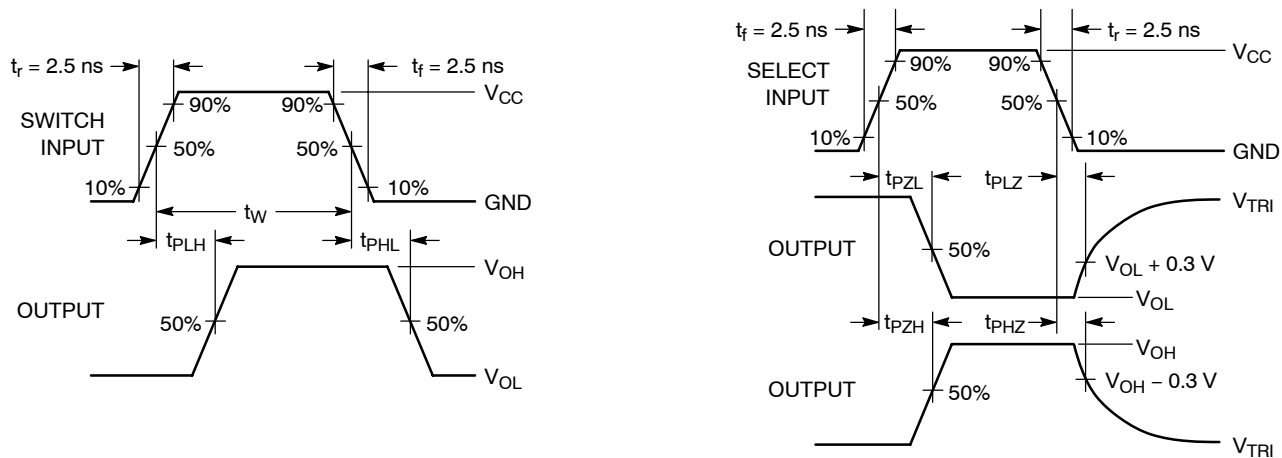


Figure 3. AC Waveforms



Figure 4. Break Before Make Interval Timing

AC LOADING AND WAVEFORMS

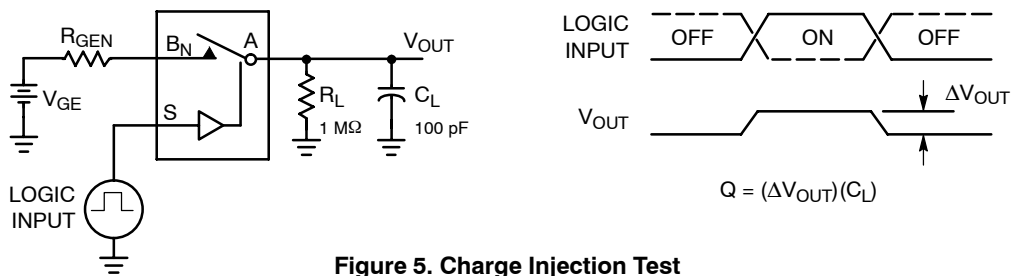


Figure 5. Charge Injection Test

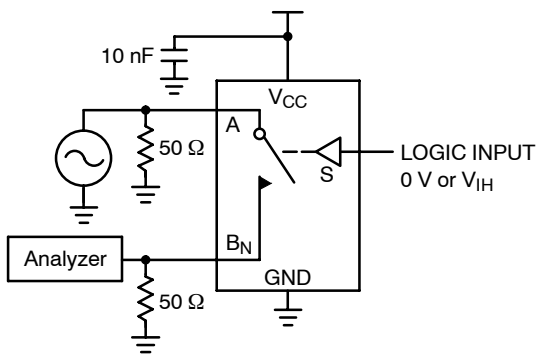


Figure 6. Off Isolation

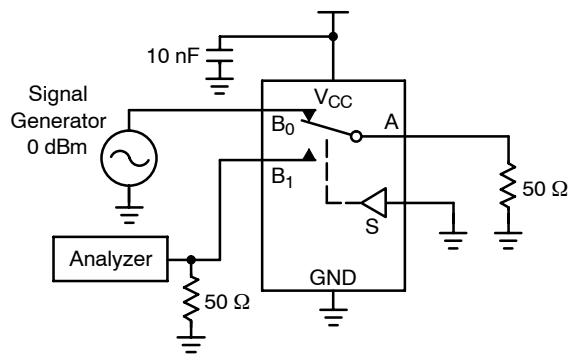


Figure 7. Crosstalk

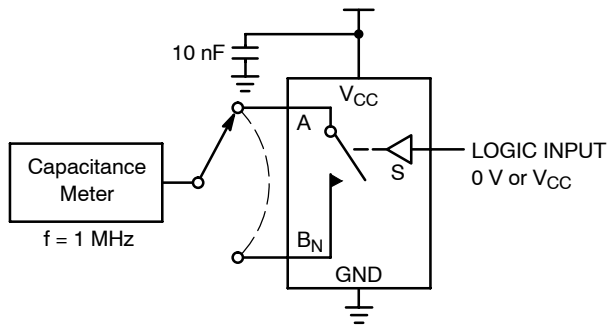


Figure 8. Channel Off Capacitance

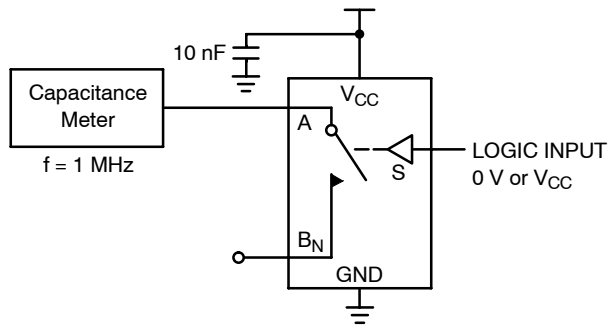


Figure 9. Channel On Capacitance

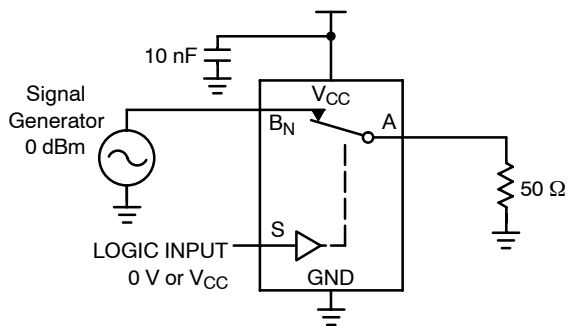
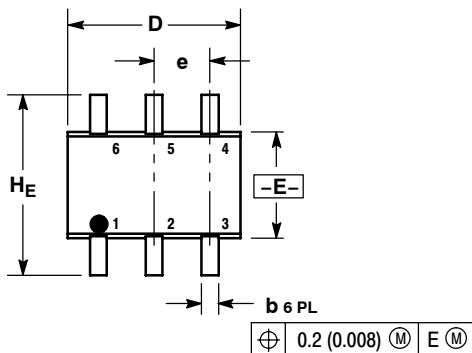


Figure 10. Bandwidth

NLAS9031

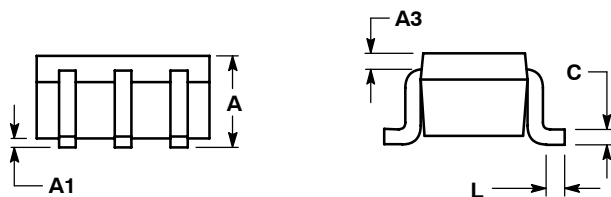
PACKAGE DIMENSIONS

SC-88/SOT-363/SC-70
 DF SUFFIX
 CASE 419B-02
 ISSUE W

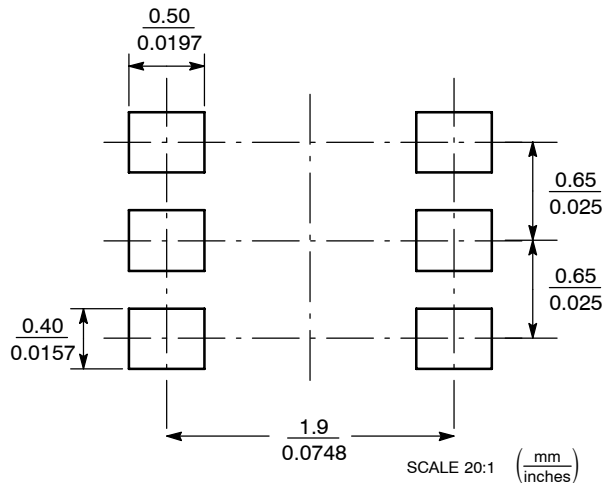


- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. 419B-01 OBSOLETE, NEW STANDARD 419B-02.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|-----------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.80 | 0.95 | 1.10 | 0.031 | 0.037 | 0.043 |
| A1 | 0.00 | 0.05 | 0.10 | 0.000 | 0.002 | 0.004 |
| A3 | 0.20 REF | | | 0.008 REF | | |
| b | 0.10 | 0.21 | 0.30 | 0.004 | 0.008 | 0.012 |
| C | 0.10 | 0.14 | 0.25 | 0.004 | 0.005 | 0.010 |
| D | 1.80 | 2.00 | 2.20 | 0.070 | 0.078 | 0.086 |
| E | 1.15 | 1.25 | 1.35 | 0.045 | 0.049 | 0.053 |
| e | 0.65 BSC | | | 0.026 BSC | | |
| L | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| HE | 2.00 | 2.10 | 2.20 | 0.078 | 0.082 | 0.086 |



SOLDERING FOOTPRINT*

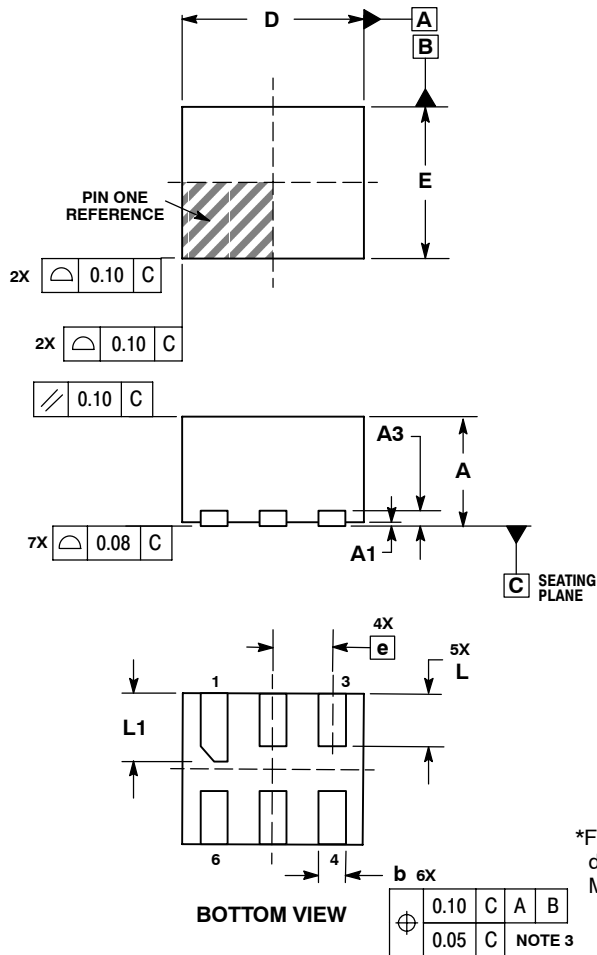


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NLAS9031

PACKAGE DIMENSIONS

WDFN6 1.2x1.0, 0.4P
CASE 506AS-01
ISSUE B

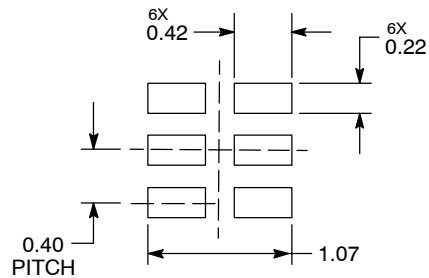


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| DIM | MILLIMETERS | |
|-----|-------------|------|
| | MIN | MAX |
| A | 0.70 | 0.80 |
| A1 | 0.00 | 0.05 |
| A3 | 0.20 REF | |
| b | 0.15 | 0.25 |
| D | 1.20 BSC | |
| E | 1.00 BSC | |
| e | 0.40 BSC | |
| L | 0.30 | 0.40 |
| L1 | 0.40 | 0.50 |

MOUNTING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*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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