

NUD3112

Integrated Relay, Inductive Load Driver

This device is used to switch inductive loads such as relays, solenoids incandescent lamps, and small DC motors without the need of a free-wheeling diode. The device integrates all necessary items such as the MOSFET switch, ESD protection, and Zener clamps. It accepts logic level inputs thus allowing it to be driven by a large variety of devices including logic gates, inverters, and microcontrollers.

Features

- Provides a Robust Driver Interface Between D.C. Relay Coil and Sensitive Logic Circuits
- Optimized to Switch Relays of 12 V Rail
- Capable of Driving Relay Coils Rated up to 6.0 W at 12 V
- Internal Zener Eliminates the Need of Free-Wheeling Diode
- Internal Zener Clamp Routes Induced Current to Ground for Quieter Systems Operation
- Low $V_{DS(ON)}$ Reduces System Current Drain
- Pb-Free Packages are Available

Typical Applications

- Telecom: Line Cards, Modems, Answering Machines, FAX
- Computers and Office: Photocopiers, Printers, Desktop Computers
- Consumer: TVs and VCRs, Stereo Receivers, CD Players, Cassette Recorders
- Industrial: Small Appliances, Security Systems, Automated Test Equipment, Garage Door Openers



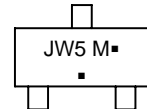
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MARKING DIAGRAMS



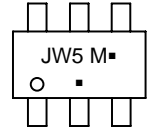
**SOT-23
CASE 318
STYLE 21**



JW5 = Specific Device Code
M = Date Code
▪ = Pb-Free Package
(Note: Microdot may be in either location)



**SC-74
CASE 318F
STYLE 7**



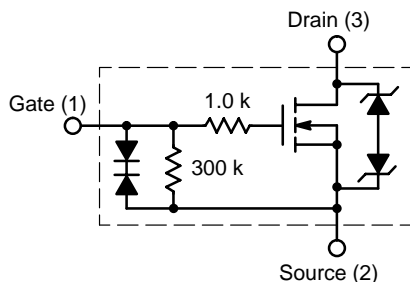
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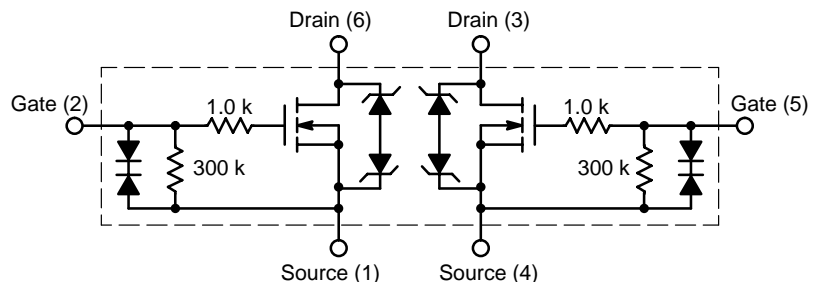
| Device | Package | Shipping† |
|--------------|------------------|------------------|
| NUD3112LT1 | SOT-23 | 3000/Tape & Reel |
| NUD3112LT1G | SOT-23 (Pb-Free) | 3000/Tape & Reel |
| NUD3112DMT1 | SC-74 | 3000/Tape & Reel |
| NUD3112DMT1G | SC-74 (Pb-Free) | 3000/Tape & Reel |

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

INTERNAL CIRCUIT DIAGRAMS



CASE 318



CASE 318F

NUD3112

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise specified)

| Symbol | Rating | Value | Unit | |
|-----------------|---|-------------|------------------|----------------------------|
| V_{DSS} | Drain to Source Voltage – Continuous | 14 | V_{dc} | |
| V_{GS} | Gate to Source Voltage – Continuous | 6 | V_{dc} | |
| I_D | Drain Current – Continuous | 500 | mA | |
| E_z | Single Pulse Drain-to-Source Avalanche Energy ($T_{Jinitial} = 25^\circ\text{C}$) | 50 | mJ | |
| T_J | Junction Temperature | 150 | $^\circ\text{C}$ | |
| T_A | Operating Ambient Temperature | -40 to 85 | $^\circ\text{C}$ | |
| T_{stg} | Storage Temperature Range | -65 to +150 | $^\circ\text{C}$ | |
| P_D | Total Power Dissipation (Note 1) Derating Above 25°C | SOT-23 | 225 | mW |
| | | | 1.8 | $\text{mW}/^\circ\text{C}$ |
| P_D | Total Power Dissipation (Note 1) Derating Above 25°C | SC-74 | 380 | mW |
| | | | 3.0 | $\text{mW}/^\circ\text{C}$ |
| $R_{\theta JA}$ | Thermal Resistance Junction-to-Ambient (Note 1) | SOT-23 | 556 | $^\circ\text{C}/\text{W}$ |
| | | SC-74 | 329 | |
| ESD | Human Body Model (HBM) According to EIA/JESD22/A114 | 2000 | V | |

1. Mounted onto minimum pad board.

TYPICAL ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Characteristic | Min | Typ | Max | Unit |
|----------------------------|--|-----|-----|-----|---------------|
| OFF CHARACTERISTICS | | | | | |
| V_{BRDSS} | Drain to Source Sustaining Voltage (Internally Clamped) ($I_D = 10\text{ mA}$) | 14 | 16 | 17 | V |
| B_{VGS0} | $I_g = 1.0\text{ mA}$ | - | - | 8 | V |
| I_{DSS} | Drain to Source Leakage Current ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$, $T_A = 25^\circ\text{C}$) ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$, $T_A = 85^\circ\text{C}$) | - | - | 20 | μA |
| | | - | - | 40 | |
| I_{GSS} | Gate Body Leakage Current ($V_{GS} = 3.0\text{ V}$, $V_{DS} = 0\text{ V}$) ($V_{GS} = 5.0\text{ V}$, $V_{DS} = 0\text{ V}$) | - | - | 35 | μA |
| | | - | - | 65 | |
| ON CHARACTERISTICS | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage ($V_{GS} = V_{DS}$, $I_D = 1.0\text{ mA}$) ($V_{GS} = V_{DS}$, $I_D = 1.0\text{ mA}$, $T_A = 85^\circ\text{C}$) | 0.8 | 1.2 | 1.4 | V |
| | | 0.8 | - | 1.4 | |
| $R_{DS(on)}$ | Drain to Source On-Resistance ($I_D = 250\text{ mA}$, $V_{GS} = 3.0\text{ V}$) ($I_D = 500\text{ mA}$, $V_{GS} = 3.0\text{ V}$) ($I_D = 500\text{ mA}$, $V_{GS} = 5.0\text{ V}$) ($I_D = 500\text{ mA}$, $V_{GS} = 3.0\text{ V}$, $T_A = 85^\circ\text{C}$) ($I_D = 500\text{ mA}$, $V_{GS} = 5.0\text{ V}$, $T_A = 85^\circ\text{C}$) | - | - | 1.2 | Ω |
| | | - | - | 1.3 | |
| | | - | - | 0.9 | |
| | | - | - | 1.3 | |
| | | - | - | 0.9 | |
| $I_{DS(on)}$ | Output Continuous Current ($V_{DS} = 0.25\text{ V}$, $V_{GS} = 3.0\text{ V}$) ($V_{DS} = 0.25\text{ V}$, $V_{GS} = 3.0\text{ V}$, $T_A = 85^\circ\text{C}$) | 300 | 400 | - | mA |
| | | 200 | - | - | |
| g_{FS} | Forward Transconductance ($V_{OUT} = 12.0\text{ V}$, $I_{OUT} = 0.25\text{ A}$) | 350 | 490 | - | mmhos |

NUD3112

TYPICAL ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Characteristic | Min | Typ | Max | Unit |
|--------|----------------|-----|-----|-----|------|
|--------|----------------|-----|-----|-----|------|

DYNAMIC CHARACTERISTICS

| | | | | | |
|-----------|--|---|----|---|----|
| C_{iss} | Input Capacitance ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 10\text{ kHz}$) | - | 23 | - | pF |
| C_{oss} | Output Capacitance ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 10\text{ kHz}$) | - | 30 | - | pF |
| C_{rss} | Transfer Capacitance ($V_{DS} = 12.0\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 10\text{ kHz}$) | - | 7 | - | pF |

SWITCHING CHARACTERISTICS

| Symbol | Characteristic | Min | Typ | Max | Units |
|-----------|--|-----|-----|-----|-------|
| t_{PHL} | Propagation Delay Times: High to Low Propagation Delay; Figure 1 ($V_{DS} = 12\text{ V}$, $V_{GS} = 5.0\text{ V}$) Low to High Propagation Delay; Figure 1 ($V_{DS} = 12\text{ V}$, $V_{GS} = 5.0\text{ V}$) | - | 21 | - | nS |
| t_{PLH} | | - | 91 | - | nS |
| t_f | Transition Times: Fall Time; Figure 1 ($V_{DS} = 12\text{ V}$, $V_{GS} = 5.0\text{ V}$) Rise Time; Figure 1 ($V_{DS} = 12\text{ V}$, $V_{GS} = 5.0\text{ V}$) | - | 36 | - | nS |
| t_r | | - | 61 | - | nS |

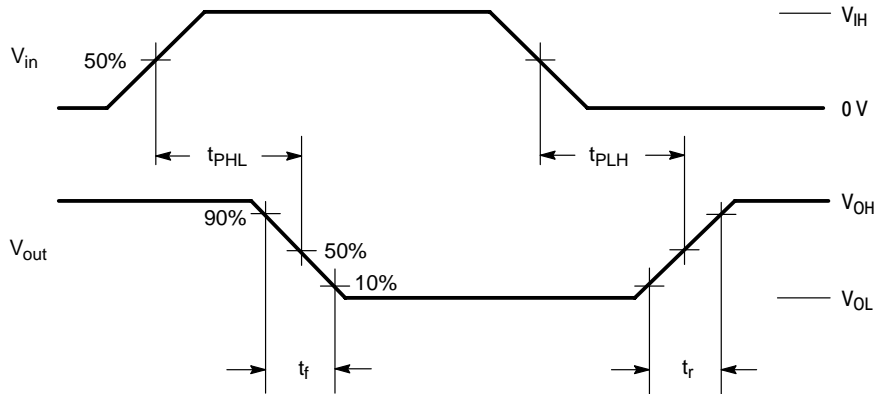


Figure 1. Switching Waveforms

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TYPICAL PERFORMANCE CURVES ($T_J = 25^\circ\text{C}$ unless otherwise specified)

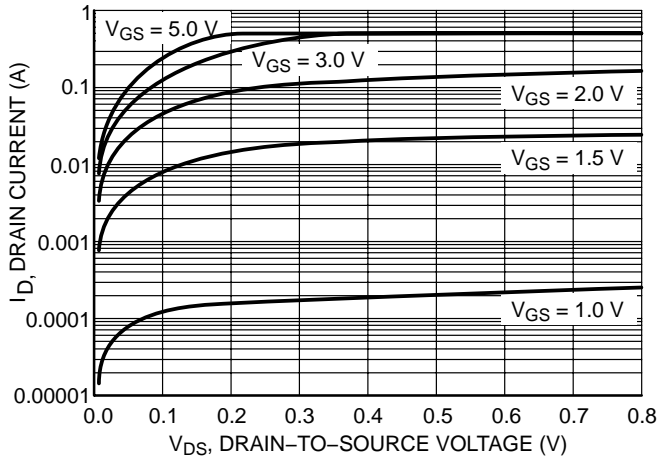


Figure 2. Output Characteristics

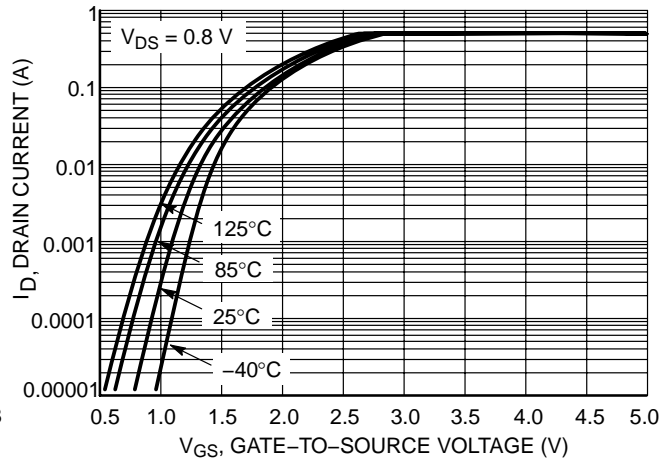


Figure 3. Transfer Function

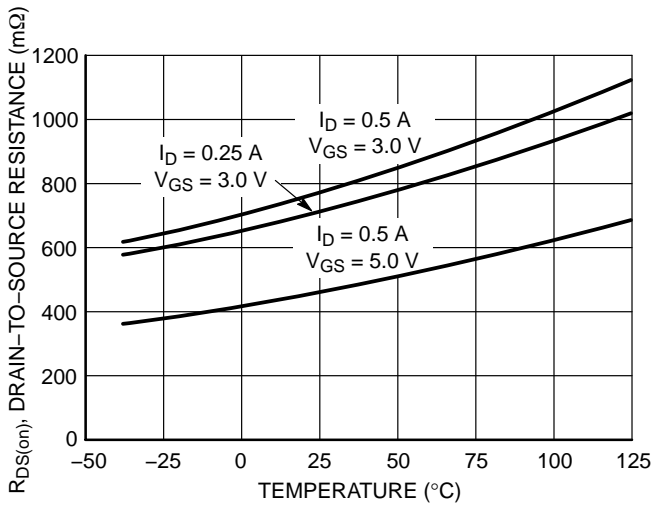


Figure 4. On-Resistance Variation vs. Temperature

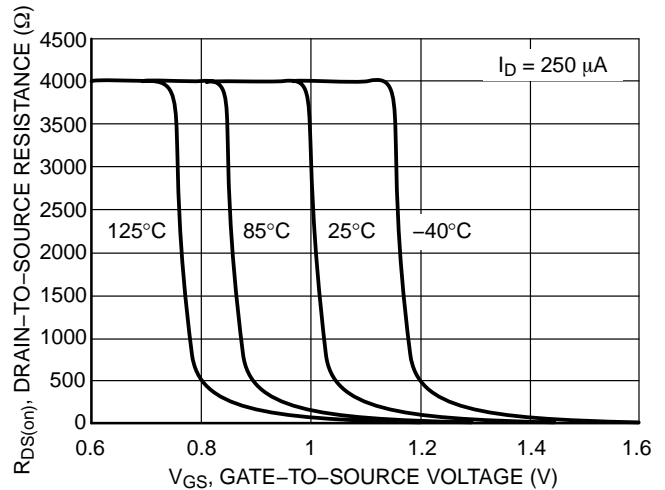


Figure 5. $R_{DS(ON)}$ Variation vs. Gate-to-Source Voltage

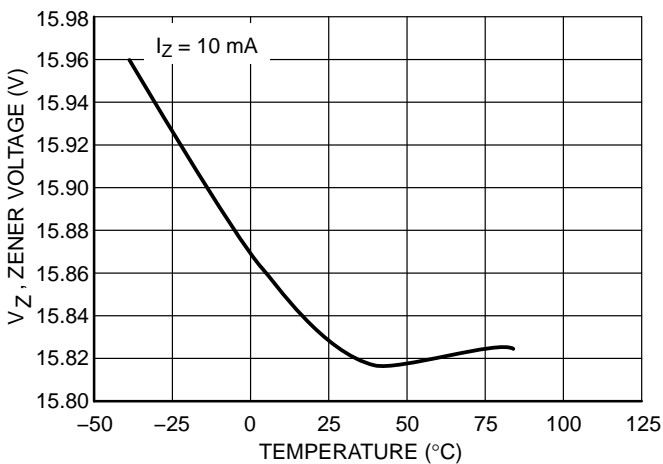


Figure 6. Zener Voltage vs. Temperature

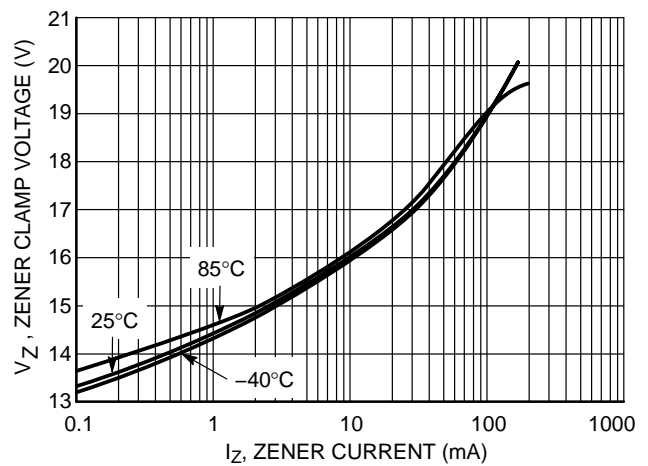


Figure 7. Zener Clamp Voltage vs. Zener Current

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TYPICAL PERFORMANCE CURVES ($T_J = 25^\circ\text{C}$ unless otherwise specified)

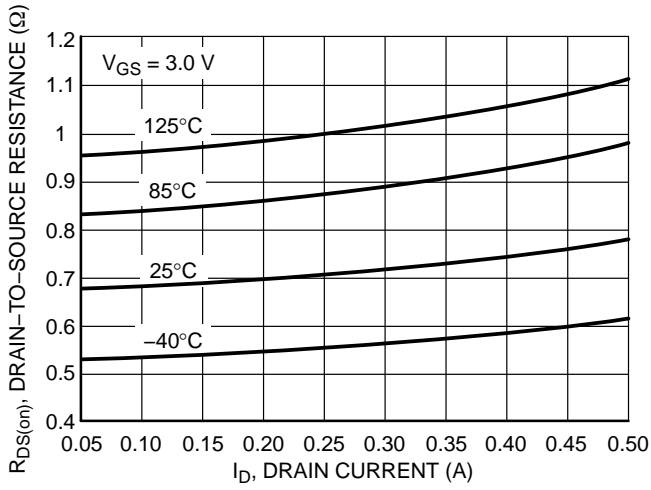


Figure 8. On-Resistance vs. Drain Current and Temperature

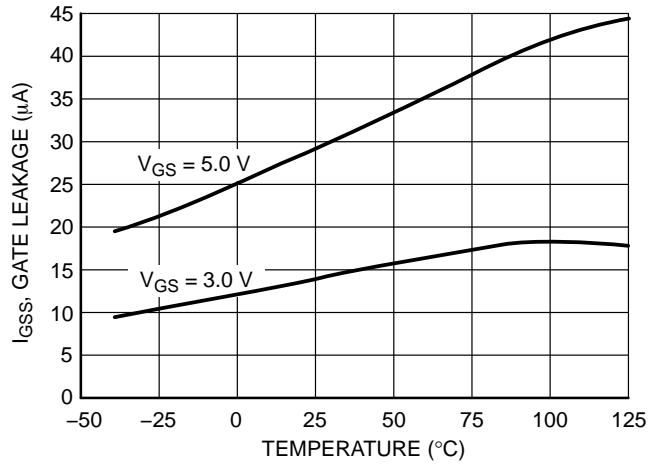


Figure 9. Gate Leakage vs. Temperature

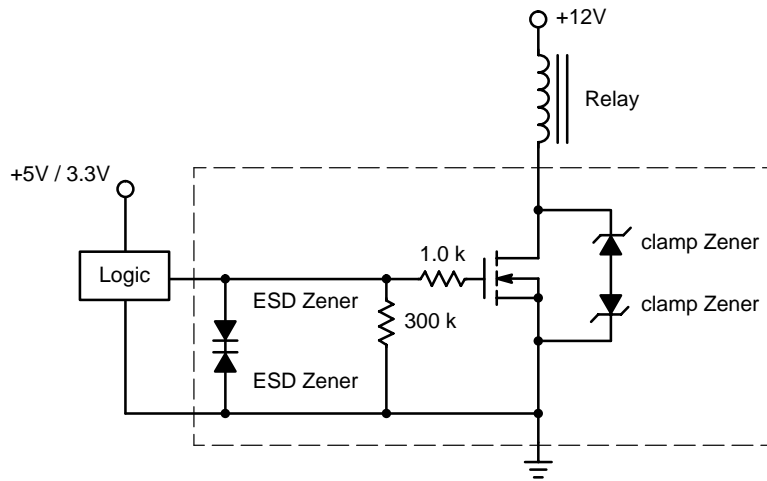
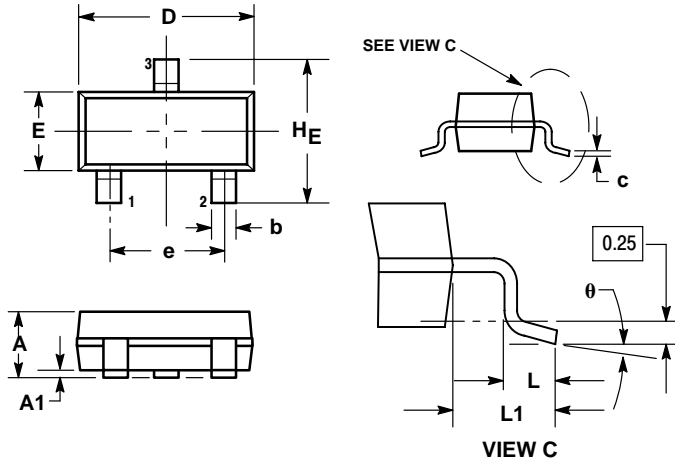


Figure 10. Typical Application Circuit

NUD3112

PACKAGE DIMENSIONS

SOT-23 (TO-236)
CASE 318-08
ISSUE AN

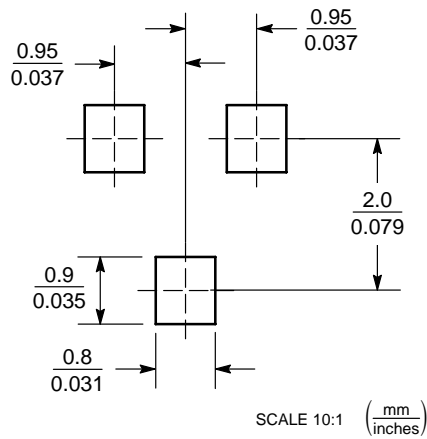


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
 4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|--------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.89 | 1.00 | 1.11 | 0.035 | 0.040 | 0.044 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.37 | 0.44 | 0.50 | 0.015 | 0.018 | 0.020 |
| c | 0.09 | 0.13 | 0.18 | 0.003 | 0.005 | 0.007 |
| D | 2.80 | 2.90 | 3.04 | 0.110 | 0.114 | 0.120 |
| E | 1.20 | 1.30 | 1.40 | 0.047 | 0.051 | 0.055 |
| e | 1.78 | 1.90 | 2.04 | 0.070 | 0.075 | 0.081 |
| L | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| L1 | 0.35 | 0.54 | 0.69 | 0.014 | 0.021 | 0.029 |
| HE | 2.10 | 2.40 | 2.64 | 0.083 | 0.094 | 0.104 |

- STYLE 21:
PIN 1. GATE
2. SOURCE
3. DRAIN

SOLDERING FOOTPRINT*

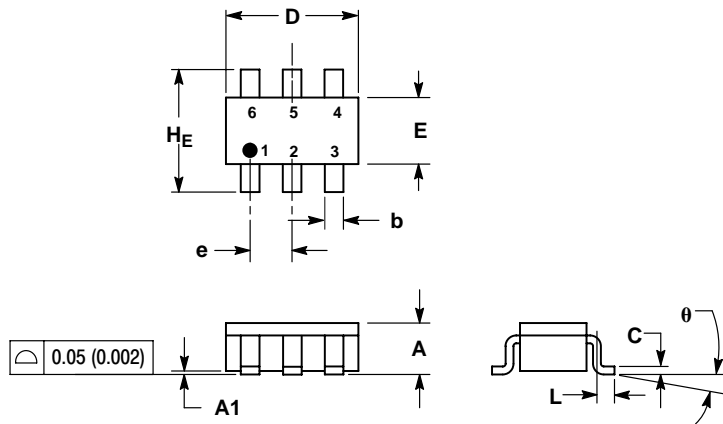


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NUD3112

PACKAGE DIMENSIONS

SC-74 CASE 318F-05 ISSUE L



NOTES:

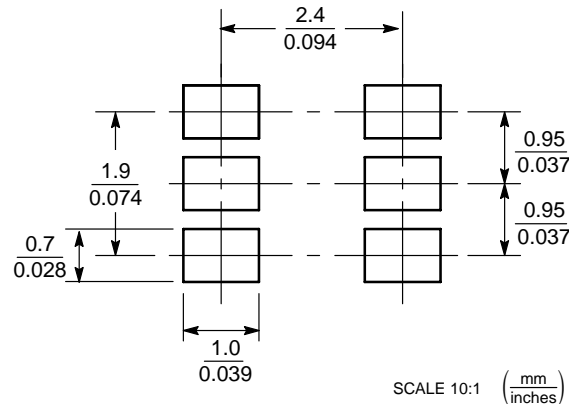
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F-01, -02, -03 OBSOLETE. NEW STANDARD 318F-04.

| 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 |
| theta | 0° | - | 10° | 0° | - | 10° |

STYLE 7:

1. SOURCE 1
2. GATE 1
3. DRAIN 2
4. SOURCE 2
5. GATE 2
6. DRAIN 1

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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