

# 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
- SZ Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These are Pb-Free Devices

### 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



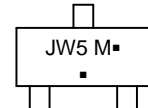
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### MARKING DIAGRAMS



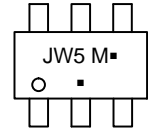
**SOT-23  
CASE 318  
STYLE 21**



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



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



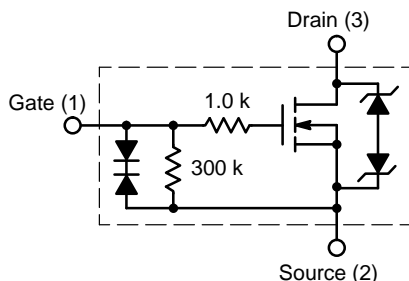
JW5 = Specific Device Code  
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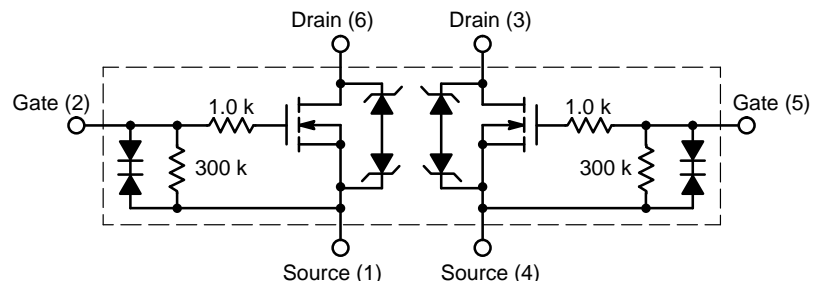
Device	Package	Shipping†
NUD3112LT1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
SZNUD3112LT1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
NUD3112DMT1G	SC-74 (Pb-Free)	3000 / Tape & Reel
SZNUD3112DMT1G	SC-74 (Pb-Free)	3000 / Tape & Reel

†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<sub>J</sub> = 25°C unless otherwise specified)

Symbol	Rating	Value	Unit	
V <sub>DSS</sub>	Drain to Source Voltage – Continuous	14	V <sub>dc</sub>	
V <sub>GS</sub>	Gate to Source Voltage – Continuous	6	V <sub>dc</sub>	
I <sub>D</sub>	Drain Current – Continuous	500	mA	
E <sub>z</sub>	Single Pulse Drain-to-Source Avalanche Energy (T <sub>Jinitial</sub> = 25°C)	50	mJ	
T <sub>J</sub>	Junction Temperature	150	°C	
T <sub>A</sub>	Operating Ambient Temperature	-40 to 85	°C	
T <sub>stg</sub>	Storage Temperature Range	-65 to +150	°C	
P <sub>D</sub>	Total Power Dissipation (Note 1) Derating Above 25°C	SOT-23	225	mW
			1.8	mW/°C
P <sub>D</sub>	Total Power Dissipation (Note 1) Derating Above 25°C	SC-74	380	mW
			3.0	mW/°C
R <sub>θJA</sub>	Thermal Resistance Junction-to-Ambient (Note 1)	SOT-23	556	°C/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<sub>A</sub> = 25°C unless otherwise noted)

Symbol	Characteristic	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

V <sub>BRDSS</sub>	Drain to Source Sustaining Voltage (Internally Clamped) (I <sub>D</sub> = 10 mA)	14	16	17	V
B <sub>VGS0</sub>	I <sub>g</sub> = 1.0 mA	–	–	8	V
I <sub>DSS</sub>	Drain to Source Leakage Current (V <sub>DS</sub> = 12 V, V <sub>GS</sub> = 0 V, T <sub>A</sub> = 25°C) (V <sub>DS</sub> = 12 V, V <sub>GS</sub> = 0 V, T <sub>A</sub> = 85°C)	–	–	20	μA
		–	–	40	
I <sub>GSS</sub>	Gate Body Leakage Current (V <sub>GS</sub> = 3.0 V, V <sub>DS</sub> = 0 V) (V <sub>GS</sub> = 5.0 V, V <sub>DS</sub> = 0 V)	–	–	35	μA
		–	–	65	

### ON CHARACTERISTICS

V <sub>GS(th)</sub>	Gate Threshold Voltage (V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0 mA) (V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 1.0 mA, T <sub>A</sub> = 85°C)	0.8	1.2	1.4	V
		0.8	–	1.4	
R <sub>DS(on)</sub>	Drain to Source On-Resistance (I <sub>D</sub> = 250 mA, V <sub>GS</sub> = 3.0 V) (I <sub>D</sub> = 500 mA, V <sub>GS</sub> = 3.0 V) (I <sub>D</sub> = 500 mA, V <sub>GS</sub> = 5.0 V) (I <sub>D</sub> = 500 mA, V <sub>GS</sub> = 3.0 V, T <sub>A</sub> = 85°C) (I <sub>D</sub> = 500 mA, V <sub>GS</sub> = 5.0 V, T <sub>A</sub> = 85°C)	–	–	1.2	Ω
		–	–	1.3	
		–	–	0.9	
		–	–	1.3	
		–	–	0.9	
I <sub>DS(on)</sub>	Output Continuous Current (V <sub>DS</sub> = 0.25 V, V <sub>GS</sub> = 3.0 V) (V <sub>DS</sub> = 0.25 V, V <sub>GS</sub> = 3.0 V, T <sub>A</sub> = 85°C)	300	400	–	mA
		200	–	–	
g <sub>FS</sub>	Forward Transconductance (V <sub>OUT</sub> = 12.0 V, I <sub>OUT</sub> = 0.25 A)	350	490	–	mmhos

# NUD3112

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

Symbol	Characteristic	Min	Typ	Max	Unit
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### 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

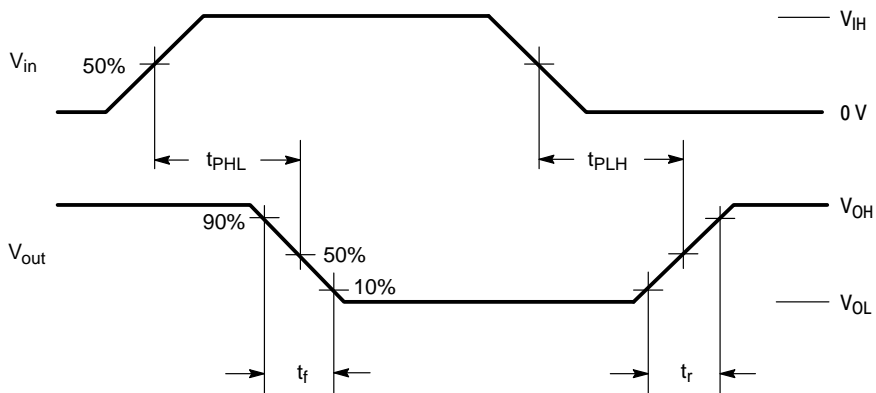


Figure 1. Switching Waveforms

# NUD3112

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

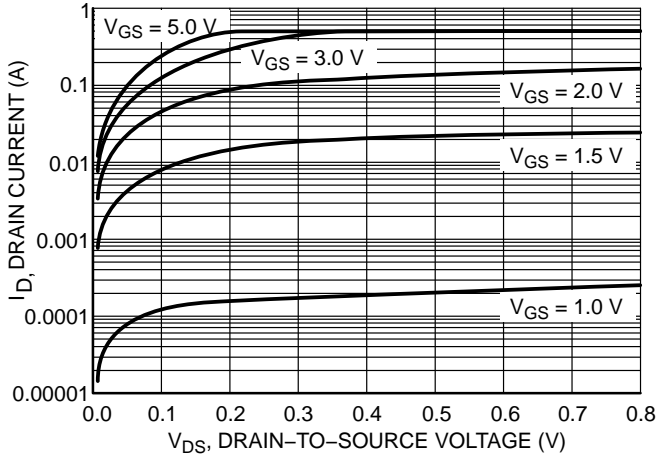


Figure 2. Output Characteristics

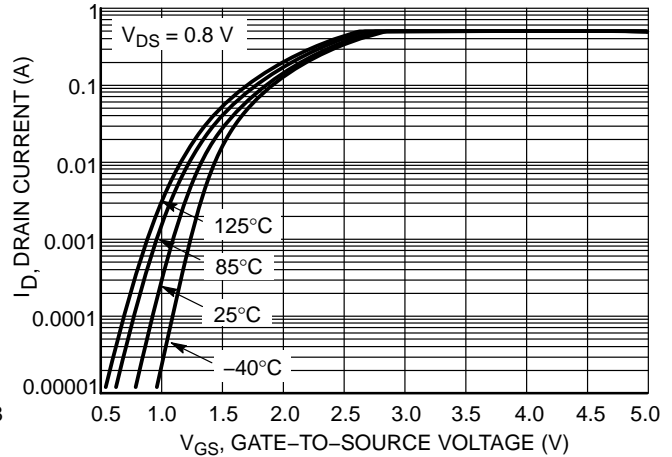


Figure 3. Transfer Function

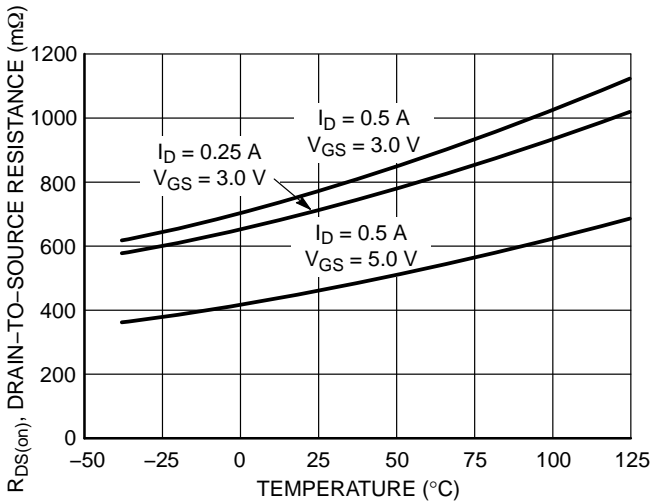


Figure 4. On-Resistance Variation vs. Temperature

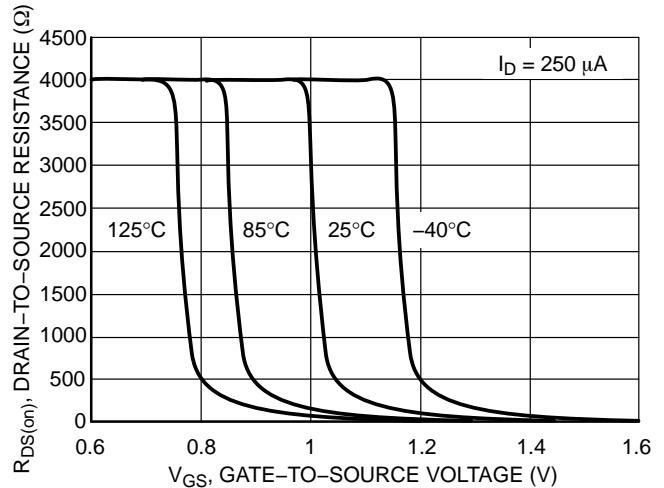


Figure 5.  $R_{DS(ON)}$  Variation vs. Gate-to-Source Voltage

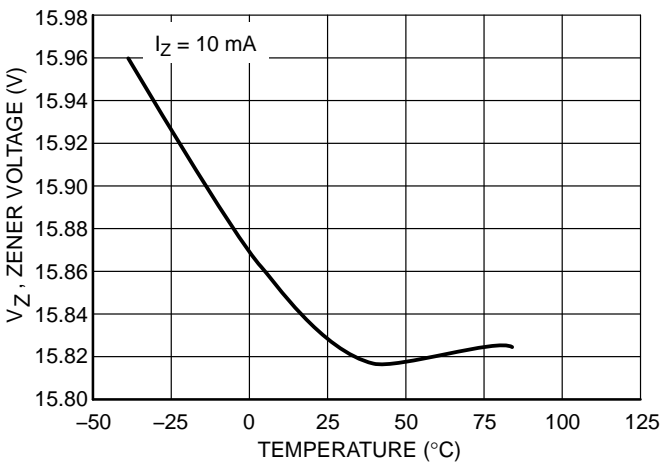


Figure 6. Zener Voltage vs. Temperature

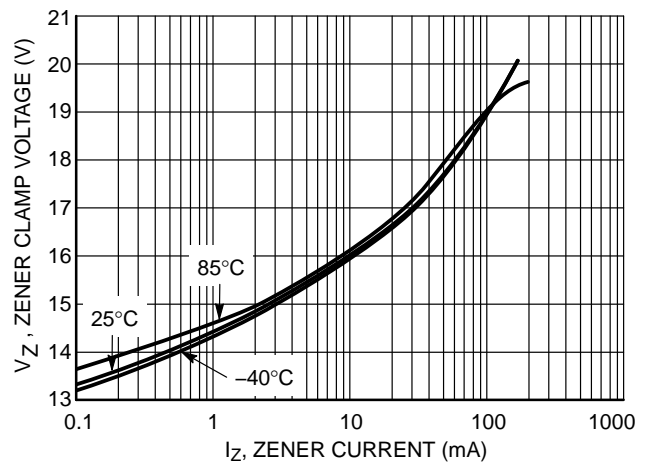


Figure 7. Zener Clamp Voltage vs. Zener Current

# NUD3112

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

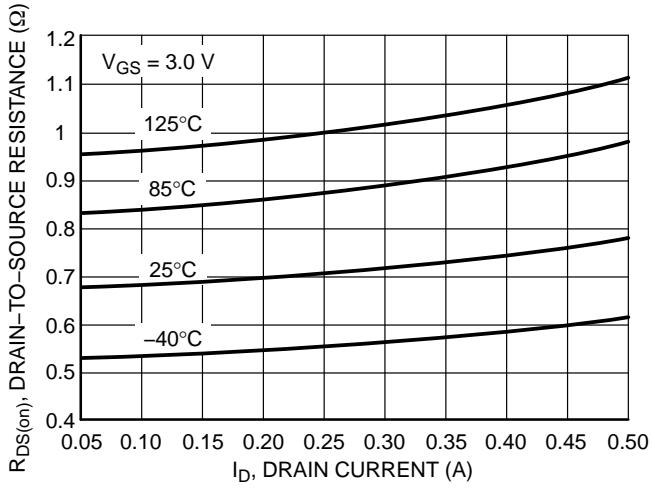


Figure 8. On-Resistance vs. Drain Current and Temperature

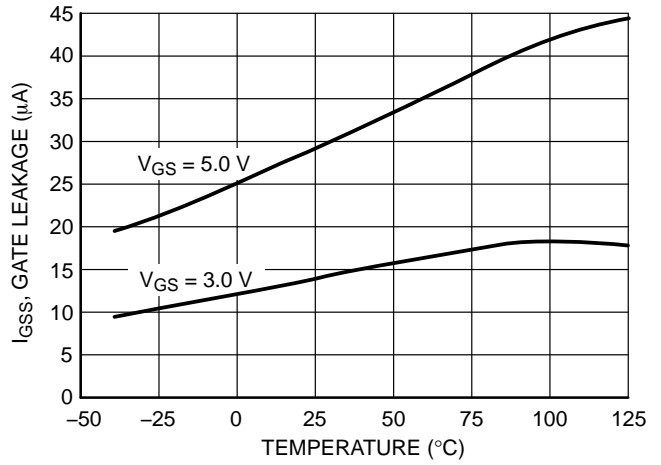


Figure 9. Gate Leakage vs. Temperature

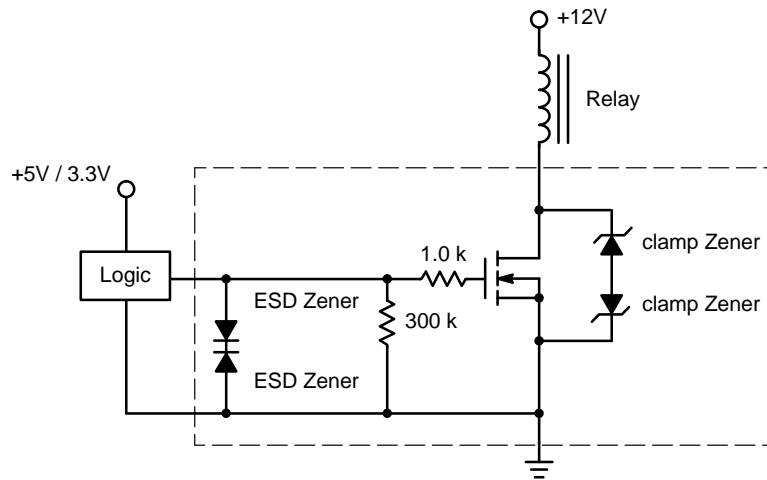
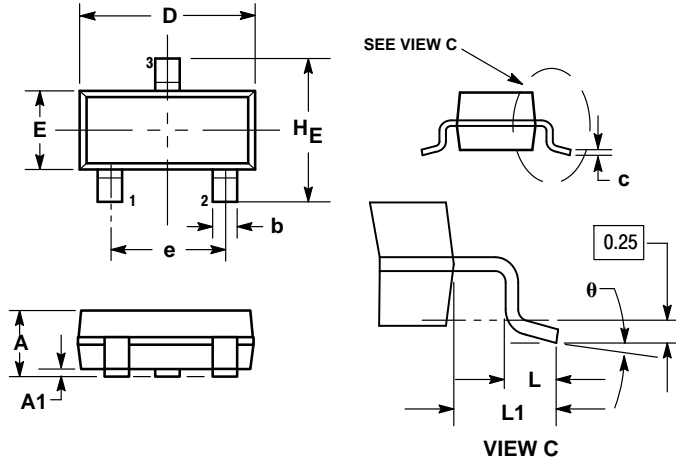


Figure 10. Typical Application Circuit

# NUD3112

## PACKAGE DIMENSIONS

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



NOTES:

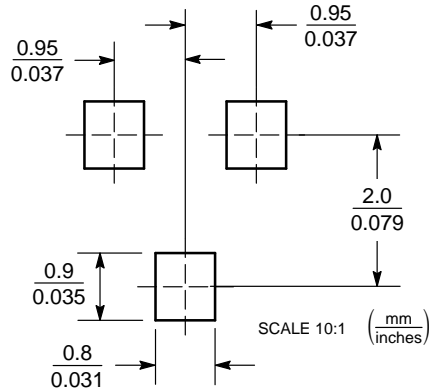
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

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
θ	0°	---	10°	0°	---	10°

STYLE 21:

1. GATE
2. SOURCE
3. DRAIN

### SOLDERING FOOTPRINT\*

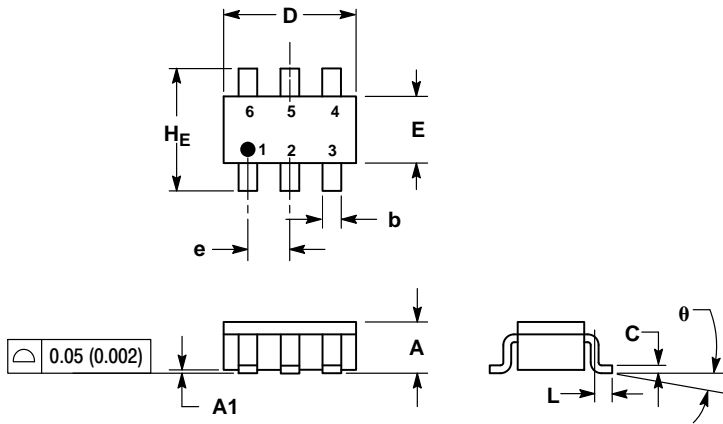


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# NUD3112

## PACKAGE DIMENSIONS

### SC-74 CASE 318F-05 ISSUE N

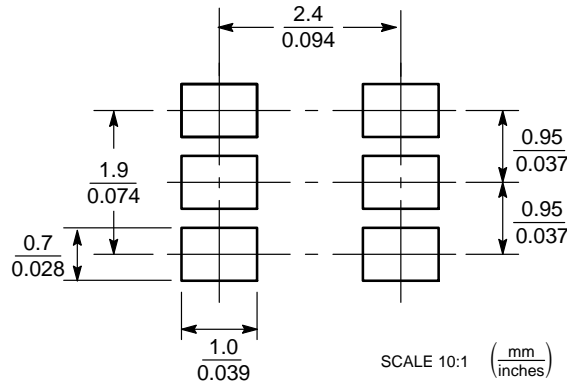


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
  4. 318F-01, -02, -03, -04 OBSOLETE. NEW STANDARD 318F-05.

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
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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