

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



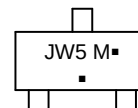
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MARKING DIAGRAMS



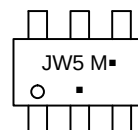
**SOT-23
CASE 318
STYLE 21**



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



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



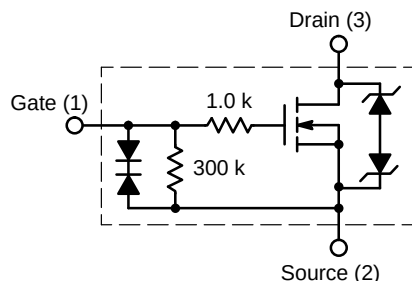
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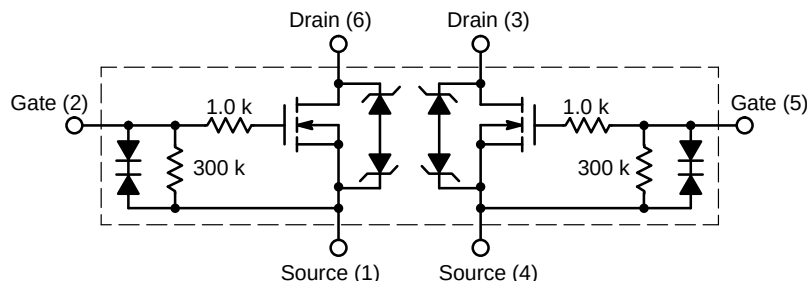
Device	Package	Shipping†
NUD3112LT1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
SZNUD3112LT1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
NUD3112DMT1G	SC-74 (Pb-Free)	3000 / Tape & Reel
SZNUD3112DMT1G	SC-74 (Pb-Free)	3000 / Tape & Reel

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

Symbol	Rating	Value	Unit
V_{DS}	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 1.8	mW mW/ $^{\circ}\text{C}$
P_D	Total Power Dissipation (Note 1) Derating Above 25°C	SC-74 380 3.0	mW mW/ $^{\circ}\text{C}$
$R_{\theta JA}$	Thermal Resistance Junction-to-Ambient (Note 1)	SOT-23 SC-74 556 329	$^{\circ}\text{C/W}$
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
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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 40	μA
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 65	μA

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 0.8	1.2 –	1.4 1.4	V
$R_{DS(on)}$	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 1.3 0.9 1.3 0.9	Ω
$I_{DS(on)}$	Output Continuous Current ($V_{DS} = 0.25\text{ V}$, $V_{GS} = 3.0\text{ V}$) ($V_{DS} = 0.25\text{ V}$, $V_{GS} = 3.0\text{ V}$, $T_A = 85^{\circ}\text{C}$)	300 200	400 –	– –	mA
g_{FS}	Forward Transconductance ($V_{OUT} = 12.0\text{ V}$, $I_{OUT} = 0.25\text{ A}$)	350	490	–	mmhos

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} t_{PLH}	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 91	– –	nS
t_f t_r	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 61	– –	nS

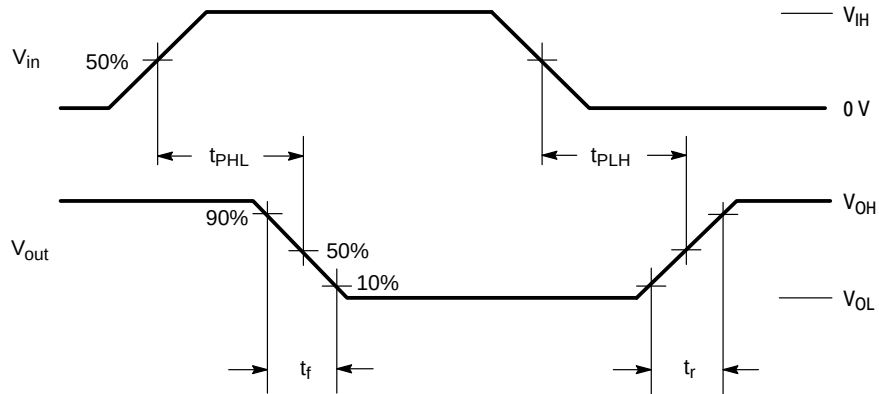


Figure 1. Switching Waveforms

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

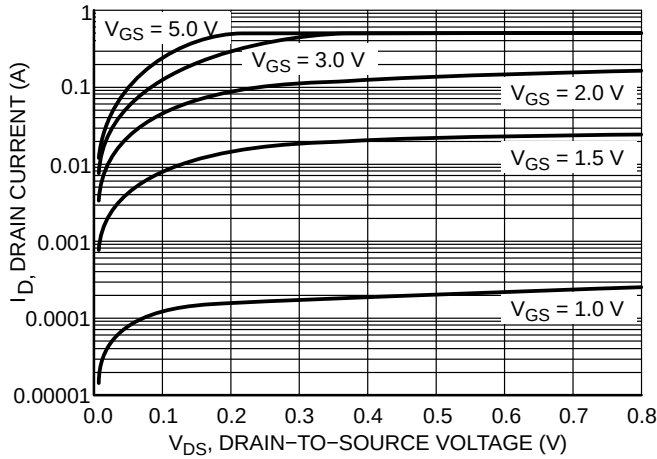


Figure 2. Output Characteristics

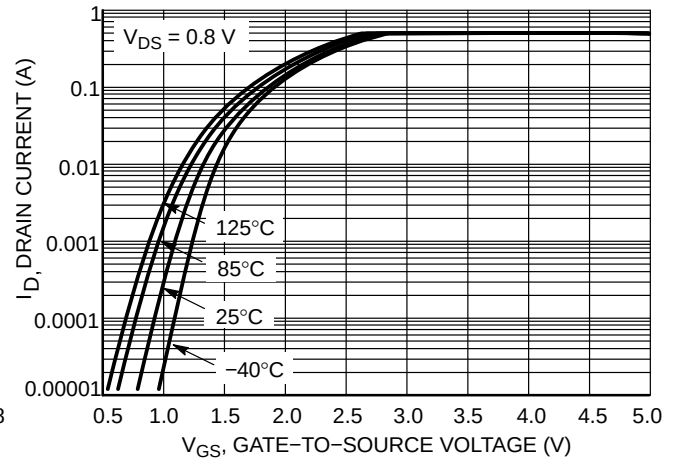


Figure 3. Transfer Function

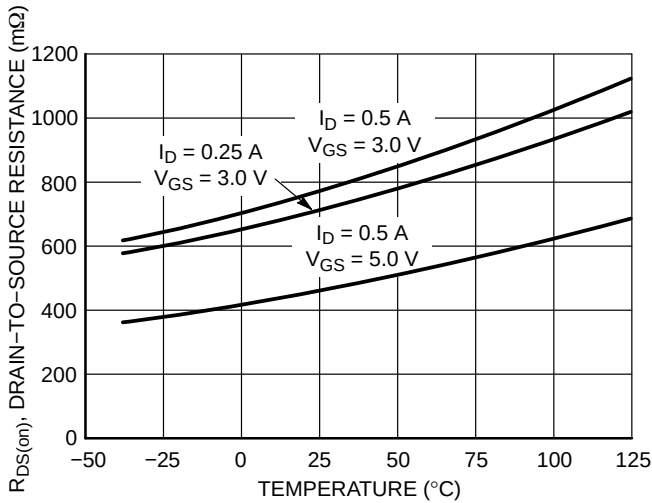


Figure 4. On-Resistance Variation vs. Temperature

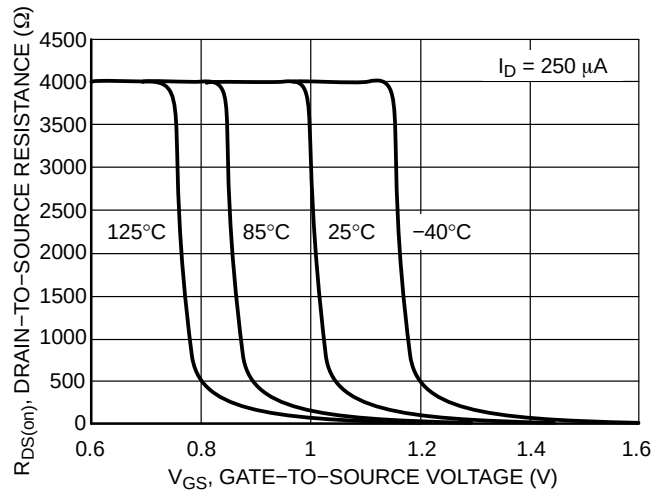


Figure 5. $R_{DS(ON)}$ Variation vs. Gate-to-Source Voltage

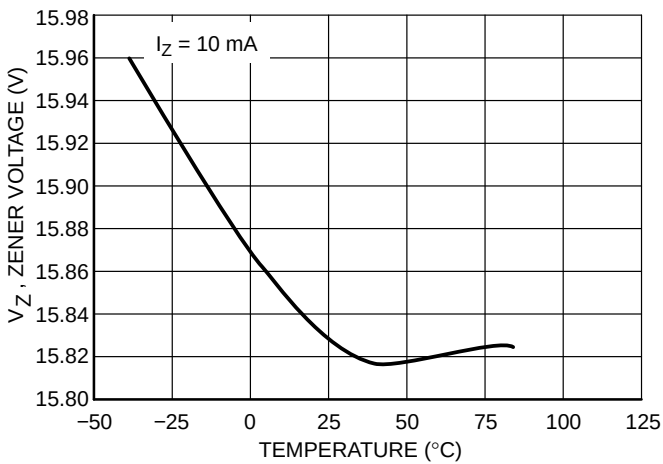


Figure 6. Zener Voltage vs. Temperature

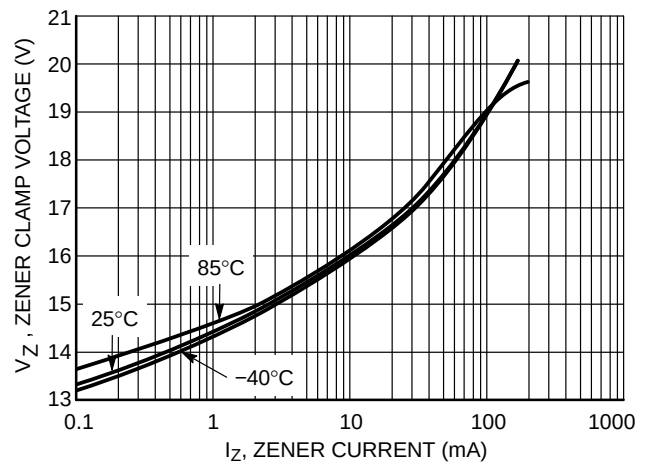


Figure 7. Zener Clamp Voltage vs. Zener Current

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

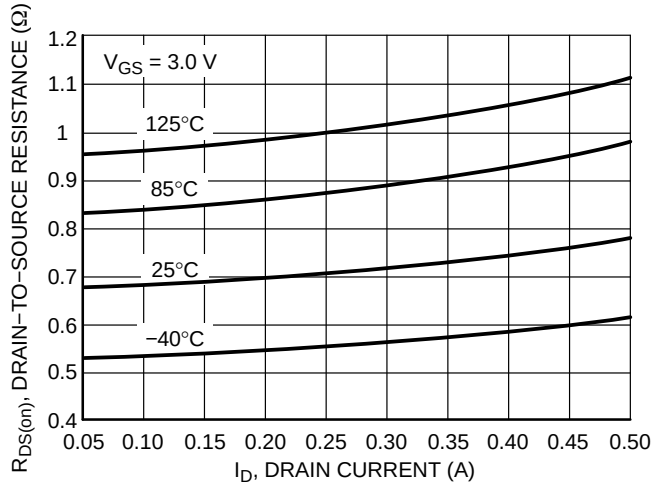


Figure 8. On-Resistance vs. Drain Current and Temperature

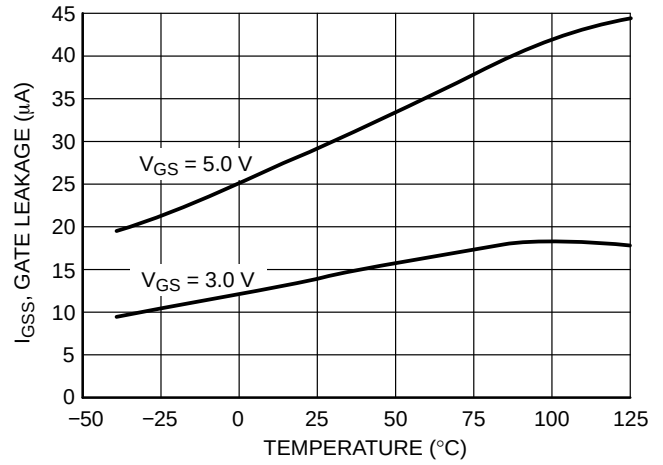


Figure 9. Gate Leakage vs. Temperature

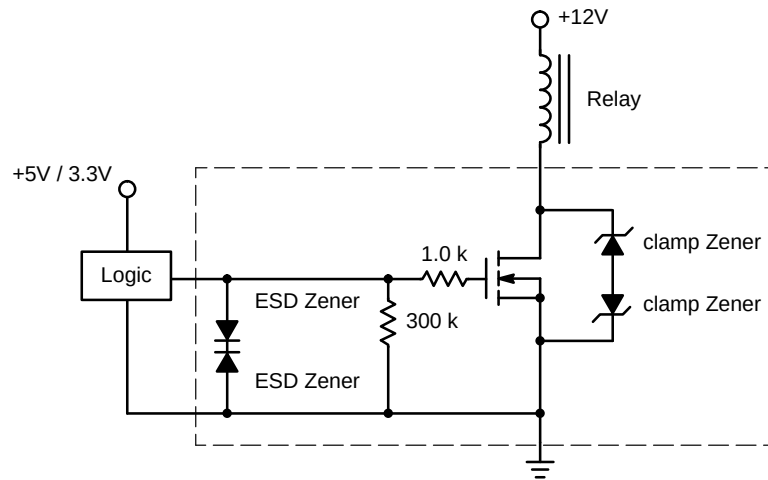
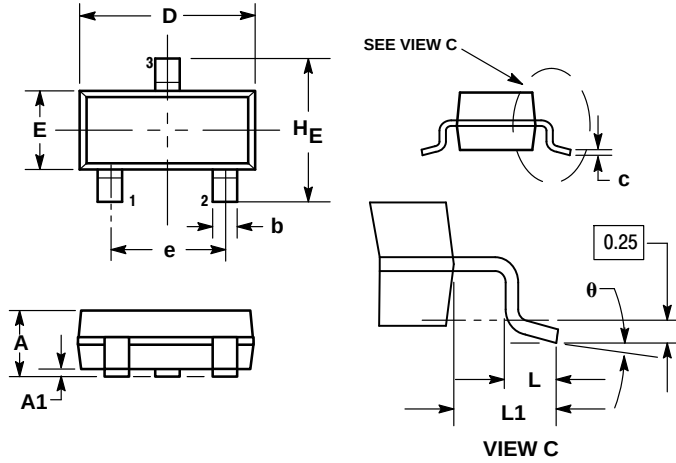


Figure 10. Typical Application Circuit

NUD3112

PACKAGE DIMENSIONS

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



NOTES:

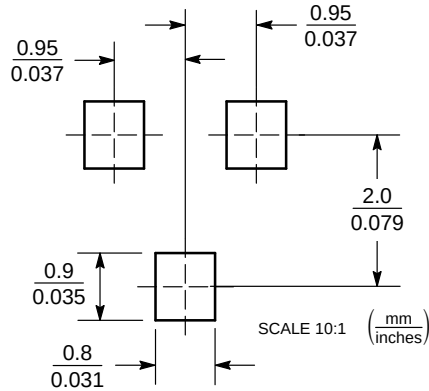
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

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
H _E	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*

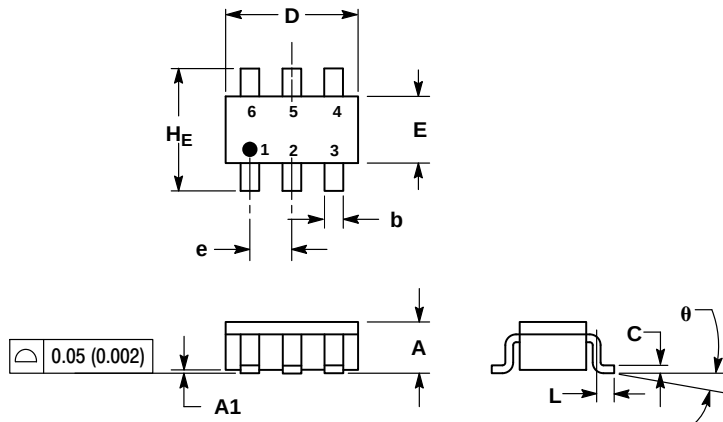


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NUD3112

PACKAGE DIMENSIONS

SC-74 CASE 318F-05 ISSUE N

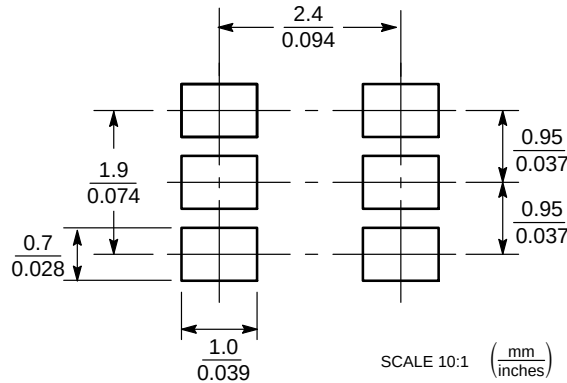


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
 4. 318F-01, -02, -03, -04 OBSOLETE. NEW STANDARD 318F-05.

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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Skype ameyasales1 ameyasales2

➤ Customer Service :

Email service@ameya360.com

➤ Partnership :

Tel +86 (21) 64016692-8333
Email mkt@ameya360.com