

# 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
- 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



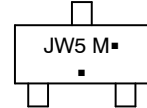
**ON Semiconductor®**

<http://onsemi.com>

### MARKING DIAGRAMS



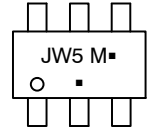
**SOT-23  
CASE 318  
STYLE 21**



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



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



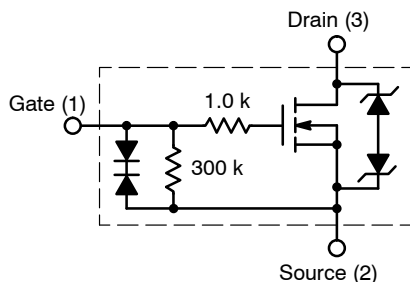
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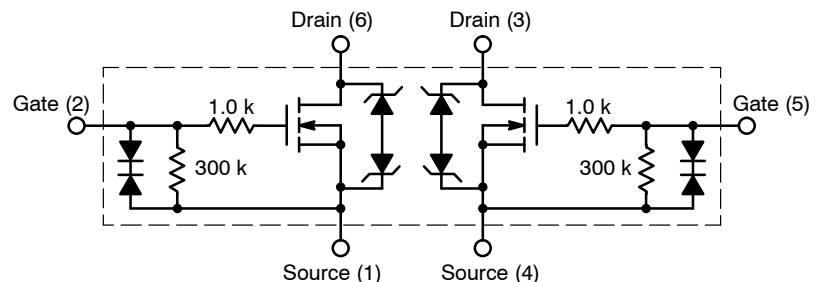
Device	Package	Shipping†
NUD3112LT1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
NUD3112DMT1G	SC-74 (Pb-Free)	3000 / Tape & Reel

†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 $25^\circ\text{C}$	SOT-23	225	mW
			1.8	$\text{mW}/^\circ\text{C}$
$P_D$	Total Power Dissipation (Note 1) Derating Above $25^\circ\text{C}$	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
<b>OFF CHARACTERISTICS</b>					
$V_{BRDSS}$	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	$\mu\text{A}$
		-	-	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	$\mu\text{A}$
		-	-	65	
<b>ON CHARACTERISTICS</b>					
$V_{GS(th)}$	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	$\Omega$
		-	-	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

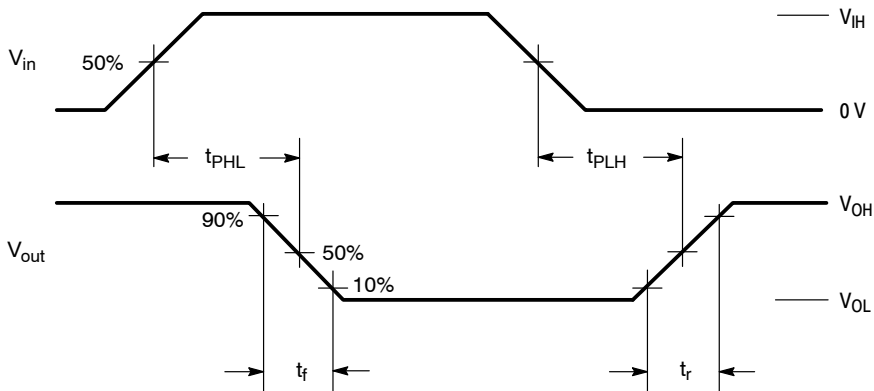
# NUD3112

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

Symbol	Characteristic	Min	Typ	Max	Unit
<b>DYNAMIC CHARACTERISTICS</b>					
$C_{iss}$	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**

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

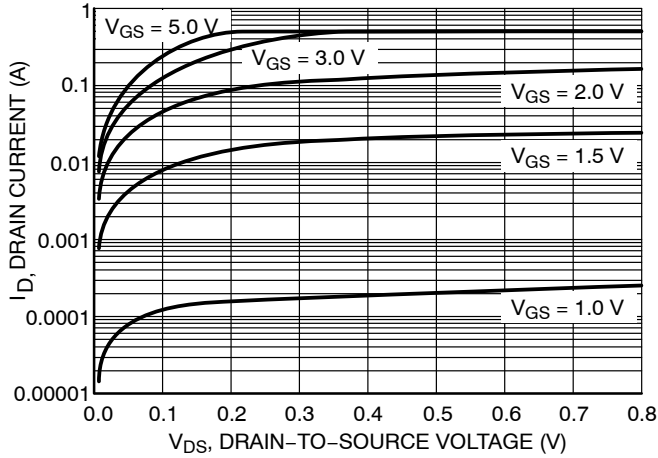


Figure 2. Output Characteristics

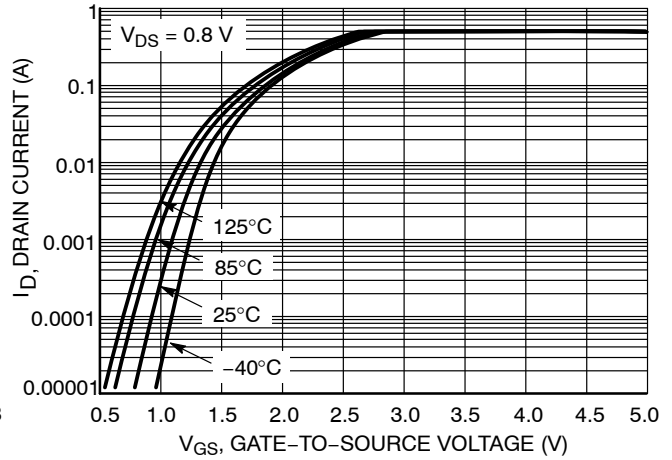


Figure 3. Transfer Function

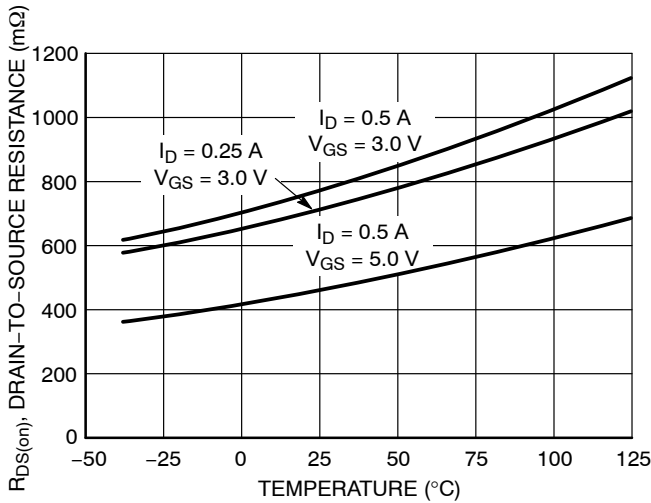


Figure 4. On-Resistance Variation vs. Temperature

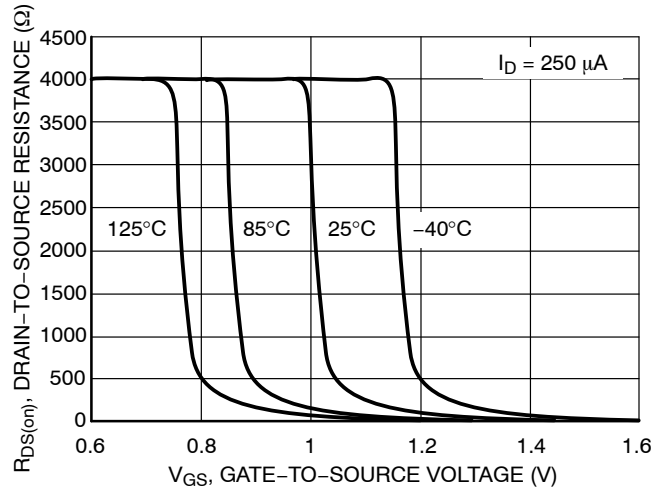


Figure 5.  $R_{DS(ON)}$  Variation vs. Gate-to-Source Voltage

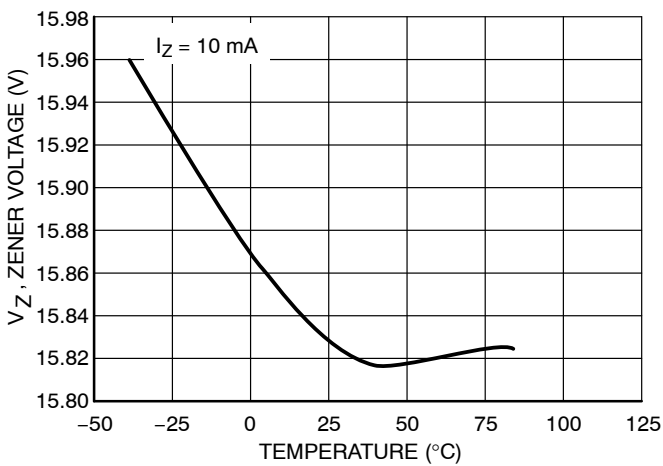


Figure 6. Zener Voltage vs. Temperature

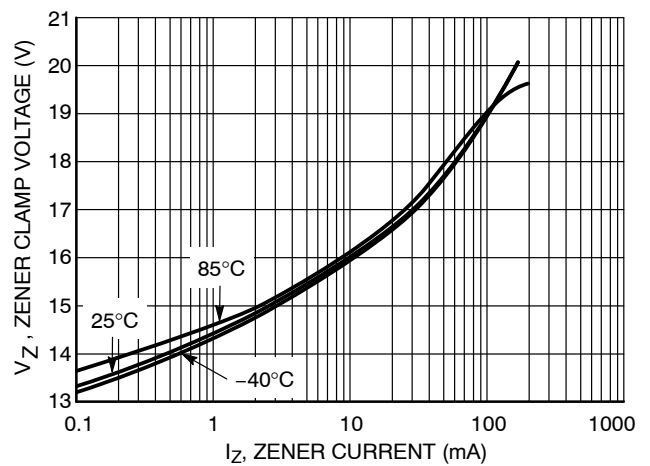
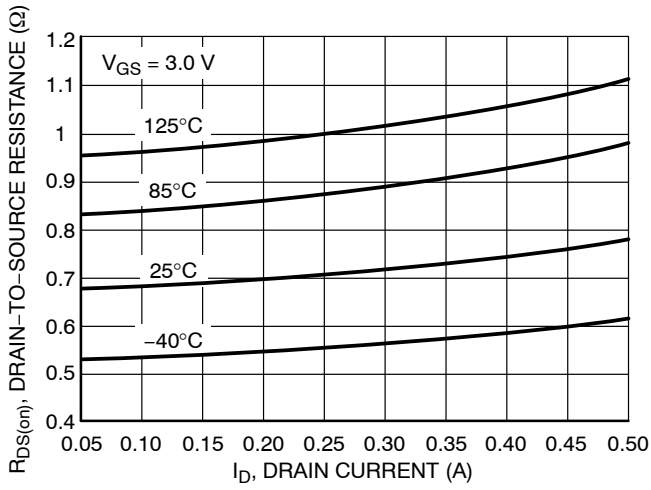


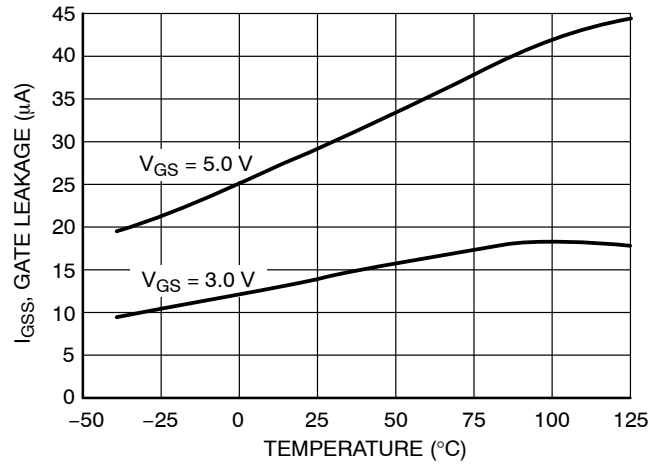
Figure 7. Zener Clamp Voltage vs. Zener Current

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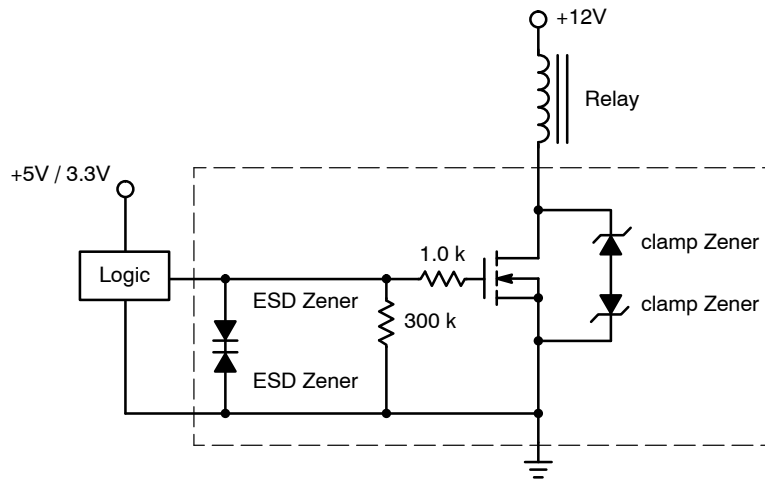
## TYPICAL PERFORMANCE CURVES ( $T_J = 25^\circ\text{C}$ unless otherwise specified)



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



**Figure 9. Gate Leakage vs. Temperature**

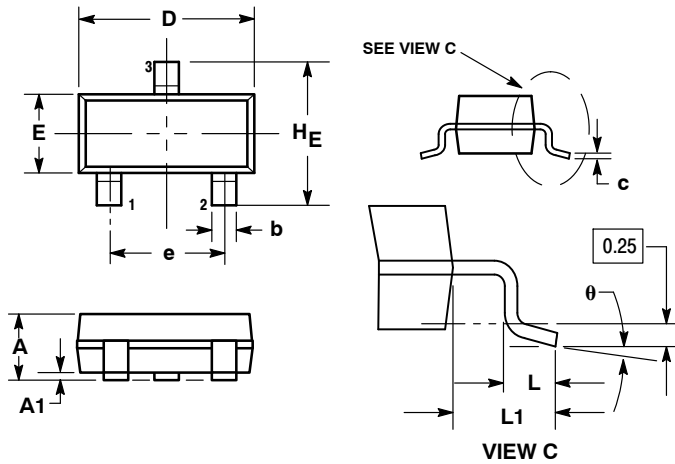


**Figure 10. Typical Application Circuit**

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## PACKAGE DIMENSIONS

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



NOTES:

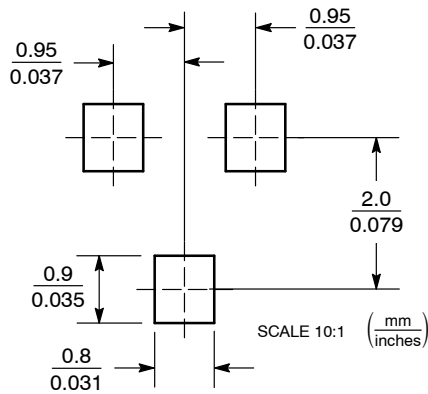
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

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\*

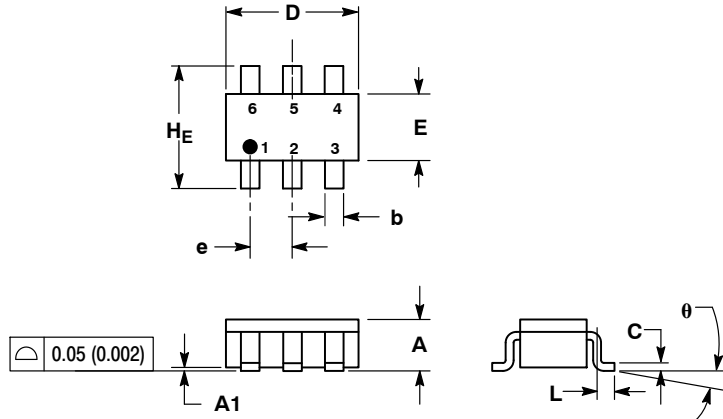


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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## PACKAGE DIMENSIONS

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



#### NOTES:

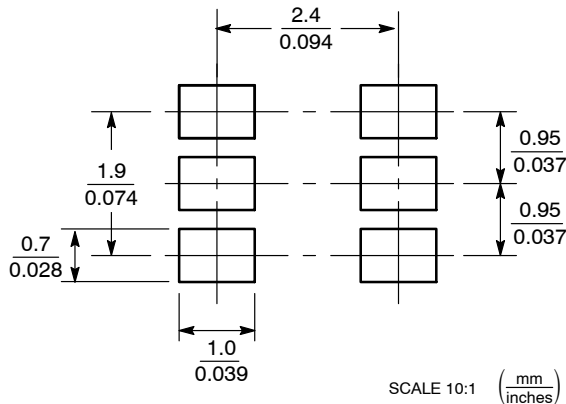
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F-01, -02, -03, -04 OBSOLETE. NEW STANDARD 318F-05.

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:

- PIN 1. SOURCE 1
- GATE 1
- DRAIN 2
- SOURCE 2
- GATE 2
- DRAIN 1

#### SOLDERING FOOTPRINT\*



SCALE 10:1 (mm/inches)

\*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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