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

ON Semiconductor®

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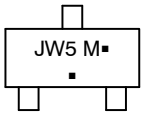
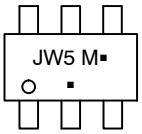
MARKING DIAGRAMS

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



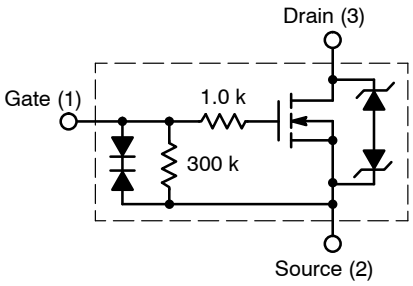
JW5 = Specific Device Code
M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

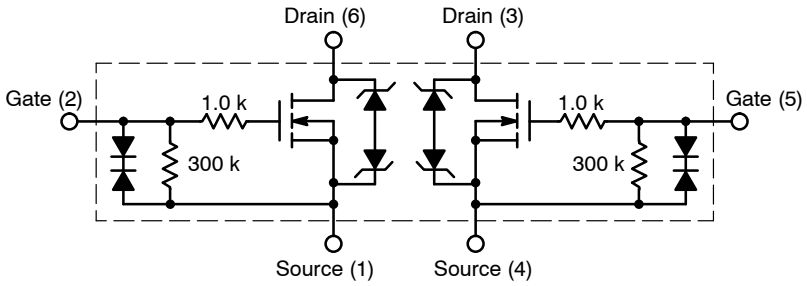
Device	Package	Shipping†
NUD3112LT1G	SOT−23 (Pb−Free)	3000 / Tape & Reel
SZNUD3112LT1G	SOT−23 (Pb−Free)	3000 / Tape & Reel
NUD3112DMT1G	SC−74 (Pb−Free)	3000 / Tape & Reel
SZNUD3112DMT1G	SC−74 (Pb−Free)	3000 / Tape & Reel

†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

MAXIMUM RATINGS (T_J = 25°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°C)		50	mJ
T_J	Junction Temperature		150	°C
T_A	Operating Ambient Temperature		–40 to 85	°C
T_{stg}	Storage Temperature Range		–65 to +150	°C
P_D	Total Power Dissipation (Note 1) Derating Above 25°C	SOT–23	225 1.8	mW mW/°C
P_D	Total Power Dissipation (Note 1) Derating Above 25°C	SC–74	380 3.0	mW mW/°C
$R_{\theta JA}$	Thermal Resistance Junction–to–Ambient (Note 1)	SOT–23 SC–74	556 329	°C/W
ESD	Human Body Model (HBM) According to EIA/JESD22/A114		2000	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Mounted onto minimum pad board.

TYPICAL ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

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

TYPICAL ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Symbol	Characteristic	Min	Typ	Max	Unit
DYNAMIC CHARACTERISTICS					
C_{iss}	Input Capacitance (V_{DS} = 12 V, V_{GS} = 0 V, f = 10 kHz)	–	23	–	pF
C_{oss}	Output Capacitance (V_{DS} = 12 V, V_{GS} = 0 V, f = 10 kHz)	–	30	–	pF
C_{rss}	Transfer Capacitance (V_{DS} = 12.0 V, V_{GS} = 0 V, f = 10 kHz)	–	7	–	pF
SWITCHING CHARACTERISTICS					
Symbol	**Characteristic**	**Min**	**Typ**	**Max**	**Units**
	Propagation Delay Times:				nS
t_{PHL}	High to Low Propagation Delay; Figure 1 (V_{DS} = 12 V, V_{GS} = 5.0 V)	–	21	–	
t_{PLH}	Low to High Propagation Delay; Figure 1 (V_{DS} = 12 V, V_{GS} = 5.0 V)	–	91	–	
	Transition Times:				nS
t_f	Fall Time; Figure 1 (V_{DS} = 12 V, V_{GS} = 5.0 V)	–	36	–	
t_r	Rise Time; Figure 1 (V_{DS} = 12 V, V_{GS} = 5.0 V)	–	61	–	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

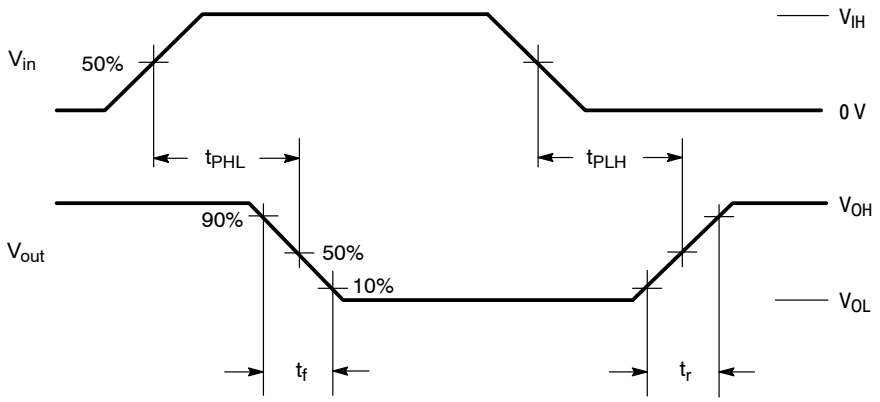


Figure 1. Switching Waveforms

TYPICAL PERFORMANCE CURVES (T_J = 25°C unless otherwise specified)

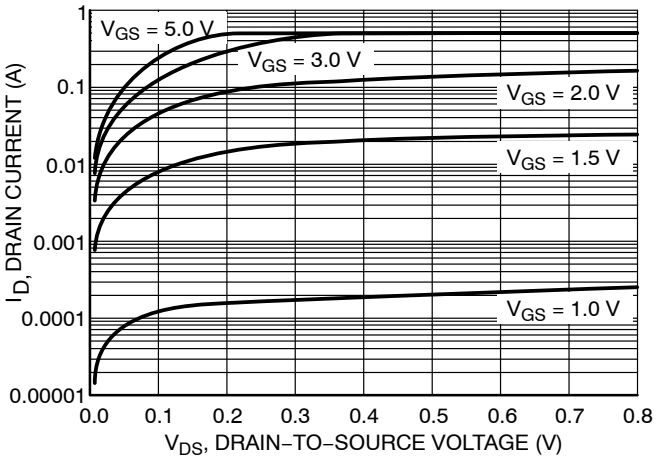


Figure 2. Output Characteristics

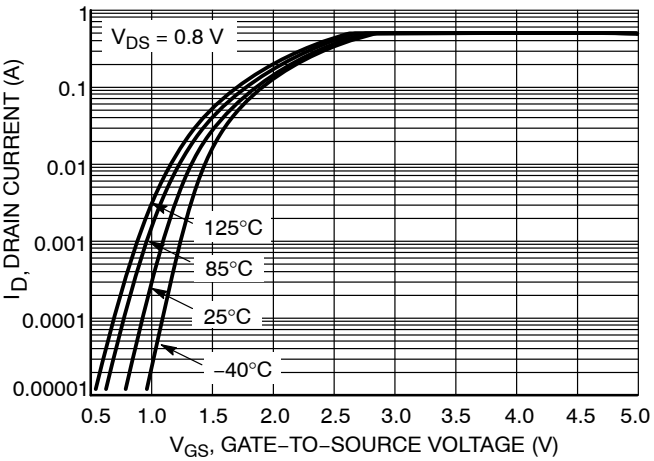


Figure 3. Transfer Function

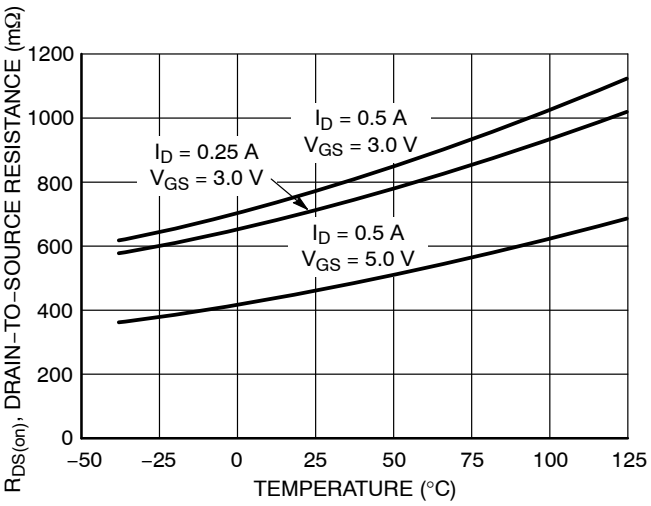


Figure 4. On−Resistance Variation vs. Temperature

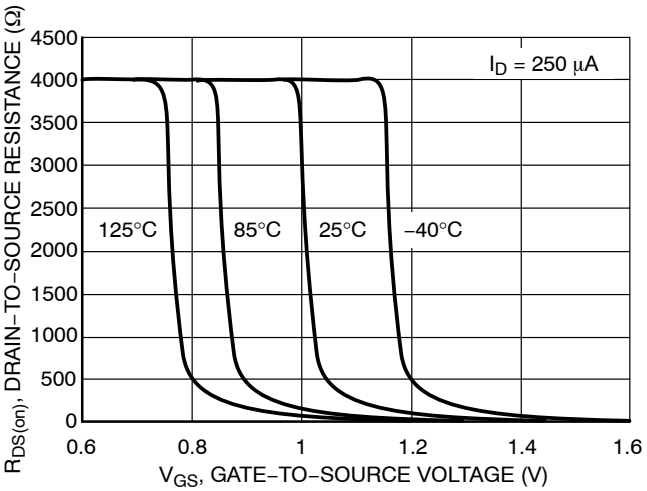


Figure 5. $R_{DS(ON)}$ Variation vs. Gate−to−Source Voltage

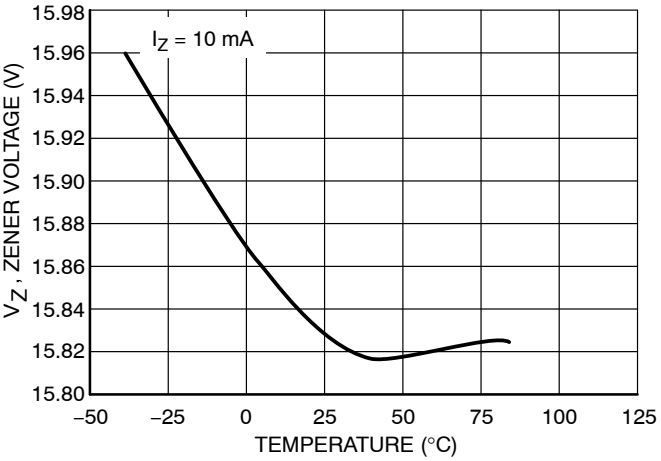


Figure 6. Zener Voltage vs. Temperature

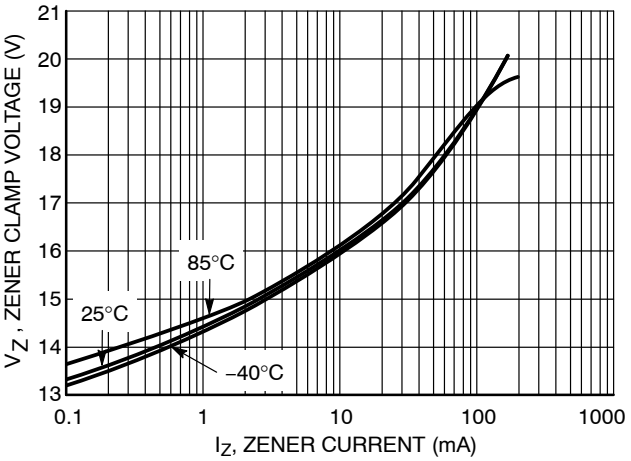


Figure 7. Zener Clamp Voltage vs. Zener Current

TYPICAL PERFORMANCE CURVES (T_J = 25°C unless otherwise specified)

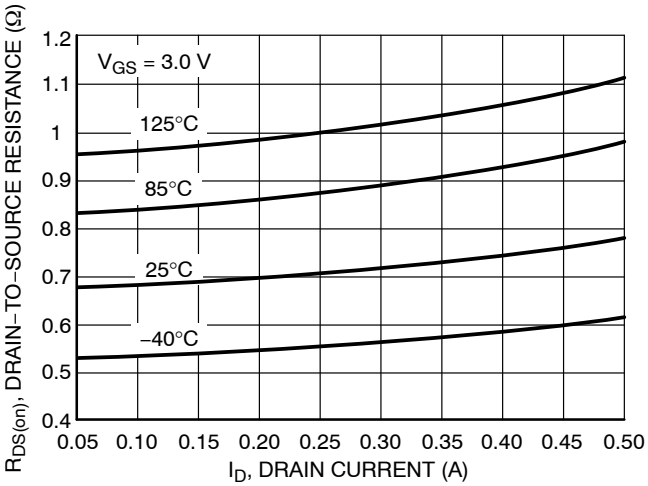


Figure 8. On−Resistance vs. Drain Current and Temperature

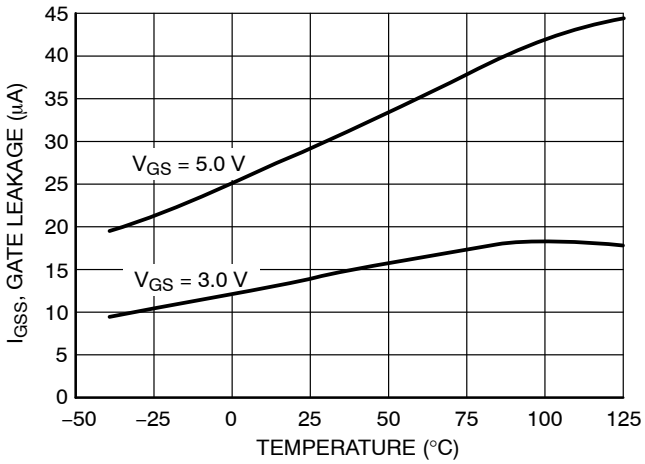


Figure 9. Gate Leakage vs. Temperature

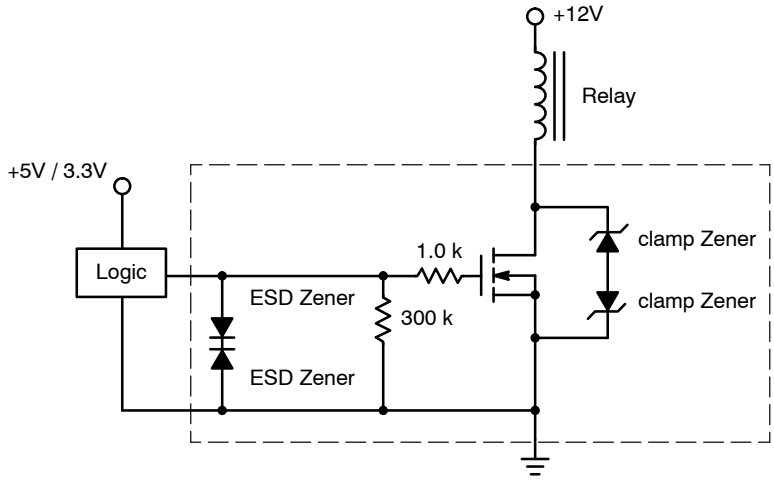


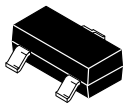
Figure 10. Typical Application Circuit

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

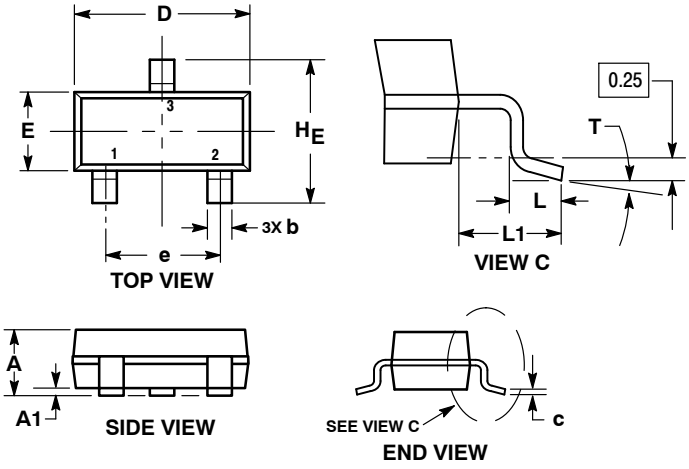
ON Semiconductor®

SOT−23 (TO−236)
CASE 318−08
ISSUE AS

DATE 30 JAN 2018



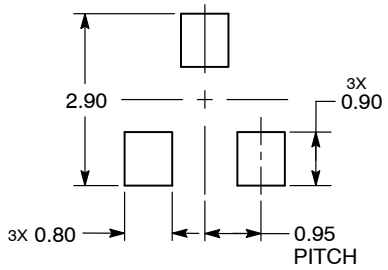
SCALE 4:1



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

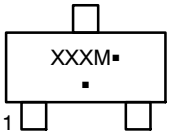
	MILLIMETERS			INCHES		
DIM	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
H_E	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	−−−	10°	0°	−−−	10°

RECOMMENDED SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

GENERIC MARKING DIAGRAM*



XXX = Specific Device Code
M = Date Code
▪ = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present.

STYLE 1 THRU 5:
CANCELLED

STYLE 6:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

STYLE 7:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

STYLE 8:
PIN 1. ANODE
2. NO CONNECTION
3. CATHODE

STYLE 9:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 10:
PIN 1. DRAIN
2. SOURCE
3. GATE

STYLE 11:
PIN 1. ANODE
2. CATHODE
3. CATHODE−ANODE

STYLE 12:
PIN 1. CATHODE
2. CATHODE
3. ANODE

STYLE 13:
PIN 1. SOURCE
2. DRAIN
3. GATE

STYLE 14:
PIN 1. CATHODE
2. GATE
3. ANODE

STYLE 15:
PIN 1. GATE
2. CATHODE
3. ANODE

STYLE 16:
PIN 1. ANODE
2. CATHODE
3. CATHODE

STYLE 17:
PIN 1. NO CONNECTION
2. ANODE
3. CATHODE

STYLE 18:
PIN 1. NO CONNECTION
2. CATHODE
3. ANODE

STYLE 19:
PIN 1. CATHODE
2. ANODE
3. CATHODE−ANODE

STYLE 20:
PIN 1. CATHODE
2. ANODE
3. GATE

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

STYLE 22:
PIN 1. RETURN
2. OUTPUT
3. INPUT

STYLE 23:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 24:
PIN 1. GATE
2. DRAIN
3. SOURCE

STYLE 25:
PIN 1. ANODE
2. CATHODE
3. GATE

STYLE 26:
PIN 1. CATHODE
2. ANODE
3. NO CONNECTION

STYLE 27:
PIN 1. CATHODE
2. CATHODE
3. CATHODE

STYLE 28:
PIN 1. ANODE
2. ANODE
3. ANODE

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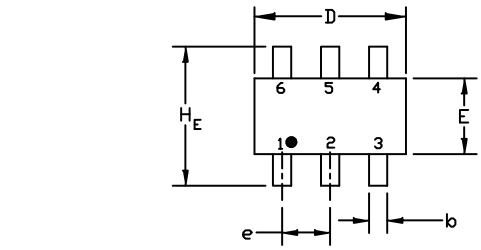
DESCRIPTION:	**SOT−23 (TO−236)**	**PAGE 1 OF 1**

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

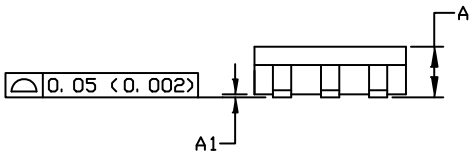
SCALE 2:1

SC−74
CASE 318F
ISSUE P

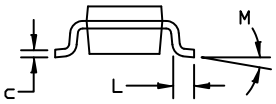
DATE 07 OCT 2021



TOP VIEW



SIDE VIEW

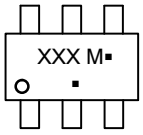


END VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994
2. CONTROLLING DIMENSION: INCHES
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.

	MILLIMETERS			INCHES		
DIM	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
H_E	2.50	2.75	3.00	0.099	0.108	0.118
L	0.20	0.40	0.60	0.008	0.016	0.024
M	0°	---	10°	0°	---	10°

GENERIC MARKING DIAGRAM*



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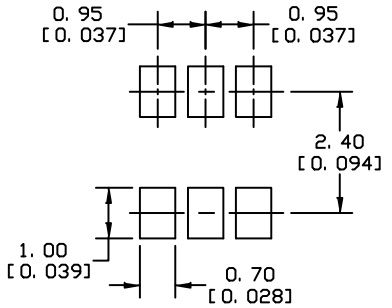
M = Date Code
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.



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

SOLDERING FOOTPRINT

STYLE 1:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. ANODE
6. CATHODE

STYLE 2:
PIN 1. NO CONNECTION
2. COLLECTOR
3. EMITTER
4. NO CONNECTION
5. COLLECTOR
6. BASE

STYLE 3:
PIN 1. EMITTER 1
2. BASE 1
3. COLLECTOR 2
4. EMITTER 2
5. BASE 2
6. COLLECTOR 1

STYLE 4:
PIN 1. COLLECTOR 2
2. EMITTER 1/EMITTER 2
3. COLLECTOR 1
4. EMITTER 3
5. BASE 1/BASE 2/COLLECTOR 3
6. BASE 3

STYLE 5:
PIN 1. CHANNEL 1
2. ANODE
3. CHANNEL 2
4. CHANNEL 3
5. CATHODE
6. CHANNEL 4

STYLE 6:
PIN 1. CATHODE
2. ANODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE

STYLE 7:
PIN 1. SOURCE 1
2. GATE 1
3. DRAIN 2
4. SOURCE 2
5. GATE 2
6. DRAIN 1

STYLE 8:
PIN 1. EMITTER 1
2. BASE 2
3. COLLECTOR 2
4. EMITTER 2
5. BASE 1
6. COLLECTOR 1

STYLE 9:
PIN 1. EMITTER 2
2. BASE 2
3. COLLECTOR 1
4. EMITTER 1
5. BASE 1
6. COLLECTOR 2

STYLE 10:
PIN 1. ANODE/CATHODE
2. BASE
3. EMITTER
4. COLLECTOR
5. ANODE
6. CATHODE

STYLE 11:
PIN 1. EMITTER
2. BASE
3. ANODE/CATHODE
4. ANODE
5. CATHODE
6. COLLECTOR

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DESCRIPTION:	**SC−74**	**PAGE 1 OF 1**

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