NUD3160, SZNUD3160

Industrial Inductive Load Driver

ON Semiconductor®

http://onsemi.com

This micro−integrated part provides a single component solution to switch inductive loads such as relays, solenoids, and small DC motors without the need of a free−wheeling diode. 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 Robust Interface between D.C. Relay Coils and Sensitive Logic
- Capable of Driving Relay Coils Rated up to 150 mA at 12 V, 24 V or 48 V
- Replaces 3 or 4 Discrete Components for Lower Cost
- Internal Zener Eliminates Need for Free−Wheeling Diode
- Meets Load Dump and other Automotive Specs
- 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

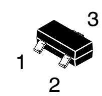
Typical Applications

- Automotive and Industrial Environment
- Drives Window, Latch, Door, and Antenna Relays

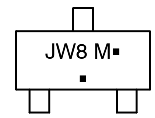
Benefits

- Reduced PCB Space
- Standardized Driver for Wide Range of Relays
- Simplifies Circuit Design and PCB Layout
- Compliance with Automotive Specifications

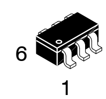
MARKING DIAGRAMS



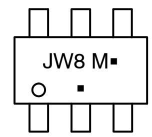
**SOT−23
CASE 318
STYLE 21**



JW8 = Specific Device Code
M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)



**SC−74
CASE 318F
STYLE 7**



JW8 = Specific Device Code
M = Date Code
▪ = Pb−Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping†
NUD3160LT1G	SOT−23 (Pb−Free)	3000 / Tape & Reel
SZNUD3160LT1G	SOT−23 (Pb−Free)	3000 / Tape & Reel
NUD3160DMT1G	SC−74 (Pb−Free)	3000 / Tape & Reel
SZNUD3160DMT1G	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.

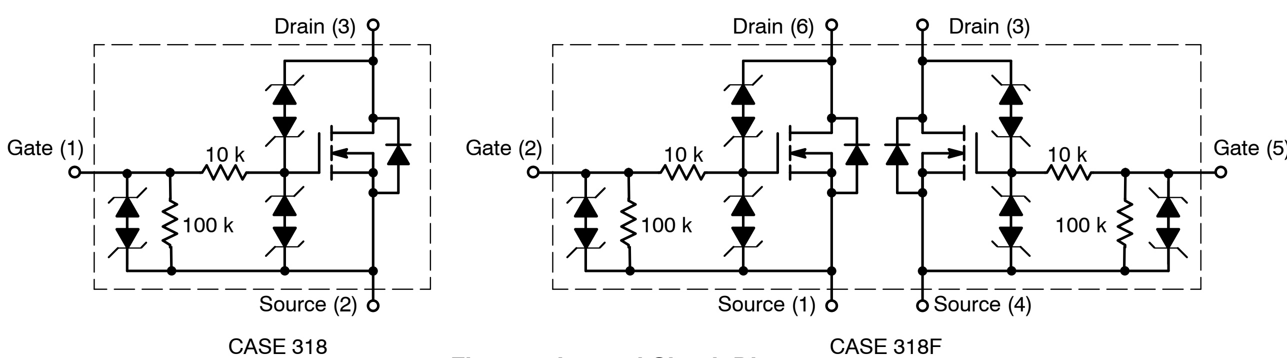


Figure 1. Internal Circuit Diagrams

MAXIMUM RATINGS (T_J = 25°C unless otherwise specified)

Symbol	Rating	Value	Unit
V_{DSS}	Drain−to−Source Voltage – Continuous (T_J = 125°C)	60	V
V_{GSS}	Gate−to−Source Voltage – Continuous (T_J = 125°C)	12	V
I_D	Drain Current – Continuous (T_J = 125°C) Minimum copper, double sided board, T_A = 80°C SOT−23 SC74 Single device driven SC74 Both devices driven 1 in^2 copper, double sided board, T_A = 25°C SOT−23 SC74 Single device driven SC74 Both devices driven	 158 157 132 ea 272 263 230 ea	mA
E_Z	Single Pulse Drain−to−Source Avalanche Energy (For Relay's Coils/Inductive Loads of 80 Ω or Higher) (T_J Initial = 85°C)	200	mJ
P_{PK}	Peak Power Dissipation, Drain−to−Source (Notes 1 and 2) (T_J Initial = 85°C)	20	W
E_{LD1}	Load Dump Pulse, Drain−to−Source (Note 3) R_{SOURCE} = 0.5 Ω, T = 300 ms) (For Relay's Coils/Inductive Loads of 80 Ω or Higher) (T_J Initial = 85°C)	60	V
E_{LD2}	Inductive Switching Transient 1, Drain−to−Source (Waveform: R_{SOURCE} = 10 Ω, T = 2.0 ms) (For Relay's Coils/Inductive Loads of 80 Ω or Higher) (T_J Initial = 85°C)	100	V
E_{LD3}	Inductive Switching Transient 2, Drain−to−Source (Waveform: R_{SOURCE} = 4.0 Ω, T = 50 μs) (For Relay's Coils/Inductive Loads of 80 Ω or Higher) (T_J Initial = 85°C)	300	V
Rev−Bat	Reverse Battery, 10 Minutes (Drain−to−Source) (For Relay's Coils/Inductive Loads of 80 Ω or more)	−14	V
Dual−Volt	Dual Voltage Jump Start, 10 Minutes (Drain−to−Source)	28	V
ESD	Human Body Model (HBM) According to EIA/JESD22/A114 Specification	2000	V

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

THERMAL CHARACTERISTICS

Symbol	Rating		Value	Unit
T_A	Operating Ambient Temperature		−40 to 125	°C
T_J	Maximum Junction Temperature		150	°C
T_{STG}	Storage Temperature Range		−65 to 150	°C
P_D	Total Power Dissipation (Note 4) Derating above 25°C	SOT−23	225 1.8	mW mW/°C
P_D	Total Power Dissipation (Note 4) Derating above 25°C	SC−74	380 3.0	mW mW/°C
$R_{\theta JA}$	Thermal Resistance, Junction−to−Ambient Minimum Copper	SOT−23 SC−74 One Device Powered SC−74 Both Devices Equally Powered	556 556 398	°C/W
	300 mm^2 Copper	SOT−23 SC−74 One Device Powered SC−74 Both Devices Equally Powered	395 420 270	

1. Nonrepetitive current square pulse 1.0 ms duration.
2. For different square pulse durations, see Figure 12.
3. Nonrepetitive load dump pulse per Figure 3.
4. Mounted onto minimum pad board.

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Drain to Source Sustaining Voltage (I_D = 10 mA)	V_{BRDSS}	61	66	70	V
Drain to Source Leakage Current	I_{DSS}				μA
(V_{DS} = 12 V, V_{GS} = 0 V)		–	–	0.5	
(V_{DS} = 12 V, V_{GS} = 0 V, T_J = 125°C)		–	–	1.0	
(V_{DS} = 60 V, V_{GS} = 0 V)		–	–	50	
(V_{DS} = 60 V, V_{GS} = 0 V, T_J = 125°C)		–	–	80	
Gate Body Leakage Current	I_{GSS}				μA
(V_{GS} = 3.0 V, V_{DS} = 0 V)		–	–	60	
(V_{GS} = 3.0 V, V_{DS} = 0 V, T_J = 125°C)		–	–	80	
(V_{GS} = 5.0 V, V_{DS} = 0 V)		–	–	90	
(V_{GS} = 5.0 V, V_{DS} = 0 V, T_J = 125°C)		–	–	110	
ON CHARACTERISTICS					
Gate Threshold Voltage	$V_{GS(th)}$				V
(V_{GS} = V_{DS}, I_D = 1.0 mA)		1.3	1.8	2.0	
(V_{GS} = V_{DS}, I_D = 1.0 mA, T_J = 125°C)		1.3	–	2.0	
Drain to Source On−Resistance	$R_{DS(on)}$				Ω
(I_D = 150 mA, V_{GS} = 3.0 V)		–	–	2.4	
(I_D = 150 mA, V_{GS} = 3.0 V, T_J = 125°C)		–	–	3.7	
(I_D = 150 mA, V_{GS} = 5.0 V)		–	–	1.8	
(I_D = 150 mA, V_{GS} = 5.0 V, T_J = 125°C)		–	–	2.9	
Output Continuous Current	$I_{DS(on)}$				mA
(V_{DS} = 0.3 V, V_{GS} = 5.0 V)		150	200	–	
(V_{DS} = 0.3 V, V_{GS} = 5.0 V, T_J = 125°C)		100	–	–	
Forward Transconductance (V_{DS} = 12 V, I_D = 150 mA)	g_{FS}	–	400	–	mmho
DYNAMIC CHARACTERISTICS					
Input Capacitance (V_{DS} = 12 V, V_{GS} = 0 V, f = 10 kHz)	C_{iss}	–	30	–	pf
Output Capacitance (V_{DS} = 12 V, V_{GS} = 0 V, f = 10 kHz)	C_{oss}	–	14	–	pf
Transfer Capacitance (V_{DS} = 12 V, V_{GS} = 0 V, f = 10 kHz)	C_{rss}	–	6.0	–	pf
SWITCHING CHARACTERISTICS					
Propagation Delay Times:					ns
High to Low Propagation Delay; Figure 2, (V_{DS} = 12 V, V_{GS} = 3.0 V)	t_{PHL}	–	918	–	
Low to High Propagation Delay; Figure 2, (V_{DS} = 12 V, V_{GS} = 3.0 V)	t_{PLH}	–	798	–	
High to Low Propagation Delay; Figure 2, (V_{DS} = 12 V, V_{GS} = 5.0 V)	t_{PHL}	–	331	–	
Low to High Propagation Delay; Figure 2, (V_{DS} = 12 V, V_{GS} = 5.0 V)	t_{PLH}	–	1160	–	
Transition Times:					ns
Fall Time; Figure 2, (V_{DS} = 12 V, V_{GS} = 3.0 V)	t_f	–	2290	–	
Rise Time; Figure 2, (V_{DS} = 12 V, V_{GS} = 3.0 V)	t_r	–	618	–	
Fall Time; Figure 2, (V_{DS} = 12 V, V_{GS} = 5.0 V)	t_f	–	622	–	
Rise Time; Figure 2, (V_{DS} = 12 V, V_{GS} = 5.0 V)	t_r	–	600	–	

TYPICAL WAVEFORMS

(T_J = 25°C unless otherwise specified)

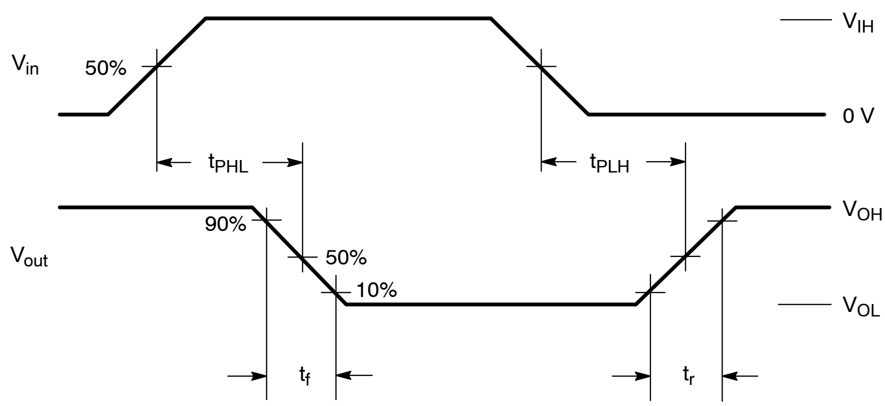


Figure 2. Switching Waveforms

Load Dump Pulse Not Suppressed:

- V_r = 13.5 V Nominal ±10%
- V_S = 60 V Nominal ±10%
- T = 300 ms Nominal ±10%
- t_r = 1 − 10 ms ±10%

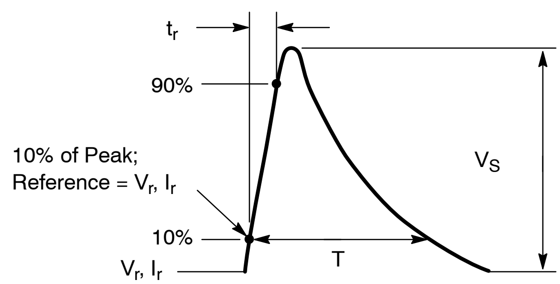


Figure 3. Load Dump Waveform Definition

TYPICAL PERFORMANCE CURVES

(T_J = 25°C unless otherwise specified)

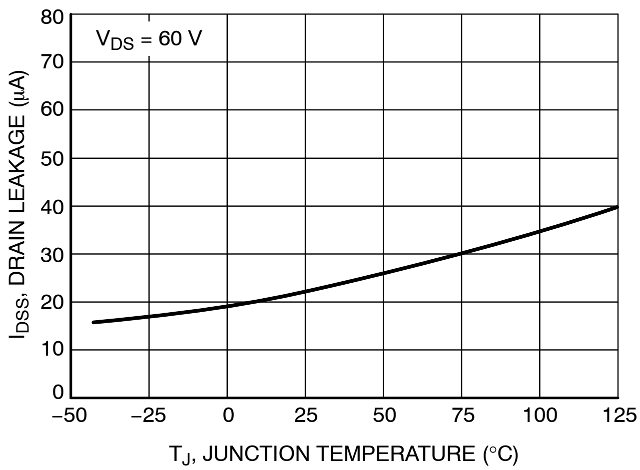


Figure 4. Drain−to−Source Leakage vs. Junction Temperature

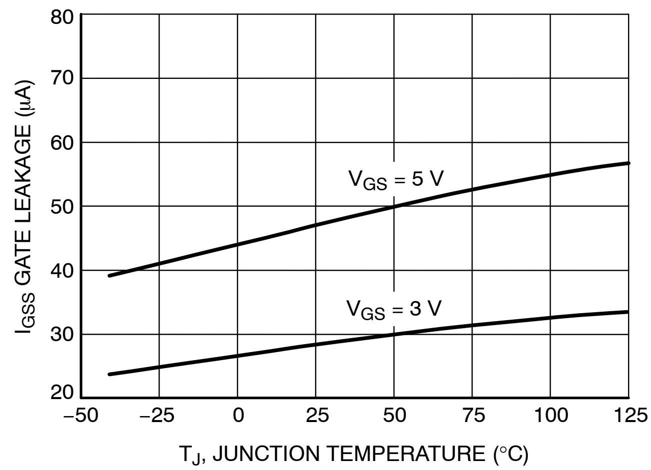


Figure 5. Gate−to−Source Leakage vs. Junction Temperature

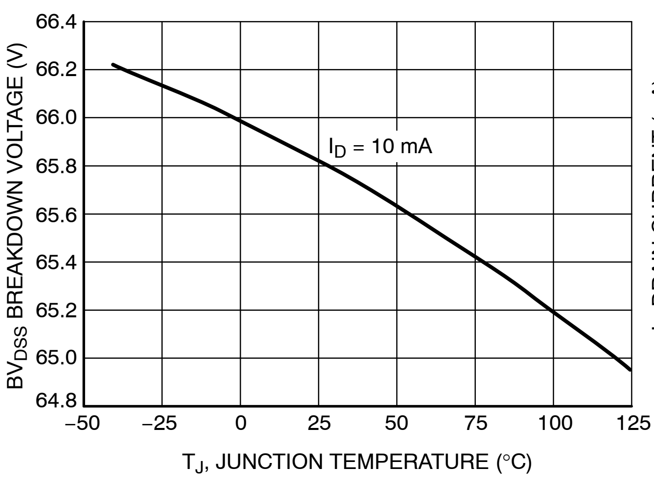


Figure 6. Breakdown Voltage vs. Junction Temperature

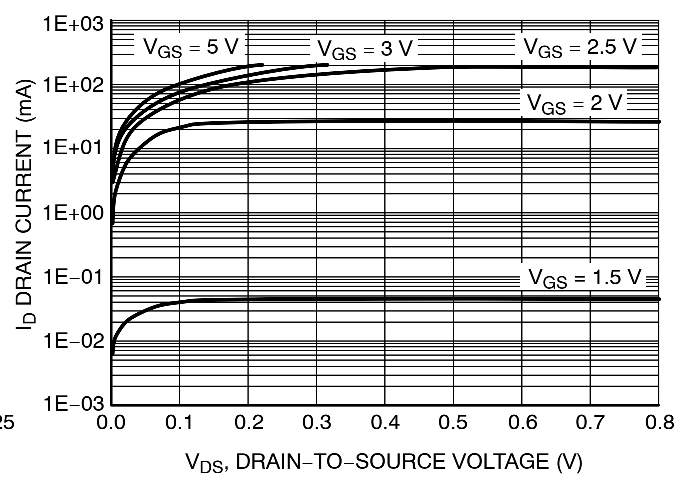


Figure 7. Output Characteristics

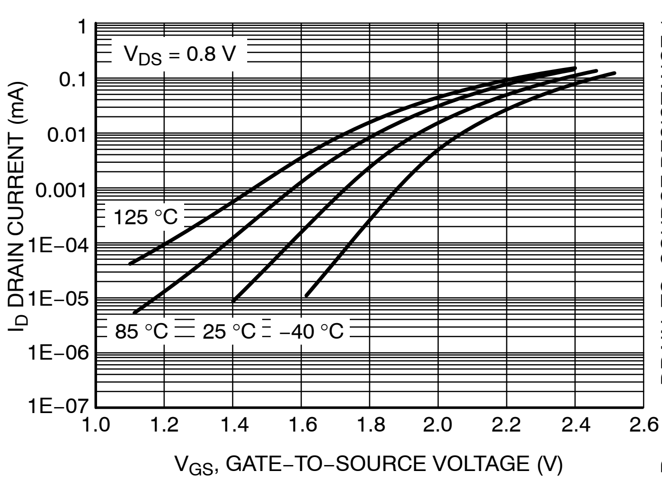


Figure 8. Transfer Function

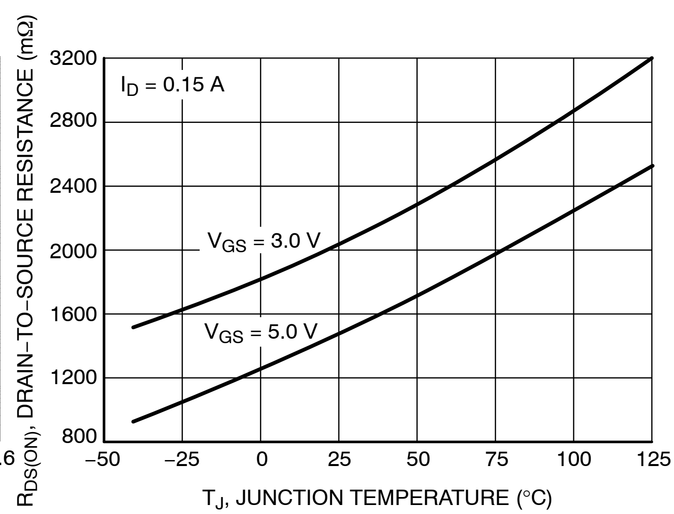


Figure 9. On Resistance Variation vs Junction Temperature

TYPICAL PERFORMANCE CURVES

(T_J = 25°C unless otherwise specified)

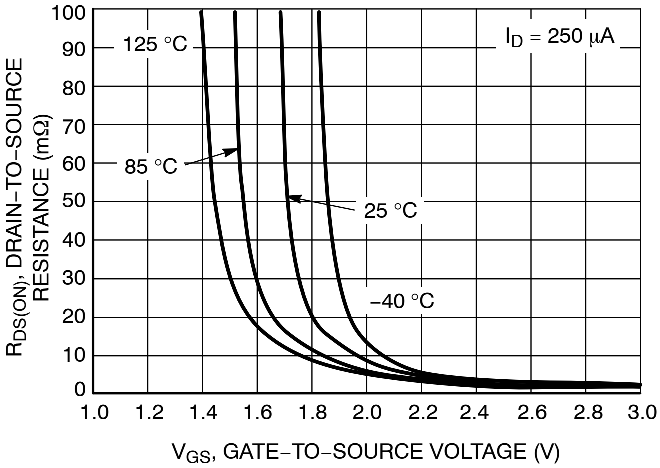


Figure 10. On Resistance Variation vs. Gate−to−Source Voltage

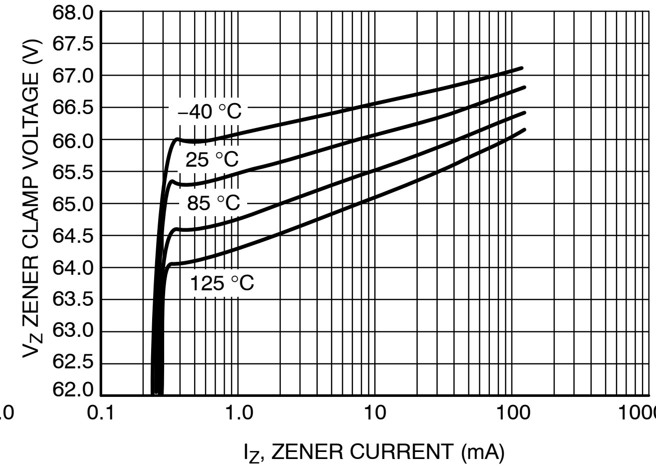


Figure 11. Zener Clamp Voltage vs. Zener Current

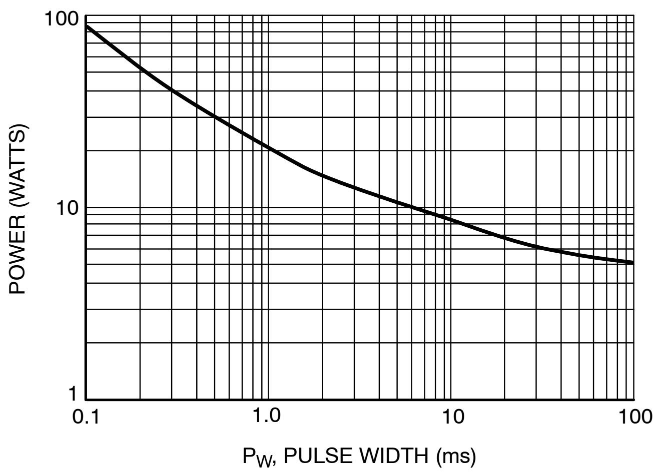


Figure 12. Maximum Non−repetitive Surge Power vs. Pulse Width

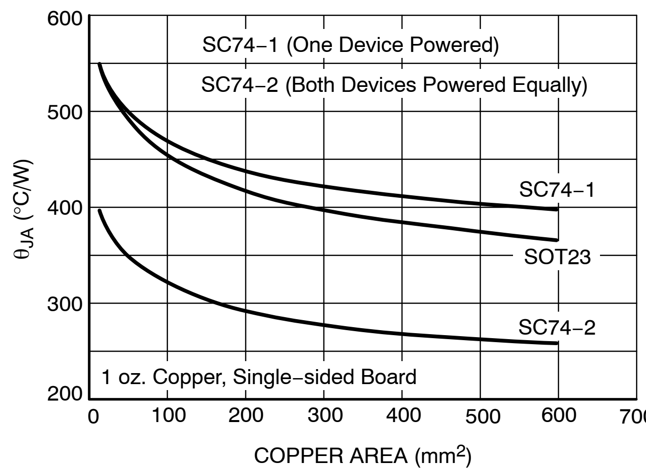


Figure 13. Thermal Performance vs. Board Copper Area

APPLICATIONS INFORMATION

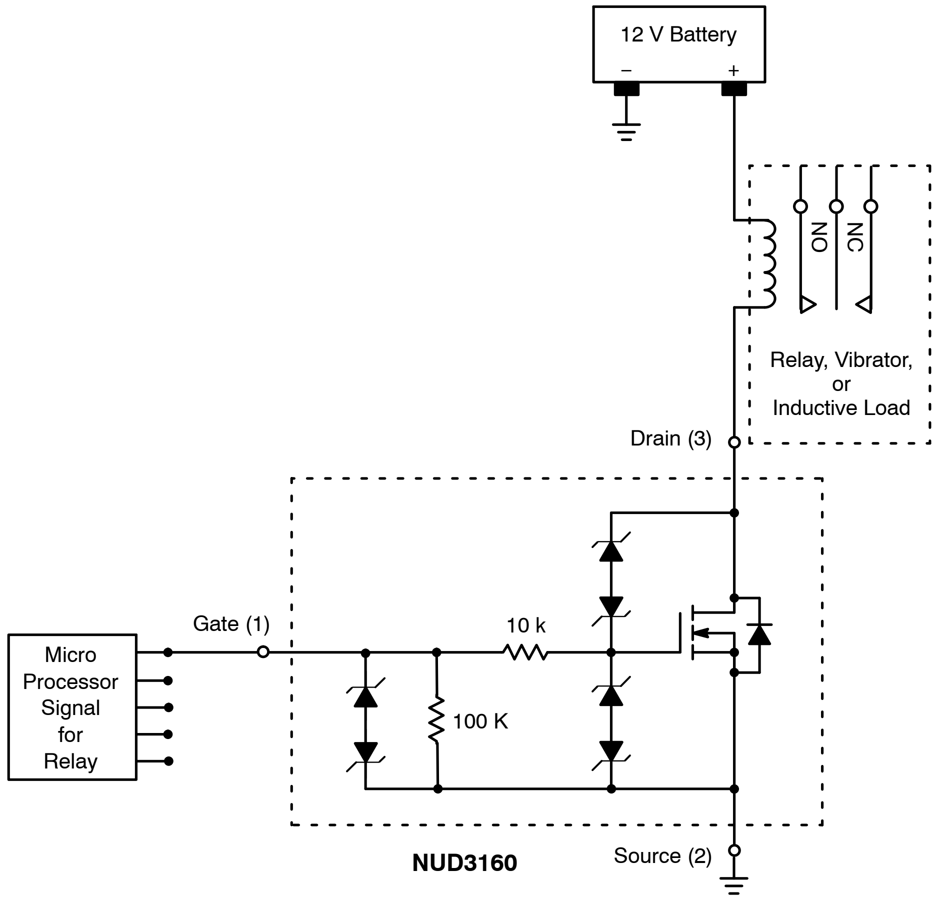
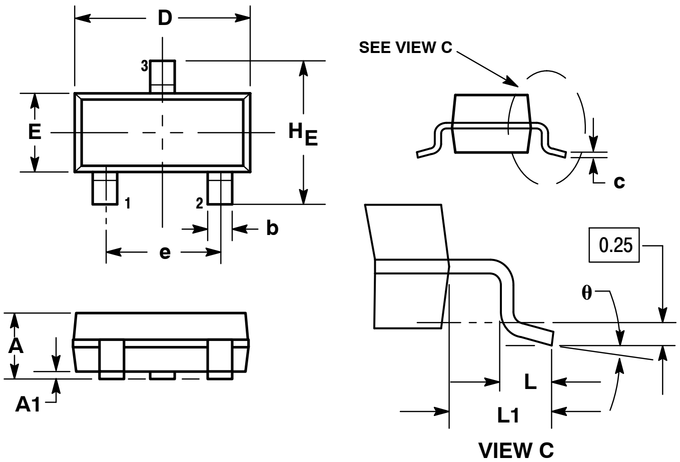


Figure 14. Applications Diagram

PACKAGE DIMENSIONS

SOT−23 (TO−236)
CASE 318−08
ISSUE AP

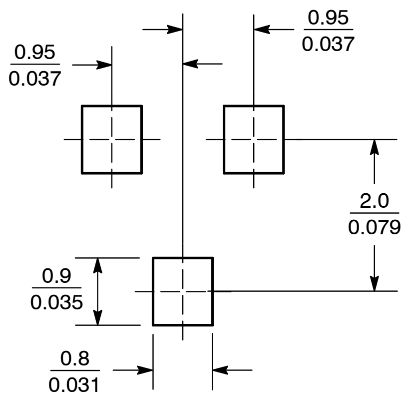


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

	MILLIMETERS			INCHES		
DIM	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:
PIN 1. GATE
2. SOURCE
3. DRAIN

SOLDERING FOOTPRINT*

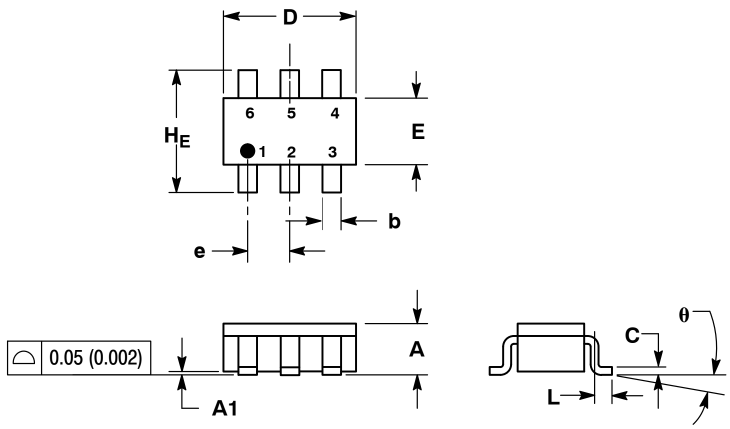


SCALE 10:1 (mm / inches)

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

PACKAGE DIMENSIONS

SC−74
CASE 318F−05
ISSUE M

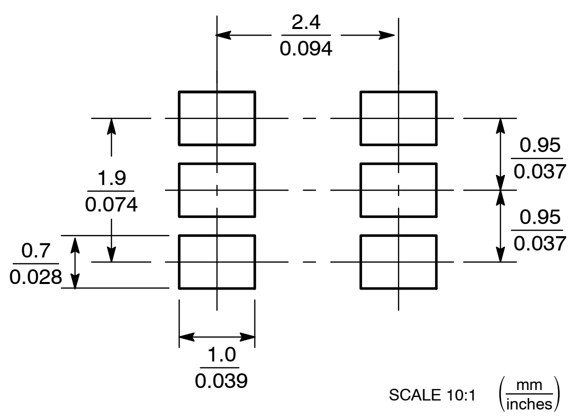


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F−01, −02, −03, −04 OBSOLETE. NEW STANDARD 318F−05.

	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
L	0.20	0.40	0.60	0.008	0.016	0.024
H_E	2.50	2.75	3.00	0.099	0.108	0.118
θ	0°	−	10°	0°	−	10°

STYLE 7:
PIN 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.

PUBLICATION ORDERING INFORMATION

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(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

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Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А