

NUD3160

Industrial Inductive Load Driver

This MicroIntegration™ 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
- Pb-Free Packages are Available

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



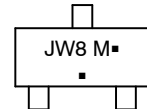
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MARKING DIAGRAMS



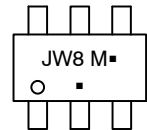
**SOT-23
CASE 318
STYLE 21**



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†
NUD3160LT1	SOT-23	3000/Tape & Reel
NUD3160LT1G	SOT-23 (Pb-Free)	3000/Tape & Reel
NUD3160DMT1	SC-74	3000/Tape & Reel
NUD3160DMT1G	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.

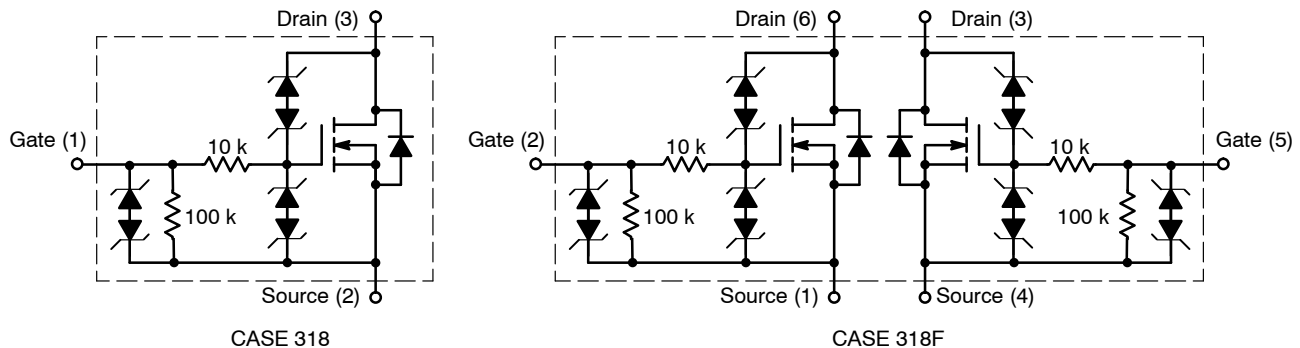


Figure 1. Internal Circuit Diagrams

NUD3160

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

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 _{θJA}	Thermal Resistance, Junction-to-Ambient Minimum Copper 300 mm ² Copper	SOT-23 556 556 398 SOT-23 395 420 270	°C/W

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.

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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 (V _{DS} = 12 V, V _{GS} = 0 V) (V _{DS} = 12 V, V _{GS} = 0 V, T _J = 125°C) (V _{DS} = 60 V, V _{GS} = 0 V) (V _{DS} = 60 V, V _{GS} = 0 V, T _J = 125°C)	I _{DSS}	–	–	0.5 1.0 50 80	μA
Gate Body Leakage Current (V _{GS} = 3.0 V, V _{DS} = 0 V) (V _{GS} = 3.0 V, V _{DS} = 0 V, T _J = 125°C) (V _{GS} = 5.0 V, V _{DS} = 0 V) (V _{GS} = 5.0 V, V _{DS} = 0 V, T _J = 125°C)	I _{GSS}	–	–	60 80 90 110	μA
ON CHARACTERISTICS					
Gate Threshold Voltage (V _{GS} = V _{DS} , I _D = 1.0 mA) (V _{GS} = V _{DS} , I _D = 1.0 mA, T _J = 125°C)	V _{GS(th)}	1.3 1.3	1.8 –	2.0 2.0	V
Drain to Source On-Resistance (I _D = 150 mA, V _{GS} = 3.0 V) (I _D = 150 mA, V _{GS} = 3.0 V, T _J = 125°C) (I _D = 150 mA, V _{GS} = 5.0 V) (I _D = 150 mA, V _{GS} = 5.0 V, T _J = 125°C)	R _{DS(on)}	–	–	2.4 3.7 1.8 2.9	Ω
Output Continuous Current (V _{DS} = 0.3 V, V _{GS} = 5.0 V) (V _{DS} = 0.3 V, V _{GS} = 5.0 V, T _J = 125°C)	I _{DS(on)}	150 100	200 –	– –	mA
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: High to Low Propagation Delay; Figure 2, (V _{DS} = 12 V, V _{GS} = 3.0 V) Low to High Propagation Delay; Figure 2, (V _{DS} = 12 V, V _{GS} = 3.0 V) High to Low Propagation Delay; Figure 2, (V _{DS} = 12 V, V _{GS} = 5.0 V) Low to High Propagation Delay; Figure 2, (V _{DS} = 12 V, V _{GS} = 5.0 V)	t _{PHL} t _{PLH} t _{PHL} t _{PLH}	– – – –	918 798 331 1160	– – – –	ns
Transition Times: Fall Time; Figure 2, (V _{DS} = 12 V, V _{GS} = 3.0 V) Rise Time; Figure 2, (V _{DS} = 12 V, V _{GS} = 3.0 V) Fall Time; Figure 2, (V _{DS} = 12 V, V _{GS} = 5.0 V) Rise Time; Figure 2, (V _{DS} = 12 V, V _{GS} = 5.0 V)	t _f t _r t _f t _r	– – – –	2290 618 622 600	– – – –	ns

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TYPICAL WAVEFORMS

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

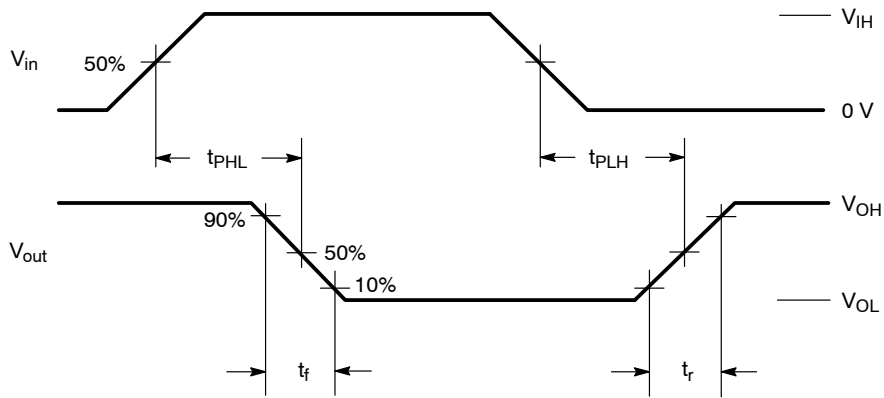


Figure 2. Switching Waveforms

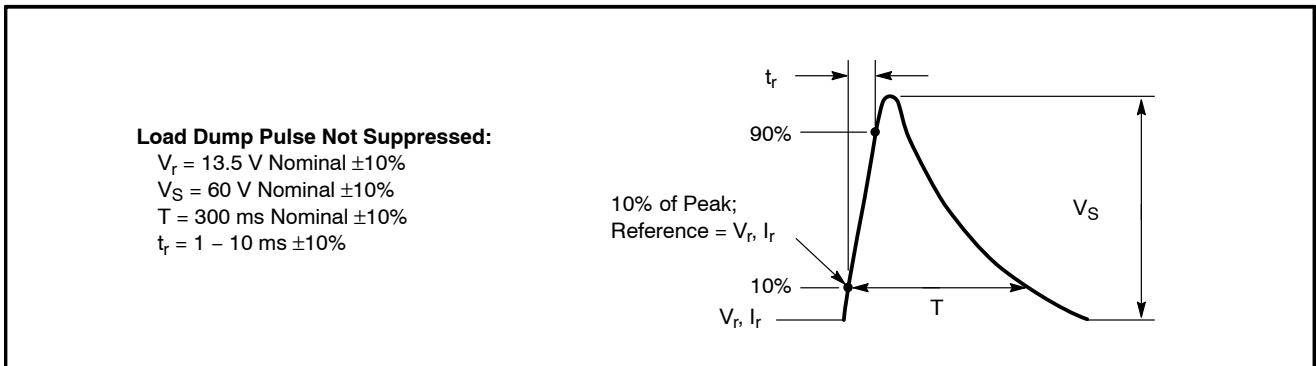


Figure 3. Load Dump Waveform Definition

TYPICAL PERFORMANCE CURVES

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

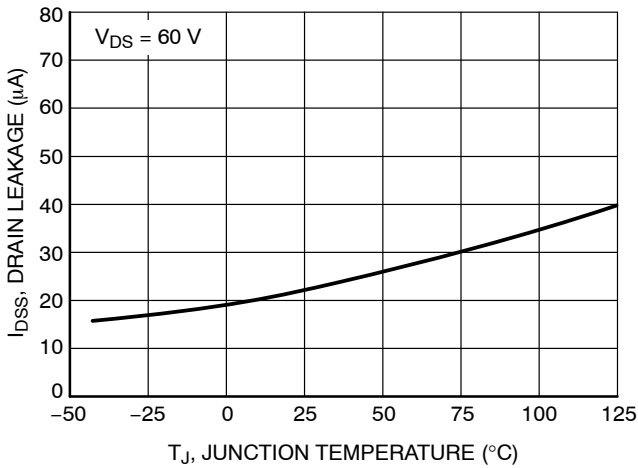


Figure 4. Drain-to-Source Leakage vs. Junction Temperature

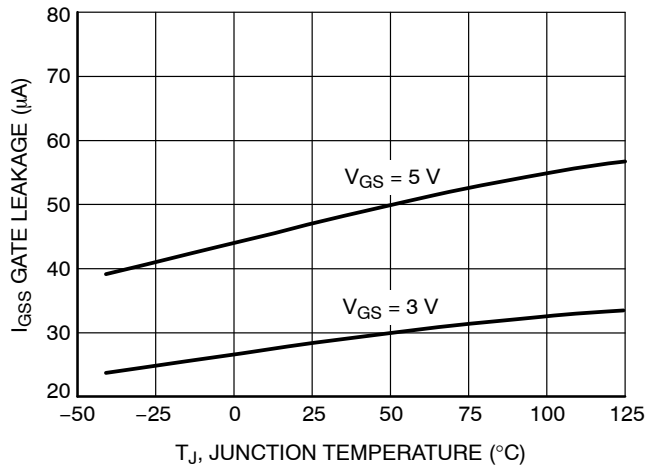


Figure 5. Gate-to-Source Leakage vs. Junction Temperature

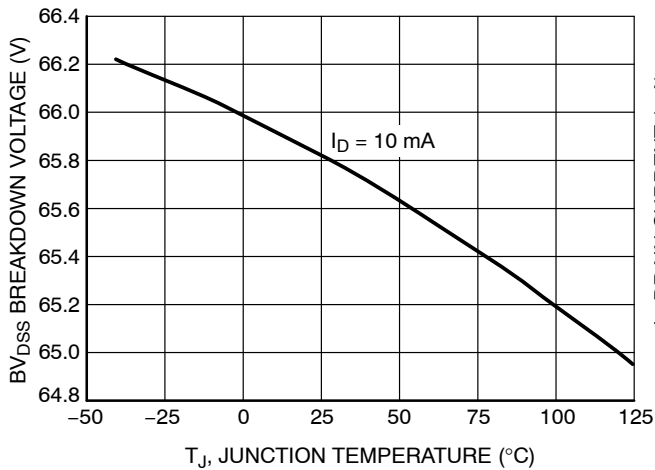


Figure 6. Breakdown Voltage vs. Junction Temperature

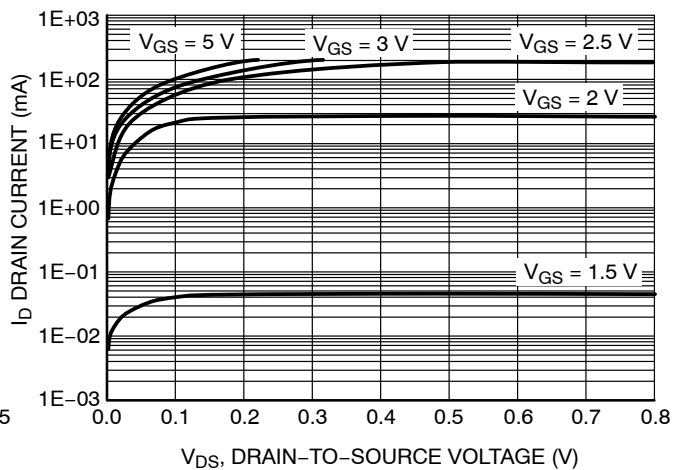


Figure 7. Output Characteristics

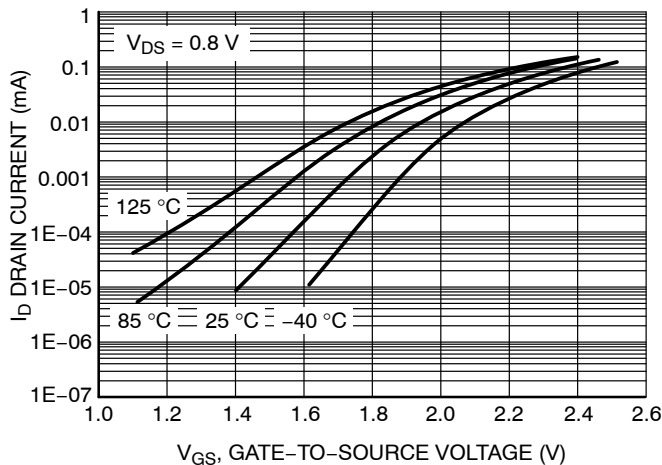


Figure 8. Transfer Function

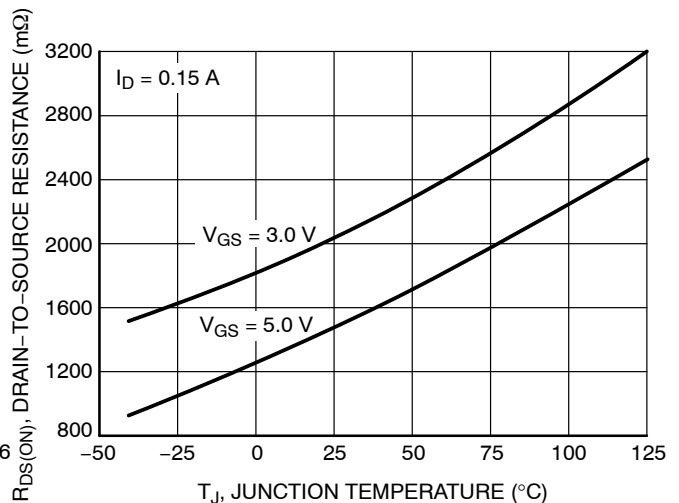


Figure 9. On Resistance Variation vs. Junction Temperature

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TYPICAL PERFORMANCE CURVES

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

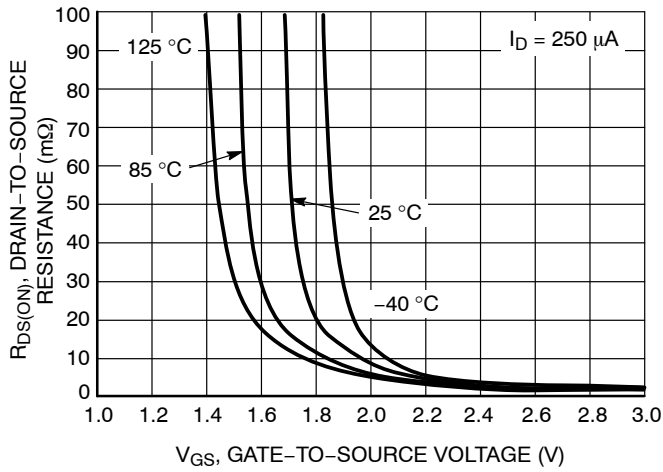


Figure 10. On Resistance Variation vs. Gate-to-Source Voltage

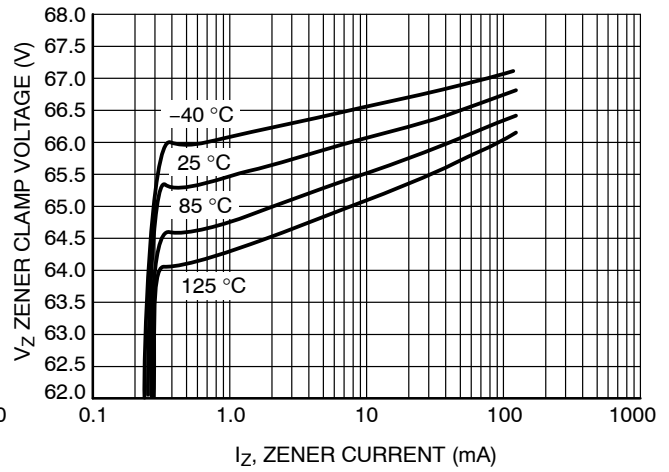


Figure 11. Zener Clamp Voltage vs. Zener Current

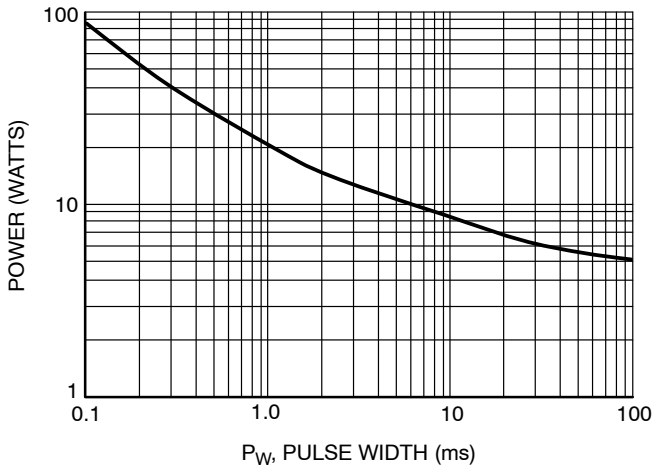


Figure 12. Maximum Non-repetitive Surge Power vs. Pulse Width

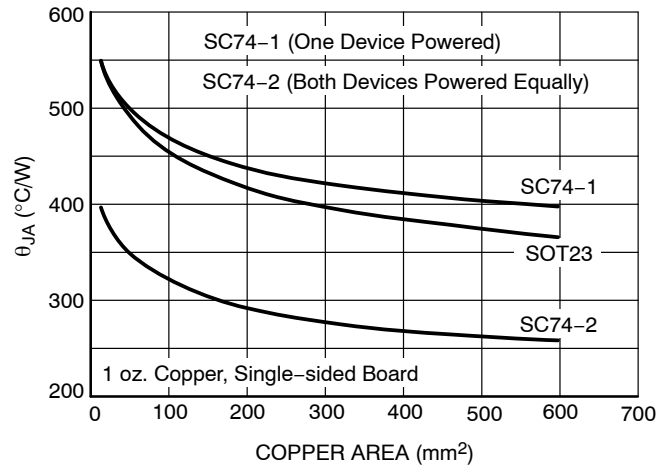


Figure 13. Thermal Performance vs. Board Copper Area

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APPLICATIONS INFORMATION

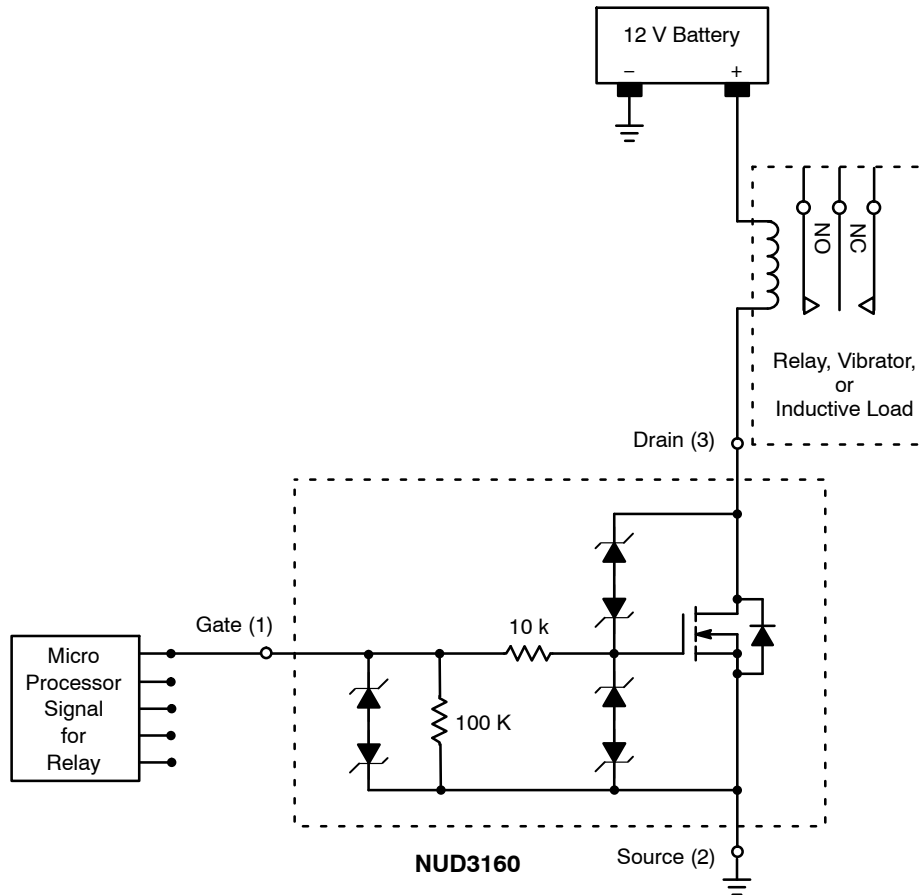
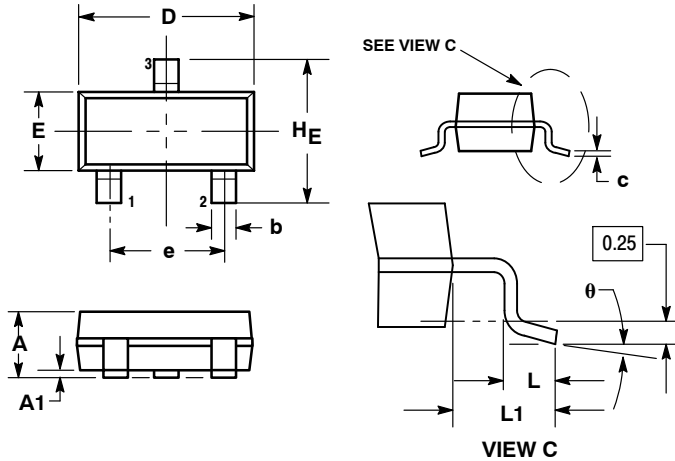


Figure 14. Applications Diagram

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PACKAGE DIMENSIONS

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

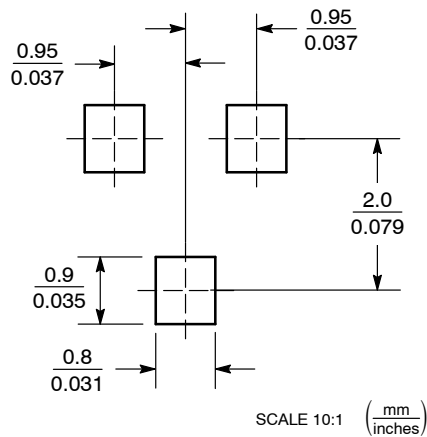


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
 4. 318-01 THRU -07 AND -09 OBSOLETE, NEW STANDARD 318-08.

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

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

SOLDERING FOOTPRINT*

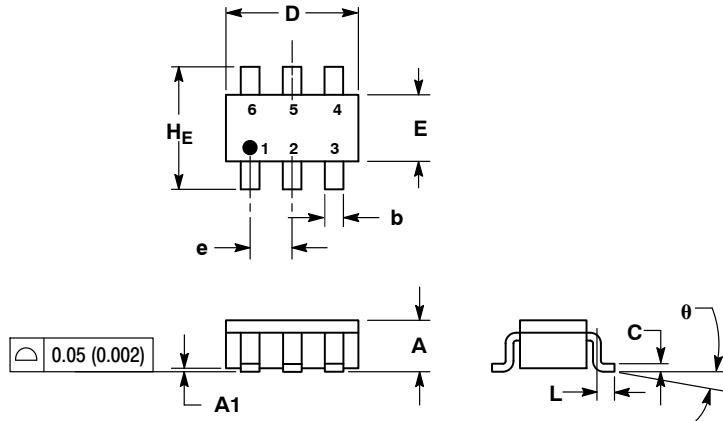


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NUD3160

PACKAGE DIMENSIONS

SC-74
CASE 318F-05
ISSUE L



NOTES:

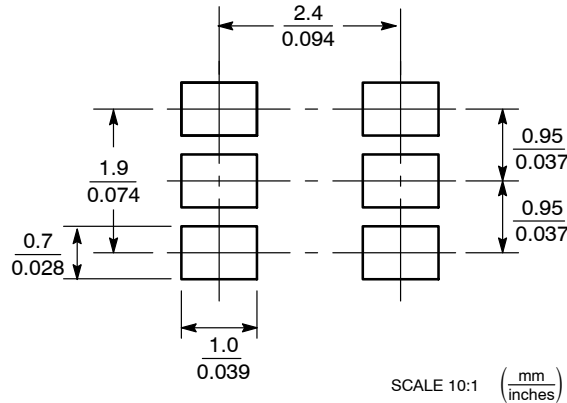
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F-01, -02, -03 OBSOLETE. NEW STANDARD 318F-04.

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
- 2. GATE 1
- 3. DRAIN 2
- 4. SOURCE 2
- 5. GATE 2
- 6. 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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