

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

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



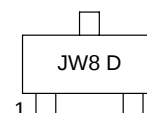
ON Semiconductor®

<http://onsemi.com>

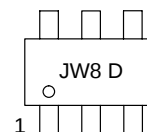


**SOT-23
CASE 318
STYLE 21**

MARKING DIAGRAMS



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

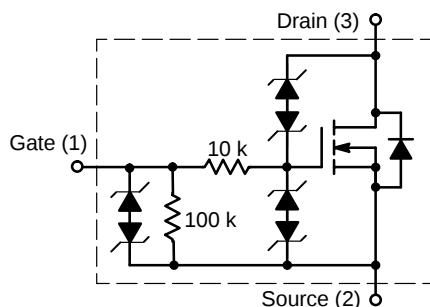


JW8 = Specific Device Code
D = Date Code

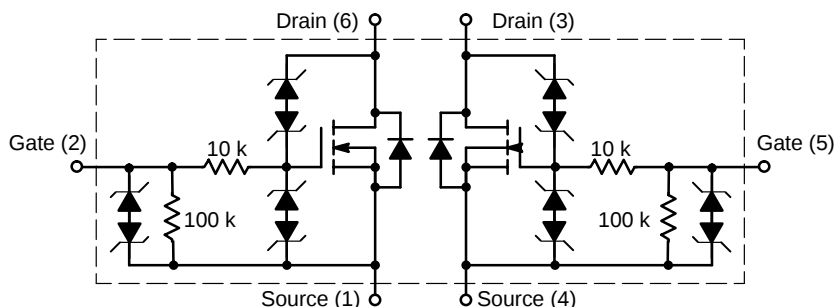
ORDERING INFORMATION

Device	Package	Shipping†
NUD3160LT1	SOT-23	3000 Tape & Reel
NUD3160DMT1	SC-74	3000 Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.



CASE 318



CASE 318F

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)	150	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
P _D	Total Power Dissipation (Note 4) Derating above 25°C	SC-74	380
			3.0
R _{θJA}	Thermal Resistance Junction-to-Ambient (Note 4)	SOT-23	556
		SC-74	329

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.

NUD3160

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Drain to Source Sustaining Voltage ($I_D = 10\text{ mA}$)	V_{BRDSS}	61	66	70	V
Drain to Source Leakage Current ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 0\text{ V}$) ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 0\text{ V}$, $T_J = 125^\circ\text{C}$) ($V_{\text{DS}} = 60\text{ V}$, $V_{\text{GS}} = 0\text{ V}$) ($V_{\text{DS}} = 60\text{ V}$, $V_{\text{GS}} = 0\text{ V}$, $T_J = 125^\circ\text{C}$)	I_{DSS}	– – – –	– – – –	0.5 1.0 50 80	μA
Gate Body Leakage Current ($V_{\text{GS}} = 3.0\text{ V}$, $V_{\text{DS}} = 0\text{ V}$) ($V_{\text{GS}} = 3.0\text{ V}$, $V_{\text{DS}} = 0\text{ V}$, $T_J = 125^\circ\text{C}$) ($V_{\text{GS}} = 5.0\text{ V}$, $V_{\text{DS}} = 0\text{ V}$) ($V_{\text{GS}} = 5.0\text{ V}$, $V_{\text{DS}} = 0\text{ V}$, $T_J = 125^\circ\text{C}$)	I_{GSS}	– – – –	– – – –	60 80 90 110	μA

ON CHARACTERISTICS

Gate Threshold Voltage ($V_{\text{GS}} = V_{\text{DS}}$, $I_D = 1.0\text{ mA}$) ($V_{\text{GS}} = V_{\text{DS}}$, $I_D = 1.0\text{ mA}$, $T_J = 125^\circ\text{C}$)	$V_{\text{GS(th)}}$	1.3 1.3	1.8 –	2.0 2.0	V
Drain to Source On-Resistance ($I_D = 150\text{ mA}$, $V_{\text{GS}} = 3.0\text{ V}$) ($I_D = 150\text{ mA}$, $V_{\text{GS}} = 3.0\text{ V}$, $T_J = 125^\circ\text{C}$) ($I_D = 150\text{ mA}$, $V_{\text{GS}} = 5.0\text{ V}$) ($I_D = 150\text{ mA}$, $V_{\text{GS}} = 5.0\text{ V}$, $T_J = 125^\circ\text{C}$)	$R_{\text{DS(on)}}$	– – – –	– – – –	2.4 3.7 1.8 2.9	Ω
Output Continuous Current ($V_{\text{DS}} = 0.3\text{ V}$, $V_{\text{GS}} = 5.0\text{ V}$) ($V_{\text{DS}} = 0.3\text{ V}$, $V_{\text{GS}} = 5.0\text{ V}$, $T_J = 125^\circ\text{C}$)	$I_{\text{DS(on)}}$	150 100	200 –	– –	mA
Forward Transconductance ($V_{\text{DS}} = 12\text{ V}$, $I_D = 150\text{ mA}$)	g_{FS}	–	400	–	mmho

DYNAMIC CHARACTERISTICS

Input Capacitance ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 0\text{ V}$, $f = 10\text{ kHz}$)	C_{iss}	–	30	–	pf
Output Capacitance ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 0\text{ V}$, $f = 10\text{ kHz}$)	C_{oss}	–	14	–	pf
Transfer Capacitance ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 0\text{ V}$, $f = 10\text{ kHz}$)	C_{rss}	–	6.0	–	pf

SWITCHING CHARACTERISTICS

Propagation Delay Times: High to Low Propagation Delay; Figure 2, ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 3.0\text{ V}$) Low to High Propagation Delay; Figure 2, ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 3.0\text{ V}$)	t_{PHL} t_{PLH}	– –	918 798	– –	ns
High to Low Propagation Delay; Figure 2, ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 5.0\text{ V}$) Low to High Propagation Delay; Figure 2, ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 5.0\text{ V}$)	t_{PHL} t_{PLH}	– –	331 1160	– –	
Transition Times: Fall Time; Figure 2, ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 3.0\text{ V}$) Rise Time; Figure 2, ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 3.0\text{ V}$)	t_f t_r	– –	2290 618	– –	ns
Fall Time; Figure 2, ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 5.0\text{ V}$) Rise Time; Figure 2, ($V_{\text{DS}} = 12\text{ V}$, $V_{\text{GS}} = 5.0\text{ V}$)	t_f t_r	– –	622 600	– –	

NUD3160

TYPICAL WAVEFORMS

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

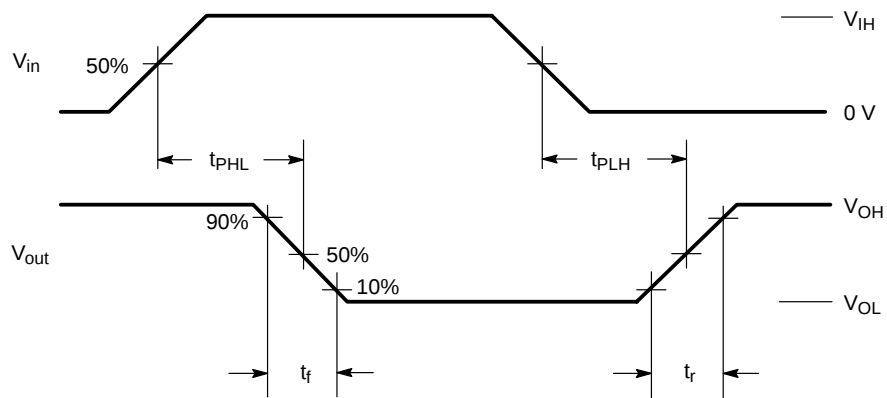


Figure 2. Switching Waveforms

Load Dump Pulse Not Suppressed:

$V_f = 13.5\text{ V}$ Nominal $\pm 10\%$
 $V_S = 60\text{ V}$ Nominal $\pm 10\%$
 $T = 300\text{ ms}$ Nominal $\pm 10\%$
 $t_r = 1 - 10\text{ ms}$ $\pm 10\%$

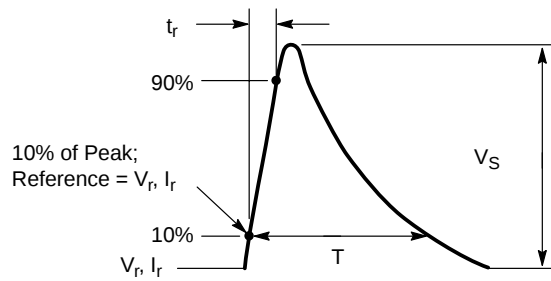


Figure 3. Load Dump Waveform Definition

TYPICAL PERFORMANCE CURVES

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

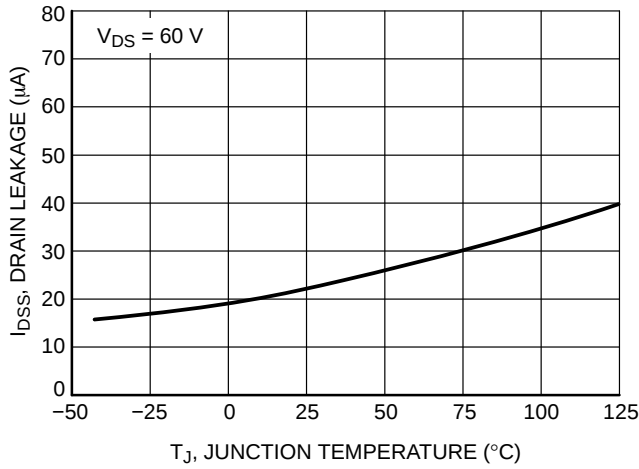


Figure 4. Drain-to-Source Leakage vs. Junction Temperature

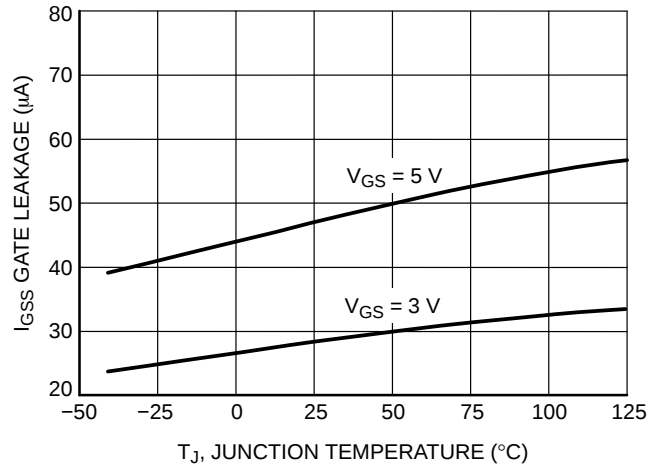


Figure 5. Gate-to-Source Leakage vs. Junction Temperature

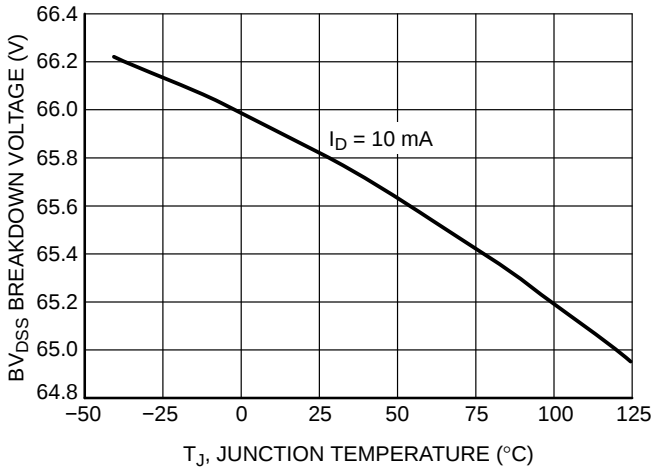


Figure 6. Breakdown Voltage vs. Junction Temperature

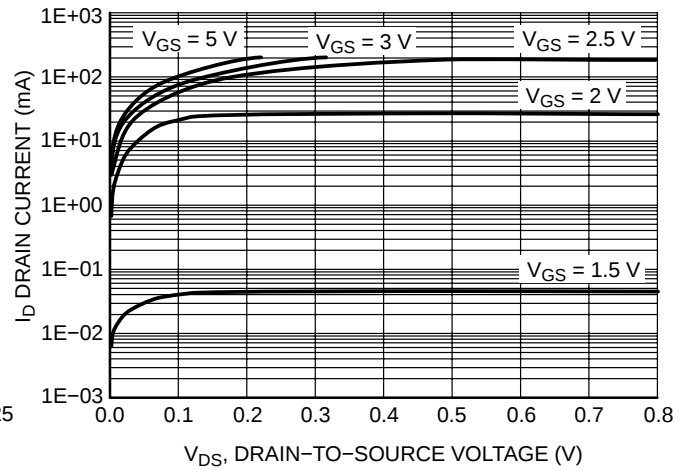


Figure 7. Output Characteristics

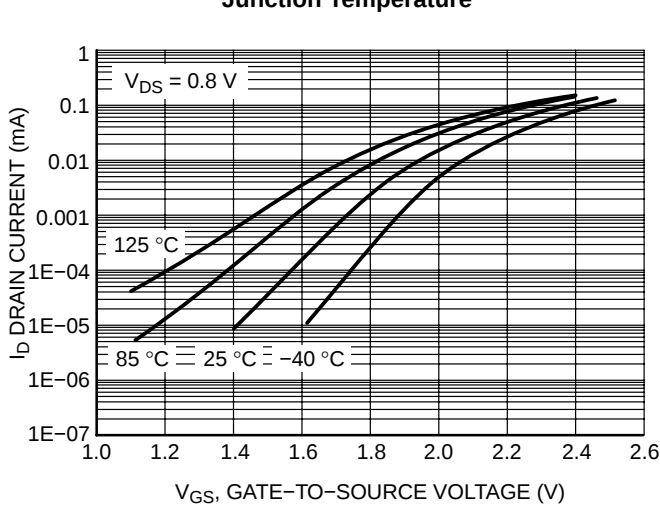


Figure 8. Transfer Function

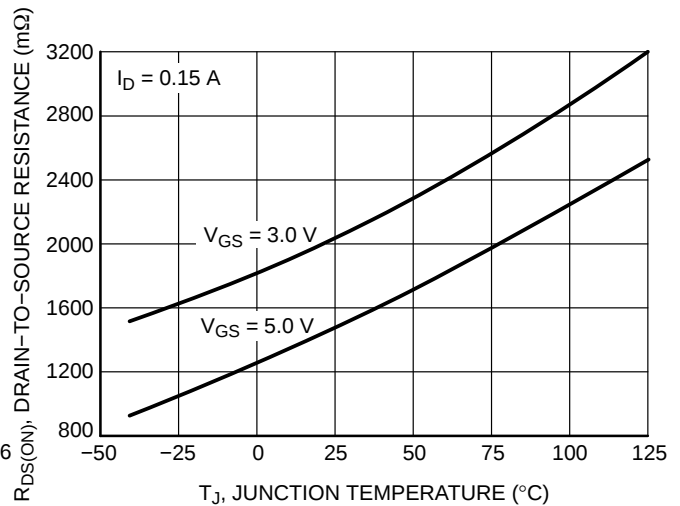


Figure 9. On Resistance Variation vs. Junction Temperature

TYPICAL PERFORMANCE CURVES

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

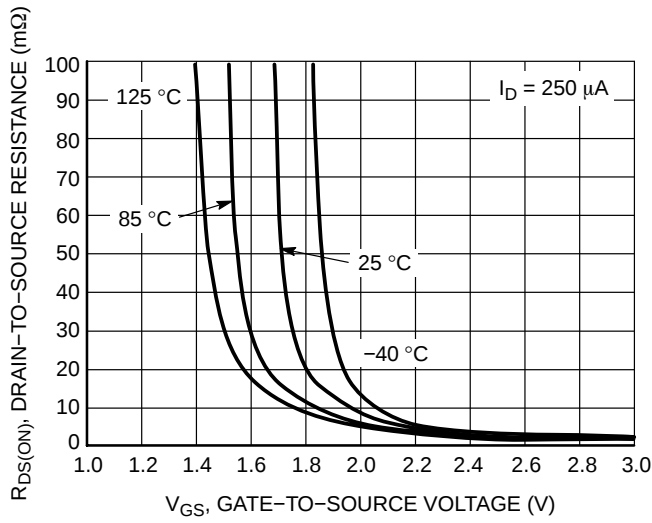


Figure 10. On Resistance Variation vs. Gate-to-Source Voltage

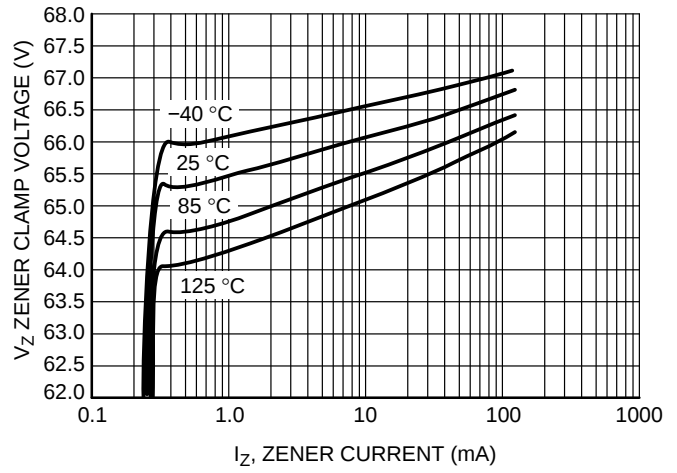


Figure 11. Zener Clamp Voltage vs. Zener Current

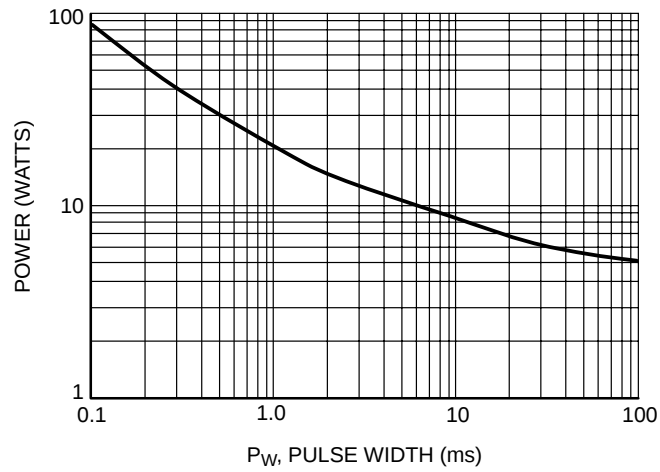


Figure 12. Maximum Non-repetitive Surge Power vs. Pulse Width

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APPLICATIONS INFORMATION

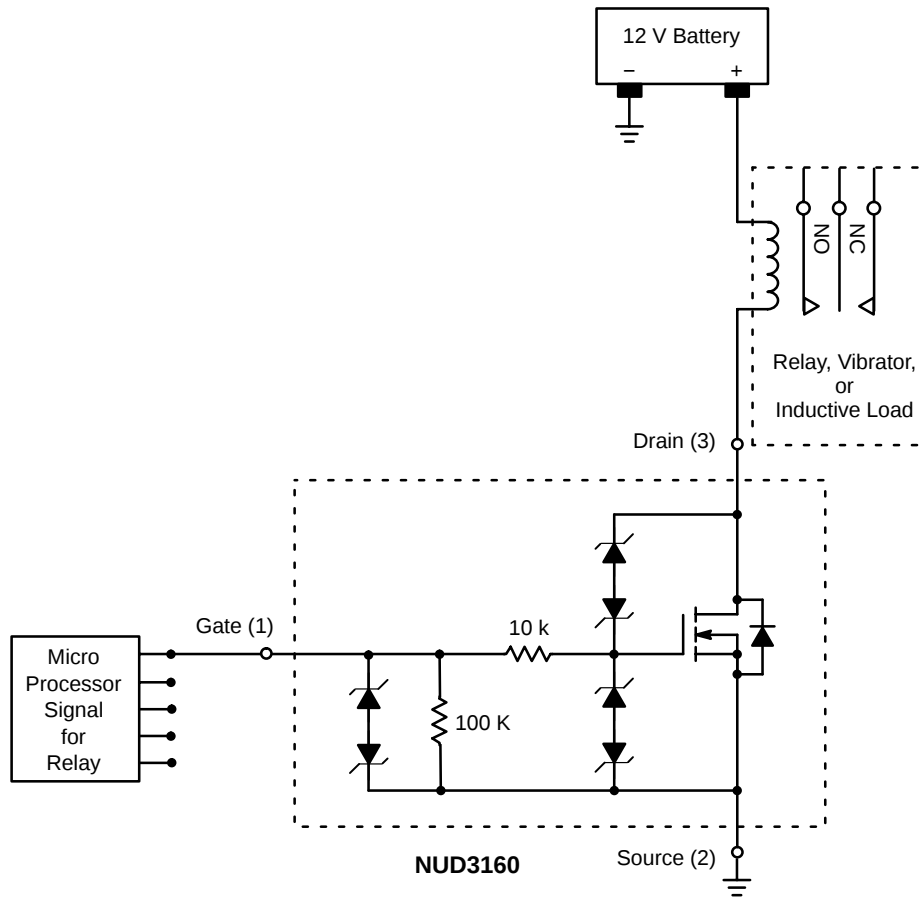
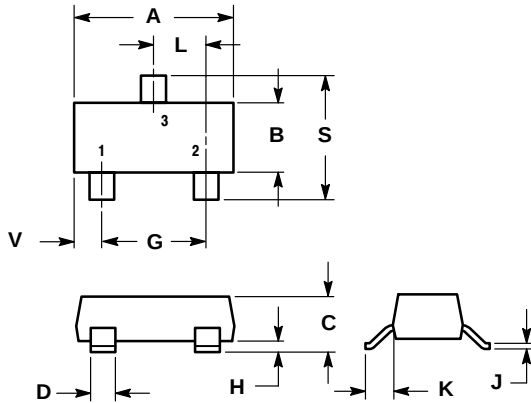


Figure 13. Applications Diagram

NUD3160

PACKAGE DIMENSIONS

SOT-23 (TO-236)
CASE 318-09
ISSUE AH



NOTES:

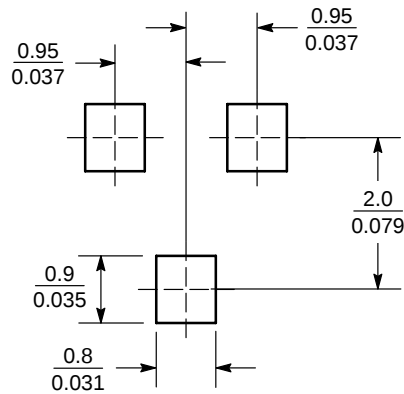
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-01, -02, AND -06 OBSOLETE, NEW STANDARD 318-09.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0385	0.0498	0.99	1.26
D	0.0140	0.0200	0.36	0.50
G	0.0670	0.0826	1.70	2.10
H	0.0040	0.0098	0.10	0.25
J	0.0034	0.0070	0.085	0.177
K	0.0180	0.0236	0.45	0.60
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.0984	2.10	2.50
V	0.0177	0.0236	0.45	0.60

STYLE 21:

- PIN 1. GATE
2. SOURCE
3. DRAIN

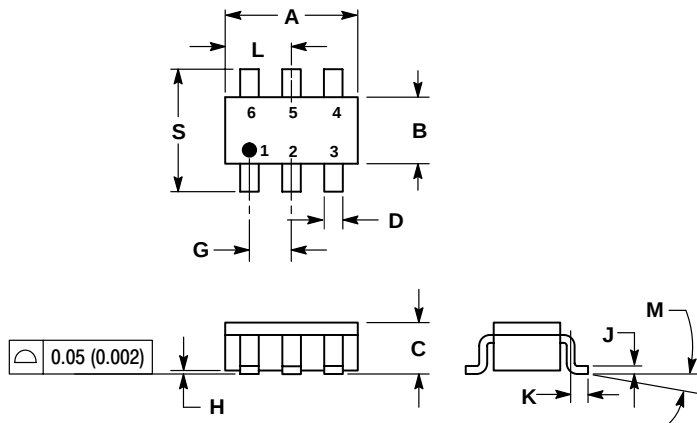
SOLDERING FOOTPRINT



NUD3160

PACKAGE DIMENSIONS

SC-74
CASE 318F-05
ISSUE K

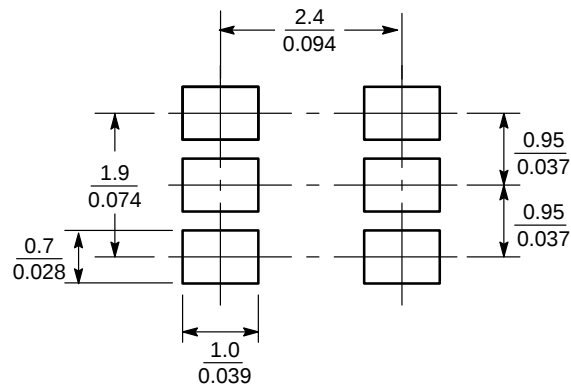


NOTES:

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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	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1142	0.1220	2.90	3.10
B	0.0512	0.0669	1.30	1.70
C	0.0354	0.0433	0.90	1.10
D	0.0098	0.0197	0.25	0.50
G	0.0335	0.0413	0.85	1.05
H	0.0005	0.0040	0.013	0.100
J	0.0040	0.0102	0.10	0.26
K	0.0079	0.0236	0.20	0.60
L	0.0493	0.0649	1.25	1.65
M	0°	10°	0°	10°
S	0.0985	0.1181	2.50	3.00

SOLDERING FOOTPRINT



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