

NUD3124

Automotive 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 Volts
- 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



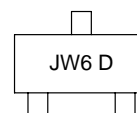
ON Semiconductor®

<http://onsemi.com>

MARKING DIAGRAMS



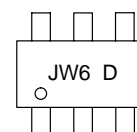
SOT-23
CASE 318
STYLE 21



JW6 = Specific Device Code
D = Date Code

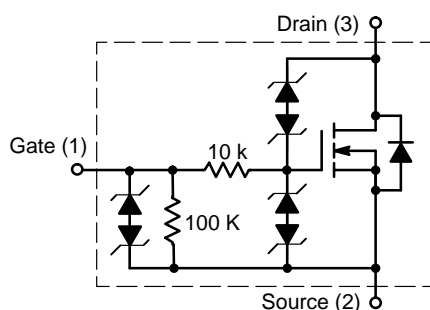


SC-74
CASE 318F
STYLE 7

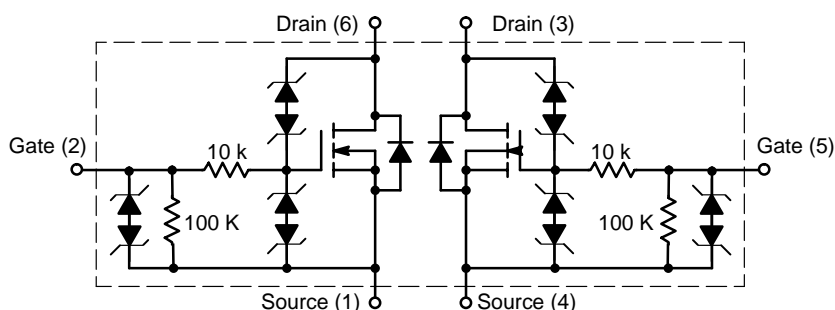


JW6 = Specific Device Code
D = Date Code

INTERNAL CIRCUIT DIAGRAMS



CASE 318



CASE 318F

ORDERING INFORMATION

Device	Package	Shipping†
NUD3124LT1	SOT-23	3000/Tape & Reel
NUD3124DMT1	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 Specification Brochure, BRD8011/D.

NUD3124

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

Symbol	Rating	Value	Unit
V_{DSS}	Drain-to-Source Voltage – Continuous ($T_J = 125^{\circ}\text{C}$)	28	V
V_{GSS}	Gate-to-Source Voltage – Continuous ($T_J = 125^{\circ}\text{C}$)	12	V
I_{D}	Drain Current – Continuous ($T_J = 125^{\circ}\text{C}$)	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)	250	mJ
P_{PK}	Peak Power Dissipation, Drain-to-Source (Notes 1 and 2) (T_J Initial = 85°C)	20	W
E_{LD1}	Load Dump Suppressed Pulse, Drain-to-Source (Notes 3 and 4) (Suppressed Waveform: $V_s = 45\text{ V}$, $R_{\text{SOURCE}} = 0.5\ \Omega$, $T = 200\text{ ms}$) (For Relay's Coils/Inductive Loads of 80 Ω or Higher) (T_J Initial = 85°C)	80	V
E_{LD2}	Inductive Switching Transient 1, Drain-to-Source (Waveform: $R_{\text{SOURCE}} = 10\ \Omega$, $T = 2.0\text{ ms}$) (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: $R_{\text{SOURCE}} = 4.0\ \Omega$, $T = 50\ \mu\text{s}$) (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	2,000	V

1. Nonrepetitive current square pulse 1.0 ms duration.
2. For different square pulse durations, see Figure 2.
3. Nonrepetitive load dump suppressed pulse per Figure 3.
4. For relay's coils/inductive loads higher than 80 Ω , see Figure 4.

THERMAL CHARACTERISTICS

Symbol	Rating	Value	Unit
T_A	Operating Ambient Temperature	-40 to 125	$^{\circ}\text{C}$
T_J	Maximum Junction Temperature	150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-65 to 150	$^{\circ}\text{C}$
P_{D}	Total Power Dissipation (Note 5) Derating above 25°C	SOT-23	225
			1.8
P_{D}	Total Power Dissipation (Note 5) Derating above 25°C	SC-74	380
			1.5
$R_{\theta\text{JA}}$	Thermal Resistance Junction-to-Ambient (Note 5)	SOT-23	556
		SC-74	329

5. Mounted onto minimum pad board.

NUD3124

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}	28	34	38	V
Drain to Source Leakage Current ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$) ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125^\circ\text{C}$) ($V_{DS} = 28\text{ V}$, $V_{GS} = 0\text{ V}$) ($V_{DS} = 28\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125^\circ\text{C}$)	I_{DSS}	– – – –	– – – –	0.5 1.0 50 80	μA
Gate Body Leakage Current ($V_{GS} = 3.0\text{ V}$, $V_{DS} = 0\text{ V}$) ($V_{GS} = 3.0\text{ V}$, $V_{DS} = 0\text{ V}$, $T_J = 125^\circ\text{C}$) ($V_{GS} = 5.0\text{ V}$, $V_{DS} = 0\text{ V}$) ($V_{GS} = 5.0\text{ V}$, $V_{DS} = 0\text{ V}$, $T_J = 125^\circ\text{C}$)	I_{GSS}	– – – –	– – – –	60 80 90 110	μA

ON CHARACTERISTICS

Gate Threshold Voltage ($V_{GS} = V_{DS}$, $I_D = 1.0\text{ mA}$) ($V_{GS} = V_{DS}$, $I_D = 1.0\text{ mA}$, $T_J = 125^\circ\text{C}$)	$V_{GS(th)}$	1.3 1.3	1.8 –	2.0 2.0	V
Drain to Source On-Resistance ($I_D = 150\text{ mA}$, $V_{GS} = 3.0\text{ V}$) ($I_D = 150\text{ mA}$, $V_{GS} = 3.0\text{ V}$, $T_J = 125^\circ\text{C}$) ($I_D = 150\text{ mA}$, $V_{GS} = 5.0\text{ V}$) ($I_D = 150\text{ mA}$, $V_{GS} = 5.0\text{ V}$, $T_J = 125^\circ\text{C}$)	$R_{DS(on)}$	– – – –	– – – –	1.4 1.7 0.8 1.1	Ω
Output Continuous Current ($V_{DS} = 0.25\text{ V}$, $V_{GS} = 3.0\text{ V}$) ($V_{DS} = 0.25\text{ V}$, $V_{GS} = 3.0\text{ V}$, $T_J = 125^\circ\text{C}$)	$I_{DS(on)}$	150 140	200 –	– –	mA
Forward Transconductance ($V_{DS} = 12\text{ V}$, $I_D = 150\text{ mA}$)	g_{FS}	–	500	–	mmho

DYNAMIC CHARACTERISTICS

Input Capacitance ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 10\text{ kHz}$)	C_{iss}	–	32	–	pf
Output Capacitance ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 10\text{ kHz}$)	C_{oss}	–	21	–	pf
Transfer Capacitance ($V_{DS} = 12\text{ V}$, $V_{GS} = 0\text{ V}$, $f = 10\text{ kHz}$)	C_{rss}	–	8.0	–	pf

SWITCHING CHARACTERISTICS

Propagation Delay Times: High to Low Propagation Delay; Figure 1, ($V_{DS} = 12\text{ V}$, $V_{GS} = 3.0\text{ V}$) Low to High Propagation Delay; Figure 1, ($V_{DS} = 12\text{ V}$, $V_{GS} = 3.0\text{ V}$) 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, ($V_{DS} = 12\text{ V}$, $V_{GS} = 5.0\text{ V}$)	t_{PHL} t_{PLH} t_{PHL} t_{PLH}	– – – –	890 912 324 1280	– – – –	ns
Transition Times: Fall Time; Figure 1, ($V_{DS} = 12\text{ V}$, $V_{GS} = 3.0\text{ V}$) Rise Time; Figure 1, ($V_{DS} = 12\text{ V}$, $V_{GS} = 3.0\text{ V}$) Fall Time; Figure 1, ($V_{DS} = 12\text{ V}$, $V_{GS} = 5.0\text{ V}$) Rise Time; Figure 1, ($V_{DS} = 12\text{ V}$, $V_{GS} = 5.0\text{ V}$)	t_f t_r t_f t_r	– – – –	2086 708 556 725	– – – –	ns

NUD3124

TYPICAL PERFORMANCE CURVES

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

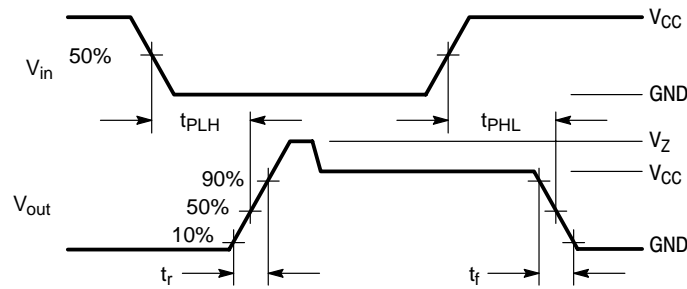


Figure 1. Switching Waveforms

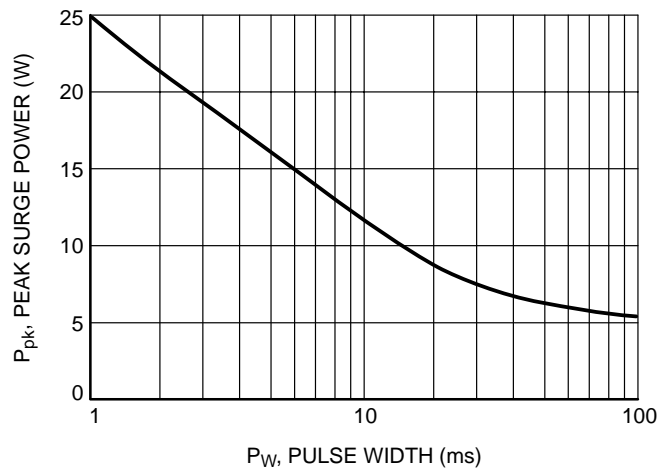


Figure 2. Maximum Non-repetitive Surge Power versus Pulse Width

Load Dump Pulse Not Suppressed:

$V_R = 13.5\text{ V}$ Nominal $\pm 10\%$

$V_S = 60\text{ V}$ Nominal $\pm 10\%$

$T = 300\text{ ms}$ Nominal $\pm 10\%$

$T_R = 1 - 10\text{ ms}$ $\pm 10\%$

Load Dump Pulse Suppressed:

NOTE: Max. Voltage DUT is exposed to is approximately 45 V.

$V_S = 30\text{ V}$ $\pm 20\%$

$T = 150\text{ ms}$ $\pm 20\%$

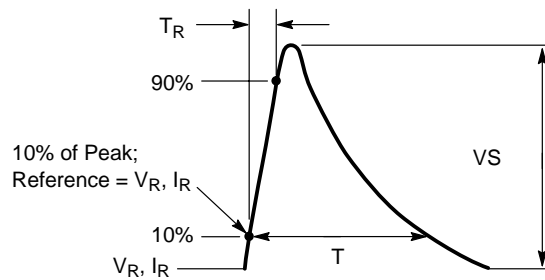


Figure 3. Load Dump Waveform Definition

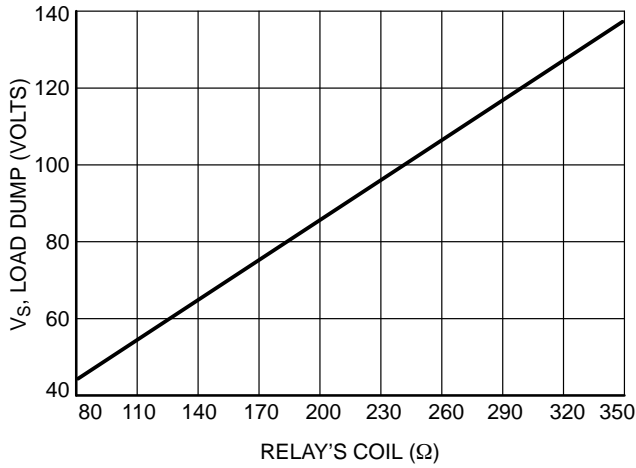


Figure 4. Load Dump Capability versus Relay's Coil dc Resistance

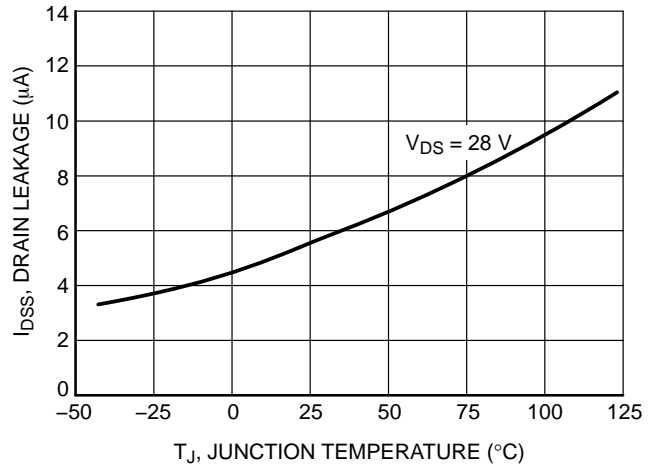


Figure 5. Drain-to-Source Leakage versus Junction Temperature

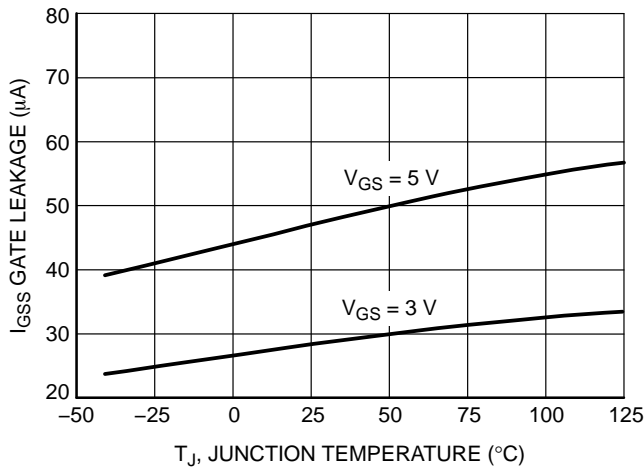


Figure 6. Gate-to-Source Leakage versus Junction Temperature

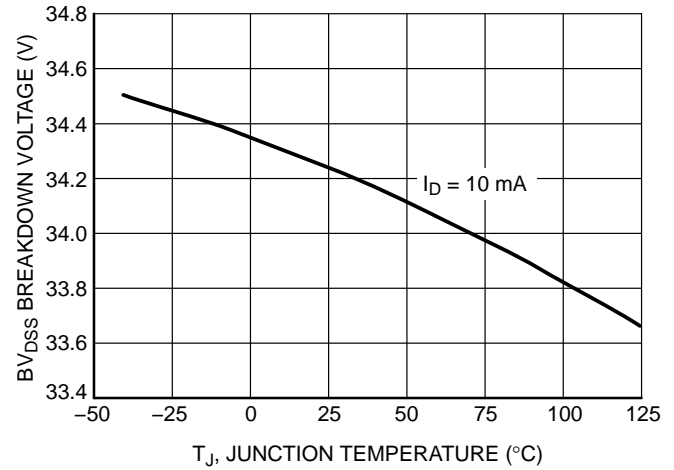


Figure 7. Breakdown Voltage versus Junction Temperature

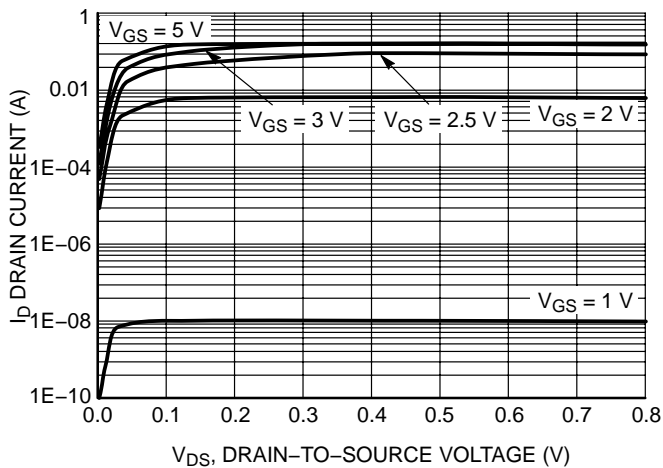


Figure 8. Output Characteristics

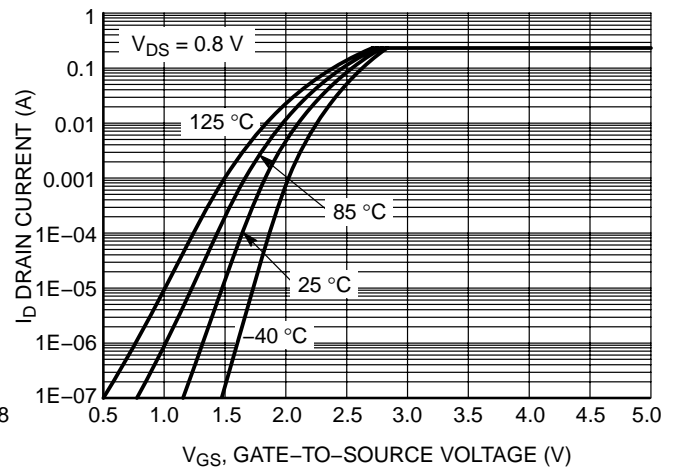
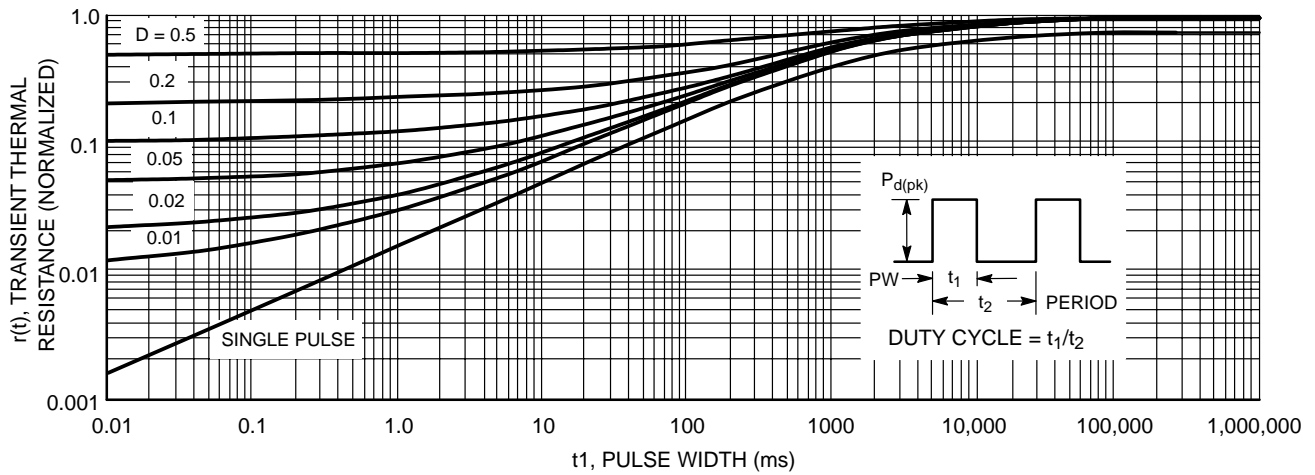
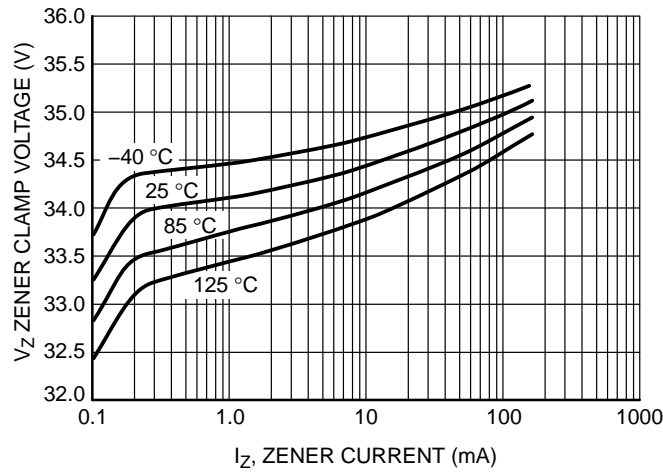
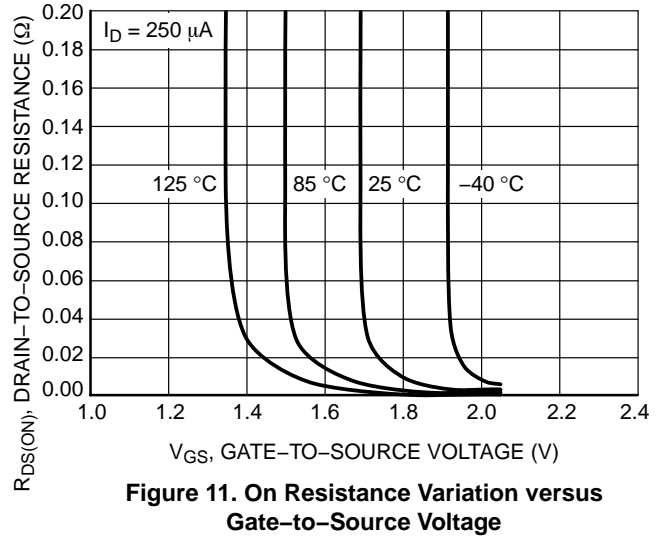
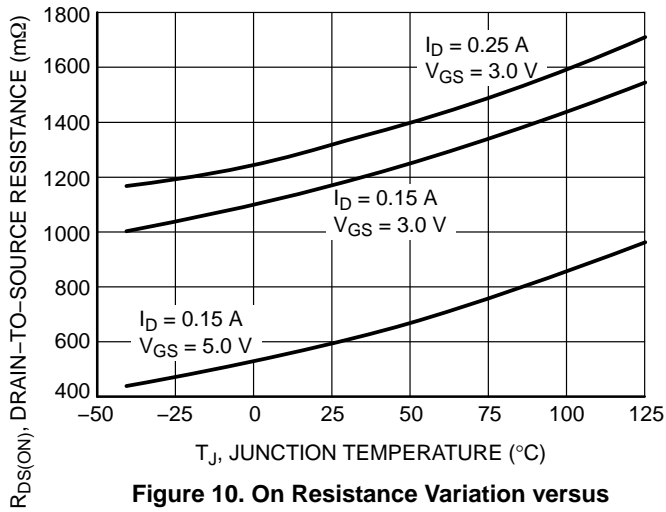


Figure 9. Transfer Function

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APPLICATIONS INFORMATION

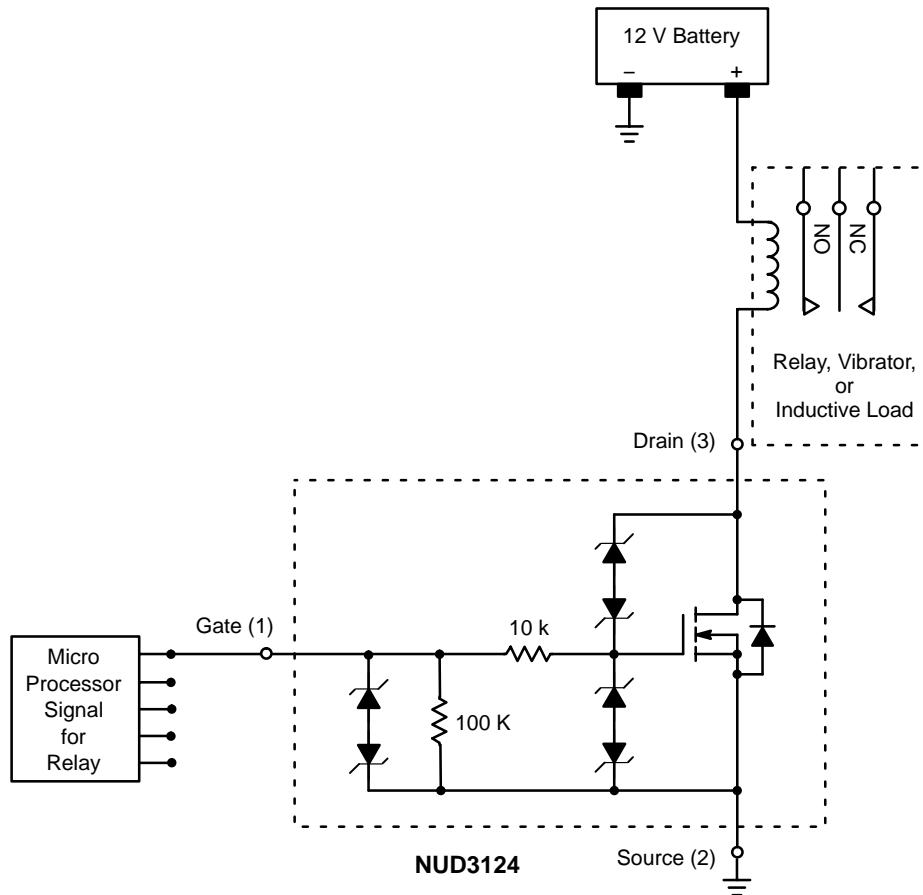
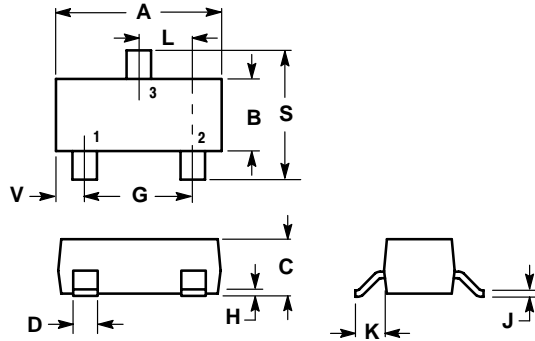


Figure 14. Applications Diagram

NUD3124

PACKAGE DIMENSIONS

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



NOTES:

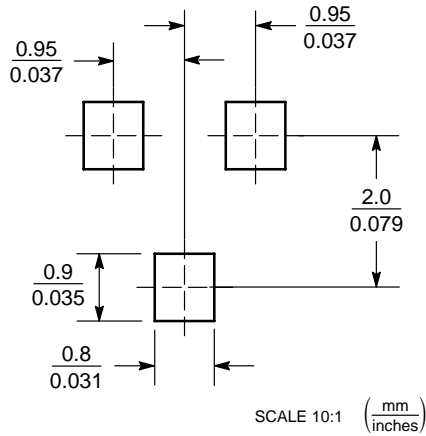
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2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318-03 AND -07 OBSOLETE, NEW STANDARD 318-08.

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	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

STYLE 21:

- PIN 1: GATE
- SOURCE
- DRAIN

SOLDERING FOOTPRINT*

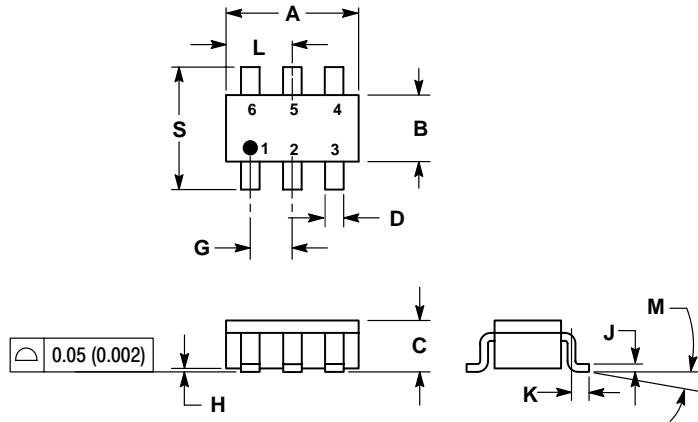


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NUD3124

PACKAGE DIMENSIONS

SC-74
CASE 318F-05
ISSUE K



NOTES:

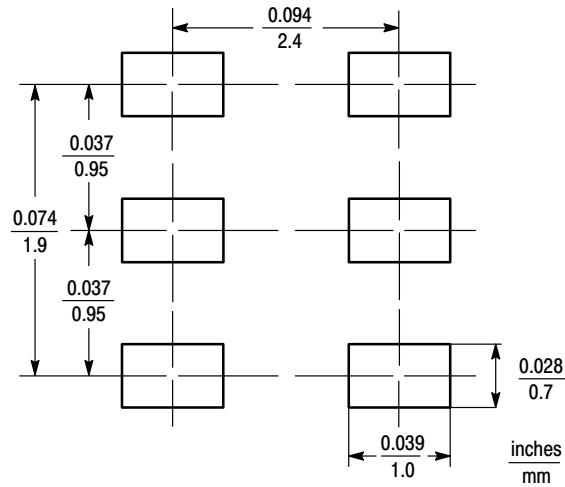
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2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. 318F-01, -02, -03 OBSOLETE. NEW STANDARD 318F-04.

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

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.

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