

NCV8408

Self-Protected Low Side Driver with Temperature and Current Limit

42 V, 10 A, Single N-Channel, DPAK

NCV8408 is a single channel protected Low-Side Smart Discrete device. The protection features include overcurrent, overtemperature, ESD and integrated Drain-to-Gate clamping for overvoltage protection. Thermal protection includes a latch which can be reset by toggling the input. This device is suitable for harsh automotive environments.

Features

- Short Circuit Protection
- Thermal Shutdown with Latched Reset
- Gate Input Current Flag During Latched Fault Condition
- Overvoltage Protection
- Integrated Clamp for Inductive Switching
- ESD Protection
- dV/dt Robustness
- Analog Drive Capability (Logic Level Input)
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

Typical Applications

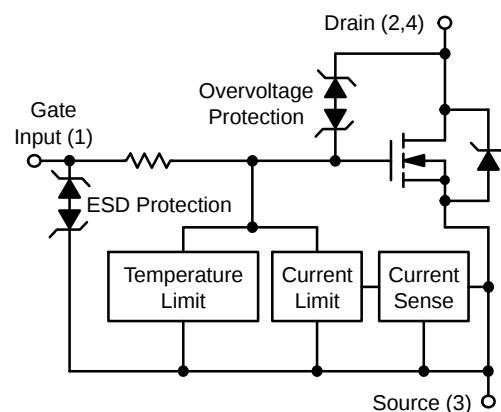
- Switch a Variety of Resistive, Inductive and Capacitive Loads
- Can Replace Electromechanical Relays and Discrete Circuits
- Automotive / Industrial



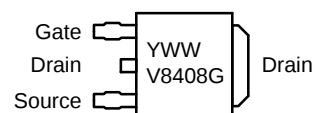
ON Semiconductor®

<http://onsemi.com>

V _{DSS} (Clamped)	R _{DS(on)} TYP	I _D MAX (Limited)
42 V	55 mΩ @ 5 V	10 A



MARKING DIAGRAM



Y = Year
WW = Work Week
V8408 = Specific Device Code
G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping†
NCV8408DTRKG	DPAK (Pb-Free)	2500/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.

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage Internally Clamped	V_{DSS}	42	Vdc
Drain-to-Gate Voltage Internally Clamped ($R_{GS} = 1.0\text{ M}\Omega$)	V_{DGR}	42	V
Gate-to-Source Voltage	V_{GS}	± 14	Vdc
Continuous Drain Current	I_D	Internally Limited	
Gate Input Current ($V_{GS} = \pm 14\text{ V}_{DC}$)	I_{GS}	± 10	mA
Source to Drain Current	I_{SD}	4.0	A
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ (Note 1) @ $T_A = 25^\circ\text{C}$ (Note 2)	P_D	1.8 2.3	W
Thermal Resistance Junction-to-Ambient Steady State (Note 1) Junction-to-Ambient Steady State (Note 2) Junction-to-Tab Steady State (Note 3)	$R_{\theta JA}$ $R_{\theta JA}$ $R_{\theta JT}$	70 55 2.1	$^\circ\text{C/W}$
Single Pulse Inductive Load Switching Energy ($V_{DD} = 20\text{ Vdc}$, $V_{GS} = 5.0\text{ V}$, $I_L = 8.0\text{ A}$)	E_{AS}	185	mJ
Repetitive Pulse Inductive Load Switching Energy ($V_{DD} = 20\text{ Vdc}$, $V_{GS} = 5.0\text{ V}$, $I_L = 8.0\text{ A}$, $T_J = 25^\circ\text{C}$)	E_{AR}	128	
Repetitive Pulse Inductive Load Switching Energy ($V_{DD} = 20\text{ Vdc}$, $V_{GS} = 5.0\text{ V}$, $I_L = 6.8\text{ A}$, $T_J = 105^\circ\text{C}$)	E_{AR}	92	
Load Dump Voltage ($V_{GS} = 0$ and 10 V , $R_I = 2.0\text{ }\Omega$, $R_L = 4.5\text{ }\Omega$, $t_d = 400\text{ ms}$, $T_J = 25^\circ\text{C}$)	V_{LD}	63	V
Operating Junction Temperature	T_J	-40 to 150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to 150	$^\circ\text{C}$

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.

1. Surface-mounted onto minimum pad FR4 PCB (1 oz Cu, 0.06" thick).
2. Surface-mounted onto 2" square FR4 PCB, (1" square, 1 oz Cu, 0.06" thick).
3. Surface-mounted onto minimum pad FR4 PCB (2 oz Cu, 0.06" thick).

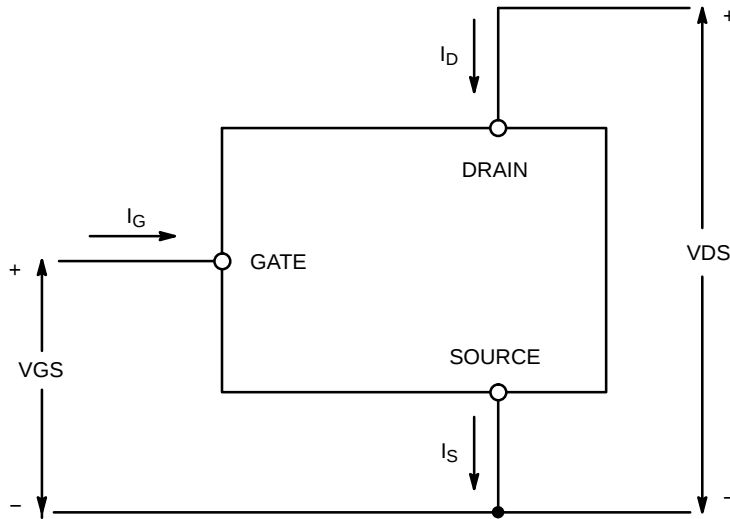


Figure 1. Voltage and Current Convention

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

Characteristic	Test Conditions	Symbol	Min	Typ	Max	Unit
----------------	-----------------	--------	-----	-----	-----	------

OFF CHARACTERISTICS

Drain-to-Source Clamped Breakdown Voltage (Note 4) ($V_{GS} = 0\text{ V}$, $I_D = 10\text{ mA}$, $T_J = 25^\circ\text{C}$) ($V_{GS} = 0\text{ V}$, $I_D = 10\text{ mA}$, $T_J = 150^\circ\text{C}$) (Note 6) ($V_{GS} = 0\text{ V}$, $I_D = 10\text{ mA}$, $T_J = -40^\circ\text{C}$) (Note 6)		$V_{(BR)DSS}$	42 40 43	46 45 47	51 51 51	V
Zero Gate Voltage Drain Current ($V_{GS} = 0\text{ V}$, $V_{DS} = 32\text{ V}$, $T_J = 25^\circ\text{C}$) ($V_{GS} = 0\text{ V}$, $V_{DS} = 32\text{ V}$, $T_J = 150^\circ\text{C}$) (Note 6)		I_{DSS}	– –	0.6 2.5	5.0 10	μA

INPUT CHARACTERISTICS (Note 4)

Gate Input Current – Normal Operation	($V_{GS} = 5.0\text{ V}$)	I_{GSSF}	–	25	50	μA
Gate Input Current – Protection Latched	($V_{GS} = 5.0\text{ V}$) (Note 6)	I_{GSSL}	–	440	–	μA
Gate Threshold Voltage	($V_{GS} = V_{DS}$, $I_D = 1\text{ mA}$)	$V_{GS(th)}$	1.0	1.7	2.2	V
Gate Threshold Temperature Coefficient		$V_{GS(th)}/T_J$	–	5.0	–	$-\text{mV}/^\circ\text{C}$
Latched Reset Voltage	(Note 6)	V_{LR}	0.8	1.4	1.9	V
Latched Reset Time	($V_{GS} = 5.0\text{ V}$ to $V_{GS} < 1\text{ V}$) (Note 6)	t_{LR}	10	40	100	μs
Internal Gate Input Resistance			–	25.5	–	$\text{k}\Omega$

ON CHARACTERISTICS (Note 4)

Static Drain-to-Source On-Resistance ($V_{GS} = 5.0\text{ V}$, $I_D = 3.0\text{ A}$, $T_J @ 25^\circ\text{C}$) ($V_{GS} = 5.0\text{ V}$, $I_D = 3.0\text{ A}$, $T_J @ 150^\circ\text{C}$) (Note 6)		$R_{DS(on)}$	– –	55 100	60 120	$\text{m}\Omega$
Source-Drain Forward On Voltage	($V_{GS} = 0\text{ V}$, $I_S = 7.0\text{ A}$)	V_{SD}	–	0.95	–	V

SWITCHING CHARACTERISTICS (Note 6)

Turn-OFF/ON Slew Rate Matching	$V_{GS} = 5.0\text{ V}$, $V_{DS} = 13\text{ V}$, $R_L = 4\text{ }\Omega$; $T_J = -40^\circ\text{C}$ $T_J = 150^\circ\text{C}$ $T_J = 25^\circ\text{C}$ $-40^\circ\text{C} < T_J < 150^\circ\text{C}$	T_{Match}	–15 –15 –5 –20	– – – –	15 15 5 20	%
Turn-ON Delay Time	$V_{GS} = 5\text{ V}$, $V_{DS} = 13\text{ V}$ $R_L = 4\text{ }\Omega$, $-40^\circ\text{C} < T_J < 150^\circ\text{C}$	$t_{d(ON)}$		10	20	μs
Rise Time (10% I_D to 90% I_D)		t_r		20	40	
Turn-OFF Delay Time		$t_{d(OFF)}$		30	60	
Fall Time (90% I_D to 10% I_D)		t_f		20	40	
Slew-Rate ON (90% V_D to 10% V_D)		$-dV_{DS}/dt_{ON}$		0.5		V/ μs
Slew-Rate OFF (10% V_D to 90% V_D)		dV_{DS}/dt_{OFF}		0.5		

SELF PROTECTION CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted) (Note 5)

Current Limit $V_{GS} = 5.0\text{ V}$, $V_{DS} = 10\text{ V}$, $T_J @ 25^\circ\text{C}$ $V_{GS} = 5.0\text{ V}$, $V_{DS} = 10\text{ V}$, $T_J = 150^\circ\text{C}$ (Note 6) $V_{GS} = 5.0\text{ V}$, $V_{DS} = 10\text{ V}$, $T_J = -40^\circ\text{C}$ (Note 6)		I_{LIM}	10 10 9	13 – –	16 18 16	A
Temperature Limit (Turn-off)	$V_{GS} = 5.0\text{ V}$ $V_{GS} = 10\text{ V}$	$T_{LIM(off)}$	150 150	175 165	200 185	$^\circ\text{C}$

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

Electro-Static Discharge Capability	Human Body Model (HBM)	ESD	4000	–	–	V
Electro-Static Discharge Capability	Machine Model (MM)	ESD	400	–	–	V

4. Pulse Test: Pulse Width = 300 μs , Duty Cycle = 2%.
5. Fault conditions are viewed as beyond the normal operating range of the part.
6. Not subject to production testing.

TEST CIRCUITS AND WAVEFORMS

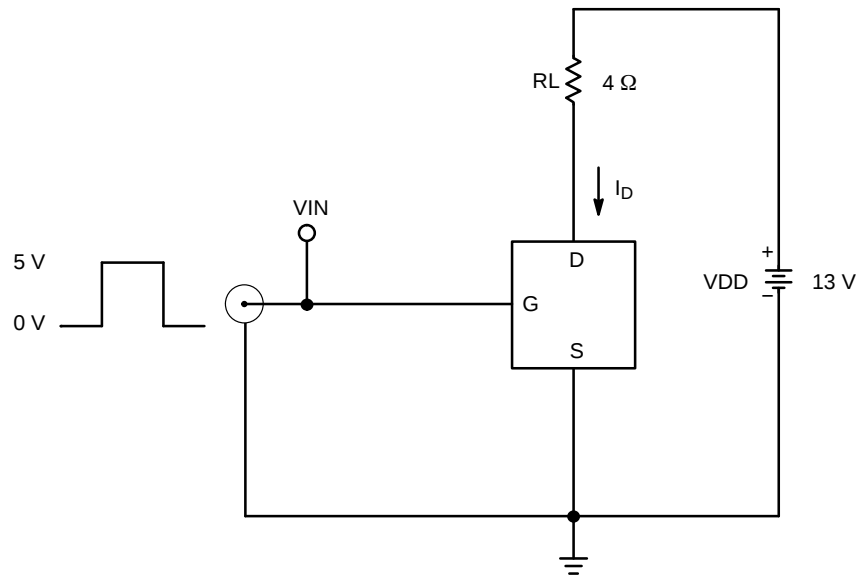


Figure 2. Resistive Load Switching Test Circuit

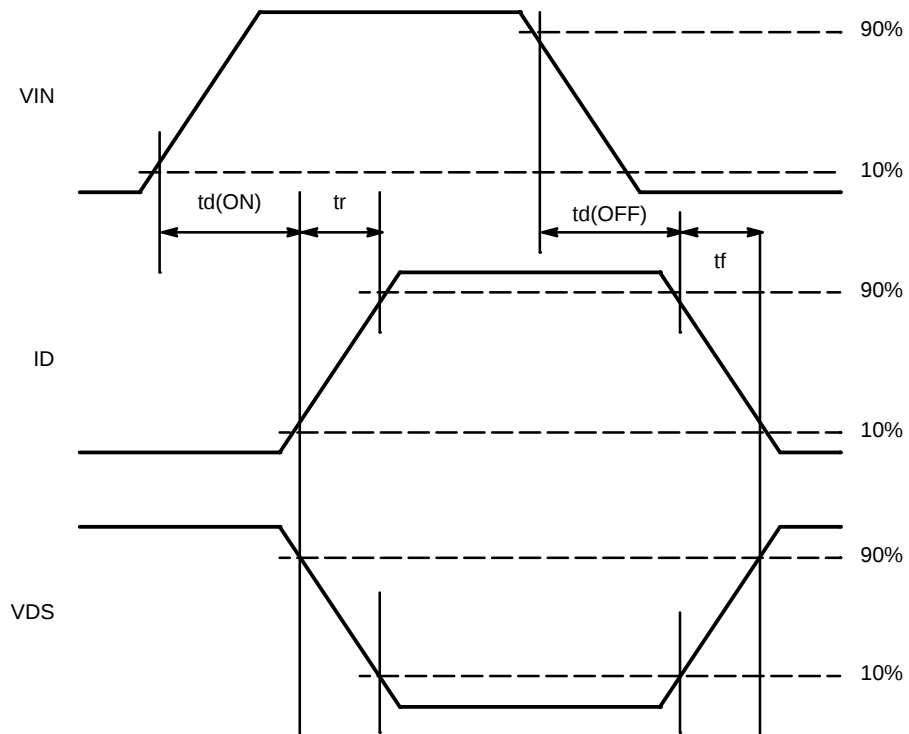


Figure 3. Resistive Load Switching Waveforms

TEST CIRCUITS AND WAVEFORMS

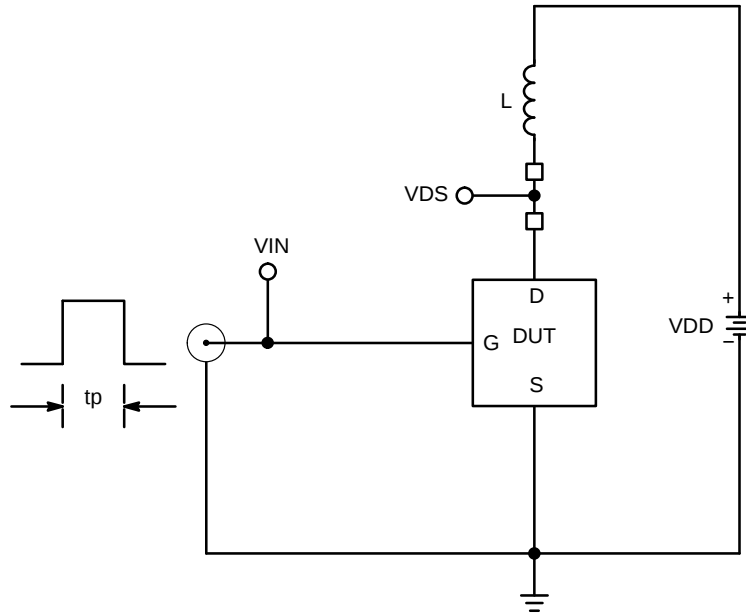


Figure 4. Inductive Load Switching Test Circuit

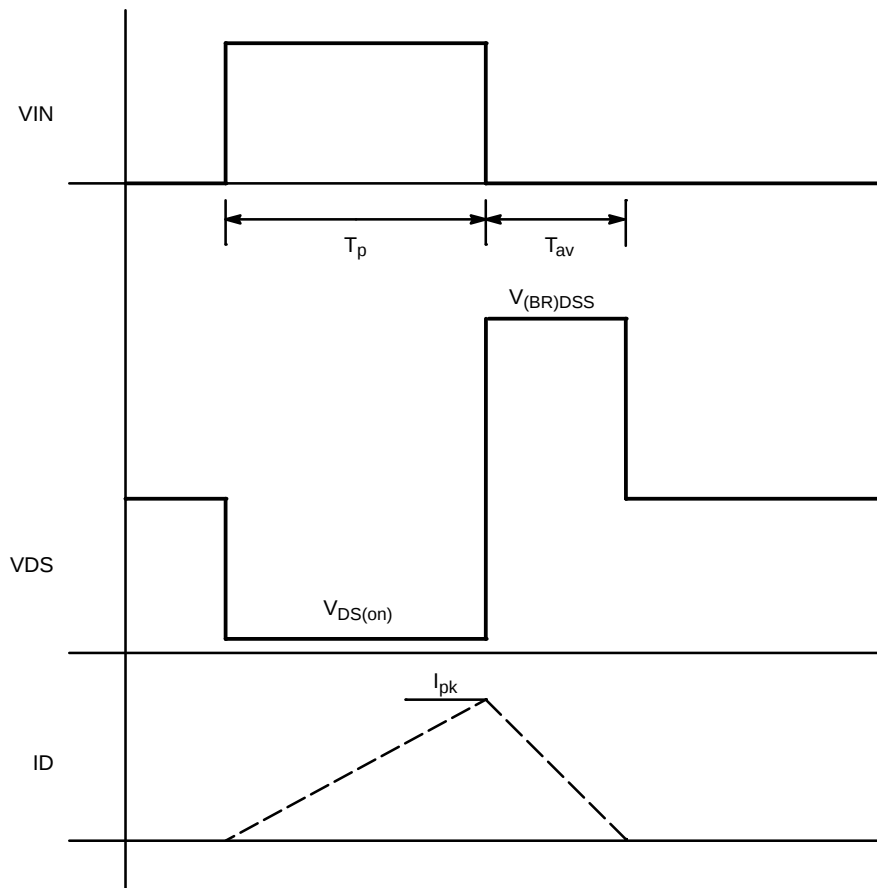


Figure 5. Inductive Load Switching Waveforms

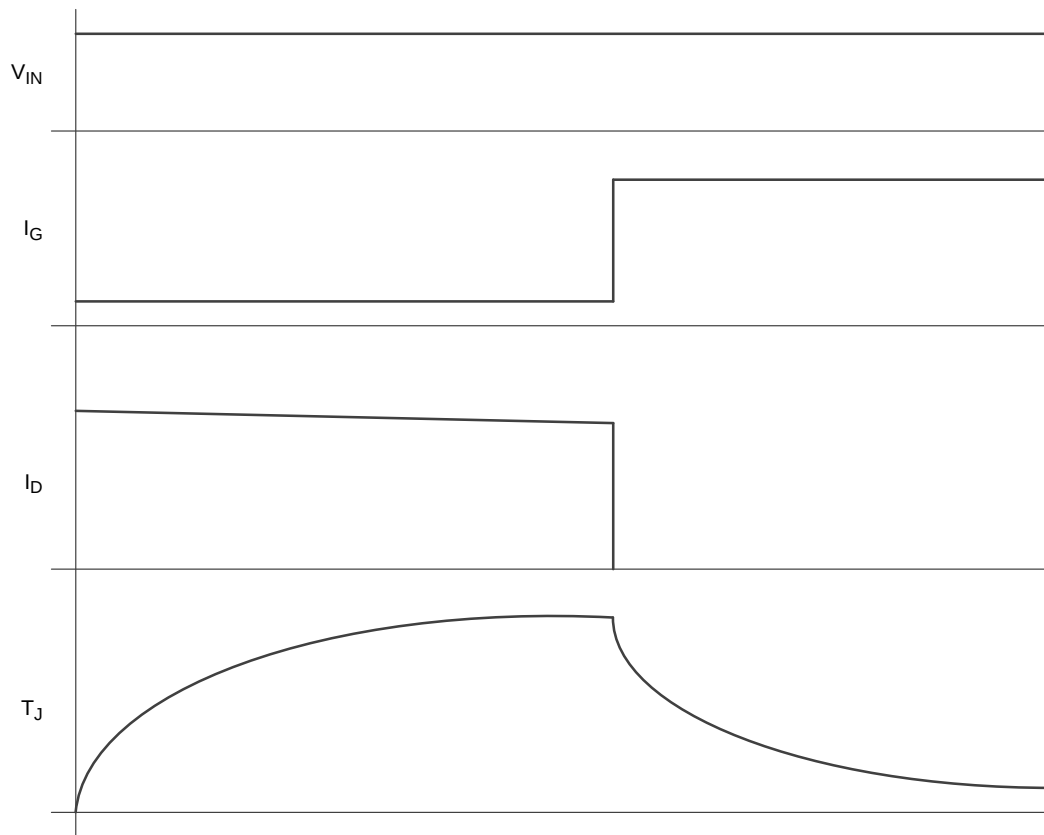


Figure 6. Short-Circuit Protection Behavior

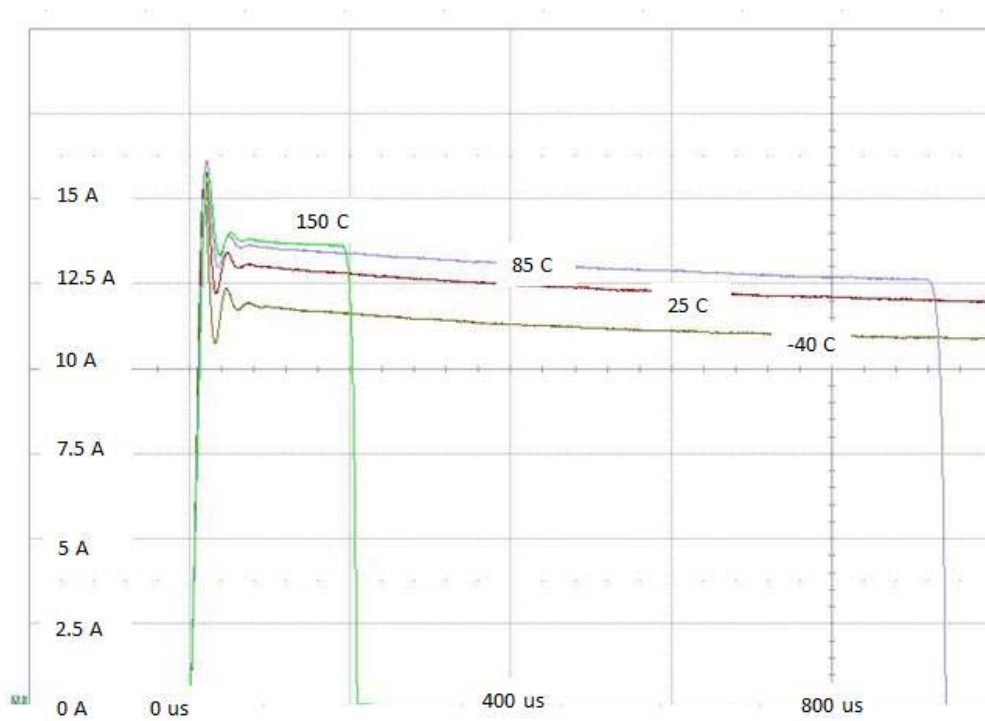


Figure 7. Turn on into Short Circuit Device Response

TYPICAL CHARACTERISTICS

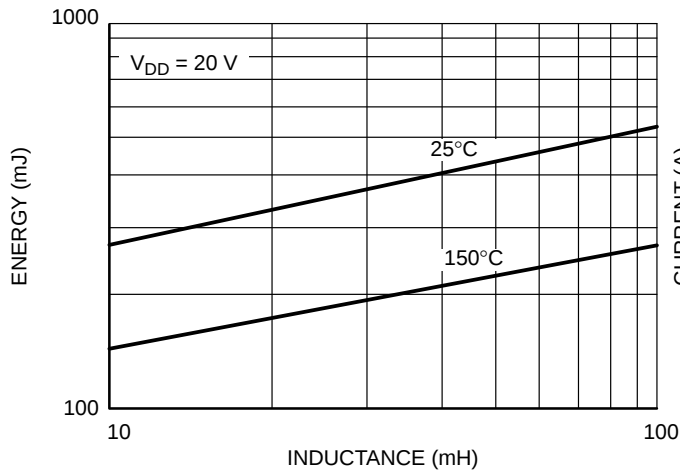


Figure 8. NCV8408 Maximum Switch Off Energy vs Inductance

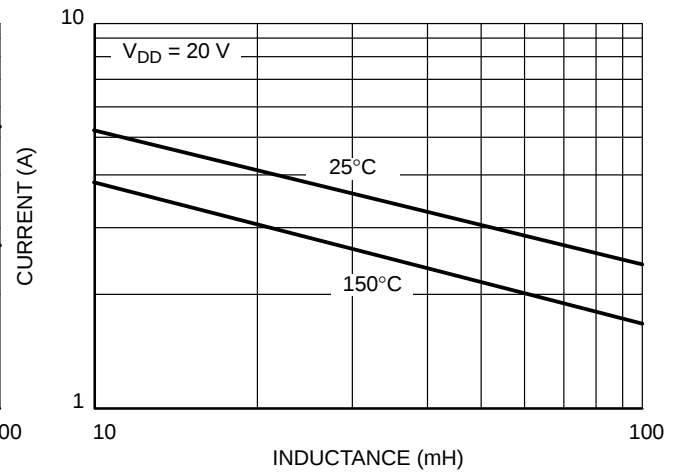


Figure 9. NCV8408 Maximum Switch Off Current vs Inductance

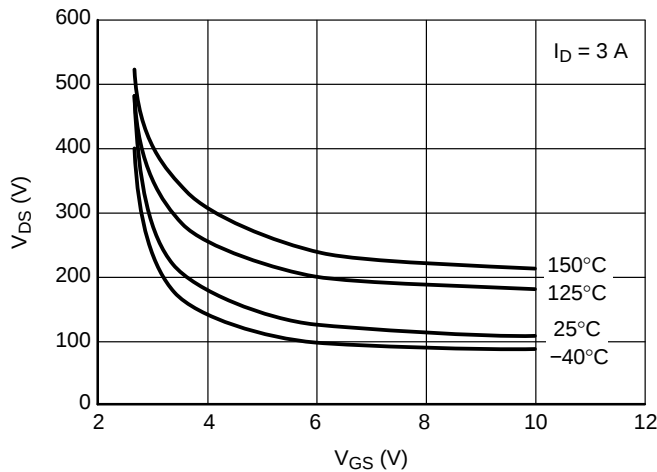


Figure 10. V_{GS} vs V_{DS}

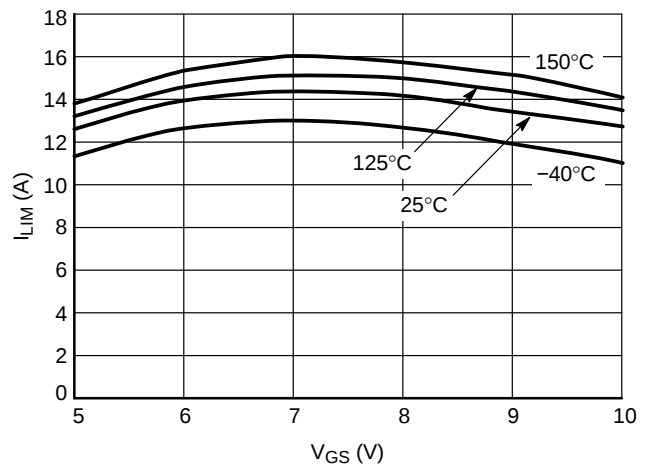


Figure 11. Current Limit vs. Gate Voltage

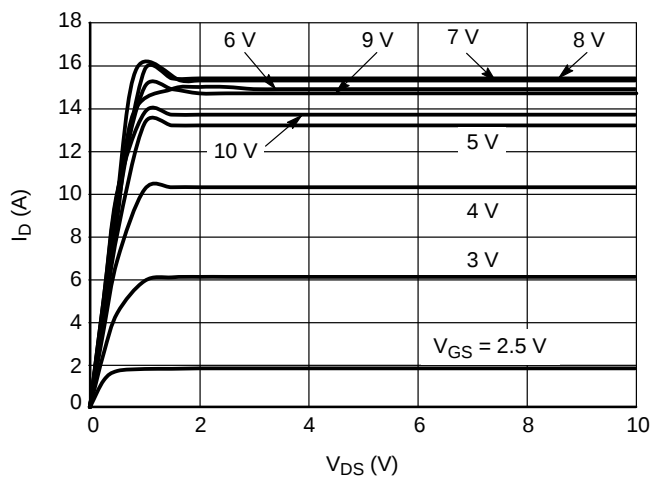


Figure 12. Drain Current vs. Drain Voltage

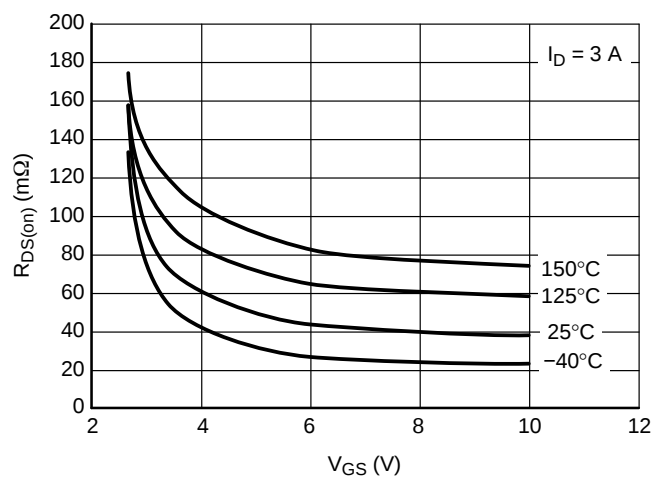


Figure 13. $R_{DS(on)}$ vs. Gate Voltage

TYPICAL CHARACTERISTICS

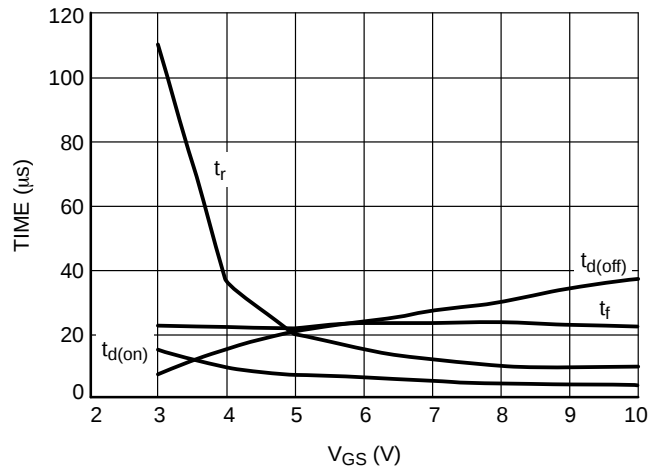


Figure 14. Resistive Switching

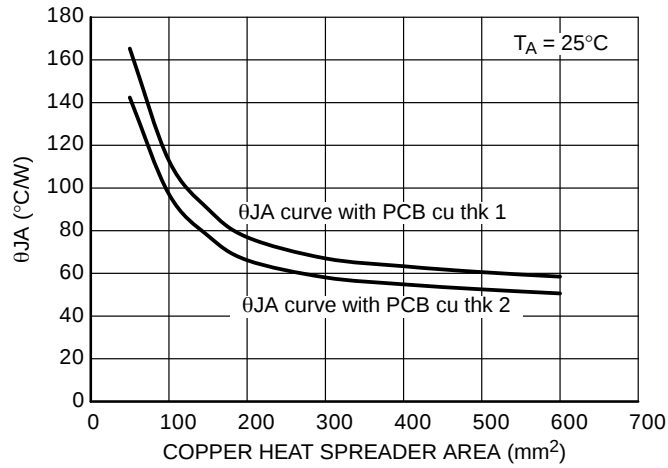


Figure 15. $R_{\theta JA}$ vs. Copper Area

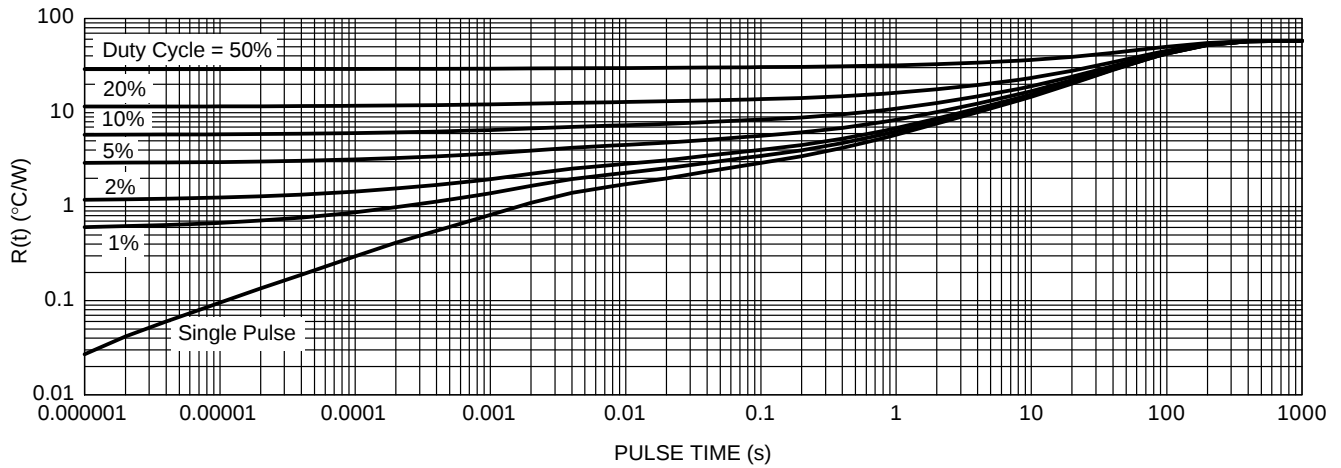
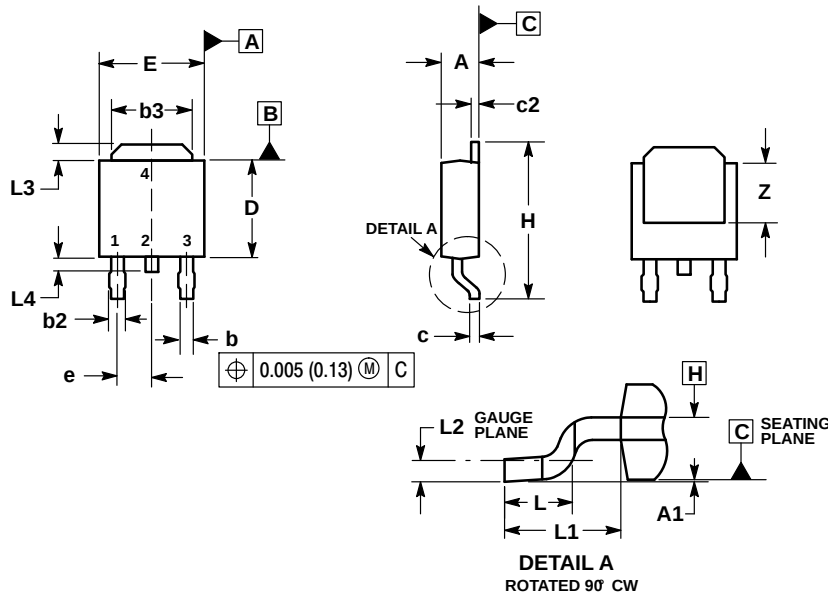


Figure 16. Transient Thermal Resistance

PACKAGE DIMENSIONS

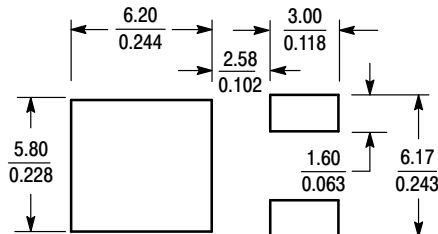
DPAK (SINGLE GAUGE)
CASE 369C
ISSUE D

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCHES.
3. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS b3, L3 and Z.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.006 INCHES PER SIDE.
5. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
6. DATUMS A AND B ARE DETERMINED AT DATUM PLANE H.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.086	0.094	2.18	2.38
A1	0.000	0.005	0.00	0.13
b	0.025	0.035	0.63	0.89
b2	0.030	0.045	0.76	1.14
b3	0.180	0.215	4.57	5.46
c	0.018	0.024	0.46	0.61
c2	0.018	0.024	0.46	0.61
D	0.235	0.245	5.97	6.22
E	0.250	0.265	6.35	6.73
e	0.090 BSC		2.29 BSC	
H	0.370	0.410	9.40	10.41
L	0.055	0.070	1.40	1.78
L1	0.108 REF		2.74 REF	
L2	0.020 BSC		0.51 BSC	
L3	0.035	0.050	0.89	1.27
L4	---	0.040	---	1.01
Z	0.155	---	3.93	---

SOLDERING FOOTPRINT*



SCALE 3:1 (mm/inches)

STYLE 2:

- PIN 1. GATE
- DRAIN
- SOURCE
- DRAIN

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

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of SCILLC's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.comOrder Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative