

# NCV8440, NCV8440A

## Protected Power MOSFET

**2.6 A, 52 V, N-Channel, Logic Level,  
Clamped MOSFET w/ ESD Protection**

### Features

- Diode Clamp Between Gate and Source
- ESD Protection – Human Body Model 5000 V
- Active Over-Voltage Gate to Drain Clamp
- Scalable to Lower or Higher  $R_{DS(on)}$
- Internal Series Gate Resistance
- These are Pb-Free Devices

### Benefits

- High Energy Capability for Inductive Loads
- Low Switching Noise Generation

### Applications

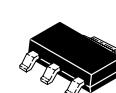
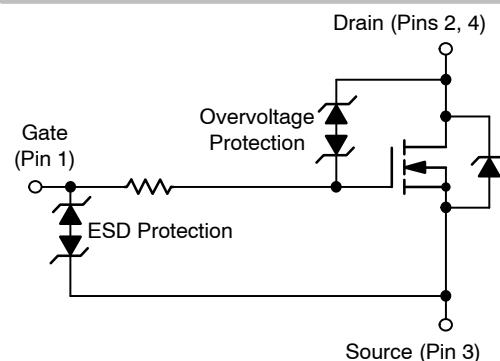
- Automotive and Industrial Markets:  
Solenoid Drivers, Lamp Drivers, Small Motor Drivers
- NCV Prefix for Automotive and Other Applications Requiring Site  
and Control Changes



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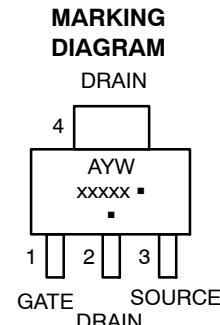
<http://onsemi.com>

$V_{DSS}$ (Clamped)	$R_{DS(ON)}$ TYP	$I_D$ MAX
52 V	95 mΩ @ 10 V	2.6 A



SOT-223  
CASE 318E  
STYLE 3

1 = Gate  
2 = Drain  
3 = Source



A = Assembly Location  
Y = Year  
W = Work Week  
xxxx = V8440 or 8440A  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

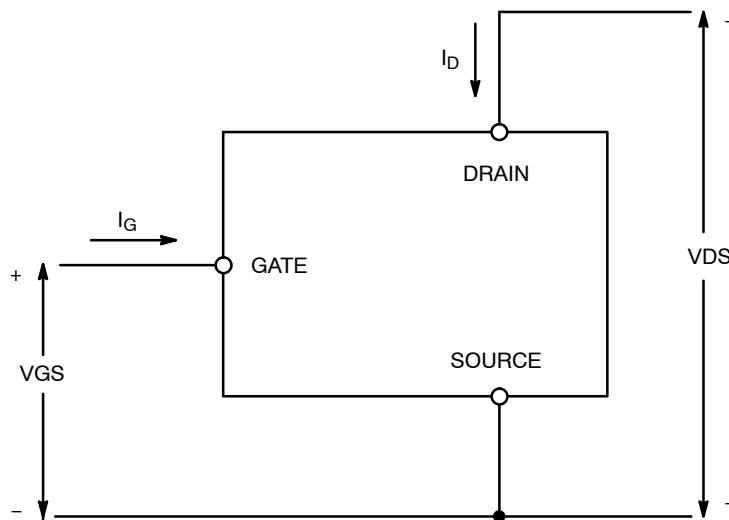
# NCV8440, NCV8440A

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage Internally Clamped	$V_{DSS}$	52–59	V
Gate-to-Source Voltage – Continuous	$V_{GS}$	$\pm 15$	V
Drain Current – Continuous @ $T_A = 25^\circ\text{C}$ – Single Pulse ( $t_p = 10 \mu\text{s}$ ) (Note 1)	$I_D$ $I_{DM}$	2.6 10	A
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ (Note 1)	$P_D$	1.69	W
Operating and Storage Temperature Range	$T_J, T_{stg}$	-55 to 150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy ( $V_{DD} = 50 \text{ V}$ , $I_{D(pk)} = 1.17 \text{ A}$ , $V_{GS} = 10 \text{ V}$ , $L = 160 \text{ mH}$ , $R_G = 25 \Omega$ )	$E_{AS}$	110	mJ
Load Dump Voltage ( $V_{GS} = 0$ and 10 V, $R_I = 2.0 \Omega$ , $R_L = 9.0 \Omega$ , $t_d = 400 \text{ ms}$ )	$V_{LD}$	60	V
Thermal Resistance, Junction-to-Ambient (Note 1) Junction-to-Ambient (Note 2)	$R_{\theta JA}$ $R_{\theta JA}$	74 169	$^\circ\text{C/W}$
Maximum Lead Temperature for Soldering Purposes, 1/8" from Case for 10 Seconds	$T_L$	260	$^\circ\text{C}$

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. When surface mounted to a FR4 board using 1" pad size, (Cu area 1.127 in<sup>2</sup>).
2. When surface mounted to a FR4 board using minimum recommended pad size, (Cu area 0.412 in<sup>2</sup>).



**Figure 1. Voltage and Current Convention**

# NCV8440, NCV8440A

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Drain-to-Source Breakdown Voltage (Note 3) ( $V_{GS} = 0 \text{ V}$ , $I_D = 1.0 \text{ mA}$ , $T_J = 25^\circ\text{C}$ ) ( $V_{GS} = 0 \text{ V}$ , $I_D = 1.0 \text{ mA}$ , $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ ) (Note 4) Temperature Coefficient (Negative)	$V_{(BR)DSS}$	52 50.8	55 54 -9.3	59 59.5	V V $\text{mV}/^\circ\text{C}$
Zero Gate Voltage Drain Current ( $V_{DS} = 40 \text{ V}$ , $V_{GS} = 0 \text{ V}$ ) ( $V_{DS} = 40 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $T_J = 125^\circ\text{C}$ ) (Note 4)	$I_{DSS}$			10 25	$\mu\text{A}$
Gate-Body Leakage Current ( $V_{GS} = \pm 8 \text{ V}$ , $V_{DS} = 0 \text{ V}$ ) ( $V_{GS} = \pm 14 \text{ V}$ , $V_{DS} = 0 \text{ V}$ )	$I_{GSS}$		$\pm 35$	$\pm 10$	$\mu\text{A}$
<b>ON CHARACTERISTICS (Note 3)</b>					
Gate Threshold Voltage (Note 3) ( $V_{DS} = V_{GS}$ , $I_D = 100 \mu\text{A}$ ) Threshold Temperature Coefficient (Negative)	$V_{GS(\text{th})}$	1.1	1.5 -4.1	1.9	V $\text{mV}/^\circ\text{C}$
Static Drain-to-Source On-Resistance (Note 3) ( $V_{GS} = 3.5 \text{ V}$ , $I_D = 0.6 \text{ A}$ ) ( $V_{GS} = 4.0 \text{ V}$ , $I_D = 1.5 \text{ A}$ ) ( $V_{GS} = 10 \text{ V}$ , $I_D = 2.6 \text{ A}$ )	$R_{DS(\text{on})}$		135 150 95	180 160 110	$\text{m}\Omega$
Forward Transconductance (Note 3) ( $V_{DS} = 15 \text{ V}$ , $I_D = 2.6 \text{ A}$ )	$g_{FS}$		3.8		Mhos
<b>DYNAMIC CHARACTERISTICS</b>					
Input Capacitance	$V_{DS} = 35 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 10 \text{ kHz}$	$C_{iss}$		155	pF
Output Capacitance		$C_{oss}$		60	
Transfer Capacitance		$C_{rss}$		25	
Input Capacitance	$V_{DS} = 25 \text{ V}$ , $V_{GS} = 0 \text{ V}$ , $f = 10 \text{ kHz}$	$C_{iss}$		170	pF
Output Capacitance		$C_{oss}$		70	
Transfer Capacitance		$C_{rss}$		30	

- 3. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
- 4. Not subject to production testing.
- 5. Switching characteristics are independent of operating junction temperatures.

# NCV8440, NCV8440A

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

Characteristic	Symbol	Min	Typ	Max	Unit
<b>SWITCHING CHARACTERISTICS (Note 5)</b>					
Turn-On Delay Time	$V_{GS} = 4.5 \text{ V}, V_{DD} = 40 \text{ V}, I_D = 2.6 \text{ A}, R_D = 15.4 \Omega$	$t_{d(on)}$		375	
Rise Time		$t_r$		1525	
Turn-Off Delay Time		$t_{d(off)}$		1530	
Fall Time		$t_f$		1160	
Turn-On Delay Time	$V_{GS} = 4.5 \text{ V}, V_{DD} = 40 \text{ V}, I_D = 1.0 \text{ A}, R_D = 40 \Omega$	$t_{d(on)}$		325	
Rise Time		$t_r$		1275	
Turn-Off Delay Time		$t_{d(off)}$		1860	
Fall Time		$t_f$		1150	
Turn-On Delay Time	$V_{GS} = 10 \text{ V}, V_{DD} = 15 \text{ V}, I_D = 2.6 \text{ A}, R_D = 5.8 \Omega$	$t_{d(on)}$		190	
Rise Time		$t_r$		710	
Turn-Off Delay Time		$t_{d(off)}$		2220	
Fall Time		$t_f$		1180	
Gate Charge	$V_{GS} = 4.5 \text{ V}, V_{DS} = 40 \text{ V}, I_D = 2.6 \text{ A}$ (Note 3)	$Q_T$		4.5	
		$Q_1$		0.9	
		$Q_2$		2.6	
Gate Charge	$V_{GS} = 4.5 \text{ V}, V_{DS} = 15 \text{ V}, I_D = 1.5 \text{ A}$ (Note 3)	$Q_T$		3.9	
		$Q_1$		1.0	
		$Q_2$		1.7	

## SOURCE-DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	$I_S = 2.6 \text{ A}, V_{GS} = 0 \text{ V}$ (Note 3) $I_S = 2.6 \text{ A}, V_{GS} = 0 \text{ V}, T_J = 125^\circ\text{C}$	$V_{SD}$		0.81 0.66	1.5	V
Reverse Recovery Time	$I_S = 1.5 \text{ A}, V_{GS} = 0 \text{ V},$ $dI_S/dt = 100 \text{ A}/\mu\text{s}$ (Note 3)	$t_{rr}$		730		ns
		$t_a$		200		
		$t_b$		530		
Reverse Recovery Stored Charge		$Q_{RR}$		6.3		$\mu\text{C}$

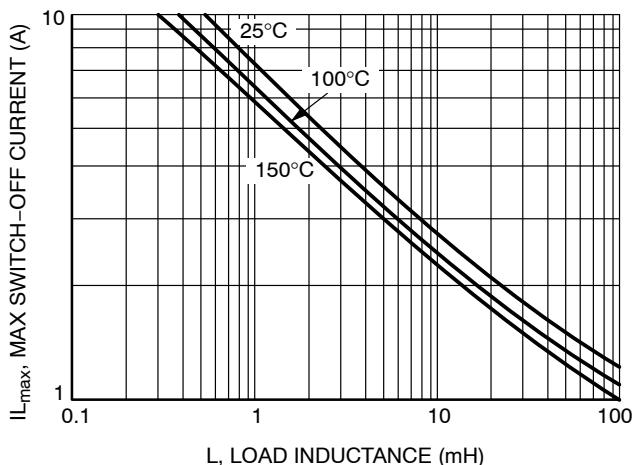
## ESD CHARACTERISTICS (Note 4)

Electro-Static Discharge Capability	Human Body Model (HBM)	ESD	5000			V
	Machine Model (MM)		500			

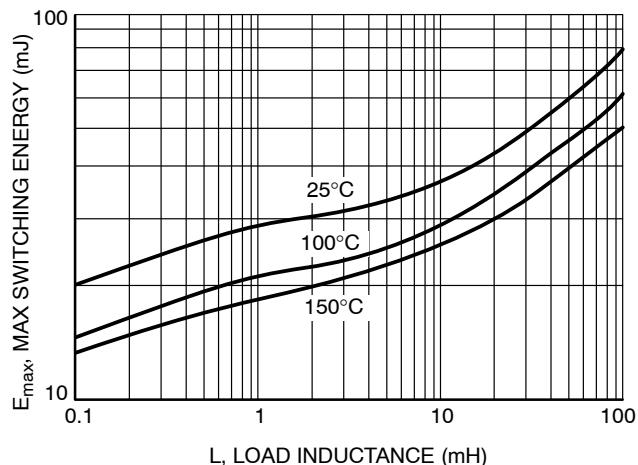
- 3. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
- 4. Not subject to production testing.
- 5. Switching characteristics are independent of operating junction temperatures.

# NCV8440, NCV8440A

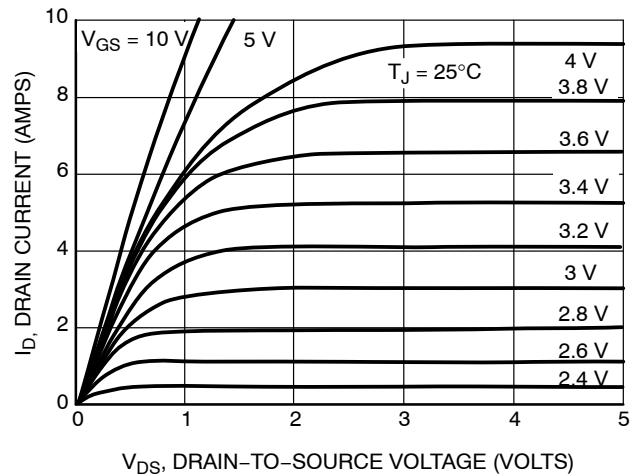
## TYPICAL PERFORMANCE CURVES



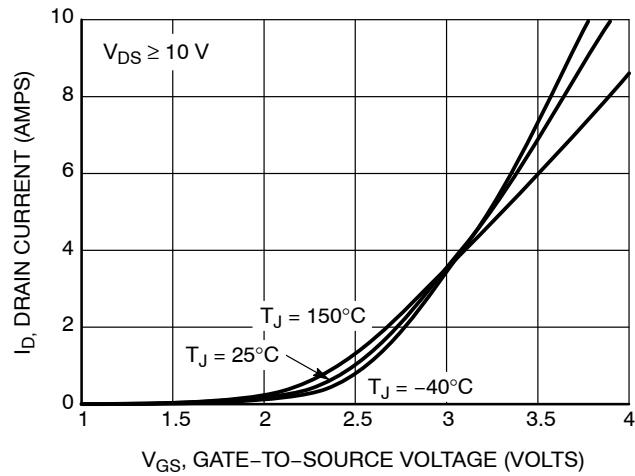
**Figure 1. Single Pulse Maximum Switch-off Current vs. Load Inductance**



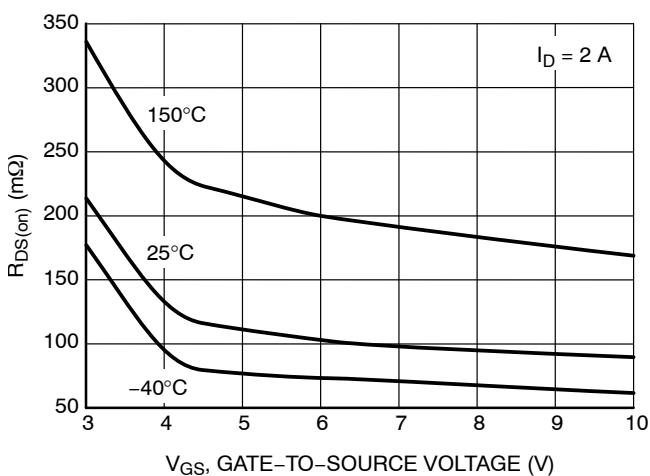
**Figure 2. Single Pulse Maximum Switching Energy vs. Load Inductance**



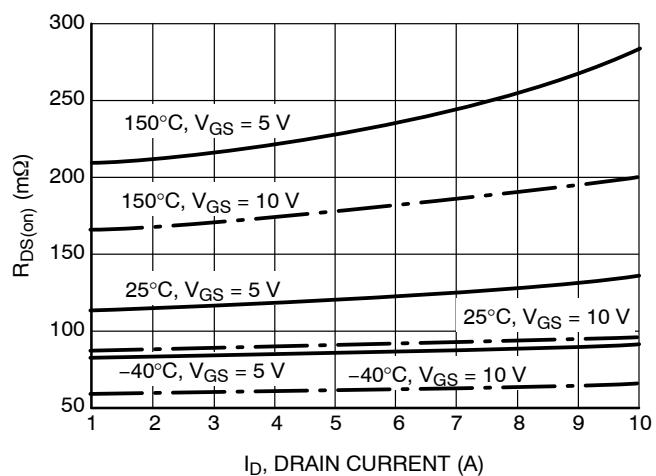
**Figure 3. On-State Output Characteristics**



**Figure 4. Transfer Characteristics**



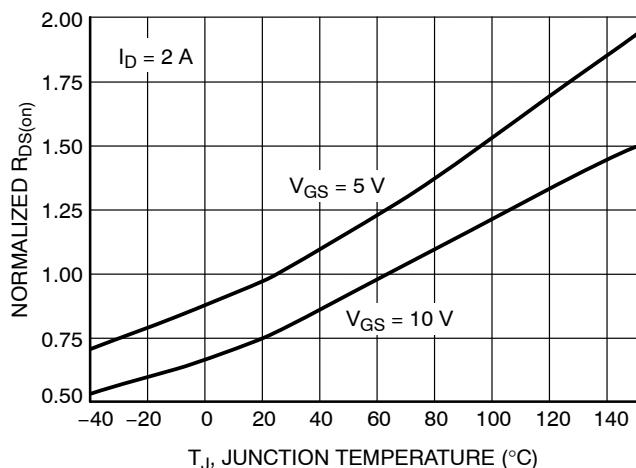
**Figure 5.  $R_{DS(\text{on})}$  vs. Gate-Source Voltage**



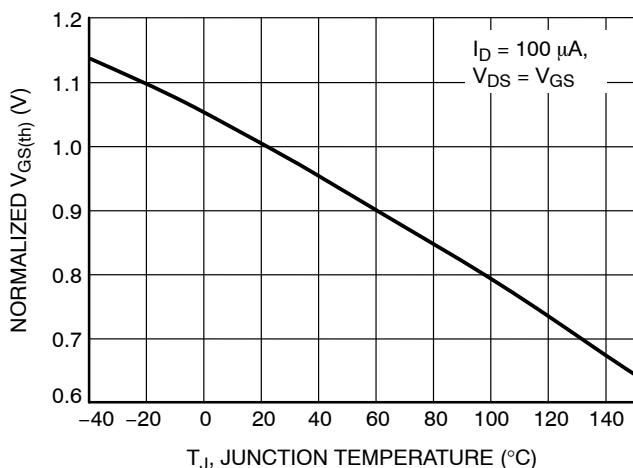
**Figure 6.  $R_{DS(\text{on})}$  vs. Drain Current**

# NCV8440, NCV8440A

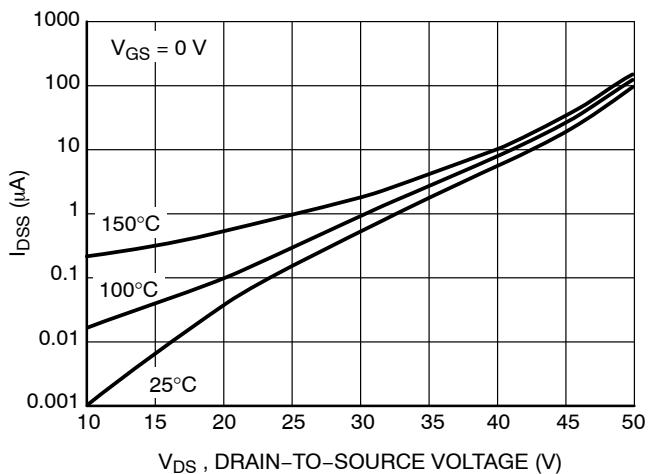
## TYPICAL PERFORMANCE CURVES



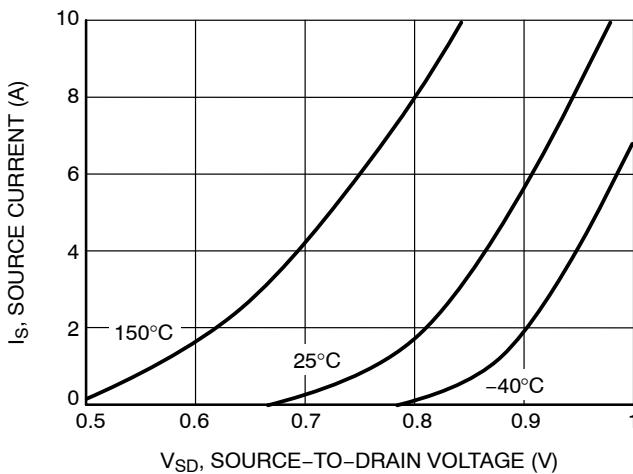
**Figure 7. Normalized  $R_{DS(on)}$  vs. Temperature**



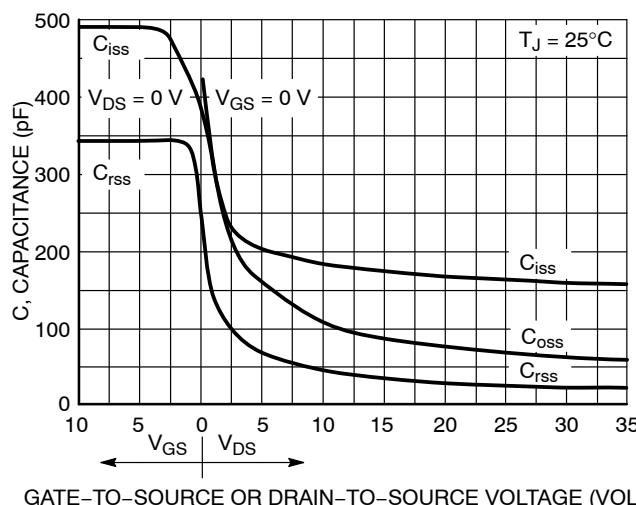
**Figure 8. Normalized Threshold Voltage vs. Temperature**



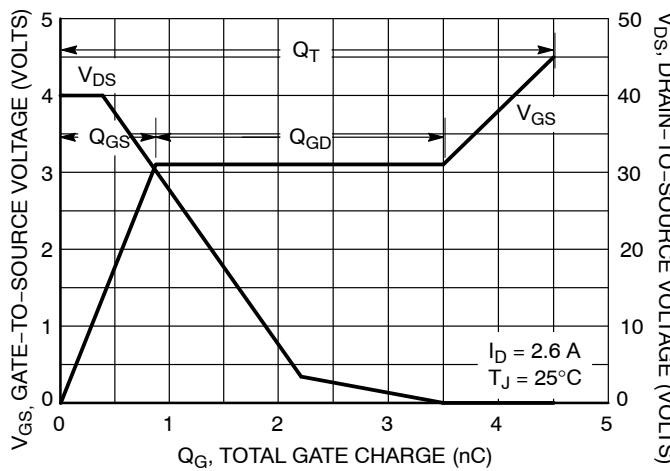
**Figure 9. Drain-to-Source Leakage Current**



**Figure 10. Source-Drain Diode Forward Characteristics**

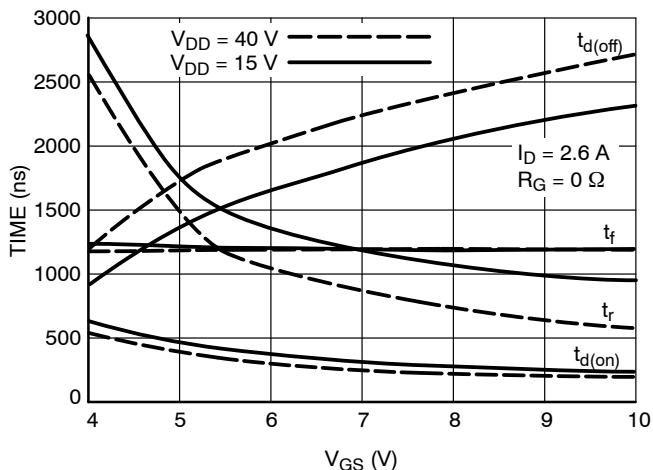


**Figure 11. Capacitance Variation**

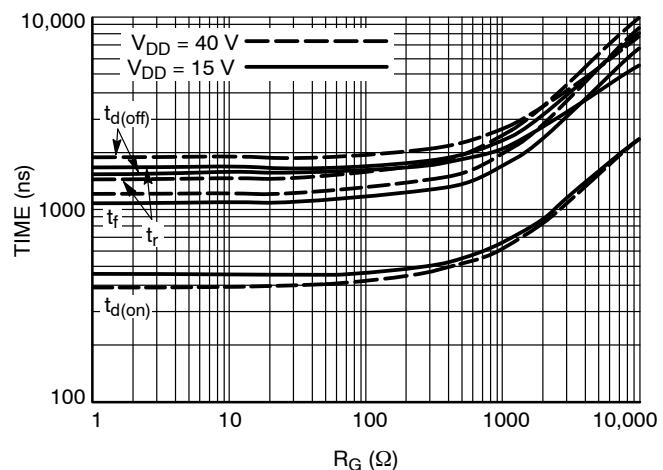


**Figure 12. Gate-to-Source Voltage vs. Total Gate Charge**

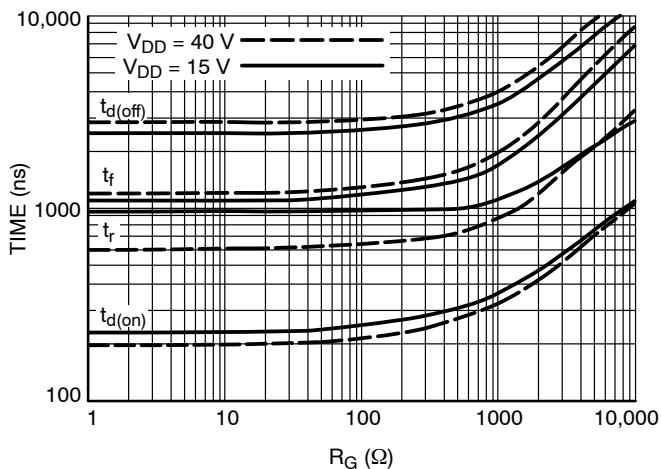
## TYPICAL PERFORMANCE CURVES



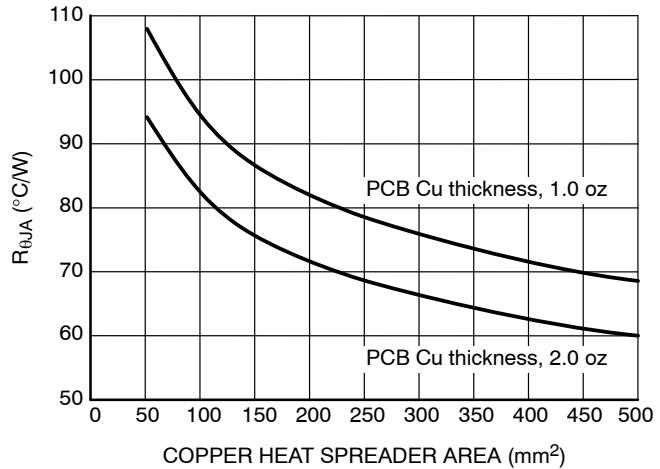
**Figure 13. Resistive Load Switching Time vs. Gate–Source Voltage**



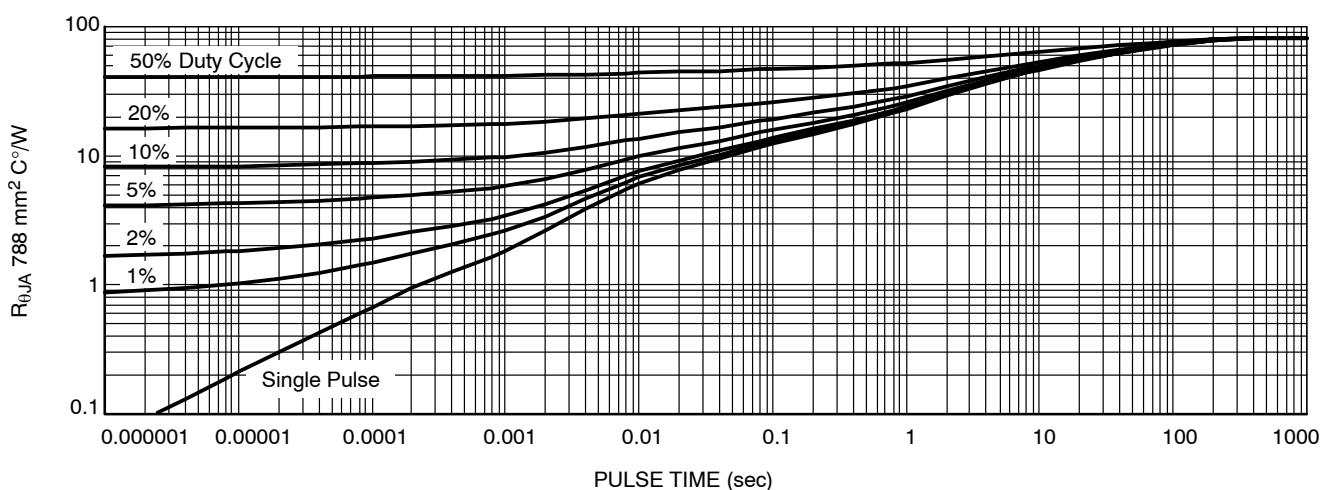
**Figure 14. Resistive Load Switching Time vs. Gate Resistance ( $V_{GS} = 5 \text{ V}$ ,  $I_D = 2.6 \text{ A}$ )**



**Figure 15. Resistive Load Switching Time vs. Gate Resistance ( $V_{GS} = 10 \text{ V}$ ,  $I_D = 2.6 \text{ A}$ )**



**Figure 16.  $R_{\theta JA}$  vs. Copper Area**



**Figure 17. Transient Thermal Resistance**

## NCV8440, NCV8440A

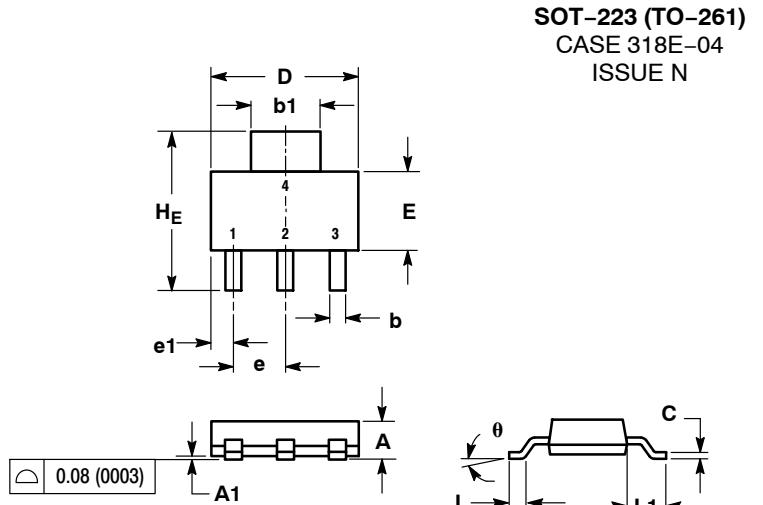
### ORDERING INFORMATION

Device	Package	Shipping <sup>†</sup>
NCV8440STT1G	SOT-223 (Pb-Free)	1000 / Tape & Reel
NCV8440ASTT1G	SOT-223 (Pb-Free)	1000 / Tape & Reel
NCV8440STT3G	SOT-223 (Pb-Free)	4000 / Tape & Reel
NCV8440ASTT3G	SOT-223 (Pb-Free)	4000 / Tape & Reel

<sup>†</sup>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.

# NCV8440, NCV8440A

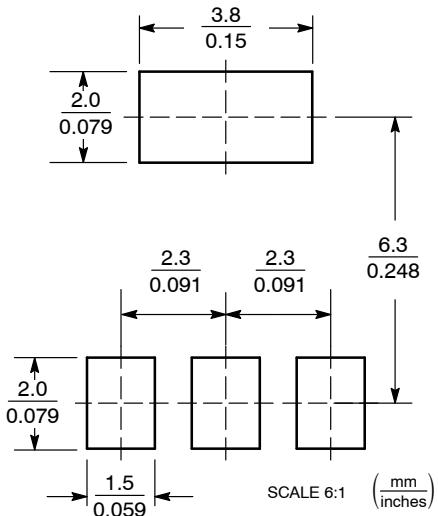
## PACKAGE DIMENSIONS



DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.50	1.63	1.75	0.060	0.064	0.068
A1	0.02	0.06	0.10	0.001	0.002	0.004
b	0.60	0.75	0.89	0.024	0.030	0.035
b1	2.90	3.06	3.20	0.115	0.121	0.126
c	0.24	0.29	0.35	0.009	0.012	0.014
D	6.30	6.50	6.70	0.249	0.256	0.263
E	3.30	3.50	3.70	0.130	0.138	0.145
e	2.20	2.30	2.40	0.087	0.091	0.094
e1	0.85	0.94	1.05	0.033	0.037	0.041
L	0.20	---	---	0.008	---	---
L1	1.50	1.75	2.00	0.060	0.069	0.078
H_E	6.70	7.00	7.30	0.264	0.276	0.287
θ	0°	-	10°	0°	-	10°

STYLE 3:  
 PIN 1. GATE  
 2. DRAIN  
 3. SOURCE  
 4. 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, SOLDERERRM/D.

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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



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