

# MOSFET – P-Channel, POWERTRENCH®

60 V

NDS9407

## General Description

This P-Channel MOSFET is a rugged gate version of onsemi's advanced PowerTrench process. It has been optimized for power management applications requiring a wide range of gate drive voltage ratings (4.5 V – 20 V).

## Features

- 3 A, –60 V.  $R_{DS(ON)} = 150 \text{ m}\Omega @ V_{GS} = -10 \text{ V}$   
 $R_{DS(ON)} = 240 \text{ m}\Omega @ V_{GS} = -4.5 \text{ V}$
- Low Gate Charge
- Fast Switching Speed
- High Performance Trench Technology for Extremely Low  $R_{DS(ON)}$
- High Power and Current Handling Capability
- These Device is Pb-Free and Halide Free

## Applications

- Power Management
- Load Switch
- Battery Protection

## ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$ unless otherwise noted

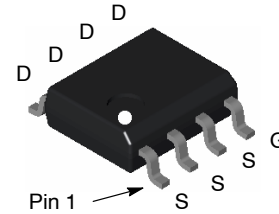
Symbol	Parameter	Value	Unit
$V_{DS}$	Drain–Source Voltage	–60	V
$V_{GS}$	Gate–Source Voltage	$\pm 20$	V
$I_D$	Drain Current – Continuous (Note 1a) – Pulsed	–3.0 –12	A
$P_D$	Power Dissipation for Single Operation (Note 1a) (Note 1b) (Note 1c)	2.5 1.2 1.0	W
$T_J, T_{stg}$	Operating and Storage Junction Temperature Range	–55 to +175	$^\circ\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## THERMAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ unless otherwise noted

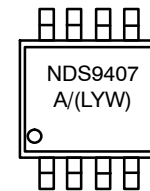
Symbol	Parameter	Value	Unit
$R_{\theta JA}$	Thermal Resistance, Junction–to–Ambient (Note 1a) (Note 1c)	50 125	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction–to–Case (Note 1)	25	$^\circ\text{C}/\text{W}$

$V_{DS}$	$R_{DS(ON)} \text{ MAX}$	$I_D \text{ MAX}$
–60 V	150 m $\Omega$ @ –10 V	–3A
	240 m $\Omega$ @ –4.5 V	



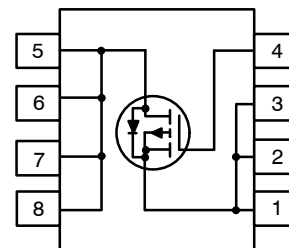
SOIC8  
CASE 751EB

## MARKING DIAGRAM



NDS9407 = Specific Device Code  
A = Assembly Site  
L = Wafer Lot Number  
YW = Assembly Start Week

## PIN ASSIGNMENT



## ORDERING INFORMATION

Device	Package	Shipping†
NDS9407	SOIC8 CASE 751EB (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 Specifications Brochure, [BRD8011/D](http://BRD8011/D).

**ELECTRICAL CHARACTERISTICS**  $T_A = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = -250\text{ }\mu\text{A}$	-60	-	-	V
$\frac{\Delta BV_{DSS}}{\Delta T_J}$	Breakdown Voltage Temperature Coefficient	$I_D = -250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	-45	-	mV/ $^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}$ $V_{DS} = -48\text{ V}, V_{GS} = 0\text{ V}, T_J = 55^\circ\text{C}$	-	-	-1 -10	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage, Forward	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	-	-	100	nA
$I_{GSSR}$	Gate-Body Leakage, Reverse	$V_{GS} = -20\text{ V}, V_{DS} = 0\text{ V}$	-	-	-100	nA

**ON CHARACTERISTICS** (Note 2)

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$	-1	-1.6	-3	V
$\frac{\Delta V_{GS(th)}}{\Delta T_J}$	Gate Threshold Voltage Temperature Coefficient	$I_D = -250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$	-	4.0	-	mV/ $^\circ\text{C}$
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = -10\text{ V}, I_D = -3.0\text{ A}$ $V_{GS} = -4.5\text{ V}, I_D = -1.6\text{ A}$ , $V_{GS} = -10\text{ V}, I_D = -3.0\text{ A}, T_J = 125^\circ\text{C}$	-	78 99 122	150 240 250	$\Omega$
$I_{D(on)}$	On-State Drain Current	$V_{GS} = -10\text{ V}, V_{DS} = -5\text{ V}$	-12	-	-	A
$g_{FS}$	Forward Transconductance	$V_{DS} = -15\text{ V}, I_D = -3.0\text{ A}$	-	8	-	S

**DYNAMIC CHARACTERISTICS**

$C_{iss}$	Input Capacitance	$V_{DS} = -30\text{ V}, V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$	-	732	-	pF
$C_{oss}$	Output Capacitance		-	86	-	pF
$C_{rss}$	Reverse Transfer Capacitance		-	38	-	pF

**SWITCHING CHARACTERISTICS** (Note 2)

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = -30\text{ V}, I_D = -1\text{ A}$ , $V_{GS} = -10\text{ V}, R_{GEN} = 6\text{ }\Omega$	-	8	16	ns
$t_r$	Turn-On Rise Time		-	11	20	ns
$t_{d(off)}$	Turn-Off Delay Time		-	10	20	ns
$t_f$	Turn-Off Fall Time		-	10	20	ns
$t_{rr}$	Diode Reverse Recovery Time	$I_F = -3.0\text{ V}$ , $d_{if} / d_t = 100\text{ A}/\mu\text{s}$	-	24	-	ns
$Q_{rr}$	Diode Reverse Recovery Charge		-	66	-	nC
$Q_g$	Total Gate Charge	$V_{DS} = -30\text{ V}, I_D = -3.0\text{ A}$ , $V_{GS} = -10\text{ V}$	-	16	22	nC
$Q_{gs}$	Gate-Source Charge		-	2.2	-	nC
$Q_{gd}$	Gate-Drain Charge		-	3.3	-	nC

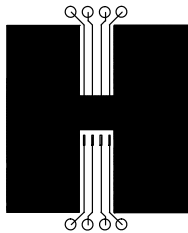
**DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS**

I <sub>S</sub>	Maximum Continuous Drain–Source Diode Forward Current		–	–	–2.1	A
V <sub>SD</sub>	Drain–Source Diode Forward Voltage	V <sub>GS</sub> = 0 V, I <sub>S</sub> = –2.1 A (Note 2)	–	–0.8	–1.2	V

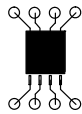
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

**NOTES:**

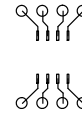
- $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient resistance where the case thermal reference is defined as the solder mounting surface of the drain pins.  $R_{\theta JC}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.



a)  $50^\circ\text{C/W}$  when mounted on a  $1\text{ in}^2$  pad of 2 oz copper.



b)  $105^\circ\text{C/W}$  when mounted on a  $0.04\text{ in}^2$  pad of 2 oz copper.



b)  $125^\circ\text{C/W}$  when mounted on a minimum pad.

Scale 1:1 on letter size paper

- Pulse Test: Pulse Width  $< 300\text{ }\mu\text{s}$ , Duty Cycle  $< 2.0\%$

TYPICAL CHARACTERISTICS

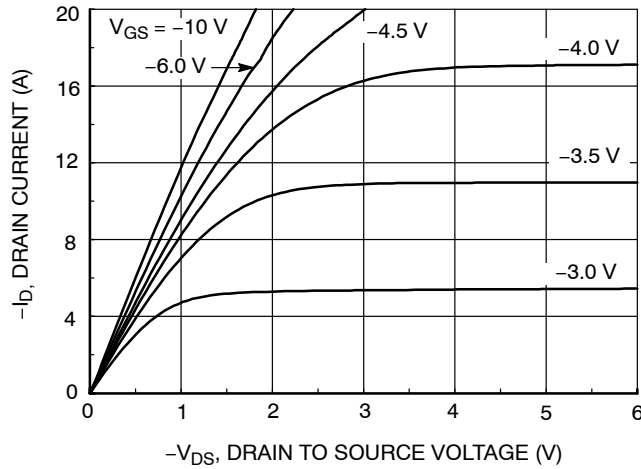


Figure 1. On-Region Characteristics

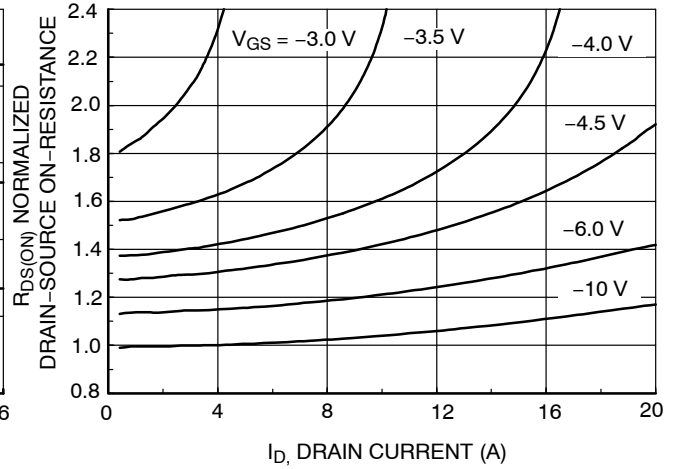


Figure 2. On-Resistance Variation with Drain Current and Gate Voltage

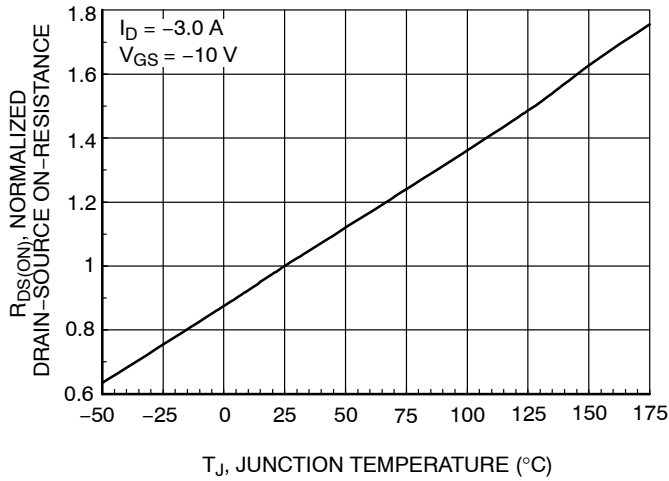


Figure 3. On-Resistance Variation with Temperature

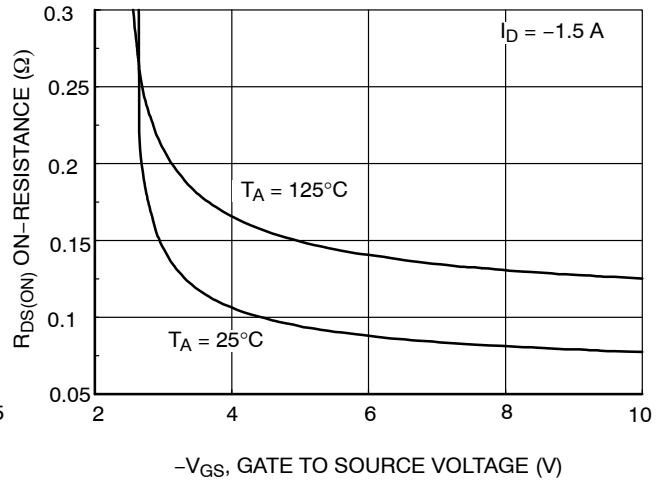


Figure 4. On-Resistance Variation with Gate-to-Source Voltage

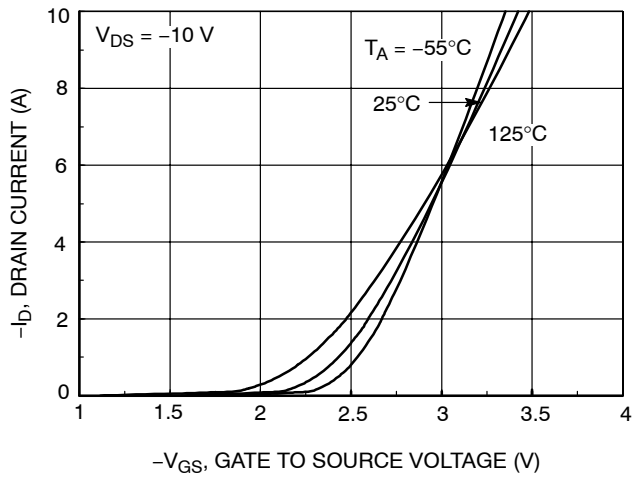


Figure 5. Transfer Characteristics

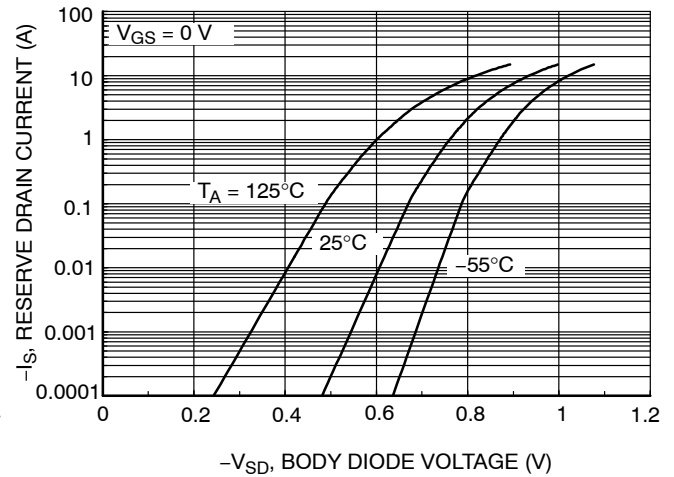


Figure 6. Body Diode Forward Voltage Variation with Source Current and Temperature

Typical Characteristics (continued)

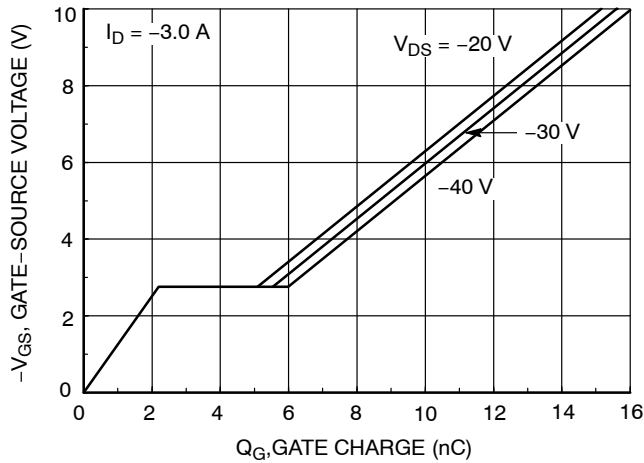


Figure 7. Gate Charge Characteristics

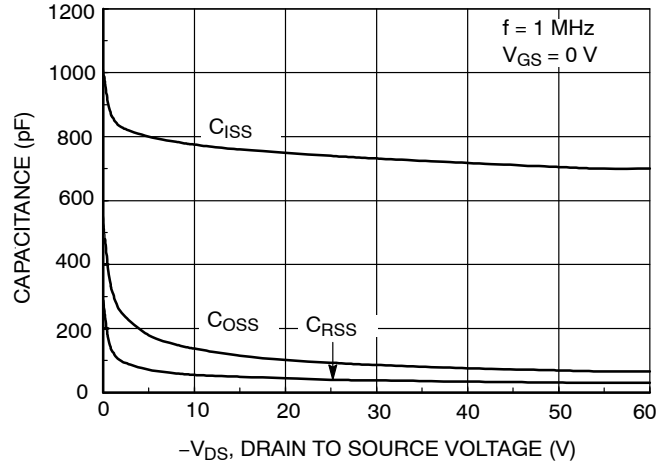


Figure 8. Capacitance Characteristics

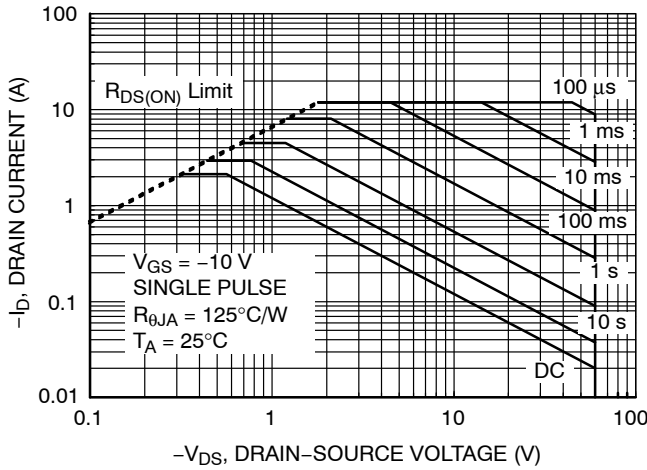


Figure 9. Maximum Safe Operating Area

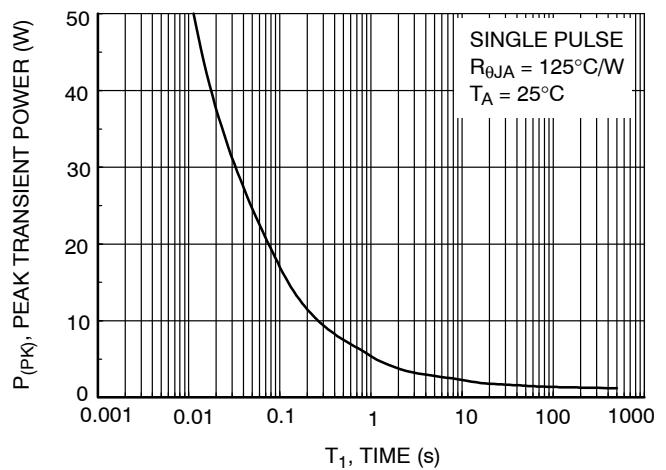


Figure 10. Single Pulse Maximum Power Dissipation

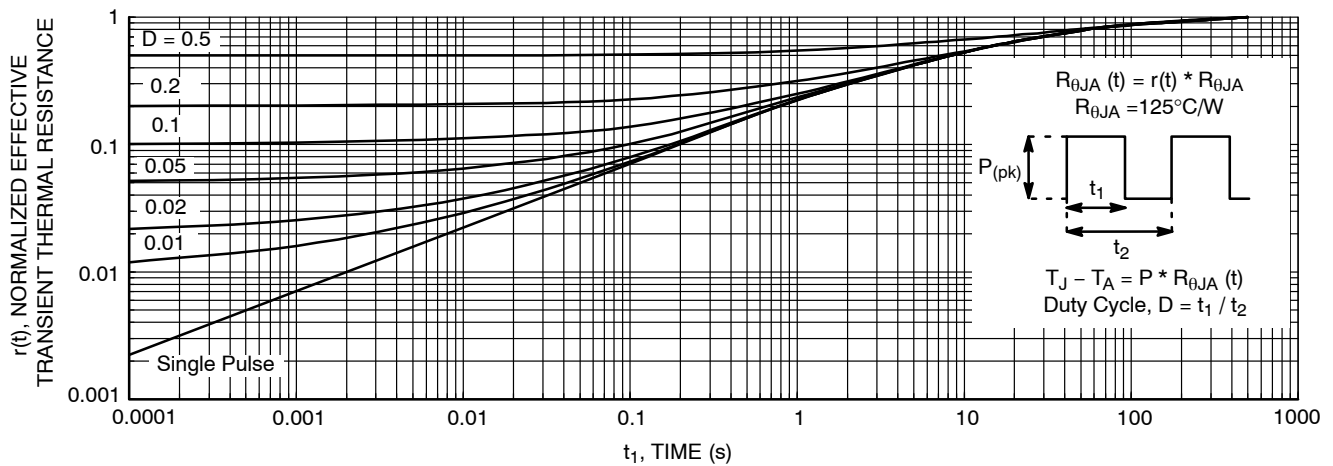


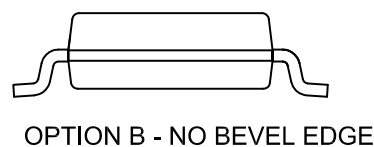
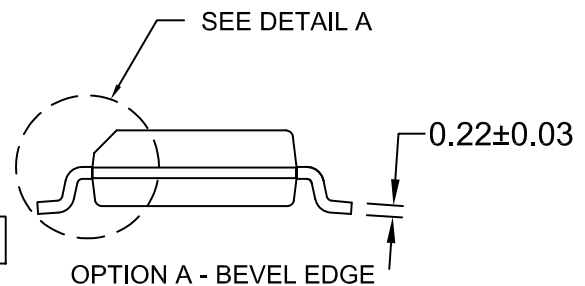
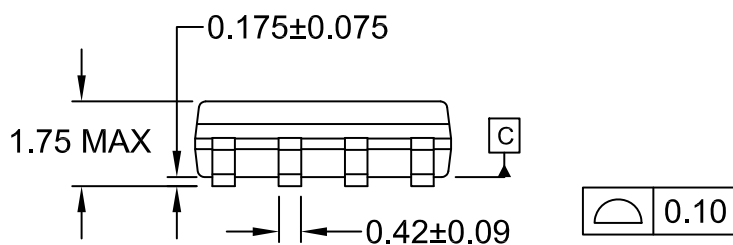
Figure 11. Transient Thermal Response Curve

Thermal characterization performed using the conditions described in Note 1c.  
Transient thermal response will change depending on the circuit board design.



**SOIC8**  
**CASE 751EB**  
**ISSUE A**

DATE 24 AUG 2017



**NOTES:**

- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AA.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) LANDPATTERN STANDARD: SOIC127P600X175-8M

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