

## N and P-Channel Enhancement Mode Power MOSFET

### Description

The NCE4503S uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The SOP-8 package is universally preferred for all commercial industrial surface mount applications and suited for low voltage applications such as DC/DC converters.

### General Features

#### ● N-Channel

- $V_{DS} = 30V, I_D = 10A$
- $R_{DS(ON)} < 20m\Omega @ V_{GS}=4.5V$
- $R_{DS(ON)} < 13.5m\Omega @ V_{GS}=10V$

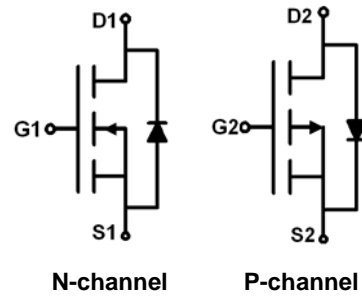
#### ● P-Channel

- $V_{DS} = -30V, I_D = -9.1A$
- $R_{DS(ON)} < 35m\Omega @ V_{GS}=-4.5V$
- $R_{DS(ON)} < 20m\Omega @ V_{GS}=-10V$

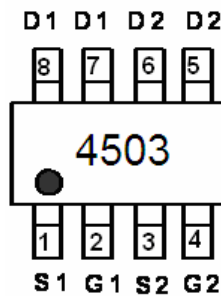
- High power and current handling capability
- Lead free product is acquired
- Surface mount package

### Application

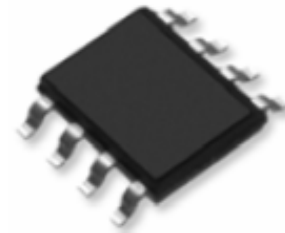
- Battery protection
- Load switch
- Power management



Schematic diagram



Marking and pin assignment



SOP-8 top view

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
4503	NCE4503S	SOP-8	Ø330mm	12mm	2500 units

### Absolute Maximum Ratings ( $T_A=25^\circ C$ unless otherwise noted)

Parameter	Symbol	N-Channel	P-Channel	Unit	
Drain-Source Voltage	$V_{DS}$	30	-30	V	
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V	
Continuous Drain Current	$I_D$	$T_A=25^\circ C$	10	-9.1	A
		$T_A=70^\circ C$	7.9	-7.2	
Pulsed Drain Current <sup>(Note 1)</sup>	$I_{DM}$	30	-30	A	
Maximum Power Dissipation	$P_D$	2.5	2.5	W	
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	-55 To 150	$^\circ C$	

## Thermal Characteristic

Thermal Resistance, Junction-to-Ambient <sup>(Note2)</sup>	R <sub>θJA</sub>	N-Ch	50	°C/W
		P-Ch	50	

## N-CH Electrical Characteristics (T<sub>A</sub>=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	30	33	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =30V, V <sub>GS</sub> =0V	-	-	1	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V	-	-	±100	nA
<b>On Characteristics</b> <sup>(Note 3)</sup>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	1	1.6	3	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =10A	-	7.5	13.5	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =5A	-	11	20	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =10A	15	-	-	S
<b>Dynamic Characteristics</b> <sup>(Note4)</sup>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> =15V, V <sub>GS</sub> =0V, F=1.0MHz	-	1550	-	PF
Output Capacitance	C <sub>OSS</sub>		-	300	-	PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	180	-	PF
<b>Switching Characteristics</b> <sup>(Note 4)</sup>						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =25V, I <sub>D</sub> =1A V <sub>GS</sub> =10V, R <sub>GEN</sub> =6Ω	-	30	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	20	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	100	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	80	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =15V, I <sub>D</sub> =10A, V <sub>GS</sub> =4.5V	-	13	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	5.5	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	3.5	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage <sup>(Note 3)</sup>	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =6A	-	0.8	1.2	V

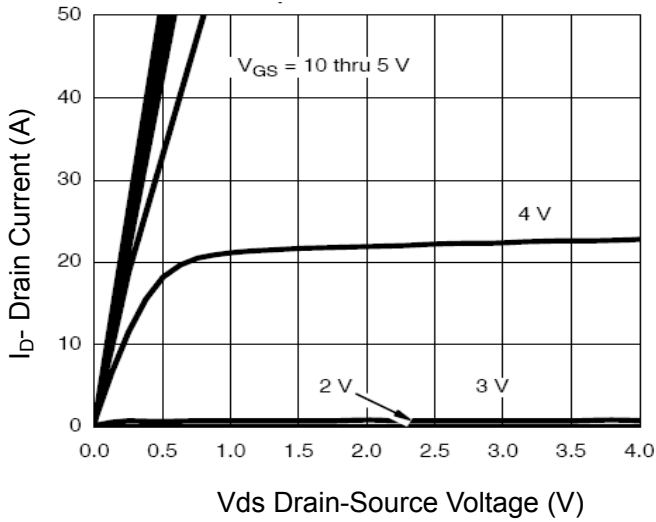
**P-CH Electrical Characteristics ( $T_A=25^{\circ}\text{C}$  unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=-250\mu A$	-30	-33	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=-30V, V_{GS}=0V$	-	-	-1	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	$\pm 100$	nA
<b>On Characteristics (Note 3)</b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-250\mu A$	-1	-1.5	-3	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=-10V, I_D=-9.1A$	-	15	20	m $\Omega$
		$V_{GS}=-4.5V, I_D=-5A$	-	21	35	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS}=-15V, I_D=-9.1A$	10	-	-	S
<b>Dynamic Characteristics (Note 4)</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=-15V, V_{GS}=0V,$ $F=1.0MHz$	-	1600	-	PF
Output Capacitance	$C_{OSS}$		-	350	-	PF
Reverse Transfer Capacitance	$C_{RSS}$		-	300	-	PF
<b>Switching Characteristics (Note 4)</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=-15V, I_D=-1A,$ $V_{GS}=-10V, R_{GEN}=6\Omega$	-	10	-	nS
Turn-on Rise Time	$t_r$		-	15	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	110	-	nS
Turn-Off Fall Time	$t_f$		-	70	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=-15V, I_D=-9.1A$ $V_{GS}=-10V$	-	30	-	nC
Gate-Source Charge	$Q_{gs}$		-	5.5	-	nC
Gate-Drain Charge	$Q_{gd}$		-	8	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage (Note 3)	$V_{SD}$	$V_{GS}=0V, I_S=-6A$	-	-	-1.2	V

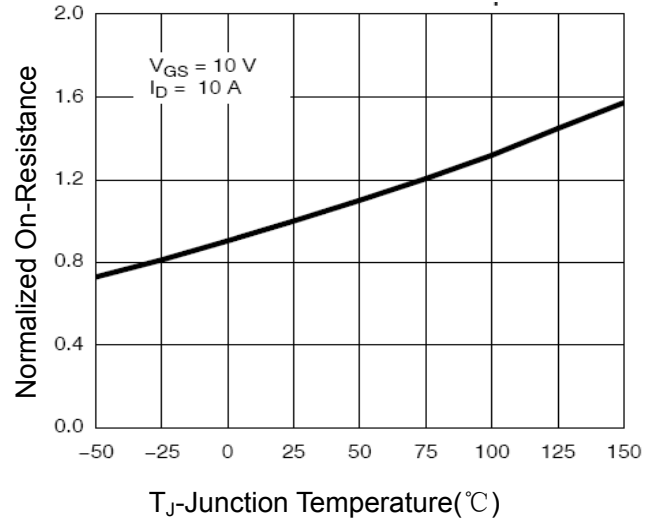
**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

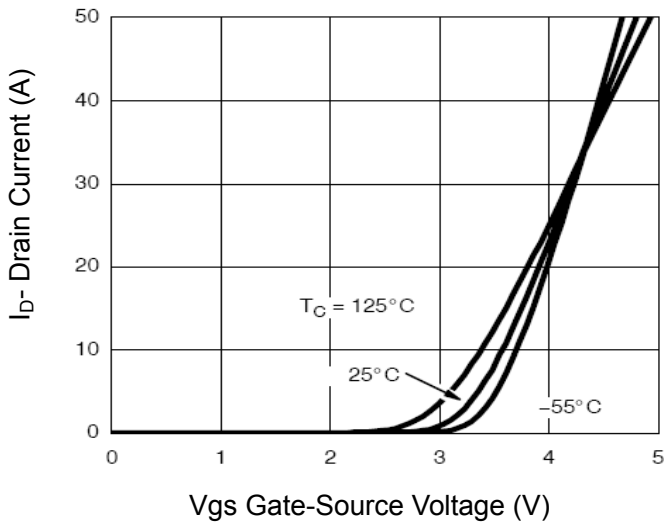
**N- Channel Typical Electrical and Thermal Characteristics (Curves)**



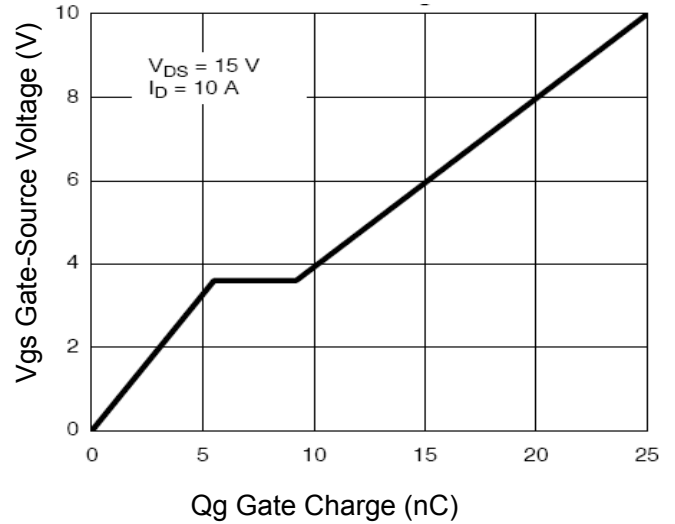
**Figure 1 Output Characteristics**



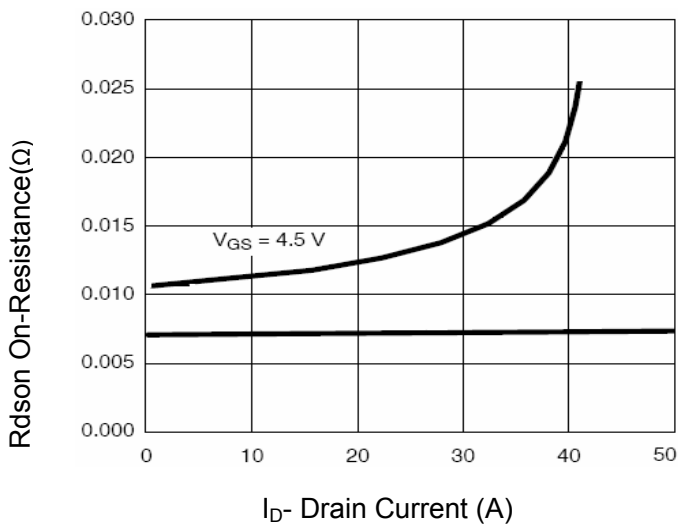
**Figure 4 Rdson- Junction Temperature**



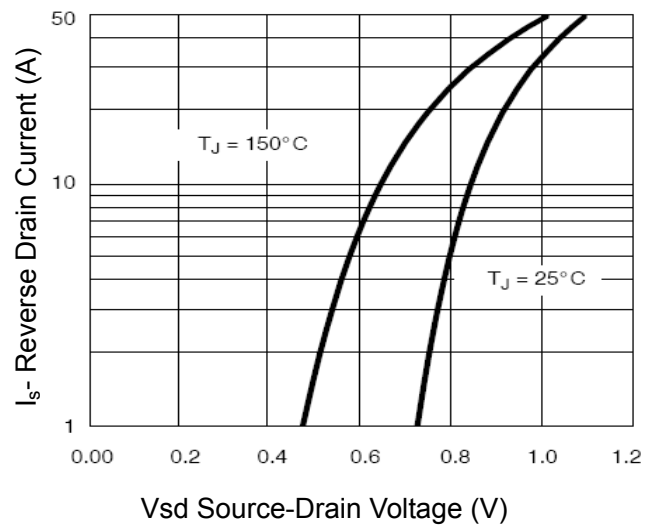
**Figure 2 Transfer Characteristics**



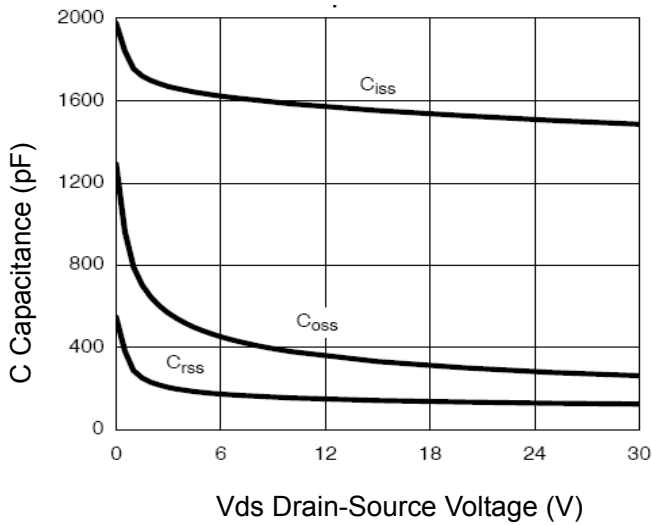
**Figure 5 Gate Charge**



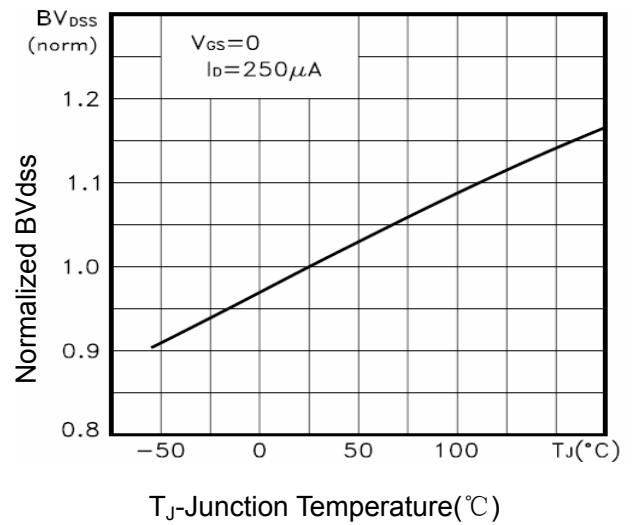
**Figure 3 Rdson- Drain Current**



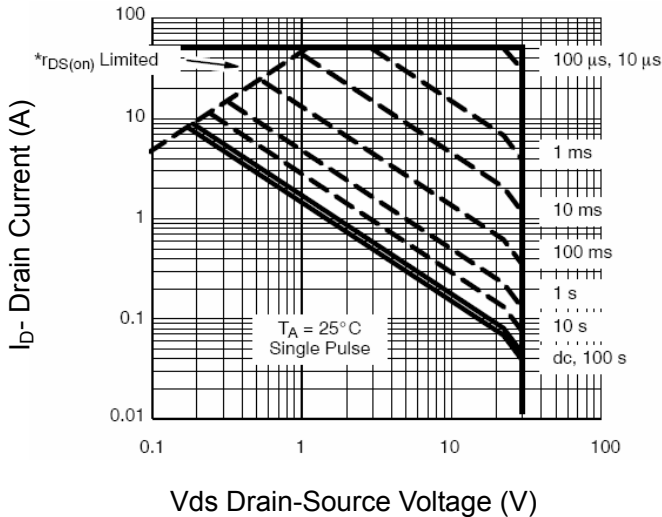
**Figure 6 Source- Drain Diode Forward**



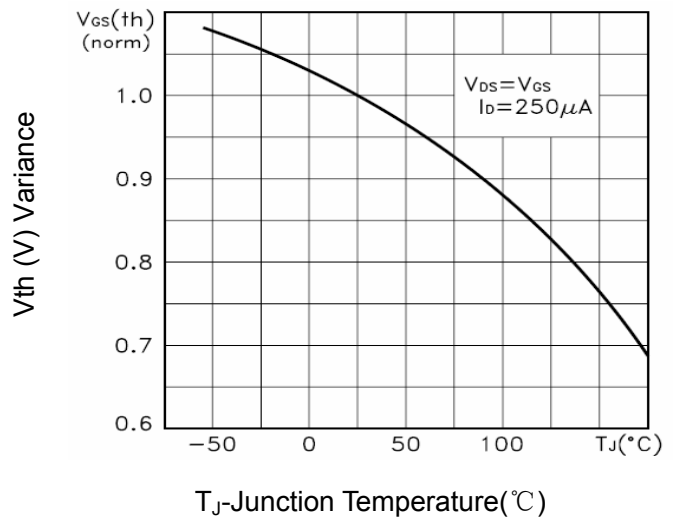
Vds Drain-Source Voltage (V)  
**Figure 7 Capacitance vs Vds**



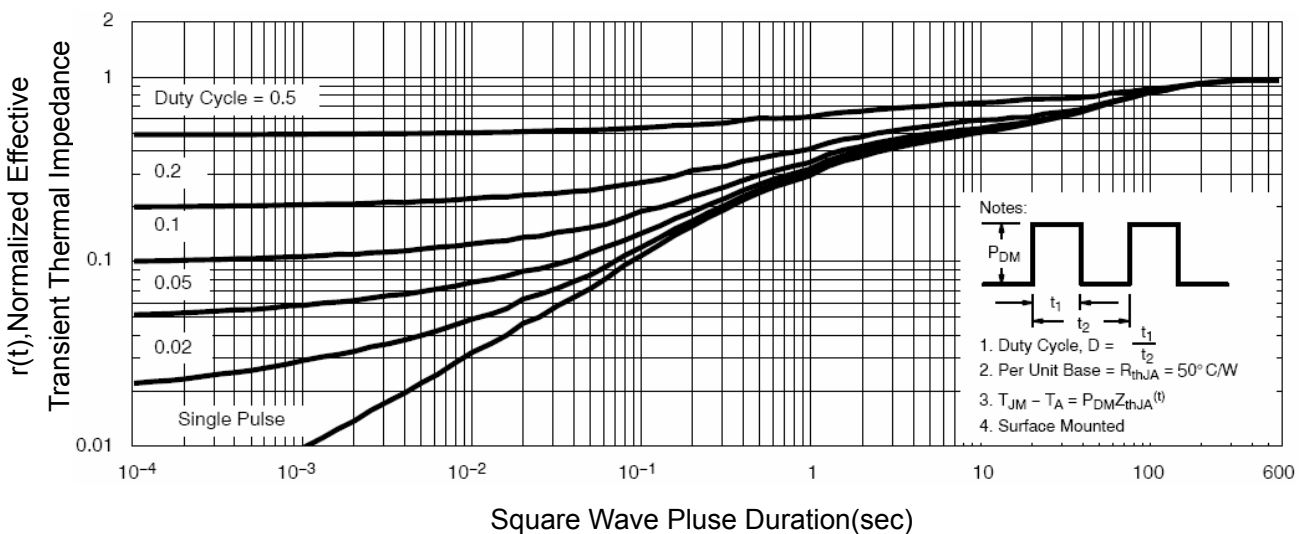
T<sub>J</sub>-Junction Temperature(°C)  
**Figure 9 BV<sub>DSS</sub> vs Junction Temperature**



Vds Drain-Source Voltage (V)  
**Figure 8 Safe Operation Area**



T<sub>J</sub>-Junction Temperature(°C)  
**Figure 10 V<sub>GS(th)</sub> vs Junction Temperature**



**Figure 11 Normalized Maximum Transient Thermal Impedance**

P-Channel Typical Electrical and Thermal Characteristics

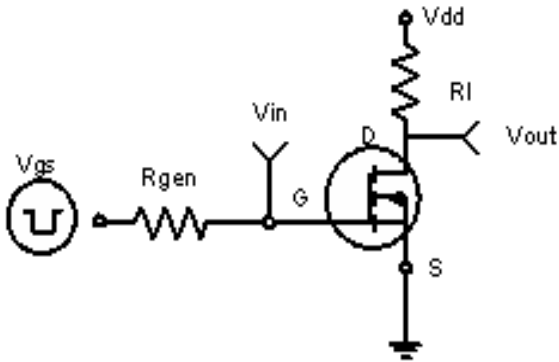


Figure 1: Switching Test Circuit

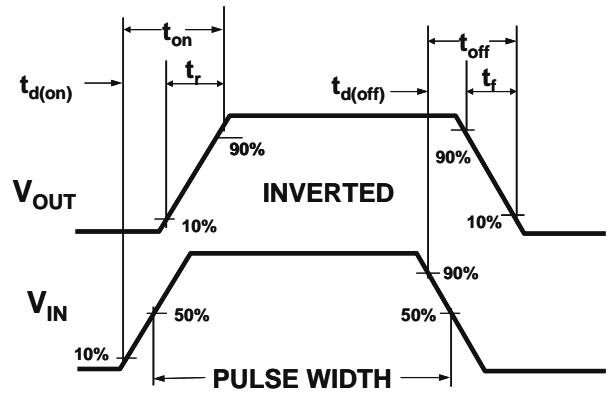


Figure 2: Switching Waveforms

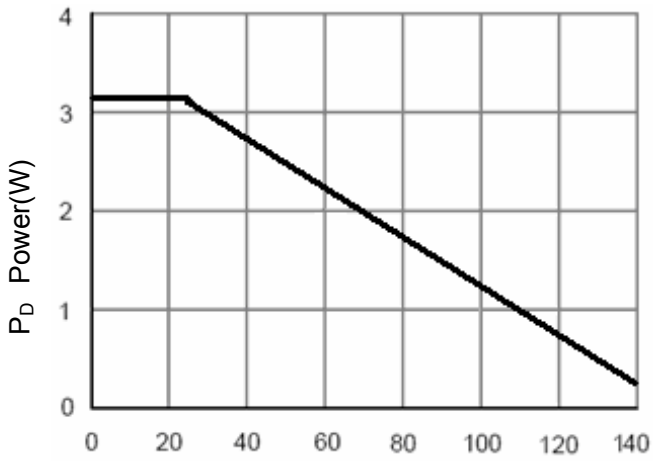


Figure 3 Power Dissipation

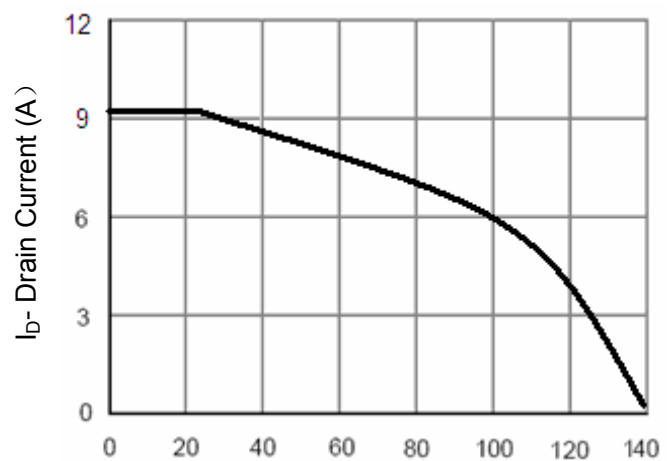


Figure 4 Drain Current

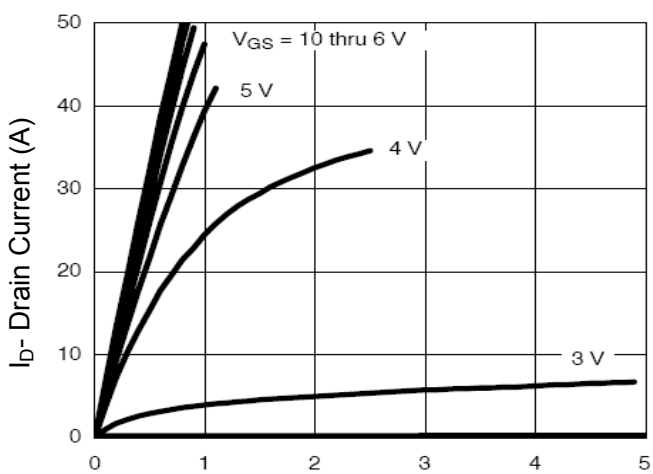


Figure 5 Output Characteristics

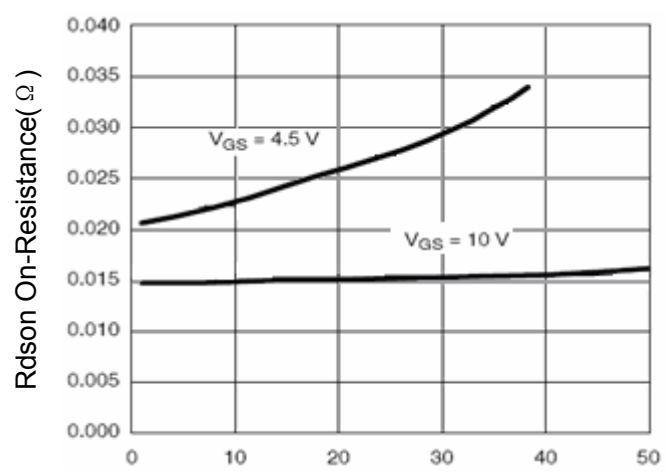


Figure 6 Drain-Source On-Resistance

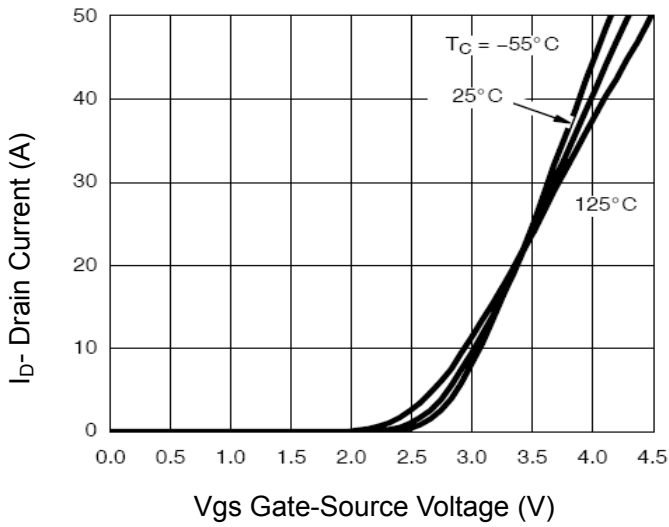


Figure 7 Transfer Characteristics

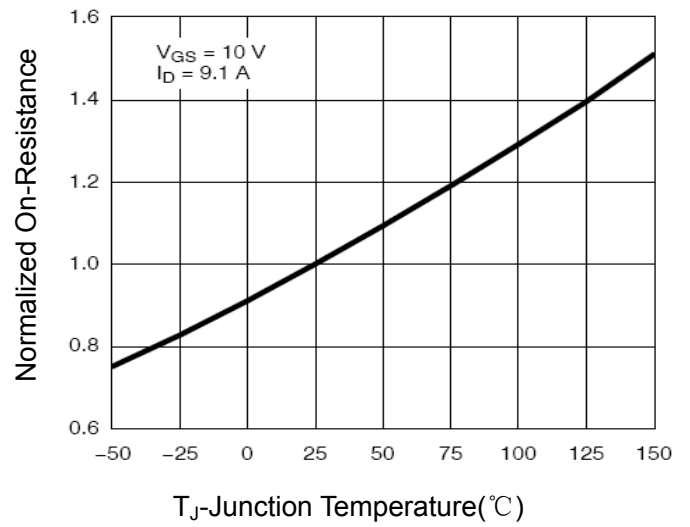


Figure 8 Drain-Source On-Resistance

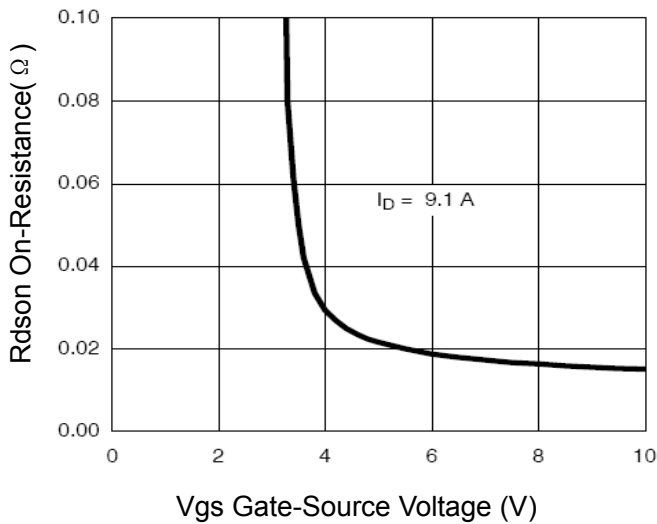


Figure 9  $R_{DS(on)}$  vs  $V_{GS}$

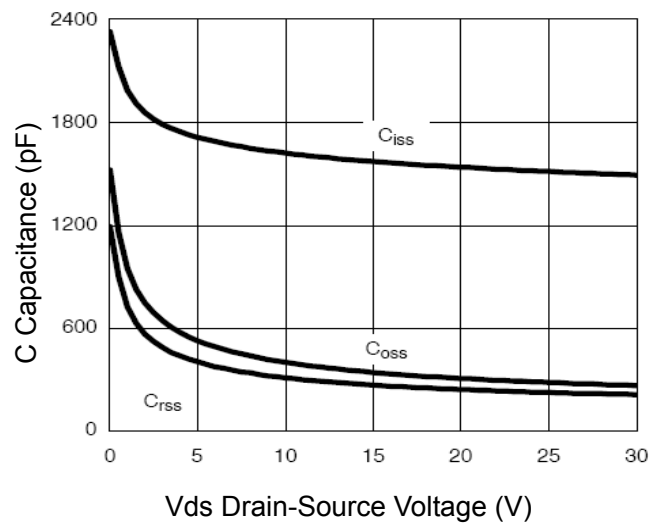


Figure 10 Capacitance vs  $V_{DS}$

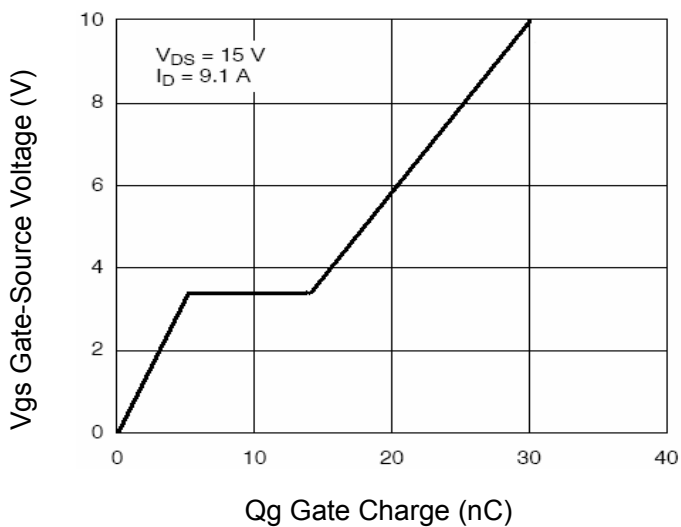


Figure 11 Gate Charge

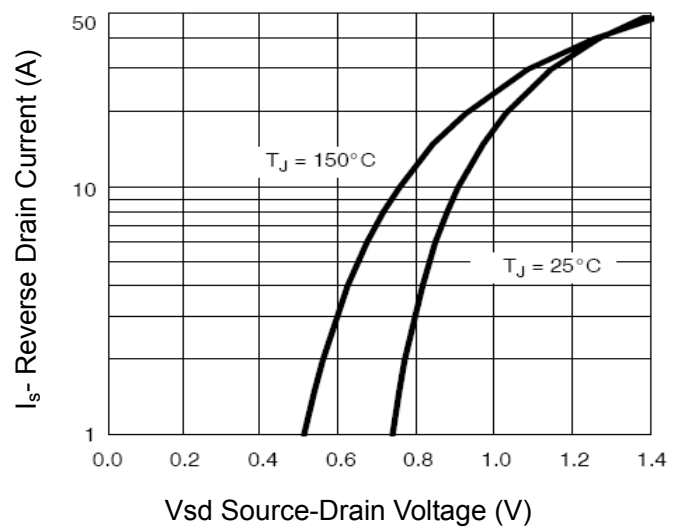


Figure 12 Source-Drain Diode Forward

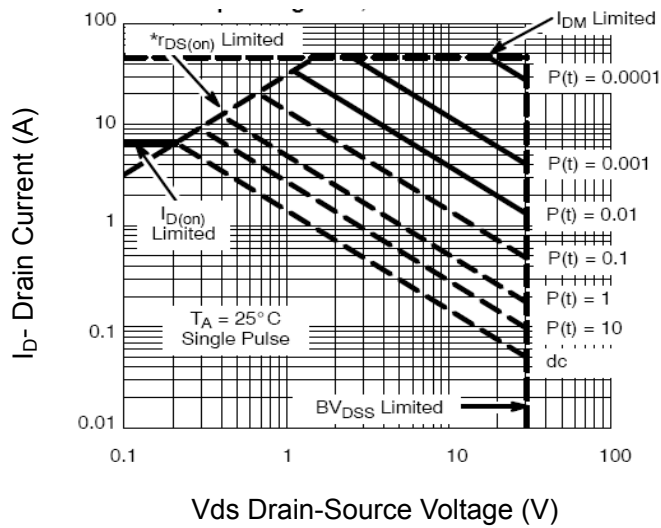


Figure 13 Safe Operation Area

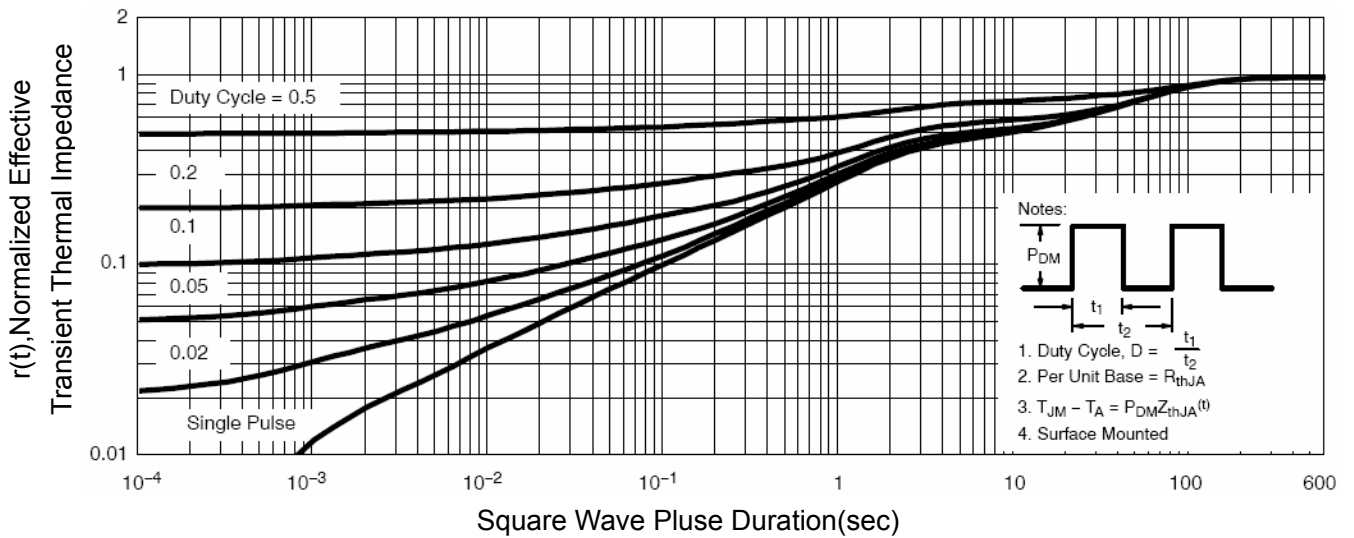
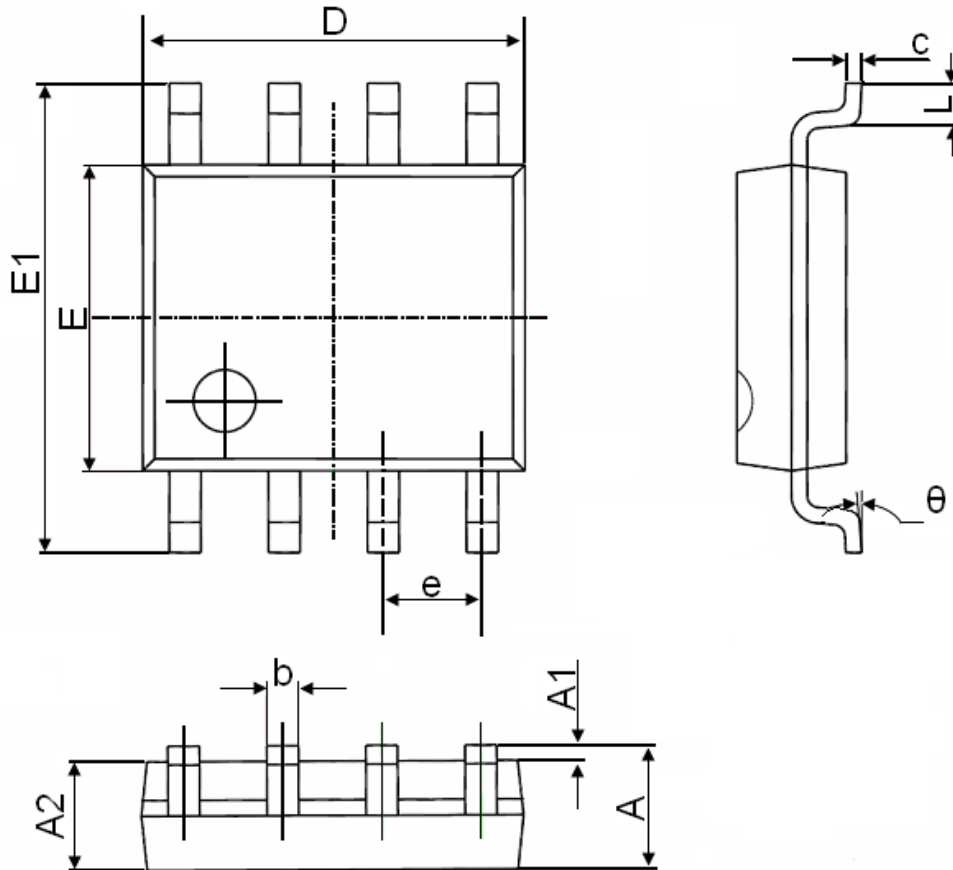


Figure 14 Normalized Maximum Transient Thermal Impedance



**SOP-8 Package Information**


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
theta	0°	8°	0°	8°

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