

## N and P-Channel Enhancement Mode Power MOSFET

### Description

The NCE4614 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. The complementary MOSFETs may be used to form a level shifted high side switch, and for a host of other applications.

### General Features

#### ● N-Channel

$$V_{DS} = 40V, I_D = 8A$$

$$R_{DS(ON)} < 19m\Omega @ V_{GS} = 10V$$

$$R_{DS(ON)} < 29m\Omega @ V_{GS} = 4.5V$$

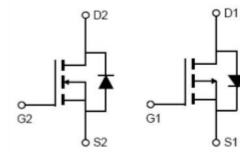
#### ● P-Channel

$$V_{DS} = -40V, I_D = -7A$$

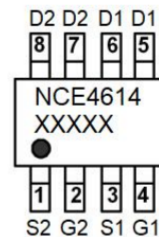
$$R_{DS(ON)} < 35m\Omega @ V_{GS} = -10V$$

$$R_{DS(ON)} < 45m\Omega @ V_{GS} = -4.5V$$

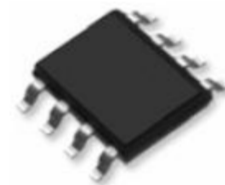
- High power and current handling capability
- Lead free product is acquired
- Surface mount package



N-channel P-channel  
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
NCE4614	NCE4614	SOP-8	Ø330mm	12mm	4000 units

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

Parameter	Symbol	N-Channel	P-Channel	Unit	
Drain-Source Voltage	$V_{DS}$	40	-40	V	
Gate-Source Voltage	$V_{GS}$	$\pm 20$	$\pm 20$	V	
Continuous Drain Current	$I_D$	$T_A = 25^\circ\text{C}$	8	-7	A
		$T_A = 70^\circ\text{C}$	6	-5.5	
Pulsed Drain Current (Note 1)	$I_{DM}$	40	-30	A	
Maximum Power Dissipation	$P_D$	2.0	2.0	W	
Single pulse avalanche energy (Note 5)	$E_{AS}$	72	64	mJ	
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	-55 To 150	$^\circ\text{C}$	

### Thermal Characteristic

Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	N-Ch	62.5	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Note 2)	$R_{\theta JA}$	P-Ch	62.5	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Lead (Note 2)	$R_{\theta JL}$	N-Ch	40	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction-to-Lead (Note 2)	$R_{\theta JL}$	P-Ch	40	$^\circ\text{C}/\text{W}$

## 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	40	-	-	V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =40V, 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> (Note 3)						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	1	1.5	2.0	V
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =8A	-	14	19	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =4A	-	19	29	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =8A	-	20	-	S
<b>Dynamic Characteristics</b> (Note 4)						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, F=1.0MHz	-	1163	-	PF
Output Capacitance	C <sub>oss</sub>		-	104	-	PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	100	-	PF
<b>Switching Characteristics</b> (Note 4)						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =20V, R <sub>L</sub> =2.5Ω V <sub>GS</sub> =10V, R <sub>GEN</sub> =3Ω	-	5.5	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	14	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	24	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	12	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =20V, I <sub>D</sub> =8A, V <sub>GS</sub> =10V	-	28	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	3.9	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	5.9	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage (Note 3)	V <sub>SD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =8A	-	0.8	1.2	V

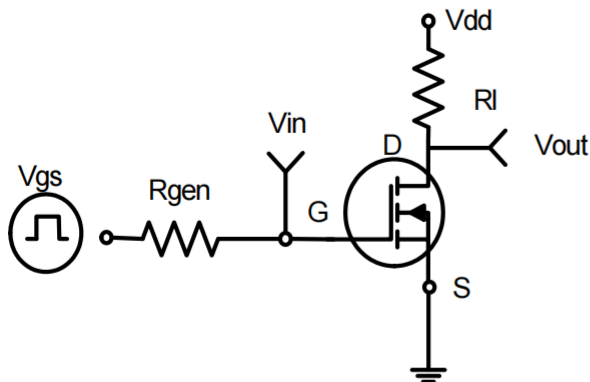
## P-CH Electrical Characteristics ( $T_A=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=-250\mu A$	-40	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=-40V, V_{GS}=0V$	-	-	-1	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	$\pm 100$	nA
<b>On Characteristics</b> (Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=-250\mu A$	-1.0	-1.5	-2.0	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=-10V, I_D=-7A$	-	29	35	m $\Omega$
		$V_{GS}=-4.5V, I_D=-4A$	-	34	45	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS}=-5V, I_D=-7A$	-	20	-	S
<b>Dynamic Characteristics</b> (Note 4)						
Input Capacitance	$C_{iss}$	$V_{DS}=-20V, V_{GS}=0V,$ $F=1.0MHz$	-	1060	-	PF
Output Capacitance	$C_{oss}$		-	121	-	PF
Reverse Transfer Capacitance	$C_{rss}$		-	111	-	PF
<b>Switching Characteristics</b> (Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=-20V, R_L=2.9\Omega$ $V_{GS}=-10V, R_{GEN}=6\Omega$	-	7.5	-	nS
Turn-on Rise Time	$t_r$		-	5.5	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	19	-	nS
Turn-Off Fall Time	$t_f$		-	7	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=-20V, I_D=-7A$ $V_{GS}=-10V$	-	26	-	nC
Gate-Source Charge	$Q_{gs}$		-	3.7	-	nC
Gate-Drain Charge	$Q_{gd}$		-	6.0	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage (Note 3)	$V_{SD}$	$V_{GS}=0V, I_S=-7A$	-	-	-1.2	V

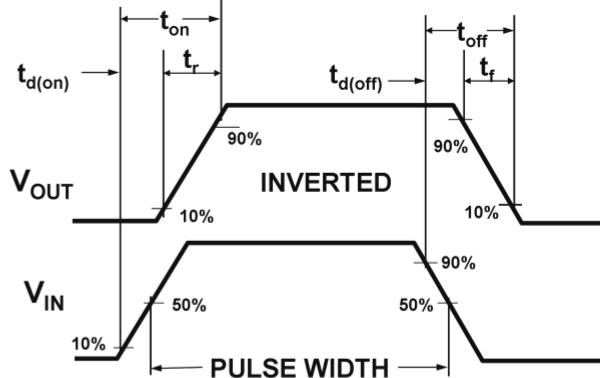
### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. The value of  $R_{\theta JA}$  is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ . The maximum allowed junction temperature of 175 $^\circ\text{C}$ . The value in any given application depends on the user's specific board design. The  $R_{\theta JA}$  is the sum of the thermal impedance from junction to lead  $R_{\theta JL}$  and lead to ambient.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production.
5. EAS condition :  $T_j=25^\circ\text{C}$ , N:  $V_{DD}=20V, V_G=10V, L=0.5mH, R_g=25\Omega$ . P:  $V_{DD}=-20V, V_G=-10V, L=0.5mH, R_g=25\Omega$ .

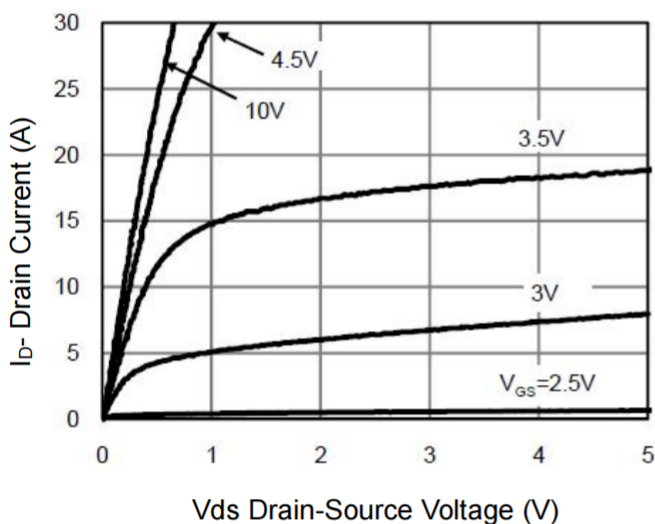
## N- Channel Typical Electrical and Thermal Characteristics (Curves)



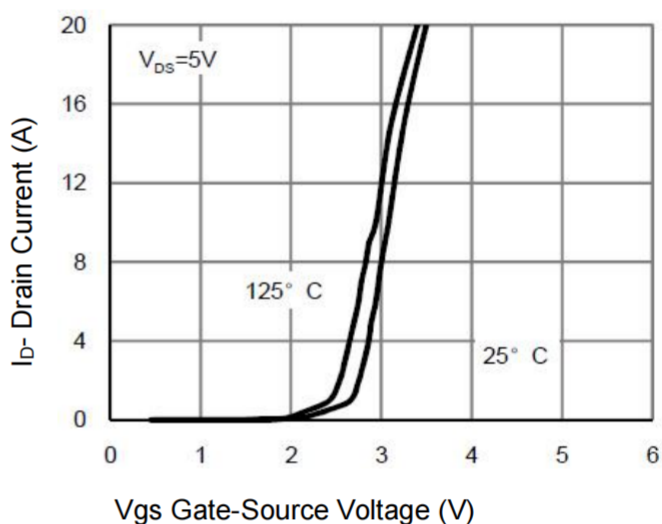
**Figure 1: Switching Test Circuit**



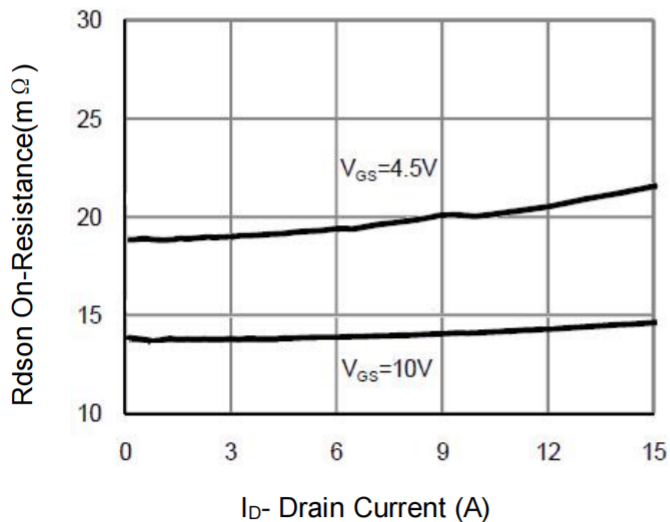
**Figure 2: Switching Waveforms**



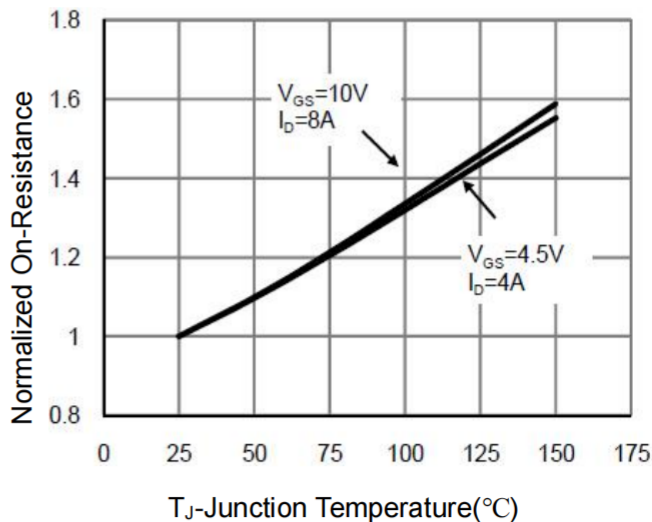
**Figure 3 Output Characteristics**



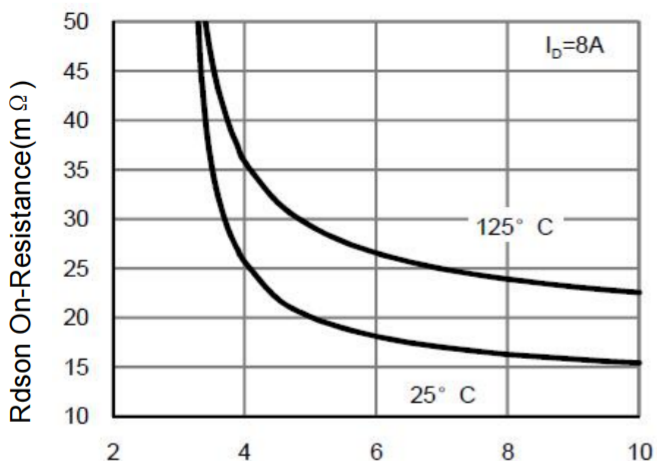
**Figure 4 Transfer Characteristics**



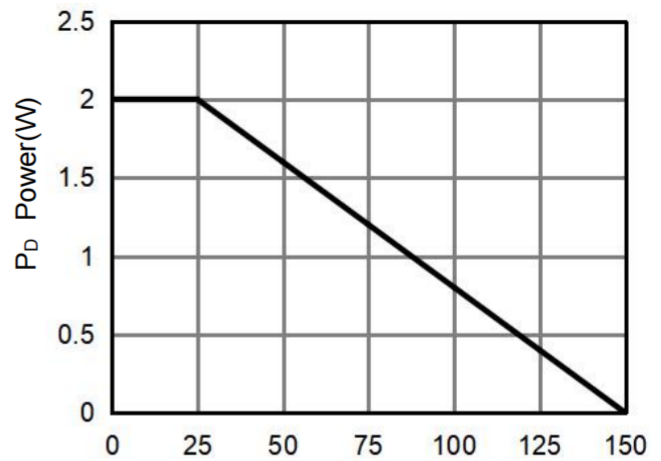
**Figure 5 Drain-Source On-Resistance**



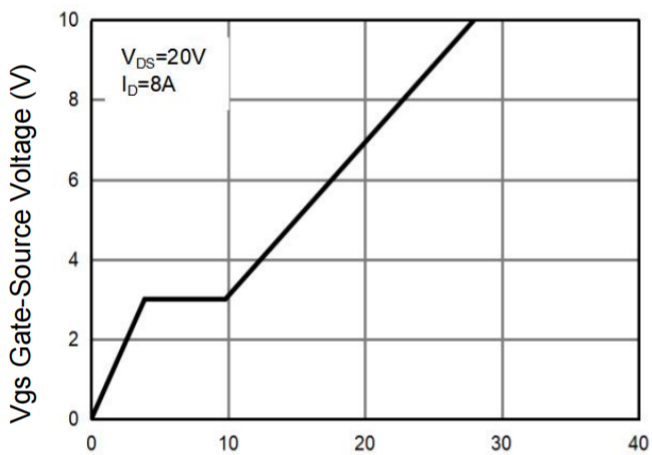
**Figure 6 Drain-Source On-Resistance**



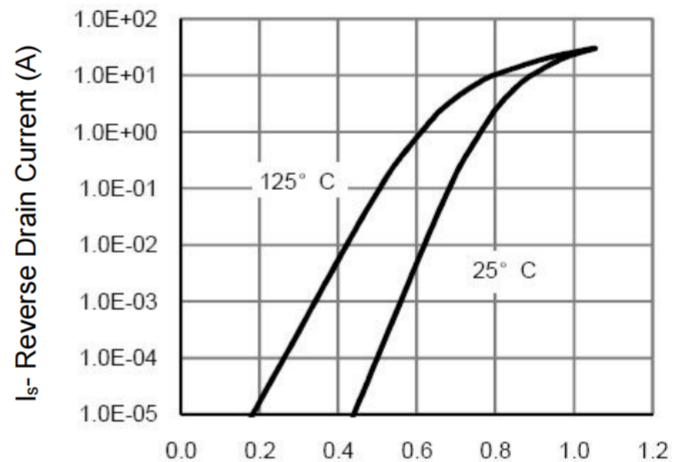
Vgs Gate-Source Voltage (V)  
**Figure 7 Rdson vs Vgs**



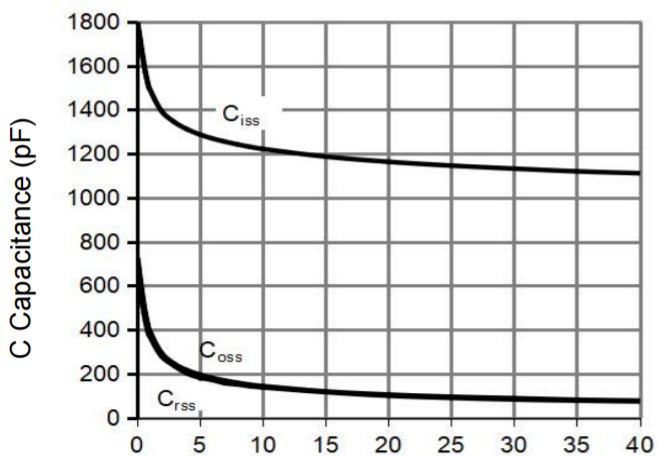
Tj-Junction Temperature(°C)  
**Figure 8 Power Dissipation**



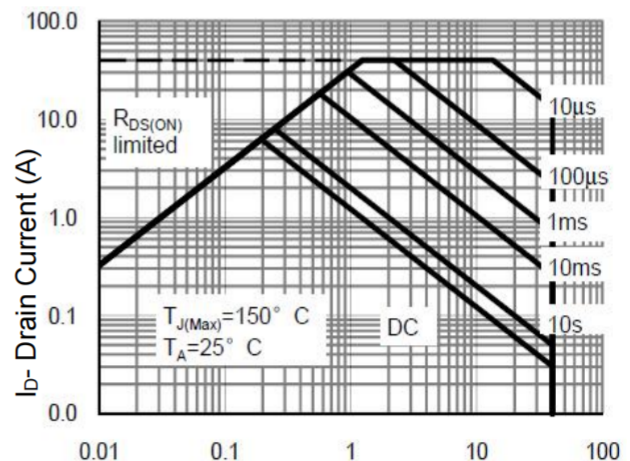
Qg Gate Charge (nC)  
**Figure 9 Gate Charge**



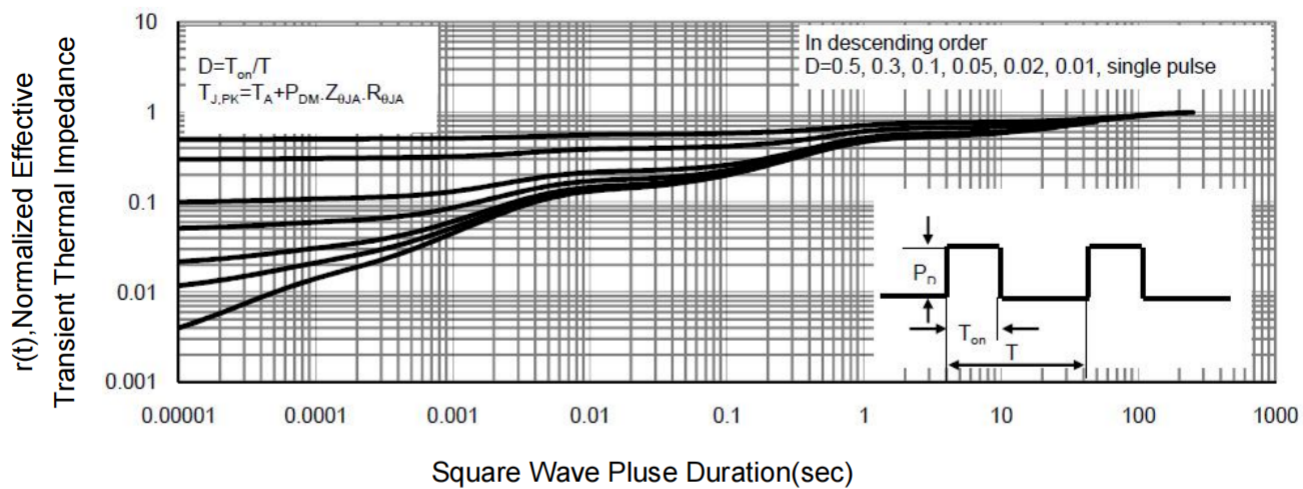
Vds Drain-Source Voltage (V)  
**Figure 10 Source-Drain Diode Forward**



Vds Drain-Source Voltage (V)  
**Figure 11 Capacitance vs Vds**

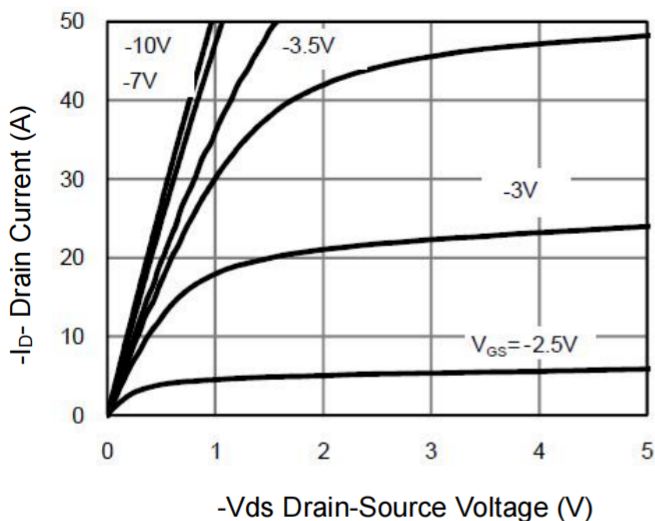


Vds Drain-Source Voltage (V)  
**Figure 12 Safe Operation Area**

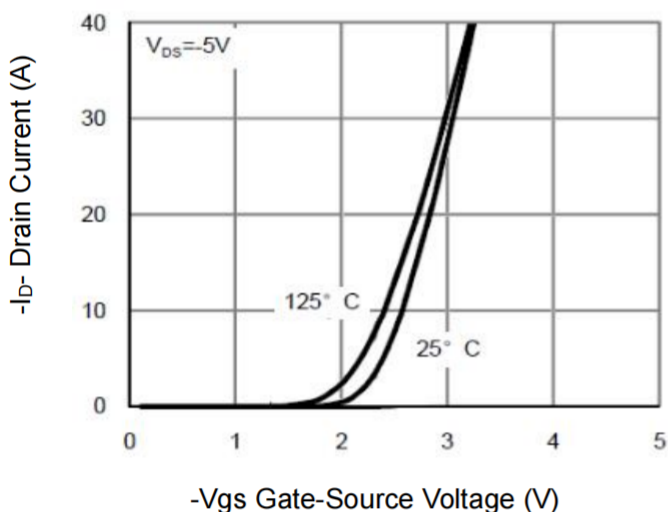


**Figure 13 Normalized Maximum Transient Thermal Impedance**

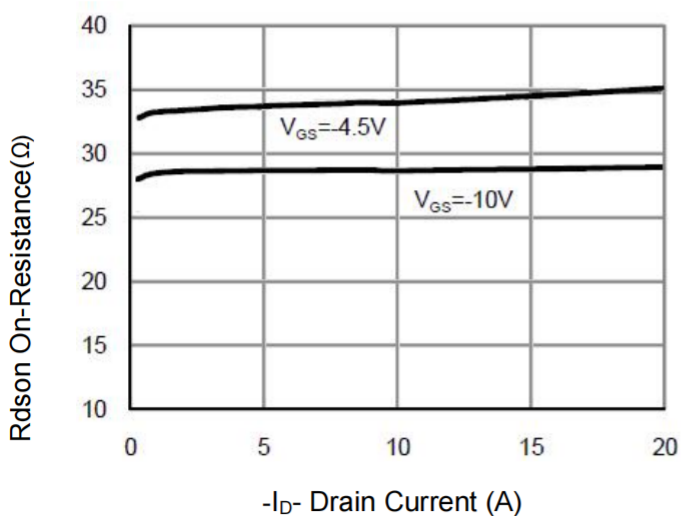
## P- Channel Typical Electrical and Thermal Characteristics (Curves)



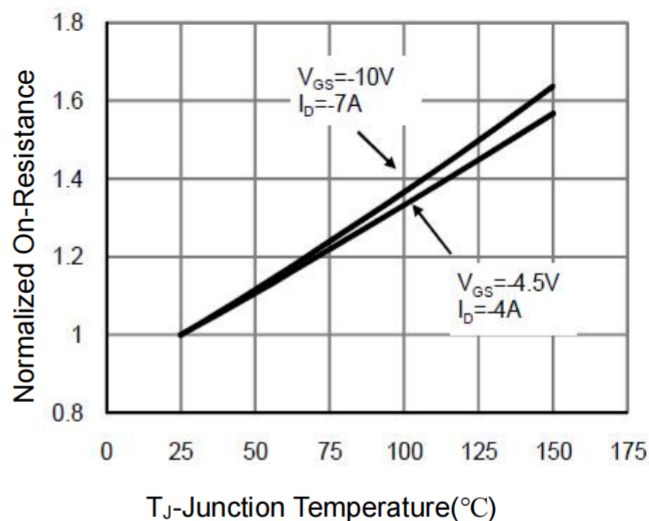
**Figure 1 Output Characteristics**



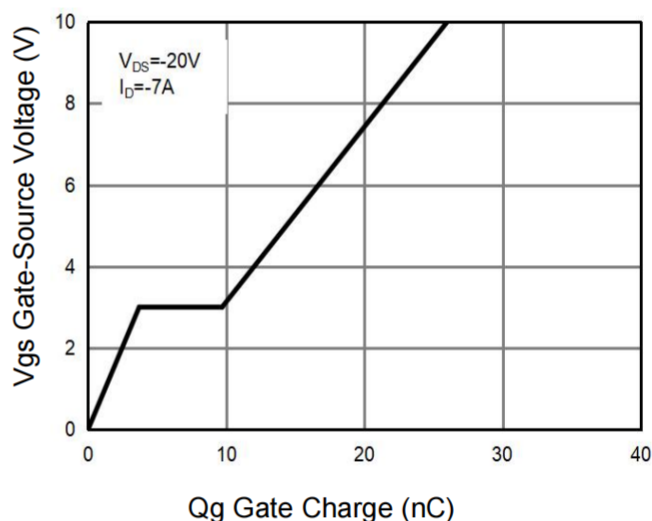
**Figure 2 Transfer Characteristics**



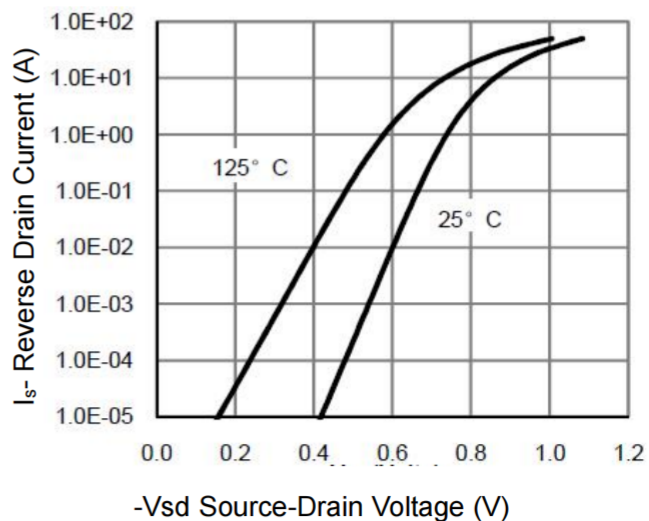
**Figure 3 Rdson- Drain Current**



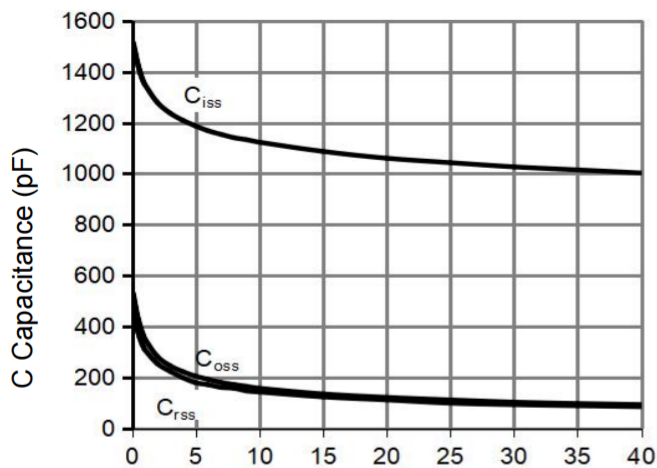
**Figure 4 Rdson-Junction Temperature**



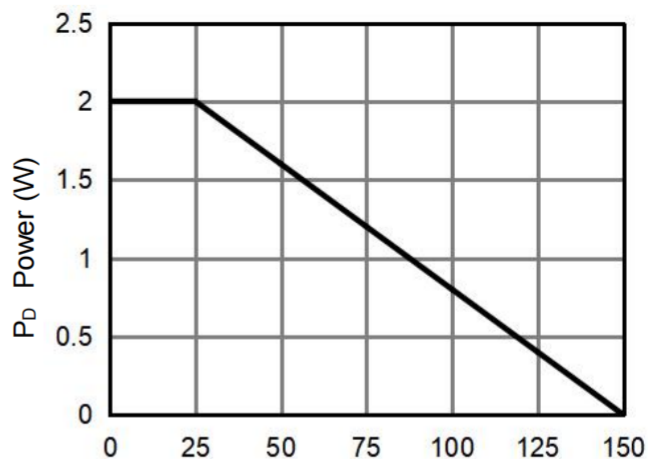
**Figure 5 Gate Charge**



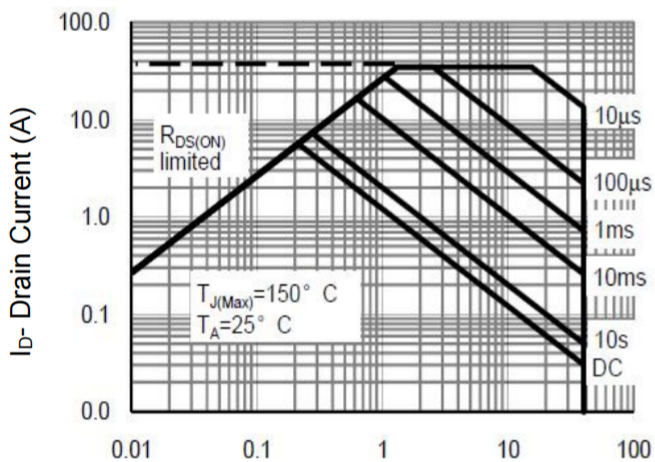
**Figure 6 Source- Drain Diode Forward**



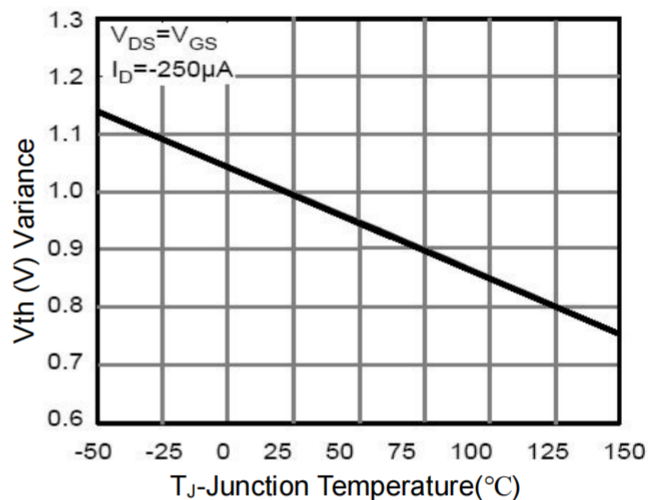
-Vds Drain-Source Voltage (V)  
**Figure 7 Capacitance vs Vds**



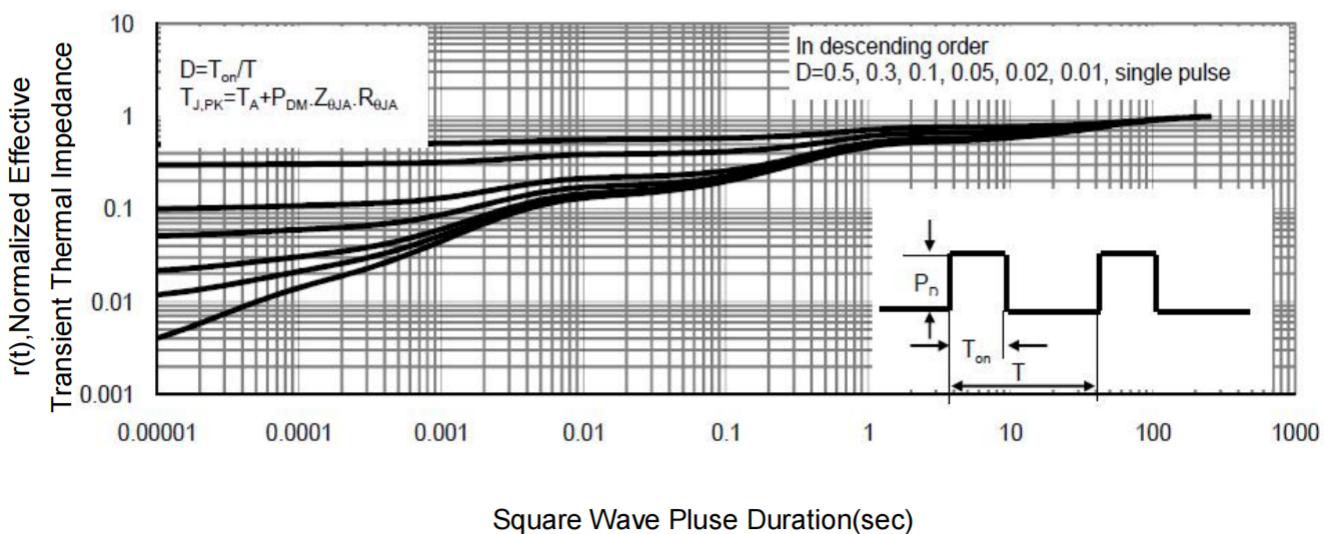
$T_J$ -Junction Temperature(°C)  
**Figure 9 Power Dissipation**



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

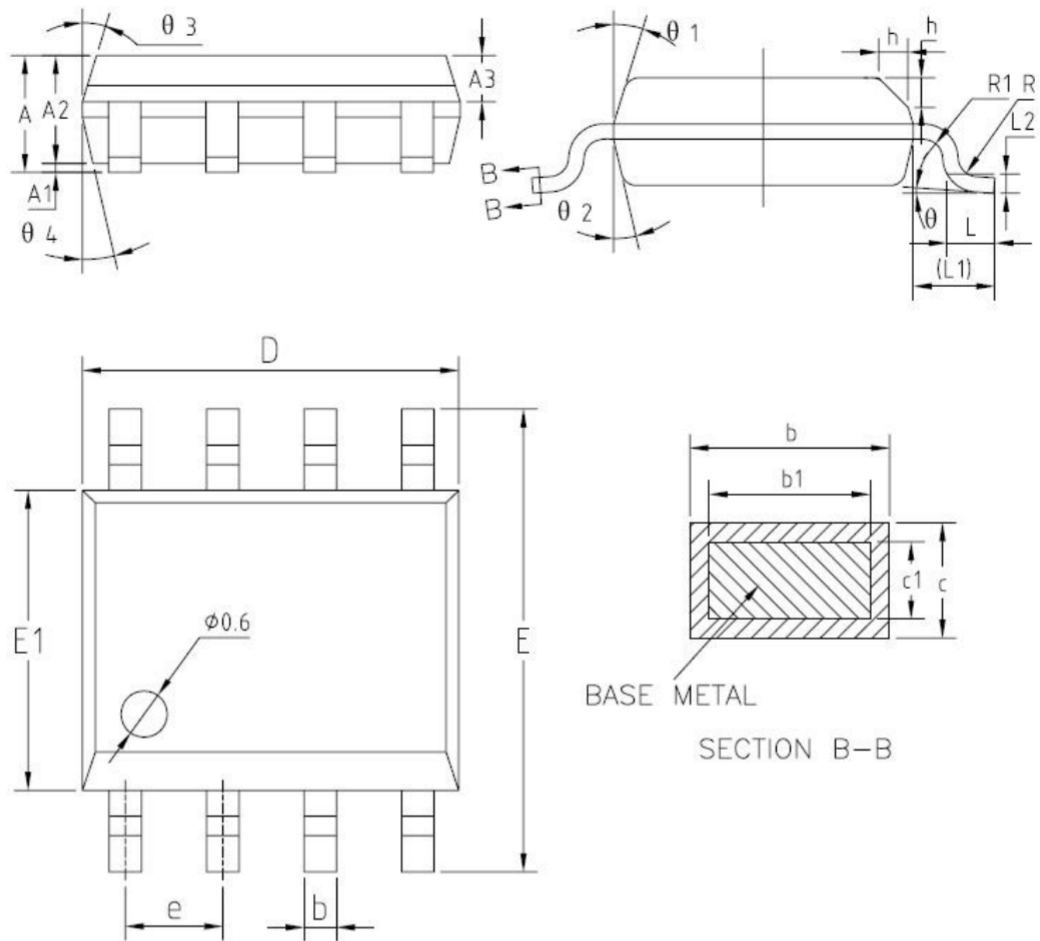


$T_J$ -Junction Temperature(°C)  
**Figure 10  $V_{GS(th)}$  vs Junction Temperature**



Square Wave Pulse Duration(sec)  
**Figure 11 Normalized Maximum Transient Thermal Impedance**

## SOP-8 Package Information



COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.15	0.25
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	—	0.51
b1	0.37	0.42	0.47
c	0.18	—	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.17	1.27	1.37
L	0.45	0.60	0.80
L1	1.04REF		
L2	0.25BSC		
R	0.07	—	—
R1	0.07	—	—
h	0.30	0.40	0.50
$\theta$	0°	—	8°
$\theta 1$	15°	17°	19°
$\theta 2$	11°	13°	15°
$\theta 3$	15°	17°	19°
$\theta 4$	11°	13°	15°

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## Attention

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