

## N and P-Channel Enhancement Mode Power MOSFET

### Description

The NCE609 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

$$V_{DS} = 40V, I_D = 21A$$

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

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

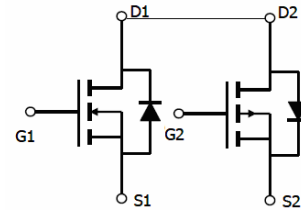
#### ● P-Channel

$$V_{DS} = -40V, I_D = -14A$$

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

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

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



Schematic diagram



Marking and pin assignment

**100% UIS TESTED!**

**100% ΔVds TESTED!**

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
NCE609	NCE609	TO-252-4L	-	-	-

### Absolute Maximum Ratings ( $T_A=25^\circ C$ 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	$I_D$	$T_A=25^\circ C$	21	-14	A
		$T_A=70^\circ C$	17.5	-11.5	
Pulsed Drain Current <sup>(Note 1)</sup>	$I_{DM}$	40	-40	A	
Maximum Power Dissipation	$P_D$	40	40	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-Case <sup>(Note2)</sup>	$R_{\theta JC}$	N-Ch	3.1	$^\circ C/W$
Thermal Resistance, Junction-to-Case <sup>(Note2)</sup>	$R_{\theta JC}$	P-Ch	3.1	$^\circ C/W$

**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 (Note 3)</b>						
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> =10A	-	14	19	mΩ
		V <sub>GS</sub> =4.5V, I <sub>D</sub> =5A	-	19	29	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =5V, I <sub>D</sub> =10A		15	-	S
<b>Dynamic Characteristics (Note4)</b>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V, F=1.0MHz	-	1500	-	PF
Output Capacitance	C <sub>oss</sub>		-	215	-	PF
Reverse Transfer Capacitance	C <sub>rss</sub>		-	135	-	PF
<b>Switching Characteristics (Note 4)</b>						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =20V, R <sub>L</sub> =2Ω V <sub>GS</sub> =10V, R <sub>GEN</sub> =3Ω	-	4	-	nS
Turn-on Rise Time	t <sub>r</sub>		-	11.5	-	nS
Turn-Off Delay Time	t <sub>d(off)</sub>		-	18	-	nS
Turn-Off Fall Time	t <sub>f</sub>		-	5.6	-	nS
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =20V, I <sub>D</sub> =10A, V <sub>GS</sub> =10V	-	24	-	nC
Gate-Source Charge	Q <sub>gs</sub>		-	4	-	nC
Gate-Drain Charge	Q <sub>gd</sub>		-	3.5	-	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> =10A	-	0.8	1.2	V

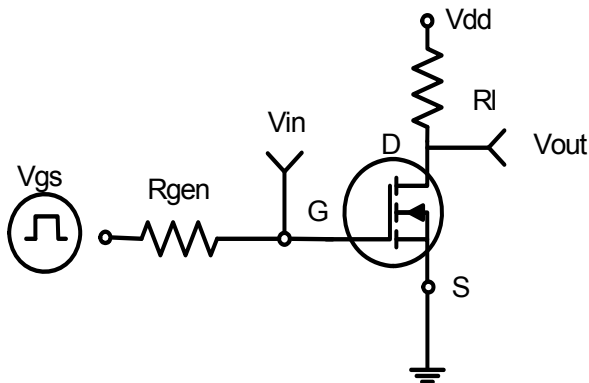
**P-CH Electrical Characteristics ( $T_A=25^{\circ}\text{C}$  unless otherwise noted)**

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 (Note 3)</b>						
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	$g_{FS}$	$V_{DS}=-5V, I_D=-7A$	-	15	-	S
<b>Dynamic Characteristics (Note 4)</b>						
Input Capacitance	$C_{iss}$	$V_{DS}=-20V, V_{GS}=0V,$ $F=1.0MHz$	-	1225	-	PF
Output Capacitance	$C_{oss}$		-	190	-	PF
Reverse Transfer Capacitance	$C_{rss}$		-	120	-	PF
<b>Switching Characteristics (Note 4)</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=-20V, R_L=2.3\Omega$ $V_{GS}=-10V, R_{GEN}=6\Omega$	-	10	-	nS
Turn-on Rise Time	$t_r$		-	15	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	30	-	nS
Turn-Off Fall Time	$t_f$		-	18	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=-20V, I_D=-7A$ $V_{GS}=-10V$	-	21	-	nC
Gate-Source Charge	$Q_{gs}$		-	3.5	-	nC
Gate-Drain Charge	$Q_{gd}$		-	3.0	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage (Note 3)	$V_{SD}$	$V_{GS}=0V, I_S=-14A$	-	-	-1.2	V

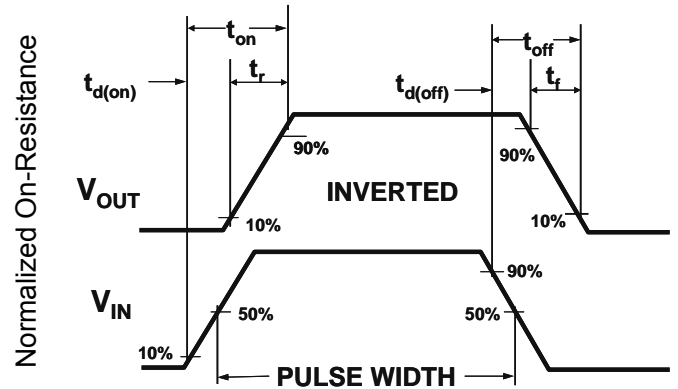
**Notes:**

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

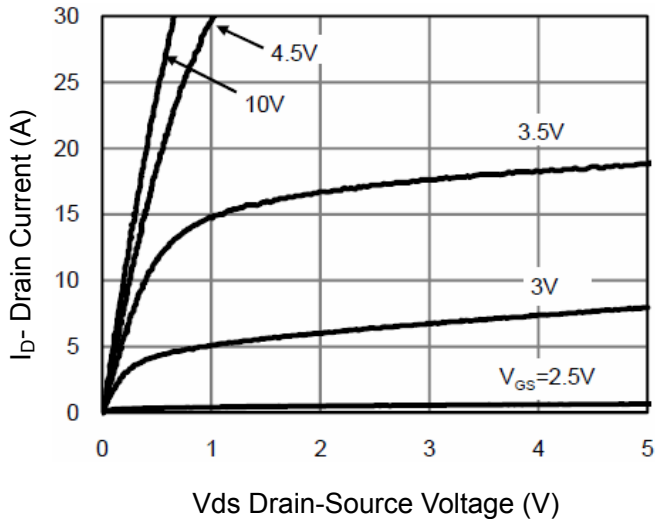
**N- Channel Typical Electrical and Thermal Characteristics (Curves)**



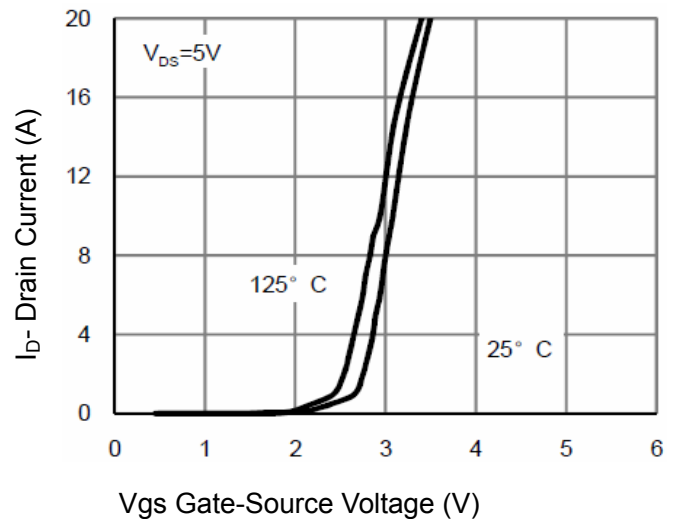
**Figure 1: Switching Test Circuit**



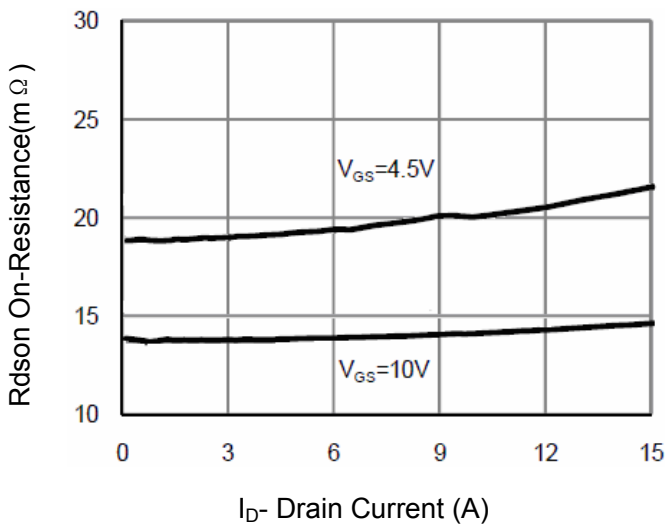
**Figure 2: Switching Waveforms**



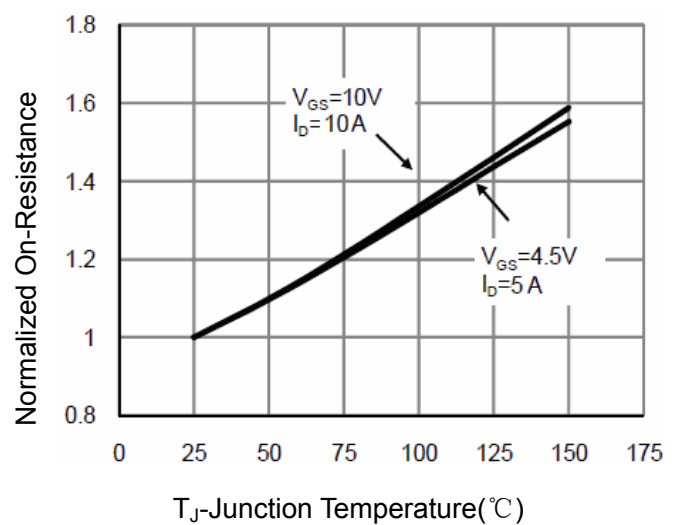
**Figure 3 Output Characteristics**



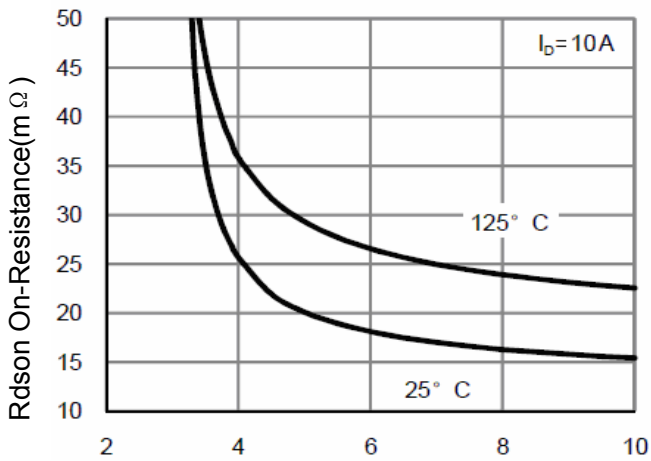
**Figure 4 Transfer Characteristics**



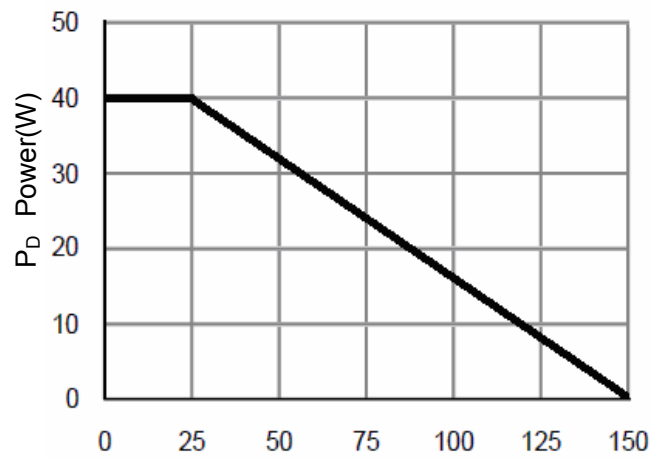
**Figure 5 Drain-Source On-Resistance**



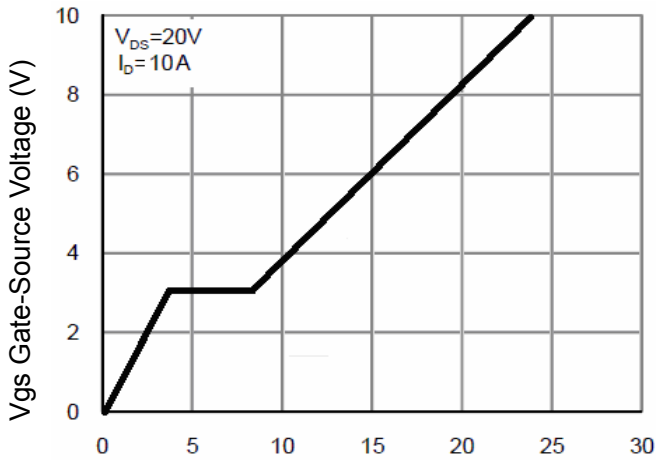
**Figure 6 Drain-Source On-Resistance**



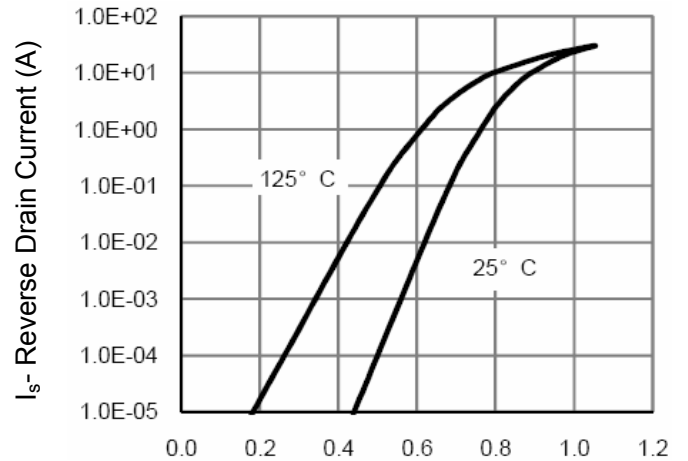
Vgs Gate-Source Voltage (V)  
**Figure 7 Rdson vs Vgs**



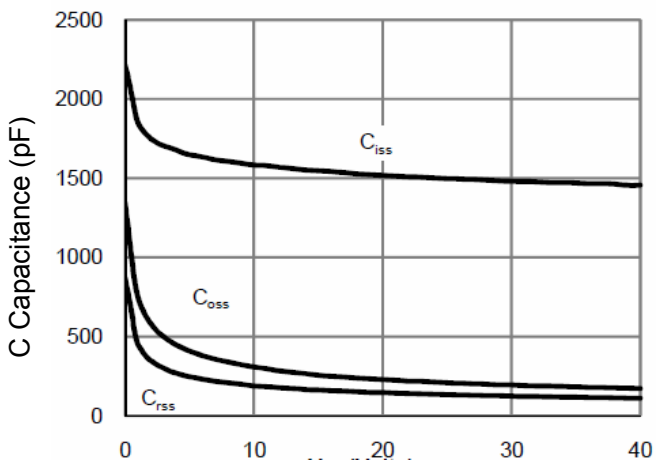
Tj Junction Temperature (°C)  
**Figure 8 Power Dissipation**



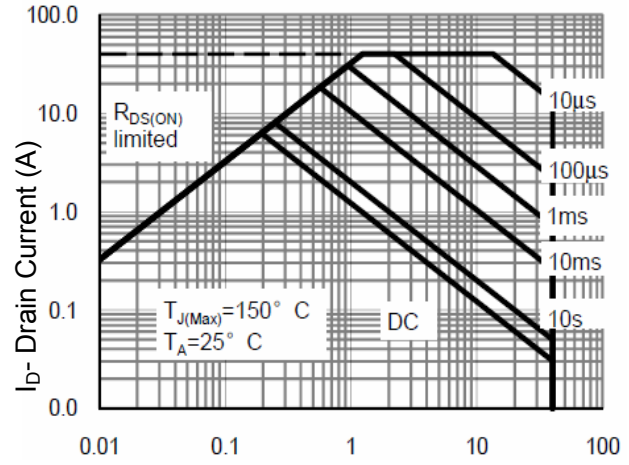
Qg Gate Charge (nC)  
**Figure 9 Gate Charge**



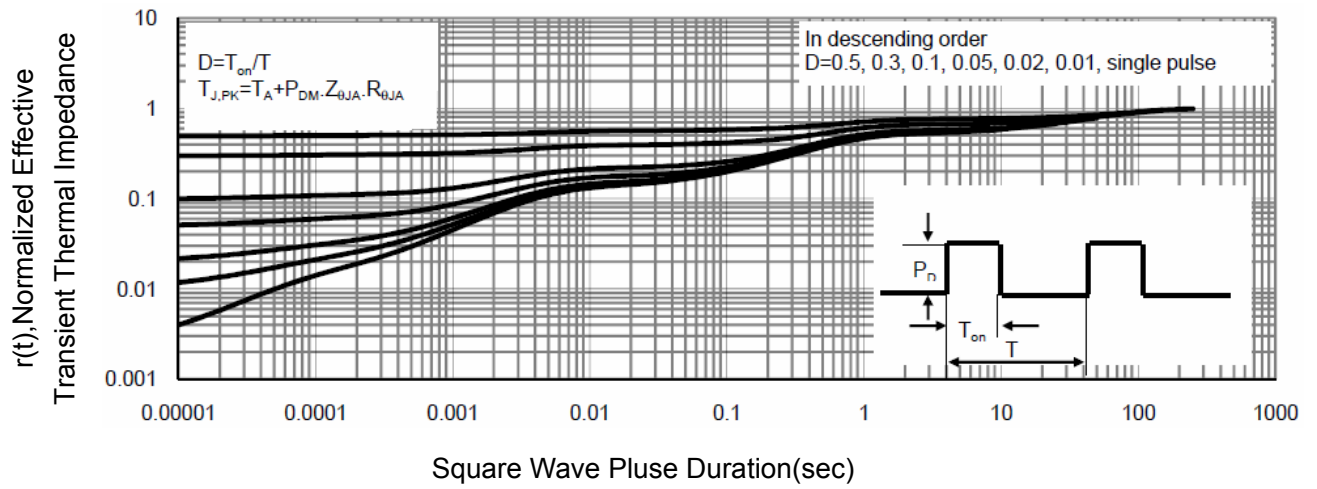
Vds Drain-Source Voltage (V)  
**Figure 10 Source- Drain Diode Forward**



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

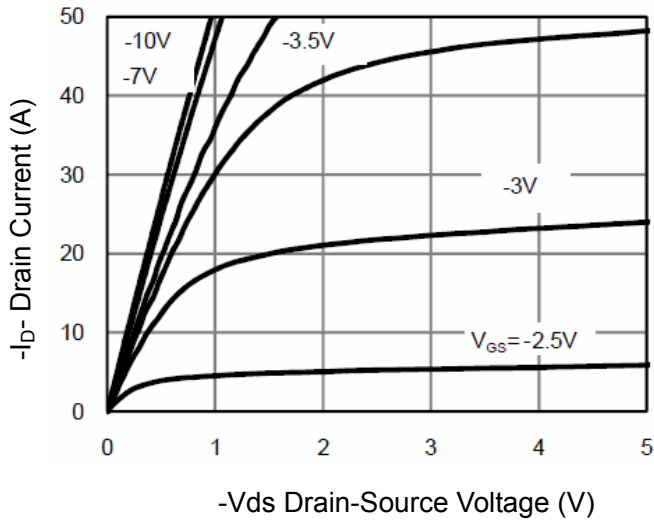


Vds Drain-Source Voltage (V)  
**Figure 12 Safe Operation Area**

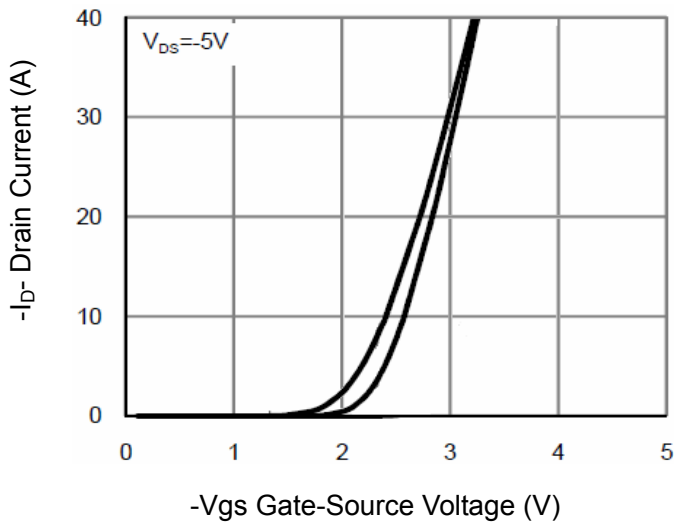


**Figure 13 Normalized Maximum Transient Thermal Impedance**

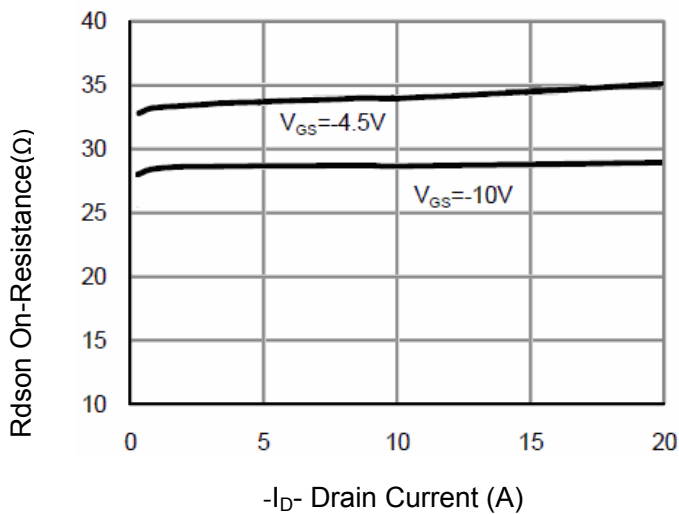
**P- Channel Typical Electrical and Thermal Characteristics (Curves)**



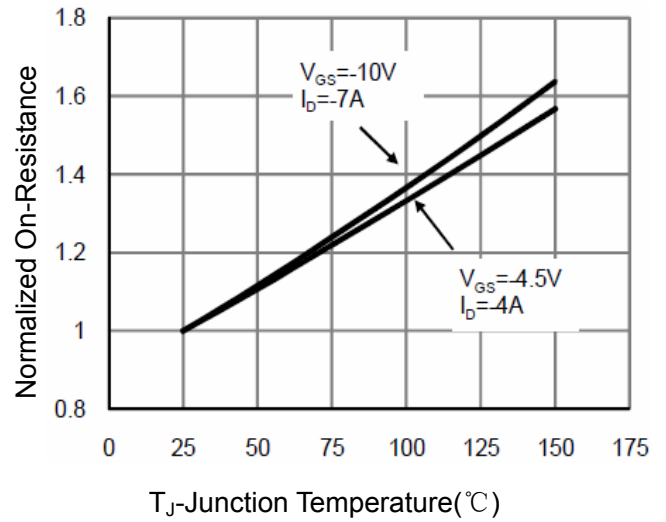
**Figure 1 Output Characteristics**



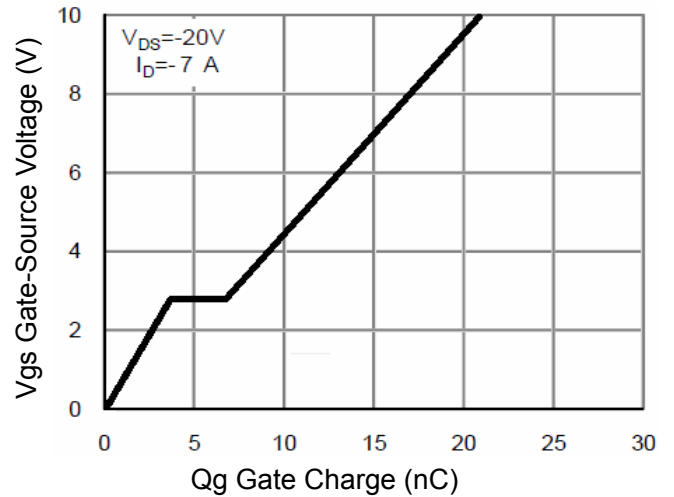
**Figure 2 Transfer Characteristics**



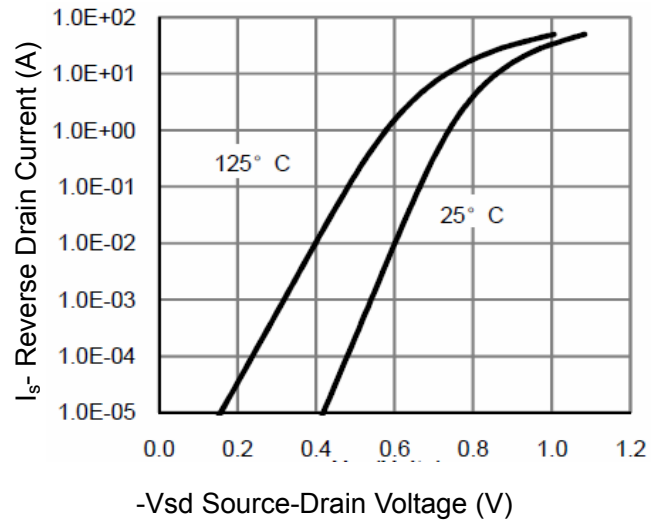
**Figure 3 Rdson- Drain Current**



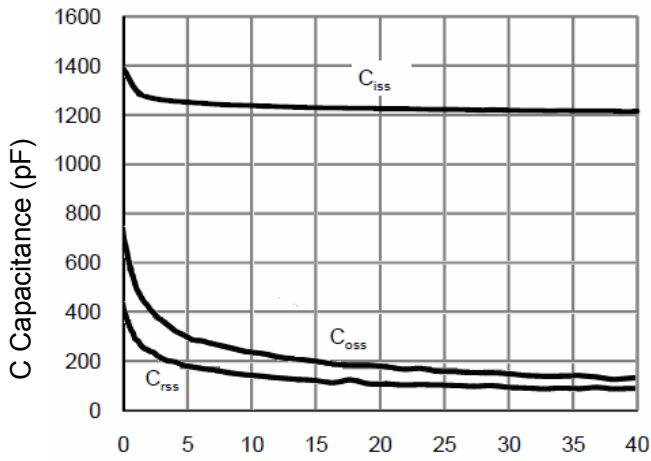
**Figure 4 Rdson-Junction Temperature**



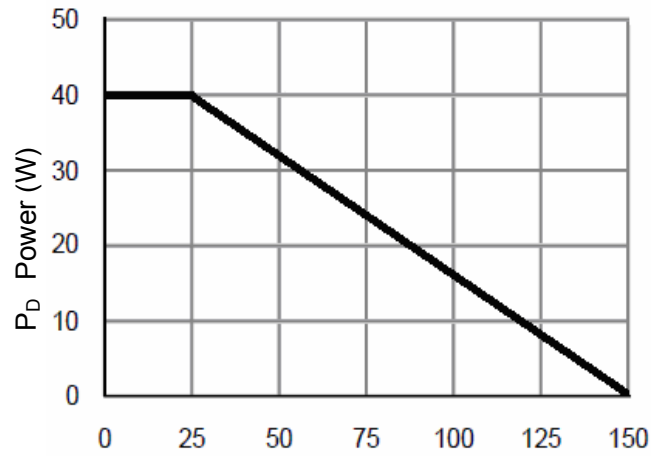
**Figure 5 Gate Charge**



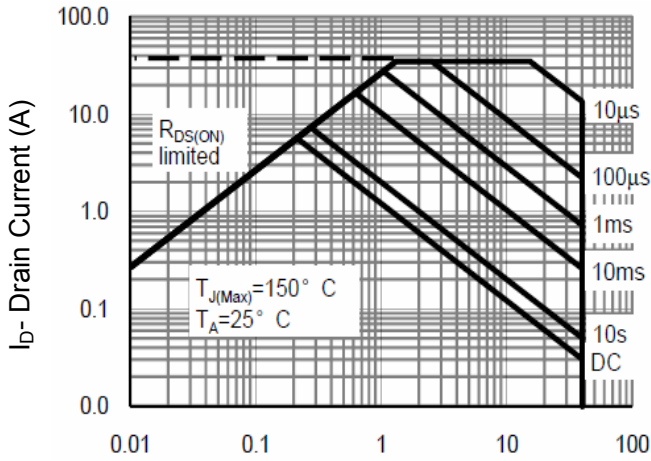
**Figure 6 Source- Drain Diode Forward**



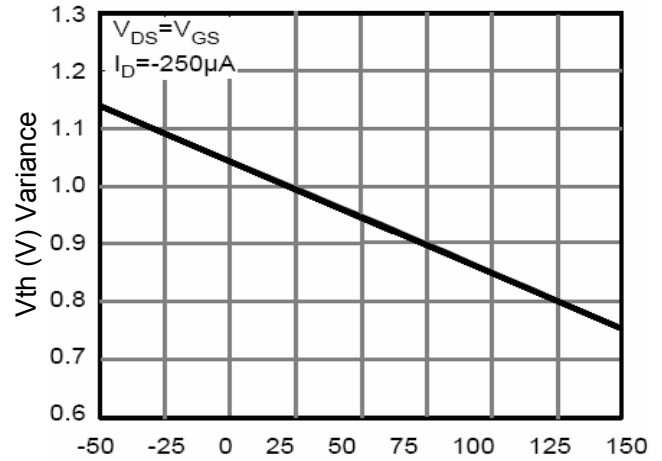
-Vds Drain-Source Voltage (V)  
**Figure 7 Capacitance vs Vds**



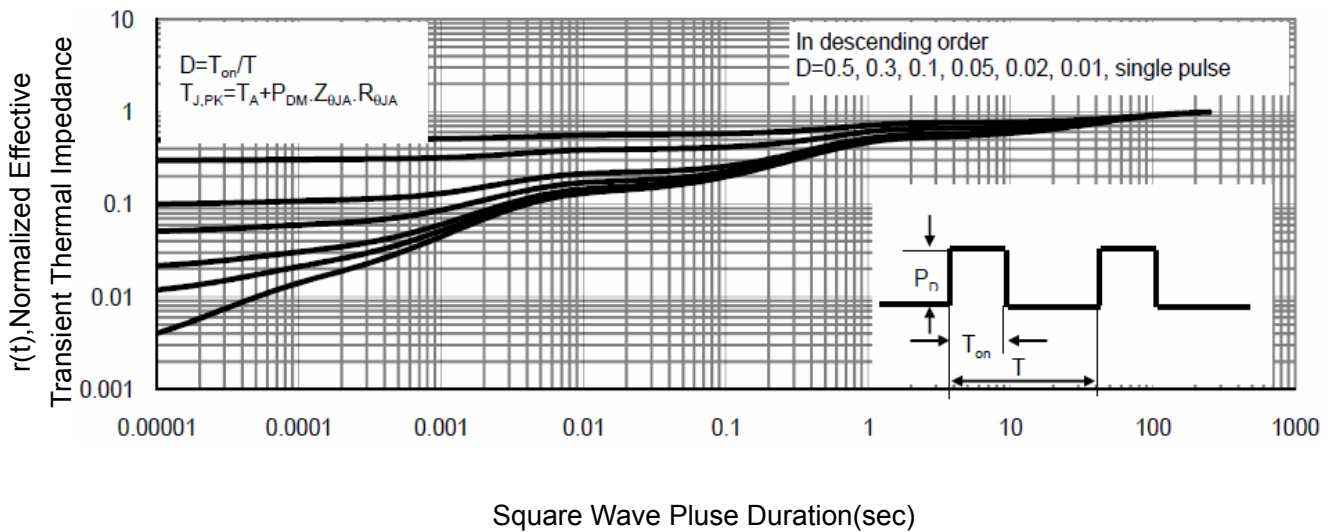
T<sub>J</sub>-Junction Temperature(°C)  
**Figure 9 Power Dissipation**



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



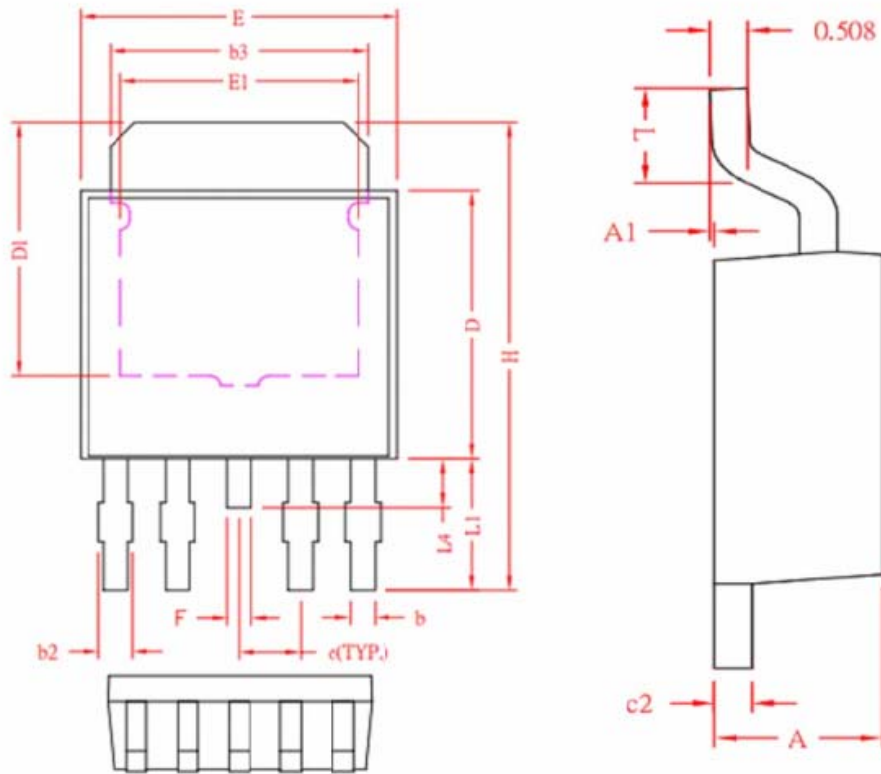
T<sub>J</sub>-Junction Temperature(°C)  
**Figure 10 V<sub>GS(th)</sub> vs Junction Temperature**



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



TO-252-4L Package Information



COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	2.20	2.30	2.40
A1	0	0.08	0.15
b	0.45	0.53	0.60
b2	0.50	0.65	0.80
b3	5.20	5.35	5.50
c2	0.45	0.50	0.55
D	5.40	5.60	5.80
D1	4.57	-	-
E	6.40	6.60	6.80
E1	3.81	-	-
e	1.27 REF.		
F	0.40	0.50	0.60
H	9.40	9.80	10.20
L	1.40	1.59	1.77
L1	2.40	2.70	3.00
L4	0.80	1.00	1.20

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