

Description

The VSM9NP06 uses advanced trench technology and design to provide excellent $R_{DS(ON)}$ with low gate charge. It can be used in a wide variety of applications.

General Features

N channel

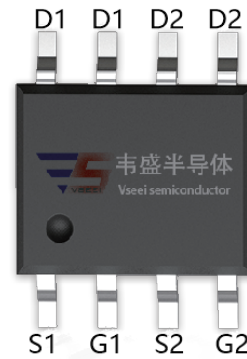
- $V_{DS} = 60V, I_D = 9A$
 $R_{DS(ON)} < 28m\Omega @ V_{GS} = 10V$
 $R_{DS(ON)} < 34m\Omega @ V_{GS} = 4.5V$

p channel

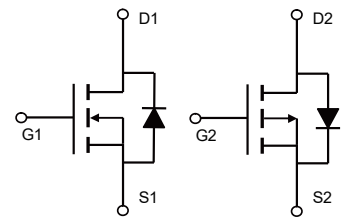
- $V_{DS} = -60V, I_D = -9A$
 $R_{DS(ON)} < 54m\Omega @ V_{GS} = -10V$
 $R_{DS(ON)} < 70m\Omega @ V_{GS} = -4.5V$
- High density cell design for ultra low R_{dson}
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high E_{AS}
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

Application

- H-bridge
- Inverters



SOP-8



Schematic

Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
VSM9NP06	VSM9NP06-S8	SOP-8	Ø330mm	12mm	4000 units

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

Parameter		Symbol	N-Channel	P-Channel	Unit
Drain-Source Voltage		V_{DS}	60	-60	V
Gate-Source Voltage		V_{GS}	± 20	± 20	V
Continuous Drain Current	$T_C = 25^\circ C$	I_D	9	-9	A
	$T_C = 100^\circ C$		6.3	-6.3	
Pulsed Drain Current (Note 1)		I_{DM}	36	-36	A
Maximum Power Dissipation		P_D	3	3	W
Operating Junction and Storage Temperature Range		T_J, T_{STG}	-55 To 150	-55 To 150	$^\circ C$

Thermal Characteristic

N-channel	Thermal Resistance, Junction-to- Ambient (Note 2)	$R_{\theta JA}$	41.67	$^\circ C/W$
P-channel	Thermal Resistance, Junction-to- Ambient (Note 2)	$R_{\theta JA}$	41.67	$^\circ C/W$
N-channel	Thermal Resistance, Junction-to- Lead (Note 2)	$R_{\theta JL}$	20	$^\circ C/W$
P-channel	Thermal Resistance, Junction-to- Lead (Note 2)	$R_{\theta JL}$	20	$^\circ C/W$

N-Channel Electrical Characteristics ($T_A=25^{\circ}\text{C}$ unless otherwise noted)

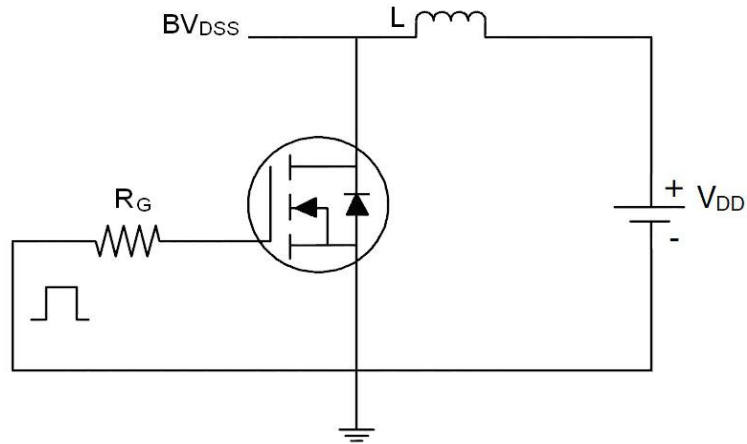
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	60	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=60V, V_{GS}=0V$	-	-	1	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	1.0	1.6	2.5	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=5A$	-	24	28	m Ω
	$R_{DS(ON)}$	$V_{GS}=4.5V, I_D=5A$		28	34	m Ω
Forward Transconductance	g_{FS}	$V_{DS}=5V, I_D=5A$	11	-	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C_{iss}	$V_{DS}=30V, V_{GS}=0V,$ $F=1.0MHz$	-	846	-	PF
Output Capacitance	C_{oss}		-	65	-	PF
Reverse Transfer Capacitance	C_{rss}		-	61.8	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=30V, R_L=2.5\Omega$ $V_{GS}=10V, R_G=3\Omega$	-	4.2	-	nS
Turn-on Rise Time	t_r		-	3.4	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	16	-	nS
Turn-Off Fall Time	t_f		-	2	-	nS
Total Gate Charge	Q_g	$V_{DS}=30V, I_D=5A,$ $V_{GS}=10V$	-	25		nC
Gate-Source Charge	Q_{gs}		-	3		nC
Gate-Drain Charge	Q_{gd}		-	6.4		nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V_{SD}	$V_{GS}=0V, I_S=5A$	-		1.2	V
Diode Forward Current (Note 2)	I_S		-	-	5	A
Reverse Recovery Time	t_{rr}	$TJ = 25^{\circ}C, IF = 5A$ $di/dt = 100A/\mu s^{(Note3)}$	-	27	-	nS
Reverse Recovery Charge	Q_{rr}		-	30	-	nC
Forward Turn-On Time	t_{on}	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

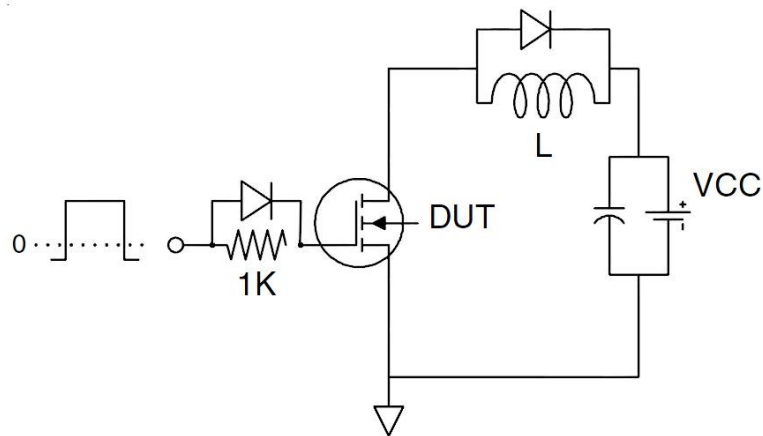
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. The value of $R_{\theta JA}$ is measured with the device mounted on 1in 2 FR-4 board with 2oz. Copper, in a still air environment with $T_A = 25^{\circ}\text{C}$.
The value in any a given application depends on the user's specific 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

Test Circuit

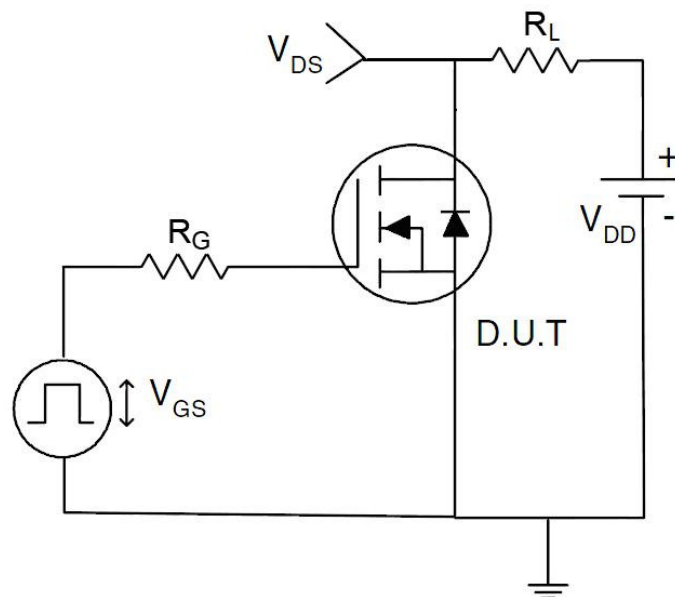
1) E_{AS} test Circuit



2) Gate charge test Circuit



3) Switch Time Test Circuit



N-Channel Typical Electrical and Thermal Characteristics (Curves)

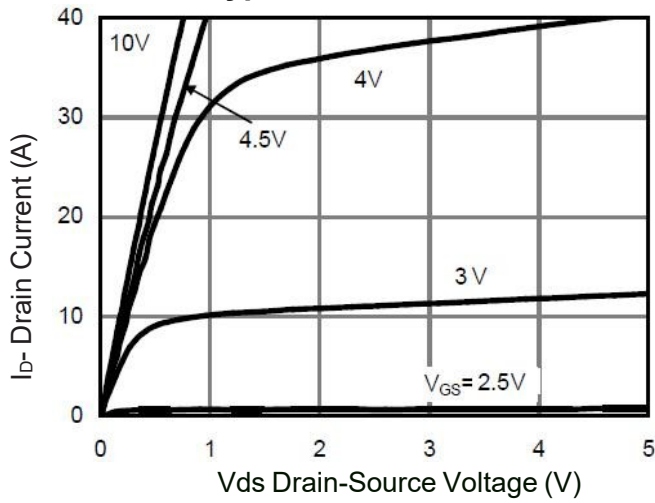


Figure 1 Output Characteristics

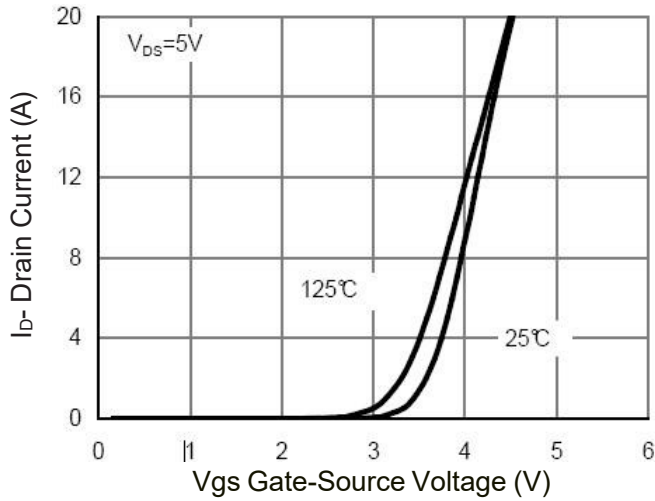


Figure 2 Transfer Characteristics

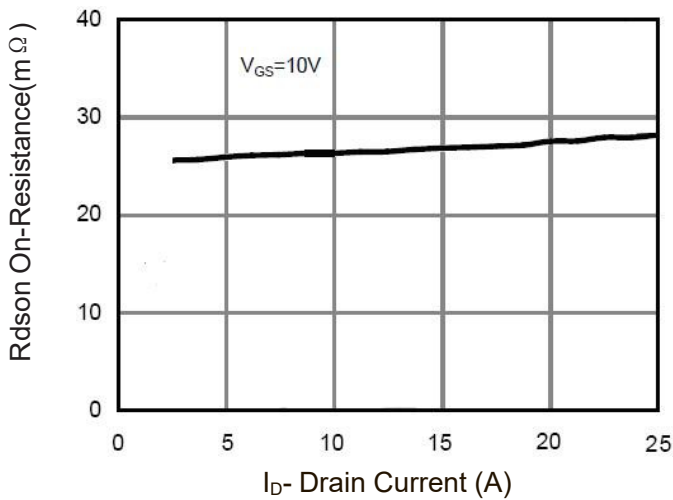


Figure 3 Rdson- Drain Current

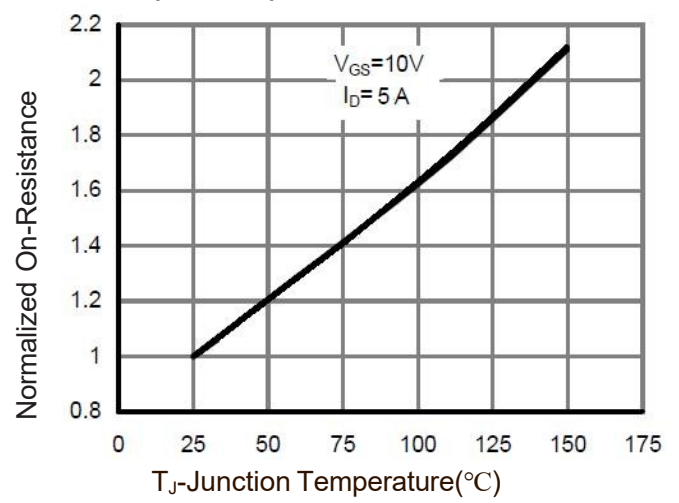


Figure 4 Rdson-Junction Temperature

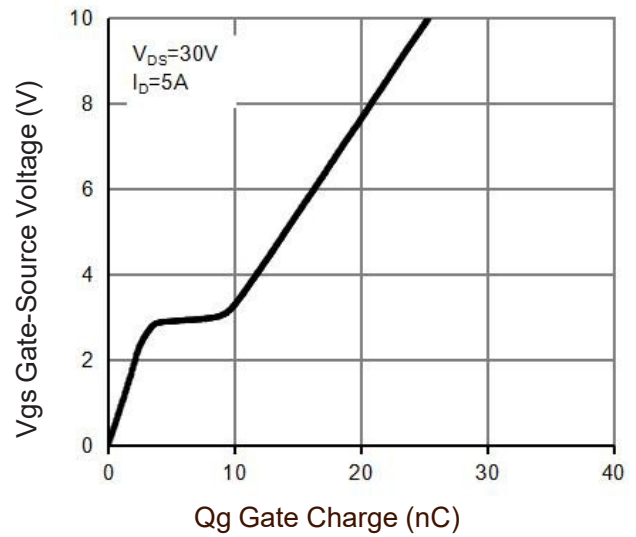


Figure 5 Gate Charge

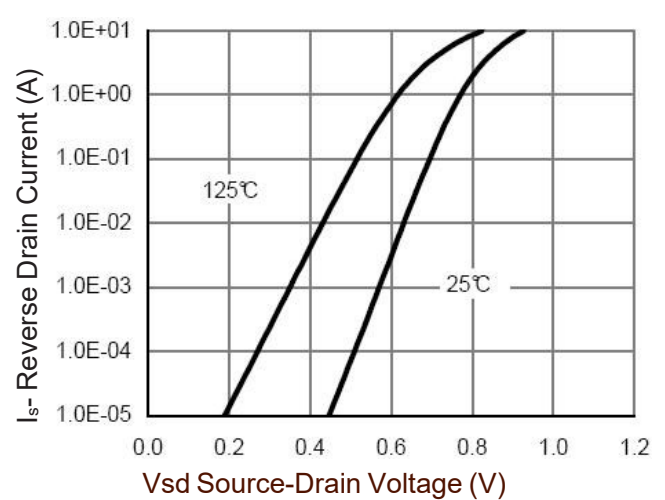
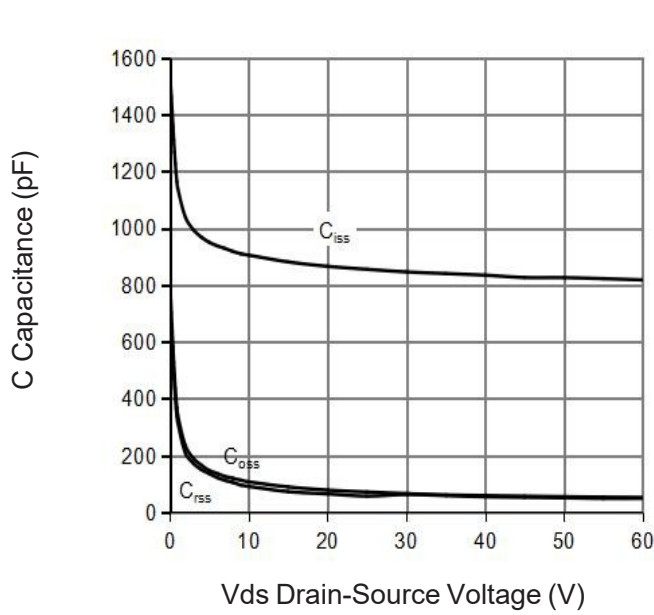
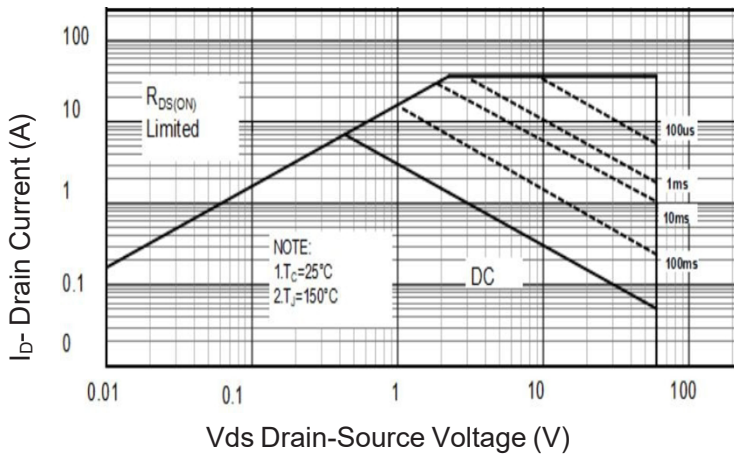
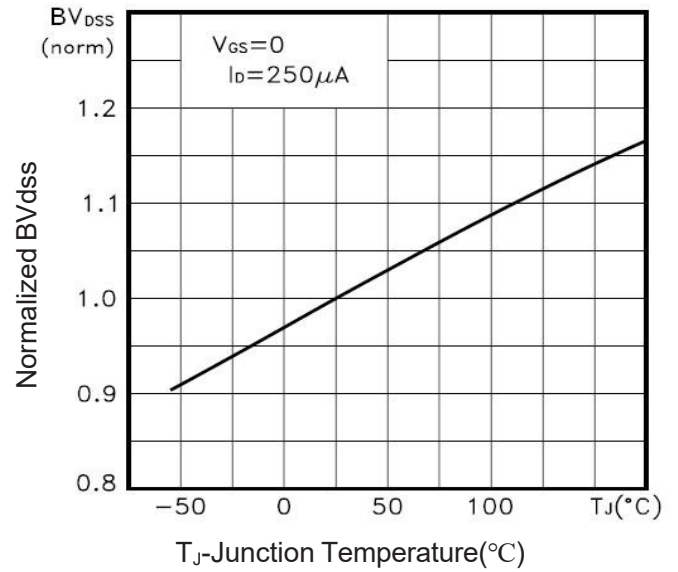
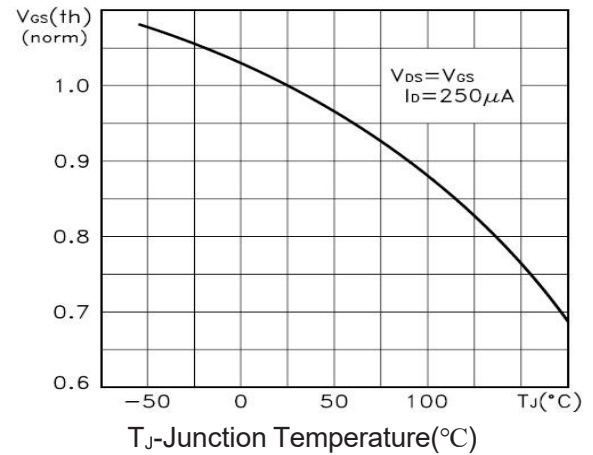
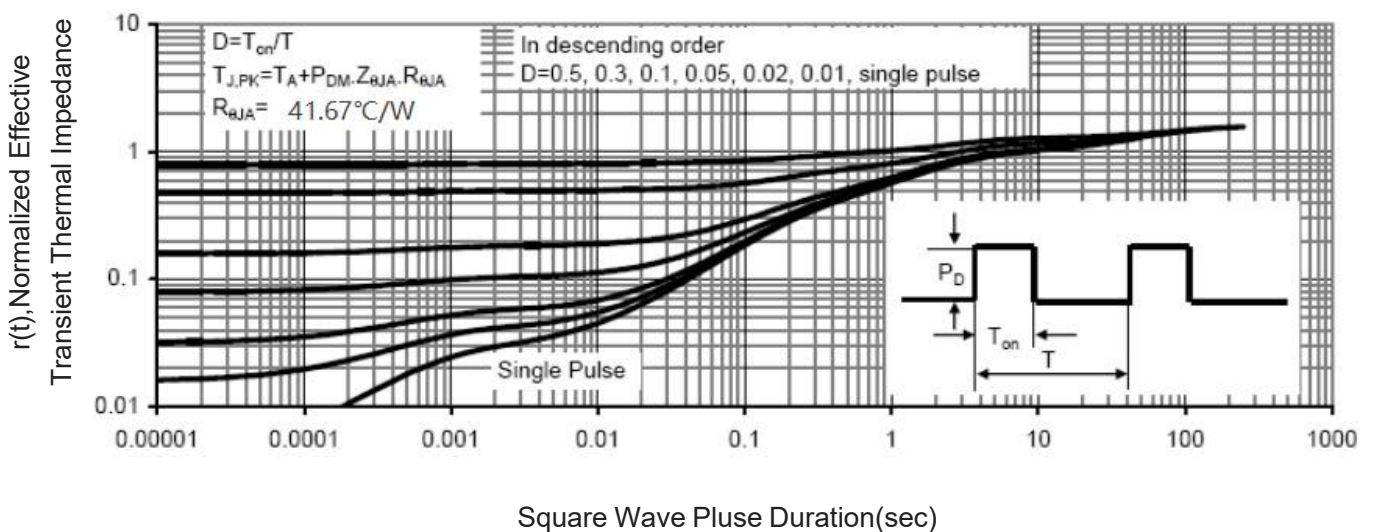


Figure 6 Source- Drain Diode Forward


Figure 7 Capacitance vs Vds

Figure 8 Safe Operation Area

Figure 9 BV_{DSS} vs Junction Temperature

Figure 10 $V_{GS(th)}$ vs Junction Temperature

Figure 11 Normalized Maximum Transient Thermal Impedance

P-Channel Electrical Characteristics (T_c=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V I _D =-250μA	-60	-	-	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =-60V, V _{GS} =0V	-	-	-1	μA
Gate-Body Leakage Current	I _{GSS}	V _{GS} =±20V, V _{DS} =0V	-	-	±100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =-250μA	-1	-1.5	-2.2	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =-10V, I _D =-5A	-	45	54	mΩ
		V _{GS} =-4.5V, I _D =-5A		52	70	mΩ
Forward Transconductance	g _{FS}	V _{DS} =-5V, I _D =-5A	-	10	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C _{iss}	V _{DS} =-30V, V _{GS} =0V, F=1.0MHz	-	1630.7	-	PF
Output Capacitance	C _{oss}		-	90.6	-	PF
Reverse Transfer Capacitance	C _{rss}		-	77.3	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	t _{d(on)}	V _{DD} =-30V, R _L =1.5Ω, V _{GS} =-10V, R _G =3Ω	-	11	-	nS
Turn-on Rise Time	t _r		-	14	-	nS
Turn-Off Delay Time	t _{d(off)}		-	33	-	nS
Turn-Off Fall Time	t _f		-	13	-	nS
Total Gate Charge	Q _g	V _{DS} =-30, I _D =-5A, V _{GS} =-10V	-	37.6		nC
Gate-Source Charge	Q _{gs}		-	4.3		nC
Gate-Drain Charge	Q _{gd}		-	7.2		nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V _{SD}	V _{GS} =0V, I _S =-5A	-		-1.2	V
Diode Forward Current (Note 2)	I _S		-	-	-7	A
Reverse Recovery Time	t _{rr}	T _J = 25°C, I _F =-5A di/dt = 100A/μs (Note3)	-	35	-	nS
Reverse Recovery Charge	Q _{rr}		-	38	-	nC
Forward Turn-On Time	t _{on}	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

P-Channel Typical Electrical and Thermal Characteristics (Curves)

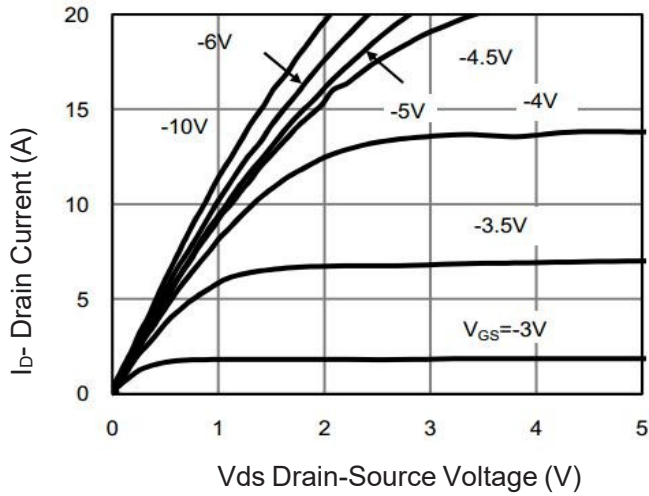


Figure 1 Output Characteristics

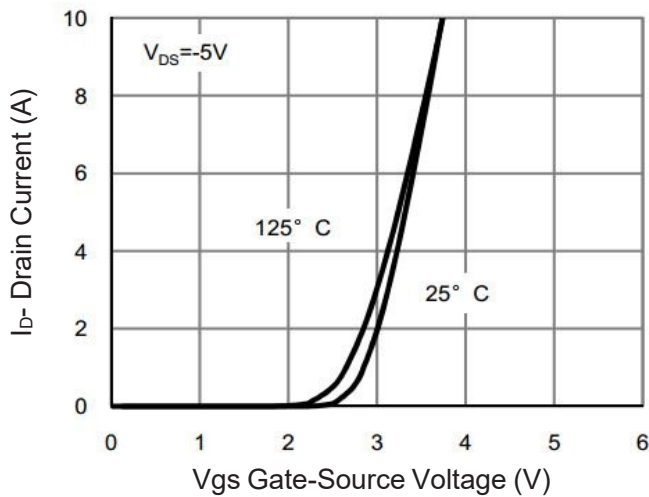


Figure 2 Transfer Characteristics

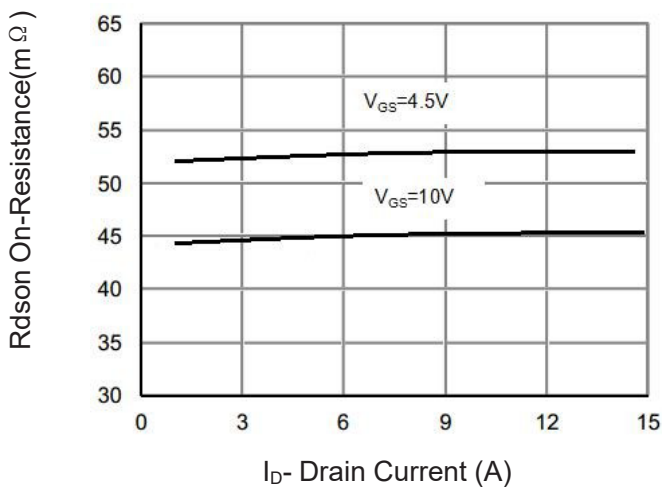


Figure 3 $R_{DS(on)}$ - Drain Current

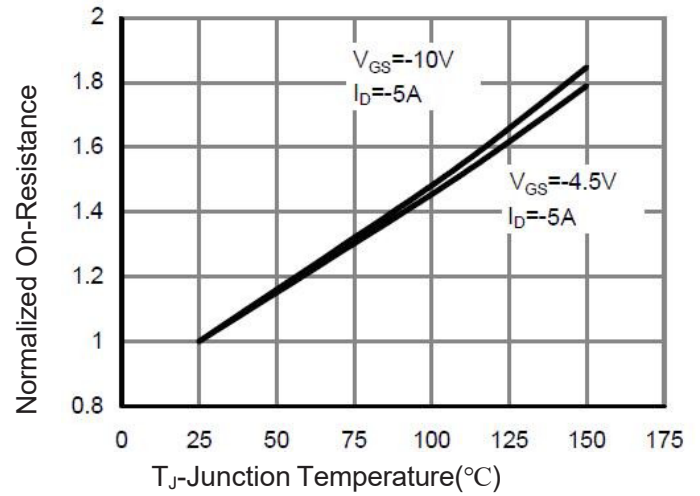


Figure 4 $R_{DS(on)}$ -Junction Temperature

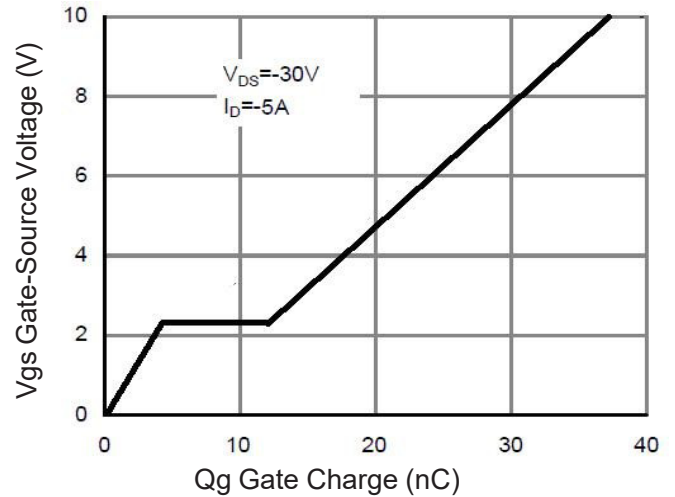


Figure 5 Gate Charge

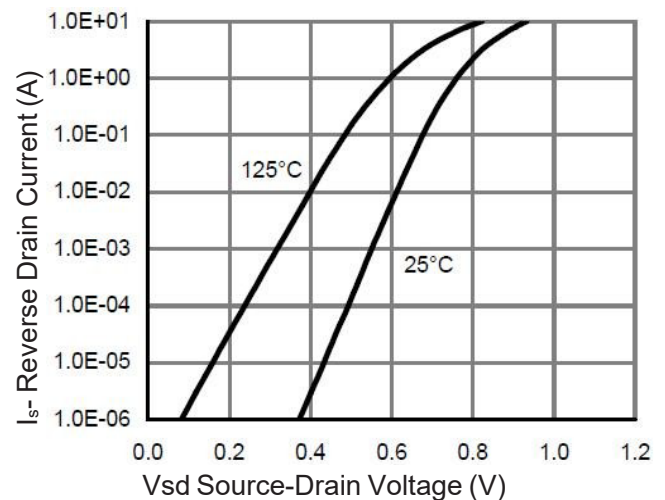
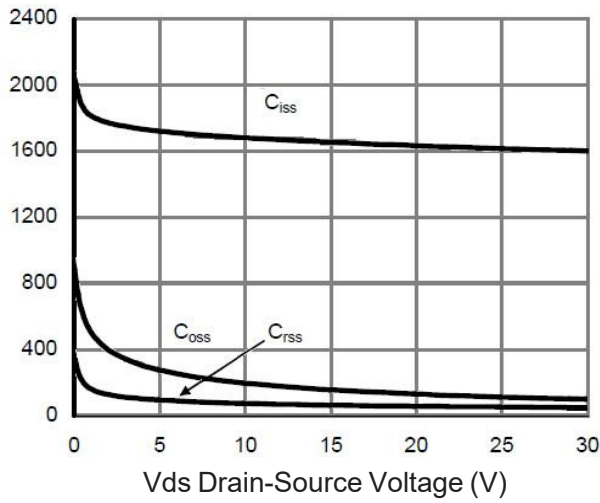
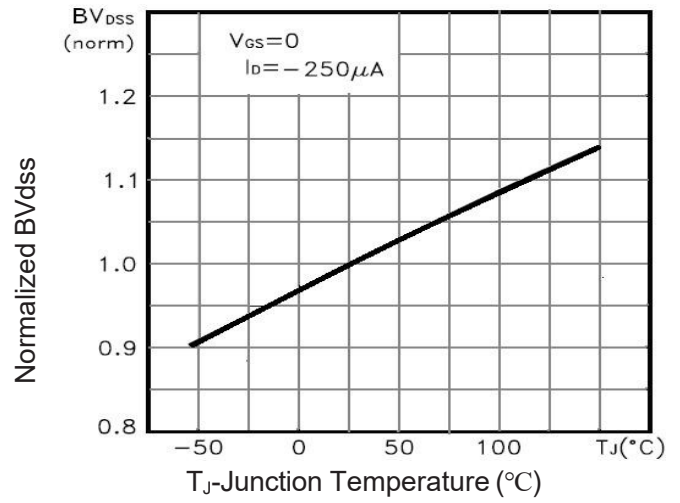
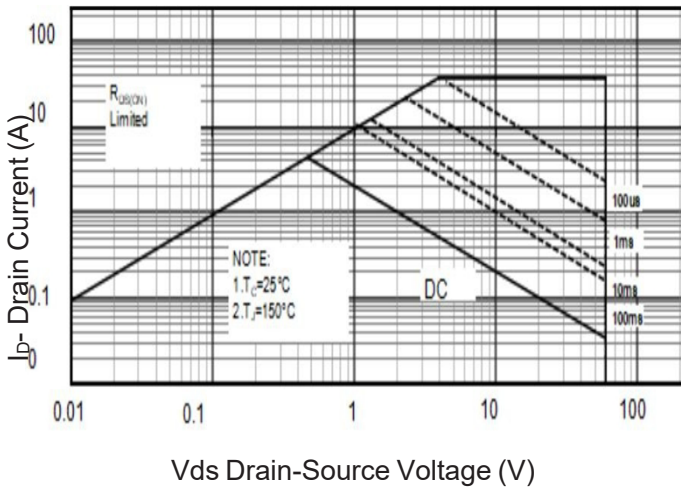
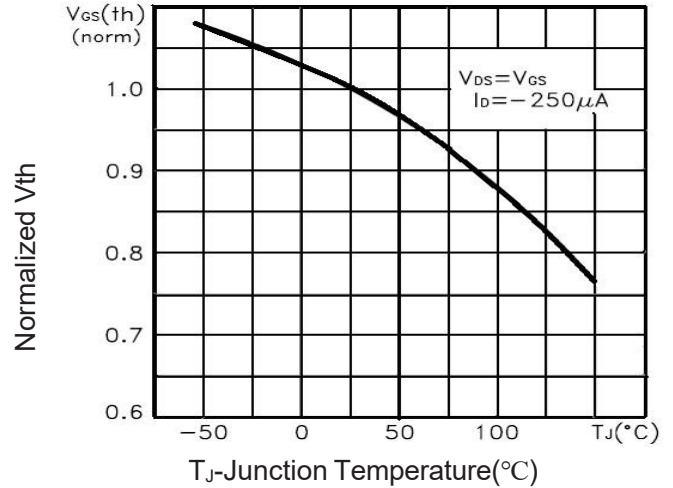
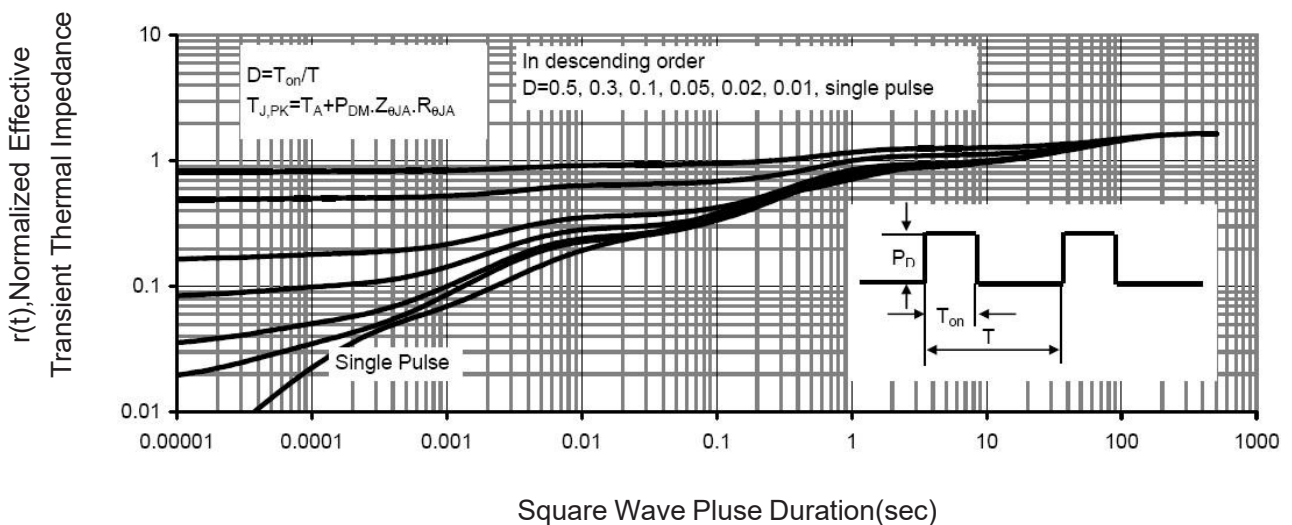


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