

Description

The VSM40NP03 uses advanced trench technology to provide excellent $R_{DS(ON)}$ and low gate charge. This device is suitable for use in inverter and other applications.

General Features

N-channel

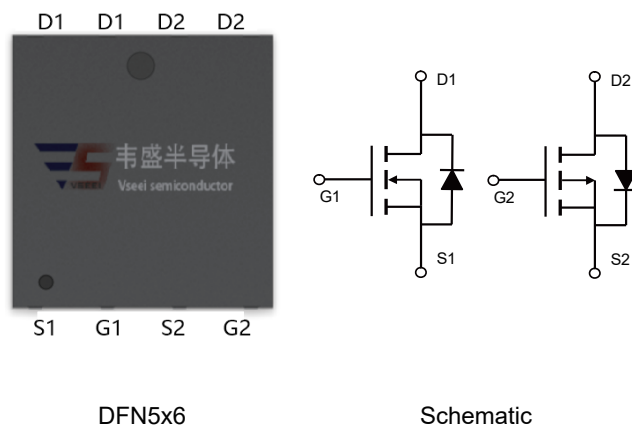
- $V_{DS} = 30V, I_D = 40A$
- $R_{DS(ON)} < 9.5m\Omega @ V_{GS}=10V$
- $R_{DS(ON)} < 23m\Omega @ V_{GS}=4.5V$
- High Power and current handling capability
- Lead free product is acquired
- Surface mount package

P-channel

- $V_{DS} = -30V, I_D = -30A$
- $R_{DS(ON)} < 11m\Omega @ V_{GS}=-10V$
- $R_{DS(ON)} < 20m\Omega @ V_{GS}=-4.5V$

Application

- H-bridge
- Inverters



Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
VSM40NP03	VSM40NP03-D56	DFN5x6	-	-	-

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

Parameter	Symbol	N-Channel	P-Channel	Unit
Drain-Source Voltage	V_{DS}	30	-30	V
Gate-Source Voltage	V_{GS}	± 20	± 20	V
Continuous Drain Current	$T_C=25^\circ C$	40	-30	A
	$T_C=100^\circ C$	28.3	-21.2	
Pulsed Drain Current (Note 1)	I_{DM}	160	-120	A
Maximum Power Dissipation	$T_C=25^\circ C$	35		W
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 To 150		$^\circ C$

Thermal Characteristic

Thermal Resistance, Junction-to-Case (Note 2)	$R_{\theta JC}$	3.6	$^\circ C/W$
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N-channel Electrical Characteristics ($T_C=25^\circ C$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	30	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=30V, V_{GS}=0V$	-	-	1	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 100	nA

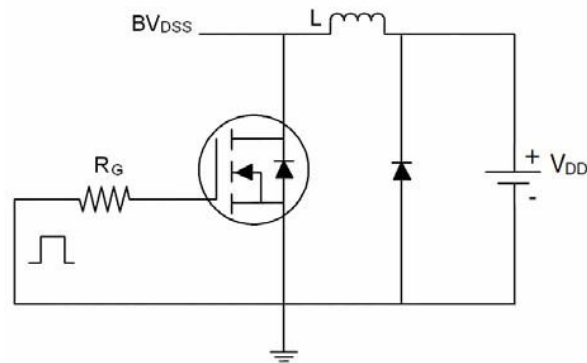
On Characteristics (Note 3)						
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	0.9	1.5	2.2	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =20A	-	7	9.5	mΩ
		V _{GS} =4.5V, I _D =20A	-	11	23	mΩ
Forward Transconductance	g _{FS}	V _{DS} =5V, I _D =20A	26	-	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C _{iss}	V _{DS} =15V, V _{GS} =0V, F=1.0MHz	-	1000	-	PF
Output Capacitance	C _{oss}		-	180.8	-	PF
Reverse Transfer Capacitance	C _{rss}		-	164.4	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	t _{d(on)}	V _{DD} =15V, R _L =0.75Ω V _{GS} =10V, R _G =3Ω	-	5	-	nS
Turn-on Rise Time	t _r		-	12	-	nS
Turn-Off Delay Time	t _{d(off)}		-	19	-	nS
Turn-Off Fall Time	t _f		-	6	-	nS
Total Gate Charge	Q _g	V _{DS} =15V, I _D =20A, V _{GS} =10V	-	17		nC
Gate-Source Charge	Q _{gs}		-	2.8		nC
Gate-Drain Charge	Q _{gd}		-	3.9		nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V _{SD}	V _{GS} =0V, I _S =20A	-		1.2	V
Diode Forward Current (Note 2)	I _S		-	-	40	A
Reverse Recovery Time	t _{rr}	T _J = 25°C, I _F =20A di/dt = 100A/μs(Note3)	-	19	-	nS
Reverse Recovery Charge	Q _{rr}		-	10	-	nC
Forward Turn-On Time	t _{on}	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

Notes:

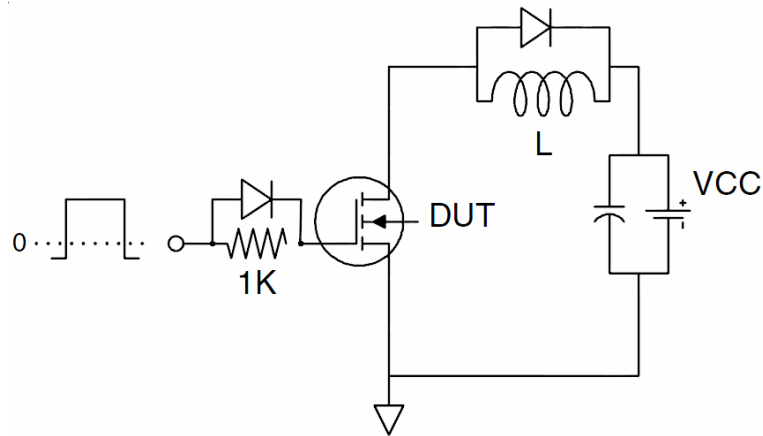
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, $t \leq 10$ sec.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production
5. EAS condition: $T_J=25^\circ C, V_{DD}=15V, V_G=10V, L=0.5mH, R_g=25\Omega$

Test circuit

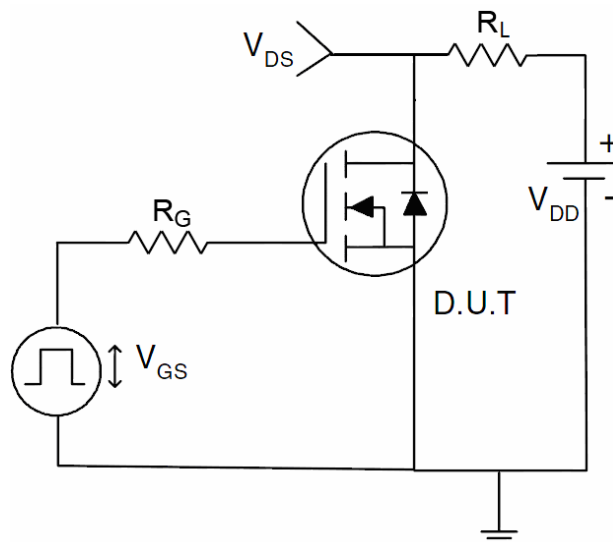
1) E_{AS} test Circuits



2) Gate charge test Circuit:



3) Switch Time Test Circuit:



N-channel Typical Electrical and Thermal Characteristics (Curves)

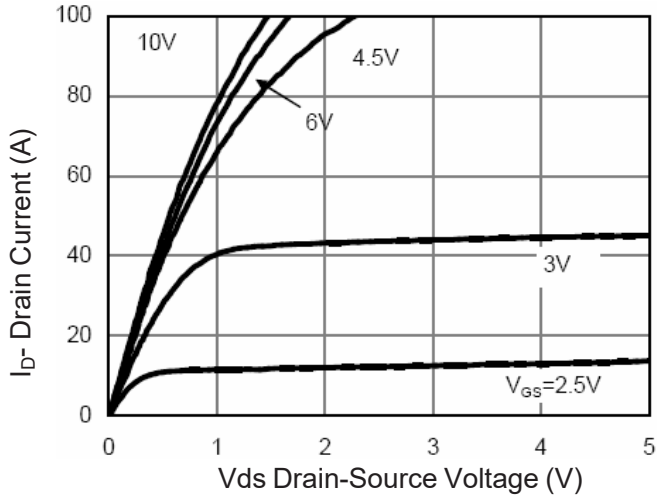


Figure 1 Output Characteristics

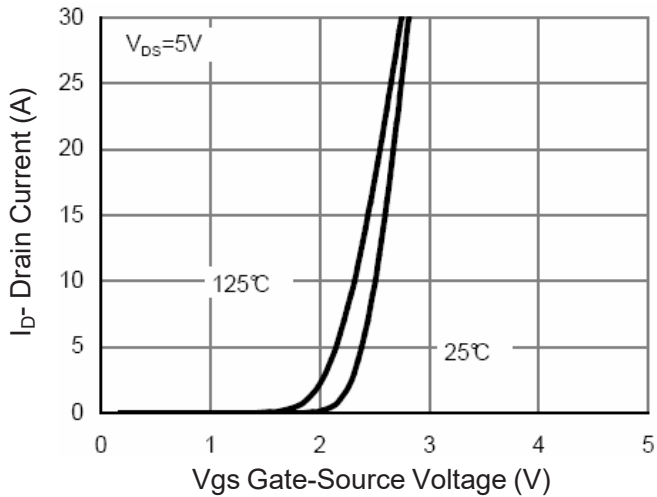


Figure 2 Transfer Characteristics

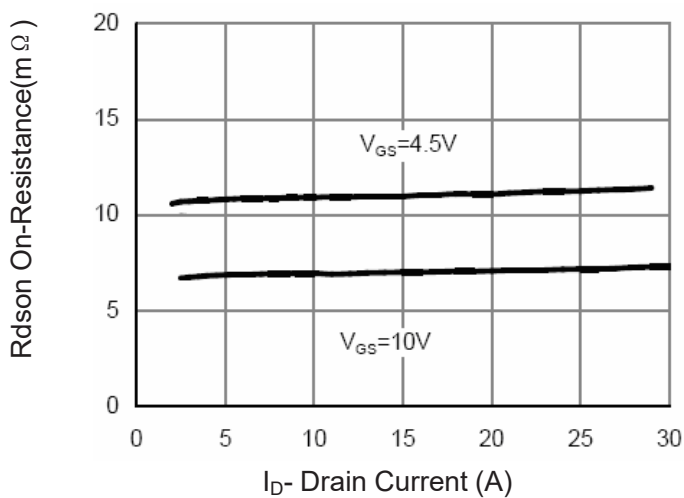


Figure 3 Rdson- Drain Current

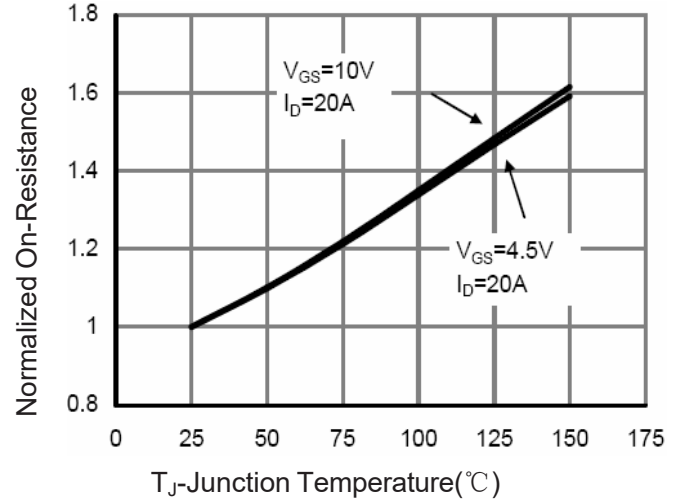


Figure 4 Rdson-Junction Temperature

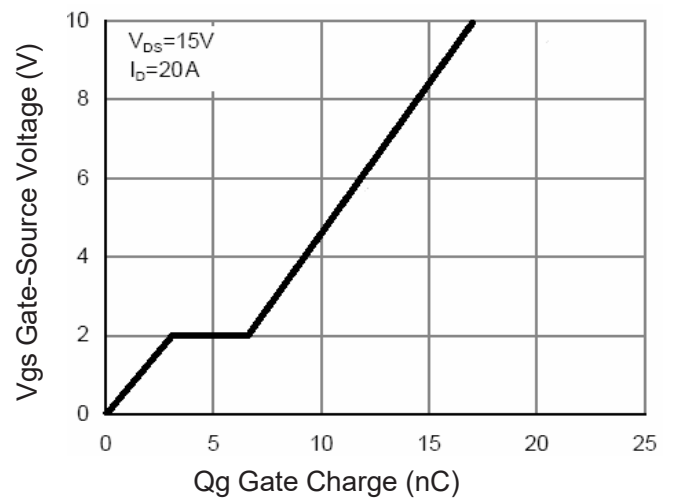


Figure 5 Gate Charge

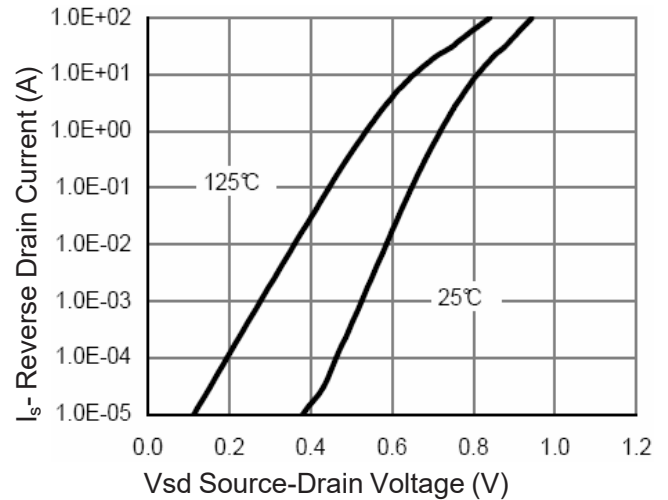
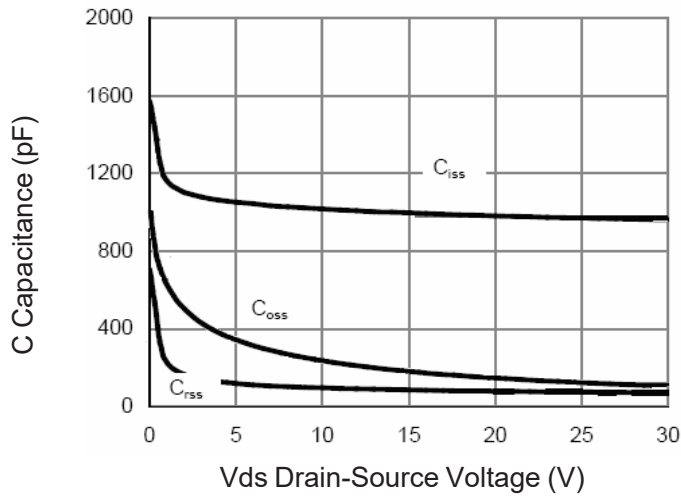
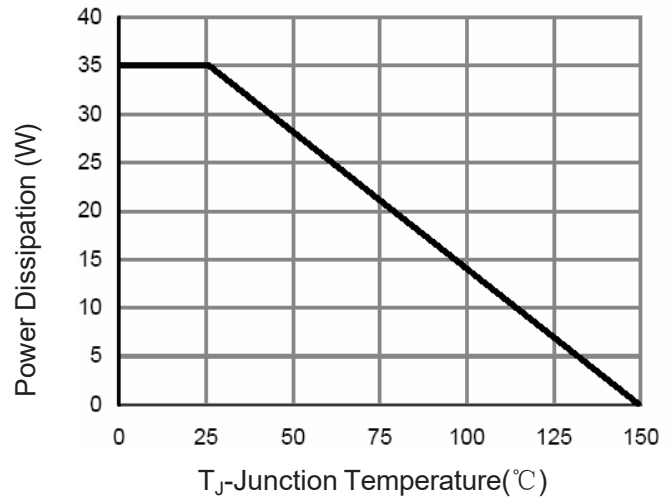
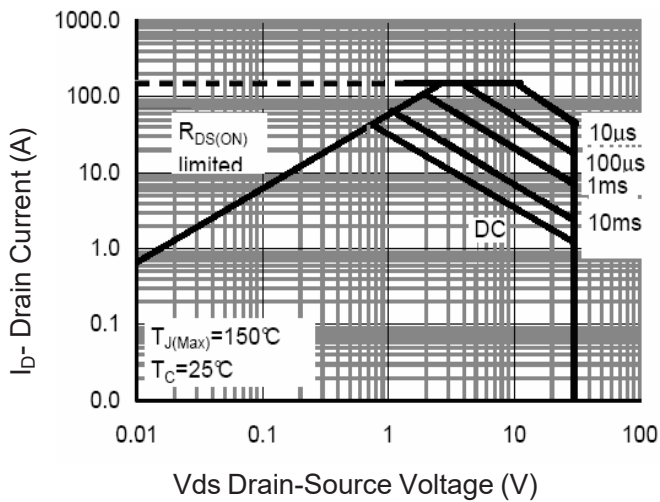
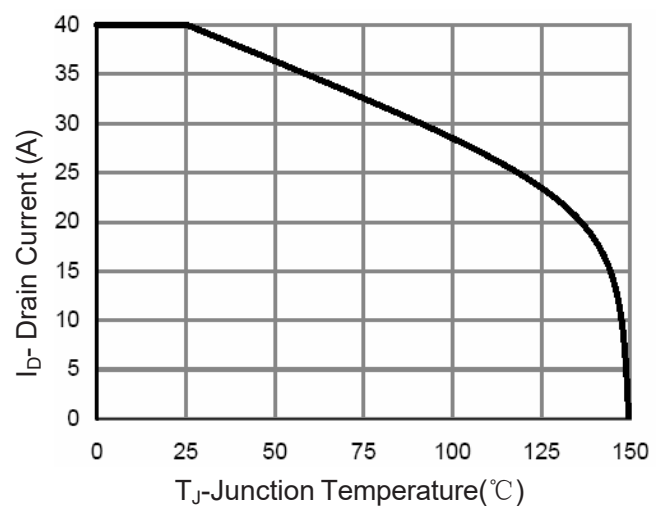
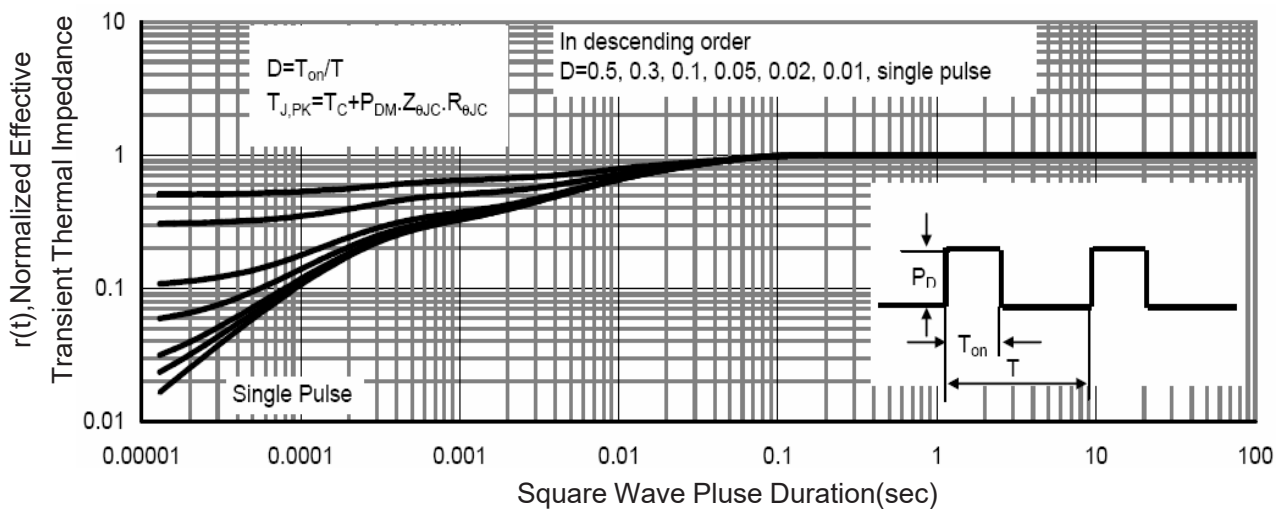


Figure 6 Source- Drain Diode Forward


Figure 7 Capacitance vs Vds

Figure 9 Power De-rating

Figure 8 Safe Operation Area

Figure 10 ID Current De-rating

Figure 11 Normalized Maximum Transient Thermal Impedance

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
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	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	-1.6	-2.2	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=-10V, I_D=-15A$	-	9	11	m Ω
		$V_{GS}=-4.5V, I_D=-15A$	-	15	20	m Ω
Forward Transconductance	g_{FS}	$V_{DS}=-5V, I_D=-15A$	15	-	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C_{iss}	$V_{DS}=-15V, V_{GS}=0V,$ $F=1.0MHz$	-	1632	-	PF
Output Capacitance	C_{oss}		-	227	-	PF
Reverse Transfer Capacitance	C_{rss}		-	178	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=-15V, I_D=-15A,$ $V_{GS}=-10V, R_{GEN}=1\Omega$	-	12	-	nS
Turn-on Rise Time	t_r		-	10	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	25	-	nS
Turn-Off Fall Time	t_f		-	13	-	nS
Total Gate Charge	Q_g	$V_{DS}=-15V, I_D=-15A, V_{GS}=-10V$	-	45.6	-	nC
Gate-Source Charge	Q_{gs}		-	4.6	-	nC
Gate-Drain Charge	Q_{gd}		-	11.1	-	nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V_{SD}	$V_{GS}=0V, I_S=-15A$	-	-	-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

Typical Electrical and Thermal Characteristics

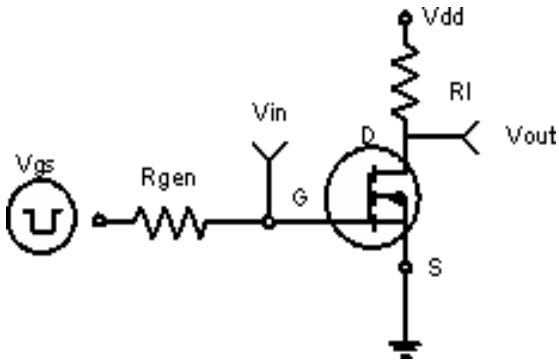


Figure 1: Switching Test Circuit

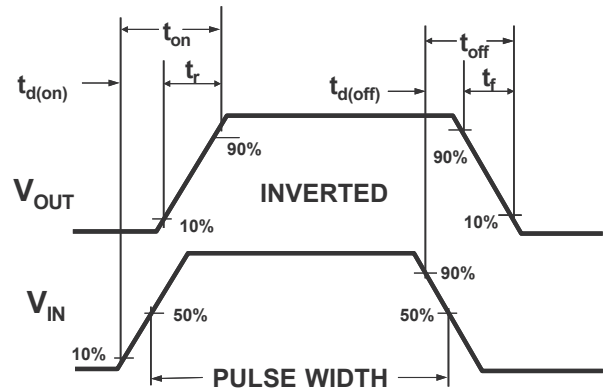


Figure 2: Switching Waveforms

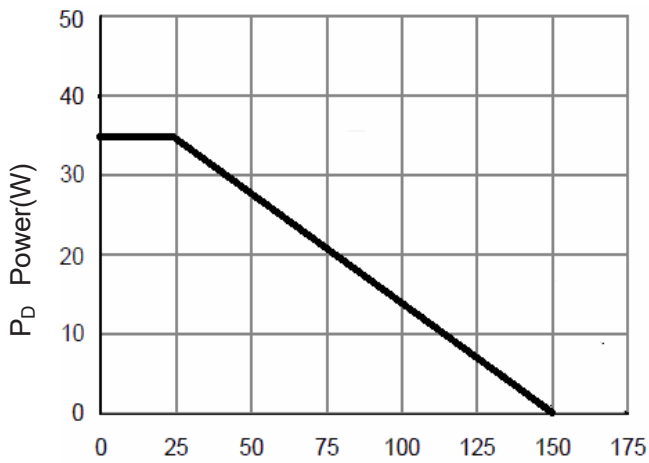


Figure 3 Power Dissipation

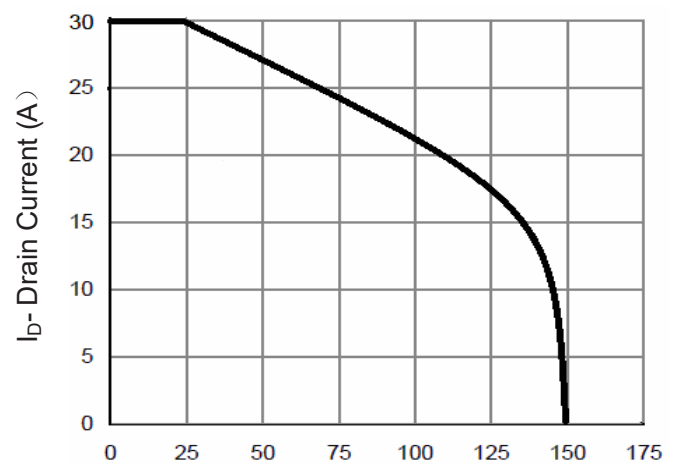


Figure 4 Drain Current

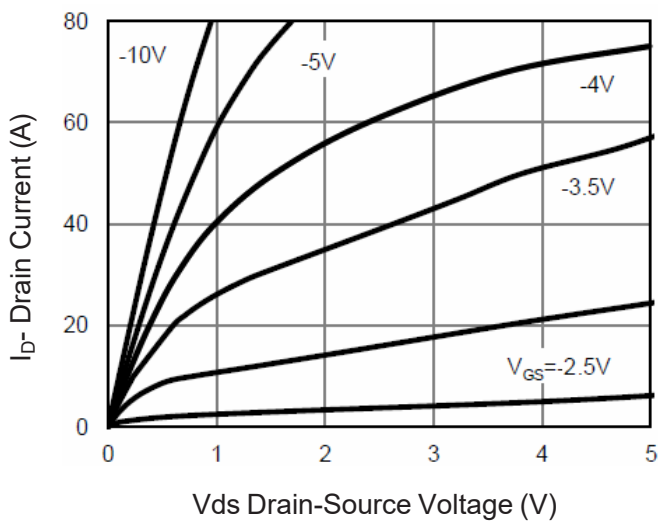


Figure 5 Output Characteristics

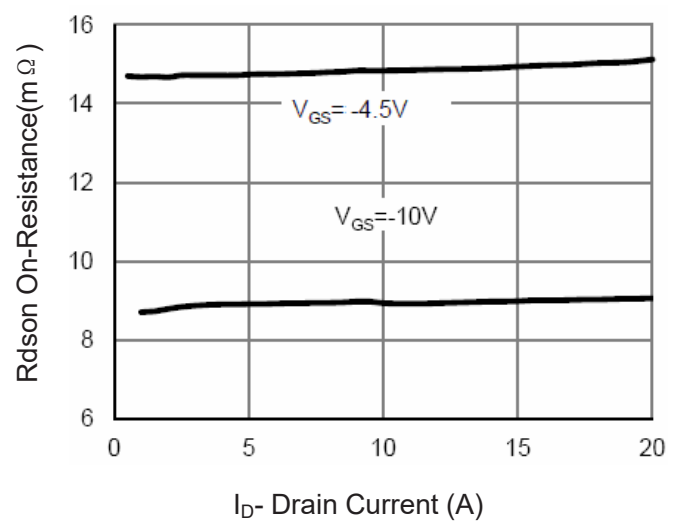
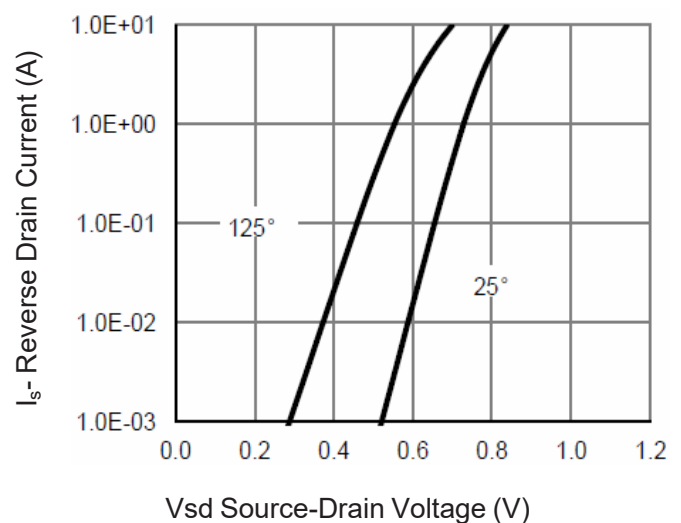
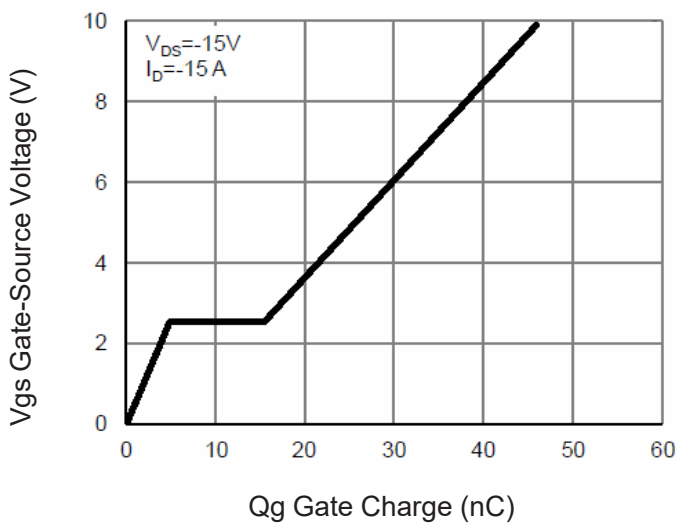
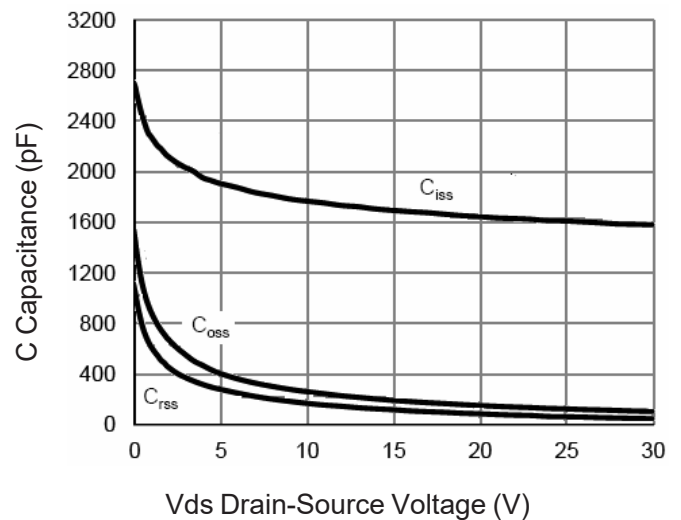
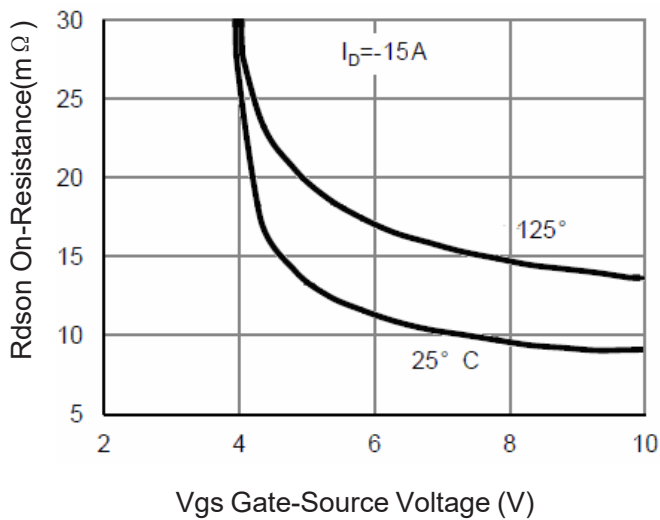
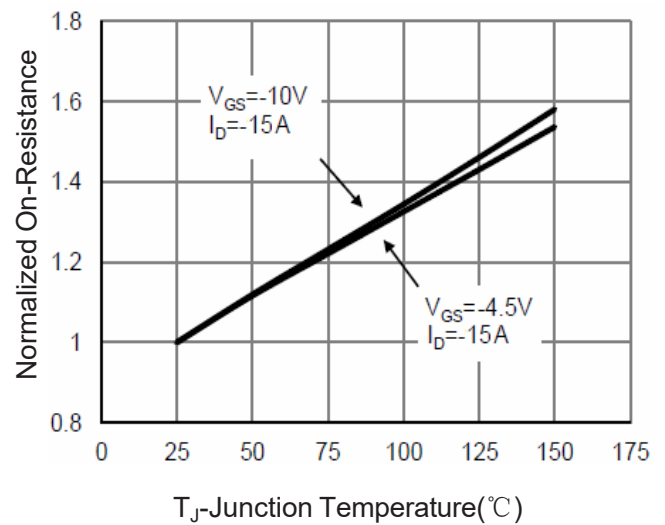
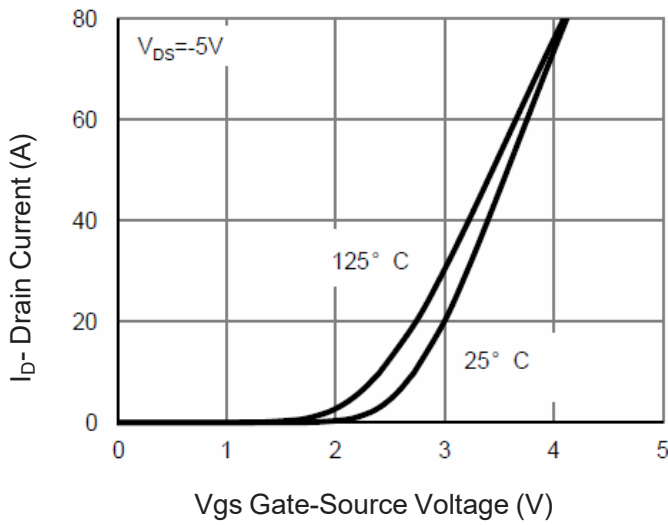
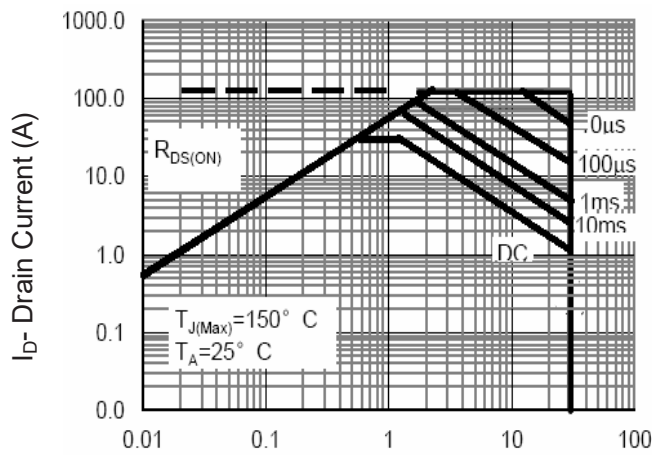
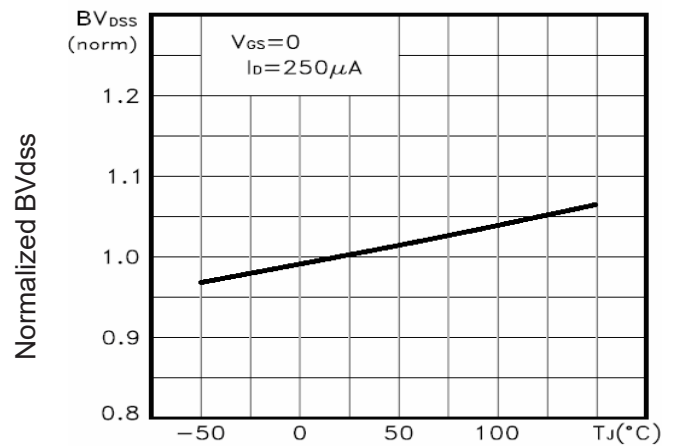


Figure 6 Drain-Source On-Resistance





Vds Drain-Source Voltage (V)
Figure 13 Safe Operation Area



TJ-Junction Temperature(°C)
Figure 14 BV_{DSS} vs Junction Temperature

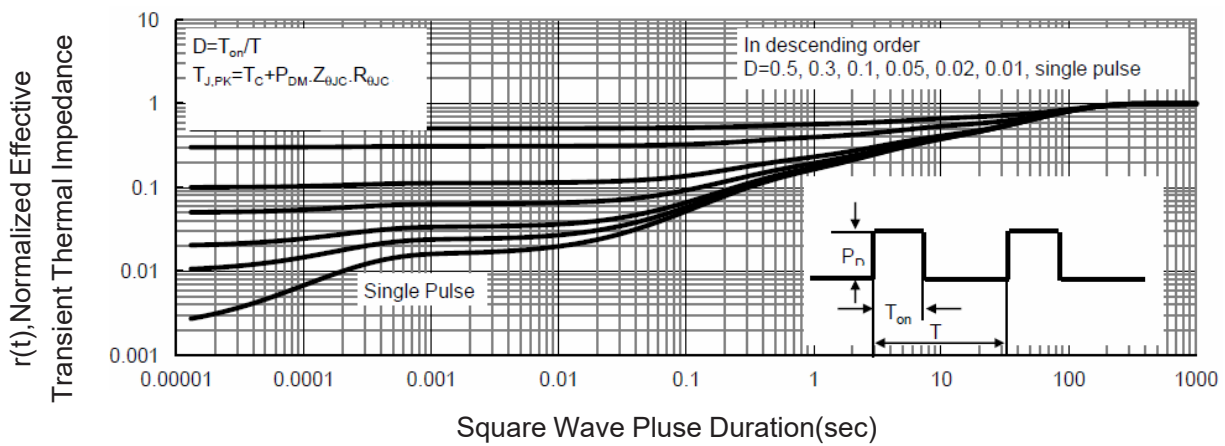


Figure 15 Normalized Maximum Transient Thermal Impedance