

Description

The VSM12DN04 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

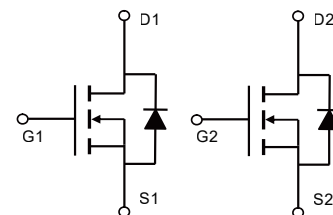
- $V_{DS}=40V, I_D=8A$ $V_{DS}=40V, I_D=12A$
 $R_{DS(ON)} < 18m\Omega @ V_{GS}=10V$ $R_{DS(ON)} < 14m\Omega @ V_{GS}=10V$
 $R_{DS(ON)} < 28m\Omega @ V_{GS}=4.5V$ $R_{DS(ON)} < 20m\Omega @ V_{GS}=4.5V$
- High density cell design for ultra low R_{dson}
- Fully characterized avalanche voltage and current

Application

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply



SOP-8



Schematic

Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
VSM12DN04	VSM12DN04-S8	SOP-8	Ø330mm	12mm	4000 units

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

Parameter		Symbol	N1-Channel	N2-Channel	Unit
Drain-Source Voltage		V_{DS}	40	40	V
Gate-Source Voltage		V_{GS}	± 20	± 20	V
Continuous Drain Current	$T_A=25^{\circ}C$	I_D	8	12	A
	$T_A=100^{\circ}C$		5.7	8.5	
Pulsed Drain Current (Note 1)		I_{DM}	32	60	A
Maximum Power Dissipation	$T_A=25^{\circ}C$	P_D	2	2.5	W
Operating Junction and Storage Temperature Range		T_J, T_{STG}	-55 To 150		$^{\circ}C$

Thermal Characteristic

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance, Junction-to-Ambient (Note 2) (N1-Channel)	$R_{\theta JA}$	62.5	85	$^{\circ}C/W$
Thermal Resistance, Junction-to-Ambient (Note 2) (N2-Channel)	$R_{\theta JA}$	50	75	$^{\circ}C/W$

N1-CH Electrical Characteristics ($T_A=25^{\circ}\text{C}$ unless otherwise noted)

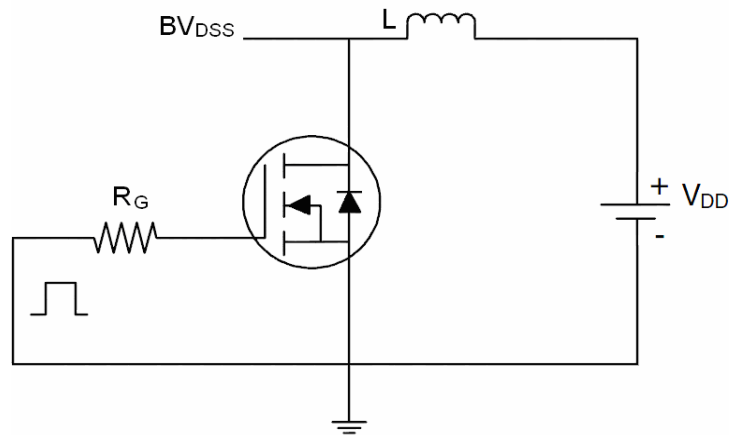
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Off Characteristics						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	40	-	-	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=40V, V_{GS}=0V$	-	-	1	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	1	1.5	2.0	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=8A$	-	15.8	18	m Ω
		$V_{GS}=4.5V, I_D=4A$	-	22	28	m Ω
Forward Transconductance	g_{FS}	$V_{DS}=5V, I_D=8A$	33	-	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C_{iss}	$V_{DS}=20V, V_{GS}=0V,$ $F=1.0MHz$	-	964	-	PF
Output Capacitance	C_{oss}		-	109	-	PF
Reverse Transfer Capacitance	C_{rss}		-	96	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=20V, R_L=2.5\Omega$ $V_{GS}=10V, R_{GEN}=3\Omega$	-	5.5	-	nS
Turn-on Rise Time	t_r		-	14	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	24	-	nS
Turn-Off Fall Time	t_f		-	12	-	nS
Total Gate Charge	Q_g	$V_{DS}=20V, I_D=8A,$ $V_{GS}=10V$	-	22.9	-	nC
Gate-Source Charge	Q_{gs}		-	3.5	-	nC
Gate-Drain Charge	Q_{gd}		-	5.3	-	nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V_{SD}	$V_{GS}=0V, I_S=8A$	-	0.8	1.2	V

Notes:

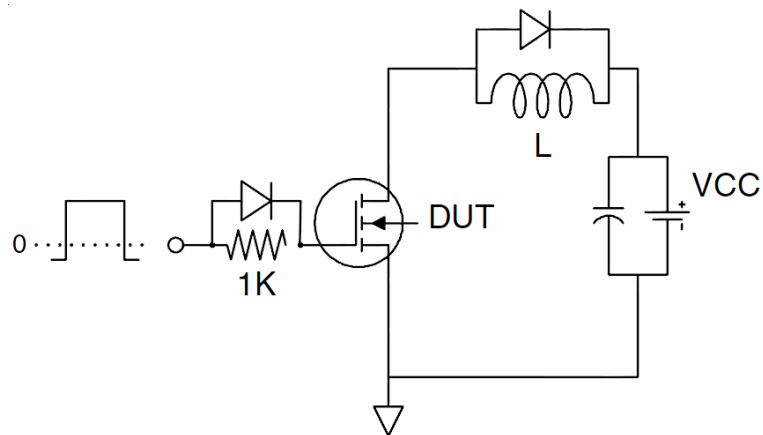
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. The value of $R_{\theta JA}$ is measured with the device mounted on 1 in² FR-4 board with 2oz. Copper, in a still air environment with $T_A=25^{\circ}\text{C}$. The value in any given application depends on the user's specific board design. Surface Mounted on FR4 Board, $t \leq 10$ sec. The current rating is based on the $t \leq 10$ s thermal resistance rating.
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 2\%$.
4. Guaranteed by design, not subject to production.

Test Circuit

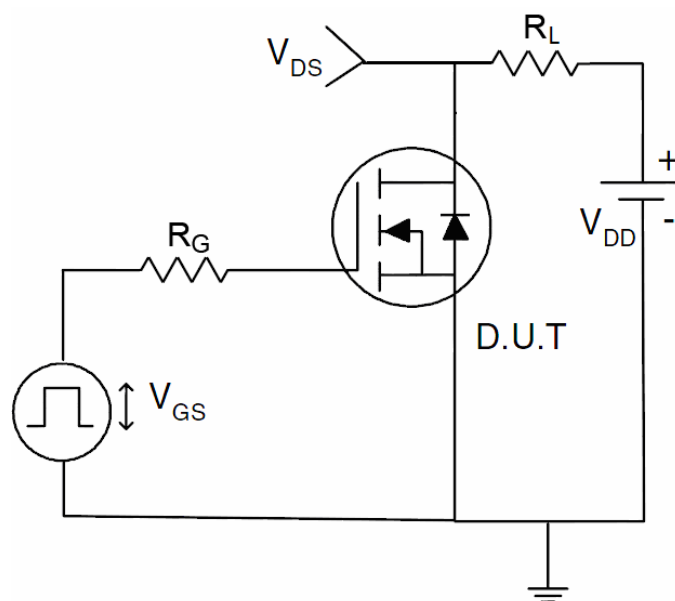
1) E_{AS} Test Circuits



2) Gate Charge Test Circuit:



3) Switch Time Test Circuit:



N1- Channel Typical Electrical and Thermal Characteristics (Curves)

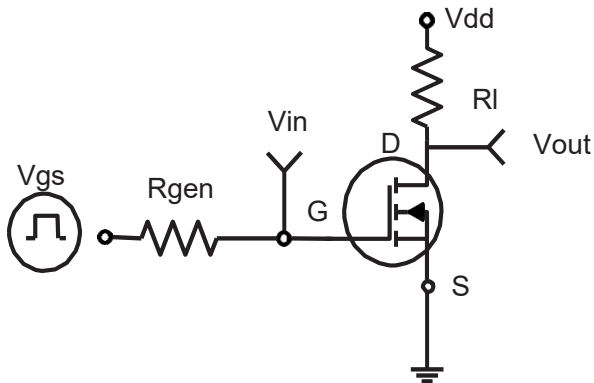


Figure 1: Switching Test Circuit

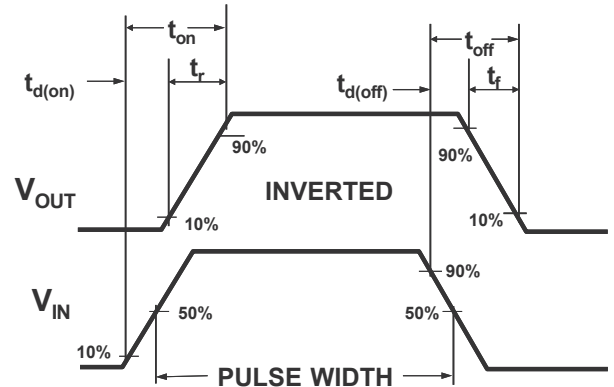


Figure 2: Switching Waveforms

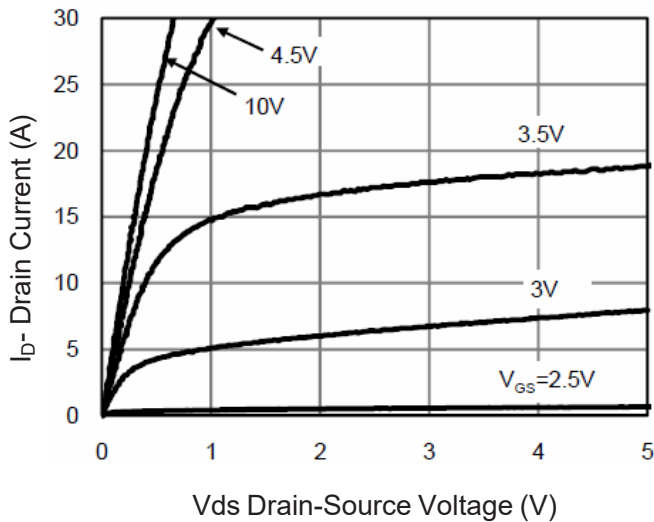


Figure 3 Output Characteristics

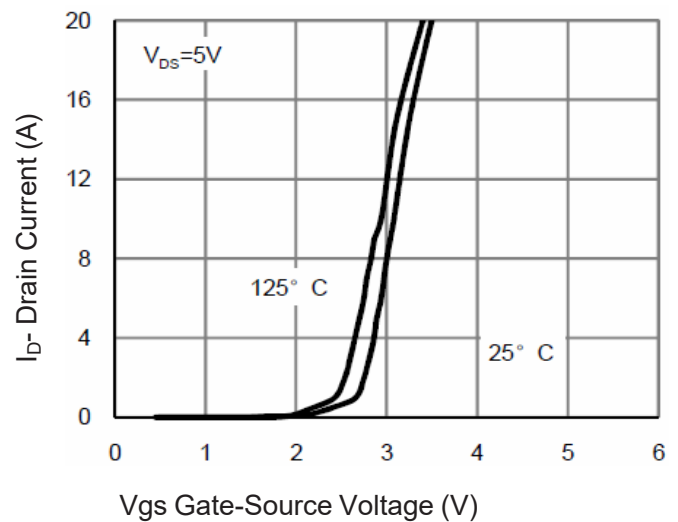


Figure 4 Transfer Characteristics

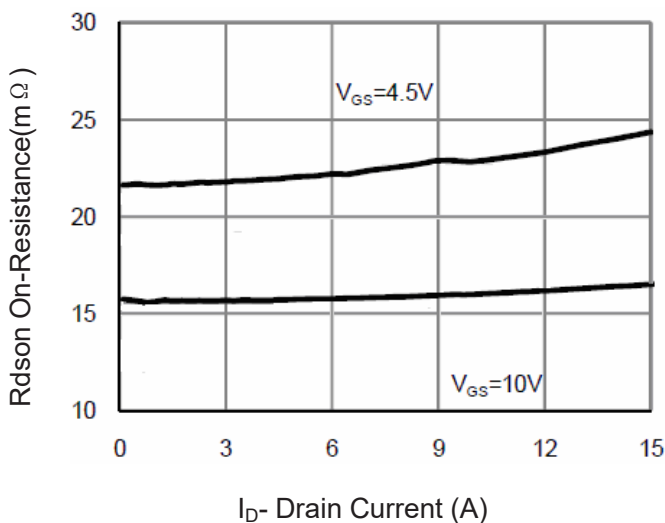


Figure 5 Drain-Source On-Resistance

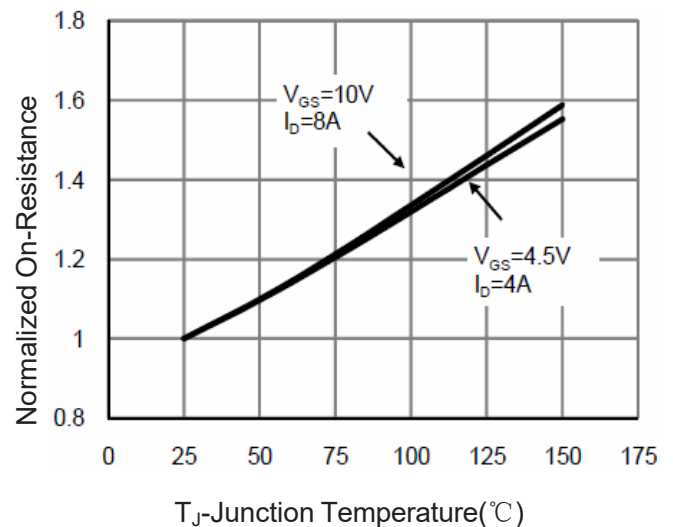
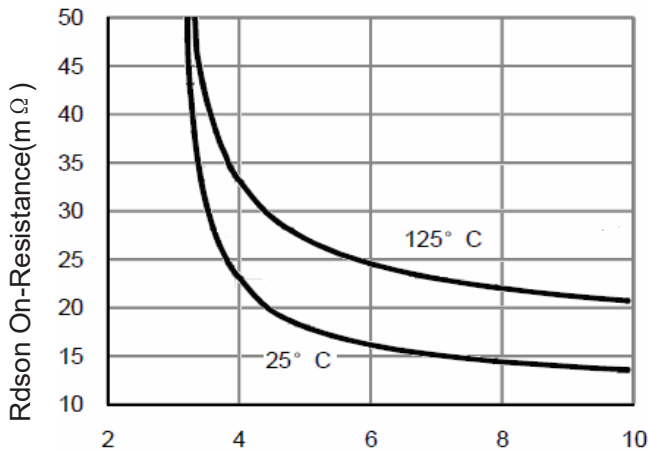
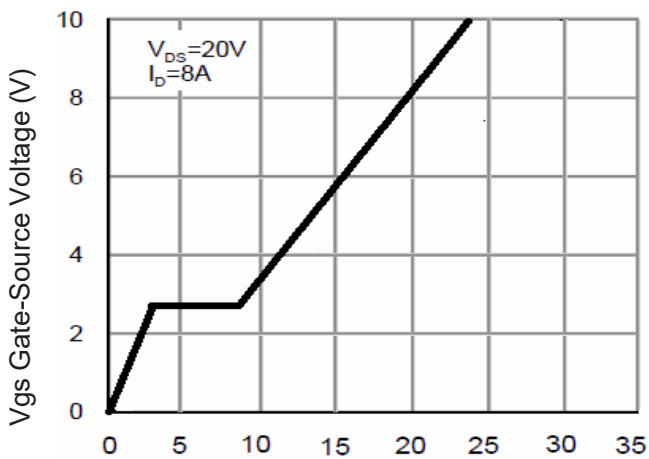


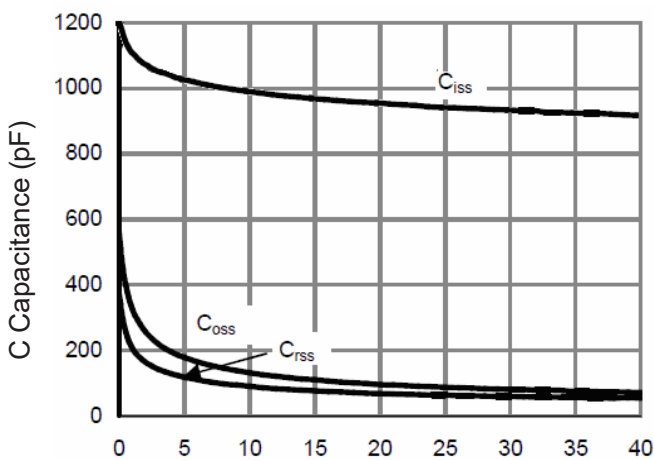
Figure 6 Drain-Source On-Resistance



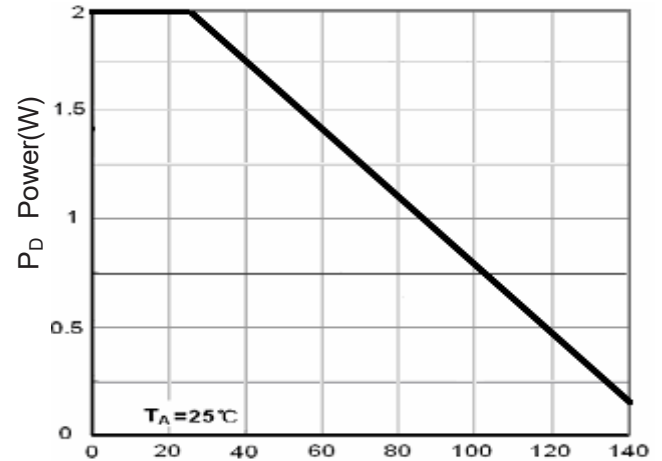
Vgs Gate-Source Voltage (V)

Figure7 Rdson vs Vgs


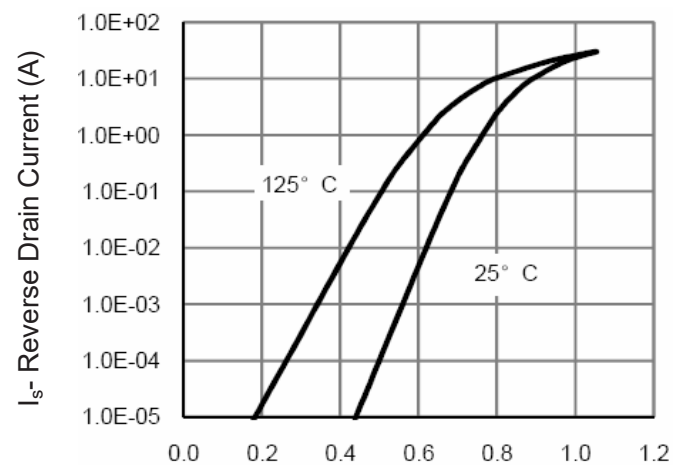
Qg Gate Charge (nC)

Figure 9 Gate Charge


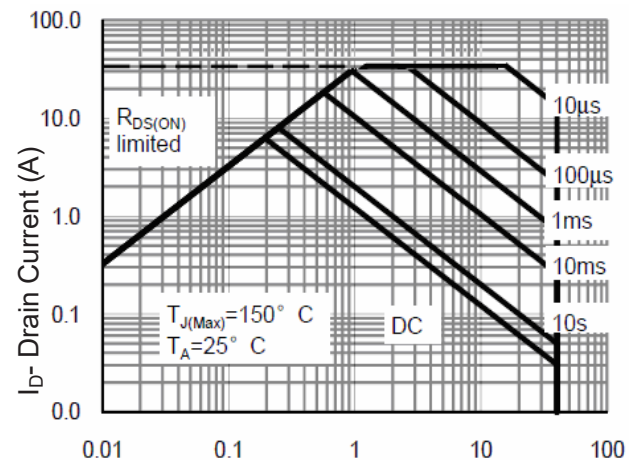
Vds Drain-Source Voltage (V)

Figure 11 Capacitance vs Vds


TA-Ambient Temperature(°C)

Figure 8 Power Dissipation


Vds Drain-Source Voltage (V)

Figure 10 Source- Drain Diode Forward


Vds Drain-Source Voltage (V)

Figure 12 Safe Operation Area

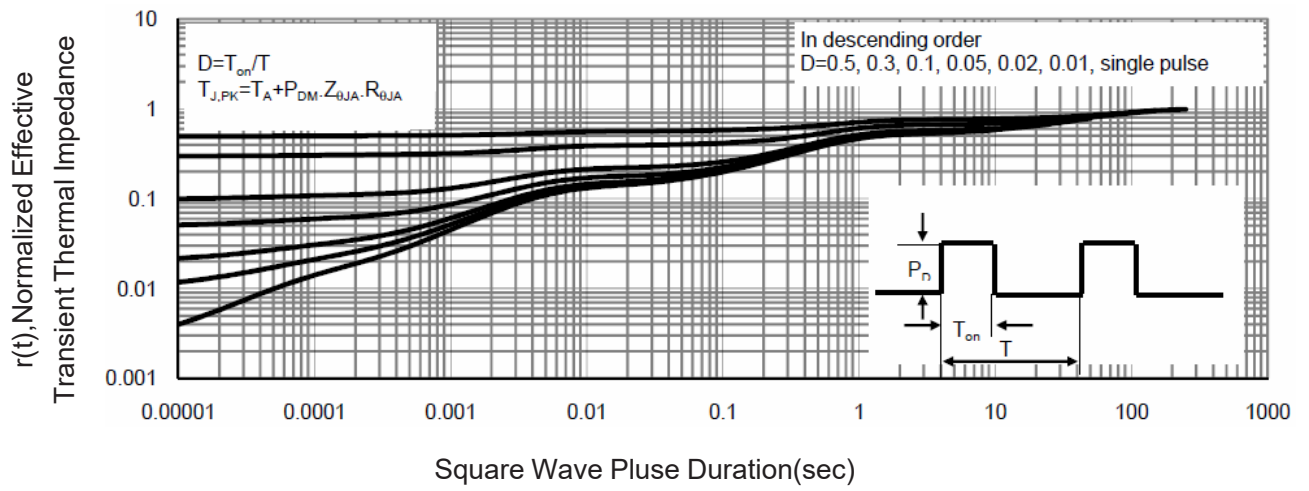


Figure 13 Normalized Maximum Transient Thermal Impedance

N2-CH 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 =250μA	40	45	-	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =40V, 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	1.2	1.6	2.5	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =10A	-	11.7	14	mΩ
		V _{GS} =4.5V, I _D =8A	-	15.6	20	mΩ
Forward Transconductance	g _{FS}	V _{DS} =5V, I _D =10A		75	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C _{iss}	V _{DS} =20V, V _{GS} =0V, F=1.0MHz	-	1780	-	PF
Output Capacitance	C _{oss}		-	209	-	PF
Reverse Transfer Capacitance	C _{rss}		-	160	-	PF
Switching Characteristics (Note 4)						
Turn-on Delay Time	t _{d(on)}	V _{DD} =20V, R _L =2Ω V _{GS} =10V, R _G =3Ω	-	6.4	-	nS
Turn-on Rise Time	t _r		-	17.2	-	nS
Turn-Off Delay Time	t _{d(off)}		-	29.6	-	nS
Turn-Off Fall Time	t _f		-	16.8	-	nS
Total Gate Charge	Q _g	V _{DS} =20V, I _D =10A, V _{GS} =10V	-	38.2		nC
Gate-Source Charge	Q _{gs}		-	5.6		nC
Gate-Drain Charge	Q _{gd}		-	7.4		nC
Drain-Source Diode Characteristics						
Diode Forward Voltage (Note 3)	V _{SD}	V _{GS} =0V, I _S =10A	-		1.2	V
Diode Forward Current (Note 2)	I _S		-	-	12	A
Reverse Recovery Time	t _{rr}	TJ = 25°C, IF = 10A di/dt = 100A/μs(Note3)	-	29	-	nS
Reverse Recovery Charge	Qrr		-	26	-	nC

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

N2-Typical Electrical and Thermal Characteristics (Curves)

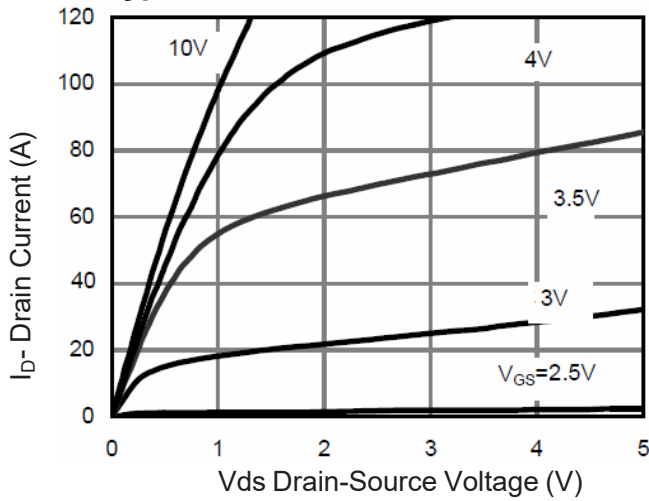


Figure 1 Output Characteristics

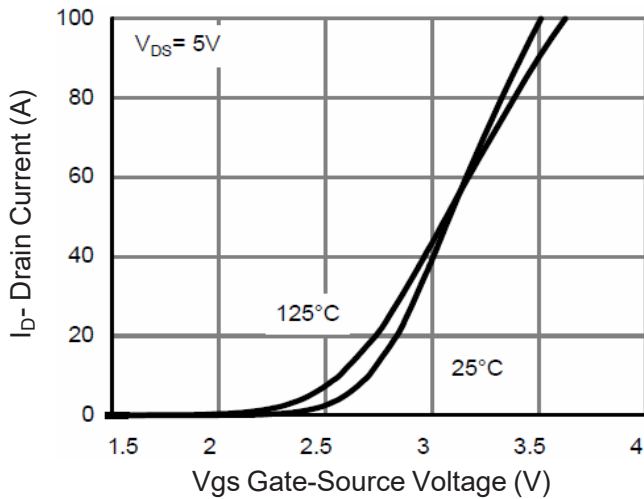


Figure 2 Transfer Characteristics

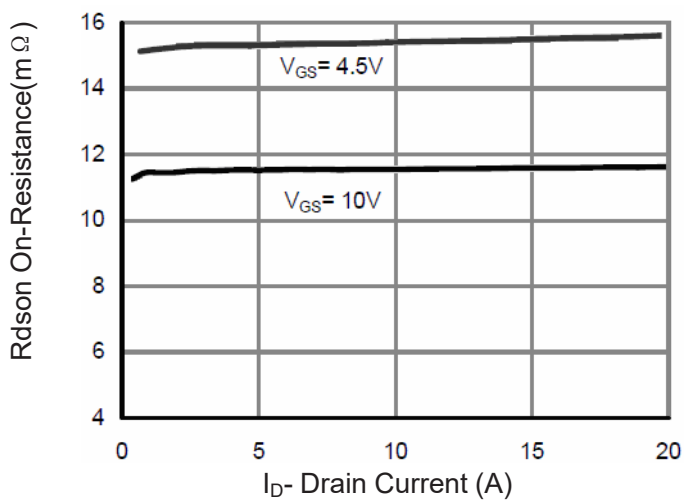


Figure 3 $R_{DS(on)}$ - Drain Current

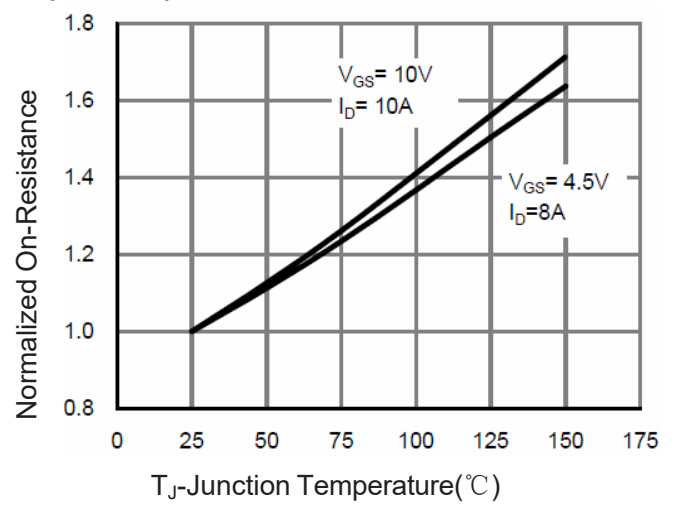


Figure 4 $R_{DS(on)}$ -Junction Temperature

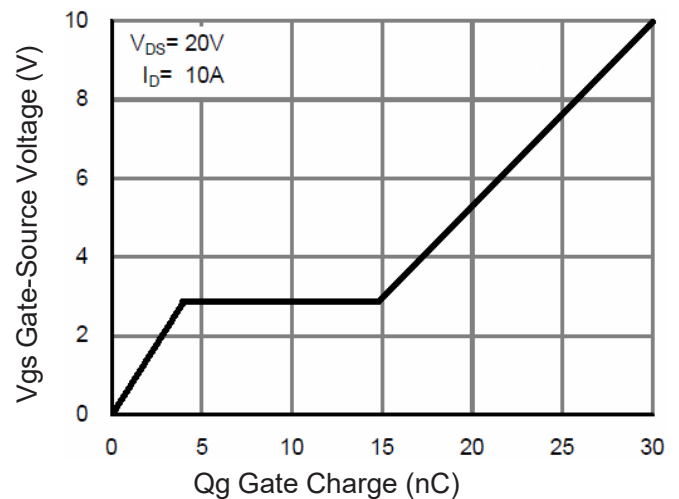


Figure 5 Gate Charge

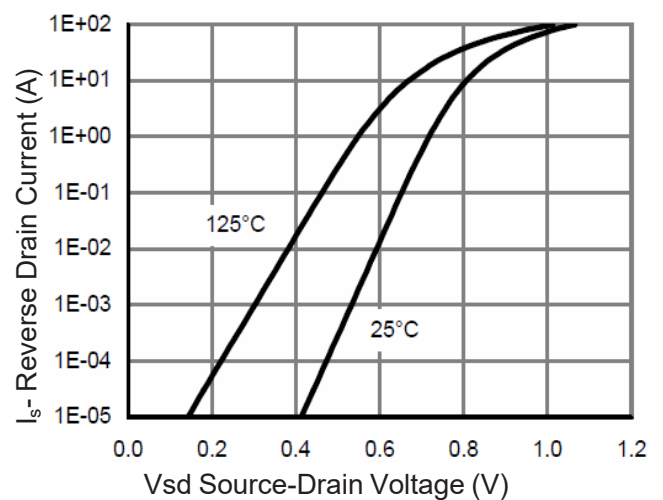
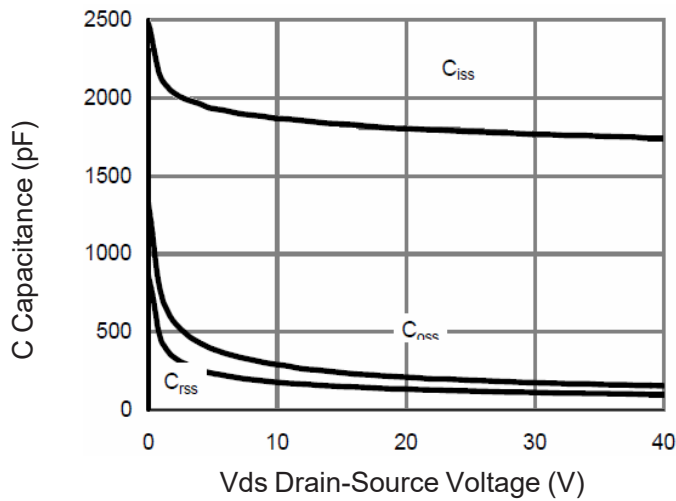
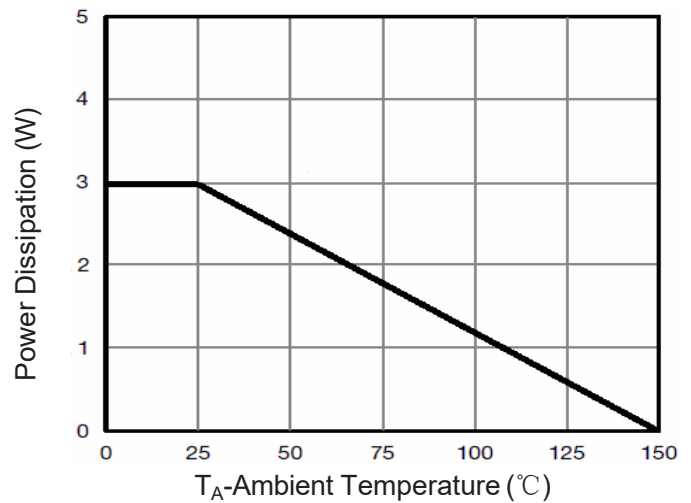
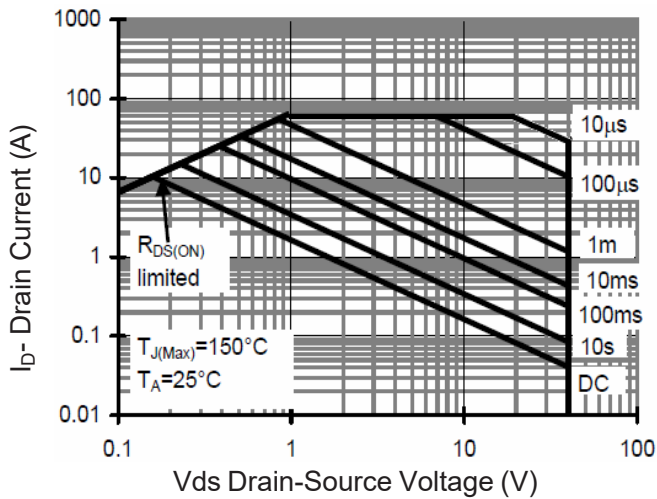
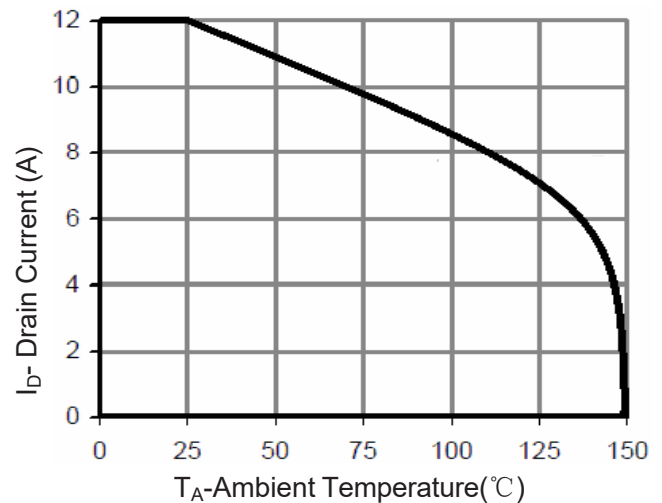
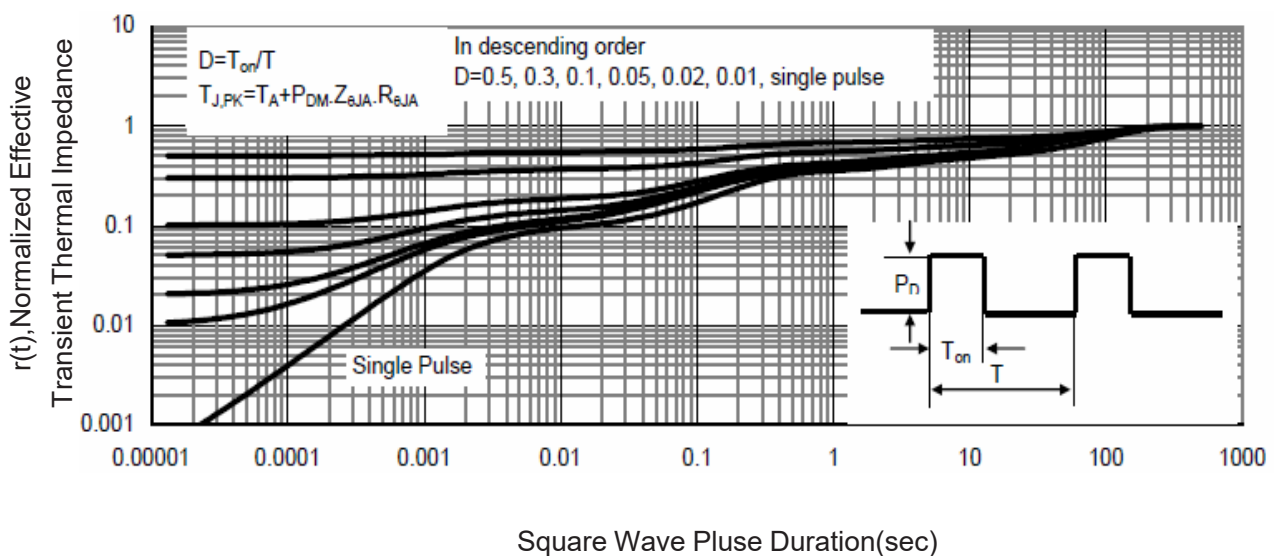


Figure 6 Source- Drain Diode Forward


Figure 7 Capacitance vs Vds

Figure 9 Power De-rating

Figure 8 Safe Operation Area

Figure 10 Current De-rating

Figure 11 Normalized Maximum Transient Thermal Impedance