

Description

The VSM20N03 is designed to provide a high efficiency synchronous buck power stage with optimal layout and board space utilization. It includes two specialized MOSFETs in a dual Power DFN3X3 package. The Q1 "High Side" MOSFET is designed to minimize switching losses. The Q2 "Low Side" MOSFET uses advanced trench technology and design to provide excellent $R_{DS(ON)}$ with low gate charge.

General Features

Q1 "High Side" MOSFET

- $V_{DS} = 30V, I_D = 15A$

$$R_{DS(ON)} < 11.5m\Omega @ V_{GS}=10V$$

$$R_{DS(ON)} < 19m\Omega @ V_{GS}=4.5V$$

- Excellent gate charge x $R_{DS(on)}$ product(FOM)

- Very low on-resistance $R_{DS(on)}$

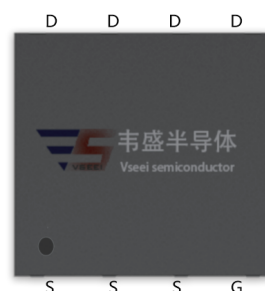
- 150 °C operating temperature

- Pb-free lead plating

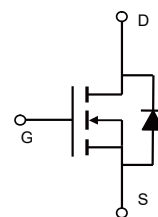
- 100% UIS tested

Application

- Compact DC/DC converter applications



DFN3x3



Schematic

Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
VSM20N03	VSM20N03-D33	DFN3x3	-	-	-

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

Parameter	Symbol	Q1	Q2	Unit
Drain-Source Voltage	V_{DS}	30	30	V
Gate-Source Voltage	V_{GS}	± 20	± 20	V
Drain Current-Continuous (Note 2)	I_D	15	20	A
		10.6	14.1	
Drain Current -Pulsed (Note 1)	I_{DM}	60	80	A
Power Dissipation	P_D	18	20	W
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 To 150	-55 To 150	$^{\circ}C$

Thermal Characteristic

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance, Junction-to-Case (Note 2) (Q1)	$R_{\theta JC}$	6.5	7	$^{\circ}C/W$
Thermal Resistance, Junction-to-Case (Note 2) (Q2)	$R_{\theta JC}$	6	6.3	$^{\circ}C/W$

Q1 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	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} =±20V, V _{DS} =0V	-	-	±100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	1.0	1.5	2.2	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =10A	-	9.8	11.5	mΩ
		V _{GS} =4.5V, I _D =10A	-	15.3	19	mΩ
Gate resistance	R _g	V _{DS} =0V, V _{GS} =0V, F=1.0MHz	1.0	2.8	4.3	Ω
Forward Transconductance	g _{FS}	V _{DS} =5V, I _D =10A	-	12	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C _{iss}	V _{DS} =15V, V _{GS} =0V, F=1.0MHz	-	690	-	pF
Output Capacitance	C _{oss}		-	105	-	pF
Reverse Transfer Capacitance	C _{rss}		-	80	-	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		-	3.5	-	nS
Turn-Off Delay Time	t _{d(off)}		-	19	-	nS
Turn-Off Fall Time	t _f		-	3.5	-	nS
Total Gate Charge	Q _g	V _{DS} =15V, I _D =10A, V _{GS} =10V	-	15		nC
Gate-Source Charge	Q _{gs}		-	2.5		nC
Gate-Drain Charge	Q _{gd}		-	3		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		-	-	15	A
Reverse Recovery Time	t _{rr}	TJ = 25°C, IF =10A	-	19	-	nS
Reverse Recovery Charge	Q _{rr}	di/dt = 100A/μs(Note3)	-	10	-	nC

Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production
5. EAS condition : T_J=25°C, V_{DD}=15V, V_G=10V, L=0.5mH, R_G=25Ω

Q1 Typical Electrical and Thermal Characteristics (Curves)

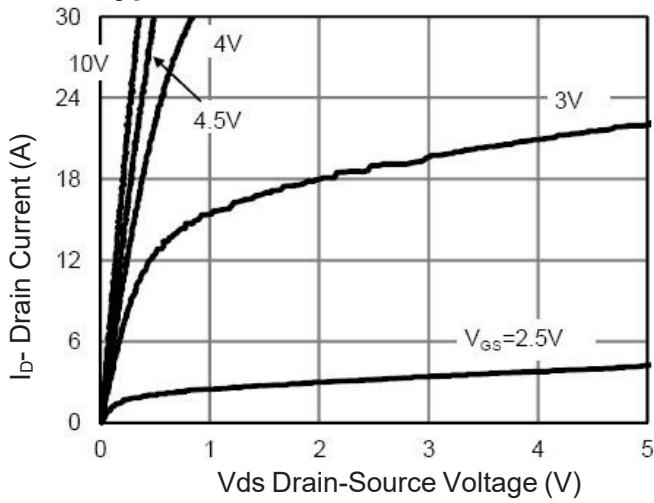


Figure 1 Output Characteristics

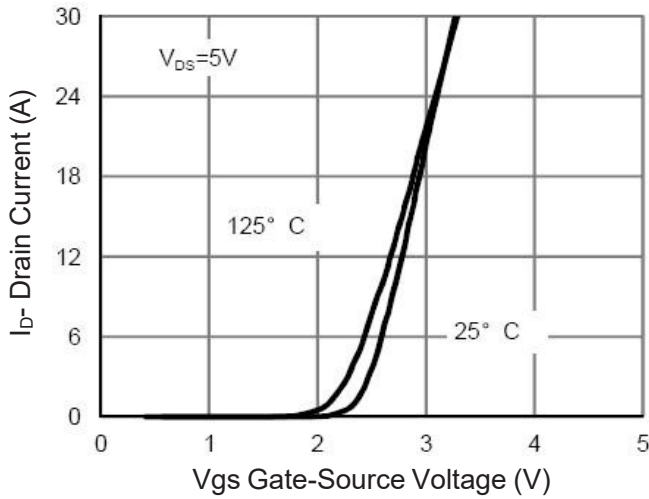


Figure 2 Transfer Characteristics

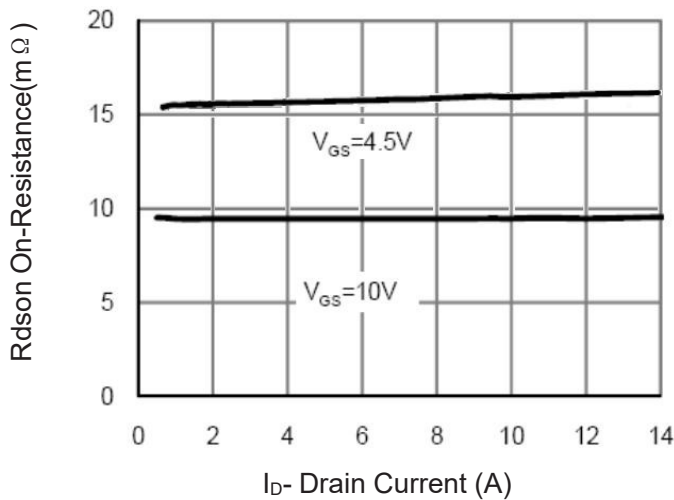


Figure 3 Rdson- Drain Current

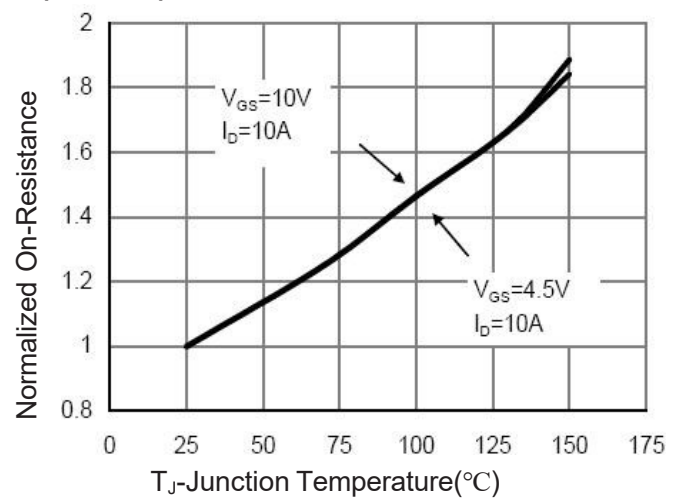


Figure 4 Rdson-Junction Temperature

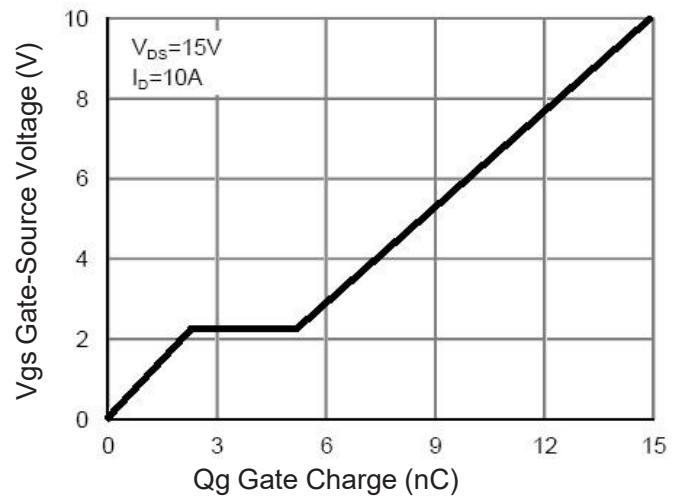


Figure 5 Gate Charge

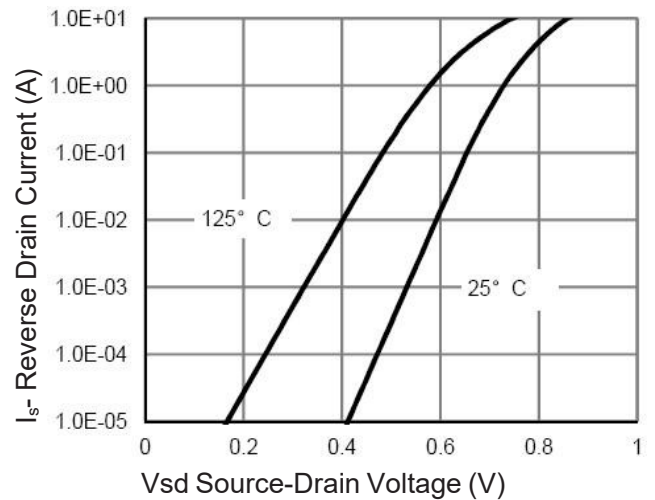
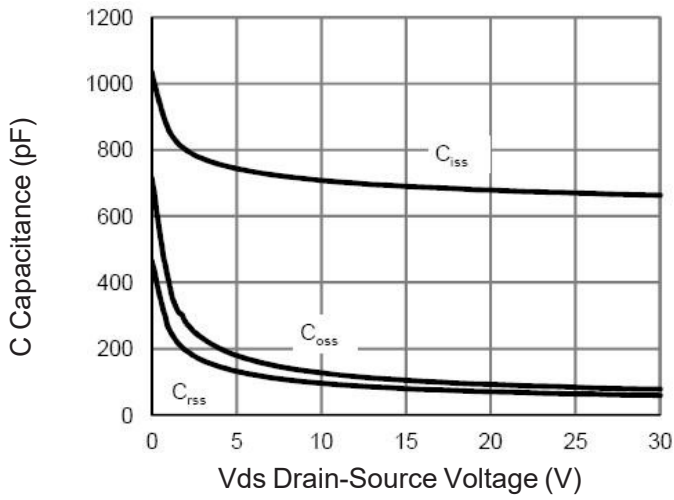
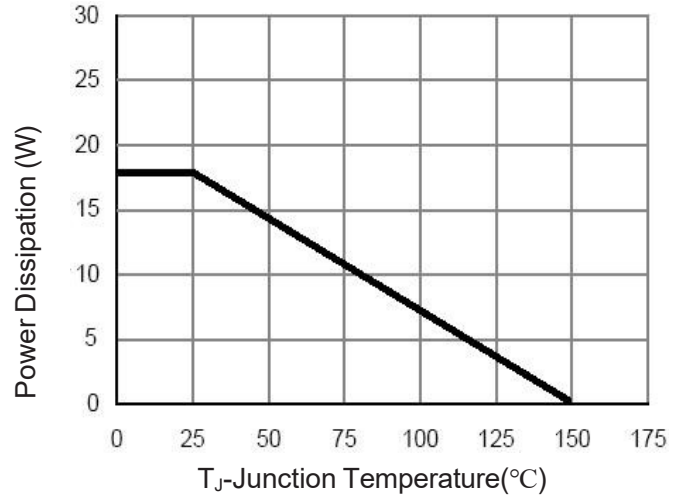
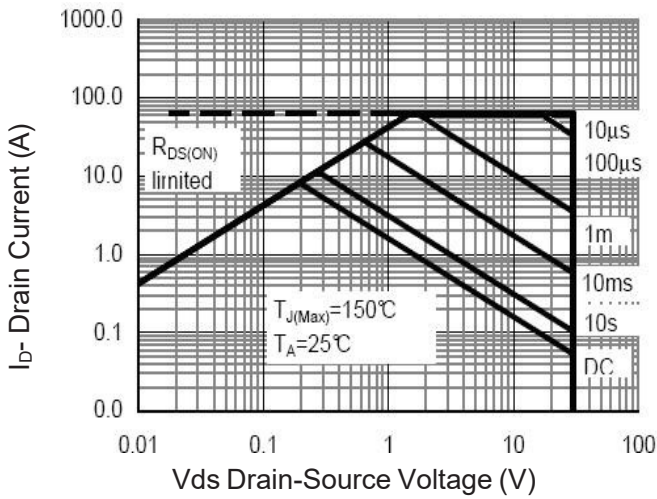
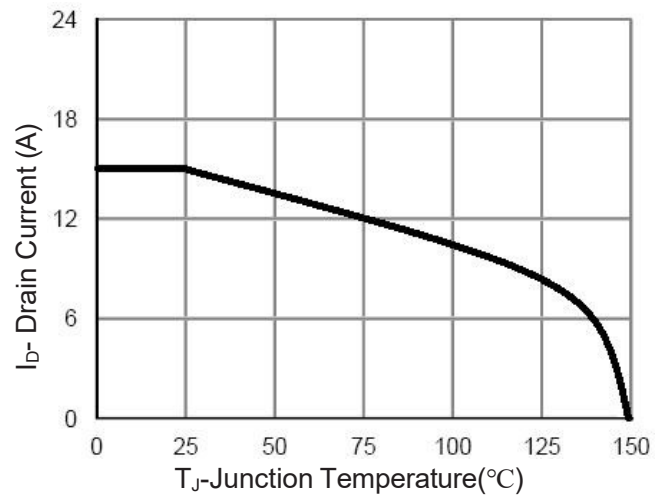
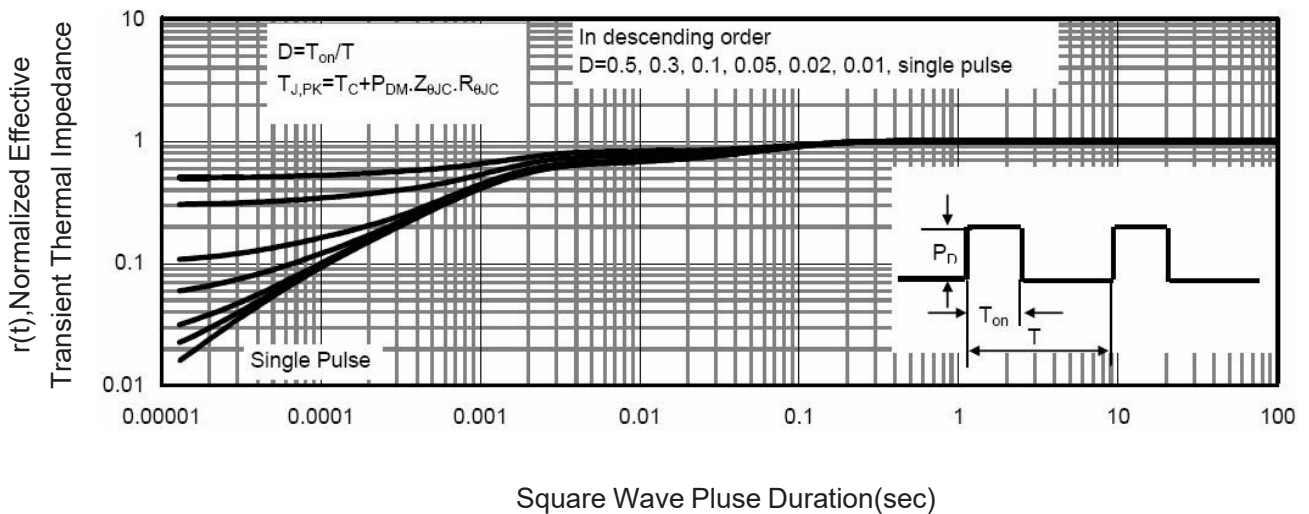
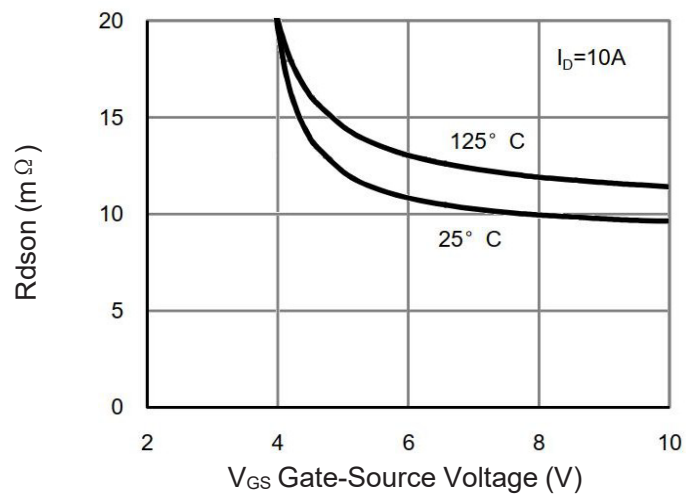


Figure 6 Source- Drain Diode Forward


Figure 7 Capacitance vs Vds

Figure 9 Power De-rating

Figure 8 Safe Operation Area

Figure 10 I_D Current De-rating

Figure 11 Normalized Maximum Transient Thermal Impedance

**Figure 12 $R_{ds(on)}$ vs V_{GS}**

Q2 Electrical Characteristics (TC=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	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} =±20V, V _{DS} =0V	-	-	±100	nA
On Characteristics (Note 3)						
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	1.0	1.5	2.2	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =10A	-	6.4	8.2	mΩ
		V _{GS} =4.5V, I _D =10A	-	10.0	13.0	mΩ
Gate resistance	R _g	V _{DS} =0V, V _{GS} =0V, F=1.0MHz	0.7	2.1	3.6	Ω
Forward Transconductance	g _{FS}	V _{DS} =5V, I _D =10A	-	15	-	S
Dynamic Characteristics (Note4)						
Input Capacitance	C _{iss}	V _{DS} =15V, V _{GS} =0V, F=1.0MHz	-	960	-	pF
Output Capacitance	C _{oss}		-	157	-	pF
Reverse Transfer Capacitance	C _{rss}		-	140	-	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 =10A, V _{GS} =10V	-	24		nC
Gate-Source Charge	Q _{gs}		-	3		nC
Gate-Drain Charge	Q _{gd}		-	6		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		-	-	20	A
Reverse Recovery Time	t _{rr}	TJ = 25°C, IF =10A	-	19	-	nS
Reverse Recovery Charge	Q _{rr}	di/dt = 100A/μs(Note3)	-	10	-	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
5. EAS condition : $T_J=25^\circ C, V_{DD}=15V, V_G=10V, L=0.5mH, R_g=25\Omega$

Q2Typical Electrical and Thermal Characteristics (Curves)

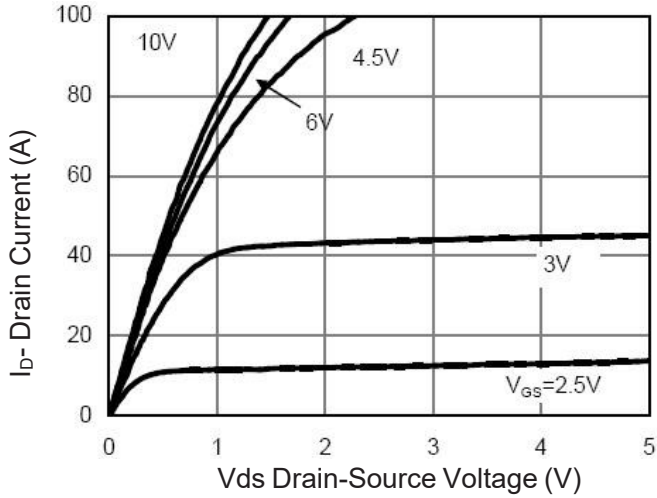


Figure 1 Output Characteristics

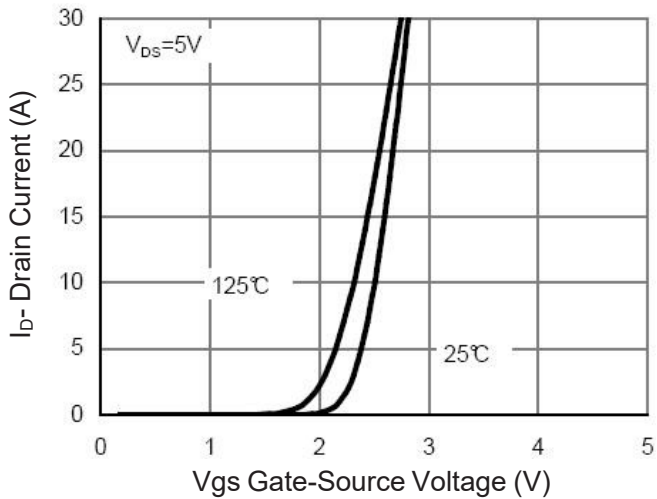


Figure 2 Transfer Characteristics

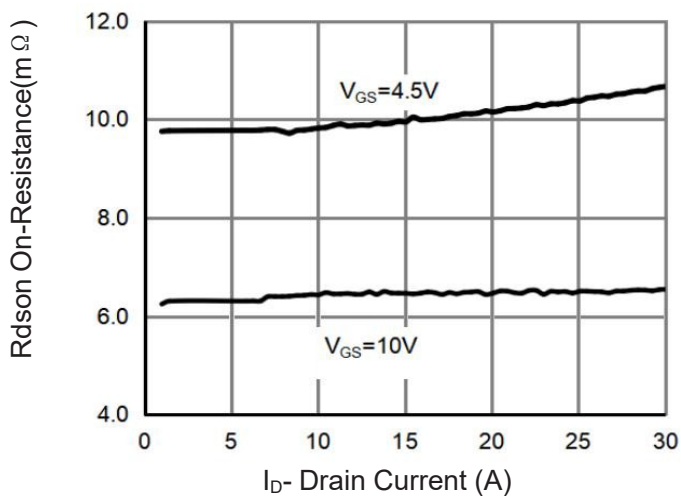


Figure 3 $R_{DS(on)}$ - Drain Current

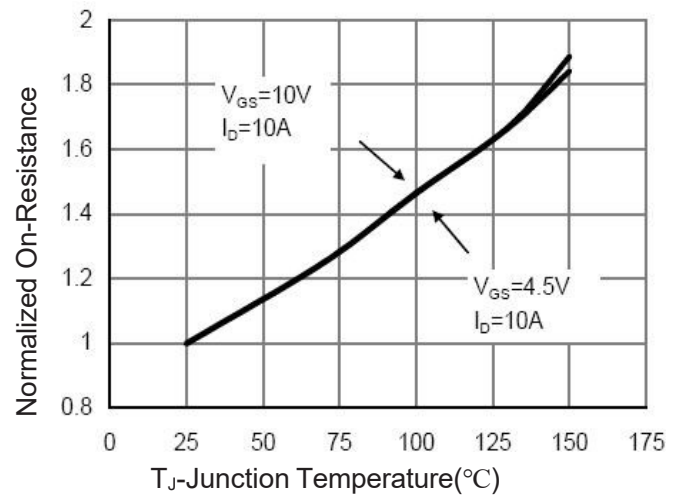


Figure 4 $R_{DS(on)}$ -Junction Temperature

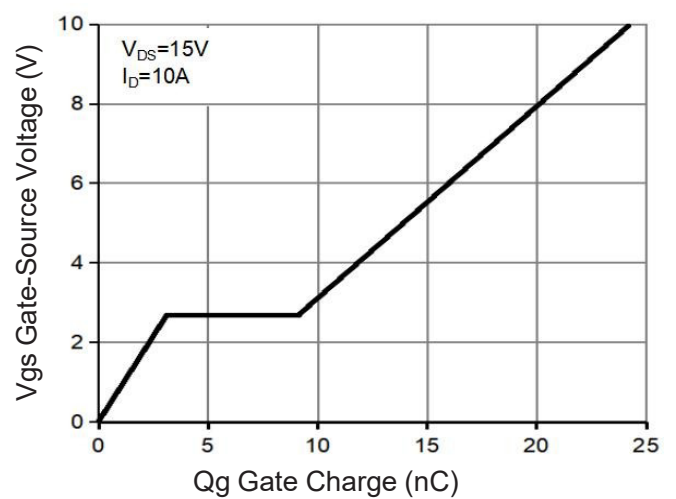


Figure 5 Gate Charge

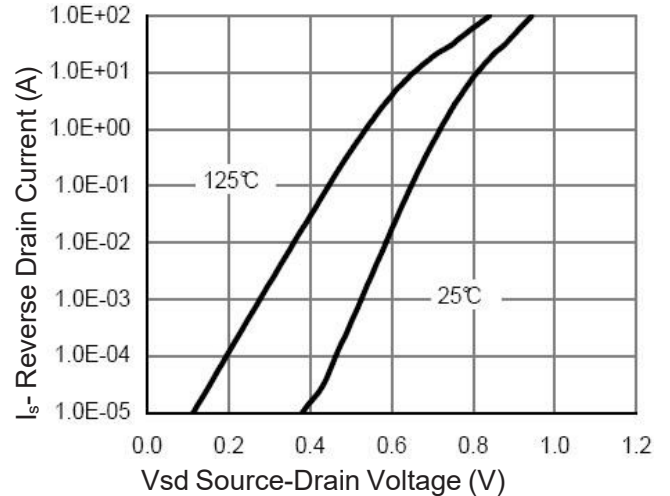
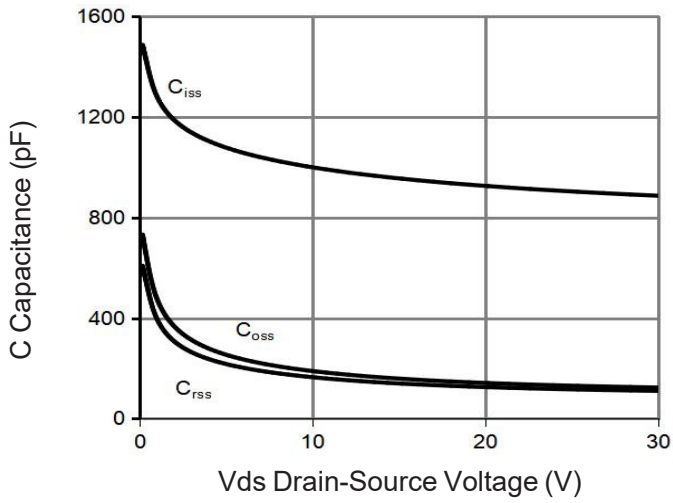
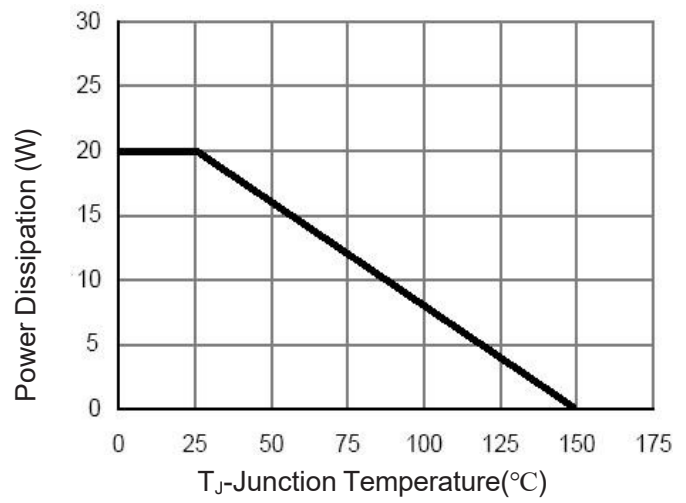
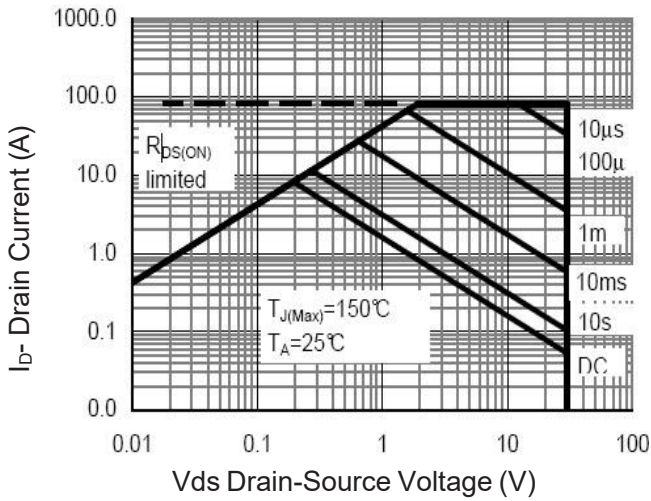
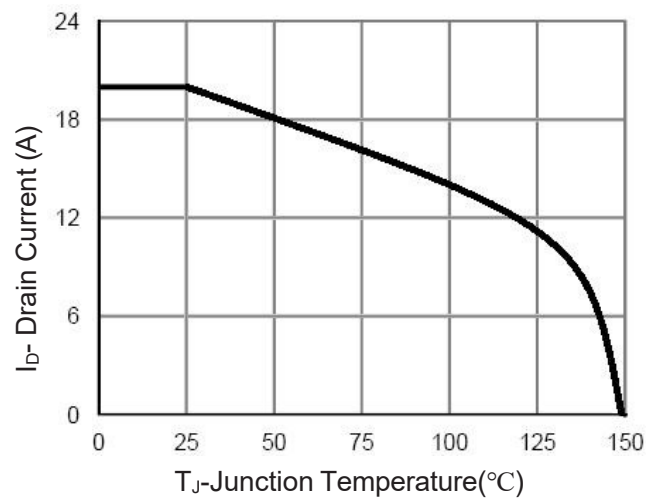
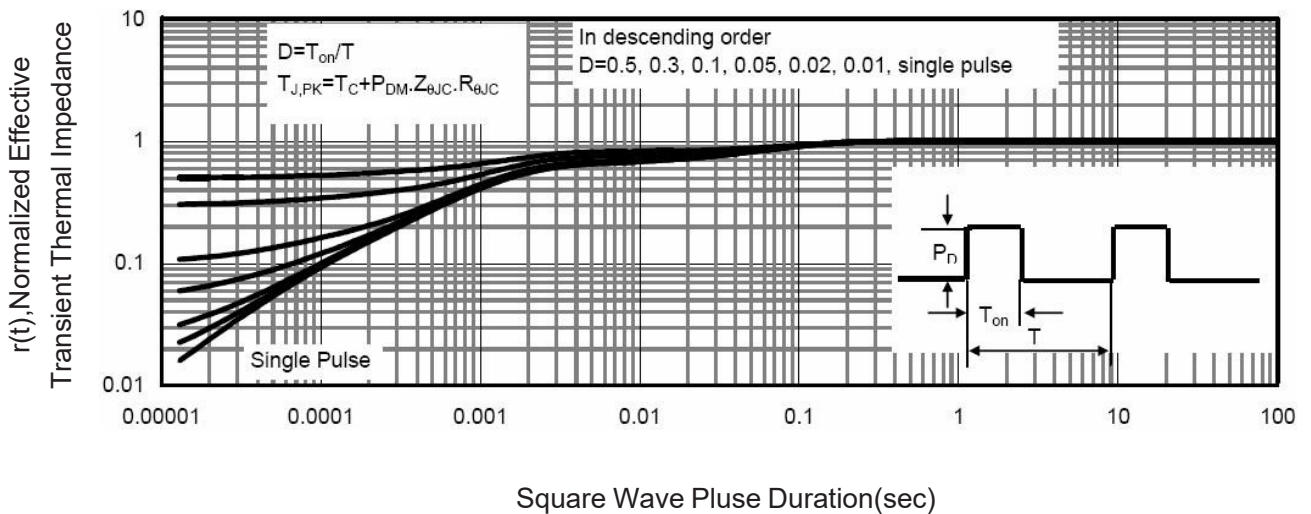
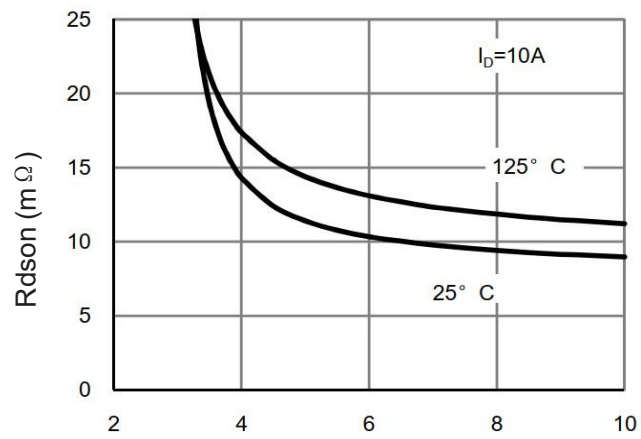


Figure 6 Source- Drain Diode Forward


Figure 7 Capacitance vs Vds

Figure 9 Power De-rating

Figure 8 Safe Operation Area

Figure 10 I_D Current De-rating

Figure 11 Normalized Maximum Transient Thermal Impedance



Vgs Gate-Source Voltage (V)
Figure 12 Rdson vs Vgs