

Features

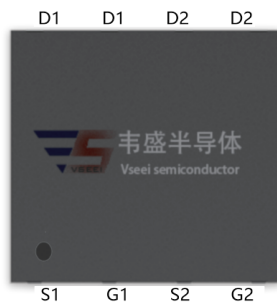
- Excellent $R_{DS(ON)}$ and Low Gate Charge
- 100% UIS Tested
- 100% ΔV_{DS} Tested
- Halogen-free; RoHS-compliant
- Pb-free plating

Applications

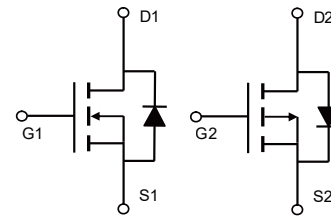
- Load Switch
- PWM Application
- Power Management

Product Summary

Parameters	N	P	Unit
V_{DSS}	40	-40	V
$V_{GS(th)_{Typ}}$	1.7	-1.7	V
$I_D(@V_{GS}=10V)$	14	-14	A
$R_{DS(ON)_{Typ}}(@V_{GS}=10V)$	16	32	$m\Omega$
$R_{DS(ON)_{Typ}}(@V_{GS}=4.5V)$	21	38	$m\Omega$



DFN3x3



Schematic

Ordering Information

Device	Marking	MSL	Form	Package	Reel(pcs)	Per Carton (pcs)
VSM14NP04-D33	VSM14NP04	1	Tape&Reel	DFN3x3	5000	50000

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

Symbol	Parameter	Value-N	Value-P	Unit
V_{DS}	Drain-to-Source Voltage	40	-40	V
V_{GS}	Gate-to-Source Voltage	± 20		V
I_D	Continuous Drain Current	$T_C = 25^\circ\text{C}$	14	A
		$T_C = 100^\circ\text{C}$	9	
I_{DM}	Pulsed Drain Current ⁽¹⁾	Refer to Fig.4		A
E_{AS}	Single Pulsed Avalanche Energy ⁽²⁾	21	21	mJ
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$	26	W
		$T_C = 100^\circ\text{C}$	10	
T_J, T_{STG}	Junction & Storage Temperature Range	-55 to 150		$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	Max		Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient ⁽³⁾	72	68	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case	4.8	4.8	

Electrical Characteristics-N(T_J = 25°C unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
V _{(BR)DSS}	Drain-Source Breakdown Voltage	I _D = 250 μA, V _{GS} = 0V	40	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 40V, V _{GS} = 0V	-	-	1.0	μA
I _{GSS}	Gate-Body Leakage Current	V _{DS} = 0V, V _{GS} = ±20V	-	-	±100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = 250 μA	1.2	1.7	2.2	V
R _{DS(ON)}	Static Drain-Source ON-Resistance ⁽⁴⁾	V _{GS} = 10V, I _D = 14A	-	16	22	mΩ
		V _{GS} = 4.5V, I _D = 10A	-	21	28	mΩ
Dynamic Characteristics						
R _g	Gate Resistance	f = 1MHz	-	2.5	-	Ω
C _{iss}	Input Capacitance	V _{GS} = 0V, V _{DS} = 20V, f = 1MHz	796	1114	1504	pF
C _{oss}	Output Capacitance		53	75	101	pF
C _{rss}	Reverse Transfer Capacitance		43	61	82	pF
Q _g	Total Gate Charge	V _{GS} = 0 to 10V V _{DS} = 20V, I _D = 5A	16	22	29	nC
Q _{gs}	Gate Source Charge		-	4.2	-	nC
Q _{gd}	Gate Drain("Miller") Charge		-	3.9	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GS} = 10V, V _{DD} = 20V I _D = 5A, R _{GEN} =2.7 Ω	-	6	-	ns
t _r	Turn-On Rise Time		-	6	-	ns
t _{d(off)}	Turn-Off DelayTime		-	24	-	ns
t _f	Turn-Off Fall Time		-	3	-	ns
Body Diode Characteristics						
I _S	Maximum Continuous Body Diode Forward Current		-	-	14	A
I _{SM}	Maximum Pulsed Body Diode Forward Current		-	-	57	A
V _{SD}	Body Diode Forward Voltage	V _{GS} = 0V, I _S = 14A	-		1.2	V
t _{rr}	Body Diode Reverse Recovery Time	I _F = 5A, di/dt = 100A/us	-	10	-	ns
Q _{rr}	Body Diode Reverse Recovery Charge		-	4.8	-	nC

Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
2. E_{AS} condition: Starting T_J=25C, V_{DD}=20V, V_{GS}=10V, R_G=25ohm, L=0.5mH, I_{AS}=9.1A, V_{DD}=0V during time in avalanche.
3. R_{θJA} is measured with the device mounted on a 1inch² pad of 2oz copper FR4 PCB.
4. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%.

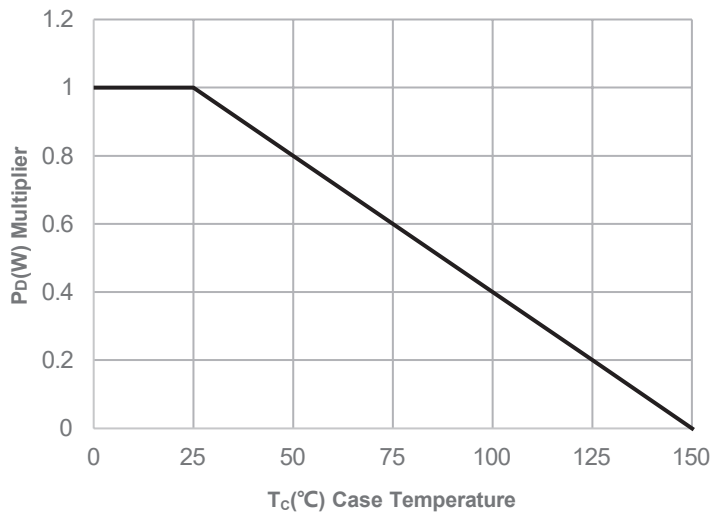
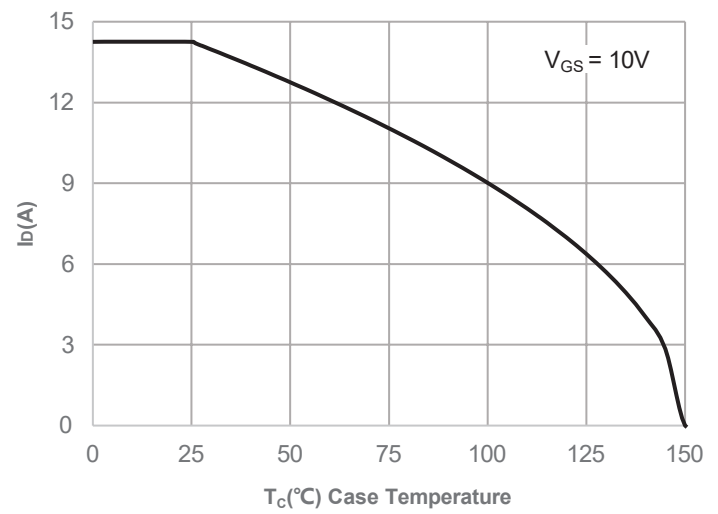
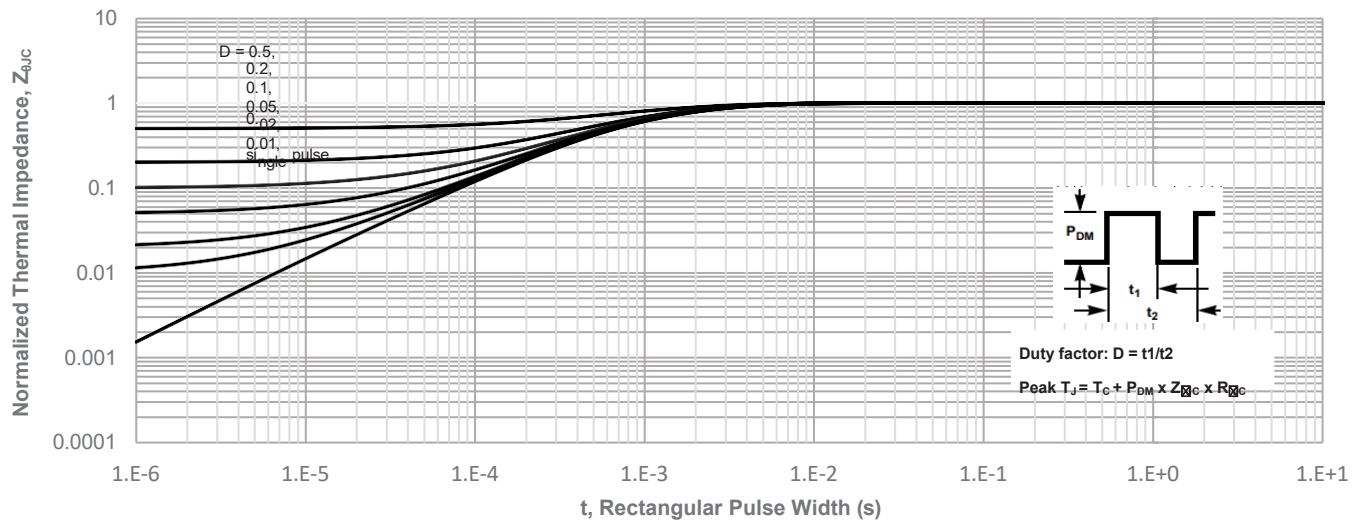
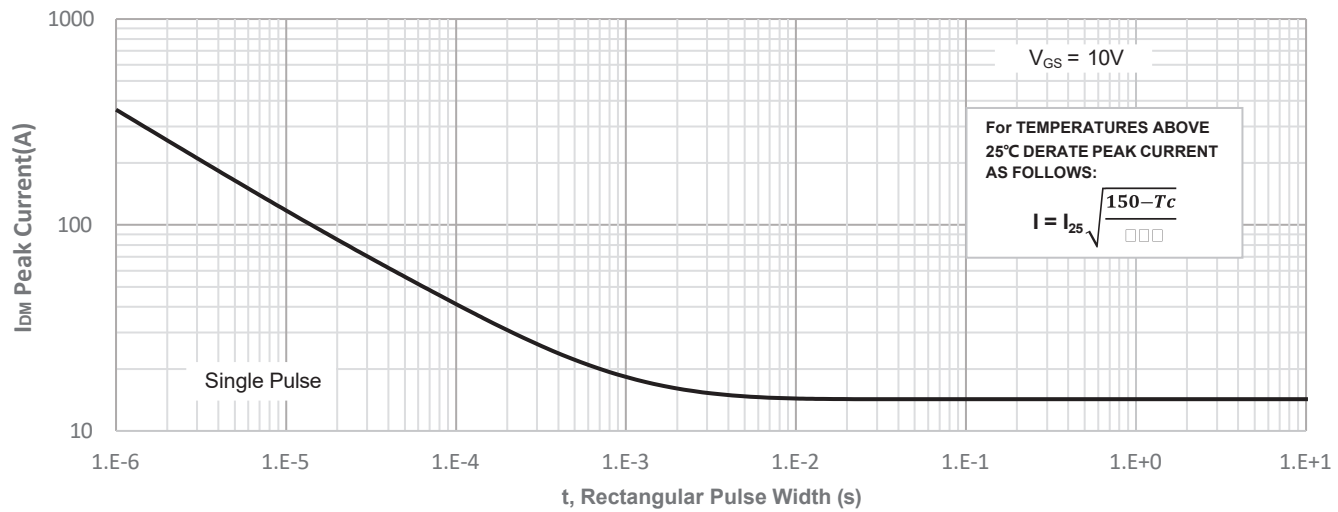
Electrical Characteristics-P ($T_J = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Off Characteristics						
V _{(BR)DSS}	Drain-Source Breakdown Voltage	I _D = -250 μA, V _{GS} = 0V	-40	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = -40V, V _{GS} = 0V	-	-	-1.0	μA
I _{GSS}	Gate-Body Leakage Current	V _{DS} = 0V, V _{GS} = ±20V	-	-	±100	nA
On Characteristics						
V _{GS(th)}	Gate Threshold Voltage	V _{DS} = V _{GS} , I _D = -250 μA	-1.2	-1.7	-2.2	V
R _{DS(ON)}	Static Drain-Source ON-Resistance ⁽⁴⁾	V _{GS} = -10V, I _D = -14A	-	32	50	mΩ
		V _{GS} = -4.5V, I _D = -10A	-	38	70	mΩ
Dynamic Characteristics						
R _g	Gate Resistance	f = 1MHz	-	12	-	Ω
C _{iss}	Input Capacitance	V _{GS} = 0V, V _{DS} = -20V, f = 1MHz	827	1157	1562	pF
C _{oss}	Output Capacitance		64	89	120	pF
C _{rss}	Reverse Transfer Capacitance		52	73	99	pF
Q _g	Total Gate Charge	V _{GS} = 0 to -10V V _{DS} = -20V, I _D = -5A	16	22	30	nC
Q _{gs}	Gate Source Charge		-	3.7	-	nC
Q _{gd}	Gate Drain("Miller") Charge		-	4	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GS} = -10V, V _{DD} = -20V I _D = -5A, R _{GEN} = 2.7 Ω	-	4.6	-	ns
t _r	Turn-On Rise Time		-	1.8	-	ns
t _{d(off)}	Turn-Off DelayTime		-	58	-	ns
t _f	Turn-Off Fall Time		-	27	-	ns
Body Diode Characteristics						
I _S	Maximum Continuous Body Diode Forward Current		-	-	-4	A
I _{SM}	Maximum Pulsed Body Diode Forward Current		-	-	-14	A
V _{SD}	Body Diode Forward Voltage	V _{GS} = 0V, I _S = -14A	-		-1.2	V
trr	Body Diode Reverse Recovery Time	I _F = -5A, di/dt = 100A/us	9	12	17	ns
Qrr	Body Diode Reverse Recovery Charge		-	6.6	-	nC

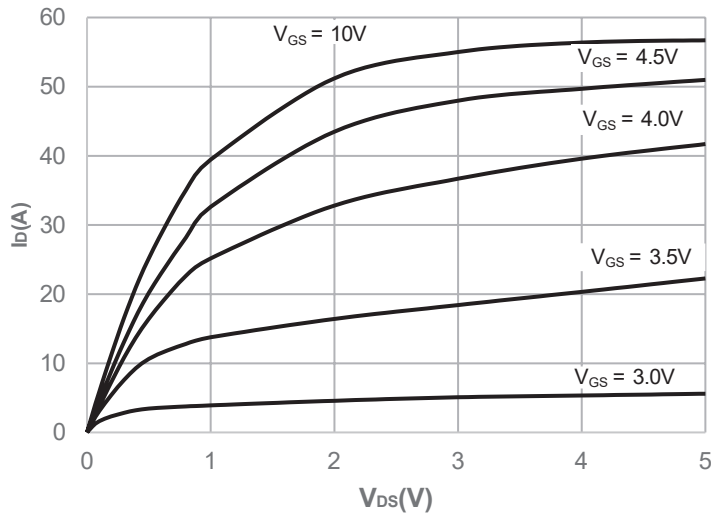
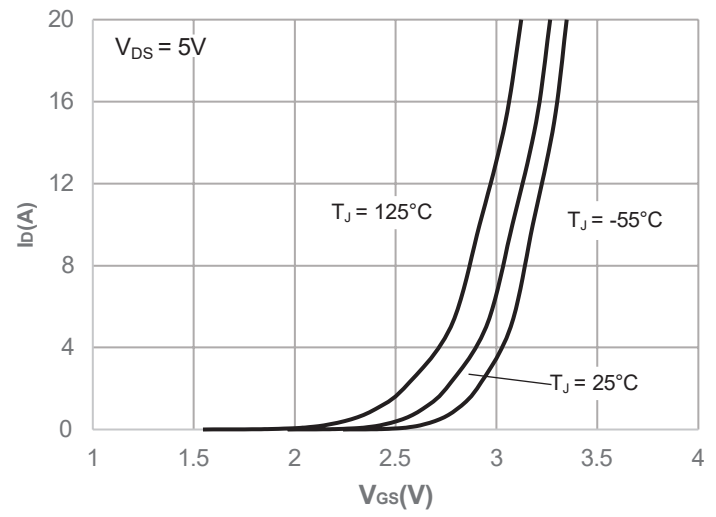
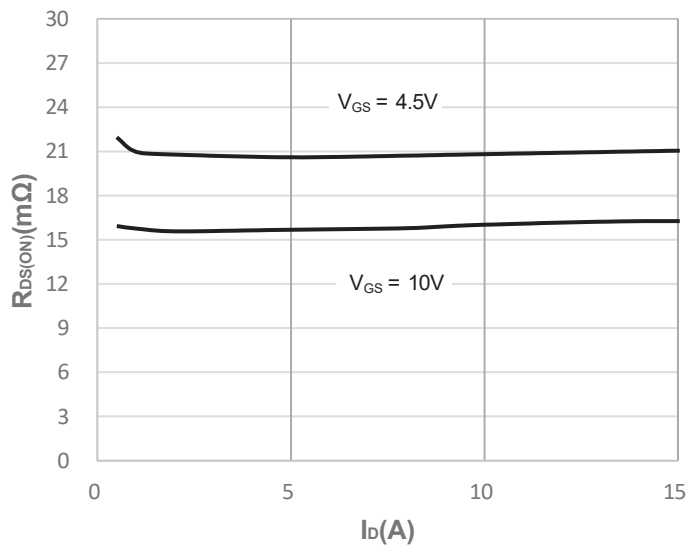
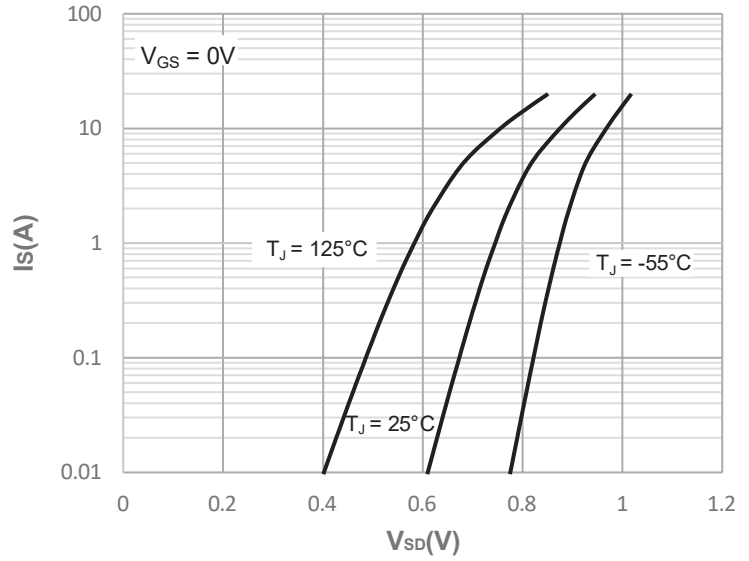
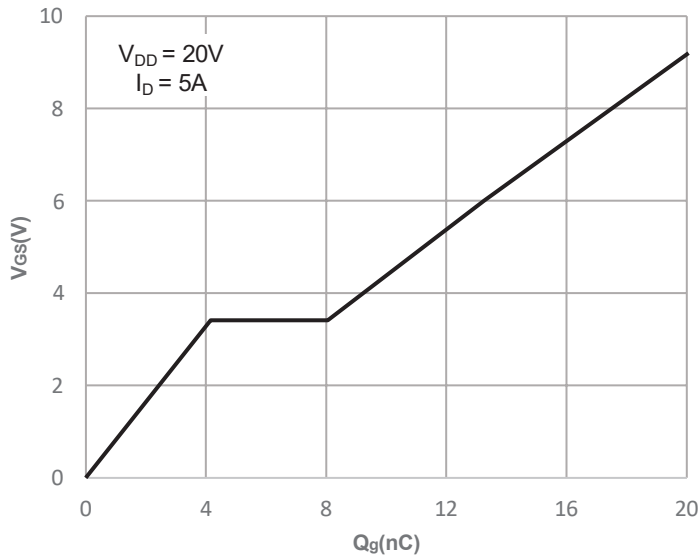
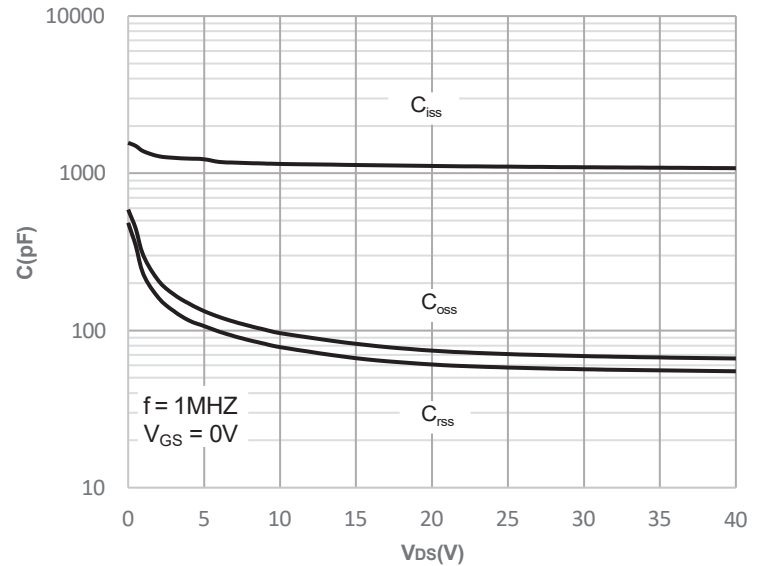
Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
2. E_{AS} condition: Starting $T_J = 25^\circ\text{C}$, $V_{DD} = -20\text{V}$, $V_{GS} = -10\text{V}$, $R_G = 25\text{ohm}$, $L = 0.5\text{mH}$, $I_{AS} = -9.1\text{A}$, $V_{DD} = 0\text{V}$ during time in avalanche.
3. $R_{\theta JA}$ is measured with the device mounted on a minimum recommended pad of 2oz copper FR4 PCB.
4. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 0.5\%$.

Typical Performance Characteristics-N

Figure 1: Power De-rating

Figure 2: Current De-rating

Figure 3: Normalized Maximum Transient Thermal Impedance

Figure 4: Peak Current Capacity


Typical Performance Characteristics-N

Figure 5: Output Characteristics

Figure 6: Typical Transfer Characteristics

Figure 7: On-resistance vs. Drain Current

Figure 8: Body Diode Characteristics

Figure 9: Gate Charge Characteristics

Figure 10: Capacitance Characteristics


Typical Performance Characteristics-N

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

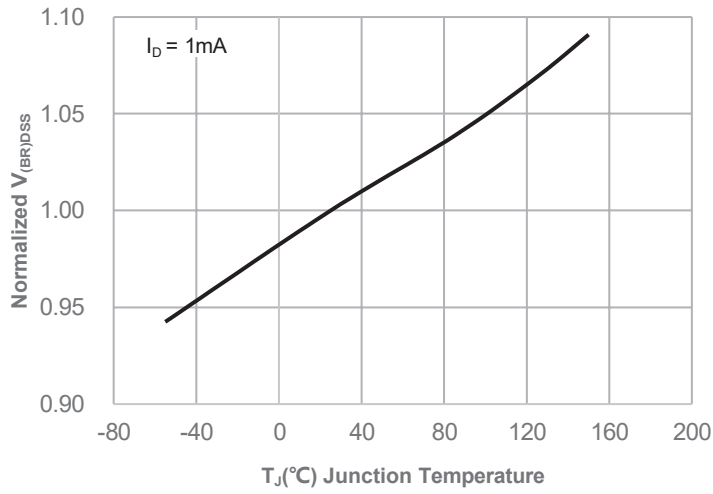


Figure 12: Normalized on Resistance vs. Junction Temperature

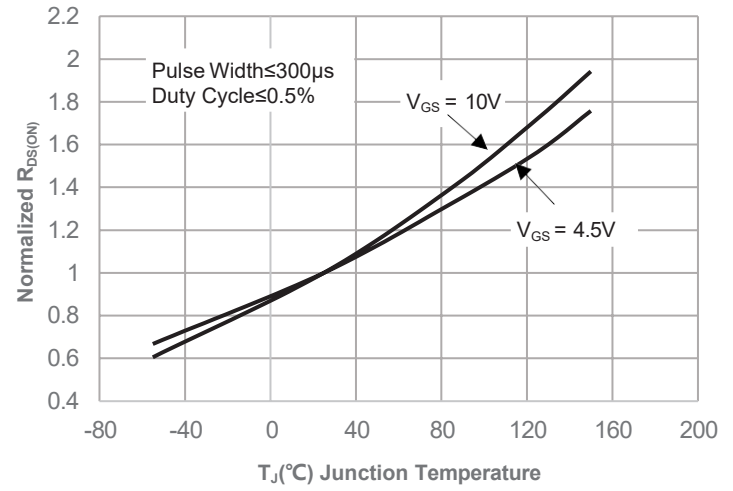


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

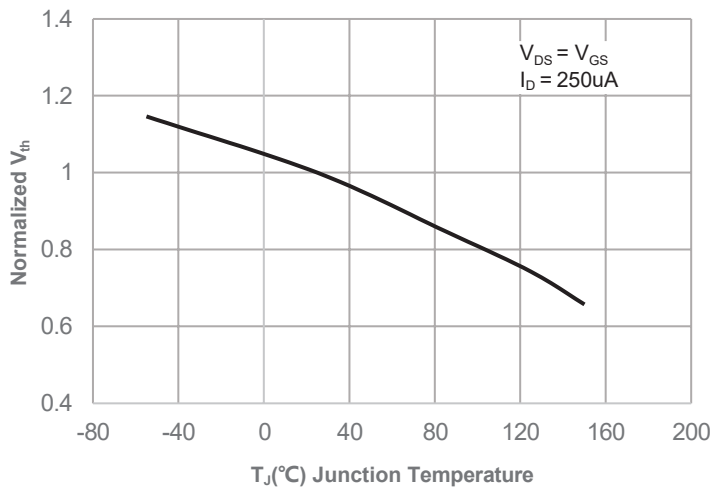


Figure 14: $R_{DS(ON)}$ vs. V_{GS}

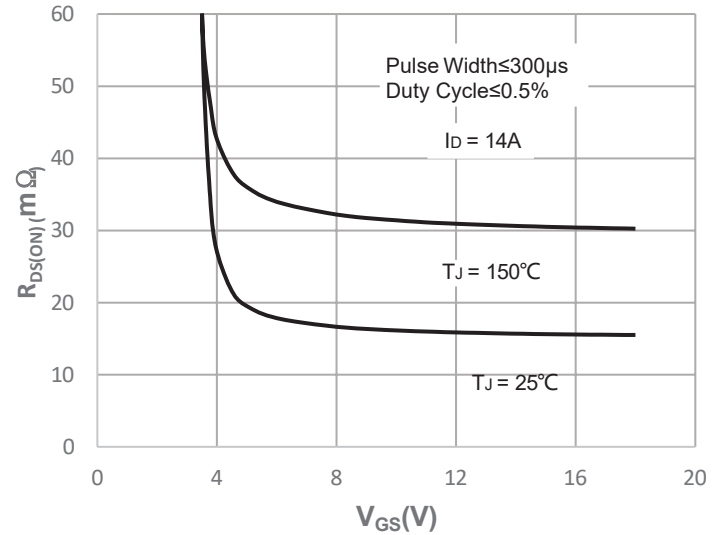
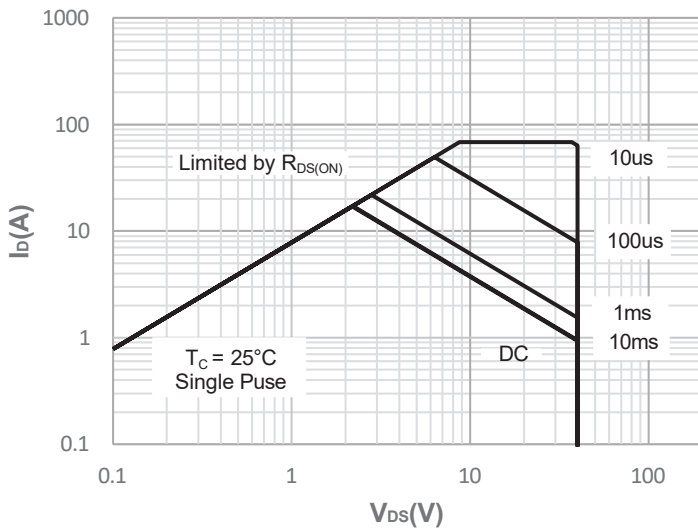
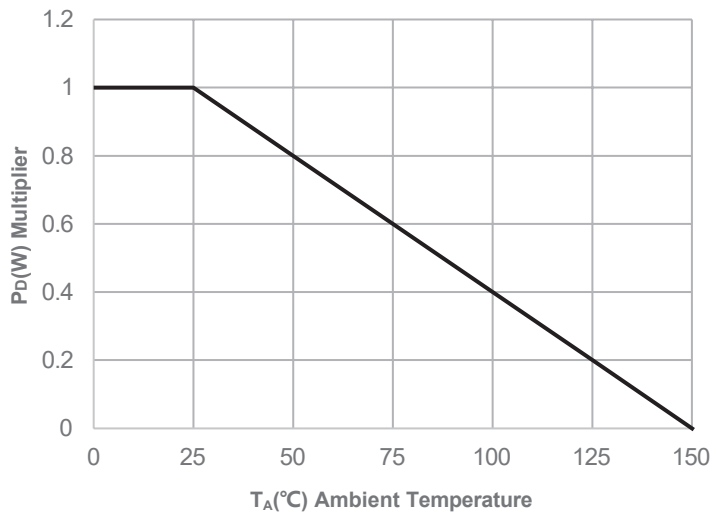
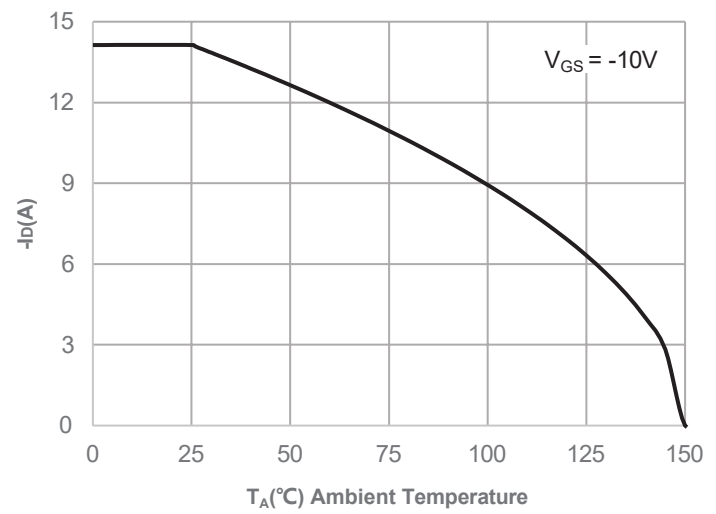
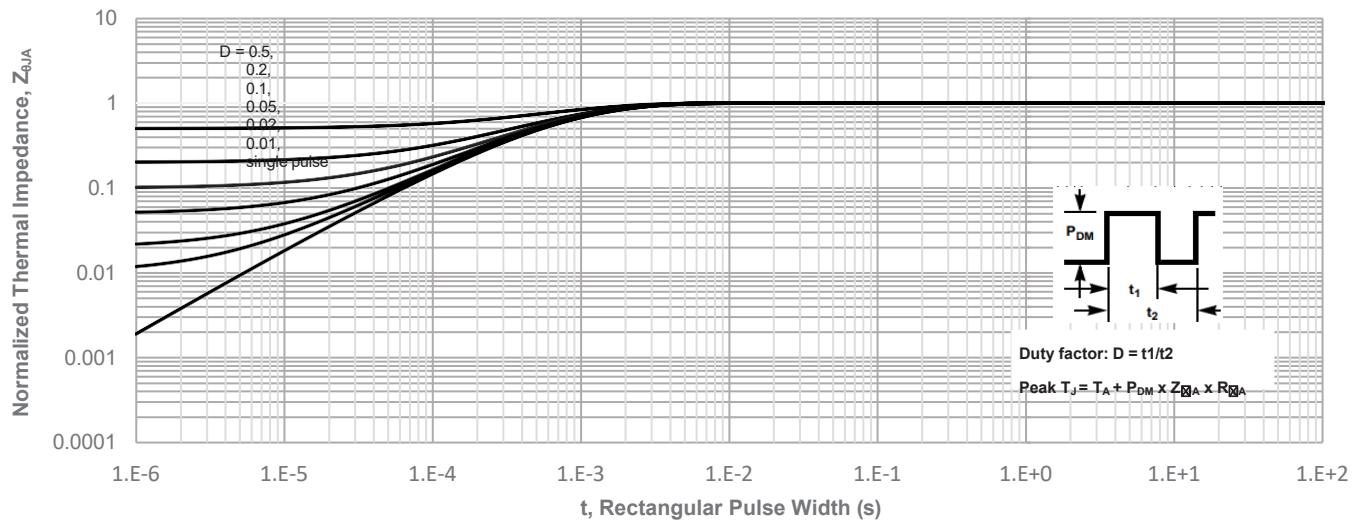
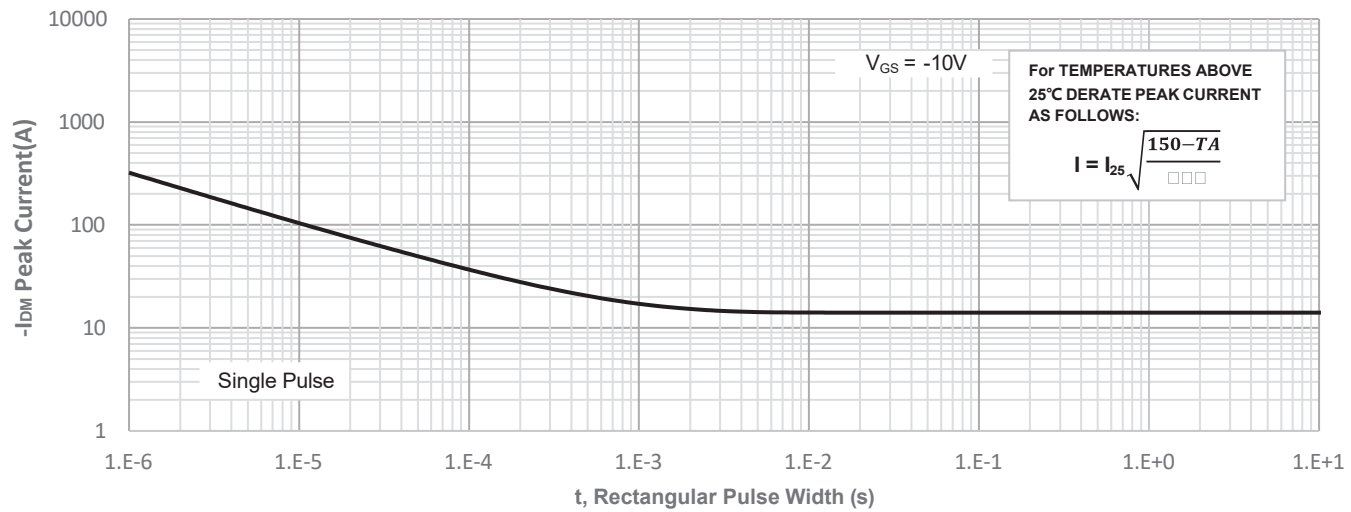


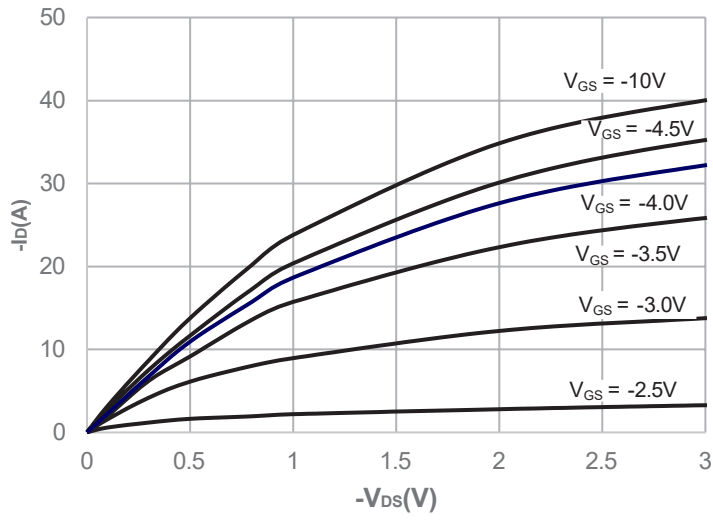
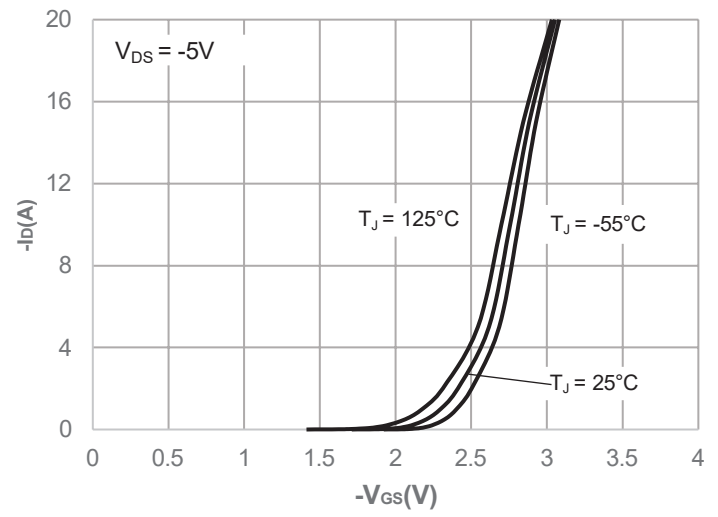
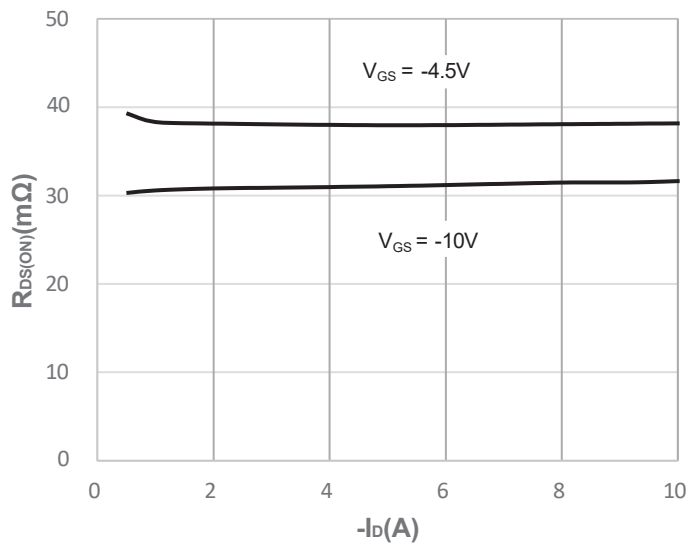
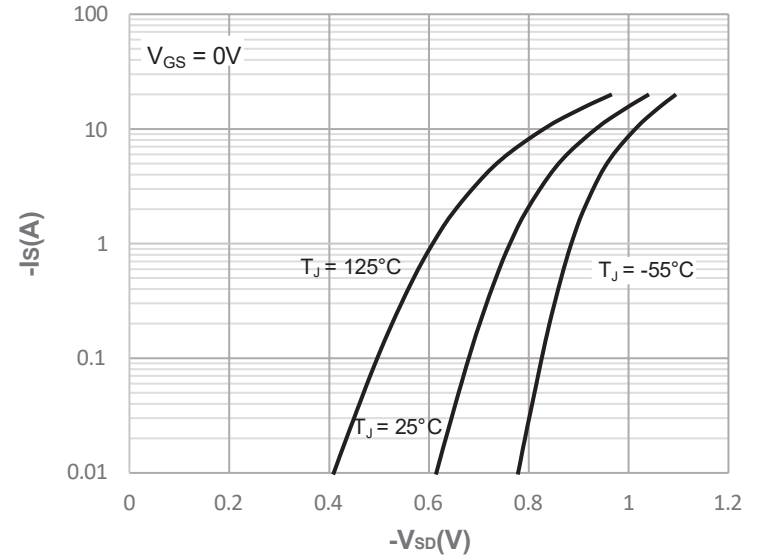
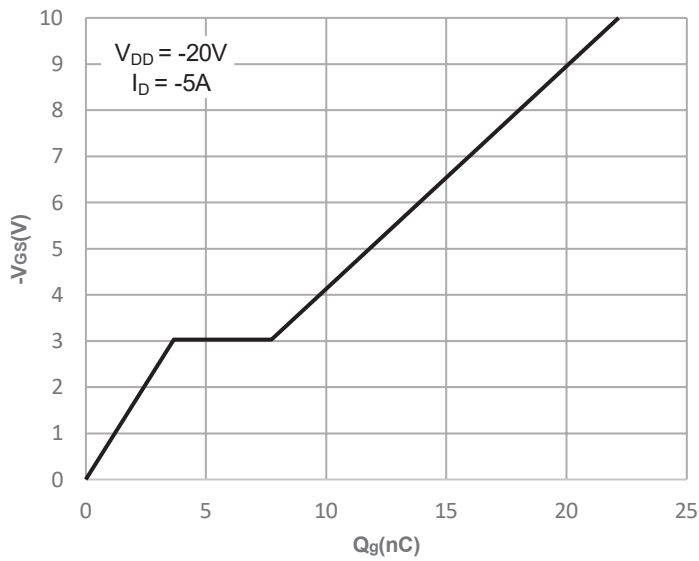
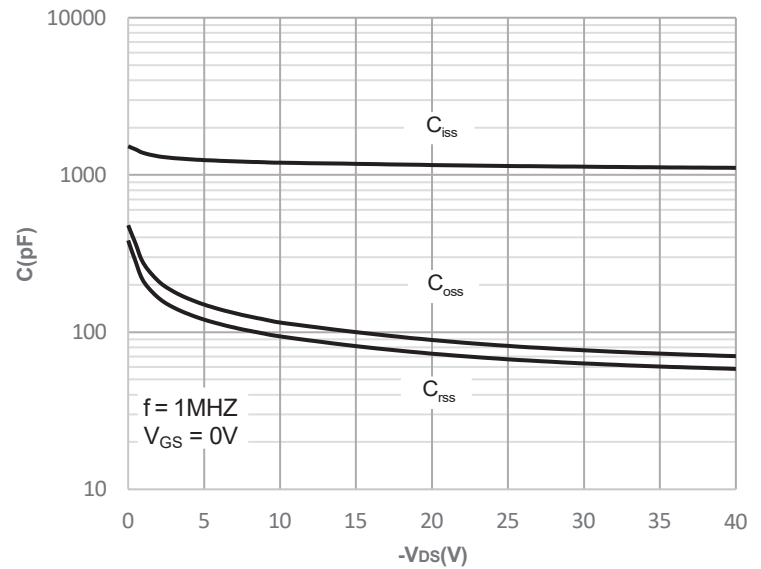
Figure 15: Maximum Safe Operating Area



Typical Performance Characteristics-P

Figure 1: Power De-rating

Figure 2: Current De-rating

Figure 3: Normalized Maximum Transient Thermal Impedance

Figure 4: Peak Current Capacity


Typical Performance Characteristics-P

Figure 5: Output Characteristics

Figure 6: Typical Transfer Characteristics

Figure 7: On-resistance vs. Drain Current

Figure 8: Body Diode Characteristics

Figure 9: Gate Charge Characteristics

Figure 10: Capacitance Characteristics


Typical Performance Characteristics-P

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

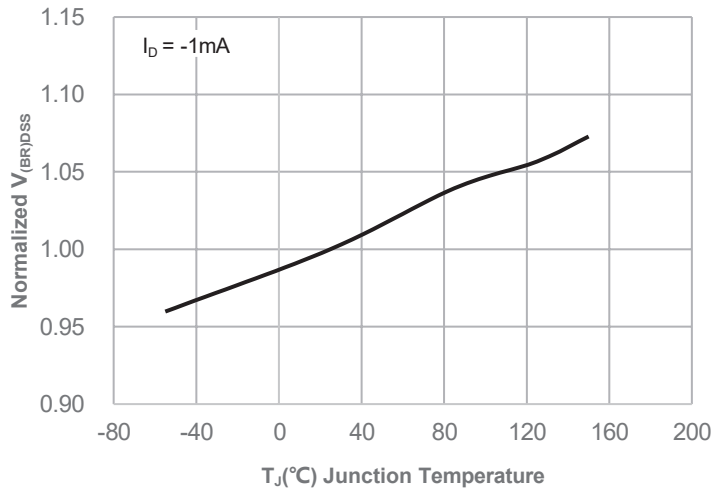


Figure 12: Normalized on Resistance vs. Junction Temperature

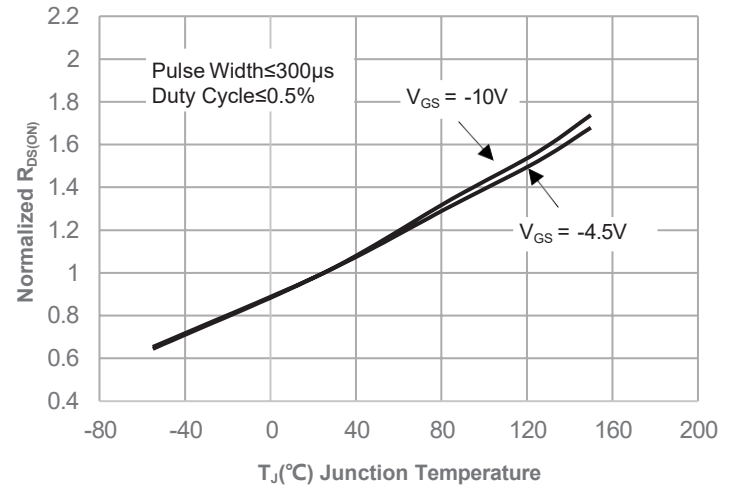


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

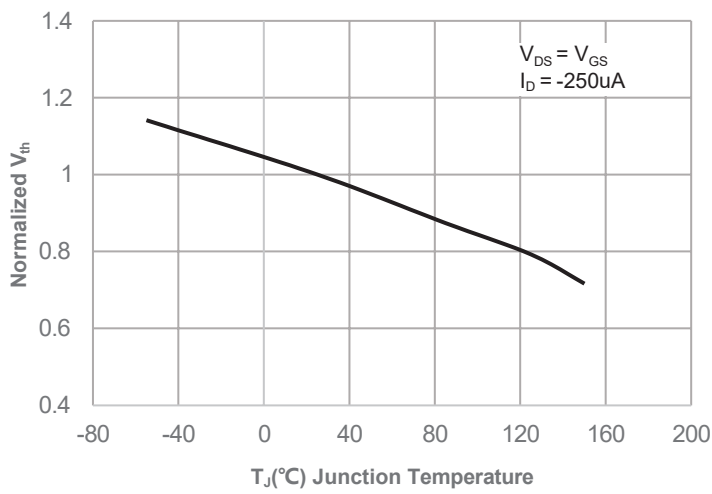


Figure 14: RDS(ON) vs. VGS

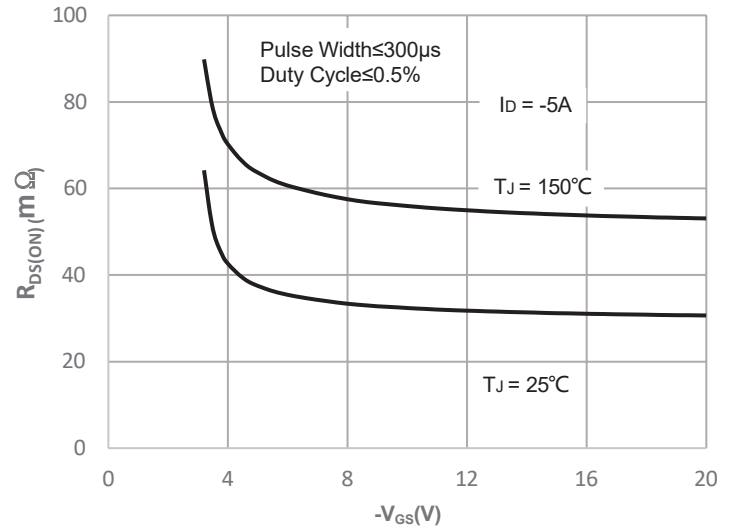
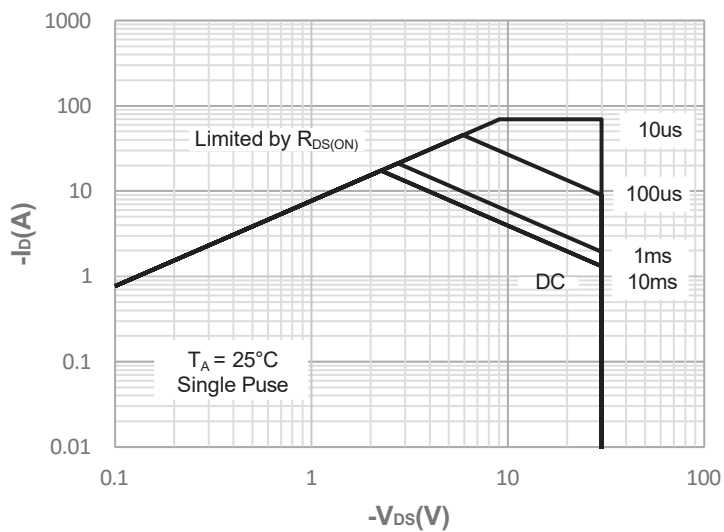


Figure 15: Maximum Safe Operating Area



Test Circuit

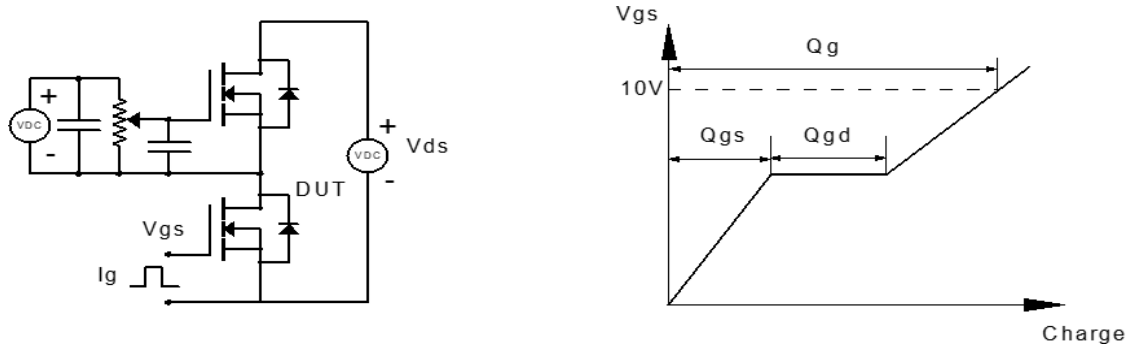


Figure 1: Gate Charge Test Circuit & Waveform

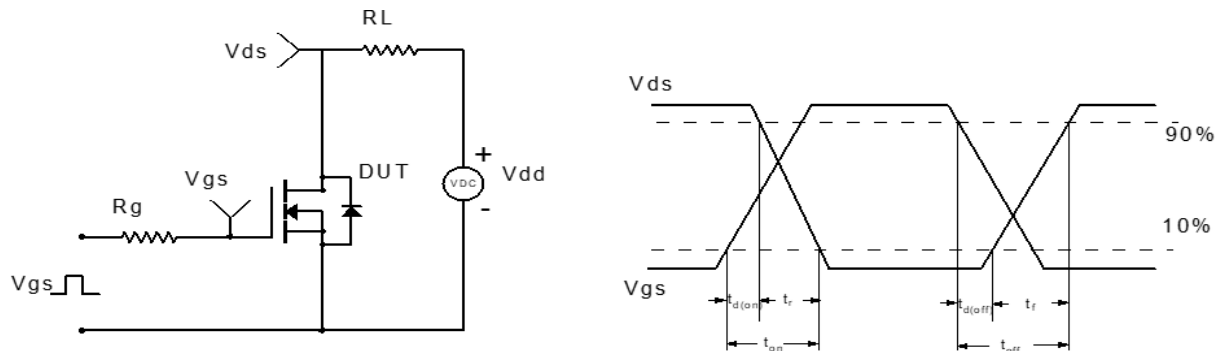


Figure 2: Resistive Switching Test Circuit & Waveform

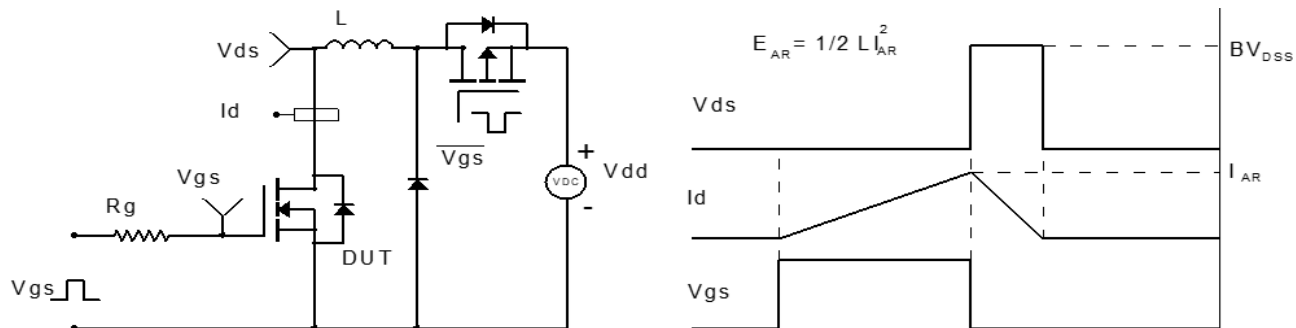


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

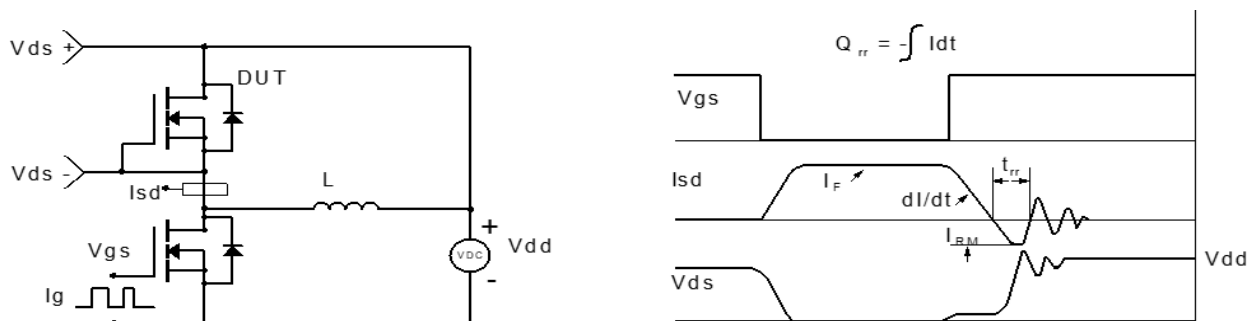
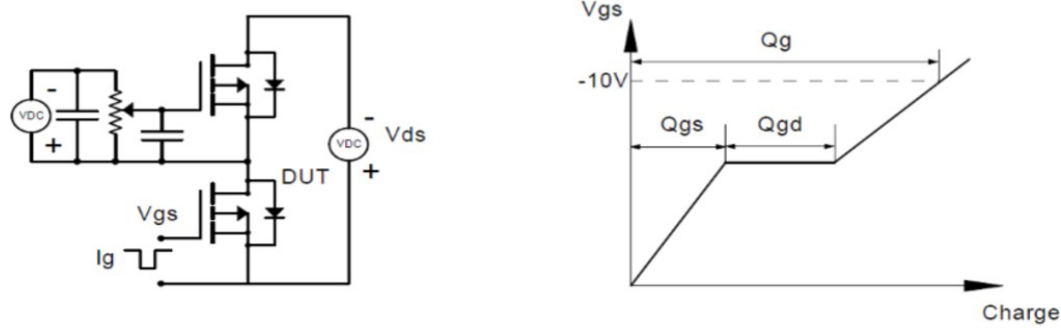
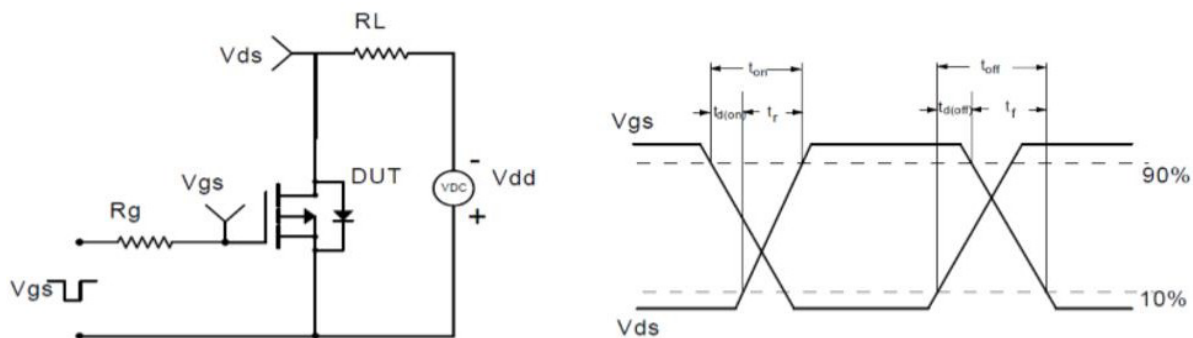
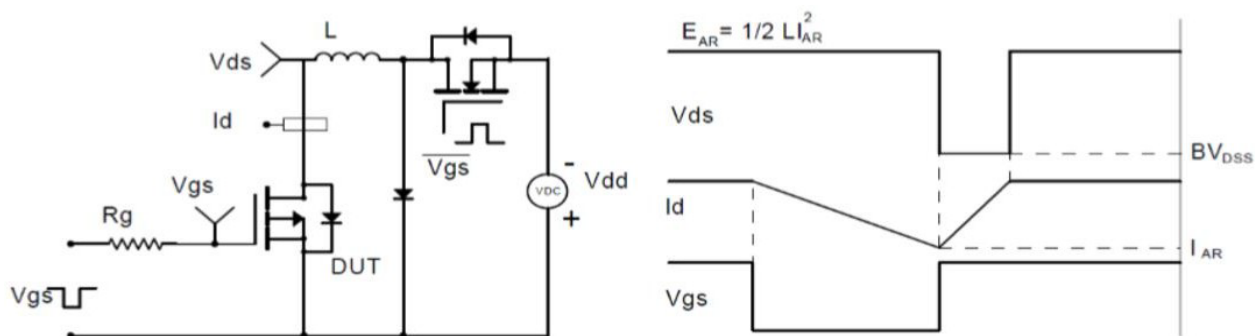
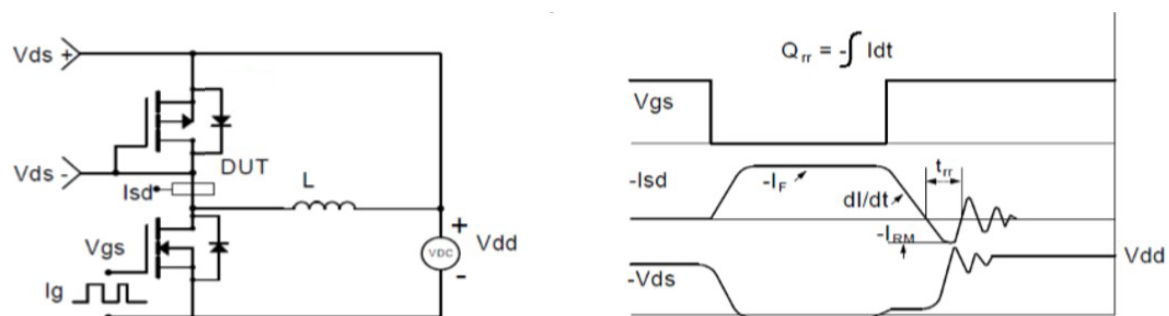


Figure 4: Diode Recovery Test Circuit & Waveform


Figure 1: Gate Charge Test Circuit & Waveform

Figure 2: Resistive Switching Test Circuit & Waveform

Figure 3: Unclamped Inductive Switching Test Circuit& Waveform

Figure 4: Diode Recovery Test Circuit & Waveform