

Features

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

Applications

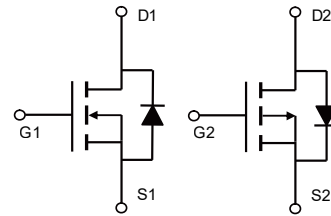
- Load Switch
- PWM Application
- Power Management

Product Summary

Parameters	N	P	Unit
V_{DSS}	40	-40	V
$V_{GS(th_Typ)}$	1.3	-1.7	V
$I_D(@V_{GS}=10V)$	29	-21	A
$R_{DS(ON_Typ)}(@V_{GS}=10V)$	14	29	$m\Omega$
$R_{DS(ON_Typ)}(@V_{GS}=4.5V)$	15	40	$m\Omega$



TO-252-4L



Schematic

Ordering Information

Device	Marking	MSL	Form	Package	Reel(pcs)	Per Carton (pcs)
VSM29NP04-T2-4	VSM29NP04	3	Tape&Reel	TO-252-4L	2500	25000

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	$T_C = 25^\circ\text{C}$ 29	-21	A
		$T_C = 100^\circ\text{C}$ 18	-14	
I_{DM}	Pulsed Drain Current ⁽¹⁾	Refer to Fig.4		A
E_{AS}	Single Pulsed Avalanche Energy ⁽²⁾	24	28	mJ
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$ 29	29	W
		$T_C = 100^\circ\text{C}$ 12	12	
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⁾	41	44	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case	4.3	4.3	

Electrical Characteristics-N($T_J = 25^{\circ}\text{C}$ 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	0.9	1.3	1.7	V
R _{DS(ON)}	Static Drain-Source ON-Resistance ⁽⁴⁾	V _{GS} = 10V, I _D = 15A	-	14	18	m Ω
		V _{GS} = 4.5V, I _D = 10A	-	15	20	m Ω
Dynamic Characteristics						
R _g	Gate Resistance	f = 1MHz	-	2.8	-	Ω
C _{iss}	Input Capacitance	V _{GS} = 0V, V _{DS} = 20V, f = 1MHz	-	1200	1620	pF
C _{oss}	Output Capacitance		-	69	93	pF
C _{rss}	Reverse Transfer Capacitance		-	58	78	pF
Q _g	Total Gate Charge	V _{GS} = 0 to 10V V _{DS} = 20V, I _D = 15A	-	26	-	nC
Q _{gs}	Gate Source Charge		-	3.8	-	nC
Q _{gd}	Gate Drain("Miller") Charge		-	4.2	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GS} = 10V, V _{DD} = 20V I _D = 15A, R _{GEN} = 3 Ω	-	6	-	ns
t _r	Turn-On Rise Time		-	19	-	ns
t _{d(off)}	Turn-Off DelayTime		-	30	-	ns
t _f	Turn-Off Fall Time		-	3	-	ns
Body Diode Characteristics						
I _S	Maximum Continuous Body Diode Forward Current		-	-	29	A
I _{SM}	Maximum Pulsed Body Diode Forward Current		-	-	115	A
V _{SD}	Body Diode Forward Voltage	V _{GS} = 0V, I _S = 15A	-		1.2	V
trr	Body Diode Reverse Recovery Time	I _F = 15A, di/dt = 100A/us	-	10	-	ns
Qrr	Body Diode Reverse Recovery Charge		-	4.9	-	nC

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
 2. E_{AS} condition: Starting $T_J = 25^{\circ}\text{C}$, $V_{DD} = 20\text{V}$, $V_{GS} = 10\text{V}$, $R_G = 25\text{ohm}$, $L = 0.5\text{mH}$, $I_{AS} = 9.8\text{A}$, $V_{DD} = 0\text{V}$ during time in avalanche.
 3. $R_{\theta JA}$ is measured with the device mounted on a 1inch² pad of 2oz copper FR4 PCB.
 4. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 0.5\%$.

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 ⁽⁵⁾	V _{GS} = -10V, I _D = -5A	-	29	37	mΩ
		V _{GS} = -4.5V, I _D = -3A	-	40	52	mΩ
Dynamic Characteristics						
R _g	Gate Resistance	f = 1MHz	-	7.2	-	Ω
C _{iss}	Input Capacitance	V _{GS} = 0V, V _{DS} = -20V, f = 1MHz	-	1173	1760	pF
C _{oss}	Output Capacitance		-	88	132	pF
C _{rss}	Reverse Transfer Capacitance		-	77	115	pF
Q _g	Total Gate Charge	V _{GS} = 0 to -10V V _{DS} = -20V, I _D = -5A	-	23	-	nC
Q _{gs}	Gate Source Charge		-	4.0	-	nC
Q _{gd}	Gate Drain("Miller") Charge		-	4.0	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GS} = -10V, V _{DD} = -20V I _D = -5A, R _{GEN} = 3 Ω	-	6.6	-	ns
t _r	Turn-On Rise Time		-	1.6	-	ns
t _{d(off)}	Turn-Off DelayTime		-	33	-	ns
t _f	Turn-Off Fall Time		-	5.9	-	ns
Body Diode Characteristics						
I _S	Maximum Continuous Body Diode Forward Current		-	-	-21	A
I _{SM}	Maximum Pulsed Body Diode Forward Current		-	-	-86	A
V _{SD}	Body Diode Forward Voltage	V _{GS} = 0V, I _S = -5A	-		-1.2	V
trr	Body Diode Reverse Recovery Time	I _F = -5A, di/dt = -100A/us	-	13	-	ns
Qrr	Body Diode Reverse Recovery Charge		-	7.6	-	nC

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
 2. E_{AS} condition: Starting $T_J=25^{\circ}\text{C}$, $V_{DD}=-20\text{V}$, $V_{GS}=-10\text{V}$, $R_G=25\text{ohm}$, $L=0.5\text{mH}$, $I_{AS}=-10.5\text{A}$, $V_{DD}=0\text{V}$ 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

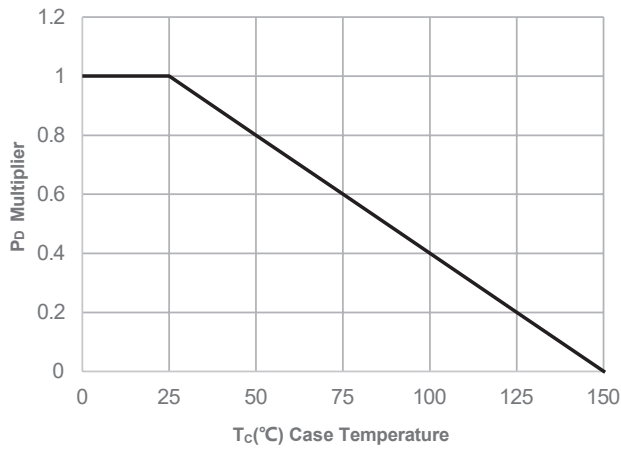


Figure 2: Current De-rating

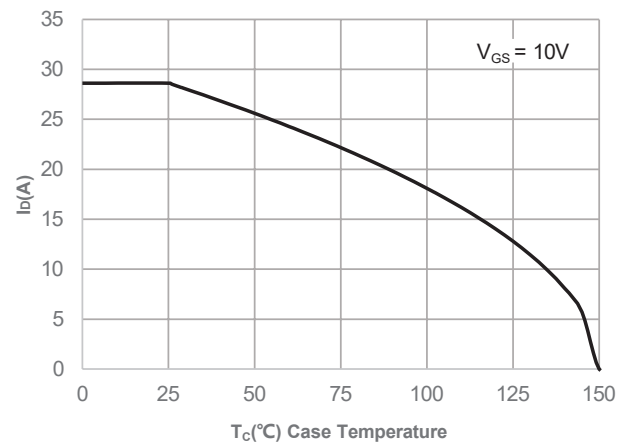


Figure 3: Normalized Maximum Transient Thermal Impedance

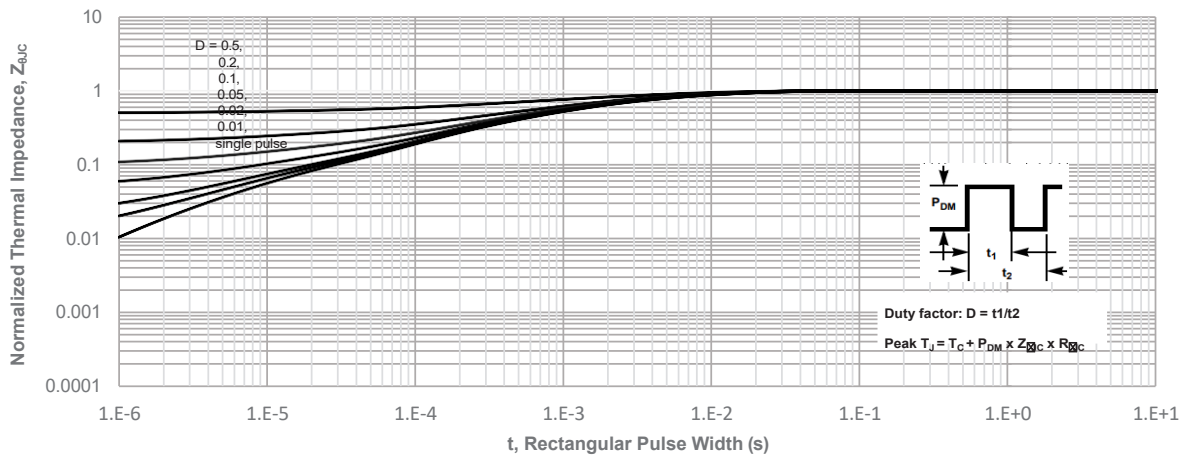
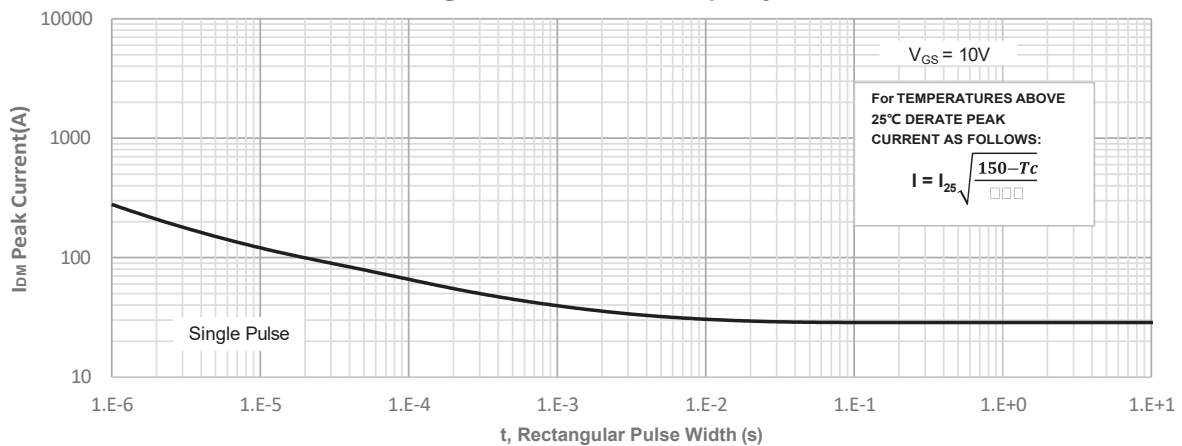


Figure 4: Peak Current Capacity



Typical Performance Characteristics-N

Figure 5: Output Characteristics

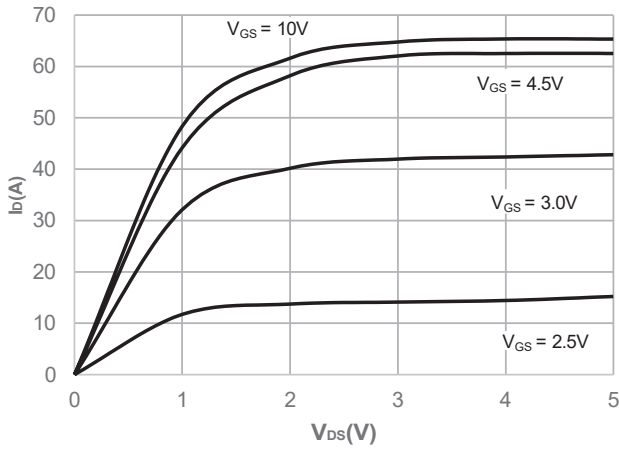


Figure 6: Typical Transfer Characteristics

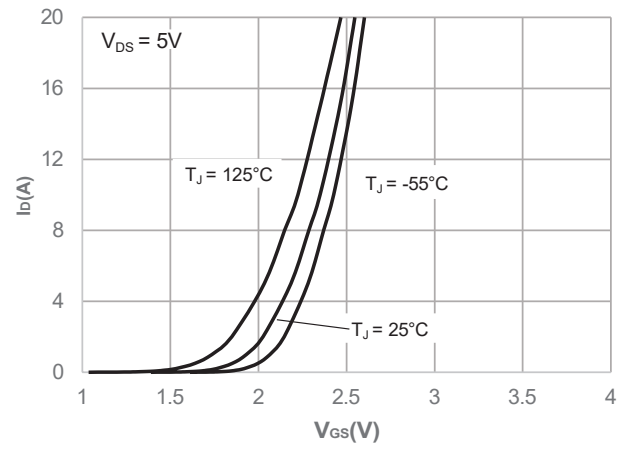


Figure 7: On-resistance vs. Drain Current

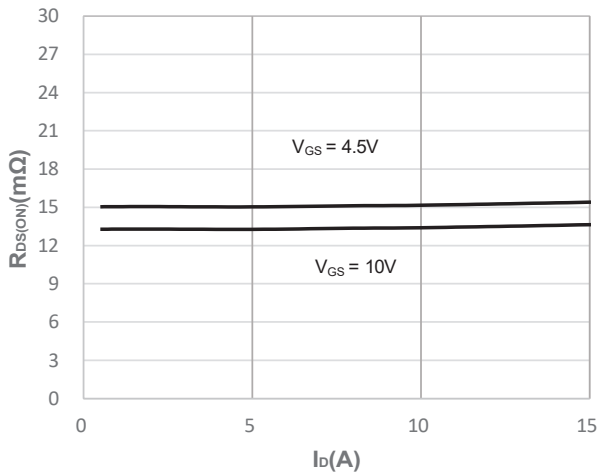


Figure 8: Body Diode Characteristics

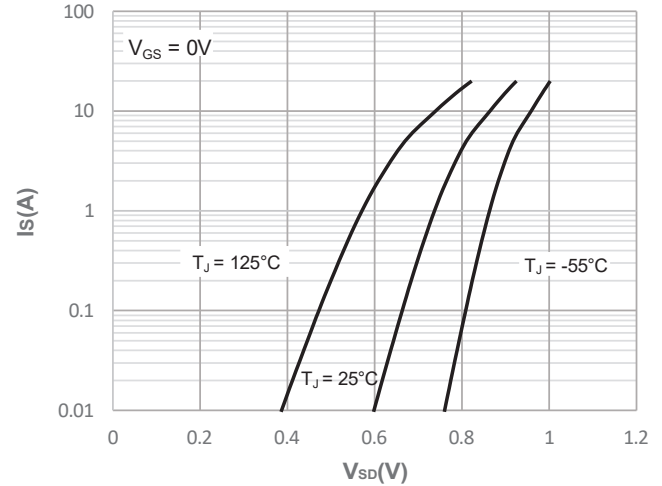


Figure 9: Gate Charge Characteristics

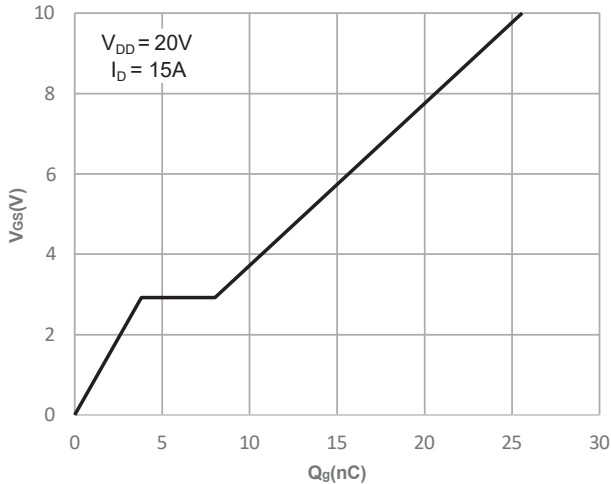
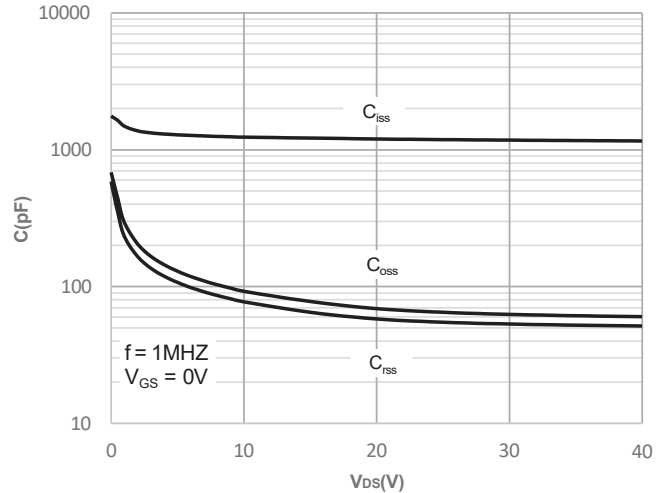


Figure 10: Capacitance Characteristics



Typical Performance Characteristics-N

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

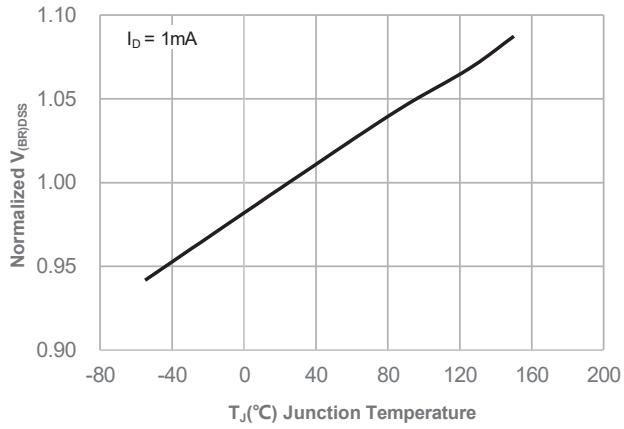


Figure 12: Normalized on Resistance vs. Junction Temperature

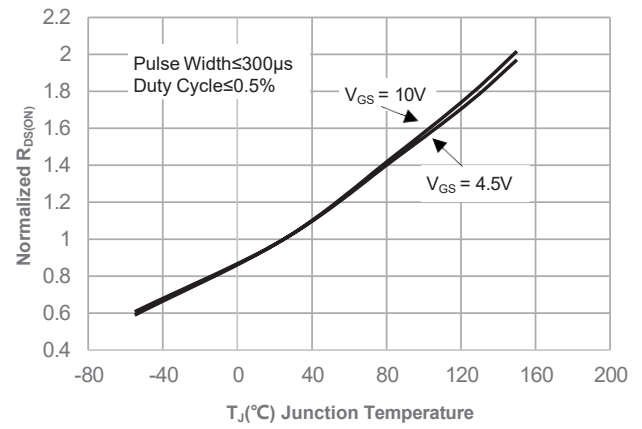


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

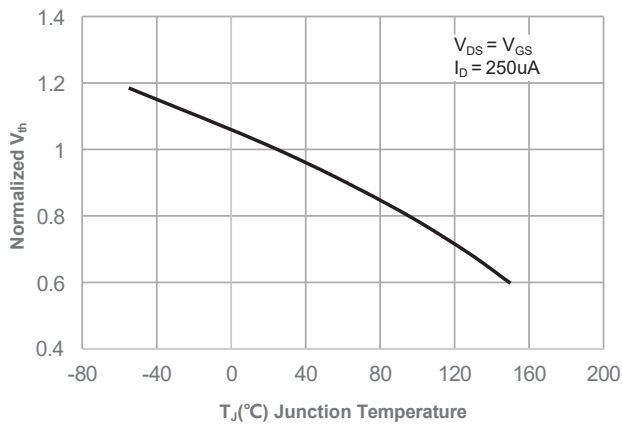


Figure 14: $R_{DS(ON)}$ vs. V_{GS}

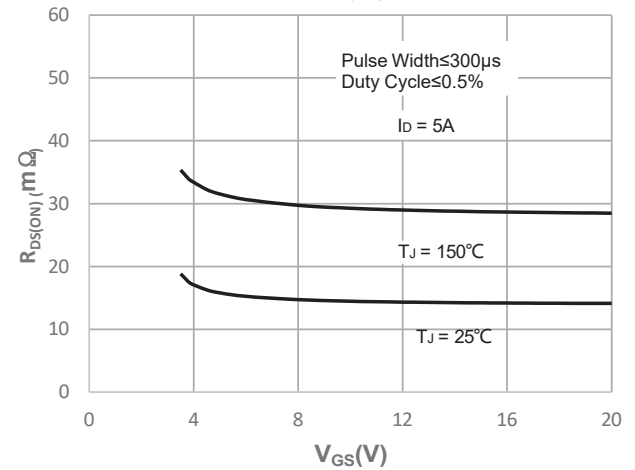
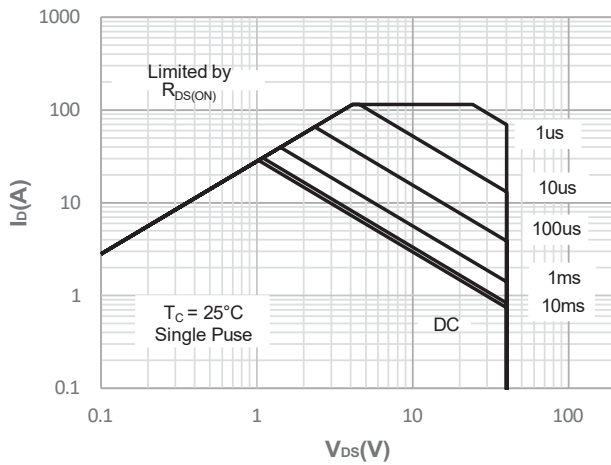


Figure 15: Maximum Safe Operating Area



Typical Performance Characteristics-P

Figure 1: Power De-rating

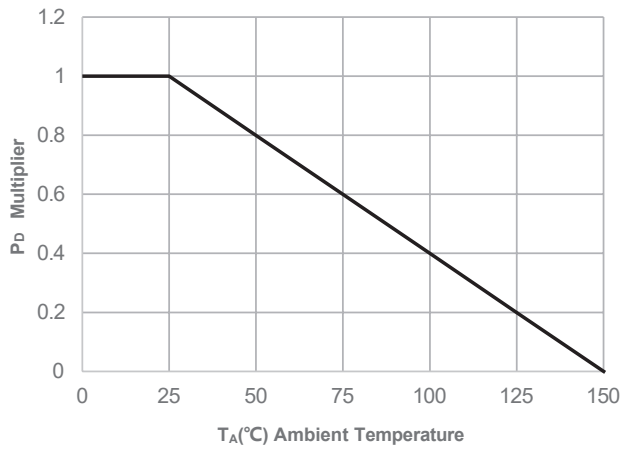


Figure 2: Current De-rating

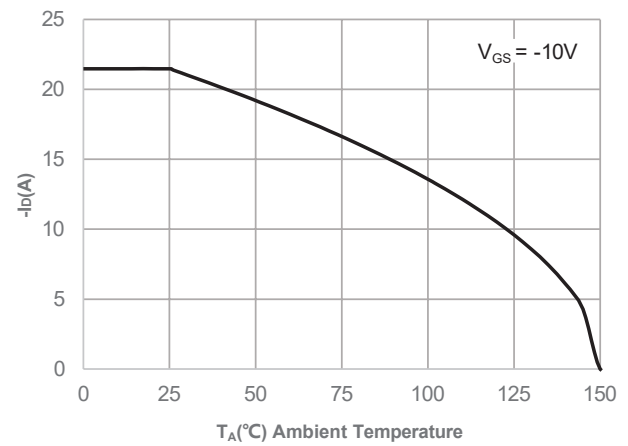


Figure 3: Normalized Maximum Transient Thermal Impedance

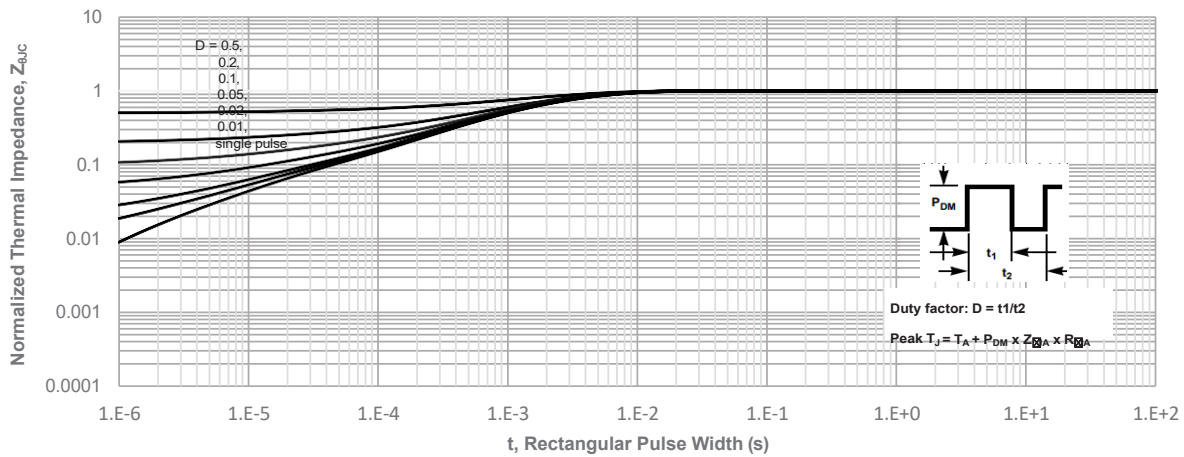
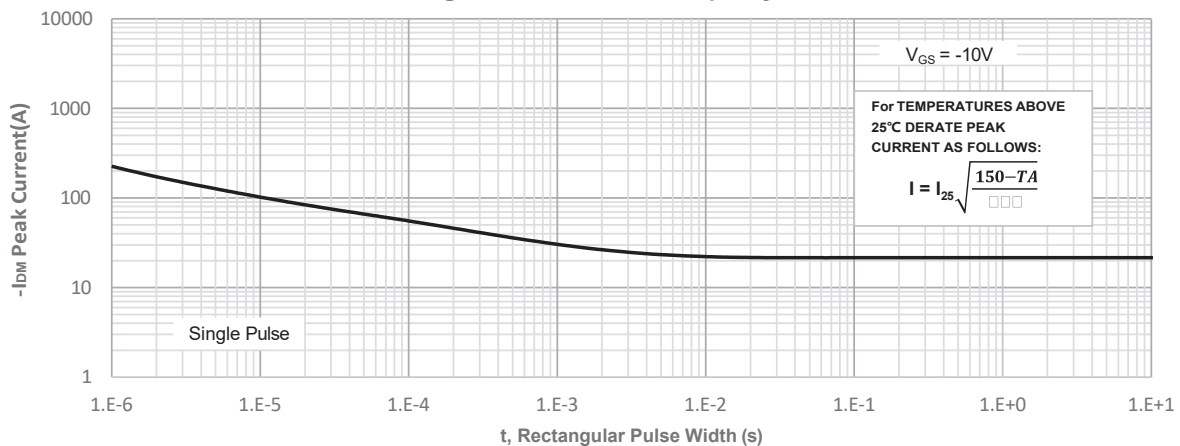


Figure 4: Peak Current Capacity



Typical Performance Characteristics-P

Figure 5: Output Characteristics

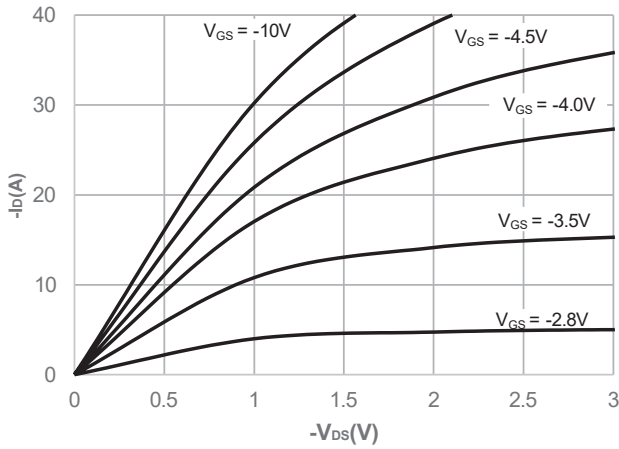


Figure 6: Typical Transfer Characteristics

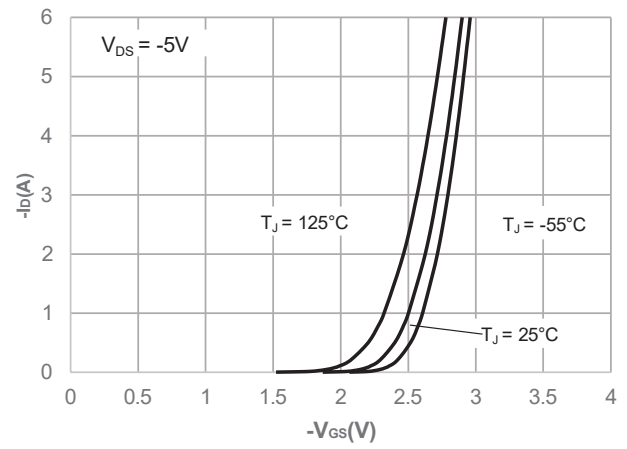


Figure 7: On-resistance vs. Drain Current

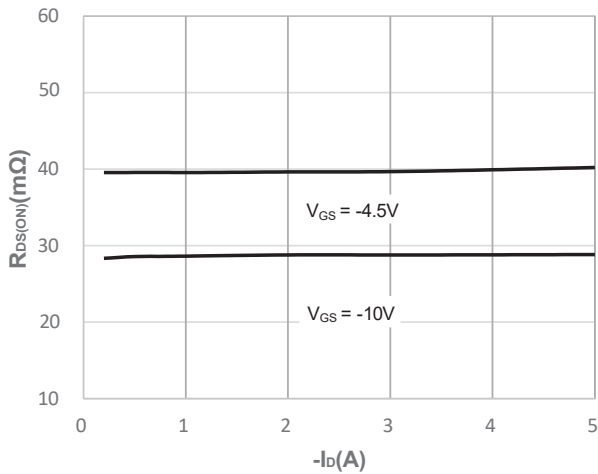


Figure 8: Body Diode Characteristics

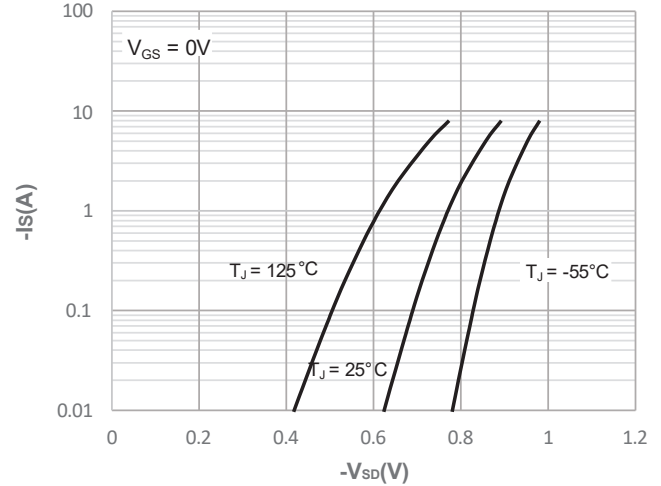


Figure 9: Gate Charge Characteristics

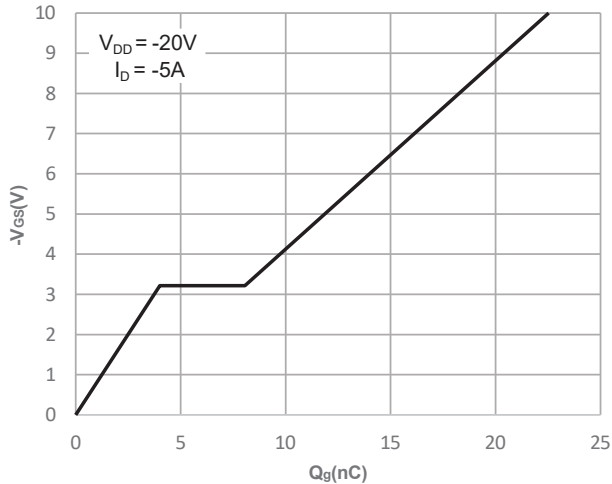
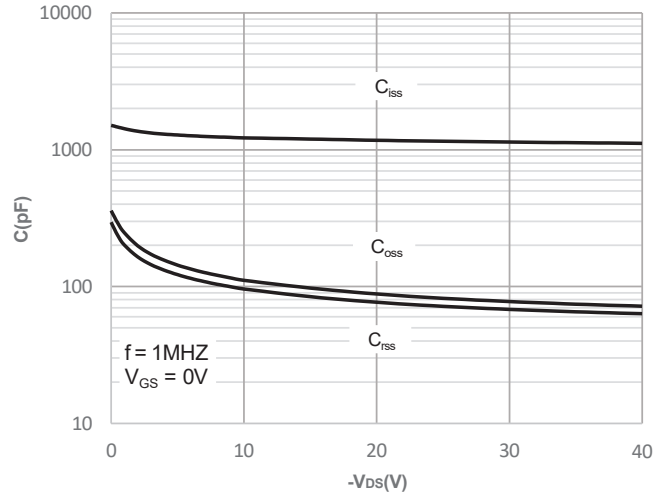


Figure 10: Capacitance Characteristics



Typical Performance Characteristics-P

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

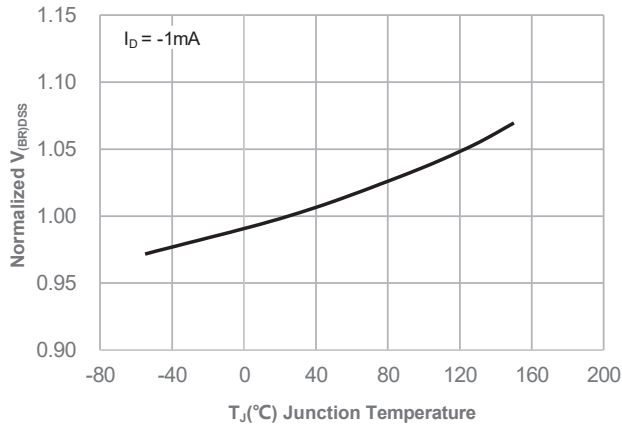


Figure 12: Normalized on Resistance vs. Junction Temperature

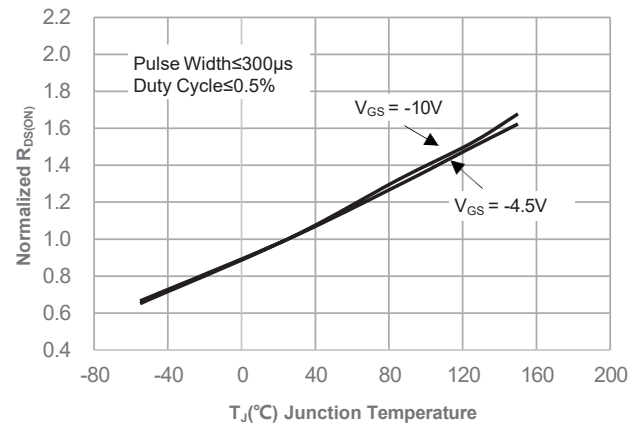


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

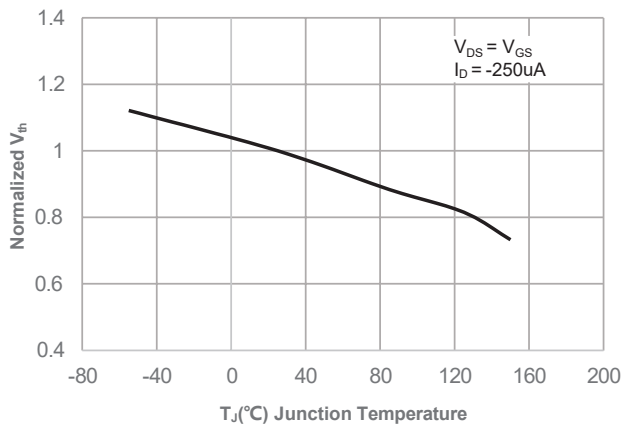


Figure 14: $R_{DS(ON)}$ vs. V_{GS}

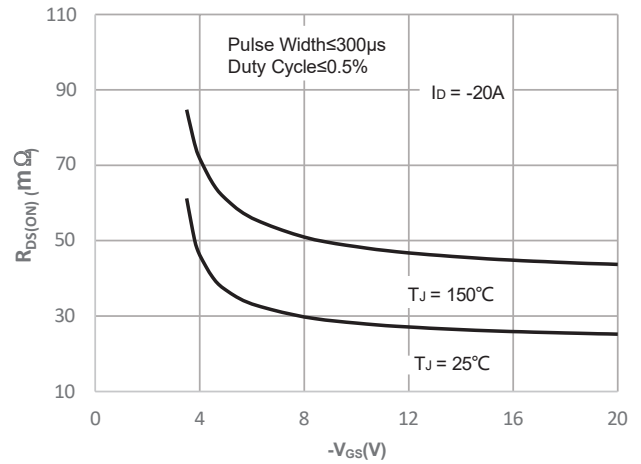
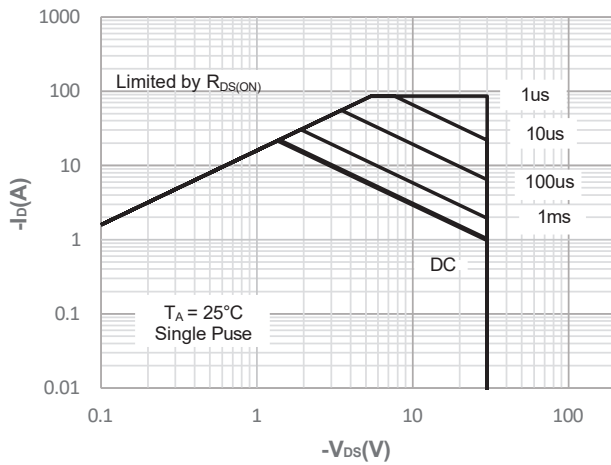


Figure 15: Maximum Safe Operating Area



Test Circuit

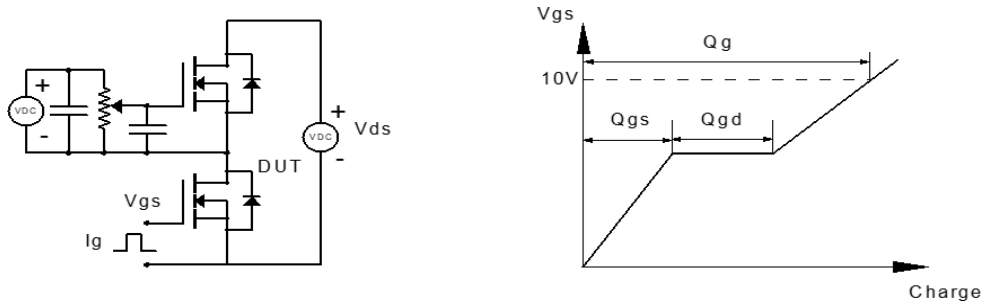


Figure 1: Gate Charge Test Circuit & Waveform

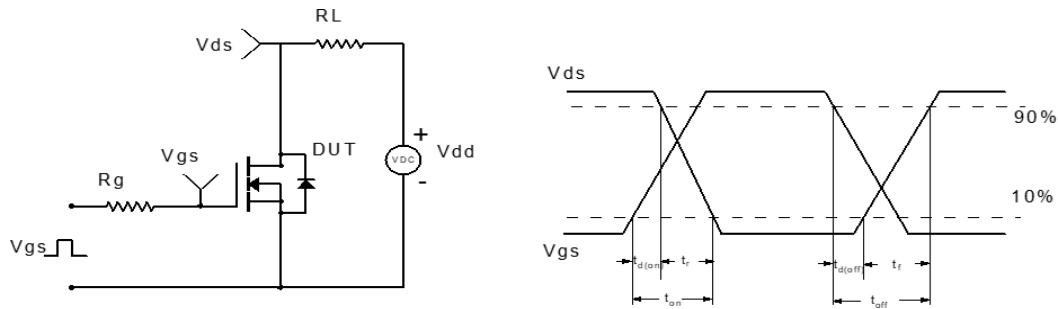


Figure 2: Resistive Switching Test Circuit & Waveform

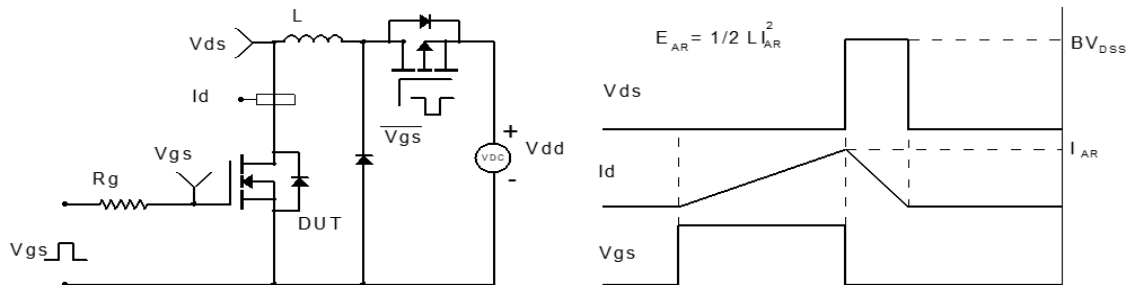


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

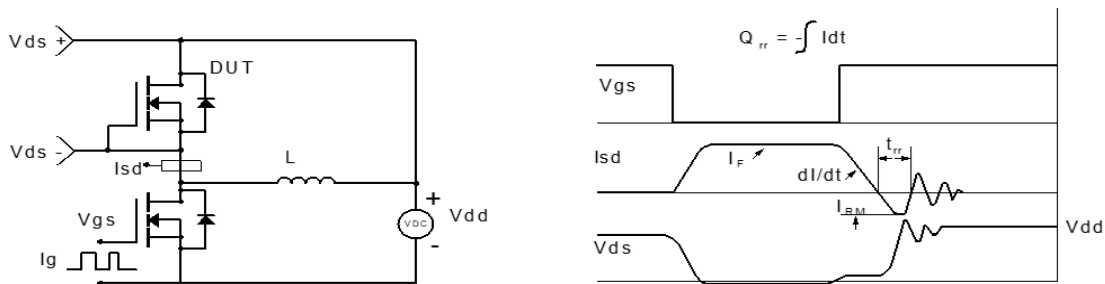
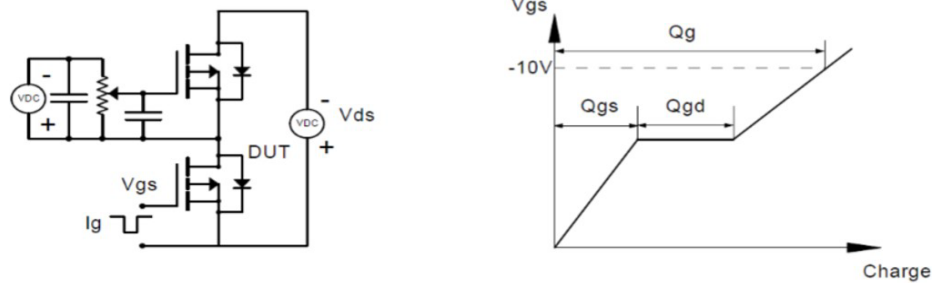
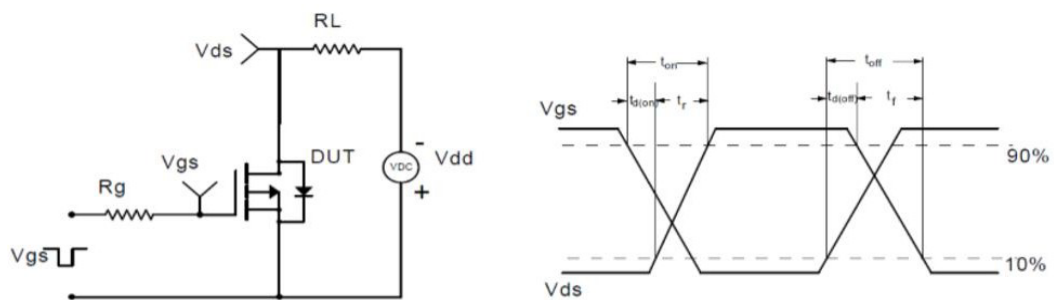
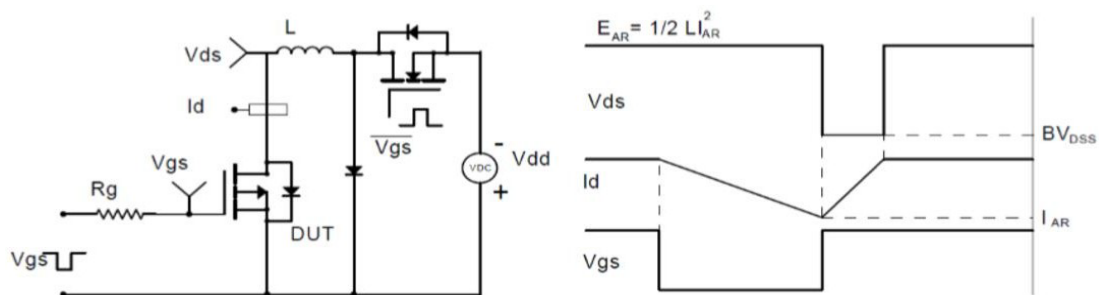
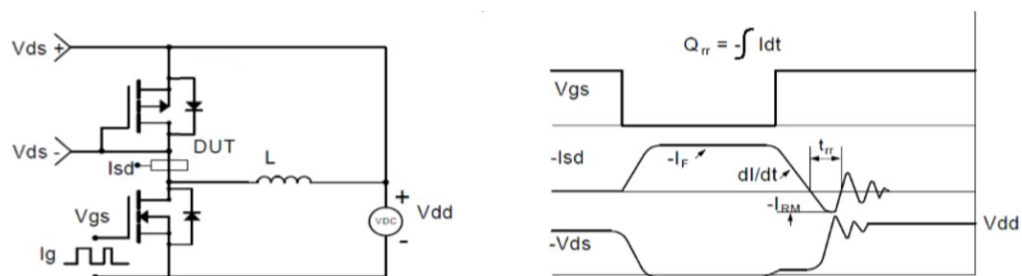


Figure 4: Diode Recovery Test Circuit & Waveform


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