

Features

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

Applications

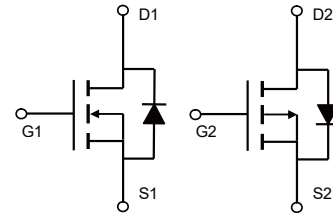
- Load Switch
- PWM Application
- Power Management

Product Summary

Parameters	N	P	Unit
V_{DSS}	30	-30	V
$V_{GS(th_Typ)}$	1.6	-1.5	V
$I_D(@V_{GS}=10V)$	54	-44	A
$R_{DS(ON_Typ)}(@V_{GS}=10V)$	6.7	11	m Ω
$R_{DS(ON_Typ)}(@V_{GS}=4.5V)$	9.2	15	m Ω



DFN5x6



Schematic

Ordering Information

Device	Marking	MSL	Form	Package	Reel(pcs)	Per Carton (pcs)
VSM54NP03-D56	VSM54NP03	1	Tape&Reel	DFN5x6	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	30	-30	V
V_{GS}	Gate-to-Source Voltage	± 20		V
I_D	Continuous Drain Current	$T_C = 25^\circ\text{C}$	54	-44
		$T_C = 100^\circ\text{C}$	34	-28
I_{DM}	Pulsed Drain Current ⁽¹⁾	Refer to Fig.4		A
E_{AS}	Single Pulsed Avalanche Energy ⁽²⁾	44	66	mJ
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$	41	44
		$T_C = 100^\circ\text{C}$	16	17
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⁾	58	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case	3.0	

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	30	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 30V, 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	1.1	1.6	2.1	V
R _{DS(ON)}	Static Drain-Source ON-Resistance ⁽⁴⁾	V _{GS} = 10V, I _D = 25A	-	6.7	8.7	mΩ
		V _{GS} = 4.5V, I _D = 15A	-	9.2	12.0	mΩ
Dynamic Characteristics						
R _g	Gate Resistance	f = 1MHz	-	2.7	-	Ω
C _{iss}	Input Capacitance	V _{GS} = 0V, V _{DS} = 15V, f = 1MHz	874	1224	1836	pF
C _{oss}	Output Capacitance		114	159	239	pF
C _{rss}	Reverse Transfer Capacitance		92	129	259	pF
Q _g	Total Gate Charge	V _{GS} = 0 to 10V V _{DS} = 15V, I _D = 25A	18	25	37	nC
Q _{gs}	Gate Source Charge		-	4.5	-	nC
Q _{gd}	Gate Drain("Miller") Charge		-	5.7	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GS} = 10V, V _{DD} = 15V I _D = 25A, R _{GEN} = 3 Ω	-	6	-	ns
t _r	Turn-On Rise Time		-	15	-	ns
t _{d(off)}	Turn-Off DelayTime		-	25	-	ns
t _f	Turn-Off Fall Time		-	6	-	ns
Body Diode Characteristics						
I _S	Maximum Continuous Body Diode Forward Current		-	-	54	A
I _{SM}	Maximum Pulsed Body Diode Forward Current		-	-	215	A
V _{SD}	Body Diode Forward Voltage	V _{GS} = 0V, I _S = 25A	-		1.2	V
trr	Body Diode Reverse Recovery Time	I _F = 15A, di/dt = 100A/us	-	11	-	ns
Qrr	Body Diode Reverse Recovery Charge		-	3.8	-	nC

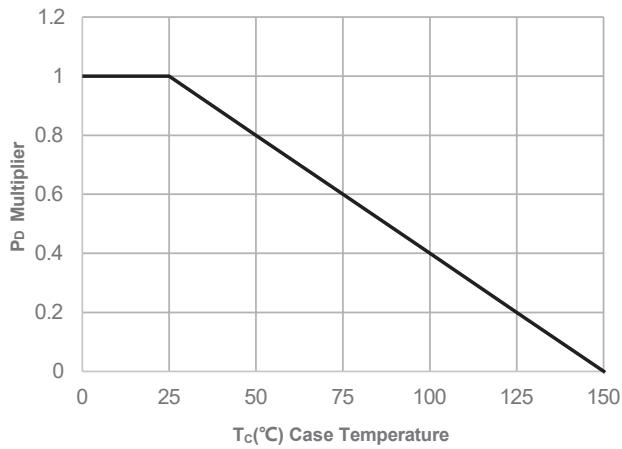
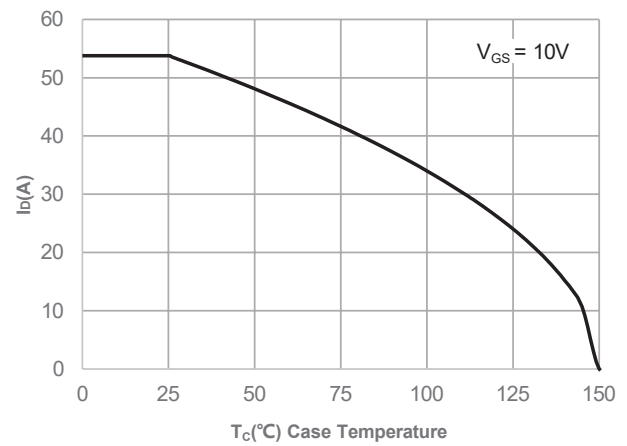
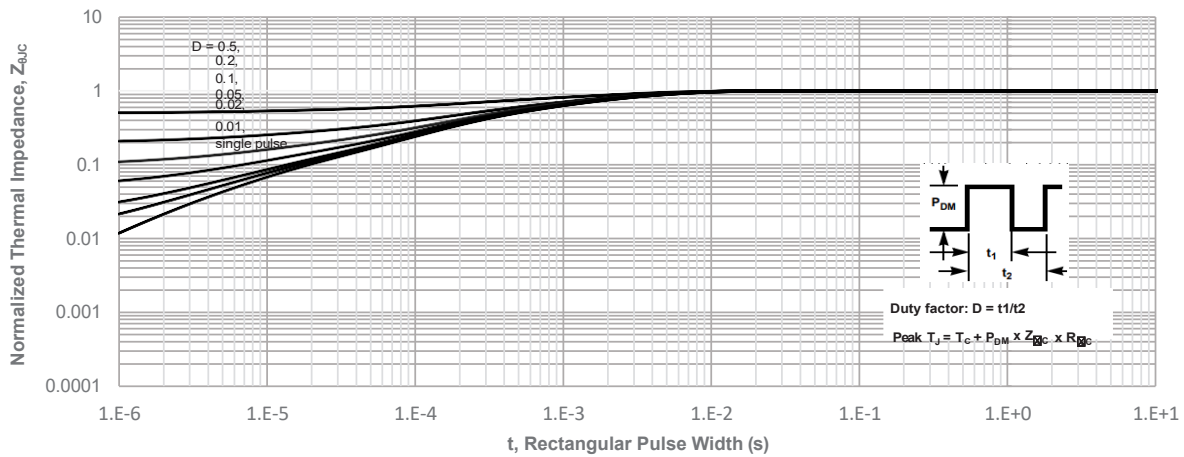
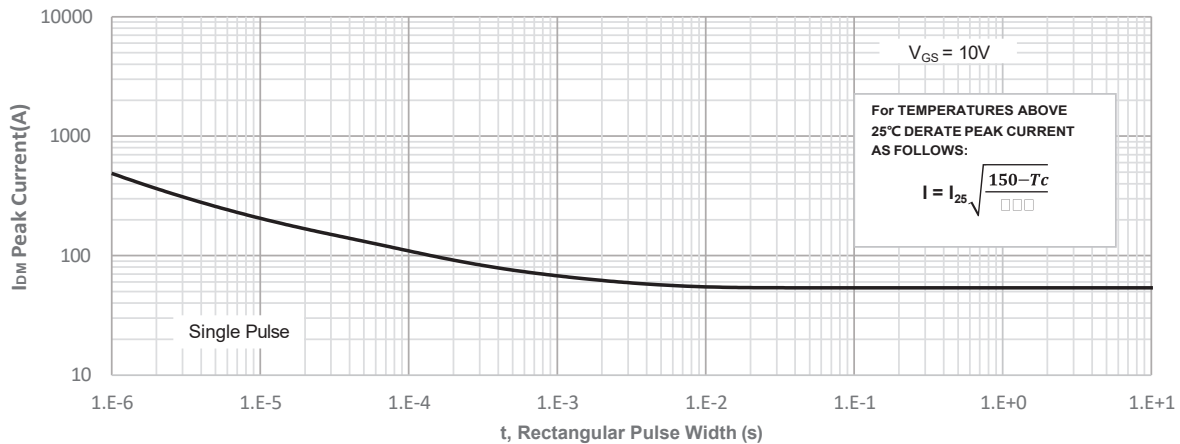
- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
 2. E_{AS} condition: Starting $T_J = 25^{\circ}\text{C}$, $V_{DD} = 15\text{V}$, $V_{GS} = 10\text{V}$, $R_G = 25\text{ohm}$, $L = 0.5\text{mH}$, $I_{AS} = 13.3\text{A}$, $V_{DD} = 0\text{V}$ during time in avalanche.
 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	-30	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = -30V, 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	-1.1	-1.5	-2.0	V
R _{DS(ON)}	Static Drain-Source ON-Resistance ⁽⁵⁾	V _{GS} = -10V, I _D = -10A	-	11	14	mΩ
		V _{GS} = -4.5V, I _D = -5A	-	15	19	mΩ
Dynamic Characteristics						
R _g	Gate Resistance	f = 1MHz	-	7.4	-	Ω
C _{iss}	Input Capacitance	V _{GS} = 0V, V _{DS} = -15V, f = 1MHz	1801	2522	3405	pF
C _{oss}	Output Capacitance		172	241	326	pF
C _{rss}	Reverse Transfer Capacitance		147	206	277	pF
Q _g	Total Gate Charge	V _{GS} = 0 to -10V V _{DS} = -15V, I _D = -10A	32	44	60	nC
Q _{gs}	Gate Source Charge		-	7.5	-	nC
Q _{gd}	Gate Drain("Miller") Charge		-	7.2	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GS} = -10V, V _{DD} = -15V I _D = -10A, R _{GEN} = 3 Ω	-	7.0	-	ns
t _r	Turn-On Rise Time		-	1.6	-	ns
t _{d(off)}	Turn-Off DelayTime		-	77	-	ns
t _f	Turn-Off Fall Time		-	45	-	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 = -10A	-		-1.2	V
trr	Body Diode Reverse Recovery Time	I _F = -10A, di/dt = -100A/us	10	14	18	ns
Qrr	Body Diode Reverse Recovery Charge		-	4.8	-	nC

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
 2. E_{AS} condition: Starting $T_J=25^{\circ}\text{C}$, $V_{DD}=-15\text{V}$, $V_{GS}=-10\text{V}$, $R_G=25\text{ohm}$, $L=0.5\text{mH}$, $I_{AS}=-16.24\text{A}$, $V_{DD}=0\text{V}$ 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

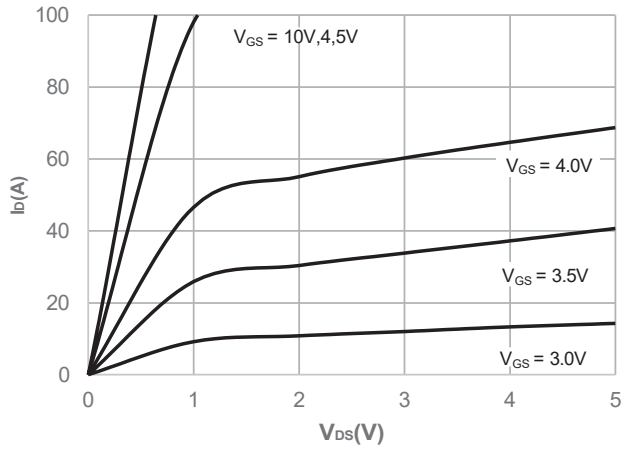


Figure 6: Typical Transfer Characteristics

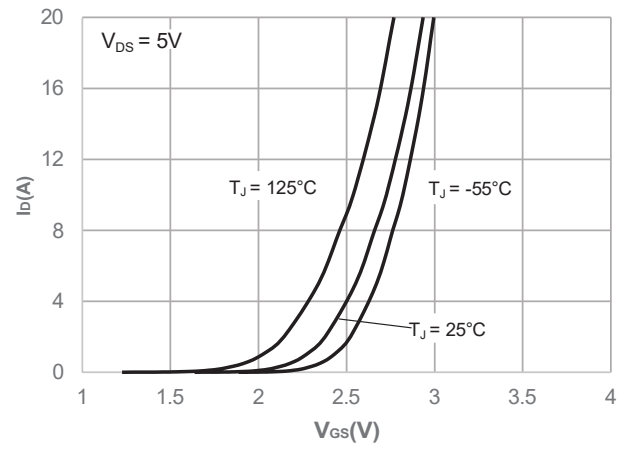


Figure 7: On-resistance vs. Drain Current

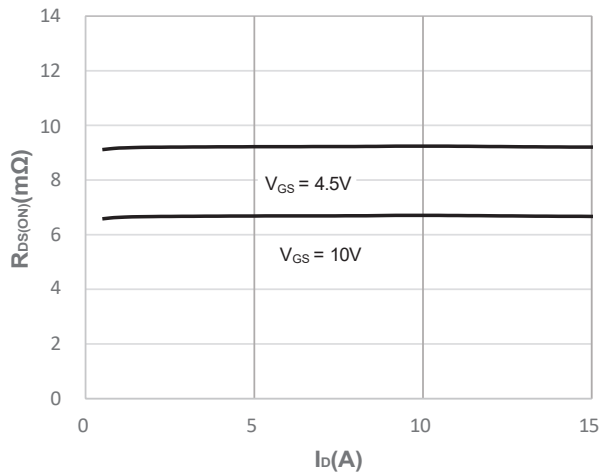


Figure 8: Body Diode Characteristics

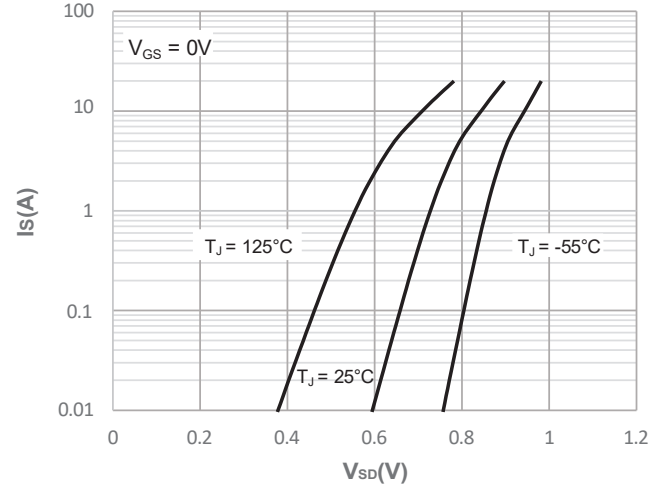


Figure 9: Gate Charge Characteristics

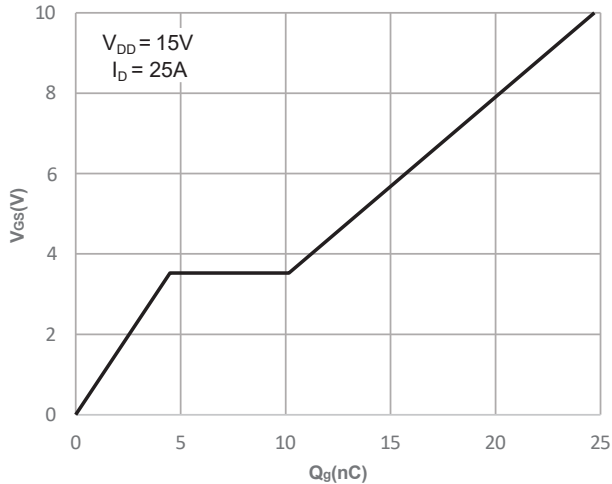
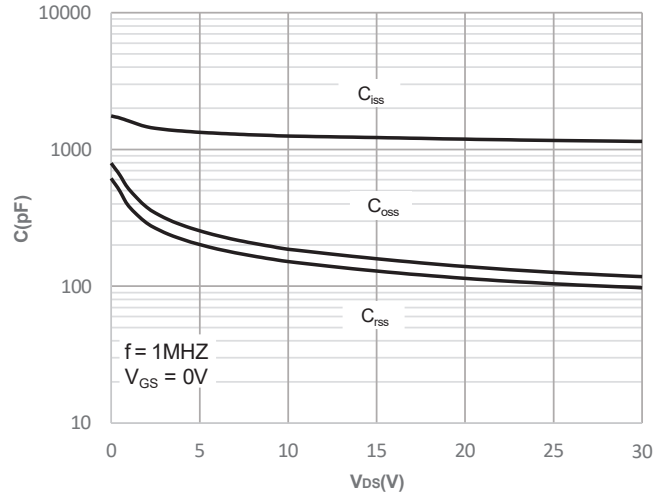


Figure 10: Capacitance Characteristics



Typical Performance Characteristics-N

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

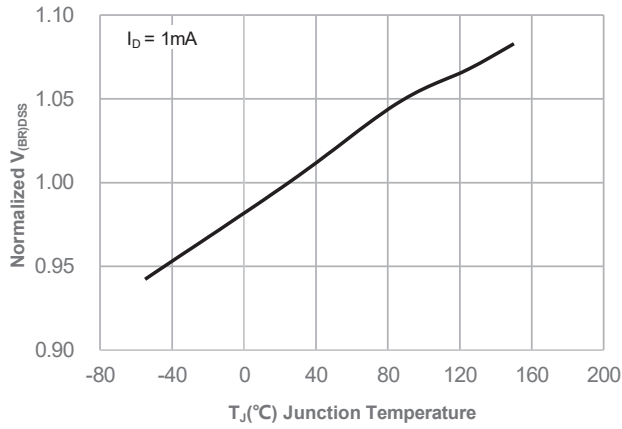


Figure 12: Normalized on Resistance vs. Junction Temperature

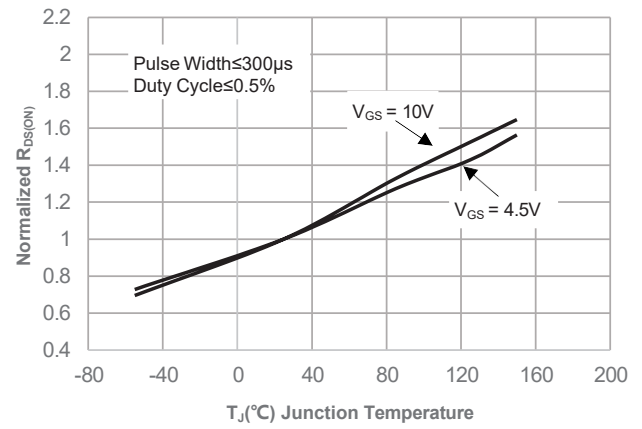


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

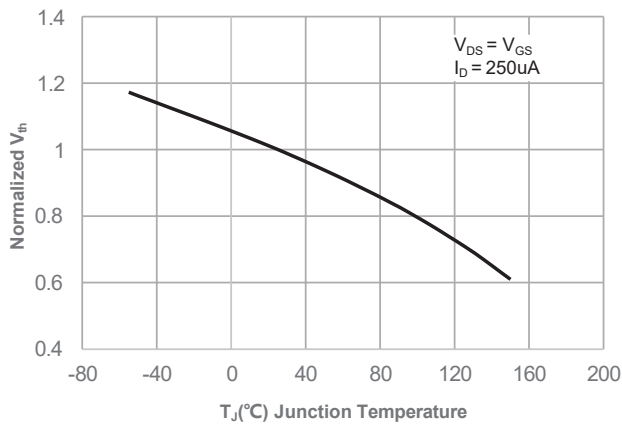


Figure 14: $R_{DS(ON)}$ vs. V_{GS}

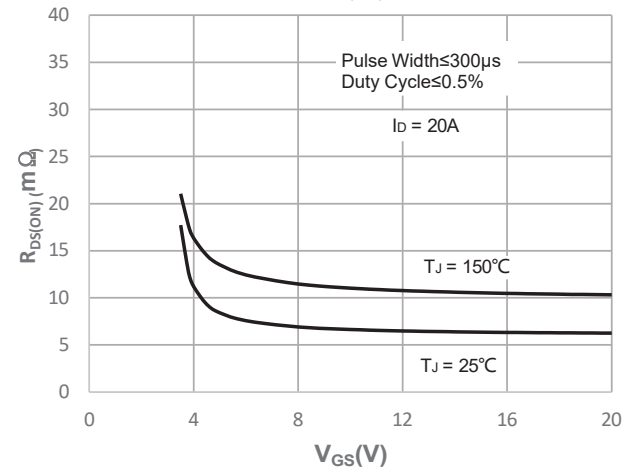
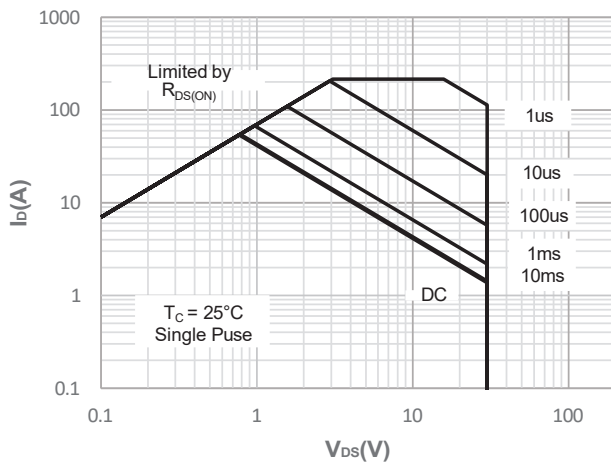
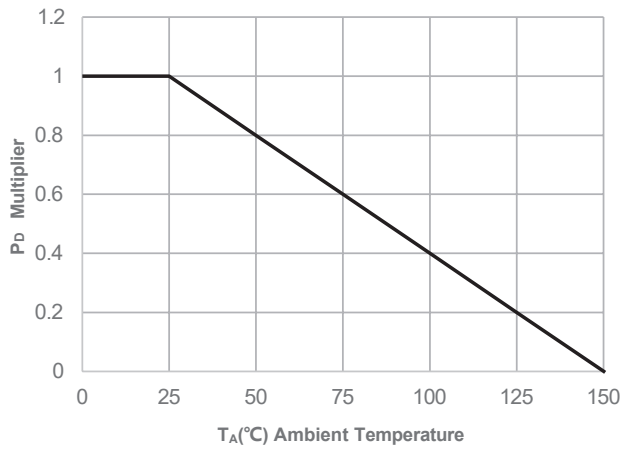
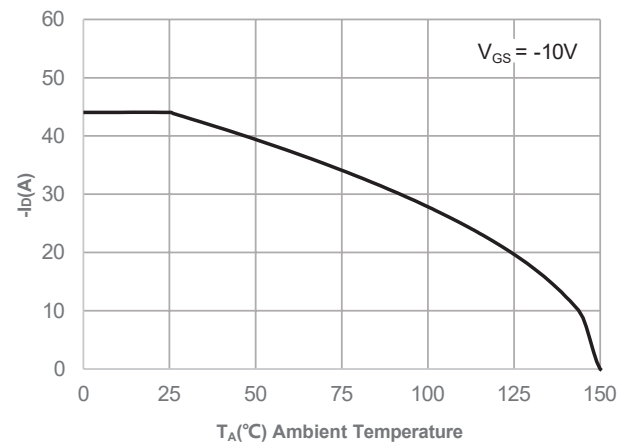
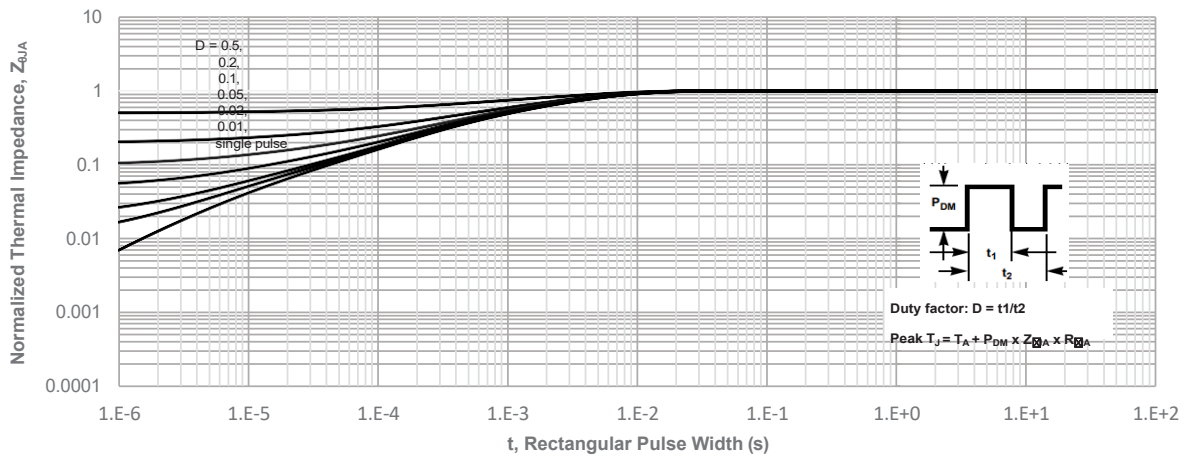
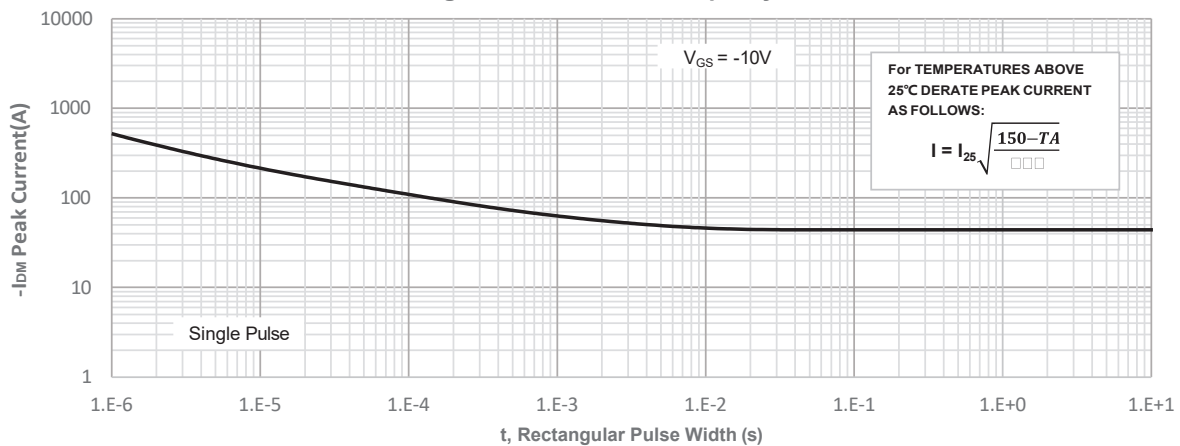


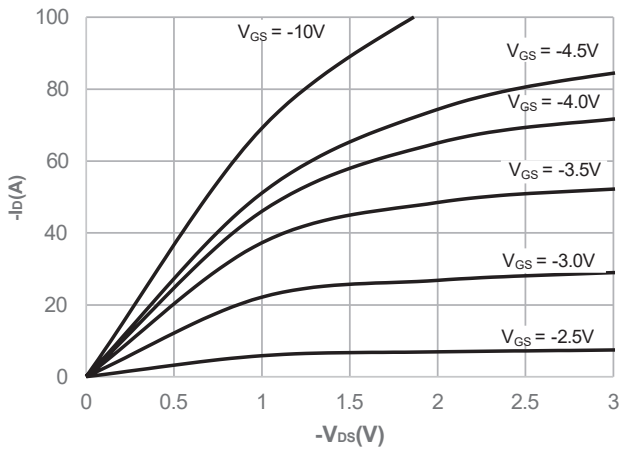
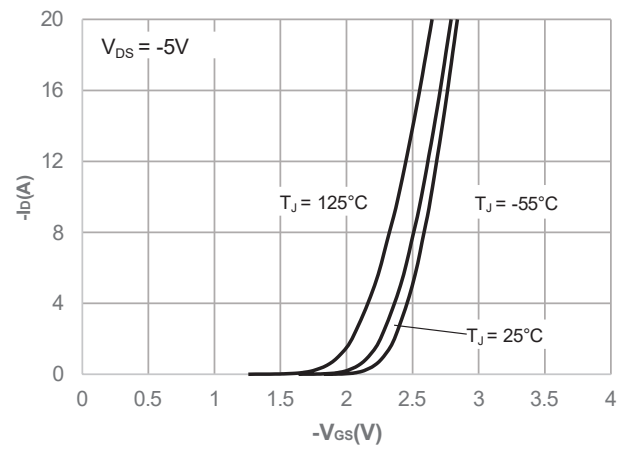
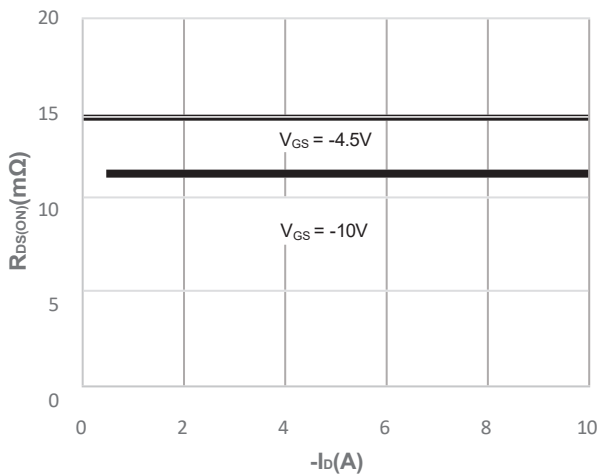
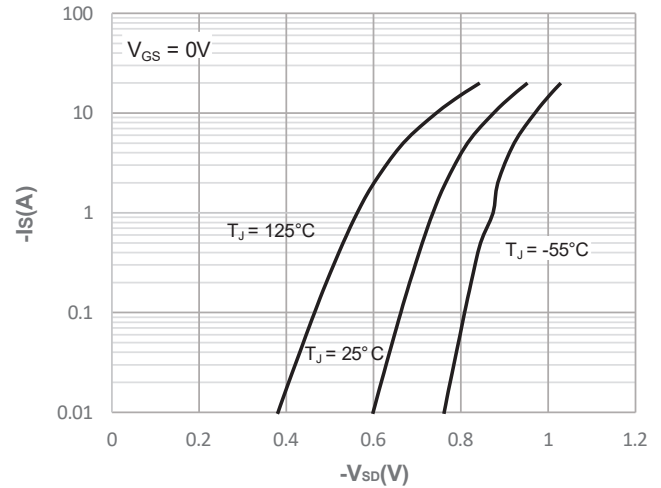
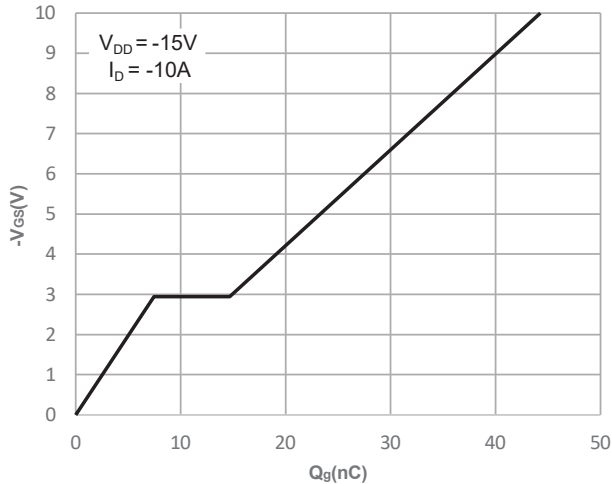
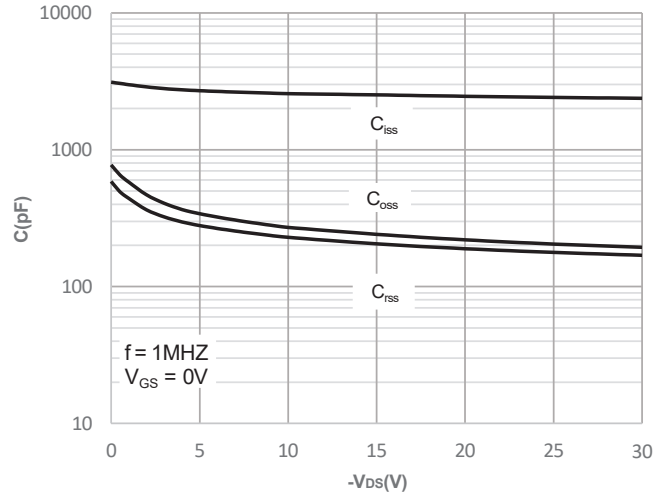
Figure 15: Maximum Safe Operating Area



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

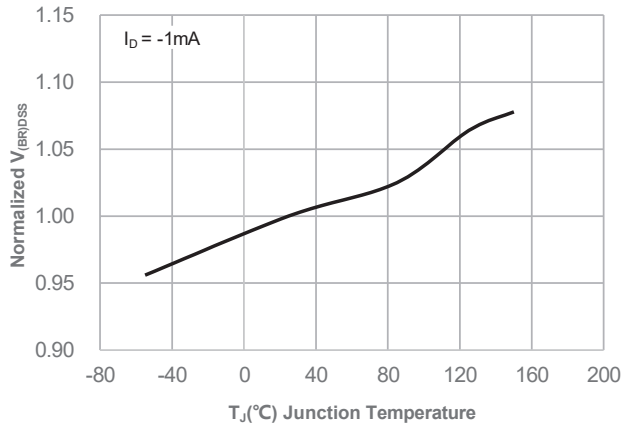


Figure 12: Normalized on Resistance vs. Junction Temperature

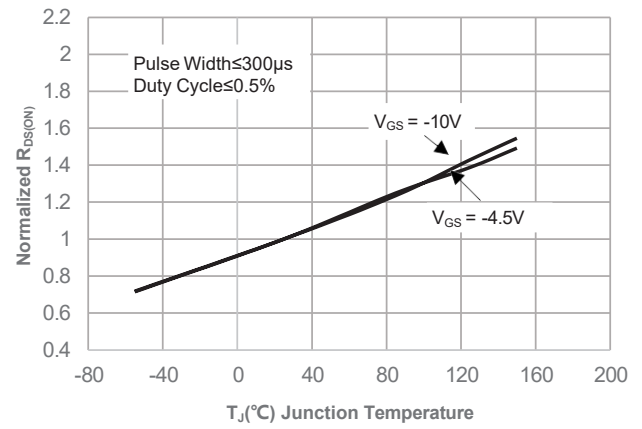


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

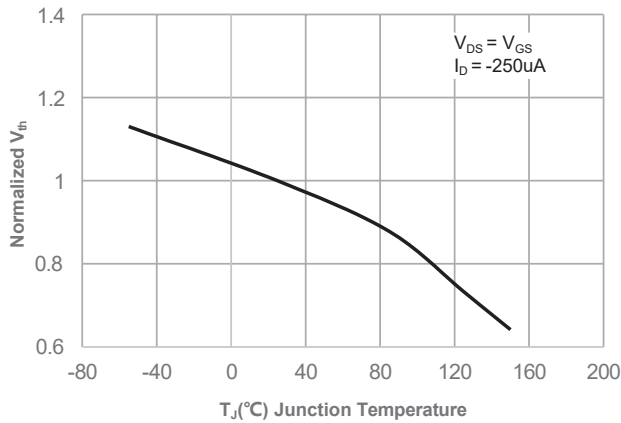


Figure 14: $R_{DS(ON)}$ vs. V_{GS}

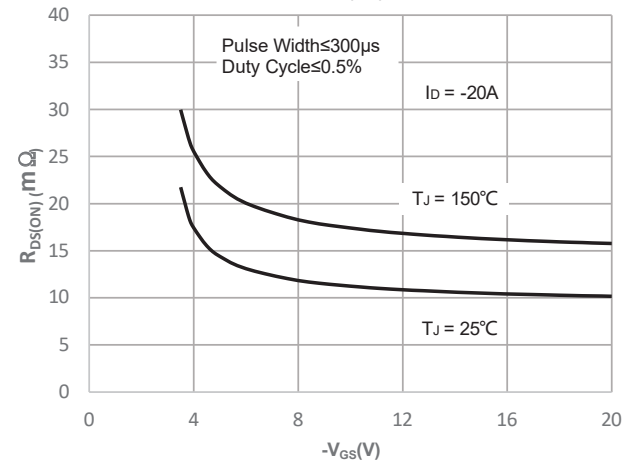
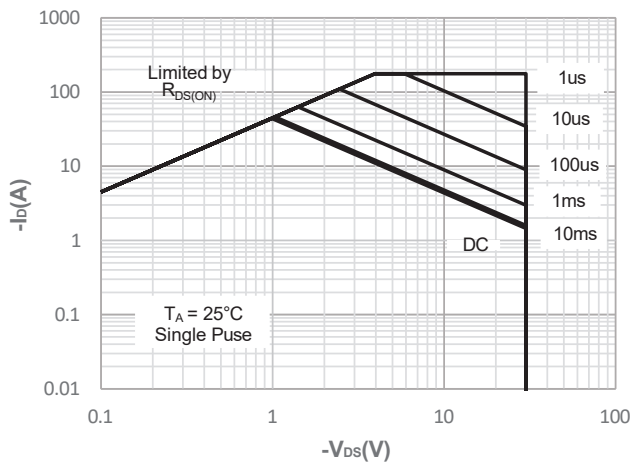


Figure 15: Maximum Safe Operating Area



Test Circuit

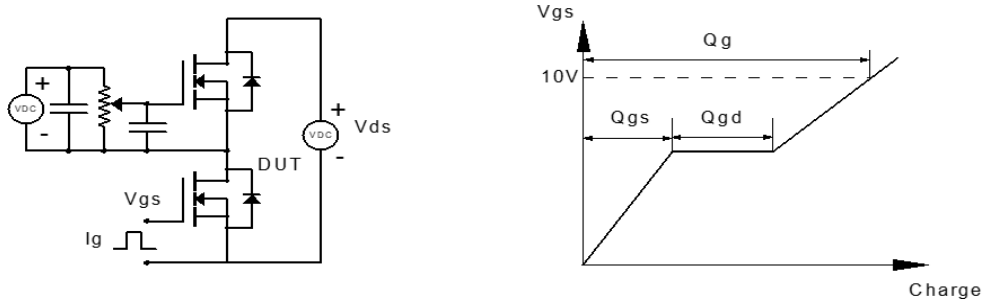


Figure 1: Gate Charge Test Circuit & Waveform

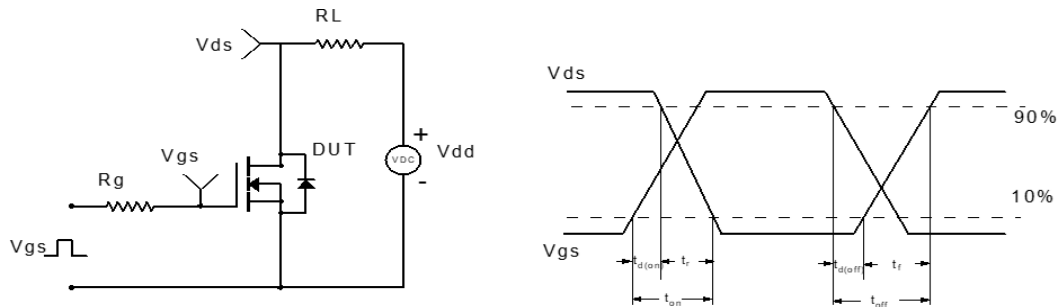


Figure 2: Resistive Switching Test Circuit & Waveform

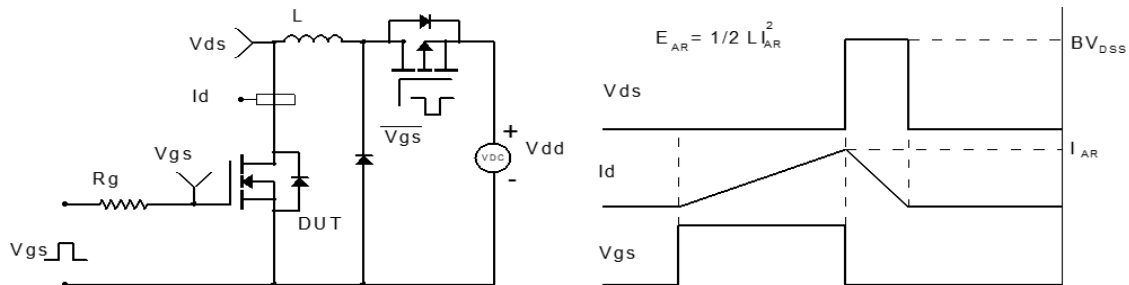


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

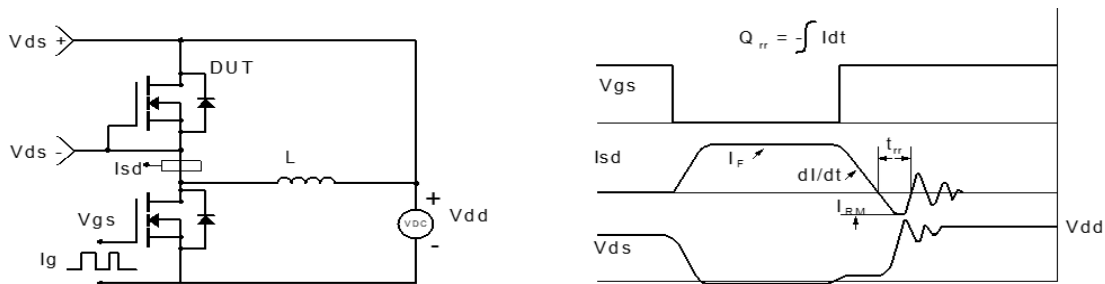
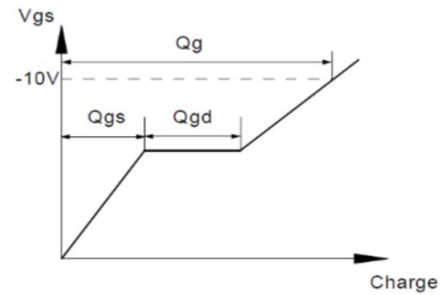
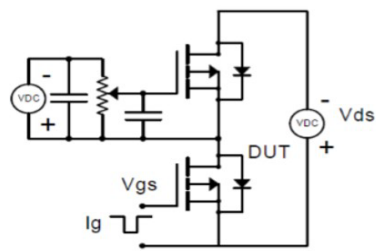
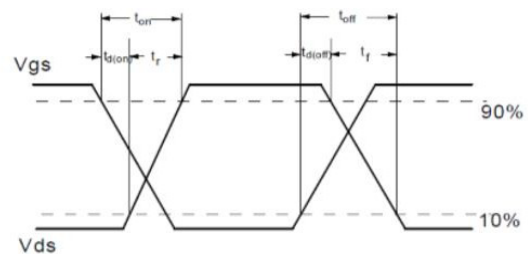
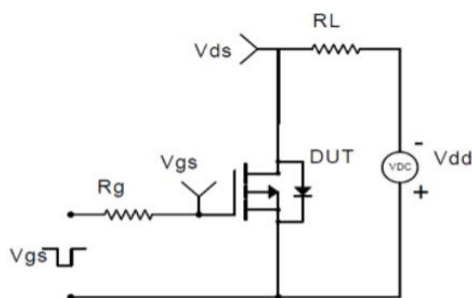
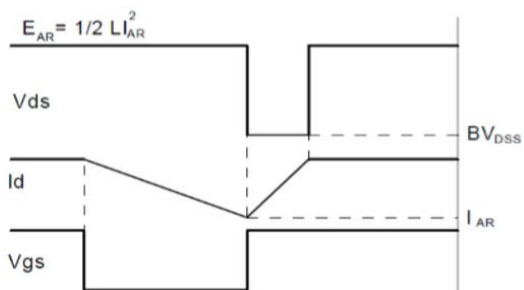
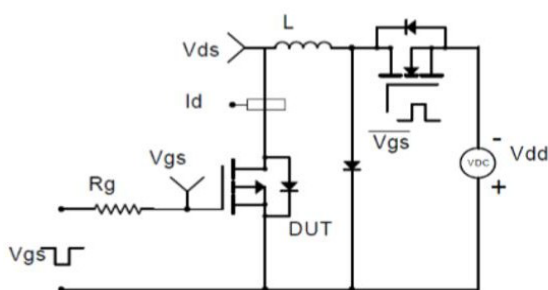
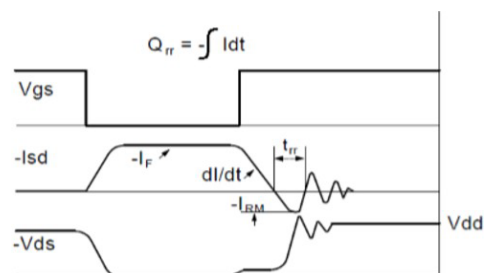
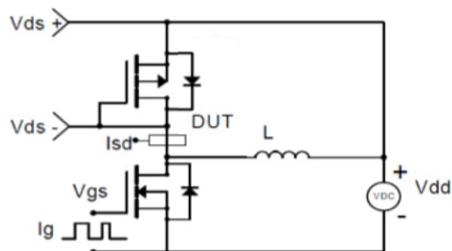


Figure 4: Diode Recovery Test Circuit & Waveform


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