

Features

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

Applications

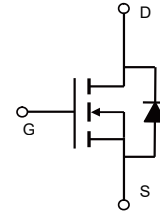
- Load Switch
- PWM Application
- Power Management

Product Summary

Parameters	Value	Unit
V_{DSS}	40	V
$V_{GS(th_Typ)}$	3.1	V
$I_D(@V_{GS}=10V)$	135	A
$R_{DS(ON_Typ)}(@V_{GS}=10V)$	2.6	m Ω



DFN5x6



Schematic

Ordering Information

Device	Marking	MSL	Form	Package	Reel(pcs)	Per Carton (pcs)
VSM135N04-D56	VSM135N04	1	Tape&Reel	DFN5x6	5000	50000

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

Symbol	Parameter	Value	Unit
V_{DS}	Drain-to-Source Voltage	40	V
V_{GS}	Gate-to-Source Voltage	± 20	V
I_D	Continuous Drain Current	$T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$	A
I_{DM}	Pulsed Drain Current ⁽¹⁾	Refer to Fig.4	A
E_{AS}	Single Pulsed Avalanche Energy ⁽²⁾	238	mJ
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$ $T_C = 100^\circ\text{C}$	W
T_J, T_{STG}	Junction & Storage Temperature Range	-55 to 150	$^\circ\text{C}$

Thermal Characteristics

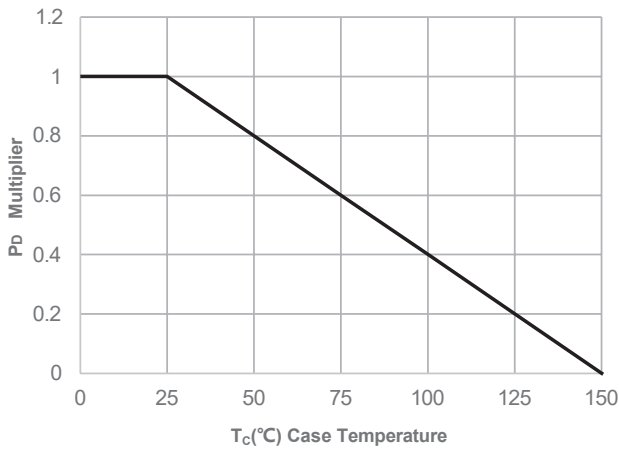
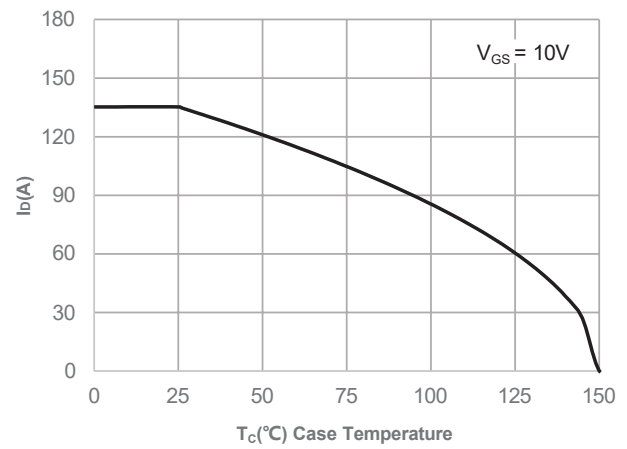
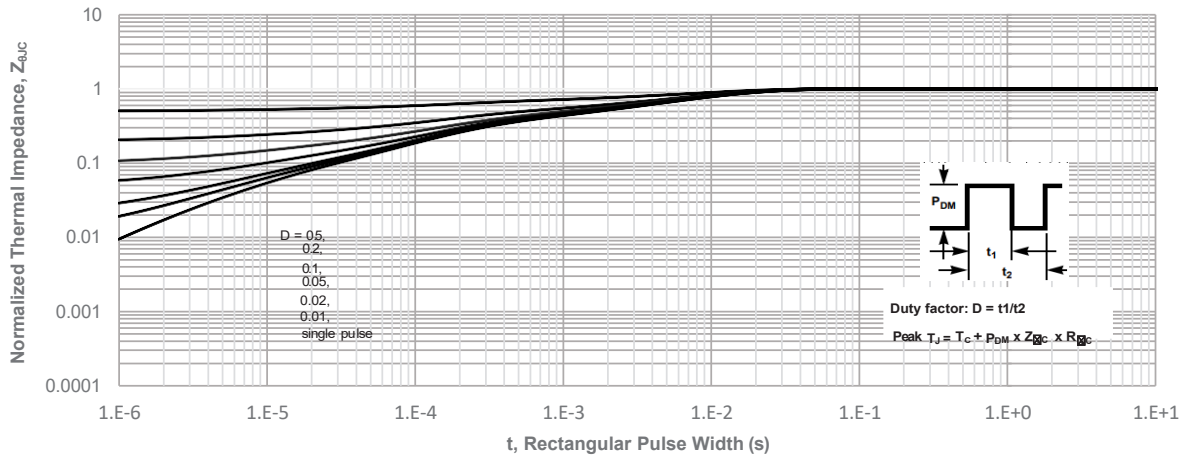
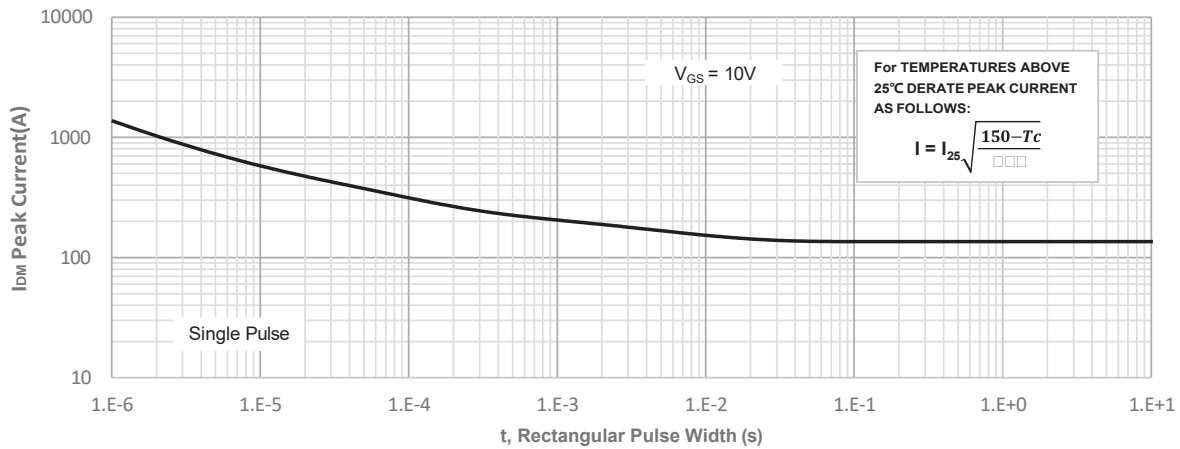
Symbol	Parameter	Max	Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient ⁽³⁾	44	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.2	

Electrical Characteristics ($T_J = 25^\circ\text{C}$ 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} = 32V, 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	2.2	3.1	4.0	V
R _{DS(ON)}	Static Drain-Source ON-Resistance ⁽⁴⁾	V _{GS} = 10V, I _D = 20A	-	2.6	3.3	mΩ
Dynamic Characteristics						
R _g	Gate Resistance	f = 1MHz	-	0.8	-	Ω
C _{iss}	Input Capacitance	V _{GS} = 0V, V _{DS} = 20V, f = 1MHz	1412	1976	2668	pF
C _{oss}	Output Capacitance		856	1198	1618	pF
C _{rss}	Reverse Transfer Capacitance		79	110	149	pF
Q _g	Total Gate Charge	V _{GS} = 0 to 10V V _{DS} = 20V, I _D = 20A	24	33	45	nC
Q _{gs}	Gate Source Charge		-	10	13	nC
Q _{gd}	Gate Drain("Miller") Charge		-	10	13	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GS} = 10V, V _{DD} = 20V I _D = 20A, R _{GEN} = 3 Ω	-	13	-	ns
t _r	Turn-On Rise Time		-	24	-	ns
t _{d(off)}	Turn-Off DelayTime		-	22	-	ns
t _f	Turn-Off Fall Time		-	9	-	ns
Body Diode Characteristics						
I _S	Maximum Continuous Body Diode Forward Current		-	-	135	A
I _{SM}	Maximum Pulsed Body Diode Forward Current		-	-	541	A
V _{SD}	Body Diode Forward Voltage	V _{GS} = 0V, I _S = 20A	-		1.2	V
trr	Body Diode Reverse Recovery Time	I _F = 20A, di/dt = 100A/us	29	40	55	ns
Qrr	Body Diode Reverse Recovery Charge		-	37	-	nC

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
 2. E_{AS} condition: Starting $T_J = 25^\circ\text{C}$, $V_{DD} = 20\text{V}$, $V_G = 10\text{V}$, $R_G = 25\text{ohm}$, $L = 3\text{mH}$, $I_{AS} = 12.6\text{A}$, $V_{DD} = 0\text{V}$ 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 $\leq 0.5\%$.

Typical Performance Characteristics

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

Figure 5: Output Characteristics

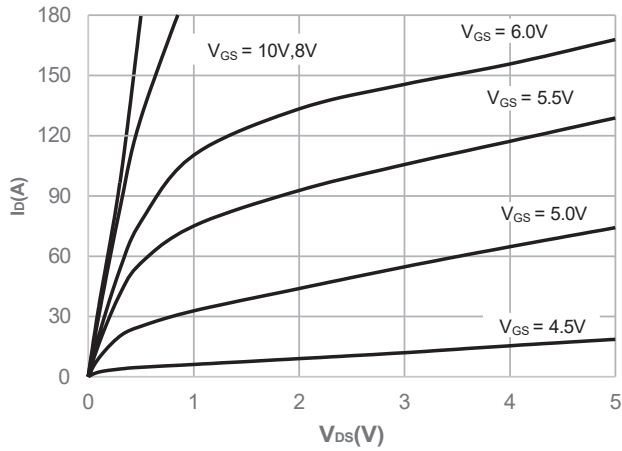


Figure 6: Typical Transfer Characteristics

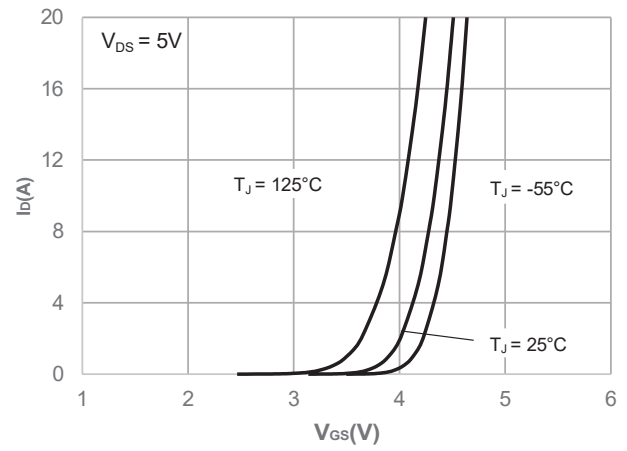


Figure 7: On-resistance vs. Drain Current

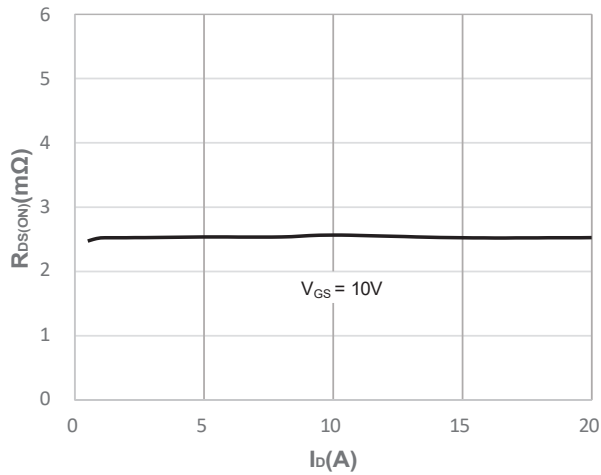


Figure 8: Body Diode Characteristics

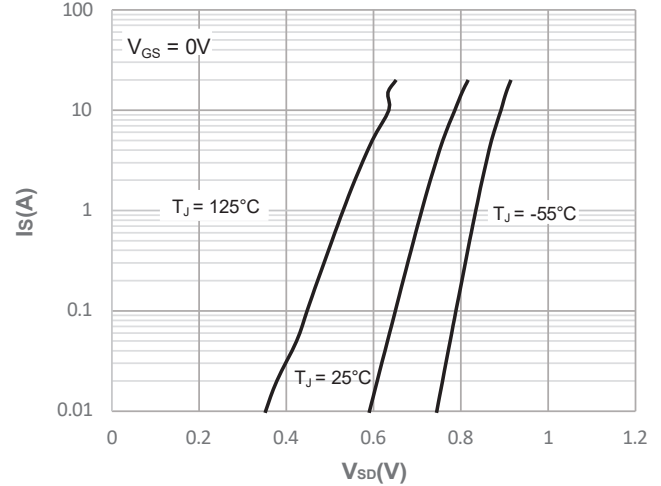


Figure 9: Gate Charge Characteristics

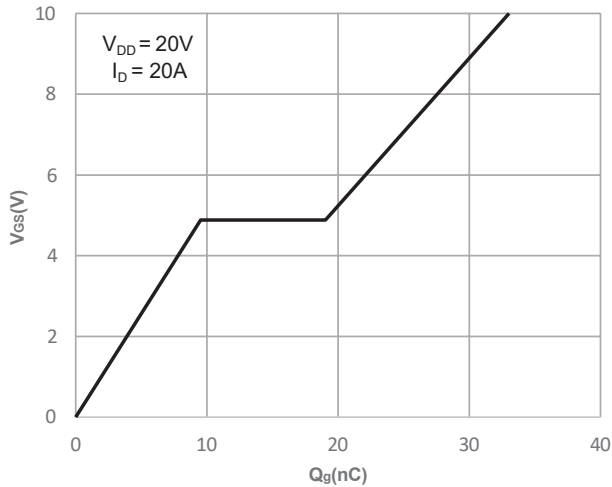
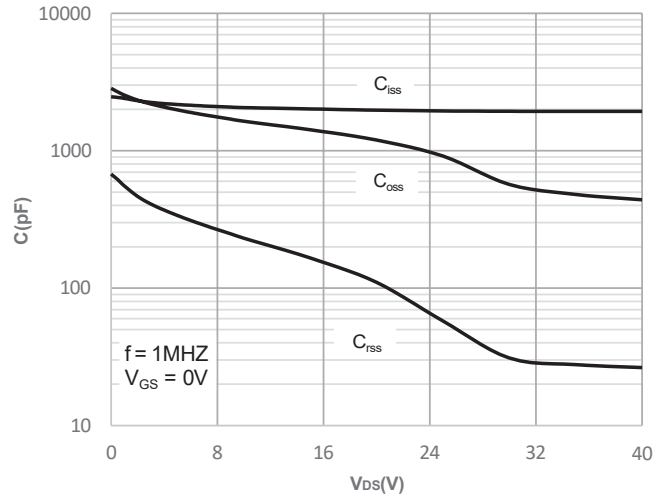


Figure 10: Capacitance Characteristics



Typical Performance Characteristics

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

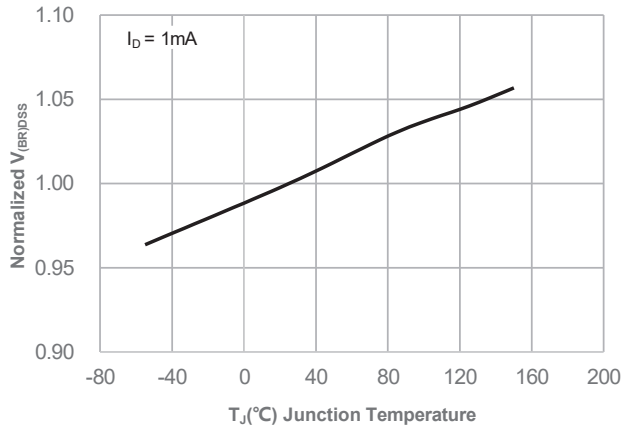


Figure 12: Normalized on Resistance vs. Junction Temperature

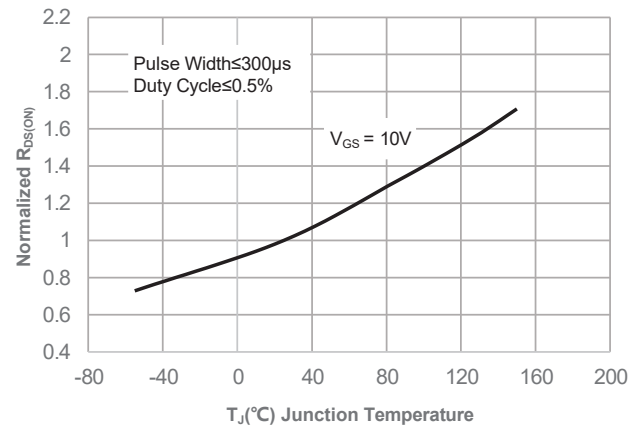


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

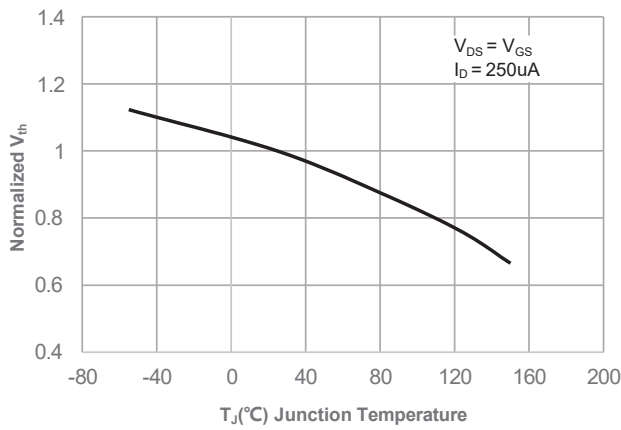


Figure 14: $R_{DS(on)}$ vs. V_{GS}

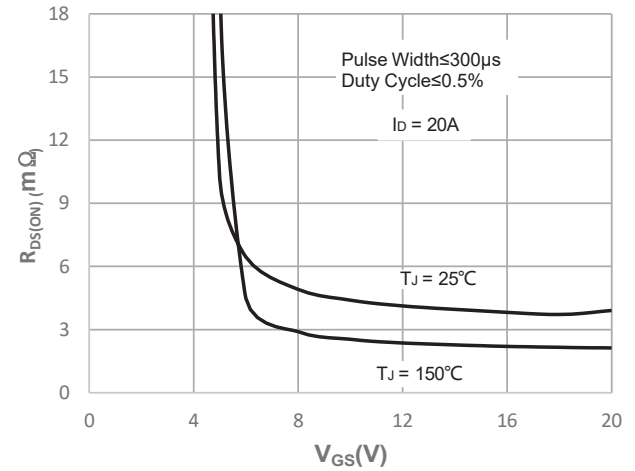
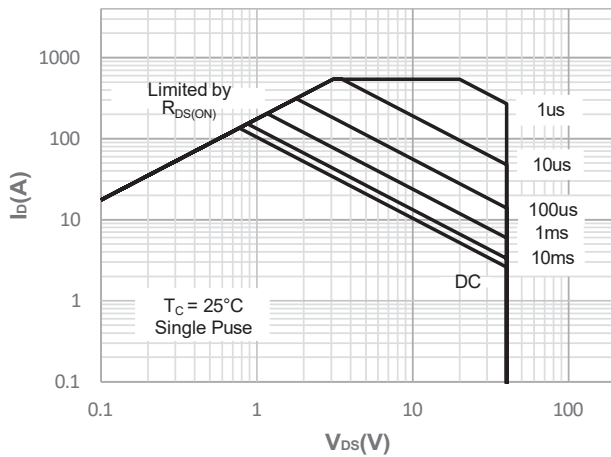


Figure 15: Maximum Safe Operating Area



Test Circuit

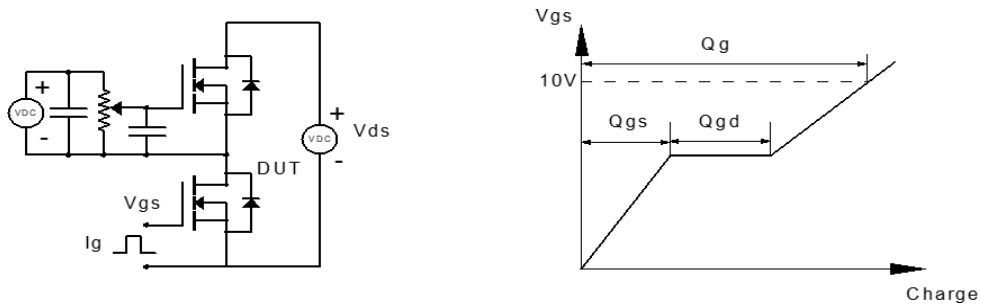


Figure 1: Gate Charge Test Circuit & Waveform

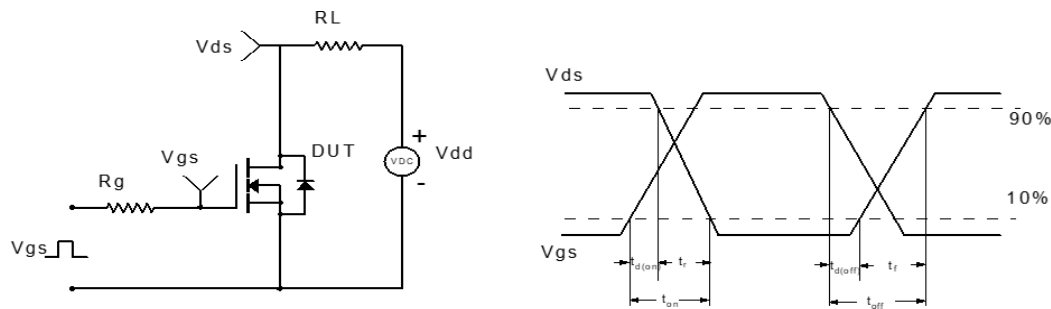


Figure 2: Resistive Switching Test Circuit & Waveform

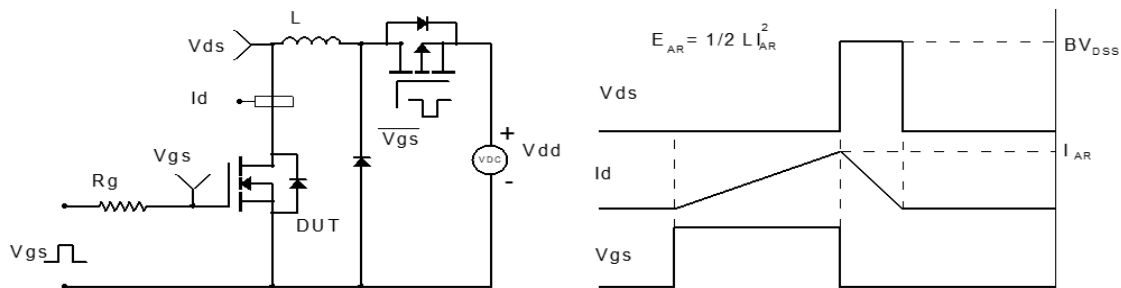


Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

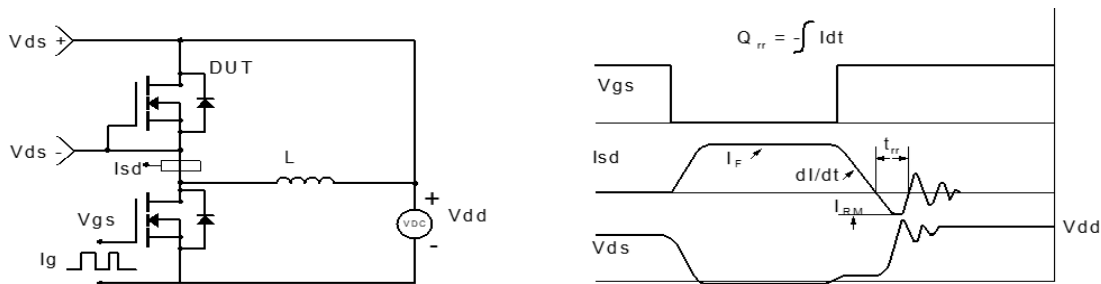


Figure 4: Diode Recovery Test Circuit & Waveform