

Features

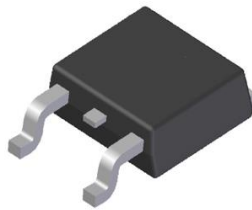
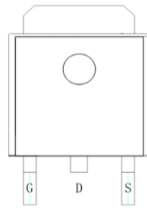
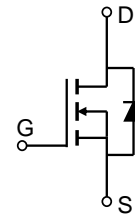
- Ultra-low ON-resistance, $R_{DS(ON)}$
- Low Gate Charge
- 100% UIS Tested
- 100% ΔV_{ds} Tested
- Halogen-free; RoHS-compliant
- AEC-Q101 Qualified

Applications

- Load Switch
- PWM Application
- General Automotive Application

Product Summary

Parameters	Value	Unit
V_{DSS}	40	V
$V_{GS(th)_Typ}$	1.6	V
$I_D(@V_{GS}=10V)$	119	A
$R_{DS(ON)_Typ}(@V_{GS}=10V)$	2.7	mΩ
$R_{DS(ON)_Typ}(@V_{GS}=4.5V)$	3.3	mΩ


TO-252-3L

Pin Assignment

Schematic Diagram
Ordering Information

Device	Marking	MSL	Form	Package	Reel(pcs)	Per Carton (pcs)
JMSL0402MKQ-13	SL0402MQ	1	Tape&Reel	TO-252-3L	2500	25000

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	$T_C = 25^\circ\text{C}$	119
		$T_C = 100^\circ\text{C}$	84
I_{DM}	Pulsed Drain Current ⁽¹⁾	Refer to Fig.4	A
E_{AS}	Single Pulsed Avalanche Energy ⁽²⁾	356	mJ
P_D	Power Dissipation	$T_C = 25^\circ\text{C}$	88
		$T_C = 100^\circ\text{C}$	44
T_J, T_{STG}	Junction & Storage Temperature Range	-55 to 175	$^\circ\text{C}$

Thermal Characteristics

Symbol	Parameter	Max	Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient ⁽³⁾	42	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.7	

**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	$I_D = 250\mu\text{A}$, $V_{GS} = 0\text{V}$	40	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 32\text{V}$, $V_{GS} = 0\text{V}$	-	-	1.0	μA
I_{GSS}	Gate-Body Leakage Current	$V_{DS} = 0\text{V}$, $V_{GS} = \pm 20\text{V}$	-	-	± 100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 250\mu\text{A}$	1.1	1.6	2.1	V
$R_{DS(ON)}$	Static Drain-Source ON-Resistance ⁽⁴⁾	$V_{GS} = 10\text{V}$, $I_D = 20\text{A}$	-	2.7	3.5	m Ω
		$V_{GS} = 4.5\text{V}$, $I_D = 15\text{A}$	-	3.3	4.2	m Ω
Dynamic Characteristics						
R_g	Gate Resistance	$f = 1\text{MHz}$	-	1.0	-	Ω
C_{iss}	Input Capacitance	$V_{GS} = 0\text{V}$, $V_{DS} = 20\text{V}$, $f = 1\text{MHz}$	3184	4458	6018	pF
C_{oss}	Output Capacitance		1429	2000	2700	pF
C_{riss}	Reverse Transfer Capacitance		110	154	208	pF
Q_g	Total Gate Charge	$V_{GS} = 0$ to 10V $V_{DS} = 20\text{V}$, $I_D = 20\text{A}$	50	70	95	nC
Q_{gs}	Gate Source Charge		10	14	19	nC
Q_{gd}	Gate Drain("Miller") Charge		10	14	18	nC
Switching Characteristics						
$t_{d(on)}$	Turn-On DelayTime	$V_{GS} = 10\text{V}$, $V_{DD} = 20\text{V}$ $I_D = 20\text{A}$, $R_{GEN} = 3\Omega$	-	15	-	ns
t_r	Turn-On Rise Time		-	26	-	ns
$t_{d(off)}$	Turn-Off DelayTime		-	47	-	ns
t_f	Turn-Off Fall Time		-	14	-	ns
Body Diode Characteristics						
I_S	Maximum Continuous Body Diode Forward Current		-	-	119	A
I_{SM}	Maximum Pulsed Body Diode Forward Current		-	-	476	A
V_{SD}	Body Diode Forward Voltage	$V_{GS} = 0\text{V}$, $I_S = 20\text{A}$	-		1.2	V
t_{rr}	Body Diode Reverse Recovery Time	$I_F = 20\text{A}$, $di/dt = 100\text{A}/\mu\text{s}$	38	53	72	ns
Q_{rr}	Body Diode Reverse Recovery Charge		-	65	-	nC

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
 2. E_{AS} condition: Starting $T_J = 25^\circ\text{C}$, $V_{DD} = 20\text{V}$, $V_{GS} = 10\text{V}$, $R_G = 25\text{ohm}$, $L = 3\text{mH}$, $I_{AS} = 15.4\text{A}$, $V_{DD} = 0\text{V}$ during time in avalanche.
 3. $R_{\theta JA}$ is measured with the device mounted on a 1inch^2 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

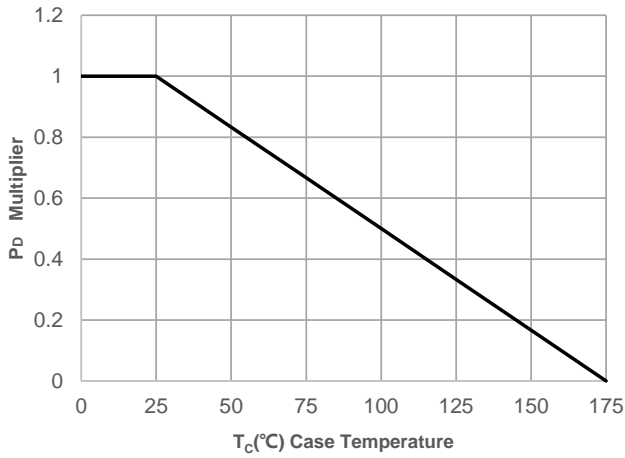


Figure 2: Current De-rating

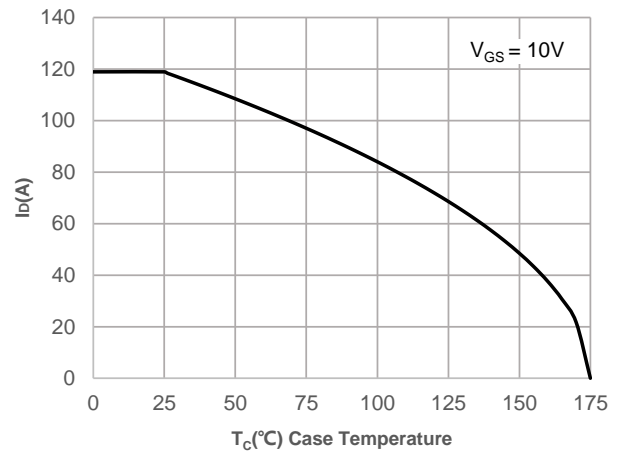


Figure 3: Normalized Maximum Transient Thermal Impedance

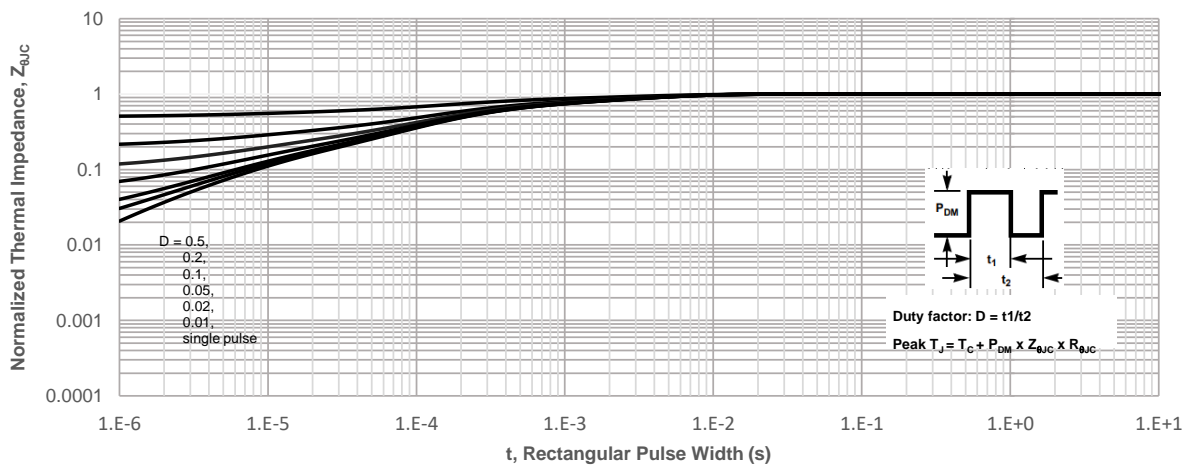
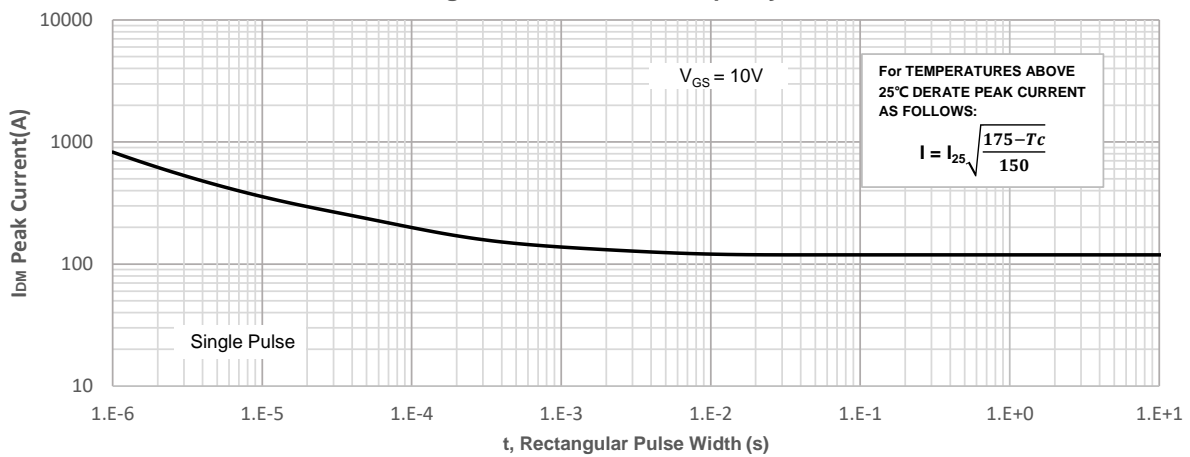


Figure 4: Peak Current Capacity



Typical Performance Characteristics

Figure 5: Output Characteristics

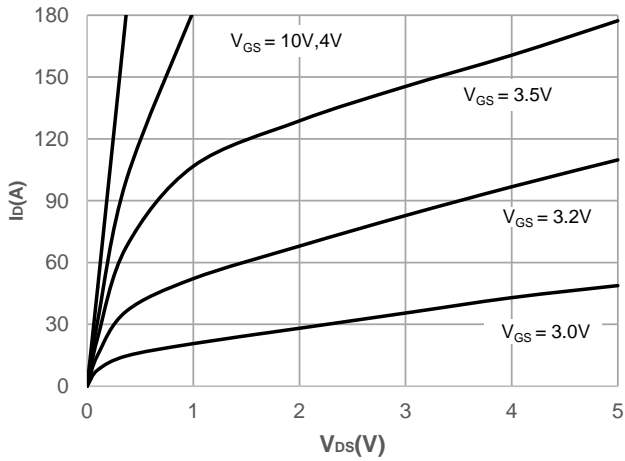


Figure 6: Typical Transfer Characteristics

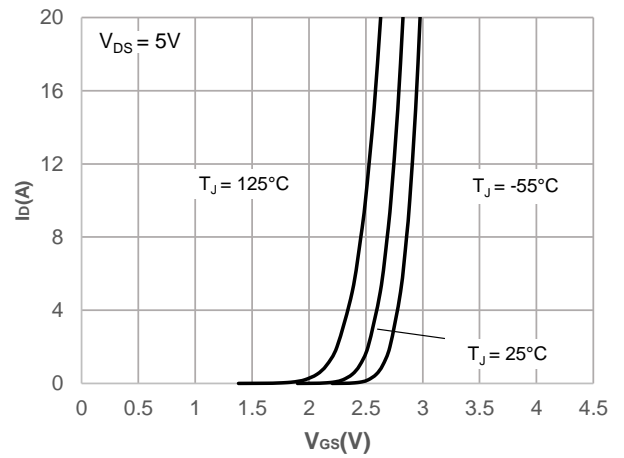


Figure 7: On-resistance vs. Drain Current

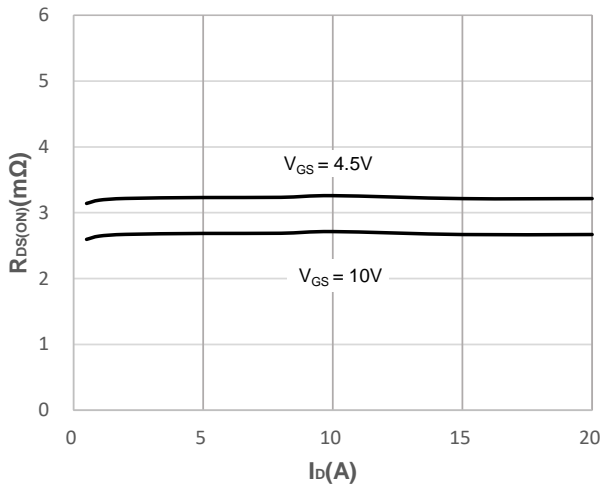


Figure 8: Body Diode Characteristics

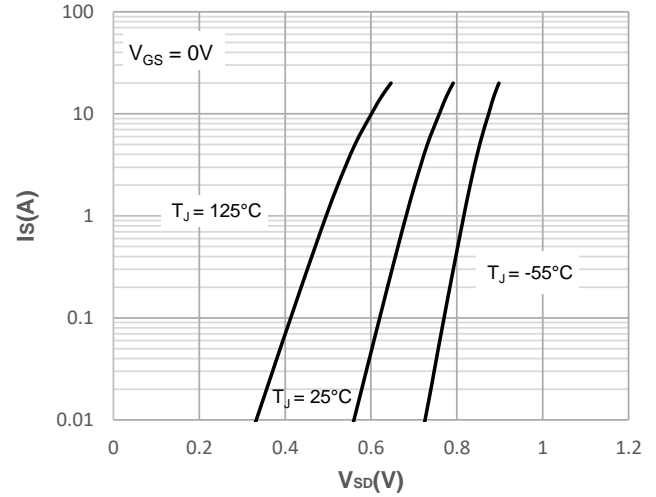


Figure 9: Gate Charge Characteristics

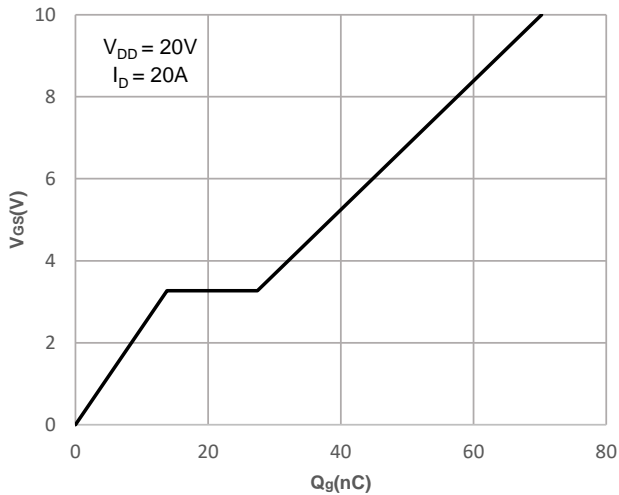
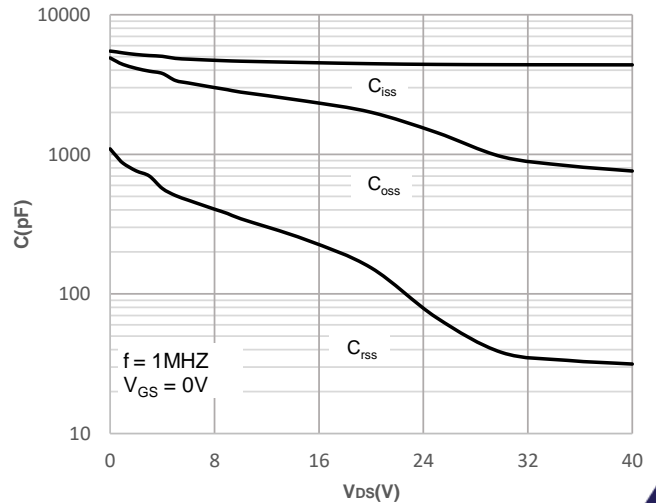


Figure 10: Capacitance Characteristics



Typical Performance Characteristics

Figure 11: Normalized Breakdown voltage vs. Junction Temperature

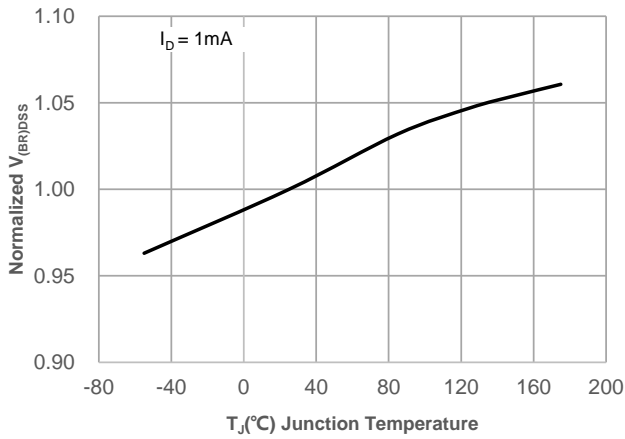


Figure 12: Normalized on Resistance vs. Junction Temperature

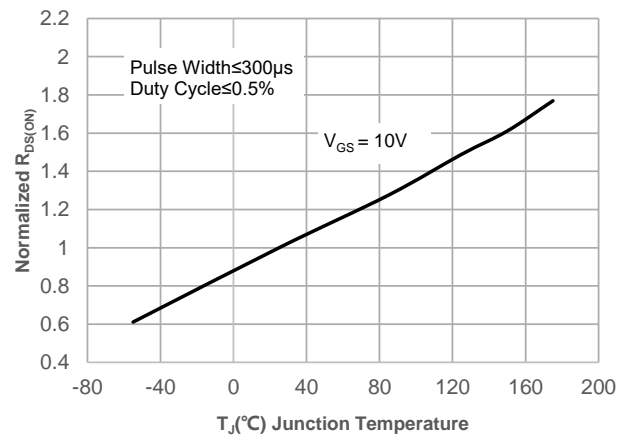


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

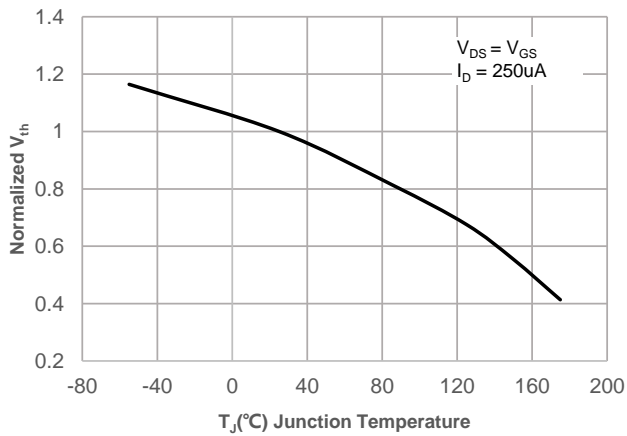


Figure 14: $R_{DS(ON)}$ vs. V_{GS}

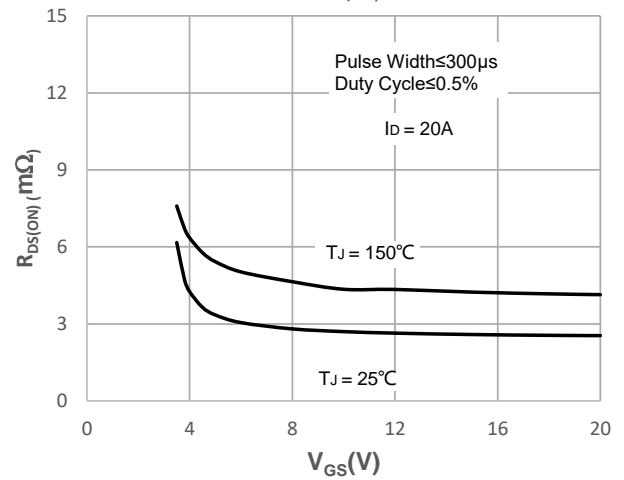
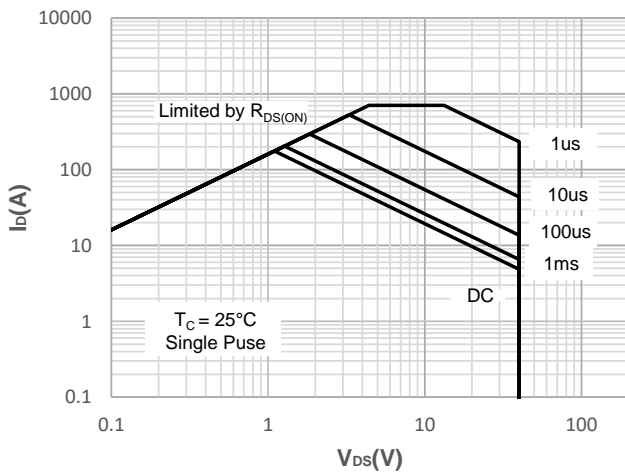


Figure 15: Maximum Safe Operating Area



Test Circuit

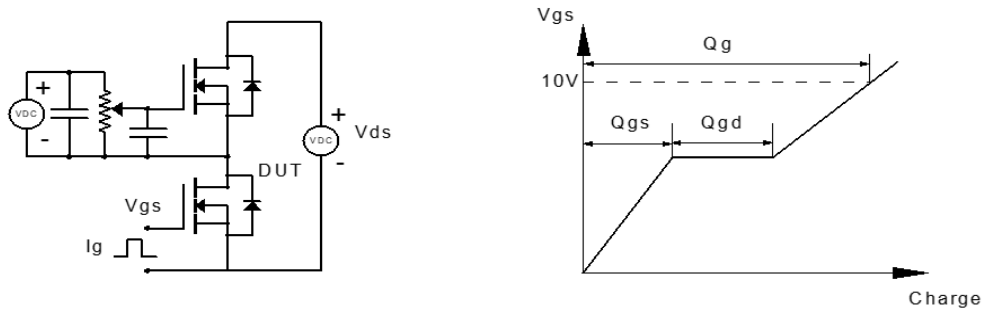


Figure 1: Gate Charge Test Circuit & Waveform

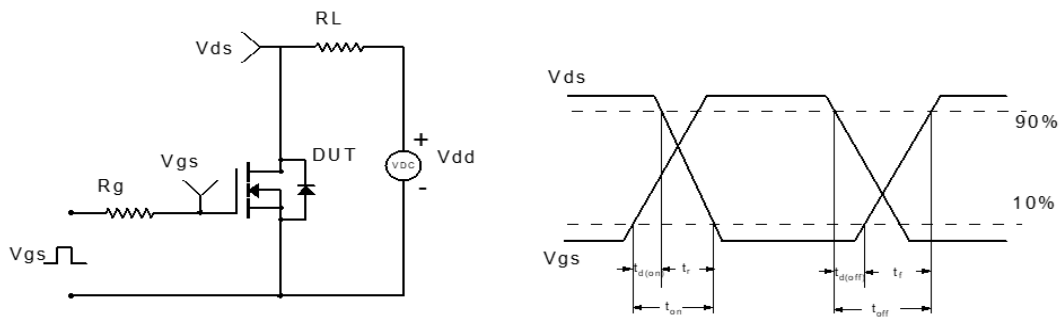


Figure 2: Resistive Switching Test Circuit & Waveform



Figure 3: Unclamped Inductive Switching Test Circuit & Waveform

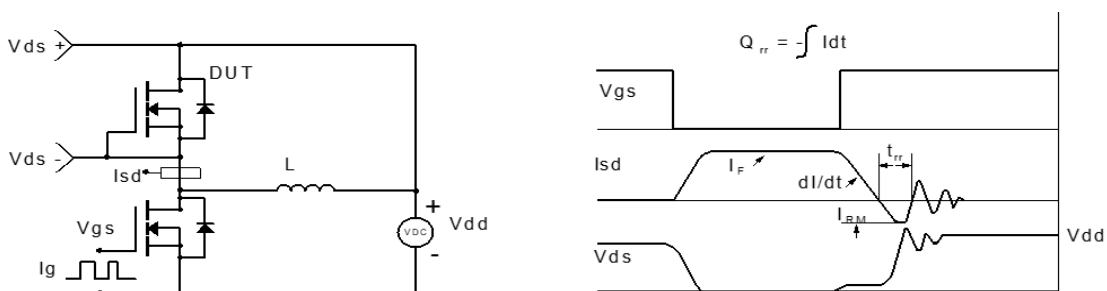
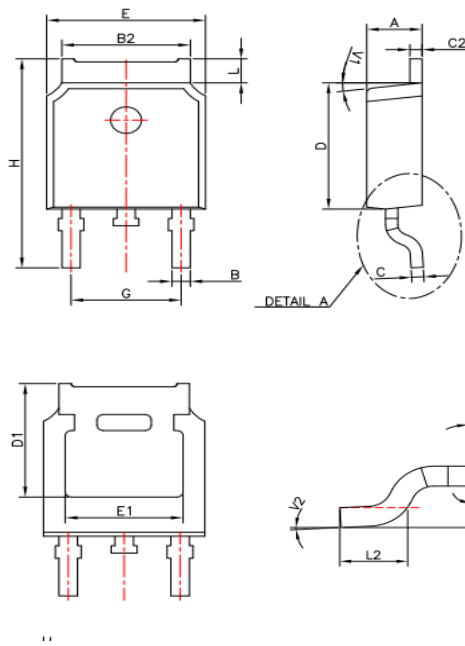


Figure 4: Diode Recovery Test Circuit & Waveform



Package Mechanical Data(TO-252-3L)


Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	2.10	2.30	2.50	0.083	0.091	0.098
A2	0	---	0.15	0	---	0.006
B	0.66	0.76	0.86	0.026	0.030	0.034
B2	5.18	5.33	5.48	0.202	0.210	0.216
C	0.40	0.508	0.60	0.016	0.020	0.024
C2	0.44	0.508	0.58	0.017	0.020	0.023
D	5.90	6.10	6.30	0.232	0.240	0.248
D1	5.30REF			0.209REF		
E	6.40	6.60	6.80	0.252	0.260	0.268
E1	4.826 REF			0.19 REF		
G	4.47	4.57	4.67	0.176	0.180	0.184
H	9.50	10.10	10.70	0.374	0.398	0.421
L	0.95	1.16	1.30	0.037	0.046	0.051
L2	1.35	1.50	1.65	0.053	0.059	0.065
V1	---	7°	---	---	7°	---
V2	0°	---	6°	0°	---	6°

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