

# 40V, 222A, 2.5mΩ N-channel Power SGT MOSFET

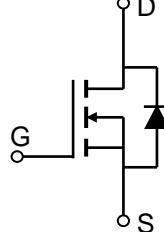
## JMSL0402MGQ

Features	Product Summary		
• Ultra-low ON-resistance, RDS(ON)	Parameters	Value	Unit
• Low Gate Charge	$V_{DSS}$	40	V
• 100% UIS Tested	$V_{GS(th)}_{Typ}$	1.9	V
• 100% $\Delta V_{ds}$ Tested	$I_D(@V_{GS}=10V)$	222	A
• Halogen-free; RoHS-compliant	$R_{DS(ON)}_{Typ}(@V_{GS}=10V)$	1.8	mΩ
• AEC-Q101 Qualified	$R_{DS(ON)}_{Typ}(@V_{GS}=4.5V)$	2.5	mΩ

Applications	RoHS
• Load Switch • PWM Application • General Automotive Application	

Top View	Bottom View		
PDFN5X6-8L	Pin Assignment	Schematic Diagram	

### Ordering Information

Device	Marking	MSL	Form	Package	Reel(pcs)	Per Carton (pcs)
JMSL0402MGQ-13	SL0402MQ	1	Tape&Reel	PDFN5x6-8L	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	$\pm 20$	V
$I_D$	Continuous Drain Current	$T_C = 25^\circ\text{C}$	222
		$T_C = 100^\circ\text{C}$	157
$I_{DM}$	Pulsed Drain Current <sup>(1)</sup>	Refer to Fig.4	A
$E_{AS}$	Single Pulsed Avalanche Energy <sup>(2)</sup>	356	mJ
$P_D$	Power Dissipation	$T_C = 25^\circ\text{C}$	150
		$T_C = 100^\circ\text{C}$	75
$T_J, T_{STG}$	Junction & Storage Temperature Range	-55 to 175	°C

### Thermal Characteristics

Symbol	Parameter	Max	Unit
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient <sup>(3)</sup>	42	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to Case	1.0	



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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Off Characteristics</b>						
$V_{(\text{BR})\text{DSS}}$	Drain-Source Breakdown Voltage	$I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$	40	-	-	V
$I_{\text{DSS}}$	Zero Gate Voltage Drain Current	$V_{DS} = 32\text{V}, V_{GS} = 0\text{V}$	-	-	1.0	$\mu\text{A}$
$I_{\text{GSS}}$	Gate-Body Leakage Current	$V_{DS} = 0\text{V}, V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GS(\text{th})}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu\text{A}$	1.3	1.9	2.4	V
$R_{\text{DS}(\text{ON})}$	Static Drain-Source ON-Resistance <sup>(4)</sup>	$V_{GS} = 10\text{V}, I_D = 20\text{A}$	-	1.8	2.4	$\text{m}\Omega$
		$V_{GS} = 4.5\text{V}, I_D = 15\text{A}$	-	2.5	3.2	$\text{m}\Omega$
<b>Dynamic Characteristics</b>						
$R_g$	Gate Resistance	$f = 1\text{MHz}$	-	1.0	-	$\Omega$
$C_{\text{iss}}$	Input Capacitance	$V_{GS} = 0\text{V}, V_{DS} = 20\text{V}, f = 1\text{MHz}$	3184	4458	6018	pF
$C_{\text{oss}}$	Output Capacitance		1429	2000	2700	pF
$C_{\text{rss}}$	Reverse Transfer Capacitance		110	154	208	pF
$Q_g$	Total Gate Charge	$V_{GS} = 0 \text{ to } 10\text{V}$ $V_{DS} = 20\text{V}, I_D = 20\text{A}$	50	70	95	nC
$Q_{\text{gs}}$	Gate Source Charge		10	14	19	nC
$Q_{\text{gd}}$	Gate Drain("Miller") Charge		10	14	18	nC
<b>Switching Characteristics</b>						
$t_{d(\text{on})}$	Turn-On Delay Time	$V_{GS} = 10\text{V}, V_{DD} = 20\text{V}$ $I_D = 20\text{A}, R_{\text{GEN}} = 3\Omega$	-	15	-	ns
$t_r$	Turn-On Rise Time		-	26	-	ns
$t_{d(\text{off})}$	Turn-Off Delay Time		-	47	-	ns
$t_f$	Turn-Off Fall Time		-	14	-	ns
<b>Body Diode Characteristics</b>						
$I_s$	Maximum Continuous Body Diode Forward Current	-	-	222	-	A
$I_{\text{SM}}$	Maximum Pulsed Body Diode Forward Current	-	-	887	-	A
$V_{SD}$	Body Diode Forward Voltage	$V_{GS} = 0\text{V}, I_s = 20\text{A}$	-		1.2	V
$\text{trr}$	Body Diode Reverse Recovery Time	$I_F = 20\text{A}, \text{di/dt} = 100\text{A/us}$	38	53	72	ns
$Q_{\text{rr}}$	Body Diode Reverse Recovery Charge		-	65	-	nC

Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.

2.  $E_{AS}$  condition: Starting  $T_J=25^\circ\text{C}$ ,  $V_{DD}=20\text{V}$ ,  $V_G=10\text{V}$ ,  $R_G=25\text{ohm}$ ,  $L=3\text{mH}$ ,  $I_{AS}=15.4\text{A}$ ,  $V_{DD}=0\text{V}$  during time in avalanche.

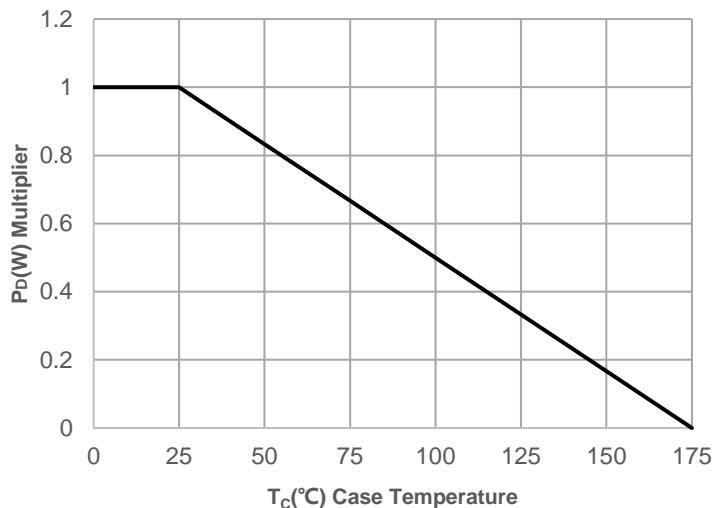
3.  $R_{\theta JA}$  is measured with the device mounted on a 1inch<sup>2</sup> pad of 2oz copper FR4 PCB.

4. Pulse Test: Pulse Width  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 0.5\%$ .

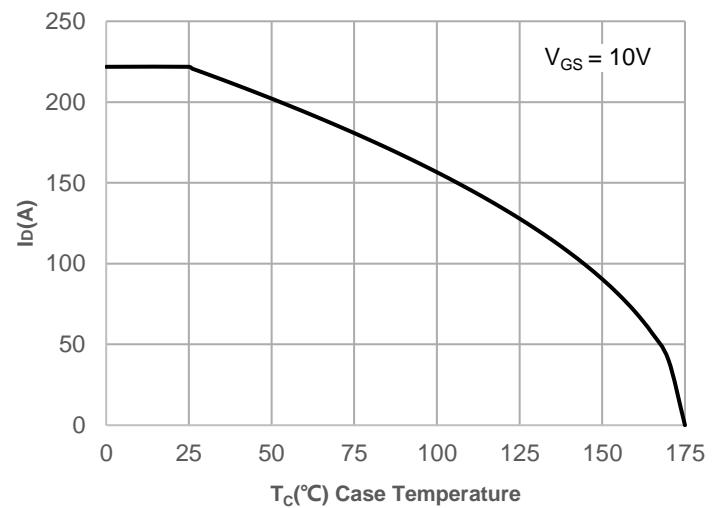


## Typical Performance Characteristics

**Figure 1: Power De-rating**



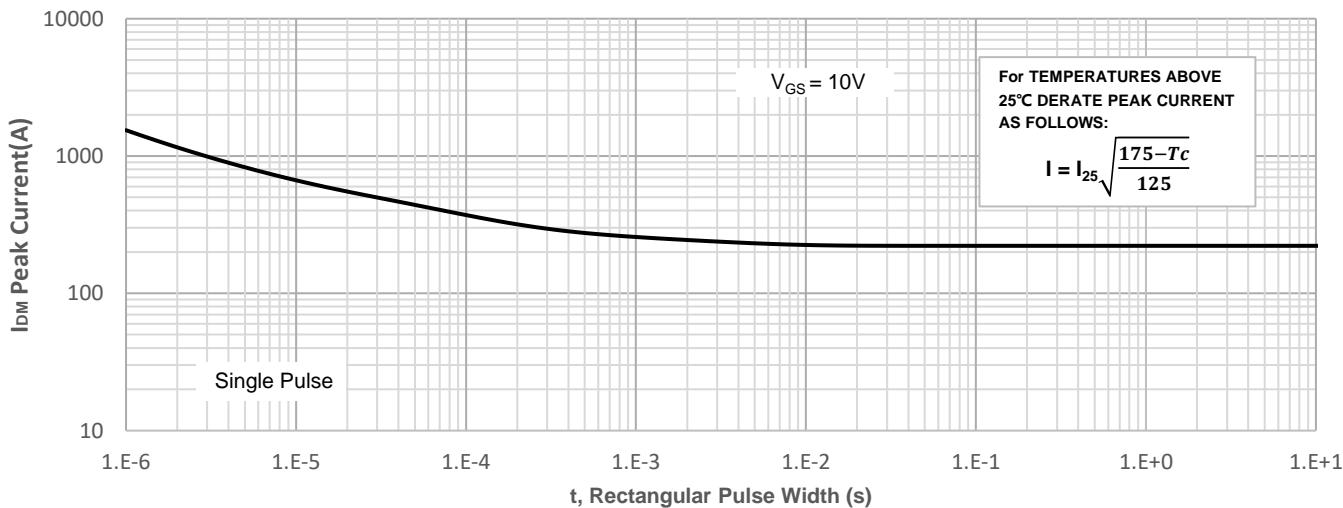
**Figure 2: Current De-rating**



**Figure 3: Normalized Maximum Transient Thermal Impedance**

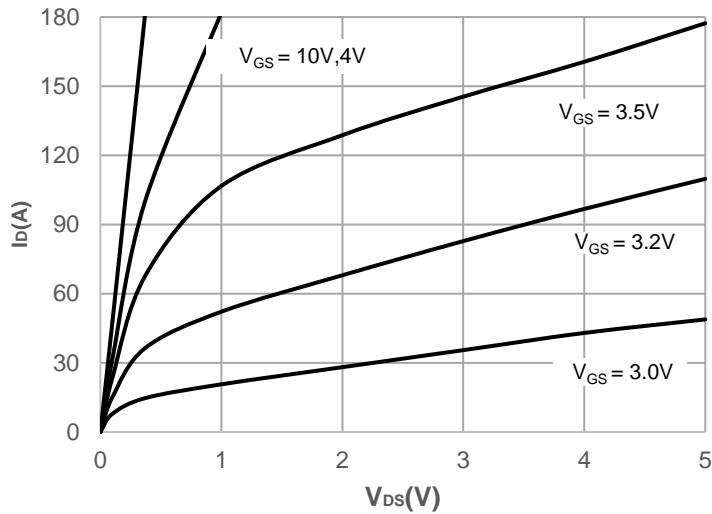


**Figure 4: Peak Current Capacity**

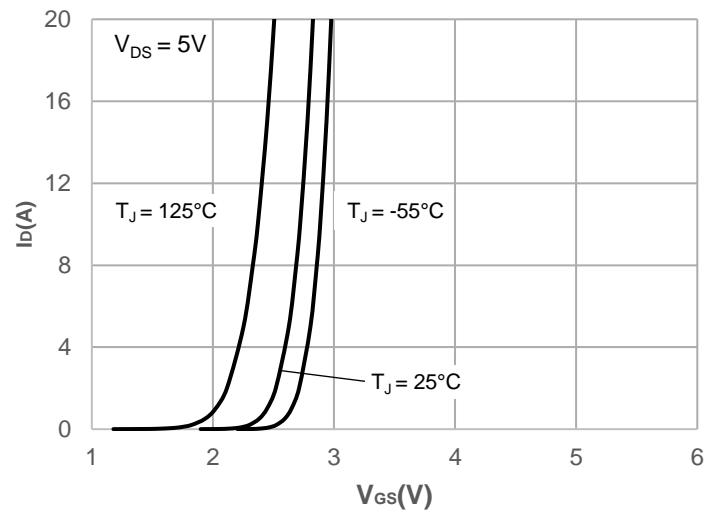


## Typical Performance Characteristics

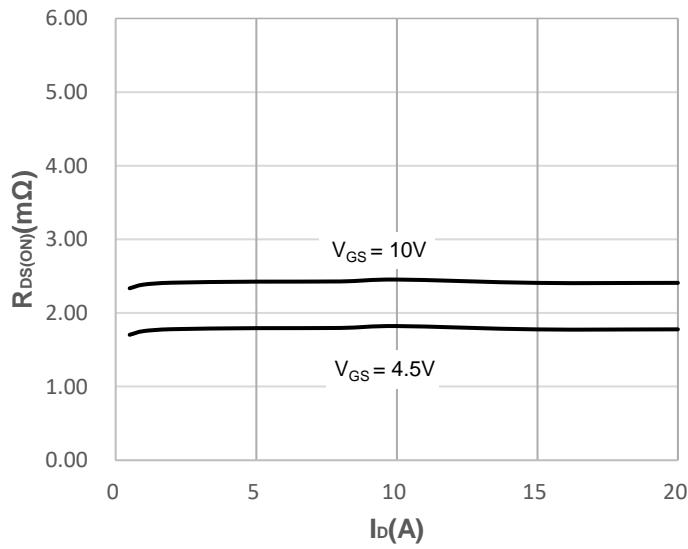
**Figure 5: Output Characteristics**



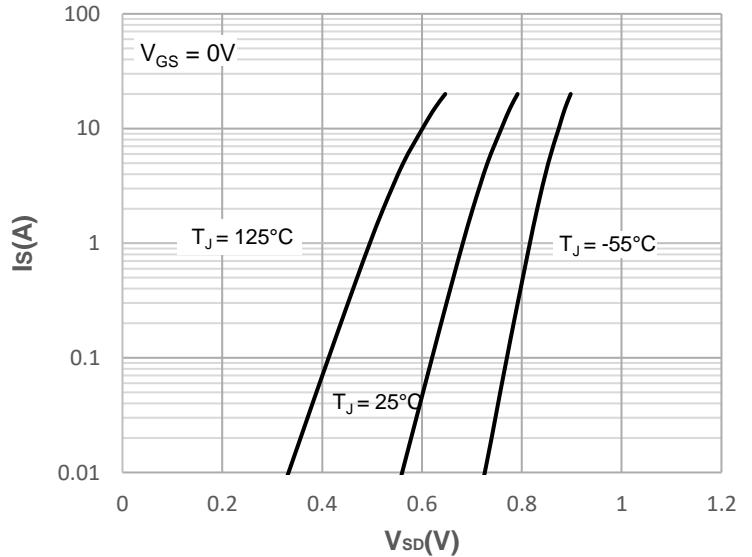
**Figure 6: Typical Transfer Characteristics**



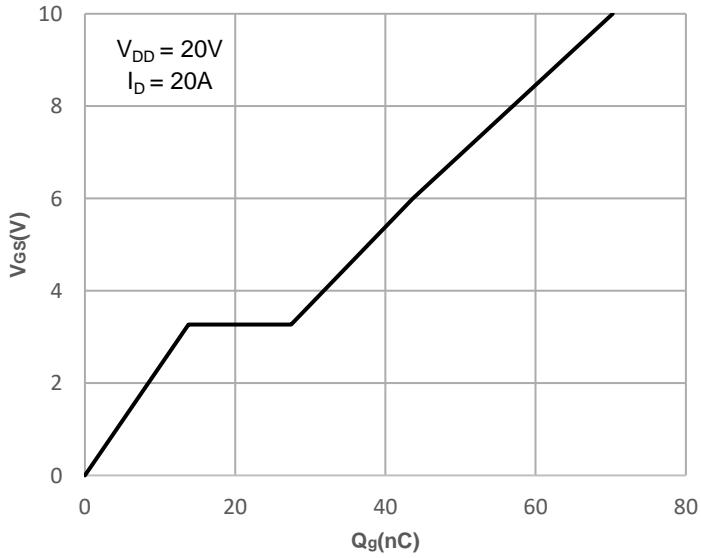
**Figure 7: On-resistance vs. Drain Current**



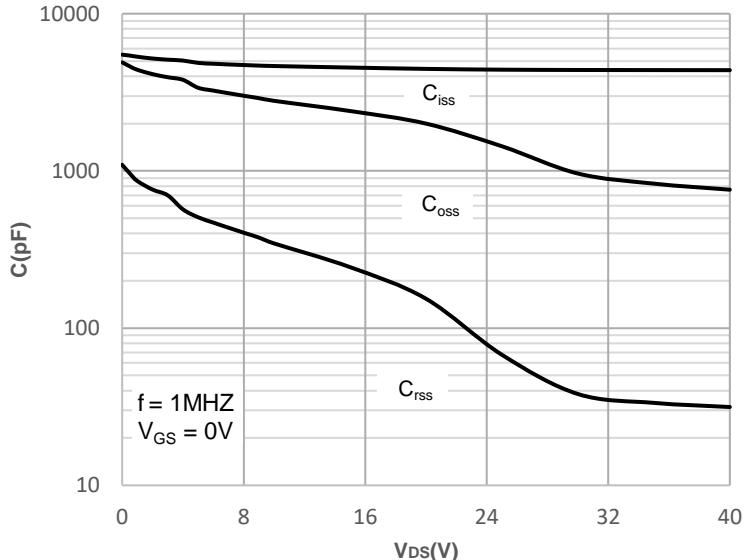
**Figure 8: Body Diode Characteristics**



**Figure 9: Gate Charge Characteristics**

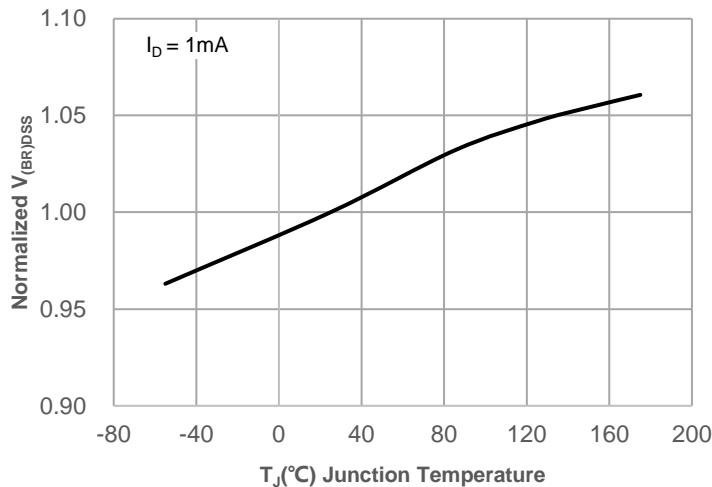


**Figure 10: Capacitance Characteristics**

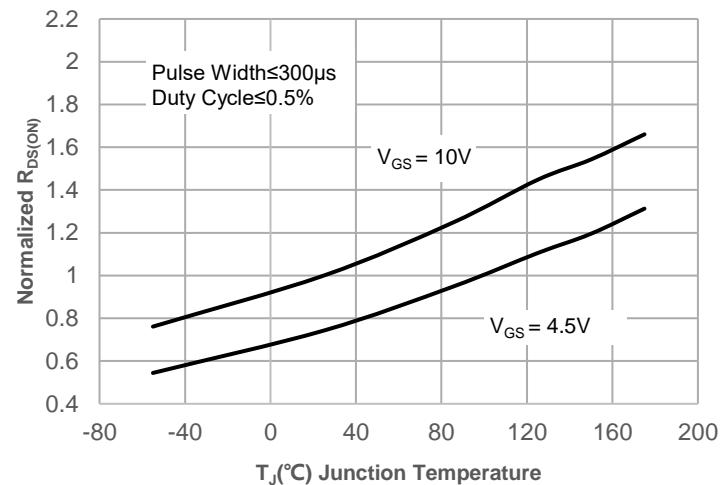


## Typical Performance Characteristics

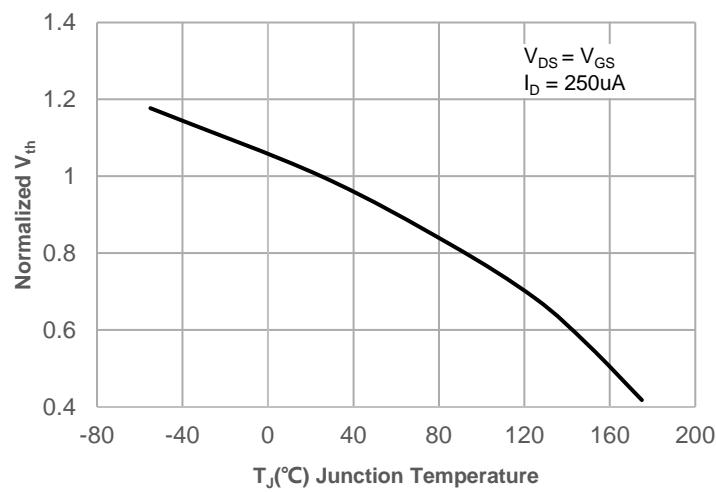
**Figure 11: Normalized Breakdown voltage vs. Junction Temperature**



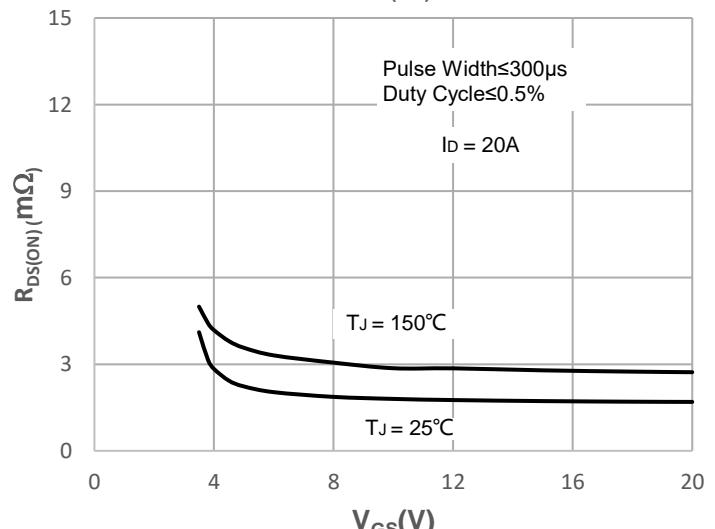
**Figure 12: Normalized on Resistance vs. Junction Temperature**



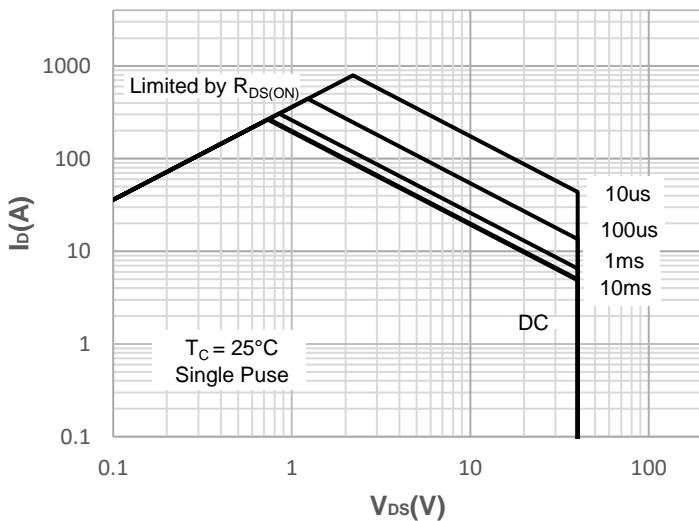
**Figure 13: Normalized Threshold Voltage vs. Junction Temperature**



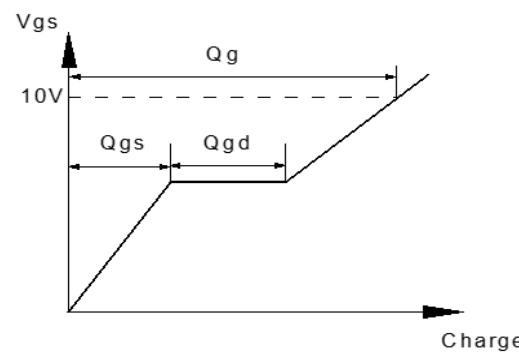
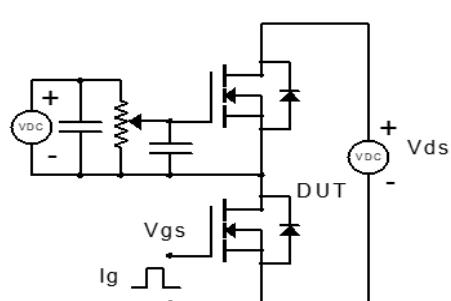
**Figure 14: R<sub>D<sub>S</sub>(on)</sub> vs. V<sub>G<sub>S</sub></sub>**



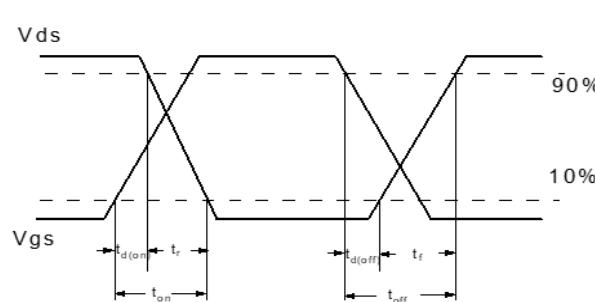
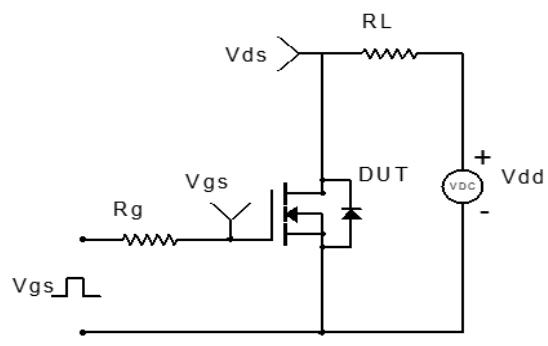
**Figure 15: Maximum Safe Operating Area**



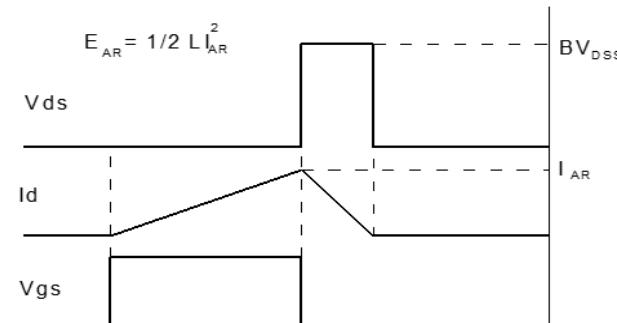
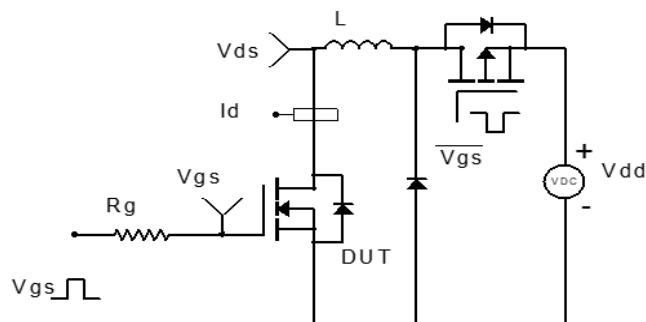
## Test Circuit



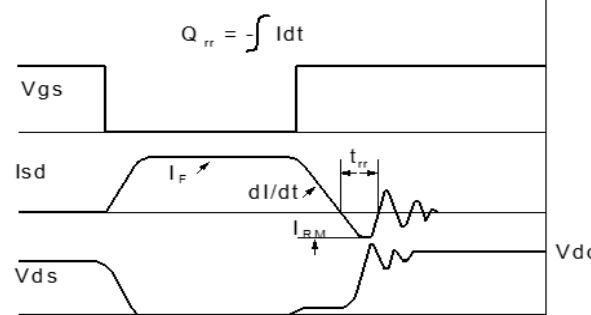
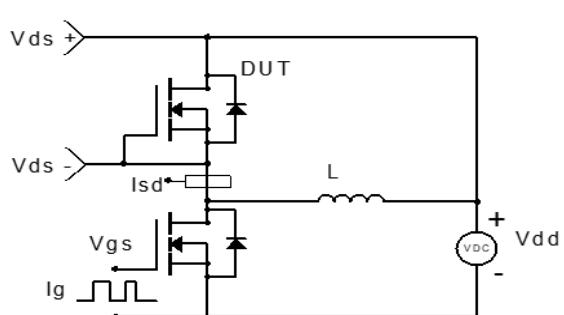
**Figure 1: Gate Charge Test Circuit & Waveform**



**Figure 2: Resistive Switching Test Circuit & Waveform**



**Figure 3: Unclamped Inductive Switching Test Circuit & Waveform**

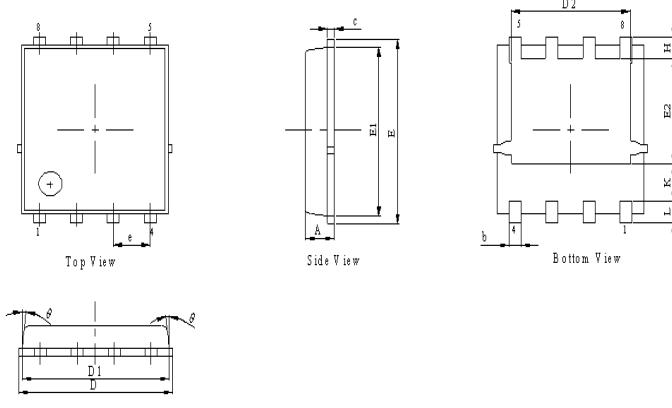


**Figure 4: Diode Recovery Test Circuit & Waveform**



## Package Mechanical Data(PDFN5X6-8L)

Package Outline

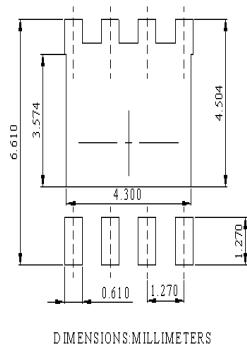


NOTES:

1. Dimension and tolerance per ASME Y14.5M, 1994.
2. All dimensions in millimeter (angle in degree).
3. Dimensions D1 and E1 do not include mold flash protrusions or gate burrs.

DIM.	MILLIMETER		
	MIN.	NOM.	MAX.
A	0.9	1	1.15
b	0.31	0.41	0.51
C	0.24	0.32	0.4
D	5	5.2	5.4
D1	4.95	5.05	5.15
D2	4	4.1	4.2
E	6.05	6.15	6.25
E1	5.5	5.6	5.7
E2	3.42	3.53	3.63
e		1.27 <sup>BSC</sup>	
H	0.6	0.7	0.8
L	0.5	0.7	0.8
K		1.23 <sup>REF</sup>	
O			10

Recommended Soldering Footprint



DIMENSIONS: MILLIMETERS

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