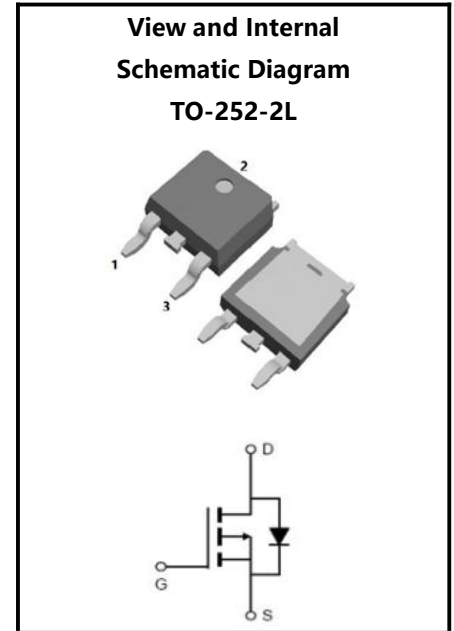


MOSFET

-39A, -60V, 19mΩ, P-CHANNEL MOSFET

Description and Applications

- ◆ Trench Power MV MOSFET technology
- ◆ Low RDS(ON) and low gate charge
- ◆ RoHS and Halogen Free Complaint
- ◆ Fast-switching
- ◆ Synchronous rectification in DC/DC and AC/DC converters
- ◆ industrial and motor drive applications.



Parameter	Values	Unit
BV_{DSS}	-60	V
I_D	-39	A
$R_{Dson(max)}$	19	mΩ
$V_{GS(th)}(Typ)$	-1.6	V

Ordering Code	Marking	Package	Packaging
X409CEA	X409CEA	TO-252-2L	Tape & Reel

Absolute Maximum Ratings($T_C=25^{\circ}C$, unless otherwise noted)

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Drain-Source Voltage	V_{DSS}	-	-	-60	V	$V_{GS}=0V$
Gate-Source Voltage	V_{GS}	-20	-	20	V	$V_{DS}=0V$
Continuous Drain Current(Note 1)	I_D	-	-	-39	A	$T_C=25^{\circ}C$
		-	-	-28	A	$T_C=100^{\circ}C$
Pulsed Drain Current(Note 2)	I_{DM}	-	-	-80	A	-
Maximum Power Dissipation	P_D	-	-	60	W	$T_C=25^{\circ}C$
		-	-	30	W	$T_C=100^{\circ}C$
Operating Junction and Storage Temperature Range	$T_{j, T_{STG}}$	-55	-	175	$^{\circ}C$	-

Thermal Characteristics

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Thermal resistance , Junction to Ambient(Note 1,4)	$R_{\theta JA}$	-	40	50	$^{\circ}C/W$	-
Thermal resistance , Junction to Case	$R_{\theta JC}$	-	1.1	2.5	$^{\circ}C/W$	-

Electrical Characteristics ($T_j=25^{\circ}\text{C}$, unless otherwise noted)
Static characteristics

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Drain-Source Breakdown Voltage	BV_{DSS}	-60	-	-	V	$V_{GS}=0V, I_D=-250\mu A$
Zero Gate Voltage Drain Current	I_{DSS}	-	-	-1	μA	$V_{DS}=-60V, V_{GS}=0V$
Gate-Body Leakage Current, Forward	I_{GSSF}	-	-	100	nA	$V_{GS}=20V, V_{DS}=0V$
Gate-Body Leakage Current, Reverse	I_{GSSR}	-	-	-100	nA	$V_{GS}=-20V, V_{DS}=0V$
Gate-Source Threshold Voltage	$V_{GS(th)}$	-1.1	-	-2.1	V	$V_{DS}=V_{GS}, I_D=-250\mu A$
Drain-Source On-State Resistance	$R_{DS(on)}$	-	14	19	m Ω	$V_{GS}=-10V, I_D=-20A$
		-	15.8	22	m Ω	$V_{GS}=-4.5V, I_D=-20A$
Gate resistance	R_g	-	8.7	-	Ω	$V_{GS}=0V, V_{DS}=0V, f=1\text{MHz}$
Forward Transconductance	g_{fs}	-	70	-	S	$V_{DS}=-5V, I_D=-20A$

Dynamic characteristics

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Input Capacitance	C_{iss}	-	5045	-	pF	$V_{DS}=-30V, V_{GS}=0V, f=1.0\text{MHz}$
Output Capacitance	C_{oss}	-	231	-	pF	
Reverse Transfer Capacitance	C_{rss}	-	157	-	pF	
Turn-On Delay Time	$t_{d(on)}$	-	8	-	ns	$V_{DD}=-30V, R_G=3\Omega, V_{GS}=-10V, R_L=1.5\Omega,$
Turn-On Rise Time	t_r	-	47	-	ns	
Turn-Off Delay Time	$t_{d(off)}$	-	85	-	ns	
Turn-Off Fall Time	t_f	-	222	-	ns	

Gate charge characteristics

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Total Gate Charge	Q_g	-	96	-	nC	$V_{DS}=-30V, I_D=-20A, V_{GS}=-10V$
Gate-Source Charge	Q_{gs}	-	18	-	nC	
Gate-Drain Charge	Q_{gd}	-	16	-	nC	

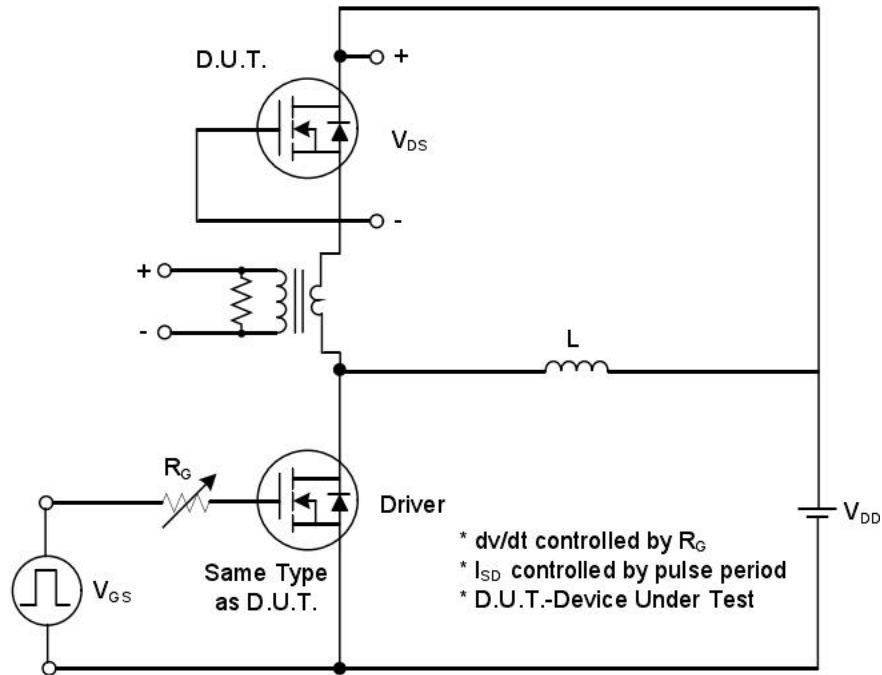
Reverse diode

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Continuous Diode Forward Current	I_S	-	-	-39	A	-
Diode Forward Voltage	V_{SD}	-	-	-1	V	$I_S=-1A, V_{GS}=0V$
Body Diode Reverse Recovery Time	t_{rr}	-	29	-	ns	$V_{GS}=0V, I_S=-20A, di/dt=-100A/\mu s$
Body Diode Reverse Recovery Charge	Q_{rr}	-	20	-	nC	

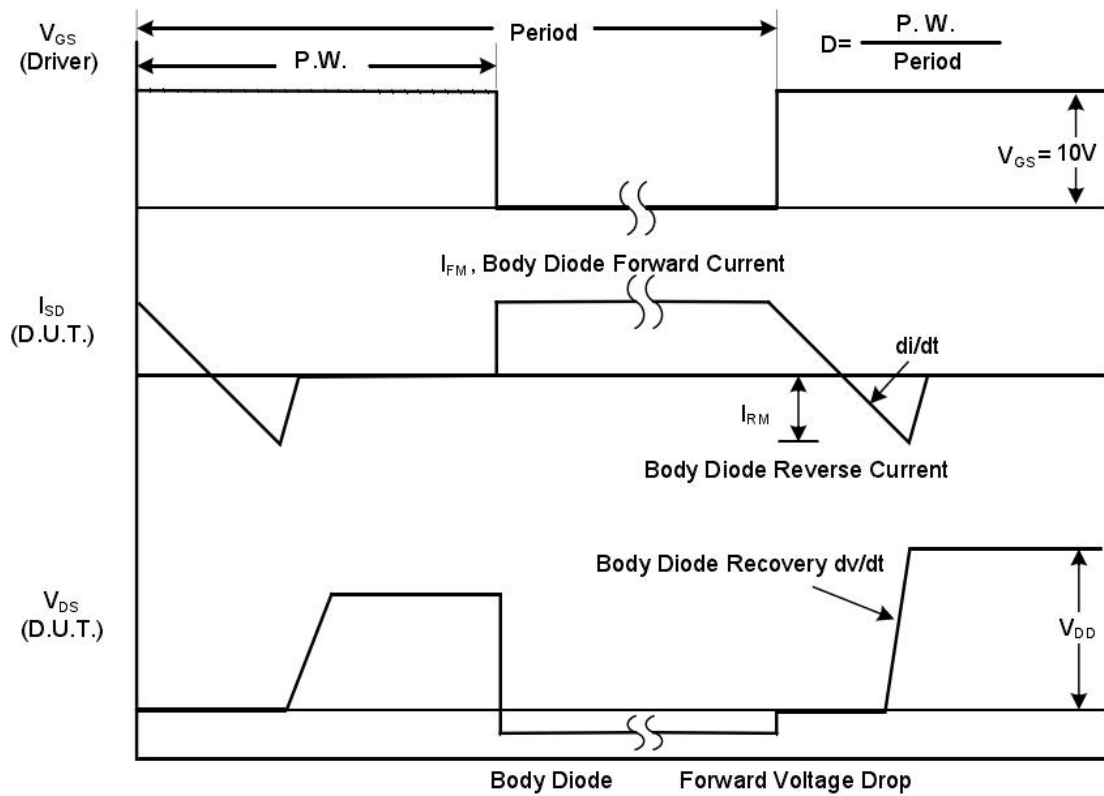
Notes

1. Computed continuous current assumes the condition of T_{j_Max} while the actual continuous current depends on the thermal & electro-mechanical application board design.
2. This single-pulse measurement was taken under $T_{j_Max} = 150^{\circ}\text{C}$.

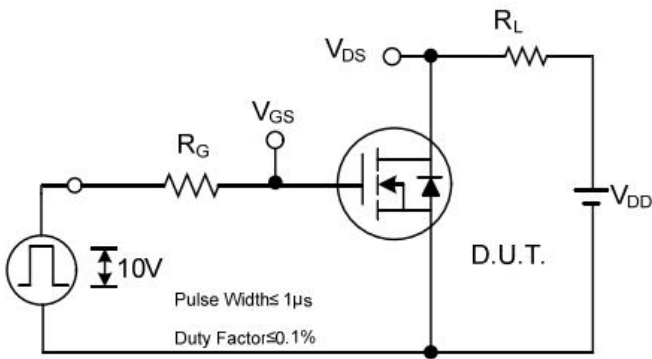
RATING AND CHARACTERISTIC CURVES



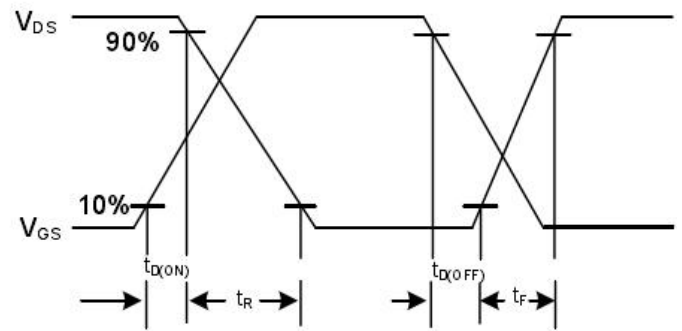
Peak Diode Recovery dv/dt Test Circuit



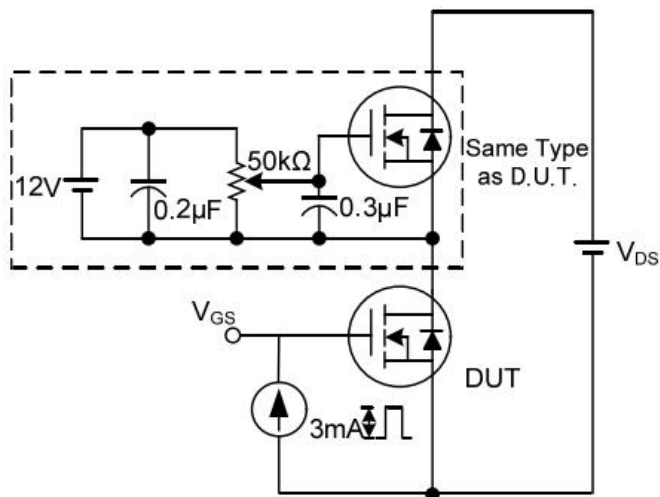
Peak Diode Recovery dv/dt Waveforms



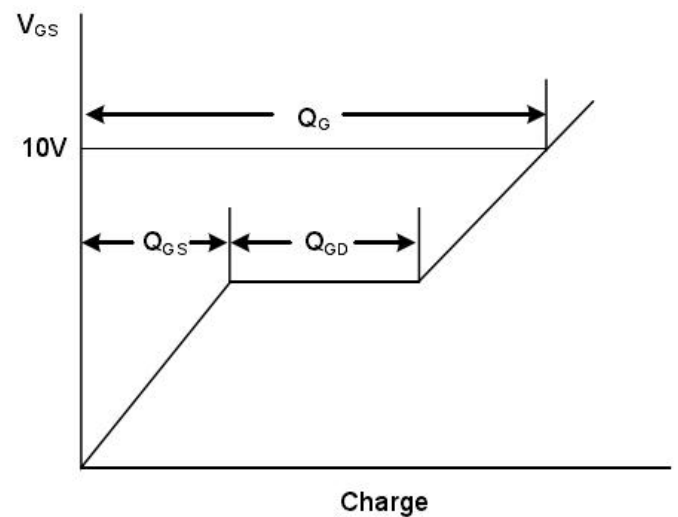
Switching Test Circuit



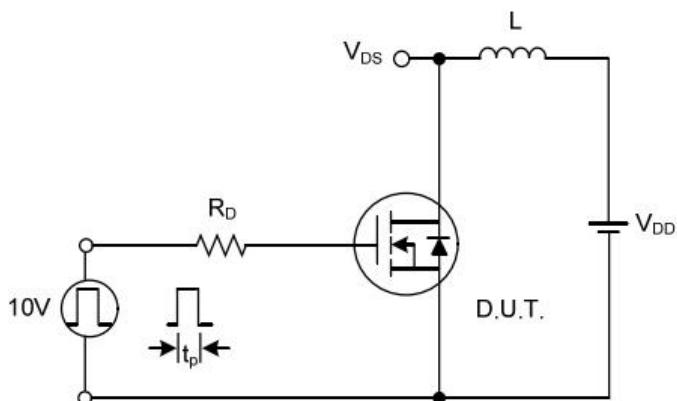
Switching Waveforms



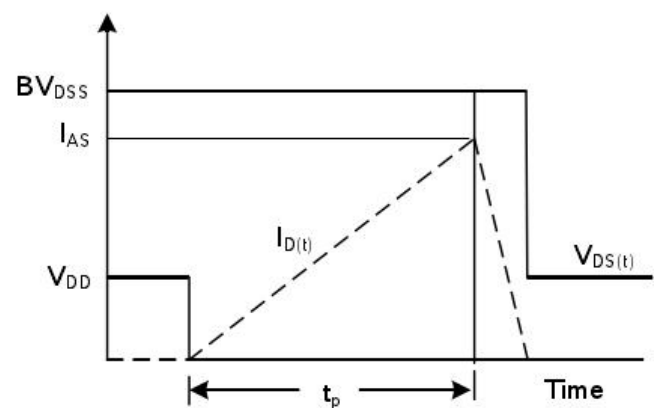
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

RATING AND CHARACTERISTIC CURVES

Figure.1 On-Region Characteristics

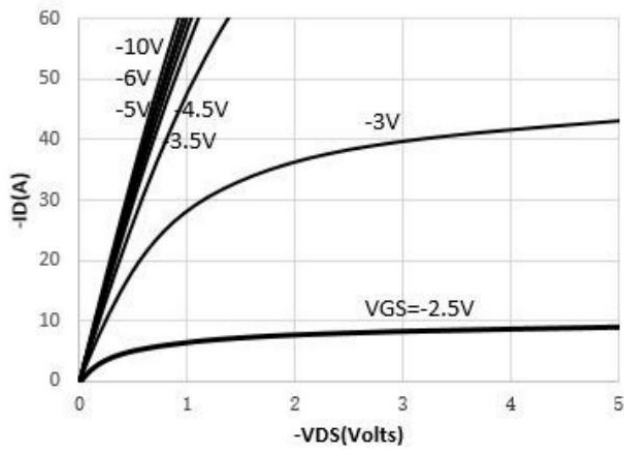


Figure.2 Transfer Characteristics

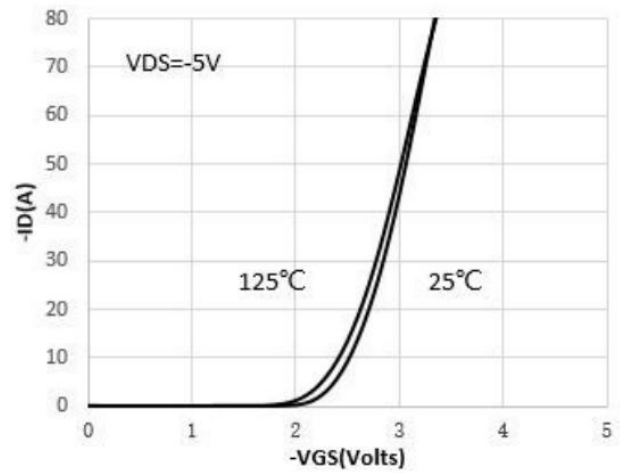


Figure.3 On-Resistance vs. Drain Current and Gate Voltage

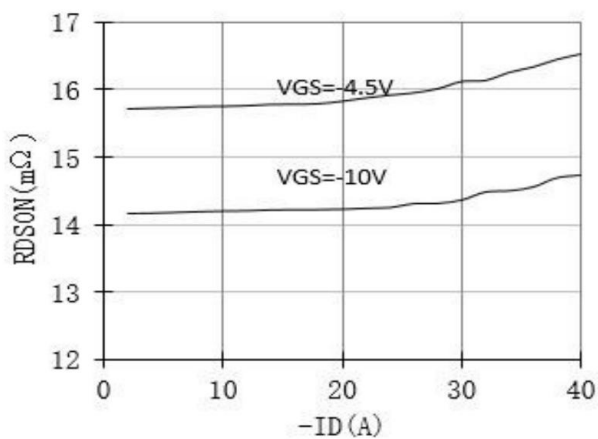


Figure.4 On-Resistance vs. Junction Temperature

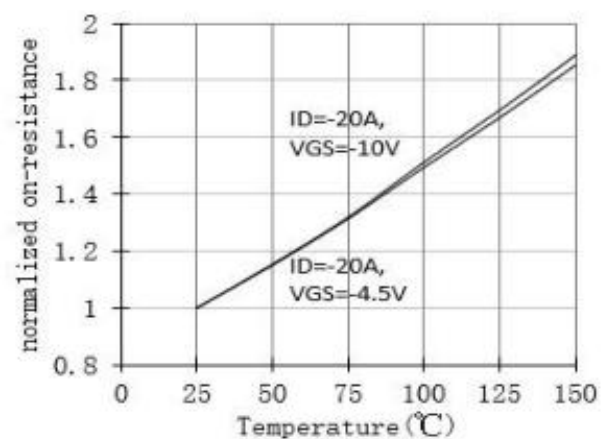


Figure.5 On-Resistance vs. Gate-Source Voltage

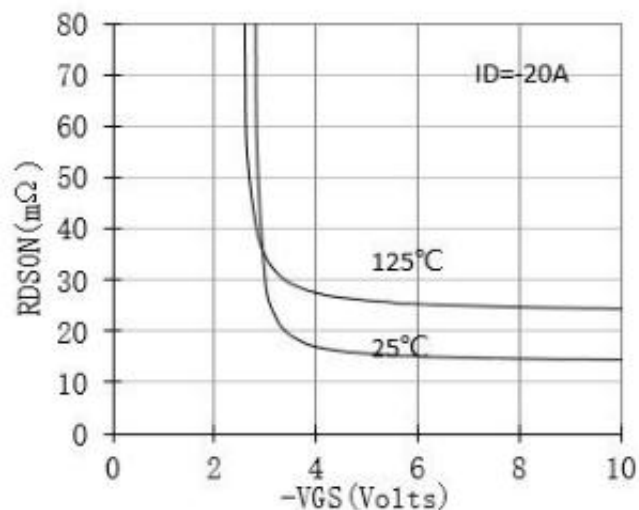


Figure.6 Body-Diode Characteristics

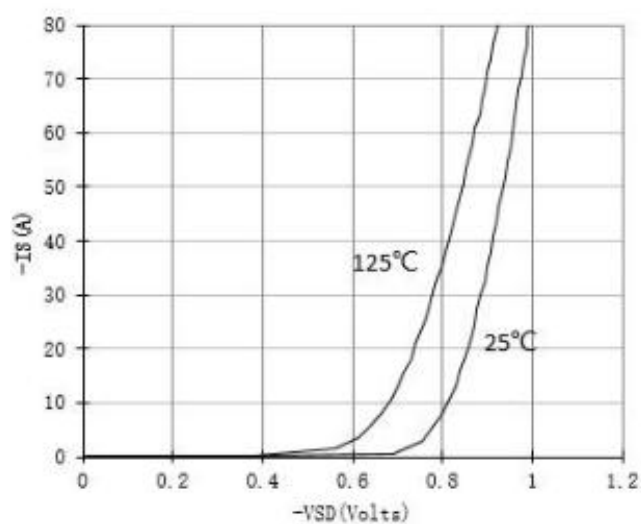


Figure.7 Gate-Charge Characteristics

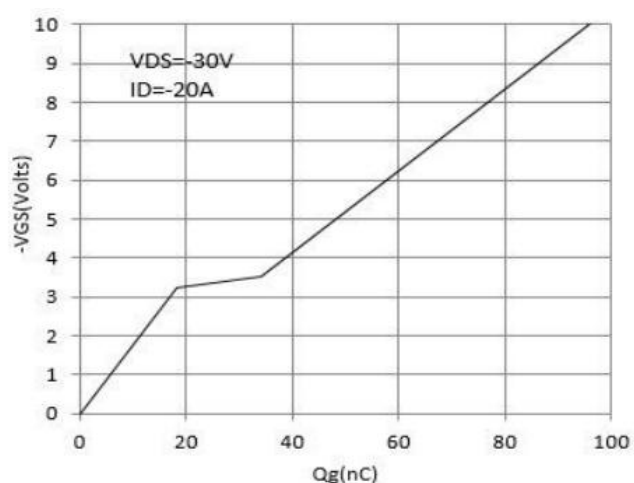


Figure.8 Capacitance Characteristics

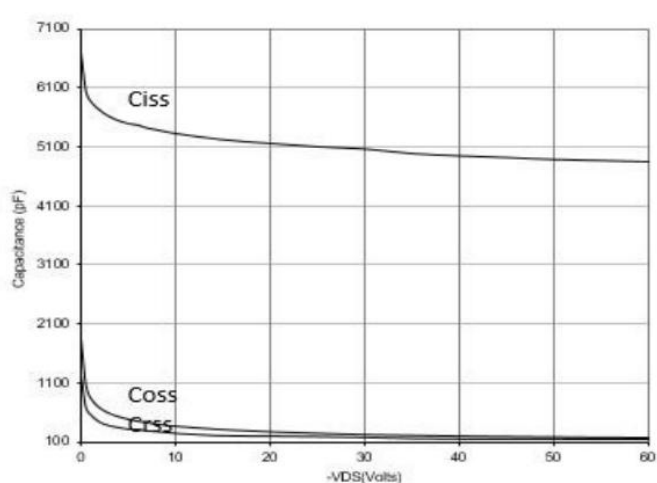


Figure.9 Maximum Forward Biased Safe Operating Area

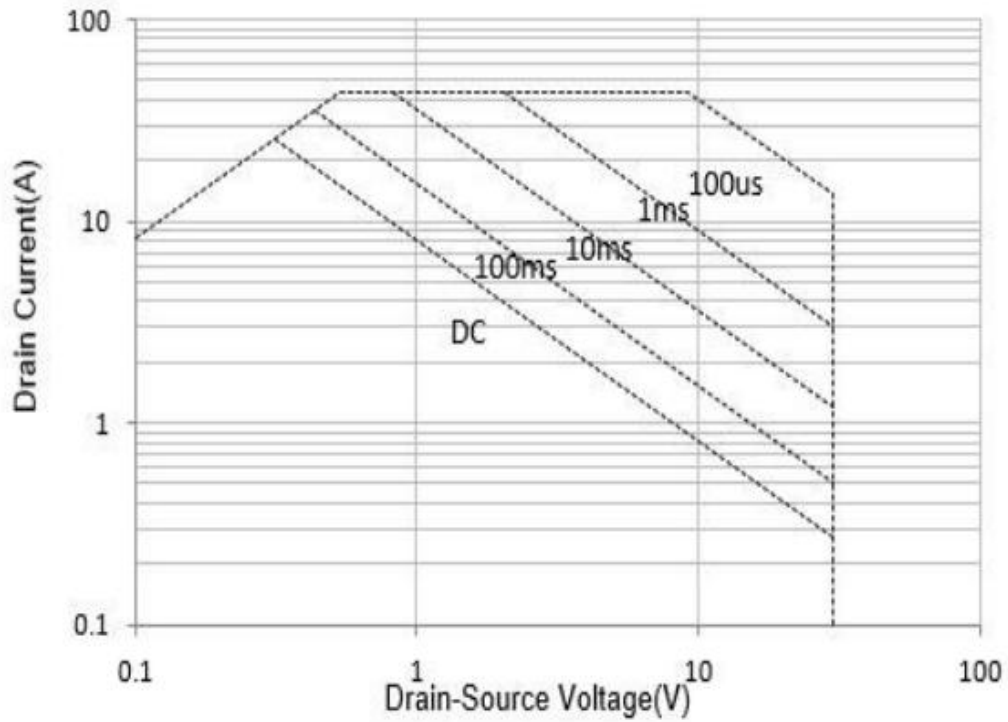
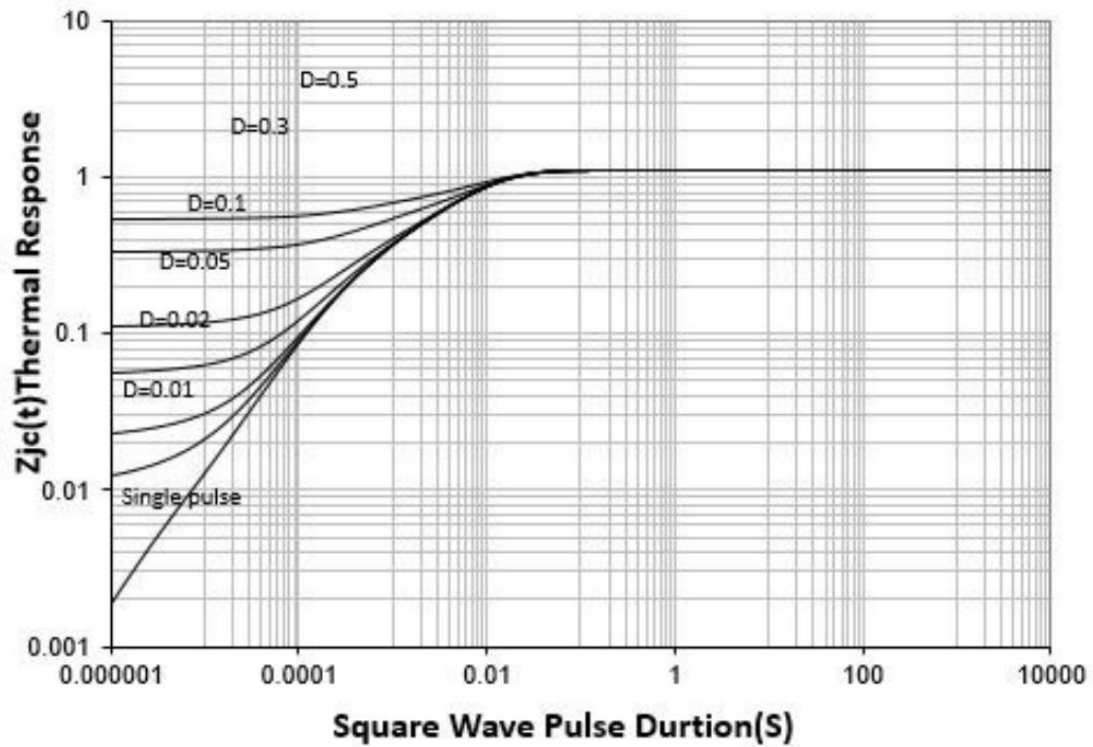
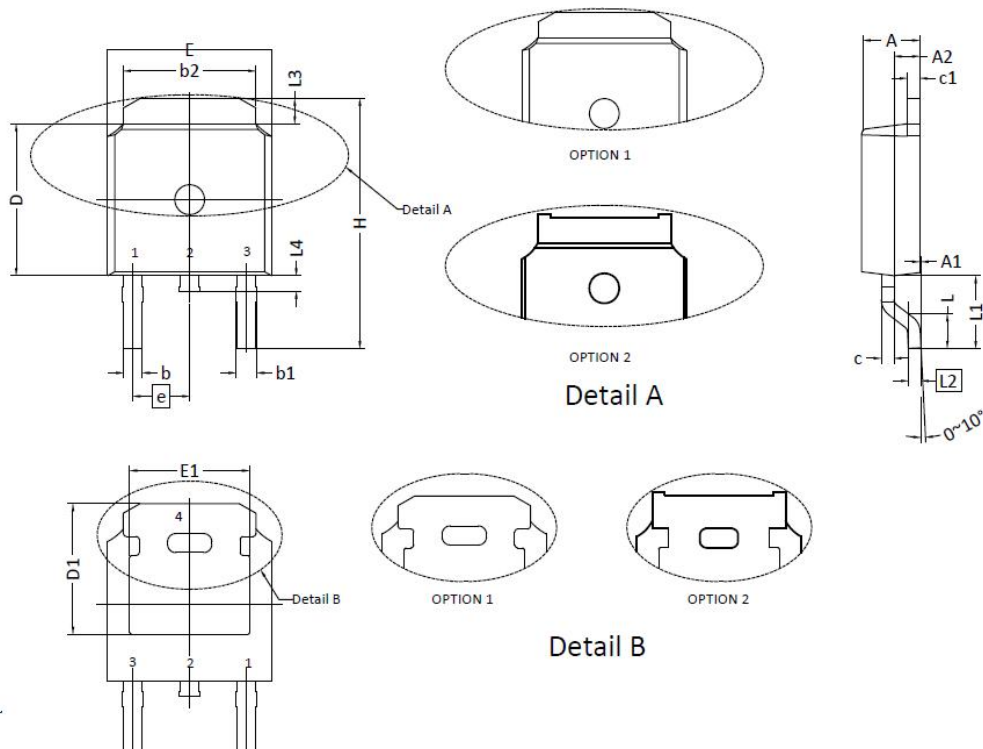


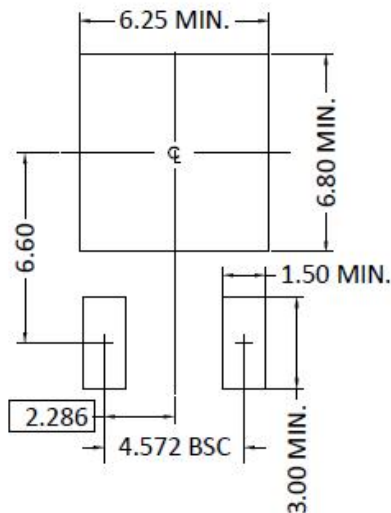
Figure 10: Maximum Transient Thermal Impedance (Note 5)



Package Outline: TO-252-2L



RECOMMENDED LAND PATTERN



SYMBOLS	DIMENSION IN MM			DIMENSION IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	2.184	2.286	2.400	0.086	0.090	0.094
A1	0.000	---	0.200	0.000	---	0.008
A2	0.889	1.041	1.170	0.035	0.041	0.046
b	0.635	0.762	0.889	0.025	0.030	0.035
b1	0.680	0.840	1.143	0.027	0.033	0.045
b2	4.953	5.340	5.500	0.195	0.210	0.217
c	0.450	0.508	0.610	0.018	0.020	0.024
c1	0.450	0.508	0.630	0.018	0.020	0.025
D	5.969	6.096	6.223	0.235	0.240	0.245
D1	5.210	5.249	5.380	0.205	0.207	0.212
E	6.350	6.604	6.800	0.250	0.260	0.268
E1	4.318	4.826	4.920	0.170	0.190	0.194
e	2.286 BSC			0.090 BSC		
e1	4.572 BSC			0.180 BSC		
H	9.398	10.033	10.500	0.370	0.395	0.413
L	1.270	1.520	2.032	0.050	0.060	0.080
L1	2.921 REF.			0.115 REF.		
L2	0.408	0.508	0.608	0.016	0.020	0.024
L3	0.889	1.016	1.270	0.035	0.040	0.050
L4	0.600	---	1.016	0.024	---	0.040

1. PACKAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS. MOLD FLASH SHOULD BE LESS THAN 6 MILS.
2. DIMENSION L IS MEASURED IN GAUGE PLANE.
3. TOLERANCE 0.10 mm UNLESS OTHERWISE SPECIFIED.
4. CONTROLLING DIMENSION IS MILLIMETER. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
5. REFER TO JEDEC TO-252 (AA).