

TM60G04GD

N+P-Channel Enhancement Mode Mosfet

General Description

- Low $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

Applications

- Load switch
- PWM

General Features

N Channel

$V_{DS} = 40V$ $I_D = 55A$
 $R_{DS(ON)} = 4.2m\Omega$ (typ.) @ $V_{GS} = 10V$

P Channel

$V_{DS} = -40V$ $I_D = -48A$
 $R_{DS(ON)} = 11m\Omega$ (typ.) @ $V_{GS} = -10V$

100% UIS Tested

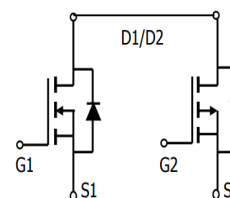
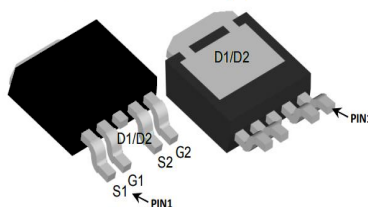
100% R_g Tested



GD:TO-252-4L



Marking: 50G04



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

Symbol	Parameter	Rating		Units
		N-Ch	P-Ch	
V_{DS}	Drain-Source Voltage	40	-40	V
V_{GS}	Gate-Source Voltage	± 20	± 20	V
$I_D @ T_a = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V^1$	55	-48	A
$I_D @ T_a = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V^1$	35	-30	A
I_{DM}	Pulsed Drain Current ²	250	-220	A
$P_D @ T_C = 25^\circ C$	Total Power Dissipation ⁴	55	55	W
T_{STG}	Storage Temperature Range	-55 to 150	-55 to 150	$^\circ C$
T_J	Operating Junction Temperature Range	-55 to 150	-55 to 150	$^\circ C$

Thermal Data

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JA}$	Thermal Resistance Junction-Ambient ¹	---	48	$^\circ C/W$
$R_{\theta JC}$	Thermal Resistance Junction-Case ¹	---	5	$^\circ C/W$



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N-CH Electrical Characteristics: ($T_c=25^{\circ}\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Off Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _D =250 μ A	40	---	---	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{GS} =0V, V _{DS} =-40V	---	---	1	μ A
I _{GSS}	Gate-Source Leakage Current	V _{GS} =± 20V, V _{DS} =0A	---	---	± 100	nA
On Characteristics						
V _{GS(th)}	GATE-Source Threshold Voltage	V _{GS} =V _{DS} , I _D =250 μ A	1	1.6	2.5	V
R _{DS(ON)}	Drain-Source On Resistance ³	V _{GS} =10V, I _D =20A	---	4.2	5.2	m Ω
		V _{GS} =4.5V, I _D =10A	---	5.3	6.8	
G _{FS}	Forward Transconductance	V _{DS} =10V, I _D =10A	---	16	---	S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} =25V, V _{GS} =0V, f=1MHz	---	2380		pF
C _{Oss}	Output Capacitance		---	230		
C _{rss}	Reverse Transfer Capacitance		---	148		
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time ^{2,3}	V _{DD} =20V, I _D =1A, R _{GEN} =3.3 Ω , V _{GS} =10V	---	14.2	28	ns
t _r	Rise Time ^{2,3}		---	18.3	36	ns
t _{d(off)}	Turn-Off Delay Time ^{2,3}		---	38.8	76	ns
t _f	Fall Time ^{2,3}		---	13.9	28	ns
Q _g	Total Gate Charge ³	V _{GS} =4.5V, V _{DS} =32V, I _D =10A	---	25	50	nC
Q _{gs}	Gate-Source Charge		---	6.5	13	nC
Q _{gd}	Gate-Drain “Miller” Charge		---	12.1	24	nC
Drain-Source Diode Characteristics						
V _{SD}	Drain Diode Forward Voltage ³	V _{GS} =0V, I _S =1A	---	---	1	V
LS	Continuous Source Current	V _G =V _D =0V , Force Current	---	---	55	A
I _{sm}	Pulsed Source Current		---	---	160	A



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Typical Characteristics: ($T_C=25^\circ\text{C}$ unless otherwise noted)

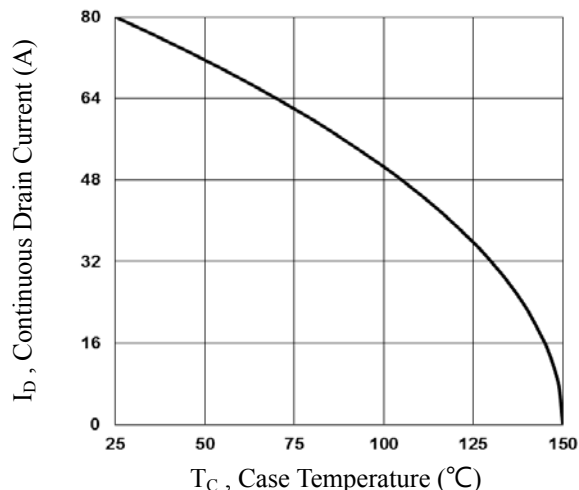


Fig.1 Continuous Drain Current vs. T_C

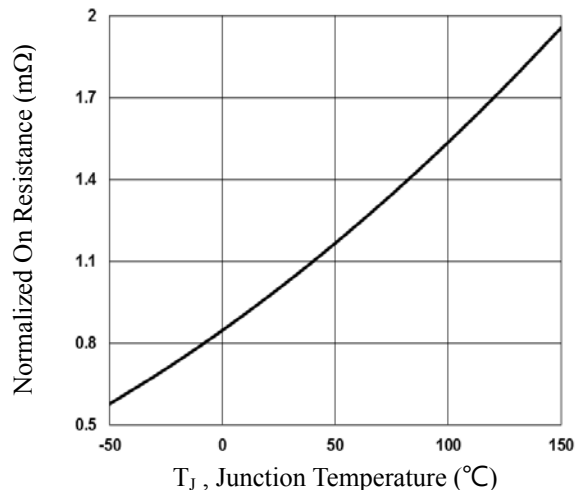


Fig.2 Normalized $R_{DS(on)}$ vs. T_J

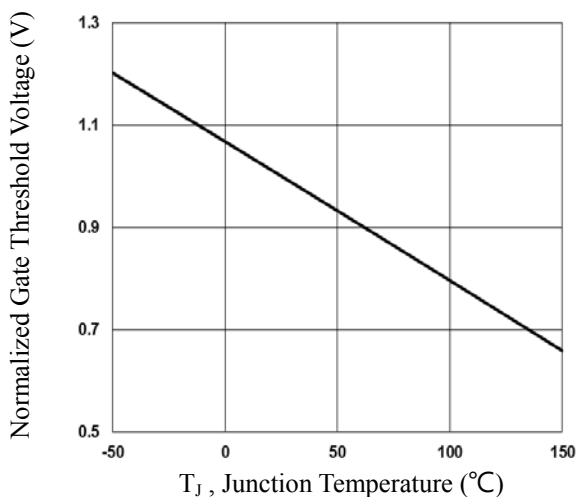


Fig.3 Normalized V_{th} vs. T_J

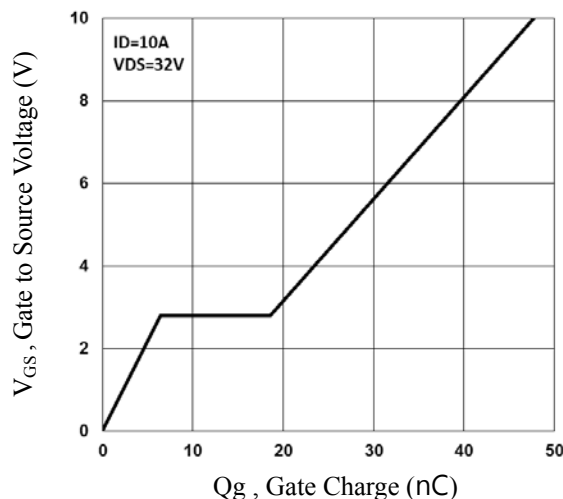


Fig.4 Gate Charge Waveform

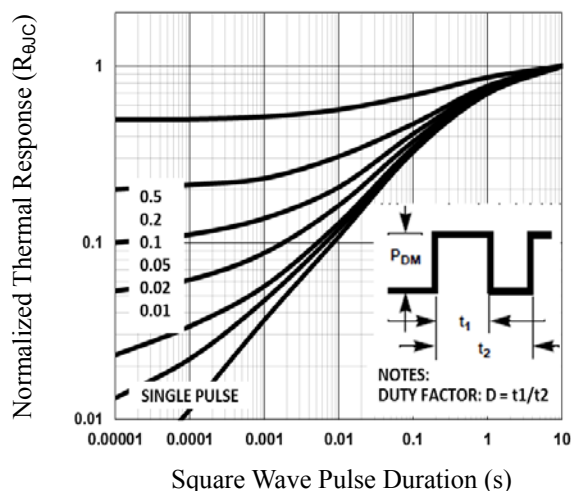


Fig.5 Normalized Transient Impedance

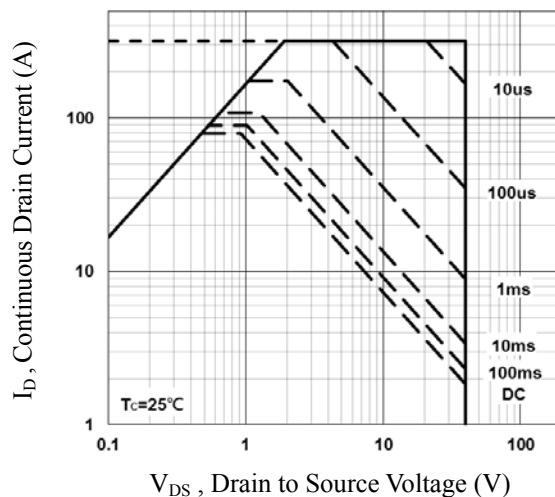


Fig.6 Maximum Safe Operation Area

TM60G04GD

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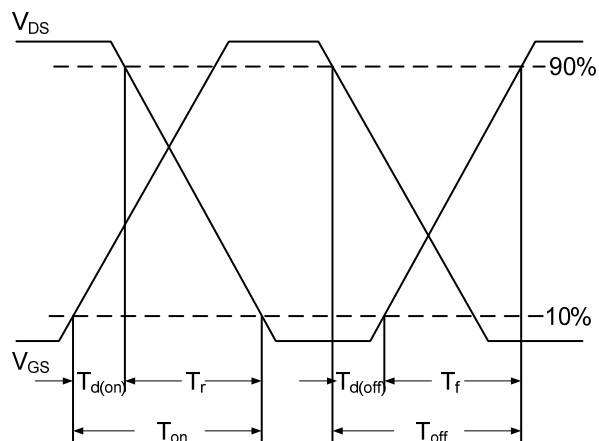


Fig.7 Switching Time Waveform

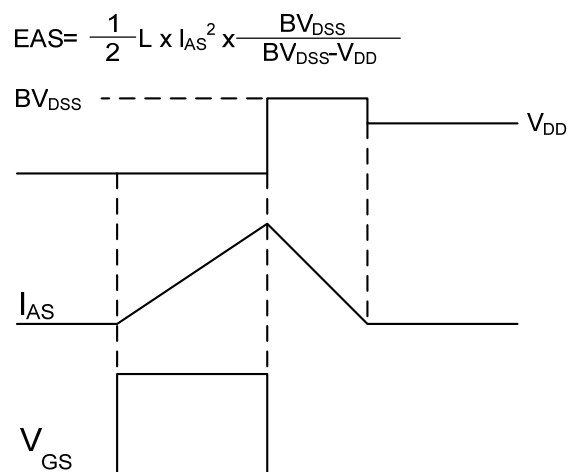


Fig.8 EAS Waveform

TM60G04GD
N+P-Channel Enhancement Mode Mosfet

P-CH Electrical Characteristics: ($T_C=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Off Characteristics						
BV _{DSS}	Drain-Sourctce Breakdown Voltage	V _{GS} =0V, I _D =250 μ A	-40	---	---	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{GS} =0V, V _{DS} =-40V, T _J =25℃	---	---	-1	μ A
I _{GSS}	Gate-Source Leakage Current	V _{GS} =± 20V, V _{DS} =0A	---	---	± 100	nA
On Characteristics						
V _{GS(th)}	GATE-Source Threshold Voltage	V _{GS} =V _{DS} , I _D =250 μ A	-1	-1.6	-2.5	V
R _{DS(ON)}	Drain-Source On Resistance	V _{GS} =-10V, I _D =-10A	---	11	14	m Ω
		V _{GS} =-4.5V, I _D =-8A	---	15	20	
G _{FS}	Forward Transconductance	V _{DS} =-10V, I _D =-10A	---	13	---	S
Dynamic Characteristics						
C _{iss}	Input Capacitance	V _{DS} =-25V, V _{GS} =0V, f=1MHz	---	2557	3800	pF
C _{OSS}	Output Capacitance		---	220	320	
C _{rSS}	Reverse Transfer Capacitance		---	127	180	
Switching Characteristics						
t _{d(on)}	Turn-On Delay Time ^{3,4}	V _{DD} =-20V, I _D =-1A, R _G =6 Ω , V _{GS} =-10V	---	23	40	ns
t _r	Rise Time ^{3,4}		---	10	20	ns
t _{d(off)}	Turn-Off Delay Time ^{3,4}		---	135	250	ns
t _f	Fall Time ^{3,4}		---	46	90	ns
Q _g	Total Gate Charge ^{3,4}	V _{GS} =-4.5V, V _{DS} =-32V, I _D =-10A	---	22.2	40	nC
Q _{gs}	Gate-Source Charge ^{3,4}		---	8.2	16	nC
Q _{gd}	Gate-Drain “Miller” Charge ^{3,4}		---	8.8	16	nC
Drain-Source Diode Characteristics						
V _{SD}	Source Drain Diode Forward Voltage ²	V _{GS} =0V, I _S =-1A, T _J =25℃	---	---	-1	V

Notes:

1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. $V_{DD}=25V, V_{GS}=10V, L=0.1\text{mH}, I_{AS}=51A, R_G=25\ \Omega$, Starting $T_J=25^\circ\text{C}$.
3. The data tested by pulsed, pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.
4. Essentially independent of operating temperature.



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Typical Characteristics: ($T_C=25^\circ\text{C}$ unless otherwise noted)

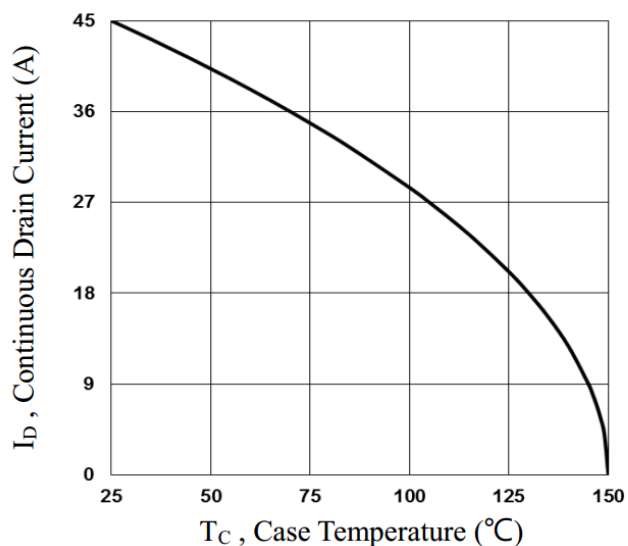


Fig.1 Continuous Drain Current vs. T_C

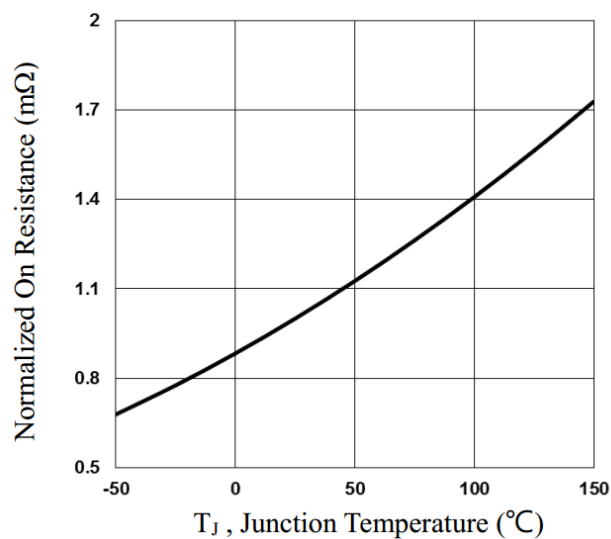


Fig.2 Normalized $R_{DS(on)}$ vs. T_J

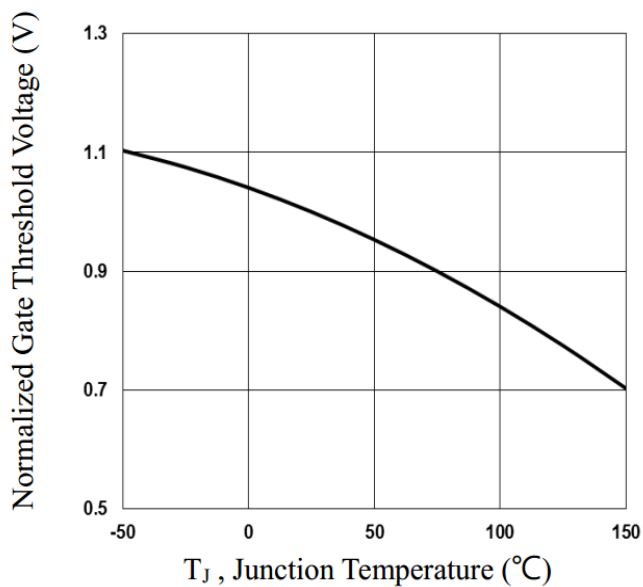


Fig.3 Normalized V_{th} vs. T_J

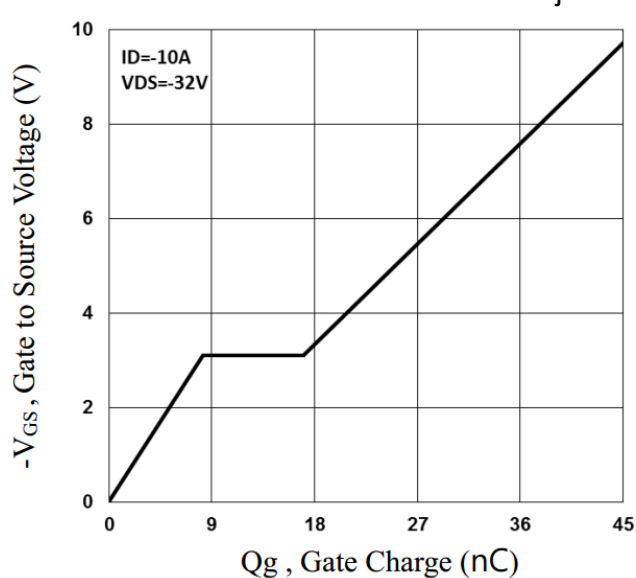


Fig.4 Gate Charge Waveform



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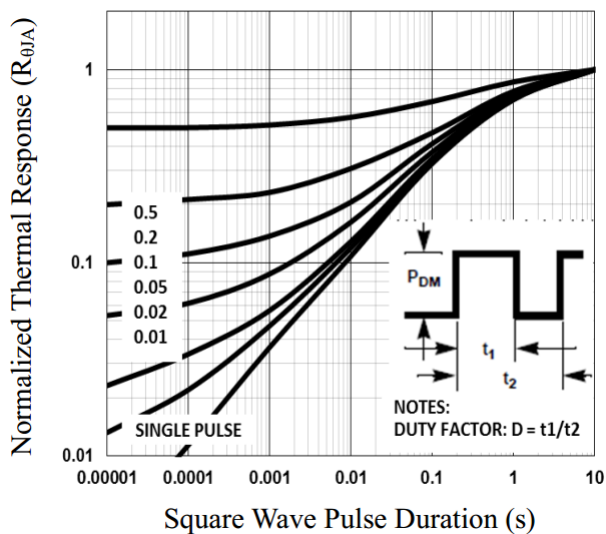


Fig.5 Normalized Transient Impedance

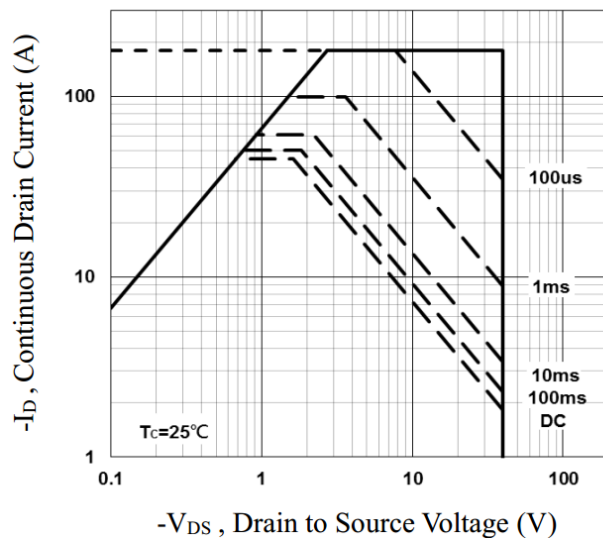


Fig.6 Maximum Safe Operation Area

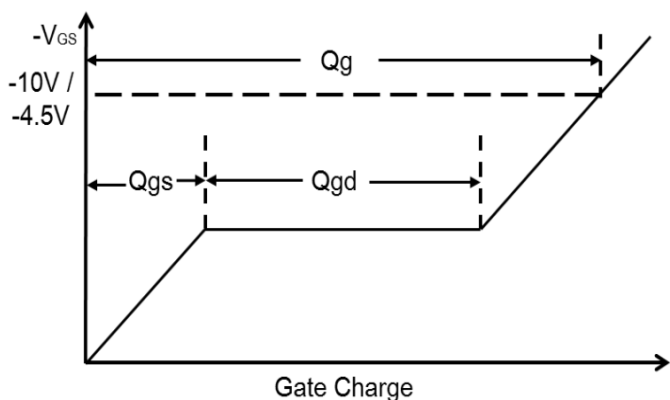


Fig.7 Switching Time Waveform

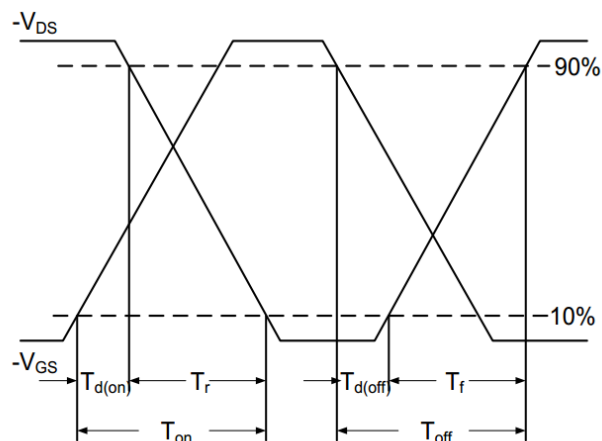
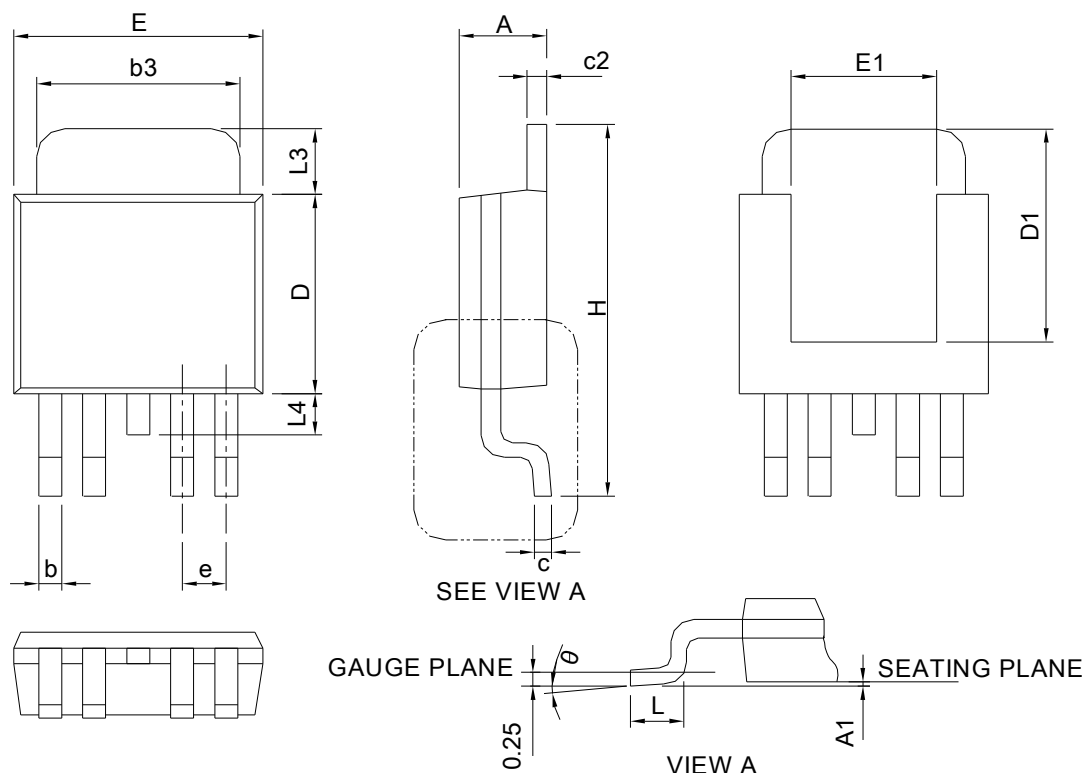


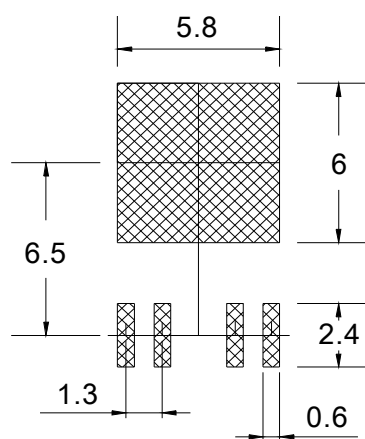
Fig.8 Gate Charge Waveform

Package Mechanical Data:TO-252-4L



SYMBOL	TO-252-4			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.39	0.086	0.094
A1	-	0.2	-	0.008
b	0.50	0.71	0.020	0.028
b3	4.32	5.46	0.170	0.215
c	0.46	0.61	0.018	0.024
c2	0.46	0.89	0.018	0.035
D	5.33	6.22	0.210	0.245
D1	4.57	6.00	0.180	0.236
E	6.35	6.73	0.250	0.265
E1	3.81	6.00	0.150	0.236
e	1.30 BSC		0.051 BSC	
H	9.40	10.41	0.370	0.410
L	1.40	1.78	0.055	0.070
L3	0.89	2.03	0.035	0.080
L4	-	1.02	-	0.040
θ	0°	8°	0°	8°

RECOMMENDED LAND PATTERN



UNIT: mm