V_{DSS}	40/-40	V
I_D	25/-25	A
$R_{DS(ON)}$	17/32mΩ	

FEATURES

- 100% EAS Guaranteed
- Green Device Available
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- Advanced high cell density Trench
- technology

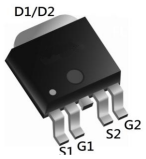
DESCRIPTION

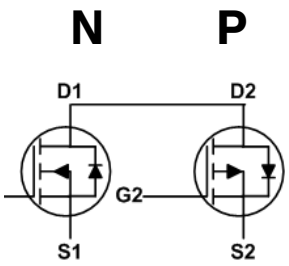
The 4012GD is the high performance complementary N-ch and P-ch MOSFETs with high cell density, which provide excellent RDSON and gate charge for most of the synchronous buck converter applications.

The 4012GD meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved.

GK xxx
4012GD

LOGO GK xxx CODE





MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings

Symbol	Parameter	N-Ch	P-Ch	Unit
V_{DS}	Drain-Source Voltage	40	-40	V
V_{GS}	Gate-Source Voltage	±20	±20	V
I_D	Continuous Drain Current, V{GS}@10V (Note 1)	25	-25	A
	Continuous Drain Current, V{GS}@10V (Note 1)	18	-16	
I_{DM}	Pulsed Drain Current (Note 2)	46	-40	A
E_{AS}	Single Pulse Avalanche Energy (Note 3)	28	66	mJ
I_{AS}	Avalanche Current	17.8	-27.2	A
P_D	Total Power Dissipation (Note 4)	25	31.3	W
T_J,T_{STG}	Operating Junction and Storage Temperature Range	-55 to 150	-55 to 150	°C
$R_{\theta JA}$	Thermal Resistance Junction-Ambient (Note 1)	62	62	°C/W
$R_{\theta JC}$	Thermal Resistance Junction-Case (Note 1)	5	5	°C/W

Note: 1. The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows Max. rating. The test condition is V_{DD}=-25V, V_{GS}=-10V, L=0.1mH, I_{AS}=-27.2A
4. The power dissipation is limited by 150°C junction temperature.

N-Channel Electrical Characteristics (T_J=25°C unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristic						
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=250μA	40			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=40V, V_{GS}=0V			1.0	μA
I_{GSS}	Gate to 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=250μA	1.0	1.5	2.5	V
$R_{DS(on)}$	Static Drain-Source on-Resistance	V_{GS}=10V, I_D=8A		17	22	mΩ
		V_{GS}=4.5V, I_D=5A		25	35	mΩ
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS}=20V, V_{GS}=0V, f=1.0MHz		633		pF
C_{oss}	Output Capacitance			67		pF
C_{rss}	Reverse Transfer Capacitance			58		pF
Q_g	Total Gate Charge	V_{DS}=20V, I_D=8A, V_{GS}=10V		12		nC
Q_{gs}	Gate-Source Charge			3.2		nC
Q_{gd}	Gate-Drain ("Miller") Charge			3.1		nC
Switching Characteristics						
$t_{d(on)}$	Turn-on Delay Time	V_{DD}=20V, R_L=2.5Ω, V_{GS}=10V, R_{GEN}=3Ω		4		ns
t_r	Turn-on Rise Time			3		ns
$t_{d(off)}$	Turn-off Delay Time			15		ns
t_f	Turn-off Fall Time			2		ns
Drain-Source Diode Characteristics and Maximum Ratings						
I_S	Maximum Continuous Drain to Source Diode Forward Current				20	A
I_{SM}	Maximum Pulsed Drain to Source Diode Forward Current				32	A
V_{SD}	Drain to Source Diode Forward Voltage	V_{GS}=0V, I_S=8A			1.2	V

Notes: 1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
2. EAS condition: T_J=25°C, V_{DD}=20V, V_G=10V, L=0.5mH, Rg=25Ω, I_{AS}=7.2A;
T_J=25°C, V_{DD}=-20V, V_G=-10V, L=0.5mH, Rg=25Ω, I_{AS}=-8.4A
3. Pulse Test: Pulse Width≤300μs, Duty Cycle≤2%

RATING AND CHARACTERISTIC CURVES

Figure 1. Output Characteristics

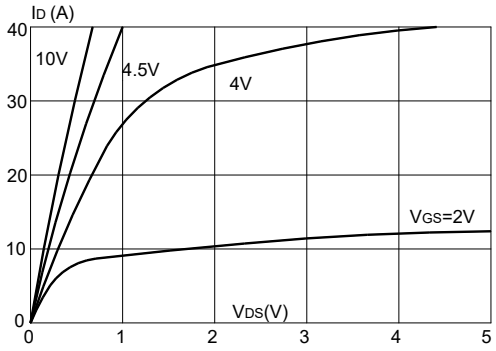


Figure 2. Transfer Characteristics

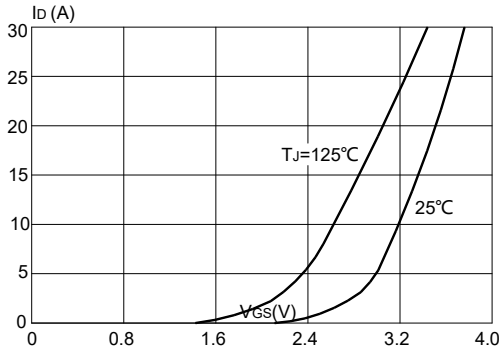


Figure 3. $R_{DS(ON)}$ vs. Drain Current

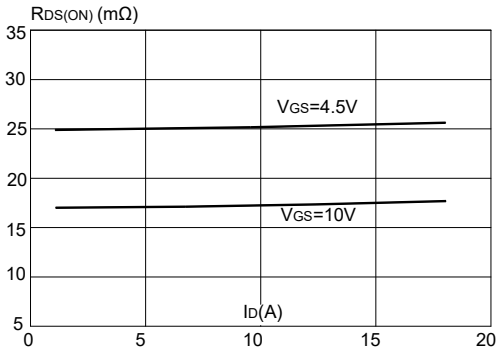


Figure 4. Body Diode Characteristics

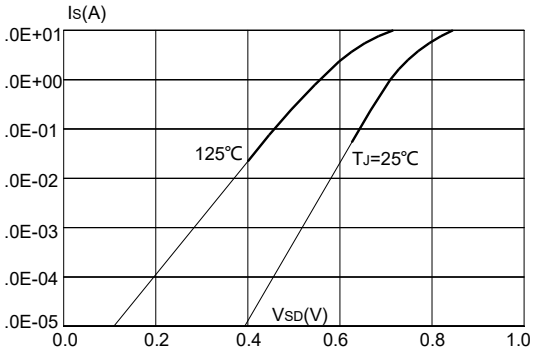


Figure 5. Gate Charge Characteristics

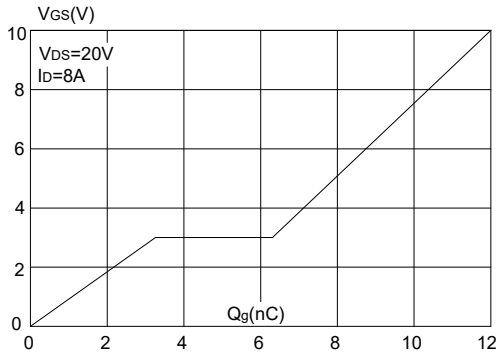
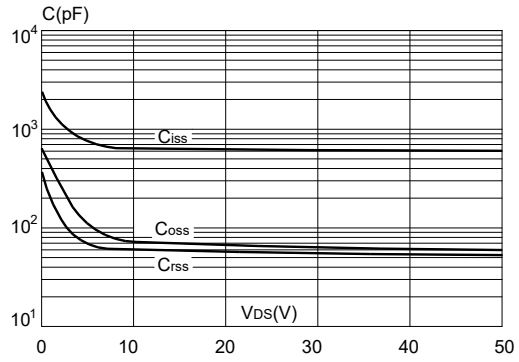


Figure 6. Capacitance Characteristics



RATING AND CHARACTERISTIC CURVES

Figure 7. Normalized BV_{DSS} vs. T_J

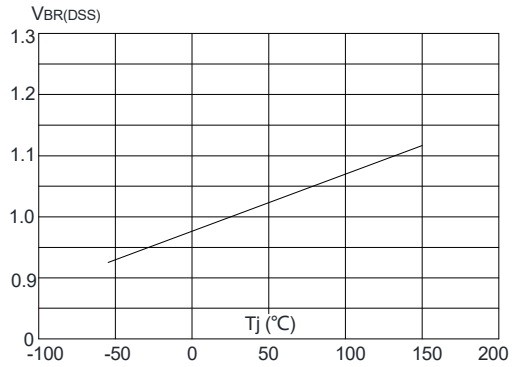


Figure 8. Normalized $R_{DS(on)}$ vs. T_J

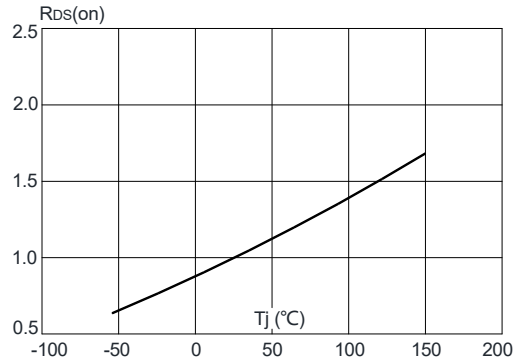


Figure 9. Maximum Safe Operating Area

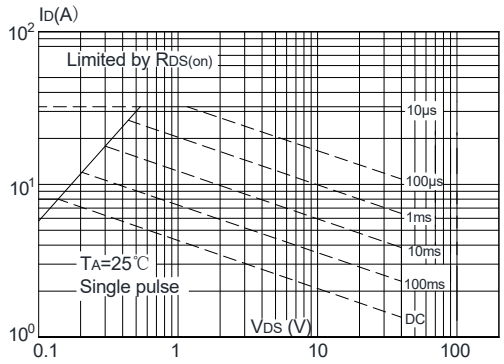


Figure 10. Max. Continuous Drain Current vs. T_A

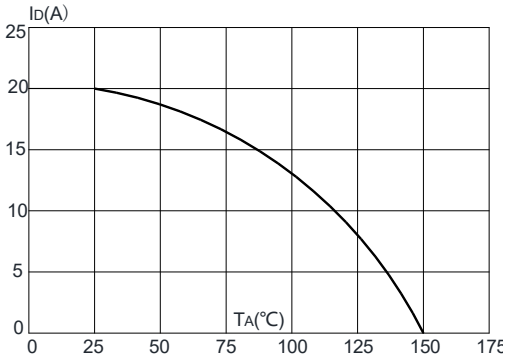
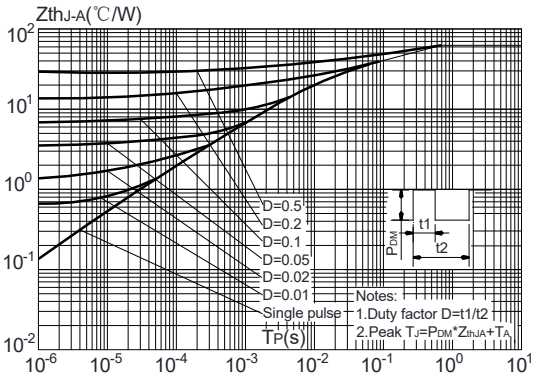


Figure 11. Max. Effective Transient Thermal Impedance



P-Channel Electrical Characteristics (T_J=25°C, unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristic						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=-250μA	-40			V
$\Delta BV_{DSS}/\Delta T_J$	BV{DSS} Temperature Coefficient	Reference to 25°C, I_D=-1mA		-0.012		V/°C
$R_{DS(ON)}$	Static Drain-Source On-Resistance (Note 2)	V_{GS}=-10V, I_D=-8A		32	45	mΩ
		V_{GS}=-4.5V, I_D=-4A		47	70	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_D=-250μA	-1.0	-1.6	-2.5	V
$\Delta V_{GS(th)}$	V{GS(th)} Temperature Coefficient			4.32		mV/°C
I_{DSS}	Drain-Source Leakage Current	V_{DS}=-32V, V_{GS}=0V, T_J=25°C			1	μA
		V_{DS}=-32V, V_{GS}=0V, T_J=55°C			5	μA
I_{GSS}	Gate-Source Leakage Current	V_{GS}=±20V, V_{DS}=0V			±100	nA
g_{fs}	Forward Transconductance	V_{DS}=-5V, I_D=-8A		12.6		S
R_g	Gate Resistance	V_{DS}=0V, V_{GS}=0V, f=1MHz		13	16	Ω
Dynamic Characteristics						
Q_g	Total Gate Charge (-4.5V)	V_{DS}=-20V, V_{GS}=-4.5V, I_D=-12A		9		nC
Q_{gs}	Gate-Source Charge			2.54		nC
Q_{gd}	Gate-Drain Charge			3.1		nC
$T_{D(on)}$	Turn-On Delay Time	V_{DD}=-15V, V_{GS}=-10V, R_G=3Ω, I_D=-1A		19.2		ns
T_r	Rise Time			12.8		ns
$T_{D(off)}$	Turn-Off Delay Time			48.6		ns
T_f	Fall Time			4.6		ns
C_{iss}	Input Capacitance	V_{DS}=-15V, V_{GS}=0V, f=1MHz		1004		pF
C_{oss}	Output Capacitance			108		pF
C_{rss}	Reverse Transfer Capacitance			80		pF
Diode Characteristics						
I_S	Continuous Source Current (Note 1, 5)	V_G=V_D=0V, Force Current			-20	A
I_{SM}	Pulsed Source Current (Note 2, 5)				-40	A
V_{SD}	Diode Forward Voltage (Note 2)	V_{GS}=0V, I_S=-1A, T_J=25°C			-1	V

Note: 1. The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper.
2. The data tested by pulsed, pulse width ≤ 300us, duty cycle ≤ 2%.
3. The EAS data shows Max. rating. The test condition is V_{DD}=-25V, V_{GS}=-10V, L=0.1mH, I_{AS}=-27.2A
4. The power dissipation is limited by 150°C junction temperature.
5. The data is theoretically the same as I_D and I_{DM}, in real applications, should be limited by total power dissipation.

RATING AND CHARACTERISTIC CURVES

Figure 1. Typical Output Characteristics

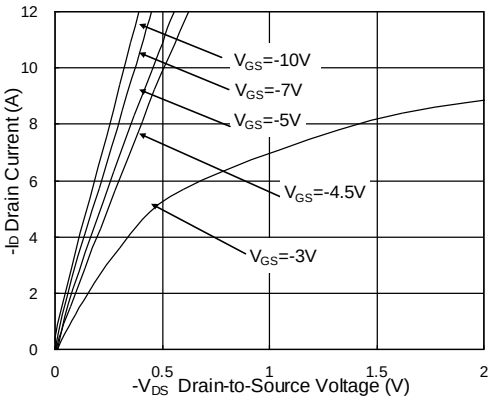


Figure 2. $R_{DS(ON)}$ vs. Gate-Source

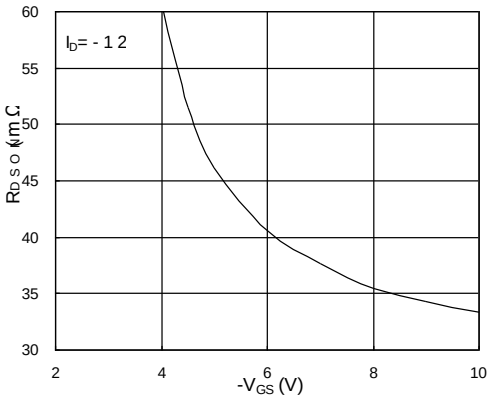


Figure 3. Forward Characteristics of Reverse

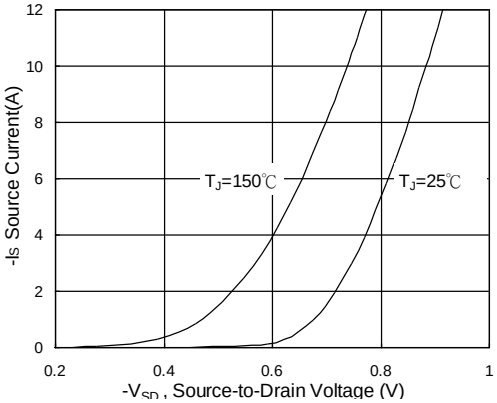


Figure 4. Gate-Charge Characteristics

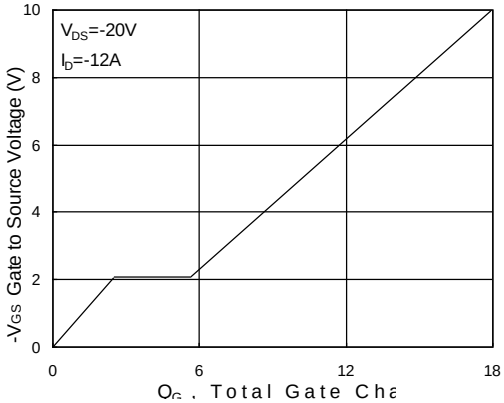


Figure 5. Normalized $V_{GS(th)}$ vs. T_J

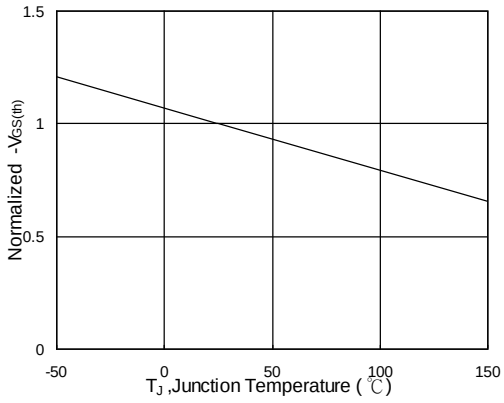
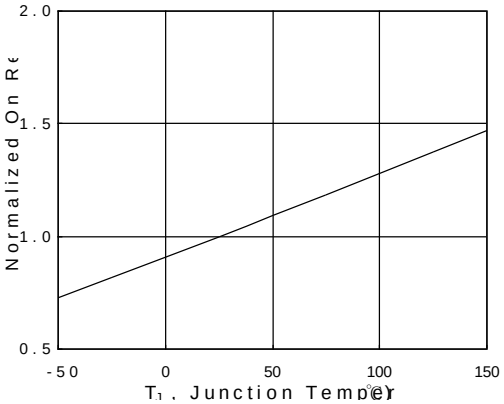


Figure 6. Normalized $R_{DS(on)}$ vs. T_J



RATING AND CHARACTERISTIC CURVES

Figure 7. Capacitance

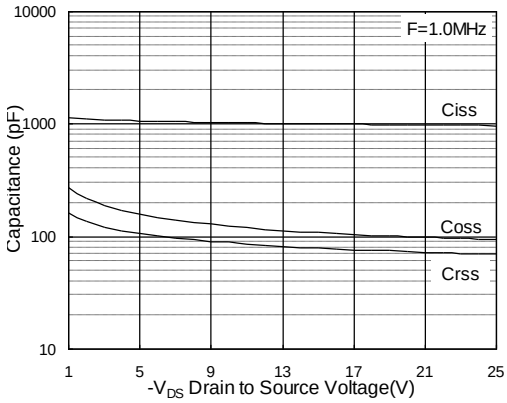


Figure 8. Safe Operating Area

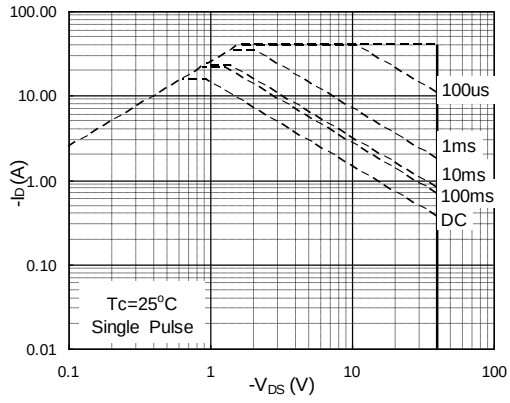


Figure 9. Normalized Transient Thermal Impedance

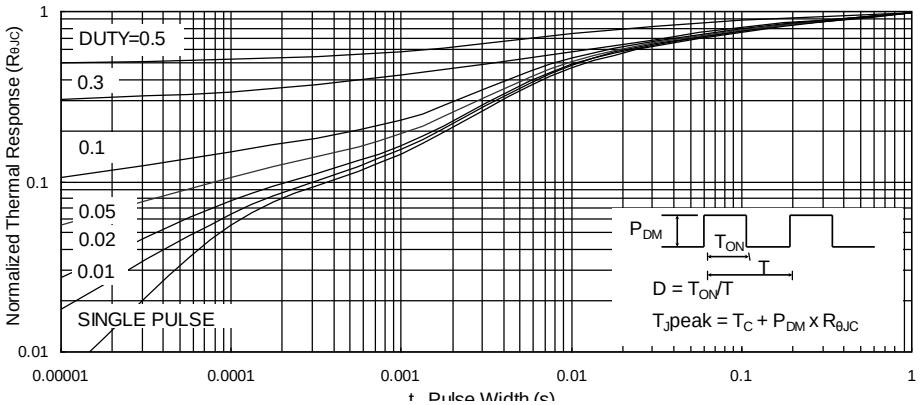


Figure 10. Switching Time Waveform

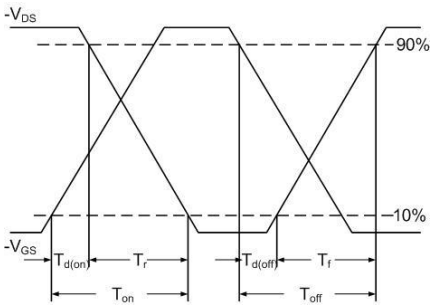


Fig.10 Switching Time Waveform

Figure 11. Unclamped Inductive Waveform

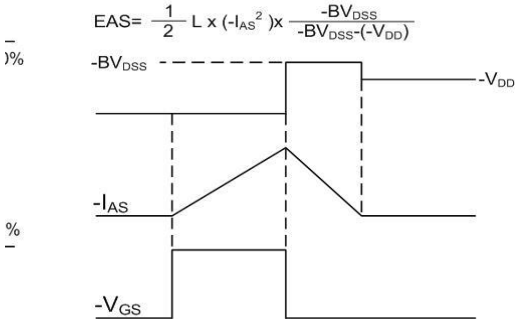
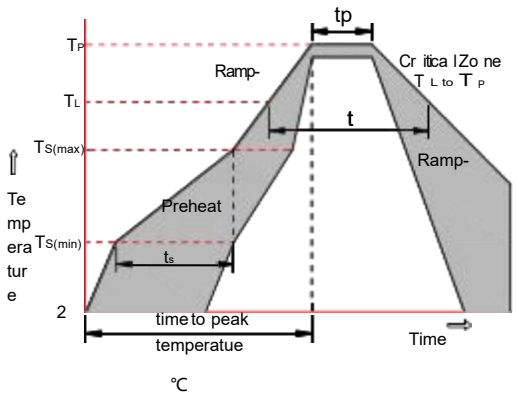


Fig.11 Unclamped Inductive Waveform

Soldering parameters

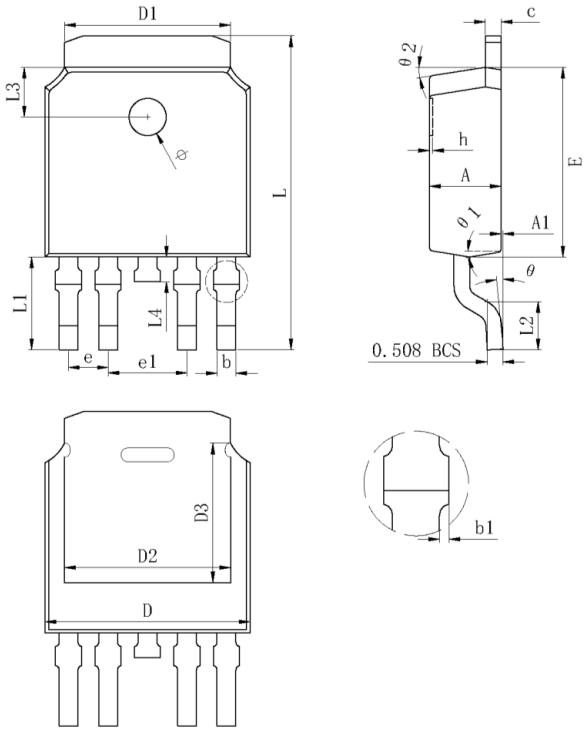
Reflow Condition		Pb-Free assembly (see as bellow)
Pre Heat	-Temperature Min ($T_{s(min)}$)	+150℃
	-Temperature Max($T_{s(max)}$)	+200℃
	-Time (Min to Max) (ts)	60-180 secs.
Average ramp up rate (Liquid us Temp (T_L) to peak)		3℃/sec. Max
$T_{s(max)}$ to T_L - Ramp-up Rate		3℃/sec. Max
Reflow	-Temperature(T_L)(Liquid us)	+217℃
	-Temperature(t_L)	60-150 secs.
Peak Temp (T_p)		+260(+0/-5)℃
Time within 5℃ of actual Peak Temp (t_p)		30 secs. Max
Ramp-down Rate		6℃/sec. Max
Time 25℃ to Peak Temp (T_P)		8 min. Max
Do not exceed		+260℃

FIG5: Reflow condition



Package Dimensions & Suggested Pad Layout

TO-252-4L



SYMBOL	MILLIMETER		
	MIN	Typ.	MAX
A	2.200	2.300	2.400
A1	0.000		0.127
b	0.550	0.600	0.650
b1	0.000		0.120
c(电镀后)	0.460	0.520	0.580
D	6.500	6.600	6.700
D1	5.334 REF		
D2	5.346 REF		
D3	4.490 REF		
E	6.000	6.100	6.200
e	1.270 TYP		
e1	2.540 TYP		
h	0.000	0.100	0.200
L	9.900	10.100	10.300
L1	2.988 REF		
L2	1.400	1.550	1.700
L3	1.600 REF		
L4	0.700	0.800	0.900
Φ	1.100	1.200	1.300
θ	0°		8°
θ1	9° TYP		
θ2	9° TYP		