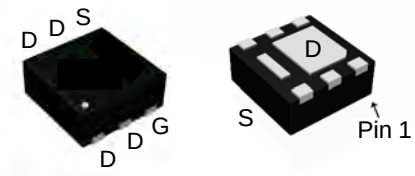
N-Channel Enhancement Mode MOSFET

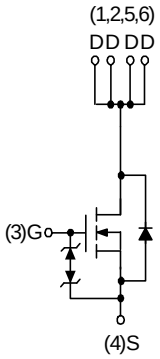
Features

- 12V/12A,
  $R_{DS(ON)}$ = 4.3mΩ(max.) @ V_{GS} =4.5V
  $R_{DS(ON)}$ = 5.6mΩ(max.) @ V_{GS} =2.5V
- 100% UIS + Rg Tested
- Reliable and Rugged
- Lead Free and Green Devices Available
  (RoHS Compliant)

Pin Description



DFN2x2A-6_EP



N-Channel MOSFET

Applications

- Battery Management Application.
- Power Management Functions.

DEVICE MARKING AND ORDERING INFORMATION

Device	Marking	Shipping
FTK2210DFN22	2210A	3000/Tape&Reel

Absolute Maximum Ratings (T_A = 25℃ Unless Otherwise Noted)

Symbol	Parameter		Rating	Unit
Common Ratings				
V_{DSS}	Drain-Source Voltage		12	V
V_{GSS}	Gate-Source Voltage		±8	
T_J	Maximum Junction Temperature		150	℃
T_{STG}	Storage Temperature Range		-55 to 150	
I_S	Diode Continuous Forward Current	T_A=25℃	1.2	A
I_D	Continuous Drain Current	T_A=25℃	12 [a]	A
		T_A=70℃	11.4	
I_{DM} [b]	Pulsed Drain Current	T_A=25℃	36	A
P_D [c]	Maximum Power Dissipation	T_A=25℃	1.32	W
		T_A=70℃	0.8	
$R_{\theta JA}$ [c]	Thermal Resistance-Junction to Ambient	t≤10s	70	℃/W
		Steady State	95	℃/W
I_{AS} [d]	Avalanche Current, Single pulse	L=0.1mH	24	A
E_{AS} [d]	Avalanche Energy, Single pulse	L=0.1mH	29	mJ

Note a Current limited by bonding wire.
Note b Pulse width limited by max. junction temperature.
Note c $R_{\theta JA}$ steady state t=999s.
Note d UIS tested and pulse width limited by maximum junction temperature 150℃ (initial temperature T_j=25℃)

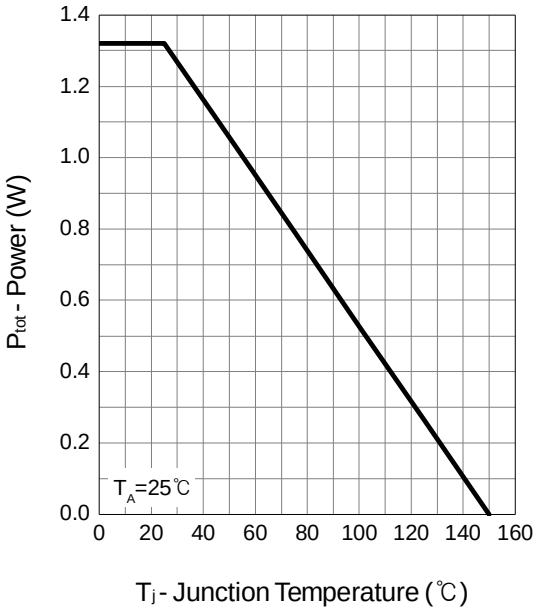
Electrical Characteristics (T_A = 25℃ Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_{DS}=250μA	12	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=10V, V_{GS}=0V	-	-	1	μA
		T_J=85℃	-	-	30	
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_{DS}=250μA	0.4	0.6	1	V
I_{GSS}	Gate Leakage Current	V_{GS}=±8V, V_{DS}=0V	-	-	±10	μA
$R_{DS(ON)}$ [e]	Drain-Source On-state Resistance	V_{GS}=4.5V, I_{DS}=12A	-	3.6	4.3	mΩ
		V_{GS}=2.5V, I_{DS}=10A	-	4.3	5.6	
Diode Characteristics						
V_{SD} [e]	Diode Forward Voltage	I_{SD}=1A, V_{GS}=0V	-	0.66	1.1	V
t_{rr}	Reverse Recovery Time	I_{SD}=4A I_{nduct} I=0.1mH V_{DD}=10V,	-	44.5	-	ns
Q_{rr}	Reverse Recovery Charge		-	23	-	nC
Dynamic Characteristics						
R_G	Gate Resistance	V_{GS}=0V,V_{DS}=0V,F=1MHz	-	3.5	4.7	Ω
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=6V, Frequency=1.0MHz	-	2770	3601	pF
C_{oss}	Output Capacitance		-	570	741	
C_{rss}	Reverse Transfer Capacitance		-	500	650	
$t_{d(ON)}$	Turn-on Delay Time	V_{DD}=6V, R_L=6Ω, I_{DS}=1A, V_{GEN}=4.5V, R_G=1Ω	-	13	-	ns
t_r	Turn-on Rise Time		-	23.5	-	
$t_{d(OFF)}$	Turn-off Delay Time		-	44	-	
t_f	Turn-off Fall Time		-	110	-	
Gate Charge Characteristics						
Q_g	Total Gate Charge	V_{ds}=6V, V_{gs}=4.5V, I_{ds}=4A	-	31.8	41.3	nC
Q_{gs}	Gate-Source Charge		-	2.9	-	
Q_{gd}	Gate-Drain Charge		-	7.8	-	

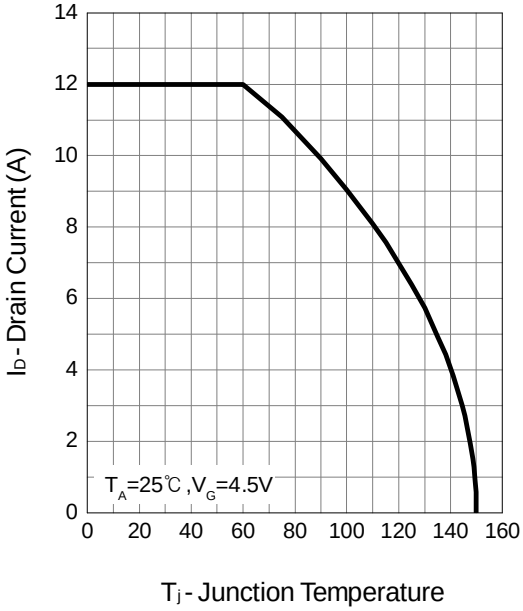
Note e Pulse test ; pulse width≤300μs, duty cycle≤2%.

Typical Operating Characteristics

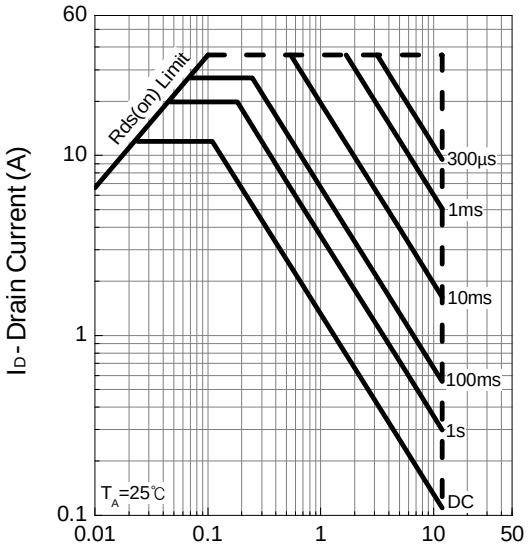
Power Dissipation



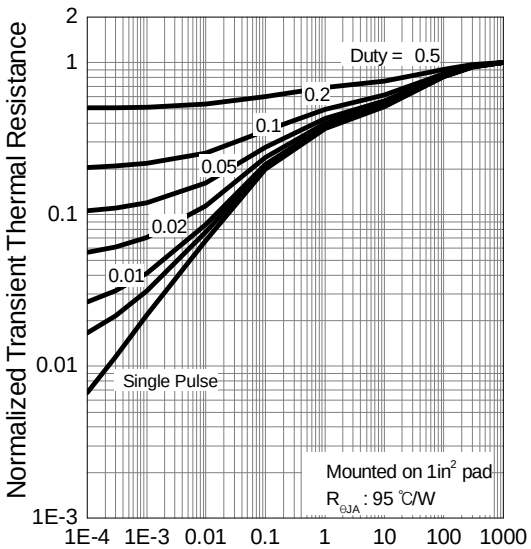
Drain Current



Safe Operation Area

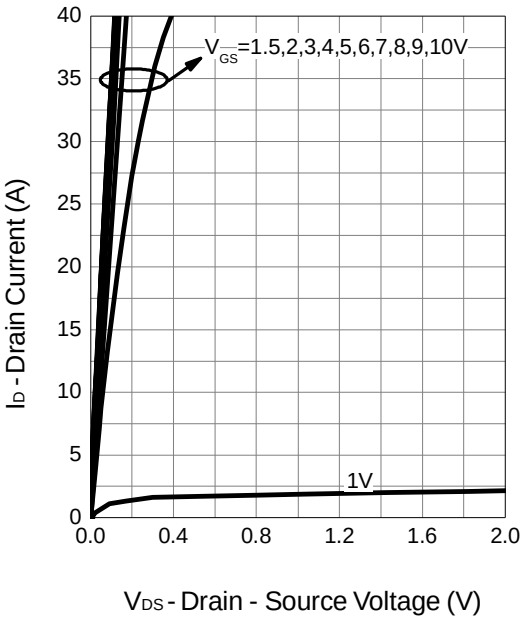


Thermal Transient Impedance

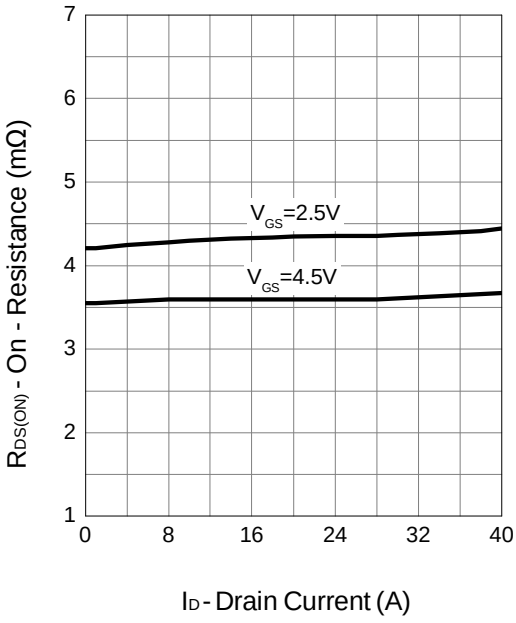


Typical Operating Characteristics (Cont.)

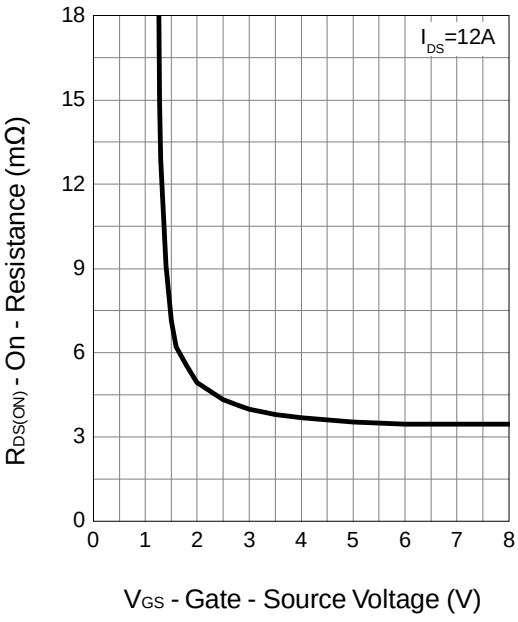
Output Characteristics



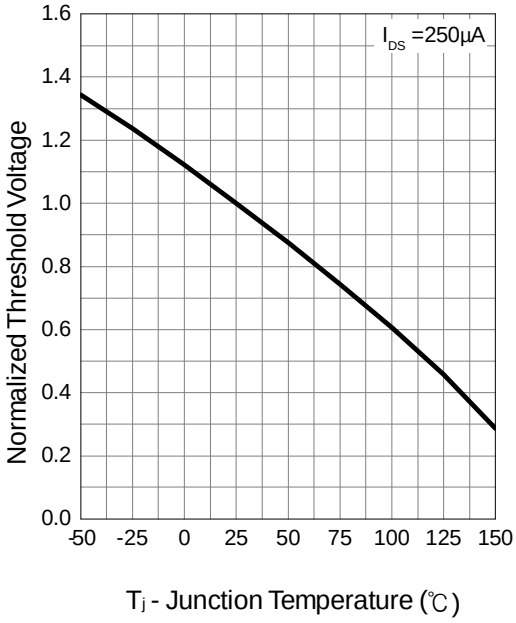
Drain-Source On Resistance



Gate-Source On Resistance

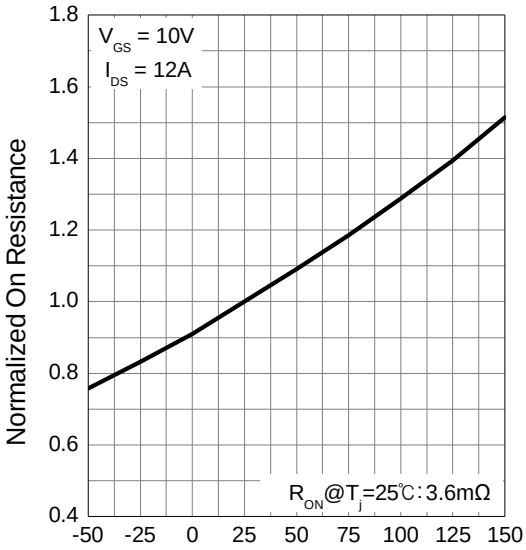


Gate Threshold Voltage



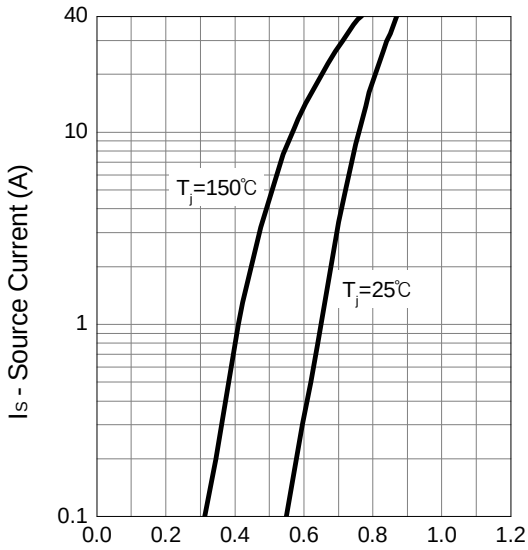
Typical Operating Characteristics (Cont.)

Drain-Source On Resistance



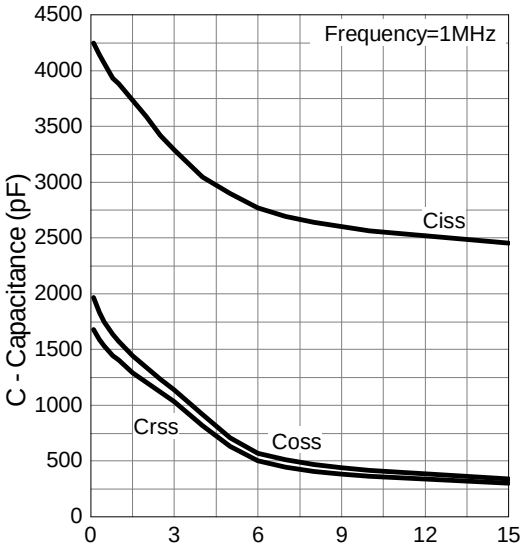
T_j - Junction Temperature (℃)

Source-Drain Diode Forward



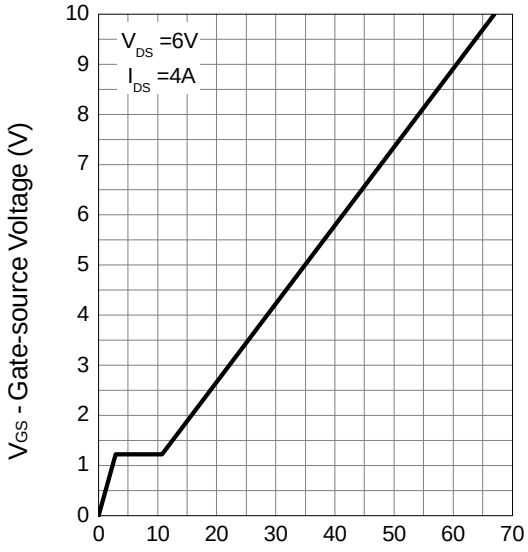
V_{SD} - Source - Drain Voltage (V)

Capacitance



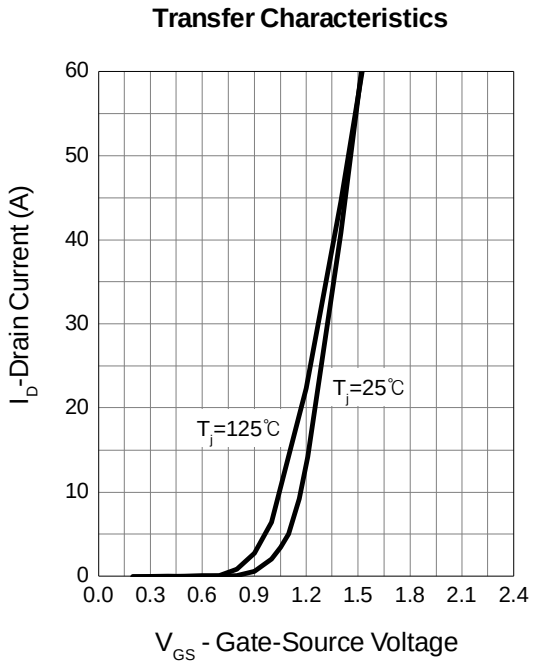
V_{DS} - Drain-Source Voltage (V)

Gate Charge

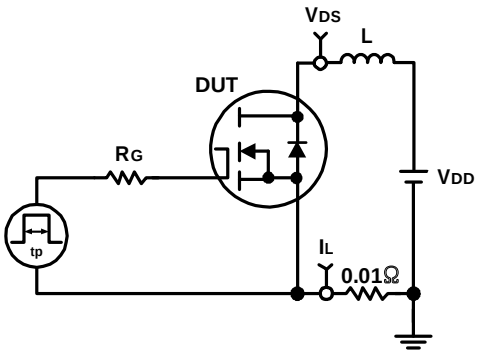


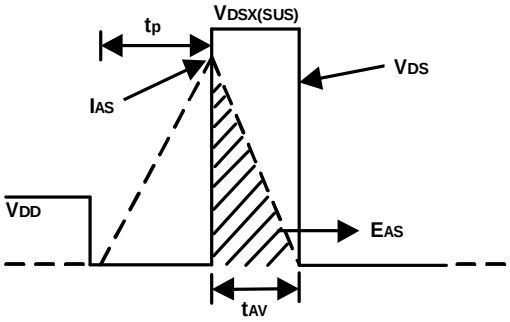
Q_G - Gate Charge (nC)

Typical Operating Characteristics (Cont.)

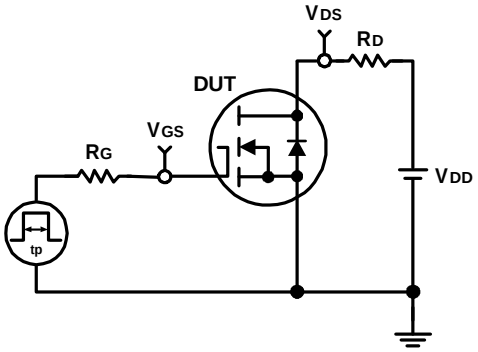


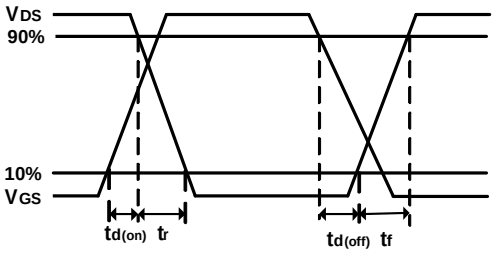
Avalanche Test Circuit and Waveforms



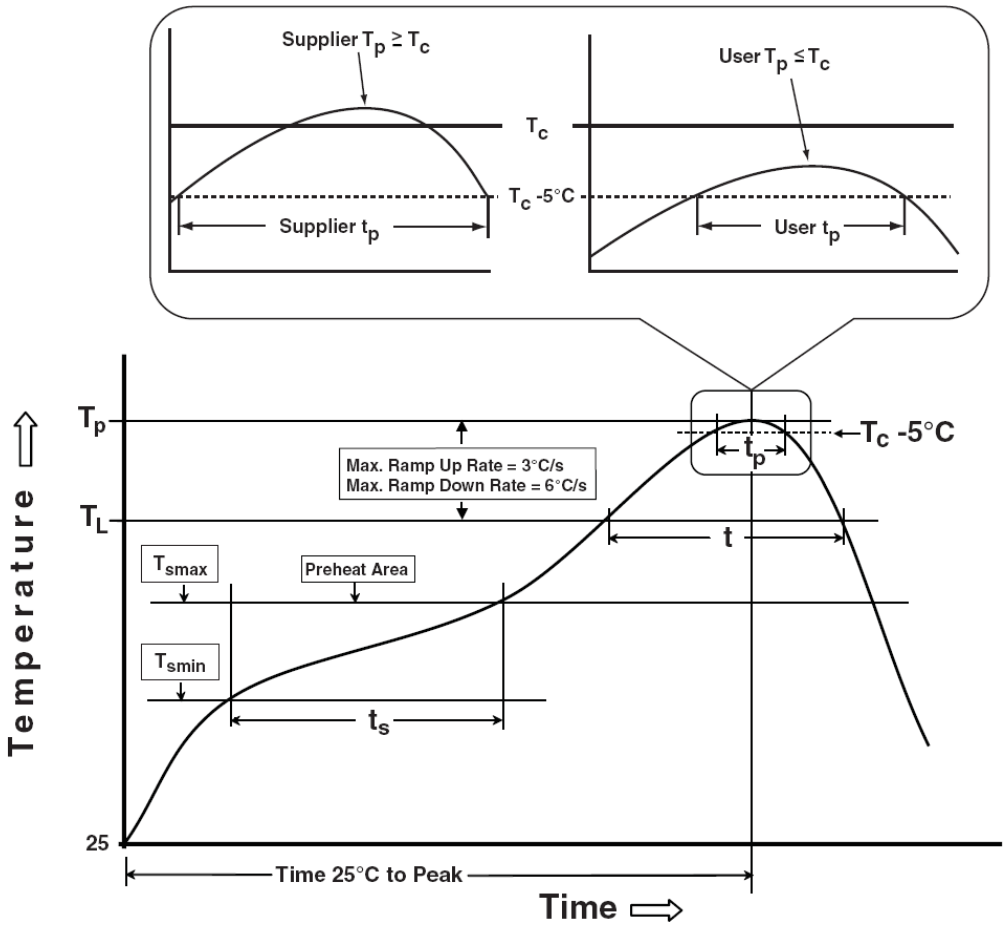


Switching Time Test Circuit and Waveforms





Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak Temperature min (T_{smin}) Temperature max (T_{smax}) Time (T_{smin} to T_{smax}) (t_s)	100 ℃ 150 ℃ 60-120 seconds	150 ℃ 200 ℃ 60-120 seconds
Average ramp-up rate (T_{smax} to T_P)	3℃ /second max.	3℃ /second max.
Liquidous temperature (T_L) Time at liquidous (t_L)	183℃ 60-150 seconds	217℃ 60-150 seconds
Peak package body Temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_P)** within 5℃ of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6℃ /second max.	6℃ /second max.
Time 25℃ to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum. ** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Table 1. SnPb Eutectic Process % Classification Temperatures (Tc)

Package Thickness	Volume mm^3 <350	Volume mm^3 ≧350
<2.5 mm	235℃	220℃
≥2.5 mm	220℃	220℃

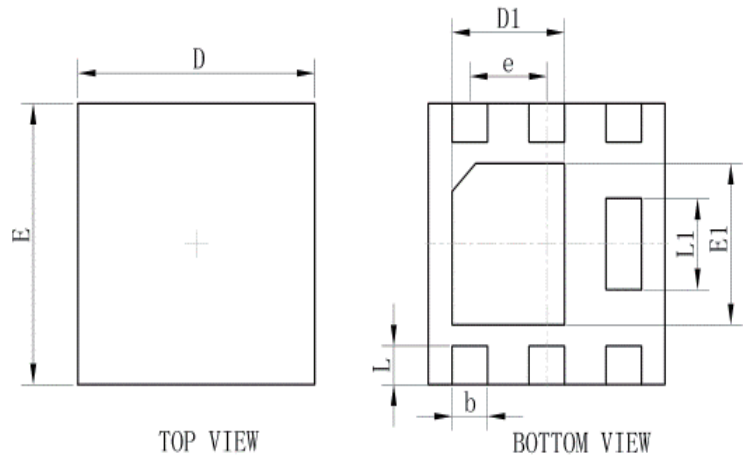
Table 2. Pb-free Process % Classification Temperatures (Tc)

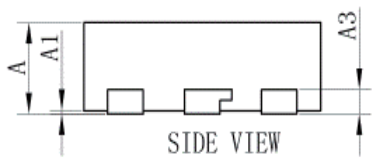
Package Thickness	Volume mm^3 <350	Volume mm^3 350-2000	Volume mm^3 >2000
<1.6 mm	260℃	260℃	260℃
1.6 mm %2.5 mm	260℃	250℃	245℃
≥2.5 mm	250℃	245℃	245℃

Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245℃
HTRB	JESD-22, A108	1000 Hrs, 80% of VDS max @ Tjmax
HTGB	JESD-22, A108	1000 Hrs, 100% of VGS max @ Tjmax
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm,121℃
TCT	JESD-22, A104	500 Cycles, -65℃~150℃

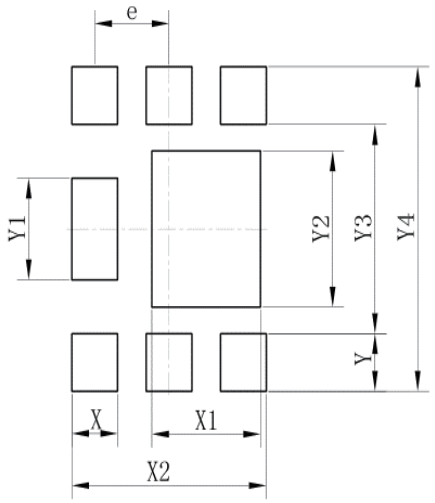
OUTLINE AND DIMENSIONS





DFN2020-6S			
DIM	MIN	NOR	MAX
A	0.60	0.65	0.70
A1	0.01	0.03	0.05
b	0.25	0.30	0.35
D	1.95	2.00	2.05
E	1.95	2.00	2.05
e	0.65TYP.		
L	0.23	0.28	0.33
L1	0.60	0.65	0.65
D1	0.90	0.95	1.00
E1	1.10	1.15	1.20
A3	0.152REF		
All Dimensions in mm			

SOLDERING FOOTPRINT



DFN2020-6S	
Dim	(mm)
X	0.40
X1	0.95
X2	1.70
e	0.65
Y	0.43
Y1	0.75
Y2	1.15
Y3	1.54
Y4	2.39