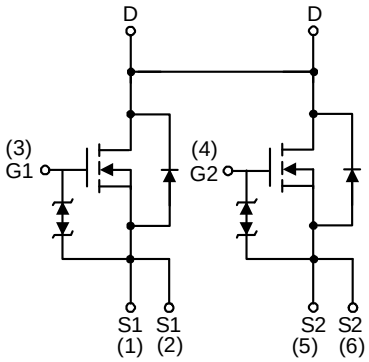
Dual N-Channel Enhancement Mode MOSFET

Features

- 20V/8A,
  $R_{DS(ON)}$=17.5mΩ (Max.) @ V_{GS}=4.5V
  $R_{DS(ON)}$=18.5mΩ (Max.) @ V_{GS}=4V
  $R_{DS(ON)}$=22mΩ (Max.) @ V_{GS}=3.1V
  $R_{DS(ON)}$=27.5mΩ (Max.) @ V_{GS}=2.5V
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

Pin Description

Top View of TDFN2x5- 6



N- Channel MOSFET

Applications

- Power Management in Notebook Computer, Portable Equipment and Battery Powered Systems.

DEVICE MARKING AND ORDERING INFORMATION

Device	Marking	Shipping
FTK9988DFN25	APM9988	3000/Tape&Reel

Absolute Maximum Ratings (T_A = 25°C Unless Otherwise Noted)

Symbol	Parameter		Rating	Unit
V_{DSS}	Drain-Source Voltage		20	V
V_{GSS}	Gate-Source Voltage		±12	
I_D	Continue Drain Current	V_{GS}=4.5V	8**	A
I_{DM}	300μs Pulsed Drain Current		40	
I_S	Diode continuous forward current		1.5	A
T_J	Maximum Junction Temperature		150	°C
T_{STG}	Storage Temperature Range		-55 to 150	
P_D	Maximum Power Dissipation	T_A=25°C	3.5	W
		T_A=85°C	1.8	
$R_{\theta JA}$*	Thermal Resistance-Junction to Ambient		36	°C/W
$R_{\theta JC}$*	Thermal Resistance-Junction to Case		5.6	°C/W

Note *Surface Mounted on 1in^2 pad area, t ≤ 10sec.

** Current limited by bond wire.

Electrical Characteristics (T_A = 25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	FTK9988DFN25			Unit
			Min.	Typ.	Max.	
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_{DS}=250μA	20	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=16V, V_{GS}=0V	-	-	1	μA
		T_J=85°C	-	-	30	
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_{DS}=250μA	0.5	0.7	1	V
I_{GSS}	Gate Leakage Current	V_{GS}=±10V, V_{DS}=0V	-	-	±10	μA
$R_{DS(ON)}$ [a]	Drain-Source On-state Resistance	V_{GS}=4.5V, I_{DS}=4A	10.5	12.5	17.5	mΩ
		V_{GS}=4V, I_{DS}=4A	11	13	18.5	
		V_{GS}=3.1V, I_{DS}=4A	11.5	14.5	22	
		V_{GS}=2.5V, I_{DS}=4A	15	18	27.5	
Diode Characteristics						
V_{SD} [a]	Diode Forward Voltage	I_{SD}=1.5A, V_{GS}=0V	-	0.7	1.3	V
t_{rr}	Reverse Recovery Time	I_{SD}=4A, dI_{SD}/dt=100μs	-	15	-	nS
Q_{rr}	Reverse Recovery Charge		-	7	-	nC

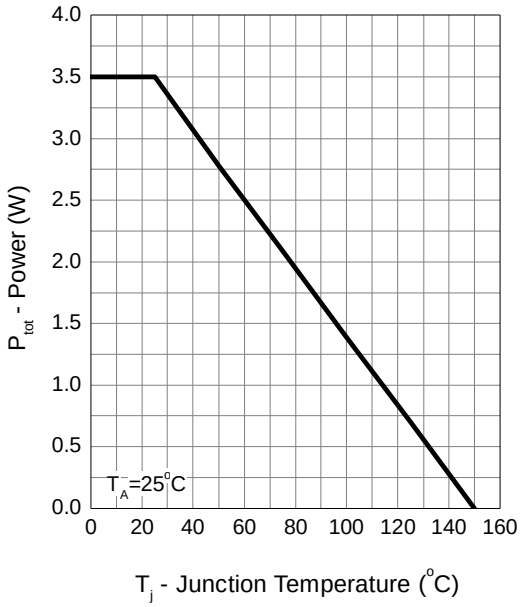
Electrical Characteristics(Cont.) (T_A = 25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	FTK9988DFN25			Unit
			Min.	Typ.	Max.	
Dynamic Characteristics [b]						
R_G	Gate Resistance	V_{GS}=0V,V_{DS}=0V,F=1MHz	-	4	-	Ω
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=10V, Frequency=1.0MHz	-	950	-	pF
C_{oss}	Output Capacitance		-	175	-	
C_{rss}	Reverse Transfer Capacitance		-	150	-	
$t_{d(ON)}$	Turn-on Delay Time	V_{DD}=10V, R_L=10Ω, I_{DS}=1A, V_{GEN}=4.5V, R_G=6Ω	-	6	12	ns
t_r	Turn-on Rise Time		-	11	21	
$t_{d(OFF)}$	Turn-off Delay Time		-	48	87	
t_f	Turn-off Fall Time		-	21	39	
Gate Charge Characteristics [b]						
Q_g	Total Gate Charge	V_{DS}=10V, V_{GS}=4.5V, I_{DS}=4A	-	13.5	-	nC
Q_{gs}	Gate-Source Charge		-	1.5	-	
Q_{gd}	Gate-Drain Charge		-	4.5	-	

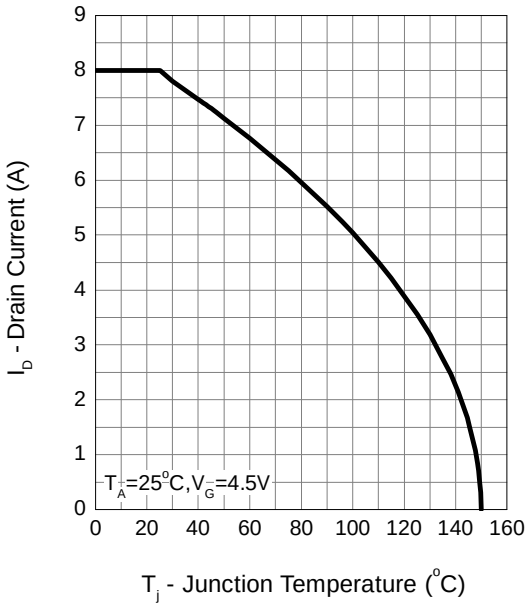
Note a : Pulse test ; pulse width≤300μs, duty cycle≤2%.
Note b : Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

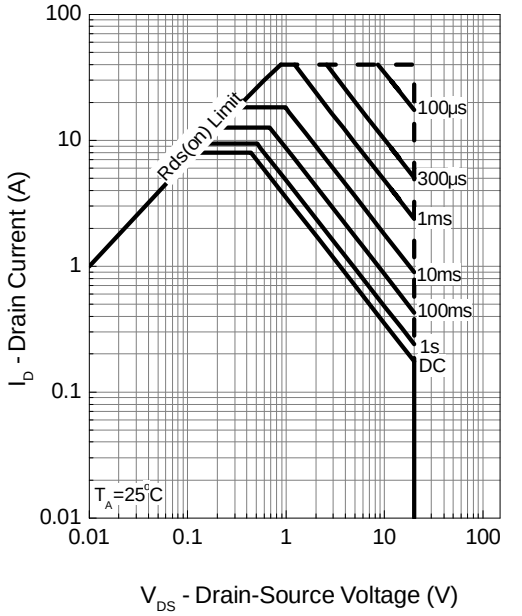
Power Dissipation



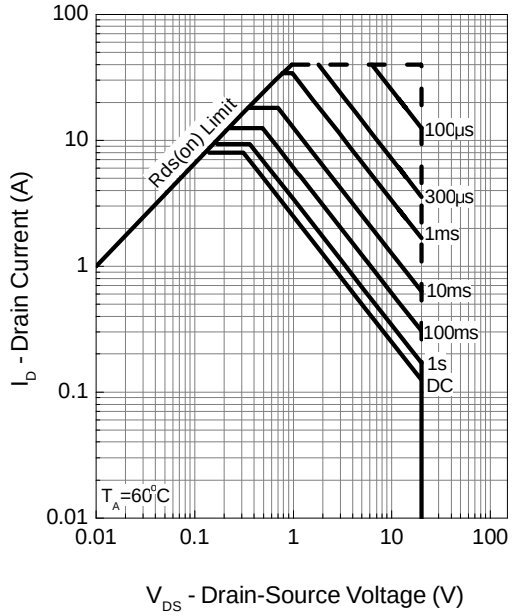
Drain Current



Safe Operation Area (T_A=25°C)

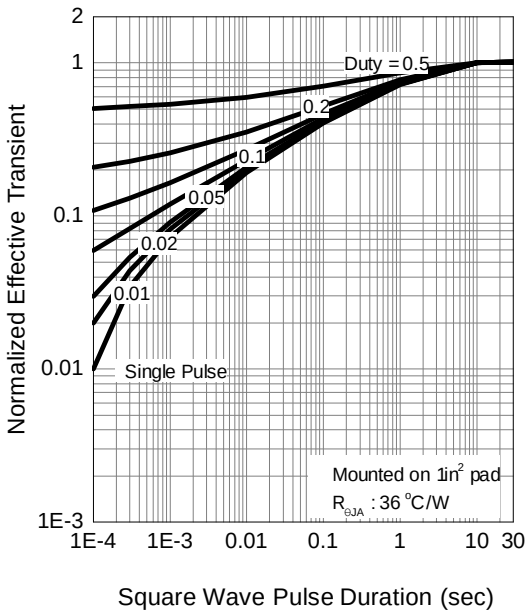


Safe Operation Area (T_A=60°C)

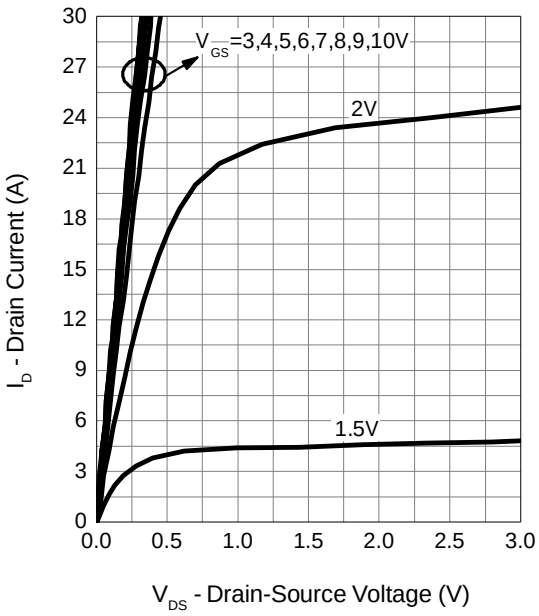


Typical Operating Characteristics (Cont.)

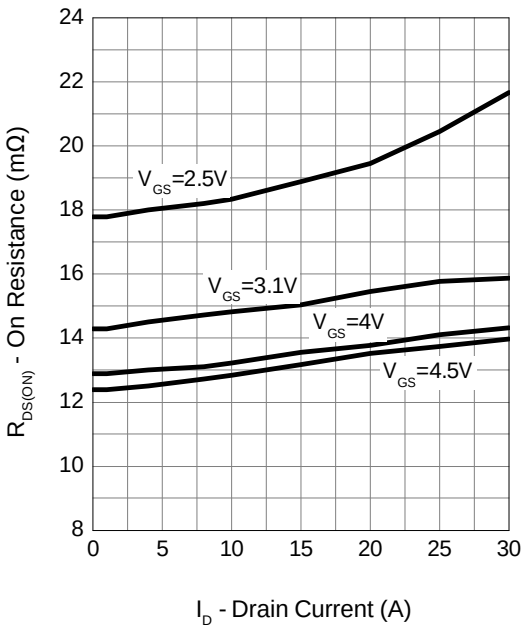
Thermal Transient Impedance



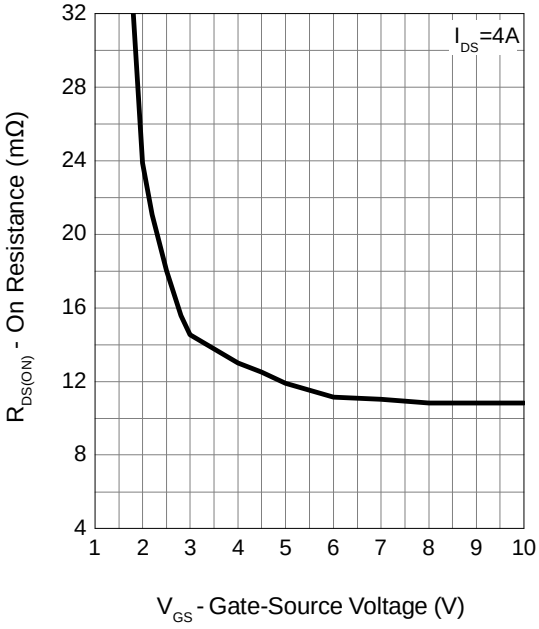
Output Characteristics



Drain-Source On Resistance

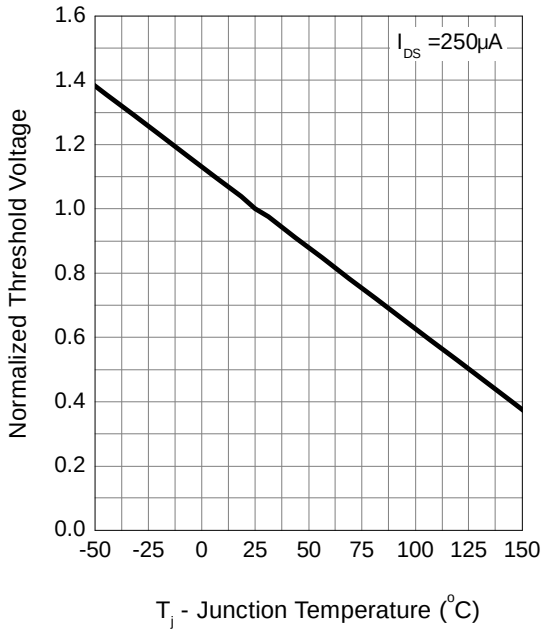


Gate-Source On Resistance

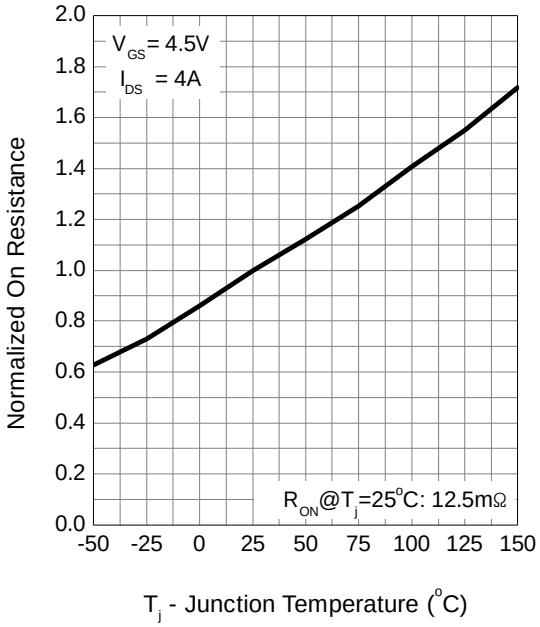


Typical Operating Characteristics (Cont.)

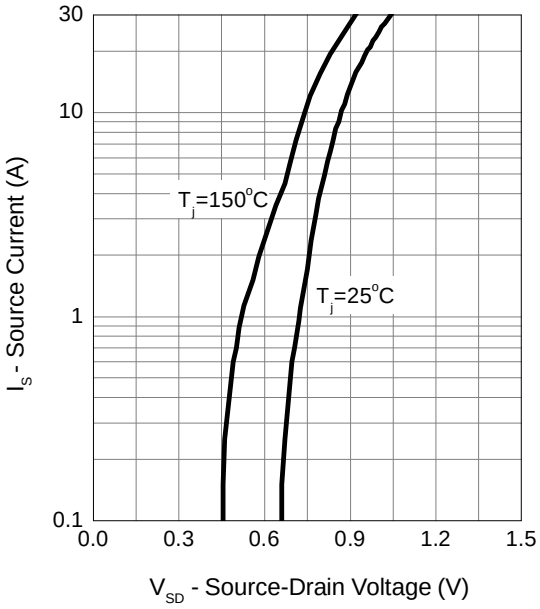
Gate Threshold Voltage



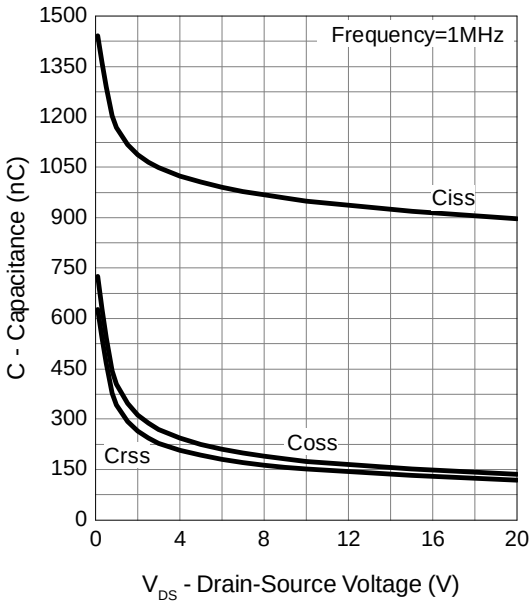
Drain-Source On Resistance



Source-Drain Diode Forward

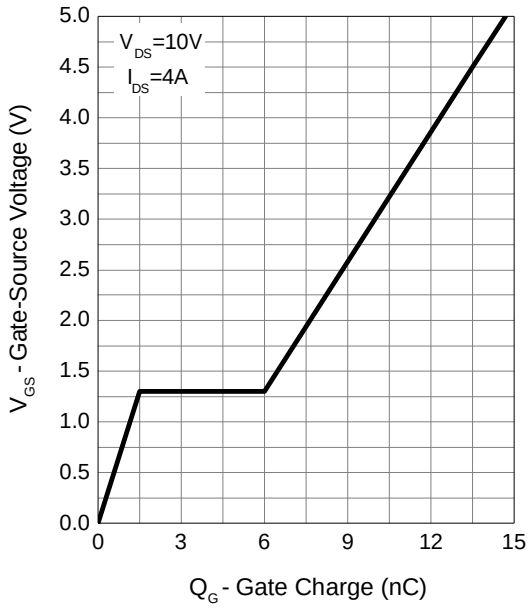


Capacitance

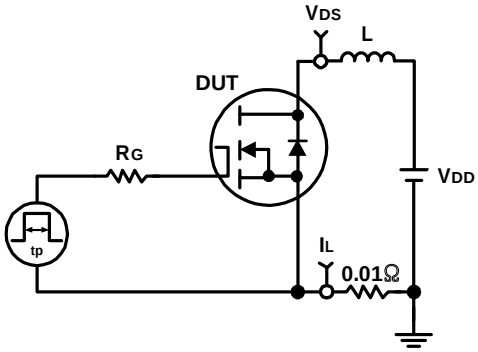


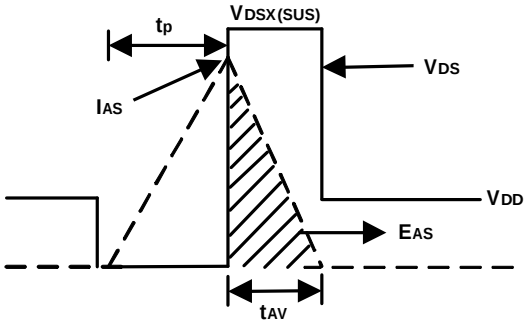
Typical Operating Characteristics (Cont.)

Gate Charge

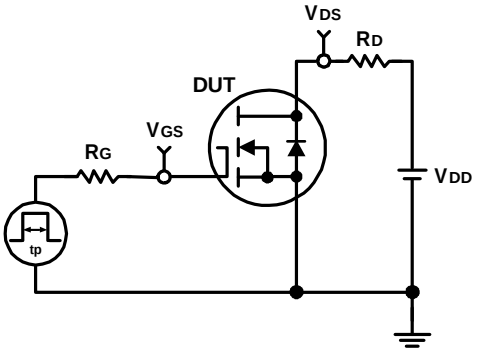


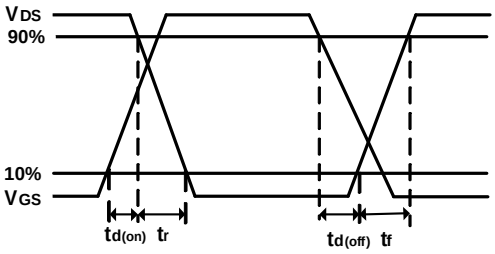
Avalanche Test Circuit and Waveforms





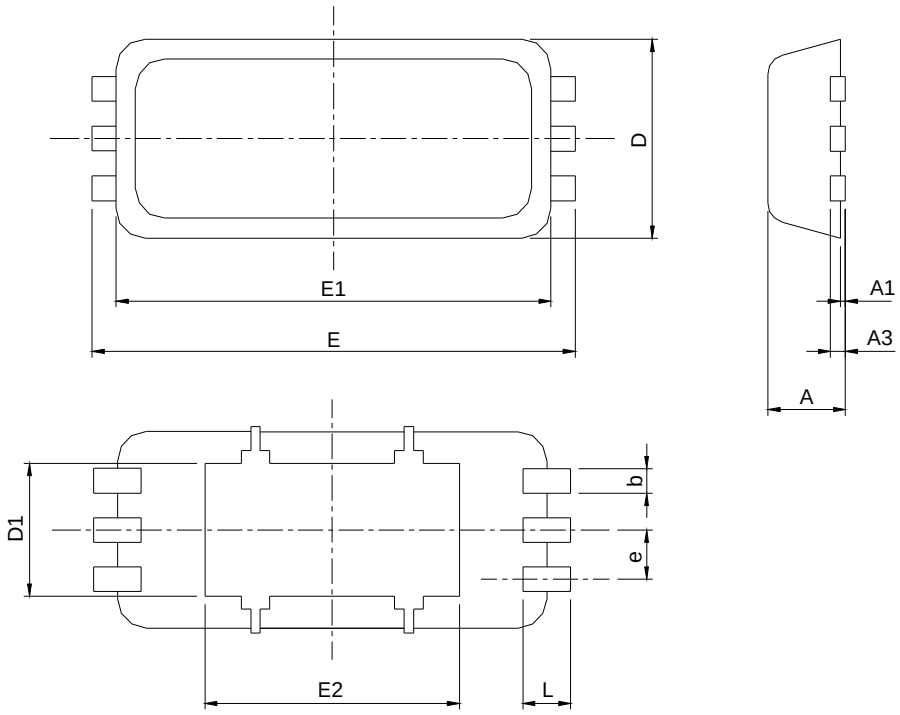
Switching Time Test Circuit and Waveforms





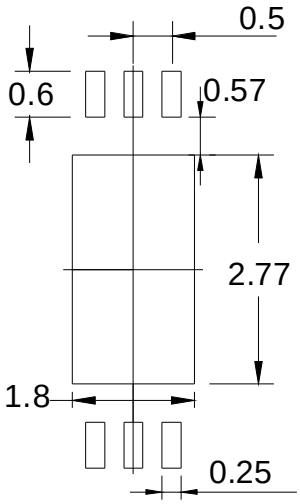
Package Information

TDFN2x5-6



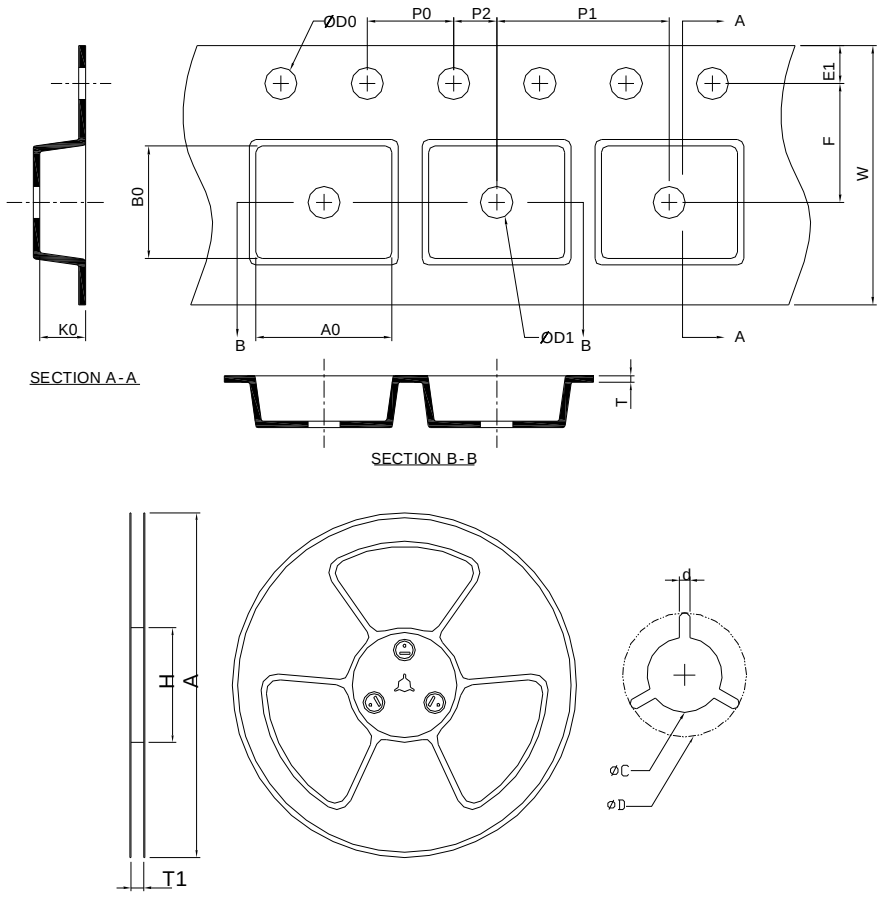
SYMBOL	TDFN2x5-6			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	0.70	0.80	0.028	0.031
A1	0.00	0.05	0.000	0.002
A3	0.10	0.20	0.004	0.008
b	0.20	0.30	0.008	0.012
D	1.90	2.10	0.075	0.083
D1	1.30	1.55	0.051	0.061
E	4.80	5.20	0.189	0.205
E1	4.40	4.60	0.173	0.181
E2	2.60	2.95	0.102	0.116
e	0.50 BSC		0.020 BSC	
L	0.40	0.60	0.016	0.024

RECOMMENDED LAND PATTERN



UNIT: mm

Carrier Tape & Reel Dimensions

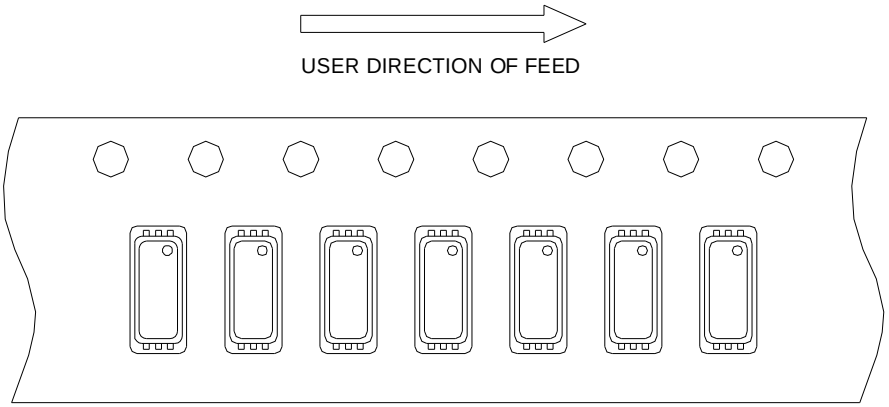


Application	A	H	T1	C	d	D	W	E1	F
TDFN2x5-6	178.0±2.00	50 MIN.	8.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	8.0±0.20	1.75±0.10	5.5±0.10
	P0	**P1**	**P2**	**D0**	**D1**	**T**	**A0**	**B0**	**K0**
	4.0±0.10	4.0±0.10	2.0±0.50	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	2.41±0.20	5.34±0.20	1.10±0.20

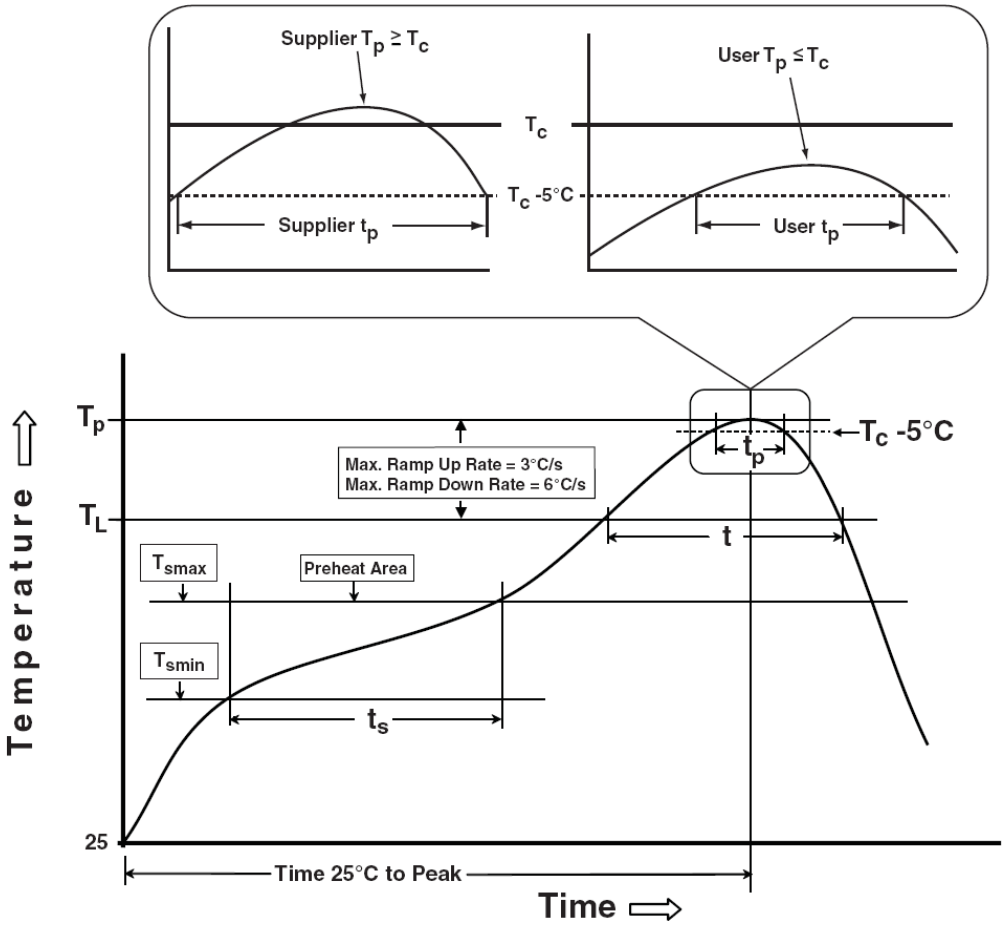
(mm)

Taping Direction Information

TDFN2x5-6



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℃