

N-Channel Enhancement Mode MOSFET

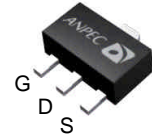
Features

- 20V/5A,
 $R_{DS(ON)}=25m\Omega(Typ.) @ V_{GS}=10V$
 $R_{DS(ON)}=30m\Omega(Typ.) @ V_{GS}=4.5V$
 $R_{DS(ON)}=50m\Omega(Typ.) @ V_{GS}=2.5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Devices Available
 (RoHS Compliant)

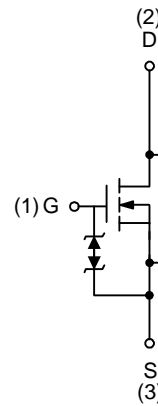
Applications

- DC/DC Converters

Pin Description



Top View of SOT-89



N-Channel MOSFET

Ordering and Marking Information

<p>APM2050N □□-□□□</p> <ul style="list-style-type: none"> □□□ — Assembly Material □□ — Handling Code □ — Temperature Range □ — Package Code 	<p>Package Code D : SOT-89 Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel Assembly Material L : Lead Free Device G : Halogen and Lead Free Device</p>
<p>APM2050N D : APM2050 XXXXX_N</p>	<p>XXXXX - Date Code</p>

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020C for MSL classification at lead-free peak reflow temperature. ANPEC defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$ 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	$V_{GS}=10V$	A	
I_{DM}^*	Pulsed Drain Current			5
I_S^*	Diode Continuous Forward Current	20	A	
T_J	Maximum Junction Temperature	150	$^\circ\text{C}$	
T_{STG}	Storage Temperature Range	-55 to 150		
P_D^*	Power Dissipation for Single Operation	$T_A=25^\circ\text{C}$	1.47	W
		$T_A=100^\circ\text{C}$	0.58	
$R_{\theta JA}^*$	Thermal Resistance-Junction to Ambient	85	$^\circ\text{C}/\text{W}$	

Note * : Surface Mounted on 1in^2 pad area, $t \leq 10$ Seconds.

Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	APM2050ND			Unit
			Min.	Typ.	Max.	
STATIC CHARACTERISTICS						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_{DS}=250\mu\text{A}$	20	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=16V, V_{GS}=0V$	-	-	1	μA
		$T_J=85^\circ\text{C}$	-	-	30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$	0.6	0.9	1.5	V
I_{GSS}	Gate Leakage Current	$V_{GS}=\pm 12V, V_{DS}=0V$	-	-	± 10	μA
$R_{DS(ON)}^a$	Drain-Source On-state Resistance	$V_{GS}=10V, I_{DS}=5A$	-	25	35	m Ω
		$V_{GS}=4.5V, I_{DS}=3.5A$	-	30	50	
		$V_{GS}=2.5V, I_{DS}=2.5A$	-	50	85	
V_{SD}^a	Diode Forward Voltage	$I_{SD}=2A, V_{GS}=0V$	-	0.8	1.3	V
GATE CHARGE CHARACTERISTICS^b						
Q_g	Total Gate Charge	$V_{DS}=10V, V_{GS}=4.5V, I_{DS}=5A$	-	6	8	nC
Q_{gs}	Gate-Source Charge		-	1	-	
Q_{gd}	Gate-Drain Charge		-	2.6	-	

Electrical Characteristics (Cont.) (T_A = 25°C unless otherwise noted)

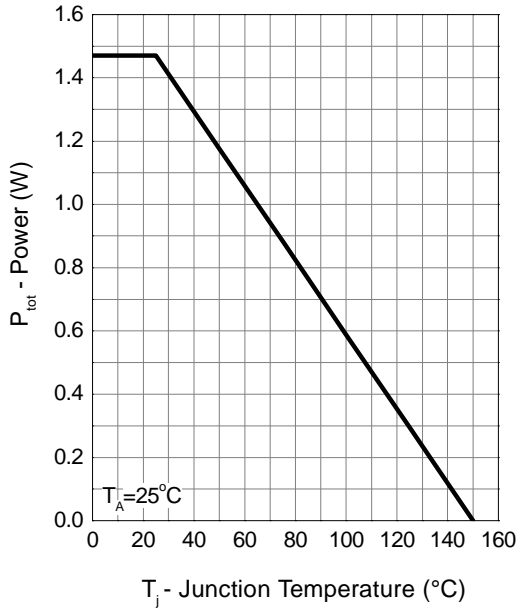
Symbol	Parameter	Test Conditions	APM2050ND			Unit
			Min.	Typ.	Max.	
DYNAMIC CHARACTERISTICS^b						
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =10V, Frequency=1.0MHz	-	375	-	pF
C _{oss}	Output Capacitance		-	105	-	
C _{rss}	Reverse Transfer Capacitance		-	85	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =10V, R _L =10Ω, I _{DS} =1A, V _{GEN} =4.5V, R _G =6Ω	-	4	8	ns
T _r	Turn-on Rise Time		-	11	21	
t _{d(OFF)}	Turn-off Delay Time		-	22	41	
T _f	Turn-off Fall Time		-	8	15	
t _{rr}	Reverse Recovery Time	I _{DS} =5A, di _{SD} /dt=100A/μs	-	15	-	ns
Q _{rr}	Reverse Recovery Charge		-	5	-	nC

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

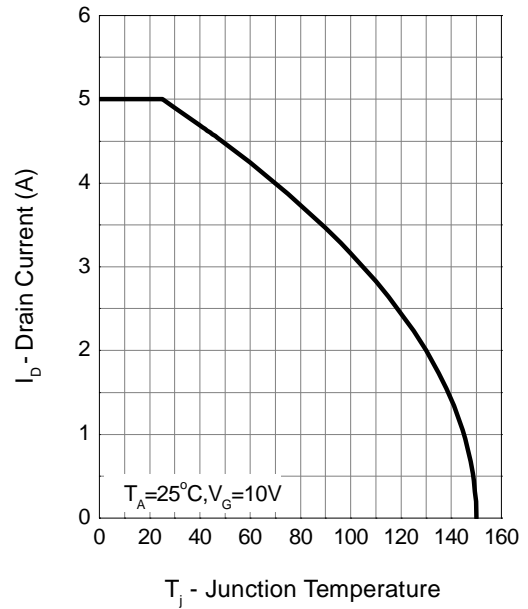
Note b : Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

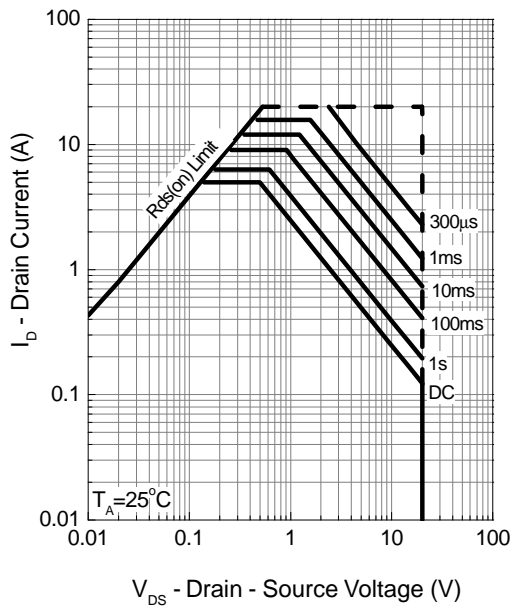
Power Dissipation



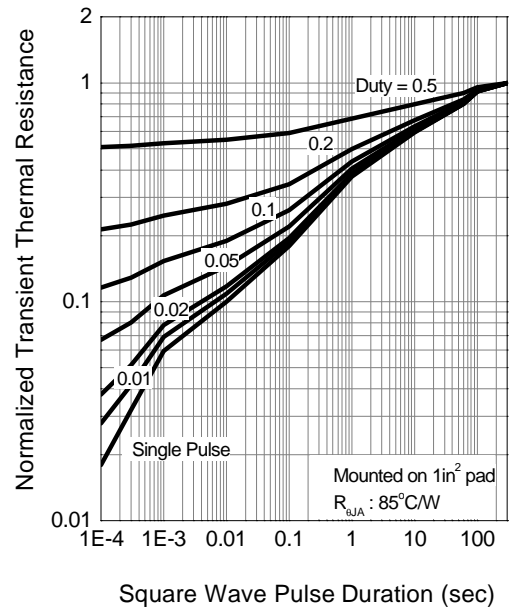
Drain Current



Safe Operation Area

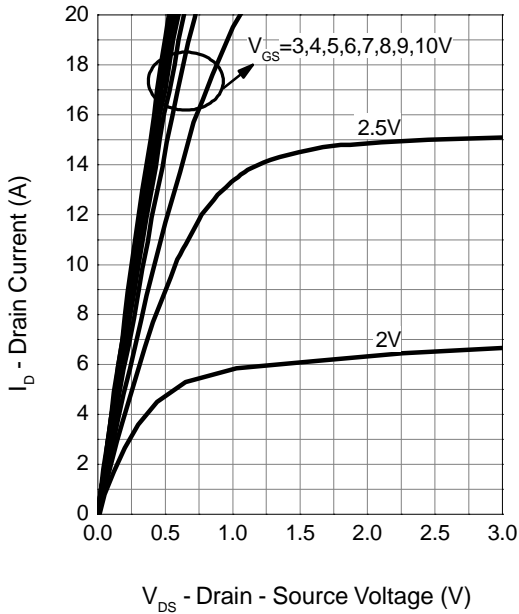


Thermal Transient Impedance

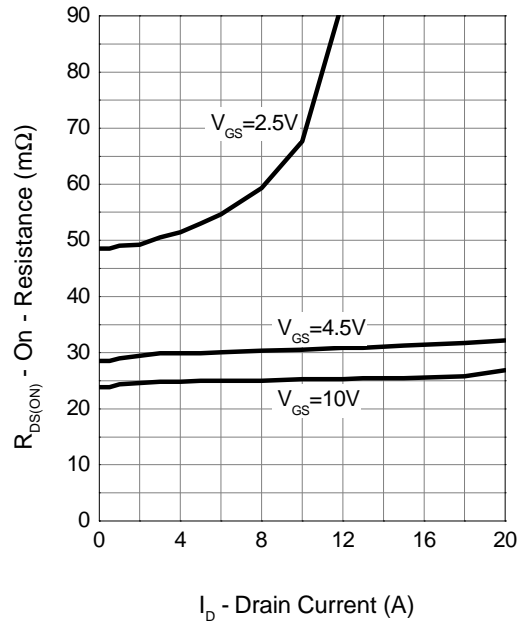


Typical Operating Characteristics (Cont.)

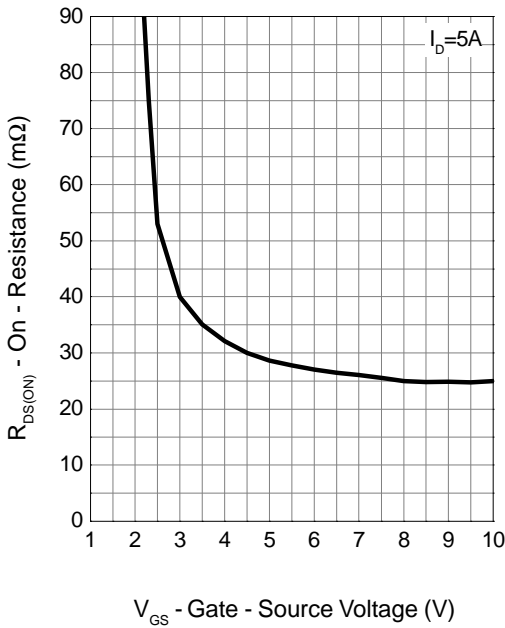
Output Characteristics



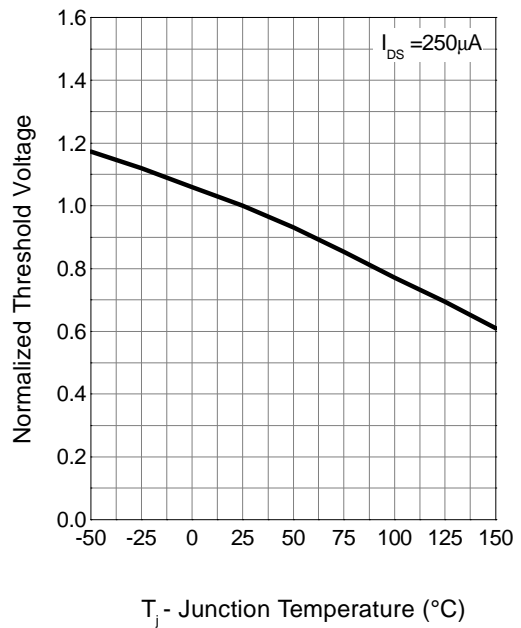
Drain-Source On Resistance



Drain-Source On Resistance

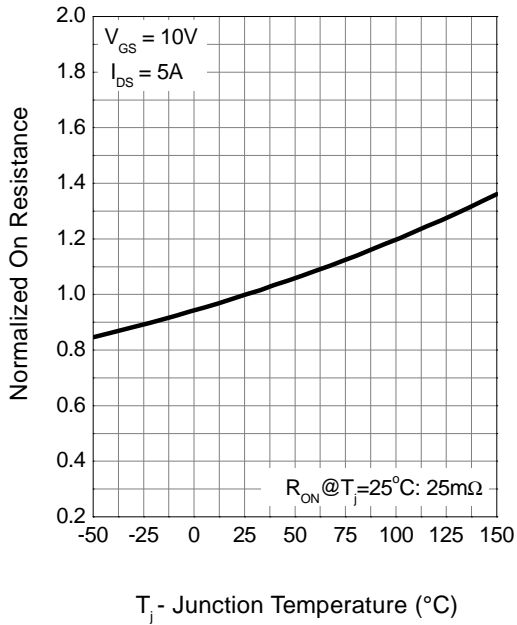


Gate Threshold Voltage

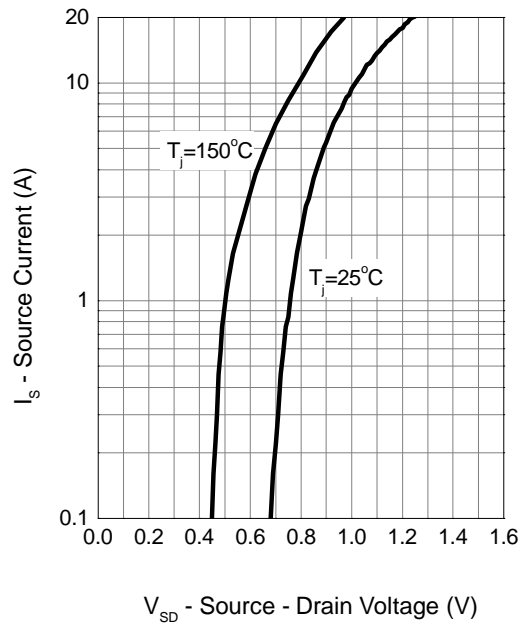


Typical Operating Characteristics (Cont.)

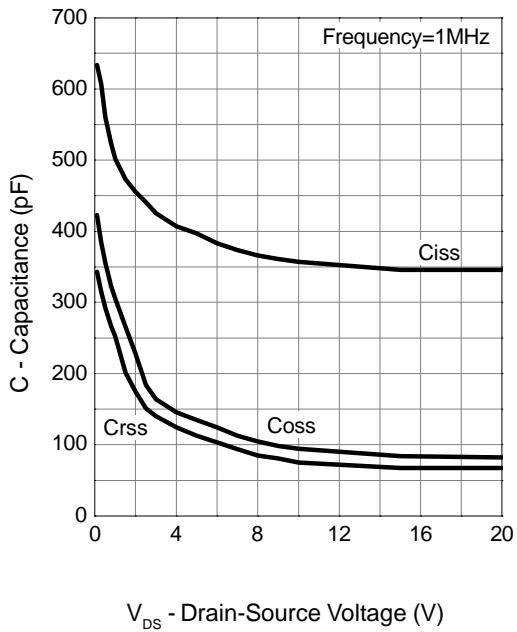
Drain-Source On Resistance



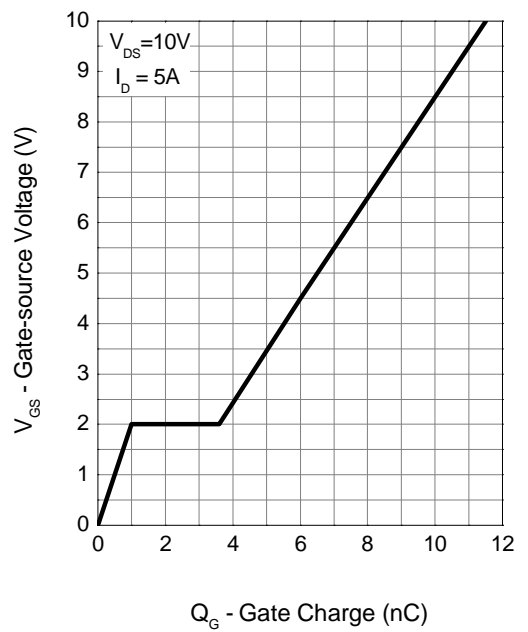
Source-Drain Diode Forward



Capacitance

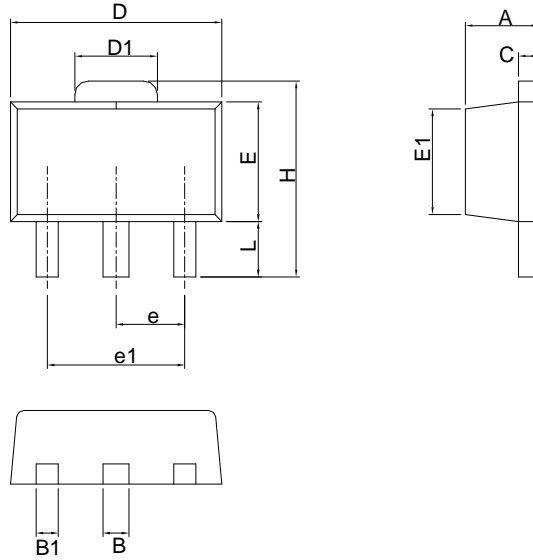


Gate Charge



Package Information

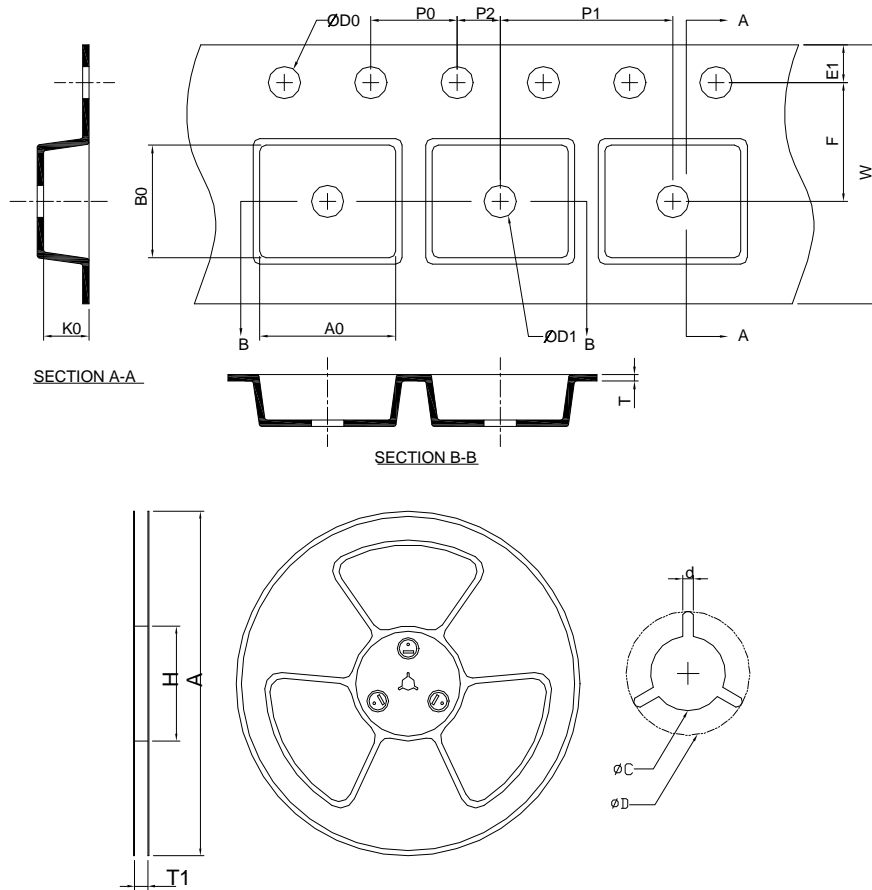
SOT-89



SYMBOL	SOT-89			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	1.40	1.60	0.055	0.063
B	0.44	0.56	0.017	0.022
B1	0.36	0.48	0.014	0.019
C	0.35	0.44	0.014	0.017
D	4.40	4.60	0.173	0.181
D1	1.62	1.83	0.064	0.072
E	2.29	2.60	0.090	0.102
E1	2.13	2.29	0.084	0.090
e	1.50 BSC		0.059 BSC	
e1	3.00 BSC		0.118 BSC	
H	3.94	4.25	0.155	0.167
L	0.89	1.20	0.035	0.047

Note : Follow JEDEC TO-243 AA.

Carrier Tape & Reel Dimensions



Application	A	H	T1	C	d	D	W	E1	F
SOT-89	178.0 ±0.00	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0 ±0.30	1.75 ±0.10	5.50 ±0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0 ±0.10	8.0 ±0.10	2.0 ±0.05	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	4.80 ±0.20	4.50 ±0.20	1.80 ±0.20

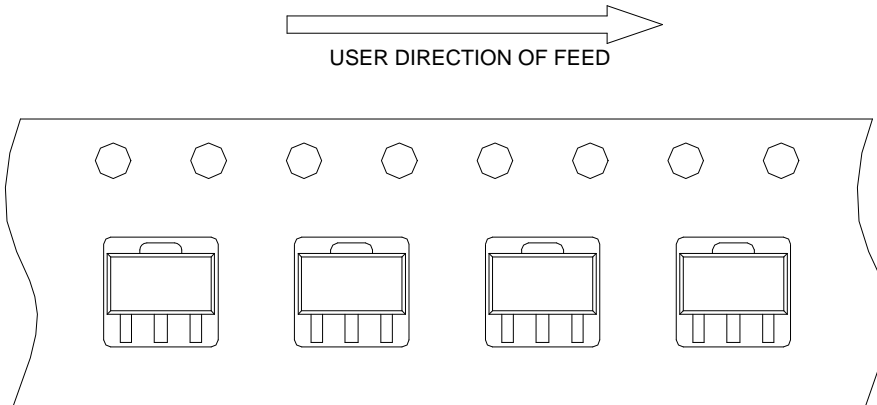
(mm)

Devices Per Unit

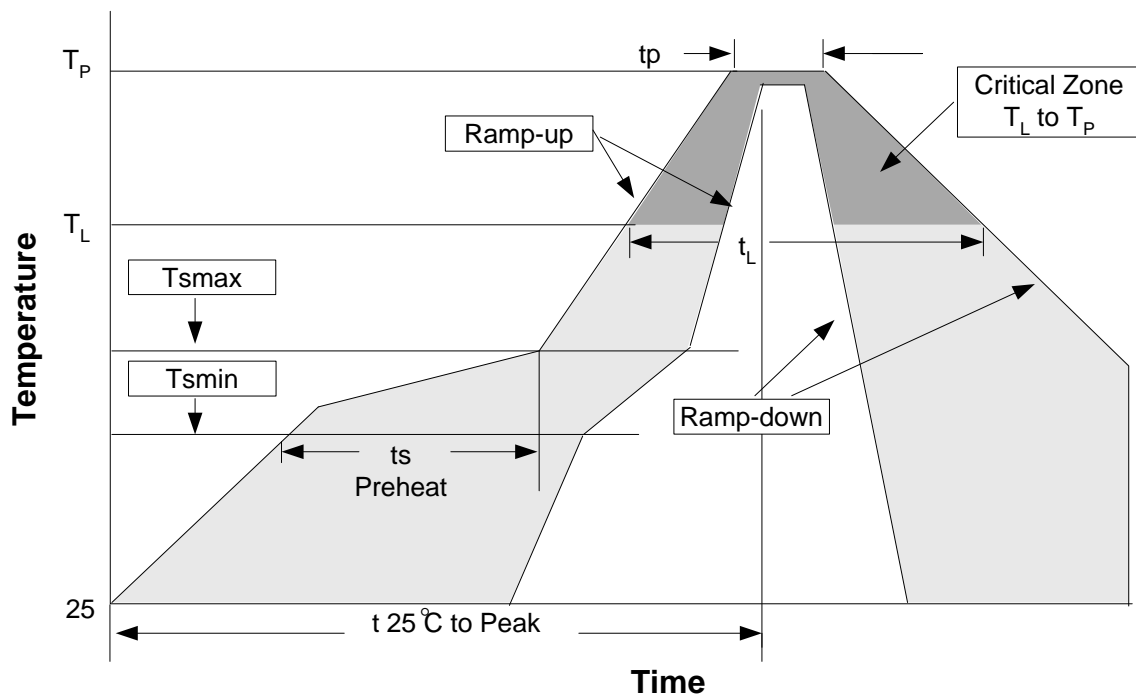
Package Type	Unit	Quantity
SOT-89	Type & Reel	1000

Taping Direction Information

SOT-89



Reflow Condition (IR/Convection or VPR Reflow)



Reliability Test Program

Test item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245°C, 5 sec
HOLT	MIL-STD-883D-1005.7	1000 Hrs Bias @125°C
PCT	JESD-22-B, A102	168 Hrs, 100%RH, 121°C
TST	MIL-STD-883D-1011.9	-65°C~150°C, 200 Cycles
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms, 1 _{tr} > 100mA

Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T _L to T _P)	3°C/second max.	3°C/second max.
Preheat		
- Temperature Min (T _{min})	100°C	150°C
- Temperature Max (T _{max})	150°C	200°C
- Time (min to max) (ts)	60-120 seconds	60-180 seconds
Time maintained above:		
- Temperature (T _L)	183°C	217°C
- Time (t _L)	60-150 seconds	60-150 seconds
Peak/Classification Temperature (T _p)	See table 1	See table 2
Time within 5°C of actual Peak Temperature (t _p)	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max.	6°C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

Note: All temperatures refer to topside of the package. Measured on the body surface.

Table 1. SnPb Eutectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	240 +0/-5°C	225 +0/-5°C
≥2.5 mm	225 +0/-5°C	225 +0/-5°C

Table 2. Pb-free Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*

*Tolerance: The device manufacturer/supplier shall assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0°C. For example 260°C+0°C) at the rated MSL level.

Customer Service

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