

Absolute Maximum Ratings

Symbol	Parameter		Rating	Unit
Common Ratings (T _A =25°C Unless Otherwise Noted)				
V _{DSS}	Drain-Source Voltage		40	V
BV _{DS(Avalanche)} *	Drain-Source Avalanche Voltage (Maximum)		45	
V _{GSS}	Gate-Source Voltage		±20	
T _J	Maximum Junction Temperature		175	°C
T _{STG}	Storage Temperature Range		-55 to 175	°C
I _S	Diode Continuous Forward Current		40	A
I _{DP}	300μs Pulse Drain Current Tested	T _C =25°C	160	A
		T _C =100°C	90	
I _D	Continuous Drain Current	T _C =25°C	60***	A
		T _C =100°C	48	
P _D	Maximum Power Dissipation	T _C =25°C	60	W
		T _C =100°C	30	
R _{θJC}	Thermal Resistance-Junction to Case		2.5	°C/W
R _{θJA}	Thermal Resistance-Junction to Ambient		50	°C/W
E _{AS} **	Drain-Source Avalanche Energy, L=0.5mH		140	mJ

Notes :

* Avalanche single pulse test and avalanche period time $t_{\text{av}} \leq 100 \mu\text{s}$, duty $< 1\%$.** Avalanche test condition: $T_J=25^{\circ}\text{C}$, $L=0.5\text{mH}$, $I_{\text{AS}}=24\text{A}$, $V_{\text{DD}}=30\text{V}$, and $V_{\text{GS}}=10\text{V}$.

*** Current limited by bond wire.

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

Symbol	Parameter	Test Conditions	SM4028NSU			Unit
			Min.	Typ.	Max.	
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =250μA	40	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =32V, V _{GS} =0V	-	-	1	μA
		T _J =85°C	-	-	30	
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250μA	1.5	2	3	V
I _{GSS}	Gate Leakage Current	V _{GS} =±20V, V _{DS} =0V	-	-	±100	nA
R _{DS(ON)} ^a	Drain-Source On-state Resistance	V _{GS} =10V, I _{DS} =20A	-	6.2	8	mΩ
		V _{GS} =4.5V, I _{DS} =10A	-	9.2	13	

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

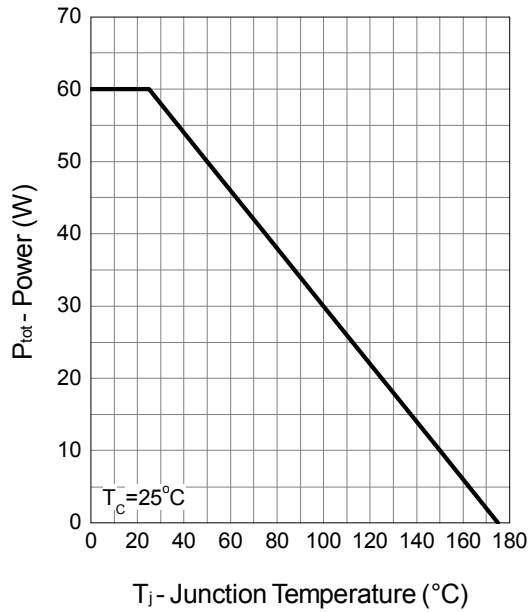
Symbol	Parameter	Test Conditions	SM4028NSU			Unit
			Min.	Typ.	Max.	
Diode Characteristics						
V_{SD}^a	Diode Forward Voltage	$I_{SD}=20A, V_{GS}=0V$	-	0.8	1.1	V
t_{rr}	Reverse Recovery Time	$I_{DS}=40A, di_{SD}/dt=100A/\mu s$	-	28	-	ns
Q_{rr}	Reverse Recovery Charge		-	24	-	nC
Dynamic Characteristics ^b						
R_G	Gate Resistance	$V_{GS}=0V, V_{DS}=0V, F=1MHz$	-	1.4	-	Ω
C_{iss}	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=20V,$ Frequency=1.0MHz	-	1460	-	pF
C_{oss}	Output Capacitance		-	180	-	
C_{rss}	Reverse Transfer Capacitance		-	146	-	
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=20V, R_L=20\Omega,$ $I_{DS}=1A, V_{GEN}=10V,$ $R_G=6\Omega$	-	11	21	ns
t_r	Turn-on Rise Time		-	13	24	
$t_{d(OFF)}$	Turn-off Delay Time		-	37	67	
t_f	Turn-off Fall Time		-	11	21	
Gate Charge Characteristics ^b						
Q_g	Total Gate Charge	$V_{DS}=20V, V_{GS}=10V,$ $I_{DS}=40A$	-	31.2	44	nC
Q_{gs}	Gate-Source Charge		-	3.8	-	
Q_{gd}	Gate-Drain Charge		-	9	-	

Note a : Pulse test ; pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$.

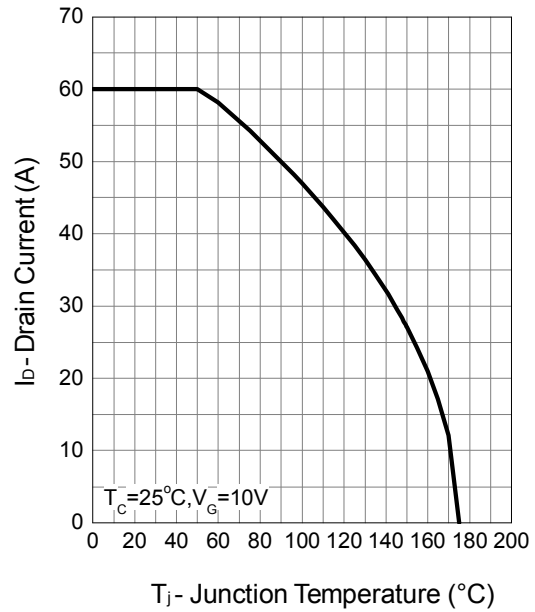
Note b : Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

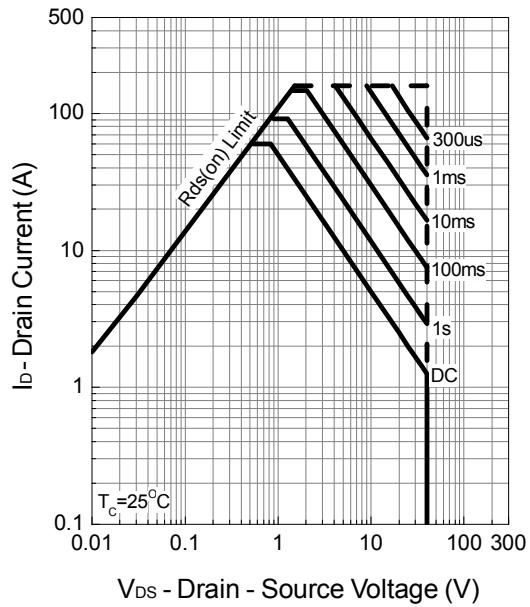
Power Dissipation



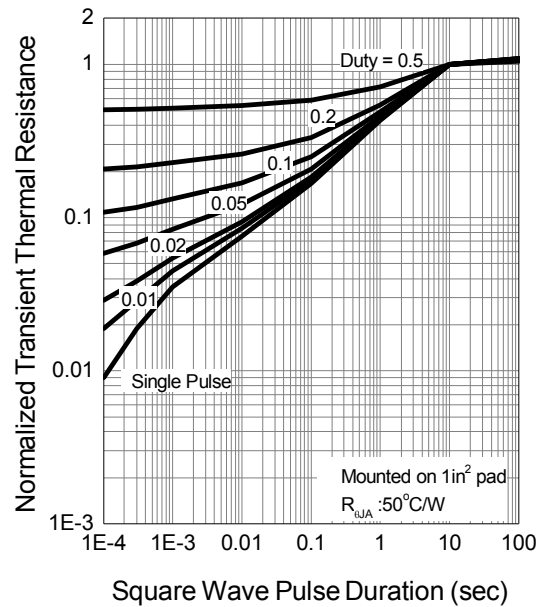
Drain Current



Safe Operation Area

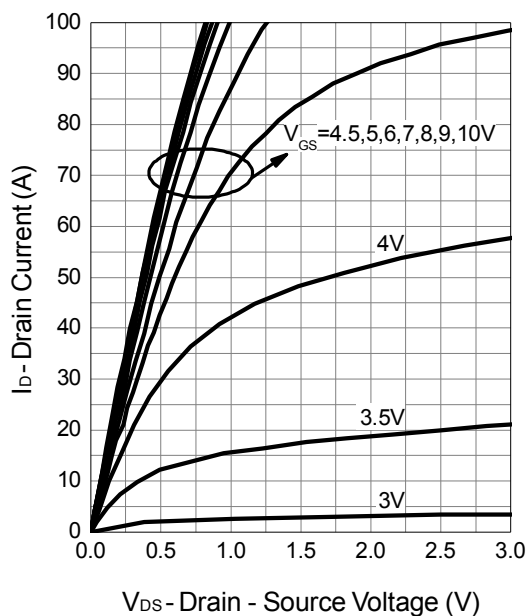


Thermal Transient Impedance

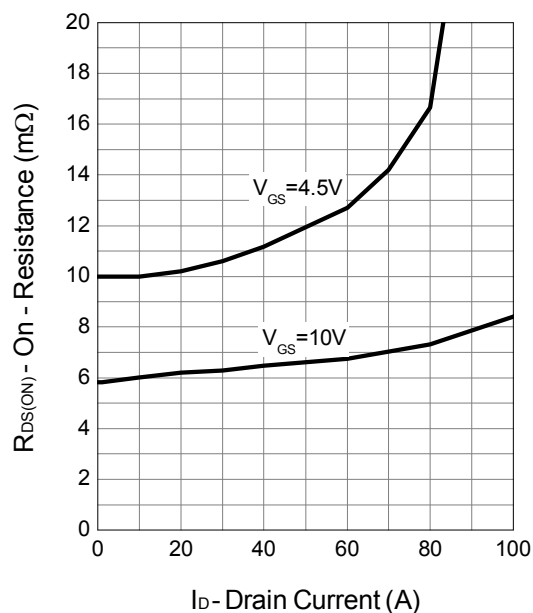


Typical Operating Characteristics (Cont.)

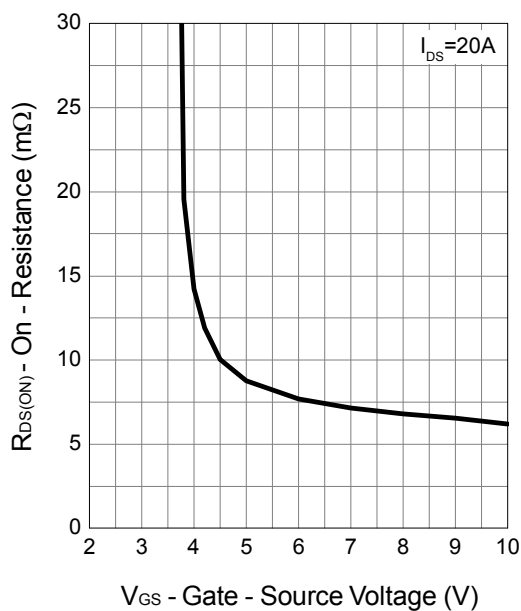
Output Characteristics



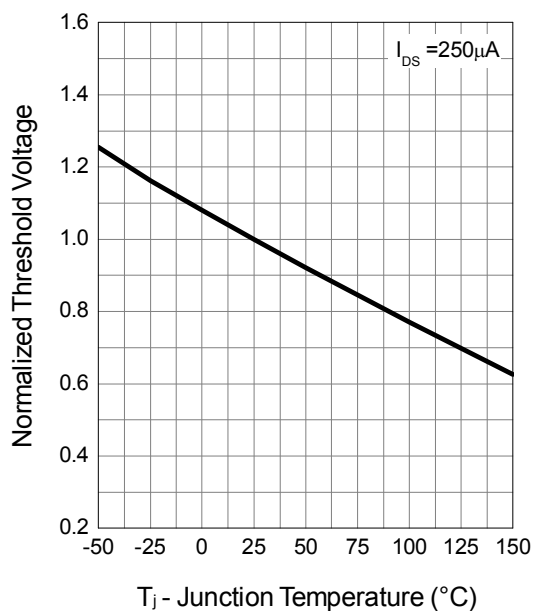
Drain-Source On Resistance



Gate-Source On Resistance

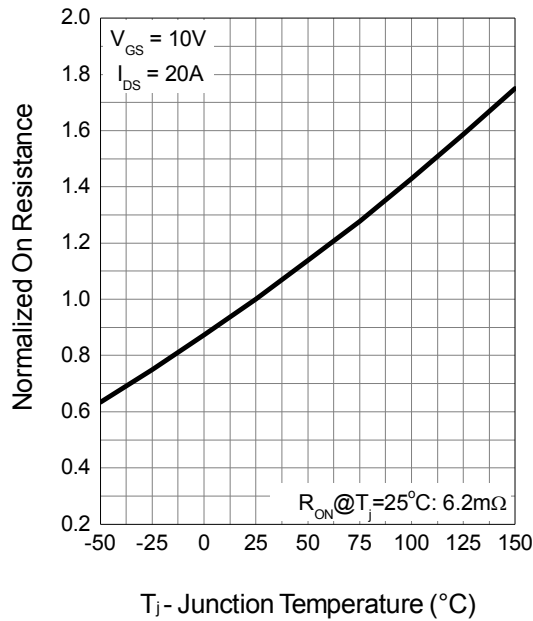


Gate Threshold Voltage

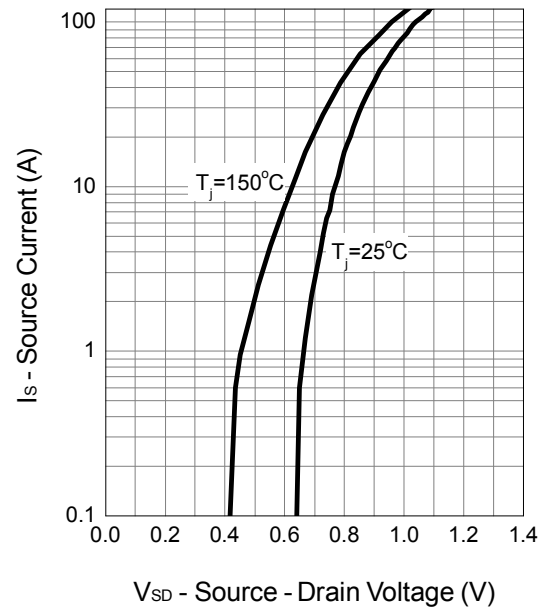


Typical Operating Characteristics (Cont.)

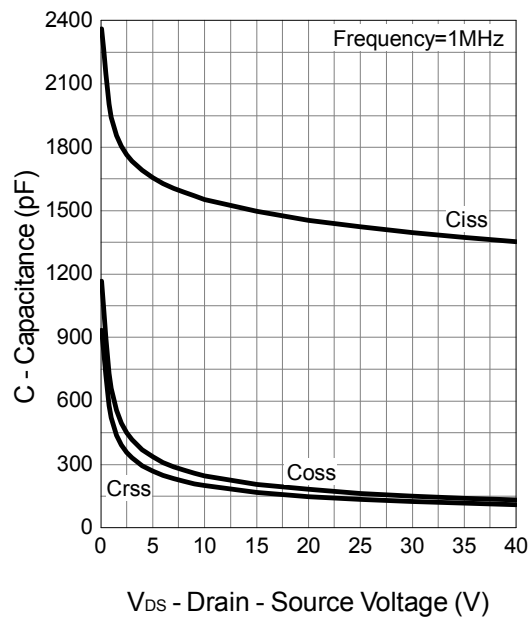
Drain-Source On Resistance



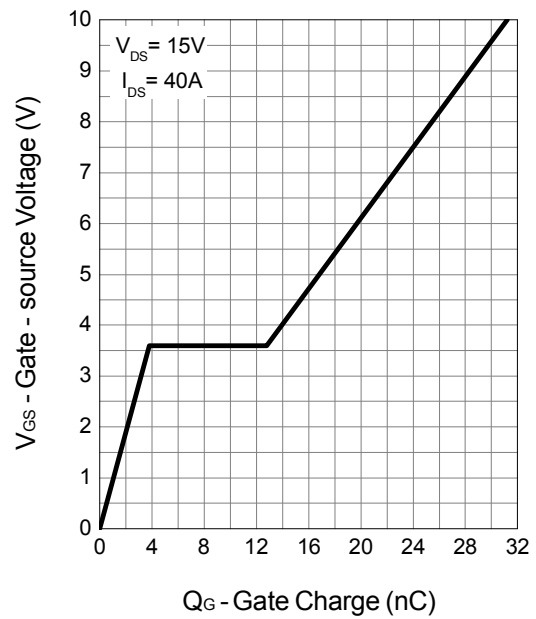
Source-Drain Diode Forward



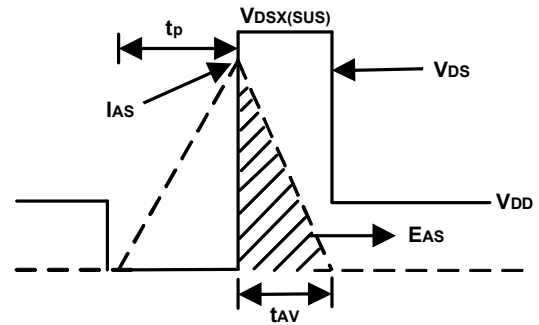
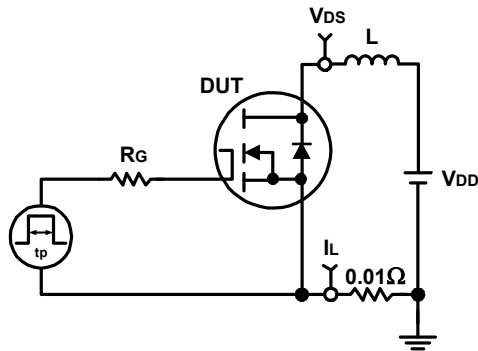
Capacitance



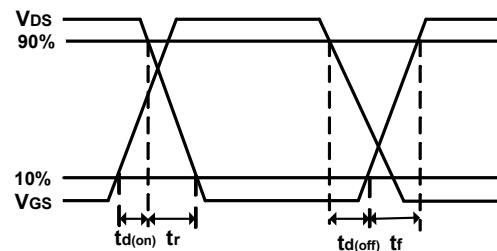
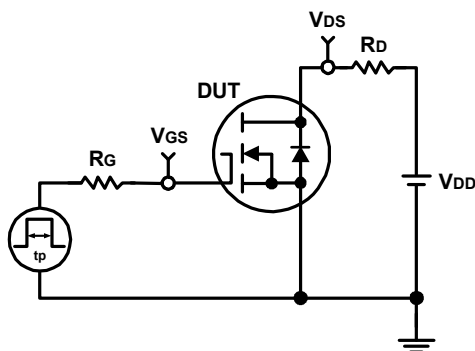
Gate Charge



Avalanche Test Circuit and Waveforms

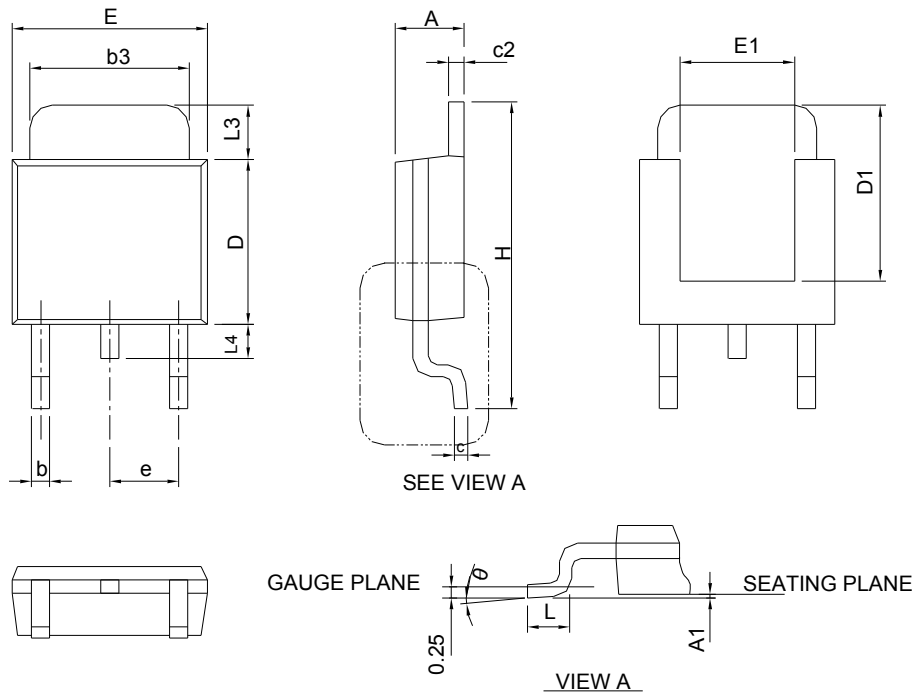


Switching Time Test Circuit and Waveforms



Package Information

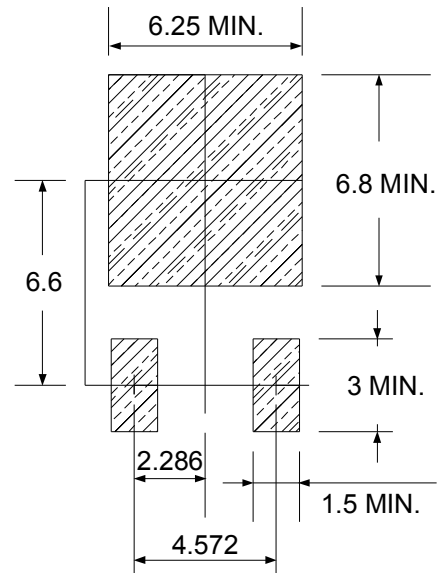
TO-252-3



SYMBOL	TO-252-3			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.39	0.086	0.094
A1	-	0.13	-	0.005
b	0.50	0.89	0.020	0.035
b3	4.95	5.46	0.195	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	2.29 BSC		0.090 BSC	
H	9.40	10.41	0.370	0.410
L	0.90	1.78	0.035	0.070
L3	0.89	2.03	0.035	0.080
L4	-	1.02	-	0.040
θ	0°	8°	0°	8°

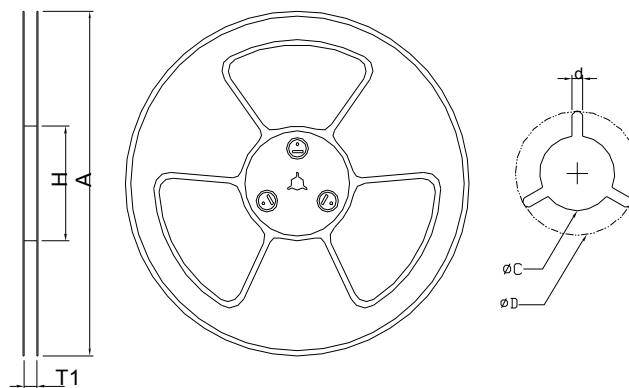
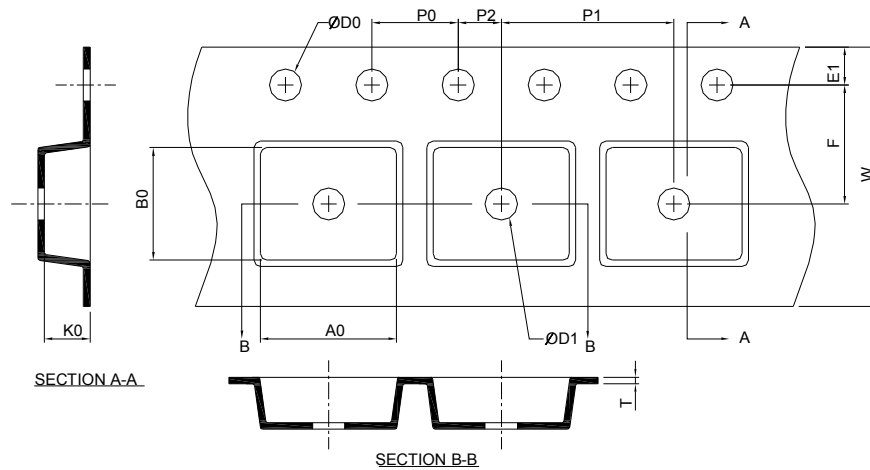
Note : Follow JEDEC TO-252 .

RECOMMENDED LAND PATTERN



UNIT: mm

Carrier Tape & Reel Dimensions

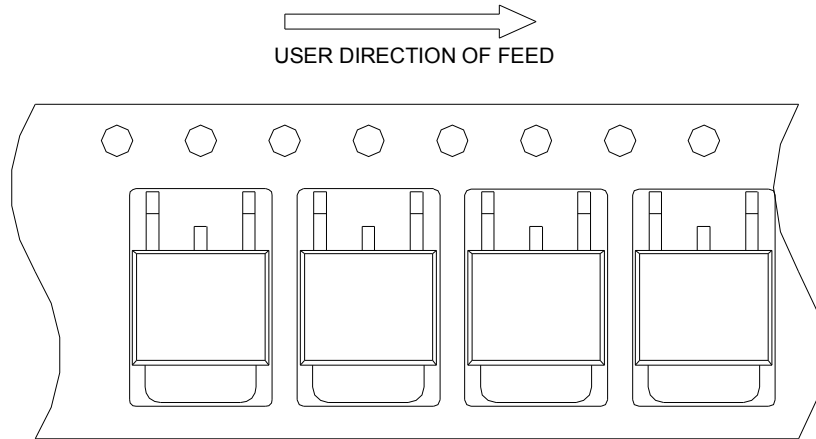


Application	A	H	T1	C	d	D	W	E1	F
TO-252-3	330.0 ± 2.00	50 MIN.	$16.4 + 2.00 - 0.00$	$13.0 + 0.50 - 0.20$	1.5 MIN.	20.2 MIN.	16.0 ± 0.30	1.75 ± 0.10	7.50 ± 0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0 ± 0.10	8.0 ± 0.10	2.0 ± 0.05	$1.5 + 0.10 - 0.00$	1.5 MIN.	$0.6 + 0.00 - 0.40$	6.80 ± 0.20	10.40 ± 0.20	2.50 ± 0.20

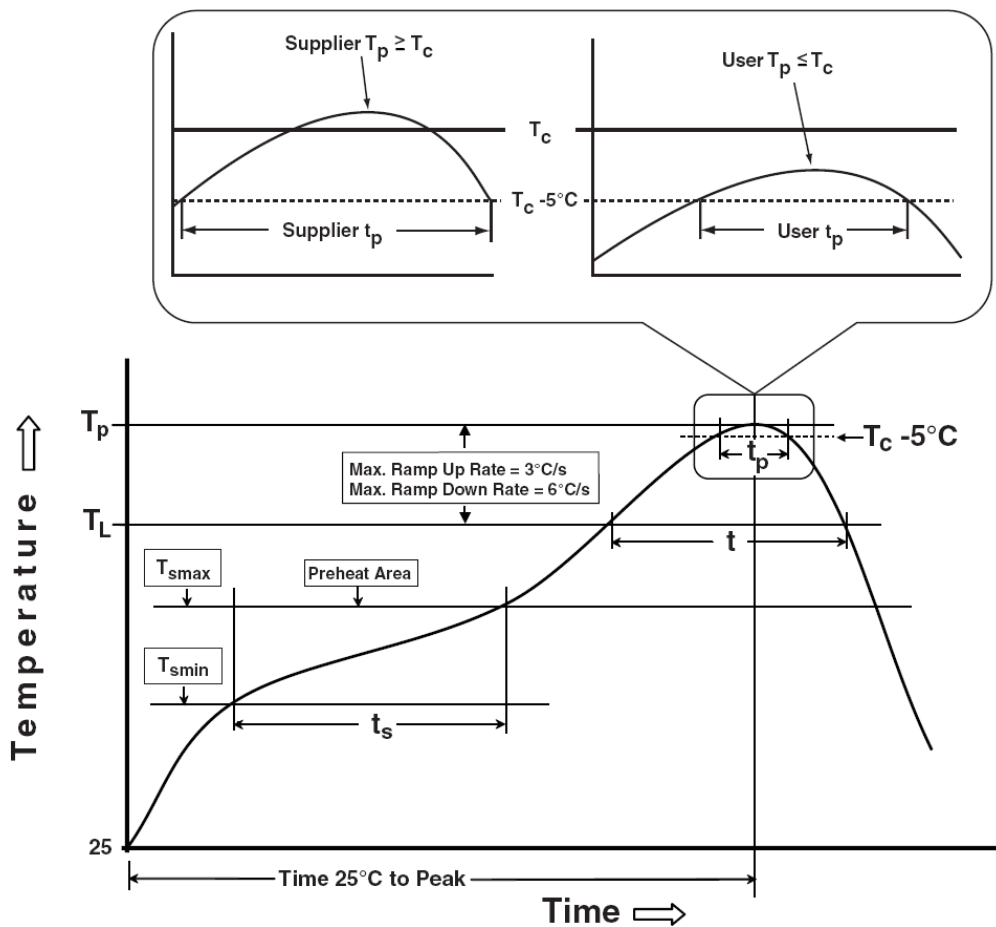
(mm)

Taping Direction Information

TO-252-3



Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin})	100 °C	150 °C
Temperature max (T_{smax})	150 °C	200 °C
Time (T_{smin} to T_{smax}) (t_s)	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{smax} to T_p)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L)	183 °C	217 °C
Time at liquidous (t_L)	60-150 seconds	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°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C 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 (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (T_c)

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

Reliability Test Program

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

Customer Service

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