

P-Channel Enhancement Mode MOSFET

Features

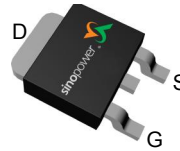
- 30V/-88A,
 $R_{DS(ON)} = 6.5m\Omega$ (max.) @ $V_{GS} = -10V$
 $R_{DS(ON)} = 11.5m\Omega$ (max.) @ $V_{GS} = -4.5V$
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)
- HBM ESD capability level of 2.6KV typical

Note : The diode connected between the gate and source serves only as protection against ESD. No gate overvoltage rating is implied.

Applications

- Power Management in LCD TV Inverter.

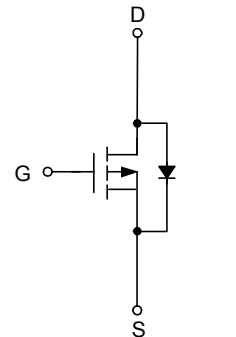
Pin Description



Top View of TO-252




Top View of TO-251



P-Channel MOSFET

Ordering and Marking Information

<p>SM4301PS □□□-□□□</p> <div style="margin-left: 40px;"> <p>└─ Assembly Material</p> <p>└─ Handling Code</p> <p>└─ Temperature Range</p> <p>└─ Package Code</p> </div>	<p>Package Code U : TO-252 UC : TO-251</p> <p>Operating Junction Temperature Range C : -55 to 150°C</p> <p>Handling Code TR : Tape & Reel (TO-252, 2500ea/reel) TU : Tube (TO-251, 80ea/tube)</p> <p>Assembly Material G : Halogen and Lead Free Device</p>
<p>SM4301P U/UC :</p> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;">  SM4301P XXXXX </div>	<p>XXXXX - Lot Code</p>

Note : SINOPOWER lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. SINOPOWER lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. SINOPOWER 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).

SINOPOWER 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

Symbol	Parameter	Rating	Unit	
Common Ratings ($T_A=25^\circ\text{C}$ Unless Otherwise Noted)				
V_{DSS}	Drain-Source Voltage	-30	V	
V_{GSS}	Gate-Source Voltage	± 25		
T_J	Maximum Junction Temperature	150	$^\circ\text{C}$	
T_{STG}	Storage Temperature Range	-55 to 150		
I_S	Diode Continuous Forward Current	$T_C=25^\circ\text{C}$	-30	A
I_D	Continuous Drain Current	$T_C=25^\circ\text{C}$	-88	
		$T_C=100^\circ\text{C}$	-55	
I_{DM}	Pulsed Drain Current	$T_C=25^\circ\text{C}$	-352 ^a	
P_D	Maximum Power Dissipation	$T_C=25^\circ\text{C}$	78	W
		$T_C=100^\circ\text{C}$	31	
$R_{\theta JC}$	Thermal Resistance-Junction to Case	Steady State	1.6	$^\circ\text{C/W}$
I_D	Continuous Drain Current	$T_A=25^\circ\text{C}$	-25	A
		$T_A=70^\circ\text{C}$	-20	
P_D	Maximum Power Dissipation	$T_A=25^\circ\text{C}$	6.3	W
		$T_A=70^\circ\text{C}$	4.0	
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	$t \leq 10\text{s}$	20	$^\circ\text{C/W}$
		Steady State	55	
I_{AS}^c	Avalanche Current, Single pulse ($L=0.1\text{mH}$)		-56	A
E_{AS}^c	Avalanche Energy, Single pulse ($L=0.1\text{mH}$)		156	mJ

Note a : Pulse width limited by max. junction temperature.

Note b : UIS tested and pulse width limited by maximum junction temperature 150°C (initial temperature $T_J=25^\circ\text{C}$).

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0\text{V}, I_{DS}=-250\mu\text{A}$	-30	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=-24\text{V}, V_{GS}=0\text{V}$ $T_J=85^\circ\text{C}$	-	-	-1	μA
			-	-	-30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=-250\mu\text{A}$	-1.3	-1.8	-2.3	V
I_{GSS}	Gate Leakage Current	$V_{GS}=\pm 25\text{V}, V_{DS}=0\text{V}$	-	-	± 100	nA
$R_{DS(ON)}^c$	Drain-Source On-state Resistance	$V_{GS}=-10\text{V}, I_{DS}=-25\text{A}$	-	5.2	6.5	m Ω
		$V_{GS}=-4.5\text{V}, I_{DS}=-20\text{A}$	-	8.5	11.5	

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

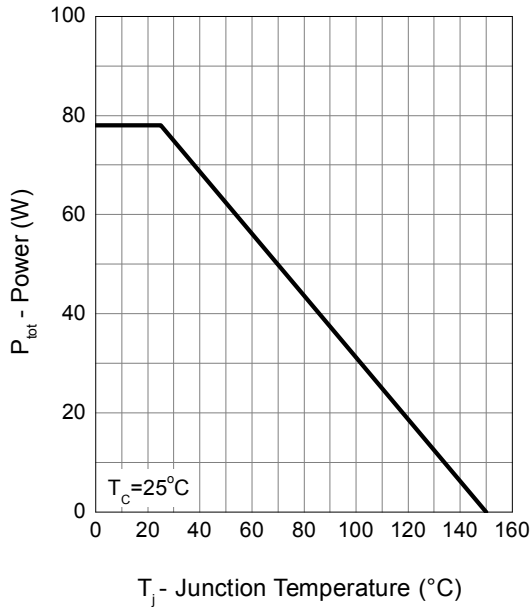
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Diode Characteristics						
V_{SD}^c	Diode Forward Voltage	$I_{SD}=-1\text{A}, V_{GS}=0\text{V}$	-	-0.7	-1	V
t_{rr}	Reverse Recovery Time	$I_{SD}=-25\text{A}, dI_{SD}/dt=100\text{A}/\mu\text{s}$	-	30	-	ns
Q_{rr}	Reverse Recovery Charge		-	20	-	nC
Dynamic Characteristics ^d						
R_G	Gate Resistance	$V_{GS}=0\text{V}, V_{DS}=0\text{V}, F=1\text{MHz}$	-	2	-	Ω
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=-15\text{V},$ Frequency=1.0MHz	-	3200	-	pF
C_{oss}	Output Capacitance		-	640	-	
C_{rss}	Reverse Transfer Capacitance		-	600	-	
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=-15\text{V}, R_L=15\Omega,$ $I_{DS}=-1\text{A}, V_{GEN}=-10\text{V},$ $R_G=6\Omega$	-	15	-	ns
t_r	Turn-on Rise Time		-	19	-	
$t_{d(OFF)}$	Turn-off Delay Time		-	88	-	
t_f	Turn-off Fall Time		-	62	-	
Gate Charge Characteristics ^d						
Q_g	Total Gate Charge	$V_{DS}=-15\text{V}, V_{GS}=-10\text{V},$ $I_{DS}=-25\text{A}$	-	70	-	nC
Q_{gs}	Gate-Source Charge		-	10	-	
Q_{gd}	Gate-Drain Charge		-	18	-	

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

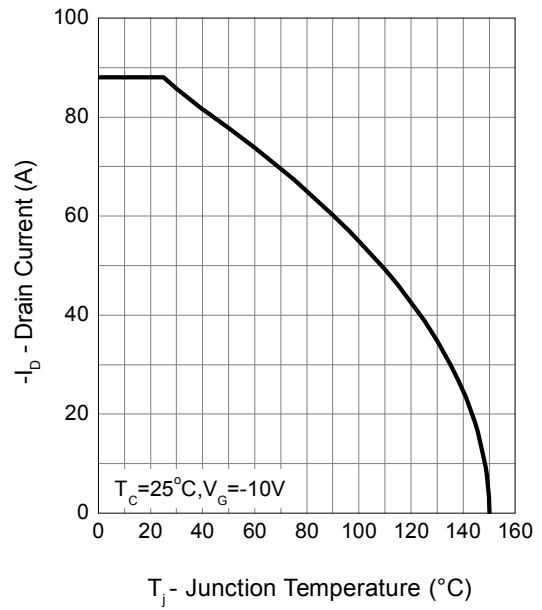
Note d : Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

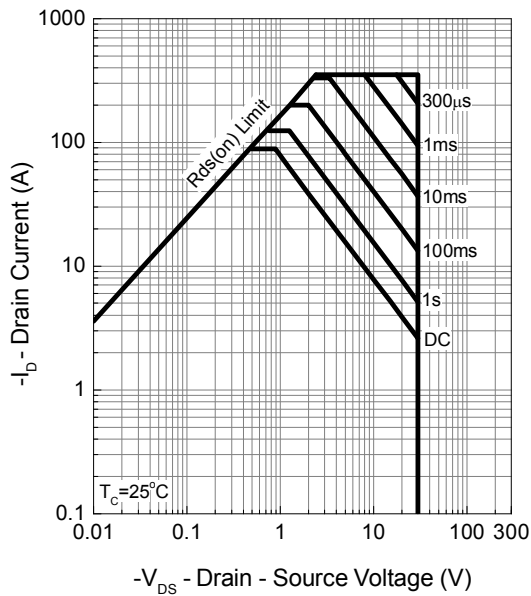
Power Dissipation



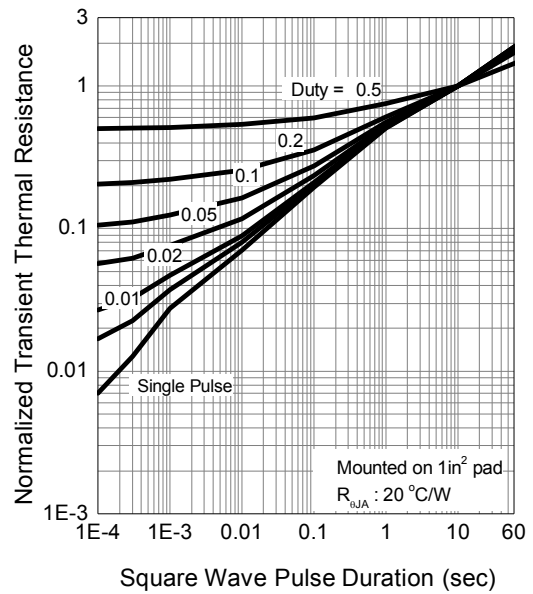
Drain Current



Safe Operation Area

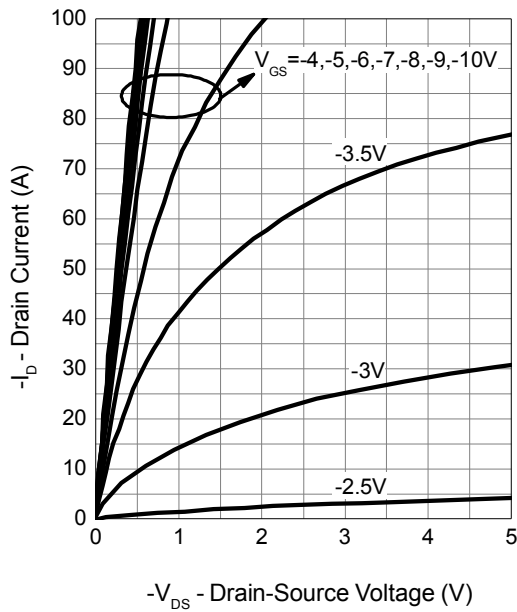


Thermal Transient Impedance

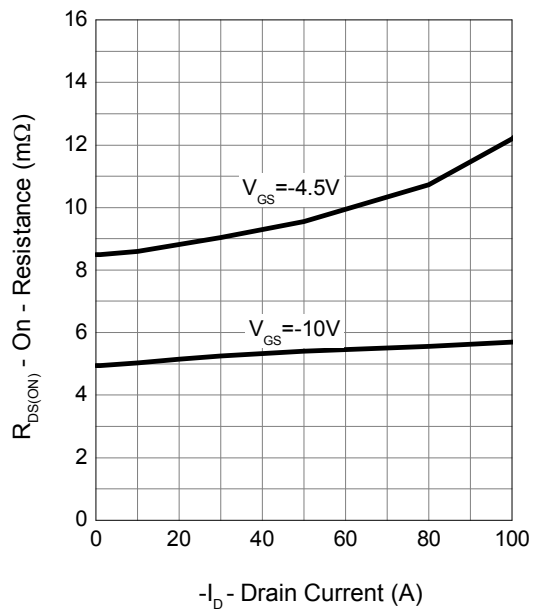


Typical Operating Characteristics (Cont.)

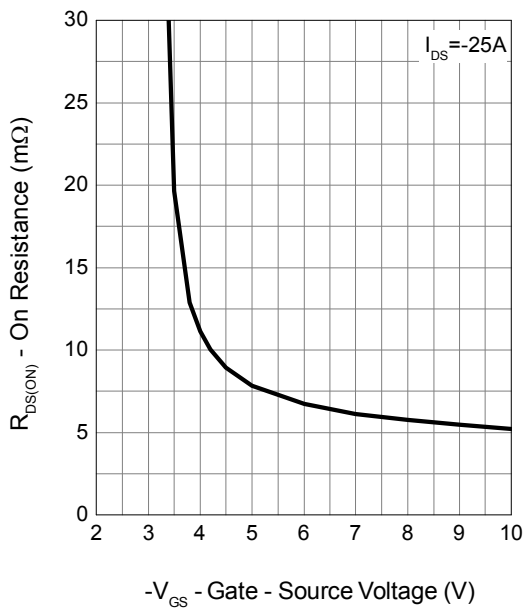
Output Characteristics



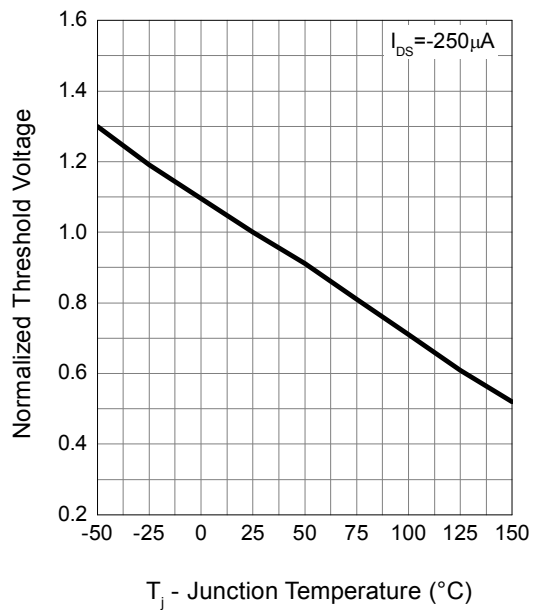
Drain-Source On Resistance



Gate-Source On Resistance

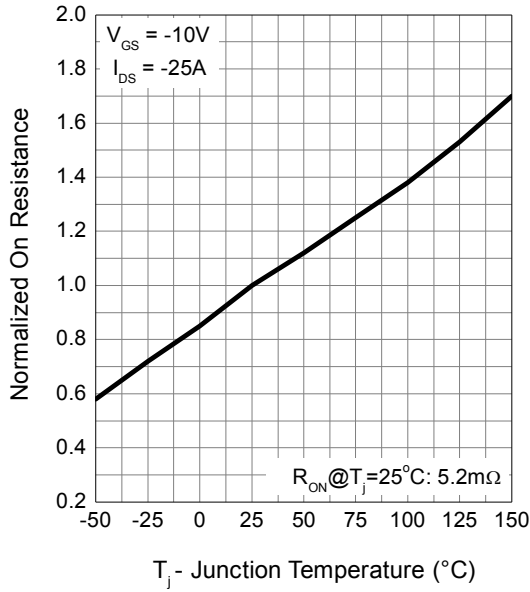


Gate Threshold Voltage

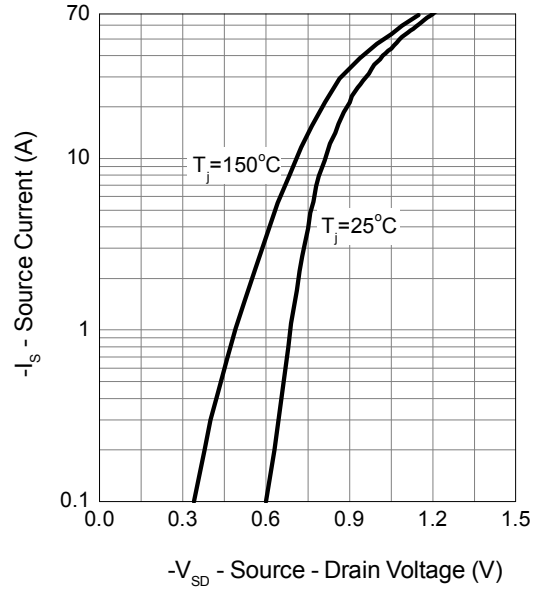


Typical Operating Characteristics (Cont.)

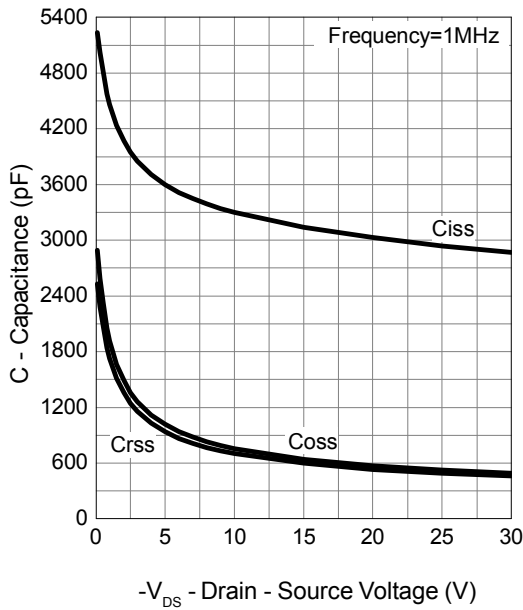
Drain-Source On Resistance



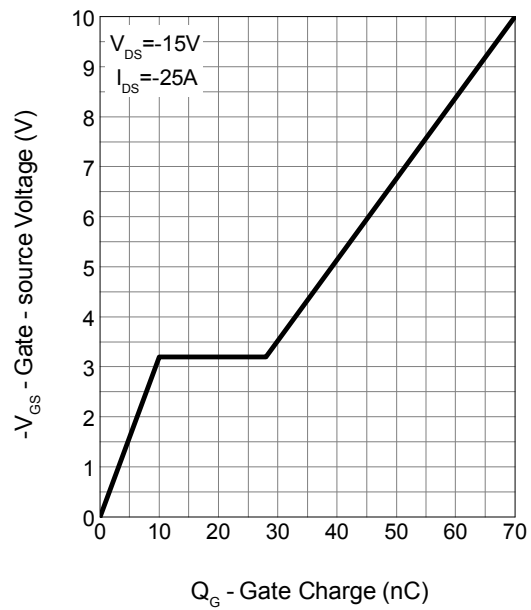
Source-Drain Diode Forward



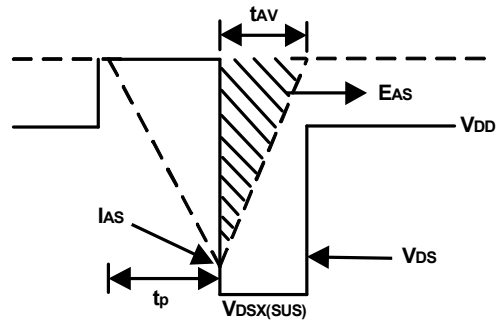
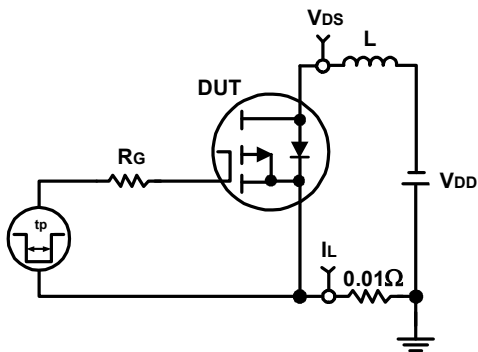
Capacitance



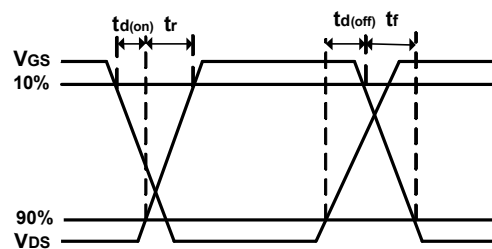
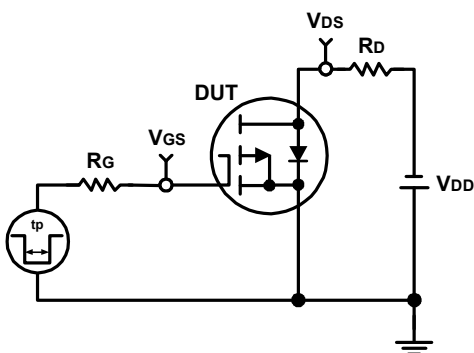
Gate Charge



Avalanche Test Circuit and Waveforms

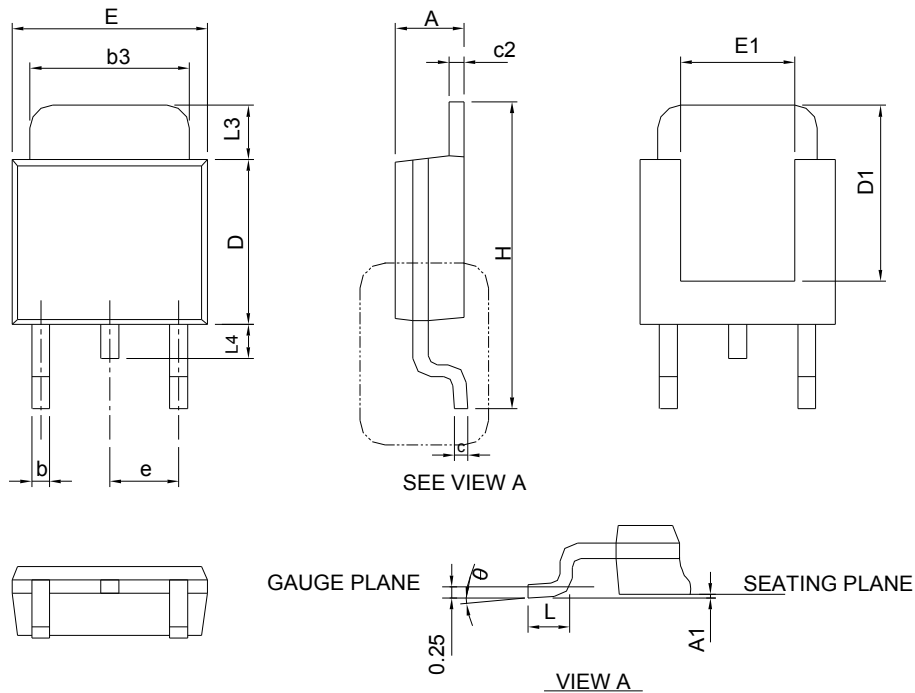


Switching Time Test Circuit and Waveforms



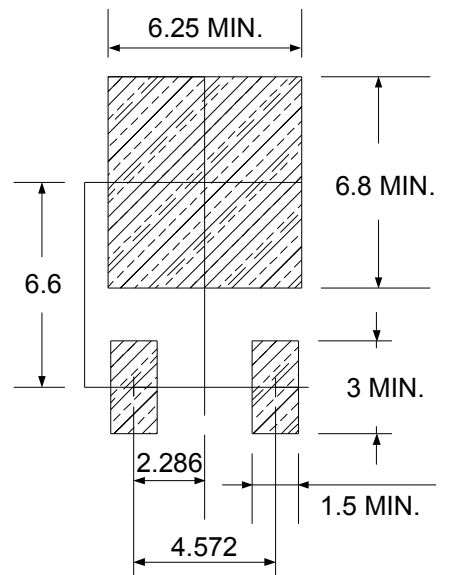
Package Information

TO-252



DIMENSIONS	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°

RECOMMENDED LAND PATTERN

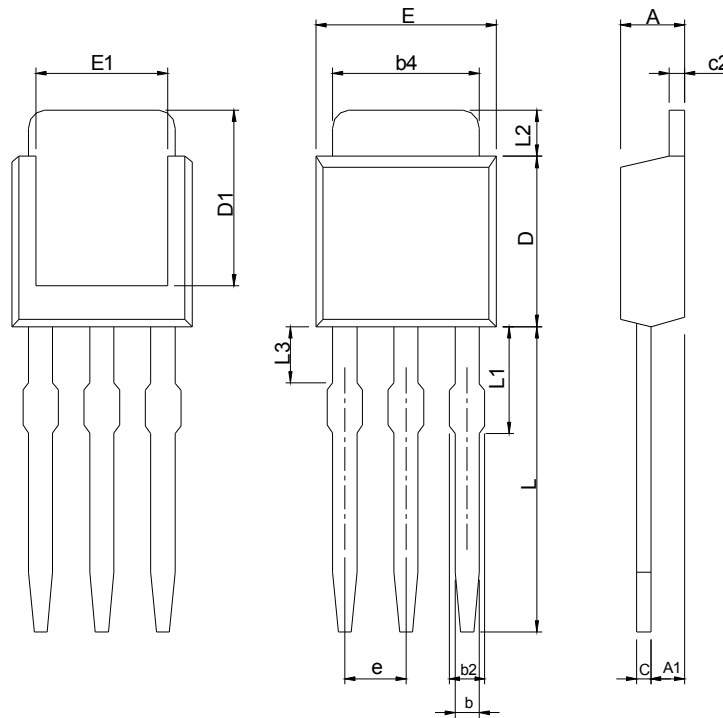


UNIT: mm

Note : Follow JEDEC TO-252 .

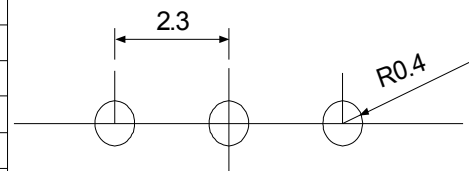
Package Information

TO-251



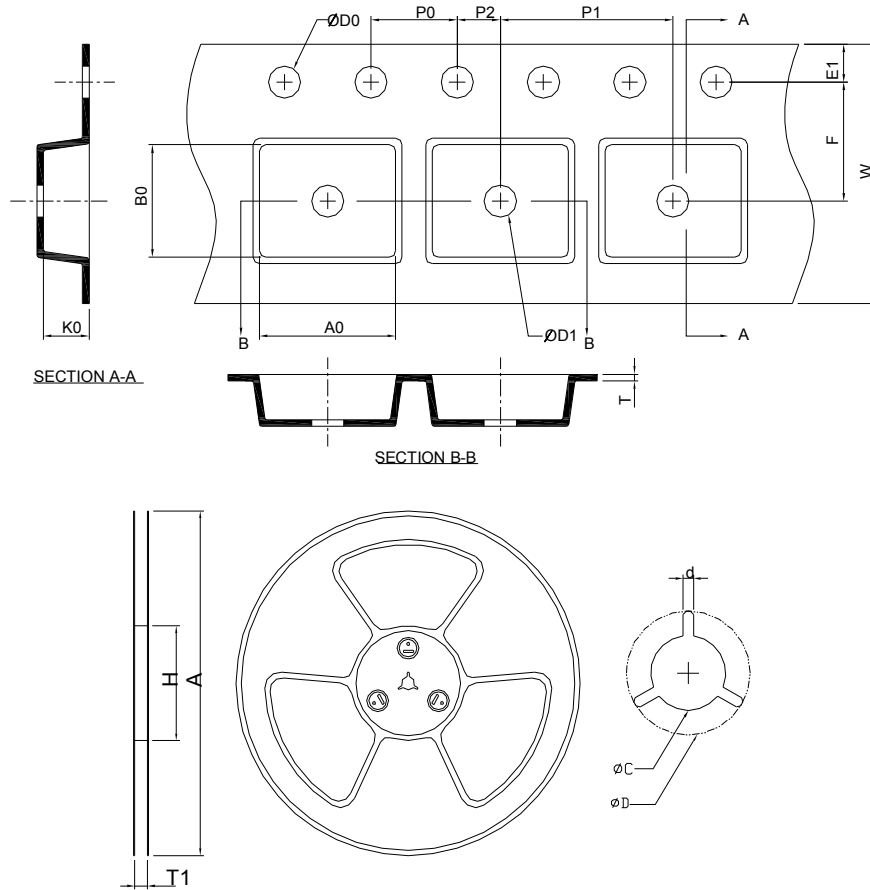
SYMBOL	TO-251(AC)			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.10	2.50	0.083	0.098
A1	0.89	1.14	0.035	0.045
b	0.40	0.89	0.016	0.035
b2	0.50	1.14	0.020	0.045
b4	4.80	5.46	0.189	0.215
c	0.35	0.65	0.014	0.026
c2	0.40	0.89	0.016	0.035
D	5.30	6.22	0.209	0.245
D1	4.90	-	0.193	-
E	6.30	6.73	0.248	0.265
E1	4.32	-	0.170	-
e	2.29 BSC		0.090 BSC	
L	3.20	3.80	0.126	0.150
L1	1.40	2.29	0.055	0.090
L2	0.89	1.70	0.035	0.067
L3	0.50	1.52	0.020	0.060

RECOMMENDED LAND PATTERN



UNIT: mm

Carrier Tape & Reel Dimensions

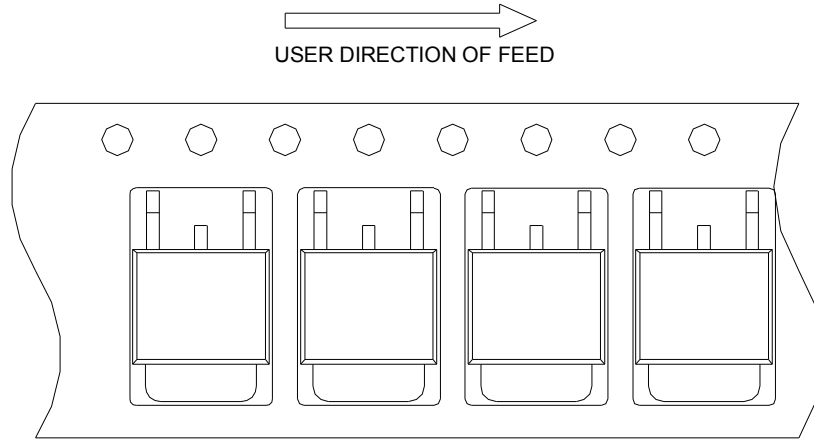


Application	A	H	T1	C	d	D	W	E1	F
TO-252	330.0±2.00	50 MIN.	16.4+2.00 0	13.0+0.50 -0.2	1.5 MIN.	20.2 MIN.	16.0±0.30	1.75±0.10	7.5±0.10
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0±0.10	8.0±0.10	2.0±0.10	1.5 +0.10	1.5 MIN.	0.6 +0.00	6.8±0.20	10.4±0.20	2.5±0.20

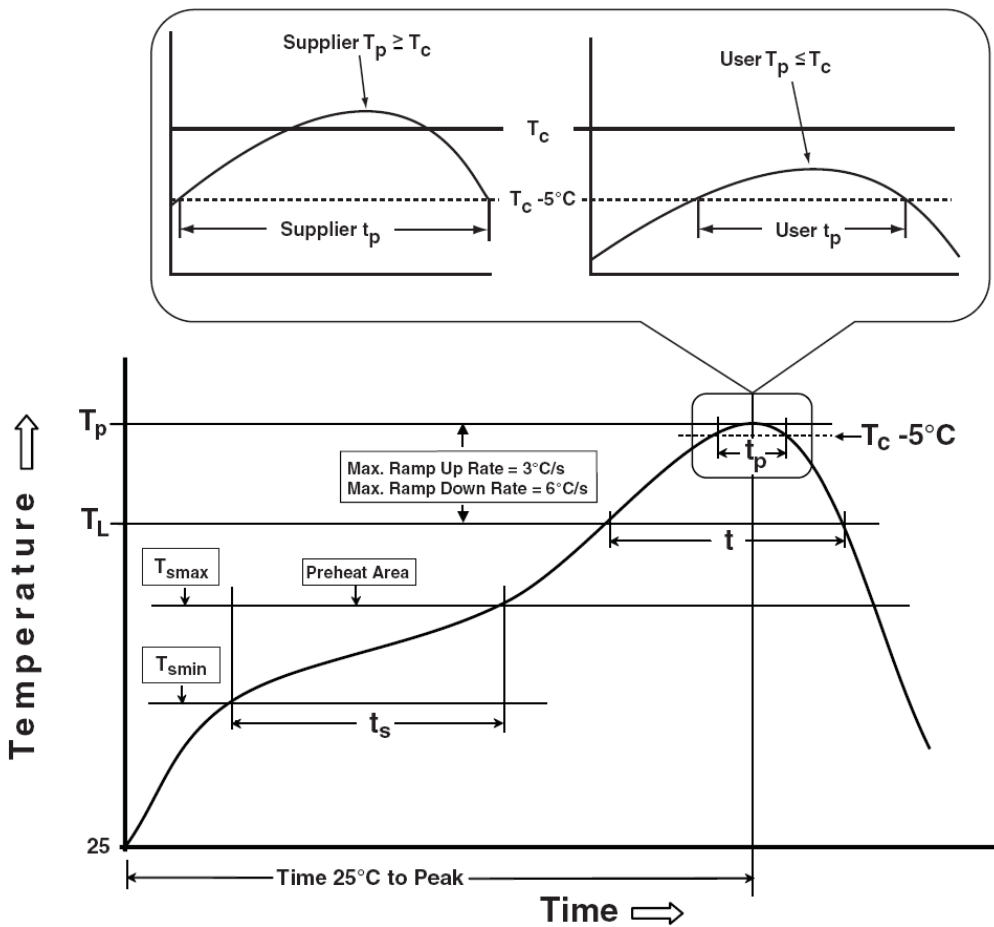
(mm)

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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