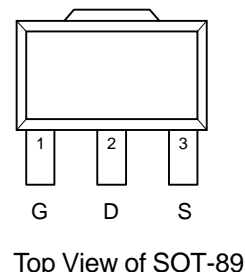
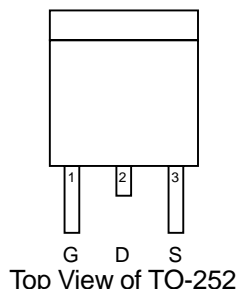


## N-Channel Enhancement Mode MOSFET

### Features

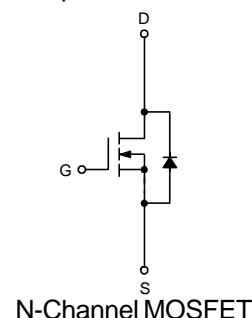
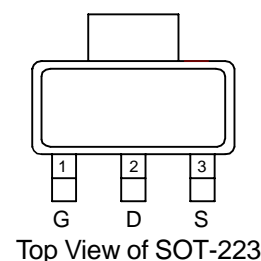
- 20V/12A,  $R_{DS(ON)}=35m\Omega(\text{typ.}) @ V_{GS}=10V$   
 $R_{DS(ON)}=45m\Omega(\text{typ.}) @ V_{GS}=4.5V$   
 $R_{DS(ON)}=110m\Omega(\text{typ.}) @ V_{GS}=2.5V$
- Super High Dense Cell Design
- High Power and Current Handling Capability
- TO-252, SOT-89 and SOT-223 Packages

### Pin Description



### Applications

- Switching Regulators
- Switching Converters



### Ordering and Marking Information

<p>APM2054N □□-□□□</p> <p>Lead Free Code Handling Code Temp Range Package Code</p>	<p>Package Code D : SOT-89      V : SOT-223      U : TO-252 Operation Junction Temp. Range C : -55 to 150 °C Handling Code    o TR : Tape &amp; Reel Lead Feed Code L : Lead Free Device      Blank : Original Device</p>
<p>APM2054N D/V : <span style="border: 1px solid black; padding: 2px;">APM2054N XXXXX</span></p>	<p>XXXXX - Date Code</p>
<p>APM2054N U : <span style="border: 1px solid black; padding: 2px;"> APM2054N XXXXX</span></p>	<p>XXXXX - Date Code</p>

### 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		$\pm 16$		
$I_D^*$	Maximum Drain Current – Continuous		TO-252	10	
			SOT-223/SOT-89		4
$I_{DM}$	Maximum Drain Current – Pulsed		TO-252	25	
			SOT-223/SOT-89		12
$P_D^*$	Maximum Power Dissipation	$T_A=25^\circ\text{C}$	TO-252	5	W

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
$P_D^*$	Maximum Power Dissipation	$T_A=25^\circ\text{C}$ SOT-223/SOT-89	1.25
		$T_A=100^\circ\text{C}$ TO-252	2
		$T_A=100^\circ\text{C}$ SOT-223/SOT-89	0.5
$T_J$	Maximum Junction Temperature	150	$^\circ\text{C}$
$T_{STG}$	Storage Temperature Range	-55 to 150	$^\circ\text{C}$

\* Surface Mounted on FR4 Board,  $t \leq 10$  sec.

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

Symbol	Parameter	Test Condition	APM2054N			Unit
			Min.	Typ.	Max.	
<b>Static</b>						
$BV_{DSS}$	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	$\mu\text{A}$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$	0.7	0.9	1.5	V
$I_{GSS}$	Gate Leakage Current	$V_{GS}=\pm 16V, V_{DS}=0V$			$\pm 100$	nA
$R_{DS(ON)}$	Drain-Source On-state Resistance	$V_{GS}=10V, I_{DS}=12A$		35	40	m $\Omega$
		$V_{GS}=4.5V, I_{DS}=6A$		45	54	
		$V_{GS}=2.5V, I_{DS}=2A$		110	130	
$V_{SD}$	Diode Forward Voltage	$I_{SD}=6A, V_{GS}=0V$		0.7	1.3	V
<b>Dynamic</b>						
$Q_g$	Total Gate Charge	$V_{DS}=10V, V_{GS}=4.5V, I_{DS}=6A$		11	13	nC
$Q_{gs}$	Gate-Source Charge			3.8		
$Q_{gd}$	Gate-Drain Charge			5.2		
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=10V, I_{DS}=1A, V_{GEN}=4.5V, R_G=6\Omega$		12	24	ns
$t_r$	Turn-on Rise Time			10	20	
$t_{d(OFF)}$	Turn-off Delay Time			40	74	
$t_f$	Turn-off Fall Time			20	38	
$C_{iss}$	Input Capacitance	$V_{GS}=0V$		450		pF
$C_{oss}$	Output Capacitance	$V_{DS}=15V$		100		
$C_{riss}$	Reverse Transfer Capacitance	Frequency=1.0MHz		60		

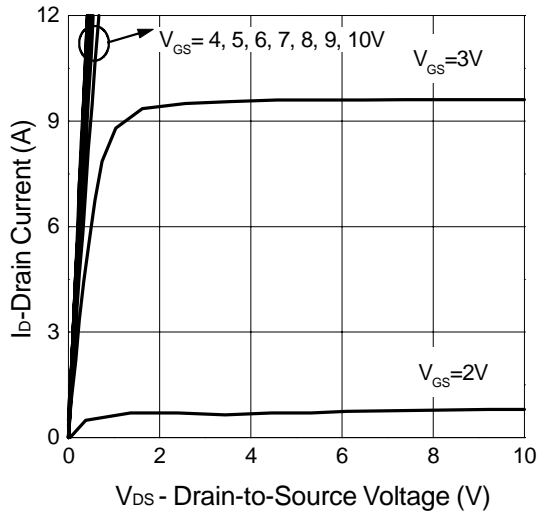
**Notes**

<sup>a</sup> : Pulse test ; pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$

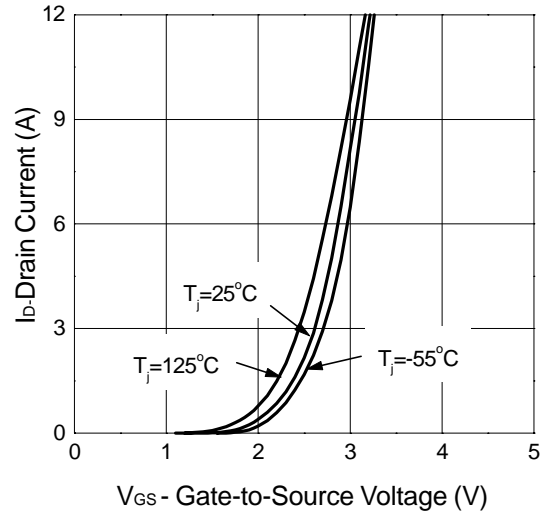
<sup>b</sup> : Guaranteed by design, not subject to production testing

## Typical Characteristics

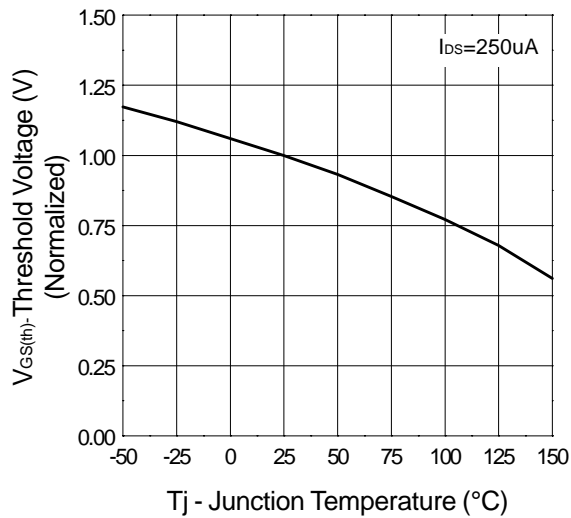
Output Characteristics



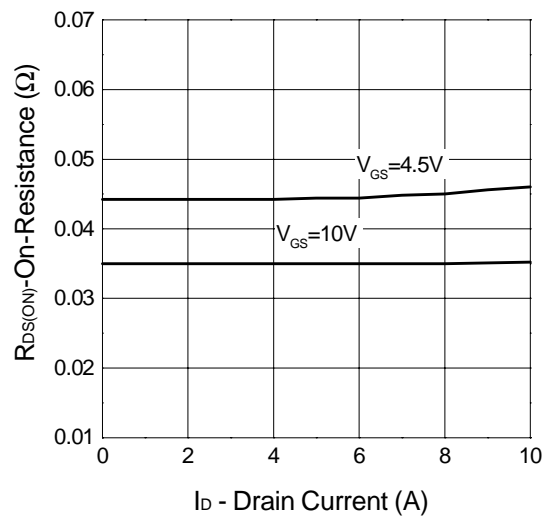
Transfer Characteristics



Threshold Voltage vs. Temperature

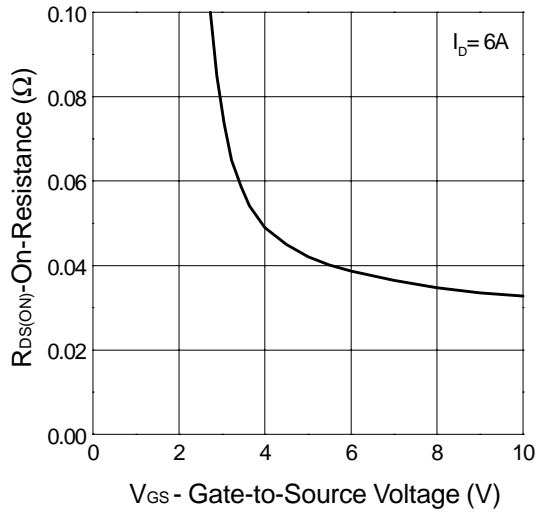


On-Resistance vs. Drain Current

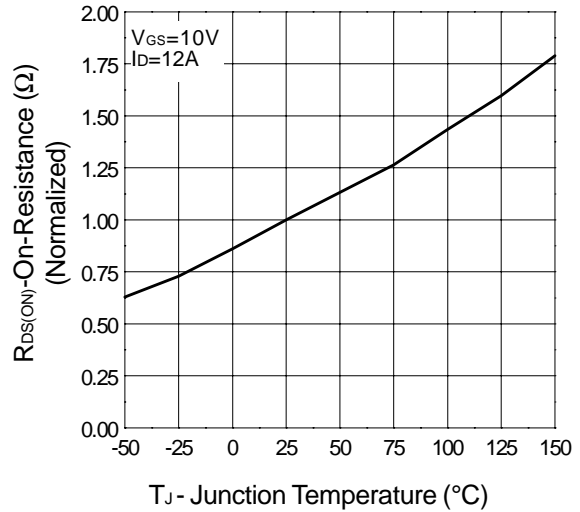


## Typical Characteristics

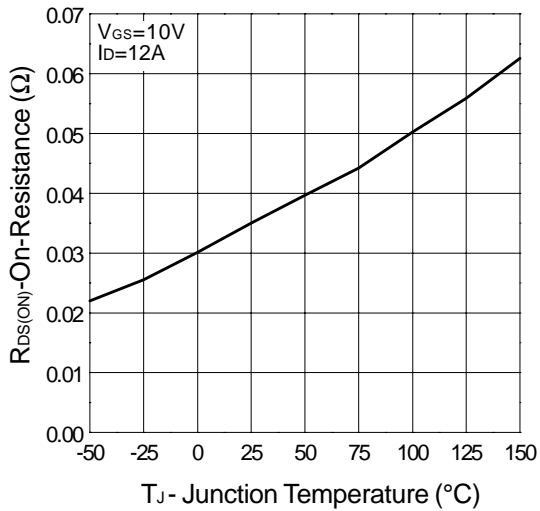
On-Resistance vs. Gate-to-Source Voltage



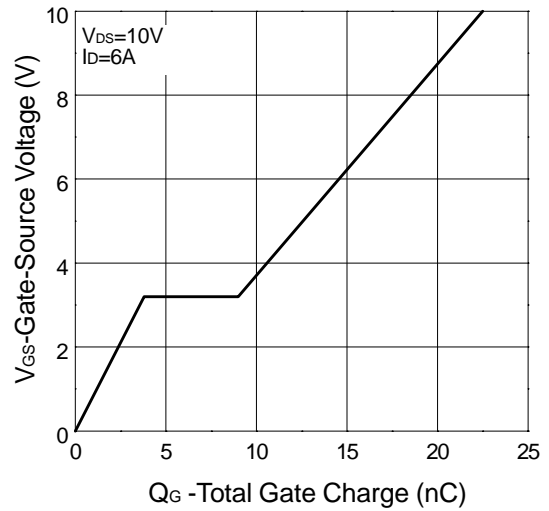
On-Resistance vs. Junction Temperature



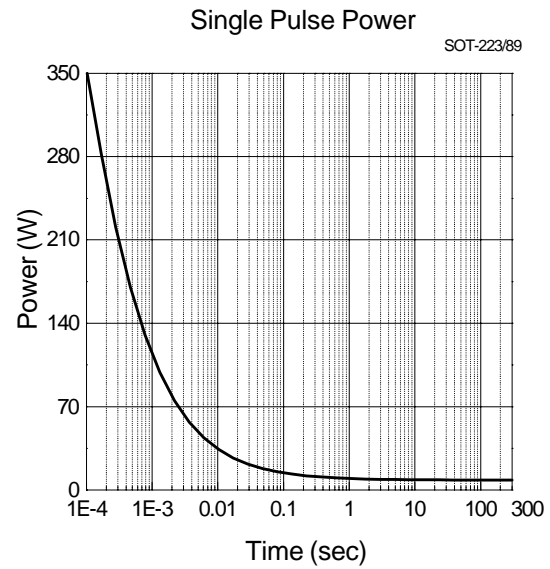
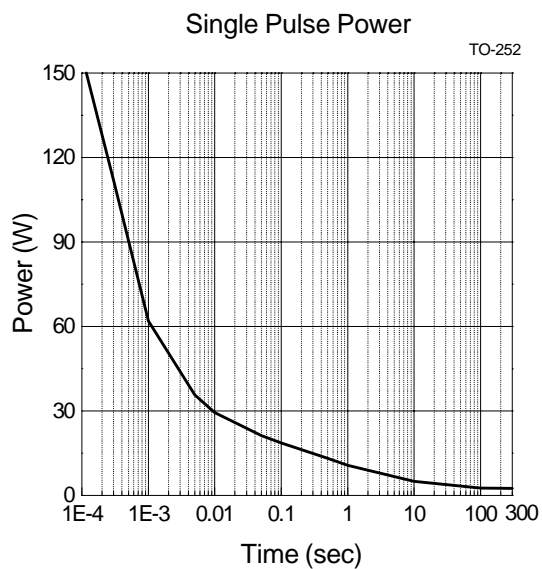
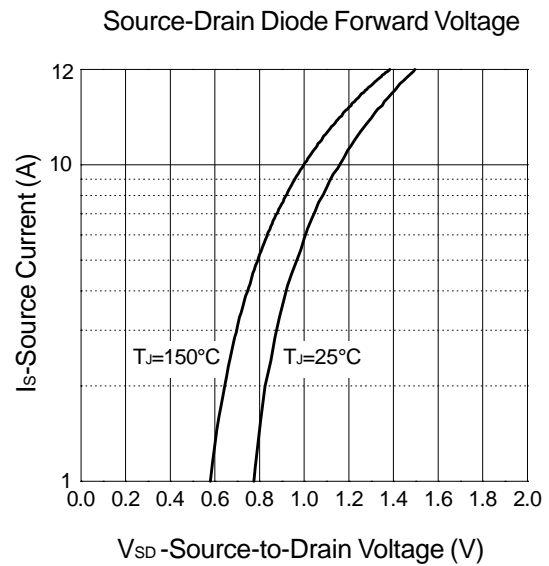
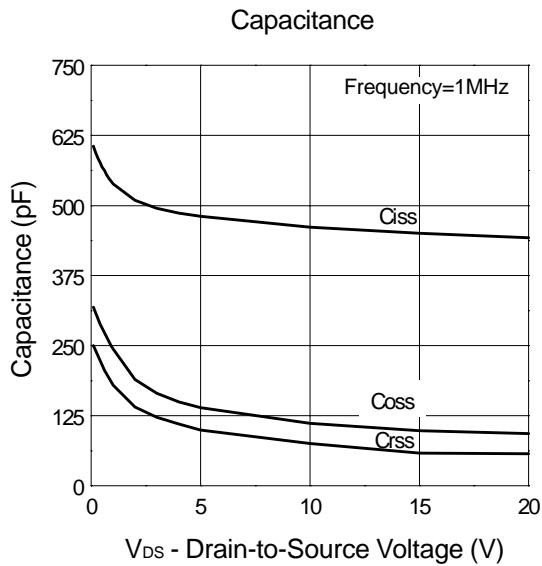
On-Resistance vs. Junction Temperature



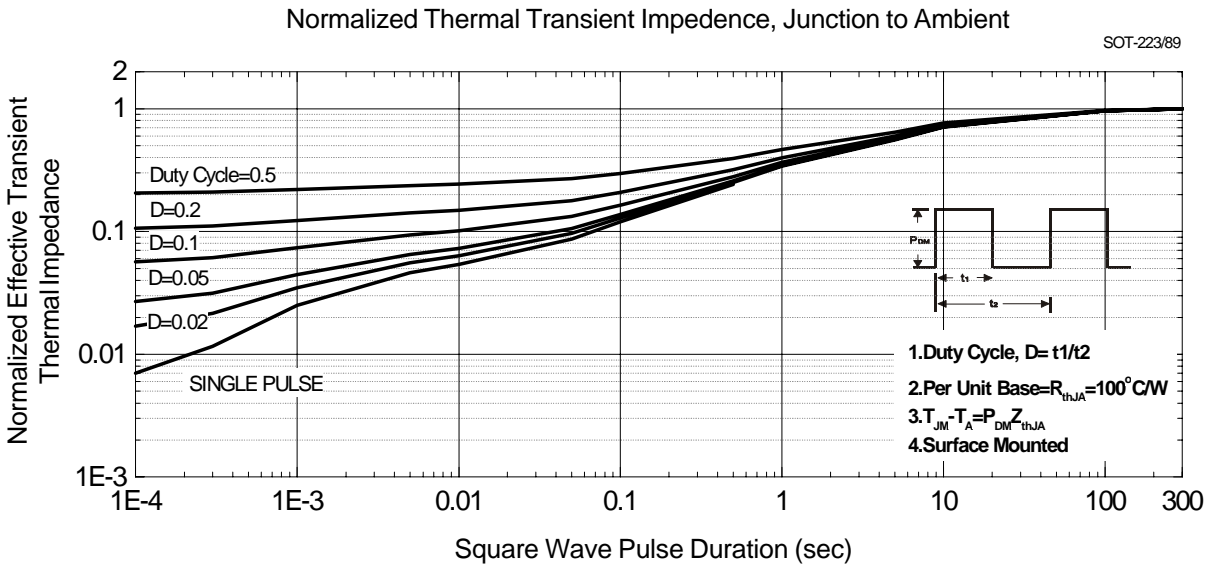
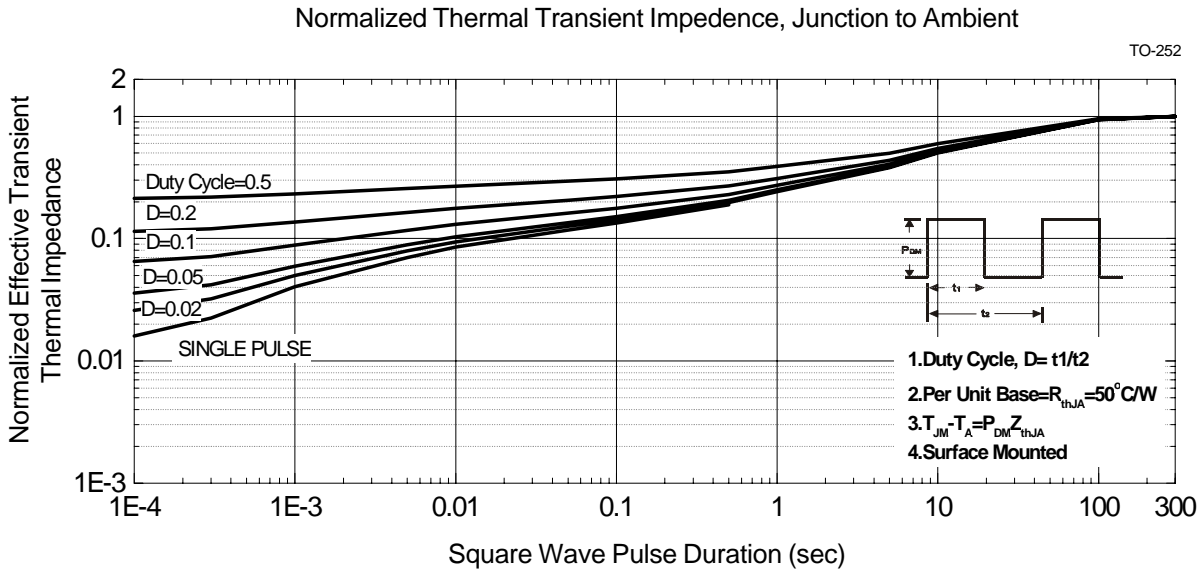
Gate Charge



## Typical Characteristics

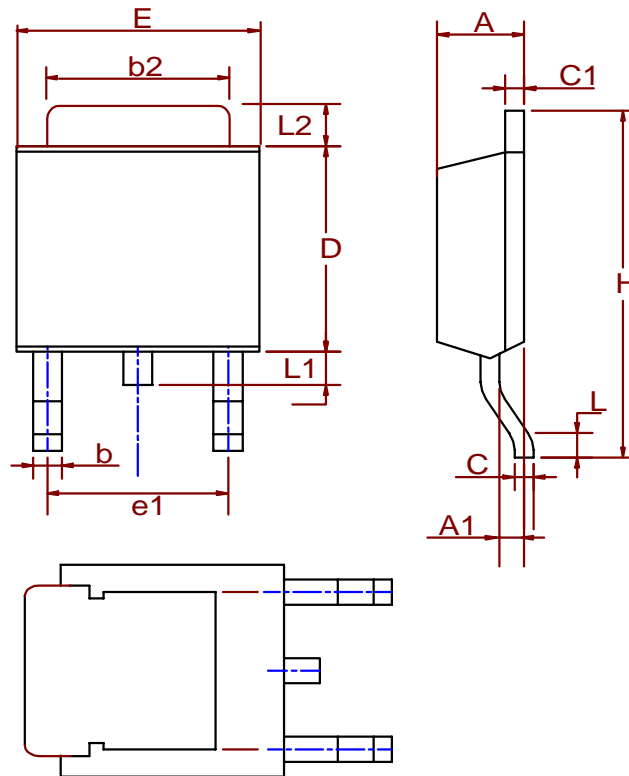


# Typical Characteristics



Package Information

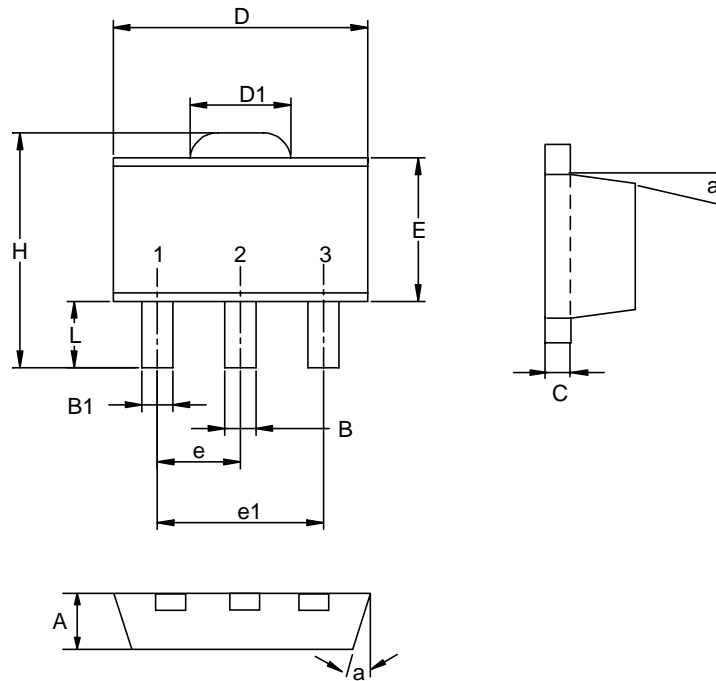
TO-252( Reference JEDEC Registration TO-252)



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	2.18	2.39	0.086	0.094
A1	0.89	1.27	0.035	0.050
b	0.508	0.89	0.020	0.035
b2	5.207	5.461	0.205	0.215
C	0.46	0.58	0.018	0.023
C1	0.46	0.58	0.018	0.023
D	5.334	6.22	0.210	0.245
E	6.35	6.73	0.250	0.265
e1	3.96	5.18	0.156	0.204
H	9.398	10.41	0.370	0.410
L	0.51		0.020	
L1	0.64	1.02	0.025	0.040
L2	0.89	2.032	0.035	0.080

## Package Information

SOT-89 (Reference EIAJ ED-7500A Registration SC-62)

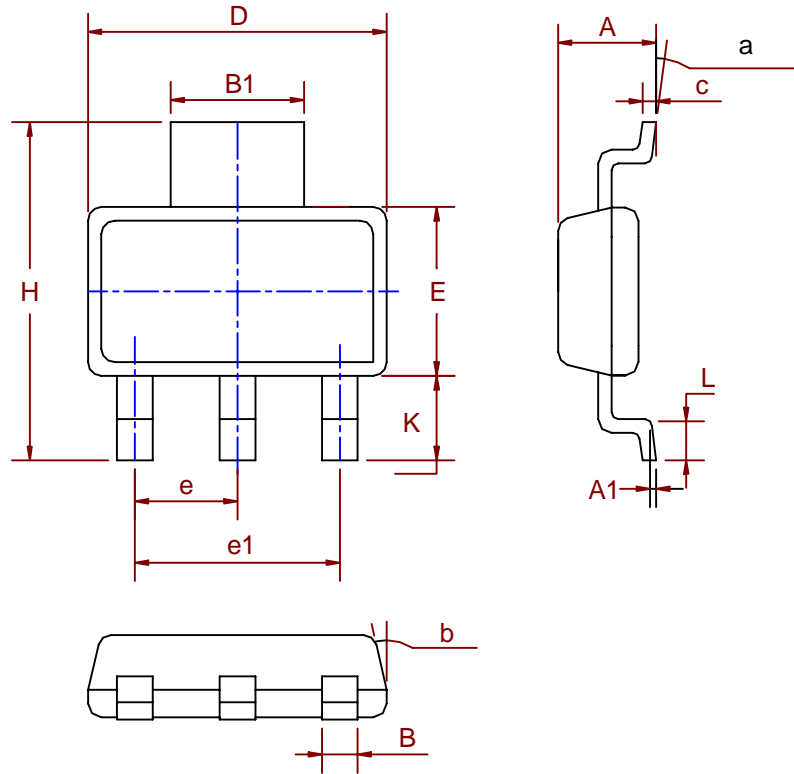


Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.40	1.60	0.055	0.063
B	0.40	0.56	0.016	0.022
B1	0.35	0.48	0.014	0.019
C	0.35	0.44	0.014	0.017
D	4.40	4.60	0.173	0.181
D1	1.35	1.83	0.053	0.072
e	1.50 BSC		0.059 BSC	
e1	3.00 BSC		0.118 BSC	
E	2.29	2.60	0.090	0.102
H	3.75	4.25	0.148	0.167
L	0.80	1.20	0.031	0.047
α		10°		10°



## Package Information

SOT-223( Reference JEDEC Registration SOT-223)

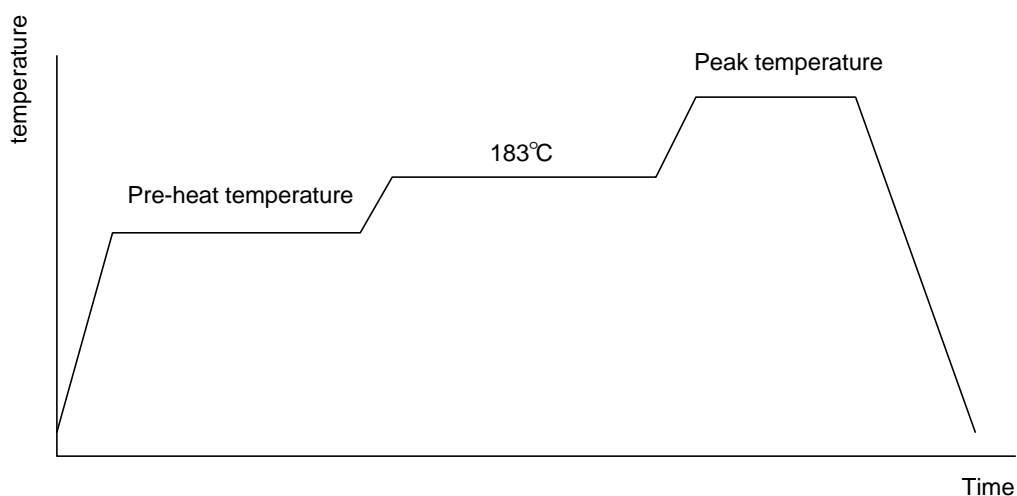


Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.50	1.80	0.06	0.07
A1	0.02	0.08		
B	0.60	0.80	0.02	0.03
B1	2.90	3.10	0.11	0.12
c	0.28	0.32	0.01	0.01
D	6.30	6.70	0.25	0.26
E	3.30	3.70	0.13	0.15
e	2.3 BSC		0.09 BSC	
e1	4.6 BSC		0.18 BSC	
H	6.70	7.30	0.26	0.29
L	0.91	1.10	0.04	0.04
K	1.50	2.00	0.06	0.08
α	0°	10°	0°	10°
β	13°		13°	

## Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb)
Lead Solderability	Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.

## Reflow Condition (IR/Convection or VPR Reflow)



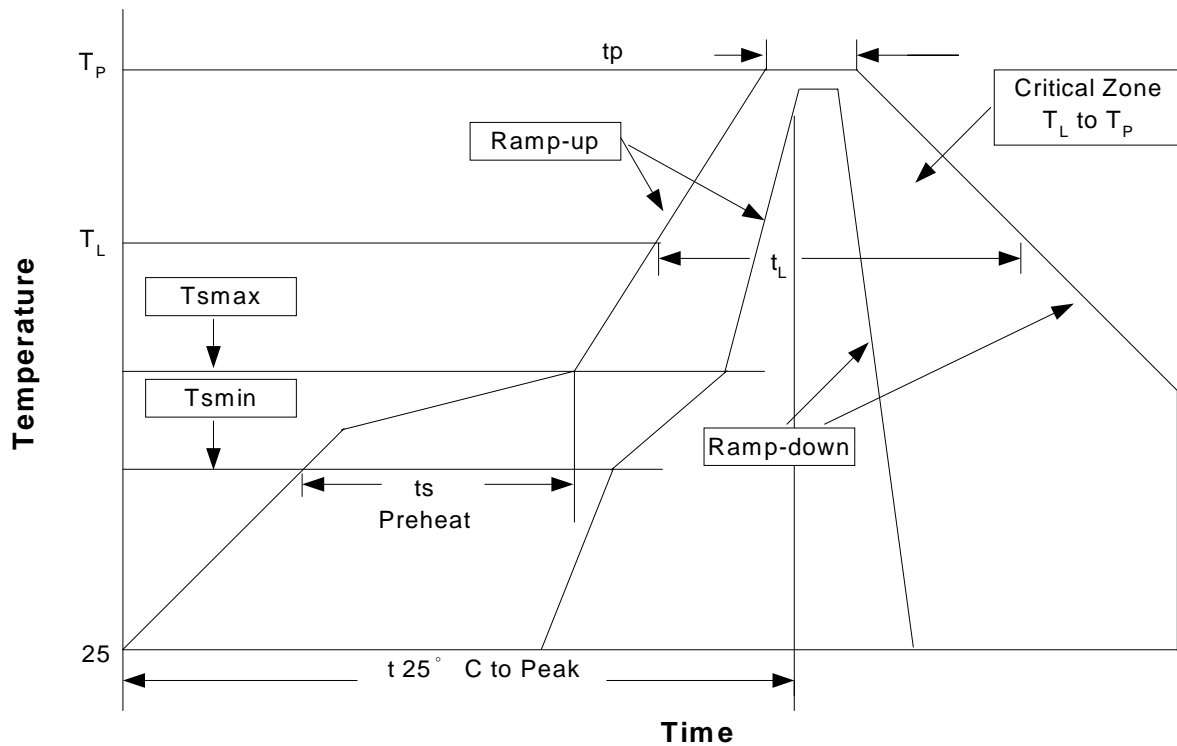
## Classification Reflow Profiles

	Convection or IR/ Convection	VPR
Average ramp-up rate(183°C to Peak)	3°C/second max.	10 °C /second max.
Preheat temperature 125 ± 25°C)	120 seconds max	
Temperature maintained above 183°C	60 – 150 seconds	
Time within 5°C of actual peak temperature	10 –20 seconds	60 seconds
Peak temperature range	220 +5/-0°C or 235 +5/-0°C	215-219°C or 235 +5/-0°C
Ramp-down rate	6 °C /second max.	10 °C /second max.
Time 25°C to peak temperature	6 minutes max.	

## Package Reflow Conditions

pkg. thickness ≥ 2.5mm and all bgas	pkg. thickness < 2.5mm and pkg. volume ≥ 350 mm <sup>3</sup>	pkg. thickness < 2.5mm and pkg. volume < 350mm <sup>3</sup>
Convection 220 +5/-0 °C		Convection 235 +5/-0 °C
VPR 215-219 °C		VPR 235 +5/-0 °C
IR/Convection 220 +5/-0 °C		IR/Convection 235 +5/-0 °C

Reflow Condition (IR/Convection or VPR Reflow)



Classification Reflow Profiles

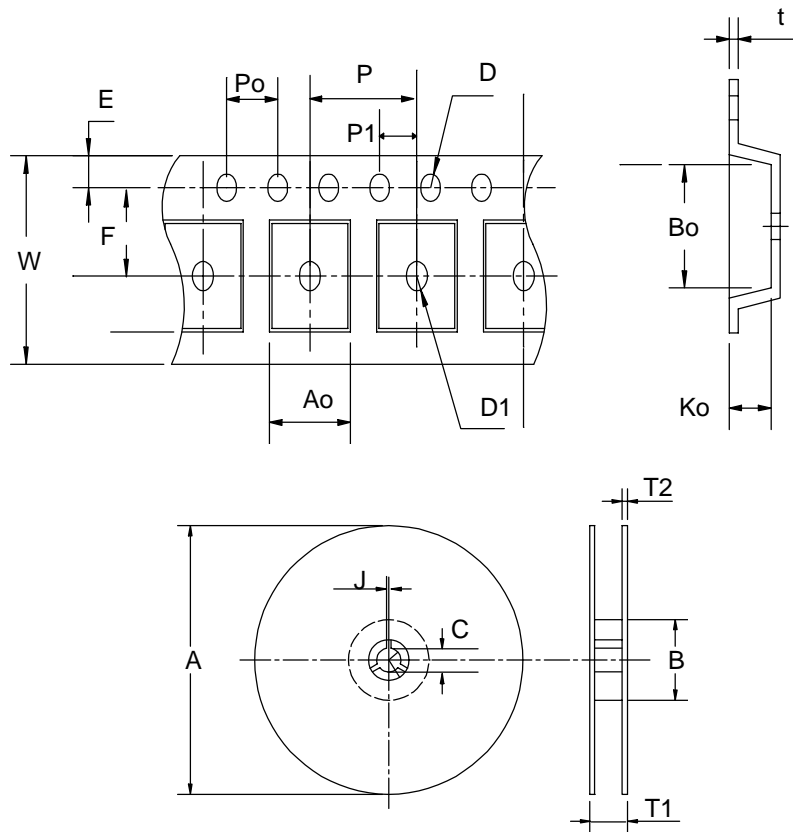
Profile Feature	Sn-Pb Eutectic Assembly		Pb-Free Assembly	
	Large Body	Small Body	Large Body	Small Body
Average ramp-up rate (T <sub>L</sub> to T <sub>P</sub> )	3°C/second max.		3°C/second max.	
Preheat - Temperature Min (T <sub>min</sub> ) - Temperature Mix (T <sub>max</sub> ) - Time (min to max)(t <sub>s</sub> )	100°C 150°C 60-120 seconds		150°C 200°C 60-180 seconds	
T <sub>max</sub> to T <sub>L</sub> - Temperature(T <sub>L</sub> ) - Time (t <sub>L</sub> )			3°C/second max	
Peak Temperature(T <sub>p</sub> )	183°C 60-150 seconds		217°C 60-150 seconds	
Time within 5°C of actual Peak Temperature(t <sub>p</sub> )	225 +0/-5°C	240 +0/-5°C	245 +0/-5°C	250 +0/-5°C
Ramp-down Rate	10-30 seconds	10-30 seconds	10-30 seconds	20-40 seconds
Time 25°C to Peak Temperature	6°C/second max. 6 minutes max.		6°C/second max. 8 minutes max.	

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

## 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

## Carrier Tape & Reel Dimensions



Application	A	B	C	J	T1	T2	W	P	E
TO-252	330±3	100±2	13±0.5	2±0.5	16.4 +0.3 -0.2	2.5±0.5	16 +0.3 -0.1	8±0.1	1.75±0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	7.5±0.1	1.5±0.1	1.5±0.25	4.0±0.1	2.0±0.1	6.8±0.1	10.4±0.1	2.5±0.1	0.3±0.05
Application	A	B	C	J	T1	T2	W	P	E
SOT-89	178±1	70±2	13.5±0.15	3±0.15	14±2	1.3±0.3	12 +0.3 12 -0.1	8±0.1	1.75±0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	5.5±0.05	1.5±0.1	1.5±0.1	4.0±0.1	2.0±0.1	4.8±0.1	4.5±0.1	1.80±0.1	0.3±0.013
Application	A	B	C	J	T1	T2	W	P	E
SOT-223	330±1	62±1.5	12.75± 0.15	2±0.6	12.4±0.2	2±0.2	12±0.3	8±0.1	1.75±0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	5.5±0.05	1.5±0.1	1.5±0.1	4.0±0.1	2.0±0.05	6.9±0.1	7.5±0.1	2.1±0.1	0.3±0.05

## Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOT- 89	12	9.3	1000
SOT- 223	12	9.3	2500
TO- 252	16	13.3	2500

## Customer Service

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