1A Bipolar Linear Regulator

LR1117C

DESCRIPTION

LR1117C is a series of low dropout three terminal regulators with a dropout of 1.3V at 1A load current. LR1117C features a very low standby current 2mA compared to 5mA of competitor.

Other than a fixed version, Vout = 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, 5V, and 12V, LR1117C has an adjustable version, which can provide an output voltage from 1.25 to 12V with only two external resistors.

LR1117C offers thermal shut down and current limit functions, to assure the stability of chip and power system. And it uses trimming technique to guarantee output voltage accuracy within ±2%. Other output voltage accuracy can be customized on demand, such as ±1%

LR1117C is available in SOT223 and TO-252 (DPAK) power packages.

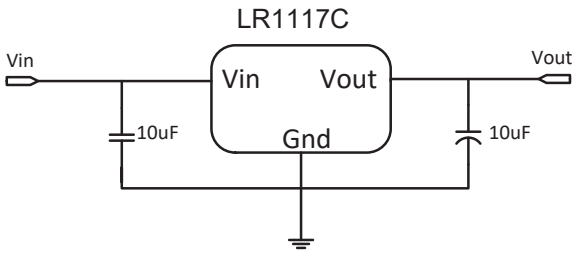
FEATURES

- Other than a fixed version and an adjustable version, output value can be customized on demand.
- Maximum output current is 1A
- Range of operation input voltage: Max 15V
- Standby current: 2mA (typ.)
- Line regulation: 0.1%/V (typ.)
- Load regulation: 10mV (typ.)
- Environment Temperature: -40°C~85°C

APPLICATIONS

- Power Management for Computer Mother Board, Graphic Card
- BLD Monitor and BLD TV
- DVD Decode Board
- ADSL Moderm
- Post Regulators for Switching Supplies

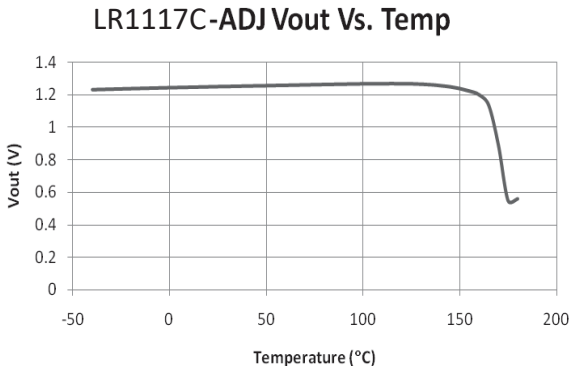
TYPICAL APPLICATION



Application circuit of LR1117C fixed version

NOTE: Input capacitor (Cin=10uF) and Output capacitor (Cout=10uF) are recommended in all application circuit. Tantalum capacitor is recommended.

TYPICAL ELECTRICAL CHARACTERISTIC



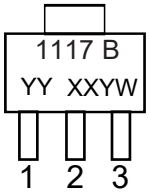
ORDERING INFORMATION

LR1117C*X XX X*

- Temp. Range & Rohs Std.
  - X：Pb-free Rohs Std,Output voltage accuracy within ±2%
- Output Voltage：
  - 12……1.2V
  - 15……1.5V
  - 18……1.8V
  - 25……2.5V
  - 33……3.3V
  - 50……5.0V
  - ……ADJ
- Package Type：
  - S：SOT-223
  - D：TO-252

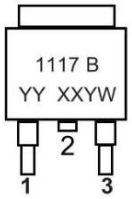
PACKING INFORMATION

SOT-223



Pin No.	Symbol	Definition
1	Vss/ADJ	Ground
2	Vout	Output
3	Vin	Input

TO-252



Pin No.	Symbol	Definition
1	Vss/ADJ	Ground/Adjustable
2	Vout	Output
3	Vin	Input

1117 B: Fixed product code
YY: Output voltage
XX: Lot NO. YW: Year week code

ABSOLUTE MAXIMUM RATING

Parameter	Value
Max Input Voltage	18V
Max Operating Junction Temperature(Tj)	150°C
Ambient Operating Temperature(Ta)	-40°C - 85°C
Storage Temperature(Ts)	-40°C - 150°C
Lead Temperature & Time	260°C, 10S

Note: Exceeding these limits will cause damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

RECOMMENDED WORK CONDITIONS

Parameter		Value
Input Voltage Range		Max. 15V
Operating Junction Temperature(Tj)		-40°C -125°C
Thermal resistance - Junction to Ambient (No air flow)	SO-T223	136°C/W
	TO-252	105°C/W
Thermal resistance - Junction to Case	SOT-223	25°C/W
	TO-252	10°C/W

Note: 1.Rθja Test conditions:The device mounted on 42.25mm2(Pin2) FR-4 board with 2oz. Copper

2. $P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$

ELECTRICAL CHARACTERISTICS

Tj=25℃

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vref	Reference Voltage	LR1117C-ADJ 10mA≤Iout≤1A , Vin=3.25V	1.225	1.25	1.275	V
Vout	Output Voltage	LR1117C-1.2V 0≤Iout≤1A , Vin=3.2V	1.176	1.2	1.224	V
		LR1117C-1.5V 0≤Iout≤1A , Vin=3.5V	1.47	1.5	1.53	V
		LR1117C-1.8V 0≤Iout≤1A , Vin=3.8V	1.764	1.8	1.836	V
		LR1117C-2.5V 0≤Iout≤1A , Vin=4.5V	2.45	2.5	2.55	V
		LR1117C-3.3V 0≤Iout≤1A , Vin=5.3V	3.234	3.3	3.366	V
		LR1117C-5.0V 0≤Iout≤1A , Vin=7.0V	4.9	5	5.1	V
		LR1117C-12.0V 0≤Iout≤1A , Vin=14V	11.76	12	12.24	V
ΔVout	Line Regulation	LR1117C-1.2V Iout=10mA, 2.7V≤Vin≤10V		0.1	0.2	%/V
		LR1117C-ADJ Iout=10mA, 2.75V≤Vin≤12V		0.1	0.2	%/V
		LR1117C-1.5V out=10mA, 3.0V≤Vin≤12V		0.1	0.2	%/V
		LR1117C-1.8V Iout=10mA, 3.3V≤Vin≤12V		0.1	0.2	%/V
		LR1117C-2.5V Iout=10mA, 4.0V≤Vin≤12V		0.1	0.2	%/V
		LR1117C-3.3V Iout=10mA, 4.8V≤Vin≤12V		0.1	0.2	%/V
		LR1117C-5.0V Iout=10mA, 6.5V≤Vin≤12V		0.1	0.2	%/V
		LR1117C-12.0V Iout=10mA, 13.5V≤Vin≤20V		0.1	0.2	%/V
ΔVout	Load Regulation	LR1117C-1.2V Vin =2.7V, 10mA≤Iout≤1A		10	30	mV
		LR1117C-ADJ Vin =2.75V, 10mA≤Iout≤1A		10	30	mV
		LR1117C-1.5V Vin=3.0V, 10mA≤Iout≤1A		10	30	mV
		LR1117C-1.8V Vin=3.3V, 10mA≤Iout≤1A		10	30	mV
		LR1117C-2.5V Vin=4.0V, 10mA≤Iout≤1A		10	30	mV
		LR1117C-3.3V Vin=4.8V, 10mA≤Iout≤1A		10	30	mV
		LR1117C-5.0V Vin=6.5V, 10mA≤Iout≤1A		10	30	mV
		LR1117C-12.0V Vin=13.5V, 10mA≤Iout≤1A		10	30	mV

ELECTRICAL CHARACTERISTICS continued

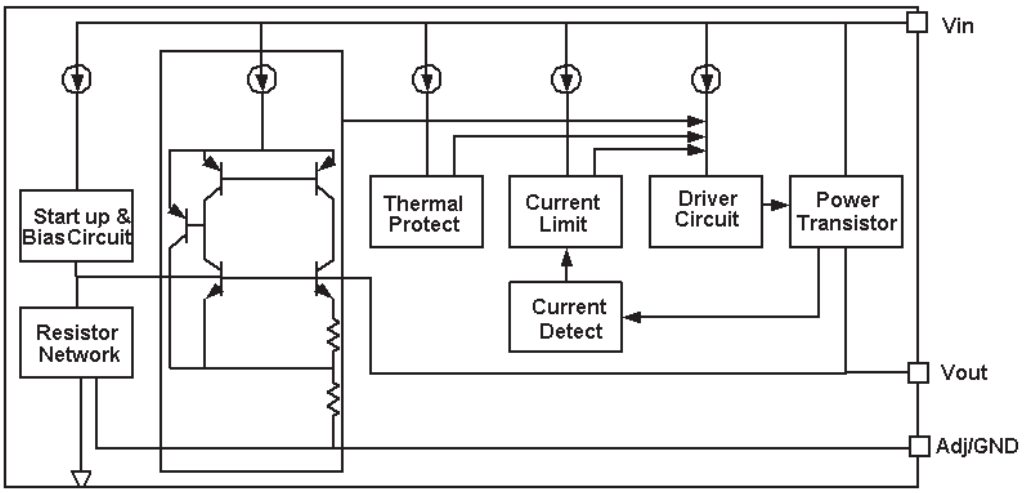
Tj=25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vdrop	Dropout Voltage	Iout=100mA		1.23	1.3	V
		Iout=1A		1.3	1.5	V
Ilimit	Current Limit	Vin-Vout=2V, Tj=25°C	1			A
SVR	Supply Voltage Rejection	f = 120Hz, VIN – VOUT = 3V + 1VPP Ripple		60		dB
Imin	Minimum Load Current	LR1117C-ADJ		2	10	mA
Iq	Quiescent Current	LR1117C-1.2V, Vin =10V	1	2	5	mA
		LR1117C-1.5V, Vin =11V	1	2	5	mA
		LR1117C-1.8V, Vin =12V	1	2	5	mA
		LR1117C-2.5V,Vin =12V	1	2	5	mA
		LR1117C-3.3V, Vin =12V	1	2	5	mA
		LR1117C-5.0V, Vin =12V	1	2	5	mA
		LR1117C-12.0V, Vin =20V	1	2	5	mA
IAdj	Adjust Pin Current	LR1117C-ADJ Vin =5V, 10mA≤Iout≤1A	35	55	120	uA
Ichange	Iadj change	LR1117C-ADJ Vin =5V, 10mA≤Iout≤1A		0.2	10	uA
ΔV/ΔT	Temperature coefficient			±100		ppm

Note1: All test are conducted under ambient temperature 25°C and within a short period of time 20ms

Note2: Load current smaller than minimum load current of LR1117C-ADJ will lead to unstable or oscillation output.

BLOCK DIAGRAM



DETAILED DESCRIPTION

LR1117C is a series of low dropout voltage, three terminal regulators. Its application circuit is very simple: the fixed version only needs two capacitors and the adjustable version only needs two resistors and two capacitors to work. It is composed of some modules including start-up circuit, bias circuit, bandgap, thermal shutdown, current limit, power transistors and its driver circuit and so on.

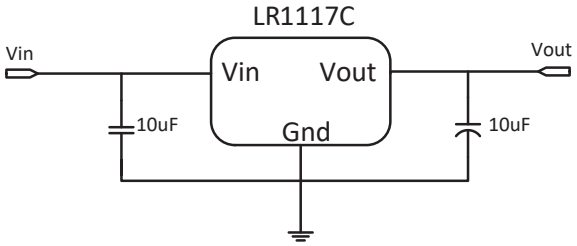
The thermal shut down modules can assure chip and its application system working safety when the junction temperature is larger than 140°C.

The bandgap module provides stable reference voltage, whose temperature coefficient is compensated by careful design considerations. The temperature coefficient is under 100 ppm/°C. And the accuracy of output voltage is guaranteed by trimming technique.

TYPICAL APPLICATION

LR1117C has an adjustable version and six fixed versions (1.2V, 1.5V, 1.8V, 2.5V, 3.3V, 5V and 12V)

Fixed Output Voltage Version

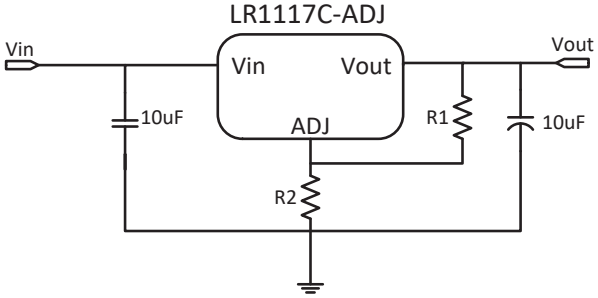


Application circuit of LR1117C fixed version

1) *Recommend using 10uF tan capacitor or MLCC capacitor as bypass capacitor (C1) for all application circuit.*
2) *Recommend using 10uF tan capacitor MLCC capacitor to assure circuit stability.*
3) *Capacitor ESR range: 3mΩ ~ 22Ω*

Adjustable Output Voltage Version

LR1117C-ADJ provides a 1.25V reference voltage. Any output voltage between 1.25V~12V can be achievable by choosing two external resistors (schematic is shown below), R1 and R2



Application Circuit of LR1117C-ADJ

The output voltage of adjustable version follows the equation: Vout=1.25×(1+R2/R1)+IAdj×R2.
We can ignore IAdj because IAdj (about 50uA) is much less than the current of R1 (about 2~10mA).

1) *To meet the minimum load current (>10mA) requirement, R1 is recommended to be 125ohm or lower. As LR1117C-ADJ can keep itself stable at load current about 2mA, R1 is not allowed to be higher than 625ohm.*

2) *Using a bypass capacitor (C_{ADJ}) between the ADJ pin and ground can improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. The impedance of C_{ADJ} should be less than R1 to prevent ripple from being amplified. As R1 is normally in the range of 100Ω~500Ω, the value of C_{ADJ} should satisfy this equation: $1/(2\pi \times f_{ripple} \times C_{ADJ}) < R1$.*

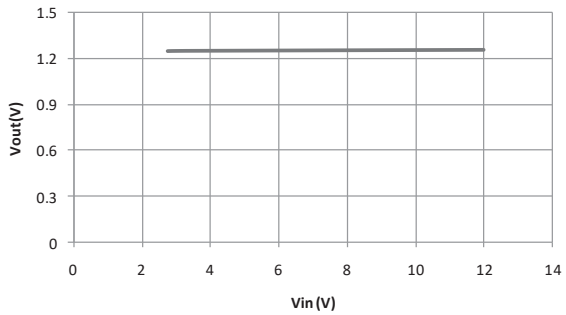
THERMAL CONSIDERATIONS

We have to take heat dissipation into great consideration when output current or differential voltage of input and output voltage is large. Because in such cases, the power dissipation consumed by LR1117C series is very large. LR1117C series uses TO-252 (DPAK) package type and its thermal resistance is about 10°C/W. And the copper area of application board can affect the total thermal resistance. If copper area is 5cm*5cm (two sides), the resistance is about 20°C/W. So the total thermal resistance is about 10°C/W + 20°C/W. We can decrease total thermal resistance by increasing copper area in application board. When there is no good heat dissipation copper are in PCB, the total thermal resistance will be as high as 100°C/W, then the power dissipation of LR1117C series could allow on itself is less than 1W. And furthermore, LR1117C series will work at junction temperature higher than 125°C under such condition and no lifetime is guaranteed.

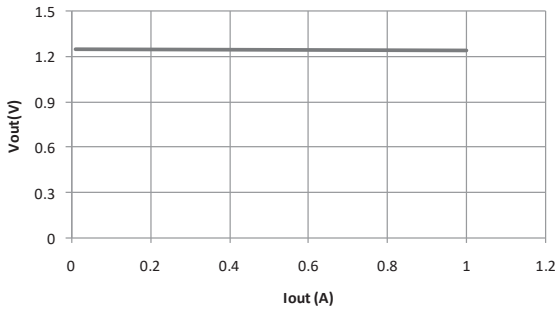
PERFORMANCE CHARACTERISTIC CURVES

Line Regulation

-ADJ Vout Vs. Vin

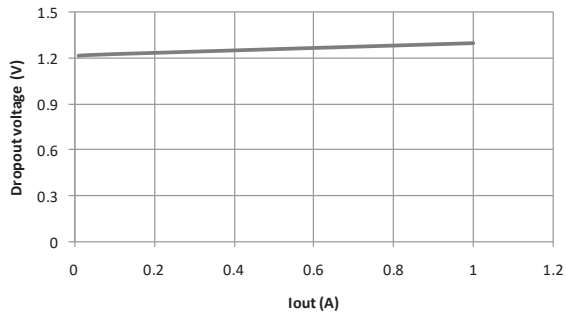


-ADJ Vout Vs. Iout

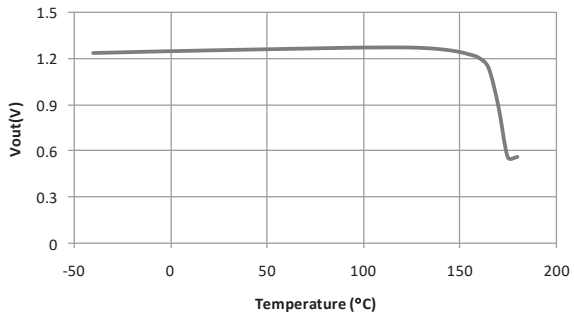


Dropout Voltage

-ADJ Dropout Vs. Iout

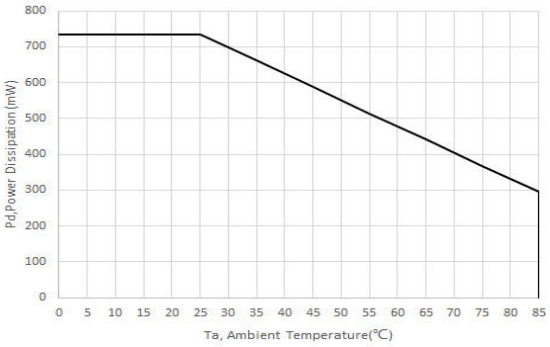


-ADJ Vout Vs. Temp

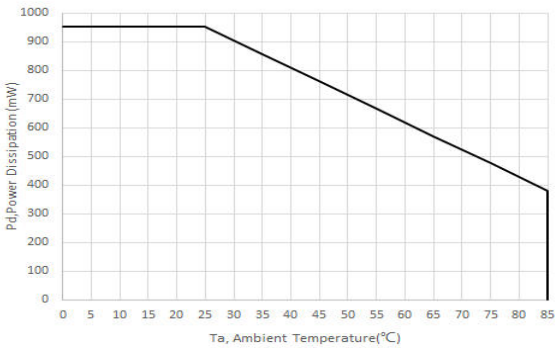


Derating Curve

Pd Vs. Ta(LR1117CS)



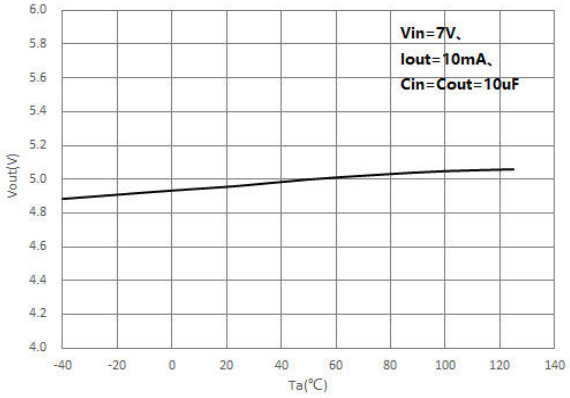
Pd Vs. Ta(LR1117CD)



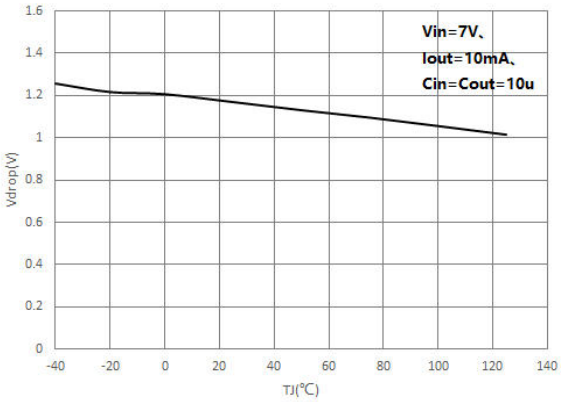
Note：PCB size：30.0mm×25.0mm×1.6mm(FR4)；Copper Foil Thickness：35um；

PERFORMANCE CHARACTERISTIC CURVES

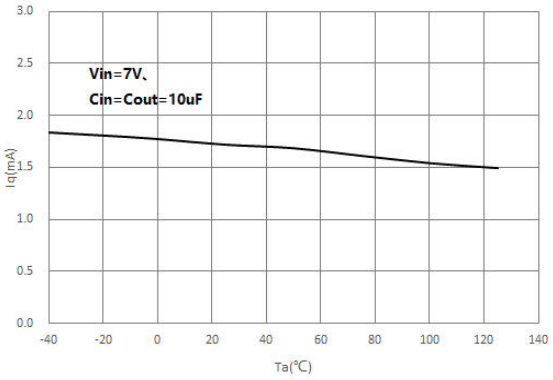
Vdrop **Vs. Ta**



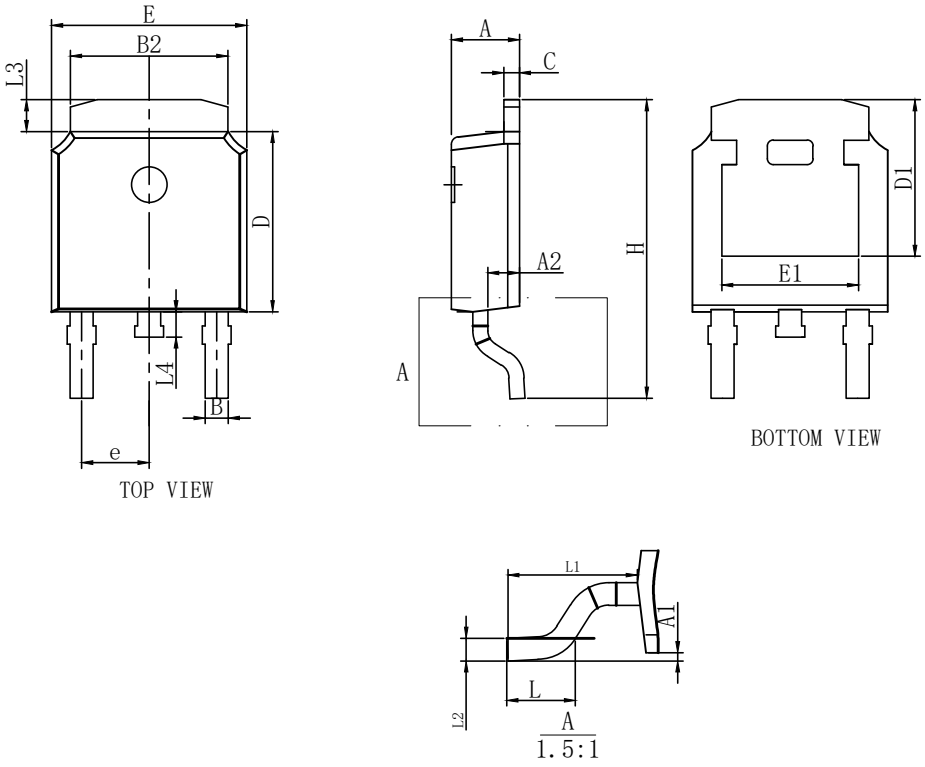
Vdrop **Vs. Tj**



Iq **Vs. Ta**

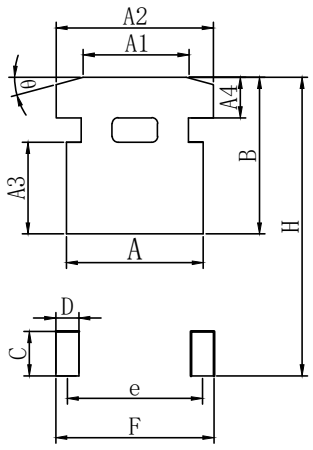


TO-252-2L PACKAGE OUTLINE DIMENSIONS



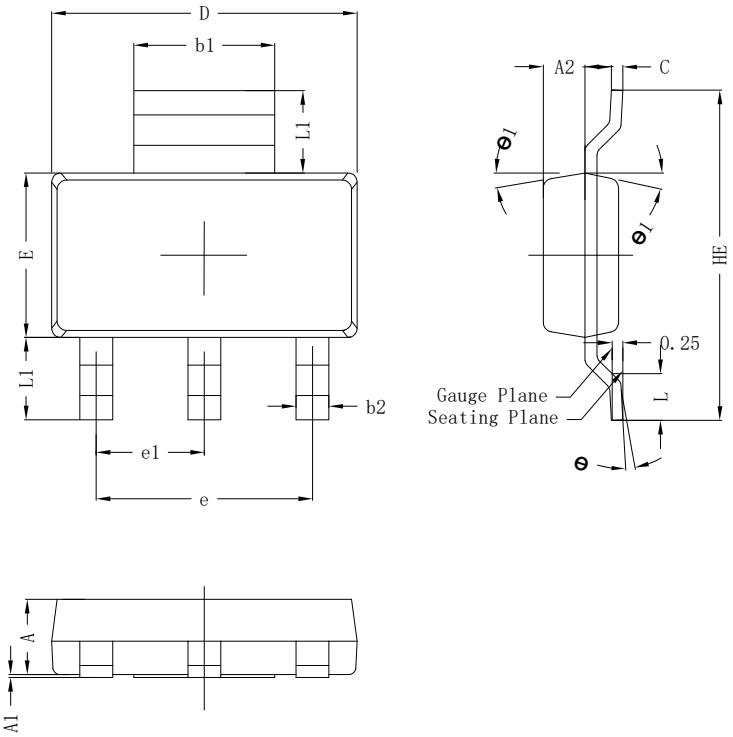
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	2.15	2.30	2.45
A1	0	-	0.20
A2	0.90	1.07	1.17
B	0.68	0.78	0.88
B2	5.20	5.33	5.46
C	0.49	-	0.58
D	5.90	6.10	6.30
D1	5.30REF		
E	6.40	6.60	6.80
E1	4.63	4.83	5.03
e	2.286BSC		
H	9.8	10.10	10.4
L	1.09	1.29	1.49
L1	2.90REF		
L3	0.88	1.08	1.28
L4	0.55	0.80	1.05

Suggested Pad layout



DIM	MIN(mm)
A	6.03
A1	4.50
A2	6.46
A3	4.10
A4	2.37
B	6.50
C	2.50
D	1.68
e	4.80
H	12.35
F	5.95

SOT-223 PACKAGE OUTLINE DIMENSIONS

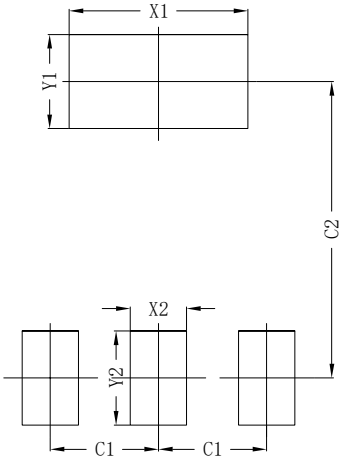


SOT223			
DIM	MIN	NOR	MAX
A	1.50	1.60	1.70
A1	0.00	0.05	0.10
A2	0.80	0.90	1.00
b1	2.90	3.02	3.10
b2	0.60	0.72	0.80
c	0.20	0.27	0.35
D	6.30	6.50	6.70
E	3.30	3.50	3.70
e	4.60BSC		
e1	2.30BSC		
HE	6.80	7.00	7.20
L	0.80	1.00	1.20
L1	1.75(REF)		
θ	0°~8°		
θ 1	8°	10°	12°
All Dimensions in mm			

GENERAL NOTES

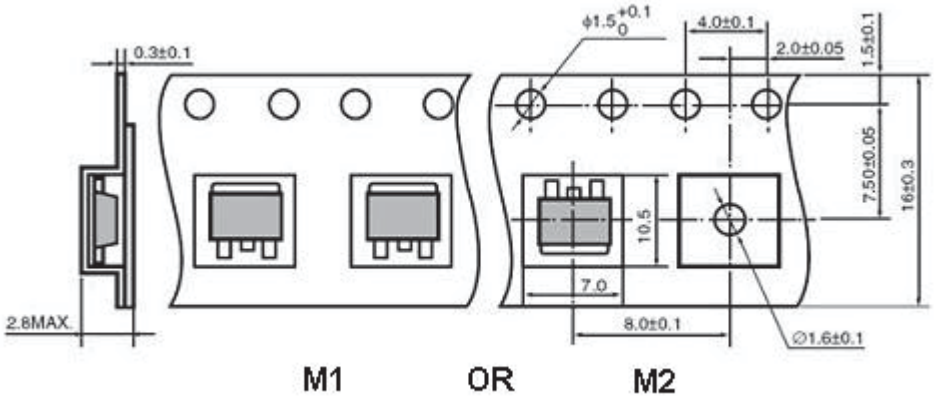
1. Top package surface finish Ra0.4±0.2um
2. Bottom package surface finish Ra0.7±0.2um
3. Side package surface finish Ra0.4±0.2um
4. Protrusion or Gate Burrs shall not exc d 0.10mm per side.

Suggested Pad layout

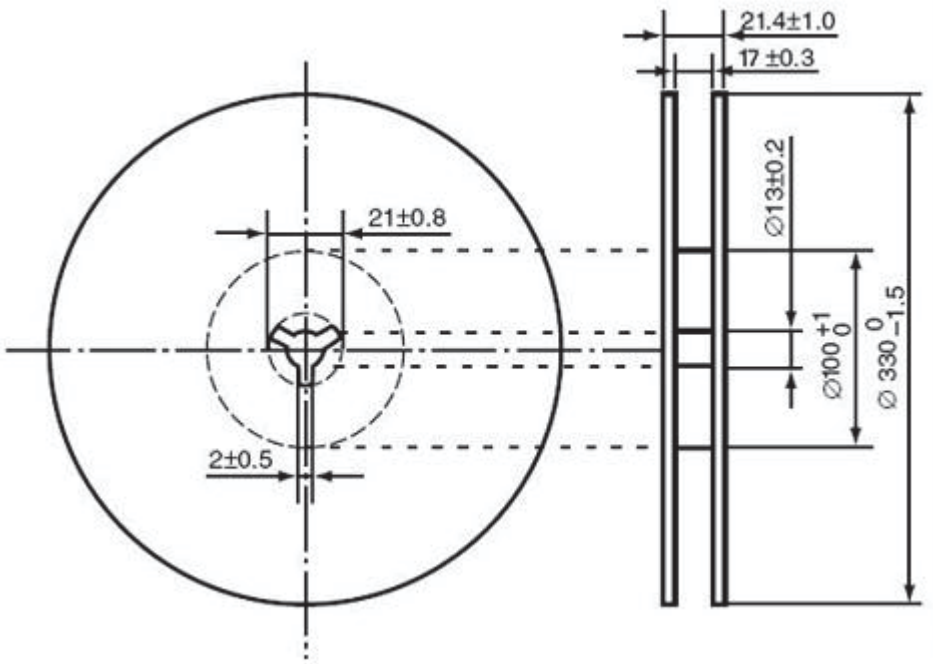


SOT223	
DIM	(mm)
X1	3.80
Y1	2.00
X2	1.20
Y2	2.00
C1	2.30
C2	6.30

Taping dimension：（M1：Standard Type，M2：Customized）



Taping reel dimension：



REVISION HISTORY

Version	Description	Update by	Update Date
1.6	Update POD; Delete marking information when SOT-223 adjustable Version	Li Song	2022-09-21
1.7	Delete device and marking information about SOT-223 package.	Chen S	2023-01-11
1.8	Add power derating curve; Delete thermal resistance;	Chen S	2023-09-21
1.9	Add device and marking information about SOT-223 package.	Chen S	2023-10-11

DISCLAIMER

- Curve guarantee in the specification. The curve of test items with electric parameter is used as quality guarantee. The curve of test items without electric parameter is used as reference only.

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