

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, $V_{out} = 1.2V, 1.5V, 1.8V, 2.5V, 3.3V, 5V,$ 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 $\pm 2\%$. Other output voltage accuracy can be customized on demand, such as $\pm 1\%$

LR1117C is available in SOT-223, TO-252 power package.

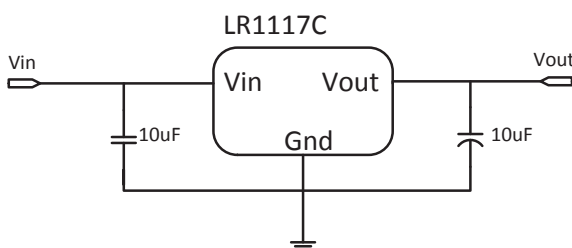
FEATURES

- 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 12V
- Standby current: 2mA (typ.)
- Line regulation: 0.1%/V (typ.)
- Load regulation: 10mV (typ.)
- Environment Temperature: $-40^{\circ}C \sim 85^{\circ}C$

APPLICATIONS

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

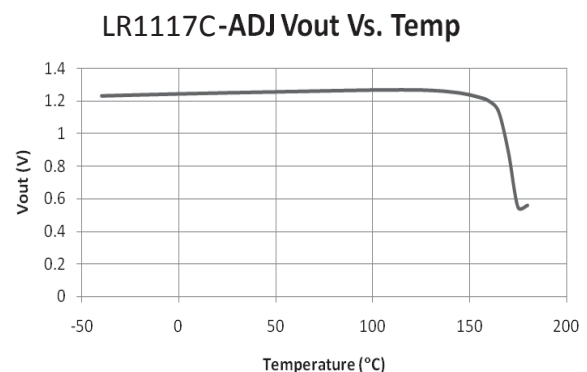
TYPICAL APPLICATION



Application circuit of LR1117C fixed version

NOTE: Input capacitor ($C_{in}=10\mu F$) and Output capacitor ($C_{out}=10\mu F$) are recommended in all application circuit. Tantalum capacitor is recommended.

TYPICAL ELECTRICAL CHARACTERISTIC



ORDERING INFORMATION

LR1117C X XX X

Temp. Range & Rohs Std.
 X: 85C & Pb-free Rohs Std, Output voltage accuracy within $\pm 2\%$

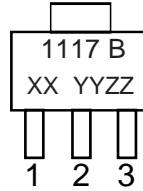
Output Voltage:
 12.....1.2V
 15.....1.5V
 18.....1.8V
 25.....2.5V
 33.....3.3V
 50.....5.0V
ADJ

Package Type:
 S: SOT-223
 D: TO-252

PIN CONFIGURATION AND MARKING

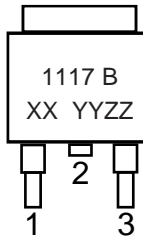
Pin Description:

SOT-223



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

TO-252

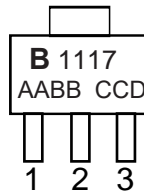


Pin No.	Symbol	Definition
1	Vss/ADJ	Ground/Adjustable
2	Vout	Output
3	Vin	Input

1117: Product code B: Fab code XX: Output voltage
YY: Lot No. ZZ: Date code

Marking information when SOT-223 adjustable Version:

SOT-223



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

B: Fab code 1117: Product code
AA: Manufacture weeks BB: Manufacture LOT No.
CC: Output Voltage Value D: Temp. Range&Rohs Std

ABSOLUTE MAXIMUM RATING

Parameter	Value	
Max Input Voltage	15V ^①	
Max Operating Junction Temperature(Tj)	150°C	
Ambient Operating Temperature(Ta)	-40°C – 85°C	
Package Thermal Resistance	SOT-223	20°C / W
	TO-252	10°C / W
Storage Temperature(Ts)	-40°C - 150°C	
Lead Temperature & Time	260°C, 10S	

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

RECOMMENDED WORK CONDITIONS

Parameter	Value
Input Voltage Range	Max. 12V ^①
Operating Junction Temperature(Tj)	-20°C –125°C

^①Exceptional for LR1117C -12V, the maximum input voltage for LR1117C-12V is 20V.

ELECTRICAL CHARACTERISTICS

Tj=25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vref	Reference Voltage	LR1117-ADJ 10mA ≤ I _{out} ≤ 1A, V _{in} = 3.25V	1.225	1.25	1.275	V
Vout	Output Voltage	LR1117-1.2V 0 ≤ I _{out} ≤ 1A, V _{in} = 3.2V	1.176	1.2	1.224	V
		LR1117-1.5V 0 ≤ I _{out} ≤ 1A, V _{in} = 3.5V	1.47	1.5	1.53	V
		LR1117-1.8V 0 ≤ I _{out} ≤ 1A, V _{in} = 3.8V	1.764	1.8	1.836	V
		LR1117-2.5V 0 ≤ I _{out} ≤ 1A, V _{in} = 4.5V	2.45	2.5	2.55	V
		LR1117-3.3V 0 ≤ I _{out} ≤ 1A, V _{in} = 5.3V	3.234	3.3	3.366	V
		LR1117-5.0V 0 ≤ I _{out} ≤ 1A, V _{in} = 7.0V	4.9	5	5.1	V
		LR1117-12.0V 0 ≤ I _{out} ≤ 1A, V _{in} = 14V	11.76	12	12.24	V
		ΔVout	Line Regulation	LR1117-1.2V I _{out} = 10mA, 2.7V ≤ V _{in} ≤ 10V		0.1
LR1117-ADJ I _{out} = 10mA, 2.75V ≤ V _{in} ≤ 12V				0.1	0.2	%/V
LR1117-1.5V I _{out} = 10mA, 3.0V ≤ V _{in} ≤ 12V				0.1	0.2	%/V
LR1117-1.8V I _{out} = 10mA, 3.3V ≤ V _{in} ≤ 12V				0.1	0.2	%/V
LR1117-2.5V I _{out} = 10mA, 4.0V ≤ V _{in} ≤ 12V				0.1	0.2	%/V
LR1117-3.3V I _{out} = 10mA, 4.8V ≤ V _{in} ≤ 12V				0.1	0.2	%/V
LR1117-5.0V I _{out} = 10mA, 6.5V ≤ V _{in} ≤ 12V				0.1	0.2	%/V
LR1117-12.0V I _{out} = 10mA, 13.5V ≤ V _{in} ≤ 20V				0.1	0.2	%/V
ΔVout	Load Regulation	LR1117-1.2V V _{in} = 2.7V, 10mA ≤ I _{out} ≤ 1A		10	30	mV
		LR1117-ADJ V _{in} = 2.75V, 10mA ≤ I _{out} ≤ 1A		10	30	mV
		LR1117-1.5V V _{in} = 3.0V, 10mA ≤ I _{out} ≤ 1A		10	30	mV
		LR1117-1.8V V _{in} = 3.3V, 10mA ≤ I _{out} ≤ 1A		10	30	mV
		LR1117-2.5V V _{in} = 4.0V, 10mA ≤ I _{out} ≤ 1A		10	30	mV
		LR1117-3.3V V _{in} = 4.8V, 10mA ≤ I _{out} ≤ 1A		10	30	mV
		LR1117-5.0V V _{in} = 6.5V, 10mA ≤ I _{out} ≤ 1A		10	30	mV
		LR1117-12.0V V _{in} = 13.5V, 10mA ≤ I _{out} ≤ 1A		10	30	mV

ELECTRICAL CHARACTERISTICS continued

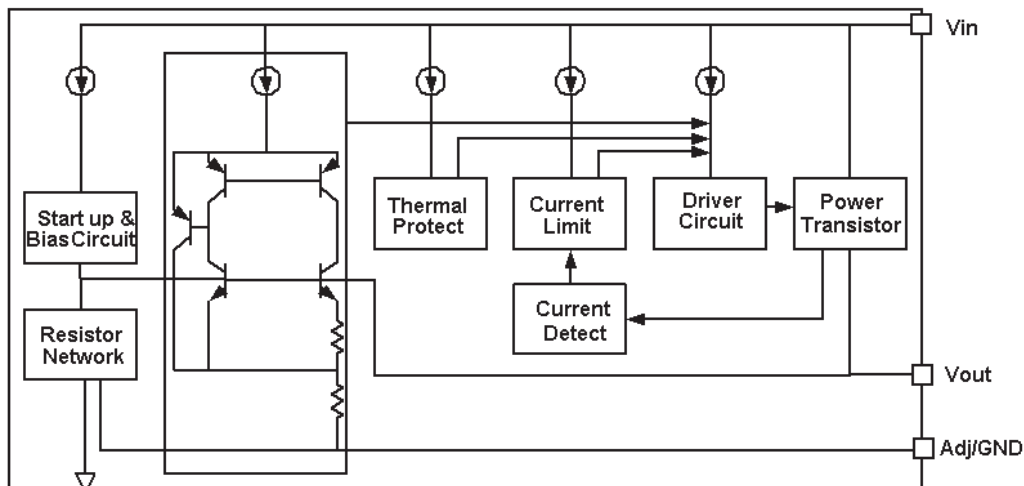
T_j=25°C

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vdrop	Dropout Voltage	I _{out} =100mA		1.23	1.3	V
		I _{out} =1A		1.3	1.5	V
Ilimit	Current Limit	V _{in} -V _{out} =2V, T _j =25°C	1			A
SVR	Supply Voltage Rejection	f = 120Hz, V _{IN} - V _{OUT} = 3V + 1VPP Ripple		60		dB
Imin	Minimum Load Current	LR1117-ADJ		2	10	mA
Iq	Quiescent Current	LR1117-1.2V, V _{in} =10V	1	2	5	mA
		LR1117-1.5V, V _{in} =11V	1	2	5	mA
		LR1117-1.8V, V _{in} =12V	1	2	5	mA
		LR1117-2.5V, V _{in} =12V	1	2	5	mA
		LR1117-3.3V, V _{in} =12V	1	2	5	mA
		LR1117-5.0V, V _{in} =12V	1	2	5	mA
		LR1117-12.0V, V _{in} =20V	1	2	5	mA
IAdj	Adjust Pin Current	LR1117-ADJ V _{in} =5V, 10mA ≤ I _{out} ≤ 1A	35	55	120	uA
Ichange	Iadj change	LR1117-ADJ V _{in} =5V, 10mA ≤ I _{out} ≤ 1A		0.2	10	uA
ΔV/ΔT	Temperature coefficient			±100		ppm
θ _{JC}	Thermal Resistance	SOT-223		20		°C/W
		TO-252		10		
θ _{JA}	Thermal Resistance Junction-to-Ambient (No air flow)	SOT-223 (No heat sink)		136		°C/W
		TO-252 (No heat sink)		92		

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.

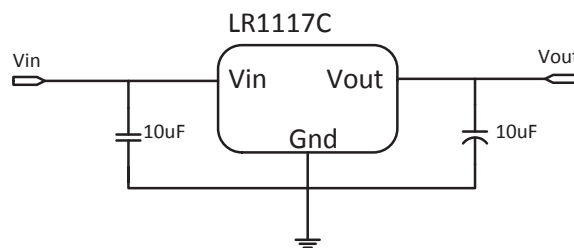
The thermal shut down modules can assure chip and its application system working safety when the junction temperature is larger than 140°C.

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

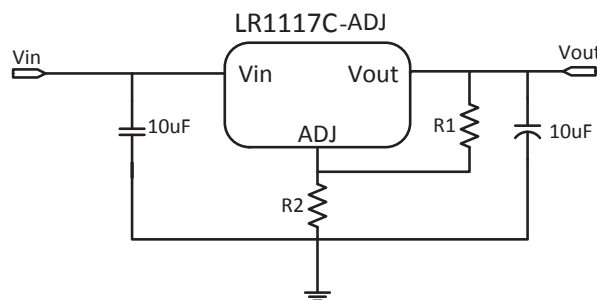


Application circuit of LR1117C fixed version

- 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: $3m\Omega \sim 22\Omega$

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: $V_{out} = 1.25 \times (1 + R2/R1) + I_{Adj} \times R2$. We can ignore I_{Adj} because I_{Adj} (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 $100\Omega \sim 500\Omega$, the value of C_{ADJ} should satisfy this equation: $1/(2\pi \times f_{ripple} \times C_{ADJ}) < R1$.

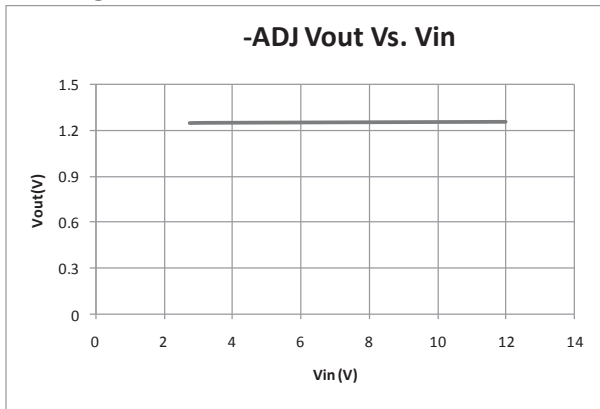
THERMAL CONSIDERATIONS

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 LR1117 is very large. LR1117 series uses SOT-223 package type and its thermal resistance is about $20^{\circ}\text{C}/\text{W}$. And the copper area of application board can affect the total thermal resistance. If copper area is $5\text{cm} \times 5\text{cm}$ (two sides), the resistance is about $30^{\circ}\text{C}/\text{W}$. So the total thermal resistance is about $20^{\circ}\text{C}/\text{W} + 30^{\circ}\text{C}/\text{W}$. 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 $120^{\circ}\text{C}/\text{W}$, then the power dissipation of LR1117 could allow on itself is less than 1W. And furthermore, LR1117 will work at junction temperature higher than 125°C under such condition and no lifetime is guaranteed.

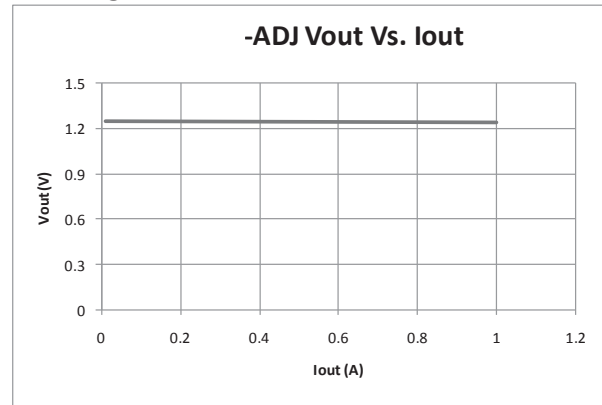
TYPICAL PERFORMANCE CHARACTERISTICS

$T=25^{\circ}\text{C}$ unless specified.

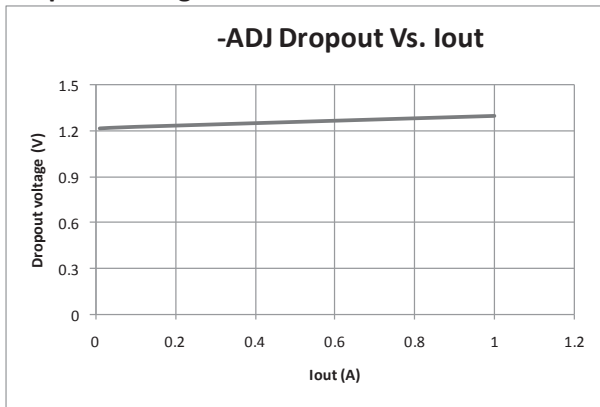
Line Regulation



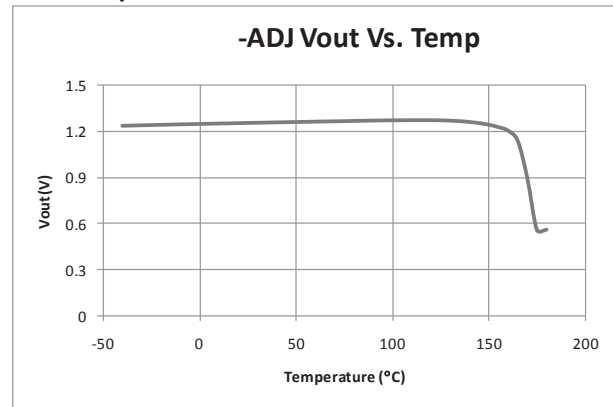
Load Regulation



Dropout Voltage

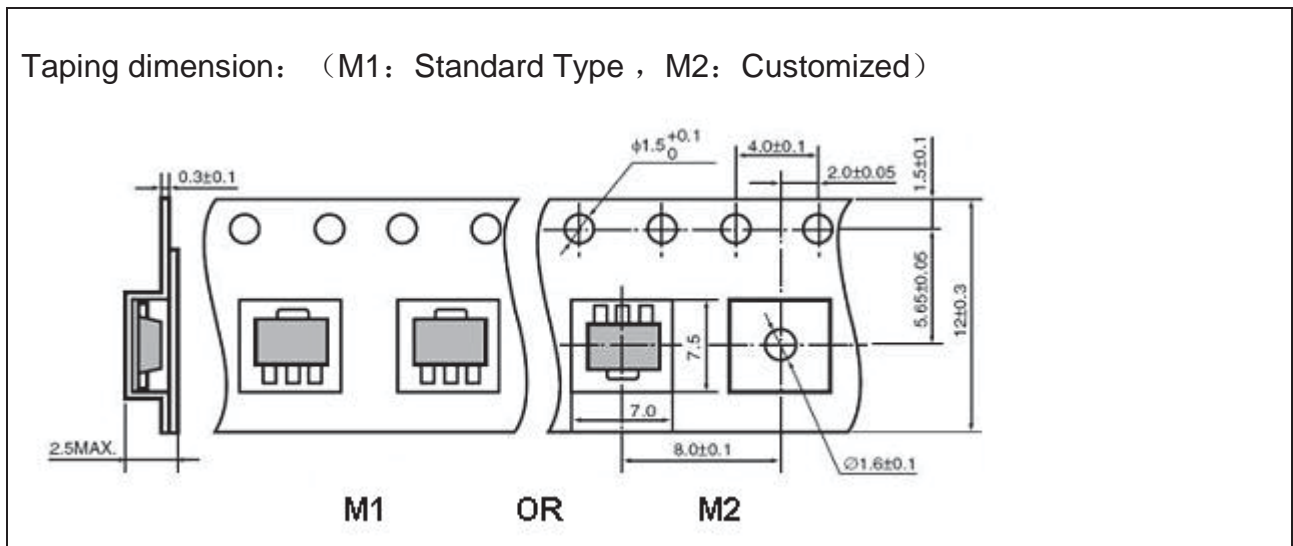


Thermal performance with OTP

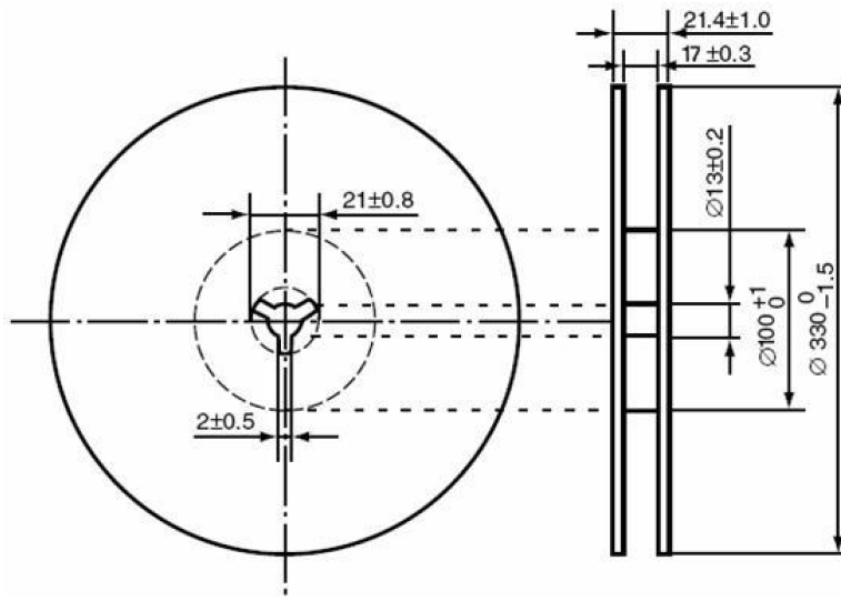


PACKAGE OUTLINE

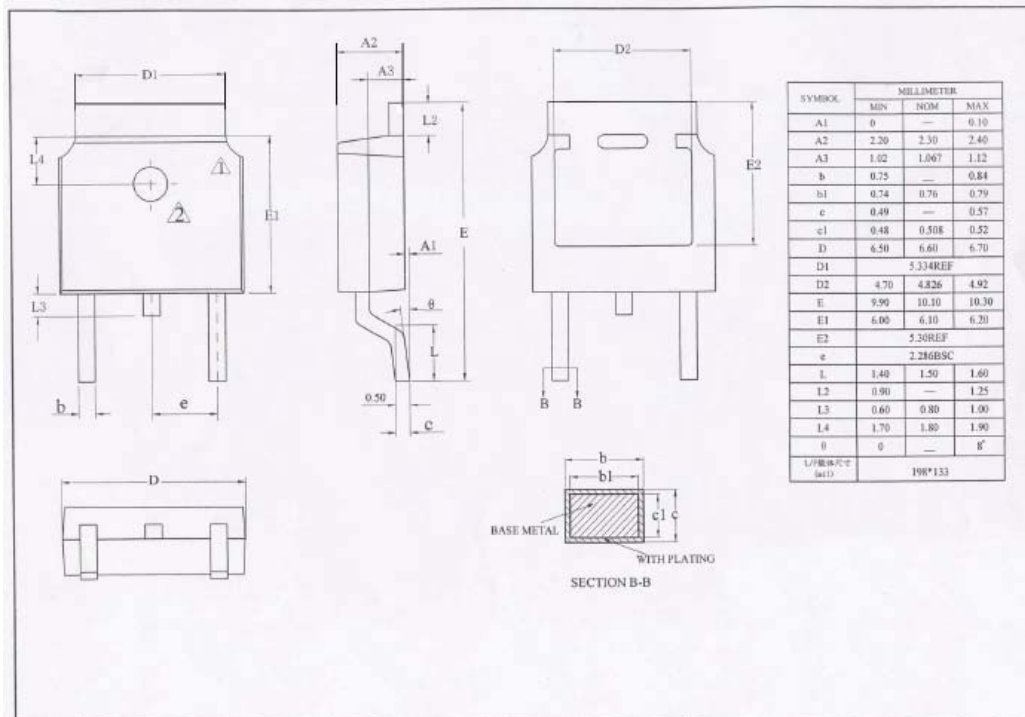
Package	SOT-223	Devices per reel	2500	Unit	mm																																																																																								
Package spec			<table border="1"> <thead> <tr> <th></th> <th>MIN</th> <th>NOM</th> <th>MAX.</th> </tr> </thead> <tbody> <tr><td>A</td><td>1.50</td><td>1.65</td><td>1.80</td></tr> <tr><td>A1</td><td>0.02</td><td>0.06</td><td>0.10</td></tr> <tr><td>A2</td><td>1.45</td><td>1.60</td><td>1.75</td></tr> <tr><td>A3</td><td>0.80</td><td>0.90</td><td>1.00</td></tr> <tr><td>b</td><td>0.67</td><td>-</td><td>0.80</td></tr> <tr><td>b1</td><td>0.66</td><td>0.71</td><td>0.75</td></tr> <tr><td>b2</td><td>2.96</td><td>-</td><td>3.09</td></tr> <tr><td>b3</td><td>2.95</td><td>3.00</td><td>3.05</td></tr> <tr><td>c</td><td>0.30</td><td>-</td><td>0.35</td></tr> <tr><td>c1</td><td>0.29</td><td>0.30</td><td>0.31</td></tr> <tr><td>D</td><td>6.35</td><td>-</td><td>7.05</td></tr> <tr><td>D1</td><td>6.30</td><td>6.50</td><td>6.70</td></tr> <tr><td>E</td><td>6.80</td><td>7.00</td><td>7.20</td></tr> <tr><td>E1</td><td>3.40</td><td>3.50</td><td>3.60</td></tr> <tr><td>e</td><td colspan="3">2.30BSC</td></tr> <tr><td>e1</td><td colspan="3">4.60BSC</td></tr> <tr><td>L</td><td>0.80</td><td>1.00</td><td>1.20</td></tr> <tr><td>L1</td><td colspan="3">1.75REF</td></tr> <tr><td>L2</td><td colspan="3">0.25BSC</td></tr> <tr><td>θ</td><td>0°</td><td>-</td><td>8°</td></tr> <tr><td>θ 1</td><td>10°</td><td>12°</td><td>14°</td></tr> </tbody> </table>				MIN	NOM	MAX.	A	1.50	1.65	1.80	A1	0.02	0.06	0.10	A2	1.45	1.60	1.75	A3	0.80	0.90	1.00	b	0.67	-	0.80	b1	0.66	0.71	0.75	b2	2.96	-	3.09	b3	2.95	3.00	3.05	c	0.30	-	0.35	c1	0.29	0.30	0.31	D	6.35	-	7.05	D1	6.30	6.50	6.70	E	6.80	7.00	7.20	E1	3.40	3.50	3.60	e	2.30BSC			e1	4.60BSC			L	0.80	1.00	1.20	L1	1.75REF			L2	0.25BSC			θ	0°	-	8°	θ 1	10°	12°	14°
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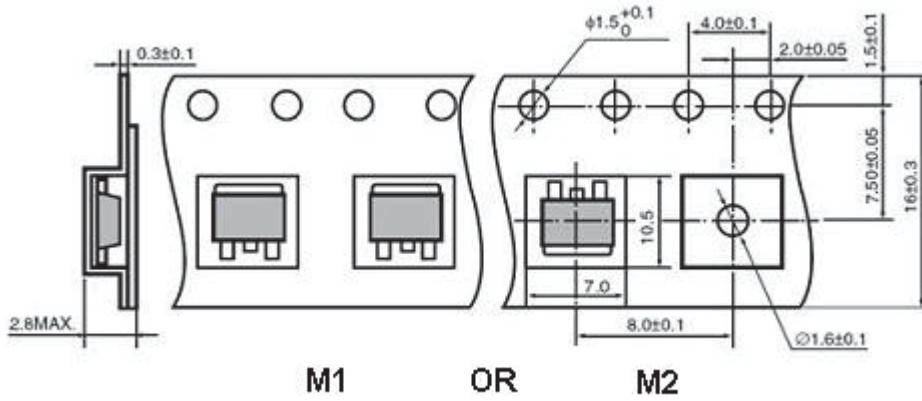
Taping reel dimension:



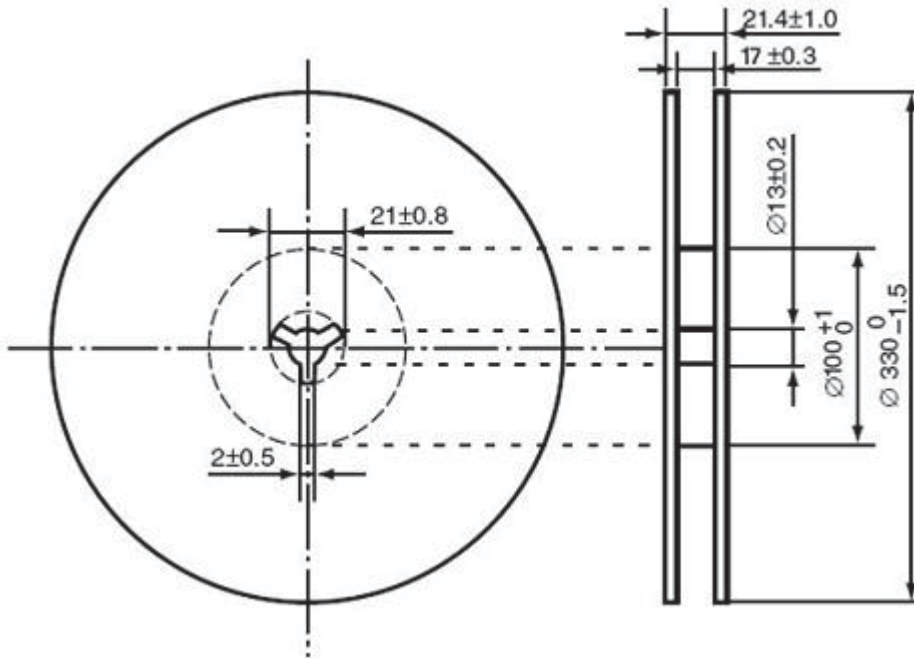
Package	TO-252	Devices per reel	2500	Unit	mm
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Taping dimension: (M1: Standard Type , M2: Customized)



Taping reel dimension:



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