1A Low-Dropout Linear Regulator

Features

- Maximum output current is 1.2A
- Range of operation input voltage: Max 15V
- Line regulation: 0.03%/V (typ.)
- Standby current: 2mA (typ.)
- Load regulation: 0.2%/A (typ.)
- Environment Temperature: -40℃~85℃

Applications

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

General Description

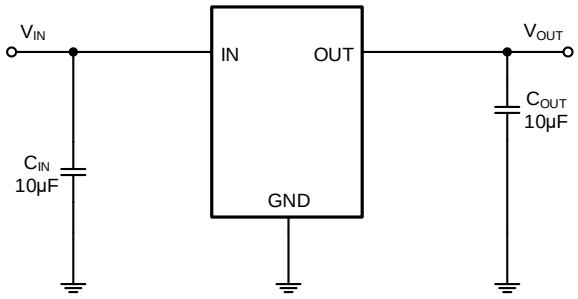
RY1117B is a series of low dropout three-terminal regulators with a dropout of 1.3V at 1A load current. RY1117B features a very low standby current 2mA compared to 5mA of competitor.

Other than a fixed version, V_{OUT} = 1.2V, 1.5V, 1.8V, 2.5V, 2.85V, 3.3V, and 5V, RY1117B has an adjustable version, which can provide an output voltage from 1.25 to 12V with only two external resistors.

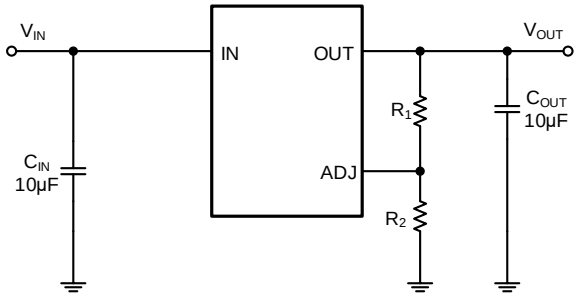
RY1117B offers thermal shut down function, to assure the stability of chip and power system. It uses trimming technique to guarantee output voltage accuracy within 2%. Other output voltage accuracy can be customized on demand, such as 1%.

RY1117B is available in SOT-223, TO-252, SOT-89 power package.

Typical Application Circuit



RY1117B fixed version application circuit



RY1117B ADJ version application circuit

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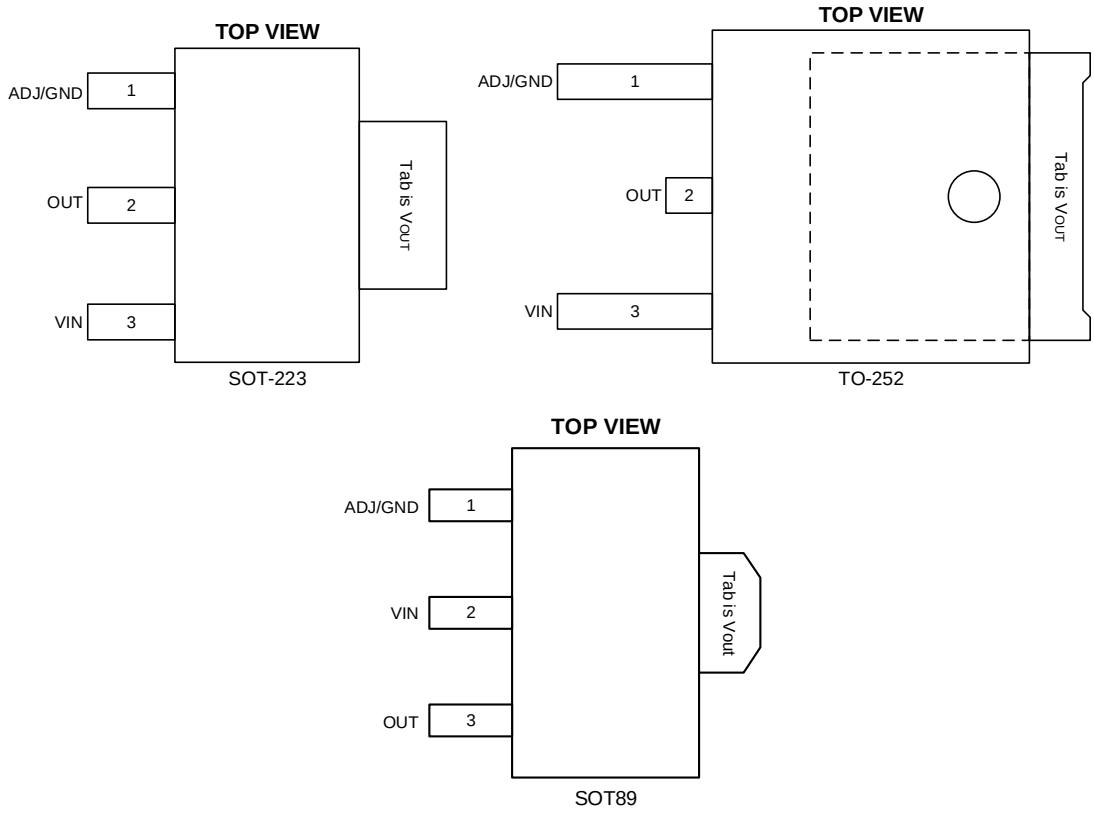
Pin Description

Pin Configuration



Pin Description

SOT-223 Pin No.	TO-252 Pin No.	SOT-89 Pin No.	Name	Function
1	1	1	ADJ/GND	Adjust pin for adjustable output version GND Ground pin for fixed output versions.
2	2	2	OUT	Output voltage (V_{OUT}) pin for the regulator. Tab is V_{OUT}
3	3	3	VIN	Input voltage (V_{IN}) pin for the regulator.

Marking Rule

Marking	Designator	Description
Product Code VV YYWW	1117	Product Code
	VV adj	Fixed Version Output Voltage (1.2~12.0V) Adjustable Version Output Voltage (adj)
	YYWW	Date Code

Note: “XX” stands for output voltages. Other voltages can be specially customized

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Order Information (1)

RY1117B-①②③

Designator	Symbol	Description
①② Output Voltage(1.2~12.0V)	12	1.2V
	15	1.5V
	18	1.8V
	25	2.5V
	28	2.85V
	33	3.3V
	50	5.0V
	AD	Adj
③ (Package)	L	SOT-223
	O	TO-252
	T	SOT-89

Part No.	Model	Description	Package	T/R Qty
70603001	RY1117B-12L	RY1117B-12L LDO, 1.2V, SOT-223	SOT-223	2500PCS
70603002	RY1117B-12O	RY1117B-12O LDO, 1.2V, TO-252	TO-252	3000PCS
70603015	RY1117B-15L	RY1117B-15L LDO, 1.5V, SOT-223	SOT-223	2500PCS
70603016	RY1117B-15O	RY1117B-15O LDO, 1.5V, TO-252	TO-252	3000PCS
70603003	RY1117B-18L	RY1117B-18L LDO, 1.8V, SOT-223	SOT-223	2500PCS
70603004	RY1117B-18O	RY1117B-18O LDO, 1.8V, TO-252	TO-252	3000PCS
70603005	RY1117B-25L	RY1117B-25L LDO, 2.5V, SOT-223	SOT-223	2500PCS
70603006	RY1117B-25O	RY1117B-25O LDO, 2.5V, TO-252	TO-252	3000PCS
70603007	RY1117B-28L	RY1117B-28L LDO, 2.8V, SOT-223	SOT-223	2500PCS
70603008	RY1117B-28O	RY1117B-28O LDO, 2.8V, TO-252	TO-252	3000PCS
70603009	RY1117B-33L	RY1117B-33L LDO, 3.3V, SOT-223	SOT-223	2500PCS
70603010	RY1117B-33O	RY1117B-33O LDO, 3.3V, TO-252	TO-252	3000PCS
70603011	RY1117B-50L	RY1117B-50L LDO, 5.0V, SOT-223	SOT-223	2500PCS
70603012	RY1117B-50O	RY1117B-50O LDO, 5.0V, TO-252	TO-252	3000PCS
70603013	RY1117B-ADL	RY1117B-ADL LDO, ADJ, SOT-223	SOT-223	2500PCS
70603014	RY1117B-ADO	RY1117B-ADO LDO, ADJ, TO-252	TO-252	3000PCS
70603017	RY1117B-ADT	RY1117B-ADT LDO, ADJ, SOT89-3	SOT-89	1000PCS

Note (1): All RYCHIP parts are Pb-Free and adhere to the RoHS directive.

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Specifications

Absolute Maximum Ratings (1) (2)

Item	Min	Max	Unit
Maximum V_{IN} voltage		17	V
Power dissipation (3)	Internally Limited		
Operating junction temperature, $T_{J(MAX)}$		150	°C
Storage temperature, T_{stg}	–55	150	°C
Lead Temperature (Soldering, 10sec.)		260	°C

Note (1): Exceeding these ratings may damage the device.

Note (2): The device is not guaranteed to function outside of its operating conditions.

Note (3): The maximum allowable power dissipation is a function of the maximum junction temperature, $T_{J(MAX)}$, the junction-to-ambient thermal resistance, $R_{\theta JA}$, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{D\,(MAX)} = (T_{J(MAX)} - T_A)/R_{\theta JA}$. Exceeding the maximum allowable power dissipation causes excessive die temperature, and the regulator goes into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage. Thermal shutdown engages at T_J=160°C (typical) and disengages at T_J= 130°C (typical).

ESD Ratings

Item	Description	Value	Unit
$V_{(ESD-HBM)}$	Human Body Model (HBM) ANSI/ESDA/JEDEC JS-001-2014 Classification, Class: 2	±2000	V
$V_{(ESD-CDM)}$	Charged Device Mode (CDM) ANSI/ESDA/JEDEC JS-002-2014 Classification, Class: C0b	±200	V
$I_{LATCH-UP}$	JEDEC STANDARD NO.78E APRIL 2016 Temperature Classification, Class: I	±150	mA

Recommended Operating Conditions

Item	Min	Max	Unit
Operating junction temperature (1)	-40	125	°C
Operating temperature range	-40	85	°C
Input voltage V_{IN}		15	V
Output current	0	1	A

Note (1): All limits specified at room temperature (TA = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

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Thermal Information

Item	Description	SOT-223	TO-252	SOT-89	Unit
		Value	Value	Value	
$R_{\theta JA}$	Junction-to-ambient thermal resistance (1)(2)	62	56	54	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	43	43	88	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	10	29.5	9.6	°C/W
ψ_{JT}	Junction-to-top characterization parameter	2.5	5.5	6.2	°C/W
ψ_{JB}	Junction-to-board characterization parameter	10	29	9.7	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	-	4.2	7.7	°C/W

Note (1): The package thermal impedance is calculated in accordance to JESD 51-7.

Note (2): Thermal Resistances were simulated on a 4-layer, JEDEC board

Electrical Characteristics

T_A=25°C, unless otherwise noted.

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
V_{REF}	Reference Voltage	RY1117B-ADJ 10mA≤I_{OUT}≤1A, V_{IN}=3.25V	1.225	1.25	1.275	V
V_{OUT}	Output Voltage	RY1117B-1.2V 0≤I_{OUT}≤1A, V_{IN}=3.2V	1.176	1.2	1.224	V
		RY1117B-1.5V 0≤I_{OUT}≤1A, V_{IN}=3.5V	1.470	1.5	1.530	V
		RY1117B-1.8V 0≤I_{OUT}≤1A, V_{IN}=3.8V	1.764	1.8	1.836	V
		RY1117B-2.5V 0≤I_{OUT}≤1A, V_{IN}=4.5V	2.45	2.5	2.55	V
		RY1117B-2.85V 0≤I_{OUT}≤1A, V_{IN}=4.85V	2.793	2.85	2.907	V
		RY1117B-3.3V 0≤I_{OUT}≤1A, V_{IN}=5.3V	3.234	3.3	3.366	V
		RY1117B-5.0V 0≤I_{OUT}≤1A, V_{IN}=7.0V	4.9	5	5.1	V
ΔV_{OUT}	Line Regulation	RY1117B-1.2V I_{OUT}=10mA, 2.7V≤V_{IN}≤10V		0.03	0.2	%/V
		RY1117B-1.5V I_{OUT}=10mA, 3.0V≤V_{IN}≤10V		0.03	0.2	%/V
		RY1117B-ADJ I_{OUT}=10mA, 2.75V≤V_{IN}≤12V		0.03	0.2	%/V
		RY1117B-1.8V I_{OUT}=10mA, 3.3V≤V_{IN}≤12V		0.03	0.2	%/V
		RY1117B-2.5V I_{OUT}=10mA, 4.0V≤V_{IN}≤12V		0.03	0.2	%/V
		RY1117B-2.85V		0.03	0.2	%/V

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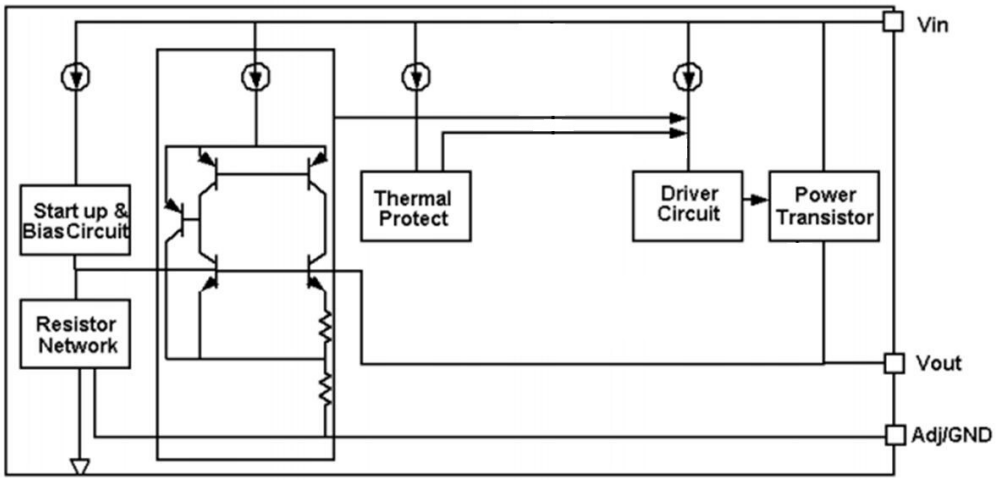
		I_{OUT}=10mA, 4.35V≤V_{IN}≤12V				
		RY1117B-3.3V I_{OUT}=10mA, 4.8V≤V_{IN}≤12V		0.03	0.2	%/V
		RY1117B-5.0V I_{OUT}=10mA, 6.5V≤V_{IN}≤12V		0.03	0.2	%/V
ΔV_{OUT}	Load Regulation	RY1117B-1.2V V_{IN} =2.7V, 10mA≤I_{OUT}≤1A		2	8	mV
		RY1117B-1.5V V_{IN} =3.0V, 10mA≤I_{OUT}≤1A		2	8	mV
		RY1117B-ADJ V_{IN} =2.75V, 10mA≤I_{OUT}≤1A		2	8	mV
		RY1117B-1.8V V_{IN} =3.3V, 10mA≤I_{OUT}≤1A		3	12	mV
		RY1117B-2.5V V_{IN} =4.0V, 10mA≤I_{OUT}≤1A		4	16	mV
		RY1117B-2.85V V_{IN} =4.35V, 10mA≤I_{OUT}≤1A		5	20	mV
		RY1117B-3.3 V_{IN} =4.8V, 10mA≤I_{OUT}≤1A		6	24	mV
		RY1117B-5.0 V_{IN} =6.5V, 10mA≤I_{OUT}≤1A		9	36	mV
V_{DROP}	Dropout Voltage	I_{OUT} =100mA		1.15	1.3	V
		I_{OUT}=1A		1.3	1.5	V
Power Supply Rejection Ratio	PSRR	VOUT=1.2V, VIN=3.3V	f = 100Hz	-	70	-	dB
			f = 1KHz	-	65	-	dB
I_{MIN}	Minimum Load Current	RY1117B-ADJ			2	10	mA
I_Q	Quiescent Current	RY1117B-1.2V, V_{IN}=10V			2	5	mA
		RY1117B-1.5V, V_{IN}=10V			2	5	mA
		RY1117B-1.8V, V_{IN}=12V			2	5	mA
		RY1117B-2.5V, V_{IN}=12V			2	5	mA
		RY1117B-2.85V, V_{IN}=12V			2	5	mA
		RY1117B-3.3V, V_{IN}=12V			2	5	mA
		RY1117B-5.0V, V_{IN}=12V			2	5	mA
I_{ADJ}	Adjust pin Current	RY1117B-ADJ V_{IN}=5V, 10mA≤I_{OUT}≤1A			55	120	uA
I_{CHANGE}	I_{ADJ} Change	RY1117B-ADJ V_{IN}=5V, 10mA≤I_{OUT}≤1A			0.2	10	uA
ΔV/ΔT	Temperature Coefficient				±100		ppm

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

Note2: Load current smaller than minimum load current of RY1117B-ADJ will lead to unstable or oscillation output.

Block Diagram



RY1117B Block Diagram

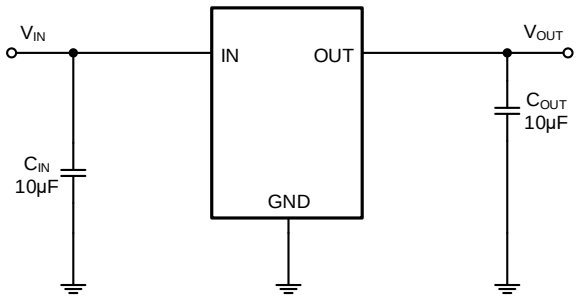
Detailed Description

RY1117B 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, 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

RY1117B has an adjustable version and six fixed versions (1.2V, 1.5V, 1.8V, 2.5V, 2.85V, 3.3V and 5V)

Fixed Output Voltage Version



RY1117B fixed version application circuit

1) Recommend using 10uF tan capacitor as bypass capacitor (C1) for all application circuit.
2) Recommend using 10uF tan capacitor to assure circuit stability.

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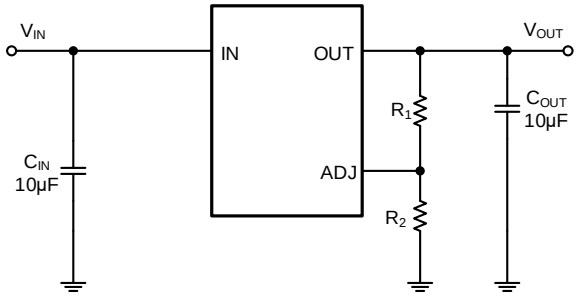
Adjustable Output Voltage Version



RY1117B ADJ version application circuit

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).

As RY1117B-ADJ can keep itself stable at load current about 2mA, R1 is not allowed to be higher than 625ohm.

V_{OUT}(V)	R1(Ω)	R2(Ω)	C_{IN}(μF)	C_{OUT}(μF)
1.5	500	100	10	10
1.8	500	220	10	10
2.5	500	500	10	10
3.3	500	820	10	10
5	500	1.5	10	10

Using a bypass capacitor (CADJ) 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 CADJ should be less than R1 to prevent ripple from being amplified. As R1 is normally in the range of 100Ω~500Ω, the value of CADJ should satisfy this equation: $1/(2\pi\times fRIPPLE\times CADJ) <R1$.

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 RY1117B is very large. RY1117B series uses SOT-223 package type and its thermal resistance is about 20°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 30°C/W. So, the total thermal resistance is about 20°C/W + 30°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 120°C/W, then the power dissipation of RY1117B could allow on itself is less than 1W. And furthermore, RY1117B will work at junction temperature higher than 125°C under such condition and no lifetime is guaranteed.

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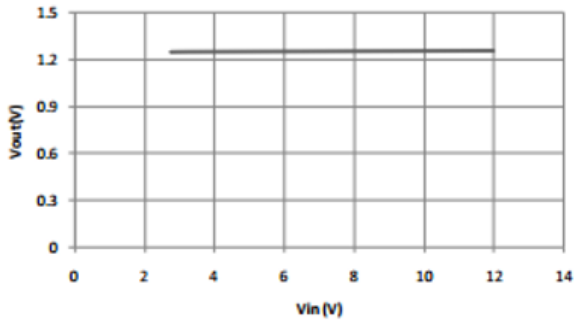
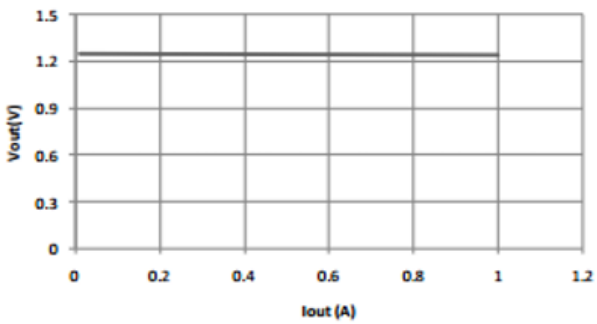
Typical Performance Characteristics

TA=25℃, unless otherwise noted.

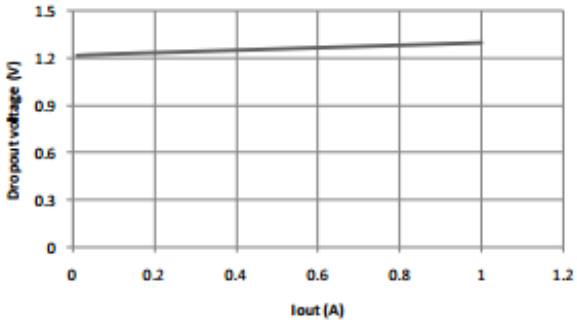
Line regulation



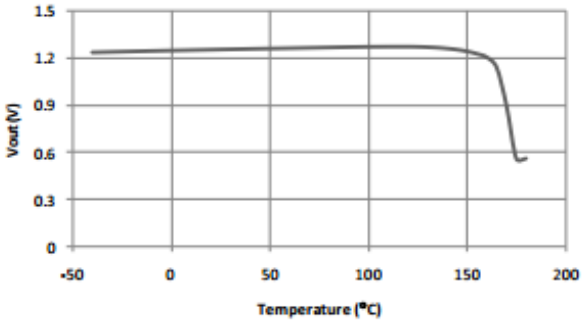
Dropout voltage



Load regulation



Thermal performance with OTP



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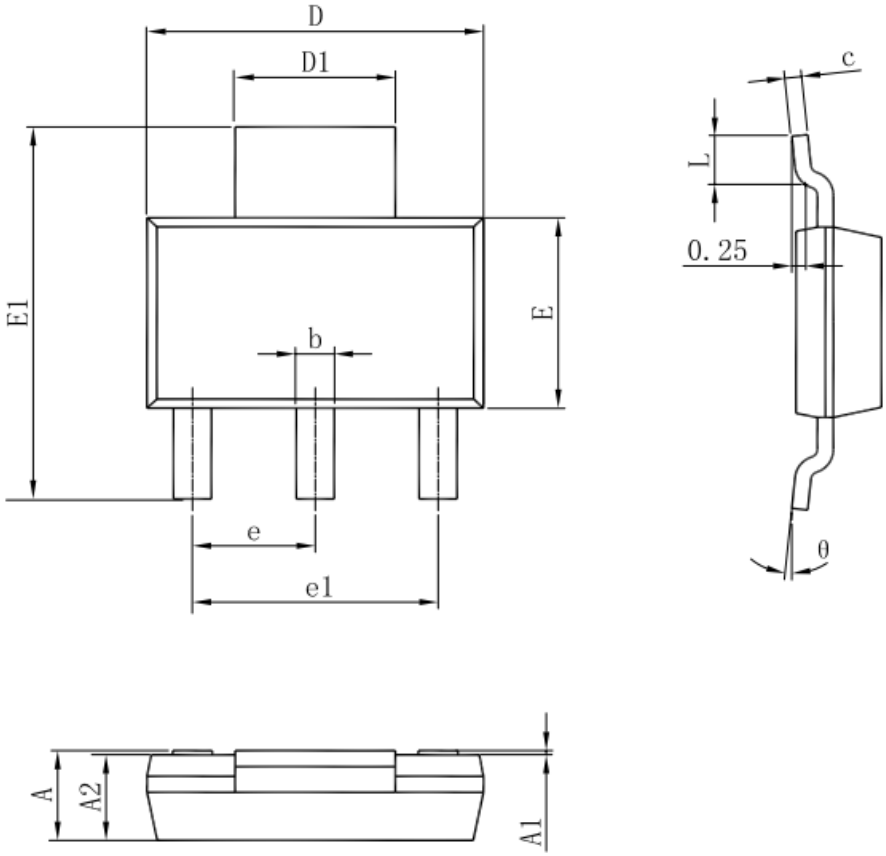
Packaging Information

SOT-223 Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.520	1.800	0.060	0.071
A1	0.000	0.100	0.000	0.004
A2	1.500	1.700	0.059	0.067
b	0.660	0.820	0.026	0.032
c	0.250	0.350	0.010	0.014
D	6.200	6.400	0.244	0.252
D1	2.900	3.100	0.114	0.122
E	3.300	3.700	0.130	0.146
E1	6.830	7.070	0.269	0.278
e	2.300(BSC)		0.091(BSC)	
e1	4.500	4.700	0.177	0.185
L	0.900	1.150	0.035	0.045
θ	0°	10°	0°	10°

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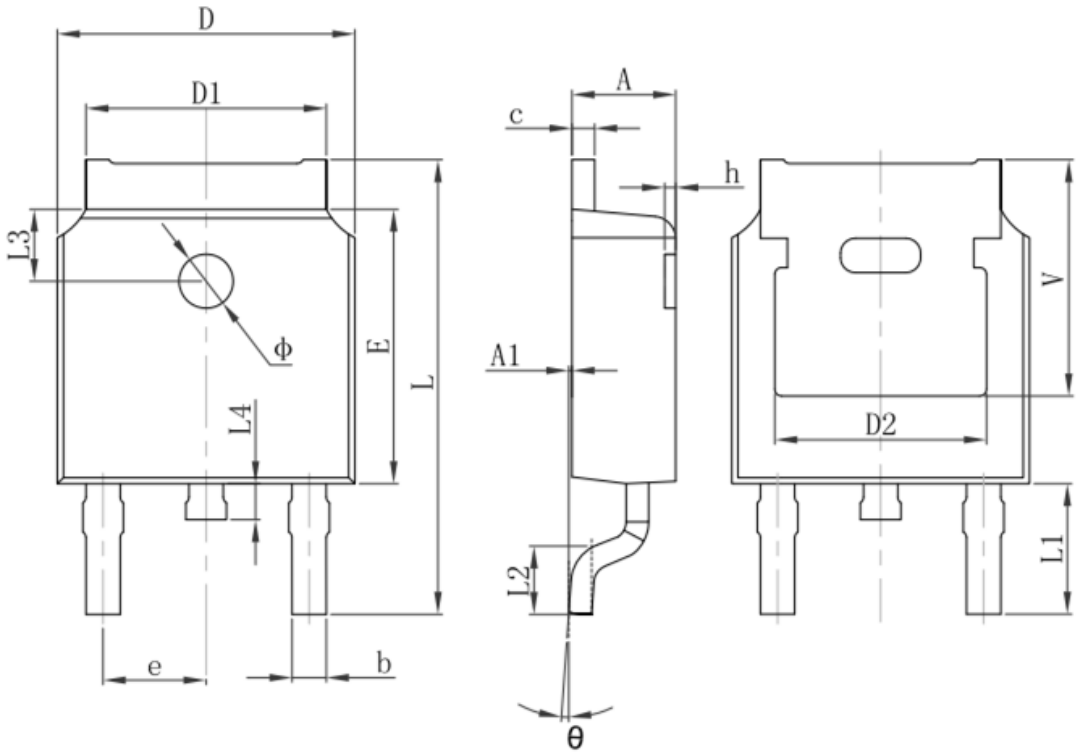
TO-252-3L Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.660	0.860	0.026	0.034
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	4.830 REF.		0.190 REF.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.800	10.400	0.386	0.409
L1	2.900 REF.		0.114 REF.	
L2	1.400	1.700	0.055	0.067
L3	1.600 REF.		0.063 REF.	
L4	0.600	1.000	0.024	0.039
Φ	1.100	1.300	0.043	0.051
θ	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.350 REF.		0.211 REF.	

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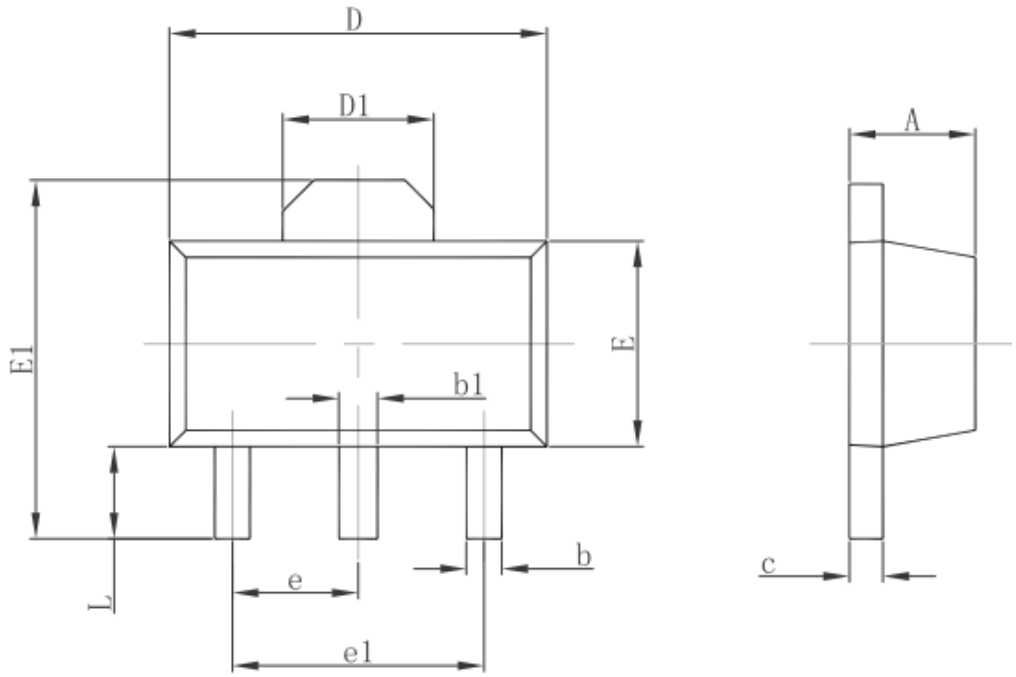
3-Pin SOT89 Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060 TYP.	
e1	3.000 TYP.		0.118 TYP.	
L	0.900	1.200	0.035	0.047