BL9110

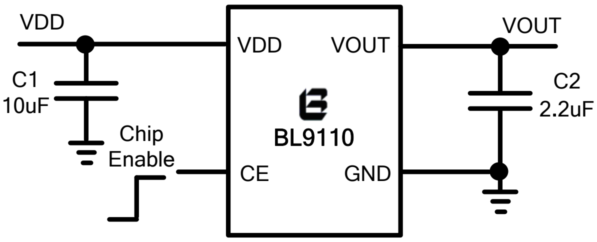
1A Low Dropout, Low Quiescent Current High PSRR CMOS Linear Regulator

DESCRIPTION

The BL9110 is a low-dropout regulator that operates the input voltage from 2.5V to 6V and delivers 1A load current. The BL9110 is available in two types, either fixed or adjustable output voltage. The output voltage of the fixed types is preset at an internally trimmed voltage 1V, 1.2V, 1.3V, 1.5V, 1.8V, 2.5V, 2.7V, 2.8V, 2.85V, 3.0V, 3.2V, 3.3V, 5V or can be made with options of the output range from 1V to 5V in 50mV increments. The output range of adjustable types is from 1V to 5V. The BL9110 consists of a voltage reference, an error amplifier, resistor net for setting output voltage, a current limit circuit for over-current and a thermal-shutdown circuit.

A standby mode with ultra low supply current can be realized with the chip enable function. Since the packages for BL9110 are SOT89-5, TO252-2, SOT223 and SOT89-3 with high power dissipation, high density mounting of the IC on board is possible.

TYPICAL APPLICATION



FEATURES

- Up to 1A Output Current
- 70uA Operating Supply Current
- Excellent Line Regulation: 0.05%/V
- Low Dropout: 350mV@1A(V_{OUT}=3.3V)
- High Power Supply Rejection Ratio
- Wide Operating Voltage Range: 2.5V to 6.0V
- 1V to 5V Factory-Preset Output
- High Accuracy: ±1% or ±2%
- Built-in Auto Discharge Function
- 500mA in-rush Current Limit
- Fold-back Current Limit Protection
- Thermal Shutdown Protection
- SOT89-5, TO252-2, SOT223 and SOT89-3 Package
- RoHS Compliant and 100% Lead (Pb)-Free

APPLICATIONS

- Portable Communication Equipment
- Battery-Powered Equipment
- Laptop, Palmtops, Notebook Computers
- Hand-Held Instruments
- PCMCIA Cards and Wireless LAN
- Electrical appliances such as cameras, VCRS

ORDERING INFORMATION

BL9110- VVV X X XX

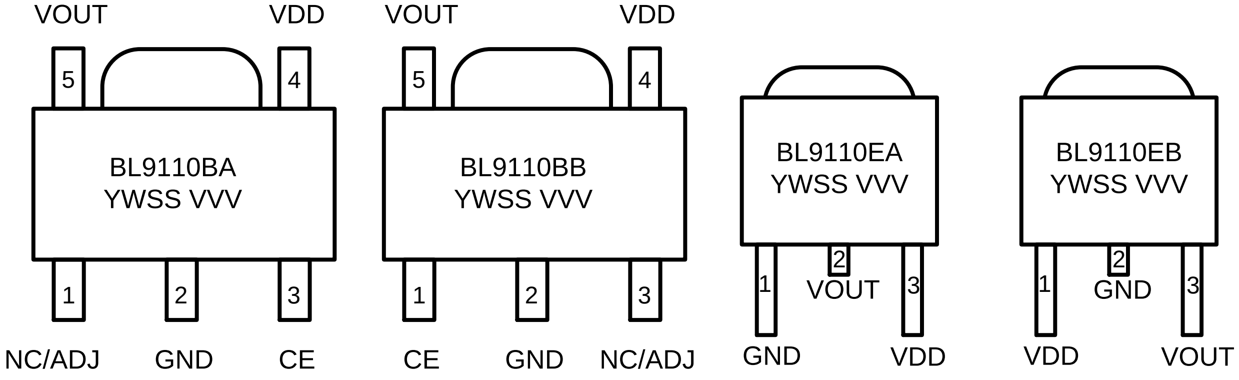
Package：
- BA: SOT89-5(A) BB: SOT89-5(B)
- EA: TO252-2(A) EB: TO252-2(B)
- FA: SOT223(A) FB: SOT223(B)
- FC: SOT223(C) FD: SOT223(D)
- IA: SOT89-3(A) IB: SOT89-3(B)
- IC: SOT89-3(C)

Features:
- P: Standard(default, lead free)
- C: Customized

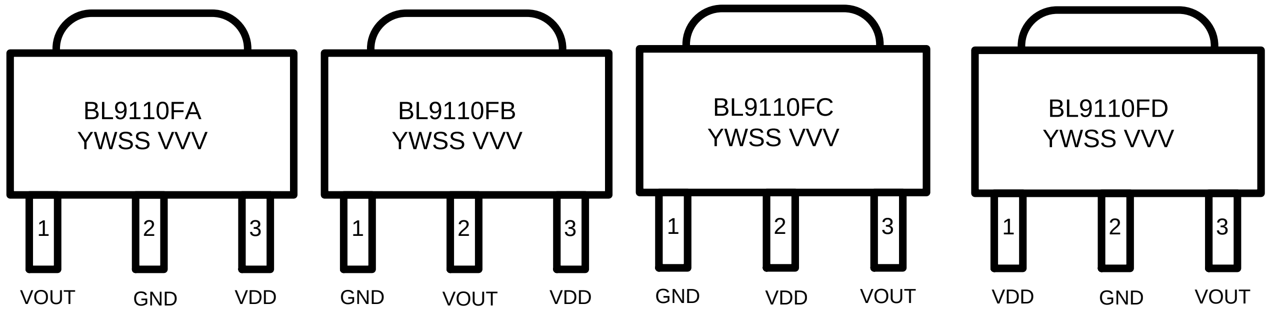
Output Voltage Accuracy
- A:±1%
- B:±2%

Output Voltage：
- 100:1.0V 120:1.2V 130:1.3V 150:1.5V
- 180:1.8V 250:2.5V 270:2.7V 280:2.8V
- 285:2.85V 300:3.0V 320:3.2V 330:3.3V
- 500:5.0V
- ADJ:adjustable

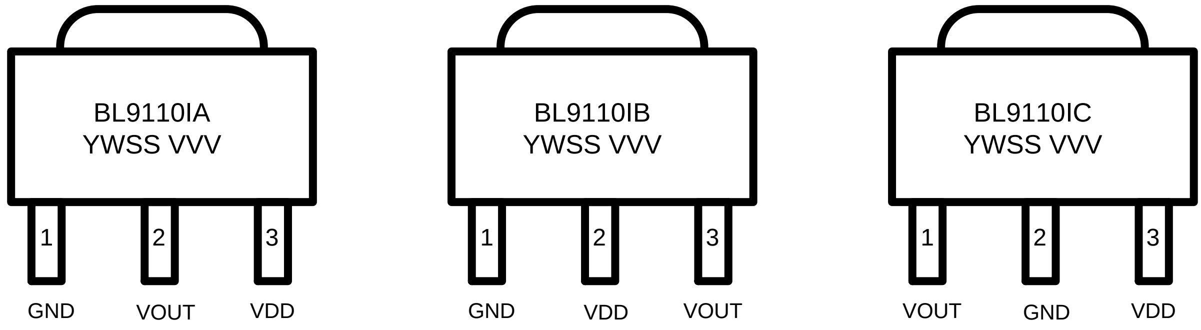
MARKING DESCRIPTION



SOT89-5(A) SOT89-5(B) TO252-2(A) TO252-2(B)



SOT223(A) SOT223(B) SOT223(C) SOT223(D)



SOT89-3(A) SOT89-3(B) SOT89-3(C)

VVV	100	120	130	…	285	…	495	500	ADJ
Output voltage	1.0	1.2	1.3	…	2.85	…	4.95	5.0	Adjustable

Y: The Year of manufacturing, “1” stands for year 20X1, “2” stands for year 20X2, and “8” stands for year 20X8. (X=0,1,2,….,9)

W: The week of manufacturing. “A” stands for week 1, “Z” stands for week 26, “$\overline{A}$” stands for week 27, “$\overline{Z}$” stands for week 52.

PIN DESCRIPTION

Symbol	Description
VOUT	Output Pin
GND	Ground Pin
CE	Chip Enable Pin(High active)
VDD	Input Pin
ADJ/NC	Adjustable/No Connection

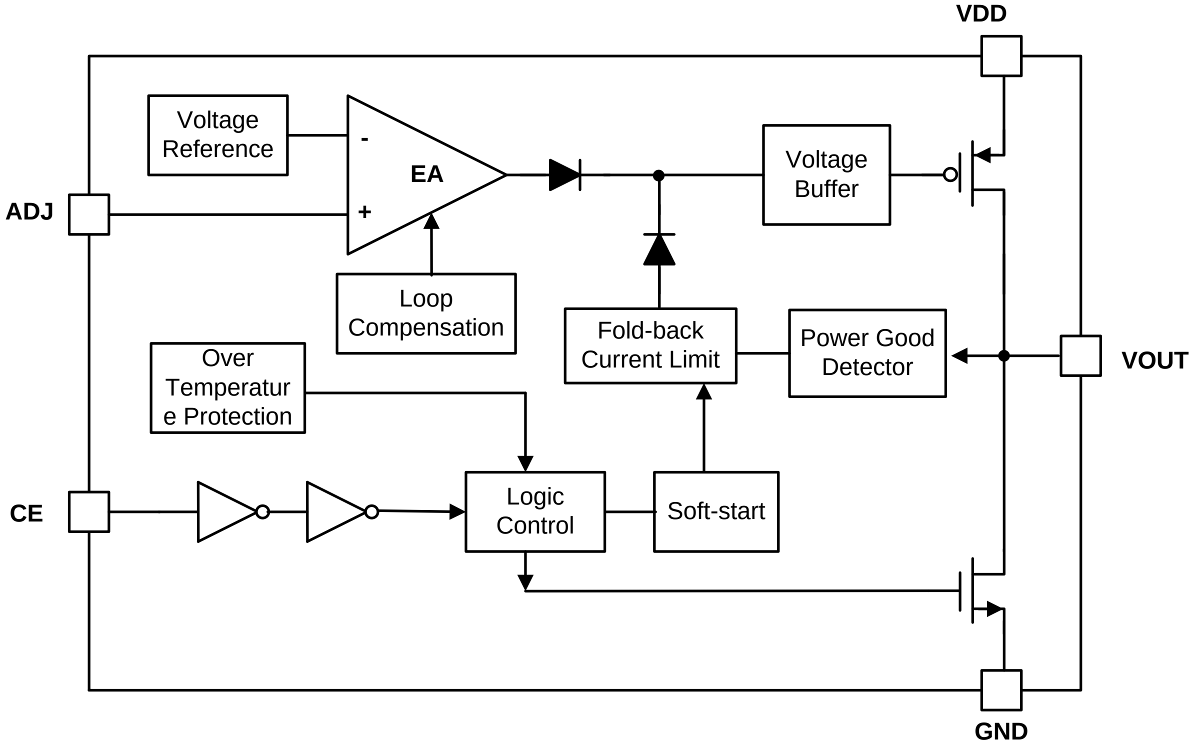
ABSOLUTE MAXIMUM RATING

Parameter		Value
Input Supply Voltage (V_{DD})		-0.3V to +7V
CE Input Voltage		-0.3V to +7V
Output Voltages		-0.3V to V_{IN} +0.3V
Output Current		1.4A
Max junction Temperature (T_J)		150°C
Operating Temperature Range		-40°C to 85°C
Storage Temperature Range (T_S)		-65°C to 150°C
Lead Temperature & Time		300°C, 10s
Package Thermal Resistance (θ_{JA})	SOT89-5	160°C/W
	TO252-2	90°C/W
	SOT223	160°C/W
	SOT89-3	180°C/W
Package Thermal Resistance (θ_{JC})	SOT89-5	45°C/W
	TO252-2	10°C/W
	SOT223	20°C/W
	SOT89-3	50°C/W

Note:

1) Absolute maximum ratings are those values beyond which the life of a device may be impaired.
2) The BL9110 is guaranteed to meet performance specifications from 0°C to 70°C. Specifications over the –40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.
3) Thermal resistance is specified with approximately 1 square of 1 oz. copper.

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS (Note 1)

BL9110-1.2V Electrical Characteristics

(V_{DD}=2.5V, V_{OUT}=1.2V, CE=V_{DD}, C_{IN}=10μF, C_{OUT}=2.2μF, T_A=25°C, unless otherwise noted.)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Input Voltage		2.5		6	V
ΔV_{OUT}	Output Voltage Accuracy (Note 2)	I_{OUT}=1mA	-1		+1	%
			-2		+2	
I_{LIM}	Current Limit		1.0	1.3		A
I_{SCC}	Short Circuit Current	V_{OUT}=0		250		mA
I_Q	Quiescent Current	I_{OUT}=0mA		70	120	uA
I_{STBY}	Standby Current	V_{CE}=GND, Shutdown		0.01	1	uA
V_{DROP}	Dropout Voltage (Note 3)	I_{OUT}=300mA		420	715	mV
		I_{OUT}=1A		870	1310	
ΔV_{LINE}	Line Regulation (Note 4)	2.5V≤V_{DD}≤ 6V, I_{OUT}=100mA		0.05	0.5	%/V
ΔV_{LOAD}	Load Regulation (Note 5)	1mA≤I_{OUT}≤1A		20		mV
TC_{VOUT}	Output Voltage (Note 6) Temperature Coefficient	I_{OUT}=100mA -40°C≤T≤85°C		±100		ppm/°C
V_{IL}	CE Input Threshold Logic Low	Shutdown			0.4	V
V_{IH}	CE Input Threshold Logic High	Start up	1.0			V
R_{CE}	CE Pull-down Resistance			5		MΩ
e_{NO}	Output Noise Voltage	10Hz to100KHz, I_{OUT}=1mA		45		uV_{RMS}
PSRR	Power Supply Rejection Ratio	f=1kHz(VOUT≤3.3V), 0.2V_{P-P} Ripple I_{OUT}=100mA		70		dB
		f=1kHz(VOUT>3.3V) 0.2V_{P-P} Ripple I_{OUT}=100mA		60		dB
T_{SD}	Thermal Shutdown Temperature	Shutdown, Temp increasing		165		°C
T_{SDHY}	Thermal Shutdown Hysteresis			30		°C
R_{DSC}	Output Discharge Resistance			50		Ω

BL9110-1.5V Electrical Characteristics

(V_{DD}=2.5V, V_{OUT}=1.5V, CE=V_{DD}, C_{IN}=10μF, C_{OUT}=2.2μF, T_A=25°C, unless otherwise noted.)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Input Voltage		2.5		6	V
ΔV_{OUT}	Output Voltage Accuracy (Note 2)	I_{OUT}=1mA	-1		+1	%
			-2		+2	
I_{LIM}	Current Limit		1.0	1.3		A
I_{SCC}	Short Circuit Current	V_{OUT}=0		250		mA
I_Q	Quiescent Current	I_{OUT}=0mA		70	120	uA
I_{STBY}	Standby Current	V_{CE}=GND, Shutdown		0.01	1	uA
V_{DROP}	Dropout Voltage (Note 3)	I_{OUT}=300mA		260	445	mV

		I_{OUT}=1A		700	1050	
ΔV_{LINE}	Line Regulation(Note 4)	2.5V≤V_{DD}≤ 6V, I_{OUT}=100mA		0.05	0.5	%/V
ΔV_{LOAD}	Load Regulation(Note 5)	1mA≤I_{OUT}≤1A		20		mV
TC_{VOUT}	Output Voltage(Note 6) Temperature Coefficient	I_{OUT}=100mA -40°C≤T≤85°C		±100		ppm/°C
V_{IL}	CE Input Threshold Logic Low	Shutdown			0.4	V
V_{IH}	CE Input Threshold Logic High	Start up	1.0			V
R_{CE}	CE Pull-down Resistance			5		MΩ
e_{NO}	Output Noise Voltage	10Hz to100KHz, I_{OUT}=1mA		45		uV_{RMS}
PSRR	Power Supply Rejection Ratio	f=1kHz(VOUT≤3.3V), 0.2V_{P-P} Ripple I_{OUT}=100mA		70		dB
		f=1kHz(VOUT>3.3V) 0.2V_{P-P} Ripple I_{OUT}=100mA		60		dB
T_{SD}	Thermal Shutdown Temperature	Shutdown, Temp increasing		165		°C
T_{SDHY}	Thermal Shutdown Hysteresis			30		°C
R_{DSC}	Output Discharge Resistance			50		Ω

BL9110-1.8V Electrical Characteristics

(V_{DD}=2.8V, V_{OUT}=1.8V, CE=V_{DD}, C_{IN}=10μF, C_{OUT}=2.2μF, T_A=25°C, unless otherwise noted.)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Input Voltage		2.5		6	V
ΔV_{OUT}	Output Voltage Accuracy(Note 2)	I_{OUT}=1mA	-1		+1	%
			-2		+2	
I_{LIM}	Current Limit		1.0	1.3		A
I_{SCC}	Short Circuit Current	V_{OUT}=0		250		mA
I_Q	Quiescent Current	I_{OUT}=0mA		70	120	uA
I_{STBY}	Standby Current	V_{CE}=GND, Shutdown		0.01	1	uA
V_{DROP}	Dropout Voltage(Note 3)	I_{OUT}=300mA		180	308	mV
		I_{OUT}=1A		570	855	
ΔV_{LINE}	Line Regulation(Note 4)	2.5V≤V_{DD}≤ 6V, I_{OUT}=100mA		0.05	0.5	%/V
ΔV_{LOAD}	Load Regulation(Note 5)	1mA≤I_{OUT}≤1A		20		mV
TC_{VOUT}	Output Voltage(Note 6) Temperature Coefficient	I_{OUT}=100mA -40°C≤T≤85°C		±100		ppm/°C
V_{IL}	CE Input Threshold Logic Low	Shutdown			0.4	V
V_{IH}	CE Input Threshold Logic High	Start up	1.0			V
R_{CE}	CE Pull-down Resistance			5		MΩ
e_{NO}	Output Noise Voltage	10Hz to100KHz, I_{OUT}=1mA		45		uV_{RMS}
PSRR	Power Supply Rejection Ratio	f=1kHz(VOUT≤3.3V), 0.2V_{P-P} Ripple I_{OUT}=100mA		70		dB

		f=1kHz(VOUT>3.3V) 0.2V_{P-P} Ripple I_{OUT}=100mA		60		dB
T_{SD}	Thermal Shutdown Temperature	Shutdown, Temp increasing		165		°C
T_{SDHY}	Thermal Shutdown Hysteresis			30		°C
R_{DSC}	Output Discharge Resistance			50		Ω

BL9110-2.5V Electrical Characteristics

(V_{DD}=3.5V, V_{OUT}=2.5V, CE=V_{DD}, C_{IN}=10µF, C_{OUT}=2.2µF, T_A=25°C, unless otherwise noted.)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Input Voltage		2.5		6	V
ΔV_{OUT}	Output Voltage Accuracy(Note 2)	I_{OUT}=1mA	-1		+1	%
			-2		+2	
I_{LIM}	Current Limit		1.0	1.3		A
I_{SCC}	Short Circuit Current	V_{OUT}=0		250		mA
I_Q	Quiescent Current	I_{OUT}=0mA		70	120	uA
I_{STBY}	Standby Current	V_{CE}=GND, Shutdown		0.01	1	uA
V_{DROP}	Dropout Voltage(Note 3)	I_{OUT}=300mA		140	240	mV
		I_{OUT}=1A		440	660	
ΔV_{LINE}	Line Regulation(Note 4)	2.5V≤V_{DD}≤ 6V, I_{OUT}=100mA		0.05	0.5	%/V
ΔV_{LOAD}	Load Regulation(Note 5)	1mA≤I_{OUT}≤1A		20		mV
TC_{VOUT}	Output Voltage(Note 6) Temperature Coefficient	I_{OUT}=100mA -40°C≤T≤85°C		±100		ppm/°C
V_{IL}	CE Input Threshold Logic Low	Shutdown			0.4	V
V_{IH}	CE Input Threshold Logic High	Start up	1.0			V
R_{CE}	CE Pull-down Resistance			5		MΩ
e_{NO}	Output Noise Voltage	10Hz to100KHz, I_{OUT}=1mA		45		uV_{RMS}
PSRR	Power Supply Rejection Ratio	f=1kHz(VOUT≤3.3V), 0.2V_{P-P} Ripple I_{OUT}=100mA		70		dB
		f=1kHz(VOUT>3.3V) 0.2V_{P-P} Ripple I_{OUT}=100mA		60		dB
T_{SD}	Thermal Shutdown Temperature	Shutdown, Temp increasing		165		°C
T_{SDHY}	Thermal Shutdown Hysteresis			30		°C
R_{DSC}	Output Discharge Resistance			50		Ω

BL9110-3.3V Electrical Characteristics

(V_{DD}=4.3V, V_{OUT}=3.3V, CE=V_{DD}, C_{IN}=10µF, C_{OUT}=2.2µF, T_A=25°C, unless otherwise noted.)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Input Voltage		2.5		6	V
ΔV_{OUT}		I_{OUT}=1mA	-1		+1	%

	Output Voltage Accuracy(Note 2)		-2		+2	
I_{LIM}	Current Limit		1.0	1.3		A
I_{SCC}	Short Circuit Current	V_{OUT}=0		250		mA
I_{Q}	Quiescent Current	I_{OUT}=0mA		70	120	uA
I_{STBY}	Standby Current	V_{CE}=GND, Shutdown		0.01	1	uA
V_{DROP}	Dropout Voltage(Note 3)	I_{OUT}=300mA		110	188	mV
		I_{OUT}=1A		350	525	
ΔV_{LINE}	Line Regulation(Note 4)	2.5V≤V_{DD}≤ 6V, I_{OUT}=100mA		0.05	0.5	%/V
ΔV_{LOAD}	Load Regulation(Note 5)	1mA≤I_{OUT}≤1A		20		mV
TC_{VOUT}	Output Voltage(Note 6) Temperature Coefficient	I_{OUT}=100mA -40°C≤T≤85°C		±100		ppm/°C
V_{IL}	CE Input Threshold Logic Low	Shutdown			0.4	V
V_{IH}	CE Input Threshold Logic High	Start up	1.0			V
R_{CE}	CE Pull-down Resistance			5		MΩ
e_{NO}	Output Noise Voltage	10Hz to100KHz, I_{OUT}=1mA		45		uV_{RMS}
PSRR	Power Supply Rejection Ratio	f=1kHz(VOUT≤3.3V), 0.2V_{P-P} Ripple I_{OUT}=100mA		70		dB
		f=1kHz(VOUT>3.3V) 0.2V_{P-P} Ripple I_{OUT}=100mA		60		dB
T_{SD}	Thermal Shutdown Temperature	Shutdown, Temp increasing		165		°C
T_{SDHY}	Thermal Shutdown Hysteresis			30		°C
R_{DSC}	Output Discharge Resistance			50		Ω

BL9110-5.0V Electrical Characteristics

(V_{DD}=6.0V, V_{OUT}=5.0V, CE=V_{DD}, C_{IN}=10μF, C_{OUT}=2.2μF, T_A=25°C, unless otherwise noted.)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Input Voltage		2.5		6	V
ΔV_{OUT}	Output Voltage Accuracy(Note 2)	I_{OUT}=1mA	-1		+1	%
			-2		+2	
I_{LIM}	Current Limit		1.0	1.3		A
I_{SCC}	Short Circuit Current	V_{OUT}=0		250		mA
I_{Q}	Quiescent Current	I_{OUT}=0mA		70	120	uA
I_{STBY}	Standby Current	V_{CE}=GND, Shutdown		0.01	1	uA
V_{DROP}	Dropout Voltage(Note 3)	I_{OUT}=300mA		100	170	mV
		I_{OUT}=1A		340	510	
ΔV_{LINE}	Line Regulation(Note 4)	2.5V≤V_{DD}≤ 6V, I_{OUT}=100mA		0.05	0.5	%/V
ΔV_{LOAD}	Load Regulation(Note 5)	1mA≤I_{OUT}≤1A		20		mV
TC_{VOUT}	Output Voltage(Note 6) Temperature Coefficient	I_{OUT}=100mA -40°C≤T≤85°C		±100		ppm/°C
V_{IL}	CE Input Threshold Logic Low	Shutdown			0.4	V

V_{IH}	CE Input Threshold Logic High	Start up	1.0			V
R_{CE}	CE Pull-down Resistance			5		MΩ
e_{NO}	Output Noise Voltage	10Hz to100KHz, I_{OUT}=1mA		45		uV_{RMS}
PSRR	Power Supply Rejection Ratio	f=1kHz(VOUT≤3.3V), 0.2V_{P-P} Ripple I_{OUT}=100mA		70		dB
		f=1kHz(VOUT>3.3V) 0.2V_{P-P} Ripple I_{OUT}=100mA		60		dB
T_{SD}	Thermal Shutdown Temperature	Shutdown, Temp increasing		165		°C
T_{SDHY}	Thermal Shutdown Hysteresis			30		°C
R_{DSC}	Output Discharge Resistance			50		Ω

Note:

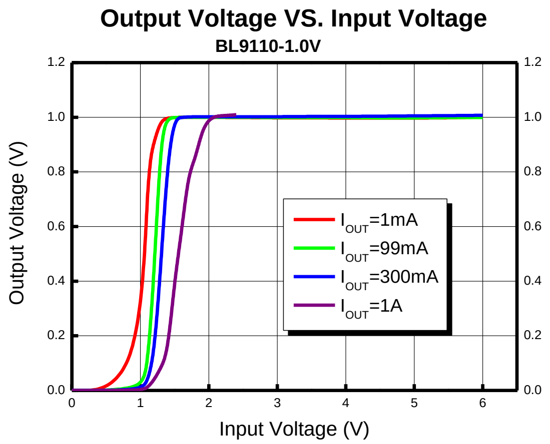
1) 100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.
2) This IC includes two kinds of output voltage accuracy versions. A: ±1%, B: ±2%.
3) The required minimum input operating voltage is equal to $V_{OUT}+V_{DROP}$, and if $V_{OUT}+V_{DROP}$ <2.5V, the required minimum input operating voltage must be set to 2.5V. V_{OUT} is the normal output voltage, e.g. V_{OUT}=2.8V for 2.8V fixed output version.
4) Line regulation is calculated by $\Delta V_{LINE} = \left(\frac{V_{OUT1}-V_{OUT2}}{\Delta V_{DD}\times V_{OUT}}\right)\times 100$

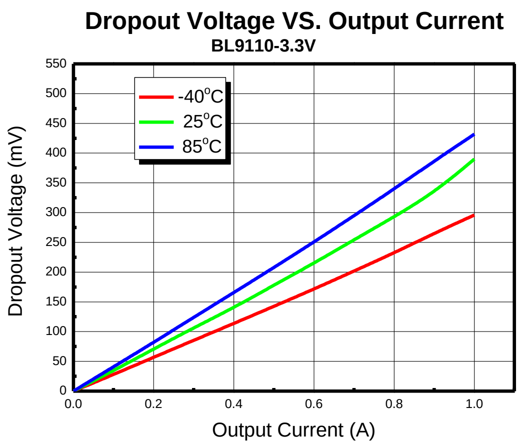
   Where V_{OUT1} is the output voltage when V_{DD1}=6.0V, V_{OUT2} is the output voltage when V_{DD2}=max(V_{OUT}+0.5V, 2.5V). $\Delta V_{DD}=V_{DD1}-V_{DD2}$
5) Load regulation is calculated by $\Delta V_{LOAD} = V_{OUT1} - V_{OUT2}$

   Where V_{OUT1} is the output voltage when I_{OUT1}=1mA, and V_{OUT2} is the output voltage when I_{OUT2}=1A.
6) The temperature coefficient is calculated by $TC_{V_{OUT}} = \frac{\Delta V_{OUT}}{\Delta T\times V_{OUT}}$

TYPICAL PERFORMANCE CHARACTERISTICS

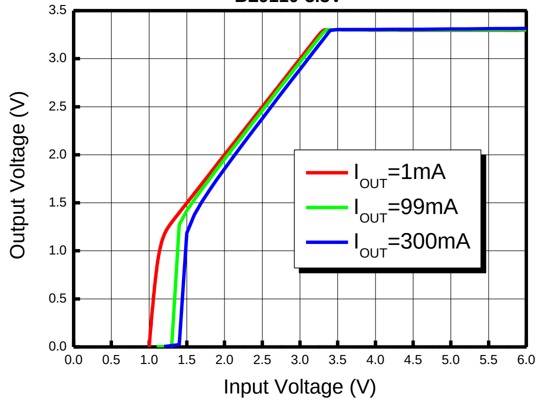
($V_{DD}=V_{OUT}$+1V, and if V_{OUT}<1.5V, V_{DD}=2.5V CE=V_{DD}, C_{IN}=10μF, C_{OUT}=2.2μF, T_A=25°C, unless otherwise noted.)





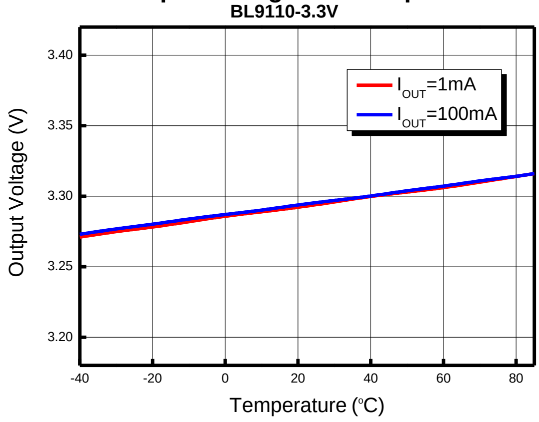
Output Voltage VS. Input Voltage

BL9110-3.3V



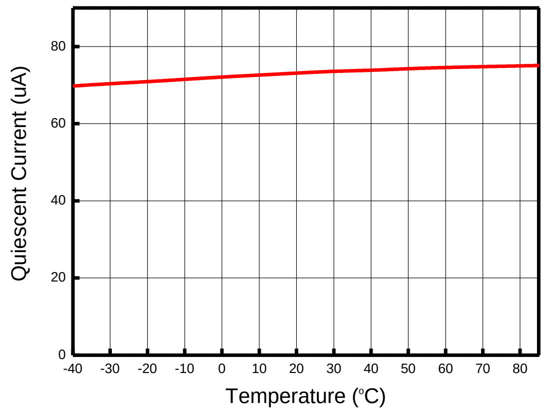
Output Voltage VS. Temperature

BL9110-3.3V



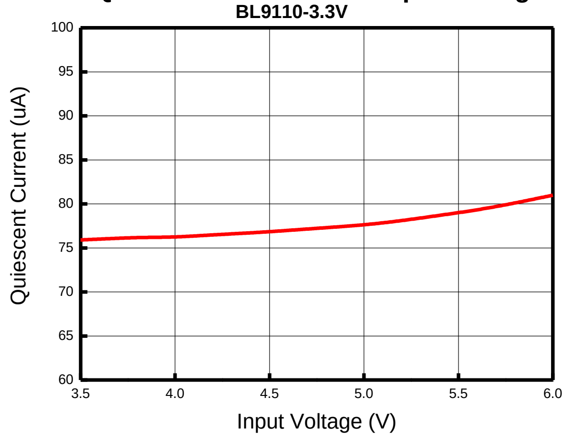
Quiescent Current VS. Temperature

BL9110-3.3V



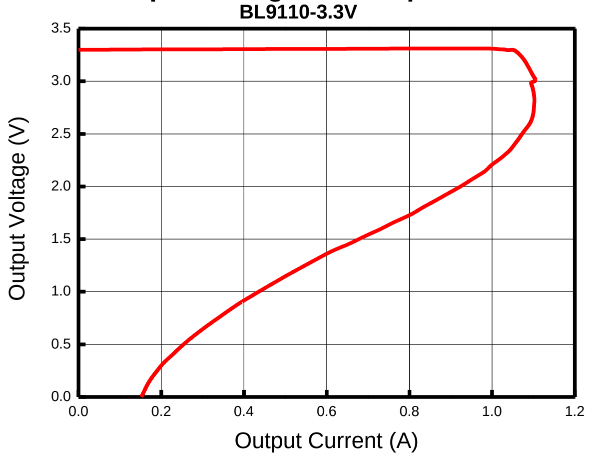
Quiescent Current VS. Input Voltage

BL9110-3.3V



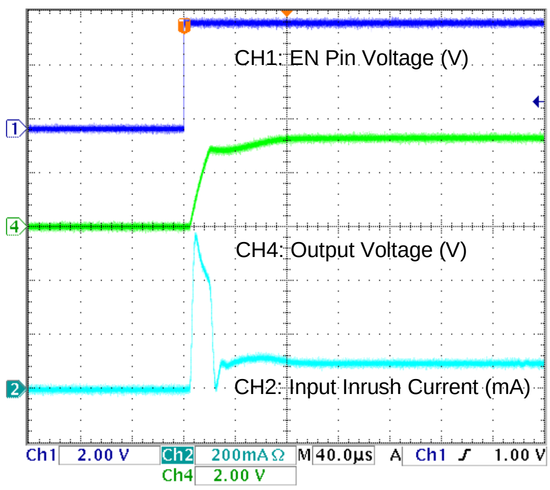
Output Voltage VS. Output Current

BL9110-3.3V



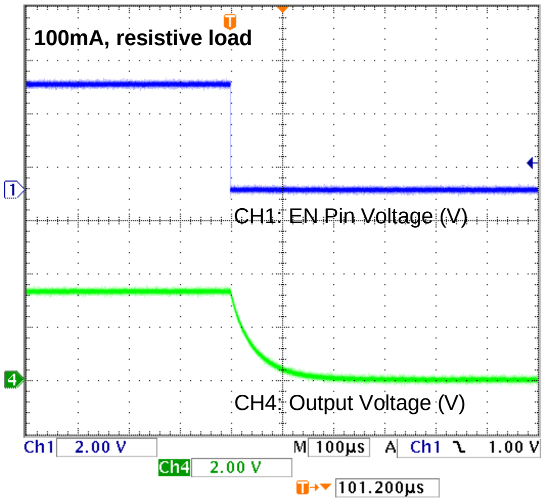
Turn off Transient Response

BL9110-3.3V



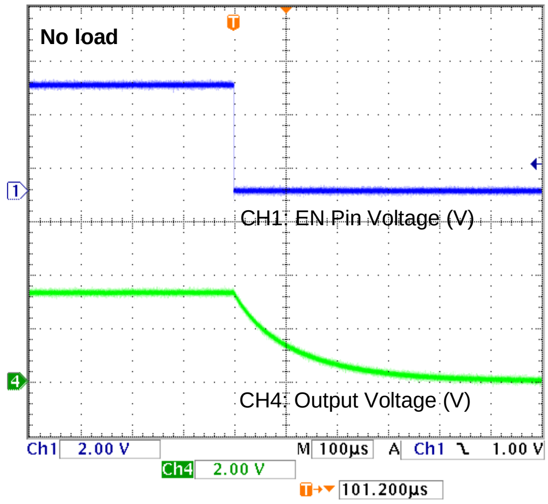
Turn off Transient Response

BL9110-3.3V



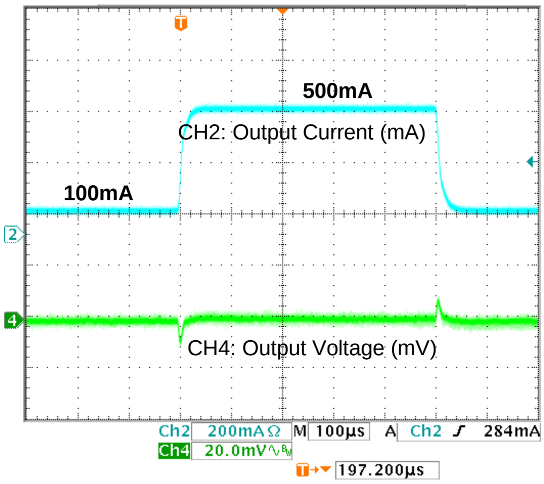
Turn off Transient Response

BL9110-3.3V



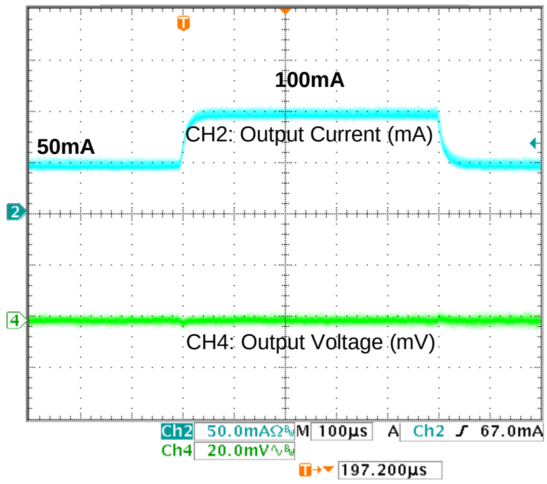
Load Transient Response

BL9110-3.3V



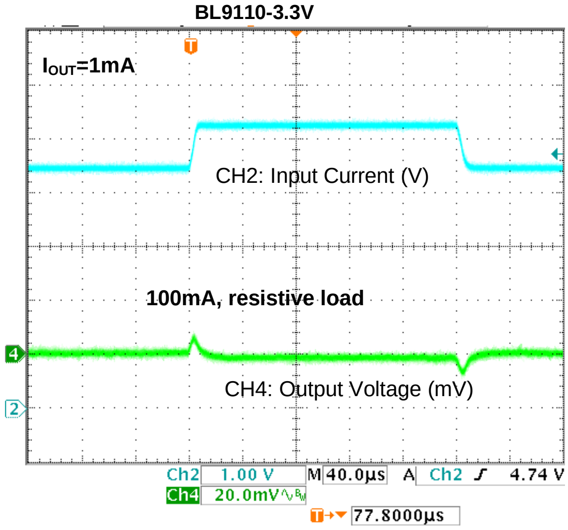
Load Transient Response

BL9110-3.3V



Line Transient Response

BL9110-3.3V



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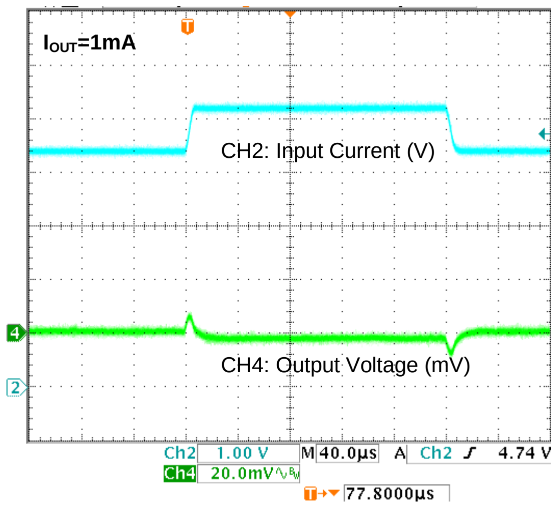


APPLICATION INFORMATION

The BL9110 is a low dropout CMOS-based positive voltage regulator that operates the input voltage from +2.5V to 6.0V. Output voltages are optional ranging from 1.0V to 5.0V, and can supply current up to 1.0 A.

Enable Function

The BL9110 is shutdown by pulling the CE input low, and turn on by driving the input high. If this feature is not be used, the CE input should be floating or tied to V_{DD} to keep the regulator on at all times.

Programming the BL9110 Adjustable LDO regulator

The BL9110 is available in two types, either fixed or adjustable output voltage. The output range of the adjustable types is from 1V to 5V. The output voltage of the BL9110 adjustable regulator is programmed using an external resistor divider as show in Figure as below. The output voltage is calculated using equation as below:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R1}{R2}\right)$$

Where VREF=1V is the internal reference voltage.

Resistors R1 and R2 should be chosen for approximately 50uA divider current. Lower value resistors can be used for improved noise performance, but the solution consumes more power. Higher resistor values should be avoided as leakage current at ADJ increases the output voltage error. The recommended design procedure is to choose R2=20kΩ to set the divider current at 50uA, and then calculate R1 using Equation as below:

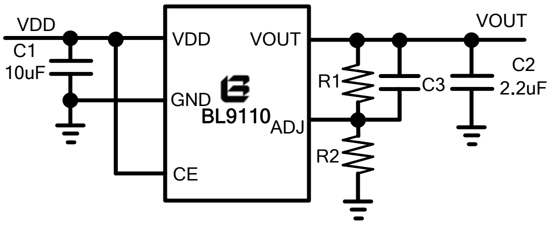
$$R1 = \left(\frac{V_{OUT}}{V_{REF}} - 1\right) \times R2$$

A small compensation capacitor C3 placed between V_{OUT} and ADJ may improve the stability of the adjustable. The suggested value of this capacitor is about 10pF to 22pF.

Output Voltage Programming Guide

Output Voltage	R1	R2
1.8V	16 kΩ	20 kΩ
2.5V	30 kΩ	20 kΩ
3.3V	51 kΩ	22 kΩ
3.6V	62 kΩ	24 kΩ

BL9110 Adjustable LDO regulator Programming



Thermal Protection

Thermal overload protection limits total power dissipation in the BL9110. When the junction temperature exceeds T_J=165°C, the OTP circuit starts the thermal shutdown function and turns the pass element off allowing the IC to cool. The OTP circuit turns on the pass element again after IC's junction temperature cool by 30°C, result in a pulsed output during continuous thermal overload conditions. Thermal-overloaded protection is designed to protect the BL9110 in the event of fault conditions. Do not exceed the absolute maximum junction temperature rating of T_J=125°C for continuous operation. The build-in fold-back current limit protection circuit will reduce current value as output voltage drops. When output is shorted to ground, current limit is reduced to 250mA, avoiding damaging the device.

Operating Region and Power Dissipation

The maximum power dissipation of BL9110 depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The power dissipation across the device is:

$$P_D = (V_{DD} - V_{OUT}) \times I_{OUT} + V_{DD} \times I_Q$$

The maximum power dissipation is:

$$P_D\ (MAX) = (T_J\ (MAX) - T_A) / \theta_{JA}$$

Where T_J (MAX) is the maximum operation junction temperature 125°C, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance. The GND pin of the BL9110 performs the dual function of providing an electrical connection to ground and channeling heat away. Connect the GND pin to ground using a large pad or ground plane.

Capacitor Selection and Regulator Stability

Like any low-dropout regulator, the external capacitors used with the BL9110 must be carefully selected for regulator stability and performance. The BL9110 requires an output capacitor between the VOUT and GND pins for phase compensation. Using a capacitor whose value is ≥10μF on the BL9110 input and the amount of capacitance can be increased without limit. The input capacitor must be located a distance of not more than 0.5 inch from the input pin of the IC and returned to a clean analog ground. Any good quality ceramic or tantalum can be used for this capacitor. The capacitor with larger value and lower ESR (equivalent series resistance) provides better PSRR and line-transient response. The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDO applications. The BL9110 is designed specifically to work with low ESR ceramic output capacitor in space-saving and performance consideration. In the BL9110, phase compensation is made with the output capacitor for securing stable operation even if the load current is varied. For this purpose, use a 2.2uF capacitor between V_{OUT} pin and GND pin as close as possible.

Load-Transient Considerations

The BL9110 load-transient response graphs show two components of the output response: a DC shift from the output impedance due to the load current change, and the transient response. The DC shift is quite small due to the excellent load regulation of the IC. Typical output voltage transient spike for a step change in the load current from 0mA to 50mA is tens of mV, depending on the ESR of the output capacitor. Increasing the output capacitor's value and decreasing the ESR attenuates the overshoot.

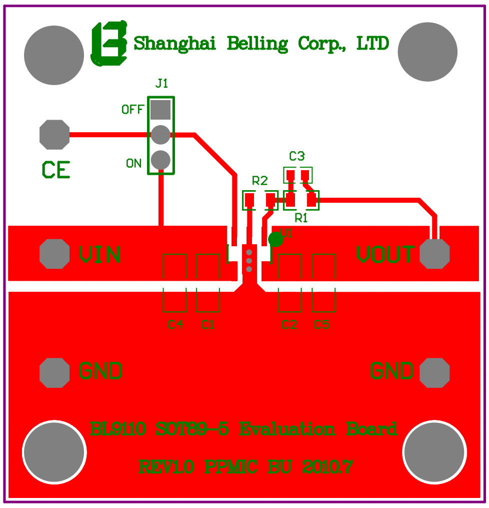
Input-Output (Dropout) Voltage

A regulator's minimum input-output voltage differential (or dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. Because the BL9110 uses a P-Channel MOSFET pass transistor, the dropout voltage is a function of drain-to-source on resistance [$R_{DS(ON)}$] multiplied by the load current.

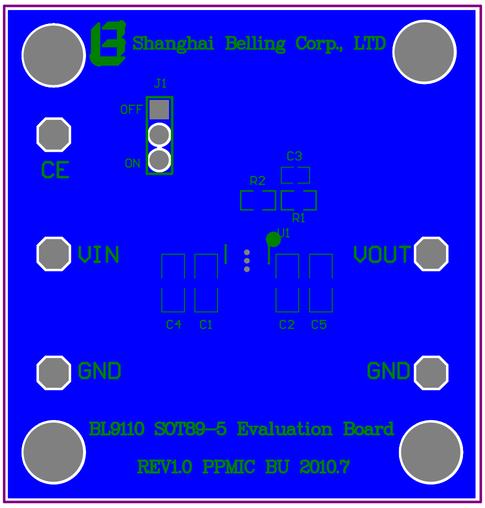
Layout Considerations

To improve AC performance such as PSRR, output noise, and transient response, it is recommended that the PCB be designed with separate ground planes for V_{DD} and V_{OUT}, with each ground plane connected only at the GND pin of the device. Make V_{DD} and GND lines sufficiently wide. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor C1 between V_{DD} and GND pin, as close as possible to the pins. Set external components, especially the output capacitor C2, as close as possible to the IC, and make wiring as short as possible.

BL9110 SOT89-5 PCB Layout for Reference



Top Layer

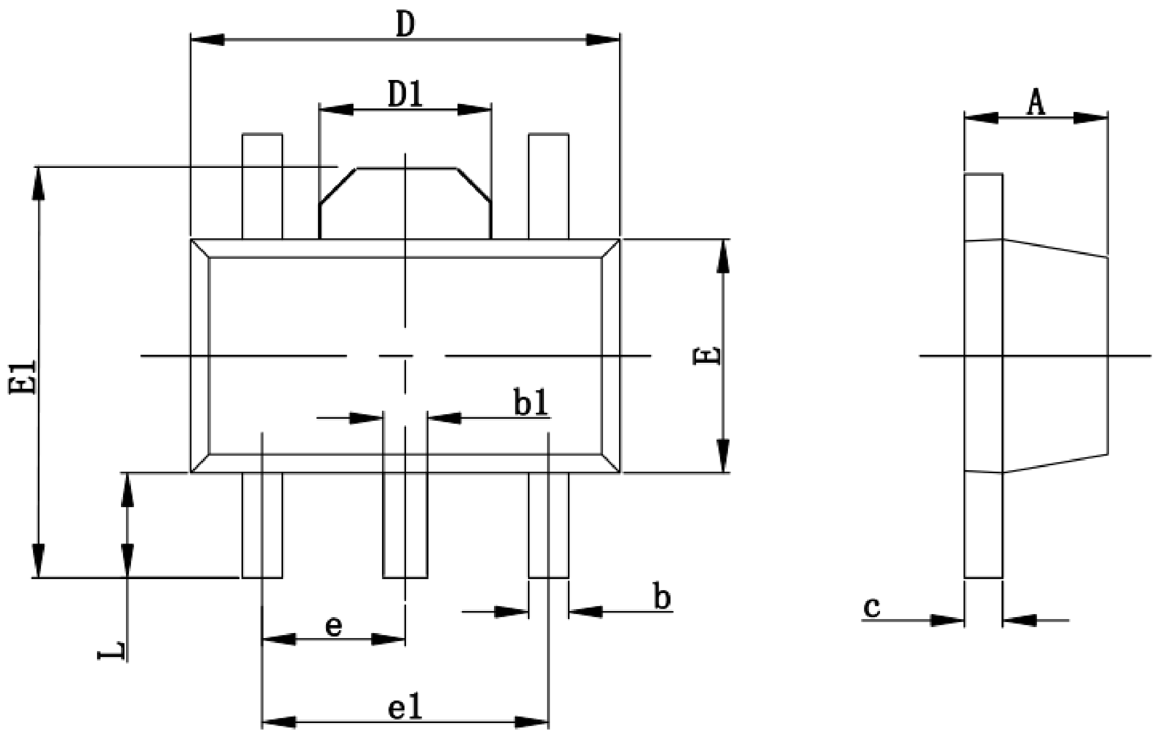


Bottom Layer

PACKAGE OUTLINE

Package	SOT89-5	Devices per reel	1000pcs

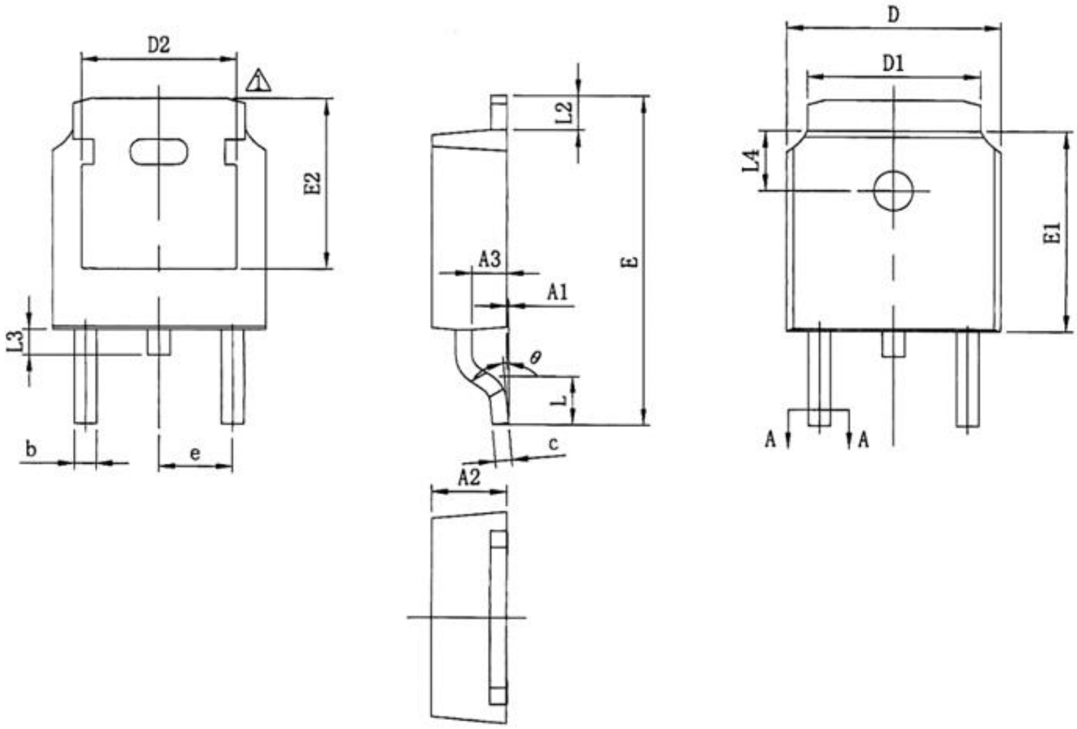
Package dimension:



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.397	1.600	0.055	0.063
b	0.350	0.520	0.014	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.394	4.600	0.173	0.181
D1	1.397	1.800	0.055	0.071
E	2.350	2.591	0.093	0.102
E1	3.937	4.250	0.155	0.167
e	1.500 TYP		0.059 TYP	
e1	2.900	3.100	0.114	0.122
L	0.787	1.194	0.031	0.047

Package	TO252-2	Devices per reel	2500pcs

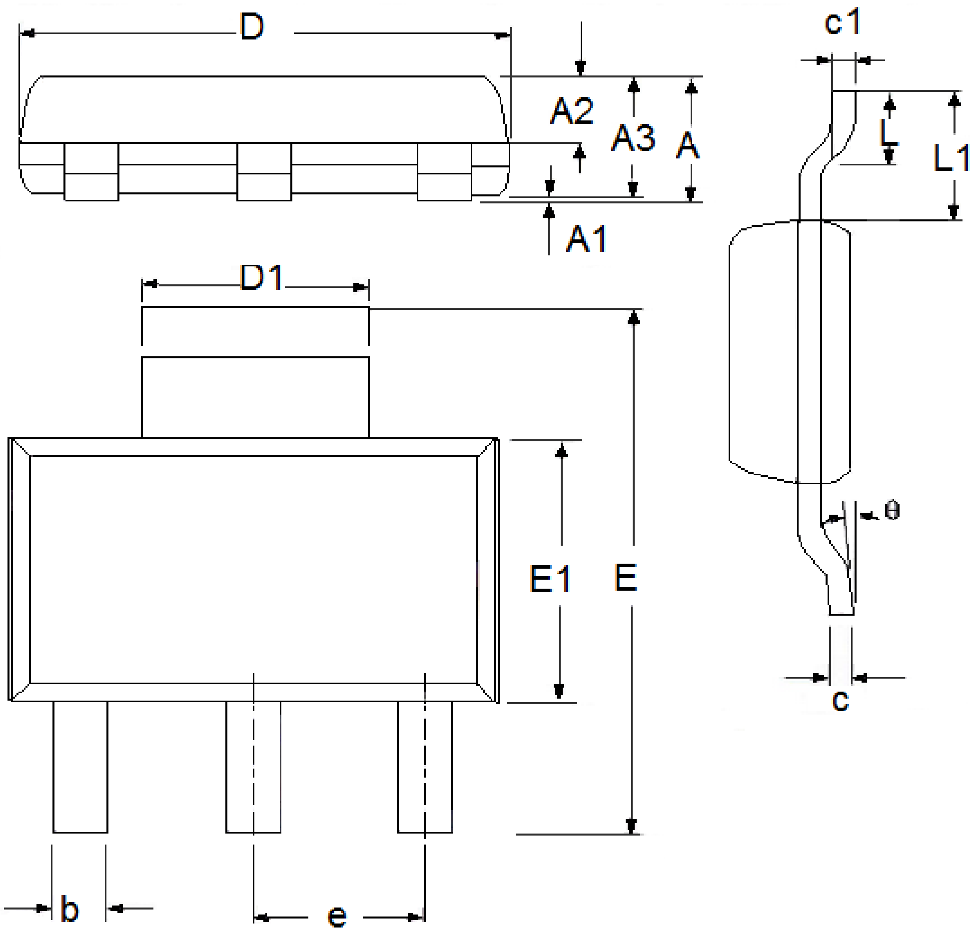
Package dimension:



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A1	0.000	0.100	0.000	0.004
A2	2.200	2.400	0.087	0.094
A3	1.020	1.120	0.040	0.044
b	0.650	0.820	0.026	0.032
c	0.510	0.550	0.020	0.021
D	6.500	6.700	0.260	0.264
D1	5.330 REF		0.210 REF	
D2	4.830 REF		0.190 REF	
E	9.900	10.300	0.390	0.406
E1	6.000	6.200	0.236	0.244
E2	5.300 REF		0.209 REF	
e	2.286 REF		0.090 REF	
L	1.400	1.600	0.055	0.063
L2	0.900	1.250	0.035	0.049
L3	0.600	1.000	0.024	0.039
L4	1.700	1.900	0.070	0.075
θ	0	8°	0°	8°

Package	SOT223	Devices per reel	2500pcs

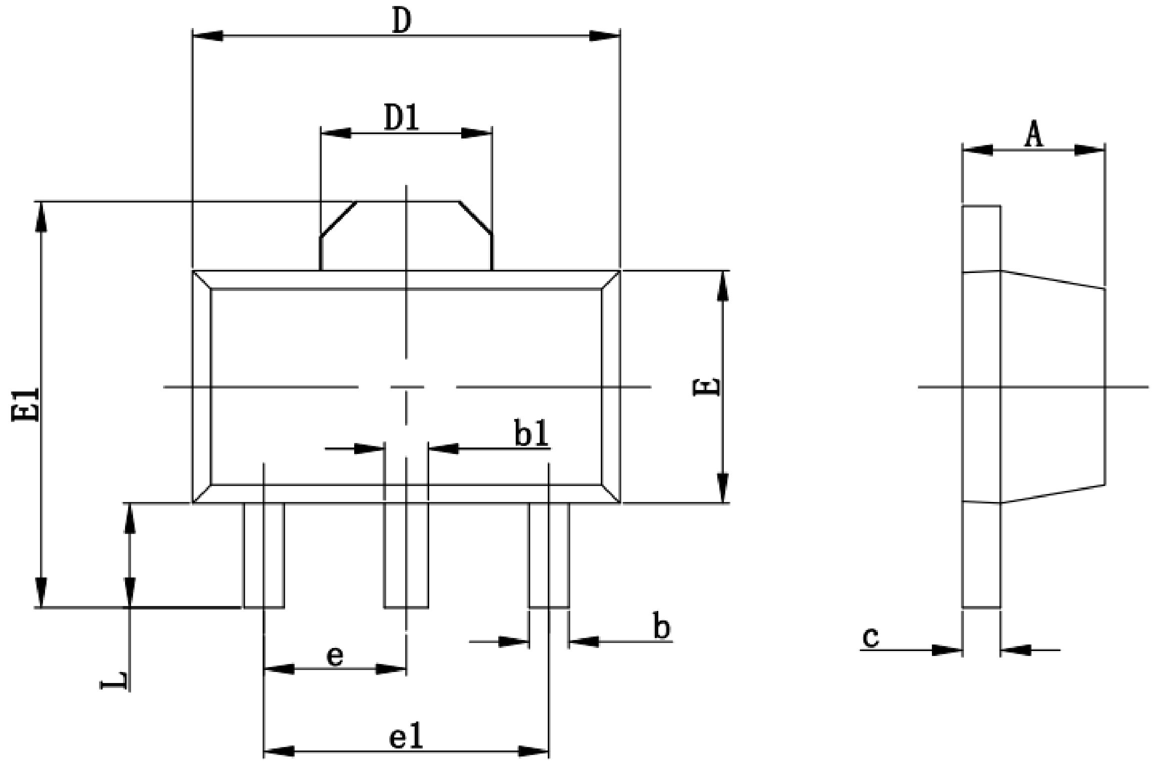
Package dimension:



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.500	1.800	0.059	0.071
A1	0.020	0.100	0.001	0.004
A2	0.800	1.000	0.031	0.039
A3	1.450	1.750	0.057	0.069
b	0.600	0.820	0.024	0.032
c	0.200	0.350	0.008	0.014
D	6.200	6.600	0.244	0.260
D1	2.900	3.100	0.114	0.122
E	6.700	7.300	0.264	0.287
E1	3.300	3.700	0.130	0.146
e	2.300 TYP		0.091 TYP	
L	0.760	1.160	0.030	0.046
L1	1.750 TYP		0.069 TYP	
θ	0	10°	0	10°
c1	0.250 TYP		0.010 TYP	

Package	SOT89-3	Devices per reel	1000pcs

Package dimension:



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.350	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	2.350	2.550	0.093	0.100
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	1.100	0.035	0.043