VS1117B Series Linear Regulator

1 Introduction

The VS1117B series is a group of low dropout three-terminal regulators with a dropout of 1.3V(typ.) at 1A output current.

The VS1117B series is available in an adjustable version, which can set the output voltage from 1.25V to 18 V with only two external resistors. In addition, it is available in seven fixed voltages: 1.8V, 2.5V, 3.3V and 5.0V.

The VS1117B series offer thermal shutdown protection. Its circuit includes a fuse trimmed bandgap reference to assure output voltage accuracy to within ±1.0%.

A minimum of 10μF tantalum capacitor is required at the output to improve the transient response and stability.

Unlike PNP type regulators where up to 10% of the output current is wasted as quiescent current, the quiescent current of the VS1117B flows into the load, increasing efficiency.

2 Available Packages

PART NUMBER	PACKAGE
VS1117B Series	SOT-89-3L
	SOT-223
	TO-220-3L
	TO-252-2L
	TO-263-2L

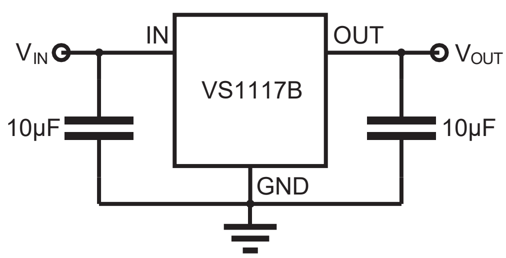
Note: For all available packages, please refer to the part *Orderable Information*.

3 Features

- Low Dropout Voltage:
  1.3V(typ.) at 1A Output Current，25℃
- Built-in current limit and over temperature protection
- Three-Terminal Adjustable to
  1.8V, 2.5V, 3.3V, 5.0V
- Operation Junction Temperature:
  -40°C to 125°C
- Output Voltage Accuracy:
  ±1.0%
- Adjustable version availability
  (V_{REF} = 1.25 V)
- Support MLCC
- Space-saving SOT-223，SOT-89-3L TO-220-3L, TO-252-2L, TO-263-2L packages

4 Applications

- PC Motherboard
- BOX，TV
- LCD Monitor
- Graphic Card
- DVD-Video Player
- NIC/Switch
- Telecom Modem
- ADSL Modem
- Printer and Other Peripheral Equipment



Typical Application Circuit

6 Specifications

6.1 Absolute Maximum Ratings

(T_A = 25°C, unless otherwise specified)[1]

Parameter	Symbol	Value	Unit
Input Voltage	V_i	20	V
Maximum Junction Temperature	T_j	-40~+150	℃
Storage Temperature	T_{stg}	-40~+150	℃
Lead Temperature (Soldering, 10s)	T_L	260	℃

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

6.2 Recommended Operating Conditions

PARAMETER	SYMBOL	MIN.	NOM.	MAX.	UNIT
Input voltage	V_{IN}	1.25	-	18	V
Operating junction temperature	T_J	-40	-	125	°C

6.3 ESD Ratings

ESD RATINGS		SYMBOL	VALUE	UNIT
Electrostatic discharge[2]	Human body model	$V_{ESD\text{-}HBM}$	8000	V

(2) ESD testing is conducted in accordance with the relevant specifications formulated by the Joint Electronic Equipment Engineering Commission (JEDEC). The human body model (HBM) electrostatic discharge test is based on the JS-001-2017 test standard, using a 100pF capacitor and discharging to each pin of the device through a resistance of 1.5kΩ.

6 Specifications

6.4 Thermal Information

THERMAL METRIC(3)	SYMBOL	VS1117B Series			UNIT
Junction-to-ambient thermal resistance	$R_{\Theta JA}$	SOT-223	SOT-89-3L	TO-252-2L	°C/W
		100.0	160.0	80.0	
Junction-to-case thermal resistance	$R_{\Theta JC}$	SOT-223	SOT-89-3L	TO-252-2L	°C/W
		20.0	52.5	14.5	
Reference maximum power dissipation for continuous operation	$P_{D\ Ref}$	SOT-223	SOT-89-3L	TO-252-2L	W
		1.0	0.62	1.25	

(3) Thermal metric is measured in still air with T_A = 25°C and mounted on a 1 in2 FR-4 substrate PCB covered with 2 ounces of copper.

6 Specifications

6.5 Electrical Characteristics

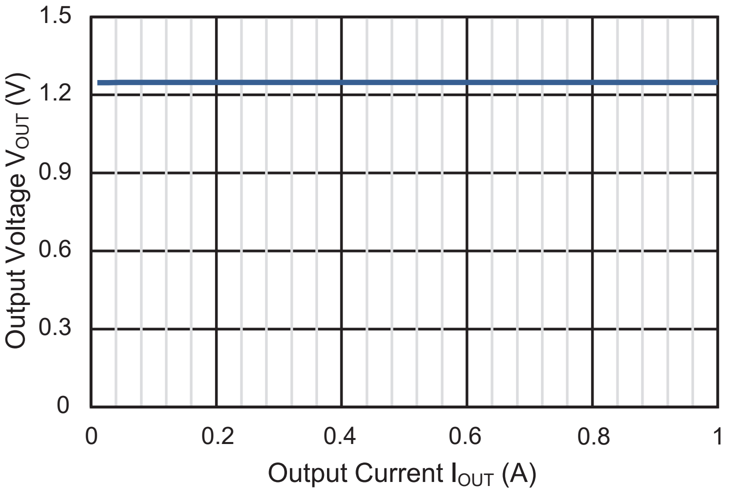
T_J = 25°C, unless otherwise specified

CHARACTERISTIC	SYMBOL	PART NO.	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Reference Voltage	V_{IROC}	Adjustable	I_{OUT}=10mA, V_{IN}=3.25V	1.238	1.250	1.262	V
			10mA≤I_{OUT}≤1A, 2.75V≤V_{IN}-V_{OUT}≤12V	1.225	1.250	1.275	
Output Voltage	V_O	1.8V	I_{OUT}=10mA, V_{IN}=3.8V	1.782	1.8	1.818	V
			10mA≤I_{OUT}≤1A, 3.3V≤V_{IN}≤12V	1.764	1.8	1.836	
		2.5V	I_{OUT}=10mA, V_{IN}=4.5V	2.475	2.5	2.525	
			10mA≤I_{OUT}≤1A, 4V≤V_{IN}≤12V	2.450	2.5	2.550	
		3.3V	I_{OUT}=10mA, V_{IN}=5.3V	3.267	3.3	3.333	
			10mA≤I_{OUT}≤1A, 4.8V≤V_{IN}≤12V	3.234	3.3	3.366	
		5.0V	I_{OUT}=10mA, V_{IN}=7.0V	4.950	5.0	5.050	
			10mA≤I_{OUT}≤1A, 6.5V≤V_{IN}≤12V	4.900	5.0	5.100	
Line Regulation	LNR	Adjustable	I_{OUT}=10mA, 1.5V≤V_{IN}-V_{OUT}≤10.75V		0.03	0.2	%
		1.8V	I_{OUT}=10mA, 1.5V≤V_{IN}-V_{OUT}≤10.2V		1	6	mV
		2.5V	I_{OUT}=10mA, 1.5V≤V_{IN}-V_{OUT}≤9.5V		1	6	
		3.3V	I_{OUT}=10mA, 1.5V≤V_{IN}-V_{OUT}≤8.7V		1	6	
		5.0V	I_{OUT}=10mA, 1.5V ≤V_{IN}-V_{OUT}≤7V		1	10	
Load Regulation	LDR	Adjustable	V_{IN}-V_{OUT}=1.5V, 10mA≤I_{OUT}≤1A		0.08	0.4	%
		1.8V			3	7.2	mV
		2.5V			4	10	
		3.3V			6	13.2	
		5.0V			9	20	
Dropout Voltage	V_D		I_{OUT}=1A		1.3	1.5	V
Adjust Pin Current	I_{adj}	Adjustable	V_{IN}= 5V, I_{OUT}=10mA		65	120	μA
			V_{IN}= 5V, I_{OUT}=1A		65	120	μA
I_{Adj} change	ΔI_{adj}	Adjustable	V_{IN}= 5V 10mA≤I_{OUT}≤1A		2	10	μA
Current Limit	I_{LIMIT}		V_{IN}-V_{OUT}=5V	1000	1300		mA
Minimum Load Current	I_L	Adjustable			0.5	10	mA
Quiescent Current	I_q	1.8V	V_{IN}= 12V		0.9	1.2	mA
		2.5V	V_{IN}= 12V		0.9	1.2	mA
		3.3V	V_{IN}= 12V		0.9	1.2	mA
		5.0V	V_{IN}= 12V		0.9	1.2	mA
Ripple Rejection	RR		f=1kHz,C_{IN}=10μF/25V, C_{OUT}=10μF/25V , V_{IN}-V_{OUT}=2V, I_{OUT}=10mA		75		dB

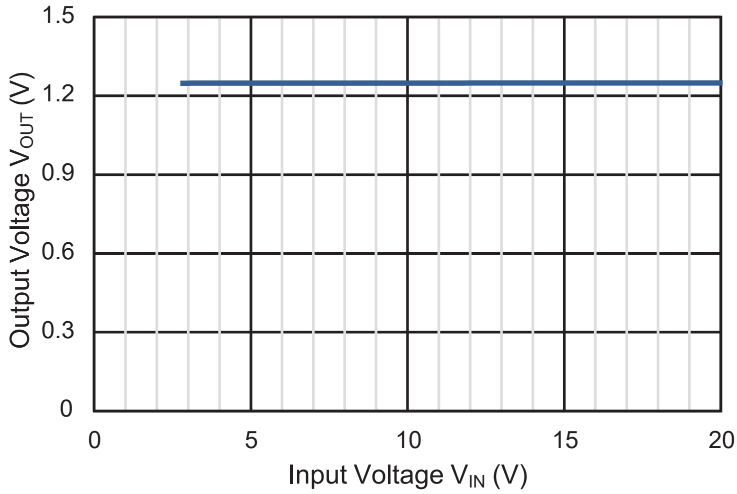
6 Specifications

6.6 Typical Characteristics

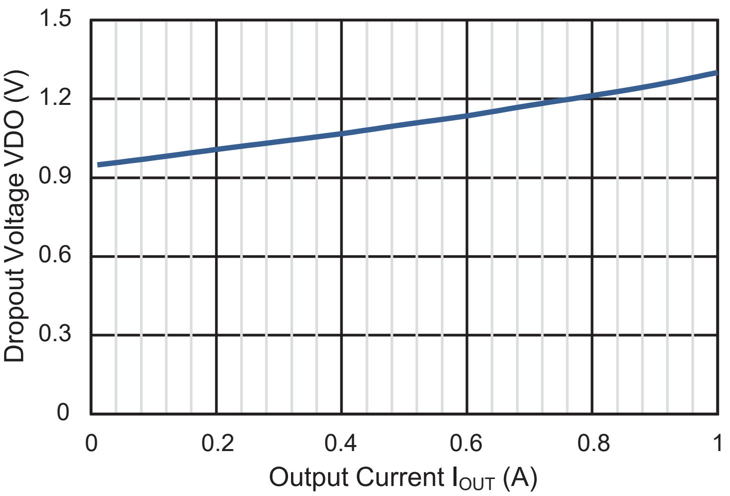
Load regulation



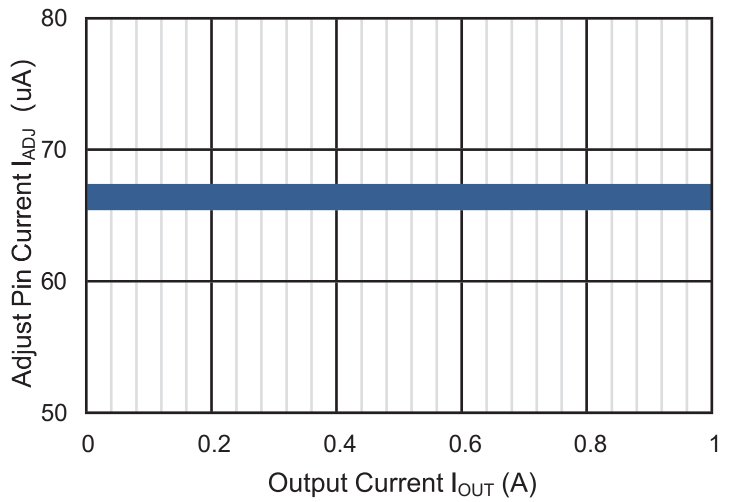
Line regulation



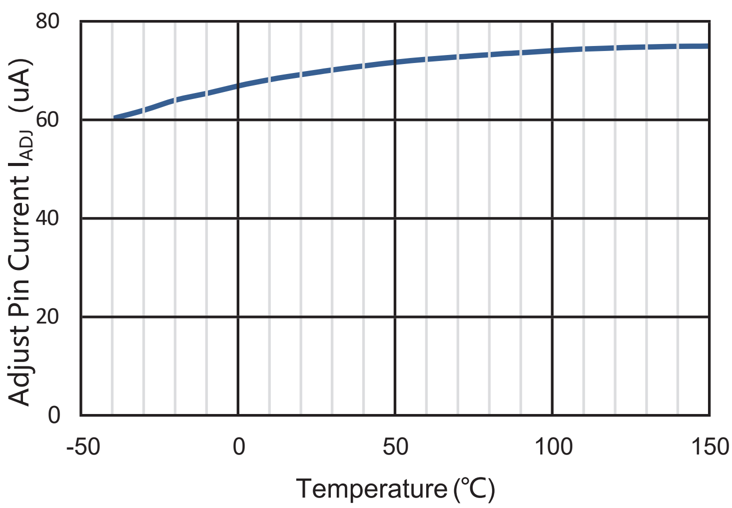
Dropout Voltage (ADJ Only)



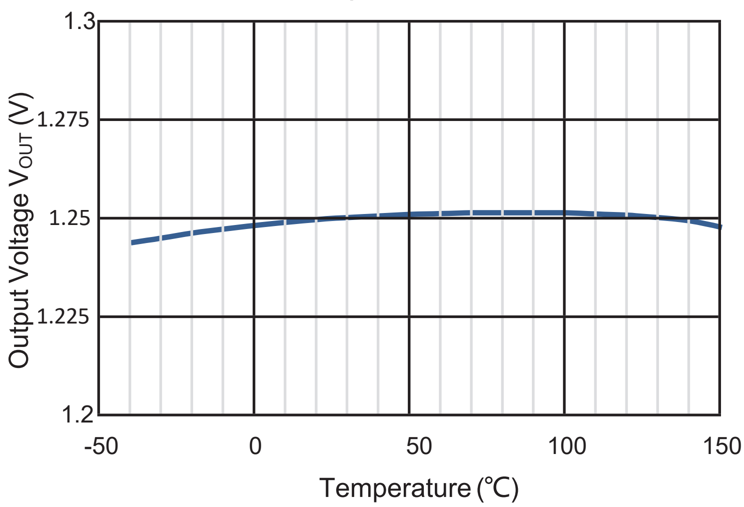
I_{ADJ} vs. I_{LOAD}



Adjust Pin Current vs. Temperature



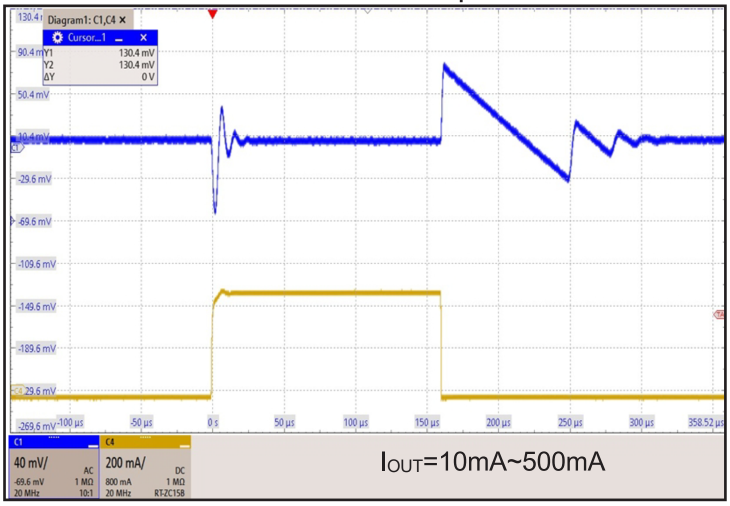
Thermal performance



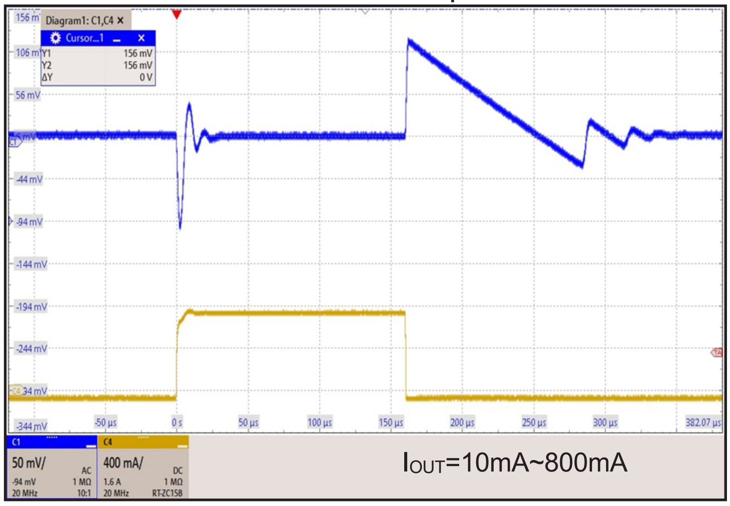
6 Specifications

6.6 Typical Characteristics (continued)

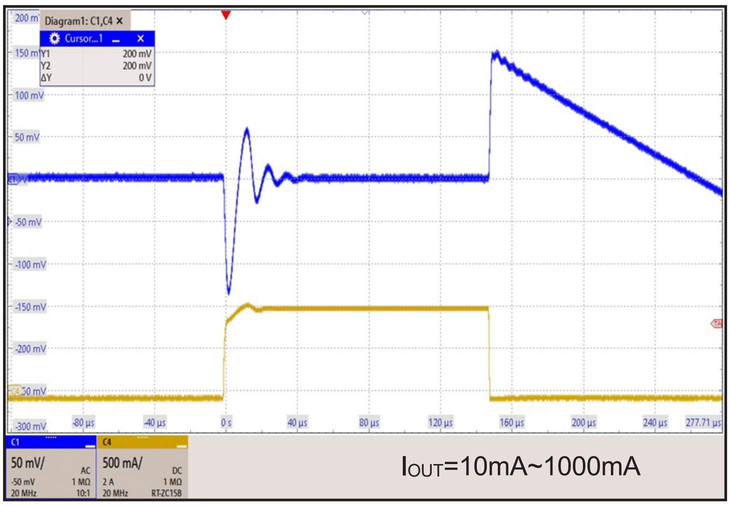
Load Transient Response



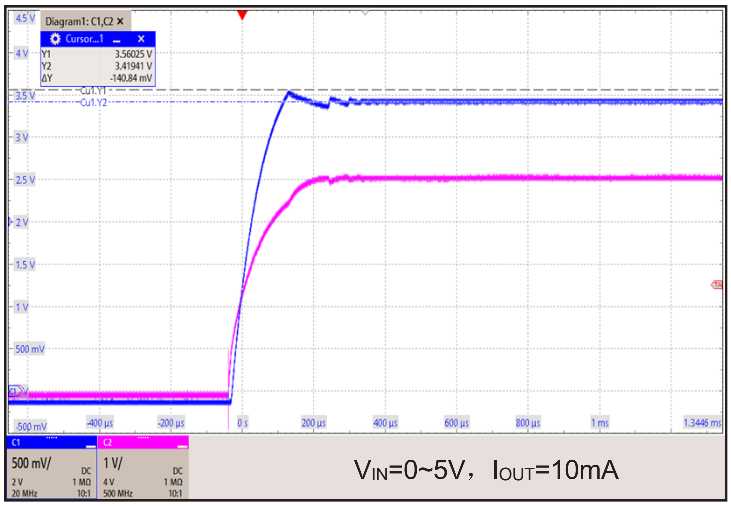
Load Transient Response



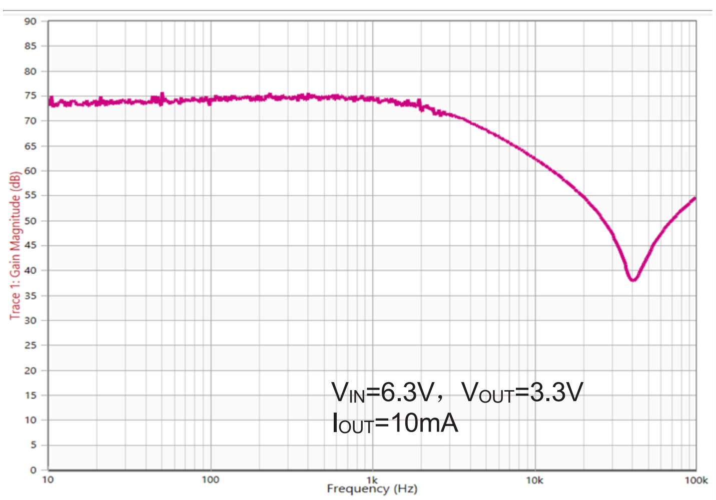
Load Transient Response



Power ON Response



PSRR



7 Detailed Description

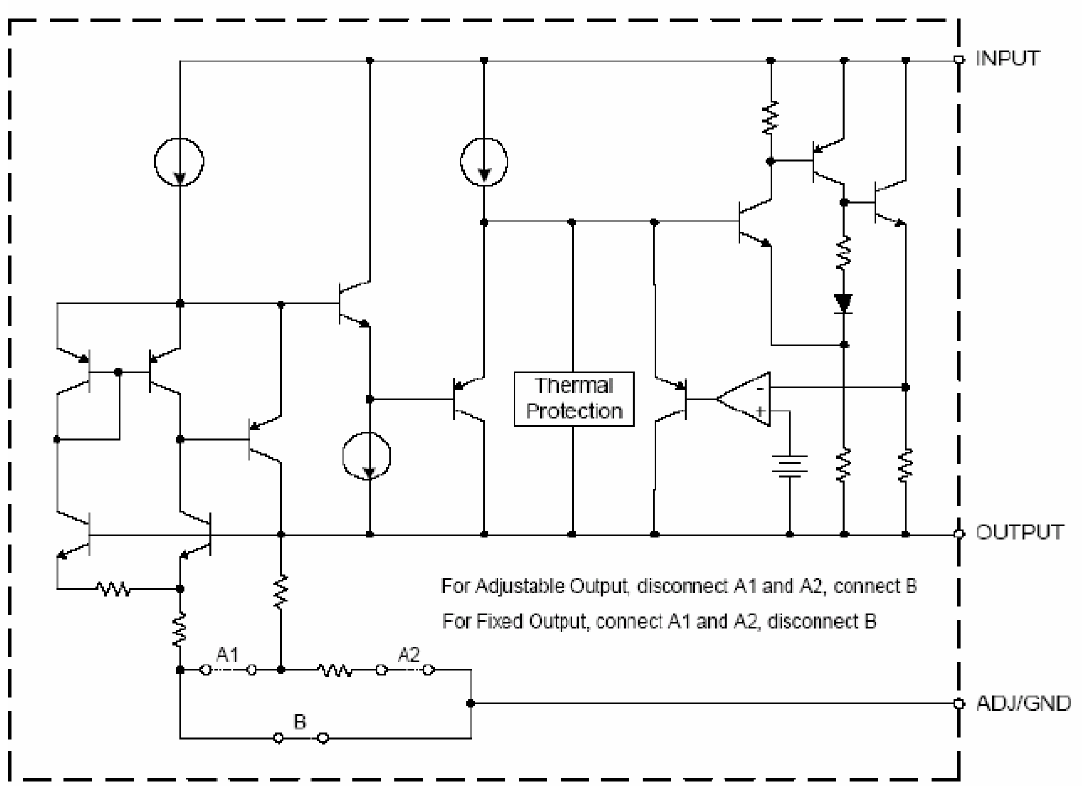
7.1 Description

VS1117B Series 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 170°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.

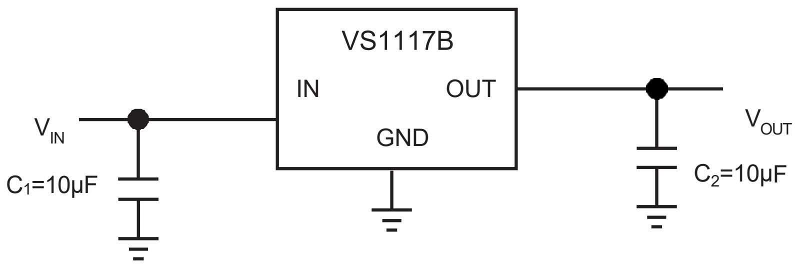
7.2 Function Block Diagram



8 Application and Implementation

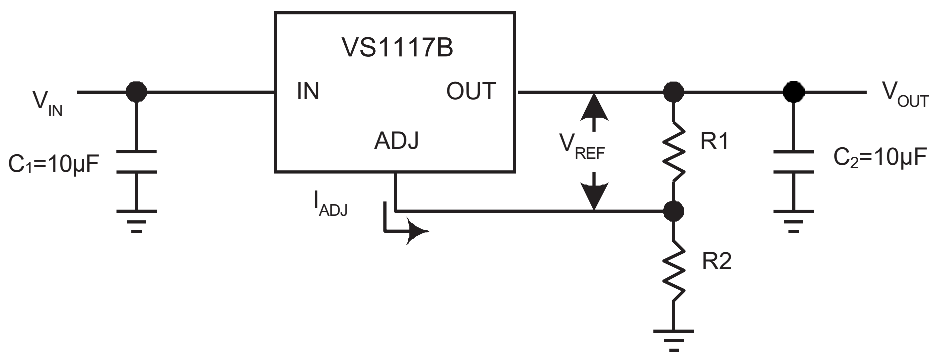
8.1 Typical Application Circuits

Fixed Output Voltage Version



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

Adjustable Output Voltage Version



$V_{OUT} = V_{REF} \times (1+ R2/R1)+I_{ADJ} \times R2$

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 50μA) 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 VS1117B-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: $1/(2\pi\times f_{ripple}\times C_{ADJ})<R1$.