Low Quiescent Current_Low Dropout CMOS Voltage Regulator

BP9953XX Series 500mA

The BP9953XX series is a family of Low Quiescent Low Dropout Positive regulators. developed using CMOS technology.
These ICS perform with high output voltage accuracy, low quiescent current , Output current 500mA,
The allow operation voltage as high as 10V.

■ Ferture:

- high output voltage accuracy ±2%
- low dropout voltage 1.5mV Iout=1mA
- low quiescent current 1.2uA
- Max input voltage 10V
- Output current 500mA

■ Applications

- Power source for home electric/electronic appliances
- Power source for battery-powered devices
- Power source for personal communication devices

■ Selection table

Part NO.	Output voltage (Note)	Tolerance	MARK SOT-89 TO-92	MARK SOT-23-3
BP995312	1.2V	±2%	5-12	M512
BP995315	1.5V	±2%	5-15	M515
BP995317	1.7V	±2%	5-17	M517
BP995318	1.8V	±2%	5-18	M518
BP995321	2.1V	±2%	5-21	M521
BP995325	2.5V	±2%	5-25	M525
BP995327	2.7V	±2%	5-27	M527
BP995328	2.8V	±2%	5-28	M528
BP995330	3.0V	±2%	5-30	M530
BP995333	3.3V	±2%	5-33	M533
BP995336	3.6V	±2%	5-36	M536
BP995338	3.8V	±2%	5-38	M538
BP995344	4.4V	±2%	5-44	M544
BP995350	5.0V	±2%	5-50	M550

NOTE: for semi_custom parts selectable output voltage from 1.2~7.0V in 0.1v increment

■ Package and Pin Assignment

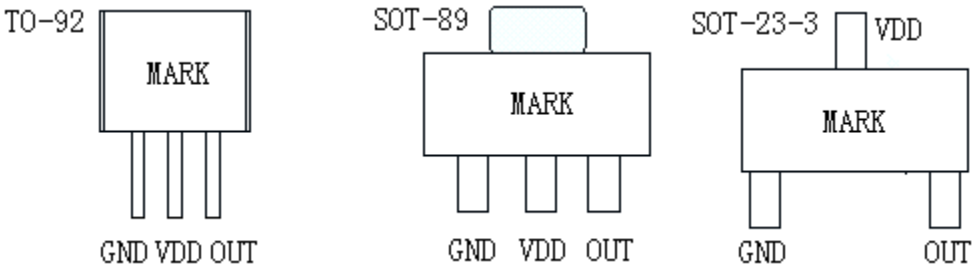


Figure 1

Absolute Maximum Ratings: (Ta=25℃ unless otherwise specified)

Item	Symbol	Absolute Maximum Ratings	Unit
Input voltage	V_{IN}	12	V
Output voltage	V_{OUT}	V_{ss}-0.3~ V_{IN}+0.3	
Power dissipation	P_D	SOT_89 500 TO_92 300 SOT_23 200	Mw
Operation temperature range	T_{opr}	-40~+85	℃
Storage temperature range	T_{stg}	-40~+125	

Caution The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

Electrical Characteristics:

BP9953XX series (BP995312,Output voltage +1.2V) (Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=2. 2V, I_{OUT}=40mA	1.176	1.2	1.224	V	1
Output current *1	I_{OUT}	V_{IN}= 2.2V	180			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=100 mA		25 280	35 380	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	2.2V≤V_{IN}≤10V I_{OUT}=10mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=2.2V 1.0mA≤I_{OUT}≤100mA		15	30	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=2.2V, I_{OUT}=1mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series(BP995315,Output voltage +1.5V)　(Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=2. 5V, I_{OUT}=40mA	1.470	1.5	1.530	V	1
Output current *1	I_{OUT}	V_{IN}= 2.5V	220			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=100 mA		20 200	28 280	mV	1
Line regulation	$\triangle V_{OUT1}$ / $\triangle V_{IN} \cdot V_{OUT}$	2.5V≤V_{IN}≤10V I_{OUT}=10mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=2.5V 1.0mA≤I_{OUT}≤100mA		15	30	mV	
Temperature coefficient	$\triangle V_{OUT}$ / $\triangle Ta \cdot V_{OUT}$	V_{IN}=2.5V, I_{OUT}=1mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series(BP995317,Output voltage +1.7V)　(Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=2. 7V, I_{OUT}=40mA	1.666	1.7	1.734	V	1
Output current *1	I_{OUT}	V_{IN}= 2.7V	260			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=100 mA		17 160	24 240	mV	1
Line regulation	$\triangle V_{OUT1}$ / $\triangle V_{IN} \cdot V_{OUT}$	2.7V≤V_{IN}≤10V I_{OUT}=10mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=2.7V 1.0mA≤I_{OUT}≤100mA		30	45	mV	
Temperature coefficient	$\triangle V_{OUT}$ / $\triangle Ta \cdot V_{OUT}$	V_{IN}=2.7V, I_{OUT}=1mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series(BP995318,Output voltage +1.8V)　(Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=2. 8V, I_{OUT}=40mA	1.764	1.8	1.836	V	1
Output current *1	I_{OUT}	V_{IN}= 2.8V	280			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=100 mA		15 140	21 210	mV	1
Line regulation	$\triangle V_{OUT1}$ / $\triangle V_{IN} \cdot V_{OUT}$	2.8V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=2.8V 1.0mA≤I_{OUT}≤150mA		30	45	mV	
Temperature coefficient	$\triangle V_{OUT}$ / $\triangle Ta \cdot V_{OUT}$	V_{IN}=2.8V, I_{OUT}=1mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	

Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series (BP995321, Output voltage +2.1V) (Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 3.1V, I_{OUT}=40mA	2.058	2.1	2.142	V	1
Output current *1	I_{OUT}	V_{IN}= 3.1V	320			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=100 mA		13 130	18 180	mV	1
Line regulation	$\triangle V_{OUT1}$ / $\triangle V_{IN} \cdot V_{OUT}$	3.1V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=3.1V 1.0mA≤I_{OUT}≤150mA		30	45	mV	
Temperature coefficient	$\triangle V_{OUT}$ / $\triangle Ta \cdot V_{OUT}$	V_{IN}=3.1V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series (BP995325, Output voltage +2.5V) (Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 3.5V, I_{OUT}=50mA	2.450	2.5	2.550	V	1
Output current *1	I_{OUT}	V_{IN}= 3.5V	350			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=100 mA		12 120	17 170	mV	1
Line regulation	$\triangle V_{OUT1}$ / $\triangle V_{IN} \cdot V_{OUT}$	3.5V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=3.5V 1.0mA≤I_{OUT}≤150mA		30	45	mV	
Temperature coefficient	$\triangle V_{OUT}$ / $\triangle Ta \cdot V_{OUT}$	V_{IN}=3.5V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series(BP995327,Output voltage +2.7V) (Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 3.7V, I_{OUT}=50mA	2.646	2.7	2.754	V	1
Output current *1	I_{OUT}	V_{IN}= 3.7V	400			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=200 mA		12 220	18 300	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	3.7V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=3.7V 1.0mA≤I_{OUT}≤150mA		25	40	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=3.7V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series(BP995328,Output voltage +2.8V) (Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 3.8V, I_{OUT}=50mA	2.744	2.8	2.856	V	1
Output current *1	I_{OUT}	V_{IN}= 3.8V	400			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=200 mA		12 220	18 300	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	3.8V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=3.8V 1.0mA≤I_{OUT}≤150mA		25	40	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=3.8V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series(BP995330,Output voltage +3.0V) (Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 4V, I_{OUT}=50mA	2.940	3.0	3.060	V	1
Output current *1	I_{OUT}	V_{IN}= 4V	450			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=200 mA		10 200	14 280	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	4V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=4V 1.0mA≤I_{OUT}≤200mA		30	45	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=4V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series(BP995333,Output voltage +3.3V) (Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 4.3V, I_{OUT}=50mA	3.234	3.3	3.366	V	1
Output current *1	I_{OUT}	V_{IN}= 4.3V	500			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=200 mA		10 200	14 280	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	4.3V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=4.3V 1.0mA≤I_{OUT}≤200mA		30	45	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=4.3V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series（BP995336 Output voltage +3.6V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 4.6V, I_{OUT}=50mA	3.528	3.6	3.672	V	1
Output current *1	I_{OUT}	V_{IN}= 4.6V	500			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=200mA		10 200	14 280	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	4.6V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=4.6V 1.0mA≤I_{OUT}≤200mA		30	45	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=4.6V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series（BP995338, Output voltage +3.8V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 4.8V, I_{OUT}=50mA	3.724	3.8	3.876	V	1
Output current *1	I_{OUT}	V_{IN}= 4.8V	500			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=200mA		10 200	14 280	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	4.8V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=4.8V 1.0mA≤I_{OUT}≤200mA		30	45	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=4.8V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series（BP995344，Output voltage +4.4V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 5.4V, I_{OUT}=50mA	4.312	4.4	4.488	V	1

Output current *1	I_{OUT}	V_{IN}= 5.4V	500			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=200mA		10 200	14 280	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	5.4V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=5.4V 1.0mA≤I_{OUT}≤200mA		30	45	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=5.4V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			10	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

BP9953XX series(BP995350,Output voltage +5.0V) (Ta=25℃ unless otherwise specified)

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}= 6V, I_{OUT}=50mA	4.900	5.0	5.100	V	1
Output current *1	I_{OUT}	V_{IN}= 6V	500			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA I_{OUT}=200 mA		10 200	14 280	mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	6V≤V_{IN}≤10V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=6V 1.0mA≤I_{OUT}≤200mA		30	45	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=6V, I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=10V No Load		1.2	2.5	uA	2
Input voltage	VIN	--			15	V	
Short current limit	Ilim	Vout=0V		50	70	mA	

＊1.Increasing output current slowly, The I_{OUT} when output voltage decreasing two percent

＊2.$V_{drop}=V_{IN1}-(V_{OUT(E)} \times 0.98V)$

$V_{OUT(E)}$ Effective output voltage, i.e., the output voltage when fixing I_{OUT}(1mA) and inputting $V_{OUT(S)}$ 2.0 V.

V_{IN1}: is the Input voltage at which output voltage becomes 98 of $V_{OUT(E)}$ after gradually decreasing input voltage

Application Circuits:

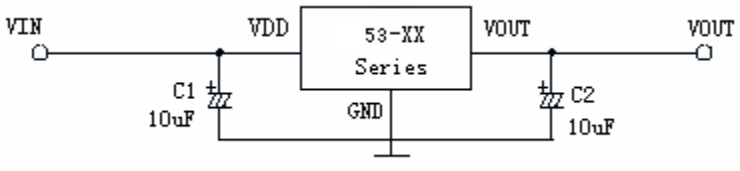


Figure 2

Test Circuits

1.

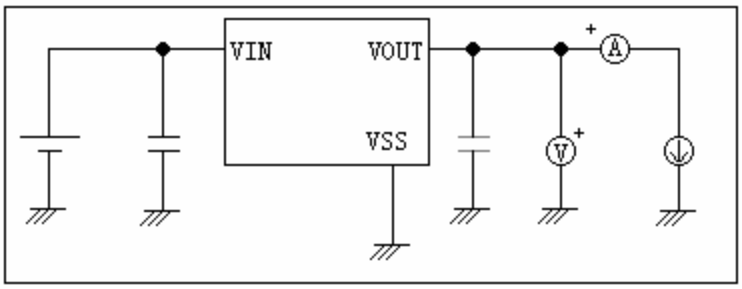


图 1

2.

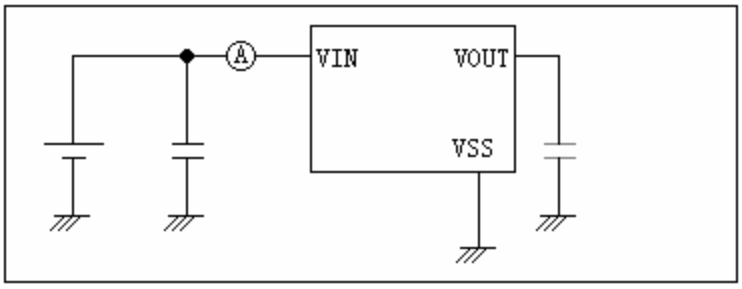


图 2

3.

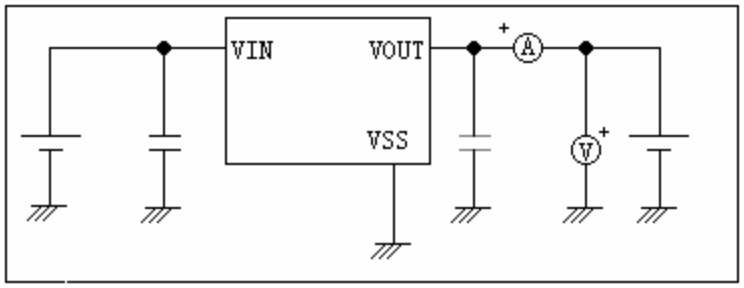


图 3

Figure 3

Standard Circuit

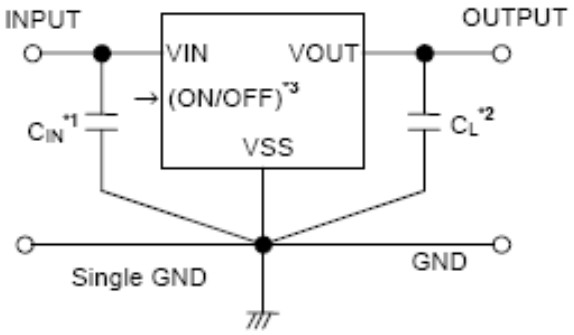


Figure 7

*1. CIN is a capacitor for stabilizing the input.

*2. A ceramic capacitor can be used for CL besides a tantalum capacitor.

*3. In case of product with shutdown function.

Caution The above connection diagram and constant will not guarantee successful operation.

Perform through evaluation using the actual application to set the constant.

Input capacitors(CIN): >1.0 μF.

Output capacitors(CL): >2.2 μF(tantalum capacitors) Or
>10.0 μF(aluminum capacitors).

■Technical Terms

1. Output capacitors (CL)

Output capacitors are generally used to stabilize regulation operation and to improve transient response characteristics. But the BP9953XX series can provide stable operation without output capacitors. Capacitors are used only to improve transient response characteristics. Output capacitors can hence be removed in applications in which transient response can be negligible. When an output capacitor is used, a low ESR (Equivalent Series Resistance) capacitor like ceramic capacitor can also be used.

2. Output voltage (VOUT)

The accuracy of the output voltage is ± 2.0% guaranteed under the specified conditions for input voltage, which differs depending upon the product items, output current, and temperature.

Caution: If the above conditions change, the output voltage value may vary and go out of the accuracy range of the output voltage. See the electrical characteristics and characteristics data for details.

3. Line regulations (ΔVOUT1/ΔVIN*VOUT)

These parameters indicate the input voltage dependence on the output voltage. That is, the values show how much the output voltage changes due to a change in the input voltage with the output current remained unchanged.

4. Load regulation (ΔVOUT2)

This parameter indicates the output current dependence on the output voltage. That is,

the value shows how much the output voltage changes due to a change in the output current with the input voltage remained unchanged.

5. Dropout voltage (V_{drop})

This parameter indicates the difference between the input voltage (V_{IN1}) and the output voltage when

output voltage falls to 98 % of $V_{OUT(E)}$ by gradually decreasing the input voltage (V_{IN}).

$V_{drop} = V_{IN1} - [V_{OUT(E)} \times 0.98]$

■Description of Operation

1.Basic Operation

Figure 8 shows the block diagram of the BP9953XX series.The error amplifier compares a reference voltage Vref with a part of the output voltage divided by the feedback resistors R_S and R_F, and supplies the gate voltage to the output transistor, necessary to ensure certain output voltage independent from change of input voltage and temperature.

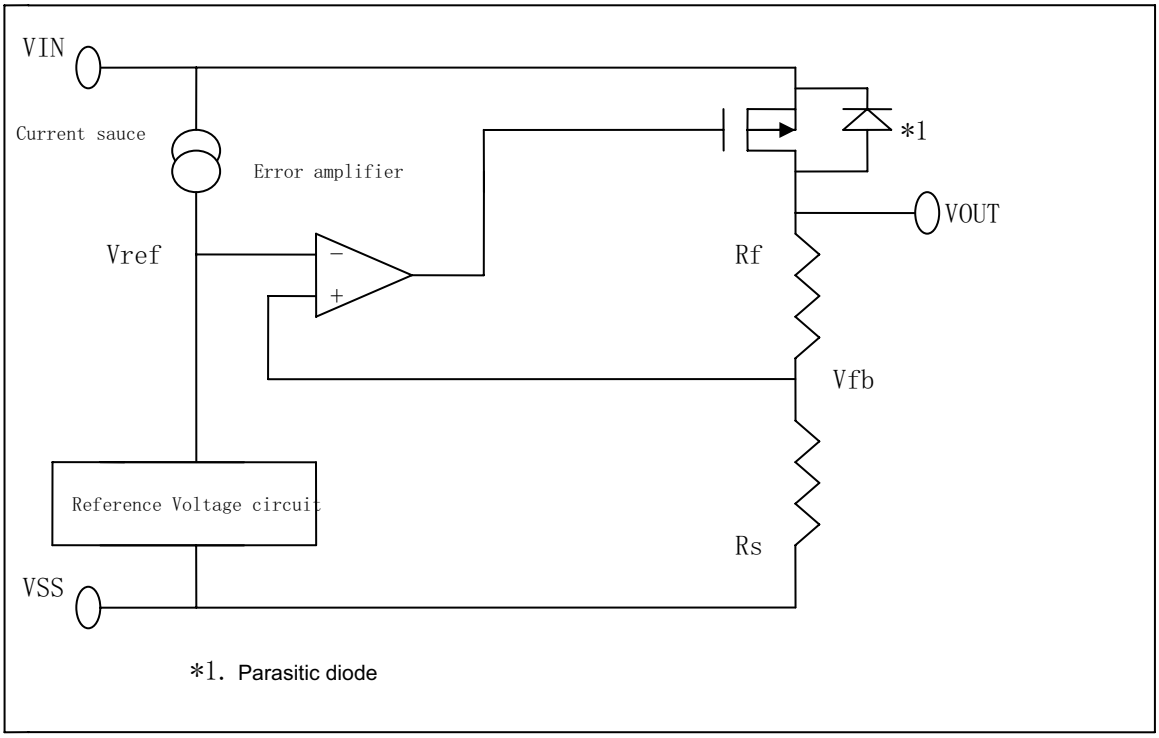


Figure 8

2.Output Transistor

The BP9953XX Series uses a Pch MOS FET as the output transistor.

The voltage at VOUT must not exceed V_{IN}+0.3V. When the V_{OUT} voltage becomes higher than that of V_{IN}, reverse current flows and may break the regulator since a parasitic diode

between VOUT and VIN exists inevitably

3. Shutdown function (ON/OFF pin)

The ON/OFF pin controls the start and stop of the regulation operation.
When the ON/OFF pin is set to shutdown level, halting whole internal circuit and turning off the Pch MOS FET between VIN and VOUT, current consumption is drastically reduced. The voltage of the VOUT pin becomes VSS level due to the internal resistance divider of several MΩ between VOUT and VSS. The ON/OFF pin should not be left afloat since no pull-up nor pull-down is made internally as shown in figure 9. Note also that a current will flow to the VIN side via the parasitic diode inside the IC if a voltage of V_{IN} + 0.3 V or more is applied. When the shutdown function is not used, connect the pin to the VIN pin in case of positive logic and to the VSS pin in case of negative logic. When a regulation operation at light load less than 100 μA is halted, output voltage may increase. If the increase of the output voltage should be avoided, pull down the VOUT pin to the V_{SS} level as soon as ON/OFF pin goes to the shutdown level.

Logic Type	ON/OFF Pin	Internal Circuits	VOUT Pin Voltage	Current Consumption
B	“L”: Power off	Stopped	V_{SS} level	I_{SS2}
B	“H”: Power on	on Operating	Set value	I_{SS1}

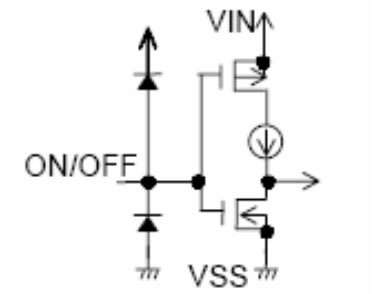


Figure 9

4. Short-circuit protection

Installation of the short-circuit protection which protects the output transistor against short-circuit between VOUT and VSS can be selected in the BP9953XX series. The short-circuit protection controls output current as shown in the typical characteristics, (1) OUTPUT VOLTAGE versus OUTPUT CURRENT, and suppresses output current at about 40 mA even if VOUT and VSS pins are short-circuited.
The short-circuit protection can not at the same time be a thermal protection. Attention

should be paid to the Input voltage and the load current under the actual condition so as not to exceed the power dissipation of the package including the case for short-circuit.

When the output current is large and the difference between input and output voltage is large even if not shorted, the short-circuit protection may work and the output current is suppressed to the specified value. Products without short-circuit protection can provide comparatively large current by removing a short-circuit protection.

■ Selection of External Components

Output Capacitor (C_L)

The BP9953XX series can provide stable operation without output capacitor (CL) since the regulator has an internal phase compensation circuit to stabilize operation when the load changes. The transient response of the regulator, however, changes with the output capacitor and the magnitude of overshoot and undershoot on output voltage accordingly changes. Please refer to C_L dependence data in “Transient Response Characteristics”

to select suitable value for the capacitor.
When a tantalum or an aluminum electrolytic capacitor is used, the ESR of the capacitor shall be 10Ω or less. When an aluminum electrolytic capacitor is used attention should be especially paid to since the ESR of the aluminum electrolytic capacitor increases at low temperature and possibility of oscillation becomes large. Sufficient evaluation including temperature characteristics is indispensable.

■ Precautions:

• Design wiring patterns for VIN, VOUT and GND pins to hold low impedance.
When mounting an output capacitor between the VOUT and VSS pins (C_L) and a capacitor for stabilizing the input between VIN and VSS pins (C_{IN}), the distance from the capacitor to the VOUT pin and to the VSS pin should be as short as possible.

• Note that output voltage may be increased at low load current of less than 1 uA.

•To prevent oscillation, it is recommended to use the external parts under the following conditions.

Equivalent Series Resistance (ESR): 30Ω or less

Input series resistance (R_{IN}): 10Ω or less

• A voltage regulator may oscillate when power source impedance is high and input capacitor is low or not connected.

• The application condition for input voltage and load current should not exceed the package power dissipation.

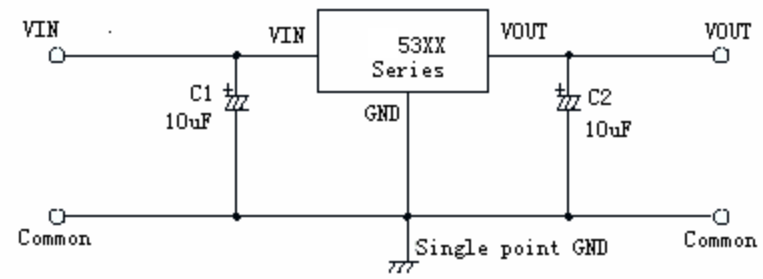
• Pay attention to the operating conditions for input/output voltage and load current so that the power loss in the IC does not exceed the power dissipation of the package.

• Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.

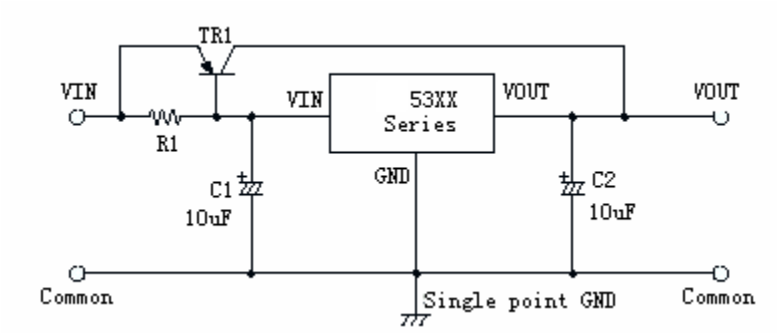
• SII claims no responsibility for any and all disputes arising out of or in connection with any infringement of the products including this IC upon patents owned by a third party.

Application Circuits

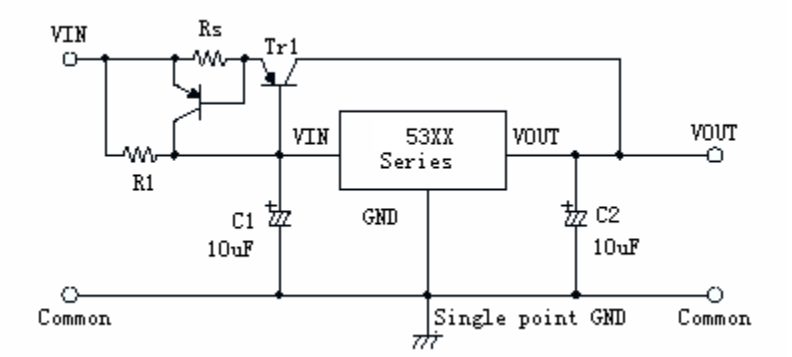
Basic Circuits



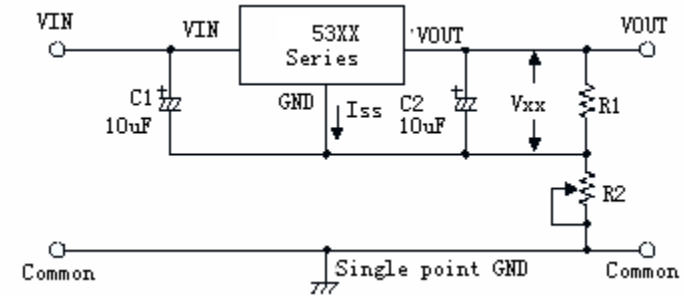
High Output Current Positive Voltage Regulator



Short-Circuit Protection by Tr1

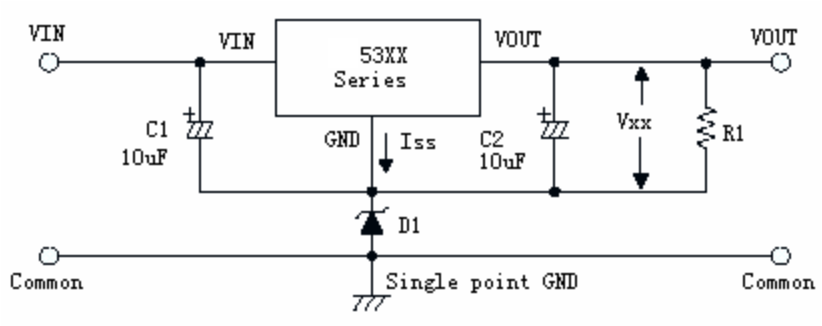


Circuit for Increasing Output Voltage



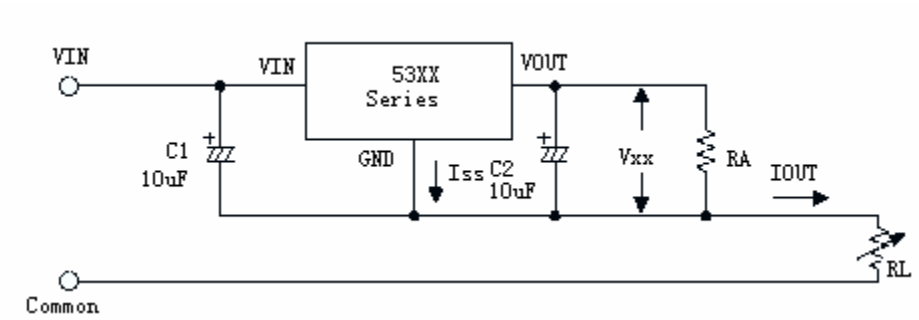
$V_{OUT}=V_{XX}(1+R2/R1)+IssXR2$

Circuit for Increasing Output Voltage



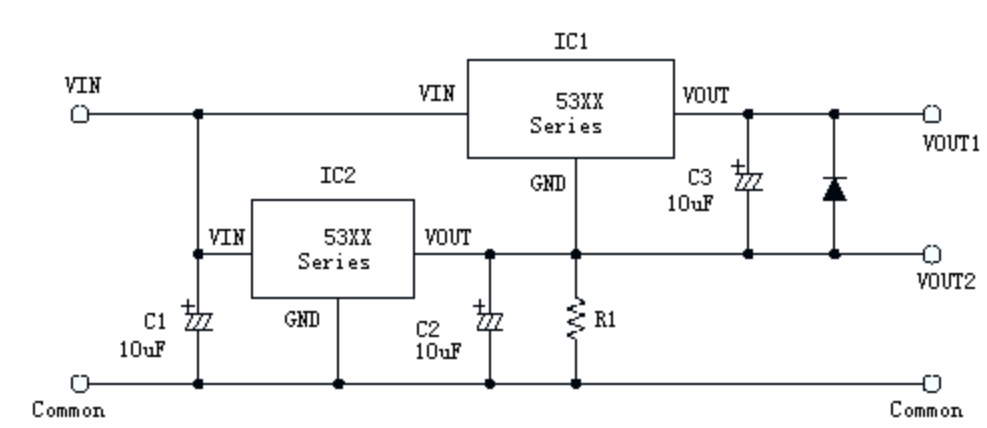
$V_{OUT}=V_{XX}+V_{D1}$

Constant Current Regulator



IOUT=Vxx/RA+Iss

Dual Supply



V8.6.30