SG2002/A

300mA, Low Power, Low Noise Low Dropout, Linear Regulators

GENERAL DESCRIPTION

The SG2002/A series low-power, low-noise, low-dropout, CMOS linear voltage regulators operate from a 2.5V to 5.5V input and deliver up to 300mA. They are the perfect choice for low voltage, low power applications. An ultra low ground current (110μA at 300mA output) makes this part attractive for battery operated power systems. The SG2002/A series also offer ultra low dropout voltage (210mV at 300mA output) to prolong battery life in portable electronics. Systems requiring a quiet voltage source, such as RF applications, will benefit from the SG2002/A series' ultra low output noise (30μVRMS). An external noise bypass capacitor connected to the device's BP pin can further reduce the noise level.

The output voltage is preset to voltages in the range of 1.5V to 5.0V. Other features include a 10nA logic-controlled shutdown mode, foldback current limit and thermal shut-down protection.

Devices come in 5-pin SOT23 package.

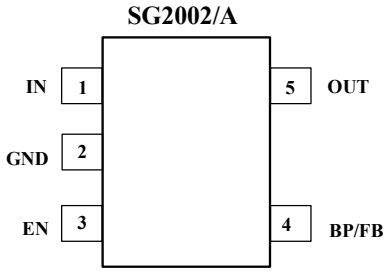
FEATURES

- **Low Output Noise: 30μVRMS typ(10Hz to 100KHz)**
- **Ultra-Low Dropout Voltage:**
  210mV at 300mA output
- **Low 77μA No-Load Supply Current**
- **Low 110μA Operating Supply Current**
  at 300mA Output
- **Thermal-Overload Protection**
- **Output Current Limit**
- **Preset Output Voltages (±1. 6% Accuracy)**
- **10nA Logic-Controlled Shutdown**
- **Available in Multiple Output Voltage Versions**
  Fixed Outputs of 1.5V, 1.8V, 2.5V, 2.8V, 2.85V, 3.0V,3.3V, and 5.0V
  Adjustable Output from 1.5V to 5.0V

APPLICATIONS

Cellular Telephones
Cordless Telephones
PHS Telephones
PCMCIA Cards
Modems
MP3 Player
Hand-Held Instruments
Palmtop Computers
Electronic Planners
Portable/Battery-Powered Equipment

PIN CONFIGURATIONS（TOP VIEW）



SOT23-5

ORDERING INFORMATION

MODEL	V_{OUT}(V)	PIN-PACKAGE	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKAGE OPTION
SG2002-1.5	1.5V	SOT23-5	- 40°C to +125°C	SG2002-1.5XN5/TR	X215	Tape and Reel, 3000
SG2002-1.8	1.8V	SOT23-5	- 40°C to +125°C	SG2002-1.8XN5/TR	X218	Tape and Reel, 3000
SG2002-2.5	2.5V	SOT23-5	- 40°C to +125°C	SG2002-2.5XN5/TR	X225	Tape and Reel, 3000
SG2002-2.8	2.8V	SOT23-5	- 40°C to +125°C	SG2002-2.8XN5/TR	X228	Tape and Reel, 3000
SG2002-2.85	2.85V	SOT23-5	- 40°C to +125°C	SG2002-2.85XN5/TR	X22J	Tape and Reel, 3000
SG2002-3.0	3.0V	SOT23-5	- 40°C to +125°C	SG2002-3.0XN5/TR	X230	Tape and Reel, 3000
SG2002-3.3	3.3V	SOT23-5	- 40°C to +125°C	SG2002-3.3XN5/TR	X233	Tape and Reel, 3000
SG2002-5.0	5.0V	SOT23-5	- 40°C to +125°C	SG2002-5.0XN5/TR	X250	Tape and Reel, 3000
SG2002A	adjustable	SOT23-5	- 40°C to +125°C	SG2002-XN5/TR	X2AA	Tape and Reel, 3000

ABSOLUTE MAXIMUM RATINGS

IN to GND..... - 0.3V to +6V
Output Short-Circuit Duration .....Infinite
EN to GND..... - 0.3V to +6V
OUT, BP/FB to GND.....- 0.3V to (V_{IN} + 0.3V)
Power Dissipation, P_D @ T_A = 25℃
SOT23-5 .....0.4W
Package Thermal Resistance
SOT23-5, θ_{JA}..... 250℃/W

Operating Temperature Range.....- 40°C to +125°C
Junction Temperature.....+150°C
Storage Temperature.....- 65°C to +150°C
Lead Temperature (soldering, 10s).....260°C
ESD Susceptibility
HBM.....7000V
MM.....400V

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	IN	Regulator Input. Supply voltage can range from 2.5V to 5.5V. Bypass with a 1μF capacitor to GND.
2	GND	Ground.
3	EN	Shutdown Input. A logic low reduces the supply current to 10nA. Connect to IN for normal operation.
4	BP	Reference-Noise Bypass(fixed voltage version only). Bypass with a low-leakage 0.01μF ceramic capacitor for reduced noise at the output.
4	FB	Adjustable voltage version only—this is used to set the output voltage of the device.
5	OUT	Regulator Output.

ELECTRICAL CHARACTERISTICS

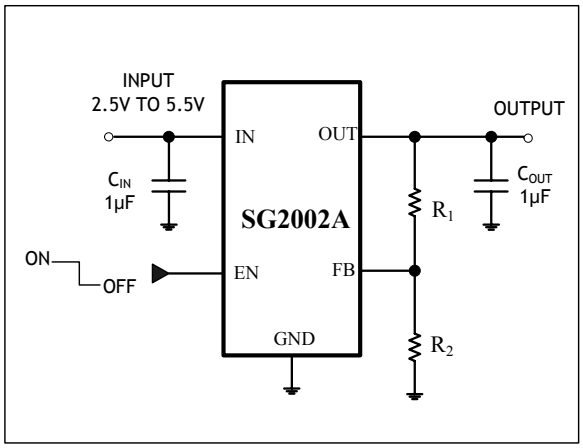
(V_{IN} = $V_{OUT\ (NOMINAL)}$ + 0.5V or 2.5V (whichever is greater), T_A = - 40°C to +125°C, unless otherwise noted. Typical values are at T_A = + 25°C.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Input Voltage	V_{IN}			2.5		5.5	V
Output Voltage Accuracy		I_{OUT} = 0.1mA, V_{OUT} ≥2. 5V, T_A = +25°C		-1.6		1.6	%
		I_{OUT} = 0.1mA to 300mA, V_{OUT} ≥2. 5V T_A = 0°C to +70°C				2.3	
		I_{OUT} = 0.1mA to 300mA, V_{OUT} ≥2. 5V T_A = - 40°C to +125°C				2.7	
		I_{OUT} = 0.1mA to 300mA, V_{OUT}, <2. 5V T_A = - 40°C to +125°C				2.9	
Maximum Output Current				300			mA
Current Limit	I_{LIM}			310	750		mA
Ground Pin Current	I_Q	No load, EN = 2V	V_{OUT}≤3.3V		77	130	μA
			V_{OUT}>3. 3V		77	145	
		I_{OUT} = 300mA, EN = 2V			110		
Dropout Voltage (Note1)		I_{OUT} = 1mA			0.8		mV
		I_{OUT} = 300mA			210	340	
Line Regulation	ΔV_{LNR}	V_{IN} = 2.5V or (V_{OUT} + 0.1V) to 5.5V, I_{OUT} = 1mA			0.004	0.15	%/V
Load Regulation	ΔV_{LDR}	I_{OUT} = 0.1mA to 300mA, C_{OUT} = 1μF			0.0005	0.002	%/mA
Output Voltage Noise	e_n	f = 10Hz to 100KHz, C_{BP} = 0.01μF, C_{OUT} = 10μF			30		μV_{RMS}
Power Supply Rejection Rate	PSRR	C_{BP} = 0.1μF, I_{LOAD} = 50mA,	f = 100Hz,		74		dB
		C_{OUT} = 1μF	f = 1KHz,		54		dB
SHUTDOWN							
EN Input Threshold	V_{IH}	V_{IN} = 2.5V to 5.5V		2.0			V
	V_{IL}					0.4	
EN Input Bias Current	$I_{B(SHDN)}$	EN = 0V and EN = 5.5V	T_A = +25°C		0.01	1	μA
			T_A = +125°C		0.01		
Shutdown Supply Current	$I_{Q(SHDN)}$	EN = 0.4V	T_A = +25°C		0.01	1	μA
			T_A = +125°C		0.01		
Shutdown Exit Delay(Note2)		C_{BP} = 0.01μF C_{OUT} = 1μF, No load	T_A = +25°C		30		μs
THERMAL PROTECTION							
Thermal Shutdown Temperature	T_{SHDN}				160		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}				15		℃

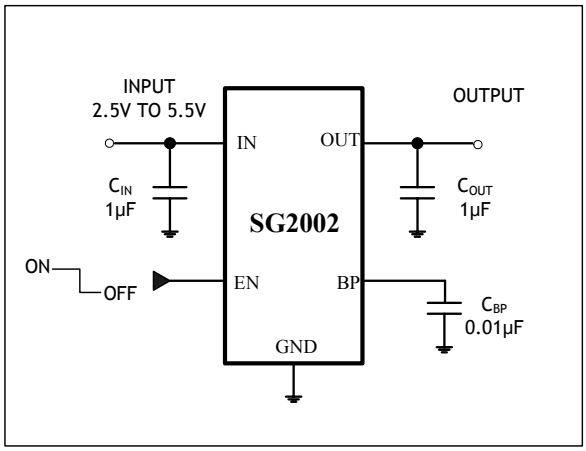
Specifications subject to change without notice.

Note 1: The dropout voltage is defined as V_{IN} - V_{OUT}, when V_{OUT} is 100mV below the value of V_{OUT} for V_{IN} = V_{OUT} + 0.5V. (Only applicable for V_{OUT} = +2.5V to +5.0V.)
Note 2: Time needed for V_{OUT} to reach 95% of final value.

TYPICAL OPERATION CIRCUIT



Adjustable Voltage Version



Fixed Voltage Version

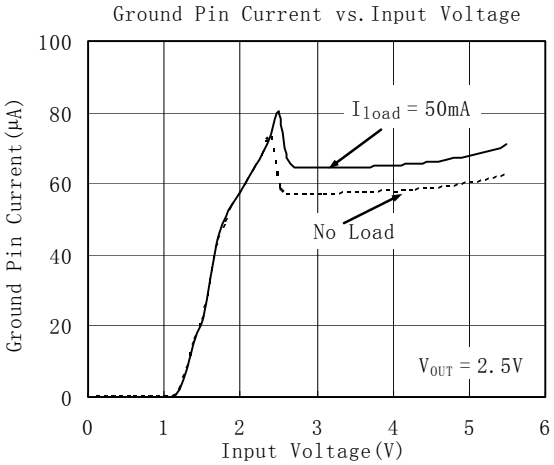
Standard 1% Resistor Values for Common Output Voltages of Adjustable Voltage Version

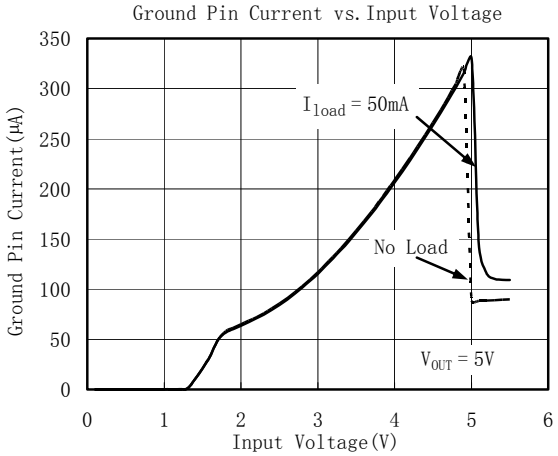
V_{OUT}(V)	R_1(kΩ)	R_2(kΩ)
1.5	13	61.9
1.8	28	61.9
2.5	63.4	61.9
2.8	78.7	61.9
2.85	80.6	61.9
3.0	88.7	61.9
3.3	95.3	57.6
5.0	187	61.9

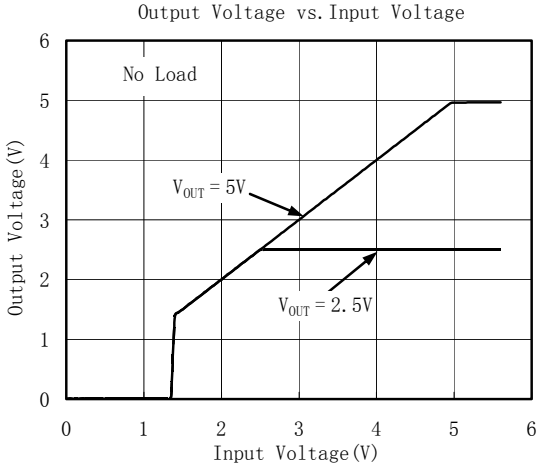
Note: $V_{OUT} = (R_1 + R_2)/ R_2 \times 1.2395$

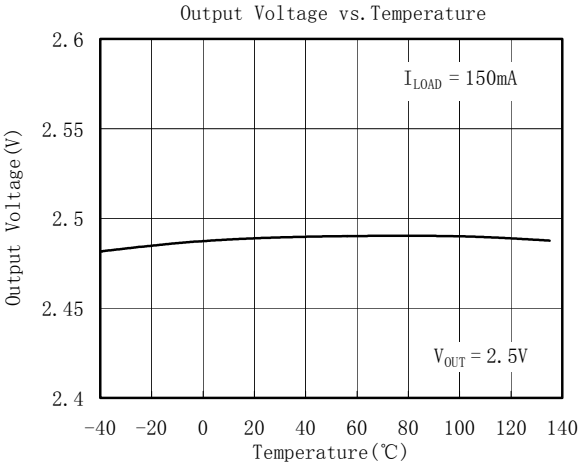
TYPICAL OPERATING CHARACTERISTICS

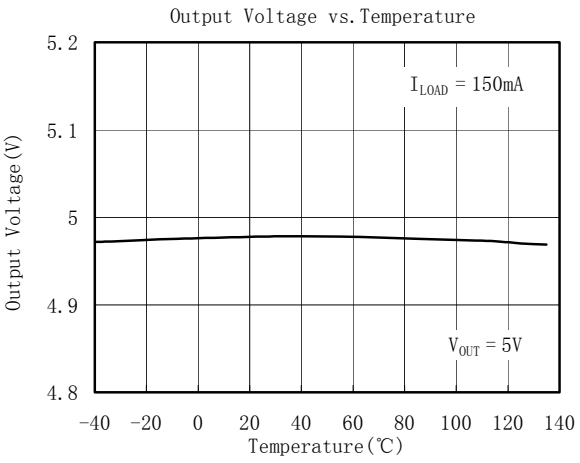
$V_{IN} = V_{OUT(NOMINAL)} + 0.5V$ or 2.5V (whichever is greater), $C_{IN} = 1\mu F$, $C_{OUT} = 1\mu F$, $C_{BP} = 0.01\mu F$, $T_A = +25℃$, unless otherwise noted.

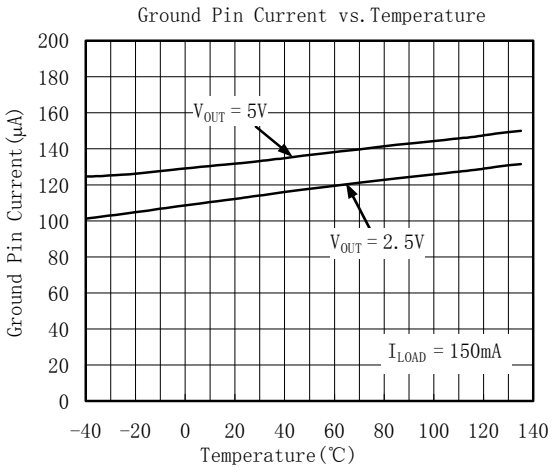












TYPICAL OPERATING CHARACTERISTICS

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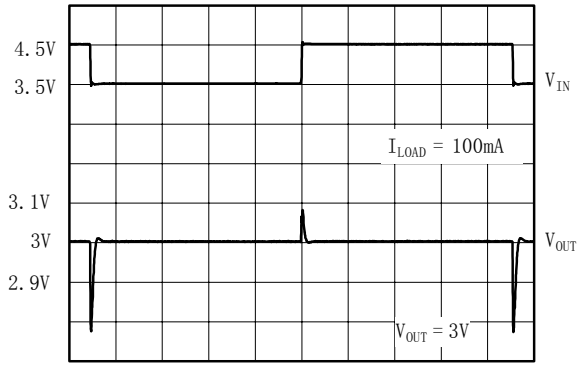
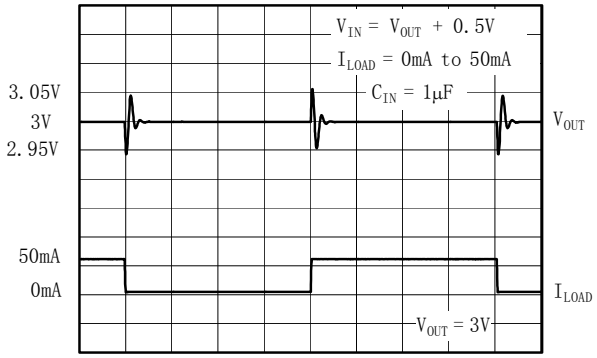
Line-Transient Response



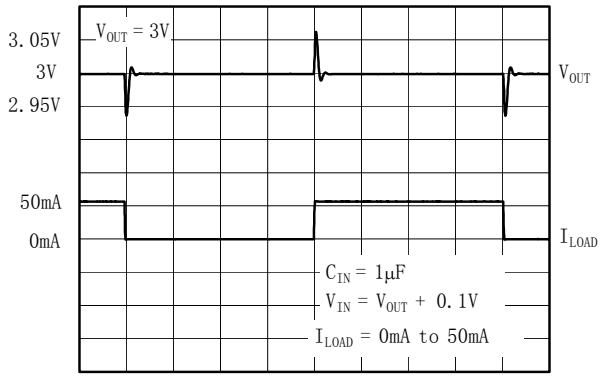
100μS/div

Load-Transient Response



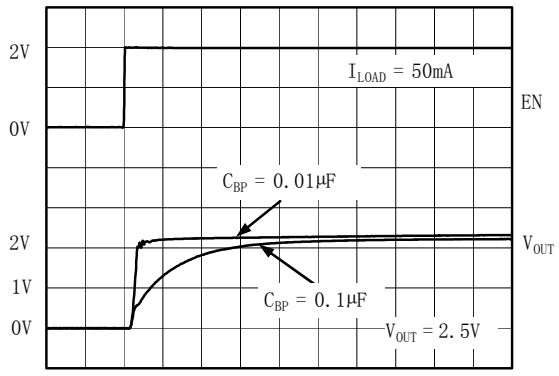
40μS/div

Load-Transient Response Near Dropout



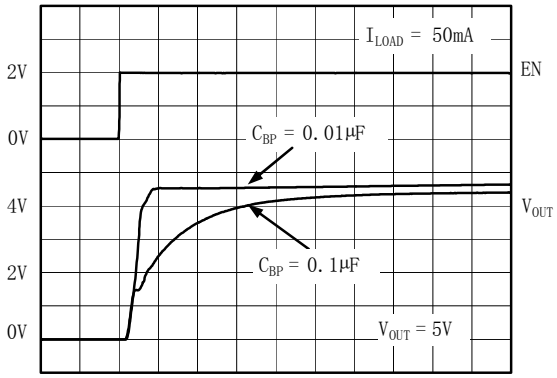
40μS/div

Shutdown Exit Delay



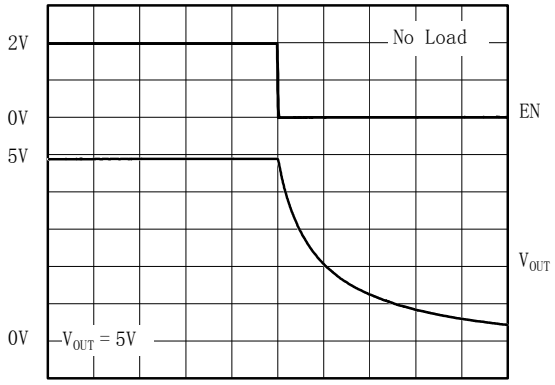
100μS/div

Shutdown Exit Delay



100μS/div

Entering Shutdown

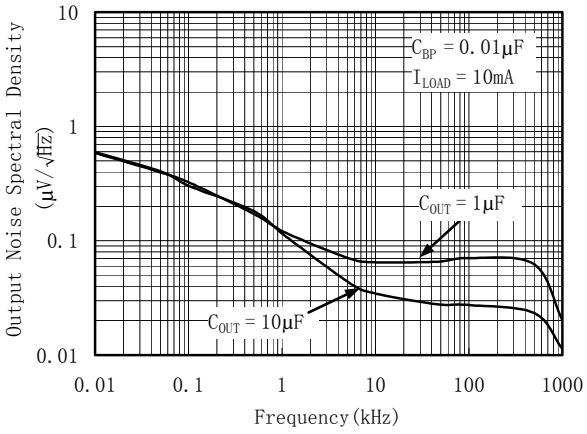


40μS/div

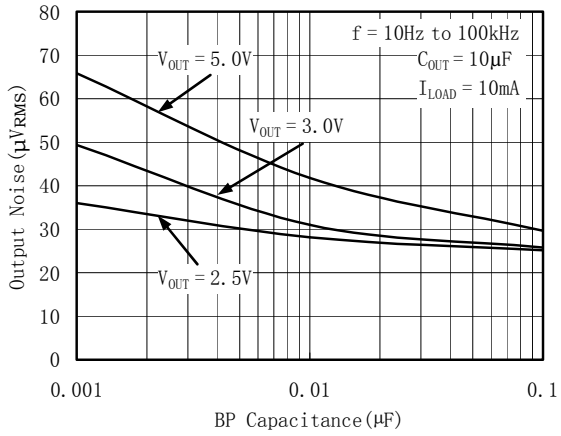
TYPICAL OPERATING CHARACTERISTICS

$V_{IN} = V_{OUT(NOMINAL)} + 0.5V$ or 2.5V (whichever is greater), $C_{IN} = 1\mu F$, $C_{OUT} = 1\mu F$, $C_{BP} = 0.01\mu F$, $T_A = +25℃$, unless otherwise noted.

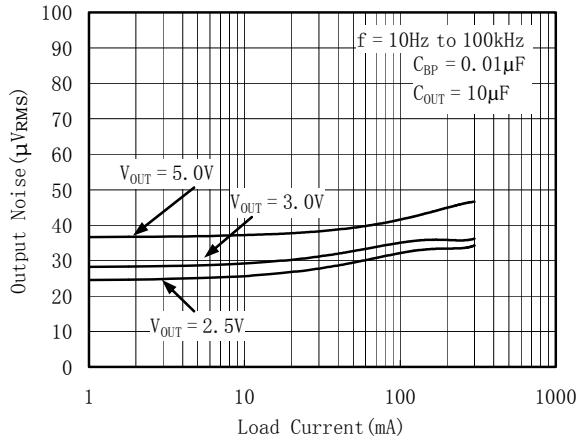
Output Noise Spectral Density vs. Frequency



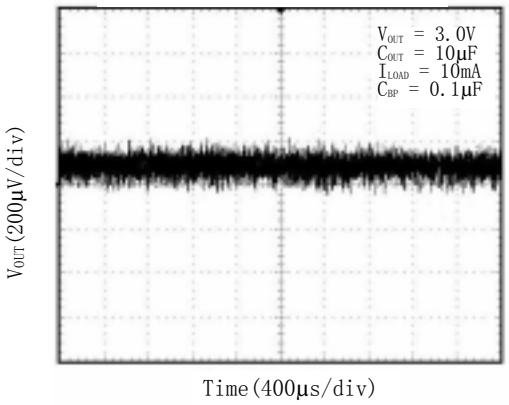
Output Noise vs. BP Capacitance



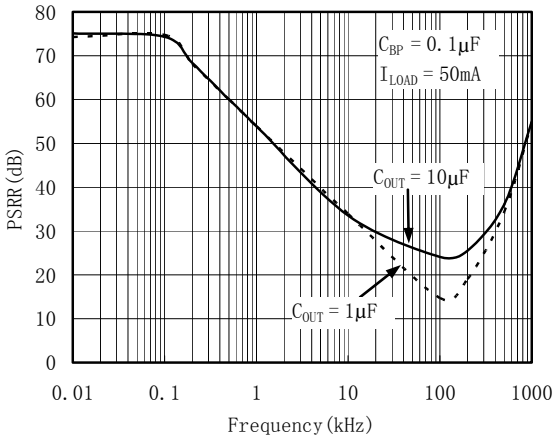
Output Noise vs. Load Current



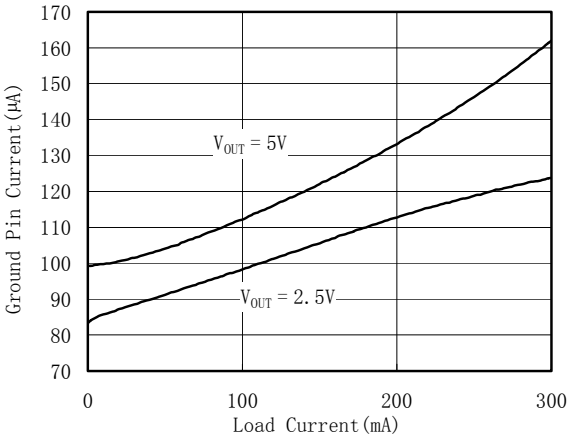
Output Noise 10Hz To 100KHz



Power-Supply Rejection Ratio vs. Frequency



Ground Pin Current vs. Load Current



TYPICAL OPERATING CHARACTERISTICS

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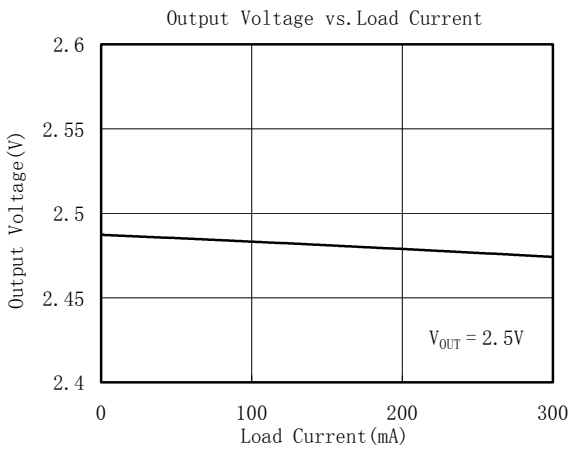

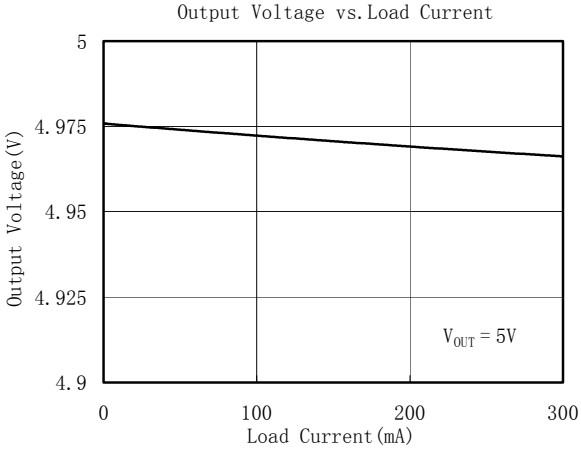

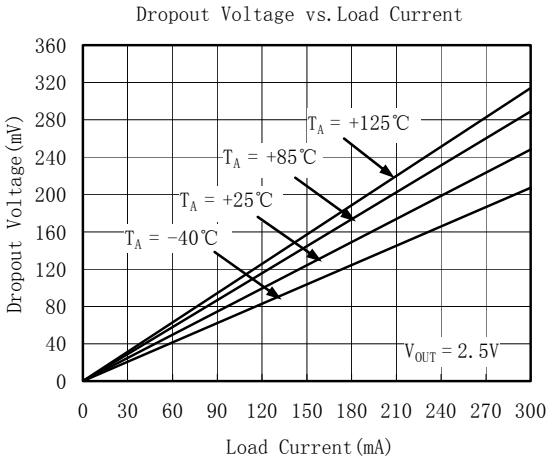

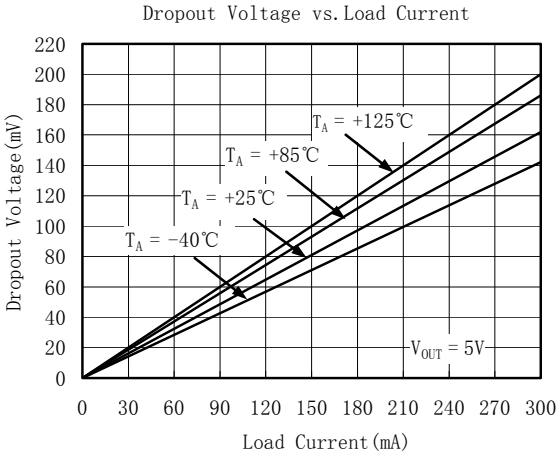

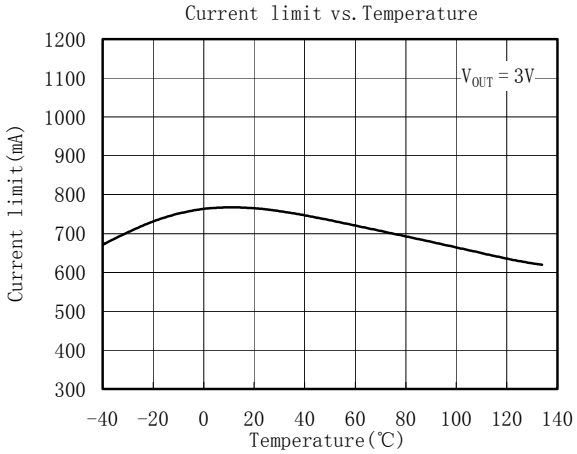

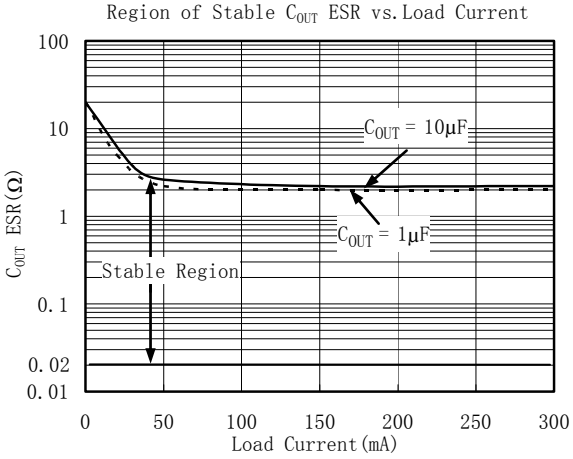

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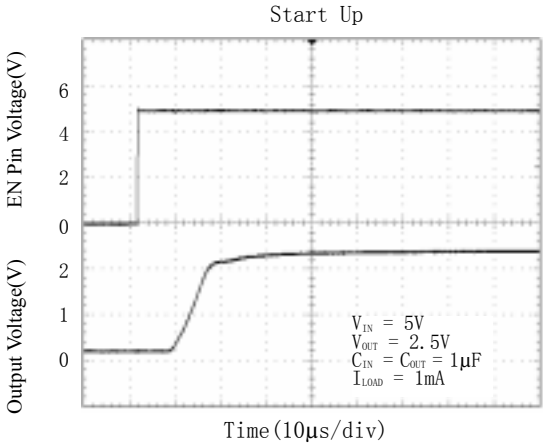
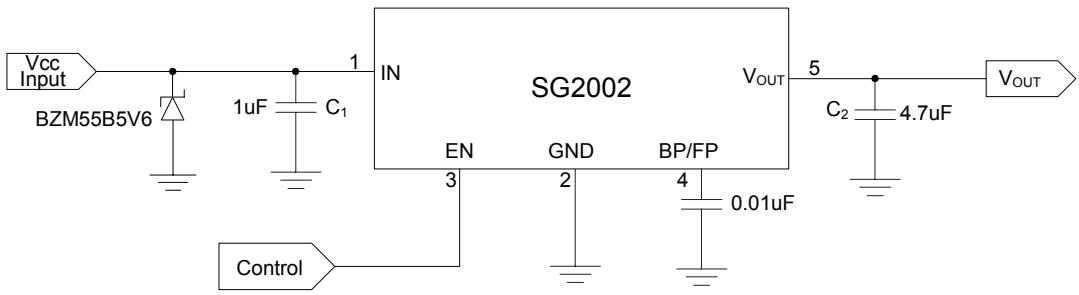


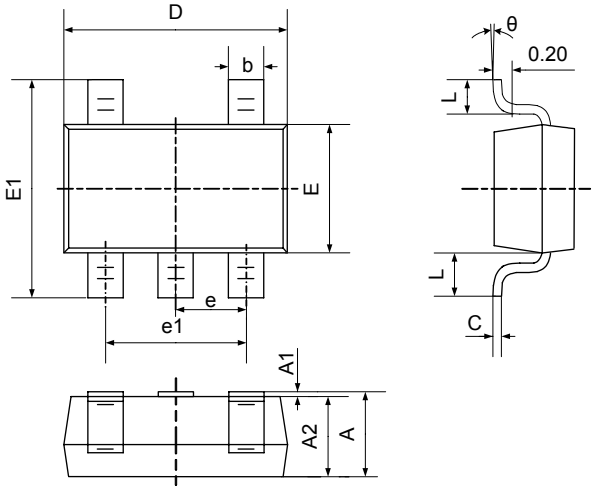
Application Notes

When LDO is used in handheld products, Attention must be paid to voltage spike which would damage SG2002. In such applications, voltage spike will be generated at changer interface and V_{BUS} pin of USB interface when changer adapters and USB equipments are hot-inserted. Besides this, handheld products will be tested on the production line on the condition of no battery. Test Engineer will apply power from the connector pin which connects with positive pole of the battery. When external power supply is turned on suddenly, the voltage spike will be generated at the battery connector. The voltage spike will be very high, it always exceeds the absolute maximum input voltage (6.0V) of LDO. In order to get robust design. Design Engineer needs to clear up this voltage spike. Zener diode is a cheap and effective solution to eliminate such voltage spike. For example, BZM55B5V6 is a 5.6V small package Zener diode which can be used to remove voltage spike in cell phone design. The schematic is shown in below:



PACKAGE OUTLINE DIMENSIONS

SOT23-5



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

REVISION HISTORY

Location **Page**

9/05— Data Sheet changed from preliminary to REV. A

12/06— Data Sheet changed from REV. A to REV. B

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