High Voltage Low Power Consumption LDO

1.General Description

XG80XX is a high voltage (up to 36V) ultra-low quiescent current low dropout voltage regulator (LDO) manufactured in CMOS processes. It can deliver up to 300mA of current while consuming only 1.5μA of quiescent current. It consists of a reference voltage generator, an error amplifier, a current foldback circuit, and a phase compensation circuit plus a driver transistor. The XG80XX is designed specifically for applications where very-low IQ is a critical parameter. This device maintains low quiescent current consumption even in dropout mode to further increase the battery life. When in shutdown or disabled mode, the device consumes less than 100-nA IQ even with input voltage of 36V that helps increase the shelf life of the battery.

2.Features

- Ultra-low Quiescent Current: 1.5μA
- Maximum Input Voltage: 36V
- Output Voltage Highly Accurate: ±2%
- Maximum Output Current: 300mA
- Dropout Voltage: 4mV@I_{OUT}=1mA
- Temperature Stability: ±50ppm/℃
- ON/OFF Logic = Enable High
- Protections Circuits: Current Limiter, Foldback, Thermal shutdown
- Output Capacitor: Low ESR Ceramic Capacitor Compatible

3.Applications

- Smart wearer
- Long-life battery-powered devices
- Portable mobile devices, such as mobile phones, cameras, and so on
- Wireless communication equipment

4.Package

- SOT23-5,SOT23-3,SOT89-3

5.Typical Applications

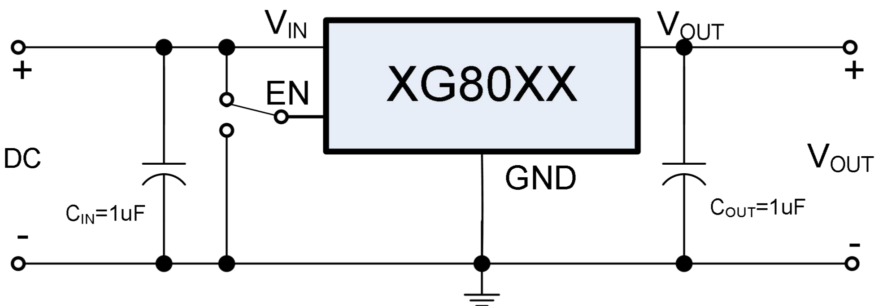

Figure 1. Typical application circuit

Notes on Use:

1. Input Capacitor (C_{IN}): 1μF above.
2. Output Capacitor (C_{OUT}): 1μF above.
3. If the output capacitor is 1μF, it is recommended that the withstand voltage value is not less than 25V, and the capacitance value change rate at high temperature or low temperature does not exceed 20%.

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6.Ordering Information

Ordering Type	V_{OUT}(V)	Package	Ordering Name	Marking	Package Information
XG8018	1.8	SOT23-5L	XG80E18QC3	XG8018	Tape and Reel, 3000pcs
XG8025	2.5	SOT23-5L	XG80E25QC3	XG8025	
XG8028	2.8	SOT23-5L	XG80E28QC3	XG8028	
XG8030	3.0	SOT23-5L	XG80E30QC3	XG8030	
XG8033	3.3	SOT23-5L	XG80E33QC3	XG8033	
XG8036	3.6	SOT23-5L	XG80E36QC3	XG8036	
XG8050	5.0	SOT23-5L	XG80E50QC3	XG8050	
XG8025	2.5	SOT23-3L	XG80E25QA3	XG8025	Tape and Reel, 3000pcs
XG8030	3.0	SOT23-3L	XG80E30QA3	XG8030	
XG8033	3.3	SOT23-3L	XG80E33QA3	XG8033	
XG8033	3.5	SOT23-3L	XG80E35QA3	XG8035	
XG8036	3.6	SOT23-3L	XG80E36QA3	XG8036	
XG8050	5.0	SOT23-3L	XG80E50QA3	XG8050	
XG8055	5.5	SOT23-3L	XG80E55QA3	XG8055	
XG8025	2.5	SOT89-3L	XG80E25PA1	XG8025	Tape and Reel, 1000pcs
XG8027	2.7	SOT89-3L	XG80E27PA1	XG8027	
XG8030	3.0	SOT89-3L	XG80E30PA1	XG8030	
XG8033	3.3	SOT89-3L	XG80E33PA1	XG8033	
XG8036	3.6	SOT89-3L	XG80E36PA1	XG8036	
XG8040	4.0	SOT89-3L	XG80E40PA1	XG8040	
XG8050	5.0	SOT89-3L	XG80E50PA1	XG8050	
XG8053	5.3	SOT89-3L	XG80E53PA1	XG8053	
XG8055	5.5	SOT89-3L	XG80E55PA1	XG8055	
XG8057	5.7	SOT89-3L	XG80E57PA1	XG8057	
XG8060	6.0	SOT89-3L	XG80E60PA1	XG8060	
XG8080	8.0	SOT89-3L	XG80E80PA1	XG8080	
XG8090	9.0	SOT89-3L	XG90E90PA1	XG8090	
XG80C0	12.0	SOT89-3L	XG80EC0PA1	XG80C0	
XG80F0	15.0	SOT89-3L	XG80EF0PA1	XG80F0	
XG8018A	1.8	SOT89-3L	XG80A18PA1	XG8018A	Tape and Reel, 1000pcs
XG8025A	2.5	SOT89-3L	XG80A25PA1	XG8025A	
XG8027A	2.7	SOT89-3L	XG80A27PA1	XG8027A	
XG8028A	2.8	SOT89-3L	XG80A28PA1	XG8028A	
XG8030A	3.0	SOT89-3L	XG80A30PA1	XG8030A	
XG8033A	3.3	SOT89-3L	XG80A33PA1	XG8033A	

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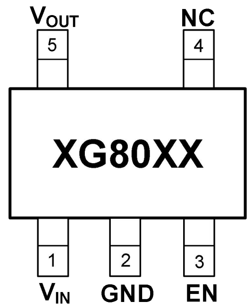
XG8035A	3.5	SOT89-3L	XG80A35PA1	XG8035A	
XG8036A	3.6	SOT89-3L	XG80A36PA1	XG8036A	
XG8040A	4.0	SOT89-3L	XG80A40PA1	XG8040A	
XG8044A	4.4	SOT89-3L	XG80A44PA1	XG8044A	
XG8050A	5.0	SOT89-3L	XG80A50PA1	XG8050A	
XG8080A	8.0	SOT89-3L	XG80A80PA1	XG8080A	
XG8090A	9.0	SOT89-3L	XG80A90PA1	XG8090A	
XG80C0A	12.0	SOT89-3L	XG80AC0PA1	XG80C0A	
XG80F0A	15.0	SOT89-3L	XG80AF0PA1	XG80F0A	

Notes:

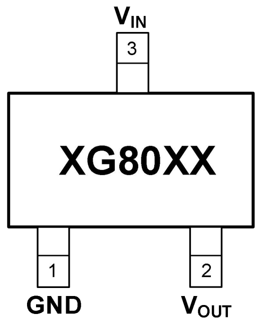
1. Customer can request to customize the output voltage ranged from 1.2V to 15V if desired voltage is not found in the selections.
2. Customer can request customization of package choice.
3. Please pay attention to the MARKING of the product package type.

7.Pin Configuration and Functions

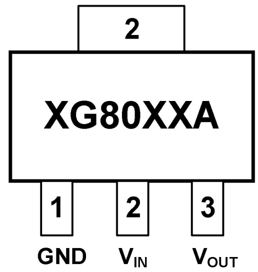
SOT23-5
Top View



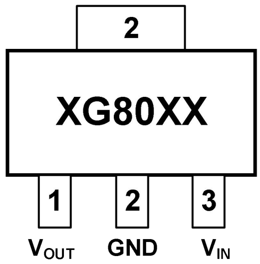
SOT23-3
Top View



SOT89-3(A_Type)
Top View



SOT89-3
Top View



Pin	Pin Function
V_{IN}	Power Input Pin.
EN	Enable pin.Drive this pin high to enable the device. Drive this pin low to put the device into low current shutdown.
V_{OUT}	Regulated output voltage pin
GND	Ground
Thermal pad	The thermal pad is electrically connected to the GND node. Connect this pad to the GND plane for improved thermal performance.
NC	No internal connection

8.Absolute Maximum Ratings

PARAMETER	SYMBOL	RATINGS		UNITS
Input Voltage	V_{IN}	-0.3~40		V
Output Voltage	V_{OUT}	V_{SS}-0.3~V_{IN}+0.3V		
Power Dissipation	P_D	SOT23-5	250	mW
		SOT23-3	250	
		SOT89-3	1000	
Thermal Resistance	$R_{\theta JA}$	SOT23-5	1XG80	℃/W
		SOT23-3	200	
		SOT89-3	100	
Operating Ambient Temperature	T_{opr}	-40~+85		℃
Storage Temperature	T_{stg}	-40~+125		
ESD Protection	ESD HBM	5000		V
Humidity sensitive level	MSL	3		

Notes：Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device.

9.Electrical Characteristics

Unless otherwise indicated： T_a=25℃

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage[*1]	$V_{OUT(S)}$	V_{IN}= $V_{OUT(S)}$+2V， I_{OUT}=1mA	$V_{OUT(S)}$ ×0.98	$V_{OUT(S)}$	$V_{OUT(S)}$× 1.02	V
Dropout Voltage[*2]	V_{DROP}	V_{EN}=V_{IN}, $V_{OUT(S)}$=3.3V I_{OUT}=1mA		4	8	mV
		V_{EN}=V_{IN}, $V_{OUT(S)}$=3.3V I_{OUT}=300mA		1200	1XG800	
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \bullet V_{OUT(s)}}$	$V_{OUT(S)}$+2V⩽V_{IN}⩽36V I_{OUT} =1mA		0.01	0.02	%/V
Load Regulation	ΔV_{OUT2}	V_{IN} = $V_{OUT(S)}$+2V 1mA⩽I_{OUT}⩽ 300mA; $V_{OUT(S)}$⩽ 5.3V		25	60	mV
		$V_{OUT(S)}$>5.3V		50	90	
Temperature Stability	$\frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT(s)}}$	V_{IN} = $V_{OUT(S)}$+2V， I_{OUT}=10mA -40℃ ⩽T_a⩽125℃		±50		ppm/℃
GND Current (V_{EN}=V_{IN})	I_{GND}	no load; $V_{OUT(S)}$<3.0V	0.8	1.2	2	μA
		no load; 3.0⩽$V_{OUT(S)}$⩽ 5.3V	1	1.5	2.5	
		no load; $V_{OUT(S)}$>5.3V	1.5	2.3	3.5	
		I_{OUT}=100mA		420		
Shutdown Current (EN=0)	I_{SHUT}	V_{IN}=36.0V, V_{EN}=0		0.1	1	
Input Voltage	V_{IN}	---	2.2		36	V
Maximum Output Current	I_{OUTMAX}		300	350		mA
Current Limit[*3]	I_{LIM}	V_{IN}= $V_{OUT(S)}$+2V, V_{OUT} = 0.95 ×$V_{OUT(S)}$	350	550		
Short Circuit Current[*4]	I_{SHORT}	V_{IN}=V_{EN}=$V_{OUT(S)}$+2.0V V_{OUT}=0V		65		
Power Supply Rejection Ratio	PSRR	f=100Hz, I_{OUT} =10mA		79		dB
		f=1kHz, I_{OUT} =10mA		62		
		f=10kHz, I_{OUT} =10mA		48		
		f=100kHz, I_{OUT} =10mA		40		

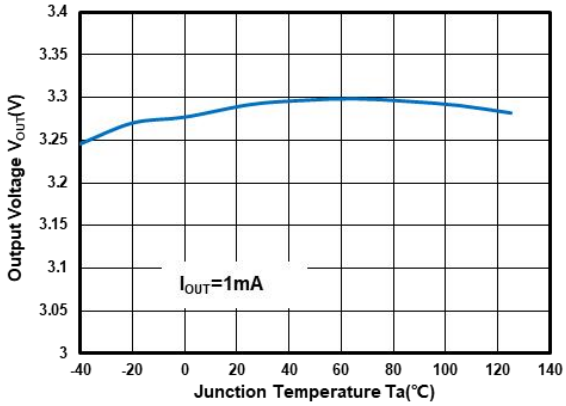
EN ‘H’ Level Voltage	V_{ENH}		1.5		36	V
EN ‘L’ Level Voltage	V_{ENL}		0		0.6	
EN ‘H’ Level Current	I_{ENH}	V_{IN}=36V, V_{EN}=V_{IN}	-0.1		0.1	µA
EN ‘L’ Level Voltage	I_{ENL}	V_{IN}=36V, V_{EN}=0	-0.1		0.1	
Over Temperature Protection	OTP	I_{OUT}=1mA		170		℃

Notes:

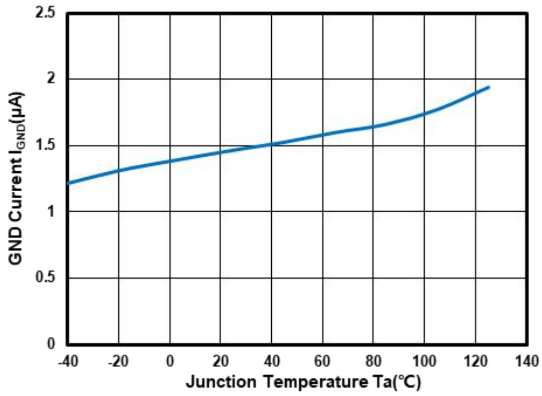
1. $V_{OUT(S)}$: Output voltage when V_{IN}=V_{OUT}+2V, I_{OUT}=1mA.
2. V_{DROP}=V_{IN1}-（$V_{OUT(S)}$×0.98） where V_{IN1} is the input voltage when V_{OUT}=$V_{OUT(S)}$×0.98.
3. I_{LIM}: Output current when V_{IN}=$V_{OUT(S)}$+2V and V_{OUT} = 0.95*$V_{OUT(S)}$.
4. V_{OUT} pin should be shorted to GND pin, and the impedance between them is less than 0.1 ohm.

10.Typical Performance Characteristics

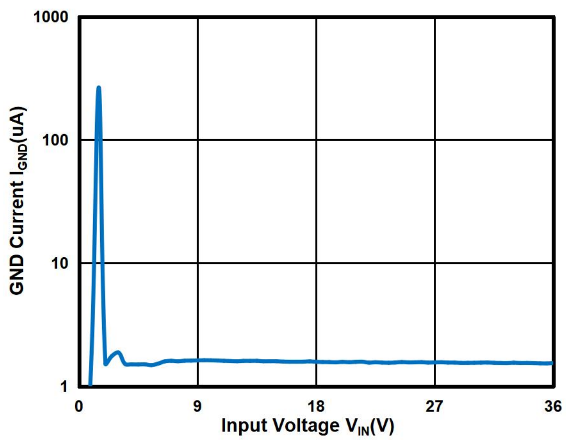
Test Conditions: $V_{IN}=V_{OUT}+2.0V$, $C_{IN}=2.2\mu F$, $C_{OUT}=2.2\mu F$, $T_a=25℃$, unless otherwise indicated.



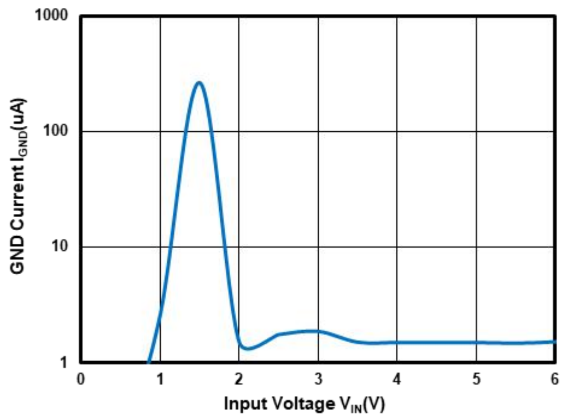
Output Voltage vs Temperature at V_{OUT}=3.3V



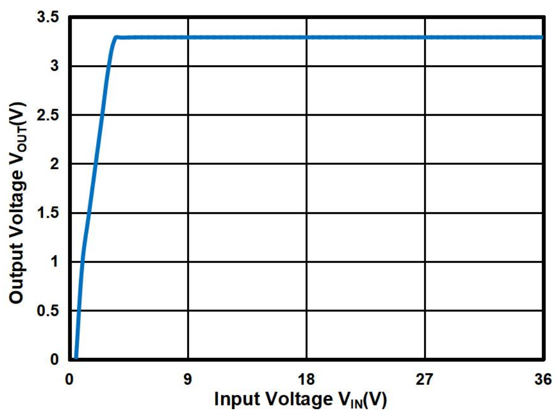
GND Current vs Temperature at V_{OUT}=3.3V



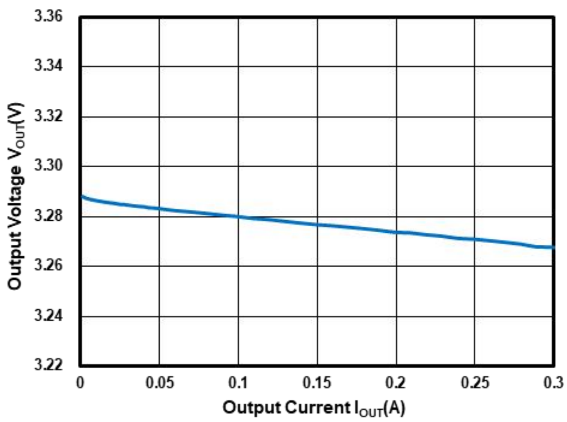
GND Current vs Input Voltage at V_{OUT}=3.3V



GND Current vs Input Voltage at V_{OUT}=3.3V



Output Voltage vs Input Voltage at V_{OUT}=3.3V

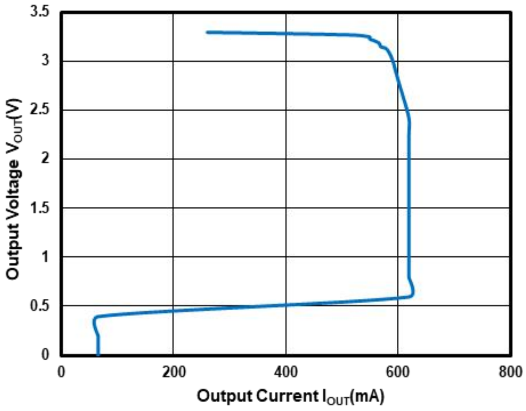


Output Voltage vs Output Current at V_{OUT}=3.3V

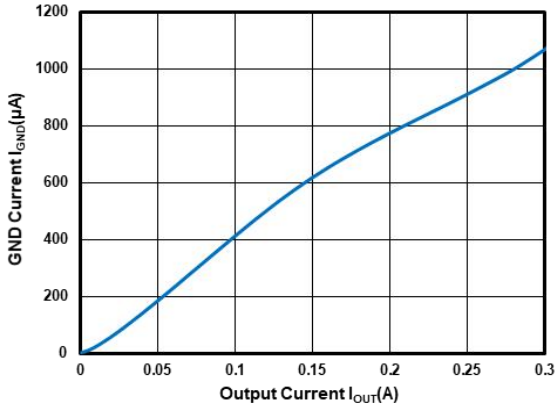
High Voltage Low Power Consumption LDO

Typical Performance Characteristics (Continued)

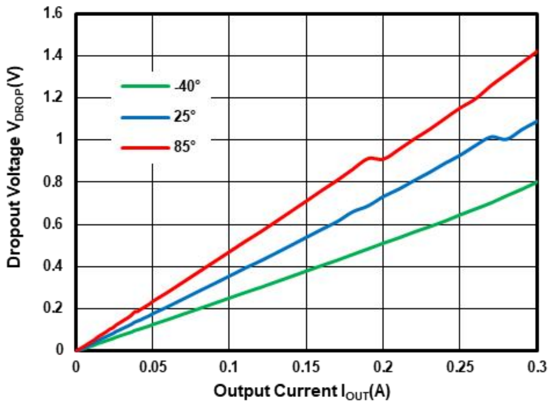
Test Conditions: $V_{IN}=V_{OUT}+2.0V$, $C_{IN}=2.2\mu F$, $C_{OUT}=2.2\mu F$, $T_a=25^{\circ}C$, unless otherwise indicated.



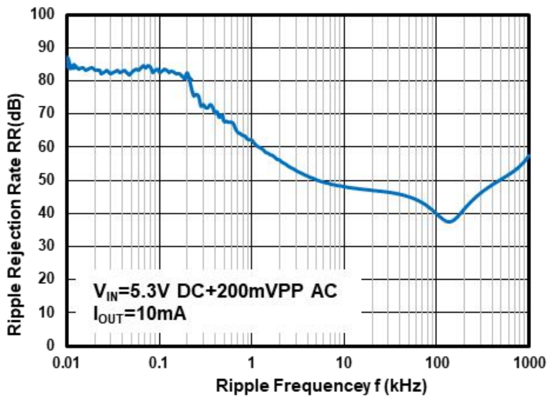
Output Current Fold-back at $V_{OUT}=3.3V$



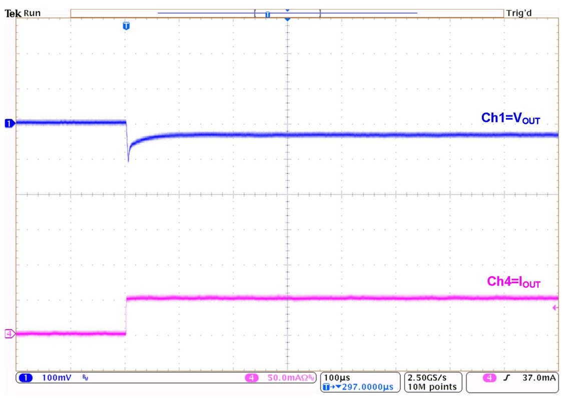
GND Current vs Output Current at $V_{OUT}=3.3V$



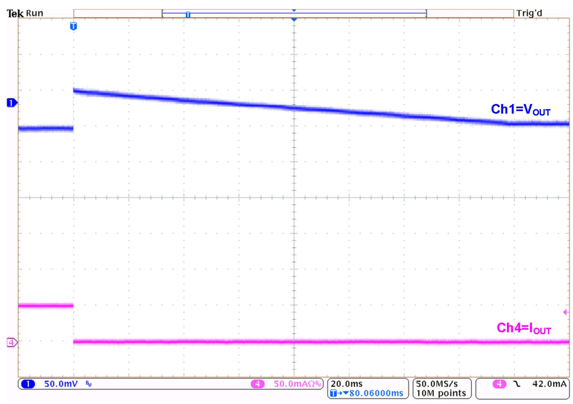
Dropout Voltage vs Temperature at $V_{OUT}=3.3V$



Power Supply Rejection Ratio at $V_{OUT}=3.3V$



Load Transient at $V_{OUT}=3.3V$:($I_{OUT}=0mA\sim50mA$)

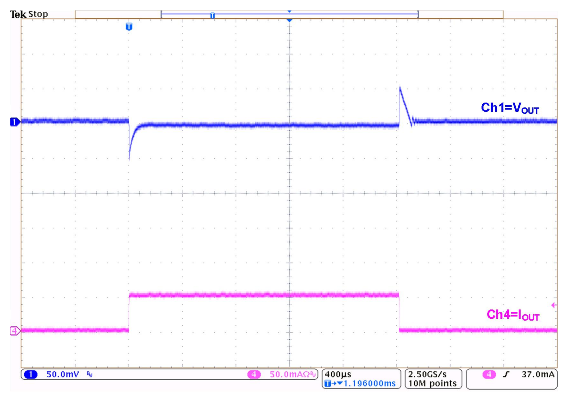


Load Transient at $V_{OUT}=3.3V$:($I_{OUT}=50mA\sim0mA$)

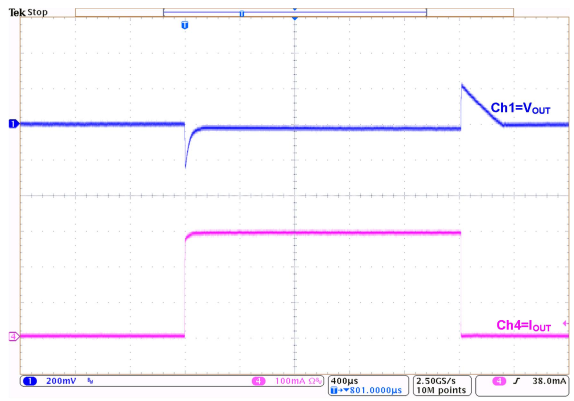
High Voltage Low Power Consumption LDO

Typical Performance Characteristics (Continued)

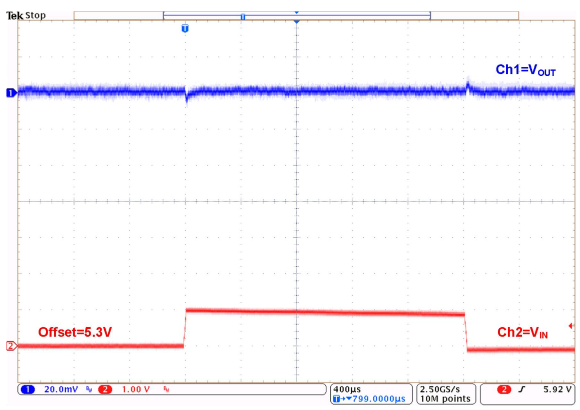
Test Conditions: $V_{IN}=V_{OUT}+2.0V$, $C_{IN}=2.2\mu F$, $C_{OUT}=2.2\mu F$, $T_a=25^\circ C$, unless otherwise indicated.



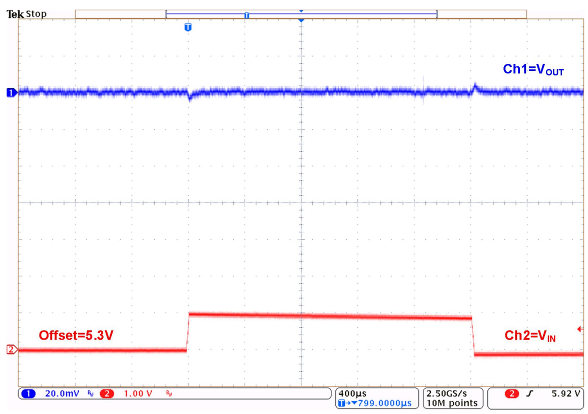
Load Transient at
$V_{OUT}=3.3V$:(I_{OUT}=1mA~50mA~1mA)



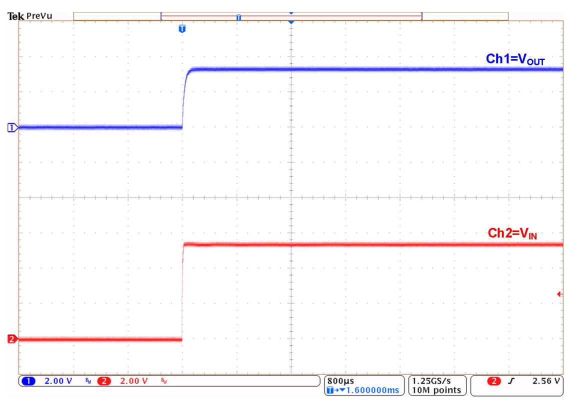
Load Transient at
$V_{OUT}=3.3V$:(I_{OUT}=1mA~300mA~1mA)



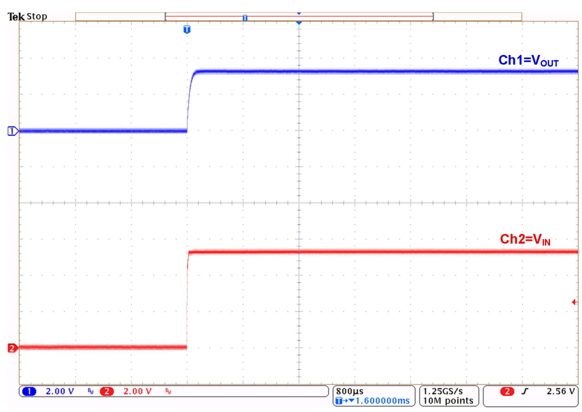
Line Transient at $V_{OUT}=3.3V$:(I_{OUT}=1mA)



Line Transient at $V_{OUT}=3.3V$:(I_{OUT}=10mA)



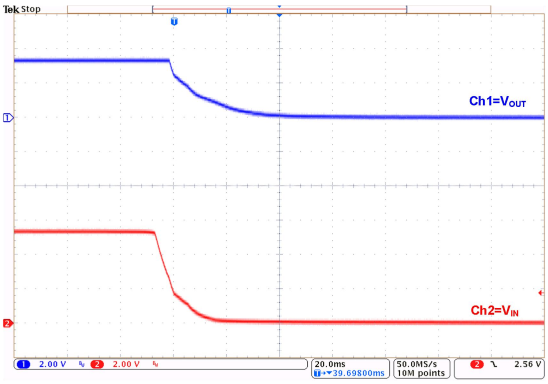
Power-Up at $V_{OUT}=3.3V$:(I_{OUT}=1mA)



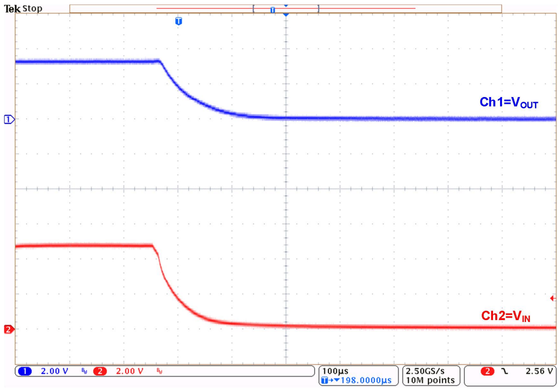
Power-Up at $V_{OUT}=3.3V$: (I_{OUT}=300mA)

Typical Performance Characteristics (Continued)

Test Conditions: $V_{IN}=V_{OUT}+2.0V$, $C_{IN}=2.2\mu F$, $C_{OUT}=2.2\mu F$, $T_a=25^\circ C$, unless otherwise indicated.



Power-Down at V_{OUT}=3.3V:(I_{OUT}=1mA)

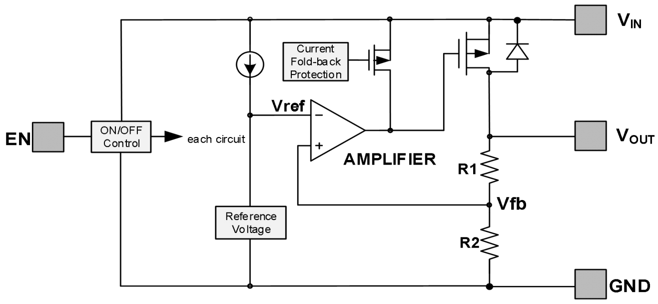


Power-Down at V_{OUT}=3.3V:(I_{OUT}=300mA)

11.Operational Explanation

11.1 Output voltage control

The voltage divided by resistors R1 and R2 is compared with the internal reference voltage by the error amplifier. The amplifier output then drives the P-channel MOSFET connected to the V_{OUT} pin. The output voltage at the V_{OUT} pin is regulated by this negative feedback system. The current limit circuit and short protect circuit operate in relation to output current level. Further, the IC's internal circuitry can be in operation or shutdown modes controlled by the CE pin's signal.



11.2 Pass transistor

The pass transistor with low turn-on resistance used in XG80XX is a P-channel MOSFET. If the potential on V_{OUT} pin is higher than V_{IN}, it is possible that IC will be destroyed due to reverse current which is caused by parasitic diodes between V_{IN} and V_{OUT}. Therefore, the V_{OUT} pin potential exceeds V_{IN}+0.3V is not allowed.

11.3 Current foldback and over temperature protection

The XG80XX series includes a combination of a fixed current limiter circuit and a foldback circuit, which aid the operations of the current limiter and circuit protection. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, output voltage drops further and output current decreases. This design can prevent the chip be damaged due to over temperature, moreover, the heat dissipation is limited by the package type.

Special attention should be paid to that the product of the dropout voltage on the chip and the output current must be smaller than the heat dissipation. If power consumption on the chip is more than the heat dissipation, OTP will protect the chip from damaging due to over temperature.

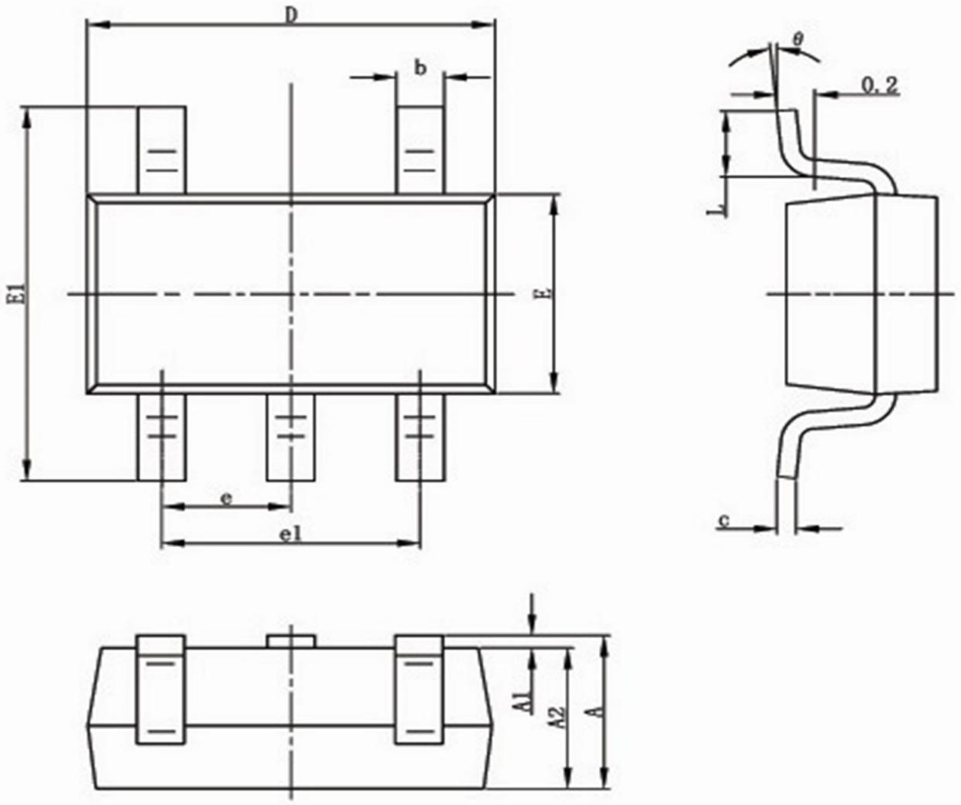
Notes:

1. The input and output capacitors should be placed as close as possible to the IC.
2. If the impedance of the power supply is high, which is caused by forgetting installing input capacitor or installing too small value capacitor, the oscillation may occur.
3. Pay attention to the operation conditions of input and output voltage and load current, such that the power consumption in the IC should not exceed the allowable power consumption of the package even though the chip has short circuit protection.
4. IC has a built-in anti-static protection (ESD) circuit, but please do not add excessive stress to the IC.

12. Packaging Information

Package Type： SOT23-5

SOT-23-5L PACKAGE OUTLINE DIMENSIONS



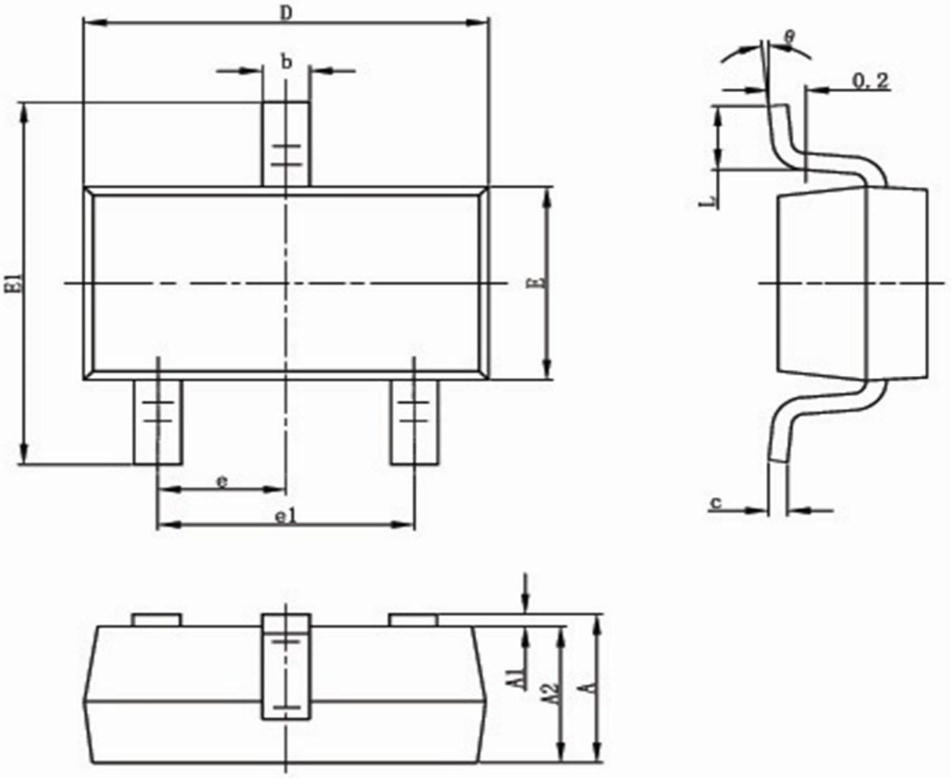
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

High Voltage Low Power Consumption LDO

Packaging Information(Continued)

Package Type： SOT23-3

SOT-23-3L PACKAGE OUTLINE DIMENSIONS



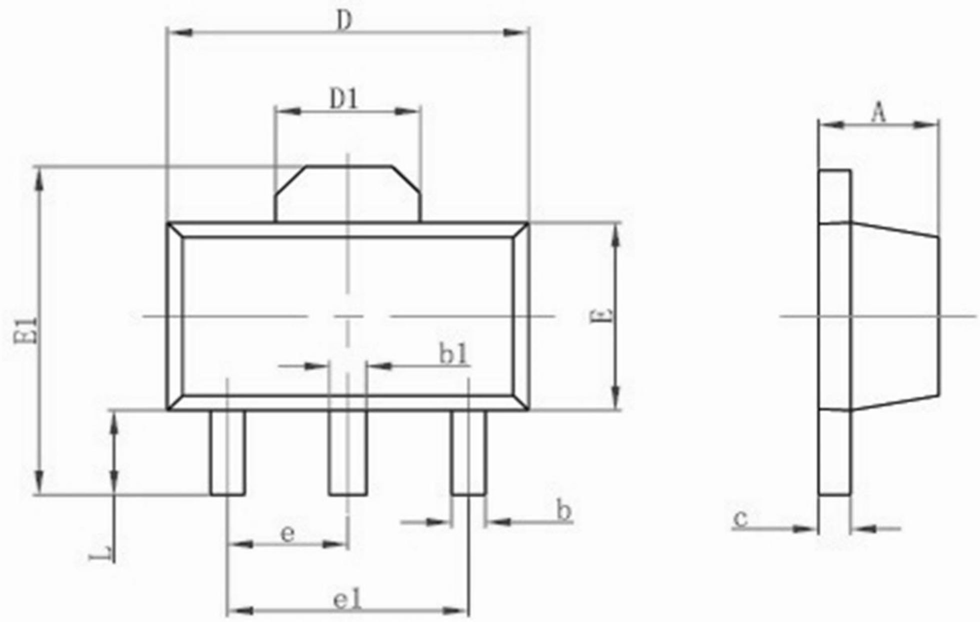
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

High Voltage Low Power Consumption LDO

Packaging Information(Continued)

Package Type：SOT89-3

SOT-89-3L PACKAGE 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	0.197
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		0.060TYP	
e1	3.000 TYP		0.118TYP	
L	0.900	1.200	0.035	0.047