

## DESCRIPTION

The SG9233-E Series is a CMOS PFM-control step-up switching controller that mainly consists of a reference voltage source, an oscillator, and a comparator. Enabling products with a low ripple over a wide range, high efficiency, and high output current. Products with a fixed duty ratio of 75 % (Lower Output Voltage) or 88% (Higher Output Voltage) are also available. With the SG9233-E Series, a step-up switching regulator can be configured by using an external coil, capacitor, NMOSFET and diode. This feature, along with the mini package and low current consumption, makes the SG9233-E Series ideal for applications such as the power supply unit of portable equipment. The SG9233-E Series, which features an external transistor, is suitable for applications requiring a high output current.

## FEATURES

- Low voltage operation: Startup at 0.9 V min. ( $I_{OUT}=1$  mA) guaranteed
- Low input current: During maximum operation: 13  $\mu$ A ( $V_{OUT}=3.3$  V, typ.)
- Duty ratio: 75 % or 88% Built-in fixed-type PFM controller
- External parts: Coil, capacitor, NMOSFET and diode
- Output voltage: Settable to between 1.5 to 6.0V accuracy of  $\pm 2\%$

## APPLICATIONS

- Power supply for portable equipment such as digital cameras, electronic notebooks, and PDA
- Power supply for audio equipment such as portable CD/MD players
- Constant voltage power supply for cameras, video equipment, and communications equipment
- Power supply for microcomputers

## PACKAGE

- SOT-23-3
- SOT-89-3

## BLOCK DIAGRAM

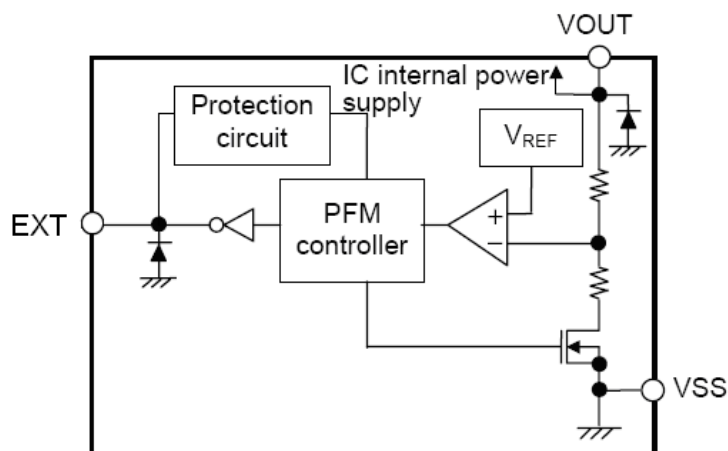


Figure 1

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MAXIMUM RATING	UNIT
Input voltage	VDD	$V_{SS}-0.3 \sim V_{SS}+10$	V
Output voltage	VOUT	$V_{SS}-0.3 \sim V_{SS}+10$	
	VCONT	$V_{SS}-0.3 \sim V_{SS}+10$	
Power dissipation	PD	SOT-23-3	150
		SOT-89-3	500
Operating ambient temperature	Topr	$-40 \sim +80$	°C
Storage ambient temperature	Tstg	$-40 \sim +125$	

**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

(Ta=25°C unless otherwise specified)

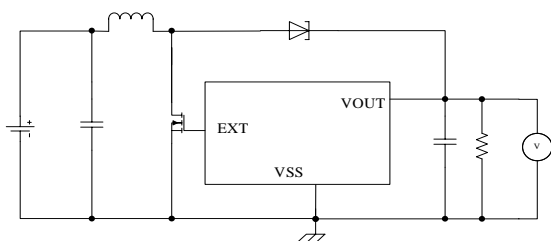
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test circuit
Output voltage	VOUT	-	$V_{OUT}(s) \times 0.98$	$V_{OUT}(s)$	$V_{OUT}(S) \times 1.02$	V	1
Input Voltage	VIN	-	-	-	10		
Operation start voltage	VST1	IOUT=1mA	-	-	0.9		
OSC start voltage	VST2	-	-	-	0.8		2
Input current without load	IIN	IOUT=0	-	9.0	-	μA	1
Current consumption 1	ISS1	$V_{OUT} = \text{Output voltage} \times 0.95$	-	13.2	23.6	μA	2
Current consumption 2	ISS2	$V_{OUT} = \text{Output voltage} + 0.5$	-	2.9	4.4		
Line regulation	$\Delta V_{OUT1}$	$V_{IN} = V_{OUT}(S) \times 0.4 \sim 0.6$	-	30	60	mV	1
Load regulation	$\Delta V_{OUT2}$	$I_{OUT} = 10\mu A \sim V_{OUT}(S) / 250 \times 1.25$	-	30	60		
Output voltage temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta T_a \cdot V_{OUT}}$	Ta=-40°C ~ +85°C	-	±50	-	ppm/°C	
Maximum oscillation frequency	fosc	$V_{OUT} = \text{Output voltage} \times 0.95$ , Measured waveform at CONT pin	280	330	370	kHz	2

Duty ratio	Duty	VOUT=Output voltage× 0.95, Measured waveform at CONT pin	70	75	80	%	
			84	88	92		
Efficiency	EFFI	—	—	88	—	%	1
EXT “High” ON Resistance	Rexth	VOUT=3.3V, EXT=Vdd-0.4V		24	36	Ω	3
EXT “LOW” ON Resistance	Rextl	VOUT=3.3V, EXT= 0.4V		16	24	Ω	3

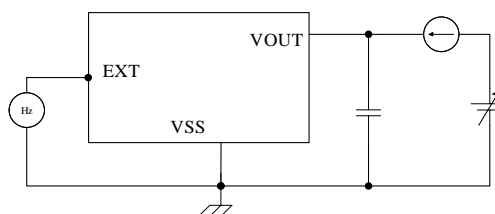
**Remarks** VOUT(S) specified above is the set output voltage value, and VOUT is the typical value of the actual output voltage.

### ■ TEST CIRCUITS

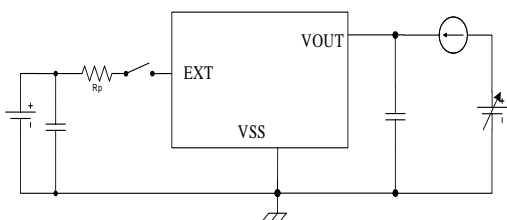
Test circuit 1



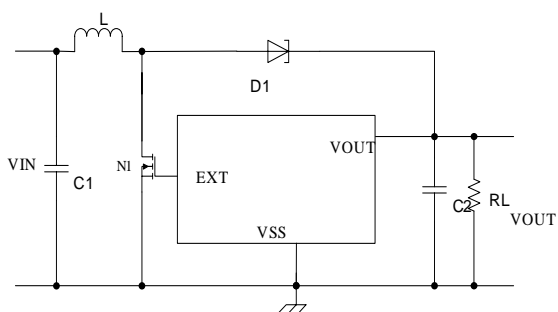
Test circuit2



Test circuit 3



### ■ TYPICAL APPLICATION CIRCUIT

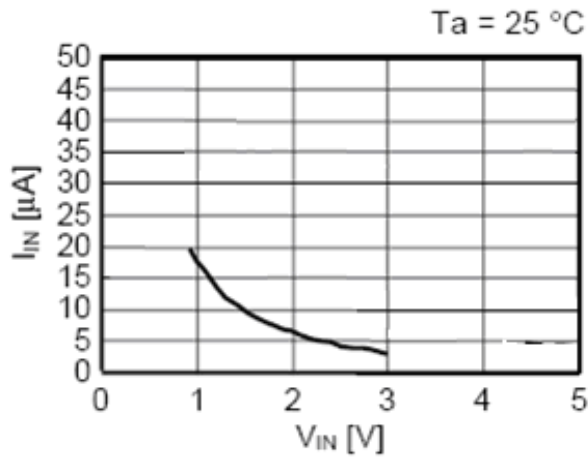


Components Normal Value:

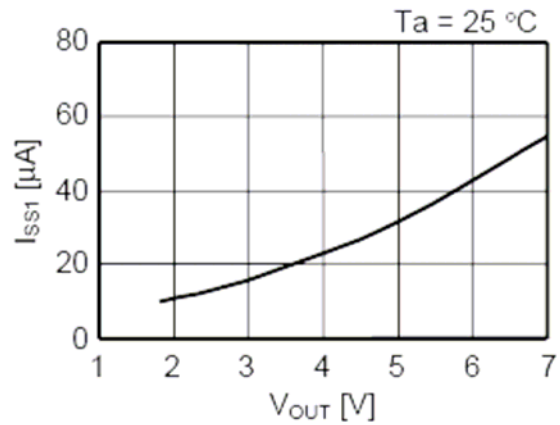
- C1 10uF
- C2 47uF
- L 47uH
- D1 1N5817
- N1 PT2300

■ TYPICAL PERFORMANCE CHARACTERISTICS

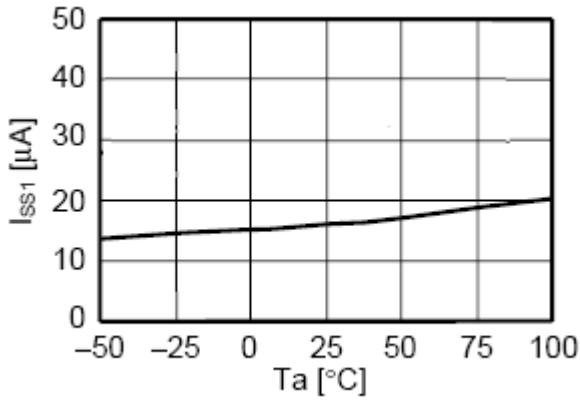
1. Input voltage vs. Power Supply Input Current at No Load



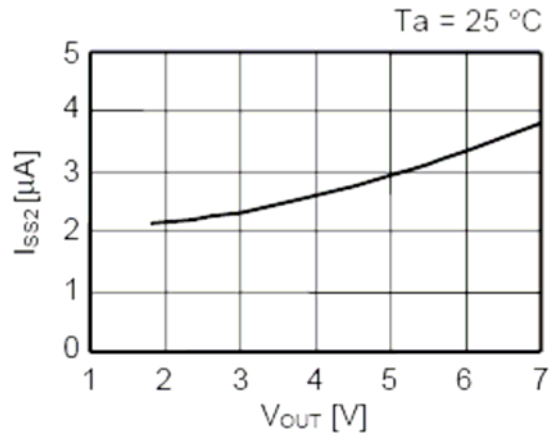
2. Output Voltage vs. Current Consumption 1



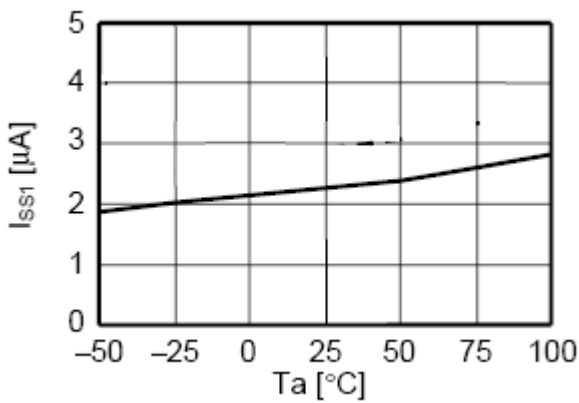
3. Temperature vs. Current consumption 1



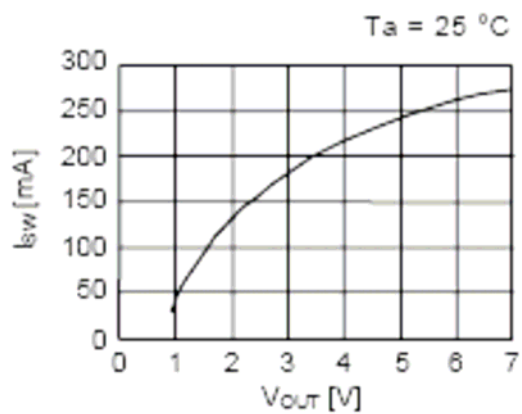
4. Output Voltage vs. Current consumption 2



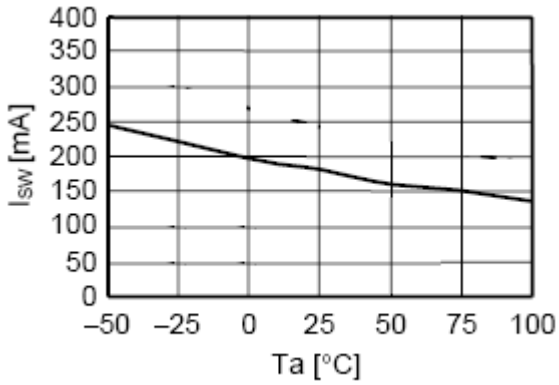
5. Temperature vs. Current consumption 2



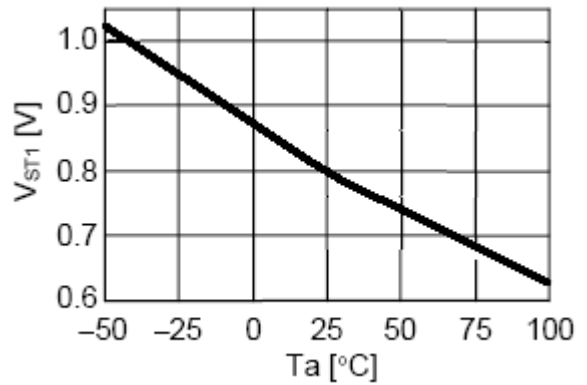
6. Output Voltage vs. Switching Current



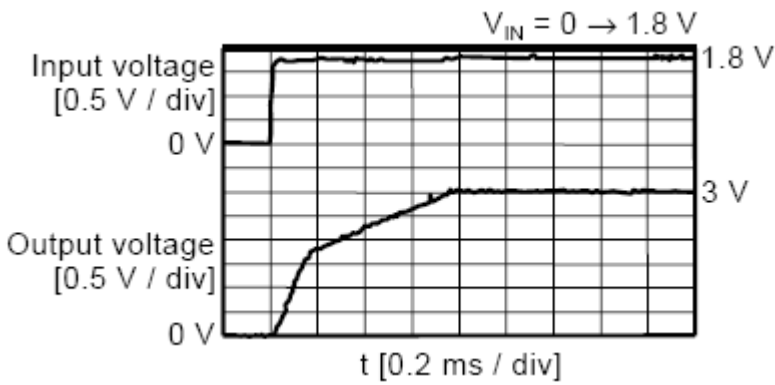
7. Temperature vs. Switching Current



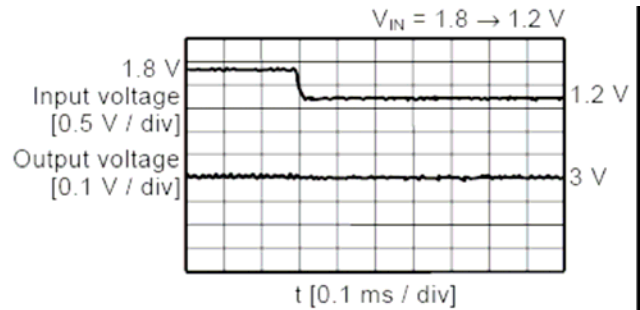
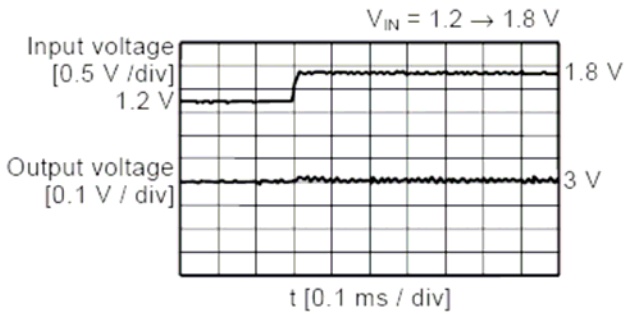
8. Temperature vs. Operation Start Voltage



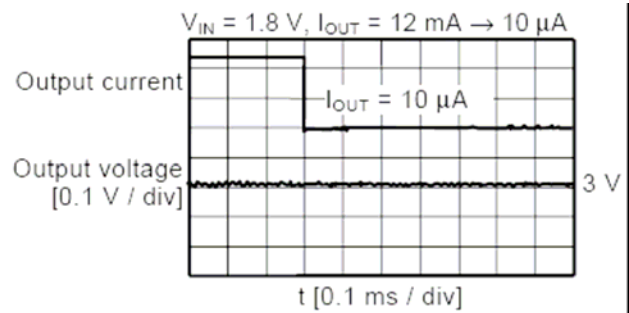
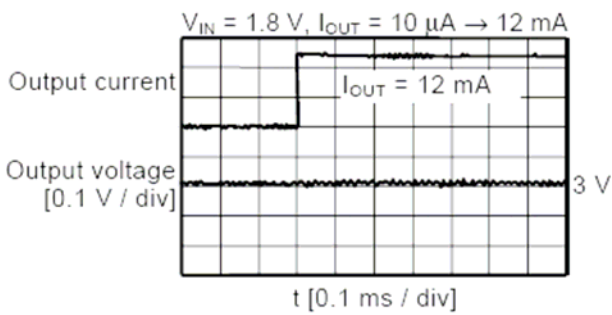
9. Power On



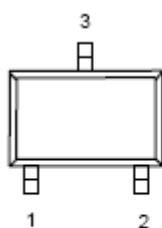
10. Power Supply Voltage Fluctuation ( $T_a=25^\circ\text{C}$ ,  $R_L=250 \Omega$ )



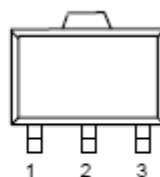
11. Load Current Fluctuation ( $T_a=25^\circ\text{C}$ )



## ■ Pin Configuration



SOT23-3  
(TOP VIEW)



SOT89-3  
(TOP VIEW)

**Remark** Please contact the Natlinear marketing department for other packages.

## ■ Pin Assignment

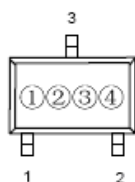
PIN NUMBER		PIN NAME	FUNCTION
SOT23-3	SOT89-3		
3	2	Vout	OUTPUT
1	1	Vss	GROUND
2	3	EXT	EXTERNAL TRANSISTOR CONNECTION

## ■ ORDERING INFORMATION

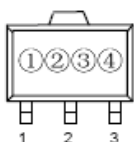
DESIGNATOR	SYMBOL	DESCRIPTION	DESIGNATOR	SYMBOL	DESCRIPTION
①	52	Indicates the product number	④	2	Output Voltage Accuracy e. g. 2: $\pm 2\%$
②③	15~70	Output Voltage e. g. 30:3.0V 50:5.0V	⑤	M	SOT23-3
				P	SOT89-3
			⑥	R	Embossed Tape :Standard Feed
L	Embossed Tape :Reverse Feed				

## ■ MARKING

### ● SOT23-3, SOT89-3



SOT23-3  
(TOP VIEW)



SOT89-3  
(TOP VIEW)

① Represents the product name

SYMBOL	PRODUCT NAME
A	SG9233****

② Represents the type of regulator

VOLTAGE (V)	0.1~3.0	3.1~6.0
SYMBOL	7	8

③ Represents the Output Voltage

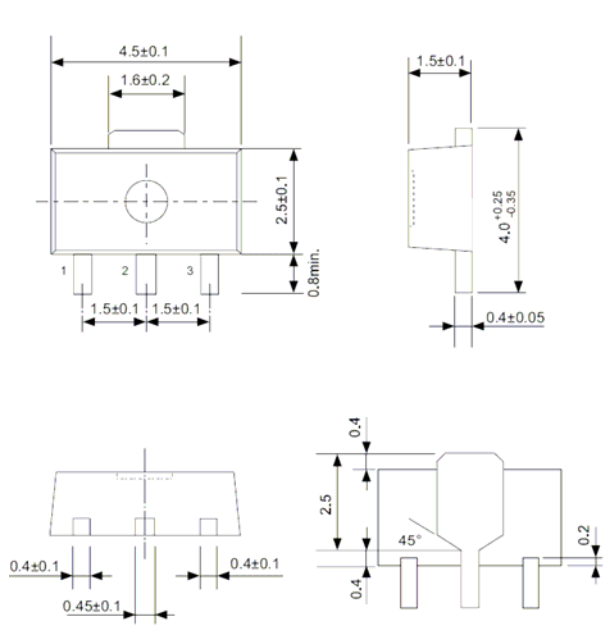
SYMBOL	OUTPUT VOLTAGE (V)			SYMBOL	OUTPUT VOLTAGE (V)		
0	-	3.1	-	F	1.6	4.6	-
1	-	3.2	-	H	1.7	4.7	-
2	-	3.3	-	K	1.8	4.8	-
3	-	3.4	-	L	1.9	4.9	-
4	-	3.5	-	M	2	5.0	-
5	-	3.6	-	N	2.1	5.1	-
6	-	3.7	-	P	2.2	5.2	-
7	-	3.8	-	R	2.3	5.3	-
8	-	3.9	-	S	2.4	5.4	-
9	-	4	-	T	2.5	5.5	-
A	-	4.1	-	U	2.6	5.6	-
B	-	4.2	-	V	2.7	5.7	-
C	-	4.3	-	X	2.8	5.8	-
D	-	4.4	-	Y	2.9	5.9	-
E	1.5	4.5	-	Z	3	6.0	-

④ Represents the assembly lot No.

0~9, A~Z repeated (G, I, J, O, Q, W expected)

■ PACKAGING INFORMATION

SOT-89-3



SOT23-3

