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## ULTRA-SMALL PACKAGE PWM/PFM SWITCHING CONTROL STEP-UP SWITCHING REGULATOR

### General Description

The ME2129 series is a CMOS step-up switching regulator which mainly consists of a reference voltage source, an oscillation circuit, an error amplifier, a phase compensation circuit, a PWM/PFM switching control circuit. Without the use of external low-ON-resistance Nch Power MOS, can be applied to need a high efficiency, high output current of the application circuit. The ME2129 series switches its operation to the PFM control circuit whose duty ratio is 15 % with to the PWM/PFM switching control circuit under a light load and to prevent decline in the efficiency by IC operation current.

### Features

- Low voltage operation: Start-up is guaranteed from 0.9 V(IOUT =1 mA )
- Duty ratio: Built-in PWM/PFM switching control circuit 15 to 78 % .
- oscillator frequency: 300KHz
- External parts: coil, diode, capacitor, and transistor
- Output voltage range: 1.5V ~ 20V
- Output voltage accuracy:  $\pm 2\%$
- Soft start function: 2 ms

### Applications

- Mobile phones (PDC, GSM, CDMA, IMT200 etc.)
- Bluetooth equipment
- PDA
- Portable communication modem
- Portable games
- Cameras
- Digital cameras
- Cordless phones
- Notebook computers

### Package

- 5-pin SOT23-5

Typical Application Circuit

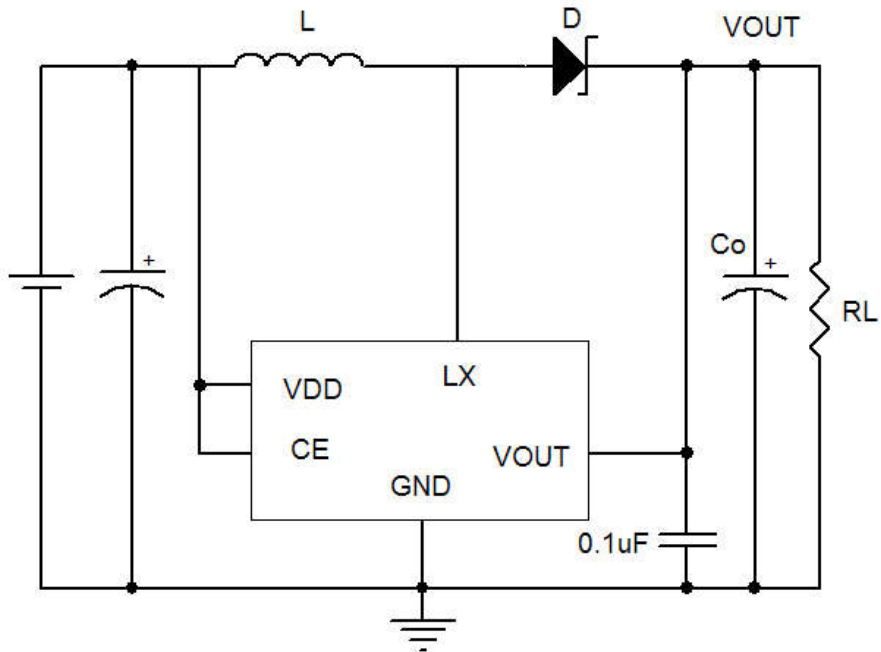


Fig.1 For use chip enable

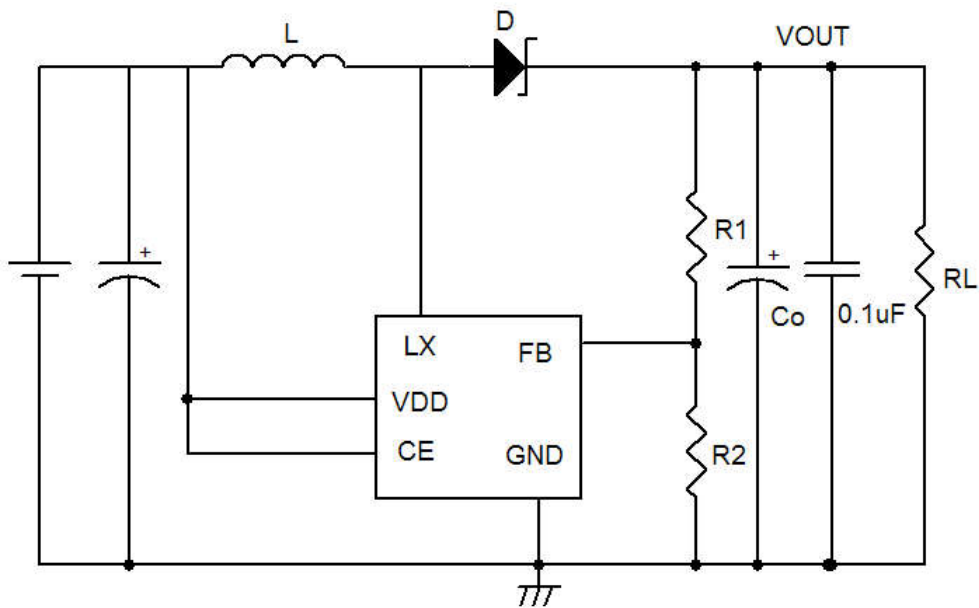
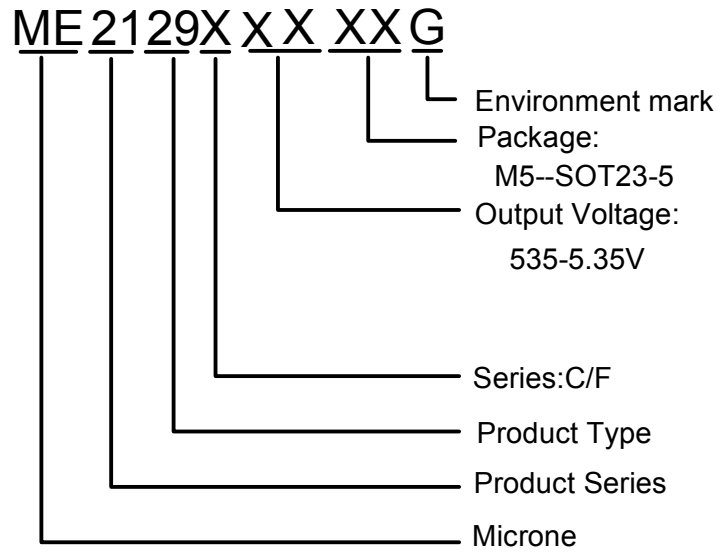


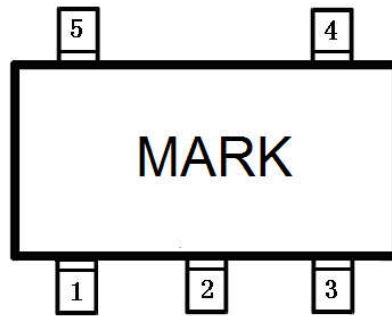
Fig.2 For Feedback and chip enable

Selection Guide



product series	switching transistor	CE function	VDD function	FB function	features
ME2129C535M5G	Build in Transistor	Yes	Yes	No	LX+ Enable
ME2129FM5G	Build in Transistor	Yes	Yes	Yes	LX+Feedback

## Pin Configuration



SOT-23-5

## Pin Assignment

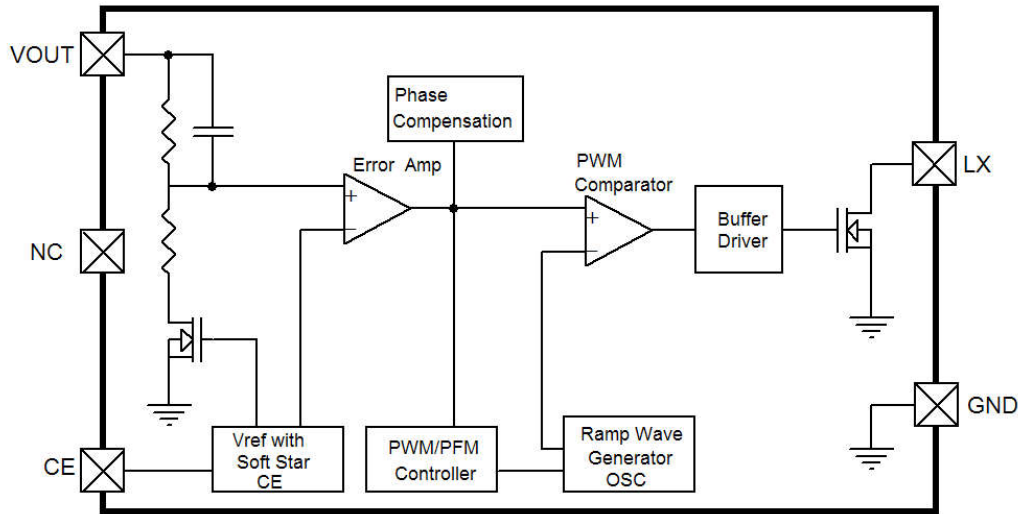
### ME2129CxxM5G

Pin Number	Pin Name	Function
SOT-23-5		
1	CE	Shutdown pin
2	LX	Swich
3	GND	GND pin
4	NC	NC
5	VOUT	Output voltage pin

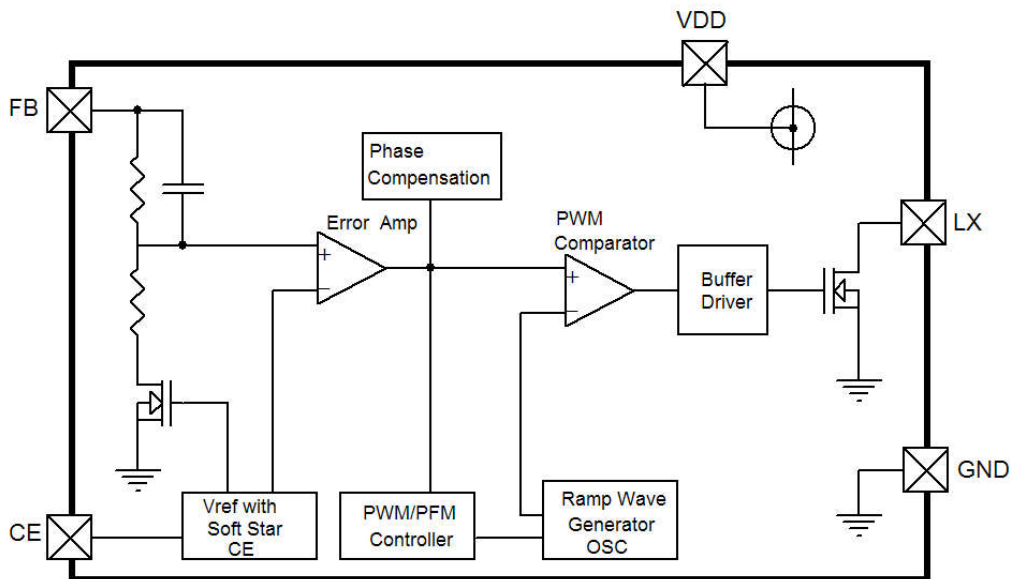
### ME2129FM5G

Pin Number	Pin Name	Function
SOT-23-5		
1	CE	Shutdown pin
2	LX	Swich
3	GND	GND pin
4	VDD	IC power supply pin
5	FB	Feed Back voltage pin

### Block Diagram



ME2129C Series



ME2129F Series

### Absolute Maximum Ranges

PARAMETER	SYMBOL	RATINGS	UNITS
VDD Pin Voltage	VDD	-0.3~6.5	V
LX Pin Voltage	LX	-0.3~20	V
VOUT Pin Voltage	VOUT	-0.3~6.5	V
CE Pin Voltage	VCE	-0.3~Vin+0.3	V
LX Pin Current	ILX	±1000	mA
Power Dissipation (SOT23-5)	Pd	300	mW
Operating Temperature Range	T <sub>Opr</sub>	-25~+85	°C
Storage Temperature Range	T <sub>stg</sub>	-40~+125	°C

## Electrical Characteristics

### ME2129CxxG

Measuring conditions:  $V_{DD}=V_{OUT(S)} \times 0.6$ ,  $I_{OUT}=100\text{mA}$ ,  $V_{CE}=V_{DD}$ ,  $T_{opt}=25^{\circ}\text{C}$ . Unless otherwise specified.

Parameter	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	CIRCUIT	
Output voltage	VOUT	-	$V_{OUT(S)} \times 0.98$	$V_{OUT(S)}$	$V_{OUT(S)} \times 1.02$	V	2	
Input voltage	VDD	-	-	-	6	V	2	
Operation start voltage	VST	$I_{OUT}=1\text{mA}$	-	-	0.9	V	2	
Operation holding voltage	VHLD	$I_{OUT}=1\text{mA}$ , Measured by decreasing $V_{IN}$ voltage gradually	0.7	-	-	V	2	
Current consumption 1	ISS1	$V_{OUT}=V_{OUT(S)} \times 0.95$	-	2.3	-	mA	1	
Current consumption 2	ISS2	$V_{OUT}=V_{OUT(S)}+0.5\text{V}$	-	20	-	$\mu\text{A}$	1	
Current consumption during shutdown	ISSS	$V_{CE}=0\text{V}$	-	0.1	0.5	$\mu\text{A}$	1	
Line regulation	$\Delta V_{OUT1}$	$V_{DD}=V_{OUT(S)} \times 0.4 \sim \times 0.6$	-	30	-	mV	2	
Load regulation	$\Delta V_{OUT2}$	$I_{OUT}=10\mu\text{A} \sim V_{OUT}/50 \times 1.25$	-	35	-	mV	2	
Output voltage temperature coefficient		$T_a=-25 \sim 85^{\circ}\text{C}$	-	$\pm 50$	-	ppm/ $^{\circ}\text{C}$	2	
Oscillation frequency	fosc	$V_{OUT}=V_{OUT(S)} \times 0.95$	255	300	345	kHz	1	
Max. duty ratio	MAXDUTY	$V_{OUT}=V_{OUT(S)} \times 0.95$	-	78	-	%	1	
PWM/PFM switching duty ratio	PFMDUTY	$V_{DD}=V_{OUT(S)}-0.1\text{V}$ , no load	-	15	-	%	1	
Shutdown pin input voltage	VSH	Measured the oscillation at EXT pin	0.75	-	-	V	1	
	VSL1	Judged the stop of oscillation at EXT pin	$V_{OUT} \geq 1.5\text{V}$	-	-	0.3	V	1
	VSL2		$V_{OUT} < 1.5\text{V}$	-	-	0.2	V	1
Shutdown pin input voltage	ISH	$V_{CE}=V_{OUT(S)} \times 0.95$	-0.1	-	0.1	$\mu\text{A}$	1	
	ISL	$V_{CE}=0\text{V}$	-0.1	-	0.1	$\mu\text{A}$	1	
Soft start time	tss	-		2		mS	2	
Efficiency	EFFI	-		85		%	2	

**ME2129FxxG**

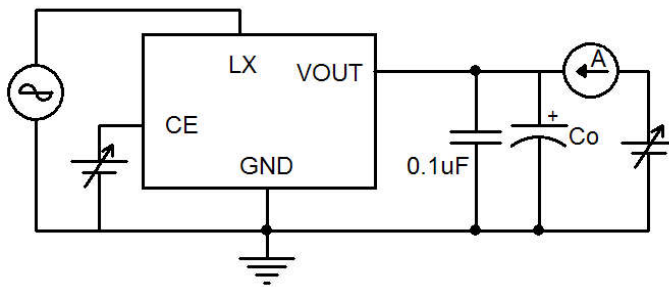
Measuring conditions: VDD=VCE=3.3V, Topt=25°C。 Unless otherwise specified.

Parameter	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	CIRCUIT
Feed back voltage	VFB	-	1.225	1.25	1.275	V	4
Input voltage	VDD	-		-	6	V	4
Operation start voltage	VST	IOUT=1mA	-	-	0.9	V	4
Operation holding voltage	VHLD	IOUT=1mA, Measured by decreasing VIN voltage gradually	0.7	-	-	V	4
Current consumption 1	ISS1	VFB=VFB(S)× 0.95	-	1.5	-	mA	3
Current consumption 2	ISS2	VFB=1.5V	-	15	-	uA	3
Current consumption during shutdown	ISSS	VCE=0V	-	0.01	0.5	uA	3
Feed back voltage temperature coefficient		Ta=-25—85°C	-	±50	-	ppm/°C	4
Oscillation frequency	fosc	VFB=VFB(S)× 0.95-	255	300	345	kHz	3
Max. duty ratio	MAXDUTY	VFB=VFB(S)× 0.95	-	78	-	%	3
PWM/PFM switching duty ratio	PFMDUTY	VFB=VFB(S)× 1.5, no load	-	15	-	%	3
Shutdown pin input voltage	VSH	Measured the oscillation at LX pin	0.75	-	-	V	3
	VSL1	Judged the stop of oscillation at LX pin   VOUT≥1.5V	-	-	0.3	V	3
Shutdown pin input voltage	ISH	VCE=VFB(S)×0.95	-0.1	-	0.1	uA	3
	ISL	VCE=0V	-0.1	-	0.1	uA	3
Soft start time	tss	-	-	2	-	mS	4
Efficiency	EFFI	-	-	85	-	%	4

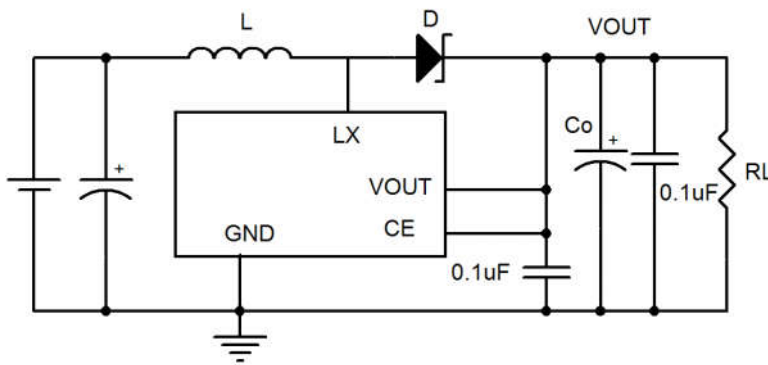
1. VOUT(S) is the set output voltage value, and VOUT is the typical value of the output voltage.
2. VOUT(S) can be set by using the rate of VFB and output voltage setting resistors (R1, R2).
3. VFB(S) is the set output voltage value.
4. This product from the start when the VDD=0.9V booster work, but in order to stabilize the output voltage and oscillation frequency, to control the VDD,  $1.8V \leq VDD < 6V$ .

Test Circuit

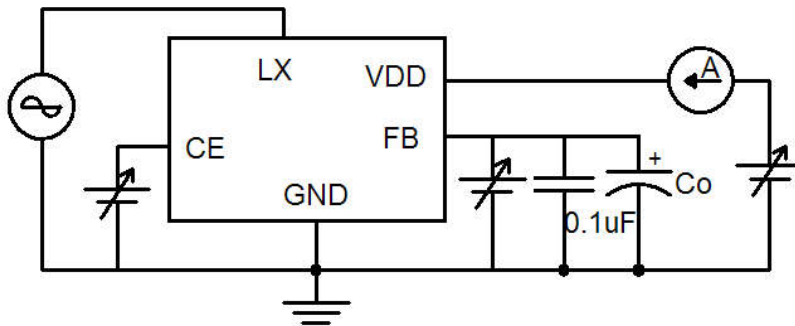
1.



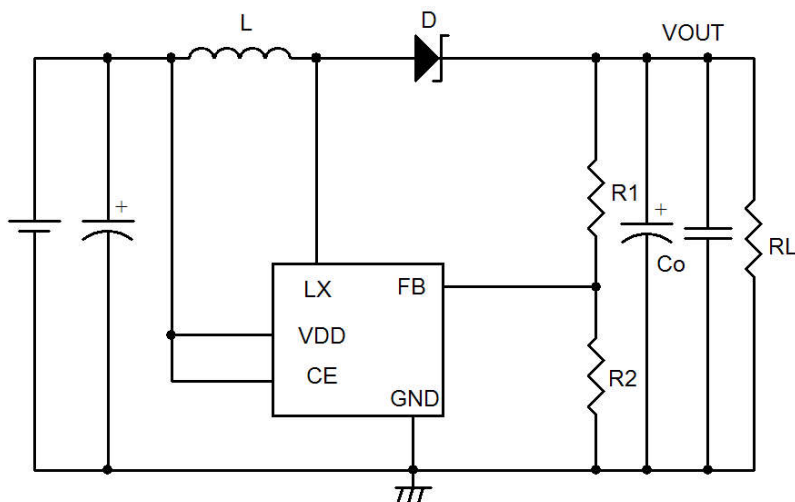
2.



3.



4.





### External parts (suggest)

- 1、 Diode use Schottky diode such as IN5817 or IN5819 (forward voltage drop:0.2V)
- 2、 Inductor: 22 $\mu$ H ( $r < 0.5\Omega$ )
- 3、 Capacitor: Tantalum type 47 $\mu$ F
- 4、 Feed back resistors:  $R1 + R2 < 50K$

### External parts selection for DC/DC converter

The relationship between major characteristics of the step-up circuit and characteristics parameters of the external parts are shown in Figure 1.

For larger output current?	For hight efficiency?		For smaller ripple voltage?
	Operation efficiency	Stand-by efficiency	
Smaller inductance	Larger inductance		
Smaller DC resisance of inductor			
Large output capacitance			Large output capacitance

Figure 1 Relationship between major characteristics of the step-up circuit and external parts

#### 1. Inductor

An inductance has strong influence on maximum output current  $I_{OUT}$  and efficiency  $\eta$ .

Figure 2 shows the relation between  $I_{OUT}$ , and  $\eta$  characteristics to L of ME2129.

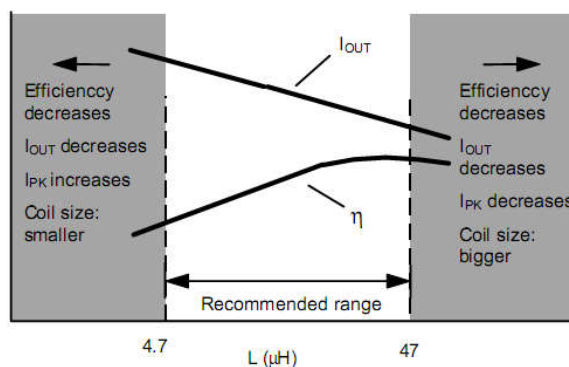


Figure 2 L— $I_{OUT}$  and  $\eta$  characteristics

The peak current ( $I_{PK}$ ) increases by decreasing L and the stability of a circuit improves and  $I_{OUT}$  increases. If L is furthermore made small, efficiency falls and in running short,  $I_{OUT}$  decreases. (Based on the current drive capability of external switching transistor.)

The loss of  $I_{PK}$  by the switching transistor decreases by increasing L and the efficiency becomes maximum at

a certain L value. Further increasing L decreases efficiency due to the loss of DC resistance of the coil. Also, I<sub>OUT</sub> decreases, too.

Oscillation frequency is higher, smaller one can be chosen and also makes coil smaller. The recommended inductances are 22 to 100 μH inductor for ME2129.

Choose a value for L by referring to the reference data because the maximum output current is due to the input voltage in an actual case. Choose an inductor so that I<sub>PK</sub> does not exceed the allowable current. Exceeding the allowable current of the inductor causes magnetic saturation, remarkable low efficiency and destruction of the IC chip due to a large current.

I<sub>PK</sub> in uncontinuous mode is calculated from the following equation

$$I_{PK} = \sqrt{\frac{2I_{OUT}(V_{OUT} + V_D - V_{IN})}{f_{OSC} \cdot L}} (A)$$

f<sub>osc</sub> = oscillation frequency, V<sub>D</sub> ≈ 0.4 V.

## 2. Diode

Use an external diode that meets the following requirements:

- Low forward voltage: (V<sub>F</sub> < 0.3 V)
- High switching speed: (50 ns max.)
- Reverse voltage: V<sub>OUT</sub> + V<sub>F</sub> or more
- Rated current: I<sub>PK</sub> or more

## 3. Capacitor (C<sub>IN</sub>, C<sub>O</sub>)

A capacitor at the input side (C<sub>IN</sub>) improves the efficiency by reducing the power impedance and stabilizing the input current. Select a C<sub>IN</sub> value according to the impedance of the power supply used.

A capacitor at the output side (C<sub>O</sub>) is used for smoothing the output voltage. For step-up types, the output voltage flows intermittently to the load current so that step-up types need a larger capacitance than step-down types. Therefore, select an appropriate capacitor depending on the ripple voltage that increases in case of a higher output voltage or a higher load current. The capacitor value should be 10 μF minimum.

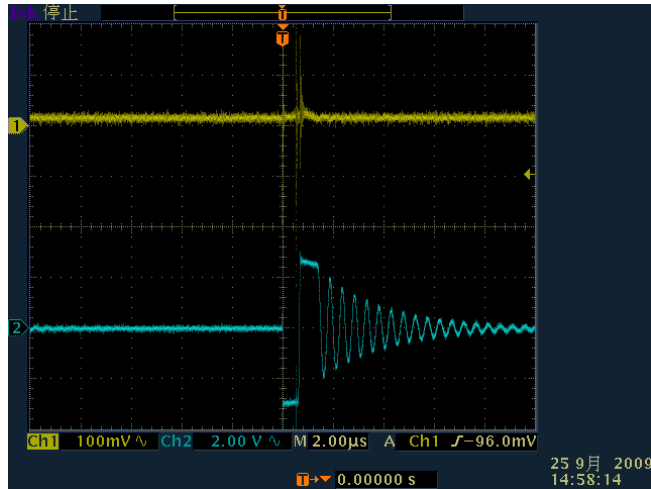
Select an appropriate capacitor with an ESR (Equivalent Series Resistance) for stable output voltage. A stable range of the voltage at this IC depends on the ESR. Although the inductance (L) is also a factor, an ESR of 30 mΩ to 500 mΩ draws out the characteristics. However, the best ESR may depend on L, capacitance, wiring and applications (output load). Therefore, fully evaluate ESRs under an actual condition to determine the best value.

## 4. Precautions

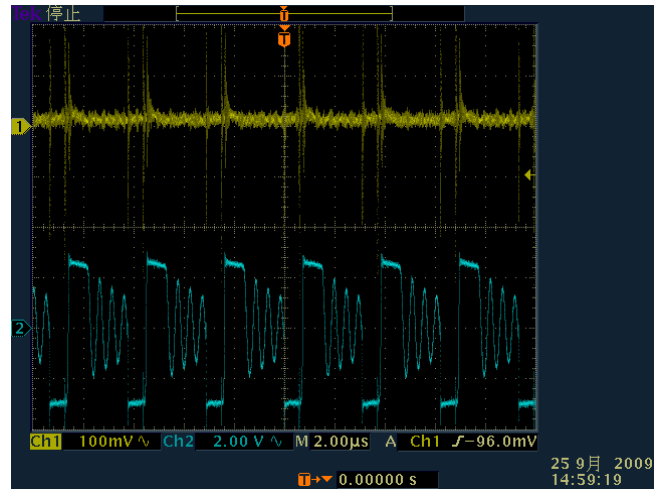
- Mount external capacitors, a diode, and a coil as close as possible to the IC.
- Unique ripple voltage and spike noise occur in switching regulators. Because they largely depend on the coil and the capacitor used, check them using an actually mounted model.
- Make sure dissipation of the switching transistor (especially at a high temperature) does not exceed the allowable power dissipation of the package.
- The performance of this IC varies depending on the design of the PCB patterns, peripheral circuits and external parts. Thoroughly test all settings with your device. Also, try to use recommended external parts.

## Typical Performance Characteristics

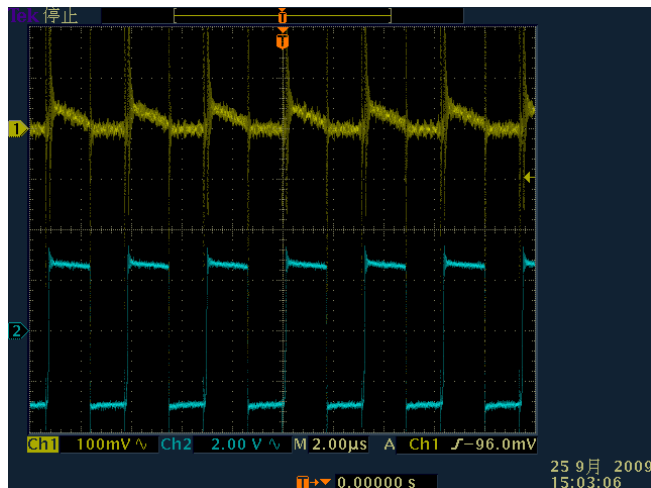
### 1. Output Waveforms



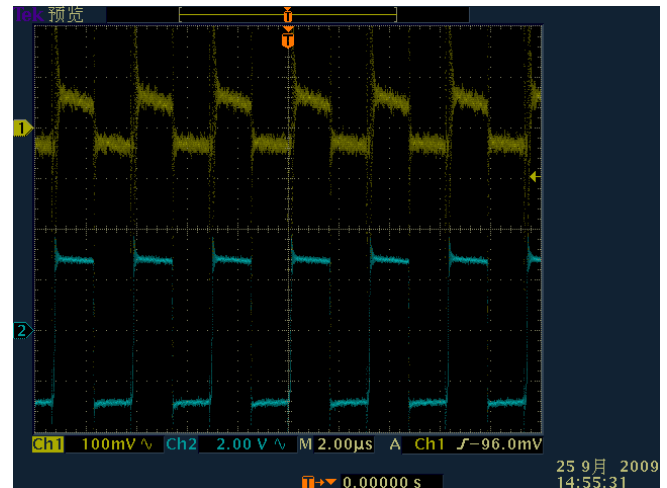
I<sub>out</sub>=1mA



I<sub>out</sub>=10mA



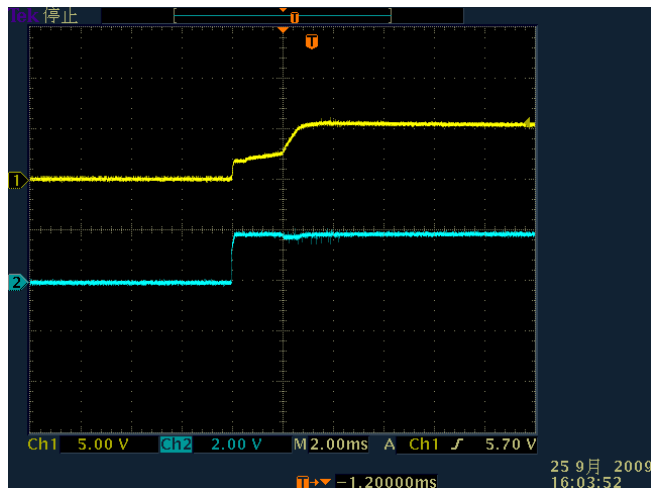
I<sub>out</sub>=100mA



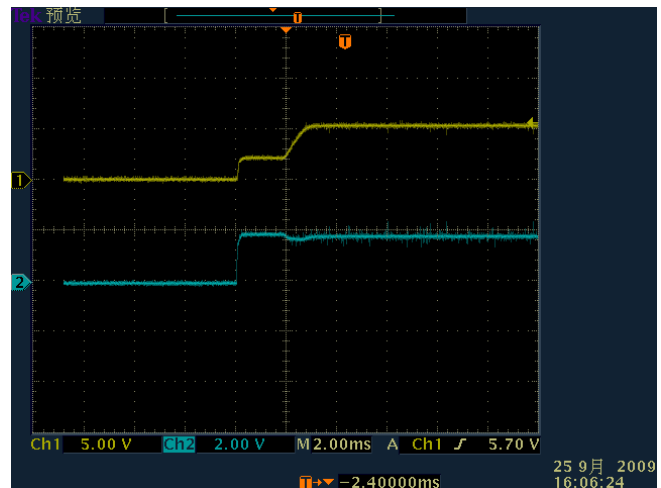
I<sub>out</sub>=200mA

### 2. Transient Response characteristics

#### (1) Powering ON (V<sub>in</sub>: 0→2V)

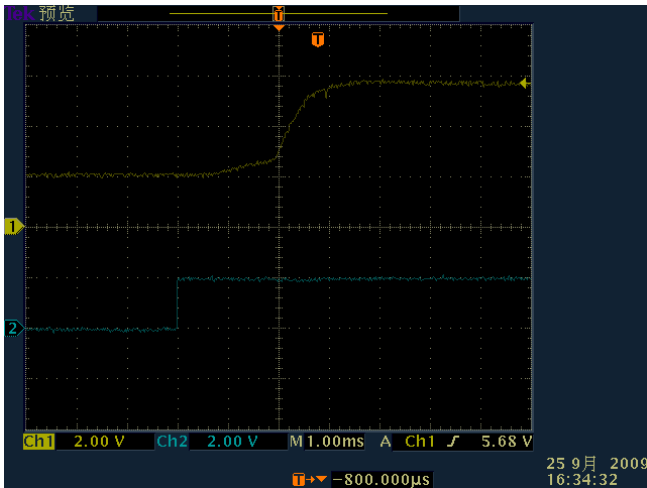


I<sub>out</sub>=1mA

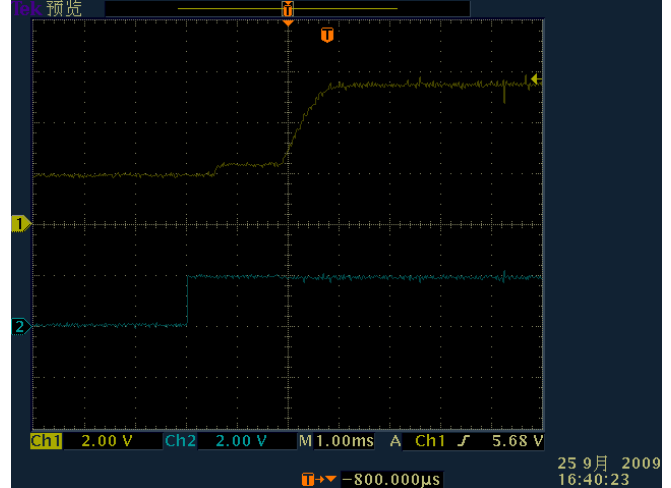


I<sub>out</sub>=100mA

(2) Responses of CE pin (CE: 0→2V)

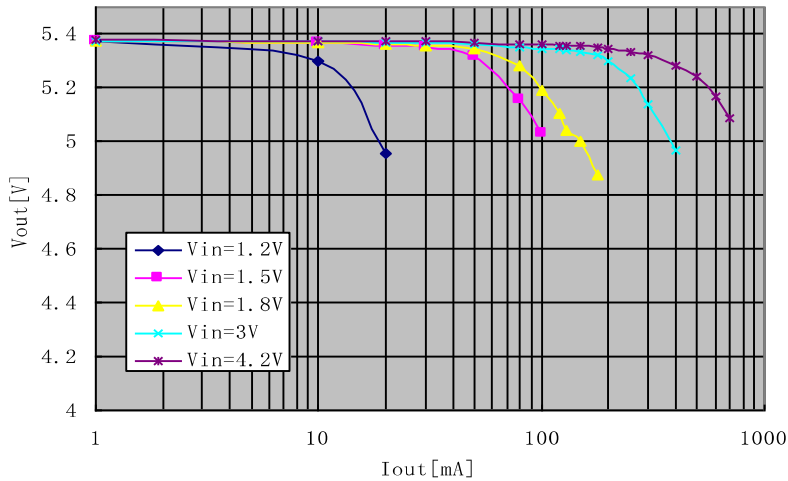


Iout=1mA

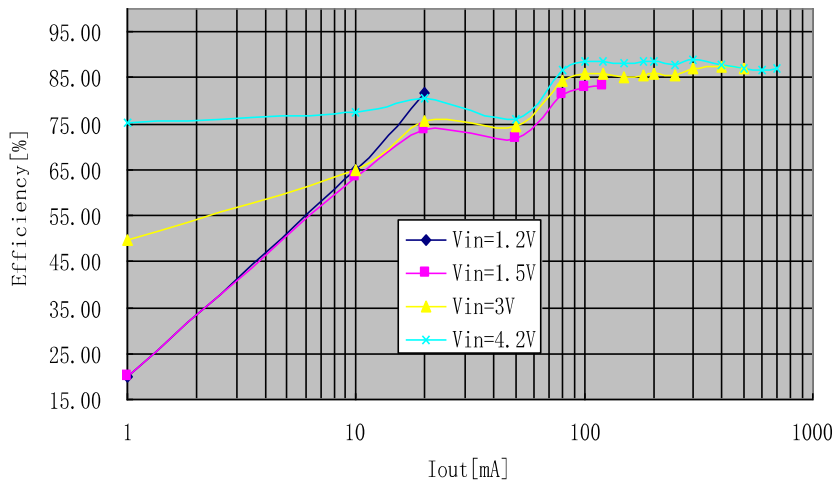


Iout=100mA

3. Output Current vs. Output Voltage

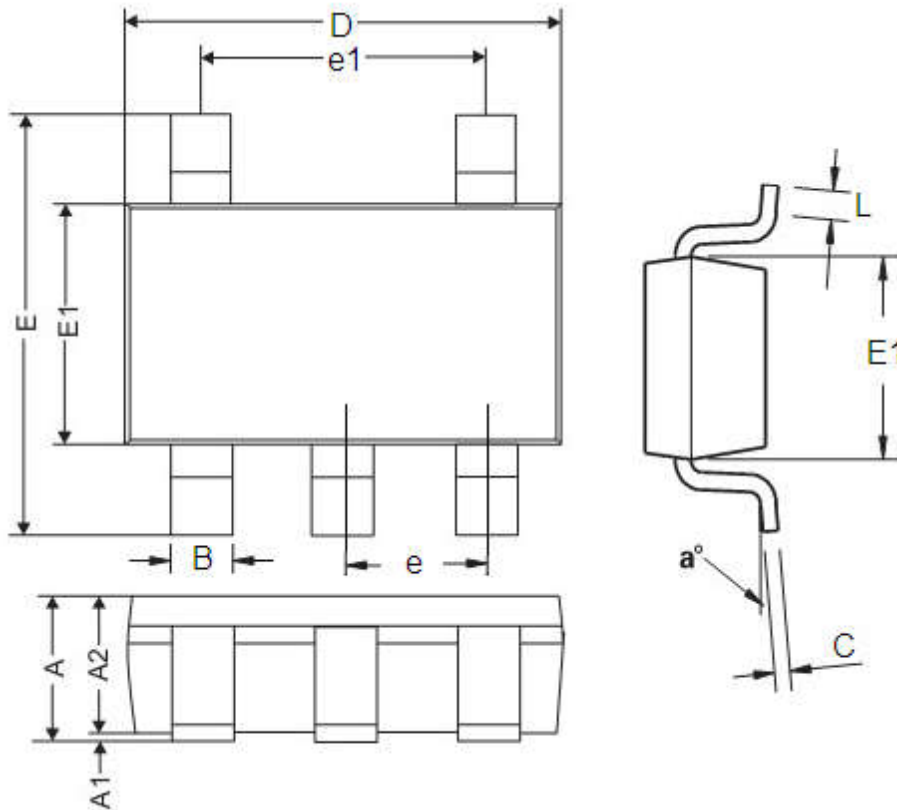


4. Output Current vs. Efficiency



## Packaging Information

● SOT23-5



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	0.9	1.45	0.0354	0.0570
A1	0	0.15	0	0.0059
A2	0.9	1.3	0.0354	0.0511
B	0.2	0.5	0.0078	0.0196
C	0.09	0.26	0.0035	0.0102
D	2.7	3.10	0.1062	0.1220
E	2.2	3.2	0.0866	0.1181
E1	1.30	1.80	0.0511	0.0708
e	0.95REF		0.0374REF	
e1	1.90REF		0.0748REF	
L	0.10	0.60	0.0039	0.0236
a°	0°	30°	0°	30°

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