# 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：<20V
- Output voltage accuracy：±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

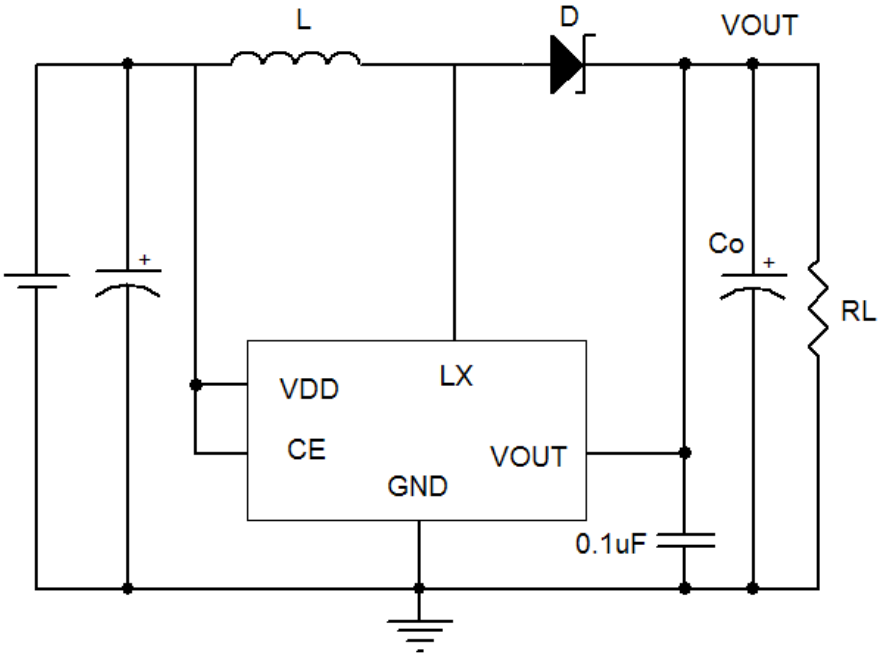



**Fig.1** For use chip enable

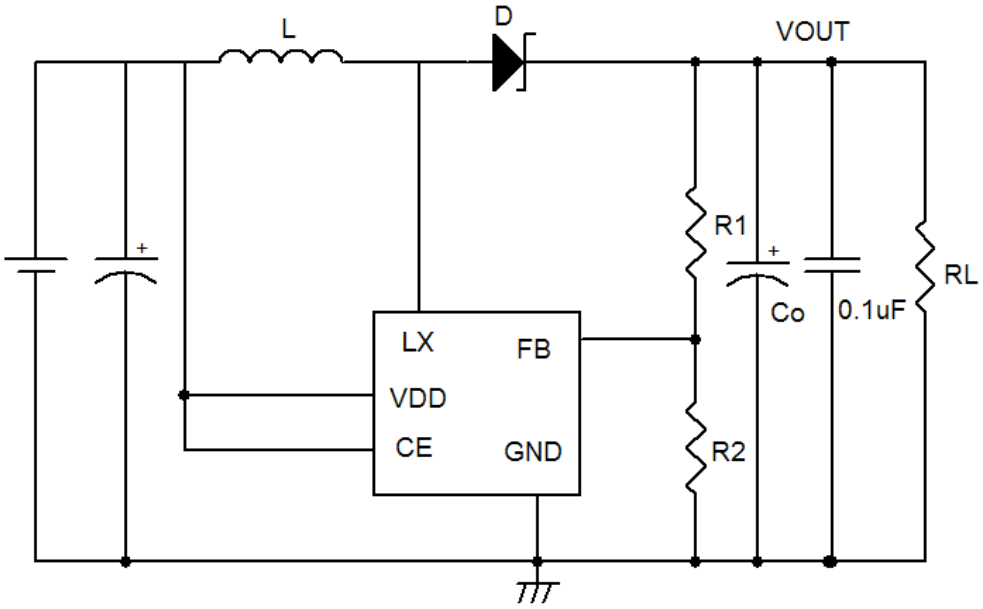
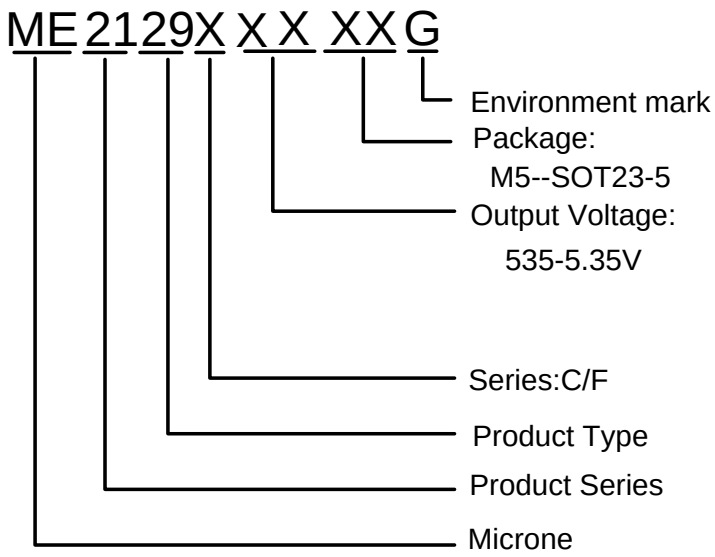


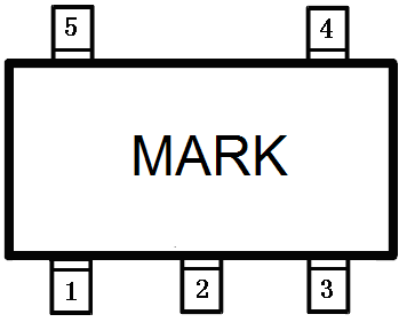

**Fig.2** For Feedback and chip enable

## 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

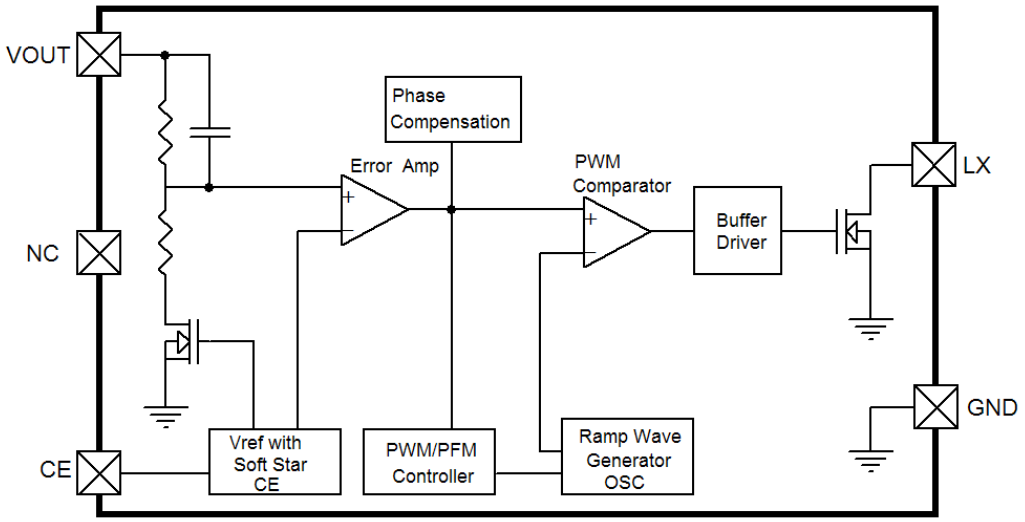
**ME2129CxxM5G**

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

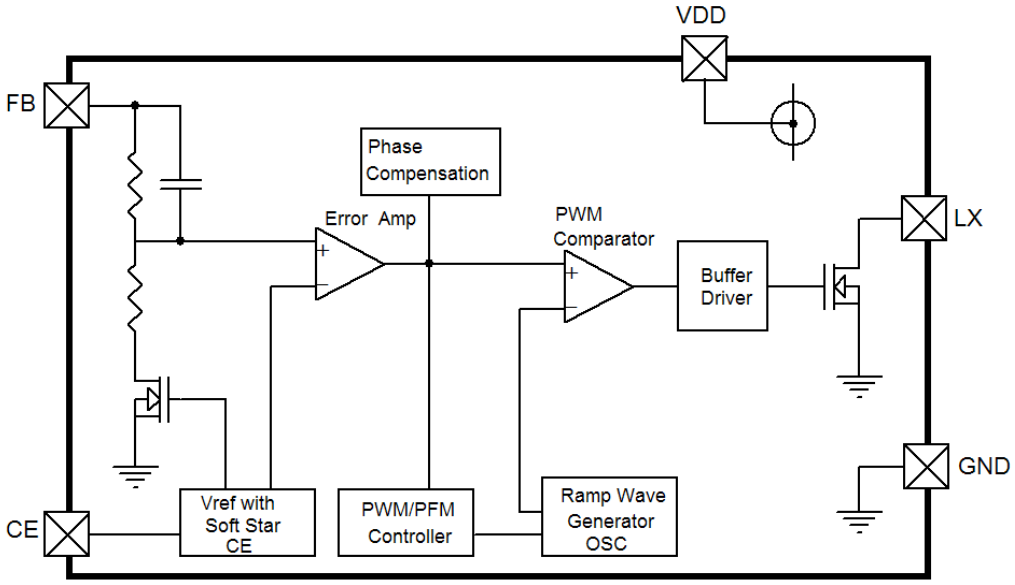
**ME2129FM5G**

| Pin Number SOT-23-5 | Pin Name | Function |
|---|---|---|
| 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 Rangs

| PARAMETER | SYMBOL | RATINGS | UNITS |
|---|---|---|---|
| VDD Pin Voltage | VDD | -0.3～6.5 | V |
| LX Pin Voltage | LX | -0.3～VDD+0.3 | V |
| CE Pin Voltage | VCE | -0.3～VDD+0.3 | V |
| LX Pin Voltage | ILX | ±1000 | mA |
| Power Dissipation (SOT23-5) | Pd | 300 | mW |
| OperatingTemperature Range | $T_{Opr}$ | -25~+85 | ℃ |
| StorageTemperature Range | $T_{stg}$ | -40~+125 | ℃ |

# Electrical Characteristics

## ME2129CxxG

Measuring conditions：VDD=VOUT(S)X0.6,IOUT=100mA,VCE=VDD，Topt=25℃。Unless otherwise specified。

| Parameter | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS | CIRCUIT |
|---|---|---|---|---|---|---|---|---|
| Output voltage | VOUT | - | | VOUT(S) X0.98 | VOUT(S) | VOUT(S) X1.02 | V | 2 |
| Input voltage | VDD | - | | - | - | 6 | V | 2 |
| Operation start voltage | VST | IOUT=1mA | | - | - | 0.9 | V | 2 |
| Operation holding voltage | VHLD | IOUT=1mA，Measured by decreasing VIN voltage gradually | | 0.7 | - | - | V | 2 |
| Current consumption 1 | ISS1 | VOUT=VOUT(S)× 0.95 | | - | 2.3 | - | mA | 1 |
| Current consumption 2 | ISS2 | VOUT=VOUT(S)+0.5V | | - | 20 | - | uA | 1 |
| Current consumption during shutdown | ISSS | VCE=0V | | - | 0.1 | 0.5 | uA | 1 |
| Line regulation | △VOUT1 | VDD=VOUT(S)×0.4～×0.6 | | - | 30 | - | mV | 2 |
| Load regulation | △VOUT2 | IOUT=10uA～VOUT/50×1.25 | | - | 35 | - | mV | 2 |
| Output voltage temperature coefficient | | Ta=-25—85℃ | | - | ±50 | - | ppm/℃ | 2 |
| Oscillation frequency | fosc | VOUT=VOUT(S)× 0.95- | | 255 | 300 | 345 | kHz | 1 |
| Max. duty ratio | MAXDUTY | VOUT=VOUT(S)× 0.95 | | - | 78 | - | % | 1 |
| PWM/PFM switching duty ratio | PFMDUTY | VDD=VOUT(S)-0.1V, 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 | VOUT≥1.5V | - | - | 0.3 | V | 1 |
| | VSL2 | | VOUT<1.5V | - | - | 0.2 | V | 1 |
| Shutdown pin input voltage | ISH | VCE= VOUT(S) × 0.95 | | -0.1 | - | 0.1 | uA | 1 |
| | ISL | VCE=0V | | -0.1 | - | 0.1 | uA | 1 |
| Soft start time | tss | - | | | 2 | | mS | 2 |
| Efficiency | EFFI | - | | | 85 | | % | 2 |

## ME2129FxxG

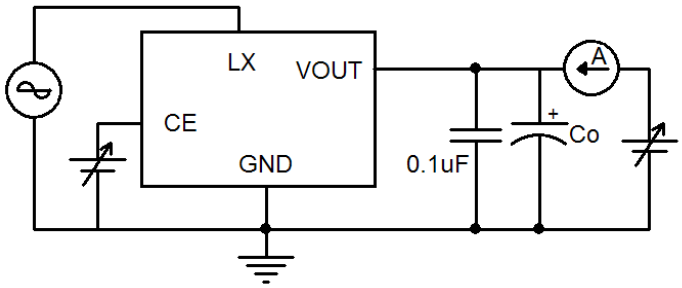
Measuring conditions：VDD=VCE=3.3V，Topt=25℃。Unless otherwise specified。

| 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℃ | - | ±50 | - | ppm/℃ | 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 |

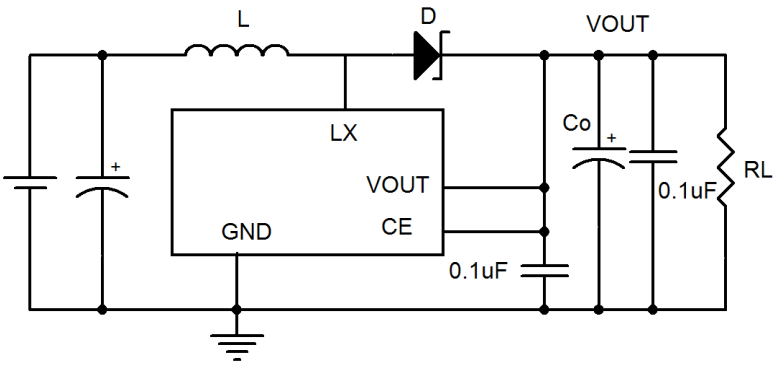
1. VOUT(S) is the set output voltage value,and VOUT is the typital value of the output voltage.
2. VOUT(S) can be set by using the rate of VFB and output voltage setting resisitors(R1,R2).
3. VFB(S) is the set output voltage value.
4. This product from the start when the VDD=0.9V booster work ,but in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

## Test Circuit

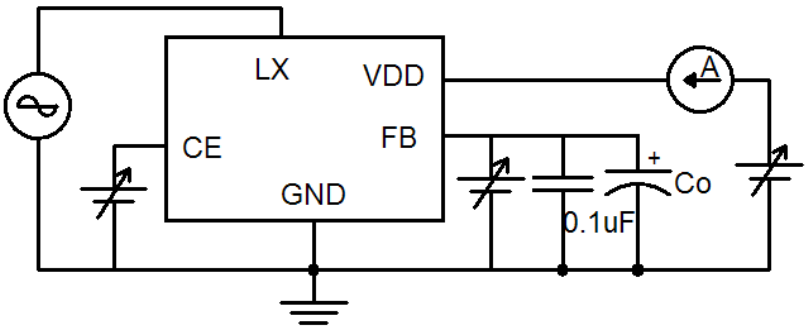
**1.**



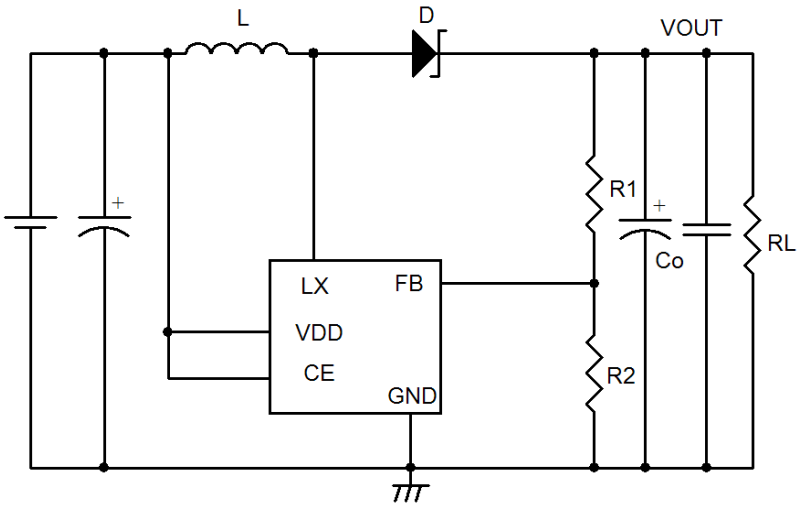

**2.**




**3.**




**4.**



## External parts（suggest）

1、Diode use Schottky diode such as IN5817 or IN5819 (forward voltage drop:0.2V)
2、Inductor：22μH（r<0.5Ω）
3、Capacitor：Tantalum type 47uF

## 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.

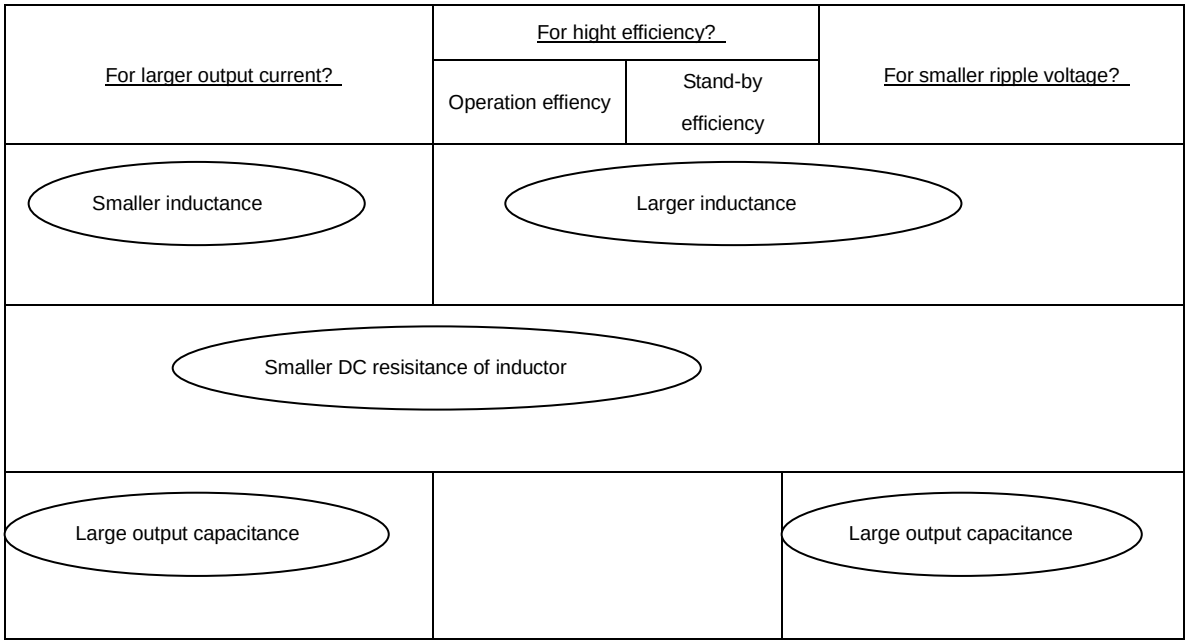



Figure 1 Relationship between major characterstics of the step-up circuit and external parts

**1. Inductor**

An inductance has strong influence on maximum output current IOUT and efficiency η.1.
Figure 2 shows the relation between IOUT, and η characteristics to L of ME2129.

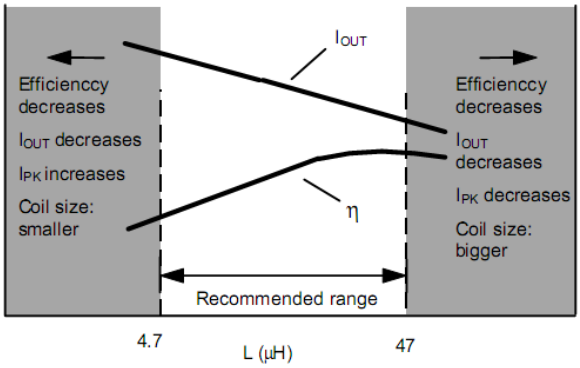



Figure 2 L－IOUT and η characteristics

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

The loss of IPK 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, IOUT decreases, too.

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

Choose a value for L by refering to the reference data because the maximum output current is due to the input voltage in an actual case. Choose an inductor so that IPK 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.

$I_{PK}$ in uncontinuous mode is caluculated from the following equatuon

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

fosc = oscillation frequency, $V_D \cong 0.4$ V.

**2. Diode**

Use an external diode that meets the following requirements:

• Low forward voltage: ($V_F$<0.3 V)
• High switching speed: (50 ns max.)
• Reverse voltage: $V_{OUT}$ + $V_F$ or more
• Rated current: $I_{PK}$ or more

**3. Capacitor ($C_{IN}$, $C_O$)**

A capacitor at the input side ($C_{IN}$) improves the efficiency by reducing the power impedance and stabilizing the input current. Select a CIN value according to the impedance of the power supply used.

A capacitor at the output side ($C_O$) 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.

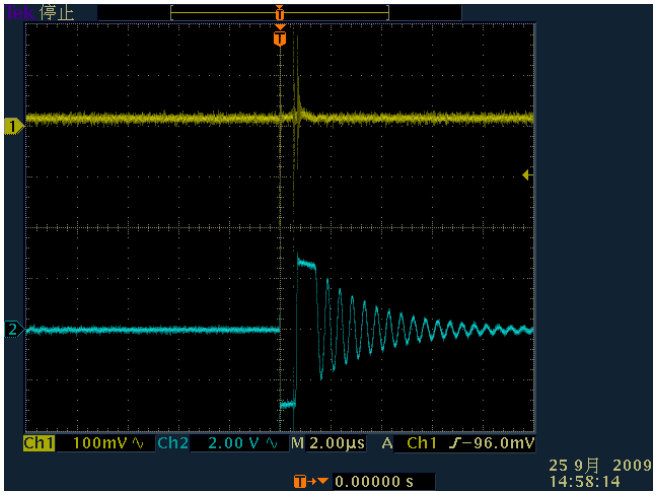
Select an appropriate capacitor with an ESR (Equivalent Series Resistance) for stable output voltage. A stable range of the volatge at this IC depends on the ESR. Although the inductance (L) is also a factor, an ESR of 30 mΩ to 500 mΩ draws out the characteristics. However, the best ESR may depend on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

## 4. Precautions

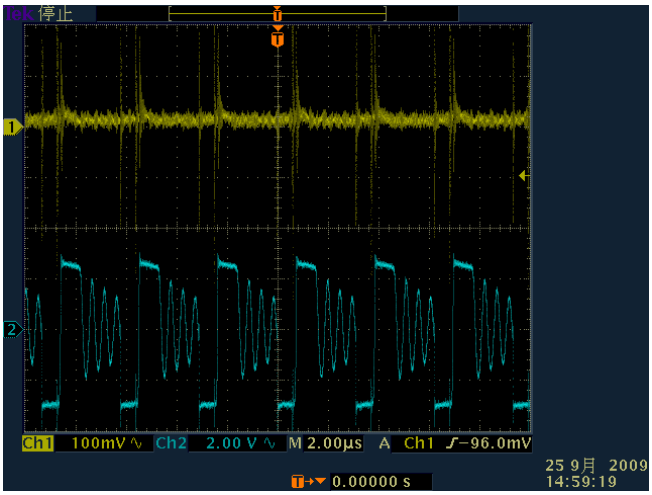
● Mount external capacitors, a diode, and a coil as close as possible to the IC.
● Unique ripple voltage and spike noise occur in switching regulators. Because they largely depend on the coil and the capacitor used, check them using an actually mounted model.
●Make sure dissipation of the switching transistor (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

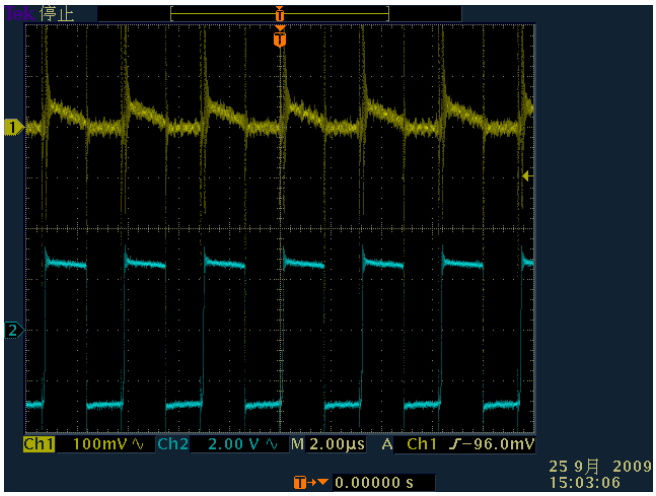
## 1. Output Waveforms



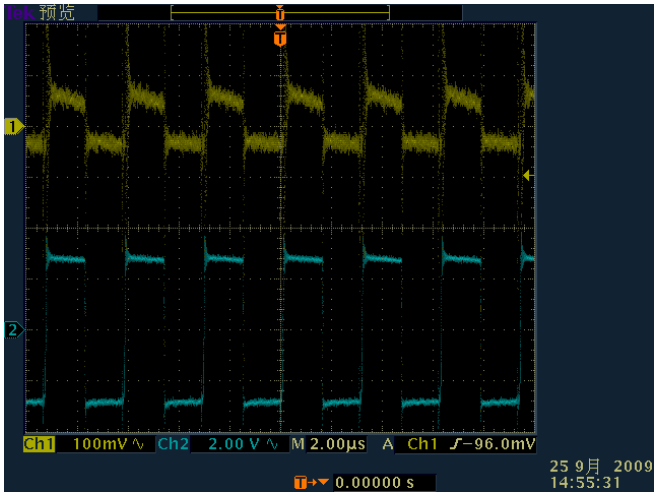

Iout=1mA




Iout=10mA



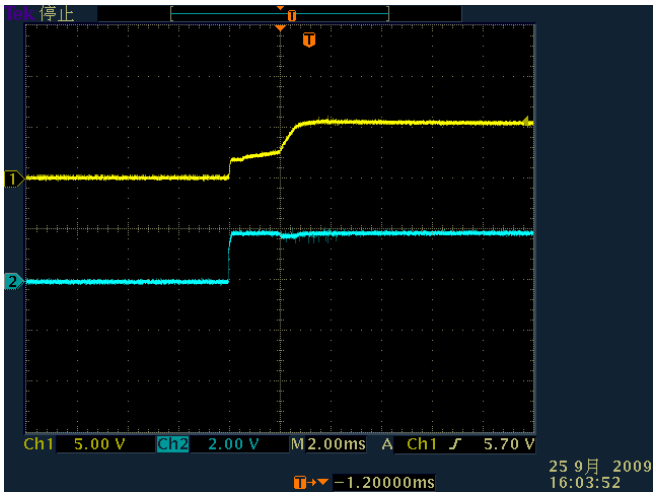

Iout=100mA



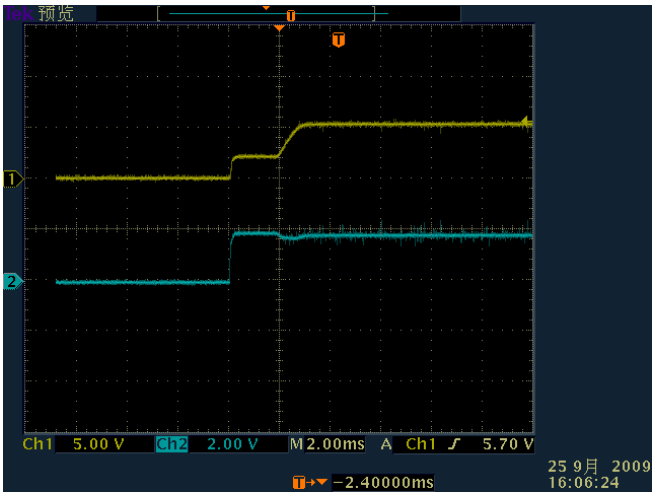

Iout=200mA

## 2. Transient Response characteristics

### （1）Powering ON（Vin: 0→2V）

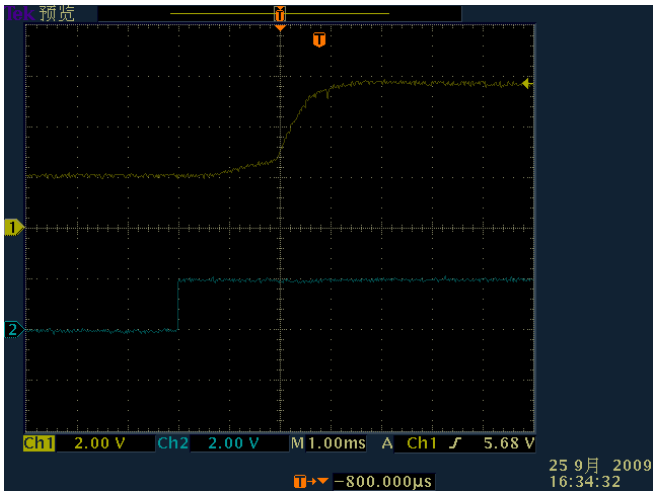



Iout=1mA

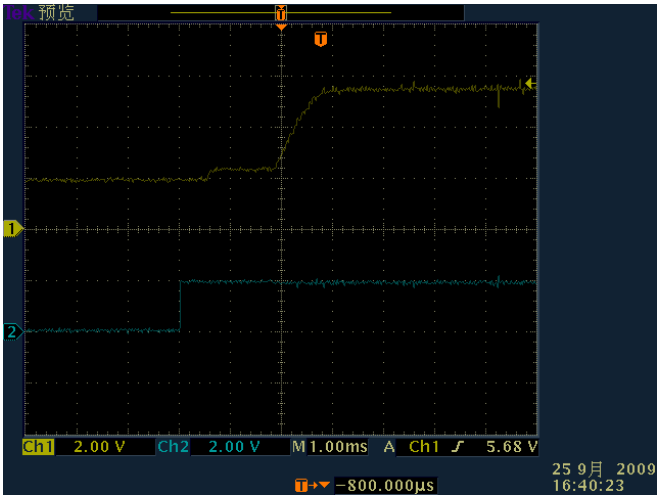



Iout=100mA

**（2）Responses of CE pin（CE: 0→2V）**

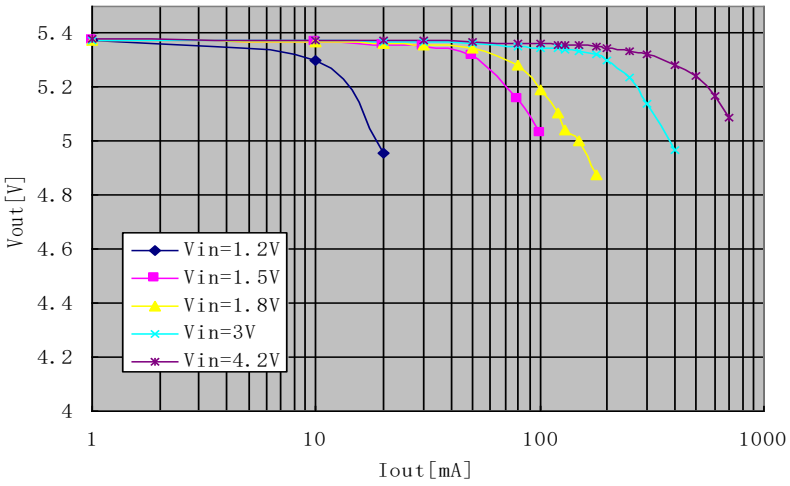



Iout=1mA

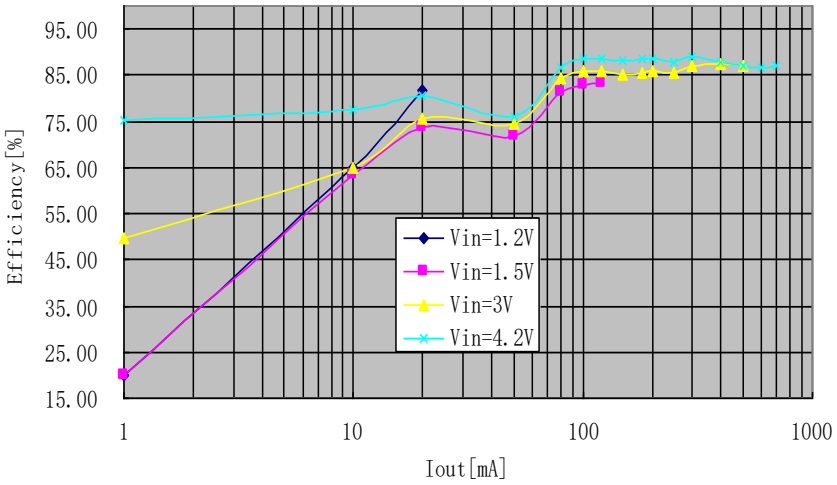



Iout=100mA

### 3. Output Current vs. Output Voltage

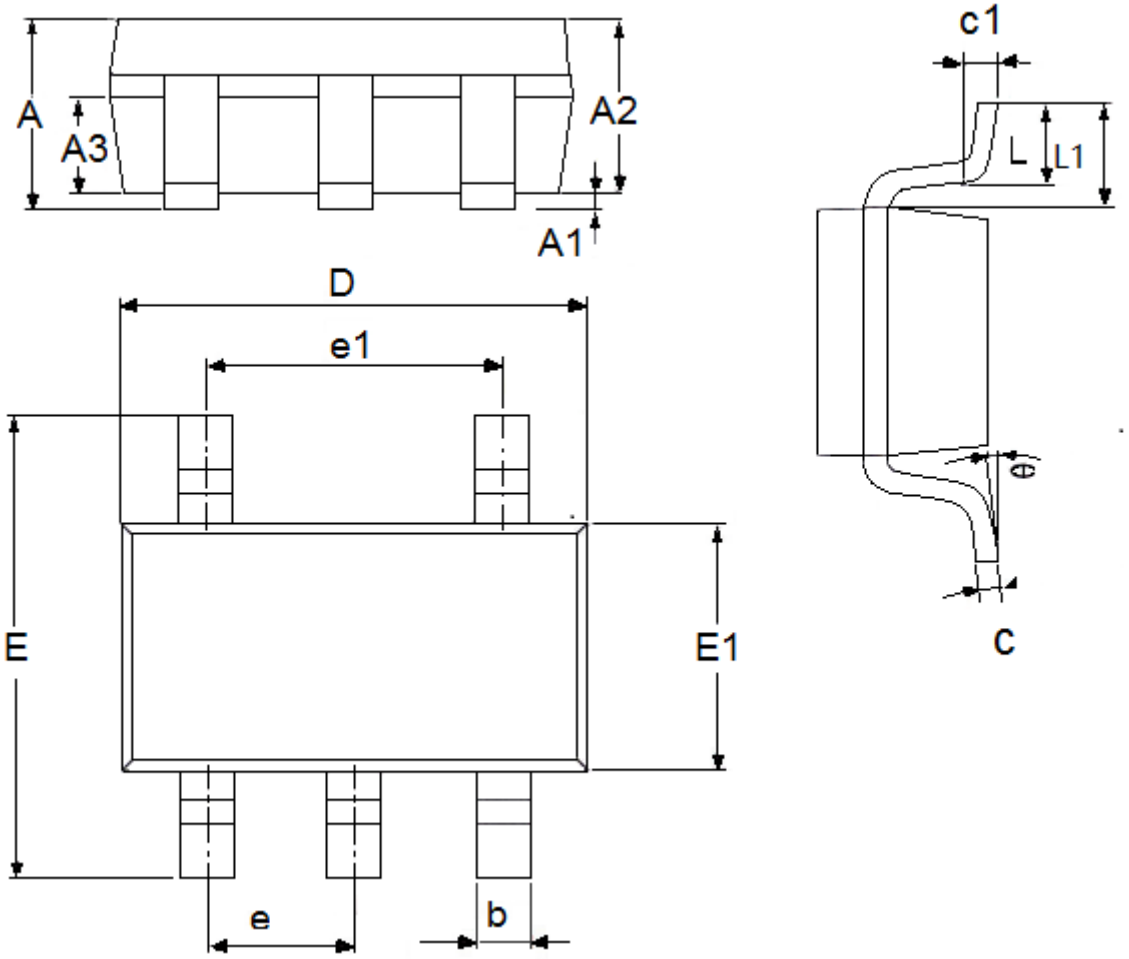



### 4. Output Current vs. Efficiency



## Packaging Information

- SOT23-5




| DIM | Millimeters | | Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.9 | 1.45 | 0.0354 | 0.0571 |
| A1 | 0 | 0.15 | 0 | 0.0059 |
| A2 | 0.9 | 1.3 | 0.0354 | 0.0512 |
| A3 | 0.6 | 0.7 | 0.0236 | 0.0276 |
| b | 0.25 | 0.5 | 0.0098 | 0.0197 |
| c | 0.1 | 0.26 | 0.0039 | 0.0102 |
| D | 2.8 | 3.1 | 0.1102 | 0.122 |
| e1 | 1.9(TYP) | | 0.0748(TYP) | |
| E | 2.6 | 3.1 | 0.1024 | 0.1201 |
| E1 | 1.5 | 1.8 | 0.05118113 | 0.07086618 |
| e | 0.95(TYP) | | 0.0374(TYP) | |
| L | 0.25 | 0.6 | 0.0098 | 0.0236 |
| L1 | 0.59(TYP) | | 0.0232(TYP) | |
| θ | 0 | 8° | 0 | 8° |
| c1 | 0.2(TYP) | | 0.0079(TYP) | |

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