升压超小型 300 kHz PWM / PFM切换控制 DC/DC控制器

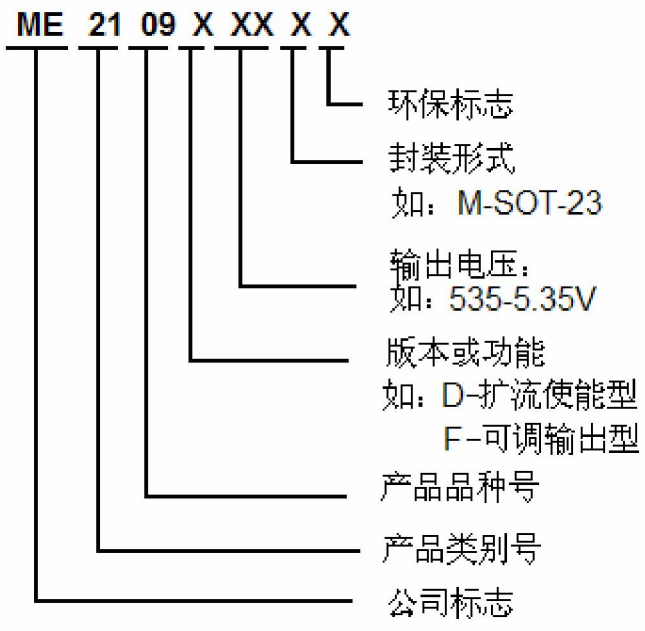
描述：

ME2109 是一种由基准电压源、振荡电路、误差放大器、相位补偿电路、PWM / PFM 切换控制电路等构成的CMOS 升压DC/DC 控制器。通过使用外接低通态电阻N 沟道功率MOS，即可适用于需要高效率、高输出电流的应用电路上。通过PWM / PFM 切换控制电路，在负载较轻时，将工作状态切换为占空系数为15%的PFM 控制电路，可以防止因IC 的工作电流引起的效率降低。

特点：

- **低电压工作：可保证以** 0.9 V (I_{OUT} = 1 mA)**启动**
- **占空比: 内置** PWM / PFM **切换控制电路**(15 ~ 78%)
- **振荡频率：**300KHz
- **输出电压：在** 1.5～6.5V **之间**
- **输出电压精度：**±2%
- **软启动功能：**2mS
- **带开/关控制功能**
- **外接部件：线圈、二极管、电容器、晶体管**
- **封装形式：**SOT-23-5

选型指南：

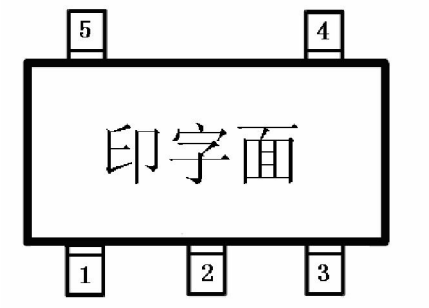


应用：

- **移动电话**（PDC, GSM, CDMA, IMT200 **等**）
- **蓝牙设备**
- PDA
- **便携式通讯设备**
- **游戏机**
- **数码相机**
- **无绳电话**
- **笔记本**

型号	后缀	封装	开关晶体管	CE 端	VDD 端	FB 端	特点
ME2109Dxx	M5	SOT-23-5	外置	Yes	Yes	No	扩流使能型
ME2109F	M5	SOT-23-5	外置	Yes	Yes	Yes	可调输出型

引脚排列图：



SOT-23-5

引脚分配：

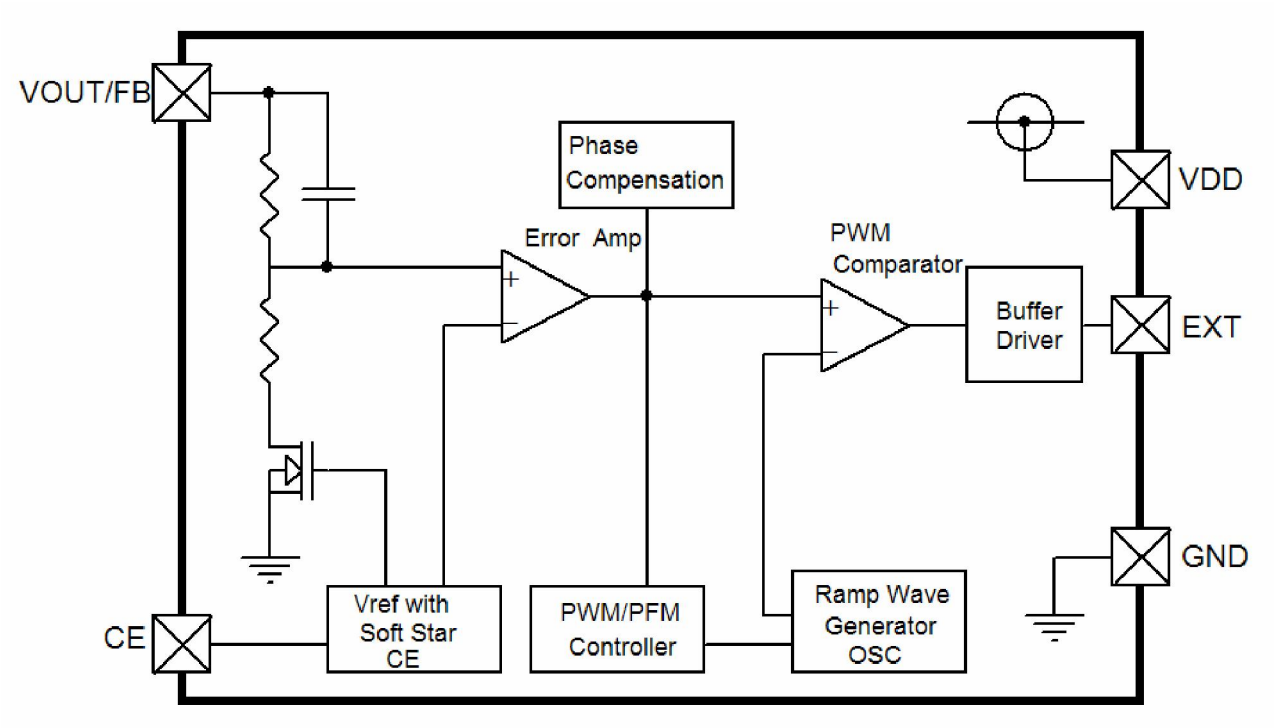
ME2109Dxx

引脚号 SOT-23-5	符号	引脚描述
1	VOUT	电压输出引脚
2	VDD	IC电源引脚
3	CE	使能引脚
4	GND	接地引脚
5	EXT	外接晶体管引脚

ME2109F

引脚号 SOT-23-5	符号	引脚描述
1	FB	电压反馈引脚
2	VDD	IC电源引脚
3	CE	使能引脚
4	GND	接地引脚
5	EXT	外接晶体管引脚

功能块框图：



绝对最大额定值：

参数	符号	极限值	单位
VDD 脚电压	VDD	-0.3～6.5	V
EXT 脚电压	EXT	-0.3～VDD+0.3	V
VOUT 脚电压	VOUT	-0.3～6.5	V
CE 脚电压	VCE	-0.3～Vin+0.3	V
EXT 脚电流	IEXT	±1000	mA
封装功耗(SOT-23-5)	Pd	250	mW
工作温度	T_{Opr}	-25~+85	℃
储存温度	T_{stg}	-40~+125	℃

主要参数及工作特性：

ME2109D535

测试条件：VIN=VOUT(S)X0.6,IOUT=100mA,VCE=VDD=VOUT，Topt=25℃。有特殊说明除外。

测试项目	符号	条件	最小值	典型值	最大值	单位	测定电路
输出电压	VOUT	-	VOUT(S)X 0.98	VOUT(S)	VOUT(S)X 1.02	V	2
输入电压	VIN	-		-	6	V	2
开始工作电压	VST1	IOUT=1mA	-	-	0.9	V	2
振荡开始电压	VST2	没有外接，向 VOUT 加电压	-	-	0.7	V	1
工作保持电压	VHLD	IOUT=1mA，降低 VIN 观测	0.7	-	-	V	2
消耗电流 1	ISS1	VOUT=VOUT(S)× 0.95	-	200	-	uA	1
消耗电流 2	ISS2	VOUT=VOUT(S)+0.5V	-	20	-	uA	1
休眠时消耗电流	ISSS	VCE=0V	-	0.1	0.5	uA	1
EXT 端子输出电流	IEXTH	VEXT=VOUT-0.4V	-	-35	-	mA	1
	IEXTL	VEXT=0.4V	-	55	-	mA	1
输入稳定度	△VOUT1	VIN=VOUT(S)×0.4～×0.6	-	30	-	mV	2
负载稳定度	△VOUT2	IOUT=10uA～VOUT/50×1.25	-	35	-	mV	2
输出电压温度系数		Ta=-25—85℃	-	±50	-	ppm/℃	2
振荡频率	fosc	VOUT=VOUT(S)× 0.95	255	300	345	kHz	1
最大占空系数	MAXDUTY	VOUT=VOUT(S)× 0.95	-	78	-	%	1
模式切换占空系数	PFMDUTY	VIN=VOUT(S)-0.1V,没有负载	-	15	-	%	1
CE 端输入电压	VSH	测定 EXT 端振荡	0.75	-	-	V	1
	VSL1	判断 EXT 端振荡停止 VOUT≥1.5V	-	-	0.3	V	1
	VSL2	判断 EXT 端振荡停止 VOUT<1.5V	-	-	0.2	V	1
CE 端输入电流	ISH	VCE=VOUT(S)×0.95	-0.1	-	0.1	uA	1
	ISL	VCE=0V	-0.1	-	0.1	uA	1
软启动时间	tss	-	-	2	-	mS	2
效率	EFFI	-	-	85	-	%	2

ME2109F

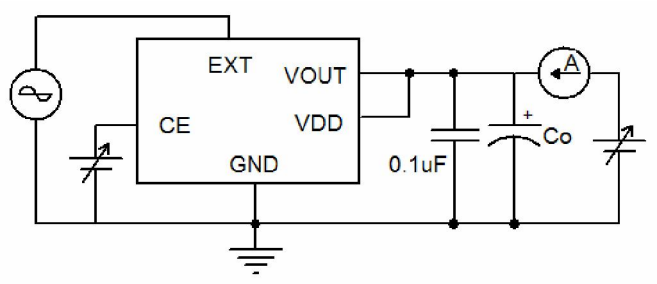
测试条件：VDD=VCE=3.3V，Topt=25℃。**有特殊说明除外。**

测试项目	符号	条件	最小值	典型值	最大值	单位	测定电路
输出反馈电压	VFB	-	1.225	1.25	1.275	V	4
输入电压	VIN	-		-	6	V	4
开始工作电压	VST1	IOUT=1mA	-	-	0.9	V	4
振荡开始电压	VST2	没有外接，向 VOUT 加电压	-	-	0.7	V	3
工作保持电压	VHLD	IOUT=1mA，降低 VIN 观测	0.7	-	-	V	4
消耗电流 1	ISS1	VFB=VFB(S)× 0.95	-	100	-	uA	3
消耗电流 2	ISS2	VFB=1.5V	-	15	-	uA	3
休眠时消耗电流	ISSS	VCE=0V	-	0.01	0.5	uA	3
EXT 端子输出电流	IEXTH	VEXT=VDD-0.4V	-	-25	-	mA	3
	IEXTL	VEXT=0.4V	-	40	-	mA	3
FB 电压温度系数		Ta=-25—85℃	-	±50	-	ppm/℃	4
振荡频率	fosc	-	255	300	345	kHz	3
最大占空系数	MAXDUTY	VFB=VFB(S)× 0.95	-	78	-	%	3
模式切换占空系数	PFMDUTY	VFB=VFB(S)× 1.5,没有负载	-	15	-	%	3
CE 端输入电压	VSH	测定 EXT 端振荡	0.75	-	-	V	3
	VSL1	判断 EXT 端振荡停止 VOUT≥1.5V	-	-	0.3	V	3
	VSL2	判断 EXT 端振荡停止 VOUT<1.5V	-	-	0.2	V	3
CE 端输入电流	ISH	VCE=VFB(S)×0.95	-0.1	-	0.1	uA	3
	ISL	VCE=0V	-0.1	-	0.1	uA	3
软启动时间	tss		-	2	-	mS	4
效率	EFFI		-	85	-	%	4

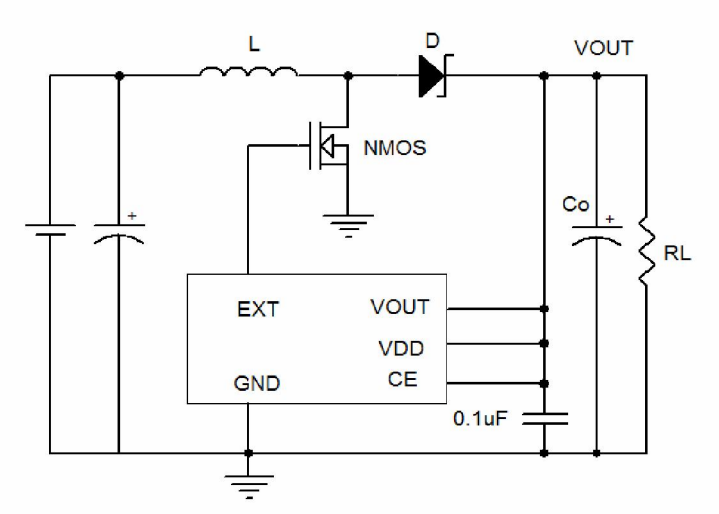
1. VOUT(S)表示输出电压设定值。VOUT表示实际输出电压的典型值。
2. VOUT(S)可根据VFB值与输出电压设定电阻（R1,R2）之间的比例来进行设定。
3. VFB(S)表示FB电压的设定值。
4. 关于VDD/VOUT分离型产品
   为了稳定输出电压、振荡频率，请将VDD控制在1.8V≤ VDD< 6V的范围内。

测定电路：

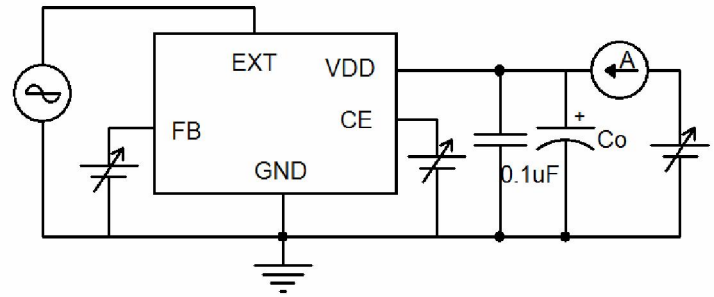
1.


EXT
VOUT
CE
VDD
GND
0.1uF
Co
A

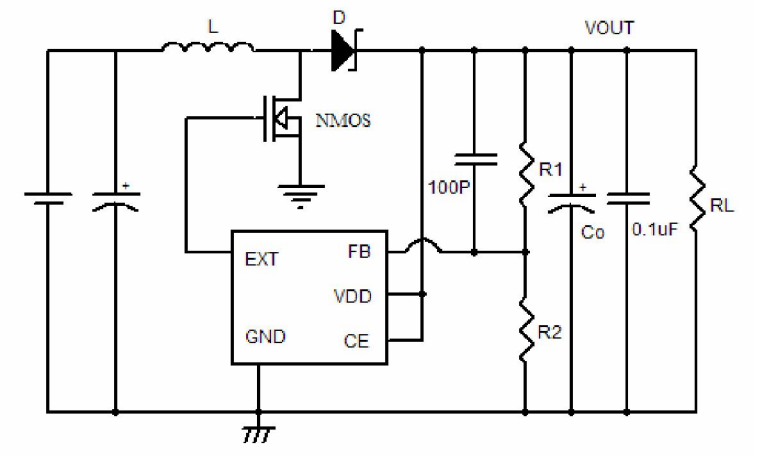
2.


L
D
VOUT
NMOS
Co
RL
EXT
VOUT
VDD
GND
CE
0.1uF

3.


EXT
VDD
CE
FB
GND
0.1uF
Co
A

4.


L
D
VOUT
NMOS
100P
R1
Co
0.1uF
RL
EXT
FB
VDD
GND
CE
R2

外部器件(推荐)：

1．Diode采用肖特基二极管（正向压降约为0.2V），如IN5817 , IN5819

2．电感：采用22uH(r<0.5Ω)

3．电容：采用钽电容 ,47uF

4．反馈电阻：R1+R2<50K

外接器件的选择：

外接部件的特性参数与升压电路的主要特性之间的关系如图1所示。

要使输出电流变大时？	要提高效率？		要使纹波电压变小时？
	使用时效率	待机时效率	
使电感值变小	使电感值变大		
使电感器直流电阻变小			
使输出电容值变大			使输出电容值变大
使用 MOSFET 时，使通态电阻变小	使用 MOSFET 时，使输入电容值小		
使用双极型晶体管时，使外接电阻 Rb 变小	使用双极型体管时，使外接电阻 Rb 变大		

图1 主要特性与外接部件之间的关系

1. 电感器

电感值(L值)对最大输出电流(I_{OUT})和效率(η)产生很大的影响。

ME2109的I_{OUT}、η的"L"依靠性的曲线图如图2所示

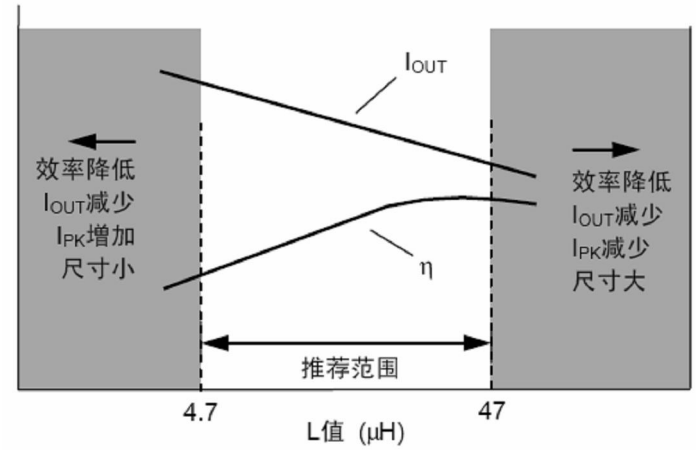


图2 L 值－IOUT 特性、L 值－η特性

L值变得越小，峰值电流(IPK)就变得越大，提高电路的稳定性并使IOUT增大。接着，若使L值变得更小，会降低效率而导致开/关切换晶体管的电流驱动能力不足，促使IOUT逐渐减少。L值逐渐变大时，开/关切换晶体管的IPK所引起的功耗也随之变小，达到一定的L值时效率变为最大。接着，若使L值变得更大，因线圈的串联电阻所引起的功耗变大，而导致工作效率的降低。IOUT也会减少。因为振荡频率较高的产品可以选择L值较小的产品，因此可使线圈的形状变小。推荐使用22 ~ 100 μH的电感器。此外，在选用电感器时，请注意电感器的容许电流。若电感器流入超过此容许电流的电流，会引起电感器处于磁性饱和状态，而明显地降低工作效率并导致IC的破损。
因此，请选用IPK不超过此容许电流的电感器。在连续模式下的IPK如下公式所示。

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

在此，fosc为振荡频率。VD大约为0.4 V。

2. 二极管

所使用的外接二极管请满足以下的条件。

- 正向电压较低。(VF＜0.3 V)
- 开关切换速度快。(500 ns 最大值)
- 反向耐压在VOUT＋VF 以上。
- 电流额定值在IPK 以

3. 电容器 (CIN、CO)

输入端电容器(CIN)可以降低电源阻抗，另外可使输入电流平均化而提高效率。请根据使用电源的阻抗的不同而选用CIN 值。

输出端电容器(CO)是为了使输出电压变得平滑而使用的，升压型的产品因为针对负载电流而断续地流入电流，与降压型产品相比需要更大的电容值。在输出电压较高以及负载电流较大的情况下，由于纹波电压会变大，因此请根据各自的情况而选用相应的电容值。推荐使用10 μF以上电容器。

为了获得稳定的输出电压，请注意电容器的等效串联电阻(RESR)。本IC因RESR的不同，输出的稳定领域会产生变化。因电感值(L值)的不同而异，使用30 ~ 500 mΩ左右的RESR，可以发挥最佳的特性。但是，最佳的RESR值因L值以及电容值、布线、应用电路(输出负载)而不同，请根据实际的使用状况，在进行充分的评价之后，再予以决定。

4. 外接晶体管

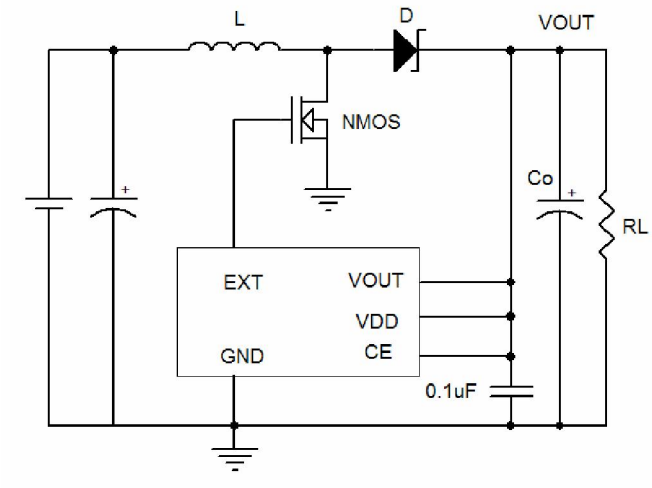
外接晶体管可以使用增强(N 沟道)MOS FET 型产品。所选用的MOS FET，请使用N沟道功率MOS FET。
由于所外接的功率MOS FET的门极电压以及电流，是由升压后的输出电压(VOUT)来供应，因此可以更有效地驱动MOS FET。因所选用的MOS FET的不同而异，在接通电源时有可能流入较大的电流。请在实际电路上进行充分的评价基础上，再予以使用。推荐使用MOS FET的输入容量在700 pF以下的产品。

另外，MOS FET 的通态电阻依靠输出电压(VOUT)与MOS FET 的阈值电压的电压差，因此会对输出电流量以及效率产生影响。输出电压处于较低的情况下，如果不选用带有输出电压值以下的阈值电压的MOS FET，电路就不能正常工作，务请注意。

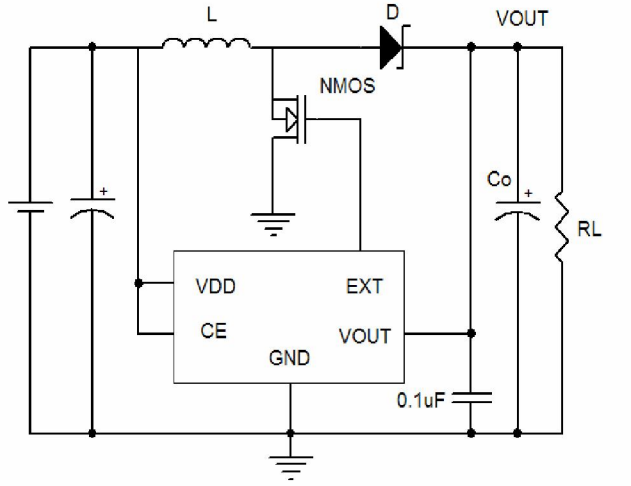
5. 使用注意事项：

- 外接的电容器、二极管、线圈等请尽量安装在IC 的附近。
- 包含了DC/DC控制器的IC，会产生特有的纹波电压和尖峰噪声。另外，在电源投入时会产生冲击电流。这些现象会因所使用的线圈、电容器以及电源阻抗的不同而受到很大的影响，因此在设计时，请在实际的应用电路上进行充分的评价。
- 请注意开/关切换晶体管的功耗(特别在高温时)不要超过封装的容许功耗。
- DC/DC控制器的性能会因为基板布局、外围电路、外围部件的设计的不同而产生很大的变化。设计时，请在实际的应用电路上进行充分的评价。
- 本IC虽内置防静电保护电路，但请不要对IC施加超过保护电路性能的过大静电。

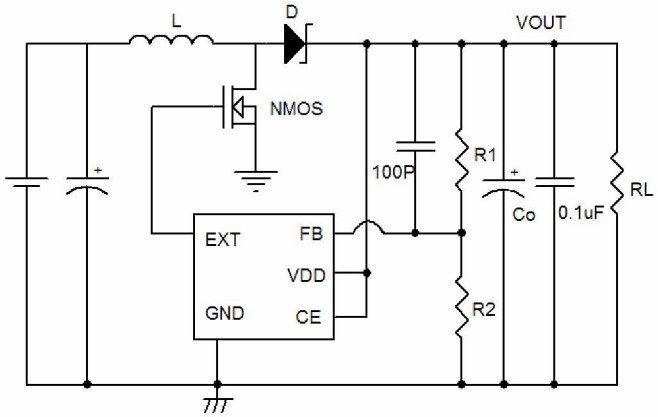
典型应用：



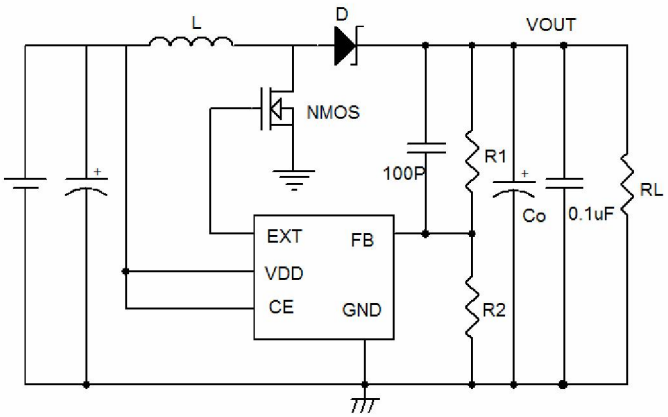
扩流使能型产品使用示意图1



扩流使能型产品使用示意图2



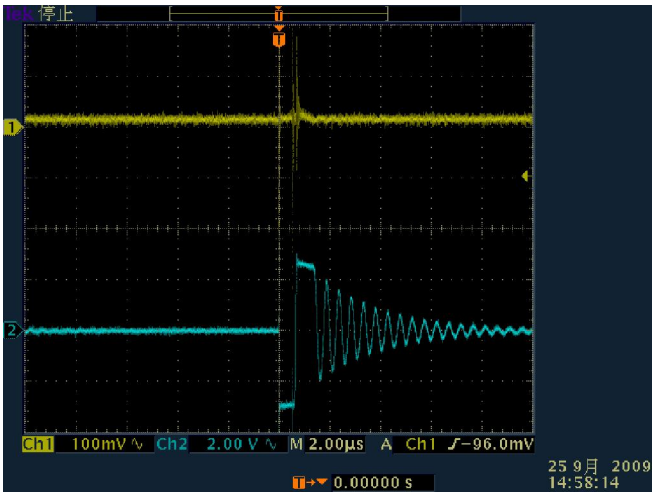
可调输出型产品使用示意图 1



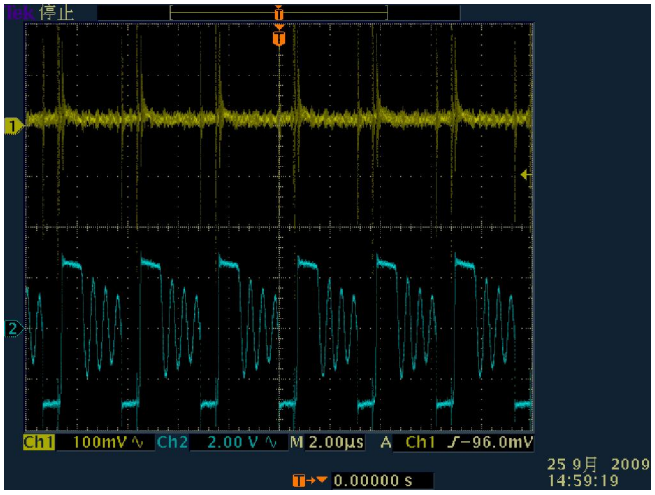
可调输出型产品使用示意图 2

特性曲线图

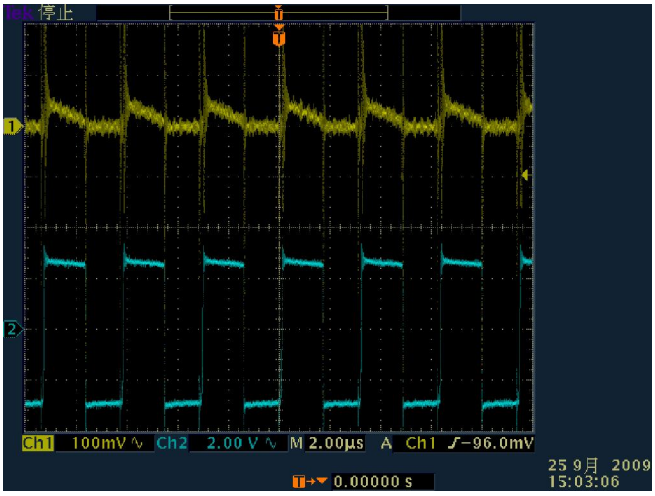
1. 输出波形



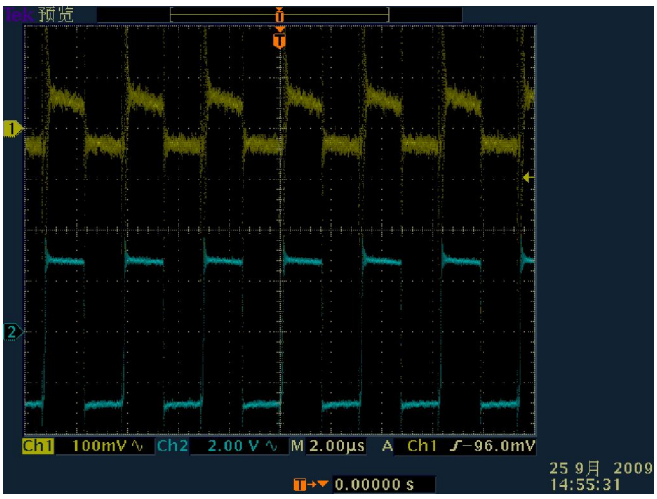
Iout=1mA



Iout=10mA



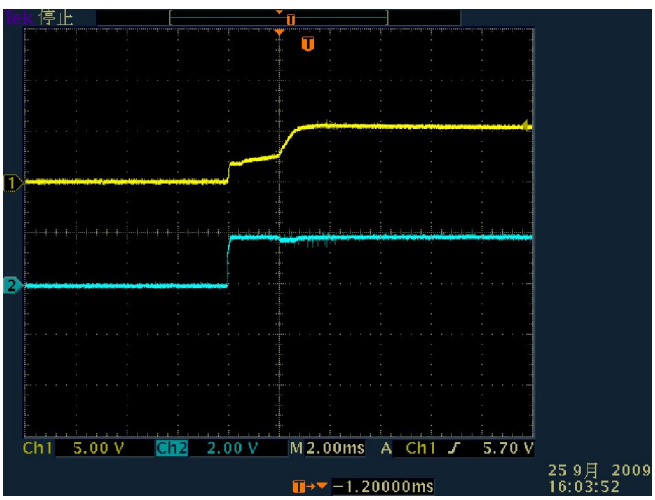
Iout=100mA



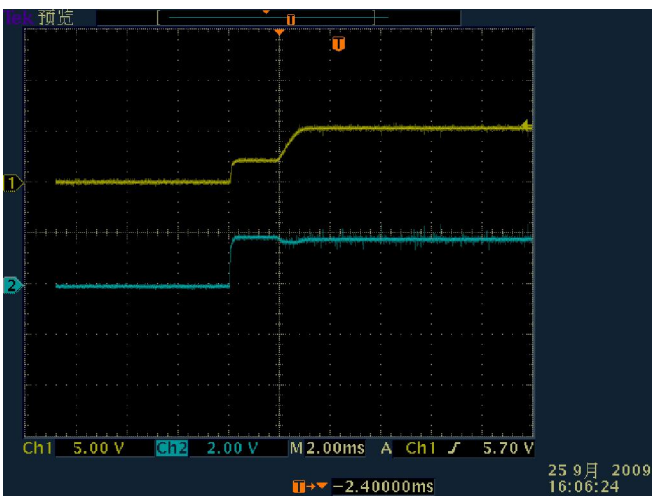
Iout=200mA

2. 过渡响应特性

（1）电源投入（Vin: 0→2V）

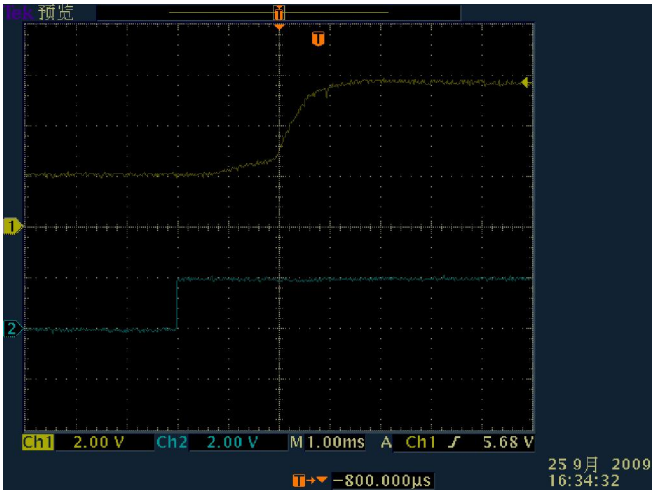


Iout=1mA

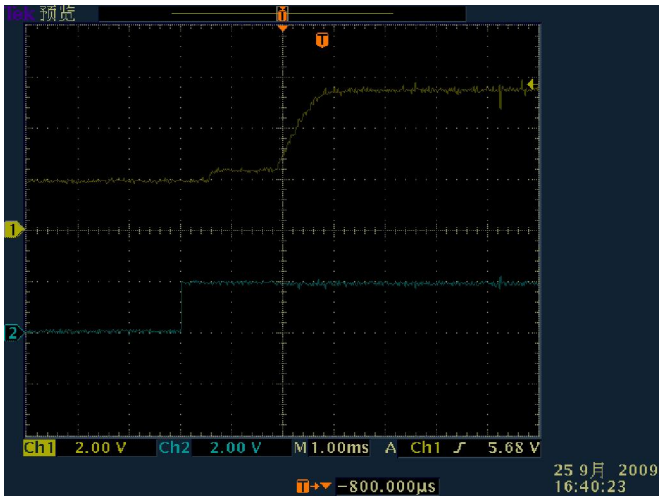


Iout=100mA

（2）CE端子响应（Vin: 0→2V）

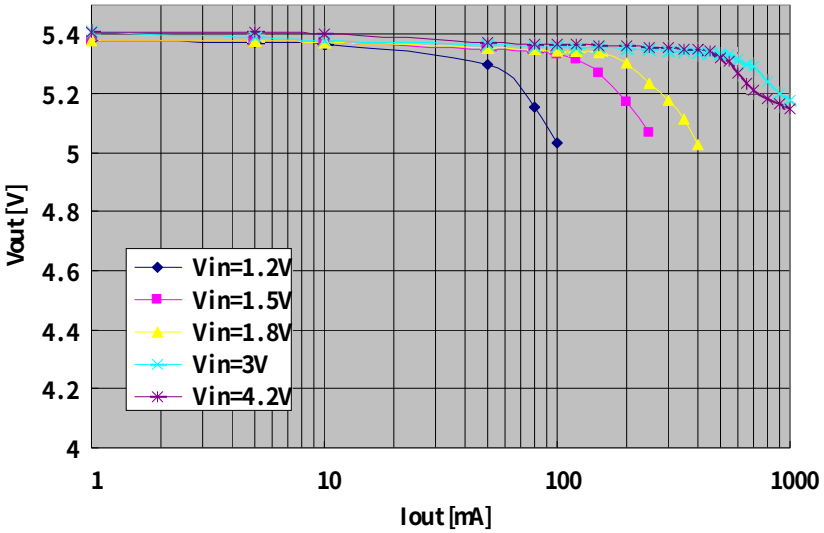


Iout=1mA

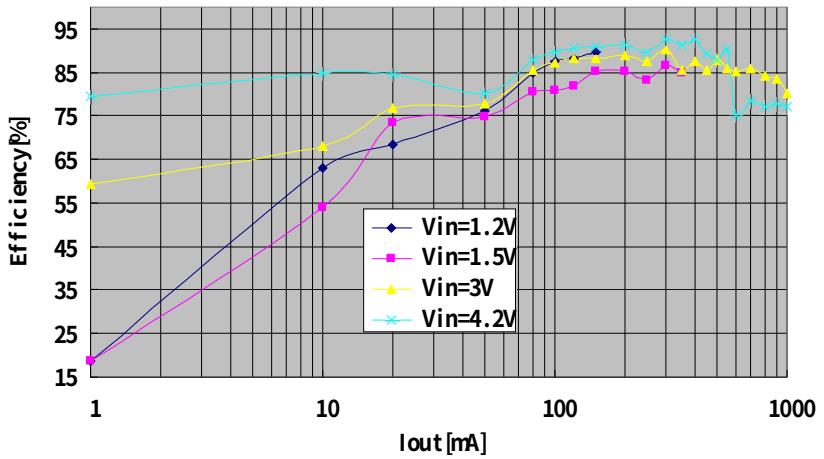


Iout=100mA

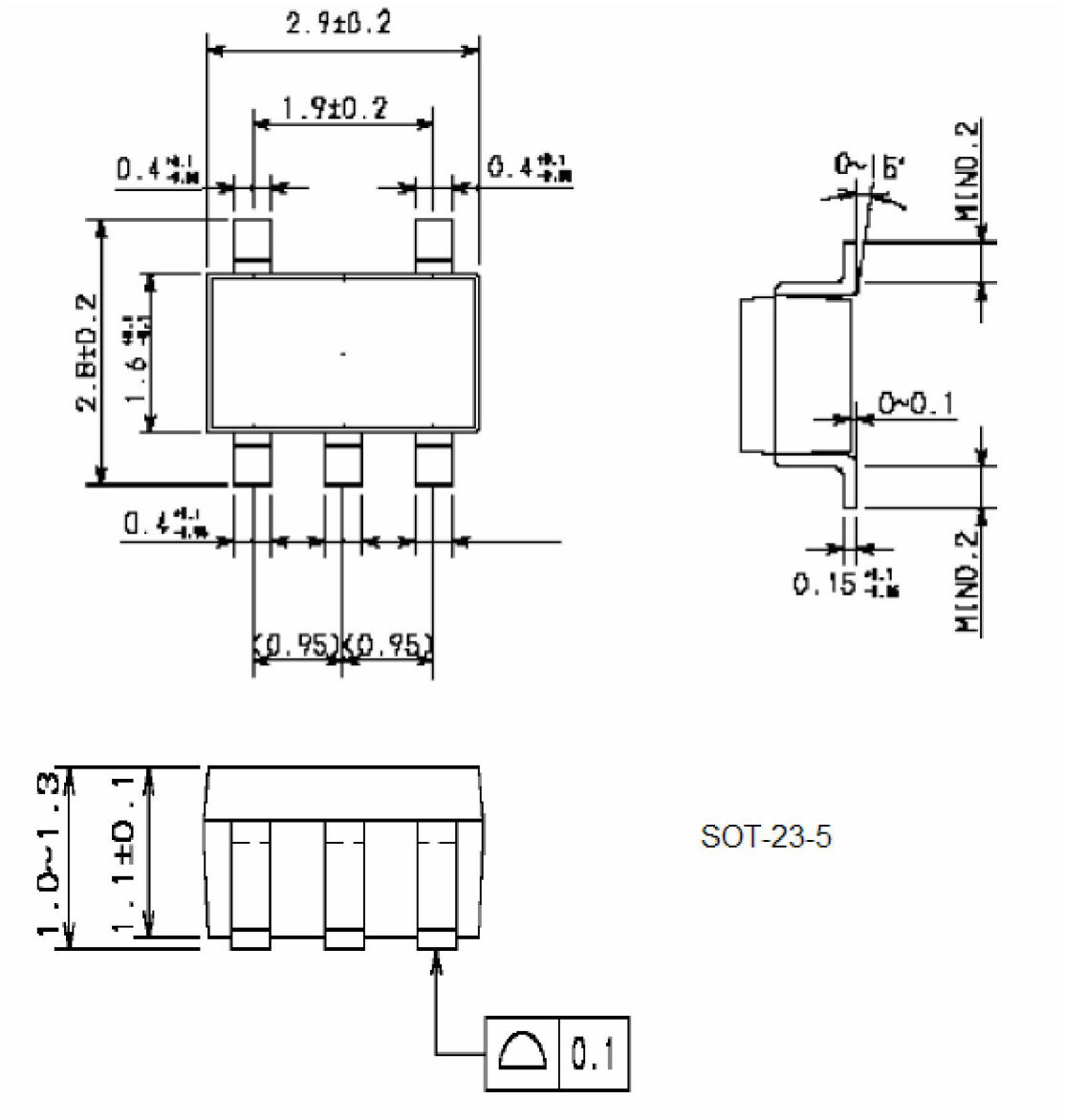
3. 输出电流(Iout)—输出电压(Vout)特性



4. 输出电流(Iout)—效率（Efficiency）特性



封装尺寸：


2.9±0.2
1.9±0.2
0.4
0.4
2.8±0.2
1.6
0.4
(0.95)
(0.95)
0~5°
MIND.2
0~0.1
0.15
MIND.2
1.0~1.3
1.1±0.1
0.1
SOT-23-5

ULTRA-SMALL PACKAGE PWM/PFM SWITCHING CONTROL

STEP-UP SWITCHING REGULATOR

General Description

The ME2139 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. With an external low-ON-resistance Nch Power MOS, this product is applicable to applications requiring high efficiency and high output current. The ME2139 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：1.0MHz
- External parts: coil, diode, capacitor, and transistor
- Output voltage range：<20V
- Feedback voltage accuracy：±2%
- Soft start function: 2 ms

Applications

- MP3 players, digital audio players
- Digital cameras, GPS, wireless transceiver
- Portable devices

Package

- 5-pin SOT23-5

Typical Application Circuit

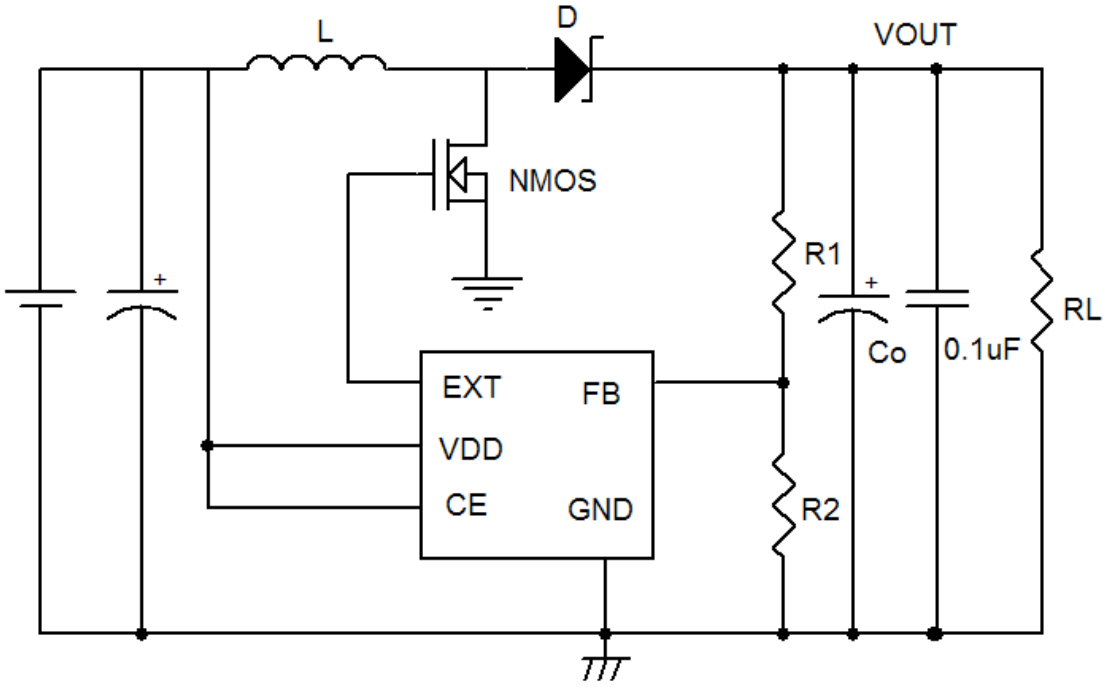
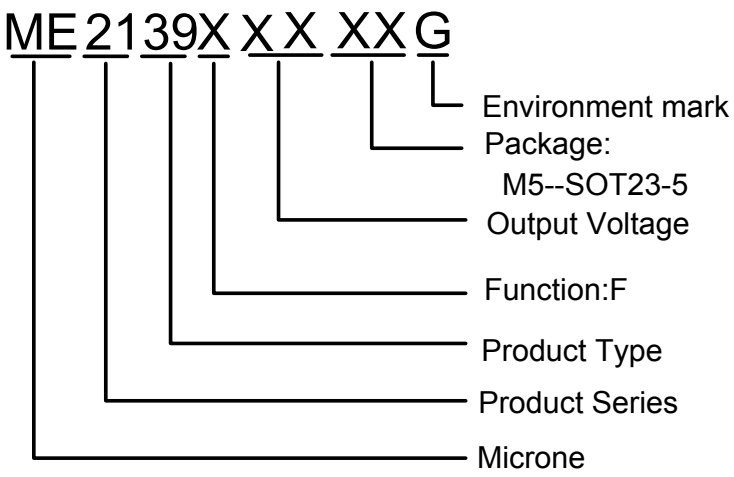


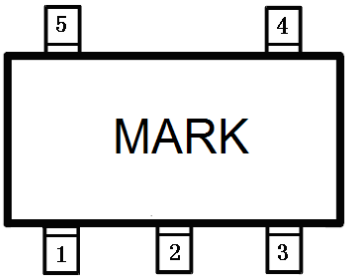
Fig.1 For Feedback and external

Selection Guide



product series	switching transistor	CE function	VDD function	FB function	features
ME2139FM5G	External Transistor	Yes	Yes	Yes	Ext +Feedback

Pin Configuration



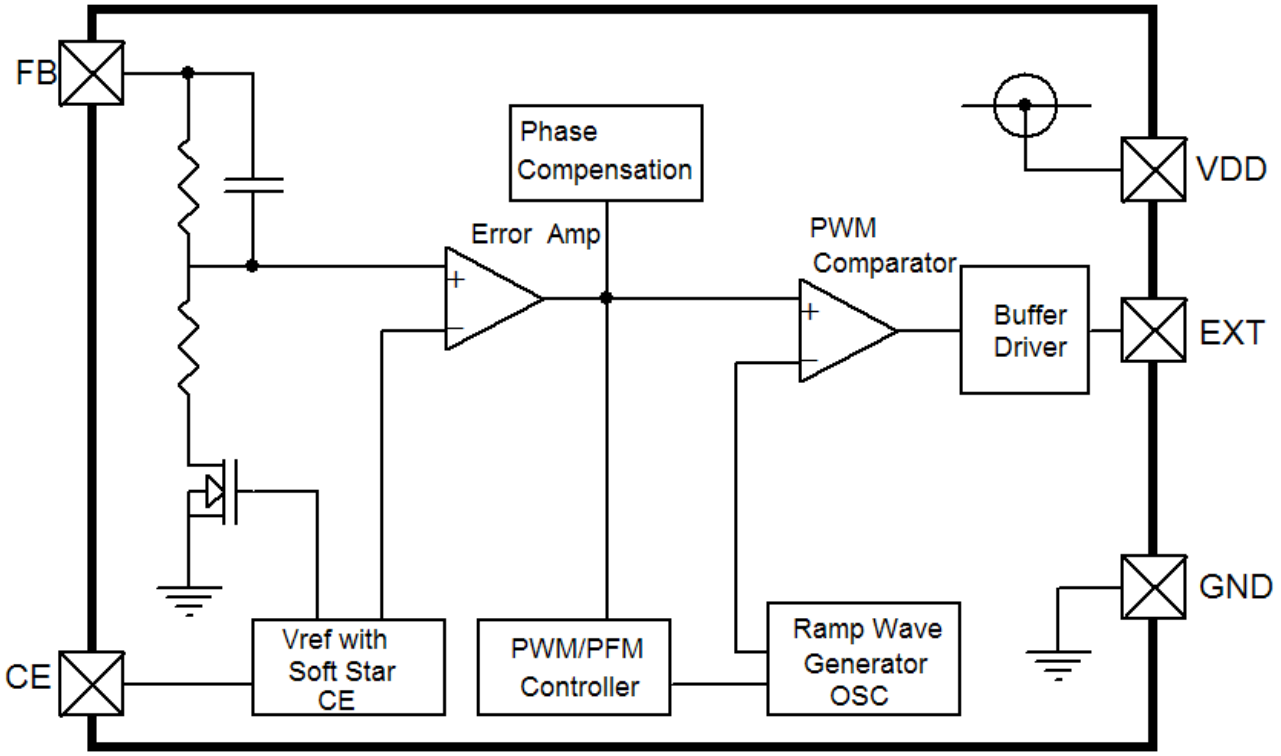
SOT-23-5

Pin Assignment

ME2139FM5G

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

Block Diagram



Absolute Maximum Rangs

PARAMETER	SYMBOL	RATINGS	UNITS
VDD Pin Voltage	VDD	-0.3～6.5	V
EXT Pin Voltage	EXT	-0.3～VDD+0.3	V
CE Pin Voltage	VCE	-0.3～VDD+0.3	V
EXT Pin Voltage	IEXT	±1000	mA
Power Dissipation (SOT23-5)	Pd	300	mW
Operating Temperature Range	T_{Opr}	-25~+85	℃
Storage Temperature Range	T_{stg}	-40~+125	℃

Electrical Characteristics

ME2139FxxG

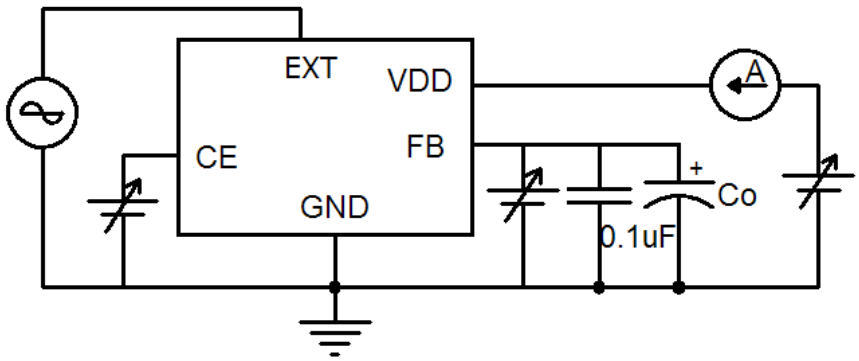
Measuring conditions：VDD=VCE=3.3V，Topt=25℃。Unless otherwise specified。

Parameter	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	Circuit
Feedback voltage	V_{FB}	-	1.225	1.25	1.275	V	2
Input voltage	V_{IN}	-		-	6	V	2
Operation start voltage	V_{ST}	I_{OUT}=1mA	-	-	0.9	V	2
Operation holding voltage	V_{HLD}	I_{OUT}=1mA，Measured by decreasing VIN voltage gradually	0.7	-	-	V	2
Current consumption 1	I_{SS1}	V_{FB}=V_{FB}(S)× 0.95	-	200	-	μA	1
Current consumption 2	I_{SS2}	V_{FB}=1.5V	-	15	-	μA	1
Current consumption during shutdown	I_{SSS}	V_{CE}=0V	-	0.02	0.5	μA	1
EXT pin output current	I_{EXTH}	V_{EXT}=V_{OUT}-0.4V	-	-25	-	mA	1
	I_{EXTL}	V_{EXT}=0.4V	-	40	-	mA	1
Feed back voltagetemperature coefficient		Ta=-25-85℃	-	±50	-	ppm/℃	2
Oscillation frequency	Fosc	-	0.8	1.0	1.2	MHz	1
Max. duty ratio	MAXDUTY	V_{FB}=V_{FB}(S)× 0.95	-	78	-	%	1
PWM/PFM switchingduty ratio	PFMDUTY	V_{FB}=V_{FB}(S)× 1.5, no load	-	15	-	%	1
Shutdown pin input voltage	V_{SH}	Measured the oscillation at EXT pin	0.75	-	-	V	1
	V_{SL1}	Judged the stop of oscillation at EXT pin, V_{OUT}≥1.5V	-	-	0.3	V	1
	V_{SL2}	Judged the stop of oscillation at EXT pin, V_{OUT}<1.5V	-	-	0.2	V	1
Shutdown pin input voltage	I_{SH}	V_{CE}=V_{FB}(S)×0.95	-0.1	-	0.1	μA	1
	I_{SL}	V_{CE}=0V	-0.1	-	0.1	μA	1
Soft start time	tss	-	-	2	-	mS	2
Efficiency	EFFI	-	-	90	-	%	2

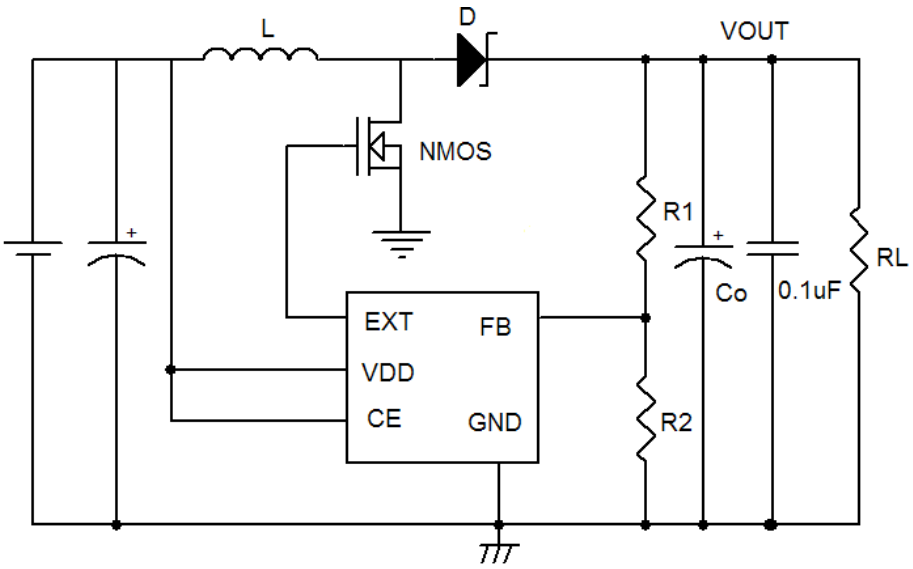
1. VOUT(S) is the set output voltage value,and VOUT is the typital value of the output voltage.
2. VOUT(S) can be set by using the rate of VFB and output voltage setting resisitors(R1,R2).
3. VFB(S) is the set output voltage value.
4. This product from the start when the VDD=0.9V booster work , but in order to stabilize the output voltage and oscillation frequency ,to control the VDD, 2.5V≦VDD<6V.

Test Circuit：

1.



2.



External parts（suggest）

1、Diode use Schottky diode such as SS14 or SS34 forward voltage drop:0.2V)
2、NMOS：MEM8205 or MEM2310
3、Inductor：3.3μH（r<0.5Ω）
4、Capacitor：Tantalum type 22uF

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 high efficiency?		For smaller ripple voltage?
	Operation efficiency	Stand-by efficiency	
Smaller inductance	Larger inductance		
Smaller DC resistance of inductor			
Large output capacitance		Large output capacitance	
With MOSFET, smaller ON resistance	With MOSFET, smaller input capacitance		
With bipolar transistor, smaller external	With bipolar transistor, larger external resistance Rb		

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 η.1.

Figure 2 shows the relation between I_{OUT}, and η characteristics to L of ME2139F.

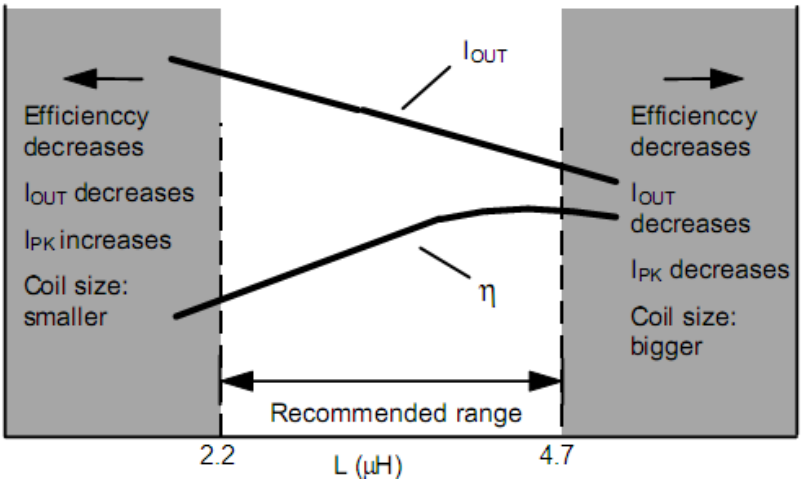


Figure 2 L－I_{OUT} and η characteristics

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_{OUT} decreases, too.

Oscillation frequency is higher, smaller one can be chose and also makes coil smaller. The recommended inductances are 2.2 to 4.7 μH inductor for ME2139F.

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_{PK} 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 calculated from the following equation:

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

Fosc = oscillation frequency, V_{DD} =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)

To improve efficiency, an input capacitor (C_{IN}) lowers the power supply impedance and averages the input current. Select C_{IN} according to the impedance of the power supply used. The recommended capacitance is 10μF for the ME2139F.

An output capacitor (C_{OUT}), which is used to smooth the output voltage, requires a capacitance larger than that of the step-down type because the current is intermittently supplied from the input to the output side in the step-up type. A 22μF ceramic capacitor is recommended for the ME2139F. However, a higher capacitance is recommended if the output voltage is high or the load current is large. If the output voltage or load current is low, about 10μF can be used without problems.

Select C_{OUT} after sufficient evaluation with actual application.

A ceramic capacitor can be used for both the input and output.

4. Enhancement MOS FET type

Depending on the MOS FET you use in your device, there is a chance of a current overrun at power ON. Thoroughly test all settings with your device before deciding on which one to use. Also, try to use a MOS FET with the input capacitance of 700 pF or less.

Since the ON resistor of the MOS FET might depend on the difference between the output voltage V_{OUT} and the threshold voltage of MOS FET, and affect the output current as well as the efficiency, the threshold voltage should be low. When the output voltage is low, the circuit operates only when the MOS FET has the threshold voltage lower than the output voltage.

5. Precautions

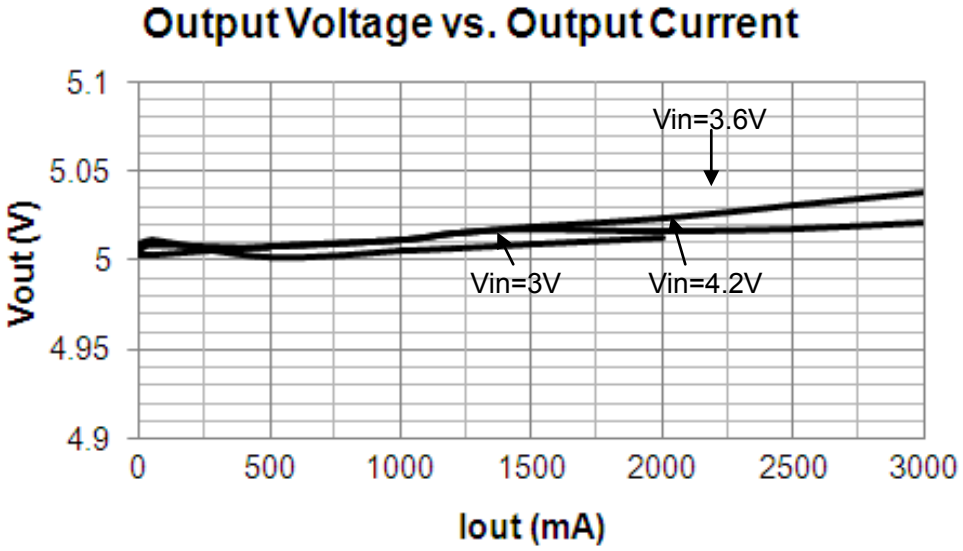
● Mount external capacitors, a diode, and a coil as close as possible to the IC.

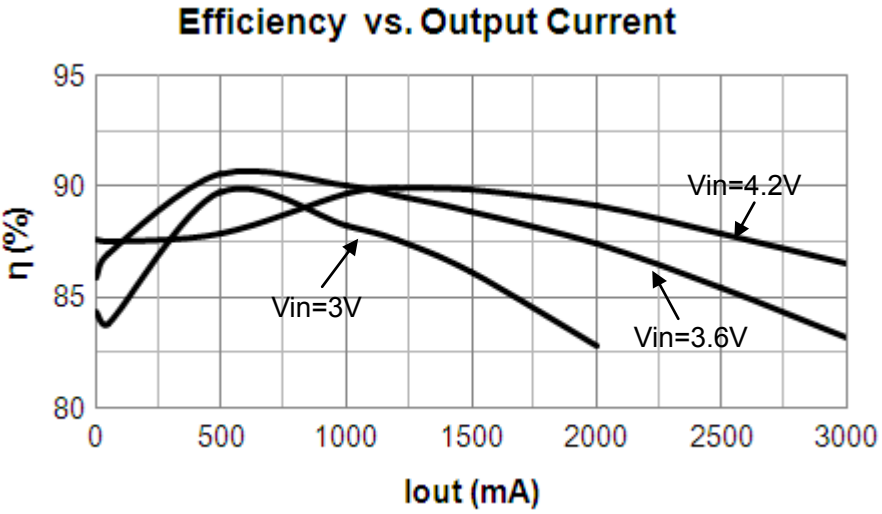
● Unique ripple voltage and spike noise occur in switching regulators. Because they largely depend on the coil and the capacitor used, check them using an actually mounted model.

●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.

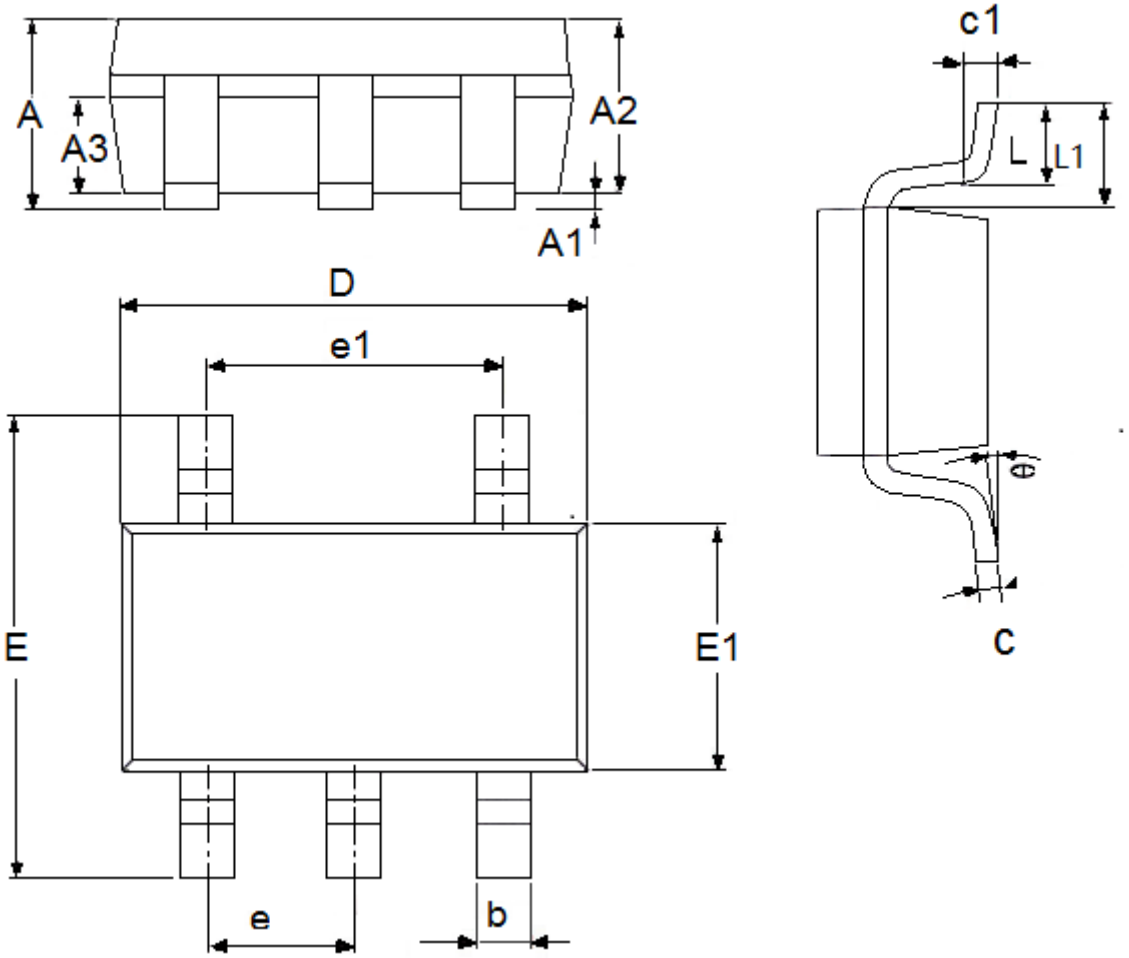
Typical Performance Characteristics





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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ULTRA-SMALL PACKAGE PWM/PFM SWITCHING CONTROL

STEP-UP SWITCHING REGULATOR

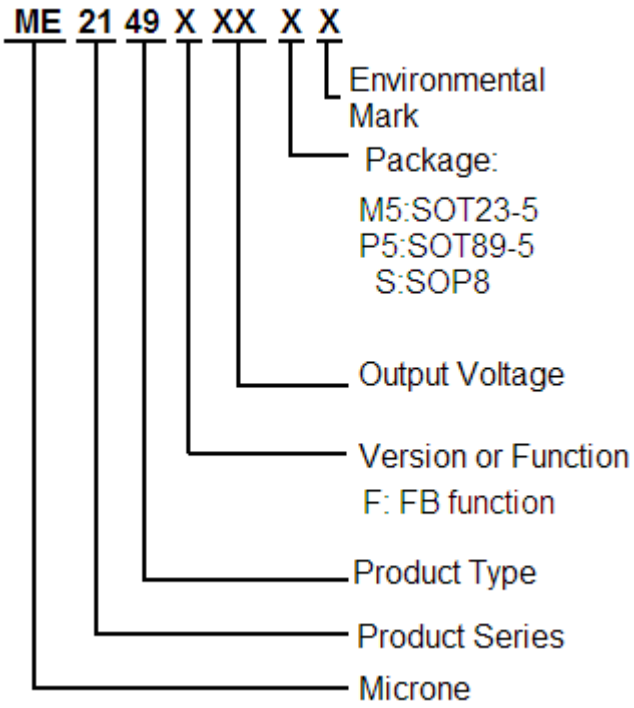
Description

The ME2149 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. With an internal low-ON-resistance Nch Power MOS, this product is applicable to applications requiring high efficiency and high output current. The ME2149 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.

Feature

- Low voltage operation: Start-up is guaranteed from 0.9 V(I_{OUT} =1 mA)
- Duty ratio: Built-in PWM/PFM switching control circuit 15 to 78 % .
- oscillator frequency：1.0MHz
- Output voltage range: 1.5V ~6.5 V
- Output voltage accuracy：±2%
- Soft start function: 2 mS.
- PACKAGE：SOT23-5,SOT89-5,SOP8

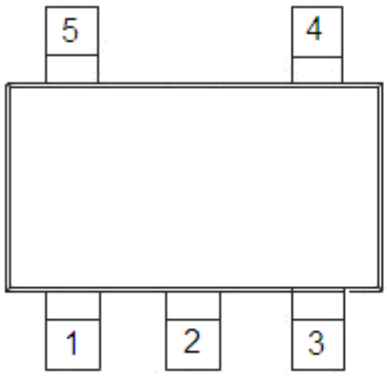
Selection Guide



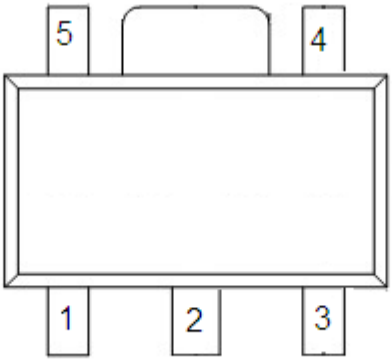
Typical Application

- MP3 players, digital audio players
- Digital cameras, GPS, wireless transceiver
- Portable devices

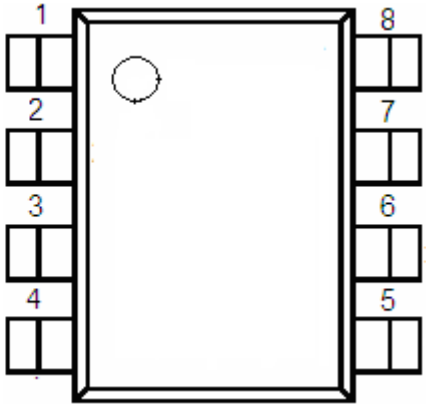
Pin Configuration



SOT23-5



SOT89-5



SOP8

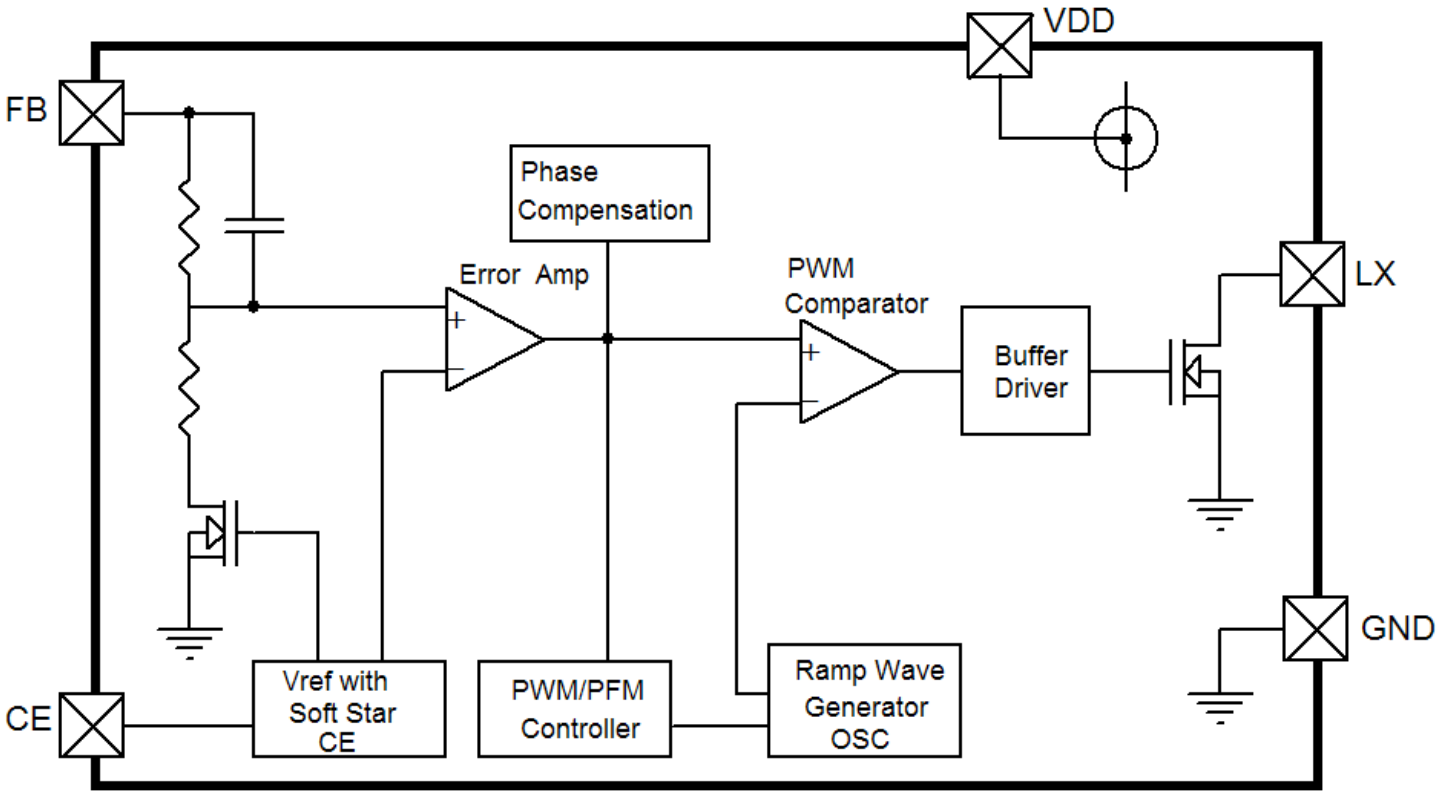
Pin information

TYPE	POSFIX	PACKAGE	SWICHING TRANSISTOR	CE FUNCTION	VDD FUNCTION	FB FUNCTION	FEATURE
ME2149F	M5	SOT23-5	Build in Transistor	Yes	Yes	Yes	LX+FB
	P5	SOT89-5					
	SOP8	SOP8					

ME2149F

Pin Number			Pin Name	Function
SOT23-5	SOT89-5	SOP8		
1	3	3	CE	Shutdown pin
2	2	7,8	LX	External transistor connection pin
3	1	2	GND	GND pin
4	5	5,6	VDD	IC power supply pin
5	4	4	FB	Feed Back voltage pin
		1	NC	NC

Block Diagram



Absolute Maximum Rang

PARAMETER	SYMBOL	RATING		UNIT
VDD Pin Voltage	VDD	-0.3～6.5		V
LX Pin Voltage	LX	-0.3～20		V
CE Pin Voltage	V_{CE}	-0.3～Vin+0.3		V
LX Pin Current	I_{LX}	±4000		mA
Power Dissipation	Pd	SOT23-5	300	mW
		SOT89-5	500	
		SOP8	800	
Operating Temperature Range	T_{Opr}	-25~+85		℃
Storage Temperature Range	T_{stg}	-40~+125		℃

Electrical Characteristics

ME2149F

Measuring conditions：VDD=V_{CE}=3.3V，Topt=25℃。Unless otherwise specified。

Parameter	SYMBOL	CONDITION		MIN	TYP	MAX	UNIT	Circuit
Feedback voltage	V_{FB}	-		1.225	1.25	1.275	V	2
Input voltage	VDD	-		-	-	6	V	2
Operation start voltage	V_{ST1}	I_{OUT}=1mA		-	-	0.9	V	2
Oscillation start voltage	V_{ST2}	No external parts, voltage applied to V_{OUT}		-	-	0.7	V	1
Operation holding voltage	V_{HLD}	I_{OUT}=1mA，Measured by decreasing VIN voltage gradually		0.7	-	-	V	2
Current consumption 1	I_{SS1}	V_{FB}=V_{FB}(S)× 0.95		-	4.0	-	mA	1
Current consumption 2	I_{SS2}	V_{FB}=1.5V		-	25	-	μA	1
Current consumption during shutdown	I_{SSS}	V_{CE}=0V		-	0.02	0.5	μA	1
Feedback voltage temperature coefficient		Ta=-25-85℃		-	±50	-	ppm/℃	2
Oscillation frequency	Fosc	-		0.8	1.0	1.2	MHz	1
Max. duty ratio	MAXDUTY	V_{FB}=V_{FB}(S)× 0.95		-	78	-	%	1
PWM/PFM switchingduty ratio	PFMDUTY	V_{FB}=V_{FB}(S)× 1.5, no load		-	15	-	%	1
Shutdown pin input voltage	V_{SH}	Measured the oscillation at LX pin		0.75	-	-	V	1
	V_{SL1}	Judged the stop of oscillation at LX pin	V_{OUT}≥1.5V	-	-	0.3	V	1
	V_{SL2}		V_{OUT}<1.5V	-	-	0.2	V	1
Shutdown pin input voltage	I_{SH}	V_{CE}=V_{FB}(S)×0.95		-0.1	-	0.1	μA	1
	I_{SL}	V_{CE}=0V		-0.1	-	0.1	μA	1
Soft start time	tss	-		-	2	-	mS	2
Efficiency	EFFI	-		-	90	-	%	2

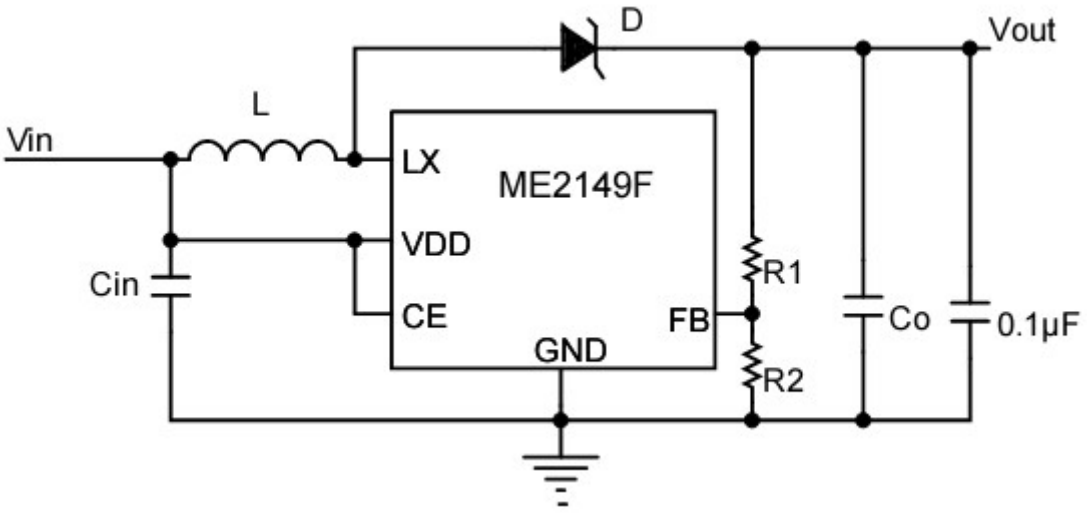
Note:

1. V_{OUT}(S) is the set output voltage value, and V_{OUT} is the typical value of the output voltage.
2. V_{OUT}(S) can be set by using the rate of V_{FB} and output voltage setting resistors (R1, R2).
3. V_{FB}(S) is the set output voltage value.
4. VDD/V_{OUT} separate type:

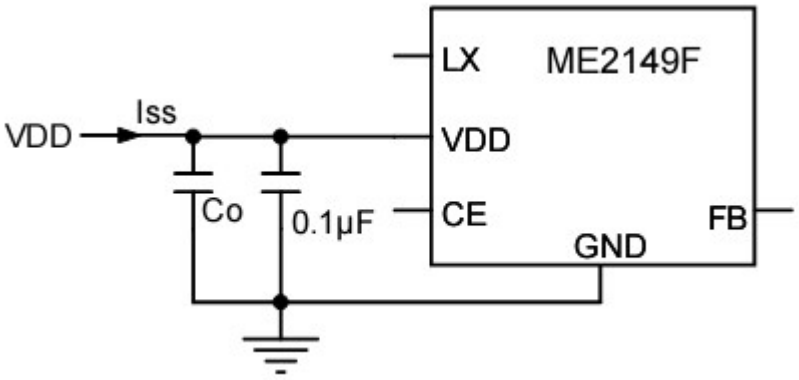
   1.8V≦VDD<6V is recommended to stabilize the output voltage and oscillation frequency.

Test Circuit

1.



2.



External parts（suggest）

1、Diode use Schottky diode such as SS14 or SS34 (forward voltage drop:0.2V)

2、Inductor：3.3μH（r<30mΩ）

3、Capacitor：ceramic capacitor 22μF（It is best to use two parallel connection ceramic capacitors）

4、Feed back resistors:R1+R2<50KΩ

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.

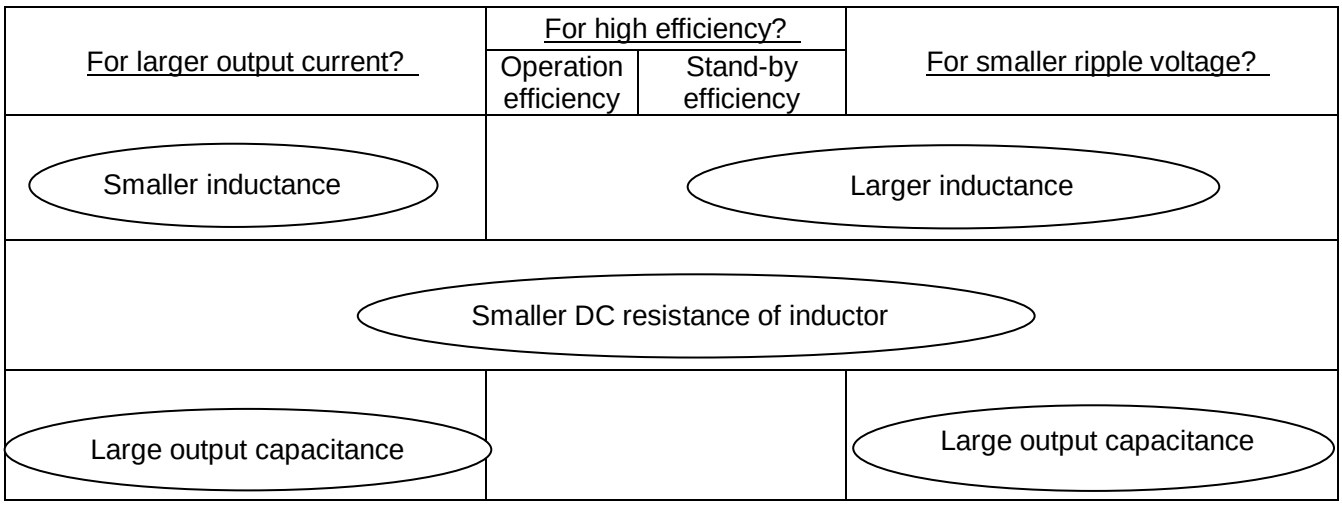


Figure 1 Relationship between major characteristics of the step-up circuit and external parts

1. Inductor

An inductance has strong influence on maximum output current I_{OUT} and efficiency η.1.

Figure 2 shows the relation between I_{OUT}, and η characteristics to L of ME2149.

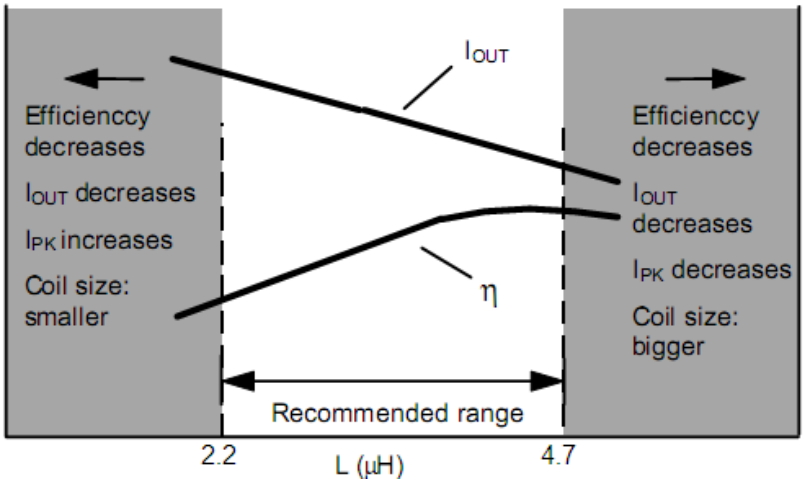


Figure 2 L－I_{OUT} and η characteristics

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_{OUT} decreases, too.

Oscillation frequency is higher, smaller one can be chose and also makes coil smaller. The recommended inductances are 2.2 to 4.7 μH inductor for ME2149.

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_{PK} 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 calculated from the following equation:

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

Fosc = oscillation frequency, V_{DD} =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)

To improve efficiency, an input capacitor (C_{IN}) lowers the power supply impedance and averages the input current. Select C_{IN} according to the impedance of the power supply used. The recommended capacitance is 10μF for the ME2149.

An output capacitor (C_{OUT}), which is used to smooth the output voltage, requires a capacitance larger than that of the step-down type because the current is intermittently supplied from the input to the output side in the step-up type. A 22μF ceramic capacitor is recommended for the ME2149 . However, a higher capacitance is recommended if the output voltage is high or the load current is large. If the output voltage or load current is low, about 10μF can be used without problems.

Select C_{OUT} after sufficient evaluation with actual application.

A ceramic capacitor can be used for both the input and output.

4. Precautions

● Mount external capacitors, a diode, and a coil as close as possible to the IC.

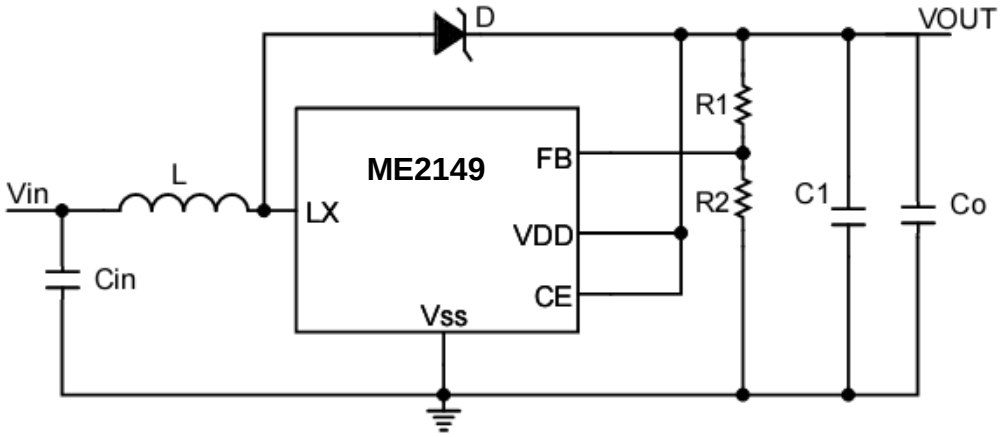
● Unique ripple voltage and spike noise occur in switching regulators. Because they largely depend on the coil and the capacitor used, check them using an actually mounted model.

●Make sure dissipation of the switching transistor (especially at a high temperature) does not exceed the allowable power dissipation of the package.

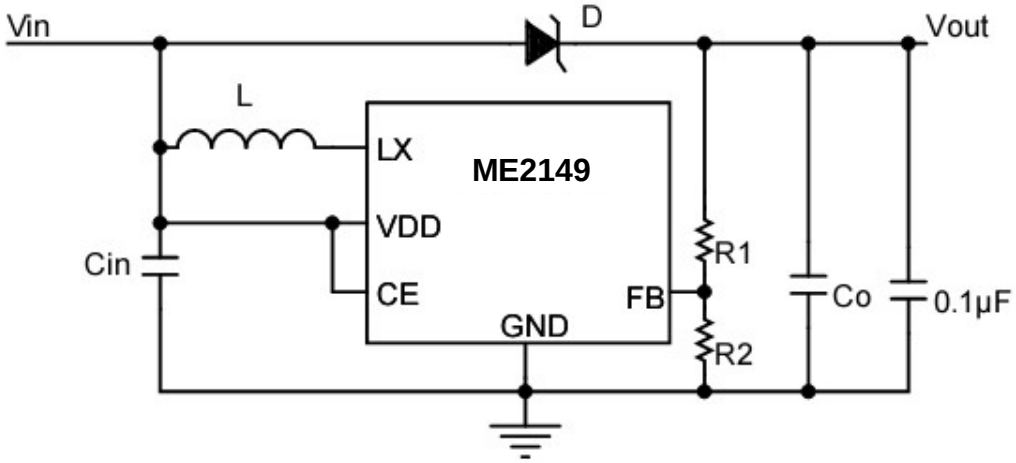
●The performance of this IC varies depending on the design of the PCB patterns, peripheral circuits and external

parts. Thoroughly test all settings with your device. Also, try to use recommended external parts.

Typical Application Circuit



For FB and external 1



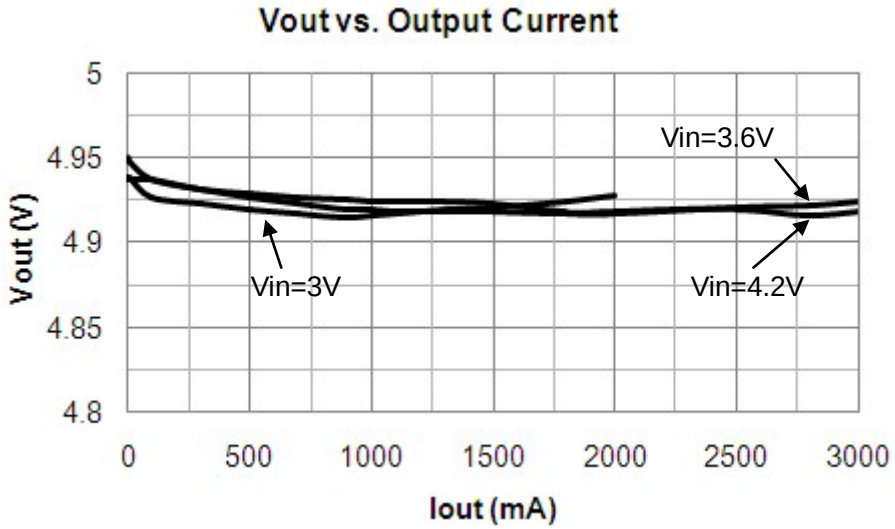
For FB and external 2

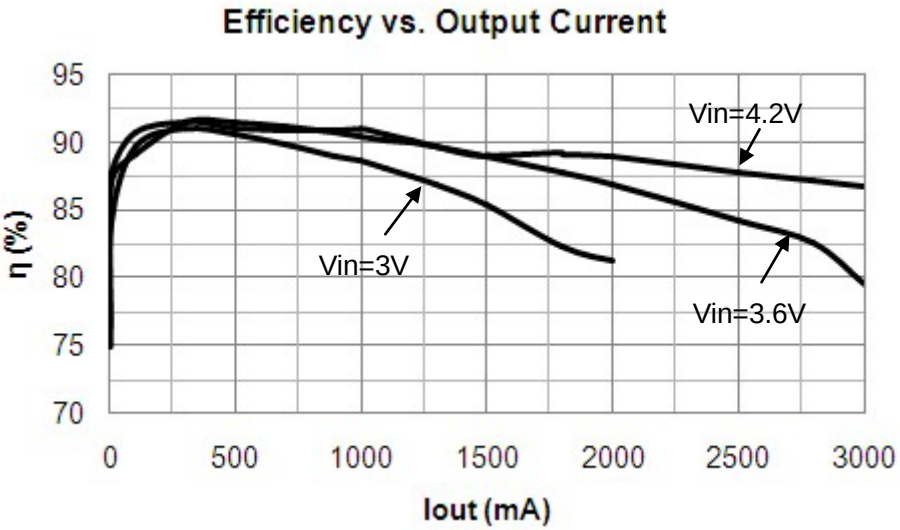
Note:

1. If VDD connected to Vin , Vin should above 2.5V.

2. ME2149F has three packages, suggestion: SOT23-5 loading is not more than 1A; SOT89-5 is not more than 1.5A; SOP8 is not more than 2A.

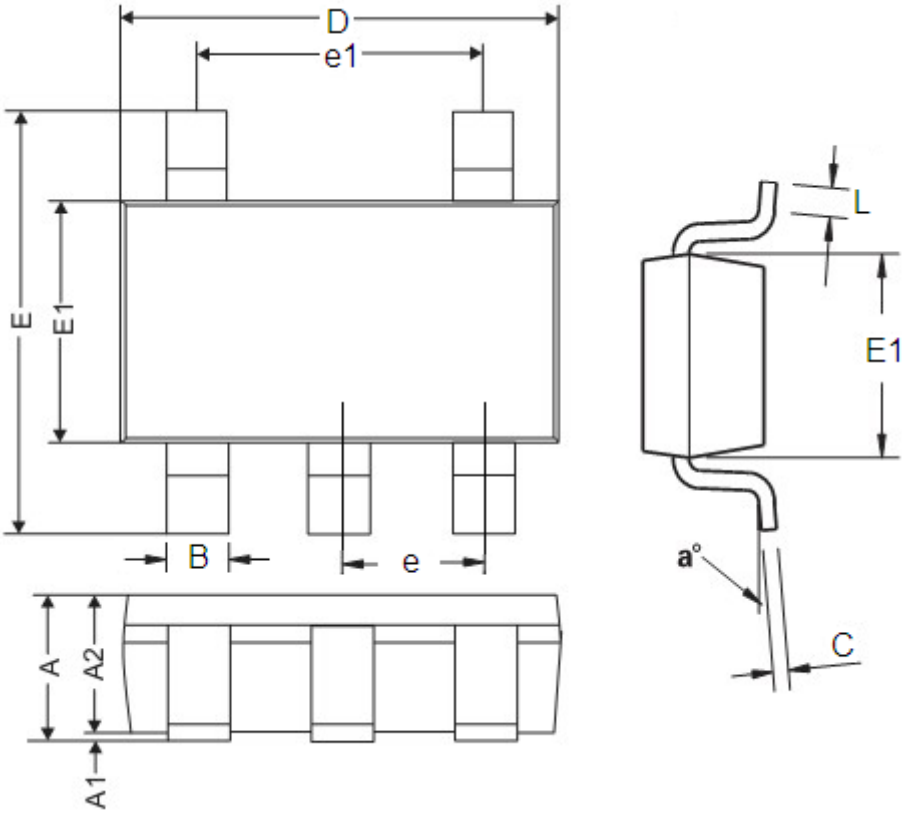
Typical Performance Characteristics





Package Dimension

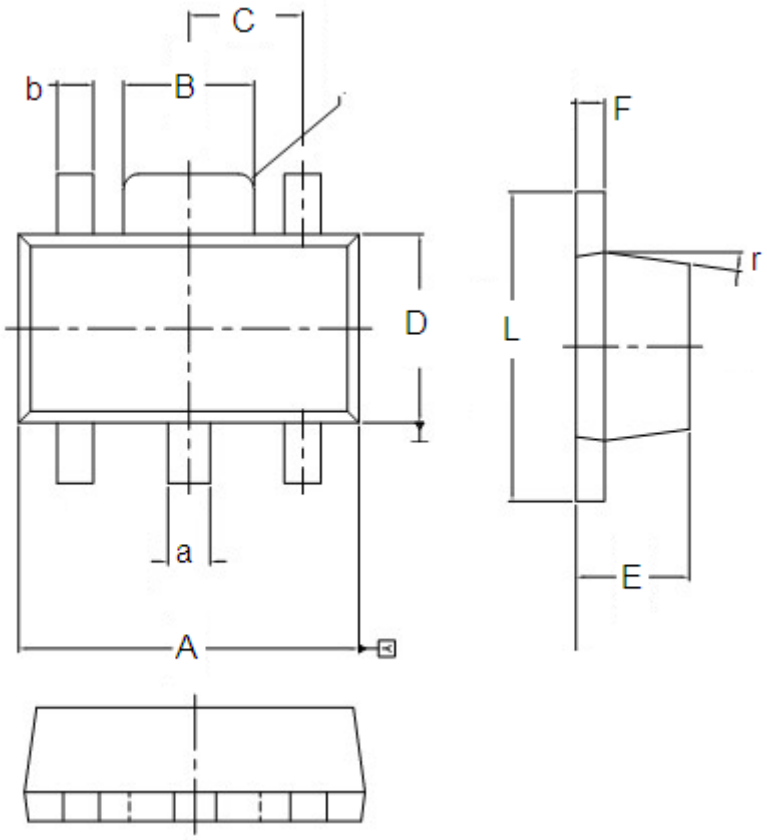
Package type:SOT23-5 **Unit:mm(inch)**



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	0^0	30^0	0^0	30^0

Package Dimension

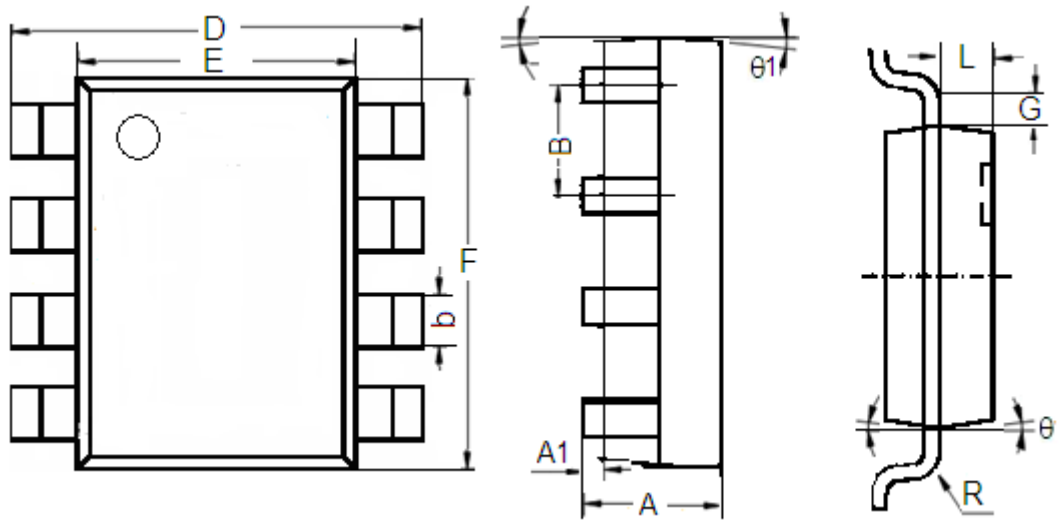
Package type:SOT89-5 **Unit:mm(inch)**



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	4.4	4.6	0.173	0.181
a	0.5	0.62	0.02	0.024
B	1.63	1.83	0.064	0.072
b	0.44	0.54	0.017	0.021
C	Type:1.5		Type:0.059	
D	2.4	2.6	0.094	0.102
E	1.4	1.6	0.054	0.063
F	0.35	0.43	0.013	0.017
L	3.95	4.25	0.155	0.167
r	Type:8^0		Type:8^0	

Package Dimension

Package type:SOP8 Unit:mm(inch)



Character	Dimension (mm)		Dimension (Inches)	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.1	0.3	0.004	0.012
B	1.27(Typ.)		0.05(Typ.)	
b	0.330	0.510	0.013	0.020
D	5.8	6.2	0.228	0.244
E	3.800	4.000	0.150	0.157
F	4.7	5.1	0.185	0.201
L	0.675	0.725	0.027	0.029
G	0.32(Typ.)		0.013(Typ.)	
R	0.15(Typ.)		0.006(Typ.)	
θ1	7°		7°	
θ	8°		8°	

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