Current Mode PWM Controller With Frequency Shuffling ME8204

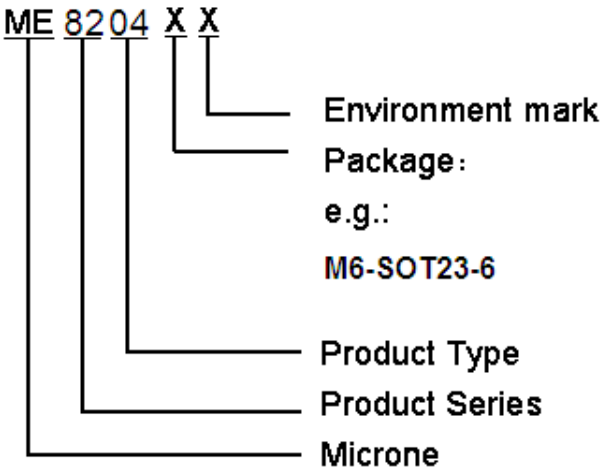
General Description

ME8204 is a highly integrated current mode PWM control IC optimized for high performance, low standby power (<100mW) and cost effective offline flyback converter applications in 40W～60W range. ME8204 offers complete protection coverage with automatic self-recovery feature including Cycle-by-Cycle current limiting (OCP), CS short protection, over load protection (OLP), and VDD under voltage lockout (UVLO) and latch feature including over temperature protection (OTP), over voltage (fixed or adjustable) protection(OVP). Excellent EMI performance is achieved with frequency shuffling technique together with soft switching control at the totem pole gate drive output. Tone energy at below 20KHz is minimized in the design and audio noise is eliminated during operation.

Features

- ●Power on Soft Start Reducing MOSFET V_{DS} Stress
- ●Frequency shuffling for EMI
- ●Audio Noise Free Operation
- ●Extended Burst Mode Control For Improved Efficiency and Minimum Standby Power Design
- ●Internal Synchronized Slope Compensation
- ●Fixed 65KHz Switching Frequency
- ●Good protection coverage with auto self-recovery
  - * VDD Under Voltage Lockout with Hysteresis (UVLO)
  - * Over Temperature Protection (OTP) with latch shut down
  - * Cycle-by-cycle over current threshold setting for constant output power limiting over universal input voltage range
  - * Overload Protection (OLP) with auto-recovery
  - * VDD Over voltage Protection(OVP) with latch shut down
  - * Adjustable OVP through external Zener
  - * CS floating protection with auto-recovery
  - * CS short protection with auto-recovery
- ● Available in SOT23-6 package

Selection Guide



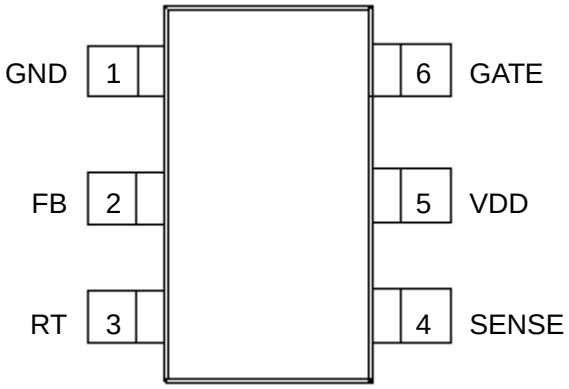
Typical Application

Offline AC/DC flyback converter for

- AC/DC adapter
- PDA power supplies
- Digital cameras and camcorder adapter
- VCR,SVR, STB, DVD&DVCD player SMPS
- Set-top box power
- Auxiliary power supply for PC and server
- Open-frame SMPS

Pin Configuration

The ME8204 is offered in SOT23-6 packages shown as below.



PIN Assignments

Pin Num.	Symbol	Description
1	GND	Ground
2	FB	Feedback input pin. The PWM duty cycle is determined by voltage level into this pin and the current-sense signal at PIN 3.
3	RT	Dual function PIN. Either connected through a NTC resistor to ground for over temperature shutdown/latch control or connected through Zener to VDD for adjustable over voltage protection.
4	SENSE	Current sense input pin. Connected to MOSFET current sensing resistor node.
5	VDD	Chip DC power supply pin.
6	GATE	Totem-pole gate drive output for the power MOSFET.

Absolute Maximum Ratings

Parameter	Range		Unit
VDD/VIN DC Supply Voltage	40		V
VDD Zener Clamp Voltage[Note]	VDD_Clamp+0.1V		V
VDD DC Clamp Continuous Current	10		mA
V_{FB} ,V_{SENSE} ,V_{RI},V_{RT} (Voltage at FB,SENSE,RI,RT to GND)	-0.3 to 7		V
Min/Max Operating Junction Temperature T_J	-20 to 150		°C
Min/Max Storage Temperature Tstg	-55 to 150		°C
$R_{\theta JA}$ thermal Resistance	SOT23-6	200	°C/W

Caution: The absolute maximum ratings are rated values exceeding which the product could suffer physical damage.

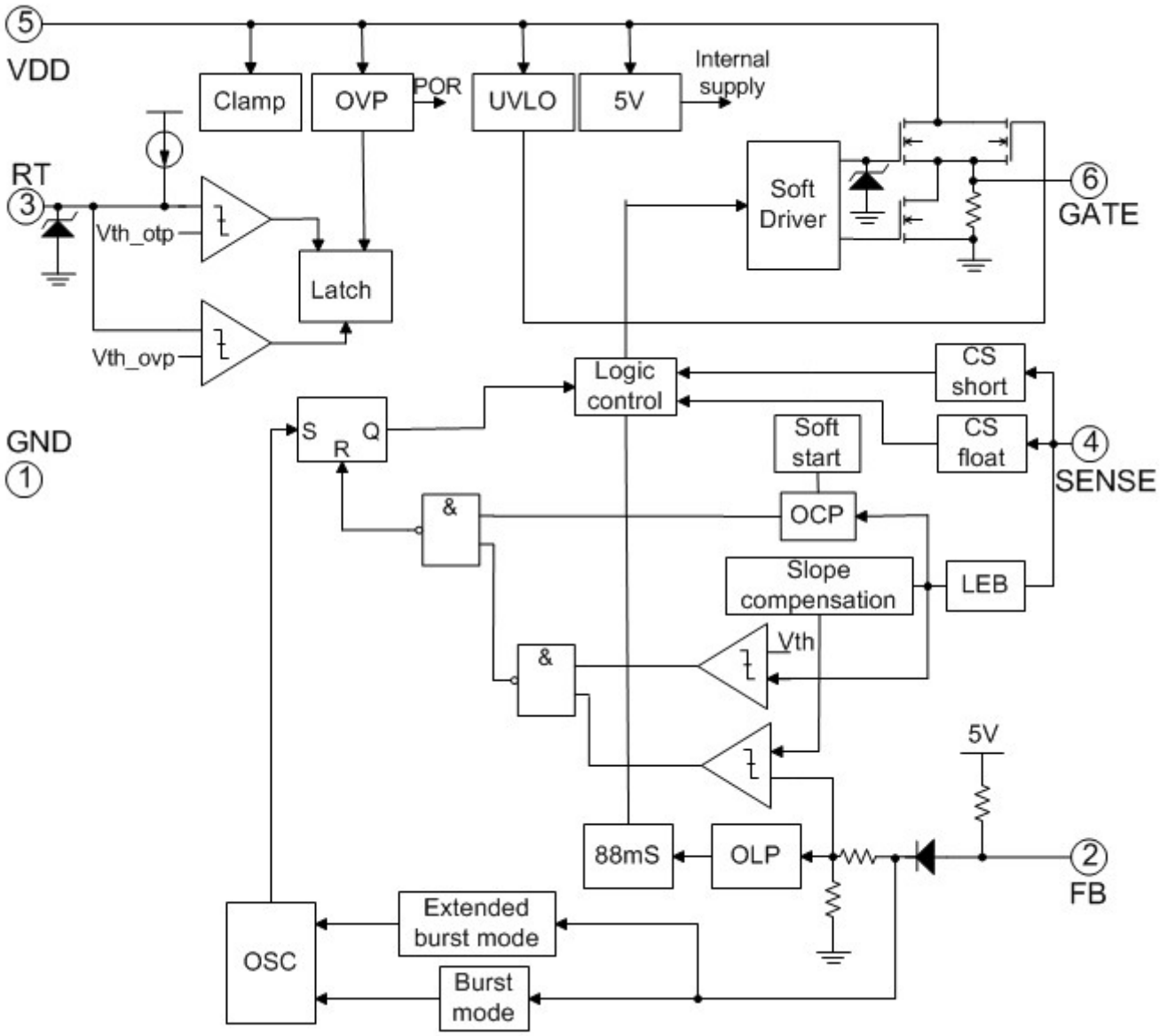
These values must therefore not be exceeded under any conditions.

Note: VDD_Clamp has a nominal value of 32V.

Recommended Operating Condition

Parameter	Range	Unit
VDD Supply Voltage	10 to 30	V
T_A Operating Ambient Temperature	-20 to 85	°C

Block Diagram



Electrical Characteristics(T_A = 25°C,VDD=16V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD)						
$I_{Startup}$	VDD Start up Current	VDD=11V, Measure leakage current into VDD	-	2	20	μA
$I_{VDD\_Operation}$	Operation Current	V_{FB}=3V	-	1.8	3	mA
$UVLO_{ON}$	VDD Under Voltage Lockout Enter		8	9	10	V
$UVLO_{OFF}$	VDD Under Voltage Lockout Exit (Recovery)		13	14	15.5	V
$V_{PULL-UP}$	Pull-up PMOS active		-	13	-	V
V_{DD_Clamp}		I_{VDD} = 10 mA	30	32	34	V
OVP_{ON}	VDD Over voltage protection enter	CS=0V,FB=3V Ramp up VDD until gate clock is off	24	26	28	V
V_{LATCH_REASE}	Latch release voltage		-	5	-	V
Feedback Input Section(FB Pin)						
AV_{CS}	PWM Input Gain $\Delta V_{FB}/\Delta V_{CS}$		-	2	-	V/V
Maximum duty cycle	Max duty cycle	V_{DD}=16V,V_{FB}=3V, V_{CS}=0V	75	80	85	%
V_{FB_Open}	V_{FB} Open Loop Voltage		3.9	4.2	-	V
I_{FB_Short}	FB pin short circuit current	Short FB pin to GND, measure current	-	0.3	-	mA
V_{REF_GREEN}	The threshold enter green mode		-	1.4	-	V
$V_{REF\_BURST\_H}$	The threshold exit burst mode		-	0.675	-	V
$V_{REF\_BURST\_L}$	The threshold enter burst mode		-	0.575	-	V
V_{TH_PL}	Power Limiting FB Threshold Voltage		-	3.7	-	V
T_{D_PL}	Power limiting Debounce Time		80	88	96	mS
Z_{FB_IN}	Input Impedance		-	4	-	KΩ
Current Sense Input(Sense Pin)						
Soft start time			-	4	-	mS
T_blanking	Leading edge blanking time		-	220	-	nS
Z_{SENSE_IN}	Input Impedance		-	40	-	KΩ
T_{D_OC}	Over Current Detection and Control Delay	From over current occurs till the gate drive output start to turn off	-	120	-	nS
V_{TH_OC}	Internal current limiting threshold voltage	FB=3.3V	-	0.875	-	V
$V_{OCP\_CLAMPER}$	CS voltage clamper		-	0.95	-	V
Oscillator						

F_{OSC}	Normal Oscillation Frequency	VDD=16V,FB=3V,CS=0V	60	65	70	KHz
Δf_OSC	Frequency jittering		-	±4	-	%
Δf_Temp	Frequency Temperature Stability	-20°C to 100 °C	-	1	-	%
F_shuffling	Shuffling frequency		-	32	-	Hz
Δf_VDD	Frequency Voltage Stability		-	1	-	%
F_Burst	Burst Mode Base Frequency		-	22	-	KHz
Gate Drive Output						
V_{OL}	Output Low Level	V_{DD}=16V,I_O = 5 mA	-	-	1	V
V_{OH}	Output High Level	V_{DD}=16V,Io = 20 mA	6	-	-	V
V_Clamp	Output Clamp Voltage		-	12	-	V
T_r	Output Rising Time 1V～12V	C_L = 1000pF	-	175	-	nS
T_f	Output Falling Time 12V～1V	C_L = 500pF	-	85	-	nS
Over Temperature Protection						
I_{RT}	Output current of RT pin		95	100	105	μA
V_{OTP}	Threshold voltage for OTP		0.95	1	1.05	V
V_{OTP_FL}	Float voltage at RT pin		-	2.3	-	V
T_{D_OTP}	OTP De-bounce time		-	32	-	Cycle
V_{RT_OVP}	RT Pin open voltage		-	4	-	V

Operation Description

The ME8204 is a low power off-line SMPS Switcher optimized for off-line flyback converter applications in 40W~60W power range. The 'Extended burst mode' control greatly reduces the standby power consumption and helps the design easily to meet the international power conservation requirements.

●Startup Current and Start up Control

Startup current of ME8204 is designed to be very low so that VDD could be charged up above UVLO threshold level and device starts up quickly. A large value startup resistor can therefore be used to minimize the power loss yet provides reliable startup in application. For a typical AC/DC adaptor with universal input range design, a 2 MΩ, 1/8 W startup resistor could be used together with a VDD capacitor to provide a fast startup and low power dissipation design solution.

●Operating Current

The Operating current of ME8204 is low at 1.8mA. Good efficiency is achieved with ME8204 low operating current together with extended burst mode control features.

●Frequency shuffling for EMI improvement

The frequency Shuffling/jittering (switching frequency modulation) is implemented in ME8204. The oscillation frequency is modulated with a random source so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore reduces system design challenge.

●Extended Burst Mode Operation

At zero load or light load condition, majority of the power dissipation in a switching mode power supply is from switching loss on the MOSFET transistor, the core loss of the transformer and the loss on the snubber circuit. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency leads to the reduction on the power loss and thus conserves the energy.

The switching frequency is internally adjusted at no load or light load condition. The switch frequency reduces at light/no load condition to improve the conversion efficiency. At light load or no load condition, the FB input drops below burst mode threshold level and device enters Burst Mode control. The Gate drive output switches only when VDD voltage drops below a preset level and FB input is active to output an on state. Otherwise the gate drive remains at off state to minimize the switching loss and reduces the standby power consumption to the greatest extend. The nature of high frequency switching also reduces the audio noise at any loading conditions.

●Oscillator Operation

The switching frequency of ME8204 is internally fixed at 65KHz. No external frequency setting components are required for PCB design simplification.

●Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in ME8204 current mode PWM control. The switch current is detected by a sense resistor into the sense pin. An internal leading edge blanking circuit chops off the sense voltage spike at initial MOSFET on state due to Snubber diode reverse recovery so that the external RC filtering on sense input is no longer required. The current limiting comparator is disabled and thus cannot turn off the external MOSFET during the blanking period. PWM duty cycle is determined by the current sense input voltage and the FB input voltage.

●Internal Synchronized Slope Compensation

Built-in slope compensation circuit adds voltage ramp onto the current sense input voltage for PWM generation. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation and thus reduces the output ripple voltage.

●Gate Drive

The power MOSFET is driven by a dedicated gate driver for power switch control. Too weak the gate drive strength results in higher conduction and switch loss of MOSFET while too strong gate drive output compromises the EMI. A good trade-off is achieved through the built-in totem pole gate design with right output strength and dead time control. The low idle loss and good EMI system design is easier to achieve with this dedicated control scheme.

●Over Temperature Protection

A NTC resistor in series with a regular resistor should connect between RT and GND for temperature sensing and protection.NTC resistor value becomes lower when the ambient temperature rises. With the fixed internal current I_{RT} flowing through the resistors, the voltage at RT pin becomes lower at high temperature. The internal OTP circuit is triggered and shutdown the MOSFET when the sensed input voltage is lower than V_{TH_OTP}.

●Protection Controls

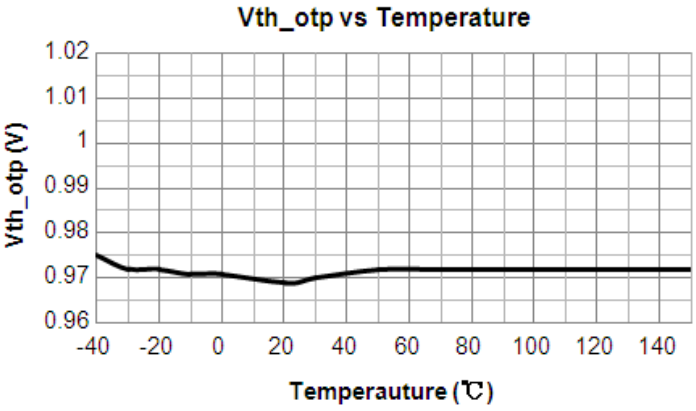
Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), Over Load Protection (OLP), CS short protection, CS floating protection, and latch features including over temperature protection (OTP), fixed or adjustable over voltage protection (OVP), and Under Voltage Lockout on VDD (UVLO).

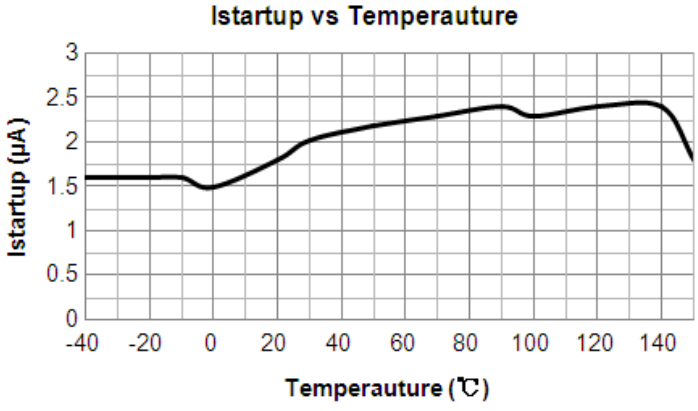
The OCP is line voltage compensated to achieve constant output power limit over the universal input voltage range.

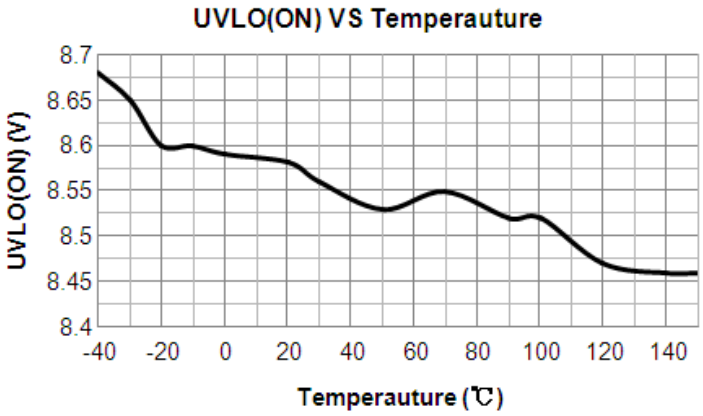
At overload condition, When FB input exceeds power limit threshold value for more than T_{D_PL}, control circuit reacts to shut down the output power MOSFET. Similarly, control circuit reacts to shut down the switcher. Switcher restarts when VDD voltage drops below UVLO limit. For latch mode, control circuit shutdowns (latch) the power MOSFET when an Over Temperature condition or Over Voltage condition is detected until VDD drops below 5V (Latch release voltage) , and device enters power on restart-up sequence thereafter.

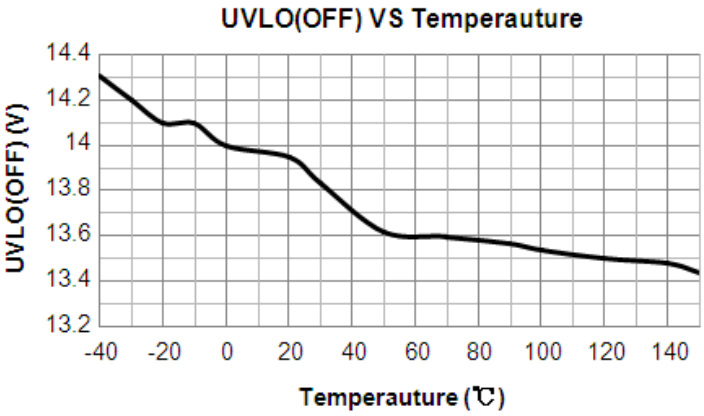
Typical performance characteristics

V_{DD} = 16V, T_A = 25℃ condition applies if not otherwise noted

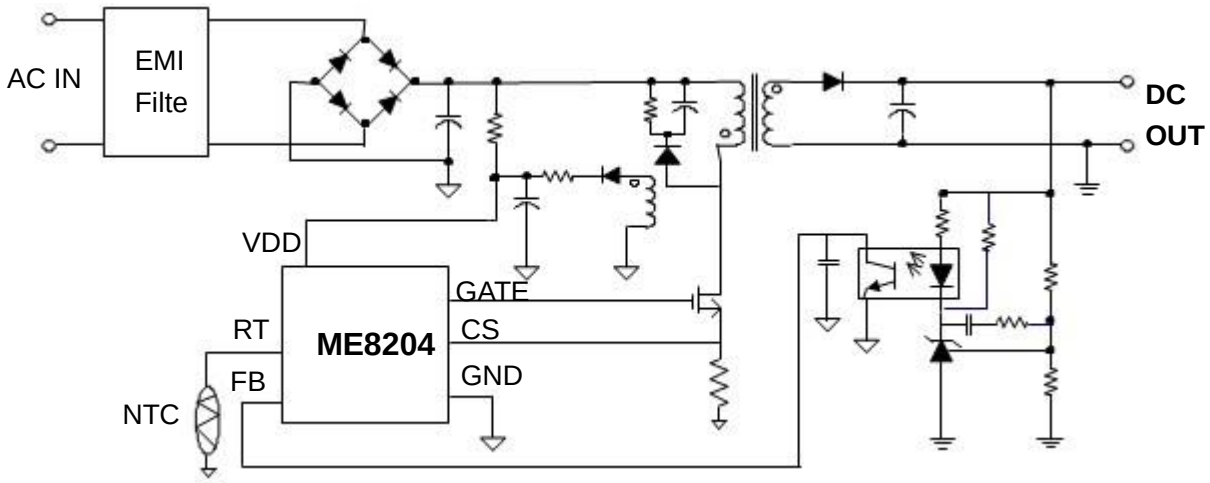






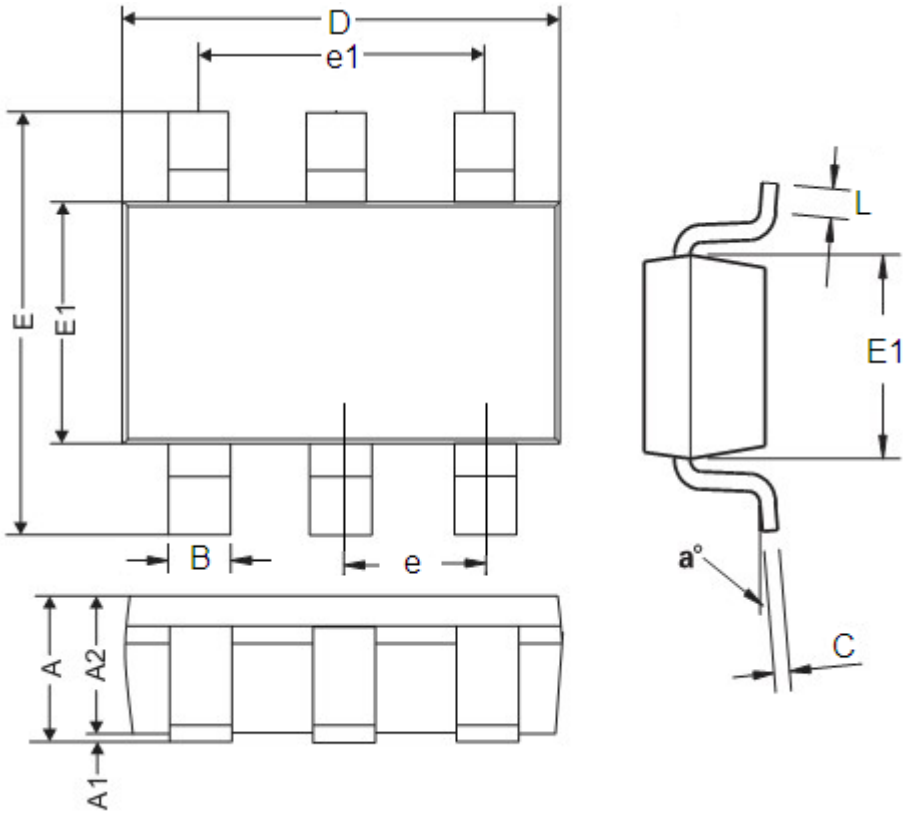


Typical Application



Packaging Information

Package type:SOT23-6 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

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电流模式准谐振 PWM 控制器

概述

ME8206 是一个电流模式准谐振 PWM 控制器，在 85V-265V 的宽电压范围内提供高达 100W 的输出功率，在大范围的负载和输入电压变化情况下确保谷底电压导通。

ME8206 采用高压启动设计，芯片直接连接到高压，以提供芯片启动所需电流，并在启动后关闭，以降低待机功耗；另外在轻载时进入跳周期模式，在更轻载时进入突发模式，从而实现了在全输入电压时小于 100mW 的待机空耗，并且使进入 20KHz 以下的音频区的范围最小化，以保证在正常工作状态无异音。芯片内部的 7.5uS 计时器限制了开关频率小于 120KHz（低于 CISPR-22EMI 中的 150KHz 限制），可以有效简化 EMI 设计。

ME8206 拥有完善的保护功能，包括过流保护（OCP），过载保护（OLP），欠压锁定（UVLO），过压保护（OVP），过温保护（OTP）等，以确保系统可靠的工作。

特点

- 内置高压启动电路
- 谷底电压导通
- 软启动功能
- 降噪功能
- 轻载进入绿色模式
- 过功率补偿
- 前沿消隐
- 斜坡补偿
- 完善的保护：OCP，OLP，UVLO，OVP，OTP

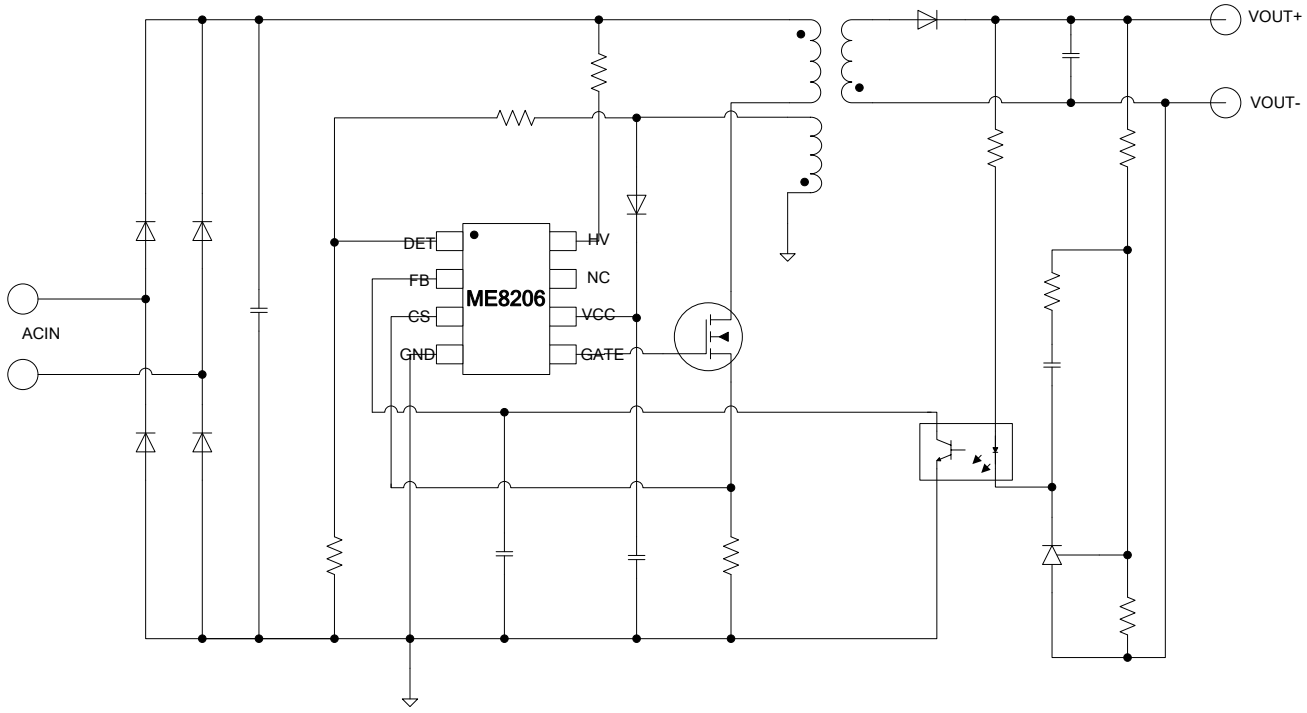
应用场合

- 适配器
- 机顶盒
- 开放式电源

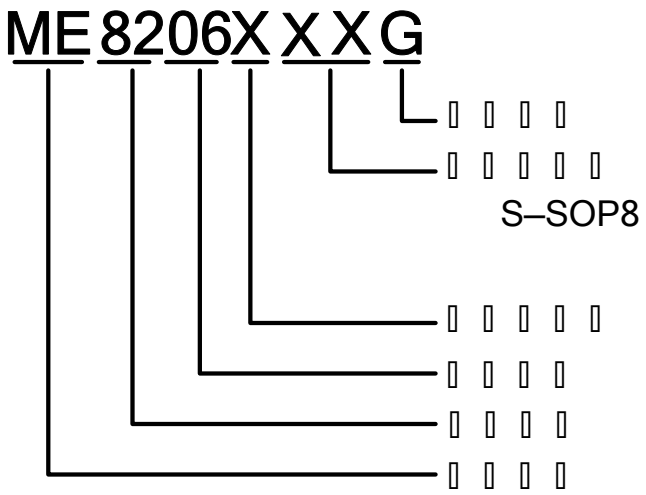
封装形式

- 8-pin SOP8

典型应用电路

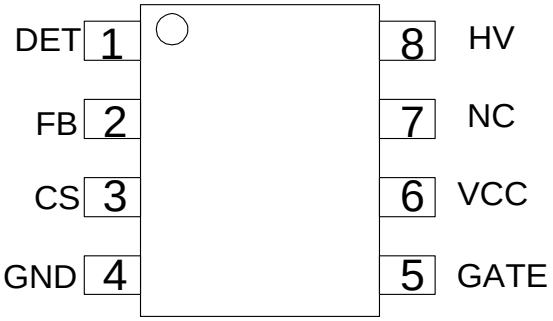


选购指南



产品型号	产品说明
ME8206ASG	封装形式：SOP8

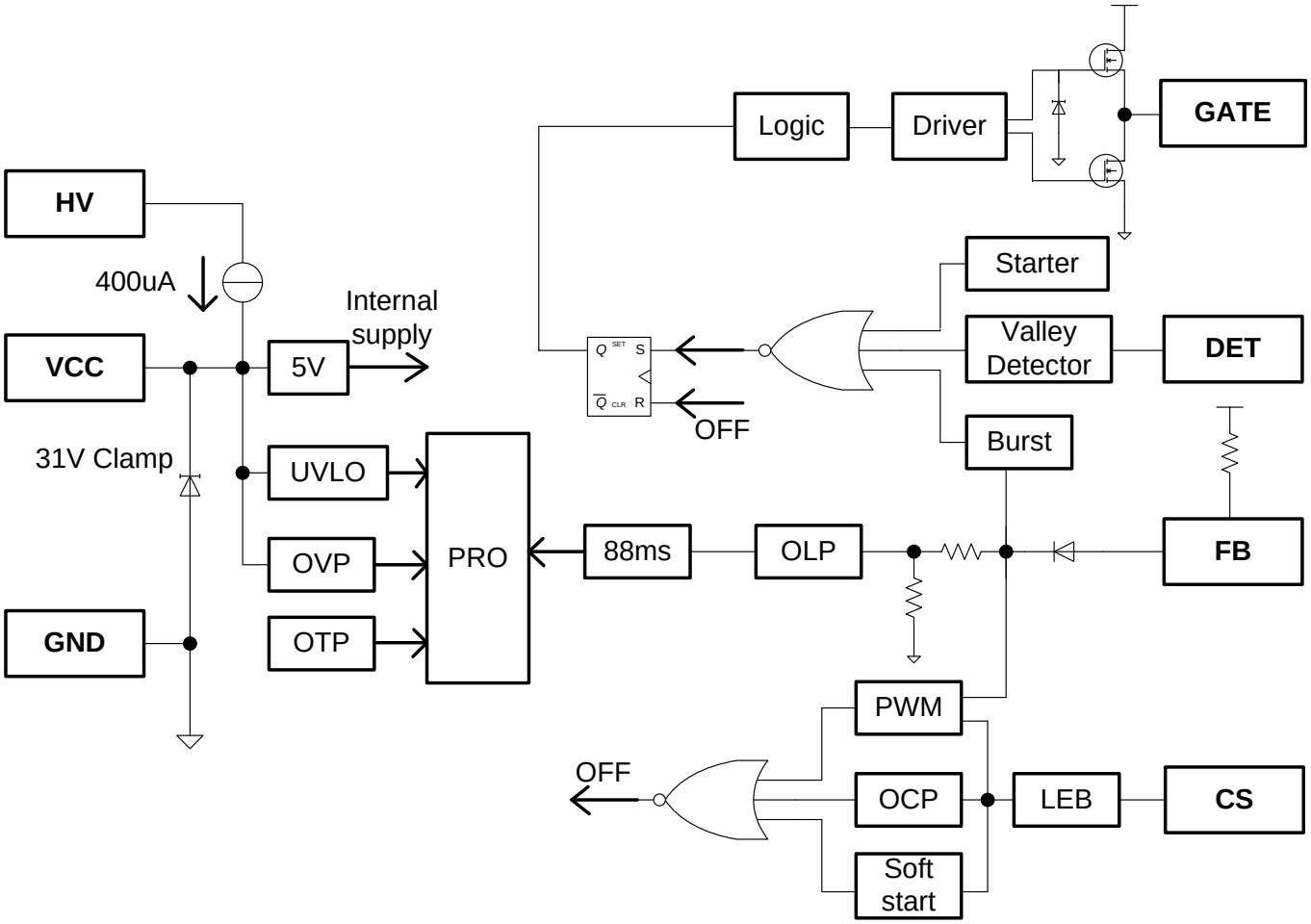
产品脚位图



脚位功能说明

PIN 脚位	符号名	功能说明
1	DET	谷底检测
2	FB	反馈
3	CS	电流检测
4	GND	地
5	GATE	功率管驱动
6	VCC	电源
7	NC	悬空
8	HV	高压启动

芯片功能示意图


HV
400uA
Internal
supply
VCC
5V
31V Clamp
UVLO
OVP
OTP
PRO
GND
88ms
OLP
FB
Logic
Driver
GATE
Starter
Valley
Detector
DET
Burst
OFF
PWM
OFF
OCP
LEB
CS
Soft
start

极限参数

参数	极限值	单位
电源电压：VCC	30	V
DRAIN电压	-0.3 ～ 650	V
VCC钳位电流	10	mA
FB，SENSE	-0.3 ～ 7	V
工作温度范围	-20～150	ºC
储存温度范围	-55～150	ºC
焊接温度和时间	+260（10秒）	ºC

注意：绝对最大额定值是本产品能够承受的最大物理伤害极限值，请在任何情况下勿超出该额定值。

推荐工作条件

参数	范围	单位
VCC 电源电压	10 to 30	V
工作温度	-20 to 85	°C

电气参数 (除非特殊说明，测试条件为：T_A = 25°C,VCC=16V)

符号	参数	条件	Min	Typ.	Max	Unit
高压启动 (HV)						
I_{Start}	高压启动电流	V_{HV} = 50 V	-	400	-	μA
电源(VCC)						
$I_{Startup}$	启动电流	VCC= $UVLO_{OFF}$ -1V，流入 VCC 的电流	-	5	20	μA
$I_{VCC\_Operation}$	工作电流	V_{FB}=3V	-	1.5	3.5	mA
$UVLO_{ON}$	VCC 欠压锁定电压		7.5	8.5	9.5	V
$UVLO_{OFF}$	VCC 欠压锁定解锁电压		13.5	14.5	15.5	V
$VCC_{\_Clamp}$	VCC 嵌位电压	I_{VCC} = 10 mA	31	34	36	V
OVP_{ON}	VCC 过压保护电压	CS=0V,FB=3V Ramp up VCC until gate clock is off	30	33	35	V
OTP	过温保护		-	145	-	℃
反馈 (FB)						
V_{FB_Open}	FB 开路电压		4.5	5	5.5	V
I_{FB_Short}	FB 短路电流	Short FB pin to GND, measure current	0.4	0.5	0.6	mA
V_{REF_GREEN}	进入绿色模式时的 FB 电压		-	1.7	-	V
$V_{REF\_BURST\_H}$	解除突发模式时的 FB 电压		-	1.15	-	V
$V_{REF\_BURST\_L}$	进入突发模式时的 FB 电压		-	1.05	-	V
V_{TH_PL}	过功率保护 FB 电压		-	3.7	-	V
T_{D_PL}	过功率保护反跳时间		80	88	96	mS
电流检测 (CS)						
T_ soft start	软启动时间		-	4	-	mS
T_blanking	前沿消隐时间		-	300	-	nS
T_{D_OC}	检测到控制的延迟时间		-	120	-	nS
V_{TH_OC}	最大电流限制比较电压	FB=3.3V	0.8	0.85	0.9	V
谷底检测(DET)						
T_{D_DET}	谷底检测延迟时间		-	300	-	nS
Toff_min	最小关断时间		7	7.5	8.5	uS
驱动（GATE)						
$T_{\_R}$	驱动上升时间	1V-12V@CL=3nF	150	-	-	nS
$T_{\_F}$	驱动下降时间	1V-12V@CL=3nF	100	-	-	nS
$V_{\_CLAMP}$	驱动嵌位电压		-	16	20	V

功能描述

ME8206 是一个电流模式准谐振 PWM 控制器，在大范围的负载和输入电压变化情况下确保谷底电压导通。初级峰值电流决定输出关闭时间，功率开关导通时间由变压器谷底检测电路触发。另外 ME8206 还集成高压启动功能，有效降低待机功耗。

启动过程

启动过程中，芯片内置高压 JFT 直接连到外部高压线上，JFT 恒流 0.4mA 左右给 VCC 端电容充电，当 VCC 升到 14V 时，芯片使能控制 JFT 关闭以及芯片内部模块开始工作，驱动高压 MOS 开关。一个 4mS 的软启动设计可以有效降低启动过程中 MOS 的开关应力。正常工作状态，辅助绕组上的电压会随着输出电压的升高而升高，到一定程度后开始给芯片供电。如果 VCC 电压低于 9V，芯片将自动关闭，重新进入启动过程。

谷底检测

ME8206 的功率开关导通时间由变压器谷底检测电路触发。芯片通过 DET 脚检测辅助绕组电压，当 DET 电压过零时，延时 300nS 后控制功率开关导通，此时功率开关的 D-S 电压接近最低点，次级整流二极管的电流也已经降低到零，可以有效降低功率开关和次级整流二极管损耗，同时也可以降低 EMI 和噪声干扰。

电流检测以及前沿消隐

ME8206 进行逐周期电流检测，开关电流经过一个检测电阻被 SENSE 脚检测到，到达一定阈值时控制开关关闭。为避免功率管开启时产生的尖峰造成误触发，有必要做一个前沿消隐时间，这里是 300nS。在这个时间里，开关不能被关闭。

绿色模式和突发模式

在空载或者轻载时，大部分能量损耗在功率开关管，而这损耗是和开关频率成正比的，因此低的开关频率可以有效降低损耗。

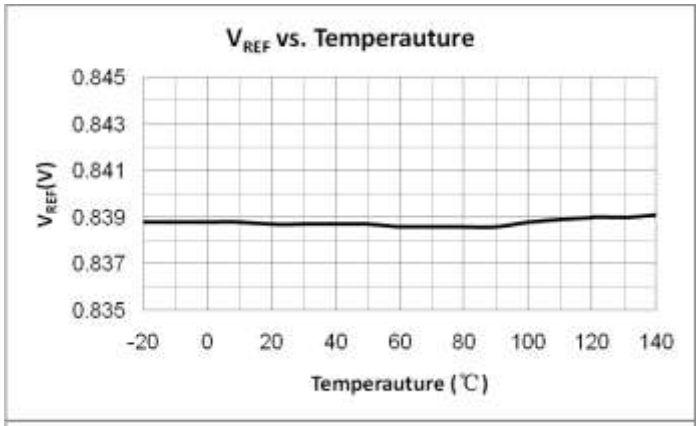
ME8206 设计开关频率在空载和轻载时调整，在空载和轻载时 FB 电压会降低，降到 1.7V 时进入绿色模式，芯片频率随着 FB 电压降低而降低，当 FB 电压进一步降低到 0.57V 时，芯片进入突发模式，及芯片驱动关断，直到 FB 升到 0.67V 时恢复开关。因此可以有效降低系统待机功耗。

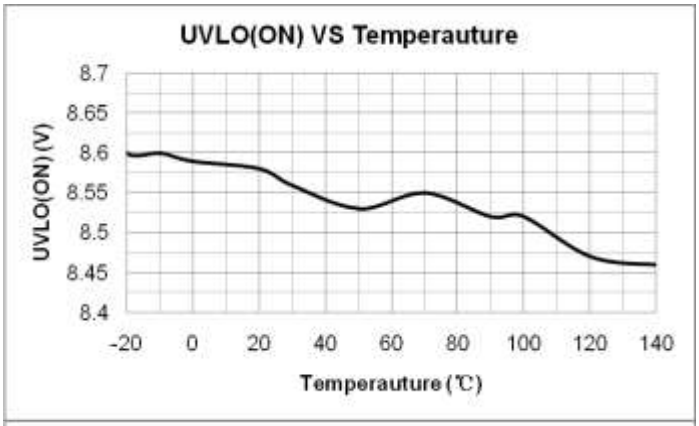
保护功能

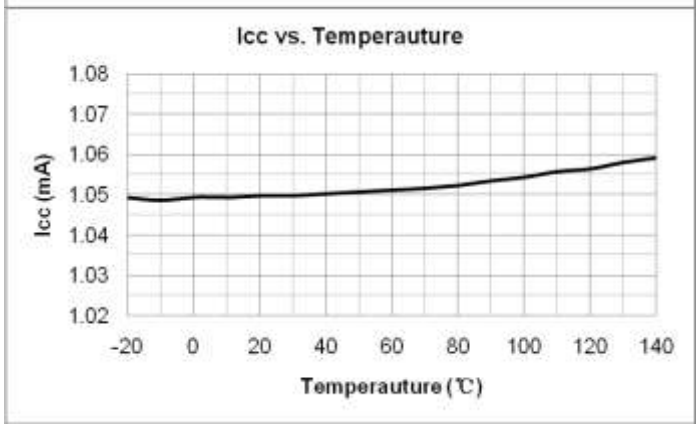
ME8206 拥有完善的保护功能，以确保系统可靠的工作。包括逐周期过流保护（OCP），过载保护（OLP），VCC 欠压锁定（UVLO），VCC 过压保护（OVP），过温保护（OTP）等。

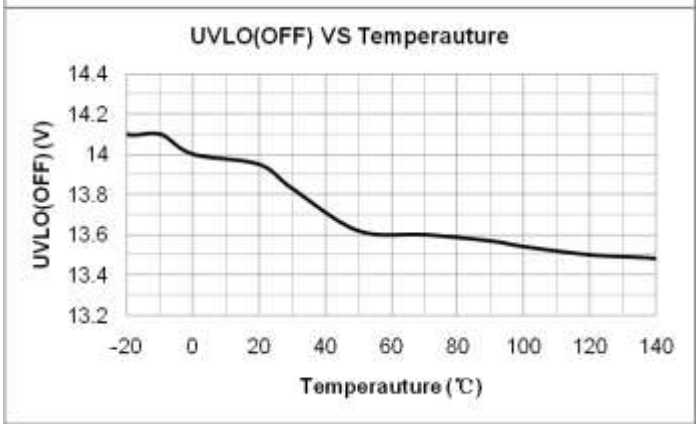
当 ME8206 工作在超负载状态时，输出电压无法到达额定电压，FB 电压超过内部设置的功率限制阈值电压达到 88mS 时控制电路关闭开关管，辅助绕组无法继续供电，VCC 开始下降，直到降低到 9V，芯片重新启动。

典型性能参数


V_{REF} vs. Temperauture
0.845
0.843
0.841
0.839
0.837
0.835
V_{REF}(V)
-20 0 20 40 60 80 100 120 140
Temperauture (℃)

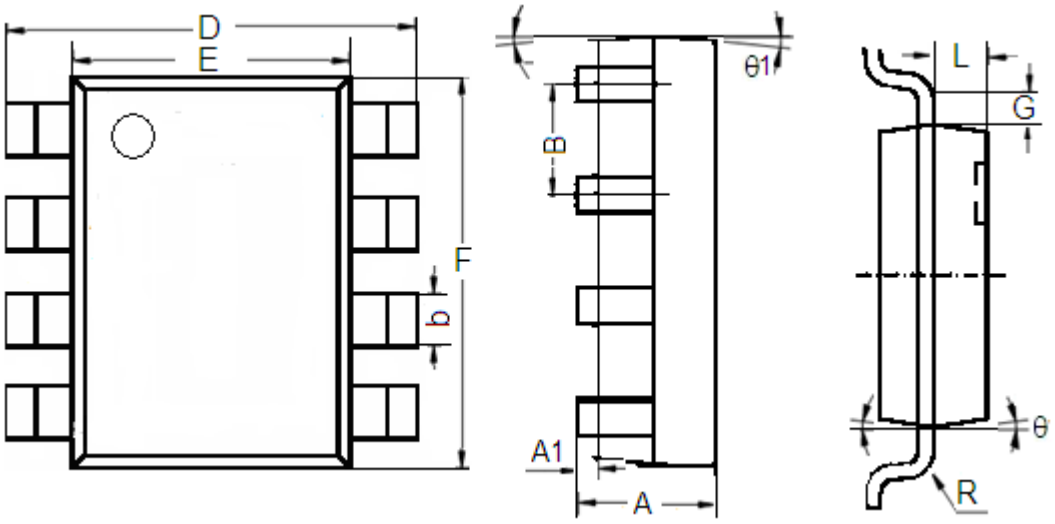

UVLO(ON) VS Temperauture
8.7
8.65
8.6
8.55
8.5
8.45
8.4
UVLO(ON) (V)
-20 0 20 40 60 80 100 120 140
Temperauture (℃)


Icc vs. Temperauture
1.08
1.07
1.06
1.05
1.04
1.03
1.02
Icc (mA)
-20 0 20 40 60 80 100 120 140
Temperauture (℃)


UVLO(OFF) VS Temperauture
14.4
14.2
14
13.8
13.6
13.4
13.2
UVLO(OFF) (V)
-20 0 20 40 60 80 100 120 140
Temperauture (℃)

封装信息

- **封装类型: SOP8**



参数	尺寸 (mm)		尺寸 (Inch)	
	最小值	最大值	最小值	最大值
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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