CURRENT MODE PWM CONTROLLER

DESCRIPTION

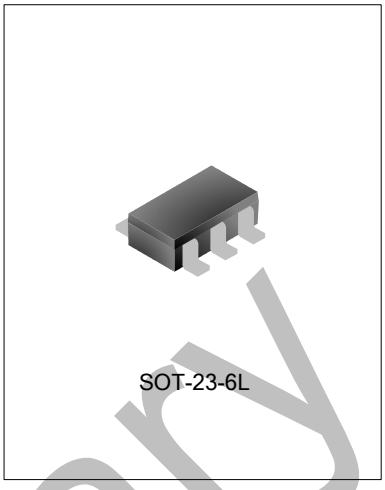
SD4871 is a current mode PWM controller IC for high performance, low standby power offline flyback converter application.

In no load or light load condition, the IC operates in Light Load Mode to reduce switching loss and improve efficiency.

Large startup resistor could be used in the startup circuit to minimize the standby current because of low startup current.

SD4871 offers complete protection functions including cycle-by-cycle over current protection, over load protection, over voltage and under voltage protections for V_{DD} voltage, etc.

Excellent EMI performance is achieved with frequency shuffling technique and soft switching control at the totem pole gate driver output.



FEATURES

* Frequency shuffling to improve EMI performance
* Light Load Mode for minimum standby power
* External programmable switching frequency
* 3μA low startup current
* Internal LEB circuit
* V_{DD} over voltage and under voltage protection
* Gate output maximum voltage clamp
* Current limiting
* Over load protection
* SOT-23-6L package

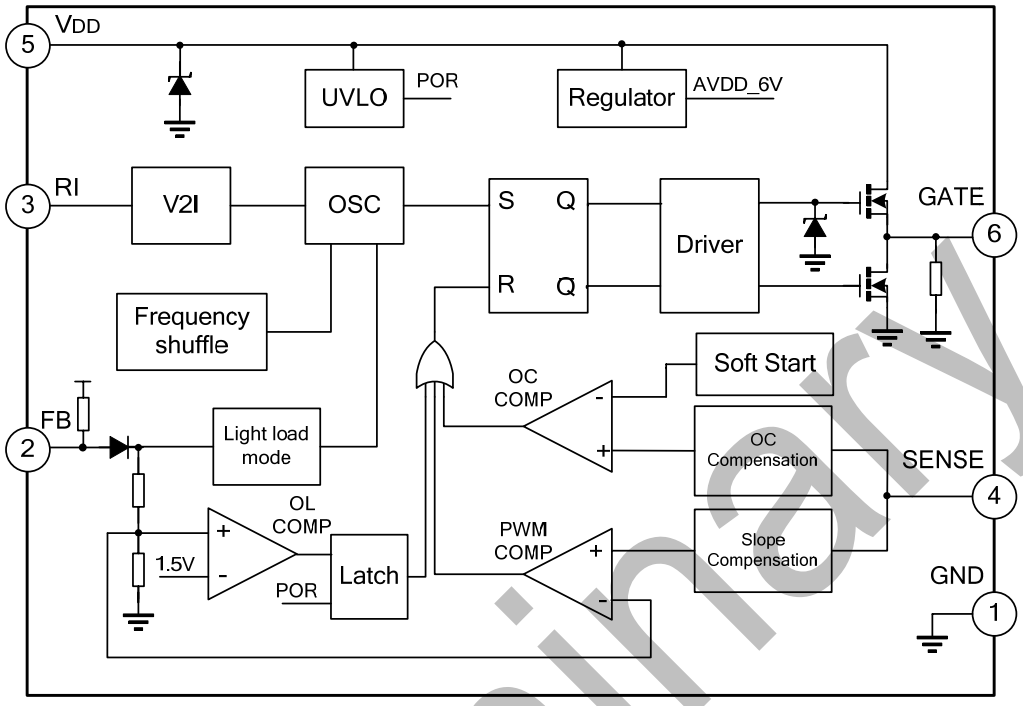
APPLICATIONS

* Battery Chargers
* Adapters
* Set-Top Box Power Supplies

ORDERING INFORMATION

Part No.	Package	Marking	Material	Packing
SD4871TR	SOT-23-6L	4871	Pb free	Tape & Reel

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

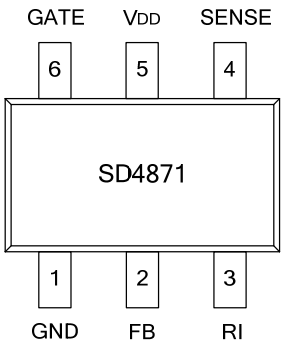
Characteristics	Symbol	Rating	Unit
Supply Voltage	V_{DD}	28	V
Feedback Voltage	V_{FB}	-0.3~6	V
SENSE Voltage	V_{SENSE}	-0.3~6	V
RI Voltage	V_{RI}	-0.3~6	V
Junction Temperature Range	T_j	-20~150	°C
Lead Temperature	T_L	260	°C
Storage Temperature Range	T_{stg}	-55~160	°C

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, T_{amb}=25°C)

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
V_{DD}						
Startup Current	I_{VDD_ST}	V_{DD}=12 V, R_I=100kΩ	--	3	20	μA
Operation Current	I_{VDD}	V_{DD}=16V, V_{FB} =3V, R_I=100kΩ	--	2	--	mA
Start up Voltage	V_{START}		13.3	14.3	15.3	V
Shut down Voltage	V_{SHUT}		--	7.8	--	V
V_{DD} OVP Voltage	V_{VDD_OVP}		--	27.5	--	V
V_{DD} Clamp Voltage	V_{VDD_CLP}	I_{VDD} =10mA	--	28	--	V

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Feedback						
PWM Gain	A_{VCS}	$\Delta V_{FB}/\Delta V_{SENSE}$	--	2	--	V/V
FB Open Loop Voltage	V_{FB_OPEN}		4.5	4.8	5	V
FB Short Circuit Current	I_{FB_SHORT}	FB short connected to ground	0.3	0.35	0.4	mA
FB OL Threshold Voltage	V_{FB_OL}		--	3.8	--	V
OL Debounce Time	T_{D_OL}			35	--	ms
FB Input Impedance	Z_{FB_IN}		18	23	--	kΩ
Maximum Duty Cycle	D_{MAX}	V_{DD}=16V, R_I=100kΩ V_{FB} =3V, V_{SENSE} =0V	--	75	--	%
Current Sense						
LEB Time	T_{LEB}	R_I=100kΩ	--	300	--	ns
SENSE Input Impedance	Z_{SENSE_IN}		--	85	--	kΩ
OC Control Delay	T_{OC}		--	75	--	ns
OC Detection Threshold	V_{SENSE_OC}		0.7	0.75	0.8	V
Soft Start						
Soft start time	T_{ss}	R_I=100kΩ	--	4	--	ms
Switching Frequency						
Ocsillation Frequency	f_S	R_I=100kΩ	60	65	70	kHz
Frequency Stability With VDD	Δf_{S_VDD}	V_{DD}=12~28V, R_I=100kΩ	--	5	--	%
RI External Resistance Range	R_{RI_RANGE}		50	100	150	kΩ
Light Load Mode Frequency	f_{S_LLM}		--	22	--	kHz
Frequency Shuffling Range	Δf_{S_SHUF}	R_I=100kΩ	-3	--	3	%
Gate Driver						
Output Low Level	V_{OL}	V_{DD}=16V, I_O=-20mA	--	--	0.8	V
Output High Level	V_{OH}	V_{DD}=16V, I_O=20mA	10	--	--	V
Output Clamp Voltage Level	V_{OH_CLAMP}		--	13	--	V
Output Rising Time	T_R	V_{DD}=16V, C_L=1nF	--	220	--	ns
Output Falling Time	T_F	V_{DD}=16V, C_L=1nF	--	70	--	ns

PIN CONFIGURATION



PIN DESCRIPTIONS

Pin No.	Pin Name	I/O	Description
1	GND	--	Ground.
2	FB	I	Feedback input pin.
3	RI	I/O	Oscillator frequency setting pin. A resistor connected between RI and GND.
4	SENSE	I	Switch current sense input pin.
5	VDD	--	Power supply pin.
6	GATE	O	Gate driver output pin.

FUNCTION DESCRIPTIONS

SD4871 is a current mode PWM controller used in applications for offline flyback converter. The description of functions is as follows.

Startup Control

Startup current of SD4871 is very low so that IC could start up quickly. A large startup resistor can be used in startup circuit to minimize standby power loss yet provides reliable startup in application.
A 2 MΩ, 1/8 W startup resistor is recommended in normal input range.

Frequency Shuffling Control

Frequency shuffling is used in SD4871 to improve EMI performance.
The oscillation frequency is modulated randomly so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and the system design can be easier.
The entire application system design can become simpler.

Light Load Mode

In no load or light load condition, major power loss of total power consumption is from switching loss on the MOSFET transistor switching loss, the core loss of the transformer and the loss on the external snubber circuit, which become the majority in total power loss. The value of those power losses is proportional to switching actions within a fixed period of time. So reducing number of switching actions can reduce the power loss.
SD4871 enters Light Load Mode in no load or light load condition. The gate drive output switches only when output DC voltage drops below a preset level and the switching frequency reduces. Otherwise the gate drive remains at off state.

Oscillation Frequency Setting

The oscillation frequency is determined by resistor connected between RI and GND. The relationship between the value of this resistor and frequency are shown below

$f_S = \frac{6500}{R_{RI}}(kHz)$, where R_{RI} is the value of external resistor and its unit is KΩ.

Current Sense and LEB

At switching leading edge time, the current spike due to Snubber diode reverse recovery should be chopped off for it will affect the error of PWM comparator. And this is available through internal LEB (Leading Edge Blanking) circuit. So that the external RC filter circuit on SENSE input is no longer required. During the blanking period, the PWM comparator and OC comparator are disabled and MOSFET transistor keeps turn-on state. The minimum on time of MOSFET is LEB time.

Soft Start

SD4871 features an internal 4ms soft start during startup（when the switching frequency is set to 65kHz）.

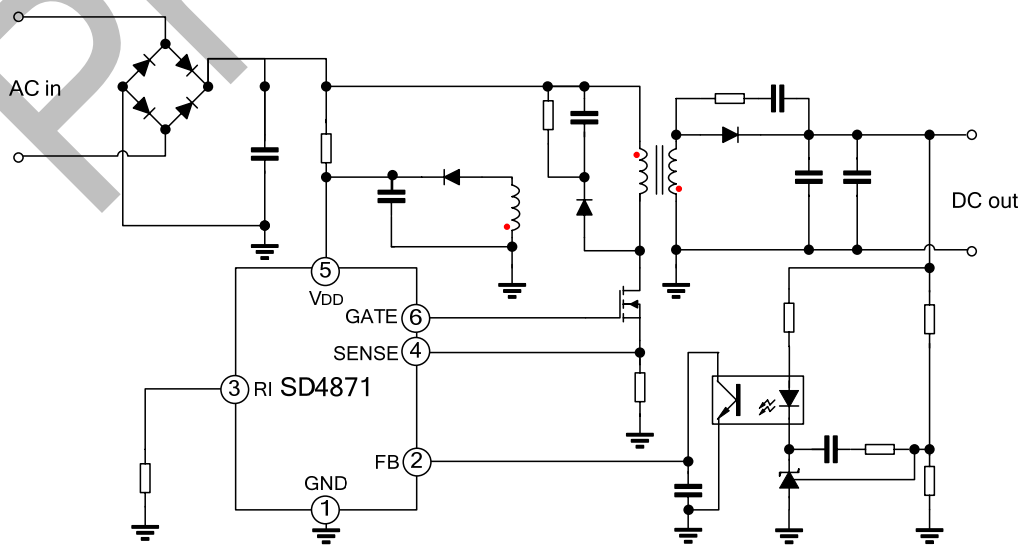
Gate Driver

GATE pin is connected to external MOSFET's gate for switch control. Too weak the gate drive ability results in more switch loss of MOSFET while too strong gate drive compromises the EMI performance.
A good tradeoff is achieved through the totem pole gate drive design with appropriate output ability and dead time control.

Protections control

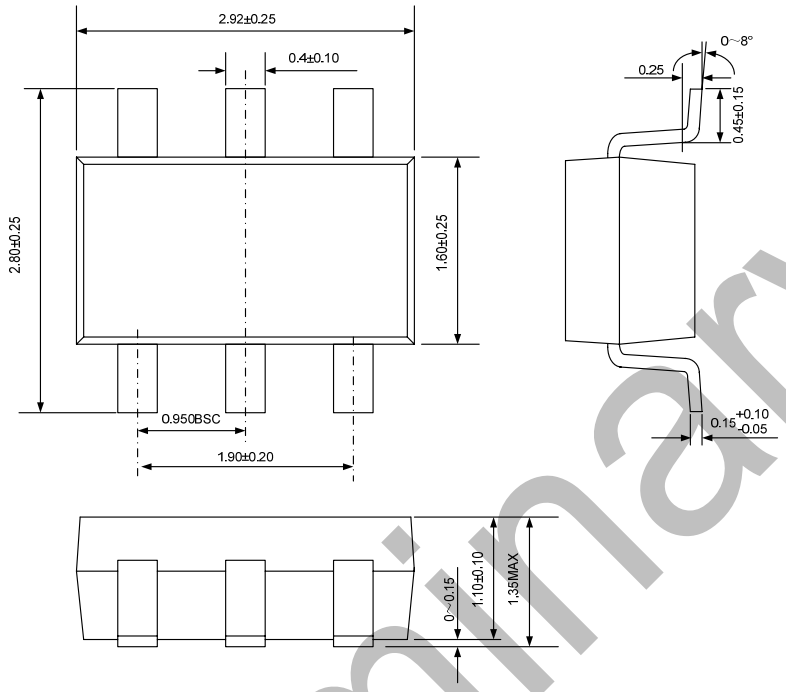
SD4871 offers complete protection functions including cycle-by-cycle over current protection, over load protection, over voltage and under voltage protection for V_{DD} input voltage, etc.
Constant output power limit over universal input voltage range is achieved with over current protection threshold line voltage compensation to over current protection threshold.
V_{DD} is supplies by auxiliary winding output of the transformer. It is clamped when V_{DD} is higher than clamp threshold value. The MOSFET is shut down when V_{DD} drops below shut-down voltage and IC enters power on startup sequence thereafter.
When FB input voltage is higher than over load threshold voltage for more than T_{D_OL}, the MOSFET is shut down and V_{DD} voltage drops. IC restarts when V_{DD} is lower than shut-down voltage.

TYPICAL APPLICATION CIRCUIT



PACKAGE OUTLINEPACKAGE OUTLINE

SOT-23-6L UNIT: mm



MOS DEVICES OPERATE NOTES:

Electrostatic charges may exist in many things. Please take following preventive measures to prevent effectively the MOS electric circuit as a result of the damage which is caused by discharge:

- The operator must put on wrist strap which should be earthed to against electrostatic.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed in antistatic/conductive containers for transportation.

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