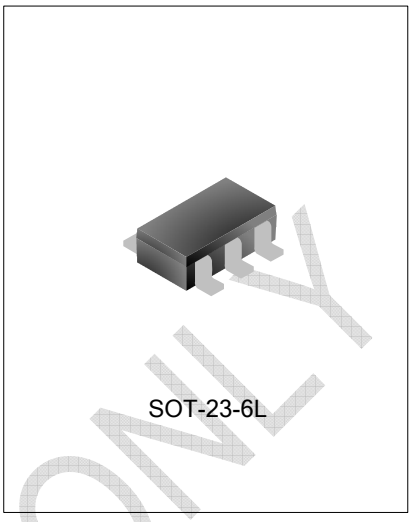
PRIMARY SIDE CONTROL SMPS FOR LED DRIVER

DESCRIPTION

SD6855/6 is a primary side control SMPS for LED driver with accurate constant voltage, constant current (CV/CC) control loop for high average efficiency and reliability. Using SD6855/6 for system design can reduce the component count without using opto-coupler, secondary feedback control, and loop compensation circuit, which will reduce the BOM cost.

The output voltage can be set by the feedback resistor and the output current can be set by peak current sensing resistor within a certain output power range, which can meet the requirements of different solutions for driving LEDs in series or in parallel.

SD6855 adopts an external driving transistor suitable for 1~5W output power; SD6856 uses an external driving MOSFET suitable for 5~7W output power; They are both available in SOT-23-6L package.



FEATURES

* Primary side control
* Low start-up current
* Leading edge blanking
* Pulse-Frequency Modulation(PFM)
* Overvoltage protection
* Undervoltage lockout
* Over temperature protection
* Cycle by cycle current limiting
* Open loop protection

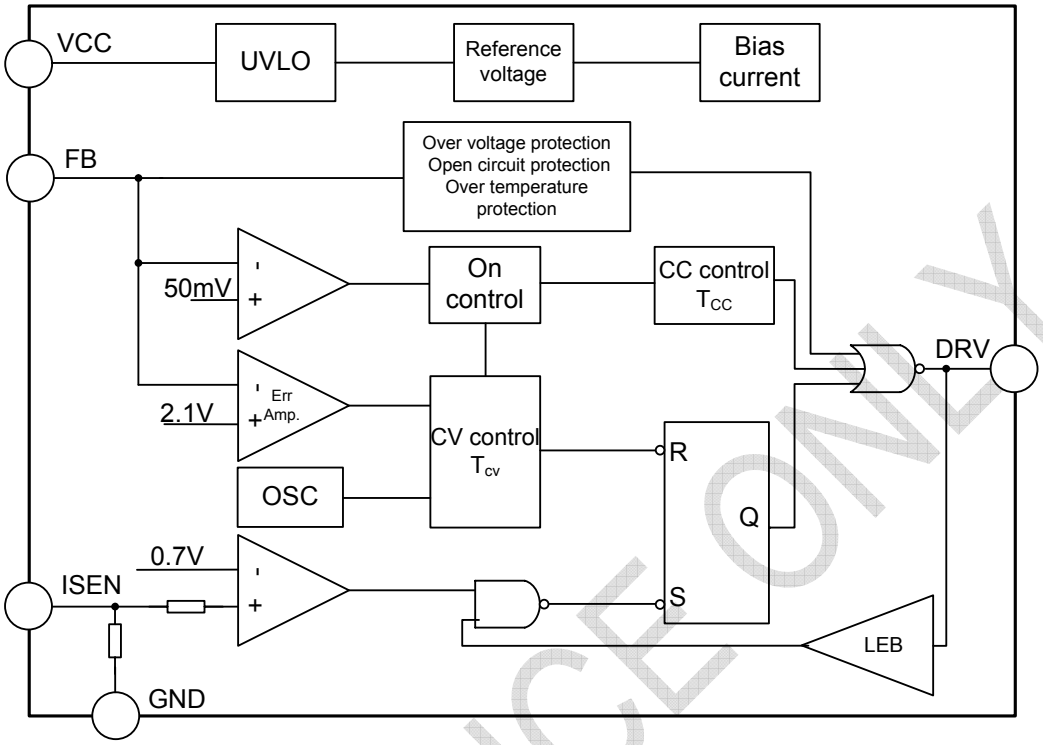
APPLICATIONS

* High voltage spotlight
* Bulb light
* PAR light

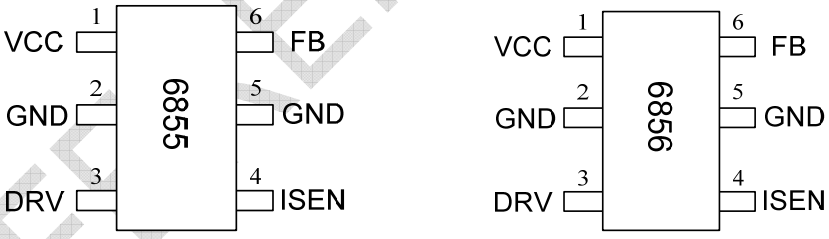
ORDERING INFORMATION

Part No.	Package	Marking	Material	Packing
SD6855TR	SOT-23-6L	6855	Pb free	Tape&Reel
SD6855GTR		6855G	Halogen free	Tape&Reel
SD6856TR		6856	Pb free	Tape&Reel
SD6856GTR		6856G	Halogen free	Tape&Reel

BLOCK DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION（The pin configurations of SD6855 and SD6856 are the same）

Pin No.	Pin Name	I/O	Function description
1	VCC	-	Power supply
2	GND	-	Ground
3	DRV	O	Driving output pin
4	ISEN	I	Peak current sensing pin
5	GND	-	Ground
6	FB	I	Feedback voltage input pin

ABSOLUTE MAXIMUM RATING (unless otherwise specified, T_{amb}=25°C)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.3~23	V
Internal voltage reference	V_{REF5V}	-0.3~5.5	V
Input voltage on pin FB	V_{FB}	-20~18	V
Input voltage on other pins	V_{IN}	-0.3~ 5.3	V
Input current	I_{IN}	-10~10	mA
Operating junction temperature	T_J	+160	°C
Operating temperature range	T_{amb}	-20~ +85	°C
Storage temperature range	T_{STG}	-40~+125	°C
ESD(body mode)	ESD	2500	V

ELECTRICAL CHARACTERISTICS (unless otherwise specified, V_{CC}=18V, T_{amb}=25°C)

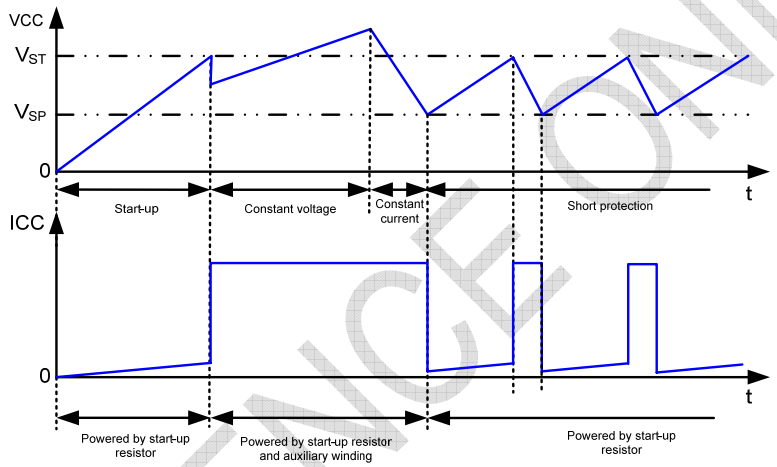
Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Supply voltage						
Start-up current	I_{ST}	V_{CC} =14V	--	3	10	μA
Quiescent current	I_{OP}			300	450	μA
Start threshold voltage	V_{ST}		13	14.5	16	V
Shutdown threshold voltage	V_{SP}		5.5	6.5	7.5	V
Reference power supply	V_{REF5V}		4.75	5.0	5.25	V
Feedback						
Enable turn on voltage	V_{EN}		20	50	80	mV
Over voltage protection	V_{OVP}		4.8	5.0	5.2	V
Loop open voltage	V_{BLANK}		-1.2	-1	-0.8	V
Dynamitic parameter						
Leading-edge blanking time	T_{LEB}		0.3	0.6	0.9	μs
Maximum duty of constant-voltage loop	D_{Smax}		50	57	64	%
PFM frequency range	f_S		100		200k	Hz
Over voltage recover time	T_{OVP}		12	18	24	ms
Current Limit						
Peak current detecting threshold voltage	V_{PK}		500	700	900	mV
Over Temperature Protection						
Over temperature detection	T_{sd}		125	140	--	°C
Over temperature hysteresis	T_{sdhys}		20	35	50	°C

FUNCTION DESCRIPTION

SD6855/6 is designed for off-line SMPS. The primary winding on time T_{ON}, auxiliary winding discharge time T_{OFF1} and oscillation attenuation time T_{OFF2} are detected for output constant current.

1. Start-up and under voltage lockout

At the beginning of power on, the capacitor connected to pin VCC is charged via start resistor by high voltage DC bus and the circuit start to work if voltage at VCC is 14.5V. The circuit is powered by start resistor and auxiliary winding for normal operation. The whole control circuit is shutdown if VCC is decreased to 6.5V, and the capacitor connected to pin VCC is still charged through start resistor and IC is restarted when VCC=14.5V.



2. Peak Current Detection

When $V_{DRV}=1$, transistor/MOS is on, the linearly increased primary current is detected by the sense resistor. When this current increased to the threshold value (peak value), the transistor/MOS is off and the driving voltage $V_{DRV}=0$.

There is a burr when transistor/MOS is on, and if its voltage is more than threshold voltage of the peak current, the transistor/MOS will be off. So the leading edge blanking time $T_{LEB}=0.6\mu s$ is set to avoid this error.

3. Constant Current Realization

The control circuit detects the time when V_{FB} is positive, negative or attenuation. T_{OFF1} is the time when V_{FB} is positive which means there is current delivered to the auxiliary winding; T_{ON} is the time when V_{FB} is negative which means the transistor is on; T_{OFF2} is the time when V_{FB} is attenuation. And during T_{ON} and T_{OFF2}, there is no current delivered to the auxiliary winding. The duty cycle of this SMPS is:

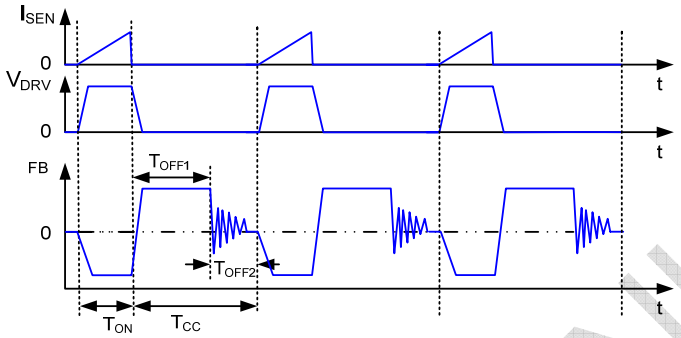
$$D_S = \frac{T_{OFF1}}{T_{OFF1}+T_{OFF2}+T_{ON}} = \frac{T_{OFF1}}{T};$$

Output current, also the average current in secondary winding:

$$I_{OUT} = \frac{I_{SP}\cdot T_{OFF1}}{2T} = \frac{nD_S}{2} I_{PK};$$

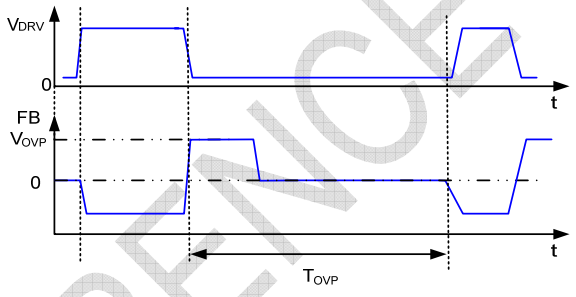
I_{SP}—peak current in secondary winding, I_{PK}—peak current in primary winding, n—turns ratio of primary/secondary windings.

So, under the condition of constant peak current, keeping $T_{OFF1}=T_{OFF2}+T_{ON}$ can realize the constant current output.



4. Over voltage protection

The output is shutdown if V_{FB} exceeds the threshold V_{OVP} and this state is kept for 18ms, then the circuit restarts.



5. Over temperature protection

If the circuit is over temperature, the output is shut down to prevent the circuit from damage. The hysteresis of over temperature protection is used to avoid frequently change between normal and protection modes. The over protection threshold value is 140°C and hysteresis value is about 35°C. Hence, the circuit can be normal until the temperature decreased to 105°C below.

6. Open loop protection

When transistor is on, if $V_{FB}>-1V$, the loop is open and open loop protection is active to shutdown the output, which keeps for 18ms and then the circuit restarts.

7. PFM frequency setting

PFM frequency range is determined by the constant on time T_{ON} and constant-voltage loop off time. When off time is T_{CVmax}, the circuit works with no load and operating frequency value is minimum; when off time is T_{CVmin}, the circuit works with full load and operating frequency value is maximum.

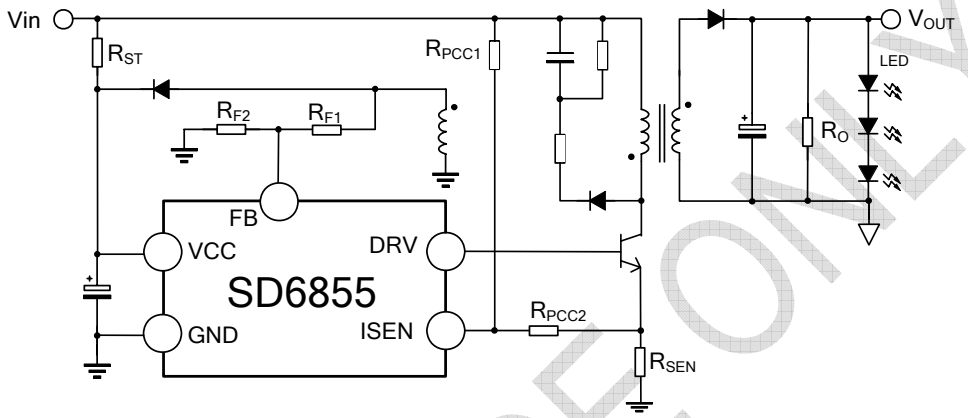
According to the formula: $P_O = V_O \cdot I_O = \frac{1}{2} L_m I_{PK}^2 \cdot f_S \cdot \eta$

Where, Lm—primary inductance, I_{PK}—peak current in primary side, fs—operating frequency, η—efficiency.

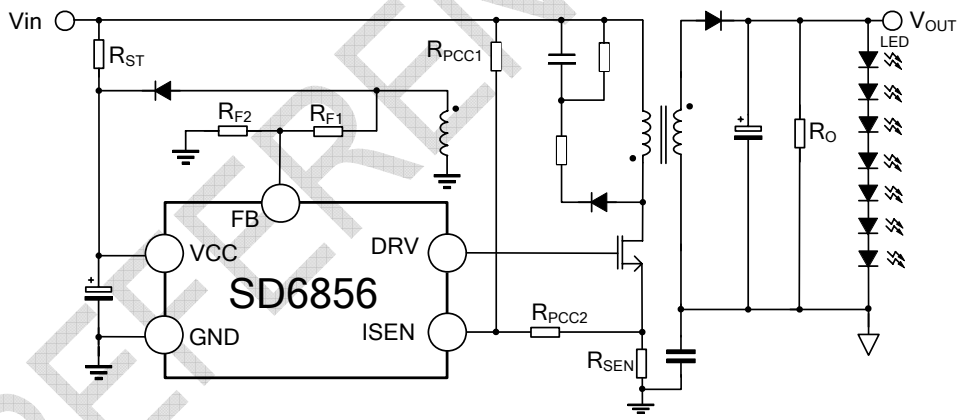
Hence, $f_S = \frac{2V_O \cdot I_O}{L_m I_{PK}^2 \cdot \eta}$

TYPICAL APPLICATION CIRCUIT

1）SD6855 adopts an external driving transistor suitable for 1~5W output power. Output 3W application is shown below: output 12V/300mA;



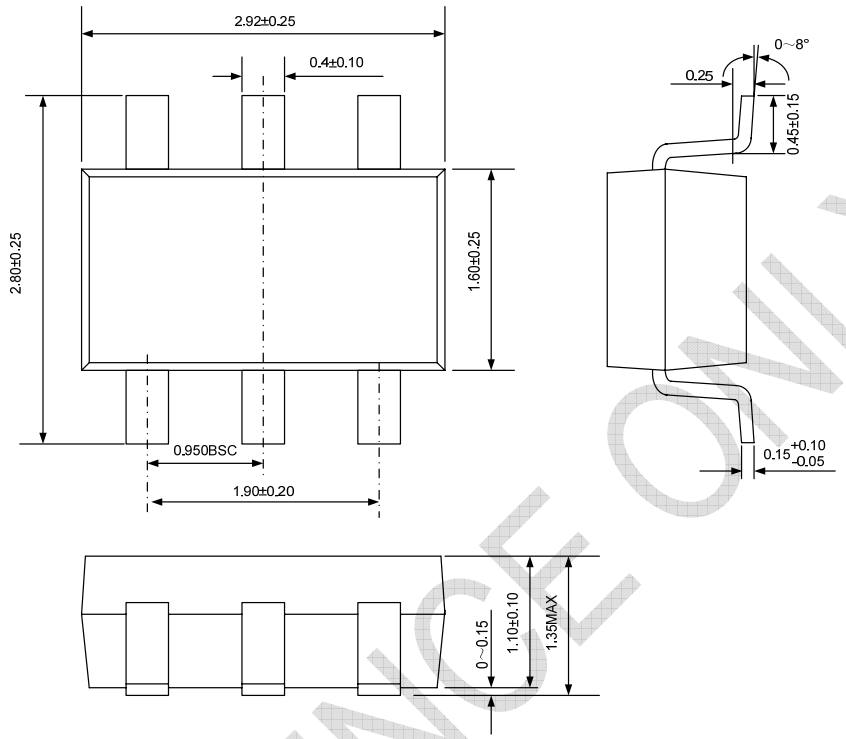
2）SD6856 adopts an external driving MOSFET suitable for 5~7W output power. Output 7W application is shown below: output 25V/300mA;



Note: The circuit and parameters are for reference only; please set the parameters of the real application circuit based on the real test.

PACKAGE 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.