CURRENT MODE PWM+PFM CONTROLLER

DESCRIPTION

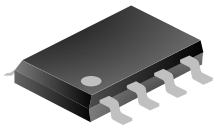
SDH6871X is a current mode controller for SMPS. It has various built-in functions to improve the operating performance.

The built-in high voltage constant current source reduces the start-up time and the system loss.

SDH6871X uses multi-mode operating control for improving the conversion efficiency under light load and no load. Under heavy load, PWM mode is used; under light load, PFM mode is used; while under super light load or no load, Burst mode is used.

SDH6871X uses peak current control mode with cycle-by-cycle current limiting; It has built-in slope compensation with simple loop stability design; AC input voltage is sensed via the pin BO for output over power linear compensation, which can realize the constant output power in the whole voltage range.

SDH6871X provides multiple protections including overload protection, overvoltage protection for VCC, undervoltage/ overvoltage protection for AC input and over temperature protection, etc.



SOP-8-225-1.27

APPLICATIONS

* AC-DC adapter for notebook
* Consumer electronics such as DVD player , set-top box, etc.

FEATURES

* Sandby Power Dissipation: SDH6871/L/R<50mW @230V;
  SDH6871A<30mW @230V;
* High-voltage start;
* Switch frequency 66kHz/132kHz selectable with frequency jitter for low EMI;
* Reduced frequency control for improving the efficiency under light load;
* Burst mode under no load;
* External power MOSFET for cycle-by-cycle overcurrent protection;
* Built-in pulse leading edge blanking(LEB) and slope compensation;
* VCC undervoltage protection;
* VCC overvoltage protection (auto restart or lockout selectable);
* Overload protection (auto restart or lockout selectable);
* Linear output power compensation;
* Overvoltage protection for input voltage(lockout);
* Overvoltage protection for AC input voltage (lockout);
* Undervoltage protection for AC input voltage (auto restart);
* SOP-8 package.

ORDERING INFORMATION

Part No.	Package	Marking	Material	Packing
SDH6871/L/R/A	SOP-8-225-1.27	SDH6871/L/R/A	Pb free	Tube
SDH6871TR/LTR/RTR/ATR	SOP-8-225-1.27	SDH6871/L/R/A	Pb free	Tape&Reel

FUNCTIONAL CLASSIFICATION

Part No.	OVP Protection	OLP Protection	BO
SDH6871/TR	Lockout	Restart	Yes
SDH6871L/TR	Lockout	Lockout	Yes
SDH6871R/TR	Restart	Restart	Yes
SDH6871A/TR	Lockout	Restart	No

BLOCK DIAGRAM(SDH68711)

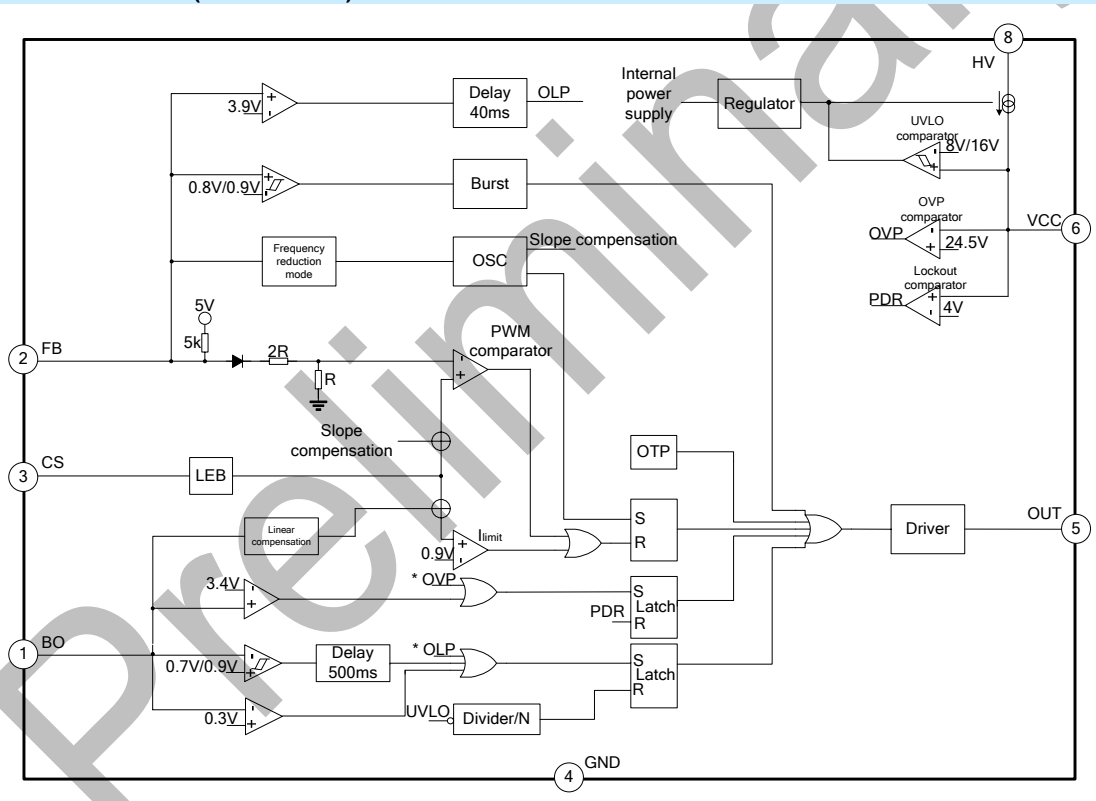


Fig.1 The block diagram of SDH6871

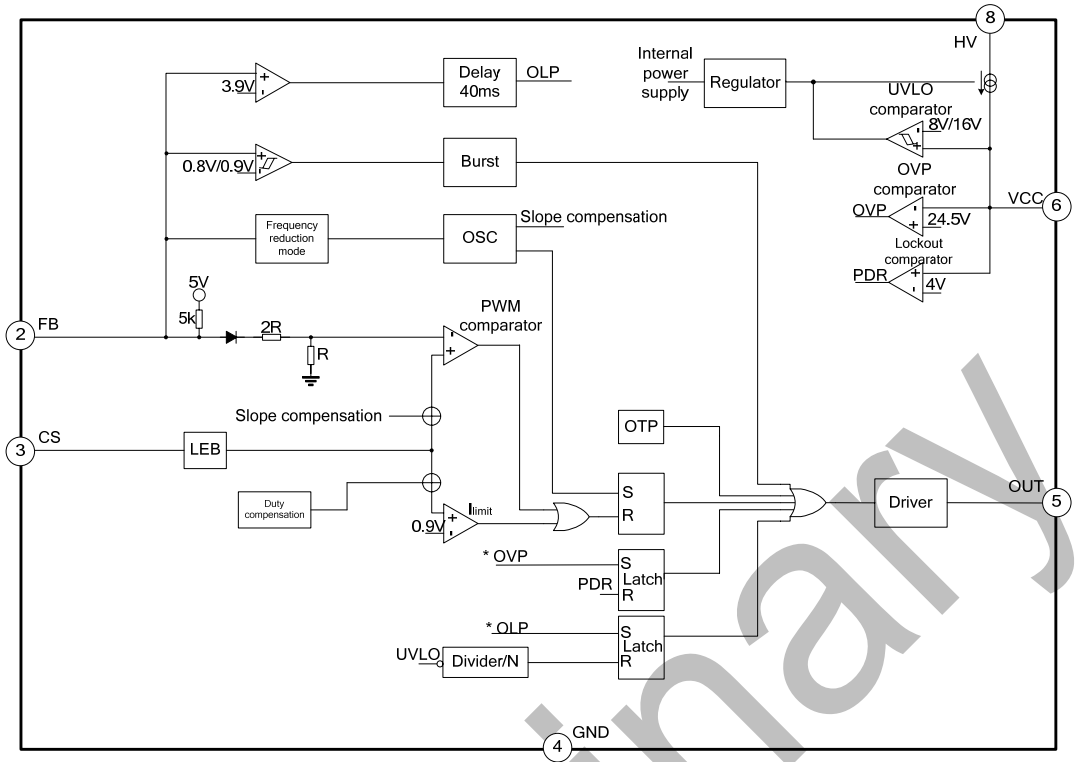


Fig. 2. The block diagram of SDH6871A

ABSOLUTE MAXIMUM RATING

Characteristics	Symbol	Ratings	Unit
Voltage on pin BO	V_{BO}	-0.3~12	V
Voltage on pin FB	V_{FB}	-0.3~12	V
Voltage on pin CS	V_{CS}	-0.3~12	V
Voltage on pin OUT	V_{OUT}	-0.3~50	V
Voltage on pin VCC	V_{CC}	-0.3~50	V
Voltage on pin HV	V_{HV}	-0.3~600	V
Junction temperature range	T_J	-20~150	°C
Operating temperature range	T_A	-20~85	°C
Storage temperature range	T_{stg}	-55~160	°C

ELECTRICAL CHARACTERISTICS（Unless otherwise specified, V_{CC}=16V , T_{amb}=25°C）

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
HV						
Charge current for high-voltage power supply	I_C	230V on pin HV, 0V on pin VCC	--	600	--	μA
Leakage current	I_L		--	1	20	μA
VCC						
VCC level for circuit starting (UVLO on)	VCC_{ON}	VCC is increasing	16.5	17	17.5	V

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
VCC level for circuit shutdown (UVLO off)	VCC_{OFF}	VCC is decreasing	7.5	8	8.5	V
VCC reset voltage	VCC_{RESET}		--	4	--	V
VCC level for overvoltage protection	VCC_{OVP}		24	25.5	27	V
I_{vcc} (V_{FB}=3V)	I_{VCC}		--	1.5	--	mA
BO (SDH6871, SDH6871L and SDH6871R)						
Start voltage	$V_{BOSTART}$		--	0.9	--	V
Delay shutdown voltage	V_{BOOFF2}		--	0.7	--	V
Delay time	T_{DELAY}		--	0.5	--	
Complete shutdown voltage	V_{BOOFF1}		--	0.3	--	
Input overvoltage detecting point (lockout)	V_{BOOVP}		--	3.4	--	V
FB						
Maximum pull-up current	I_{FBMAX}	Short connect FB to GND	--	300	400	μA
Overvoltage protection	V_{FBOVP}		3.9	4	4.1	V
Overvoltage detecting delay	$T_{FBDELAY}$		--	100	--	ms
Frequency reduction start voltage	V_{ING}		--	2.1	--	V
Frequency reduction end voltage	V_{ENDG}		--	1.5	--	V
Input voltage of burst mode	V_{INB}		--	0.9	--	V
Output voltage of burst mode	V_{OUTB}		--	0.8	--	V
Oscillator						
Frequency	f_{OSC}		62	66	70	kHz
Operating frequency of burst mode	f_{OSCG}		--	22	--	kHz
Frequency jitter range	f_{DV}	f_{OSC} =66 kHz	--	2.5	--	kHz
Maximum duty cycle	D_{MAX}		72	77	82	%
CS (SDH6871, SDH6871L and SDH6871R)						
Max. voltage of current sense	V_{CSMAX}	BO=0.9V	--	0.9	--	V
Min. voltage of current sense	V_{CSMIN}	BO=3.4V	--	0.7	--	V
OUT						
Rising time	T_R	Load capacitance is 1nF	--	200	--	ns
Falling time	T_F	Load capacitance is 1nF	--	100	--	ns
Output maximum voltage	V_{OUTMAX}		--	17	--	V
LEB time	T_{LEB}		--	300	--	ns
Over temperature protection						
Over temperature protection voltage	T_{OTP}	The temperature is rising	--	150	--	°C
Restart temperature	$T_{RESTART}$		--	130	--	°C

PIN CONFIGURATION

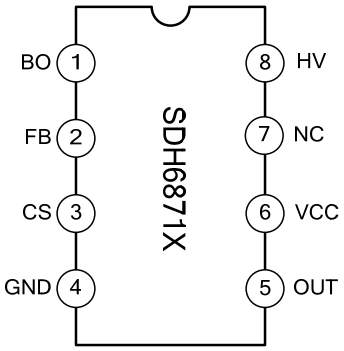


Fig.3 Configuration of SDH6871, SDH6871L and SDH6871R

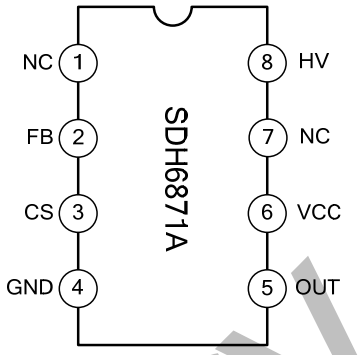
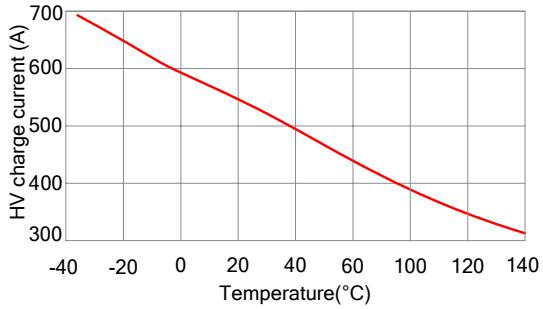


Fig. 4 Configuration of SDH6871A

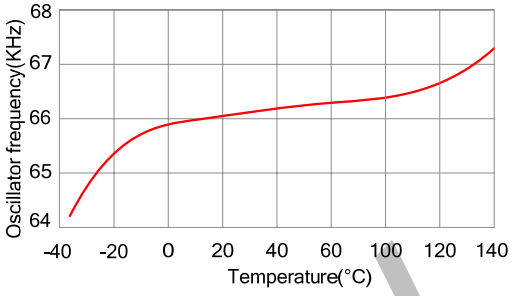
PIN DESCRIPTION

Pin No.	Pin Name	I/O	Function description
1	BO	I	AC input voltage detecting pin.
	NC	--	NC(SDH6781A).
2	FB	I/O	Feedback pin. The output voltage is fed back to FB pin via the opto-coupler.
3	CS	I/O	External current sense pin
4	GND	G	Ground.
5	OUT	I/O	Output pin for external power MOSFET.
6	VCC	I/O	Power supply pin
7	NC	--	NC
8	HV	I	High voltage pin.

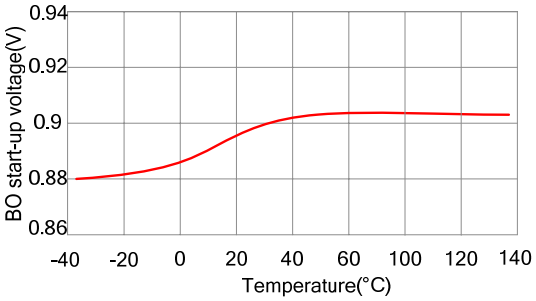
TYPICAL CHARACTERISTICS CURVE



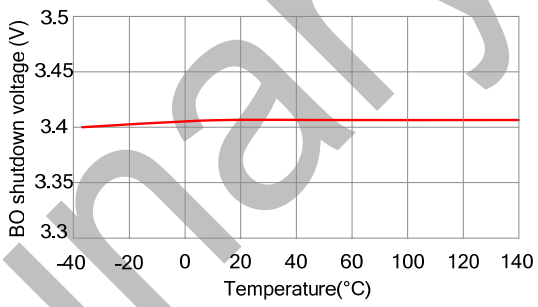
HV charge current vs. temperature curve



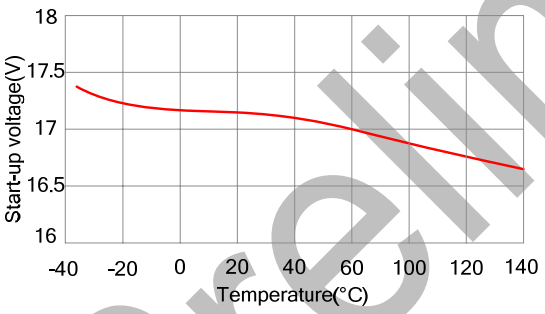
Oscillator frequency vs. temperature curve



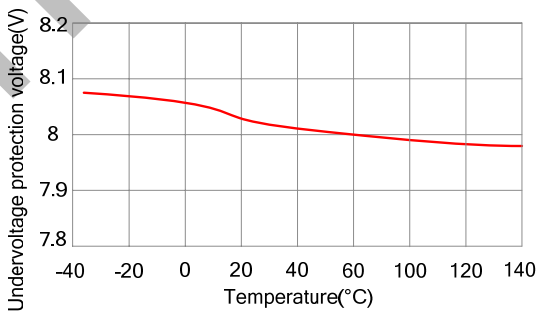
BO start voltage vs. temperature curve



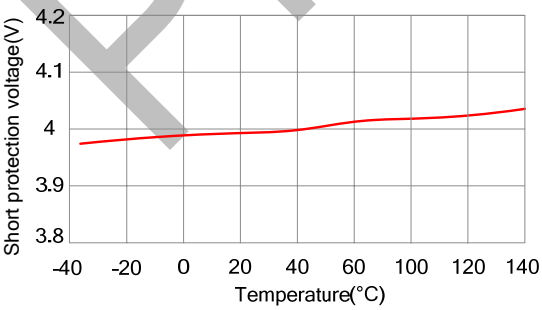
BO shutdown voltage vs. temperature curve



Start voltage vs. temperature curve



Shutdown voltage vs. temperature curve



Short-circuit protection voltage vs. temperature curve

FUNCTION DESCRIPTION

The traditional PWM controller cannot meet the requirements of new specifications following the development of power design. The circuit needs to integrate more functions to reduce the peripheral components of the system by the constraints of cost and size. SD6871X provides a simple solution with high efficiency introduced below:

High-voltage start

It integrates high voltage constant current source. The high voltage pin HV can be connected directly to the high voltage wire without connecting an external start-up resistor. During the start period, the VCC is charged by the constant current provided by the built-in high voltage constant current source to reduce the start-up time. The circuit is powered by auxiliary winding and the HV constant current source is off for low power dissipation during normal working.

When the circuit is powered on, the VCC is charged by the HV constant current source and the internal current limit resistor can prevent the charge current more than 1mA; when VCC is increasing to VCC_{ON}, the HV constant current source is off and the circuit quits the undervoltage mode and is powered by the external capacitor at VCC. After the circuit is working normally, the VCC is powered by auxiliary winding. If VCC is decreasing to VCC_{OFF}, the HV constant current source restarts to charge VCC. The typical values of VCC_{OFF} and VCC_{ON} are 16V and 8V respectively.

Mode control

SDH6871X has multiple operating modes that are determined by the loads. The peak current control mode of SDH6871X decides that the FB voltage is related to the load. So the FB voltage decides the operating mode, which is shown in fig. 5 (except for soft start and abnormal conditions).

When the circuit is working with rated load (50%~100% of rated full load), it uses PWM control mode with operating frequency of 66kHz; at 50%~10% of rated power, the circuit is operating in PFM mode with operating frequency between 22kHz and 66kHz; at 10% below of rated power, SDH6871X enters Burst Mode.

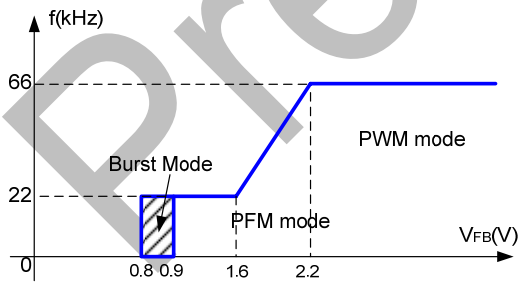


Fig.5 Relation between operating frequency and V_{FB}

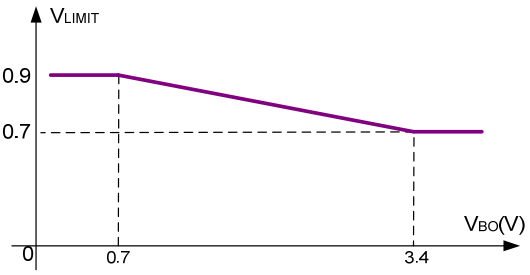


Fig. 6 Relation between the current limit at CS and V_{BO}

Function of pin BO (SDH6871, SDH6871L and SDH6871R)

Pin BO has two functions:

AC input undervoltage/overvoltage detection: when the voltage on pin BO is more than 0.9V, the circuit starts to work; when the voltage on pin BO is less than 0.7V for more than 0.5s, the circuit enters AC input

undervoltage protection state and the driver signal is shut down; when the voltage on pin BO is less than 0.3V,the circuit enters AC input undervoltage protection state directly and the driver signal is shut down; when the voltage on pin BO is more than 3.4V, the circuit enters AC input overvoltage protection state and the driver signal is shut down and the circuit is locked with most modules off until the VCC is less than 4V, the locking will released and the circuit restarts to work.

Linear compensation for output over power: if the CS current limit pint is fixed, the max. output power will change with the AC input voltage. The linear compensation function can change the CS current limit point according to the AC input voltage to make sure that the output max. power is constant in the whole voltage range. The relation between the current limit at CS and V_{BO} is shown in fig.6.

Peak current control

The circuit using peak current control mode features fast load response speed and cycle by cycle current limit. Pin CS is used to sense the current delivered to the external power MOSFET. The on time of power MOSFET is decided by the sampling signal sensed by CS pin and the voltage on FB pin. When at the rising edge of the square waveform output from the internal oscillator, the power MOSFET is on; while the sampling signal sensed by CS pin is increasing to $V = \frac{V_{FB} - 0.7}{3}$, the power MOSFET is off. The max. voltage on CS pin is 0.9V, which is changed following the voltage on BO pin.

Soft start-up

In order to reduce the surge current during the start-up, the circuit integrates soft start-up function. The current limit point is increasing gradually to the normal value during the 5.5ms soft start-up time.

Frequency jitter mode

The oscillation frequency is kept changed for low EMI and decreasing radiation on one frequency. The oscillation frequency changes within a very small range to simplify EMI design. The rule of frequency changing (frequency center is 66 KHz): ±2.5KHz change in 4ms, 63 frequency points in all. The adjacent frequency is interleaved changing, i.e. the frequency next to f-nΔf is f+nΔf.

VCC overvoltage protection

The voltage on VCC is detected, when it is more than 24.5V, the SDH6871X enters overvoltage protection state (auto restart or lockout).

If the circuit enters auto restart state, the driver signal is shut down; only when the AC input is disconnected and VCC voltage decreased to VCC_{OFF} below, the circuit restarts to normal working state. Each signal is shown in fig. 7.

If the circuit enters lockout state, the driver signal is shut down; only when the AC input is disconnected and VCC voltage decreased to VCC_{RESET} below, the lockout is released and restarts to normal working state. Each signal is shown in fig. 8.

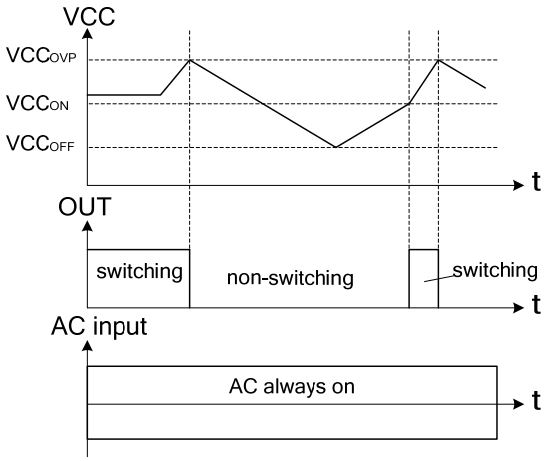


Fig.7 VCC overvoltage auto restart

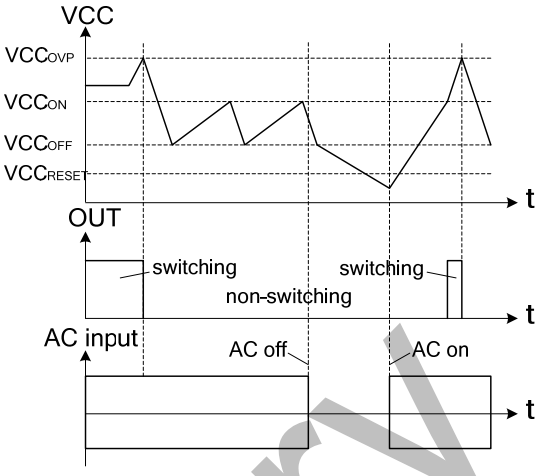


Fig.8 VCC overvoltage lockout

Overload protection

FB voltage increases following the load; when FB voltage is more than 3.9V and lasts for 100ms, the circuit enters overload protection state (auto restart or lockout).

If the circuit enters auto restart state, the driver signal is shut down and VCC is decreasing; when VCC is less than VCC_{OFF}, the circuit restarts to normal working state and each signal is shown in fig. 9.

If the circuit enters lockout state, the driver signal is shut down; only when the AC input is disconnected and VCC voltage decreased to VCC_{RESET} below, the lockout is released and restarts to normal working state. Each signal is shown in fig. 10.

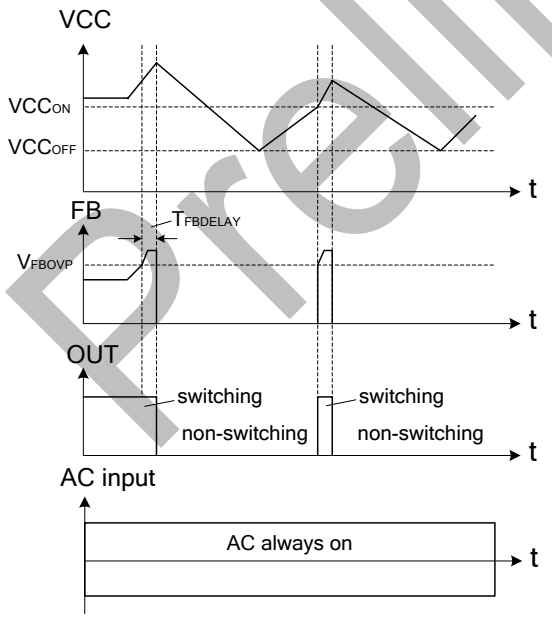


Fig. 9 Overload auto restart

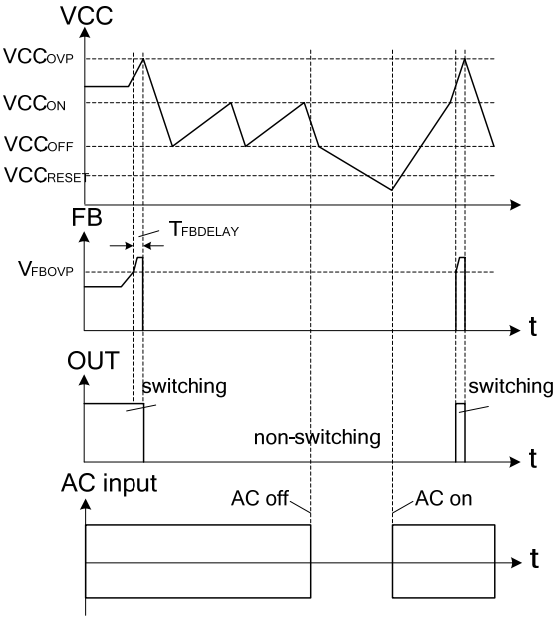


Fig. 10 Overload lockout

Over temperature protection

The over temperature protection can shut down the circuit when the IC temperature is more than 150°C, while the circuit resumes working until the IC temperature decreases to about 130°C.

TYPICAL APPLICATION CIRCUIT

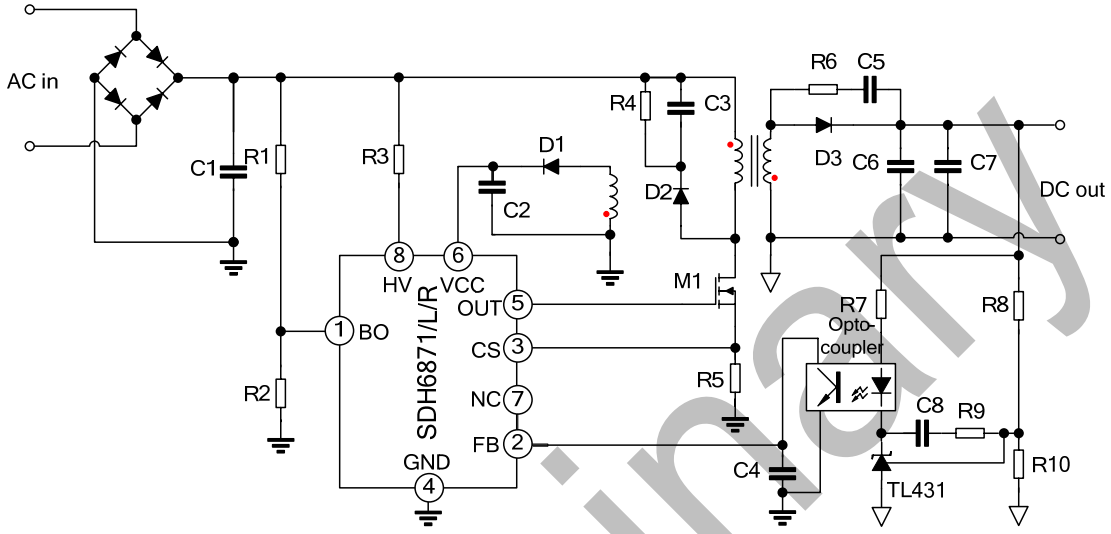


Fig. 11 Typical application circuit of SDH6871/L/R

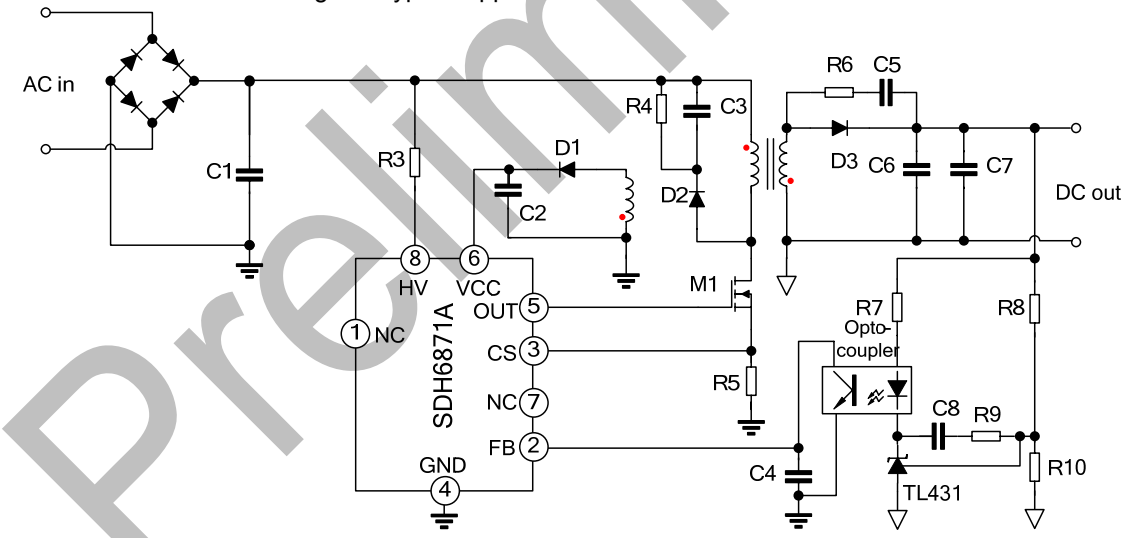
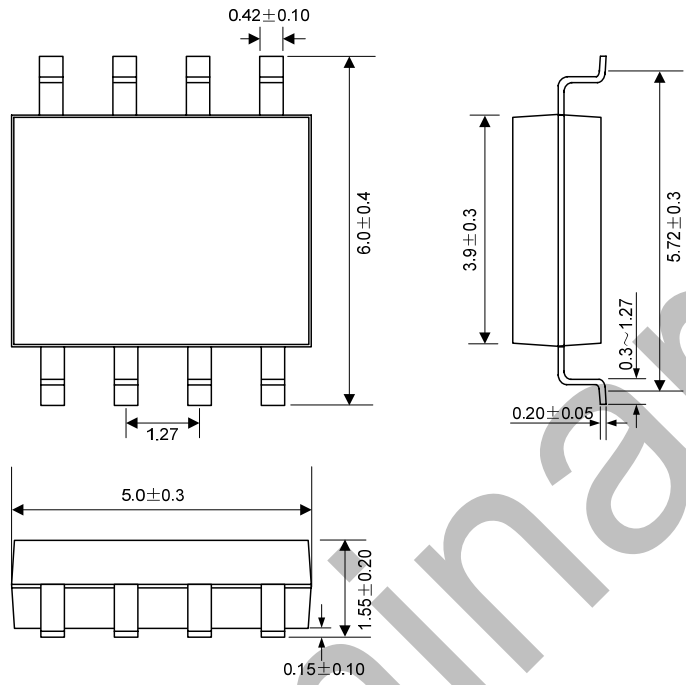


Fig. 12 Typical application circuit of SDH6871A

PACKAGE OUTLINE

SOP-8-225-1.27 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.