SY52257

Secondary Side Synchronous Rectification Converter

General Description

SY52257 is a high-performance synchronous rectifier which contains controller and MOSFET devices. This solution not only directly reduces power dissipation of the rectifier but also indirectly reduces primary-side losses, due to compounding of efficiency gains. The DRAIN pin of SY52257 can support 60V voltage stress.

SY52257 will achieve ultra-low power consumption when the circuit operates in no load.

The SY52257 is available in a compact SOT335 package.

Features

- Smart Turn off Technology
- Secondary-side Synchronous Rectifier Optimized for 5V~12V Systems
- Suitable for Discontinuous Mode (DCM), Critical Conduction Mode (CRM)
- Suitable for Primary Side Regulation(PSR), Secondary Side Regulation (SSR)
- RoHS Compliant and Halogen Free
- Compact Package: SOT335

Applications

- AC/DC Adapters
- Battery Chargers
- Consumer Electronics
- Auxiliary Power Supplies

Recommended operating output power		
Products	V_{OUT}=5V	V_{OUT}=12V
SY52257	2.1A	2A

Typical Application

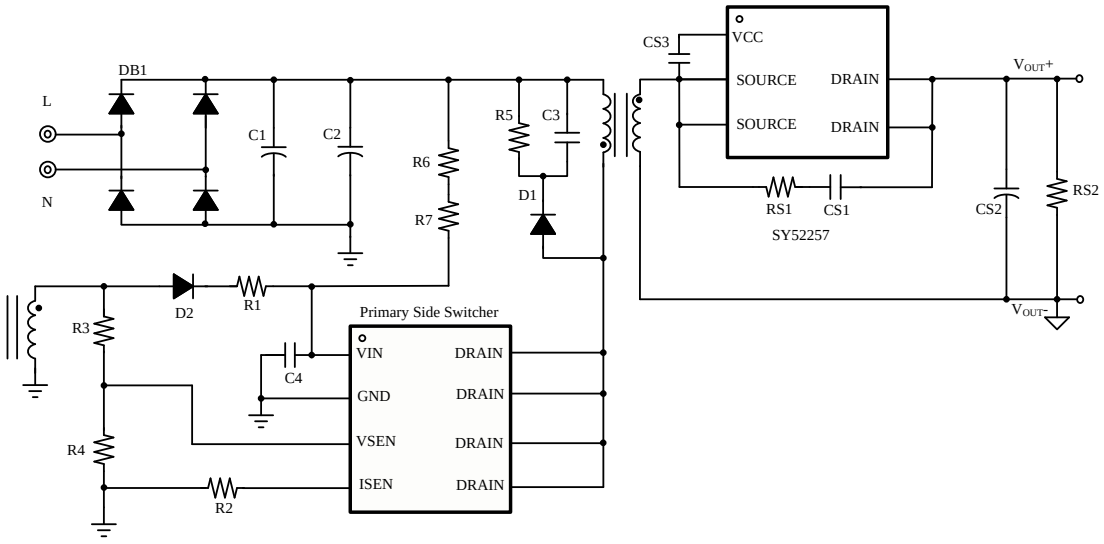


Fig.1 Typical Application Circuit in High Side

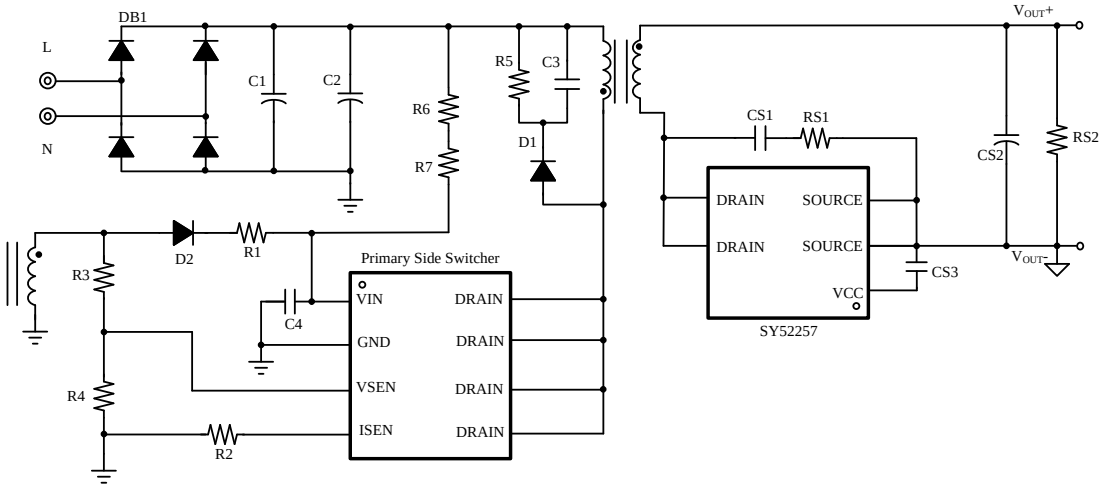
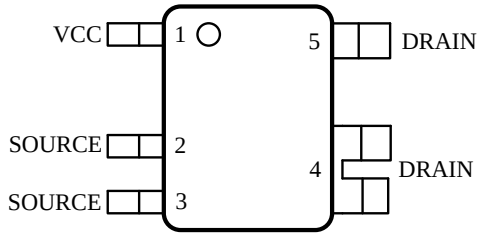


Fig.2 Typical Application Circuit in Low Side

Ordering Information

SY52257□(□□)□
- Temperature Code
- Package Code
- Optional Spec Code



Pinout (top view)

Ordering Number	Package	Top Mark
SY52257AZC	SOT335	CMZxyz

x=year code, y=week code, z= lot number code

Pinout (top view)

Pin number	Pin Name	Pin Description
1	VCC	Power supply pin. This pin connects a 0.1μF or larger ceramic bypass capacitor.
2,3	SOURCE	SOURCE of the internal power MOSFET.
4,5	DRAIN	DRAIN of the internal power MOSFET.

Absolute Maximum Ratings (Note 1)

VCC ---------- -0.3V~16V
DRAIN ---------- -1.5V~60V
I_{VCC} ---------- 20mA
Power Dissipation, @ TA = 25°C SOT335---------- 0.67W
Package Thermal Resistance (Note 2)
SOT335, θ_{JA}---------- 160°C/W
SOT335, θ_{JC}---------- 55°C/W
Junction Temperature Range ---------- -45°C to 150°C
Lead Temperature (Soldering, 10 sec.) ---------- 260°C
Storage Temperature Range ---------- -65°C to 150°C

Recommended Operating Conditions

Junction Temperature Range ---------- -40°C to 125°C
Ambient Temperature Range ---------- -40°C to 105°C

Electrical Characteristics

(V_{VCC} = 10V, T_A = 25°C unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Power Supply Section						
VCC Turn-on Threshold	V_{VCC_ON}		3.6	3.75	3.9	V
Hysteresis Voltage	$V_{HYSTERESIS}$		75	115	155	mV
Quiescent Current				160	200	μA
Threshold Section						
On_threshold			-240	-190	-140	mV
Blanking Time section						
Min Ton	T_{ON_BLANK}		800	1200	1600	ns
Min Toff	T_{OFF_BLANK}		1800	2200	2600	ns
MOSFET Section						
Mosfet Break Down Voltage	$V_{DSS(BR)}$	V_{GS}=0V,I_D=0.25mA	60			V
Mosfet On-state Resistor	$R_{DS(ON)}$	V_{GS}=10V,I_D=5A		16		mΩ
Thermal Section						
Thermal Shutdown Temperature	T_{SD}			150		°C
Hysteresis to Resume Operating	T_{OTP_HYS}			20		°C

Note 1: Stresses beyond the "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 2: θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

Block Diagram

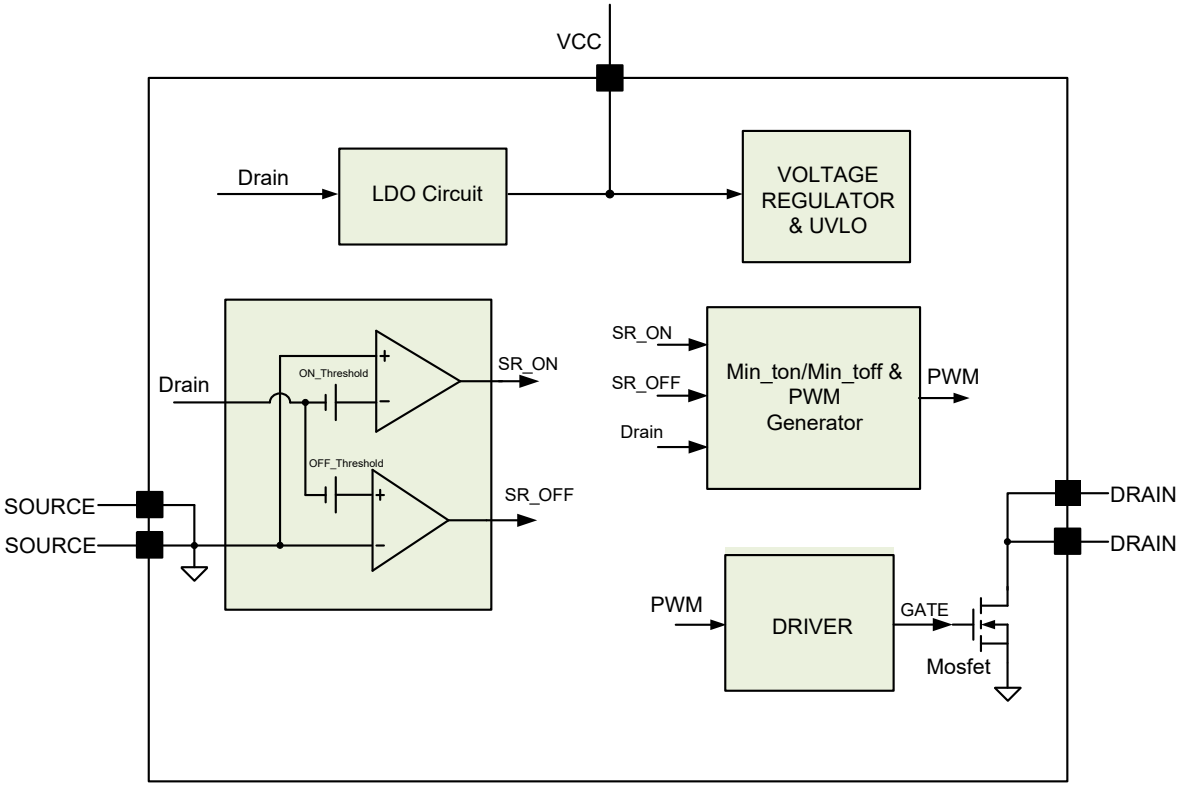
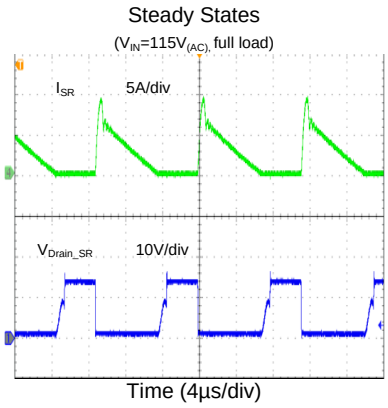
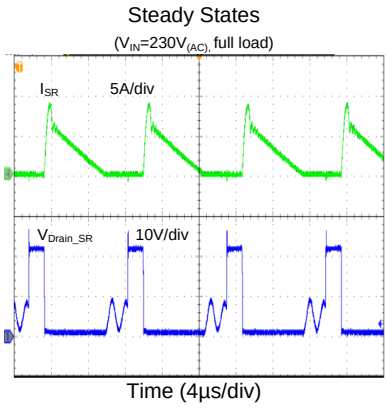


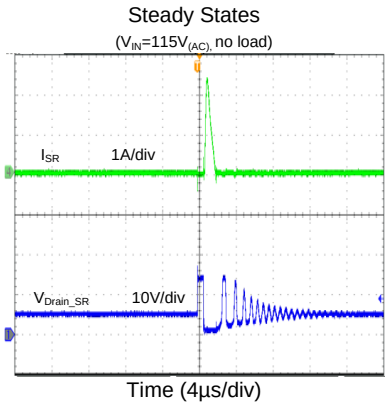
Fig.3 Block diagram

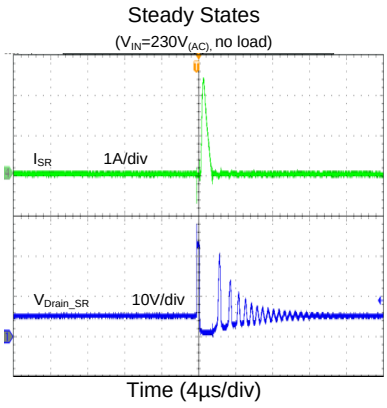
Typical Performance Characteristics

(Test condition: input voltage: 90Vac; output spec: 5Vdc_2.1A; Ambient temperature: 25±5 °C; Ambient humidity: 65±25 %.)









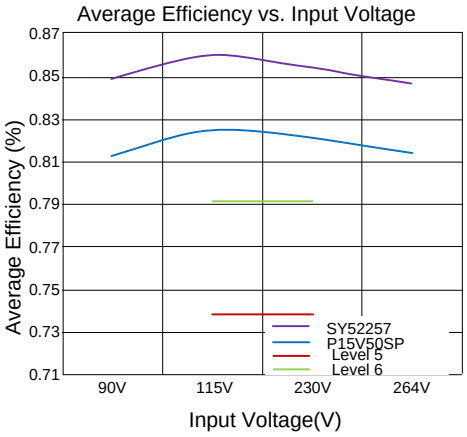


Fig.4 Average Efficiency Curve

Description

SR Turn On

When a negative voltage lower than on threshold V_{ON_THR} is sensed on the DSEN pin, the driver logic turns up, then after a delay time, the GATE is pulled high.

Accuracy Zero Current Turn off Strategy

The initial turn off threshold $V_{OFF\_INITIAL}$ of SR switcher is -30mV (typical value). When the Drain voltage on the SR is higher than the turn off threshold, the SR would turn off after a delay time.

SY52257 adopts a smart control strategy to achieve SR accuracy zero current turn off by compensating the off threshold each switching period, which also make SR operating in high efficiency and reliability.

Min Ton & Min Toff

After switch-on of the SY52257, the input signal on the DRAIN pin is blanked during the on blanking time T_{ON_BLANK}. This action eliminates false switch-off due to high frequency ringing at the start of the secondary stroke. (See ON_BLANK in Fig.5).

After switch-off of the SY52257, the input signal on the DRAIN pin is blanked during the off blanking time. This action eliminates false switch-on due to high frequency ringing at the start of the secondary stroke. (See OFF_BLANK in Fig.5)

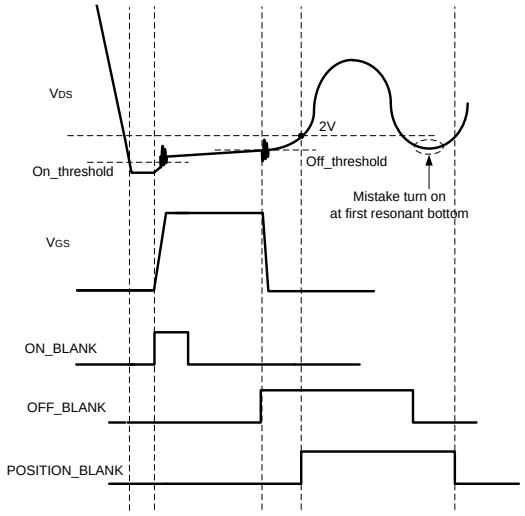


Fig.5 timing diagram of Min_ton & Min_toff

To prevent SR false turn on after resonant period which caused by primary magnetic inductor and primary equivalent cap, the off blanking time is not enough to accomplish. The position blanking time $T_{POSITION\_BLANK}$ can work out. (See POSITION_BLANK in Fig.5)

Self-Power Supply

When SR turns off, the voltage of DSEN will be pulled up. If the voltage of DSEN is higher than voltage of VCC, the charging current will flow to VCC from DSEN. As the DSEN exceed the Zener diode D2 breakdown voltage, the VCC will be clamped to the voltage. The charging current is limited to 30mA (typical value). If the voltage of DSEN is lower than voltage of VCC, the charging function is shut down. As in Fig. 6.

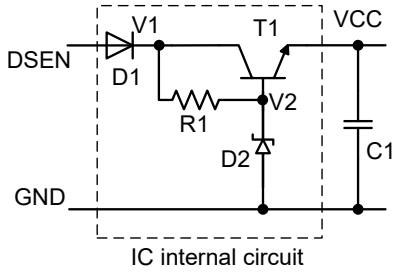


Fig. 6 circuit diagram of self-power supply

UVLO

The IC leaves the under-voltage lockout state and activates the synchronous rectifier circuit when the voltage on the VCC pin is above V_{VCC_ON}. When the voltage drops below V_{VCC_OFF}, the under-voltage lockout state is entered and the SR driver output is actively kept low. As in Fig. 7.

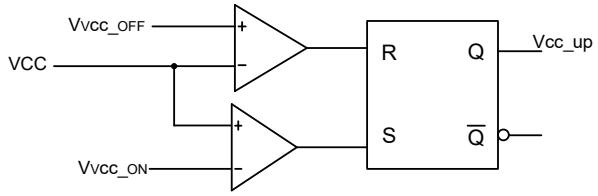


Fig.7 circuit diagram of UVLO

Power design

A few applications are shown as below.

Typical application specification

Products	Input range	Output	Temperature rise
SY52257	90Vac~264Vac	12V/2A	53°C
	90Vac~264Vac	5V/2.1A	51°C

The test is operated in natural cooling condition at 25 °C ambient temperature.

Layout

(a) To achieve better EMI and Efficiency performance, the output connector should be connected to the output cap first, then to the SR Power pin.

(b) The circuit loop of all switching circuit should be kept small: secondary power loop, secondary RC snubber circuit loop and IC power supply loop.

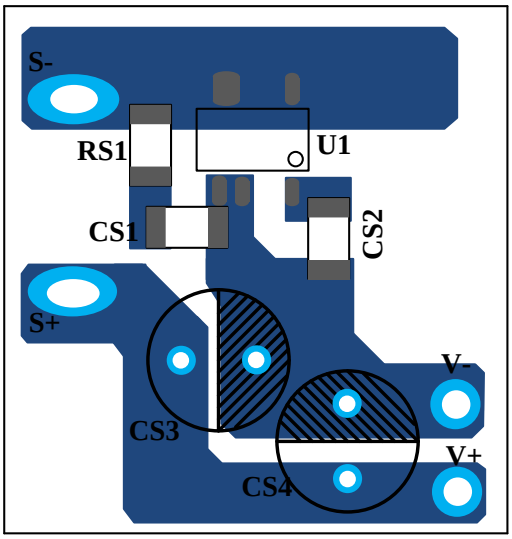
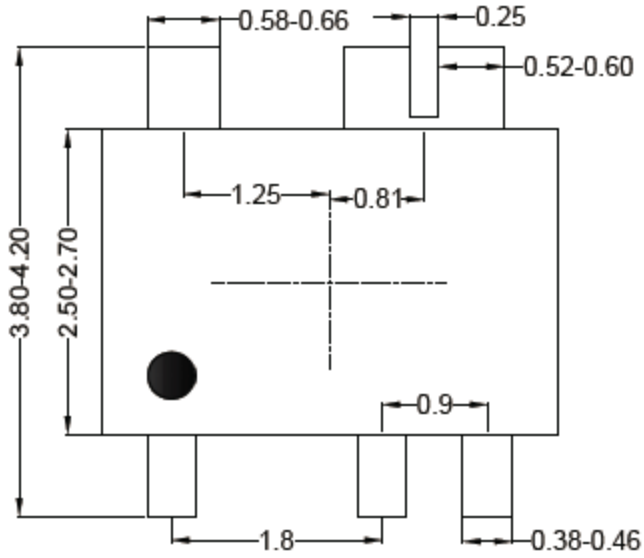


Fig.8 layout example

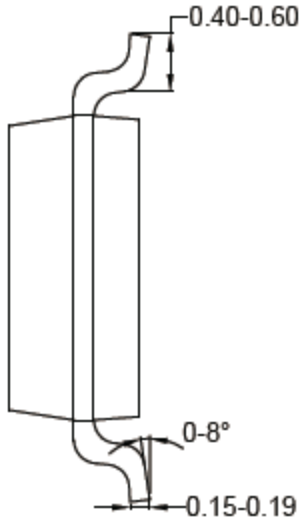
Design Notice

1. At no load, secondary side diode freewheeling time should be longer than 1.6us at no load.
2. To consider the reliability of SR switcher and the startup performance in all temperature range, the recommended value of VCC capacitance is 0.47uF.
3. To achieve better system ESD performance, the VCC cap should be close to SR switcher as soon as possible.
4. To achieve better EMI performance and improve the efficiency, the loop of secondary switching circuit should be kept as small as possible.
5. To prevent SR false turn on during SR off_threshold adjustment stage, the primary switch should be turned on before second DCM resonant bottom.
6. To prevent primary and secondary switch conduct at the same time when circuit operates in Continuous Current Mode, the shut down time of primary switch should be larger than 24uS.

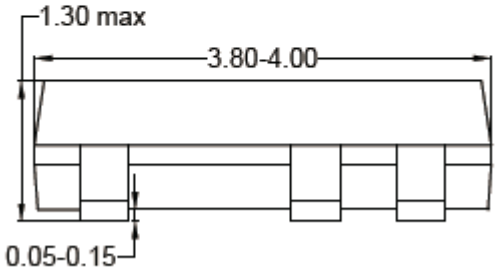
SOT335 Package Outline Drawing



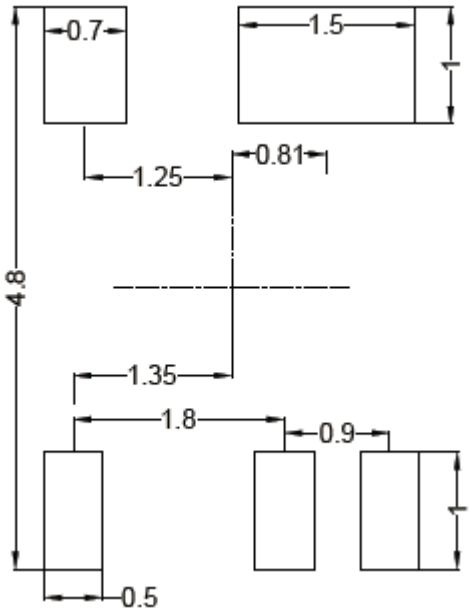
Top view



Side view



Front view



Recommended PCB layout
(Reference only)

Notes: 1, all dimension in millimeter and exclude mold flash & metal burr;
2, the center line refers chip body center

Revision History

The revision history provided is for informational purpose only and is believed to be accurate, however, not warranted. Please make sure that you have the latest revision.

Date	Revision	Change
	Revision 0.9	Initial Release