Synchronous Rectifier Controller IC with DSSS™

1. Feature

- Built-in TrueWave™ real-time waveform tracking function
- Built-in DSSS™ dynamic adaptive power supply technology
- CCM/CrM/DCM mode of switching power is supported
- High current ultra-fast totem pole output drive circuit
- Extremely wide operating voltage by charge range up to 200 V
- Built-in high voltage isolation switch with BVDSS up to 200 V
- Build an ideal diode with Low RdsON MOSFET
- Meets energy efficiency such as CoC V5 and DoE VI or more
- Support switching power supply frequency up to 250 kHz
- Only one capacitance is required for the extremely simple extra components
- SOT23-5 package form with a small footprint is available

2. Applications

- QC / PD Quick Charger
- High efficiency USB Charger
- Multi-port USB Charger
- Low-voltage High-current Switching Power Supply

3. Description

LN5S06B is a high performance switching power supply secondary side synchronous rectification controller integrated circuit, which can easily construct a low voltage and high current switching power supply system that meets energy efficiency such as CoC V5 and DoE VI. It is the ideal ultra low on voltage drop rectifier device solution. A unique TrueWave™ real time waveform tracking function and dynamic adaptive power supply technology is built-in on this chip, it can also support up to 250 kHz switching frequency application and various operating modes of switching power supplies such as CCM/CrM/DCM. The external Low RdsON MOSFET device can be automatically turned on or off fast at the edge of each waveform conversion of the switching power supply, Its extremely low turn-on voltage is used to achieve much lower conduction losses than Schottky diodes, the conversion efficiency of the system is greatly improved. The temperature of the rectifying device is greatly reduced, and the switching power supply application of low voltage and large current can be conveniently realized.

The high current totem pole drive output with voltage clamp can be used directly to drive external MOSFET devices. Peak sink current drive capability up to 3 A ensures fast turn-on/ turn-off of external high-current MOSFET devices for excellent conversion performance. The output voltage clamping function makes the gate safe and reliable even at high supply voltages.

The chip also has built-in high-voltage direct detection function, the detection isolation switch MOSFET BVDSS up to 200 V.

With DSSS™ dynamic adaptive power supply technology, it can support power supply from voltage levels up to 200 V, the controller can be used directly in rectification applications with output voltages up to 0~25V in the usual flyback power supply, greatly expanding the usable range.

Benefit from the adaptive power supply design, the system can work on the positive or negative side of the output side and only requires one capacitor.

Now available in halogen-free SOT23-5 standard green package.

4. Functional Block Diagram

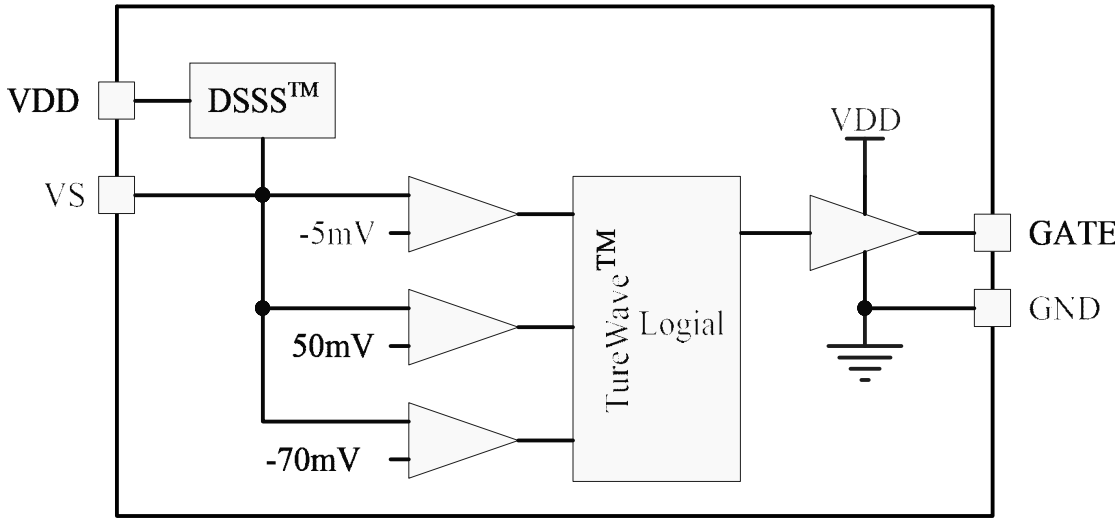

Fig1. Internal functional block diagram

5. Pin Definitions

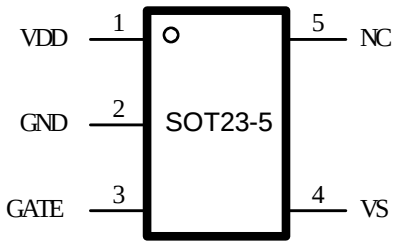

Fig2. Pin Definitions

6. Pin Function Description

PIN	Symbol	Function
1	VDD	Power supply pin, connect the decoupling capacitor
2	GND	Ground pin, connecting with external MOSFET source
3	GATE	Output drive pin, connecting external MOSFET gate
4	VS	Signal detection pin, connected to the external MOSFET drain
5	NC	Empty pin, not used, can be floating or connected to adjacent pins in the application

7. Typical Simplified Schematic

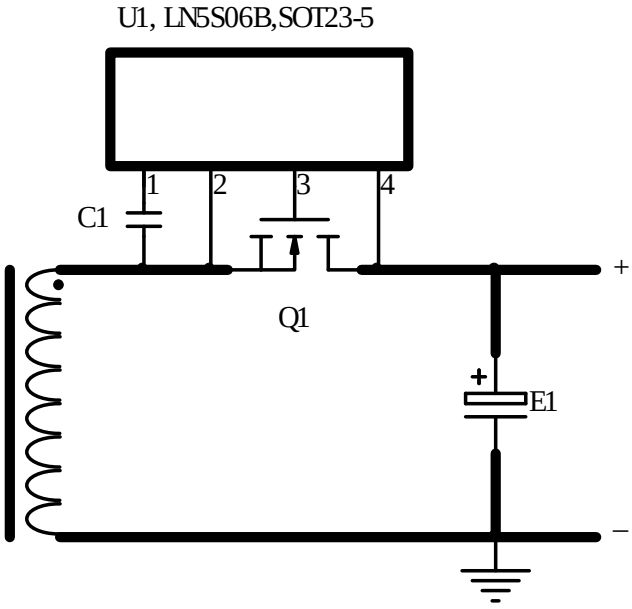

Fig3a. Typical Simplified Schematic for high side application

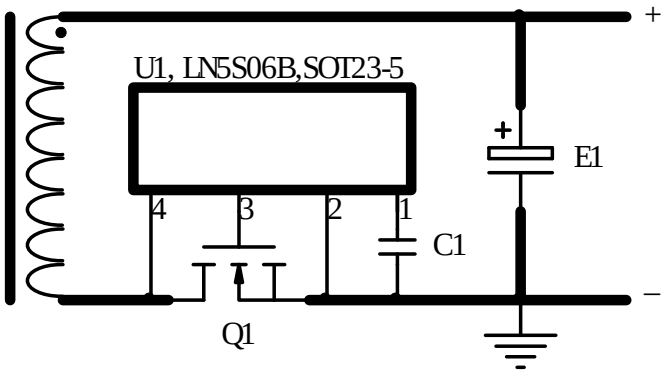

Fig3b. Typical Simplified Schematic for low side application

8. Absolute Maximum Ratings *

Parameter		Rating	Units
VS Pin Input Voltage		-0.3~200**	V
VDD / GATE Pin Input Voltage		-0.3~12***	V
PD Power Dissipation		250	mW
Min/Max Operating Junction Temperature T_J		-40 to +150	℃
Min/Max Operating Ambient Temperature Ta		-20 to +105	℃
Min/Max Storage Temperature Tstg		-55 to +150	℃
Rθj-a		350	℃/W
ESD	HBM	2500	V
	MM	250	V
	VS pin	200	V

Note*: Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute maximum-rated conditions for ex tended periods may affect device reliability.** : with 1mA limit. *** : with 10mA limit. *

9. Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Units
VDD	VDD Supply Voltage	4.5		12	V
VS	VS Peak Voltage			200	V
TA	Operating Ambient Temperature	-20		85	℃

10. Electrical Characteristics (Ta = 25℃, VDD=6.5V, if not otherwise noted)

Power Supply Voltage (VDD Pin)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
VDD_{ON}	VDD Start-up Voltage	VDD from 0V to 7V	-	4.3	-	V
VDD_{OFF}	VDD Shut-down Voltage	VDD from 7V to 0V	-	4.0	-	V
VDD_{HYT}	UVLO Hysteresis Voltage		-	0.3	-	V
I_{VDD}	VDD Standby Current	GATE=OPEN,VS=6V	-	0.2	-	mA
I_{VDD2}	VDD Operating Current	GATE=2nF,VS=50kHz	-	2.5	-	mA
I_{VDDCHG}	VDD Charge Current		10	-	200	mA
I_{VDDC}	VDD Current Limit		-	30	-	mA

Drive output (GATE Pin)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
RD_{UP}	Output High Side Switch Internal Resistance	VDD = 6.5V, Io = 100 mA	-	10	-	Ω
RD_{DOWN}	Output Low Side Switch Internal Resistance	VDD = 6.5V, Io = -100 mA	-	1.5	-	Ω
V_{OL}	Output Low Level	VDD = 6.5V, Io = -100 mA	-	0.10	-	V
T_r	Output Rise Time	0->4V, CL = 2nF	-	20	-	nS
T_f	Output Falling Time	4V->0V, CL = 2nF	-	10	-	nS

Waveform sampling (VS Pin)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V_{VSBR}	VS Withstand Voltage	IVS=10uA	200	-	-	V
VS_{THON}	VS Turn-on Threshold Voltage	RVS=0Ω	-	-200	-300	mV
VS_{KPON}	VS Turn-on keep Voltage	RVS=0Ω	-	-60	-100	mV
VS_{THOFF}	VS Shut-down Threshold Voltage	RVS=0Ω	-	-5	-	mV
VS_{THONS}	VS Reset Threshold Voltage	RVS=0Ω	-	50	100	mV
T_{HOLD}	VS Blanking Hold Time		-	1.5	-	us

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12. Application and Implementation

LN5S06B is a compact, high performance secondary side synchronous rectification control IC designed for energy efficient switching power converters. High compatibility can be used in various power modes such as CCM/CrM/DCM, allows systems with low voltage and high current output to easily meet the requirements of international energy efficiency standards such as CoC V5 and DoE VI.

12.1 VDD Supply

After the system is powered on, the internal circuit charges VDD through the VS terminal. When the VDD voltage reaches the starting voltage, the system circuit starts to initialize, establishes the internal reference voltage and reference current, and starts to enter the working state. The VDD voltage will be automatically maintained during system operation Within the scope of the design, and has the function of automatic adjustment and control, in the application, only a necessary decoupling capacitor needs to be connected to the VDD pin to meet the needs of the system. Under general conditions, it is recommended to use an external VDD capacitor of no less than 2uF. It should be placed closest to the VDD and GND pins.

The typical VDD capacitor configuration is shown in the figure below.

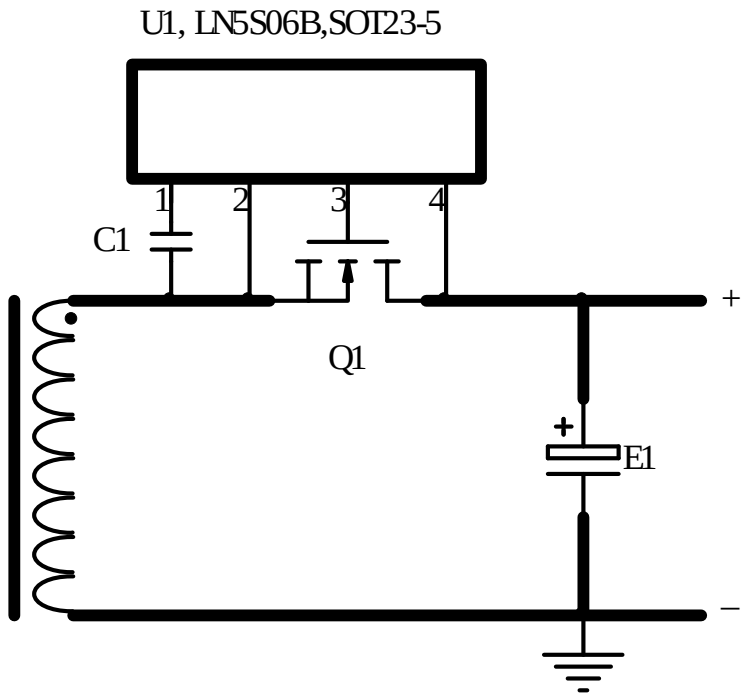


Fig4. VDD Decoupling Circuit

12.2 VS Switch Waveform Sampling

LN5S06B uses a waveform sampling circuit with the BVdss voltage capacity of up to 200V by medium and high voltage process. So it can be directly connected to the transformer by the VS pin to obtain the waveform signal of the switching power supply, and analyzing and judging inside the chip, thereby switching control of external MOSFET correctly and

quickly on the edge of the switch.

The typical withstand voltage capability of the VS pin is 200V, so the voltage greater than 200V should not be applied at this pin on applications to avoid overvoltage damage.

Connecting a 10-50 Ω（e.g. 39Ω） resistor in series with VS can further improve the anti-reverse current capability of the system.

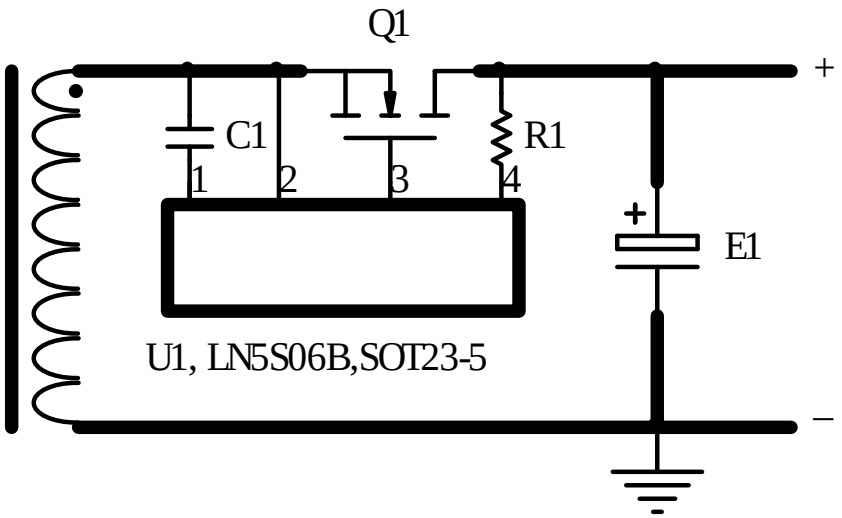


Fig5. VS resistance

12.3 GATE Output Driver

Built-in totem pole output driver on chip with the voltage clamp function at the same time. Because the VDD voltage is automatically limited to no more than 12V, the driver output voltage amplitude is automatically limited to no more than 12V, thus avoiding the overvoltage damage of the MOSFET gate caused by the driver's high output voltage.

Built-in driver circuit with drive sink capability up to 3A peak current. The necessary resistor network should be connected in series between GATE terminal and MOSFET gate to reduce gate driving speed and optimize the index of EMI, while maintaining fast MOSFET switching speed and good synchronous rectification conversion efficiency. The optional gate drive circuit is shown below.

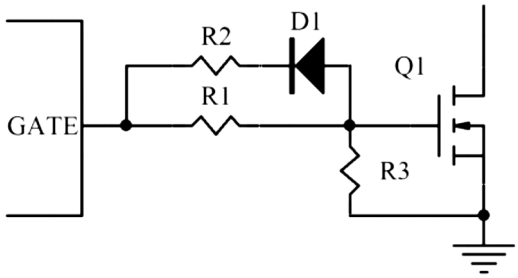


Fig6. Optional Gate Drive Network

13. Layout Guidelines

13.1 Principles of high-frequency layout

A reasonable PCB layout should be maintained on applications to ensure that the chip-related connection pins have as short path as possible.

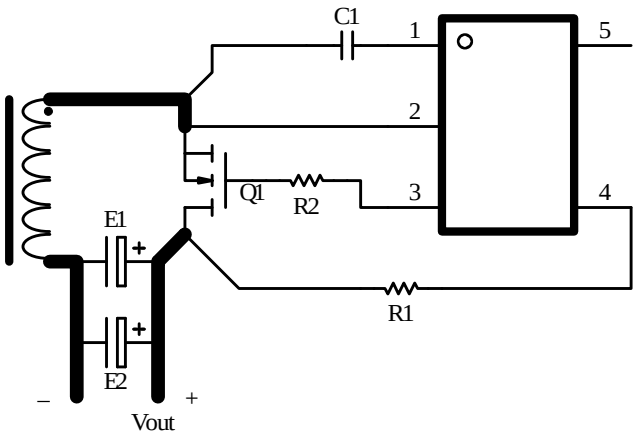


Fig7. PCB Layout Recommendation

Fig8. PCB Layout Demonstration

14. Typical Application Circuit Schematic (input：90~265Vac, 65W PD Charger)

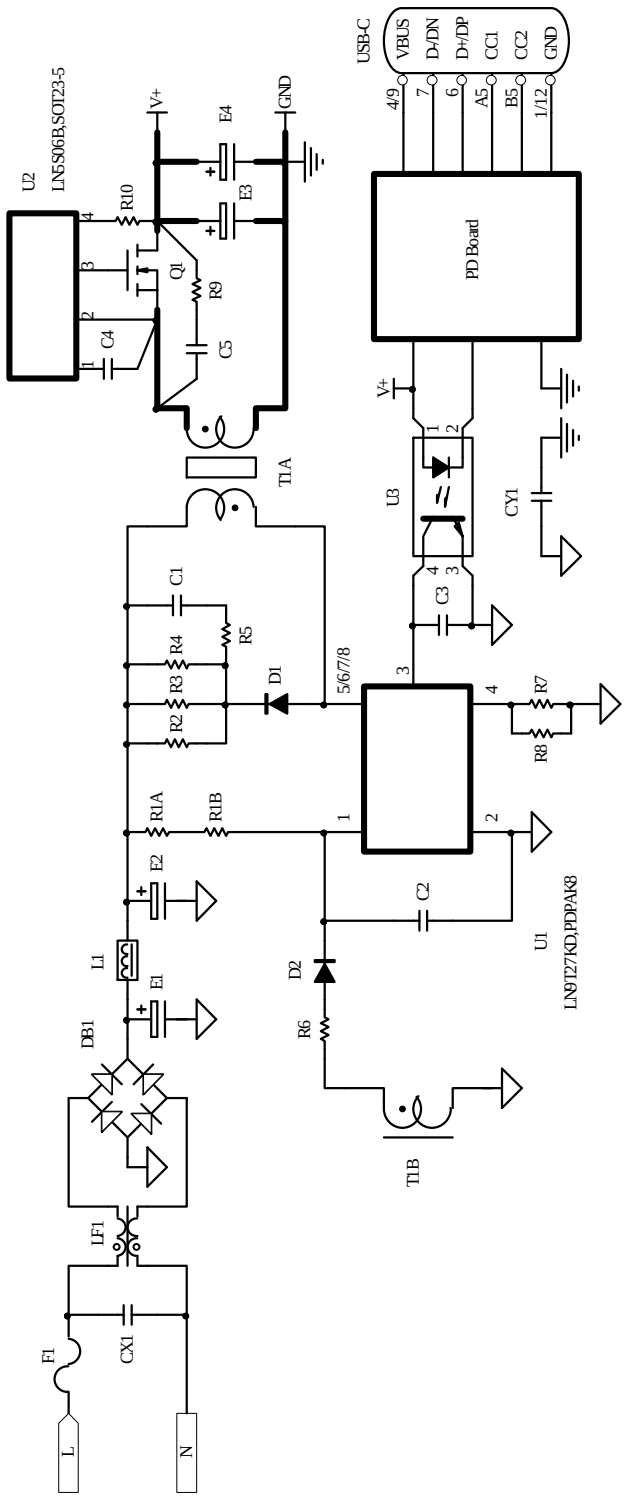
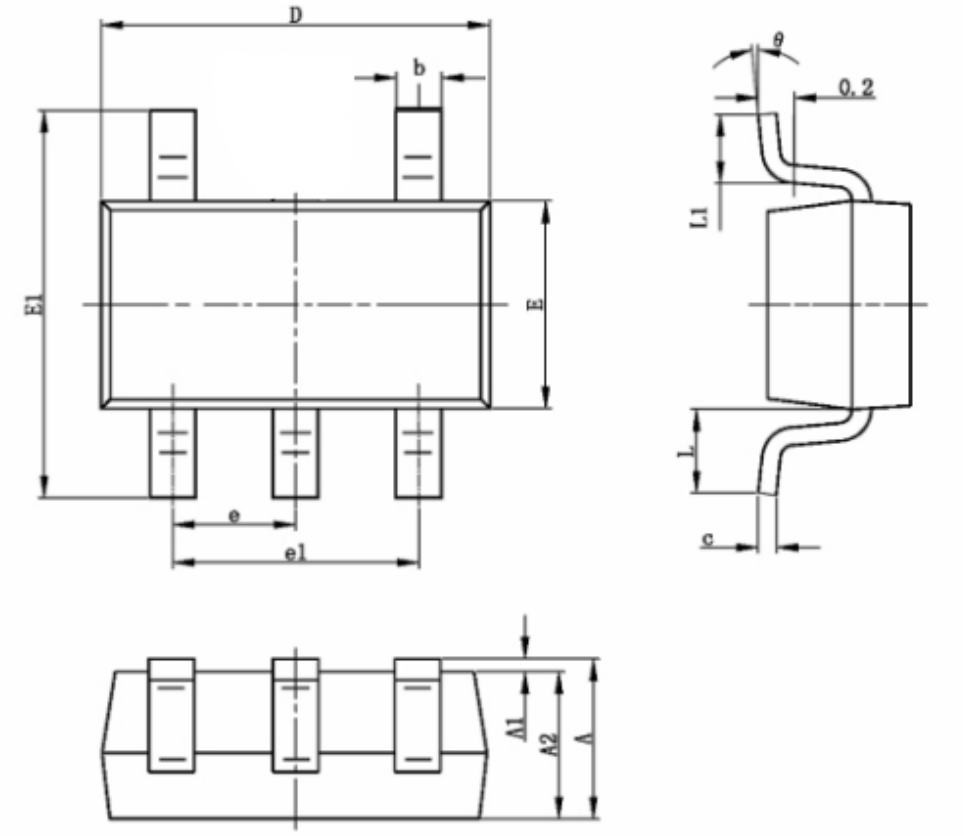


Fig9. Typical Application Circuit Schematic

15. Mechanical and Packaging

SOT23-5



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950TYP		0.037TYP	
e1	1.800	2.000	0.071	0.079
L	0.700REF		0.028REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Fig10. Mechanical Dimensional Drawings

16. Orderable Information

Part number	Green Standard	Package	Quantity
LN5S06B	Halogen-free	SOT23-5	3000PCS/REEL

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