Product Manual of Synchronous Rectifying Circuit

Description

SL0610G is a high-performance switching power supply secondary side synchronous rectifying circuit, integrated with control chip, energy storage capacitor and the power MOSFET with low RDSON With the self-powered technology, it can turn on/turn off MOS through current detection. Can be automatically switched to the Schottky diode for use in the switching power supply system, it is a secondary rectifying circuit solution with simple application and excellent performance.

SL0610G can be applied to the switching power supply system with 5V output that can meet the CoC Tier 2 level-six energy efficiency, with the maximum working frequency of 150kHz; in addition, the QR/DCM mode is supported. The extremely low conduction loss of power MOSFET is utilized to reduce the conduction power loss of the Schottky diode, to increase the switching power supply conversion efficiency and reduce the temperature rise of the rectifier, so as to meet the application of the high-efficiency switching power supply.

The chip is equipped with a high-voltage self-powered unit circuit, coordinated with the highly-concentrated chip scheme, the peripheral circuit of the chip is extremely simple, in no need of any external device, which can be directly used in the system instead of the Schottky diode.

Characteristics

- Take the place of the Schottky diode directly, in no need of any external device
- Self-powered, in no need of external power supply
- Quiescent working current as low as 350μA
- The highest working frequency as high as 150kHz
- QRM/DCM mode is supported
- High Side/Low Side rectification is supported
- Integrated MOSFET RDSON as low as 10mΩ
- 3%~5% improved when compared with the rectification efficiency of Schottky diode

Application ranges

- QC 5V quick charger
- USB-PD adapter
- Other flyback switching power supply

Characteristics of device

Information of the device	VKA withstanding voltage	On-State Resistance	Packaging mode	Operating Junction Temperature
SL0610G	60 V	10mΩ	TO-220	-40℃～ 125℃

Functional block diagram

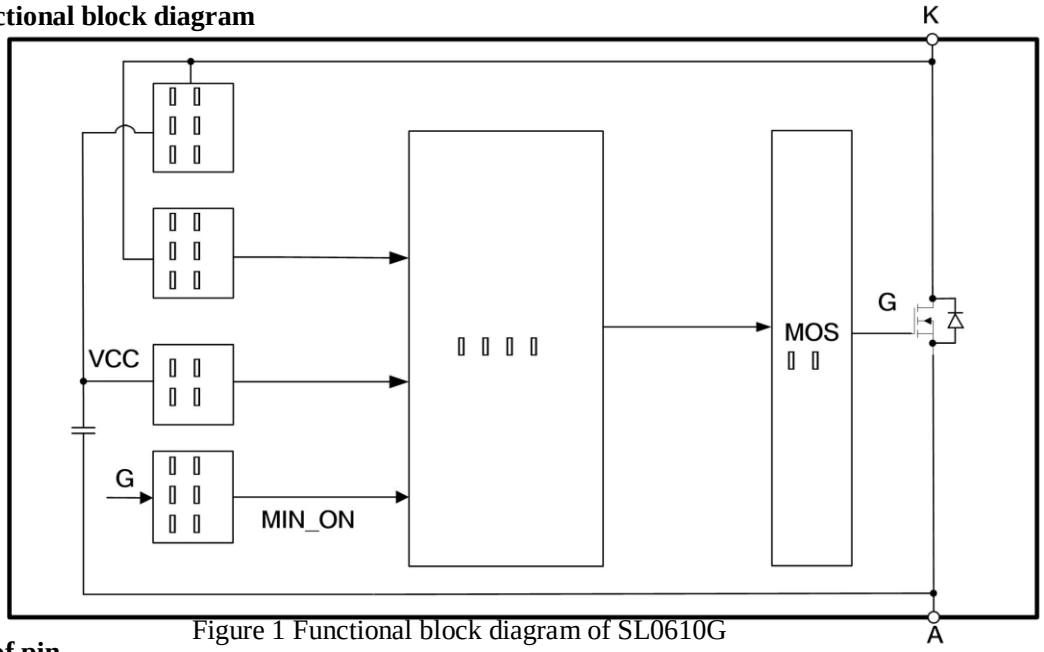
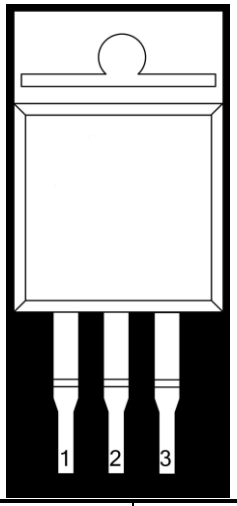


Figure 1 Functional block diagram of SL0610G

Definition of pin



Serial number of the leading-out terminal	Symbol	Description
1，3	A	Positive pole
2	K	Negative pole

Figure2 SL0610G Definition of Pins

Absolute Max. rated value

(End A shall be taken as reference for all the voltage values, the same below)

Parameters	Min	Max	Unit
Highest reverse working voltage	-0.3	66	V
Operating Junction Temperature	-40	150	℃
Storage temperature	-55	150	
Welding resistance temperature		10s@260℃	/
Thermal resistance R_{JC} (Junction to Case)	---	1.5	℃/W

Recommended working conditions

Parameters	Min	Max	Unit
Reverse working voltage	15	60	V
Operating Junction Temperature	-40	125	℃

Electrical Property

SL0610G control IC electrical characteristics

Parameters	Symbols	Conditions（T_j=-40℃~125℃, unless otherwise specified.）	Min	Typical	Max	Unit
Min. self-powered voltage	V_{KA1}		13	15	---	V
Highest reverse working voltage	V_{KA2}		120		---	
Reverse leakage current	I_{dss}	V_{K-A}=20V	---	350	600	μA
		V_{K-A}=120V				
Min. opening time	t_{min_on}		---	1	---	μs
Opening delay	td_{on}	C_{LOAD}=2.2nF	---	60	100	ns
Closing delay	t_{doff}		---	30	60	
A-K positive opening voltage threshold value	V_{on-ak}		200	300	400	mV
A-K positive closing voltage threshold value	V_{off-ak}		-6	3	12	
A-K reverse closing voltage threshold value	$V_{-off-ak}$	Without tmin_on	---	-300	---	

SL0610G power MOSFET electrical characteristics

Quiescent parameters (unless otherwise specified, T_A=25℃)						
Parameters	Symbols	Conditions	MIN	Typical	MAX	Unit
Drain-source breakdown voltage	V(BR)DSS	V_{GS}=0V,I_D=250uA	60		---	V
Max. continuous leakage current	IDMAX			60		A
Maximum pulse current	$IDpuse$			120		A
Gate pole threshold voltage	VGS(th)	V_{GS}=V_{DS},I_D=250uA	1.4	1.7	2	V
Drain Current	IDSS	V_{GS}=0V,V_{DS}=60V,T_j=25℃	---	---	1	μA
		V_{GS}=0V,V_{DS}=60V,T_j=100℃	---	---	100	
On-State Resistance	RDS(on)	VGS=10V,I_D=12A	---	8.2	9.8	mΩ
		VGS=4.5V,I_D=10A	---	11.1	13.9	

Functional description

SL0610G synchronous rectifying circuit is mainly divided as the control IC, the storage capacitor and the power MOSFET. The control IC charges for the storage capacitor through the power supply generation circuit within the scope of suitable reverse working voltage, and the electric quantity stored in the capacitor as the control IC power supply. When the control IC detects that the A-K voltage is higher than the V_{on_ak} through the comparator, the control IC driving power MOSFET breaks over. After conduction, the A-K dropout voltage reduces; when the A-K dropout voltage is close to 0mV, the control chip closes the power MOSFET, and the typical working waveform is as shown in Figure 3.

- **Power supply generation circuit**

During the reverse dropout of the synchronous rectifying diode at A-K, electric charges are stored in the capacitor through the charging to the storage capacitor by the power supply generation circuit, to generate voltage VCC, and VCC supplies power for the control IC other unit circuit when the working A-K dropout is positive. When A-K dropout is in reverse direction, the VCC voltage is lower than 8.5V, and it charges from K to VCC, and the charging is forbidden when it is higher than 10V; for this reason, VCC is always stable during 8.5V~10V. In order to ensure the power supply generation circuit can work reliably, the A-K reverse dropout shall be higher than 15V.

- **Control logic**

When the A-K positive dropout is detected as higher than Von_ak, the control power MOS is conducted, with the minimum conduction time of 1us. After conduction, the A-K dropout reduces; when A-K dropout is detected as $V_{off\text{-}ak}$, the control power MOSFET is closed.

- **Voltage acquisition circuit**

The unique voltage sampling method is adopted to collect the A-K dropout to the comparison end of the comparator accurately, so that the comparator can generate accurate control logic, to achieve the purpose of accurate control of the power MOSFET.

- **Minimum opening time**

When it is detected that the power MOSFET is opening, the minimum opening time is 1us, to improve the anti-jamming ability of the circuit, so as to ensure that there is no miss-closing in MOSFET.

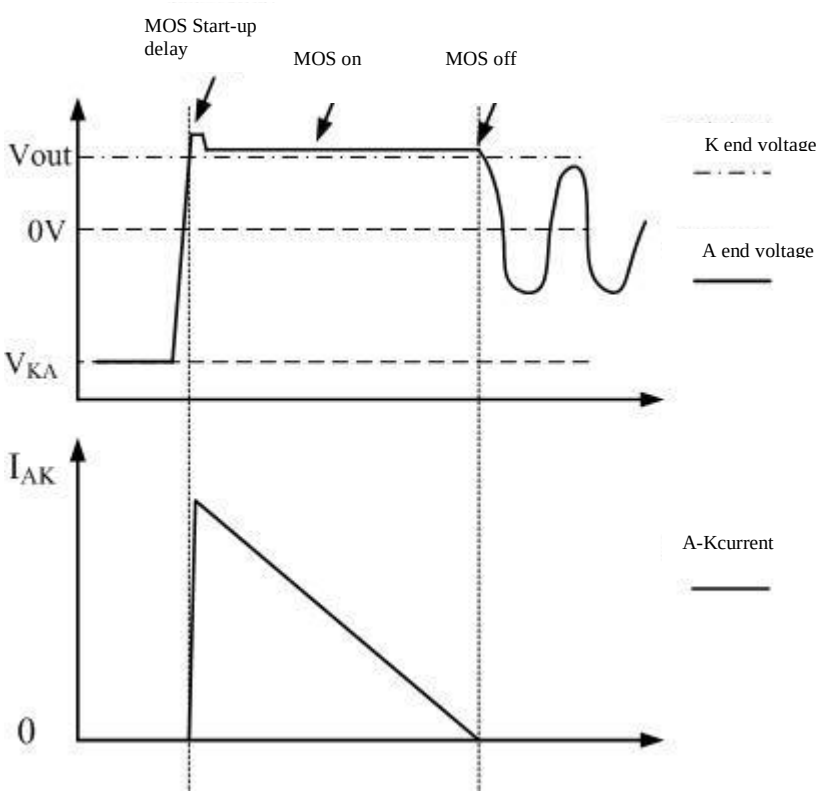


Figure 3 Typical working waveform

Typical application circuit

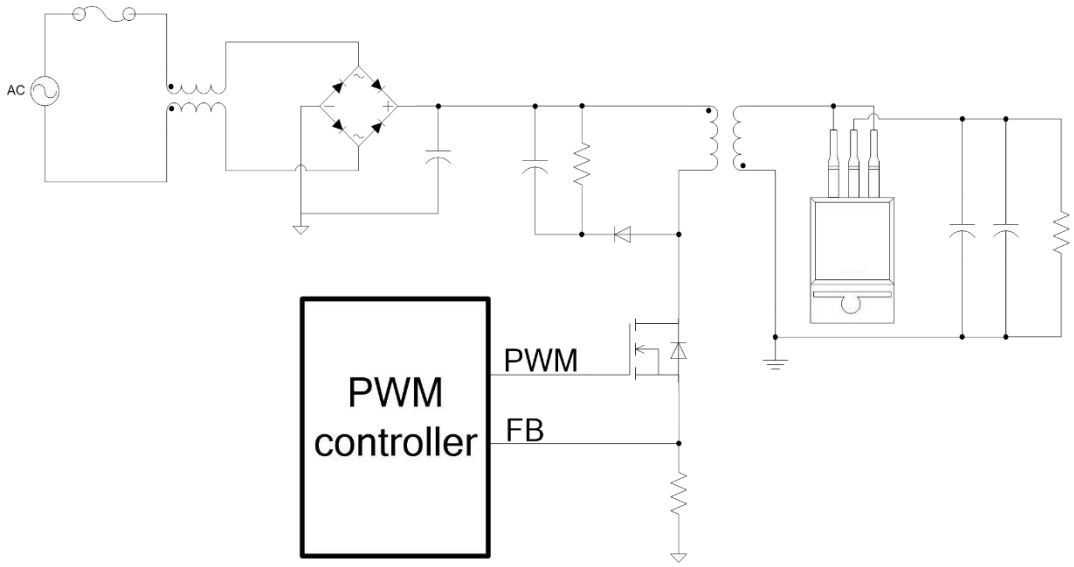


Figure 4 SL0610G High Side Typical application diagram of rectifier

Typical testing curve

- **Quiescent current and VCC voltage testing (notes: the curve is only the testing curve of the internal control IC)**

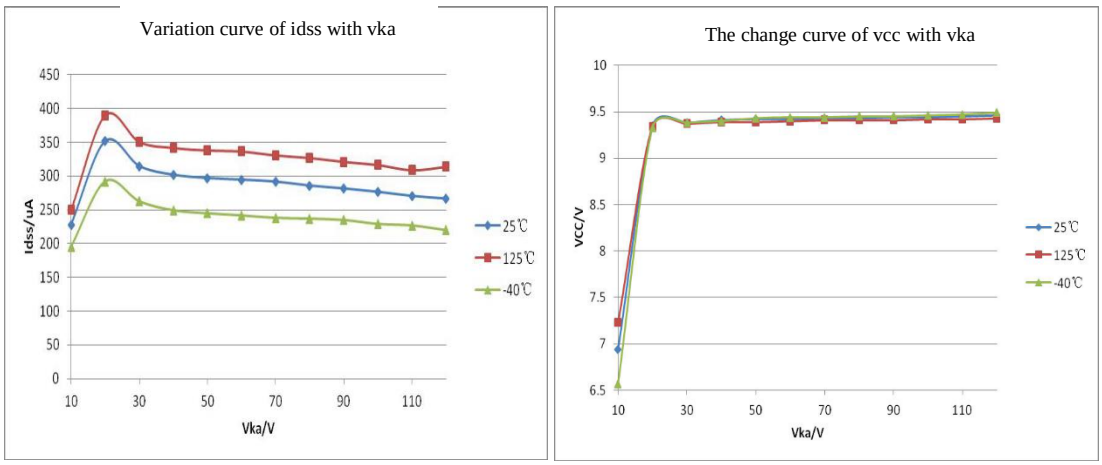
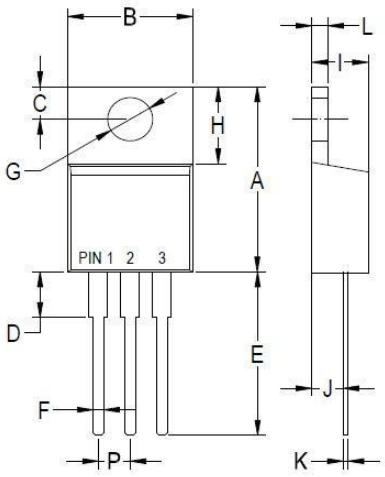


Figure 5 Three temperature curve diagram of Idss and VCC of the internal control IC of SL0610G with Vka

Packaging information: unit: inch (mm)



TO-220AB		
Dim	Min	Max
A	.573(14.55)	.603(15.32)
B	——	.412(10.5)
C	.103(2.62)	.113(2.87)
D	.140(3.56)	.160(4.06)
E	.510(13.0)	.560(14.3)
F	.027(0.68)	.037(0.94)
G	.148(3.74)	.154(3.91)
H	.230(5.84)	.270(6.86)
I	.175(4.44)	.185(4.86)
J	.100(2.54)	.110(2.79)
K	.014(0.35)	.025(0.64)
L	.045(1.14)	.055(1.40)
P	.095(2.41)	.105(2.67)

Figure 6 TO-220AB packaging outline

Matters needing attention:

- The voltage stress of V_{KA} shall lower than V（BR)DSS of MOSFET during use
- The series of products are applicable to the DCM/QRM mode only
- When used in DCM mode, it should be ensured that the voltage stress of the secondary side rectifier and the primary side switching MOSFET meets the design requirements when the power is turned on and the load is abruptly changed.
- Anti-static damage: The device is a static-sensitive device, and adequate anti-static measures should be taken during transmission, assembly, and testing.