

Description

The KP2113x is an SR's product which is a high performance and highly integrated secondary side synchronous rectifier in switch mode power supply system. It integrates various low voltage drop N-channel MOSFET to replace the output rectifier diode in a flyback topology. This can reduce heat dissipation, improve system efficiency, and simplify thermal design. It can effectively help power system meet the latest DOE2.0 standard average efficiency requirement. Very low quiescent current in standby mode ensures lower system standby power.

The KP2113x is suitable for flyback converter operating in continuous conduction mode (CCM), discontinuous conduction mode (DCM), and quasi-resonant mode. Especially for CCM, to guarantee system reliability, Patented Gate voltage adjustment technology and Fast shutdown judgment methods are used in SR turn-off control.

The KP2113x can support wide range of system output voltage 5-20V offline AC/DC flyback converter with universal AC inputs, such as PD/QC adaptor e.g. It is suitable for fast charging power solutions within 20W.

FEATURES

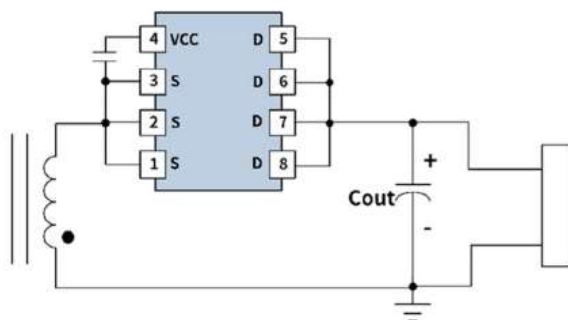
- Integrated various Power MOSFET
- Supports CCM, DCM and QR Operation Mode
- Suitable for 10-150KHz switching frequency
- Fix minimum on time
- Up to 50V VD pin high voltage
- Power savings in standby mode or light load
- Self-powered technology
- Fast turns on/off
- Supports both High/Low Side Rectification
- Available in a Standard SOP8/DFN5x6 Package
- Pb Free, RoHS and REACH Compliant
- Halogen Free and "Green" Device

APPLICATIONS

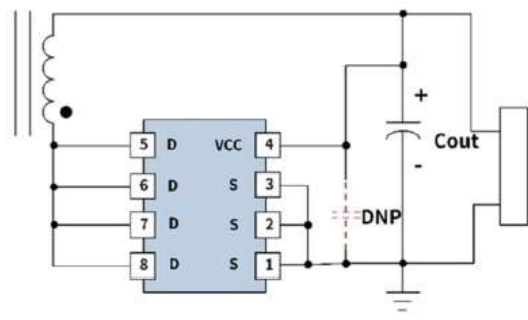
- Universal AC-DC adaptors
- USB QC/PD Quick Chargers/Adaptors
- High Output Current Flybacks
- High Efficiency Flybacks

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Simplified Application



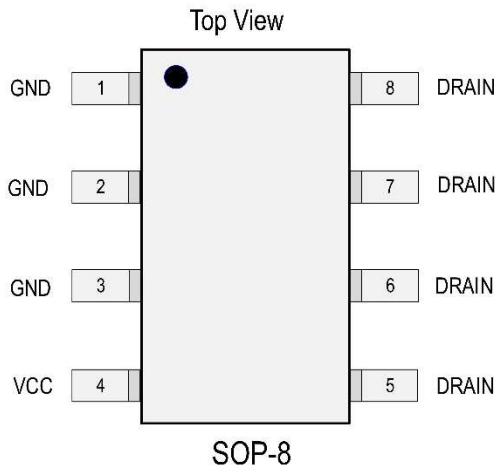
Used in high side rectification



Used in low side rectification

	PART No.	PACKAGE	TOP MARK	Pcs/Reel
ORDERING INFORMATION	KP2113BE	SOP-8	<u>KP2113BE</u>	4000
	KP2113B	SOP-8	<u>KP2113B</u>	4000

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

VD Voltage	-0.7V to 45V
VCC Voltage	-0.3V to 7V
DRAIN Voltage	-0.7V to VDS
Maximum Power Dissipation (SOP-8)	2.5W
Operating Temperature Range	-40°C to 145°C
Storage Temperature Range	-55°C to 150°C
Thermal Resistance θ_{JA}	
SOP-8	80.....°C/W
Lead Temperature (Soldering, 10sec)	260°C

ELECTRICAL CHARACTERISTICS

($V_{CC} = 10V$, unless otherwise specified. Typical values are at $T_A = 25^\circ C$.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply (VCC PIN)					
VCC Turn-On Voltage	VCC Rising from 0	3.3	3.5	5	V
VCC Turn-Off Voltage	VCC Falling after Turn-on	2.7	3.0	3.3	V
VCC Operation Normal Voltage	VCC Rising from 0	5	6	7	V
VCC Charging Current	VCC Rising from 0		40		mA
VCC Supply Current	VCC=7V, $C_L=2.2nF$, Freq=100K		6	8	mA
Quiescent Supply Current	VCC=7V, after VCC Turn-on		0.3	0.45	mA
Startup Supply Current	VCC=3V, before VCC Turn-on		50	100	μA

PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1,2,3	GND	IC Ground.
4	VCC	Power Supply. This pin provides bias power for the IC during startup and steady state operation.
5,6,7,8	DRAIN/VD	Internal N-MOSFET transistor drains terminal, and Voltage Detection for voltage sense.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Voltage Detection (Controller VD PIN)					
Turn-off Threshold (VD-GND)	VCC=5V, CL=2.2nF	-11	-6	-1	mV
Turn-on Threshold	VCC=5V, CL=2.2nF	-340	-280	-220	mV
Turn-on slew rate detection timer	VCC=5V, CL=2.2nF	20	30	40	nS
Forward regulation voltage (VD - GND)	VCC=5V, CL=2.2nF	-50	-40	-30	mV
Turn-on Blanking Time	VCC=5V, CL=2.2nF		333		nS
Turn-on Delay Time	VCC=5V, CL=2.2nF		30		nS
Turn-off Blanking Time	VCC=5V, CL=2.2nF		1		us
Turn-off Delay Time	VCC=5V, CL=2.2nF		25		nS
VD Leakage Current	VD=105V			1	uA
Minimum On Time			1		μS
Power MOSFET Parameter (DRAIN PIN)					
Drain to Source Breakdown Voltage	KP2113BE			50	V
	KP2113B			50	V
Drain to Source on Resistor	KP2113BE		18	20	mΩ
	KP2113B		13	15	mΩ

FUNCTIONAL DECRPTION

The KP2113x is designed for flyback converters, which can work in secondary side current discontinuous conduction mode (DCM), continuous conduction mode (CCM), and quasi-resonant (QR) mode. The control circuitry turns on the SR MOSFET when MOSFET's body diode conduct and turn off it when secondary side current drops to near zero level. The IC can support both high side and low side.

Startup and under voltage lockout (UVLO)

During startup, the VCC capacitor is charged by VD pin. When VCC capacitor is charged to VCC_ON threshold, the device wakes up quickly. And then The IC will monitor VD voltage. Once the conditions meet, the GATE will output immediately. When Vcc is below the UVLO threshold, the KP2113x enters sleep mode, and GATE remains at a low level.

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Gate Driver

In order to guarantee fast turn-on and turn-off of SR MOSFET, KP2113x gate driver offer strong driver capability, typical 2A source and 3A sink current.

Under the same SR MOSFET conditions, KP2113x provides a 10V driving voltage, higher than the conventional 5V gate driver, resulting in smaller R_{DS(on)} of SR MOSFET to reduce power loss.

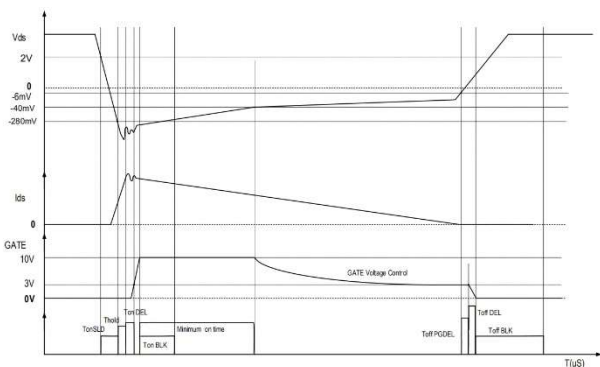
The drive voltage of KP2113x will start automatic

loop adjustment when VDS is greater than -40mV after the blanking time. The gate voltage may be drop to its minimum value 3V. This makes KP2113x prepare for even the fast turn-off operation.

In any other case except to actively turn on the SR MOSFET, the GATE keeps at a low impedance to pull down the SR MOSFET gate voltage to prevent false turn-on.

Turn on/off phase

When the switch current flows through the body diode of the MOSFET, there is negative VDS across the MOSFET. When VDS drops to ~2V, a turn-on timer begins counting. If VDS reaches -280mV turn on threshold from 2V within the Tonsld, and VDS keeps less than -280mv for more than THOLD, The MOSFET is turned on after a turn-on delay. In DCM/QR/CCM mode, when VDS rises to trigger the turn off threshold (-6mV), the gate voltage is pulled to zero after a very short turn-off propagation delay. The turn off delay time is generally within 25ns, benefit from KP2113x's larger pull-down current 3A and GATE voltage intelligent adjustment which will reduce to gate voltage in advance according to the VDS. High shutdown speed ensures the safety of CCM system and further improves the efficiency.



Sleep Mode

Sleep Mode is a low-power operating mode. This mode automatically reduces switching losses under light-load conditions by pulling Vg output

low whenever the detected synchronous conduction time is less than 1.0uS. While in sleep Mode, the MOSFET body-diode conduction time is continuously monitored. When this time exceeds 1.12uS, the device will turn on Vg in the next switching cycle

Minimum On Time (MOT)

MOT stands for the minimum on time of synchronous MOSFET or the maximum duty cycle of primary MOSFET. The MOT is fixing value about 1uS.

VCC internal LDO regulator

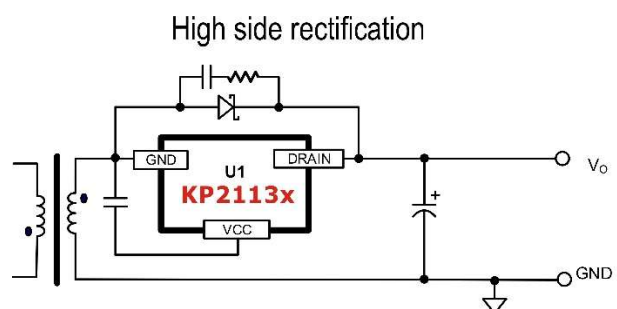
When primary switch is on, VD pin can go to very high and through internal LDO regulator to charge the cap on VCC pin. The voltage on VCC pin is the supply of the chip. This is regulated at 6V maximum and can get 10V Vg voltage without another Winding when VOUT is 5V.

Thermal Shutdown

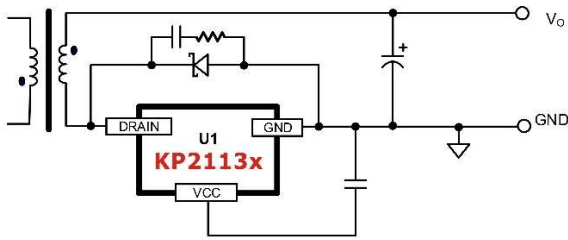
If the junction temperature of the chip exceeds 150°C, VG is pulled low, and the KP2113x stops switching. The KP2113x resumes normal operation after the junction temperature drops to 130°C.

High/Low Side Rectification

The KP2113x can support for high/low side rectification in most applications. The detailed circuit connection is as follows:



Low side rectification



VCC Power Supply

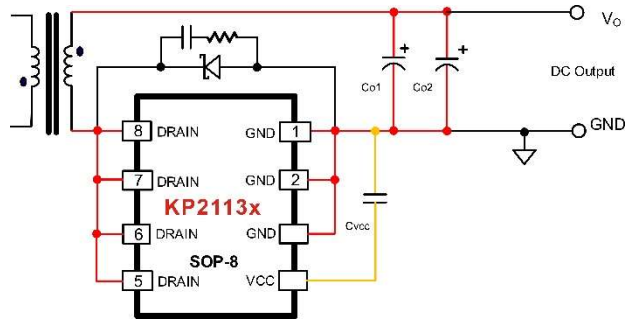
The power supply of VCC is realized by rectifying of the VD pin to charge the VCC capacitor when the primary switch is turned on. However, pay attention to ensuring that the voltage of VCC should be within the safe operating range under all conditions to avoid damage to the chip.

RC Series Snubber Circuit

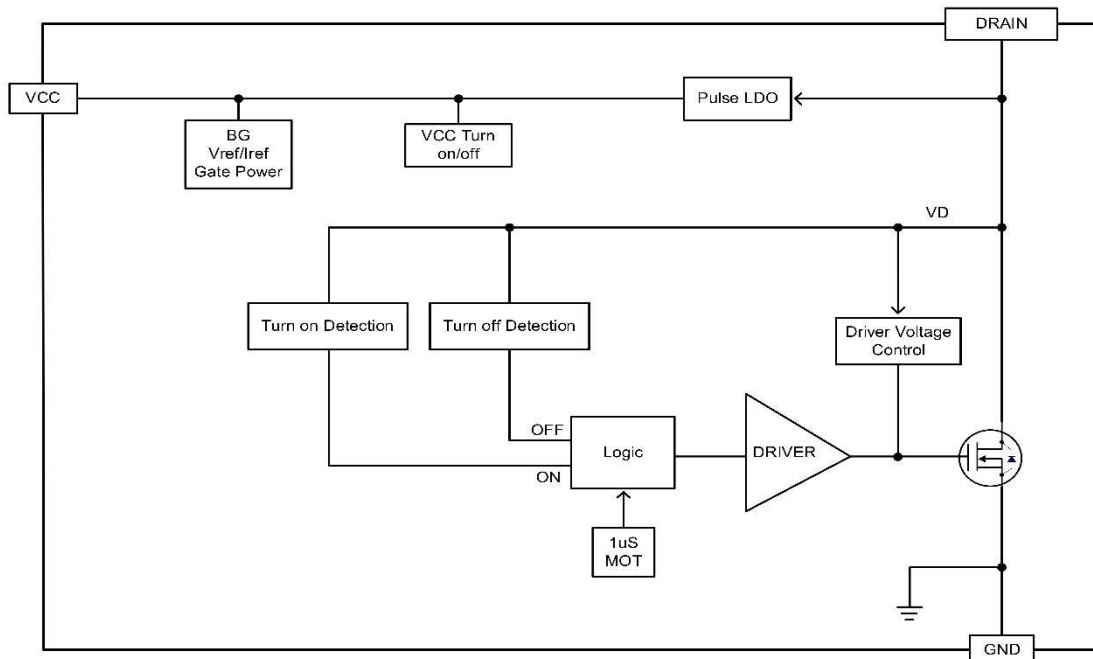
In many conditions, the voltage spike across the synchronous rectifier is very high, so a snubber circuit with a conventional resistor and capacitor in series is recommended to be placed between the DRAIN and GND terminals of the chip.

PCB GUIDELINES

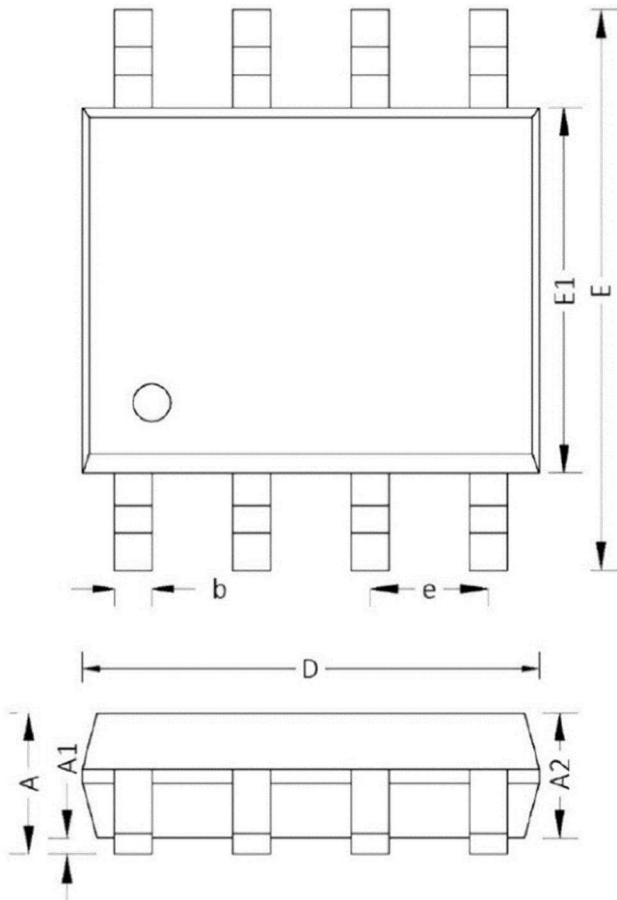
Since the KP2113x has only 3 function pins, the Layout is much simpler. Just guarantee the main current loop (red wire) as short and thick as possible in the secondary. And connect the VCC capacitor directly to the KP2113x VCC and GND pin (orange wire). Finally, it should be noted that due to the integration of the power MOSFET, the heat dissipation of the PCB must be considered. The KP2113x series dissipates heat through the DRAIN pin, so the PCB must have enough exposed copper to dissipate heat to meet the system temperature requirements.



FUNCTIONAL BLOCK DIAGRAM



Package Information



SOP8 COMMON DIMENSIOS(millimeter)			
SYMBOL	MIN	NOM	MAX
A	-	-	1.75
A1	0.10	-	0.25
A2	1.25	-	1.65
b	0.32	-	0.50
c	0.15	0.20	0.25
D	4.70	4.90	5.00
E	5.80	6.00	6.20
E1	3.70	3.90	4.00
e	1.27REF		
L1	0.40	-	0.80
L	1.00	1.05	1.10