60V/16mΩ, HF Synchronous Rectification Switcher

1. Description

The MK17361 is a compact secondary side synchronous rectification switcher which integrated controller and MOSFET for high performance flyback converters. It is compatible with DCM and QR operations.

The MK17361 can generate its own supply voltage while with high-side rectification; this eliminates the need of auxiliary winding of the transformer, which is usually required to produce supply voltage.

The MK17361 offers the proprietary circuit to avoid potential false turn-on during DCM and QR operations. This feature eliminates the need of minimum off time for SR gate and makes system more reliable.

The precise zero voltage turn off allows the maximum synchronous rectification of MOSFET conduction time for the high efficiency design.

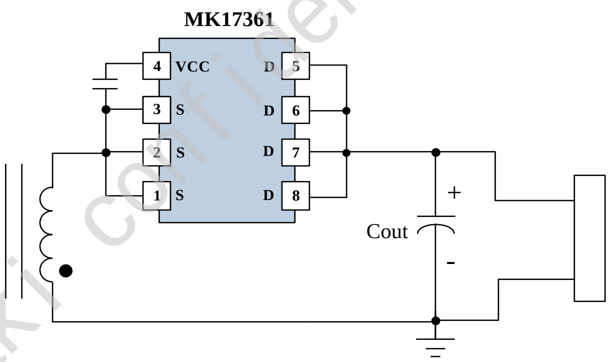
2. Typical Applications

- 9V/12V Output AC/DC Adapters
- USB-PD Chargers

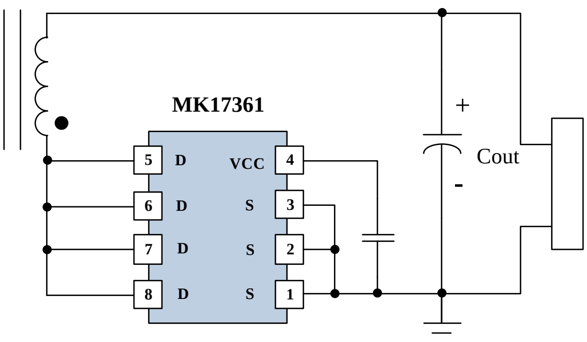
3. Features

- Integrated 16mΩ 60V Power MOSFET
- Operates in a wide output voltage range down to 3V voltage (self-supply)
- Self-supply for operations with low-side rectification and high–side rectification without an auxiliary winding
- No need of external capacitor in low side with Vout bias configuration (Vout<6V)
- Supports DCM and QR Operations
- Precise 0V turn off for maximum efficiency
- Designed for <300kHz working frequency
- <1mW power dissipation in standby
- Available in SOP-8 Package

4. Simplified Application



Used in high side rectification

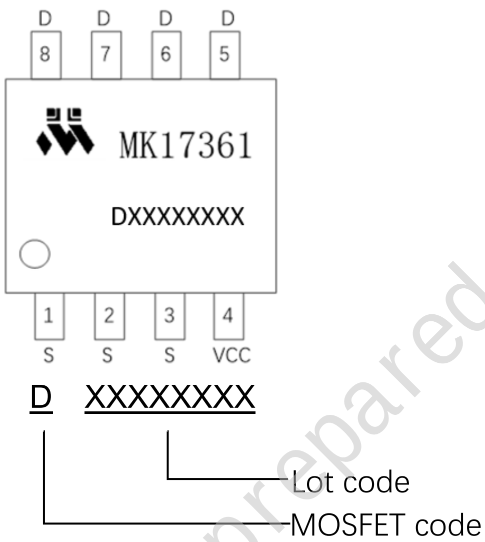


Used in low side rectification

5. Ordering Information

Order No.	Description
MK17361DAB	SOP-8, 4000 pcs/reel

6. Package Reference



Absolute Maximum Ratings [1]

VCC to S........................... -0.3V to +7V (T_J = +25°C)
D to S.. –1V to +60V
Continuous Power Dissipation.2.5W (Ta = +25°C)[2]
Junction Temperature.......................................150°C

Recommended Operation Conditions

VCC to S…. .... ……. .0V to 6V
D to S……………………………….……..-0.7V to 55V
Maximum Junction Temp. (T_J)........................ +125°C[3]

Thermal Resistance [4]

	θ_{JA}	θ_{JC}	
SOP-8	80	35	°C/W

Notes:

(1) Exceeding these ratings may damage the device.

(2) Ta=25℃; Calculated continuous current based on maximum allowable junction temperature

(3) The maximum allowable power dissipation is a function of the maximum junction temperature T_J(MAX), the junction-to-ambient thermal resistance θ_{JA}, and the ambient temperature T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_D(MAX)=(T_J(MAX)-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature.

(4) Measured on JESDSD51-7, 4 layers PCB

7. ESD Ratings

		Value	Units
Electrostatic discharge V_{ESD}	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins[1]	4000	V
	Charged device model (CDM), per JEDEC specification JESD22-C101, all pins [2]	1750	V

Notes:

(1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process

(2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process

8. Electrical Characteristics

T_A=25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Internal Mos Section						
Internal MOS Rdson	R_{dson}			16		mΩ
Drain to Source Breakdown	$V_{DSS(BR)}$		60			V
Supply Management Section						
VCC UVLO Rising	V_{CC_ON}		2.6	3	3.3	V
VCC UVLO Falling	V_{CC_OFF}		2.15	2.25	2.35	V
VCC UVLO Hysteresis	V_{CC_HYST}			0.75		V
VCC Regulation Voltage	V_{CC_REG}	V_D= 7.5V	4.3	5	5.5	V
Operating Current	I_{CC}	VCC=5V, Fsw=100KHz,			2.4	mA
		VCC=5V, Fsw=1KHz			0.18	mA
Quiescent Current	$I_{q(VCC)}$	VCC=5V, Fsw=0Hz	80	130	160	µA
VCC Discharging voltage (OVP)	V_{CC_dis}			6.3		V
VCC Discharging current (OVP)	I_{VCC_dis}			3		mA
Control Circuitry Section						
Turn-On Threshold (V_D–V_{SS})	V_{ON_th}		-300	-200		mV
Turn Off Threshold (V_D–V_{SS})	V_{OFF_th}			0		mV
Turn-On Propagation Delay	T_{D_on}			30		ns
Turn-Off Propagation Delay	T_{D_off}			25	30	ns
Turn On Blanking Time	T_{B_ON}	C_{LOAD} = 2.2nF	0.4	0.5	0.6	µs
Gate Driver Section						
Gate driver output low voltage	V_{G_LOW}		0		0.2	V
Gate driver output high voltage	V_{G_HIGH}				5.4	V

9. PIN Functions

Pin #	Name	Description
1,2,3	S	Ground, also used as FET source sense reference for VD
4	VCC	Inner Regulator Output, supply MK17361
5,6,7,8	D	FET drain voltage sense; Internal LDO input

10. Block Diagram

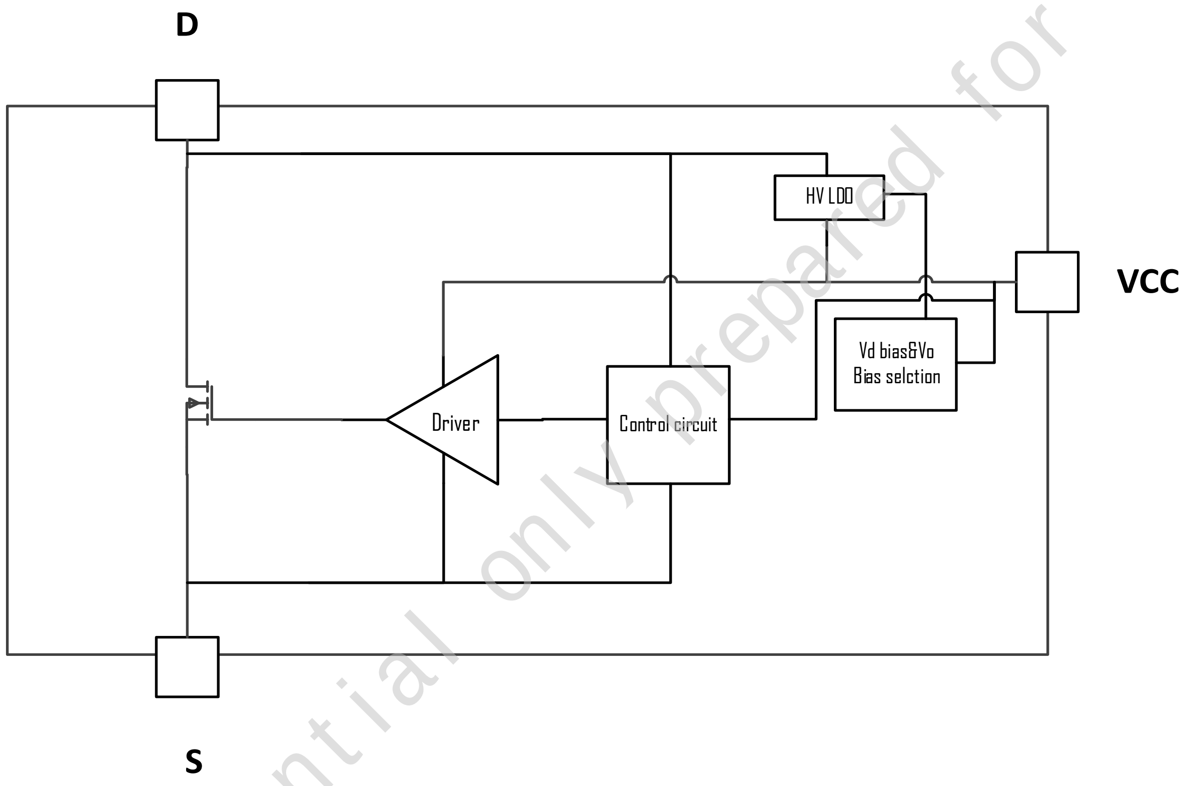


Figure 1. Functional Block Diagram

11. Feature Description

MK17361 is a high-performance synchronous rectifier switch used to replace flyback secondary Schottky rectifiers. It supports high-frequency QR operation mode and is equipped with a low conduction impedance power MOSFET to improve system efficiency. By adopting patented technology, three power supply application can be provided, which can be flexibly and adaptively placed at the positive or negative output terminal, or powered by the output terminal (Vout<6V). When placed at the positive end of the output, there is no need for additional auxiliary windings.

Vcc Power Supply

MK17361 can be powered in two ways. One way is to supply power from the D pin to the internal LDO, and another is to supply power from the Vout, when placed on the output negative terminal. When MK17361 is placed on the output negative terminal and powered by Vout, the Vout must to be less than 6V. MK17361 will automatically determine whether to use internal LDO to power the chip. When the VCC voltage is greater than the VCC overvoltage protection threshold V_{CC_dis} (typical value is 6.3V), an I_{VCC_dis} (typical value is 3mA) current will discharge the VCC. When VCC is powered by Vout, it can suppress instantaneous system OVP and also protect the interface chip.

Turn on

MK17361 adopts patented technology to determine whether to turn on internal MOSFETs, it can determine whether Vds crossing the turn on threshold is caused by demagnetization or DCM ringing, to avoid erroneous turn-on of MOSFETs. The 30ns turn on delay and -200mV turn on threshold reduce the body diode conduction time of MOSFETs and improve efficiency.

Blanking Time

When the synchronous rectifier is turned on, MK17361 avoids false shutdown caused by ringing on the Vds when the synchronous rectifier is turned on, with an internal blanking time of about 0.5us.

Turn off

When the Vg voltage of the internal MOSFET increases, the conduction resistance of the internal MOSFET becomes very small. The gradual decrease of the secondary current Isd will raise the Vds gradually increase to 0V. When the Vds voltage reaches V_{OFF_th}, the MK17361 will turn off the internal MOSFET.

12. Typical Applications

As shown in Figure 2, MK17361 can be placed at the output positive end to replace Schottky and does not require auxiliary winding power supply. In this case, the VCC is powered by the D pin and regulated to around 5V. In the constant current output mode of the system, the output voltage will be lower than 5V, but the VCC will still be regulate to around 5V.

MK17361 supports two applications，when it is placed on the output negative terminal.

One application is powered by the D pin, and the VCC is connected to a capacitor ranging from 0.1uF to 1uF, as shown in Figure 3. VCC is adjusted to around 5V.

Another application is powered by the system output, and the VCC is directly connected to the Vout. This connection method is only suitable for applications with an output voltage less than 6V, as shown in Figure 4. When the PCB layout is good and the VCC wiring is short, this connection method does not require VCC decoupling capacitors. This connection method has VCC voltage equal to Vout. When Vout drops to Vcc_off, MK17361 will enter an undervoltage protection state, and the current will conduct through the body diode of the MOSFET. Considering the ripple effect of Vout, MK17361 will enter undervoltage protection state at the earliest when Vout drops to 2.3V. When VCC is powered directly by the system output Vout, the steady-state output voltage of the system should not exceed VCC_dis (typical value is 6.3V). Because the internal circuit of VCC will sink a current of about 3mA when the VCC voltage exceeds V_{CC_dis}, which will cause very low efficiency and chip overheating when the VCC voltage exceeds V_{CC_dis} for a long time.

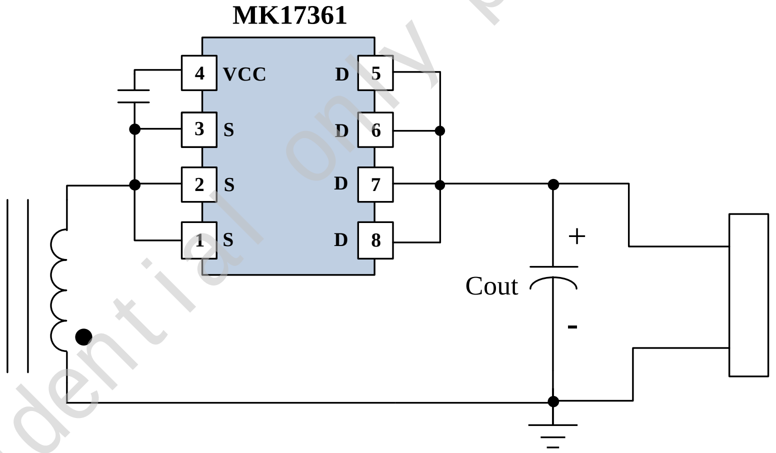


Figure 2. SR placed on the positive terminal typical application circuit

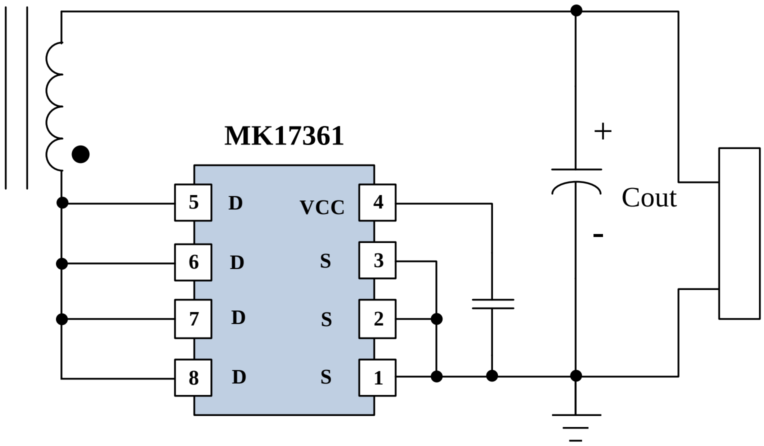


Figure 3. SR placed on negative terminal typical application circuit (1)

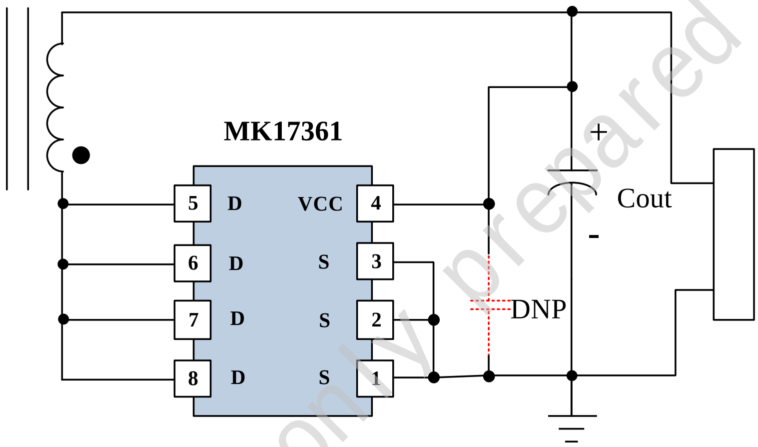


Figure 4. SR placed in negative terminal typical application circuit (2) (only supports Vout<6V)

13. Package Information (SOP-8)

Symbol	Dimensions In Millimeters	
	MIN	MAX
A	1.3	1.75
A1	0.05	0.25
A2	1.25	1.65
b	0.33	0.51
c	0.2	0.25
D	4.7	5.1
E	5.8	6.2
E1	3.8	4.0
e	1.270(BSC)	
L	0.4	1.27
θ	0°	8°