

# Synchronous Rectification Switcher Supporting CCM

## 1. Description

The MK1203H is a compact secondary side synchronous rectification switcher which integrated controller and MOSFET for high performance flyback converters. It is compatible with CCM, DCM and QR operations.

The MK1203H 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 extremely low 10ns turn-off propagation delay time and high sink current (~4A) capability of the driver improve SR VDS stress at CCM mode.

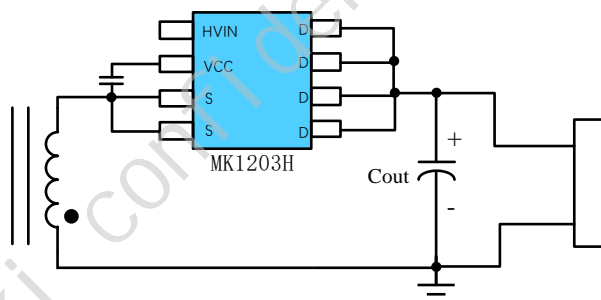
## 3. Features

- Integrated 14mΩ 100V 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
- 10ns Fast Turn-off and 25ns Turn-on Delay
- VG Clamping Circuit works well when VCC is below 2V
- Supports CCM, DCM and QR operations
- Precise 0V turn off for maximum efficiency
- Designed for < 500kHz working frequency
- Available in SOP-8 Package

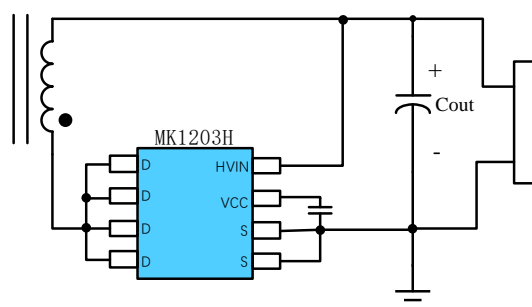
## 2. Typical Applications

- AC/DC Adapters for Mobile Phone and Notebook
- High Power density AC/DC Power Supplies
- Battery Powered System

## 4. Simplified Application



Used in high side rectification

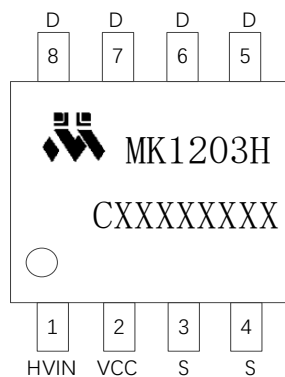


Used in low side rectification

## 5. Ordering Information

Ordering No. <sup>(1)</sup>	Description
MK1203HCAB	SOP-8, MSL-3, 4000 pcs/reel

## 6. Pin Configuration and Functions



CXXXXXXXX: Lot code  
**SOP-8**

**Table 1. Pin Functions**

Pin #	Name	Description
1	HVIN	MK1203H Power supply for internal LDO
2	VCC	Inner Regulator Output, supply
3,4	S	Ground
5,6,7,8	D	FET drain

## 7. Specifications

### 7.1 Absolute Maximum Ratings <sup>(1)</sup>

VCC to S.....	-0.3V to +20V
D to S.....	-0.7V to 100V
HVIN to S.....	-1V to 110V
HVIN to S.....	-3V to 120V <sup>(2)</sup>
Continuous drain current $I_D$ .....	7A <sup>(3)</sup>
Pulsed drain current $I_{DM}$ .....	26A <sup>(4)</sup>
Continuous Power Dissipation. $2.5W$ ( $T_A = +25^\circ C$ ) <sup>(5)</sup>	
Junction Temperature.....	150°C

### 7.2 Recommended Operation Conditions

VCC to S.....	.5V to 9.5V
D to S.....	-0.7V to 90V
Maximum Junction Temp. ( $T_J$ ).....	+125°C

### 7.3 Thermal Resistance <sup>(6)</sup>

	$\theta_{JA}$	$\theta_{JC}$
SOP-8 .....	80	35 °C/W

#### Notes:

- (1) Exceeding these ratings may damage the device.
- (2) Repetitive pulse < 200ns
- (3) Calculated continuous current based on maximum allowable junction temperature
- (4) Repetitive rating: pulse width limited by maximum junction temperature
- (5) The maximum allowable power dissipation is a function of the maximum junction temperature  $T_J(MAX)$ , the junction-to-ambient thermal resistance  $\theta_{JA}$ , 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.
- (6) Measured on JESD51-7, 4 layers PCB

## 7.4 Electrical Characteristics

$T_A=25^{\circ}\text{C}$ , unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
<b>Internal MOS Section</b>						
Internal MOS Rdson	$R_{dson}$	$V_{CC}=9\text{V}$ , $I_d=1\text{A}$		14		m $\Omega$
Drain to Source Breakdown	$V_{DSS(BR)}$	$V_{CC}=H_{VIN}=0\text{V}$ , $I_d=250\mu\text{A}$	100			V
<b>Supply Management Section</b>						
VCC UVLO Rising	$V_{CC\_ON}$		4.3	4.6	4.9	V
VCC UVLO Falling	$V_{CC\_OFF}$		3.8	4	4.3	V
VCC UVLO Hysteresis	$V_{CC\_HYST}$		0.25	0.6	0.75	V
VCC Regulation Voltage	$V_{CC\_REG}$	$V_D=14\text{V}$	8.2	9.1	10	V
Operating Current	$I_{CC}^{(1)}$	$V_{CC}=6\text{V}$ , $F_{sw}=100\text{KHz}$ ,	1.5	2.0	2.5	mA
Quiescent Current	$I_{q(VCC)}$	$V_{CC}=6.4\text{V}$ , $F_{sw}=0\text{Hz}$		350	550	$\mu\text{A}$
<b>Mosfet Voltage Sensing</b>						
$V_D-V_{SS}$ Adjusting Voltage	$V_{DS\_REG}$		-55	-40	-25	mV
Turn-On Threshold ( $V_D-V_{SS}$ )	$V_{ON\_th}$		-350	-300	-50	mV
Turn Off Threshold ( $V_D-V_{SS}$ )	$V_{OFF\_th}$			0	10	mV
Turn-On Propagation Delay	$T_{D\_on}$			25	40	ns
Turn-Off Propagation Delay	$T_{D\_off}$			10	15	ns
Turn On Blanking Time	$T_{B\_ON}$	$C_{LOAD} = 2.2\text{nF}$	0.35		0.5	$\mu\text{s}$
Turn Off Blanking $V_{DS}$ Threshold in $T_{B\_ON}$	$V_{B\_OFF}$			2		V
Turn Off Blanking Time	$T_{OFF}$		250	300	350	ns
<b>Gate Driver</b>						
$V_G$ (Low)	$V_{G\_LOW}$	$V_{CC}=6.4\text{V}$ , $I_{LOAD}=0.1\text{A}$	0	0.2	0.4	V
$V_G$ (High)	$V_{G\_HIGH}$	$V_{CC}=6.4\text{V}$ , $I_{LOAD}=0.1\text{A}$	$V_{CC}-0.6$	$V_{CC}-0.3$	$V_{CC}$	V

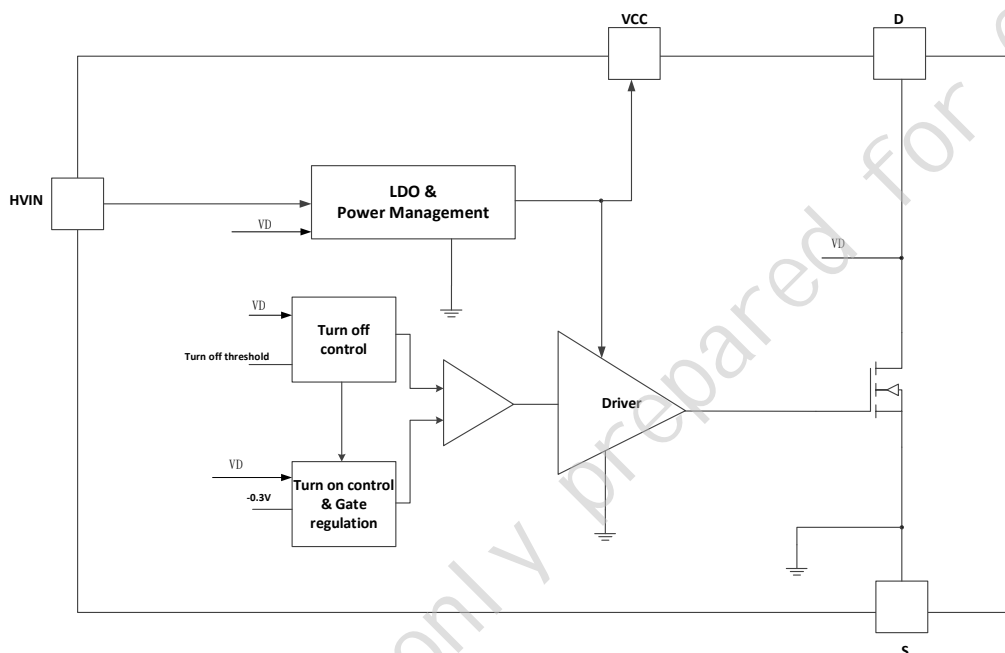
**Note:**

(1) ICC in the table is the current consumed by the internal controller when 2.2nF load capacitance and 100kHz operating frequency.

## 8. Operation Descriptions

MK1203H is a high-performance synchronous rectifier which can replace the Schottky diode rectification in the flyback converter to improve efficiency, which supports DCM, CCM and QR operations. A great flexibility for system design is brought by Self-supply which supports operations with both low-side rectification and high-side rectification without an auxiliary winding.

### 8.1 Functional Block Diagram



**Figure 1. Functional Block Diagram**

### 8.2 Conduction Phase

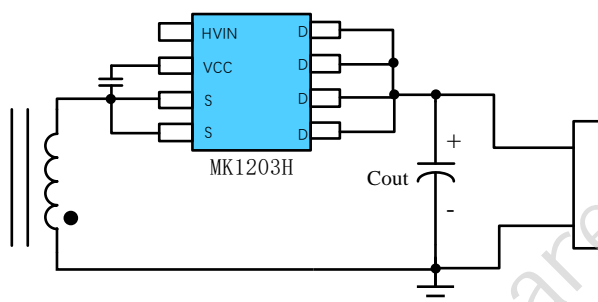
After SR VG turns on, a minimum blanking time  $T_{B\_ON}$  is required to prevent the parasitic ringing from falsely turning off SR VG. The minimum turn-on blanking time is around 0.43us for MK1203H, during which the turn off threshold is increased to 2V. Right before  $T_{B\_ON}$  timer expires, MK1203H starts monitoring  $V_{DS}$  against a -40mV value to determine if internal VG needs to be slowly discharged. This operation adjusts  $V_{DS}$  of SR MOSFET to be around -40mV until the current through SR MOSFET drops to zero.

### 8.3 Turn off Phase

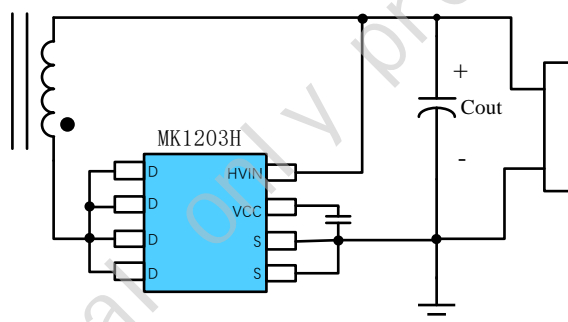
MK1203H's turn-off threshold is different at different time. Within the minimum turn-on blanking time  $T_{B\_ON}$ ,  $V_{DS}$  turn-off threshold is 2V which is the same as  $V_{B\_OFF}$ . After the minimum turn-on blanking time  $T_{B\_ON}$ , the turn-off threshold is around 0V, that combines with extremely fast 10ns turn-off propagation delay and 4A VG pull-down (sinking) current, synchronous rectifier is able to be turned off not too early which causes more SR FET body diode conduction time and more negative turn-off ringing, or not too late which creates risk of shoot through between primary side and SR side.

## 9. Typical Implementations

MK1203H supports both high side rectification and low side rectification to replace Schottky diode without the need of auxiliary winding as shown in Figure 2 and Figure 3. VCC is powered from pin D internally and regulated at ~6V even when Vout is much lower than 5V. When HVIN pin is connected to Vout as shown in Figure 3, VCC is equal to ~6V (if  $V_{out} \leq 6.7V$ ),  $V_{out} - 0.7V$  (if  $6.7V < V_{out} < 9.7V$ ) or ~9V (if  $V_{out} \geq 9.7V$ ). A 0.1uF bypass capacitor is suggested to regulate the bias voltage and reduce noise coupling from switching.

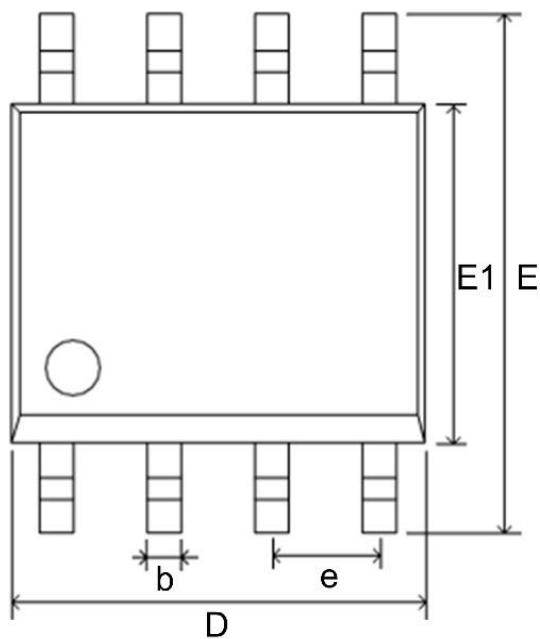


**Figure 2. The High Side Rectification**

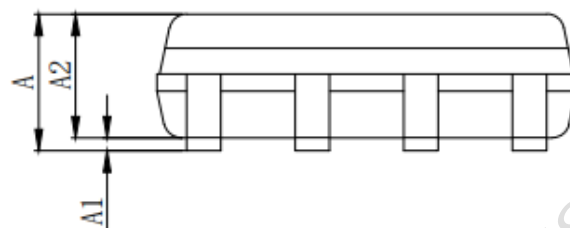


**Figure 3. The Low Side Rectification**

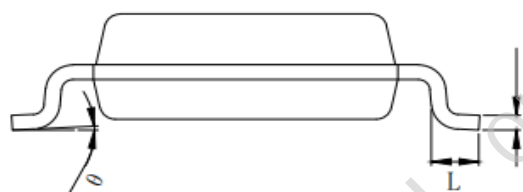
## 10. Package Information (SOP-8)



**Top View**



**Front View**



**Side View**

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
$\theta$	0°	8°