FEATURES

- Supports DCM, Quasi-Resonant, CrCM and CCM operation
- Support the Flyback topology
- Supports High-side and Low-side Rectification
- Output voltage directly supply VCC
- Low quiescent current
- Under-voltage protection
- Fast driver capability for CCM operation
- SOP-8 package

APPLICATIONS

- Flyback converter
- Adaptor

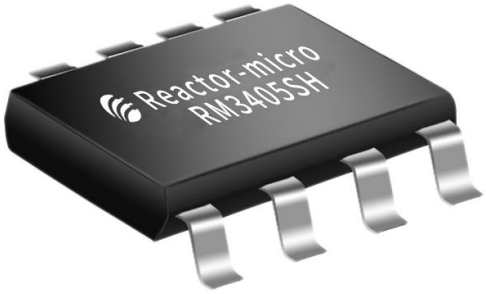
GENERAL DESCRIPTION

RM3405SH is a synchronous rectifier, used for the secondary side rectification of Flyback. By driving an internal MOSFET, RM3405SH is able to significantly improve the efficiency comparing with the conventional Diode rectifier.

When RM3405SH senses VDS of internal MOSFET less than -300mV, it turns on the internal MOSFET. Once the VSWS is greater than -10mV, RM3405SH turns off the internal MOSFET.

RM3405SH supports multiple operation modes, such as DCM, CrCM, CCM and Quasi-Resonant. By implementing the proprietary technology, RM3405SH is able to handle CCM operation.

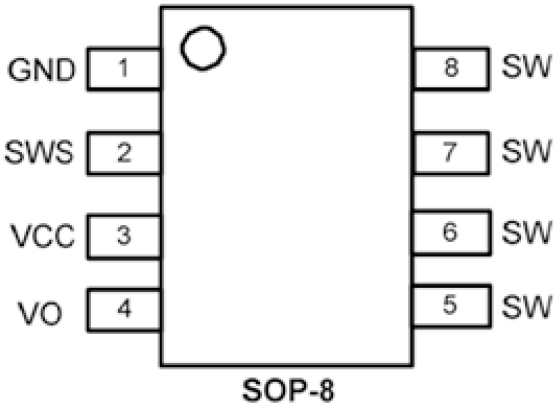
RM3405SH is available in SOP-8 package.



ORDERING INFORMATION

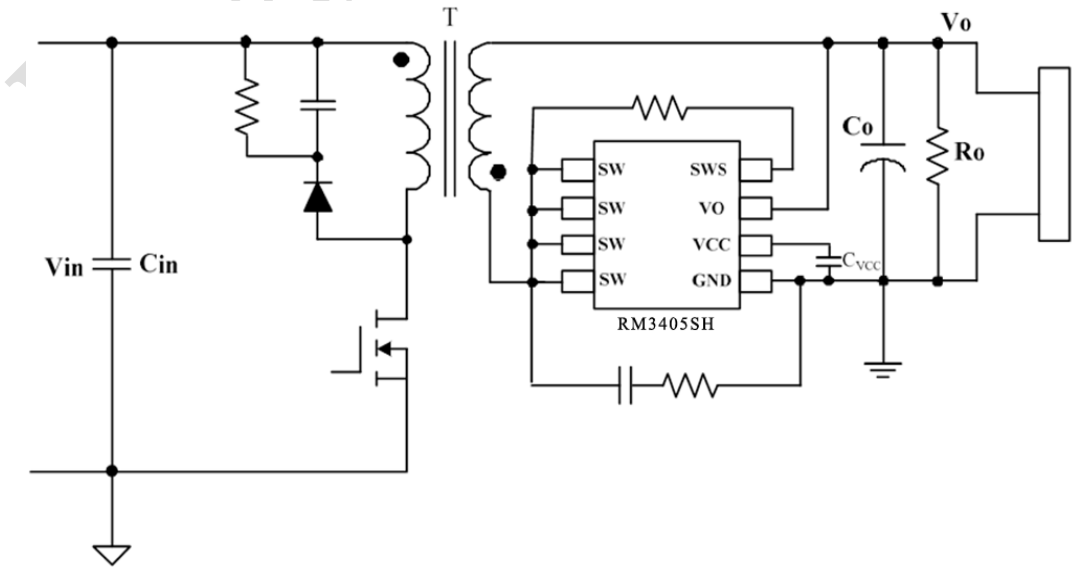
Product Name	Package	Silk Screen	Description	Package
RM3405SH	SOP-8	RM3405SH	Halogen-Free	Coil

PIN INFORMATION

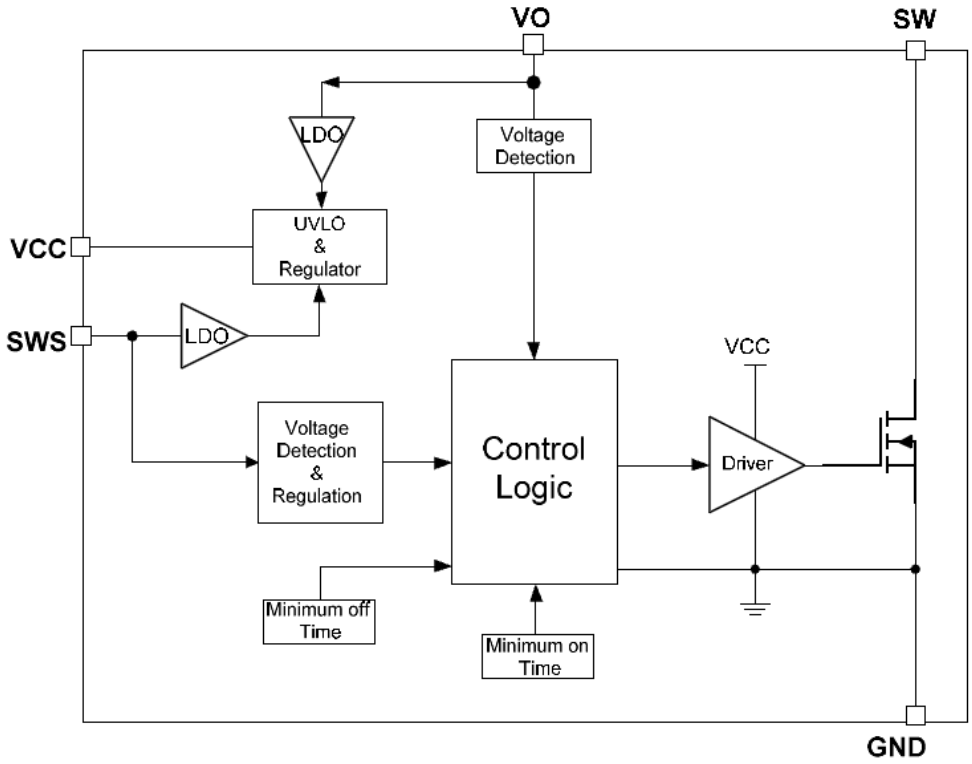


Pin Number	Pin Name	Description
1	GND	Power Ground.
2	SWS	Internal Power MOSFET Drain Voltage Sensing. Charging to VCC.
3	VCC	Power supply. Bypass a Capacitor Between VCC and GND.
4	VO	Output Voltage Sensing and Charging to VCC.
5-8	SW	Internal Power MOSFET Drain.

TYPICAL APPLICATION



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

SW PIN 100V

SWS PIN 100V

VO PIN 30V

VCC PIN.....6.5V

Maximum Power Dissipation[1)].....1.3W

Junction Temperature[2)].....150ºC

Lead Temperature 260ºC

Storage Temperature.....-65ºC to 150ºC

ESD Susceptibility (Human Body Model) 2kV

Note :

1) TA=25°C .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 $P_D(MAX)=(T_J(MAX)-T_A)/\theta_{JA}$.

2) The RM3405SH guarantees robust performance from -40°C to 150°C junction temperature. The junction temperature range specification is assured by design, characterization and correlation with statistical process controls.

ELECTRICAL CHARACTERISTICS

TA = 25ºC, unless otherwise stated						
Item	Symbol	Condition	Min.	Typ.	Max.	Units
VCC Section						
VCC Voltage	VCC	SWS=40V, VCC=2.2uF	5.9	6.1	6.3	V
VCC Startup voltage	$V_{CC\_Startup}$		3.9	4.2	4.3	V
VCC UVLO	V_{CC_UVLO}		3.8	4.0	4.2	V
Quiescent Current	I_q	VCC=4.5V, VCC=2.2uF	28	32	36	uA
Internal Driver Section						
Internal Gate Pull up current	I_{GU}	GT=1V		0.65		A
Internal Gate Pull down current	I_{GD}	GT=5V		4.7		A
Internal Gate Minimum on Time	T_{MIN_ON}			1.3		uS
Internal Gate Minimum off Time	T_{MIN_OFF}			650		nS
Turn-on total delay	T_{DON}			84		nS
Turn-off total delay	T_{DOF}			22.4		nS
SWS and VO Section						
Internal MOSFET Turn on Threshold	V_{SWS_ON}			-300		mV
Internal MOSFET Turn off Threshold	V_{SWS_OFF}			-10		mV
Internal MOSFET Turn off Threshold	$V_{SWS\_OFF\_}$			+75		mV
SWS Control Voltage	V_{SWS_REG}			-40		mV
SWS Control Voltage MAX	V_{SWS_REG}			-170		mV
VO Enable Charge Voltage	V_{O_EN}	VCC=4V, SWS=0V		4.3		V
VO Disable Charge Voltage	V_{O_DIS}	VCC=4V, SWS=0V		4.2		V
VCC Charge Current	I_{CV}	SWS=40V, VCC=4V		18		mA
VO Charge Current	I_{VO_CHG}	SWS=0V, VCC=4V VO=5V		20		mA
Vo Short-circuit Detection Voltage	V_{O_SHORT}		1.8	2.1	2.3	V
Internal MOSFET Section						
Internal MOSFET Rdson	Rdson			10		mΩ
Breakdown voltage	$B_{(BR)DSS}$		100			V

FUNCTIONAL DESCRIPTION

Operation

RM3405SH is a synchronous rectifier which combined with internal MOSFET can replace the Schottky Barrier Diode. It supports all operations, such as DCM, CrCM, (Quasi-Resonant) and CCM when adopted in flyback converter.

Startup

During the startup period, when the VCC is lower than startup voltage, the external MOSFET is turned off. The current flows though body diode before the VCC reaches to the startup voltage Vcc_startup.

Under-Voltage Lockout (UVLO)

When the VCC is below UVLO threshold, the external MOSFET is turned off and pulled low internally. Once the VCC exceeds the startup voltage Vcc_startup, the parts is activated again.

LDO Charging Logic

RM3405SH have two internal LDO to charge the VCC pin. When VO is lower than 4.3V, RM3405SH can power itself through the internal LDO connected to SWS pin during the SR turn-off period, which means primary the primary side MOSFET is turned on and SWS presents a positive voltage. A capacitor between VCC and GND is required to store the energy and supply to IC during the SR turn-on period.

The other internal LDO is connected from VO to VCC, it charges VCC pin when VO is higher than 4.3V.

Turn On Phase

When the synchronous MOEFET is conducting, current flows through the body diode of MOSFET, which generates a negative voltage V_{SWS} across it. When V_{SWS} is lower than V_{MOS_ON}, the part will pull the internal gate high to turn on the synchronous MOSFET after turn on delay time T_{DON}.

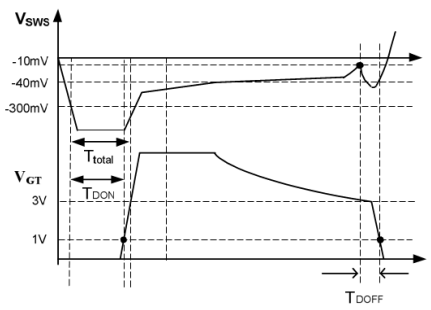


Figure-1 Turn on delay and turn off delay

- Conducting Phase

When the synchronous MOSFET is turn on, the drain source voltage V_{SWS} it is determined by its on resistance and the current through it. The part adjusts the gate voltage and regulates the VSW to a internal threshold (typical -40mV) after the synchronous MOSFET turn on. When the V_{SWS} is lower than -40mV, the gate keep its maximum voltage. And the synchronous MOSFET is fully on.

The control circuit contains a minimum on time function. The V_{SWS} voltage may have a parasitic ring when the synchronous MOSFET turns on. So a minimum on time (MOT) is very important to avoid the MOSFET turn off threshold is false triggered. During the minimum time, the gate can still be turned off if V_{SWS} touches a positive threshold value, +75mV.

- Turn Off Phase

After synchronous MOSFET conducting, once the voltage VSWS touches the MOSFET turn off threshold (-10mV), the internal gate is pulled to low after a turn off delay time TDOFF. A 650nS blanking time is necessary to avoid error trigger.

- Minimum on-time (MOT)

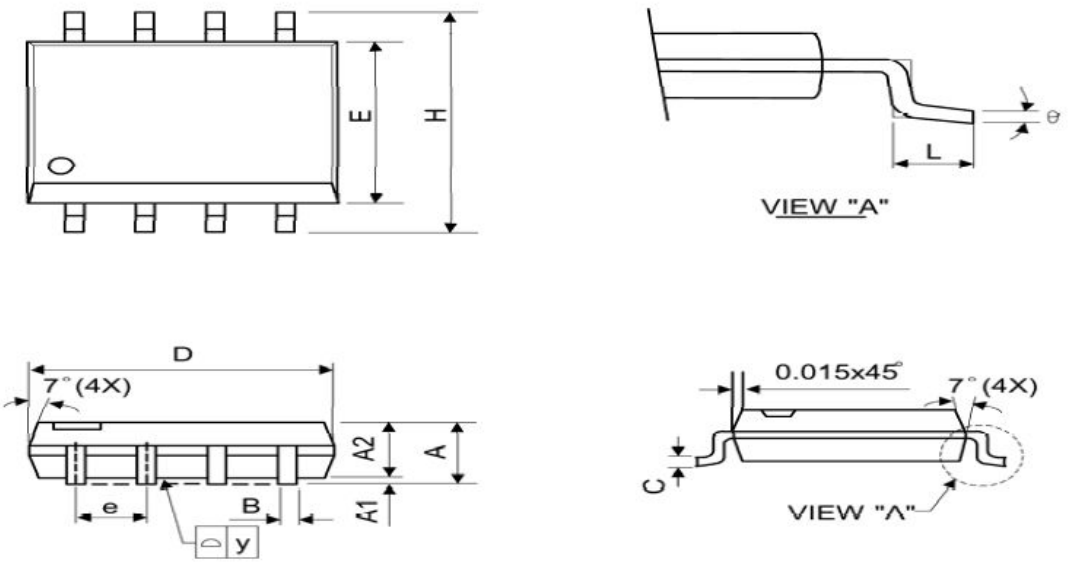
MOT stands for the minimum on time of synchronous MOSFET. For RM3405SH, MOT is about 1.3uS.

- Output Voltage Detection

The RM3405SH has output voltage detection function via VO pin. To avoid the gate error turn on during starting-up period, the whole SR control logic is disabled when the VO voltage is lower than 2.1V. VCC is charged from VO pin when VO is higher than 4.3V to save power loss caused by the LDO when charging from SWSS pin to VCC pin.

PACKAGE MECHANIC DATA: SOP-8

SOP-8



Symbol	Millimeter			Inch		
	Min	Typ	Max	Min	Typ	Max
A	1.40	1.60	1.75	0.055	0.063	0.069
A1	0.10	-	0.25	0.040	-	0.100
A2	1.30	1.45	1.50	0.051	0.057	0.059
B	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.010
D	4.80	5.05	5.30	0.189	0.199	0.209
E	3.70	3.90	4.10	0.146	0.154	0.161
e	-	1.27	-	-	0.050	-
H	5.79	5.99	6.20	0.228	0.236	0.244
L	0.38	0.71	1.27	0.015	0.028	0.050
y	-	-	0.10	-	-	0.004
θ	0°	-	8°	0°	-	8°

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