General Describtion

RM326X is a high performance off-line PWM power switch for low power AC/DC charger and adapter applications,It operates in primary-side sensing and regulation.Consequently,opto-coupler and TL431 could be eliminated, Proprietary constant voltage and constant current control is integrated as shown in the figure below.

In constant current control,the current and output power setting can be adjusted externally by the sense resistor RS at CS pin,In constant voltage control,multi-mode operations are utilized to achieve high performance and high efficiency.In addition,good load regulation is achieved by the built-in cable drop compensation. Device operates in PFM in CC mode as well at large load condition and it operates in PWM with frequency reduction at light/medium load.

RM326X offers power on soft start control and protection coverage with auto-recovery features including Cycle-by-Cycle current limiting,VDD OVP,VDD clamp and UVLO,Excellent EMI perfoemance is achieved with proprietary frequency shuffling technique.high precision constant voltage and constant current can be achieved by RM326X. Otherwise,RM326X is offered in SOP8 and DIP-8 package.

Features

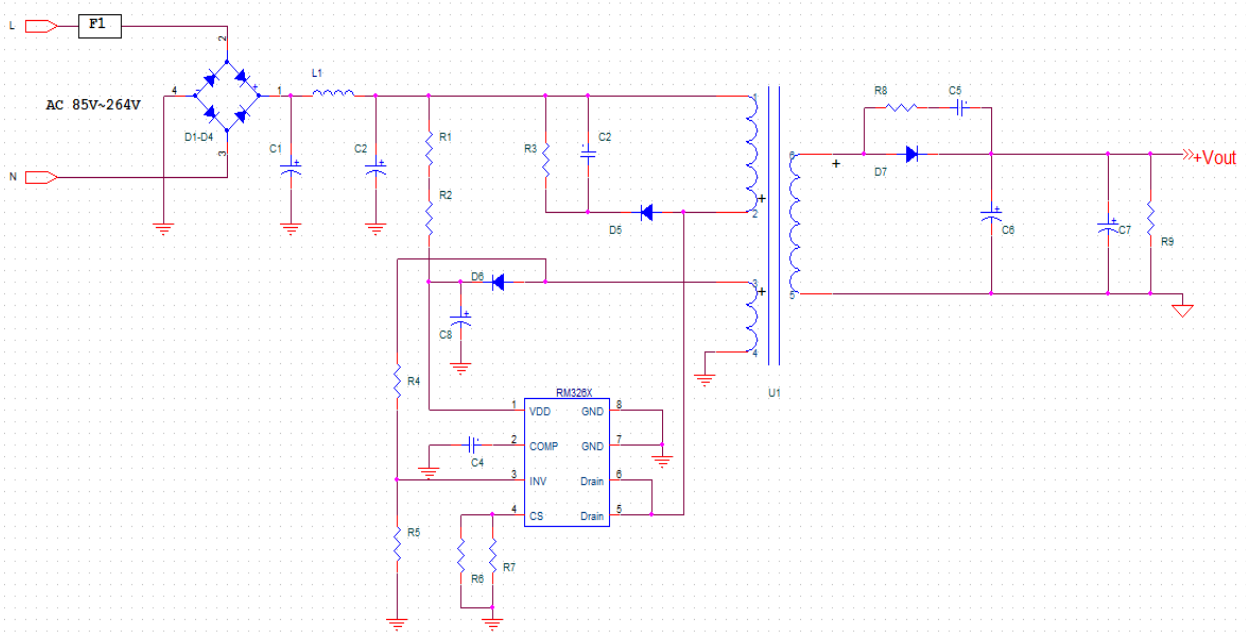
- ±5% constant voltage regulation at universal AC input.
- High precision constant current regulation at universal AC input.
- Primary-side sensing and regulation without TL431 and opto-coupler.
- Programmable constant voltage and constant current regulation.
- Adjustable constant current and output power setting.
- Built-in secondary constant current control with primary side feedback.
- Built-in adaptive current peak regulation.
- Built-in primary winding inductance compensation.
- Programmable cable drop compensation.
- Power on soft-start.
- Built-in Leading Edge Blanking.
- Cycle-by-Cycle current limiting.
- VDD under voltage lockout with hysteresis.
- VDD over voltage protect.
- VDD clamp.

Applications

Low Power AC/DC off-line SMPS for

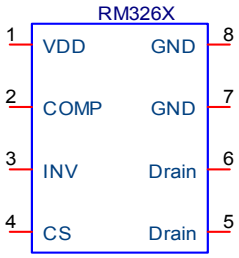
- Cell phone charger
- Digital cameras charger
- Small power adapter
- Auxiliary power for PC/TV etc.
- Linear regulator/RCC replacement.

Typical Application



GENERAL INFORMATION

Pin configuration



Pin Num	Pin Name	I/O	Description
1	VDD	P	Power Supply
2	COMP	I	Loop compensation for CV stability
3	INV	I	The voltage feedback from auxiliary winding, connected to resistor divider from auxiliary winding reflecting output voltage,PWM duty cycle is determined by EA output and current sense signal at PIN 4.
4	CS	I	Current sense input
5/6	Drain	O	HV MOSFET drain pin.the drain pin is connected to the primary lead of the transformer
7/8	GND	P	Ground

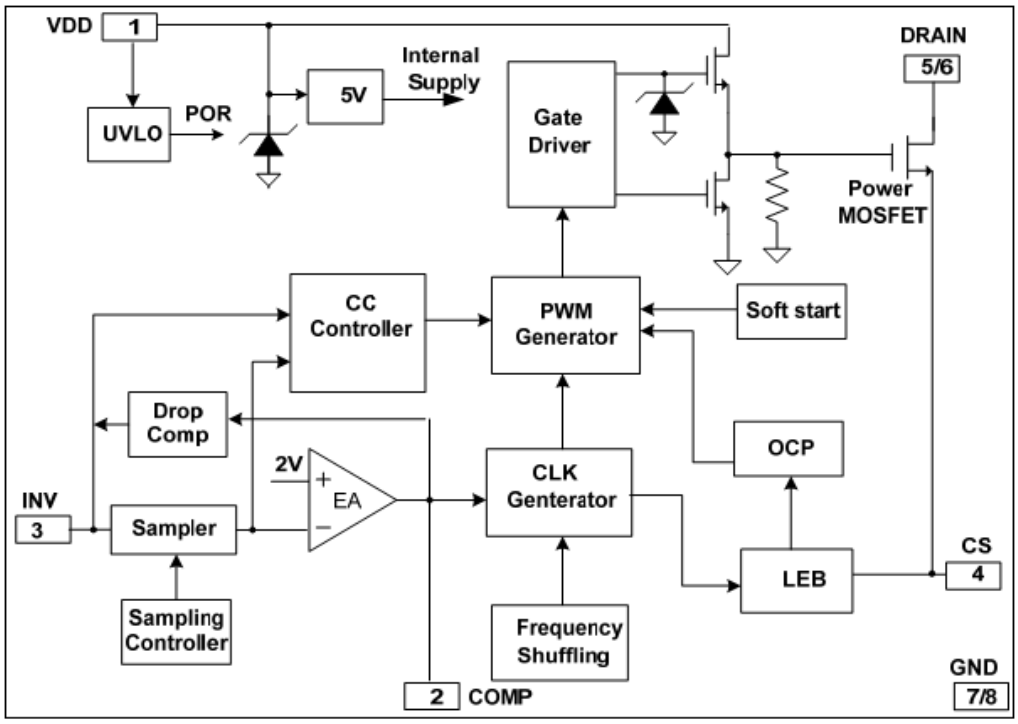
Ordering Information

Part Number	Output Power		Drive MOSFET	Package
	85V-265Vac	230Vac		
RM3260T	18W	24W	External	SOT23-6
RM3261S	5W	6W	1N60(Internal)	SOP-8
RM3261D	6W	7W	1N60(Internal)	DIP-8
RM3262D	12W	15W	2N60(Internal)	DIP-8
RM3264D	15W	18W	4N60(Internal)	DIP-8

Absolute Maximum Ratings

Parameter	Value
Drain Voltage(Off STATE)	-0.3V to Bvdss
VDD Voltage	-0.3V to Vdd_clamp
VDD zener clamp continuous current	10mA
COMP voltage	-0.3V to 7V
CS input voltage	-0.3V to 7V
INV input voltage	-0.3V to 7V
Max operating junction temperature Tj	150℃
MIN/MAX Storage Temperature	-55 to 150℃
Lead tenperature (soldering 10secs)	260℃

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

(T_A =25℃,VDD=VDDG=16V,if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Supply Voltage (VDD) Section						
$I_{DD\ ST}$	Standby Current	VDD=13V		5	20	uA
$I_{DD\ op}$	Operation Current	Operation supply current INV=2V, CS=0V, VDD=VDDG=18V	-	2	3	mA
UVLO(ON)	VDD Under Voltage Lockout Enter	VDD falling	8.2	9.0	10.5	V
UVLO(OFF)	VDD Under Voltage Lockout Exit	VDD rising	13.5	14.8	16.0	V
V_{DD}_clamp	Maximum VDD operation voltage	I_{DD}=10mA	27	28.5	30	V
OVP	Over voltage protection Threshold	Ramp VDD until gate shut down	26	27.5	29	V
Current Sense Input Section						
TLEB	LEB time			625		ns
Vth_oc	Over current threshold		880	910	940	mV
Td_oc	OCP Propagation delay			110		ns
Z_{SENSE}_IN	Input Impedance		50			Kohm
T_ss	Soft start time			17		ms
Frequency Section						
Freq_Max[Note 1]	IC Maximum frequency		55	60	65	KHz
Freq_Nom	System Nominal switch frequency			50		KHz
Freq_startup		INV=0V, Comp=5V		14		KHz
△f/Freq	Frequency shuffling range			+/-6		%
Error Amplifier section						
Vref_EA	Reference voltage for EA		1.97	2	2.03	V
Gain	DC gain of EA			60		dB
I_COMP_MAX	Max. Cable compensation current	INV=2V, Comp=0V		37.5		uA
Power MOSFET Section						
BVdss	MOSFET Drain-Source Breakdown Voltage		600			V
Rdson	On Resistance	Static, Id=0.4A		12	15	Ω

Note:

1. Freq_max indicates IC internal maximum clock frequency.in system application,the maximum operation frequency of 60khz nominal occurs at maximum output power or the transition point from constant voltage to constant current.

OPERATION DESCRIPTION

RM326X is a cost effective PWM power switch optimized for off-line low power AC/DC applications including battery chargers and adapters.It operates in primary side sensing and regulation,thus opto-coupler and TL431 are not required. Proprietary bulit-in CV and CC control can achieve high precision CC/CV control meeting most adapter and charger application requirement.

- **Start-up current and start-up control**

Start-up current of RM326X is designed to be very low so that VDD could be charged up above UVLO threshold and start-up quickly. A large value start-up resistor can therefore be used to minimize the power loss in application.

- **Operation Current**

The operation current of RM326X is as low as 2.5mA.Good efficiency is achieved with the low operation current together with‘Multi-mode’control feature.

- **Soft Start**

RM326X features an internal soft start to minimize the component electrical over-stress during power on start-up.As soon as VDD reaches UVLO(off),the control algorithm will ramp peak current voltage threshold gradually from nearly zero to normal setting of 0.9V.Every restart is a soft-start.

- **CC/CV Operation**

RM326X is designed to produce good CC/CV control characteristic as shown in the Fig.1.

In charger applications,a discharged battery charging start in the CC portion of the curve until it is nearly full charged and smoothly switches to operate in CV portion of the curve.

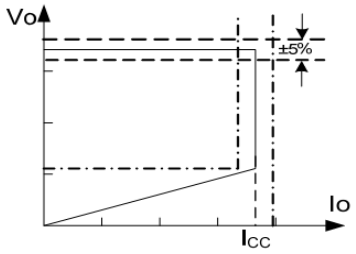


Fig.1. Typical CC/CV Curve

In an AC/DC adapter,the normal operation occurs only on the CV portion of the curve,The CC protion provides output current limiting.In CV operation,The output voltage is regulated through the primary side control,In CC operation mode, RM326X will regulate the output current constant regardless of the output voltage drop.

- **Principle of Operation**

To support RM326X proprietary CC/CV control,system needs to be designed in DCM mode for flyback system.

In the DCM flyback converter.the output voltage can be sensed via the auxiliary winding.During MOSFET turn-on time,the load current is supplied from the output filter capacitor.The current in the primary winding ramps up.When MOSFET turns off,the primary current transfers to the secondary at the amplitude of

$$I_S = \frac{N_P}{N_S} \times I_P \qquad (1)$$

The auxiliary voltage reflects the output voltage as shown in fig 2 and it is given by

$$V_{AUX} = \frac{N_{AUX}}{N_S} \times (V_O + \Delta V) \qquad (2)$$

Where Δ V indicates the drop voltage of the output Diode.

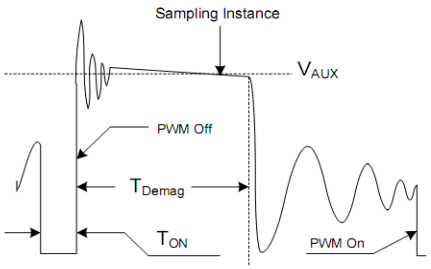


Fig.2. Auxiliary voltage waveform

Via a resistor divider connected between the auxiliary winding and INV,the auxiliary volatge is sampled at the end of the demagnetization and it is hold until the next sampling. The sampled voltage is compared with Vref(2.0V) and the error is amplified.The error amplifier output COMP reflects the load condition and controls the PWM switching frequency to regulate the output voltage ,thus constant output voltage can be achieved.

When sampled voltage is below Vref and the error amplifier output COMP reaches its maximum.the switching frequency is controlled by the sampled voltage thus the output voltage to regulate the output current,thus the constant output current can be achieved.

- **Adjustable CC point and Output Power**

In RM326X,the CC point and maximum output power can be externally adjusted by external current sense resistor RS at CS pin as illustrated in typical application diagram.The output power is adjusted through CC point change.The larger RS,the samller CC point is,and the samller output power becomes,and vice versa as shown in Fig.3.

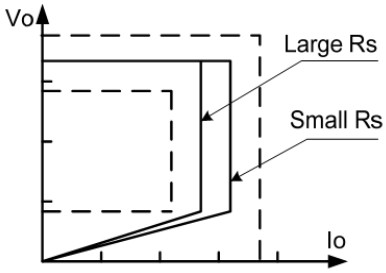


Fig.3 Adjustable output power by changing Rs

- **Operation switching frequency**

The switching frequency of RM326X is adaptively controlled according to the load conditions and the operation modes.No external frequency setting components are required,The operation switching frequency at maximum output power is set to 60KHZ internally.

For flyback operating in DCM,the maximum output power is given by

$$P_{O(MAX)} = \frac{1}{2} \times L_P \times F_{SW} \times I_P^2 \qquad (3)$$

Where Lp indicate the inductance of primary winding and Ip is the peak current of primary winding.

Refer to the equation 3, the change of the primary winding inductance results in the change of the maximum output power and the constant output current in CC mode.To compensate the change from variations of primary widing inductance, the switching frequency is locked by an internal loop such that the switching frequency is

$$F_{SW} = \frac{1}{2 \times T_{DEMAG}}$$

Since T_{DEMAG} is inversely proportional to the inductance,as a result,the product Lp and Fsw is constant current in CC mode will not change as primary winding inductance changes,Up to $\pm$ 10% variation of the primary winding inductance can be compensated.

- **Frequency shulffling for EMI improvement**

The frequency shulffing is implemented in RM326X.The oscillation frequency is modulated so that the tone energy is spread out.The spread spectrum minimizies the conduction band EMI and therefore eases the system design.

- **Current Sensing and Leading Edge Blanking**

Cycle-by-Cycle current limiting is offered in RM326X current mode PWM control. The switch current is detected by a sense resistor into the CS pin.An internal leading edge blanking circuit chops off the sensed voltage spike at initial internal power MOSFET on state so that the external RC filtering on sense input is no longer needed.The PWM duty cycle is determined by the current sense input voltage and the EA output voltage.

- **Gate Drive**

The internal power MOSFET in RM326X is driven by a delicated gate driver for power switch control. Too weak the gate drive strength results in higher conduction and switch loss of MOSFET while too strong gate drive compromises EMI.

A good trade off is achieved through the built-in totem pole gate design with right output strength control.

- **Programmable Cable drop Compensation**

In RM326X,cable drop compensation is inplemented to achieve good load regulation.An offset voltage is generated at INV by an internal current flowing into the resistor divider.The current is inversely proportional to the voltage across pin COMP.as a result,it is inversely proportional to the output load current,thus the drop due to the cable loss can be compensated.As the load current decreases from full-load to no-load,the offset voltage at INV will increase.it can aslo be programmed by adjusting the resistance of the divider to compensate the drop for various cable lines used.

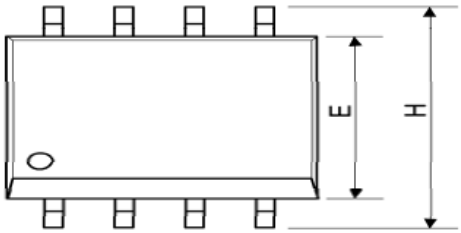
- **Protection Control**

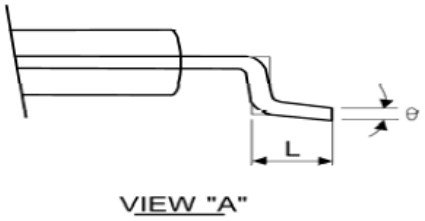
Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting,VDD clamp,Power on Soft-start and Under Voltage Lockout on VDD.

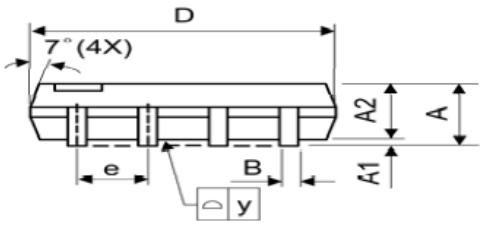
VDD is supplied by transformer auxiliary winding output.the output of RM326X is shut down when VDD drops below UVLO(ON) limit and switcher enter power on start-up sequence thereafter.

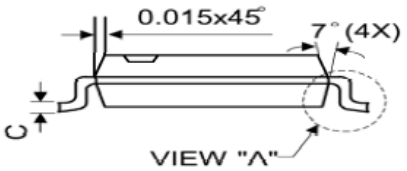
PACKAGE MECHANICAL DATA

SOP-8



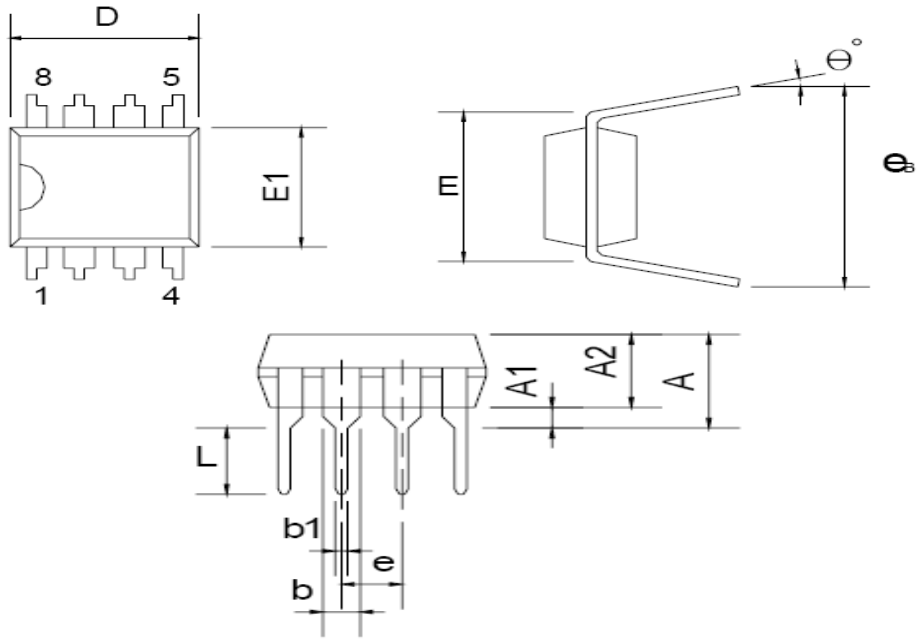






Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.40	1.60	1.75	0.055	0.063	0.069
A1	0.10	-	0.25	0.040	-	0.100
A2	1.30	1.45	1.50	0.051	0.057	0.059
B	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.010
D	4.80	5.05	5.30	0.189	0.199	0.209
E	3.70	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°

DIP-8



DIMENSION

Symbol	Millimeter			Inch		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5.334			0.210
A1	0.381			0.015		
A2	3.175	3.302	3.429	0.125	0.130	0.135
b		1.524			0.060	
b1		0.457			0.018	
D	9.017	9.271	10.160	0.355	0.365	0.400
E		7.620			0.300	
E1	6.223	6.350	6.477	0.245	0.250	0.255
E		2.540			0.100	
L	2.921	3.302	3.810	0.115	0.130	0.150
e_B	8.509	9.017	9.525	0.335	0.355	0.375
θ°	0°	7°	15°	0°	7°	15°