12W AC/DC converter IC

Product Overview

DK112C is a secondary feedback flyback AC-DC off-line switching power supply controller IC. The IC is designed with highly integrated CMOS circuitry and has protection functions for output short circuit, OC over-voltage, over temperature, VDD over-voltage, etc. The IC has built-in high-voltage power transistor and self-powered circuit, and there are very few peripheral components. The transformer design is simple (the transformer for isolating the output circuit only requires two windings).

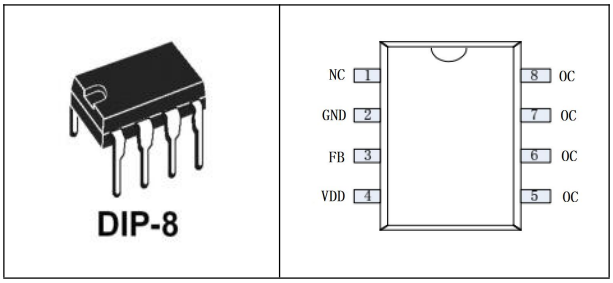
Product Features

- Full voltage input 85V-265V
- Built-in 700V high voltage power transistor
- Built-in high-voltage constant-current start-up circuit, no need for external starting resistors
- Standby-power consumption less than 0.3W
- 65KHz PWM Switching Frequency
- Over temperature, over current, over voltage and output short circuit, secondary open circuit protection
- Patented self-powered technology, no need for external auxiliary winding power
- Built-in jittering function that automatically reduces the operating frequency when in standby, meeting European green energy standards (< 0.3W) while reducing the ripple of the output voltage
- Built-in ramp compensation circuit to ensure circuit stability at low voltage and high power output circuit stability
- Frequency jitter reduces EMI filtering costs
- 4KV anti-static ESD test

Typical Applications

- LED Power Supply
- Power adapter
- Small household appliances such as induction cookers, air conditioners, DVDs, set-top boxes, etc

PINS CONFIGURATION



Typical power

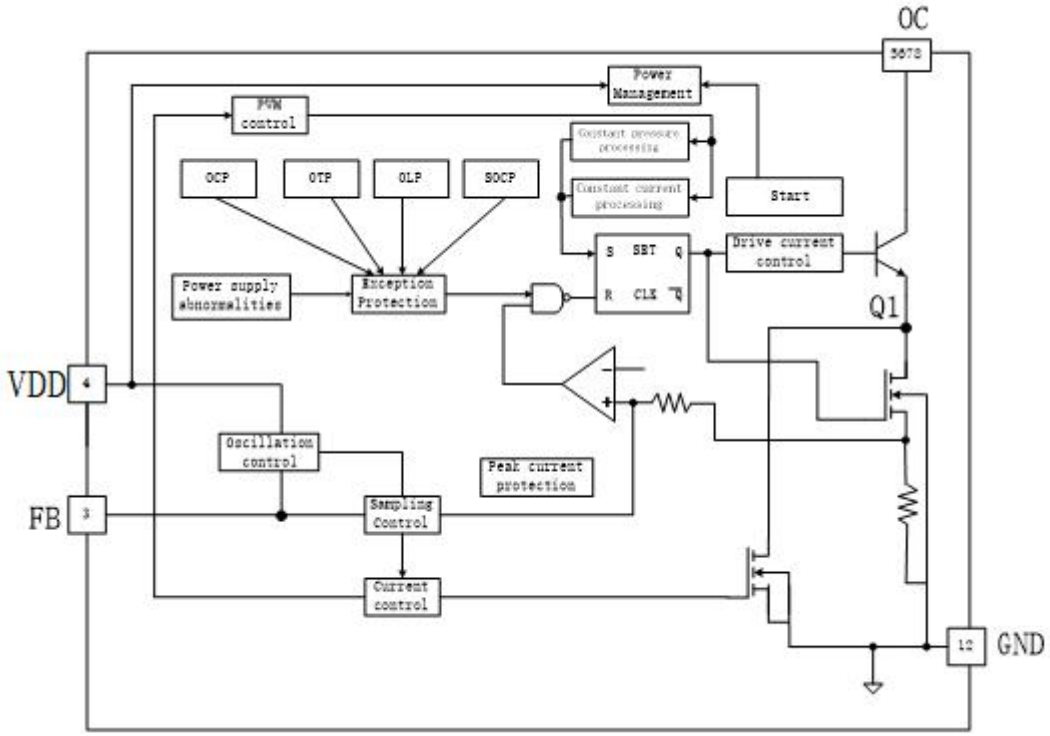
Product Model	Input Voltage	Typical Power
DK112C	230VAC	15W
	85-265VAC	12W

Notes:Typical power is tested in a closed environment at 45℃.

Pins function

Pin No.	Pin Name	Description
1	NC	Suspended
2	GND	Reference ground
3	FB	Optocoupler feedback control pin, connected to 1nF~10nF capacitor
4	VDD	Power supply pin, externally connected to ground with 10uF~47uF capacitor
5,6,7,8	OC	Output pin, connected to built-in high-voltage power transistor, externally connected to transformer

Functional Structure Diagram



ABSOLUTE MAXIMUM RATINGS (TA=25℃ Unless otherwise noted)

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage VDD	$U_{S(vdd)}$	-0.3		7.2	V
Supply current VDD	$I_{S(vdd)}$		100		mA
FB Voltage	U_{FB}	-0.3		VDD	V
OC voltage	U_{OC}	-0.3		730	V
Peak current	I_{PK}			1000	mA
Total power dissipation	P_{TOT}		800		mW
Operating temperature range	T_R	-25		125	℃
Storage temperature range	T_{STG}	-55		150	℃
Welding temperature	T_W		280/5S		℃

ELECTRIC CHARACTERISTICS (TA=25℃ Unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operating voltage section						
VDD operating voltage	$V_{DD(no)}$	AC input 85V-----265V		4.7		V
VDD start-up voltage	$V_{DD(start)}$	AC input 85V-----265V		5.1		V
VDD restart voltage	$V_{DD(reset)}$	AC input 85V-----265V		3.4		V
VDD protection voltage	$V_{DD(ovp)}$	AC input 85V-----265V		5.7		V
VDD supplementary supply voltage	$V_{DD(ps)}$			4.5		V
VDD operating current	$I_{VDD(no)}$	VDD=4.7V，FB=2.2V	10	20	30	mA
Start-up section						
High voltage starting current	$I_{OC(start)}$	AC input 265V			1.2	mA
Start-up time	$t_{(start)}$	AC input 85V，C=100uF			500	ms
Power section						
Power transistor withstand voltage	$V_{OC(bv)}$	Ioc=1mA	700			V
Power transistor protection voltage	$V_{OC(prot)}$	L_P=1.2mH		640		V
Peak current protection	$I_{PK(ocp)}$	VDD=4.7V FB=0V--1.4V	690	760	830	mA

Other						
PWM maximum frequency	$F_{PWM(max)}$	VDD=4.7V FB=0V--2.5V	50	65	70	KHz
PWM minimum frequency	$F_{PWM(min)}$	VDD=4.7V FB=2.5V--2.9V		22		KHz
Short circuit protection threshold	$V_{FB(olp)}$	VDD=4.7V Measure FB voltage			0.9	V
Variable frequency threshold voltage	$V_{FB(sfpm)}$	VDD=4.7V Measure FB voltage		2.5		V
Burst mode threshold	$V_{FB(std)}$	VDD=4.7V Measure FB voltage		2.9		V
Maximum peak current threshold	$V_{FB(ocp)}$	VDD=4.7V Measure FB voltage		1.4		V
Temperature protection	T_{SD}	VDD=5V FB=0V--1.4V	120	125	130	℃
LEB time	$t_{(leb)}$	VDD=4.7V		250		ns
Minimum turn-on time	$t_{on(min)}$	VDD=4.7V		500		ns
Protection time	$t_{(stop)}$			500		ms
First overload time	$t_{(olp1)}$			500		ms
Second overload time	$t_{(olp2)}$			32		ms
Duty Cycle	D_{on}	VDD=4.7V FB=1.6V--3.6V	5		75	%
Standby power consumption	$P_{in(std)}$				270	mW
VDD capacitor ESR	$R_{ESR(max)}$				1	Ω

Operation Principle

1. Power on and start

The IC has a built-in high-voltage startup current source; when the VDD voltage is less than the startup voltage at power-on, the triode is turned on to charge the external VDD storage capacitor. When the VDD voltage reaches 4.9V start voltage, the start current source is turned off, the start process is finished, and the control logic starts to output PWM pulses.

2. Soft start

After the power on startup is completed, in order to prevent the saturation of the transformer core that may occur during the process of establishing output voltage, excessive stress on the power transistor and secondary rectifier transistor, the IC is equipped with a soft start. During the soft start, the I_{PK} decreases.

3. PWM output

A PWM cycle consists of 3 stages:

Inductor charging stage (switching transistor turn-on)：T1=LP*IP/Vin；

Inductor discharge stage (switching transistor turn-off)：T2=LP*IP/Vvor；

OC resonant stage with resonant period:$T3 = 2\pi\sqrt{Lp * Coc}$. IC 65KHz fixed frequency output mode, turn-on time controlled by FB feedback voltage.

4. FB detection and feedback control

Connect a capacitor externally to the FB pin to smooth the FB voltage. External capacitors can affect the feedback transient characteristics and stable operation of the circuit. Typical applications can be selected between 1nF and 10nF;

The FB voltage will linearly adjust the limiting current between $V_{FB\ (ocp)}$ and $V_{FB\ (sfpm)}$. $V_{FB\ (ocp)}$ corresponds to the maximum limiting current, while $V_{FB\ (sfpm)}$ corresponds to the minimum limiting current. When the load increases, the FB voltage will gradually decrease; On the contrary, the FB voltage will gradually increase. When the load is too heavy and the FB voltage is less than $V_{FB\ (olp)}$, the IC will enter the judgment of short circuit or overload protection. When the load is light and the FB voltage is greater than $V_{FB\ (sfpm)}$, the control circuit will reduce the switching frequency of PWM from $F_{PWM\ (max)}$ to $F_{PWM\ (min)}$ and turn it on at the minimum turn-on time. When the load is lighter, the FB voltage will continue to rise; When the FB voltage is higher than $V_{FB\ (std)}$, the control circuit stops PWM output and the IC enters standby burst mode.

5. Self-powered technology

The IC uses patented self powering technology to control the voltage of VDD around $V_{DD\ (no)}$, providing the current consumption of the IC itself without the need for external auxiliary windings. Self powered circuits can only provide the current consumption of the IC itself and cannot provide energy for external circuits.

The maximum withstand voltage of VDD is $U_{S\ (vdd)}$, so VDD power supply electrolytic capacitors need to choose products with low ESR characteristics. It is recommended that the ESR does not exceed $R_{ESR\ (max)}$. When applying, the distance between the VDD capacitor and the main control IC should be short to reduce the interference of parasitic ESR and ESL on VDD during self power supply, and ensure that the VDD voltage of the IC does not exceed the withstand voltage value during self power supply. When working at low temperatures, it is best to connect another ceramic capacitor in parallel with the VDD capacitor.

6. Over-temperature protection

Any time the IC temperature is detected to exceed T_{SD}, the over-temperature protection is immediately activated, the output pulse is stopped, the power transistor is turned off and the abnormal protection

mode is entered.

7. Primary short circuit protection

When the current in the primary coil of the external transformer is too high, if the current in the primary coil reaches $I_{PK(ocp)}$ at $t_{on(min)}$ after the soft start, the IC immediately turns off the power transistor and enters abnormal protection mode.

8. Power abnormalities

When the VDD voltage falls below $V_{DD(reset)}$ due to an external abnormality, the IC will turn off the power transistor for restart.

When the VDD voltage is higher than $V_{DD(ovp)}$ due to external abnormality, the VDD over-voltage protection is immediately activated, stopping the output pulse and entering the abnormal protection mode.

9. Short circuit and overload protection

When the secondary output is short circuited or overloaded, the FB voltage will be lower than $V_{FB\ (olp)}$; In some applications, due to the high starting current required by inductive loads such as motors during startup, the circuit may experience short-term overload. Therefore, the judgment time for the first overload protection of the chip is $t_{(olp1)}$. If the FB voltage returns to normal within $t_{(stop)}$, the chip will not determine overload or short circuit; If the FB voltage remains below $V_{FB\ (olp)}$ within $t_{(stop)}$, it is considered a secondary short circuit. The PWM output is immediately turned off and abnormal protection mode is entered. The short circuit protection judgment time is shortened to $t_{(olp2)}$ until the short circuit condition is resolved.

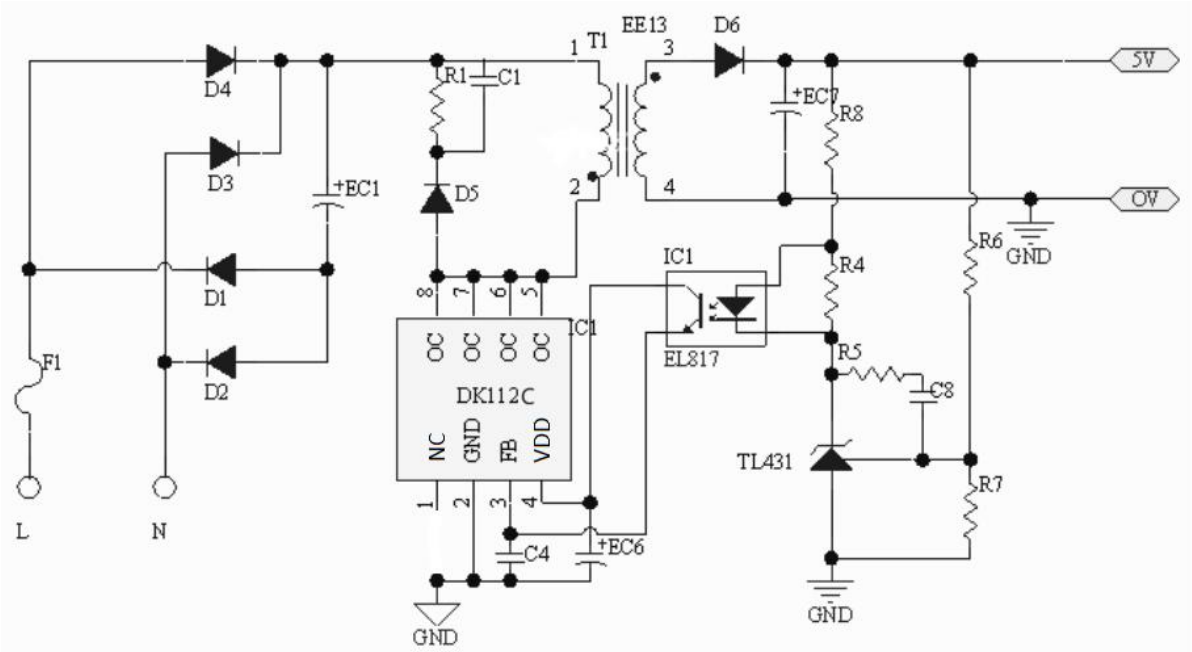
10. Secondary open circuit protection

When OC voltage >$V_{OC(prot)}$ is detected, immediately turn off the PWM output and enter standby mode until OC voltage <$V_{OC(prot)}$.

11. Exception protection mode

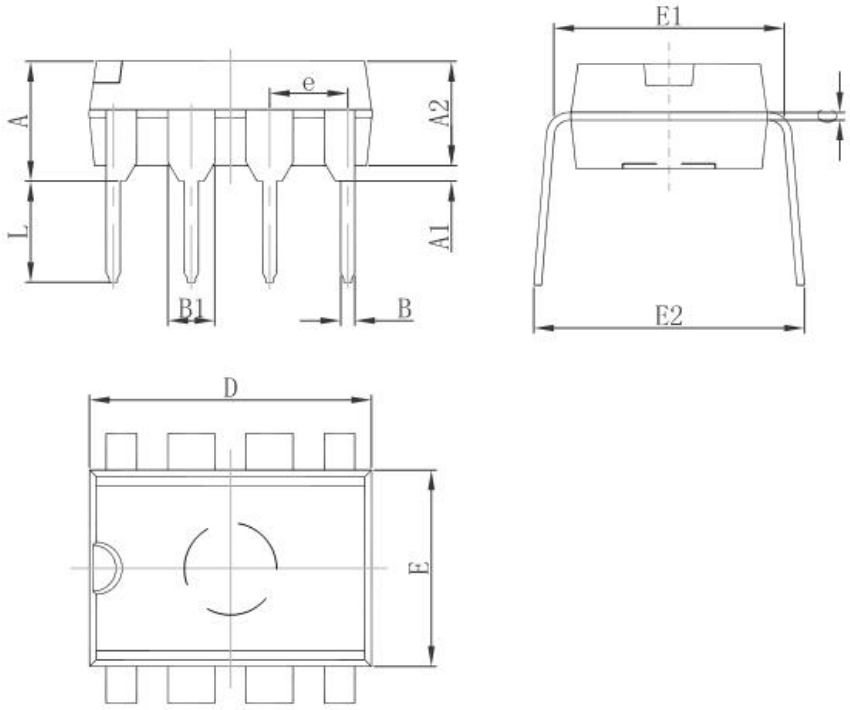
After the IC enters the abnormal protection mode (stop=1), the PWM output is turned off and the $t_{(stop)}$ timer is started. Within $t_{(stop)}$, the VDD voltage drops and maintains $V_{DD(ps)}$, and after $t_{(stop)}$, the IC ends the abnormal state.

Typical Application Circuit Diagram



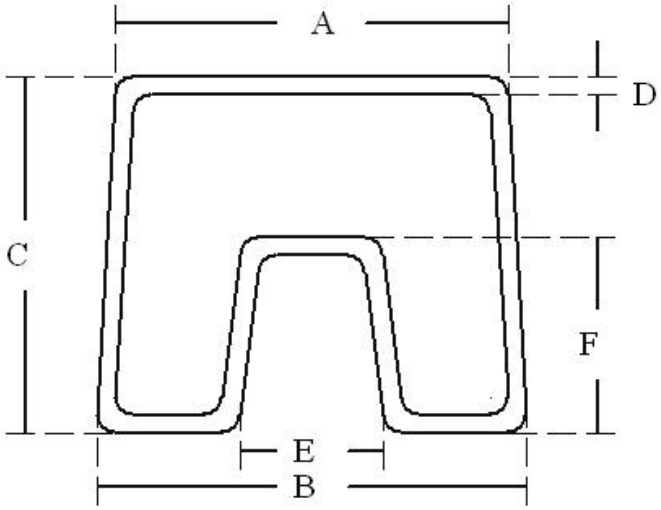
Package and Packing Information

1. DIP-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	4.310	0.146	0.170
A1	0.510		0.020	
A2	3.200	3.600	0.126	0.142
B	0.380	0.570	0.015	0.022
B1	1.524(BSC)		0.060(BSC)	
C	0.204	0.360	0.008	0.014
D	9.000	9.400	0.354	0.370
E	6.200	6.600	0.244	0.260
E1	7.320	7.920	0.288	0.312
e	2.540(BSC)		0.100(BSC)	
L	3.000	3.600	0.118	0.142
E2	8.400	9.200	0.331	0.354

2. Packaging specification：



Symbol	Dimensions In Milimeters		
	Min	Rated Value	Max
A	11.00	11.50	12.00
B	11.50	12.00	12.50
C	10.00	10.50	11.00
D	0.40	0.50	0.60
E	3.50	4.00	4.50
F	5.00	5.50	5.10

QTY/transistor	QTY/inner carton	QTY/master carton
50	2000	20000

Caution: This product is a static sensitive component, please pay a attention to protect! The scope of ESD damage can be extended from minor performance to equipment failure. Precision IC may be damaged, which may result in component parameters not meeting the published specifications.

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