DK 3113 low power offline switching power supply control chip

•Main features

l **Input voltage** 85V to 265V **full voltage range**

l **Built-in** 700V **power tube**

l**Built** -in self-powered circuit (patent), no auxiliary winding power supply required

l **Integrated self-starting circuit**

l **Current mode** PWM **control**

l VCC **operating voltage range** 4V to 6V

l 65Khz **switching frequency**

l **Automatically enters skip cycle mode when light load**

l **Over temperature, over current, over voltage and over load protection**

l **Standby power consumption is less than** 0.3W

l **Frequency jitter reduces** EMI **filtering costs**

•Application areas

l AC/DC **power adapter**

l DVD/VCD **power supply**

l **Air conditioning power supply**

l **Induction cooker power supply**

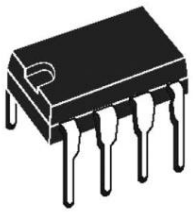
LED power supply

Set-top box power supply

Power range

Input voltage (ac) 85~265V		85~145V	180~265V
Maximum output power 15W		15W	18W

•Package and pin definition



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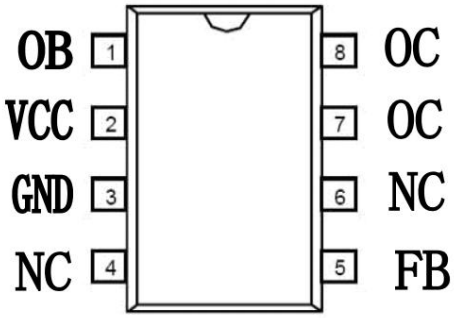


Pin Symbol	Function Description
1	OB **is the power-on start pin. There is a start-up circuit inside that is connected to the high-voltage** OC **pin. This pin is left floating.**
2	VCC **power supply pin, externally connect a** 10UF~100UF **energy storage capacitor to ground.**
3	GND **Ground pin.**
4	NC: **Empty pin, no electrical connection inside.**
5	FB **feedback control terminal pin, connect 1nF~10nF capacitor to ground, and optocoupler to ground to control output.**
6	NC: **Empty pin, no electrical connection inside.**
7,8	OC **output pin, connected to the high-voltage power tube inside the chip, and connected to the switching transformer externally.**

•Limit parameters

Supply voltage Vcc ..... -0.3V--8V

Supply current Vcc 100mA

Pin voltage..... -0.3V--Vcc+0.3V

Power tube withstand voltage..... -0.3V--730V

Power tube current..... 1.5A

Peak current..... ...

Total power dissipation..... ...

Operating temperature..... -20 C--+125 C

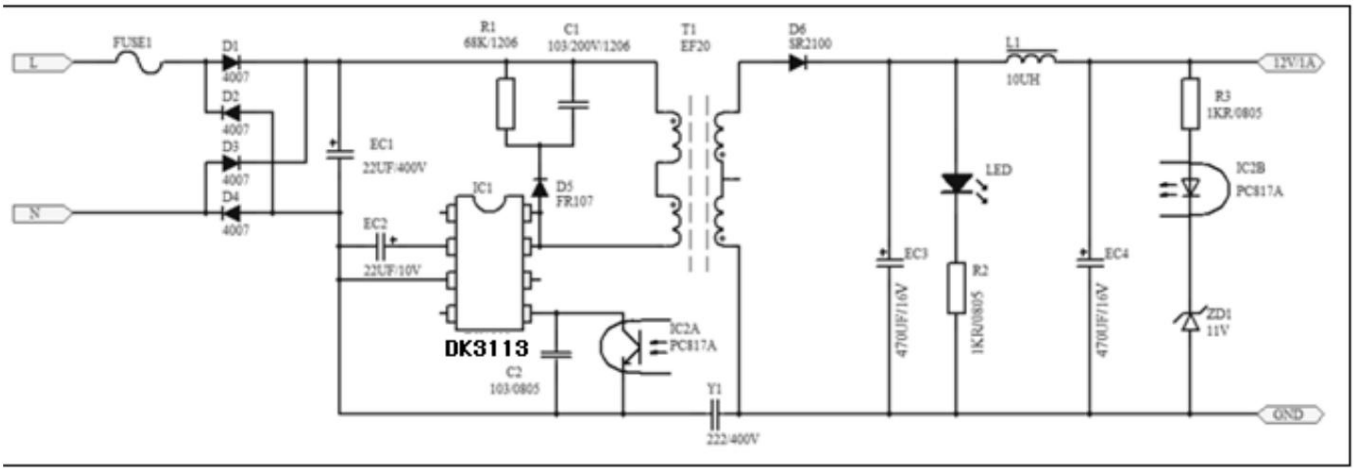
Storage temperature..... -55 C--+150 C

Soldering temperature..... +280 C/5S

•Electrical parameters

project	Test conditions	Min.	Typ.	Max.	Unit
Power supply voltage Vcc	AC **input** 85V------265V	4	5	6	V
Startup voltage Vcc	AC **input** 85V------265V	4.8	5	5.2	V
Shutdown voltage Vcc	AC **input** 85V------265V	3.6	4	4.2	V
Supply Current	Vcc=5VÿFb=2.2V	10	20	30	mA
Startup time	AC **input** 85V	--	--	500	mS
OC **protection voltage**	L=1.2mH	460	480	500	V
Power tube withstand voltage	Ioc=1mA	700	--	--	V
Maximum current of power tube	Vcc=5VÿFb=1.6V---3.6V	600	660	700	mA
Peak current protection	Vcc=5VÿFb=1.6V---3.6V	650	720	800	mA
Swing frequency	Vcc=5VÿFb=1.6V---2.8V	50	65	70	Khz
Frequency conversion	Vcc=4.6VÿFb=2.8V---3.6V	0.05	--	65	Khz
Frequency jitter stepping	Vcc=4.6VÿFb=1.6V---2.8V	0.8	1	1.2	Khz
Temperature protection	Vcc=4.6VÿFb=1.6V---3.6V	120	125	130	C
PWM **Duty Cycle**	Vcc=4.6VÿFb=1.6V---3.6V	5	--	75	%
Control voltage Fb	AC **input** 85V------265V	1.6	--	3.6	V

•Typical application circuit (12V/1A output offline flyback switching power supply)



ÿ **Component list in the application diagram**

No.	Component Name	Specification/Model	Position No.	quantity	Remark
1	**Fuse** F2A/AC250V		F1	1	
2	**diodes**	IN4007	D1~D4	4	
3	**diodes**	FR107	D5	1	
4	**diodes**	SR2100	D6	1	
5	**LEDs red**		LED	1	
6	**voltage regulator diodes**	11V/0.5W	ZD1	1	
7	**electrolytic capacitor**	22uF/400V	EC1	1	
8	**electrolytic capacitors**	22uF/10V	EC2	1	
9	**electrolytic capacitor**	470uF/16V	EC3,EC4	1	
10	**ceramic capacitors**	103/200V	C1	1	
11	**Ceramic capacitor**	103/25V	C2	1	
12	Y **capacitor**	222/400V	Y1	1	
13	**I-shaped inductor**	10uH	L1	1	
14	IC	DK3113	IC1	1	
15	**Optocoupler**	PC817	IC2	1	
16	**Resistors**	100K/0.25W	R1	1	
17	**Resistors**	1K/0.125W	R2,R3	2	
18	**Transformer**	EF20	T1	1	

ÿ **Transformer design (for reference only)**

2.1. Parameter

Determination When designing a transformer, some parameters need to be determined first: (1) **Input voltage range:** AC85V~265V (2) Output voltage and current: DC12V/1A (3) Switching frequency: Freq=65Khz (4) **Maximum duty cycle: D=0.5 2.2. Selection of magnetic core**

First calculate the input power of the power supply P=Pout/h *(h* **refers to the efficiency of the switching power supply, set to** 0.8), **and** Pout=Vout*Iout=12V*1A=12W, that is, **P=12W/0.8=15W. We can choose from the chart provided by the core manufacturer, or by calculation. We can choose from the chart to choose** EE20 **or** EF20 cores for a 15W **power supply . Here we choose** EE25 **core for the next step of calculation.**

2.3. Calculate the primary voltage Vs

The input voltage is AC85V~265V. Calculate the maximum power at the lowest voltage. When the lowest voltage is 85V ,

Vs =85*1.3=110V **(taking into account line voltage drop and rectification voltage drop).**

2.4. Calculate PWM **on-time**

Ton =(1/F)*D=(1/65)*0.5=7.7uS

2.5. Calculate the number of turns *Np* of the primary side

$$E.g \quad \frac{Vs\ Ton}{Bac\ Ae} \quad \frac{110\ 7.7}{0.25\ 34} \quad 99.6\ 100\ \text{turns}$$

Np ----------Number of primary turns

Vs ----------Primary DC voltage (minimum voltage value)

Ton ----------Conduction time

Bac ---------- Alternating working magnetic flux density (mT), set to 0.25

Ae ----------Core effective area (mm) , EF20 **core is** 34m ^{2} 2 *m*

2.6. Calculate the number of secondary turns *Ns*

$$Ns \quad \frac{Vout\ Np}{Before} \quad \frac{13\ 100}{100} \quad 13\ \text{turns}$$

Ns ----------Number of secondary turns

Vout ----------Output voltage (including line voltage drop and fast flow tube voltage drop, 12V+1V=13V)

Vor ----------Flyback voltage (Set this voltage no higher than **120V to avoid overvoltage damage to the chip.**

(set to 100V in the calculation)

2.7. Calculate the primary inductance L_p

$$L_p \quad \frac{V_s T_{on}}{I_p} \quad \frac{110\ 7.7}{720} \quad 1.2\,mH$$

L_p **……..Primary inductance**

I_p **……..Primary peak current (the chip sets the maximum peak current to** 720mA)

2.8 Transformer leakage inductance

Since the transformer is not an ideal device, leakage inductance will definitely exist during the manufacturing process. Leakage inductance will affect the stability and safety of the product. Therefore, in order to reduce leakage inductance, the sandwich winding method can reduce leakage inductance.

•Design considerations

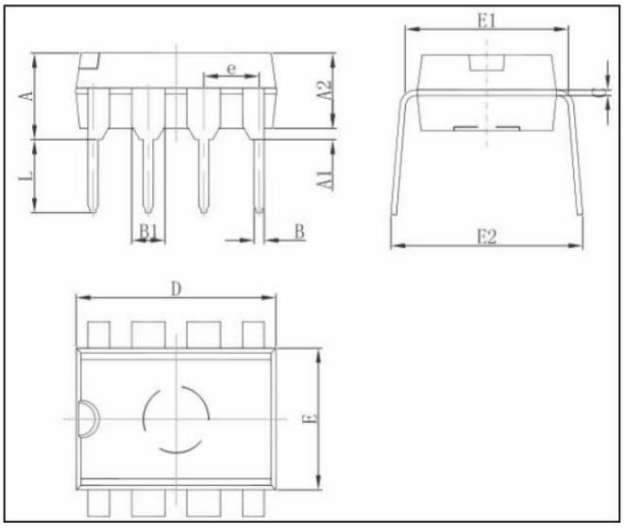
1. Power devices need to dissipate heat. The main heat of the chip comes from the power tube. The power tube is connected to pins 7 and 8 , so when PCB **wiring,**

The copper foil area of **pins** 7 and 8 **is enlarged and tinned to increase the heat dissipation capacity. 2.** Pins 7 and 8 of the chip **are the high-voltage part of the chip, and the maximum voltage can reach** more than 600V , **so the circuit layout must be ensured to be consistent with the low-voltage part.**

A safety distance of more than 1.5mm **is required to avoid circuit breakdown and discharge.**

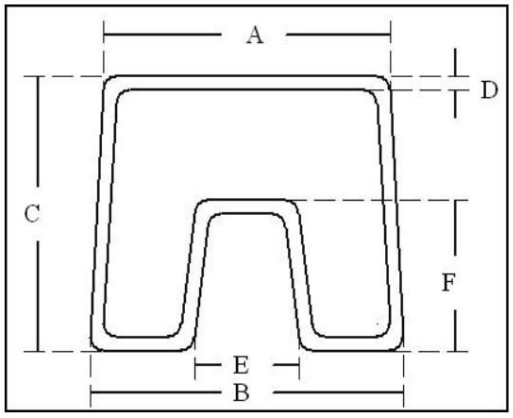
•Package size

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	9.000	0.331	0.354



•Packing information

1. The chip is packaged in anti-static tubes:



generation / Number	Minimum (mm)	Rating (mm)	Maximum (mm)
A	11	11.5	12
B	11.5	12	12.5
C	10	10.5	11
D	0.4	0.5	0.6
AND	3.5	4	4.5
F	5	5.5	6

2. Packing quantity:

Package	quantity
Single tube	50
Single packing box	2000
Large packaging box	20000