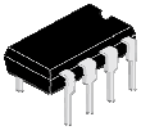
OFF-LINE SWITCH MODE POWER CONTROLLER

CD421P



DIP-8

DIP-8 Leaded
Plastic Package
RoHS compliant

1. General Description

The CD421P IC is specially design for off-line switch mode power supply, maximum power is 24W. Different from PWM controller and external power separated MOS combination design, the PWM controller, 700V power transistor, and high voltage starting circuit are integrated into his CD421P IC. So that to save external circuit, component use and cost. Also size and weight of the product is reduced. It is specially suitable for price sensitive flyback switch mode power supply.

2. Features

1. 85V—265V wide range AC power input.
2. Build-in 700V power transistor.
3. Internal integrated high voltage starting circuit, no need for additional resistance.
4. Internal 16mS soft-start circuit.
5. Internal power compensation circuit to keep the stability of max. output power in both high and low voltage.
6. Patent dynamic self-power supply, no need for auxiliary winding.
7. Internal frequency modulation circuit to reduce EMI filter cost.
8. Over current, Over loading, Over temperature, Over voltage and Short circuit Protection.

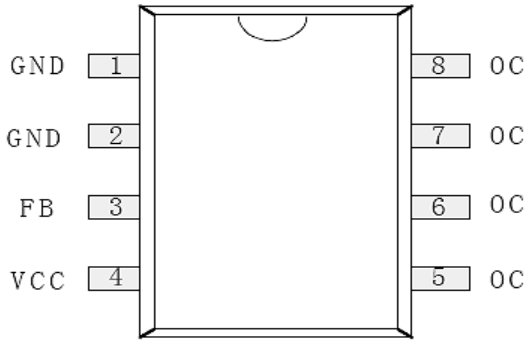
3. Applications

1. Battery charger
2. DVD/VCD/VCR power supply
3. Power AC/DC adapters
4. Air conditioner power supply
5. STB power supply ·
6. LED driver applications
7· Electromagnetic oven power supply
8. TV/Monitor power supply

4. Power Range

Input Voltage	85-264V AC	85-145V AC	180-264V AC
Max. output power	12W	18W	18W

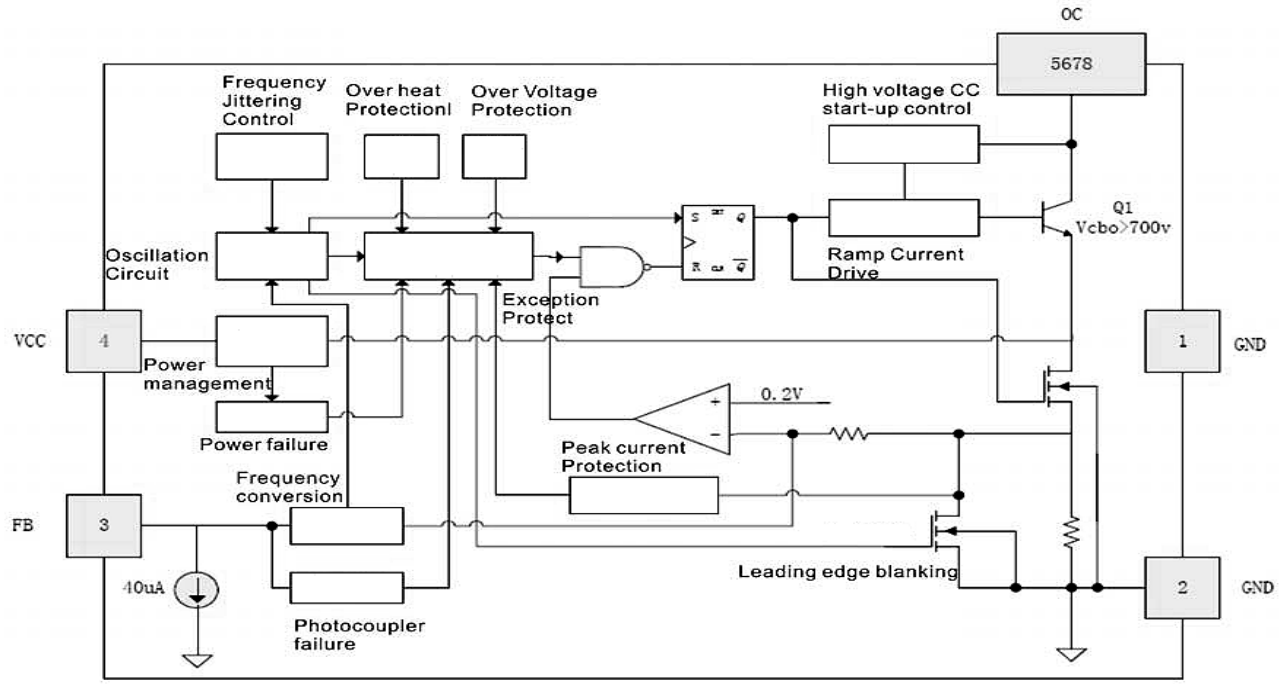
5. Pins Description



6. Pins Functions

Pin No.	Pin Name	Description
1,2	GND	Ground reference of IC
3	FB	Feedback control pin
4	Vcc	Power supply of the control
5,6,7,8	Collector	Output pin of power transistor

7. Block Diagram



8. ABSOLUTE MAXIMUM RATINGS (Ta = 25 ℃ Unless otherwise specified)

Parameters	Symbol	Value	Unit
Supply voltage	Vcc	-0.3V ~ 8	V
Current of supply voltage	Ivcc	100	mA
Pin voltage	Vpin	-0.3 Vcc +0.3	V
Collector to GND voltage	Vcol	-0.3 ~ 780	V
Peak current	Ip	1.5	A
Dissipation power	Pd	1	W
Case operating temperature	Tc	-20 ~ +140	ºC
Storage temperature	Tstg	-55 ~ 150	ºC
Soldering temperature	Tsol	280	ºC/5S

9. Electrical Characteristics(V_{DD}=15V, T_A=25℃, unless otherwise specified)

Parameter	Test condition	Value			Unit
		Min.	Typ.	Max	
Vcc (Work Power Supply)	AC input: 85V-265V	4.65	4.95	5.25	V
Start threshold Voltage	AC input: 85V-265V	4.75	5.05	5.35	V
Stop threshold Voltage	AC input: 85V-265V	3.30	3.60	3.90	V
Protect Voltage of VCC	AC input: 85V-265V	6.25	6.55	6.85	V
Current of Vcc	Vcc=5V, Fb=1.5V	--	--	50	mA
High voltage start current	AC input: 85V-265V	0.30	0.60	1.20	mA
Start time	AC input: 85V	--	--	500	mS
BJT Voc Breakdown voltage	Ioc=1mA	700	--	--	V
Collector Protection Voltage	Check OC voltage	540	600	660	V
Peak Current Protection	Vcc=5V, Fb=1.5V ~ 2.8V	1100	1300	1500	mA
PWM Output frequency	Vcc=5V, Fb=1.5V ~ 2.5V	61	65	69	KHz
	Vcc=5V, Fb=2.5V ~ 2.8V	20	22	24	
Stepped Frenquency	Vcc=5V, Fb=1.5V ~ 2.5V	--	0.5	--	KHz
Short circuit protection threshold	Tested FB voltage	1.15	1.33	1.50	V
Frequency conversion threshold voltage	Tested FB voltage	2.30	2.70	2.70	V
Burst mode threshold	Tested FB voltage	2.60	2.80	3.00	V
Temperature protection	junction temperature	120	130	140	℃
Leading edge blanking time	Vcc=5V, Fb=1.5V ~ 2.5V	--	250	--	nS
Min. turn-on time	Vcc=5V, Fb=2.6V	--	500	--	nS
Duty cycle of PWM	Vcc=5V, Fb=1.5V ~ 2.5V	5	--	70	%
Standby power loss	Vcc=5V, Fb=1.5V ~ 2.5V	--	240	--	mW

10. OPERATION PRINCIPLE

10.1. Start Up

When power on, external VCC capacitor is charged by internal high voltage constant current coming for internal connected OC and VCC pins. When VCC voltage comes up to 5V, starting up finishes, the circuit enters into normal working mode and outputs PWM.

10.2 Soft-start

As to protect the transistor and secondary commutator tube, there is a 16 mS soft start-up circuit in the IC. In the 16mS, it the PWM starting up time is increased step by step, so that the peak current of resistor increased linearly from 100mA to peak current.

10.3 Self-Power Supply Circuit (National patent owned)

There is self-power supply circuit inside the IC, which can control the power voltage about 5V for the electricity consumption of the IC itself. It can only afford the electricity consumption of itself only but can not afford for the external circuit

10.4 Frequency Jittering Circuit

By sweeping the switching frequency around its nominal value 65KHz, it spreads the energy content on adjacent frequencies rather then keeping it centered in one single ray. This offers the benefit to artificially reduce the measurement noise on a standard EMI/EMC receiver and pass the tests more easily.

10.5 Over Temperature Protection (OTP)

When the controller detects the device temperature exceeds 130℃, OTP is activated. It stops the switching operation immediately and enters into the stop status. The controller will restart to switching operation when the temperature falls down.

10.6 Over Current Protection (OCP)

Whenever the collector current (Ip) abnormally exceeds the maximum current limit of 1.3A, the controller would stop operation and enters into stop status.

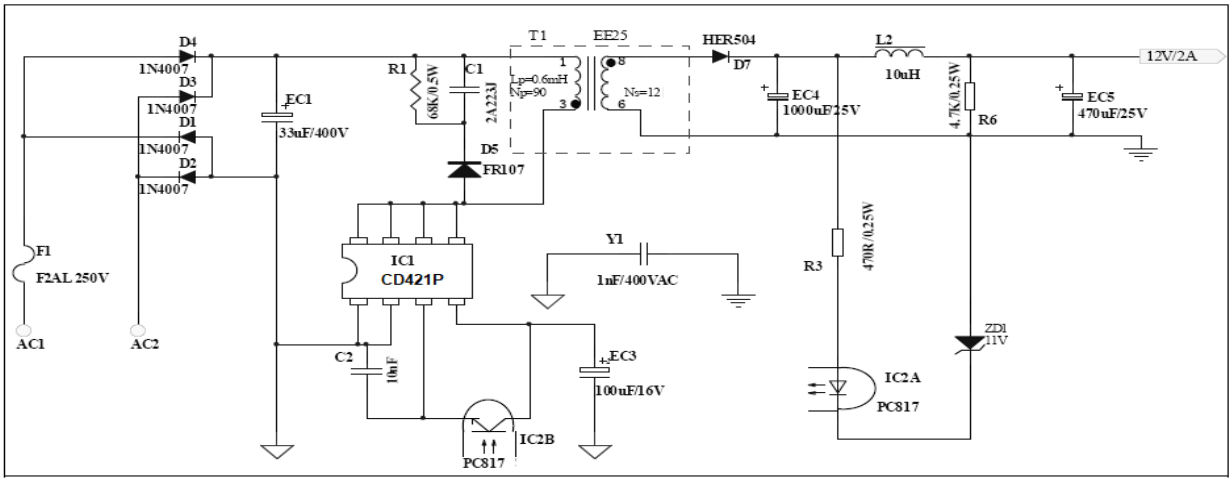
10.7 Abnormal Voltage Protection

Whenever the power voltage (Vcc) abnormally exceeds 6.5V and drops under 3.6V, the controller would stop operation and enters into stop status until the voltage comes back to normal.

10.8 Over Collector Voltage Protection

Whenever the voltage of the collector pin exceeds the limit of 600V, the controller will decrease the power output to make sure the collector pin coming back to normal. It could reduce the stress of the power transistor and the protect power transistor from avalanche damage.

11. Typical Schematic Diagram (12V2A)



12. Bill of Materials

Sl. NO.	Description	Circuit Code	Qty
1	Fuse F2A/AC250V	F1	1
2	Diode IN4007	D1 ~ D4	4
3	Diode FR107	D5	1
4	Diode HER504	D7	1
5	Elco. 100uF/16V	EC3	1
6	Elco. 1000uF/25V	EC4	1
7	Elco. 470uF/25V	EC5	1
8	Elco. 33uF/400V	EC1	1
9	Capacitor 2A223J	C1	1
10	Cera. capacitor 10nF/50V	C2	1
11	Y capacitor 1nF/400V	Y1	1
12	Resistance 68K/0.5W ± 10%	R1	1
13	Resistance 470R/0.25W ± 10%	R3	1
14	Resistance 4.7K/0.25W ± 10%	R6	1
15	Zener 11V/1W	ZD1	1
16	Drum core Inductance 10uH	L2	1
17	IC CD421P DIP-8	IC1	1
18	Photo-coupler PC817	IC2	1
19	Transformer EE25	T1	1

Notes:

1. Heat dissipation: A good estimate is that the controller will dissipate the output power. So enough cooper area connected to the 5, 6, 7, 8 COLLECTED pins and tin-plating are necessary to provide the controller heat sink.
2. The 5, 6, 7, 8 COLLECTED pins is high voltage part of the IC, peak voltage is as high as 600V, so it should be at least 1.5mm far away from the low voltage part in the PCB as to avoid circuit breakdown and discharging.
3. Pin No.1 is for testing only. It is prohibited to be connected with other circuits when in use

13. TRANSFORMER DESIGN (for ref. only)

13.1. Parameter confirmation: confirm the below parameter before transformer design

1. Input voltage range (for example :AC85V-265V)
2. Output Voltage and current (for example DC12V 2A)
3. Switching frequency (for example F=65KHz)
4. MAX. duty cycle (for example D=0.5)

13.2. Core selecting

13.2.1. Input power calculation

P=Pout/ η (η is the efficiency of the power supply, take it 0.8 for example), Pout=Vout*Iout=12V*2A=24W, P=24/0.8=30W.

13.2.2. Choose the core:

Checking via supplier or the correlative chart can know that EE25 or EE19 core is suitable for 30W power supply. Now we choose EE25 for below calculation.

13.2.3. Input voltage setting

Input voltage is AC85V-265V, as to get the MAX. power value according to the lowest voltage and take the voltage loss(from wires and rectification) into consideration, Vs=85*1.3=110V

13.2.4. Conduction time

Ton=1/F*D=1/65*0.5=7.7μS

13.2.5. Number of the original(input) turns (Np)

$$N_P = \frac{L_P * I_P\,\max}{\Delta B * Ae} = \frac{0.53*1.32}{0.2*0.04} \approx 90$$

Where:

ΔB : Alternating working magnetic flux density (mT), set to be 0.2

Ae : Core effective area (m m²), EE25/19's Ae is 40 mm²

13.2.6. Number of the output turns (Ns)

Ns=(Vout*Np)/Vor=（13*90）/80 ≈ 15

Where:

Vout :Output voltage=12V+1V=13V, take the voltage loss (from wires and rectification) into consideration.

Vor :Flyback voltage=80V, set it lower then 150V for the safety of IC.

13.2.7. Input inductance value (Lp)

$$Lp = \frac{2*Pi}{Ip*Ip*Fs} = \frac{2*30W}{1.32A*1.32A*65K} = 0.53mH$$

Where:

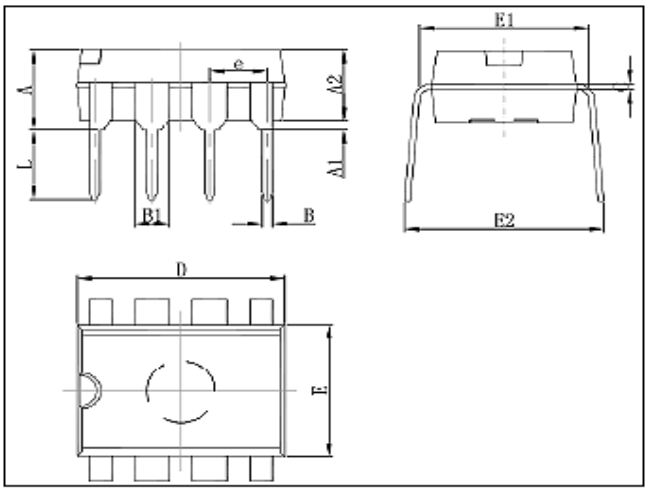
Ip : Input peak current (it is set to be 1.32A in the IC)

14. Ordering and Marking Information

Part number	Package	Marking
CD421P	DIP-8	CD421P

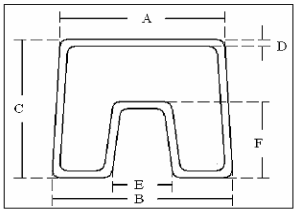
15. Package Details

DIP-8 Leaded Plastic Package



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

16. Anti-static tube packing



All dimensions are in mm

Symbol	Value		
	Min.	Typ.	Max.
A	11	11.5	12
B	11.5	12	12.5
C	10	10.5	11
D	0.4	0.5	0.6
E	3.5	4	4.5
F	5	5.5	6

17. Packing quantity

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

Recommended Product Storage Environment for Semiconductor Devices

This storage environment assumes that the Semiconductor devices are packed properly inside the original packing supplied by CDIL.

- Temperature 5 °C to 30 °C
- Humidity between 40 to 70 %RH
- Air should be clean.
- Avoid harmful gas or dust.
- Avoid outdoor exposure or storage in areas subject to rain or water spraying .
- Avoid storage in areas subject to corrosive gas or dust. Product shall not be stored in areas exposed to direct sunlight.
- Avoid rapid change of temperature.
- Avoid condensation.
- Mechanical stress such as vibration and impact shall be avoided.
- The product shall not be placed directly on the floor.
- The product shall be stored on a plane area. They should not be turned upside down. They should not be placed against the wall.

Shelf Life of CDIL Products

The shelf life of products is the period from product manufacture to shipment to customers. The product can be unconditionally shipped within this period. The period is defined as 2 years.
If products are stored longer than the shelf life of 2 years the products shall be subjected to quality check as per CDIL quality procedure.
The products are further warranted for another one year after the date of shipment subject to the above conditions in CDIL original packing.

Floor Life of CDIL Products and MSL Level

When the products are opened from the original packing, the floor life will start.
For this, the following JEDEC table may be referred:

JEDEC MSL Level		
Level	**Time**	**Condition**
1	Unlimited	≤30 °C / 85% RH
2	1 Year	≤30 °C / 60% RH
2a	4 Weeks	≤30 °C / 60% RH
3	168 Hours	≤30 °C / 60% RH
4	72 Hours	≤30 °C / 60% RH
5	48 Hours	≤30 °C / 60% RH
5a	24 Hours	≤30 °C / 60% RH
6	Time on Label(TOL)	≤30 °C / 60% RH

Customer Notes

Component Disposal Instructions

1. CDIL Semiconductor Devices are RoHS compliant, customers are requested to please dispose as per prevailing Environmental Legislation of their Country.
2. In Europe, please dispose as per EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE).

Disclaimer

The product information and the selection guides facilitate selection of the CDIL's Semiconductor Device(s) best suited for application in your product(s) as per your requirement. It is recommended that you completely review our Data Sheet(s) so as to confirm that the Device(s) meet functionality parameters for your application. The information furnished in the Data Sheet and on the CDIL Web Site/CD are believed to be accurate and reliable. CDIL however, does not assume responsibility for inaccuracies or incomplete information. Furthermore, CDIL does not assume liability whatsoever, arising out of the application or use of any CDIL product; neither does it convey any license under its patent rights nor rights of others. These products are not designed for use in life saving/support appliances or systems. CDIL customers selling these products (either as individual Semiconductor Devices or incorporated in their end products), in any life saving/support appliances or systems or applications do so at their own risk and CDIL will not be responsible for any damages resulting from such sale(s).
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