High Performance Non-isolated PFM converters

General Description

The PN8046 consists of an integrated Pulse Frequency Modulator (PFM) controller and power MOSFET，specifically designed for small power non-isolated switching power supply. PN8046 has internal high voltage start-up circuit and complete intelligent protections including Over Load Protection (OLP), Under Voltage Lockout (UVLO) and Over Temperature Protection (OTP). Excellent EMI performance could be achieved with Pulse Frequency Modulation.

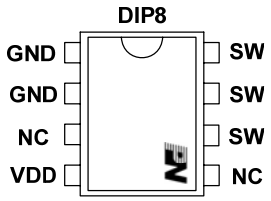
Features

- Internal 650V avalanche-rugged smart power VDMOSFET
- Internal HV Start-up Circuit
- Be optimized with 18V output non-isolated application
- Semi enclosed steady output power 9W @230VAC, DIP-8
- Frequency modulation for low EMI
- Excellent constant voltage regulation and High efficiency
- Excellent Protection Coverage:
  - ✧ Over Load Protection (OLP)
  - ✧ Over Temperature Protection（OTP）
  - ✧ Under Voltage Lockout（UVLO）

Applications

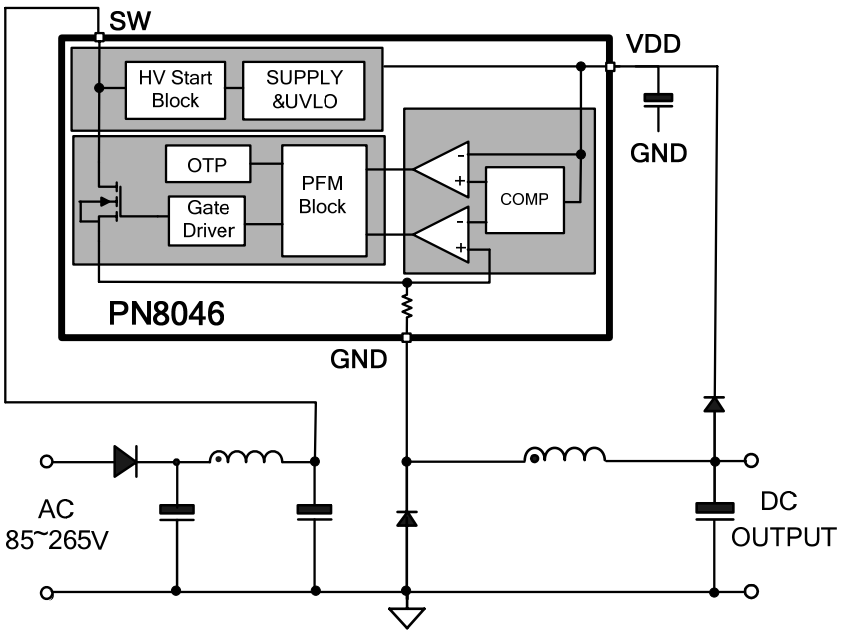
- non-isolated assistant power supply

Package/Order Information



Order Code	Package
PN8046NEC-T1	DIP-8

Typical Circuit



Pin Definitions

Pin Name	Pin Number	Pin Function Description
GND	1,2	Ground
NC	3	No connection
VDD	4	Positive Supply voltage Input.
NC	5	No connection
SW	6,7,8	HV MOSFET Drain pin.

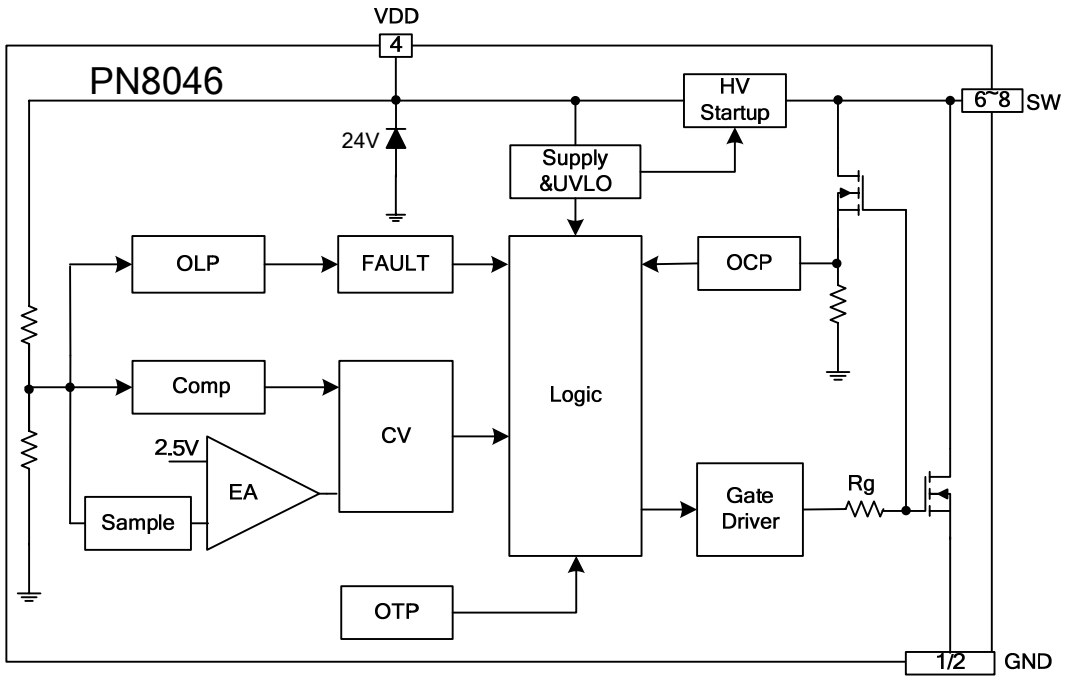
Typical Power

Part number	Input Voltage	Steady output power (1)	Peak Power(2)
PN8046	150-265 V_{AC}	9W(18V500mA)	12.6W(18V700mA)
	85-265 V_{AC}	7.2W(18V400mA)	10.8W(18V600mA)

Note:

1. Maximum output power in a semi enclosed design measured at 75°C ambient temperature, Duration:2 hours
2. Peak power in a semi enclosed design measured at 75°C ambient temperature, Duration:1 min

Block Diagram



Absolute Maximum Ratings

Supply voltage Pin VDD……-0.3~40V

High-Voltage Pin, SW……. -0.3~650V

Operating Junction Temperature……-40~150℃

Storage Temperature Range…… ….-55~150℃

Lead Temperature (Soldering, 10Secs)……...260℃

Package Thermal Resistance（DIP-8）…….40℃/W

HBM ESD Protection (1) ……..…….±6kV

ESD voltage Protection (2)……...……...8kV

Pulse Drain Current（T_{pulse}=100us）……..…..5A

Note：1.Test standard: ESDA/JEDEC JDS-001-2014.

2. Air discharge to pins of PN8046 with ESD Generator, Enterprise internal standards, for reference only.

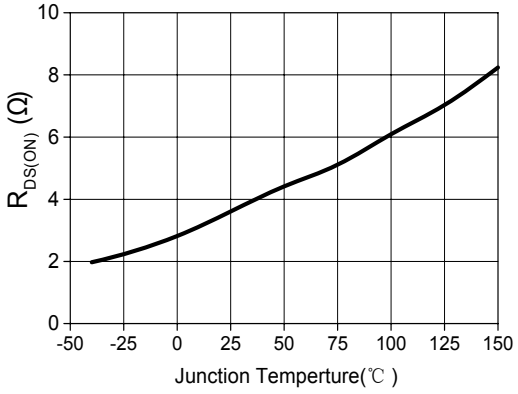
Electrical Characteristics

(T_A = 25°C, V_{DD} = 15 V, unless otherwise specified)

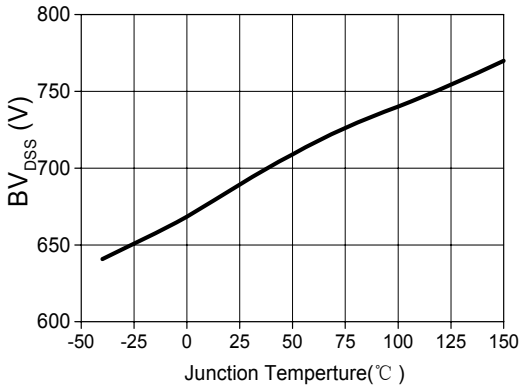
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Power Section						
Drain Break-down voltage	BVDSS	I_{SW} =250uA	650	690		V
Off-state drain current	I_{OFF}	V_{sw} =500V			100	μA
Drain-source on state resistance DIP-7	$R_{DS(on)}$	I_{sw} = 1A, T_J =25°C		3.6		Ω
Start up threshold	V_{SW_START}	V_{DD}=V_{DDon} - 1V		30		V
Supply Voltage Section						
VDD start up threshold	V_{DDon}		13.5	15	16.5	V
VDD under voltage shutdown threshold	V_{DDoff}		8.5	9.5	10.5	V
VDD voltage Hysteresis	V_{DDhys}			5		V
VDD clamp voltage	$V_{DDclamp}$		22	24	26	V
VDD feedback reference	V_{DD-REF}			18.3		V
Supply Current Section						
VDD charge current	I_{DDch}	Vsw=105V, V_{DD}=11V		-2		mA
Off-state current	I_{DD0}	V_{DD}=6V	0.3	0.6	0.9	mA
Operating supply current	I_{DD1}	V_{DD} =17V		2		mA
Current Sense Section						
Drain current limit	I_{limit}		0.92	1.1	1.28	A
Leading edge blanking time	T_{LEB}			300		ns
Feedback Input Section						
Minimum turn OFF time	T_{offmin}		15	18	21	μs
Minimum turn ON time	T_{onmax}			13		μs
Thermal Shutdown Section						
OTP threshold	T_{SD}		135	150		°C
OTP Protect Hysteresis	T_{HYST}			30		°C
Restart Protection Section						

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Restart time	$T_{RESTART}$	C_{VDD}=4.7μF		3		S

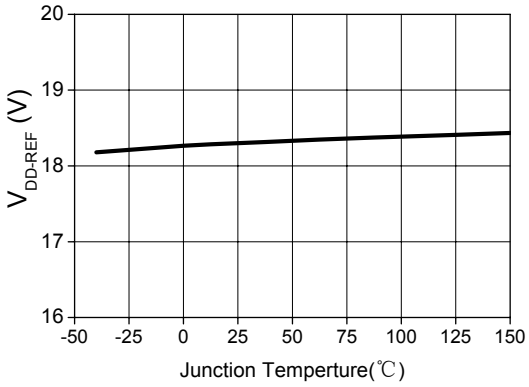
Typical Characteristics Plots



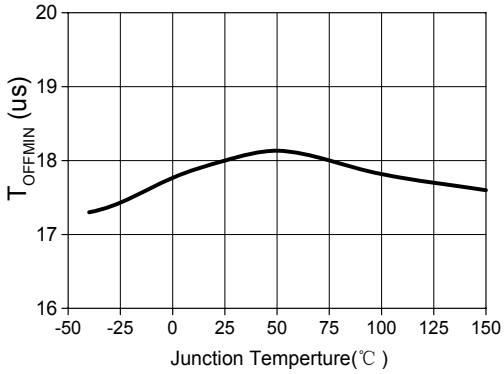
(a) $R_{DS(on)}$ vs T_j



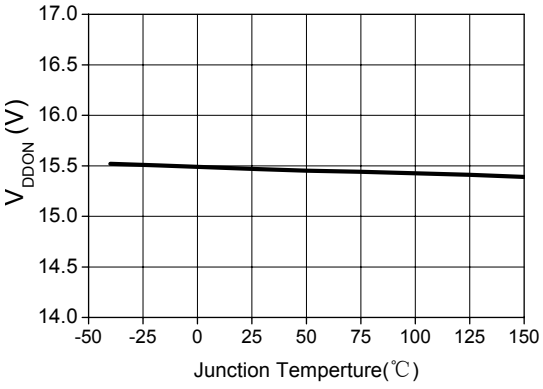
(b) BV_{DSS} vs T_j



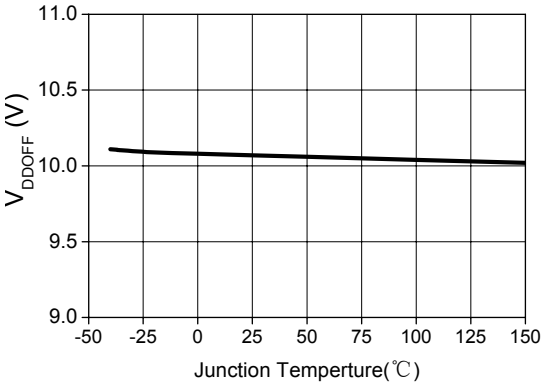
(c) V_{REF} vs T_j



(d) T_{offmin} vs T_j



(e) V_{DDon} vs T_j



(f) V_{DDoff} vs T_j

Functional Description

The PN8046 consists of an integrated Pulse Frequency Modulator (PFM) controller and power MOSFET, specifically designed for small power non-isolated switching power supply. PN8046 has internal high voltage start-up circuit and complete intelligent protections including Over Load Protection (OLP), Under Voltage Lockout (UVLO) and Over Temperature Protection (OTP). Excellent EMI performance could be achieved with Pulse Frequency Modulation.

1. Startup

At start up, the internal high-voltage current source supplies 2.0mA current to charges the external VDD capacitor. When VDD rises to V_{DDon}, PN8046 starts switching and the internal high-voltage current source stops charging the capacitor. After start up, the VDD voltage is supplied from output.

2. CV Operation Mode

In CV operation, PN8046 samples the feedback signal through VDD pin. While the feedback voltage remains below $V_{REF,}$ the IC turns on the integrated MOSFET. When the current of the inductor reaches the peak current limit (Ipeak), the integrated MOSFET is turned off. Figure1-1 and Figure 1-2 shows the operating waveform of key nodes in continuous conduction mode (CCM) and discontinuous conduction mode (DCM). Meanwhile, the IC integrates load compensation function to improve load regulation and CV accuracy.

In actual applications, VDD sampling voltage is affected by the forward drop of D2 in addition.

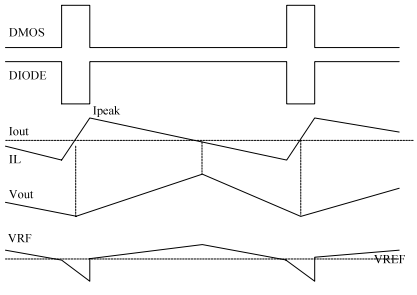


Figure 1-1 Waveform if CCM mode

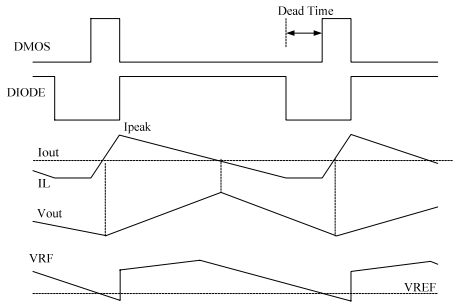


Figure 1-2 Waveform of DCM mode

3. PFM modulation

The IC operates in PFM mode, and Ipeak is set to decrease with the decrease of the IC operating frequency (Fsw).when the IC switching cycle increase 1us，Ipeak will decrease 12mA.As a result of the internal current sampling and the maximum current limit (I_{limit}), inductance is the only parameter of the frequency modulation when output voltage and output current are fixed.

4. Soft-Start up

In order to regulate peak current in deep CCM mode, PN8046 build in soft-start function, at the first 10ms of start up, the switching frequency decrease to 25% of the maximum frequency, while 10ms to 15ms of start up, the switching frequency decrease to 50% of the maximum frequency. Meanwhile, the leading edge blanking (LEB) is 300ns (Typ.), in order to regulate peak current.

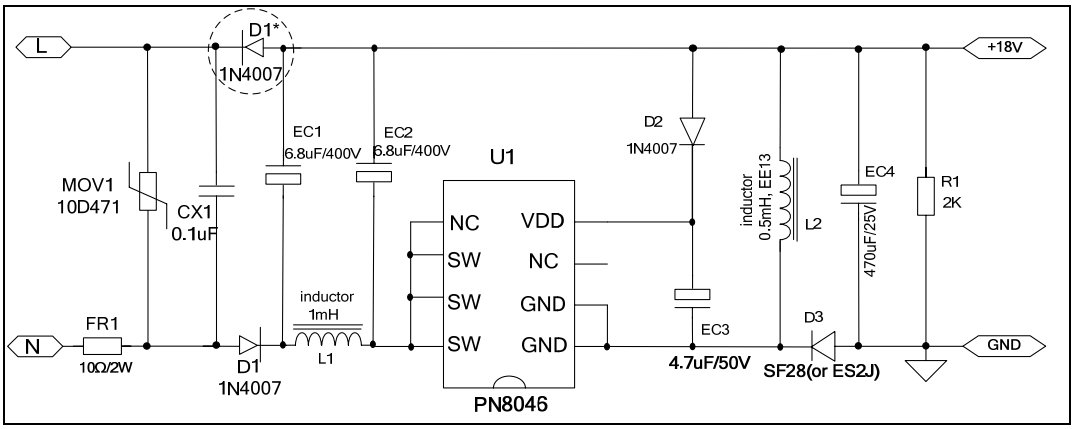
5. Smart Protection Control

PN8046 has several smart self-protection functions, such as Over Temperature Protection (OTP),VDD Under-Voltage Lockout (UVLO).And all these protections have self-recovery mode.

OTP----If the inner junction temperature exceeds 150℃,the IC will shut down switching, until the junction temperature falls to 120℃.

UVLO----If VDD pin Voltage drops below V_{DDoff}, the IC will restart. Otherwise, self-restart time can be changed by VDD capacitor. The larger the capacitor, the longer the self-restart time is.

Typical Application

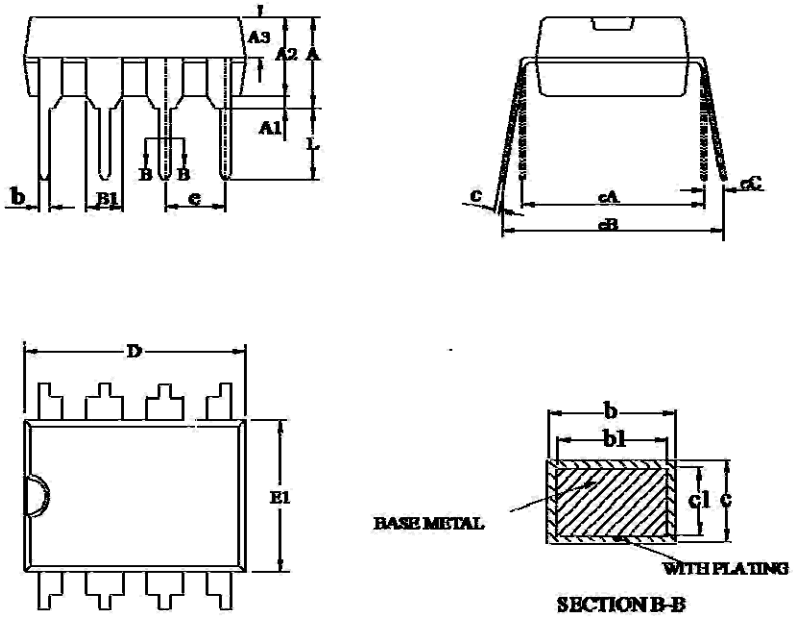


Component Parameter and Layout Considerations:

1. VDD capacitor EC3 should be placed at the nearest place from the VDD pin and the GND pin.

Package Information

DIP-8 Package Information



Size / symbol	Min.(mm)	Max.(mm)	Size / symbol	Min.(mm)	Max.(mm)
A	3.60	4.00	c1	0.23	0.27
A1	0.51	——	D	9.05	9.45
A2	3.00	3.40	E1	6.15	6.55
A3	1.55	1.65	e	2.54BSC	
b	0.44	0.53	e A	7.62BSC	
b1	0.43	0.48	e B	7.62	9.30
B1	1.52BSC		e C	0.00	0.84
c	0.24	0.32	L	3.00	——

TOP MARK	Package
PN8046 YWWXXXXX	DIP-8

Note: Y: Year Code; WW: Week Code; XXXXX: Internal Code

Notes:

1. This drawing is subjected to change without notice.
2. Body dimensions do not include mold flash or protrusion.

Important Notice

Wuxi Chipown Microelectronics Co. Ltd. reserves the right to make changes without further notice to any products or specifications herein. Wuxi Chipown Microelectronics Co. Ltd. does not assume any responsibility for use of any its products for any particular purpose, nor does Wuxi Chipown Microelectronics Co. Ltd assume any liability arising out of the application or use of any its products or circuits. Wuxi Chipown Microelectronics Co. Ltd does not convey any license under its patent rights or other rights nor the rights of others.