PN8015N

Chipown

Non-isolated Off-line PWM converters

General Description

The PN8015N consists of an integrated Pulse Width Modulator (PWM) controller and power MOSFET，specifically designed for small power non-isolated switching power supply. Variable output voltage could be adjusted by FB resistors. PN8015N has internal high voltage start-up and self-supply circuit, and complete intelligent protections including Cycle-by-Cycle current limiting (OCP), 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 800V avalanche-rugged smart power VDMOSFET
- Internal HV Start-up and Self-supply Circuit
- Supporting Buck, Buck-Boost and Flyback topologies
- Variable Output Voltage 3.3V~12V adjusted by FB resistors
- Semi enclosed steady output current >200mA @230VAC
- 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
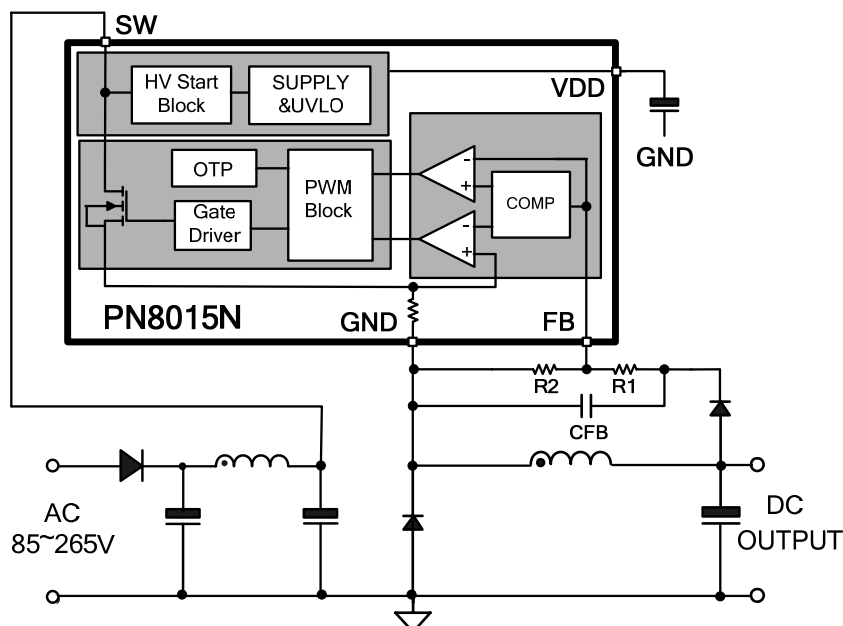
- Non-isolated standby power
- Household appliance
- Smart Home
- LED

Package/Order Information
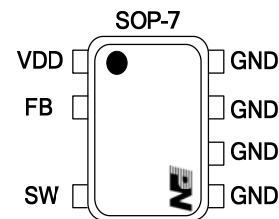
SOP-7

Order Code	Package
PN8015NSSC-R1	SOP-7

Typical Circuit

Pin Definitions

Table 1. Pin Definitions

Pin Number	Pin Name	Pin Function Description
1	VDD	VDD supply
2	FB	Output voltage feedback
3	SW	Drain of the internal MOSFET
4、5、6、7	GND	Ground

Typical Power

Table 2. Typical power

Part number	Input Voltage	Steady output power [1]	Peak Power[2]
PN8015N	**85-265 V_{AC}**	**1W(5V200mA)**	**1.5W(5V300mA)**

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

Absolute Maximum Ratings

VDD Pin………-0.3V to 40V

SW Pin………………………………………………………….……………………………..………………-0.3V to 750V

FB Pin………………………………………………………………………………………………….-0.3V to 7V

Junction Operating Temperature…………………………………………………………….……..…………..-40~150℃

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

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

Package Thermal Resistance (SOP-7)……………………….......................…………….………………………80℃/W

ESD Capability of HBM（ESDA/JEDEC JDS-001-2014）……………………………….……..…..………….. ±4kV

ESD Capability of air discharge [1] (Air discharge to pins with ESD Generator)………………...……..…………..……...8kV

Drain pulse current (T_{pulse}=100us)…………………………………………………….…....……….…..…..2A

Note: 1. Enterprise internal standards, for reference only.

Electrical Characteristics

Table 3. Power Supply Section (T_A =25°C, V_{DD} = 15V; unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
BVDSS	Drain Break-down voltage	I_{SW} =250uA	750	820		V
I_{OFF}	Off-state drain current	V_{sw} =500V			100	uA
$R_{DS(on)}$	VDMOS on state resistance	I_{SW} = 400mA, T_J =25°C		18		Ω
V_{SW_START}	Start up threshold	V_{DD}=V_{DDon} - 1V		30		V

Table 4. Supply Section (T_A =25°C, V_{DD} = 15V; unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
VDD VOLTAGE PARAMETER						
V_{DD}	Operating voltage range	After turn-on	10		17	V
V_{DDon}	VDD start up threshold		12	13.5	15	V
V_{DDoff}	VDD under voltage shutdown threshold		10	11	12	V
V_{DDhys}	VDD voltage Hysteresis			2.5		V
$V_{DDclamp}$	VDD clamp voltage		17	20	23	V
VDD CURRENT PARAMETER						
I_{DDch}	VDD charge current	V_{DD}=9V		-2.5		mA
I_{DD0}	Operating supply current, switching	V_{DD}=15V	220	330	450	uA
I_{DD1}	Operating supply current,	f_s=40KHz		500		uA
$I_{DDFAULT}$	Operating supply current, with protection tripping	V_{DD}=15V		150		uA

Table 5. Control Section (T_A =25°C, V_{DD} = 15V; unless otherwise specified)

| SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
CURRENT SENSE PARAMETER						
I_{limit}	Drain current limit		320	400	480	mA
T_{LEB}	Leading edge blanking time			300		ns
Feedback Input						
T_{offmin}	Minimum turn OFF time		15	18	21	us
T_{onmax}	Minimum turn ON time			13		us
V_{REF}	MOSFET feedback turn-on Reference Voltage		2.45	2.5	2.55	V
V_{REF_OLP}	OLP Reference Voltage		1.6	1.7	1.8	V
T_{OLP}	OLP delay Time			150		ms
Thermal Shutdown						
T_{SD}	OTP threshold		140	160		°C
T_{HYST}	OTP Protect Hysteresis			30		°C

Typical Characteristics Plots
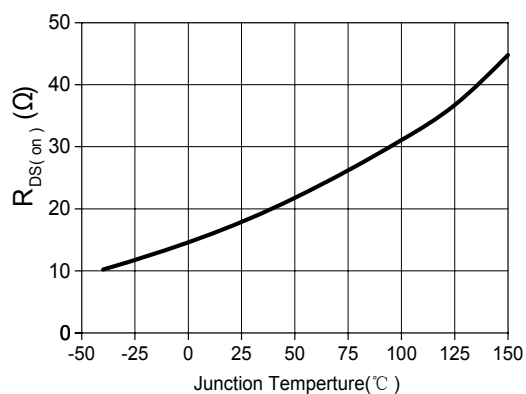
(a) $R_{DS(on)}$ vs T_j
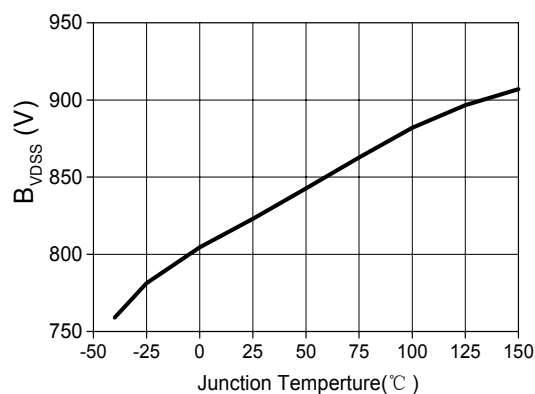
(b) B_{VDSS} vs T_j
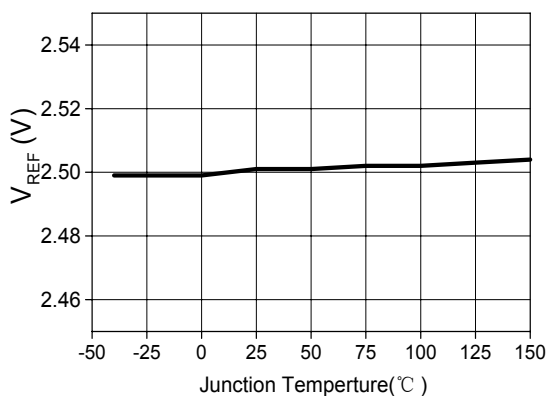
(c) V_{REF} vs T_j
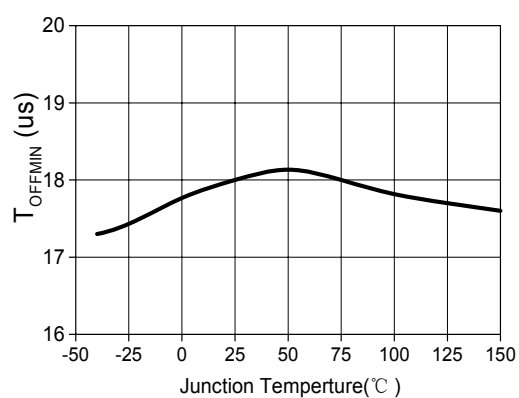
(d) T_{offmin} vs T_j
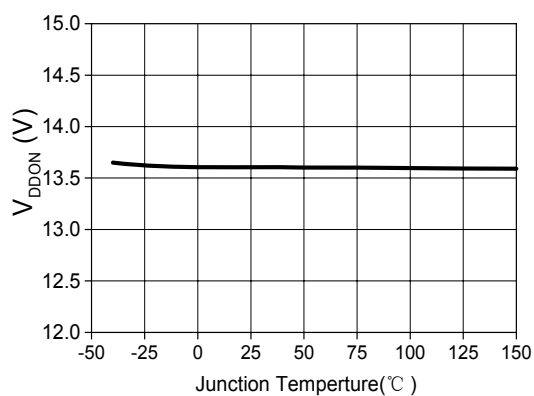
(e) V_{DDon} vs T_j
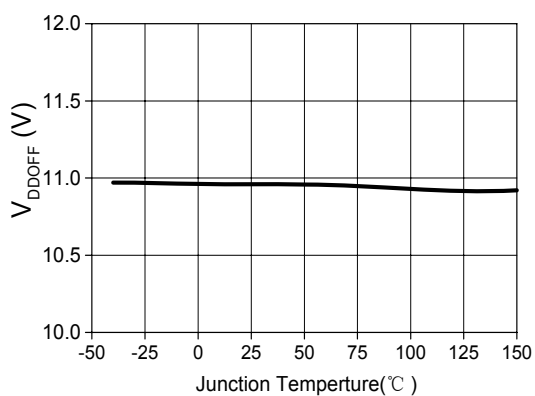
(f) V_{DDoff} vs T_j

Block Diagram
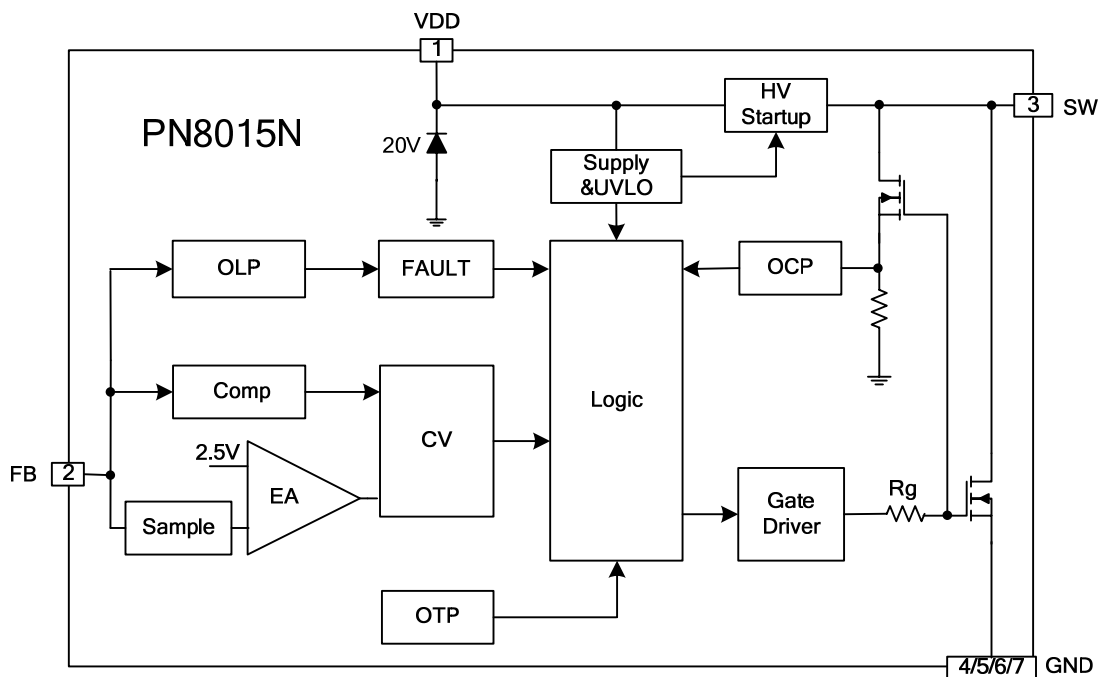
Typical Application
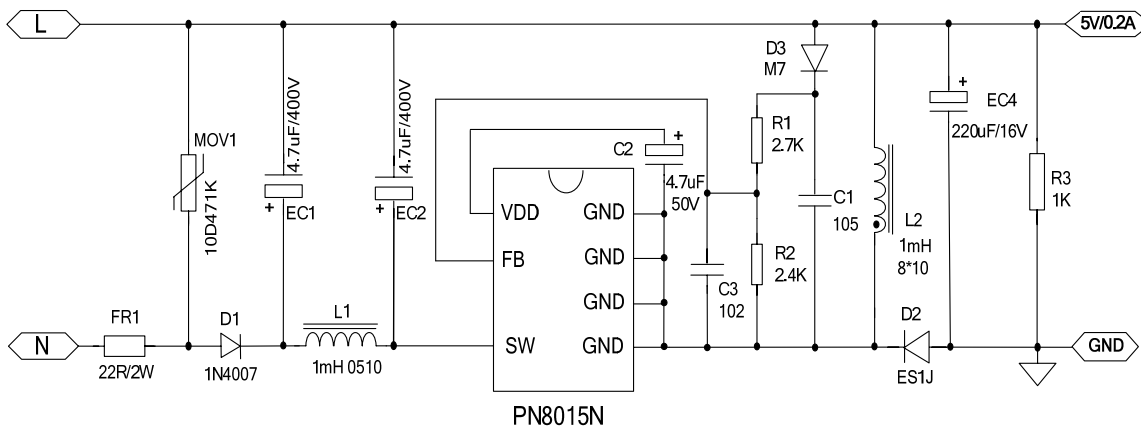
Functional Description

The PN8015N consists of an integrated Pulse Width Modulator (PWM) controller and power MOSFET, specifically designed for small power non-isolated switching power supply. PN8015N offers fully intelligentized protections including Cycle-by-Cycle current limiting (OCP), Over Load Protection (OLP), Under Voltage Lockout and Over Temperature Protection (OTP). Excellent EMI performance is achieved with Pulse Frequency Modulation. PN8015N also consists of the high voltage start-up circuit to ensure that start quickly.

1. Startup

At start up, the internal high-voltage current source supplies 2.5mA current to charges the external VDD capacitor. When VDD rises to V_{DDon}, PN8015N starts switching and the internal high-voltage current source stops charging the capacitor. When VDD drops to V_{DDoff}，PN8015N continues switching while the internal high-voltage current source returns to supplies 2.5mA current to charge the external VDD capacitor. The internal high-voltage regulator self-supplies the IC, so extra component is not needed for power supply.

2. CV Operation Mode

In CV operation, PN8015N samples the feedback signal through FB 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.
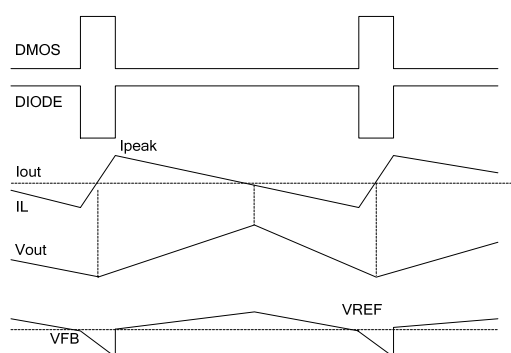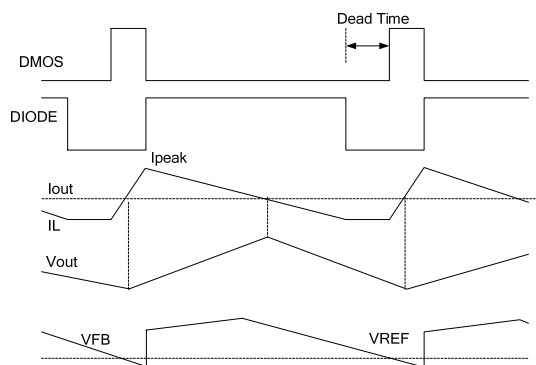

Figure 1-1 Waveform if CCM mode   Figure 1-2 Waveform of DCM mode

The output voltage of PN8015N can be adjusted by FB voltage dividing circuit. Use similar equation to determine the output voltage:

$$V_{Out} = 2.5V \times \frac{R_1 + R_2}{R_2}$$

（In actual applications, FB sampling voltage is affected by the forward drop of D3 in addition.）

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 1.3mA.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, PN8015N 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

PN8015N has several smart self-protection functions, such as Over Load Protection(OLP),Over Temperature Protection(OTP),FB Open Loop Detection(OLD),VDD Under-Voltage Lockout(UVLO).And all these protections have self-recovery mode.

OLP----If the FB pin voltage remains in lower than 1.7V for more than 150ms, the IC will self-restart.

OTP----If the inner junction temperature exceeds 160℃,the IC will shut down switching, until the junction temperature falls to 130℃.

OLD----If the FB pin voltage is lower than 100mV after soft-start up, the IC will self-restart.

UVLO----If VDD pin Voltage drops below 8V, 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.

Package Dimensions

Table 6. SOP-7 mechanical data

Size symbol	Min.(mm)	Nom.(mm)	Max.(mm)	Size symbol	Min.(mm)	Nom.(mm)	Max.(mm)
A	1.35	1.55	1.75	L	0.45	0.60	0.80
A1	0.10	0.15	0.25	L1	1.04REF		
A2	1.25	1.40	1.65	L2	0.25BSC		
A3	0.50	0.60	0.70	R	0.07	—	—
b	0.38	—	0.51	R1	0.07	—	—
b1	0.37	0.42	0.47	h	0.30	0.40	0.50
c	0.17	—	0.25	θ	0°	—	8°
c1	0.17	0.20	0.23	$\theta 1$	15°	17°	19°
D	4.80	4.90	5.00	$\theta 2$	11°	13°	15°
E	5.80	6.00	6.20	$\theta 3$	15°	17°	19°
E1	3.80	3.90	4.00	$\theta 4$	11°	13°	15°
e	1.270(BSC)						

Figure 2. Package Outline Dimensions
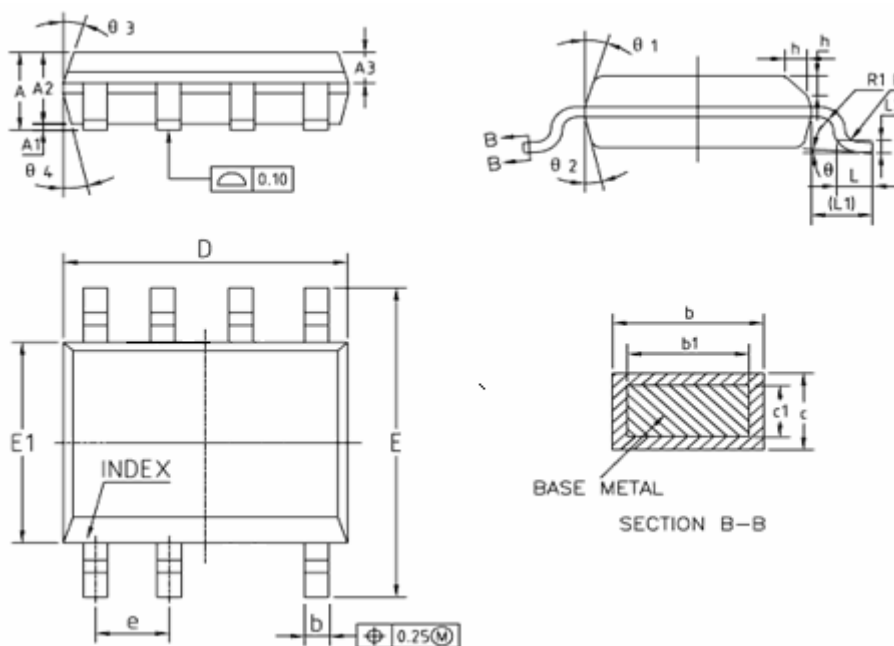
TOP MARK	Package
PN8015N YWWXXXXX	SOP-7

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