High Precision CC/CV Primary-Side Converter

General Description

The PN8355 consists of a high precision CC/CV primary side controller and a 650V power MOSFET, specifically designed for a high performance low power AC/DC charger and LED lighting with minimal external components. PN8355 operates in primary-side sensing and regulation, so opto-coupler and TL431 could be eliminated. PN8355 offers complete protection coverage with automatic self-recovery feature including Cycle-by-Cycle current limiting protection (OCP), over voltage protection (OVP) and feedback loop open protection (OLP), over temperature protection (OTP) and short circuit protection etc. Internal HV Start-up circuit and the chip's very low consumption help to meet the strict standby power standard. In CC control, the current and output power setting can be adjusted externally by the sense resistor Rcs at CS pin. In CV control, PFM operations are utilized to achieve high performance and high efficiency. In addition, good load regulation is achieved by the built-in cable drop compensation.

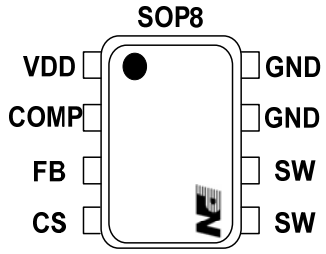
Features

- Internal 650 V avalanche-rugged power MOSFET
- ±5% Constant current Regulation at Universal AC input
- Primary-side Sensing and Regulation Without TL431 and Opt coupler
- Programmable CV and CC Regulation
- Programmable Cable Drop Compensation
- Built-in Primary winding inductance compensation
- Internal HV Start-up Circuit
- Excellent Protection Coverage:
  - ✧ Over Temperature Protection (OTP)
  - ✧ VDD Under Voltage Lockout (UVLO)
  - ✧ Cycle-by-Cycle Current Limiting (OCP)
  - ✧ Open Loop Protection (OLP)
  - ✧ VDD Over Voltage Protection (OVP)
  - ✧ Auto- recovery protection Mode

Applications

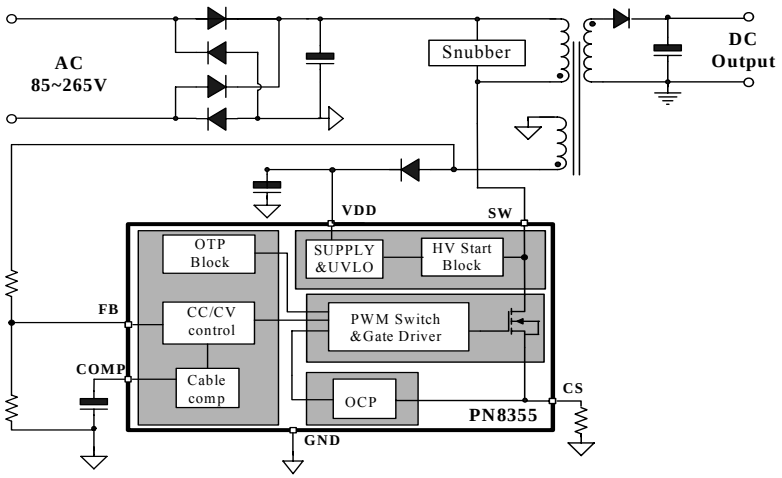
- Switch AC/DC Adaptor and Battery Charger
- LED Light

Package/Order Information



Order codes	Package	Vcable	Typical power 85~265 V_{AC}
PN8355SEC-R1	**SOP8**	**3%**	**5W**
PN8355SEC-R1B	**SOP8**	**6%**	**5W**
PN8355SEC-R1C	**SOP8**	**0%**	**5W**

Typical Application



Pin Definitions

Table 1. Pin Definitions

Pin Number	Pin Name	Pin Function Description
1	VDD	Positive Supply voltage Input
2	COMP	Loop compensation
3	FB	The voltage feedback from auxiliary winding. Connected to resistor divider from auxiliary winding reflecting output voltage
4	CS	Current Sense Input
5	SW	HV MOSFET Drain pin. The Drain pin is connected to the primary lead of the transformer.
6		
7	GND	Ground
8		

Typical power

Table 2. Typical power

Part number	85-265 V_{AC}	
	Open Frame	Adapter
PN8355	6W	5W

Note:

1. Continuous power in open frame design at75°C ambient temperature,
2. Maximum practical continuous power in adapter design at 40°C ambient temperature, with enough cooling conditions.

Absolute Maximum Ratings

Supply voltage Pin VDD……..……..-0.3~25V

High-Voltage Pin, SW……..…650V

Pin FB, COMP……...…-0.3~5.5V

Operating Junction Temperature……...…..-40~140℃

Storage Temperature Range…….-55~150℃

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

ESD voltage Protection (HBM)……2.0kV

Pulse drain current……1.0A

Electrical Characteristics

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

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
V_{BVDSS}	Break-down voltage	I_{SW} = 250uA, T_J = 25℃	650	690		V
I_{OFF}	Off-state drain current	V_{SW} = 550 V		30	100	uA
$R_{DS(on)}$	Drain-source on state resistance	I_{SW} = 0.4A,T_J = 25℃		13.5	17.5	Ω
		I_{SW} = 0.4A , T_J = 125℃		30	35	

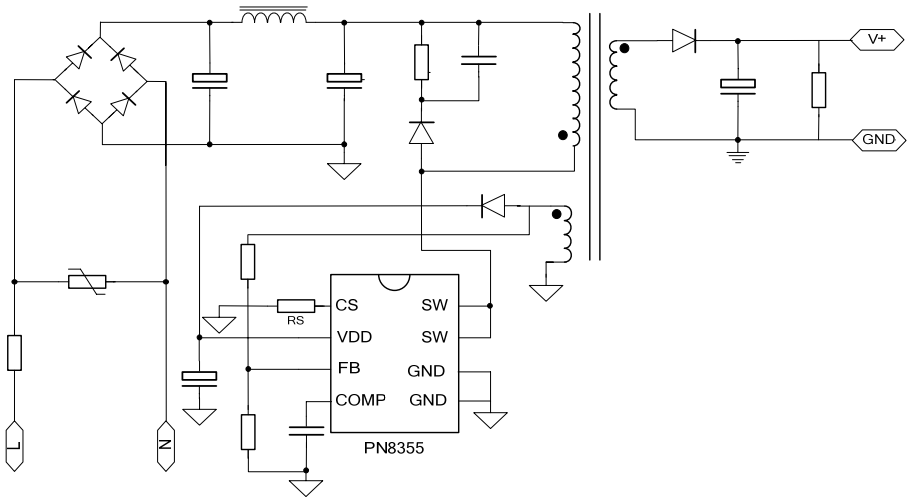
Table 4. Supply section (T_J = 25°C, V_{DD} = 15 V; unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY VOLTAGE SECTION						
V_{SW_START}	Drain-source start voltage		20			V
I_{DD_CH}	Start up charging current	V_{DD}<V_{DDOFF}, Isw charge V_{DD}	-0.6	-1	-1.4	mA
V_{DD}	Operating voltage range	After turn-on	8		25	V
V_{DDon}	VDD start up threshold	V_{DD}>17V, I_{VDD} increase	13.5	15	16.5	V
V_{DDoff}	VDD under voltage shutdown threshold	V_{DD}<7.0V, I_{VDD} increase	7	8	9	V
V_{DDovp}	VDD over voltage protect		25	27	29	V
$V_{DDclamp}$	VDD clamp voltage	V_{DD}>30V, I_{VDD}> 1mA	28	30	32	V
SUPPLY CURRENT SECTION						
I_{DDoff}	Operating supply current, not switching	V_{DD} = 10 V	0.1	0.2	0.4	mA
I_{DDop}	Operating supply current, switching	V_{DD}＝15V	0.2	0.4	1.0	mA
$I_{DD1FAULT}$	Operating supply current in protecting	V_{DD}＝15V after fault	0.1	0.2	0.4	mA

Table 5. Controller section (T_J = 25°C, V_{DD} = 15 V; unless otherwise specified)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
CURRENT SECTION						
T_{LEB}	Leading edge blanking time		350	450	550	nS
V_{TH_OC}	Current limiting threshold voltage		485	500	515	mV
T_{ON_MAX}	Maximal turn ON time			330		mV
FB SECTION						
V_{REF1}	No-load feedback voltage reference		1.945	1.965	1.985	V
$T_{OFF-MIN}$	Minimum turn off time		2.7	3.8	4.9	uS
$T_{OFF-MAX}$	Maximal turn off time		7.5	10	12.5	mS
T_{ONMAX}	Maximal turn on time		20	25	30	uS
COMP SECTION						
Vcable1	Line resistance value compensation			0%		
Vcable2	Line resistance value compensation			3%		
Vcable3	Line resistance value compensation			6%		
THERMAL SECTION						
T_{SD}	Thermal shutdown temperature		140	160		°C
T_{HYST}	Thermal shutdown hysteresis			30		°C

Typical circuit



Operation Description

1. Startup

At start up, the internal high-voltage current source supplies the internal bias and charges the external VDD capacitor. When VDD reaches 15V, the device starts switching and the internal high-voltage current source stops charging the capacitor. The device is in normal operation provided VDD does not drop below 8V. After start up, the bias is supplied from the auxiliary transformer winding.

2. CC Operation Mode

In CC operation, The PN8355 captures the auxiliary flyback signal at FB pin through a resistor divider network. The pulse width of the auxiliary flyback signal determines the PN8355 oscillator frequency. The higher the output voltage is, the shorter the pulse width is. And the chip oscillator frequency is higher, thus the constant output current can be achieved.

3. CV Operation Mode

In CV operation, The PN8355 captures the auxiliary flyback signal at FB pin through a resistor divider network. The voltage of the auxiliary flyback signal determines the PN8355 oscillator frequency. In full load mode, the chip oscillator frequency decreases while the output current decreases. In no load standby mode, the frequency is further reduced to minimize standby power.

4. Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in PN8355. The switch current is detected by a sense resistor into the CS pin. The CC set-point and maximum output power can be externally adjusted by external current sense resistor at CS pin.

An internal leading edge blanking circuit chops off the sensed voltage spike at initial power MOSFET on state so that the external RC filtering on sense input is no longer needed.

5. Programmable Cable drop Compensation

The Cable drop compensation block compensates the voltage drop across the cable. As the load current decreases from full load to no load, the voltage drop across the cable decreases. In the no load mode, the block decrease the CV set-point and inversely in the full load mode the block increase the CV set-point. The compensation is determined by the chip inside setting, different version chip could meet different compensation ranges.

6. Protection Control

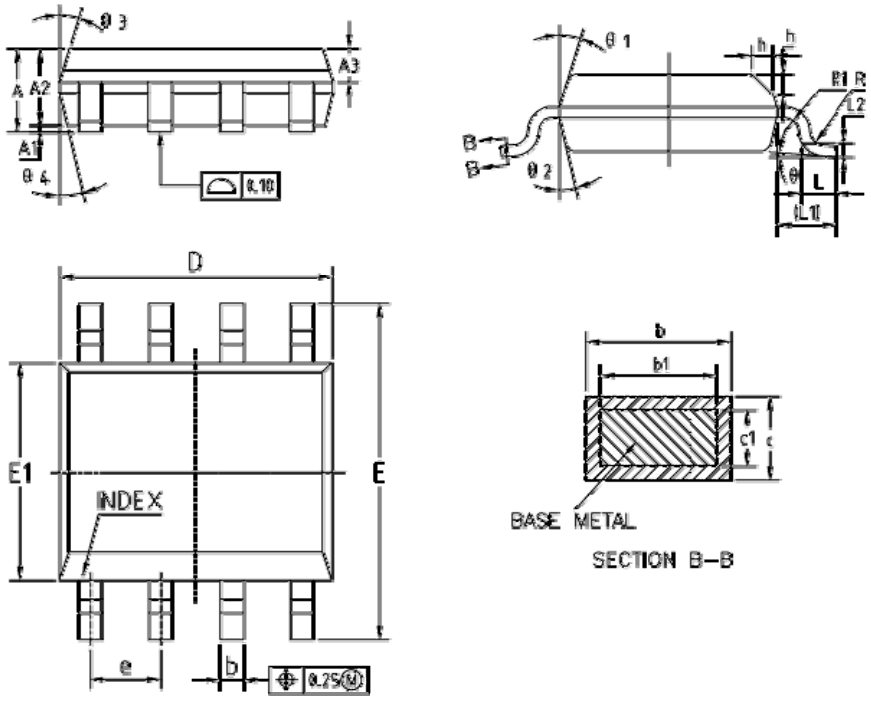
The PN8355 has several self-protection functions, such as Over-Voltage Protection, Over-Temperature Protection, Feedback Loop open Protection, Output short circuit Protection, CS resistor short circuit Protection and Under Voltage Lockout on VDD. All protections are implemented as auto-restart mode.

Package Dimensions（SOP8）

Table 6. SOP8 mechanical data

尺寸 / 符号	最小(mm)	正常(mm)	最大(mm)	尺寸 / 符号	最小(mm)	正常(mm)	最大(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	θ1	15°	17°	19°
D	4.80	4.90	5.00	θ2	11°	13°	15°
E	5.80	6.00	6.20	θ3	15°	17°	19°
E1	3.80	3.90	4.00	θ4	11°	13°	15°
e	1.270（BSC）						

Figure1. Package dimensions



TOP MARK	Package
PN8355 YWWXXXXX	SOP8

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