■ Introduction

Adopting the primary side voltage and current sampling technology, CN1611 simplify the CV/CC mode switching power supply design without optical coupling and secondary side control circuit,but also has accurate output voltage and current regulation.

Standby power consumption, high efficiency and noise free for 75 mW can be achieved CN1611 a variety of operation modes. Frequency jitter technology can greatly reduce the cost of EMI filters.

The CN1611 of DIP-7 package can be adjusted accurately CV/CC, with low cost and high reliability. while providing rich protection features: including cycle-by-cycle peak current limits, VCC undervoltage locking (UVLO), overvoltage protection (OVP), and clamp.When an exception occurs, the controller continuously attempts a soft restart until the fault condition is eliminated.

CN1611 provide DIP-7 packaging, built-in voltage up to 1000V of MOSFET, to ensure the reliable operation of the product in harsh power supply environment.

■ Features

- CV/CC adjustment error ±5%
- Control circuits without optical coupling and all secondary CV/CC
- Quasi resonant working mode
- Built-in line compensation for more precise CC regulation
- Built-in front blanking (LEB)
- Periodic Current Limit
- VCC undervoltage locking (UVLO) with hysteresis
- Built-in short circuit protection and output overvoltage protection
- Built-in over-temperature protection
- Output power up to 15 W

■ APPLICATIONS

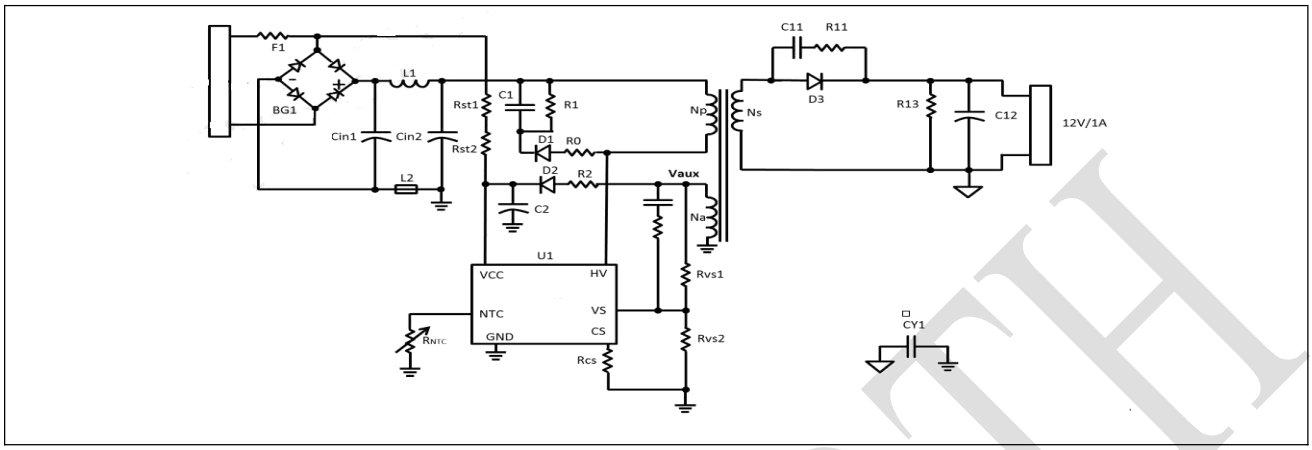
- Industrial Instrument: Single-phase watt-hour meter/three-phase watt-hour meter
- Outdoor monitoring/protection equipment
- AC-DC of high input voltage

■ Ordering information

Order code	Encapsulation information	Packing form	Number	Order code
CN1611	DIP-7	Pipe fittings	100	CN1611

■ Typical application circuit

CN1611 Typical application circuit



■ Pin description

Pin number	Name	Function
1	VCC	Chip power input pin
2	VS	The auxiliary winding voltage sampling input pin is connected with the auxiliary winding through resistance
3	EN/NTC	Enable control pin to connect to ground NTC resistor or low level off control
4	CS	connected to the power MOS tube source stage.Primary current sampling input
5,6	HV	Connected to power MOS drain level
7	GND	Chip Reference

■ Limit parameter (note 1)

Symbol	Parameters	Value	Unit
VCC	Input voltage	-0.5~40	V
VS	Voltage sampling input	-30~6	V
C S	Current sampling pin ground voltage	-0.5~6	V
EN/NTC	Enable control of end-to-ground voltage	-0.5~6	V
HV	Power MOS drain voltage	-0.5~1000	V
T_A	Working temperature	-40~105	℃
T_{JMAX}	Maximum junction temperature	150	℃
T_{STG}	Storage temperature	-55~150	℃
T_{LEA}	Welding temperature	260	℃

Note 1: The limit parameter is a threshold that can not be exceeded under any condition (even an instant). In addition, it can not be equal to any two values in the limit parameter at the same time.Once the chip runs beyond the limit parameters, it may cause aging or permanent damage.the limit parameter only emphasizes numerical values and does not necessarily indicate that the chip can work properly under these limits.

■ Electrical characteristics

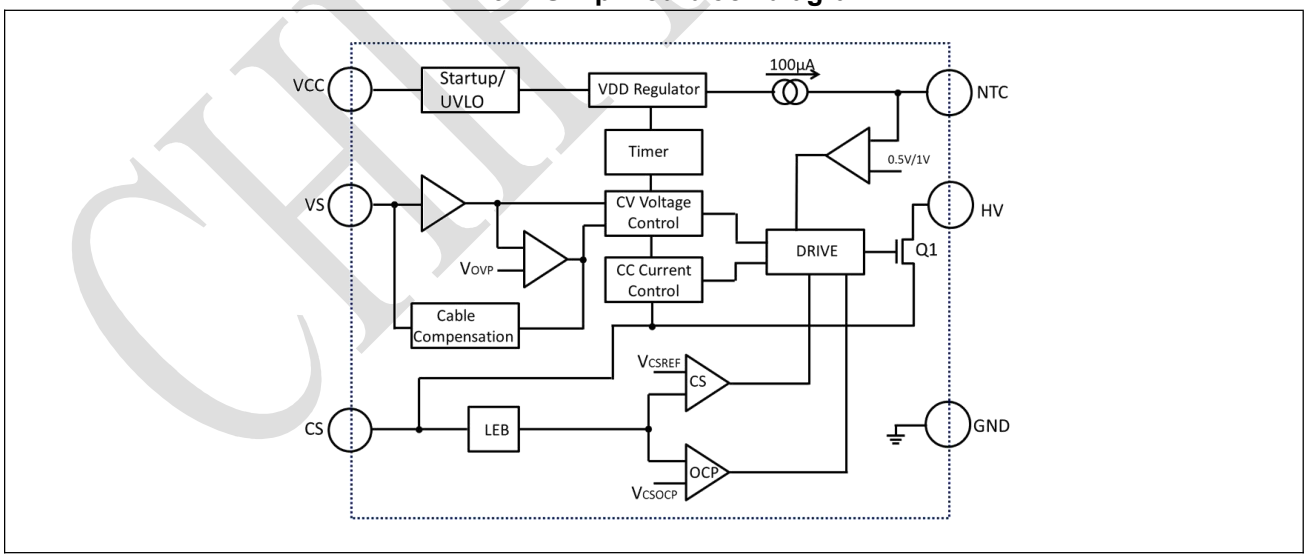
Criteria for testing: T_A=25°C, unless otherwise stated

Parameters	Symbol	Test conditions	Minimum	Typical	Maximum	Unit
Power supply (VCC pins)						
VCC Overpressure Protection	VCCOVP		33	36	39	V
Static current @ no load	ICC	VCC=Vst-1 V	240	300	360	μA
Start-up voltage	VST		10.8	12.8	14.8	V
Minimum operating voltage	VUVLO		6.8	7.5	8.2	V
Start current	IST	VCC=Vst-0.5V		0.1	0.6	μA
Voltage control (VS pin)						
VS reference voltage	Vvs		1.97	2.0	2.03	V
Line Loss Compensation Current	I_{CAB}	No load		54		μA
Minimum break time	D_{MIN}			1.5		mS
Current control (CS pin)						
Turn-off voltage @ full load	V_{CSMAX}		580	600	620	mV
Off voltage @ light load	V_{CSMIN}			200		mV
Front blanking time	TLEB			600		nS
Secondary maximum duty cycle	DSMAX		0.47	0.50	0.53	
Protection function						
Over-temperature	TOTP		130	160	190	°C

protection						
NTC thermal protection off voltage				0.5		V
NTC thermal protection recovery voltage				1.0		V
NTC pull up current				100		μA
Output overvoltage protection	Vvs -OVP		2.2	2.5	2.8	V
Short-circuit voltage	Vvs -HICCUP		0.7	0.85	1	V
power tube (HV pin)						
Breakdown voltage	BVDSS	IDSS=250μA	1000			V
on-resistance	RDSON	VG=10 V,IDVG=1 A		7.8	8.8	Ω

■ Simplified logic block

CN1611 Simplified block diagram



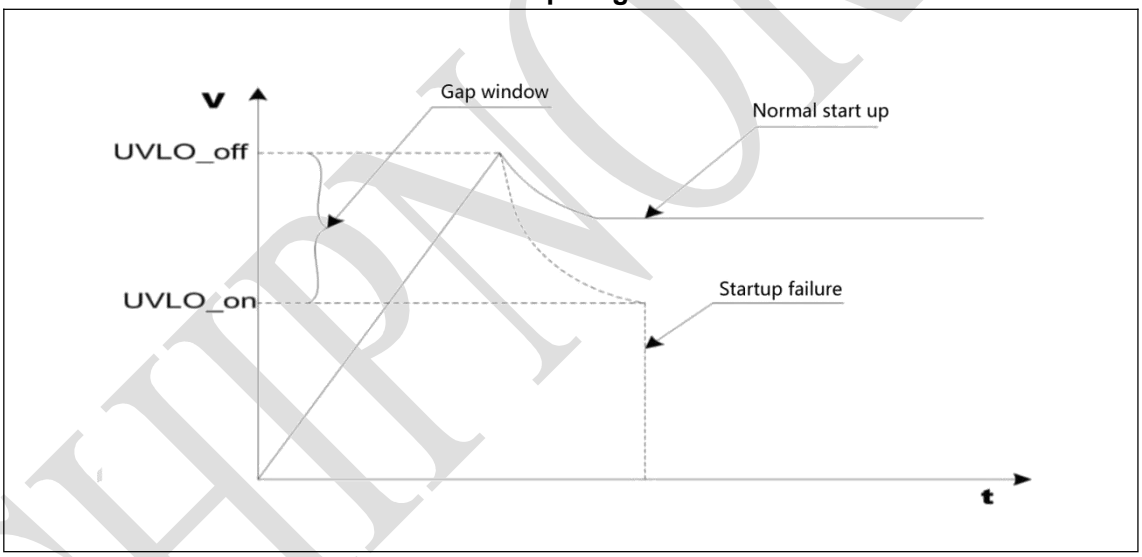
■ Job description

CN1611 is an innovative AC-DC controller that employs proprietary primary side control technology to eliminate the optocoupler isolated feedback and secondary control circuits required in traditional design.effectively improve cost effectiveness and enhance reliability.furthermore, CN1611 used some new technologies to further improve the performance.

1. Start

thanks to the innovative internal start circuit and adaptive sleep control technology, when the CN1611 circuit is powered on, the voltage of the V CC pin can be pulled to higher than U VLO (off) through the start resistance with a large resistance value (>6 M Ω) to bring the CN1611 into normal working condition.the starting current consumed by the CN1611 is provided by the V CC decoupling capacitor in the initial stage of startup, so the decoupling capacitor voltage is reduced; at the same time, the voltage of the auxiliary winding of the transformer will increase proportionally with the increase of the output voltage. finally, when the voltage of the auxiliary winding is equal to the voltage of the V CC decoupling capacitor, the auxiliary winding will replace the V CC decoupling capacitor as the CN1611 power supply.

Start-up diagram



2. Constant (CV) mode

In order to achieve accurate output voltage regulation, it is necessary to implement the detection of output and load changes.the CN1611 VS pin detects the feedback signal of the auxiliary winding through Rvs 1 and R vs2.The rectified input voltage is VIN mapped to a turn ratio of - N during power on$_{AUX}$N /$_{P}$The auxiliary winding. Its voltage can be expressed as:

$$V_{AUX} = - V_{IN} \cdot \frac{N_{AUX}}{N_P}$$

Among them, N$_{AUX}$N the number of turns of the auxiliary winding$_{P}$for the number of turns on the primary side.

During power off, the voltage of the secondary winding is mapped to the auxiliary winding, denoted as:

$$V_{AUX} = (V_O + V_D) \cdot \frac{N_{AUX}}{N_s}$$

Among them, N_S are turns of secondary windings, V_D is the voltage drop of the rectifier diode.

Auxiliary winding voltage V in typical application diagram$_{AUX}$ via Rvs 1,Rvs 2 to CN1611 VS pins.After comparing with the reference voltage V vs inside the chip, the duty cycle is adjusted to keep the output voltage constant.

The adjusted final output voltage is equal to:

$$V_O = \frac{N_S}{N_{AUX}} * \text{Vvs} \left(1 + \frac{Rvs1}{Rvs2} \right) - V_D$$

where the internal reference current Vvs equal to 2 V (typical values)

3. Constant current (C C) mode

the chip detects the peak current of the inductor on a periodic basis. the CS end is connected to the input of the internal peak current comparator to compare with the internal threshold voltage. when the CS external voltage reaches the internal detection threshold, the power tube is turned off.

The expression of peak inductance current at full load is as follows:

$$\mathrm{I}_{P\_PK} = \frac{V_{CS}}{R_{CS}}(mA)$$

the output of the C S comparator also includes a 500 nS front blanking time.

Output current calculation method:

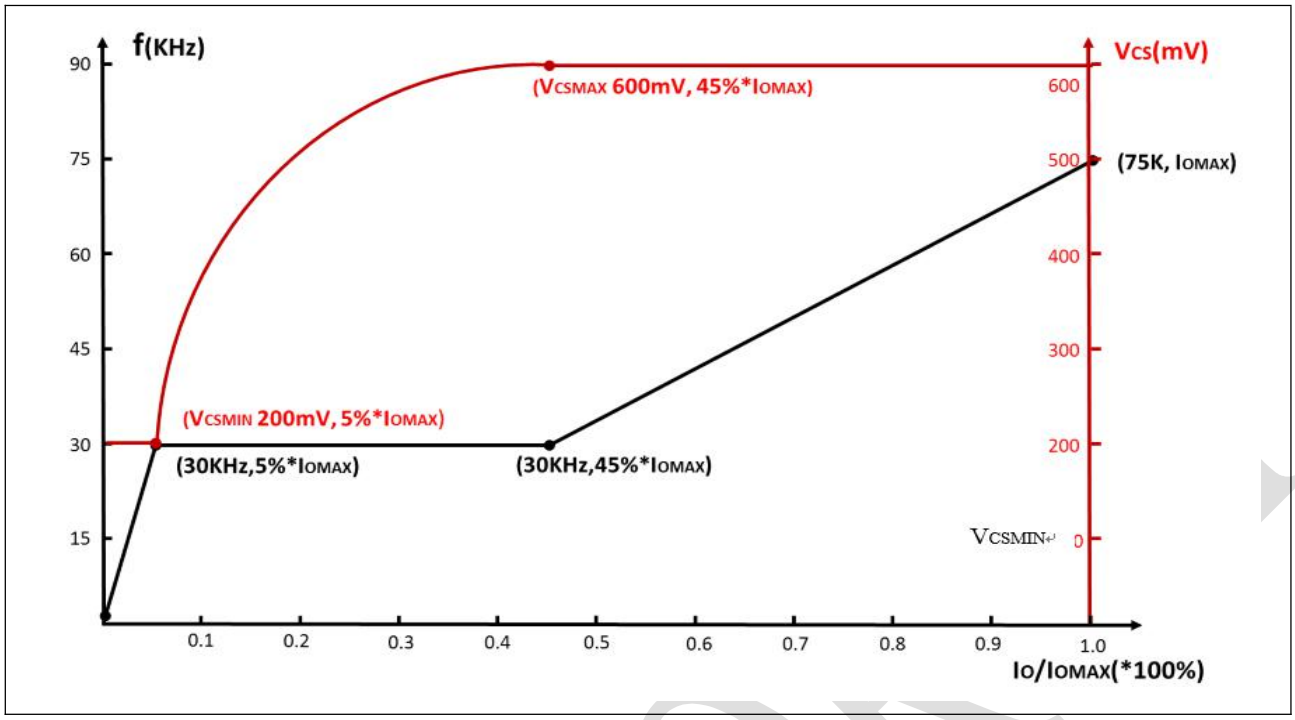
$$I_o = \frac{1}{4} \times I_{\mathrm{P\_PK}} \times \frac{N_P}{N_S}$$

Where, Np is the number of turns of the main stage of the transformer, Ns is the number of turns of the secondary stage of the transformer, I_{P_PK} is the peak current on the main stage side.

4. PWM/PFM mixed mode

to compromise between different characteristics such as efficiency, no-load standby, noise, ripple and so on, PWM/PFM mixing mode is used in the CN1611. Under constant pressure (CV) mode, from the middle load to the full load, CN1611 the system works in pure P W M mode; from the middle load to the no load, the system runs in mixed PWM/PFM mode. figure 7 illustrates the trend of frequency and peak current after load change.

f_{OSC}I and$_{PK}$Relation to load



5. Protection function

CN1611 integrated complete protection features including built-in OVP 、 OTP 、 UVLO 、 OCP 、 output short/open protection and open loop protection.

using the pin, CN1611 is able to monitor the primary measured peak current through the CS pin. this allows control and limitation of the cycle-by-cycle peak current. when the voltage of the CS pin reaches the internal OCP threshold, the overcurrent is CN1611 detected and the power MOS switch is turned off immediately until the next pulse is generated.

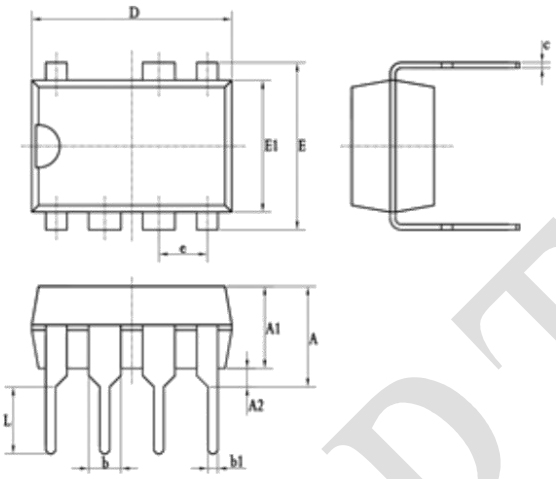
VCC protection is achieved by UVLO and OVP. when the VCC voltage drops below the UVLO (on) threshold or rises above the OVP threshold and the power system enters the automatic restart sequence, the output of the CN1611 is turned off. UVLO (on) and OVP can also be triggered in case of output short circuit or disconnection, and CN1611 can be turned off and enter the automatic restart sequence.

Excessive temperature protection (OTP) circuit detects chip temperature.OTP threshold is usually set at 150℃.as the chip temperature rises above the threshold, the CN1611 closes and enters the automatic restart sequence.

If open loop occurs, CN1611 can detect the fault state, close and enter the automatic restart sequence.

■ Encapsulation information

DIP-7



Symbol	mm			In inches		
	Minimum	Typical values	Maximum	Minimum	Typical values	Maximum
A	3.710	-	4.310	0.146	-	0.170
A1	0.510	-	-	0.020	-	-
A2	3.200	-	3.600	0.126	-	0.142
b	0.330	-	0.510	0.013	-	0.020
b 1	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	-	-	0.100	-
L	3.000	-	3.600	0.118	-	0.142

■ ORDER INFORMATION:

date	Version	Revision notes	Reviser
2020.3.30	V1.0	Initial data compilation	ZhangSongfeng