CJ8115 Current-Mode PWM Controller

1 Introduction

The CJ8115 is a high-performance current mode PWM controller designed specifically for cost-effective AC/DC converters, providing up to 18W of continuous output power over a wide voltage range of 85-265V. The optimized high rationality circuit design combined with the cost-effective bipolar manufacturing process maximizes the overall cost savings of the product. This power controller can operate in a typical flyback circuit topology, forming a simple AC/DC converter. The internal startup circuit of the IC is designed as a unique current suction method, which can use the amplification effect of the power switch tube to complete the startup, significantly reducing the power consumption of the startup resistor. When the output power is low, the IC will automatically reduce the operating frequency, thereby achieving extremely low standby power consumption. When VCC reaches 20V, the chip will activate over-voltage protection internally, limiting the rise of output voltage to prevent the output voltage from being too high caused by optocoupler or feedback circuit damage. The IC also provides complete overload and saturation prevention functions, which can prevent abnormal conditions such as overload, transformer saturation, and output short circuit in real time, improving the reliability of the power supply.

2 Available Packages

PART NUMBER	PACKAGE
CJ8115	DIP7

Note: For all available packages, please refer to the part Orderable Information.

3 Features

- Thermal Shutdown Protection
- Output Transistor Safe-Area Protection
- Built-in 700V High-Voltage Power Switch.
- Built in high-voltage starting current source for quick startup.
- Built in energy efficiency processing control, standby power below 0.1W.
- Built in over-voltage, under-voltage, and short-circuit protection functions.
- Built in overload and over temperature protection functions.
- Accurate temperature compensation, precise cycle by cycle current control.
- Low starting current and low operating current.
- Adaptive frequency swing design with minimal EMI interference.
- Wide voltage output power can reach up to 18W
- Fewer peripheral components and lower overall cost.

4 Applications

- Adaptor (for example, travel charger, out power station)
- Open Frame (for example, DVD, DVB)

4 Applications

4.1 Typical Application Circuit

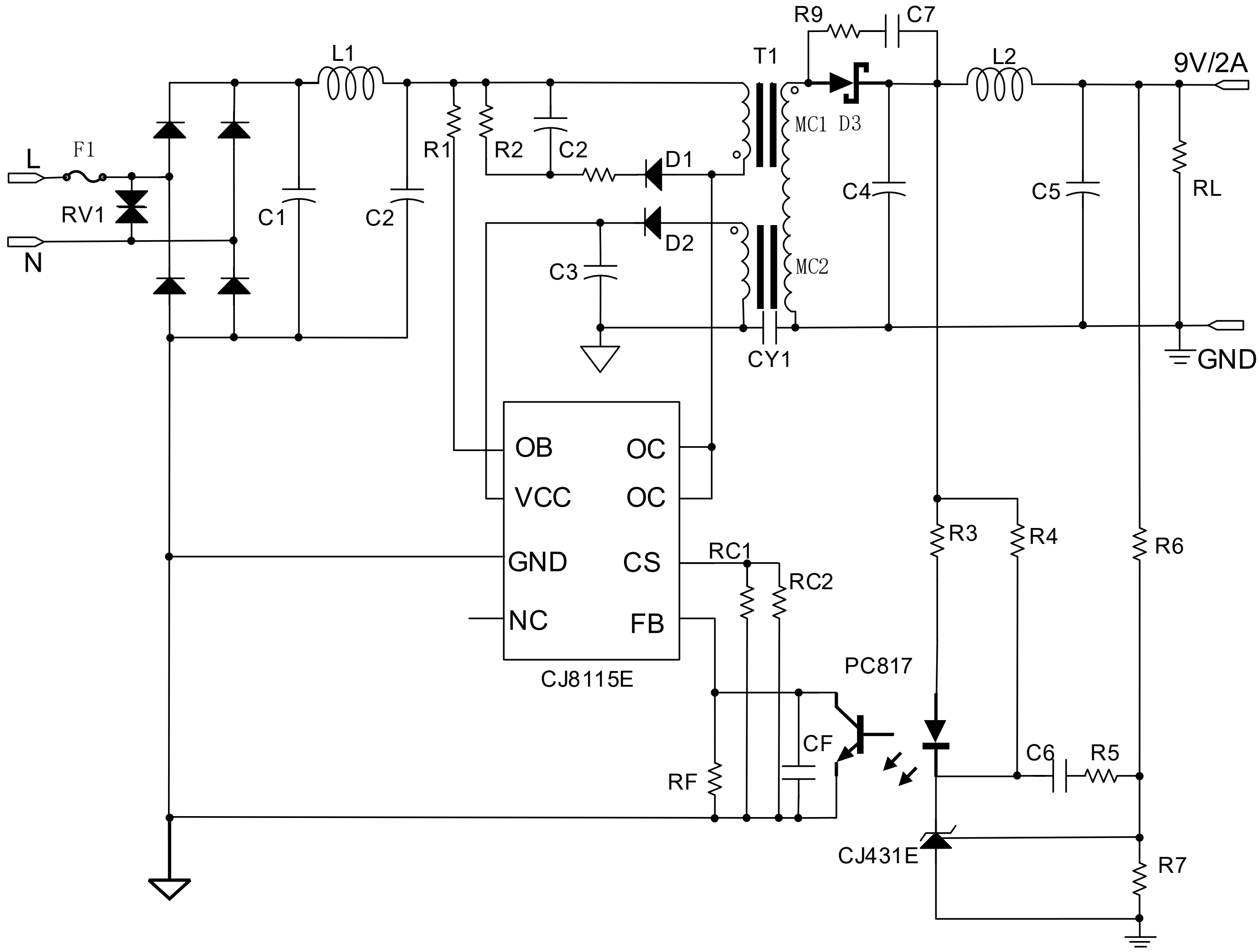
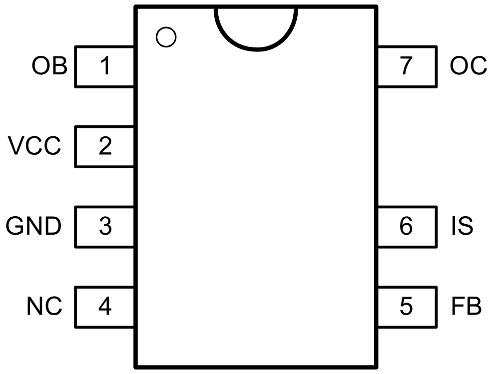


Figure 4-1. Typical Application Circuit

5 Pin Configuration and Marking Information

5.1 Pin Configuration and Function



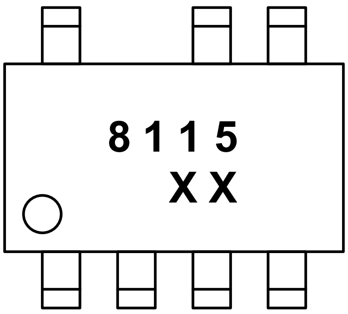
DIP7

Figure 5-1. Package Top View

5.2 Pin Function

PIN NAME	CJ8115	DESCRIPTION
OB	1	Power transistor base, starting current input, external starting resistor
VCC	2	Power Supply Pin
GND	3	Ground
NC	4	No connect
FB	5	Feedback pins
CS	6	Switching current sampling and setting limits, external current sampling resistor
OC	7	Output pin, connected to switch transformer

5.3 Marking Information



"**8115**": Device number.

"**XX**": Code, indicates weekly record information.

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range, unless otherwise specified(1).

PARAMETER	SYMBOL	VALUE	UNIT
Power supply voltage(2)	V_{CC}	18	V
Pins input voltage	V_{IN}	V_{CC} + 0.3	V
Endurance voltage of OC collector	V_{OC}	-0.3 - 700	V
Switching current of peak value	I_{peak-S}	1000	mA
Continuous Total Power Dissipation	P_D	2000	mW
Operating Ambient Temperature	T_A	-40 ~ +125	°C
Storage temperature	T_{stg}	-55 ~ 150	°C
Soldering temperature & time	T_{solder}	260°C, 10s	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to network ground terminal.

6.2 Recommend Operating Conditions

PARAMETER	SYMBOL	MIN.	NOM.	MAX.	UNIT
Power supply voltage	V_{CC}	4.5	6.5	15	V
Pins input voltage	V_{IN}	-0.3	-	V_{CC}	V
Reverse voltage of peak value	I_{peak-R}	-	-	560	V
Switching current of peak value	I_{peak-S}	-	-	1000	mA
Operating junction temperature	T_J	0	-	125	°C

6.3 ESD Ratings

ESD RATINGS		SYMBOL	VALUE	UNIT
Electrostatic discharge(3)	Human body model	$V_{ESD-HBM}$	2000	V

(3) ESD testing is conducted in accordance with the relevant specifications formulated by the Joint Electronic Equipment Engineering Commission (JEDEC). The human body mode (HBM) electrostatic discharge test is based on the JESD22-A114D test standard, using a 100pF capacitor and discharging to each pin of the device through a resistance of 1.5kΩ. The electrostatic discharge test in mechanical mode (MM) is based on the JESD22-A115-A test standard and uses a 200pF capacitor to discharge directly to each pin of the device.

6 Specifications

6.4 Electrical Characteristics

CJ8115 (T_J = 25°C, V_{IN} = 5.5 - 9V, R_S = 1Ω, unless otherwise specified).

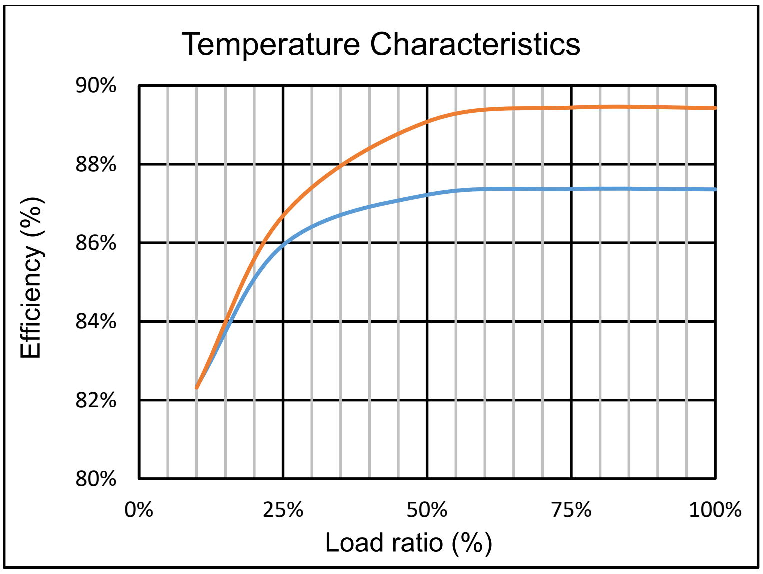
CHARACTERISTIC		TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output						
Maximum pressure resistance of switching tube		V_{CC} = 0V, I_{OC} = 1mA	700	-	-	V
on-saturation pressure drop		I_{OC} = 600mA	-	-	1	V
Output rise-time		C_L=1nF	-	-	75	ns
Output fall-time		C_L=1nF	-	-	75	ns
Output limit current		T_j = 0 - 100°C	-	1000	-	mA
Oscillator						
Oscillating frequency			-	60	-	kHz
Frequency change ratio with voltage		V_{CC} = 5.5 - 9V	-	-	3	%
Frequency change rate with temperature		T_A = 0 - 85°C	-	-	1	%
Feedback						
Input impedance	Pull-up current		-	0.45	0.6	mA
	pull-down resistance		-	40	-	kΩ
Power supply rejection ratio		V_{CC} = 5.5V - 9V	-	60	70	dB
Current sampling						
Current sampling limit			0.55	0.6	0.65	V
upper limit current prevention		R_S = 1Ω	0.55	0.6	0.65	A
Power supply rejection ratio			-	60	70	dB
transmission delay			-	150	250	ns
Modulation of pulse width						
Maximum duty cycle			53	57	61	%
Minimum duty cycle			-	-	3.5	%
Power current						
Startup acceptance current		I_{OB} = 0.5mA	1.65	1.85	2.05	mA
Startup static current			-	55	80	μA
Static current		V_{CC} = 8V	-	2.6	-	mA
Startup voltage			8.6	8.9	9.2	V
Close voltage of oscillator			3.7	3.95	4.2	V
Restart voltage			-	2.0	-	V
Over-voltage limit margin			18	20	22	V

6 Specifications

6.5 Typical Characteristics

Efficiency testing.

	items	Vout(V)	Iout(A)	Pout(W)	Pin(W)	eff	Avg.
90Vac/60Hz	10%	9.178	0.2	1.780532	2.195	81.12%	
	25%	9.176	1	4.523768	5.382	84.05%	84.82%
	50%	9.177	1	9.121938	10.698	85.27%	
	75%	9.176	1.5	13.690592	16.052	85.29%	
	100%	9.18	2	18.29574	21.605	84.68%	
115Vac/60Hz	10%	9.178	0.2	1.771354	2.151	82.35%	
	25%	9.178	0.5	4.524754	5.265	85.94%	86.97%
	50%	9.179	1	9.114747	10.45	87.22%	
	75%	9.179	1.5	13.685889	15.665	87.37%	
	100%	9.18	2	18.28656	20.93	87.36%	
230Vac/50Hz	10%	9.179	0.2	1.771547	2.152	82.32%	
	25%	9.179	0.5	4.525247	5.22	86.69%	88.66%
	50%	9.179	1	9.114747	10.232	89.08%	
	75%	9.18	1.5	13.68738	15.303	89.44%	
	100%	9.18	2	18.27738	20.437	89.43%	
264Vac/50Hz	10%	9.18	0.2	1.77174	2.171	81.61%	
	25%	9.18	0.5	4.52574	5.251	86.19%	88.19%
	50%	9.18	1	9.10656	10.348	88.00%	
	75%	9.181	1.5	13.688871	15.38	89.00%	
	100%	9.181	2	18.279371	20.406	89.58%	

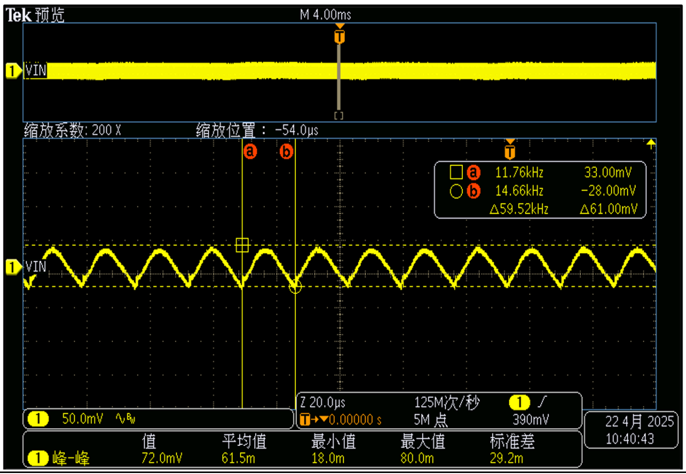


6 Specifications

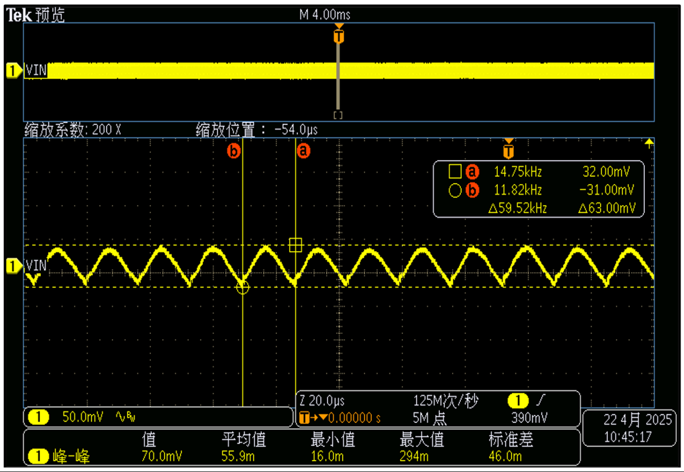
6.6 Typical Characteristics(continue)

Ripple test

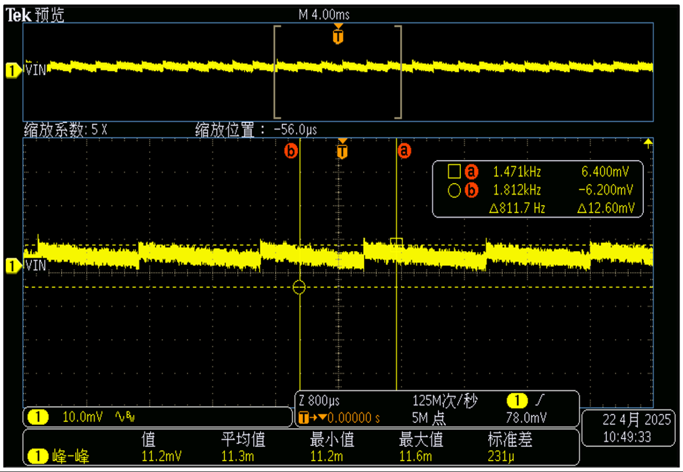
Vin = 115V AC, Vo = 9V/2A



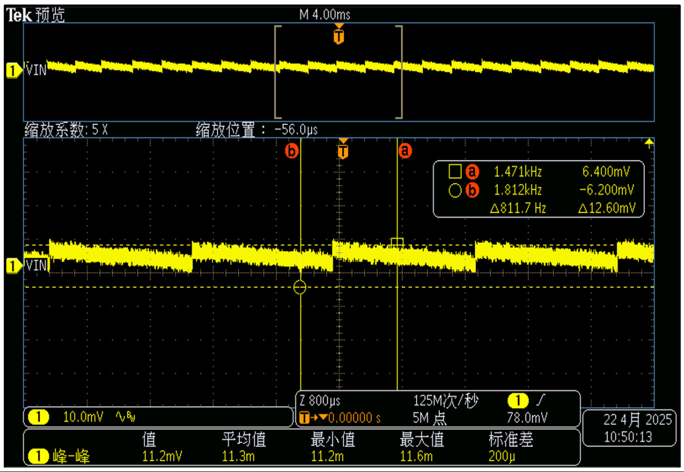
Vin = 230V AC, Vo = 9V/2A



Vin = 115V AC, Vo = 9V/0A



Vin = 230V AC, Vo = 9V/0A

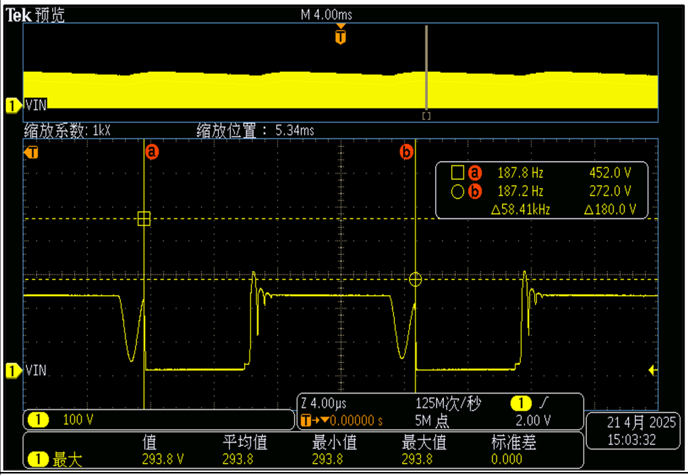


6 Specifications

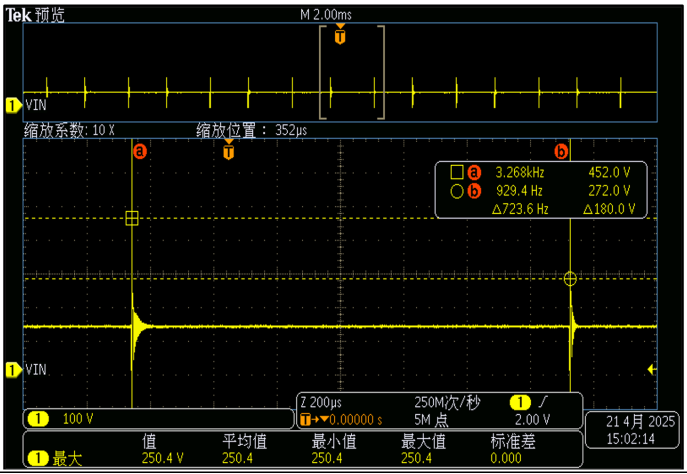
6.6 Typical Characteristics(continue)

Peak voltage test

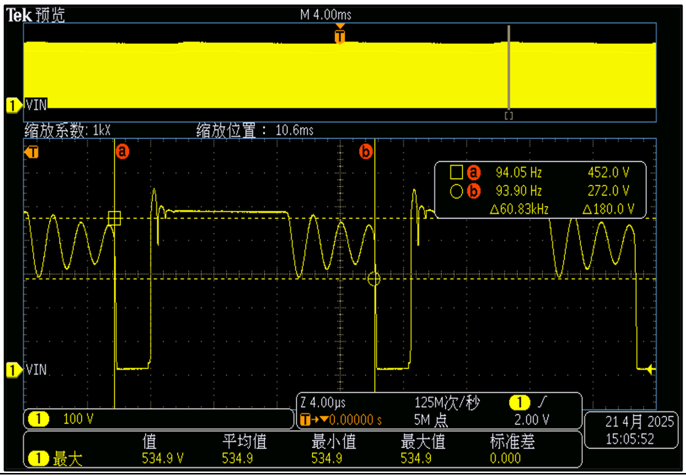
Vin = 90V AC, Vo = 9V/2A



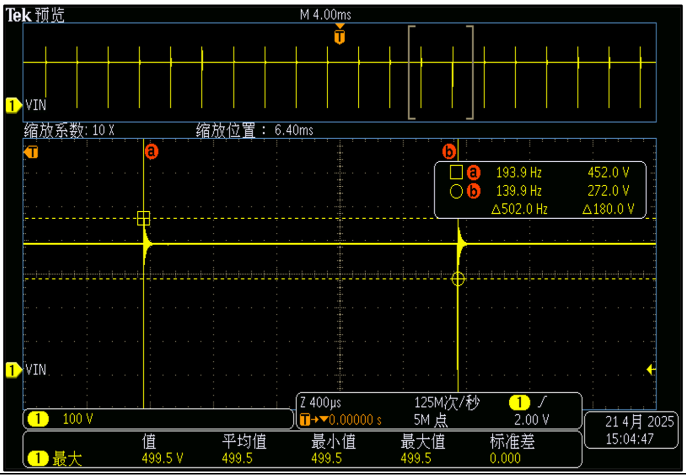
Vin = 90V AC, Vo = 9V/0A



Vin = 264V AC, Vo = 9V/2A



Vin = 264V AC, Vo = 9V/0A



7 Detail Description

7.1 Description

During the startup phase, when powered on, VREF is turned off and the FB pull-up current source is turned off; OE is fed with a starting current from the power transistor to VCC; OB controls the base current of the power transistor and limits the collector current of the power transistor (i.e. CJ8115 startup acceptance current) to ensure the safety of the power transistor; When the VCC voltage rises to 9.0V, the startup phase ends and enters the normal phase.

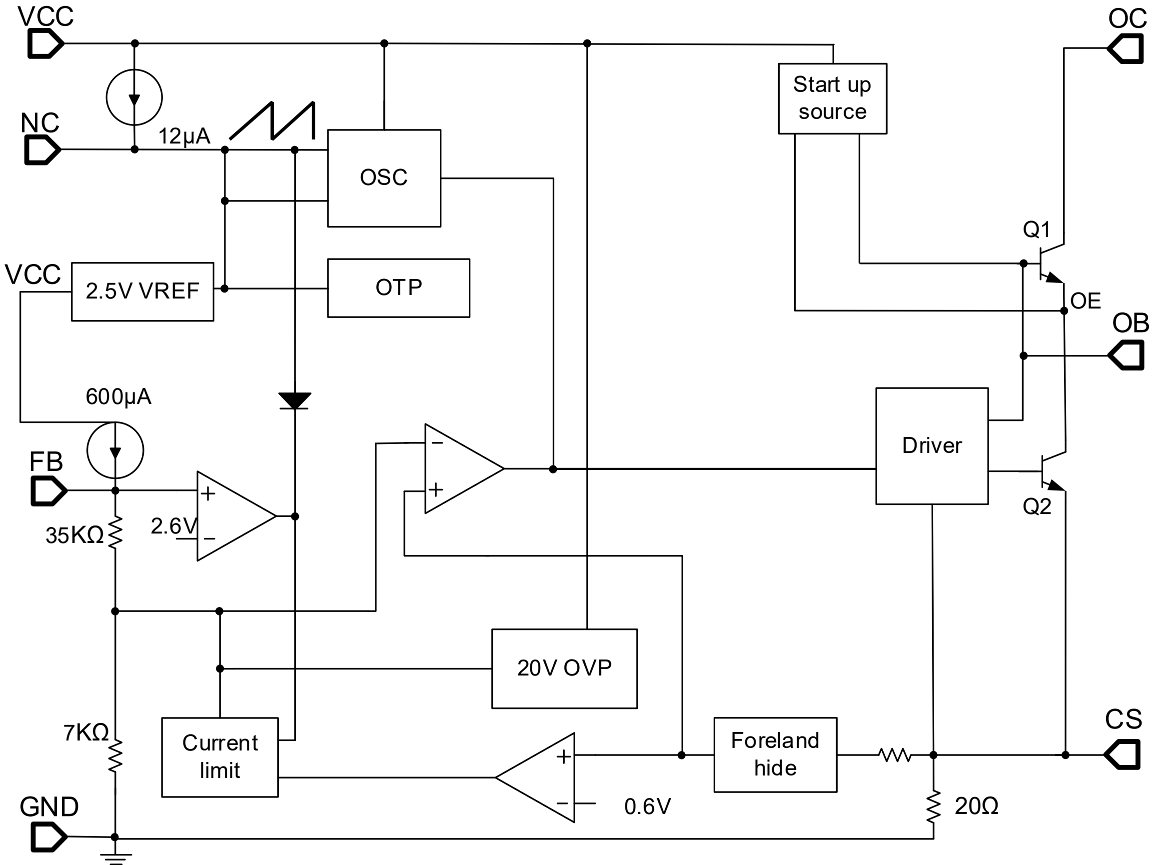
Normal stage: The VCC voltage should be maintained at 4.2 - 18V, and the VREF output should be 2.5V reference; Turn on the FB pull-up current source; The oscillator output OSC1 determines the maximum duty cycle, and the output OSC2 attempts to trigger the power supply to enter the on cycle and shield the power transistor from the current peak; If FB is less than 2.6V (approximately between 1.25 and 2.6V), the oscillator period will increase accordingly. The smaller FB, the wider the oscillator period, until the oscillator stops oscillating (this feature reduces the standby power consumption of the switching power supply). If the peripheral feedback attempts to make VCC greater than 20V, the internal circuit will feedback to FB to stabilize VCC at 20V (this feature can be used to stabilize the output voltage by the internal circuit without using the peripheral feedback circuit, but the voltage stabilization accuracy is lower); On cycle, OB provides the base current for the power transistor, OE pulls down the emitter of the power transistor to IS, and OB is driven by a ramp current (referring to the OB on current being a function of IS, when IS=0V, the OB on current is about 40mA, and then the OB on current increases linearly with IS. When IS increases to 0.6V, the OB on current is about 120mA, which effectively utilizes the output current of OB and reduces power consumption). If IS detects the specified current of FB, it enters the off cycle; During the on or off cycle, if the power transistor exceeds the upper limit current, the upper limit current trigger will be set first, forcing FB to decrease and the duty cycle to decrease, thereby protecting the power transistor and transformer. At the beginning of the next off cycle or when FB is less than 2.6V, the upper limit current trigger is reset. In addition, this circuit has built-in thermal protection. When the internal temperature is higher than 150°C, the period of the oscillator is widened so that the temperature does not exceed 163°C. If VCC drops to around 4.0V, the oscillator will turn off, OSC1 and OSC2 will be low, and the power supply will remain off for a period of time; VCC continues to drop to around 2.0V, and CJ8115 enters the startup phase again.

7.2 Definition of electrical parameters

- Start up accepting current: OC point current when OB input is 0.5mA during the startup phase.
- Start-up Quiescent Current: VCC is connected to a filtering capacitor and an adjustable current source, with other pins suspended to minimize the current source current during VCC oscillation.
- Start-up Voltage: The maximum VCC value of the VCC oscillation mentioned above.
- Re-start Voltage: Minimum VCC value of above VCC oscillation.
- Oscillator shutdown voltage: The VCC value at which the oscillator stops oscillating due to the falling edge of the VCC oscillation mentioned above.
- Quiescent Current: VCC power current when FB is grounded with 1.0KΩ of resistance at normal phase.
- FB Pull-up Current: Pull-up current on FB at normal phase when FB is 2.5V, CS is 0V.
- Internal Feedback Power Voltage: VCC value of CJ8115 power supply of the circuit without peripheral standby at normal phase.
- Ramp current drive: it refers to the power tube base drive OB on-current is the function of CS, when CS is 0V, on-current OB is about 40mA, then on-current OB will increase linearly with IS, when CS is increased to 0.6V, on-current OE is about 120mA.

7 Detail Description

7.3 Block Diagram



8 Application and Implementation

● OB power transistor base

Start current input, external starting resistor, designed with a resistance of 1206 between 2-12M, maximum driving current of 2mA, subject to specific starting time requirements. A small resistor will start quickly, otherwise it will start slowly.

● FB feedback and control

In normal working state, the voltage of FB will decide the value of the maximum switching current, the higher the voltage is, the bigger the switching current is (it is only limited at the peak value). FB pins pull up 650μA power source internally, the pull-down resistance is about 40kΩ (it approximates the equivalent value). In addition, when FB voltage is less than 2.6V, the oscillating cycle will be enlarged, the switching frequency will declined, the more it is less than 2.6V, the lower the switching frequency is. The external FB capacitance will influence the feedback bandwidth, so some external parameters will be affected, such as transient-state characteristic. As for the value of CFB capacitance, the typical application can be selected according to the frequency character of feedback circuit between 10nF and 100nF. (Refer to Fig.1)

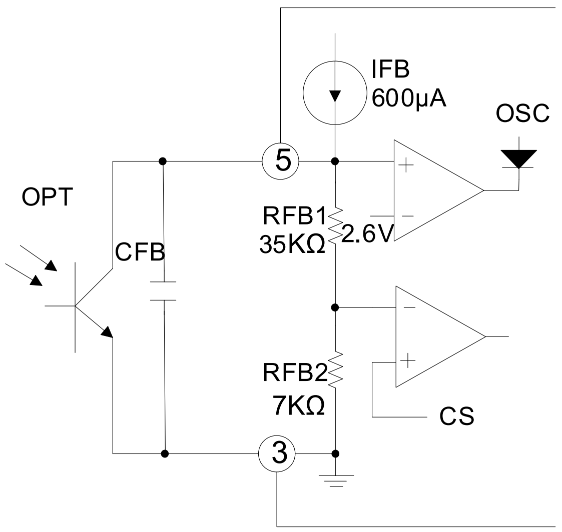


Fig.1

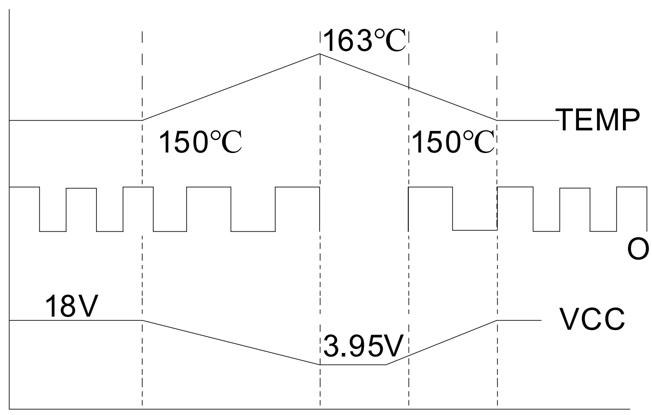


Fig.2

● Over temperature protection

The interior of IC integrates the function of over temperature protection. When the internal temperature of the chip reaches 160°C, the over-heat protection circuit will work, it will pull down the clock signal, the switching frequency will fall until the oscillator is turned off. (As shown Fig.2)

● Driving characteristic and high voltage endurance bias technology of power tube

The power tube adopts the ramp current drive, the driving current will increase with the output power, when FB is 0, the current of OB is about 40mA, and the driving power consumption will decrease remarkably when the output is low. The interior of IC integrates the particular bias technology, when the power tube is shut, the output of OB will be pulled down to the ground, meanwhile, it will bias the output of OE to 1.5V or so, bias the emitter junction, accelerate the decreasing speed of Ic current, expand the effective safe working area, the switching tube affords the reverse voltage CB, therefore, the endurance characteristic of the switching tube can be up to 700V. For more detail information for the voltage endurance characteristic of the switching tube, please refer to the relevant technical data.

8 Application and Implementation

● Over-voltage and under-voltage protection

IC has the function of slow-moving under-voltage protection, when the voltage of VCC reaches 9.0V, IC will set out to start, the initial start-up voltage is provided by the driving resistance, the high voltage of input will be injected into the base of the switching tube through IC current, consequently, the driving voltage is formed. When IC works normally, the voltage of VCC should be keep between 4.2V and 18V (including the situation of full load output), when it decreases to 4.2V further, IC will begin to reset. As shown in Fig.3:

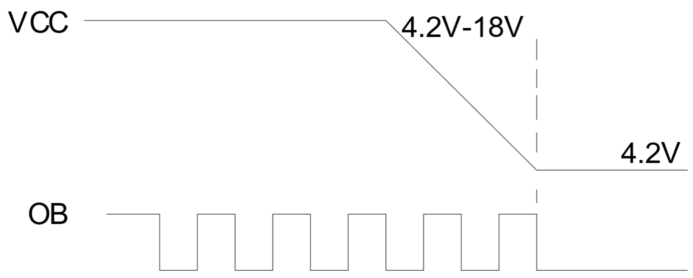


Fig.3

VCC in side IC is provided with a comparator controller of the upper limit voltage, if VCC tries to be more than 20V, the comparator will work, FB will be pulled down, and it will lock VCC to 20V, and reach the limit function of over voltage, by which the voltage feedback function of the front terminal can be accomplished conveniently, the rising phenomenon of the output voltage in large extent can be avoided when the open-loop is output, so as to guarantee the security of the load. Because of the existence of this characteristic, the design of VCC shall be kept at the proper range, so as to avoid VCC rising excessively high when the output is high, and make the output voltage escape from decreasing when IC over-voltage limit works.

● Maximum switching current limit

IC has a cycle by cycle current limiting function. Each switching cycle detects the switch current, and when it reaches the FB set current or the upper limit current, it enters the switching cycle. The current detection has real-time leading edge blanking function, shields switch spikes, and avoids erroneous detection of switch current. Reasonable temperature compensation eliminates the influence of temperature, and compared to conventional MOSFET switch chips (where Ron changes greatly when temperature changes), the switching current can be very accurate over a wide range. This allows designers to meet a large operating temperature range without leaving too much margin in the design scheme, improving the safety of circuit use.
For CJ8115, its maximum allowable switching current limit is approximately 1A. In a flyback power supply designed with a reflected voltage of 65V and a switching current of 1A, it is easy to achieve an output power greater than 18W and meet a wide temperature range.

● Requirement of heat elimination

For a typical power switch, necessary heat dissipation measures should be taken to avoid excessive temperature causing thermal protection. The main heat generated inside the IC is due to the switching losses of the switching tubes, so the appropriate heat dissipation location is the PIN-7 pins of the IC. An easy-to-use method is to lay a certain area of PCB copper foil on the PIN-7 pins, especially tin plating treatment on the copper foil, which will greatly increase the heat dissipation capacity. For a typical application with 85-265V input and 18W output, a copper foil area of 200mm^2 is necessary.
When laying out the PCB, a safe distance of at least 1mm should be maintained between PIN-6 and PIN-7 to avoid discharge.

NOTE

The application information in this section is not part of the data sheet component specification, and JSCJ makes no commitment or statement to guarantee its accuracy or completeness. Customers are responsible for determining the rationality of corresponding components in their circuit design and making tests and verifications to ensure the normal realization of their circuit design.

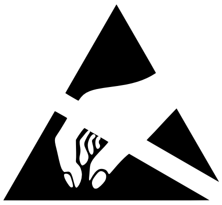
9 Notes and Revision History

9.1 Associated Product Family and Others

To view other products of the same type or IC products of other types, click the official website of JSCJ -- ***http://www.jscj-elec.com*** for more details.

9.2 Notes

Electrostatic Discharge Caution



This IC may be damaged by ESD. Relevant personnel shall comply with correct installation and use specifications to avoid ESD damage to the IC. If appropriate measures are not taken to prevent ESD damage, the hazards caused by ESD include but are not limited to degradation of integrated circuit performance or complete damage of integrated circuit. For some precision integrated circuits, a very small parameter change may cause the whole device to be inconsistent with its published specifications.

9.3 Revision History

June, 2025: released CJ8115 series rev - 1.0.

10 Orderable, Mechanical, and Packaging Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser based versions of this data sheet, refer to the left hand navigation.

Orderable Information

MODEL	DEVICE	PACKAGE	OP T_J	ECO PLAN	MSL	PACKING OPTION	SORT
CJ8115	CJ8115-PRN	DIP7	0 ~ 125°C	RoHS & Green	NA	Tube 50 Units / Tube	Active
Others	-	-	-	-	-	-	Customized

Note:

ECO PLAN: For the RoHS and Green certification standards of this product, please refer to the official report provided by JSCJ.

MSL: Moisture Sensitivity Level. Determined according to JEDEC industry standard classification.

SORT: Specifically defined as follows:

Active: Recommended for new products;

Customized: Products manufactured to meet the specific needs of customers;

Preview: The device has been released and has not been fully mass produced. The sample may or may not be available;

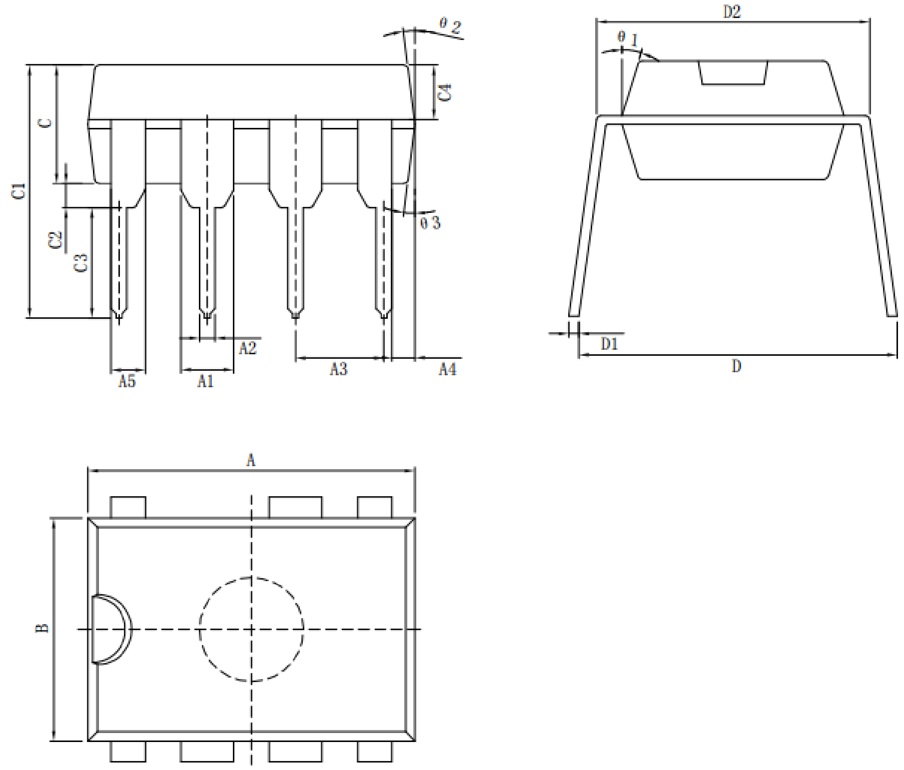
NoRD: It is not recommended to use the device for new design. The device is only produced for the needs of existing customers;

Obsolete: The device has been discontinued.

Mechanical Information

DIP7 Mechanical Information

DIP7 Outline Dimensions



DIM	Millimeters		DIM	Millimeters	
	Min(mm)	Max(mm)		Min(mm)	Max(mm)
A	9.00	9.20	C2	0.50TYP	
A1	1.474	1.574	C3	3.20	3.40
A2	0.41	0.51	C4	1.47	1.57
A3	2.44	2.64	D	8.20	8.80
A4	0.51TYP		D1	0.244	0.264
A5	0.99TYP		D2	7.62	7.87
B	6.10	6.30	θ1	17°TYP	
C	3.20	3.40	θ2	10°TYP	
C1	7.10	7.30	θ3	8°TYP	

DISCLAIMER

IMPORTANT NOTICE, PLEASE READ CAREFULLY

The information in this data sheet is intended to describe the operation and characteristics of our products. JSCJ has the right to make any modification, enhancement, improvement, correction or other changes to any content in this data sheet, including but not limited to specification parameters, circuit design and application information, without prior notice.

Any person who purchases or uses JSCJ products for design shall: 1. Select products suitable for circuit application and design; 2. Design, verify and test the rationality of circuit design; 3. Procedures to ensure that the design complies with relevant laws and regulations and the requirements of such laws and regulations. JSCJ makes no warranty or representation as to the accuracy or completeness of the information contained in this data sheet and assumes no responsibility for the application or use of any of the products described in this data sheet.

Without the written consent of JSCJ, this product shall not be used in occasions requiring high quality or high reliability, including but not limited to the following occasions: medical equipment, military facilities and aerospace. JSCJ shall not be responsible for casualties or property losses caused by abnormal use or application of this product.

Official Website: ***www.jscj-elec.com***