PWM Controller of High-performance Current Mode ME8115

General Description

PWM controller of high-performance current mode is specially designed for AC/DC transformer with high performance and price ratio.Up to 12W/18W continuous output power over a wide voltage range of 85-265V. The combination of optimized reasonable circuit design and bipolar facture technology with high performance and price ratio economizes the whole cost ultimately. The power controller can be applied to the typical flyback circuit topology so as to form a simple AC/DC transformer. The startup circuit inside IC is designed as a particular current inhalation way, so it can start up with the magnification function of the power switch tube itself, which lessens the power consumption for starting the resistance remarkably; when the output power is lower, IC will reduce the working frequency automatically, therefore, the standby power consumption becomes extremely low. When the power tube is closed, the interior circuit will bias it reversely, utilize the characteristic of high pressure resistance CB of bipolar transistor directly, and improve its pressure resistance capacity to the high voltage of 700V, which ensures the security of the power tube.

Meanwhile, the perfect function of overload and saturation prevention is provided inside of IC, which can keep away some abnormal status, such as overload, saturation of transformer, and output short circuit, so as to improve the reliability of the power supply. The current limit can be set up by exterior components.

Features

- ●Set-in high-voltage power switch tube of 700V and few peripheral components.
- ●The built-in high voltage startup current source to quick start
- ●With the function of output frequency reduction, the non-output power consumption can be less than 0.1W
- ●The independent upper-limit current testing controller deals with over-current and over-load of the controller real-timely.
- ●The period emission pole is turned off and it outputs by deflected voltage, and the pressure resistance of the power tube is improved.
- ●Set-in current limit resistance with temperature compensation, which makes the current limit precise
- ●Set-in heat protection circuit
- ●Startup is accomplished with the magnification function of the switch power tube, and the power consumption of startup resistance is reduced more than10 times.
- ●Low startup and operating current
- ●VCC over-voltage automatic limit
- ●High conversion efficiency, meet energy star 2.0
- ●Up to 12W/18W continuous output power over a wide voltage range of 85-265V.

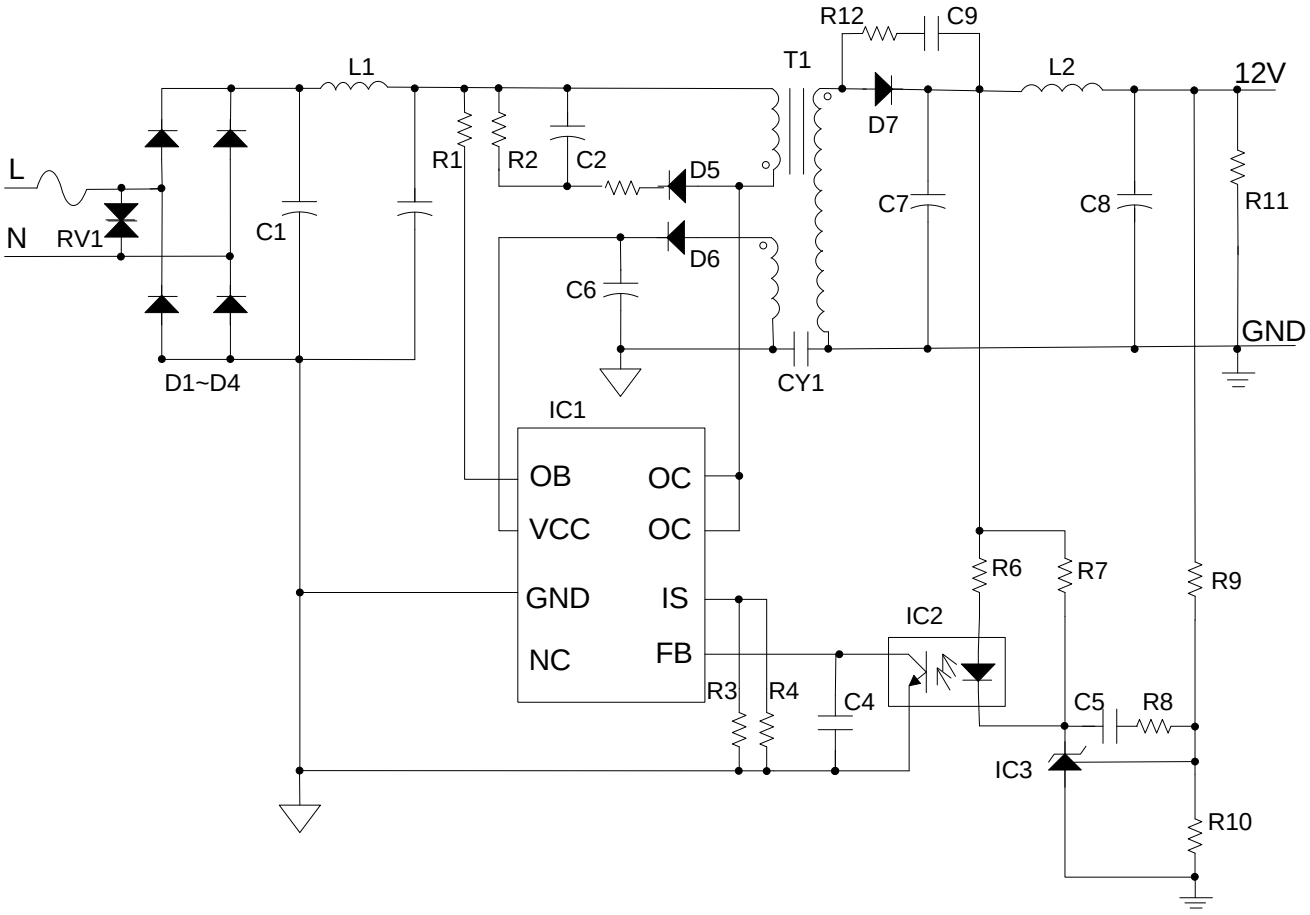
Typical Application

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

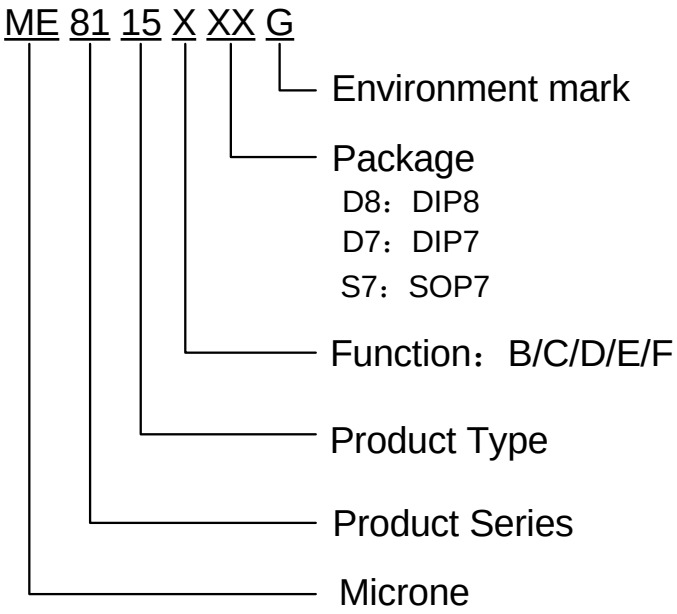
Package

- ●8-pin DIP8
- ●7-pin DIP7(B)、SOP7

Typical Application Circuit



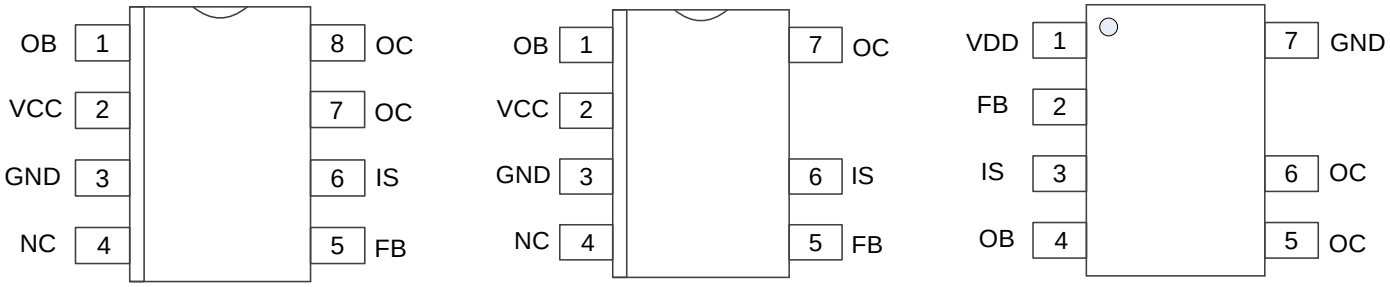
Selection Guide



product series	product description
ME8115D8G	Up to 12W；VTH=9.9V；Package：DIP8
ME8115D7G	Up to 12W；VTH=9.9V；Package：DIP7
ME8115BD7G	Up to 18W；VTH=9.9V；Package：DIP7
ME8115BD8G	Up to 18W；VTH=9.9V；Package：DIP8
ME8115CD7G	Up to 12W；VTH=12.0V；Package：DIP7
ME8115DD7G	Up to 18W；VTH=12.0V；Package：DIP7
ME8115ED7G	Up to 12W；VTH=22.5V；Package：DIP7
ME8115ES7G	Up to 12W；VTH=22.5V；Package：SOP7
ME8115FD7G	Up to 18W；VTH=22.5V；Package：DIP7

NOTE: If you need other voltage and package, please contact our sales staff。

Pin Configuration& Pin Assignment



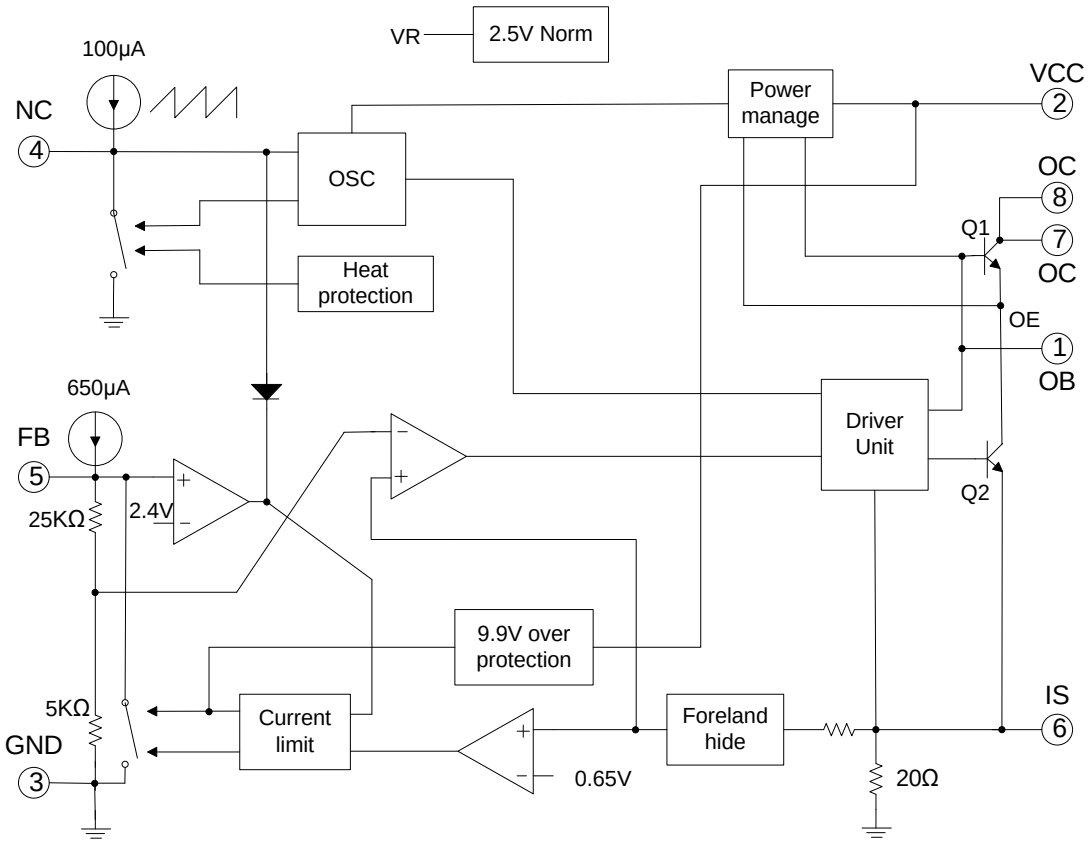
DIP8 DIP7(B) SOP7

Pin Assignment

Pin umber (DIP8)	Pin Number (DIP7B)	Pin Number (SOP7)	Symbol	Function
1	1	4	OB	Base electrode of power tube, control terminal of start-up current, external startup resistance.
2	2	1	V_{CC}	Power Supply Pin.
3	3	7	GND	Ground.
4	4	NC	NC	No connect
5	5	2	FB	Feedback pins.
6	6	3	IS	Switching current sampling and limit enactment, sampling resistance of external current.
7	NC	5	OC	Output pins, meet switching transformer.
8	7	6	OC	Output pins, meet switching transformer.

Note: During PCB layout, the security distance should be kept more than 1mm between Pin6 and Pin7, so as to avoid discharging.

Block Diagram



Absolute Maximum Ratings

Parameter		Ratings	Unit
Power supply voltage, V_{CC}（A/B/C/D）		18	V
Power supply voltage, V_{CC}（E/F）		23.5	V
Pins input voltage		VCC+0.3	V
Endurance voltage of OC collector		-0.3-700	V
Switching current of peak value		800	mA
Thermal resistance(Junction to air)	SOP7	86	℃/W
	DIP7	74	℃/W
	DIP8	90	℃/W
Continuous Total Power Dissipation	SOP7	1.45	W
	DIP7	1.69	W
	DIP8	1.39	W
Operating Ambient Temperature		-20~+125	℃
Storage Temperature		-55~+150	℃
Maximum junction temperature		-40~+150	℃
Soldering temperature and time		+260（Recommended 10S）	℃

Recommended working condition

Parameter	Min	Typ.	Max	Unit
Power supply voltage, VCC （A/B）	4.5	6.5	9.0	V
Power supply voltage, VCC （C/D）	4.5	6.5	11	V
Power supply voltage, VCC （E/F）	4.1	6.5	21	V
Pins input voltage	-0.3	-	VCC	V
Reverse voltage of peak value	-	-	550	V
Switching current of peak value	-	-	650	mA
Oscillating frequency	52	60	66	KHz
Operating temperature	0	-	100	℃

Electrical Characteristics（Ta=25℃，V_{CC}=5.5-7.5V，Rs=1Ω）

Item		Testing condition	Min	Typ.	Max	Unit
Output						
Maximum pressure resistance of switching tube		VCC=0V,Ioc=1mA	700	-	-	V
on-saturation pressure drop		Ioc=600mA	-	-	1	V
Output rise-time		CL=1nF	-	-	75	ns
Output fall-time		CL=1nF	-	-	75	ns
Output limit current		Tj=0-100℃	600	650	700	mA
Oscillator						
Oscillating frequency			-	60	-	KHz
Frequency change ratio with voltage		VCC=5.5-9V	-	-	3	%
Frequency change rate with temperature		Ta=0-85℃	-	-	1	%
Feedback						
Input impedance	Pull-up current		-	0.5		mA
	pull-down resistance		-	30	-	KΩ
Power supply rejection ratio		VCC=5.5V-9V	-	60	70	dB
Current sampling						
Current sampling limit				0.65	0.70	V
upper limit current prevention		R_S=1Ω	0.60	0.65	0.70	A
Power supply rejection ratio			-	60	70	dB
Modulation of pulse width						
Maximum duty cycle			53	57	61	%
Minimum duty cycle			-	-	3.5	%
Power current						

Startup acceptance current	Iob=0.5mA	1.6	2.0	2.4	mA
Startup static current		-	55	80	μA
Static current	VCC=8V	-	2.8	-	mA
Startup voltage		8.60	9.0	9.30	V
Close voltage of oscillator	ME8115/B	3.5	4.0	4.5	V
	ME8115C/D	3.5	4.0	4.5	V
	ME8115E/F	3.5	3.8	4.1	V
Restart voltage		-	2.12	-	V
Over-voltage limit margin	ME8115/B	9.5	9.9	10.2	V
	ME8115C/D	11	12	13	V
	ME8115E/F	21.5	22.5	23.5	V

Definition of Electric Parameter

- Start-up acceptance current: the current on OC when OB inputs 0.5mA during the start-up phase.
- Start-up Quiescent Current: the current of minimum current source that can make VCC oscillate when VCC meets filter capacitance and adjustable current source, and other pins hang in the air.
- Start-up Voltage: Maximum VCC value of above VCC oscillation.
- Re-start Voltage: Minimum VCC value of above VCC oscillation.
- Close Voltage of Oscillator: VCC value that makes RC oscillator stop oscillating when the above VCC oscillates the falling edge.
- 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, IS is 0V.
- Internal Feedback Power Voltage: VCC value of ME8115 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 IS, when IS is 0V, on-current OB is about 40mA, then on-current OB will increase linearly with IS, when IS is increased to 0.6V, on-current OE is about 120mA.

Description of the Principle

During start-up phase, Vref is closed when electrified; FB pull-up power source is closed, the start-up current is input from power tube to VCC through OE; OB controls the base current of power tube and limits the current of power tube collector (namely, ME8115 starts the acceptance current), accordingly, the security of the power tube is ensured; when VCC voltage goes up to 9.0V, the start-up phase is ended, and it comes into the normal phase.

During normal phase, VCC voltage shall keep at 3.9~9.0V, VR outputs 2.5V benchmark; FB pull-up current

source starts up; the oscillator output OSC1 decides the maximum duty cycle, output OSC2 tries to touch off the power supply to enter open cycle to enter the open cycle, and shield flashing peak current of the power tube ; if FB is less than 2.4V (about between 0.9-2.4V), the cycle of the oscillator will increase with it, the less FB is, the wider the cycle of the oscillator is, until the oscillation stops (This characteristic reduces the standby power consumption of the switching power.) ; if the peripheral feedback tries to make VCC more than 10V, the in-circuit is fed back to FB and makes VCC stabilize the voltage at 9.9V/12V/22.5V (According to this characteristic, we can may not adopt peripheral feedback circuit, and stabilize the output voltage by in-circuit, but the precision of stabilizing voltage is low); During the open cycle, OB supplies base current for the power tube, OE pulls down the emitter of the power tube to IS, and OB adopts the driving parameter of ramp current (it refers to that OB on-current is the parameter of IS, when I_S is 0V, OB on-current is about 40mA, then OB on-current increases linearly with IS, when IS increases to 0.6V, OB on-current is about 120mA, this characteristic makes effective use of the output current of OB, decreases the power consumption of ME8115), if IS detects that the specified current FB, it will come into the close cycle; during open or close cycle, if the power tube is detected beyond the upper limit current, the trigger of the upper limit current will be placed preferentially and forces FB to drop, the duty cycle will become less so as to protect the power tube and transformer; at the beginning of next close cycle or when FB is less than 2.4V, the trigger of the upper limit current will reset. In addition, ME8115 is installed over heat protection internally, when the internal temperature is higher than 150℃, it will broaden the cycle of the oscillator and makes the temperature of ME8115 less than 160℃;

If VCC falls to about 4.0V, the oscillator is closed;VCC continued to descend to about 2.2 V, and ME8115 will come into the start-up phase once again.

Application Information

switching frequency

Generally, the appropriate switching frequency is about 60KHz.

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 33KΩ (it approximates the equivalent value). In addition, when FB voltage is less than 2.4V, the oscillating cycle will be enlarged, the switching frequency will declined, the more it is less than 2.4V, 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)

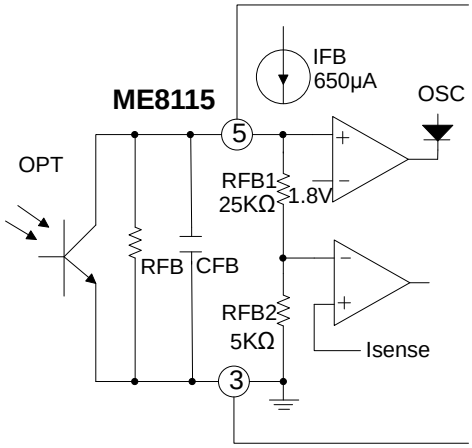


Fig.1

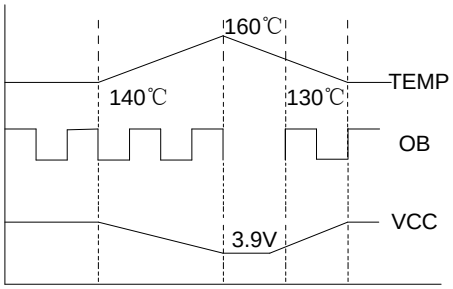


Fig.2

Over temperature protection

The interior of IC integrates the function of over temperature protection. When the internal temperature of the chip reaches 160℃, 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.

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 4.5V and 9V (including the situation of full load output), when it decreases to 3.9V further, IC will begin to reset. As shown in Fig.3:

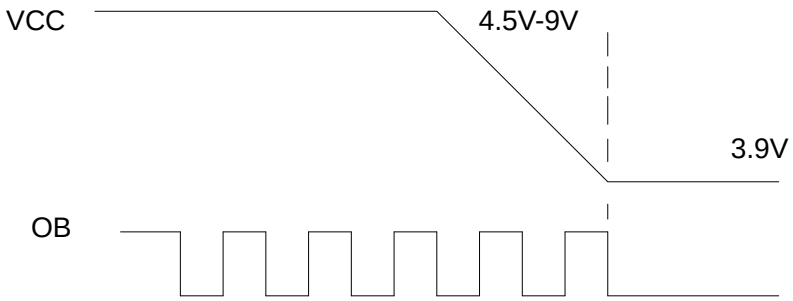


Fig.3

VCC inside IC is provided with a comparator controller of the upper limit voltage, if VCC tries to be more than 9.9V/12V/22.5V, the comparator will work, FB will be pulled down, and it will lock VCC to 9.9V/12V/22.5V, 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 the function of current limit cycle by cycle. It will test every switching current in every switching cycle, if the current fixed by FB or upper limit current prevention is reached, it will come into the close cycle, and the detection of the current has the function of real-time foreland hide, it can shield the switching peak, and avoid the wrong detection of the switching current. Then the reasonable temperature compensation eliminates the influence of temperature, comparing with normal MOSFET (the alteration of Ron will be large when the temperature changes) switching chip, the switching current can always be very accurate in a larger range, thus not too much allowance is needed to match a larger working temperature range for the designer when he designs the scenario, and the security of the circuit for use can be improved.

The maximum limit value of switching current for ME8115 is 0.80A. When designing a flyback power with 65V of emitter voltage and 0.8A of switching current, it can accomplish the output power of more than 12W easily, and meet the broad temperature range.

Requirement of heat elimination

As for a typical power switch, it must have necessary heat elimination measures, so as to avoid that the excessive heat leads to heat protection. The primary heat inside IC is produced by the on-off wasting of the switching tube, so appropriate heat elimination position is Pin7-8 pin of IC, one wieldy way is to pave PCB copper foil of a certain area on Pin7-8 pin, what's more, plating tin on the copper foil will improve the heat elimination ability greatly. For an input of 85-265V, the typical application of 12W output and 200mm^2 copper foil are necessary. Reference wiring is as Fig.4:

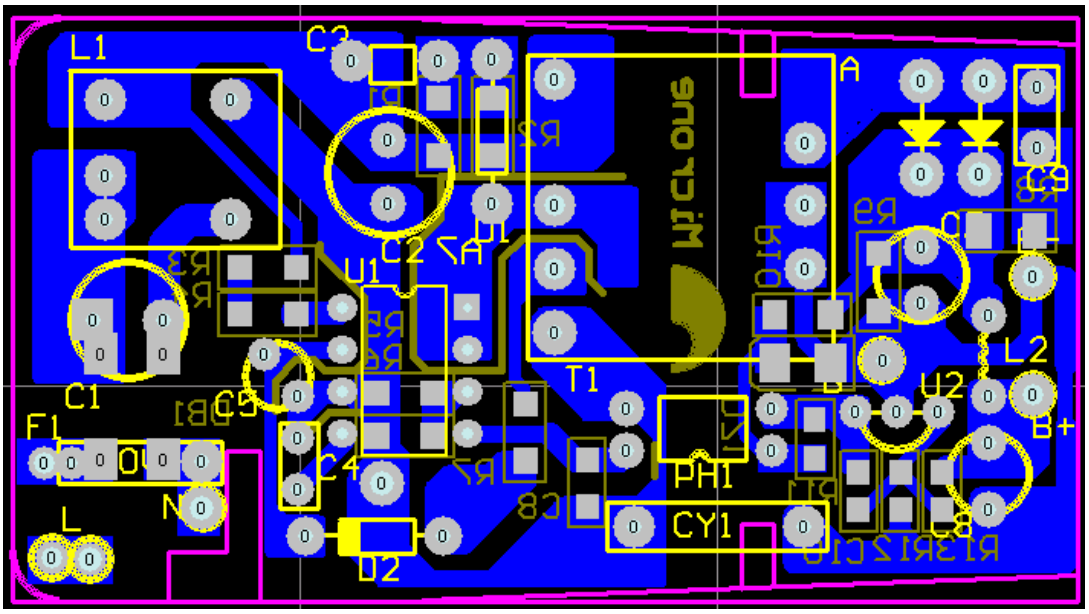
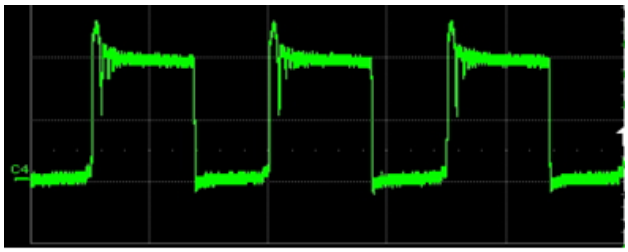


Fig.4

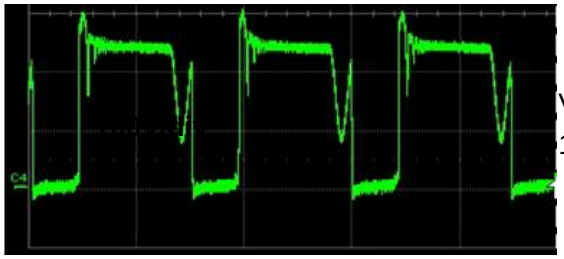
Primary waveform of testing point

1.VDS waveform diagram (X-axis: 10μS/div; Y-axis: 100V/div)

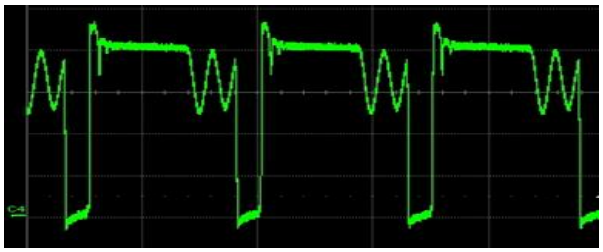
Vin=85V AC，Io=1A



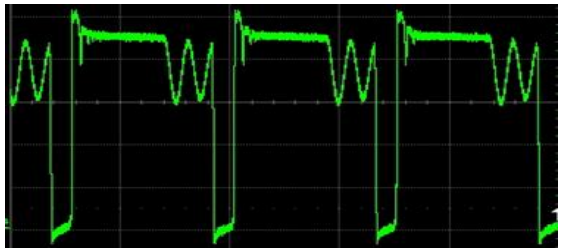
Vin=115V AC，Io=1A



Vin=230V AC，Io=1A

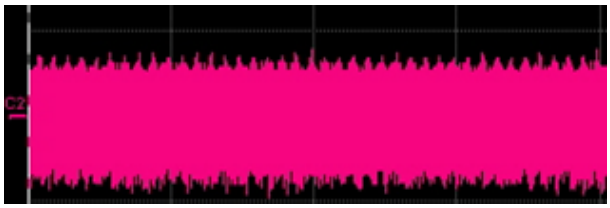


Vin=264V AC，Io=1A



2.Output noise waveform

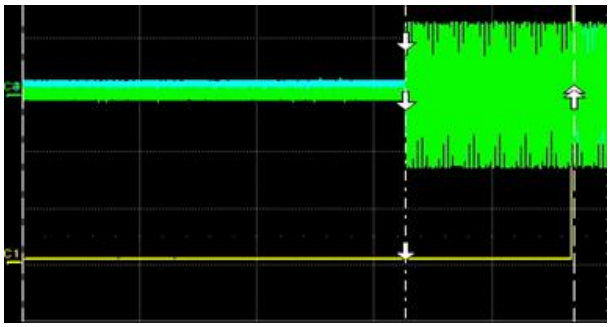
Vin=115V AC，Io=1A



Vin=230V AC，Io=1A

3.Output waveform on start-up

Vin=85V，Io=1A



Vin=265V，Io=1A

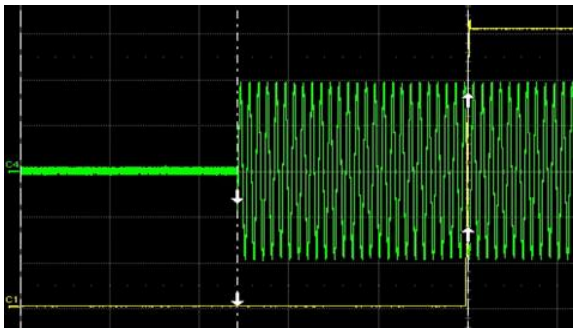
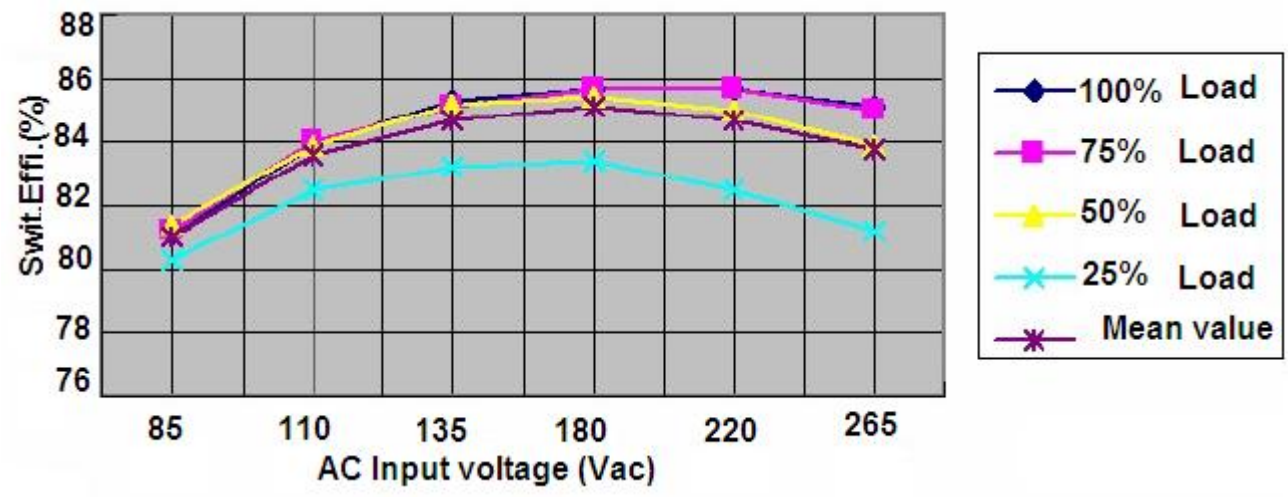
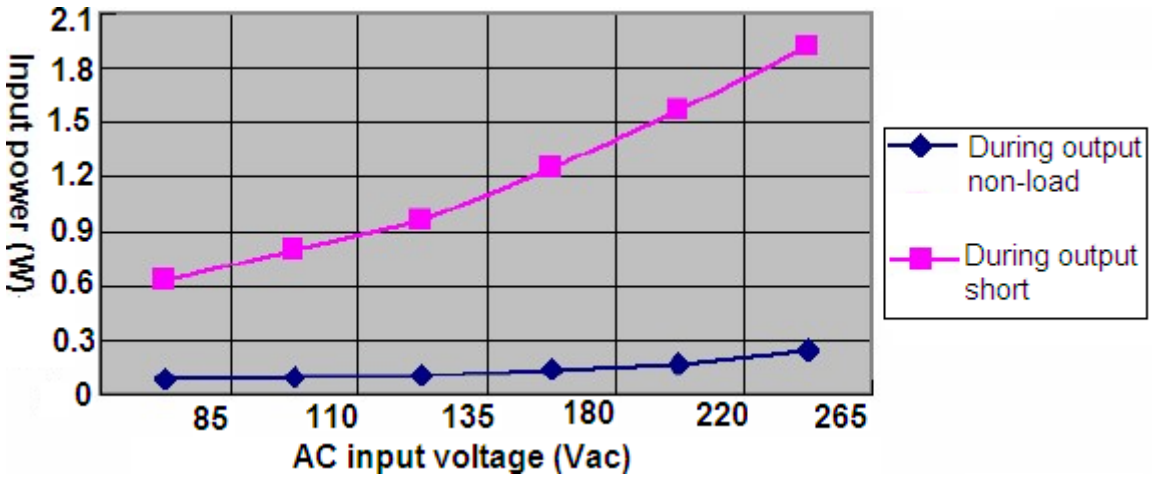


Diagram of Switch efficiency and input power consumption

Efficiency curve under various conditions of input and output

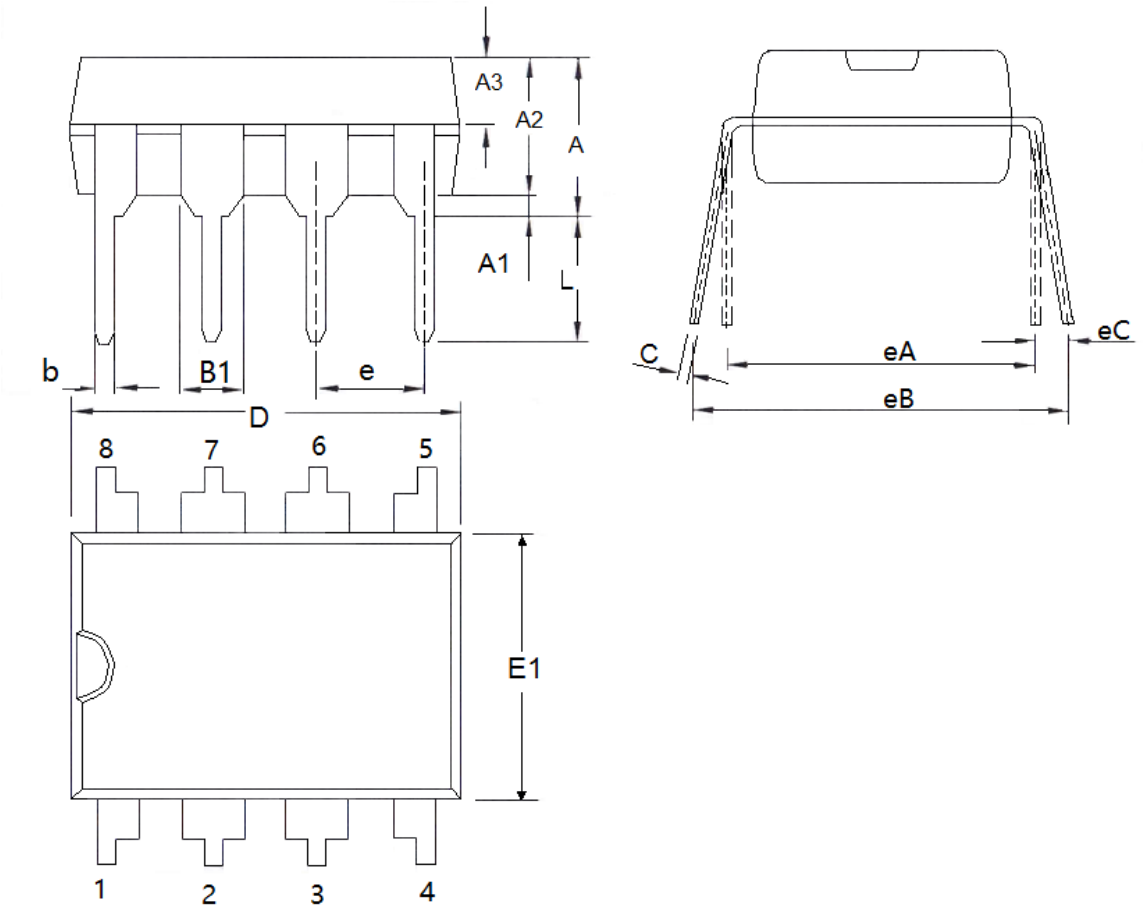


Input power curve during non-load



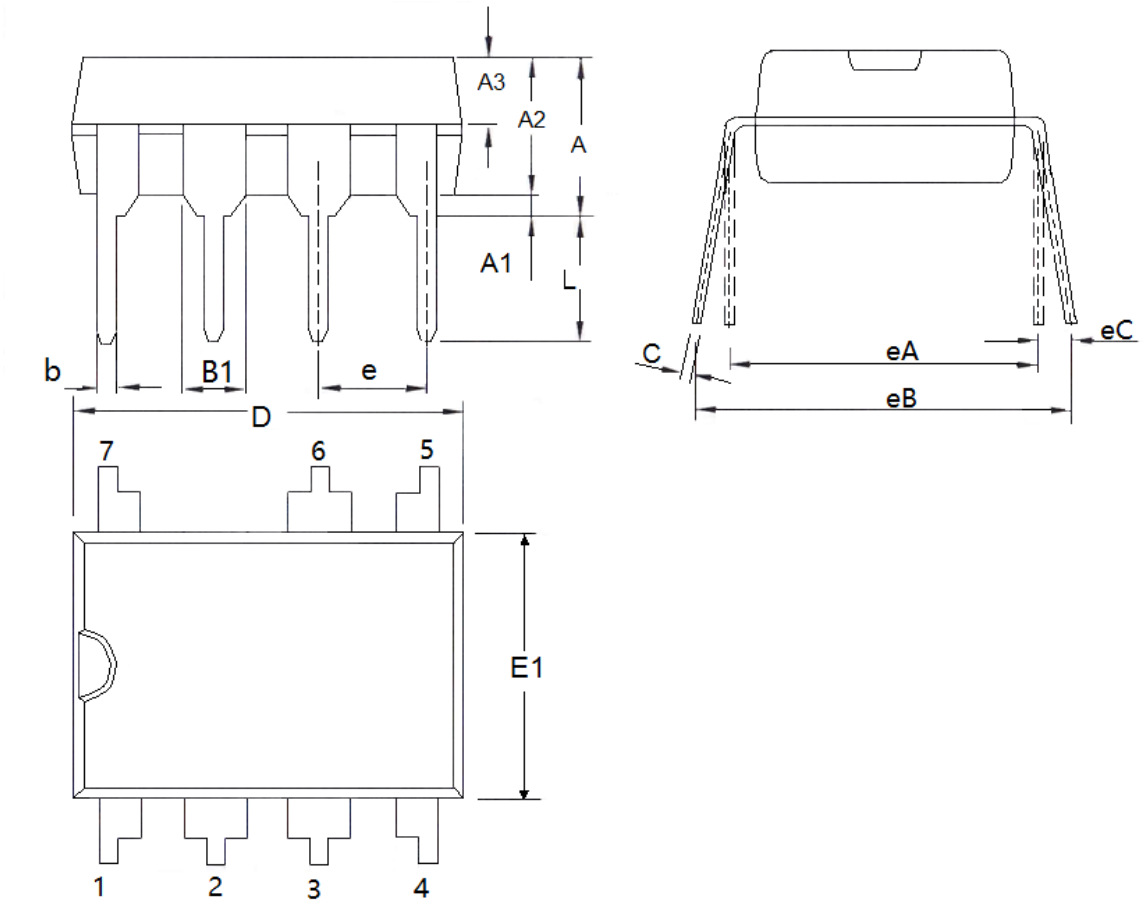
Packaging Information

- **DIP8**



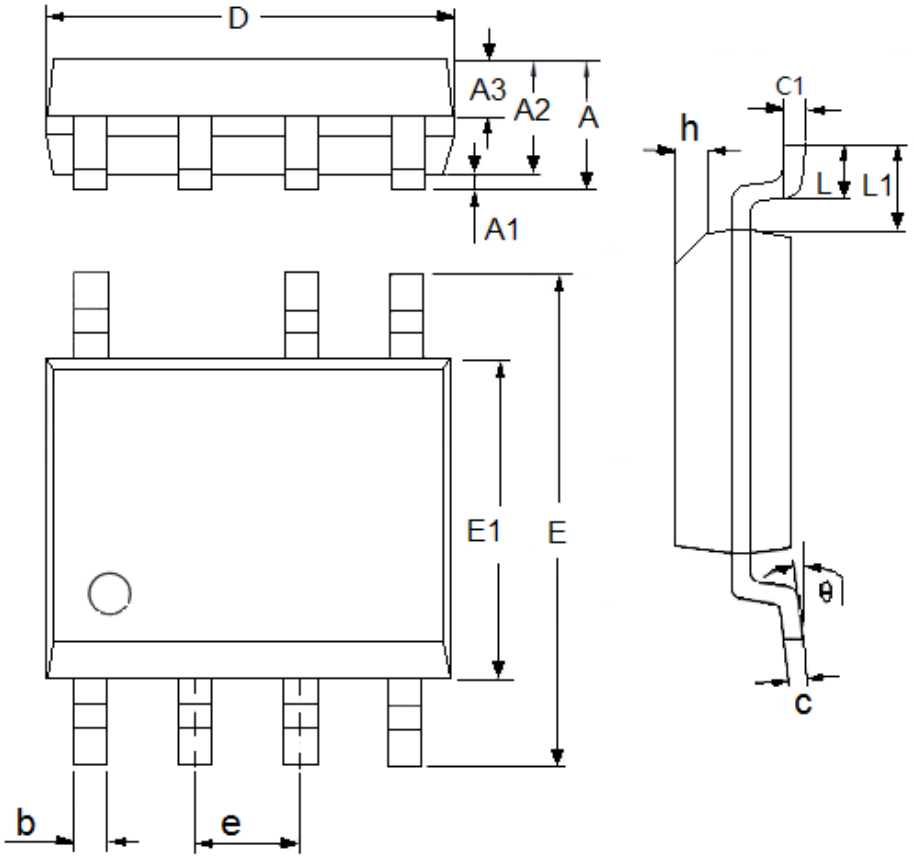
DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	3.6	4.31	0.1417	0.1697
A1	0.5(TYP)		0.0197(TYP)	
A2	3.2	3.6	0.1260	0.1417
A3	1.47	1.65	0.0579	0.0650
b	0.38	0.57	0.0150	0.0224
B1	1.52(TYP)		0.0598(TYP)	
C	0.2	0.36	0.0079	0.0142
D	9	9.4	0.3543	0.3700
E1	6.1	6.6	0.2402	0.2598
eA	7.62(TYP)		0.3(TYP)	
eB	7.62	9.3	0.3000	0.3661
e	2.54(TYP)		0.1(TYP)	
eC	0	0.84	0.0000	0.0331
L	3	3.6	0.1181	0.1417

- **DIP7(B)**



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	3.6	4.31	0.1417	0.1697
A1	0.5(TYP)		0.0197(TYP)	
A2	3.2	3.6	0.1260	0.1417
A3	1.47	1.65	0.0579	0.0650
b	0.38	0.57	0.0150	0.0224
B1	1.52(TYP)		0.0598(TYP)	
C	0.2	0.36	0.0079	0.0142
D	9	9.4	0.3543	0.3700
E1	6.1	6.6	0.2402	0.2598
e A	7.62(TYP)		0.3(TYP)	
e B	7.62	9.3	0.3000	0.3661
e	2.54(TYP)		0.1(TYP)	
e C	0	0.84	0.0000	0.0331
L	3	3.6	0.1181	0.1417

- **SOP7**



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.35	1.75	0.0531	0.0689
A1	0.05	0.25	0.0020	0.0098
A2	1.25	1.65	0.0492	0.0650
A3	0.5	0.7	0.0197	0.0276
b	0.33	0.51	0.0130	0.0201
c	0.17	0.25	0.0067	0.0098
D	4.7	5.1	0.1850	0.2008
E	5.8	6.2	0.2283	0.2441
E1	3.8	4	0.1496	0.1575
e	1.27(TYP)		0.05(TYP)	
h	0.25	0.5	0.0098	0.0197
L	0.4	1.27	0.0157	0.0500
L1	1.04(TYP)		0.0409(TYP)	
θ	0	8°	0.0000	8°
c1	0.25(TYP)		0.0098(TYP)	

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