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Features

◆ Less than 75mW standby power consumption Integrated 650V MOSFET

◆ Multi-Mode Operation：

Fixed 65kHz@Heavy Load

Green mode@ Middle and Light Load

Burst Mode@ No Load

Frequency shuffling for EMI

◆ Power on 4ms soft start

◆ Audio noise free operation

◆ Built-in synchronous slope compensation

◆ Built-in leading-edge blanking (LEB) function

◆ Over Load Protection(OLP) and Cycle-by-Cycle Current Limiting Protection(OCP)

◆ Over voltage protection(OVP), Over temperature protection(OTP), VDD over voltage clamp and under voltage lockout with hysteresis(UVLO)

◆ SOP8 Pb-free Package

Applications

◆ Cell Phone Charger

◆ AC/DC Adapter

◆ Set-TOP Box Power Supply

◆ Auxiliary Power

General Description

The IP6648 integrated a current mode PWM controller and a high voltage power MOSFET, which is applied to power less than 18W. IP6648 operates in the fixed frequency at heavy load and operates in Green Mode at no load or light load.Slope compensation circuit is integrated in IP6648, which improves system large signal stability and reduces the possible sub-harmonic oscillation at high PWM duty cycle. Leading-edge blanking on current sense input eliminates the signal glitch due to snubber circuit diode reverse recovery current. Frequency Shuffling technique is integrated in IP6648, which helps to achieve excellent EMI performance. IP6648 offers complete protection functions with auto-recovery including cycle-by-cycle current limiting protection (OCP), over load protection (OLP), VDD over voltage protection(OVP), VDD over voltage clamp and under voltage lockout (UVLO). Driven by internal totem pole can improve the EMI characteristics of the system and the soft start control of the switch. IP6648 is offered in SOP8 Pb-free package.
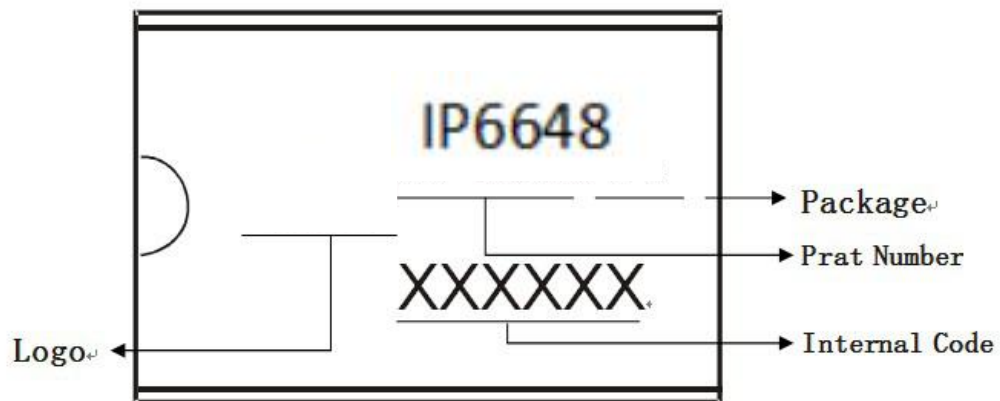
Simplified Application
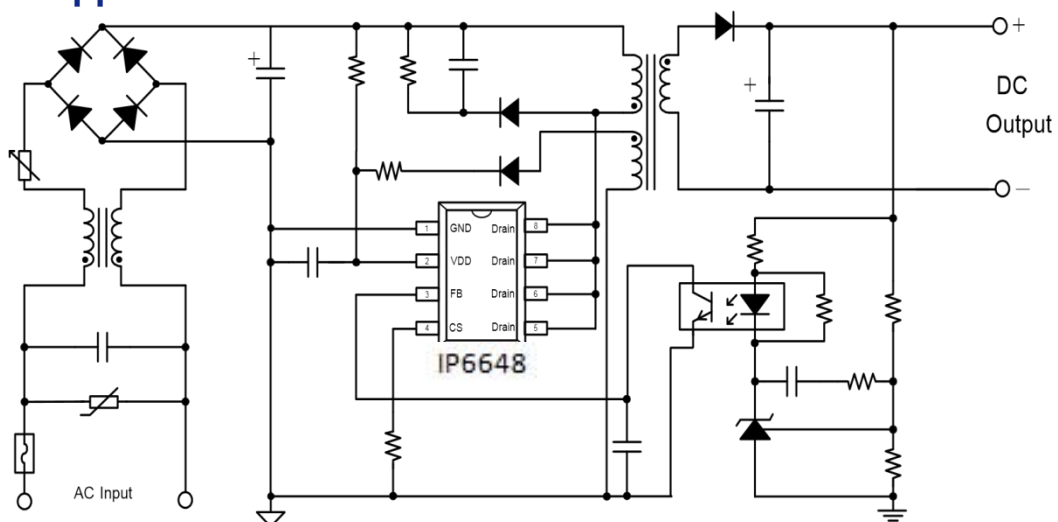
Pin Function Description
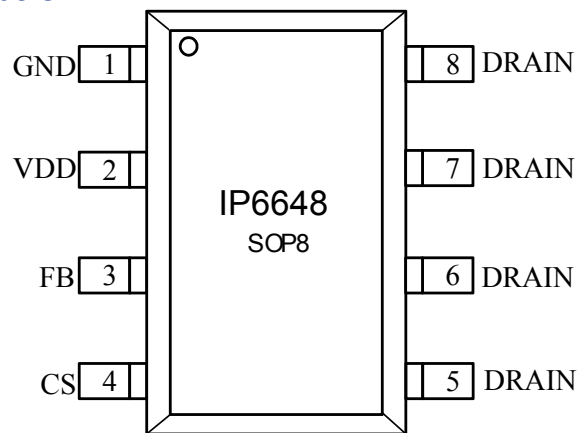
Pin No	Pin Name	Function Description
1	GND	Ground
2	VDD	Power Supply for IC
3	FB	Feedback Input Pin
4	CS	Current Sense Input Pin
5/6/7/8	DRAIN	Connected to the Drain of Internal Power MOSFET

Ordering and Marking Information

Package Dissipation Rating

Package	θ JC（℃/W）	θ JA（℃/W）
SOP-8	50	130

Absolute Maximum Ratings

Symbol	Description	Value	Units
V_{DRAIN_MAX}	Drain Input Voltage	650	V
V_{DD}	VDD Input Voltage	40	V
I_{DD}	VDD input current	10	mA
V_{FB}	FB Input Voltage	-0.3~7	V
V_{CS}	CS Input Voltage	-0.3~7	V
$T_{STORAGE}$	Min/Max Storage Temperature	-55 to 160	℃
T_J	Operating Junction Temperature	150	℃
T_{LEAD}	Lead Temperature(Soldering,10secs)	260	℃

Product information

Product Number	Package Description
IP6648	SOP8、Pb-free

Recommended Operating Conditions

Symbol	Description	Value	Units
VDD	VDD Supply Voltage	9~34	V

Output Power Table

Part Number	90VAC to 265VAC	
	Airtight space	Open space
IP6648	18W	

Note: The temperature of the environment is not higher than 45, and the Drain foot has a larger area of copper coating to improve heat dissipation.
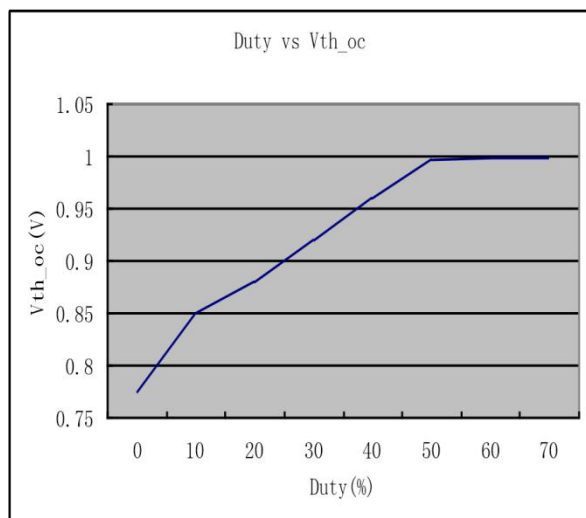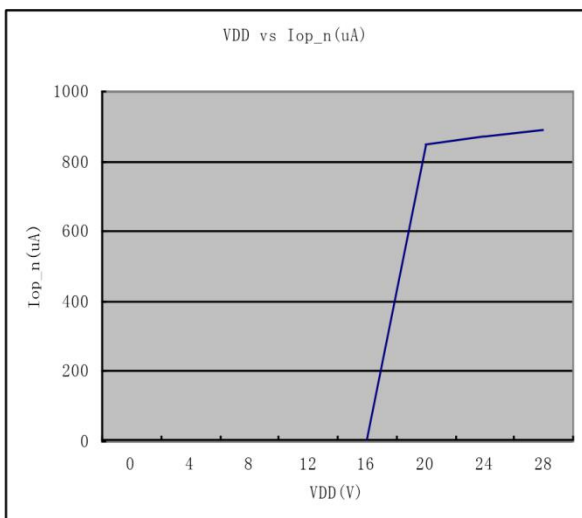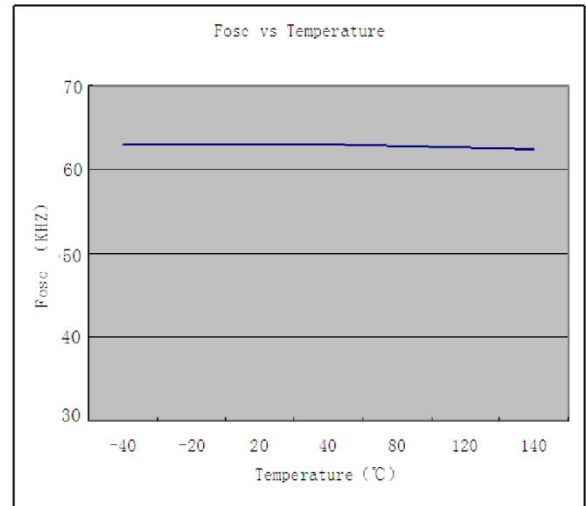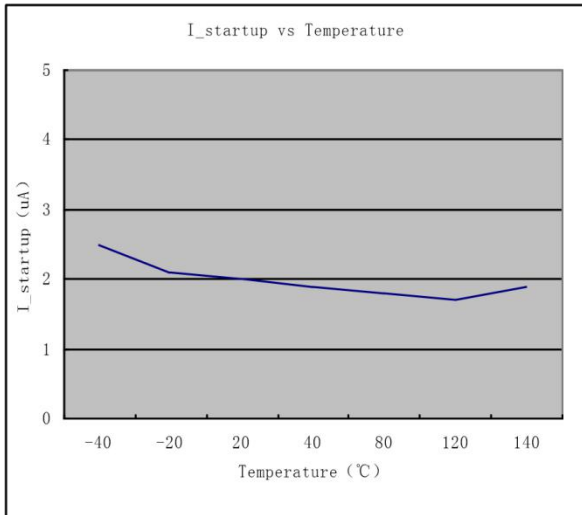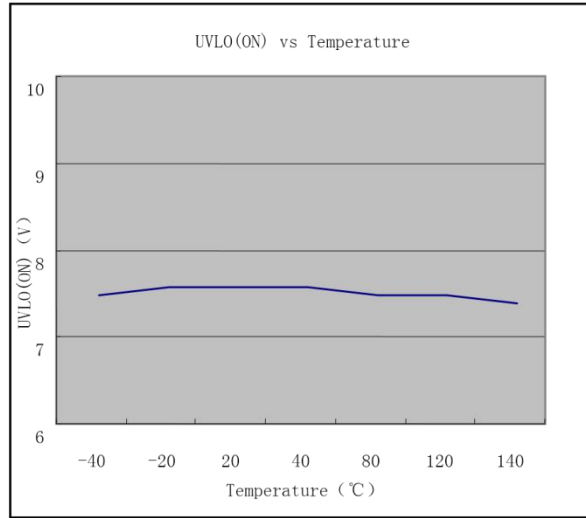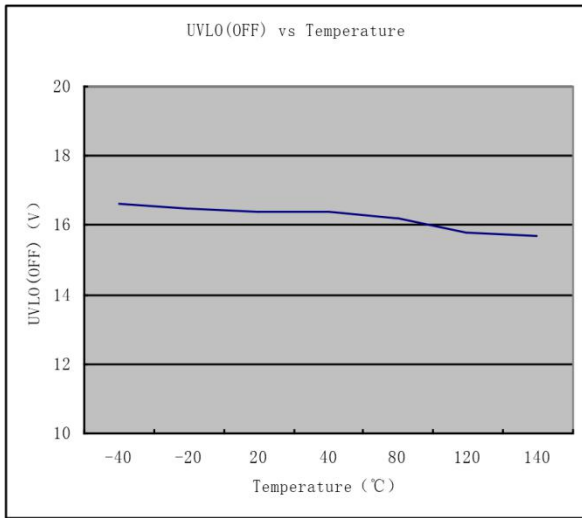
Block diagram
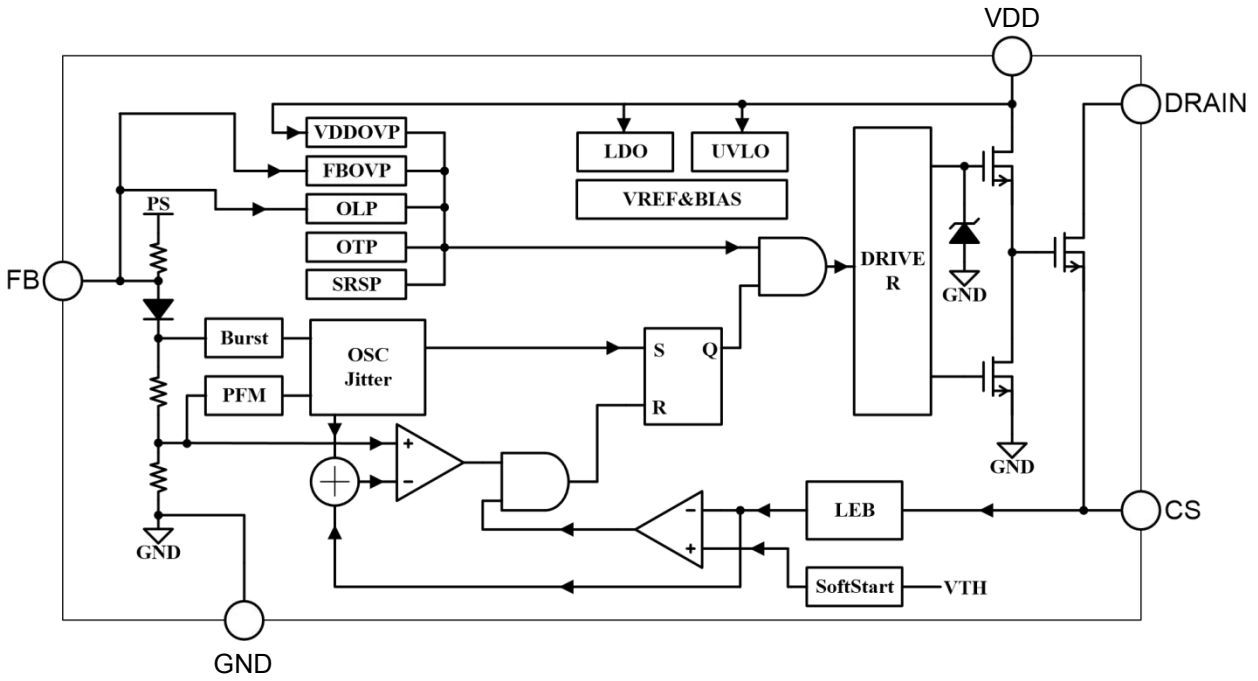
Electrical Characteristics

Test conditions: TA=25, VDD=17V. Exceptions are excepted

Symbol	Description	Test Conditions	Min	Typ	Max	Units
I_{DD_ST}	Start up Current	VDD = $V_{uvlo（OFF）}$ -1 V , measure current into VDD		5	20	uA
I_{OP}	Operation Current	VDD=17V, VFB=3V, VCS=0V		1.5		mA
$V_{uvlo（ON）}$	VDD Under Voltage Lockout Enter	VDD Going Down	7.0	7.7	8.4	V
$V_{uvlo（OFF）}$	VDD Under Voltage Lockout Exit	VDD Going Up	15.2	16.2	17.2	V
VDD_ET	Frequency hopping protection voltage	FB=0V, CS=0V	7.7	8.2	8.7	V
V_{OVP}	Overvoltage protection	VDD=17V, VCS =0V, VFB =3V, VDD rise until DRAIN end frequency disappears.	35	36.5	38	V
V_{FB_OPEN}	FB open loop voltage		4.9	5.5	6.1	V
I_{FB_SHORT}	FB short circuit current	VDD=17V, FB short circuit to ground current		0.35		mA
V_{TH_PL}	Zero Duty Cycle FB Threshold Voltage	VDD=17V, VCS=0V, VFB=3V,FB up to power pipe off		4.0		V
V_{TH_GREEN}	Green Mode	VDD=17V, VCS=0V, VFB=3V, FB drops, when the DRIAN end frequency is less than 35KHZ		2.2		V
T_{LEB}	LEB time			270		ns
Z_{CS_IN}	CS Input Impedance			40		KΩ
T_{OVP_delay}	Overvoltage protection delay	OVP potential exceeds 2.5V and triggers continuously		8		Cycle
V_{TH_OC}	CS Overcurrent protection threshold	VDD=17V, VFB=3V, CS up to off power pipe	0.72	0.77	0.82	V
T_{D_OC}	Over current protection delay time	Delay time from overcurrent protection to power transistor shutdown		120		ns
F_{OSC}	oscillation frequency	VDD=17V ,VFB=3V,VCS=0V	60	65	70	KHz
D_{MAX}	Maximum duty cycle	VDD=17V ,VFB=3.3V,VCS=0V	65	70	85	%
F_{BURST}	Burst Mode Frequency			22		KHz

ΔF_{OSC}	Frequency Modulation Range		-4		4	%
$R_{DS(ON)}$	Static Drain To Source On Resistance			1.8		Ω

Typical Performance Characteristics

UVLO(OFF) vs Temperature

UVLO(ON) vs Temperature

I_startup vs Temperature

Fosc vs Temperature

VDD vs Iop_n(uA)

Duty vs Vth_oc

Application Example
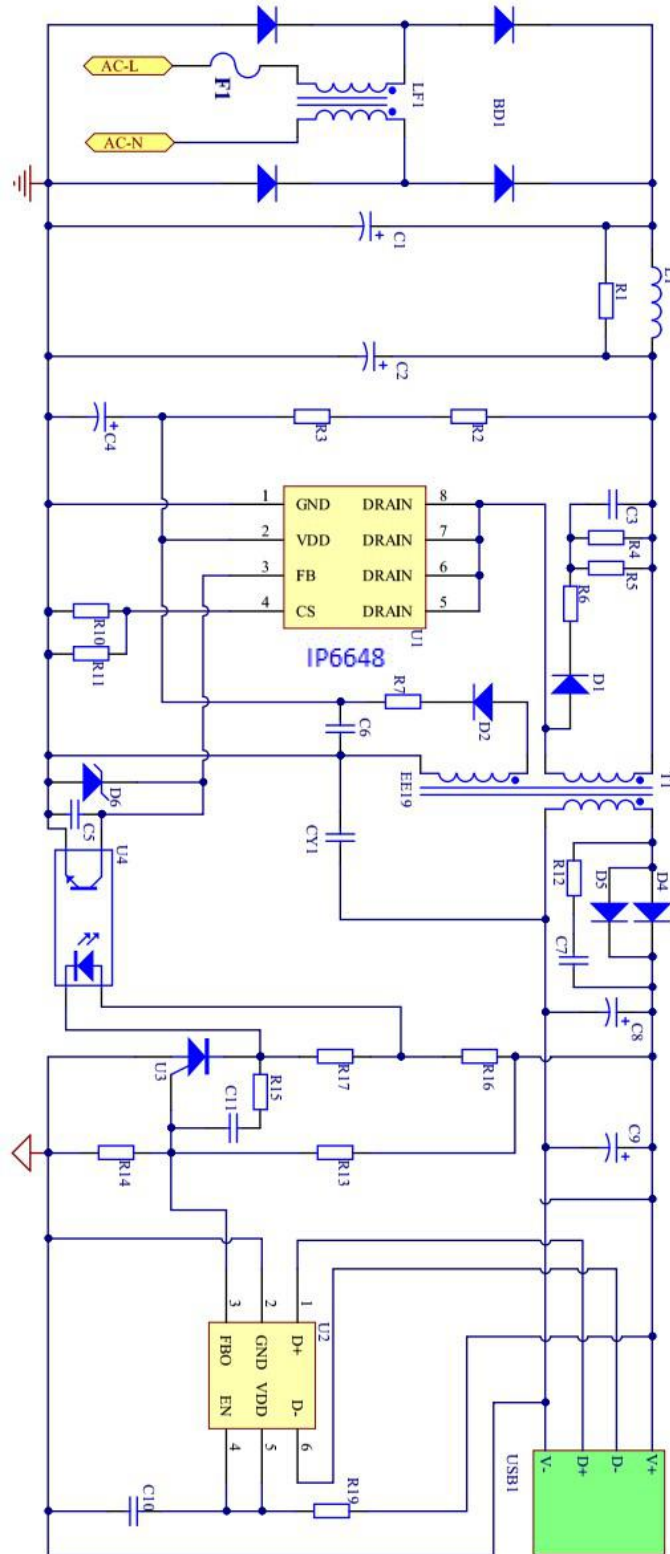
Functional Description

General Description

IP6648 is a low power SMPS (Switching Mode Power Supply) switcher optimized for offline fly-back converter applications ,and applications in sub 18W range. Integrated with functions as frequency Shuffling and extended burst mode control, IP6648 helps to minimize the standby power consumption and improve the EMI performance, which make designs more easily to meet the international power conservation requirements. Start up

Startup current of IP6648 is designed to be very low, so the voltage of the capacitance in VDD could be charged up to the Turn-on level quickly and then IC starts to work. Thus a large value resistor can be used in the startup circuit which will minimize the power loss when startup process is still reliable. For most AC/DC adaptor with universal input range design, two 2MΩ, 1/8W startup resistor could be used together with a VDD capacitance to provide a fast startup and yet low power dissipation design solution. Operating Current

The operating current of IP6648 is about 1.5mA, so using smaller capacitance in VDD PIN can improve efficiency. Soft Start

IP6648 features an internal 4ms(typical) soft start to soften the electrical stress occurring in the power supply during startup. It is activated during the power on sequence. As soon as VDD reaches UVLO(OFF), the peak current is gradually increased from nearly zero to the maximum level of 0.77V. Every restart up is followed by a soft start.

Extended Burst Mode

At no load or light load condition, most of the power dissipation in the system is from switching loss on the power MOSFET, the core loss of the transformer and the loss on the snubber circuit. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency results in less power loss and thus conserves the energy.

The switching frequency is adjusted by the loop and controller IC in the system using IP6648. At no load or light load, the frequency reduces to improve the conversion efficiency, otherwise if FB input drops below the burst mode threshold level, then IP6648 enters burst mode. The gate drive output switches only when FB input is active to output an on state. Otherwise, the gate drive remains at off state to minimize the switching loss and reduces the standby power consumption to the greatest extend. The frequency control also eliminates the audio noise at any loading conditions.

Switching Frequency

The switching frequency of IP6648 is internally set as 65 KHz in PWM mode. No external component is needed to program the switching frequency.

Current sampling and Leading Edge Blanking

Using current mode PWM control, cycle-by-cycle current limiting is offered in IP6648. The switch current is detected by a sense resistor connected to the sense pin. An internal leading edge blanking circuit chops off the sense voltage spike at initial internal power MOSFET on state due to snubber diode reverse recovery and surge gate current of internal power MOSFET so that the external RC filtering on sense input is no longer needed. The current limiting comparator is disabled and cannot turn off the internal power MOSFET during the blanking period. The PWM duty cycle is determined by the current sense input voltage and the FB input voltage.

Internal synchronous slope compensation

Built-in slope compensation circuit adds voltage ramp on the current sense input voltage. This function greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation.

Power MOSFET Driver

For the general power control circuit, the power MOSFET is driven by a dedicated gate driver for power switch control. Too weak the gate driver strength results in higher conduction and switch loss

of MOSFET while too strong gate driver strength results the compromise of EMI.

IP6648 get a good trade off through the built-in totem pole gate design with proper output strength and dead time control. Low idle loss and improved EMI is easier to achieve with this dedicated control scheme. An internal 16V clamp is added for internal MOSFET gate protection at higher than expected VDD input.

Protection Control

IP6648 have rich protection features including cycle-by-cycle current limiting (OCP), over load protection (OLP), over voltage protection (OVP), VDD over voltage clamp and under voltage lockout on VDD (UVLO).

OCP compensation function is integrated in IP6648, with optimized design, OCP threshold

voltage could be compensated with different line voltage, thus constant output power limit over the universal input voltage achieved.

At overload condition, when FB input voltage exceeds power limit threshold value for more than TD_PL, control circuit reacts to shut down the internal power MOSFET.IP6648 restarts when VDD voltage drops below UVLO limit.

VDD is supplied by transformer auxiliary winding output after start up. If the voltage on VDD is higher than VOVP, control circuit reacts to shut down the internal power MOSFET, and then IP6648 enters another startup sequence.

The internal MOSFET is shut down when VDD drops below UVLO limit and then device enters another start-up sequence.

Package Information（Units:mm）
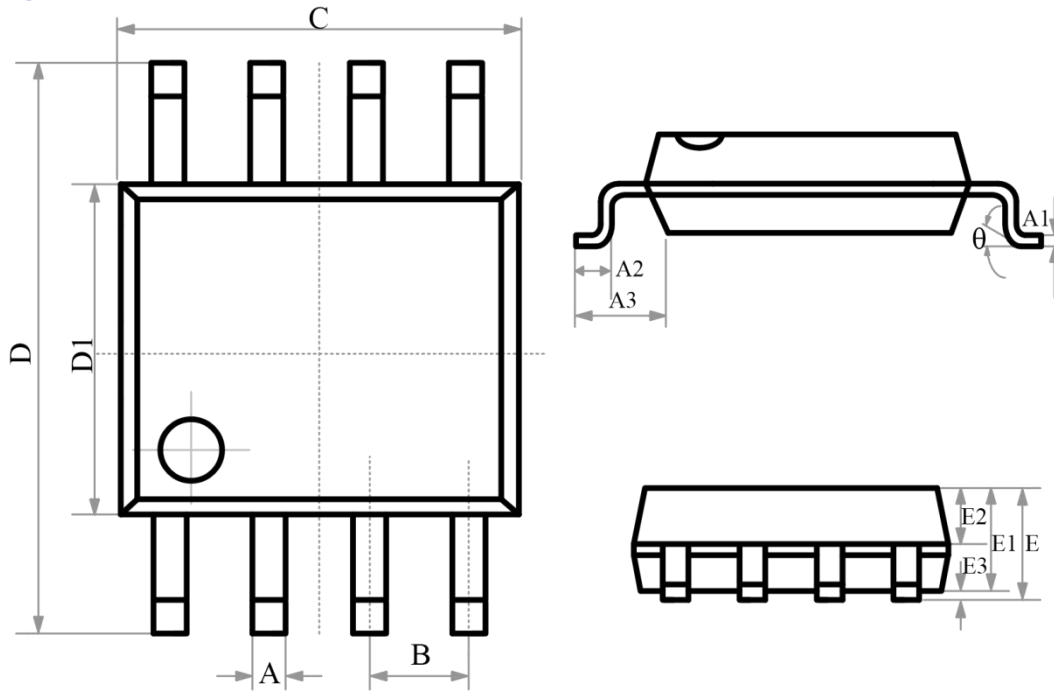
SYMBOL	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.39	-	0.48	0.0154	-	0.0189
A1	0.21	-	0.28	0.008	-	0.011
A2	0.50	-	0.80	0.020	-	0.031
A3	1.05BSC			0.041BSC		
B	1.27BSC			0.050BSC		
C	4.70	4.90	5.10	0.185	0.193	0.201
D	5.80	6.00	6.20	0.228	0.236	0.244
D1	3.70	3.90	4.10	0.146	0.154	0.161
E	-	-	1.75	-	-	0.069
E1	1.30	1.40	1.50	0.051	0.055	0.059
E2	0.60	0.65	0.70	0.024	0.026	0.028
E3	0.10	-	0.225	0.004	-	0.009
θ	0	-	8°	0	-	8°

Restrictions on Product Use

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◆ Any semiconductor product has a certain failure or failure under certain conditions, the buyer has the responsibility to comply with the safety standards and take safety measures in the use of the company's products for system design and machine manufacturing, in order to avoid potential failure risks that may cause personal injury or property loss.

◆ The promotion of the product is endless. Our company will try our best to provide better products for our customers.

Revision History

Change Date	Rev.	Description of Change
2018/4/10	1.0	