DESCRIPTION

The AP8012 combines a dedicated current mode PWM controller with a high voltage power MOSFET on the same silicon chip.

Typical Power Capability:

Type	SOP8	DIP8
European (195-265 Vac)	8W	13W
US (85-265 Vac)	5 W	8W

The AP8012 is available in SOP8 and DIP8 package.

ORDERING INFORMATION

Package Type	Part Number	
SOP8	M8	AP8012M8U
		AP8012M8R
		AP8012M8VU
		AP8012M8VR
DIP8	P8	AP8012P8U
		AP8012P8VU
Note	R: Tape & Reel V: Green Package	
AiT provides all Pb free products Suffix " V" means Green Package		

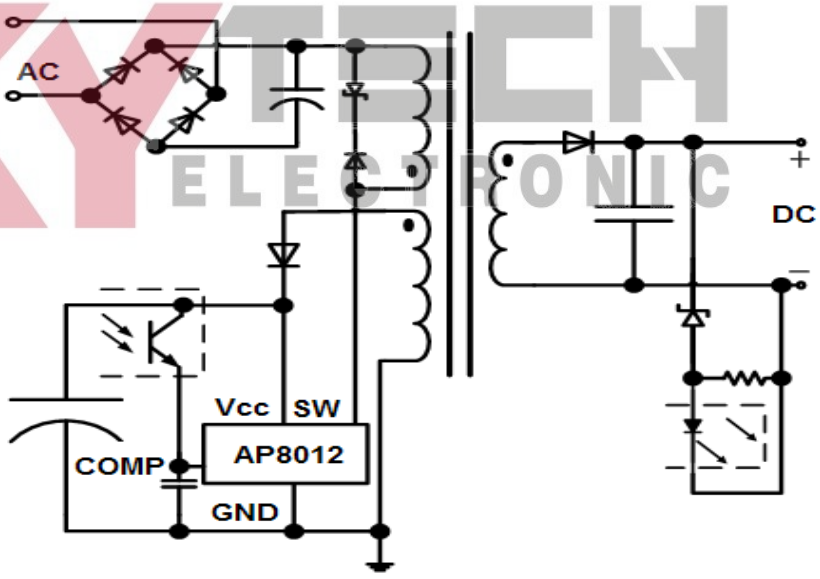
FEATURES

- 85v to 265v wide range AC voltage input
- A 700v MOSFET on the same silicon chip
- Auto start up with high voltage current source
- PWM with current mode control
- 9v to 38v wide range VCC voltage
- Fixed 60KHz switching frequency
- Automatic skip cycle mode in low load condition.
- Over temperature, over current and over voltage protection
- Auxiliary under voltage lockout with hysteresis
- Available in SOP8 and DIP8 Package

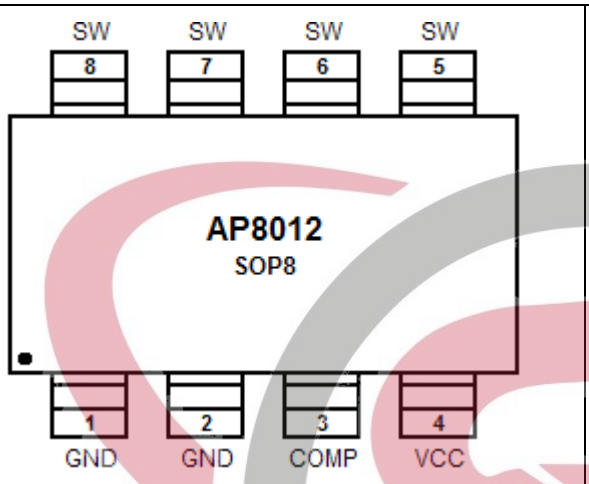
APPLICATION

- Power AC/DC Adapters for Chargers
- DVD/VCD power supplies
- Electromagnetic Oven power supplies
- Air Conditioner power supplies
- STB power supplies
- AC/DC LED Driver Applications

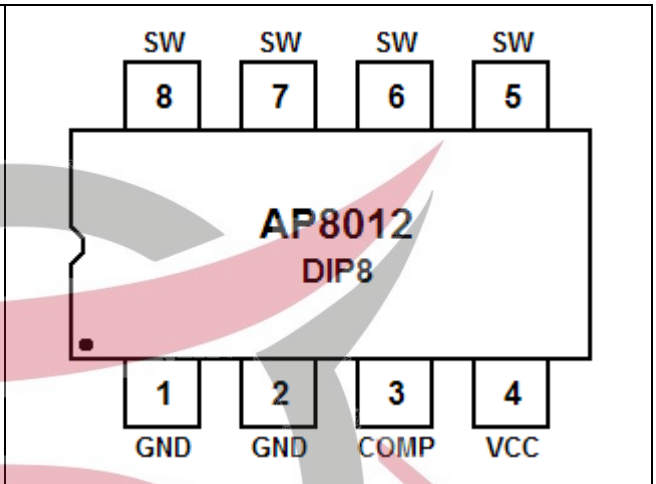
Typical Application



PIN DESCRIPTION



Top View



Top View

Pin #	Symbol	Function
1,2	GND	Sense FET source terminal on primary side and internal control ground.
3	COMP	Feedback input defines the peak drain MOSFET current.
4	VCC	Positive supply voltage input. Although connected to an auxiliary transformer winding, current is supplied from SW via an internal switch during startup (see Internal Block Diagram section). It is not until VCC reaches them UVLO upper threshold (14.5V) that the internal start-up switch opens and device power is supplied via the auxiliary transformer winding.
5,6,7,8	SW	The SW pin is designed to connect directly to the primary lead of the transformer and is capable of switching a maximum of 700V.

ABSOLUTE MAXIMUM RATINGS

(T_A=25°C, unless otherwise specified)

V_{SW}	SW to GND Voltage (T_j=25-125°C)	-0.3 to 730	V
I_D	Continuous VDMOS Drain Current	Internally limited	A
VCC	Supply Voltage	0 to 50	V
I_{COMP}	Feedback Current	3	mA
V_{ESDMM}	Electrostatic Discharge: Machine Model ((R=0Ω; C=200pF)	200	V
V_{ESDHBM}	Electrostatic Discharge: HBM	2000	V
T_j	Junction Operating Temperature	Internally limited	°C
T_c	Case Operating Temperature	-40 to 150	°C
T_{STG}	Storage Temperature	-55 to 150	°C

Stresses above may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

Power

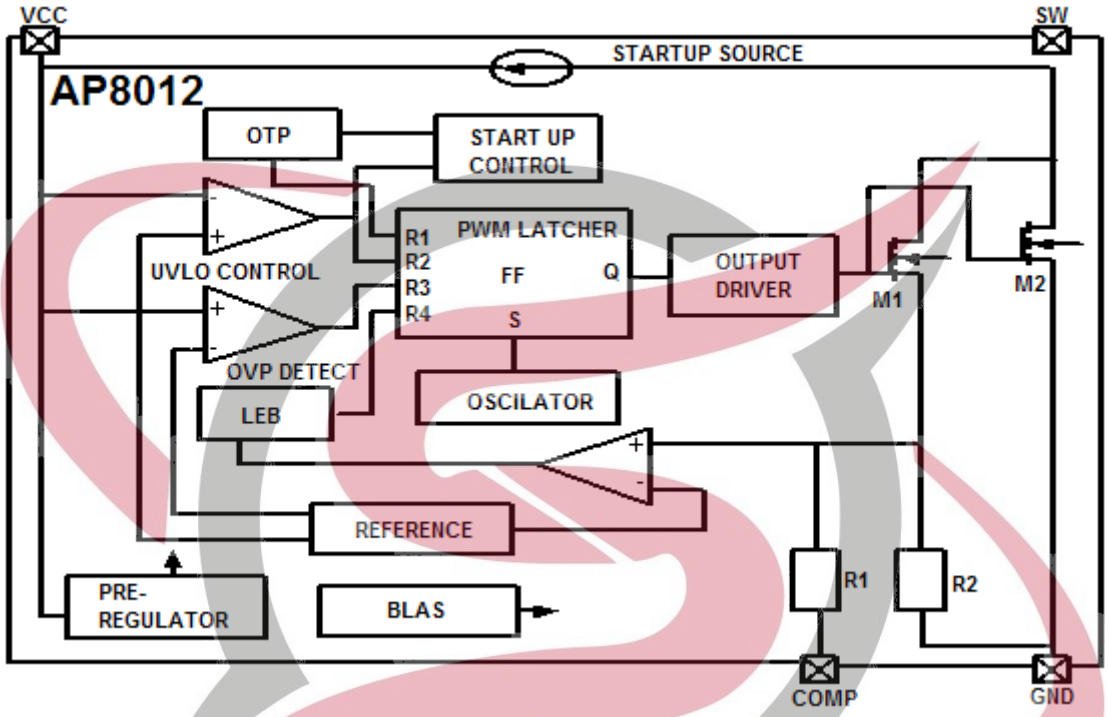
Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
BV_{DSS}	VDMOS Breakdown Voltage	I_D=1mA; V_{COMP}=2V	730			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=500V; V_{COMP}=2V;			100	μA
R_{DSON}	Static Drain-Source on Resistance	V_{GS}=10V I_D=0.4A;		27	30	Ω
T_r	Rise Time	I_D=0.1A; V_{IN}=300V		50		ns
T_f	Fall Time	I_D=0.2A; V_{IN}=300V		100		ns
C_{OSS}	VDMOS Drain Capacitance	V_{DS}=25V		40		pF

Control

(T_A=25°C, VCC=18V, unless otherwise specified)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
UVLO SECTION						
V_{START}	VCC Start Threshold Voltage	V_{COMP}=0V	13	14.5	16	V
V_{STOP}	VCC Stop Threshold Voltage	V_{COMP}=0V	7	8	9	V
V_{HYS}	VCC Threshold Hysteresis		5.8	6.5	7.2	V
OSCILLATOR SECTION						
F_{OSC}	Initial Accuracy	V_{STOP}≤VCC≤35V; 0≤T_j≤ 100°C	54	60	66	kHz
ΔF/ΔT	Frequency Change With Temperature	-25°C ≤ T_j ≤ +85°C		±5	±10	%
FEEDBACK SECTION						
I_{COMP}	Feedback Shutdown Current	Tj=25°C, V_{COMP} = 0V		0.9		mA
R_{COMP}	COMP Pin Input Impedance	ID=0mA		1.2		kΩ
CURRENT LIMIT(SELF-PROTECTION)SECTION						
G_{ID}	I_{COMP} to I_D Current Gain			320		
I_{LIM}	Peak Current Limit	T_j = 25°C	0.32	0.40	0.48	A
T_D	Current Sense Delay to Turn-Off	I_D=0.2A			200	ns
T_B	Blanking Time				500	ns
T_{ONMIN}	Minimum Turn On Time				700	ns
PROTECTION SECTION						
T_{SD}	Thermal Shutdown Temperature		140	170	-	°C
T_{HYST}	Thermal Shutdown Hysteresis			40		°C
V_{OVP}	Over Voltage Protection		38	42	46	V
SUPPLY CURRENT SECTION						
I_{CH}	Startup Charging Current			1		mA
I_{CHOFF}	Start Up Charging Current in Thermal Shutdown	VCC=5V; V_{DS}=100V T_j > T_{SD}			0.2	mA
I_{OP0}	Operating Supply Current (Control Part Only) Switching	V_{COMP} = 0V		4.5		mA
I_{OP1}	Operating Supply Current (Control Part Only) Not Switching	V_{COMP} = 2V		3	5	mA

BLOCK DIAGRAM

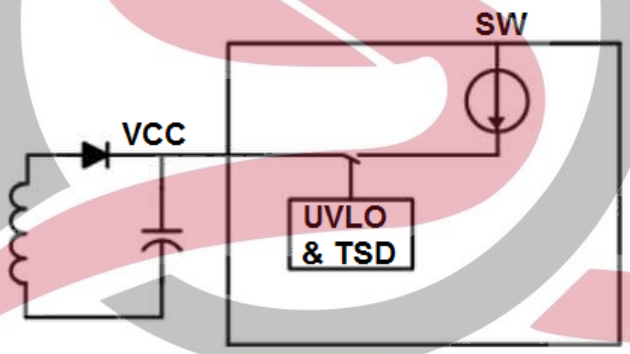


DETAILED INFORMATION

Startup

This device includes a high voltage start up current source connected on the SW of the device. As soon as a voltage is applied on the input of the converter, this start up current source is activated and to charge the VCC capacitor as long as VCC is lower than VSTART. When reaching VSTART, the start up current source is cut off by UVLO&TSD and the device begins to operate by turning on and off its main power MOSFET. As the COMP pin does not receive any current from the opto-coupler, the device operates at full current capacity and the output voltage rises until reaching the regulation point where the secondary loop begins to send a current in the opto-coupler. At this point, the converter enters a regulated operation where the COMP pin receives the amount of current needed to deliver the right power on secondary side.

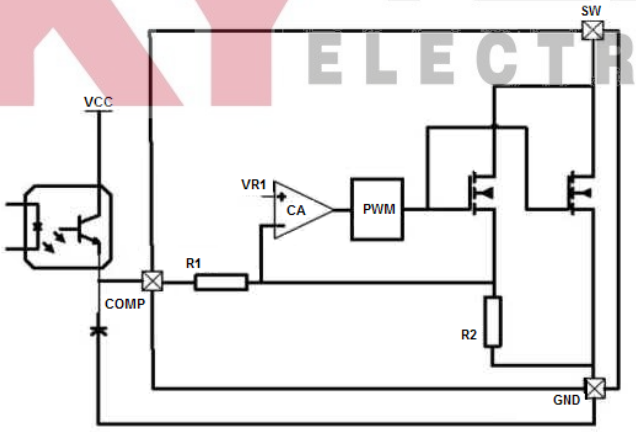
Fig 1. Startup circuit



Feedback

A feedback pin controls the operation of the device. Unlike conventional PWM control circuits which use a voltage input, the COMP pin is sensitive to current. The Fig 2. presents the internal current mode structure.

Fig 2. Feedback Circuit



The Power MOSFET delivers a sense current which is proportional to the main current. R2 receives this current and the current coming from the COMP pin. The voltage across R2 VR2 is then compared to a fixed reference voltage. The MOSFET is switched off when VR2 equals the reference voltage.

Leading Edge Blanking (LEB)

At the instant the internal Sense FET is turned on, there usually exists a high current spike through the Sense FET, caused by the primary side capacitance and secondary side rectifier diode reverse recovery. Excessive voltage across the sense resistor would lead to false feedback operation in the current mode PWM control. To counter this effect, the device employs a leading edge blanking (LEB) circuit. This circuit inhibits the PWM comparator for a short time (typically 500ns) after the Sense FET is turned on.

Under Voltage Lock Out

Once fault condition occurs, switching is terminated and the Sense FET remains off. This causes VCC to fall. When VCC reaches the UVLO stop voltage, 8V, the protection is reset and the internal high voltage current source charges the VCC capacitor. When VCC reaches the UVLO start voltage, 14.5V, the device resumes its normal operation. In this manner, the auto-restart can alternately enable and disable the switching of the power Sense FET until the fault condition is eliminated.

Thermal Shutdown (TSD)

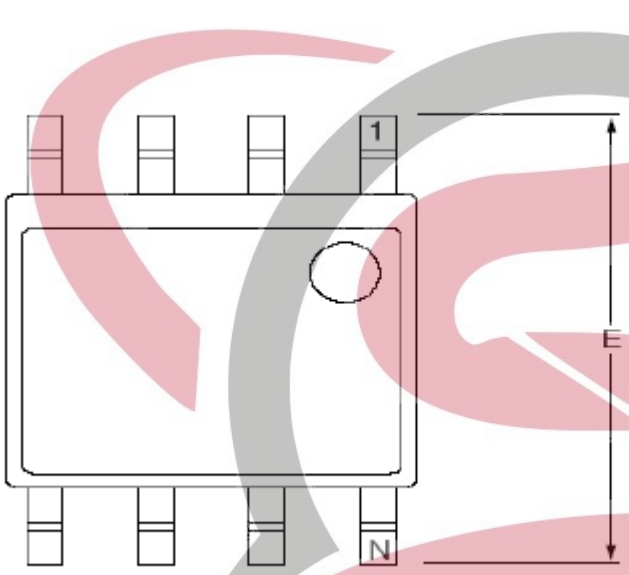
The Sense FET and the control IC are integrated in the same chip, making it easier for the control IC to detect the temperature of the Sense FET. When the temperature exceeds approximately 170°C, thermal shutdown is activated, the device turn off the Sense FET and the high voltage current source to charge VCC. The device will go back to work when the lower threshold temperature about 140°C is reached.

Over Voltage Protection (OVP)

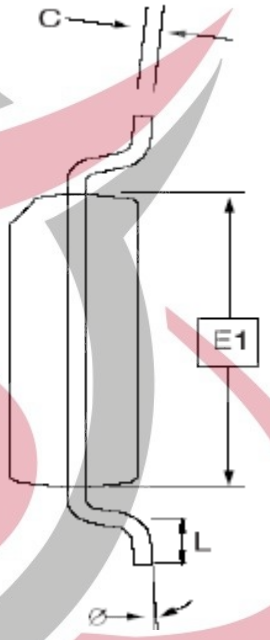
In case of malfunction in the secondary side feedback circuit, or feedback loop open caused by a defect of solder, the current through the opto-coupler transistor becomes almost zero. Because excess energy is provided to the output, the output voltage may exceed the rated voltage, resulting in the breakdown of the devices in the secondary side. In order to prevent this situation, an over voltage protection (OVP) circuit is employed. If VCC exceeds 42V, OVP circuit is activated resulting in termination of the switching operation. In order to avoid undesired activation of OVP during normal operation, VCC should be properly designed to be below 42V.

PACKAGE INFORMATION

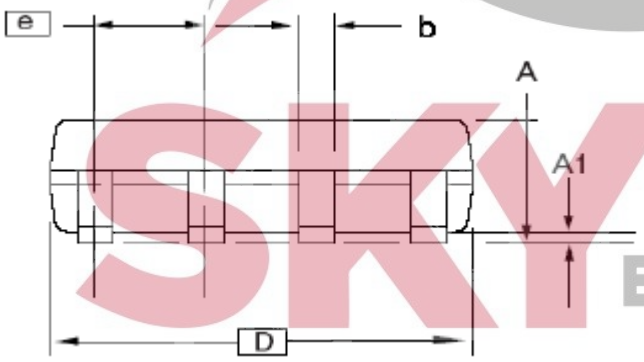
Dimension in SOP8 Package (Unit: mm)



TOP VIEW



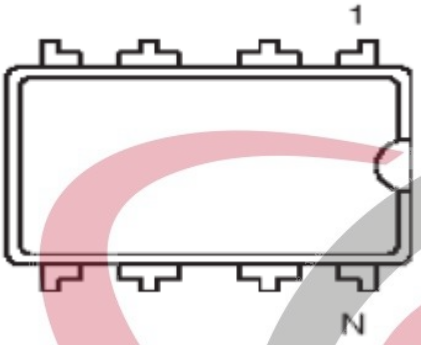
END VIEW



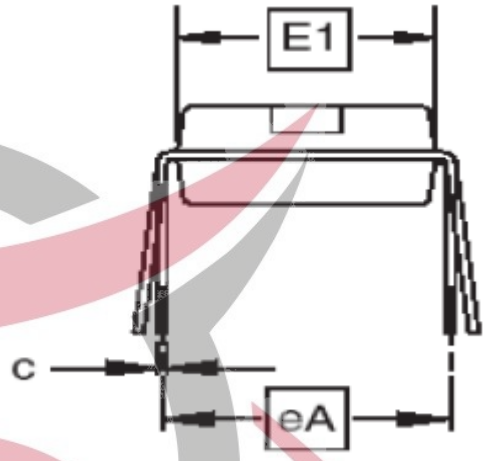
SIDE VIEW

SYMBOL	MIN	NOM	MAX
A	-	-	1.77
A1	0.08	0.18	0.28
B	0.44	-	0.53
C	0.21	-	0.26
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
E		1.27BSC	
Φ	0	-	8°

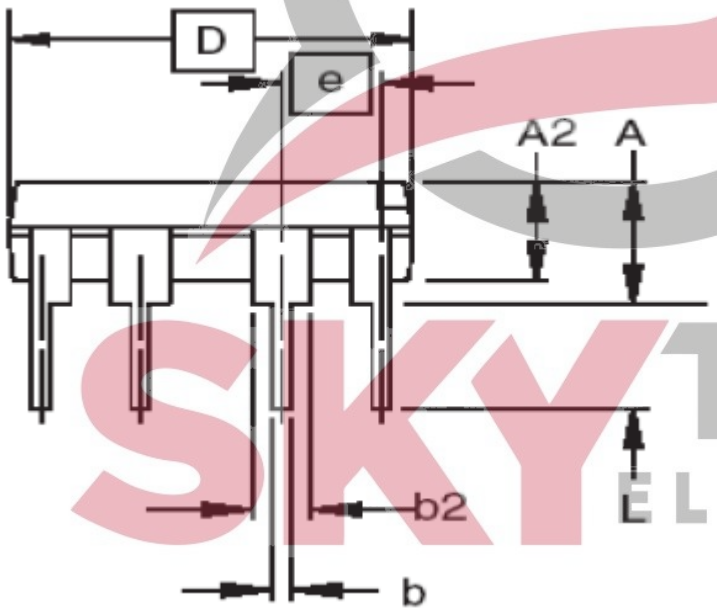
Dimension in DIP8 Package (Unit: mm)



TOP VIEW



END VIEW



SIDE VIEW

SYMBOL	MIN	NOM	MAX
A	3.60	3.80	4.00
A2	3.10	3.30	3.50
b	0.44	-	0.53
B1		1.52BSC	
c	0.25	-	0.31
c1	0.24	0.25	0.26
D	9.05	9.25	9.45
E1	6.15	6.35	6.55
e		2.54BSC	
eA		7.62BSC	
L	3.00	-	-

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