

Low Power Primary Switcher for Off Line SMPS

1. Description

The iP7612S is highly functionally integrated device which combines an integrated PWM controller with current mode control and a high voltage power MOSFET on the same silicon chip.

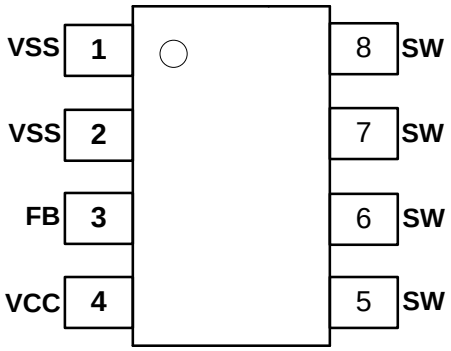
2. Applications

- Off line power supply for battery charger adapters
- Standby power supply for TV or monitors
- Auxiliary supply for motor control
- Air conditioner power supply
- Electromagnetic oven power supply

3. Features

- Fixed 60kHz switching frequency
- 9V to 38V wide range VCC voltage
- Wide AC input range from $85V_{AC}$ to $265V_{AC}$
- PWM with current mode control
- Auxiliary Under Voltage Lock Out with hysteresis
- High voltage start-up current source
- Excellent standby low power consumption
- Over-temperature, Over-current and Over-voltage protection with auto-restart
- Integrated 730V MOSFET
- Burst mode under low load conditions

4. Pin Assignments



SOP-8L

5. Marking Information

Product Name	Marking
iP7612S	iP7612S XXXXX X : Date Code

6. Ordering Code

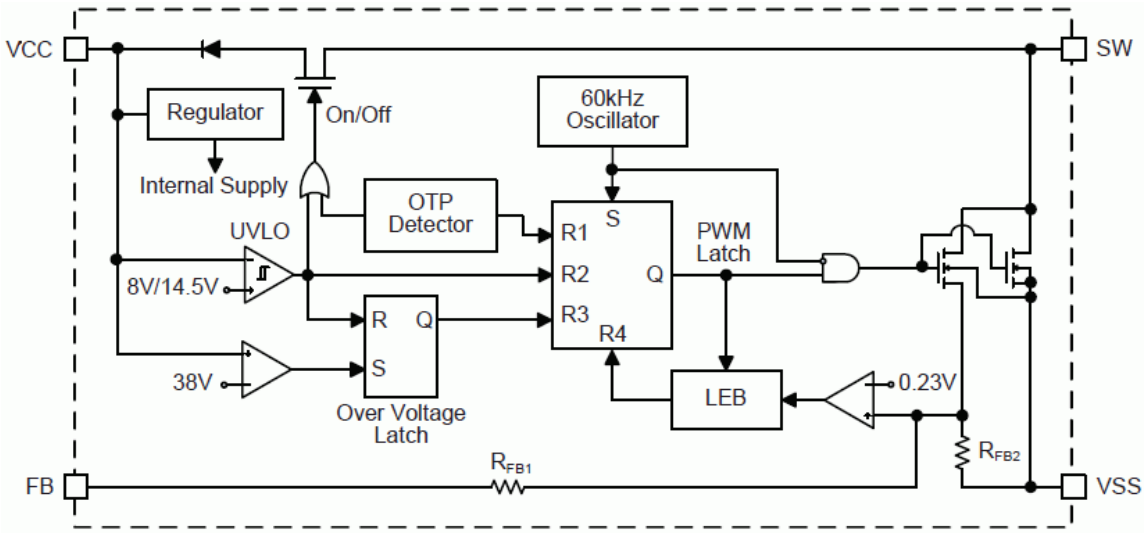
iP7612S □ └── Assembly Material	Assembly Material G: Halogen and Lead Free Device

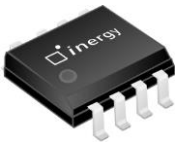
Note: inergy defines “Green” as lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900 ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500 ppm by weight ; Follow IEC 61249-2-21 and IPC/JEDEC J-STD-020C)

7. Pin Description

Pin No	Name	Description
1,2	VSS	Power MOSFET source and circuit ground reference.
3	FB	Feedback input. The useful voltage range extends from 0V to 1V, and defines the peak drain MOSFET current. The current limitation, which corresponds to the maximum drain current, is obtained for when the FB pin is shorted to the VSS pin.
4	VCC	Control circuits power supply. Also provides a charging current during start up thanks to a high voltage current source connected to SW. For this purpose, a hysteresis comparator monitors the VCC voltage and provides two thresholds: V_{CCON}：Voltage value (typically 14.5V) at which the device starts switching and turns off the start up current source. V_{CCOFF}：Voltage value (typically 8V) at which the device stops switching and turns on the start-up current source.
5,6,7,8	SW	Power MOSFET drain. Also used by the internal high voltage current source during the start up phase to charge the external VCC capacitor.

8. Block Diagram





9. Absolute Maximum Ratings

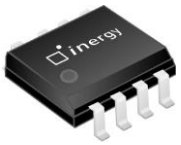
Parameter	Symbol	Value	Unit
Switching Drain Source Voltage (TJ=25 to 125°C) (Note1)	$V_{DS(sw)}$	-0.3 ~ 730	V
Start-up Drain Source Voltage (TJ=25 to 125°C) (Note2)	$V_{DS(st)}$	-0.3 ~ 400	V
Continuous Drain Current	I_D	Internally limited	A
Supply Voltage	V_{CC}	0~41	V
Feedback Current	I_{FB}	3	mA
Electrostatic Discharge: Machine mode	V_{ESD}	400	V
Electrostatic Discharge: Human body mode		3	KV
Operating Temperature Range	T_C	- 40 to + 150	℃
Storage Temperature Range	T_{STG}	- 55 to + 150	℃
Junction Operating Temperature	T_J	Internally limited	℃
Thermal resistance junction-case	R_{THJC}	25	°C/W
Thermal resistance ambient-case(Note3)	R_{THJA}	55	°C/W

Notes: 1. This parameter applies when the start-up current source is off. This is the case when the V_{CC} voltage has reached V_{CCON} and remains above V_{CCOFF}.
2. This parameter applies when the start up current source is on. This is the case when the V_{CC} voltage has not yet reached V_{CCON} or has fallen below V_{CCOFF}.
3. When mounted on a standard single-sided FR4 board with 200mm^2 of Cu (at least 35μm thick) connected to all SW pins.

10. Electrical Characteristics

(Ta=25℃, Vcc =18V,unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage section						
Start-Up Charging Current	I_{CCCH}	V_{DS}=100V; V_{CC}=0V to V_{CCON}	-	-1	-	mA
Start-Up Charging Current In Thermal Shutdown	I_{CCOFF}	V_{CC}=5V;V_{DS}=100V T_J>T_{SD}-T_{HYST}	0	-	-	mA
Operating Supply Current Not Switching	I_{CC}	I_{FB}=2mA	-	0.65	0.8	mA
Operating Supply Current Switching		I_{FB}=0.5mA; I_D=50mA(Note4)	-	0.7	0.9	mA



Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage section						
Restart Duty-Cycle	D_{RST}	-	-	16	-	%
V_{CC} Under-voltage Shutdown Threshold	V_{CCOFF}	-	7	8	9	V
V_{CC} Start-Up Threshold	V_{CCON}	-	13	14.5	16	V
V_{CC} Threshold Hysteresis	V_{CCHYST}	-	5.8	6.5	7.2	V
V_{CC} Over-voltage Threshold	V_{CCOVP}	-	35	38	41	V
Drain section						
Drain-Source Voltage	BV_{DSS}	I_D=1mA; V_{FB}=2V	730	-	-	V
Off State Drain Current	I_{DSS}	V_{DS}=500V; V_{FB}=2V; T_J=125°C	-	-	0.1	mA
Static Drain-Source On State Resistance	$r_{DS(ON)}$	I_D=0.2A	-	19	22	Ω
Fall Time	t_F	I_D=0.1A; V_{IN}=300V(Note5)	-	100	-	nS
Rise Time	t_R	I_D=0.2A; V_{IN}=300V(Note5)	-	50	-	nS
Drain Capacitance	C_{OSS}	V_{DS}=25V	-	20	-	pF
Oscillation section						
Oscillator Frequency Total Variation	f_{OSC}	V_{CC}=V_{CCOFF} to 35V; T_J=0 to 100°C	54	60	66	kHz
PWM comparator section						
IFB to ID Current Gain	G_{ID}	-	-	320	-	-
Peak Current Limitation	I_{DLIM}	V_{FB}=0V	0.32	0.4	0.48	A
IFB Shutdown Current	I_{FBSD}	-	-	0.9	-	mA
FB Pin Input Impedance	R_{FB}	I_D=0mA	-	1.2	-	kΩ
Current Sense Delay to Turn-Off	t_D	I_D=0.2A	-	200	-	nS
Blanking Time	t_B	-	-	350	-	nS
Minimum Turn-On Time	t_{ONMIN}	-	-	550	-	nS
Over temperature section						
Thermal Shutdown Temperature	T_{SD}	-	140	170	-	°C
Thermal Shutdown Hysteresis	T_{HYST}	-	-	40	-	°C

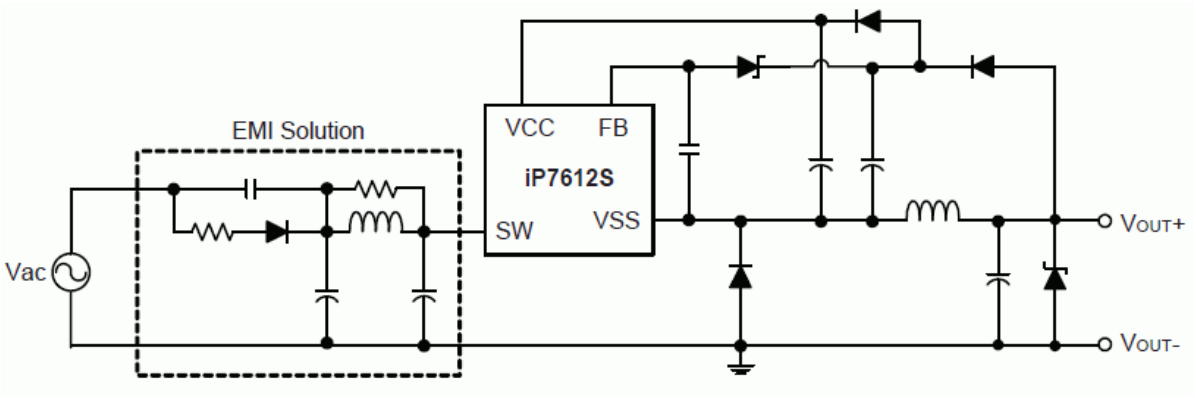
Notes:

Absolute maximum ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. The guaranteed specifications apply only for the test conditions listed.

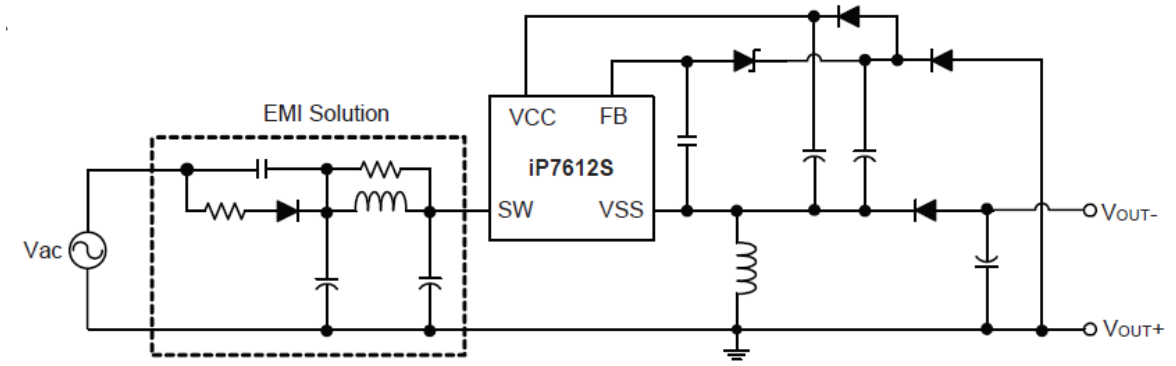
4. These test conditions are obtained with a resistive load which permit the maximum conduction time of the device.
5. For clamped inductive load

11. Application Circuit

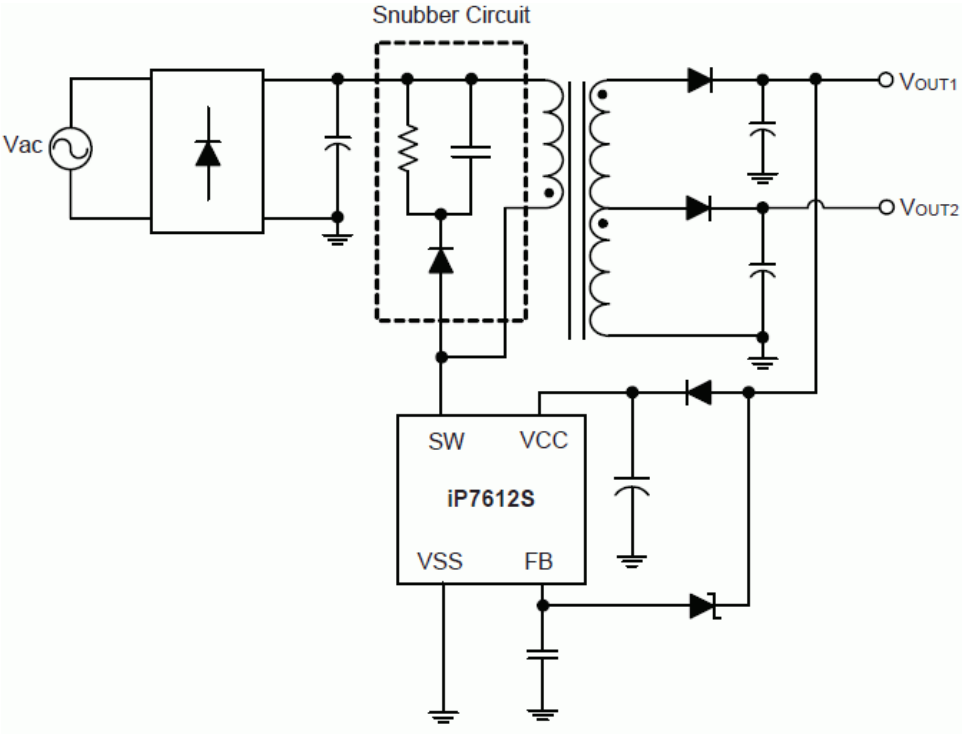
Buck Topology



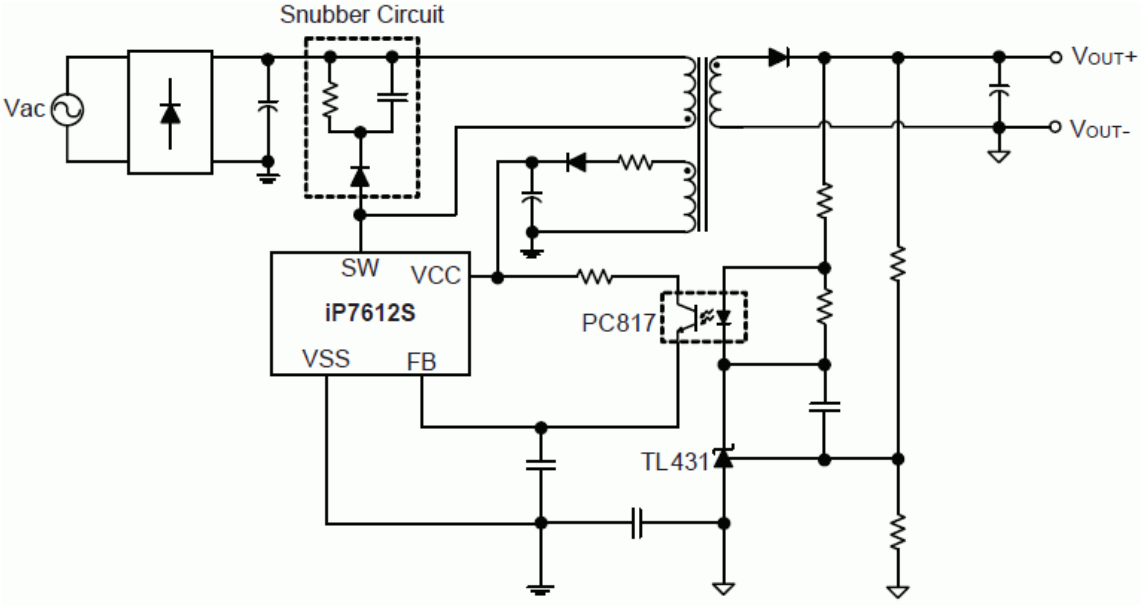
Buck − Boost Topology

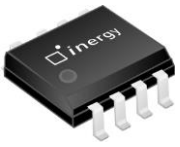


Non-Isolation Flyback Topology



Isolation Flyback Topology





12. Functional Description

The iP7612S is highly functionally integrated device which combines an integrated PWM controller with current mode control and a high voltage power MOSFET on the same silicon chip. The secondary side feedback signal passes through a photo-coupler on the primary side while the output voltage is regulated by the device according to the feedback signal. The device has a small quiescent current and low power consumption when operating in the standby mode. It also has a range of protection features to protect the controller from fault conditions.

a. High Voltage Start up

The SW pin in the device is a high voltage start up current source. This current source will generate a current which is regulated from a high voltage and which will charge the VCC pin until the UVLO is triggered when an AC voltage is applied on the converter input. When the VCC voltage is larger than the UVLO trigger voltage, the high voltage start up current source will be cut off by UVLO and the device will start operation by switching the power MOSFET on and off.

b. Feedback

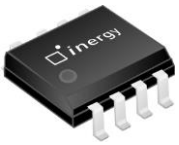
The FB pin determines the device operation. The power MOSFET current will be sensed by the current sensing resistor which is connected between the source terminal of the power MOSFET and the ground terminal. In addition, this sensing resistor also senses the current coming from the FB pin. The voltage across the resistor will be compared to a fixed reference voltage (0.23V). The power MOSFET is turned off when the sensing resistor voltage is larger than 0.23V.

c. Leading Edge Blanking – LEB

When the power MOSFET is turned on, there is usually a high current spike which is generated by the primary side capacitor and the secondary side rectifier diode reverse recovery. This spike will be sensed by the sensing resistor to indicate an excessive voltage which will in turn lead to false feedback operation in the current mode PWM control circuit. In order to avoid this problem, the device includes a leading edge blanking circuit which inhibits the comparator for a short time after the power MOSFET is turned on.

d. Under Voltage Lock Out – UVLO

When the fault condition happens, the device will shut down the power MOSFET and cause the V_{cc} voltage to fall. When the V_{cc} voltage is lower than the UVLO lower voltage (8V), the protection circuits will be reset and the internal high voltage start up current source will charge the V_{cc} capacitor. Not until the V_{cc} voltage reaches the UVLO higher voltage (14.5V), the device will resume normal operation. In this way, the auto-restart function can enable and disable the power MOSFET switching alternately until the fault condition is eliminated.



e. Thermal Shutdown – TSD

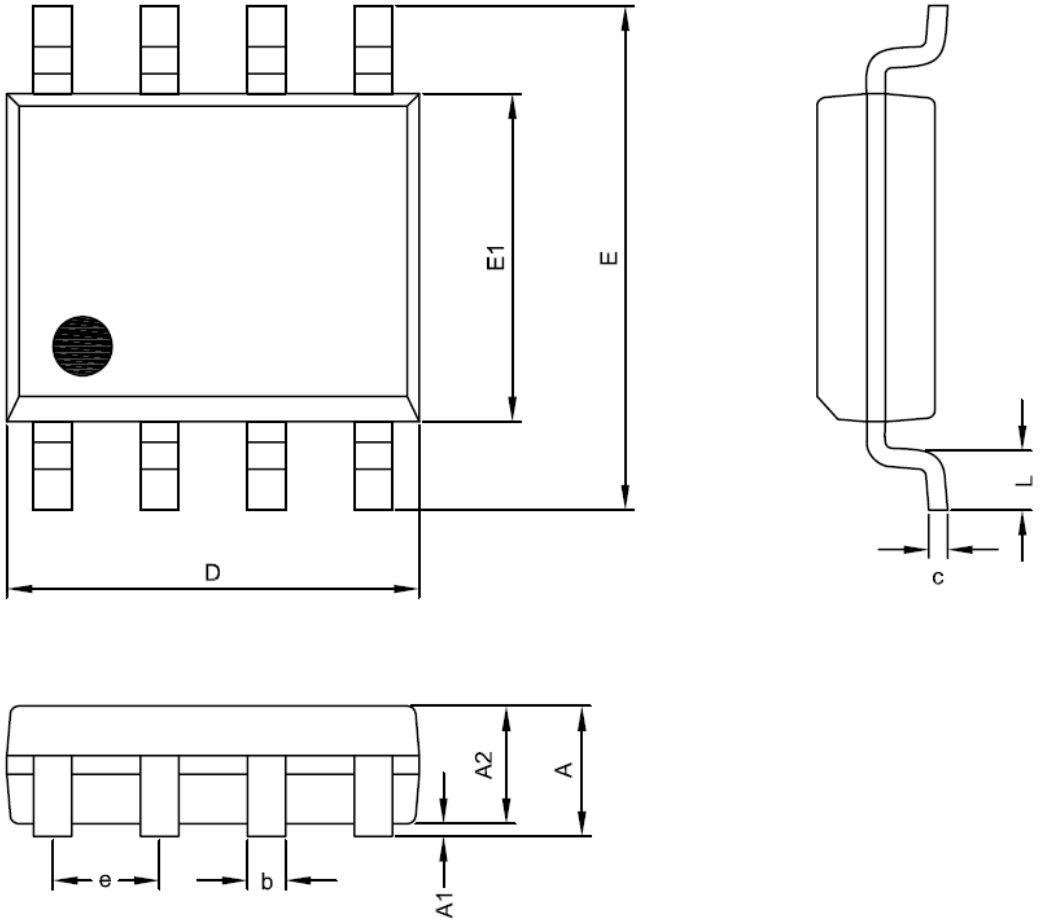
Because the device integrates the controller and the power MOSFET on the same chip, the temperature of the device including the power MOSFET can be easily detected. When the temperature is over 170°C, the thermal shutdown protection function will be active to turn off the power MOSFET. The device will resume normal operation when the device temperature is lower than the recovery temperature of about 130°C and when the VCC voltage is lower than 2V.

f. Over Voltage Protection – OVP

When a malfunction occurs in the secondary side feedback circuit, or if a wiring defect allows the feedback loop to be open, the current through the opto-coupler will be near to zero. At this time, as the excess energy will be supplied to the output, the output voltage may be higher than the regulated voltage and may damage the components in the secondary side. The device includes an over voltage protection function to avoid this condition happening. If the VCC voltage is higher than 38V, the device will be shut down by the OVP protection function to prevent the malfunctions from damaging components.

13. Package Dimensions

SOP- 8L



Symbol	Dimensions In Millimeters	
	MIN.	MAX.
A	1.35	1.75
A1	0.00	0.25
A2	1.15	1.50
D	4.80	5.00
E	5.80	6.20
E1	3.80	4.00
c	0.19	0.27
b	0.33	0.53
e	1.27 BSC	
L	0.40	1.27

Notes：

1. JEDEC outline ： MS-012AA
2. Dimensions ” D ” does not include mold flash, protrusions and gate burrs shall not exceed .15 mm (.006 in) per side .
3. Dimensions “ E1 ” does not include inter-lead flash, or protrusions. Inter-lead flash and protrusions shall not exceed .25 mm (.010 in) per side.