Current Mode PWM Controller with Frequency Shuffling

General Description

FSP8123 integrates a PWM controller and high voltage power MOSFET of 650V/7A. FSP8123 has the features of very low standby power (<100mW) when AC power above 220Vac. And cost effective offline flyback converter applications in 36W range(With radiator: 40W).

FSP8123 offers complete protection coverage with Cycle-by-Cycle current limiting (OCP), over temperature protection (OTP), over load protection (OLP), and VCC under voltage lockout (UVLO) and over voltage protection (OVP).

Features

- Low startup current
- Audio Noise Free Operation
- Burst Mode Control
- Frequency Shuffling Technology
- Compensation for ac-in
- Leading Edge Blanking
- Internal Synchronized Slope Compensation
- Good Protection Coverage With Auto Self-Recovery：OCP, OLP, UVLO, OVP, OTP

Typical Application

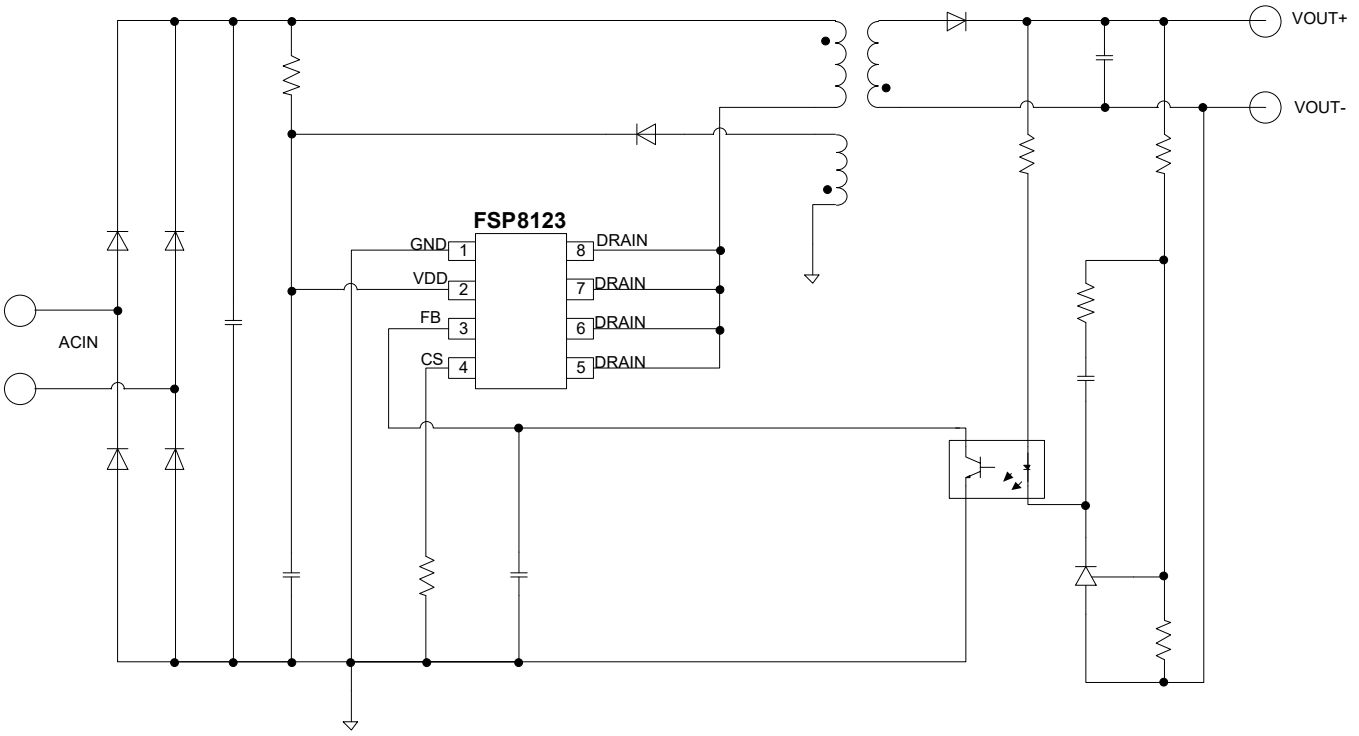
Offline AC/DC flyback converter for

- Switching AC/DC Power battery charge
- Digital cameras and camcorder adapter
- Set-top box power
- Auxiliary power supply for PC and server
- Open-frame SMPS
- PD fast charge

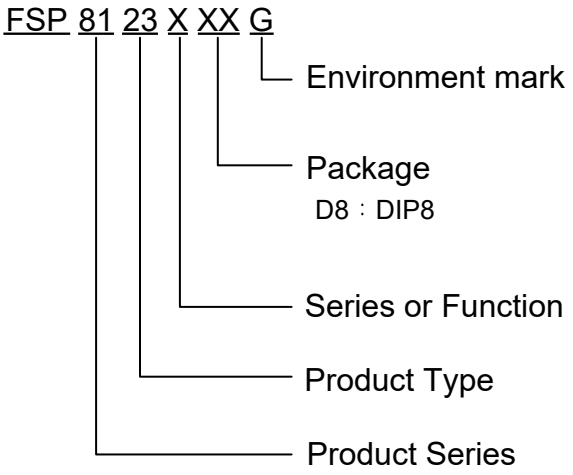
Package

- 8-pin DIP8

Typical Application Circuit

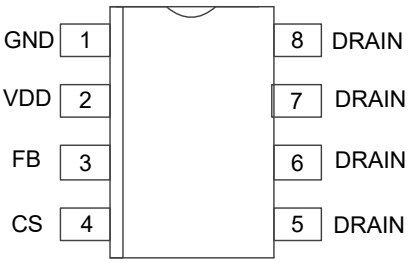


Selection Guide



product series	product description
FSP8123AD8G	Package：DIP8

Pin Configuration& Pin Assignment

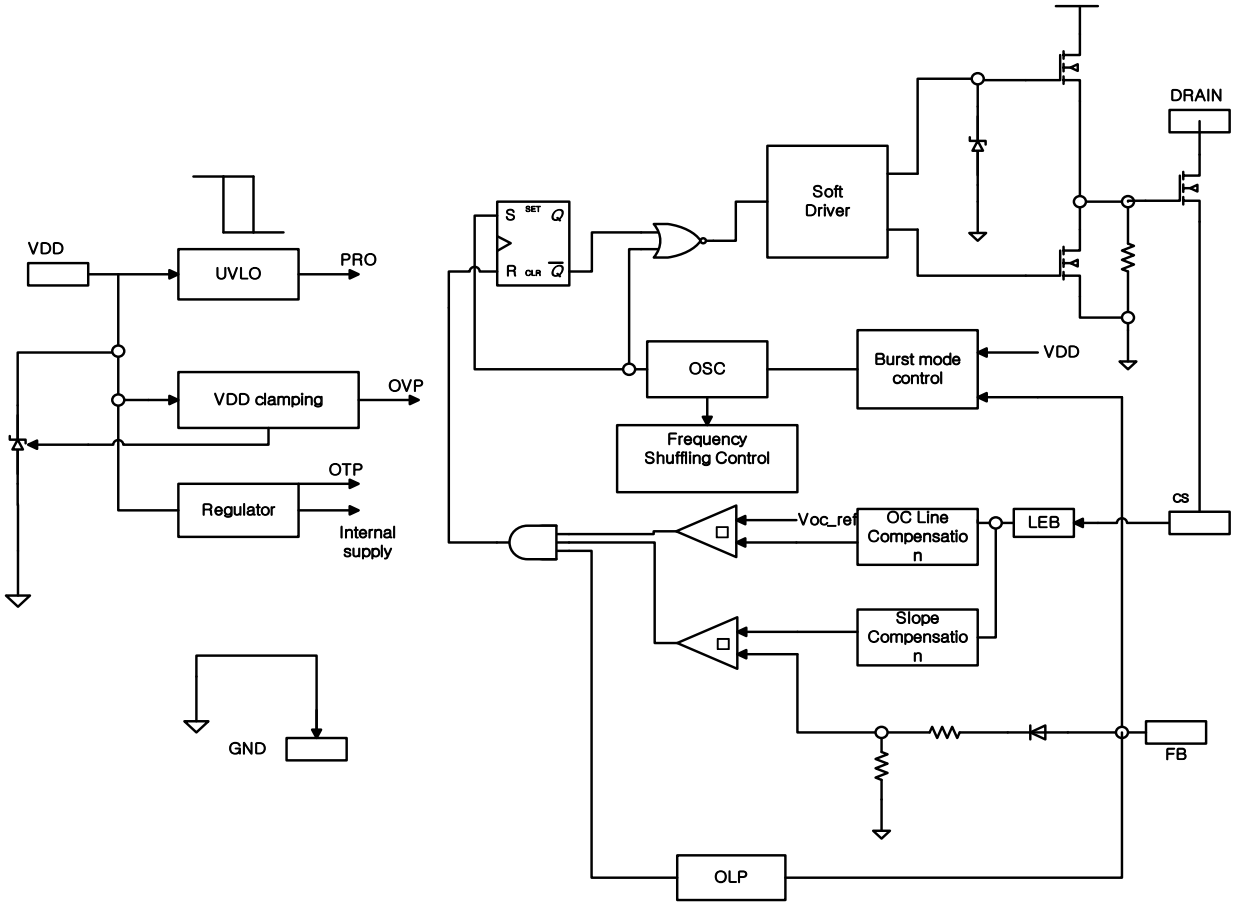


DIP8

PIN Assignments

Symbol	Pin Num.	Functions	Description
GND	1	Ground	Ground
VDD	2	Power Supply	Power Supply
FB	3	Input	Feedback
CS	4	Input	Current Sense
DRAIN	5,6,7,8	Input	Drain of the MOS

Block Diagram



Absolute Maximum Ratings

Parameter	Range	Unit
DRAIN Input Voltage	650	V
VDD Input Voltage	-0.3~30	V
VDD Input Current	0~5	mA
CS, FB Input Voltage	-0.3~7	V
Thermal resistance (Junction to air) Θ_{JA}	90	℃/W
Continuous Total Power Dissipation P_D	1.39	W
Operating ambient temperature :T_A	-20 ~ 85	ºC
Storage Temperature Tstg	-55 ~ 150	ºC
Maximum junction temperature T_J	-40 ~ 150	ºC
Welding Temperature	+260（10sec）	ºC

Recommended Operating Condition

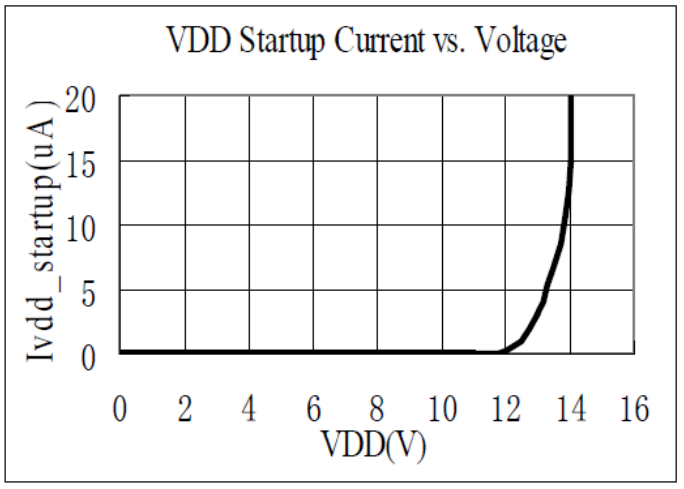
Parameter	Range	Unit
VDD Input Voltage	10~30	V
Operating Ambient Temperature	-20~85	°C

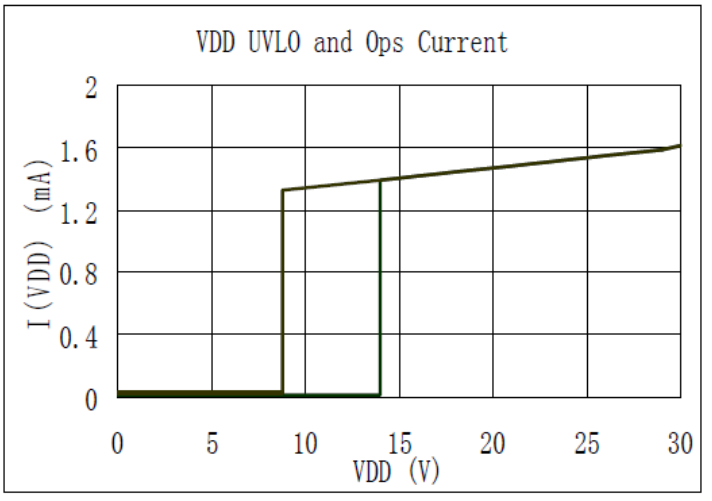
Electrical Characteristics (TA = 25°C,VDD=16V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD)						
I_S	Start-Up Current Sourced from VDD Pin	VDD= $UVLO_{OFF}$ -1V , Current flowing into VDD	-	5	20	μA
I_O	Operation Current	V_{FB}=3V	-	1	2	mA
$UVLO_{ON}$	Under-Voltage Lockout Voltage of VDD Pin		8	9	10	V
$UVLO_{OFF}$	Start-Up Voltage of VDD Pin		14	15	16	V
$VDD_{\_Clamp}$	Clamp Voltage of VDD Pin	I_{VDD} = 5 mA	32	35	37	V
OVP_{ON}	OVP Voltage of VDD Pin		28	30	32	V
OVP_{OFF}	OVP off Voltage of VDD Pin		24	26	28	V
OTP			145	155	165	°C
Feedback(FB)						
AV_{SENSE}	PWM Input Gain		-	2	-	V/V
Maximum duty cycle	Maximum Duty Cycle	VDD=16V , V_{FB}=3V , V_{CS}=0V	75	80	85	%
V_{FB_Open}	FB pin Open Loop Voltage		4.5	5	5.5	V
I_{FB_Short}	FB pin short circuit current		-	0.4	-	mA
V_{REF_GREEN}	The threshold enter green mode		-	1.8	-	V

$V_{REF\_BURST\_H}$	The threshold exit burst mode		-	1.1	-	V
$V_{REF\_BURST\_L}$	The threshold enter burst mode		-	1	-	V
V_{TH_PL}	Power Limiting FB Threshold Voltage		-	3.5	-	V
T_{D_PL}	Power limiting Debounce Time		30	38	46	mS
Current Sense Input(CS)						
T_blanking	Leading edge blanking time		-	220	-	nS
T_{D_OC}	Over Current Detection and Control Delay		-	120	-	nS
V_{TH_OC}	Over Current Threshold Voltage at zero Duty Cycle	FB=3.3V	0.7	0.75	0.8	V
Oscillator						
F_{OSC}	Normal Oscillation Frequency	VDD=16V,FB=3V,CS=0V	60	67.5	75	KHz
Δf_Temp	Frequency Temperature Stability	VDD = 16V, TA -20°C to 140 °C		5		%
Δf_VDD	Frequency Voltage Stability	VDD = 9-25V,		5		%
Δf_OSC	Frequency Modulation range /Base frequency		-	±6	-	%
F_shuffling	Shuffling Frequency		-	32	-	Hz
F_Burst	Burst Mode Base Frequency		-	25	-	KHz
Drain of the MOSFET (DRAIN)						
BVdss	Drain-Source Voltage	Vgs=0	650	-	-	V
Ron	Static Drain-Source On-Resistance	V_{GS}=10V, Id=3.5A	-	-	1.4	Ω
I_D	Continuous drain current		-	7	-	A

Typical performance characteristics





Operation Description

The FSP8123 is a low power off-line SMPS Switcher optimized for off-line flyback converter applications in 50W power range. The 'Extended burst mode' control greatly reduces the standby power consumption and helps the design easily to meet the international power conservation requirements.

Startup Current and Start up Control

Startup current of FSP8123 is designed to be very low so that VCC could be charged up above UVLO threshold level and device starts up quickly. A large value startup resistor can therefore be used to minimize the power loss yet provides reliable startup in application. For a typical AC/DC adaptor with universal input range design, a 2 MΩ, 1/8 W startup resistor could be used together with a VCC capacitor to provide a fast start up and low power dissipation design solution.

Frequency shuffling for EMI improvement

The frequency Shuffling/jittering (switching frequency modulation) is implemented in FSP8123. The oscillation frequency is modulated with a random source so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore reduces system design challenge.

Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in FSP8123 current mode PWM control. The switch current is detected by a sense resistor into the sense pin. Each time the power MOSFET is switched on, a turn-on spike will inevitably occur at the sense resistor. To avoid fault trigger, a 220ns leading-edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current-limit comparator is disabled and cannot switch off the gate driver.

Extended Burst Mode Operation

At zero load or light load condition, majority of the power dissipation in a switching mode power supply is from switching loss on the MOSFET transistor, 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 leads to the reduction on the power loss and thus conserves the energy.

The switching frequency is internally adjusted at no load or light load condition. The switch frequency reduces at light/no load condition to improve the conversion efficiency. At light load or no load condition, the FB input drops below burst mode threshold level and device enters Burst Mode control. The Gate drive output switches only when VCC voltage drops below a preset level and 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 nature of high frequency switching also reduces the audio noise at any loading conditions.

Protection Controls

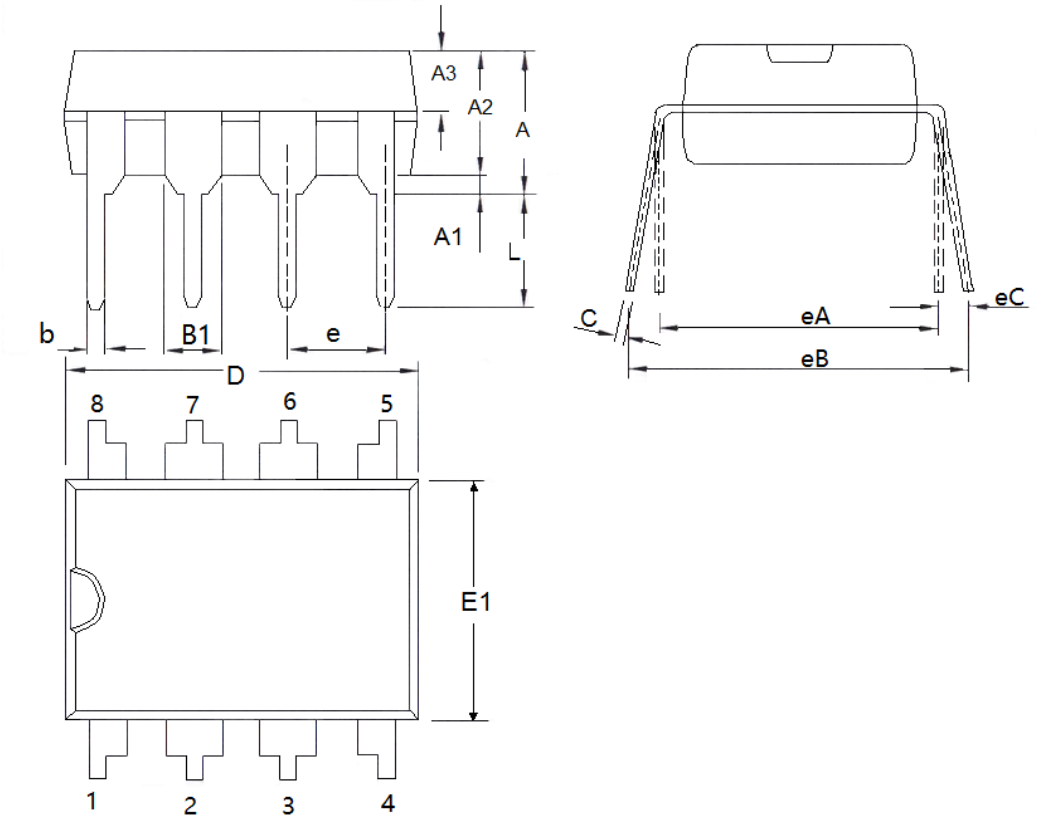
Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), Over Load Protection (OLP), CS short protection, CS floating protection, over voltage protection (OVP), and Under Voltage Lockout on VCC (UVLO).

The OCP is line voltage compensated to achieve constant output power limit over the universal input voltage range.

At overload condition, When FB input exceeds power limit threshold value for more than T_{D_PL}, control circuit reacts to shut down the Input power MOSFET. Similarly, control circuit reacts to shut down the switcher. Switcher restarts when VCC voltage drops below UVLO limit.

Packaging Information

- **Packaging Type: 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
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