

Single Synchronous Buck PWM Controller

General Description

The LD7120 is a single PWM controller designed to drive N-channel MOSFET in a synchronous buck topology. The IC integrates the controller, output adjustment, monitoring, and protection functions in a single 8-pin package.

The LD7120 provides simple, single feedback loop, voltage mode controller with fast transient response. Internal 0.8V temperature-compensated reference voltage is designed to meet low output voltage for further applications. A fixed 300KHz frequency oscillator reduces design complexity, while balancing typical application cost and efficiency.

The LD7120 features over current protection. The output current is monitored by sensing the voltage drop across the MOSFET $R_{DS(ON)}$, which eliminates the need for a current sensing resistor.

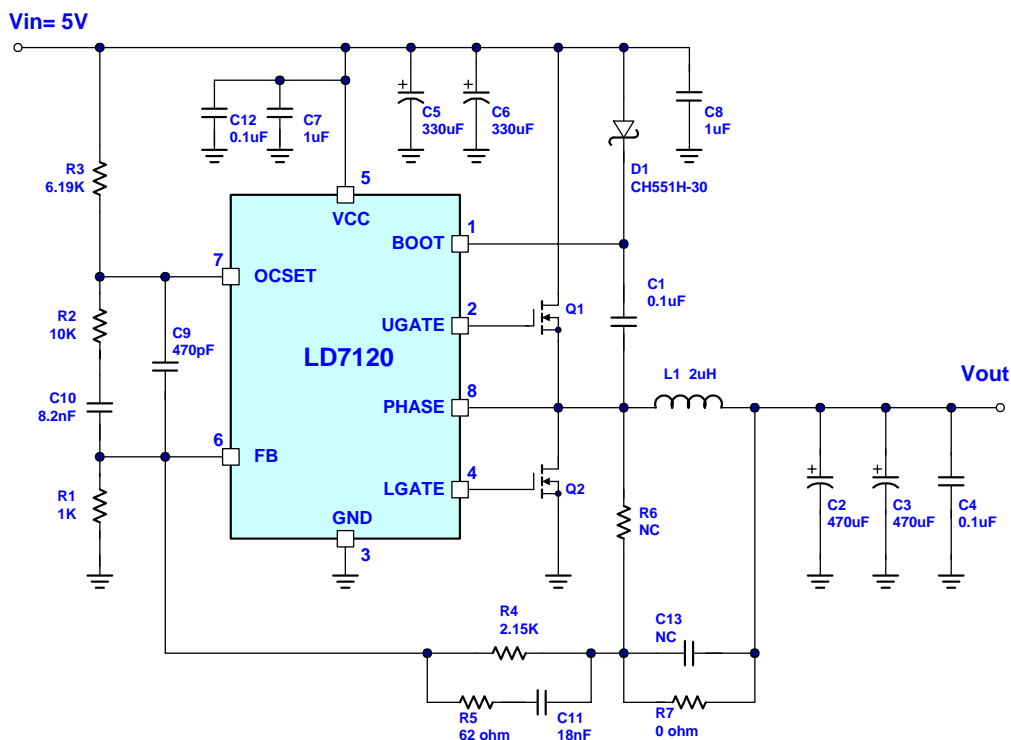
Features

- Operates from 5V
- Drives Two N-channel MOSFETs
- Fixed 300KHz Constant Switching Frequency
- Full 0~100% Duty-cycle
- Programmable Over Current Protection
- Internal Soft-start
- Fast Transient Response
- Under-voltage Lockout

Applications

- Motherboard
- Graphic Cards
- 5V Input DC/DC Converter
- Memory Supplies
- Cable Modem, Set Top Box and DSL Modems
- DSP and Core Communications Processor Supplies

Typical Application



Pin Configuration

SOP-8 (TOP VIEW)



YY: Year code
 WW: Week code
 PP: Production code

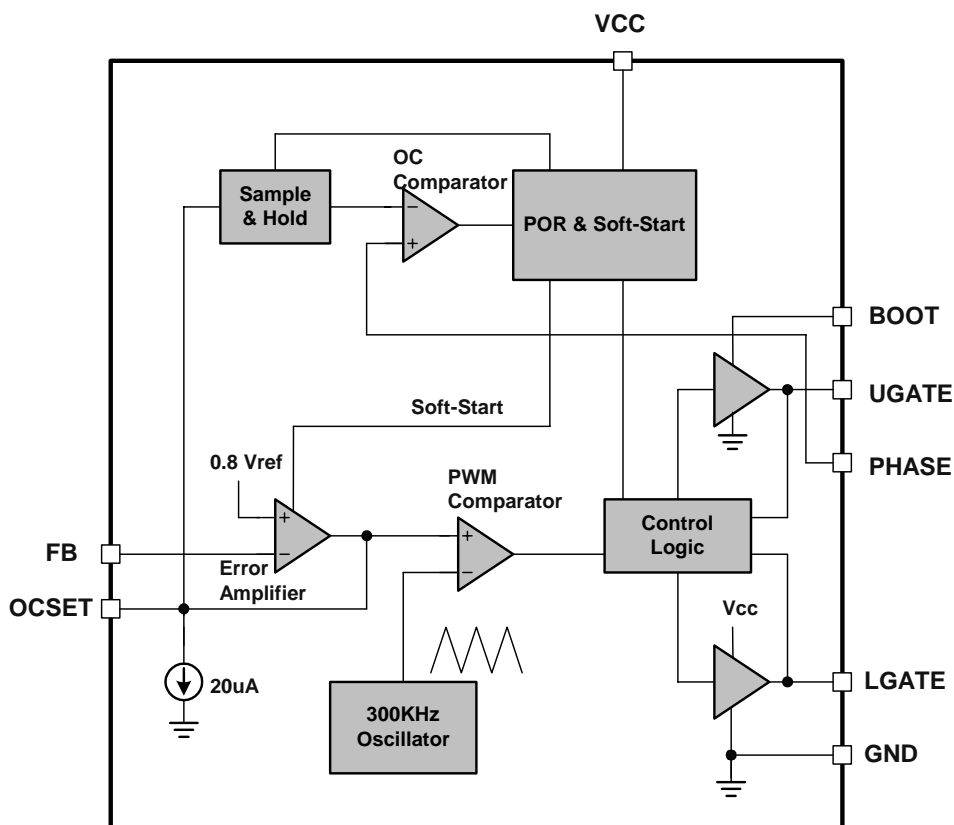
Ordering Information

Part number	Package	Top Mark	Shipping
LD7120 CS	SOP-8	LD7120CS	2500 /tape & reel
LD7120 PS	SOP-8 (PB Free)	LD7120PS	2500 /tape & reel

Pin Descriptions

PIN	NAME	FUNCTION
1	BOOT	This pin provides ground reference bias voltage to the upper MOSFET driver. Connect this pin to a bootstrap circuit to pump a boot voltage to drive a N-channel MOSFET.
2	UGATE	Connect UGATE pin to the PWM converter's upper MOSEFT gate. This pin provides the gate drive for the upper MOSFET.
3	GND	Signal and power ground for the IC. All voltage levels are measured with respect to this pin.
4	LGATE	Connect LGATE pin to the PWM converter's lower MOSEFT gate. This pin provides the gate drive for the lower MOSFET.
5	VCC	Connect this pin to 5V supply voltage. This pin provides the bias for the control circuitry and the low side MOSFET driver. The voltage at this pin is monitored for Power-On Reset (POR) purpose.
6	FB	This pin is the inverting input of the internal error amplifier. Connect this pin to the output of the converter via an external resistor divider.
7	OCSET	Connect a resistor from this pin to the drain of the upper MOSFET. This resistor, internal 20 μ A current source, and upper MOSFET on resistance set the over current trip point.
8	PHASE	This pin is used to monitor the voltage drop across the upper MOSFET for over current protection.

Block Diagram



Absolute Maximum Ratings

Supply Voltage Vcc.....	-0.3~7V
BOOT and UGATE to GND.....	15V
Operating Temperature Range.....	0°C to 70°C
Storage Temperature Range.....	-55°C to 125°C
Junction Temperature.....	125°C
Package Thermal Resistance, SOP-8.....	160°C/W
Lead Temperature (Soldering, 10sec).....	260°C

Caution:

Stresses beyond the ratings specified in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electrical Characteristics

 (T_A = +25°C unless otherwise stated, V_{CC}=5.0V)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Vcc Supply Current					
Nominal Supply	UGATE and LGATE Open		2.0		mA
Power On Reset					
Rising VCC POR Threshold		4.1	4.3	4.5	V
VCC POR Threshold Hysteresis			0.4		V
Oscillator					
Frequency	Vcc=5V	250	300	340	KHz
Ramp Amplitude			1.5		Vp-p
Reference					
Reference Voltage Tolerance				2	%
Nominal Reference Voltage			0.8		V
Error Amplifier					
DC Gain			70		dB
Gain Bandwidth Product		10			MHz
Gate Drivers					
Upper Gate Source Current			-1		A
Upper Gate Sink Current			1		A
Lower Gate Source Current			-1		A
Lower Gate Sink Current			2		A
Protection/Disable					
OCSET Current Source		17.5	20	22.5	μA
Disable Threshold			0.8		V

Typical Performance Characteristics

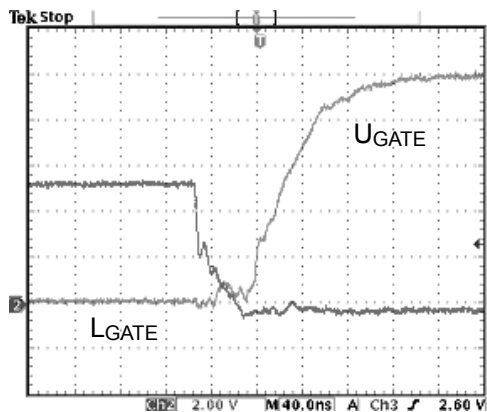


Fig. 1 Dead Time

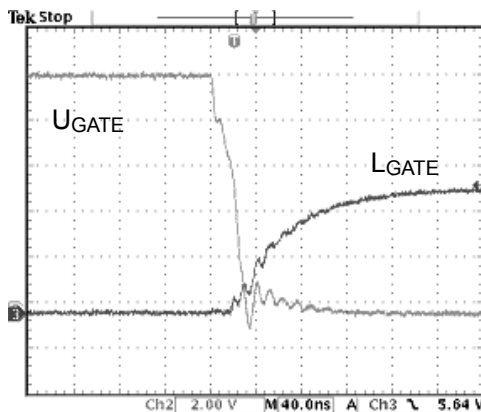


Fig. 2 Dead Time

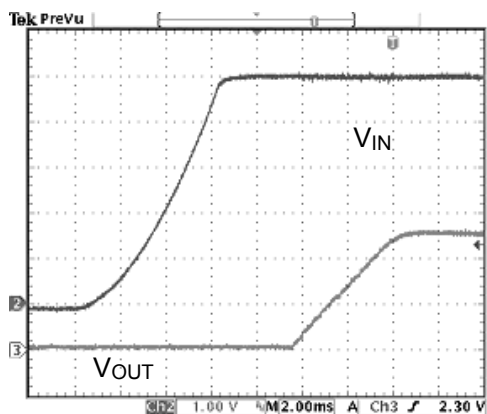


Fig. 3 Power ON

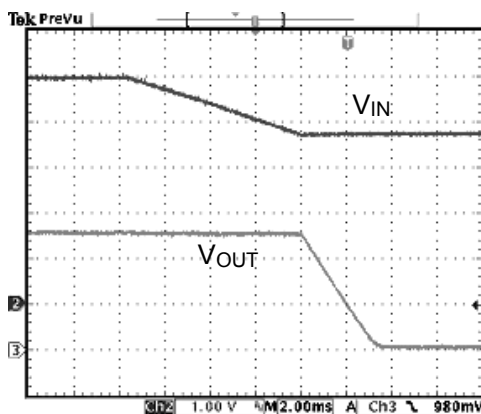


Fig. 4 Power Off

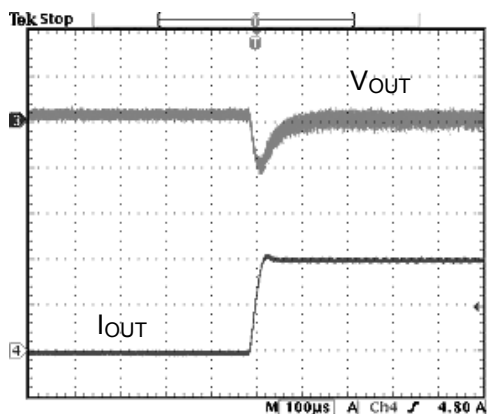


Fig. 5 Load Transient

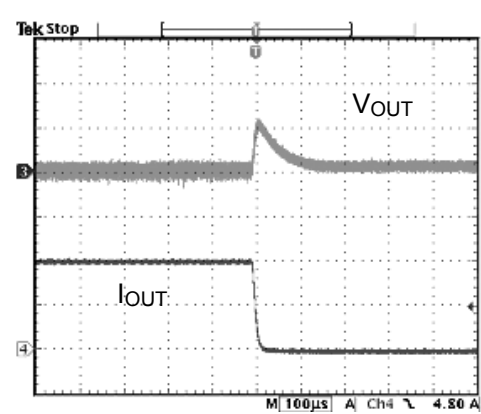


Fig. 6 Load Transient

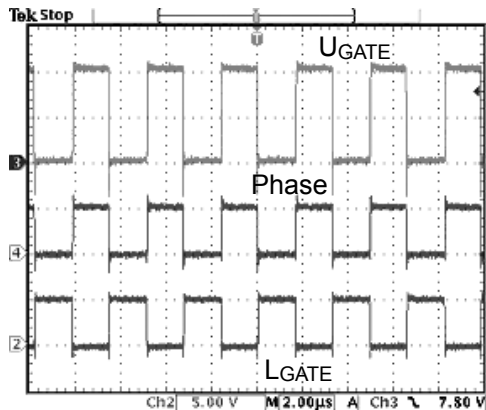


Fig. 7 Bootstrap Waveform

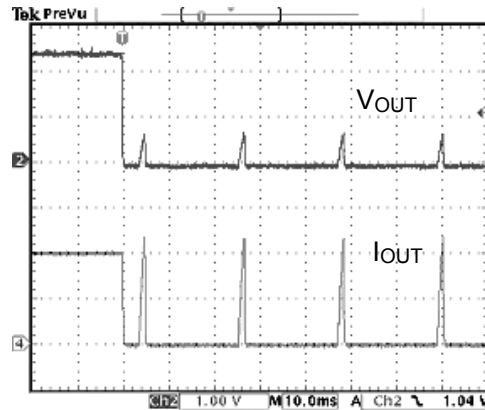


Fig. 8 OCP Waveform

Application Information

Initialization

The LD7120 automatically initializes upon receipt of power. The Power On Reset (POR) function continually monitors the bias voltage at the VCC pin. The POR function initiates the Over Current Protection (OCP) sampling and hold operation after the supply voltage exceeds its POR threshold. Upon completion of the OCP sampling and hold operation, the POR function initiates the Soft Start operation.

Over Current Protection

The over current function cycles the soft start function in a hiccup mode to provide fault protection. A resistor R_{OCSET} from OCSET pin to the drain of high side MOSFET programs the over current trip level. The resistor, an internal $20\ \mu\text{A}$ current source I_{OCSET} and the MOSFET on resistance set the over current trip point I_{PEAK} according to the following formula:

$$I_{PEAK} = \frac{I_{OCSET} \times R_{OCSET}}{R_{DS(ON)}}$$

To avoid over current tripping in the normal operating load range, find the R_{OCSET} resistor from the equation above with:

1. The maximum $R_{DS(ON)}$ at the highest junction temperature.
2. The minimum I_{OCSET} from the specification table.
3. Determine I_{PEAK} for $I_{PEAK} > I_{OUT(MAX)} + \frac{\Delta I}{2}$

Where ΔI is the output inductor ripple current.

Pulling and holding this pin below 0.8V with an open drain device will shut down the IC. Releasing OCSET will initiate soft start on the controller.

Soft Start

The POR function initiates the soft start function after the over current set point has been sampled. The built in soft start function is to prevent inrush current and output voltage overshoot during power on. An internal digital counter controls the soft start voltage. It clamps the ramping of reference voltage at the input of error amplifier and the pulse width of the output driver slowly. The typical soft start duration is 6.8mS.

Bootstrap Operation

In a single power supply system, an external bootstrap circuit, as Fig.9, powers the UGATE driver of LD7120. The boot capacitor, C_{boot} , generates a floating reference at the PHASE pin. Typical $0.1\ \mu\text{F}$ C_{boot} is enough for most of MOSFETs used with the LD7120. The voltage drop between BOOT and PHASE is refreshed to a voltage of $V_{CC} - \text{diode drop}$ while the low side MOSFET turning on.

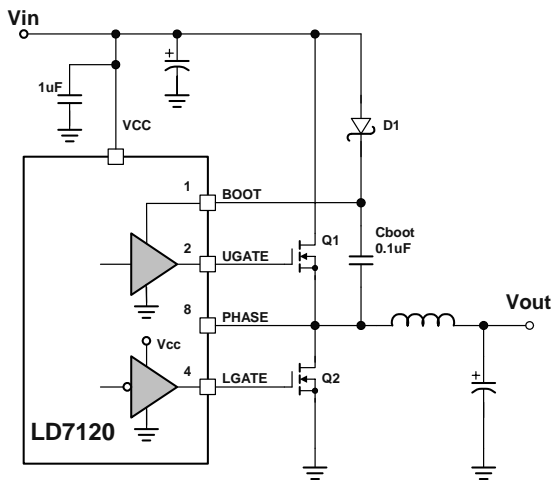
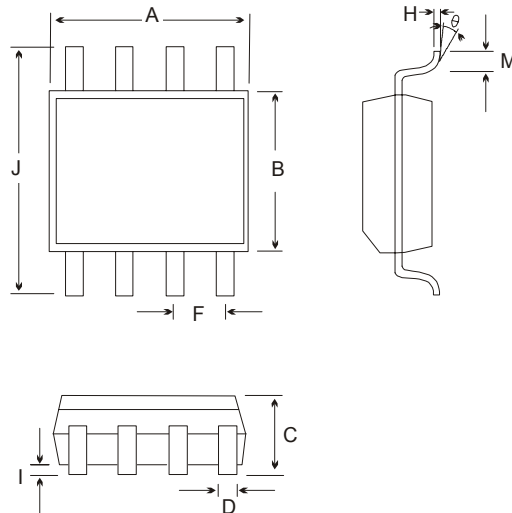


Fig. 9

Layout Consideration

Layout is very important in high switching convert design. There are two sets of critical components in DC/DC converter using LD7120. The switching components are the most critical because they switch large amount of energy, and therefore tend to generate large amount of noise. Next are the small signal components, which connect to sensitive nodes, or those supplying critical bypass current and signal coupling. Care should be taken to separate these two sets of components and their associated grounds. Below are some guidelines for PCB layout while using LD7120.

1. Keep the bypass capacitor 1µF very close to IC.
2. Keep output voltage feed back network, FB pin and OCSET pin related components (small signal components) very close to IC.
3. Signal ground plane of FB and OCSET pin (small signal components) should be connected to the power ground plane with a via or only one point to minimize the effect of power ground currents.
4. Switching node such as BOOT, UGATE, PHASE and LGATE should be kept as small as possible and routed away from FB and OCSET pin.
5. The PCB traces carrying discontinuous currents and any high current path should be made as short and wide as possible.
6. If possible, a multi-layer PCB is recommended. Please refer to the EV kit of LD7120 for a PCB layout example.

Package Information
Package: SOP-8


Symbols	Dimensions in Millimeters		Dimensions in Inch	
	MIN	MAX	MIN	MAX
A	4.801	5.004	0.189	0.197
B	3.810	3.988	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.330	0.508	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.178	0.229	0.007	0.009
I	0.102	0.254	0.004	0.010
J	5.791	6.198	0.228	0.244
M	0.406	1.270	0.016	0.050
θ	0	8°	0	8°

Important Notice

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