1.5MHz, 1.5A, High Efficiency PWM Step-Down DC/DC Converter

Features

- 2.5V to 5.5V Input Voltage Range
- Adjustable Output Voltage as Low as 0.6V Up to 92% Efficiency
- High Efficiency: Up to 95%
- 1.5MHz Constant Switching Frequency
- 1.5A Available Load Current
- 100% Duty Cycle in Dropout
- Current Mode Control
- Short Circuit Protection
- Thermal Fault Protection
- <0.1μA Shutdown Current
- Small 6-Lead DFN2x2 Package

Product Description

LPD6010 is a high efficiency step-down DC/DC converter operated with the current mode and the constant frequency. The internal switch and synchronous rectifier are integrated for high efficiency. External Schottky diodes are not required. The supply current is only 200μA during operation and drops to less than 1μA in shutdown. LPD6010 can supply 1.5A of load current from 2.5V to 5.5V supply voltage. The output voltage can be regulated as low as 0.6V. The switching frequency is set at 1.5MHz, allowing the use of small surface mount inductors and capacitors. It can run 100% duty cycle for low dropout application. LPD6010 is available in the DFN 2x2 - 6L package.

Applications

- Cellular and Smart Phones
- Microprocessors and DSP Core Supplies
- Set Top Box
- USB Dongle
- Digital Still and Video Cameras
- Portable Navigation Device

Pin Configuration

LPD6010 (DFN 2x2-6L)

PIN Name		Description
1 7	N/C	No Internal Connection (Floating or Connecting to GND).
2	EN	On/Off Control Input. Pull EN above 1.5V to turn the device on.
3	VIN	Power Supply Input. Drive 2.5V to 5.5V voltage to this pin to power on this chip. Connecting a 10uF ceramic bypass capacitor between VIN and GND to eliminate noise
4	SW	Switch Output. Connect this pin to the switching end of the inductor.
5	GND	Ground. This pin is the voltage reference for the regulated output voltage. For this reason care must be taken in its layout.
6	FB	Feedback Input. Connect FB to the center point of the external resistor divider. The feedback threshold voltage is 0.6V.

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Typical Application Circuit

Figure.1 Typical Application Circuit

Vout	R1	R2	C3	L1	C2
3.3V	300K	68K	1.5pF	2.2uH	10uF
2.5V	150K	47K	7pF	2.2uH	10uF
1.8V	100K	50K	10pF	2.2uH	10uF
1.2V	50K	50K	20pF	1.5uH	20uF
1.0V	68K	100K	15pF	1.2uH	20uF

Table 1 Recommended Component Selection

Ordering Information

Part Number	Package	Shipment
LPD6010-ADA	DFN2x2-6L	Tape&Reel / 3000

A：Output Voltage Adjustable
DA：Package Type DFN2X2-6L

Marking Information

Part Number	Product Code
LPD6010-ADA	6010
LPD6010-ADA	01

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Absolute Maximum Ratings (Note1)

Symbol	Description	Value	Units
V_{IN}	Input Supply Voltage	6	V
All Other Pins	All Other Pins	–0.3V to +6V	V
V_{SW}	SW Voltage	-0.3 to 20	V
T_{LEAD}	Lead Temperature (Soldering 10 sec)	+260	℃
T_j	Maximum Junction Temperature	150	℃
	Storage Temperature	-65 to 150	℃
	ESD Classification (HBM)	Class 2	V
Recommended Operating Conditions (Note2)			
V_{IN}	Input Supply Voltage	2.5V ~ 5.5V	V
V_{OUT}	Output Voltage	0.6V ~ 5.5V	V
T_A	Ambient Temperature	-40 ~ 85	℃
Thermal Characteristics			
	DFN-6L 2x2, θ_{JA}	120	℃/W
	DFN-6L 2x2, θ_{JC}	20	℃/W

Notes:
(1) Stresses exceed those ratings may damage the device.
(2) If out of its operation conditions, the device is not guaranteed to function.

Electrical Characteristics

(V_{IN} = 3.6V, V_{OUT}=1.8V, L1=2.2uH, C2=10uF, TA = 25℃, unless otherwise specified)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Input Voltage Range	Vin			2.5		5.5	V
Quiescent Current	I_Q	Switching Without I_{Load}	5V→3.3V			3.2	
Shutdown Current	I_S	VEN=0V, VIN =5.5V			0.1	1	μA
IN Under Voltage Lockout Threshold	UVLO	Vin Falling Edge		2.0	2.2	2.5	V
IN Under Voltage Lockout Hysteresis					0.2		V
Reference Voltage	V_{REF}			0.582	0.6	0.618	V
Output Voltage Accuracy	$\Delta V_{out}/V_{out}$	I_{OUT} = 0~1.5A		-3		3	%
FB Input Current	I_{FB}	VFB = 0.65V		-50		50	nA
PFET On Resistance(*)	$R_{(ON)_P}$	ISW = 200mA			0.28		Ω
NFET On Resistance(*)	$R_{(ON)_N}$	ISW = -200mA			0.25		Ω
SW Leakage Current				-1		1	μA
PFET Current Limit		Duty Cycle = 100%, Current Pulse Width < 1ms		1.8	2.2		A
Oscillator Frequency	F_{SW}	VIN = 3.6V, IOUT = 200mA		1.2	1.5	1.8	MHZ
IN Under Voltage Lockout Hysteresis					0.2		V
Reference Voltage	V_{REF}			0.582	0.6	0.618	V

*: Guaranteed by design.

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Electrical Characteristics

(VIN = 3.6V, VOUT=1.8V, L1=2.2uH, C2=10uF, TA = 25℃, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Maximum Duty Cycle				100		%
Minimum On-Time(*)		T_{ON}		80		nS
Thermal Shutdown Trip Threshold(*)				145		℃
EN High-Level Input Voltage		–40°C ≤ T_A ≤ +85°C	1.5			V
EN Low-Level Input Voltage					0.4	V
EN Input Current		V_{EN} = 0V to 5.5V	-1		1	μA

*: Guaranteed by design.

Functional Block Diagram:

Figure.2 Functional Block Diagram

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Functional Block Diagram:

C1 = 10uF , C2 = 10uF, C3 = 30pF, L1 = 2.2uH,TA = +25℃, unless otherwise noted.

Efficiency Test

Vin=5V

Steady State

Vin=5V,Vout=1.2V,Iout=0A

Steady State

Vin=5V,Vout=1.2V,Iout=1.5A

Dynamic loading

Vin=5V,Vout=1.2V,Iout=0.15 to 1.35A

Power On

Vin=5V,Vout=1.2V,Iout=1.5A

Shut Down

Vin=5V,Vout=1.2V,Iout=0.05A

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Application Information:

- Setting Output Voltage

The external resistor divider sets the output voltage. The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor. Table 1 shows a list of resistor selection for common output voltages

$$Vout = 0.6 \times \left(1 + \frac{R1}{R2}\right) V$$

- Selecting the Inductor

A 1μH to 4.7μH inductor with DC current rating at least 25% higher than the maximum load current is recommended for most applications. For best efficiency, the inductor DC resistance shall be <20mΩ.
For most designs, the required inductance value can be derived from the following equation.

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L * F_{SW}}$$

Where ΔIL is the inductor ripple current. Choose inductor ripple current approximately 30% of the maximum load current, 1.5A.
The maximum inductor peak current is:

$$I_{L(MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Under light load conditions below 100mA, larger inductance is recommended for improved efficiency.

- Selecting the Input Capacitor

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency shall be less than input source impedance to prevent high frequency switching current passing to the input. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. For most applications, a 10μF capacitor is sufficient.

- Selecting the Output Capacitor

The output capacitor keeps output voltage ripple small and ensures regulation loop stable. The output capacitor impedance shall be low at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended.
The output ripple ΔVOUT is approximately:

$$\Delta V_{OUT} \le \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times F_{SW} \times L} \times \left[ESR + \frac{1}{8 \times F_{SW} \times C2} \right]$$

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PCB Layout Recommendation:

1. The high current paths (GND, VIN and SW) should be placed very close to the device with short, direct and wide traces.
2. Place the input capacitors, output capacitors as close to the device as possible. Trace to these capacitors should be as short and wide as possible to minimize parasitic inductance and resistance.
3. CIN must be close to Pins VIN and GND. The loop area formed by CIN and VIN/GND pins must be minimized.
4. The external feedback resistors shall be placed next to the FB pin.
5. Keep the switching node SW short and away from the feedback network.

Package Information

DFN 2×2-6L

SYMBOLS	Min	Typ	Max
A	0.7	0.75	0.8
A3	-----	0.2	-----
b	0.25	0.30	035
D	-----	2	-----
D2	1.30	1.40	1.50
E	-----	2	-----
E2	0.50	0.60	0.70
e	-----	0.65	-----
L	0.25	0.30	0.35

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