AS1310

Dual 1.5MHz, 0.8A Synchronous Rectified Step-Down DC/DC Converter

DESCRIPTION

The AS1310 contains two independent 1.5MHz constant frequency current mode PWM step-down converters. Each converter integrates a main switch and a synchronous rectifier for high efficiency without an external Schottky diode. The AS1310 is ideal for powering portable equipment that runs from a single cell Lithium-Ion (Li+) battery. Each converter can supply 800mA of load current from a 2.5V to 6.5V input voltage. The output voltage for can be regulated as low as 0.6V. The AS1310 can also run at 100% duty cycle for low dropout applications.

The AS1310 is available in a low profile (1mm) 10-pin, TDFN package.

ORDER INFORMATION

Part Number	Package
AS1310EPT	TDFN-10L(EP)

EVALUATION BOARD

Board Number	Dimensions
EV1310EP-00A	30^{mm}X x 50^{mm}Y x 1.4^{mm}Z

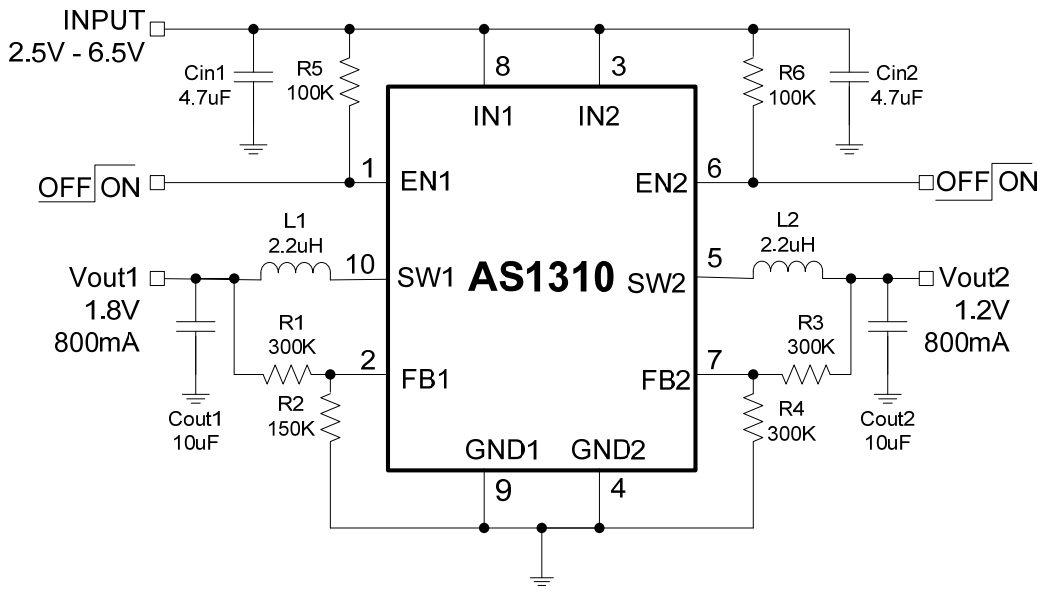
FEATURES

- High Efficiency：Up to 95%
- 1.5MHz Constant Switching Frequency
- 0.8A Available Load Current
- 2.5V to 6.5V Input Voltage Range:
- Output Voltage as low as 0.6V
- 100% Duty Cycle In Dropout
- Current Mode Control
- Short Circuit Protection
- Over Temperature Protection
- <1μA Shutdown Current
- Package: TDFN-10L(EP)

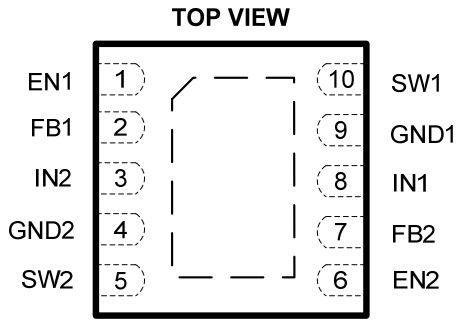
APPLICATIONS

- Cellular & Smart Phones
- Wireless and DSL Modems
- PDAs & MP3 Player
- Digital Still and Video Cameras
- Portable instruments

TYPICAL APPLICATION



PACKAGE REFERENCE



Part Number*	Package	Operate Temp.
AS1310EPT	TDFN-10L(EP)	-40~85ºC

*

ABSOLUTE MAXIMUM RATINGS(1)

$V_{IN1/IN2}$ Voltage..... -0.3V to 7.0V
$V_{SW1/SW2}$ Voltage ..... -0.3V to V_{IN} +0.3V
$V_{EN1/EN2}$, $V_{FB1/FB2}$ Voltage .....-0.3V to V_{IN} +0.3V
SW sink & source peak current 1.5A
Junction Temperature ..... 125°C
Lead Temperature(Soldering, 10sec.) .....+300°C
Storage Temperature Range ..... -65℃ to 150°C

Recommended Operating Conditions(2)

Supply Voltage V_{IN}.....2.5V to 6.5V
Output Voltage V_{OUT}.....0.6V to 6.5V
Operating Temperature ..... -40°C to 85°C

Thermal Resistance(3)	Θ_{JA}	Θ_{JC}
TDFN-10L	45	10 °C/W

NOTEs:
1) Exceeding these ratings may damage the device.
2) The device is not guaranteed to function outside of its operating conditions.
3) Measure on approximately 1"square of 1 oz copper.

ELECTRICAL CHARACTERISTICS

V_{IN} = V_{EN} =3.6V, T_A = 25°C Unless otherwise noted.

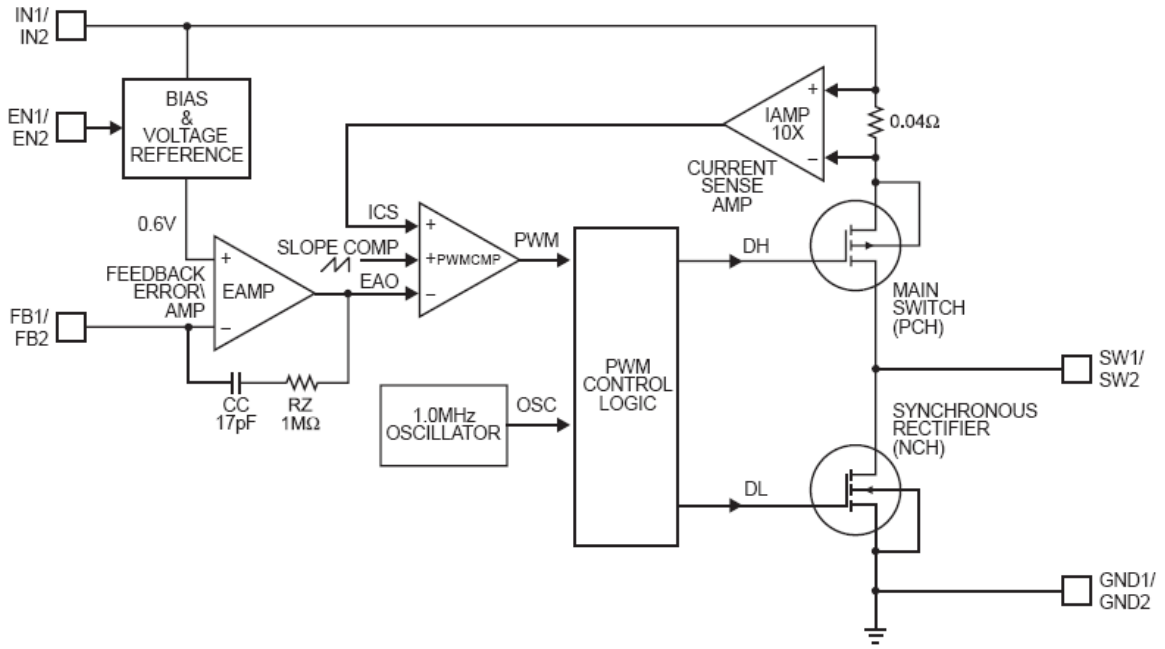
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	-	2.5		6.5	V
Each Converter Supply Current	Active Mode, V_{FB} = 0.5V		300	400	μA
	Shutdown Mode, V_{FB} = 0V, V_{IN} = 4.2V		0.1	1.0	
Regulated Feedback Voltage	T_A = 25°C	0.5880	0.6000	0.6120	V
	T_A = 0°C ≤ TA ≤ 85°C	0.5865	0.6000	0.6135	
	T_A = -40°C ≤ TA ≤ 85°C	0.5850	0.6000	0.6150	
FB Input Bias Current	V_{FB} = 0.65V			±30	nA
Output Voltage Line Regulation	V_{IN} = 2.5V to 5.5V, I_{OUT} = 10mA		0.04	0.40	%/V
Output Voltage Load Regulation	I_{OUT} = 10mA to 2000mA		0.50		%/A
Peak Inductor Current	VIN=3V, VFB=0.5V or VOUT=90%, Duty cycle<35%	0.75	1.00	1.25	A
Oscillator Frequency	V_{FB} = 0.6V or V_{OUT} = 100%	1.20	1.50	1.80	MHz
P-CH MOSFET $R_{DS(ON)}$	I_{LX} = 300mA		0.40	0.50	Ω
N-CH MOSFET $R_{DS(ON)}$	I_{LX} = -300mA		0.35	0.45	
Enable Threshold	T_A = -40°C ≤ TA ≤ 85°C	0.3	-	1.3	V
Enable Leakage Current		-1.0		1.0	μA

Note: 100% production test at +25℃; Specification over the temperature range are guaranteed by design.

PIN FUNCTIONS

PIN NUMBER	PIN NAME	FUNCTION
1	EN1	Channel 1 Enable Control Input. Drive EN1 above 1.5V to turn on the Channel 1. Drive EN1below 0.3V to turn it off (shutdown current < 0.1μA).
2	FB1	Channel 1 Feedback Input. Connect FB1 to the center point of the external resistor divider. The feedback voltage is 0.6V.
3	IN2	Channel 2 Supply Input. Bypass to GND with a 2.2μF or greater ceramic capacitor.
4	GND2	Ground 2.
5	SW2	Channel 2 Power Switch Output. Inductor connection to drains of the internal PFET and NFET switches.
6	EN2	Channel 2 Enable Control Input. Drive EN2 above 1.5V to turn on the Channel 2. Drive EN2 below 0.3V to turn it off (shutdown current < 0.1μA).
7	FB2	Channel 2 Feedback Input. Connect FB2 to the center point of the external resistor divider. The feedback voltage is 0.6V.
8	IN1	Channel 1 Supply Input. Bypass to GND with a 2.2μF or greater ceramic capacitor.
9	GND1	Ground 1.
10	SW1	Channel 1 Power Switch Output. Inductor connection to drains of the internal PFET and NFET switches.

FUNCTION BLOCK DIAGRAM



OPERATION

The AS1310 has dual independent constant frequency current mode PWM step-down converters. The AS1310 is optimized for low voltage, Li-Ion battery powered applications where high efficiency and small size are critical. The AS1310 uses external resistor divider to set the output voltage from 0.6V to 6.5V. The device integrates both a main switch and a synchronous rectifier, which provides high efficiency and eliminates an external Schottky diode. The AS1310 can achieve 100% duty cycle. The duty cycle D of a step-down converter is defined as:

$$D=Ton\times fosc\times 100\%\approx\frac{Vout}{Vin}\times 100\%$$

Where Ton is the main switch on time, fosc is the oscillator frequency (1.5MHz), Vout is the output voltage and Vin is the input voltage.

CURRENT MODE PWM CONTROL

Slope compensated current mode PWM control provides stable switching and cycle-by-cycle current limit for excellent load and line response and protection of the internal main switch and synchronous rectifier. The AS1310 switches at a constant frequency (1.5MHz) and regulates the output voltage. During each cycle the PWM comparator modulates the power transferred to the load by changing the inductor peak current based on the feedback error voltage. During normal operation, the main switch is turned on for a certain time to ramp the inductor current at each rising edge of the internal oscillator, and switched off when the peak inductor current is above the error voltage. When the main switch is off, the synchronous rectifier will be turned on immediately and stay on until either the next cycle starts.

DROPOUT OPERATION

When the input voltage decreases toward the value of the output voltage, the AS1310 allows the main switch to remain on for more than one switching cycle and increases the duty cycle until it reaches 100%. The output Voltage then is the input voltage minus the voltage drop across the main switch and the inductor.

SHORT CIRCUIT PROTECTION

The AS1310 has short circuit protection. When the output is shorted to ground, the oscillator frequency is reduced to prevent the inductor current from increasing beyond the PFET current limit. The PFET current limit is also reduced to lower the short circuit current. The frequency and current limit will return to the normal values once the short circuit condition is removed and the feedback voltage reaches 0.6V.

Maximum Load current

The AS1310 can operate down to 2.5V input voltage, however the maximum load current decreases at lower input due to large IR drop on the main switch and synchronous rectifier. The slope compensation signal reduces the peak inductor current as a function of the duty cycle to prevent sub-harmonic oscillations at duty cycles greater than 50%. Conversely the current limit increases as the duty cycle decreases.

APPLICATION INFORMATION

OUTPUT VOLTAGE SETTING

Tthe output voltage is set by a resistive divider according to the following formula:

$$V_{OUT}=0.6\times(1+\frac{R1}{R2})$$

Table1 Resistor Select for Output Voltage Setting

Vout	R1	R2
1.2V	300K	300K
1.5V	300K	200K
1.8V	300K	150K
2.5V	300K	95.3K

INDUCTOR SELECTION

A 1μH to 10μH 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 <200mΩ. For most designs, the inductance value can be derived from the following equation:

$$L = \frac{V_{OUT}\times(V_{IN}-V_{OUT})}{V_{IN}\times\Delta I_L\times f_{OSC}}$$

Where ΔI_L is the inductor ripple current. Choose inductor ripple current approximately 30% of the maximum load current, 700mA.

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

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

INPUT CAPACITOR SELECTION

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 4.7μF capacitor is sufficient.

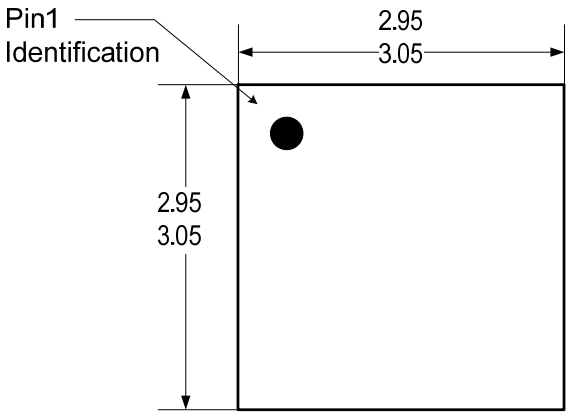
OUTPUT CAPACITOR SELECTION

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:

$$\Delta V_{OUT}\leq\frac{V_{OUT}\times(V_{IN}-V_{OUT})}{V_{IN}\times f_{OSC}\times L}\times\left(ESR+\frac{1}{8\times f_{OSC}\times C3}\right)$$

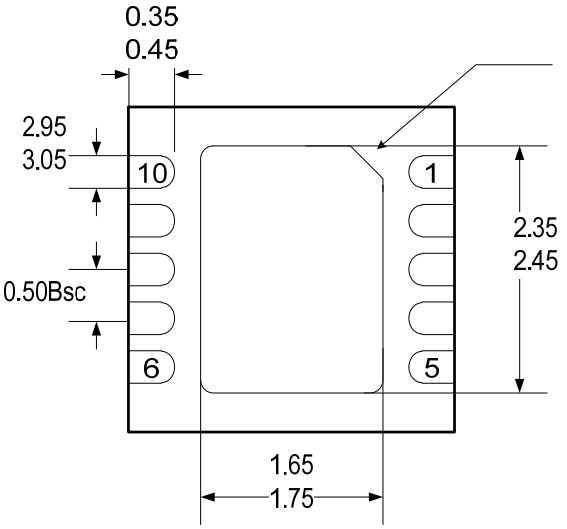
PACKAGE DESCRIPTION

Package
10-Lead Plastic TDFN-10L(EP)

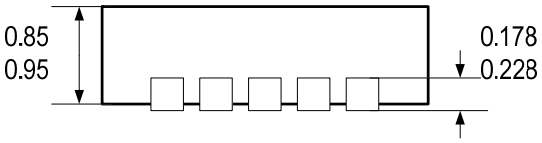


NOTE:
1. DIMENSIONS ARE IN MILLIMETERS
2. DRAWING NOT TO SCALE
3. DIMENSIONS ARE INCLUSIVE OF PLATING
4. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH AND METAL BURR
5. MOLD FLASH SHALL NOT EXCEED 0.254mm
6. JEDEC PACKAGE REFERENCE IS MO-193

TOP VIEW



BOTTOM VIEW



SIDE VIEW