1.5MHz, 1A Synchronous Step-Down Converter

FEATURES

- High Efficiency: Up to 96%
- 1.5MHz Constant Frequency Operation
- 1A Output Current
- No Schottky Diode Required
- 2.0V to 5.5V Input Voltage Range
- Output Voltage as Low as 0.6V
- 100% Duty Cycle in Dropout
- Low Quiescent Current: 20µA
- Slope Compensated Current Mode Control for Excellent Line and Load Transient Response
- Short Circuit Protection
- Thermal Fault Protection
- Inrush Current Limit and Soft Start
- <1µA Shutdown Current
- Tiny SOT23-5 Package

APPLICATIONS

- Cellular and Smart Phones
- Wireless and DSL Modems
- PDAs
- Digital Still and Video Cameras
- MP3 Players

GENERAL DESCRIPTION

The PJ3406 is a constant frequency, current mode PWM step-down converter. The device integrates a main switch and a synchronous rectifier for high efficiency without an external Schottky diode. It is ideal for powering portable equipment that runs from a single cell Lithium-Ion (Li+) battery. The output voltage can be regulated as low as 0.6V. The PJ3406 can also run at 100% duty cycle for low dropout operation, extending battery life in portable system. This device offers two operation modes, PWM control and PFM Mode switching control, which allows a high efficiency over the wider range of the load.

The PJ3406 is offered in a low profile(1mm) 5-pin, thin SOT package, and is available in an adjustable version and fixed output voltage of 1.2V,1.5V, 1.8V,2.5V and 3.3V.
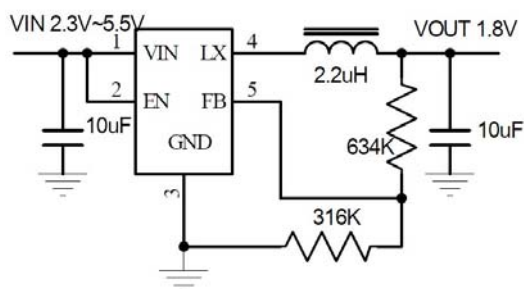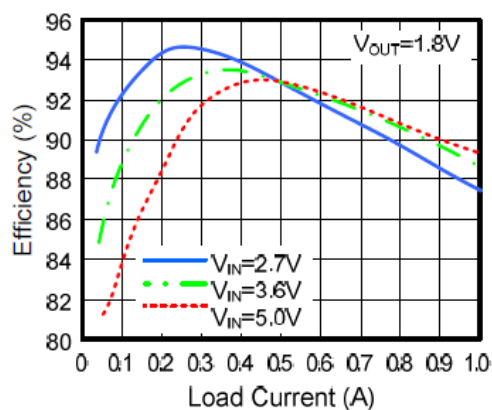
TYPICAL APPLICATION

Figure 1. Basic Application Circuit

ABSOLUTE MAXIMUM RATINGS (Note 1)

Input Supply Voltage ...... -0.3V to 6V

RUN,VOUT Voltages....... -0.3V to 6V

SW Voltage   ....-0.3V to (Vin+0.3V)

Peak SW Sink and Source Current…1.8A

Operating Temperature Range … -40°C to +85°C

Junction Temperature(Note2) ……………..125°C

Storage Temperature Range ..…-65°C to 150°C

Lead Temperature(Soldering,10s) ....+300°C

PACKAGE/ORDER INFORMATION
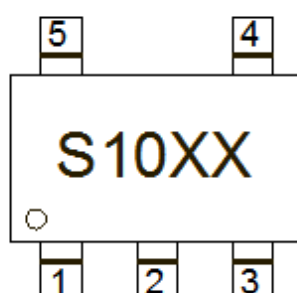
Part Number	SWICHING FREQUENCY	Temp Range	OUTPUT VOLTAGE (V)	OUTPUT CURRENT (A)
PJ3406-ADJ	1.5MHz	-40°Cto+85°C	ADJ	1.0

PIN DESCRIPTION

PIN	NAME	FUNCTION
1	RUN	Chip Enable Pin. Drive RUN above 1.5V to turn on the part. Drive RUN below 0.3V to turn it off. Do not leave RUN floating.
2	GND	Ground Pin
3	SW	Power Switch Output. It is the switch node connection to Inductor. This pin connects to the drains of the internal P-ch and N-ch MOSFET switches.
4	VIN	Power Supply Input. Must be closely decoupled to GND with a 4.7µF or greater ceramic capacitor.
5	VOUT	Output Voltage Feedback Pin. An internal resistive divider divides the output voltage down for comparison to the internal reference voltage.

ELECTRICAL CHARACTERISTICS [Note 3]

(V_{IN}=V_{RUN}=3.5.5V, V_{OUT}=1.8V, T_A = 25°C, unless otherwise noted.)

Parameter	Conditions	MIN	TYP	MAX	unit
Input Voltage Range		2.0		5.5	V
UVLO Threshold		1.7	1.9	2.1	V
Input DC Supply Current	(Note 4)				μA
PWM Mode	Vout = 90%, Iload=0mA		140	300	μA
PFM Mode	Vout = 105%, Iload=0mA		20	35	μA
Shutdown Mode	V_{RUN} = 0V, V_{IN}=4.2V		0.1	1.0	μA
Regulated Feedback Voltage	T_A = 25°C	0.588	0.600	0.612	V
	T_A = 0°C ≤ T_A ≤ 85°C	0.586	0.600	0.613	V
	T_A = -40°C ≤ T_A ≤ 85°C	0.585	0.600	0.615	V
Reference Voltage Line Regulation	Vin=2.0V to 5.5V		0.04	0.40	%/V
Output Voltage Line Regulation	V_{IN} = 2.0V to 5.5V		0.04	0.4	%
Output Voltage Load Regulation			0.5		%
Oscillation Frequency	Vout=100%		1.5		MHz
	Vout=0V		300		KHz
On Resistance of PMOS	I_{SW}=100mA		0.25	0.35	Ω
ON Resistance of NMOS	I_{SW}=-100mA		0.2	0.35	Ω
Peak Current Limit	V_{IN}= 3V, Vout=90%		1.5		A
RUN Threshold		0.30	1.0	1.50	V
RUN Leakage Current			±0.01	±1.0	μA
SW Leakage Current	V_{RUN}=0V,V_{IN}=Vsw=5V		±0.01	±1.0	μA

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + (P_D) \times (250°C/W)$.

Note3: 100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

Note 4: Dynamic supply current is higher due to the gate charge being delivered at the switching frequency
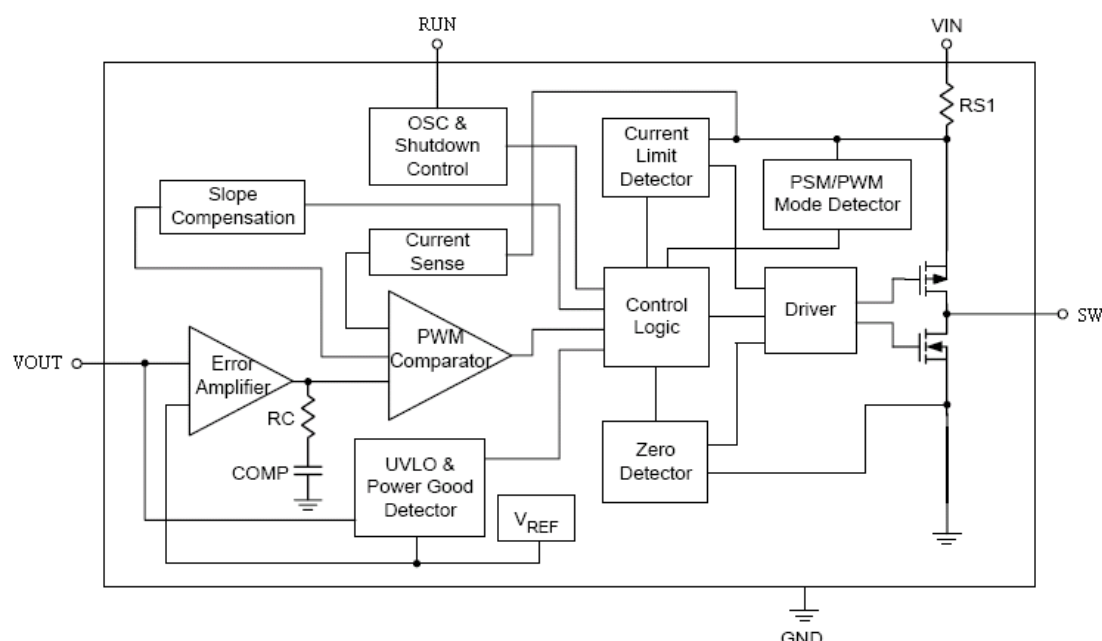
FUNCTIONAL BLOCK DIAGRAM

Figure 2. PJ3406 Block Diagram

FUNCTIONAL DESCRIPTION

The is PJ3406 a high performance 1A 1.5MHz monolithic step-down converter. The PJ3406 requires only three external power components (Cin, Cout and L). The adjustable version can be programmed with external feedback to any voltage, ranging from 0.5.5V to the input voltage.

At dropout, the converter duty cycle increases to 100% and the output voltage tracks the input voltage minus the Rdson drop of the high-side MOSFET.

The internal error amplifier and compensation provides excellent transient response, load, and line regulation. Soft start function prevents input inrush current and output overshoot during start up.

APPLICATIONS INFORMATION

Inductor Selection

For most designs, the PJ3406 operates with in ductors of 1µH to 4.7µH. Low inductance values are physically smaller but require faster switching, which results in some efficiency loss. The inductor 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 inductor Ripple Current. Large value inductors result in lower ripple current and small value inductors result in high ripple current. For optimum voltage-positioning load transients, choose an inductor with DC series resistance in the 50mΩ to 150mΩ range.

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 should be less than input source impedance to prevent high frequency switching current passing to the input.

A low ESR input capacitor sized for maximum RMS current must be used.   Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients.

A 4.7µF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

Output Capacitor Selection

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current ratings. The output ripple V_{OUT} is determined by:

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

10µF ceramic can satisfy most applications.

PC Board Layout Checklist

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the PJ3406 .Chec k the following in your layout:

1. The power traces, consisting of the GND trace, the SW trace and the VIN trace should be kept short, direct and wide.
2. Does the (+) plates of Cin connect to Vin as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.
3. Keep the switching node, SW, away from the sensitive VOUT node.
4. Keep the (-) plates of Cin and Cout as close as possible

PACKAGE DESCRIPTION
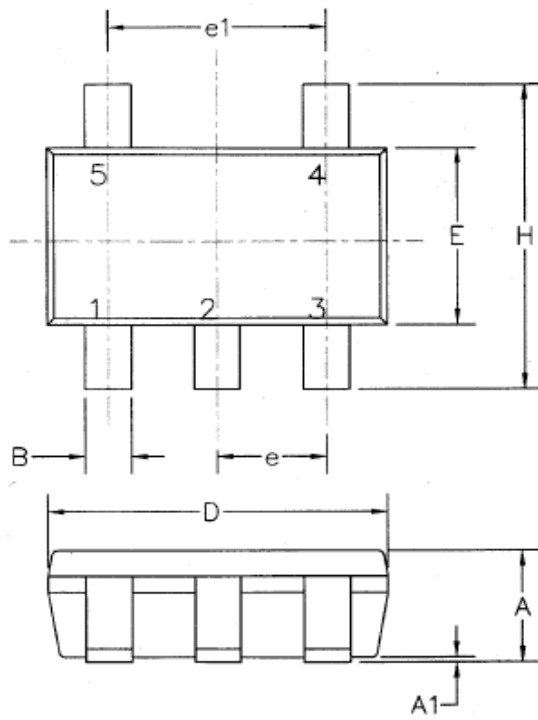
5LD SOT-23 PACKAGE OUTLINE DIMENSIONS
ALL DIMENSIONS IN MM.

Dimension	Min.	Max.
A	0.9	1.10
A1	0.01	0.13
B	0.3	0.5
C	0.09	0.2
D	2.8	3.0
H	2.5	3.1
E	1.5	1.7
e	0.95 REF.	
e1	1.90 REF.	
L1	0.2	0.55
L	0.35	0.8
Q	0°	10°