

600mA 4MHz Synchronous Step-Down DC/DC Converter

GENERAL DESCRIPTION

The XF45061 is a current mode synchronous step-down converter with fixed operating frequency. The supply current is only 130uA at operating and less than 1uA at shutdown. This device is the ideally solution for Li-Ion battery powered system applications and small size board applications.

This device has internal switch, no external diode. It has internal fixed 4MHz frequency and makes application circuit smaller.

The XF45061 is available in an adjustable output voltage version. The adjustable version has wide output range from 0.6V to VIN. The XF45061 is available in a low profile (1mm) tiny SOT23-5 package.

FEATURES

- 600mA Output Current
- High Efficiency up to 92%
- 2.5V to 5.5 V Input Range
- Adjustable Output Voltage from 0.6V to VIN
- Low Quiescent Current 130uA
- No Schottky Diode Required
- 4MHz Constant Frequency Operation
- Low Dropout Operation: 100% Duty Cycle
- Current Mode Operation for Excellent Line and Load Transient Response
- Operating Temperature: -40°C to +85°C
- Available in tiny SOT23-5 Package

APPLICATIONS

- Cell Phones, Smart Phones
- 3G RF PA
- WLAN, GPS and Bluetooth Applications
- DTV Tuner Applications
- Note Books, Ultra-Mobile PCs

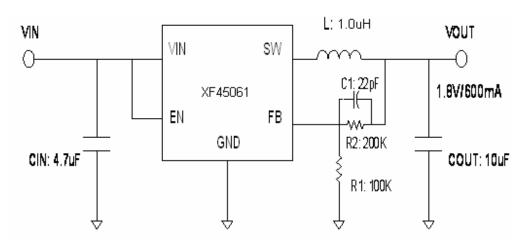


Figure 1. Typical Application Circuit



ORDERING INFORMATION

| PART NUMBER | TEMP RANGE | SWICHING FREQUENCY | OUTPUT VOLTAGE (V) | OUTPUT CURRENT (A) | PACKAGE | PINS |
|----------------|------------------|-----------------------|-----------------------|-----------------------|---------|------|
| XF45061_ADJ | -40°C to 85°C | 4MHz | Adjustable | 0.6 | SOT23-5 | 5 |

PIN CONFIGURATION

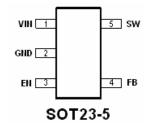


Figure 2. PIN Configuration

PIN DESCRIPTION

| PIN NUMBER | PIN NAME | PIN DESCRIPTION | | |
|---------------|-------------|---|--|--|
| 1 | VIN | Power Supply | | |
| 2 | GND | Ground. | | |
| 3 | EN | Enable Input. When higher than 1.5V, this pin turns the IC on. When lower than 0.3V, his pin turns the IC off. | | |
| 4 | FB | Feedback Input. The voltage at this pin is regulated to 0.6V. Connect to the resistor divider between output and ground to set output voltage | | |
| 5 | SW | Switch Output. Connect this pin to the inductor. | | |

ABSOLUTE MAXIMUM RATINGS

(Note: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

| PARAMETER | VALUE | UNIT |
|--------------------------------------|-----------------|------|
| Supply Voltage VIN | -0.3 to 6.5 | V |
| FB, EN Voltage | -0.3 to VIN+0.3 | V |
| SW Voltage | -0.3 to VIN+0.3 | V |
| Operating Ambient Temperature | -40 to 85 | °C |
| Maximum Junction Temperature | 125 | °C |
| Storage Temperature | -55 to 150 | °C |
| Lead Temperature (Soldering, 10 sec) | 300 | °C |



ELECTRICAL CHARACTERISTICS

($V_{IN} = 3.6V$, $T_A = 25^{\circ}C$ unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------------|-------------------|--|--------|------|--------|------|
| Input Voltage Range | V _{IN} | | 2.0 | | 6.0 | V |
| UVLO Threshold | V _{UVLO} | V _{HYSTERESIS} =100mV | 1.0 | 1.4 | 1.8 | V |
| Operating Supply Current | 1 | V _{FB} =0.5V or V _{OUT} =90%, I _{Load} =0 | | 130 | 170 | μA |
| Shutdown Supply Current | SUPPLY | V _{EN} =0V, V _{IN} =4.2V | | 0.1 | 1 | μΛ |
| | | T _a =25°C | 0.588 | 0.6 | 0.612 | |
| Regulated Feedback Voltage | V _{FB} | 0< T _a <85°C | 0.5865 | 0.6 | 0.6135 | V |
| | | -40°C < T _a <85°C | 0.585 | 0.6 | 0.615 | |
| Reference Voltage Line Regulation | | V _{IN} =2.7V to 5.5V | | 0.04 | 0.4 | % |
| Regulated Output Voltage | V _{OUT} | V _{OUT} =1.8V; I _{OUT} =100mA | 1.746 | 1.8 | 1.854 | V |
| Output Voltage Load Regulation | | | | 0.5 | | % |
| Peak Inductor Current | I _{PEAK} | V_{IN} =3V, V_{FB} =0.5V or V_{OUT} =90%, Duty Cycle<35% | | 1 | | А |
| Oscillator Frequency | F _{osc} | V _{FB} =0.6V or V _{OUT} =100% | 3.2 | 4 | 4.8 | MHz |
| Coomator Frequency | | V _{FB} =0 or V _{OUT} =0 | | 300 | | KHz |
| Rds(ON) of P-channel FET | | I _{SW} =100mA | | 0.3 | 0.4 | Ohm |
| Rds(ON) of N-channel FET | | I _{SW} =-100mA | | 0.2 | 0.3 | Ohm |
| Enable Threshold | | V _{IN} = 2.5V to 5.5V | 0.3 | 1 | 1.5 | V |
| Enable Leakage Current | | | -0.1 | | 0.1 | μΑ |
| SW Leakage Current | | $V_{EN} = 0V$, $V_{SW} = 0V$ or 5V, $V_{IN} = 5V$ | -1 | | 1 | uA |



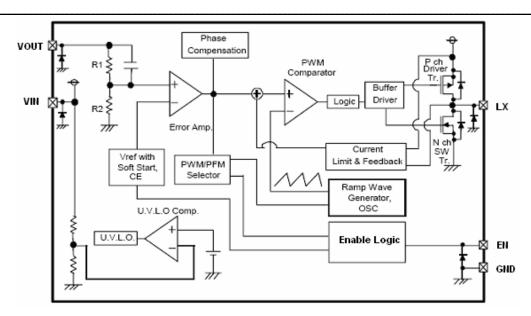


Figure 3. Functional Block Diagram

FUNCTIONAL DESCRIPTION

NORMAL OPERATION

In normal operation the high-side MOSFET turns on each cycle and remains on until the current comparator turns it off. At this point the low-side MOSFET turns on and remains on until either the end of the switching cycle or until the inductor current approaches zero. The error amplifier adjusts the current comparator's threshold as necessary in order to ensure that the output remains in regulation.

OVER CURRENT OPERATION

The part has internal current limit function, which is detected cycle by cycle. When its maximum inductor current limit is reached the charging cycle is terminated, and the low-side MOSFET is turned on to allow the inductor current to decrease. Under extreme overloads, such as short-circuit conditions, it reduces the oscillator frequency to 300KHz to allow further inductor current reduction and to minimize power dissipation.

APPLICATION INFORMATION

INDUCTOR SELECTION

In normal operation, the inductor maintains continuous current to the output. The inductor current has a ripple that is dependent on the inductance value. The high inductance reduces the ripple current. In general, select the inductance by the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \cdot f \cdot VI}$$

Where $V_{\it OUT}$ is the output voltage, $V_{\it IN}$ is the input voltage, f is the switch frequency, and $V\!\!I$ is the peak-to-peak inductor ripple current. Typically, choose $V\!\!I$ as the 30% of the maximum output current.

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| Manuf acture r | Part Number | Induct ance(u H) | DRC max (Ohms) | Dimensions L*W*H(mm3) |
|----------------------|----------------|------------------------|--------------------------|--------------------------|
| Murata | LQH32PN | 1 | 0.06 | 3.2*2.5*1.7 |
| | | 2.2 | 0.09 | |
| | | 4.7 | 0.15 | |
| Sumid | CDRH3D 16 | 1.5 | 0.04 | 4*4*1.8 |
| а | | 2.2 | 0.07 | |
| | | 3.3 | 0.11 | |
| | | 4.7 | 0.16 | |

Table 1. Recommend Surface Mount Inductors

INPUT CAPACITOR SELECTION

The input capacitor reduces input voltage ripple to the converter, low ESR ceramic capacitor is highly recommended. For most applications, a 4.7uF capacitor is used. The input capacitor should

be placed as close as possible to VIN and GND.

OUTPUT CAPACITOR SELECTION

A low ESR output capacitor is required in order to maintain low output voltage ripple. In the case of ceramic output capacitors, capacitor ESR is very small and does not contribute to the ripple, so a lower capacitance value is acceptable when ceramic capacitors are used. A 10uF ceramic output capacitor is suitable for most applications.

OUTPUT VOLTAGE PROGRAMMING

In the adjustable version, the output voltage is set by a resistive divider according to the following equation:

$$R_2 = R_1 \times \left(\frac{V_{OUT}}{0.6} - 1 \right)$$

Typically choose R1=100K and determine R2 from the following equation:

Connect a small capacitor across R1 feed forward capacitance at the FB pin for better performance.

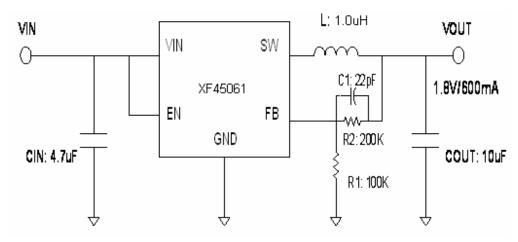


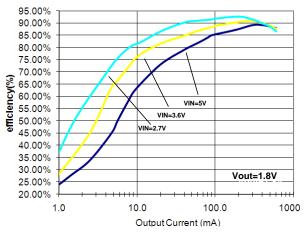
Figure 4. Typical Application Circuit for Adjustable Version



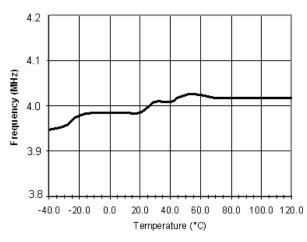
TYPICAL PERFORMANCE CHARACTERISTICS

(VIN=VEN=3.6V, L=1.0uH, CIN=4.7uF, COUT=10uF)

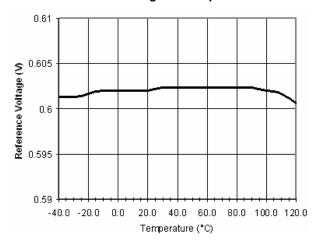
Efficiency vs. Output Current



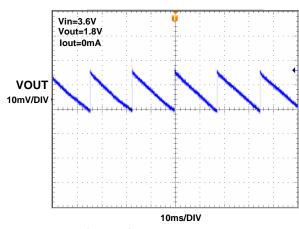
Oscillator Frequency vs. Temperature



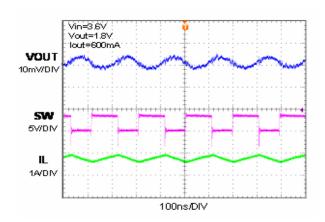
Reference Voltage vs. Temperature



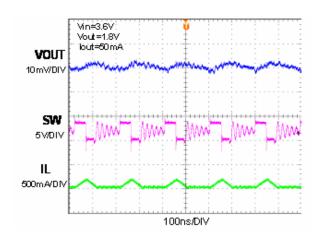
Steady State Waveform



Steady State Waveform

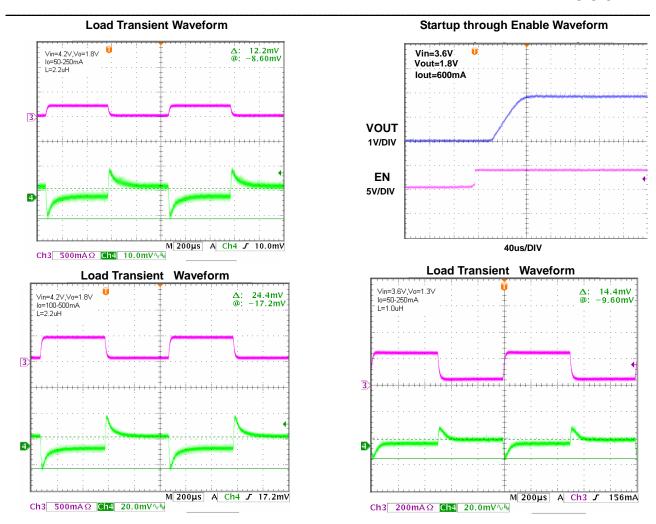


Steady State Waveform





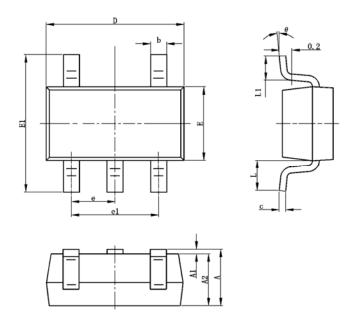
XF45061





PACKAGE OUTLINE

SOT23-5 PACKAGE OUTLINE AND DIMENSIONS



| SYMB OL | DIMEN II MILIMI | | | MENSION INCHES | | |
|------------|-----------------------|-----------|-------|-------------------|--|--|
| | MIN | MAX | MIN | MAX | | |
| Α | 1.050 | 1.250 | 0.041 | 0.049 | | |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 | | |
| A2 | 1.050 | 1.150 | 0.041 | 0.045 | | |
| b | 0.300 | 0.400 | 0.012 | 0.016 | | |
| С | 0.100 | 0.200 | 0.004 | 0.008 | | |
| D | 2.820 | 3.020 | 0.111 | 0.119 | | |
| E | 1.500 | 1.700 | 0.059 | 0.067 | | |
| E1 | 2.650 | 2.950 | 0.104 | 0.116 | | |
| е | 0.950 | 0.950 TYP | | TYP | | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 | | |
| L | 0.700 REF | | 0.028 | REF | | |
| L1 | 0.300 | 0.600 | 0.012 | 0.024 | | |
| θ | 0° | 8° | 0° 8° | | | |