

1.4MHz SOT23 Current-Mode Step-Up DC/DC Converter

Description

The FP6736 is a current-mode, pulse-width modulation and step-up DC/DC converter. The built-in high voltage N-channel MOSFET allows FP6736 for step-up applications with up to 30V output voltage, as well as for Single Ended Primary Inductance Converter (SEPIC) and other low-side switching DC/DC converter.

The high switching frequency (1.4MHz) allows the use of small external components. The soft-start function is programmable with an external capacitor, which sets the input current ramp rate.

The FP6736 is available in space-saving SOT-23-6 and TSOT-23-5 packages.

Features

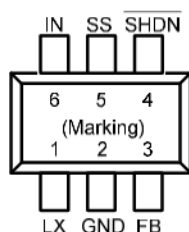
- Fixed Frequency 1.4MHz Current-Mode PWM Operation
- Adjustable Output Voltage up to 30V
- Guaranteed 13V/200mA Output with 5V Input
- 2.5V to 5.5V Input Range
- Maximum 0.1μA Shutdown Current
- Programmable Soft-Start
- Need Only Tiny Inductor and Capacitor
- SOT-23-6 and TSOT-23-5 Packages
- RoHS Compliant

Applications

- Notebook Computer
- LCD Display
- Portable Application
- PCMCIA Card
- Handheld Device

Pin Assignments

S6 Package (SOT-23-6)



S8 Package (TSOT-23-5)

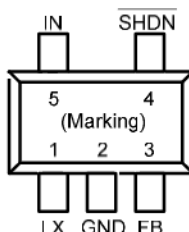
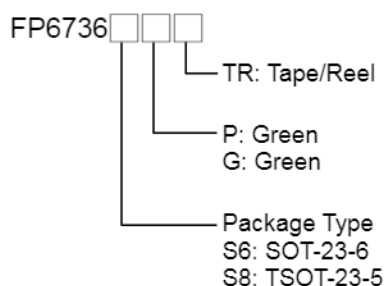


Figure 1. Pin Assignment of FP6736

Ordering Information



SOT-23-6 Marking

Part Number	Product Code
FP6736S6P	C3
FP6736S6G	C3=

TSOT-23-5 Marking

Part Number	Product Code
FP6736S8G	F11

Typical Application Circuit

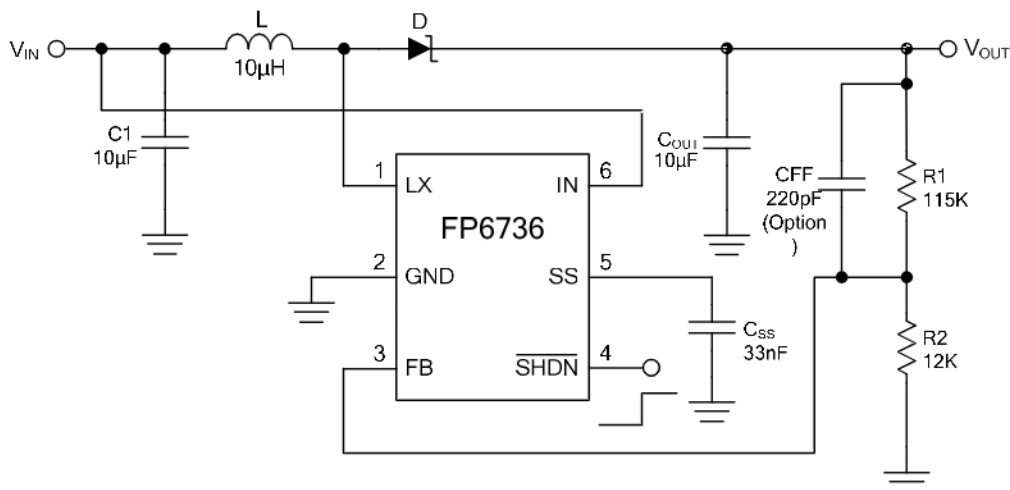


Figure 2. Typical Application Circuit of FP6736

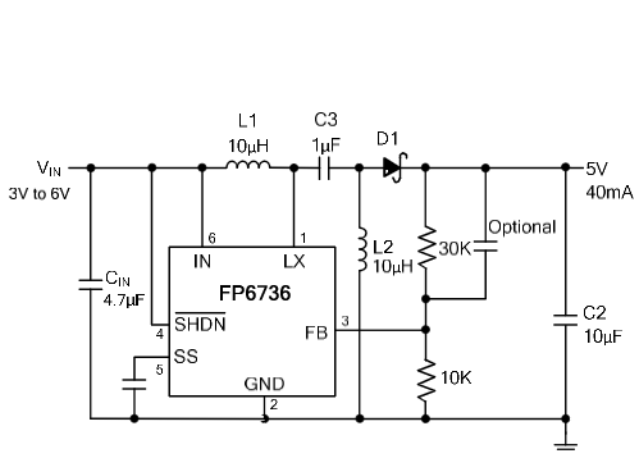


Figure 3. 4-Cell to 5V SEPIC Converter

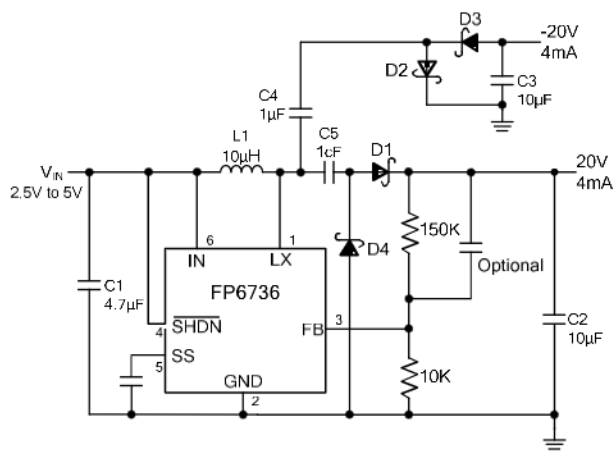


Figure 4. +20V Dual Output Converter with Output Disconnect

Pin Name	Pin Function
LX	Power Switching Connection. Connect LX to the inductor and output rectifier. Connect components as close to LX as possible.
GND	Ground.
FB	Feedback Pin. Connect a resistive voltage-divider from the output to FB to set the output voltage.
$\overline{\text{SHDN}}$	Shutdown Input. Drive $\overline{\text{SHDN}}$ low to turn off the converter. To automatically start the converter, connect $\overline{\text{SHDN}}$ to VIN. Do not leave $\overline{\text{SHDN}}$ unconnected.
SS	Soft-Start Input. Connect a soft-start capacitor from SS to GND to soft-start the converter. Leave SS open to disable the soft-start function.
IN	Internal Bias Voltage Input. Connect VIN to the input voltage source. Bypass VIN to GND with a 1 μ F or greater capacitor as close to VIN as possible.

The diagram illustrates a power MOSFET driver circuit. Key components and their connections include:

- Input and Biasing:** An input signal **IN** is connected to a **4 μ A** current source and the **SSO** pin. A **1.23V VREF** source is connected to the non-inverting input of the **ERROR AMP.**
- Feedback and Error Amplification:** The **FBO** pin is connected to the inverting input of the **ERROR AMP.** The output of the error amplifier is connected to the non-inverting input of the **PWM COMPARATOR** through a resistor **RC** and a capacitor **CC**.
- Control and Timing:** The **PWM/PFM CONTROL** block provides a reference to the **CONTROL LOGIC** block. The **CONTROL LOGIC** block also receives a **1.4MHz OSCILLATOR** signal and a **SLOPE COMPENSATION** signal (represented by a sawtooth symbol). The output of the control logic is connected to the **DRIVER** block.
- Output Stage:** The **DRIVER** block drives the gate of the MOSFET **M1**. The MOSFET's source is connected to **GND** through a resistor **RS**. The drain of **M1** is connected to the **LX** pin and the **SHDN** pin.
- Current Sensing:** A **CURRENT AMP.** (current amplifier) is connected to the source of **M1** through **RS** and to the **CONTROL LOGIC** block.

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Absolute Maximum Ratings ^(Note 1)

- LX to GND ----- -0.3V to +33V
- IN, $\overline{\text{SHDN}}$, FB to GND ----- -0.3V to +6V
- SS to GND ----- -0.3V to $V_{\text{IN}} + 0.3\text{V}$
- Power Dissipation @ $T_{\text{A}} = +25^{\circ}\text{C}$, (P_{D}) ----- 0.4W
- Package Thermal Resistance, (θ_{JA}) ----- 250°C/W
- Junction Temperature (T_{J}) ----- $+150^{\circ}\text{C}$
- Storage Temperature Range (T_{S}) ----- -65°C to $+150^{\circ}\text{C}$
- Lead Temperature (Soldering, 10 sec.) (T_{LEAD}) ----- $+260^{\circ}\text{C}$

Note 1: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

Recommended Operating Conditions

- Input Voltage (V_{IN}) ----- +2.5V to +5.5V
- Operating Temperature Range (T_{OPR}) ----- -40°C to $+85^{\circ}\text{C}$

Electrical Characteristics

($V_{IN}=V_{SHDN}=3V$, $FB=GND$, $SS=Open$, $T_A=25^{\circ}C$, unless otherwise specified.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Supply Range	V _{IN}		2.5		5.5	V
Output Voltage Adjustable Range	V _{OUT}				30	V
Quiescent Current	I _{IN}	V _{FB} =1.3V, not switching		75	200	μA
		V _{FB} =1.0V, switching		1	2.5	mA
Shutdown Supply Current	I _{SD}	V _{SHDN} =0V		0.1	10	μA
Under Voltage Lockout	V _{UVLO}		2	2.2	2.4	V
Error Amplifier						
Feedback Regulation Set Point	V _{FB}		1.205	1.23	1.255	V
FB Input Bias Current	I _{FB}	V _{FB} =1.24V		21	80	nA
Line Regulation		2.5V<V _{IN} <5.5V		0.05	0.2	%/V
Oscillator						
Frequency	f _{OSC}		1000	1400	1800	kHz
Maximum Duty Cycle	DC		86	93		%
Power Switch						
On Resistance ^(Note2)	R _{DS(ON)}			1		Ω
Switch Current Limit ^(Note2)	I _{LIM}			600		mA
Leakage Current	I _{LX(OFF)}	V _{LX} =12V, T _A =+25°C		0.1	1	μA
		V _{LX} =12V			10	μA
Soft-start						
Reset Switch Resistance ^(Note2)					2	kΩ
Charge Current		V _{SS} =1.2V	1.5	4	7	μA
Control Input						
Input Low Voltage	V _{IL}	V _{SHDN} , V _{IN} =2.5V to 5.5V			0.3	V
Input High Voltage	V _{IH}	V _{SHDN} , V _{IN} =2.5V to 5.5V	1.0			V
SHDN Input Current	I _{SHDN}	V _{SHDN} =1.8V		25	50	μA
	I _{SHDN}	V _{SHDN} =0V		0.01	0.1	μA

Note 2: The specification is guaranteed by design, not production tested.

Typical Performance Curves

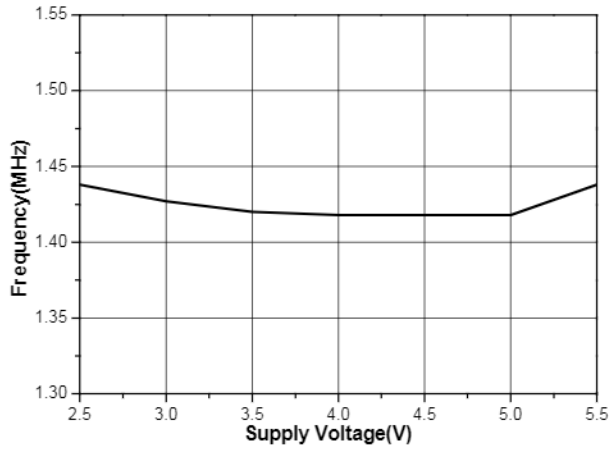


Figure 6. Frequency vs. Supply Voltage

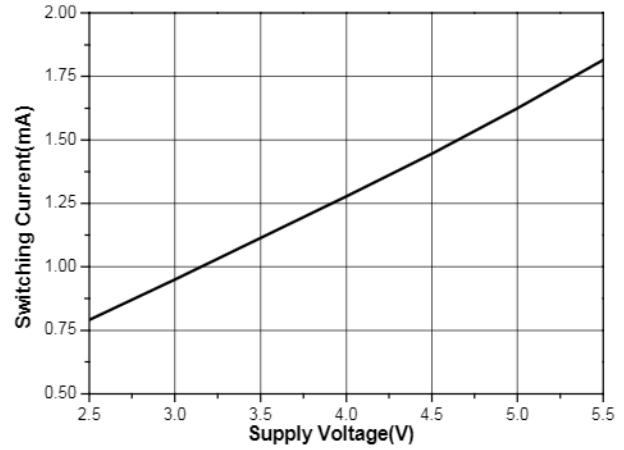


Figure 7. Switching Current vs. Supply voltage

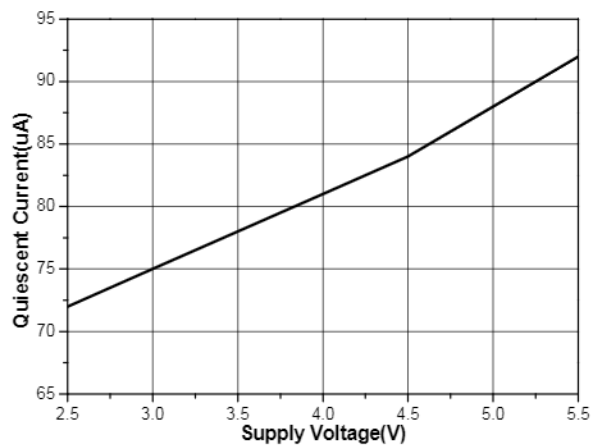


Figure 8. Non-Switching Current vs. Supply Voltage

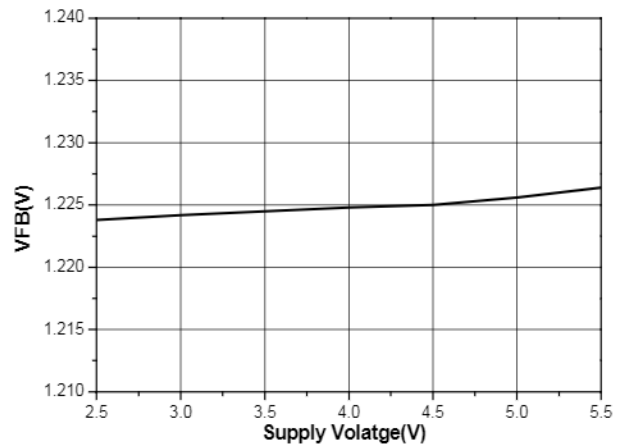


Figure 9. Feedback Voltage vs. Supply Voltage

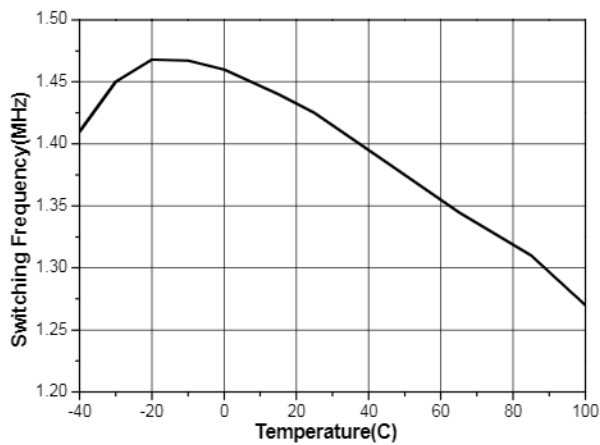


Figure 10. Switching Frequency vs. Temperature

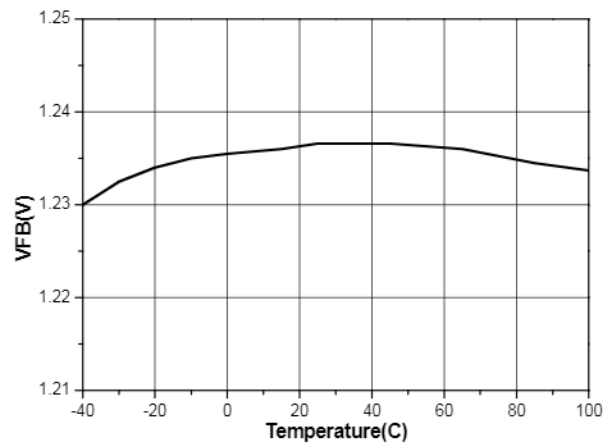


Figure 11. Feedback Voltage vs. Temperature

Typical Performance Curves (Continued)

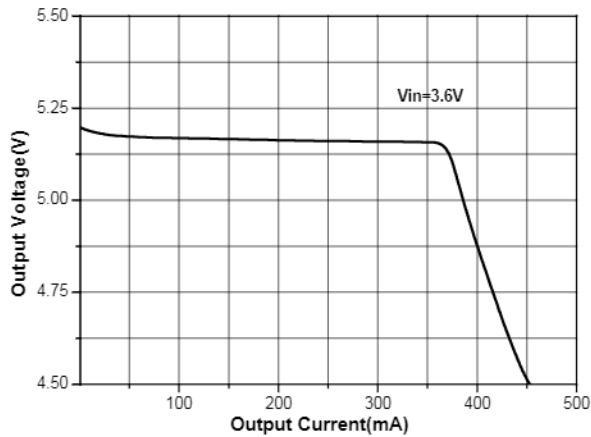


Figure 12. Load Regulation ($V_o=5V$)

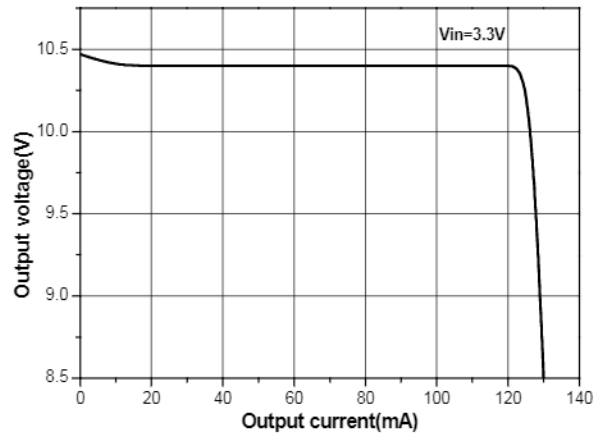


Figure 13. Load Regulation ($V_o=10V$)

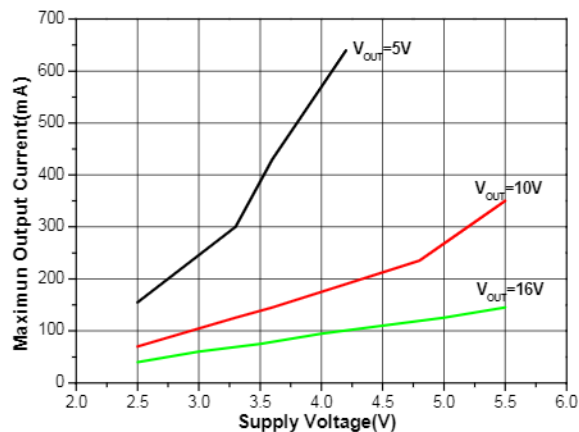


Figure 14. Maximum Output Current vs. Supply Voltage

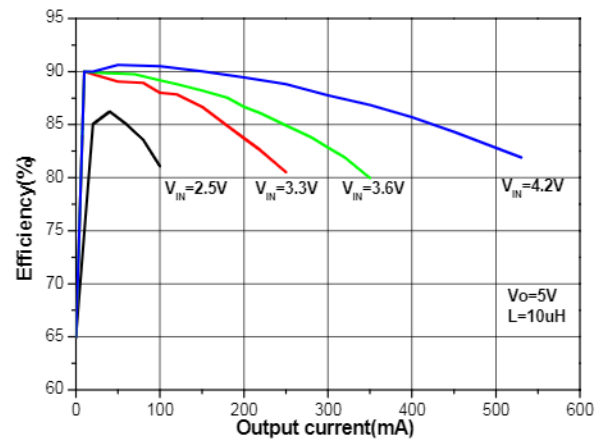


Figure 15. Efficiency vs. Output Current ($V_o=5V$)

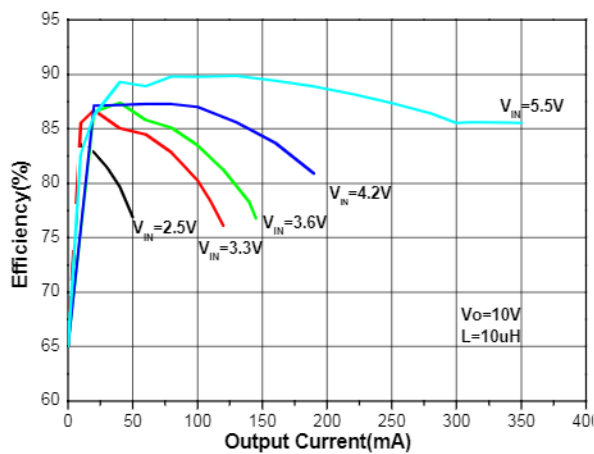
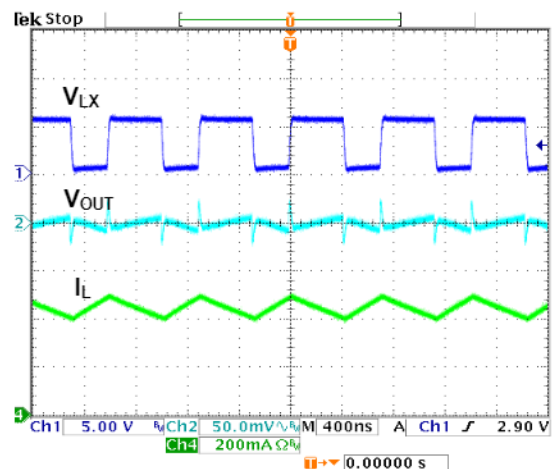


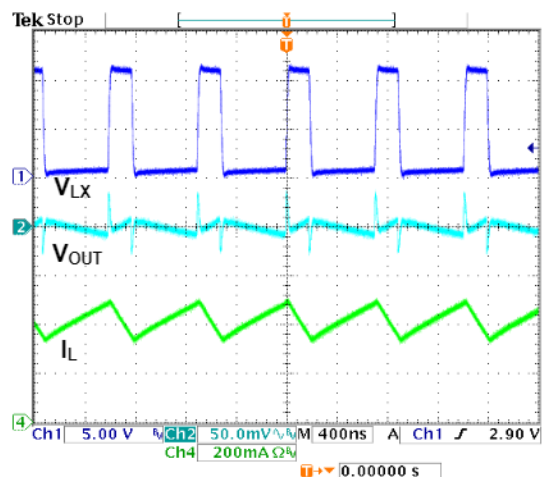
Figure 16. Efficiency vs. Output Current ($V_o=10V$)



$V_{IN}=3.6V$, $V_{OUT}=5V$, $I_o=250mA$, $L1=10\mu H$

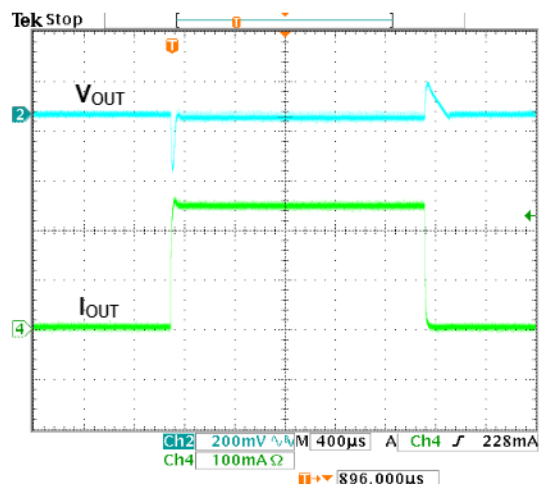
Figure 17. Operation Waveform

Typical Performance Curves (Continued)



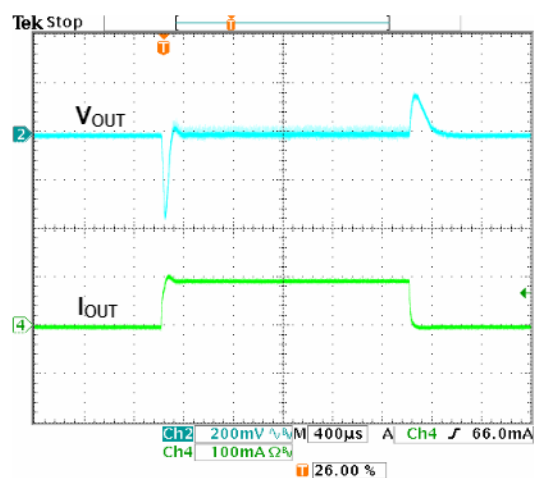
$V_{IN}=3.3V$, $V_{OUT}=10V$, $I_O=100mA$, $L1=10\mu H$

Figure 18. Operation Waveform



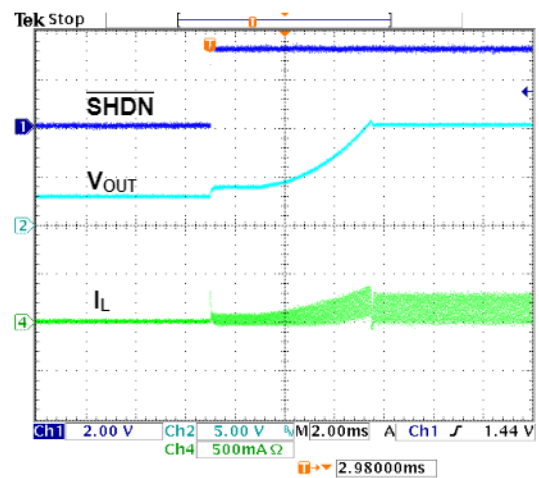
$V_{IN}=3.6V$, $V_{OUT}=5V$, $I_O=5$ to $250mA$, $CFF=220pF$

Figure 19. Load Step Response



$V_{IN}=3.3V$, $V_{OUT}=10V$, $I_O=5$ to $250mA$, $CFF=220pF$

Figure 20. Load Step Response



$V_{IN}=3.3V$, $V_{OUT}=10V$, $I_O=50mA$, $CSS=33nF$

Figure 21. Start-Up from Shutdown

Application Information

Inductor Selection

A 10 μ H inductor is recommended for most FP6736 applications. Although small size and high efficiency are major concerns, the inductor should have low core losses at 1.4MHz and low DCR (copper wire resistance).

Capacitor Selection

Small size ceramic capacitors are ideal for FP6736 applications. 5R and X7R types are recommended because they retain their capacitance over wider voltage and temperature ranges better than other types such as Y5V or Z5U. A 4.7 μ F input capacitor and a 4.7 μ F output capacitor are sufficient for most FP6736 applications.

Diode Selection

Schottky diodes, with low forward voltage drop and fast reverse recovery, are the ideal choices for FP6736 applications. The forward voltage drop of a Schottky diode represents the conduction losses in the diode while the diode capacitance (C_T or C_D) represents the switching losses. For diode selection, both forward voltage drop and diode capacitance need to be considered. Schottky diodes with higher current ratings usually have lower forward voltage drop and larger diode capacitance, which can cause significant switching losses at the 1MHz switching frequency of the FP6736. A Schottky diode rated at 100mA to 400mA is sufficient for most FP6736 applications.

Open-Circuit Protection

In the cases of output open circuit, when R1 is disconnected from the circuit, the feedback voltage will be zero. The FP6736 will then switch at a high duty cycle resulting in a high output voltage, which may cause the LX pin voltage to exceed its maximum 33V rating. A Zener diode can be used at the output to limit the voltage on the LX pin (Figure 22). The Zener voltage should be larger than the maximum voltage of the V_{OUT} . The current rating of the Zener should be larger than 0.1mA.

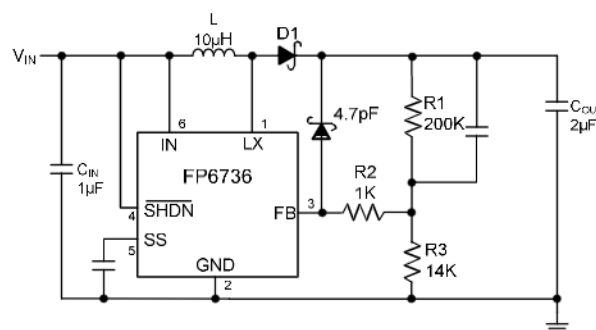
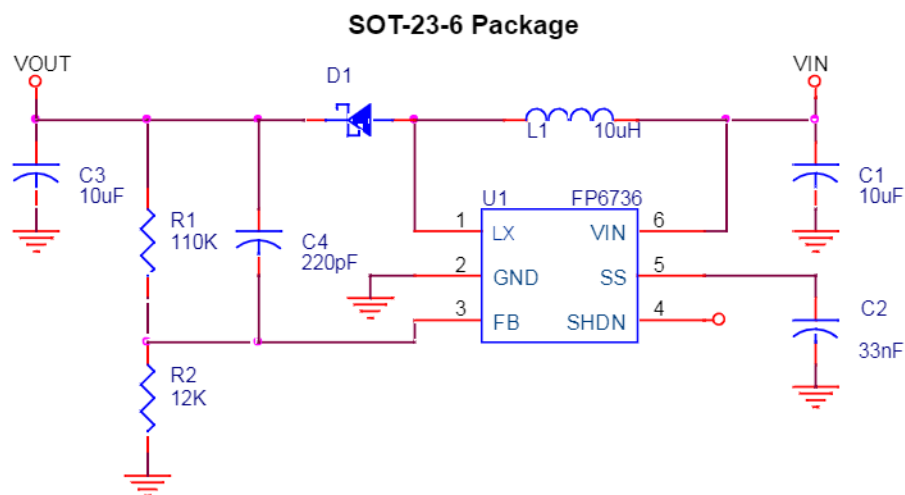
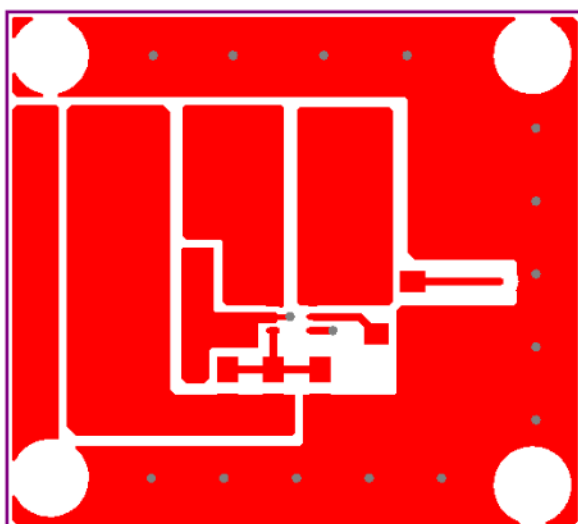


Figure 22. With Open-Circuit Protection

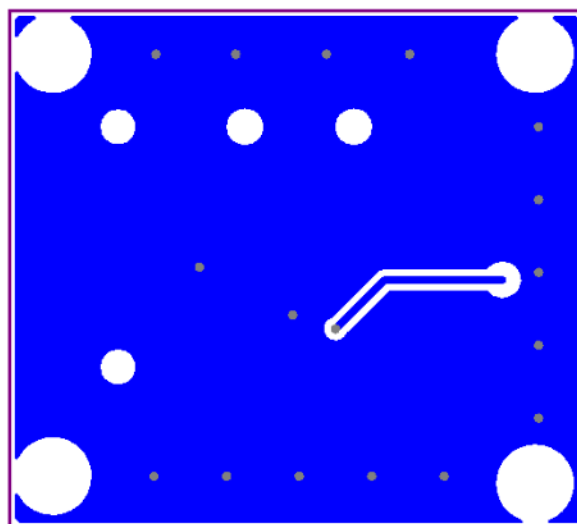
Demo Board Circuit & Layout



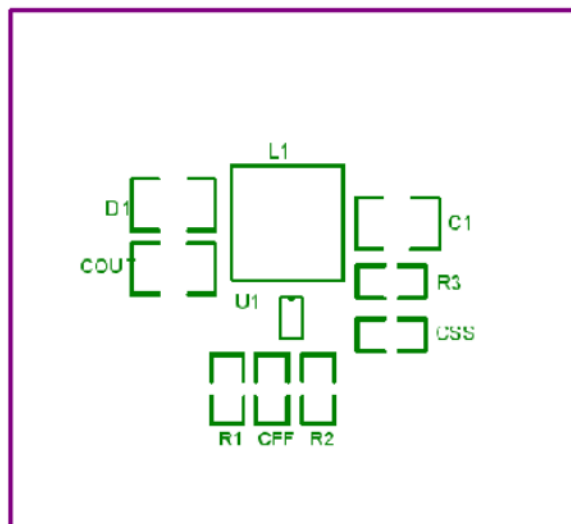
Top Side (SOT-23-6 Package)



Bottom Side (SOT-23-6 Package)

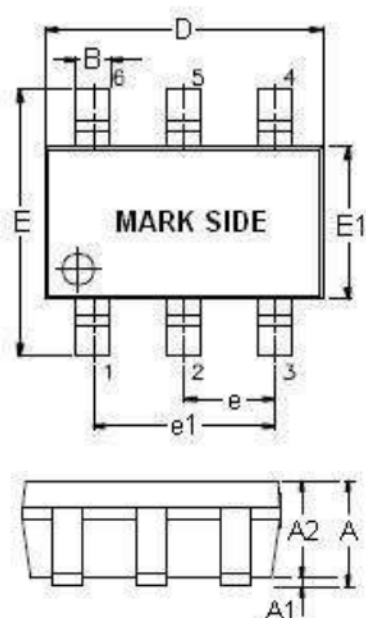


Component Placement(SOT-23-6 Package)



Outline Information

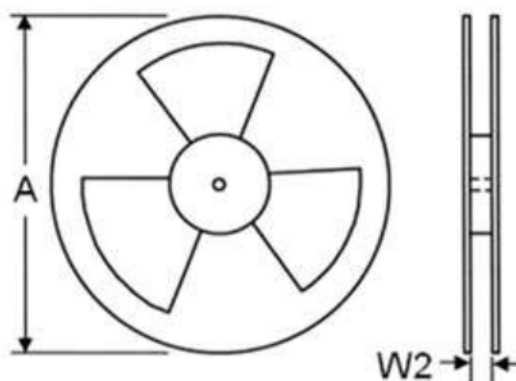
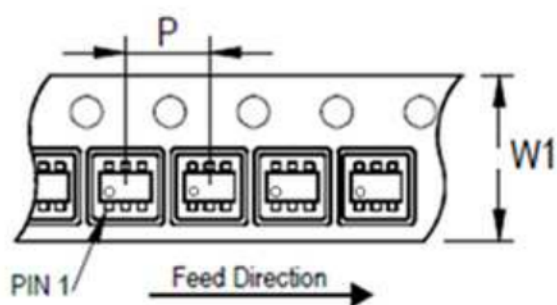
SOT-23-6 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
B	0.30	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
L	0.30	0.60

Note: Followed From JEDEC MO-178-C.

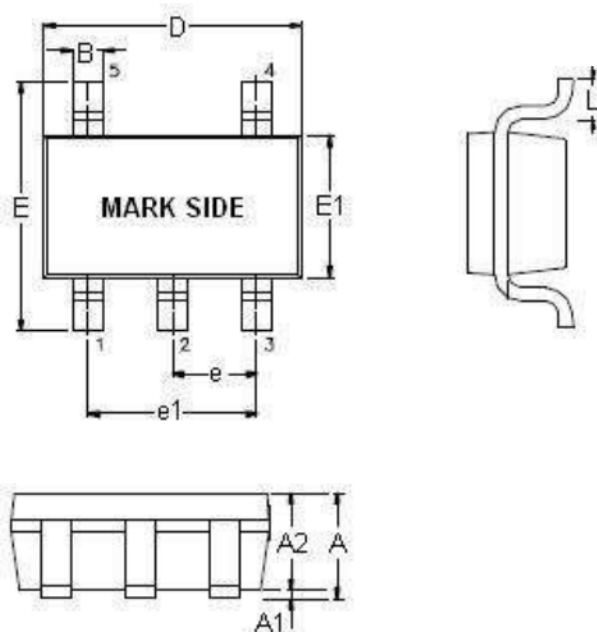
Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	8.4	300~1000	3,000

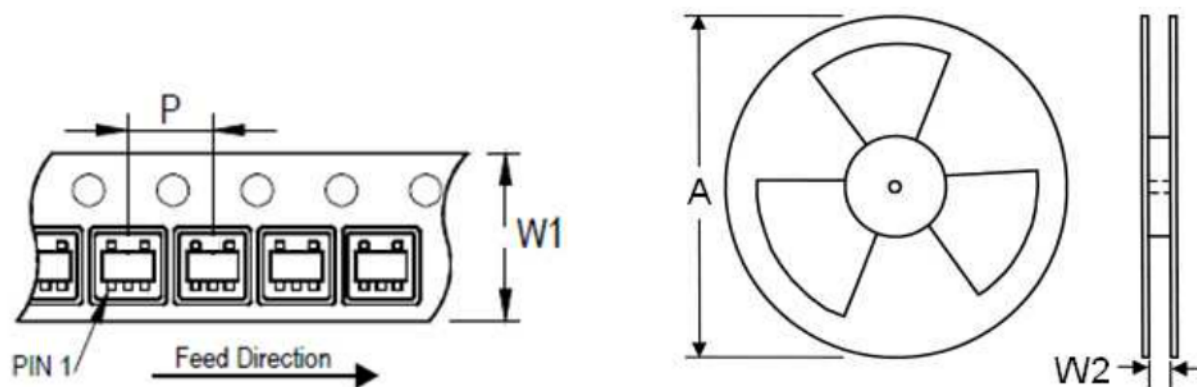
Outline Information (Continued)

TSOT-23-5 Package (Unit: mm)



SYMBOLS UNIT	DIMENSION IN MILLIMETER	
	MIN	MAX
A	0.70	0.90
A1	0.00	0.10
A2	0.70	1.00
B	0.30	0.50
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.70
e	0.90	1.00
e1	1.80	2.00
L	0.30	0.60

Carrier Dimensions



Tape Size (W1) mm	Pocket Pitch (P) mm	Reel Size (A)		Reel Width (W2) mm	Empty Cavity Length mm	Units per Reel
		in	mm			
8	4	7	180	8.4	300~1000	3,000

Life Support Policy

Fitipower's products are not authorized for use as critical components in life support devices or other medical systems.