

FAN4860

3MHz, Synchronous TinyBoost™ Regulator

Features

- Operates with Very Small External Components:
1 μ H Inductor and 0402 Case Size Input and Output Capacitors
- Input Voltage Range from 2.3V to 4.5V
- Fixed 3.3V or 5.0V Output Voltage Options
- Maximum Load Current >200mA at $V_{IN}=2.3V$
- Maximum Load Current 300mA at $V_{IN}=3.3V$, $V_{OUT}=5V$
- Maximum Load Current 300mA at $V_{IN}=2.7V$, $V_{OUT}=3.3V$
- Up to 92% Efficient
- Low Operating Quiescent Current
- True Load Disconnect During Shutdown
- Variable On-time Pulse Frequency Modulation (PFM) with Light-Load Power-Saving Mode
- Internal Synchronous Rectifier (No External Diode Needed)
- Thermal Shutdown and Overload Protection
- 6-Pin 2 x 2mm UMLP
- 6-Bump WLCSP, 0.4mm Pitch

Applications

- USB "On the Go" 5V Supply
- 5V Supply – HDMI, H-Bridge Motor Drivers
- Powering 3.3V Core Rails
- PDAs, Portable Media Players
- Cell Phones, Smart Phones, Portable Instruments

Description

The FAN4860 is a low-power boost regulator designed to provide a regulated 3.3V or 5V output from a single cell Lithium or Li-Ion battery. Output voltage options are fixed at either 3.3V or 5.0V with a guaranteed maximum load current of 200mA at $V_{IN}=2.3V$ and 300mA at $V_{IN}=3.3V$. Input current in shut-down mode is less than 1 μ A, which maximizes battery life.

Light-load PFM operation is automatic and "glitch-free". The regulator maintains output regulation at no-load with as low as 37 μ A quiescent current.

The combination of built-in power transistors, synchronous rectification, and low supply current make the FAN4860 ideal for battery powered applications.

The FAN4860 is available in 6-bump 0.4mm pitch Wafer-Level Chip Scale Package (WLCSP) and a 6-lead 2x2mm ultra-thin MLP package.

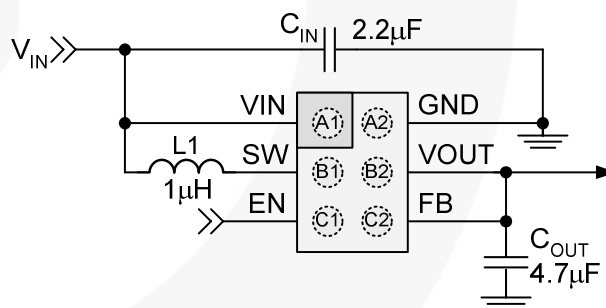


Figure 1. Typical Application

Ordering Information

Part Number	Operating Temperature Range	Package	Packing Method
FAN4860UC5X	-40°C to 85°C	WLCSP, 0.4mm Pitch	Tape and Reel
FAN4860UMP5X	-40°C to 85°C	UMLP-6, 2 x 2mm	Tape and Reel
FAN4860UC33X	-40°C to 85°C	WLCSP, 0.4mm Pitch	Tape and Reel

Please refer to tape and reel specifications at <http://www.fairchildsemi.com/packaging>.

Block Diagrams

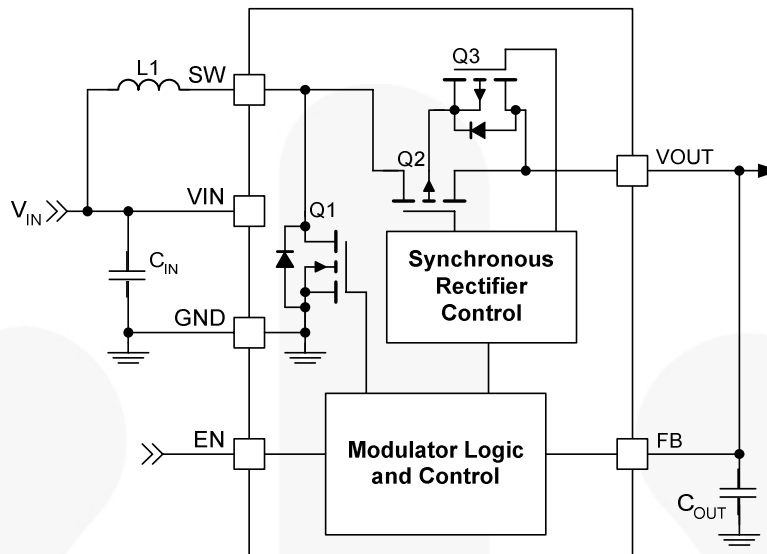


Figure 2. IC Block Diagram

Pin Configuration

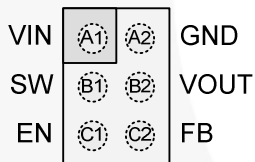


Figure 3. WLCSP (Top View)

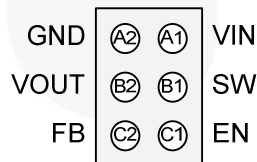


Figure 4. WLCSP (Bottom View)

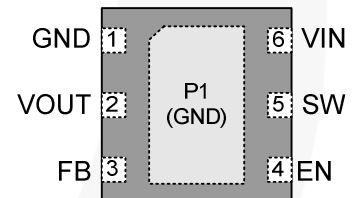


Figure 5. 2X2mm UMLP (Top View)

Pin Definitions

Pin #		Name	Description
WLCSP	UMLP		
A1	6	VIN	Input Voltage. Connect to Li-Ion battery input power source and input capacitor (C_{IN}).
B1	5	SW	Switching Node. Connect to inductor.
C1	4	EN	Enable. When this pin is HIGH, the circuit is enabled. This pin should not be left floating.
C2	3	FB	Feedback. Output voltage sense point for V_{OUT} . Connect to output capacitor (C_{OUT}).
B2	2	VOUT	Output Voltage. This pin is both the output voltage terminal as well as an IC bias supply.
A2	1, P1	GND	Ground. Power and signal ground reference for the IC. All voltages are measured with respect to this pin.

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter		Min.	Max.	Units
V _{IN}	VIN Pin		-0.3	5.5	V
V _{OUT}	VOUT Pin		-2	6	V
V _{FB}	FB Pin		-2	14	V
V _{SW}	SW Node	DC	-0.3	5.5	V
		Transient: 10ns, 3MHz	-1.0	6.5	
V _{EN}	EN Pin		-0.3	5.5	V
ESD	Electrostatic Discharge Protection Level	Human Body Model per JESD22-A114	2		kV
		Charged Device Model per JESD22-C101	1		
T _J	Junction Temperature		-40	+150	°C
T _{STG}	Storage Temperature		-65	+150	°C
T _L	Lead Soldering Temperature, 10 Seconds			+260	°C

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter		Min.	Max.	Units
V_{IN}	Supply Voltage	5.0 V_{OUT}	2.3	4.5	V
		3.3 V_{OUT}	2.5	3.2	V
I_{OUT}	Output Current			200	mA
T_A	Ambient Temperature		-40	+85	°C
T_J	Junction Temperature		-40	+125	°C

Thermal Properties

Junction-to-ambient thermal resistance is a function of application and board layout. This data is measured with four-layer 2s2p boards in accordance to JEDEC standard JESD51. Special attention must be paid not to exceed junction temperature $T_{J(max)}$ at a given ambient temperature T_A .

Symbol	Parameter		Typical	Units
θ_{JA}	Junction-to-Ambient Thermal Resistance	WLCSP	130	°C/W
		UMLP	57	°C/W

Electrical Specifications

Minimum and maximum values are at $V_{IN}=V_{EN}=2.3V$ to $4.5V$ (2.5 to $3.2 V_{IN}$ for $3.3 V_{OUT}$ option), $T_A=-40^{\circ}C$ to $+85^{\circ}C$; circuit of Figure 1, unless otherwise noted. Typical values are at $T_A=25^{\circ}C$, $V_{IN}=V_{EN}=3.6V$ for $V_{OUT}=5V$, and $V_{IN}=V_{EN}=2.7V$ for $V_{OUT}=3.3V$.

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Units
I _{IN}	V _{IN} Input Current	5.0 V _{OUT}	Quiescent: V _{IN} =3.6V, I _{OUT} =0, EN=V _{IN}		37	45	μA
			Shutdown: EN=0, V _{IN} =3.6V		0.5	1.5	
		3.3 V _{OUT}	Quiescent: V _{IN} =2.7V, I _{OUT} =0, EN=V _{IN}		50	65	
			Shutdown: EN=0, V _{IN} =2.7V		0.5	1.5	
I _{LK_OUT}	V _{OUT} Leakage Current		V _{OUT} =0, EN=0, V _{IN} ≥3V		10		nA
I _{LK_RVSR}	V _{OUT} to V _{IN} Reverse Leakage		V _{OUT} =5V, V _{IN} =3.6V, EN=0			2.5	μA
			V _{OUT} =3.3V, V _{IN} =3V, EN=0				
V _{UVLO}	Under-Voltage Lockout		V _{IN} Rising		2.2	2.3	V
V _{UVLO_HYS}	Under-Voltage Lockout Hysteresis				190		mV
V _{ENH}	Enable HIGH Voltage			1.05			V
V _{ENL}	Enable LOW Voltage					0.4	V
I _{LK_EN}	Enable Input Leakage Current				0.01	1	μA
V _{OUT}	5.0 V _{OUT} Output Voltage Accuracy ⁽¹⁾		V _{IN} from 2.3V to 4.5V, I _{OUT} ≤200mA	4.80	5.05	5.15	V
			V _{IN} from 2.7V to 4.5V, I _{OUT} ≤200mA	4.85	5.05	5.15	
			V _{IN} from 3.3V to 4.5V, I _{OUT} ≤300mA	4.85	5.05	5.15	
			3.3 V _{OUT} Output Voltage Accuracy ⁽¹⁾	V _{IN} from 2.5V to 3.2V, I _{OUT} ≤200mA	3.17	3.33	
V _{REF}	Reference Accuracy		Referred to V _{OUT} =5V	4.975	5.050	5.125	V
			Referred to V _{OUT} =3.3V	3.280	3.330	3.380	
t _{OFF}	Off Time		V _{IN} =3.6V, V _{OUT} =5V, I _{OUT} =200mA	195	240	265	ns
			V _{IN} =2.7V, V _{OUT} =3.3V, I _{OUT} =200mA	240	290	350	
I _{OUT}	Maximum Output Current ⁽²⁾	5.0 V _{OUT}	V _{IN} =2.3V	200			mA
			V _{IN} =3.3V	300			
			V _{IN} =3.6V		400		
		3.3 V _{OUT}	V _{IN} =2.5V	250			
			V _{IN} =2.7V	300			
I _{SW}	SW Peak Current Limit	5.0 V _{OUT}	V _{IN} =3.6V, V _{OUT} >V _{IN}	930	1100	1320	mA
		3.3 V _{OUT}	V _{IN} =2.7V, V _{OUT} >V _{IN}	650	800	950	
I _{SS}	Soft-Start Input Peak Current Limit ⁽²⁾	5.0 V _{OUT}	V _{IN} =3.6V, V _{OUT} < V _{IN}		850		mA
		3.3 V _{OUT}	V _{IN} =2.7V, V _{OUT} < V _{IN}		700		
t _{SS}	Soft-Start Time ⁽³⁾	5.0 V _{OUT}	V _{IN} =3.6V, I _{OUT} =200mA		100	300	μs
		3.3 V _{OUT}	V _{IN} =2.7V, I _{OUT} =200mA		250	750	
R _{DS(ON)}	N-Channel Boost Switch		V _{IN} =3.6V		300		mΩ
	P-Channel Sync Rectifier		V _{IN} =3.6V		400		
T _{TSD}	Thermal Shutdown		I _{LOAD} =10mA		150		°C
T _{TSD_HYS}	Thermal Shutdown Hysteresis				30		°C

Notes:

- I_{LOAD} from 0 to I_{OUT} ; also includes load transient response. V_{OUT} measured from mid-point of output voltage ripple. Effective capacitance of $C_{OUT} > 1.5\mu F$.
- Guaranteed by design and characterization; not tested in production.
- Elapsed time from rising EN until regulated V_{OUT} .

5.0 V_{OUT} Typical Characteristics

Unless otherwise specified, circuit per Figure 1, $3.6V_{IN}$, $T_A=25^{\circ}C$.

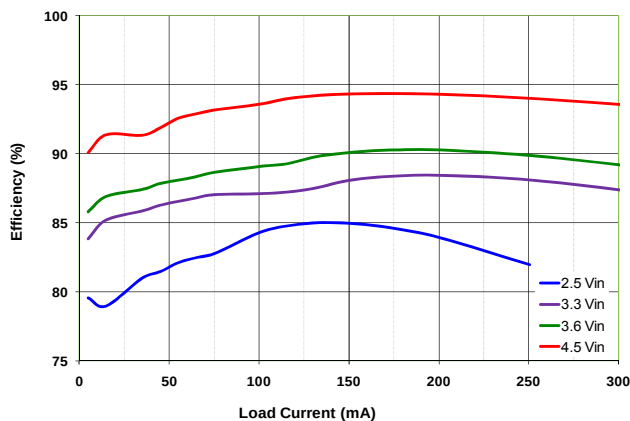


Figure 6. Efficiency vs. V_{IN}

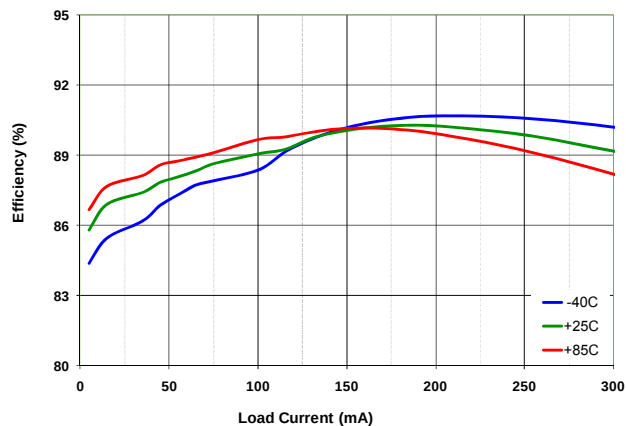


Figure 7. Efficiency vs. Temperature, $3.6V_{IN}$

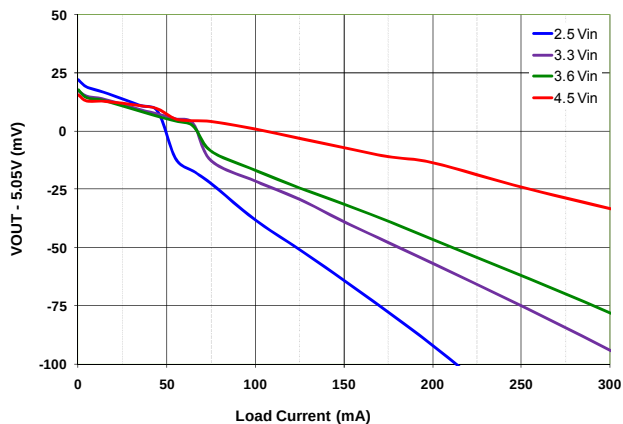


Figure 8. Line and Load Regulation

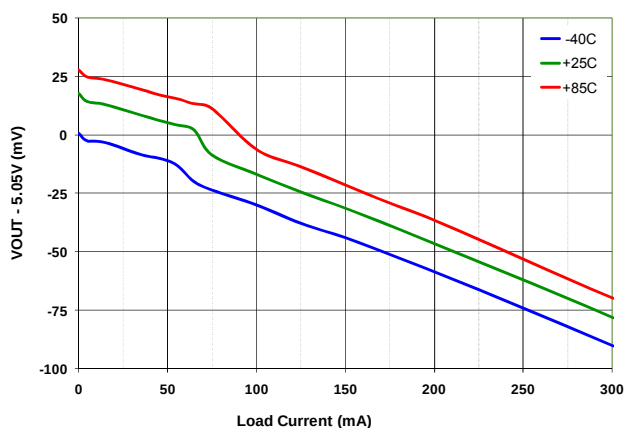


Figure 9. Load Regulation vs. Temperature, $3.6V_{IN}$

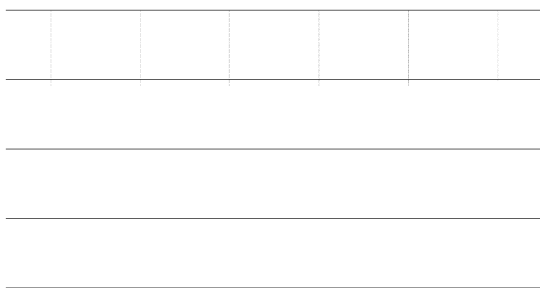


Figure 10. Switching Frequency



Figure 11. Quiescent Current