2MHz 2A Synchronous Buck Converter

General Description

The FTD6817H is a high-efficiency monolithic synchronous buck regulator using a constant frequency, current mode architecture. The device is available in an adjustable version. Supply current with no load is 70µA and drops to <1uA in shutdown. The 2.5V to 5.5V input voltage range makes the FTD6817H ideally suited for single Li-Ion battery powered applications. 100% duty cycle provides low dropout operation, extending battery life in portable systems. PWM/PFM mode operation provides very low output ripple voltage for noise sensitive applications.

Switching frequency is internally set at 2MHz, allowing the use of small surface mount inductors and capacitors. Low output voltages are easily supported with the 0.6V feedback reference voltage.

The FTD6817H is available in SOT-23-5 package.

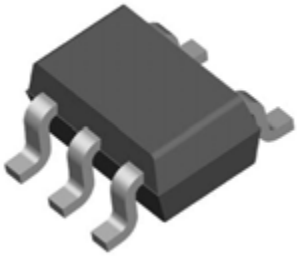
Features

- 2.5V to 5.5V Input Voltage Range
- High efficiency Up to 96%
- 2MHz switching frequency
- No Schottky Diode Required
- Low Dropout Operation:100% Duty Cycle
- PFM Mode for High Efficiency in Light Load
- Low Quiescent Current: 70µA
- Short circuit protection
- Thermal protection
- Over Voltage Protection
- Inrush Current Limit and Soft-Start
- Available in SOT-23-5 PbFree Package

Application

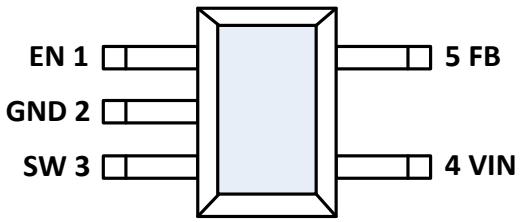
- Cellular and Smart Phones
- Wireless and DSL Modems
- Portable Instruments
- Digital Still and Video Cameras
- PC Card

Package Types



SOT-23-5

Pin Configurations



(Top view)

Pin Description

Pin Number	Pin Name	Description
1	EN	Chip Enable Pin. Drive EN above 1V to turn on the part. Drive EN below 0.3V to turn it off. Do not leave EN 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 10µF or greater ceramic capacitor.
5	FB	Output Voltage Feedback Pin. An internal resistive divider divides the output voltage down for comparison to the internal reference voltage.

Function Block

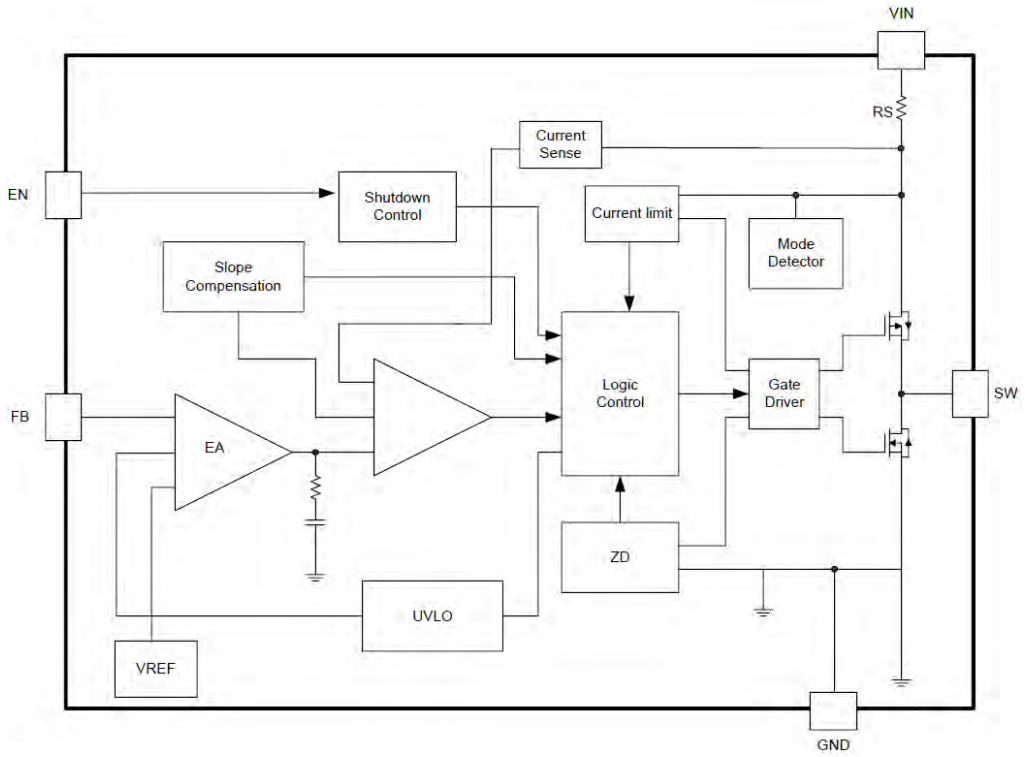
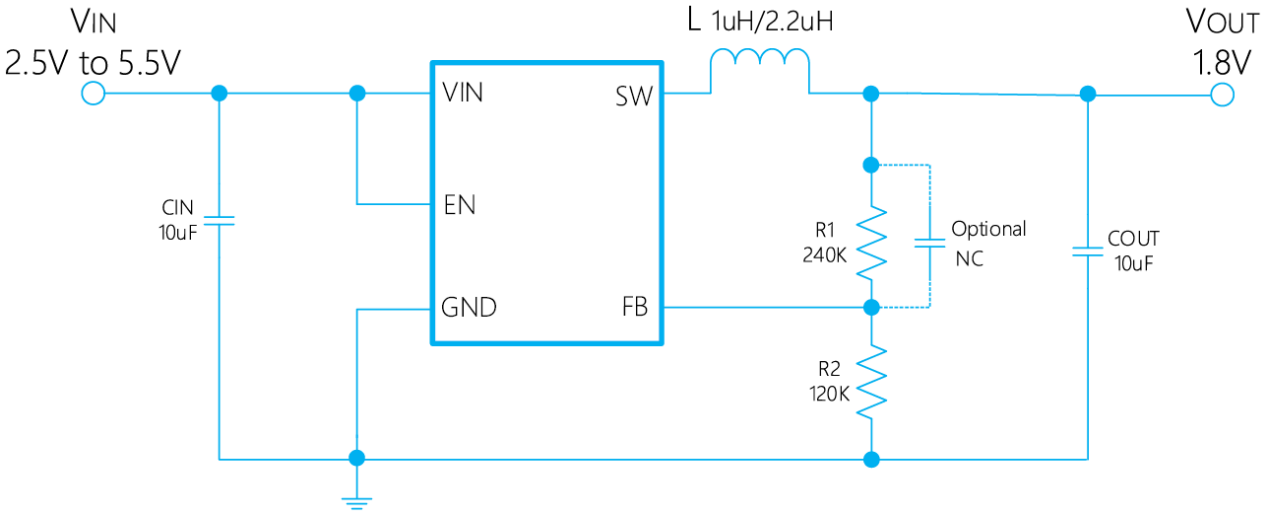


Figure 1 Function Block Diagram of FTD6817H

Typical Application Circuit



Absolute Maximum Ratings (at T_A=25℃)

Symbol	Parameter	Rating	Unit
V_{IN}		-0.3 to 6.0	V
V_{EN}	EN Voltage	-0.3 to 6.0	V
V_{SW}	SW Voltage	-0.3 to V_{IN}+0.3	V
T_{OP}	Operating Junction Temperature	-40 to 165	°C
T_{STG}	Storage Temperature	-65 ~ 150	°C
T_{SDR}	Maximum Lead Soldering Temperature (10 Seconds)	260	°C

Electrical Characteristics

All typical values are at T_j=25°C(unless otherwise noted)

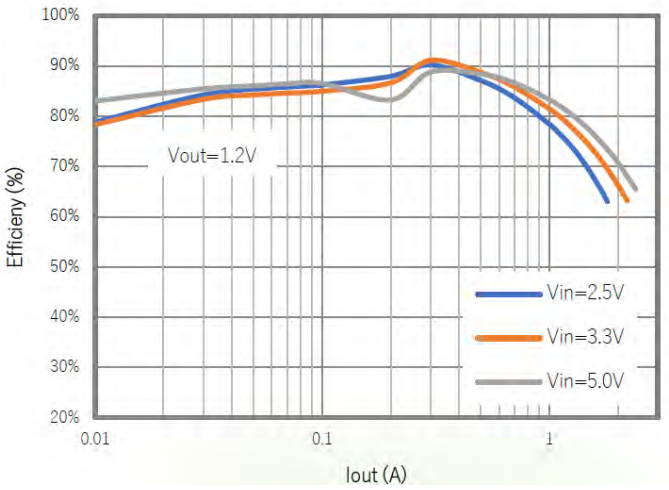
Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		2.5	-	5.5	V
Input overvoltage threshold	V_{OVP}		-	6.1	-	V
Input UVLO	UVLO		2.1	2.3	2.5	V
VIN Under Voltage Lockout Hysteresis	UVLO_HYST		0.1	0.2	0.3	V
FB Voltage	V_{FB}	No load	0.588	0.6	0.612	V
Switching Frequency	F_{OSC}	V_{FB}=0.5V	1.6	2	2.4	MHz
Maximum Duty	Dmax		-	100	-	%
Quiescent Current	I_Q		-	70	120	μA
Shutdown Current	I_{SD}	V_{EN}=0V	-	0.1	1	μA
Efficiency		I_{LOAD}=0.6A	85	90	-	%
Line regulation		I_{LOAD}=0.3A	-	0.1	0.2	%/V
Load regulation		I_{LOAD}=0-1.0A	-	0.1	0.2	%/V
P-Switch $RDS_{(ON)}$ (Note)	$RDS_{(ON)-P}$	I_{SW}=100mA	-	160	320	mΩ
N-Switch $RDS_{(ON)}$ (Note)	$RDS_{(ON)-N}$	I_{SW}=100mA	-	80	160	mΩ
Peak Current Limit	I_{LIM}	Duty Cycle=100%	-	3	-	A
SW Leakage Current	I_{SW}	V_{IN}= 6V, V_{SW}= 0 or 6V, EN=0	-	-	10	μA
EN Input Low Voltage	ENL		-	-	0.3	V
EN Input High Voltage	ENH		1	-	-	V
Thermal Shutdown(Note)	T_{SD}		135	150	165	°C
Thermal Shutdown Protection hysteresis(Note)	T_{SH}		20	30	40	°C

Note: Guaranteed by design.

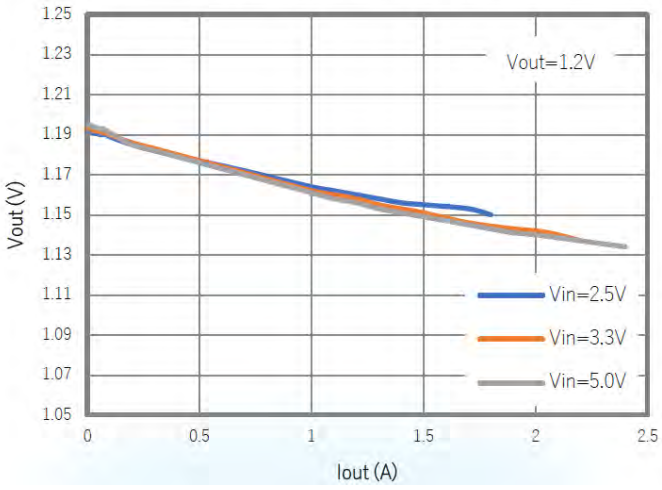
Typical Operating Characteristics

(C_{IN}=C_{OUT}=10uF, L=2.2uH, T_A = 25℃, unless otherwise specified)

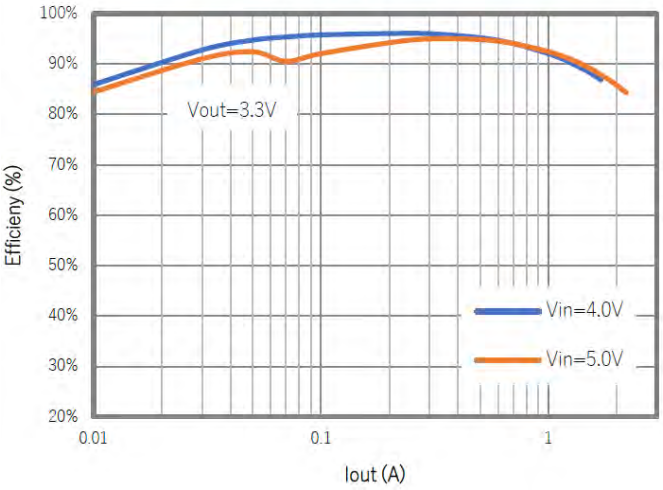
Efficiency Vout=1.2V



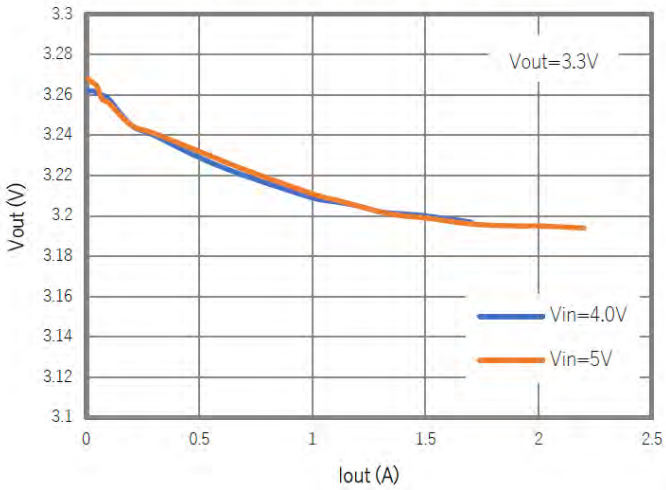
Load Regulation Vout=1.2V



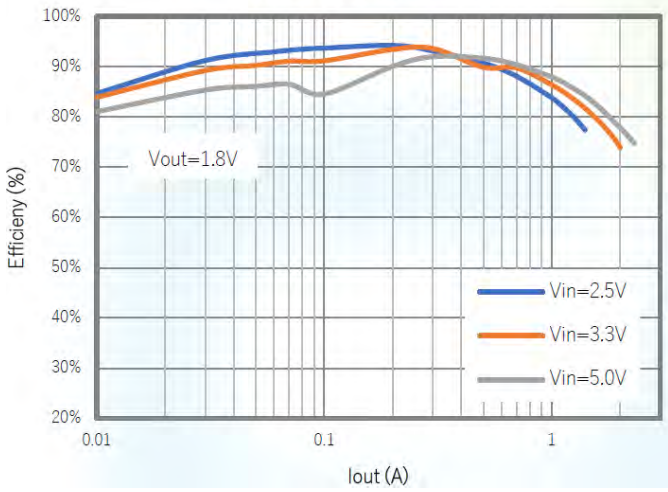
Efficiency Vout=3.3V



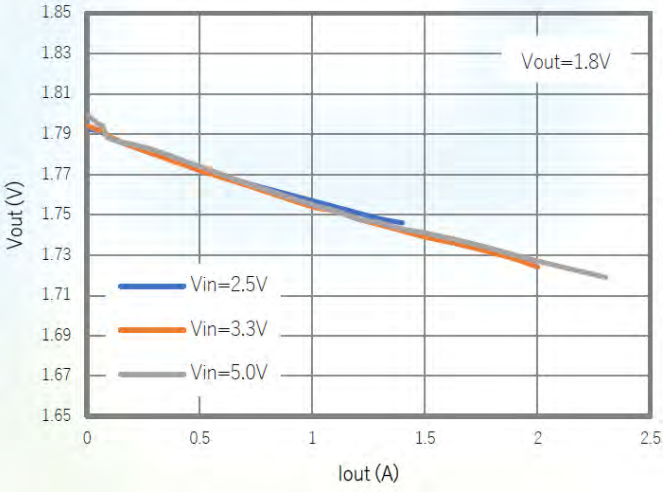
Load Regulation Vout=3.3V



Efficiency Vout=1.8V



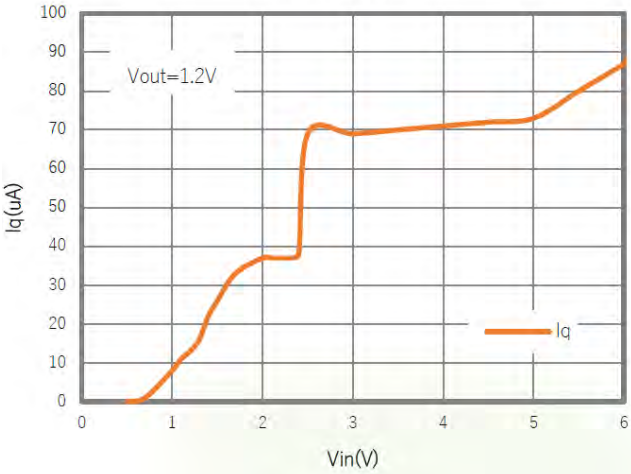
Load Regulation Vout=1.8V



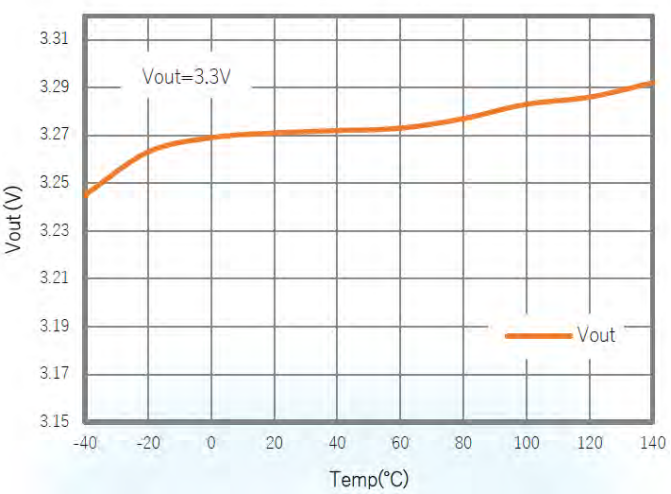
Typical Operating Characteristics (Cont.)

(C_{IN}=C_{OUT}=10uF, L=2.2uH, T_A = 25℃, unless otherwise specified)

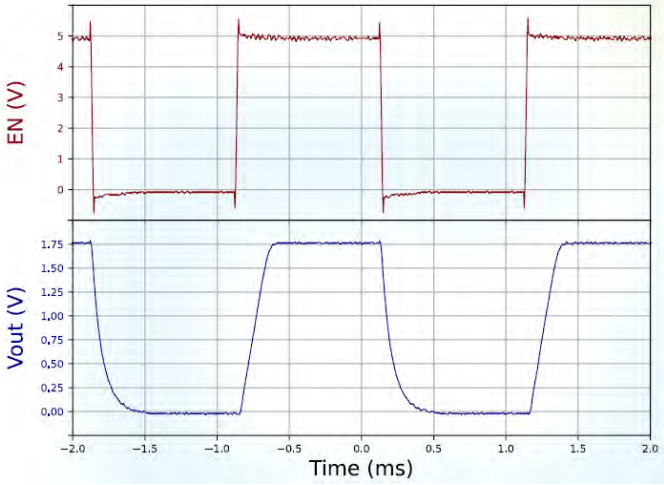
Iq VS. Vin



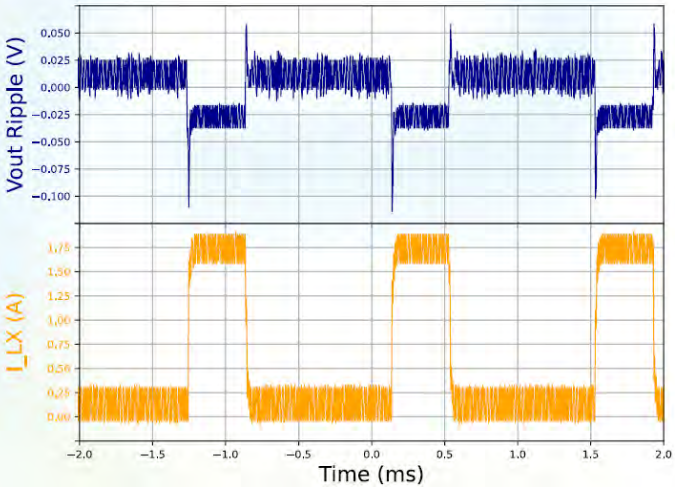
Vout VS Temp



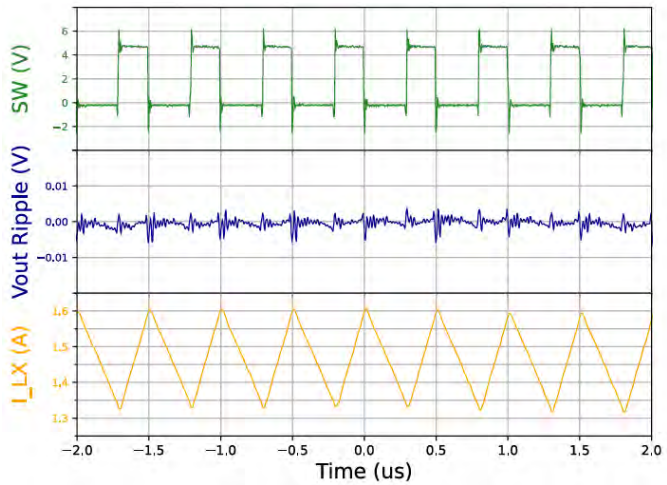
EN ON_OFF, Vin=5V, Vout=1.8V, Iout=0.5A



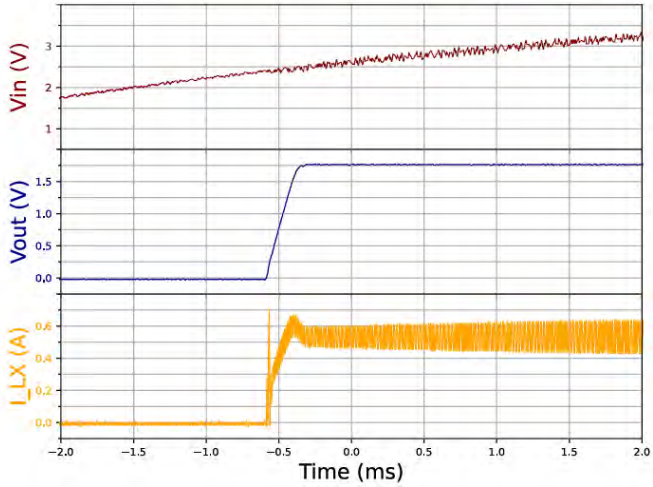
Load Transient Vin=5V, Vout=1.8V, Iout=0.1_1.8A



Operation Waveform Vin=5V, Vout=1.8V, Iout=1.5A



Power ON, Vin=5V, Vout=1.8V, Iout=0.5A



Function Description

Setting the Output Voltage

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

$$R_2 = \frac{R_1}{\frac{V_{OUT}}{V_{FB}} - 1}$$

The external resistive divider is connected to the output, allowing remote voltage sensing as shown in on page 3.

Inductor Selection

For most designs, the FTD6817H operates with inductors of 1 μ H to 4.7 μ H. 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:

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

Where ΔL 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

Higher values, lower cost ceramic capacitors are now becoming available in smaller case sizes. Their high ripple current, high voltage rating and low ESR make them ideal for switching regulator applications. Because the FTD6817H's control loop does not depend on the output capacitor's ESR for stable operation, ceramic capacitors can be used freely to achieve very low output ripple and small circuit size. However, care must be taken when ceramic capacitors are used at the input and the output. When a ceramic capacitor is used at the input and the power is supplied by a wall adapter through long wires, a load step at the output can induce ringing at the input, VIN. At best, this ringing can couple to the output and be mistaken as loop instability. At worst, a sudden inrush of current through the long wires can potentially cause a voltage spike at VIN, large enough to damage the part. When choosing the input and output ceramic capacitors, choose the X5R or X7R dielectric formulations. These dielectrics have the best temperature and voltage characteristics of all the ceramics for a given value and size.

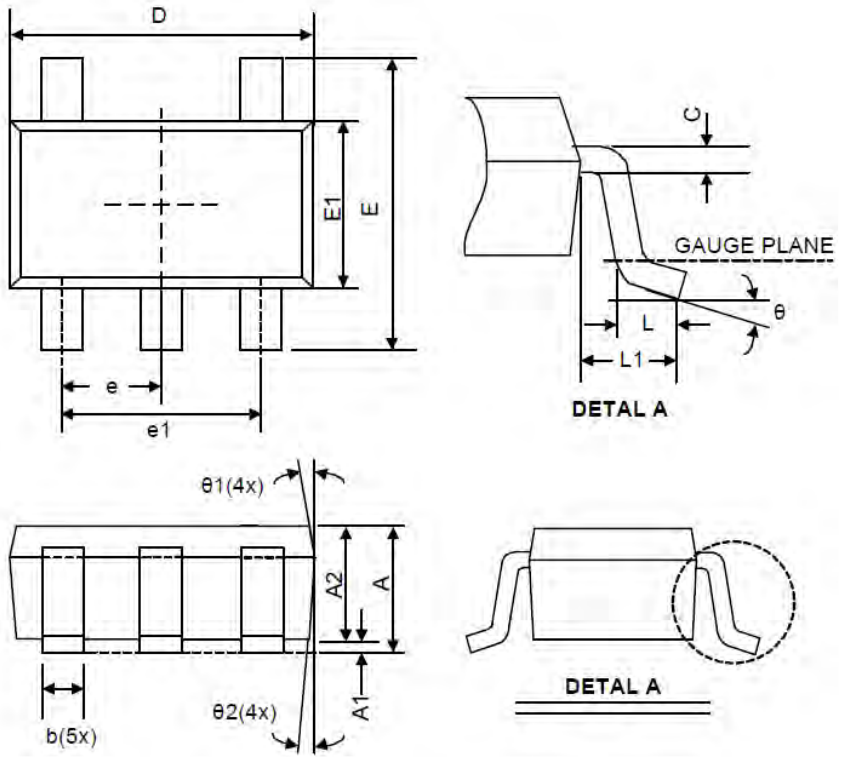
PCB Layout Checklist

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the FTD6817H. Check 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. Place the Cin to FTD6817H's Vin and GND pins as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.
3. Better to make a star connection of ground node for Cin, FTD6817H's ground and Cout.
4. Keep the switching node, SW, away from the sensitive feedback node.
5. Keep the (-) terminal of Cin and Cout as close as possible, to minimize current loop area for EMI concern.

Package Information

SOT-23-5 Package Outline Dimensions



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.05	-	1.35	0.041	-	0.053
A1	0.05	-	0.15	0.002	-	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.30	-	0.50	0.012	-	0.020
C	0.08	-	0.22	0.003	-	0.009
D	2.80	2.90	3.00	0.110	0.114	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	-	0.60	0.012	-	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e1	1.80	1.90	2.00	0.071	0.075	0.079
e	0.85	0.95	1.05	0.033	0.037	0.041
θ	0°	4°	8°	0°	4°	8°
θ1	5°	10°	15°	5°	10°	15°
θ2	5°	10°	15°	5°	10°	15°