

2MHz 2A Synchronous Buck Converter

TD6817H

General Description

The TD6817H 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 70 μ A and drops to <1 μ A in shutdown. The 2.5V to 5.5V input voltage range makes the TD6817H 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 TD6817H is available in SOT23-5L package.

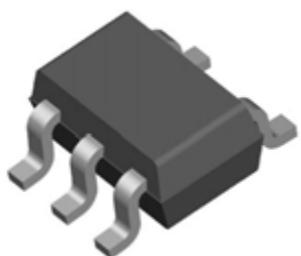
Features

- 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: 70 μ A
- Short circuit protection
- Thermal protection
- Over Voltage Protection
- Inrush Current Limit and Soft-Start
- Available in SOT23-5 PbFree Package

Application

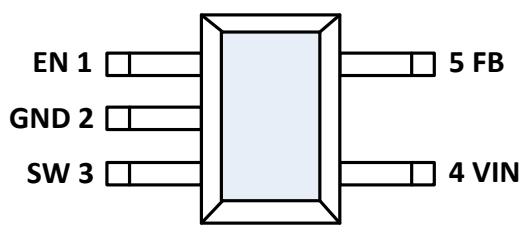
- Cellular and Smart Phones
- Wireless and DSL Modems
- Portable Instruments
- Digital Still and Video Cameras
- PC Card

Package Types



SOT23-5

Pin Configurations



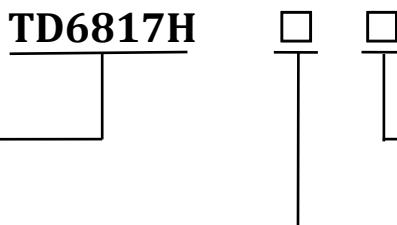
2MHz 2A Synchronous Buck Converter

TD6817H

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 10 μ F 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.

Ordering Information



Circuit Type _____

Package _____

T: SOT23-5

Packing:

Blank: Tube

R: Tape and Reel

2MHz 2A Synchronous Buck Converter

TD6817H

Function Block

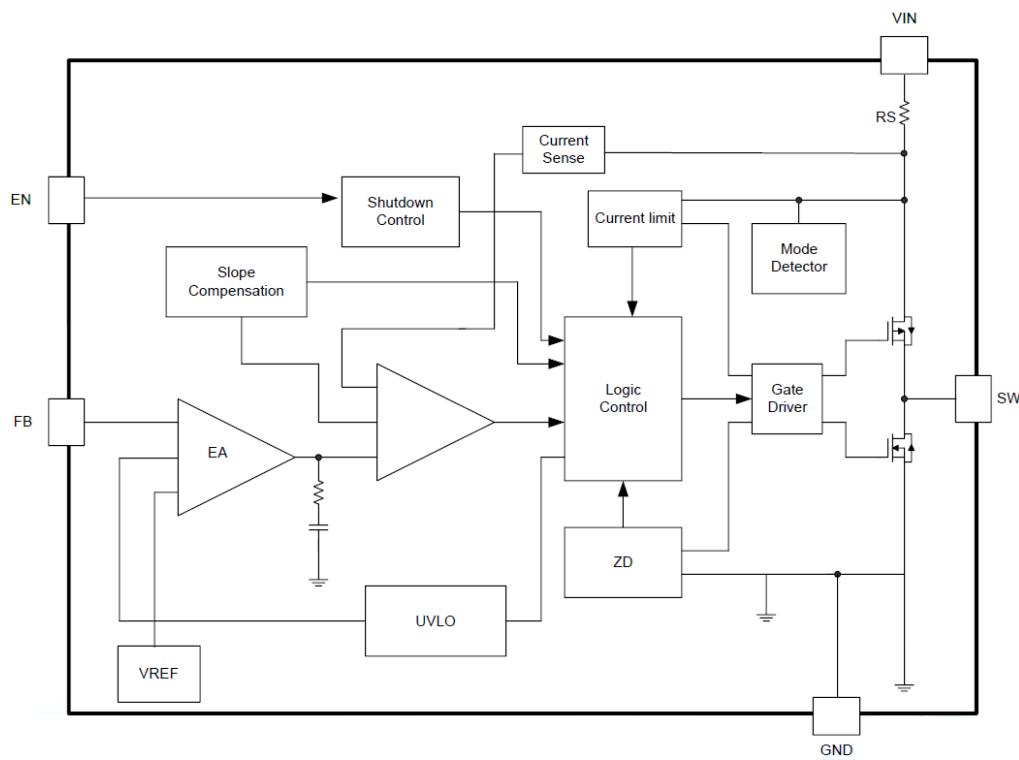
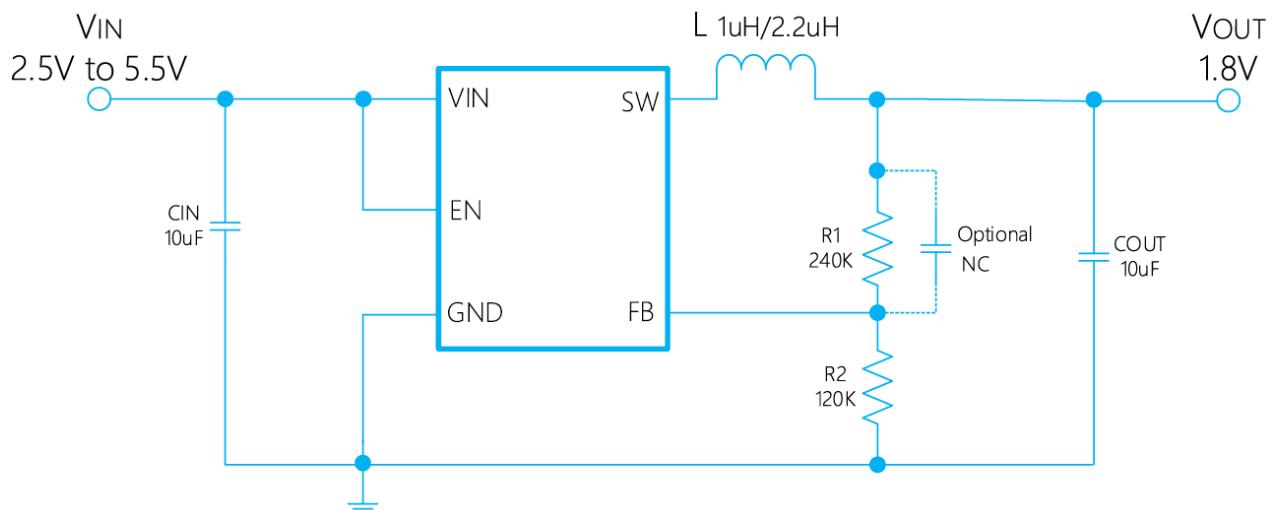


Figure1 Function Block Diagram of TD6817H

Typical Application Circuit



2MHz 2A Synchronous Buck Converter

TD6817H

Absolute Maximum Ratings (at $T_A=25^\circ\text{C}$)

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	$^\circ\text{C}$
T_{STG}	Storage Temperature	-65 ~ 150	$^\circ\text{C}$
T_{SDR}	Maximum Lead Soldering Temperature (10 Seconds)	260	$^\circ\text{C}$

Electrical Characteristics

All typical values are at $T_j=25^\circ\text{C}$ (unless otherwise noted)

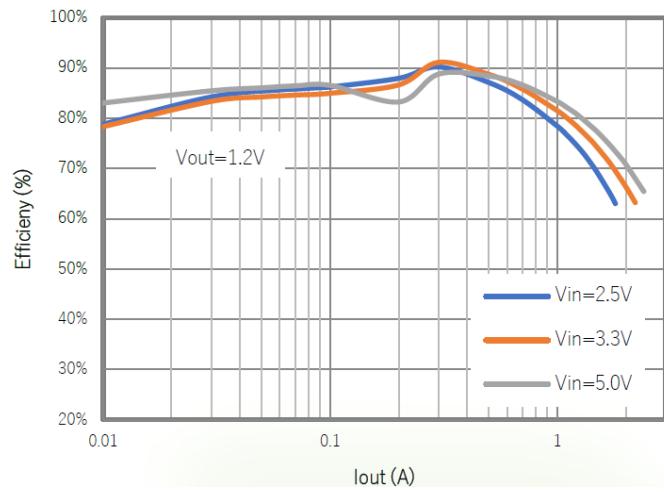
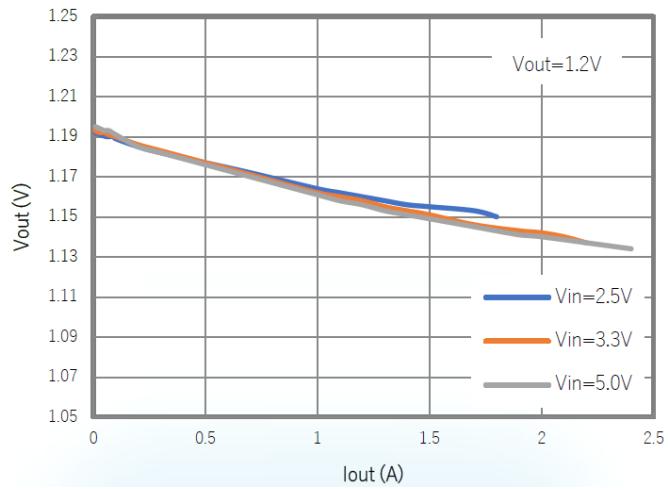
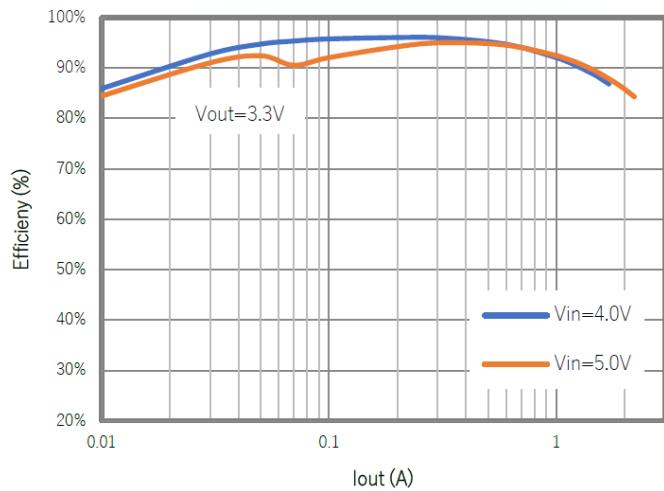
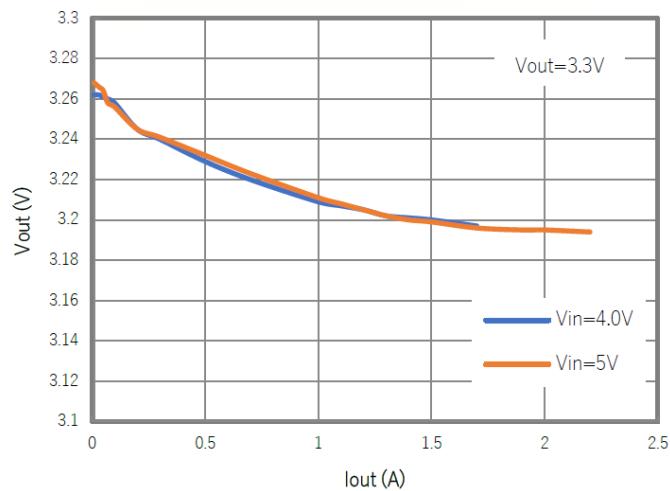
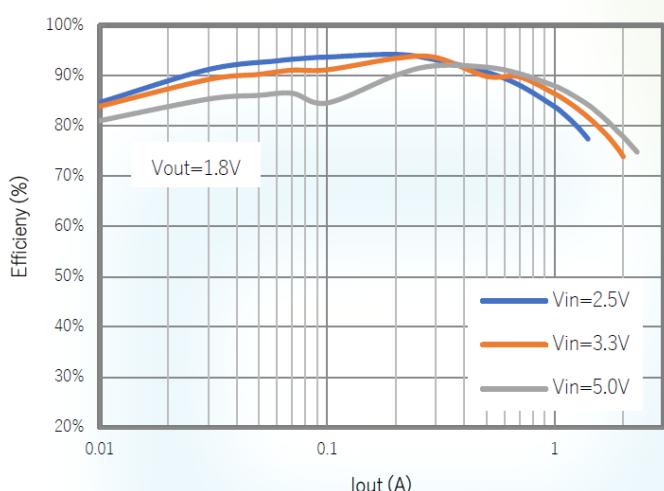
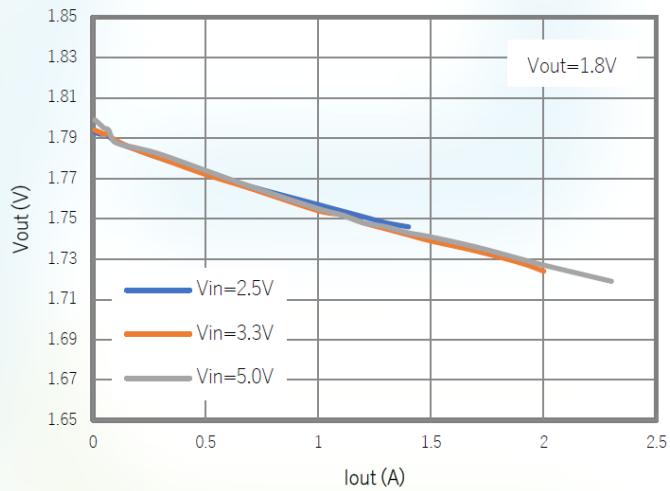
Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		2.5	-	5.5	V
Input overvoltage threshold	V_{OVP}		-	6.1	-	V
Input UVLO	UVLO		2.1	2.3	2.5	V
VIN Under Voltage Lockout Hysteresis	UVLO_HYST		0.1	0.2	0.3	V
FB Voltage	V_{FB}	No load	0.588	0.6	0.612	V
Switching Frequency	Fosc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

Note: Guaranteed by design.

2MHz 2A Synchronous Buck Converter

TD6817H

Typical Operating Characteristics

 $C_{IN}=C_{OUT}=10\mu F$, $L=2.2\mu H$, $T_A = 25^\circ C$, unless otherwise specifiedEfficiency $V_{out}=1.2V$ Load Regulation $V_{out}=1.2V$ Efficiency $V_{out}=3.3V$ Load Regulation $V_{out}=3.3V$ Efficiency $V_{out}=1.8V$ Load Regulation $V_{out}=1.8V$ 

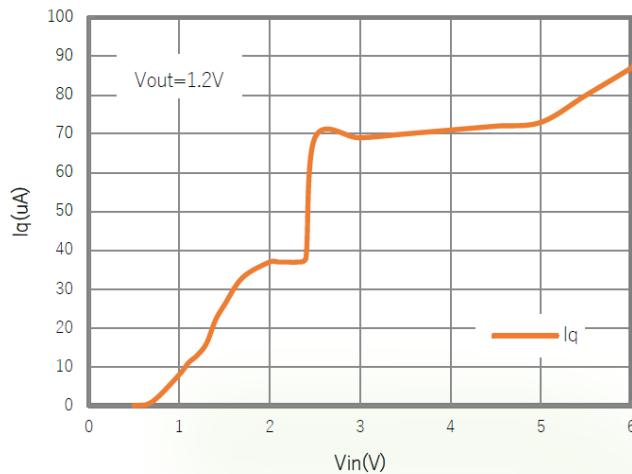
2MHz 2A Synchronous Buck Converter

TD6817H

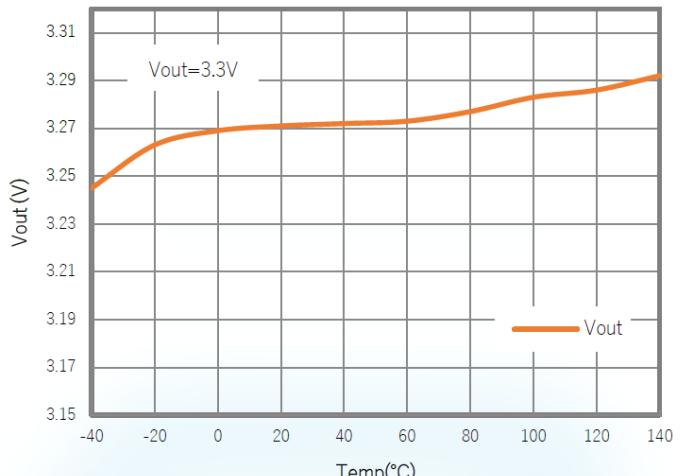
Typical Operating Characteristics (Cont.)

 $C_{IN}=C_{OUT}=10\mu F$, $L=2.2\mu H$, $T_A = 25^\circ C$, unless otherwise specified

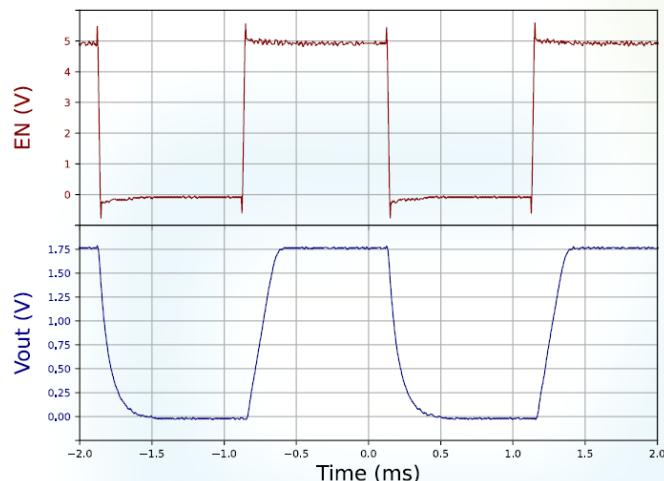
Iq VS. Vin



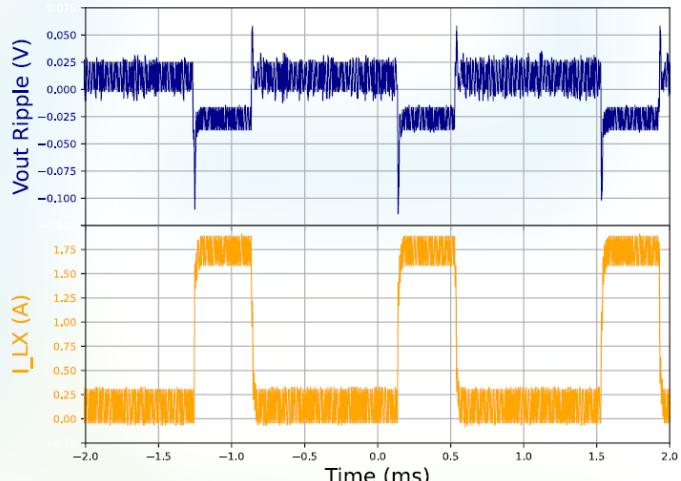
Vout VS Temp



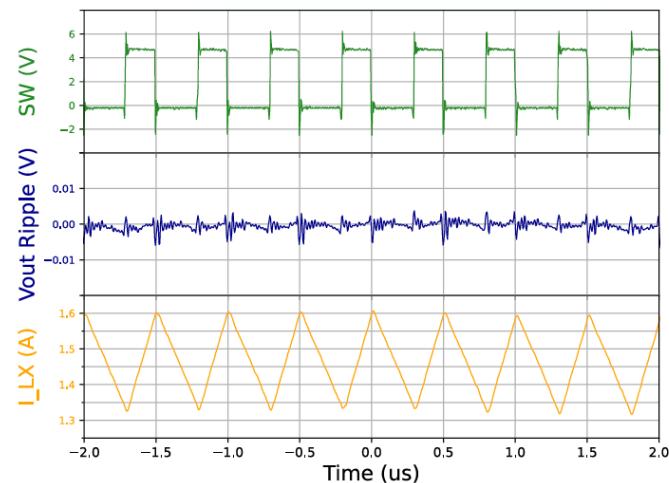
EN ON/OFF, Vin=5V, Vout=1.8V, Iout=0.5A



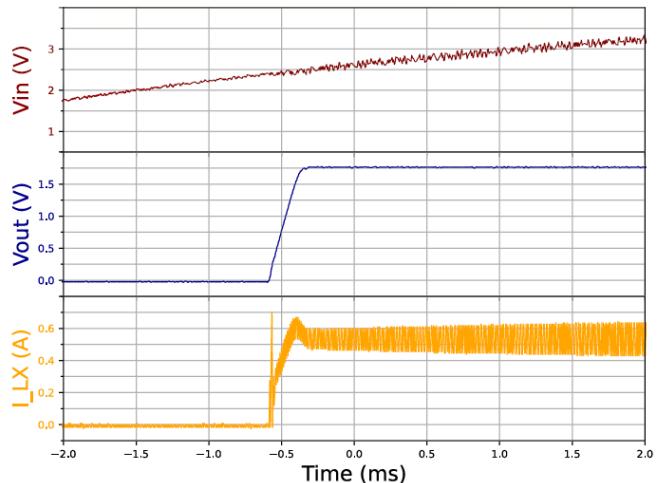
Load Transient Vin=5V, Vout=1.8V, Iout=0.1_1.8A



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



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



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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 TD6817H 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 50m Ω to 150m Ω 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 TD6817H'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

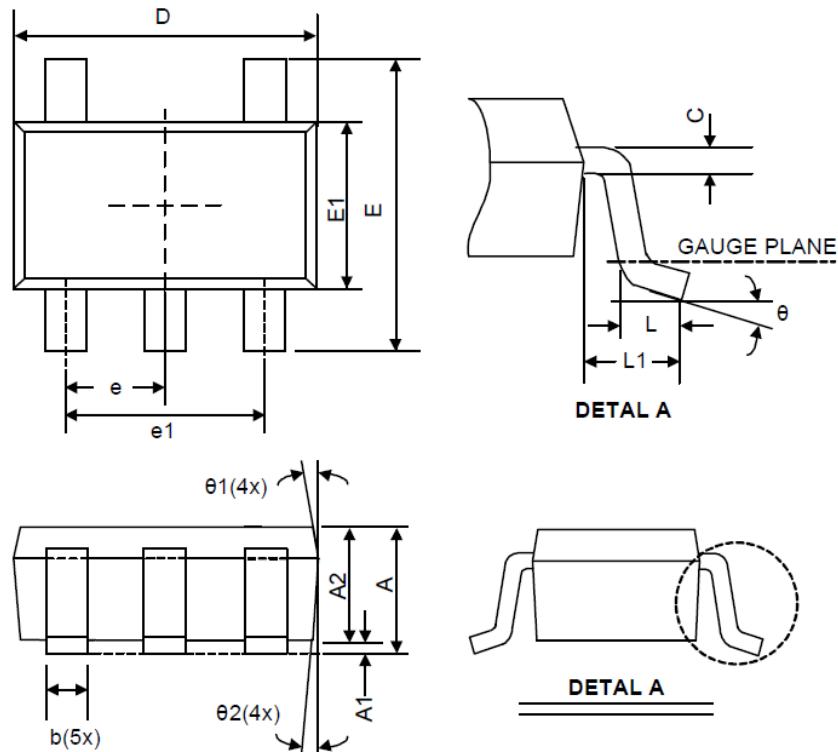
When laying out the printed circuit board, the following checking should be used to ensure proper operation of the TD6817H.

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 TD6817H'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, TD6817H'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

SOT23-5 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
theta	0°	4°	8°	0°	4°	8°
theta1	5°	10°	15°	5°	10°	15°
theta2	5°	10°	15°	5°	10°	15°

Design Notes