5.5V, 1A, 2MHz Synchronous Buck Converter TD6810D

General Description

The TD6810D 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 TD6810D 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.

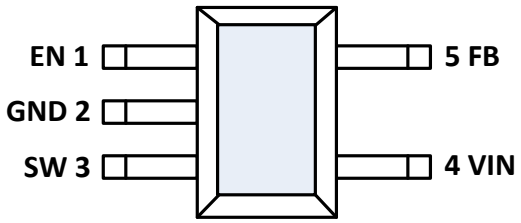
Switching frequency is internally set at 2MHz, allowing the use of small surface mount inductors and capacitors. Low output voltages are easily supported with the 0.6V feedback reference voltage.

TD6810D is available in SOT23-5L packages.

Features

- Up to 96% peak efficiency
- Up to 1A output current
- 2.5V to 5.5V operating input range
- Feedback voltage, VFB：0.6V±1%
- Quiescent Current, IQ：70uA
- PFM Mode for High Efficiency in Light Load
- 2MHz switching frequency
- No Schottky Diode Required
- Low Dropout Operation:100% Duty Cycle
- Inrush Current Limit and Soft Start
- With enabling pin
- With input over-voltage protection, under-voltage protection, peak current limit, output short-circuit protection, and over-temperature protection

Pin Configurations



(Top view)

Application

- Set Top Box
- Wireless and DSL Modems
- Portable Instruments

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
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.

Ordering Information

TD6810D □ □

Circuit Type

Package
T：SOT23-5

Packing:
Blank：Tube
R: Tape and Reel

Function Block

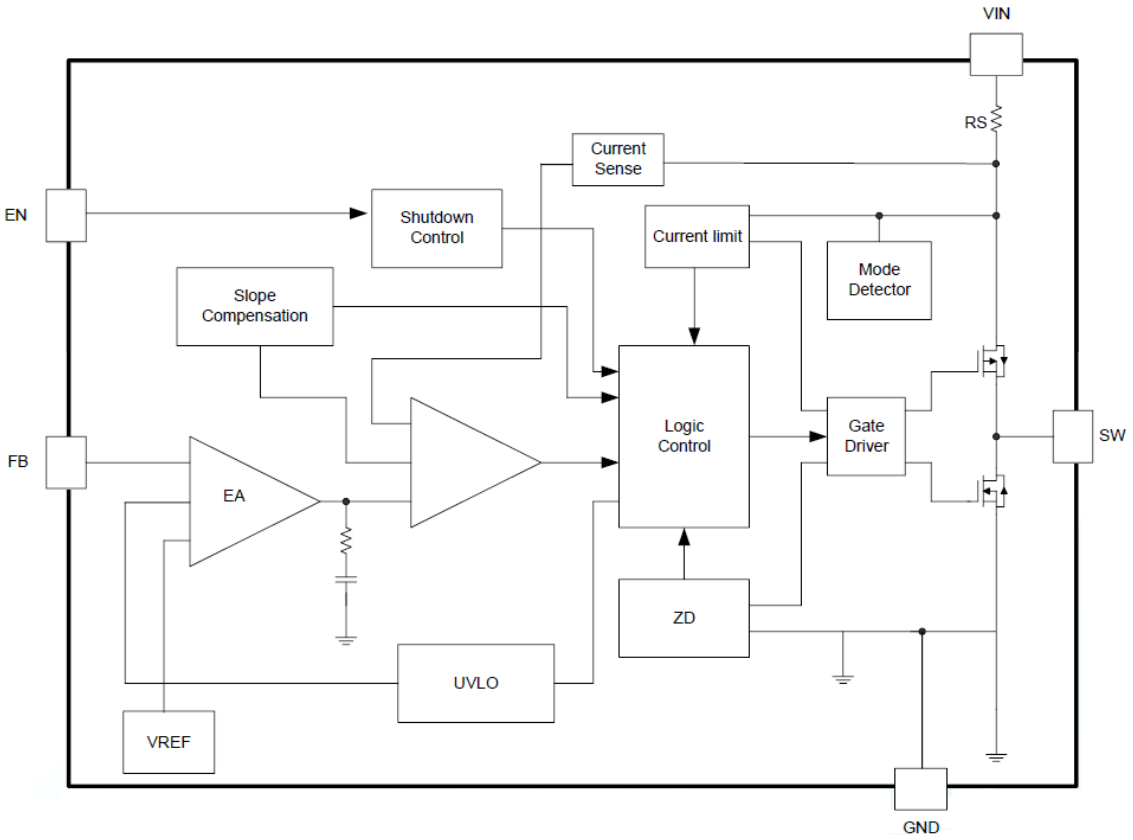


Figure1 Function Block Diagram of TD6810D

Absolute Maximum Ratings (at T_A=25℃)

Symbol	Parameter	Rating	Unit
V_{IN}	VIN pin voltage	-0.3 ~ 7	V
EN	EN voltage	-0.3 to +6.0	V
SW	SW voltage	-0.3 to (Vin+0.3)	V
	Peak SW Sink and Source Current	2.2	A
P_D	Continuous Power Dissipation (T_A = 25℃)	0.5	W
θ_{JA}	Junction-to-Ambient Resistance in free air	170	°C/W
θ_{JC}	Junction-to-Case Resistance in free air	75	°C/W
T_J	Operating Junction Temperature	-40 to 165	°C
T_{STG}	Storage Temperature	-55 ~ 150	°C
T_{SDR}	Maximum Lead Soldering Temperature (10 Seconds)	260	°C

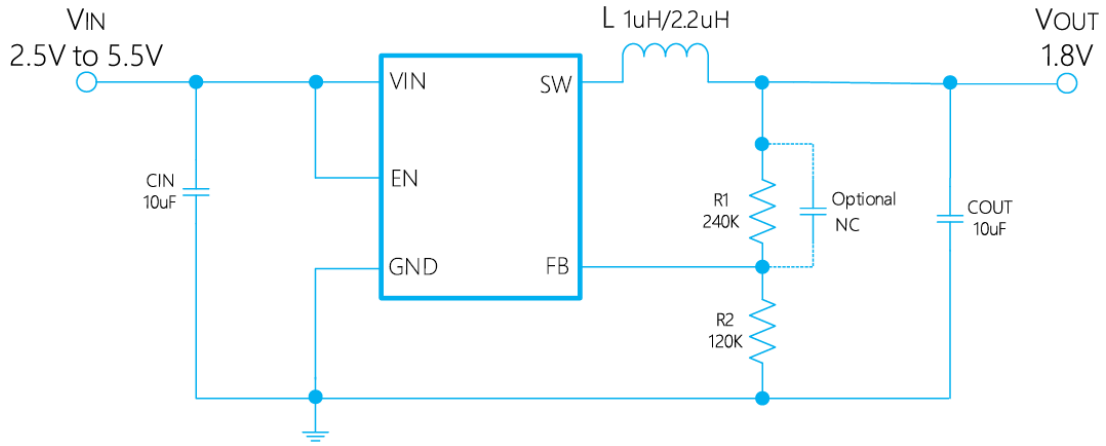
Electrical Characteristics

Unless otherwise specified, these specifications apply over V_{IN}=5V, T_J = 25°C.

Symbol	Characteristics	Conditions	Min	Typ	Max	Units
V_{IN}	Input Voltage Range		2.5	-	5.5	V
V_{OVP}	VIN Over Voltage Protection	Input overvoltage threshold	-	6.1	-	V
UVLO			2.1	2.3	2.5	V
UVLO hysteresis			0.1	0.2	0.3	V
I_Q	Quiescent Current		-	70	120	μA
I_{SD}	Shutdown Current	V_{EN}=0V	-	0.1	1	μA
V_{FB}	FB Pin Voltage	No load	588	600	612	mV
	Max duty cycle		-	100	-	%
Efficiency		I_{LOAD}=0.6A	85	90	-	%
	Line regulation	I_{LOAD}=0.3A	-	0.1	0.2	%/V
	Load regulation	I_{LOAD}=0-1A	-	0.1	0.2	%/A
f_{SW}	Switching Frequency		1.6	2	2.4	MHz
R_{ONP}	PMOSFET $RDS_{(ON)}$	I_{SW} =100mA	-	350	-	mΩ
R_{ONN}	NMOSFET $RDS_{(ON)}$	I_{SW} =100mA	-	250	-	mΩ
I_{LIM}	Current Limit		1.4	1.8	2.2	A
I_{SW}	SW Leakage Current	V_{IN}=6V， V_{SW}=0V or 6V， V_{EN}=0V	-	-	10	μA
V_{ENH}	EN Input High Voltage		1	-	-	V

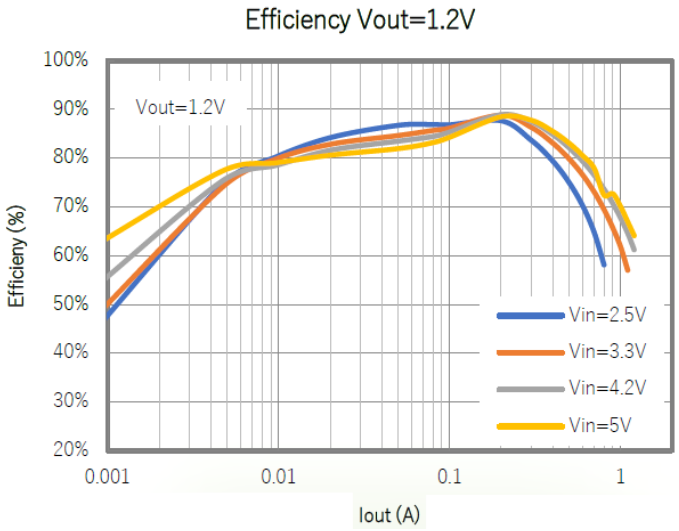
V_{ENL}	EN Input Low Voltage		-	-	0.3	V
T_{SD}	Thermal Shutdown		135	150	165	°C
T_{SD_HYS}	Thermal Shutdown Protection hysteresis		20	30	40	°C

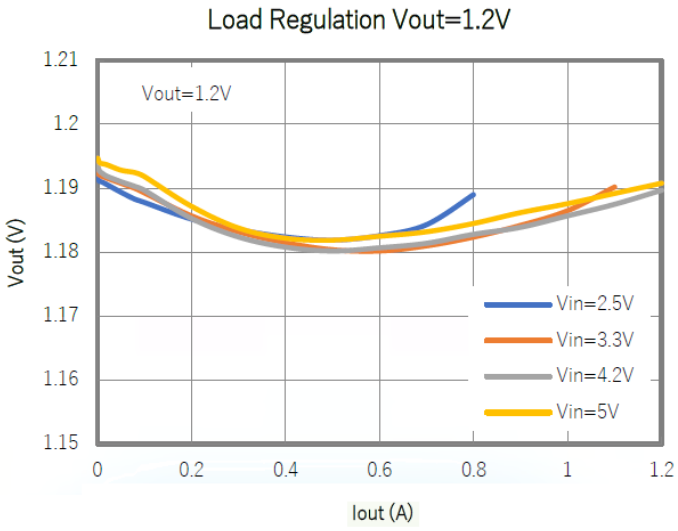
Typical Application Circuit



Typical Operating Characteristics

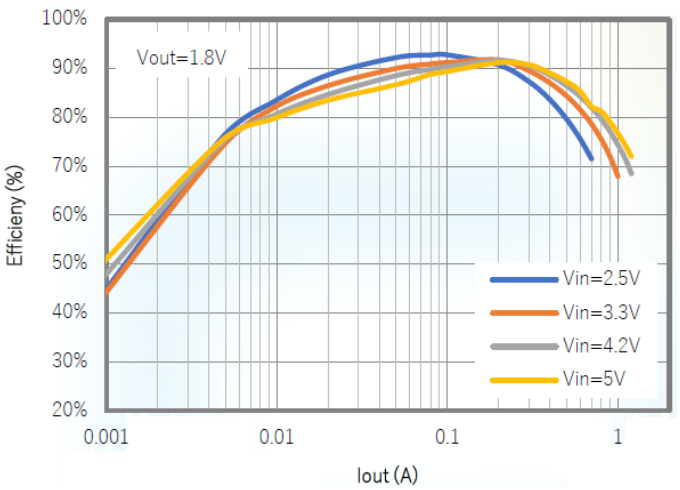
C_{IN}=C_{OUT}=10uF, L=2.2uH, T_A=25℃, unless otherwise noted.



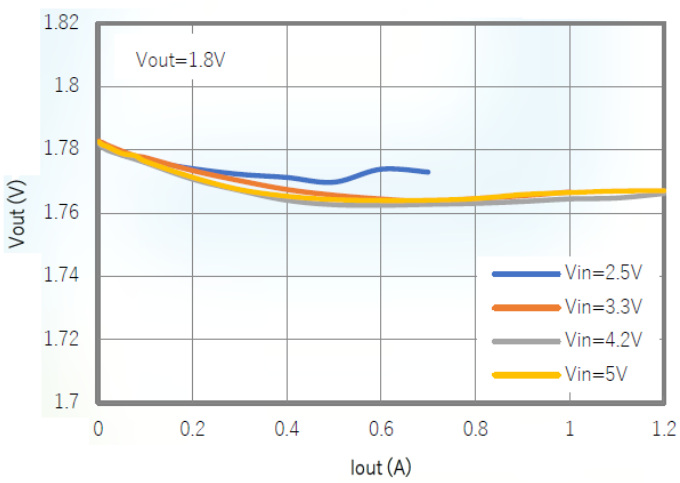


Typical Operating Characteristics(cont.)

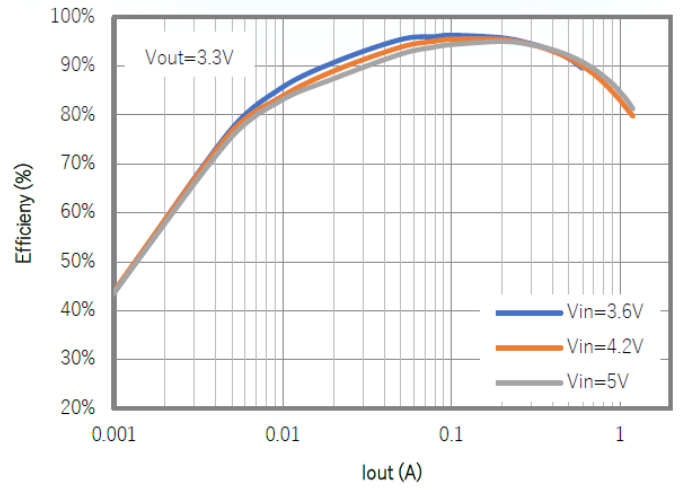
Efficiency Vout=1.8V



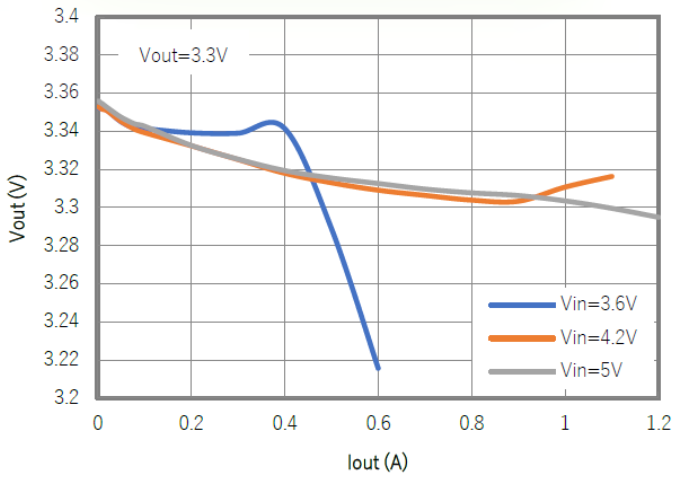
Load Regulation Vout=1.8V



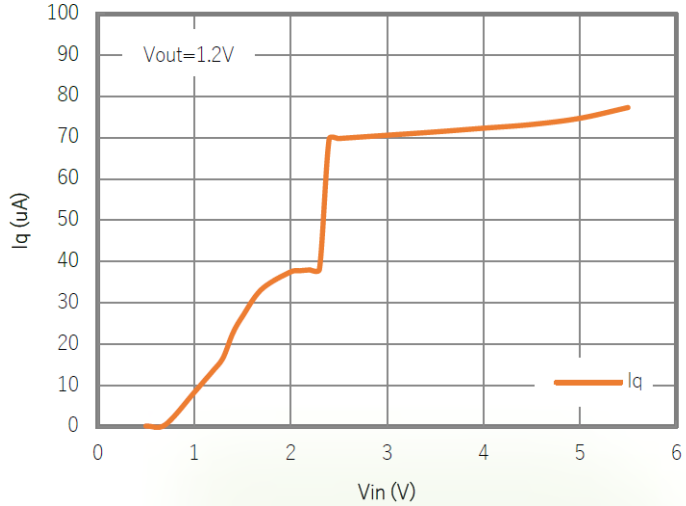
Efficiency Vout=3.3V



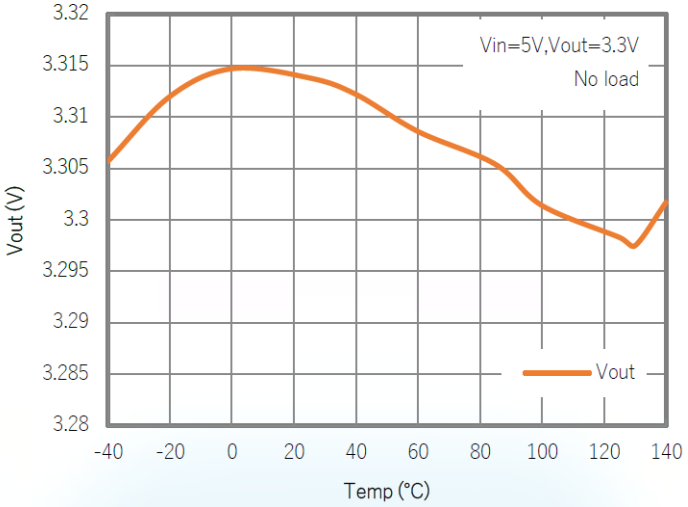
Load Regulation Vout=3.3V



Iq Vs. Vin

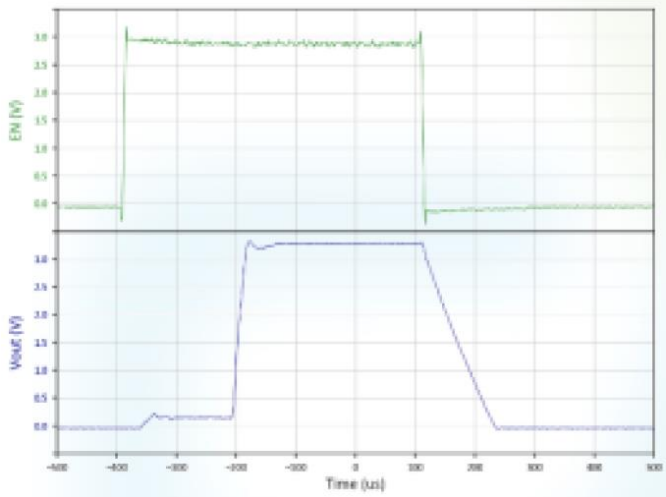


Vout Vs. Temp

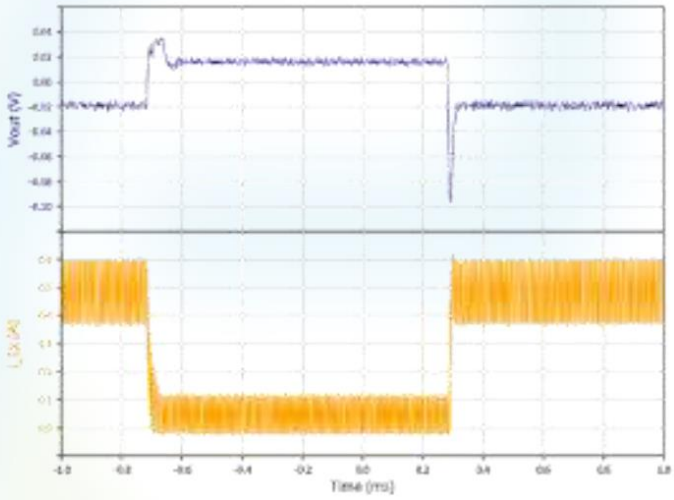


Typical Operating Characteristics(cont.)

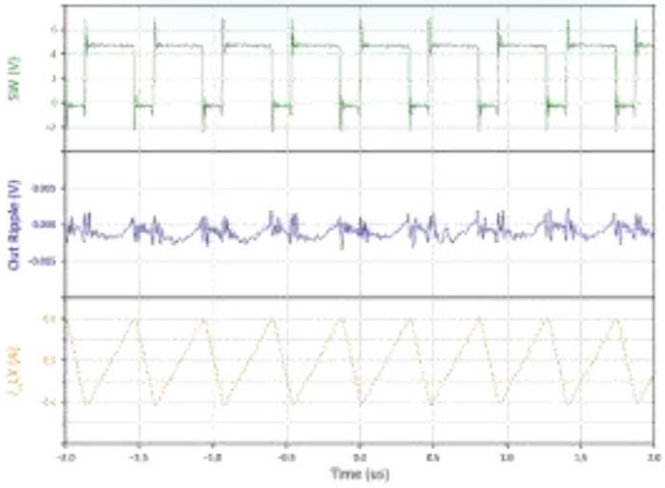
EN ON_OFF, Vin=5V, Vout=3.3V, Iout=0.5A



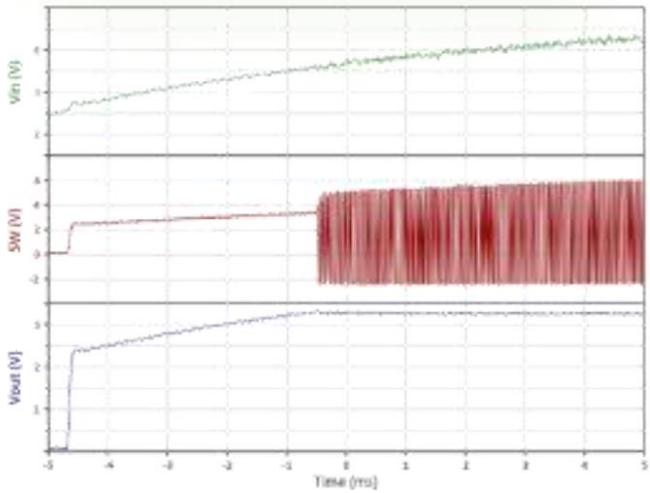
Load Transient Vin=5V, Vout=3.3V, Iout = 0.01 - 0.5A



Operation Wavefrom Vin=5V, Vout=3.3V, Iout=0.5A



Power ON, Vin=5V, Vout=3.3V, Iout=0.5A



APPLICATION INFORMATION

Output Voltage Set

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 4.

Inductor

For most designs, the TD6810D operates with inductors of 1μH to 4.7μH. 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:

$$L=\frac{V_{OUT}X(V_{IN}-V_{OUT})}{V_{IN}X\Delta I_L X fosc}$$

Where ΔI_L 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 TD6810D'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.

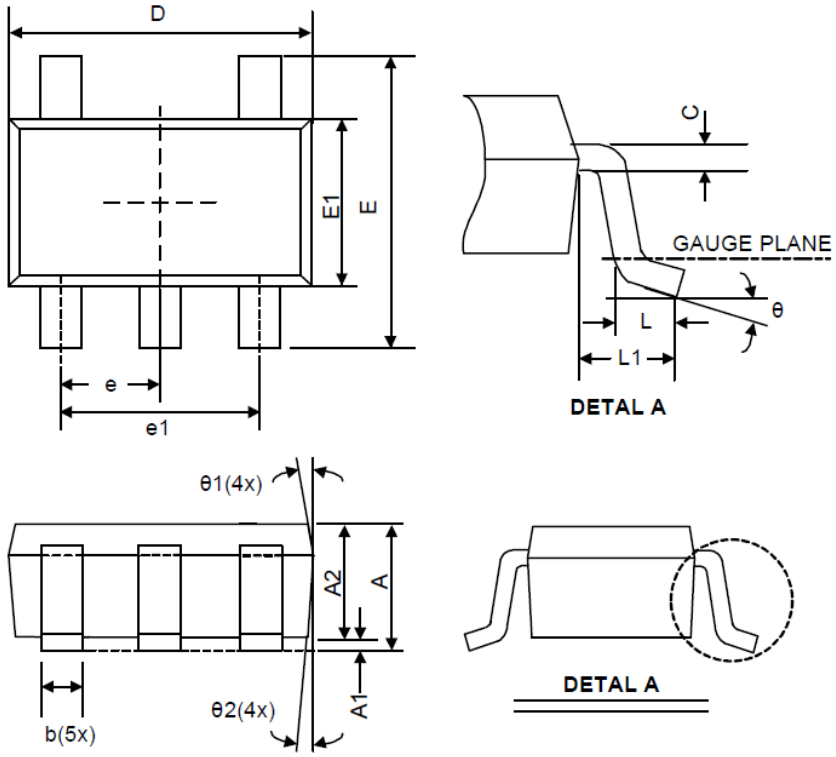
PCB Layout Checklist

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the TD6810D. 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 TD6810D'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, TD6810D'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
θ	0°	4°	8°	0°	4°	8°
θ1	5°	10°	15°	5°	10°	15°
θ2	5°	10°	15°	5°	10°	15°

Design Notes