Features

- Up to 94% Efficiency
- Low voltage start-up：0.9V
- Shut-down current: < 1μA
- Input voltage：0.9V～4.4V
- Output voltage：2.5V～4.3V (Up to 5V with Schottky)
- Low switch on resistance R_{DS}(ON), Internal switch: 0.35Ω
- 1.4MHz fixed frequency switching
- Automatic PWM/PFM mode switching
- High switch on current: 0.9A
- Low profile SOT-23-6 package (lead-free packaging is now available)

Applications

- Digital cameras and MP3
- Palmtop computers / PDAs
- Cellular phones
- Wireless handsets and DSL modems
- PC cards
- Portable media players

Description

The XA2317 is high efficiency synchronous, PWM step-up DC/DC converters optimized to provide a high efficient solution to medium power systems. The devices work under the input voltage between 0.9V and 4.4V with a 1.4MHz fixed frequency switching. These features minimize overall solution footprint by allowing the use of tiny, low profile inductors and ceramic capacitors. Automatic PWM/PFM mode switching at light load saves power and improves efficiency.

The XA2317 is capable of supplying an output voltage between 2.5V and 4.3V, the internal synchronous switch is desired to provide high efficiency without Schottky.

The devices also featured providing up to 260mA from a single AA cell input or up to 600mA from a 2-cell AA with a 3V/3.3V output.

The XA2317 regulators are available in the industry standard SOT-23-6 power packages (or upon request).

Order Information

XA2317 - ① ②

Symbol	Description
①	Denotes Output voltage: A : Adjustable Output
②	Denotes Package Types: F: SOT-23-6

Typical Applications

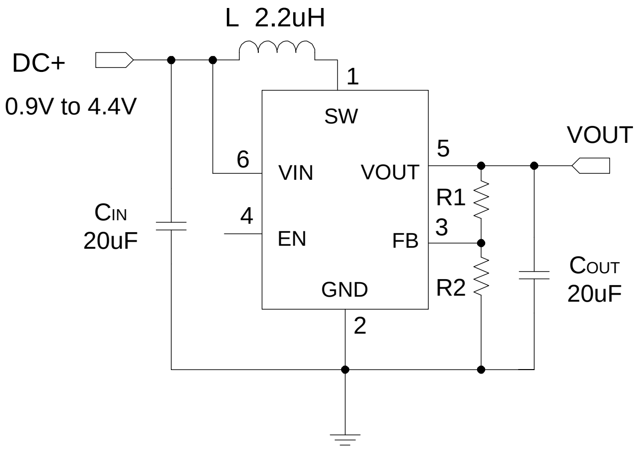


Figure 1: Typical Application Circuit

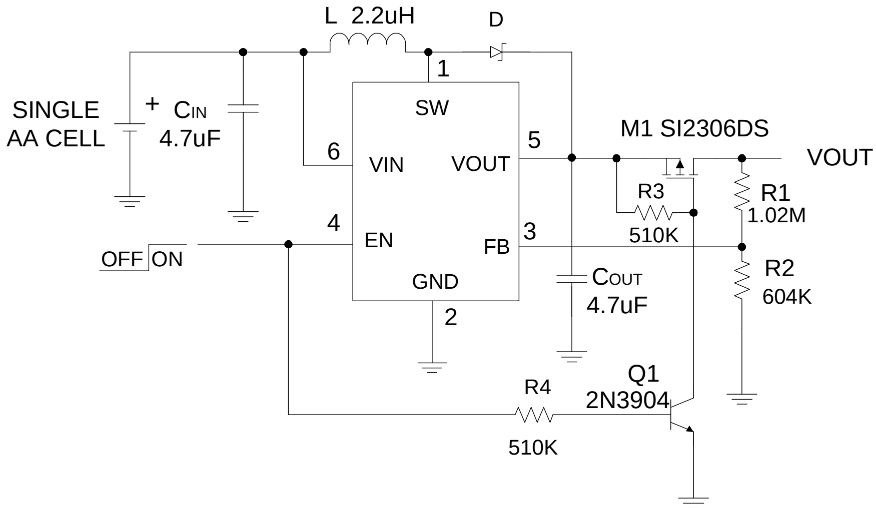


Figure 2: Single Cell to 3.3V Synchronous Boost Converter with Load Disconnect in Shutdown.

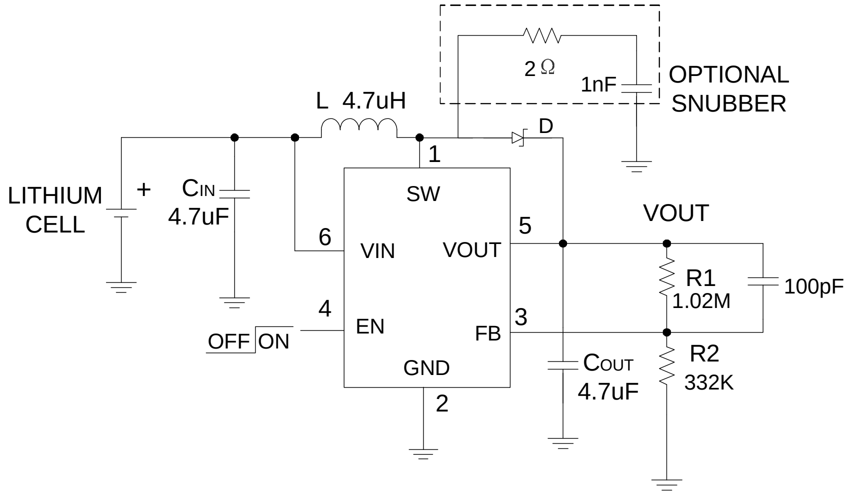


Figure 3: Single Lithium Cell to 5V with Load 250mA

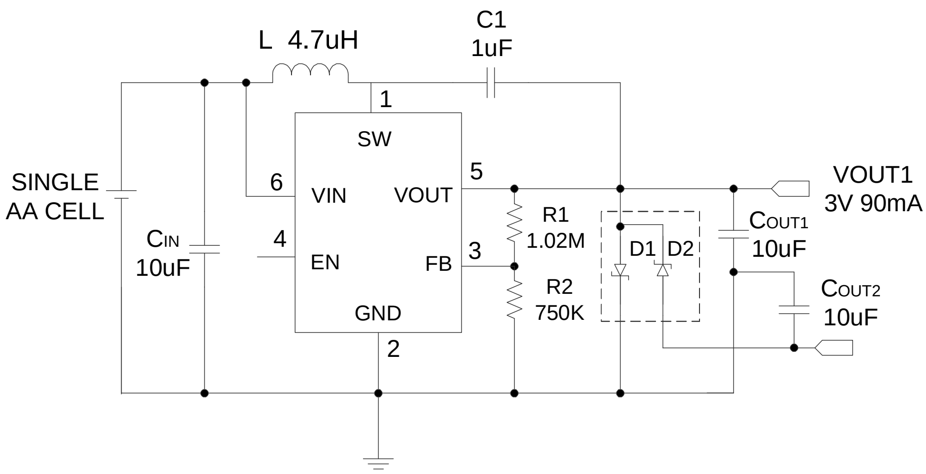
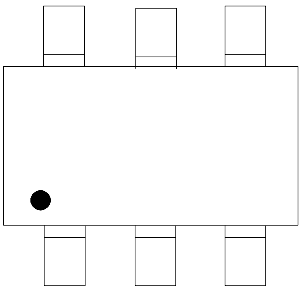


Figure 4: Single Cell AA Cell to ±3V Synchronous Boost Converter

Pin Assignment



PIN Number SOT23- 6L	PIN Name	Function
1	SW	Switch Output
2	GND	Ground
3	FB	Feedback
4	EN	ON/OFF Control (High Enable)
5	V_{OUT}	Output
6	V_{IN}	Input

Absolute Maximum Ratings （Note 1）

- Power Dissipation……………………………………………………………………Internally limited
- V_{IN} …………………………………………………………………………………- 0.3 V ～ + 6.6V
- V_{OUT}……………………………………………………………………………- 0.3 V ～ + 6.6V
- V_{SW} ………………………………………………………………………………- 0.3 V ～ + 6.6 V
- V_{EN}, V_{OUT}………………………………………………………………………- 0.3 V ～ + 6.6 V
- Operating Temperature Range （Note 2）………………………………………- 30℃ ～ + 85℃
- Lead Temperature (Soldering 10 sec.) ………………………………………………+ 300℃
- Storage Temperature Range ……………………………………………………- 65℃ ～ + 125℃

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: The XA2317 are guaranteed to meet performance specifications from 0℃ to 70℃. Specifications over the – 30℃ to 85℃ operating temperature range are assure d by design, characterization and correlation with statistical process controls.

Electrical Characteristics

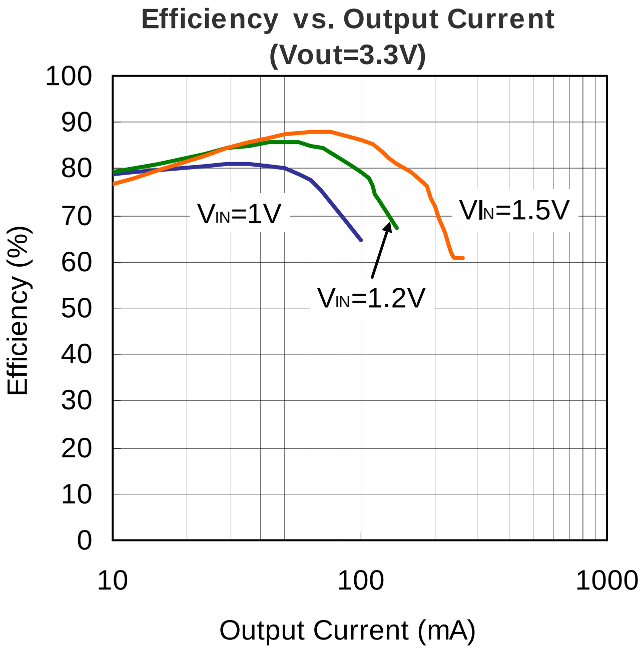
Operating Conditions: TA=25℃, V_{IN}=1.2V, V_{OUT}=3.3V unless otherwise specified.

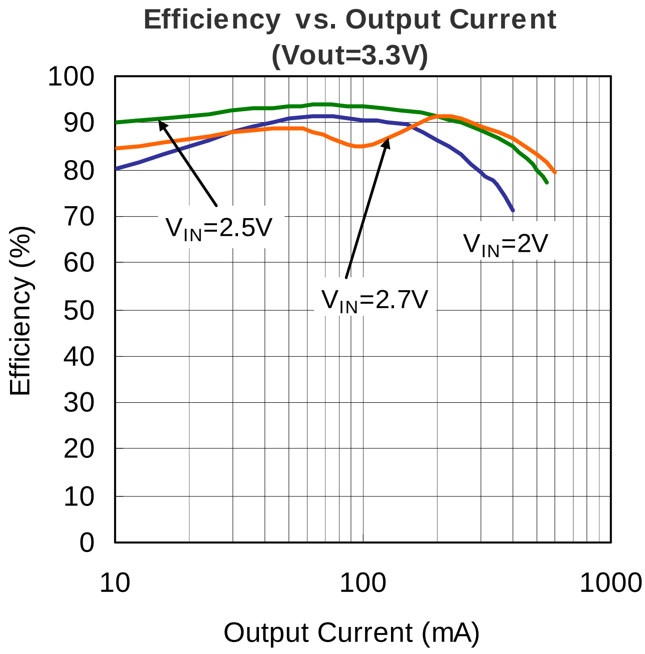
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Output Voltage Range (Adj.)		2.5		5	V
Minimum Start-Up Voltage (Note 3)	I_{LOAD} = 1mA		0.9	1.1	V
Minimum Operating Voltage	EN = V_{IN}		0.6	0.75	V
Switching Frequency		1.1	1.4	1.7	MHz
Max Duty Cycle	V_{FB} = 1.15V	80	87		%
Current Limit Delay to Output	(Note 4)		40		ns
Feedback Voltage		1.165	1.212	1.241	V
Feedback Input Current	V_{FB} = 1.22V (Note 4)		1		nA
NMOS Switch Leakage	V_{SW} = 5V		0.1	5	μA
PMOS Switch Leakage	V_{SW} = 0V		0.1	5	μA
NMOS Switch On Resistance	V_{OUT} = 3.3V		0.35		Ω
PMOS Switch On Resistance	V_{OUT} = 3.3V		0.45		Ω
NMOS Current Limit		700	950		mA
Quiescent Current (Active)	Measured On V_{OUT}, No switching		260		μA
Shutdown Current	V_{EN}=0V, Including Switch Leakage		0.1	1	μA
En Input High		1			V
En Input Low				0.35	V
En Input Current	V_{EN} = 5.5V		0.01	1	μA

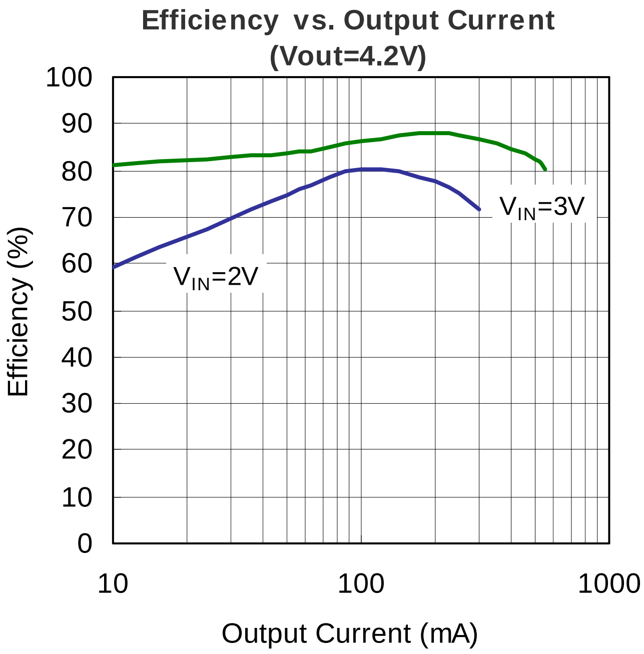
Note 3: Minimum V_{IN} operation after start-up is only limited by the battery's ability to provide the necessary power as it enters a deeply discharged state.

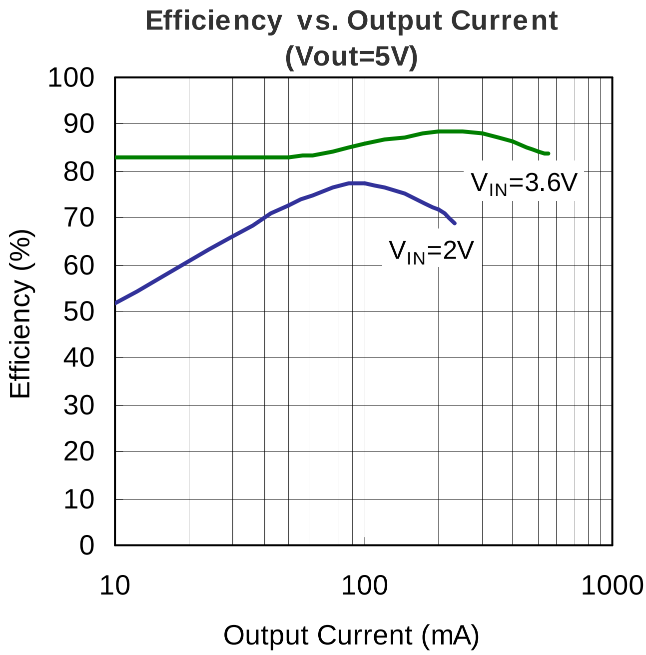
Note 4: Specification is guaranteed by design and not 100% tested in production.

Typical Performance Characteristics









Pin Functions

SW (Pin1): Switch Pin. Connect inductor between SW and V_{IN}. Keep these PCB trace lengths as short and wide as possible to reduce EMI and voltage overshoot.

GND (Pin 2): Signal and Power Ground. Provide a short direct PCB path between GND and the (–) side of the output capacitor(s).

FB (Pin 3): Feedback Input to the g_m Error Amplifier. Connect resistor divider tap to this pin. The output voltage can be adjusted from 2.5V to 5V by: V_{OUT} = 1.212V • [1 + (R1/R2)]

EN (Pin 4): Logic Controlled Shutdown Input. EN = High: Normal free running operation, 1.4MHz typical operating frequency. EN = Low:
Shutdown, quiescent current <1µA. Output capacitor can be completely discharged through the load or feedback resistors.

VOUT (Pin 5): Output Voltage Sense Input and Drain of the Internal Synchronous Rectifier MOSFET. Bias is derived from V_{OUT}. PCB trace length from V_{OUT} to the output filter capacitor(s) should be as short and wide as possible.

VIN (Pin 6): Battery Input Voltage. The device gets its start-up bias from V_{IN}. Once V_{OUT} exceeds V_{IN}, bias comes from V_{OUT}. Thus, once started, operation is completely independent from V_{IN}. Operation is only limited by the output power level and the battery's internal series resistance.

Operation

The XA2317 are 1.4MHz, synchronous boost converters housed in a 6-lead ThinSOT package. Able to operate from an input voltage below 1V, the devices feature fixed frequency, current mode PWM control for exceptional line and load regulation. With its low RDS(ON) and gate charge internal MOSFET switches, the devices maintain high efficiency over a wide range of load current. Detailed descriptions of the three distinct operating modes follow. Operation can be best understood by referring to the Block Diagram.

Low Voltage Start-Up

The XA2317 will start up at a typical VIN voltage of 0.9V or higher. The low voltage start-up circuitry controls the internal NMOS switch up to a maximum peak inductor current of 850mA (typ), with an approximate 1.5ms off-time during start-up, allowing the devices to start up into an output load. Once VOUT exceeds 2.3V, the start-up circuitry is disabled and normal fixed frequency PWM operation is initiated. In this mode, the XA2317 operate independent of VIN, allowing extended operating time as the battery can droop to several tenths of a volt without affecting output voltage regulation. The limiting factor for the application becomes the ability of the battery to supply sufficient energy to the output.

Low Noise Fixed Frequency Operation

Oscillator: The frequency of operation is internally set to 1.4MHz. Error Amp: The error amplifier is an internally compensated transconductance type (current output) with a transconductance (gm) = 33 microsiemens. The internal 1.212V reference voltage is compared to the voltage at the FB pin to generate an error signal at the output of the error amplifier. A voltage divider from VOUT to ground programs the output voltage via FB from 2.5V to 5V using the equation: VOUT = 1.212V • [1 + (R1/R2)] Current Sensing: A signal representing NMOS switch current is summed with the slope compensator. The summed signal is compared to the error amplifier output to provide a peak current control command for the PWM.

Peak switch current is limited to approximately 850mA independent of input or output voltage. The current signal is blanked for 40ns to enhance noise rejection. Zero Current Comparator: The zero current comparator monitors the inductor current to the output and shuts off the synchronous rectifier once this current reduces to approximately 20mA. This prevents the inductor current from reversing in polarity improving efficiency at light loads.

Antiringing Control: The antiringing control circuitry prevents high frequency ringing of the SW pin as the inductor current goes to zero by damping the resonant circuit formed by L and C_{SW} (capacitance on SW pin).

Burst Mode Operation

Portable devices frequently spend extended time in low power or standby mode, only switching to high power drain when specific functions are enabled. In order to improve battery life in these types of products, high power converter efficiency needs to be maintained over a wide output power range. In addition to its high efficiency at moderate and heavy
operation that improves efficiency of the power converter at light loads. Burst mode operation is initiated if the output load current falls below an internally programmed threshold. Once initiated, the Burst Mode operation circuitry shuts down most of the device, only keeping alive the circuitry required to monitor the output voltage.

When the output voltage has drooped approximately 1% from nominal, the XA2317 wakes up and commences normal PWM operation. The output capacitor recharges and causes the XA2317 to reenter sleep if the output load remains less than the sleep threshold. The frequency of this intermittent PWM or burst operation is proportional to load current; that is, as the load current drops further below the burst threshold, the XA2317 turns on less frequently. When th e load current increases above the burst threshold, the XA2317 will resume continuous PWM operat ion seamlessly. Referring to the Block Diagram, an optional capacitor (C_{FF}) between VOUT and FB in some circumstances can reduce the peak-to-peak VOUT ripple and input quiescent current during Burst Mode operation. Typical values for C_{FF} range from 15pF to 220pF.

PCB Layout Guidelines

The high speed operation of the XA2317 demands carefu l attention to board layout. You will not get advertised performance with careless layout. Figure 5 shows the recommended component placement. A large ground pin copper area will help to lower the chip temperature. A multilayer board with a separate ground plane is ideal, but not absolutely necessary.

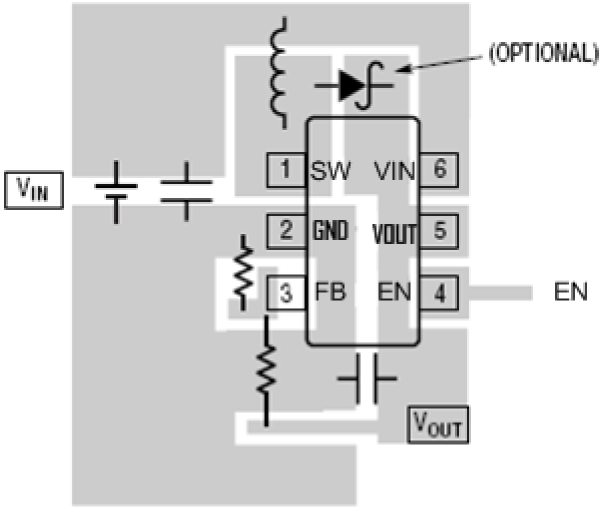


Figure 5: Recommended Component Placement for Single Layer Board

Note 5：Recommended component placement: traces carrying high current are direct. Trace area at FB pin is small .Lead length to battery is short.

Applications Information

Inductor Selection

The XA2317 can utilize small surface mount and chip ind uctors due to their fast 1.4MHz switching frequency. A minimum inductance value of 3.3uH is necessary for 3.6V and lower voltage applications and 4.7uH for output voltages greater than 3.6V. Larger values by reducing the inductor ripple current. Increasing the inductance above 10uH will increase size while providing little improvement in output current capability.

The inductor current ripple is typically set for 20% to 40% of the maximum inductor current (I_P). High frequency ferrite core inductor materials reduce frequency dependent power losses compared to cheaper powdered iron types, improving efficiency. The inductor should have low ESR (series resistance of the windings) to reduce the I^2R power losses, and must be able to handle the peak inductor current without saturating. Molded chokes and some chip inductors usually do not have enough core to support the peak inductor currents of 850mA seen on the XA2317. To minimize radiated noise,

use a toroid, pot core or shielded bobbin inductor. See Table 1 for some suggested components and suppliers.

In continuous mode, the source current of the top MOSFET is a square wave of duty cycle V_{OUT}/V_{IN}. To prevent large voltage transients, a low ESR input capacitor sized for the maximum RMS current must be used. The maximum RMS capacitor current is given by:

$$C_{IN} \text{ required } I_{RMS} \cong I_{OMAX} \frac{\left[V_{OUT}(V_{IN} - V_{OUT})\right]^{1/2}}{V_{IN}}$$

This formula has a maximum at $V_{IN} = 2V_{OUT}$, where $I_{RMS} = I_{OUT}/2$. This simple worst-case condition is commonly used for design because even significant deviations do not offer much relief. Note that the capacitor manufacturer's ripple current ratings are often based on 2000 hours of life. This makes it advisable to further derate the capacitor, or choose a capacitor rated at a higher temperature than required. Always consult the manufacturer if there is any question.

The selection of C_{OUT} is driven by the required effective series resistance (ESR). Typically, once the ESR requirement for C_{OUT} has been met, the RMS current rating generally far exceeds the $I_{RIPPLE(P-P)}$ requirement. The output ripple ΔV_{OUT} is determined by:

$$\Delta V_{OUT} \cong \Delta I_L \left(ESR + \frac{1}{8fC_{OUT}} \right)$$

Where f = operating frequency, C_{OUT} = output capacitance and ΔI_L = ripple current in the inductor. For a fixed output voltage, the output ripple is highest at maximum input voltage since ΔI_L increases with input voltage.

Aluminum electrolytic and dry tantalum capacitors are both available in surface mount configurations. In the case of tantalum, it is critical that the capacitors are surge tested for use in switching power supplies. An excellent choice is the AVX TPS series of surface mount tantalum. These are specially constructed and tested for low ESR so they give the lowest ESR for a given volume. Other capacitor types include

Table 2 shows a list of several ceramic capacitor manufacturers. Consult the manufacturers directly for detailed information on their entire selection of ceramic parts.

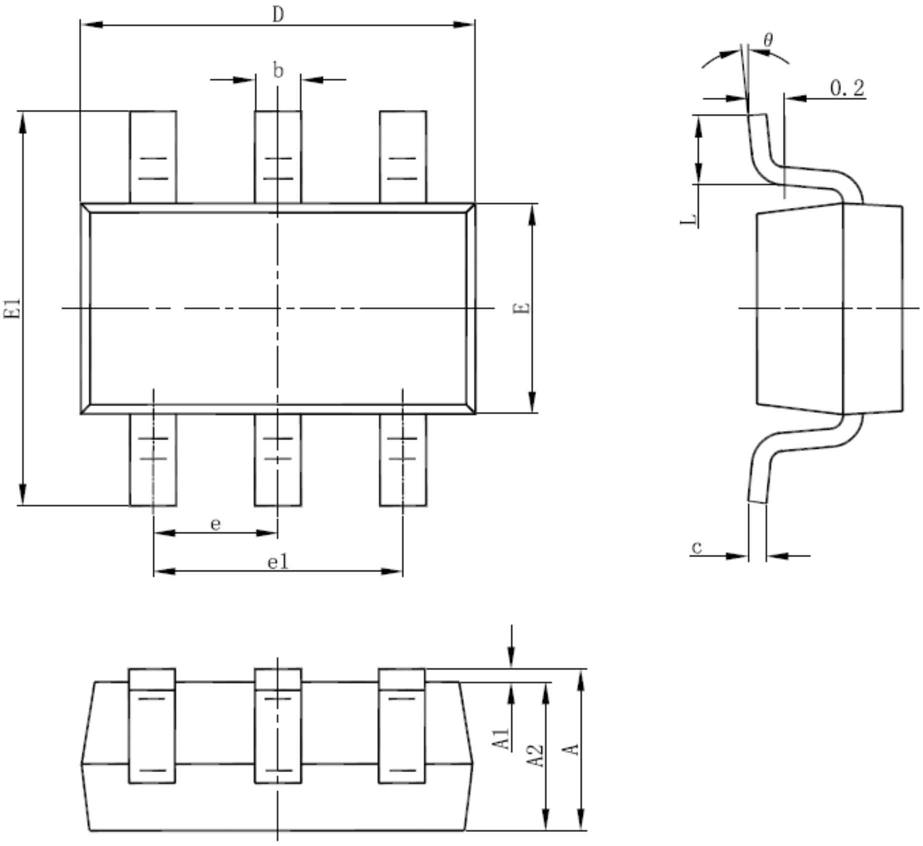
Table 1: Suggested Inductors

Vendor	Part	Inductance (uH)	MAM DCR (mΩ)	Height (mm)
Sumida (847)956-0666 www.sumida.com	CDRH5D18-4R1	4.1	57	2.0
	CDRH5D18-100	10	124	2.0
	CDRH3D16-4R7	4.7	105	1.8
	CDRH3D16-6R8	6.8	170	1.8
	CR43-4R7	4.7	109	3.5
	CR43-100	10	182	3.5
	CMD4D06-4R7MC	4.7	216	0.8
	CMD4D06-3R3MC	3.3	174	0.8
Coilcraft (847)639-6400 www.coilcraft.com	DS1608-472	4.7	60	2.9
	DS1608-103	10	75	2.9
	DS1608C-472	4.7	90	2.9
Toko (408)432-8282 www.takoam.com	D52LC-4R7M	4.7	84	2.0
	D52LC-100M	10	137	2.0
Murata www.murata.com	LQH3C4R7M24	4.7	195	2.2

Table 2: Suggested Capacitors for C_{IN} and C_{OUT}

Component Supplier	Part No.	Capacitance (uF)	Case Size
TDK	C1608JB0J475M	4.7	0603
TDK	C2012JB0J106M	10	0805
MURATA	GRM188R60J475KE19	4.7	0603
MURATA	GRM219R60J106ME19	10	0805
TAIYO YUDEN	JMK107BJ475RA	4.7	0603
TAIYO YUDEN	JMK107BJ106MA	10	0603
TAIYO YUDEN	JMK212BJ106RD	10	0805

Packaging Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°