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## **BCT1473**

### **3A, 600KHz Synchronous Step-Down Converter**

#### **GENERAL DESCRIPTION**

BCT1473 is a high efficiency synchronous buck converter with integrated 90mΩ/50mΩ power MOSFET. The BCT1473 design with an ACOT control scheme providing fast transient response and supporting both low equivalent series resistance output capacitors.

The BCT1473 operates in pulse skip mode, which maintains high efficiency during light load operation.

The BCT1473 is also equipped with Power-on-reset, soft start, and whole protections over-temperature, under-voltage, over-current into a single package.

This device, available in FCSOT23-6 package, provides a very compact system solution external components and PCB area.

#### **FEATURES**

- 4.5V to 17V operating input voltage range
- 90mΩ/50mΩ internal NFET (when  $V_{in} > 5V$ ), efficiency: up to 94%
- ACOT Control with fast transient response
- 600kHz Switching Frequency
- Pulse-skip mode
- Cycle-by-cycle current limit
- Internal soft start 1ms
- Startup from Pre-Biased Output Voltage
- Short-circuit protection
- Thermal shutdown
- Available in FCSOT23-6 Package

#### **APPLICATIONS**

- Point of load DC/DC
- Set-top-box
- DVD players/recorders
- Digital photo frames

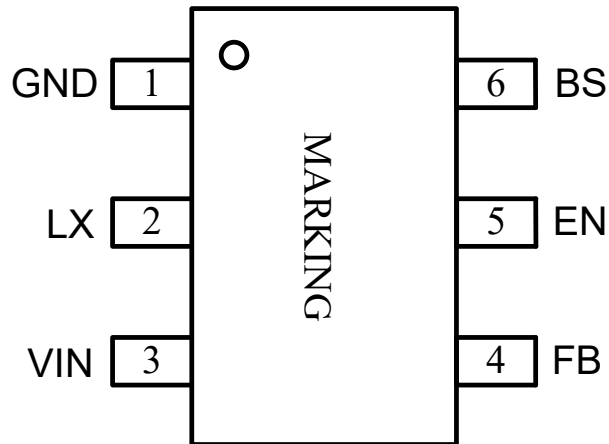
#### **ORDERING INFORMATION**

Order Number	Package Type	Temperature Range	Marking	QTY/Reel
BCT1473EEA-TR	FCSOT23-6	-40°C to +85°C	PCXX	3000

**Note:**

1. "PC" in Marking is product short code for 1473
2. "XX" in Marking will be appeared as the batch code.

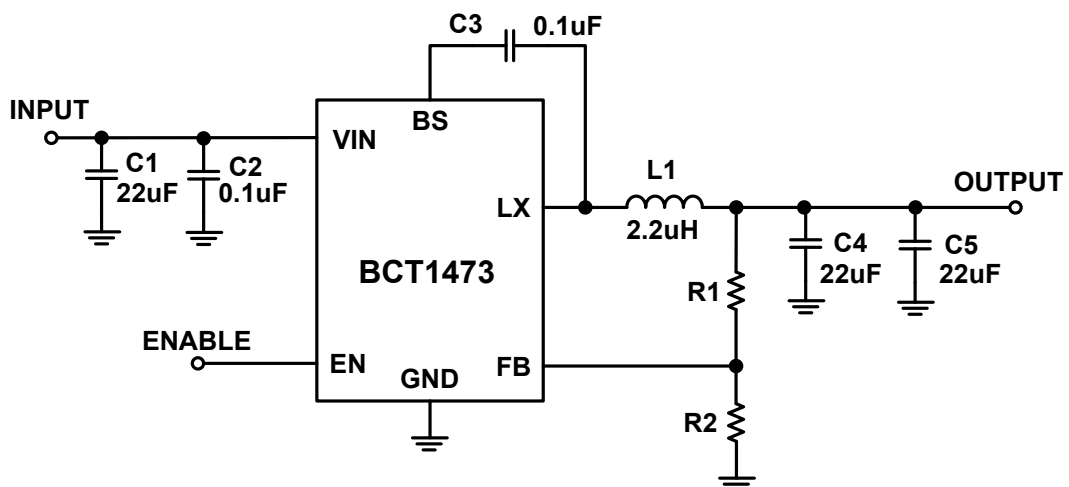
### PIN CONFIGURATION (TOP VIEW)



### PIN DESCRIPTION

PIN	NAME	FUNCTION
1	GND	Power ground pin.
2	LX	Power Switching Output. Connect an inductor to internal high side NMOS and low side NMOS.
3	VIN	Power Supply Input.
4	FB	Output feedback pin. Connect a resistive divider at FB.
5	EN	Enable input control. Active high.
6	BS	High-side Gate driver supply Voltage input. The BS supplies the voltage to drive the high-side N-channel MOSFET.

### Typical Operating Circuit





# BCT1473

## 3A, 600KHz Synchronous Step-Down Converter

### ABSOLUTE MAXIMUM RATINGS

VIN,EN to GND.....-0.3V to 19V  
LX to GND.....-1V to 19V  
BS to GND.....VLX-0.3V to VLX+6V  
Storage Temperature Range.....-65°C to +150°C  
Junction Temperature.....150°C  
Lead Temperature (Soldering, 10 sec).....260°C  
Package Thermal Resistance( $\theta_{JA}$ ) .....100°C/W  
Package Thermal Resistance( $\theta_{JC}$ ) .....50°C/W

### ESD Protection

Human Body Model.....3000V  
Charged-device model.....1500V

#### NOTE:

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. Broadchip recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Broadchip reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact Broadchip sales office to get the latest datasheet.

### RECOMMENDED OPERATING CONDITIONS

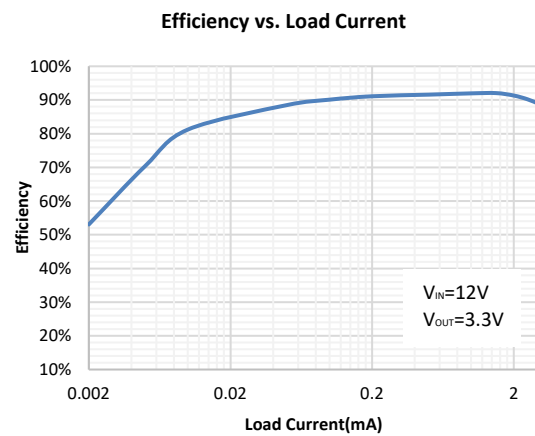
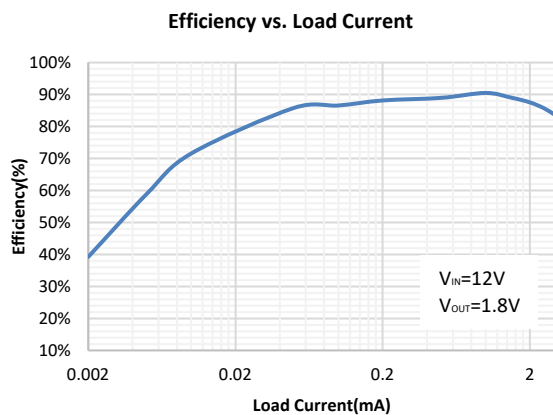
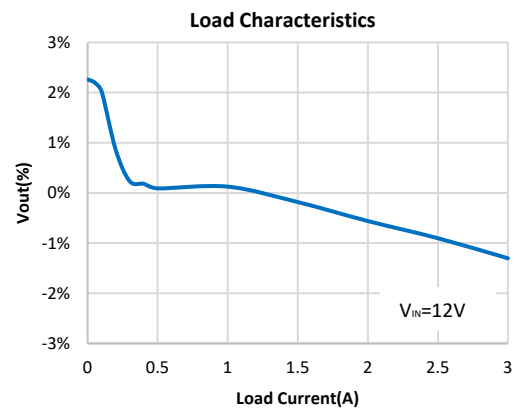
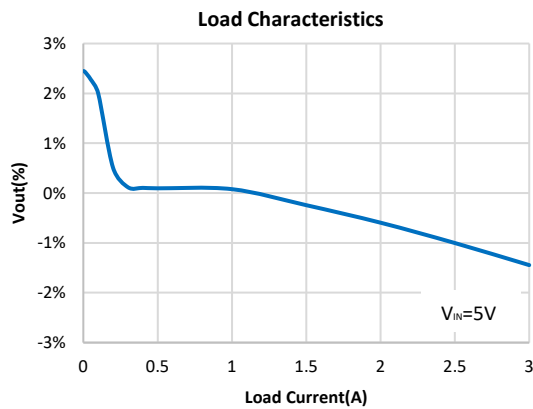
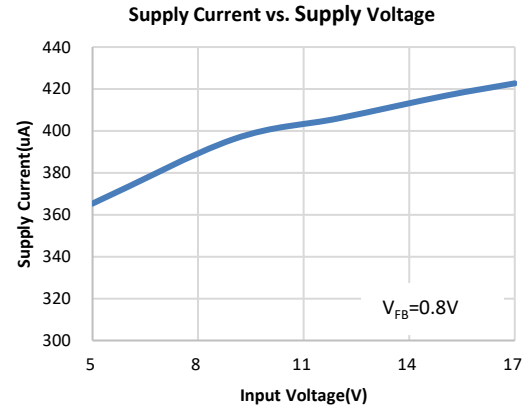
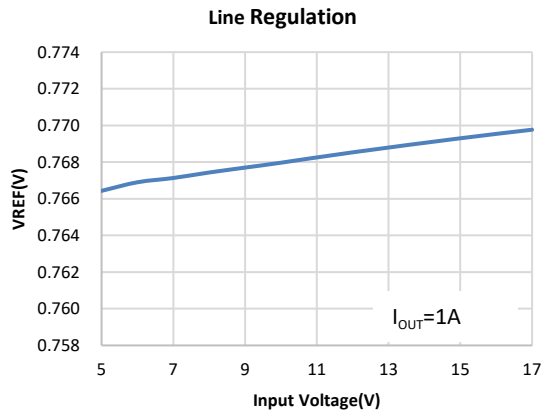
Symbol	Parameter	Range	Unit
VIN	VIN Supply Voltage	4.5 to 17	V
VOUT	Converter Output Voltage	0.768 to 6.5	V
IOUT	Converter Output Current	0 to 3	A
TA	Ambient Temperature	-40 to 85	°C
TJ	Junction Temperature	-40 to 125	°C

### ELECTRICAL CHARACTERISTICS

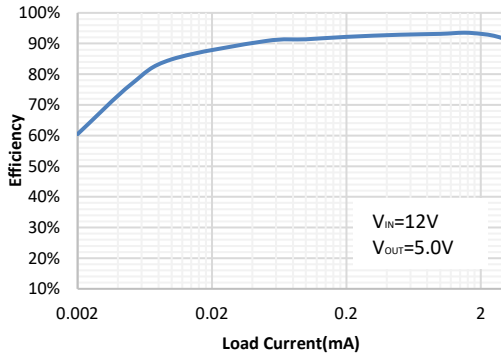
V<sub>IN</sub>= 12V, T<sub>A</sub> = 25°C, unless otherwise specified.

SYM	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>SUPPLY CURRENT</b>						
I <sub>Q</sub>	V <sub>IN</sub> Supply Current	V <sub>IN</sub> =12V, V <sub>EN</sub> =5V, V <sub>FB</sub> =0.8V, non-switching		380	520	uA
I <sub>SD</sub>	V <sub>IN</sub> Shutdown Supply Current	V <sub>EN</sub> =0V		1	10	uA
<b>UVLO</b>						
V <sub>IN_MIN</sub>	V <sub>IN</sub> UVLO Threshold	V <sub>IN</sub> Rising	3.5	3.8	4.1	V
V <sub>IN_MIN_HYST</sub>	V <sub>IN</sub> UVLO Hysteresis	V <sub>IN</sub> Falling		0.2		V
<b>REFERENCE VOLTAGE</b>						
V <sub>FB</sub>	Feedback Voltage	V <sub>OUT</sub> =1.05V, I <sub>OUT</sub> =10mA, Pulse-skip mode		774		mV
V <sub>FB</sub>	Feedback Voltage	V <sub>OUT</sub> =1.05V, CCM mode	749	768	787	mV
I <sub>FB</sub>	FB Input current	V <sub>FB</sub> =0.8V		0	1	uA
<b>FREQUENCY</b>						
F <sub>SW</sub>	Switch Frequency	V <sub>OUT</sub> =1.05V, CCM mode		600		KHz
<b>POWER MOSFET</b>						
R <sub>DS(ON)T</sub>	Top Switch On-Resistance	V <sub>BS</sub> – LX = 5.5 V		90		mΩ
R <sub>DS(ON)B</sub>	Bottom Switch On-Resistance	T <sub>A</sub> =25°C		50		mΩ
I <sub>LIM</sub>	Current Limit	V <sub>OUT</sub> =1.05V, L=2.2μH	3.3	4.2	5.1	A
<b>PROTECTIONS</b>						
T <sub>SD</sub>	Thermal Shutdown Threshold			170		°C
T <sub>HYS</sub>	Thermal Shutdown Hysteresis			35		°C
<b>ON-TIME TIMER CONTROL</b>						
T <sub>Off_MIN</sub>	Minimum Off Time			220	310	ns
<b>SOFT-START</b>						
t <sub>ss</sub>	Soft-Start Time			1		ms
<b>LOGIC THRESHOLD</b>						
V <sub>EN_H</sub>	EN Rising threshold voltage	V <sub>EN</sub> rising	1.6			V
V <sub>EN_L</sub>	EN Falling threshold	V <sub>EN</sub> falling			0.8	V
R <sub>IN</sub>	EN Pin Resistance	V <sub>EN</sub> =12V	225	400	900	kΩ

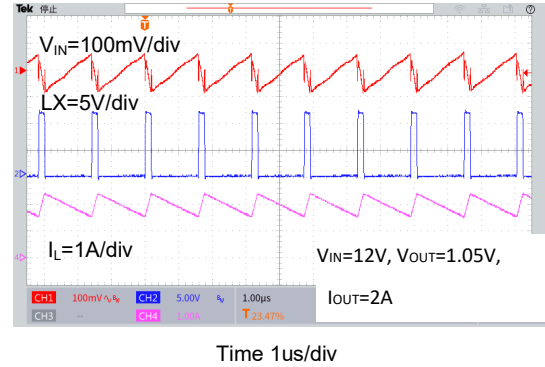
### Typical Characteristics



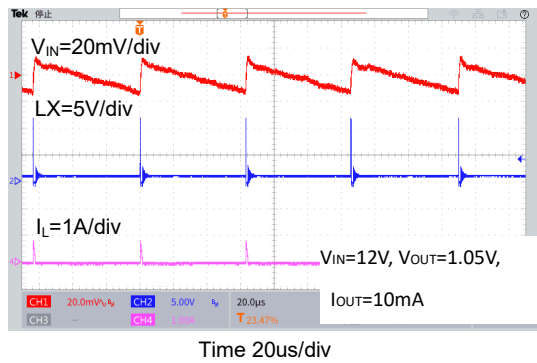
Efficiency vs. Load Current



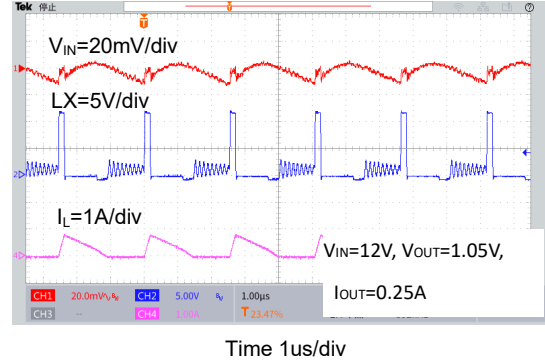
Input Voltage Ripple



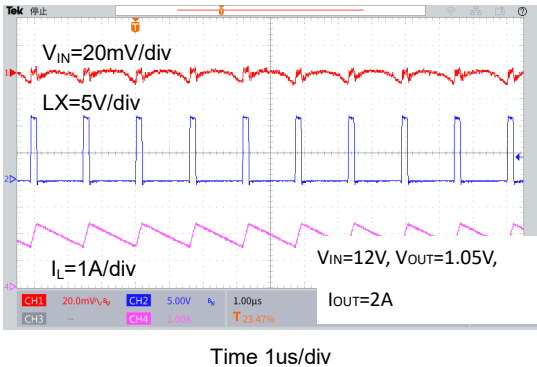
Output Voltage Ripple



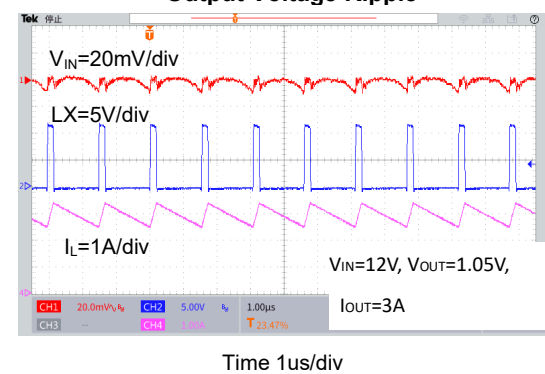
Output Voltage Ripple



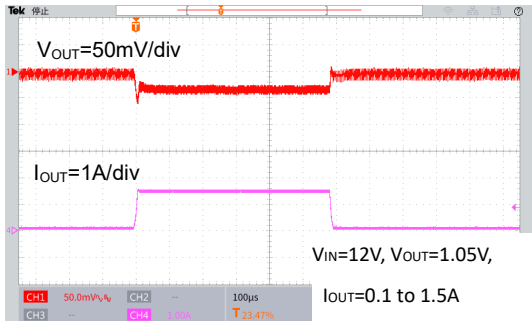
Output Voltage Ripple



Output Voltage Ripple

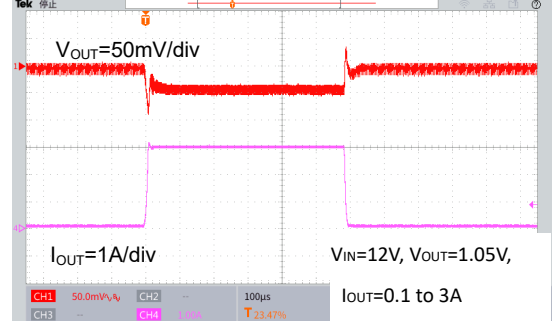


Transient Response



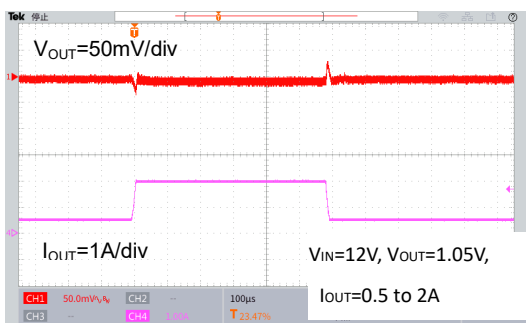
Time 100us/div

Transient Response



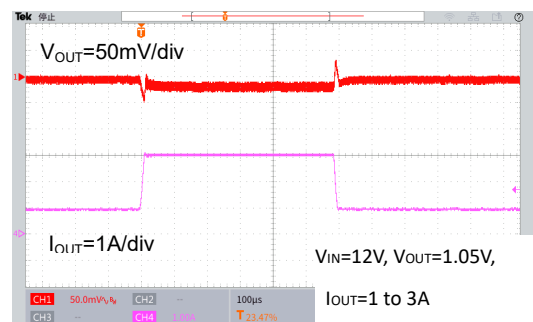
Time 100us/div

Transient Response



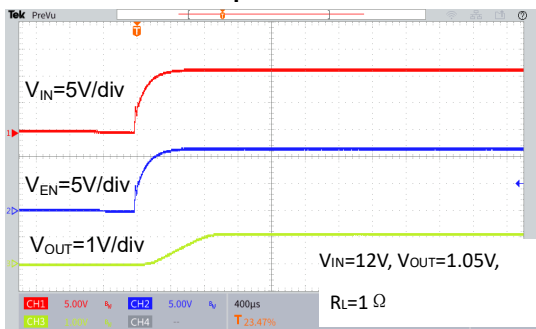
Time 100us/div

Transient Response



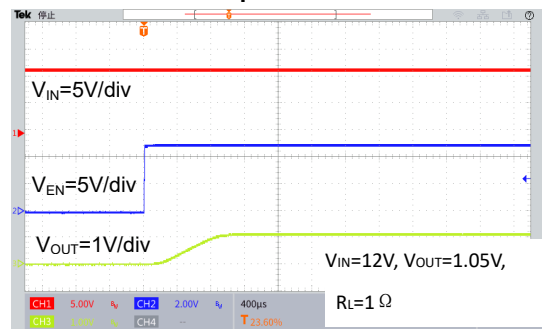
Time 100us/div

Start Up Relative to VIN

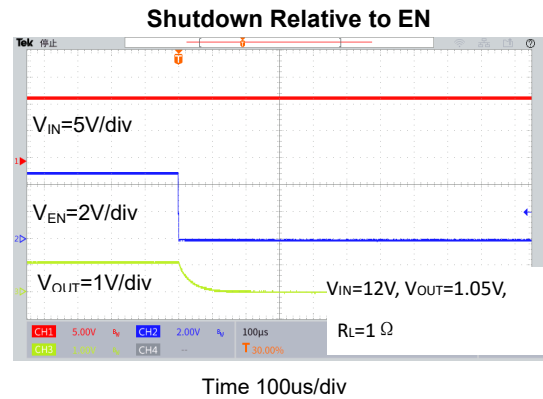
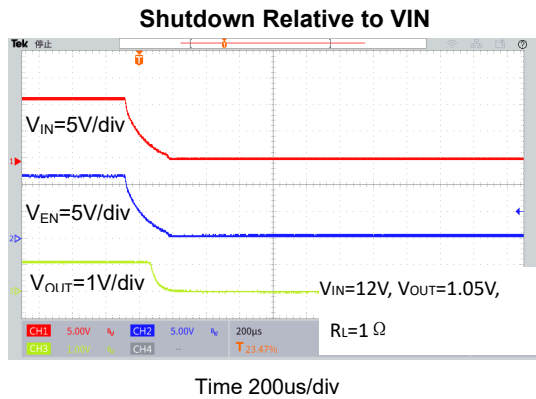


Time 400us/div

Start Up Relative to EN



Time 400us/div





### FUNCTIONAL DESCRIPTION

BCT1473 is a high efficiency synchronous buck converter with integrated 90mΩ/50mΩ power MOSFET. The BCT1473 design with an ACOT control scheme, can convert wide input voltage of 4.5V to 17V to the output voltage adjustable from 0.8V to 6.5V to provide excellent output voltage regulation.

The BCT1473 is equipped with an automatic DCM/CCM mode operation. At light load, the IC operates in the DCM mode to reduce the switching losses. The BCT1473 provides very high efficiency over light to heavy loads with loading-modulated switching frequencies.

The BCT1473 is also equipped with Power-on-reset, soft start, and whole protections (over-temperature, under-voltage, over-current) into a single package.

This device, available in FCSOT23-6 package, provides a very compact system solution external components and PCB area.

### APPLICATION INFORMATION

#### Inductor Selection

For most designs, the BCT1473 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:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_S}$$

Where  $\Delta I_L$  is inductor Ripple Current. Large value inductors result in lower ripple current and small value inductors result in high ripple current.

#### Setting the Output Voltage

The internal reference voltage is 0.768V (Typical). The output voltage is divided by a resistor, R1 and R2 to the FB pin. The output voltage is given by:

$$V_{OUT} = 0.768 \times \left(1 + \frac{R1}{R2}\right)$$

The R1 had be divide into R1\_1 and R1\_2 in the typical application circuit, This is to facilitate production, the recommended component values in the below table:

VIN(V)	VOUT(V)	R1(kΩ)	R2(kΩ)	L1(μH)	C <sub>OUT</sub> (μF)
12	1.0	3.09	10.0	1.5—3.3	44
12	1.05	3.74	10.0	1.5—3.3	44
12	1.2	5.76	10.0	1.5—3.3	44
12	1.5	9.53	10.0	2.2--4.7	44
12	1.8	13.7	10.0	2.2--4.7	44
12	2.5	22.6	10.0	2.2--4.7	44
12	3.3	33.2	10.0	2.2--4.7	44
12	5.0	54.9	10.0	2.2--4.7	44
12	6.5	75.00	10.0	3.3--4.7	44

**Input Capacitor Selection**

Because buck converters have a pulsating input current, a low ESR input capacitor is required. This results in the best input voltage filtering, minimizing the interference with other circuits caused by high input voltage spikes. Also, the input capacitor must be sufficiently large to stabilize the input voltage during heavy load transients. For good input voltage filtering, usually a 22uF input capacitor is sufficient. It can be increased without any limit for better input-voltage filtering. Two 10uF Ceramic capacitors show better performance because of the low ESR value. An additional 0.1-μF capacitor is optional to provide additional high frequency filtering. Place the input capacitor as close as possible to the input and GND pin of the device for better performance.

**Output Capacitor Selection**

The output capacitor is required to keep the output voltage ripple small and to ensure regulation loop stability. The output capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectrics are recommended due to their low ESR and high ripple current ratings. The output voltage ripple can be estimated by:

$$\Delta V_{OUT} = \frac{V_{OUT}}{f_s \times L} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right) \times \left(R_{ESR} + \frac{1}{8 \times f_s \times C_{OUT}}\right)$$

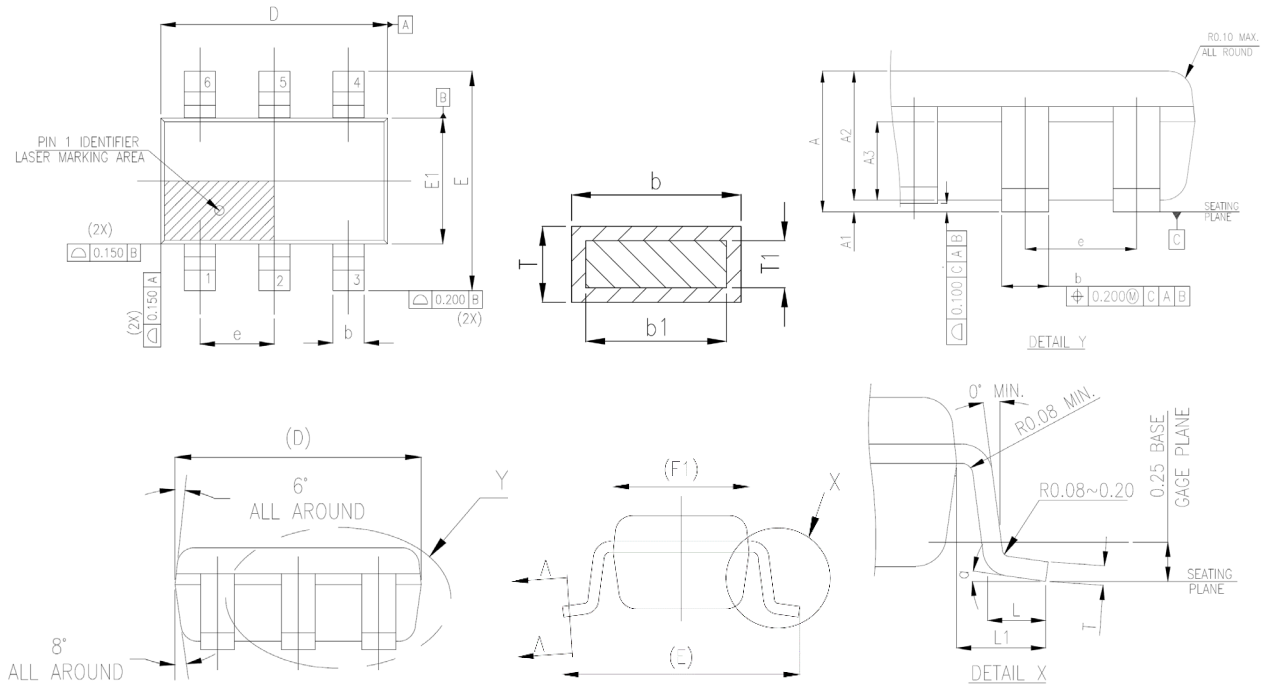
**PCB Layout Recommendations**

For all switching power supplies, the layout is an important step in the design; especially at high peak currents and switching frequencies. If the layout is not carefully done, the regulator might show noise problems and duty cycle jitter.

1. The input capacitor should be placed close to the VIN and GND. Connecting the capacitor and VIN/GND with short and wide trace without any via holes for good input voltage filtering. The distance between VIN/GND to capacitor less than 2mm respectively is recommended.
2. To minimize copper trace connections that can inject noise into the system, the inductor should be placed as close as possible to the LX pin to minimize the noise coupling into other circuits.
3. The output capacitor should be placed close to converter VOUT and GND.
4. Since the feedback pin and network is a high impedance circuit the feedback network should be routed away from the inductor. The feedback pin and feedback network should be shielded with a ground plane or trace to minimize noise coupling into this circuit.
5. A star ground connection or ground plane minimizes ground shifts and noise is recommended.

### PACKAGE OUTLINE DIMENSIONS

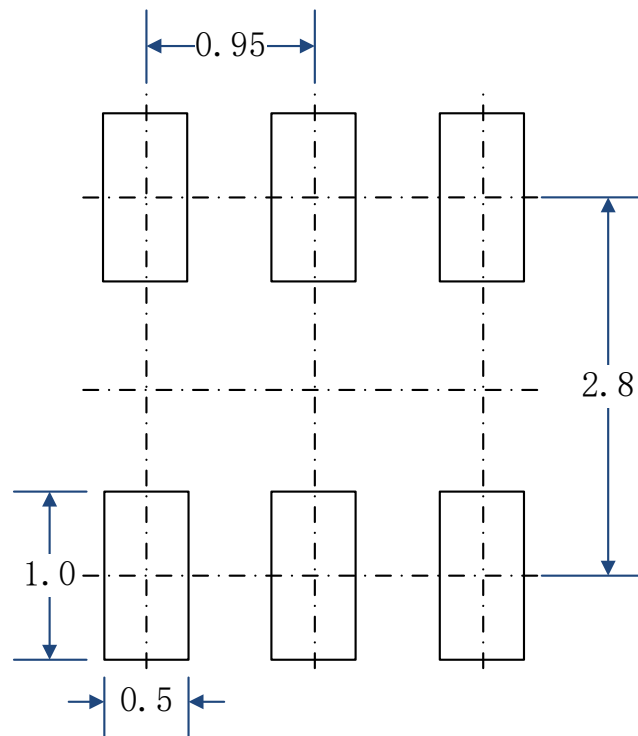
#### FCSOT23-6



DIMENSION LIST (FOOTPRINT: 0.90)

S/N	SYM	DIMENSIONS	REMARKS
1	A	1.150±0.100	OVERALL HEIGHT
2	A1	0.050±0.050	STANDOFF
3	A2	1.100±0.050	PKG THICKNESS
4	A3	0.670±0.050	BTM. PKG THICKNESS
5	D	2.900±0.100	PKG. LENGTH
6	E	2.800±0.200 $\Delta$	LEAD TIP TO TIP
7	E1	1.600±0.100	PKG. WIDTH
8	L	0.450±0.150	FOOT LENGTH
9	L1	0.600 REF.	LEAD LENGTH
10	T	0.080~0.220	FRAME THICKNESS
11	T1	0.127±0.030	FRAME BASE METAL THICKNESS
12	b	0.400±0.100 $\Delta$	LEAD WIDTH
13	b1	0.400±0.050	LEAD BASE METAL WIDTH
14	e	0.950 BASE	LEAD PITCH
15	a	0°~8°	FOOT ANGLE

**PCB Layout Pattern: FCSOT23-6**



**RECOMMENDED PCB LAYOUT PATTERN** (Unit: mm)