



# BCT1722

## 2A, 1MHz ACOT

### Synchronous Step-Down Converter

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#### GENERAL DESCRIPTION

The BCT1722 is a high efficiency synchronous DC-DC step-down converter. Its input voltage range is from 2.7V to 6.0V. The Adaptive Constant-On-time (ACOT) operation with internal compensation allows the transient response to be optimized over a wide range of loads and output capacitors.

The internal synchronous switch increases efficiency and eliminates the need for external Schottky diode. At shutdown mode, the input supply current is less than 1 $\mu$ A.

The BCT1722 integrates Valley current limit, under voltage protection and thermal protection.

The BCT1722 is available in a SOT23-5 and SOT23-6 package, which provides a compact solution with minimal external components.

#### FEATURES

- 2.7V~6.0V Input Voltage Range
- 2 A Output Current
- 1MHz Switching Frequency Minimizes the External Components
- Up to 95% efficiency
- ACOT Control for Best Transient Response, Robust Loop Stability with Low-ESR (MLCC) COUT
- Output Voltage as Low as 0.6V
- No Schottky Diode Required
- Internal soft-start
- Output short protection
- Output Auto-Discharge When EN Low
- Output POK indication
- Thermal protection
- SOT23-5 and SOT23-6 Packages

#### APPLICATIONS

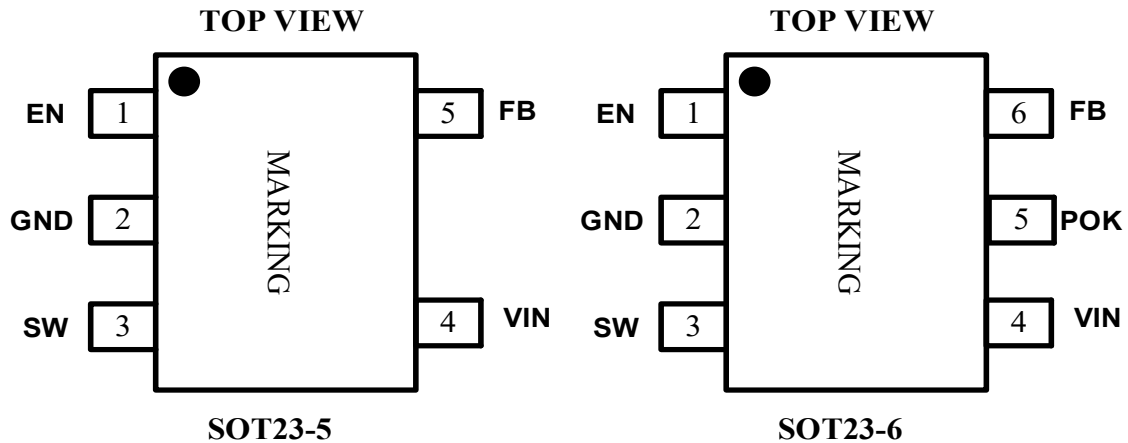
- STB, Cable Modem & xDSL Platforms
- LCD TV Power Supply & Metering Platforms
- General Purpose Point of Load (POL)

#### ORDERING INFORMATION

Order Number	Package Type	Temperature Range	Marking	QTY/Reel
BCT1722EUK-TR	SOT23-5	-40°C to +85°C	PEXX	3000
BCT1722EUT-TR	SOT23-6	-40°C to +85°C	PFXX	3000

Note: "XX" in Marking will be appeared as the batch code.

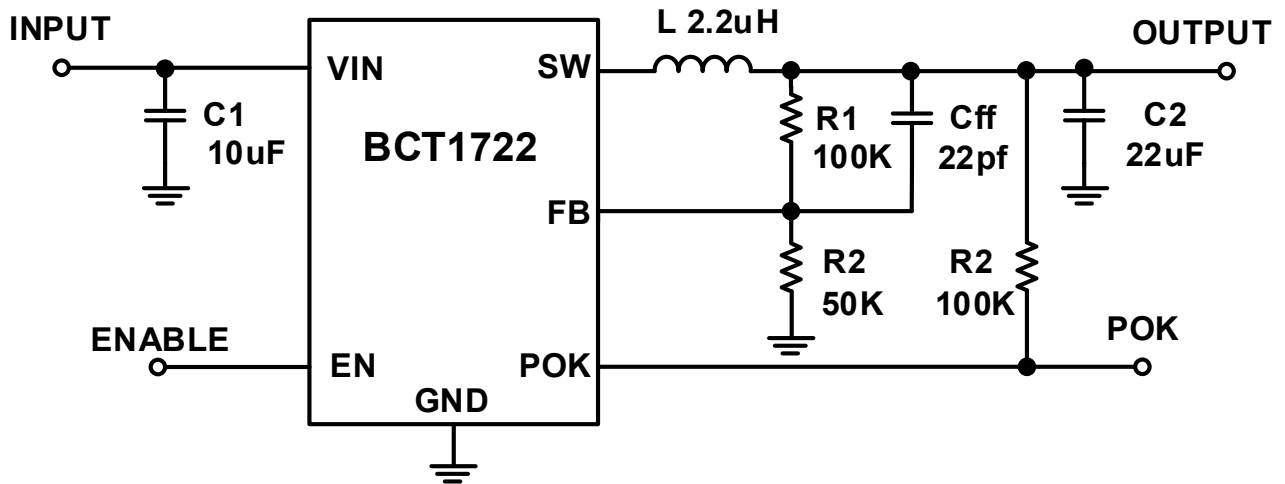
## PIN CONFIGURATION



## PIN DESCRIPTION

PIN		NAME	FUNCTION
SOT23-5	SOT23-6		
1	1	EN	Drive EN pin high to turn on the regulator and low to turn off the regulator.
2	2	GND	Power ground pin.
3	3	SW	Power Switching Output. Connect an inductor to the drains of internal high side PMOS and low side NMOS.
4	4	VIN	Power Supply Input. Must be closely decoupled to GND with a 10μF or greater ceramic capacitor.
5	6	FB	Output feedback pin. FB senses the output voltage and is regulated by the control loop to 0.6V. Connect a resistive divider at FB.
-	5	POK	Power OK indicator. The output of this pin is an open-drain with external pull-up resistor. PG is pulled up when the FB voltage is within 90%, otherwise it is LOW.

#### Typical Operating Circuit(VOUT=1.8V)



Notes: Cff Optional for performance fine-tune

#### Suggested Component Values:

VOUT (V)	R1 (k $\Omega$ )	R2 (k $\Omega$ )	C1(uF)	L (uH)	C2 (uF)
3.3	90	20	10	1 to 3.3	22
1.8	100	50	10	1 to 3.3	22
1.5	100	66.6	10	1 to 3.3	22
1.2	100	100	10	1 to 3.3	22
1.05	100	133	10	1 to 3.3	22
1	100	148	10	1 to 3.3	22



# BCT1722 2A, 1MHz ACOT Synchronous Step-Down Converter

## ABSOLUTE MAXIMUM RATINGS

Input Supply Voltage.....	-0.3V to 7.0V
EN, FB ,SW PIN .....	-0.3V to VIN+0.3V
Storage Temperature Range.....	-65°C to +150°C
Junction Temperature.....	150°C
Operating Temperature Range.....	-40°C to +85°C
Lead Temperature (Soldering, 10 sec).....	260°C
Package Thermal Resistance( $\theta_{JA}$ )	
SOT23-5.....	260°C/W
SOT23-6.....	250°C/W
Package Thermal Resistance( $\theta_{JC}$ )	
SOT23-5.....	110°C/W
SOT23-6.....	100°C/W
ESD Susceptibility	
HBM.....	2000V

### 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.

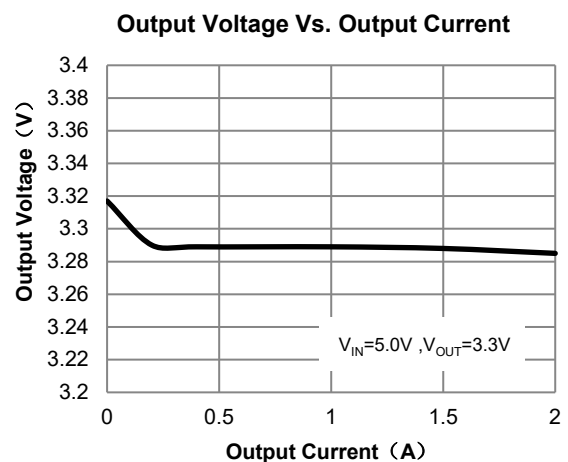
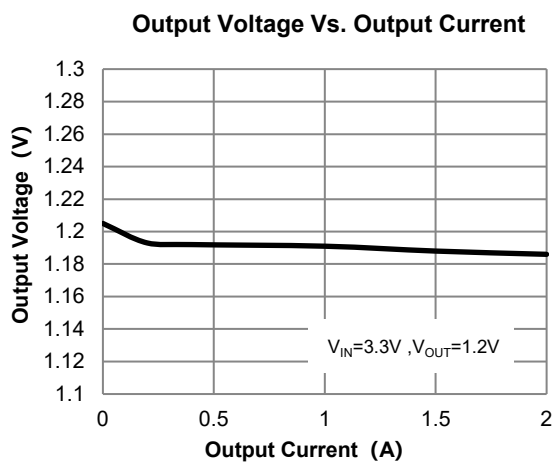
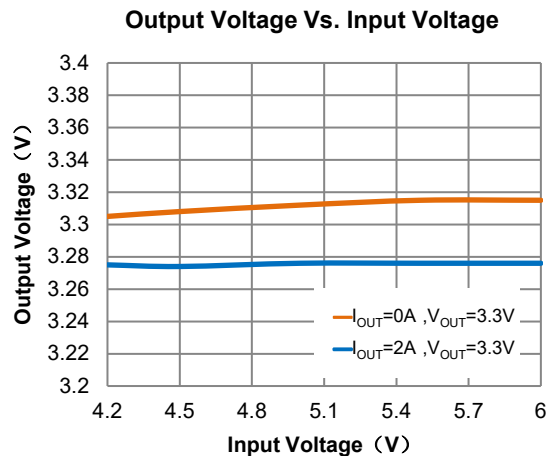
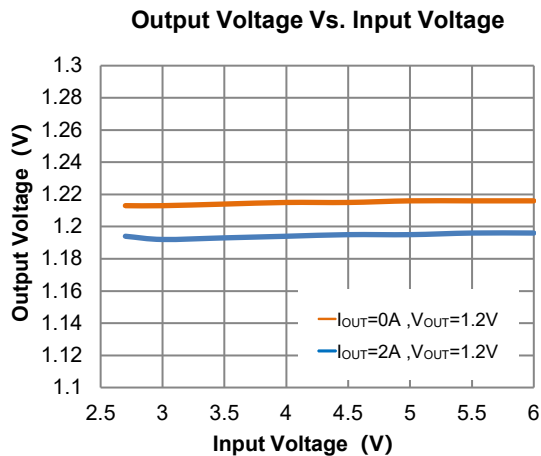
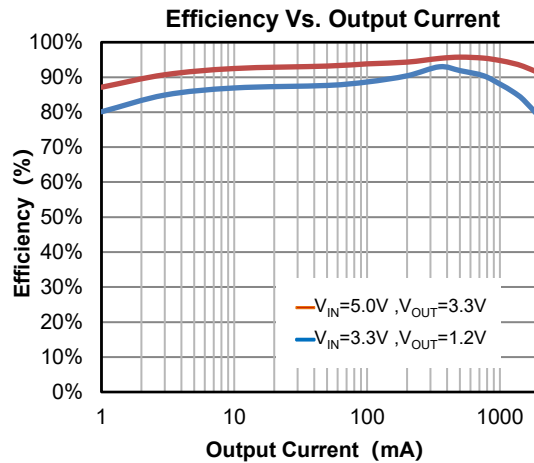
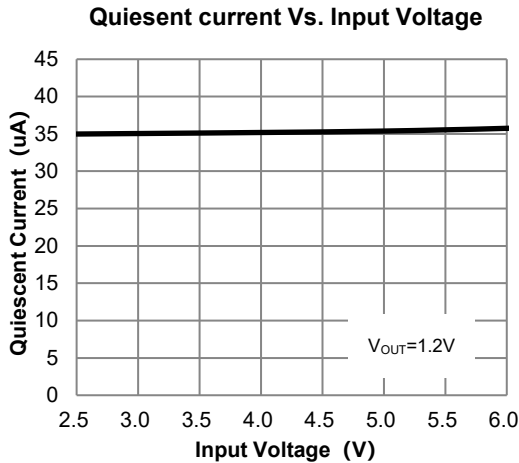
## ELECTRICAL CHARACTERISTICS

(VIN= 3.6V, TA = 25°C, unless otherwise specified.)

PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
V <sub>IN</sub> Input Supply Voltage	V <sub>IN</sub>		2.7		6.0	V
V <sub>IN</sub> UVLO Threshold	V <sub>IN_MIN</sub>	V <sub>IN</sub> Rising	2.05	2.25	2.35	V
V <sub>IN</sub> Under Voltage Lockout Threshold Hysteresis	V <sub>IN_MIN_HYST</sub>	V <sub>IN</sub> Falling		250		mV
Shutdown Supply Current	I <sub>SD</sub>	V <sub>EN</sub> =0V			1	uA
Supply Current	I <sub>Q</sub>	V <sub>FB</sub> =0.63V		33		uA
Feedback Voltage	V <sub>FB</sub>		0.593	0.600	0.607	V
FB Input Current	I <sub>FB</sub>	V <sub>FB</sub> =0.6V			0.1	uA
Top Switch On-Resistance	R <sub>DS(ON)T</sub>	I <sub>sw</sub> =0.3A		110		mΩ
Bottom Switch On-Resistance	R <sub>DS(ON)B</sub>	I <sub>sw</sub> =0.3A		70		mΩ
Switch Frequency	F <sub>SW</sub>		0.8	1	1.2	MHz
Valley Current Limit	I <sub>LIM</sub>		2.1	2.6	3.3	A
Minimum Off Time	T <sub>Off_MIN</sub>		70	120	180	ns
EN Rising threshold voltage	V <sub>EN_H</sub>	V <sub>EN</sub> rising	1.5			V
EN Falling threshold	V <sub>EN_L</sub>	V <sub>EN</sub> falling			0.4	V
POK Pin Threshold (relative to VOUT)		Rising		90		%
		Falling		82		
POK Sink Capability (POK = low)		V <sub>POK</sub> =0.3V		40		mA
Soft-Start Time	t <sub>SS</sub>			0.9		ms
Thermal Shutdown Temperature	T <sub>SD</sub>			150		°C
	T <sub>HYS</sub>			25		°C
Output Discharge Switch On Resistance				1.6		kΩ

## TYPICAL PERFORMANCE CHARACTERISTICS

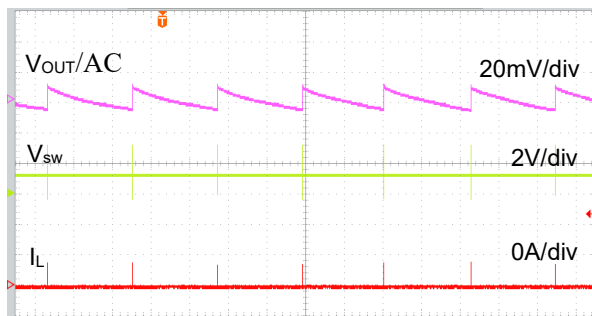
$V_{IN} = 3.3V$ ,  $C_{IN} = 10\mu F$ ,  $C_{OUT} = 22\mu F$ ,  $L = 2.2\mu H$ ,  $T_A = +25^\circ C$ , unless otherwise noted.



## TYPICAL PERFORMANCE CHARACTERISTICS

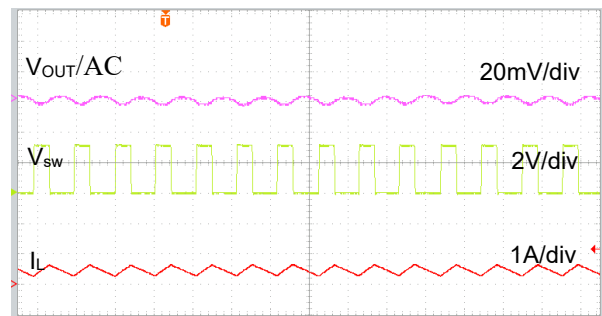
$V_{IN} = 3.3V$ ,  $C_{IN} = 10\mu F$ ,  $C_{OUT} = 22\mu F$ ,  $L = 2.2\mu H$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

**Output Ripple ( $V_{IN}=3.3V, V_{OUT}=1.2V, I_O=0A$ )**



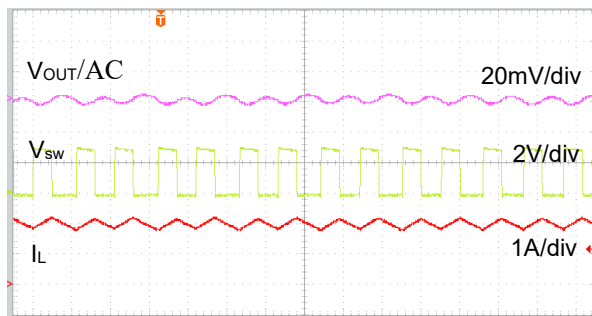
Time 10ms/div

**Output Ripple ( $V_{IN}=3.3V, V_{OUT}=1.2V, I_O=0.5A$ )**



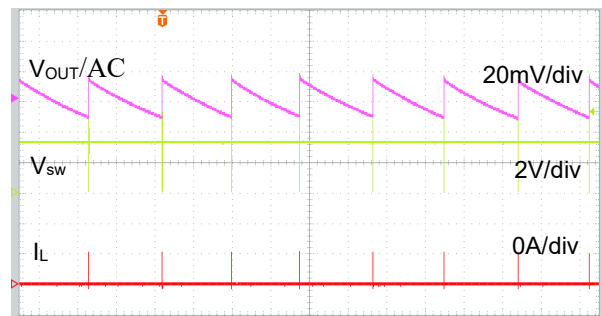
Time 1us/div

**Output Ripple ( $V_{IN}=3.3V, V_{OUT}=1.2V, I_O=2A$ )**



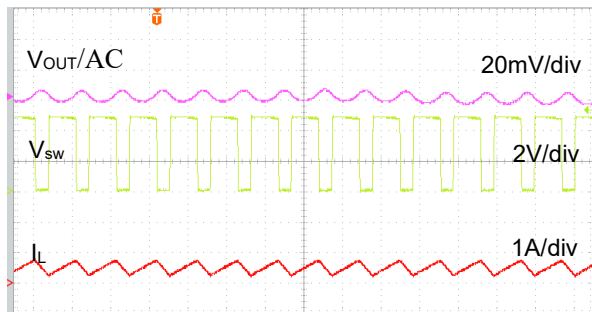
Time 1us/div

**Output Ripple ( $V_{IN}=5.0V, V_{OUT}=3.3V, I_O=0A$ )**



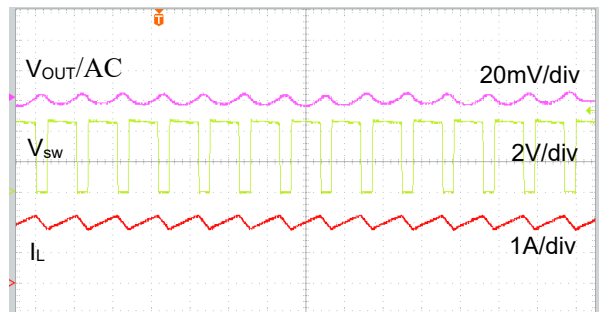
Time 10ms/div

**Output Ripple ( $V_{IN}=5.0V, V_{OUT}=3.3V, I_O=0.5A$ )**



Time 1us/div

**Output Ripple ( $V_{IN}=5.0V, V_{OUT}=3.3V, I_O=2A$ )**

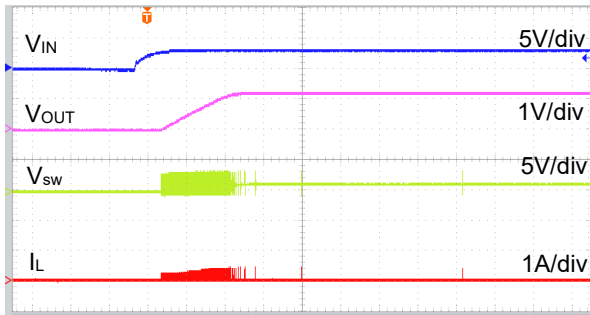


Time 1us/div

## TYPICAL PERFORMANCE CHARACTERISTICS

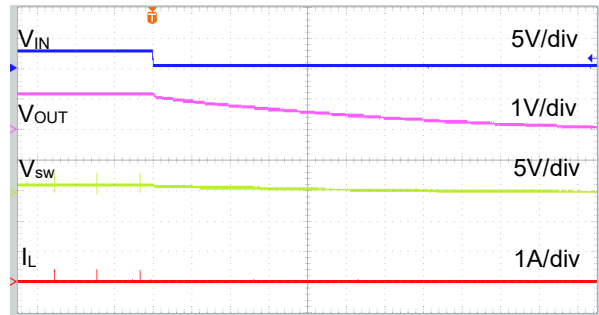
$V_{IN} = 3.3V$ ,  $C_{IN} = 10\mu F$ ,  $C_{OUT} = 22\mu F$ ,  $L = 2.2\mu H$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

**$V_{IN}$  Power Up ( $V_{OUT}=1.2V, I_O=0A$ )**



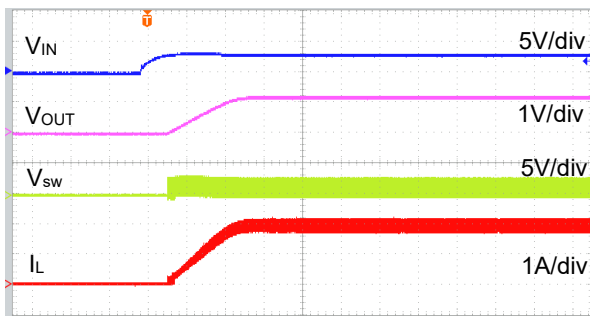
Time 400us/div

**$V_{IN}$  Power Off ( $V_{OUT}=1.2V, I_O=0A$ )**



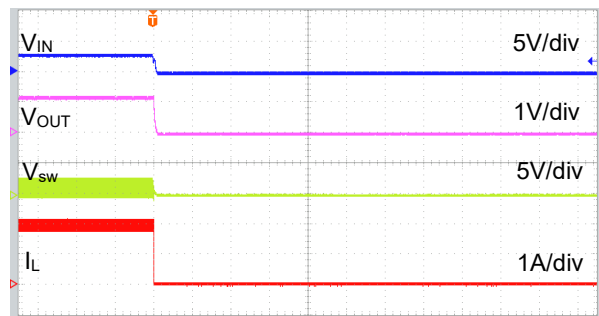
Time 10ms/div

**$V_{IN}$  Power Up ( $V_{OUT}=1.2V, I_O=2A$ )**



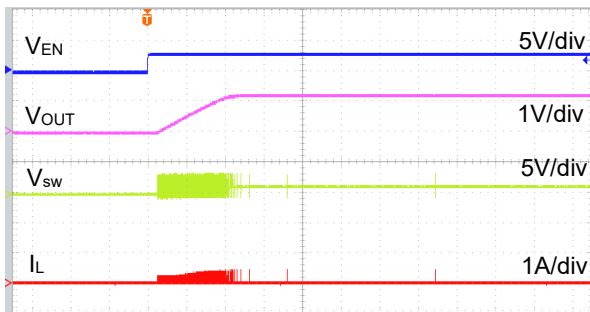
Time 400us/div

**$V_{IN}$  Power Off ( $V_{OUT}=1.2V, I_O=2A$ )**



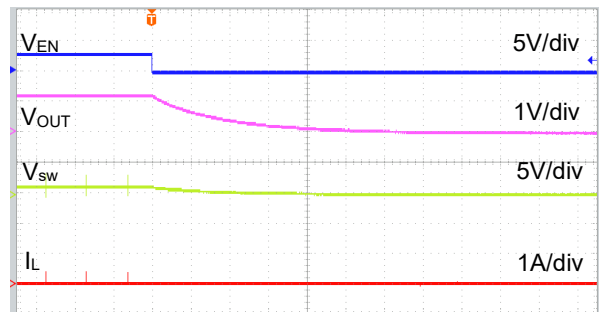
Time 400us/div

**EN Start Up ( $V_{OUT}=1.2V, I_O=0A$ )**



Time 400us/div

**EN Shut Down ( $V_{OUT}=1.2V, I_O=0A$ )**



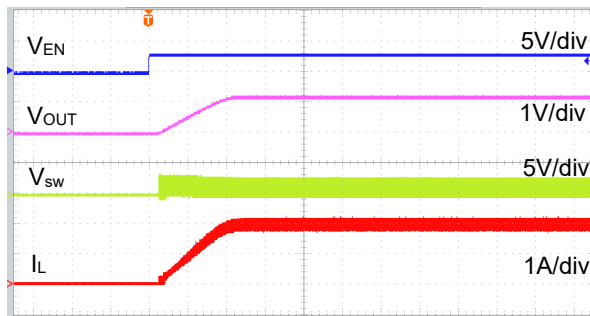
Time 10ms/div



## TYPICAL PERFORMANCE CHARACTERISTICS

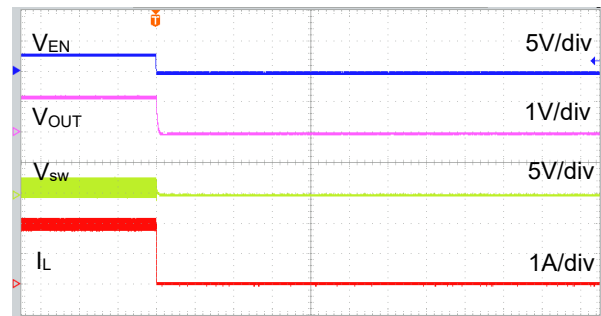
$V_{IN} = 3.3V$ ,  $C_{IN} = 10\mu F$ ,  $C_{OUT} = 22\mu F$ ,  $L = 2.2\mu H$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

**EN Start Up ( $V_{OUT}=1.2V, I_O=2A$ )**



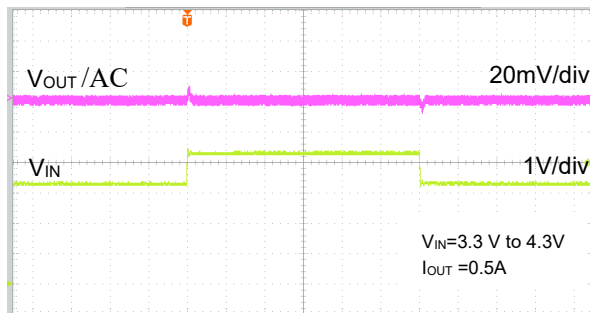
Time 400us/div

**EN Shut Down ( $V_{OUT}=1.2V, I_O=2A$ )**



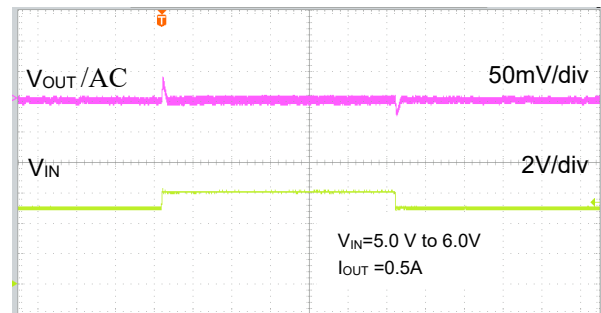
Time 400us/div

**Line Transient ( $V_{OUT}=1.2V$ )**



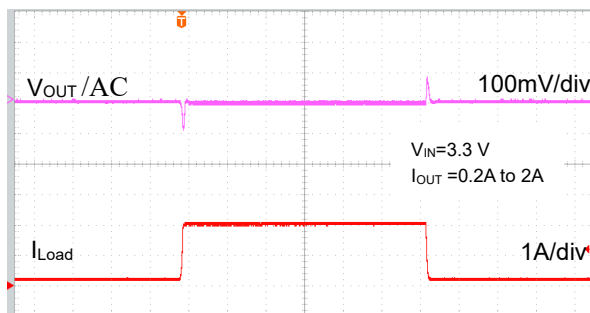
Time 100us/div

**Line Transient ( $V_{OUT}=3.3V$ )**



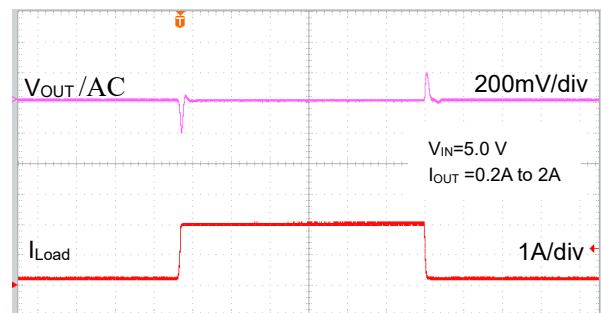
Time 100us/div

**Load Transient ( $V_{OUT}=1.2V$ )**



Time 100us/div

**Load Transient ( $V_{OUT}=3.3V$ )**



Time 100us/div

## FUNCTIONAL DESCRIPTION

The BCT1722 is a step-down converter. It provides constant on-time, current mode control with fast transient response. A fixed switching frequency (1MHz) oscillator and internal compensation are integrated to minimize external component count. Protection features include over current protection, under voltage protection and over temperature protection.

## APPLICATION INFORMATION

### Setting the Output Voltage

The internal reference VREF is 0.6V (Typical). The output voltage is divided by a resistor, R1 and R2 to the FB pin. The output voltage is given by:

$$V_{OUT} = 0.6 \times \left(1 + \frac{R1}{R2}\right)$$

### Internal Soft-Start

The BCT1722 provides an internal soft-start function to prevent large inrush current and output voltage overshoot when the converter starts up. The soft-start (SS) automatically begins once the chip is enabled. During soft-start, the internal soft-start capacitor becomes charged and generates a linear ramping up voltage across the capacitor. This voltage clamps the voltage at the FB pin, causing PWM pulse width to increase slowly and in turn reduce the input surge current. The internal 0.6V reference takes over the loop control once the internal ramping-up voltage becomes higher than 0.6V.

### UVLO Protection

The BCT1722 has input Under Voltage Lockout protection (UVLO). If the input voltage exceeds the UVLO rising threshold voltage (2.25V typ), the converter resets and prepares the PWM for operation. If the input voltage falls below the UVLO falling threshold voltage during normal operation, the device will stop switching. The UVLO rising and falling threshold voltage has a hysteresis to prevent noise - caused reset.

### Inductor Selection

For most designs, the BCT1722 operates with inductors of 1μH to 3.3μH. 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.

The inductor saturation current rating must be greater than the calculated peak current. The inductor peak current can be derived from the following equation:

$$I_{PEAK} = I_{OUT} + \frac{\Delta I_L}{2}$$

### Input Capacitor Selection

The input capacitor reduces the surge current drawn from the input and switching noise from the device. The input capacitor impedance at the switching frequency should be less than input source impedance to prevent high frequency switching current passing to the input. A low ESR input capacitor sized for maximum RMS current must be used. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients.

#### APPLICATION INFORMATION

Voltage rating and current rating are the key parameters when selecting an input capacitor. Generally, selecting an input capacitor with voltage rating 1.5 times greater than the maximum input voltage is a conservatively safe design. The input capacitor is used to supply the input RMS current, which can be approximately calculated using the following equation:

$$I_{IN\_RMS} = I_{OUT} \times \sqrt{\frac{V_{OUT}}{V_{IN}} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)}$$

One good design uses more than one capacitor with low equivalent series resistance (ESR) in parallel to form a capacitor bank. The input capacitance value determines the input ripple voltage of the regulator. The input voltage ripple can be approximately calculated using the following equation :

$$\Delta V_{IN} = \frac{I_{OUT}}{C_{IN} \times f_{SW}} \times \frac{V_{OUT}}{V_{IN}} \times \left(1 - \frac{V_{OUT}}{V_{IN}}\right)$$

A 10μF ceramic capacitor for most applications is sufficient. A large value may be used for improved input voltage filtering.

#### 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:

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

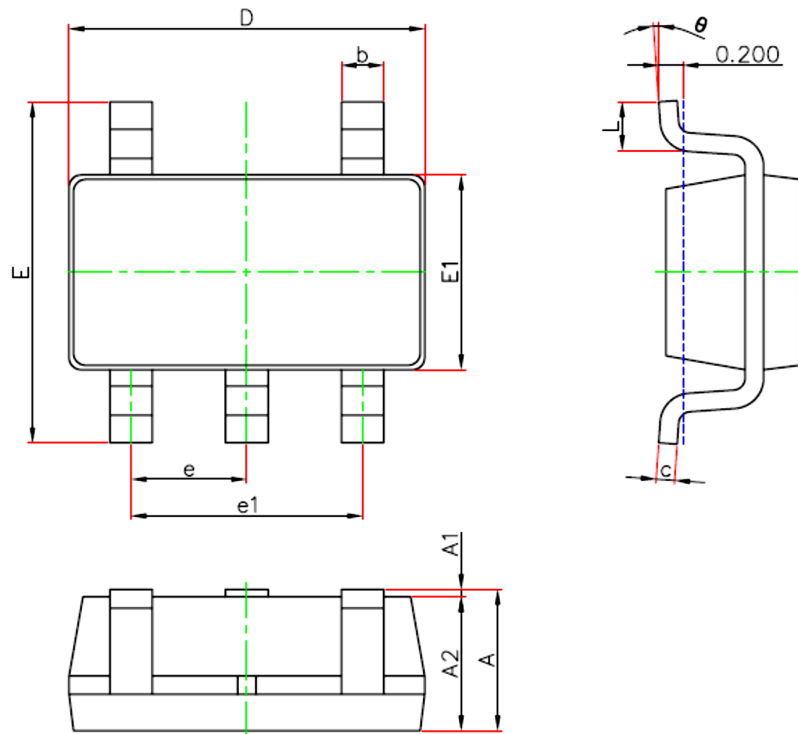
#### PCB Layout Recommendations

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the BCT1722 Check the following in your layout:

- ☐ The power traces, consisting of the GND trace, the SW trace and the VIN trace should be kept short, direct and wide
- ☐ Does the (+) plates of C<sub>IN</sub> connect to V<sub>IN</sub> as closely as possible. This capacitor provides the AC current to the internal power MOSFETs.
- ☐ Keep the switching node, SW, away from the sensitive V<sub>OUT</sub> node.
- ☐ Keep the (-) plates of C<sub>IN</sub> and C<sub>OUT</sub> as close as possible

## PACKAGE OUTLINE DIMENSIONS

SOT23-5

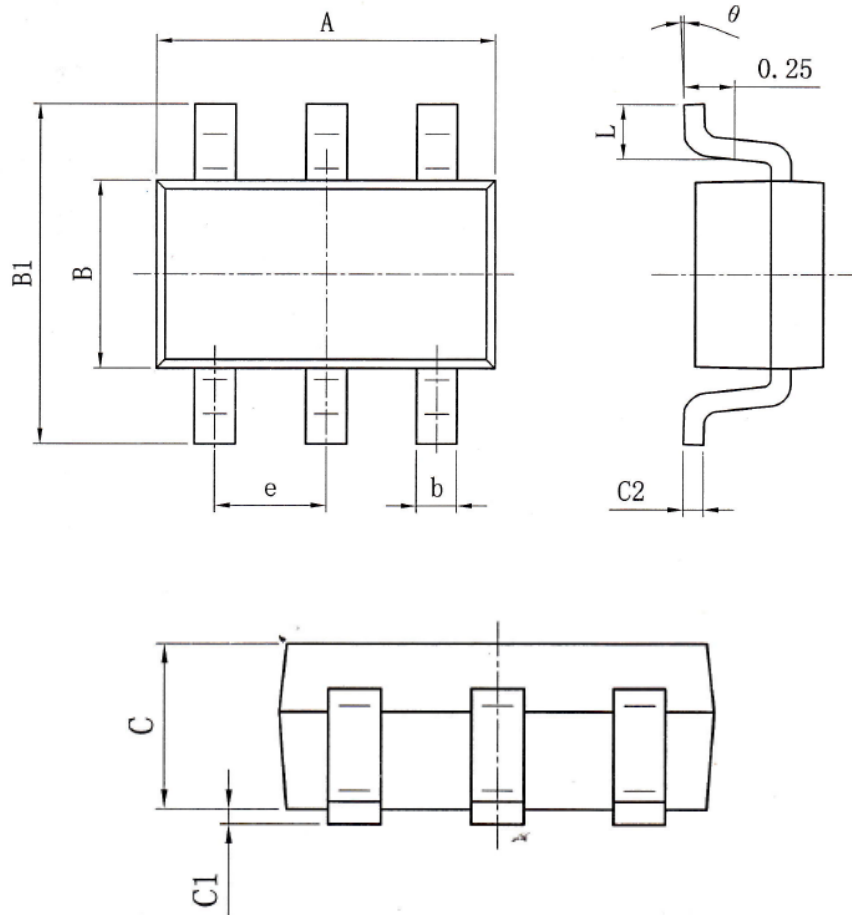


Symbol	Dimensions In Millimeters	
	Min	Max
A	1.05	1.3
A1	0	0.15
A2	1.05	1.15
b	0.28	0.5
c	0.1	0.23
D	2.82	3.02
E1	1.5	1.7
E	2.65	3.05
e	0.95(BSC)	
e1	1.8	2
L	0.3	0.6
θ	0°	8°

SOT23-5 Surface Mount Package

## PACKAGE OUTLINE DIMENSIONS

SOT23-6

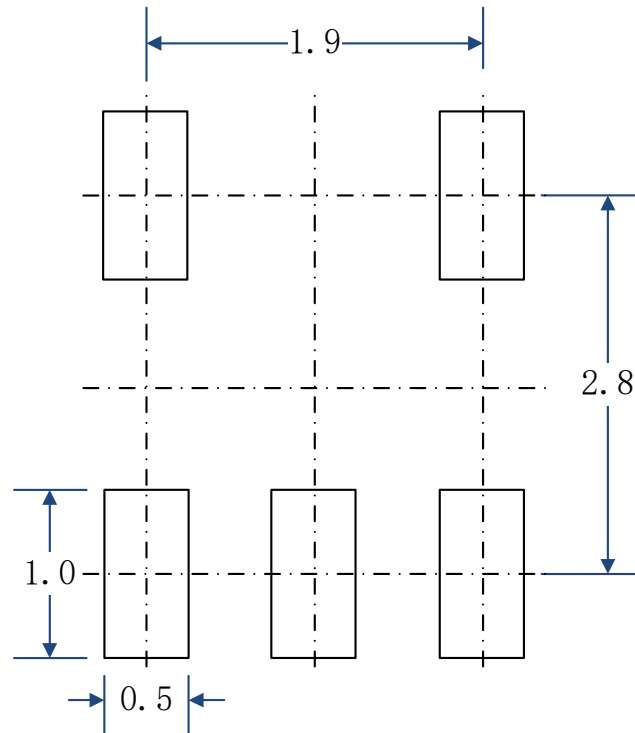


Symbols	Dimensions in millimeters	
	Min.	Max.
A	2.82	3.02
e	0.95 (BSC)	
b	0.28	0.45
B	1.5	1.7
B1	2.75	3.05
C	1.05	1.15
C1	0.03	0.15
C2	0.12	0.23
L	0.35	0.55
θ	0°	8°

SOT23-6 Surface Mount Package

## PCB Layout Pattern

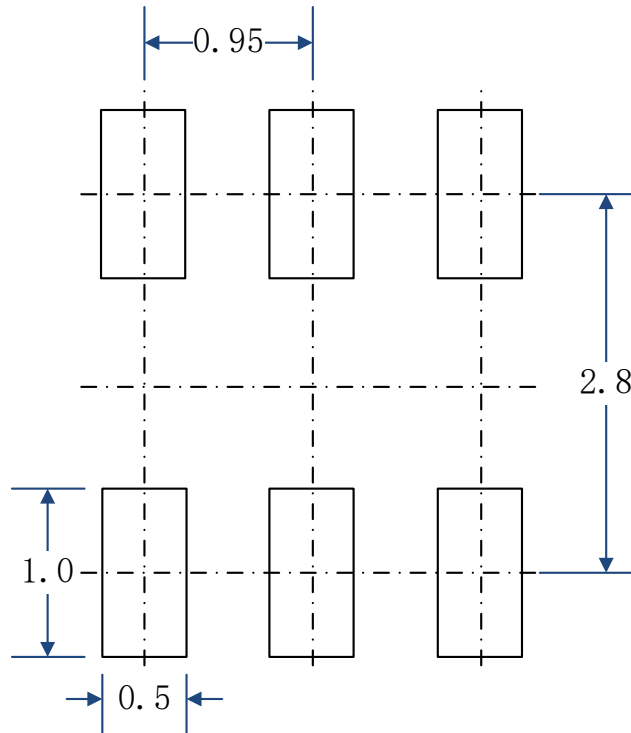
SOT23-5



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

## PCB Layout Pattern

SOT23-6



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