



BCT12569A

2A, 1MHz ACOT

Synchronous Step-Down Converter

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GENERAL DESCRIPTION

The BCT12569A 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 μ A.

The BCT12569A integrates Valley current limit, under voltage protection and thermal protection.

The BCT12569A is available in a SOT563 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
- Thermal protection
- SOT563 Packages

APPLICATIONS

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

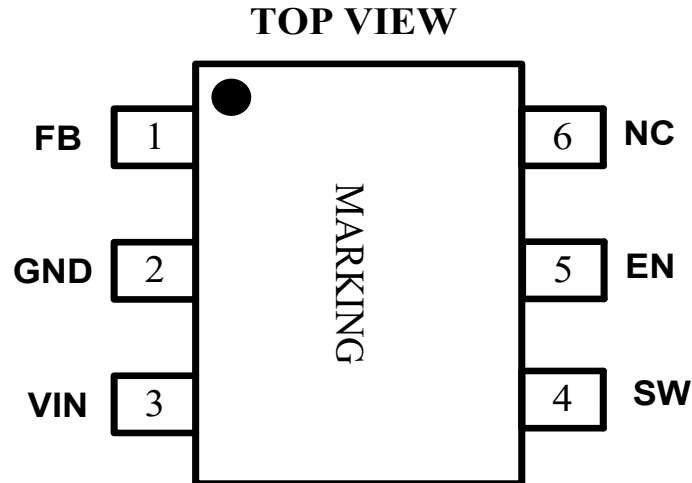
ORDERING INFORMATION

Order Number	Package Type	Temperature Range	Marking	QTY/Reel
BCT12569AEYT-TR	SOT563	-40°C to +85°C	PLXX	5000

Note:

1. "PL" in Marking is product short code for BCT12569A.
2. "XX" in Marking will be appeared as the batch code.

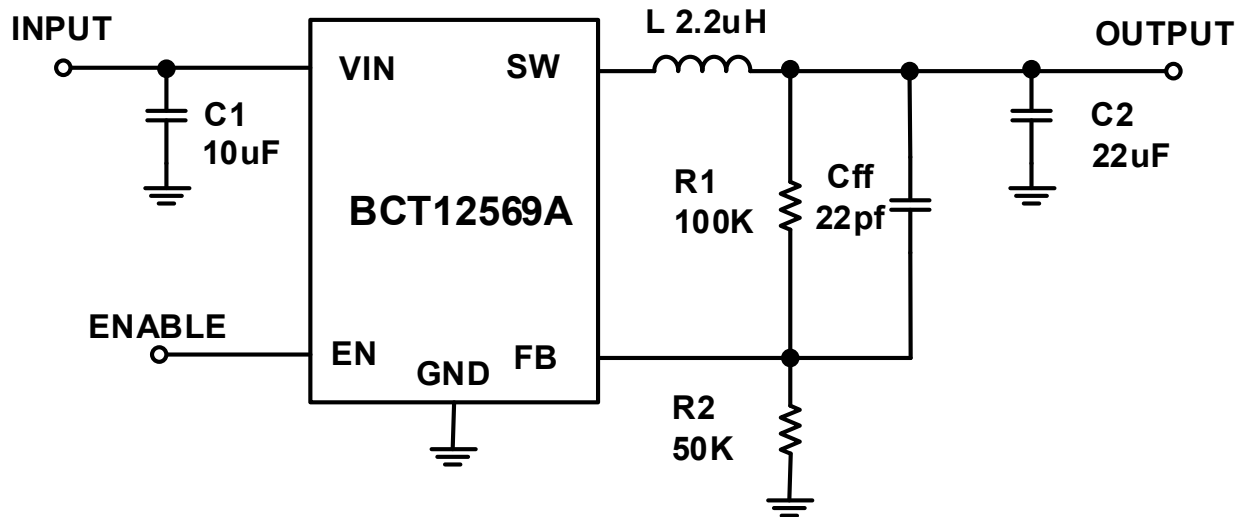
PIN CONFIGURATION



PIN DESCRIPTION

PIN	NAME	FUNCTION
1	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.
2	GND	Power ground pin.
3	VIN	Power Supply Input. Must be closely decoupled to GND with a 10 μ F or greater ceramic capacitor.
4	SW	Power Switching Output. Connect an inductor to the drains of internal high side PMOS and low side NMOS.
5	EN	Drive EN pin high to turn on the regulator and low to turn off the regulator.
6	NC	No Connect.

Typical Operating Circuit(VOUT=1.8V)



Notes: Cff Optional for performance fine-tune

Suggested Component Values:

VOUT (V)	R1 (k Ω)	R2 (k Ω)	C1 (μ F)	L (μ H)	C2 (μ F)
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



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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(θ_{JA})	
SOT563.....	130°C/W
Package Thermal Resistance(θ_{JC})	
SOT563.....	60°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.

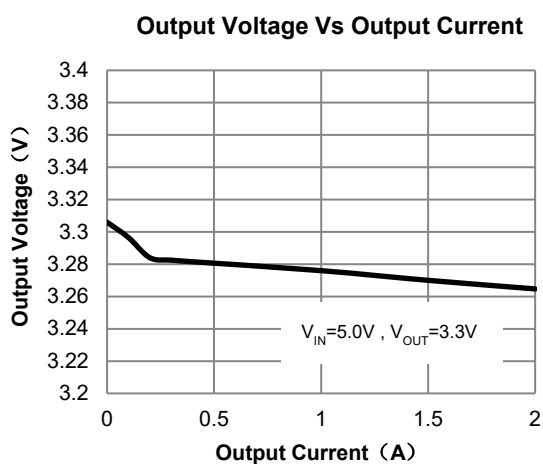
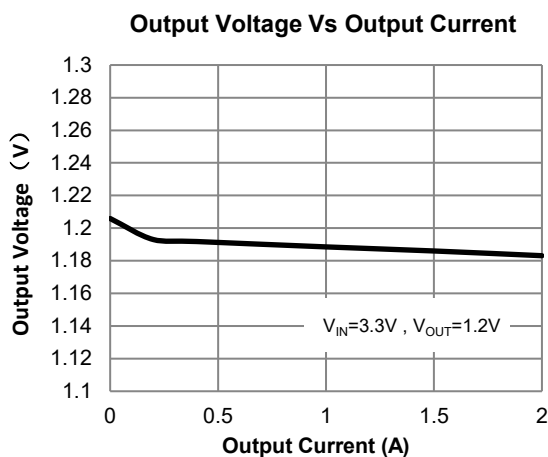
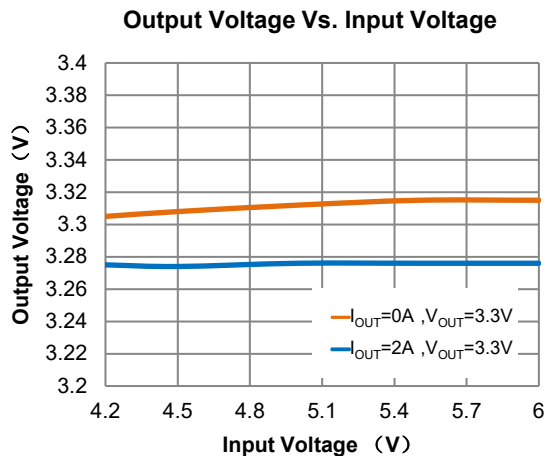
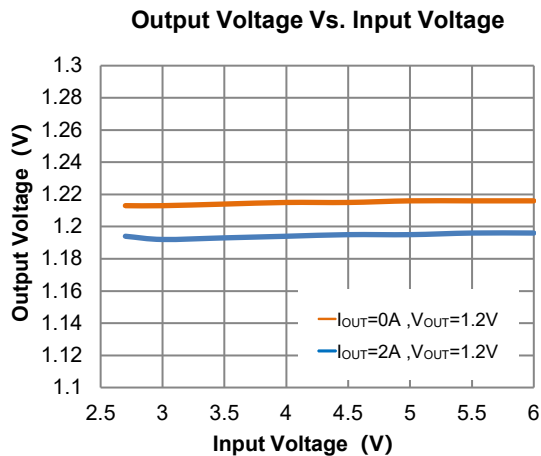
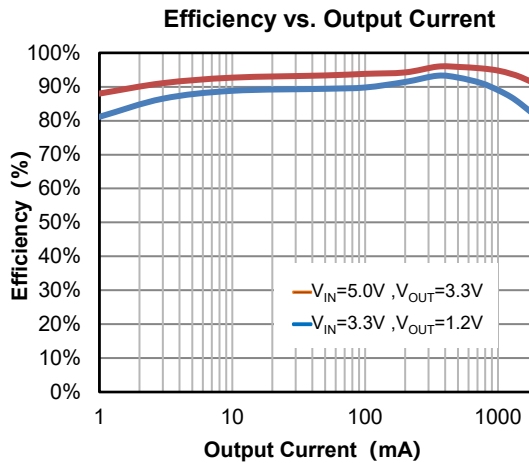
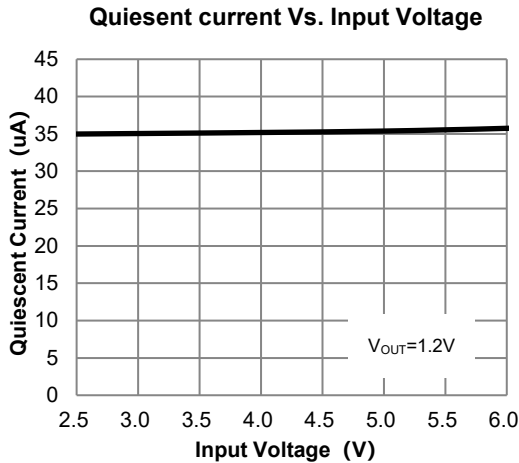
ELECTRICAL CHARACTERISTICS

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

PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
VIN Input Supply Voltage	VIN		2.7		6.0	V
VIN UVLO Threshold	VIN_MIN	VIN Rising	2.05	2.25	2.35	V
VIN Under Voltage Lockout Threshold Hysteresis	VIN_MIN_HYST	VIN Falling		250		mV
Shutdown Supply Current	ISD	VEN=0V			1	uA
Supply Current	IQ	VFB=0.63V		33		uA
Feedback Voltage	VFB		0.593	0.600	0.607	V
FB Input Current	IFB	VFB=0.6V			0.1	uA
Top Switch On-Resistance	RDS(ON)T	ISW=0.3A		110		mΩ
Bottom Switch On-Resistance	RDS(ON)B	ISW=0.3A		70		mΩ
Switch Frequency	FSW		0.8	1	1.2	MHz
Valley Current Limit	ILIM		2.1	3.0		A
Minimum Off Time	TOff_MIN		70	120	180	ns
EN Rising threshold voltage	VEN_H	VEN rising	1.5			V
EN Falling threshold	VEN_L	VEN falling			0.4	V
Soft-Start Time	tSS			0.9		ms
Thermal Shutdown Temperature	TSD			150		°C
	THYS			25		°C
Output Discharge Switch On Resistance				1.6		kΩ

TYPICAL PERFORMANCE CHARACTERISTICS

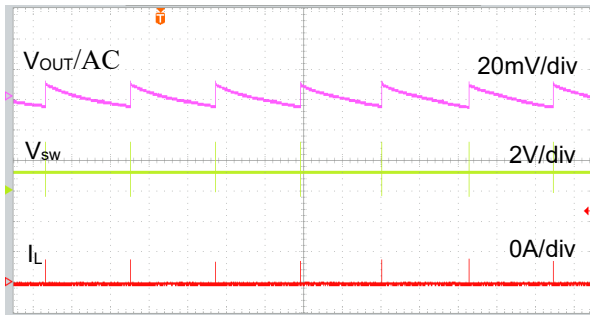
$V_{IN} = 3.3V$, $C_{IN} = 10\mu F$, $C_{OUT} = 22\mu F$, $L = 2.2\mu H$, $T_A = +25^\circ C$, unless otherwise noted.



TYPICAL PERFORMANCE CHARACTERISTICS

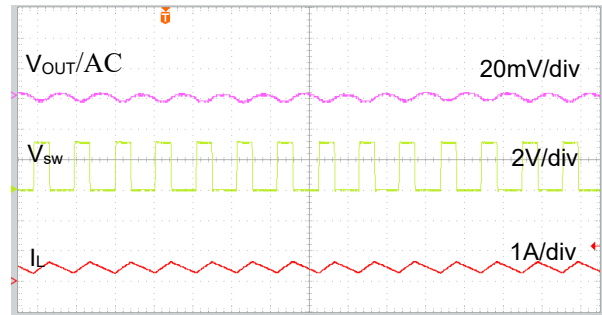
$V_{IN} = 3.3V$, $C_{IN} = 10\mu F$, $C_{OUT} = 22\mu F$, $L = 2.2\mu H$, $T_A = +25^\circ C$, unless otherwise noted.

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



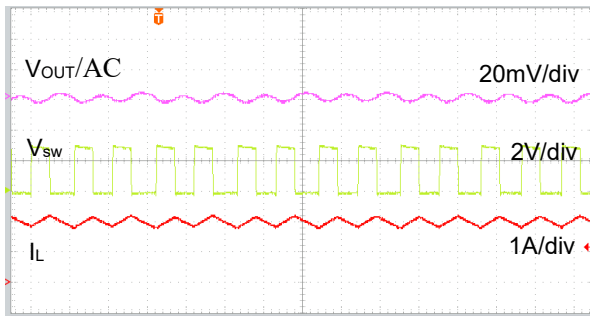
Time 10ms/div

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



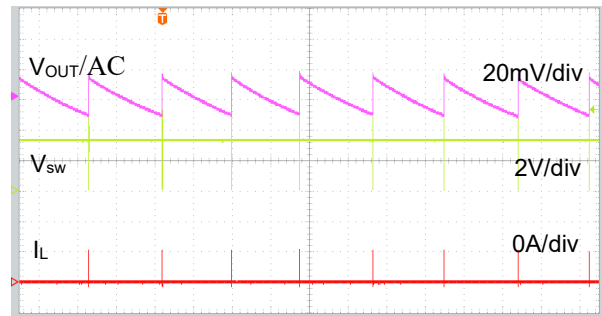
Time 1us/div

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



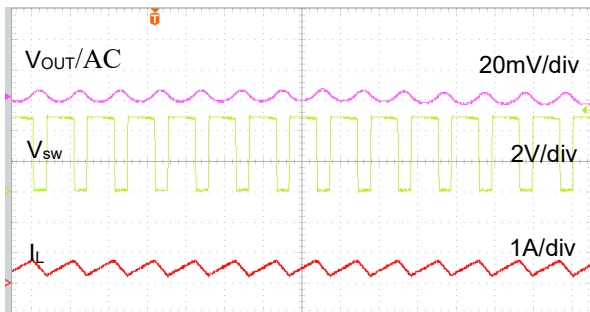
Time 1us/div

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



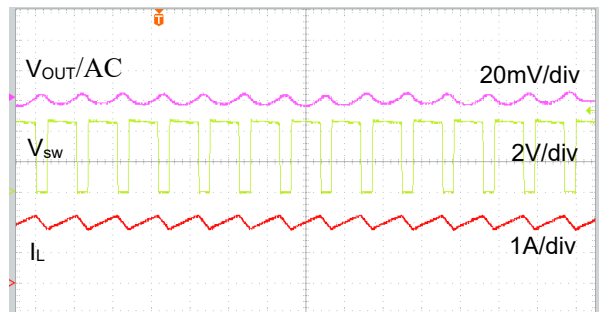
Time 10ms/div

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



Time 1us/div

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

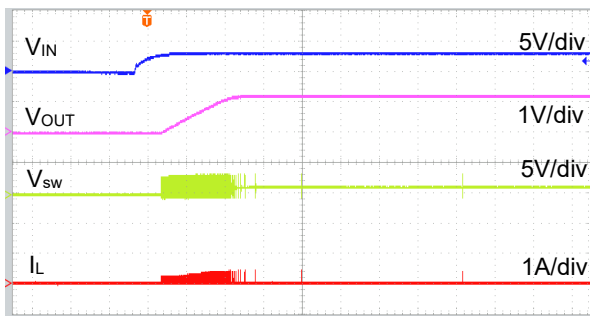


Time 1us/div

TYPICAL PERFORMANCE CHARACTERISTICS

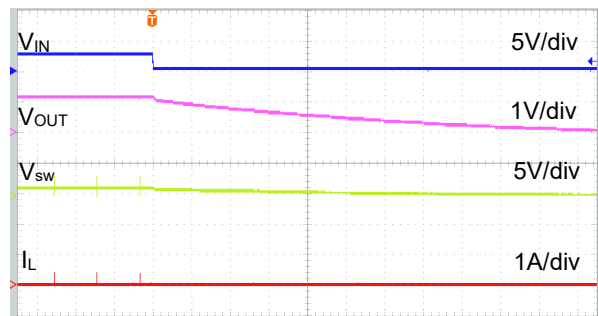
$V_{IN} = 3.3V$, $C_{IN} = 10\mu F$, $C_{OUT} = 22\mu F$, $L = 2.2\mu H$, $T_A = +25^\circ C$, unless otherwise noted.

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



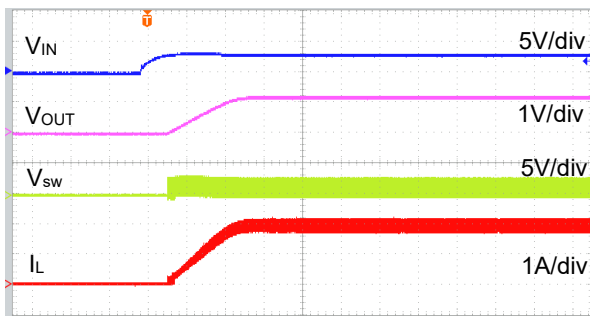
Time 400us/div

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



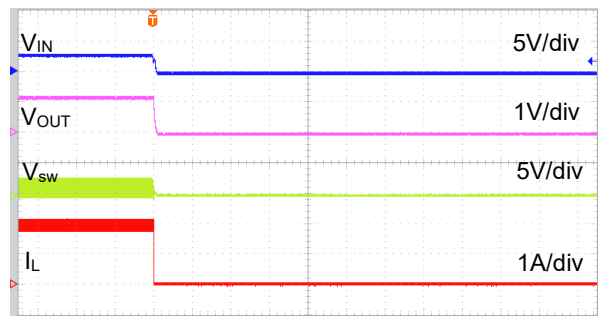
Time 10ms/div

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



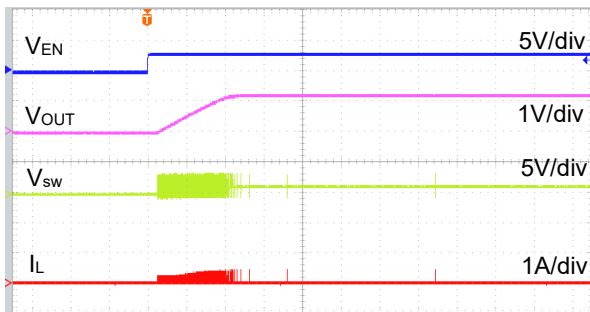
Time 400us/div

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



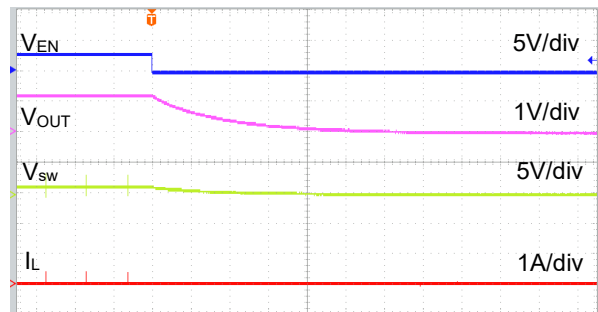
Time 400us/div

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



Time 400us/div

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

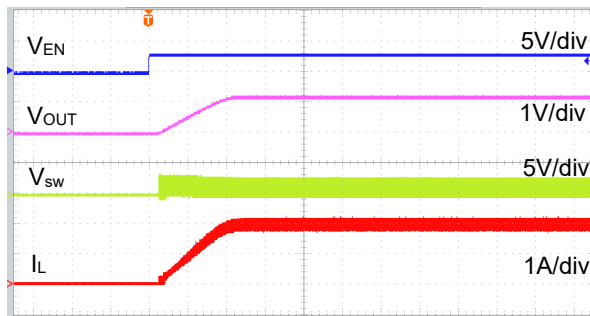


Time 10ms/div

TYPICAL PERFORMANCE CHARACTERISTICS

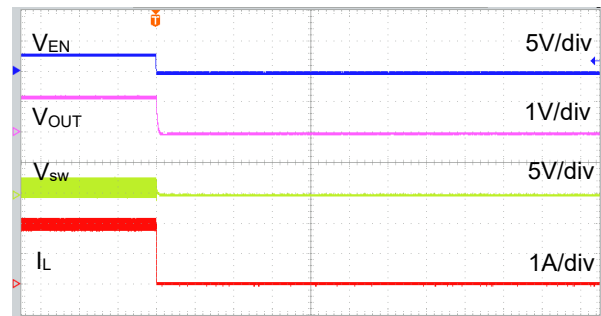
$V_{IN} = 3.3V$, $C_{IN} = 10\mu F$, $C_{OUT} = 22\mu F$, $L = 2.2\mu H$, $T_A = +25^\circ C$, unless otherwise noted.

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



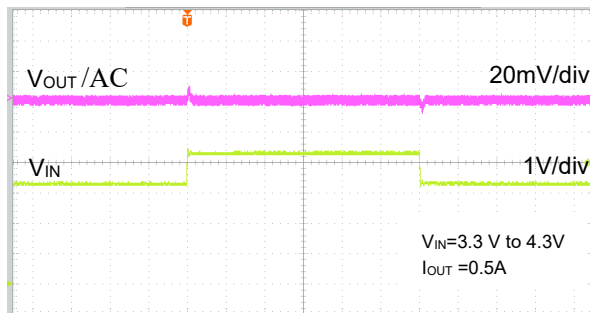
Time 400us/div

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



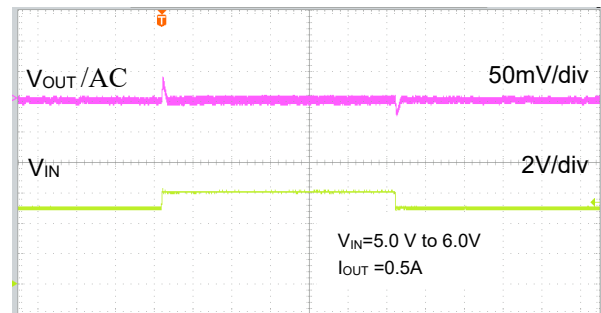
Time 400us/div

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



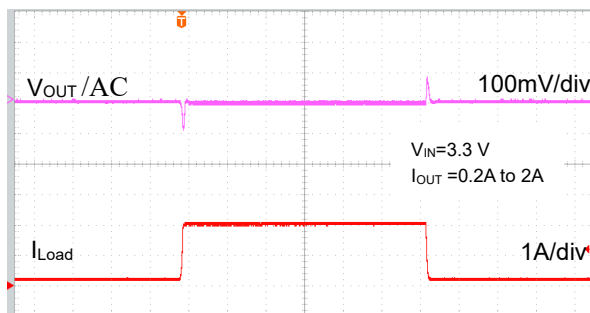
Time 100us/div

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



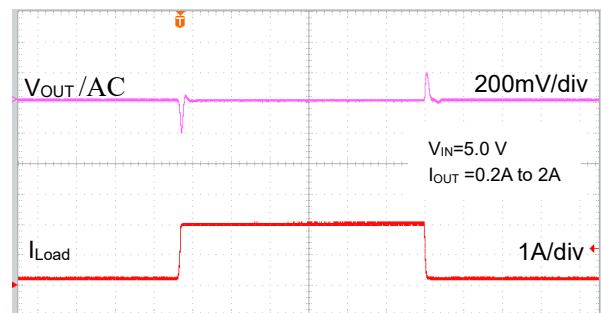
Time 100us/div

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



Time 100us/div

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



Time 100us/div

FUNCTIONAL DESCRIPTION

The BCT12569A 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 BCT12569A 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 BCT12569A 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 BCT12569A 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 ΔI_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:

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

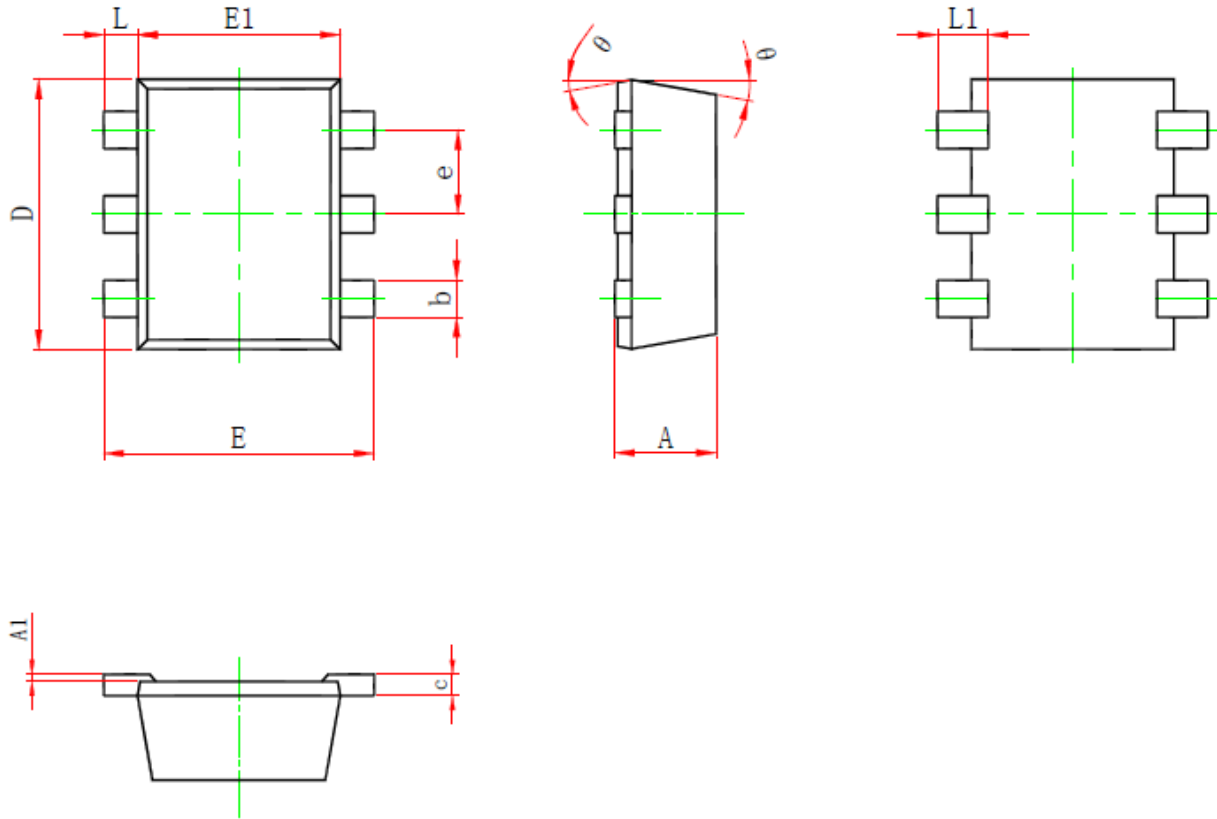
PCB Layout Recommendations

When laying out the printed circuit board, the following checking should be used to ensure proper operation of the BCT12569A 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_{IN} connect to V_{IN} 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_{OUT} node.
- ☐ Keep the (-) plates of C_{IN} and C_{OUT} as close as possible

PACKAGE OUTLINE DIMENSIONS

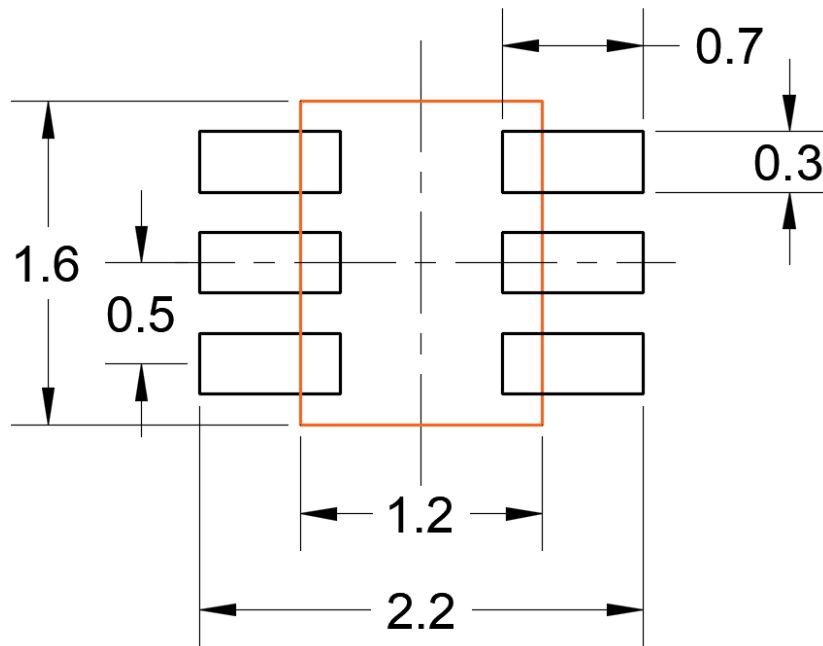
SOT563



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.525	0.600	0.021	0.024
A1	0.000	0.050	0.000	0.002
e	0.450	0.550	0.018	0.022
c	0.090	0.180	0.004	0.007
D	1.500	1.700	0.059	0.067
b	0.170	0.270	0.007	0.011
E1	1.100	1.300	0.043	0.051
E	1.500	1.700	0.059	0.067
L	0.100	0.300	0.004	0.012
L1	0.200	0.400	0.008	0.016
θ	9° REF.		9° REF.	

SOT563 Surface Mount Package

PCB Layout Pattern: SOT563



RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)