

General Description

The BCT8113/BCT8123/BCT8115/BCT8123 is an advanced output control and monitoring circuit intended for use in the secondary side of the switching mode power supply (SMPS). It consists of a shunt regulator which is needed for the feedback control, additional linear regulator output and protection circuit. The chip can monitor the output over-voltage protection (OVP), load Over-current protection (OCP), VDD over-voltage protection, integrated thermal protection. In addition, the shut down (SHDN) and power good (PGOOD) are the control signals provided by BCT8123/BCT8125 for any application which is incorporated with MCU or digital circuit.

The BCT8113/BCT8123/BCT8115/BCT8123 offers a quick solution to provide protection feature and increase the overall reliability to the end-user products. Besides, it offers simple circuit and cost effective solution with minimal external components and reduced PCB board space for switching power supply.

Features

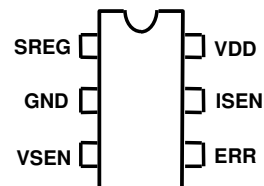
- On chip shunt regulator for feedback control
- Load Over Voltage Protection (OVP)
- Load Over Current Protection (OCP)
- VDD over voltage protection
- Over Temperature Protection (OTP)
- Additional linear regulator output
 - BCT8115/BCT8125: 5.0V
 - BCT8113/BCT8123: 3.3V
- Additional Power Good (PGOOD) and Shunt Down (SHDN) control pin for SOP8 package
- Option in latched fault or non-latched fault
- Low power consumption
- Available in Pb-free SOP8 or SOT23-6 package

Applications

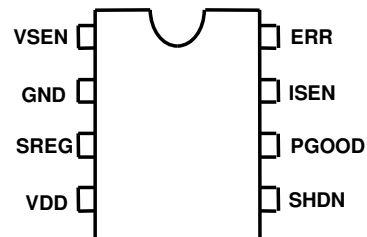
- Battery charger, AC/DC adapter
- Auxiliary switching power supply
- Switching power supply for home appliance

Pin Assignments

SOT23-6



SOP8



Typical Application Circuit

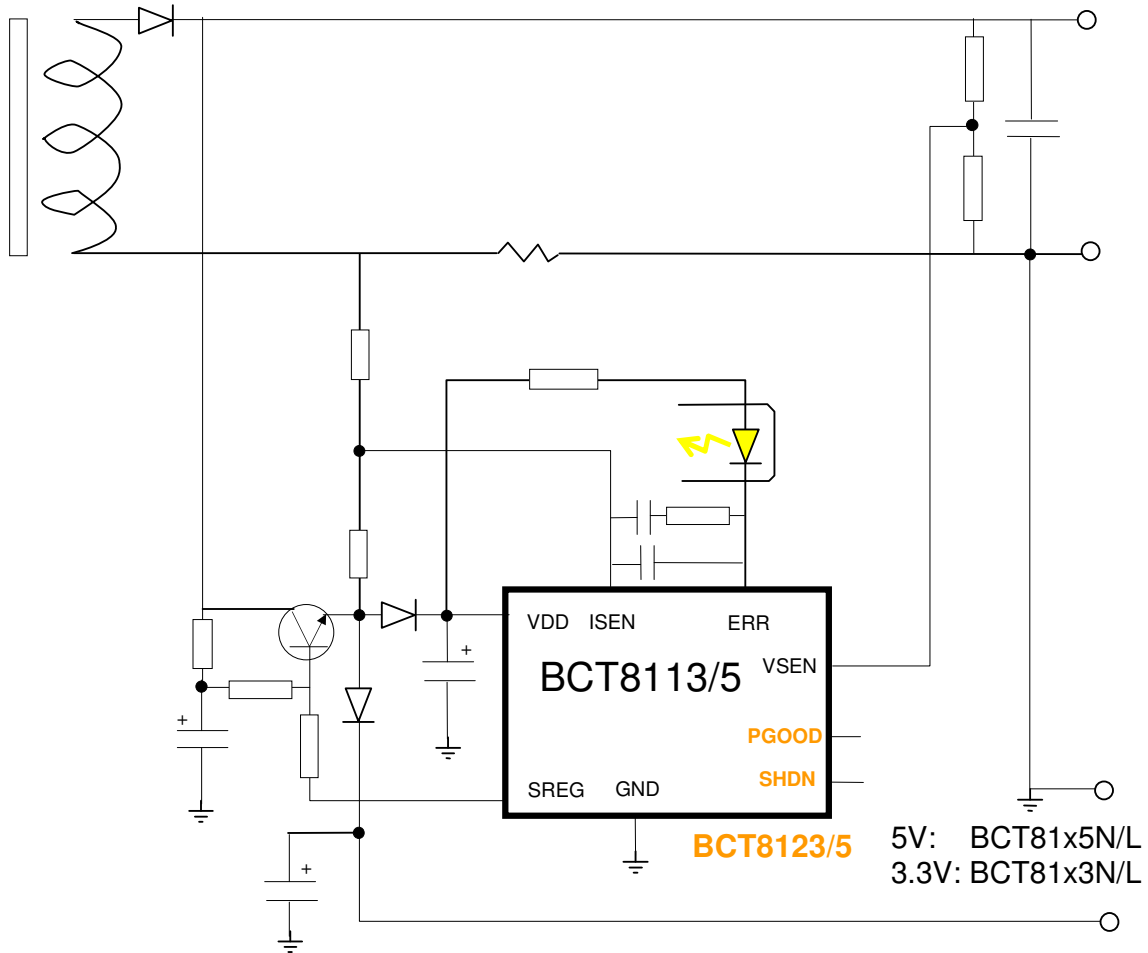


Figure 1: Typical Application

Feature Comparisons	BCT8113	BCT8115	BCT8123	BCT8125
VDD (Linear Regulator)	3.3V	5V	3.3V	5V
Fault Mode	<u>Latched:</u> BCT8113L <u>Non-latched:</u> BCT8113N	<u>Latched:</u> BCT8115L <u>Non-latched:</u> BCT8115N	<u>Latched:</u> BCT8123L <u>Non-latched:</u> BCT8123N	<u>Latched:</u> BCT8125L <u>Non-latched:</u> BCT8125N
Shunt Down (SHDN)	No	No	Yes	Yes
Power Good (PGOOD)	No	No	Yes	Yes
Package	SOT23-6	SOT23-6	SO8	SO8

Functional Block Diagram

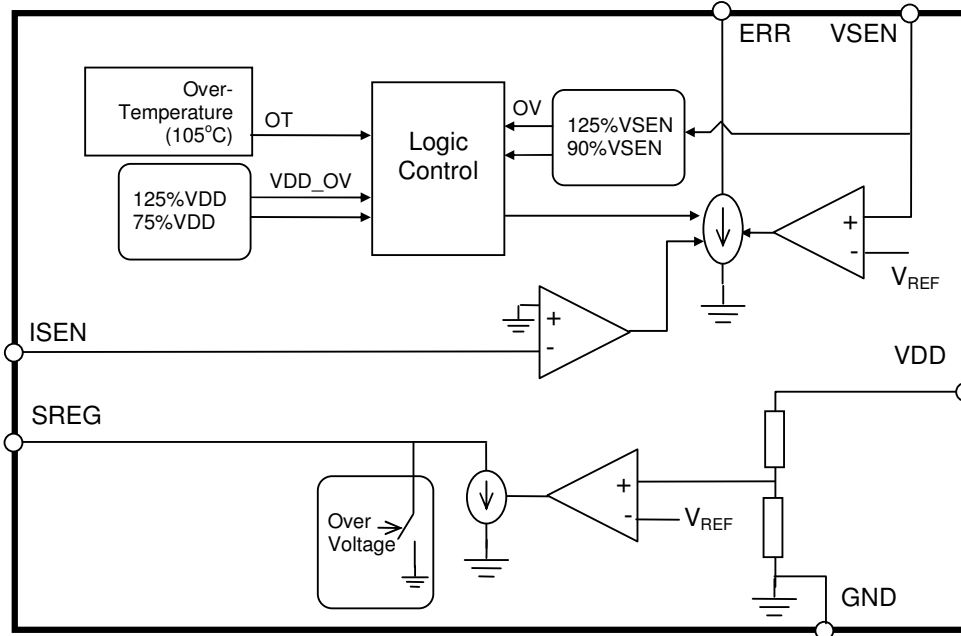


Figure 2: Functional Block Diagram of BCT8113/BCT8115

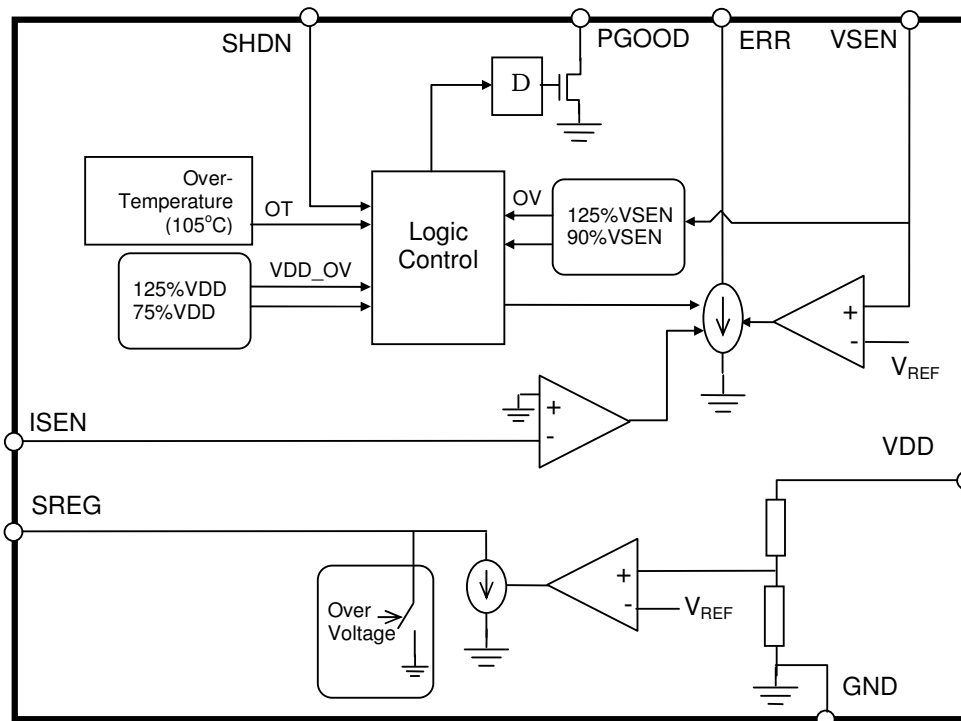


Figure 3: Functional Block Diagram of BCT8123/BCT8125

Pin Descriptions

BCT8125/ BCT8123 Pin #	BCT8115/ BCT8113 Pin #	Pin Name	I/O	Description
4	6	VDD	Power	Chip Supply Voltage
2	2	GND	Power	Ground
7	5	ISEN	Input	Load Output current sense input
1	3	VSEN	Input	Load Output voltage sense input
8	4	ERR	Output	Connect to Opto-coupler for the Output Voltage Feedback Control
3	1	SREG	Output	Shut Regulator Output
6	--	PGOOD	Output	Power Good Indicator. Open drain output (need external pull up resistor)
5	--	SHDN	Input	Chip Shut Down (Active High) with internal pull down resistor

Absolute Maximum Specifications

Rating	Symbol/ Conditions	Value	Unit
Supply voltage range	VDD, SREG	-0.3 to 7	Volts
Input voltage range	VSEN, ERR, SHDN	-0.3 to $V_{DD}+0.3$	Volts
Operating temperature range	T_{OPR}	0 to 110	$^{\circ}C$
Storage temperature range	T_{STR}	-20 to 110	$^{\circ}C$

A.C. / D.C. Specifications

All specifications are rated at $T_{AMBIENT}$ from 0 °C to +110°C (-40 °C to +110°C on request). Supply Voltage at Nominal +/- 10% unless otherwise specified.

Parameter	Description	Conditions	Min	Typ	Max	Unit
V_{reg}	Regulated Supply	BCT8115/BCT8125	4.6	5.0	5.5	V
		BCT8113/BCT8123	3.1	3.3	3.6	V
V_{SREG}	Input control voltage for shunt regulator	BCT8115/BCT8125 BCT8113/BCT8123			6	V
V_{DD}	Input Power Voltage	BCT8115/BCT8125 BCT8113/BCT8123			7	V
I_{VDD}	Supply Current	VSEN = 1.25V, SREG = Open		500		μA
5V0ov	VDD5V0 Over Voltage Threshold	BCT8115/BCT8125	5.7	6.25	6.8	V
3V3ov	VDD3V3 Over Voltage Threshold	BCT8113/BCT8123	3.7	4.1	4.5	V
5V0uv	VDD5V0 Under Voltage Threshold	BCT8115/BCT8125 SREG = open	3.4	3.75	4.1	V
3V3uv	VDD3V3 Under Voltage Threshold	BCT8113/BCT8123 SREG = open	2.2	2.5	2.7	V
VSENnom	VSENSE Normal Voltage Threshold			90		%
VSENov	VSENSE Over Voltage Threshold			125		%
I_{PD}	Power Down Current	SHDN =high		350		μA
I_{ERR}	Current Sink	VSEN = SREG voltage, ISEN at -0.3V		50	65	mA
R_{VS}	VSEN input impedance		100k	150k	200k	Ohm
T_{SHUNT}	Over Temperature Shunt Down		95	105	115	°C
V_{OF_ISEN}	Offset voltage on ISEN			18	30	mV
V_{REF}	Bandgap Reference Voltage	BCT8115/BCT8125 BCT8113/BCT8123		1.25		V
T_{PG}	Delay time for Power Good	VSEN ramp up at 1.125V		300		μS
R_{DI}	Digital Input Pins Impedance, SHDN	BCT8123/BCT8125		50K		Ohm

Description

The BCT81xx series is a secondary-side power supply controller chip which operates together with the primary side controller chip to form a switched mode power supply application solution. The BCT81xx provides a regulated output voltage, it monitors the load requirement from the secondary side and feeds back the signal to the primary controller via an opto-coupler. The BCT81xx have protection features of include Load Over Voltage Protection (OVP) Over current protection (OCP), Over Temperature Protection (OTP) and built-in shunt regulator.

Highlights:

1. On-chip shunt regulator, allow direct connection to the opto-coupler
2. On-chip linear voltage regulator
3. Fault protection: Load OVP, VDD OVP, OCP & OTP
4. Power Good indication
5. Shut down control signal
6. Fault mode selection

1. Power Supply and Linear Regulator

1.1 Simple linear regulator and self power circuit

The VDD and SREG pins are connected together via a series resistor R_L to the positive terminal of the rectified 2nd winding output V_{IN+} . The SREG pin is the shunt regulator output; it is driven by a current source which is controlled by a high gain amplifier. The voltage at VDD is regulated by compared against an internal bandgap reference V_{REF} . VDD and SREG should always keep under the absolute maximum voltage = 7V

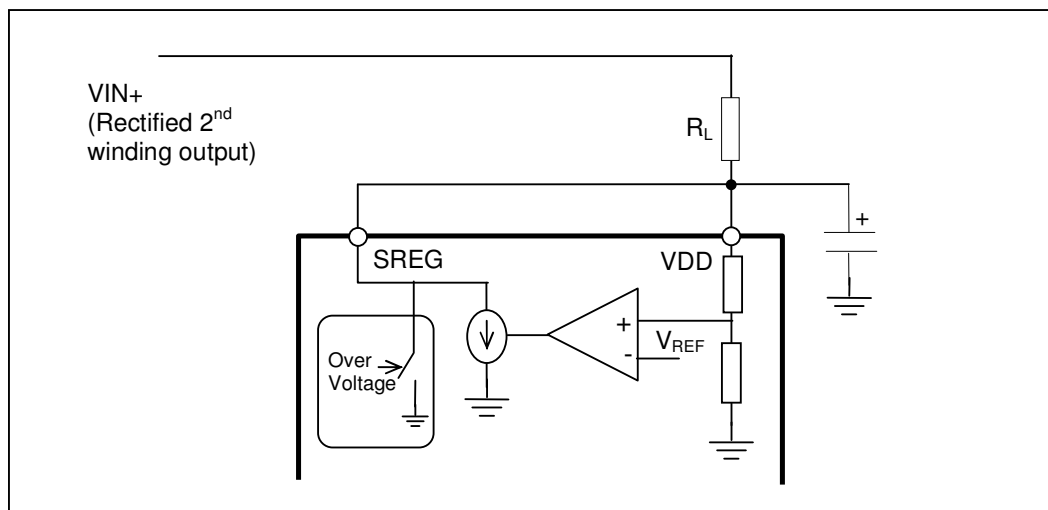


Figure 5: Simple self supply shunt regulator

1.2 Linear Regulator

An external high voltage (high power) BJT incorporated with bias circuit are shown in Fig. 6 to form a linear regulator with fixed 5V (BCT81x5) or 3.3V (BCT81x3) output. The output voltage (VDD) is regulated by controlling the base current of the BJT via an internal high gain amplifier and bandgap reference. As shown in Fig 7, D_{V1} , D_{V2} and C_{V3} are used to ensure sufficient power to maintain BCT81xx operation when fault conditions occur.

The value of R_{V2} and R_{V3} should set the voltage of SREG well below 6V to avoid exceeding the max operation voltage of the chip.

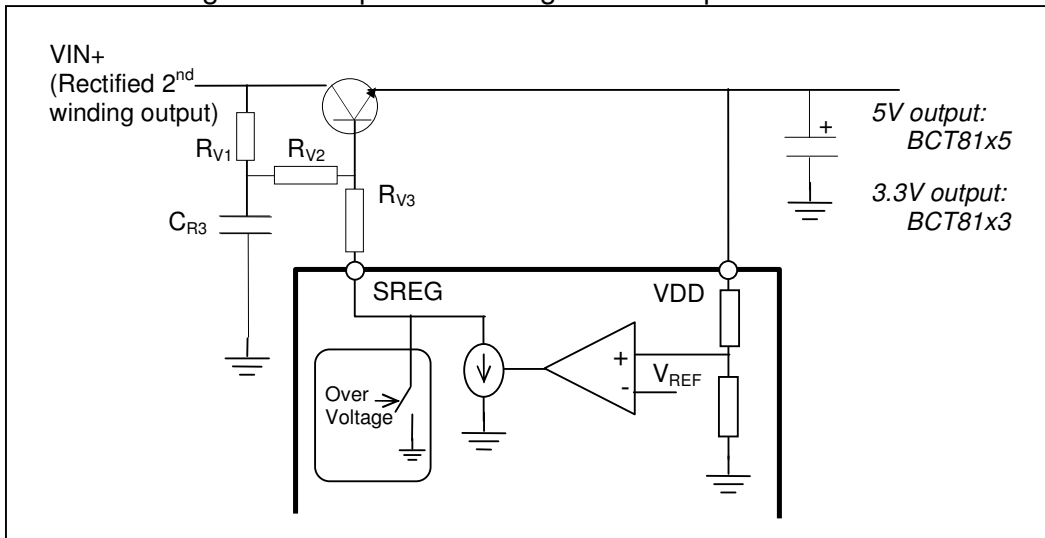


Figure 6: Fixed voltage linear regulator

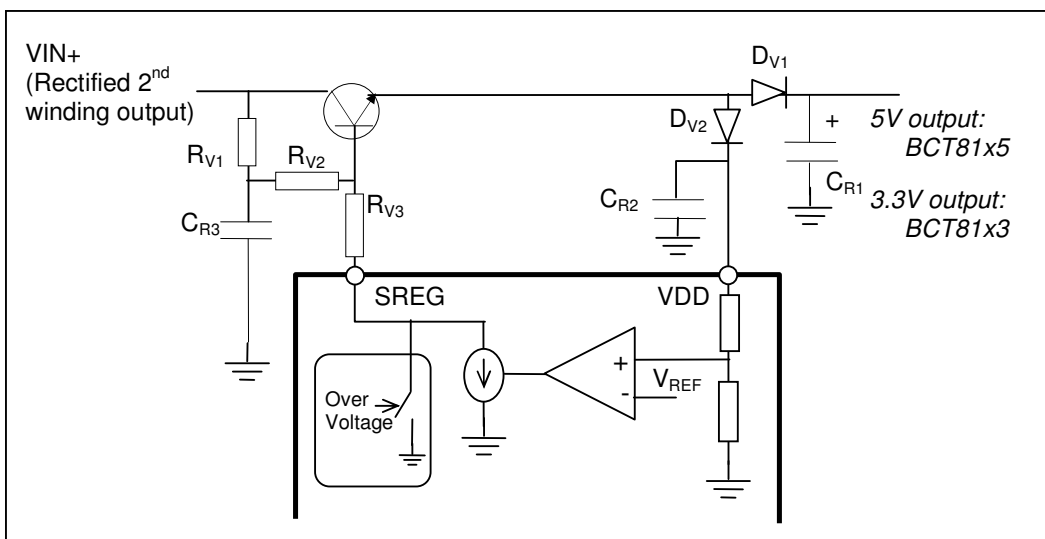


Figure 7: Fixed voltage linear regulator with own power capacitor

2. Load Output Voltage and Load Over-voltage Protection (OVP)

The load output voltage which is set by the resistor divider at VSEN as shown in Fig 8, is regulated by comparing with an internal high precision band gap voltage reference. When the load output voltage greater than 125% of this nominal value for more than 300μS, the over voltage detection circuit will be activated.

The load output voltage is determined by resistor divider R_{F1} and R_{F2}:

$$V_{\text{load}} = V_{\text{REF}} \frac{R_{F2}}{R_{F1} + R_{F2}}$$

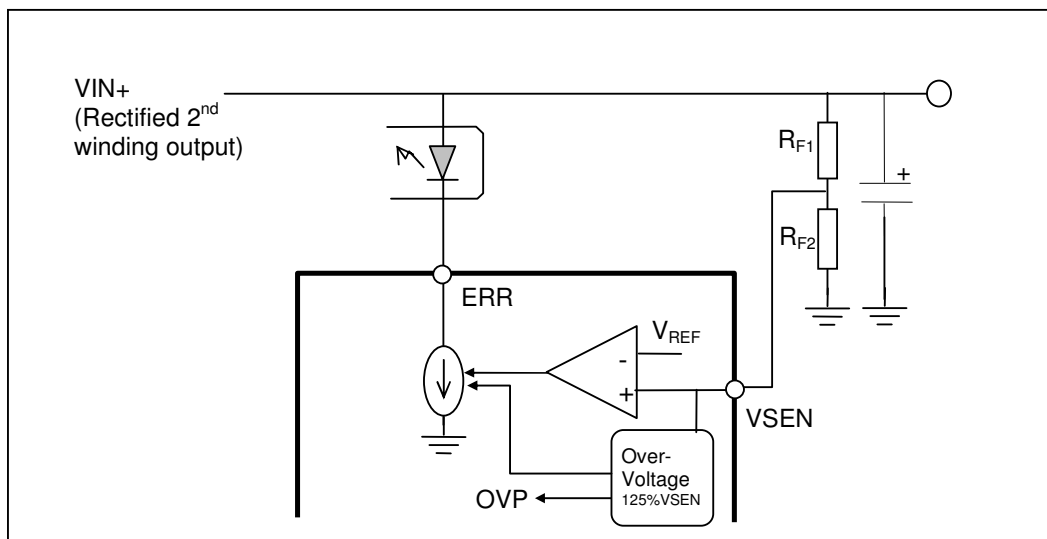


Figure 8: Load Output Voltage and over-voltage Protection

3. Load Over Current Protection (OCP)

As shown in Fig. 9, the load current is sensing by a comparator with respect to the GND voltage at the positive input. When voltage at ISEN pin is lower than GND voltage, ERR pin will sink more current to maintain the same output power.

R_{C1}, R_{C2} and R_C are used to set the maximum load current. At no load current condition, the voltage at ISEN should set in the range of +50mV and +500mV.

The overload current is calculated by

$$I_{\text{load}} (\text{max}) = V_{\text{DD}} \frac{R_{C2}}{R_{C1} * R_C}$$

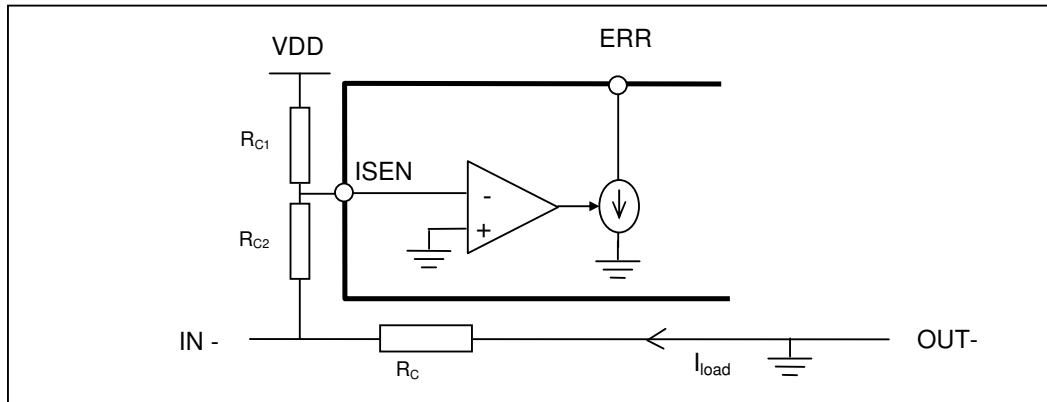


Figure 9: Load Over Current Protection

4. Fault Mode

4.1 Latched Fault Mode

An on-chip Fault Lock Register as shown in Fig. 10 is available for BCT81xxL devices. Once the Fault Lock Register is set, the PWM controller in the primary side will be turned off by any one of the following conditions,

- a) Load over voltage (OVP)
Load output voltage excess 125% of its nominal value
- b) VDD over voltage (VDD_OV)
VDD voltage excess 120% of its nominal value
- c) Over temperature (OTP)
The chip temperature excess 105°C

The Fault Lock register can only be reset and the fault conditions can be released until VDD voltage drop to 75% of its nominal value.

It is a safer way for handling a fault conditions when end-user product is powered by SMPS. End user needs to switch off the AC power first, and then switch on the AC power to reset the Fault Lock Register. The capacitor C_{R2} in Figure 7 is used to set the required time to reset the Fault Lock Register.

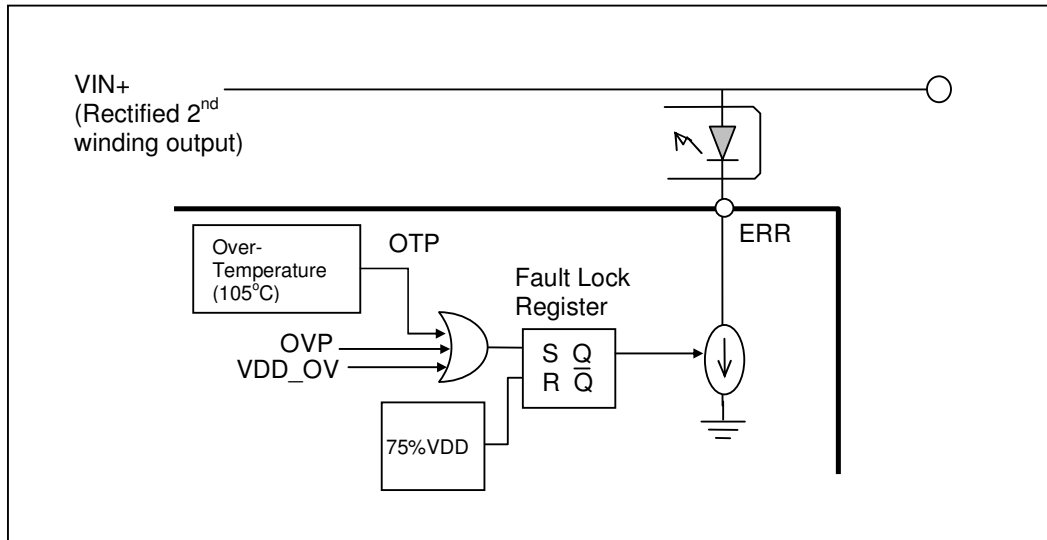


Figure 10: Fault Lock Register

4.2 Non-latched Fault Mode

When one of the following fault conditions is occur, the PWM controller in the primary side will be turned off. The output (ERR and PGOOD) will return to its normal value once all the fault conditions are removed. The non-latched fault mode is applied to BCT81xxN.

- a) Load over voltage (OVP)
Load output voltage excess 125% of its nominal value
- b) Over temperature (OTP)
The chip temperature excess 105°C

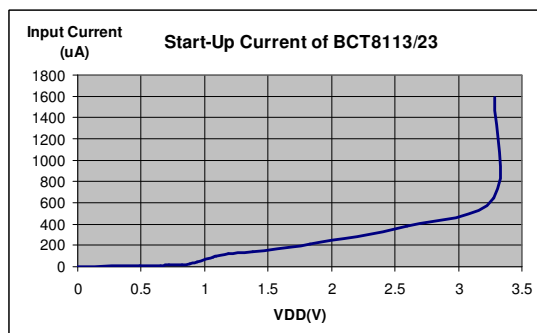
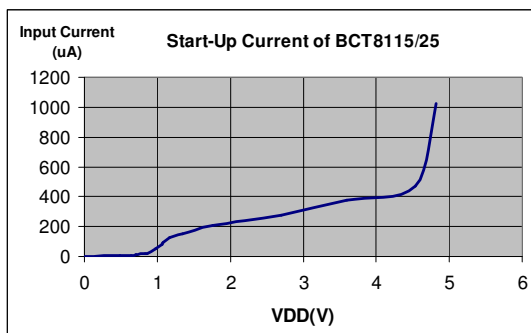
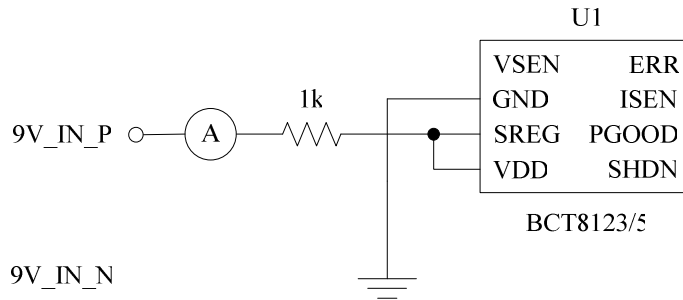
However, when VDD voltage is over the 125% of its nominal value, it will set the Fault Lock Register. The Fault Lock register can only be reset and the fault conditions can be released until VDD voltage drop to 75% of its nominal value

5. Shunt Down and Power Good

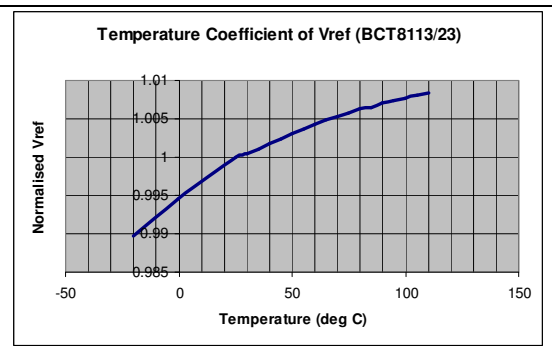
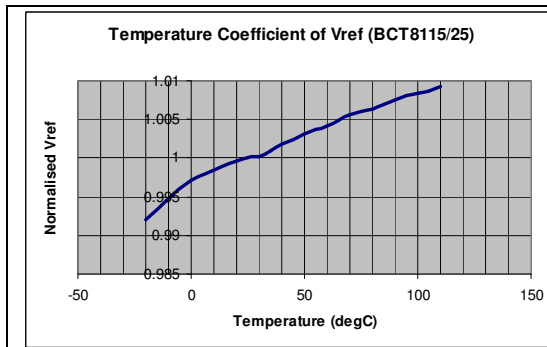
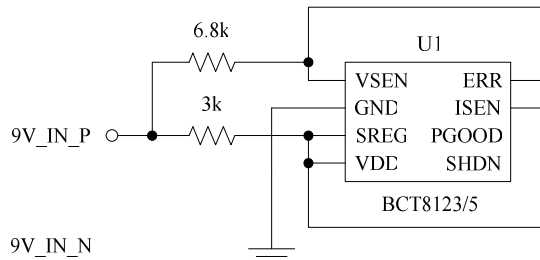
Shut down (SHDN) and Power Good (PGOOD) controls are used incorporated with power supply which has MCU or digital logic control circuit. The load output will be disabled when shut down goes high. The PGOOD (connected with pull up resistor) will go high when load output voltage excess 90% of its nominal value after a delay of ~300uS.

Typical Characteristic

1. Startup Current, $T_A = 25^\circ\text{C}$, unless otherwise noted

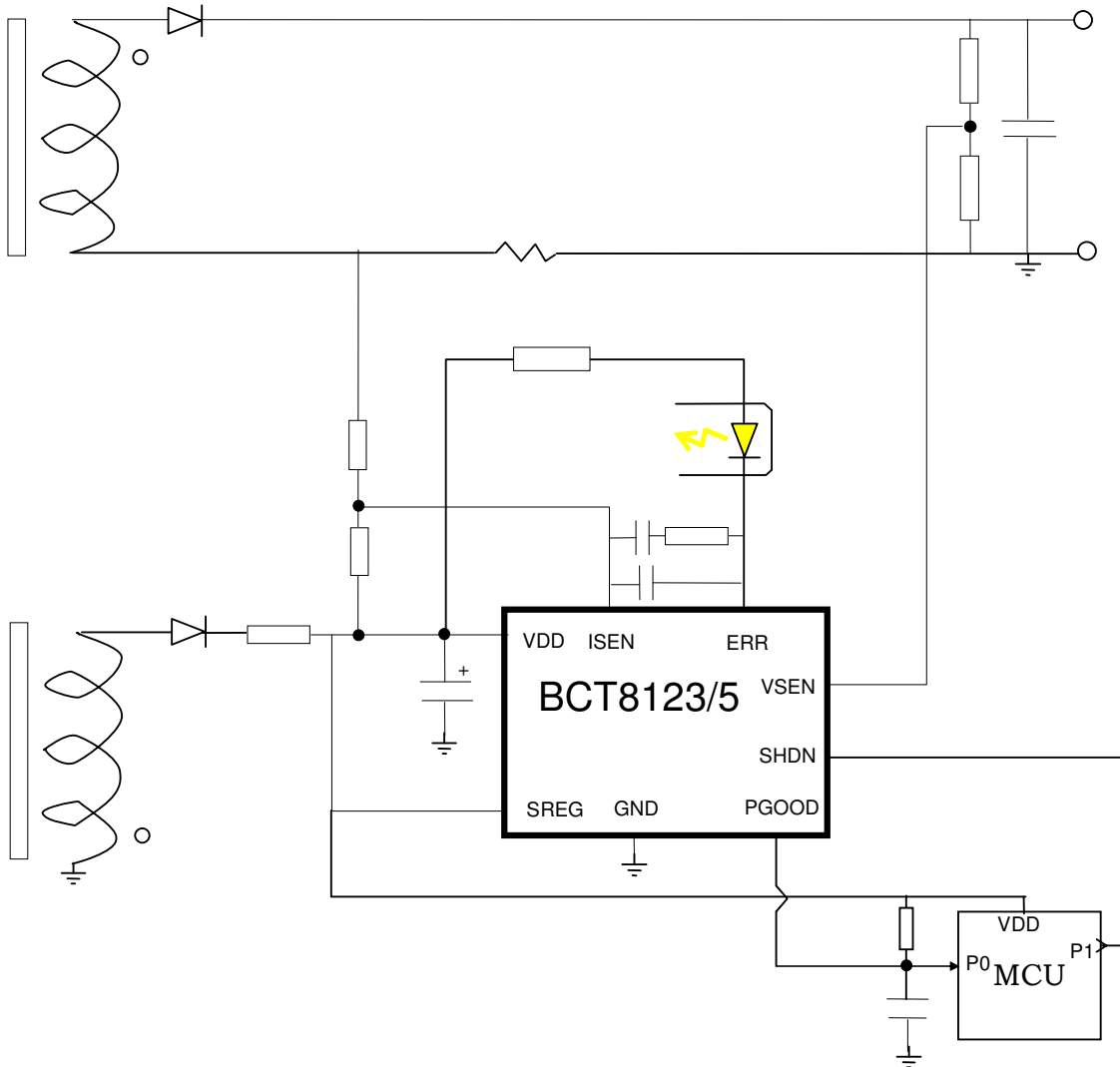


2. Temperature coefficient on reference V_{REF}

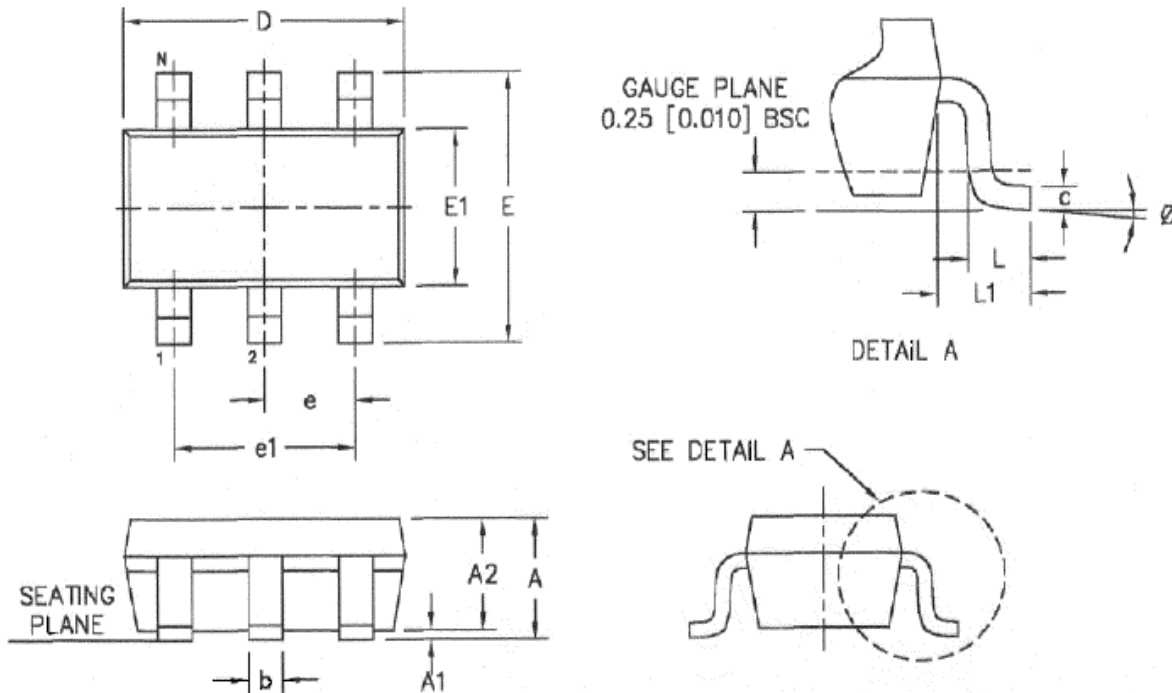


Application Example:

Battery Charger, MCU powered by BCT8123/25

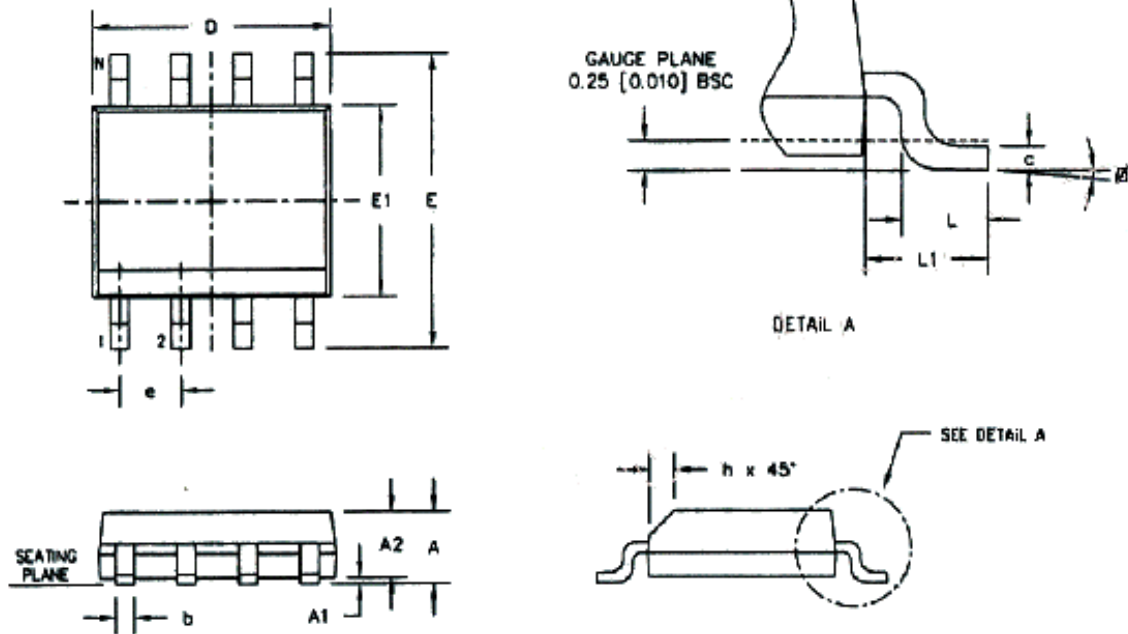


Package Information: SOT23-6



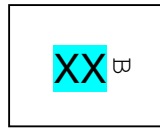
SYMBOL	MIN (Millimeter)	NOM (Millimeter)	MAX (Millimeter)
A	1.14	1.24	1.35
A1	0.05	0.10	0.15
A2	1.09	1.14	1.19
b	0.30	0.35	0.40
c	0.08	0.15	0.22
D	2.87	2.92	2.97
E1	1.55	1.63	1.68
E	2.67	2.79	2.92
e		0.95	
e1		1.90	
L	0.35	0.40	0.45
L1	0.53	0.58	0.64
θ	0°	--	8°

Package Information: SOP8

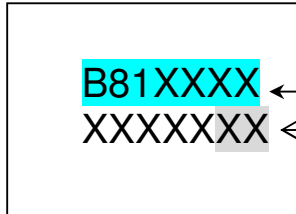


SYMBOL	MIN (Millimeter)	NOM (Millimeter)	MAX (Millimeter)
A	1.45	1.52	1.60
A1	0.10	0.15	0.25
A2	1.30	1.37	1.45
b	0.33	0.41	0.51
c	0.18	0.20	0.25
D	4.85	4.90	4.95
E1	3.84	3.89	3.94
E	5.79	5.99	6.20
e		1.27	
L	0.51	0.66	0.81
L1	1.02	1.07	1.12
θ	0°	--	8°
h	0.28	0.38	0.48

Marking Notation / Ordering Information



IC Part Number
SOT23-6
3L: BCT8113L
3N: BCT8113N
5L: BCT8115L
5N: BCT8115N



IC Part Number
SOP8
B8123LS: BCT8123LS
B8123NS: BCT8123NS
B8125LS: BCT8125LS
B8125NS: BCT8125NS

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