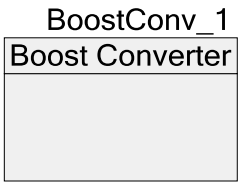
Boost Converter (BoostConv)
1.0



Features

- Produces a selectable output voltage which is higher than the input voltage
- Input voltage range between 0.5V and 5.0V
- Boosted output voltage range between 1.8V and 5.0V
- Source up to 30mA from a Vbat input between 0.5 and 1.6V, 50mA for Vbat input above 1.6V
- Three modes of operation: Active, Standby and Sleep

General Description

The Boost Converter component provides the user with the ability to configure and control the PSoC boost converter hardware block. The boost converter enables the user to take input voltages which are lower than desired system voltages and boost them to the desired system voltage level. The converter uses an external indicator to convert the input voltage to the desired output voltage.

When the Boost Converter component is placed in a design, it will be enabled by default with a selected Vout of 3.3V to ensure the chip supply voltage is sufficient for power up.

The boost converter has three main operating modes:

- **Active:** In this mode the boost converter is boosting the input voltage to the desired output voltage and actively monitoring the output voltage to maintain the selected target voltage.
- **Standby**: In this mode the boost converter bandgap circuitry and comparators are active while all remaining circuitry is turned off. The boost converter can monitor the output voltage and provide status while in this mode. An “Automatic Thump” mode can be configured so that he boost converter will pulse the output voltage periodically as the output voltage drops below the selected level.

  An under voltage signal (UVInt) can be used as a wake up source for the PSoC power management infrastructure.
- **Sleep:** In this mode all boost converter circuitry, with the exception of the bandgap, are turned off. Registers maintain their state during sleep, but all other activity is disabled.

  The Boost component can have its parameters adjusted at run time through APIs. The configuration defined in the component customizer will be the default configuration.

PRELIMINARY

When to use the Boost Component

The Boost component should be used when the available voltage source for a system is less than the required voltage level to operate the system. The boost converter accepts a battery or other voltage source and produces a higher output voltage. The Vbat source may be the primary voltage source or a secondary power source.

As an example, the system may use a 0.5V solar cell as the primary power source and rely on the boost block to power the 1.8V PSoC core. In another application, a 3.3V system could use the boost converter to power a 5.0V LCD glass.

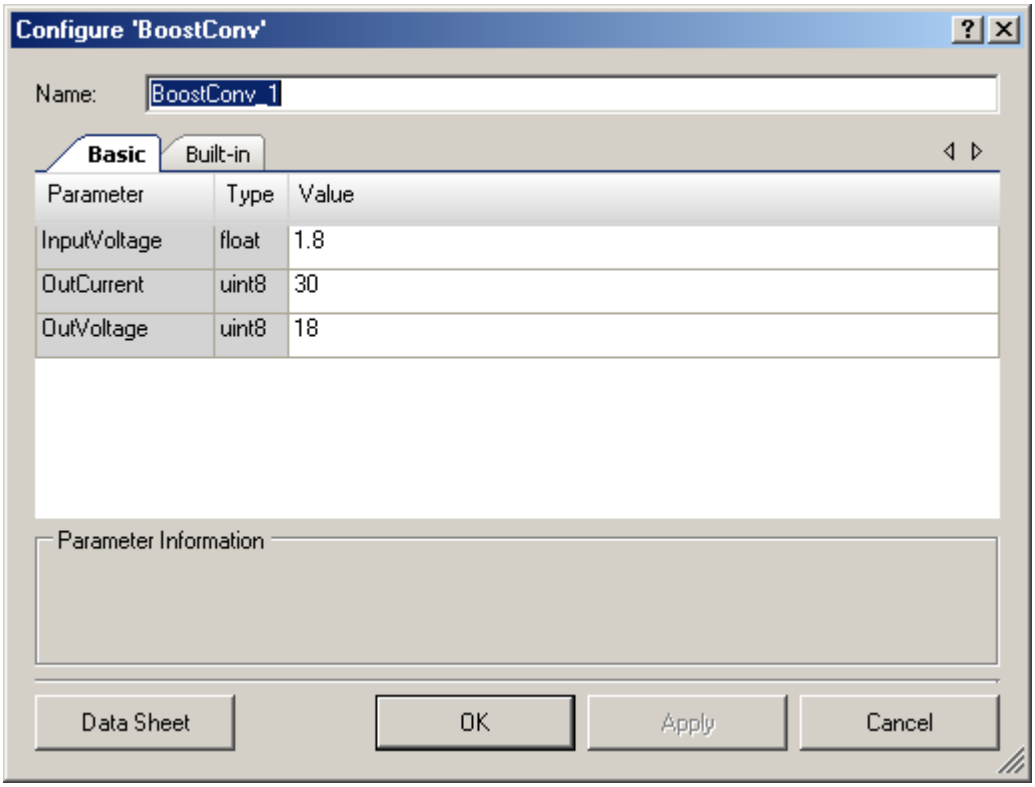
Input/Output Connections

The Boost component requires no connections in the project schematic view. Fixed functions pins support the boost converter block circuit. The system circuit must provide connections for the Vbat input voltage, Vpwr output voltage, Bgnd battery ground and the Ind inductor pins. Refer to the schematic representation.

Component Parameters

Drag a Boost component onto your design and double-click it to open the Configure dialog.

Figure 1 Configure Boost Component Dialog



InputVoltage

This is the Vbat or other voltage source that will be used as the input voltage to the boost converter block. This system circuit will connect this voltage to the Vbat PSoC pin. The input voltage can be between 0.5V and 5.0V. The default value is 1.8V.

Output Voltage

This is the target output voltage that the boost converter block will maintain. Use the pull-down menu to select the desired output voltage. Output voltage levels are provided in 0.1V increments from 1.6V to 3.6V and in 0.25 volt increments from 4.00v to 5.00v.

An external Shottky diode is required for output voltages above 3.6V (refer to Figure 2).

This value can be modified at run time via the _SelVoltage API.

OutputCurrent

This is simply to inform the user of an exceeded limit as well as to use for the calculation to determine the inductor and capacitor values.

Placement

The Boost component utilizes the dedicated boost converter hardware block in the silicon. No placement options are available.

Resources

The Boost component utilizes the dedicated boost converter hardware block in the silicon.

Application Programming Interface

Application Programming Interface (API) routines allow you to configure the component using software. The following table lists and describes the interface to each function. The subsequent sections cover each function in more detail.

By default, PSoC Creator assigns the instance name "BoostConv_1" to the first instance of a component in a given design. You can rename it to any unique value that follows the syntactic rules for identifiers. The instance name becomes the prefix of every global function name, variable, and constant symbol. For readability, the instance name used in the following table is "BoostConv".

Function	Description
BoostConv_Start	Starts the Boost component and puts the boost block into Active mode. By default the component is started.
BoostConv_Stop	Disables the Boost converter component. Turns off power to the boost converter circuitry.
BoostConv_SetMode	This function sets the boost converter mode: Active, Standby or Sleep. This function also sets switching frequency clock source for the boost block to the 32kHz external clock; enables automatic thump mode for Standby mode; and disables automatic thump mode for Active and Sleep modes.
BoostConv_SelVoltage	This function selects the target output voltage the boost converter will maintain.
BoostConv_SelFreq	This function sets the switching frequency to one of the 4 possible values: 100kHz, 400kHz, and 2 MHz (generated internal to the boost converter block) or 32kHz (sourced external to the boost converter block from the chip ECO-32kHz oscillator).
BoostConv_EnableAutoThump	This function enables automatic thump mode (only available when the boost block is in Standby mode and the switching frequency is set to 32 kHz)
BoostConv_DisableAutoThump	This function disables automatic thump mode
BoostConv_ManualThump	This function forces a single pulse of the boost converter switch transistors.
BoostConv_Enable	This function enables the boost block (only valid when in Active mode). Component is enabled by default.
BoostConv_Disable	This function disables the boost block
BoostConv_ReadStatus	This function returns the boost block status register.

void BoostConv_Start(void)

Description: Starts the Boost component and puts the boost block into Active mode. The component is in this state at when the chip powers up.

Parameters: None

Return Value: None

Side Effects: None

void BoostConv_Stop(void)

Description: Disables the Boost converter component. Turns off power to the boost converter circuitry.

Parameters: None

Return Value: None

Side Effects: None

void BoostConv_SetMode (uint8 mode)

Description: This function sets the boost converter mode: Active, Standby or Sleep.

Parameters: mode – sets the operational mode for the boost block:

mode	Notes
BoostConv_BOOSTMODE_ ACTIVE	In the active mode the boost block maintains the selected output voltage.
BoostConv_BOOSTMODE_STANDBY	Low power state, only bandgap and comparator circuitry is active. Automatic Thump mode may be used with the external 32 kHz clock to regulate output voltage
BoostConv_BOOSTMODE_SLEEP	Minimum power state. All boost circuitry inactive (with the exception of bandbap)

Return Value: None

Side Effects: For Standby mode this function enables automatic thump mode and sets switching frequency clock source for the boost block to the 32 kHz external clock. For Active and Sleep modes this function disables automatic thump mode.

void BoostConv_SelVoltage (uint8 vout)

Description: This function selects the target output voltage the boost converter will maintain.

Parameters: vout – target output voltage for the boost converter block. Output voltages above 3.6V require an external Schottky diode

Power Setting	Notes	
BoostConv_VOUT_OFF	Off - High-Z	
BoostConv_VOUT_1_6V	1.6V	
BoostConv_VOUT_1_7V	1.7V	
BoostConv_VOUT_1_8V	1.8V	
BoostConv_VOUT_1_9V	1.9V	
BoostConv_VOUT_2_0V	2.0V	
BoostConv_VOUT_2_1V	2.1V	
BoostConv_VOUT_2_2V	2.2V	
BoostConv_VOUT_2_3V	2.3V	
BoostConv_VOUT_2_4V	2.4V	
BoostConv_VOUT_2_5V	2.5V	
BoostConv_VOUT_2_6V	2.6V	
BoostConv_VOUT_2_7V	2.7V	
BoostConv_VOUT_2_8V	2.8V	
BoostConv_VOUT_2_9V	2.9V	
BoostConv_VOUT_3_0V	3.0V	
BoostConv_VOUT_3_1V	3.1V	
BoostConv_VOUT_3_2V	3.2V	
BoostConv_VOUT_3_3V	3.3V	
BoostConv_VOUT_3_4V	3.4V	
BoostConv_VOUT_3_5V	3.5V	
BoostConv_VOUT_3_6V	3.6V	
BoostConv_VOUT_4_0V	4.00V	(external Schottky diode required)
BoostConv_VOUT_4_25V	4.25V	(external Schottky diode required)
BoostConv_VOUT_4_5V	4.50V	(external Schottky diode required)
BoostConv_VOUT_4_75V	4.75V	(external Schottky diode required)
BoostConv_VOUT_5_0V	5.00V	(external Schottky diode required)

Return Value: None

Side Effects: None

void BoostConv_SelFreq(uint8 switch_freq)

Description: This function sets the switching frequency to one of the 4 possible values

Parameters: switch_freq: desired switching frequency

switch_freq	Notes
BoostConv_SWITCH_FREQ_100KHZ	
BoostConv_SWITCH_FREQ_400KHZ	
BoostConv_SWITCH_FREQ_2MHZ	
BoostConv_SWITCH_FREQ_32KHZ	block external chip ECO-32kHz oscillator

Return Value: None

Side Effects: None

void BoostConv_EnableAutoThump(void)

Description: This function enables automatic thump mode. The AutoThump mode is available only when the boost block is in the Standby mode. The switching frequency clock source for the boost block must be set to the 32kHz external clock. In this mode standby boost operation is accomplished by generating a boost switch pulse on each edge of the switching clock when the output voltage is below the selected value.

Parameters: None

Return Value: None

Side Effects: None

void BoostConv_DisableAutoThump(void)

Description: This function disables automatic thump mode

Parameters: None

Return Value: None

Side Effects: None

void BoostConv_ManualThump(void)

Description: This function forces a single pulse of the boost converter switch transistors. This function can be called when the system periodically comes out of sleep mode to offset the effects of voltage drift during sleep.

Parameters: None

Return Value: None

Side Effects: This routine writes a ‘0’ followed by a ‘1’ to the bit 7 “thump” bit in the boost block BOOST_CR0 register

void BoostConv_Enable(void)

Description: This function enables the boost block (only valid when in Active mode). Component is enabled by default.

Parameters: None

Return Value: None

Side Effects: None

void BoostConv_Disable(void)

Description: This function disables the boost block.

Parameters: None

Return Value: None

Side Effects: None

uint8 BoostConv_ReadStatus(void)

Description: This function returns the contents of the boost block status register

Parameters: None

Return Value: Boost block status register: BOOST_SR:

Bit	Name	Description
7	BoostConv_RDY	When set, internal circuits have been initialized
6	BoostConv_START	When set, converter is in startup mode
5	BoostConv_NO_BAT	When set, battery input is grounded (no battery present)
4	BoostConv_OV	Output above overvoltage limit when 1, below limit when 0
3	BoostConv_VHI	Output is above vhigh limit when 1, below limit when 0
2	BoostConv_VNOM	Output is above nominal when 1, below nominal when 0
1	BoostConv_VLO	Output is above vlow limit when 1, below limit when 0
0	BoostConv_UV	Output is above undervoltage limit when 1, below limit when 0

Side Effects: None

Sample Firmware Source Code

The following is a C language example demonstrating the basic functionality of the Boost component. This example assumes the component has been placed in a design with the default name "BoostConv_1."

Note If you rename your component you must also edit the example code as appropriate to match the component name you specify.

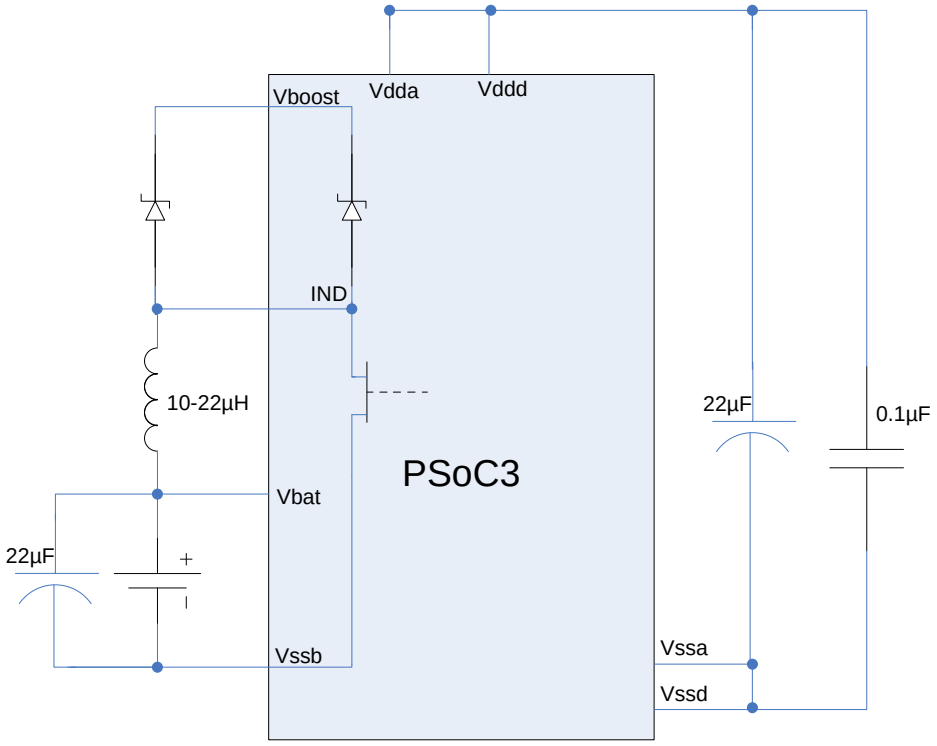
```
#include <device.h>
void main()
{
    BoostConv_1_Start();
    BoostConv_1_SelFreq(BoostConv_1_SWITCH_FREQ_100KHZ);
    BoostConv_1_Stop();
}
```

Interrupt Service Routine

None.

Functional Description

Figure 2 Application for Boost Converter.



By default the component is started during power up so there is no need to call Start function at the beginning of user code, because the hardware Boost block need to be turn on at startup. When you place this component to the project the component provide user with the access to configuration register of the Boost hardware block. User should be careful with component API functions because he can affect the chip core accidentally with some of functions.

The Boost Converter component has inputs and outputs which are shown for informational purpose. They can't be used to connect them to other component inputs/outputs or GPIO pins. They only inform user that this lines presented in the chip as a specialized pins.

By default components is in Active mode.

Switching Frequency

This is the switching frequency at which the boost converter block will operate. Switching frequency options are:

- 100 kHz
- 400 kHz
- 2 MHz

- 32 kHz – intended for Standby mode automatic thump regulation.

The 100 kHz, 400 kHz, and 2 MHz switching frequencies are generated using oscillators internal to the boost converter block. When the 32 kHz switching frequency is selected, the clock is derived from the system 32 kHz.

DC and AC Electrical Characteristics

The following values are indicative of expected performance and based on initial characterization data. Unless otherwise specified in the tables below, all T_A = 25°C, V_{dd} = 5.0V

5.0V/3.3V DC and AC Electrical Characteristics

Parameter	Description	Conditions	Min	Typical	Max	Units
Vbat	Input Voltage		0.5	-	5.5	V
IOUTMAX1	Load current	Vin=0.8-1.6V, Vout=1.6-3.6V, internal diode	-	-	30	mA
	Load current	Vin=1.6-5.5V, Vout=3.6-5.5V, external diode	-	-	50	mA
IOUTMAX2	Load current	Vin=0.8-1.6V, Vout=3.6-5.5V, external diode	-	-	20	mA
VSTART	Startup supply voltage		-	-	0.5	V
	Boost inductor	10 µH spec'd	4.7	10	47	µH
	Filter capacitor(1)	22 µF || 0.1 µF spec'd	10	22	47	µF
Vout	Boost output voltage range(1)					
	1.8V		1.71	1.80	1.89	V
	1.9V		1.81	1.90	2.00	V
	2.0V		1.90	2.00	2.10	V
	2.4V		2.28	2.40	2.52	V
	2.7V		2.57	2.70	2.84	V
	3.0V		2.85	3.00	3.15	V
	3.3V		3.14	3.30	3.47	V
	3.6V		3.4	3.6	3.8	V
	5.0V	External diode required	4.75	5	5.25	V

PRELIMINARY