# Step-Up Converters
# General Remarks

**PREMA offers the integration of step-up converters into custom specific IC's, operating from as low as 0.9V.**

A single-cell battery supply for portable devices saves cost and allows smaller dimensions and lower weight. However, the voltage of sometimes less than 1.0V is insufficient for most electronic circuits, LEDs and even many step-up converters.

PREMA offers a solution for ASICs with the design of a low-voltage step-up converter, operating from 0.9V. This allows the supply of other circuit blocks within the IC, such as sensor signal amplifiers, MOSFET drivers or serial interfaces. In addition the ASIC can also power external components, such as a microcontroller or LEDs with higher voltages.

Single-cell battery applications often require adapted application specific solutions, as offered by PREMA with expertise in design and outstanding manufacturing solutions for analog ASICs.

According to customer's requirements, different types of step-up converters can be integrated, e.g. a two-position controller with fixed pulse width and burst operation.
The output voltage is switchable to reduce power consumption for devices with standby mode. Due to the unique features of the PREMA ModuS U6 process, the ASIC circuit can be operated on a very low current level and supply voltage, making it very suitable for battery operation.

The requirements for DC-DC-converters vary widely with the application, so cells contained in a library will often be the basis for a custom specific development.
However, there are some general remarks we can make:

- In our process, circuits — here especially the oscillator and the switching circuit — can be designed to operate with less than 0.9V (1 $V_{BE}$ + 1 $V_{sat}$). This allows to operate the step-up converter from a single battery supply.
- Depending on the voltage, current, switching frequency and efficiency required, the freewheeling diode (especially if it should be a Schottky type) and the power transistor can be either integrated or have to remain as external components.
- The PREMA process can operate at voltages up to 75V. Therefore step-up converters up to this voltage (and by using external components also more) can be developed.

The following pages highlight the library cell PS100S, which has been developed to operate a system containing a 3.6V microcontroller from a single or double NiMH battery cell (0.9 ... 2.7V supply).

To support the hibernate mode of the microcontroller, in which the supply voltage is decreased to 2.3V, the step-up converter has a control input to switch between power-up and hibernate mode to conserve power.

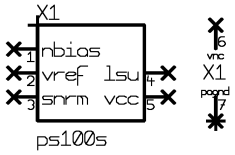
As reference voltage source, our library offers different types of bandgap voltage sources, like the compact and precise BG100L cell that is shown in the application schematic.

The PS100S includes the switch transistor and the free-wheeling diode. For higher currents or increased efficiency, it may be necessary to use external components however.

# PS100S

## SYMBOL



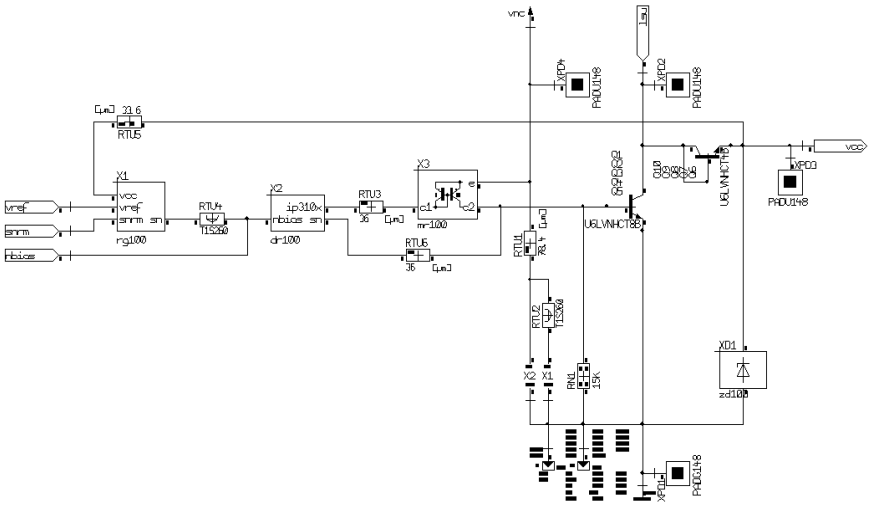

## GENERAL DESCRIPTION

step-up DC-DC converter

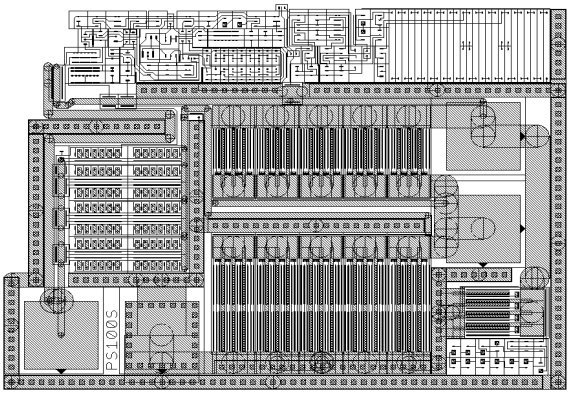
## FEATURES

- supply voltage down to 0.9V
- two 2-position-controlled output voltages: 3.6V / 2.3V, 10mA
- fixed pulse widths, burst operation
- only external inductor and capacitor
- shutdown mode less than 2µA

## SCHEMATIC DIAGRAMS




## LAYOUT




Layout size: 1117.2µm x 831.6µm = 0,929mm²

## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | Symbol | CONDITIONS | MIN | MAX | UNITS |
|---|---|---|---|---|---|
| Supply voltage | $V_{NC}$ | $T_a$=23°C | 0 | 8 | V |

## ELECTRICAL CHARACTERISTICS

***DC***

***Conditions:*** $V_{NC}$ = 1.2V, $V_{REF}$ = 1.175V, $I_{NBIAS}$ = 1µA, $T_a$=23°C, L=270µH / 0.8Ω, C=100µF unless otherwise specified.

| PARAMETER | Symbol | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{NC}$ | | 0.9 | 1.2/2.4 | 2.7 | V |
| Supply current | $I_{NC}$ | $V_{SNRM}$ = HIGH<br>$I_{CC}$ = 10mA | | 85 | | mA |
| Shutdown current | $I_{NC, SHD}$ | $I_{NBIAS}$ = 0A | 0.5 | 1 | 2 | µA |
| Bias | $I_{NBIAS}$ | $I_{CC} \leq$ 10mA | 0.7 | 1 | 10 | µA |
| Output voltage | $V_{CC}$ | $V_{SNRM}$ = LOW<br>$V_{SNRM}$ = HIGH<br>$I_{CC} \leq$ 10mA | 3.5<br>2.2 | 3.6<br>2.3 | 3.8<br>2.5 | V |
| Output current | $I_{CC}$ | $V_{AC} \geq$ 1V<br>$V_{AC} \geq$ 0.8V | 10<br>2 | | | mA |

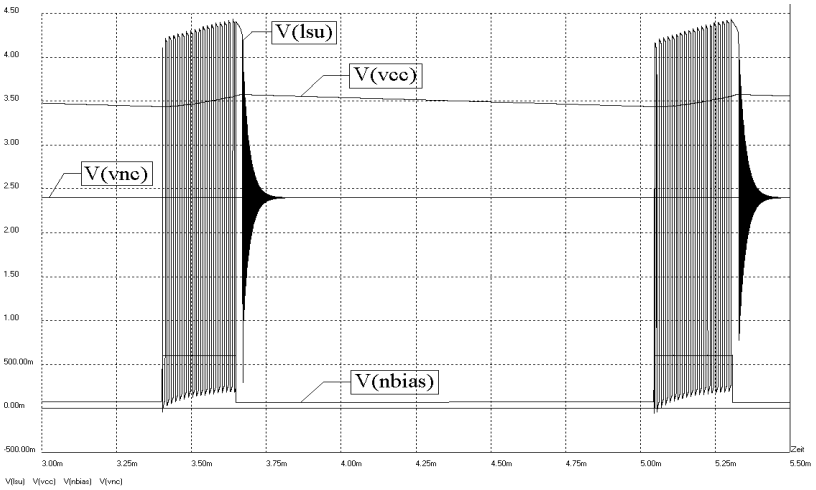
***TRAN***

| PARAMETER | Symbol | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Pulse width | v | $V_{NC} \leq$ 1.5V<br>$V_{NC} \geq$ 1.8V | | 85<br>60 | | % |
| PW-changeover | $V_{CC}$ | | | 1.6-1.75 | | V |
| regulation hyst. | $V_{CCHYS}$ | 1V ≤ $V_{CC} \leq$ 2.7V<br>$V_{SNRM}$ = LOW | | 110 | | mV |
| Frequency | f | | | 95 | | kHz |

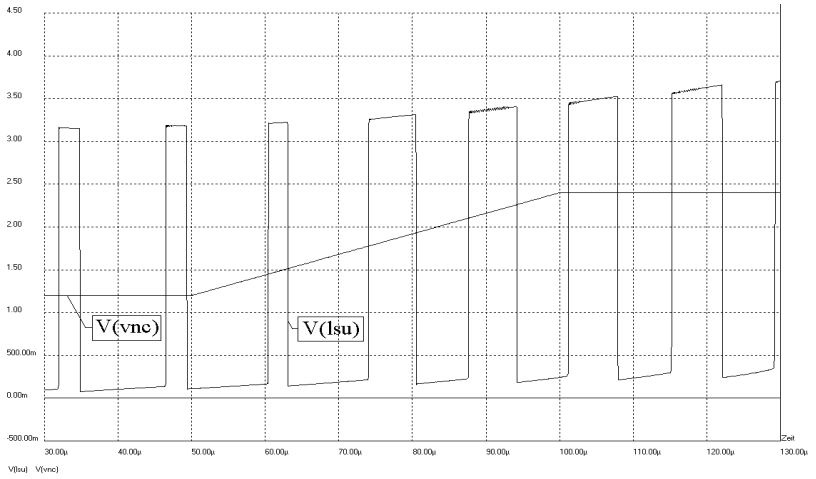
## TYPICAL PERFORMANCE CHARACTERISTICS

***Conditions:*** $V_{NC}$ = 2.4V, $I_{CC} \leq$ 10mA , $I_{NBIAS}$ = 1µA, $V_{REF}$ = 1.175V, $T_a$=23°C, L=270µH, C=100µF unless otherwise specified.

Burst cycle:




Pulse width changeover, 1-cell and 2-cell operation, dependent on $V_{NC}$:



## COMMENTS

The component PS100S is designed for battery applications with one or two cells. The pulse width switches over automatically to the chosen cell number. Bandgap BG100L can be used as voltage reference at Pin *Vref*. For applications with a low power consumption mode the output voltage can be switched from 3.6V to 2.3V by Pin *Snrm* (LOW/HIGH). In the shutdown mode (no current at Pin *Nbias*) the supply current drops to less than 2µA. Pin *Vcc* is protected against inductive voltages over 6V via Pin *Lsu* in cases of a bad capacitor (connection).

It is recommended to observe the well-known rules for switching converters to prevent the circuit itself and other components from parasitic oscillations and any other malfunction:

ASIC:
- as much as possible distance to low level components.
- cell is prepared for a corner placement in your layout, substrate contacts for chip edge are already integrated.

PCB:
- short and low impedance ways between ASIC, capacitor (low inductance type) and inductor (low series resistance type).
- no ground loops!

## TYPICAL APPLICATIONS

Step up DC-DC Converter, one cell operation, at least 10mA output current at constant 3.6V output voltage.