01 Tiny Solar Supply

Sunlight In, 3.3 V Out

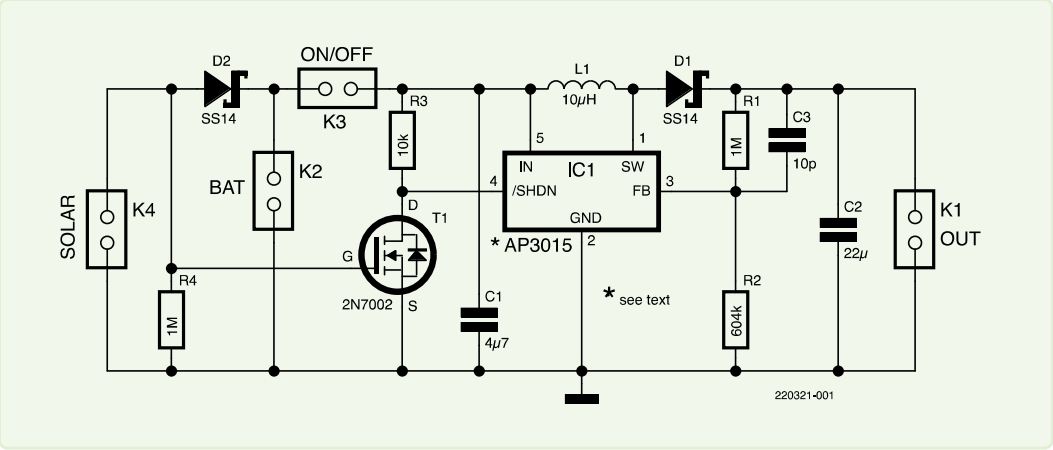

Figure 1: The A-version of step-up converter IC1 works with input voltages from 1 V up to 12 V and can deliver 100 mA.

By Clemens Valens (Elektor)

Need a regulated voltage out of an AA(A) solar-charged battery? Then, this tiny boost converter might just be what you're looking for.

We used to have two solar-powered garden light strings from Ikea lighting up our garden at night. They worked very well, but over the years, the colorful lights slowly disintegrated until only the solar panels were left over. As these solar panels are well-built, waterproof and all that, I decided to keep them and see if I couldn't do something else with them.

During the day, the solar panel charges a single 1.2 V Ni-MH AA rechargeable battery. When it gets dark, charging stops, and a tiny boost converter switches on to pump up the battery voltage to something suitable for powering a string of white LEDs. Nice, but unregulated, as the output voltage depends on the load.

Circuit Diagram

That's why I designed this little circuit. It turns the 1.2 V at its input into a regulated 3.3 V suitable for e.g. a microcontroller-based something. The schematic is shown in **Figure 1.** The heart of the circuit is IC1, an AP3015 micropower step-up DC/DC converter from Diodes, Inc. Its A-version works with input voltages as low as 1 V (and up to 12 V) and can deliver 100 mA. The non-A version starts at 1.2 V, but can supply up to 350 mA.

The output voltage is determined by the ratio of R1 to R2:

$V_{OUT} = 1.23 \times (1 + R1/R2)$

With the given values, the output voltage is (almost) 3.3 V.

L1, D1, and C1 to C3 are the recommended components needed to

make the boost converter work. L1 can be one of those inductors that look like a resistor, as long as it can pass the maximum load current.

While the solar panel (on K4) is getting light, it charges the battery (connected to K2) through diode D2. At the same time, it pulls the gate of T1 up. This makes T1 conduct, pulling the shutdown pin of IC1 low, turning it off. When the output voltage of the solar panel drops too low, battery charging stops, T1 switches off and IC1 switches on. If you don't want this automatic switching, then leave T1 out. An On/Off switch or jumper connected to K3 gives you a bit more control over the circuit.

I designed a little PCB for the circuit that fits nicely inside the old Ikea solar panel. Today, this model is obsolete, but I am sure it will fit in other types too. The design files can be found at [1].

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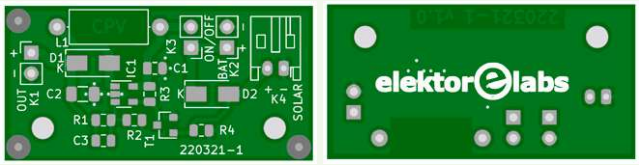
Questions or Comments?

Do you have questions or comments about this article? Email the author at clemens.valens@elektor.com, or contact Elektor at editor@elektor.com.

About the Author

Clemens Valens is an engineer who manages the Elektor Labs online platform. He holds a BSc in Electronics and an MSc in Electronics and Information Technology. Clemens started working for Elektor in 2008 as Editor in Chief of Elektor France, and he has also worked as an editor for Elektor UK/US and ElektorMagazine.com. Later, Clemens was head of Elektor's design labs in the Netherlands, Germany, and India. Today, he is Elektor's Creative Technologist responsible for the Elektor Labs community website where electronics enthusiasts can publish their work and interact with peers from all over the world. Besides contributing his own projects and other articles to the magazine, he also produces regular videos for Elektor TV and moderates webinars. His main interests are sound generation and signal processing.

Component List



Resistors (0805, 0.125 W)
R1, R4 = 1 MΩ
R2 = 604 kΩ, 1%
R3 = 10 kΩ

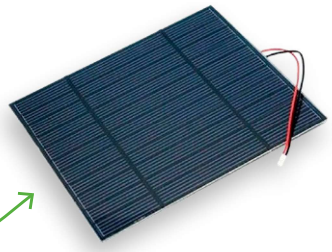
Capacitors
C1 = 4.7 µF, 50 V, X7R (0805)
C2 = 22 µF, 10 V, X7R (1206)
C3 = 10 pF, 50 V, X7R (0805)

Inductors
L1 = 10 µH, 680 mA

Semiconductors
D1, D2 = SS14 (DO-214AC)
IC1* = AP3015 or AP3015A
T1 = 2N7002 (SOT-23)

Miscellaneous
K1, K2, K3 = pin header, 1 row, 2 contacts, 2.54 mm pitch
K4 = pin header, 1 row, 2 contacts, right-angle, 2 mm pitch

* = see text



Related Products

- **Seeed Studio Solar Panel for Outdoor Environments (3 W)**
  https://elektor.com/19131
- **Qoitech Otii Arc – Power Supply, Power Meter, and Data Acquisition**
  https://elektor.com/19270

WEB LINKS

[1] Project files at Elektor Labs: https://elektormagazine.com/labs/tiny-solar-supply