



# Peak Power Solar Charger

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## Porting Arduino Charger to Contiki

- Original project by Tim Nolan
- . . . for Arduino platform
- Unfortunately original project no longer online

### Additions

- + Port to Contiki OS for Merkurboard by **OSDomotics**
- + Code rewrite
- + Measurements as CoAP Resources via 6loWPAN
- + 3.3V design

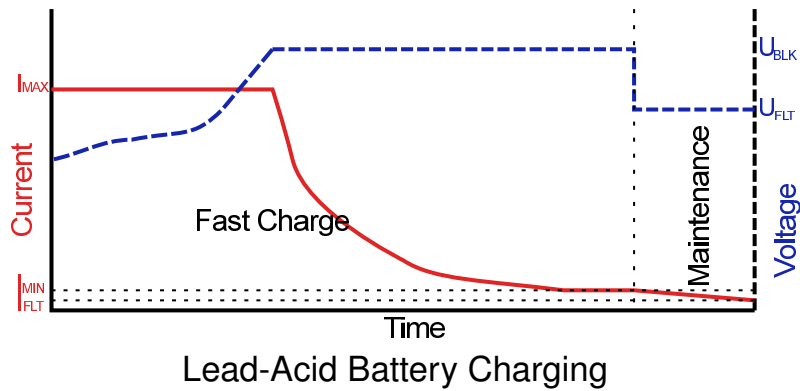


## Lead-Acid Battery Charging

- Fast Charge in two phases
  - 1: Constant current (while voltage below  $U_{BLK}$ )
  - 2: Constant voltage  $U_{BLK}$
- Optional Maintenance Charge (not implemented)
- For photovoltaics  $I_{MAX}$  need not be reached
- $U_{BLK}$ ,  $I_{MAX}$  given by manufacturer datasheet
- $I_{MAX}$  typically 1/10 Capacity in A
- e.g. 1A for a 10Ah battery



## Lead-Acid Battery Charging

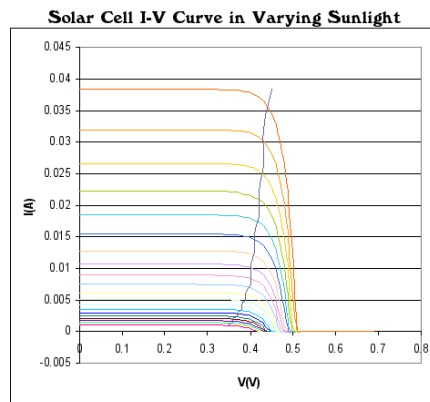


## What is Peak Power Charging?

- $P = U * I$ , (U in Volt, I in Ampere, P in Watt)
  - Photovoltaic Cells
    - ... mainly a *constant current* source
    - ... but not near maximum voltage point
  - Lead-Acid Battery maximum current should be above Photovoltaics Module
  - Below  $U_{MAX}$  we could simply connect the module to the battery
- inefficient
- And we need to limit U (voltage) to  $U_{MAX}$



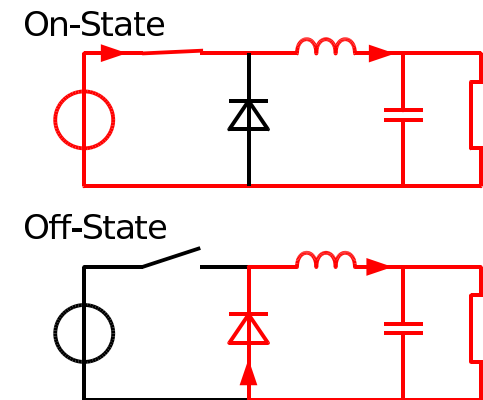
## What is Peak Power Charging?



Solar Cell U/I with MPP (© Wikimedia)



## Step-Down Converter Principle



Step-Down converter (Buck converter) (© Wikimedia)



## Implementation

- For the switch we use MosFETs
- ... controlled by PWM-signal from microcontroller
- The width of the PWM controls the voltage
- We measure voltage @battery, current, voltage @photovoltaics
- calculate power
- regulate to maximum power
- Other modes for low current, constant voltage, dark/full battery



## Contiki-OS

- For microcontrollers
- 6LoWPAN: IPv6 over IEEE 802.15.4 RFC 4944
- Multitasking
- CoAP (Constrained Application Protocol RFC 7252)
- CoAP Resource-Handling
- In our application:  $U_{SOL}$ ,  $I$ ,  $U_{BAT}$ , power
- ... available as CoAP resources via IPv6



## Resources

Everything available under Open Source Licenses

- Contiki-OS fork for Merkur Board  
[github.com/osdomotics/osd-contiki](https://github.com/osdomotics/osd-contiki)
- Solar Charger circuit design and sourcecode  
[github.com/osdomotics/solar-charger](https://github.com/osdomotics/solar-charger)
- Getting started with Merkur Board (german)  
[wiki.osdomotics.com/doku.php/de:start](http://wiki.osdomotics.com/doku.php/de:start)