

Energy harvesting - solar energy

Jaroslav Páral

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Introduction



Image source: <http://electronicsmaker.com/energy-harvesting-for-iot-wireless-applications>

Problem with solar energy

- Sun (energy provide from the sunrise to sunset)
- Weather (clouds, snow, temperature)
- Season (summer/winter)
- Efficiency of photo-voltaic panels (10 - 15 %)
- Efficiency in time
- Required energy by device
- Energy use (\Rightarrow accumulate)
- Efficient accumulation

Harvesting of solar energy - many elements

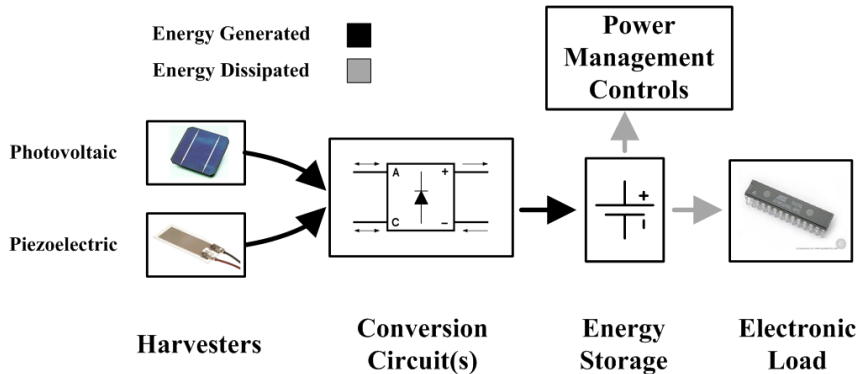


Image source: http://www.mae.cornell.edu/research/groups/lims/research/lab_on_a_bird.cfms

Solar energy => photovoltaic panel (1)

Solar energy (maximum usable energy from the sun): 1000 W/m^2

Efficiency of photo-voltaic panels: 10 - 15 %

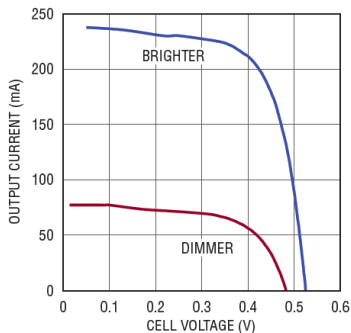
1 dm^2 solar panel (10 %) => 10 W (theoretical max output)

Tests with real panel:

1. Maximum (1000 W/m^2) = 100 %
2. Best weather condition = 33 %
3. April - September = 21 %
4. October - March = 10 %
5. December - January = 4 %
6. Year average = 14 %

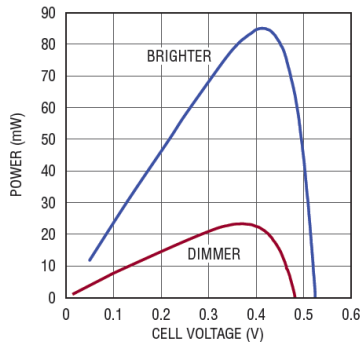
Data source: https://is.muni.cz/th/359790/fi_b/

Solar energy => photovoltaic panel (2)



2 × 1 INCH POLYCRYSTALLINE CELL

Figure : V-A characteristic



2 × 1 INCH POLYCRYSTALLINE CELL

Figure : V-W characteristic

Image source:

<https://vyvoj.hw.cz//firemni-clanky/sos-electronic/ltc3105-solarni-zne-v-praxi-1-cast.html>

Solar energy => photovoltaic panel (3)

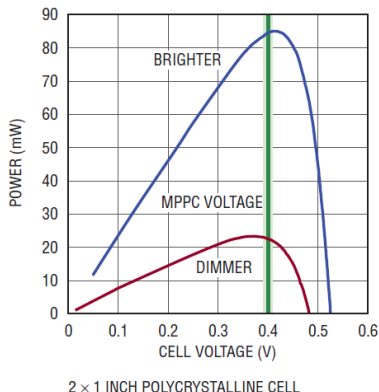


Figure : V-W characteristic - MPP (Maximum Power Point)

Image source:

<https://vyvoj.hw.cz//firemni-clanky/sos-electronic/ltc3105-solarni-zne-v-praxi-2-cast.html>

Harvesting of solar energy - many elements

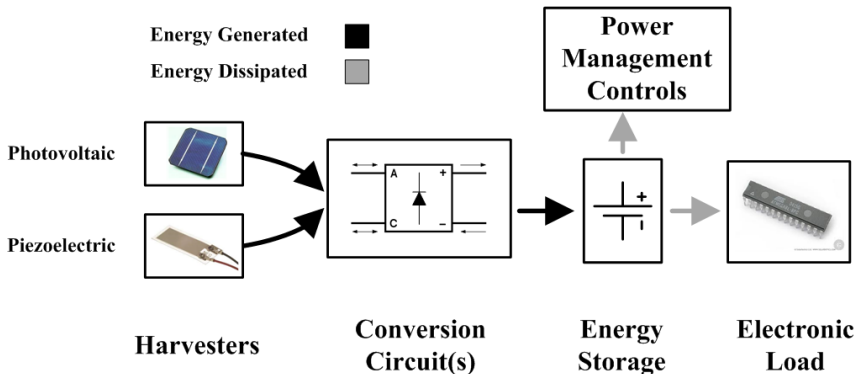


Image source: http://www.mae.cornell.edu/research/groups/lims/research/lab_on_a_bird.cfms

Electronic load

1. Hardware

- MCU
- sensors
- communication module

2. Usage

- period of measuring
- period of sending data

3. Other elements

- interference
- temperature

Electronic load - communication

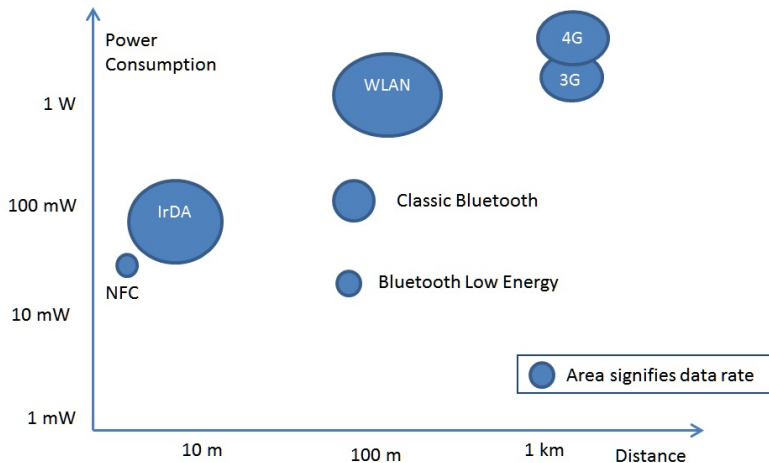


Image source: <https://goo.gl/exzYSa>

Energy storage

1. capacity
2. max. input current
3. max. output current
4. self-discharge



Image source: <http://rksale.cz/akumulatory-a-baterie/129-li-pol-akumulator-pro-syma-x5c-a-x5w-37v-500mah.html>

Conversion circuit

Two types:

A) linear

B) step-up

Parameters:

- own consumption
- efficient
- input voltage
- MPP (Maximum Power Point)?

Conversion circuit - linear

Example: MCP73831

Parameters:

- prize: 0.5 Euro
- input: 4.25 – 6.5 V
- max output: 800 mA
- without MPP

Source: [http:](http://uk.farnell.com/microchip/mcp73831t-2aci-ot/li-ion-li-poly-charge-controller/dp/1332158)

[//uk.farnell.com/microchip/mcp73831t-2aci-ot/li-ion-li-poly-charge-controller/dp/1332158](http://uk.farnell.com/microchip/mcp73831t-2aci-ot/li-ion-li-poly-charge-controller/dp/1332158)

Conversion circuit - MCP73831 - Typical Application

500 mA Li-Ion Battery Charger

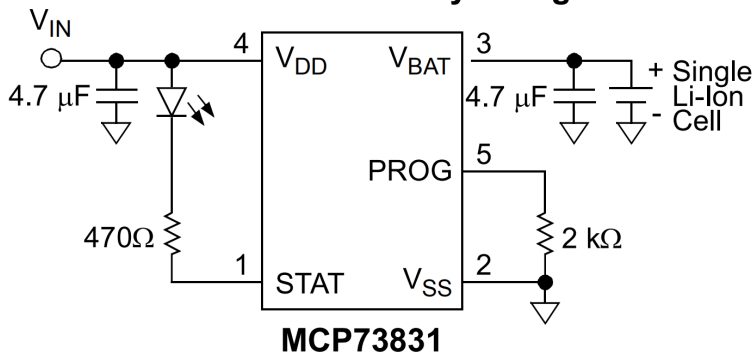


Image source:

<https://vyvoj.hw.cz/firemni-clanky/sos-electronic/ltc3105-solarni-zne-v-praxi-2-cast.html>

Conversion circuit - step-up

Example: LTC3105

Parameters:

- prize: 5 Euro
- input: 0.25 – 5 V
- output: 1.2 – 5.25 V
- max output: 400 mA
- with MPP

Source: <https://www.soselectronic.cz/products/linear-technology/ltc3105ems-pbf-129761>

Conversion circuit - LTC3105 - Typical Application

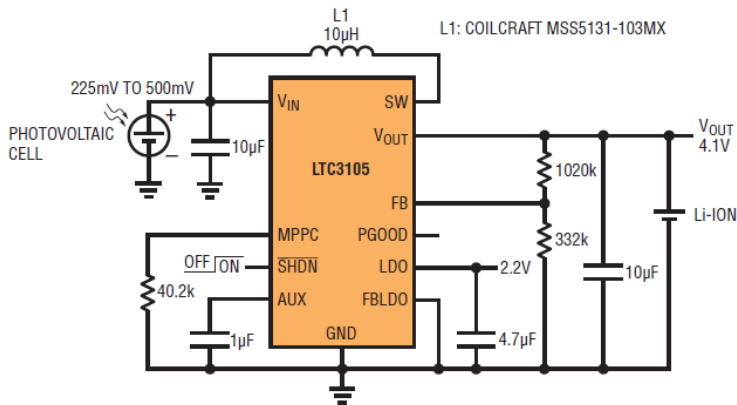
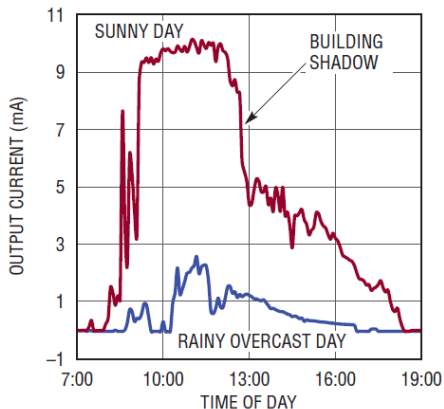


Image source:

<https://vyvoj.hw.cz//firemni-clanky/sos-electronic/ltc3105-solarni-zne-v-praxi-2-cast.html>

Conversion circuit - LTC3105 - Electronic load



2 x 1 INCH POLYCRYSTALLINE CELL

Image source:

<https://vyvoj.hw.cz//firemni-clanky/sos-electronic/ltc3105-solarni-zne-v-praxi-2-cast.html>

Thank you for your attention