



**„PV Standalone system design and battery
charging technologies “**

IOREC

International OFF-GRID Renewable Energy Conference & Exhibition

1. – 2. November 2012 ACCRA, GHANA

M. Müller, Elektronik Steca GmbH

Steca, power electronics regional and international



Production in Memmingen, Germany and Plovdiv, Bulgaria

700 Employees
2009 Turnover : 70 Mio €

Solar Technology

- off - grid technology
- grid tied inverters
- solar water heating

Industry Electronics

- automotiv products
- medical electronics
- cooling/heating technology

Independend and private family company

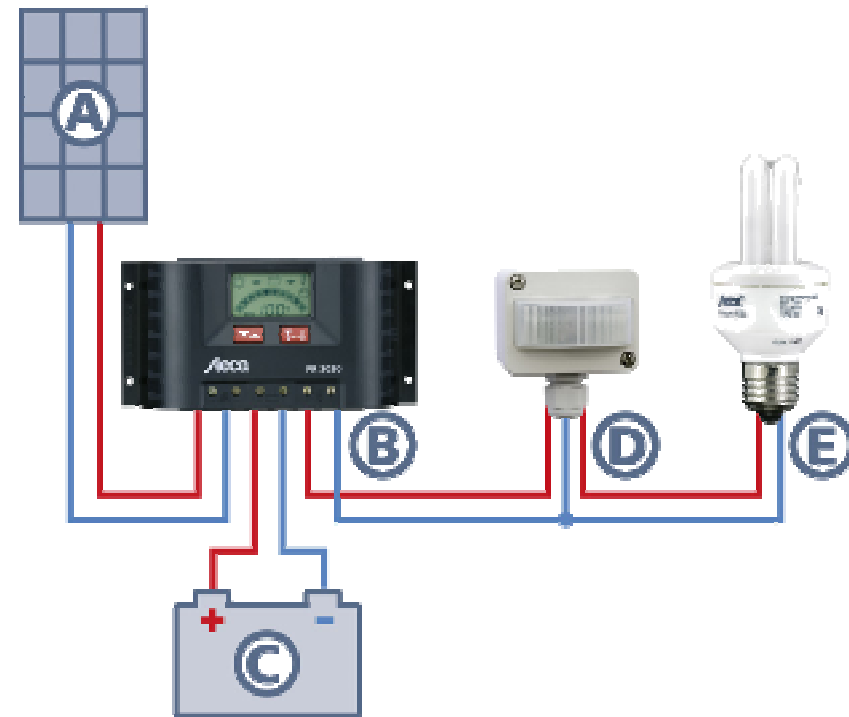
Memmingen Bulgaria





Solar Home Systems

Typically 12V, pure DC, up to about 1kWp



Key:

- A Solar modules
- B Solar charge controller
- C Battery
- D Motion detector
- E Electrical load



Life-time - Costs

Solar module	> 20 years	25 - 30 %
Charger	about 10 years	2 - 4 %
Battery	2 - 6 years	50 - 60 %
Rest	> 10 years	10 %

The system technology has significant influence to the life-time of the battery.

Don't loose your system by using simple and cheap chargers !

Charge controller function

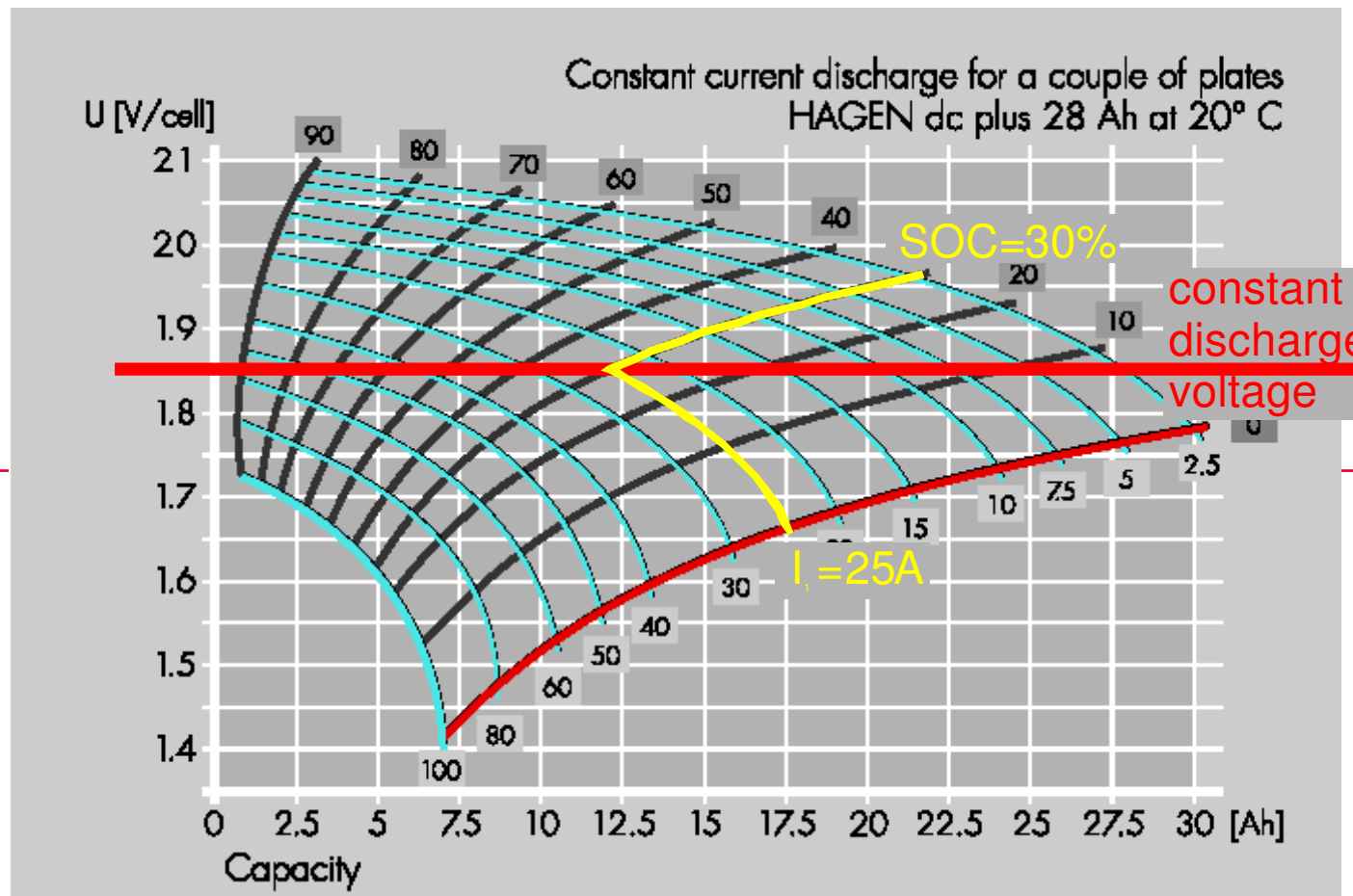


- | | | |
|---------|---|------------------------------|
| System | } | • Low self consumption |
| Battery | | • HVD |
| | } | • LVD |
| | | • Charging strategy |
| | } | • SOC calculation |
| User | | • Adoption to user behaviour |
| | } | • Robustness |
| | | • User friendliness |
| | } | • Solid connection terminal |

State of Charge



The batteries voltage does not reflect the State of Charge (SOC)



User Interface

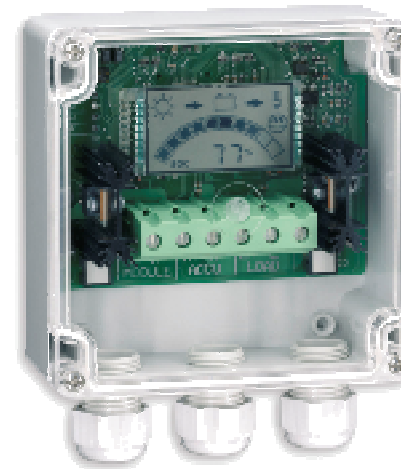


- Big display
- Easy understanding
- Symbol indication
- Robustheit



Inverter Systems

Solar Charge Controllers



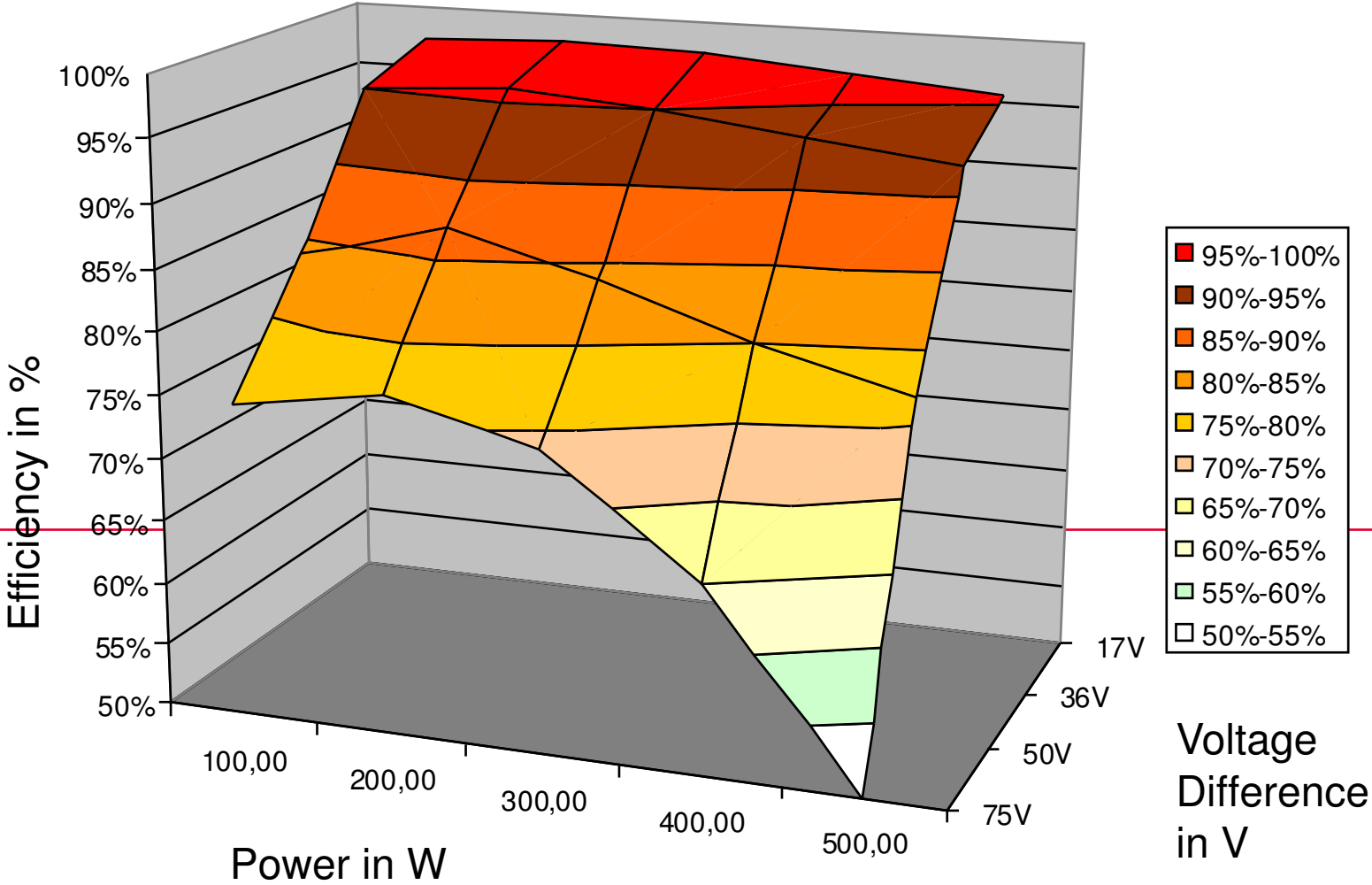
Steca PR

- 12 V / 24 V, 10 A, 15 A, 20 A, 30 A
- Full electronic protection
- User friendly display
- Load switch
- Energy datalogger

Steca PR 2020 IP

- Configuration
- State of charge control
- IP 65 option

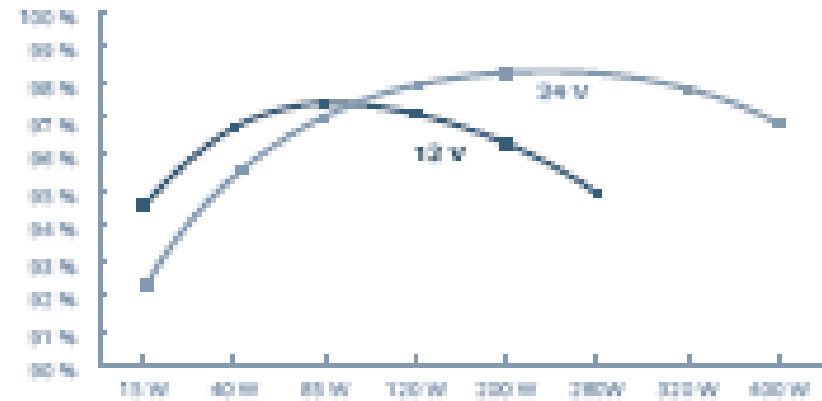
MPPT Charge controller - specifications





Inverter Systems

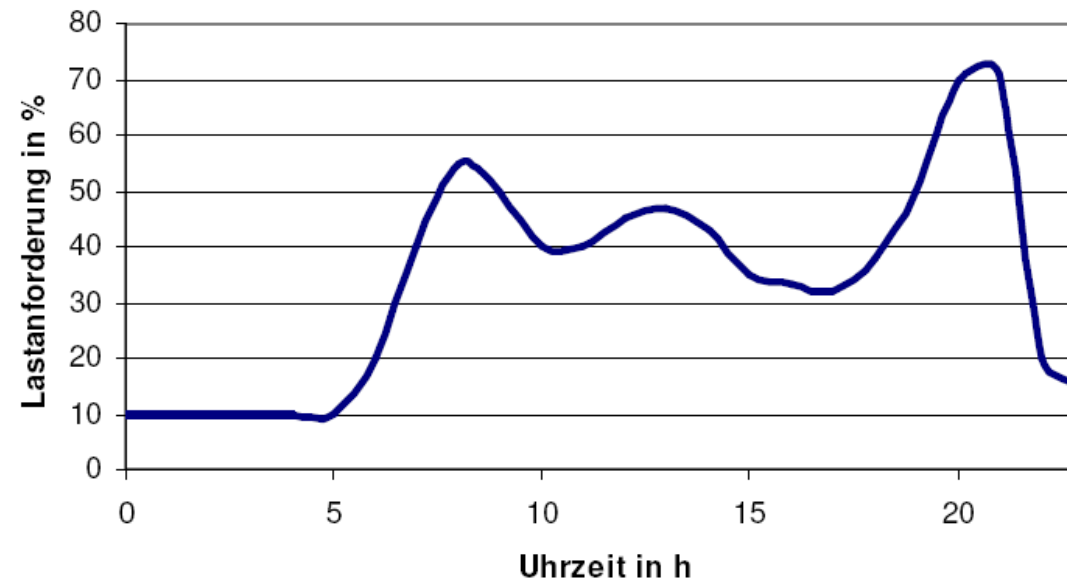
Solar Charge Controllers



Steca Solarix MPPT 2010

- Maximum power point tracker
- 12 V / 24 V, 20 A
- 17 V – 100V input, 250 Wp / 500 Wp
- 10 A load control
- Latest MPPT controller
- Maximum efficiency 98,8% !
- Remote configuration option
- Multi-battery LEDs

System Simulation



- Simulation system
- Load : 440kWh/a (1200 Wh/d), max. power 200W
- Battery 12V@200Ah
- Solar module 250Wp



Definition

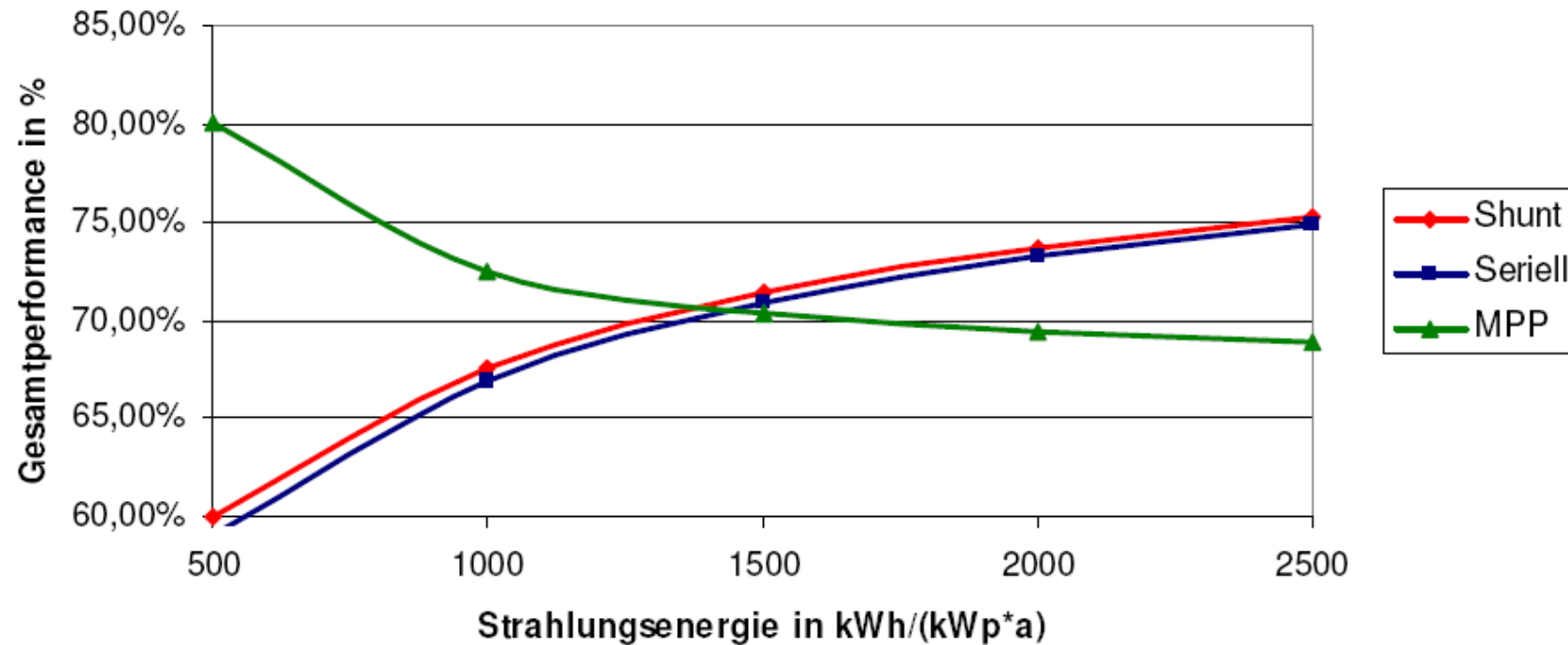
$$\text{Solarer Usage [\%]} = \frac{\text{Usable Irradiation [kWh/a]}}{\text{Available Irradiation [kWh/a]}}$$

$$\text{Load supply [\%]} = \frac{\text{Supply of Load [kWh/a]}}{\text{Load demand [kWh/a]}}$$

$$\text{Performance Indikator [\%*\%]} = \text{Solarer usage [\%]} * \text{Load supply [\%]}$$



Performance indikator in %



System Simulation



- Systems with 36cells to charge a 12V Battery:

	Warm Zone > 1750 kWh/kWp*a	Cold Zone < 1300 kWh/kWp*a
Small Systems	Seriell	MPPT
Medium Systems	Shunt	MPPT
Large Systems	MPPT / Shunt	MPPT

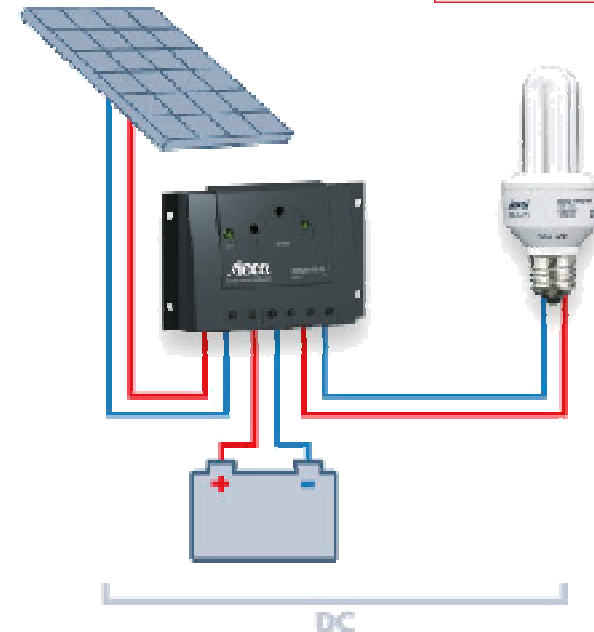
- All other Systems : MPPT



Introduction



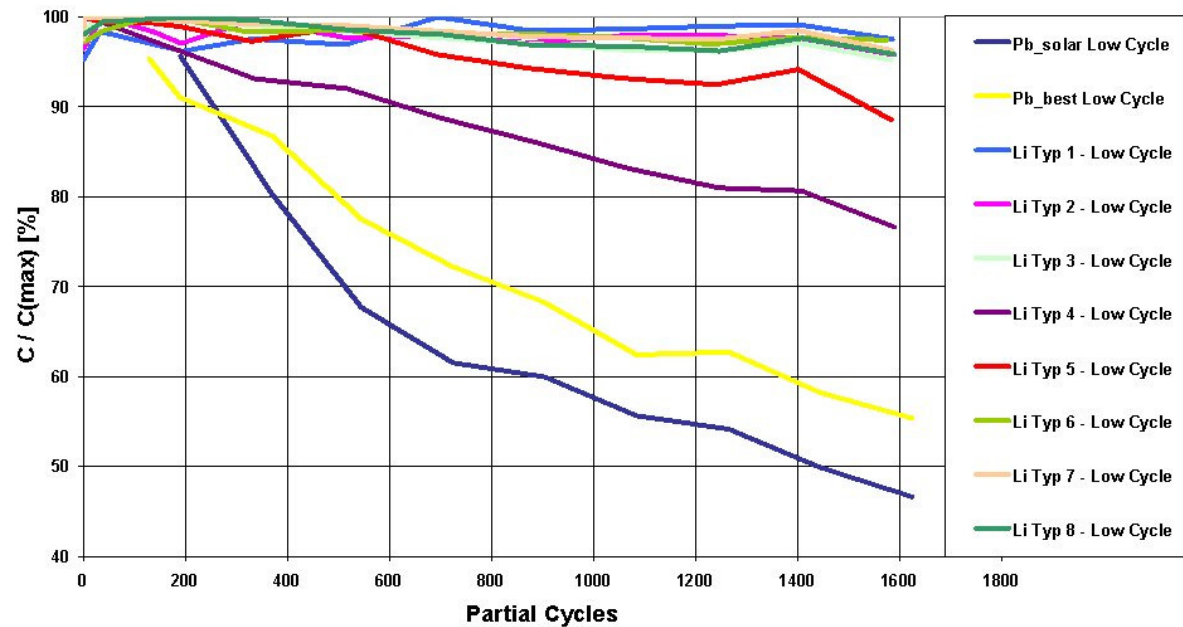
- The battery is still the weak point in off-grid PV systems.
- Over the life-time it causes more than 50% of the overall system costs. (Due to price change of modules)
- The Battery needs to be changed several times during life-time (maintenance costs)



- The battery-part of the system can be optimized
- Can new battery technologies improve this situation ?
- Li-Ion batteries have developed (high life-cycles, low self-discharge, high energy density)
- Probably significant price change due to usage in electric vehicles



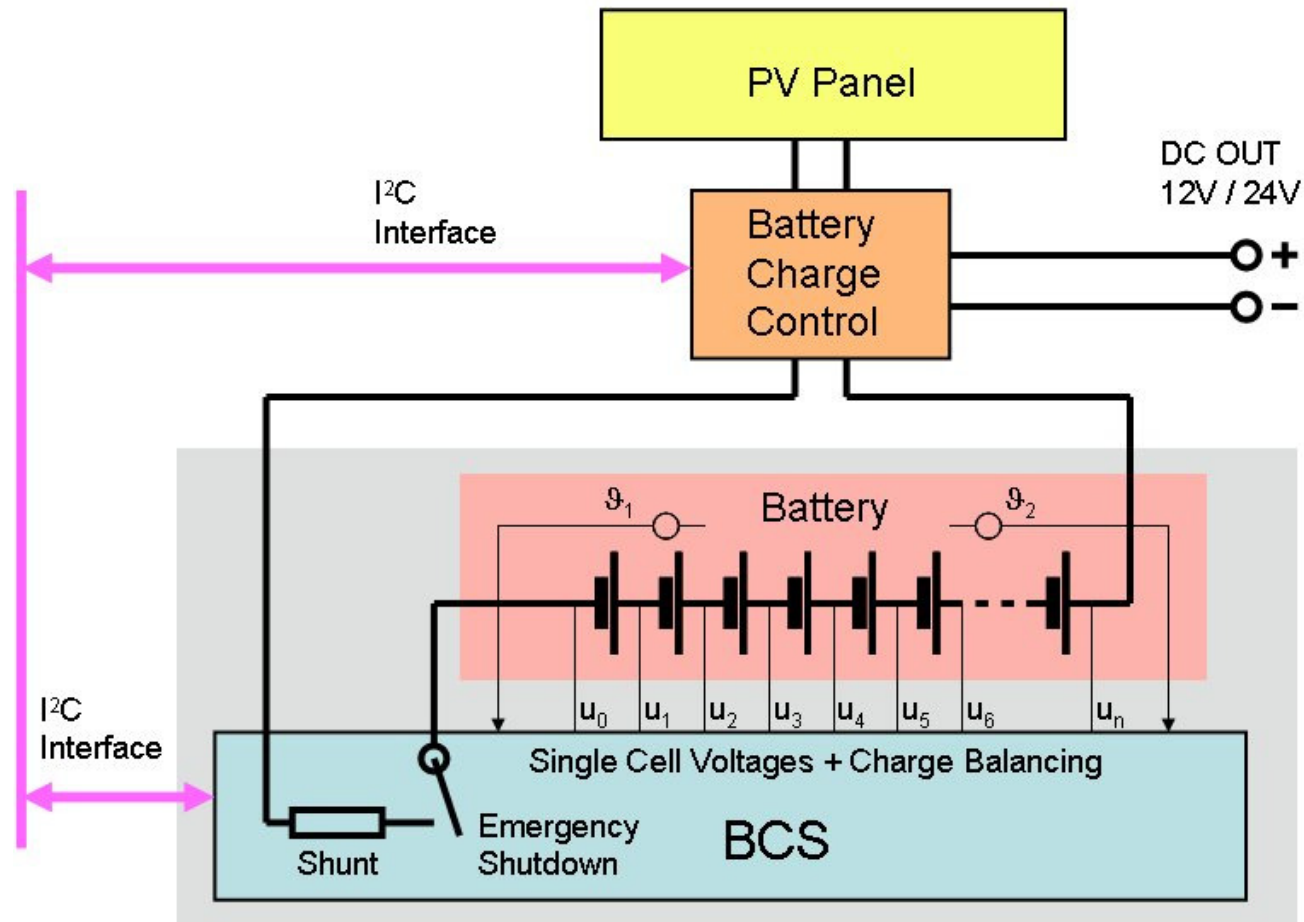
Battery test procedure – low cycle



- After 1600 cycles:
 - Li-Ion generally much better than liquid-acid
 - Two are week – only 80% and 90%
 - All others still have more than 95% of nominal capacity



PILEBI Battery Control System (BCS)





Field test





Inverter Systems

Typically 24V Battery, between 1kW and 4 kW

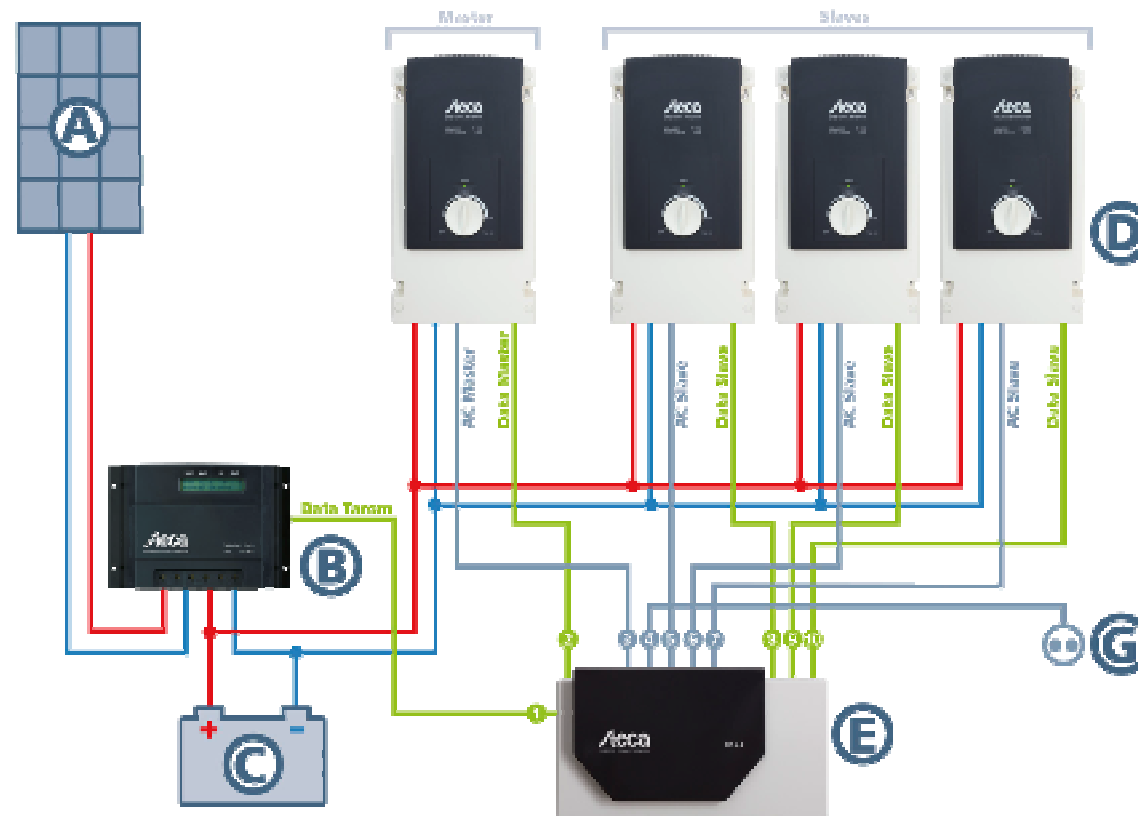


Steca Solarix PI Inverter systems

- 12 V / 500 W – 2 kW
- 24 V / 1 kW – 4 kW
- Plug & play with Steca PAX4
- Steca PI & Steca Taronm unique feature :
- Indication
- Configuration
- SOC based load control
- Free of costs !

Key:

- A Solar modules
- B Solar charge controller
- C Battery
- D Steca Solarix PI sine wave inverter
- E Steca PAX4 parallel switch box
- G Electrical load (230 V~)



References: Village power supply in South Africa





Summary and recommendations



- **Conservative sizing**
- **Good solar battery**
- **Don't lose your system by using a cheap controller**
- **Local knowledge**
- **Maintenance / Infrastructure**
- **Social aspects?**



- **Michael.Mueller@Steca.de**
- **THANKS FOR YOUR ATTENTION !**