Low-cost Converter Design to Interface Solar to Inductive Cooking in Rural Areas.

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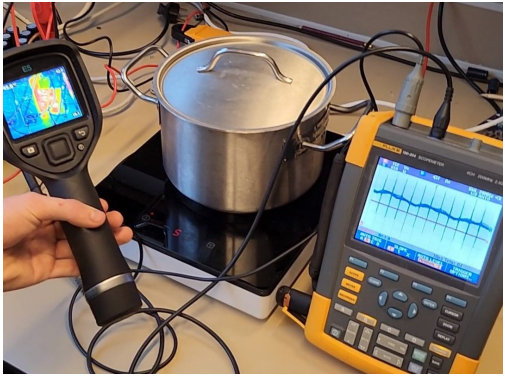
Contents

Solar powered inductive cooking.

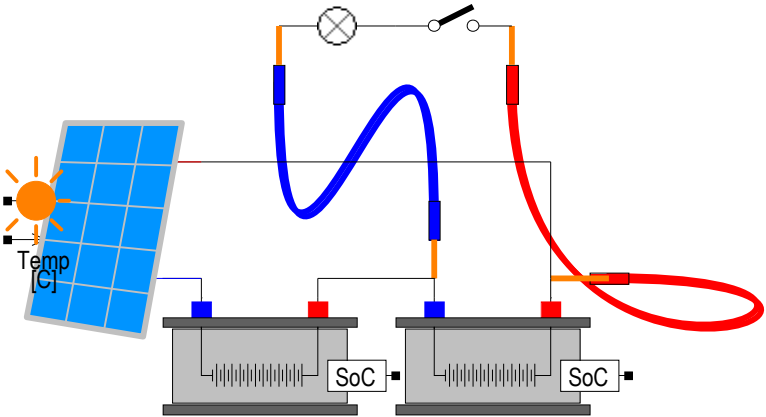
Introduction

- Improve quality of life in remote rural areas
- Replace cooking on wood-stove by solar powered induction cooking
- Store solar power in battery via DC microgrid
- Low-cost converter to interface DC microgrid to commercial available low-cost induction cooker



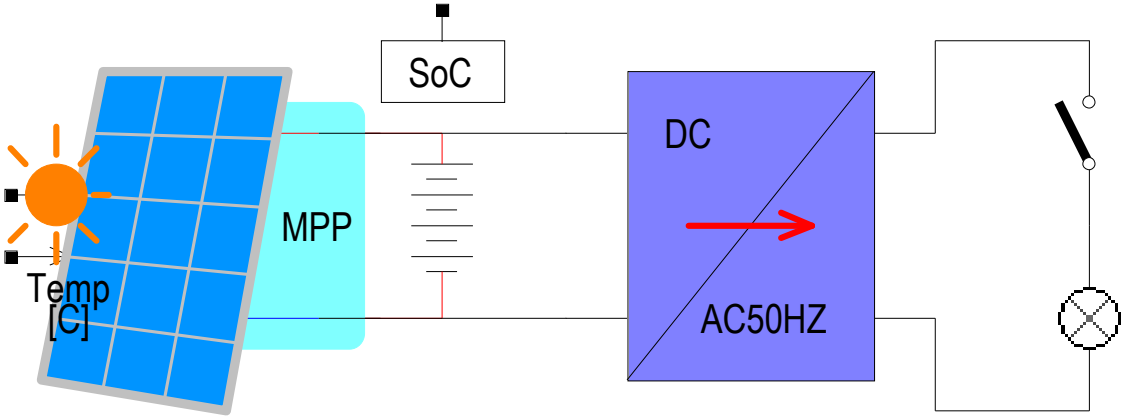
Experimental setup.

Simple



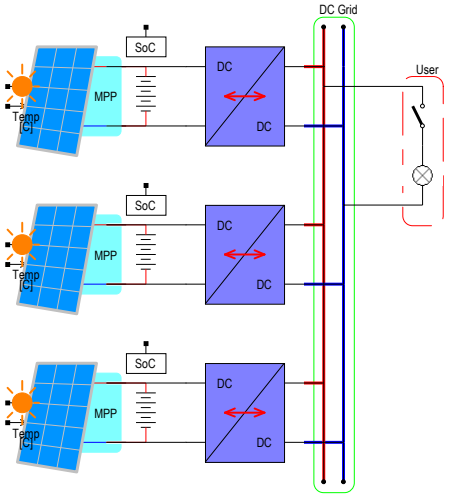
Solar panel directly coupled to two car batteries.

Maximum power point tracker



Maximum power point tracker and AC inverter.

DC grid

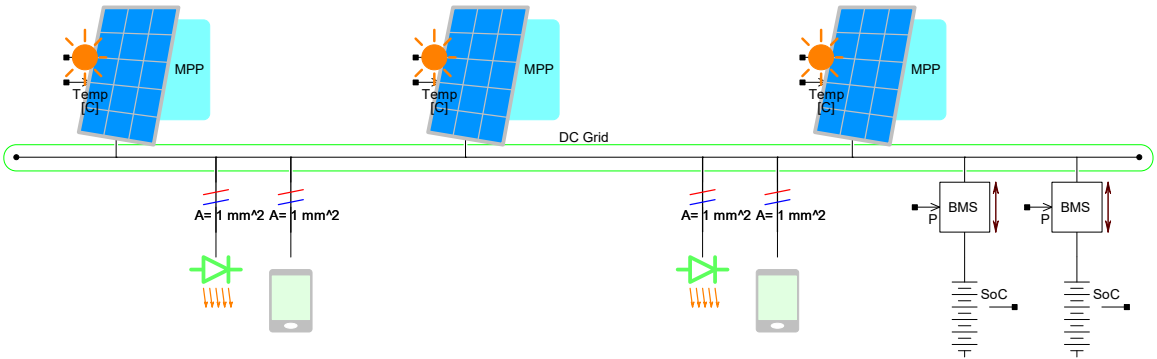


Sharing power over DC grid, with combined solar-battery.

Townships

Solar power harvesting[Courtesy:SSS] in South African townships.

DC microgrid



Sharing power and storage, using a DC grid.

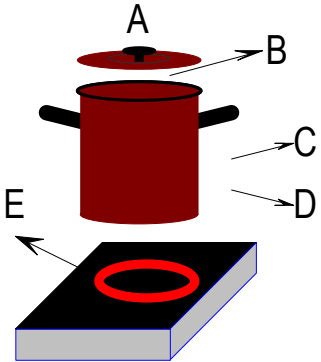
Typical consumption

Tabel: Energy consumption of typical appliances

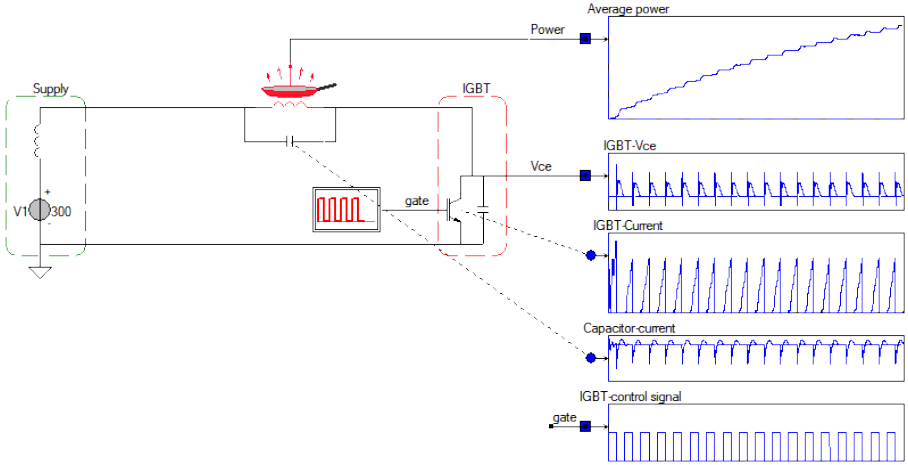
Appliance	Power[W]	Day[h]	Night[h]	Day[Wh]	Night[Wh]
Lighting	5	2	8	10	40
Mobile Phone	5	1	1	5	5
TV	25	5	5	125	125
Inductive Cooker	750	1	1	750	750
Fan	25	8	4	200	100
Total				1090	1020

Losses during cooking

Losses during cooking	
A	Radiation and steam losses at the surface (a lit can reduce these losses)
B	Evaporation losses during heating up and steam losses during boiling
C	Radiant losses from the side of the pan
D	Convection losses from the side of the pan
E	Convection losses for the heat going from the bottom of the cooker to the top of the pan and food



Simulation inductive cooker



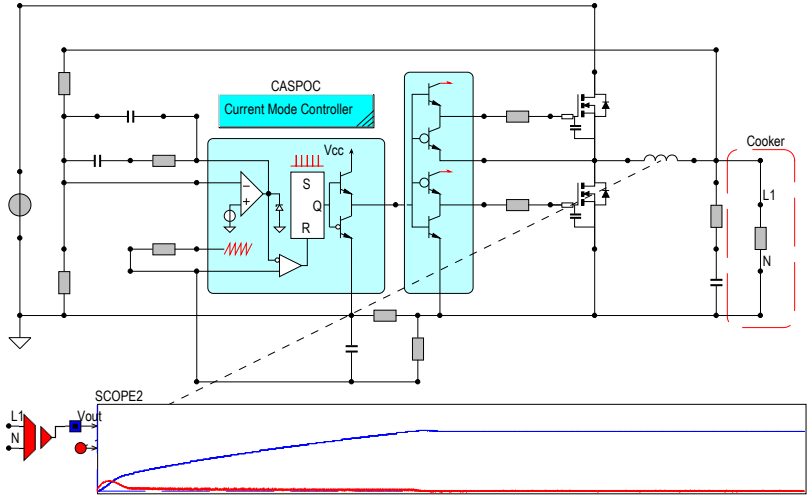
Simulation of a Single-Ended converter. IGBT Voltage stress is visible in the second scope

Conversion required

Conversion between DC microgrid and inductive cooker is required:

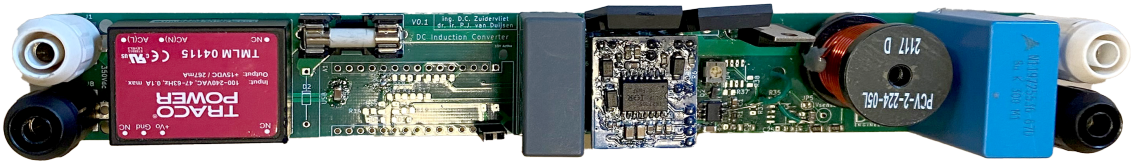
- DC microgrid typically between 350-400 volt
- Commercial available induction cooker typically for AC 230v RMS

Buck converter simulation



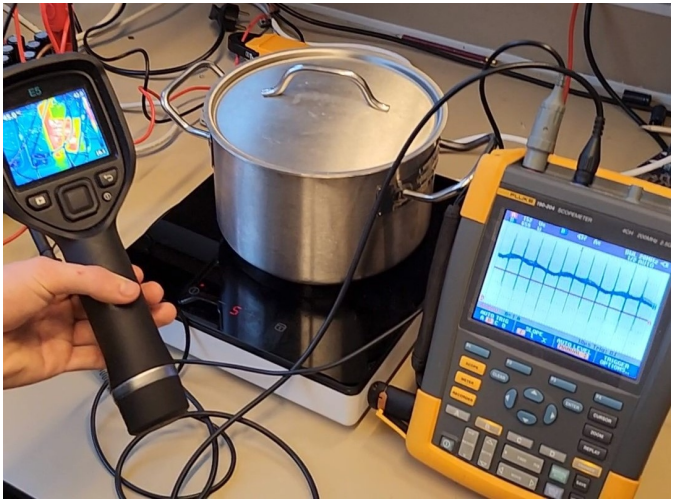
Simulation of the start-up of the complete buck converter, including gating control in Caspoc.

Buck converter design



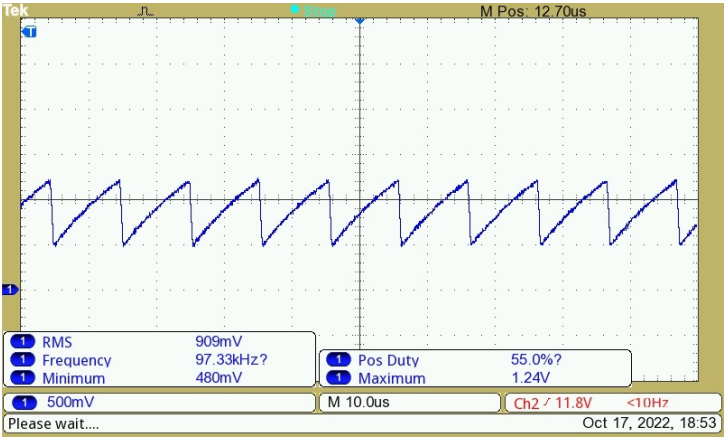
Assembled PCB with Buck converter, control and auxiliary supplies. From left to right: Auxiliary supply, fuse, input filter, gate driver PCB, Mosfet, Diode, current sense resistor, inductor and output capacitor.

Boiling water



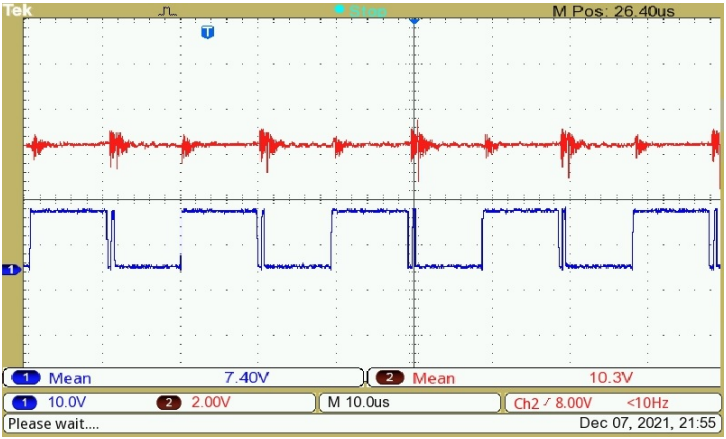
Boiling water on a low cost induction cooker.

Measurement result internal converter current



Inductor current waveform, measured via the sense resistor.

Measurement result output voltage



Output voltage and gating signal. Without slope compensation, there is sub-harmonic oscillation, as visible in the small second pulse in the gating signal.

Conclusion

- Improve the quality of life in remote rural areas
  - Reduce air pollution.
  - Solar-powered
- Solar power
  - Stand alone application
  - DC microgrid
- Inductive cooking
  - Low-cost induction cooker
  - Required power day/night
- Developed hardware
  - Low-Cost DCDC converter
  - Control the amount of power via the converter

www.dc-lab.org www.caspoc.com