Solar-Powered RF Signal Generation for Energy Harvester Applications

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Introduction

- Photovoltaic panel to harness solar energy to convert to electrical energy
- Transmit a 915 MHz EM wave using an antenna
- EM Energy received and converted to useable energy by an energy harvester
- Designed for 24/7 operation
- Based on Panduit wireless energy project completed in 2016-2017

System

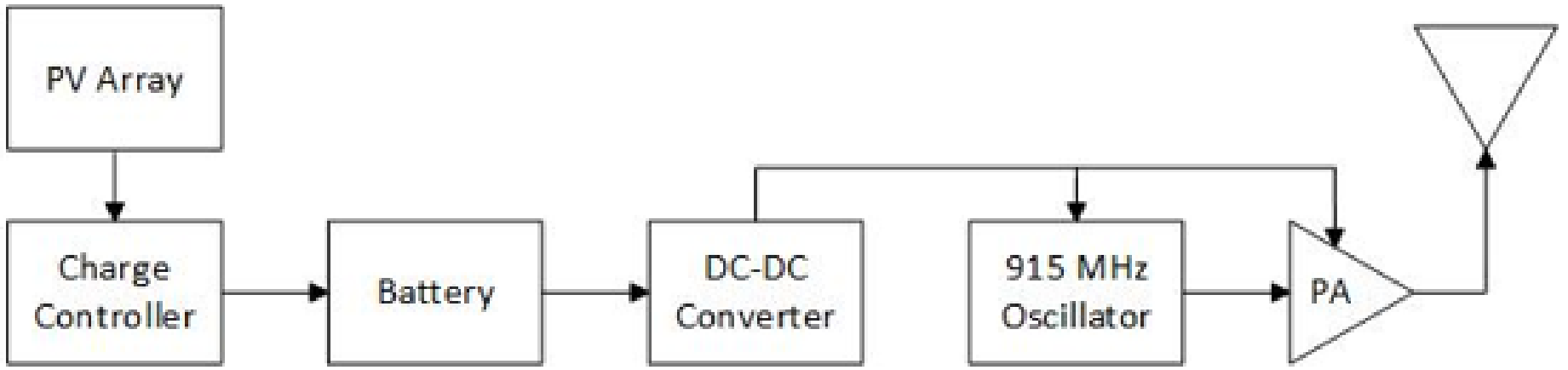

Fig. 1 Block Diagram of Solar-Powered Signal Generation for Energy Harvester Applications

System

- Photovoltaic (PV) Array
- Charge Controller
- Battery
- DC-DC Converter
- 915 MHz Oscillator
- Power Amplifier

Subsystems

Fig. 2 PV Array Subsystem

Charge Controller

- PV panels output higher than 12 V
- Prevents overcharging battery
- Types:
  - 1 and 2 Stage
  - PWM
  - Maximum Power Point Tracking

Subsystems

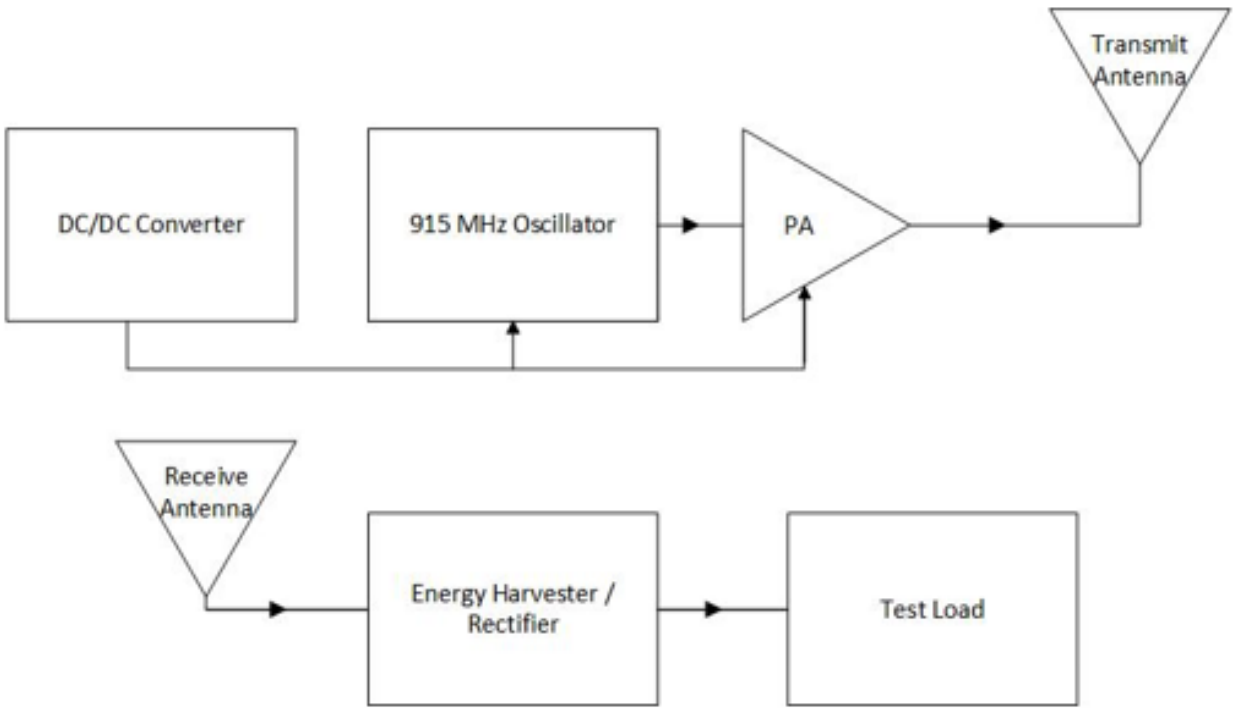

Fig. 3 Wireless Power Transfer Subsystem

System Specifications

- Generate a 915 MHz signal
- Amplified by PA
- Output Power less than 1 Watt
- Variable Duty Cycle
- 24/7 Operation

RF Subsystem Specifications

Part Name	Part Number	Vcc	Current	Power Output	Gain	Frequency	Impedance
Voltage Controlled Oscillator	ZOS-1025+	12V	140mA	8dBm		685MHz-1025MHz	50Ω
Power Amplifier	ZX60-V63+	5.0V	69mA	18.5W	21dB	0.05-6GHz	50Ω

PV Subsystem Specifications

Part	Part Name	Type	Rated Panel Power	Nominal Battery Voltage	Max Voltage	Panel Short-Circuit Current
PV Panel	BP 350		50W	12V	17.5V	3.2A
Charge Controller	Genasun GV-4	MPPT	50W	12V	27V	4A

Parts

- ZOS-1025+: 915 MHz Oscillator (Mini Circuits)
- ZX60-V63+: Power Amplifier (Mini Circuits)
- BP 350: Photovoltaic Panel (BP Solar)
- Genasun GV-4: MPPT Charge Controller (Genasun)
- Battery: TBD, Lead Acid/AGM/Gel/Sealed/Flooded

Tests and Measurements

- Verify operational specifications of components
- Test sub-systems throughout assembly
- RF Lab (Jobst 325) will be used
  - Network Analyzer
  - Spectrum Analyzer
  - Oscilloscopes
  - Signal Generators

Tasks and Schedule

Task	Date (2017-2018)	Team Lead
Proposal Presentation	November 28th	MS & SC
Final Proposal	November 30th	MS & SC
Website Update	December 7th	MS
Order Parts	December 13th	SC
RF Parts Tested	4th Week of January	MS
PV Parts Tested	4th Week of January	SC
Assemble PV Subsystem (and test)	1st Week of February	SC
Assemble RF Subsystem (and test output power)	1st Week of February	MS
Test Wireless Power Transfer System	2nd Week of February	MS
Midpoint Progress Self-Check	February 15th	MS & SC
Assemble Full System	3rd Week of February	MS & SC

Tasks and Schedule

Task	Date (2017-2018)	Team Lead
Test Full System for Functionality	4th Week of February	SC
Test Efficiency of System	1st Week of March	MS
Begin Collecting Data of System Performance	2nd Week of March	SC
Final Report Draft	March 29th	MS
Poster Print	April 5th	SC
Student Expo	April 10th -13th	MS
Final Presentation Draft	April 17th	MS & SC
Senior Project Conference and Reception	April 28th	MS & SC
Final Report and All Deliverables	May 1st	MS & SC
Final Presentation	End of Spring Semester	MS & SC

Concluding Remarks

- Completed at the end of 2018 Spring Semester
- Solar-Powered
- 915 MHz Signal
- Energy Harvesting

References

[1] Guoen Cao, Zhicheng Guo, Yibo Wang, Kai Sun, Hee-Jun Kim, "A DC-DC conversion system for high power HVDC-connected photovoltaic power system", *Electrical Machines and Systems (ICEMS) 2017 20th International Conference on*, pp. 1-6, 2017.

[2] Li, Kai, et al. “Wireless Power Transfer and Data Collection in Wireless Sensor Networks.” *IEEE Transactions on Vehicular Technology*, PP, no. 99, 13 Nov. 2017, pp. 1–1. *IEEE Xplore*

[3] U. Jadli, P. Thakur, and R. D. Shukla, “A New Parameter Estimation Method of Solar Photovoltaic,” *IEEE Journal of Photovoltaics*, vol. PP, no. 99, pp.1-9, Nov. 2017. *IEEE Xplore*