

OTG X-Band Weather Radar System Document

The Off-the-Grid (OTG) X-Band radar is a concept developed by UPRM students under the CASA Engineering Research Center. The basic idea is to develop an X-band radar which is low cost and requires minimum infrastructure for operation. The radar will be used to measure rain reflectivity at a range of 15 Km. The sensor is a single polarization no-Doppler system.

The OTG radar is prepared to be self-sufficient, meaning that solar energy is used to power up the radar and a wireless internet connection is installed for control and data transfer. A Furuno marine radar was modified for this purpose and properly calibrated at CSU-CHILL facilities.

A total of 3 OTG radars were developed by UPRM for the Summer of 2010. A network of the OTGs was installed in a triangular configuration to provide overlapping coverage of the Mayaguez town. During this time, the radar network provided valuable data to the NWS Office in San Juan to help monitor the weather for the Central American and Caribbean Games celebrated in the Summer of 2010. Since then, several weather events have been observed with the OTGs and comparisons with NEXRAD are excellent.

In the documentation found below, a description of the system is found.

Parts List (All commercially available):

- Furuno 1934C-BB (4kW) radar with processor box, controller.
- Parabolic Dish (3.8 degree BW, SLL 22dB) with W/G Transition
- 2 Gel batteries @ 12 V & 97.6 Ah
- 2 Solar panels @ 12 V & 85 W
- 12 V Sine wave inverter
- Rutter Sigma 6 digitizer
- Custom PC (windows XP based)
- Web Relay
- Point to Point wireless radio links

Software:

- Windows XP
- Secure Shell
- RadR
- C#
- Seascan (12 bit)

Remarks of the system:

Parameters \ Radar	OTG radar
Frequency	9.41± .30 GHz (X-Band)
Operational Range	15.36km
Peak Power	4 kW
Pulse width	0.8 μs
Min Detectable signal	-105 dBm
RPMs	26
Polarization	Vertical
Antenna Beamwidth	3.8°
Antenna Gain	32.4 dB
Side-lobe level	-22 dB

- Has a Photovoltaic System designed and implemented to power the radar enabling it to harvest its own energy and operate independently of the power grid.
- A custom PC developed to interface the radar's signals with software.
- Code that transforms raw marine radar data into reflectivity data that can be plotted like weather radar data.
- Comparison of rain event measurements between the OTG and the CSU-CHILL National Weather Radar demonstrated the OTG's capability as a Weather radar.
- Off-The-Grid, easy to deploy weather radar that can map rainfall in lower atmosphere gaps.

The system can be bought with the part list provided, and has few modifications, that can be easily accomplished in the lab. Some of the parts of the radar were bought to EMC Canada, which is a marine radar company. Those are the parabolic antenna and the manual tilt mechanism. The Data is acquired using seascan (Rutter software) interface with RadR (which is an open source software), and the processing of the data is done through C# using standard weather radar equations. The data is sent through the wireless radio links and processed in the campus server for faster results, but is standard procedure as well.

Block Diagram of Photovoltaic System

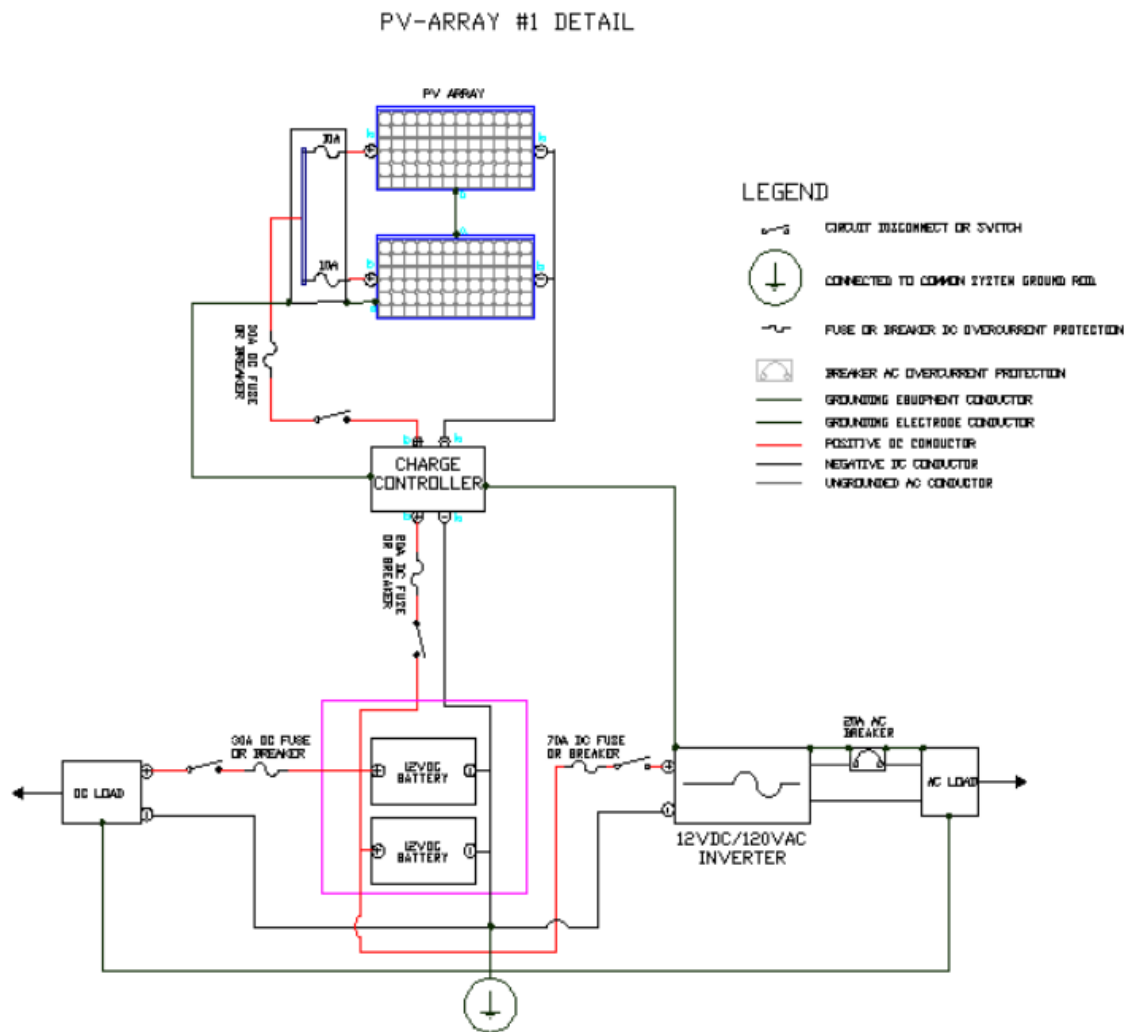
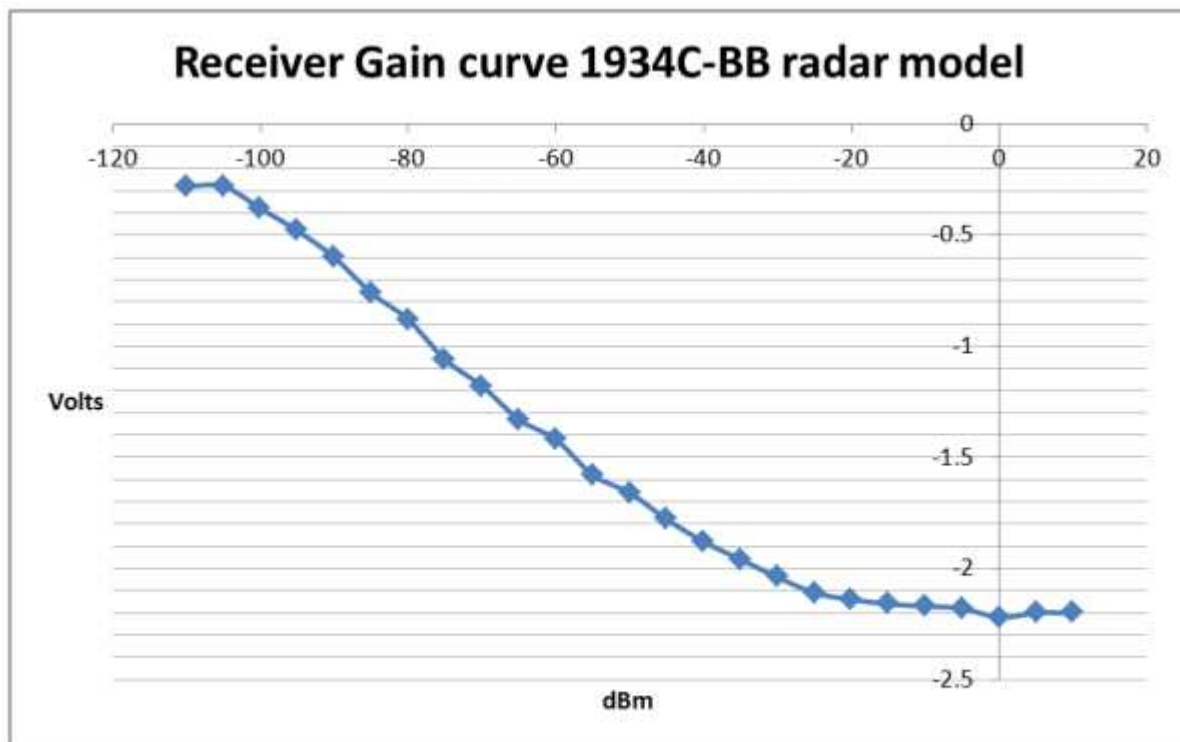


Figure 4-4 PV System Schematics

Trigger Delay	31
Trigger Threshold	155
Video Gain	184
Video Offset	61

Table 5-3 Seascan configuration values



Receiver Gain curve for Furuno radar 1934C-BB model

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VALIDATION AND CALIBRATION OFF-THE-GRID, HIGH RESOLUTION RADAR RAINFALL ESTIMATION IN PUERTO RICO

Ariel Mercado-Vargas
Dept. of Electrical and Computer Engineering
University of Puerto Rico, Mayaguez, PR

Sionel A. Arocho-Meaux
Dept. of Civil Engineering and Surveying
University of Puerto Rico, Mayaguez, PR

Cariel Arocho-Meaux
Dept. of Crop and Agro-Environmental Sciences
University of Puerto Rico, Mayaguez, PR

Gianni A. Pablos-Vega
Dept. of Electrical and Computer Engineering
University of Puerto Rico, Mayaguez, PR

Eric W. Harmsen
Dept. of Agricultural and Bio-Systems Engineering
University of Puerto Rico, Mayaguez, PR
eric.harmsen@upr.edu

José Colom Ustáriz
Dept. of Electrical and Computer Engineering;
University of Puerto Rico, Mayaguez, PR

- Poster and paper presented at CREST 2010 at PR:

CALIBRATION AND VALIDATION OF CASA RADAR RAINFALL ESTIMATION

SIONEL A. AROCHO-MEAUX¹, GIANNI A. PABLOS-VEGA², ARIEL MERCADO-VARGAS², ERIC W. HARMSSEN³, SANDRA CRUZ-POL², JOSE COLOM-USTARIZ²

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OTG Radar Estimated Development Cost	
Radar Subsystem Parts	Price
4 kW Furuno Radar	\$7,495.00
Parabolic Antenna w/ Manual Adjust	\$4,495.00
Rutter Sigma S6 Radar Processor	\$8,300.00
Computer Hardware and Software	\$500.00
Total (Manual Antenna Elev. Adjust)	\$20,790.00
Solar Power Sub-System	Price
Solar Panels (2)	\$800.00
Batteries (2)	\$450.00
Solar Charger	\$200.00
Power Inverter	\$200.00
Total	\$1,650.00
Miscellaneous	\$500
Radar System Total (Antenna Manual Control)	\$22,940.00
OTG X-Band radar system costs	

Furuno®	8,000
Parabolic antenna w/ adjust	4,500
Rutter Sigma6 digitizer	8,300
Computer Hardware & Software	500
Solar panels	800
Deep Cycle Gel Batteries	450
Charge controller	200
Power inverter	200
Miscellaneous	500
Communication radios	1,000
TOTAL	24,450

Table 2: OTG Radar Node Parts Cost (in US \$)
