

DESIGN OF A RADIO FREQUENCY (RF) POWER DETECTOR SYSTEM

Members: Ahmad Al-Hayem, Ali Al-Yami, Hassan Al-Rubaii and Odai Al-Hubail

Advisor: Dr.Mohammad S. Sharawi



Objectives:

- Design an RF power detector system to measure the power levels coming from an antenna array operating at 2.45 GHz.
- Programming a microcontroller to analyse the input data and display the RF power output level.
- Come up with an RF power tracking feature based on the measured level.
- Testing the system to see if it works as designed.

Block Diagram:

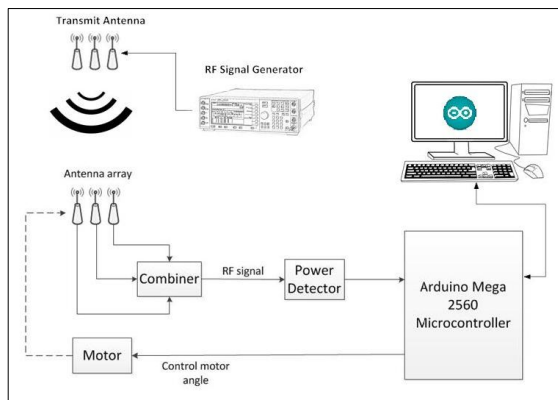


Figure 1: The block diagram of the RF Power Detector System.

Components list:

- Agilent N5184A MXG Analog Signal Generator.
- PE51049 Transmit antenna.
- Antenna array.
- Combiner board.
- ZX47-40LN-S+ Power Detector circuit.
- Arduino mega 2560 microcontroller board.
- HS-422 servo motors with tilt pan set.

System setup:



Figure 2: RF power detector system.

System Implementation:

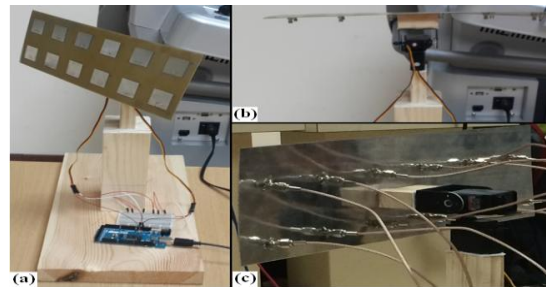


Figure 3: (a) The base. (b) The motor. (c) back view of the array

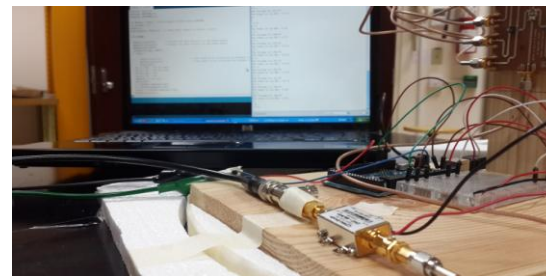


Figure 4: The Arduino connected with the power detector.

Results:

Table 1: 3-loops 0.5s delay

Theoretical			Experimental			Difference		
ϕ	θ	P_R (dBm)	ϕ	θ	P_R (dBm)	$\Delta \phi$	$\Delta \theta$	ΔP_R (dBm)
-45	0	-13.18	-45	-37	-14.89	0	37	1.71
-45	0	-13.18	-45	-37	-14.89	0	37	1.71
-45	0	-13.18	-45	-30	-14.89	0	30	1.71
0	0	-13.18	0	-30	-14.22	0	30	1.04
0	0	-13.18	0	-30	-14.22	0	30	1.04
0	0	-13.18	0	-30	-14.22	0	30	1.04
45	0	-13.18	0	-23	-22.12	45	23	8.94
45	0	-13.18	0	-23	-22.12	45	23	8.94
45	0	-13.18	0	-23	-22.12	45	23	8.94

Table 2: 4-loops 1s delay

Theoretical			Experimental			Difference		
ϕ	θ	P_R (dBm)	ϕ	θ	P_R (dBm)	$\Delta \phi$	$\Delta \theta$	ΔP_R (dBm)
-45	0	-13.176	-50	-26	-14.12	5	26	0.94
-45	0	-13.176	-50	-26	-14.12	5	26	0.94
-45	0	-13.176	-50	-27	-14.12	5	27	0.94
0	0	-13.176	0	-23	-14.12	0	23	0.94
0	0	-13.176	0	-23	-14.12	0	23	0.94
0	0	-13.176	0	-30	-14.12	0	30	0.94
45	0	-13.176	22	-45	-24.42	23	45	11.24
45	0	-13.176	22	-45	-24.42	23	45	11.24
45	0	-13.176	22	-45	-23.66	23	45	10.48

Conclusion:

A maximum RF power detector system was designed and assembled. The RF power detector system uses an RF power detector to convert the RF signal received through an antenna array into a DC voltage value.

An Arduino microcontroller is used to process the DC voltage into a power reading in dBm.

The system is able to detect direction of maximum power using an algorithm run on the Arduino, which will control two servo-motors to direct the antenna.

The system accuracy was assessed in terms of direction and the number of loops within the algorithm.