AN ULTRA HIGH FREQUENCY 921 MHZ ARRAY ANTENNA FOR RFID READER

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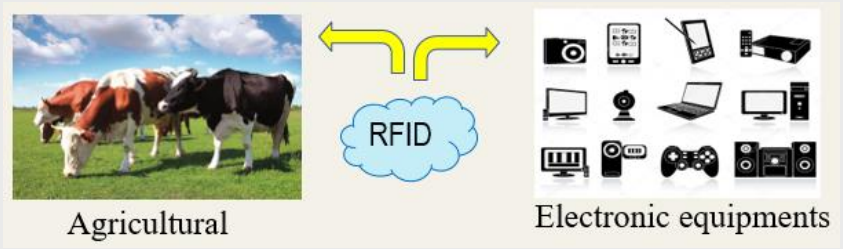
PRODUCT BACKGROUND

- Radio frequency identification (RFID) : agriculture goods, electronic devices, manifold volumes of industrial products for position recording, distribution reports and location facilitation
- An ultra-high frequency, UHF (300 MHz - 3GHz) frequency band RFID reader antenna has proven to be better compared to low frequency, LF (30 KHz – 300 kHz) and high frequency, HF (3 MHz – 300 MHz) frequency bands as it offers excellent read range and reading rate
- This project aims to develop an efficient high-gain patch antenna array to comply with the Malaysian Standard Frequency set for UHF RFID ranging from 921 MHz to 923 MHz.



STATE OF THE ART/ METHODS

- **Antenna Geometry and Design**
  - The antenna is composed of an altered rectangular shape patch array with a U-slot that is printed onto an FR-4 substrate with 1.6mm thickness, the loss tangent of 0.019 and dielectric constant (ε_r) of 4.7.

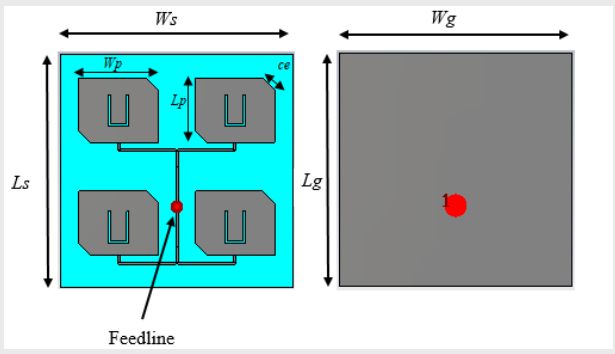


Figure-1. The geometry design of the proposed antenna.

- An ultra-high frequency, UHF (300 MHz - 3GHz) frequency band RFID reader antenna has proven to be better compared to low frequency, LF (30 KHz – 300 kHz) and high frequency, HF (3 MHz – 300 MHz) frequency bands as it offers excellent read range and reading rate
- The mathematical equations of the width of patch (W) and length of patch (L) of the Rectangular Patched Microstrip antenna are given as

$$W = \frac{c}{2 f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \quad \text{and} \quad L_{eff} = \frac{c}{2 f_r \sqrt{\varepsilon_{reff}}}$$

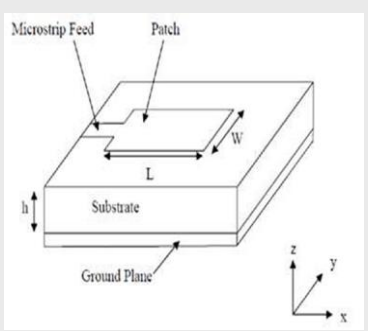


Figure-2. Microstrip patch antenna dimensions

Figure-3. Fabricated microstrip antenna array

RESULTS

Simulation Result of the projected antenna

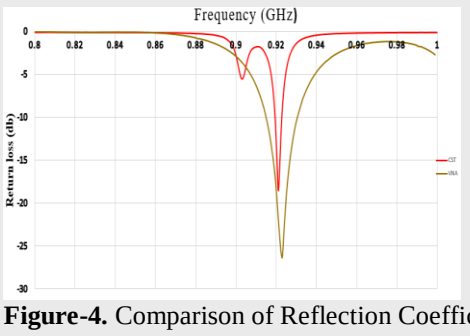


Figure-4. Comparison of Reflection Coefficient S_{11} Between Simulation and Actual Antenna

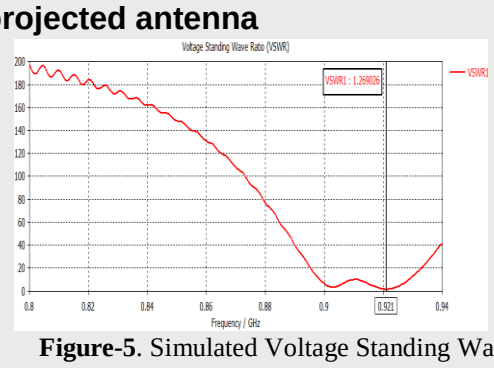


Figure-5. Simulated Voltage Standing Wave Ratio

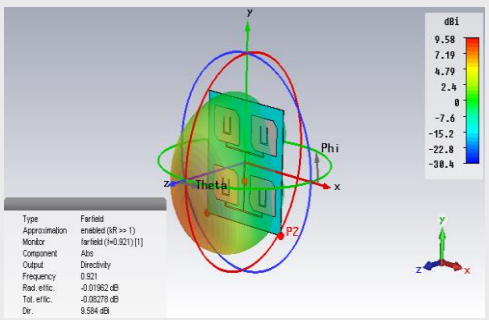


Figure-6. Simulated Far Field view 3D radiation pattern

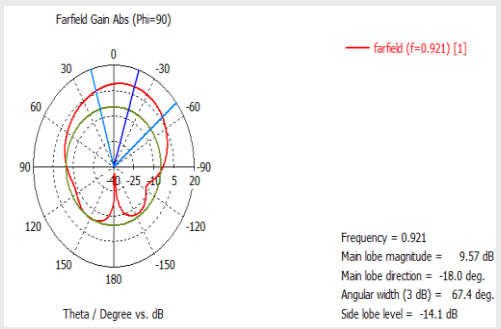
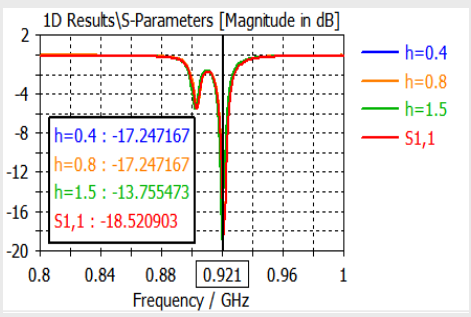


Figure-7. Simulated Polar plot for Gain

Substrate Thickness



Symmetrical Slot Length

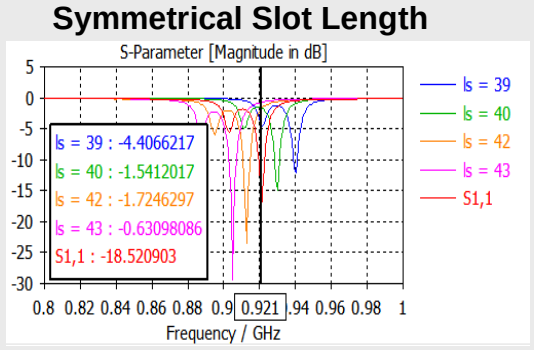


Figure-8. Return Loss and Resonating Frequency Values Due to Changes of the Substrate Thickness

Figure-9. Return Loss and Resonant Frequency Effect Due to Changes of Symmetrical Slot Length

Chamfer Edge Length

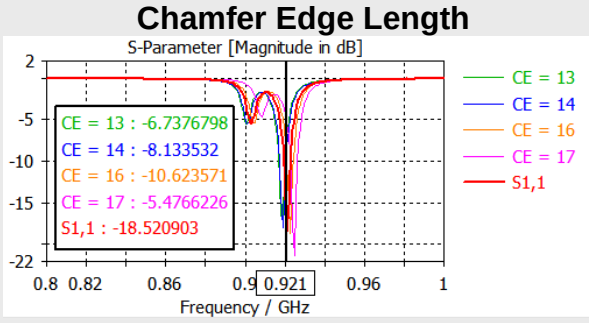


Figure-10. Return Loss and Resonating Frequency Values Due to Changes of Chamfer Edge Length of The Patch

NOVELTY/ INVENTIVENESS

The novelty of this antenna structure is a combination of a number of patch elements to create a 2 by 2 array with modest bandwidth for Malaysian Frequency Allocation.

BENEFITS/ APPLICABILITY

This antenna design follows the UHF RFID Reader for Malaysia that range between 919 MHz to 923 MHz. Furthermore, the detection range for this antenna can increase from 100 cm if using single element to up 400 cm by using this antenna.

Achievement/Award

- **Gold: Citrex 2019**
- **Gold: Itex 2019**

Publication

- **Design and Analysis of Circular Shaped Patch Antenna with Slot for UHF RFID Reader, Lecture Notes in Electrical Engineering 632, 517-527 (2020).**
- **Circular Microstrip Patch Antenna for UHF RFID Reader, Journal of Telecommunication, Electronic and Computer Engineering, 10, 61-65 (2018).**

Cost Analysis

UMP RFID	Product A	Product B
		
Price: RM 480	Price: RM 590	Price : RM 760