Customization of 433 MHz Antenna for an ISM Application using Meanderline Structure

[illegible] *1

[1] [illegible]
[illegible]
*C[illegible] -m[illegible]

Abstract – *Innovation on ISM devices has been an interensting trend in robotics application. Antenna as a wireless interfacing part in communication between the device and another requires a specific design to fit an available space in the device. This paper explores a customized design of 433MHz antenna for an application of ISM devices. Antenna is designed by using meandeline structure theory. An antenna for the frequency has been simulated and fabricated. The design is implemented in 38mm x 110mm FR-4 PCB with thickness 1.6mm. The antenna has a maximum gain 1.1 dB and SWR 1.83 at the frequency.*

Keywords: *antenna, ISM, meander line, wireless communication*

I. Introduction

[illegible]

II. Relevant Theories

[illegible]

II.1. Antenna 433MHz

[illegible] antenna, a length of half of lambda (λ) antenna [illegible] used. For the frequency with λ = 692.84

[illegible] 346.42m [illegible]. [illegible] 173.21m [illegible] Fig 1 [illegible]

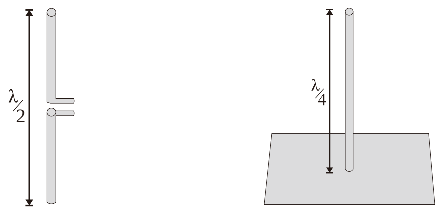

Fig 1 [illegible]

II.2. Meanderline Antenna

[illegible] [1] [illegible] [2] [illegible] [3] [illegible] 433 [illegible] PCB [illegible]

[illegible]

II.3. Electrically Small Antenna

[illegible] (ESA). [illegible] ESA [illegible] R -D, [illegible] [4] [illegible] [5] [illegible] ESA [illegible] λ/2π as expressed in (1). [illegible] [6] [illegible] (Q), [illegible] (G), [illegible] (BW) [illegible] ESA [illegible] (2), (3) [illegible] (4)

$$ka < 1 \quad (1)$$

$$Q = \frac{1 + (ka)^2}{(ka)^3} \quad (2)$$

$$G = (ka)^2 + 2(ka) \quad (3)$$

$$BW = \frac{s-1}{Q\sqrt{s}} \quad (4)$$

[illegible] k [illegible], a [illegible] Q, G [illegible] BW [illegible] (2), (3) [illegible] (4) [illegible]

[illegible] CPW [illegible] PCB. [illegible] [7] [illegible] (Z_0) [illegible] (5). [illegible] $K(k)/K(k')$ [illegible] (6) [illegible] [8]

$$Z_0 = \frac{120\pi}{\sqrt{e_{reff}}} x \frac{K(k)}{K(k^1)} \quad (5)$$

$$\frac{K(k)}{K(k^1)} \approx \begin{cases} \pi / \ln\left[2\frac{(1+\sqrt{k^1})}{(1-\sqrt{k^1})}\right] for\ 1 \le \frac{K}{K'} \le \infty \\ and\ 0 \le k \le \frac{1}{\sqrt{2}} \\ \frac{1}{\pi}\ln\left[2\frac{(1+\sqrt{k^1})}{(1-\sqrt{k^1})}\right] for\ 0 \le \frac{K}{K'} \le 1 \\ and\ \frac{1}{\sqrt{2}} \le k \le 1 \end{cases} \quad (6)$$

II.4. Standing Wave Ratio

[illegible]. An [illegible] 1. [illegible] 1 [illegible] 2. [illegible] -10dB.

[illegible] (7) [illegible] (8) where Γ is reflection coefficient.

$$\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} \quad (7)$$

$$SWR = \frac{1+\Gamma}{1-\Gamma} \quad (8)$$

III. Proposed Antenna Design and Research Methodology

[illegible] 105mm [illegible] 40mm [illegible] Fig 2. [illegible] FR-4 [illegible] PCB [illegible] 1.6mm [illegible].

III.1. Antenna Design

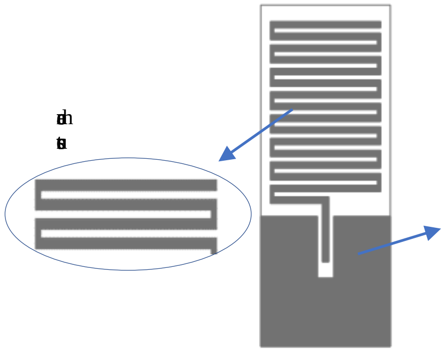

Fig 2. [illegible]

A[illegible] 15 [illegible] . [illegible] *l* is 34 [illegible] *w* is 2 [illegible] *s* is 1.5 [illegible] Fig 3. [illegible] *l*, *s* [illegible] *w*.

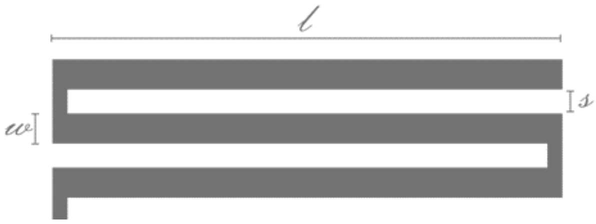

Fig 3. [illegible]

F[illegible] *f*, [illegible] 19m . [illegible] Fig 4. [illegible] s_1, is 4m [illegible] l_1 [illegible] 17m [illegible] s_2 [illegible] s_3, [illegible] 5m [illegible] 5m [illegible]

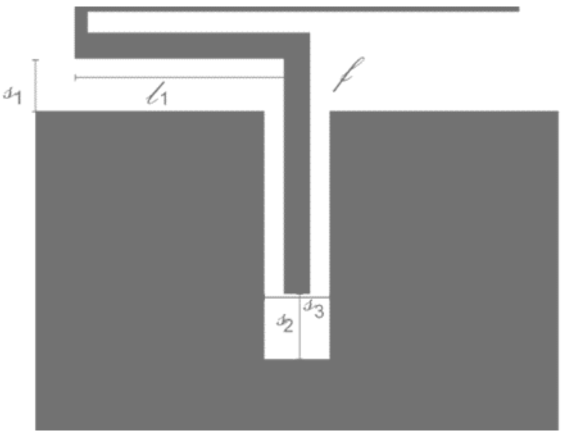

Fig 4. [illegible]

Fig 5. [illegible] 40mx40m [illegible]

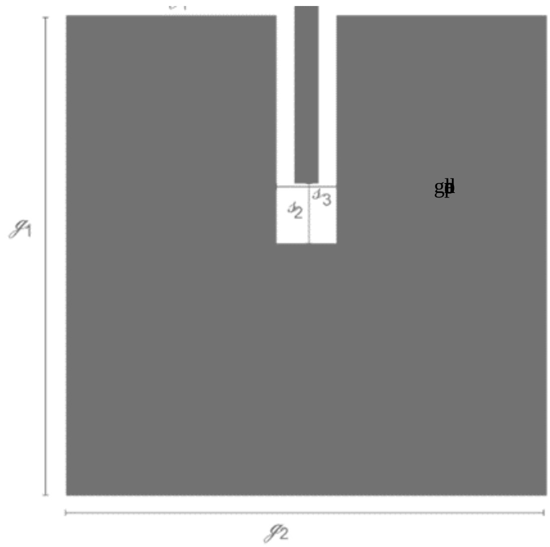

Fig 5. [illegible]

III.2. Antenna Port Design

[illegible] R [illegible] -SM [illegible] PCB [illegible] PCB. Fig 6 [illegible]

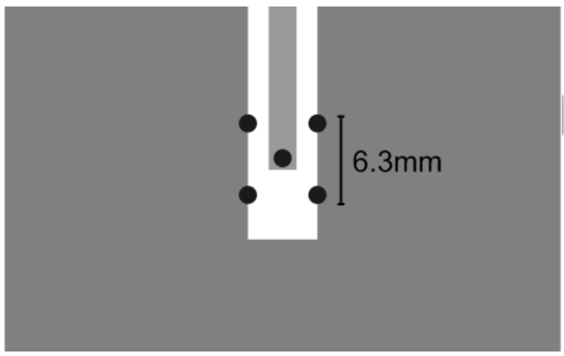

Fig 6. [illegible]

III.3. Simulation Setup

T[illegible] 3D FEM (Fi[illegible] E[illegible] M [illegible]

1. D[illegible] 3D [illegible]
2. [illegible] A[illegible]
3. [illegible] D[illegible]

4. [illegible]

Fig 7 [illegible] 3D [illegible]

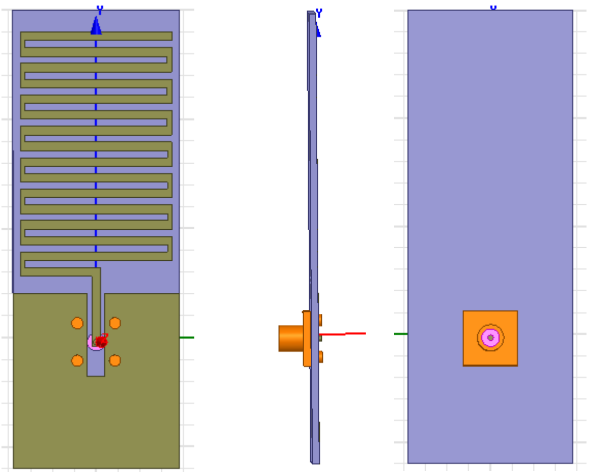

Fig 7 3D [illegible] FEM [illegible]

III.4. Hardware Implementation and Measurement

Fig 8 [illegible] 433 [illegible] FR-4 PCB. [illegible]

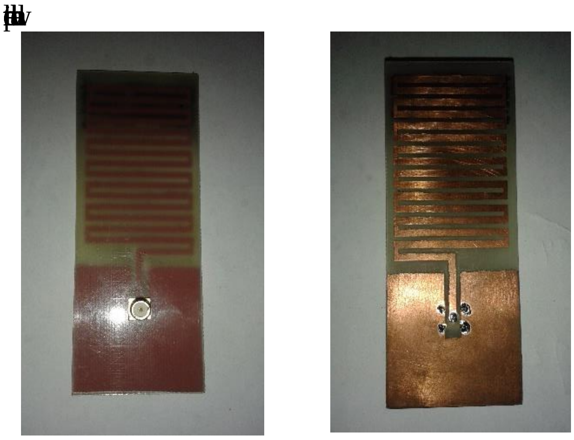

Fig 8. [illegible]

[illegible] AA1400 [illegible] (Z L).

IV. Result and Discussion

[illegible]

IV.1. Antenna Gain and Radiation Pattern

[illegible] 0 [illegible] 90 [illegible] -90 [illegible] 1.1 dB [illegible] 0 [illegible] Fig 9 [illegible]

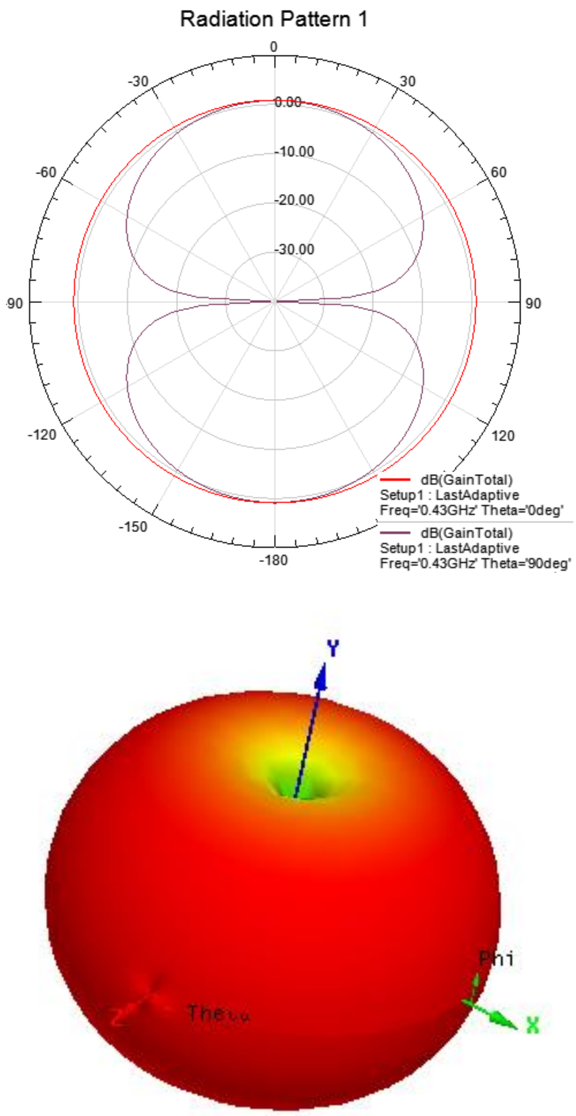

Fig . 9. [illegible]

IV.2. Standing Wave Ratio

From [illegible] SWR [illegible] Fig. 10. [illegible] S11 [illegible] -10 dB) [illegible] 430 MHz [illegible] 440 MHz [illegible] 10 MHz [illegible]

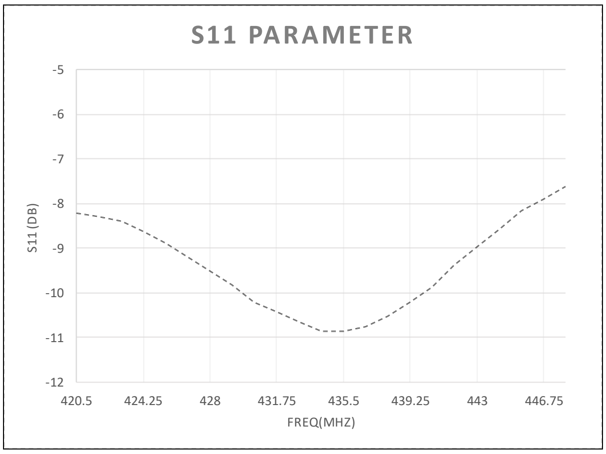

Fig. 10. S11 [illegible]

[illegible] 433 MHz [illegible] S11 [illegible] -10.65 dB. [illegible] 1.83. [illegible] (Z_L) [illegible] 27.3 Ω.

[illegible]

V. Conclusions and Future Works

[illegible]

a. A [illegible]

b. [illegible]

c. [illegible] 1.1 [illegible]

d. [illegible] SWR [illegible]

Acknowledgements

[illegible] is a part of Design [illegible] Antenna [illegible] 2017. [illegible] Department of Electrical Engineering [illegible]

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