

# Triband CPW Fed VEL-Shape Monopole Antenna for 5G Applications

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**Abstract :** This article presents a VEL-shape Triband monopole antenna for 5G applications. The designed antenna consists of CPW Fed VEL shaped radiating patch. The designed antenna has a compact size of  $18 \times 18 \times 1.6 \text{ mm}^3$ . The designed antenna made up of FR-4 dielectric substrate. The simulated result of reflection coefficient of VEL shape patch is  $-34\text{dB}$ ,  $-26\text{dB}$ , and  $-43\text{dB}$  at 3GHz, 14GHz, and 29GHz respectively. The parameters like return loss, VSWR, far-field pattern are simulated and these values are more suitable for 5G applications.

**Keywords -** CPW fed, Triband, Gain, Radiation Pattern, Bandwidth, 5G applications.

## 1 INTRODUCTION

Recently the antenna researches in the communication field developed the multiband micro size CPW fed radiator for 5G applications. But this advancement is not yet reached in RAN communication. This is because of many reasons such as lack of beam forming network, lack of base station, etc. The spectral efficiency of 5G is far better than 4G; hence it can deliver high data rates and high speed spectrum sensing ability [1]. The low energy consumption is the primary aim of every system design [2]. That means at limited power we want to transmit more data. This can be effectively achieved by a 5G network. The design of the antenna plays a crucial role in the entire above-mentioned requirement. Some of the primary objectives of 5G technologies are ultra-reliable low latency communication, enhanced mobile broadband, massive machine-type communications. Normally the 5G antennas are operated in the frequency range over the sub 6GHz (cm wave band) and above 24GHz (mm-wave band) [4].

The Triband CPW Fed VEL shape monopole antenna for 5G application is designed and simulated. FR-4 dielectric material acts as the substrate for electro-mechanical stability. To compare with reference antenna, it has been observed that antenna parameters such as Gain, directivity, VSWR, the reflection coefficient are improved in VEL shape design.

The part 1 mentioned the introduction about the existing antennas and designed antenna. Part 2 explains the design steps of the antenna and its geometrical structure. Part 3 explains the simulated results of the designed antenna, and part 4 mentioned the conclusion of the work.

## 2 DESIGN OF VEL-SHAPE ANTENNA

The CPW fed has one central strip and two ground planes lie on the same plane since it has several advantages over the microstrip fed such as low attenuation, good impedance matching, easier for fabrication, not required an additional ground plane for monopole configuration [3], [12]. The FR-4 can be expanded as flame resistant and this is woven fiberglass with a binder of epoxy resin, hence this is a composite dielectric material. The main reason for using FR-4 dielectric material is to retain its high mechanical strength and electrical insulating nature in both wet and dry conditions. Here the patch and ground materials are annealed copper is chosen, because it provides minimum return loss at the corresponding resonant frequency.

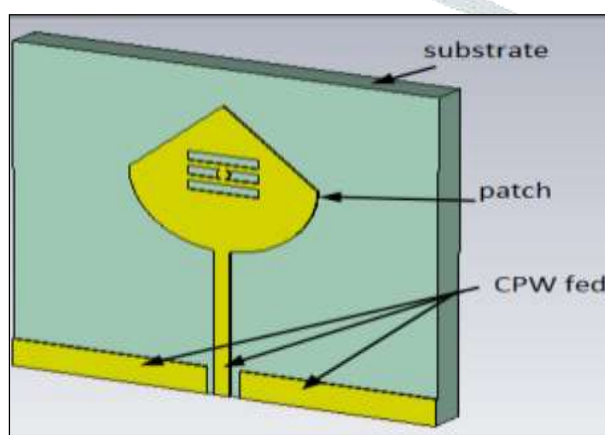


Fig.2.1. Perspective view of VEL shape antenna

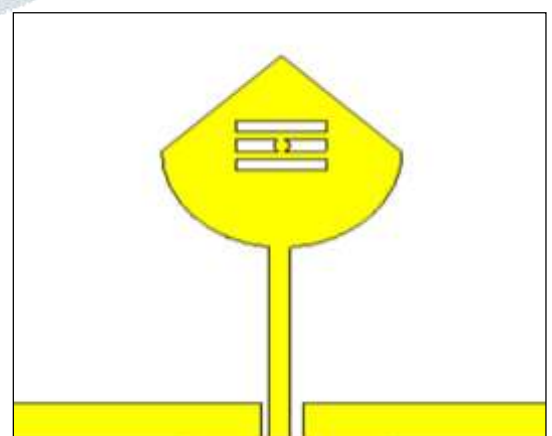


Fig. 2.2. VEL shape anetnna (front view)

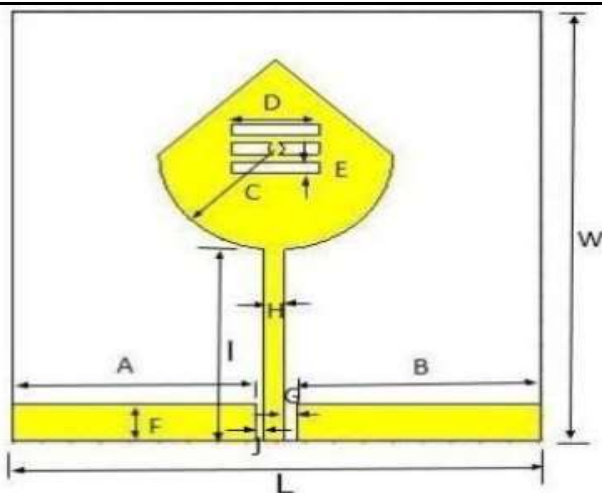


Fig.2.3. Geometrical representation of proposed antenna

Table.2.1.Dimensions of VEL shape antenna

Antenna dimensions	Values (mm)	Antenna dimensions	Values (mm)
A	8.3	G	0.4
B	8.3	H	0.7
C	4	I	8.1
D	3	J	0.3
E	0.5	L	18
F	1.5	W	18

The thickness of the substrate is mentioned in Fig.2.1. The front view of the VEL shape antenna is indicated in Fig.2.2, Fig.2.3 shows the geometrical view of triband CPW fed VEL shape monopole antenna. Here the FR-4 dielectric loss-free substrate material of size 18x18x1.6mm<sup>3</sup> is chosen. The gap between patch and ground plane is 0.3mm. The detailed tabular illustration of the dimensions is given in Table.2.1. The length and width of CPW fed are 1.5mm x 8.3mm.

### 3 RESULTS AND DISCUSSION

#### 3.1. Return Loss and VSWR

The loss of power due to the mismatch between the Zo of TL and Zin of an antenna is known as return loss [5], [6]. The VEL shape antenna RC values are -35dB at 3GHz, -26dB at 14GHz and -43dB at 29GHz. Fig.3.1 shows the magnitude of RC versus frequency plot of circular antenna and VEL-shape antenna. The VEL shape patch minimized its return loss parameter without increasing the size concerning with stage1 circular patch antenna. VSWR shows the mismatch between the connector and the CPW fed or antenna. VSWR stands for Voltage Standing Wave Ratio [7]. The value of VSWR should be one in an ideal situation, less than or equal to two is acceptable for wireless communication [8], [9]. Fig.3.2 shows the VSWR versus frequency plot of the circular patch and VEL shape antenna. The VSWR values of the designed VEL shape antenna are 1.14 at 3GHz, 1.10 at 14GHz, and 1.01 at 29GHz.

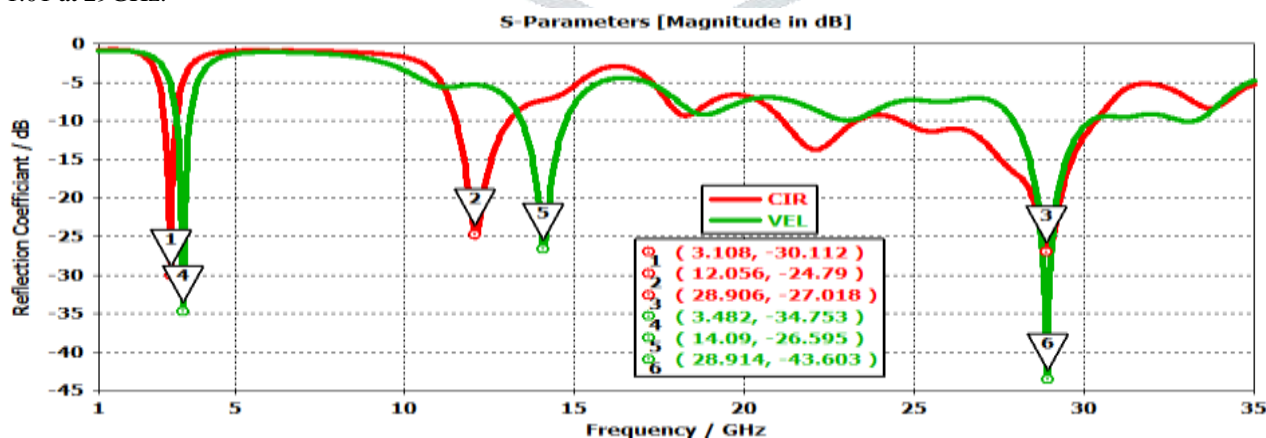


Fig. 3.1. Magnitude of RC versus Frequency plot of VEL shape antenna

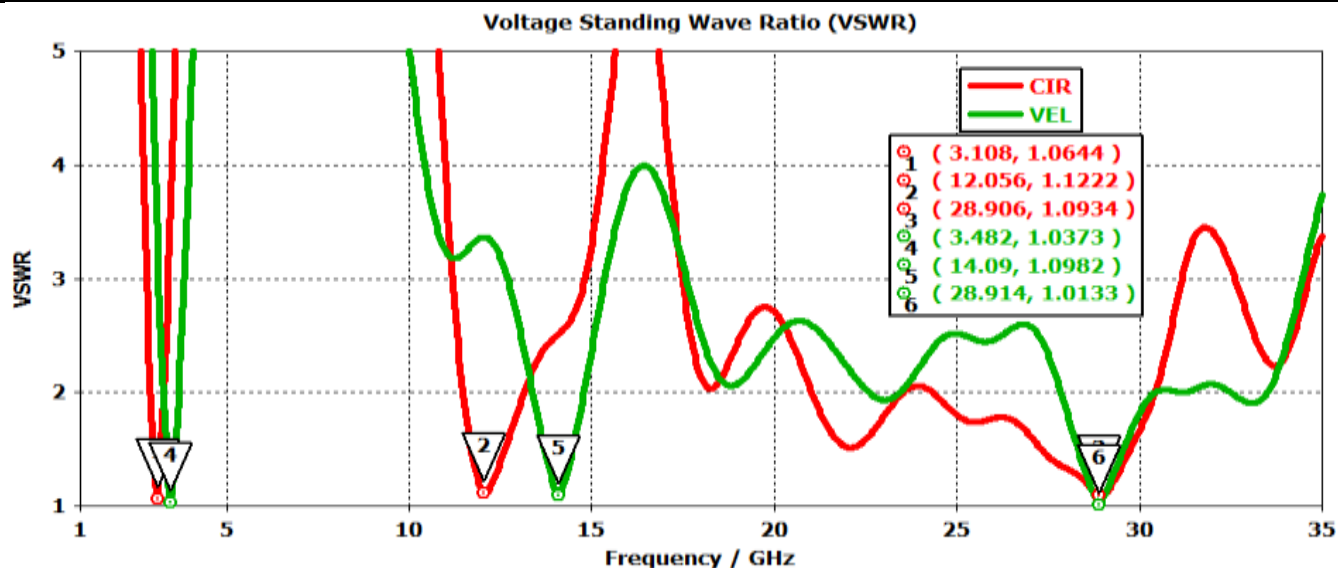


Fig.3.2. VSWR Versus Frequency Plot of VEL shape antenna

### 3.2. Gain and Field Pattern of VEL Shape Antenna

The concentration of the radiation intensity in a particular direction is called the gain of the antenna [10]. The gain pattern of the designed antenna seems to be an omnidirectional radiation pattern. Fig.(3.3-3.5) mentioned the 3D plot of directive gain of VEL shape antenna. The VEL shape antenna the directivity values of 2dBi, 6.7dBi, 6.6dBi at frequencies of 3GHz, 14GHz, and 29GHz respectively. The angular distribution of radiated power is represented in terms of field intensity (E and H field) is called the far-field pattern of the antenna [11]. The E plane pattern indicated the direction of the electric field. The H plane pattern indicated the direction of the magnetic field. For the E plane pattern, theta is 90 degrees and phi is equal to constant. For the H plane pattern, theta is equal to 0 degrees and phi is equal to constant. Fig.(3.6-3.8) indicated the electric and magnetic field plots of VEL shape antenna at 3GHz, 14GHz, and 29GHz.

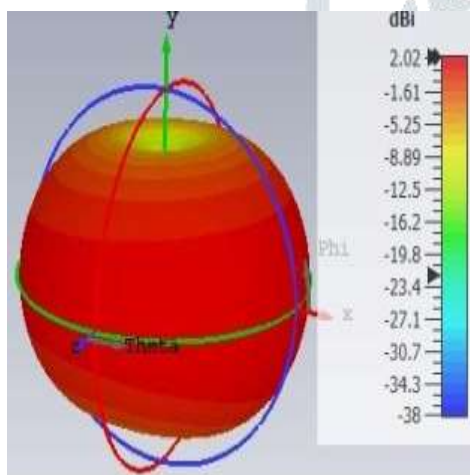


Fig.3.3. 3D plot of directivity at 3GHz

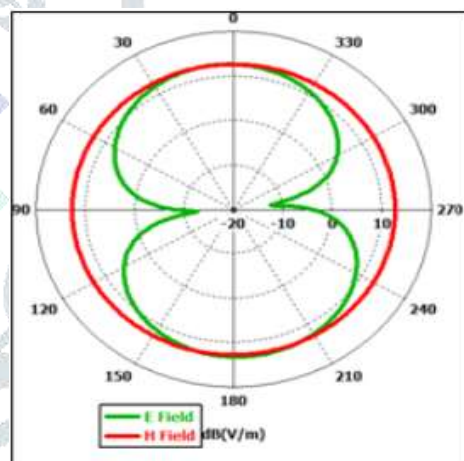


Fig.3.6. Electric and magnetic plot at 3GHz

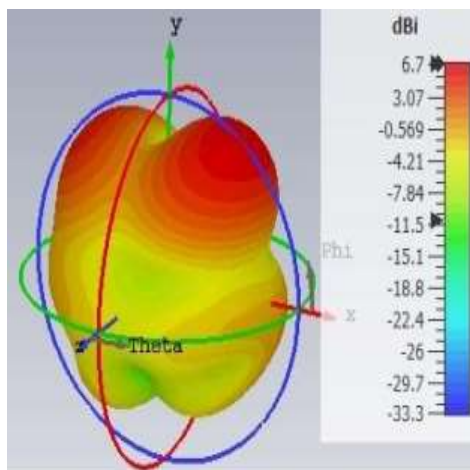


Fig.3.4. 3D plot of Directivity at 14GHz

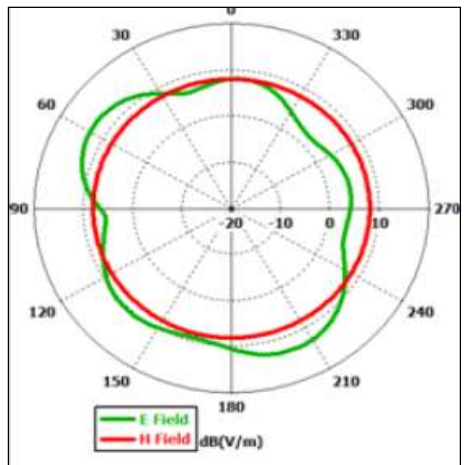


Fig.3.7. Electric and magnetic plot at 14GHz

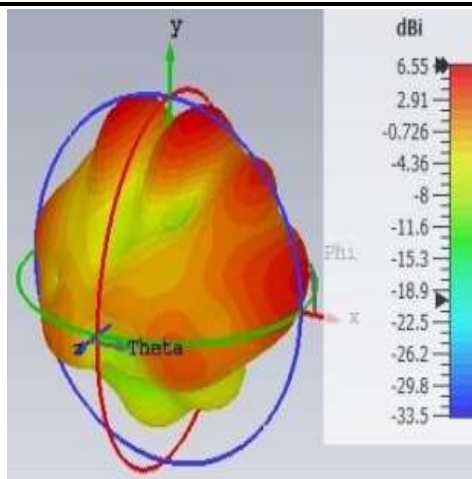


Fig.3.5. 3D plot of Directivity at 29GHz

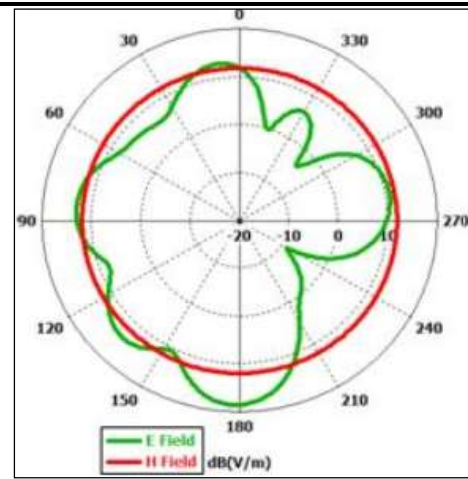


Fig.3.8. Electric and magnetic plot at 29GHz

#### 4 CONCLUSION

The CPW fed VEL shape monopole antenna has been designed and simulated. The designed antenna operated three resonating frequencies are 3GHz, 14GHz, and 29GHz. The overall dimension of the designed antenna is  $18 \times 18 \times 1.6 \text{ mm}^3$ . The maximum value of the reflection coefficient is -43dB and the corresponding VSWR value is 1.01 at 29GHz frequency. The simulated results of the VEL shape monopole planar antenna are well suitable for outdoor 5G communication.

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