

Analysis and Design of Various Noval Microstrip Patch Antenna By Deepak & Dhaynendra Parashar

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Abstract

In today's modern communication industry, antennas are the most important components required to create a communication link. Microstrip antennas are the most suited for aerospace and mobile applications because of their low profile, light weight and low power handling capacity. They can be designed in a variety of shapes in order to obtain enhanced gain and bandwidth, dual band and circular polarization to even ultra wideband operation. This paper provides a detailed study of the design of probe-fed Rectangular Microstrip Patch Antenna to facilitate effects of changing the feed point. By this paper we conclude that in the same patch we can take different feed points and same patch can be used for various applications. The main aim of this paper is to design various MSA for and analyze there results. For this first we simulate the results in IE3D and then we test these results practically after designing the hardware of the patch. In testing we find that our designed Microstrip antenna is very useful in Bluetooth technology for communication. The design parameters of the antenna have been calculated using the transmission line model and the cavity model. For the simulation process IE3D electromagnetic software which is based on method of moment (MOM) has been used.

Index terms— feed point, patch, return loss, bandwidth.

1 Introduction

ommunication between humans was first by sound through voice. With the desire for slightly more distance communication came, devices such as drums, then, visual methods such as signal flags and smoke signals were used. These optical communication devices, of course, utilized the light portion of the electromagnetic spectrum. It has been only very recent in human history that the electromagnetic spectrum, outside the visible region, has been employed for communication, through the use of radio. One of humankind's greatest natural resources is the electromagnetic spectrum and the antenna has been instrumental in harnessing this resource.

Many wireless service providers have discussed the adoption of polarization, diversity and frequency diversity schemes in place of space diversity approach to take advantage of the limited frequency spectra available for communication [1][2][3][4][5][6][7][8][9][10]. Due to the rapid development in the field of satellite and wireless communication there has been a great demand for low cost minimal weight, compact low profile antennas that are capable of maintaining high performance over a large spectrum of frequencies. Through the years, microstrip antenna structures are the most common option used to realize millimeter wave monolithic integrated circuits for microwave, radar and communication purposes. Compact microstrip antennas capable of dual polarized radiation are very suitable for applications in wireless communication systems that demand frequency reuse and polarization diversity.

2 a) Aim and Objective

The main aim of this paper to provide the very efficient bandwidth and return loss. For achieving this we designed many Microstrip antenna and obtained good results. If bandwidth is good then it can be used to any type of

7 SIMULATION RESULTS

43 application. In here my work defines that at different feed points [41, ??2] we can get a useful bandwidth where
44 we can use the different devices. The performance comparison is based on, return loss, and bandwidth at all
45 four different feed points in first MSA. In second patch we have simulate the patch at 4GHz, 5GHz, and 6GHz
46 frequency and we find wideband width. And in third patch [37,39] describe the phenomena of dual band.

3 II.

48 Dimensions Calculation of 1 st Proposed Antenna The width of the Microstrip patch antenna [36] is given by
49 equation (1) as: $W = \frac{c}{2f_r} \sqrt{\frac{2}{\epsilon_r + 1}}$

50 Substituting $c = 3e8$ m/s, $f_r = 4$. The transmission line model is applicable to infinite ground planes only.
51 However, for practical considerations, it is essential to have a finite ground plane. It has been shown by [9] that
52 similar results for finite and infinite ground plane can be obtained if the size of the ground plane is greater than
53 the patch dimensions by approximately six times the substrate thickness all around the periphery. Hence, for
54 this design, the ground plane dimensions would be given as: $L_g = 6h + L = 6(1.6) + 23.97 = 33.57\text{mm}$ (6)

55 F_{max} and F_{min} are frequency is maximum and minimum frequency at below -10db .In here $F_{max} =$
56 2.691GHz $F_{min} = 2.054$ we get $B(\%) = 26.84\%$.

57 Similarly for each feed point we can calculate the bandwidth of the patch. Now form the above results we
58 conclude that the proposed antenna give the various results at different feed points ,and all the results are useful
59 for communication field without changing any other parameter we have found the useful results at all the feed
60 points. At the 2 nd feed point we have getting the best results in all others the feed points. From the above
61 given table we can see that return loss is goes below -10 db at frequency 2.10GHz and the maximum return Loss
62 is obtained at frequency 2.32GHz is -41db. Return loss again goes above -10db at frequency 2.65GHz.

63 So from here we can calculate the bandwidth of patch at second feed point, because we test these patch at
64 second feed point.

65 $\text{Band width } (\%) = \frac{2.65 - 2.10}{2.65 + 2.10} \times 100 = 23.15\%$

66 In the simulation we have find out these bandwidth is 31.25% between frequency 1.979 GHz to 2.71GHz and
67 return loss is -51db. But as we already consider that due to various effects these results can be vary. But if we
68 optimized then we can get more effective results.

69 In the given table comparison is shown between simulated and actual testing results

4 Table 2 : Comparisons between Simulated and Testing

5 Results

6 Specifications

73 Testing Results

7 Simulation results

75 Return Loss -41 -51 Band width (%) 23.15 31.25 h) Inverted T Shape Microstrip Antenna [43,44,45] As we
76 know the main drawback of microstrip patch antenna is its narrow bandwidth but it can be improved by various
77 techniques. In here we are taking a patch and we simulate it 4GHz, 5GHz and 6GHz frequency and we observe
78 that when we goes to higher frequency its bandwidth is improved. And at 6GHz we also obtained dual bandwidth.
79 So our main work in here to improve the bandwidth of the patch by allocating the feed point at same location.

80 From the above formulas in we can calculate the W and L of the patch for different frequencies, table 4.4 are
81 given below for the W and L. In this work we are having the three same type of patch, but for each patch W and
82 L are change because frequency for each patch are change. But in here we are shown the entire patch at 4GHz,
83 5GHz and 6GHz A proposed inverted T shapes patch is analyzed with a 4GHz, 5GHz, and 6GHz. This is found
84 that by varying the operating frequency the size of patch changed [table. ??4] and a result is also changed [table
85 ??]. At 4GHz, 5GHz, 6GHz frequencies antenna parameters return loss, bandwidth are measured and compared.

86 At 4GHz frequency we take a feed point at $X = 5.425$ and $Y = 10.625$, in here we are using a coaxial probe
87 feed. From the results we conclude that the return loss is maximum at 4GHz And the minimum, return loss is
88 at 6GHz. When we conclude the bandwidth of the patch then maximum bandwidth is 50%, obtained at 5GHz
89 and minimum bandwidth is 42.42% at 4GHz (accept 1 st band at 6GHz). The main important result in here is
90 dual bandwidth is obtained at 6GHz, which can be used in various application. In the above work we have found
91 that by changing the operating frequency and keeping feed point area constant, it is seen that as bandwidth is
92 improves. We are getting single band at 4GHz and 5 GHz while as at 6GHz we obtained dual band of 4.74% and
93 47%. It suggests that the microstrip antenna performance can be upgraded by using the proposed inverted T
94 shaped patch antenna. The main focus is our work, that we are not changing the feed point area. By our work
95 compactness of microstrip patch antenna can be achieved. Return loss is a measure of the reflected energy from a
96 transmitted signal which is commonly expressed in positive dB. The larger the value the lesser is the energy that
97 is reflected. From the figure we can see that dual band width is obtained. The first Band at frequency between
98 1.87GHz -2.08GHz, and the maximum return loss at here is -26db. From this band we can find out the 10.63%
99 bandwidth by using following equation.

100 The second band of this microstrip antenna, we are obtain at frequency range 2.3GHz-3.0GHz and maximum
101 return loss is here -20db and the bandwidth is 26.41%.The return loss should be -10db is satisfactory for this
102 patch to provide better results.

103 But when we actually test this patch then we obtain some changes in results. The return loss of first band is
104 obtained same as simulation but return loss of second band is goes to -32db.s III.

105 8 Conclusion

106 We have designed various novel wideband microstrip patch antennas. The characteristics of proposed antennas
107 have been investigated through different parametric studies using IE3D simulation software. The proposed
108 antennas have achieved good impedance matching, stable radiation patterns, and high gain. The work in this
109 paper primarily focuses on the study of various results on the same patch which give the useful results, and the
110 bandwidth can be used in various applications.

111 IV.

112 9 Suggestions for Future Works

113 The proposed patch is simulated at 3GHz frequency and we seen that at all the feed points the return loss is
114 below -10db. At all the feed point we have obtain the bandwidth. This patch is simulated only on 3GHz, but
115 if simulation is done at higher frequency then it may be possible theata wide bandwidth obtain and if this is
116 possible then we can use the proposed antenna at any feed point. From this work we can prove that a single
117 patch antenna can be used at much application.

118 From second patch it may be possible that feed point location is not changed but results can be improved when
119 we goes toward higher frequency. In future if we design a patch at low frequency and bandwidth is satisfactory
120 for applications then we can also attained satisfactory results at higher frequency at same feed point location
121 .but due to limitations of testing in here we are only simulated results obtained from IE3D.

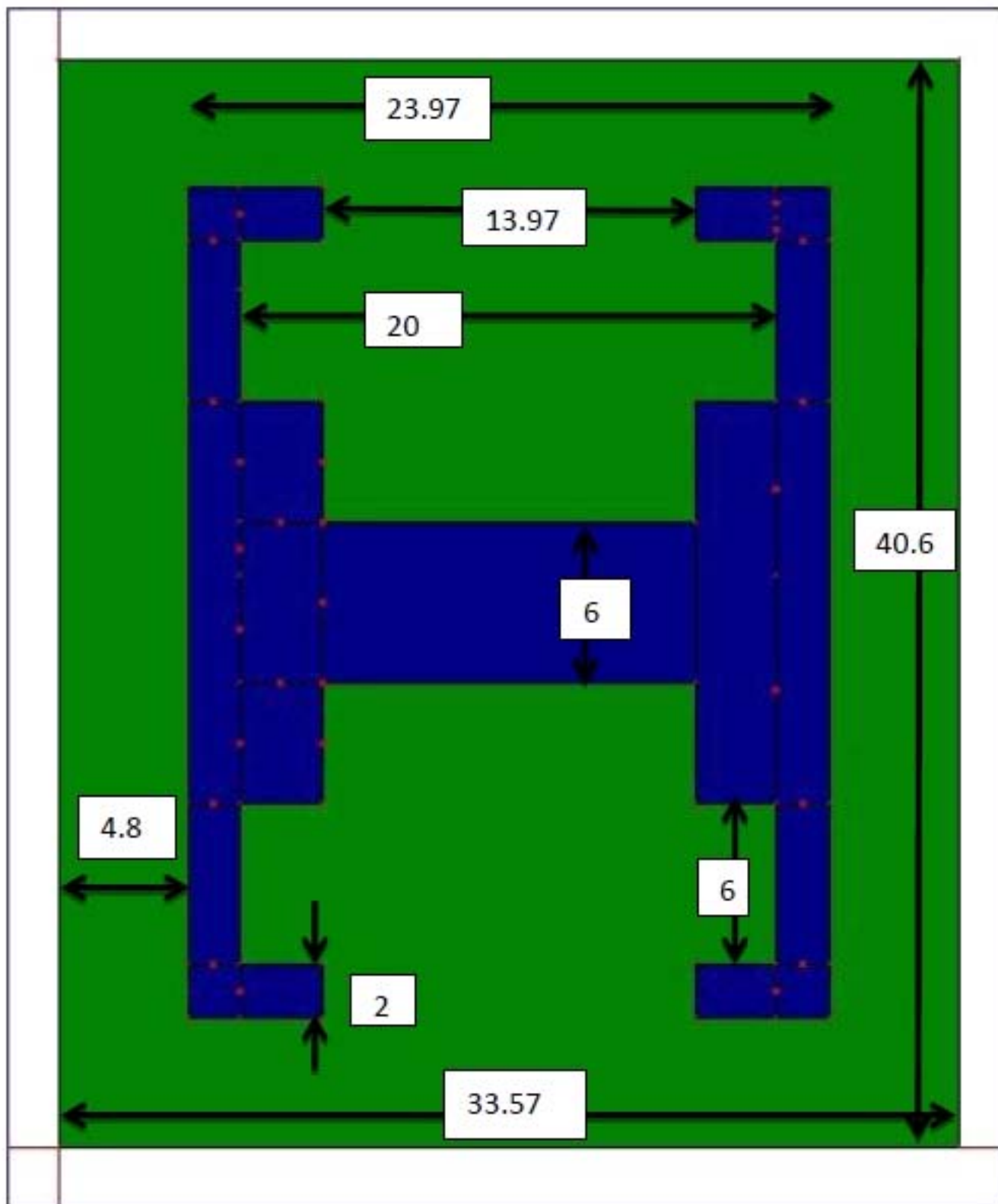
122 From last H shape patch we attained a dual bandwidth, we have seen that second band of result is goes below
123 -10db at frequency 2.3GHz to 3 GHz. And this bandwidth can be improved if we simulate same H patch at
124 higher frequency above to 3GHz. The bandwidth of this band can be improve in future, but due to limitations
125 in testing for patch above 3GHz we are goes on above 3GHz.

126 10 XIII Issue XVI Version



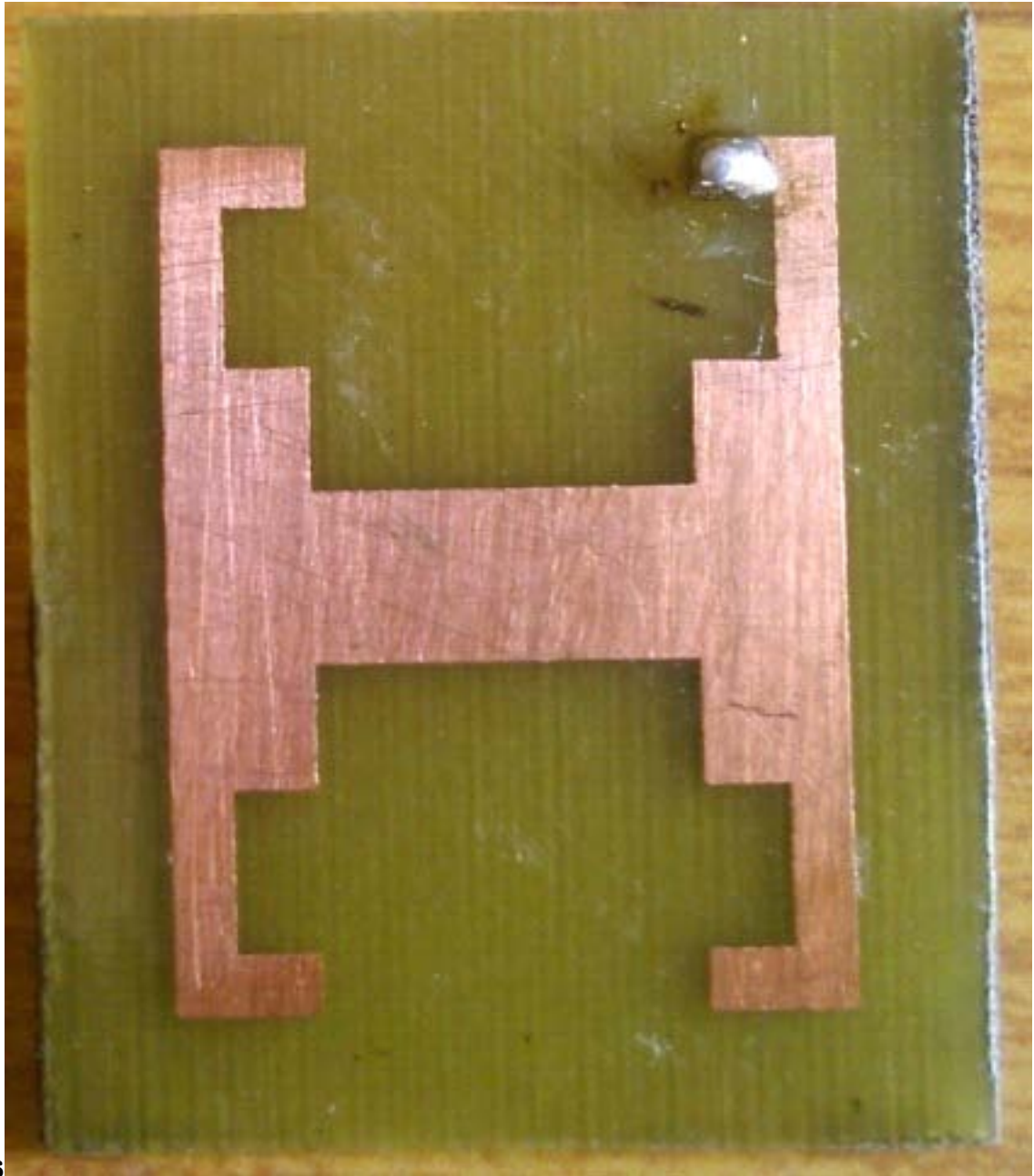
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Figure 1: Figure 1 :Figure 2 :



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Figure 2: $\epsilon_r = 2$ and $f_r = 3$ GHz



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Figure 3: Figure 3 :Figure 4 :Figure 5 :Figure 6 :

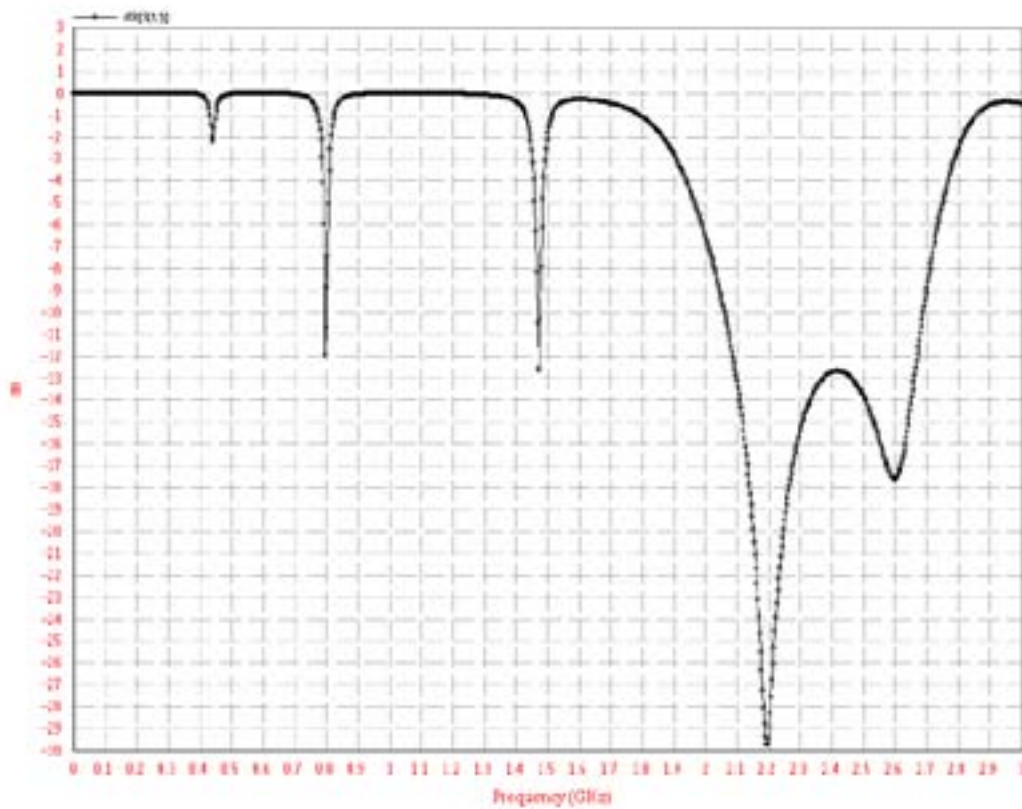
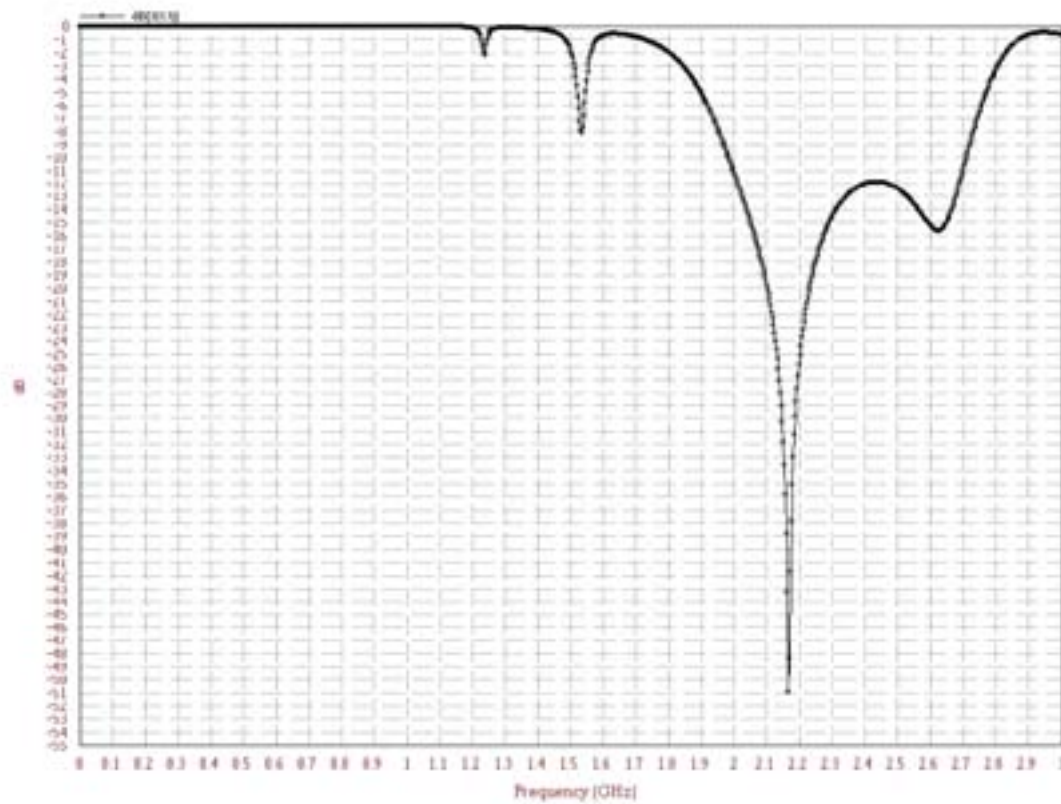
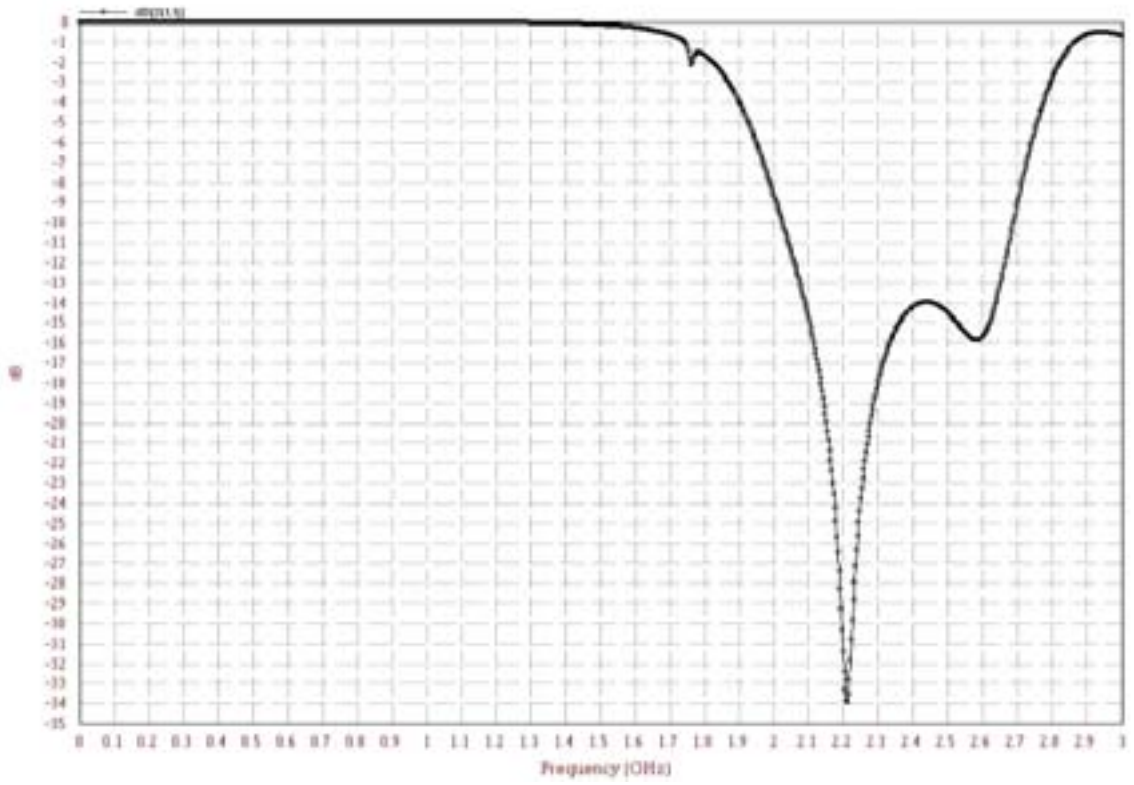


Figure 4:



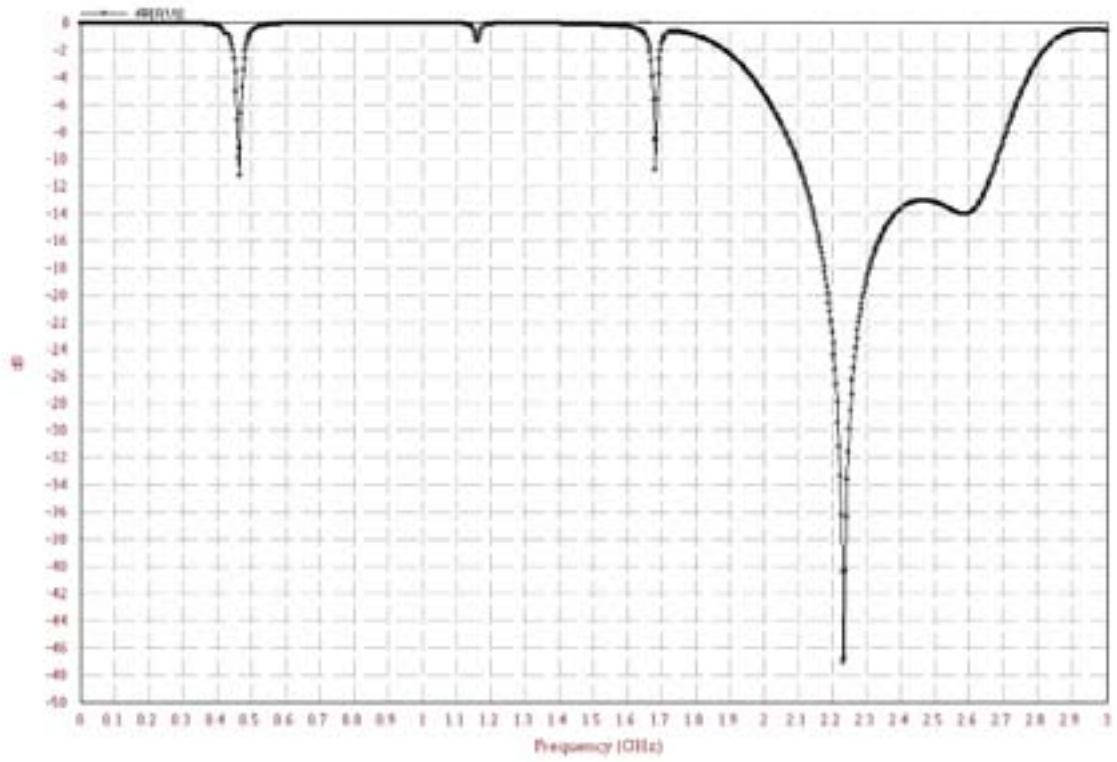
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Figure 5: Figure 7 :Figure 8 :



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Figure 6: Figure 9 :Figure 10 :Figure 11 :



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Figure 7: Figure 12 :

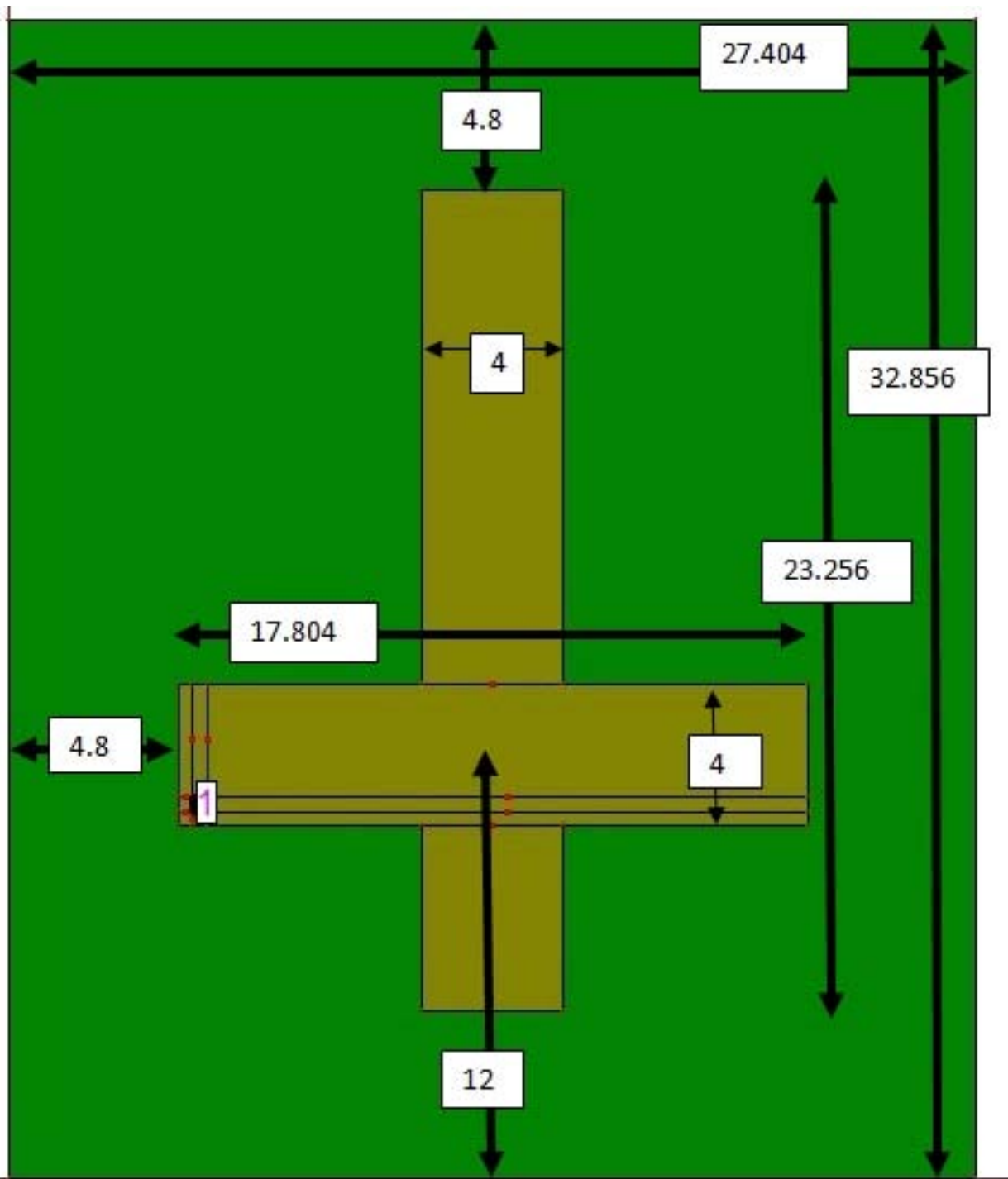


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Figure 8: Figure 13 :Figure 14 :Figure 15 :



Figure 9:



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Figure 10: Figure 17 :

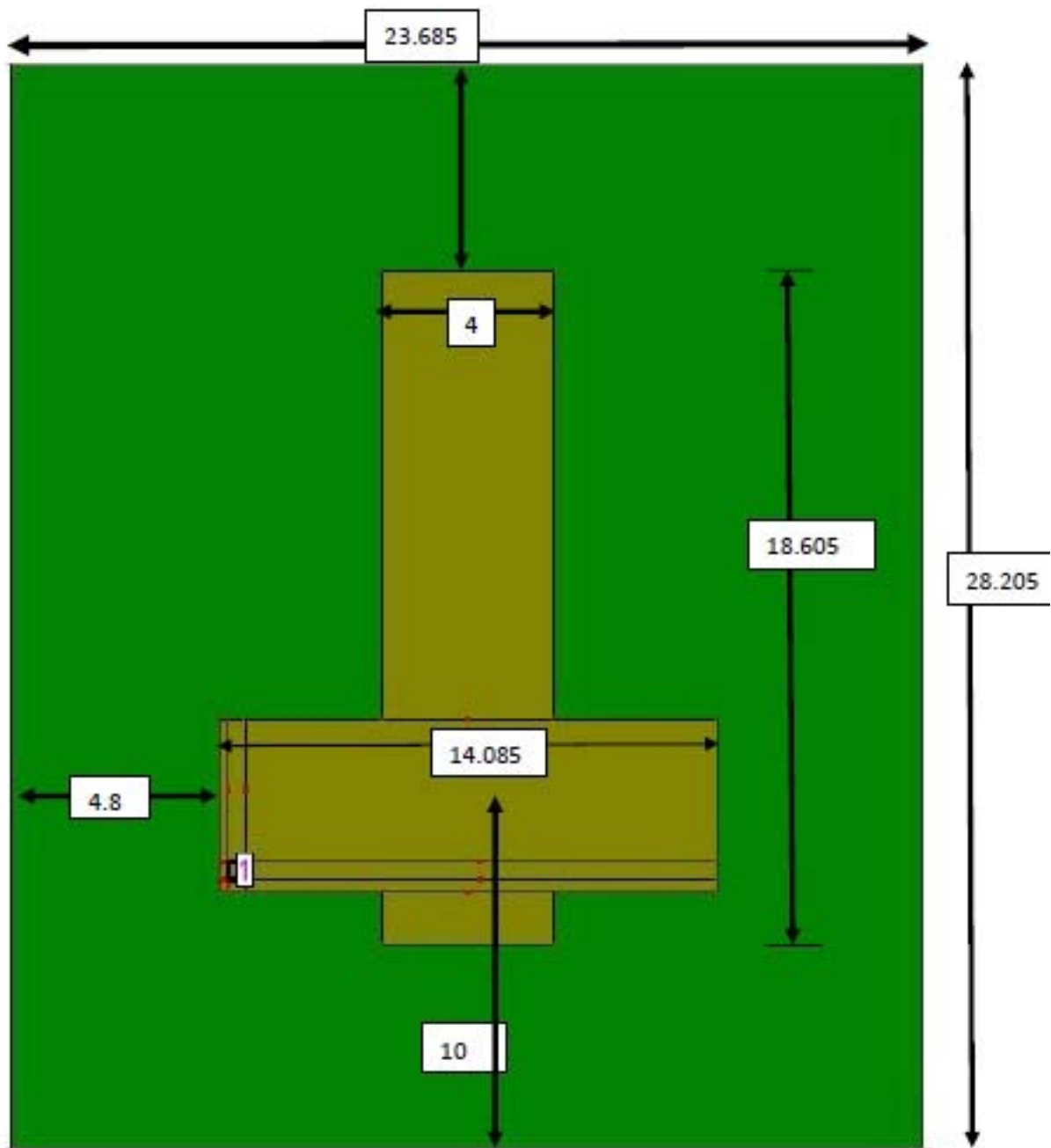
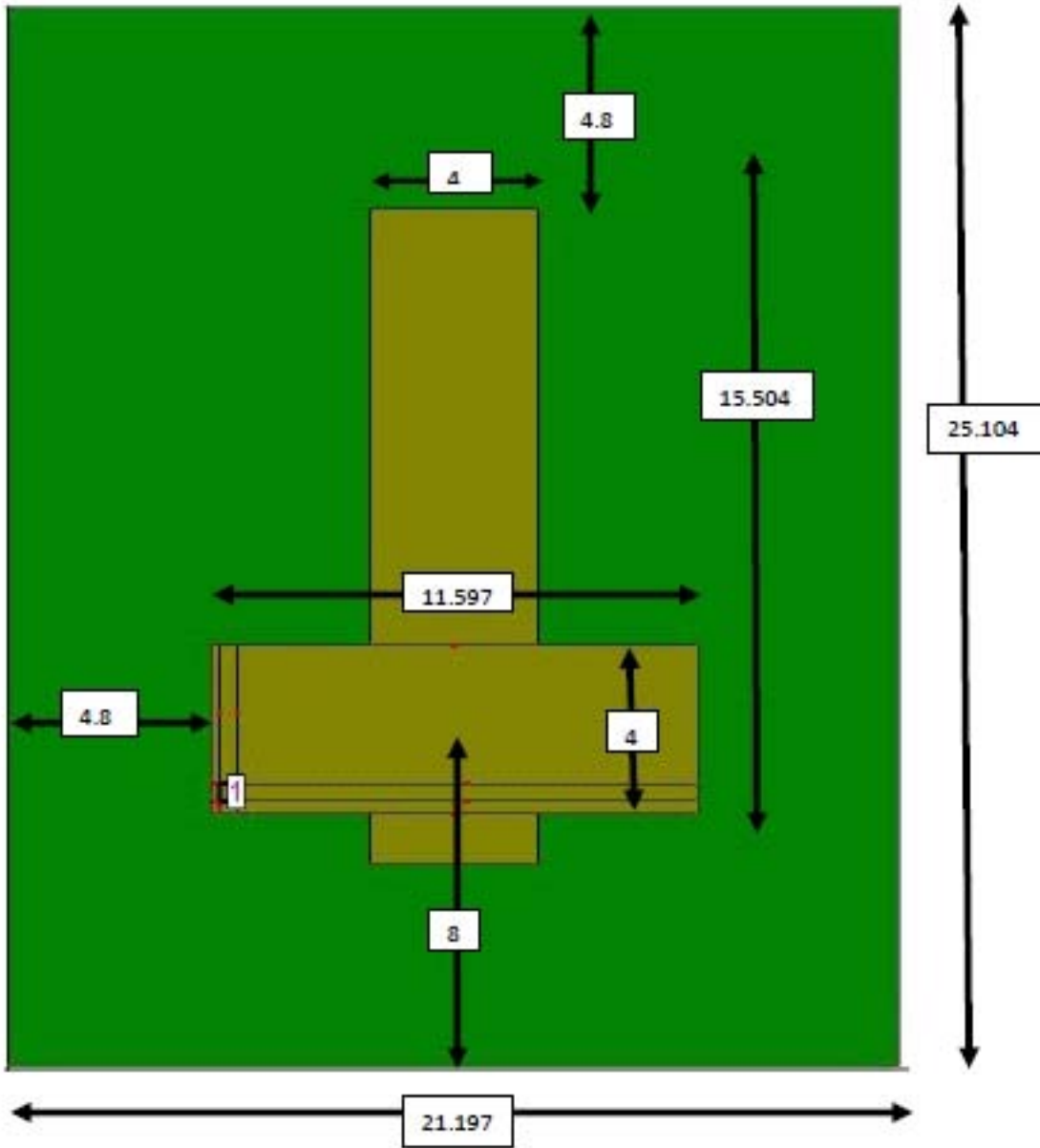


Figure 11:



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Figure 12: Figure 18 :



19

Figure 13: Figure 19 :

1

Feed points	1	2	3	4
X	24.575	7.75	8.525	24.875
Y	35.075	35.25	5.875	5.875
Return Loss	30	51	34	47
Bandwidth	26.84%	31.25%	28.69%	25%

Figure 14: Table 1 :

3

	4Ghz	5Ghz	6Ghz
W g (mm)	32.856	28.205	25.104
L g (mm)	27.404	23.686	21.197
W e (mm)	23.256	18.605	15.504
L e (mm)	17.804	14.085	11.597

Figure 15: Table 3

4

Specifications	4GHz	5GHz	6GHz
X(mm)	5.425	5.375	5.225
Y(mm)	10.625	8.65	6.5
Band	Single	Single	Dual
Band Width (%)	42.42	50	4.74 (1 st Band) 47 (2 nd Band)
Return Loss	-32	-28	-19 -20

Figure 16: Table 4 .

5

Antenna Parameters	Dimension in mm
h	1.6
W g	40.6
L g	33.57
W p	23.8
L p	23.97
K 1 & K 2	8.445
L 1	3
W 1	3
I 1	4.8

Figure 17: Table 5 :

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1 2

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