A Comparision Analyis of 2X1 Series Feed Array Antenna for Satellite Applications

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ABSTRACT:--- This paper presents 2x1 series feed array antenna for satellite applications (8.1GHz-8.35GHz). Initially 2x1 series feed antenna is designed based on specifications, but this design didn't applicable for satellite applications. In order to applicable for desired frequency, slots are placed in the design. Various slots (I slot, Inverted U Slot and Plus Slot) are used to get desired specifications. Finally the designed antenna got better results for plus shaped slotted antenna which is resonating at 8.32GHz frequency with a return loss of -26.83dB, VSWR of 1.09 and gain of 7.27dB.This antenna is applicable for satellite applications.

Keywords: Array antenna; Series feed method; slotted design; Return loss; VSWR

INTRODUCTION:

The antenna plays a key role in communication systems because based on the antenna performance only signal transmission depends. Now-a-days most of the modern communication system requires high gain, low cost, simple structure, low profile, compact size antennas. The microstrip antennas satisfies such requirement because it has low profileed., low cost. But the limitations of microstrip patch antenna are narrow frequency band, low gain.

In order to increase the gain and bandwidth of microstrip patch antenna, instead of one radiating element , two or more elements are used. All these radiating elements are internally connected and transmits signal in the desired direction. These antennas are called Microstrip patch array antennas. Based on then requirement, radiating elements can be placed in planar,linear or in circular manner. There are three different feeding methods such as series feed, corporate feed, corporate series feed method [1].

There are two ways to design array antenna. They are changing the feed position or placing slots on structure. In [2] a 2x2 array antenna used circular ring shaped slot on antenna elements in order to get broad band and circular polarization operation. In [3] a 4x1 square microstrip patch antenna is designed for wire less applications using series feed. In [4] series feed and parallel methods are used for designing array antenna for C-band applications. Gain enhancement antenna is described in [5], compared slot performance with a regular antenna structure. In [6], the patch array antenna performance interns of radiation pattern is improved by using taper structure. In [7] symmetric and asymmetric feed arrays are designed for radar applications and their performance is compared.

The Proposed 2x1 series feed array antenna is designed for satellite applications. A rectangular and slotted antennas are designed and their performance compared. The antenna is designed by using HFSS software.

ANTENNA DESIGN:

The 2x1 array antenna using series feed is designed in HFSS software is shown in Fig.1.The antenna structure consists of three layers i.e ground plane, substrate and patch elements. The FR4 substrate is used with dielectric constant of 4.4. The dimensions of the 2x1 series feed array antenna is shown in table.1.

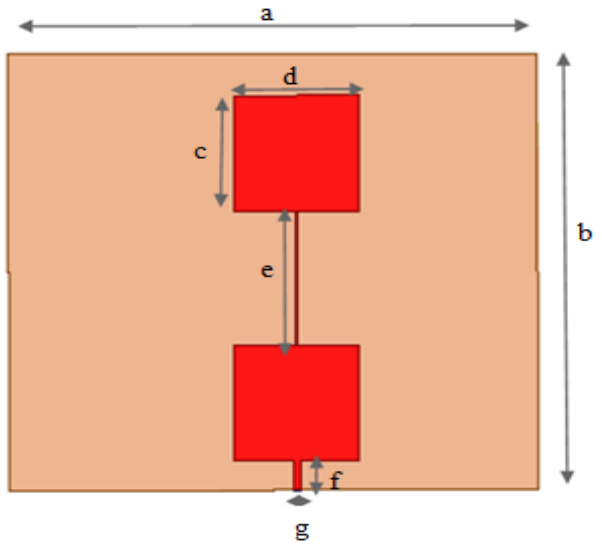

Fig.1:2x1 series feed array antenna

This 2x1 series feed antenna is resonating at a frequency of 8.46GHz with a return loss of -22.34dB and VSWR of 1.13 and gain of 7.3dB. The return loss plot is shown in Fig.2 and VSWR plot is shown in Fig.3.

Table.1: Dimensions of Series feed antenna

Parameter	Description	Value
A	Substrate width	34mm
B	Substrate length	30mm
C	Patch length	8mm
D	Patch width	8mm
E	Patch to Patch Distance	9.14mm
F	Feed line length	2mm
G	Feed line width	0.5mm

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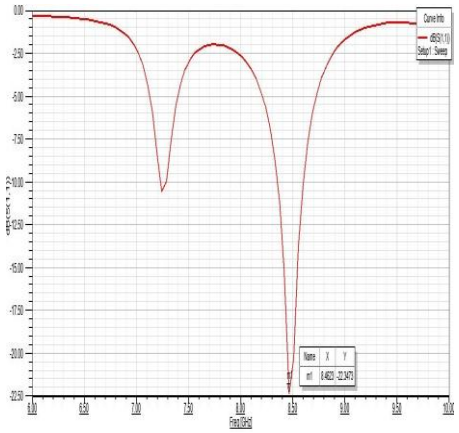


Fig.2: Return loss plot of 2x1 series feed

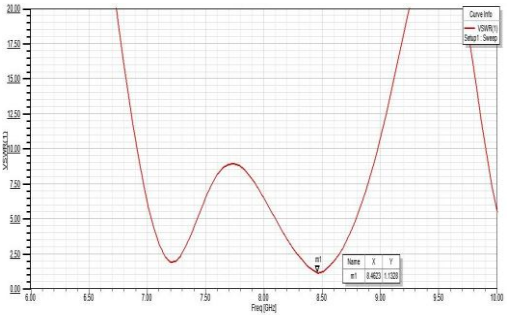


Fig.3: VSWR plot of 2x1 series feed

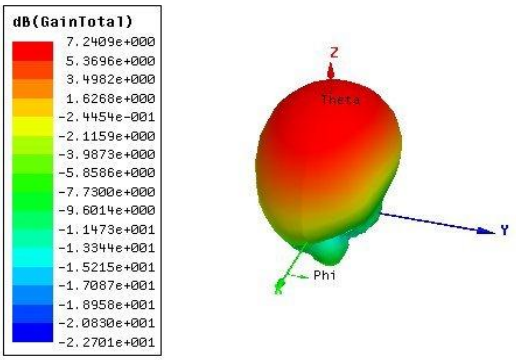
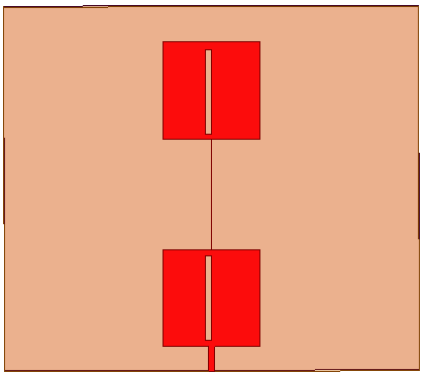
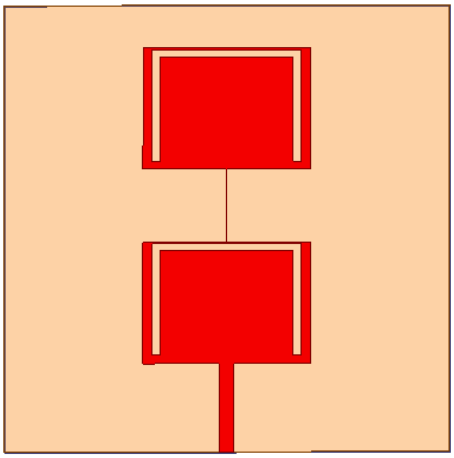


Fig:4. 3D gain plot of 2x1 series feed antenna

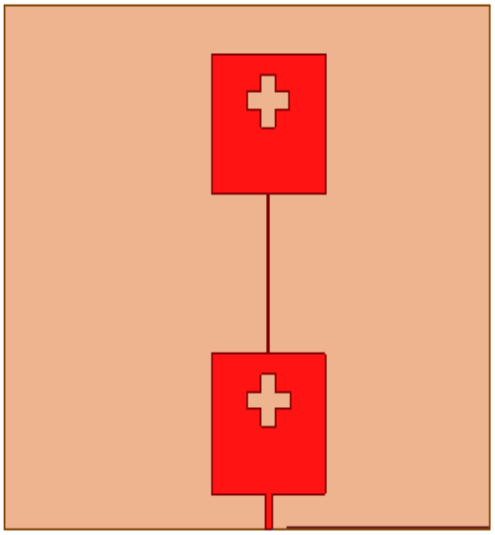
The proposed series feed antenna is not resonating in a desired frequency range. In order to resonate the design in specified frequency range (8.1GHz - 8.32GHz), different slots are placed in the array elements. The antenna is simulated for three different slots i.e I shape, inverted u and plus shaped slot.The Fig.5.shows slotted 2x1 series feed antenna.4



(a) I shaped slotted 2x1 series feed design



(b). Inverted U shaped slotted 2x1 series feed design



(c) Plus shaped slotted 2x1 series feed design

Fig.5: Slotted 2x1 array antenna designs

Initially, I shaped slot is placed in the antenna structure (shown in Fig.5(a)). In this case, the design is resonating at a frequency of 8.46GHz with a return loss of -22.85dB, VSWR of 1.15 and gain of 7.2dB. In this case also, the design is not resonating) in desired frequency range. So, Inverted U shaped slot and Plus shaped slots are placed on structure.

The inverted U shaped slotted 2x1 series feed antenna is shown in Fig.5(b), this design is resonating at a frequency of 9.42GHz with a return loss of -26.26dB, VSWR of 1.1and gain of 5.2 dB.

The Plus shaped slotted 2x1 series feed antenna is shown in Fig.5(c). This design is resonating at frequency of 8.32GHz with a return loss of -27.49dB, VSWR of 1.08 and gain of 7.27dB.

The Plus shaped slotted 2x1 series feed antenna is shown in Fig.5(c). This design is resonating at frequency of 8.32GHz with a return loss of -26.83dB, VSWR of 1.09 and gain of 7.27dB.

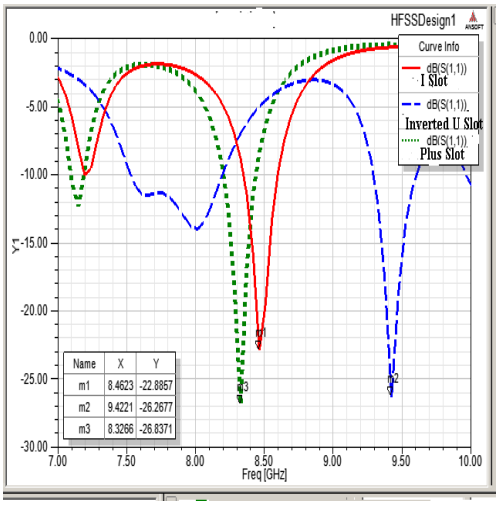


Fig.6. Return loss plot of slotted antennas

The Fig.6 shows the combined return loss plot of I, inverted U and Plus shaped designs and combined VSWR plots of slotted designs are shown in Fig.7.

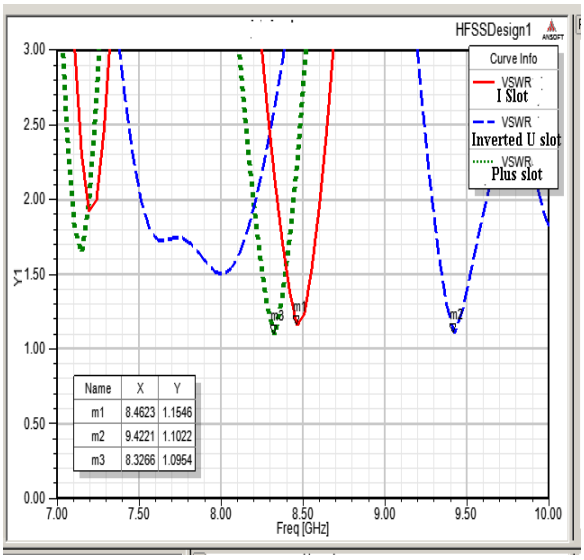
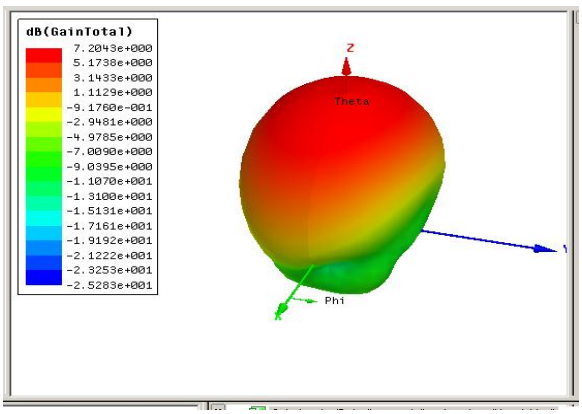
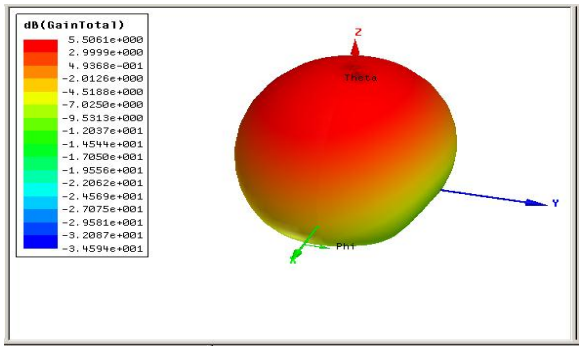


Fig.7. VSWR plot of slotted antennas

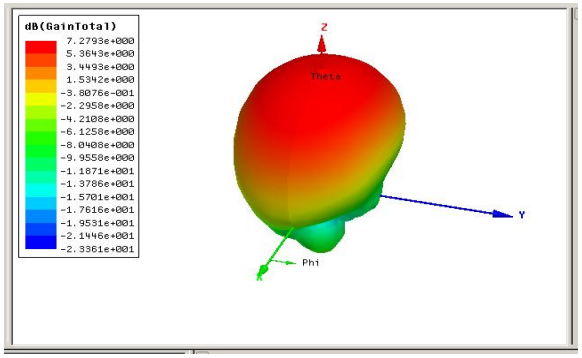
The Fig.8 (a) shows the gain plot of I slotted 2x1 series feed antenna and Fig.8(b) and (c) shows the gain plots of Inverted U and + shaped slotted antennas respectively



(a) I slot



(b) Inverted U slot



(c)Plus slot

Fig.8. 3D gain plots of slotted 2x1 series feed array antenna

The comparison results of slotted antennas are shown in Table.2. From these results, the 2x1 "I and inverted U" slotted designs are resonating at 8.46GHz and 9.42GHz.These designs are not suitable for satellite applications (8.1-8.35GHz). The Plus shaped slotted 2x1 design is resonating at 8.32GHz frequency. This antenna is suitable for satellite applications.

Table.2: Summary of results

Slot/ Parameter	Frequency	Return Loss	VSWR	Gain
I Slot	8.46GHz	-22.88 dB	1.15	7.2dB
Inverted U Slot	9.42GHz	-26.26 dB	1.1	5.2dB
+ Slot	8.32GHz	-26.83 dB	1.09	7.27 dB

CONCLUSION

2x1 series feed antennas are designed and compared. The plus shaped slotted 2x1 series feed antenna is suitable for satellite application when compared to other designs. The + slot antenna is resonating at 8.32GHs with better return loss i.e -26.83dB and gain 7.27dB values. All antennas are suitable for X-band applications.

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