"Omni-ultrawideband Antennas for Digital Satellite Receivers"

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Abstract

Recently, two kinds of the digital satellite receiver for radio and television have been developed as the global receiving system.

The frequency bands of the satellite radio system are ranging from 1,400㎒ to 2,600㎒, while the satellite television system are ranging from 11,000㎒ to 13,000㎒.

New anti-discorn antennas have been developed so that satisfies the Omni-characteristics in the horizontal directivity and approximately 45° elevation angle in the vertical directivity. These results were similar to the discorn antenna except the anti-vertical directivity.

Ⅰ. INTRODUCTION

Principally speaking, the discorn antenna in Fig. 1(b) was derived from the infinite biconical antenna in Fig. 1(a).

In this case the disk is equivalent to the upper side corner part.

On the other hand, the anti-discorn antenna in Fig. 2 is the same as the discorn antenna in Fig. 1(b), except the down tilt angle in Fig. 1(c) makes to around 45° elevation angle in Fig. 4(b) to satellite elevation.

This is the reason why the anti-discorn antenna in Fig. 2 was derived from the discorn antenna Fig. 1(b).

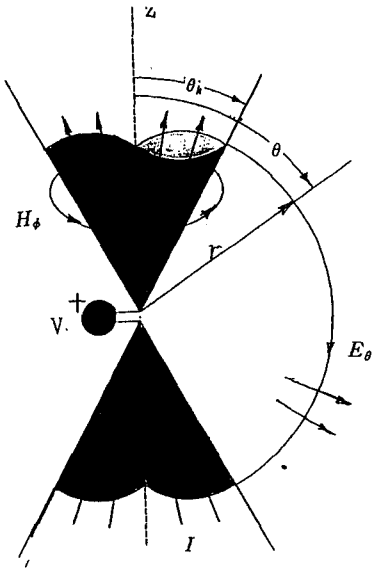

Fig. 1(a) Infinite biconical antenna

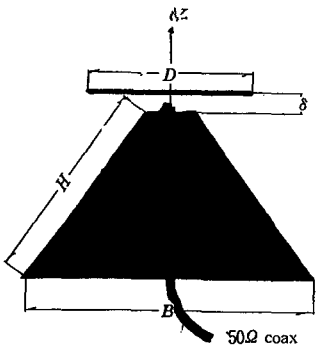

Fig. 1(b) Discorn antenna

The discorn antenna was used as the base station antenna for mobile communication or TV broadcasting antenna located on the top of the mountain. In these cases the dicorn antenna actes to decrease the interference caused by the over leached waves.

But, the vertical directivity of the anti-discorn antenna like as Fig. 4(b) is radiated around 45° elevation which has been characterized to the satellite communication from the ground station.

The characterization of this anti-discorn antenna was adjusted to the satellite receiver on the ground so that the moving receiver station should has omni in horizontal and 45° in vertical directivity. And also the bandwidth of these discorn antennas is characterized as the high-pass filtter. This is the reason why discorn ante-nna used to be called as the ultra-wideband characteristics.

II. THEORY and CHARACTERISTICS OF RADIO

(I) design theory

(1) Impedance of the antenna

$$Z\ell = \frac{V(r)}{I(r)} = \frac{Zo}{\pi} \ln \cot\frac{\theta n}{2} \quad ...(1)$$

$$= 120 \ln \cot\frac{\theta n}{2} = Zk \quad ...(1)'$$

$$\ln \cot\frac{\theta n}{2} = \ln\left[1/\tan\frac{\theta n}{2}\right] = \ln\frac{2H}{B} \quad ...(2)$$

$$H = \frac{\lambda}{4}(2n+1) \quad ...(3)$$

λ : cut-off wave-length

where $\theta n = 60° \sim 70°$: $Z\ell = Zk \sim Zo$ ...(4)

(2) Gain of the antenna(G)

$$G = \frac{2/F(Vo)^2}{\ln \cot\left(\frac{\pi+\phi}{4}\right)} \quad ...(5)$$

$$\text{Where } F(Vo) = \frac{1}{2}\int_0^{\omega}\left[J_{-\frac{1}{2}}(v) - jJ_{\frac{1}{2}}(v)\right]dv \quad ...(6)$$

$$Vo = \frac{\pi H \phi^2}{4\lambda} \quad .....(7)$$

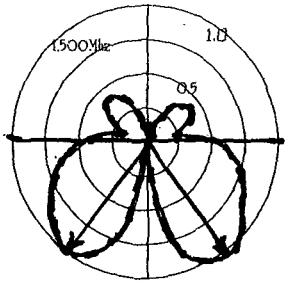

Fig. 1(c) Vertical directivity

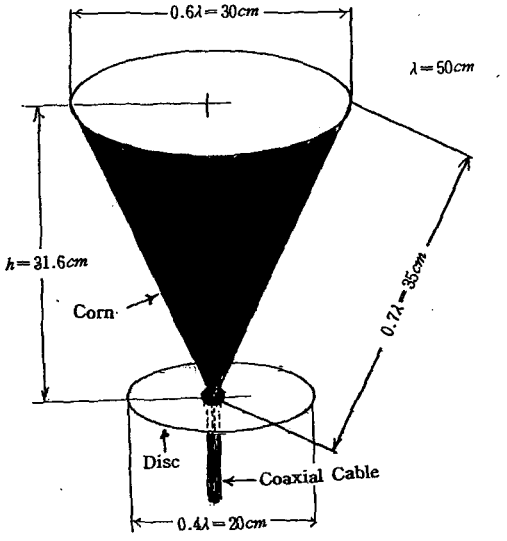

Fig. 2 Dimension of the 1,500㎒ band Anti-Discorn Antenna

(II) measured characteristics

The impedance and return loss as frequency are the following Fig. 3

(III)directivity of the horizontal and vertical are shown the following Fig. 4(a), (b)

Fig. 4 Calculated Patterns of the Antenna (a) Horizontal & (b) Vertical Directivity

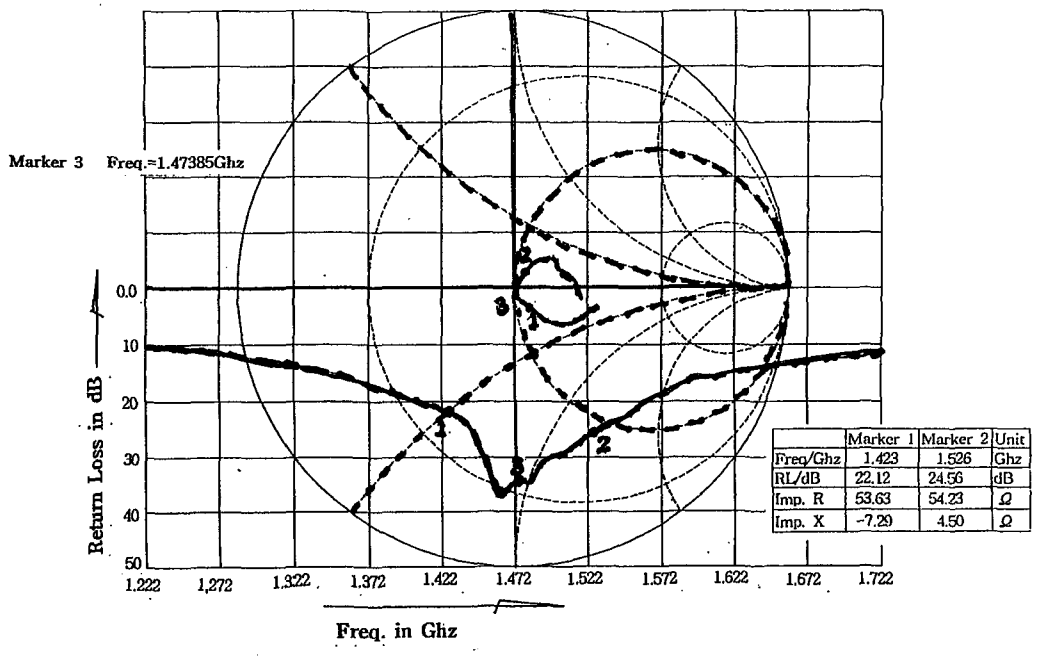

Fig. 3 Characteristics of the Reflectivity and Impedance on the Smith-chart

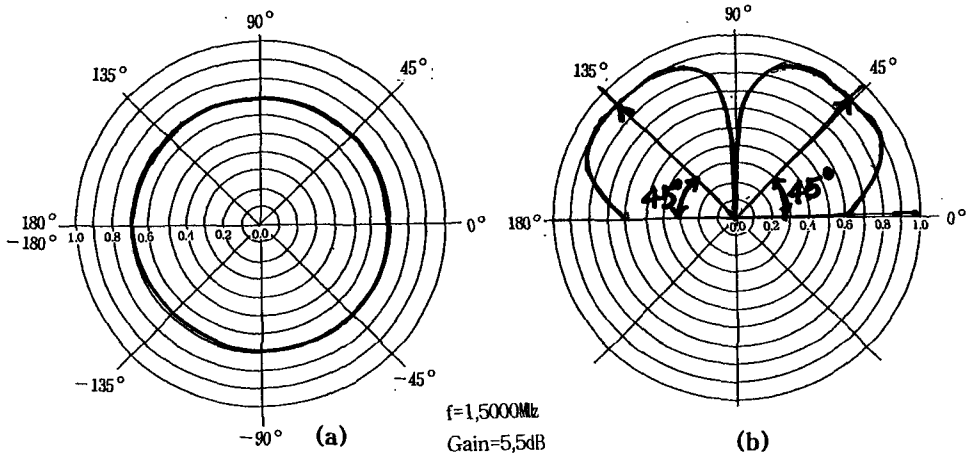

Fig. 4 Calculated Patterns of the Antenna (a) Horizontal & (b) Vertical Directivity

III. Designed single and array pattern for TV receiver

(I) Dimension of the designed single and array pattern

(II) Return loss characteristics of the single anti-discorn antenna

The return loss characteristics of the single antenna shows that the tuned frequency is 11.95 GHz.

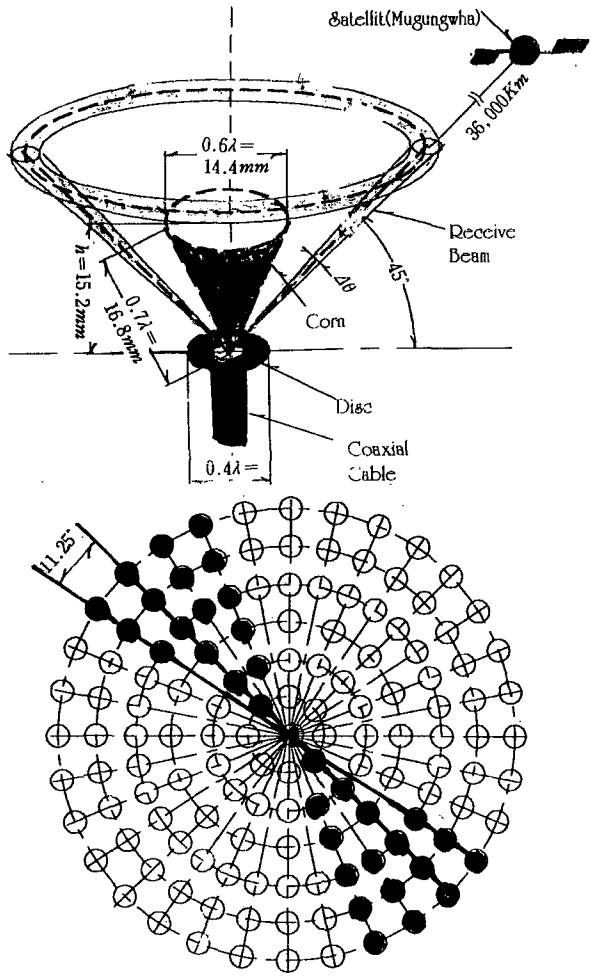

Fig. 5 Dimension of the Anti-Discorn Antenna with (a) Single and (b) Array (137ea)

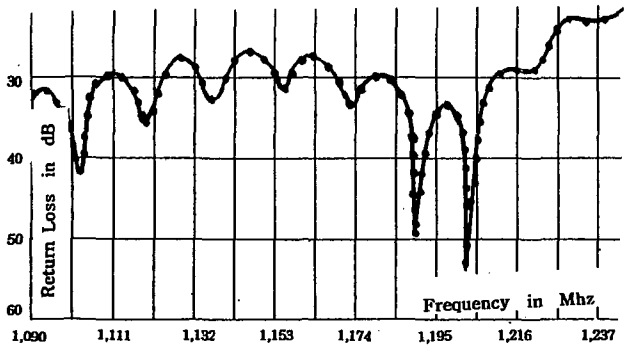

Fig. 6 Return loss characteristics over the 11GHz frequency bands

And the bandwidths around the tuned frequency are over 40GHz. There results are shown in Fig. 6

(III) Gain of the designed array antenna for the TV receiver.

Minimum gain(G) of the antenna should be larger than 27dB. In this case the radius of the layer should be bellow 15cm. And the height of the array antennas should be bellow 2cm. These results are the designed anti-discorn antenna with single and 137 arrayed antenna.

IV. CONCLUSION

The proposed anti-Discorn antenna has beer recognized as the most suitable antenna for the digital satellite receiver because of unadjustable characteristics of the anti-Discorn antennas.

This idea has been pending for a patent as of 26th July 2001.

V. REFERENCES

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