A HIGH-EFFICIENCY PARABOLOID REFLECTOR ANTENNA

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1. Introduction

There is a demand for a small and high-efficient antenna which is be able to use for the shipborne equipment for satellite telecommunications. In order to install it on a deck of the small boat, a diameter of antenna reflector is required to be less than about 0.9 meter. According to INMARSAT specifications, the antenna efficiency has to be larger than about 55 percent for 0.9 meter diameter antenna. As typical measured efficiency for front-fed paraboloid antenna with simple feeds (e.g., dipole with splash plate) are of the order 50-60 percent, it is difficult to achieve such high antenna efficiency for small size antennas.

We have developed a small front-fed paraboloid antenna with more than 69 percent efficiency using Quadrifilar Helix Antenna (QHA).

2. Characteristics of feed

In case of L-band circular polarized paraboloid antennas, crossed dipole antennas (CDA) with splash plate have been most commonly used for the feed. But CDA has disadventages as follows; (a) a radiation pattern is not axially symmetrical (b) front-to-back ratio is of about 5 dB with usual splash plate dimension(diameter of about 0.5 wavelength). (c) a splash plate blocks relatively large area in illuminated aperture plane

To overcome above disadventages, we have developed a backfire QHA, which is illustrated in Fig.1.

Fig.2 is a photograph of the QHA. The QHA consists of four helices, 90°hybrid, matching circuit and balun. Four helices are made by etching and coated by resin in order to prevent from rust. By use of 90° hybrid, circular polarization and backfire radiation are obtainable.

Fig.3 shows radiation patterns of QHA and CDA for the sake of comparison. It is obvious that QHA has a more symmetrical pattern and a better front-to-back ratio than CDA. Concerning to aperture blocking, QHA has about one twentieth crosssection compared with that of CDA's splash plate, so it is be able to minimize the loss due to blocking.

3. Antenna characteristics

Table 1 shows estimated antenna efficiency when QHA is used as a feed for 0.9 meter paraboloid antenna.

Fig.4 shows the 0.9 meter paraboloid antenna with the QHA.

Fig.5 shows the measured radiation patterns at 1540 MHz and 1640 MHz.

The other characteristics that are achieved with this antenna are shown in Table 2. They satisfy the INMARSAT specifications.

4. Concluding remarks

We have developed a small size but high-efficient paraboloid antenna for the shipborne equipment for satellite telecommunications. As a feed of this antenna,QHA was used and antenna efficiency of more than 69 percent was obtained.

In addition to the feature of high-efficiency,QHA feed provides good axial ratio and less radiation pattern degradation due to feed blocking compared with CDA feed.

It was confirmed that QHA was very suitable for a small paraboloid antenna feed.

References

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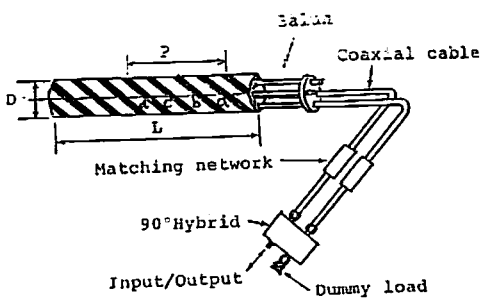
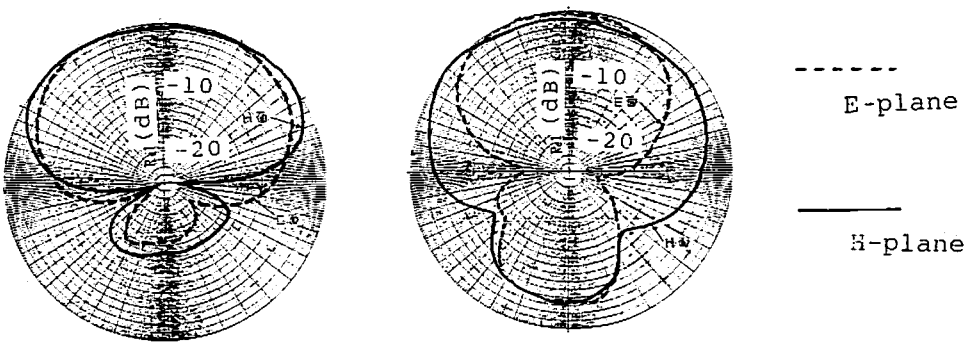


Fig.1 Configuration of QHA

Fig.2 QHA feed



(a) QHA (b) CDA

Fig.3 Radiation pattern of QHA and CDA

Table 1 Antenna efficiency (estimated)

Loss item	Efficiency
Aperture efficiency	0.797
Loss due to backradiation	0.959
Loss due to blocking	0.998
Loss due to surface error	0.980
Loss due to mismatching	0.968
Loss due to feeder network	0.933
Antenna efficiency	0.675
Antenna gain (dB)	21.5

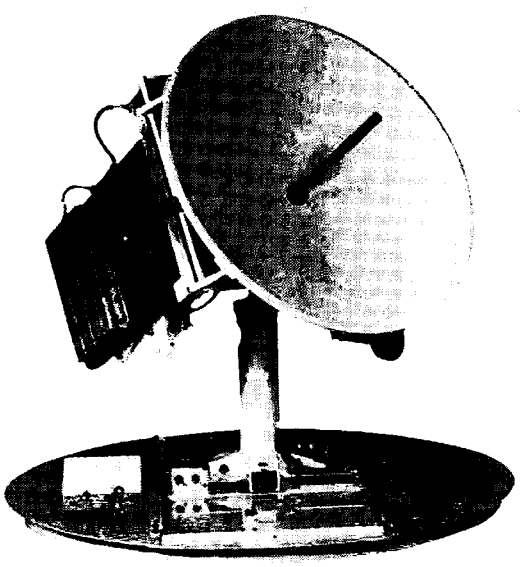


Fig.4 The 0.9 meter paraboloid antenna with QHA

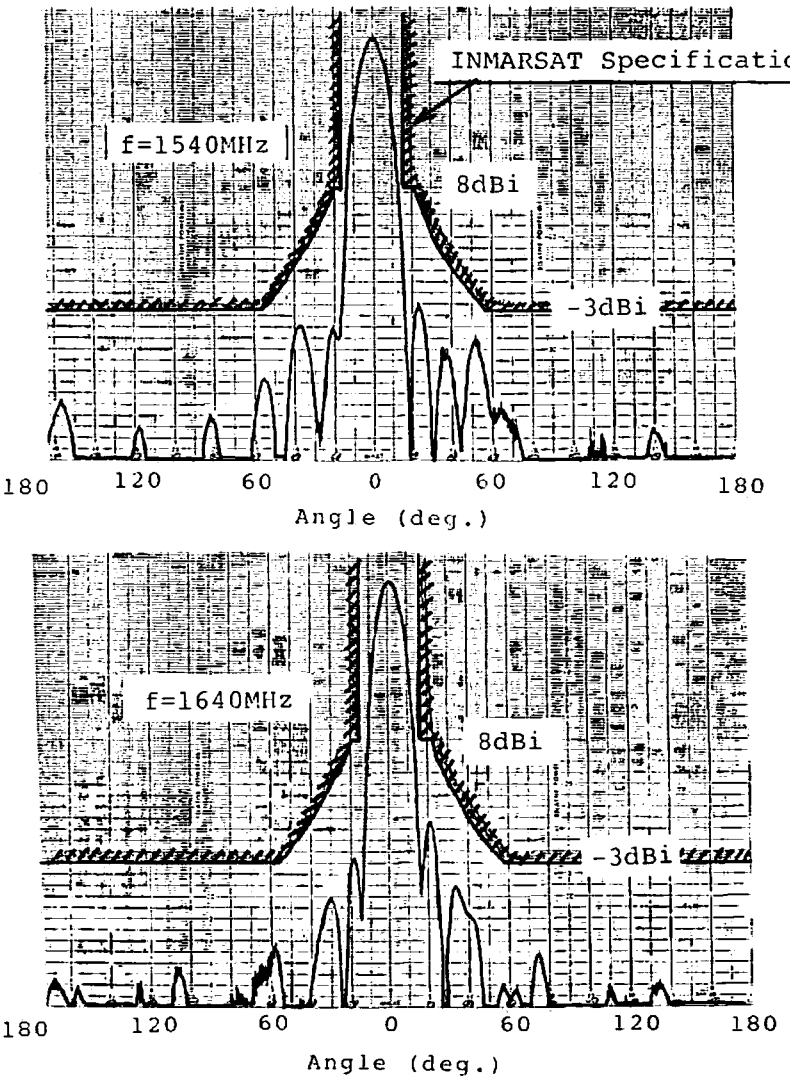


Fig.5 Measured radiation pattern

Table 2 Antenna characteristics (measured)

Frequency range	1535-1645 MHz
Polarization	Right-hand circular
Axial ratio	0.3 dB (max)
Gain	21.6 dB (@1535MHz)
Beam width	13 deg.
V S W R	1.2 (max)
Noise temperature	107k