# B-2-1 A VERY HIGH POLARIZATION PURITY ANTENNA FOR EARTH STATION IN USE WITH EUROPEAN ORBITAL TEST SATELLITE (O.T.S.)

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## I. INTRODUCTION

The first experimental and pre-operational satellite in the European Communication Satellite programme, OTS, will be launched this April or May. The rest of the year is reserved to differents satellite tests and from the next year, 1979, all kind of studies and measurements may be started.

The earth station antenna, object of this paper, is designed to be in use with this satellite. It should allow the attenuation and depolarization measurements with a very great accuracy. In taking into account the satellite stability, environmental conditions, and desired measurement accuracies, It appears that the earth station antenna for particularly attenuation and depolarization measurements must present the following characteristics : antenna diameter : 3 m, receive frequency band : 10,95 - 11,8 GHz, $G/T \geqslant 24$ dB/°K at 30° EL, cross-polarization performances $\leqslant$ - 40 dB below the maximum gain in $\pm$ 0°.2 angular cone and manual Elevation/Azimuth adjustements.

## II. DESCRIPTION OF THE ANTENNA

### II.1. Reasons of antenna choice,

The main difficulty consists in the obtention of a very high polarization purity. The cross-polarization value desired obliges to respect the following characteristics :

-a) a paraboloid of revolution of Focal over diameter ratio greater than .4 to avoid the transverse polarization generated by the curvature of the paraboloid. In our case, we have 0.43. The figure 1 shows the variation of cross-pol. value in function of F/D ratio and profiles accuracies. Bigger than F/D ratio, smaller than cross-pol. value.

-b) a very precise parabole profil to avoid the increasing in cross-polarization value. The figure n°1 shows the dependance between these two factors. We can notice that for a "focal/diameter" ratio = 0.43, and for a peak-to-peak accuracy equal to $\pm \lambda/100$, this cross-pol. value due to this factor is 40 dB, and for a peak-to-peak = $\pm \lambda/50$, this value becomes 36 dB. In our case, we obtain $\pm \lambda/65$.

-c) No paint on the parabola reflector. Indeed, we can consider the paint like a dielectric coat. So that, depending of parallel or perpendicular polarization, the insertion phase difference due to this coating is not the same and the polarization may be rotated. The figure 2 shows this depen-

dance for a paint with the permittivity value equal to 4.2 and the loss tangent = $10^{-2}$. We notice that the cross-pol. value degradation may be important. In our case, the metallic surface of the honey-comb fiber-glass reflector is obtained by zinc sprayed without paint coating.

-d) a primary source which does not generate the cross-pol. and has a radiating lobe of revolution. A corrugated horn is remained, its cross-pol. value beeing less than 55 dB.

## II.2. Description of the antenna assembly

Fig. 3 shows some view of the antenna. The antenna diameter is 3 m. The sub-reflector is.45 m. The polarization may be adjusted for + 45°. The mounting structure is a "X-Y" type. Elevation adjustement (Y) is + 10° to 90°/local horizontal. "X" adjustement is + 5° around any elevation position. All the assembly can resist to a 140 km/h wind speed without .1 degree misalignment.

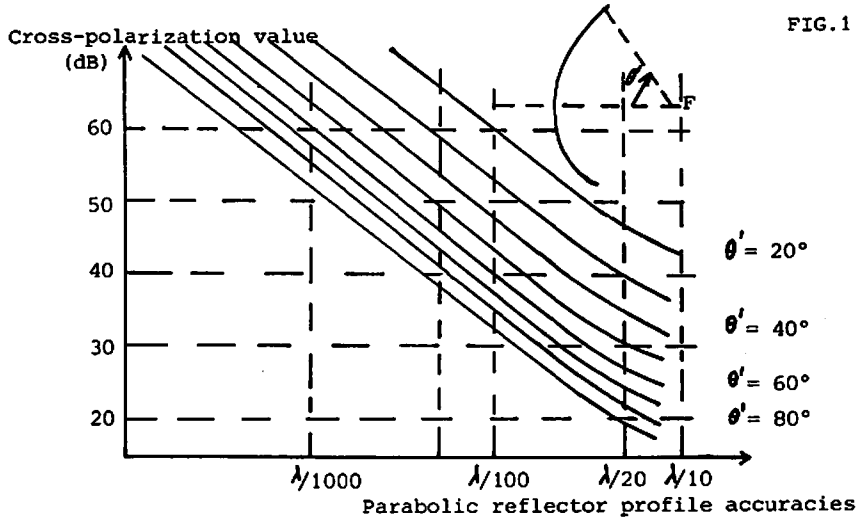
## III. ANTENNA PERFORMANCES

-a) - Receiving bandwidth : 10.95 - 11.8 GHz
- Gain in the whole band : 48.3 dBi to 49.1 dBi
- VSWR $\leqslant$ 1.15
- First side lobe level : 20 dB below the maximum
- Cross-polarization Value :
  - on axis : 65 dB below the maximum
  - off axis : - at + 0°.2 :-41 dB to - 46 dB/ maximum
    - at the highest level : - 38 dB
- G/T at 11.3 GHz and for 30° Elevation : 24 dB/°K with a 160°K parametric amplifier.

-b) - Transmitting band : 14 - 14.5 GHz
- Gain in the whole band : 50.3 dBi to 50.6 dBi
- VSWR $\leqslant$ 1.15
- First side lobe level : 20 dB below the maximum
- Cross-polarization value : as indicated as for receiving bandwidth.

INFLUENCE OF PARABOLIC PROFILE ACCURACIES ON CROSS-POLARIZATION VALUE IN FUNCTION OF F/D RATIO

FIG.1




INFLUENCE OF PAINT COATING THICKNESS ON CROSS-POLARIZATION VALUE

FIG.2

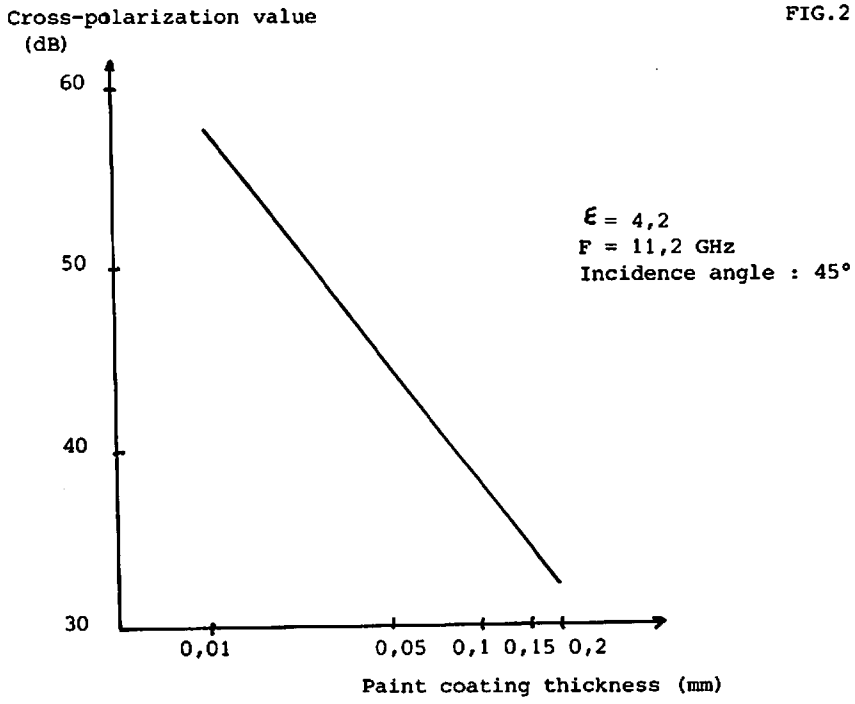


FIGURE 3

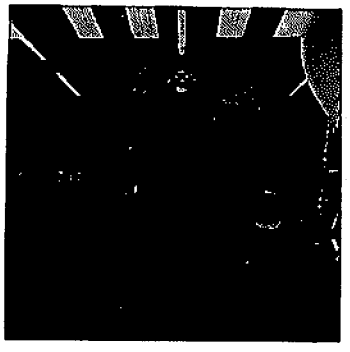


FIG 3a

Front view

FIG 3b

Rear view

SMALL EARTH STATION FOR USE WITH EUROPEAN ORBITAL TEST SATELLITE (OTS)

FIG 3c

FIG 3d

Side views