

MICROWAVE TECHNOLOGY DEVELOPMENTS IN ITALIAN SPACE PROGRAMS.

by

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Summary

The Italian aerospace industry demonstrated its ability to carry out a national space program by successfully launching into orbit the Italian satellite Sirio in 1977.

The scientific background as well as the technological advances necessary to achieve that goal has been developed through participation at various international and European space programs. The inception of this type of activity dates back to 1965 when the ELDORADO program for a European launcher was started.

Past Experience

So far, the Sirio program is the first and only domestic space program at present in operation.

The Sirio satellite is a scientific satellite devoted to propagation and communication experiments at K-band (12-18 GHz). On board microwave circuitry is concentrated in the so-called "SHF unit". A scheme of the unit is reported in fig. 1a, b.

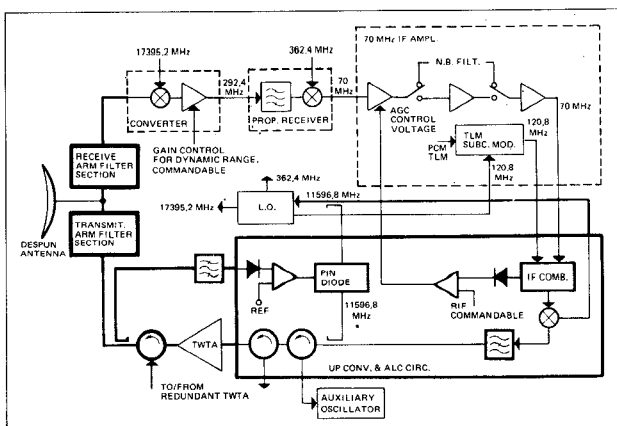


Fig. 1a - Microwave subunits in the communication experiment.

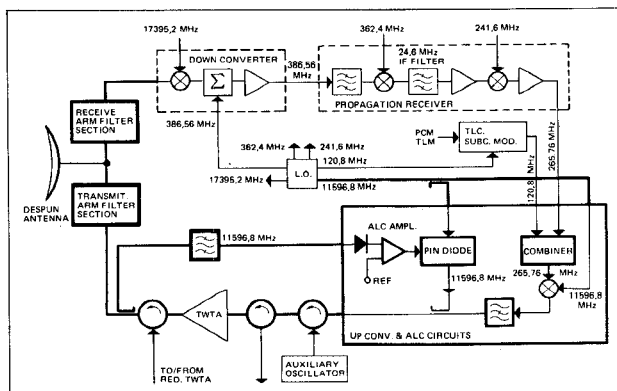


Fig. 1b - Microwave subunits in the propagation experiment.

The associated technologies are of the conventional type. Dip-brazing soldered aluminum waveguides are present as well as invar narrow band filters and electroformed hybrids. The choice of these technologies reflects the state of the art of the early 1970's when the Sirio program was firstly conceived. It was also dictated by the system requirements of a very high stability and accurate control of transmitted power levels.

Selenia S.p.A. was the main contractor for the whole SHF unit. The 18 GHz down converter was sub contracted to GTE. In fig. 3 the microwave subunit is shown.

After being put into operation in Sept. 1977, the Sirio satellite is regularly performing its tasks and presently is used for TV relaying and propagation experiments. By contract it was expected to be fully operative till Sept. 1979 for a time period of two years.

Future Programs

Italsat program is the next national space program aimed at putting a telecommunication satellite into orbit by 1990. More specifically Italsat is planned to be in a pre-operational phase in 1985 and in operational use in 1990.

In order to develop the associated technologies a number of critical components are presently being investigated within the Advanced Satellite Technical Program in collaboration with ESA. A number of Italian firms qualified for space activity are involved in this program.

Some examples of microwave hardware presently being developed are:

- 1) Differentially coherent QPSK demodulator at 12 GHz and QPSK modulator at 20 GHz. Both components were developed at Selenia.

In fig. 3 a similar demodulator operating at 14 GHz is shown.

The technology involved is thin film MIC on allumina and barium tetratitanate.

The latter material has been used to get a temperature stabilized delay line.

- 2) Parametric amplifier at 30 GHz and coherent demodulator developed by GTE.

In fig. 4 a parametric amplifier prototype is shown. The associated technology is that relative to evanescent mode waveguides.

- 3) Carrier generators, developed by FIAR. (SPLL techniques are applied to lock fundamental oscillator in S band with a 50 MHz master oscillator). Here the main technology involved is photoetching on a teflon-glass substrate.

Conclusions

The tremendous advancement of microwave technologies in Italy in the past ten years has enabled the national industry to carry out domestic space programs of increasing technological sophistication.

In this paper a description has been made of the microwave technologies associated with the first Italian national space program Sirio. In this program a large use was made of conventional waveguide circuitry.

Then, the future Italsat space program, has been mentioned, wherein a much broader spectrum of technologies is planned to be used.

Technological maturity was achieved by the Italian space industry through participation at various European programs (Eldo, Meteosat, OTS, ECS, EXOSAT) as well as international programs (Intelsat IV, V, Insat).

In house and government funding R+D activity also helped in reaching the present state of technological advancement.

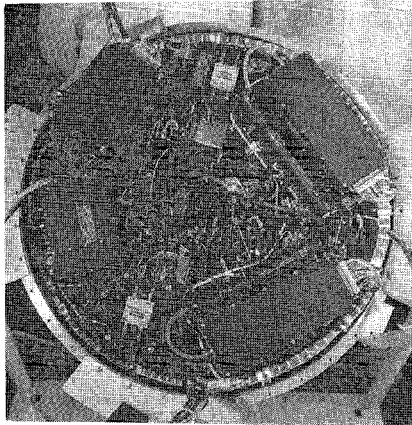


Fig. 2 - On board Sirio satellite microwave subunit.

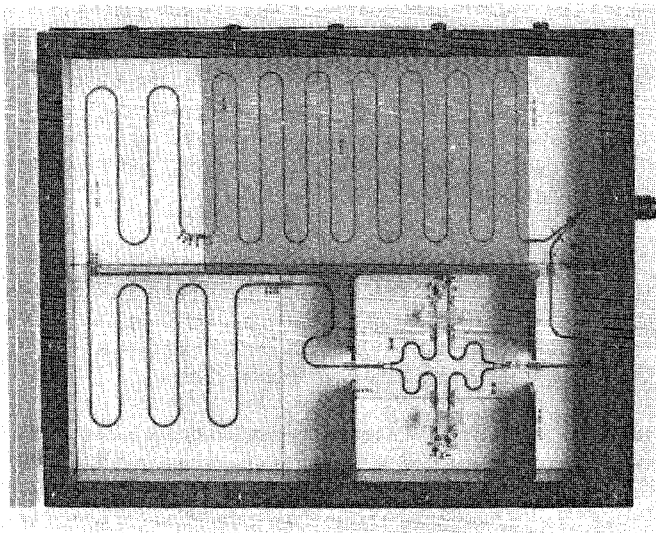


Fig. 3 - DCQPSK demodulator.

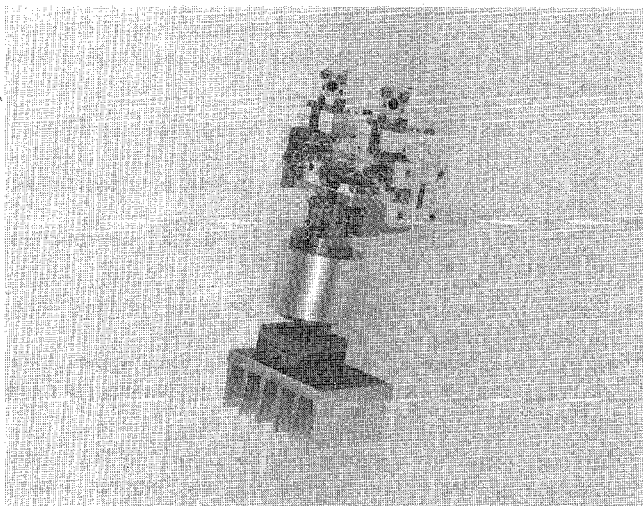


Fig. 4 - 30 GHz parametric amplifier.