# A WIDE-BAND FEED FOR RADARSAT DATA LINK ANTENNA

A. Kumar
AK Electromagnetic, Inc.
492 Westminster Avenue
Dollard-des-Ormeaux
Quebec
Canada H9G 1E5

## 1. INTRODUCTION

RADARSAT is a Canadian satellite which will map a region of the earth's surface using microwave synthetic aperture radar (SAR) techniques. This paper describes a wide-band feed which can be used for a shaped-beam telemetry antenna. The antenna is suitable for re-transmitting the radar data back to an earth at X-band (8.1 to 8.4 GHz). The basic concept of the new feed for circular polarization is the use of crossed dipoles in a cylindrical cup. The crossed dipoles have equal lengths and are fed through two separate input ports which are in phase quadrature. Radiation patterns associated with beamwidth and directivity are determined to a large extent by the size of the cup. The size and geometry of the crossed dipoles have effect on the cup for obtaining good pattern symmetry. The size and geometry of the crossed dipoles also controls the antenna impedance.

In previous applications of cup dipole feeds, a split-tube balun [1-3] is used to feed in parallel the crossed dipole from a single coaxial line, and circular polarization is generated by properly adjusting the dipole arm lengths. This approach is inherently narrow band. In present development, each dipole is separately fed from a special balun called the compensated balun [4], which is capable of broadband impedance matching.

## 2. CONSTRUCTION

Figure 1 shows a sketch of the feed which operates in the frequency range of 8.1 to 8.4 GHz. The cup has separate coaxial inputs to the vertical and horizontal dipole elements. The two inputs are fed with a 3 dB quadrature hybrid to provide circular polarization. Therefore, the feed network is made up of the hybrid and a compensated balun for each dipole.

As shown in Figure 1, the input coaxial line (Za) has its outer conductor attached to one terminal of the balanced output line, and its inner conductor is connected in series to the inner conductor of the parallel compensating line (Zb). The outer conductors of the two parallel coaxial lines form a shorted section of two-wire transmission line (Zab) which interacts with the open-circuited (Zb) line to produce a compensated impedance.

The open-circuited line and the two-wire line are both designed to be quarter-wavelength long at band center frequency. For broadest bandwidth it is desirable to make Zab as large as possible relative to the balanced load impedance. The dipole arms are excited with a 50 Ohm coaxial transmission line Za with one arm screw tapped to the outer conductor of Za. The center conductor of Za is connected to that of Zb by a thin strip. The other arm is also screw tapped to another cylindrical conductor of the same diameter as the outer conductor of the input coaxial line Za. The cylindrical conductor and the outer conductor of the coaxial line form a two-wire transmission line section shorted at one end by the cup base as shown in Figure 1, thus serving as a balanced-to-unbalanced balun impedance matching transformer. The cup has been filled with a low-loss space approved dielectric material [5, 6] to improve the antenna performance.

## 3. ANTENNA MEASUREMENTS AND RESULTS

The antenna network used is a four port 3 dB coupler. The coupler provides 0 and 90 deg. phase shift in order to excite ports 1 and 2 for generation of circular polarization. Two identical coaxial cables and an air line strecher are utilised for this purpose. The line strecher is connected to port 2 for phase difference adjustment of 90 deg. between the two ports. The line strecher is adjusted for best axial ratio achievement at midband 8.25 GHz, then locked up. Return loss curves for port 1 and port 2 are quite similar and better than -23 dB across the frequency band. When return loss of one port is measured, the other port is terminated.

The pattern measurements are performed in an anechoic chamber as shown in Figure 2. The source antenna is a linearly polarized rectangular horn and it is rotated for axial ratio pattern measurements. The axial ratio is better than 0.4 dB at 8.1 and 8.4 GHz. Figure 3 shows the axial ratio pattern at 8.25 GHz. The axial ratio is better than 0.2 dB on axis at this frequency.

## 4. CONCLUSIONS

A prototype feed has been designed, built and tested in the frequency range of 8.1 to 8.4 GHz. The feed provides a good secondary pattern for RADARSAT telemetry antenna to meet the gain and axial ratio requirements.

## REFERENCES

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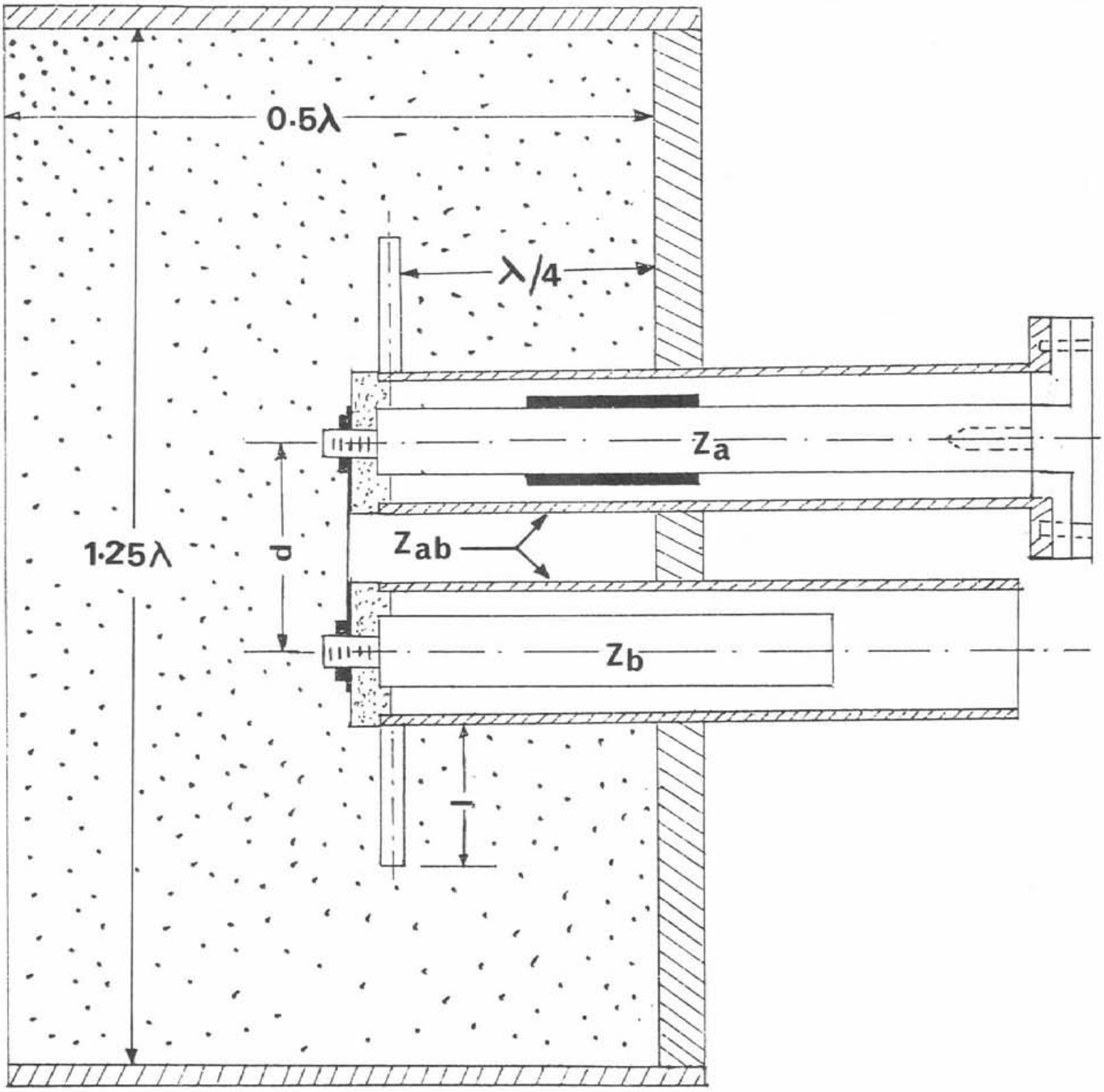

Fig. 1 Sketch of the feed

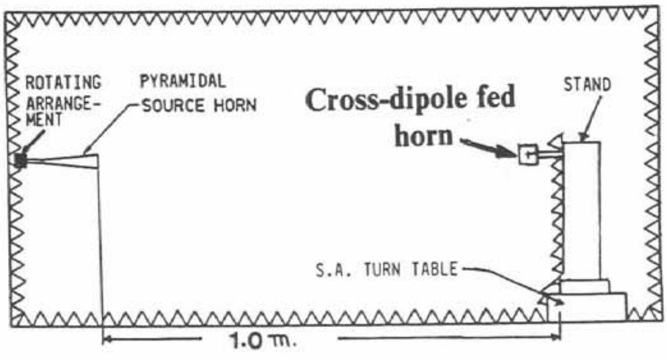

Fig. 2 Axial ratio measurement of the feed in the anechoic chamber.

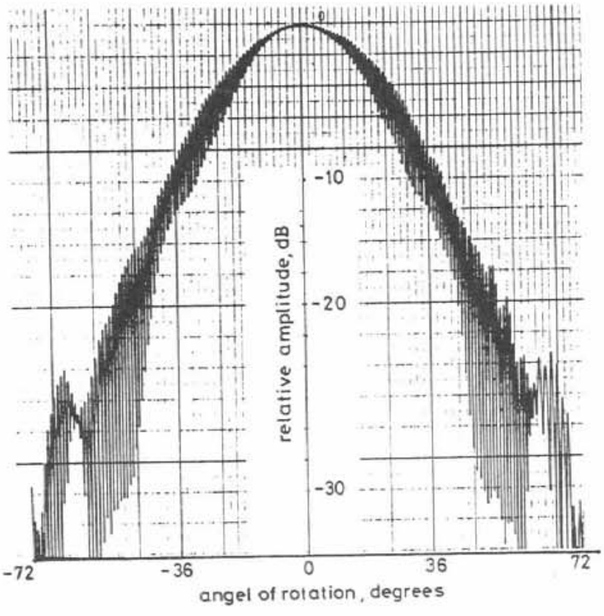

Fig. 3 Axial ratio pattern of the feed.