Dual-polarized compact first-order P-band probe for spherical near-field antenna measurements

ESA Contract No. 4000111981/15/NL/MH

Executive Summary

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CONTENTS

1. INTRODUCTION

1.1 Scope

This document summarizes the outcome of the project "Dual-polarized compact first-order P-band probe for spherical near-field antenna measurements" completed by the Technical University of Denmark (DTU) for the European Space Agency (ESA) under ESA contract no. 4000111981/15/NL/MH.

The probe developed under the contract is compliant with all the requirements of [AD1]; see below.

Compliance matrix versus the requirements of [AD1].

Requirement		Measured performance
1. Frequency:	432-438 MHz	418.8-445.6 MHz
2. Peak directivity:	9-14 dBi	9-10.8 dBi
3. Radiation pattern:		
- variation within $\theta = \pm 30°$:	< 10 dB	Yes
- front-to-back ratio:	> 10 dB	Yes
- symmetry in both orthogonal planes		Yes
4. $\lvert\mu\rvert \neq \pm 1$	< –35 dB	Yes
5. Ports orthogonality:	> 35 dB	Yes
6. Port-to-port isolation:	> 35 dB	Yes
7. Return loss	> 10 dB	Yes
8. Weight	< 10 kg	7 kg

1.2 Applicable documents

[AD1] O.S. Kim, "Proposal for Dual-polarized compact first-order P-band probe for spherical near-field antenna measurements", Proposal No. 2015-03-04, Technical University of Denmark, Department of Electrical Engineering, March 2015.

1.3 Reference documents

[RD1] O. S. Kim, S. Pivnenko, and O. Breinbjerg, "Superdirective magnetic dipole array as a first-order probe for spherical near-field antenna measurements," IEEE Trans. Antennas Propagat., vol. 60, no. 10, pp. 4670–4676, 2012.

[RD2] "Higher-Order Near-Field Probes (HONFP)", ESTEC Contract No. 22812/09/NL/JD/al.

1.4 Objective

The objective of the project is to develop a compact light-weight (< 10 kg) dual-polarized first-order probe for 435±3 MHz frequency range (BIOMASS) taking outset in the superdirective first-order probe concept proposed in [RD1].

2. SUMMARY

A number of European Space Agency's (ESA) initiatives planned for the current decade require metrology level accuracy antenna measurements at frequencies extending from L-band to as low as 400 MHz. The BIOMASS radar, the Galileo navigation and search and rescue services could be mentioned among others.

Existing probes for Spherical Near-Field (SNF) antenna measurements, which is one of the most accurate antenna measurement techniques, are either classical first-order probes based on conical horns and open-ended circular waveguides excited by the fundamental TE11-mode, or wide-band higher-order probes, as for example, those developed by the Technical University of Denmark (DTU) under ESA project "Higher-Order Near-Field Probes (HONFP)" [ESA Contract No. 22812/09/NL/JD/al]. In either case, these probes become excessively bulky and heavy at frequencies below 1 GHz, so that they cannot be handled by a single person and dedicated lifting tools are necessary.

In this project, a compact dual-polarized first-order P-band probe has been developed (Figure 1). The height of the probe is just 365 mm over a 720-mm circular ground plane and it weighs 7 kg. The probe covers the bandwidth 419-445 MHz with more than 9 dBi directivity and parasitic $|\mu| \neq 1$ spherical modes suppressed below −35 dB.

The probe has been designed, manufactured and tested by the Technical University of Denmark (DTU).

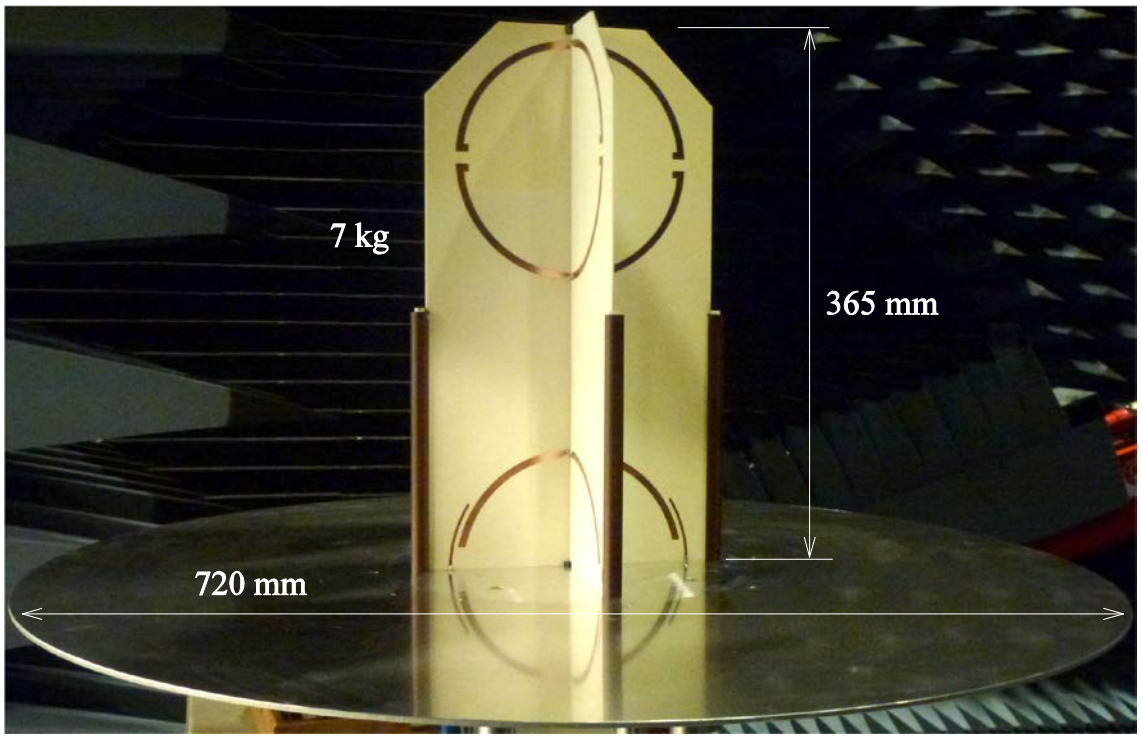

Figure 1. P-band dual-polarized first-order probe for SNF antenna measurements.