Ka-Band Cassegrain Antenna for LMDS

*Dau-Chyrh Chang, **Leo Chiang
*Da Yeh University,
dcchang@mail.dyu.edu.tw
112 Shan-Jeau Rd., Da-Tsuen, Chang-Hwa, Taiwan 515, ROC
**SmartAnt Telecomm Co., Ltd.
http//www.smartant.com
2F, No. 49-2, Lane 2, Sec. 2, Kunag-Fu Rd., Hsin-Chu, Taiwan 300, ROC

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Abstract

A Ka-band Cassegrain antenna with diameter 24.5 cm was designed and manufactured to meet the European Telecommunication Standard (ETS 300.833). Ray tracing technique is used to optimize the geometry shapes of both reflectors and feed. The physical optics is used to analyze the total efficiency and far field pattern. The test results are quite agreed with the theoretical results.

1. Introduction

For the LMDS (Local Multi-Point Distribution System) data communication, the antenna with higher gain, lower side-lobe level, higher atmospheric loss, smaller volume, wider instantaneous frequency bandwidth, and wider operational frequency bandwidth are required. In order to meet the above system requirements, the Cassegrain reflector antenna is a potential candidate to meet the ETS 300.833.

The electrical and mechanical specifications of the Cassegrain antenna are as following,

Frequency range	25.25 – 27 GHz
Antenna gain	33 dBi
Polarization	Linear vertical
VSWR	2:1
Half power beamwidth	2.9+-0.1 degrees
Instantaneous bandwidth	Infinity
Mechanical size	24.5 cm in diameter
	16.5 cm in depth

Since the antenna of LMDS will be used in different environmental weather conditions, the water proof of system is also required. In order to meet this requirement, antenna radome will be used. The purposes of radome in this design will not only for waterproof, but also for supporting the subreflector.

2. Results of Simulation

The geometry of Cassegrain antenna is as shown in Fig. 1. The diameter of paraboloid reflector is 24.5 cm, and F/D is 0.33. The diameter of hyperboloid subreflector is 5 cm. The distance the phase center of feed and the focus of paraboloid is 8 cm. The aperture diameter of the circular feed is 4 cm. Fig. 2 is the final system of this Cassegrain antenna with covered radome. From the simulation results with frequency at 27 GHz, the electrical performances are estimated as following:

Gain	34.52 dBi
Beamwidth	2.81 degrees
Peak side lobe level	-17 dB
Spillover efficiency	- 0.53 dB
Aperture efficiency	- 1.02 dB
Blockage efficiency	- 0.33 dB

From this analysis the overall efficiency is about 58 %..

3. Results of Measurement

The final assembled antenna is tested by the universal near field system at Da Yeh University. The gain within the band is changing from 33 dBi to 33.5 dBi. The beamwidth is changing from 2.8 degrees to 3 degrees. The overall efficiency is about 50%. The patterns will be presented during the conference.

4. Discussion

Due to the error of manufacturing process is under control, the results of measurement meet the specification. The material of radome is ABS plastic. The transmission loss of ABS radome, which was measured at this frequency band, is about 1 dB. If the radome loss is included in the simulation, then the results of total efficiency for both simulation and measurement are quite agreed.

5. References

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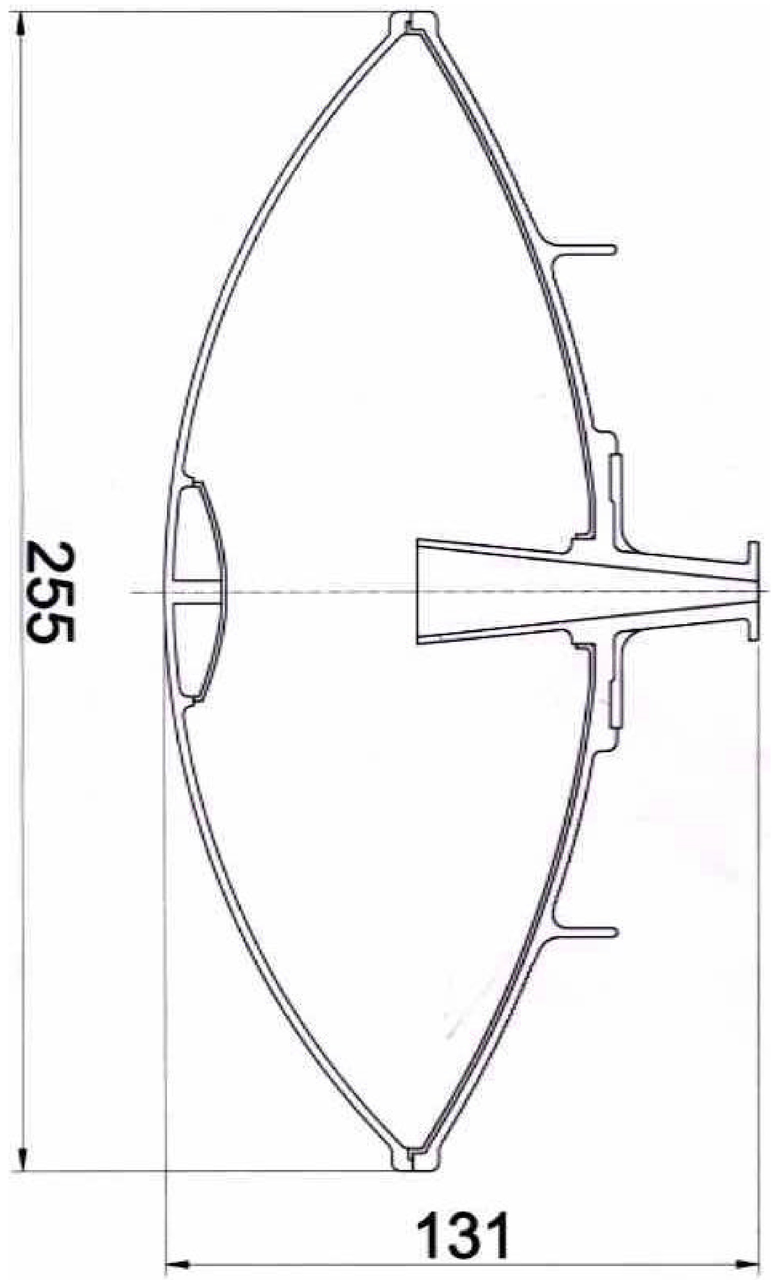

Fig. 1 Geometry of Cassegrain Antenna

Fig.2 Front view of Cassegrain antenna