Satellite Communication Experiment 2

Radiation Pattern Measurements of Dish Antenna

1. OBJECTIVES

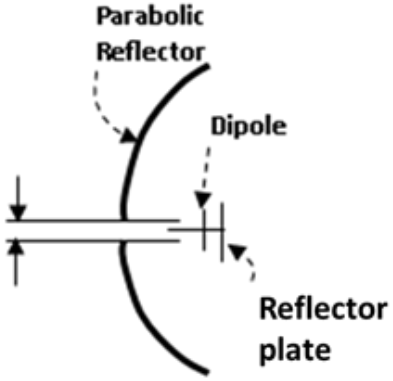
- ☑ To investigate the gain and directivity of the dish antenna.
- ☑ To estimate the gain of the dish antenna using dipole.
- ☑ Estimate the sidelobe radiation level of the Dish Antenna

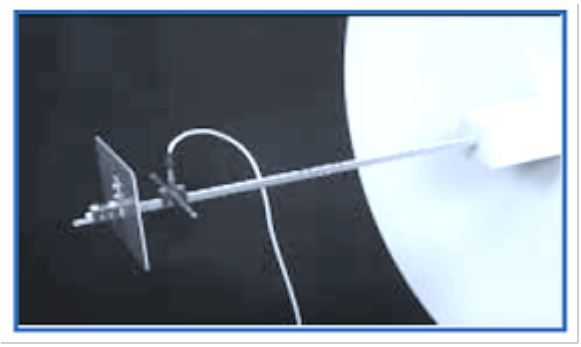
2. MATERIALS NEEDED

☑ Parabolic dish
☑ Dipole
☑ Antenna Modelling System + PC

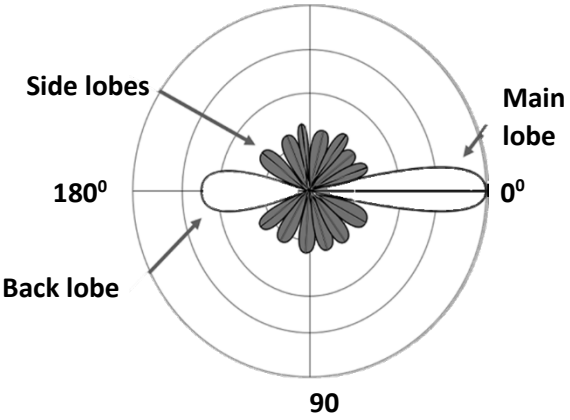
3. INTRODUCTION

In this lab setup, a simple dipole with reflector plate is to perform the task of the feed horn. It is located at the focus of a 60cm parabolic dish. The dipole is just a half-wave conductor that that divided a feeder from a receiver or transmitter. A dish is a passive reflector that focuses energy from a source into one direction, much as a parabolic mirror focuses light.

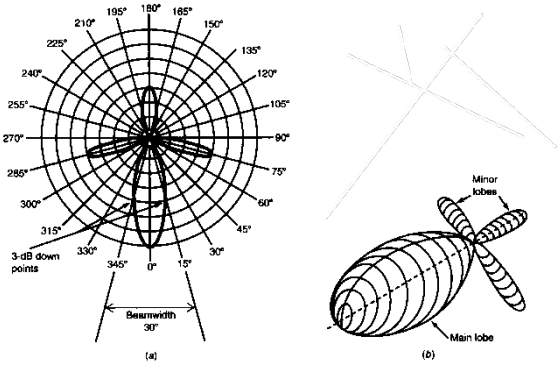




Radiation pattern
The energy radiated by the antenna is represented as the radiation pattern of the antenna. Theoretical radiation pattern and the practical polar plot of the Dish antenna is shown in Figures below.



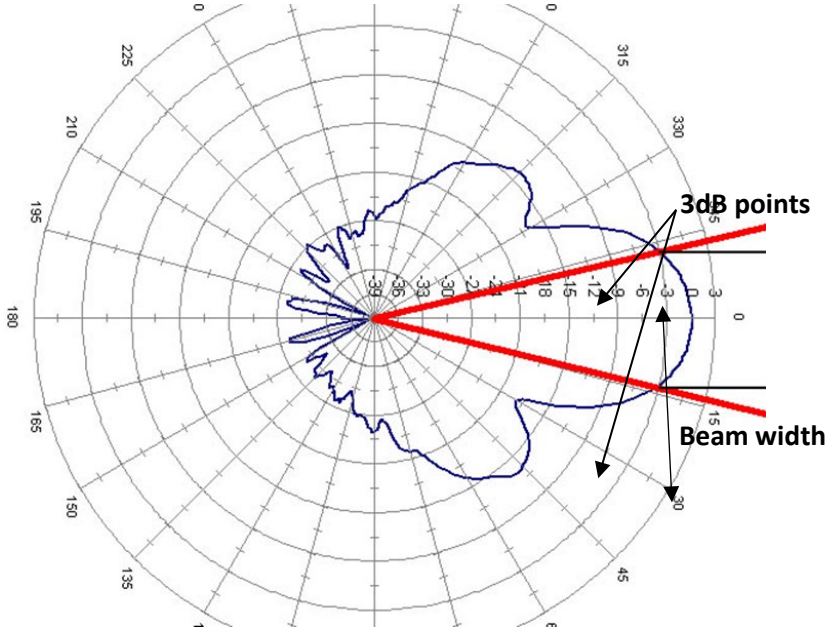
Radiation pattern



Practical Polar Plot of Dish antenna

Beamwidth

Beam width is the angular width between **half-power points** of the main lobe of the antenna radiation pattern, i.e., the angle subtended by the 3dB points on the radiation pattern of the antenna. It is an indication of the **directivity** of an antenna.



Beam width measurement of Dish Antenna

Gain

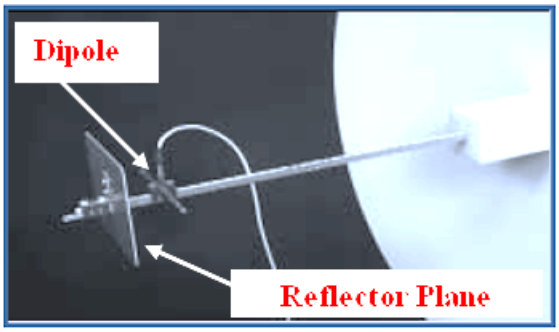
Gain in a transmitting antenna, gain represents the antenna's ability to convert input power to radio waves. In a receiving antenna, gain represents the antenna's ability to convert radio waves into electrical power.

Antenna gain and beam width are inversely proportional. The higher the gain of an antenna, the smaller the area coverage and this is actually the measured beam width. Higher antenna gain may not always be advantageous. It depends on the coverage area required.

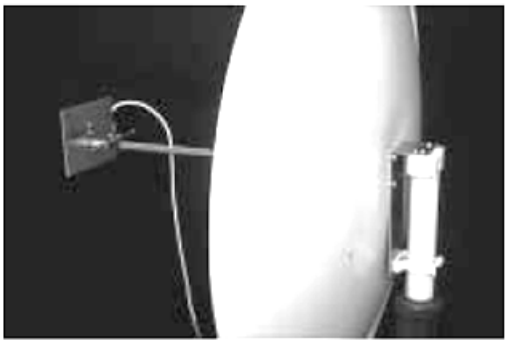
4. PROCEDURES

Part 1 Radiation pattern & Beam Width of Dish Antenna

1. Identify the Dish Antenna. Mount Dish Antenna with the boom assembly on top of the Generator Tower and position the dipole **horizontally** on the boom assembly at a distance of 5cm spacing between the reflector plane and dipole as shown in Figures below :



Dish Assembly Front View



Dish Assembly Rear View

2. Position the receiving antenna array **horizontally** and point it to the transmitting dipole antenna.

3. On the screen menu, select Polar plot and set the frequency value to **"1500 MHz"**.

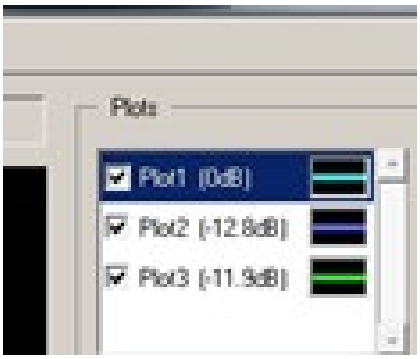
4. Press "ENTER" and quickly move away from the Dish antenna setup. The boom assembly will rotate 360^0. A Polar Plot of the radiation pattern will be display on the screen.

2. Set the scale to min:-15dB and Max: 0dB.

3. Print out the radiation pattern of the dish antenna on the Colour HP Printer.

6. Draw the 3 dB curve on the printed graph (at -3 dB circle). Estimate the beam width of the dish antenna on the polar plots from the print out:

Dish antenna **BEAM WIDTH** = _____



Part 2 Estimate the gain of the Dish Antenna using Dipole

1. Re-position and align the dipole and receiving antenna.

2. Press "C" to change from a 35 dB range to a 70dB range.

3. Press "S" to superimpose a new plot of dish antenna on the original dipole polar plot at 1500 MHz.

4. Record down the differential value in dB shown on the screen. This gives the gain of the dish antenna over the dipole antenna at 1500MHz.

   Gain of the dish antenna over dipole = _____ dBd (dB relative to dipole antenna)

5. As the gain of the dipole relative to isotropic antenna is 2.15 dBi

   Hence, the dish antenna has a gain of _____dBi (dB relative to isotropic antenna).

Part 3 Estimate the sidelobe radiation level of the Dish Antenna

1. The sidelobe radiation level (in dBi) of the dish antenna can be determined using the plotted radiation pattern of the dish antenna and the calculated dish antenna gain.

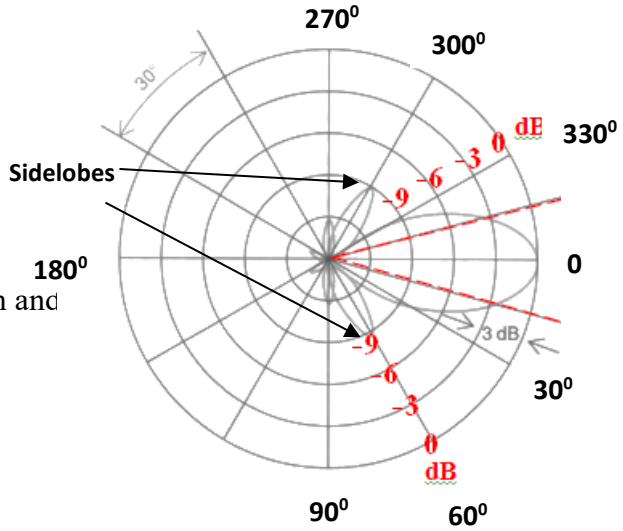
2. Assume that the plotted radiation pattern of the dish antenna is shown in Figure below.

   EXAMPLE
   If the calculated gain of the dish antenna is G = 7(dBi), The nearest sidelobe is located at 300^0 or 60^0 from the boresight (max gain) of the dish antenna.

   Hence the radiation level of the sidelobe will be:

   e.g. $S(60^0 \text{ or } 300^0) = G \text{ (dBi)} - 9 \text{ (dB)}$

   $= 7 - 9 = -2 \text{ (dBi)}$



4. Now use your plotted dish antenna radiation pattern and the calculated dish antenna gain value to determine the nearest sidelobe radiation level in dBi.

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