

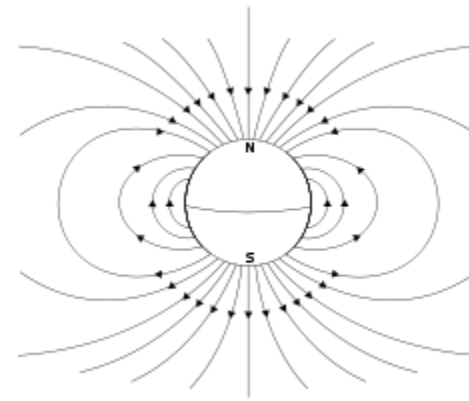
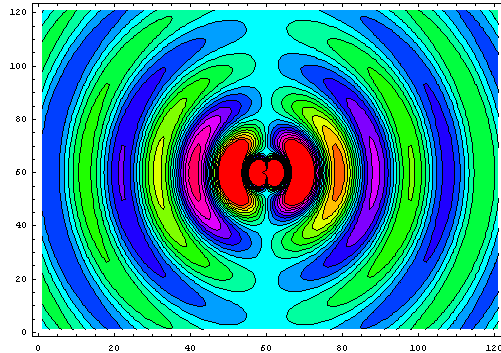
Deltalink wireless Ltd.

- Wireless Antennas
- By : Ahmad Mortazavi

1-2 March
MUM Poland (2010)

1 – Introduction

- The first antenna experiment was conducted by the German physicist Heinrich Rudolf Hertz in 1887 it is a pair of one-meter wire known as Dipole.

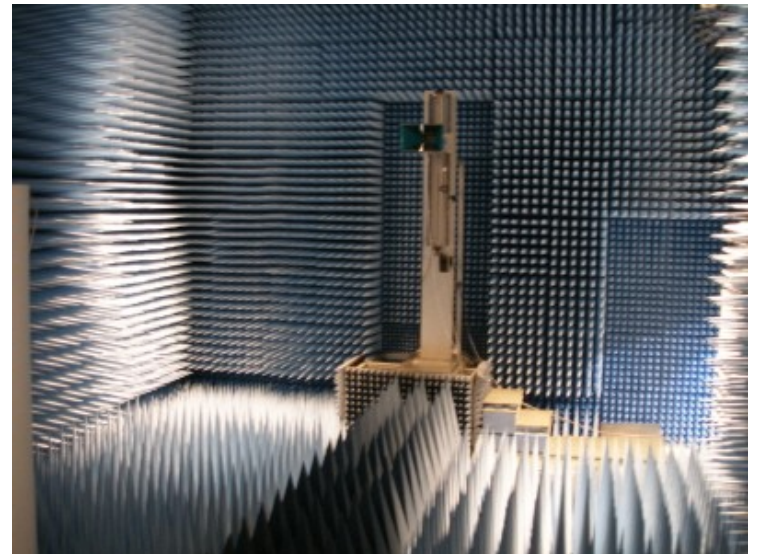
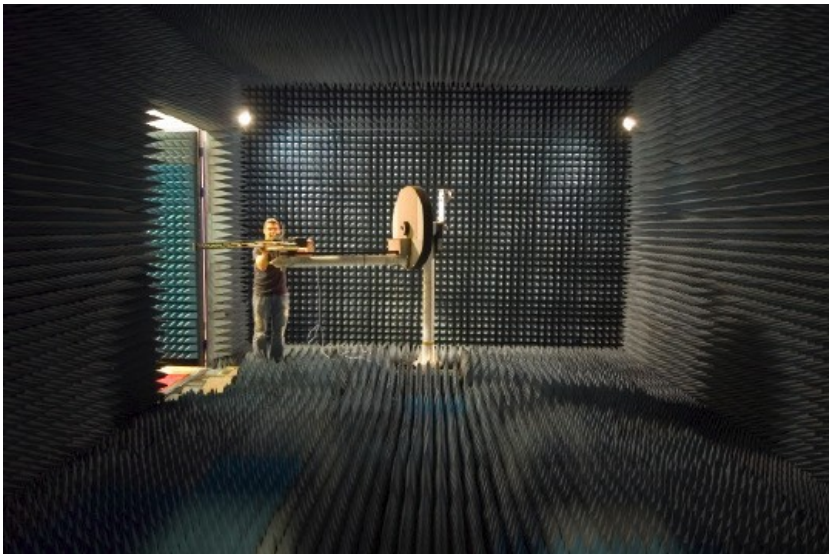


- Today an antenna was an essential part of a radio system

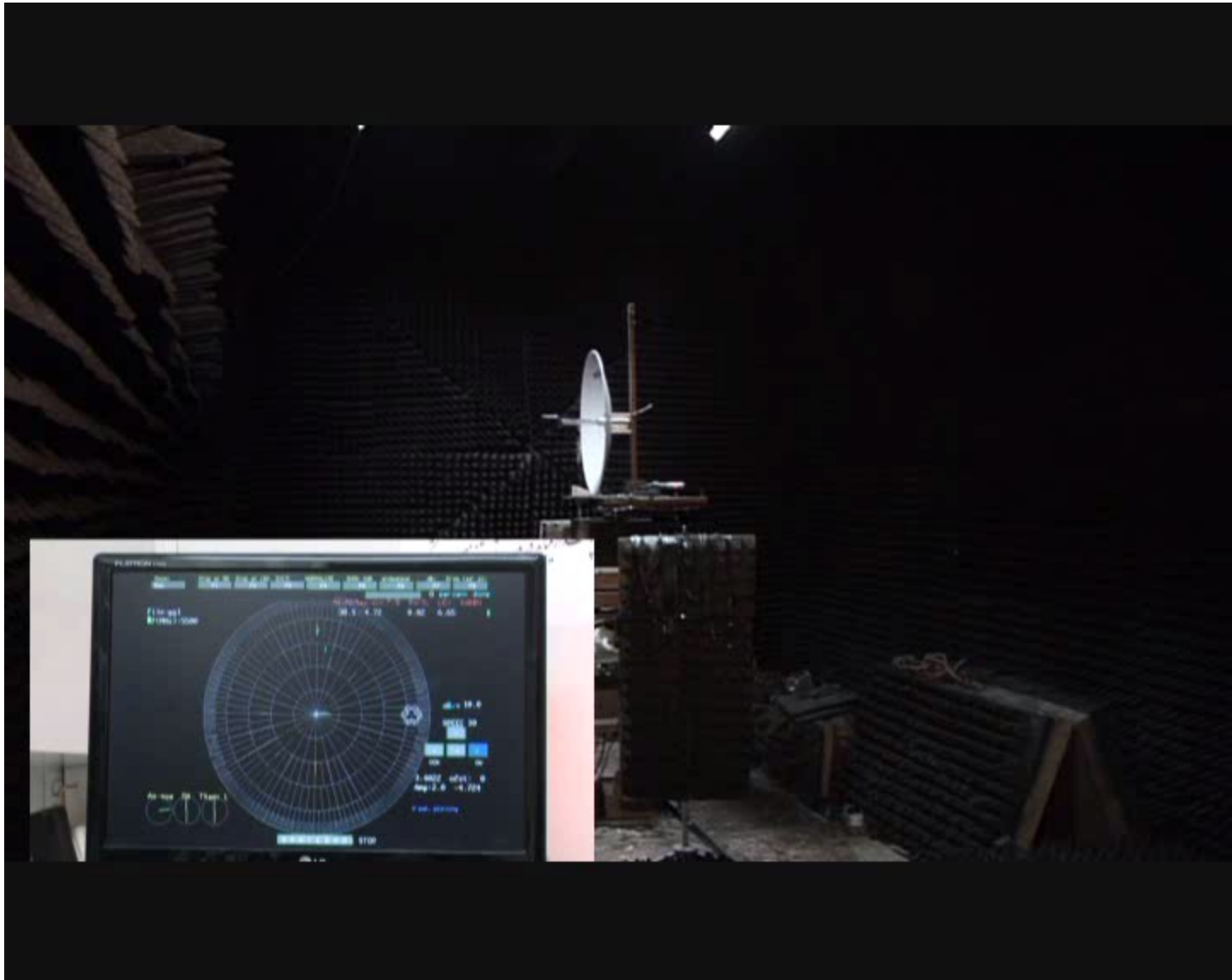


2-Radiation pattern

- Is a plot of radiated field/power as a function of angle at a fixed distance.



Radiation Pattern

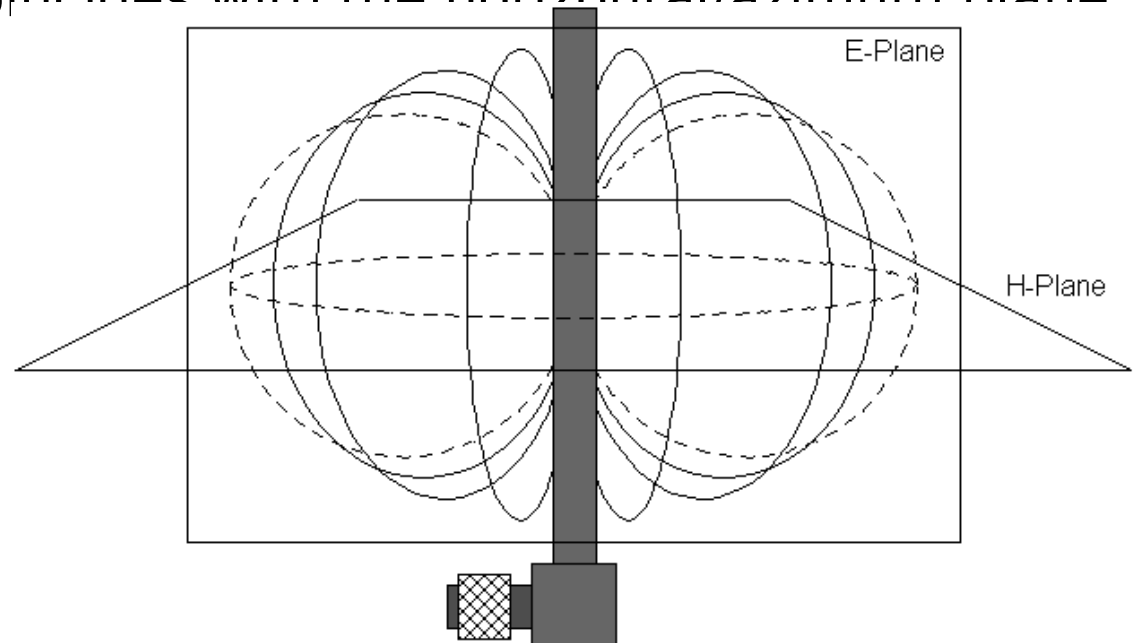


2.3.10

- E-Plane or Elevation Plane Radiation pattern: For a vertically-polarized antenna the E-plane usually coincides with the vertical/elevation plane.
- H-Plane or Azimuth Plane Radiation pattern: lies at a right angle to the "E" plane. For a vertically polarized antenna the H-plane usually coincides with the horizontal/azimuth plane



2.3.10



3dB beamwidth

- What is the 3dB or Half-power Beamwidth ?

$$\text{dBm} = 10 \text{ Log (Power in mW)}$$

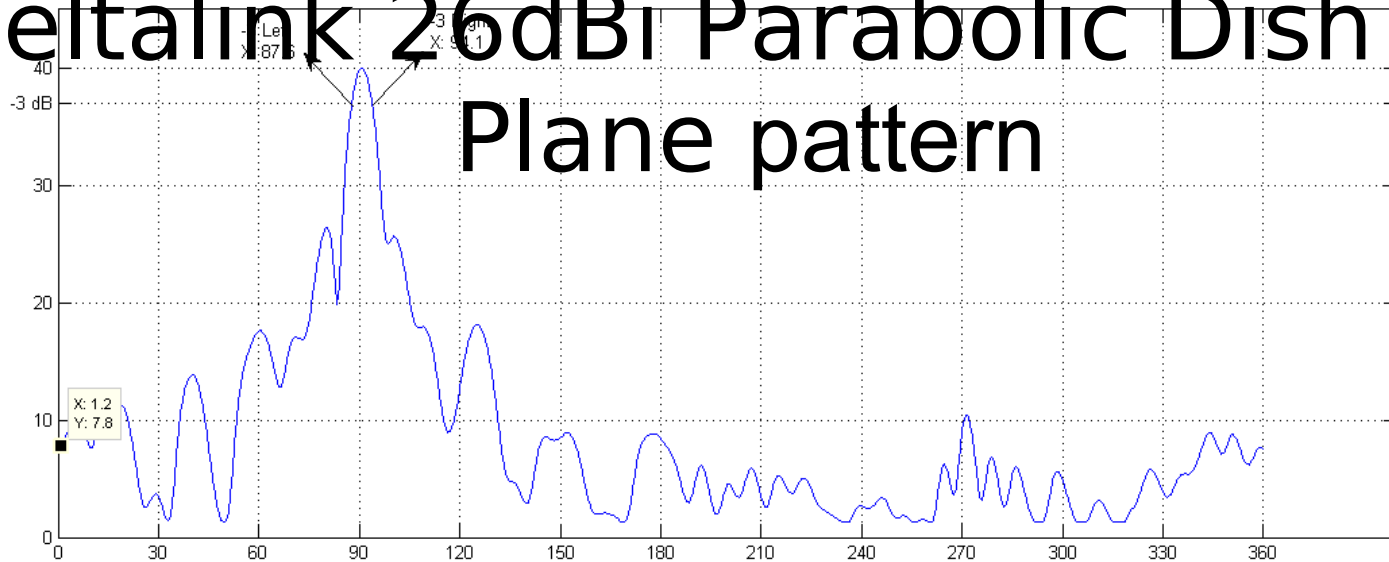
$$100 \text{ mW} \square 10 \text{ Log}(100\text{mW}) = 20\text{dBm}$$

$$100\text{mW}/2 = 50\text{mW} \square 10 \text{ Log}(50\text{mW}) = 17\text{dBm}$$

$$100\text{mW} / 2 = -3 \text{ dBm}$$

3dB beamwidth

DeltaLink 26dBi Parabolic Dish E-Plane pattern



$$3\text{dB Beamwidth} = 87.6^\circ - 94.1^\circ \square 3\text{dB} = 6.5^\circ$$

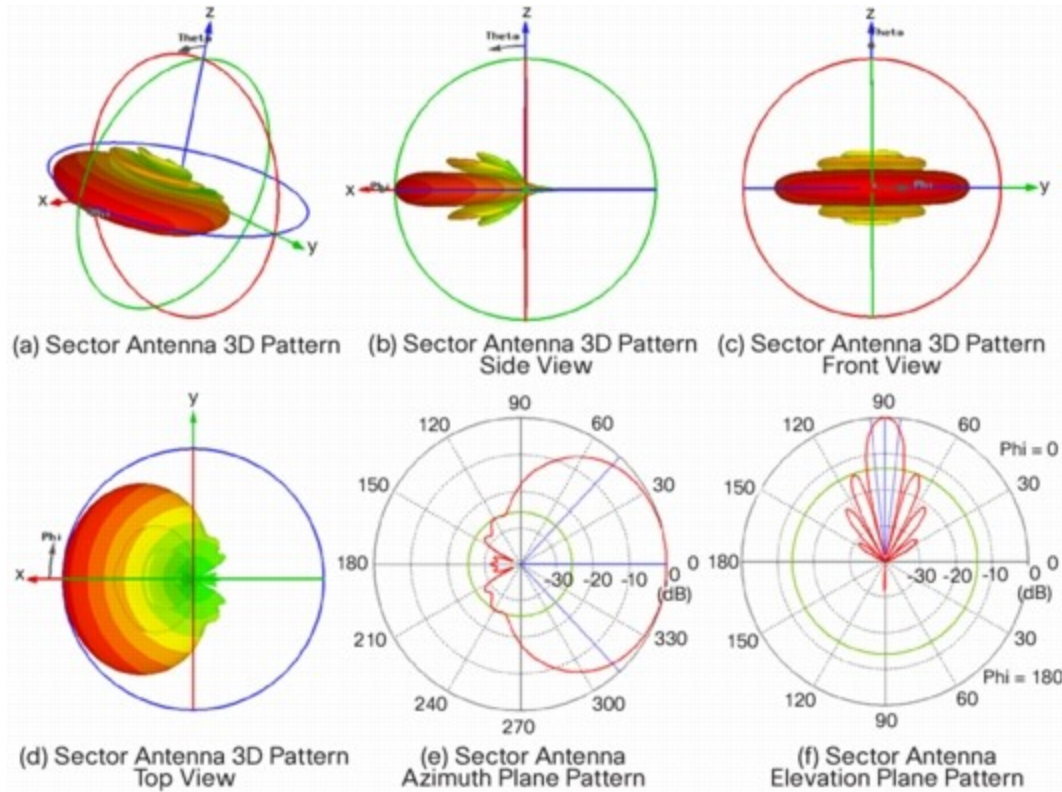
3dB beam calculation for parabolic antennas = $70\lambda/D$

D= diameter = 55 cm

$$\lambda = C/F = 30/5.5 = 5.45$$

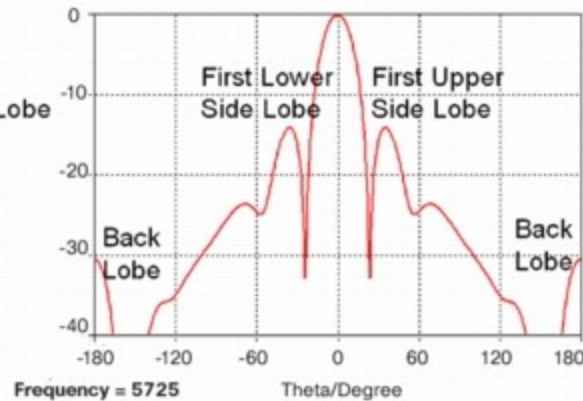
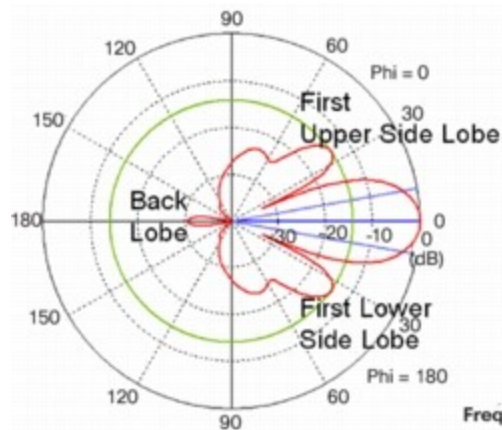
2.3.10 $3\text{dB} = 70(5.45)/55 = 6.93^\circ$

90° Sector Antenna

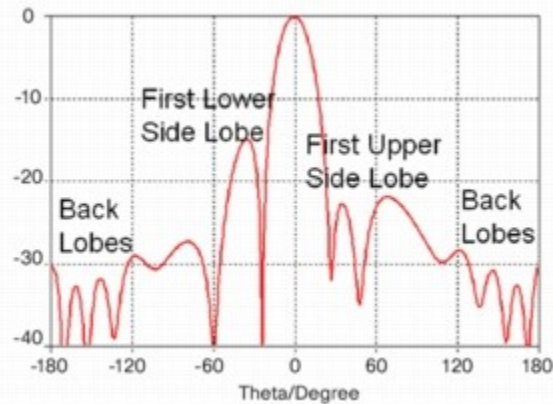
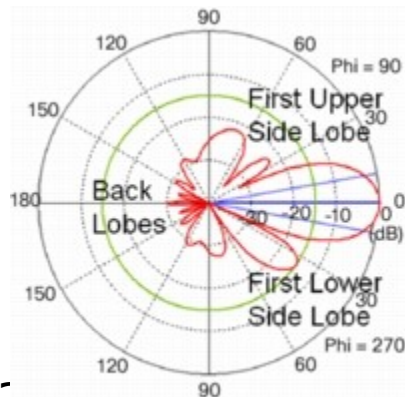


Side lobes and Back lobes

H-Plane of a Patch antenna



E-Plane of a Patch antenna

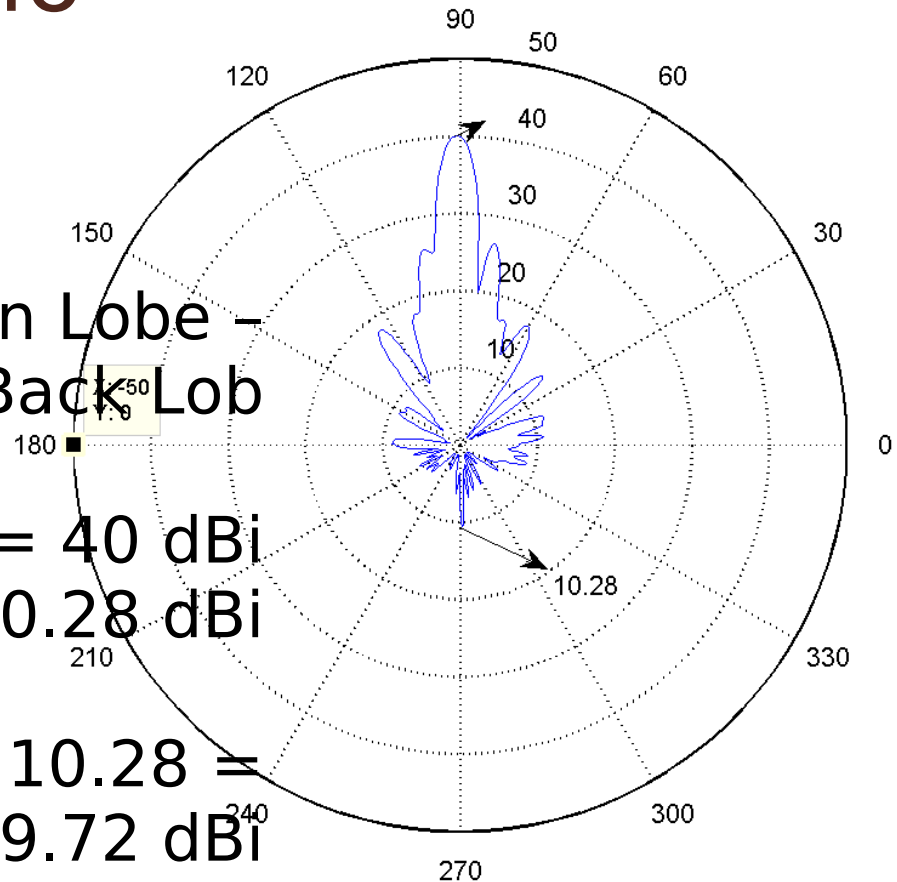


Front to Back ratio

Front to Back ratio = Main Lobe -
Back Lob

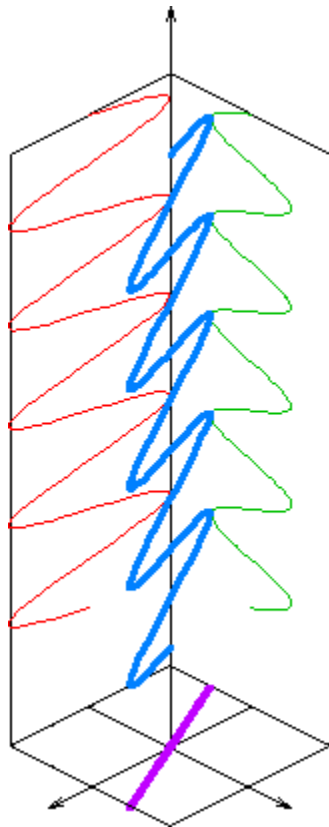
Main lobe = 40 dBi
Back lobe = 10.28 dBi

Front to Back ratio = $40 - 10.28 = 29.72$ dBi



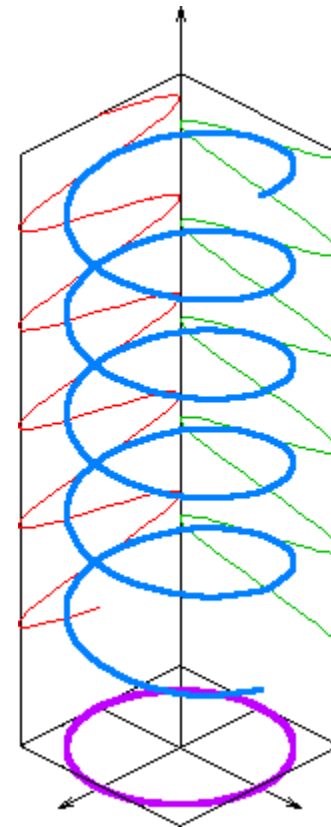
Deltalink 26dBi Parabolic Dish F

3- Polarization and dual polarized antenna



Line

2.3.10 *ar*



Circular

ar

- Mismatch Loss(for Linear Polarization)

$$\text{Polarization Mismatch Loss (dB)} = 20 \log (\cos \theta)$$

Orientation Angle	Polarization Mismatch (dB)
0.0 (aligned)	0.0
15.0	0.3
30.0	1.25
45.0	3.01
60.0	6.02
75.0	11.74
90.0 (orthogonal)	∞

4- VSWR and return Loss

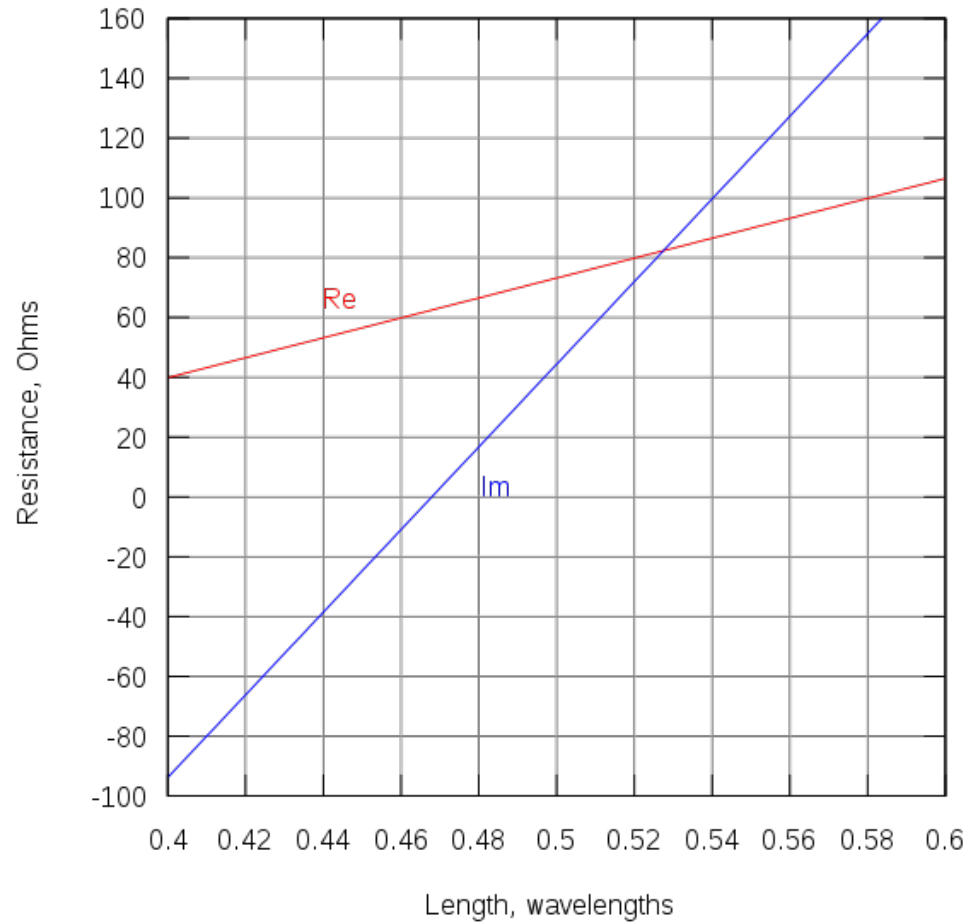
- Input impedance and the transmission lines



2.3.10
LMP 200

RG 6

- Input impedance of an antenna



- Impedance mismatching and VSWR

VSWR = Voltage Standing Wave Ratio

Start From : (1 : 1) Perfectly Match 50Ω in 50Ω system

- Acceptable : (2 : 1) up to 73Ω in 50Ω system

Up to : (∞ : 1) totally mismatch

Return Loss = Power of return signal to the transmitter in dB

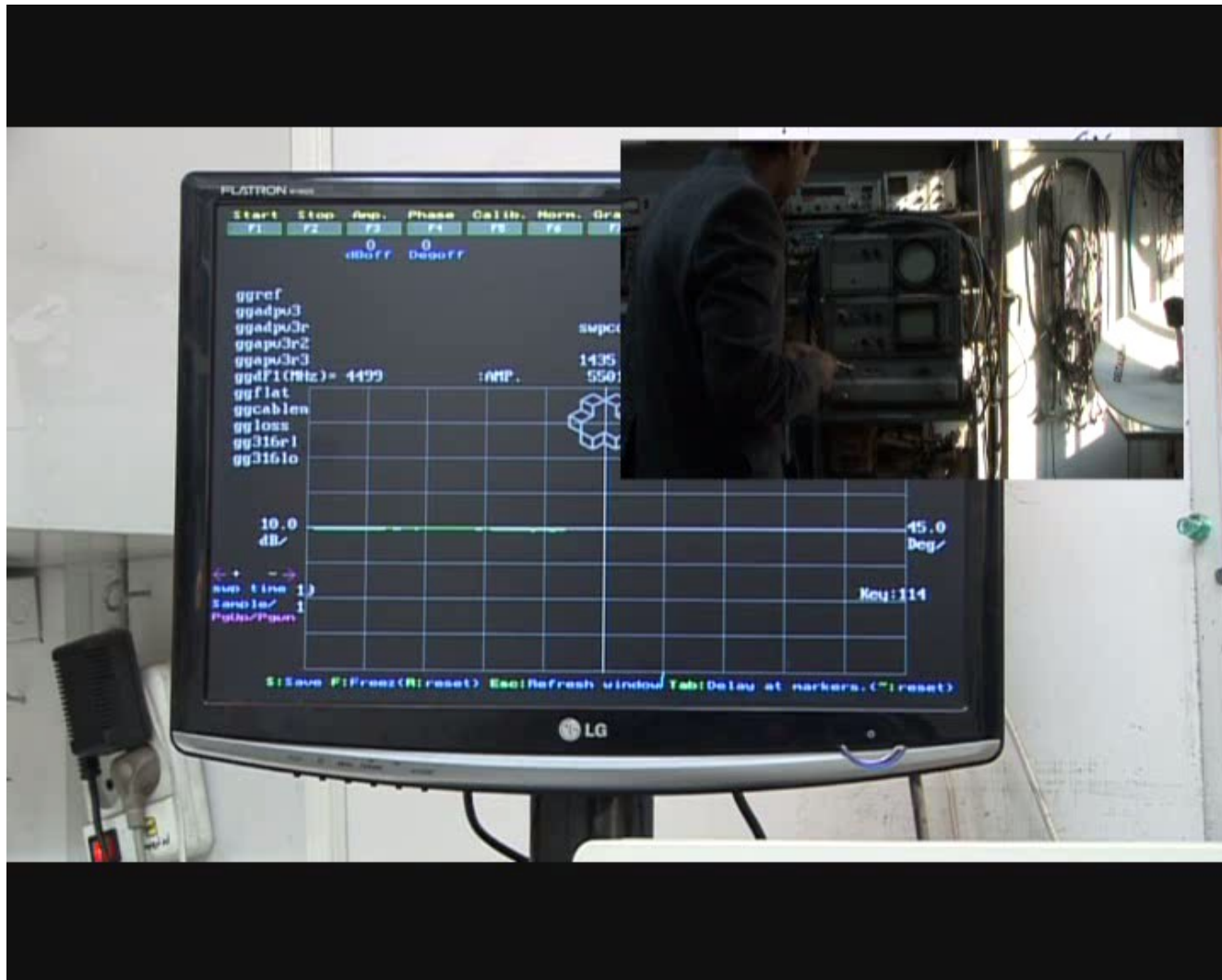
$$RL = 20 \log((VSWR+1) / (VSWR-1))$$

$$VSWR 2:1 \square RL: -9.54$$

$$2.3.10 \quad VSWR 1.01:1 \square RL: -46$$

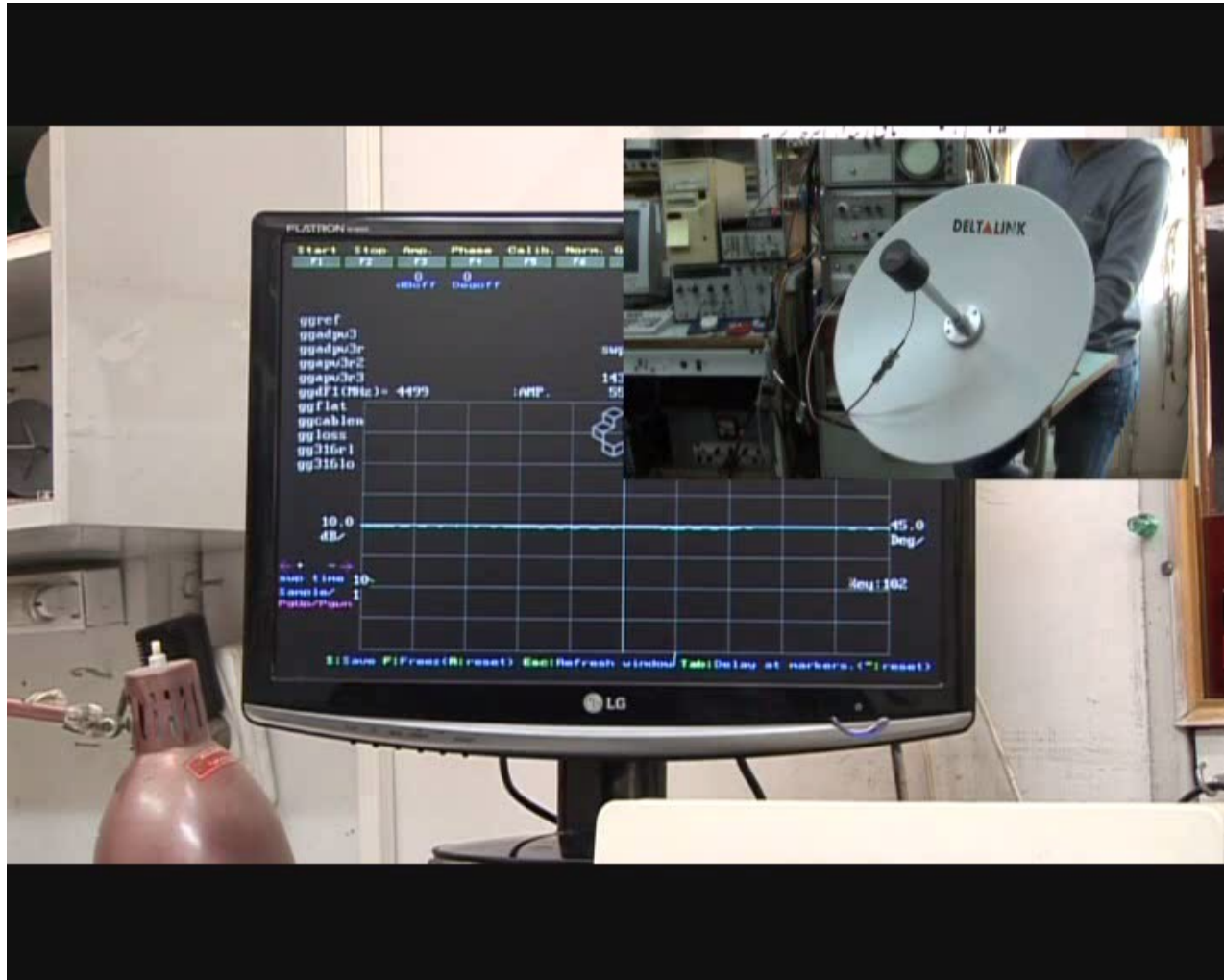
VSWR and return Loss

- Return Loss of the coaxial cable :



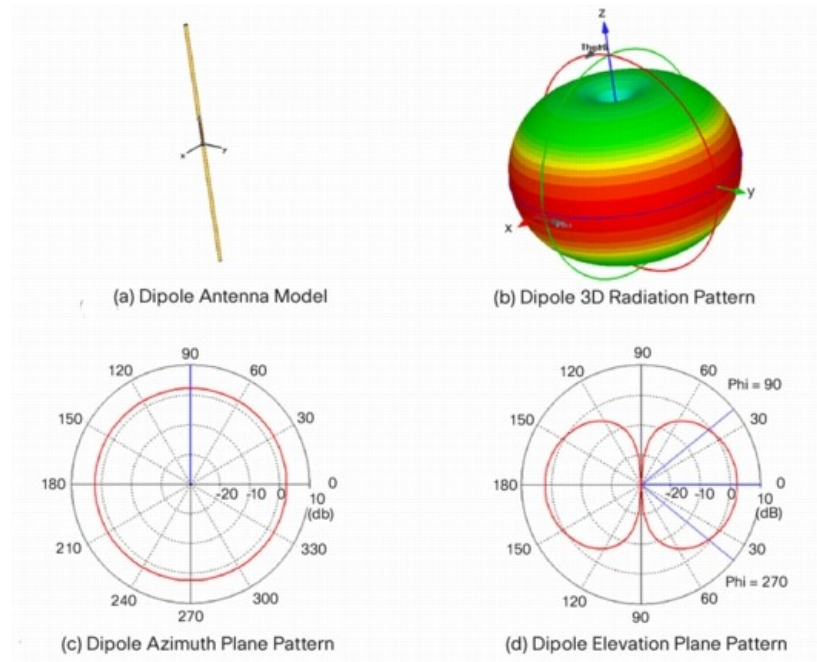
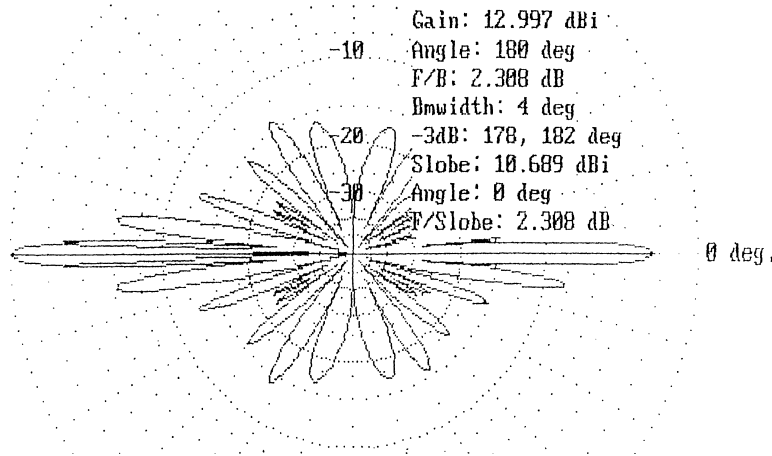
VSWR and return Loss

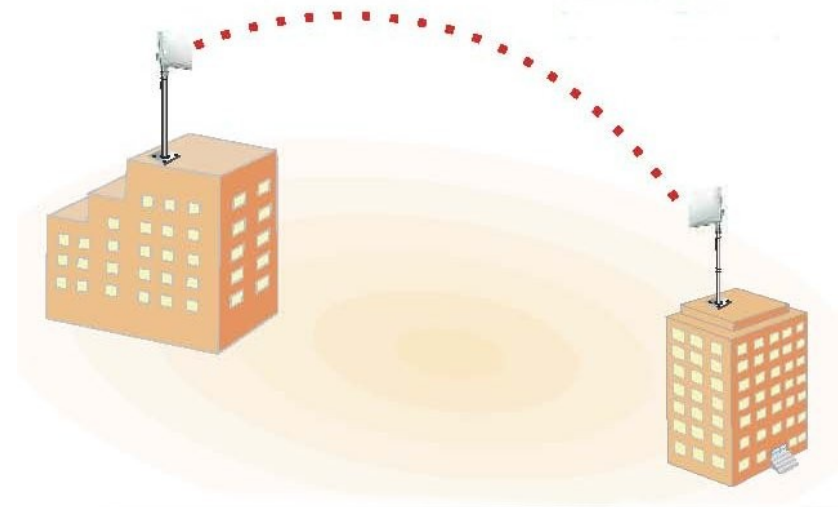
- Return Loss of an Antenna :



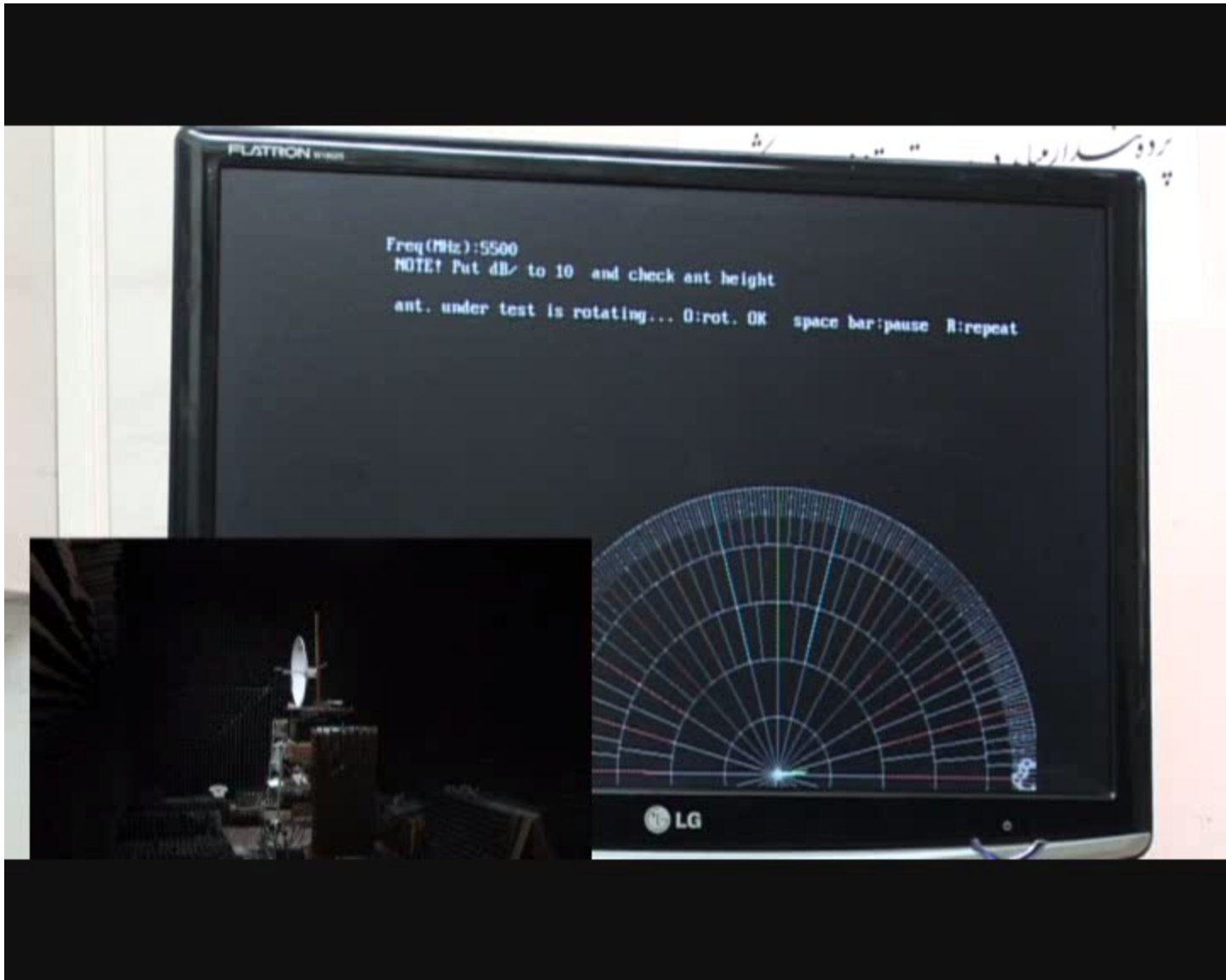
5- Antenna Gain

- **Antenna Gain** refers to the ability of the antenna to focus scattered radio frequency (RF) waves into a narrower.



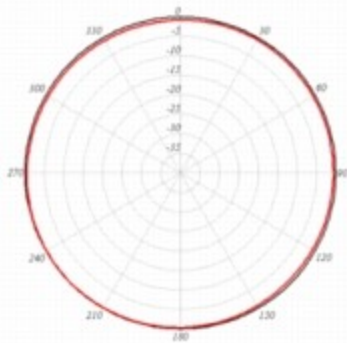
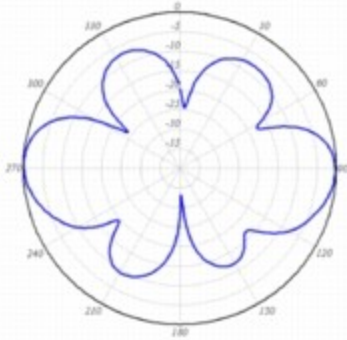


- Path loss = 139.6
- RX Signal = TX power - Cable loss + TX Antenna gain - Path loss + RX Antenna gain - Cable Loss
- RX Signal = 20(100 mW) - 1.5 dB + 18 dBi - 139.6 + 18 dBi - 1.5 = -86.6 (we have)
- We want = -71
- RX Signal(1) = 28(600 mW) - 1.5 + 18 dBi - 139.6 + 18 dBi - 1.5 = -78.6

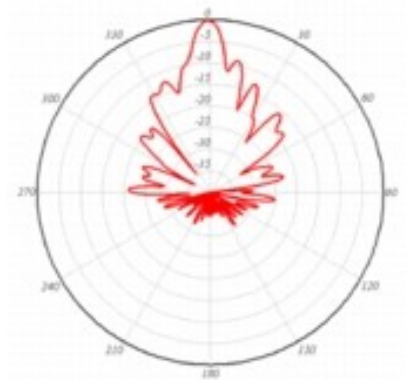
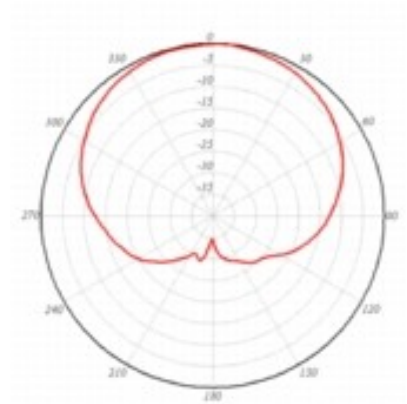


6-Different type of antennas

Omni Directional Antenna

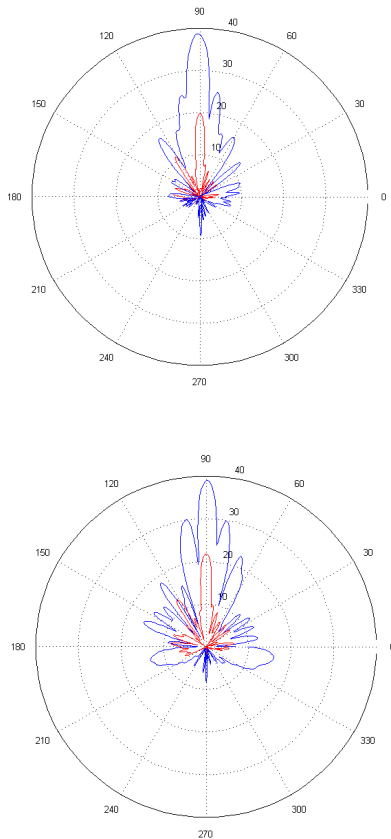


Sector Antenna



2.3.10

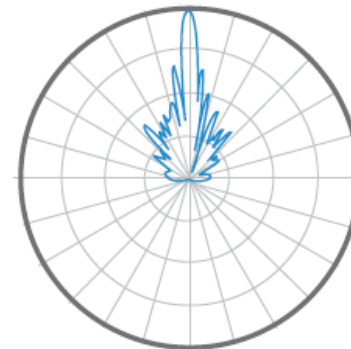
Parabolic Dish Antenna



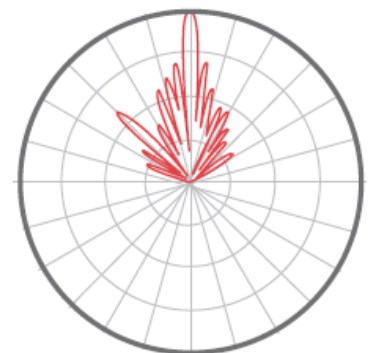
Panel Antenna



Azimuth Radiation Pattern



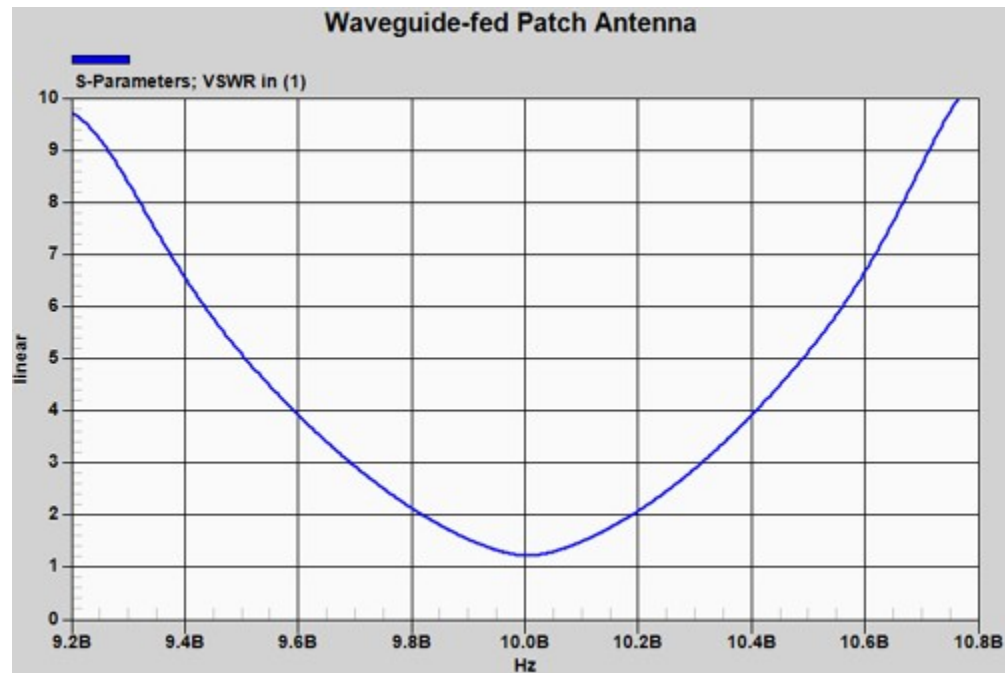
Elevation Radiation Pattern



7- Broadband and narrowband antennas

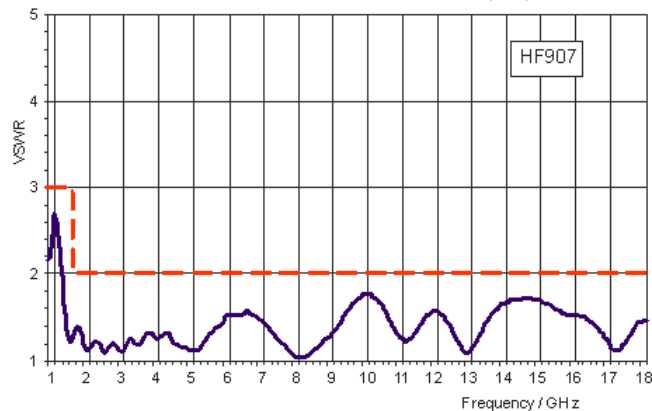
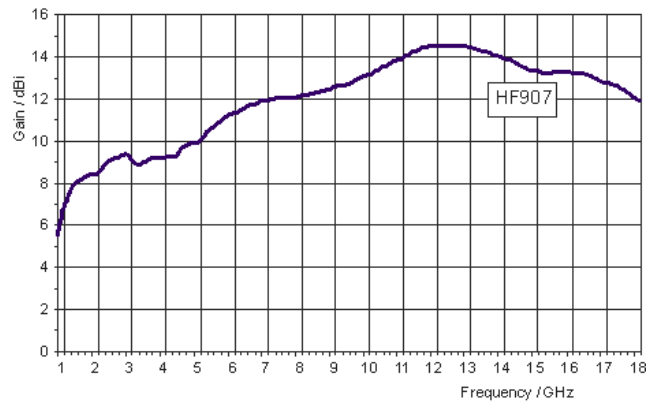
- Antenna Beamwidth:

The range of Frequency that the VSWR is lower than 2 : 1



- Broadband Antenna:

An antenna that functions satisfactorily over a wide range of frequencies for both VSWR and Gain



R&S®HF907 mounted on wooden tripod
R&S®HZ-1

