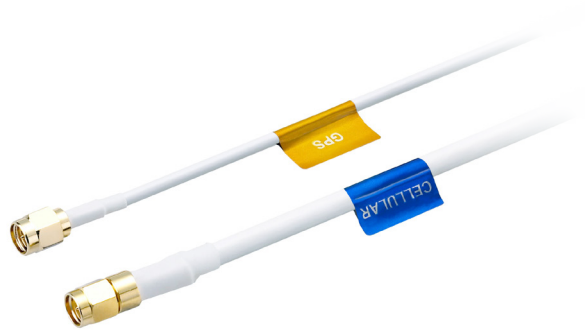




MA104.C.W.AB.002  
on ground-plane



## Hercules

MA104.C.W.AB.002

## Specification

|                     |  |
|---------------------|--|
| <b>Part No.</b>     | <b>MA104.C.W.AB.002</b>  |
| <b>Product Name</b> | <b>Hercules</b><br>MA104 2in1 Combination Hercules GPS/Cellular<br>Screw Mount (Permanent Mount)   |
| <b>Feature</b>      | <p>Low profile - Height 28.5mm and Diameter 47.8mm</p> <p>Heavy Duty Screw Mount</p> <p>White PC Casing</p> <p>GPS - Two Stage 28dB+ LNA</p> <p>Cellular - Penta Band Antenna<br/>850/900/1800/1900/2100/1575.42 MHz<br/>GSM/GPRS/CDMA/EVDO/UMTS/HSPA/WCDMA</p> <p>IP67 compliance</p> <p>Standard is 3 metres SMA(M) GPS:RG174 / Cellular:CFD200</p> <p>Cables and connectors are fully customizable</p> <p>White Version</p> <p>ROHS Compliant</p> |



## 1. Introduction

The MA104.C.W GPS & Cellular 2in1 Combination Hercules Antenna is a combination high performance GPS and penta-band cellular antenna solution for reliable asset tracking and remote monitoring. Durable UV and robust PC housing is resistant to vandalism and direct attack. At only 29 mm height it complies with the latest EU height restrictions directives for roof-mounted objects, with a diameter of 49 mm. It is designed to not catch on tree-branches.

The Hercules can be mounted on metal or non-metal structures as it has a metal ground-plane base integrated inside. The MA104 is also available in Black.

## 2. Specification

| ELECTRICAL CELLULAR     |           |           |               |             |             |      |
|-------------------------|-----------|-----------|---------------|-------------|-------------|------|
| Standard                | AMPS      | GSM       | DCS           | PCS         | 3G          |      |
| Band (MHz)              | 850       | 900       | 1800          | 1900        | 2100        |      |
| Frequency (MHz)         | 824 ~ 896 | 880 ~ 960 | 1710 ~ 1880   | 1850 ~ 1990 | 1920 ~ 2170 |      |
| <b>Return Loss (dB)</b> |           |           |               |             |             |      |
| <b>Cable Length</b>     | 0.3m      | -6.5      | -6.0          | -8          | -7          | -5   |
|                         | 1.0m      | -9.5      | -8            | -16         | -17         | -15  |
|                         | 2.0m      | -10       | -9            | -21         | -20         | -18  |
|                         | 3.0m      | -13       | -11           | -21         | -21         | -19  |
|                         | 5.0m      | -14       | -14           | -25         | -25         | -23  |
| <b>Efficiency (%)</b>   |           |           |               |             |             |      |
| <b>Cable Length</b>     | 0.3m      | 38        | MECHANICAL    | 54          | 58          | 50   |
|                         | 1.0m      | 31        | 35            | 42          | 36          | 31   |
|                         | 2.0m      | 23        | 20            | 32          | 23          | 21   |
|                         | 3.0m      | 25        | 29            | 22          | 23          | 18   |
|                         | 5.0m      | 11        | 11.5          | 11          | 12          | 11   |
| <b>Peak Gain (dB)</b>   |           |           |               |             |             |      |
| <b>Cable Length</b>     | 0.3m      | 2.0       | 3.3           | 3.6         | 4.0         | 3.0  |
|                         | 1.0m      | 1.2       | 1.3           | 1.8         | 2           | 1.2  |
|                         | 2.0m      | 0.5       | -0.35         | 1.5         | 0           | -0.1 |
|                         | 3.0m      | 0.1       | 1.6           | 0.1         | 0.6         | -0.9 |
|                         | 5.0m      | -2.5      | -2.4          | -3.0        | -2.3        | -2.0 |
| <b>Polarization</b>     |           |           | Linear        |             |             |      |
| <b>Impedance (Ohms)</b> |           |           | 50 Ohms       |             |             |      |
| <b>Input Power</b>      |           |           | 10 Watts max. |             |             |      |
| <b>VSWR</b>             |           |           | <3.5:1        |             |             |      |

## 2. Specifications

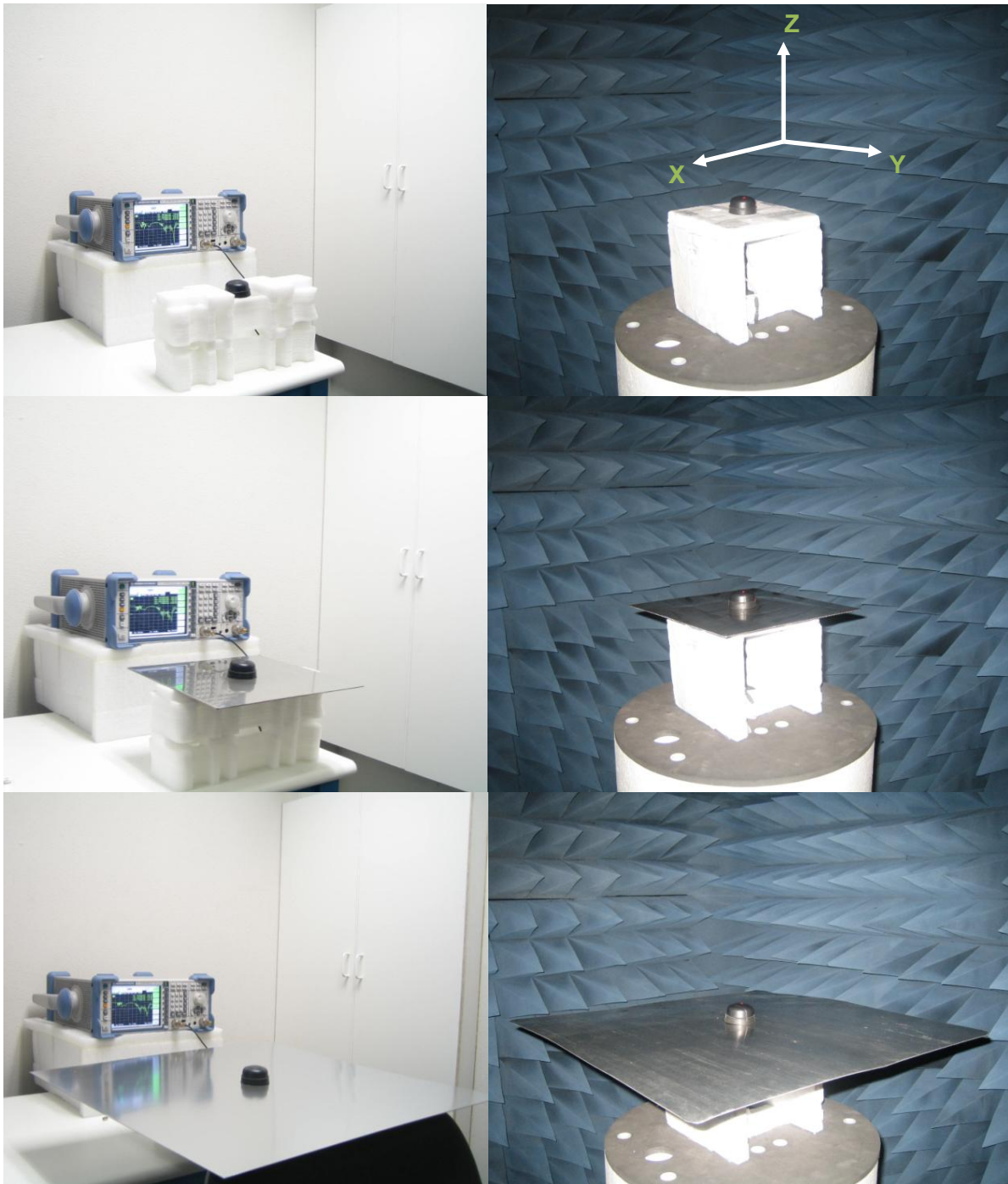
| ELECTRICAL GPS      |  |           |           |
|---------------------|--|-----------|-----------|
| Frequency           | 1575.42MHz ± 1.023MHz  |           |           |
| Impedance           | 50 ohm   |           |           |
| VSWR                | 2.0 Max  |           |           |
| GPS Patch Gain      | -2.0dB Passive Gain @ Zenith   -1.0dBi Gain @ 10 degrees elevation                       |           |           |
| Axial ratio         | 3.0 dB max   |           |           |
| Polarization        | RHCP   |           |           |
| Out Band Rejection  | fo = 1575.42MHz   fo ± 30 MHz 5dB Min.<br>fo ± 50 MHz 20dB Min.   fo ± 100 MHz 25dB Min. |           |           |
| Input Voltage       | Min:1.8V   | Typ. 3.0V | Max: 5.5V |
| Total Gain @ Zenith | 25dBic   | 30dBic    | 32dBic    |
| Current Consumption | 6mA  | 12mA      | 30mA      |
| Noise Figure        | 2.7dB  | 3.0dB     | 3.7dB     |

| MECHANICAL                  |  |
|-----------------------------|--|
| Dimensions                  | Height 28.5mm x Diameter 47.8mm                  |
| Casing                      | White PC   |
| Base and thread             | Nickel plated steel                              |
| Thread diameter             | 18mm   |
| Weather proof gasket        | DP-3060W foam with 3M9448HK double-side adhesive |
| Cable pull                  | 8 Kgf  |
| Recommended Mounting Torque | 24.5N-m  |
| Maximum Mounting Torque     | 29.4N-m  |

| ENVIRONMENTAL     |   |
|-------------------|---|
| Waterproof        | IP-67 & IP-69K  |
| Corrosion         | 5% NaCl for 96hrs - Nickel plated steel base and thread |
| Temperature Range | -40°C to +85°C  |
| Thermal Shock     | 100 cycles -40°C to +85°C                               |
| Humidity          | Non-condensing 65°C 95% RH                              |
| Shock (Drop Test) | 1m drop on concrete 6 axes                              |

**\*Note:** The return loss, efficiency and gain measurements in the above table, were taken for the antenna mounted on a 30x30 cm metal plate. For a specific case performance refers to the below plots.

### 3. Test Set Up



**Figure 1.** MA104 Antenna test set up in free space, 30x30 cm metal plate and 60x60 cm metal plate, R&SZVL6 VNA (Left) and R&S4100 CTIA 3D Chamber (Right).

## 4. Cellular Antenna Parameters

### 4.1 Return Loss

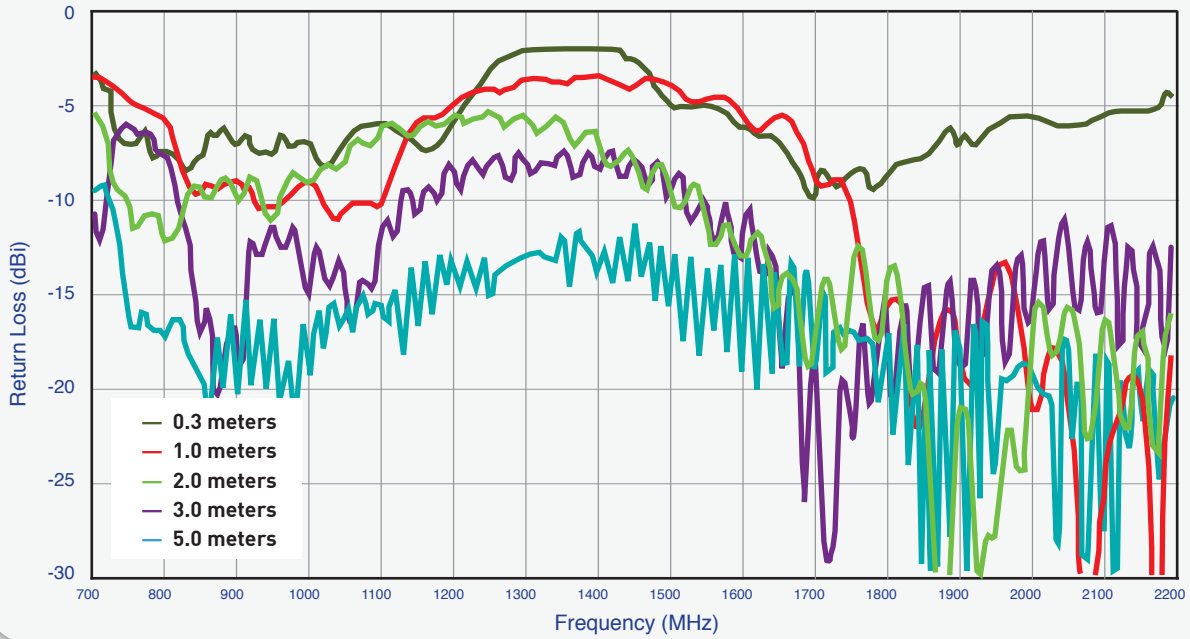


Figure 2. Return Loss of the MA104 antenna in free space

### 4.1 Return Loss

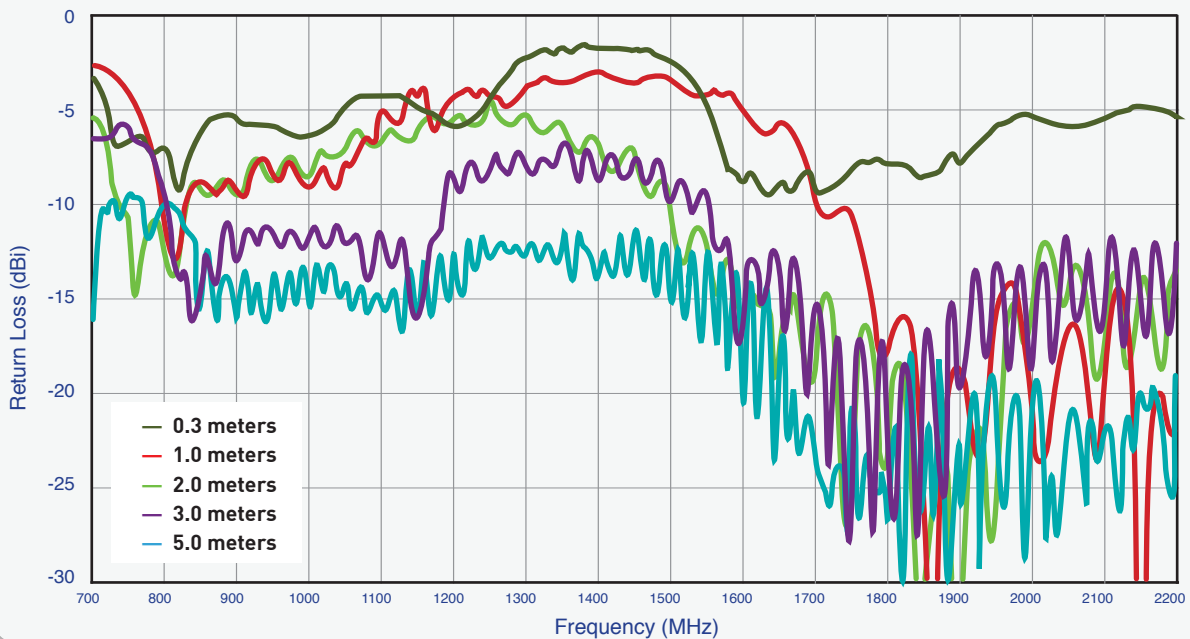


Figure 3. Return Loss of the MA104 antenna on 30\*30cm metal plate

### 4.1 Return Loss

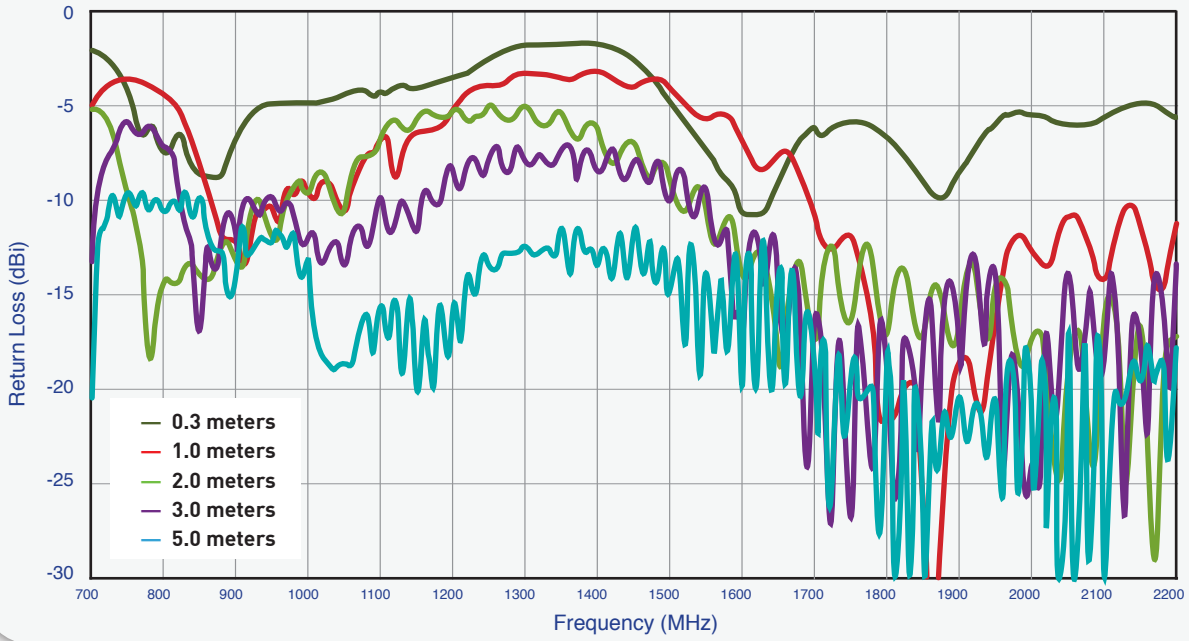


Figure 4. Return Loss of the MA104 antenna on 60\*60cm metal plate.

### 4.2 Efficiency

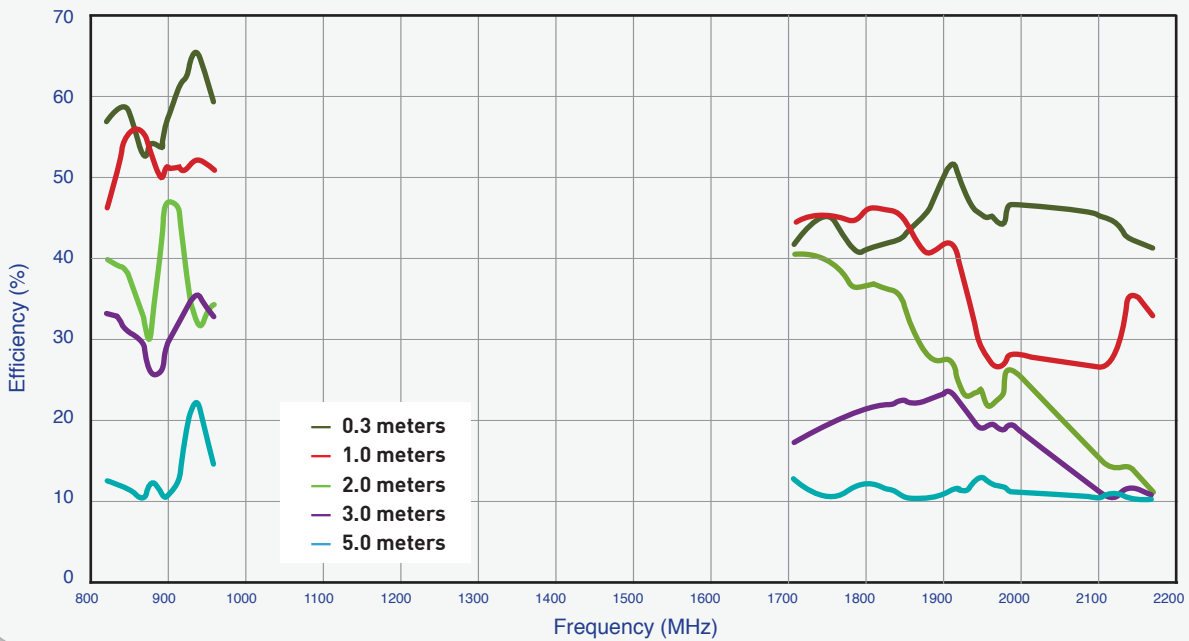


Figure 5. Efficiency of the MA104 antenna in free space.

## 4.2 Efficiency

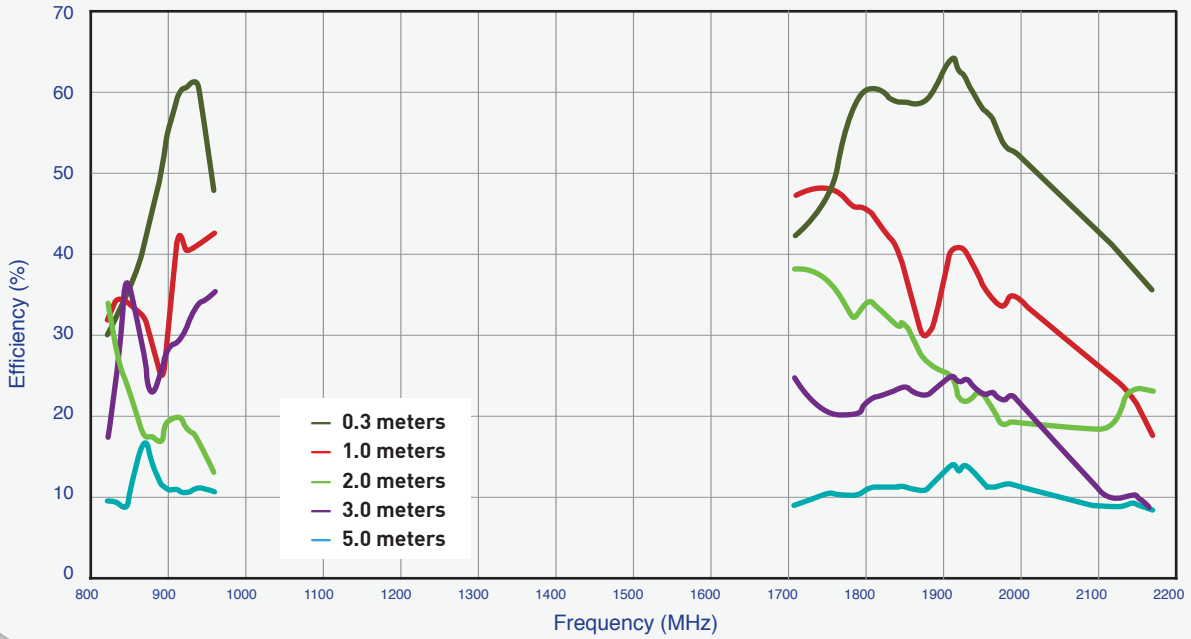


Figure 6. Efficiency of the MA104 antenna on 30\*30cm metal plate.

## 4.2 Efficiency

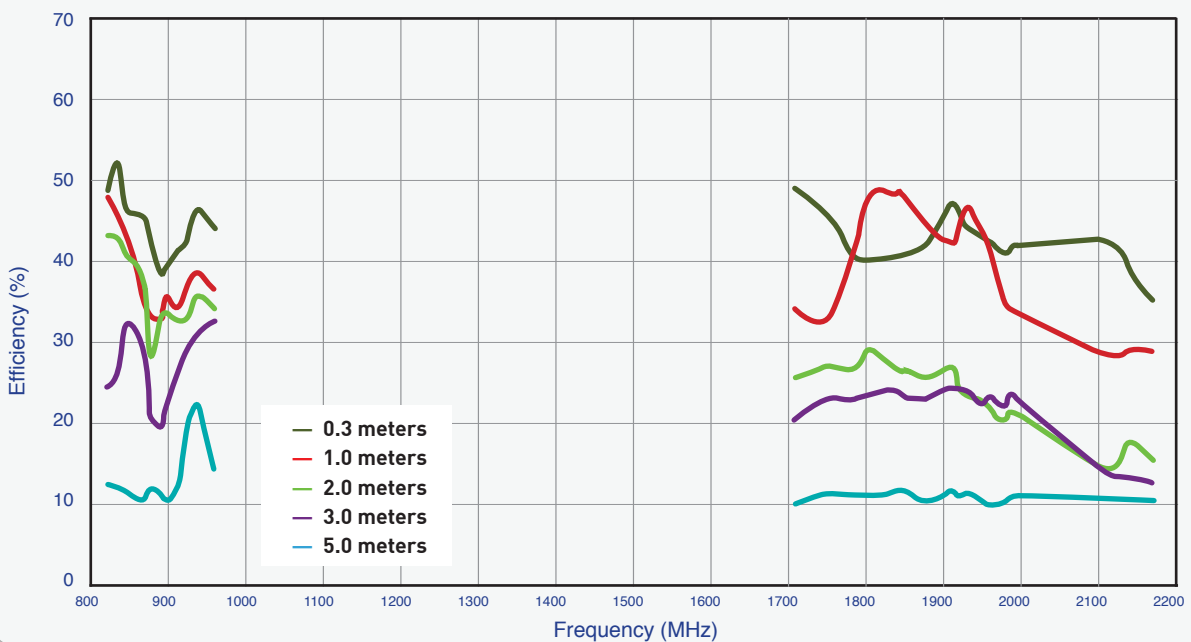


Figure 7. Efficiency of the MA104 antenna on 60\*60cm metal plate.



### 4.3 Peak Gain

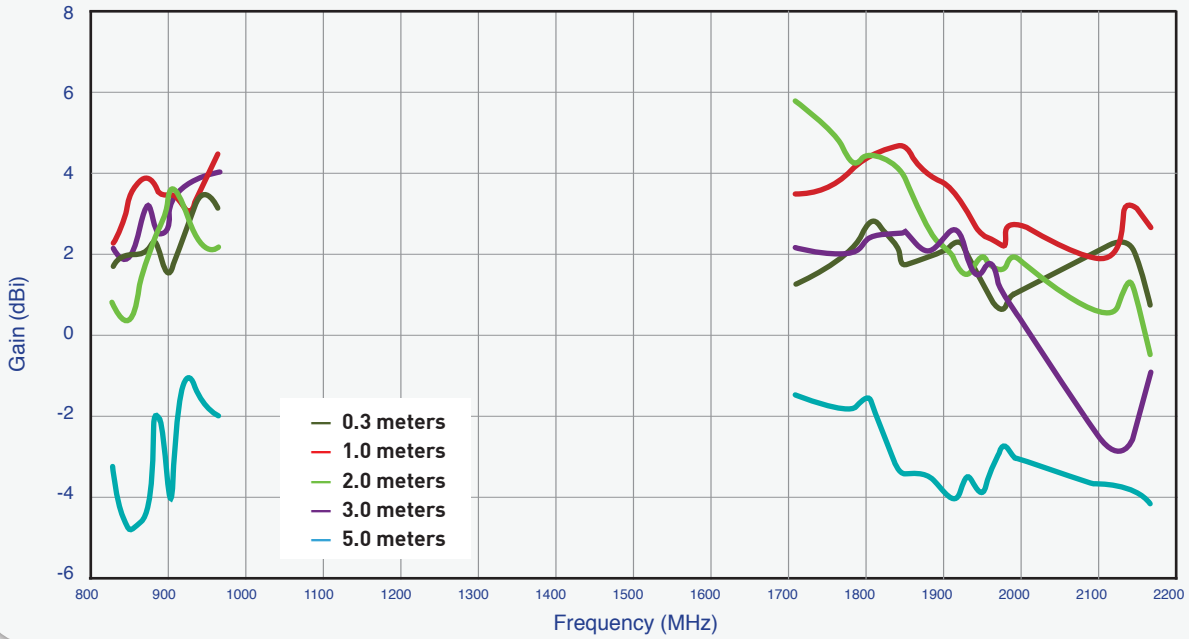


Figure 8. Gain of the MA104 antenna in free space

### 4.3 Peak Gain

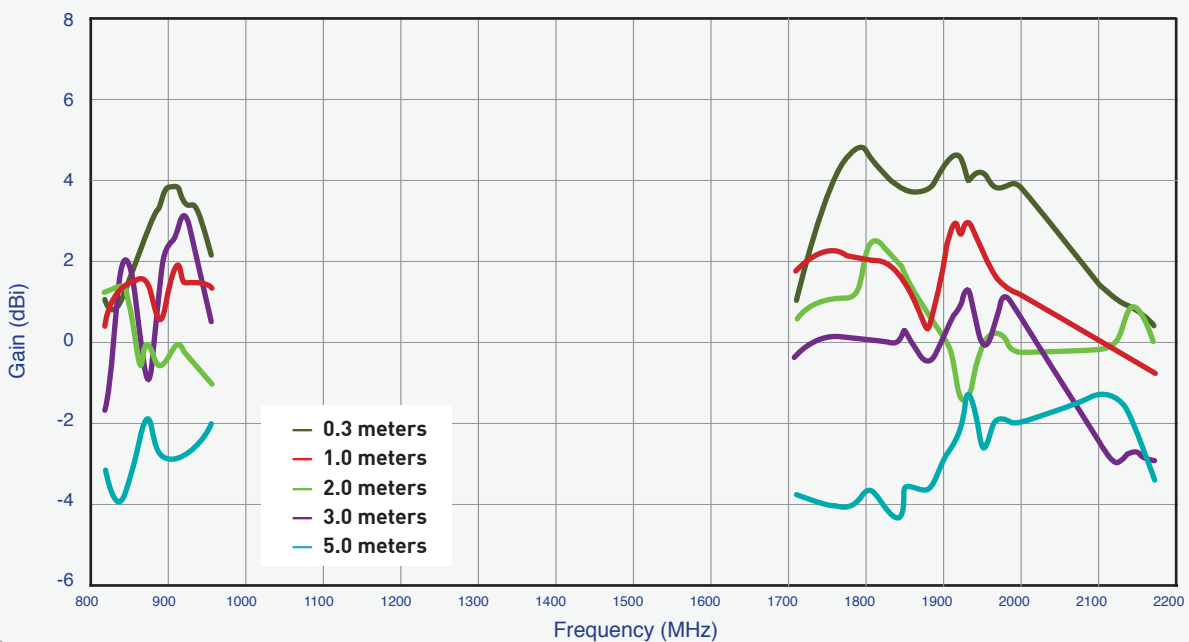


Figure 9. Gain of the MA104 antenna on 30\*30cm metal plate

### 4.3 Peak Gain

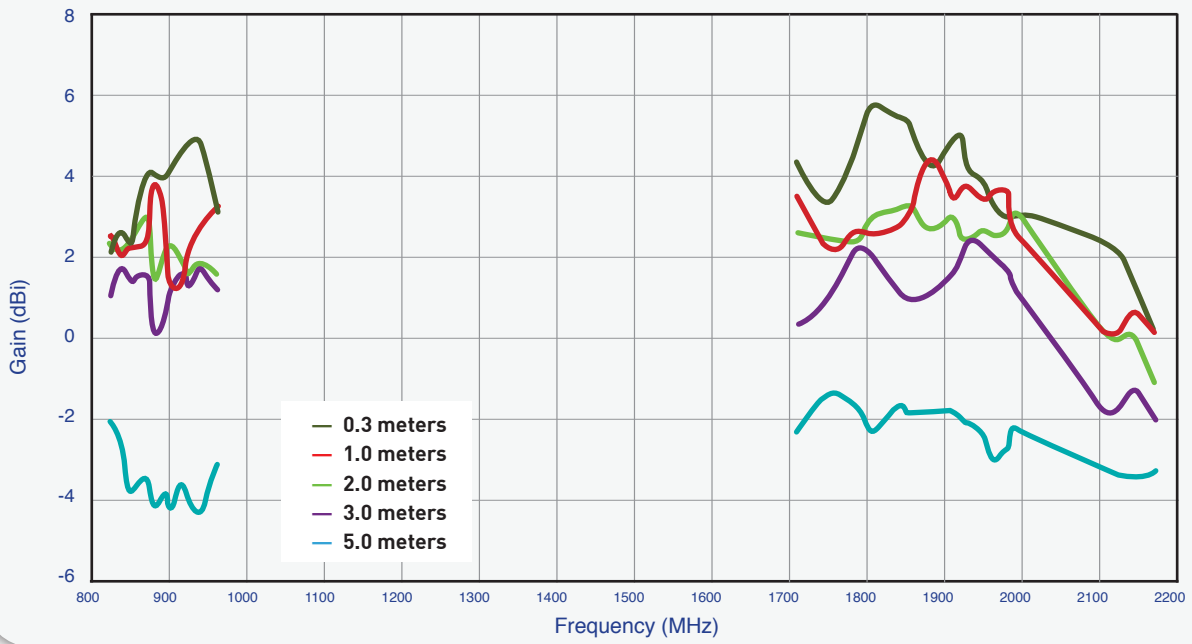
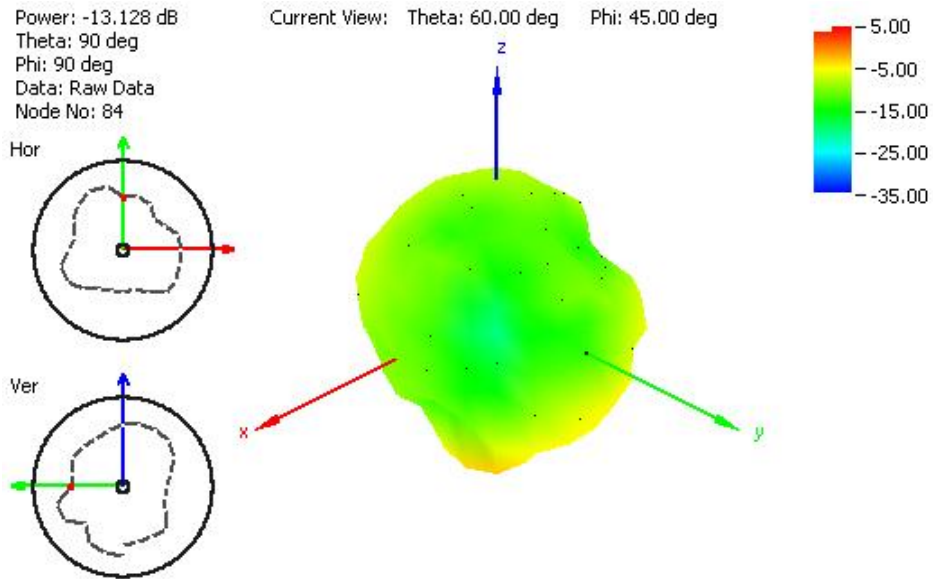
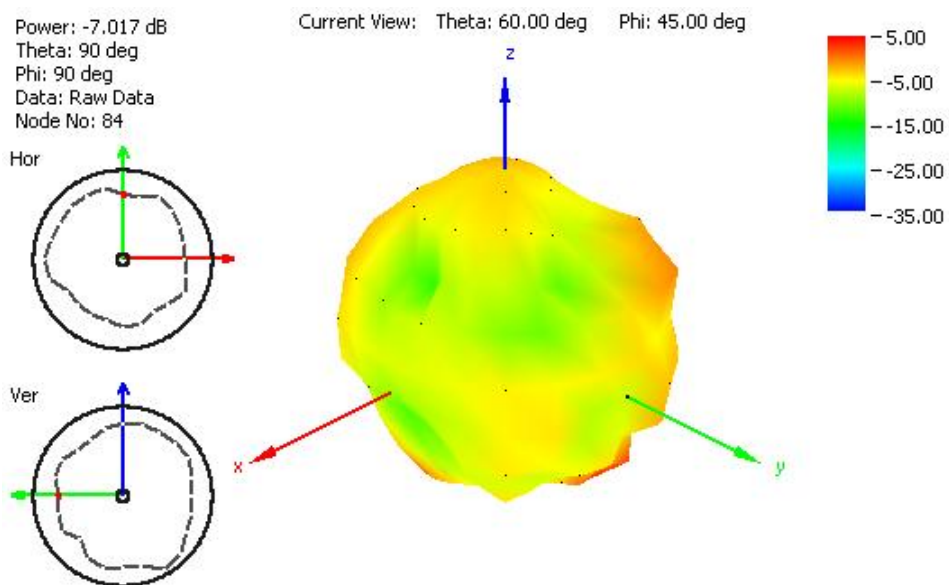


Figure 10. Gain of the MA105 antenna on 60\*60cm metal plate

## 4.4 Radiation pattern

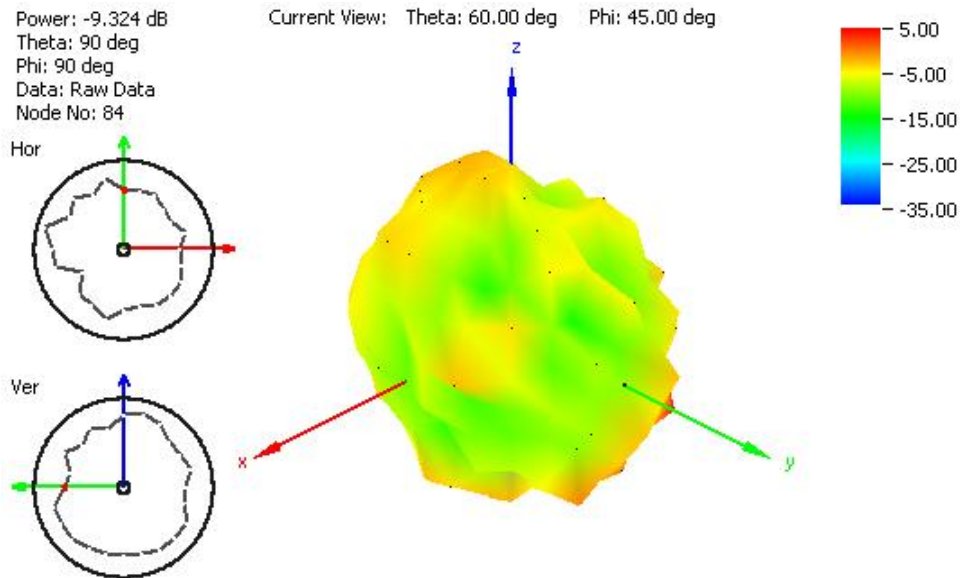


**Figure 11.** Radiation pattern at 849 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and free space

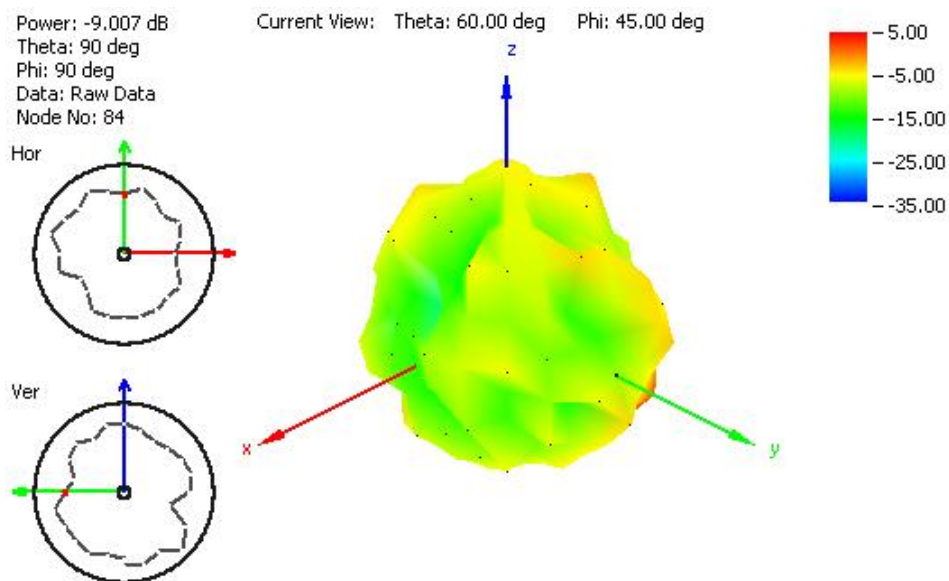


**Figure 12.** Radiation pattern at 915 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and free space

## 4.4 Radiation pattern

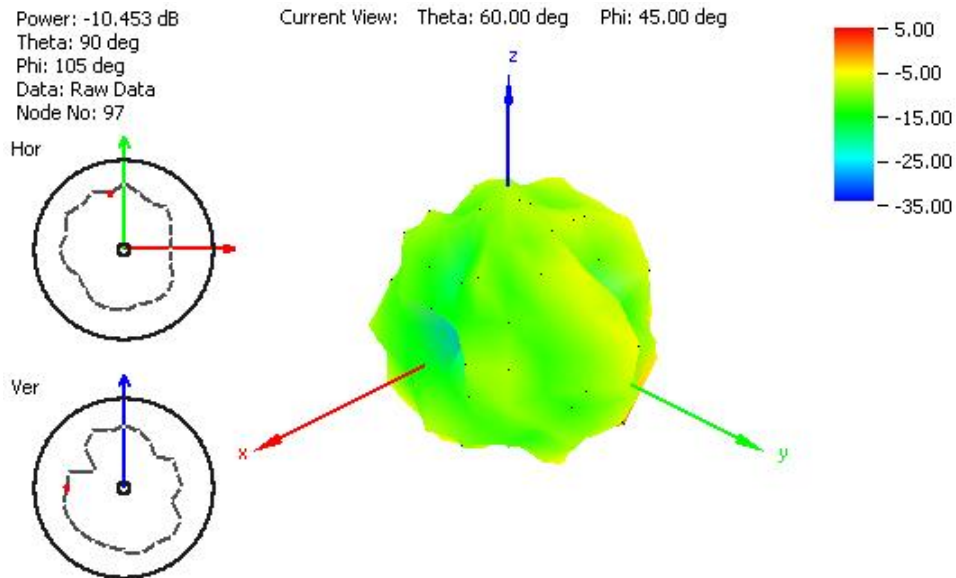


**Figure 13.** Radiation pattern at 1805 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and free space

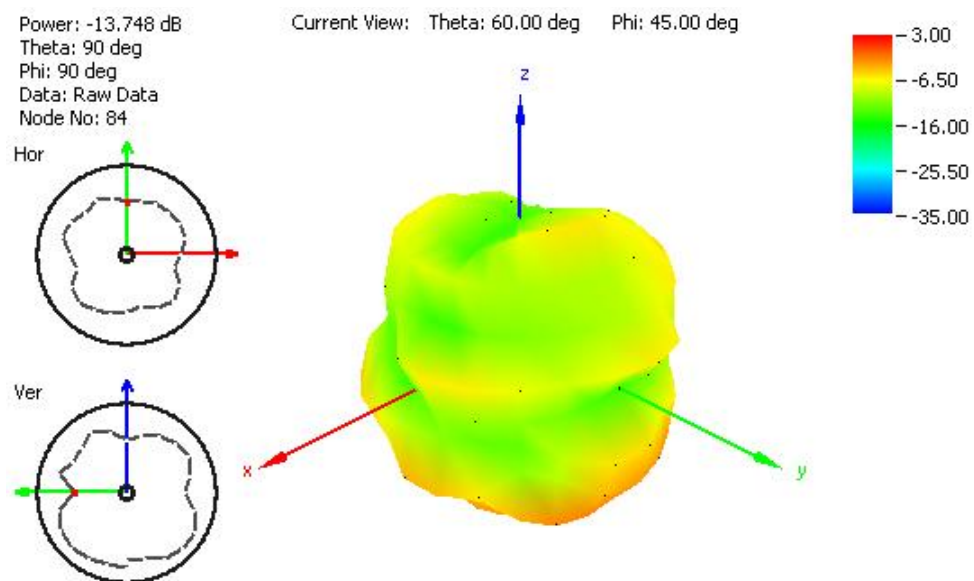


**Figure 14.** Radiation pattern at 1910 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and free space

## 4.4 Radiation pattern

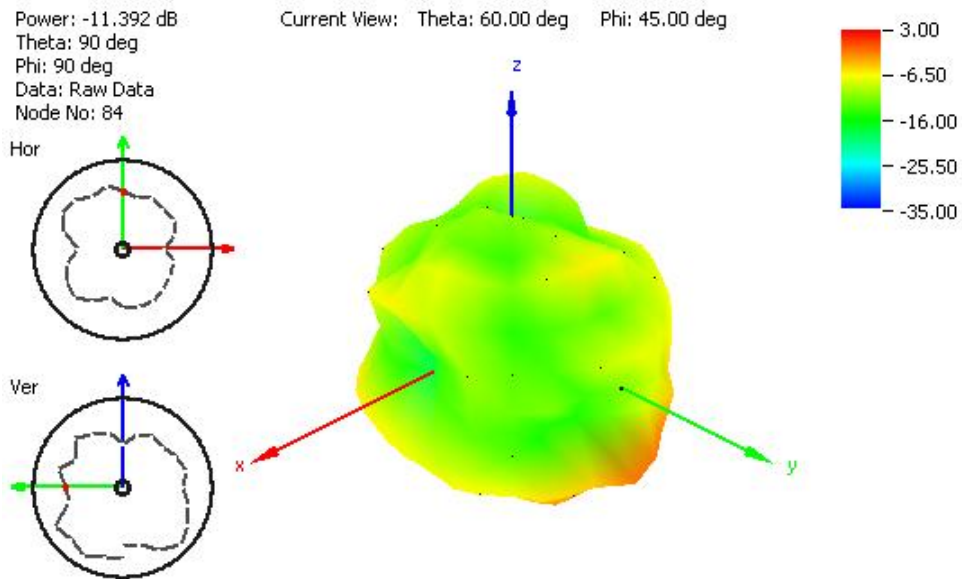


**Figure 15.** Radiation pattern at 2110 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and free space.

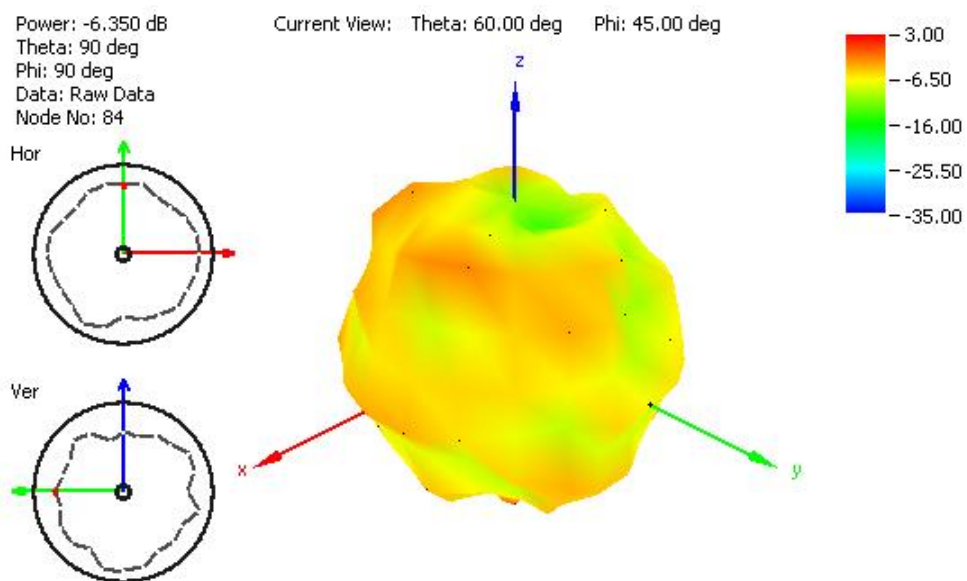


**Figure 16.** Radiation pattern at 849 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 30x30 cm metal plate

## 4.4 Radiation pattern

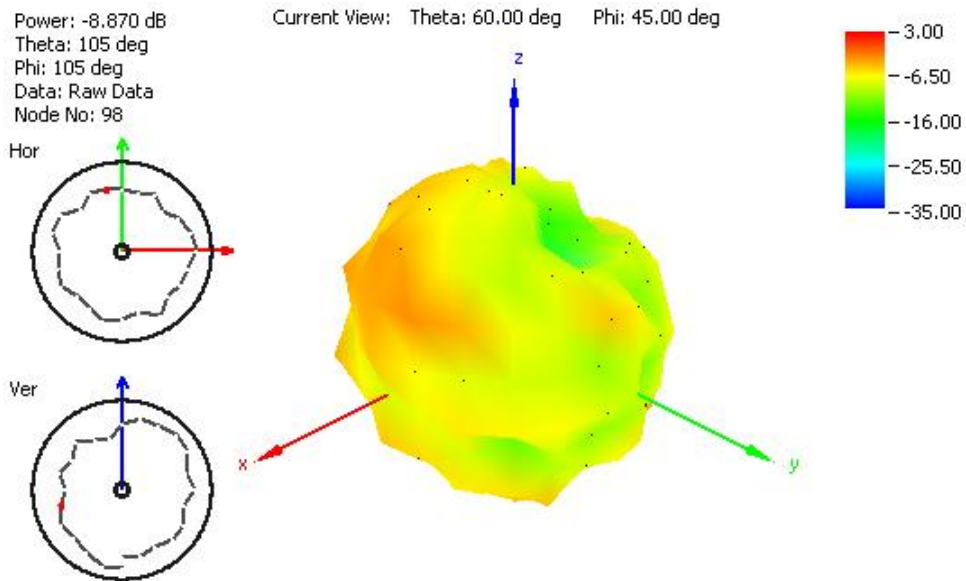


**Figure 17.** Radiation pattern at 915 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 30x30 cm metal plate

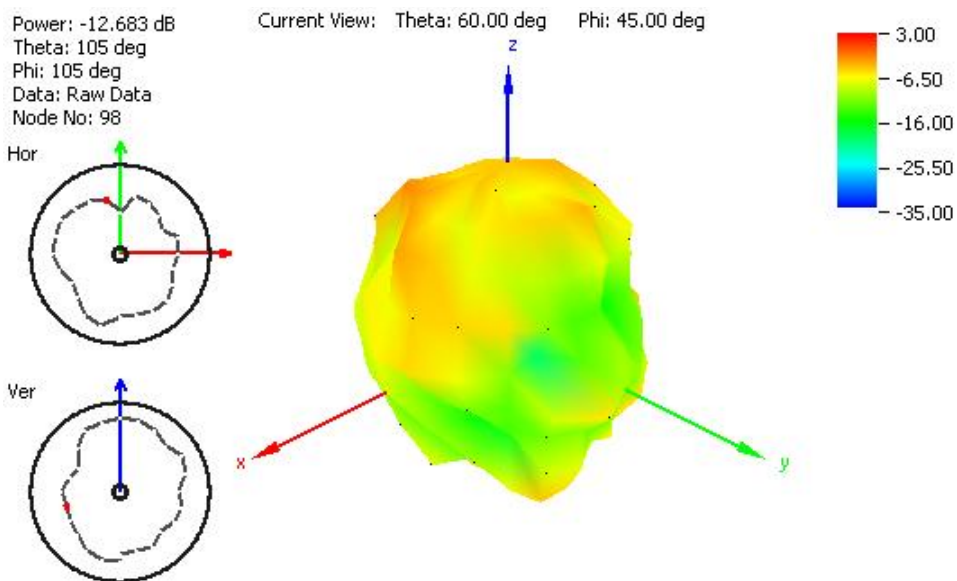


**Figure 18.** Radiation pattern at 1805 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 30x30 cm metal plate

## 4.4 Radiation pattern

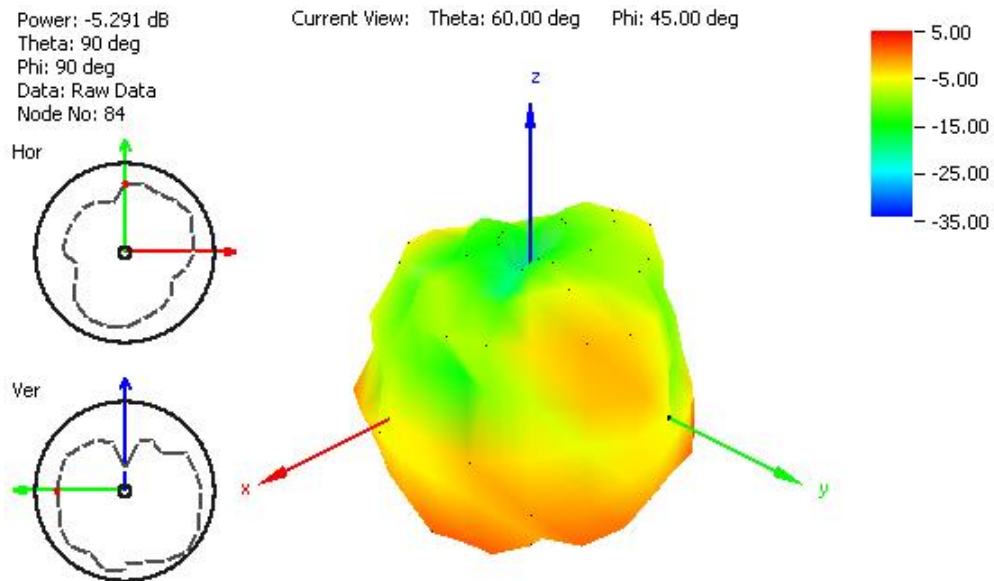


**Figure 19.** Radiation pattern at 1910 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 30x30 cm metal plate

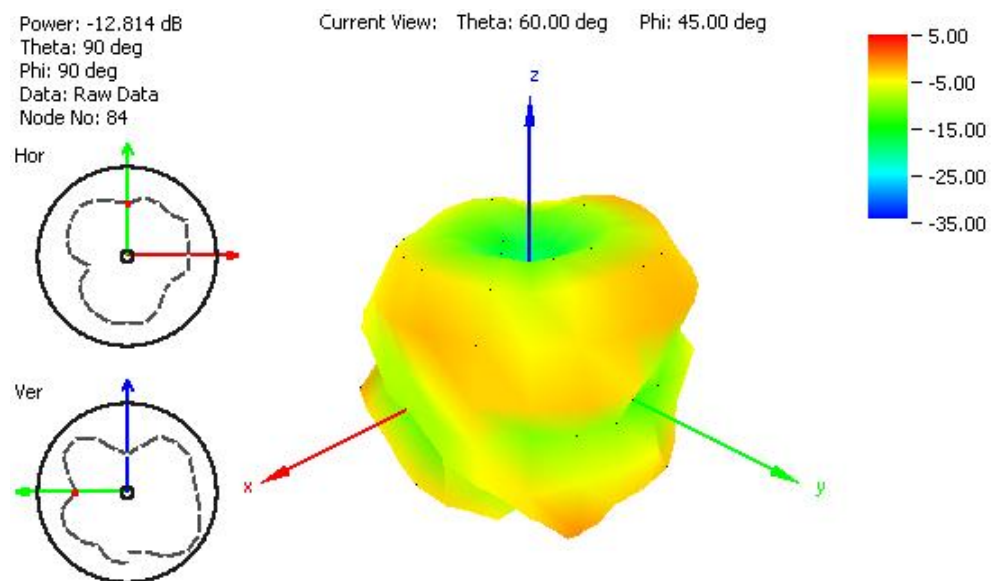


**Figure 20.** Radiation pattern at 2110 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 30x30 cm metal plate

## 4.4 Radiation pattern



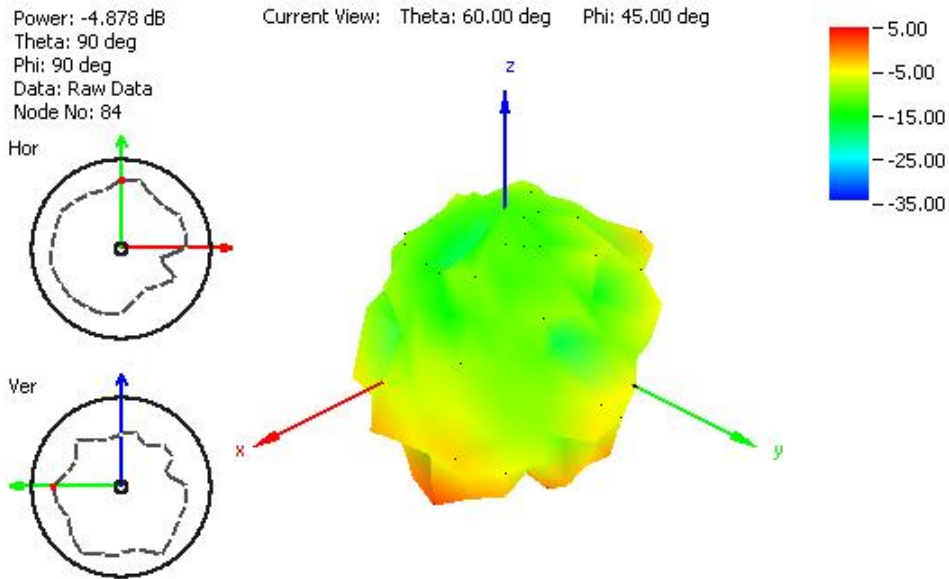
**Figure 21.** Radiation pattern at 849 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 60x60 cm metal plate



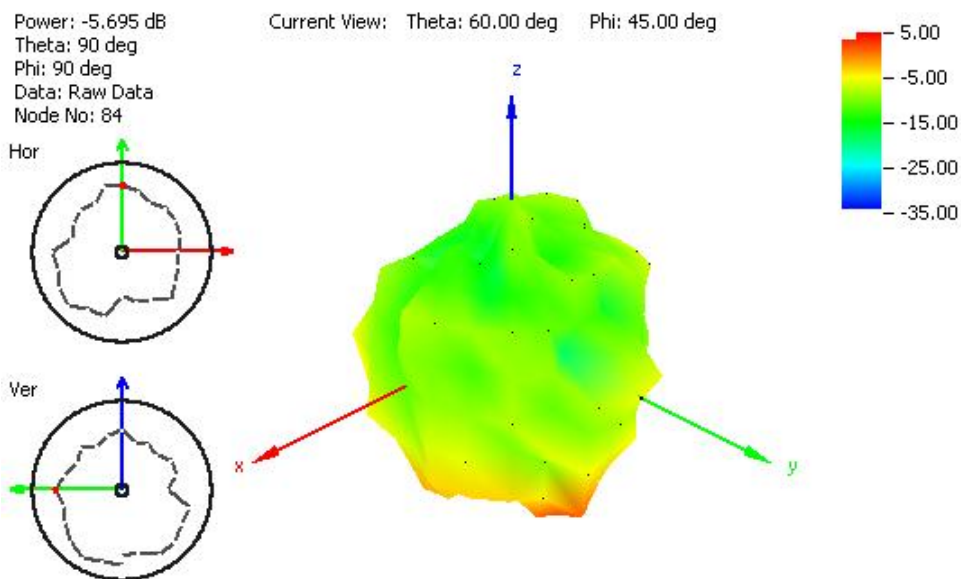
**Figure 22.** Radiation pattern at 915 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 60x60 cm metal plate



## 4.4 Radiation pattern

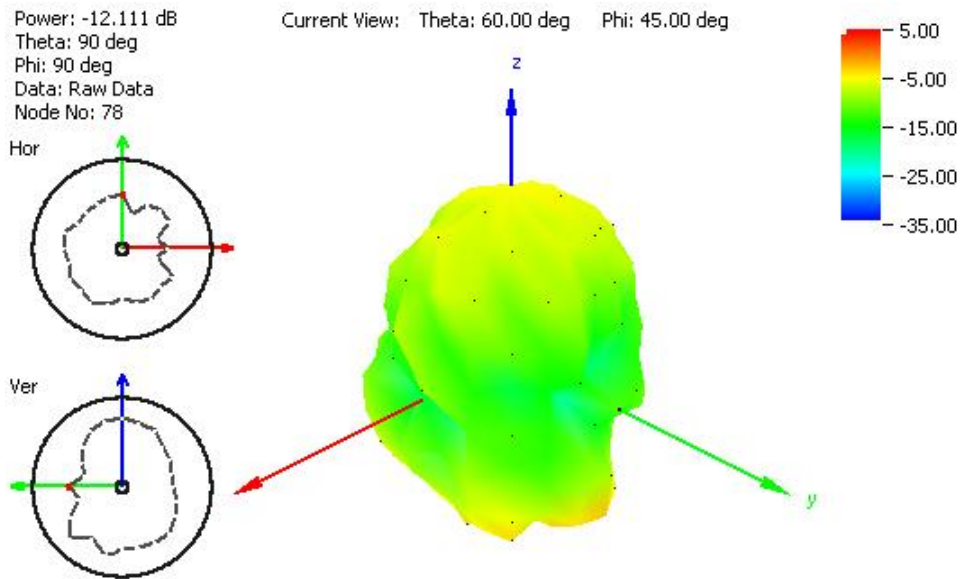


**Figure 23.** Radiation pattern at 1805 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 60x60 cm metal plate



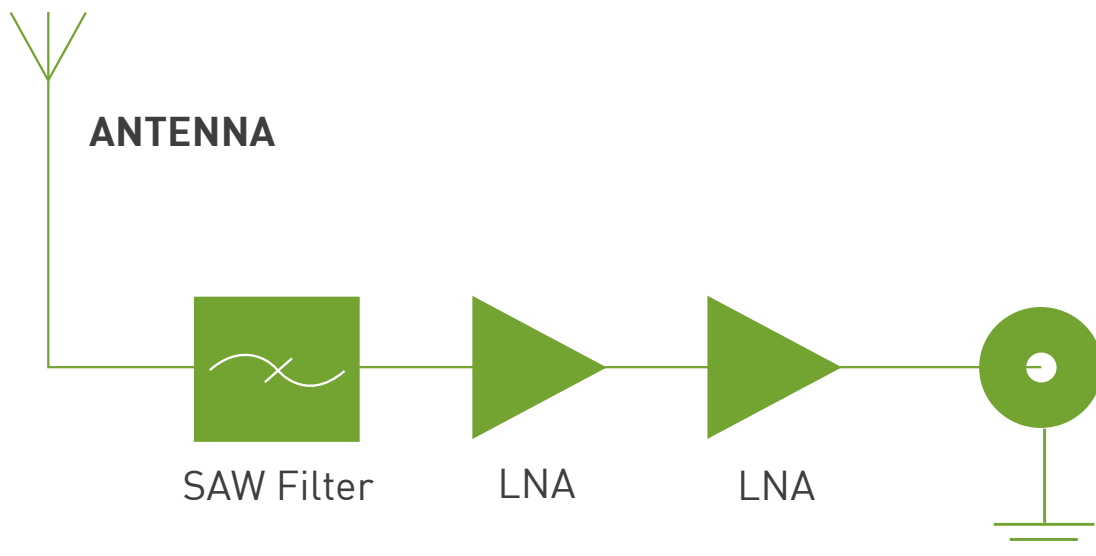
**Figure 24.** Radiation pattern at 1910 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 60x60 cm metal plate

## 4.4 Radiation pattern

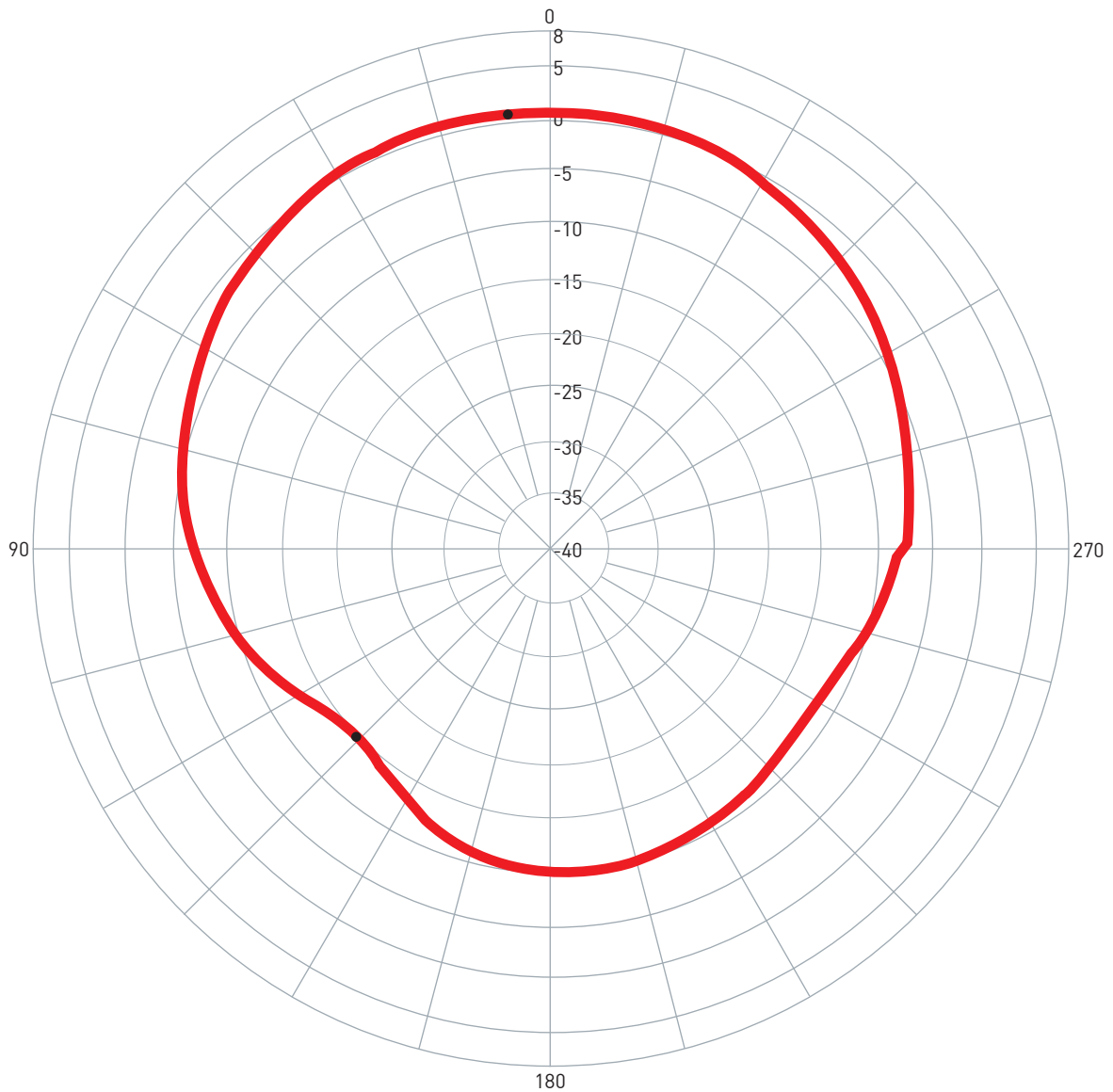


**Figure 25.** Radiation pattern at 2110 MHz, Figure 1 as reference (dB), with 2 meter RG174 cable and 60x60 cm metal plate

## 5. System Block Diagram



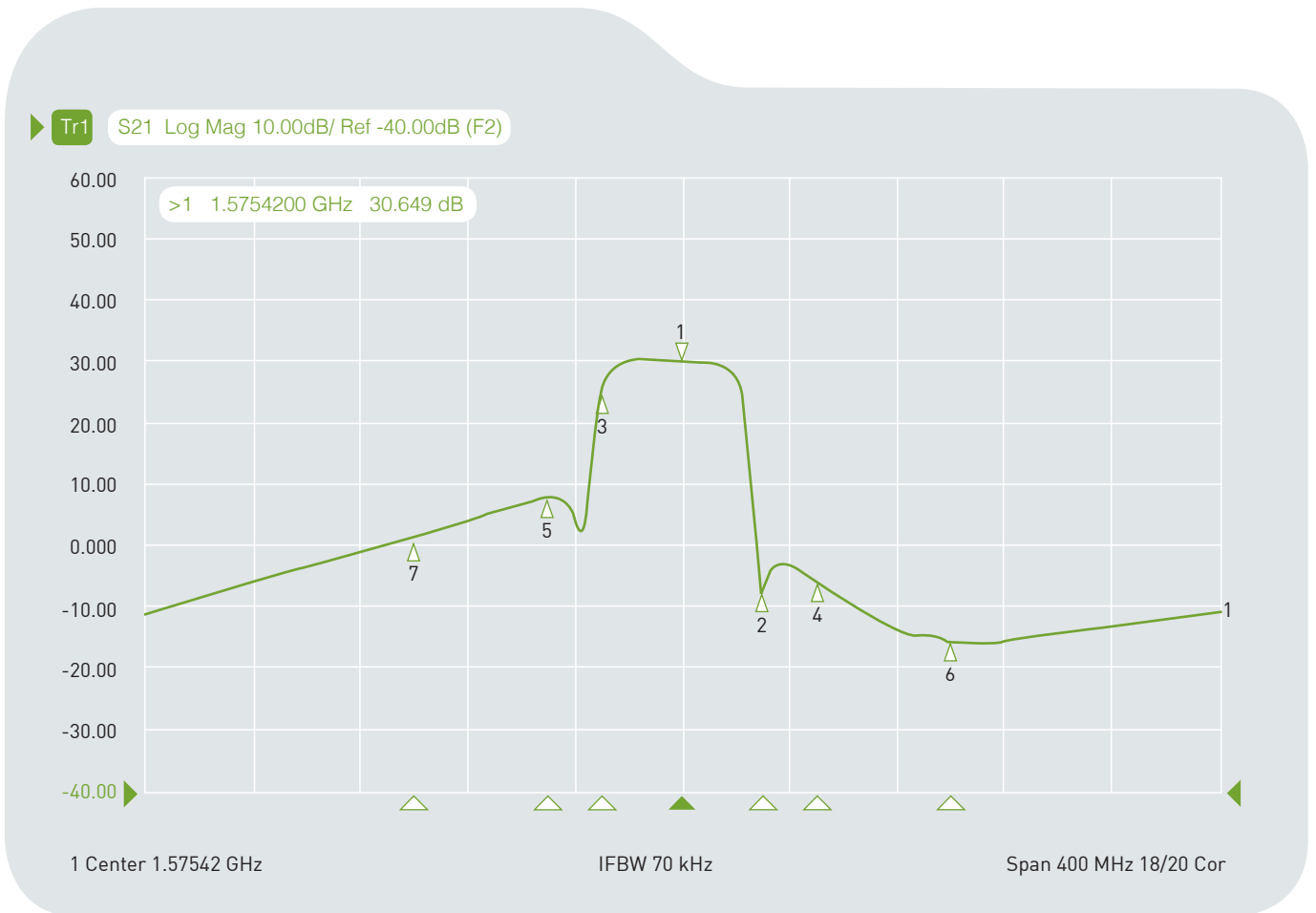
## 6. GPS Patch Radiation Pattern



**0 degree is the top of Hercules.**

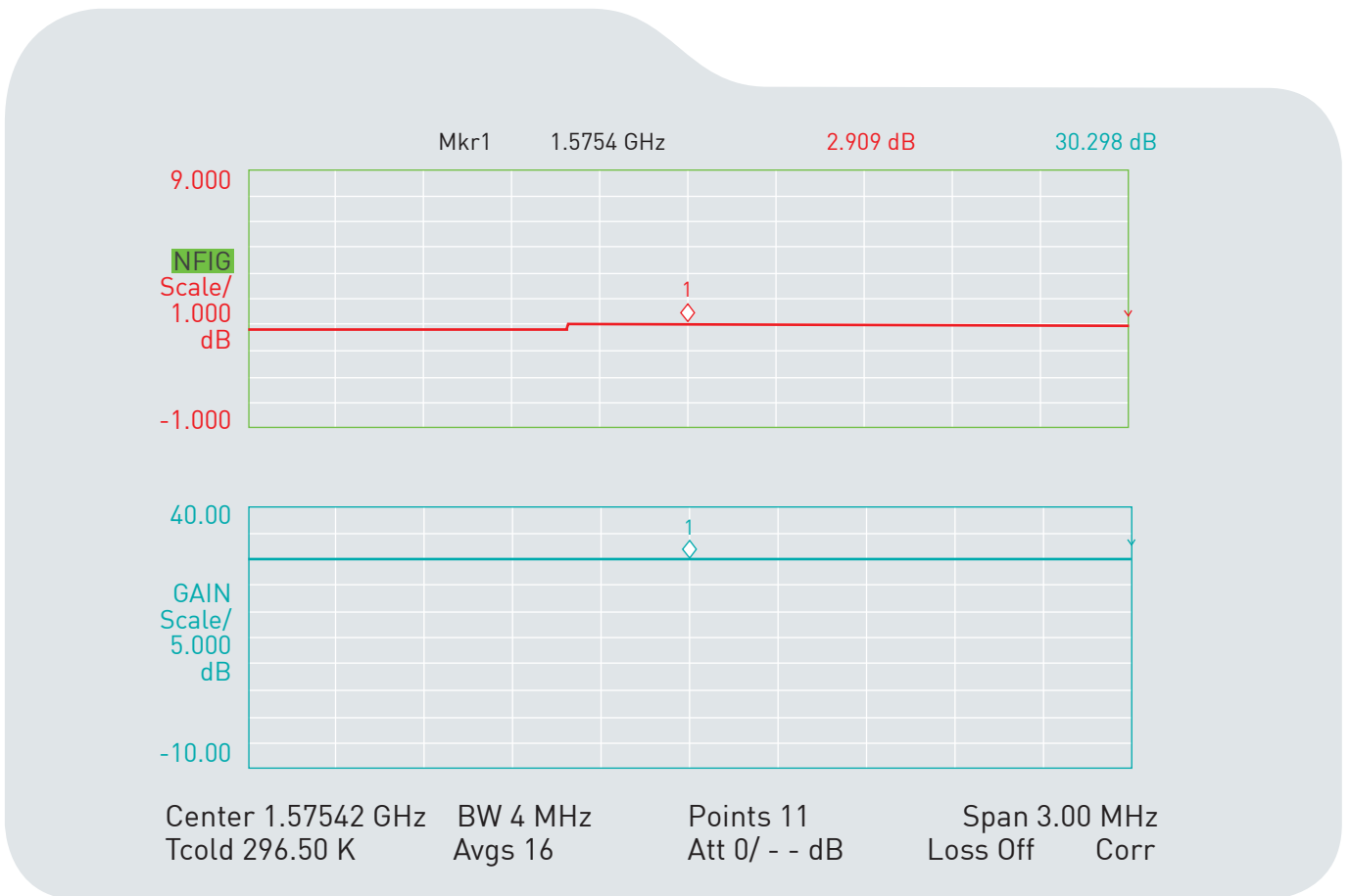
## 7. LNA Properties

### 7.1 LNA Gain and Out-band Rejection @ 3.0V

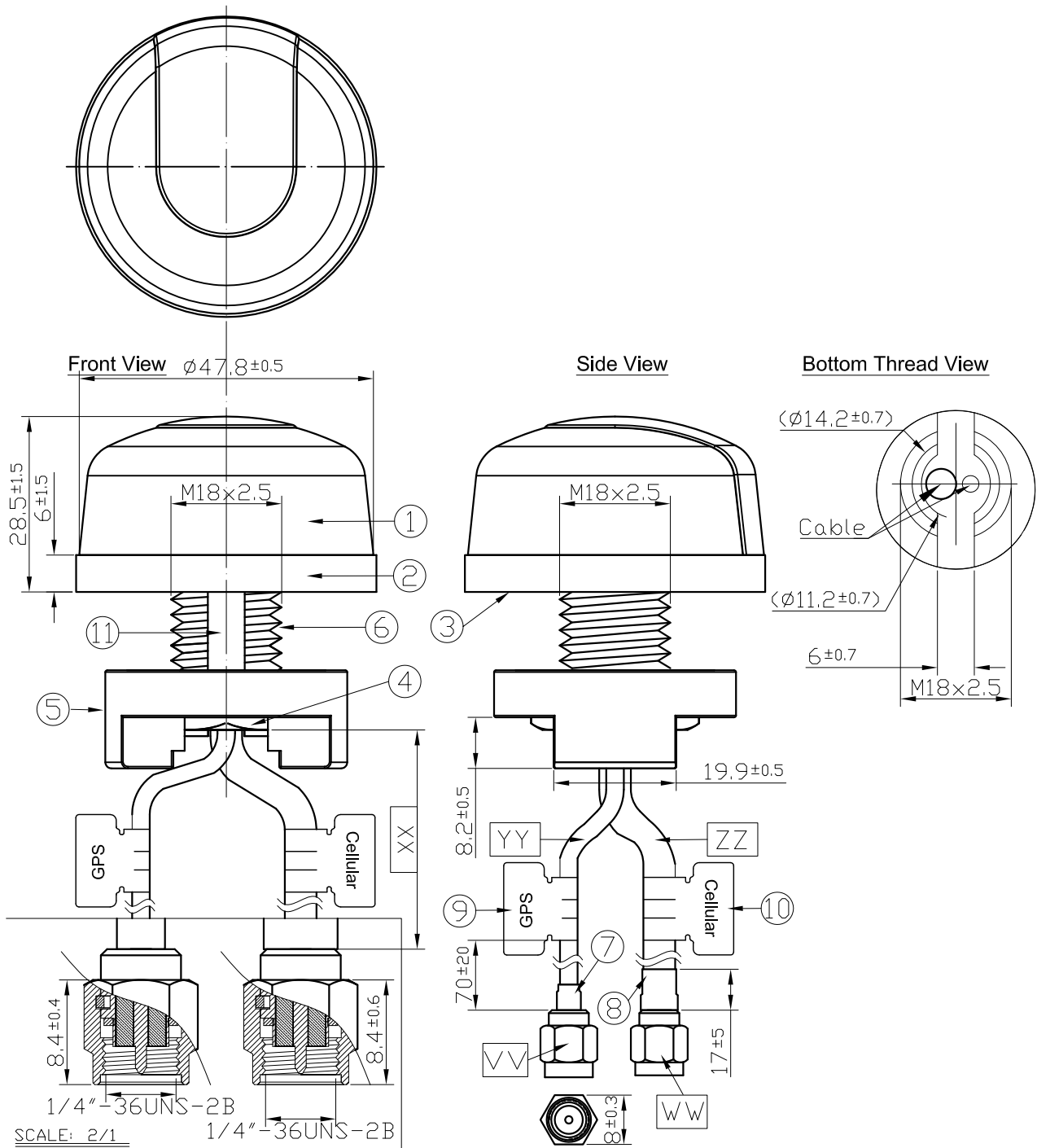


|     |     |     |    |               |         |    |
|-----|-----|-----|----|---------------|---------|----|
| Cg1 | Tr1 | S21 | >1 | 1.5754200 GHz | 30.649  | dB |
| Cg1 | Tr1 | S21 | 2  | 1.6054200 GHz | -6.7098 | dB |
| Cg1 | Tr1 | S21 | 3  | 1.5454200 GHz | 24.584  | dB |
| Cg1 | Tr1 | S21 | 4  | 1.6254200 GHz | -5.6354 | dB |
| Cg1 | Tr1 | S21 | 5  | 1.5254200 GHz | 8.0734  | dB |
| Cg1 | Tr1 | S21 | 6  | 1.6754200 GHz | -15.436 | dB |
| Cg1 | Tr1 | S21 | 7  | 1.4754200 GHz | -1.5714 | dB |

## 7.2 Noise Figure



## 8. Drawing

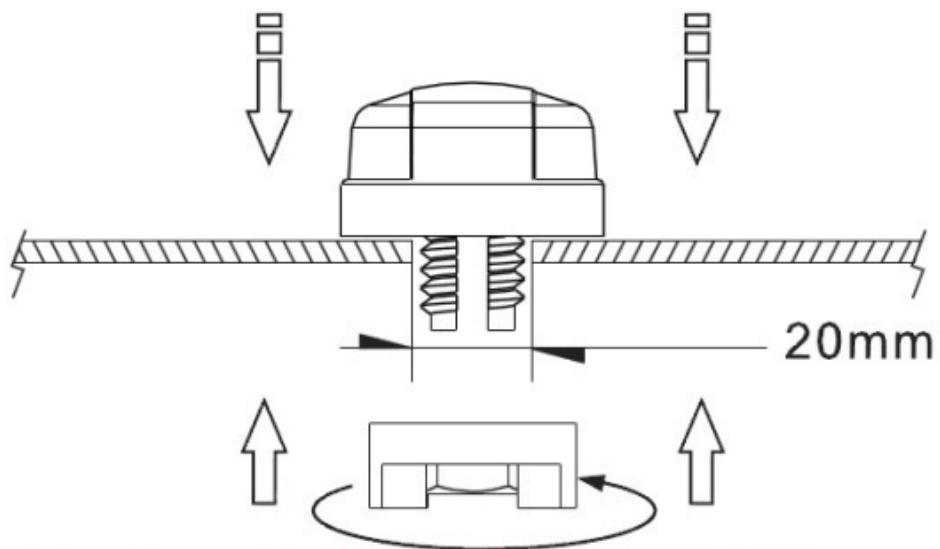


## 8. Drawing

|    | <b>Name</b>        | <b>Material</b> | <b>Finish</b> | <b>QTY</b> |
|----|--------------------|-----------------|---------------|------------|
| 1  | Housing            | PC              | White         | 1          |
| 2  | Closed Cell Foam   | DP-3060W        | White         | 1          |
| 3  | 3M Double Adhesive | 3M 9448 HK      | White Liner   | 1          |
| 4  | M18 Inner Nut      | Carbon Steel    | Ni Plated     | 1          |
| 5  | Outer Nut Cover    | ABS             | White         | 1          |
| 6  | M18x2.5 Thread     | Zinc Alloy      | Ni Plated     | 1          |
| 7  | Heat Shrink Tube   | PE              | Black         | 2          |
| 8  | GPS Label          | Coated Paper    | Orange        | 1          |
| 9  | Cellular Label     | Coated Paper    | Blue          | 1          |
| 10 | Rubber Stopper     | Rubber          | Black         | 1          |

|    | <b>Name</b>    | <b>Spec</b> | <b>Finish</b> | <b>QTY</b> |
|----|----------------|-------------|---------------|------------|
| VV | Connector Type | SMA(M) ST   | Gold          | 1          |
| WW | Connector Type | SMA(M) ST   | Gold          | 1          |
| XX | Cable Length   | 3000±60mm   |               | 1          |
| YY | Cable Type     | RG174       | Black         | 1          |
| ZZ | Cable Type     | CFD 200     | Black         | 1          |

## 9. Installation



Recommended torque for Mounting is 24.5N·m  
Maximum torque for mounting is 29.4N·m

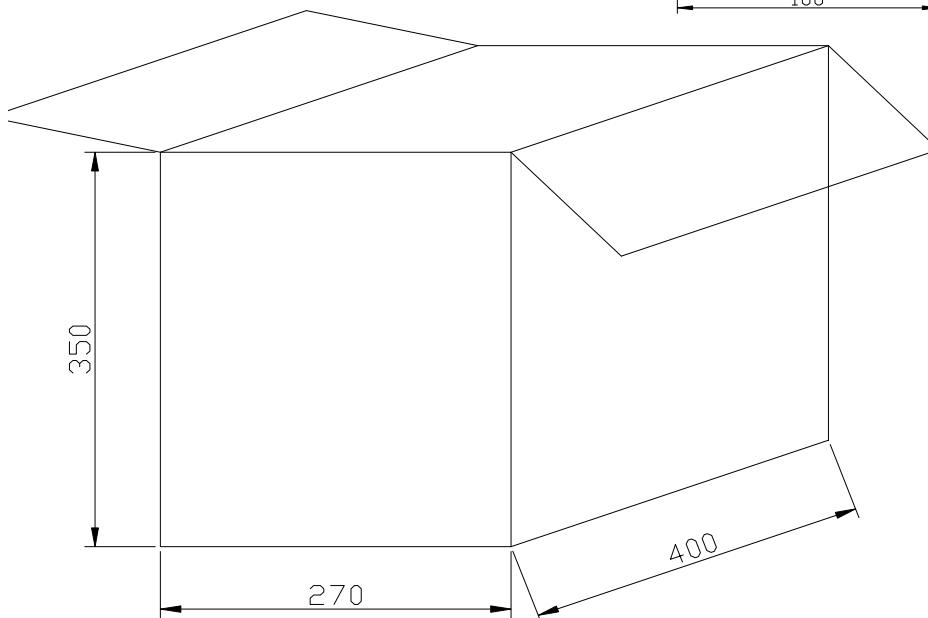
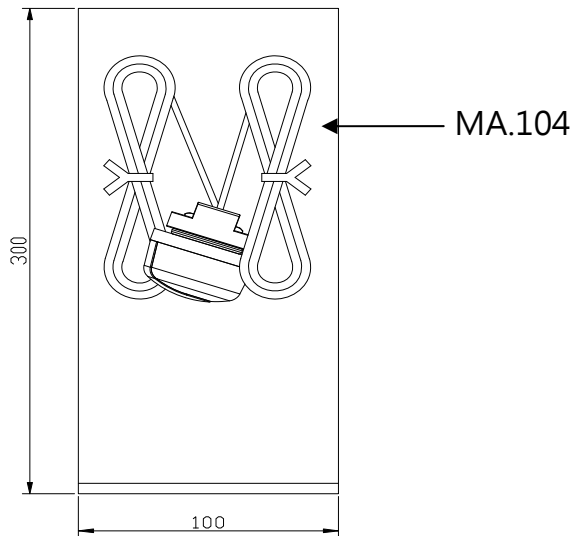




## 10. Packaging

1pcs antenna per big PE bag  
40 big PE bags per box

Unit : mm



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