CHINMORE INDUSTRY CO.,LTD.

PART NUMBER: GA-029

1 SCOPE

This specification covers the dielectric antenna for **880~960**MHz, **1710~1990**MHz.

2 Name of the product

This product is named “Dielectric Antenna”.

3 Electrical characteristics

3-1 Electrical characteristics of antenna

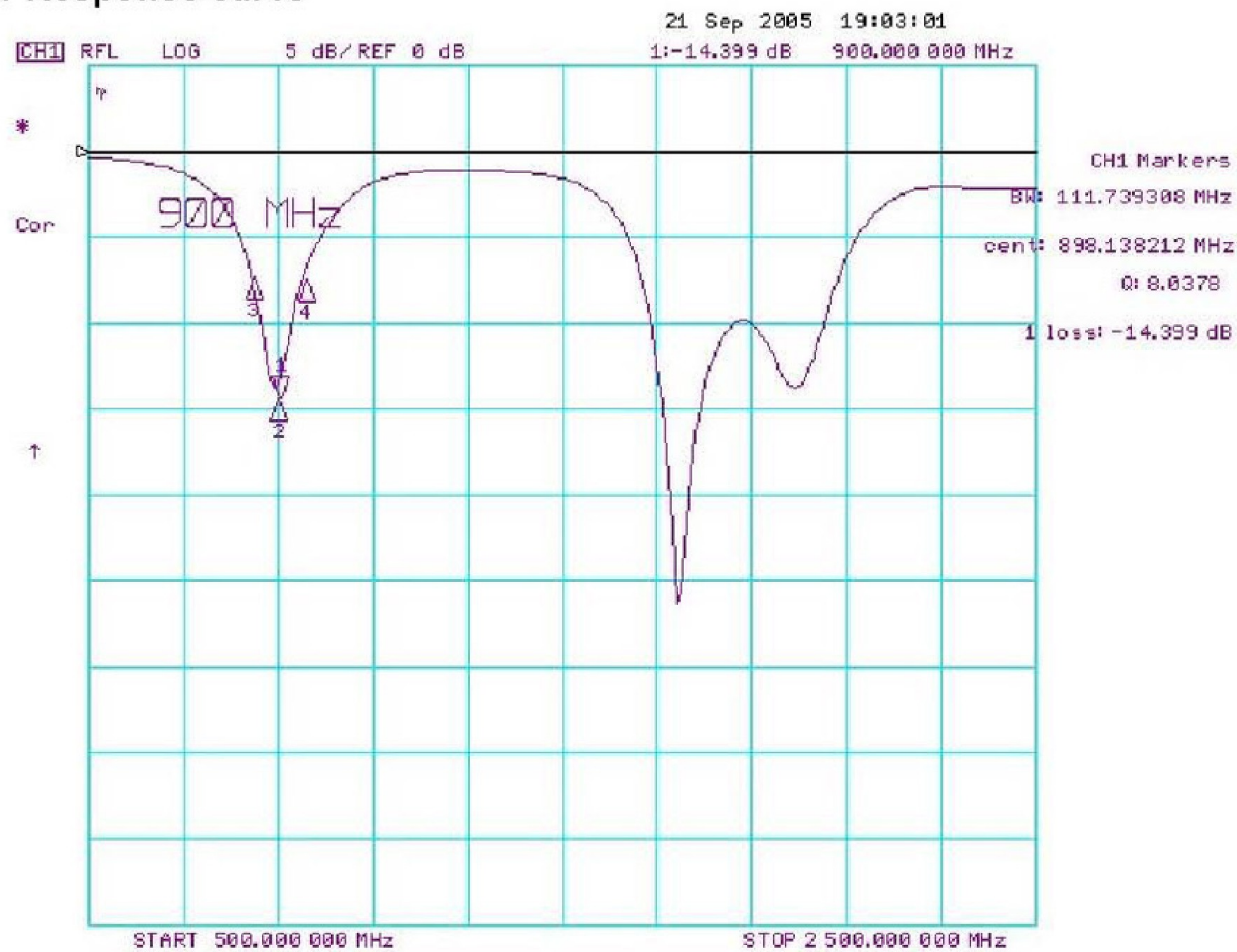
The antenna has the electrical characteristics given in Table 1 under the chinmore standard installation conditions shown in the figure of Evaluation Board.

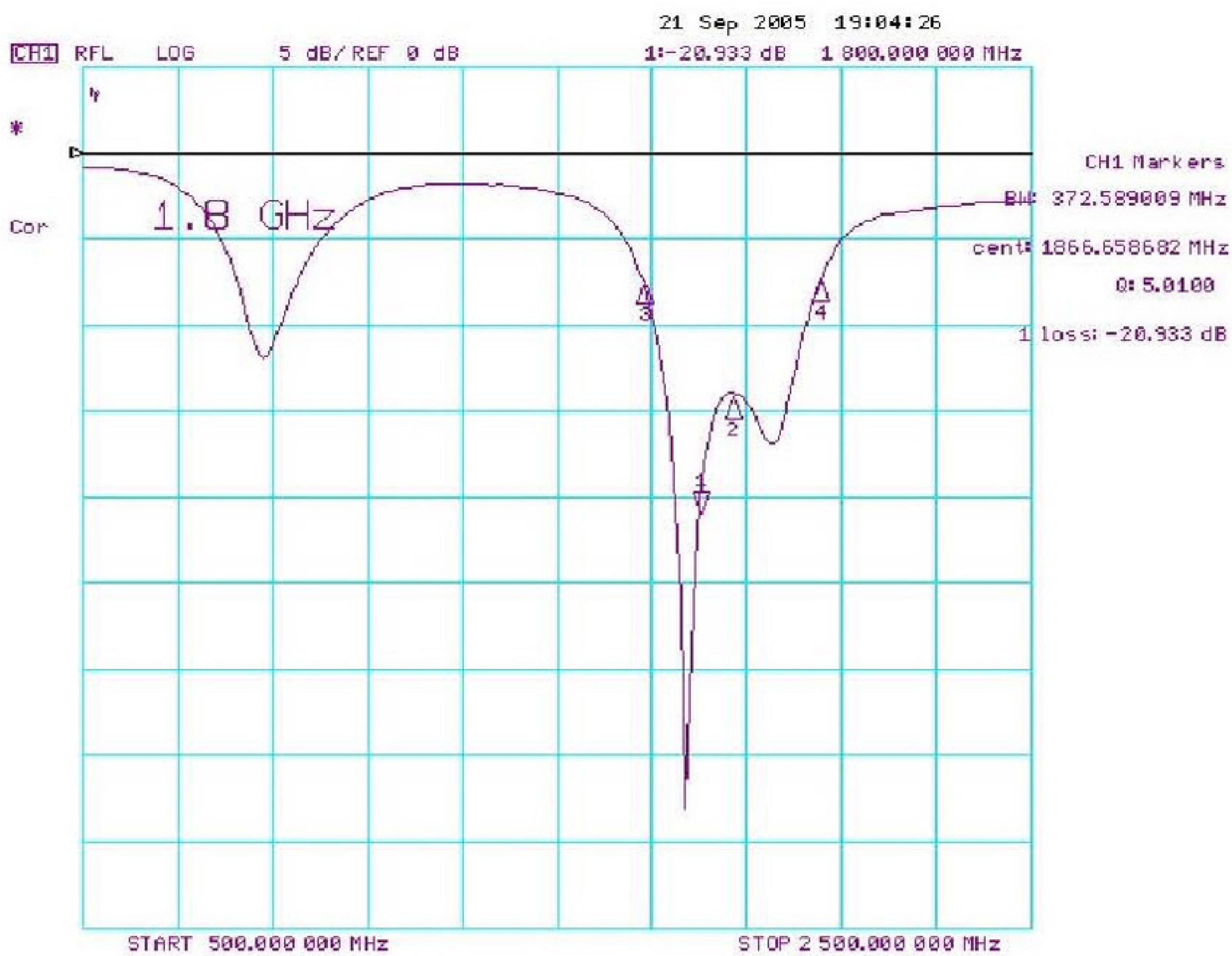
Table 1

No	Parameter	Specification
1	Working Frequency	**880~960 MHz , 1710~1990 MHz**
2	Dimension	**29.8*6*5 mm**
3	VSWR	2.5 max (depends on the special environment)
4	Polarization	Linear
5	Impedance	50 Ω
6	Operating Temperature	-40~105℃
7	Termination	Ag (Environmentally-Friendly Pb Free)

* Actual value will depend on customer ground plane size

S11 Response curve





Gain and Efficiency

GSM900

Frequency (MHz)		Peak Gain (dBi)	Efficiency (%)
TX	880.2	-3.65	21.09
	890.2	-2.73	26.25
	902.4	-2.28	31.23
	914.8	-2.04	35.24
RX	925.2	-1.96	37.02
	935.2	-2.54	33.33
	947.4	-2.96	31.17
	959.8	-3.16	29.47

GSM1800

Frequency (MHz)		Peak Gain (dBi)	Efficiency (%)
TX	1710.2	2.28	60.63
	1747.6	2.35	61.53
	1784.8	2.58	60.77
RX	1805.2	2.32	56.67
	1842.6	2.43	56.31
	1879.8	2.59	58.69

GSM1900

Frequency (MHz)		Peak Gain (dBi)	Efficiency (%)
TX	1850.2	2.48	56.95
	1880.0	2.60	58.75
	1909.8	2.12	52.79
RX	1930.2	2.01	52.02
	1960.0	1.31	47.26
	1989.8	0.30	38.62

Power average gain

GSM900

Frequency (GHz)		Plane	Average Gain (dBi)
TX	880.2	XY plane	-7.133
		YZ plane	-9.766
		XZ plane	-6.101
	890.2	XY plane	-5.968
		YZ plane	-8.845
		XZ plane	-5.126
	902.4	XY plane	-4.898
		YZ plane	-8.892
		XZ plane	-4.350
	914.8	XY plane	-4.077
		YZ plane	-7.477
		XZ plane	-3.865
RX	925.2	XY plane	-3.599
		YZ plane	-7.202
		XZ plane	-3.732
	935.2	XY plane	-3.802
		YZ plane	-7.648
		XZ plane	-4.290
	947.4	XY plane	-3.788
		YZ plane	-7.843
		XZ plane	-4.579
	959.8	XY plane	-3.801
		YZ plane	-7.913
		XZ plane	-5.187

GSM1800

Frequency (GHz)		Plane	Average Gain (dBi)
TX	**1710.2**	XY plane	-2.648
		YZ plane	-4.661
		XZ plane	-1.687
	1747.6	XY plane	-2.529
		YZ plane	-4.696
		XZ plane	-1.207
	1784.8	XY plane	-2.685
		YZ plane	-4.687
		XZ plane	-0.888
RX	**1805.2**	XY plane	-3.193
		YZ plane	-4.911
		XZ plane	-1.105
	1842.6	XY plane	-3.468
		YZ plane	-4.753
		XZ plane	-1.145
	1879.8	XY plane	-3.745
		YZ plane	-4.131
		XZ plane	-1.430

GSM1900

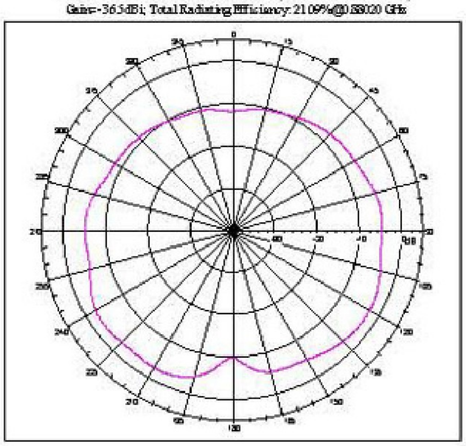
Frequency (GHz)		Plane	Average Gain (dBi)
TX	**1850.2**	XY plane	-3.511
		YZ plane	-4.649
		XZ plane	-1.147
	1880.0	XY plane	-3.746
		YZ plane	-4.124
		XZ plane	-1.435

	1909.8	XY plane	-4.683
		YZ plane	-4.228
		XZ plane	-2.525
RX	1930.2	XY plane	-5.539
		YZ plane	-4.270
		XZ plane	-3.257
	1960.0	XY plane	-6.444
		YZ plane	-4.441
		XZ plane	-4.126
	1989.8	XY plane	-8.068
		YZ plane	-5.359
		XZ plane	-5.477

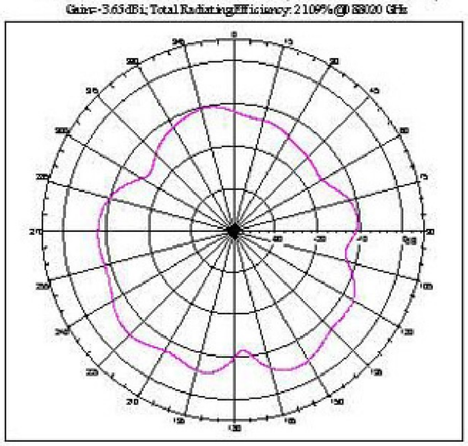
Antenna Pattern For GSM

GSM900
Frequency :880.2 MHz

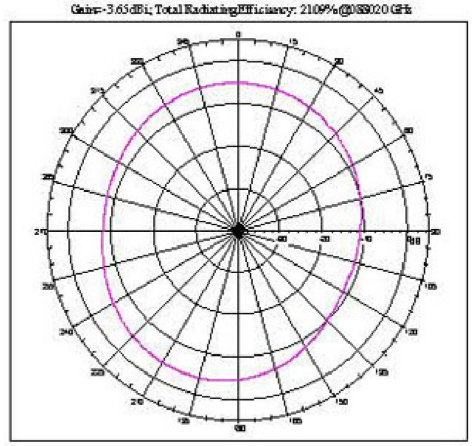
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain=-3.65dBi; Total Radiating Efficiency: 21.09%@0.88020 GHz



Farfield Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain=-3.65dBi; Total Radiating Efficiency: 21.09%@0.88020 GHz

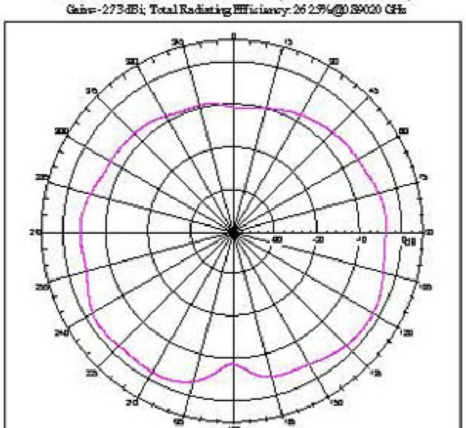


Far-field Power Distribution on X-Y Plane
Gain=-3.65dBi; Total Radiating Efficiency: 21.09%@0.88020 GHz



Frequency :890.2 MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain=-2.73dBi; Total Radiating Efficiency: 26.25%@0.89020 GHz



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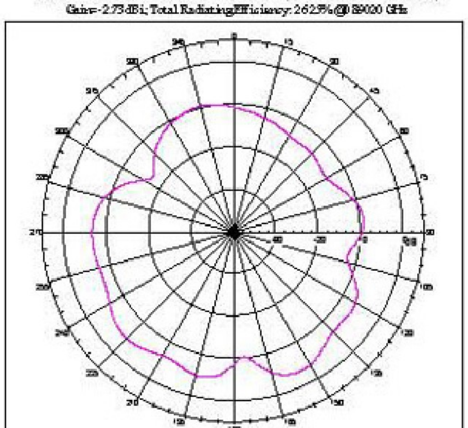
Gain=-2.73dBi; Total Radiating Efficiency: 26.25%@0.89020 GHz



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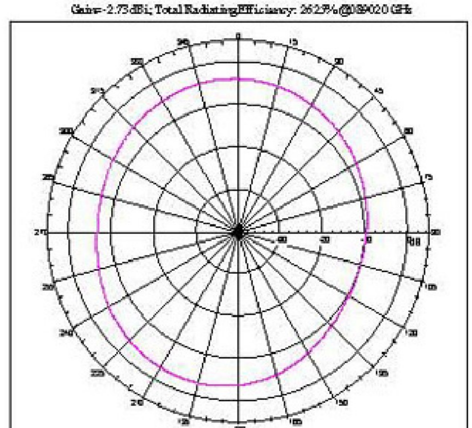
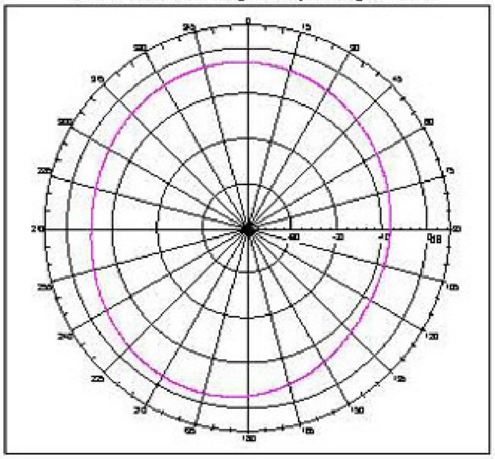
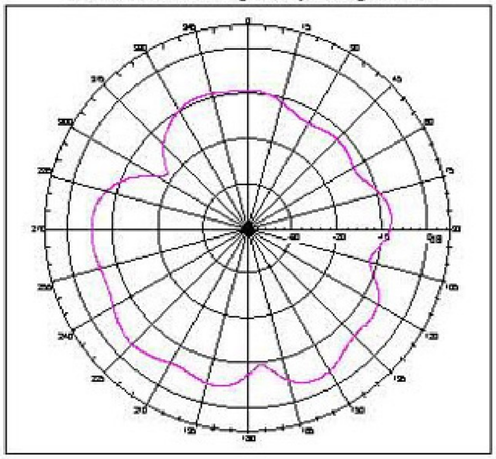


Frequency :902.4MHz

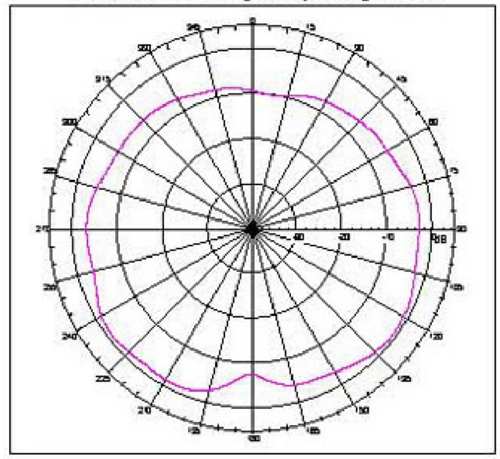
Far-field Power Distribution on X-Y Plane
Gain=-2.28dBi; Total Radiating Efficiancy: 31.23%@0.90240 GHz



Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain=-2.28dBi; Total Radiating Efficiancy: 31.23%@0.90240 GHz

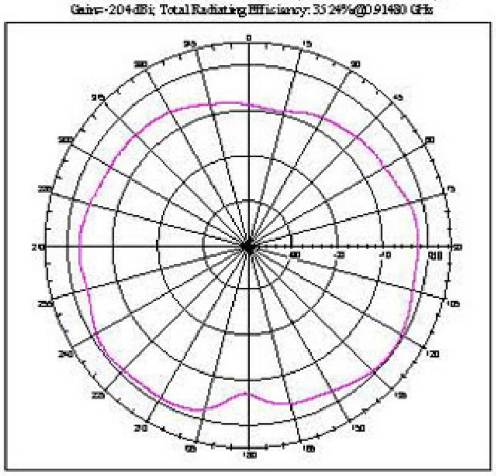


Far-field Power Distribution on X-Z Plane (E-Plane of L3 Pol Sense)
Gain=-2.28dBi; Total Radiating Efficiancy: 31.23%@0.90240 GHz

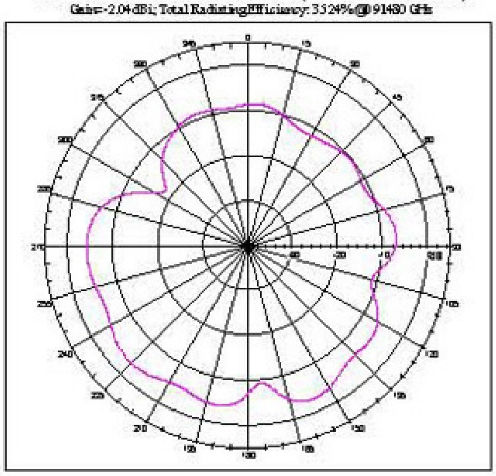


Frequency :914.8MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain=-2.04dBi; Total Radiating Efficiancy: 35.24%@0.91480 GHz



Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain=-2.04dBi; Total Radiating Efficiancy: 35.24%@0.91480 GHz



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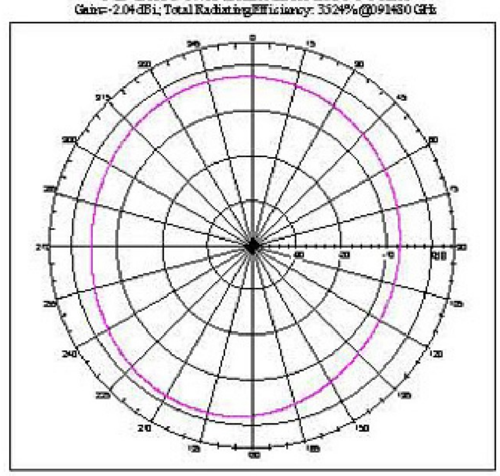
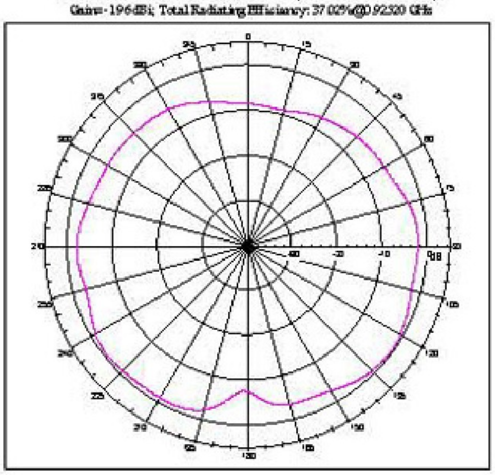
Gain=-2.04dBi; Total Radiating Efficiancy: 35.24%@0.91480 GHz



Frequency :925.2MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain=-1.96dBi; Total Radiating Efficiancy: 37.02%@0.92320 GHz



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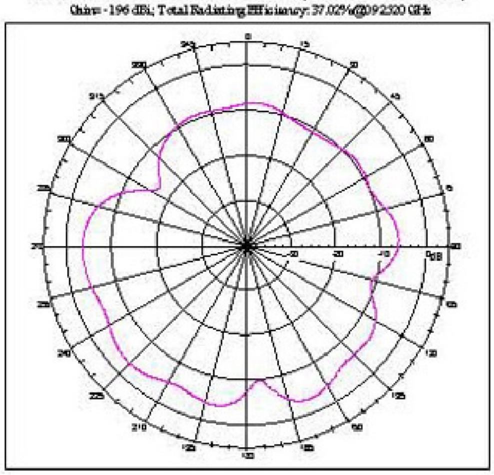

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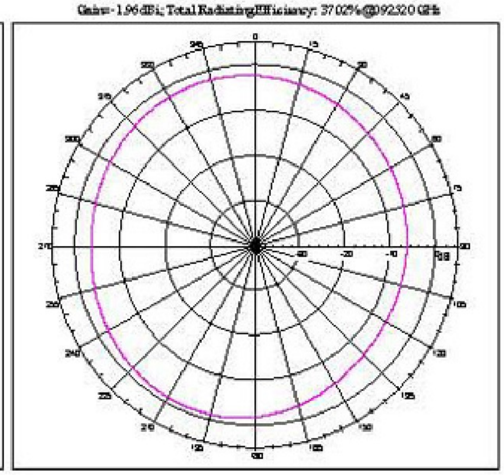
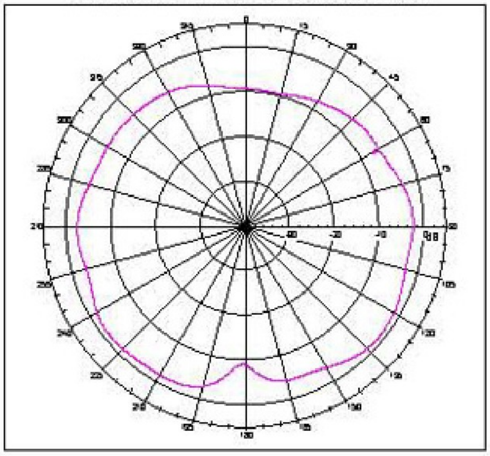


Frequency :935.2MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain=-2.54 dBi; Total Radiating Efficiency: 33.33%@0.93520 GHz



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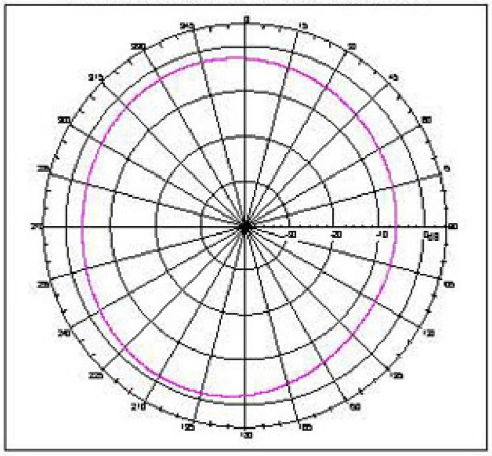

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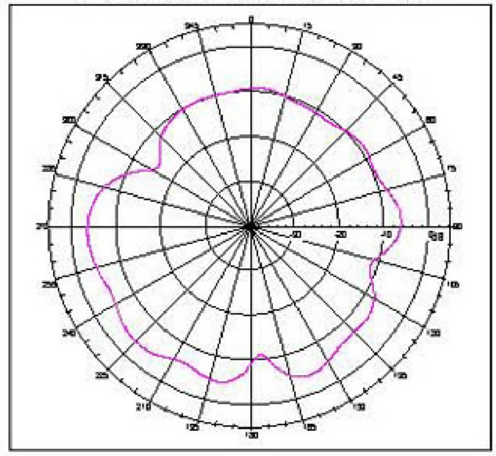
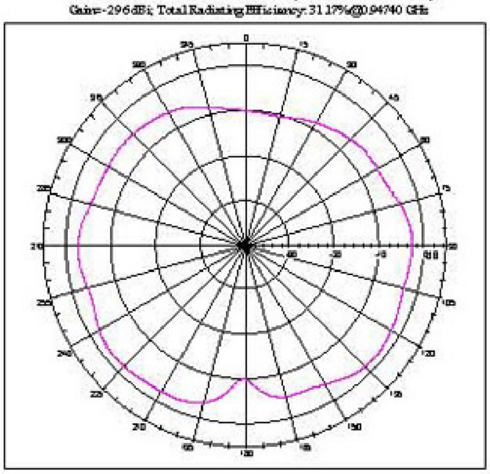
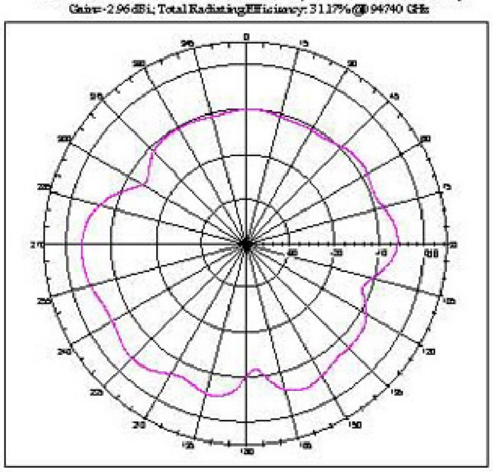


Frequency :947.4MHz

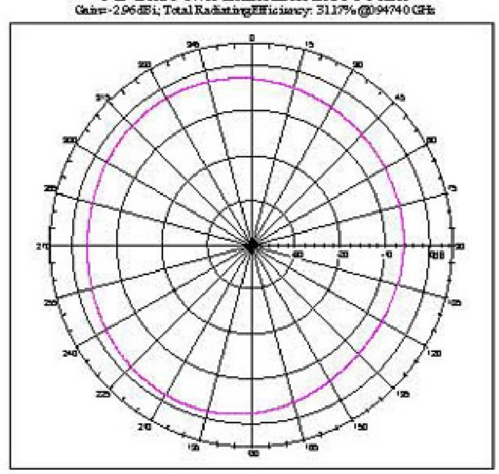
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain=-2.96 dBi; Total Radiating Efficiency: 31.17%@0.94740 GHz



Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain=-2.96 dBi; Total Radiating Efficiency: 31.17%@0.94740 GHz

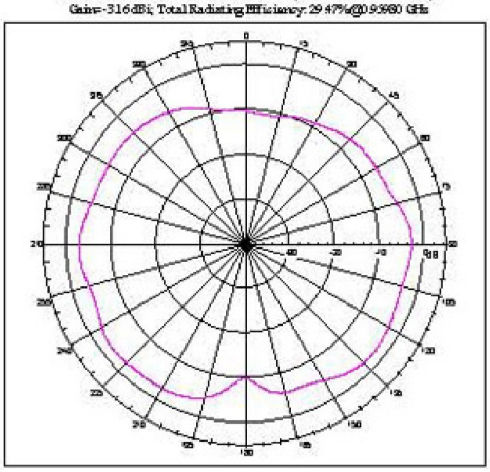


Far-field Power Distribution on X-Y Plane
Gain=-2.96 dBi; Total Radiating Efficiency: 31.17%@0.94740 GHz



Frequency :959.8MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain=-3.16 dBi; Total Radiating Efficiency: 29.47%@0.95980 GHz



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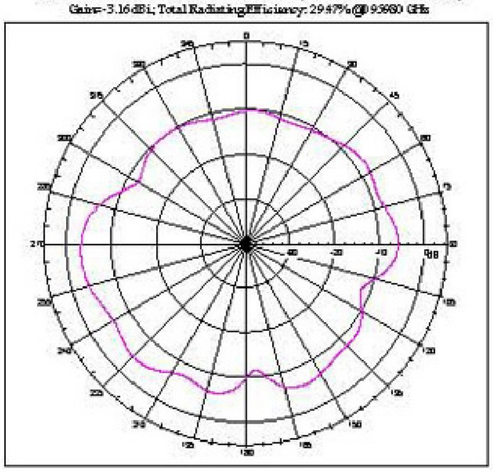

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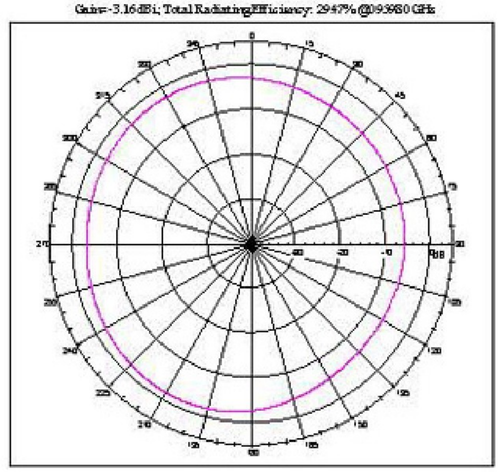
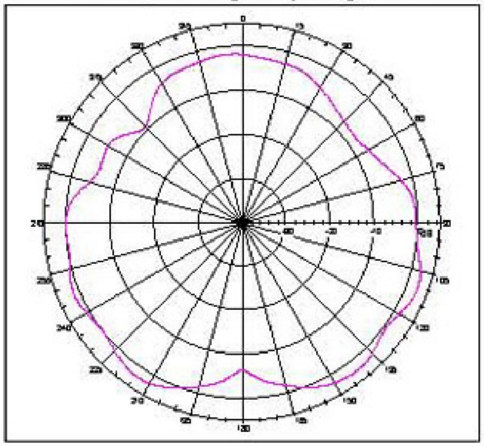


GSM1800

Frequency :1710.2 MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.28 dBi; Total Radiating Efficiency: 60.63%@1.71020 GHz



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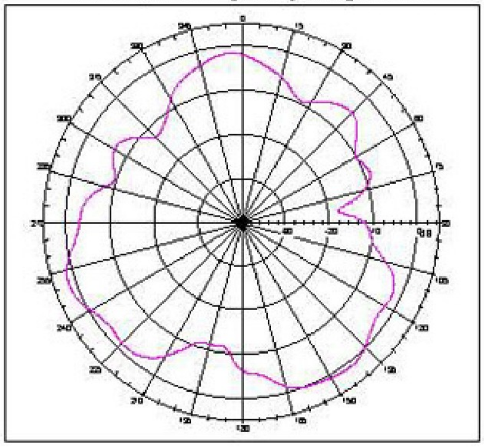

Far-field Power Distribution on X-Y Plane
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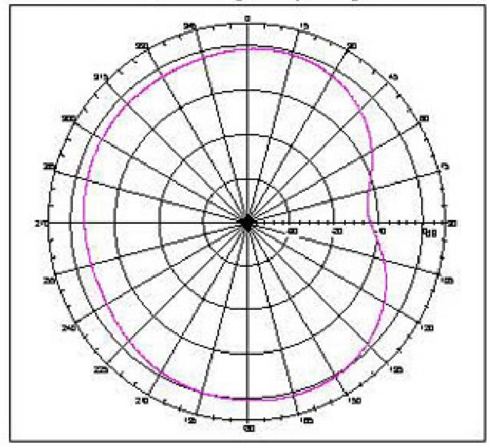
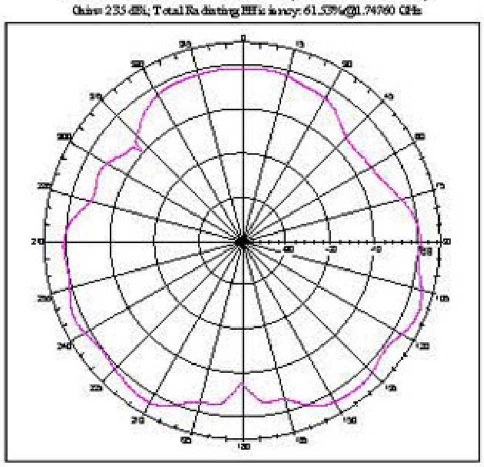


Frequency :1747.6 MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.35 dBi; Total Radiating Efficiency: 61.53%@1.74760 GHz



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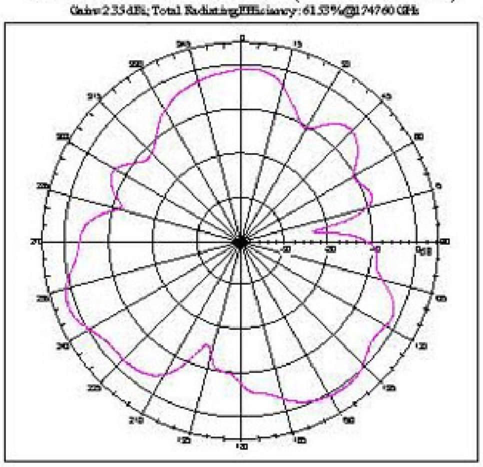
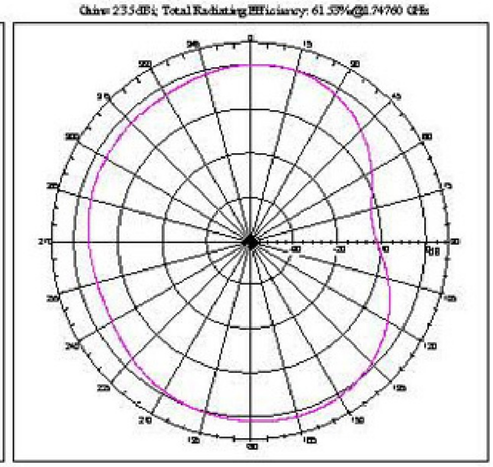
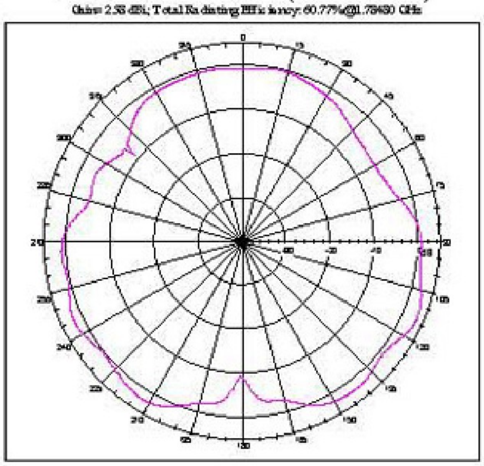


Far-field Power Distribution on X-Y Plane
Gain= 2.35 dBi; Total Radiating Efficiency: 61.53%@1.74760 GHz

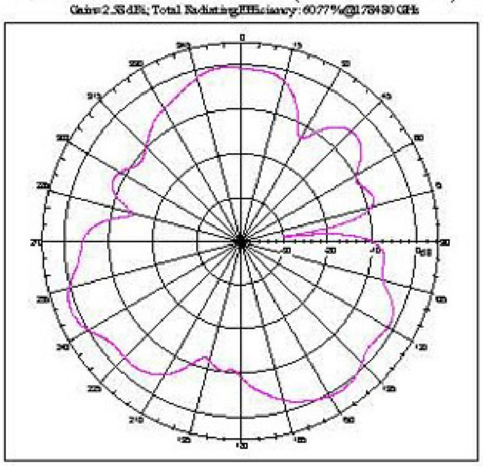


Frequency :1784.8 MHz

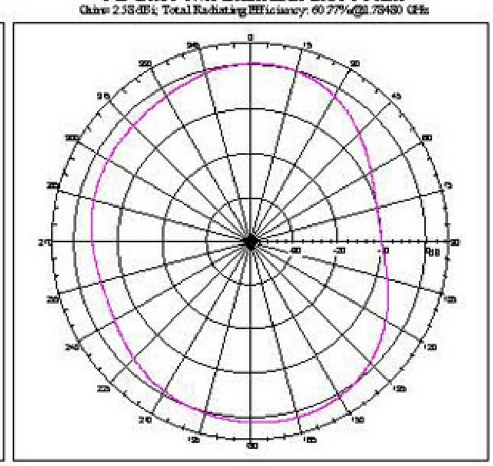
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.58 dBi; Total Radiating Efficiency: 60.77%@1.78480 GHz



Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain= 2.58 dBi; Total Radiating Efficiency: 60.77%@1.78480 GHz

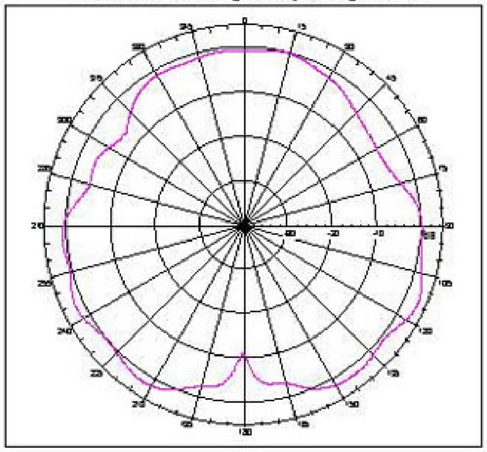


Far-field Power Distribution on X-Y Plane
Gain= 2.58 dBi; Total Radiating Efficiency: 60.77%@1.78480 GHz



Frequency :1805.2 MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.32 dBi; Total Radiating Efficiency: 56.67%@1.80320 GHz



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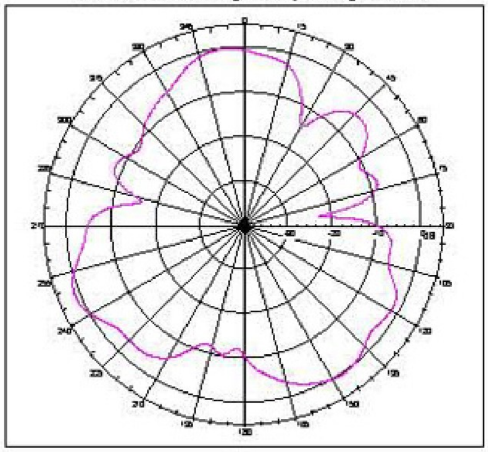
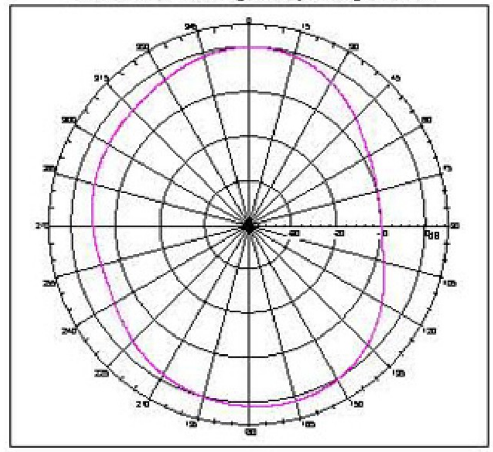
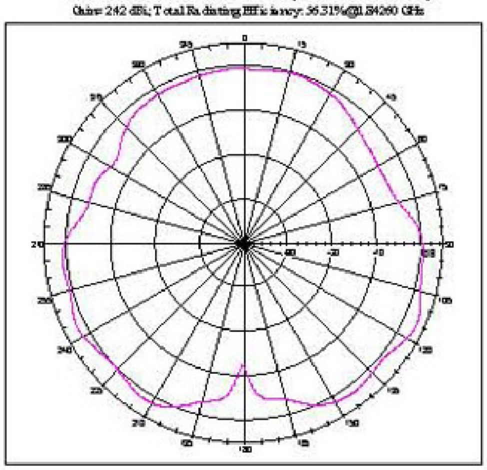


Far-field Power Distribution on X-Y Plane
Gain= 2.32 dBi; Total Radiating Efficiency: 56.67%@1.80320 GHz



Frequency :1842.6 MHz

Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.42 dBi; Total Radiating Efficiency: 56.31%@1.84260 GHz



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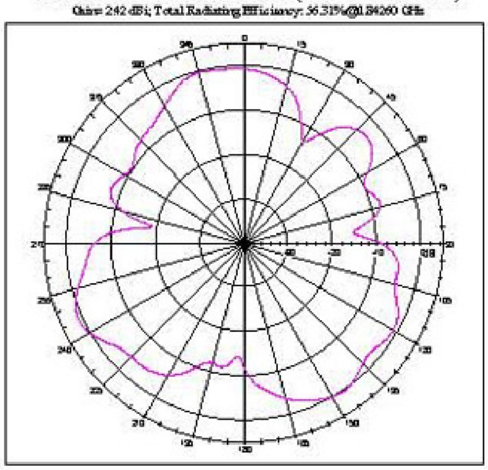
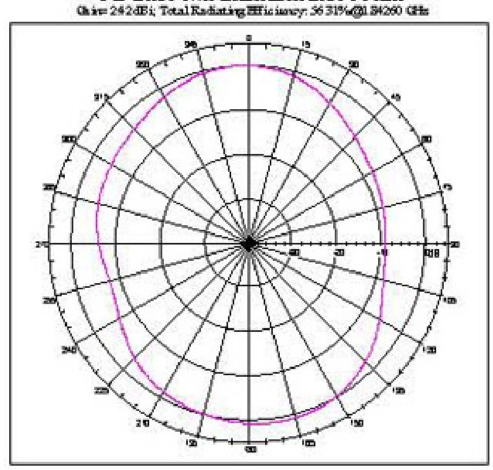
Gain= 2.42 dBi; Total Radiating Efficiency: 56.31%@1.84260 GHz

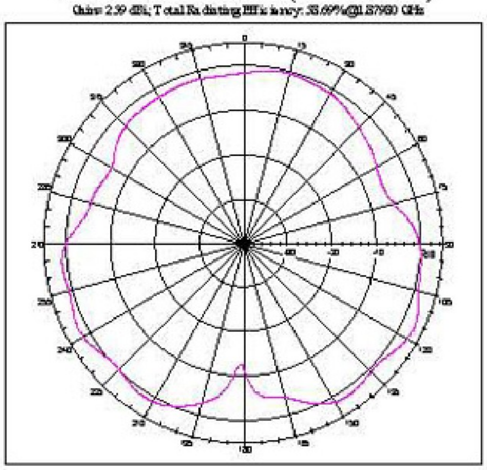


Far-field Power Distribution on X-Y Plane
Gain= 2.42 dBi; Total Radiating Efficiency: 56.31%@1.84260 GHz

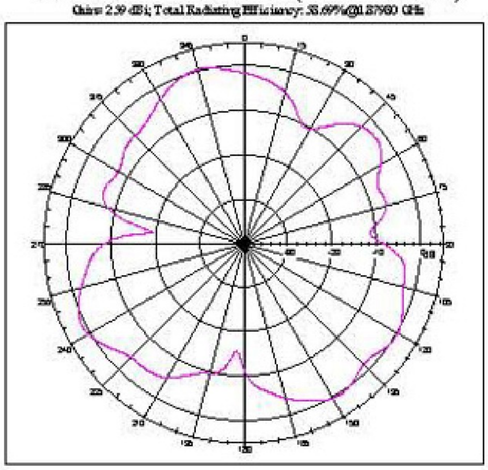


Frequency :1879.8 MHz

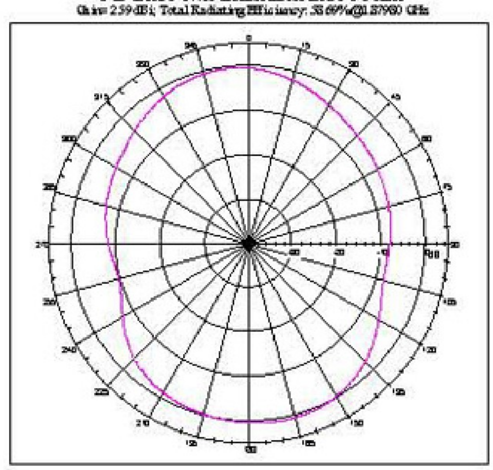
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.59 dBi; Total Radiating Efficiency: 55.69%@1.87960 GHz



Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain= 2.59 dBi; Total Radiating Efficiency: 55.69%@1.87960 GHz



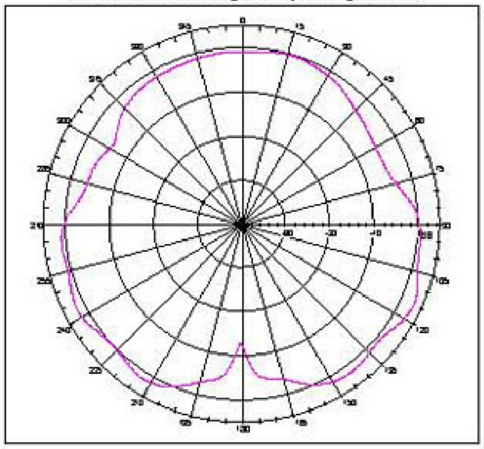
Far-field Power Distribution on X-Y Plane
Gain= 2.59 dBi; Total Radiating Efficiency: 55.69%@1.87960 GHz



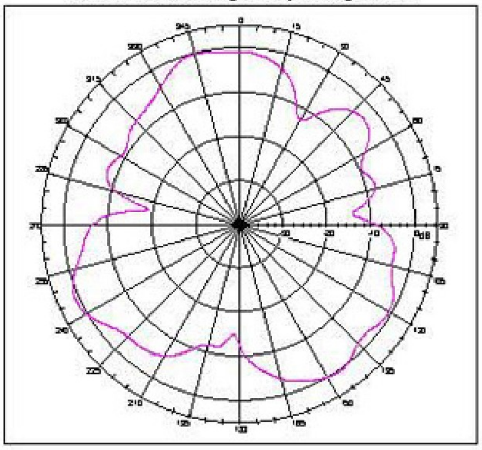
GSM1900

Frequency :1850.2 MHz

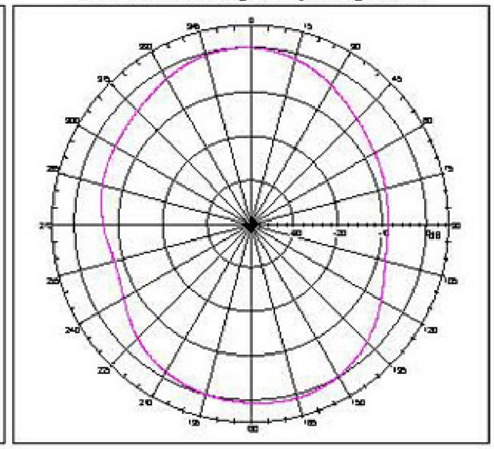
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.48 dBi; Total Radiating Efficiency: 56.95%@1.85020 GHz



Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain= 2.48 dBi; Total Radiating Efficiency: 56.95%@1.85020 GHz

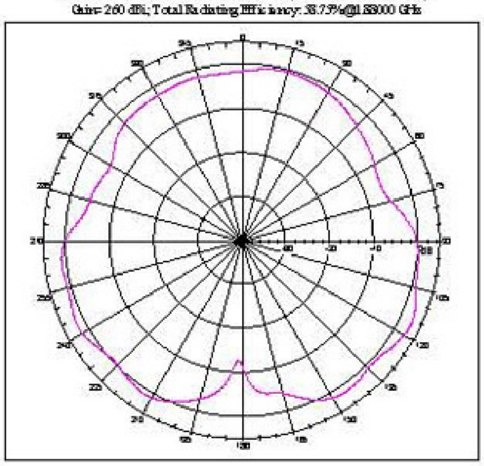


Far-field Power Distribution on X-Y Plane
Gain= 2.48 dBi; Total Radiating Efficiency: 56.95%@1.85020 GHz

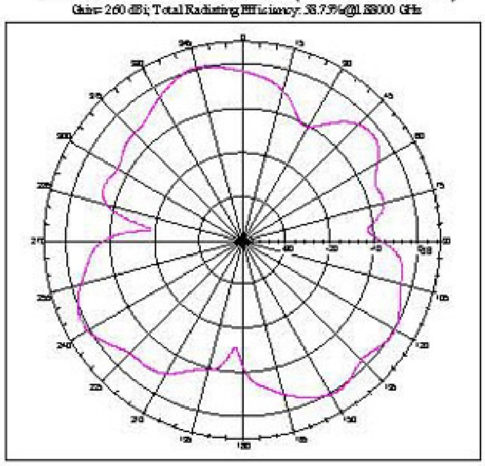


Frequency :1880.0 MHz

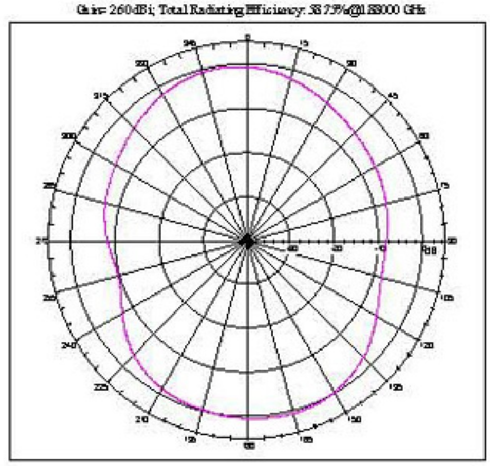
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.60 dBi; Total Radiating Efficiency: 58.73%@1.88000 GHz



Farfield Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain= 2.60 dBi; Total Radiating Efficiency: 58.73%@1.88000 GHz

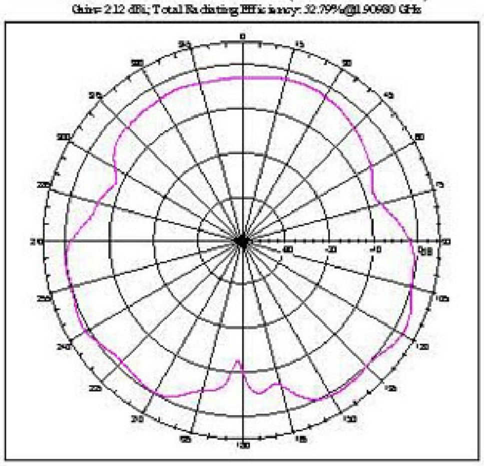


Far-field Power Distribution on X-Y Plane
Gain= 2.60 dBi; Total Radiating Efficiency: 58.73%@1.88000 GHz

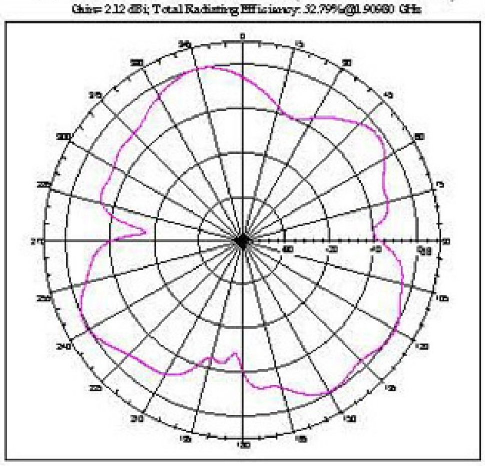


Frequency :1909.8 MHz

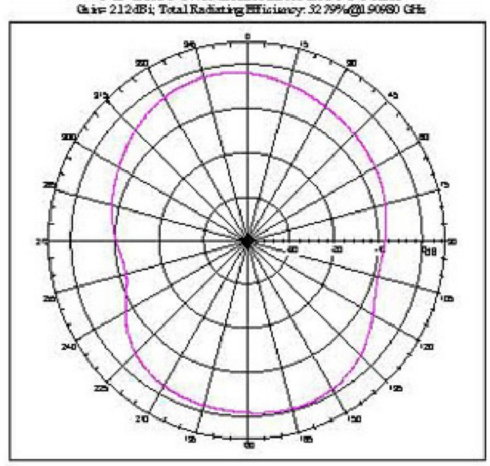
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 2.12 dBi; Total Radiating Efficiency: 52.79%@1.90980 GHz



Farfield Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain= 2.12 dBi; Total Radiating Efficiency: 52.79%@1.90980 GHz

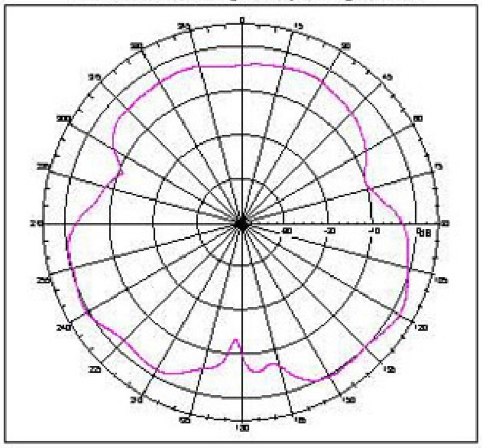


Far-field Power Distribution on X-Y Plane
Gain= 2.12 dBi; Total Radiating Efficiency: 52.79%@1.90980 GHz

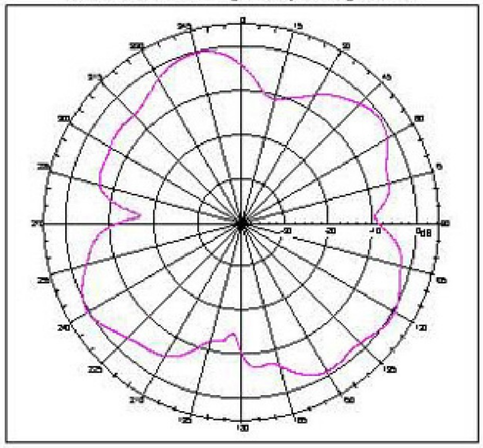


Frequency : 1930.2 MHz

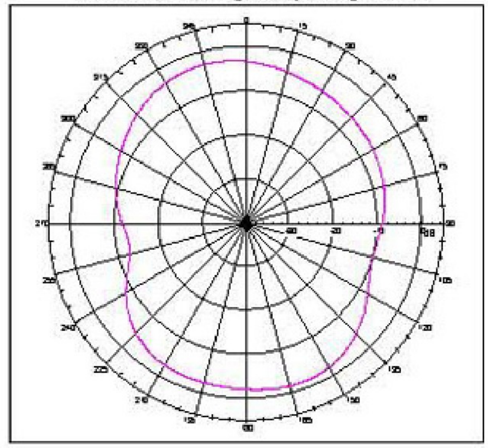
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 1.80 dBi; Total Radiating Efficiency: 30.11%@1.93020 GHz



Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain= 1.80 dBi; Total Radiating Efficiency: 30.11%@1.93020 GHz

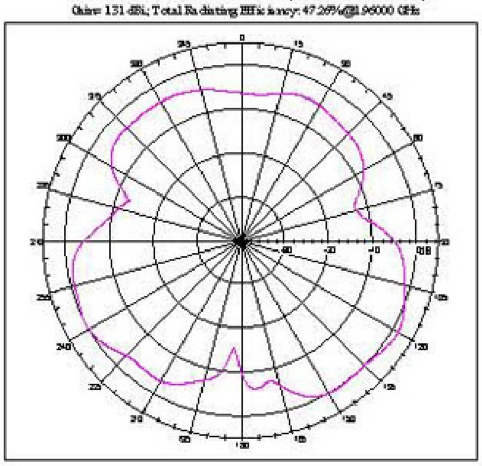


Far-field Power Distribution on X-Y Plane
Gain= 1.80 dBi; Total Radiating Efficiency: 30.11%@1.93020 GHz

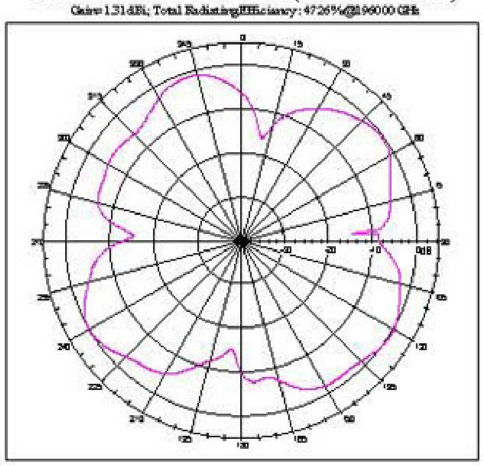


Frequency : 1960.0 MHz

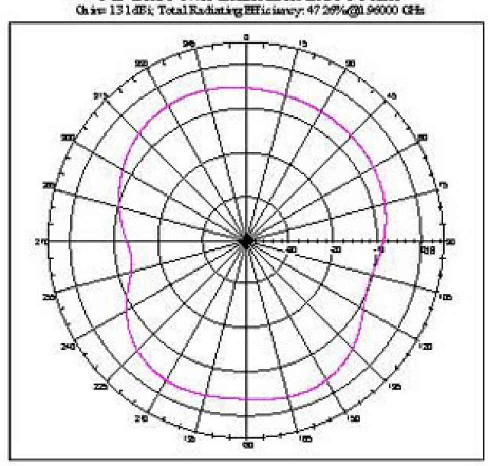
Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 1.31 dBi; Total Radiating Efficiency: 47.26%@1.96000 GHz



Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain= 1.31 dBi; Total Radiating Efficiency: 47.26%@1.96000 GHz

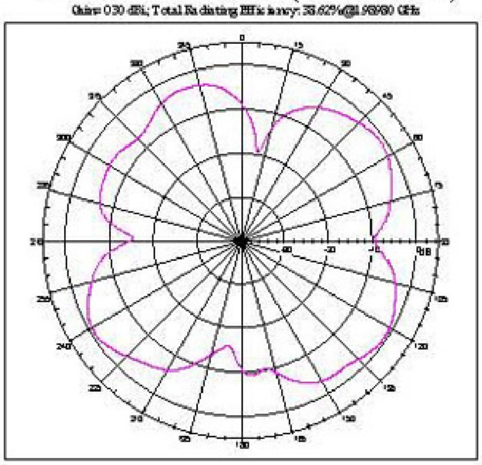


Far-field Power Distribution on X-Y Plane
Gain= 1.31 dBi; Total Radiating Efficiency: 47.26%@1.96000 GHz

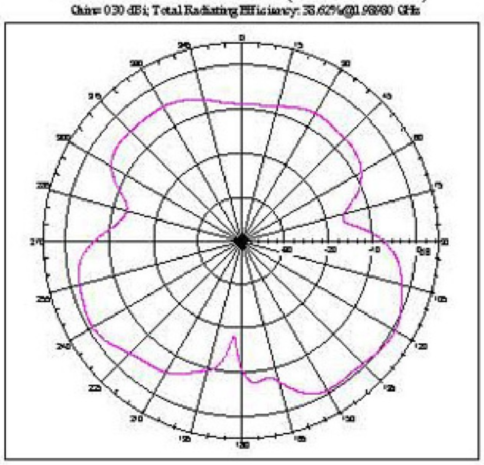


Frequency : 1989.8 MHz

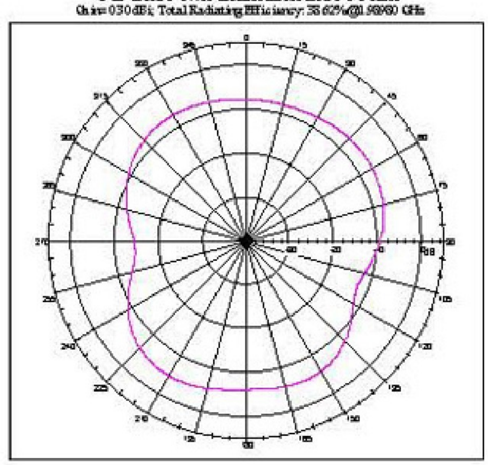
Far-field Power Distribution on Y-Z Plane(H-Plane of L3 Pol Sense)
Gain= 0.30 dBi; Total Radiating Efficiency: 38.62%@1.98980 GHz



Far-field Power Distribution on X-Z Plane(E-Plane of L3 Pol Sense)
Gain= 0.30 dBi; Total Radiating Efficiency: 38.62%@1.98980 GHz



Far-field Power Distribution on X-Y Plane
Gain= 0.30 dBi; Total Radiating Efficiency: 38.62%@1.98980 GHz



4 Environmental conditions

4-1 Operating conditions

The antenna has the electrical characteristics given in Tables 1 in the temperature range of -30℃ to +85℃ and under the environmental conditions of +40℃ and 0-95 % r.h..

4-2 Storage temperature range

The storage temperature range of product is -40℃ to +100℃

5 Reliability tests

5-5-2 and 5-6 examination of enforced. Moreover, the decision standard of the movement confirmation is judged by 3 and 4 of the tables-1, and the decision standard of the appearance isn't thought function problem become defect be.

The decision standard of the confirmation of the movement is doing the characteristic electric standard of the antenna module. And, the decision standard of the appearance isn't thought function problem become defect be.

5-1. Low-temperature test

Expose the specimen to -30℃ for 500 hours and then to normal temperature /humidity for 24 hours or more. After that examine the appearance and functions.

5-2 High-temperature test

Expose the specimen to +85℃ for 500 hours and then to normal temperature /humidity for 24 hours or more. After that examine the appearance and functions.

5-3 High-temperature/high-humidity test

Subject the object to the environmental conditions of +85℃ and 90-95% r.h. for 96 hours, then expose to normal temperature/humidity for 24 hours or more After this, check the appearance and functions.

5-4 Thermal shock test

Subject the object to cyclic temperature change (-30℃, 30 minutes ⟺ +85℃, 30 minutes) for 5 cycles, the expose to normal temperature/humidity for 24 hours or more.

5-5 Vibration test

5-5-1 Sinusoidal vibration test

Subject the object to vibrations of 5 to 200 to 5Hz swept in 10 minutes, 4.5G at maximum (2mm amplitude), in X and Y directions for two hours each and in Z direction for four hours. After this, check the appearance functions.

5-5-2 Vibration test in packaged condition

Subject the object, which is packaged as illustrated, to vibrations of 15 to 60 to 15Hz swept in 6 minutes, 4G at maximum (2mm amplitude at maximum), applied in X, Y and Z directions for two hours each, i.e. six hours in total. After this, check the appearance and functions.

5-6 Free fall test in packaged condition

Drop the object, which is packaged as illustrated, to a concrete surface from the height of 90 cm, on one comer, three edges and six faces once each, i.e. 10 times in total. After this, check the appearance and functions.

5-7. Soldering Heat Resistance Test:

After the lead pins of the unit are soaked in solder bath at 270 ± 5℃ for 10± 0.5 seconds and then be left for more than 1 hour at 25±5℃ in less than 65% relative humidity.

5-8. Adhesion Test:

The device is subjected to be soldered on test PCB. Then apply 0.5Kg(5N) of force for 10±1 seconds in the direction of parallel to the substrate. (the soldering should be done by reflow and be conducted with care so that the soldering is uniform and free of defect by stress such as heat shock) .

6 Inspection

As for the examination in the mass production, the receiving character of the ratio wave sent in a shield box from the standard antenna and VSWR are confirmed in the picking out examination.

7 Warranty

If any defect occurs form the product during proper use within a year after delivery, it will be repaired or replaced free of charge.

8 Other

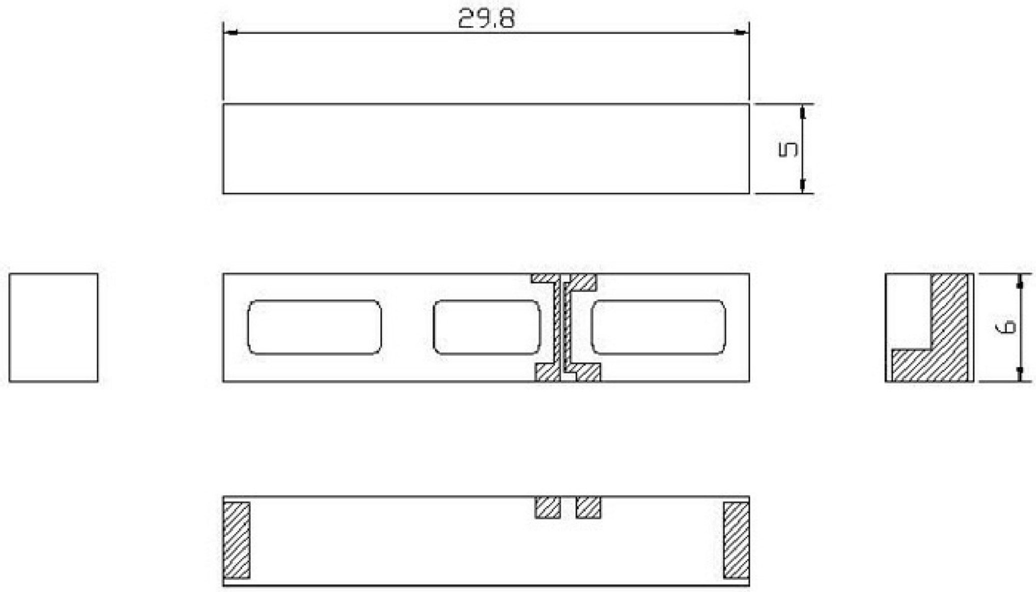
Any question arising from this specification manual shall be solved by arrangement made by both parties.

9 Precautions for use

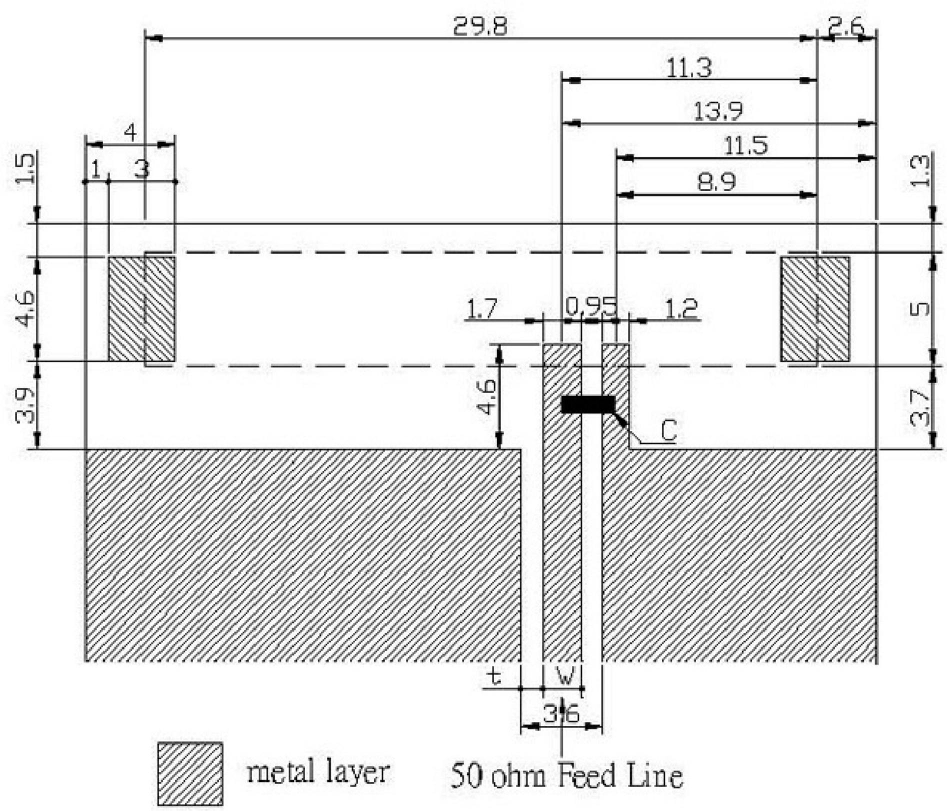
- Antenna pattern use a Ag electrode.
- Please don’t use the corrosion gas (sulfur gas, chlorine gas) in the atmosphere.
- Please don’t direct solder onto the gold electrode of Antenna pattern.

10. Drawings

Shape and Dimension



Recommend foot print for Evaluation Board

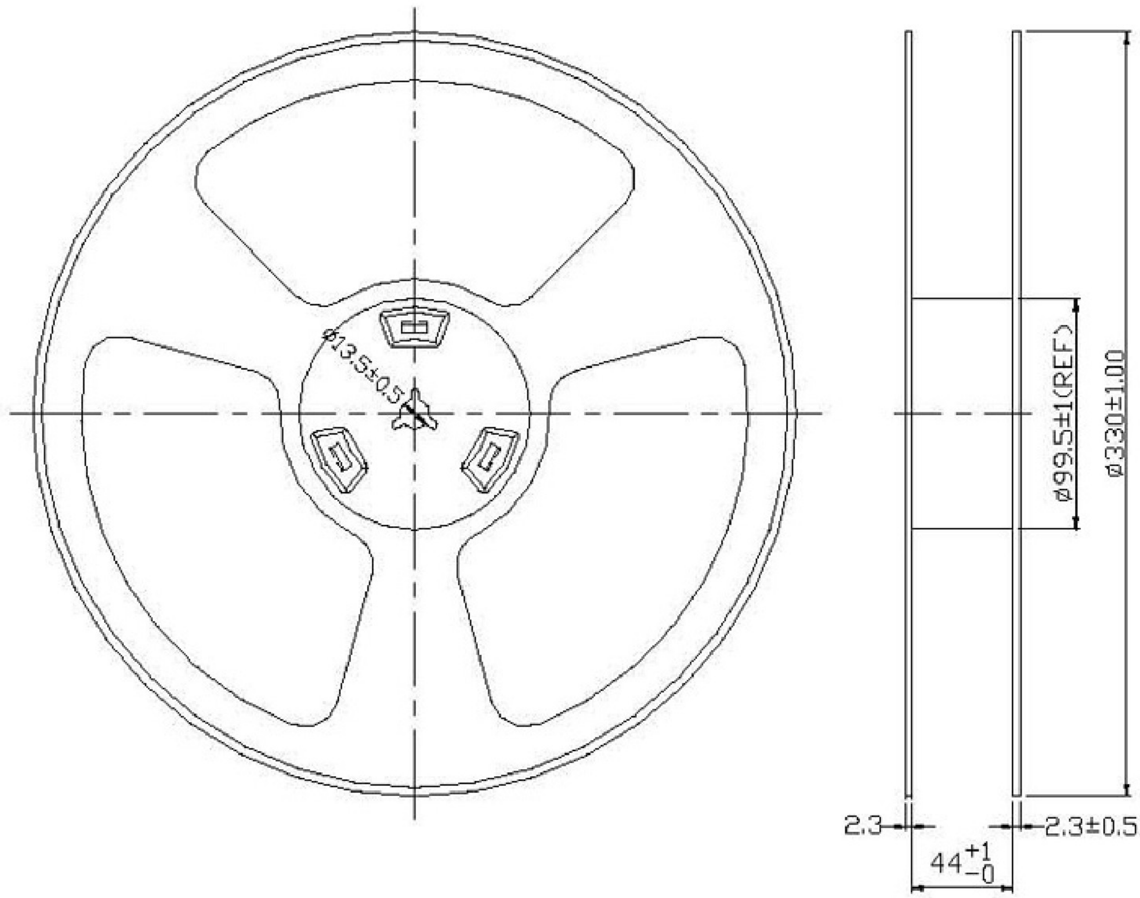


t,w=Unique dimensioning according to your PCB.
C=inductor and capacitor values according to your specific device.

Delivery mode

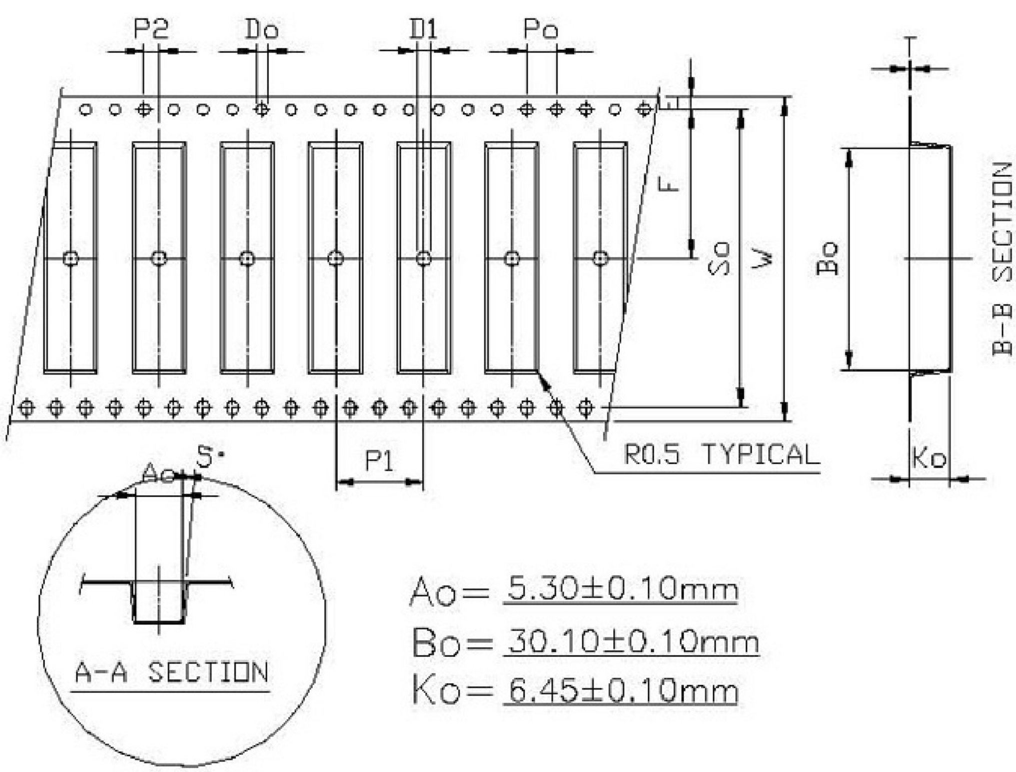
1 Blister tape to IEC 286-3，polyester。

2 Pieces/tape：1000

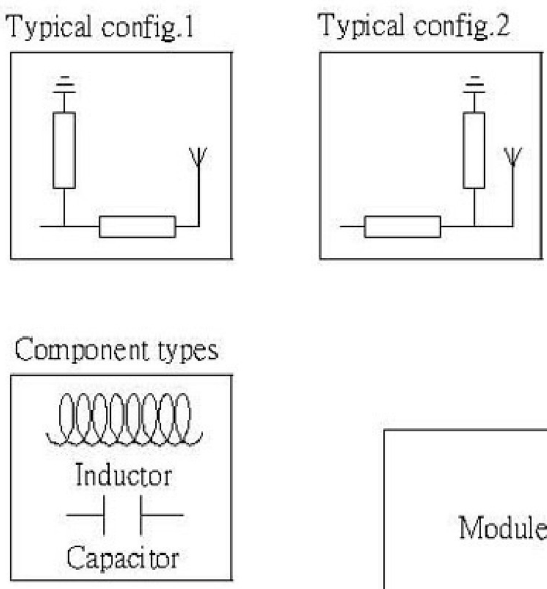


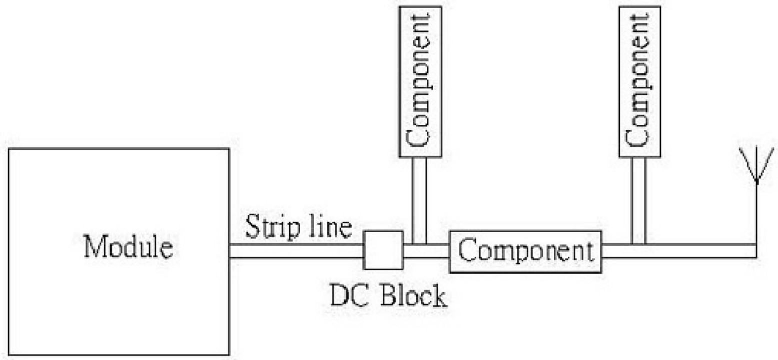
Unit: mm

Symbol	Spec.
K1	—
Po	4.0±0.10
P1	12.0±0.10
P2	2.0±0.15
Do	$1.5\ ^{+0.1}_{+0.}$
D1	2.0(Min)
E	1.75±0.10
F	20.2±0.10
10Po	40.0±0.10
W	44.0±0.30
T	0.30±0.05
So	40.4±0.10



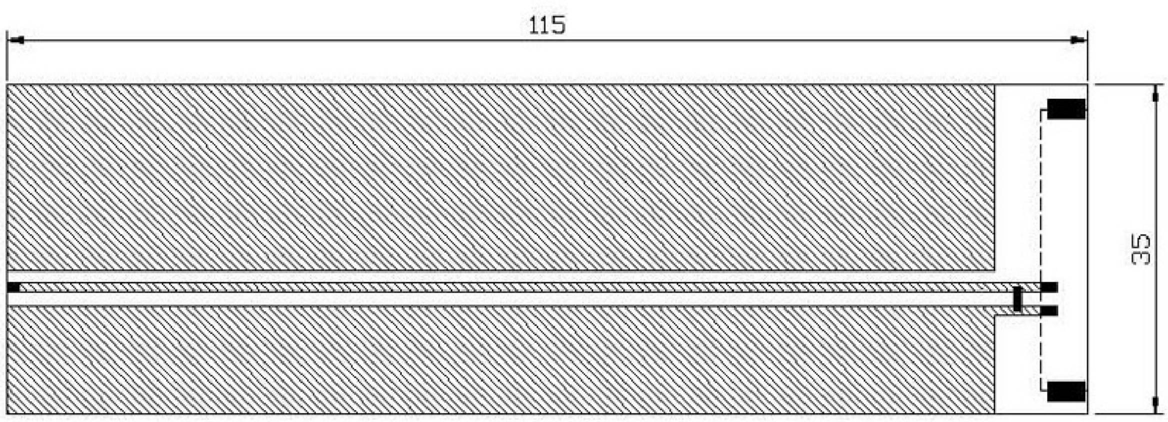
Transmission line and matching





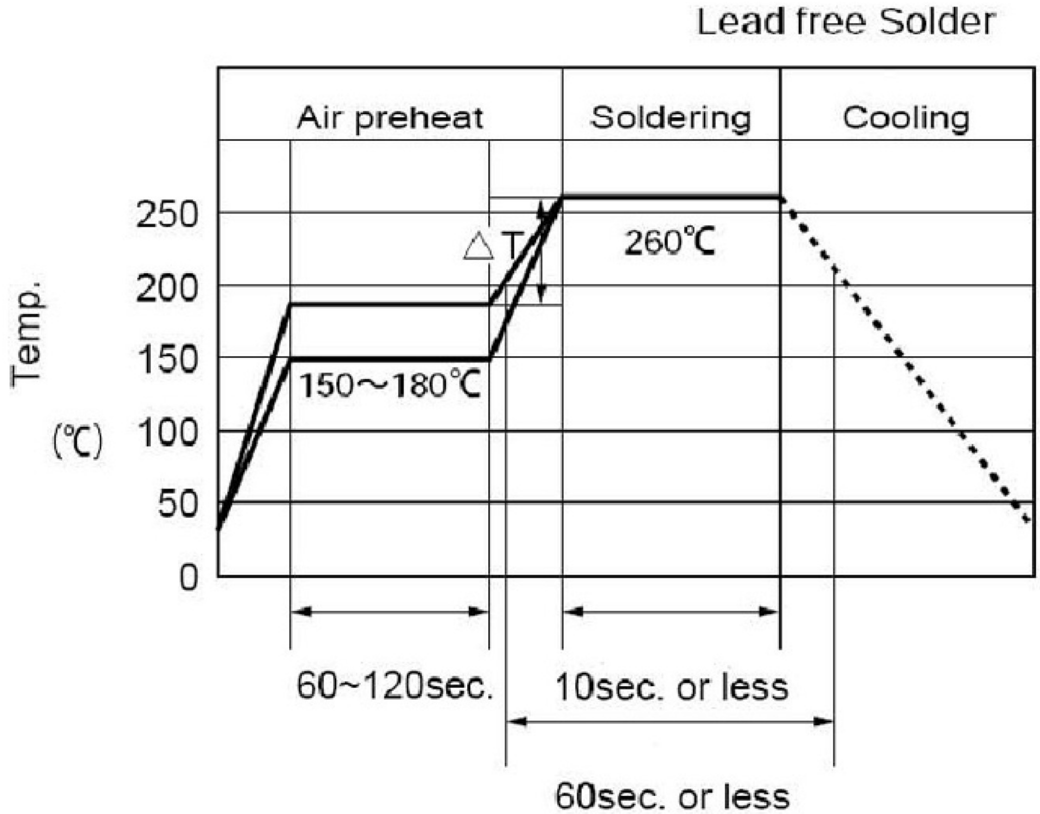
The matching network has to be individually designed using one,two or three components.

Test board dimensions



The testboard is designed for evaluation purposes for

11.Recommended Reflow Temperature Profile



(1) Time shown in the above figures is measured from the point when chip surface reaches temperature.
(2) Temperature difference in high temperature part should be within 110°C.
(3) After soldering, do not force cool, allow the parts to cool gradually.

*General attention to soldering:

●High soldering temperatures and long soldering times can cause leaching of the termination, decrease in adherence strength, and the change of characteristic may occur.

- For soldering, please refer to the soldering curves above. However, please keep exposure to temperatures exceeding 200°C to under 50 seconds.

- Please use a mild flux (containing less than 0.2wt% Cl). Also, if the flux is water soluble, be sure to wash thoroughly to remove any residue from the underside of components that could affect resistance.

Cleaning:

When using ultrasonic cleaning, the board may resonate if the output power is too high. Since this vibration can cause cracking or a decrease in the adherence of the termination, we recommend that you use the conditions below.

Frequency: 40 kHz max.

Output power: 20W/liter

Cleaning time: 5minutes max.

1.What is radio wave?

Radio waves are waves produced by the interaction of time -varying electric and magnetic fields. More properly they are referred to as electromagnetic waves. With the Wireless Telegraphy Act it was decided that all electromagnetic waves with a frequency below 3,000GHz would be called radio waves.

2. What is antenna?

An antenna converts electrical energy to radio waves and transmits them into the sky as well as collecting radio waves from the sky and converting them to electrical energy.

3.What is good antenna (1)?

As antenna serves as the electrical power conversion device between a circuit and the air, the keys to it's efficiency are as follows:
(1) Input characteristics with the contact point on the circuit side
(2) Radiation characteristics from the contact point to the air
Input Characteristics
Electric power is supplied efficiently to the antenna without reflecting back into the circuit at the feeding point
> If the impedance between the antenna and the feed line is not matched correctly, the signal will reflect back and no power will be supplied to the antenna.

Radiation Characteristics
The power supplied to the antenna is not lost within the antenna but is transmitted as a radio wave.
> If the antenna is made of high loss material (conductors and dielectrics), then the power that was supplied to the antenna will be dissipated into heat and lost.

4. What is good antenna (2)?

The characteristics of a general antenna are shown below.
(1) Input Characteristics
Frequency - Return loss chart …where the return loss is low, indicates that the antenna is
Frequency – VSWR chart … …well matched at that frequency. In the same way, a low value shows a good matching of the antenna.
* Bandwidth … The antenna is good to the extent of good matching and the width of the frequency domain.

(2) Radiation Characteristics
Radiation pattern …The strength of the antenna emission is displayed.
It shows that antennas emit well in their projected direction.
It is usually displayed in three planes (XY, YZ and ZX planes).
Gain [dBd] … …Given as a ratio to a standard antenna (half wave dipole).

Usually displayed as the average of the three planes (XY, YZ and ZX planes).
Designated as a combination of the vertical and horizontal polarity power gains.

5. Importance of tuning?

Because many things, such as the board shape, surrounding components and the case covering the board, can affect the characteristics of an antenna, most designs require customization of the antenna to compensate for the shift in characteristics. Correcting the shift in the characteristics of the antenna is known as tuning. For this work, having lots of experience from adjusting many items and equipment is where an antenna maker can really show their strengths.
This experience can really help the user in getting the help needed for a quick product design.

6. Our workflow for tuning?

Customer

↓ Receipt of customers board

Tuning

(1) Mount standard part on board and check for shift in characteristics
(2) Select an item from the frequency and impedance series to correct the shift in characteristics
(3) Mount the new part on the board and check characteristics. Repeat steps 2 and 3 if necessary to get the best results

Standard measurements

↓ Measure the radiation pattern in the company's anechoic chamber.
Check the center frequency, upper and lower band limits as well as verify the gain.

Make technical report

↓ Send the customer a technical report of the test results and recommendation for the part to use.

Customer

(1) We have anticipated the characteristic shifts and created a series of parts that match those shifts and corrects them.

• Frequency Series Parts

When an antenna is mounted, the center frequency will shift due to surrounding elements. These parts will bring that frequency back to the proper center frequency. There are 18 values available in 29MHz steps.

• Impendence Series Parts

The impedance of an antenna will appear different depending on the shape of the board and other items surrounding the antenna. Normally in these situations, designers will make a matching circuit by adding capacitors or inductors, we however have created antennas with 3 different impedances values, so a standard antenna can be quickly matched to the design without any modifications to the circuit.

(2) Complete Measurement Environment

Our facilities are complete with a full anechoic chamber and all required test equipment for quick and complete testing.

(2) Standard Data Reporting

Using standardized data forms, the information can quickly be assembled into a report.

* If a verbal reply is sufficient, we can reply within 2 days of receiving the customer's board.

8. How to select the correct antenna?

It is important to select the correct antenna for the application.

1) Important Information about Small Antennas!

As for chip antennas, you must consider the ground plane surrounding the area the chip is mounted. When using a small antenna it is often necessary to make a large ground plan to improve the characteristics of the antenna, the results is a larger area on the board for the antenna. Also, since small antennas typically are lambda/4 type antennas, a large GND is also important. In fact if the GND is not large enough, there are some small antennas that will not operate.

> We consider the ground plane area in addition to the area for mounting antenna as a set, and can propose the optimum configuration for both.

Also, if there is room in your design, the larger antenna you can use the better off you will be. (It has been theoretically proven that as an antenna becomes smaller the performance deteriorates.)

2) Use Directivity Appropriately!

When you know the direction of the transmission, you should choose to use a directional antenna. If you don't, you will scatter the radio waves and the power will be wasted.

Also, as seen in the recent case with SAR, directional antennas were best to effectively isolate the body.

> We have both directional and omni directional antennas, so please consider what are best for your application.

For return loss characteristics, the loss amount is a combination of the transmission power and the power lost. Even in the case where the power loss is great and there is no transmission at all, the antenna may be seen as having very good broadband characteristics. To best judge the band, the gain's frequency characteristics should be judged.

> The standard data we submit then is the average gain for the necessary frequency.

4) Losses for the Matching Circuit!

This circuit is used to match the impedance at the feed of the antenna. In actuality, this circuit is also the primary cause of power loss. In addition, this circuit takes up additional space on the board, adding to the total area required for the antenna. If however, the antenna's impedance is matched with the characteristic impedance from the beginning, there is no need for this circuit.

> We do not use matching circuits, but instead have the ability to tune the antenna to match the impedance.