Buddi

Lucida (SR4L002)

Serica (SR4W035)

Author: Yu Kai Yeung

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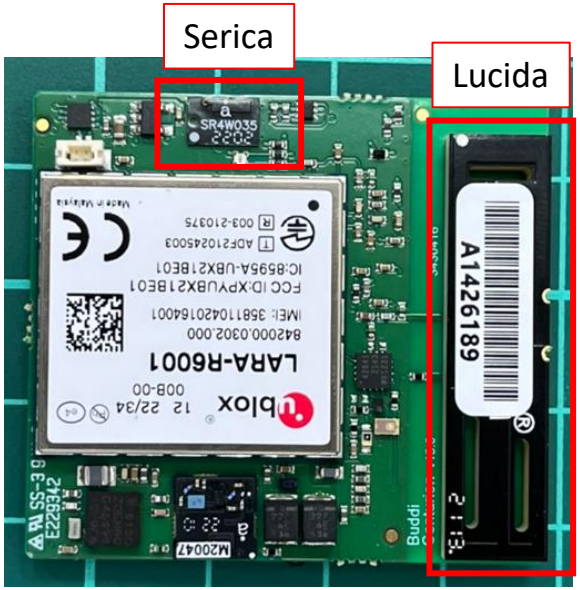
Project: 18036 -03

Introduction

- Buddi provided a device to find the optimal matching circuit for Lucida(Band 1,2,4,5,8,12,17,26), Serica(2.4GHz).
- All test results in report are in full housing with battery.



Equipment used

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Return loss/Isolation

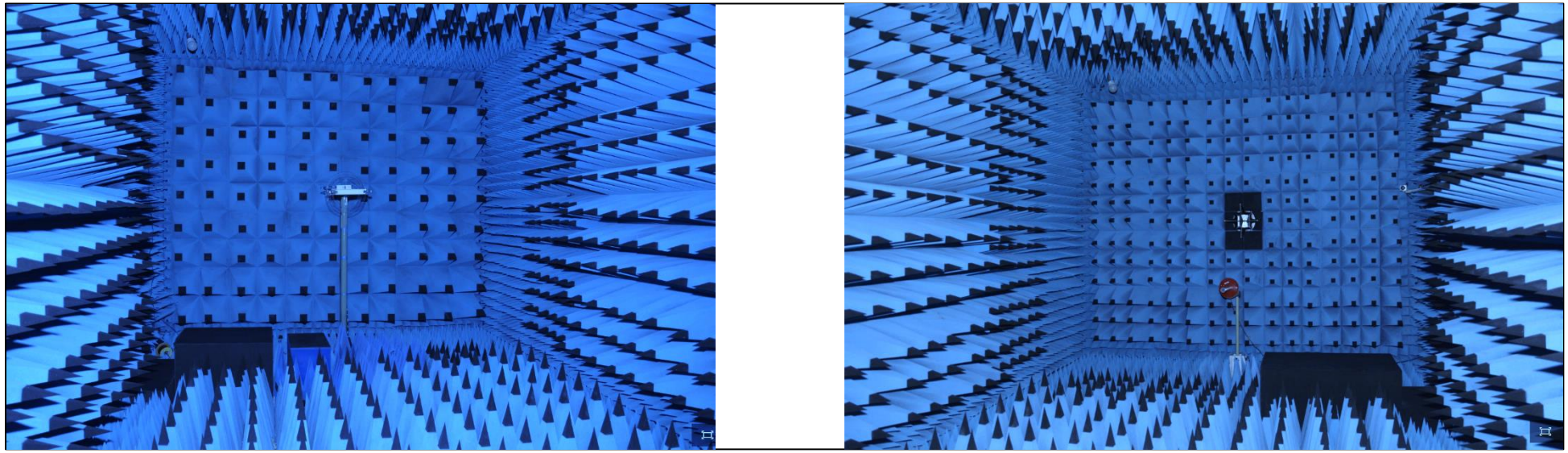
Agilent E5071B (300KHz-8.5GHz) ENA

Passive Efficiency

Chamber equipment Rig

Equipment used

Anechoic chamber 700MHz – 6000MHz

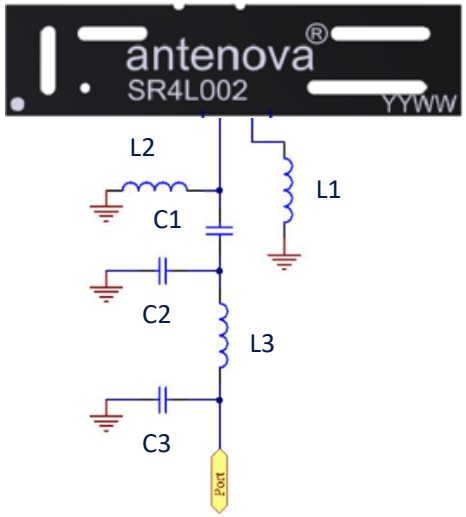


All tests using this arrangement were performed in free space. The return loss at the input of the matching circuit was measured using an Agilent ENA E5071C RF Network Analyser. For all measurements, the relevant sleeve choke was used to reduce the effect of the cable radiation.

LTE Antenna

Recommended Matching Circuits

Circuit diagram



SR4L002				
Designator	***Type***	***Value***	***Manufacturer****	***Series***
L1	Resistor	0R	Non-Specific	NA
L2	Inductor	8.2 nH	Murata	LQG15 Series
L3	Inductor	1.5nH	Murata	LQG15 Series
C1	Capacitor	2.7pF	Murata	GJM15 Series
C2	Inductor	7.5nH	Murata	LQG15 Series
C3	DNF	DNF		

**Equivalent components can be used*

The recommended matching circuit is valid only for the hardware configuration provided. Any changes to the PCB layout, hardware or relative position of the antenna, including microphones, speakers, batteries, cases, etc, may modify the antenna impedance and it would require a different matching circuit.

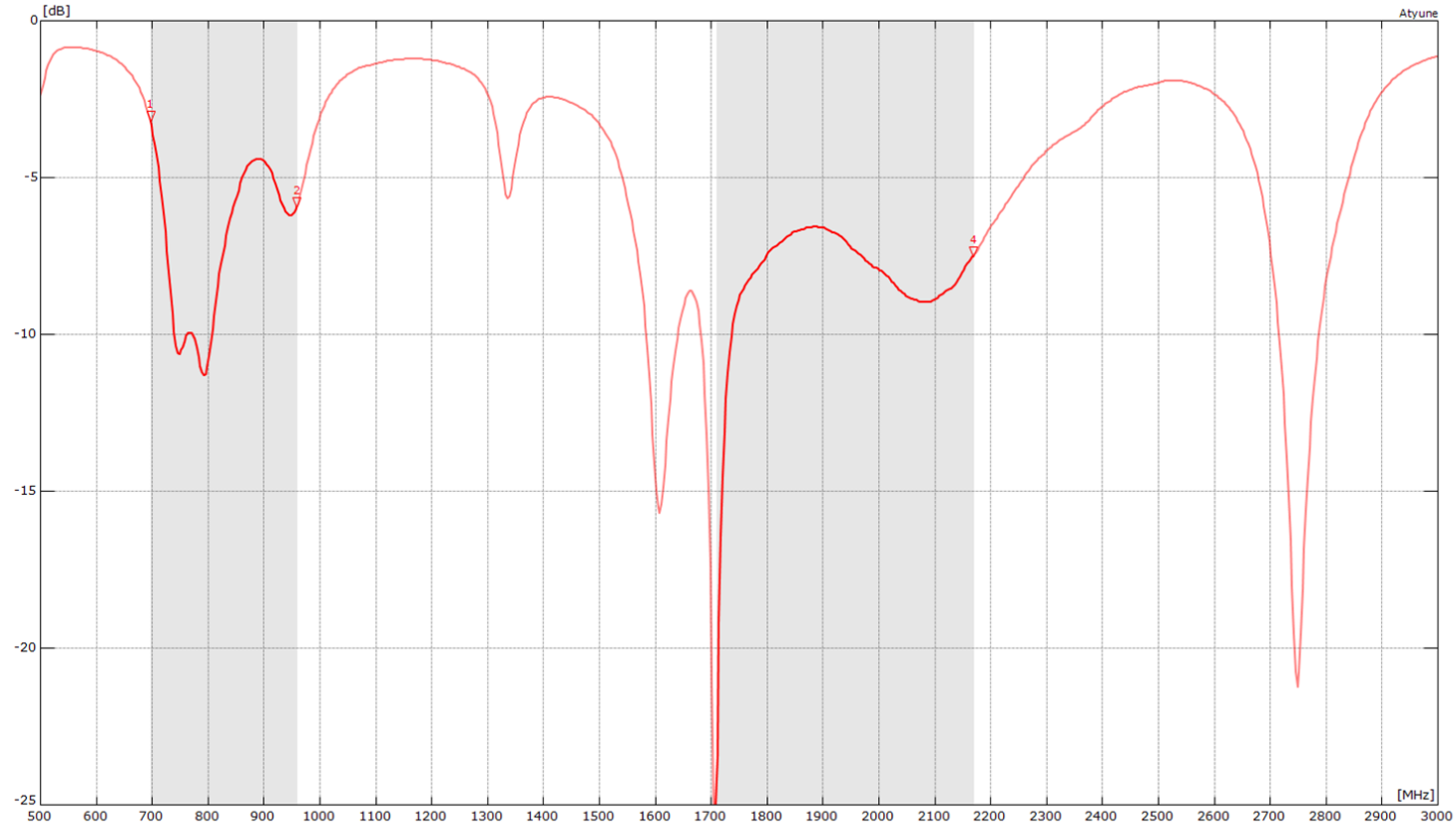
Results Summary

- Test results using recommended matching circuits for cellular band:1,2,4,5,8,12,17 and 26

	698-960 MHz	1710-2170 MHz
Efficiency (min)	10.2%	20.8%
Efficiency (avg)	16.1%	35.4%
Gain (peak)	-1.3dBi	0.3dBi
Gain (avg.)	-7.9dB	-4.5dB

S-Parameter

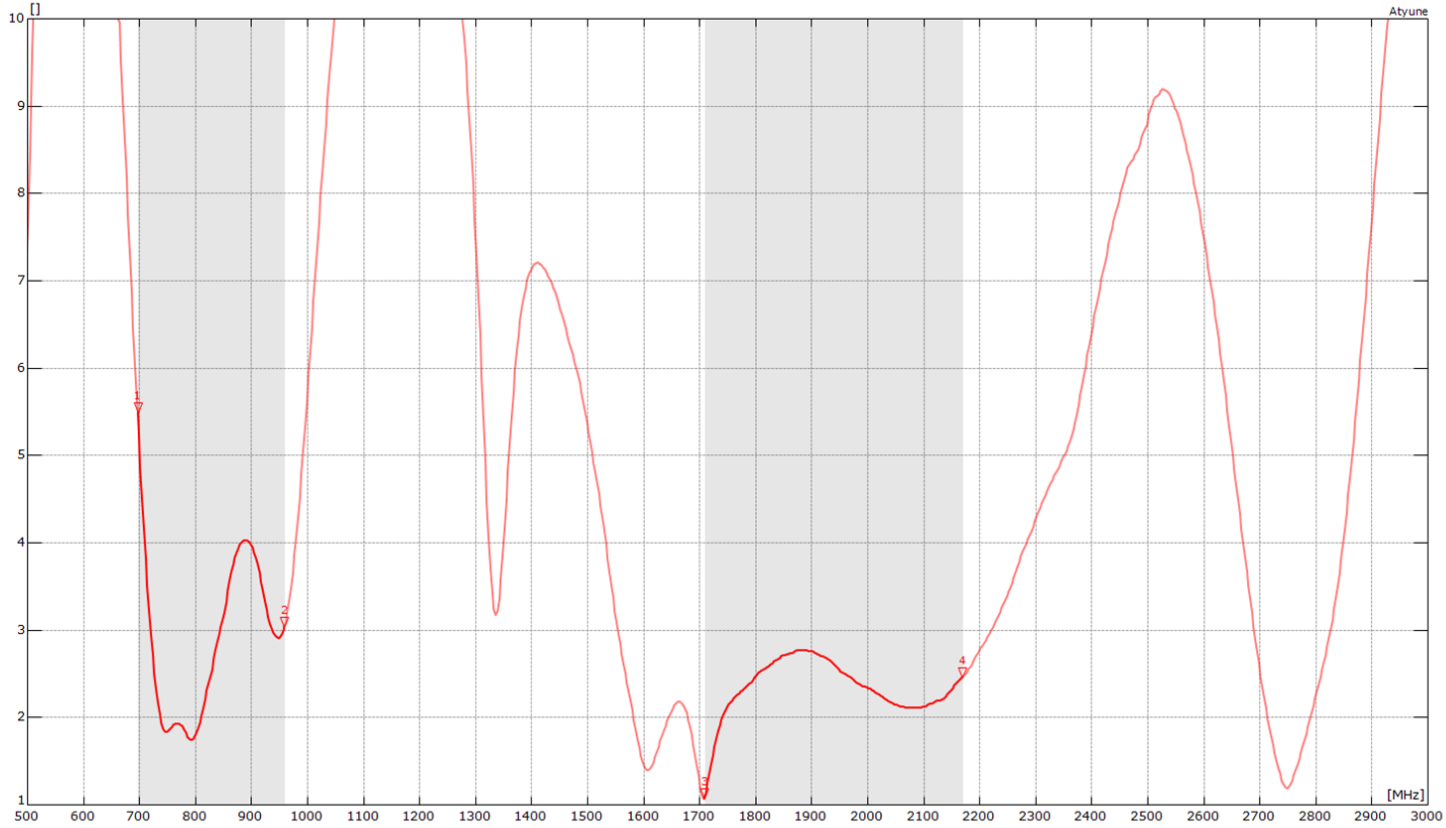
- The Return Loss at the input of the matching circuit was measured using an Agilent E5071C RF Network Analyzer.



MARKERS:	MHz	dB	MHz	dB
LTE Antenna, Lucida				
	1: 698	-3.20	3: 1710	-28.88
	2: 960	-5.95	4: 2170	-7.50

VSWR

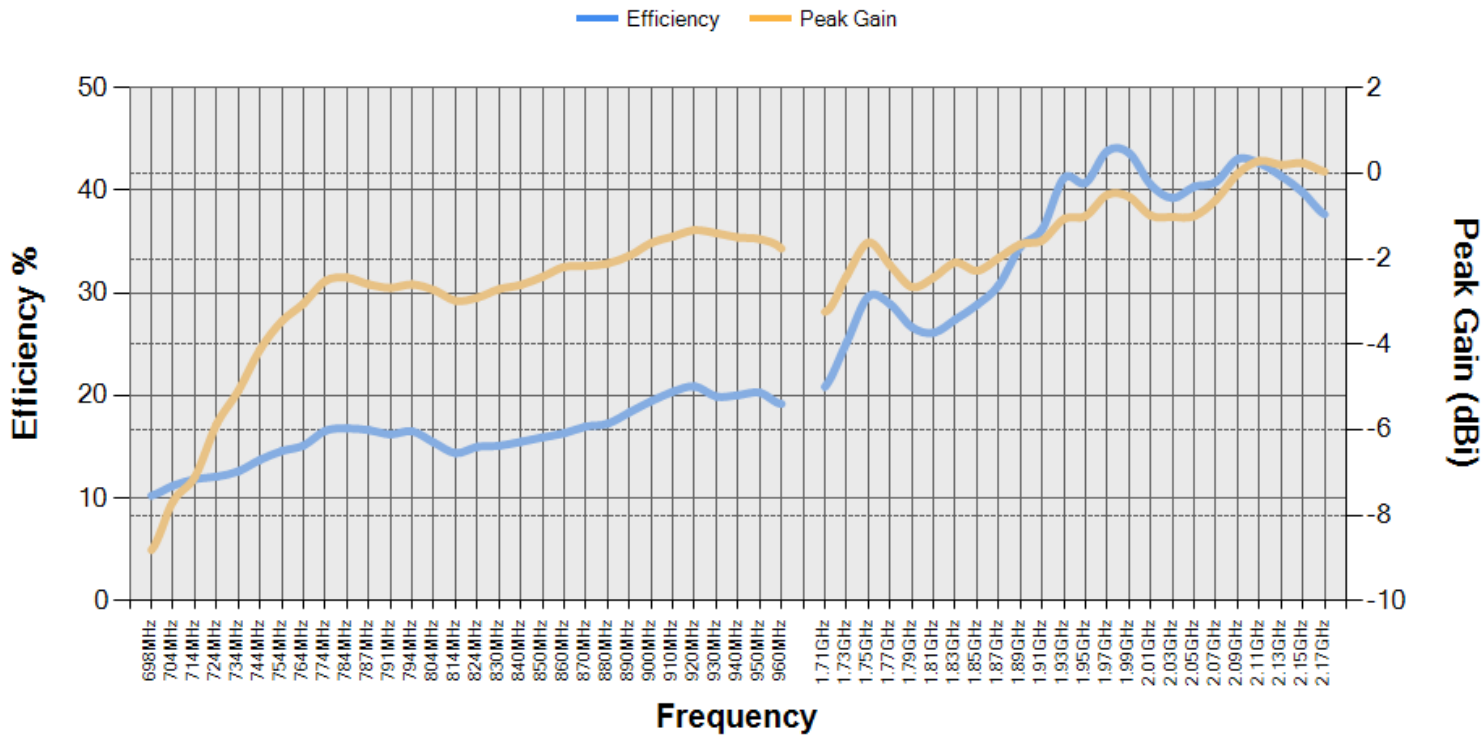
- The VSWR at the input of the matching circuit was measured using an Agilent E5071C RF Network Analyzer.



MARKERS: MHz		MHz	
LTE Antenna, Lucida			
1: 698	5.49	3: 1710	1.07
2: 960	3.03	4: 2170	2.46

Efficiency

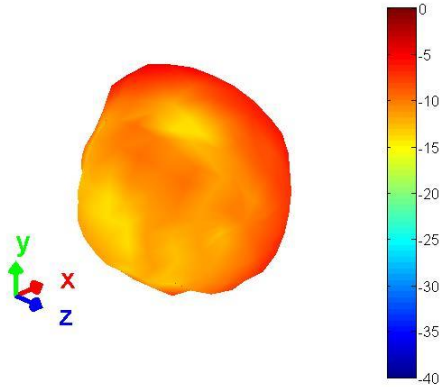
- Antenna efficiency measured in anechoic chamber.

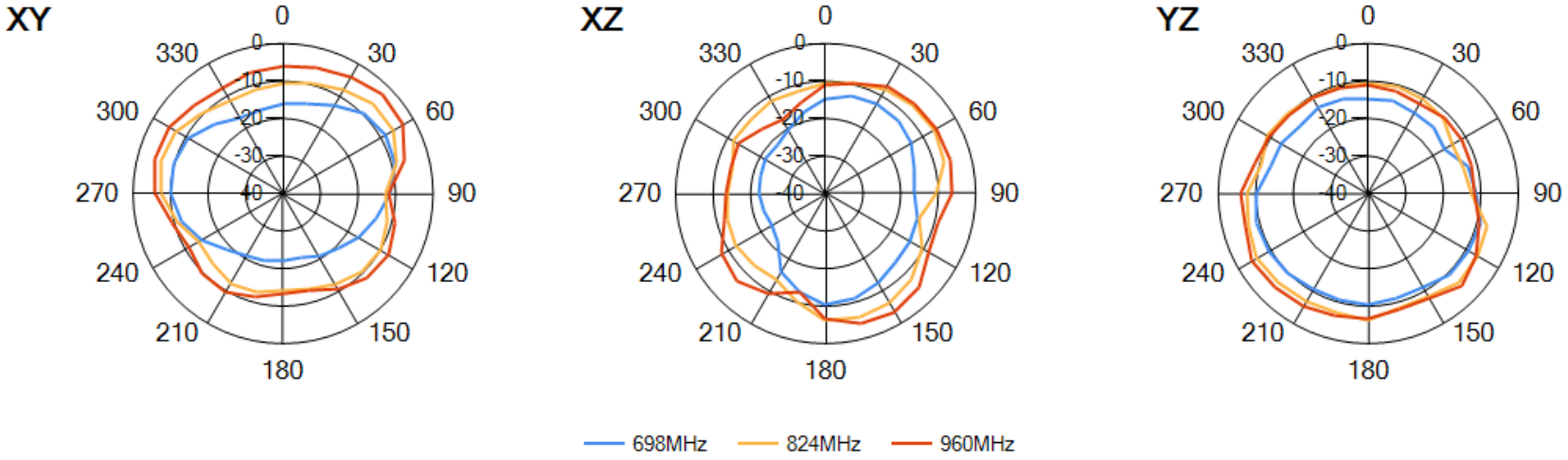


Radiation Patterns

- Antenna radiation pattern measured in anechoic chamber.

3D Pattern at 824 MHz

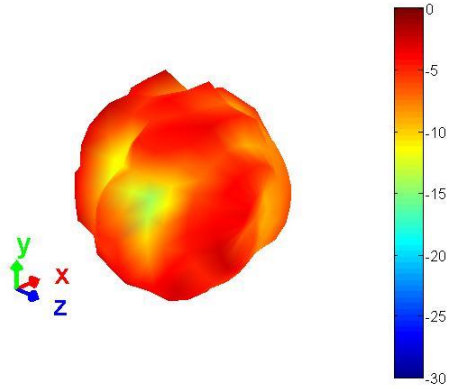


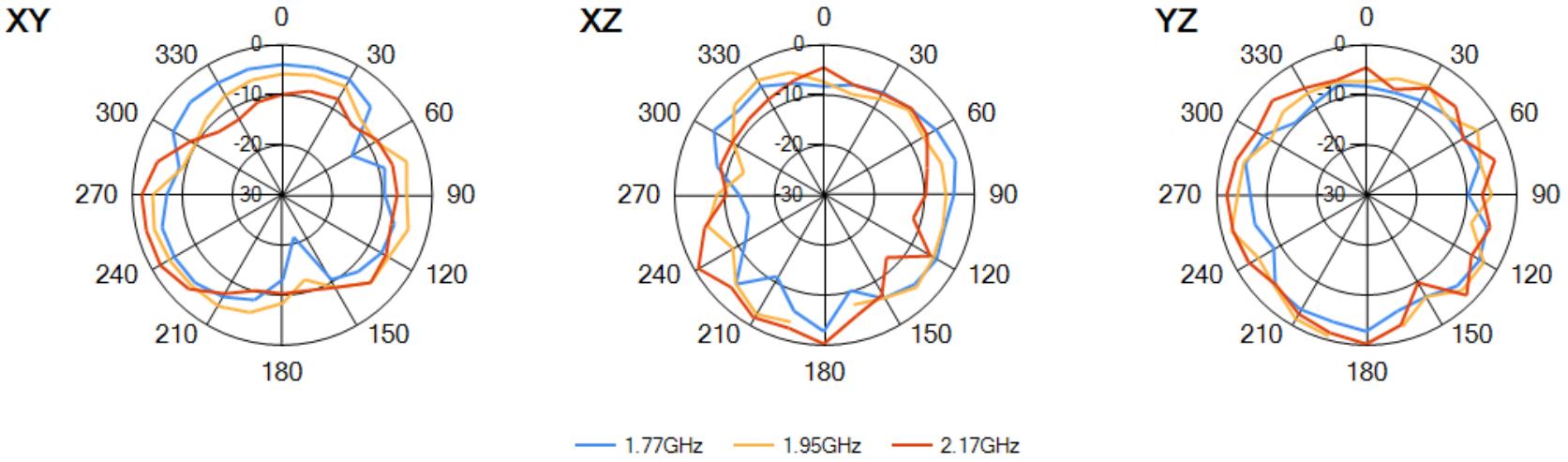


Radiation Patterns

- Antenna radiation pattern measured in anechoic chamber.

3D Pattern at 1950 MHz



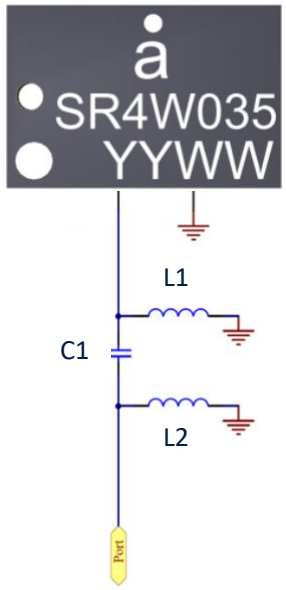


Wi-Fi Antenna

Recommended Matching Circuits

antenova®

Circuit diagram



SR4W035				
Designator	***Type***	***Value***	***Manufacturer****	***Series***
L1	Inductor	15nH	Murata	LQG15 Series
C1	Capacitor	10 pF	Murata	GRM155 Series
L2	DNF		DNF	
**Equivalent components can be used*				

The recommended matching circuit is valid only for the hardware configuration provided. Any changes to the PCB layout, hardware or relative position of the antenna, including microphones, speakers, batteries, cases, etc, may modify the antenna impedance and it would require a different matching circuit.

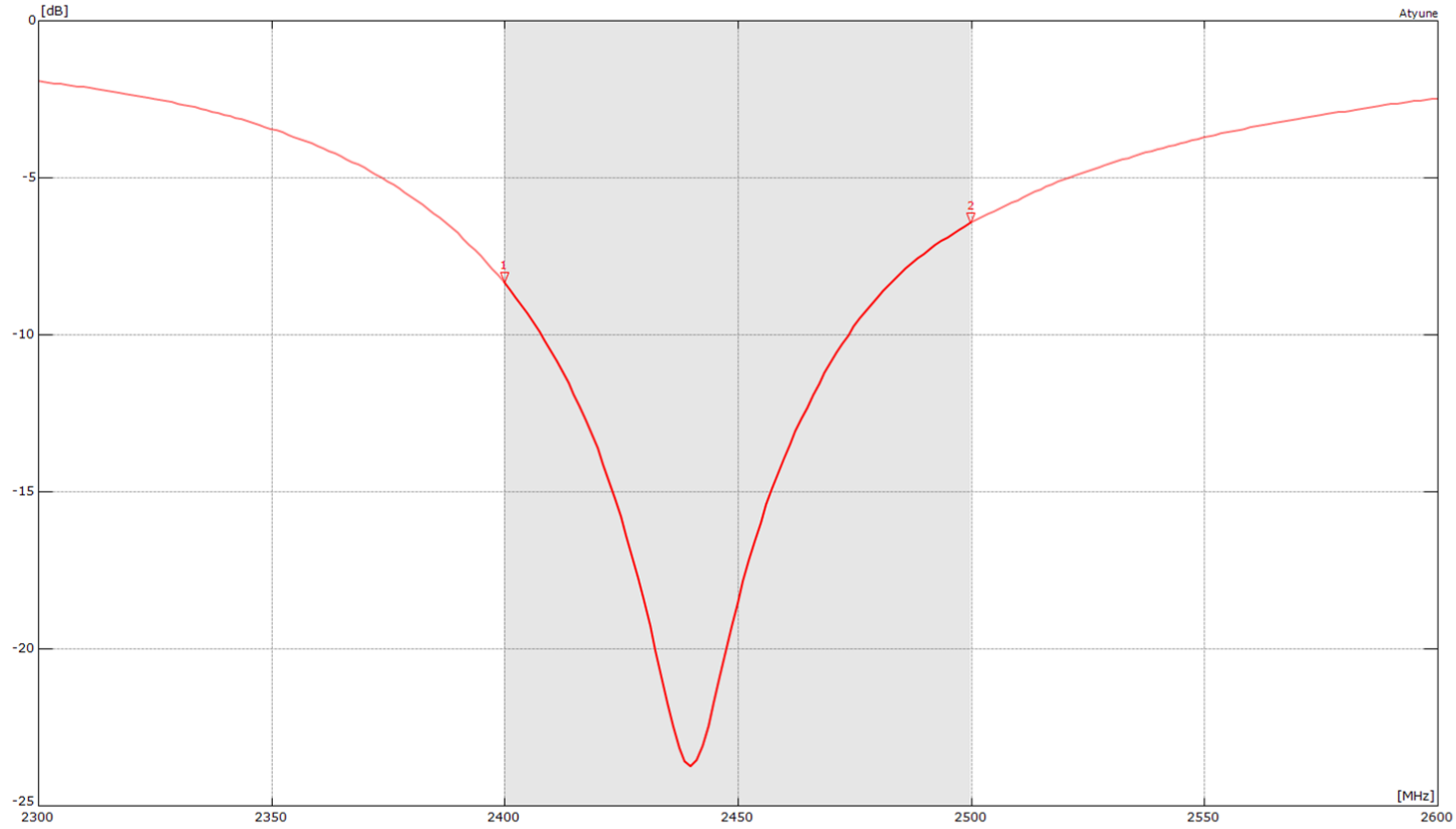
Results Summary

- Test results using recommended matching circuits for Wi-Fi 2.4GHz.

	2400-2500 MHz
Efficiency(min)	22.5%
Efficiency(avg)	27.7%
Gain(peak)	-0.8dBi
Gain(avg.)	-5.6dB

S-Parameter

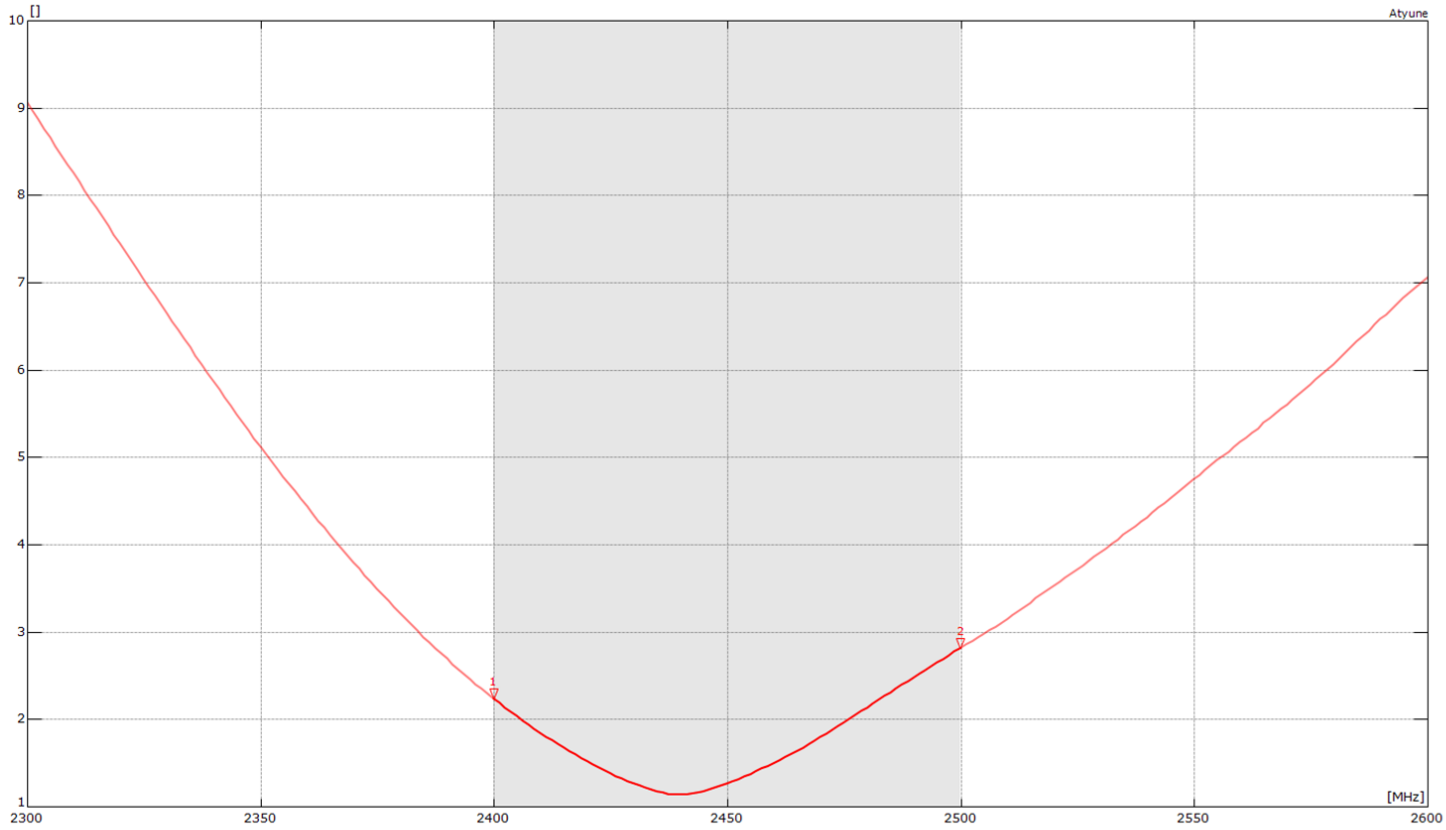
- The Return Loss at the input of the matching circuit was measured using an Agilent E5071C RF Network Analyzer.



MARKERS: MHz dB
Wi-Fi antenna, Serica
1: 2400 -8.33
2: 2500 -6.44

VSWR

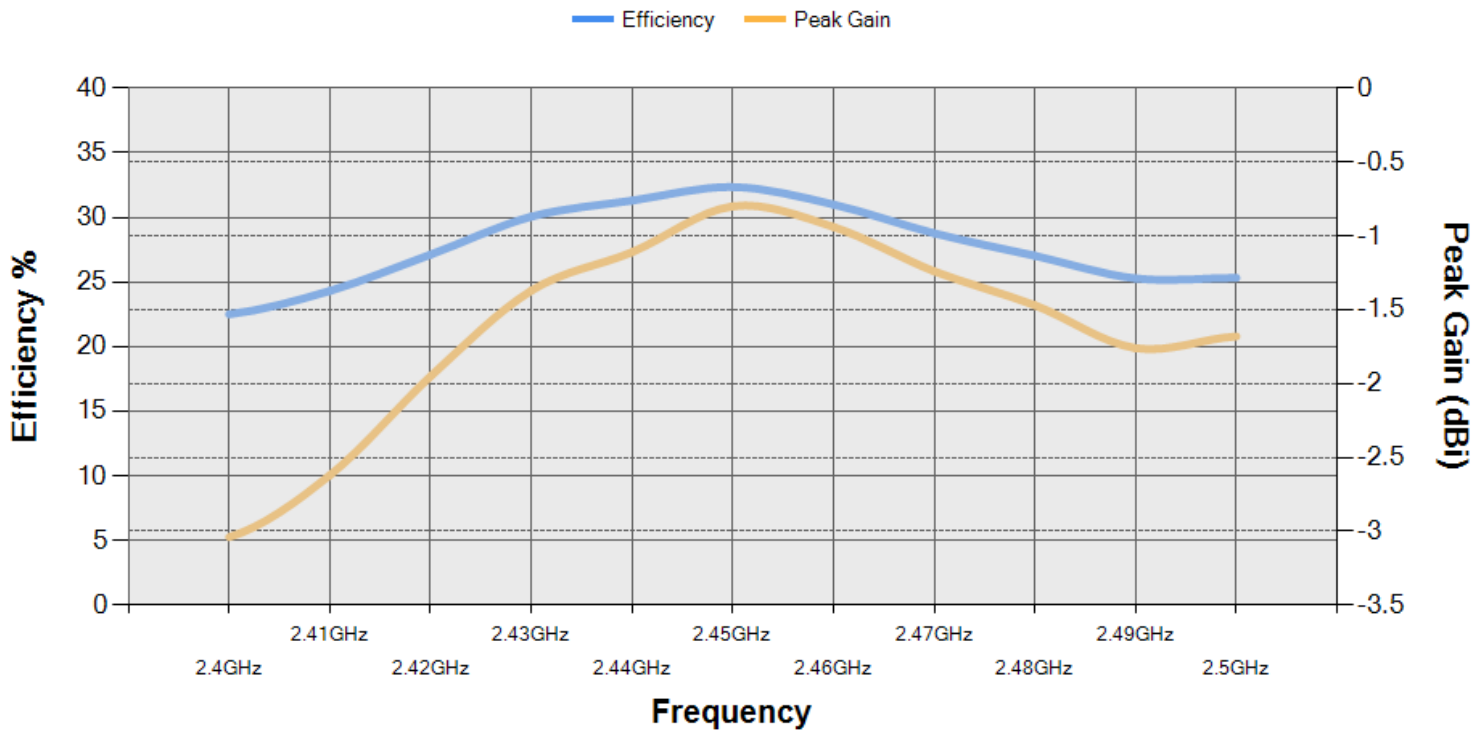
- The VSWR at the input of the matching circuit was measured using an Agilent E5071C RF Network Analyzer.



MARKERS: MHz
Wi-Fi antenna, Serica
1: 2400 2.24
2: 2500 2.82

Efficiency

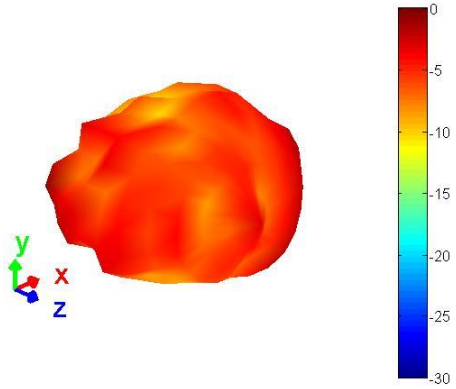
- Antenna efficiency measured in anechoic chamber.

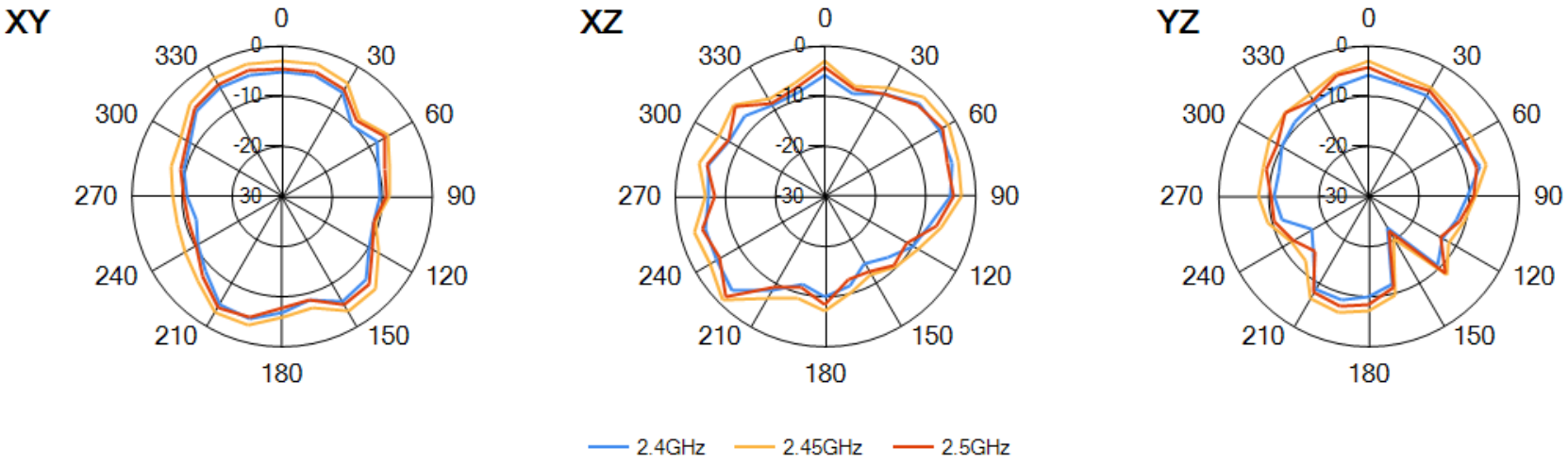


Radiation Patterns

- Antenna radiation pattern measured in anechoic chamber.

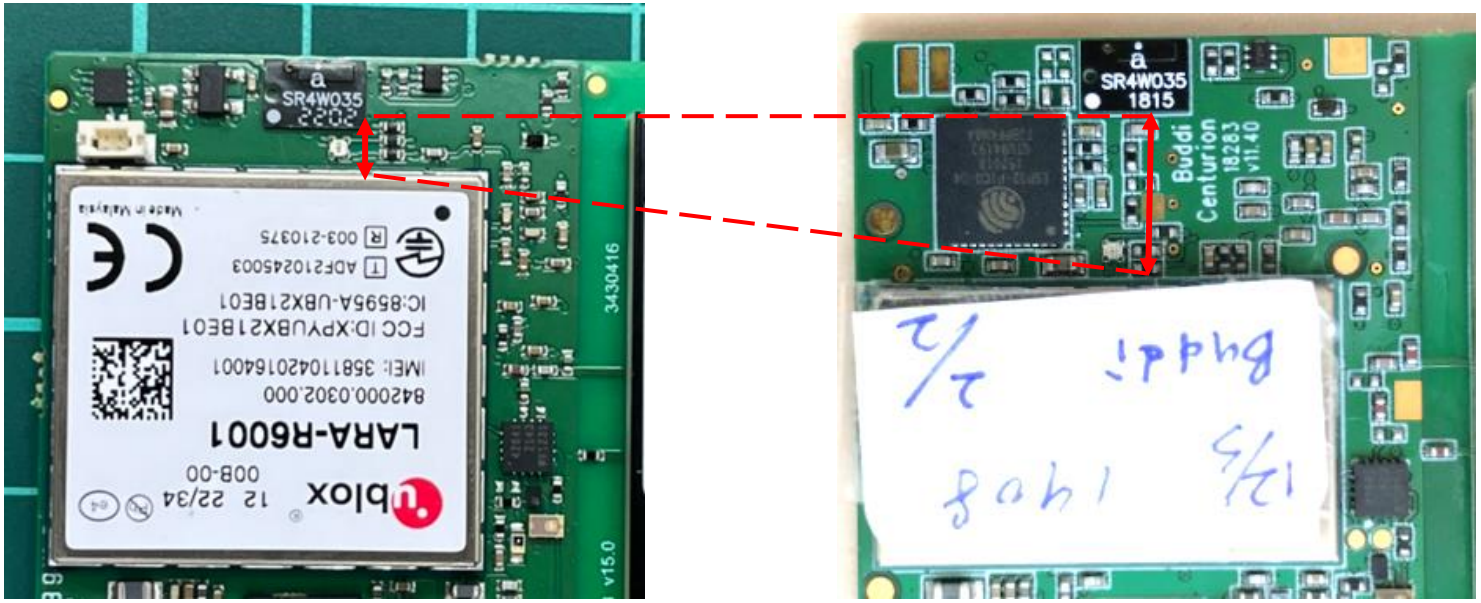
3D Pattern at 2450 MHz





Conclusion

- The antennas performance are matched and optimized for the current ground plane size(39x32mm), to improve the low band of LTE antenna the ground plane size needs to be longer.
- The battery placed underneath, will affect the antenna performance. Increasing the distance between the antennas and the battery will improve antenna performance.
- The module in this version of the board is much closer to the Wi-Fi antenna than the previous version. This will affect the performance.



Statement On Intellectual Property & Disclaimer

Statement on Intellectual Property

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End of Document

TRP & Efficiency

The below table shows the relationship between the passive performance Gain and TRP (Total Radiated Power). This does not represent a certainty for the active performance but is to be used as a guide only. A device may still fail certification due to device issues not related to the antenna.

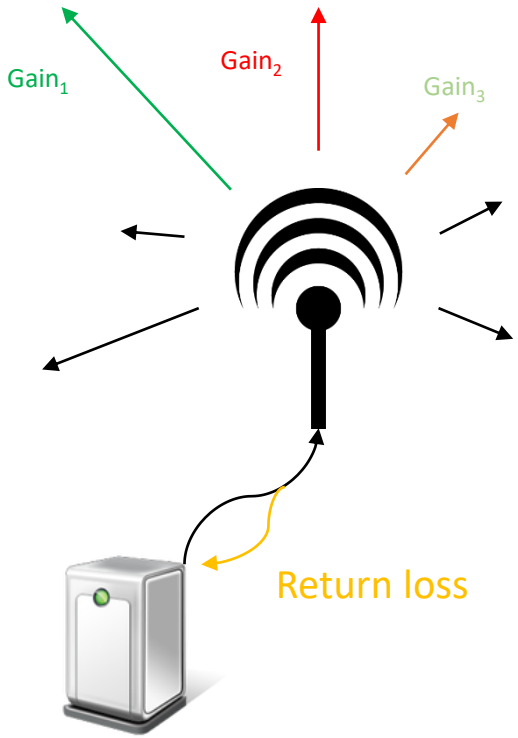
	Efficiency	Antenna Gain (Avg)	2G 850/900	2G 1800/1900	3G	LTE
*1	100%	0dB	33dBm	30dBm	24dBm	23dBm
	50%	-3dB	30dBm	27dBm	21dBm	20dBm
	30%	-5.2dB	27.8dBm	23.8dBm	18.8dBm	17.8dBm
*2	25%	-6dB	27dBm	23dBm	18dBm	17dBm
	10%	-10dB	23dBm	20dBm	14dBm	13dBm
	5%	-13dB	20dBm	17dBm	11dBm	10dBm

Please note: This is to be used as a guide and may not represent how the antenna and radio system will perform as a unit. It is recommended to measure the Total Radiated Power (TRP) for actual results.

**1: Typical minimum requirements for certification (Dependant on your required specification)*
**2: The performance could be self-defined depending on usage/application for those devices that certifications are not mandatory.*

Glossary

- **Return Loss:** It is the loss of signal power resulting from the reflection caused at a discontinuity in a transmission line.
- **Gain:** It is a figure which combines the antenna's directivity and electrical efficiency, and describes how well the antenna converts input power into radio wave headed in a specified direction and how well the antenna converts radio waves arriving from a specified direction into electrical power.
- **Efficiency:** The ratio of the total power radiated by an antenna to the net power accepted by the antenna from the connected transmitter.
- **Radiation Pattern**: A plot of the gain as a function of direction.



$$\frac{1}{return \quad loss} \propto Efficiency \propto \frac{Gain_1 + Gain_2 + Gain_3 + ... + Gain_N}{N}$$