






DESIGN SPECIFICATION
Part Number: LT31411 (SM-T638U)
Rev. A

DESIGN SPECIFICATION

DESIGN	INTERNAL ANTENNA
MODEL / TYPE	SM-T638U / SUB1 INTENNA
KYOCERA AVX P/N	LT31411
SEC CODE	GH42-06923A
CUSTOMER	SAMSUNG ELECTRONICS CO., LTD.
SUPPLIER	KYOCERA AVX INC.

ENGINEERING MANAGER CHECKED	MECHANICAL MANAGER CHECKED	DESIGN MANAGER CHECKED
 JH Jeong	 JC Kim	 KJ Chun



MSL1

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Purpose and Scope

The purpose of this document is to establish a design specification for the antenna DESIGN that Kyocera AVX is developing for the Samsung SM-T638U Tablet. Any changes or additions to this specification can affect schedule and/or cost or the DESIGN and should be negotiated between Kyocera AVX and Samsung before being incorporated into the specification. Upon agreement of this specification, Kyocera AVX will make no changes without the written approval from Samsung. Any changes requested by Samsung will be given to Kyocera AVX with sufficient time to evaluate the cost impact and react as required.

1. Abbreviations and Definitions

AVG	Average
°	Degree
°C	Celsius (degrees Centigrade)
cm	Centimeter
G	Gravitational Force
g	Grams
Hz	Hertz
In	Inches
IQC	Incoming Quality Control
MHz	Megahertz
m	Meter
mm	Millimeter
N	Newton
PCB	Printed Circuit Board
TX	Transmit Band
RH	Relative Humidity
RX	Receive Band
VSWR	Voltage Standing Wave Ratio
W	Watt

Design specification: A target specification to guide design process.
DESIGN Specification: A final specification for the qualified DESIGN.



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2. ELECTRICAL SPECIFICATION FOR SM-T638U

2.1. Frequency Band

Mode	Frequency Band (MHz)
Sub 1	617~960 MHz, 1,805~2,690 MHz

Mode	Frequency Band (MHz)
Sub 2	3,300~4,200 MHz

Mode	Frequency Band (MHz)
Sub 4	1,805~2,690 MHz, 3,300~4,200 MHz

2.2. Electrical Characteristics

2.2.1. VSWR

< Tablet mounted typical measurements >

Frequency Range	617 MHz	960 MHz	1,805 MHz	2,690 MHz
V.S.W.R	$2.5 \pm 0.5:1$	$1.7 \pm 0.5:1$	$1.4 \pm 0.5:1$	$2.8 \pm 0.5:1$

<Sub 1 Antenna>

Frequency Range	3,300 MHz	4,200 MHz
V.S.W.R	$1.3 \pm 0.5:1$	$2.7 \pm 0.5:1$

<Sub 2 Antenna>

Frequency Range	1,805 MHz	2,690 MHz	3,300 MHz	4,200 MHz
V.S.W.R	$3.9 \pm 0.5:1$	$2.5 \pm 0.5:1$	$4.6 \pm 0.5:1$	$4.3 \pm 0.5:1$

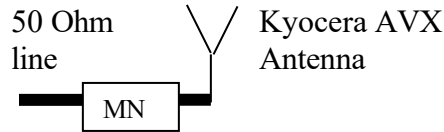
<Sub 4 Antenna>



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Matching Requirements

In order to assure the best performance of the antenna, the matching will be evaluated in free space and in talk position. The antenna will comply with the Electrical Specification requirements, as set out below, while mounted on the Tablet containing the PCB. The Tablet and PCB are to be provided by the customer and should be representative of the latest design version of all parts. Any modifications in the Tablet or PCB can affect the performance of the antenna and should be discussed with Kyocera AVX to determine the affect of such changes on the antenna performance and delivery requirements.



Optional matching network to be determined by SAMSUNG RF team if needed.

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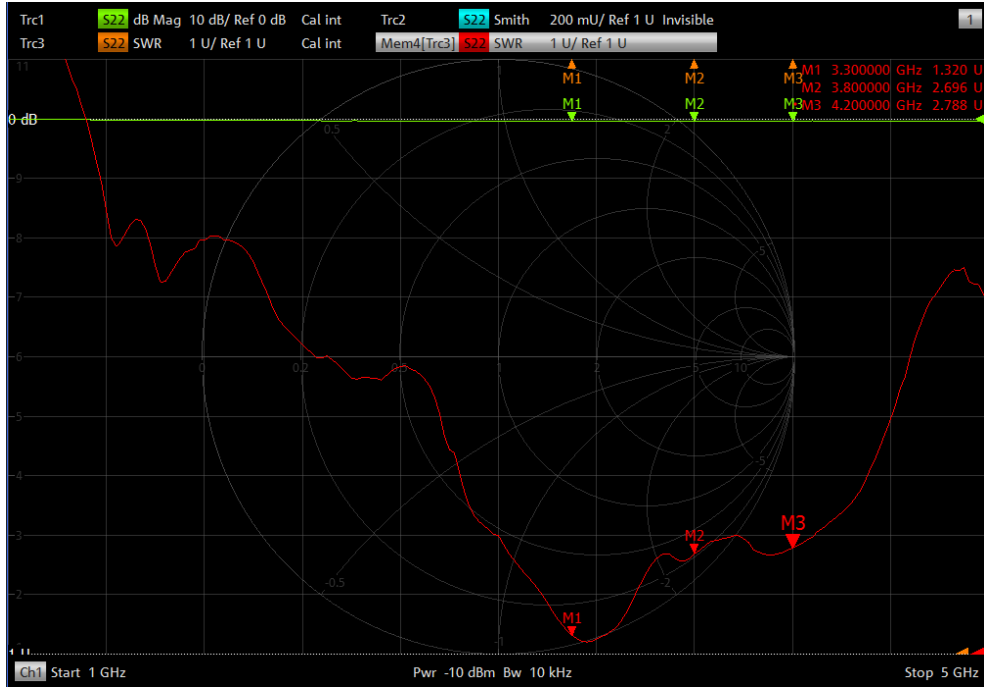
2.3. Passive Measurement

2.3.1. Input Return Loss and VSWR

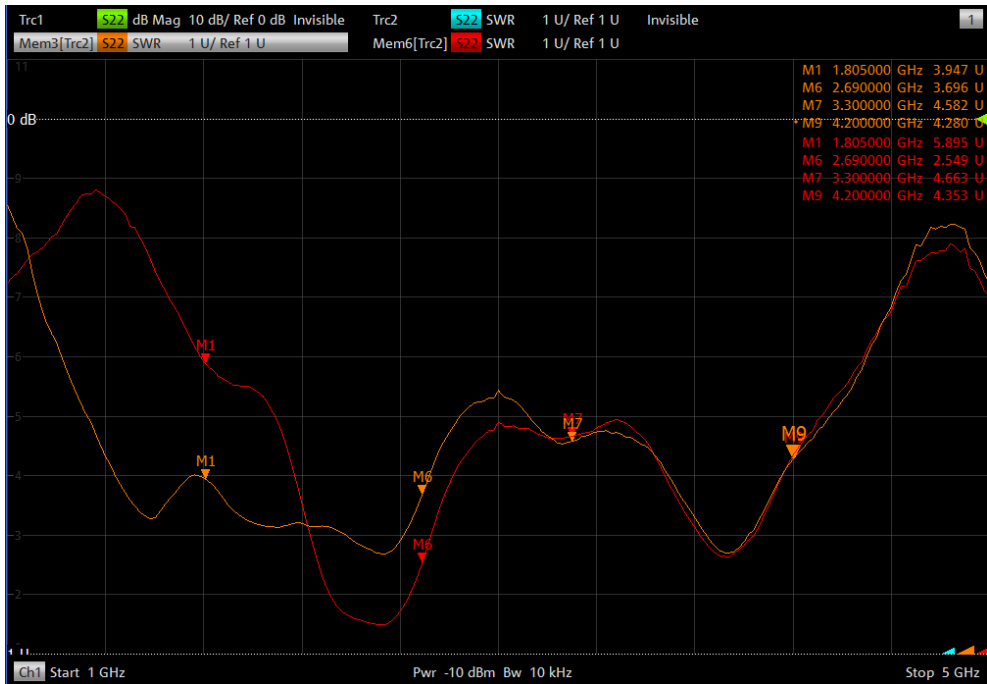


Sub 1 Antenna

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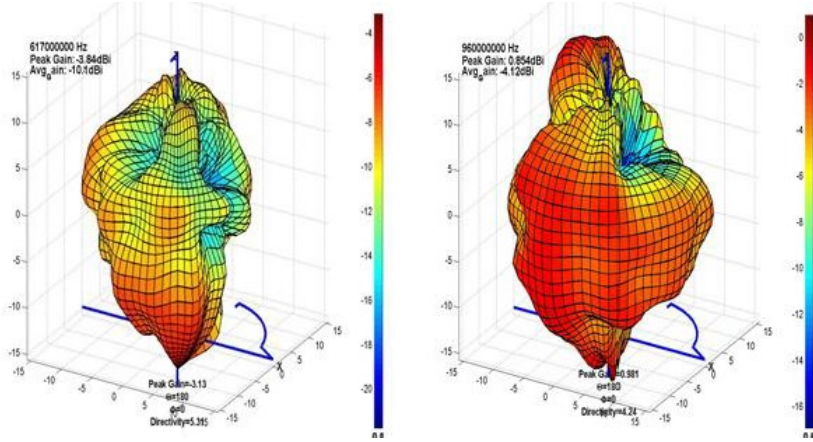
Sub 2 Antenna



Sub 4 Antenna

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2.4. SM-T638U Tablet Sub 1 INTENNA Low Band

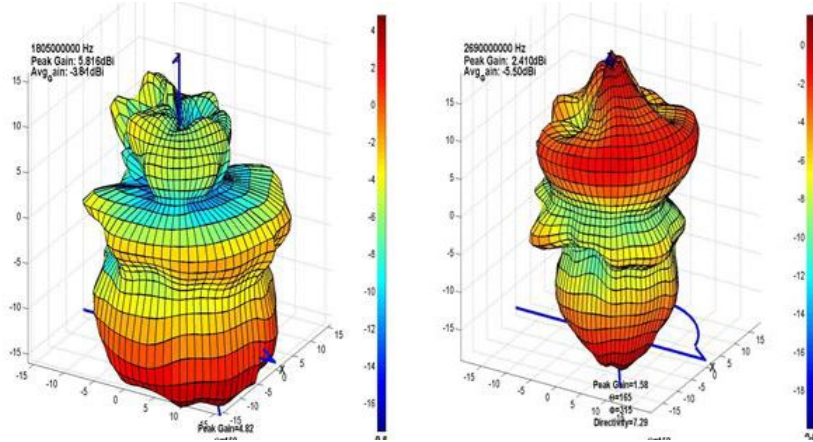


<Tablet mounted typical measurements>

Frequency	Efficiency	Max Gain		
		Ver	Hor	Total
617,000,000 Hz	10.0 %	-5.8 dBi	-5.7 dBi	-3.8 dBi
634,500,000 Hz	12.7 %	-4.3 dBi	-4.3 dBi	-2.5 dBi
652,000,000 Hz	16.2 %	-3.2 dBi	-3.2 dBi	-1.6 dBi
729,000,000 Hz	26.5 %	-2.1 dBi	-2.2 dBi	-0.2 dBi
734,000,000 Hz	27.4 %	-2.1 dBi	-2.1 dBi	0.0 dBi
737,000,000 Hz	26.8 %	-2.3 dBi	-2.3 dBi	-0.1 dBi
740,000,000 Hz	26.9 %	-2.4 dBi	-2.4 dBi	-0.1 dBi
746,000,000 Hz	27.3 %	-2.4 dBi	-2.4 dBi	-0.1 dBi
751,000,000 Hz	27.1 %	-2.5 dBi	-2.5 dBi	-0.1 dBi
756,000,000 Hz	27.0 %	-2.5 dBi	-2.6 dBi	-0.1 dBi
758,000,000 Hz	27.4 %	-2.1 dBi	-2.3 dBi	-0.2 dBi
780,000,000 Hz	29.1 %	-1.8 dBi	-1.8 dBi	0.3 dBi
791,000,000 Hz	29.6 %	-1.5 dBi	-1.5 dBi	0.6 dBi
803,000,000 Hz	26.1 %	-1.8 dBi	-1.8 dBi	0.3 dBi
806,000,000 Hz	26.2 %	-1.9 dBi	-1.9 dBi	0.1 dBi
821,000,000 Hz	28.4 %	-1.7 dBi	-1.7 dBi	0.3 dBi
859,000,000 Hz	46.2 %	0.4 dBi	0.4 dBi	2.7 dBi
869,000,000 Hz	47.5 %	0.4 dBi	0.3 dBi	2.5 dBi
876,000,000 Hz	50.1 %	0.6 dBi	0.4 dBi	2.8 dBi
881,000,000 Hz	53.7 %	0.9 dBi	0.6 dBi	3.1 dBi
894,000,000 Hz	49.9 %	0.1 dBi	-0.1 dBi	2.6 dBi
925,000,000 Hz	52.0 %	0.0 dBi	0.0 dBi	2.5 dBi
942,500,000 Hz	47.2 %	-0.7 dBi	-0.7 dBi	1.6 dBi
960,000,000 Hz	39.3 %	-1.4 dBi	-1.4 dBi	0.8 dBi

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2.5. SM-T638U Tablet Sub 1 ANTENNA Mid Band

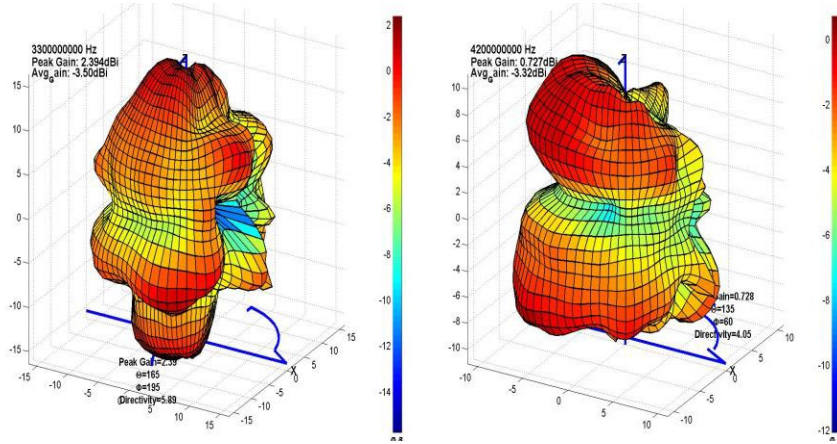


<Tablet mounted typical measurements>

Frequency	Efficiency	Max Gain		
		Ver	Hor	Total
1,805,000,000 Hz	41.8 %	-0.1 dBi	5.0 dBi	5.8 dBi
1,842,500,000 Hz	43.4 %	-0.1 dBi	5.3 dBi	6.2 dBi
1,880,000,000 Hz	47.7 %	0.8 dBi	5.9 dBi	6.7 dBi
1,930,000,000 Hz	46.0 %	-1.6 dBi	5.2 dBi	5.5 dBi
1,960,000,000 Hz	44.4 %	-2.5 dBi	4.1 dBi	4.5 dBi
1,990,000,000 Hz	44.5 %	-2.7 dBi	3.3 dBi	3.9 dBi
1,995,000,000 Hz	44.5 %	-2.6 dBi	3.2 dBi	3.9 dBi
2,110,000,000 Hz	37.8 %	-1.1 dBi	3.6 dBi	4.6 dBi
2,132,000,000 Hz	38.3 %	-1.6 dBi	3.0 dBi	4.1 dBi
2,140,000,000 Hz	39.8 %	-1.6 dBi	2.9 dBi	4.0 dBi
2,155,000,000 Hz	38.1 %	-1.9 dBi	2.4 dBi	3.5 dBi
2,170,000,000 Hz	39.3 %	-1.8 dBi	2.2 dBi	3.5 dBi
2,200,000,000 Hz	35.7 %	-2.5 dBi	1.6 dBi	2.8 dBi
2,300,000,000 Hz	28.9 %	-4.0 dBi	-0.4 dBi	1.0 dBi
2,350,000,000 Hz	26.9 %	-4.5 dBi	-1.2 dBi	0.3 dBi
2,400,000,000 Hz	29.8 %	-2.7 dBi	-1.0 dBi	-0.2 dBi
2,496,000,000 Hz	29.1 %	-4.8 dBi	0.3 dBi	1.1 dBi
2,570,000,000 Hz	31.1 %	-4.5 dBi	1.4 dBi	2.4 dBi
2,593,000,000 Hz	33.7 %	-3.5 dBi	2.1 dBi	3.2 dBi
2,595,000,000 Hz	33.7 %	-3.4 dBi	2.2 dBi	3.3 dBi
2,620,000,000 Hz	30.6 %	-3.4 dBi	2.0 dBi	3.1 dBi
2,655,000,000 Hz	29.3 %	-3.5 dBi	1.6 dBi	2.8 dBi
2,690,000,000 Hz	28.2 %	-3.7 dBi	1.2 dBi	2.4 dBi

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2.6. SM-T638U Tablet Sub 2 ANTENNA

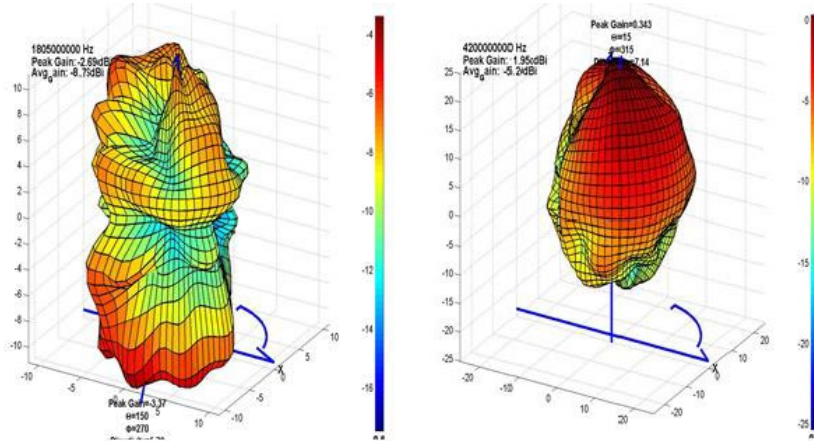


<Tablet mounted typical measurements>

Frequency	Efficiency	Max Gain		
		Ver	Hor	Total
3,300,000,000 Hz	44.7 %	-1.1 dBi	1.2 dBi	2.4 dBi
3,400,000,000 Hz	55.1 %	0.4 dBi	2.1 dBi	3.3 dBi
3,500,000,000 Hz	50.2 %	-0.6 dBi	1.3 dBi	1.7 dBi
3,600,000,000 Hz	42.1 %	-2.9 dBi	1.1 dBi	1.6 dBi
3,700,000,000 Hz	45.3 %	-2.8 dBi	0.8 dBi	1.3 dBi
3,800,000,000 Hz	40.0 %	-2.8 dBi	0.6 dBi	0.8 dBi
3,900,000,000 Hz	38.7 %	-1.6 dBi	0.1 dBi	1.4 dBi
4,000,000,000 Hz	41.7 %	-0.9 dBi	-0.2 dBi	1.6 dBi
4,100,000,000 Hz	43.3 %	-0.2 dBi	0.2 dBi	1.0 dBi
4,200,000,000 Hz	46.5 %	0.7 dBi	-0.2 dBi	0.7 dBi

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2.7. SM-T638U Tablet Sub 4 ANTENNA



<Tablet mounted typical measurements>

Frequency	Efficiency	Max Gain		
		Ver	Hor	Total
1,805,000,000 Hz	13.5 %	-6.7 dBi	-3.7 dBi	-2.7 dBi
1,880,000,000 Hz	14.1 %	-6.7 dBi	-3.8 dBi	-2.8 dBi
1,930,000,000 Hz	14.3 %	-6.4 dBi	-4.5 dBi	-2.7 dBi
1,990,000,000 Hz	16.3 %	-5.8 dBi	-5.1 dBi	-3.2 dBi
2,110,000,000 Hz	16.9 %	-5.8 dBi	-5.4 dBi	-2.6 dBi
2,140,000,000 Hz	18.3 %	-5.5 dBi	-5.1 dBi	-2.3 dBi
2,155,000,000 Hz	17.9 %	-5.6 dBi	-5.3 dBi	-2.4 dBi
2,170,000,000 Hz	17.6 %	-5.7 dBi	-5.3 dBi	-2.5 dBi
2,200,000,000 Hz	18.5 %	-5.4 dBi	-5.2 dBi	-2.3 dBi
2,300,000,000 Hz	15.1 %	-4.3 dBi	-4.2 dBi	-1.2 dBi
2,400,000,000 Hz	22.3 %	-3.5 dBi	-2.3 dBi	-0.3 dBi
2,496,000,000 Hz	27.6 %	-3.5 dBi	-1.0 dBi	-0.2 dBi
2,570,000,000 Hz	27.2 %	-3.8 dBi	-0.5 dBi	0.4 dBi
2,620,000,000 Hz	25.6 %	-4.6 dBi	-1.0 dBi	-0.1 dBi
2,690,000,000 Hz	23.7 %	-4.5 dBi	-2.8 dBi	-1.7 dBi
3,300,000,000 Hz	14.8 %	-4.6 dBi	-4.1 dBi	-2.6 dBi
3,400,000,000 Hz	24.3 %	-3.7 dBi	-2.1 dBi	-0.2 dBi
3,500,000,000 Hz	24.9 %	-2.5 dBi	-1.8 dBi	0.1 dBi
3,600,000,000 Hz	27.5 %	-2.8 dBi	-1.6 dBi	0.7 dBi
3,700,000,000 Hz	32.2 %	-2.3 dBi	-0.3 dBi	1.3 dBi
3,800,000,000 Hz	32.4 %	-2.0 dBi	-0.4 dBi	1.4 dBi
3,900,000,000 Hz	39.5 %	-1.0 dBi	0.7 dBi	2.3 dBi
4,000,000,000 Hz	45.3 %	-0.6 dBi	1.0 dBi	2.8 dBi
4,100,000,000 Hz	34.7 %	-1.7 dBi	0.5 dBi	2.4 dBi
4,200,000,000 Hz	30.2 %	-1.5 dBi	-0.2 dBi	1.9 dBi

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3. TEST METHOD

3.1. Measurement information

Measurement: KYOCERA AVX Ant Lab
 Equipment: KSS Chamber, E5071B Network Analyzer

***KSS Chamber**

The Bluetest Reverberation Test Systems is the ideal choice for developers of wireless devices and components as well as operators wanting to verify their suppliers' wireless devices. Over-The-Air (OTA) measurements reflect the true performance of the device and ensure that the tested product performs as intended once released to the market. The patented design creates a rich and isotropic multipath environment inside the chamber allowing for fast, easy and realistic performance measurements on SISO as well as MIMO devices like LTE and WLAN. The RTS is capable of performing passive measurements like antenna efficiency, diversity and MIMO gain as well as active measurements like TRP, TIS and Throughput (TPUT).

*** Test Equipment list**

Description	Manufacturer	Model	S/N	Cal Due
Network Analyzer	Agilent	E5071B	MY42403245	2021-05-03

3.2. Return Loss & VSWR Test

The VSWR measurement of antennas assembled into a fully operating SM-T638U Tablet is measured on the Network Analyzer. The Tablet is set up with a 50 Ohm coaxial cable connected to the 50 Ohm point. Calibration is done at the end of the 50 Ohm coaxial cable connection. The other end of the 50 Ohm coaxial cable is connected to a network analyzer. The Tablet is positioned on a non-conductive table for free space measurements.



Figure 1: Testing with network analyzer

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3.3. Return Loss & VSWR Test

Samsung Antenna Lab has a system that can measure VSWR using KSS chamber and E5071B network analyzer. In order to measure the VSWR of each antenna, the lab connects the coaxial cable to the point in contact with the antenna on the Sub board. The VSWR is measured through the coaxial cable connected in the set. At this time, SM-T638U is assembled in the same state as the user environment.

3.4. Radiation Pattern Test

Antennas tested for Gain and Efficiency must be assembled into the enclosure and tested in the fully assembled and operating SM-T638U Tablet. The antenna is tested in free space in the anechoic chamber in the H, E1 and, E2 planes. The radiation patterns are measured at the center of transmit and receive bands.

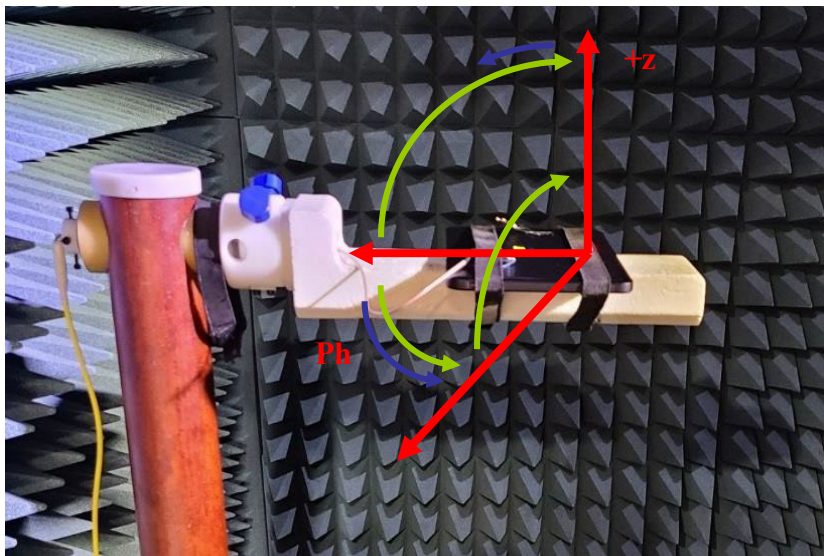


Figure 4: Geometry for SM-T638U for Radiation patterns.

3.5. Test Method (Manufacturing)

All measurements are done with SM-T638U fully assembled. Measure in consideration of the customer's usage environment. Use a fully shielded chamber environment to prevent any noise-induced errors. Typically, the electrical properties of the antenna are measured using a jig that can hold the set.