DESIGN SPECIFICATION

DESIGN	**INTERNAL ANTENNA**
MODEL / TYPE	**SM-L305U / LDS Antenna**
KYOCERA AVX P/N	**LT31485**
SEC CODE	**GH42-07062A**
CUSTOMER	**SAMSUNG ELECTRONICS CO., LTD.**
SUPPLIER	**KYOCERA AVX INC.**
TEST DATE	**2024.04.23**

ENGINEERING MANAGER CHECKED	MECHANICAL MANAGER CHECKED	DESIGN MANAGER CHECKED
DY Lee	JC Kim	KJ Chun

LEAD-FREE

MSL 1

DESIGN SPECIFICATION
Part Number: LT31485 (SM-L305U)
Rev. A

CONTENTS

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-L305U wireless Smart Watch. 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.

2. ELECTRICAL SPECIFICATION FOR SM-L305U

2.1. Frequency Band

Mode	Frequency Band (MHz)
BT/WIFI	2,400~2,500 MHz, 5,150~5,850 MHz

2.2. Electrical Characteristics

2.2.1. VSWR

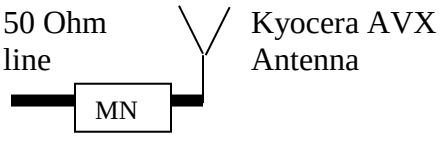
< Smart Watch mounted typical measurements >

Frequency Range	2,400 MHz	2,500 MHz	5,150 MHz	5,850 MHz
V.S.W.R	1.6 ± 0.5:1	1.6 ± 0.5:1	1.6 ± 0.5:1	4.2 ± 0.5:1

<BT/WiFi Antenna>

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 Smart Watch containing the PCB. The Smart Watch 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 Smart Watch 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.



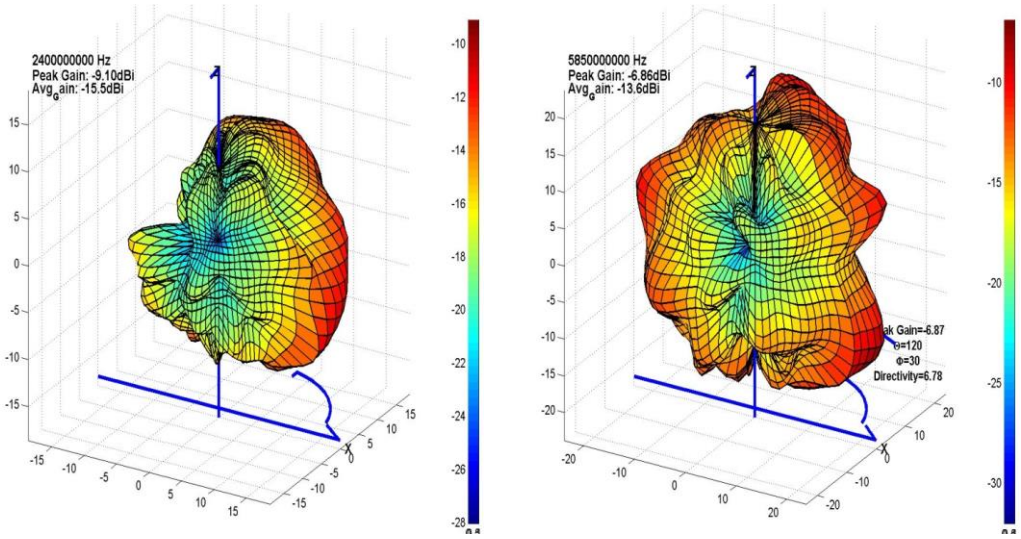
Optional matching network to be
determined by SAMSUNG RF team if needed.

2.3. Passive Measurement

2.3.1. Input Return Loss and VSWR

BT/WiFi Antenna

2.4. SM-L305U Smart Watch BT/WIFI INTENNA



<Smart Watch mounted typical measurements>

Frequency	Efficiency	Average Gain			Max Gain		
		Ver	Hor	Total	Ver	Hor	Total
2,400,000,000 Hz	2.8 %	-17.8 dBi	-19.5 dBi	-15.5 dBi	-10.0 dBi	-10.9 dBi	-9.1 dBi
2,420,000,000 Hz	3.5 %	-18.4 dBi	-16.8 dBi	-14.5 dBi	-13.0 dBi	-11.3 dBi	-9.8 dBi
2,440,000,000 Hz	3.7 %	-17.8 dBi	-16.9 dBi	-14.3 dBi	-12.7 dBi	-11.1 dBi	-9.6 dBi
2,460,000,000 Hz	3.5 %	-17.9 dBi	-17.4 dBi	-14.6 dBi	-13.0 dBi	-11.6 dBi	-9.9 dBi
2,480,000,000 Hz	3.0 %	-18.2 dBi	-18.1 dBi	-15.2 dBi	-13.6 dBi	-12.5 dBi	-10.6 dBi
2,500,000,000 Hz	3.2 %	-17.9 dBi	-18.0 dBi	-14.9 dBi	-13.3 dBi	-12.5 dBi	-10.6 dBi
5,150,000,000 Hz	6.3 %	-14.7 dBi	-15.4 dBi	-12.0 dBi	-8.5 dBi	-6.4 dBi	-6.1 dBi
5,290,000,000 Hz	6.8 %	-14.0 dBi	-15.6 dBi	-11.7 dBi	-5.9 dBi	-5.7 dBi	-5.6 dBi
5,430,000,000 Hz	7.0 %	-13.9 dBi	-15.5 dBi	-11.6 dBi	-5.7 dBi	-6.4 dBi	-5.4 dBi
5,570,000,000 Hz	6.0 %	-14.5 dBi	-16.2 dBi	-12.2 dBi	-7.9 dBi	-7.9 dBi	-7.4 dBi
5,710,000,000 Hz	4.1 %	-16.0 dBi	-17.9 dBi	-13.8 dBi	-9.2 dBi	-9.4 dBi	-8.8 dBi
5,850,000,000 Hz	4.3 %	-16.5 dBi	-16.9 dBi	-13.6 dBi	-9.5 dBi	-7.8 dBi	-6.9 dBi

3. TEST METHOD

3.1. Measurement information

-. Measurement: KYOCERA AVX Ant Lab.
-. Equipment: KSS Chamber, ZNB 8 Network Analyzer

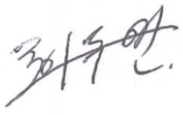
* KSS Chamber
The Bluetest Reverberation Test Systems is the ideal choice for developers of wireless devices and components as well as operators wanting to verify their suppliers' wireless devices. Over-The-Air (OTA) measurements reflect the true performance of the device and ensure that the tested product 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).

- Chamber Information
- Location : Kyocera-Avx
- Size : 3 x 2.5 x 2.5m
- Frequency : 600MHz to 6000MHz
- Tx Antenna : KSS-HA600 (Double Rigid Horn Antenna)
- KSS 3D Motion Controller

* Test Equipment list

Part	Model Name	Specification	
Tx Antenna	KSS-HA600	600MHz to 6000MHz	
Reference Antenna	KSS-HA600	600MHz to 6000MHz	
Network Analyzer	Agilent E5071B	300kHz to 8.5GHz	Cal. Due : 2024.06.04
Measurement Software	KSS-ANT		

* **Test Date : 2024-03-26**
* **Test Person : DYLee / Senior Antenna Engineer / Kyocera AVX Components.**

Signature : 

3.2. Return Loss & VSWR Test

The VSWR measurement of antennas assembled into a fully operating SM-L305U Smart Watch is measured on the Network Analyzer. The Smart Watch 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 Smart Watch is positioned on a non-conductive table for free space measurements.

Figure 1: Testing with network analyzer

3.3. Return Loss & VSWR Test

Samsung Antenna Lab has a system that can measure VSWR using KSS chamber and ZNB8 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 main board. The VSWR is measured through the coaxial cable connected in the set. At this time, SM-L305U 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-L305U Smart Watch. 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.

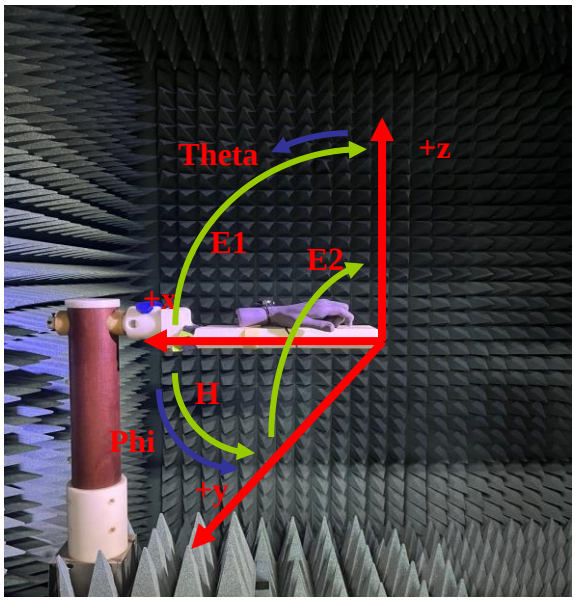


Figure 4: Geometry for SM-L305U for Radiation patterns.

Test Method (Manufacturing)

All measurements are done with SM-L305U 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.