DESIGN SPECIFICATION
Part Number: MF20164 (SM-A166U)
Rev. A

DESIGN SPECIFICATION

DESIGN	INTERNAL ANTENNA
MODEL / TYPE	SM-A166U / BT/WIFI INTENNA
KYOCERA AVX P/N	MF20164
SEC CODE	GH42-07124A
CUSTOMER	SAMSUNG ELECTRONICS CO., LTD.
SUPPLIER	KYOCERA AVX INC.
TEST DATE	2024.09.23

ENGINEERING MANAGER CHECKED	MECHANICAL MANAGER CHECKED	DESIGN MANAGER CHECKED
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LEAD-FREE

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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-A166U 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-A166U

2.1. Frequency Band

Mode	Frequency Band (MHz)
WIFI	2,400~2,485 MHz, 5,150~5,850 MHz

2.2. Electrical Characteristics

2.2.1. VSWR

< Handset mounted typical measurements >

Frequency Range	2,400 MHz	2,500 MHz	5,150 MHz	5,850 MHz
V.S.W.R	$1.2 \pm 0.5{:}1$	$2.3 \pm 0.5{:}1$	$2.4 \pm 0.5{:}1$	$1.6 \pm 0.5{:}1$

<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.
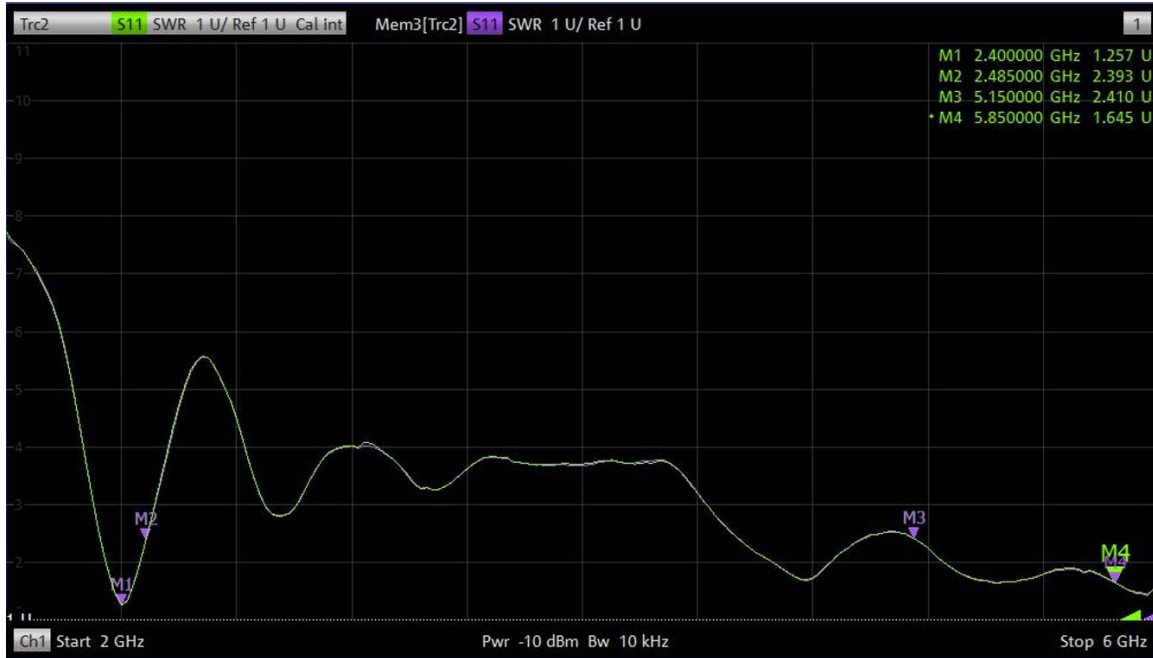
50 Ohm line   Kyocera AVX
                     Antenna

MN

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

2.3. Passive Measurement

2.3.1. Input Return Loss and VSWR

WiFi Antenna

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2.4. SM-A166U Handset WIFI INTENNA

Frequency	Efficiency	Average Gain			Max Gain		
		Ver	Hor	Total	Ver	Hor	Total
2,400,000,000 Hz	9.7 %	-14.1 dBi	-12.3 dBi	-10.1 dBi	-5.0 dBi	-8.1 dBi	-4.9 dBi
2,412,000,000 Hz	8.7 %	-13.3 dBi	-14.0 dBi	-10.6 dBi	-6.2 dBi	-6.8 dBi	-5.3 dBi
2,437,000,000 Hz	10.3 %	-12.5 dBi	-13.3 dBi	-9.9 dBi	-5.4 dBi	-7.3 dBi	-5.0 dBi
2,451,000,000 Hz	11.8 %	-13.3 dBi	-11.5 dBi	-9.3 dBi	-5.8 dBi	-5.9 dBi	-5.1 dBi
2,472,000,000 Hz	8.8 %	-13.3 dBi	-13.9 dBi	-10.6 dBi	-5.9 dBi	-7.6 dBi	-5.4 dBi
2,485,000,000 Hz	8.2 %	-13.7 dBi	-14.1 dBi	-10.9 dBi	-6.4 dBi	-7.8 dBi	-5.8 dBi
5,150,000,000 Hz	9.2 %	-12.9 dBi	-13.9 dBi	-10.4 dBi	-6.1 dBi	-6.6 dBi	-5.4 dBi
5,290,000,000 Hz	9.6 %	-14.4 dBi	-12.3 dBi	-10.2 dBi	-6.4 dBi	-6.6 dBi	-5.6 dBi
5,430,000,000 Hz	8.6 %	-12.9 dBi	-14.5 dBi	-10.7 dBi	-6.1 dBi	-8.1 dBi	-6.0 dBi
5,570,000,000 Hz	7.5 %	-13.4 dBi	-15.3 dBi	-11.2 dBi	-6.9 dBi	-8.6 dBi	-5.8 dBi
5,710,000,000 Hz	8.2 %	-14.2 dBi	-13.5 dBi	-10.9 dBi	-7.0 dBi	-5.8 dBi	-5.3 dBi
5,850,000,000 Hz	7.3 %	-13.0 dBi	-16.3 dBi	-11.4 dBi	-5.7 dBi	-6.8 dBi	-5.6 dBi

<Handset mounted typical measurements>

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3.2. Return Loss & VSWR Test

The VSWR measurement of antennas assembled into a fully operating SM-A166U 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.

Photo
(Please refer to the appendix document)

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-A166U 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-A166U Handset. 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.

Photo
(Please refer to the appendix document)

Test Method (Manufacturing)

All measurements are done with SM-A166U 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.