



EMC TEST REPORT

Applicant Espressif Systems (Shanghai) Co.,Ltd.
FCC ID 2AC7Z-ESP868504
Product Wi-Fi & Bluetooth Internet of Things
 Module
Brand ESPRESSIF
Model ESP8685-WROOM-04
Report No. R2105A0444-E1V2
Issue Date August 22, 2022

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC Code CFR47 Part15B (2021)/ ANSI C63.4-2014**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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Version	Revision description	Issue Date
Rev.0	Initial issue of report.	July 20, 2022
Rev.1	Update FCC ID.	August 12, 2022
Rev.2	Update description.	August 22, 2022

Note: This revised report (Report No. R2105A0444-E1V2) supersedes and replaces the previously issued report (Report No. R2105A0444-E1V1). Please discard or destroy the previously issued report and dispose of it accordingly.



Summary of measurement results

Number	Test Case	Clause in FCC Rules	Conclusion
1	Radiated Emission	FCC Part15.109, ANSI C63.4-2014	PASS
2	Conducted Emission	FCC Part15.107, ANSI C63.4-2014	PASS
Date of Testing: May 25, 2021 ~ November 30, 2021 and July 11, 2022 ~ July 19, 2022 Date of Sample Received: May 25, 2021			
Note: All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

1 Test Laboratory

1.1 Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2 Test facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform measurement.

1.3 Testing Location

Company: TA Technology (Shanghai) Co., Ltd.
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E-mail: fanguangchang@ta-shanghai.com

2 General Description of Equipment under Test

2.1 Applicant and Manufacturer Information

Applicant	Espressif Systems (Shanghai) Co.,Ltd.
Applicant address	Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China
Manufacturer	Espressif Systems (Shanghai) Co.,Ltd.
Manufacturer address	Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

2.2 General information

EUT Description			
Device Type	Module Device		
Model	ESP8685-WROOM-04		
Lab internal SN	R2105A0444/S01		
HW Version	V1.2		
SW Version	V1.1.3.0		
Power Rating	3.3V		
Connecting I/O Port(s)	Please refer to the User's Manual.		
Antenna Type	PCB Antenna		
Frequency	Band	Tx (MHz)	Rx (MHz)
	Bluetooth LE	2400 ~ 2483.5	2400 ~ 2483.5
	Wi-Fi 2.4G	2400 ~ 2483.5	2400 ~ 2483.5
Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.			



2.3 Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards

FCC Code CFR47 Part15B (2021)

ANSI C63.4-2014



2.4 Test Mode

Test Mode	
Mode 1	External Power Supply + PCB Layout + EUT + Bluetooth/ WLAN Receiver
Mode 2	External Power Supply + PCB Layout + EUT + Bluetooth/ WLAN Traffic

During the test, the preliminary test was performed in all modes , mode 1 is selected as the worst condition. The test data of the worst-case condition was recorded in this report.

3 Test Case Results

3.1 Radiated Emission

Ambient condition

Temperature	Relative humidity	Pressure
15°C~35°C	30%~60%	101.5kPa

Methods of Measurement

The EUT is placed on a non-metallic table 0.8m above the horizontal metal reference ground plane. The distance between EUT and receive antenna should be 3 meters. During the test, the EUT was operating in its typical mode. The test method is according to ANSI C63.4-2014. Sweep the whole frequency band through the range from 30MHz to the 5th harmonic of the carrier. During the test, the height of receive antenna shall be moved from 1 to 4 meters, and the antenna shall be performed under horizontal and vertical polarization. The turn table shall be rotated from 0 to 360 degrees for detecting the maximum of radiated signal level.

The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing. During the test, the EUT is worked at maximum output power.

Set the spectrum analyzer in the following:

Below 1GHz:

RBW=100 kHz / VBW=300 kHz / Sweep=AUTO

Above 1GHz:

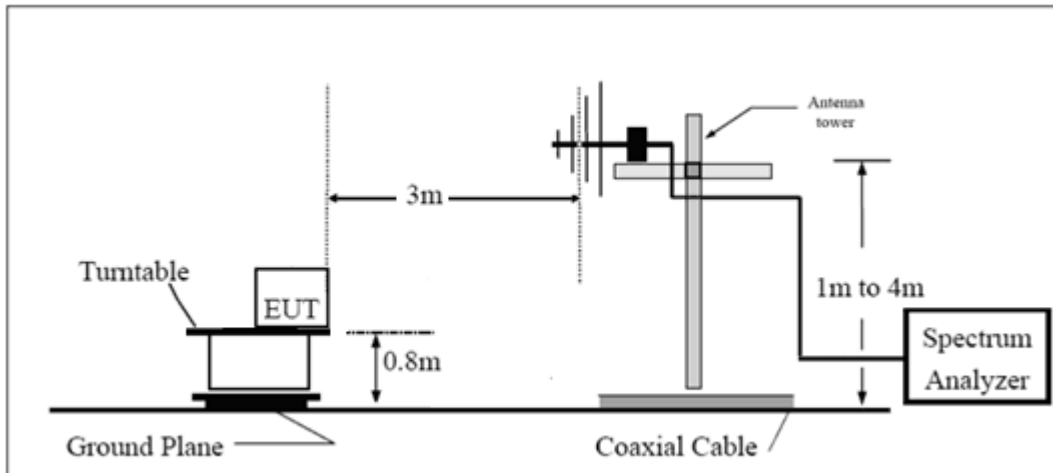
(a) PEAK Detector: RBW=1MHz / VBW=3MHz / Sweep=AUTO

(b) AVERAGE Detector: RBW=1MHz / VBW=3MHz / Sweep=AUTO

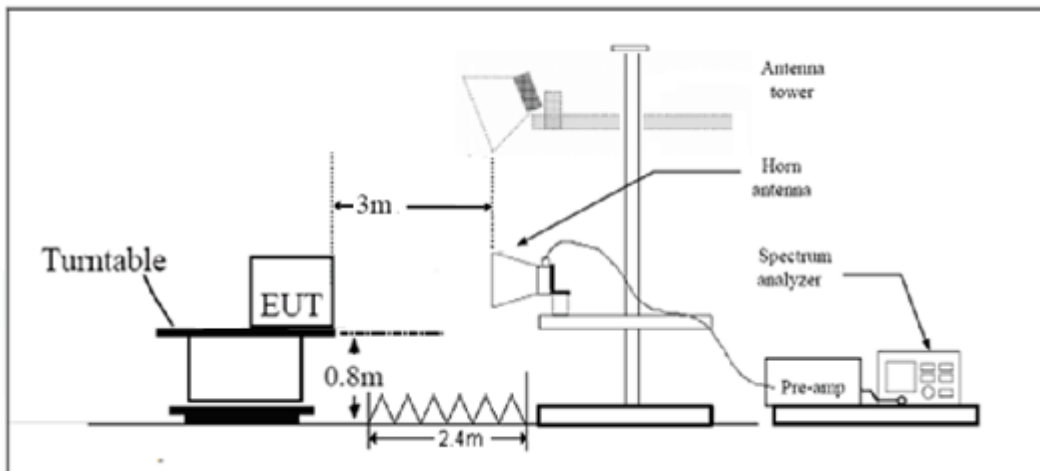
The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

Test Setup

Below 1GHz



Above 1GHz



Note: Area side: 2.4mX3.6m

Antenna Tower meets ANSI C63.4 requirements for measurements above 1 GHz by keeping the antenna aimed at the EUT during the antenna's ascent/ descent along the antenna mast.

**Limits****Class B**

Frequency (MHz)	Field Strength (dB μ V/m)	Detector
30 -88	40.0	Quasi-peak
88-216	43.5	Quasi-peak
216 – 960	46.0	Quasi-peak
960-1000	54.0	Quasi-peak
1000-5 th harmonic of the highest frequency or 40GHz, which is lower	54 74	Average Peak

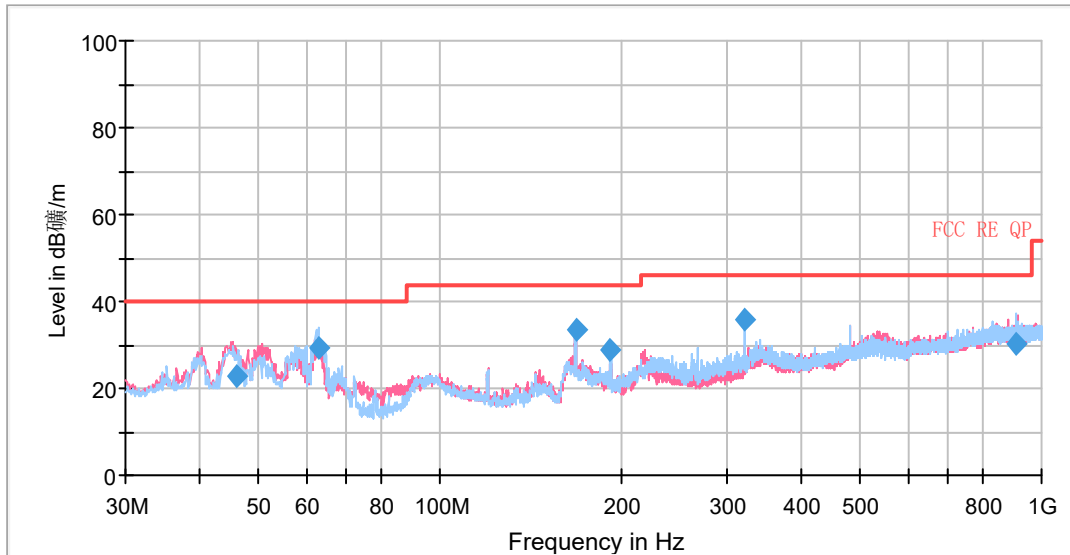
Test Results

Sweep the whole frequency band through the range from 30MHz to the 5th harmonic of the carrier. The Emissions in the frequency band 18GHz – 26.5GHz is more than 20dB below the limit are not reported.

The following graphs display the maximum values of horizontal and vertical by software.

For above 1GHz, Blue trace uses the peak detection, Green trace uses the average detection.

A font (Level in dB_{μV/m}) in the test plot =(level in dB μ V/m)

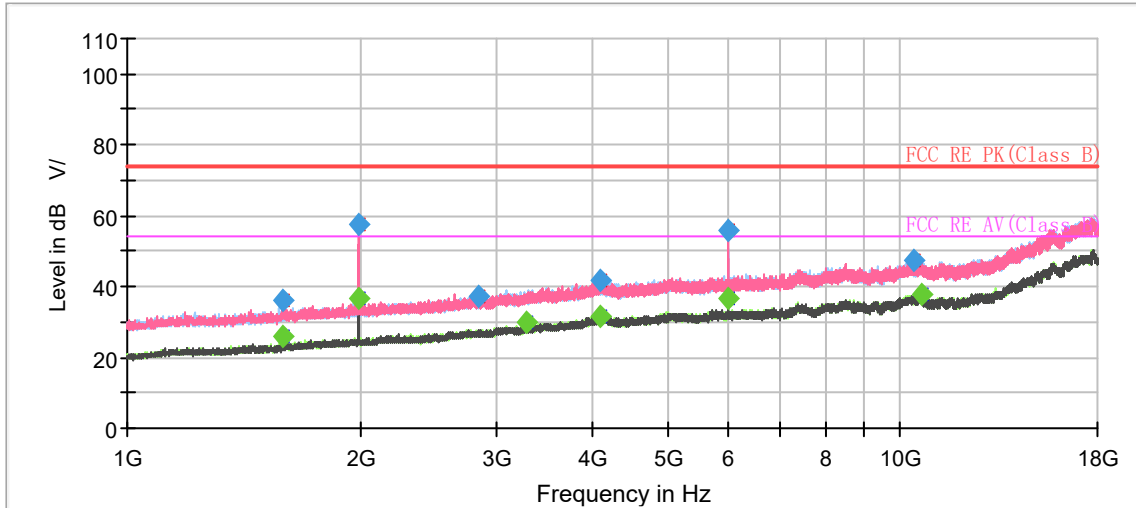


Radiated Emission from 30MHz to 1GHz

Frequency (MHz)	Quasi-Peak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Correct Factor (dB)
45.795000	22.58	40.00	17.42	120.000	100.0	V	296.0	14.1
62.700000	29.48	40.00	10.52	120.000	225.0	H	144.0	12.7
168.106250	33.35	43.50	10.15	120.000	175.0	H	37.0	10.0
192.270000	28.63	43.50	14.87	120.000	180.0	H	44.0	12.4
319.990000	35.68	46.00	10.32	120.000	100.0	H	252.0	15.3
906.463750	30.29	46.00	15.71	120.000	225.0	H	327.0	25.1

Remark: 1. Correction Factor = Antenna factor + Insertion loss(cable loss+amplifier gain)

2. Margin = Limit – Quasi-Peak



Radiated Emission from 1GHz to 18GHz

Frequency (MHz)	Peak (dBuV/m)	Average (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Polarization	Azimuth (deg)	Correct Factor (dB)
1593.866667	36.26	---	74.00	37.74	500.0	200.0	H	304.0	-15.1
1593.866667	---	25.95	54.00	28.05	500.0	200.0	H	304.0	-15.1
1991.666667	57.29	---	74.00	16.71	500.0	200.0	V	215.0	-12.7
1991.666667	---	36.42	54.00	17.58	500.0	200.0	V	215.0	-12.7
2854.700000	37.07	---	74.00	36.93	500.0	200.0	H	25.0	-8.9
3282.533333	---	29.89	54.00	24.11	500.0	200.0	V	0.0	-7.1
4089.466667	41.72	---	74.00	32.28	500.0	100.0	V	158.0	-3.3
4096.266667	---	31.83	54.00	22.17	500.0	100.0	V	201.0	-3.2
5978.733333	---	36.55	54.00	17.45	500.0	200.0	V	145.0	-0.3
5978.733333	56.07	---	74.00	17.93	500.0	200.0	V	145.0	-0.3
10401.000000	47.28	---	74.00	26.72	500.0	200.0	H	11.0	5.9
10662.233333	---	37.67	54.00	16.33	500.0	100.0	H	51.0	5.4

3.2 Conducted Emission

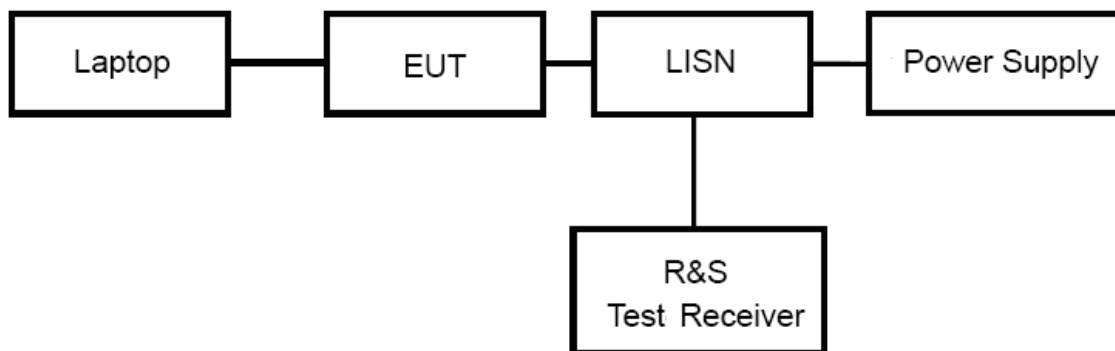
Ambient condition

Temperature	Relative humidity	Pressure
15°C~35°C	30%~60%	101.5kPa

Methods of Measurement

The EUT is placed on a non-metallic table of 80cm height above the horizontal metal reference ground plane. During the test, the EUT was operating in its typical mode. The test method is according to ANSI C63.4-2014. Connect the AC power line of the EUT to the L.I.S.N. Use EMI receiver to detect the average and Quasi-peak value. RBW is set to 9 kHz, VBW is set to 30kHz. The measurement result should include both L line and N line.

Test Setup



Note: Power Supply is AC Power source and it is used to change the voltage 120V/60Hz.

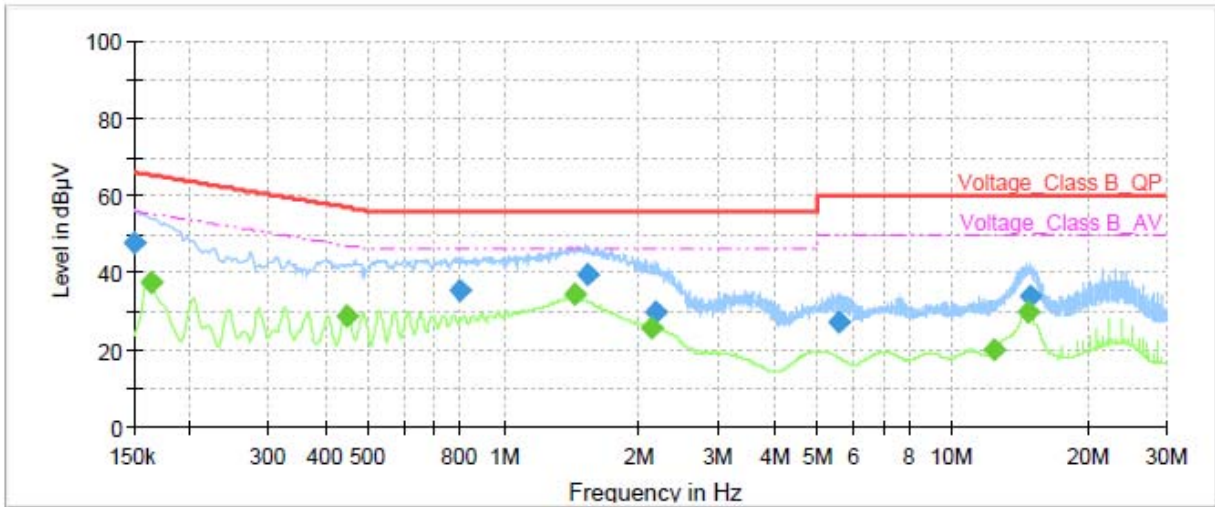
Limits

Frequency (MHz)	Conducted Limits(dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

*: Decreases with the logarithm of the frequency.

Test Results

Following plots, Blue trace uses the peak detection; Green trace uses the average detection.

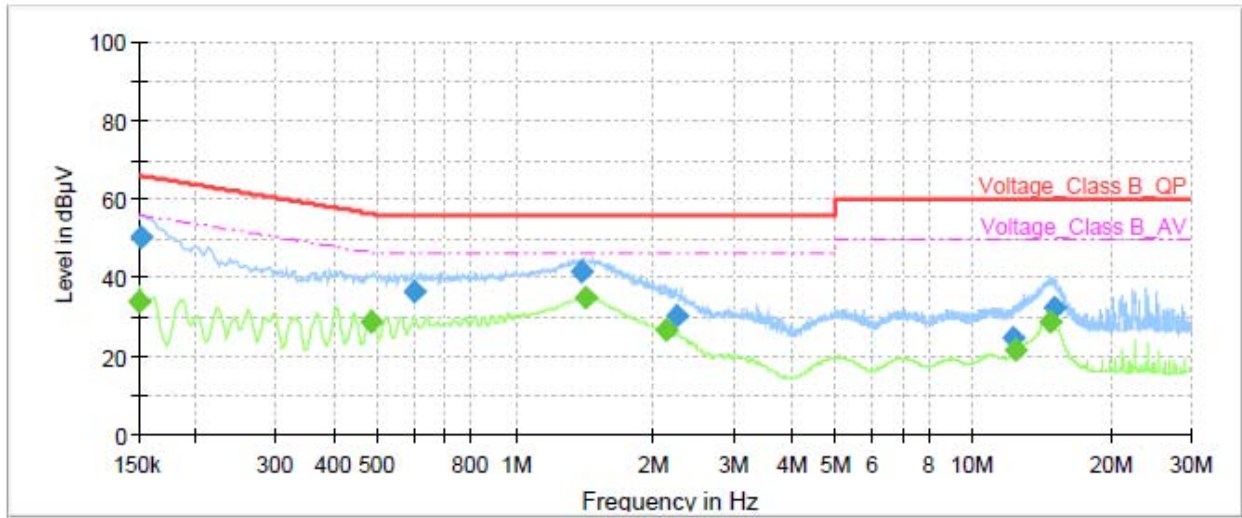


Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.15	47.74	---	66.00	18.26	70.0	9.000	L1	ON	21
0.16	---	37.36	55.28	17.92	70.0	9.000	L1	ON	21
0.45	---	28.84	46.93	18.09	70.0	9.000	L1	ON	20
0.80	35.30	---	56.00	20.70	70.0	9.000	L1	ON	20
1.44	---	34.20	46.00	11.80	70.0	9.000	L1	ON	20
1.54	39.37	---	56.00	16.63	70.0	9.000	L1	ON	20
2.12	---	25.59	46.00	20.41	70.0	9.000	L1	ON	20
2.19	29.94	---	56.00	26.06	70.0	9.000	L1	ON	20
5.56	27.04	---	60.00	32.96	70.0	9.000	L1	ON	19
12.40	---	20.07	50.00	29.93	70.0	9.000	L1	ON	20
14.71	---	29.50	50.00	20.50	70.0	9.000	L1	ON	20
14.84	33.99	---	60.00	26.01	70.0	9.000	L1	ON	20

Remark: Correct factor=cable loss + LISN factor

L line

Conducted Emission from 150 KHz to 30 MHz



Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.15	---	33.96	56.00	22.04	70.0	9.000	N	ON	21
0.15	50.41	---	65.88	15.47	70.0	9.000	N	ON	21
0.48	---	28.53	46.29	17.76	70.0	9.000	N	ON	20
0.60	36.39	---	56.00	19.61	70.0	9.000	N	ON	20
1.39	41.47	---	56.00	14.53	70.0	9.000	N	ON	20
1.43	---	35.08	46.00	10.92	70.0	9.000	N	ON	20
2.14	---	26.71	46.00	19.29	70.0	9.000	N	ON	20
2.25	30.23	---	56.00	25.77	70.0	9.000	N	ON	20
12.28	24.84	---	60.00	35.16	70.0	9.000	N	ON	20
12.40	---	21.29	50.00	28.71	70.0	9.000	N	ON	20
14.77	---	28.64	50.00	21.36	70.0	9.000	N	ON	20
15.09	32.39	---	60.00	27.61	70.0	9.000	N	ON	20

Remark: Correct factor=cable loss + LISN factor

N line

Conducted Emission from 150 KHz to 30 MHz

4 Uncertainty Measurement

Case	Uncertainty	Factor k
Radiated Emission 30MHz – 200MHz	4.17 dB	1.96
Radiated Emission 200MHz – 1GHz	4.84 dB	1.96
Radiated Emission 1GHz – 18GHz	4.35 dB	1.96
Radiated Emission 18GHz – 26.5GHz	5.90 dB	1.96
Conducted Emission	2.57 dB	2

5 Main Test Instruments

Date of Testing: May 25, 2021 ~ November 30, 2021

Name	Manufacturer	Type	Serial Number	Calibration Date	Expiration Date
EMI Test Receiver	R&S	ESCI	100948	2021-05-15	2022-05-14
Signal Analyzer	R&S	FSV40	100815	2021-05-15	2022-05-14
TRILOG Broadband Antenna	SCHWARZBECK	VULB 9163	391	2019-12-16	2022-12-15
Horn Antenna	R&S	HF907	102723	2018-08-11 2021-07-26	2021-08-10 2024-07-25
Horn Antenna	ETS-Lindgren	3160-09	00102643	2020-10-10	2023-10-09
Software	R&S	EMC32	9.26.01	/	/
Artificial main network	R&S	ENV216	101171	2020-12-13	2022-12-12
EMI Test Receiver	R&S	ESR	101667	2021-05-15	2022-05-14
Software	R&S	EMC32	10.35.10	/	/

Date of Testing: July 11, 2022 ~ July 19, 2022

Name of Equipment	Manufacturer	Type/Model	Serial Number	Calibration Date	Expiration Time
Radiated Emission					
EMI Test Receiver	R&S	ESCI7	100936	2021-12-12	2022-12-11
Signal Analyzer	R&S	FSV30	103591	2021-12-12	2022-12-11
TRILOG Broadband Antenna	SCHWARZBECK	9163	1023	2021-06-07	2024-06-06
Horn Antenna	Schwarzbeck	BBHA 9120D	430	2019-12-16	2022-12-15
Software	R&S	EMC32	9.26.01	/	/
Conducted Emission					
Artificial main network	R&S	ENV216	102191	2020-12-13	2022-12-12
EMI Test Receiver	R&S	ESR	101667	2022-05-25	2023-05-24
Software	R&S	EMC32	10.35.10	/	/

*****END OF REPORT *****



ANNEX A: The EUT Appearance

The EUT Appearance are submitted separately.



ANNEX B: Test Setup Photos

The Test Setup Photos are submitted separately.