

# TEST REPORT

Reference No..... : WTX21X12145301W  
FCC ID ..... : 2AKHW-SAMAV3663  
Applicant ..... : GMMC GmbH  
Address ..... : Kehlbergstrasse 109, 8054 Graz, Austria  
Product Name ..... : MIFARE SAM AV3 Evaluation Board  
Test Model ..... : SAMAV3-CLRC663  
Standards ..... : FCC Part 15.225  
Date of Receipt sample .... : Dec. 21, 2021  
Date of Test..... : Dec. 21, 2021 to Dec. 31, 2021  
Date of Issue ..... : Dec. 31, 2021  
Test Result..... : **Pass**

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

**Prepared By:**

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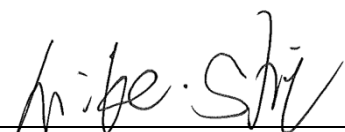
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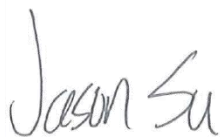
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**Report version**

Version No.	Date of issue	Description
Rev.00	Dec. 31, 2021	Original
/	/	/

## 1. GENERAL INFORMATION

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### 1.1 Product Description for Equipment Under Test (EUT)

#### Client Information

Applicant: GMMC GmbH  
Address of applicant: Kehlbergstrasse 109, 8054 Graz, Austria

Manufacturer: GMMC GmbH  
Address of manufacturer: Kehlbergstrasse 109, 8054 Graz, Austria

General Description of EUT	
Product Name:	MIFARE SAM AV3 Evaluation Board
Trade Name:	/
Model No.:	SAMAV3-CLRC663
Rated Voltage:	DC5V
Power Adapter Model:	/
<i>Note: The test data is gathered from a production sample, provided by the manufacturer.</i>	

Technical Characteristics of EUT	
Support Standards:	NFC
Frequency Range:	13.56MHz
Max. Field Strength:	67.86dBuV/m (at 3m)
Antenna Type:	PCB Antenna
Antenna Gain:	0dBi

## 1.2 Test Standards

The tests were performed according to following standards:

**FCC Rules Part 15.225**: Operation within the band 13.110-14.010MHz.

**ANSI C63.10-2013**: American National Standard for Testing Unlicensed Wireless Devices.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission/immunity, should be checked to ensure compliance has been maintained.

## 1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

## 1.4 Test Facility

### Address of the test laboratory

Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.

Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

### FCC – Registration No.: 125990

Waltek Testing Group (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

### Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

### 1.5 EUT Setup and Test Mode

The EUT was operated in the continuous transmitting mode that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

<b>Test Mode List</b>		
Test Mode	Description	Remark
TM1	Transmitting	13.56MHz

<b>Test Conditions</b>	
Temperature:	22~25 °C
Relative Humidity:	50~55 %.
ATM Pressure:	1019 mbar

<b>EUT Cable List and Details</b>			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

<b>Special Cable List and Details</b>			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
USB Cable	1.2	Unshielded	With Ferrite

<b>Auxiliary Equipment List and Details</b>			
Description	Manufacturer	Model	Serial Number
Adapter	/	EE5020-P17	/

## 1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
Frequency Deviation	2.3%	$\pm 5\%$
Conducted Emissions	Conducted	9-150kHz $\pm 3.74\text{dB}$
		0.15-30MHz $\pm 3.34\text{dB}$
Transmitter Spurious Emissions	Radiated	30-200MHz $\pm 4.52\text{dB}$
		0.2-1GHz $\pm 5.56\text{dB}$
		1-6GHz $\pm 3.84\text{dB}$
		6-18GHz $\pm 3.92\text{dB}$

**1.7 Test Equipment List and Details**

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due. Date
SEMT-1075	Communication Tester	Rohde & Schwarz	CMW500	148650	2021-03-27	2022-03-26
SEMT-1063	GSM Tester	Rohde & Schwarz	CMU200	114403	2021-03-27	2022-03-26
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2021-03-27	2022-03-26
SEMT-1079	Spectrum Analyzer	Agilent	N9020A	US47140102	2021-03-27	2022-03-26
SEMT-1080	Signal Generator	Agilent	83752A	3610A01453	2021-03-27	2022-03-26
SEMT-1081	Vector Signal Generator	Agilent	N5182A	MY47070202	2021-03-27	2022-03-26
SEMT-1028	Power Divider	Weinschel	1506A	PM204	2021-03-27	2022-03-26
SEMT-1082	Power Divider	RF-Lambda	RFLT4W5M18G	14110400027	2021-03-27	2022-03-26
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2021-03-27	2022-03-26
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2021-03-27	2022-03-26
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2021-04-12	2022-04-11
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2021-04-12	2022-04-11
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2021-03-19	2023-03-18
SEMT-1068	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2021-03-19	2023-03-18
SEMT-1042	Horn Antenna	ETS	3117	00086197	2021-03-19	2023-03-18
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2021-04-27	2023-04-26
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2021-04-27	2022-04-26
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2021-03-27	2022-03-26
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2021-03-27	2022-03-26
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2021-03-19	2023-03-18
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	/	/
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	/	/
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	/	/
SEMT-C004	Cable	Zheng DI	2M0RFC	/	/	/
SEMT-C005	Cable	Zheng DI	1M0RFC	/	/	/
SEMT-C006	Cable	Zheng DI	1M0RFC	/	/	/



<b>Software List</b>			
<b>Description</b>	<b>Manufacturer</b>	<b>Model</b>	<b>Version</b>
EMI Test Software (Radiated Emission)*	Farad	EZ-EMC	RA-03A1
EMI Test Software (Conducted Emission)*	Farad	EZ-EMC	RA-03A1

\*Remark: indicates software version used in the compliance certification testing.

## 2. SUMMARY OF TEST RESULTS

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<b>FCC Rules</b>	<b>Description of Test Item</b>	<b>Result</b>
§15.203	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§15.209	Radiated Emission	Compliant
§15.225(a)	Field Strength	Compliant
§15.225(b)(c)	Out of Band Emission	Compliant
§15.225(e)	Frequency Stability	Compliant
§15.207(a)	Conducted Emission	Compliant
§15.215(c)	Emission Bandwidth	Compliant

N/A: not applicable.

### **3. Antenna Requirement**

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#### **3.1 Standard Applicable**

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

#### **3.2 Test Result**

This product has a PCB antenna, fulfill the requirement of this section.

## 4. Radiated Emissions

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### 4.1 Standard Applicable

According to §15.225(a), the field strength of any emissions within the band 13.553–13.567MHz shall not exceed 15,848 microvolts/meter at 30 meters.

According to §15.225(d), the field strength of any emissions which appear outside of this band shall not exceed the general radiated emission limits in §15.209.

Note: Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

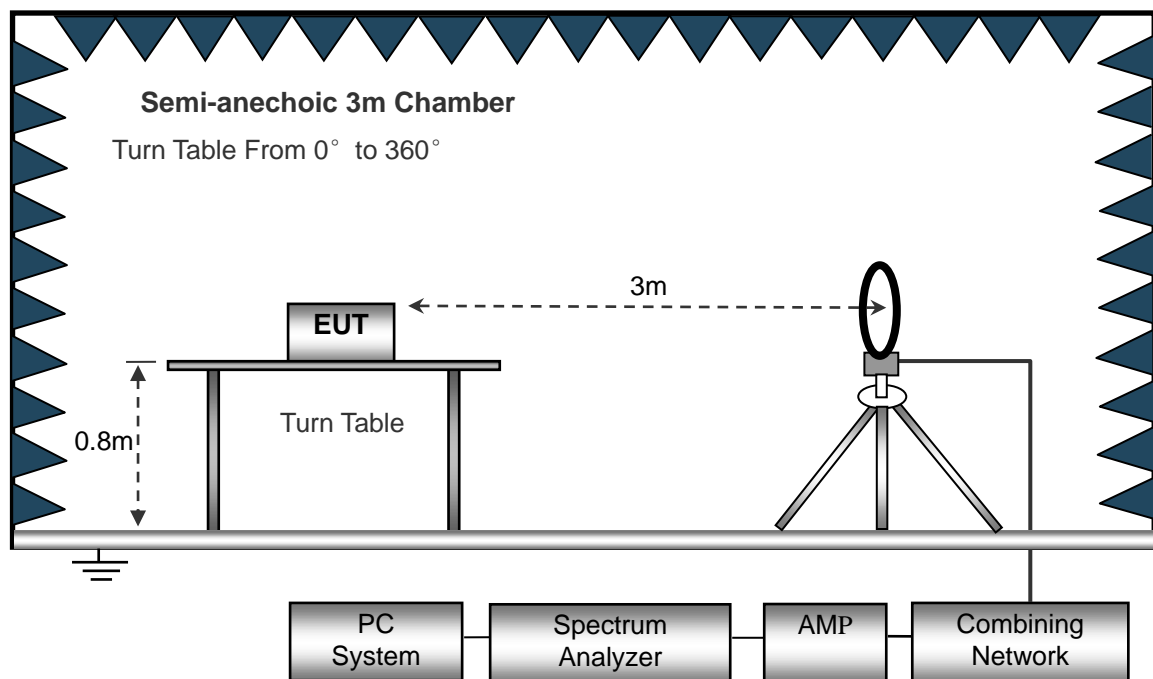
### 4.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.225(d) and FCC Part 15.209 Limit.

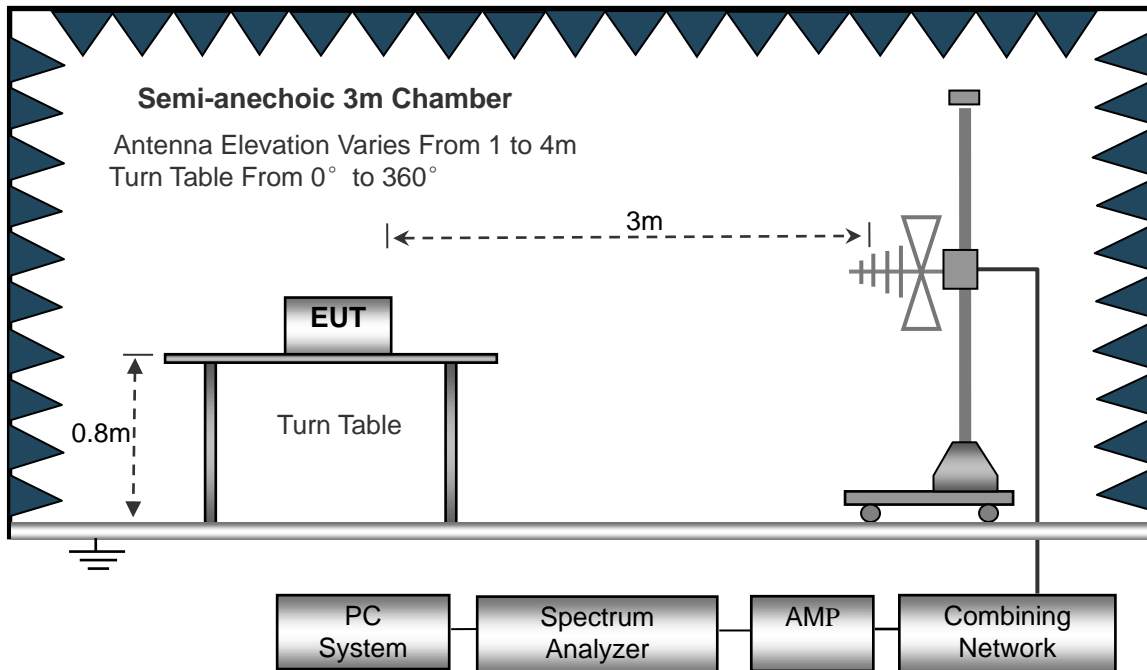
The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle.

The spacing between the peripherals was 10cm

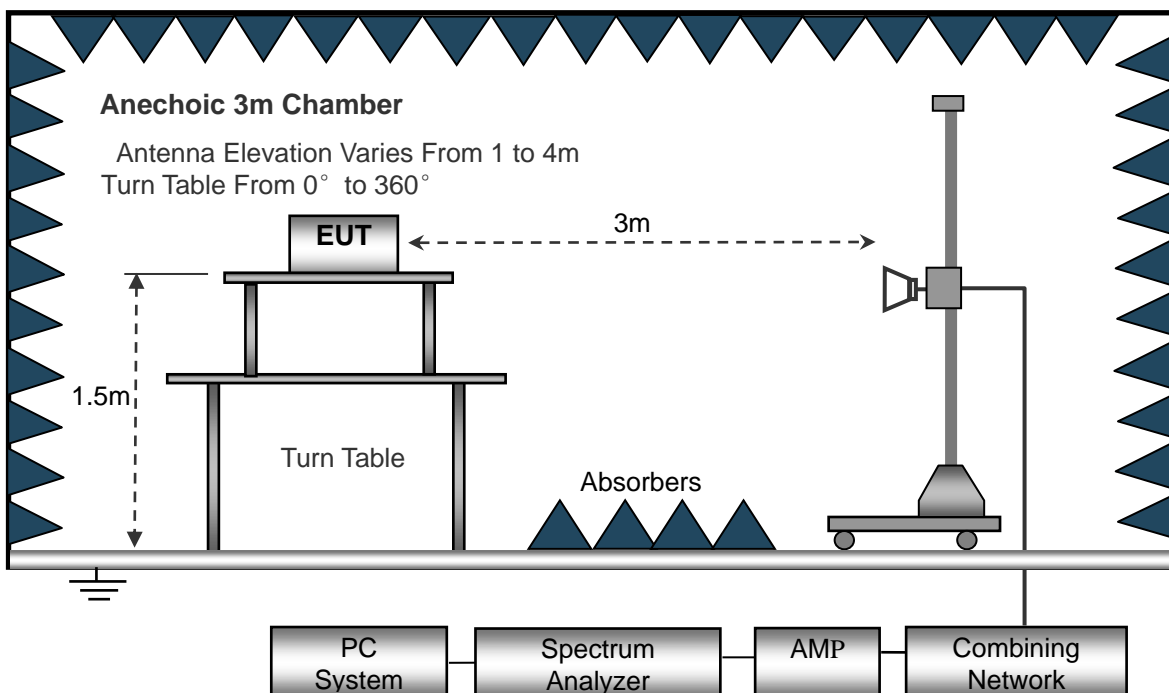
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30MHz to 1GHz.



The test setup for emission measurement above 1GHz.



Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold
Detector function = peak	Detector function = peak, QP	Detector function = peak, AV

### 4.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} - \text{Corr. Factor}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB $\mu$ V means the emission is 6dB $\mu$ V below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

#### 4.4 Summary of Test Results/Plots

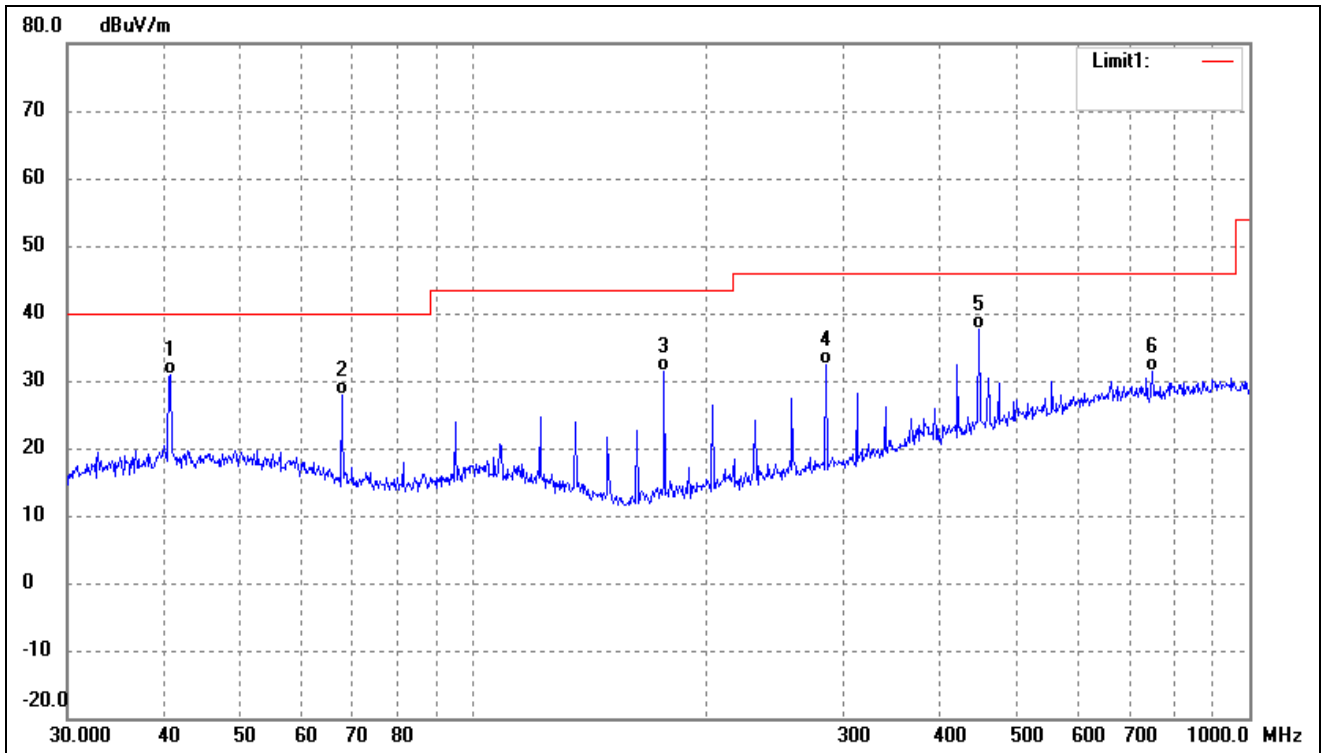
*Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

➤ Below 30MHz

Frequency	Reading	Correction Factor	Result	Limit	Margin	Polar	Detector
MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	X/Y/Z	
13.56	70.43	-2.62	67.81	124	-56.19	X	Peak
27.12	46.98	-2.27	44.71	69.5	-24.79	X	Peak
13.56	64.27	-2.62	61.65	124	-62.35	Y	Peak
27.12	43.15	-2.27	40.88	69.5	-28.62	Y	Peak
13.56	53.67	-2.62	51.05	124	-72.95	Z	Peak
27.12	41.96	-2.27	39.69	69.5	-29.81	Z	Peak

➤ Above 30MHz

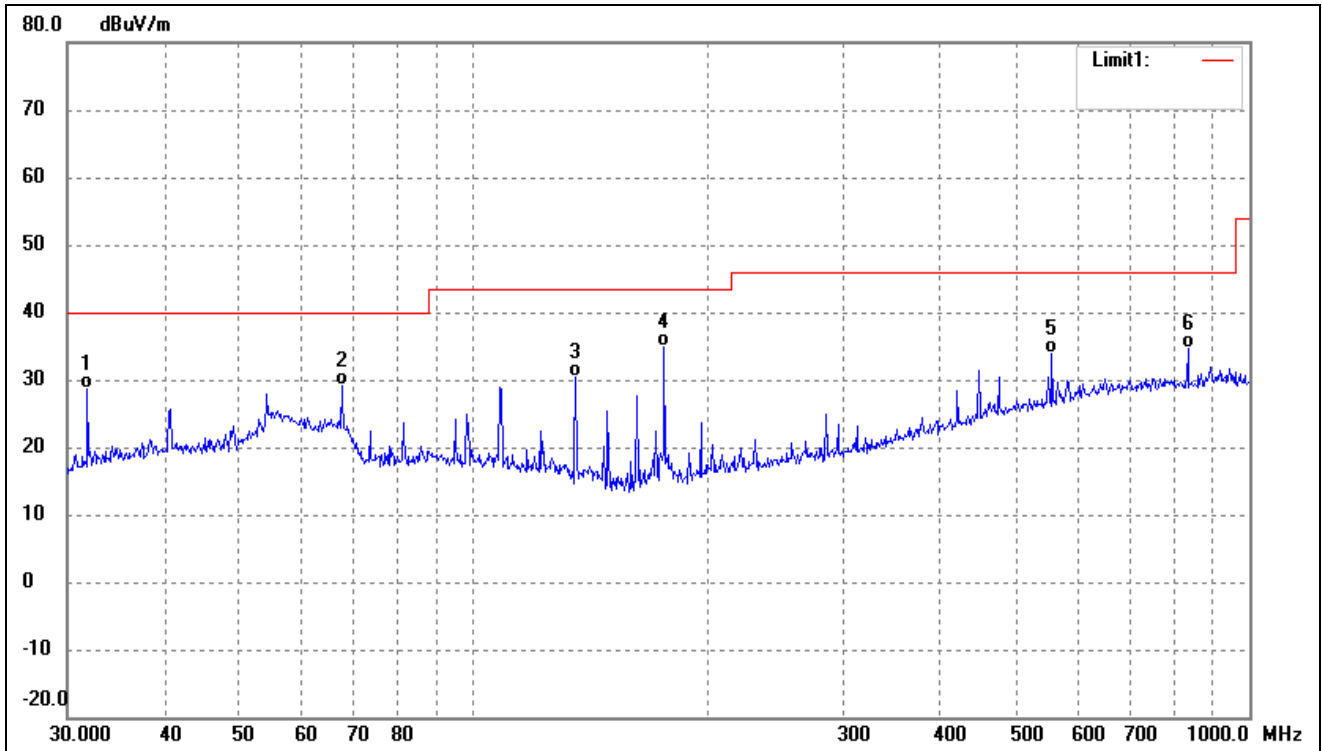
Test Mode	TM1	Polarity:	Horizontal
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	40.7016	37.79	-7.00	30.79	40.00	-9.21	-	-	QP
2	67.6751	37.70	-9.77	27.93	40.00	-12.07	-	-	QP
3	176.2686	42.80	-11.44	31.36	43.50	-12.14	-	-	QP
4	284.9767	39.64	-7.36	32.28	46.00	-13.72	-	-	QP
5	447.9822	40.28	-2.61	37.67	46.00	-8.33	-	-	QP
6	750.1083	29.56	1.76	31.32	46.00	-14.68	-	-	QP



Test Mode	TM1	Polarity:	Vertical
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	31.8427	37.51	-8.99	28.52	40.00	-11.48	-	-	QP
2	67.6751	38.84	-9.77	29.07	40.00	-10.93	-	-	QP
3	135.5062	42.20	-11.90	30.30	43.50	-13.20	-	-	QP
4	176.2686	46.26	-11.44	34.82	43.50	-8.68	-	-	QP
5	556.7744	34.18	-0.35	33.83	46.00	-12.17	-	-	QP
6	833.3171	32.39	2.29	34.68	46.00	-11.32	-	-	QP

Remark: '- Means' the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics.

## 5. OUT OF BAND EMISSIONS

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### 5.1 Standard Applicable

According to FCC 15.225 (b), within the bands 13.410–13.553MHz and 13.567–13.710MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters. (c) Within the bands 13.110–13.410MHz and 13.710–14.010MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

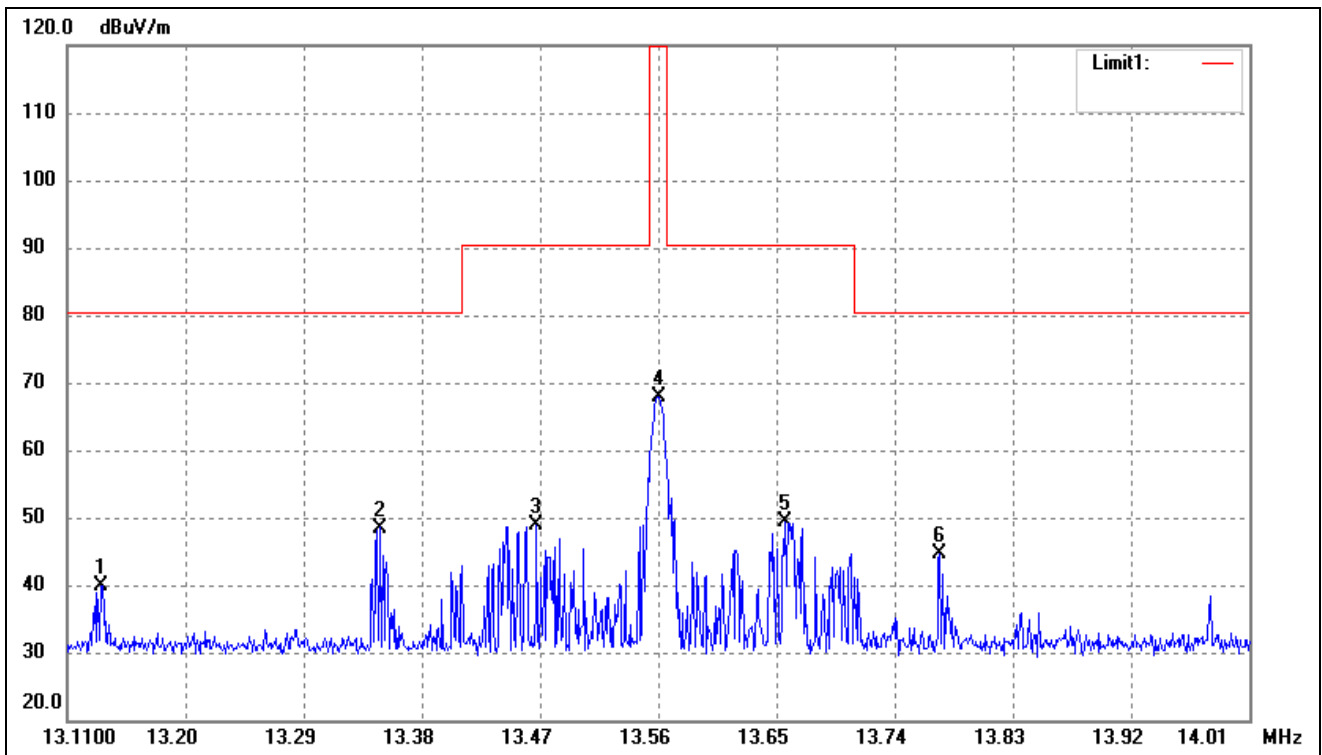
### 5.2 Test Procedure

As the radiation test, set the RBW=10kHz VBW=30kHz, observed the outside band of 13.11MHz to 14.01MHz, than mark the higher-level emission for comparing with the FCC rules.

### 5.3 Summary of Test Results/Plots

*Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

Test Mode	TM1	Polarity:	/
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ( )	Height (cm)	Remark
1	13.1361	42.60	-2.71	39.89	80.50	-40.61	-	-	peak
2	13.3485	51.16	-2.66	48.50	80.50	-32.00	-	-	peak
3	13.4673	51.49	-2.65	48.84	90.50	-41.66	-	-	peak
4	13.5600	70.48	-2.62	67.86	124.00	-56.14	-	-	peak
5	13.6563	52.02	-2.60	49.42	90.50	-41.08	-	-	peak
6	13.7742	47.17	-2.58	44.59	80.50	-35.91	-	-	peak

Remark: ‘-’Means’ the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

## 6. Frequency Stability

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### 6.1 Standard Applicable

According to 15.225(e), the frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

### 6.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure.

### 6.3 Summary of Test Results/Plots

Reference Frequency: 13.56MHz, Limit: 100ppm				
Voltage(%)	Power(VDC)	TEMP( °C)	Freq.Dev(Hz)	Deviation(ppm)
100%	5	-30	-188	-13.87
100%		-20	-186	-13.73
100%		-10	-181	-13.32
100%		0	-188	-13.83
100%		+10	-181	-13.34
100%		+20	-190	-13.99
100%		+30	-187	-13.81
100%		+40	-184	-13.57
100%		+50	-190	-14.00
Low		4.25	+20	-182
High	5.75	+20	-183	-13.52

## 7. EMISSION BANDWIDTH

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### 7.1 Applicable Standard

According to 15.215(c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

### 7.2 Test Procedure

According to the ANSI 63.10-2013, the emission bandwidth test method as follows.

Set span = 10kHz, centered on a transmitting channel

RBW  $\geq$ 1% 20dB Bandwidth, VBW  $\geq$ RBW

Sweep = auto

Detector function = peak

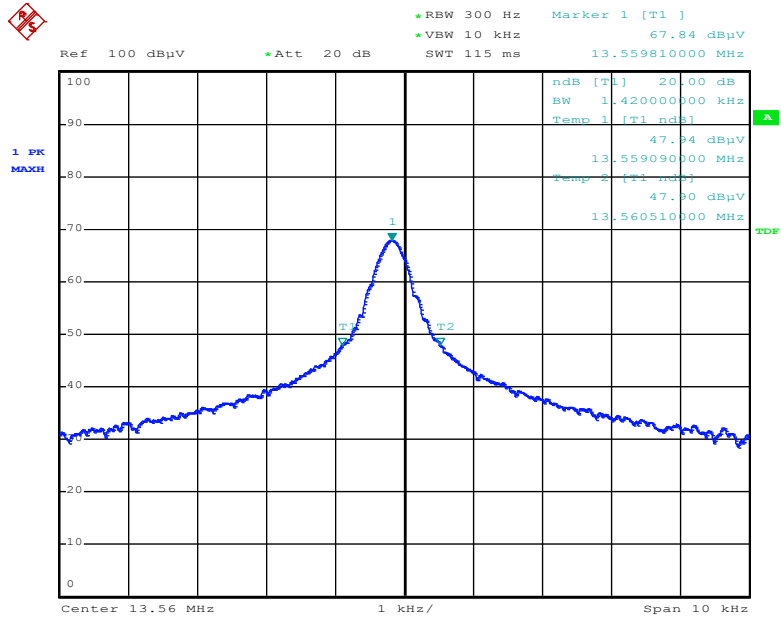
Trace = max hold

All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down of the emission.

### 7.3 Summary of Test Results/Plots

Tx Frequency	20dB Emission bandwidth(Hz)
13.56	1.42

Please refer to the test plots as below:



Date: 30.DEC.2021 09:54:11

## 8. Conducted Emissions

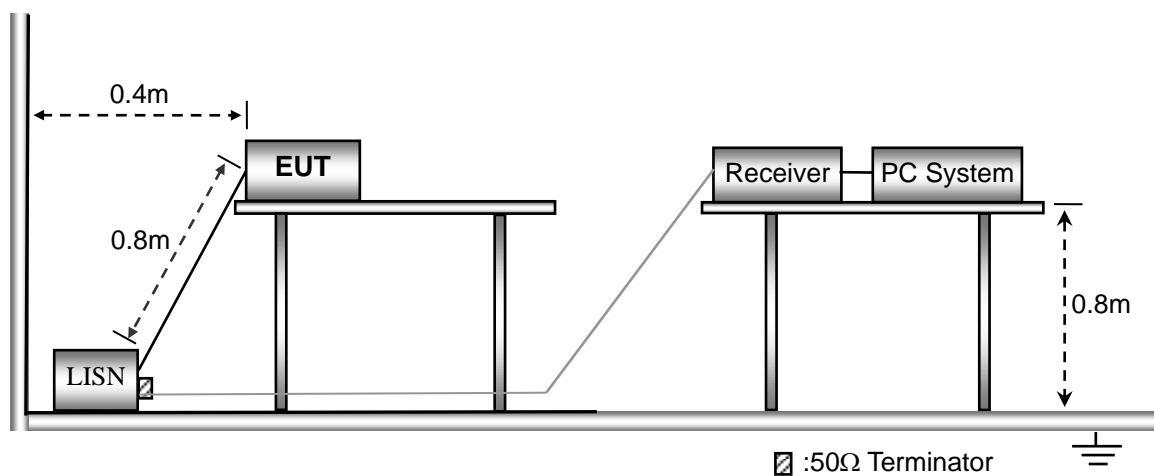
### 8.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle.

The spacing between the peripherals was 10cm.

### 8.2 Basic Test Setup Block Diagram



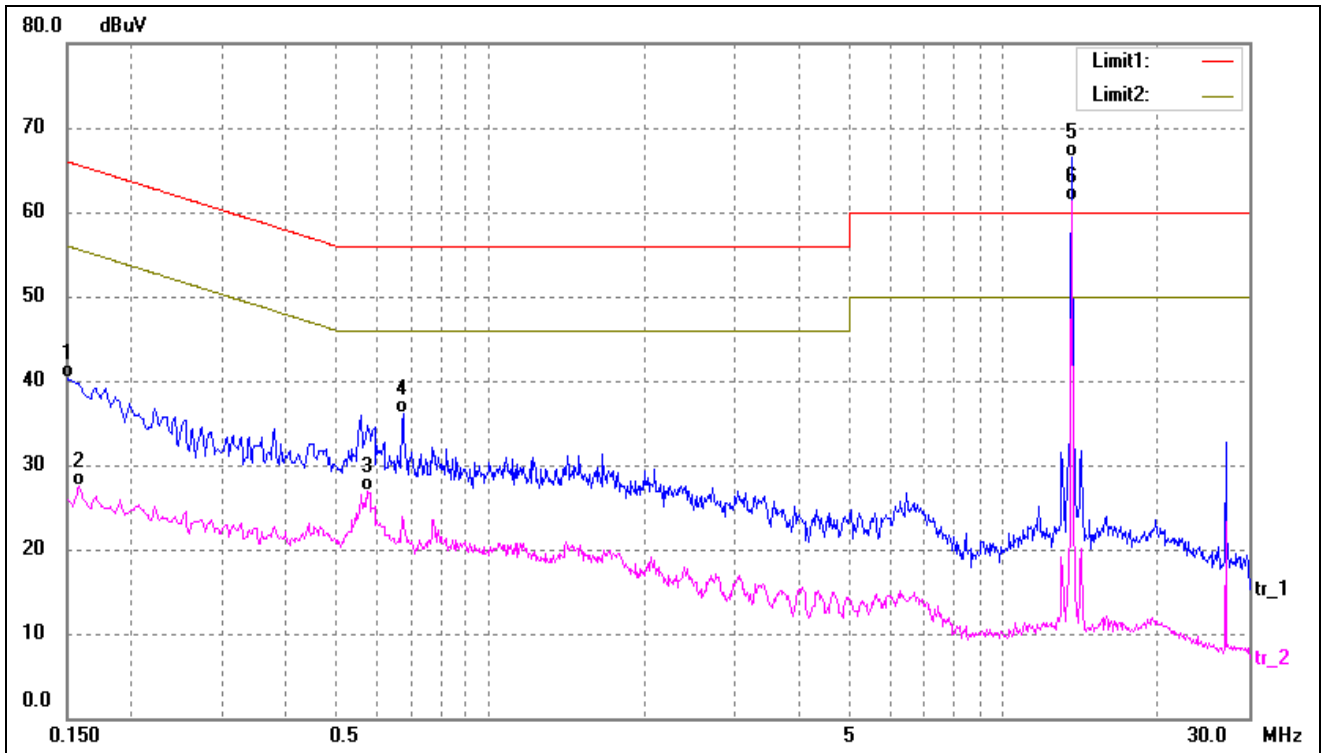
### 8.3 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

Start Frequency .....	150kHz
Stop Frequency .....	30MHz
Sweep Speed .....	Auto
IF Bandwidth.....	10kHz
Quasi-Peak Adapter Bandwidth .....	9kHz
Quasi-Peak Adapter Mode .....	Normal

### 8.4 Summary of Test Results/Plots

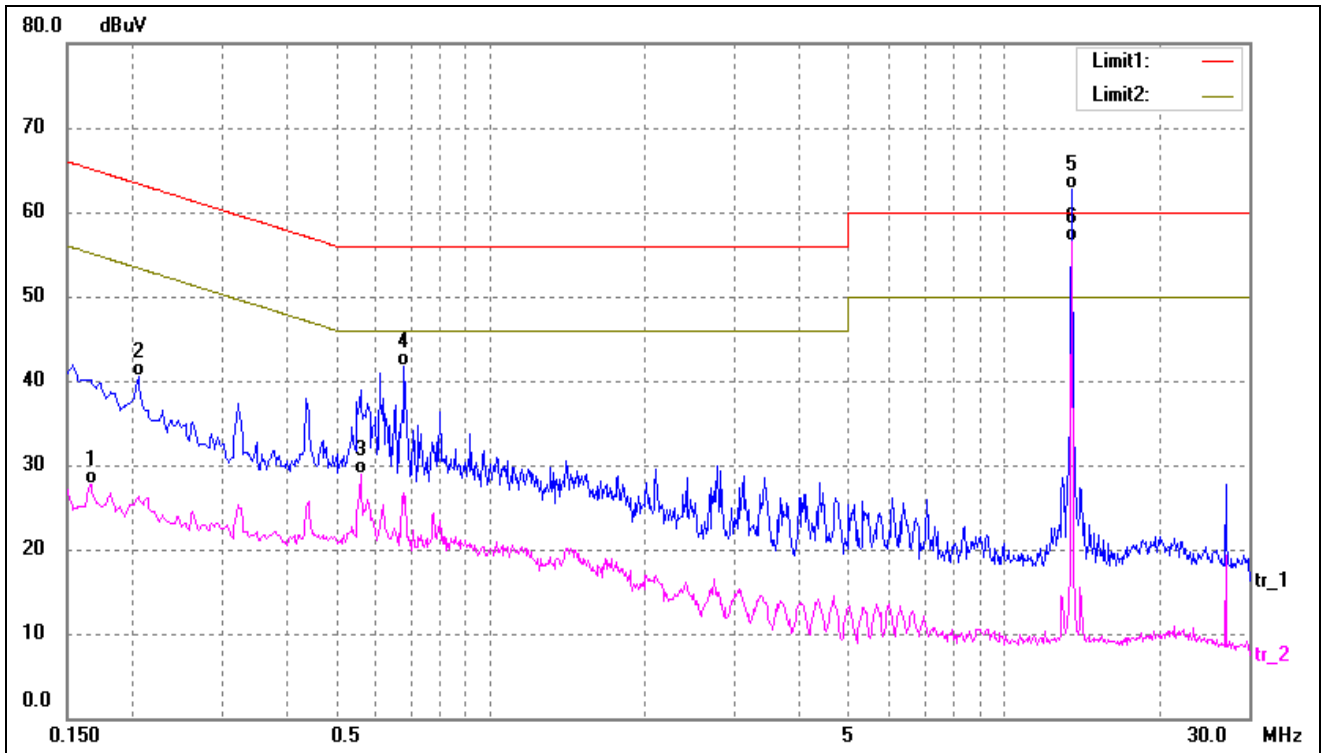
Test Mode	TM1(AC120V 60Hz)	Polarity:	Neutral
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1500	29.83	10.38	40.21	66.00	-25.79	QP
2	0.1580	17.05	10.37	27.42	55.57	-28.15	AVG
3	0.5780	16.52	10.31	26.83	46.00	-19.17	AVG
4	0.6780	25.72	10.37	36.09	56.00	-19.91	QP
5X	13.5620	56.36	10.07	66.43	Fundamental		QP
6*	13.5620	51.23	10.07	61.30			AVG



Test Mode	TM1(AC120V 60Hz)	Polarity:	Line
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1660	17.36	10.37	27.73	55.16	-27.43	AVG
2	0.2060	30.07	10.37	40.44	63.37	-22.93	QP
3	0.5580	18.71	10.29	29.00	46.00	-17.00	AVG
4	0.6820	31.40	10.37	41.77	56.00	-14.23	QP
5X	13.5580	52.55	10.07	62.62	Fundamental		QP
6*	13.5580	46.49	10.07	56.56			AVG

## **APPENDIX PHOTOGRAPHS**

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**Please refer to “ANNEX”**

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