

Prüfbericht-Nr.: <i>Test Report No.:</i>	10052437 003	Auftrags-Nr.: <i>Order No.:</i>	238511332 (P00190199)	Seite 1 von 28 <i>Page 1 of 28</i>			
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	238046473	Auftragsdatum: <i>Order date.:</i>	18 Feb. 2021				
Auftraggeber: <i>Client:</i>	Microchip Technology Inc. 6F., No. 24-2, Gongye E. 4th Rd., EAST DIST., HSINCHU CITY 300, TAIWAN, R.O.C.						
Prüfgegenstand: <i>Test item:</i>	Bluetooth Module						
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	BM78abcdefg, RN4678, BM78SPPS5MC2, BM78SPPS5NC2 (a, b, c, d, e, f, g and h= 0-9, A-Z)						
Auftrags-Inhalt: <i>Order content:</i>	TUV Rheinland - EMC service						
Prüfgrundlage: <i>Test specification:</i>	EN 301 489-1 V2.2.3 EN 301 489-17 V3.2.4						
Wareneingangsdatum: <i>Date of receipt:</i>	25 Aug. 2015 & 21 Apr. 2017						
Prüfmuster-Nr.: <i>Test sample No.:</i>	A000244783-004 & A000528342-001						
Prüfzeitraum: <i>Testing period:</i>	Refer to test report						
Ort der Prüfung: <i>Place of testing:</i>	Taichung Testing Laboratories						
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland Taiwan Ltd.						
Prüfergebnis*: <i>Test result*:</i>	Pass						
geprüft von / tested by: 	kontrolliert von / reviewed by: 						
04 Mar. 2021 Neil J. N. Tsai/ Senior Project Manager	Datum Date	Name/Stellung Name/Position	Unterschrift Signature	04 Mar. 2021 Spring C. Y. Wang/ Department Manager	Datum Date	Name/Stellung Name/Position	Unterschrift Signature
Sonstiges / Other:							
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>				Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(pass) = entspricht o.g. Prüfgrundlage(n) F(all) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(pass) = passed a.m. test specifications(s) F(all) = failed a.m. test specifications(s) N/A = not applicable N/T = not tested							
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>							

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1. Test Site

1.1. Test Facilities

Laboratory:

TUV Rheinland Taiwan Ltd. Taichung Testing Laboratories
No.9, Lane 36, Minsheng Rd., Sec. 3, Daya District, Taichung City 428, Taiwan, R.O.C.

Test Facility:

TÜV Rheinland Taiwan Ltd.
11F., No.758, Sec. 4, Bade Rd., Songshan Dist., Taipei City 105, Taiwan, R.O.C.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facilities and has found these test sites to be in compliance with the requirements under 47 CFR section 2.948. The registration number: 365730.

The Industry Canada has reviewed the technical characteristics of the radiated and conducted emission facilities and has found these test sites to be in compliance with the Canadian requirements. The filing number: 9465A.

The test facility is accredited by TAF (member of ILAC), under number 0759 according to ISO/IEC 17025: 2017.

TÜV Rheinland Taiwan Ltd. is accredited by the Federal Communications Commission as a Conformity Assessment Body under Designation Number TW1065 with Test Firm Registration Number: 799772; and Designation Number TW1108 with Test Firm Registration Number: 948515

1.2. Measurement Uncertainty

Testing Item	Frequency Range	Uncertainty
Radiated Emission (966 Chamber: 3m)	30MHz - 1000MHz	2.82 dB
Radiated Emission (966 Chamber: 3m)	Above 1GHz	2.42 dB

Note:

The uncertainty represents an expended uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2. Description of the Test Sample

2.1. General Description of Equipment

The tested samples are "Bluetooth Module" with model numbers "BBM78abcdefg, RN4678, BM78SPPS5MC2, BM78SPPS5NC2" for new approval, which are intended to enable wireless connected with other Bluetooth LE devices.

The tested samples are module where built in control host panel. Due to all electrical constructions are identical except for model name and firmware, one representative model with number "BM78abcdefg" was tested.

2.2. Rating and Physical Characteristics

Type Designation:	BM78abcdefg
Rating:	Control host panel: DC 5V (via USB port)
Protection Class:	Control host panel: III
Wireless Frequency:	2.4 - 2.4835 GHz (BT function)

2.3. Sources of Interference

- 1) IC circuits

2.4. Noise Suppression Parts

Please refer to attachment documentation for details.

2.5. Submitted Documents

- 1) Product Specification

3. Measurement Conditions

3.1. Modes of Operation

For RE & RS above 1GHz testing: The EUT was enabled the BT function to link with iPhone, then iPhone run the "mBIoT" software.

For RS below 1GHz & ESD testing: The EUT was enabled the wireless function to link with Remote equipment (R&S CBT).

The final mode:

A. BT link

3.2. Additional Equipment

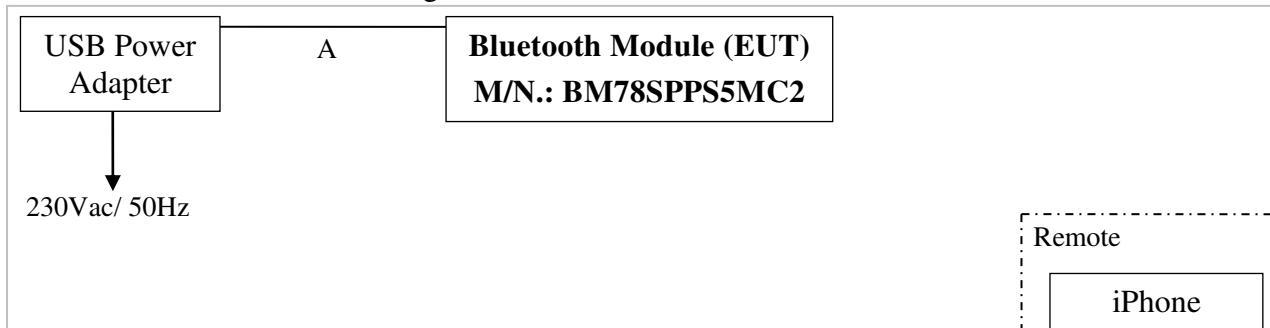
The subject sample was tested as an independent unit with the following equipment:

Description	Manufacturer	Model No.	Serial No.
iPhone 4S	Apple	A1387	C37HF4VQDTD2
USB Power Adapter	Apple	A1401	0012ADU00
Notebook	Lenovo	TP00018B	PK-2A3N7
Monitor	CHIMEI	22VD	22VDAGIW50440109
Bluetooth tester	R&S	CBT	100866
Printer	HP	VCVRA-1004	CN0C711HY9
Mouse	Lenovo	MO28UOL	44E6889
Ear/Microphone	i-Acon	CW-010MV	N/A

3.3. Test Setup

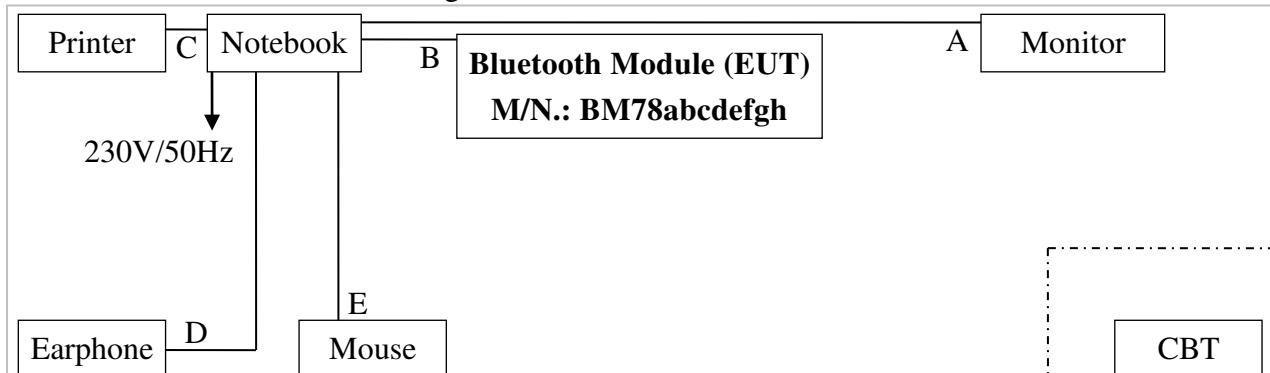
The test arrangement is configured and set according to manufacturer's installations.

For RE & RS above 1GHz testing:



Signal Cable Type		Signal Cable Description
A	USB cable	Shielded, 0.7m

For RS below 1GHz & ESD testing:



Signal Cable Type		Signal Cable Description
A	D-Sub cable	Shielded, 1.8m, 2 cores
B	USB cable	Shielded, 1.8m
C	USB cable	Shielded, 1.7m
D	Audio cable	Non shielded, 2m
E	USB cable	Shielded, 1.8m

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3.4. List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

For EMI/Radiation Measurement (Taipei: Semi-Anechoic Chamber B)

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due Date
1	Test Receiver	Rohde & Schwarz	ESR7	101549	2016/09/22	2017/09/22
2	Spectrum Analyzer	Rohde & Schwarz	FSV-40	101112	2016/09/22	2017/09/22
3	Pre-Amplifier	Hewlett Packard	8447D	2944A09270	2016/08/09	2017/08/09
4	Pre-Amplifier	Com-Power	PAM-840	461257	2016/12/01	2017/12/01
5	Pre-Amplifier	EM Electronics	EM01G18G	060649	2016/07/29	2017/07/29
6	Bilog Antenna	TESEQ	CBL6111D	29804	2016/06/23	2017/06/23
7	Horn Antenna	ETS-Lindgren	3117	00201918	2016/08/12	2017/08/12
8	Horn Antenna	Com-Power	AH-840	101031	2016/11/22	2017/11/22
9	Loop Antenna	Schwarzbeck	FMZB 1513	1513-076	2016/05/11	2017/05/11
10	Test Software	Audix	e3	Ver. 9	N/A	N/A

For EMS/RF Field Strength Susceptibility Test: RS above 1GHz (Taipei: Fully-Anechoic Chamber)

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due Date
1	Signal Generator	Rohde & Schwarz	SMB-100A	104167	2016/09/01	2017/09/01
2	Amplifier (20-1GHz)	FRANKONIA	FLH-200B	1088	N.C.R.	N.C.R.
3	Amplifier (1-6GHz)	Bonn	BLMA1060-50D	108052	N.C.R.	N.C.R.
4	Broadband Antenna (30M-3GHz)	FRANKONIA	BTA-M	08009	N.C.R.	N.C.R.
5	Horn Antenna (0.7-10.5GHz)	FRANKONIA	MAX-9	MAX-9-801	N.C.R.	N.C.R.
6	Power Meter	FRANKONIA	PMS_1084	108B1251	2016/04/18	2017/05/18
7	2 Directional Coupler	AR	DC6180A	334572	N.C.R.	N.C.R.
8	Relay Switching Unit	FRANKONIA	RSU1203	113B1224	N.C.R.	N.C.R.
9	Test Software	FRANKONIA	RF-LAB	Ver. 4.97	N/A	N/A

For EMS/ESD Test (Taipei: Shield Room)

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due Date
1	ESD Generator	TESEQ	NSG437	372	2015/08/15	2016/08/15

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For EMS/RF Field Strength Susceptibility Test: RS below 1GHz (Taipei: Fully-Anechoic Chamber)

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due Date
1	Signal Generator	Rohde & Schwarz	SMB-100A	104167	2015/08/15	2016/08/15
2	Amplifier (20-1GHz)	FRANKONIA	FLH-200B	1088	N.C.R.	N.C.R.
3	Amplifier (1-6GHz)	Bonn	BLMA1060-50D	108052	N.C.R.	N.C.R.
4	Broadband Antenna (30M-3GHz)	FRANKONIA	BTA-M	08009	N.C.R.	N.C.R.
5	Horn Antenna (0.7-10.5GHz)	FRANKONIA	MAX-9	MAX-9-801	N.C.R.	N.C.R.
6	Power Meter	FRANKONIA	PMS_1084	108B1251	2014/08/15	2015/09/15
7	2 Directional Coupler	AR	DC6180A	334572	N.C.R.	N.C.R.
8	Relay Switching Unit	FRANKONIA	RSU1203	113B1224	N.C.R.	N.C.R.

3.5. Abbreviations

PASS	: Complied with requirement	N/A	: Not applicable
FAIL	: Not complied	N.C.R.	: No calibration required

3.6. Decision rule of conformity

The decision rule of conformity of this test report is following the requirements of the requested standard in this test report, and agreed among testing laboratory and manufacturer (applicant) to exclude the consideration of Measurement Uncertainty.

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4. Test Results EMISSION

Result:	PASS
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4.1. Continuous Interference

4.1.1. Conducted Emission (AC Mains)

Port: AC Mains
Basic Standard: EN 301 489-1 V2.2.3
Frequency Range: 0.15 – 30 MHz
Limits: EN 55032: 2015, Table A.10, Class B

Result:	N/A
---------	-----

The subject sample is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

4.1.2. Conducted Emission (DC power input/output ports)

Port: DC power input/output ports
Basic Standard: EN 301 489-1 V2.2.3
Frequency Range: 0.15 – 30 MHz
Limits: EN 301 489-1 V2.2.3, Table 5

Result:	N/A
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This test is applicable for radio equipment and ancillary equipment for fixed use that are intended to be connected to a local DC power network or to local battery with connecting cables longer than 3 m.

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*Test Report No.*Seite 11 von 28
Page 11 of 28**4.1.3. Radiated Emission, 30 - 1000 MHz**

Port: Enclosure
Basic Standard: EN 301 489-1 V2.2.3
Frequency Range: 30 - 1000 MHz
Limits: EN 55032: 2015, Table A.4, Class B (3m distance)

Result:	PASS
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Test Setup

Date of Test: 25 Apr. 2017
Input Voltage: See 2.2
Operational Mode: See 3.1
Temperature: 23 °C
Relative Humidity: 49 %

Table 2: Radiated Emission, 30 - 1000 MHz**Setting:**

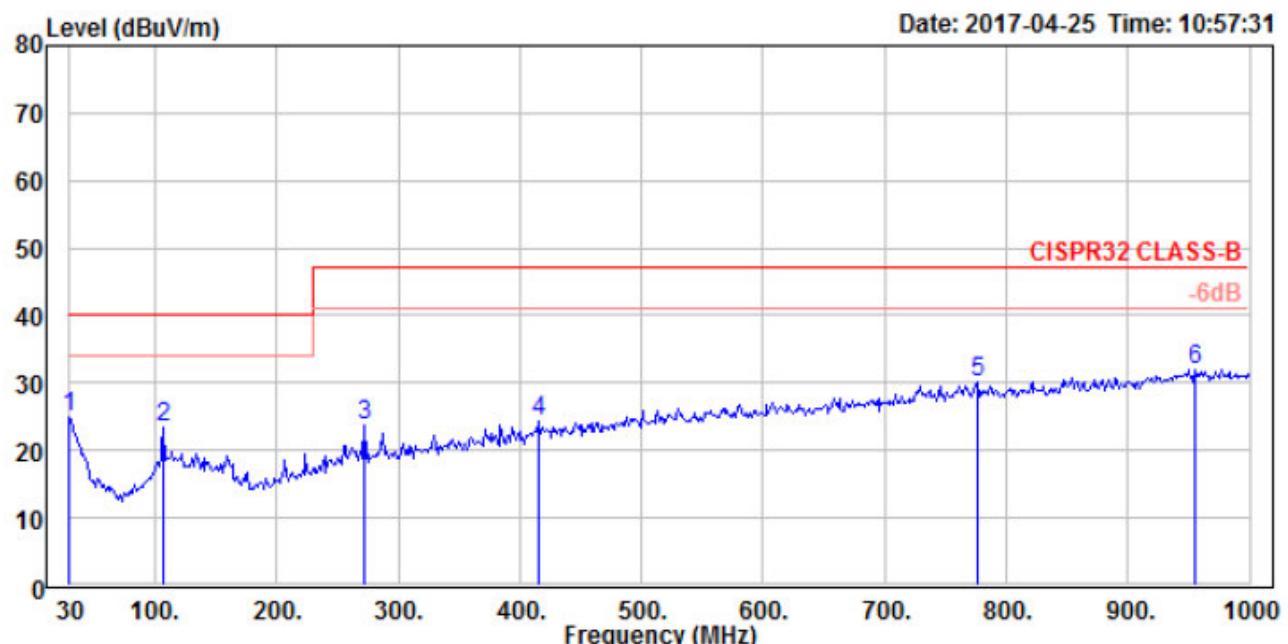
Frequency		Settings	
Start	Stop	IF Bandwidth	Detector
30 MHz	1000 MHz	120 kHz	QP

Note1: Level = Reading(Read Level) + Factor
Margin(Over Limit) = Level – Limit(Limit Line)

Note2: Factor= Antenna factor + Cable loss + (- Amplifier gain)

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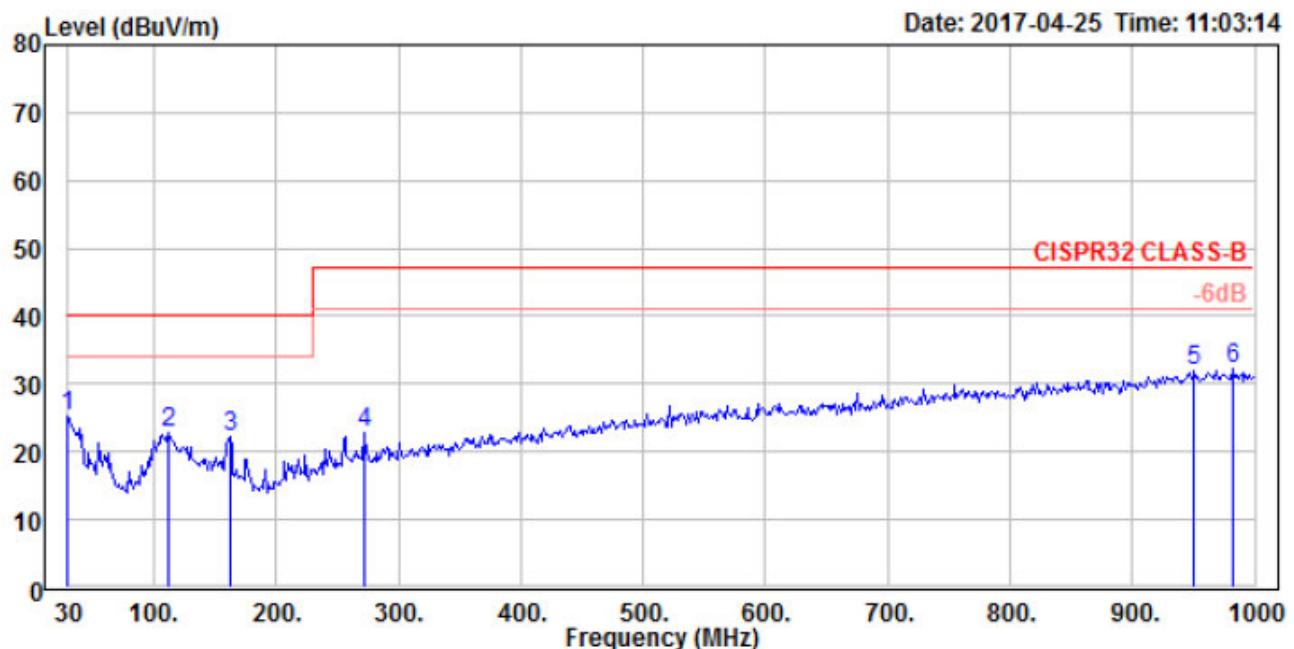
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Figure 1: Radiated Emission, 30 - 1000 MHz
Horizontal


	Freq	Read Level	Limit Factor	Over Line	Over Limit	Remark	Note
	MHz	dB _B U/m	dB _B V	dB/m	dB _B U/m	dB	
1	30.000	24.88	28.05	-3.17	40.00	-15.12	QP
2	107.319	23.32	34.77	-11.45	40.00	-16.68	QP
3	271.797	23.58	32.13	-8.55	47.00	-23.42	QP
4	415.188	24.32	30.12	-5.80	47.00	-22.68	QP
5	776.478	30.02	30.04	-0.02	47.00	-16.98	QP
6	955.015	31.97	28.88	3.09	47.00	-15.03	QP

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Vertical


Freq	Level	Read		Limit	Over	Remark	Note
		MHz	dB _B U/m	Level	Factor		
				dB/m	dB _B U/m		dB
1	30.000	25.25	28.42	-3.17	40.00	-14.75	QP
2	111.536	22.94	33.83	-10.89	40.00	-17.06	QP
3	162.145	22.14	33.52	-11.38	40.00	-17.86	QP
4	271.797	22.93	31.48	-8.55	47.00	-24.07	QP
5	950.797	31.95	28.85	3.10	47.00	-15.05	QP
6	981.725	32.26	29.19	3.07	47.00	-14.74	QP

4.1.4. Radiated Emission, Above 1 GHz

Port: Enclosure
Basic Standard: EN 301 489-1 V2.2.3
Frequency Range: 1 - 6 GHz
Limits: EN 55032: 2015, Table A.5, Class B

Result:
PASS

The highest internal source of the EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes.

- highest frequency is less than 108MHz, measurement shall only be made up to 1GHz
- highest frequency is between 108 & 500MHz, measurement shall only be made up to 2GHz
- highest frequency is between 500 & 1GHz, measurement shall only be made up to 5GHz
- highest frequency is above 1GHz, measurement shall be made up to 5 times the highest frequency or 6GHz, whichever is less.

Test Setup

Date of Test: 25 Apr. 2017
Input Voltage: See 2.2
Operational Mode: See 3.1
Temperature: 23 °C
Relative Humidity: 49 %

Table 3: Radiated Emission, Above 1 GHz

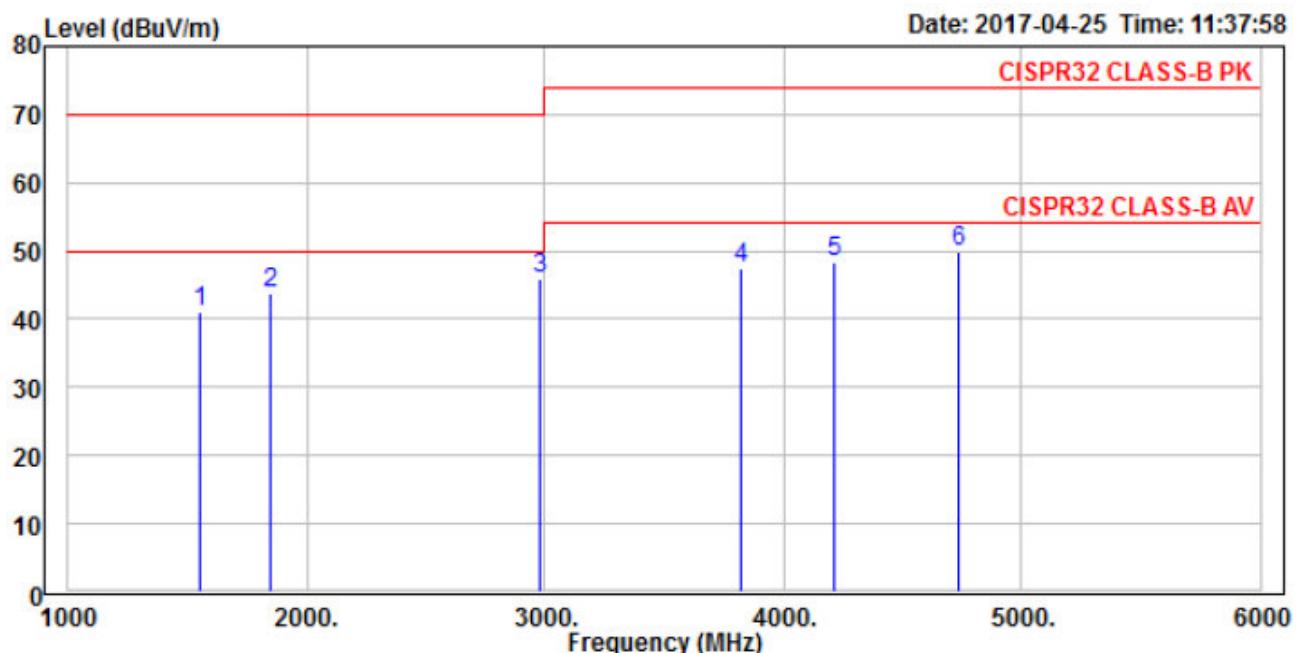
Setting:

Frequency		Settings	
Start	Stop	IF Bandwidth	Detector
1000 MHz	6000 MHz	1 MHz	Peak / Avg

Note 1: Level = Reading(Read Level) + Factor
Margin(Over Limit) = Level – Limit(Limit Line)

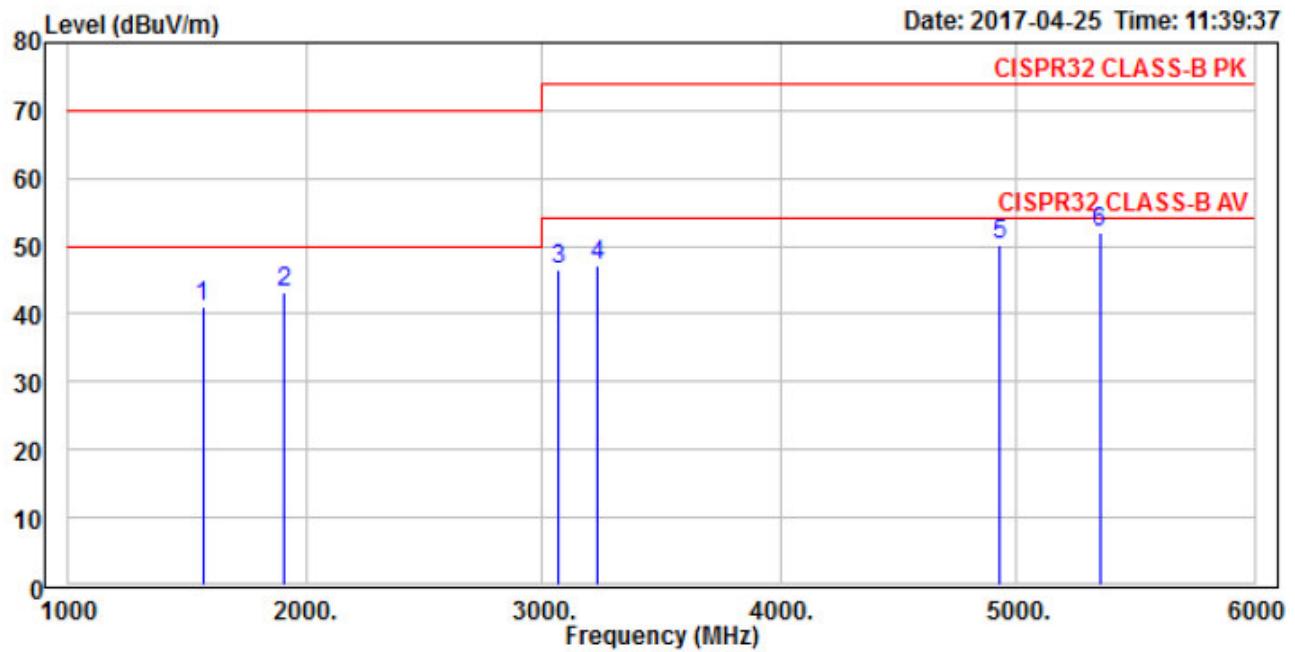
Note 2: Factor= Antenna factor + Cable loss + (- Amplifier gain)

Note 3: The highest frequency is 2.4 GHz for BT function, measurement shall made up to 6 GHz.

Figure 2: Radiated Emission, Above 1 GHz
Horizontal


Freq	Level	Read		Factor	Limit Line	Over Limit	Remark	Note
		MHz	dBuV/m		dBuV	dB/m		
1	1550.725	41.00	48.26	-7.26	70.00	-29.00	Peak	
2	1847.826	43.83	48.25	-4.42	70.00	-26.17	Peak	
3	2978.261	45.88	45.23	0.65	70.00	-24.12	Peak	
4	3818.841	47.53	45.23	2.30	74.00	-26.47	Peak	
5	4217.391	48.27	44.64	3.63	74.00	-25.73	Peak	
6	4739.130	49.85	44.10	5.75	74.00	-24.15	Peak	

Note: The peak readings were below average limit, thus no average measuring required for those.

Vertical


Freq	Level	Read		Limit Factor	Line	Over Limit	Remark	Note
		MHz	dBuV/m	dBuV	dB/m	dBuV/m	dB	
1	1565.217	40.95	48.08	-7.13	70.00	-29.05	Peak	
2	1913.043	43.21	46.99	-3.78	70.00	-26.79	Peak	
3	3065.217	46.43	45.57	0.86	74.00	-27.57	Peak	
4	3231.884	47.08	46.01	1.07	74.00	-26.92	Peak	
5	4927.536	50.26	43.69	6.57	74.00	-23.74	Peak	
6	5347.826	51.87	44.36	7.51	74.00	-22.13	Peak	

Note: The peak readings were below average limit, thus no average measuring required for those.

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4.2. Disturbances in Supply Systems

4.2.1. Harmonics

Port: AC Mains
Basic Standard: EN 301 489-1 V2.2.3
Limits: EN 61000-3-2: 2014

Result:	N/A
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The subject sample is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

4.2.2. Voltage Fluctuations

Port: AC Mains
Basic Standard: EN 301 489-1 V2.2.3
Limits: EN 61000-3-3: 2013

Result:	N/A
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The subject sample is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

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5. Test Results IMMUNITY

Result:	PASS
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5.1. Enclosure Port

5.1.1. Radiated Susceptibility

Port:	Enclosure
Basic Standard:	IEC/EN 61000-4-3
Performance Criteria:	A
Test Specification:	Frequency Range: 80 – 6000 MHz Field Strength: 3 V/m (unmodulated) Modulation: 1 kHz AM 80%

Result:	PASS
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Test Setup

Date of Test:	25 Apr. 2017 / 02 Sep. 2015
Input Voltage:	See 2.2
Operational Mode:	See 3.1
Temperature:	22 °C / 23 °C
Relative Humidity:	49 % / 51 %

Table 4: Radiated Susceptibility**Setting:**

Freq.	Freq. Step	Field Strength	Sweep mode	Meas. Time	Modulation	Observation	Result
80 – 6000 MHz	1% of the Preceding freq.	3 V/m	auto	3000 ms	1 kHz, AM 80%	@	PASS

No abnormalities were observed during and after the tests.

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5.1.2. Electrostatic Discharge

Port:	Enclosure
Basic Standard:	IEC/EN 61000-4-2
Performance Criteria:	B
Test Specification:	Voltage: 8 kV (Air Discharge) 4 kV (Contact Discharge) H.C.P. and V.C.P.

Result:	PASS
----------------	-------------

Test Setup

Date of Test:	02 Sep. 2015
Input Voltage:	See 2.2
Operational Mode:	See 3.1
Temperature:	23 °C
Relative Humidity:	50 %

Table 5: Electrostatic Discharge**Setting:**

Test point	Polarity	Number of Discharges	Observation	Result
H.C.P.	+/- 4 kV	20	@	PASS
V.C.P.	+/- 4 kV	20	normal function	PASS

Note1: There is no enclosure case on the subject sample, per client request, only H.C.P. and V.C.P. discharge method was performed during this test.

Note2: "@": During testing, the BT link was disconnecting, but it can self-recover after test, without manual operation.

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5.2. Input and Output AC Power Ports

5.2.1. Conducted Disturbances

Port:	AC Mains
Basic Standard:	IEC/EN 61000-4-6
Performance Criteria:	A
Test Specification:	Frequency Range: Voltage Level: Modulation:
	0.15 - 80 MHz 3 Vrms (unmodulated) AM 80%, 1kHz sine wave

Result:	N/A
----------------	-----

The subject sample is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

5.2.2. Fast Transients Common Mode

Port:	AC Mains
Basic Standard:	IEC/EN 61000-4-4
Performance Criteria:	B
Test Specification:	Peak Voltage: Tr/T _h Rep. Frequency
	1.0 kV 5/50 ns 5 kHz

Result:	N/A
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The subject sample is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

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5.2.3. Surges

Port:	AC Mains
Basic Standard:	IEC/EN 61000-4-5
Performance Criteria:	B
Test Specification:	Peak Voltage: Tr/T _h
	1.0 kV (line to line) 2.0 kV (line to ground) 1,2/50 μs

Result:**N/A**

The subject sample is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

5.2.4. Voltage Dips and Interruptions

Port:	AC Mains
Basic Standard:	IEC/EN 61000-4-11
Test Specification & Performance Criteria:	Test Level: 100% U _T for Voltage Reductions, no. of 0.5 periods (A) 100% U _T for Voltage Reductions, no. of 1 period (A) 30% U _T for Voltage Reductions, no. of 25 period (A) 100% U _T for Voltage Reductions, no. of 250 period (B)

Result:**N/A**

The subject sample is not intended to be connected to AC mains supply. Therefore, this test is not applicable.

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5.3. Signal and Telecommunication Ports

5.3.1. Conducted Disturbances

Port:	Signal / Telecommunication Ports
Basic Standard:	IEC/EN 61000-4-6
Performance Criteria:	A
Test Specification:	Frequency Range: Voltage Level Modulation:
	0.15 - 80 MHz 3 Vrms (unmodulated) AM 80%, 1kHz sine wave

Result:	N/A
----------------	-----

The subject sample was not including signal/ telecommunication Ports. Therefore, this test is not applicable.

5.3.2. Fast Transients Common Mode

Port:	Signal / Telecommunication Ports
Basic Standard:	IEC/EN 61000-4-4
Performance Criteria:	B
Test Specification:	Peak Voltage: Tr/T _h Rep. Frequency
	0.5 kV 5/50 ns 5 kHz

Result:	N/A
----------------	-----

The subject sample was not including signal/ telecommunication Ports. Therefore, this test is not applicable.

5.3.3. Surges

Port:	Signal / Telecommunication ports
Basic Standard:	IEC/EN 61000-4-5
Performance Criteria:	B
Test Specification:	Peak Voltage: Tr/T _h
	1.0 kV 1,2/50 μs

Result:	N/A
----------------	-----

The subject sample was not including signal/ telecommunication Ports. Therefore, this test is not applicable.

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5.4. Input DC Power Ports

5.4.1. Conducted Disturbances

Port:	Input DC ports	
Basic Standard:	IEC/EN 61000-4-6	
Performance Criteria:	A	
Test Specification:	Frequency Range: Voltage Level	0.15 - 80 MHz 3 Vrms (unmodulated) AM 80%, 1kHz sine wave

Result:	N/A
----------------	-----

This test shall be additionally performed on signal ports, wired network ports, control ports, and DC power ports, of radio equipment and associated ancillary equipment, if the cables may be longer than 3 m.

5.4.2. Fast Transients Common Mode

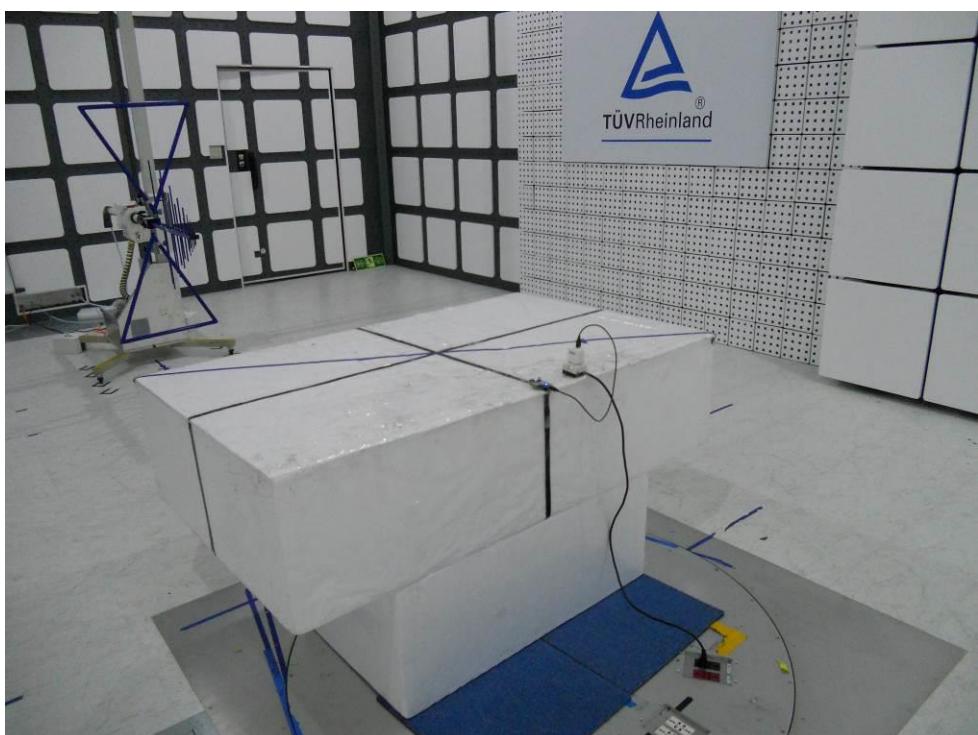
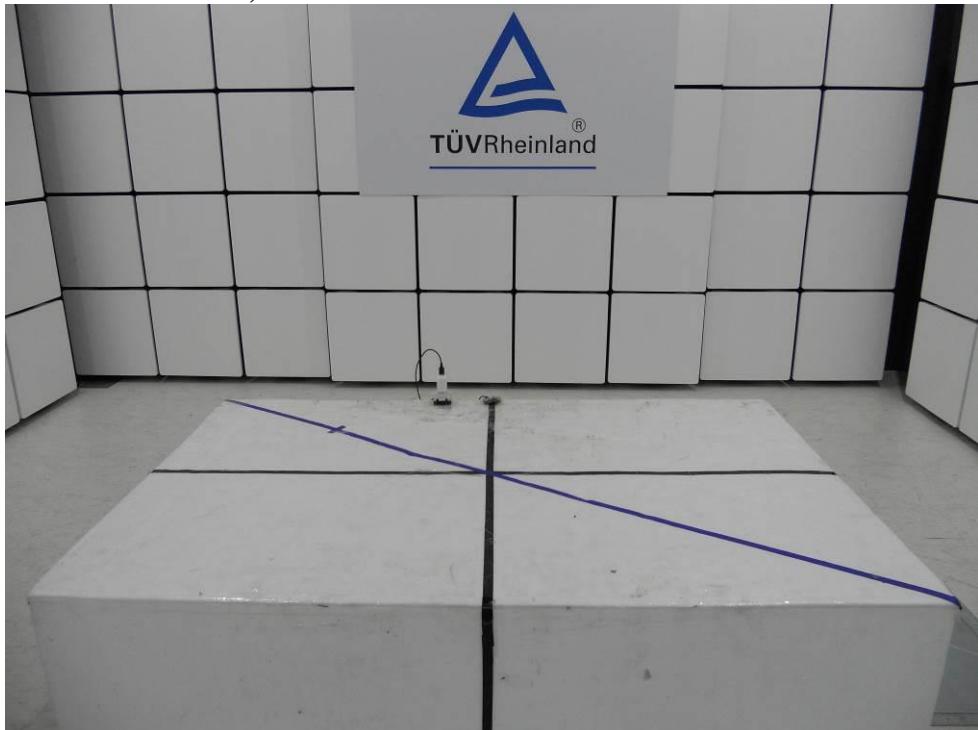
Port:	Input DC Ports	
Basic Standard:	IEC/EN 61000-4-4	
Performance Criteria:	B	
Test Specification:	Peak Voltage: Tr/Th: Rep. Frequency:	0.5kV 5/ 50ns 5 kHz

Result:	N/A
----------------	-----

This test shall be additionally performed on signal ports, wired network ports, control ports, and DC power ports, of radio equipment and associated ancillary equipment, if the cables may be longer than 3 m.

6. Photographs of the Test Set-up

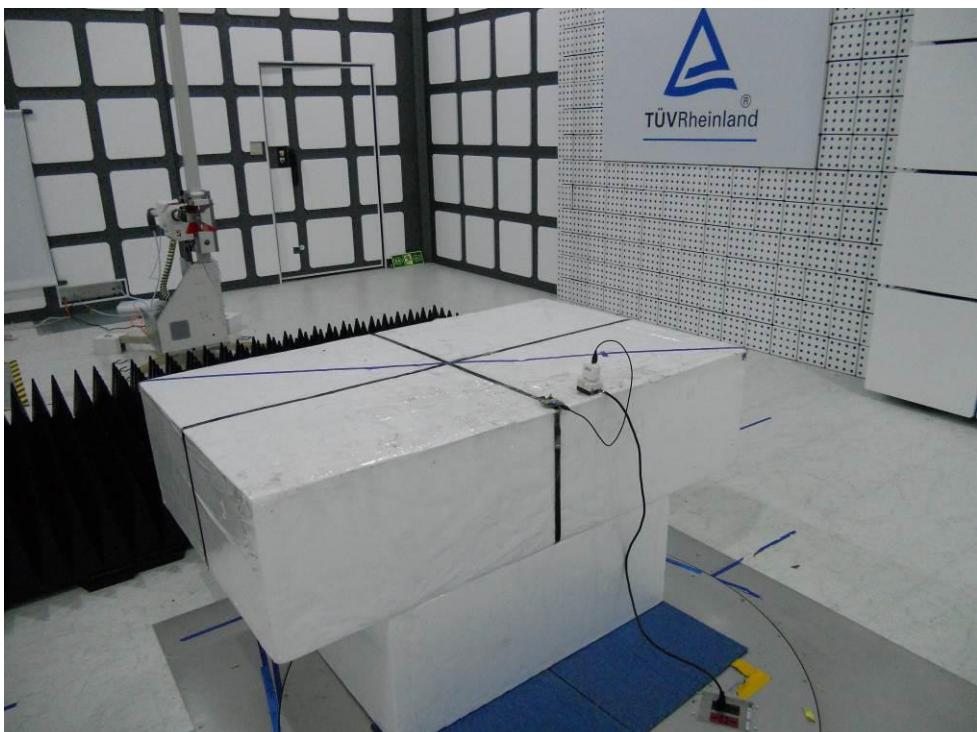
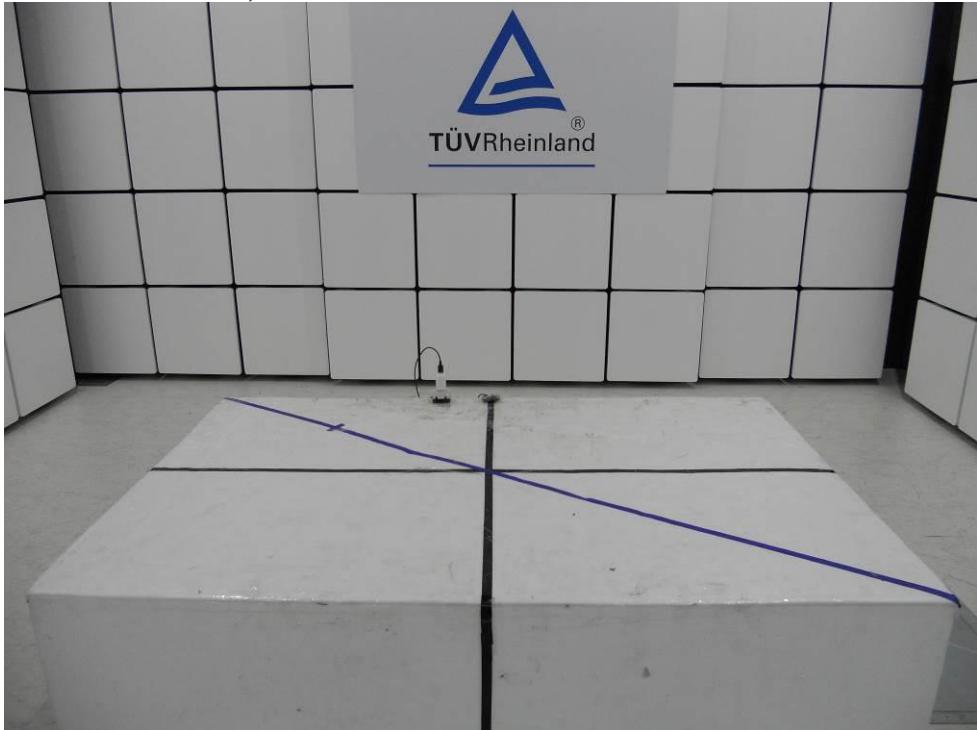
Picture 1: Radiated Emission, 30 - 1000 MHz



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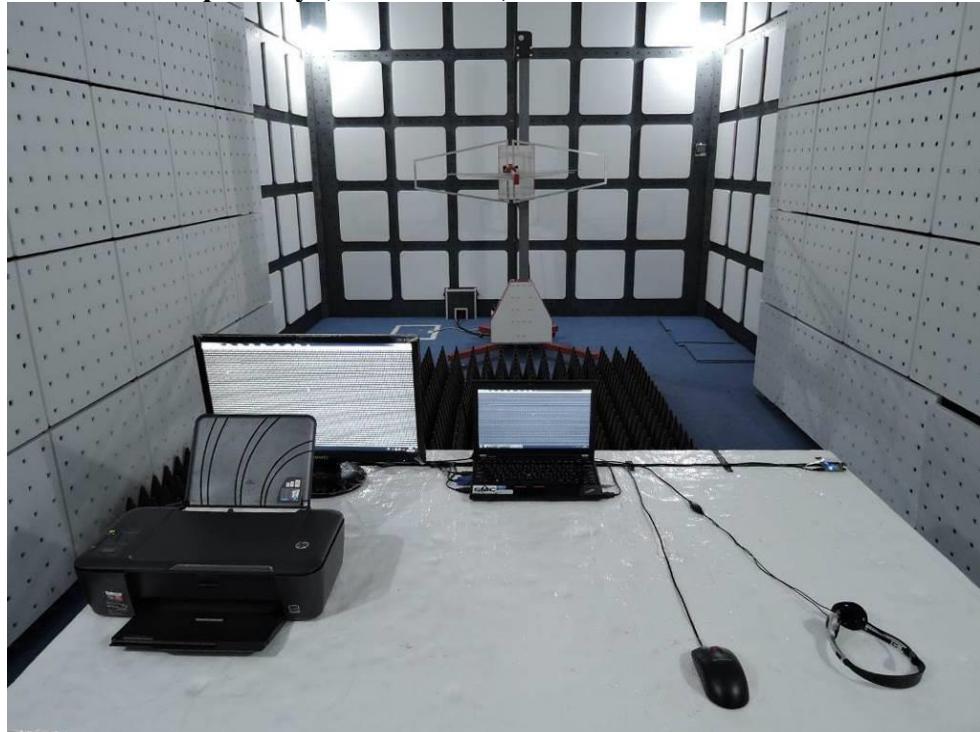
Picture 2: Radiated Emission, Above 1 GHz



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Picture 3: Radiated Susceptibility (Below 1GHz)



Picture 4: Radiated Susceptibility (Above 1GHz)



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Picture 5: Electrostatic Discharge



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ATTACHMENT

Photo Documentation



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Report No.: 10052437 003

Product: Bluetooth Module

Type Designation: BM78abcdefg

