Registration
No.788871

TEST REPORT FOR BLUETOOTH TESTING

Report No: SRTC2018-9004(F)-18010401(E)

Product Name: Sino Wealth BLE Module

Product Model: SH-BLEM01

Applicant: SINO WEALTH ELECTRONIC LTD.

Manufacturer: SINO WEALTH ELECTRONIC LTD.

Specification: FCC Part 15, Subpart C (2017)

FCC ID: 2AOT2SH-BLEM01

The State Radio_monitoring_center Testing Center (SRTC)

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1. GENERAL INFORMATION

1.1 Notes of the test report

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written permission of The State Radio_monitoring_center Testing Center (SRTC).
The test results relate only to individual items of the samples which have been tested.

1.2 Information about the testing laboratory

Company:	The State Radio_monitoring_center Testing Center (SRTC)
Address:	15th Building, No.30 Shixing Street, Shijingshan District, P.R.China
City:	Beijing
Country or Region:	P.R.China
Contacted person:	Liu Jia
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Fax:	+86 10 57996388
Email:	liujiaf@srtc.org.cn

1.3 Applicant's details

Company:	SINO WEALTH ELECTRONIC LTD.
Address:	No. 3, Lane 767, JinZhong Road, Shanghai (PC: 200335), China
City:	Shanghai
Country or Region:	China
Grantee Code:	2AOT2
Contacted person:	Lisa.Duan
Tel:	021-61219988-1321
Fax:	021-61219989
Email:	Lisa.duan@sinowealth.com

1.4 Manufacturer's details

Company:	SINO WEALTH ELECTRONIC LTD.
Address:	No. 3, Lane 767, JinZhong Road, Shanghai (PC: 200335), China
City:	Shanghai
Country or Region:	China
Contacted person:	Lisa.Duan
Tel:	021-61219988-1321
Fax:	021-61219989
Email:	Lisa.duan@sinowealth.com

1.5 Test Environment

Date of Receipt of test sample at SRTC:	2018.01.04
Testing Start Date:	2018.01.09
Testing End Date:	2018.01.26

Environmental Data:	Temperature (°C)	Humidity (%)
Ambient	25	30

Normal Supply Voltage (V d.c.):	3.3

2 DESCRIPTION OF THE DEVICE UNDER TEST

2.1 Final Equipment Build Status

Frequency Range	2.402GHz~2.480GHz
Number of Channel	40
Modulation Type	GFSK
Equipment Class	DTS
Transmission specification	Bluetooth V4.0 BLE
Channel Spacing	2MHz
Data Rate	1Mbps
Power Supply	USB
Rated Power Supply Voltage	3.3V
HW Version	V2.1
SW Version	V1.0
Serial Number	Sample1
Antenna type	Refer to Note
Antenna connector	Refer to Note

Note:

The antenna provide to the EUT, please refer to the following table:

Brand	Model	Antenna gain	Frequency range(GHz)	Antenna type	Connecter Type
N/A	N/A	0dBi	2.402GHz~2.480GHz	PCB IF	IPX

2.2 Description of Test Modes

40 channels are provided to this EUT:

CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

2.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE ≥ 1G	RE<1G	PLC	APCM	-
-	√	√	√	√	-

Where **RE 1G:** Radiated Emission above 1GHz **RE<1G:** Radiated Emission below 1GHz

PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

Radiated Emission Test (Above 1GHz):

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	0, 19, 39	GFSK	1

Radiated Emission Test (Below 1GHz):

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	0, 19, 39	GFSK	1

Power Line Conducted Emission Test:

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	0	GFSK	1

Antenna Port Conducted Measurement:

This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	0, 19, 39	GFSK	1

2.3 Duty Cycle of Test Signal

Duty cycle of test signal is < 98 %, duty factor shall be considered.

Duty cycle = 62.4%

Correction factor = 10* log (1/duty cycle) =10 * log (1/0.624) = 2.05 dB

2.4 EUT Operating conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually. EUT work with a fully-charged battery.

3 REFERENCE SPECIFICATION

Specification	Version	Title
15.35	2017	Measurement detector functions and bandwidths.
15.209	2017	Radiated emission limits; general requirements.
15.247	2017	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
15.203	2017	Antenna requirement
ANSI C63.10	2013	Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074	April 5, 2017	GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247

4 KEY TO NOTES AND RESULT CODES

Code	Meaning
PASS	Test result shows that the requirements of the relevant specification have been met.
FAIL	Test result shows that the requirements of the relevant specification have not been met.
N/T	Test case is not tested.
NTC	Nominal voltage, Normal Temperature
HV	High voltage, Normal Temperature
LV	Low voltage, Normal Temperature
HTHV	high voltage, High Temperature
LTHV	High voltage, Low Temperature
HTLV	Low voltage, High Temperature
LTLV	Low voltage, Low Temperature

5 RESULT SUMMARY

No.	Test case	Reference	Verdict
1	Occupied Bandwidth	15.247(a)(2)	Pass
2	Peak Power Output	15.247(b)(3))	Pass
3	Transmitter Power Spectral Density	15.247(e))	Pass
4	Conducted Out of band emission measurement	15.247(d)	Pass
5	Band-edge	15.247(d)	Pass
6	Spurious Radiated Emissions	15.247(d)/15.35(b)/15.209	Pass
7	AC Power line Conducted Emission	15.207	Pass
8	Antenna requirement	15.203	Pass（refer to section 2.1）

This Test Report Is Issued by: Mr. Peng Zhen	Checked by: Mr. Li Bin
Tested by: Mr. He Dengshun	Issued date: 20180201

6 TEST RESULT

6.1 Occupied Bandwidth

6.1.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.1.2 Test Description

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer and Bluetooth test set via a power splitter with a known loss. Which connected to the transmitter antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section.

6.1.3 Test limit

Part15.247 (a)(2)
The minimum permissible 6dB bandwidth is 500 kHz

6.1.4 Test Procedure Used

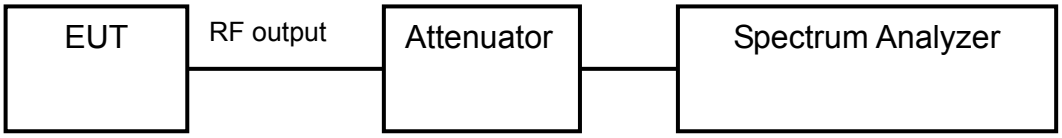
KDB 558074 D01 DTS Meas Guidance v04 – Section 8.1 Option 1

6.1.5 Test Settings

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.1.6 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.1.7 Test result

The test results are shown in Appendix A .

6.2 Peak Power Output

6.2.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.2.2 Test Description

The transmitter antenna terminal of the EUT is connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. Measurements are made while the EUT is operating at maximum power and at the appropriate frequencies.

6.2.3 Test limit

Part15.247(b)(3)
The maximum permissible conducted output power is 1 Watt.
Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW)
==> Maximum Output Power: 30.0 dBm

6.2.4 Test Procedure Used

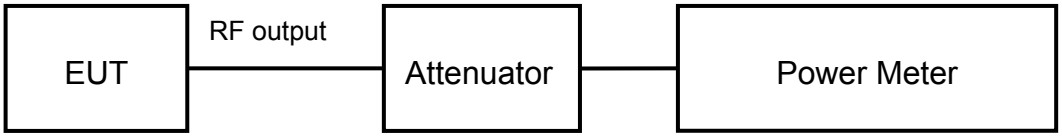
KDB 558074 D01 DTS Meas Guidance v04 – Section 9.1.3

6.2.5 Test Settings

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

6.2.6 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.2.7 Test result

The test results are shown in Appendix A .

6.3 Transmitter Power Spectral Density

6.3.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.3.2 Test Description

The peak power density is measured with a spectrum analyzer and Bluetooth test set via a power splitter with a known loss connected to the antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies.

6.3.3 Test limit

Part15.247(e)
The maximum permissible power spectral density is 8.0 dBm in any 3 kHz band.

6.3.4 Test Procedure Used

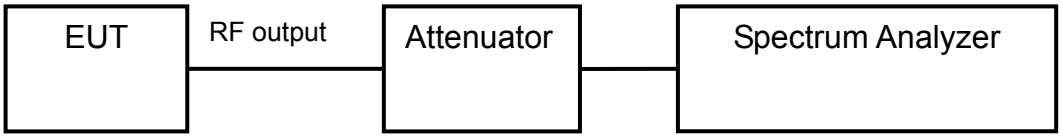
KDB 558074 D01 DTS Meas Guidance v04 Section 10.2.

6.3.5 Test Settings

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.3.6 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.3.7 Test result

The test results are shown in Appendix A.

6.4 Conducted Out of band emission measurement

6.4.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.4.2 Test Description

For the following out of band conducted spurious emissions plots, the EUT was set to transmit at maximum power with the largest packet size available. The worst case spurious emissions were found in this configuration.

6.4.3 Test limit

Part 15.247(d) The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth.

6.4.4 Test Procedure Used

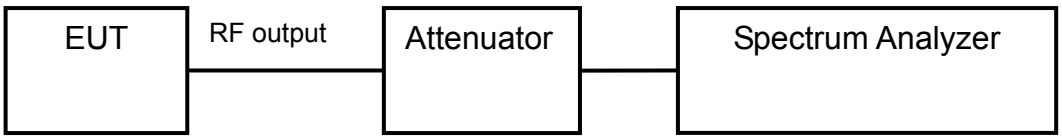
KDB 558074 D01 DTS Meas Guidance v04 Section 11.3

6.4.5 Test Settings

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100kHz.
c) Set the VBW ≥ 300kHz.
d) Detector = peak.
e) Set span to encompass the spectrum to be examined
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level.

6.4.6 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.4.7 Test result

The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.
The test results are shown in Appendix A .

6.5 Band-edge measurement

6.5.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.5.2 Test Description

For the following out of band conducted spurious emissions plots, the EUT was set to transmit at maximum power with the largest packet size available. The worst case spurious emissions were found in this configuration.

6.5.3 Test limit

Part 15.247(d)
The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth.

6.5.4 Test Procedure Used

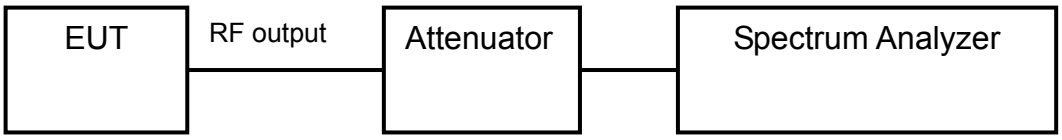
KDB 558074 D01 DTS Meas Guidance v04 Section 12.1

6.5.5 Test Settings

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100kHz.
c) Set the VBW ≥ 300kHz.
d) Detector = peak.
e) Set span to encompass the spectrum to be examined
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level.

6.5.6 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.5.7 Test result

The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.
The test results are shown in Appendix A .

6.6 Spurious Radiated Emissions

6.6.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.6.2 Test Description

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

6.6.3 Test limit

Part15.205, 15.209, 15.247(d)

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in below Table per Section 15.209.

Frequency [MHz]	Field strength [μV/m]	Measured Distance [meters]
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30～88	100	3
88～216	150	3
216～960	200	3
Above 960	500	3

Radiated Limits

Part15.35(b):

there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit

Used conversion factor: Limit (dBμV/m) = 20 log (Limit (μV/m)/1μV/m)

Frequency [MHz]	Detector	Unit (dBμV/m)
30～88	Quasi-peak	40.0
88～216	Quasi-peak	43.5
216～960	Quasi-peak	46.0
960～1000	Quasi-peak	54.0
1000～5th harmonic of the highest frequency or 40GHz, whichever is lower	Average	54.0
	Peak	74.0

Conversion Radiated limits

6.6.4 Test Procedure Used

KDB 558074 D01 DTS Meas Guidance v04 – Section 12.2.7

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. Both X and Y axes of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz
a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

For the radiated emission test above 1GHz:
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement

antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Average detection (AV) at frequency above 1GHz. If duty cycle of test signal is < 98%, the duty factor need added to measured value.
4. All modes of operation were investigated and the worst-case emissions are reported.

6.6.5 Test Settings

Average Field Strength Measurements per Section 12.2.7 of KDB 558074 (Part 15.35)
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz > 1/T
4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to run for at least 50 times (1/duty cycle) traces

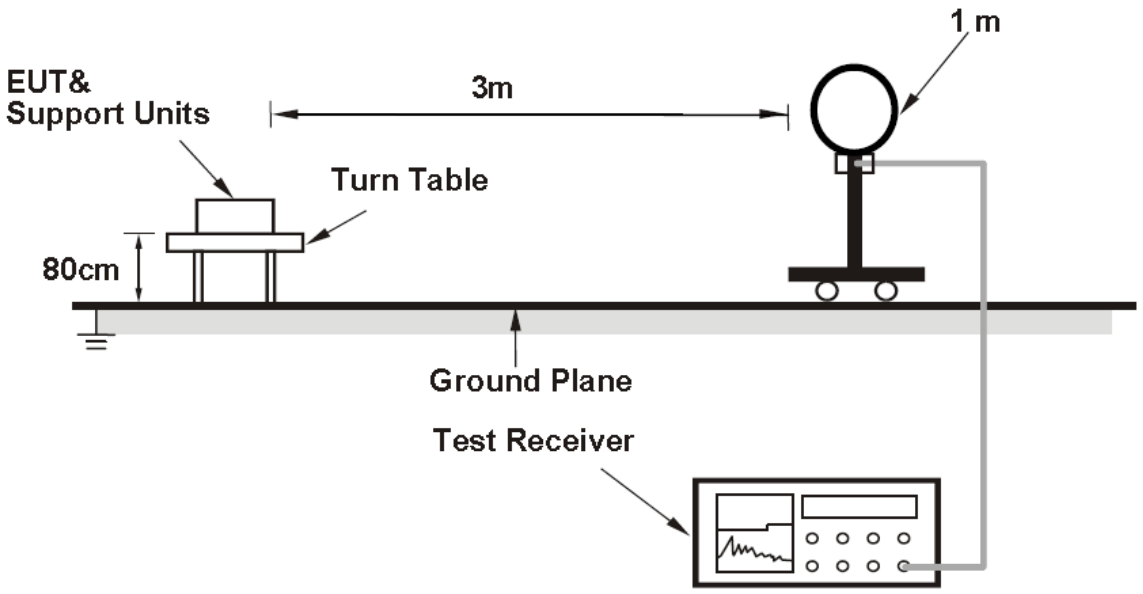
Peak Field Strength Measurements per Section 12.2.7of KDB 558074 (Part 15.35)
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in following table

Frequency	RBW
9-150kHz	200-300Hz
0.15-30MHz	9-10kHz
30-1000MHz	100-120kHz
>1000MHz	1MHz

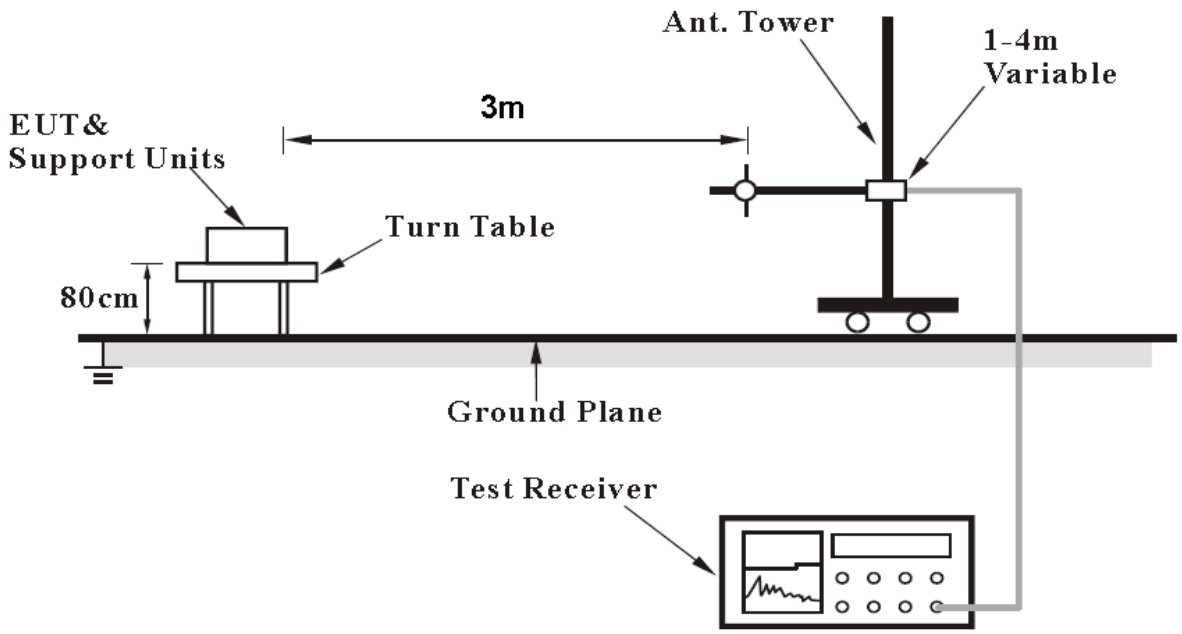
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

6.6.6 Test Setup

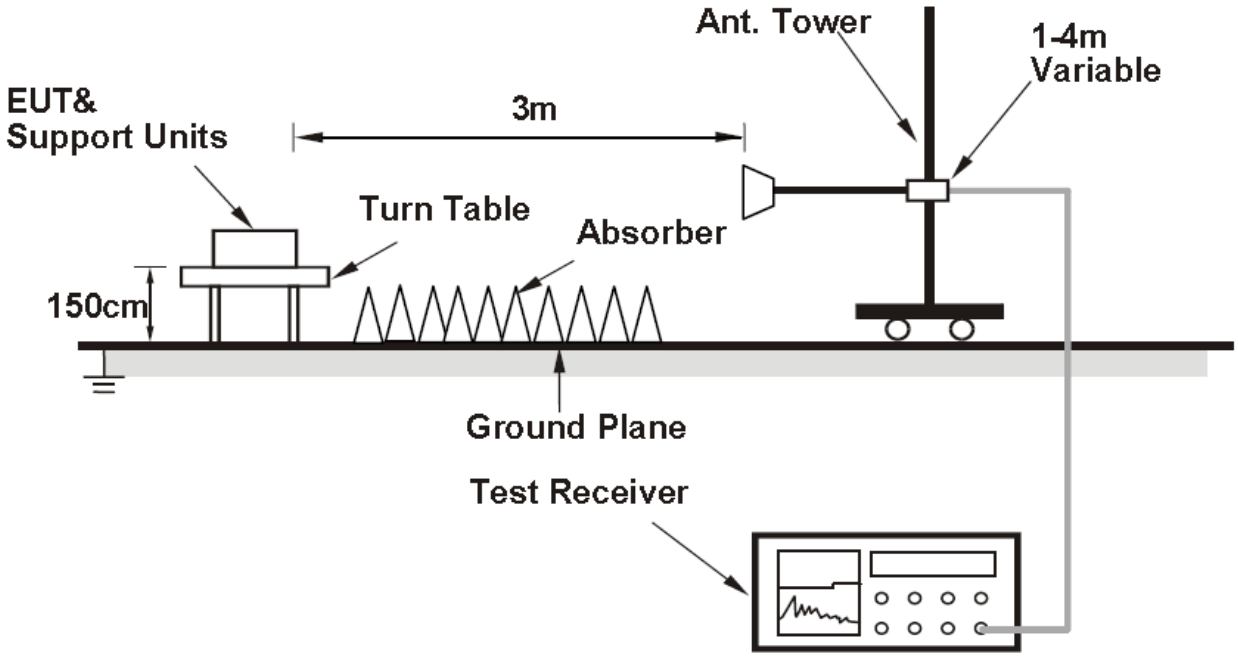
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



6.6.7 Test result

The test results are shown in Appendix B.

6.7 AC Power line Conducted Emission

6.7.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.7.2 Test limit

FCC Part15.207

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	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.

The measurement is made according to ANSI C63.10-2013

6.7.3 Test Procedures

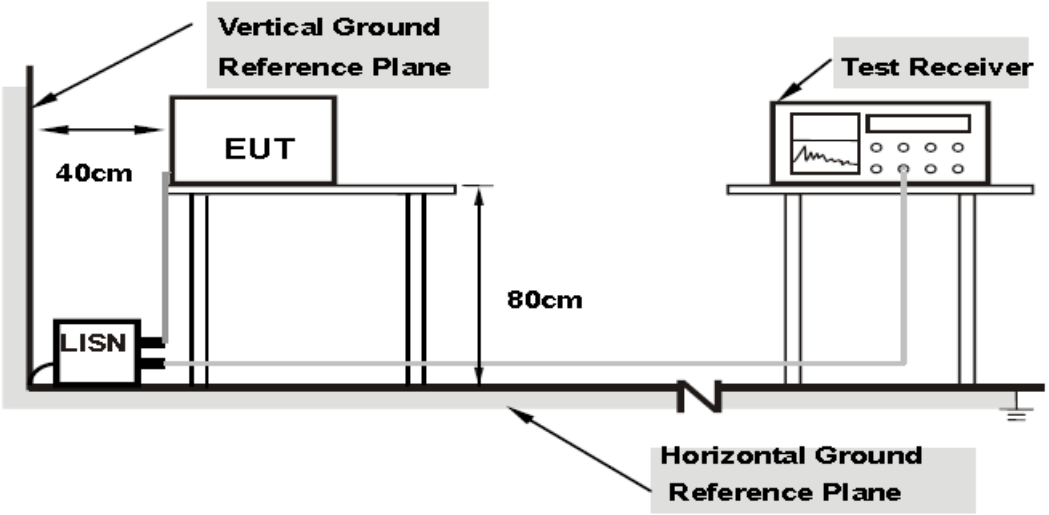
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit -20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.
The EUT shall test under the power AC120V/60Hz.

6.7.4 Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.7.5 Test result

The test results are shown in AppendixB .

7 MEASUREMENT UNCERTAINTIES

Items	Uncertainty	
Occupied Bandwidth	3kHz	
Peak power output	0.67dB	
Band edge compliance	1.20dB	
Spurious emissions	30MHz～1GHz	2.83dB
	1GHz～12.75GHz	2.50dB
	12.75GHz～25GHz	2.75dB

8 TEST EQUIPMENTS

No.	Name/ Model	Manufacturer	S/N	Cal date	Cal Due date
1.	Spectrum Analyzer FSV	ROHDE&SCHWARZ	101065	2017.08.20	2018.08.19
2.	Attenuation 6810.17.B	HUBER+SUHNER	768710	2017.08.20	2018.08.19
3.	23.18m×16.88m×9.60m Semi-Anechoic Chamber	FRANKONIA	---	-----	-----
4.	Turn table Diameter:5m	HD	-----	-----	-----
5.	Antenna master SAC(MA4.0)	MATURO	-----	-----	-----
6.	9.080m×5.255m×3.525m Shielding room	FRANKONIA	-----	-----	-----
7.	HF 906 Double-Ridged Waveguide Horn Antenna	R&S	100030	2017.08.20	2018.08.19
8.	HL562 Ultra log antenna	R&S	100016	2017.08.20	2018.08.19
9.	3160-09 Receive antenna	SCHWARZ-BECK	002058-002	2017.08.20	2018.08.19
10.	ESI 40 EMI test receiver	R&S	100015	2017.08.20	2018.08.19
11.	ESCS30 EMI test receiver	R&S	100029	2017.08.20	2018.08.19
12.	ESH3-Z5 LISN	R&S	100020	2017.08.20	2018.08.19
13.	HFH2-Z2	R&S	100340	2017.08.20	2018.08.19
14.	Cable 104EA	SUCOFLEX	9272/4EA	2017.08.20	2018.08.19

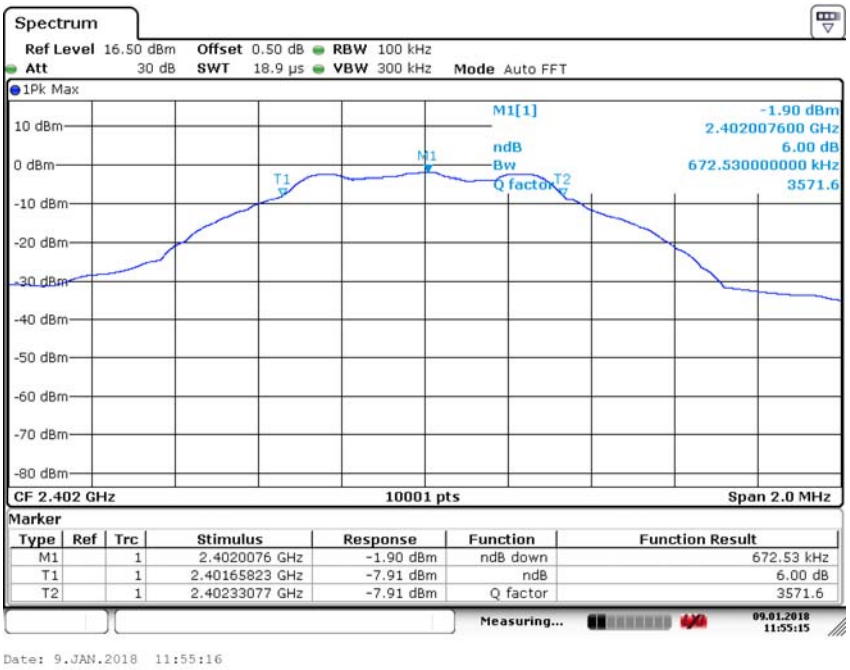
APPENDIX A – TEST DATA OF CONDUCTED EMISSION

Occupied Bandwidth

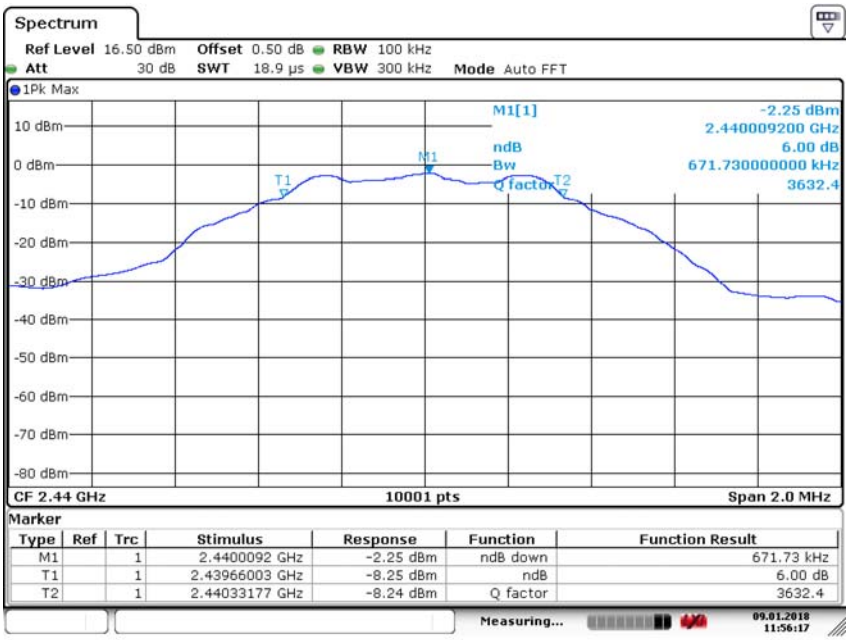
Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

Modulation type: GFSK (LE)

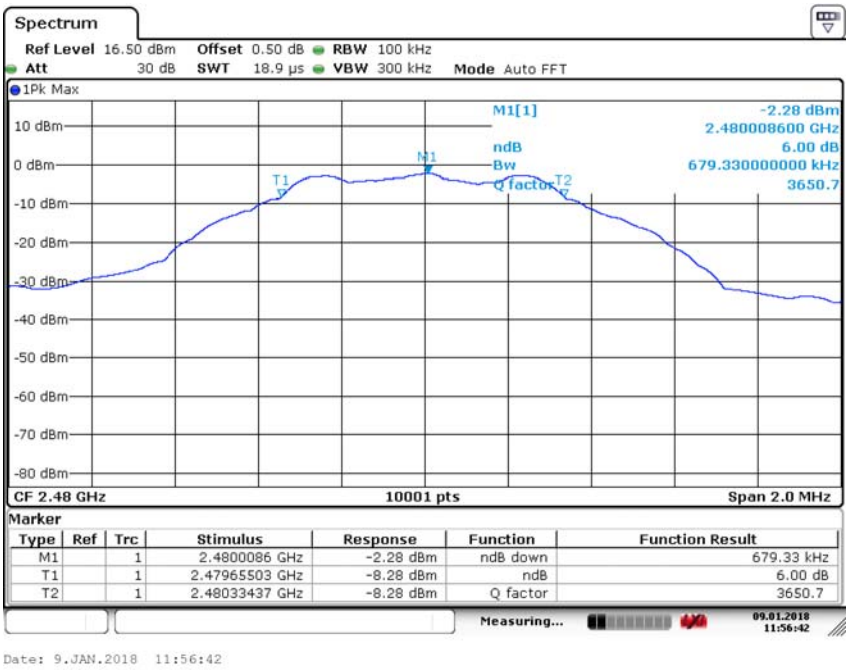
Carrier frequency (MHz)	Channel No.	6 dB bandwidth(kHz)
2402	0	672.53
2440	19	671.73
2480	39	679.33



Carrier frequency (MHz): 2402
Channel No.:0
Modulation type: GFSK (LE)



Carrier frequency (MHz): 2440
Channel No.:19
Modulation type: GFSK (LE)



Carrier frequency (MHz): 2480
Channel No.:39
Modulation type: GFSK (LE)

Peak Power Output

Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

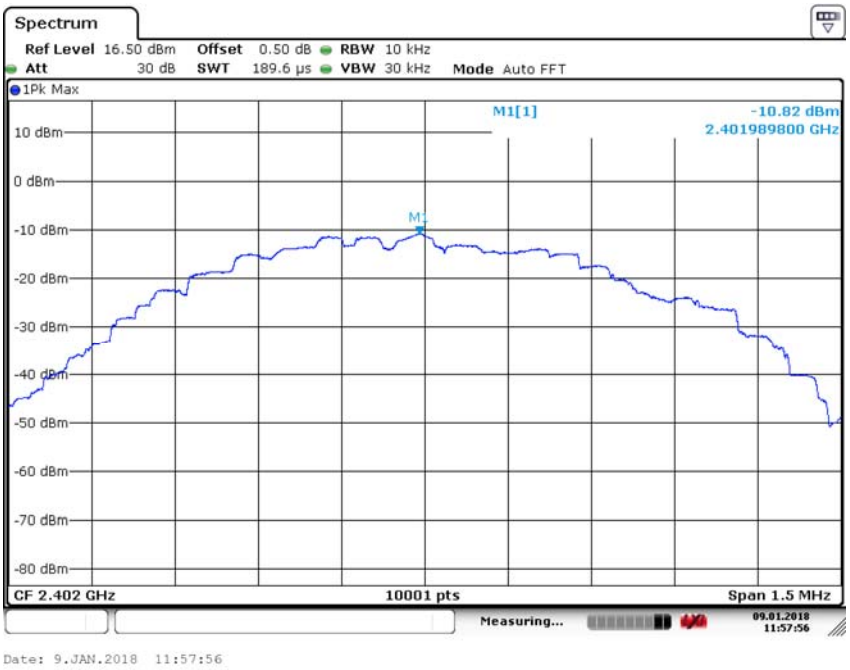
Modulation type	Peak Power Output (dBm)		
	2402MHz (Ch0)	2440MHz (Ch19)	2480MHz (Ch39)
GFSK (LE)	-1.34	-1.52	-1.58

Modulation type	Average Power Output (dBm)		
	2402MHz (Ch0)	2440MHz (Ch19)	2480MHz (Ch39)
GFSK (LE)	-3.50	-3.68	-3.75

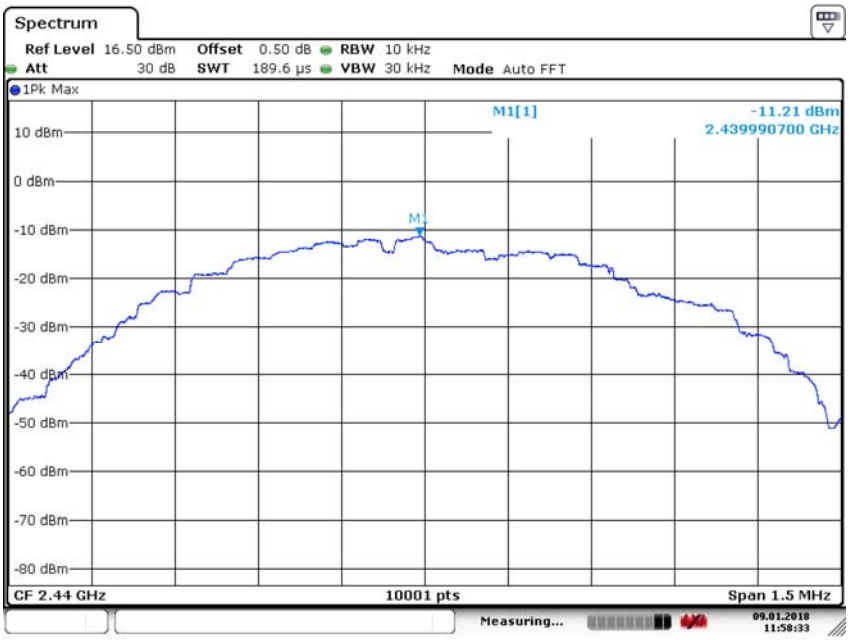
Transmitter Power Spectral Density

Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

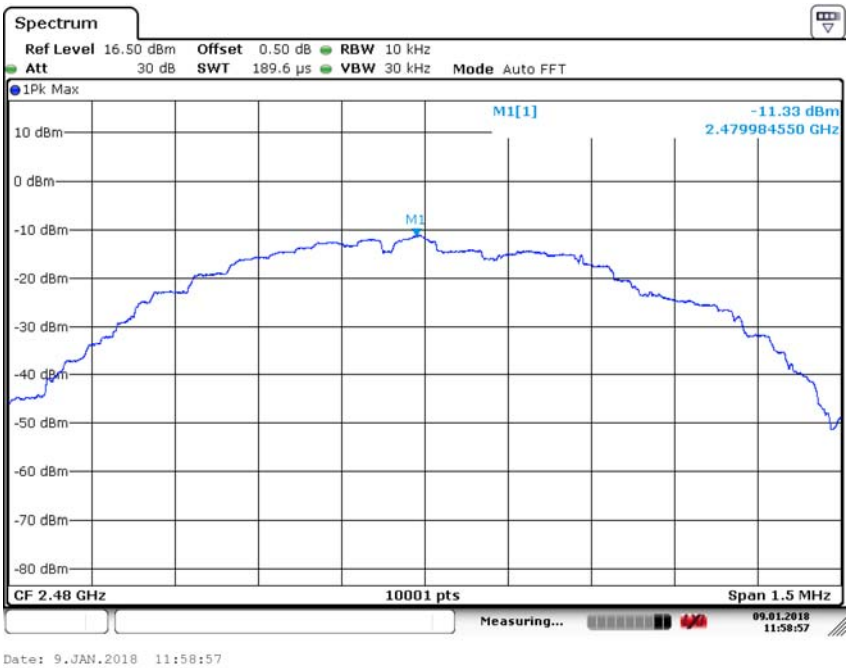
Carrier frequency (MHz)	Channel No	Power Density(dBm/10kHz)
2402	0	-10.82
2440	19	-11.21
2480	39	-11.33



Carrier frequency (MHz): 2402
Channel No.:0
Modulation type: GFSK (LE)



Carrier frequency (MHz): 2440
Channel No.:19
Modulation type: GFSK (LE)

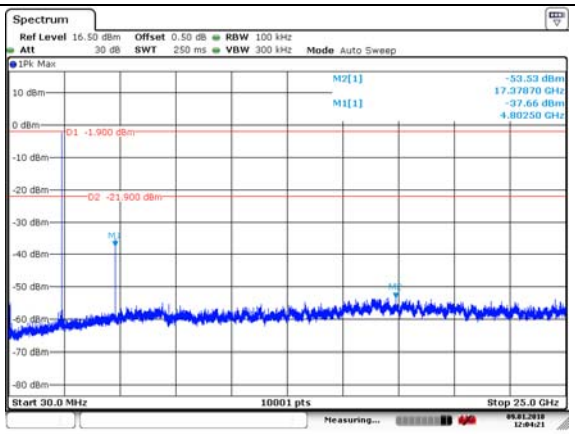


Carrier frequency (MHz): 2480
Channel No.:39
Modulation type: GFSK (LE)

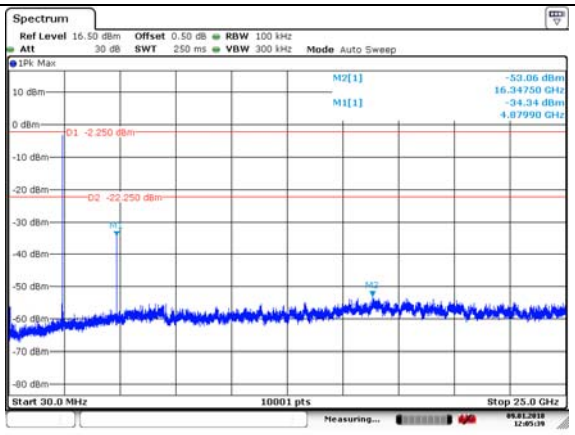
Conducted Out of band emission measurement

Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

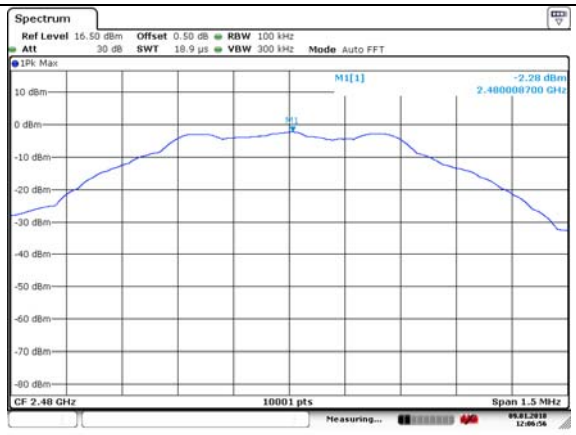
CH0

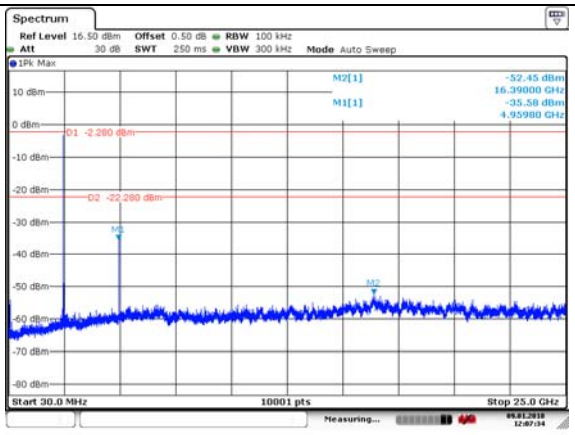


CH19



CH39

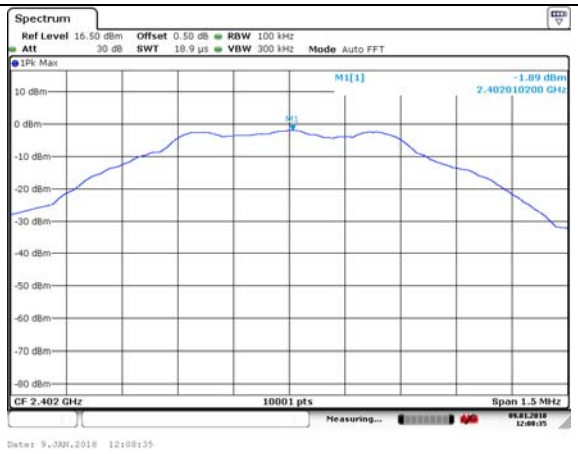


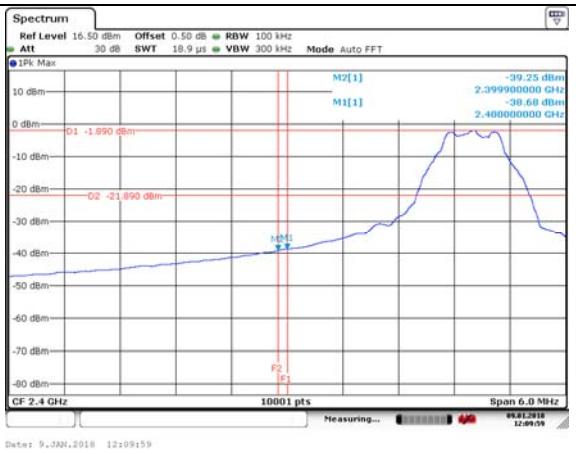


Band edge measurement (RF Conducted measurement)

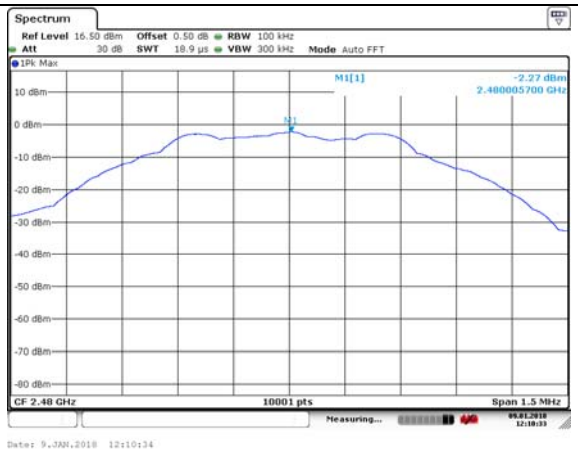
Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

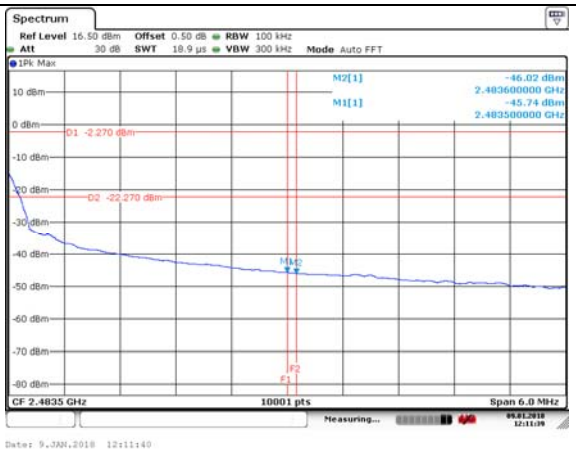
CH0





CH39





APPENDIX B – TEST DATA OF RADIATED EMISSION

Spurious Radiated Emissions

The worst case attitude: The EUT lay down.

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	89.04	55.04	N/A	N/A	8.90	25.10
2	2390	58.46	24.46	-15.54	74.0	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	82.52	48.52	N/A	N/A	8.90	25.10
2	2390	51.55	17.55	-22.45	74.0	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	78.98	44.98	N/A	N/A	8.90	25.10
2	2390	48.44	14.44	-5.56	54.0	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	73.20	39.20	N/A	N/A	8.90	25.10
2	2390	47.82	13.82	-6.18	54.0	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	86.91	52.91	N/A	N/A	8.90	25.10
2	2483.5	57.97	23.97	-16.03	74.0	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	81.21	47.21	N/A	N/A	8.90	25.10
2	2483.5	51.78	17.78	-22.22	74.0	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	73.50	39.50	N/A	N/A	8.90	25.10
2	2483.5	50.21	16.21	-3.79	54.0	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	69.39	35.39	N/A	N/A	8.90	25.10
2	2483.5	50.02	16.02	-3.98	54.0	8.90	25.10

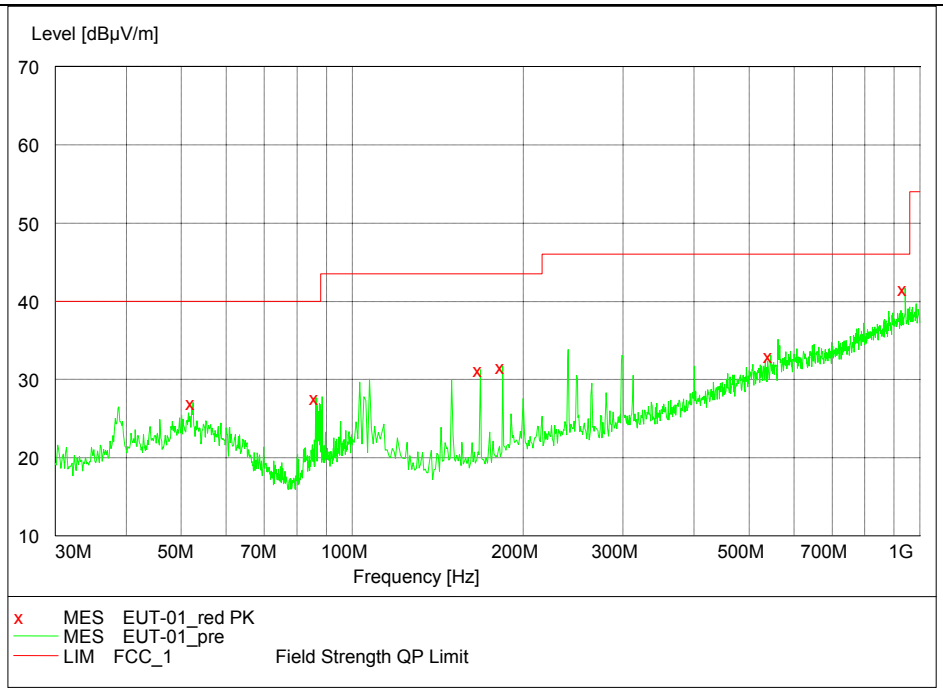
Sample Calculations
Determining Spurious Emissions Levels

A “reference path loss” is established and the A_{Rpl} is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss.
The measurement results are obtained as described below:
Result= $P_{mea} + A_{Rpl}$

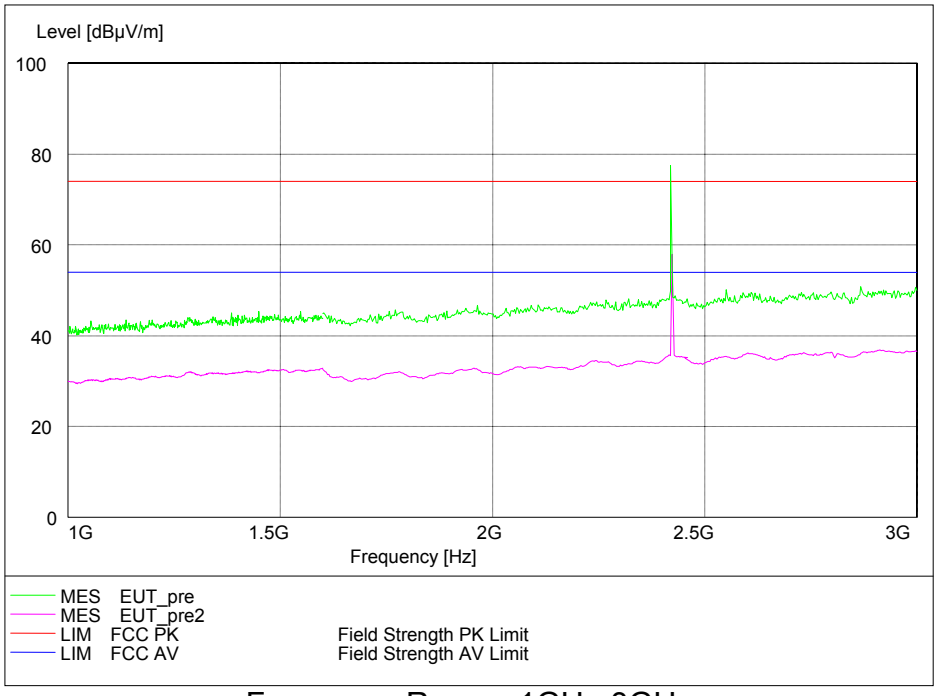
The worst case attitude: The EUT lay down.

For GFSK (LE)
Channel No.:19

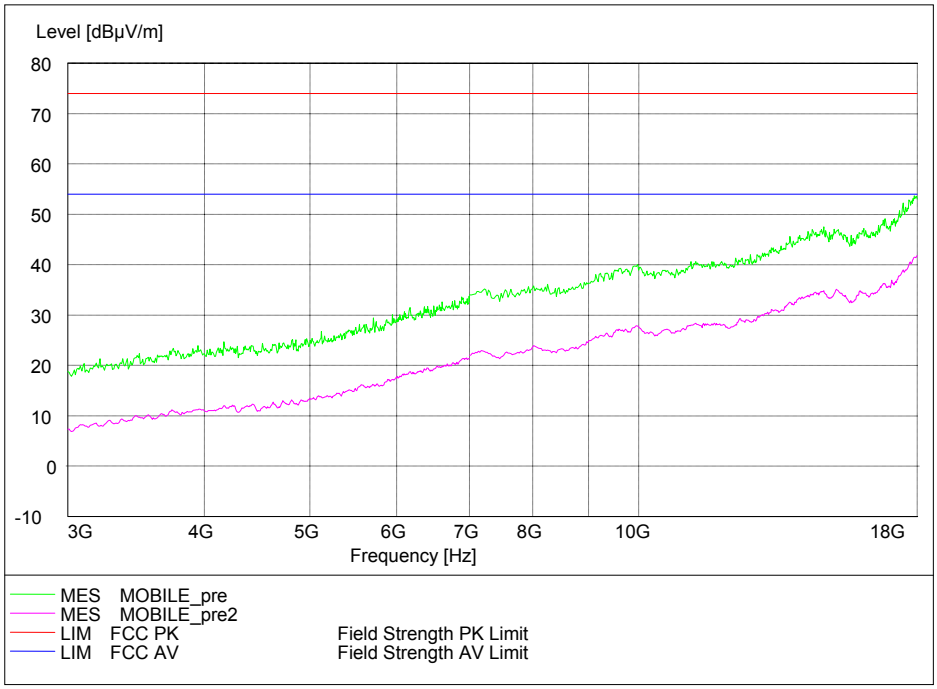
Frequency (MHz)	Result (dBuV/m)	ARpl (dB)	Pmea (dBuV/m)	Polarity	Limit (dBuV/m)
52.44	27.03	21.4	5.63	Vertical	40.0
86.53	27.64	17.0	10.64	Vertical	40.0
168.13	31.24	17.6	13.64	Vertical	43.5
184.16	31.73	18.6	13.13	Vertical	43.5
546.09	33.10	29.0	4.10	Vertical	46.0
941.88	41.67	34.6	7.07	Vertical	46.0



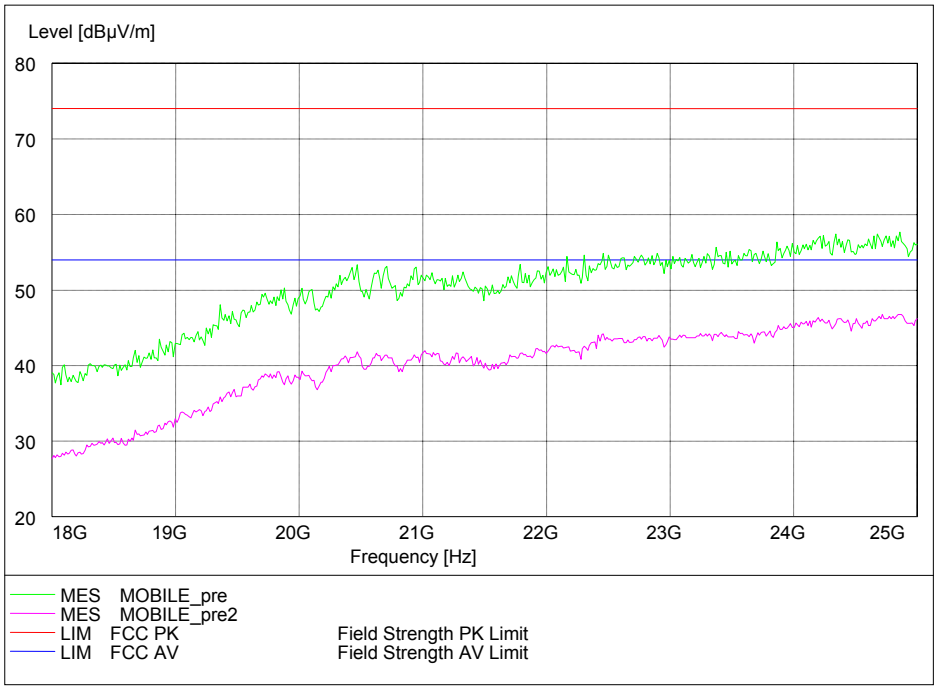
Frequency Range: 30MHz-1000 MHz
Detector: QP mode
Modulation type: GFSK (LE)



Frequency Range: 1GHz-3GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)



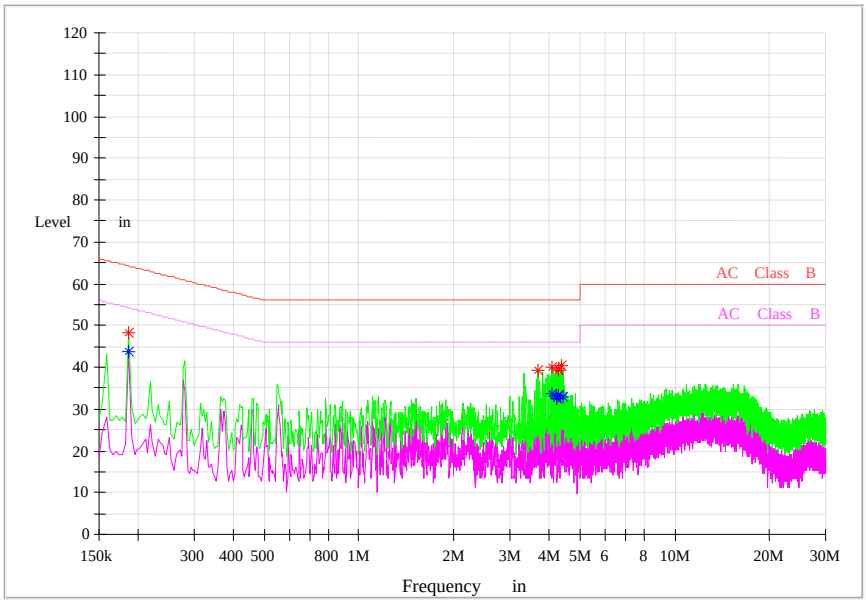
Frequency Range: 3GHz-18GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)



Frequency Range: 18GHz-25GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)

AC Power line Conducted Emission

Full



L Line

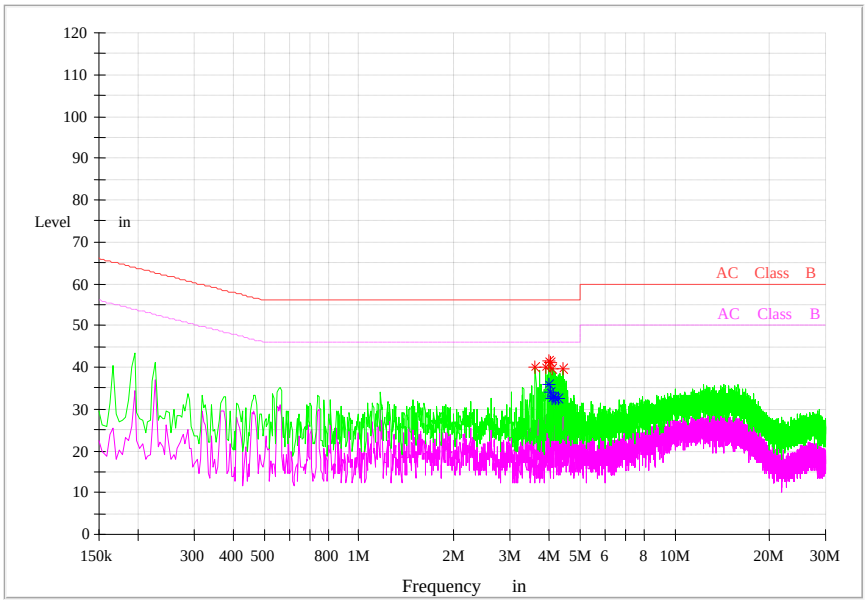
MEASUREMENT RESULT: "EUT_fin QP"

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Corr. (dB)
0.186000	48.26	64.21	15.96	30.1
3.698000	39.33	56.00	16.67	29.9
4.070000	40.07	56.00	15.93	29.9
4.270000	39.46	56.00	16.54	29.9
4.286000	39.07	56.00	16.93	29.9
4.374000	40.20	56.00	15.80	29.9

MEASUREMENT RESULT: "EUT_fin AV"

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Corr. (dB)
0.186000	43.70	54.21	10.51	30.1
4.070000	33.68	46.00	12.32	29.9
4.218000	32.80	46.00	13.20	29.9
4.230000	32.69	46.00	13.31	29.9
4.286000	33.20	46.00	12.80	29.9
4.442000	32.79	46.00	13.21	29.9

Full



N Line

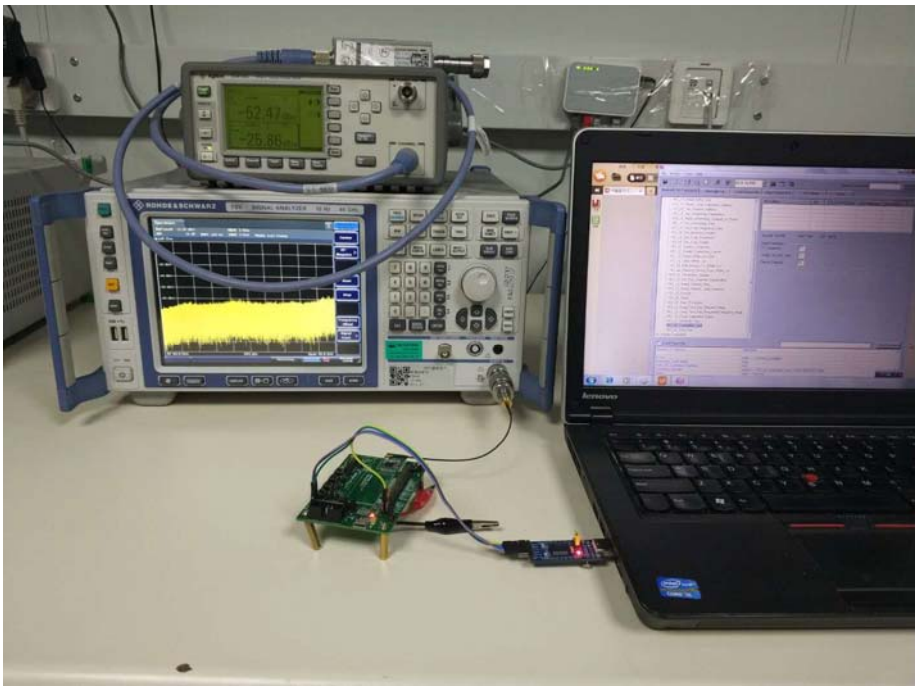
MEASUREMENT RESULT: "EUT_fin QP"

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Corr. (dB)
3.622000	39.85	56.00	16.15	29.9
3.886000	39.85	56.00	16.15	29.9
3.990000	41.55	56.00	14.45	29.9
4.042000	41.00	56.00	15.00	29.9
4.106000	39.56	56.00	16.44	29.9
4.410000	39.56	56.00	16.44	29.9

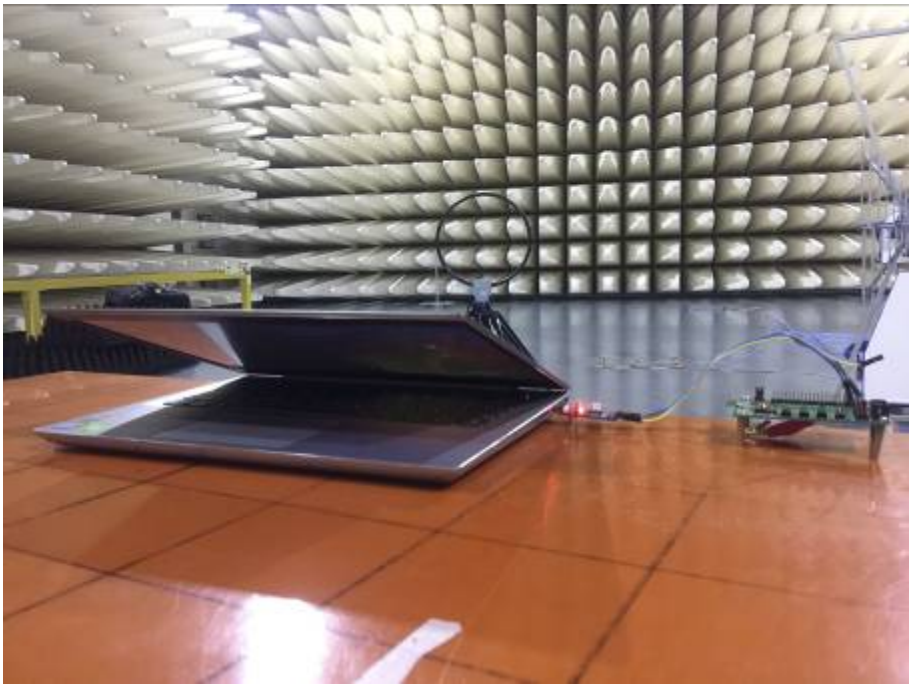
MEASUREMENT RESULT: "EUT_fin AV"

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Corr. (dB)
3.990000	35.90	46.00	10.10	29.9
4.042000	34.05	46.00	11.95	29.9
4.106000	32.37	46.00	13.63	29.9
4.146000	33.00	46.00	13.00	29.9
4.158000	32.37	46.00	13.63	29.9
4.266000	32.37	46.00	13.63	29.9

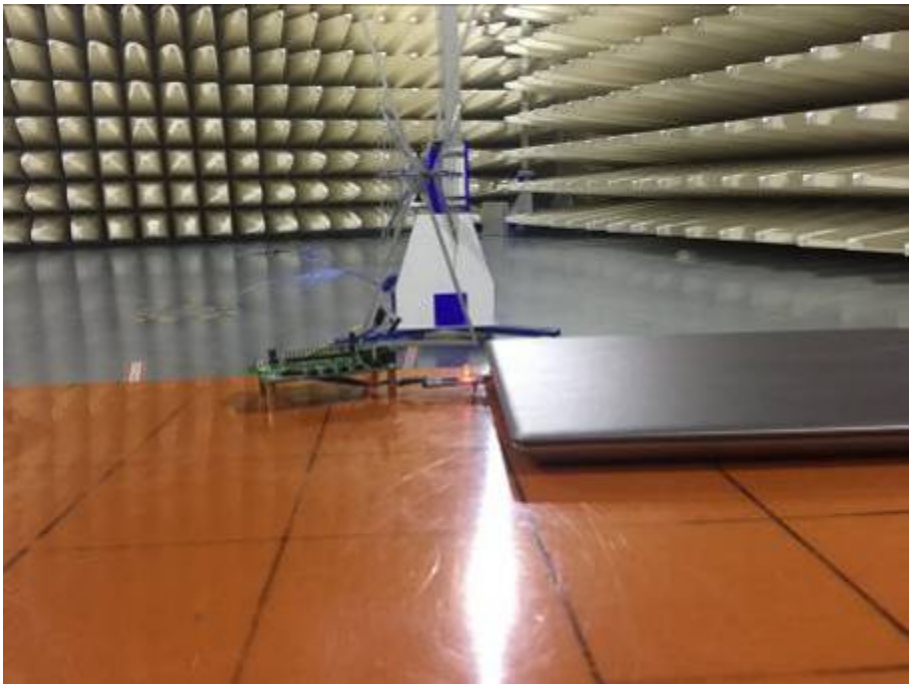
APPENDIX C – TEST SETUP



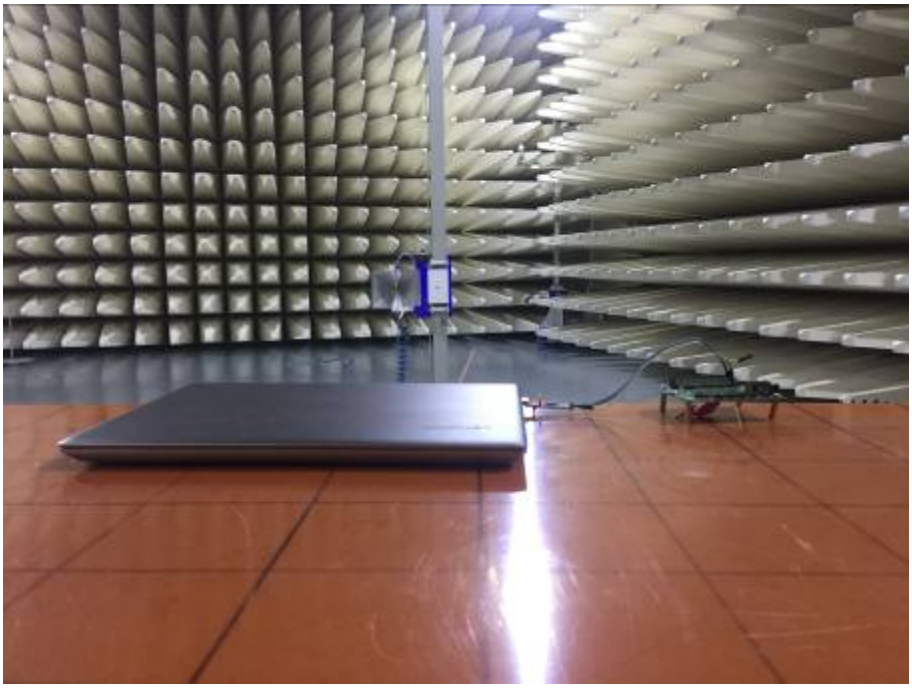
Spurious RF Conducted Emissions Test setup



Spurious Radiated Emissions Test setup (below 30MHz)



Spurious Radiated Emissions Test setup (30MHz~1GHz)



Spurious Radiated Emissions Test setup (1GHz~25GHz)

Conducted Emissions Test Setup（with laptop）

---End of Test Report---