FCC TEST REPORT

According to

CFR 47§15.247

Applicant	:	**ATBS Technology Co.**
Address	:	**3F., No.200, Gangqian Rd., Neihu District, Taipei City 11494, Taiwan.**
Manufacturer	:	**ATBS Technology Co.**
Address	:	**3F., No.200, Gangqian Rd., Neihu District, Taipei City 11494, Taiwan.**
Equipment	:	**BLE TPMS**
Model No.	:	**MS3XX，X=0-9，A-Z，a-z，or blank**
FCC ID	:	**UP5-SC-MS33**
Test Period	:	**Nov.27, 2018~ Dec.24, 2018**

■ The test result refers exclusively to the test presented test model / sample.

■ Without written approval of ***Cerpass Technology (Suzhou) Co., Ltd.*** the test. report shall not be reproduced except in full.

■ The test report must not be used by the clients to claim product certification approval by any agency of the Government.

I **HEREBY** CERTIFY THAT :

The measurements shown in this test report were made in accordance with the procedures given in **ANSI C63.10 – 2013** and the energy emitted by this equipment was ***passed.***
FCC Part 15 in both radiated and conducted emission class B limits. Testing was carried out on Dec 24,2018 at ***Cerpass Technology (Suzhou) Co., Ltd.***

Approved by:

Miro Chueh
EMC/RF Manager

Laboratory Accreditation:
Cerpass Technology Corporation Test Laboratory

☐ **TAF LAB Code: 1439**

Cerpass Technology (SuZhou) Co., Ltd.

☒ **A2LA LAB Code: 4981.01**

Contents

History of this Test Report

Report No.	Version	Issue Date	Description
SEFM1811121	Rev 01	Dec.24, 2018	Original.
SEFM1811121	Rev 02	Feb.27, 2019	Add describe the difference of the model Update Measuring Equipment list
SEFM1811121	Rev 03	Mar.05, 2019	Add the Power sensor software information on page 12

1. Report of Measurements and Examinations

Performed Test Item	Normative References	Test Performed	Deviation	Result
Conducted Emission	FCC CFR Title 47 Part 15 Subpart C Section 15.207	N/A	N/A	N/A
Radiated Emission	FCC CFR Title 47 Part 15 Subpart C Section 15.209	Yes	No	Pass
6dB Bandwidth Measurement	FCC CFR Title 47 Part 15 Subpart C Section 15.247(a)(2)	Yes	No	Pass
Output Power	FCC CFR Title 47 Part 15 Subpart C Section 15.247(b)(3)	Yes	No	Pass
Power Spectral Density	FCC CFR Title 47 Part 15 Subpart C Section 15.247(e)	Yes	No	Pass
Out-of-Band Emissions	FCC CFR Title 47 Part 15 Subpart C Section 15.247(d)	Yes	No	Pass
RF Antenna Conducted Spurious	FCC CFR Title 47 Part 15 Subpart C Section 15.247(d)	Yes	No	Pass
Radiated Emission Band Edge	FCC CFR Title 47 Part 15 Subpart C Section 15.247(d)	Yes	No	Pass

2. General Info

2.1 Description of EUT

Equipment	BLE TPMS
Model No.	MS3XX，X=0-9，A-Z，a-z， or blank
Power supply	DC3V

Note: The model differences is the naming and sales area.

2.2 Description of wireless module

Module Name	CC2540T
Bluetooth Specification	BT4.0(BLE only)
Modulation Type	GFSK
Frequency Range	2402 - 2480 MHz
BT Channel Number	40
Data Rate	1Mbps(GFSK)
Channel Separation	2MHz

Note: For more details, please refer to the EUT User manual.

2.3 Description of Antenna

Antenna	Peak Gain
PCB Antenna	0dBi

2.4 Carrier Frequency of Channels

Bluetooth Working Frequency of Each Channel: (For V4.0)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
00	2402 MHz	01	2404 MHz	02	2406 MHz	03	2408 MHz
04	2410 MHz	05	2412 MHz	06	2414 MHz	07	2416 MHz
08	2418 MHz	09	2420 MHz	10	2422 MHz	11	2424 MHz
12	2426 MHz	13	2428 MHz	14	2430 MHz	15	2432 MHz
16	2434 MHz	17	2436 MHz	18	2438 MHz	19	2440 MHz
20	2442 MHz	21	2444 MHz	22	2446 MHz	23	2448 MHz
24	2450 MHz	25	2452 MHz	26	2454 MHz	27	2456 MHz
28	2458 MHz	29	2460 MHz	30	2462 MHz	31	2464 MHz
32	2466 MHz	33	2468 MHz	34	2470 MHz	35	2472 MHz
36	2474 MHz	37	2476 MHz	38	2478 MHz	39	2480 MHz

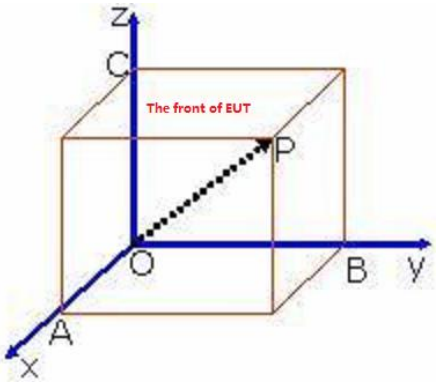
2.5 The Worst Case Configuration

Data rate Configuration:

Modulation Mode	Worst Data Rate
BLE	1Mbps

Note: 1. Power output test was verified over all data rates of each mode, and then choose the maximum power output for final test of each channel shown as the table.

2. EUT is put X,Y,Z three axial assessment test,and Y axial is the worst case,so the EUT is put Y axial for all RF items tested.



2.6 EUT Exercise Software

1	Turn on the power of equipment.
2	Run ‘SmartRF Studio 7’, input RF test command and set the test mode and channel, then press Transmit to start continue transmit.

2.7 Power Parameter Value of the test software

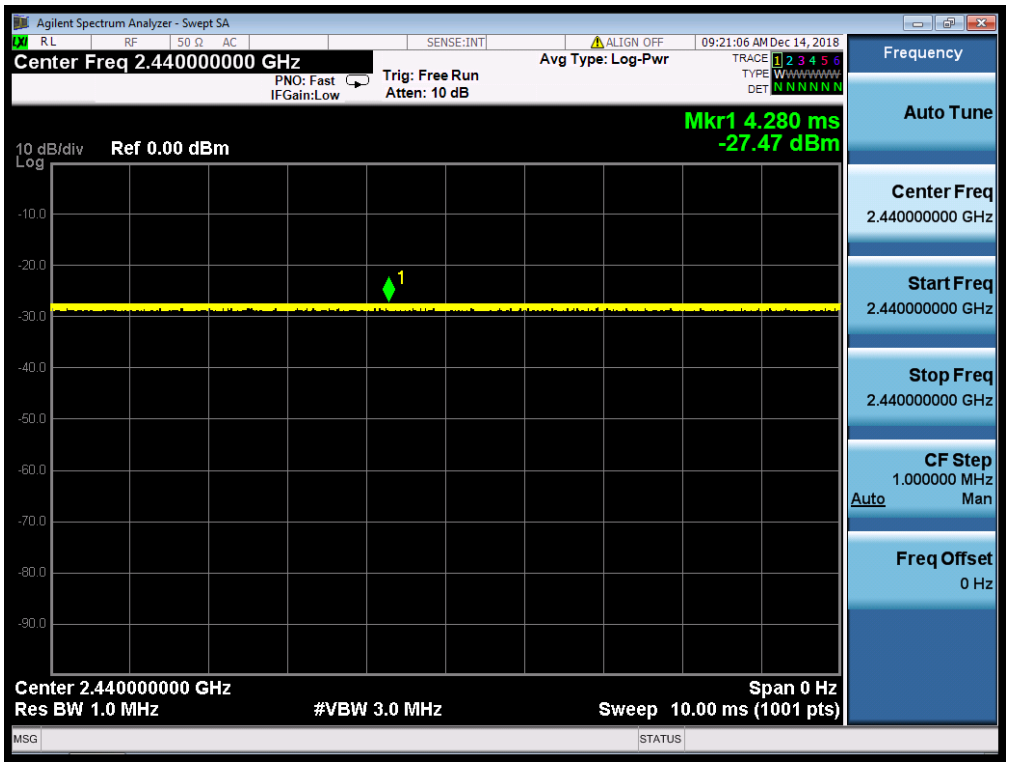
Mode	Frequency (MHz)	Power Setting
BLE	2402	-6
	2440	-6
	2480	-6

2.8 Duty cycle

Test Item	Duty cycle

Mode	Frequency (MHz)	Measurement (%)
BLE	2440	99.99

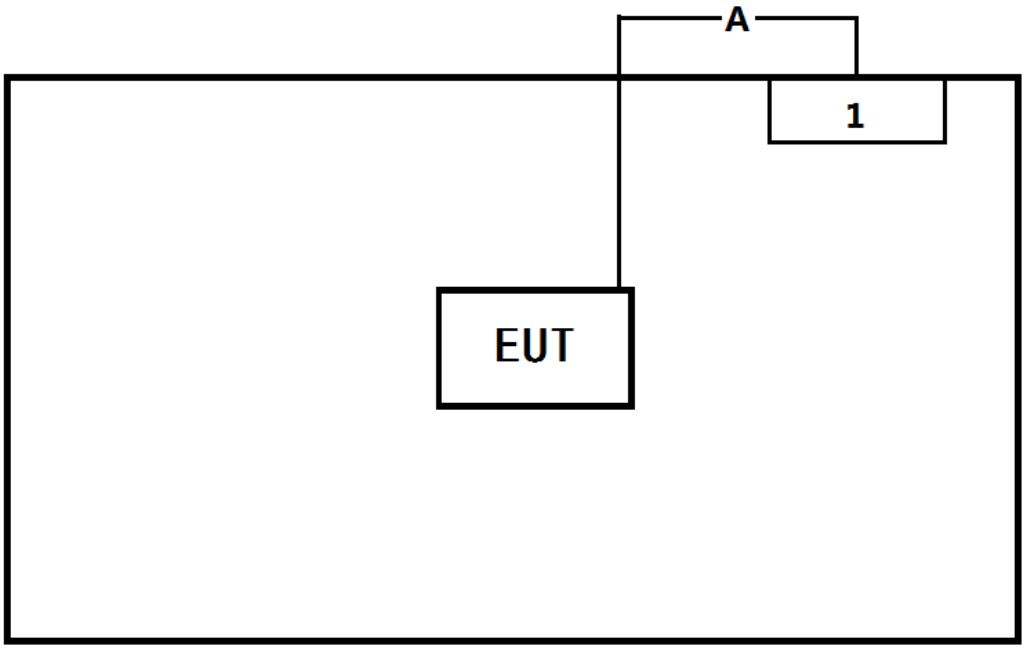
BLE (2440MHz)



2.9 Support equipment

No.	Product	Manufacturer	Model No.	Serial No.
1	Notebook	DELL	Inspiron 15	N/A

Connection Diagram



Signal Cable Type		Signal cable Description
A	USB Cable	0.3m

3. General Information of Test Site

3.1 Information of Test Site

☐	Test Site	**Cerpass Technology Corporation** Address: No.10, Ln. 2, Lianfu St., Luzhu Dist., Taoyuan City 33848, Taiwan (R.O.C.) Tel:+886-3-3226-888 Fax:+886-3-3226-881 Address: No.68-1, Shihbachongsi, Shihding Township, New Taipei City 223, Taiwan, R.O.C. Tel: +886-2-2663-8582
	FCC	TW1079, TW1061
	IC	4934E-1, 4934E-2
	VCCI	T-2205 for Telecommunication Test C-4663 for Conducted emission test R-4399, R-4218 for Radiated emission test G-812, G-813 for radiated disturbance above 1GHz
☒	Test Site	Cerpass Technology (Suzhou) Co.,Ltd Address: No.66,Tangzhuang Road, Suzhou Industrial Park, Jiangsu 215006, China Tel: +86-512-6917-5888 Fax: +86-512-6917-5666
	FCC	232863
	A2LA	4981.01
	IC	7290A-1, 7290A-2
	VCCI	T-1945 for Telecommunication Test C-2919 for Conducted emission test R-2670 for Radiated emission test G-227 for radiated disturbance above 1GHz
Frequency Range Investigated:		Conducted: from 150kHz to 30 MHz Radiation: from 30 MHz to 40000MHz
Test Distance :		The test distance of radiated emission below 1GHz from antenna to EUT is 3 M. The test distance of radiated emission above 1GHz from antenna to EUT is 3 M.

3.2 Measuring Equipment

Instrument/Ancillary	Manufacturer	Model No.	Serial No.	Calibration Date	Valid Date.
Test Receiver	R&S	ESCI	100565	2018.07.18	2019.07.17
AMN	R&S	ESH2-Z5	100182	2018.08.26	2019.08.25
Two-Line V-Network	R&S	ENV216	100325	2018.12.12	2019.12.11
Pulse Limiter	R&S	ESH3-Z2	100529	2018.03.21	2019.03.20
Temperature/ Humidity Meter	Zhicheng	ZC1-11	CEP-TH-004	2018.03.23	2019.03.22
EZ-EMC	Fala	Ver CT3A1	N/A	N/A	N/A

Instrument/Ancillary	Manufacturer	Model No.	Serial No.	Calibration Date	Valid Date.
EMI Test Receiver	R&S	ESCI	101183	2018.07.05	2019.07.04
Preamplifier	songyi	EM330	60618	2018.03.21	2019.03.20
Preamplifier	Agilent	8449B	3008A02342	2018.03.21	2019.03.20
Loop Antenna	R&S	HFH2-Z2	100150	2018.11.03	2019.11.02
Bilog Antenna	Sunol Science	JB1	A072414-1	2018.07.07	2019.07.06
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	9120D-618	2018.04.21	2019.04.20
Broad-Band Horn Antenna	Schwarzbeck	BBHA9170	9170-348	2018.06.05	2019.06.04
Preamplifier	COM-POWER	PA-840	711885	2018.06.01	2019.05.31
Spectrum Analyzer	R&S	FSP40	100324	2018.11.02	2019.11.01
Spectrum Analyzer	Agilent	N9010A	MY53400169	2018.12.12	2019.12.11
USB Wideband Power Sensor	Boonton	55006	9778	2018.06.14	2019.06.13
Software: Boonton Peak Power Analyzer Suite		Version:2.3.6.0	N/A	N/A	N/A
Temperature/ Humidity Meter	Zhicheng	ZC1-11	CEP-TH-002	2018.03.23	2019.03.22
EZ-EMC	Fala	Ver CT3A1	N/A	N/A	N/A

3.3 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2).

RF Conducted Measurement

Test Item		Uncertainty	Limit
Radio Frequency		±8.7X10^{-7}	±1X10^{-5}
RF output power, conducted		±0.63dB	±1.5dB
Power density, conducted		±1.21dB	±3dB
Unwanted emissions, conducted	30-1000MHz	±0.51dB	±3dB
	1-25GHz	±0.67dB	±3dB
All emissions, radiated	30-1000MHz	±2.28dB	±6dB
	1-25GHz	±2.59dB	±6dB
Temperature		±0.8℃	±1℃
Humidity		±3%	±5%
DC and low frequency voltages		±3%	±3%

AC Conducted Measurement

Measurement	Frequency	Uncertainty
Conducted emissions(LINE)	9KHz-30MHz	+/- 0.7738 dB
Conducted emissions(NEUTRAL)	9KHz-30MHz	+/- 0.7886 dB
Conducted emissions(10Mbps)	150KHz-30MHz	+/- 1.3013dB
Conducted emissions(100Mbps)	150KHz-30MHz	+/- 1.3197 dB
Conducted emissions(1000Mbps)	150KHz-30MHz	+/- 1.2987 dB

Radiated Measurement

Measurement	Polarity	Frequency	Uncertainty
Radiated emissions	Horizontal	below 1GHz	+/- 3.8936 dB
	Vertical	below 1GHz	+/- 3.8928 dB
	Horizontal	above 1GHz	+/- 5.18858dB
	Vertical	above 1GHz	+/- 5.18928 dB

4. AC Conducted Emission Measurement

4.1 Test Limit

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 KHz on the 120 VAC power and return leads of the EUT according to the methods defined in ANSI C63.10-2013 Section 6.2. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane as shown in section 6.2.2.The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions.

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	**Quasi Peak (dB μ V)**	**Average (dB μ V)**
0.15 – 0.5	66-56*	56-46*
0.5 – 5.0	56	46
5.0 – 30.0	60	50

*Decreases with the logarithm of the frequency.

4.2 Test Standard

Tested according to ANSI C63.10: 2013 Section 6.2 for compliance to FCC 47CFR 15.247 Part15.207 (a) requirements.

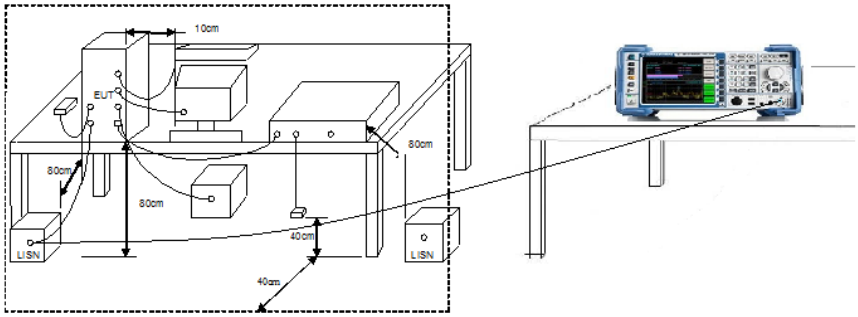
4.3 Test Procedures

The EUT was placed on a platform of nominal size, 1 m by 1.5 m, raised 80 cm above the conducting ground plane. The vertical conducting plane was located 40 cm to the rear of the EUT. All other surfaces of EUT were at least 80 cm from any other grounded conducting surface. The EUT and simulators are connected to the main power through a line impedance stabilization network (LISN). The LISN provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN. (Please refer to the block diagram of the test setup and photographs) Each current-carrying conductor of the EUT power cord, except the ground (safety) conductor, was individually connected through a LISN to the input power source.

The excess length of the power cord between the EUT and the LISN receptacle were folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

4.4 Test Setup Layout



4.5 Test Result

The EUT is powered by battery, so this project does not need to be evaluated.

5. Radiated Emission Measurement

5.1 Test Limit

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter measurement is based on the maximum conducted output power, the attenuation required under this paragraph shall be 30dB instead of 20dB. In addition, radiated emissions which fall in section 15.205(a) the restricted bands must also comply with the radiated emission limit specified in section 15.209(a).

FCC Part 15 Subpart C Paragraph 15.209		
FREQUENCIES (MHz)	**FIELD STRENGTH (micro volts/meter)**	**MEASUREMENT 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

Note 1: The lower limit shall apply at the transition frequency.
Note 2: Distance refers to the distance in meters between the measuring instrument Antenna and the closed point of any part of the device or system.
Note 3: E field strength (dBuV/m) = 20 log E field strength (uV/m)
Note 4: **Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permItted under other sections of this part, e.g., §§15.231 and 15.241.

5.2 Test Standard

KDB 558074 D01v05r01 - Section 8.5&8.6

5.3 Test Procedures

Quasi-Peak Field Strength Measurements:

The specifications for measurements using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Frequency Interference (CISPR) of the International Electrotechnical Commission.

As an alternative to CISPR quasi-peak measurement, compliance can be demonstrated to the applicable emission limits using a peak detector.

Peak Field Strength Measurements:

Analyzer center frequen was set to the frequency of the radiated spurious emission of interest

1. RBW=As specified in Table 1
2. VBW=3×RBW
3. Detector=Peak
4. Trace mode=Max hold
5. Sweep time=Auto couple
6. Allow the trace to stabilize

Table 1-RBW as a function of frequency

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

AVE Field Strength Measurements:

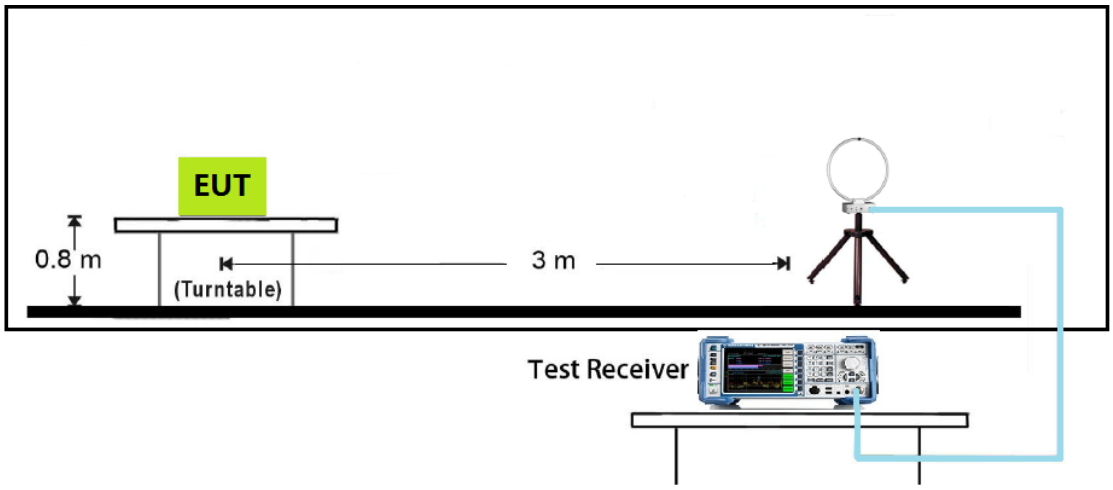
Analyzer center frequen was set to the frequency of the radiated spurious emission of interest

1. RBW= 1MHz
2. VBW≥1/T
3. Detector=Peak
4. Trace mode=Max hold
5. Sweep time=Auto couple
6. Allow max hold to run for at least 50 times(1/duty cycle) trace

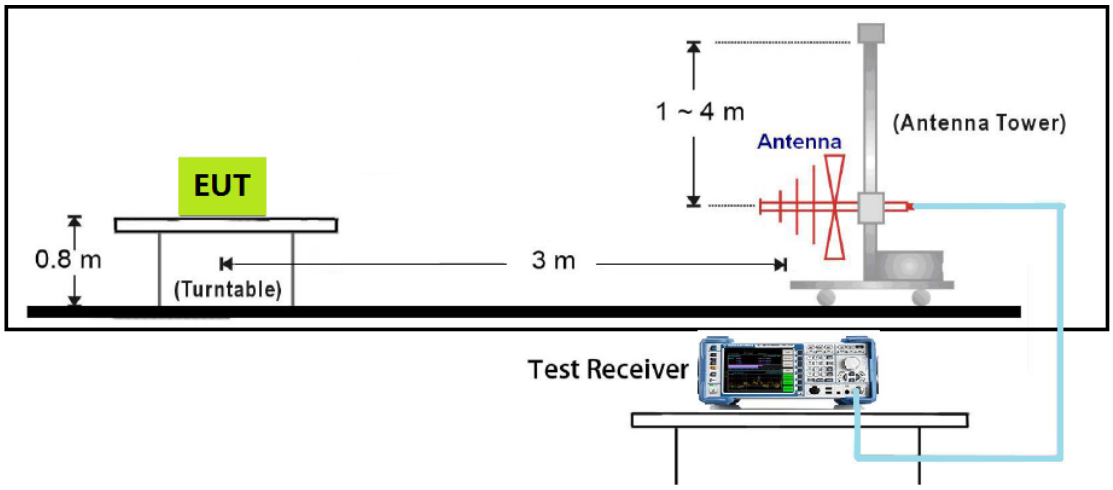
Do as an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode in order to accomplish this. Others have a setting for Average-VBW Type, which can be set to “Voltage” regardless of the display mode

5.4 Test Setup Layout

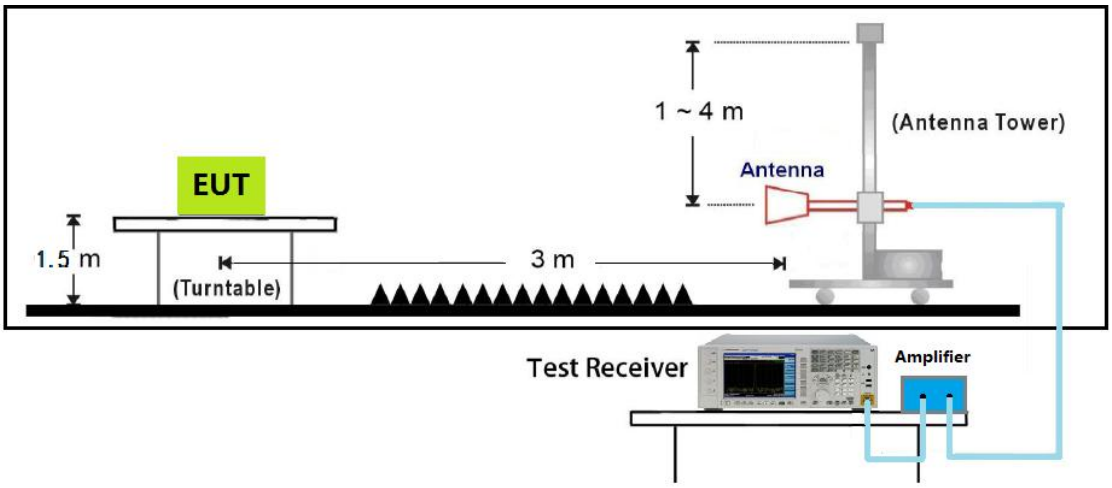
9kHz~30MHz Test Setup



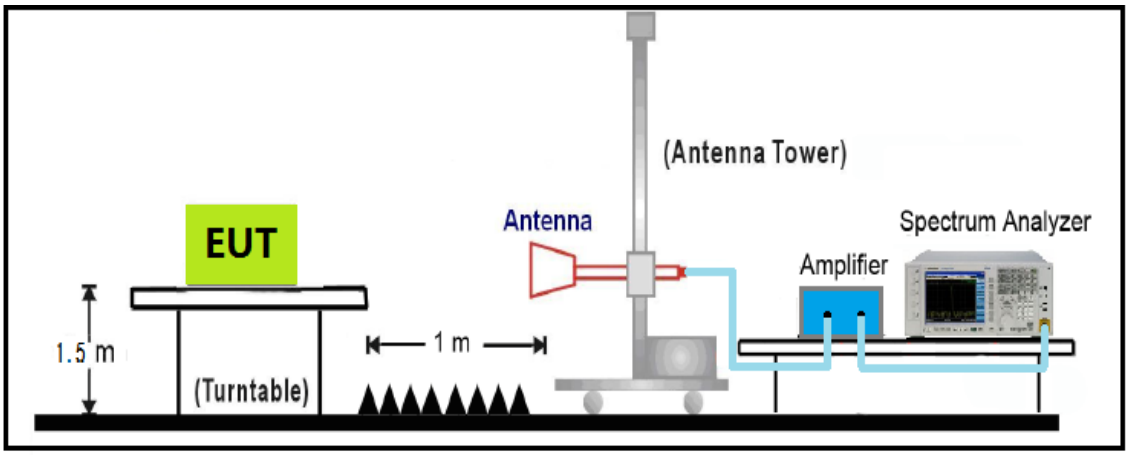
30MHz~1GHz Test Setup



1GHz~18GHz Test Setup



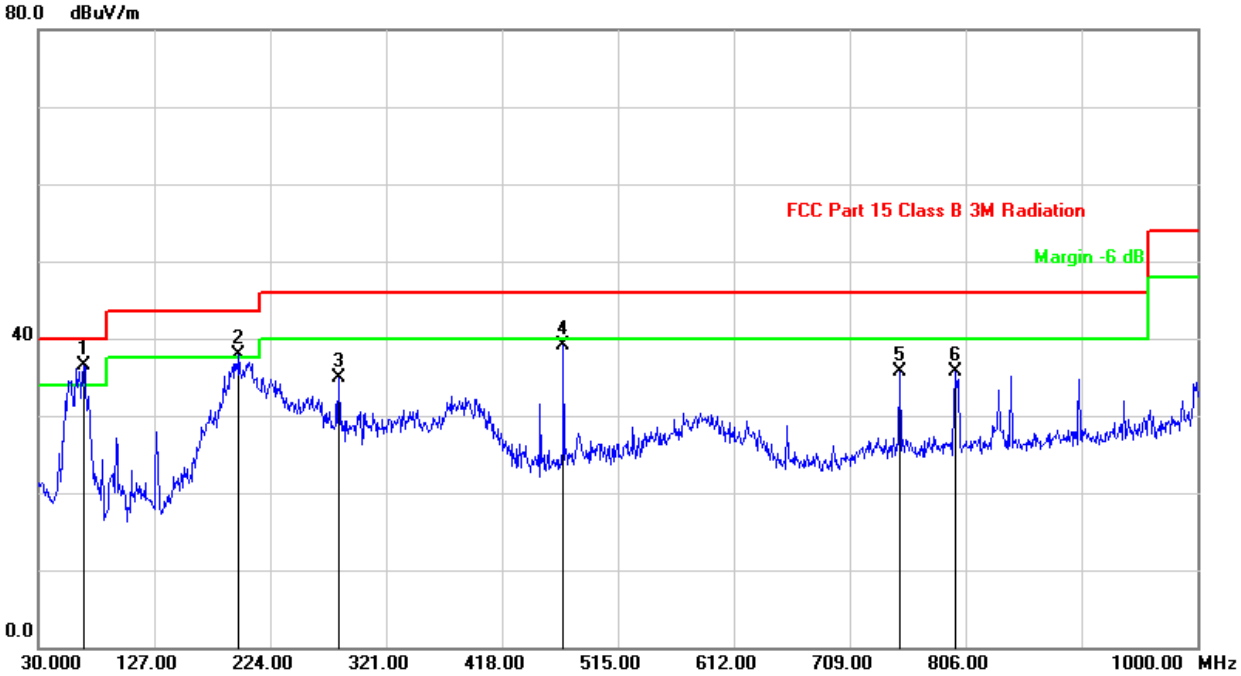
18GHz~40GHz Test Setup



5.5 Test Result

The worst case of Radiated Emission below 1GHz:

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: CBL6112D (30-1000MHz)	Polarity: Horizontal
EUT: BLE TPMS	Power: DC 3V
Note: Mode1: Transmit at channel 2402MHz by BLE	

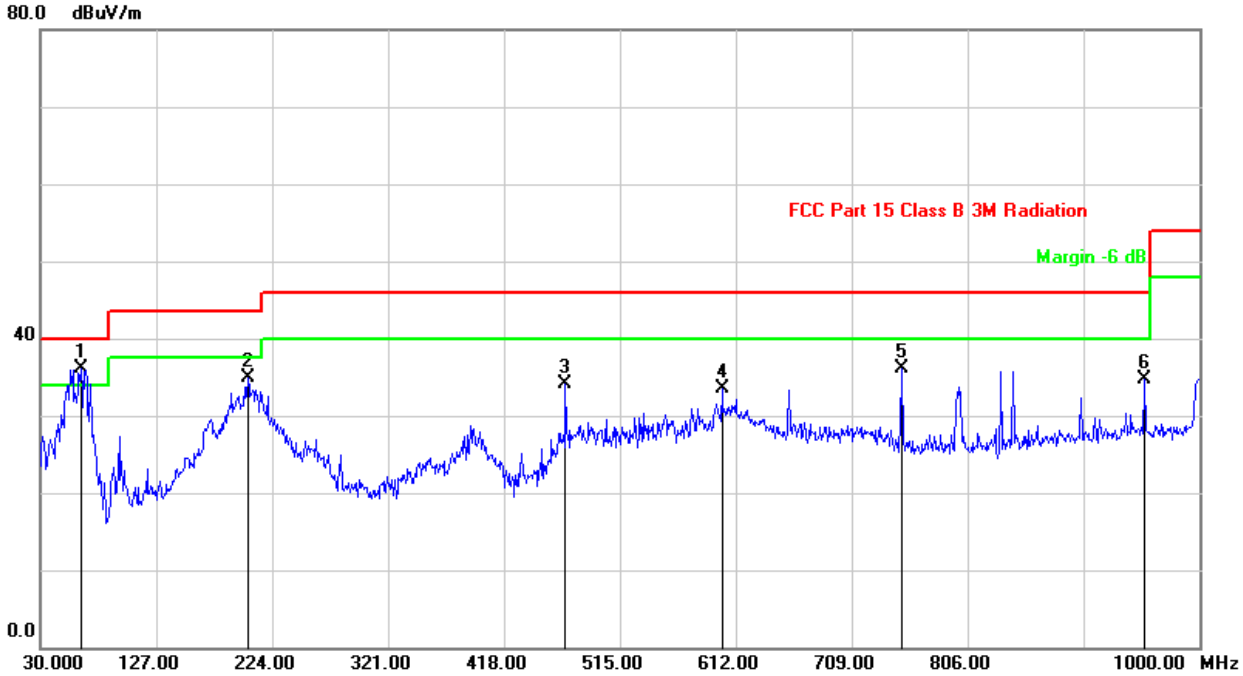


No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.	Height (cm)	Azimuth (deg)	Remark
1	67.8299	-17.18	53.75	36.57	40.00	-3.43	peak	100	34	
2	197.8100	-12.94	50.87	37.93	43.50	-5.57	peak	100	46	
3	281.2300	-10.70	45.56	34.86	46.00	-11.14	peak	100	61	
4	469.4100	-7.77	46.85	39.08	46.00	-6.92	peak	100	320	
5	750.7100	-2.19	37.93	35.74	46.00	-10.26	peak	100	29	
6	797.2698	-1.24	36.92	35.68	46.00	-10.32	peak	100	11	

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor(dB).

Factor (dB)=Cable Loss(dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain(dB)

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: CBL6112D (30-1000MHz)	Polarity: Vertical
EUT: BLE TPMS	Power: DC 3V
Note: Mode1: Transmit at channel 2402MHz by BLE	



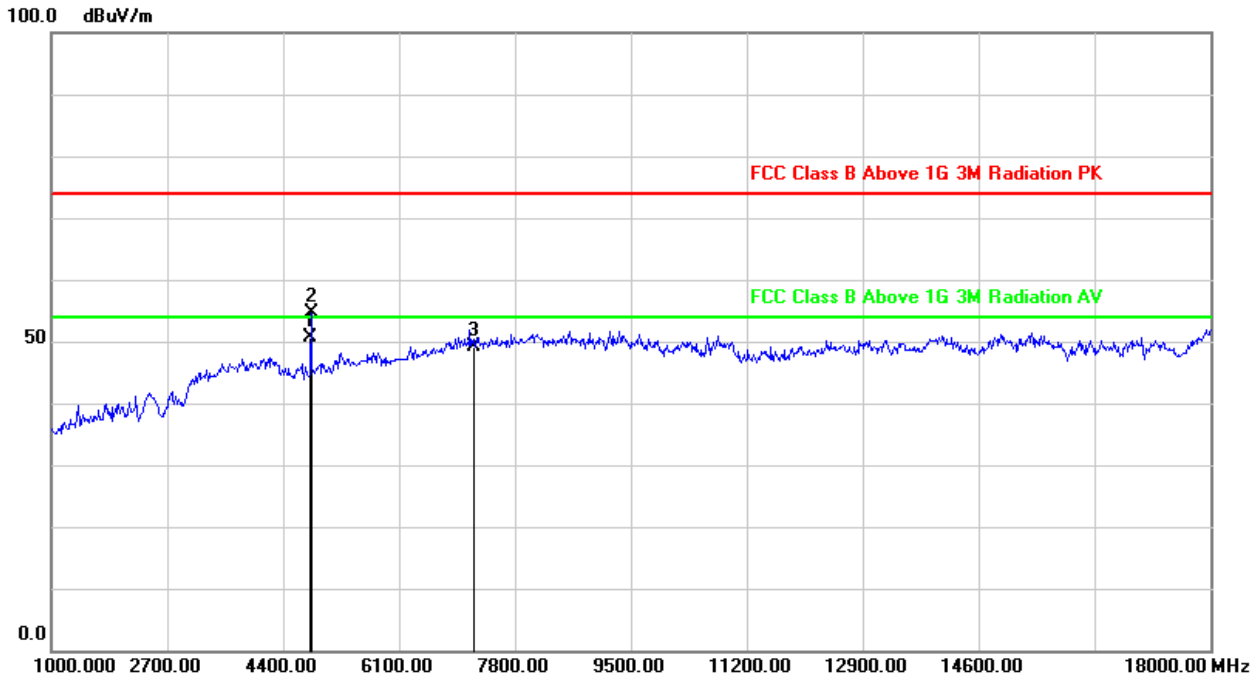
No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.	Height (cm)	Azimuth (deg)	Remark
1	63.9500	-15.54	51.72	36.18	40.00	-3.82	peak	100	92	
2	203.6300	-13.16	48.03	34.87	43.50	-8.63	peak	100	53	
3	469.4100	-7.77	41.86	34.09	46.00	-11.91	peak	100	343	
4	600.3600	-4.76	38.36	33.60	46.00	-12.40	peak	100	360	
5	750.7100	-2.19	38.32	36.13	46.00	-9.87	peak	100	343	
6	954.4100	1.01	33.61	34.62	46.00	-11.38	peak	100	98	

Note: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor(dB).

Factor (dB)=Cable Loss(dB) + Antenna Factor (dB/m) - Pre_Amplifier Gain(dB)

The worst case of Radiated Emission Above 1GHz:

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: BLE TPMS	Power: DC 3V
Note: Mode：Transmits at 2402MHz by BLE	



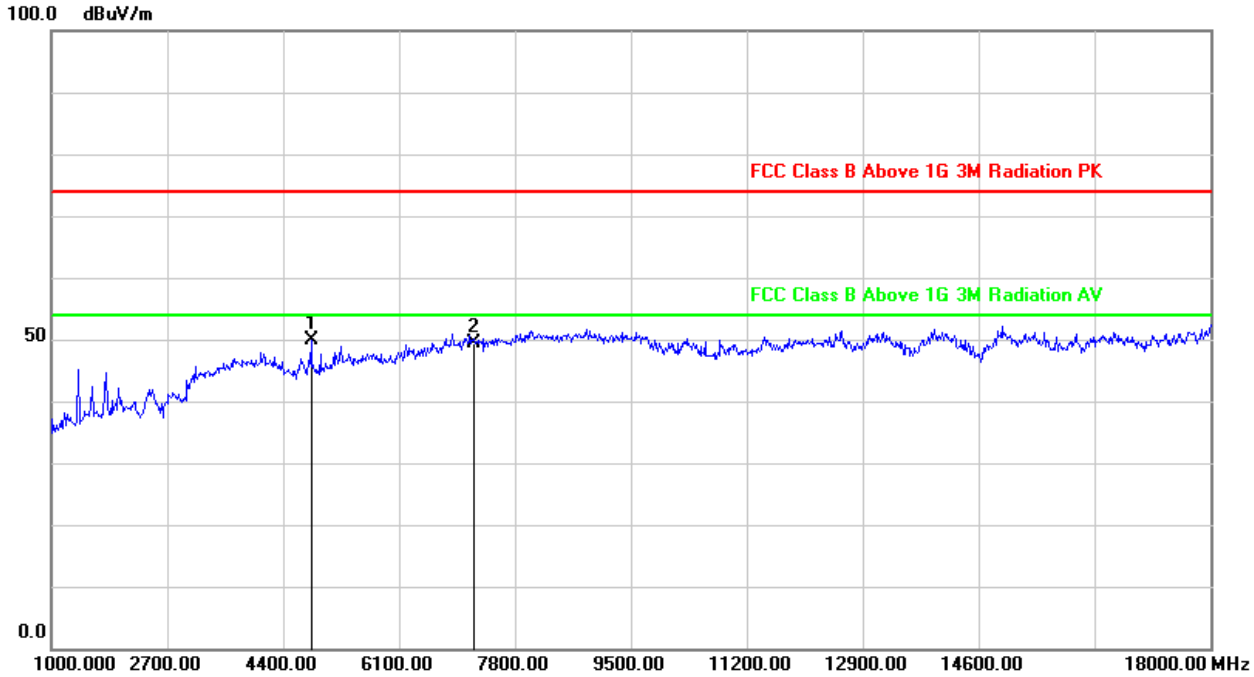
No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.	Height (cm)	Azimuth (deg)	Remark
1	4804.180	3.28	47.47	50.75	54.00	-3.25	AVG	200	330	
2	4808.000	3.29	51.24	54.53	74.00	-19.47	peak	200	315	
3	7206.000	8.19	41.06	49.25	74.00	-24.75	peak	200	125	

Note: 1. Measure Level = Reading Level + Factor.

2. The test trace is same as the ambient noise (the test frequency range: 9kHz~30MHz, 18GHz~25GHz), therefore no data appear in the report.

3. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: BLE TPMS	Power: DC 3V
Note: Mode：Transmits at 2402MHz by BLE	



No.	Frequency (MHz)	Factor (dB/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.	Height (cm)	Azimuth (deg)	Remark
1	4808.000	3.29	46.66	49.95	74.00	-24.05	peak	200	336	
2	7206.000	8.19	41.20	49.39	74.00	-24.61	peak	200	115	

Note: 1. Measure Level = Reading Level + Factor.

2. The test trace is same as the ambient noise (the test frequency range: 9kHz~30MHz, 18GHz~25GHz), therefore no data appear in the report.

3. This limit applies for using average detector, if the test result on peak is lower than average limit, then average measurement needn't be performed.

Test engineer: Kerry Zhou

6. 6dB Bandwidth Measurement

6.1 Test Limit

According to FCC part15.247 - Section (a)(2), the minimum 6dB bandwidth shall be at least 500 kHz.

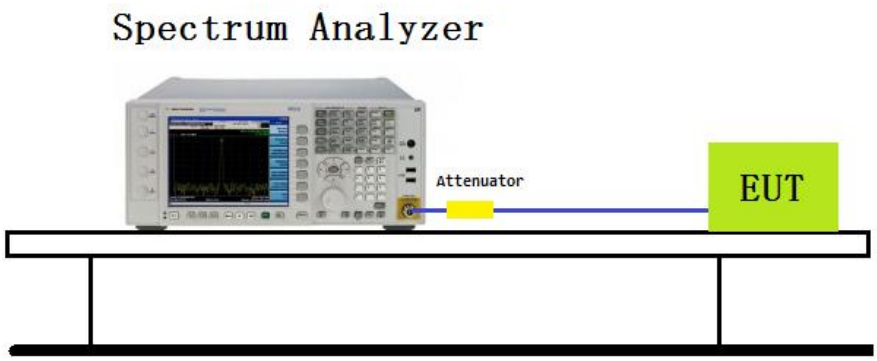
6.2 Test Standard

KDB 558074 D01v05r01– Section 8.2

6.3 Test Procedures

1. Set RBW=100KHz
2. VBW≥3×RBW
3. Detector=Peak
4. Trace mode=Max hold
5. Sweep time=Auto couple
6. Allow the trace to stabilize
7. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.

6.4 Test Setup Layout

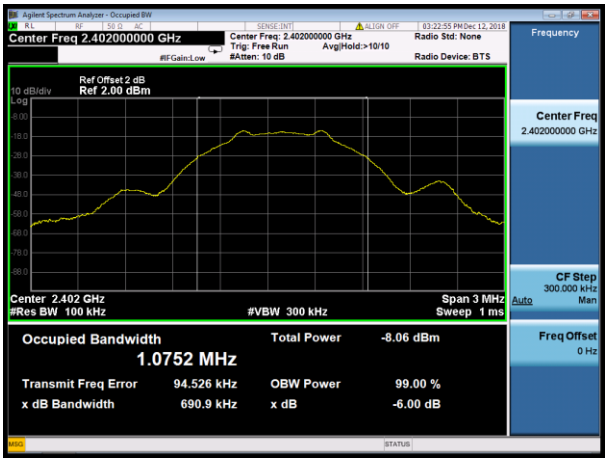


6.5 Test Result

Test Item	6dB Bandwidth
Test Mode	Mode 1: Transmit by BLE

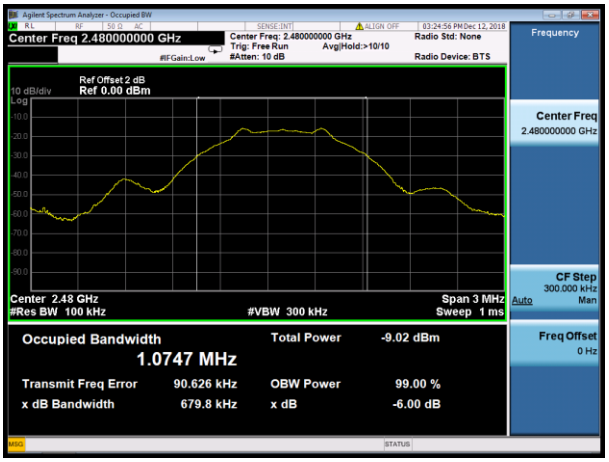
Channel No.	Frequency(MHz)	6dB Bandwidth(KHz)	99% Bandwidth(MHz)
0	2402	690.9	1.0752
19	2440	694.3	1.0762
39	2480	679.8	1.0747

Channel 0 (2402MHz)



Channel 19 (2440MHz)

Channel 39 (2480MHz)



Test engineer: Kerry Zhou

7. Output Power Measurement

7.1 Test Limit

According to FCC part15.247 (b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
Per RSS247 Issue 2 Section 5.4(d), for DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W.

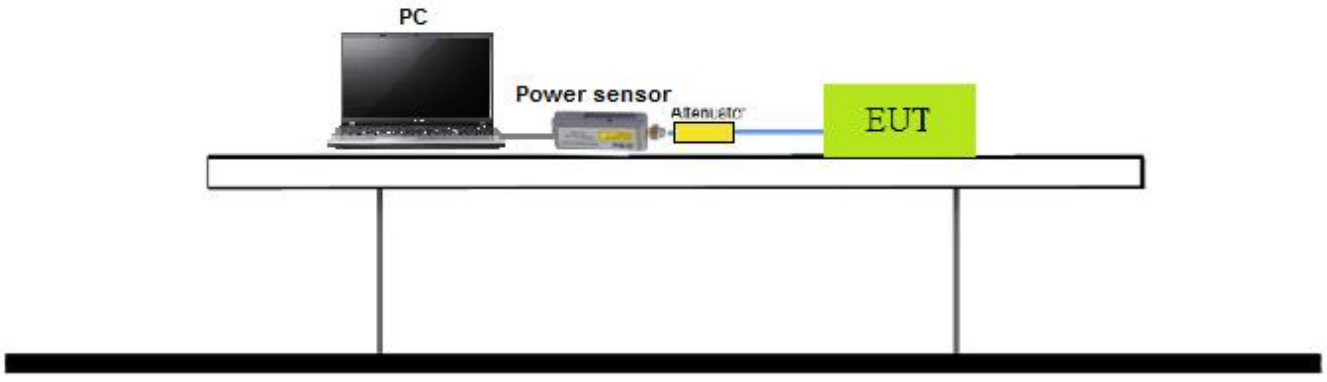
7.2 Test Standard

KDB 558074 D01v05r01 - Section 8.3.1.3

7.3 Test Procedures

Out power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

7.4 Test Setup Layout



7.5 Test Result

For Peak Power :

Test Mode	Channel No.	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	Result
BLE	0	2402	-13.32	30	Pass
	19	2440	-13.08	30	Pass
	39	2480	-13.44	30.	Pass

Test engineer: 

8. Power Spectral Density Measurement

8.1 Test Limit

According to FCC part15.247 - Section (e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

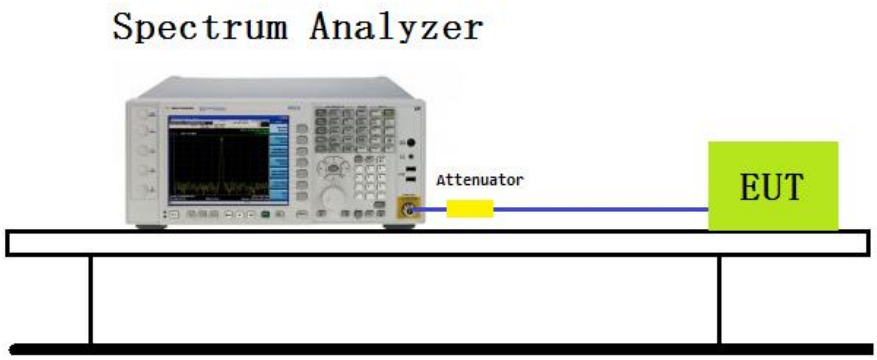
8.2 Test Standard

KDB 558074 D01v05r01- Section 8.4

8.3 Test Procedures

1. Set RBW=3kHz
2. Set RBW=10kHz
3. Span = 1.5 times the DTS channel bandwidth
4. Detector=Peak
5. Trace mode=Max hold
6. Sweep time=Auto couple
7. Allow the trace to stabilize
8. Analyzer was set to the center frequency of the DTS channel under investigation.

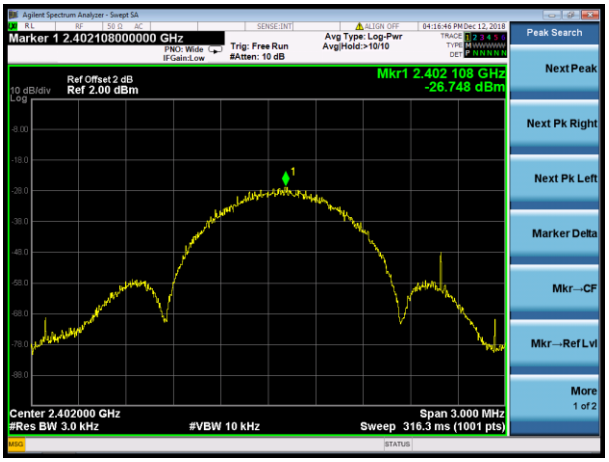
8.4 Test Setup Layout



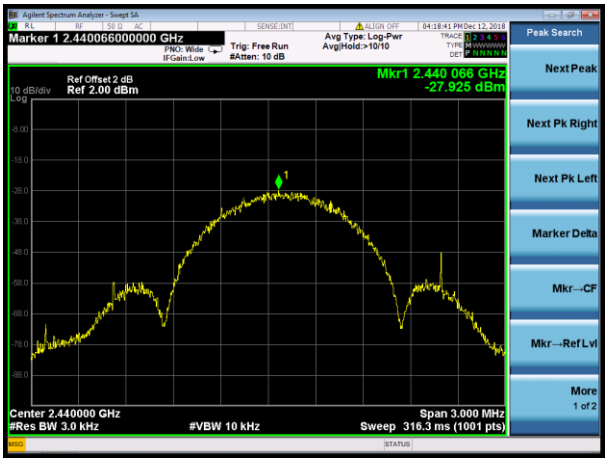
8.5 Test Result

Test Mode	Channel No.	Frequency(MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
BLE	0	2402	-26.748	8	Pass
	19	2440	-27.925	8	Pass
	39	2480	-26.718	8	Pass

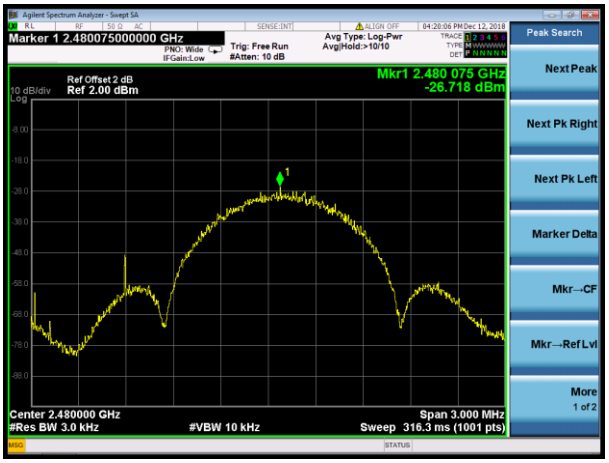
Channel 0 (2402MHz)



Channel 19 (2440MHz)



Channel 39 (2480MHz)



Test engineer: Kerry Zhou

9. Conducted Band Edge and Out-of-Band Emissions Measurement

9.1 Test Limit

According to FCC part 15.247(d) , in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) of FCC part 15 is not required.

9.2 Test Standard

KDB 558074 D01v05r01 - Section 8.7

9.3 Test Procedures

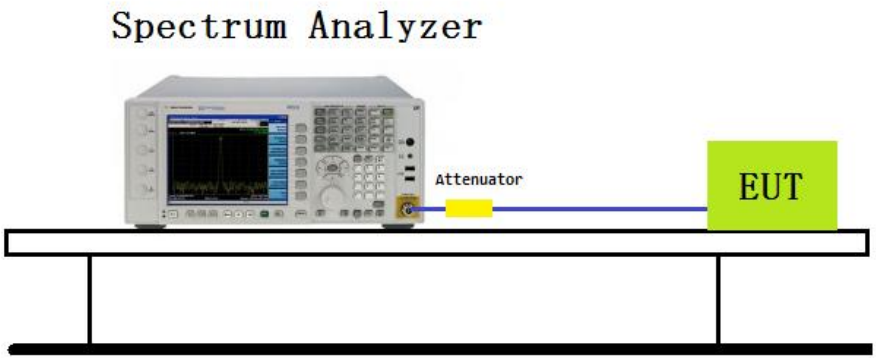
Reference level measurement:

1. Set the RBW = 100 kHz
2. Set the VBW ≥ 3 x RBW
3. Set the span to ≥ 1.5 times the DTS bandwidth
4. Detector = peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. Allow trace to fully stabilize
8. Set instrument center frequency to DTS channel center frequency

Emission level measurement:

1. RBW = 100kHz
2. VBW = 300kHz
3. Detector = Peak
4. Trace mode = max hold
5. Sweep time = auto couple
6. The trace was allowed to stabilize
7. Set the center frequency and span to encompass frequency range to be measured

9.4 Test Setup Layout

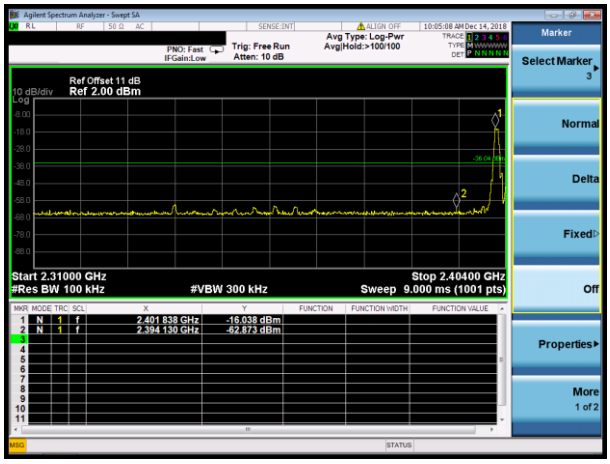


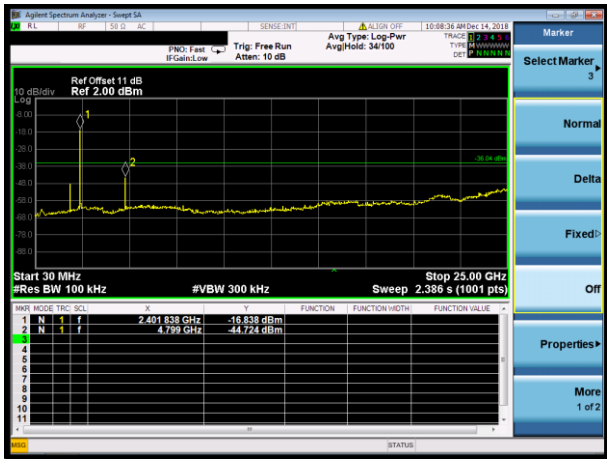
9.5 Test Result

Test Mode	Channel No.	Frequency (MHz)	Limit	Result
BLE	0	2402	20dBc	Pass
	19	2440	20dBc	Pass
	39	2480	20dBc	Pass

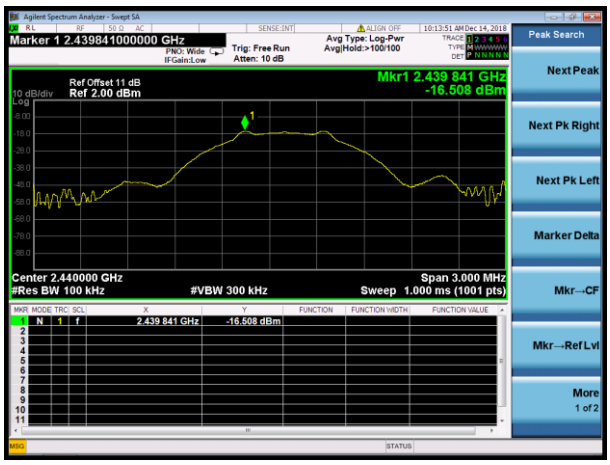
Test Item	:	Conducted Band Edge and Out-of-Band Emissions
Test Mode	:	Mode 1: Transmit by BLE

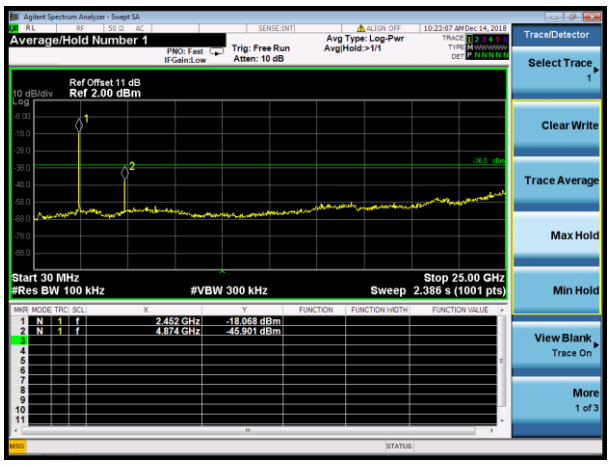
Mode 1: Transmit by BLE (2402MHz)



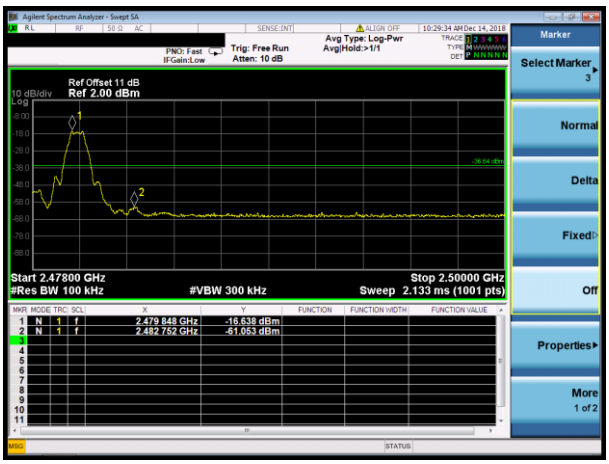


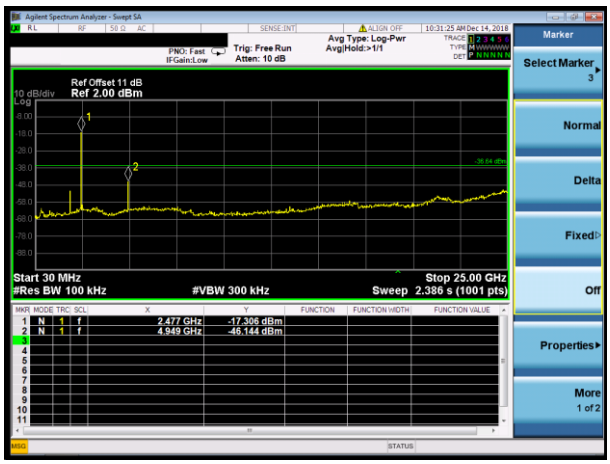
Mode 1: Transmit by BLE (2440MHz)





Mode 1: Transmit by BLE (2480MHz)





Test engineer: Kerry Zhou

10. Radiated Emission Band Edge Measurement

10.1 Test Limit

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part 15, must also comply with the radiated emission limits specified in Section 15.209(a) of FCC part 15.

10.2Test Standard

ANSI C63.10-2013 Section 6.10.5

10.3 Test Procedure

Peak Field Strength Measurements:

Analyzer center frequen was set to the frequency of the radiated spurious emission of interest

7. RBW=As specified in Table 1
8. VBW=3×RBW
9. Detector=Peak
10. Trace mode=Max hold
11. Sweep time=Auto couple
12. Allow the trace to stabilize

Table 1-RBW as a function of frequency

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

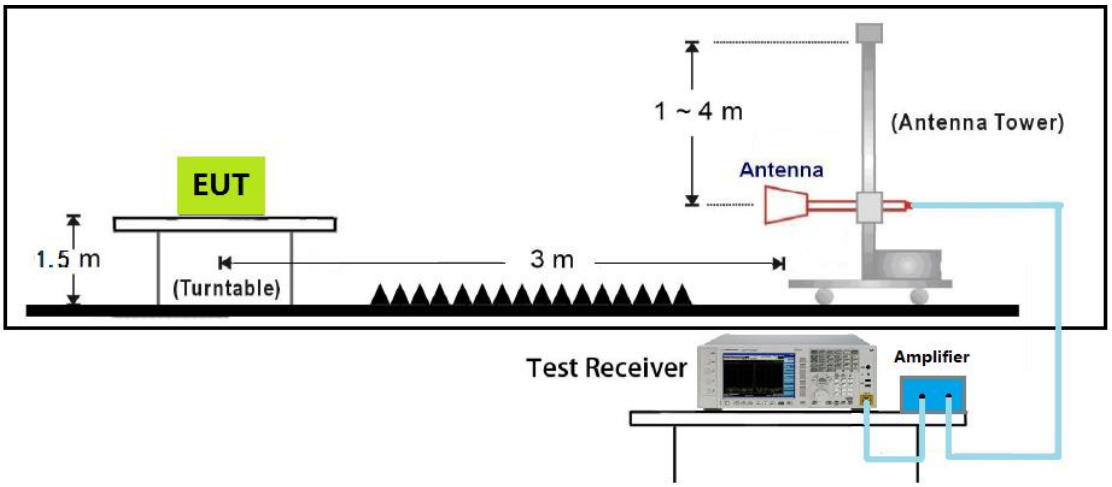
AVE Field Strength Measurements:

Analyzer center frequen was set to the frequency of the radiated spurious emission of interest

7. RBW= 1MHz
8. VBW≥1/T
9. Detector=Peak
10. Trace mode=Max hold
11. Sweep time=Auto couple
12. Allow max hold to run for at least 50 times(1/duty cycle) trace

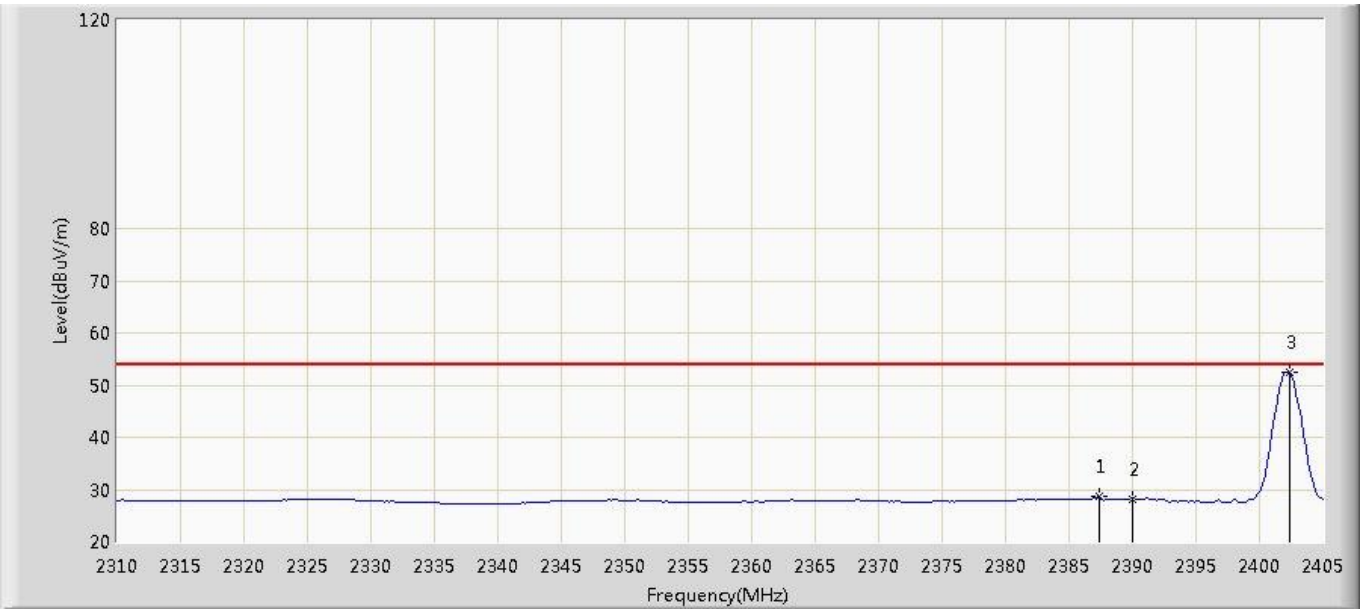
Do as an alternative, the instrument may be set to linear detector mode. Ensure that video filtering is applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode in order to accomplish this. Others have a setting for Average-VBW Type, which can be set to “Voltage” regardless of the display mode

10.4 Test Setup Layout



10.5 Test Result

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: N/A	Polarity: Horizontal
EUT: BLE TPMS	Power: DC 3V
Mode: Transmit at 2402MHz by BLE	

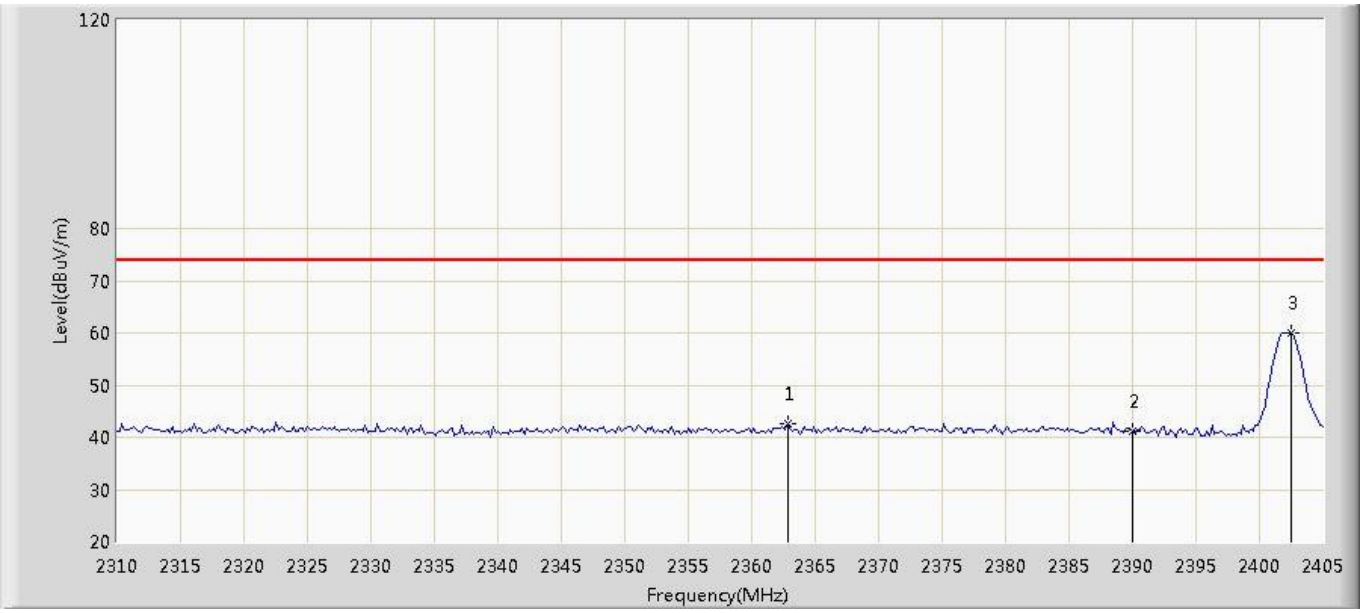


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2387.330	28.558	30.245	-25.442	54.000	-1.687	AV
2		2390.000	28.259	29.936	-25.741	54.000	-1.677	AV
3	*	2402.340	52.490	54.122	N/A	N/A	-1.632	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: N/A	Polarity: Horizontal
EUT: BLE TPMS	Power: DC 3V
Mode: Transmit at 2402MHz by BLE	

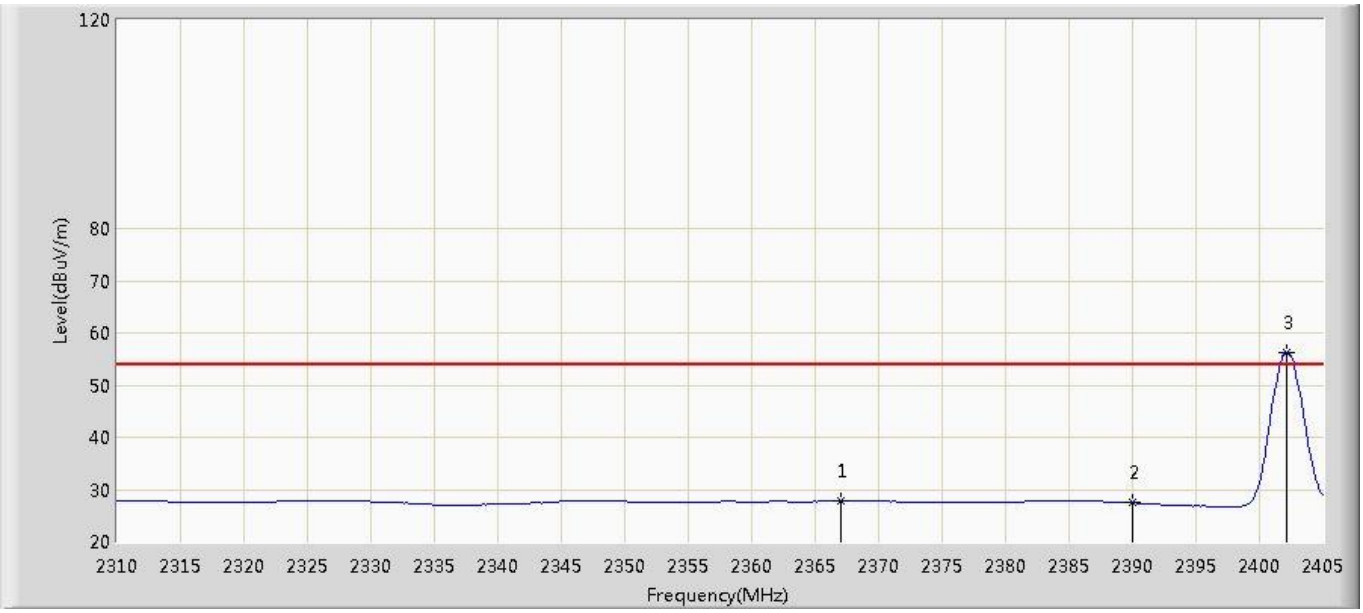


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2362.820	42.550	44.328	-31.450	74.000	-1.778	PK
2		2390.000	41.278	42.955	-32.722	74.000	-1.677	PK
3	*	2402.530	60.029	61.660	N/A	N/A	-1.631	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: N/A	Polarity: Vertical
EUT: BLE TPMS	Power: DC 3V
Mode: Transmit at 2402MHz by BLE	

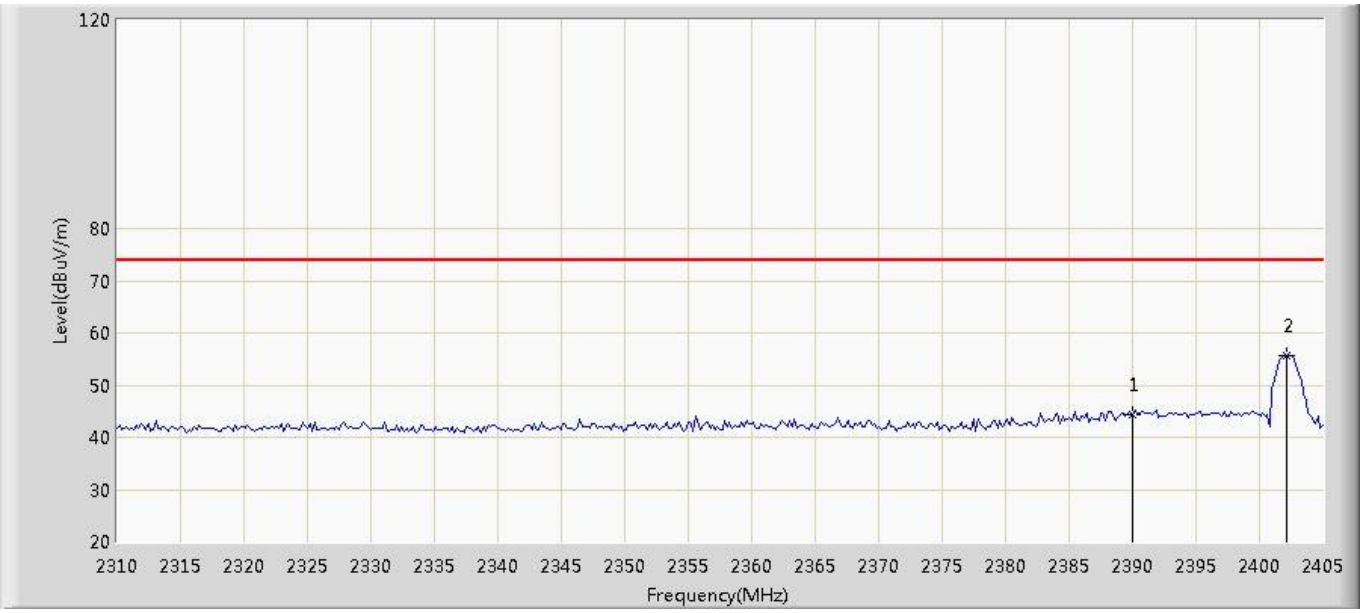


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2367.000	27.726	29.489	-26.274	54.000	-1.763	AV
2		2390.000	27.430	29.107	-26.570	54.000	-1.677	AV
3	*	2402.150	56.333	57.965	N/A	N/A	-1.632	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: N/A	Polarity: Vertical
EUT: BLE TPMS	Power: DC 3V
Mode: Transmit at 2402MHz by BLE	

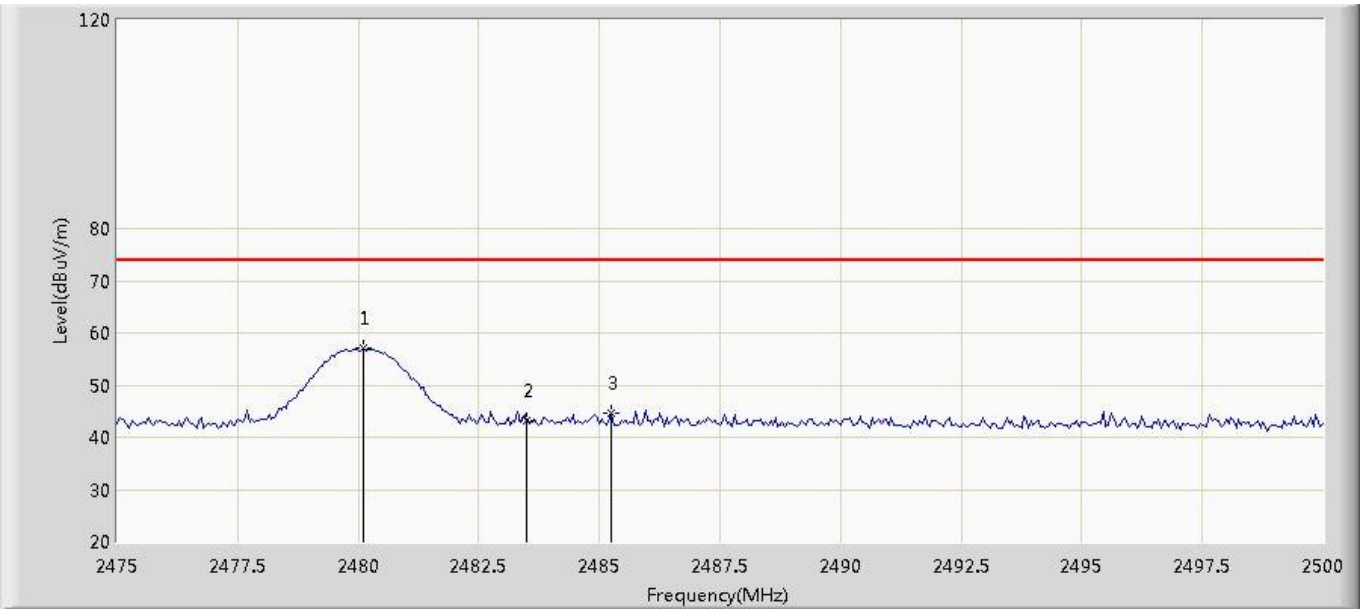


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2390.000	44.294	45.971	-29.706	74.000	-1.677	PK
2	*	2402.150	55.621	57.253	N/A	N/A	-1.632	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: N/A	Polarity: Horizontal
EUT: BLE TPMS	Power: DC 3V
Mode: Transmit at 2480MHz by BLE	

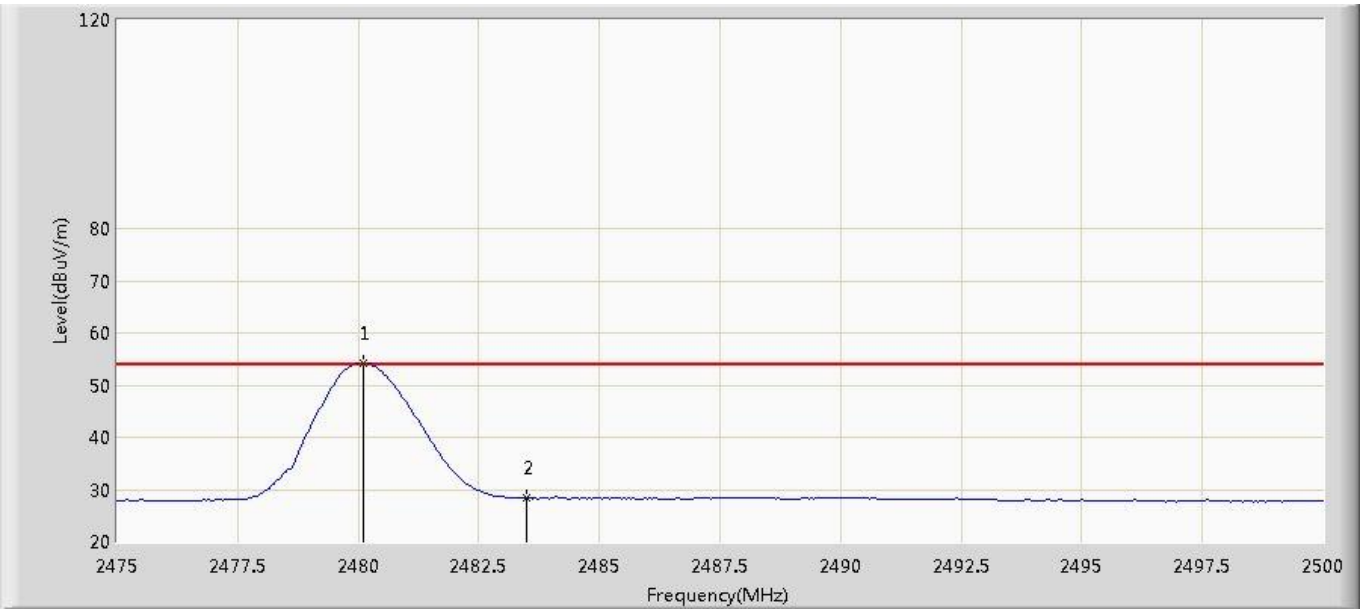


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.100	56.973	58.316	N/A	N/A	-1.343	PK
2		2483.500	43.220	44.551	-30.780	74.000	-1.331	PK
3		2485.250	44.695	46.019	-29.305	74.000	-1.324	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: N/A	Polarity: Horizontal
EUT: BLE TPMS	Power: DC 3V
Mode: Transmit at 2480MHz by BLE	

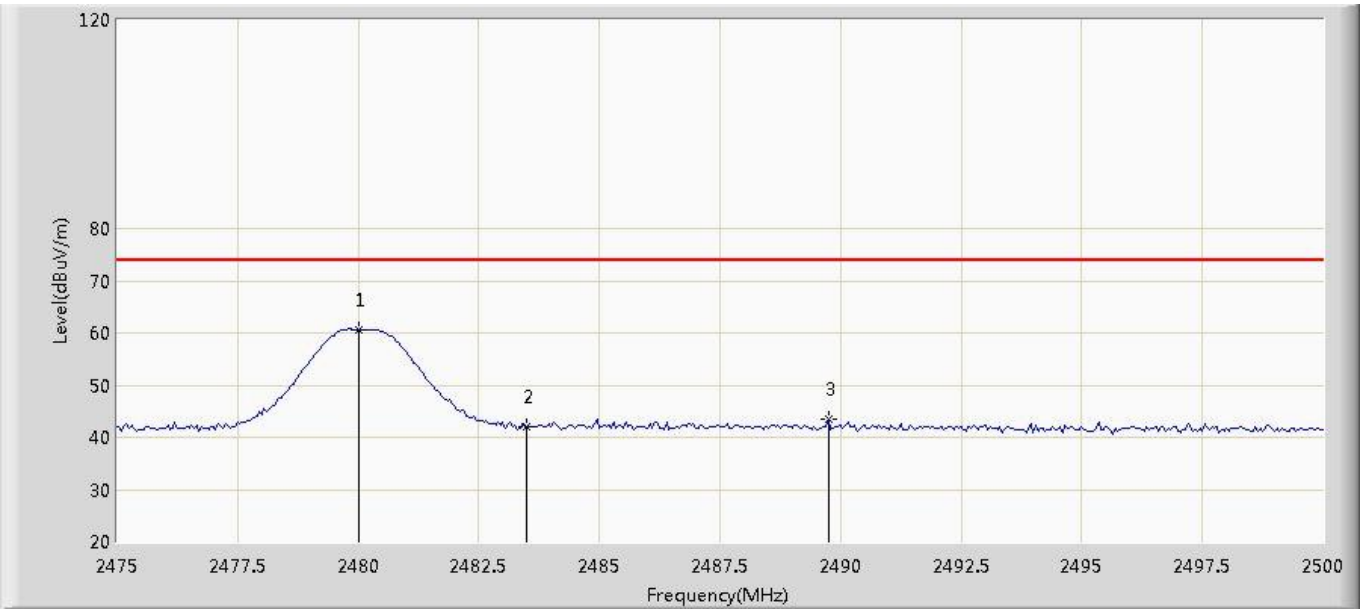


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.100	54.265	55.608	N/A	N/A	-1.343	AV
2		2483.500	28.311	29.642	-25.689	54.000	-1.331	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: N/A	Polarity: Vertical
EUT: BLE TPMS	Power: DC 3V
Mode: Transmit at 2480MHz by BLE	

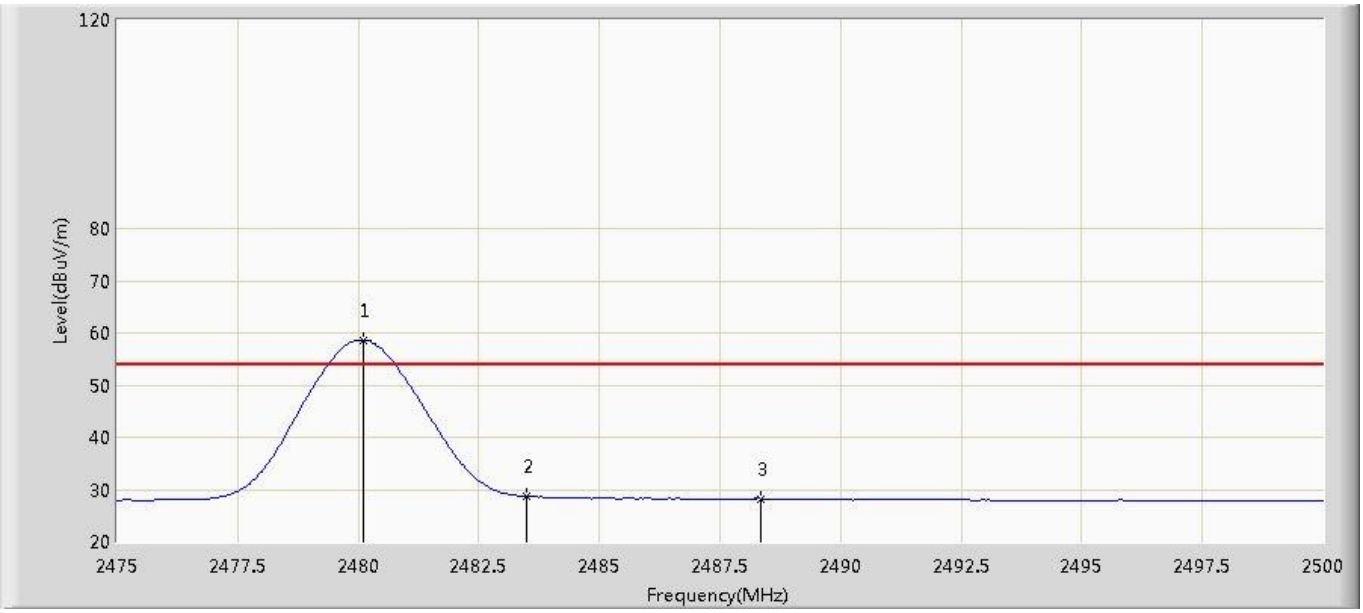


No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.000	60.587	61.931	N/A	N/A	-1.344	PK
2		2483.500	41.959	43.290	-32.041	74.000	-1.331	PK
3		2489.750	43.390	44.698	-30.610	74.000	-1.308	PK

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: N/A	Polarity: Vertical
EUT: BLE TPMS	Power: DC 3V
Mode: Transmit at 2480MHz by BLE	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2480.100	58.623	59.966	N/A	N/A	-1.343	AV
2		2483.500	28.653	29.984	-25.347	54.000	-1.331	AV
3		2488.350	28.257	29.570	-25.743	54.000	-1.313	AV

Note:

1. All Readings below 1GHz are Quasi-Peak, above are performed with peak and/or average measurements as necessary.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Factor(Probe+Cable-Amp).

Test engineer: Kerry Zhou

Annex A (TEST SETTING PHOTOGRAPHS OF EUT)

Annex B (EXTERNAL PHOTOGRAPHS OF EUT)

Annex C (INTERNAL PHOTOGRAPHS OF EUT)

The End