Product Service

FCC - TEST REPORT

Report Number	: 4840117273900	Date of Issue:	December 4, 2017

Model	: MLBT001
Product Type	: BLUETOOTH MODULE
FCC ID	: 2AOA9MLBT001
Applicant	: JIANGSU MULIN INTELLIGENCE ELECTRIC., LTD
Address	: No.10 Bangshang Rd, Cuibei Industrial Zone, Wujin Town,
	: 213101, Changzhou Jiangsu, People's Republic of China
Production Facility	: JIANGSU MULIN INTELLIGENCE ELECTRIC., LTD
Address	: No.10 Bangshang Rd, Cuibei Industrial Zone, Wujin Town,
	: 213101, Changzhou Jiangsu, People's Republic of China

Test Result	: ■ **Positive** ☐ **Negative**
Total pages including Appendices	: 40

TÜV SÜD CHINA

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch No.16 Lane, 1951 Du Hui Road, Shanghai 201108, P.R. China
FCC Registration Number:	904822
Telephone:	+86 21 6037 9100
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3 Description of the Equipment under Test

Description of the Equipment Under Test

Product:	BLUETOOTH MODULE
Model no.:	MLBT001
FCC ID:	2AOA9MLBT001
Options and accessories:	
Rating:	DC 1.8V-3.6V
RF Transmission Frequency:	2402~2480MHz
No. of Operated Channel:	40
Modulation:	GFSK
Duty Cycle:	27%
Antenna Type:	PCB
Antenna Gain:	0dBi
Description of the EUT:	Bluetooth Module

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 11-30-2017 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB558074 D01 DTS Meas Guidance v04 and ANSI C63.10 (2013).

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5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C,						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207	Conducted emission AC power port		Site 1	☐	☐	☒
§15.247 (b) (1)	Conducted peak output power	12-14	Site 1	☒	☐	☐
§15.247(a)(1)	20dB bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Dwell Time	---	---	☐	☐	☒
§15.247(a)(2)	6dB bandwidth and 99% Occupied Bandwidth	15-18	Site 1	☒	☐	☐
§15.247(e)	Power spectral density	19-21	Site 1	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	22-26	Site 1	☒	☐	☐
§15.247(d)	Band edge	27-32	Site 1	☒	☐	☐
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	33-34	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 2		☒	☐	☐

Remark
Note 1: N/A – Not Applicable.
Note 2: The EUT uses a permanently PCB Antenna, which gain is 0dBi. In accordance to §15.203, It is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AOA9MLBT001 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules.

.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date:	November 13, 2017
Testing Start Date:	November 13, 2017
Testing End Date:	November 30, 2017

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Reviewed by:

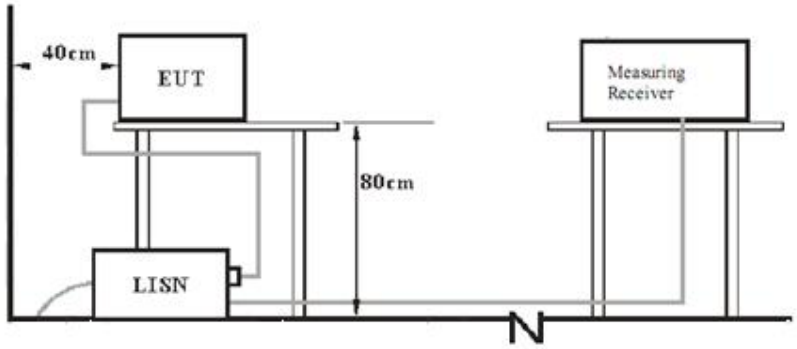
Hui TONG
Review Engineer

Prepared by:

Wenwen CHEN
Project Engineer

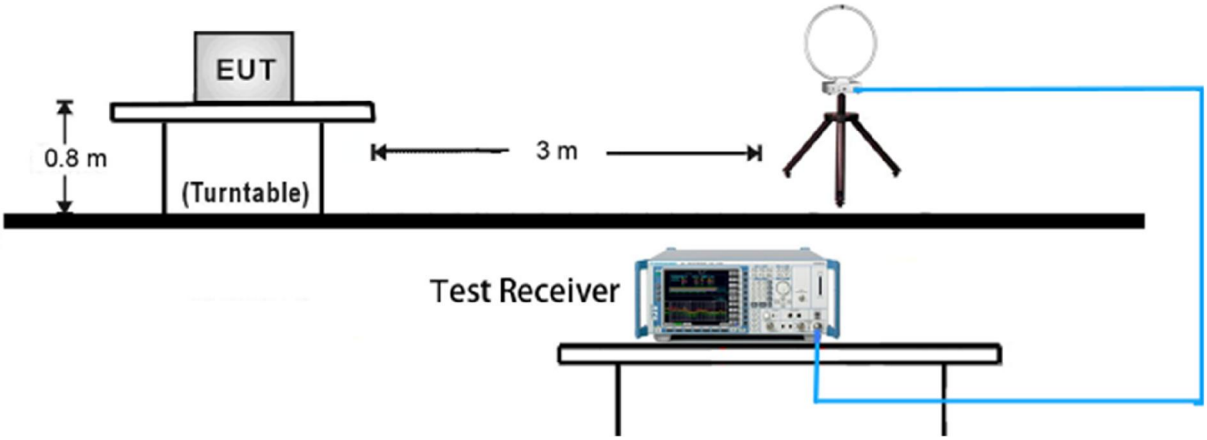
7 Test Setups

7.1 AC Power Line Conducted Emission test setups



7.2 Radiated test setups

9kHz ~ 30MHz Test Setup:



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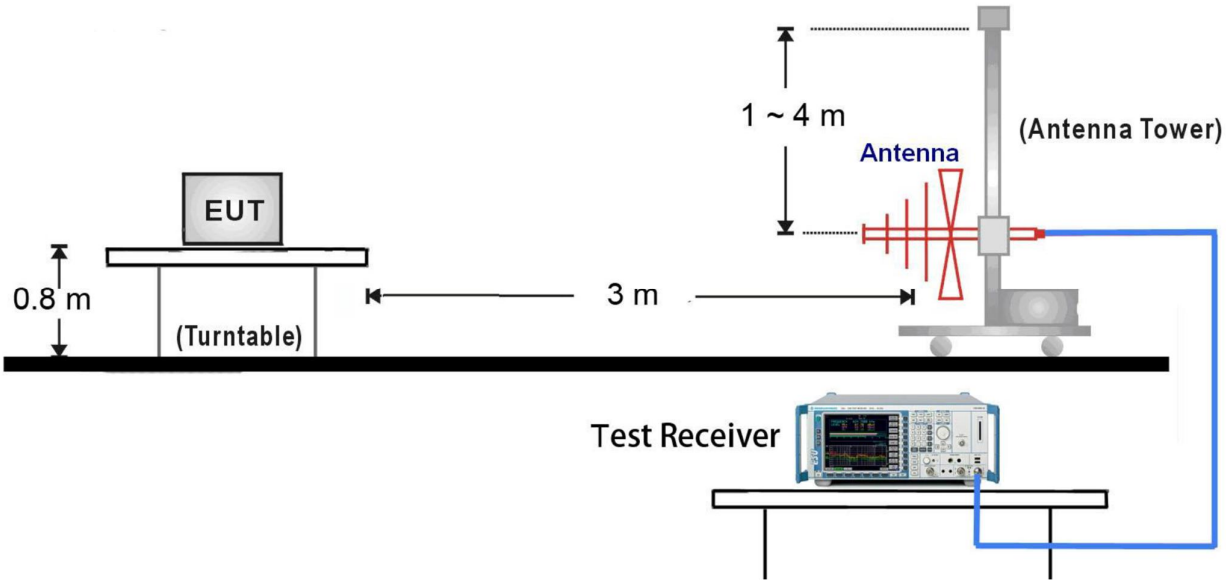
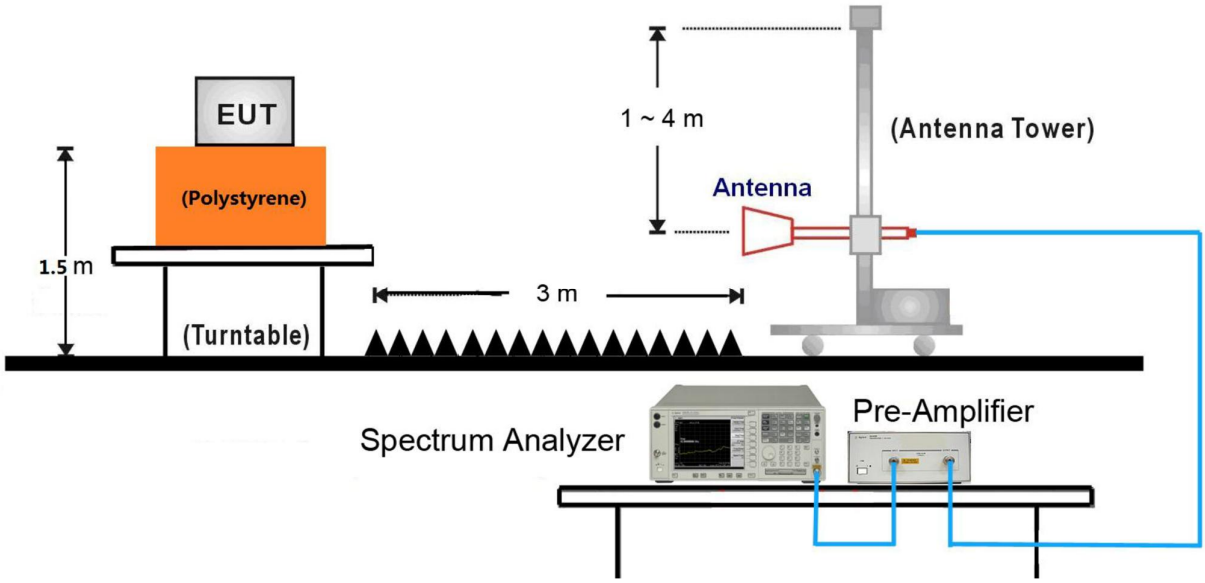
30MHz ~ 1GHz Test Setup:



1GHz ~ 18GHz Test Setup:



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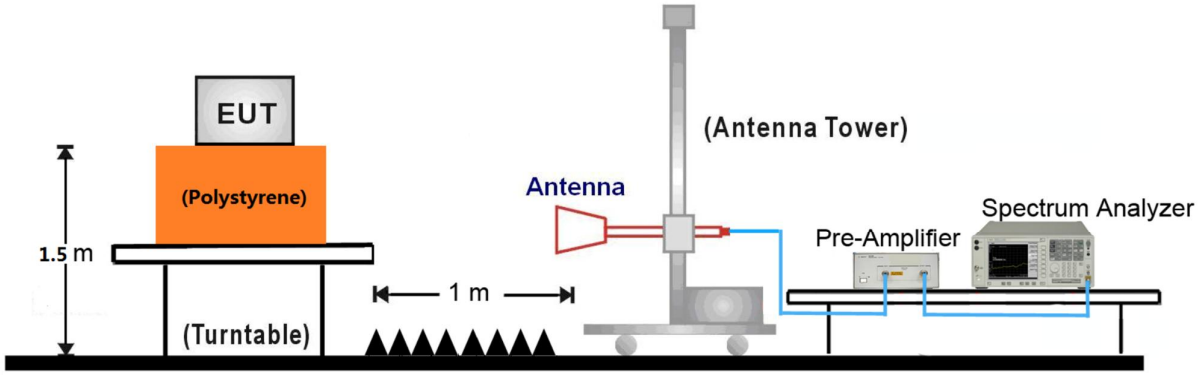
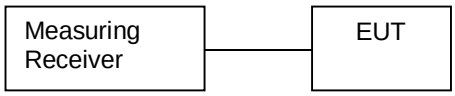
18GHz ~25GHz Test Setup:



7.3 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Laptop	Lenovo	X240	---

Test software: nRFgo Studio, which used to control the EUT in continues transmitting mode

The system was configured to channel 0, 19, and 39 for the test.

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9 Technical Requirement

9.1 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
   RBW > the 6 dB bandwidth of the emission being measured, VBW≥3RBW, Span≥3RBW
   Sweep = auto, Detector function = peak, Trace = max hold.
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

Limits

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

Test result as below table

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2402MHz	-7.32	Pass
Middle channel 2440MHz	-7.42	Pass
High channel 2480MHz	-7.06	Pass

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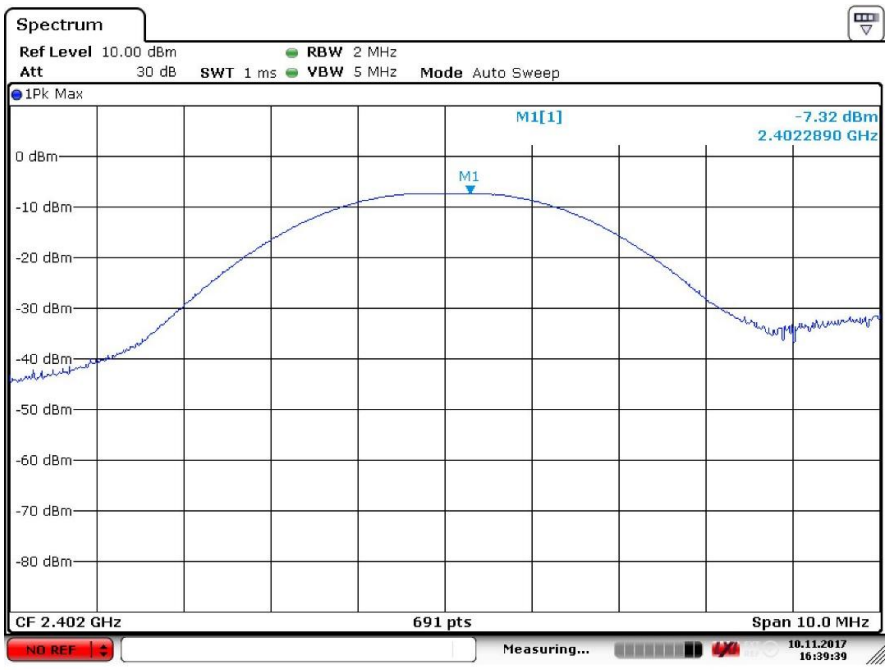

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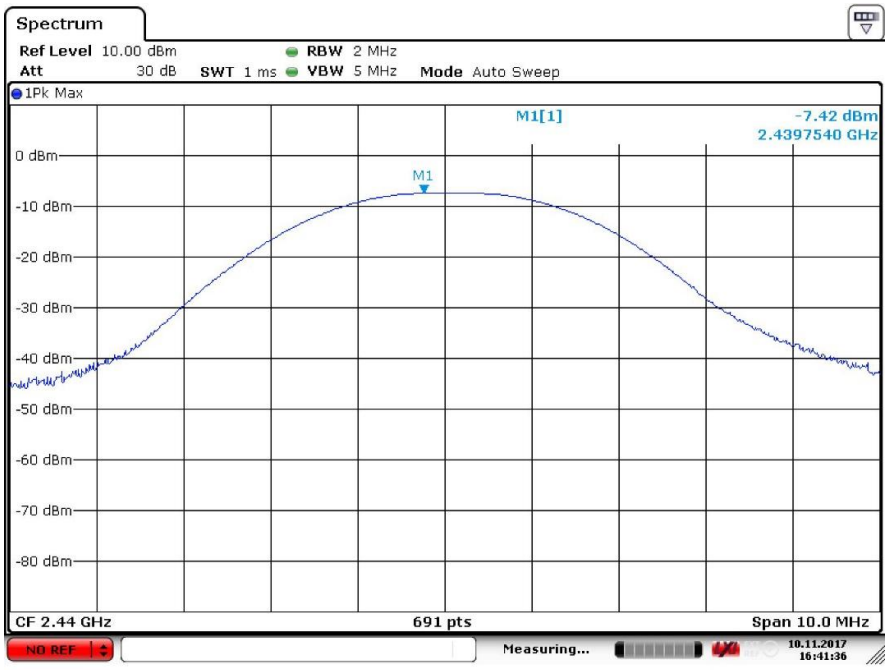

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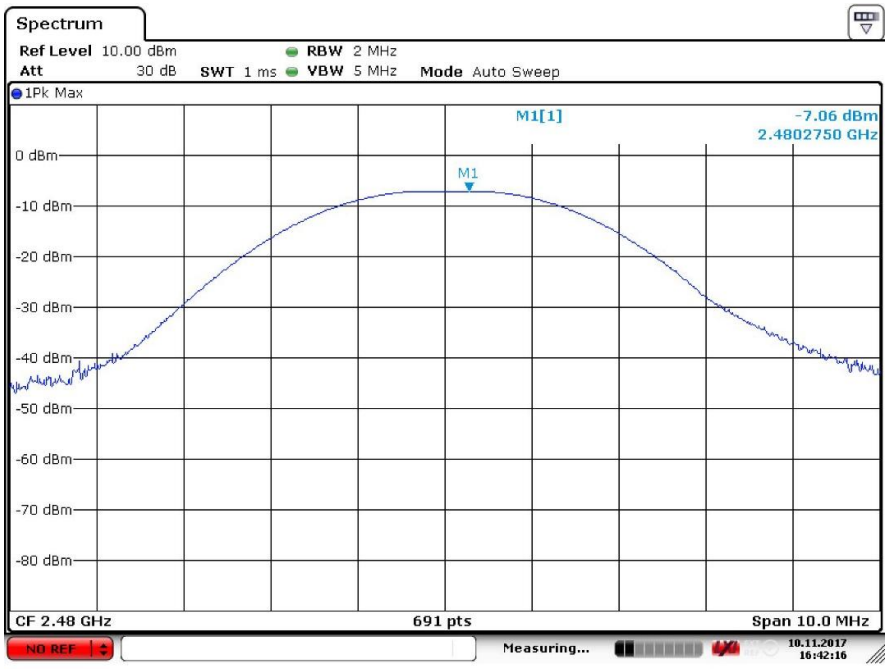

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9.2 6dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Use the following spectrum analyzer settings:
   RBW=100K, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]
≥500

Test result

Frequency MHz	6dB bandwidth kHz	**99% Bandwidth kHz**	Result
Top channel 2402MHz	712.0	1068.02	Pass
Middle channel 2440MHz	725.0	1081.04	Pass
Bottom channel 2480MHz	720.7	1081.04	Pass

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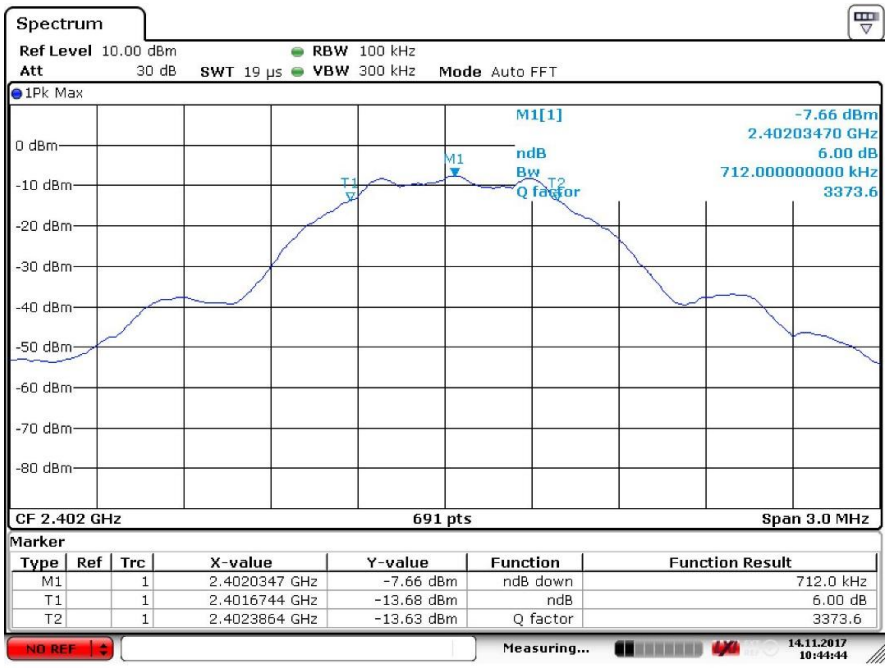
Product Service

2402MHz 6dB bandwidth



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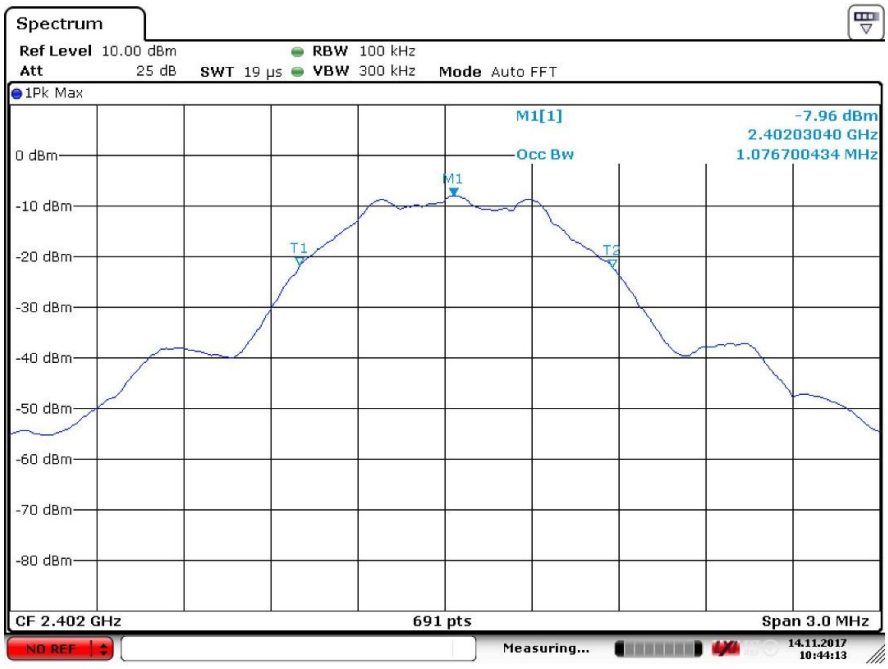
2402MHz 99% bandwidth



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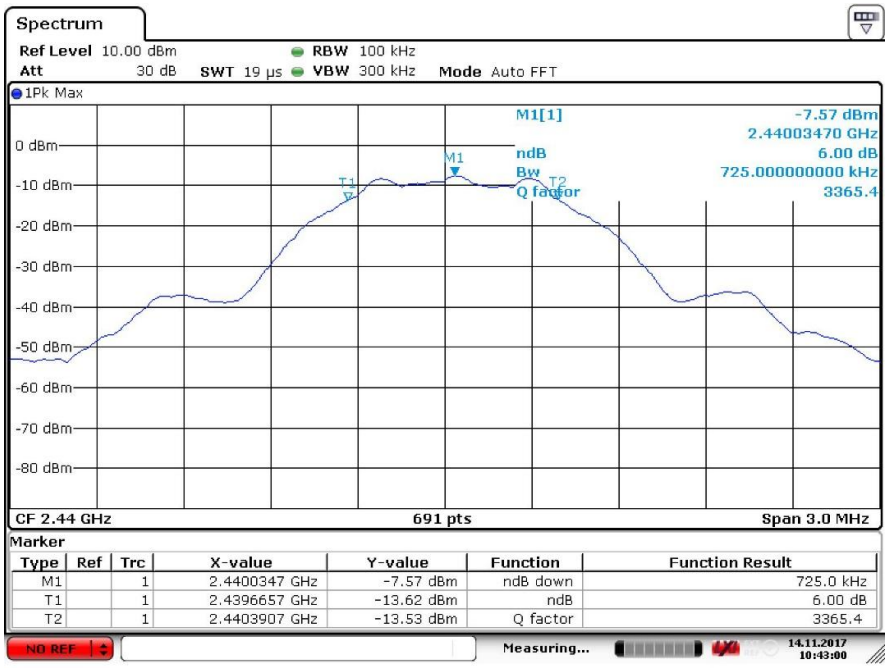
Product Service

2440MHz 6dB bandwidth



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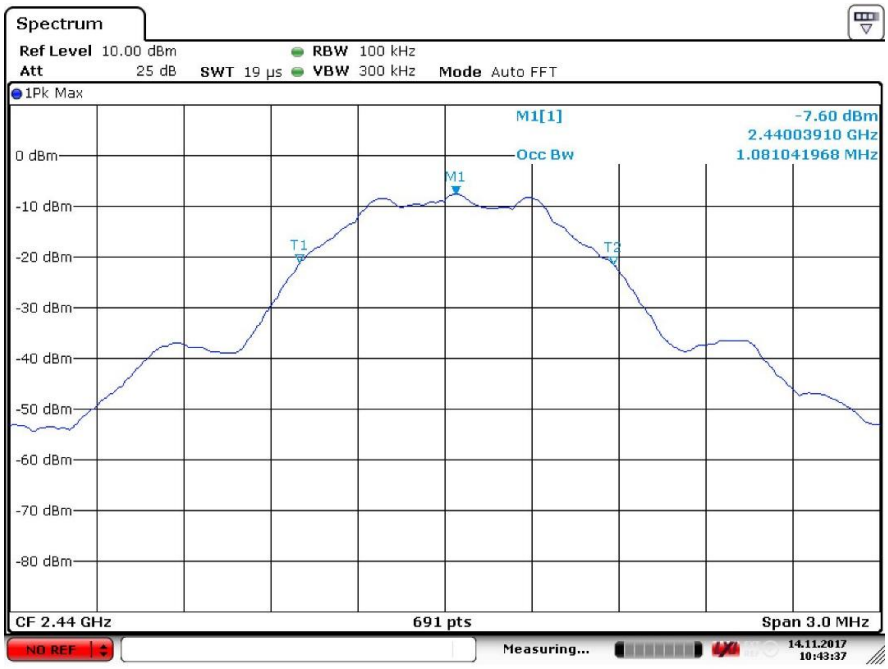
2440MHz 99% bandwidth



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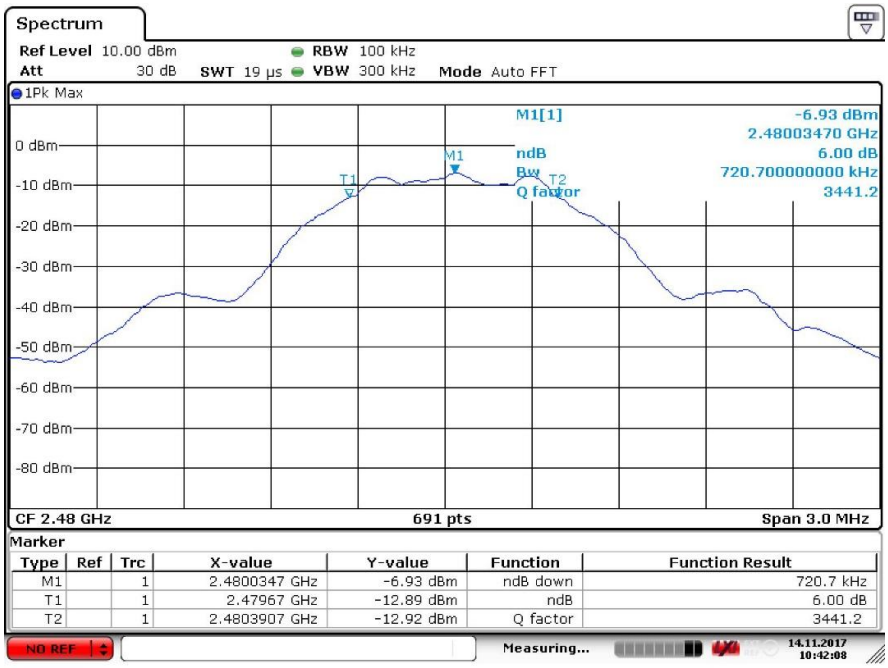
Product Service

2480MHz 6dB bandwidth



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4800347 GHz	-6.93 dBm	ndB down	720.7 kHz
T1		1	2.47967 GHz	-12.89 dBm	ndB	6.00 dB
T2		1	2.4803907 GHz	-12.92 dBm	Q factor	3441.2

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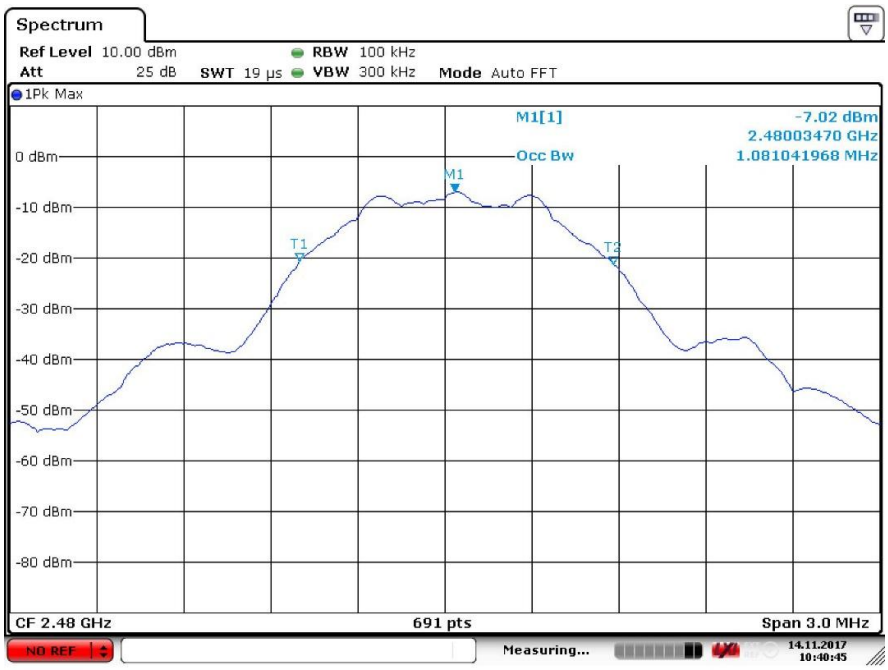
2480MHz 99% bandwidth



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9.3 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz,VBW≥3RBW,Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm]
≤8

Test result

Frequency **MHz**	Power spectral density **dBm**	Result
Top channel 2402MHz	-23.03	Pass
Middle channel 2440MHz	-23.01	Pass
Bottom channel 2480MHz	-22.83	Pass

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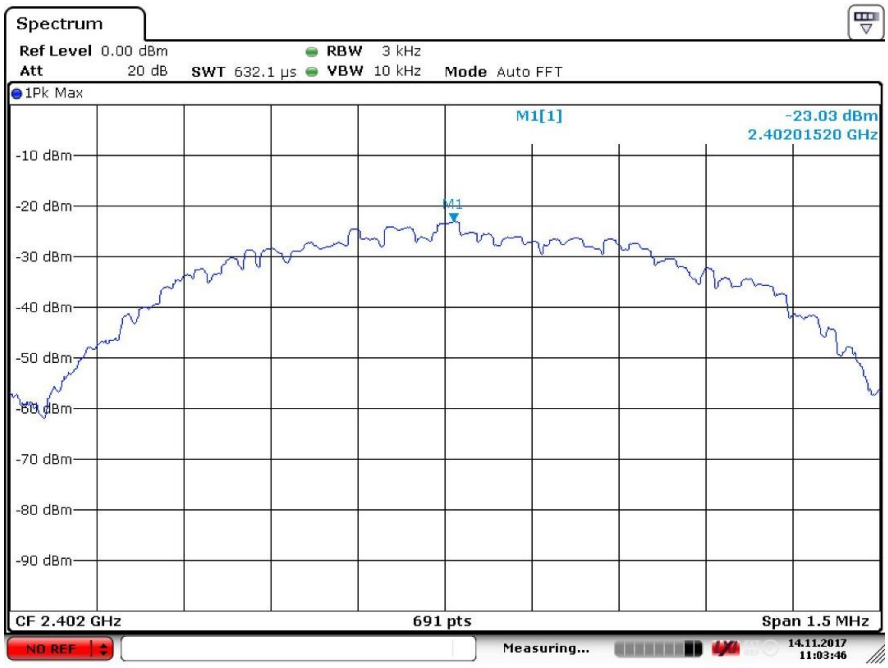
2402MHz



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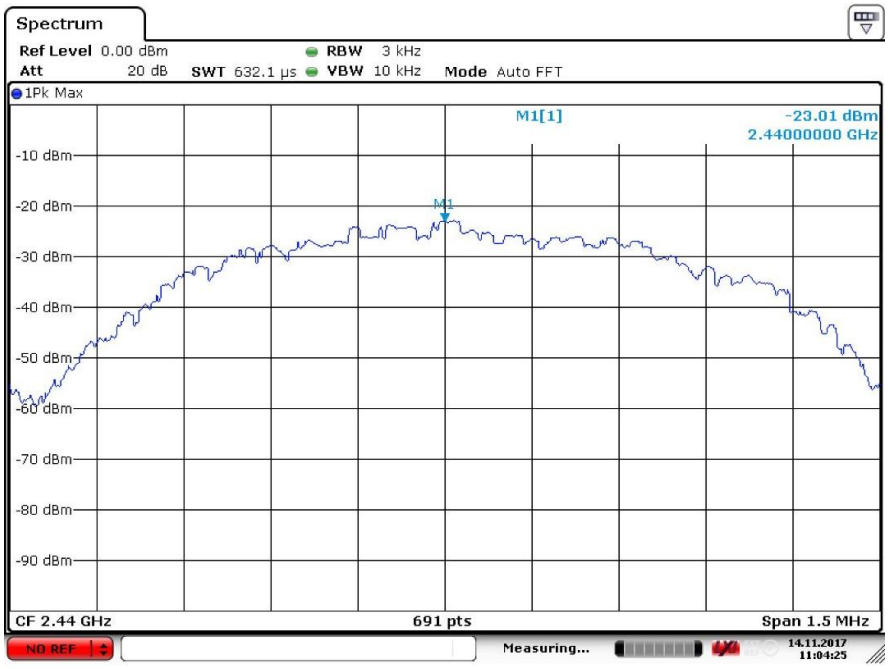
2440MHz



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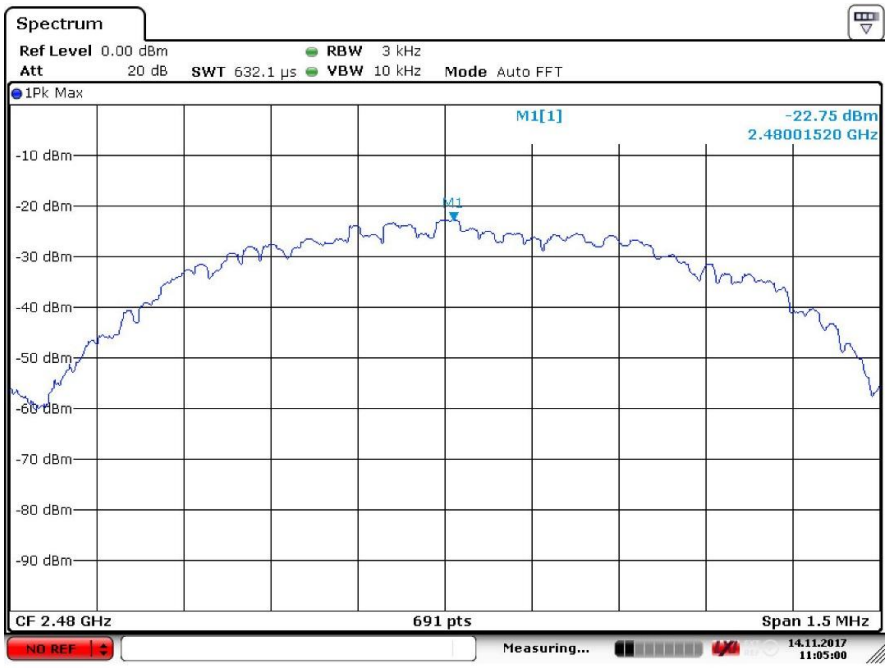
2480MHz



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9.4 Spurious RF conducted emissions

Test Method

1. Establish a reference level by using the following procedure:
   a. Set RBW=100 kHz. VBW≥3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
   b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
   a. Set the center frequency and span to encompass frequency range to be measured.
   b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

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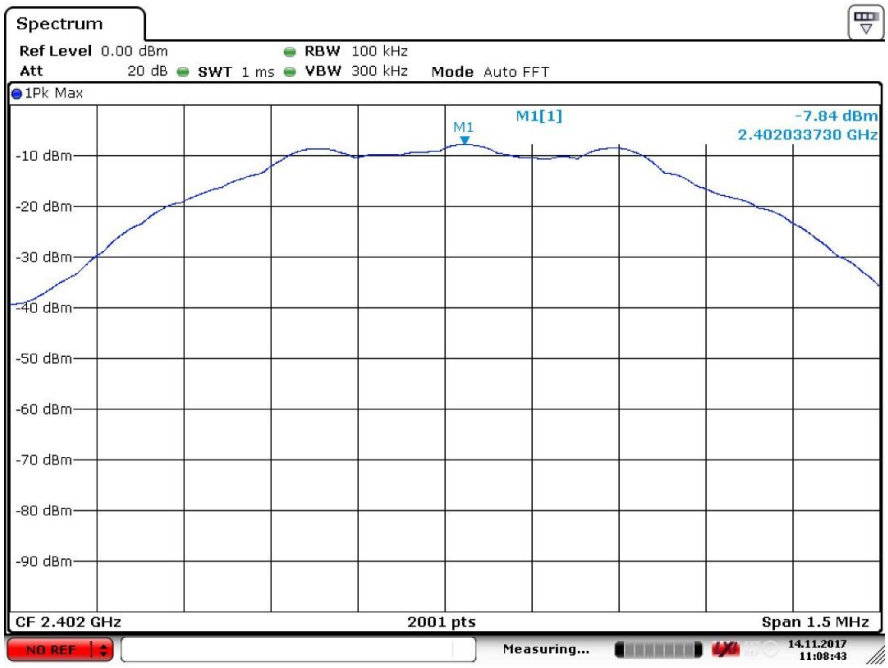
Product Service

100kHz PSD reference Level

2402MHz



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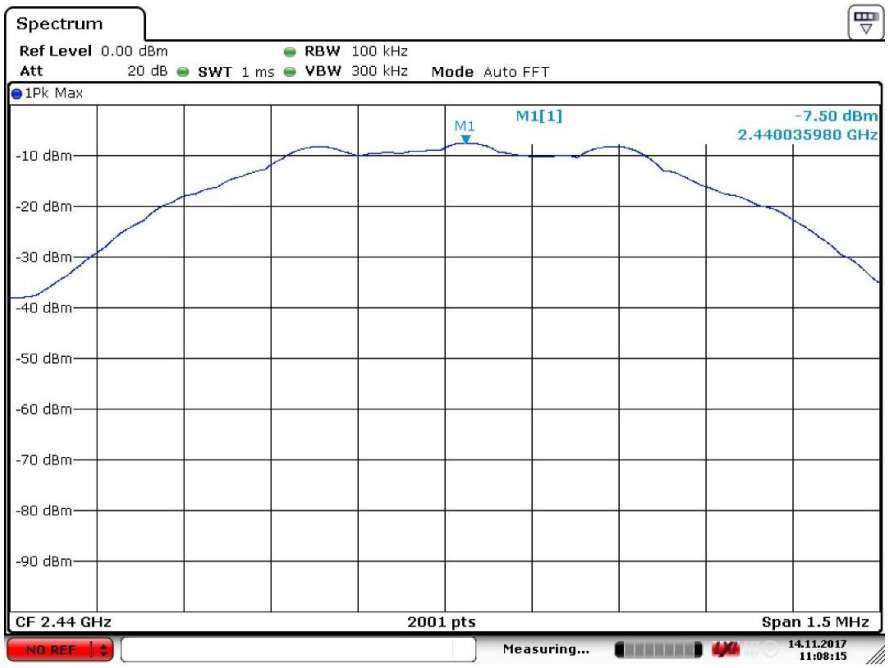
2440MHz



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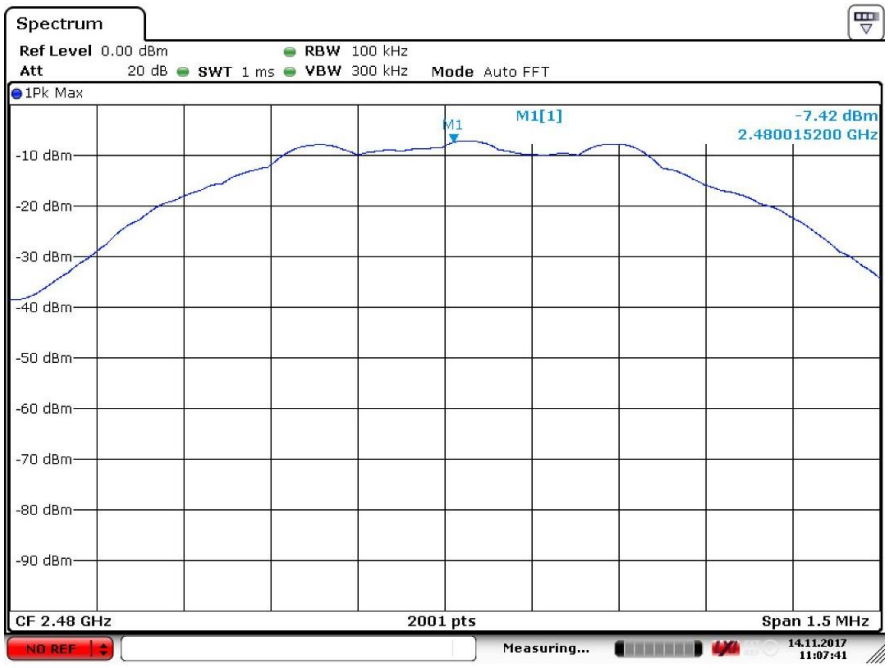
2480MHz



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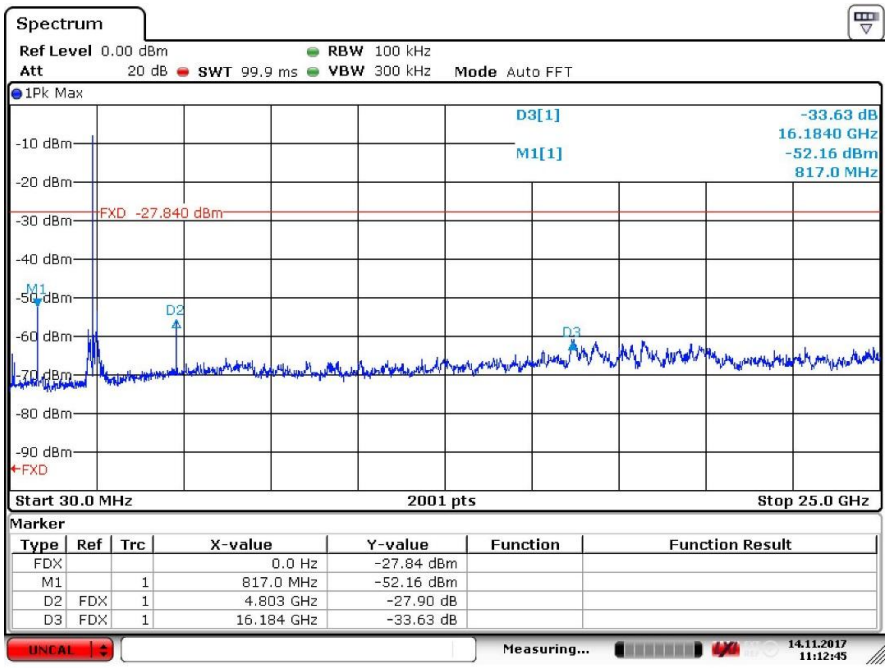
Spurious RF conducted emissions

2402MHz



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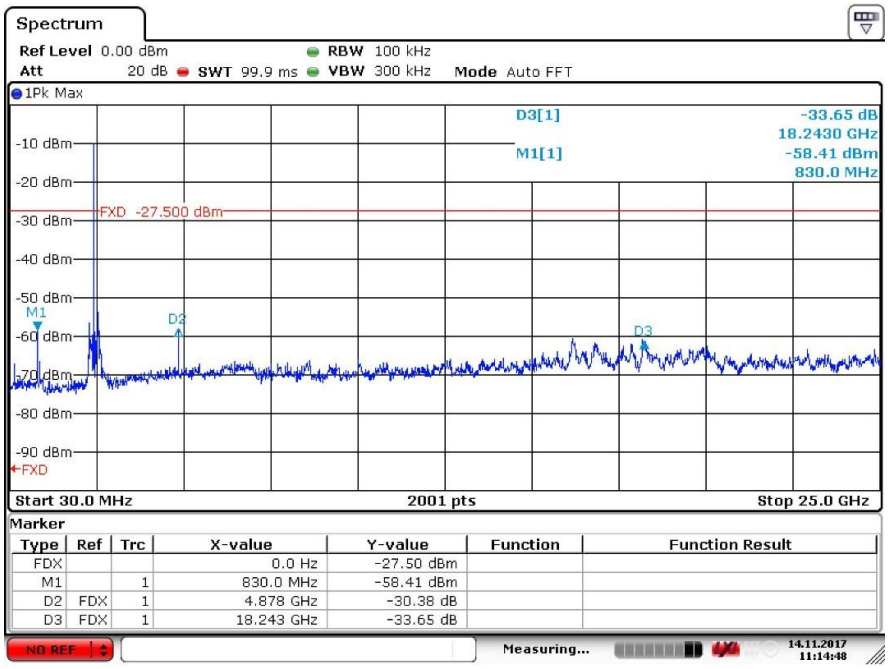
2440MHz



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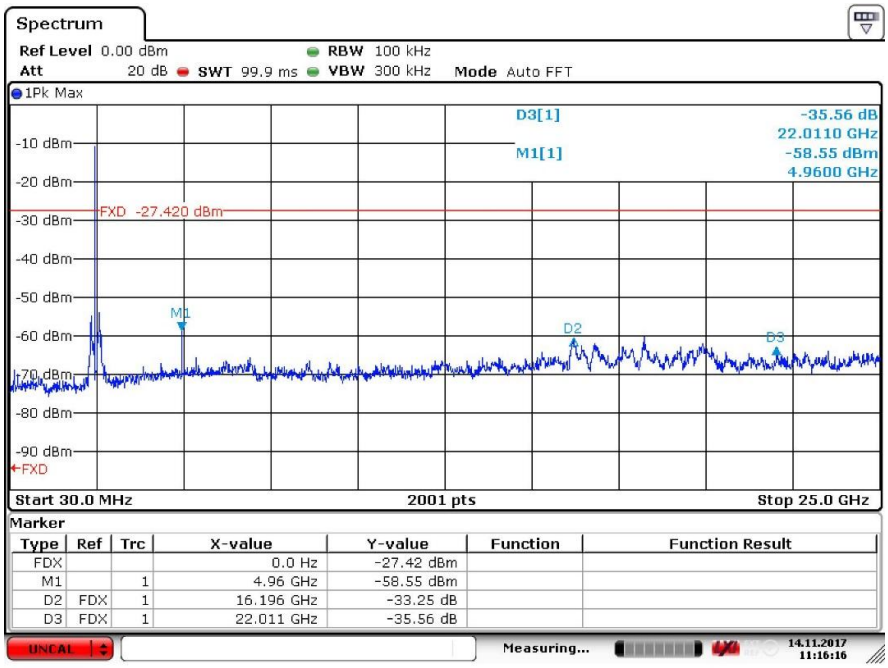
Product Service

2480MHz



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9.5 Band edge

Test Method

1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW⩾RBW, Sweep = auto, Detector function = peak, Trace = max hold.
2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
3 The level displayed must comply with the limit specified in this Section.

Limit

In any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in 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 power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) and RSS-Gen8.10, must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)) and RSS-Gen.

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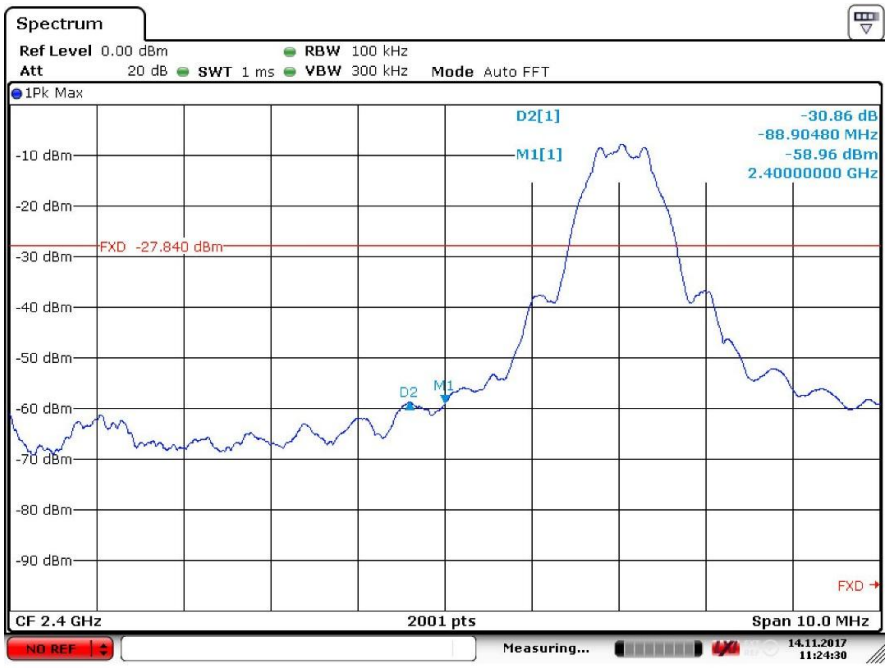
Test result



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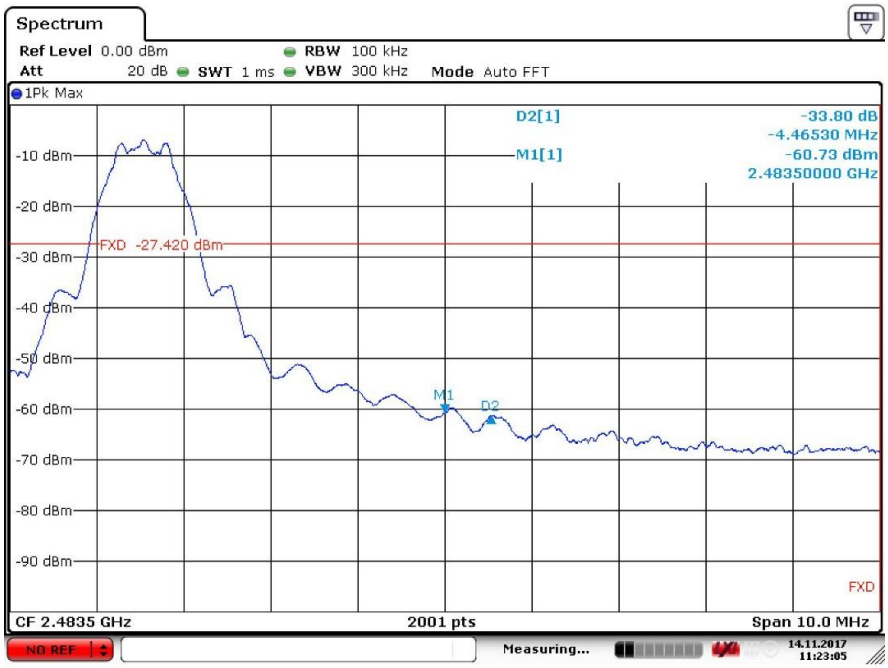

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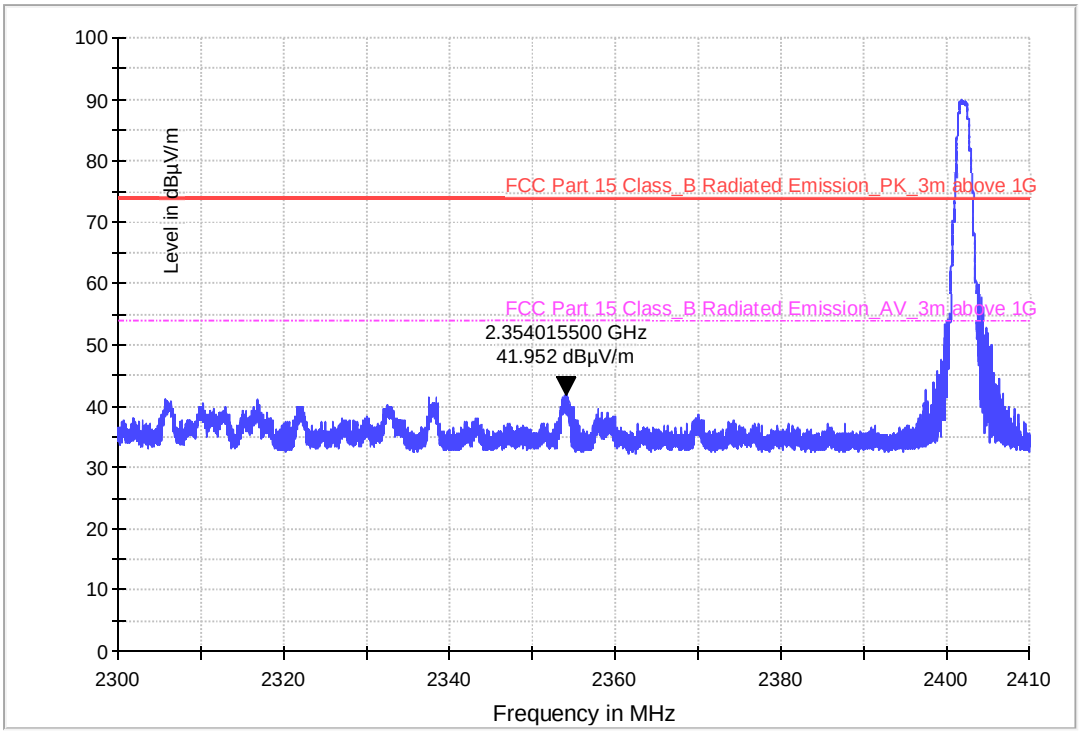
Transmit at Channel 2402MHz Horizontal

RE_HF907_pre



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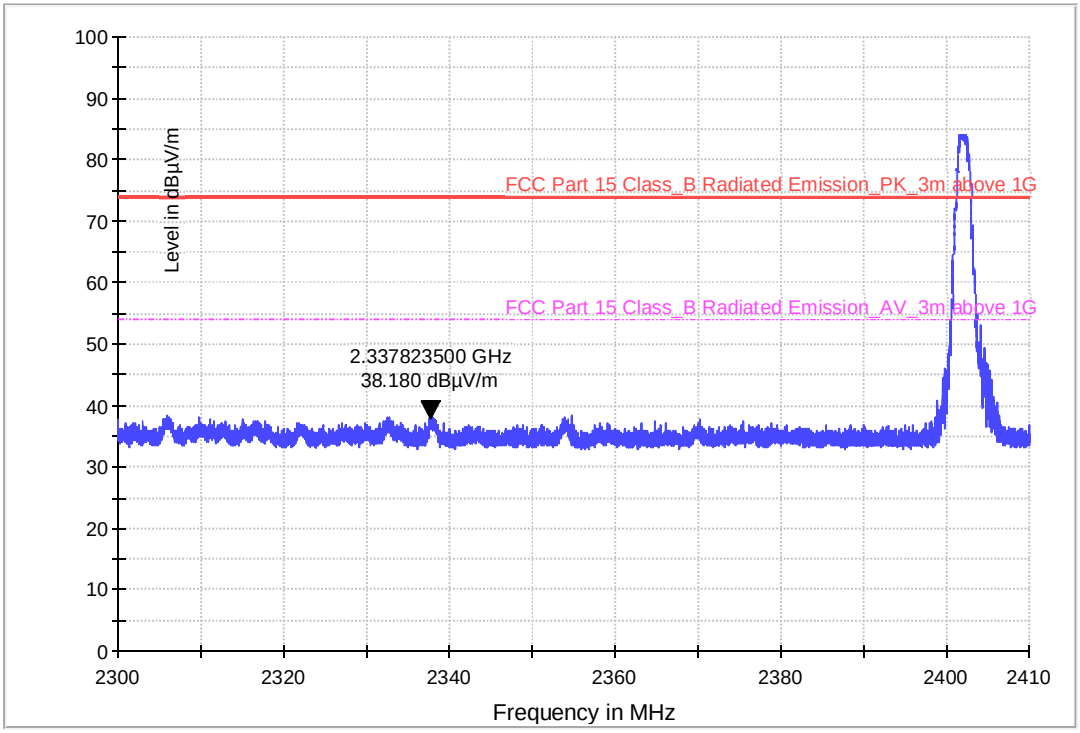
Transmit at Channel 2402MHz Vertical

RE_HF907_pre



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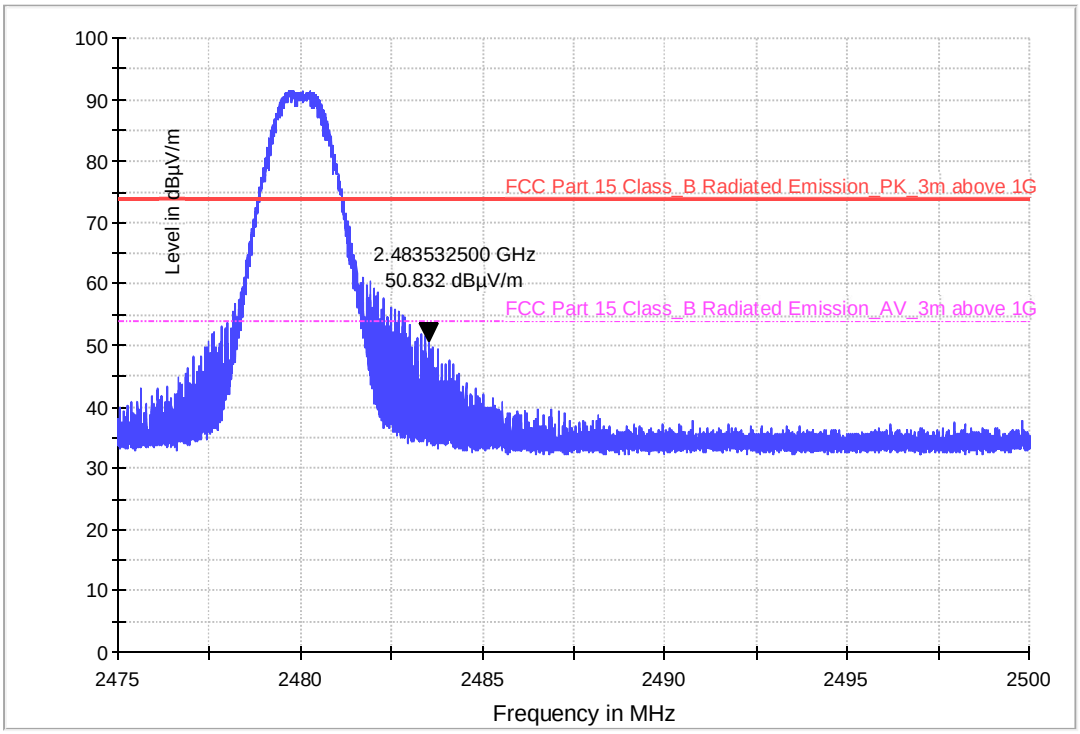
Transmit at Channel 2480MHz Horizontal

RE_HF907_pre



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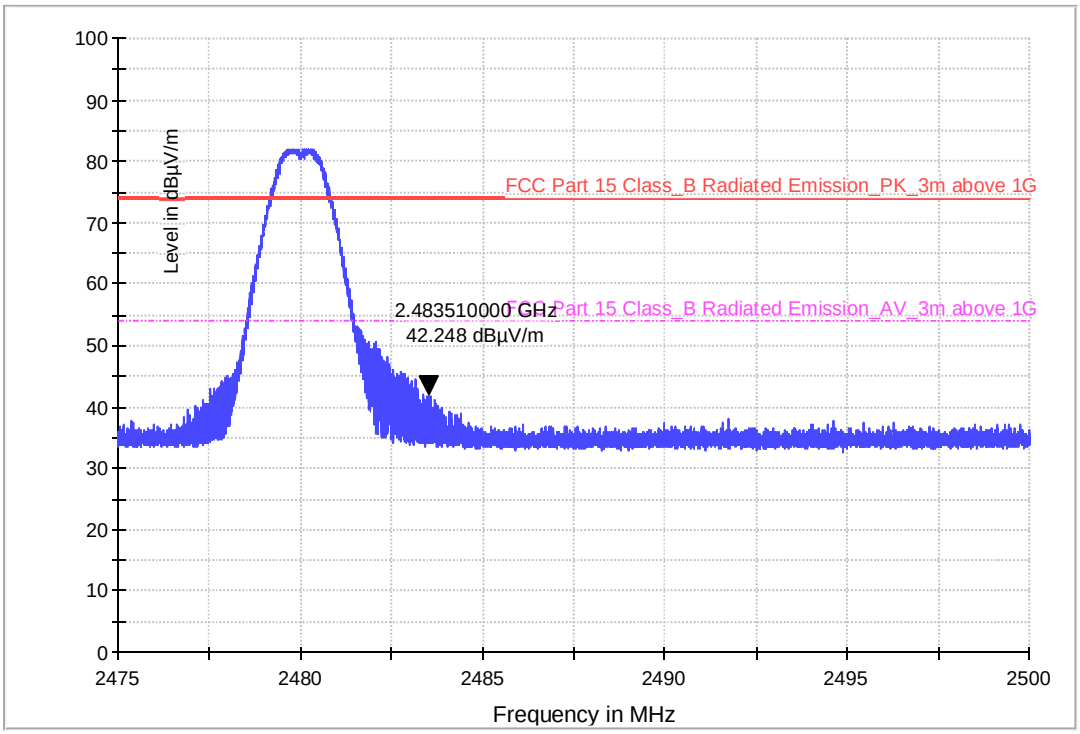
Transmit at Channel 2480MHz Vertical

RE_HF907_pre



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9.6 Spurious radiated emissions for transmitter

Test Method

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
3. Use the following spectrum analyzer settings:
   Span = wide enough to fully capture the emission being measured, RBW = 1 MHz for f ≥ 1GHz, 100 kHz for f < 1 GHz, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Follow the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc.
   The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
5. Set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the duty cycle per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log(duty cycle/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Transmitting spurious emission test result as below:

2402MHz

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBµV/m	
4803.75	51.37	H	74	PK	-22.63	Pass
6998.98	46.87	H	74	PK	-27.13	Pass
9364.12	47.45	H	74	PK	-26.55	Pass
4804.60	48.43	V	74	PK	-25.57	Pass
6989.89	48.95	V	74	PK	-25.05	Pass
9610.54	51.58	V	74	PK	-22.42	Pass

2440MHz

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBµV/m	
4879.40	49.43	H	74	PK	-24.57	Pass
6999.13	46.93	H	74	PK	-27.07	Pass
9763.51	48.61	H	74	PK	-25.39	Pass
4879.40	45.28	V	74	PK	-28.72	Pass
6999.76	47.52	V	74	PK	-26.48	Pass
9763.45	48.25	V	74	PK	-25.75	Pass

2480MHz

Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
MHz	dBuV/m		dBµV/m		dBµV/m	
4959.30	48.08	H	74	PK	-25.92	Pass
6999.96	47.71	H	74	PK	-26.29	Pass
9763.56	45.56	H	74	PK	-28.44	Pass
4959.30	46.74	V	74	PK	-27.26	Pass
6999.87	47.95	V	74	PK	-26.05	Pass
9763.52	49.96	V	74	PK	-24.04	Pass

Remark:

(1) AV Emission Level= PK Emission Level+20log (dutycycle)
(2) Data of measurement within 30-1000MHz frequency range shown "--" in the table above means the reading of emissions are attenuated more than 20db below the permissible limits or the field strength is too small to be measured.
(3) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.

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10 Test Equipment List

List of Test Instruments

Radiated Emission Test Equipment					
USED	**Equipment Name**	**Model**	**Manufacturer**	**Equipment ID.**	**Calibration Due Date**
☒	EMI test receiver	ESR3	R&S	S1503109-YQ-EMC	2018-8-07
☒	Trilog super broadband test antenna	VULB 9163	SCHWARZBECK	S1503008-YQ-EMC	2018-9-17
☒	Double-ridged waveguide horn antenna	HF907	R&S	S1503009-YQ-EMC	2018-9-17
☒	Signal conditioning unit	SCU-18D	R&S	S1503012-YQ-EMC	2018-8-07
☒	Signal and spectrum analyzer	FSV40	R&S	S1503003-YQ-EMC	2018-8-07

Conducted Test Equipment					
USED	**Equipment Name**	**Model**	**Manufacturer**	**Equipment ID.**	**Calibration Due Date**
☒	Signal and spectrum analyzer	FSV40	R&S	S1503003-YQ-EMC	2018-8-07

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density
- Spurious RF conducted emissions
- Band edge

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Emission in 3m chamber 9kHz-1000MHz	4.18dB
Uncertainty for Radiated Emission in 3m chamber 1000MHz-40000MHz	4.76dB
Uncertainty for Conducted Emission 150KHz-30MHz	3.46dB

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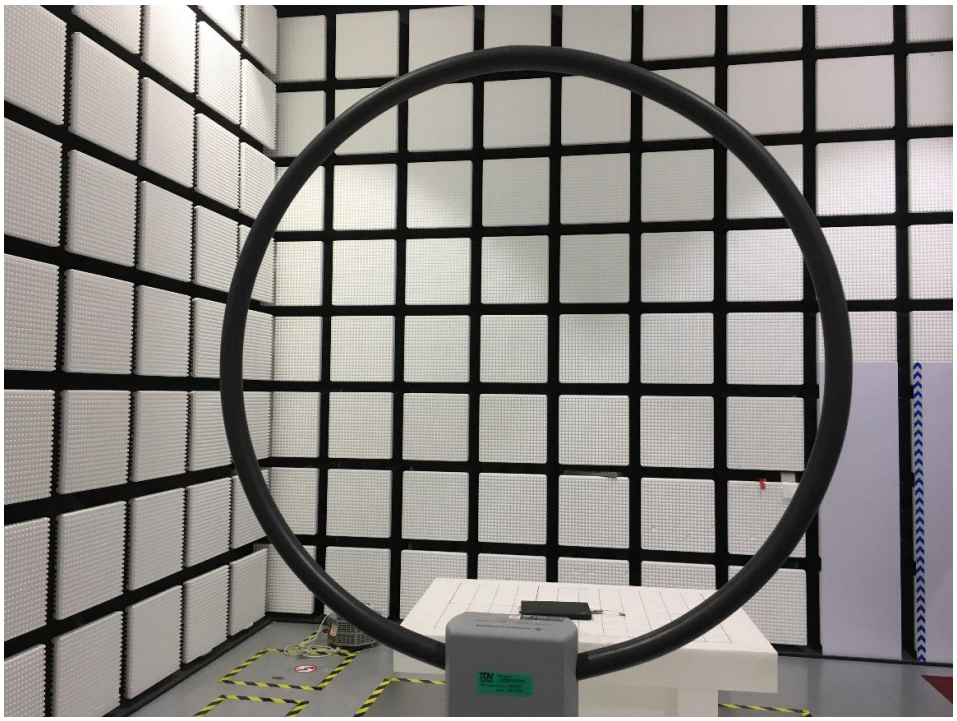
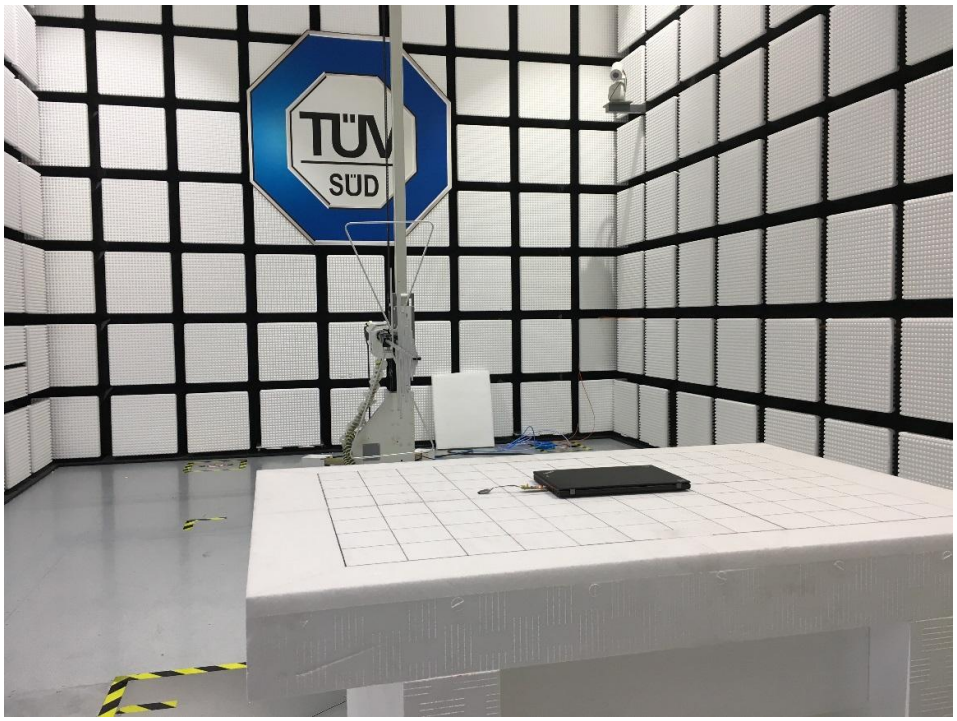
12 Photographs of Test Set-ups

Radiated Emission Setup
9k~30MHz



30MHz~1GHz



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1GHz~18GHz

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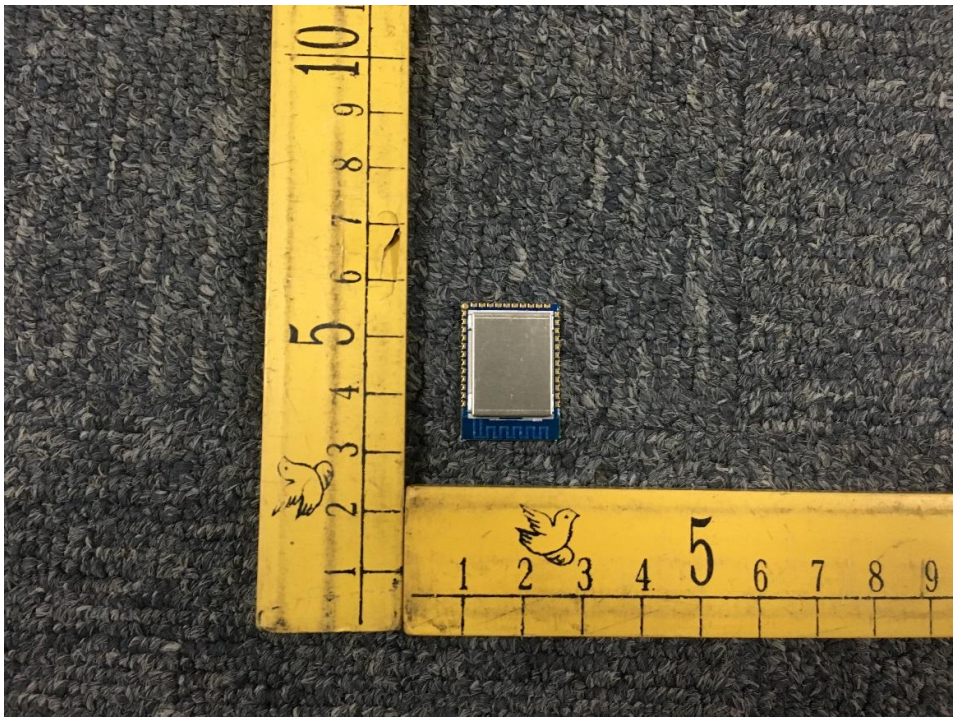
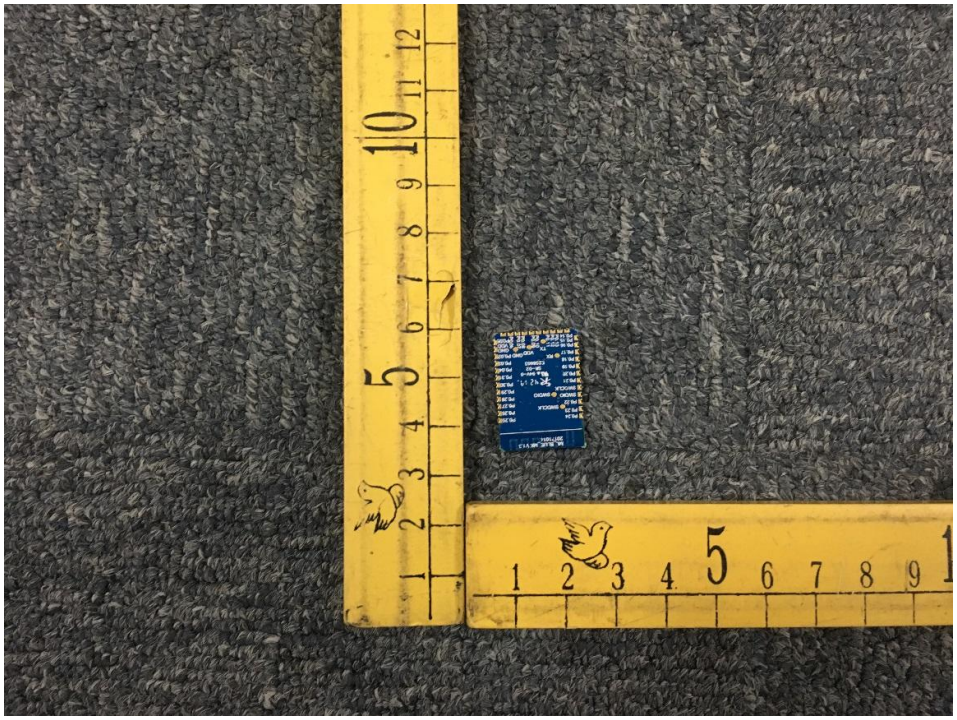
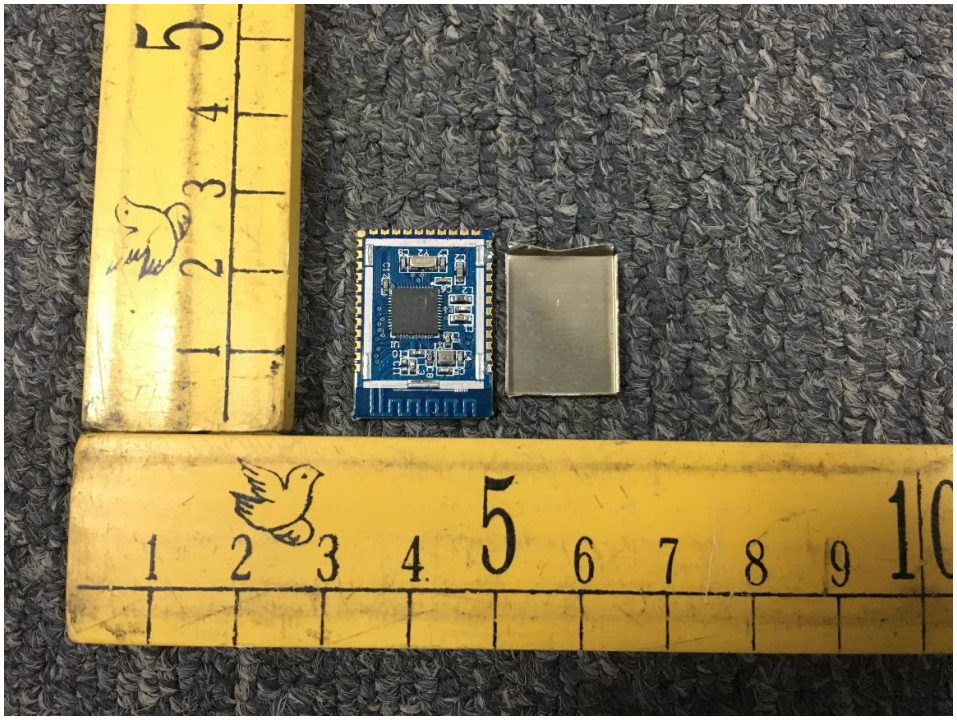
13 Photographs of EUT

External Photographs





Internal Photographs



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