FCC - TEST REPORT

Report Number	: **68.950.19.0569.01**	Date of Issue:	June 26, 2019
Model	: IPS_BEACON, BT2S IPS BEACON, IPS GATEWAY		
Product Type	: INDOOR POSITIONING SYSTEM BEACON		
Applicant	: TPL Systèmes SAS		
Address	: Zae Du Perigord Noir BP145 24200 Sarlat, France		
Manufacturer	: TPL Systèmes SAS		
Address	: Zae Du Perigord Noir BP145 24200 Sarlat, France		
Production Facility	: VINTECH CORP		
Address	: 12B Jinshun Building, No.287, Ruyi Road Longgang District		
	: ShenZhen China		

Test Result	:	■ **Positive** ☐ **Negative**
Total pages including Appendices	:	**31**

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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. Shenzhen Branch Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District Shenzhen 518052 P.R. China
Telephone:	86 755 8828 6998
Fax:	86 755 828 5299
FCC Registration No.:	514049

3 Description of the Equipment Under Test

Product:	INDOOR POSITIONING SYSTEM BEACON
Model no.:	IPS_BEACON, BT2S IPS BEACON, IPS GATEWAY
FCC ID:	2ATEXBT2S01
Brand name	TPL Systèmes SAS
Options and accessories:	NIL
Rating:	DC3.6V (Supplied by 1X3.6V AA battery)
RF Transmission Frequency:	2402MHz-2480MHz
No. of Operated Channel:	40
Modulation:	GFSK
Antenna Type:	Internal Antenna
Antenna Gain:	2.0dBi
Description of the EUT:	The Equipment Under Test (EUT) is INDOOR POSITIONING SYSTEM BEACON operated at 2.4GHz

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2018 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to KDB 558074 D01 DTS Measurement Guidance v05 DTS Measurement Guidance 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	---	---	☐	☐	☒
§15.247 (b) (1)	Conducted peak output power	10	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	16	Site 1	☒	☐	☐
§15.247(e)	Power spectral density	13	Site 1	☒	☐	☐
§15.247(d)	Spurious RF conducted emissions	20	Site 1	☒	☐	☐
§15.247(d)	Band edge	24	Site 1	☒	☐	☐
§15.247(d) & §15.209	Spurious radiated emissions for transmitter	26	Site 1	☒	☐	☐
§15.203	Antenna requirement	See note 1		☒	☐	☐

Note 1: N/A=Not Applicable.
Note 2: The EUT uses a Integrated antenna, which gain is 2.0dBi. 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: 2ATEXBT2S01 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules.

IPS_BEACON, BT2S IPS BEACON, IPS GATEWAY is a INDOOR POSITIONING SYSTEM BEACON with BLE. The TX and RX range is 2402MHz-2480 MHz.

the IPS_BEACON, IPS GATEWAY have the same technical construction including circuit diagram, PCB Layout, components and component layout, all electrical construction and mechanical construction, with BT2S IPS BEACON. The difference lies only in the outlook/color of the different models.

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:	May 23, 2019
Testing Start Date:	May 24, 2019
Testing End Date:	June 3, 2019

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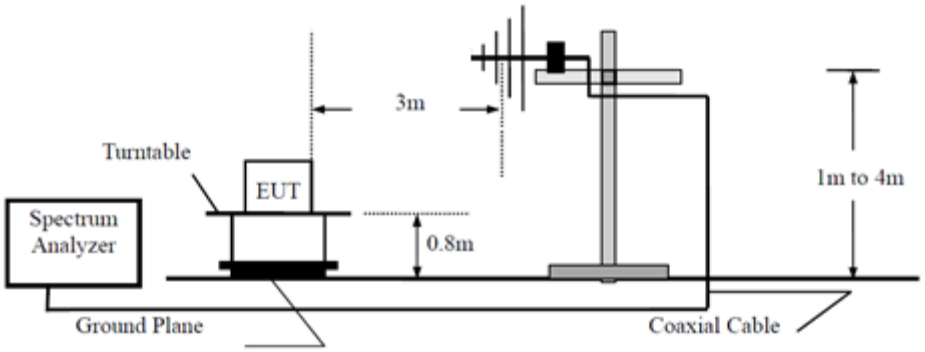
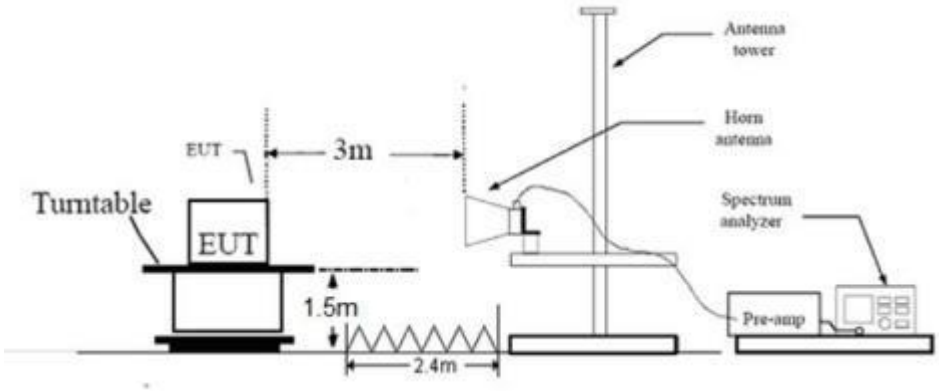
Reviewed by:	Prepared by:	Tested by:
Zhi John	Warlen Song	Louise Liu
EMC Section Manager	EMC Project Engineer	EMC Test Engineer

7 Test Setups

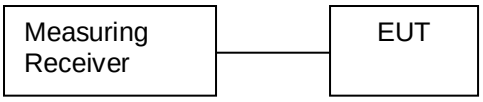
Below 1GHz



Above 1GHz



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)
Notebook	Lenovo	X220	---

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

According to §15.247 (b) (1), conducted peak output power limit as below:

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
Bottom channel 2402MHz	3.04	Pass
Middle channel 2440MHz	2.98	Pass
Top channel 2480MHz	2.81	Pass

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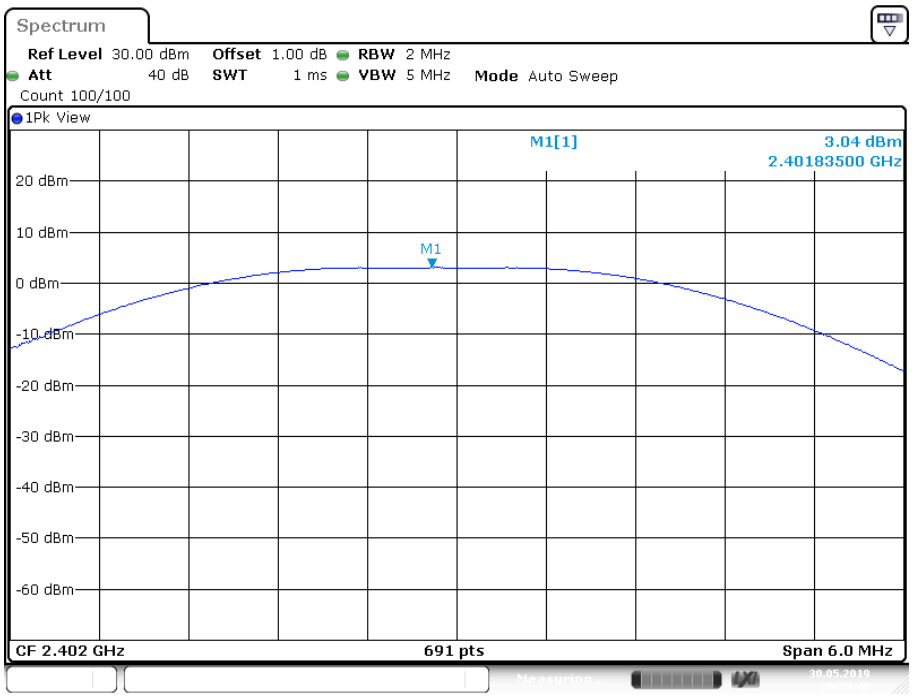
Low channel 2402MHz



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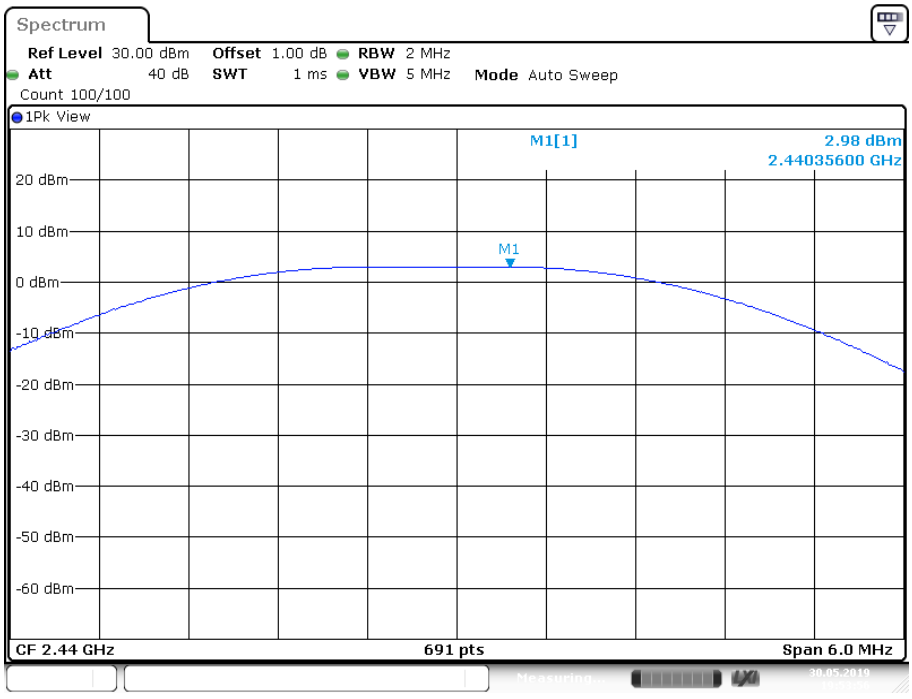
Middle channel 2440MHz



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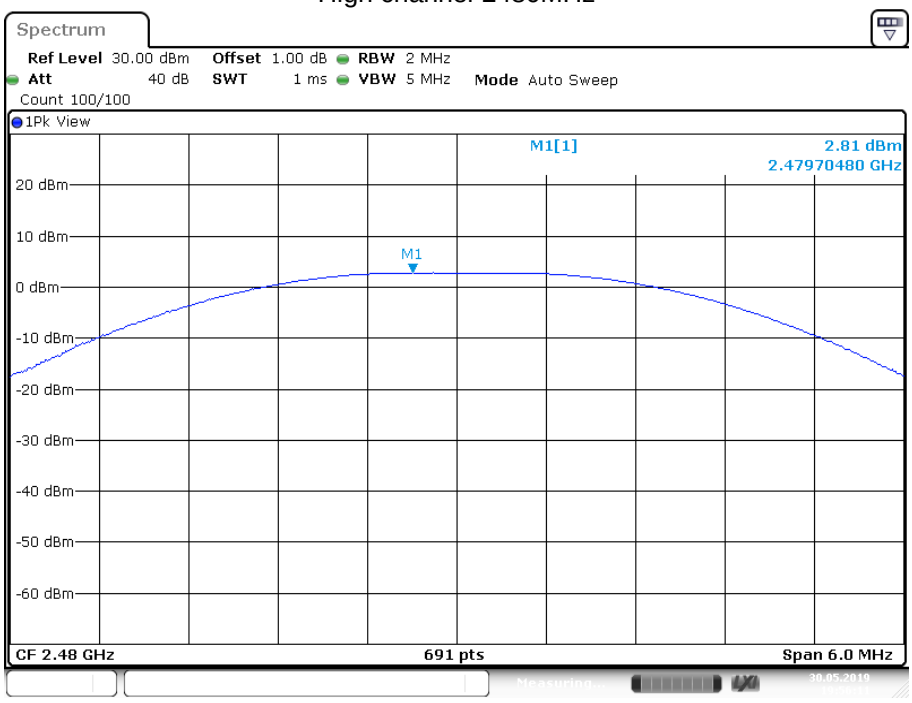
High channel 2480MHz



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9.2 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=10kHz, 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/3KHz]
≤8

Test result

Frequency MHz	Power spectral density dBm/10KHz	Result
Top channel 2402MHz	-4.09	Pass
Middle channel 2440MHz	-3.91	Pass
Bottom channel 2480MHz	-4.36	Pass

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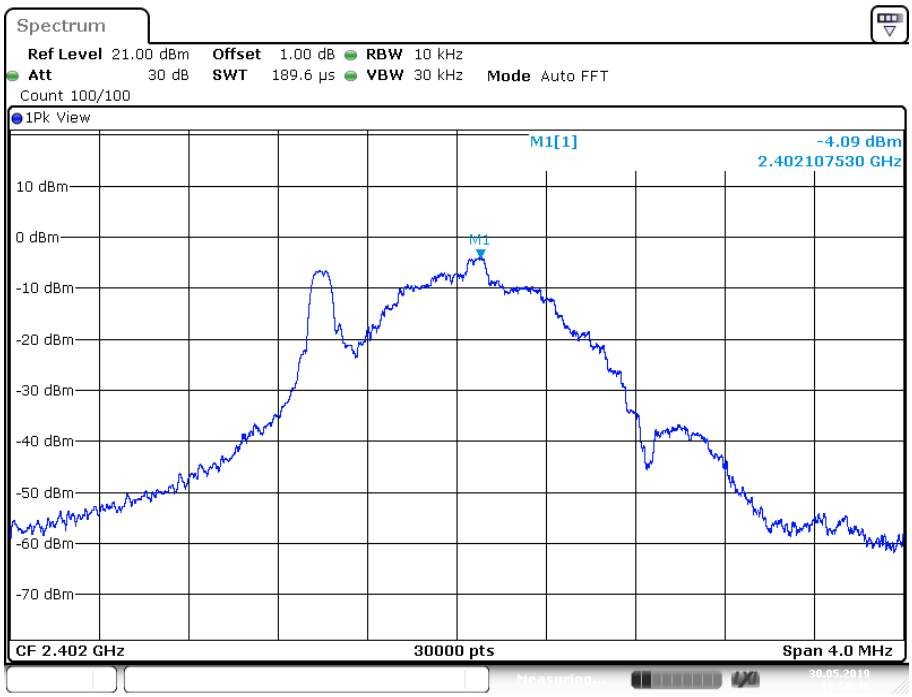
Low channel 2402MHz



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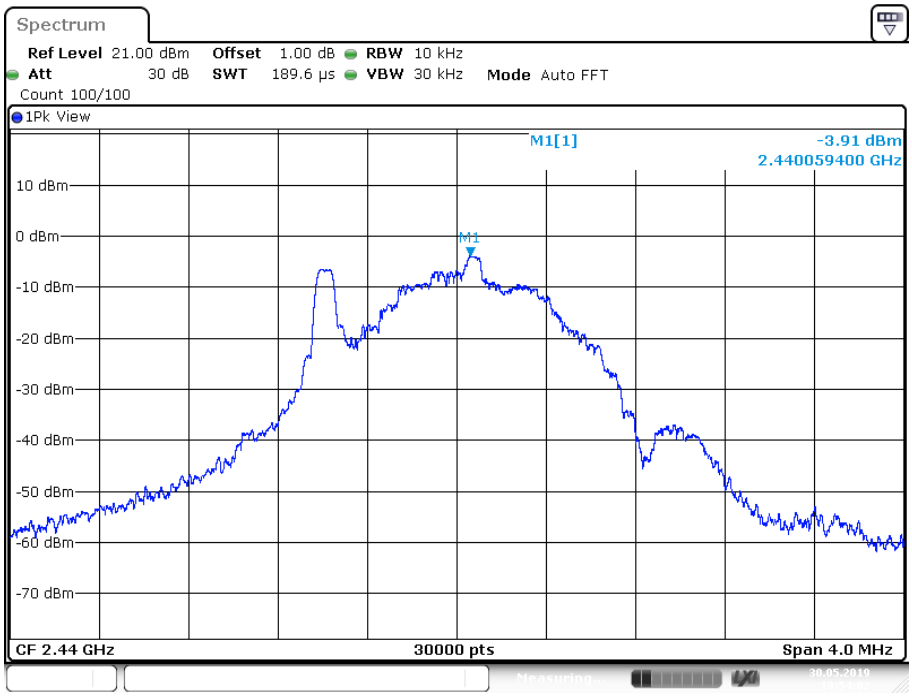
Middle channel 2440MHz



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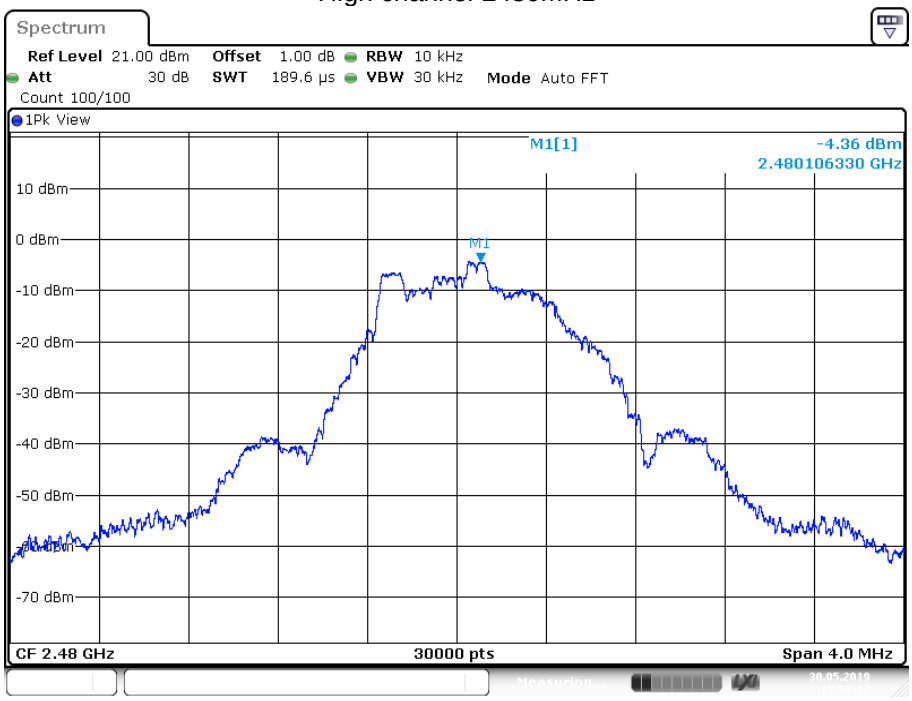
High channel 2480MHz



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9.3 6 dB 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
Bottom channel 2402MHz	1180.0	1303.0	Pass
Middle channel 2440MHz	1144.0	1267.0	Pass
Top channel 2480MHz	856.0	1031.0	Pass

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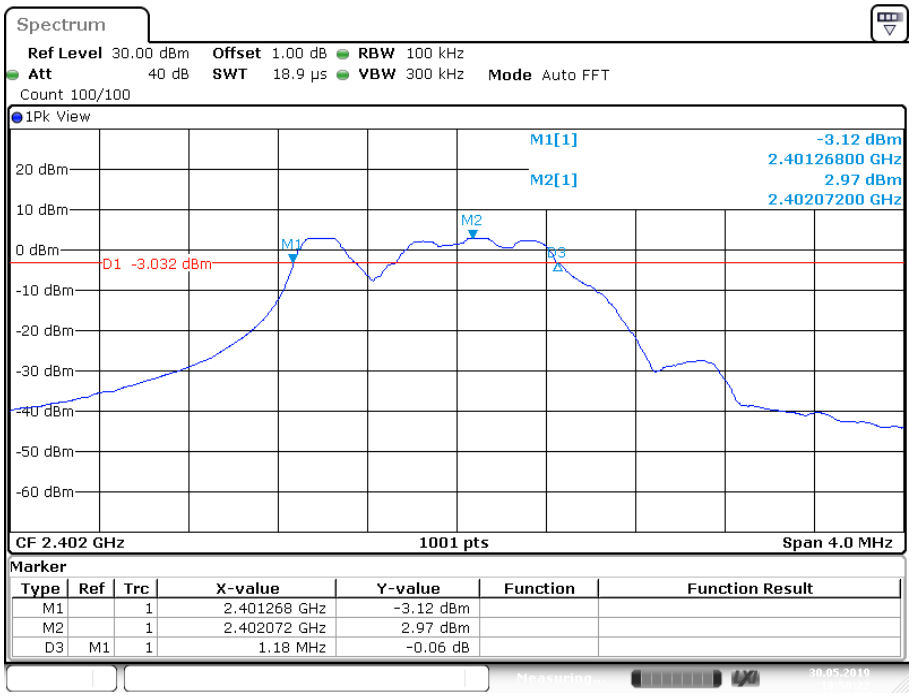
6 dB Bandwidth

Low channel 2402MHz



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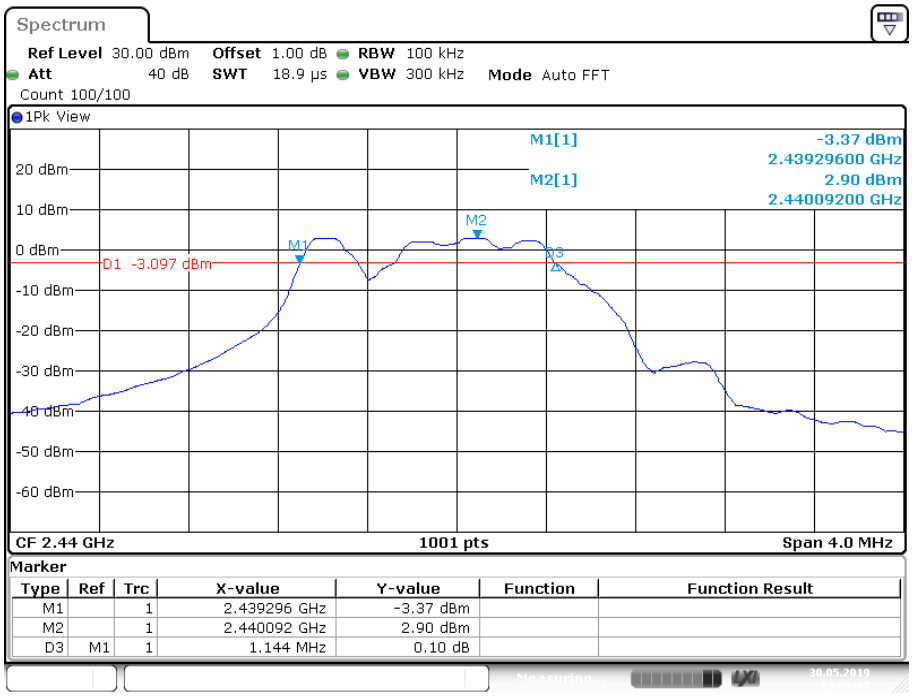
Middle channel 2440MHz



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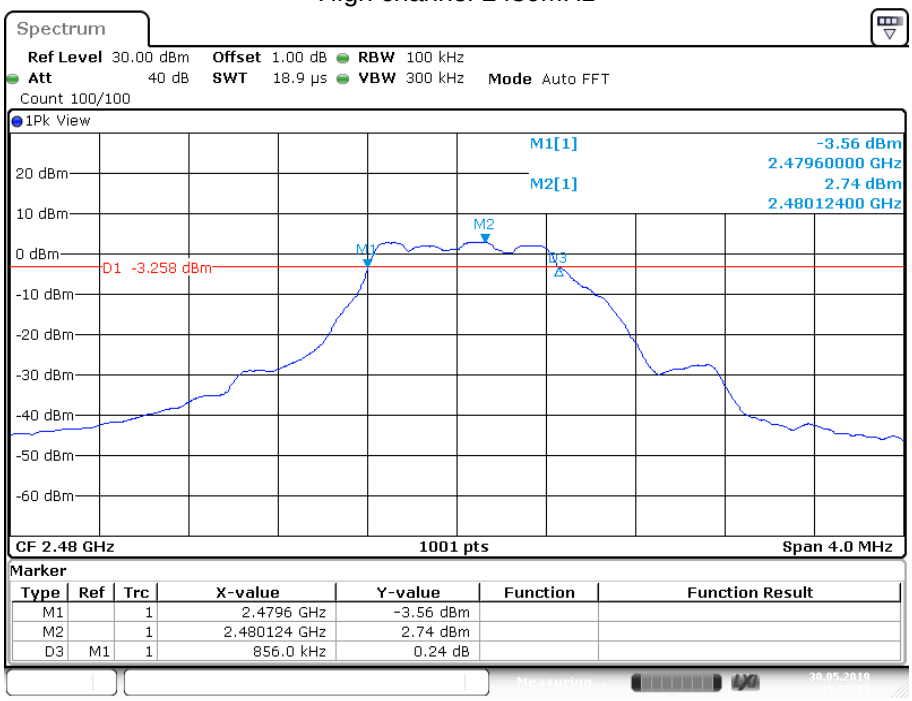
High channel 2480MHz



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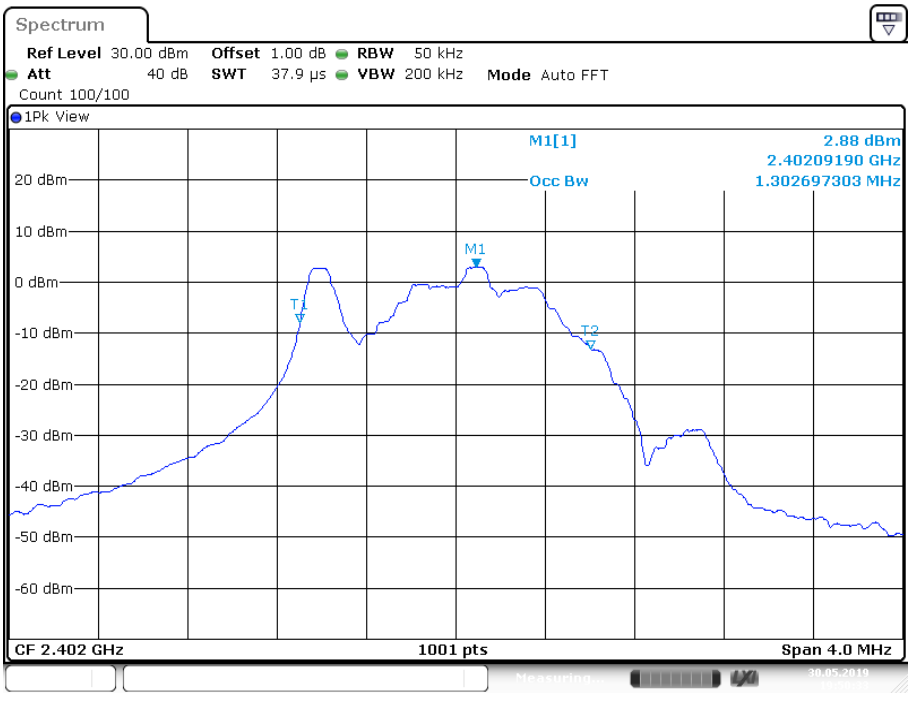
99% Occupied Bandwidth

Low channel 2402MHz



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4.71

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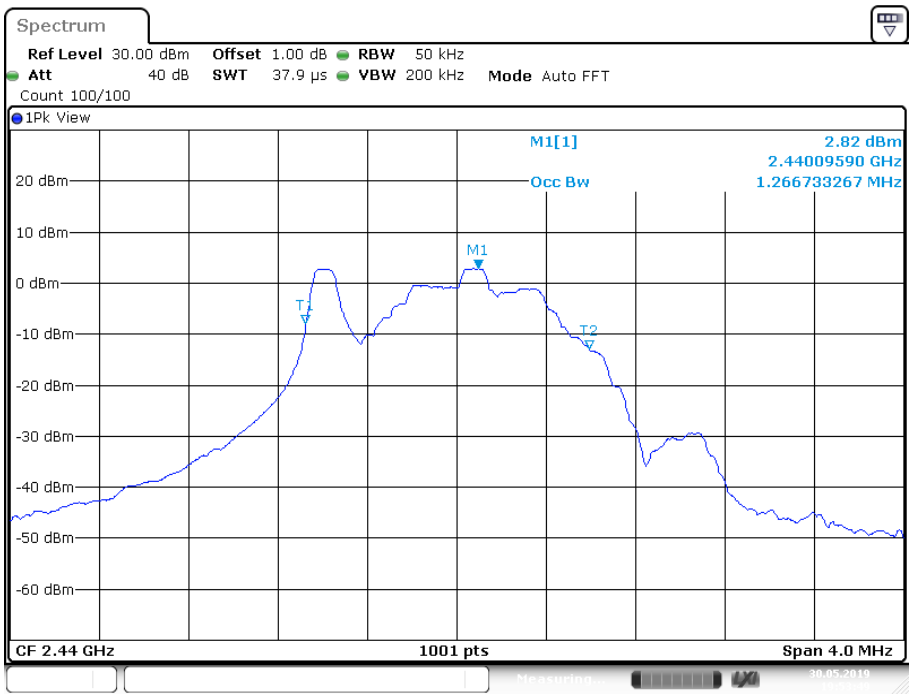
Middle channel 2440MHz



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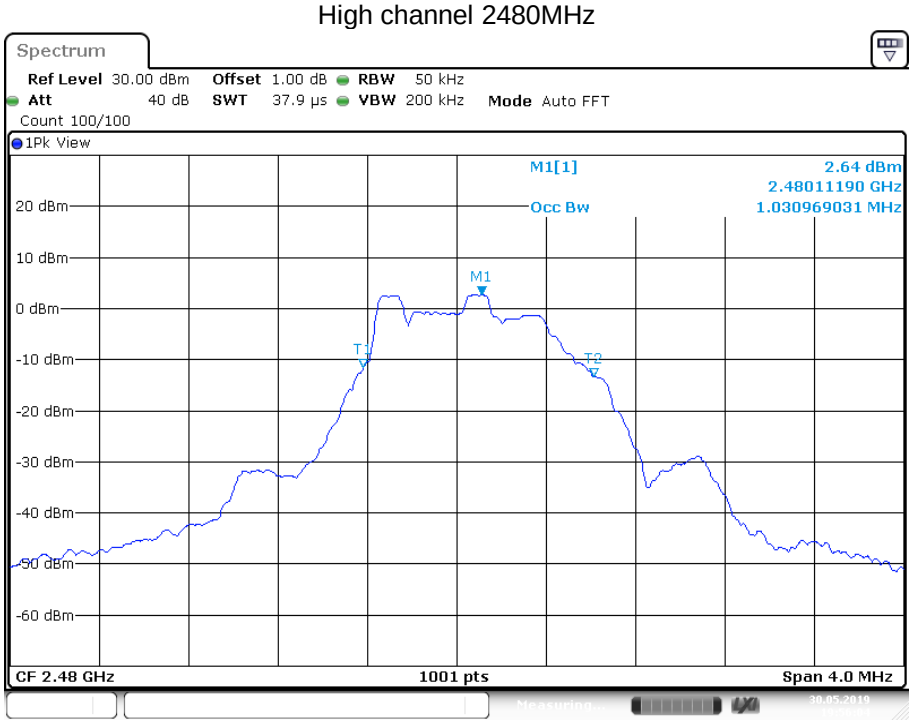
High channel 2480MHz



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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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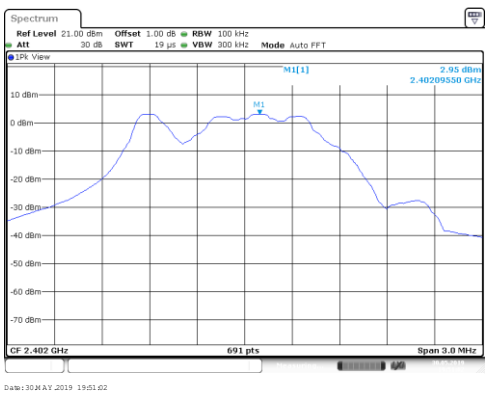
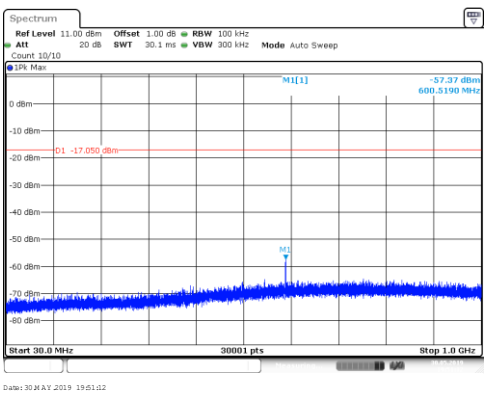
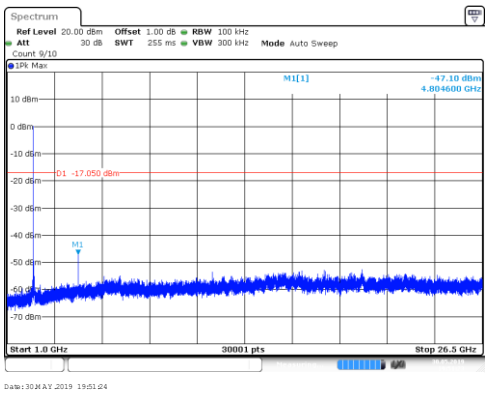
Spurious RF conducted emissions

2402MHz





30MHz-1000MHz



1GHz-26.5GHz

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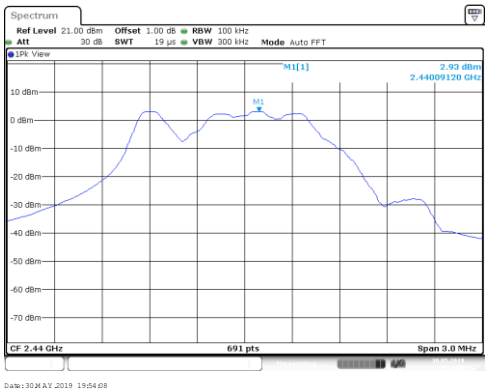
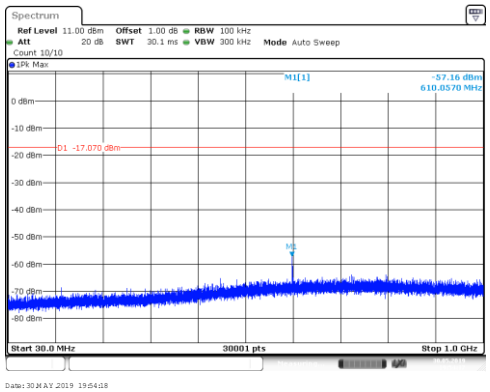
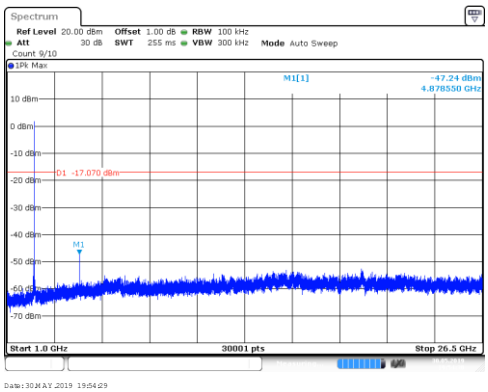
2440MHz





30MHz-1000MHz



1GHz-26.5GHz

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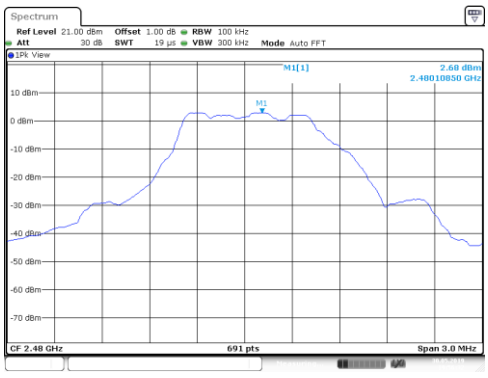
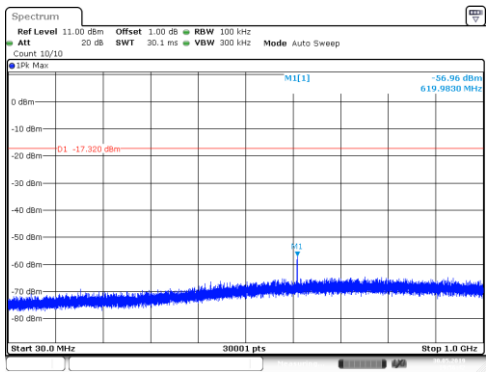
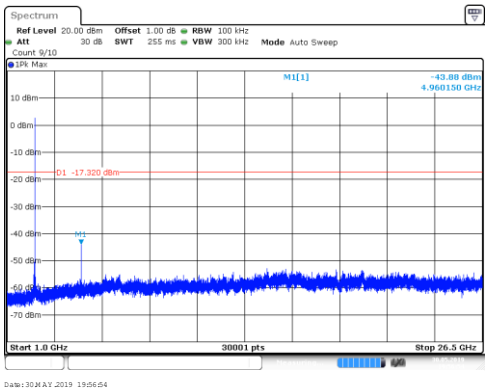
2480MHz





30MHz-1000MHz



1GHz-26.5GHz

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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

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

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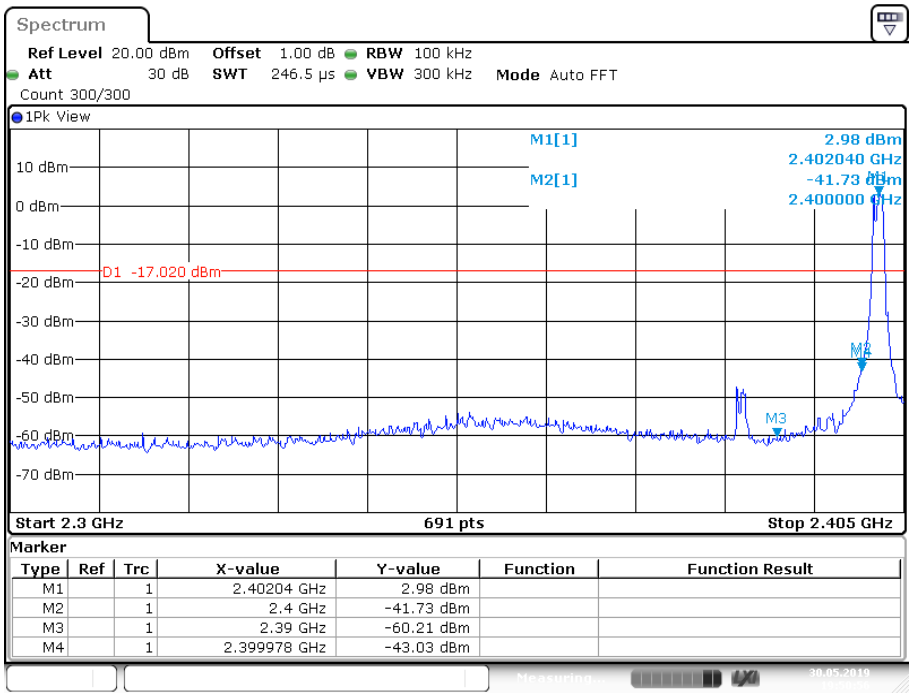
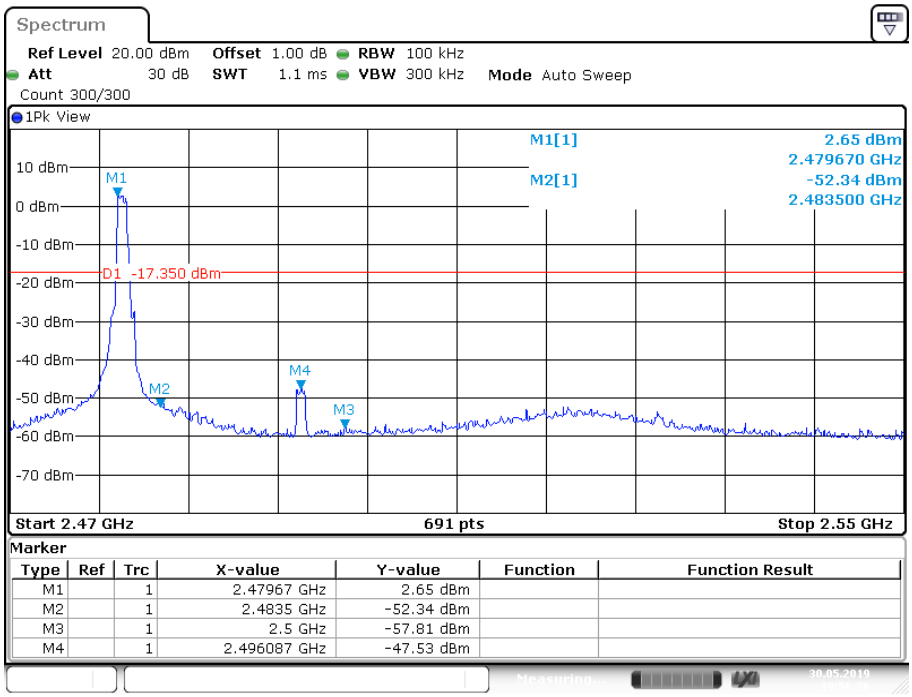
Band edge testing

2402MHz



Date: 30.MAY.2019 19:50:56

2480MHz



Date: 30.MAY.2019 19:56:27

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9.6 Spurious radiated emissions for transmitter

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.

3: 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.

4: 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.

5: Use the following spectrum analyzer settings According to C63.10:

For Above 1GHz

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥RBW for peak measurement and VBW = 10Hz for average measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Below 1GHz

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 for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Note:

1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.

2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.

3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (20log(1/duty cycle).

4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at requencyabove1GHz

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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:

Low channel 2402MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBuV/m		dBμV/m		dBuV/m	(dB/m)	
30-1000MHz	168.01*	31.14	H	43.5	QP	12.36	-29.9	Pass
	39.27	34.38	V	40	QP	5.62	-26.4	Pass
1000-25000MHz	13260.47*	44.17	H	74	PK	29.83	13.7	Pass
	--	--	H	54	AV	--	--	Pass
	15736.41*	46.97	V	74	PK	27.03	18.1	Pass
	--	--	V	54	AV	--	--	Pass

Middle channel 2440MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBuV/m		dBμV/m		dBuV/m	(dB/m)	
30-1000MHz	--	--	H	43.5	QP	--	--	Pass
	--	--	V	46	QP	--	--	Pass
1000-25000MHz	13159.22	44.89	H	74	PK	29.11	13.9	Pass
	--	--	H	54	AV	--	--	Pass
	9438.75*	40.33	V	74	PK	33.67	8.9	Pass
	--	--	V	54	AV	--	--	Pass

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High channel 2480MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBuV/m		dBµV/m		dBuV/m	(dB/m)	
30-1000MHz	--	--	H	43.5	QP	--	--	Pass
	--	--	V	46	QP	--	--	Pass
1000-25000MHz	13284.38*	42.39	H	74	PK	31.61	13.6	Pass
	--	--	H	54	AV	--	--	Pass
	15316.88	48.65	V	74	PK	25.35	18.6	Pass
	--	--	V	54	AV	--	--	Pass

Remark:

(1) " * " means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.

(2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.

(3) Above 1GHz: Correction Factor=Antenna Factor + Cable Loss – Pre-amplifier
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss
The Reading Level is recorded by software which is not shown in the sheet.

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10 Test Equipment List

List of Test Instruments

Radiated Emission Test

Description	Manufacturer	Model no.	Serial no.	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2019-7-6
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2019-6-28
Horn Antenna	Rohde & Schwarz	HF907	102294	2019-6-28
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2019-7-6
Signal Generator	Rohde & Schwarz	SMY01	839369/005	2019-7-6
Attenuator	Agilent	8491A	MY39264334	2019-7-6
3m Semi-anechoic chamber	TDK	9X6X6	----	2022-7-14
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

RF conducted test

Description	Manufacturer	Model no.	Serial no.	cal. due date
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2019-7-6
10dB Attenuator	Weinschel	4M-10	43152	2019-7-14
Test software	Rohde & Schwarz	EMC32	Version 10.38.00	N/A
Test software	Tonscend	System for BT/WIFI	Version 2.6	N/A

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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 Conducted Emission 150kHz-30MHz (for test using High Voltage Probe TK9420(VT9420))	3.21 dB
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.80dB; Vertical: 4.87dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.59dB; Vertical: 4.58dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6×10-7 or 1%

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