

## 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  
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Telephone: 86 755 8828 6998

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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<br>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 |

## 4 Summary of Test Standards

| Test Standards                             |                                                                        |
|--------------------------------------------|------------------------------------------------------------------------|
| FCC Part 15 Subpart C<br>10-1-2018 Edition | PART 15 - RADIO FREQUENCY DEVICES<br>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).

## 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            | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247 (b) (1)        | Conducted peak output power                 | 10         | Site 1    | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)          | 20dB bandwidth                              | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)          | Carrier frequency separation                | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)(iii)     | Number of hopping frequencies               | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(1)(iii)     | Dwell Time                                  | ---        | ---       | <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| §15.247(a)(2)          | 6dB bandwidth and 99% Occupied Bandwidth    | 16         | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(e)             | Power spectral density                      | 13         | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(d)             | Spurious RF conducted emissions             | 20         | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(d)             | Band edge                                   | 24         | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.247(d) & §15.209   | Spurious radiated emissions for transmitter | 26         | Site 1    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |
| §15.203                | Antenna requirement                         | See note 1 |           | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            |

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.

## 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

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

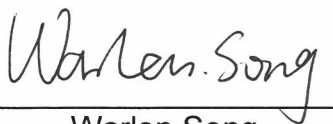
Reviewed by:

Prepared by:

Tested by:



Zhi John  
EMC Section Manager



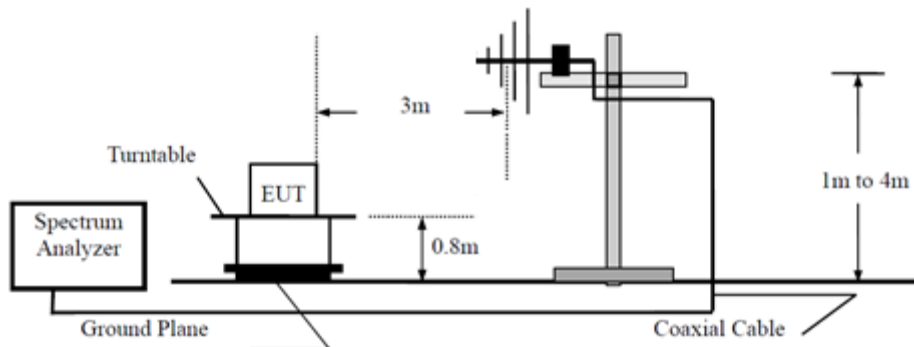
Warlen Song  
EMC Project Engineer



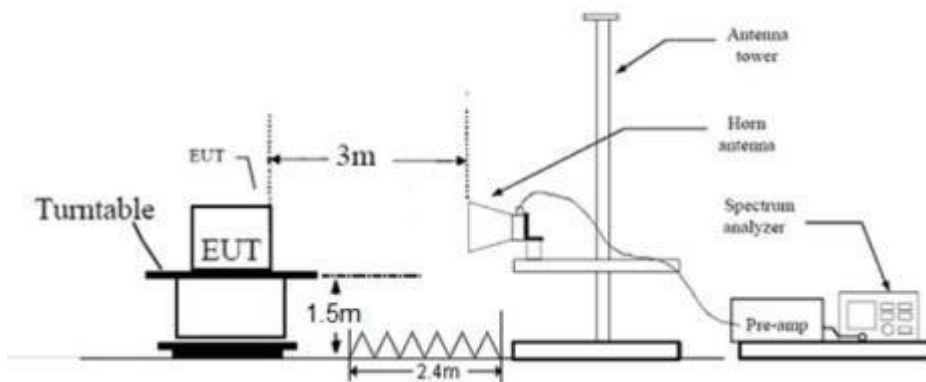
Louise Liu  
EMC Test Engineer

## 7 Test Setups

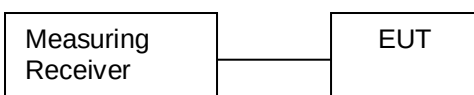
### Below 1GHz



### Above 1GHz



### Conducted RF test setups



## 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.

## 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 $\geq$ 3RBW, Span $\geq$ 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

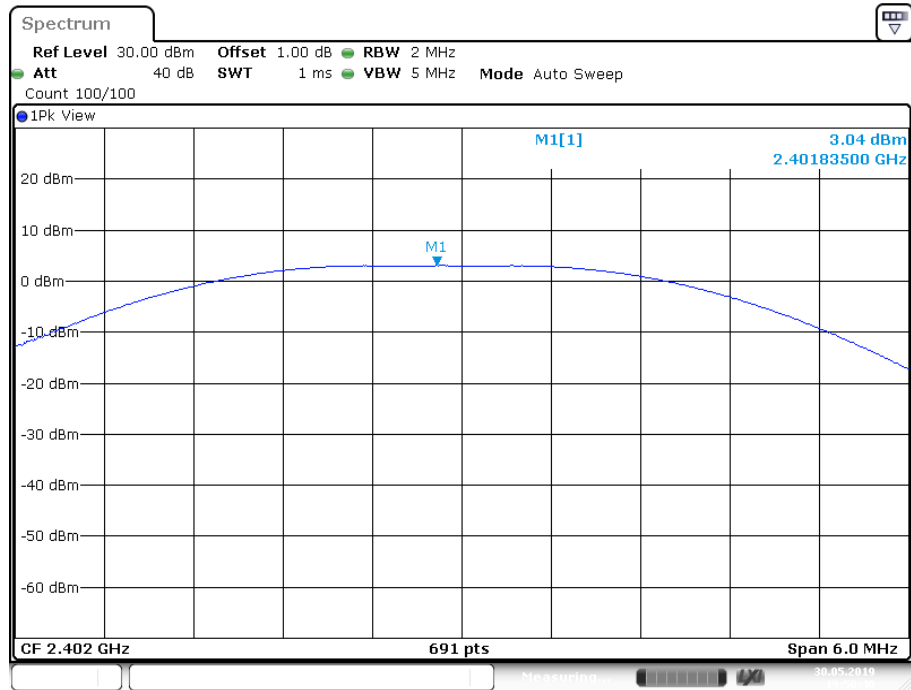
According to §15.247 (b) (1), conducted peak output power limit as below:

| Frequency Range<br>MHz | Limit<br>W | Limit<br>dBm |
|------------------------|------------|--------------|
| 2400-2483.5            | $\leq 1$   | $\leq 30$    |

Test result as below table

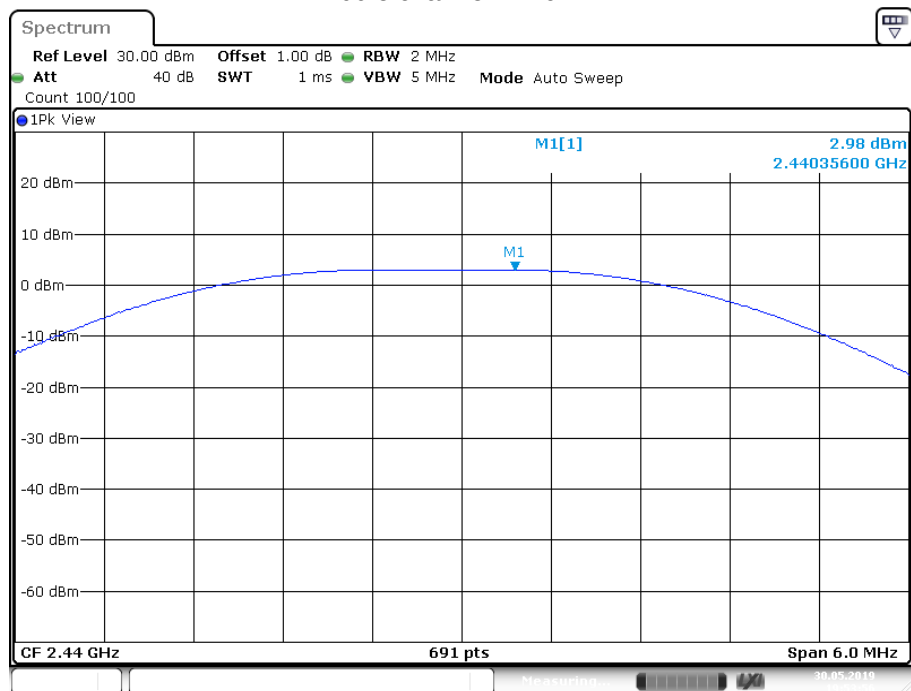
| Frequency<br>MHz       | Conducted Peak<br>Output Power<br>dBm | Result |
|------------------------|---------------------------------------|--------|
| Bottom channel 2402MHz | 3.04                                  | Pass   |
| Middle channel 2440MHz | 2.98                                  | Pass   |
| Top channel 2480MHz    | 2.81                                  | Pass   |

## Low channel 2402MHz



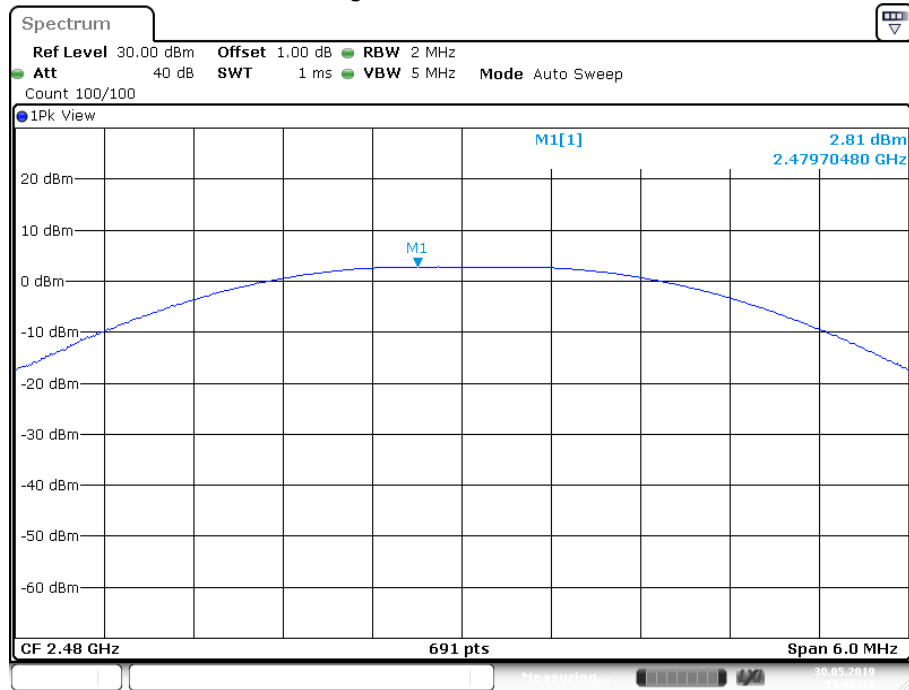
Date: 30 MAY 2019 19:50:41

## Middle channel 2440MHz



Date: 30 MAY 2019 19:53:56

# High channel 2480MHz



Date: 30 MAY 2019 19:56:11

## 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 $\geq$ 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

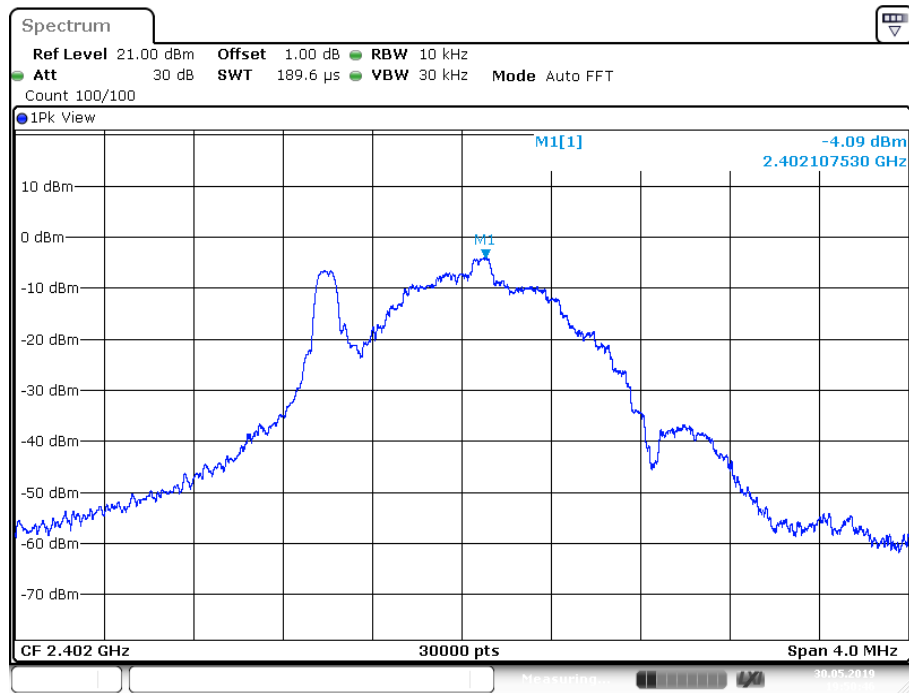
Limit [dBm/3KHz]

$\leq 8$

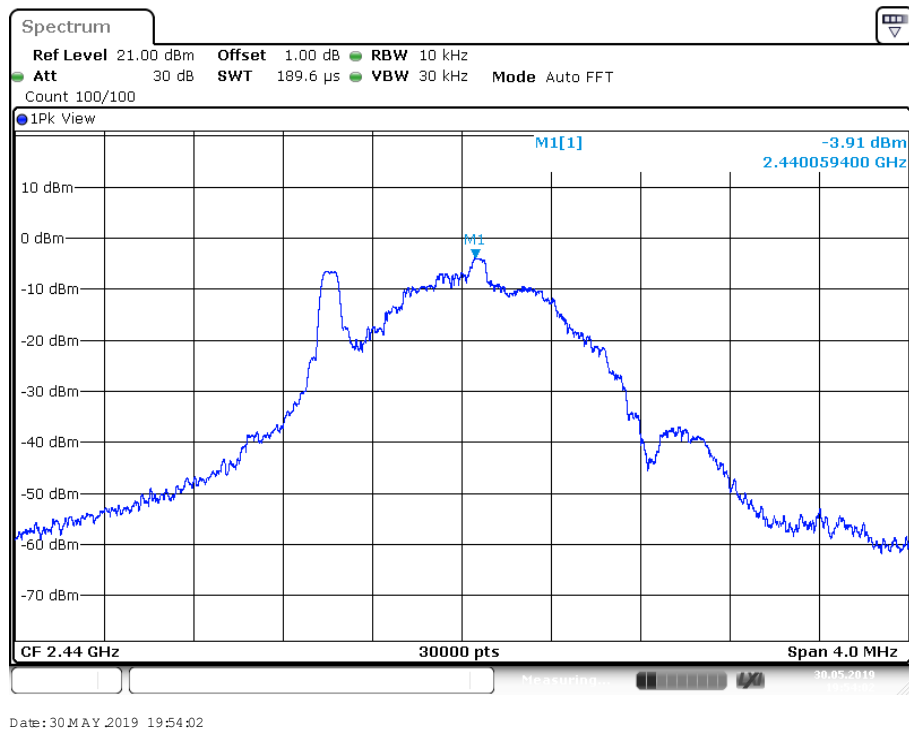
### Test result

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

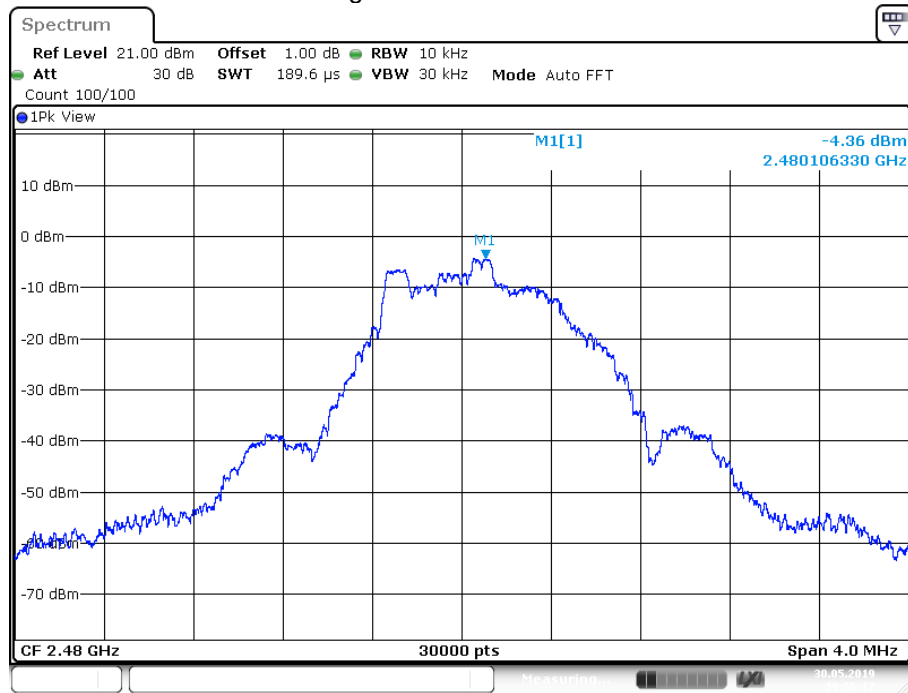
## Low channel 2402MHz



## Middle channel 2440MHz



# High channel 2480MHz



Date: 30.MAY.2019 19:56:17

### 9.3 6 dB Bandwidth and 99% Occupied Bandwidth

#### Test Method

1. Use the following spectrum analyzer settings:  
RBW=100K, VBW $\geq$ 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  $\geq$  6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

#### Limit

Limit [kHz]

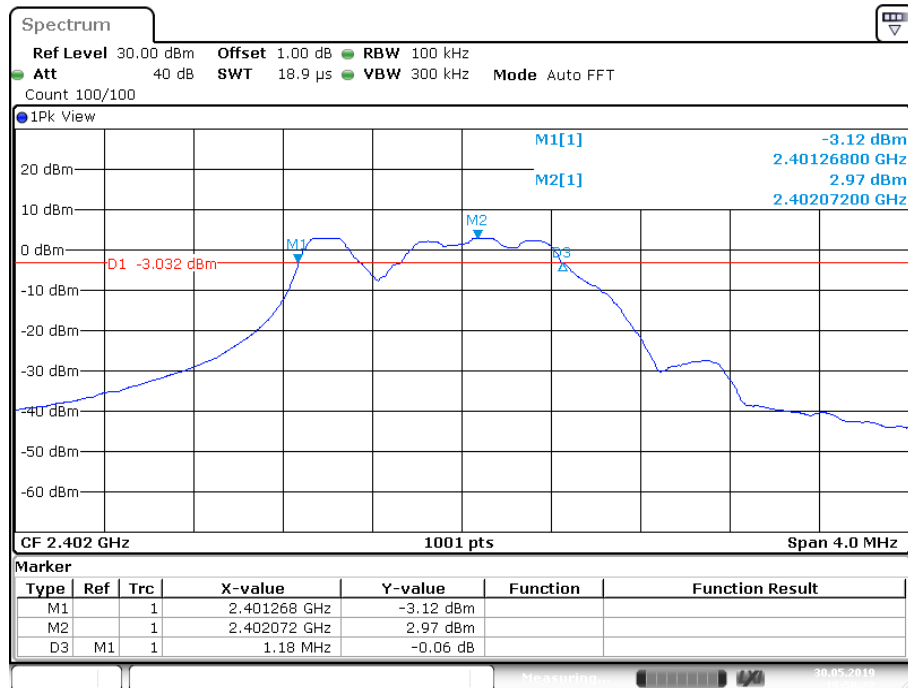
$\geq 500$

#### Test result

| Frequency<br>MHz       | 6dB bandwidth<br>kHz | 99 bandwidth<br>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   |

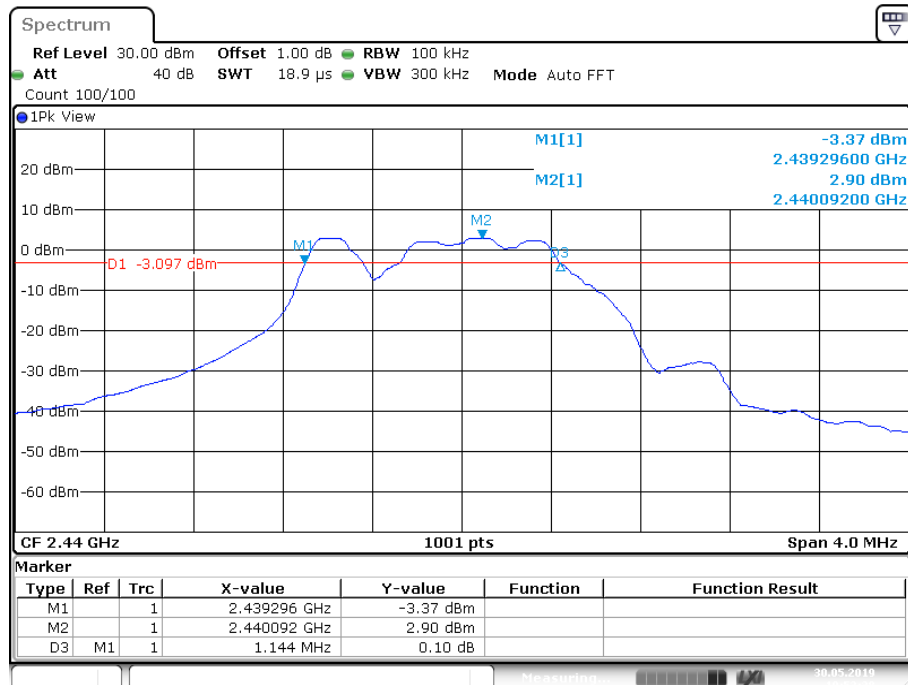
**6 dB Bandwidth**

Low channel 2402MHz



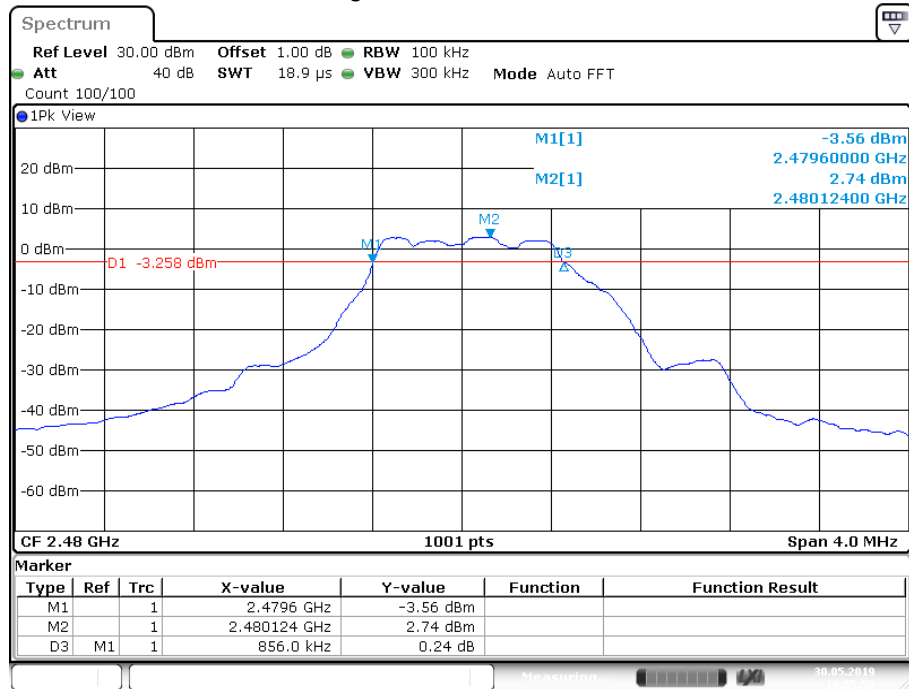
Date: 30 MAY 2019 19:50:23

Middle channel 2440MHz



Date: 30 MAY 2019 19:53:38

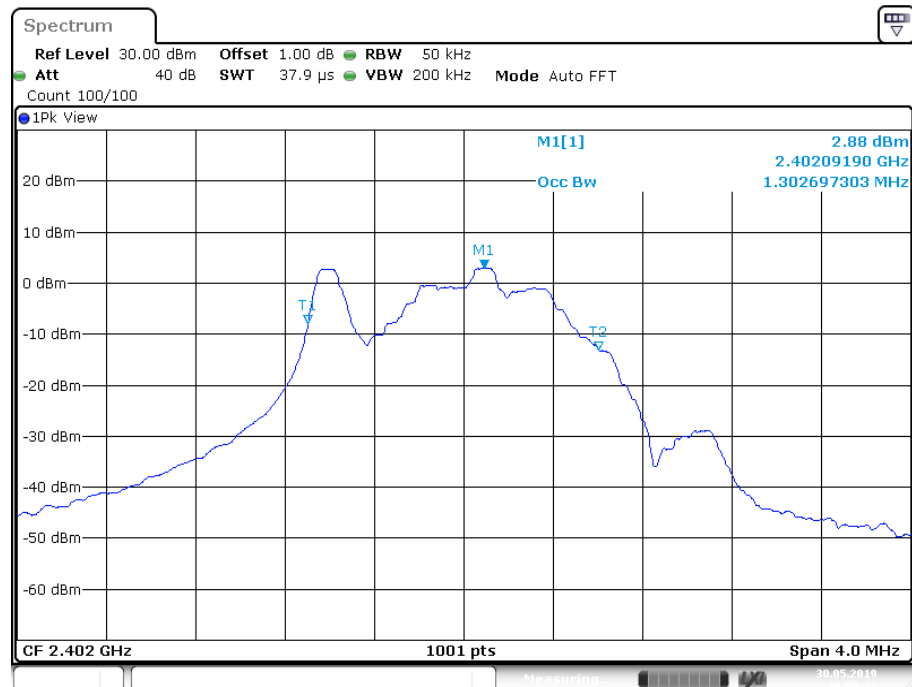
## High channel 2480MHz



Date: 30 MAY 2019 19:55:53

## 99% Occupied Bandwidth

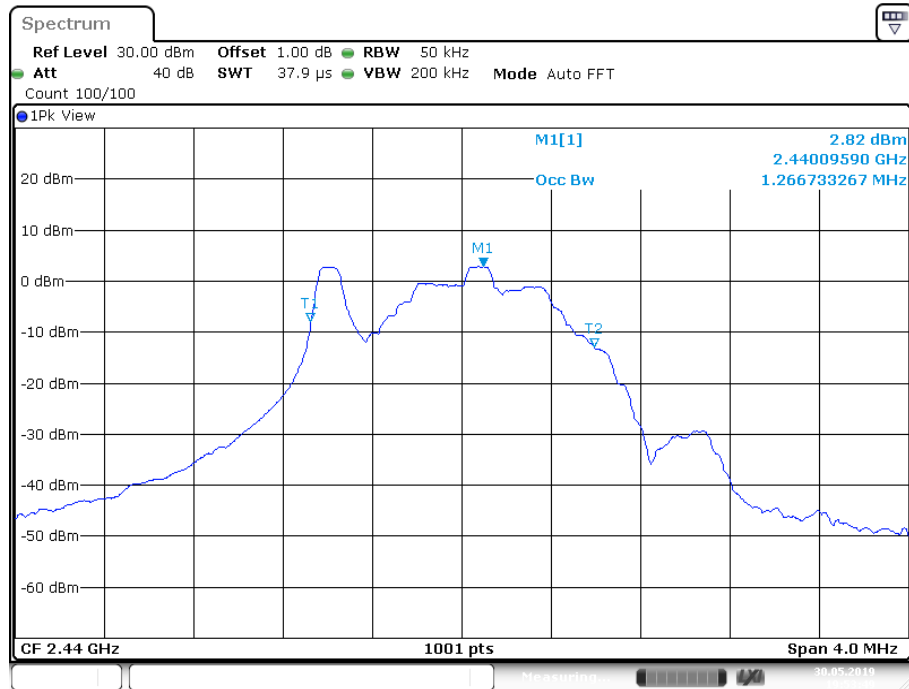
## Low channel 2402MHz



Date: 30 MAY 2019 19:50:34

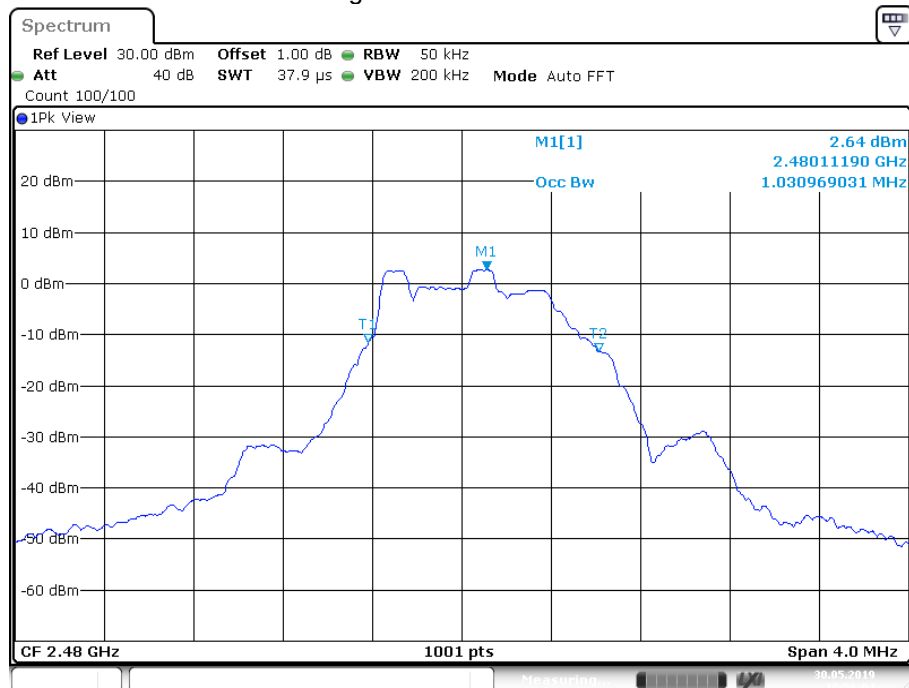
4.71

## Middle channel 2440MHz



Date: 30 MAY 2019 19:53:50

## High channel 2480MHz



Date: 30 MAY 2019 19:56:04

## 9.4 Spurious RF conducted emissions

### Test Method

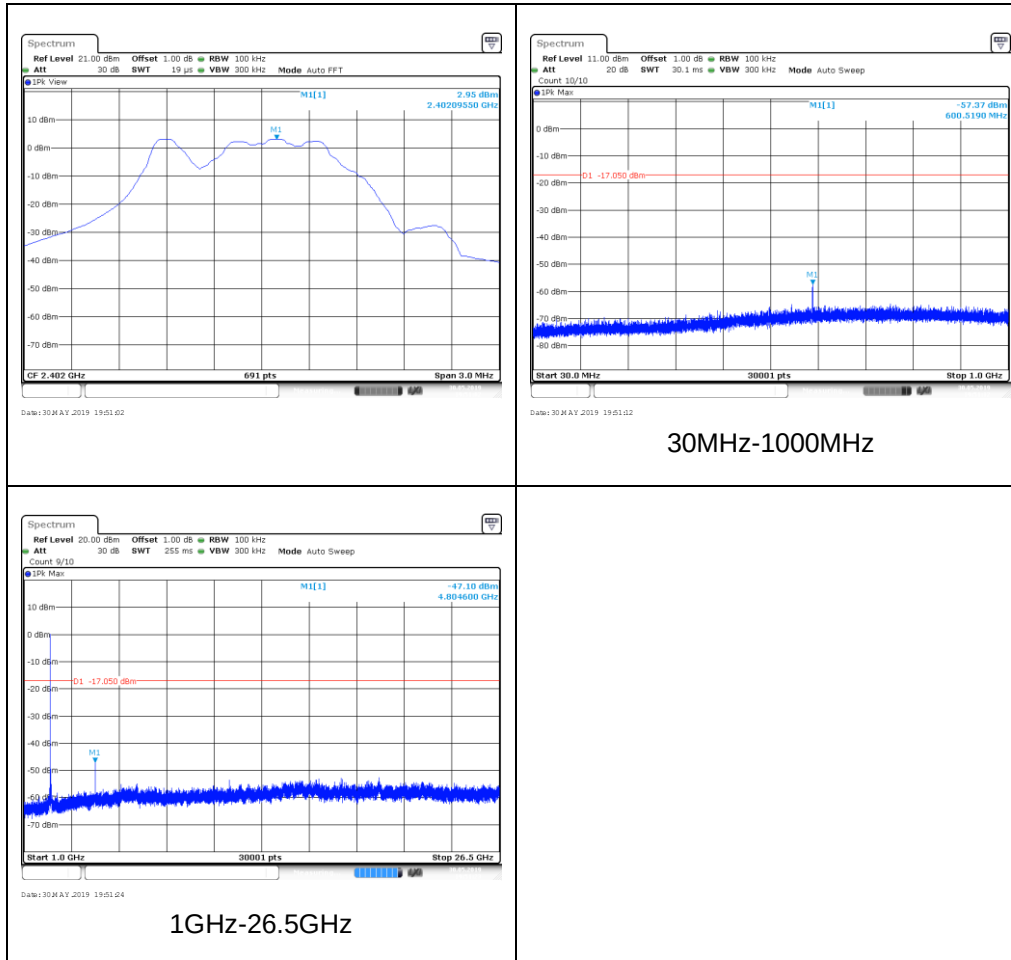
1. Establish a reference level by using the following procedure:
  - a. Set RBW=100 kHz. VBW $\geq$ 3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
  - b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level 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<br>MHz | Limit (dBc) |
|------------------------|-------------|
| 30-25000               | -20         |

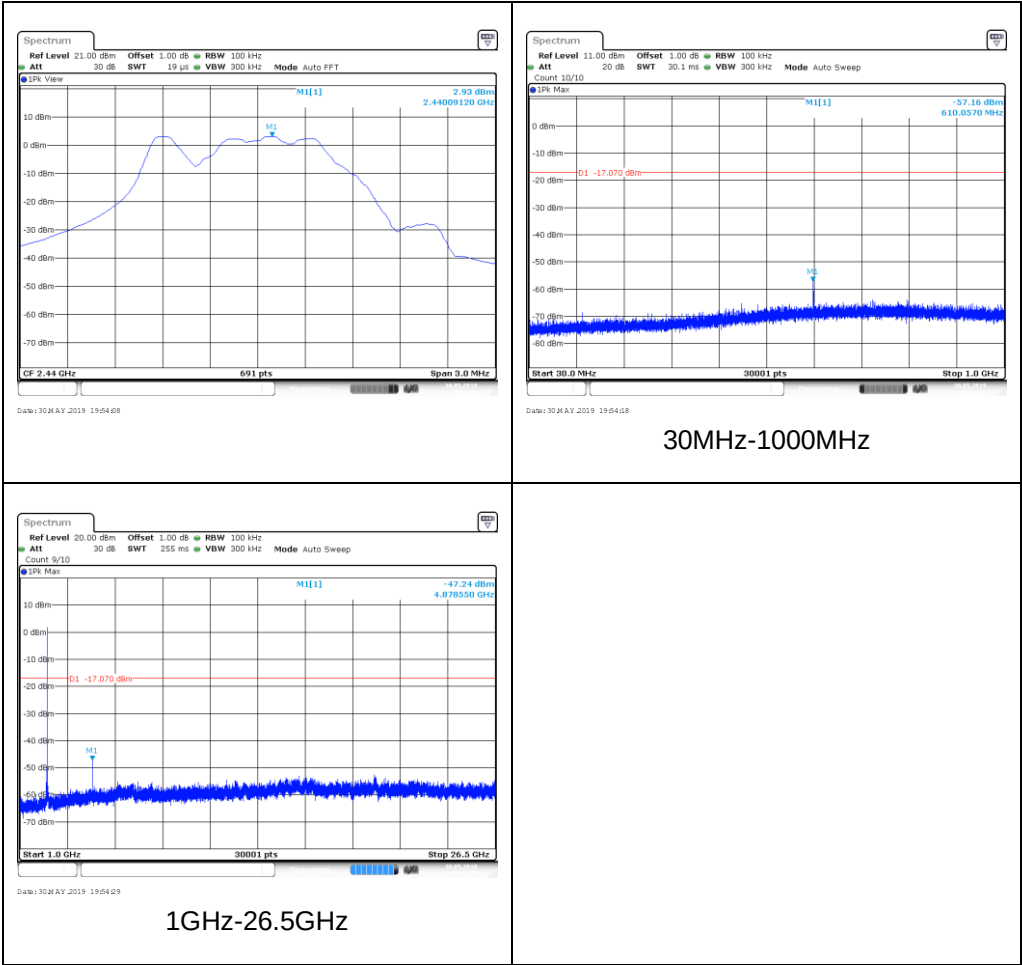
**Spurious RF conducted emissions**

2402MHz

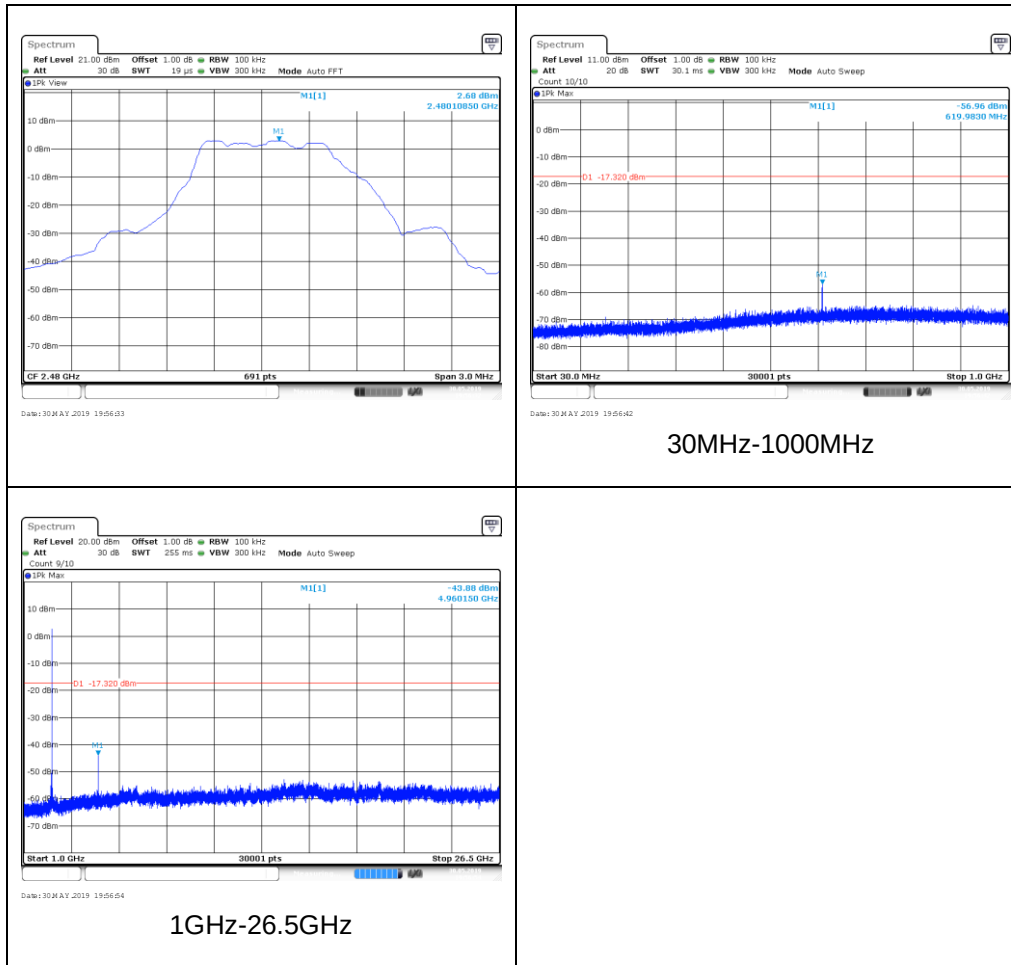




2440MHz



## 2480MHz



## 9.5 Band edge

### Test Method

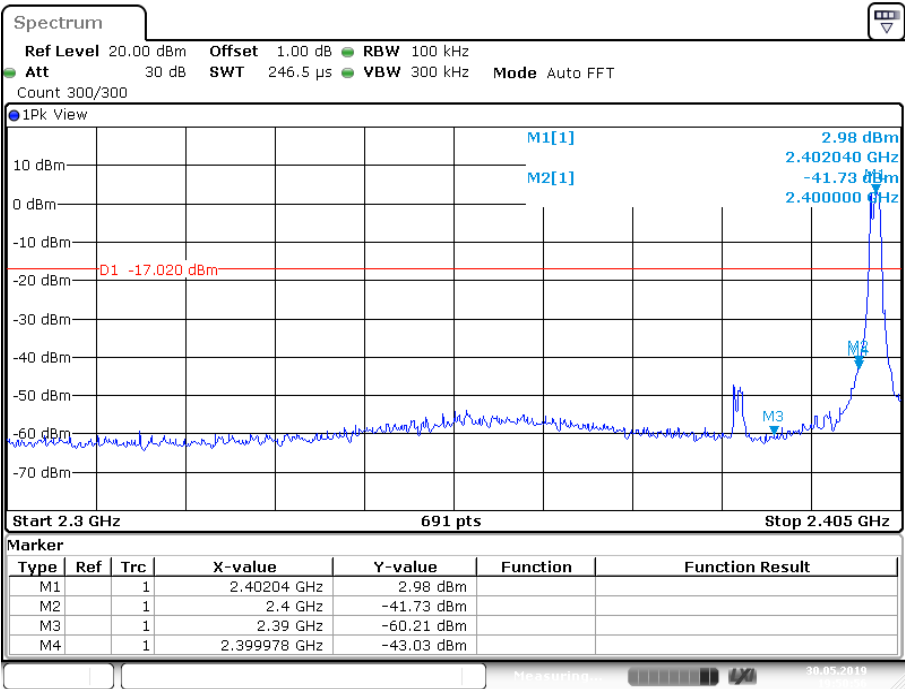
- 1 Use the following spectrum analyzer settings:  
Span = wide enough to capture the peak level of the in-band emission and all spurious  
RBW = 100 kHz, VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to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

### Limit

| Frequency Range<br>MHz | Limit (dBc) |
|------------------------|-------------|
| 30-25000               | -20         |

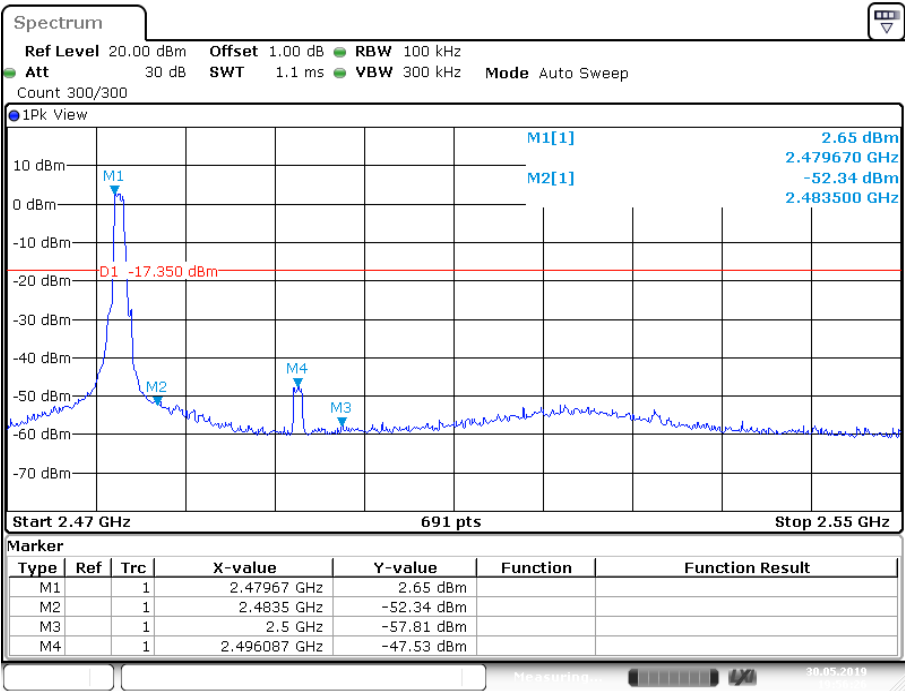
Band edge testing

2402MHz



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

2480MHz



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

## 9.6 Spurious radiated emissions for transmitter

### Test Method

- 1: The EUT was placed 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 ( $20\log(1/\text{duty cycle})$ ).
- 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 frequency above 1GHz.

## 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 section 15.205, must comply with the radiated emission limits specified in section 15.209.

| Frequency<br>MHz | Field Strength<br>uV/m | Field Strength<br>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       |

### 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<br>MHz | Emission Level<br>dBuV/m | Polarization | Limit<br>dBuV/m | Detector | Margin<br>dBuV/m | Correct factor<br>(dB/m) | Result |
|----------------|------------------|--------------------------|--------------|-----------------|----------|------------------|--------------------------|--------|
| 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<br>MHz | Emission Level<br>dBuV/m | Polarization | Limit<br>dBuV/m | Detector | Margin<br>dBuV/m | Correct factor<br>(dB/m) | Result |
|----------------|------------------|--------------------------|--------------|-----------------|----------|------------------|--------------------------|--------|
| 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   |

## High channel 2480MHz Test Result

| Frequency Band | Frequency<br>MHz | Emission Level<br>dBuV/m | Polarization | Limit<br>dBuV/m | Detector | Margin<br>dBuV/m | Correct factor<br>(dB/m) | Result |
|----------------|------------------|--------------------------|--------------|-----------------|----------|------------------|--------------------------|--------|
| 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.

## 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           |

## 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;<br>Vertical: 4.87dB;                                             |
| Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz                                        | Horizontal: 4.59dB;<br>Vertical: 4.58dB;                                             |
| Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz                                       | Horizontal: 5.05dB;<br>Vertical: 5.04dB;                                             |
| Uncertainty for Conducted RF test with TS 8997                                                     | RF Power Conducted: 1.16dB<br>Frequency test involved:<br>0.6×10 <sup>-7</sup> or 1% |