

## Test Report for FCC

FCC ID : 2A7PD-EMSC03

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                           |                                                  |                   |           |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------------------------------------|-------------------|-----------|
| Report Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                           | ESTRFC2208-001                                   |                   |           |
| Applicant                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Company name                                                              | eMoldino                                         |                   |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Address                                                                   | 15th floor, 416 Hangangdaero, Seoul, South Korea |                   |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Telephone                                                                 | +82-70-4739 -7777                                |                   |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Contact person                                                            | PARK MYUNG JIN                                   |                   |           |
| Product                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Product name                                                              | Shot counter                                     |                   |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Factory address                                                           | 15th floor, 416 Hangangdaero, Seoul, South Korea |                   |           |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Model No.                                                                 | EM-SC03                                          | Manufacturer      | eMoldino  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Serial No.                                                                | NONE                                             | Country of origin | KOREA     |
| Test date                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 29-Jul-22 ~ 7-Aug-22                                                      |                                                  | Date of issue     | 10-Aug-22 |
| Testing location                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 140-16, Eongmalli-ro, Majang-myeon, Icheon-si, Gyeonggi-do, Rep. of Korea |                                                  |                   |           |
| Standard                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | FCC PART 15 Subpart C (15.247), ANSI C 63.10(2013), KDB 558074 D01v05r02  |                                                  |                   |           |
| Measurement facility registration number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                           | 659627                                           |                   |           |
| Tested by                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Senior Engineer H.G. Lee                                                  |                                                  | (Signature)       |           |
| Reviewed by                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Engineering Manager I.K Hong                                              |                                                  | (Signature)       |           |
| Abbreviation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | OK, Pass = Passed, Fail = Failed, N/A = not applicable                    |                                                  |                   |           |
| <p>* Note</p> <ul style="list-style-type: none"> <li>- This test report is not permitted to copy partly without our permission</li> <li>- This test result is dependent on only equipment to be used</li> <li>- This test result based on a single evaluation of one sample of the above mentioned</li> <li>- This test report is not related to KOLAS accreditation</li> <li>- Additional models name: EM-SC03I, EM-SC03S, EM-SC03IC, EM-SC03SC, eMOLDINO, EShotLink</li> <li>- Basic and additional mode are same products, only Model name are different</li> </ul> |                                                                           |                                                  |                   |           |

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Appendix 1. Special diagram

Appendix 2. Antenna Information

## 1. Laboratory Information

### 1.1 General

This EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards and is tested in accordance with the measurement procedures as indicated in this report.

ESTECH Lab attests to accuracy of test data. All measurement reported herein were performed by ESTECH Co., Ltd.

ESTECH Lab assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

### 1.2 Test Lab.

Corporation Name : ESTECH Co., Ltd.

Head Office : Suite 1015 World Meridian II, 123 Gasan Digital 2-ro, Geumcheon-gu, Seoul 153-759, R. O. Korea

EMC/Telecom/Safety Test Lab :140-16, Eongmalli-ro, Majang-myeon, Icheon-si,  
Gyeonggi-do, Rep. of Korea

### 1.3 Official Qualification(s)

MSIP : Granted Accreditation from Ministry of Information & Communication for EMC, Safety and Telecommunication

KOLAS : Accredited Lab By Korea Laboratory Accreditation Schema base on CENELEC requirements

FCC : Conformity Assessment Body(CAB) with registration number 659627 under APEC TEL MRA between the RRA and the FCC

VCCI : Granted Accreditation from Voluntary Control Council for Interference from ITE

## 2. Description of EUT

### 2.1 Summary of Equipment Under Test

|                                           |                                                                                 |
|-------------------------------------------|---------------------------------------------------------------------------------|
| Modulation Type                           | : Bluetooth (GFSK)                                                              |
| Transfer Rate                             | : 1 Mbps, 2 Mbps                                                                |
| Number of Channel                         | : 40 ch                                                                         |
| PEAK Output Power                         | : GFSK : 4.56 mW                                                                |
| Rating                                    | : OUTPUT: DC 3.7 V Battery                                                      |
| Receipt Date                              | : 14-Jun-22                                                                     |
| X-tal list(s) or<br>Frequencies generated | : The highest operating frequency is 2480 MHz(Bluetooth)<br>Bluetooth : 2.4 GHz |

### 2.2 General descriptions of EUT

| Category                         | Feature               | Description                                             |
|----------------------------------|-----------------------|---------------------------------------------------------|
| LCD Display                      |                       | 7 – digit (20.8 mm x 8.2 mm)                            |
| Shot sensor recognition distance |                       | Shot In : 15 mm, Shot out : 60 mm                       |
| Bluetooth (5.0)                  | Output power          | + 8 dB                                                  |
|                                  | Transmission distance | 30 – 100 m                                              |
| Cycle time                       | Injection molding     | 2 ~ 600 sec                                             |
|                                  | Press molding         | 0.2 ~ 600 sec                                           |
| Storage temperature              |                       | - 20 °C ~ 85 °C                                         |
| Operating temperature / Humidity |                       | - 10 °C ~ 50 °C / 10 % ~ 90 %                           |
| Texture                          |                       | PBT Flame Retardant /<br>135 g (including magnet block) |
| Size                             |                       | 65 x 45 x 38                                            |

### 3. Test Standards

#### Test Standard : FCC PART 15 Subpart C (15.247)

This Standard sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license. It also contains the technical specifications, administrative requirements and other conditions relating to the marketing of Part 15 devices.

#### Test Method : ANSI C 63.10 (2013) & KDB558074 D01v05r02

This standard sets forth uniform methods of measurement of radio-frequency (RF) signals and noise emitted from both unintentional and intentional emitters of RF energy in the frequency range 9 kHz to 40 GHz. Methods for the measurement of radiated and AC power-line conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. These methods cover measurement of certain devices that deliberately radiate energy, such as intentional emitters, but does not cover licensed transmitters. This standard is not intended for certification/approval of avionic equipment or for industrial, scientific, and medical (ISM) equipment. These methods apply to the measurement of individual units or systems comprised of multiple units.

#### Summary of Test Results

| Applied Standard : 47 CFR Part 15 Subpart C |                                                    |        |                      | remark       |
|---------------------------------------------|----------------------------------------------------|--------|----------------------|--------------|
| Standard                                    | Test Type                                          | Result | Remark               | Limit        |
| 15.207                                      | AC Power Conducted Emission                        | Pass   | Meet the requirement |              |
| 15.205 & 15.209                             | Restricted band /<br>Intentional Radiated Emission | Pass   | Meet the requirement |              |
| 15.247(a)(2)                                | 6 dB Bandwidth                                     | Pass   | Meet the requirement | Min. 500 kHz |
|                                             | Occupied Bandwidth                                 |        |                      |              |
| 15.247(b)(3)                                | Maximum Peak<br>/Average output power              | Pass   | Meet the requirement | Max. 30 dBm  |
| 15.209                                      | Transmitter Radiated Emission                      | Pass   | Meet the requirement | Table 15.209 |
| 15.247(e)                                   | Power Spectral Density                             | Pass   | Meet the requirement | Max. 8 dBm   |
| 15.247(d)                                   | Band Edge Measurement                              | Pass   | Meet the requirement | 20 dB less   |

## 4. Measurement Condition

### 4.1 EUT Operation

#### a. Channel

| Ch. | Frequency | Ch. | Frequency |
|-----|-----------|-----|-----------|
| 0   | 2402 MHz  | ... | ...       |
| 1   | 2404 MHz  | 36  | 2474 MHz  |
| 2   | 2406 MHz  | 37  | 2476 MHz  |
| 3   | 2408 MHz  | 38  | 2478 MHz  |
| ... | ...       | 39  | 2480 MHz  |
| 11  | 2428 MHz  |     |           |
| ... | ...       |     |           |
| 19  | 2440 MHz  |     |           |

b. Measurement Channel : Bluetooth : Low(2402 MHz), Middle(2440 MHz), High(2480 MHz)

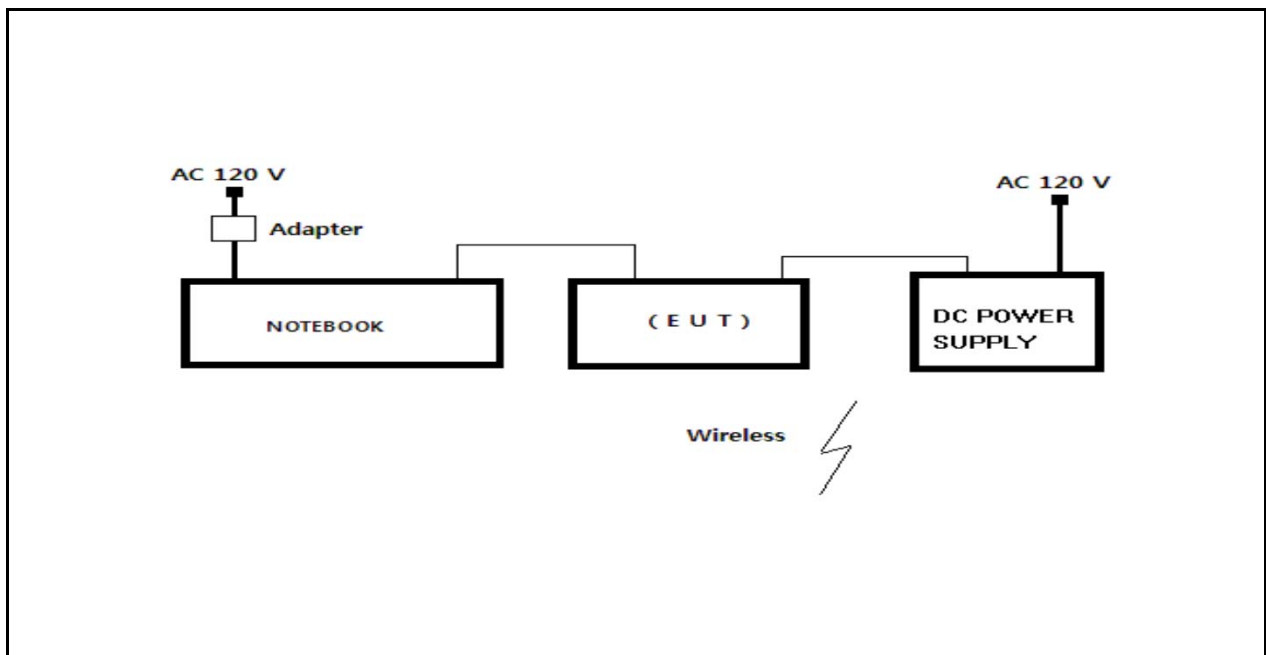
c. Test Mode : Continuous Output, GFSK

d. Test rate : 1 Mbps

## 4.2 EUT Operation.

- The EUT was in the following operation mode during all testing
  - \* Bluetooth operation check
  - \* Transmit mode were measured each channels(Low, Middle, High)
  - \* The EUT was measured up to tenth harmonic or 40 GHz of the highest operating frequencies.

## 4.3 Configuration and Peripherals



#### 4.4 EUT and Support equipment

| Equipment Name  | Model Name | S/N  | Manufacturer                                 | Remark (FCC ID) |
|-----------------|------------|------|----------------------------------------------|-----------------|
| Shot counter    | EM-SC03    | NONE | eMoldino                                     | EUT             |
| Notebook        | 80XL       | NONE | LcFc(hefei) electronics technology Co., Ltd. |                 |
| Adapter         | ADL45WCE   | NONE | CHICONY POWER TECHNOLOGY (SUZHOU) CO., LTD.  |                 |
| DC power supply | AK3010     | NONE | VM POWER                                     |                 |
|                 |            |      |                                              |                 |
|                 |            |      |                                              |                 |
|                 |            |      |                                              |                 |

#### 4.5 Cable Connecting

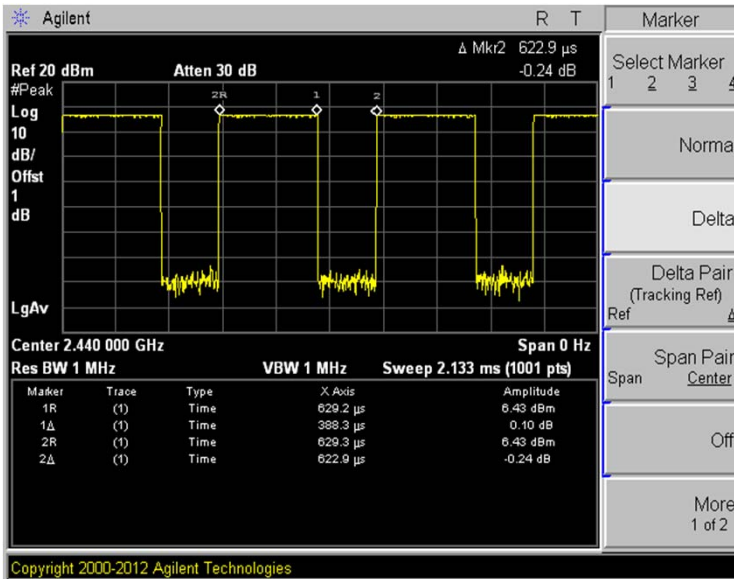
| Start Equipment |          | End Equipment   |          | Cable Standard |            | Remark |
|-----------------|----------|-----------------|----------|----------------|------------|--------|
| Name            | I/O port | Name            | I/O port | Length         | Shielded   |        |
| Shot counter    | Power    | DC power supply | –        | 2.0            | Unshielded |        |
| Shot counter    | USB      | Notebook        | USB      | 2.0            | Unshielded |        |
| Notebook        | Power    | Adapter         | –        | 2.0            | Unshielded |        |
|                 |          |                 |          |                |            |        |
|                 |          |                 |          |                |            |        |
|                 |          |                 |          |                |            |        |
|                 |          |                 |          |                |            |        |
|                 |          |                 |          |                |            |        |

## 4.6 DUTY CYCLE OF TEST SIGNAL

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

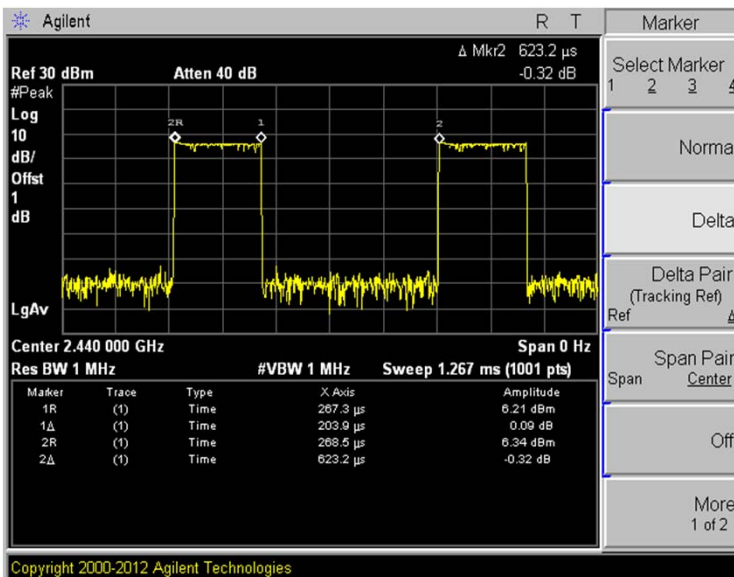
### BLE 1M

duty cycle =  $0.388/0.622=0.623$ , duty factor =  $10*\log(1/0.623)=2.052$



### BLE 2M

duty cycle =  $0.203/0.623=0.327$ , duty factor =  $10*\log(1/0.327)=4.852$



## 5. DTS bandwidth & 99 % Occupied Bandwidth

### 5.1 Test procedure

§ 15.247 (a)(2),

Systems using digital modulation techniques may operate in the 902–928MHz, 2400–2483.5MHz, and 5725–5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

### 5.2 Test instruments and measurement setup

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW  $\geq$  3 X RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, 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.

Limits : FCC § 15.247(a)(2)

#### 6dB Bandwidth Test Instruments

| Description                              | Model         | Serial Number | Cal. Due Date |
|------------------------------------------|---------------|---------------|---------------|
| Spectrum Analyzer                        | E4440A        | US42041291    | 2022-11-29    |
| RF Cable                                 | Length: 30 cm | –             |               |
| –Spectrum Analyzer $\Leftrightarrow$ EUT | Loss: 1 dB    | –             |               |

### 5.3 Measurement results

|             |              |                            |                      |
|-------------|--------------|----------------------------|----------------------|
| EUT         | Shot counter | MODEL                      | EM-SC03              |
| MODE        | GFSK         | ENVIRONMENTAL<br>CONDITION | 22.6 °C, 44.1 % R.H. |
| INPUT POWER | DC 3.7 V     |                            |                      |

#### BLE 1M

| Channel Frequency (MHz) | 99 % Occupied Bandwidth(MHz) | Bandwidth at 6dB below(MHz) | Minimum Limit (MHz) | PASS/FAIL |
|-------------------------|------------------------------|-----------------------------|---------------------|-----------|
| 2402                    | 1.05                         | 0.67                        | 0.5                 | PASS      |
| 2440                    | 1.05                         | 0.70                        | 0.5                 | PASS      |
| 2480                    | 1.05                         | 0.69                        | 0.5                 | PASS      |

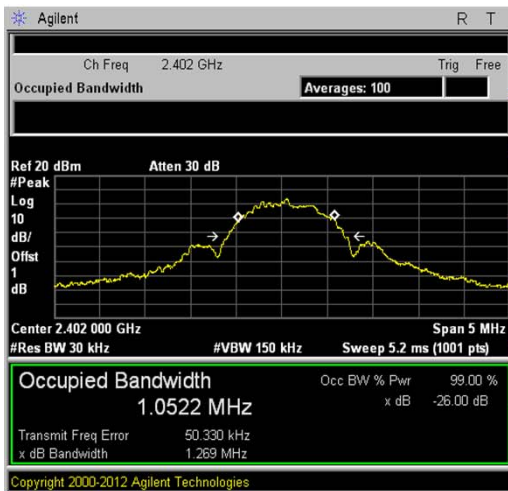
#### BLE 2M

| Channel Frequency (MHz) | 99 % Occupied Bandwidth(MHz) | Bandwidth at 6dB below(MHz) | Minimum Limit (MHz) | PASS/FAIL |
|-------------------------|------------------------------|-----------------------------|---------------------|-----------|
| 2402                    | 2.04                         | 1.18                        | 0.5                 | PASS      |
| 2440                    | 2.04                         | 1.19                        | 0.5                 | PASS      |
| 2480                    | 2.04                         | 1.17                        | 0.5                 | PASS      |

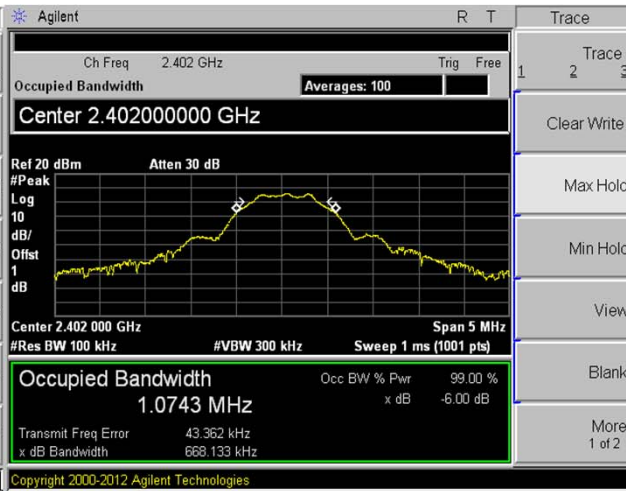
## 5.4 Trace data(BLE 1M)

(ch\_0)

99% OBW

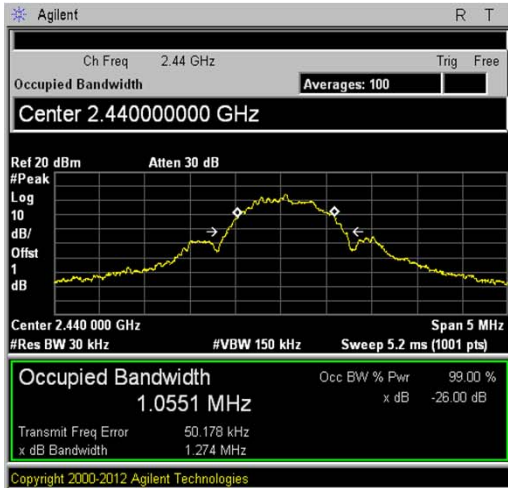


6dB below

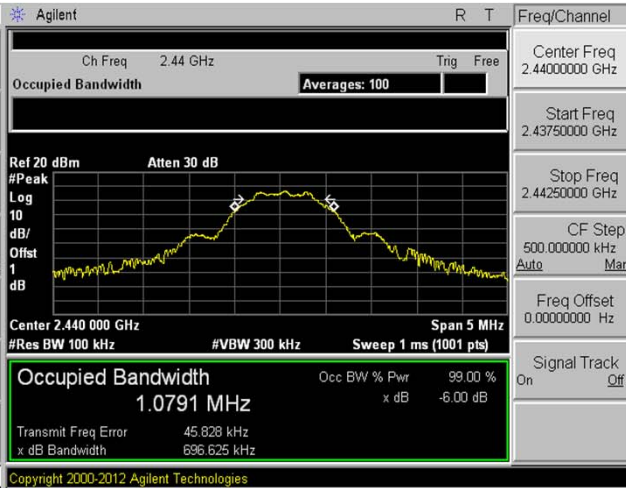


(ch\_19)

99% OBW

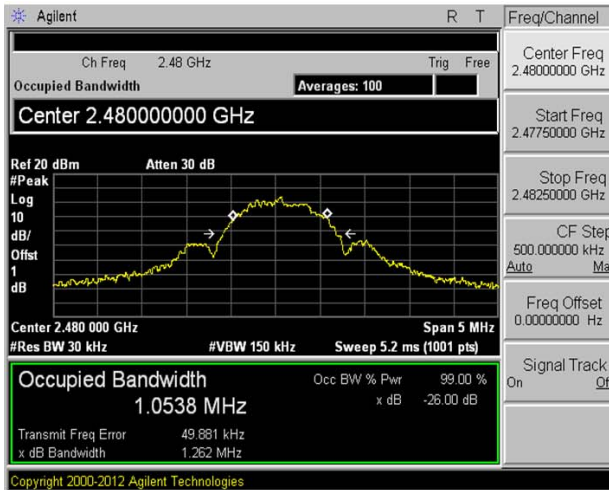


6dB below

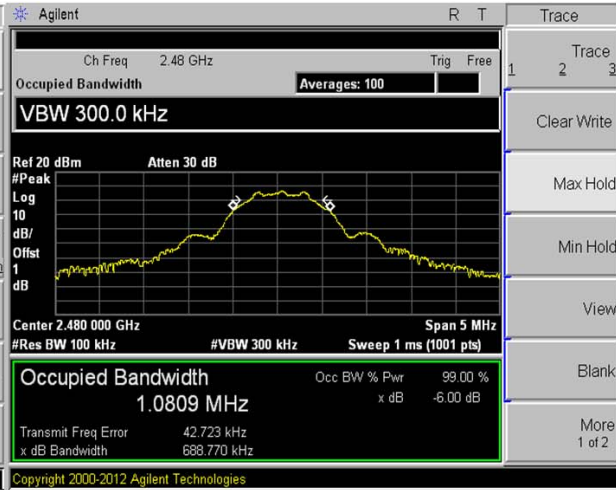


(ch\_39)

99% OBW



6dB below



BLE 2M

(ch\_0)

99% OBW

6dB below



(ch\_19)

99% OBW

6dB below



(ch\_39)

99% OBW

6dB below



## 6. Maximum peak conducted output power

### 6.1 Test procedure

The transmitter antenna terminal is connected to the input of a Power Sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum peak output power measurement is 30 dBm.

Limits : FCC § 15.247

#### Maximum Peak Output Power Test Instruments

| Description         | Model      | Serial Number | Cal. Due Date |
|---------------------|------------|---------------|---------------|
| Power Meter         | N1921A     | MY45100570    | 2022-11-29    |
| Power Sensor        | N1921A     | MY45240427    | 2022-11-29    |
| Power Meter <=> EUT | Loss: 1 dB | —             |               |

### 6.2 Measurement results

|             |              |                         |                      |
|-------------|--------------|-------------------------|----------------------|
| EUT         | Shot counter | MODEL                   | EM-SC03              |
| MODE        | GFSK         | ENVIRONMENTAL CONDITION | 22.3 °C, 44.6 % R.H. |
| INPUT POWER | DC 3.7 V     |                         |                      |

#### BLE 1M

| CHANNEL | Channel Frequency (MHz) | Conducted Power Output(dBm) |       |      | Limit[1W] (dBm) | PASS/FAIL |
|---------|-------------------------|-----------------------------|-------|------|-----------------|-----------|
|         |                         | Detector                    | (dBm) | (mW) |                 |           |
| 0       | 2 402                   | PEAK                        | 6.37  | 4.34 | 30.0            | PASS      |
| 19      | 2 440                   | PEAK                        | 6.58  | 4.55 | 30.0            | PASS      |
| 39      | 2 480                   | PEAK                        | 6.32  | 4.29 | 30.0            | PASS      |

#### BLE 2M

| CHANNEL | Channel Frequency (MHz) | Conducted Power Output(dBm) |       |      | Limit[1W] (dBm) | PASS/FAIL |
|---------|-------------------------|-----------------------------|-------|------|-----------------|-----------|
|         |                         | Detector                    | (dBm) | (mW) |                 |           |
| 0       | 2 402                   | PEAK                        | 6.37  | 4.34 | 30.0            | PASS      |
| 19      | 2 440                   | PEAK                        | 6.59  | 4.56 | 30.0            | PASS      |
| 39      | 2 480                   | PEAK                        | 6.34  | 4.31 | 30.0            | PASS      |

## 7. Maximum conducted (average) output power

### 7.1 Test procedure

The transmitter antenna terminal is connected to the input of a Power Sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum Average output power measurement is 30 dBm.

Limits : FCC § 15.247

#### Maximum conducted (average) output power Test Instruments

| Description         | Model      | Serial Number | Cal. Due Date |
|---------------------|------------|---------------|---------------|
| Power Meter         | N1921A     | MY45100570    | 2022-11-29    |
| Power Sensor        | N1921A     | MY45240427    | 2022-11-29    |
| Power Meter <=> EUT | Loss: 1 dB | –             |               |

### 7.2 Measurement results

|             |              |                         |                      |
|-------------|--------------|-------------------------|----------------------|
| EUT         | Shot counter | MODEL                   | EM-SC03              |
| MODE        | GFSK         | ENVIRONMENTAL CONDITION | 22.5 °C, 44.7 % R.H. |
| INPUT POWER | DC 3.7 V     |                         |                      |

#### BLE 1M

| CHANNEL | Channel Frequency (MHz) | Conducted Power Output(dBm) |       |            | Measured + Duty Cycle(dBm) | Measured + Duty Cycle(mW) |
|---------|-------------------------|-----------------------------|-------|------------|----------------------------|---------------------------|
|         |                         | Detector                    | (dBm) | Duty Cycle |                            |                           |
| 0       | 2 402                   | AVG                         | 4.41  | 7.84       | 12.25                      | 16.80                     |
| 19      | 2 440                   | AVG                         | 4.78  | 7.84       | 12.62                      | 18.30                     |
| 39      | 2 480                   | AVG                         | 4.49  | 7.84       | 12.33                      | 17.12                     |

#### BLE 2M

| CHANNEL | Channel Frequency (MHz) | Conducted Power Output(dBm) |       |            | Measured + Duty Cycle(dBm) | Measured + Duty Cycle(mW) |
|---------|-------------------------|-----------------------------|-------|------------|----------------------------|---------------------------|
|         |                         | Detector                    | (dBm) | Duty Cycle |                            |                           |
| 0       | 2 402                   | AVG                         | 1.11  | 7.84       | 8.95                       | 7.86                      |
| 19      | 2 440                   | AVG                         | 1.33  | 7.84       | 9.17                       | 8.27                      |
| 39      | 2 480                   | AVG                         | 1.06  | 7.84       | 8.90                       | 7.77                      |

## 8. Maximum power spectral density level in the fundamental emission

### 8.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V05r02 10.2 Method PKPSD (peak PSD)

### 8.2 Test instruments and measurement setup

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- Set the VBW  $\geq 3 \times \text{RBW}$
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Limits FCC § 15.247

The peak power density Test Instruments

| Description                | Model         | Serial Number | Cal. Due Date |
|----------------------------|---------------|---------------|---------------|
| Spectrum Analyzer          | E440A         | US42041291    | 2022-11-29    |
| RF Cable                   | Length: 30 cm | –             |               |
| –Spectrum Analyzer <=> EUT | Loss: 1 dB    | –             |               |

### 8.3 Measurement results

|             |              |                         |                      |
|-------------|--------------|-------------------------|----------------------|
| EUT         | Shot counter | MODEL                   | EM-SC03              |
| MODE        | GFSK         | ENVIRONMENTAL CONDITION | 22.6 °C, 45.1 % R.H. |
| INPUT POWER | DC 3.7 V     |                         |                      |

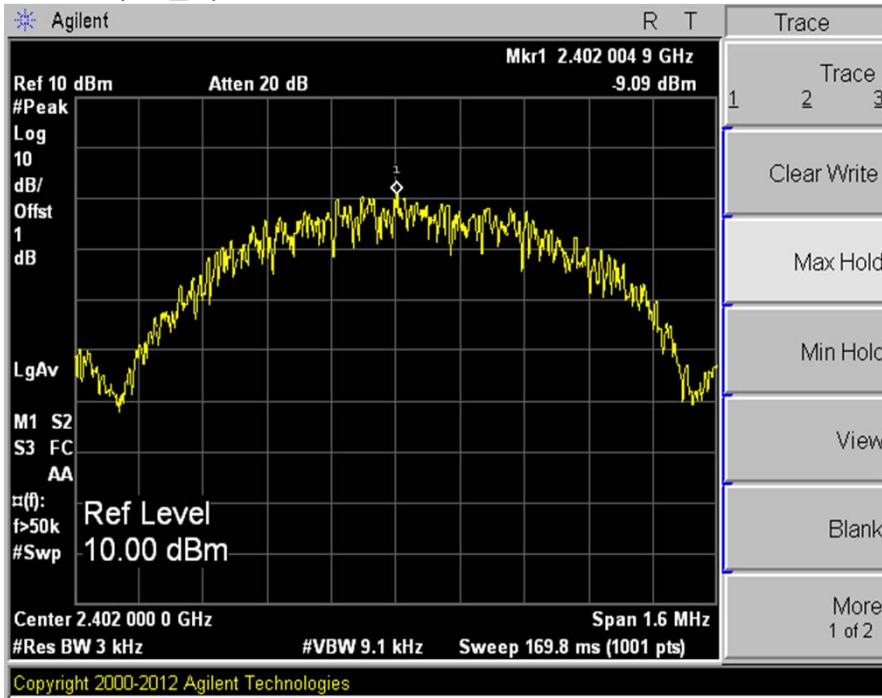
#### BLE 1M

| CHANNEL | Channel Frequency (MHz) | Measured Power Spectral Density (dBm) | Maximum Permissible Power Density (dBm/3kHz) | Margin |
|---------|-------------------------|---------------------------------------|----------------------------------------------|--------|
| 0       | 2 402                   | –18.79                                | 8.0                                          | 26.79  |
| 19      | 2 440                   | –18.54                                | 8.0                                          | 26.54  |
| 39      | 2 480                   | –18.29                                | 8.0                                          | 26.29  |

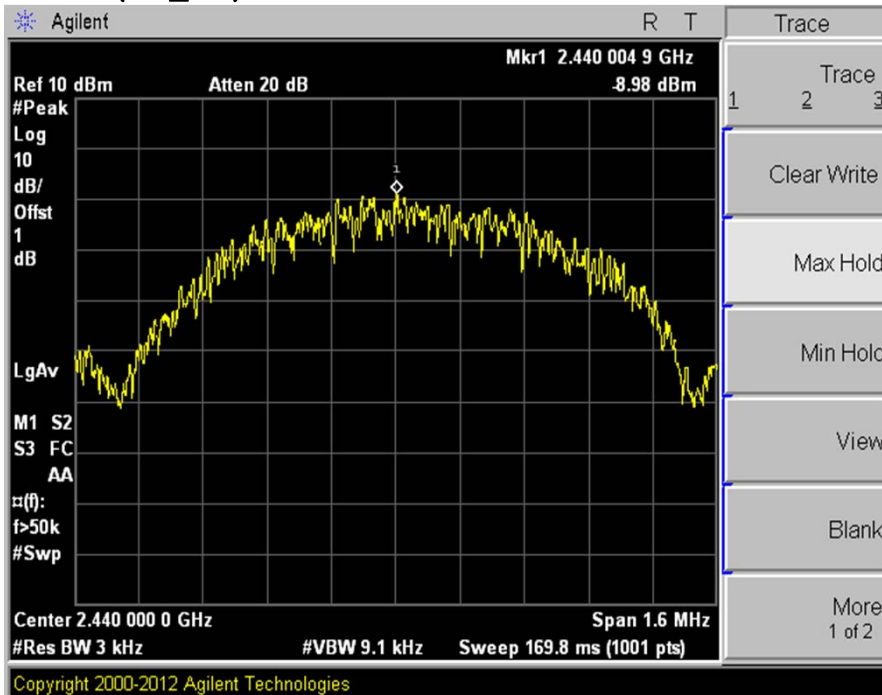
#### BLE 2M

| CHANNEL | Channel Frequency (MHz) | Measured Power Spectral Density (dBm) | Maximum Permissible Power Density (dBm/3kHz) | Margin |
|---------|-------------------------|---------------------------------------|----------------------------------------------|--------|
| 0       | 2 402                   | –18.79                                | 8.0                                          | 26.79  |
| 19      | 2 440                   | –18.54                                | 8.0                                          | 26.54  |
| 39      | 2 480                   | –18.29                                | 8.0                                          | 26.29  |

## 8.4 Trace data(BLE 1M) (ch\_0)



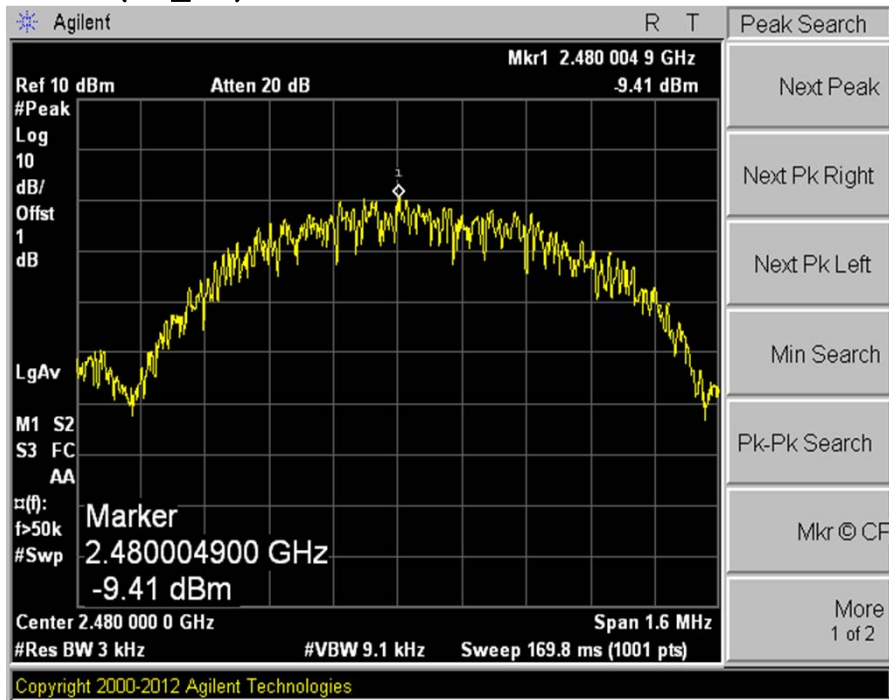
## (ch\_19)





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*your best partner*

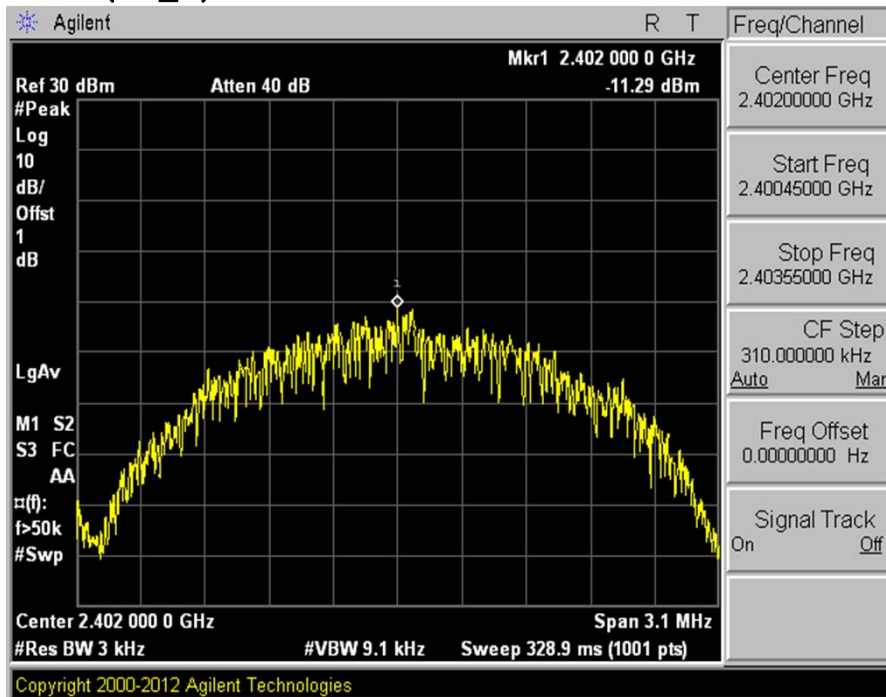
(ch\_39)



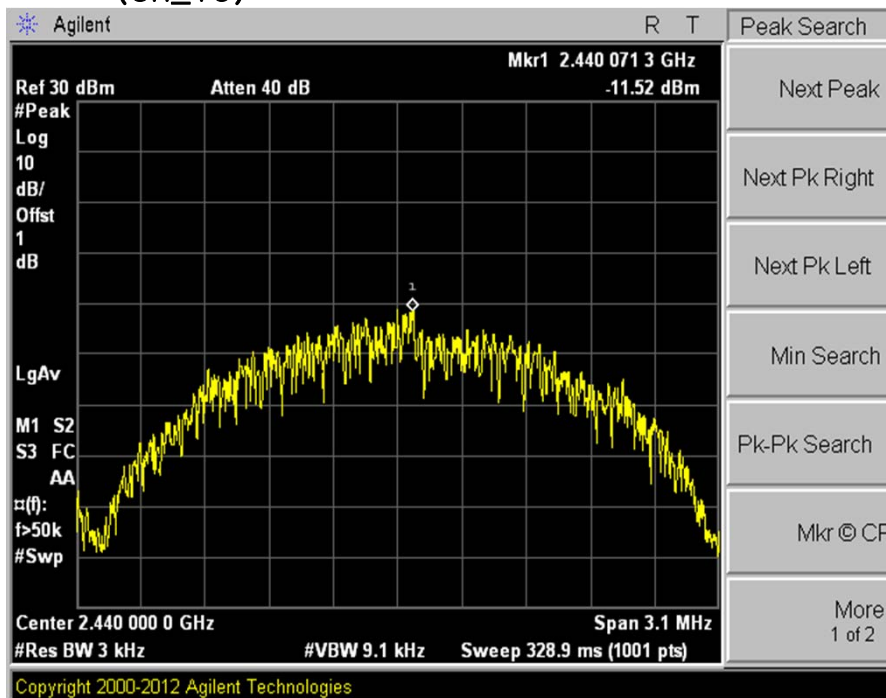


**Estech**  
your best partner

BLE 2M  
(ch\_0)



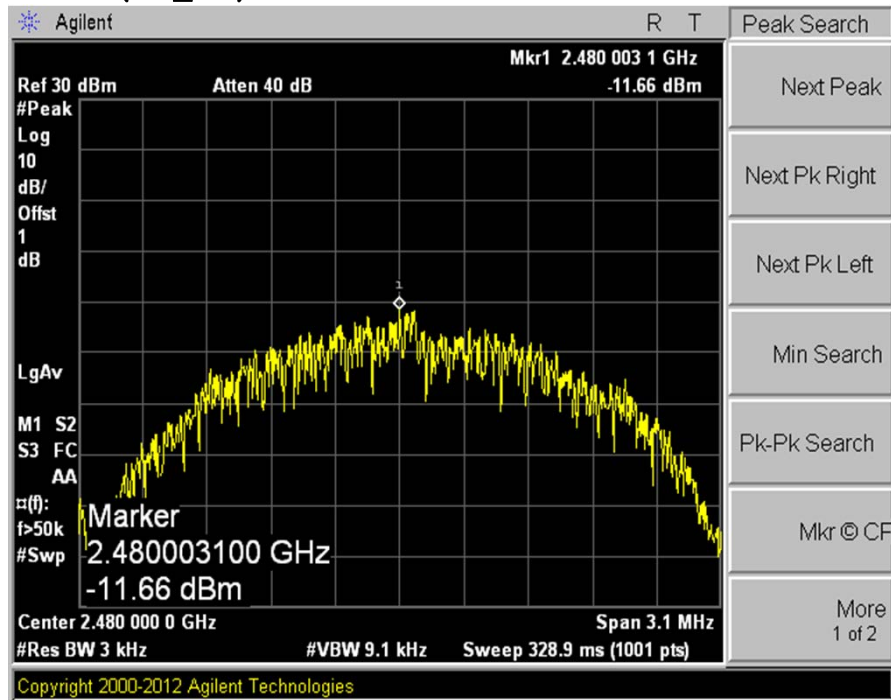
(ch\_19)





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(ch\_39)



## 9. Emissions in non-restricted frequency bands

### 9.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V05r02 11.0

### 9.2 Test instruments and measurement setup

The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions(15.247(d))

- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz.
- Set the VBW  $\geq 3 \times$  RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

Limits FCC § 15.247

#### Band Edge&Out of Emission Test Instruments

| Description                | Model         | Serial Number | Cal. Due Date |
|----------------------------|---------------|---------------|---------------|
| Spectrum Analyzer          | E4440A        | US42041291    | 2022-11-29    |
| RF Cable                   | Length: 30 cm |               | –             |
| –Spectrum Analyzer <=> EUT | Loss: 1 dB    |               | –             |

### 9.3 Measurement results of band-edge & out of emission

|             |              |                            |                     |
|-------------|--------------|----------------------------|---------------------|
| EUT         | Shot counter | MODEL                      | EM-SC03             |
| MODE        | GFSK         | ENVIRONMENTAL<br>CONDITION | 22.4 °C, 44.9 % R.H |
| INPUT POWER | DC 3.7 V     |                            |                     |

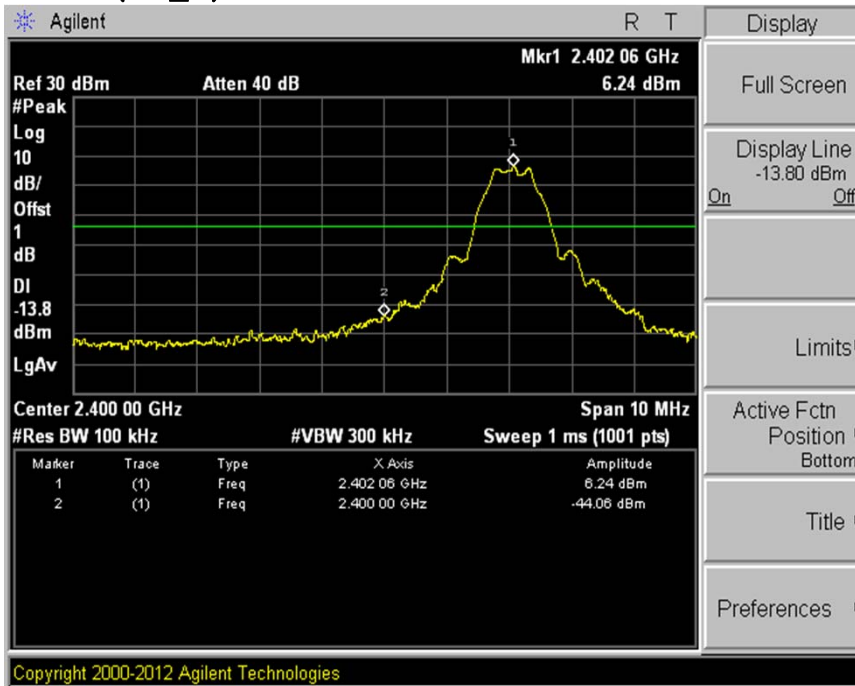
#### BLE 1M

| CHANNEL | Channel Frequency (MHz) | limit | PASS/FAIL |
|---------|-------------------------|-------|-----------|
| 0       | 2 402                   | 20dBc | PASS      |
| 39      | 2 480                   | 20dBc | PASS      |

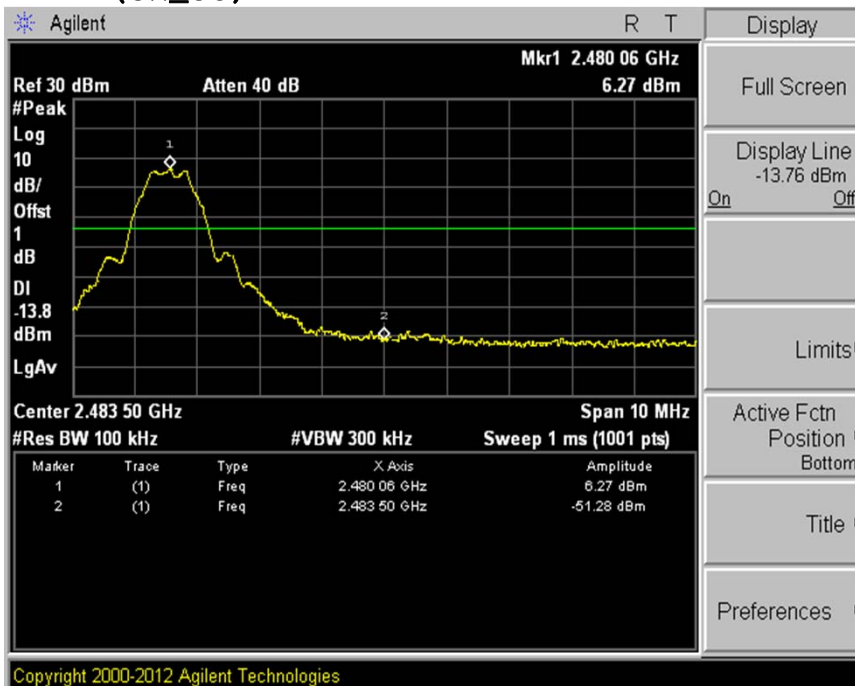
#### BLE 2M

| CHANNEL | Channel Frequency (MHz) | limit | PASS/FAIL |
|---------|-------------------------|-------|-----------|
| 0       | 2 402                   | 20dBc | PASS      |
| 39      | 2 480                   | 20dBc | PASS      |

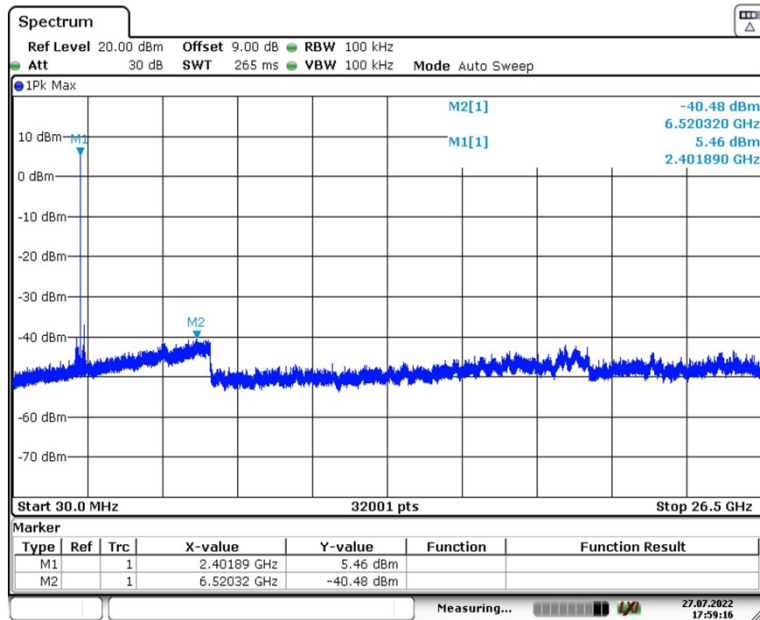
## 9.4 Trace data of band-edge & Out of Emission(BLE 1M) (ch\_0)



(ch\_39)

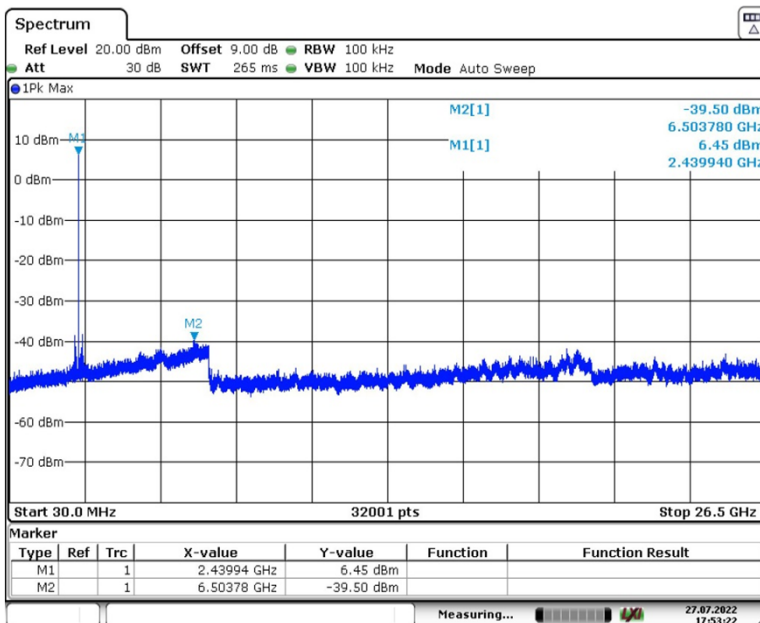


(ch\_0)



00189

(ch\_19)

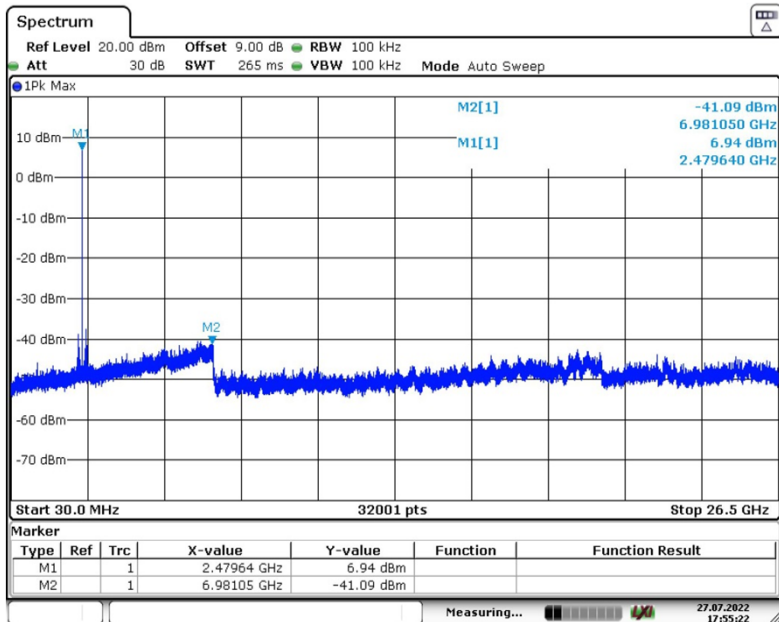


00189



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(ch\_39)



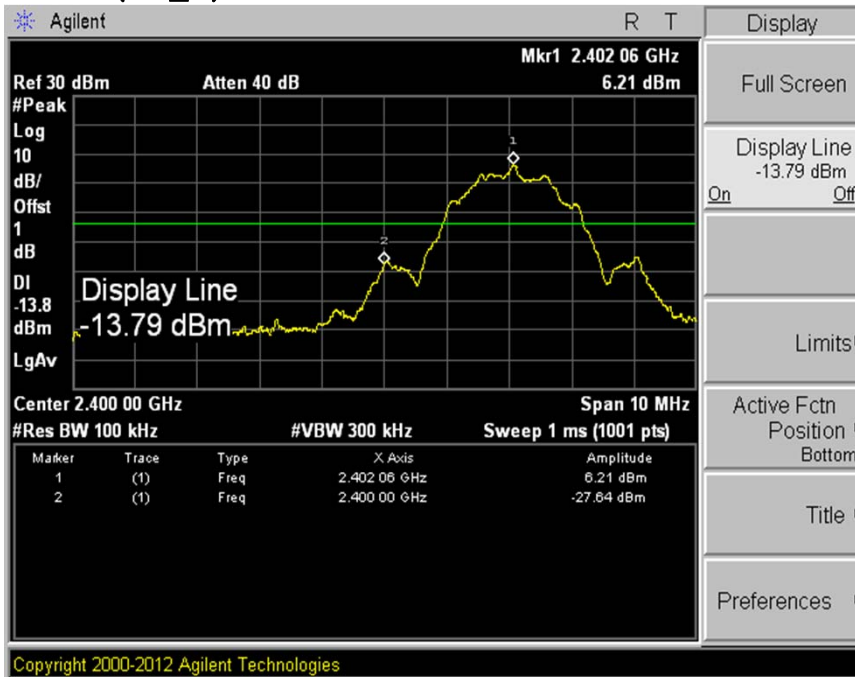
00189



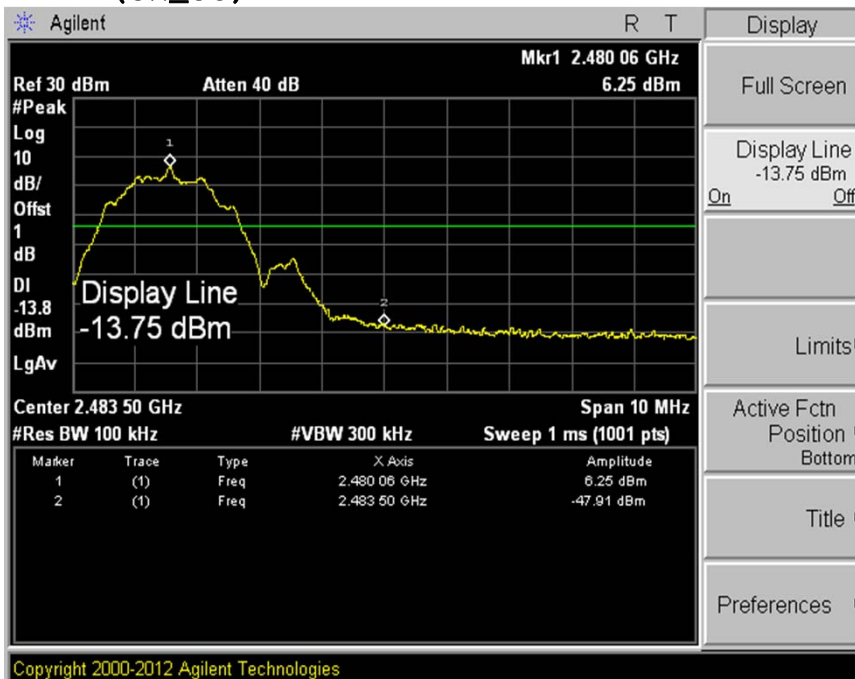
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BLE 2M

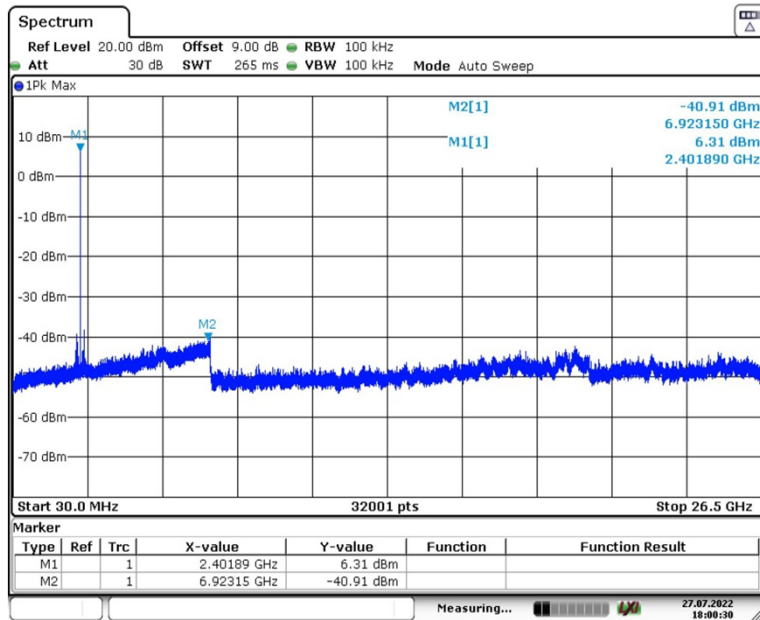
(ch\_0)



(ch\_39)

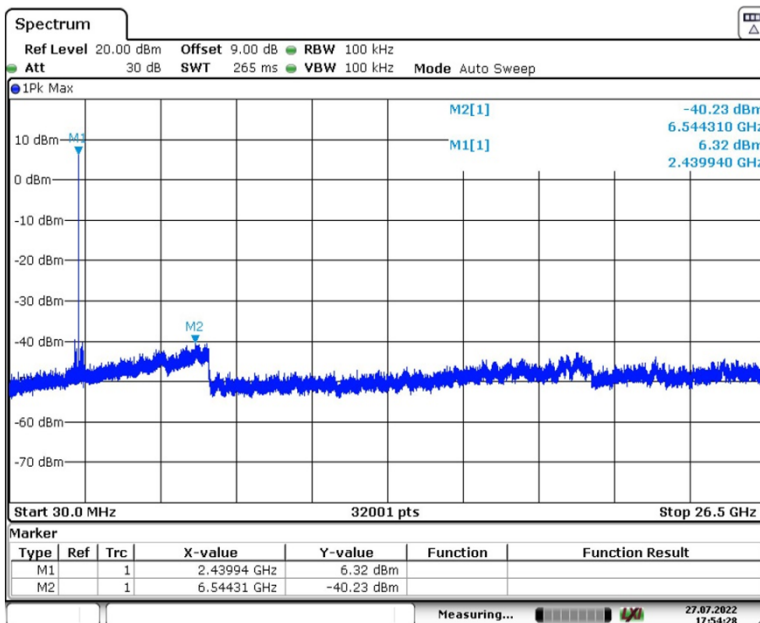


(ch\_0)



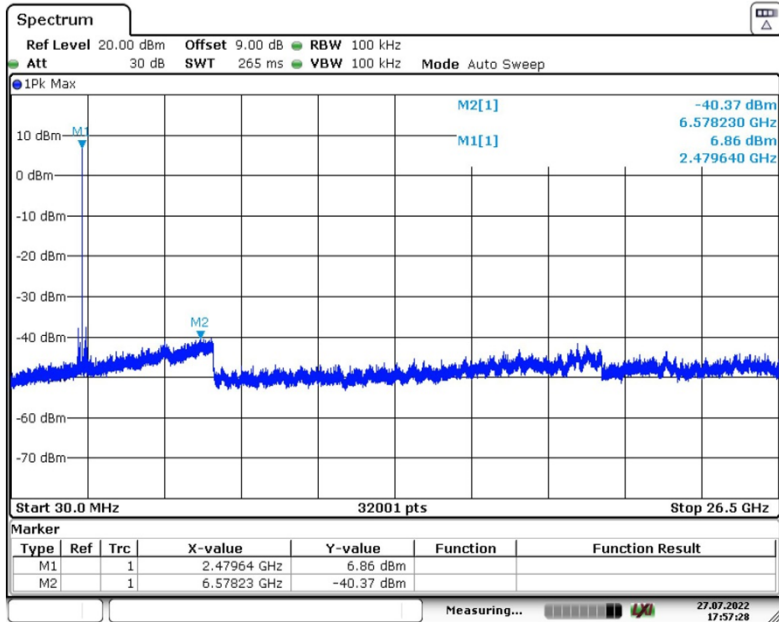
00189

(ch\_19)



00189

(ch\_39)



00189

## 10. Measurement of radiated disturbance

Above 30 MHz Electric Field strength was measured in accordance with FCC PART 15.205, 15.209 . The test setup was made according to ANSI C 63.10 (2013) & KDB 558074 D01v05r02 Semi-anechoic chamber, which allows a 3 m distance measurement. The EUT was placed in the center of styrofoam. turntable. The height of this table was 0.8 m. The measurement was conducted with both horizontal and vertical antenna polarization. The turntable has fully rotated. For further description of the configuration refer to the picture of the test setup.

### 10.1 Measurement equipments

| Equipment Name                         | Type      | Manufacturer      | Serial No.             | Next Calibration date |
|----------------------------------------|-----------|-------------------|------------------------|-----------------------|
| TEST Receiver                          | ESCI7     | ROHDE & SCHWARZ   | 100916                 | 29-Jun-23             |
| Logbicon Antenna                       | VULB 9168 | SCHWARZBECK       | 193                    | 9-Dec-23              |
| Turn Table                             | DT3000-2t | Innco System GmbH | N/A                    | –                     |
| Antenna Mast                           | MA4000-EP | Innco System GmbH | N/A                    | –                     |
| PREAMPLIFIER                           | 8449B     | HP                | 3008A00581             | 29-Jun-23             |
| Horn Antenna                           | BBHA9120D | SCHWARZBECK       | 469                    | 3-Dec-22              |
| TEST Receiver                          | ESU       | ROHDE & SCHWARZ   | 100529                 | 29-Jun-23             |
| Turn Table                             | DT1500-S  | Innco System GmbH | N/A                    | –                     |
| Antenna Mast                           | MA4000-EP | Innco System GmbH | N/A                    | –                     |
| Antenna Master & Turn table controller | C02000-P  | Innco System GmbH | CO2000/642 /28051111/L | –                     |

### 10.2 Environmental Condition

Below 1 GHz –Test Place : 10 m Semi-anechoic chamber

#### BT(BLE) MODE

Temperature (°C) : 23.2 °C

Humidity (% R.H.) : 46.1 % R.H.

Above 1 GHz–Test Place : 3 m Semi-anechoic chamber

#### BT(BLE) MODE

Temperature (°C) : 24.1 °C

Humidity (% R.H.) : 47.1 % R.H.

## 10.3 Measurement Instrument setting for Radiated Emission

### 10.3.1 Frequency range below 1 GHz

Detector : Quasi-Peak

### 10.3.2 Frequency range above 1 GHz

#### Peak Power Measurement Procedure (KDB 558074 section 12.2.4)

- a. RBW : 1 MHz , VBW : 3 MHz
- b. Trace mode = max hold
- c. Detector : Peak
- d. Sweep time = auto

#### Average Power Measurement Procedures (KDB 558074 section 12.2.5.2)

- a. Set analyzer center frequency to the frequency associated with the emission
- b. RBW : 1 MHz , VBW : 3 MHz
- c. Detector : RMS
- d. Sweep time = auto

Note

| Band       | Duty cycle(%) | Ton (ms) | Ton + Toff (ms) | DCF=10*log(1/Duty) (dB) |
|------------|---------------|----------|-----------------|-------------------------|
| BT(BLE 1M) | 62.300        | 0.388    | 0.622           | 2.052                   |
| BT(BLE 2M) | 32.700        | 0.203    | 0.623           | 4.852                   |

\* This was applied of duty cycle factor for average value because of measured with the EUT transmitting continuously less than 98 % duty cycle at its maximum power control level.

## 10.4 Test data(BLE 1M 30 MHz ~ 1 000 MHz)

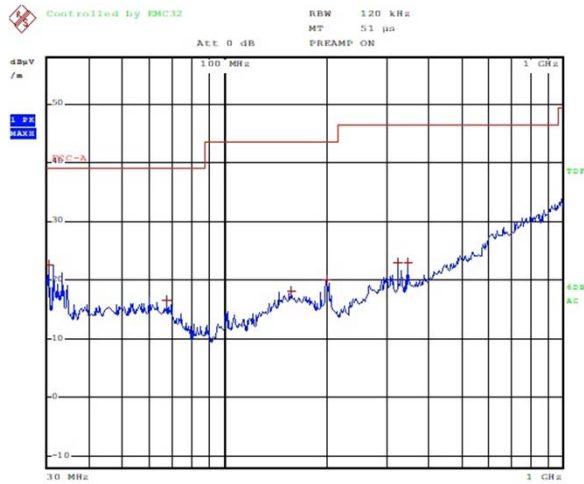
Test Date : 29-Jul-22

Measurement Distance : 10 m

| Frequency<br>(MHz) | Reading<br>(dB $\mu$ V)                                                                                                                                                                                                                                                                                                                                                                                                                    | Position<br>(V/H) | Height<br>(m) | Correction Factor  |               | Result Value(Quasi-peak) |                          |                |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|---------------|--------------------------|--------------------------|----------------|
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               | Ant Factor<br>(dB) | Cable<br>(dB) | Limit<br>(dB $\mu$ V/m)  | Result<br>(dB $\mu$ V/m) | Margin<br>(dB) |
| 30.30              | 9.43                                                                                                                                                                                                                                                                                                                                                                                                                                       | H                 | 1.0           | 12.36              | 0.81          | 40.00                    | 22.61                    | 17.39          |
| 37.40              | 7.27                                                                                                                                                                                                                                                                                                                                                                                                                                       | V                 | 1.0           | 13.12              | 0.90          | 40.00                    | 21.29                    | 18.71          |
| 56.10              | 8.77                                                                                                                                                                                                                                                                                                                                                                                                                                       | V                 | 1.0           | 13.38              | 1.11          | 40.00                    | 23.25                    | 16.75          |
| 67.60              | 3.14                                                                                                                                                                                                                                                                                                                                                                                                                                       | H                 | 1.0           | 12.19              | 1.23          | 40.00                    | 16.57                    | 23.43          |
| 80.30              | 9.53                                                                                                                                                                                                                                                                                                                                                                                                                                       | V                 | 1.4           | 9.43               | 1.33          | 40.00                    | 20.29                    | 19.71          |
| 138.60             | 6.93                                                                                                                                                                                                                                                                                                                                                                                                                                       | V                 | 1.3           | 13.00              | 1.77          | 43.50                    | 21.70                    | 21.80          |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
| Remark             | H : Horizontal, V : Vertical TEST MODE : BT BLE (CH : 19 - 2 440 MHz)<br><br>*Checked in all 3 axis and the maximum measured data were reported.( Worst data is X axis of position)<br>*CL = Cable Loss(In case of below 1 000 MHz)<br>*Result Value = Reading + Ant Factor + Cable loss<br>*The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz. |                   |               |                    |               |                          |                          |                |

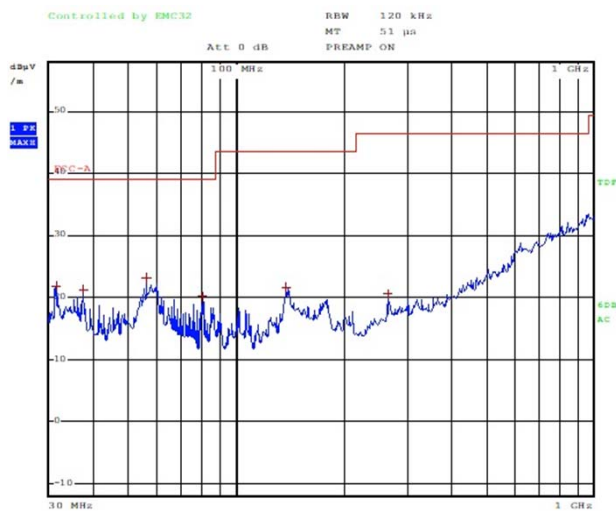
## 10.4-1 Restricted Band Edges(BLE 1M)

Polarity:Horizontal



ESTR-22-00190

Polarity:Vertical



ESTR-22-00190

## 10.4-2 Test data(BLE 2M 30 MHz ~ 1 000 MHz)

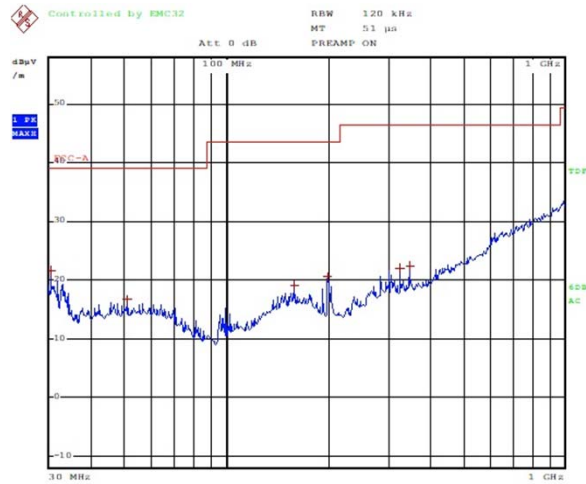
Test Date : 29-Jul-22

Measurement Distance : 10 m

| Frequency<br>(MHz) | Reading<br>(dB $\mu$ V)                                                                                                                                                                                                                                                                                                                                                                                                                    | Position<br>(V/H) | Height<br>(m) | Correction Factor  |               | Result Value(Quasi-peak) |                          |                |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|---------------|--------------------------|--------------------------|----------------|
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               | Ant Factor<br>(dB) | Cable<br>(dB) | Limit<br>(dB $\mu$ V/m)  | Result<br>(dB $\mu$ V/m) | Margin<br>(dB) |
| 30.40              | 8.55                                                                                                                                                                                                                                                                                                                                                                                                                                       | V                 | 1.0           | 12.38              | 0.81          | 40.00                    | 21.74                    | 18.26          |
| 50.90              | 2.08                                                                                                                                                                                                                                                                                                                                                                                                                                       | H                 | 1.4           | 13.66              | 1.05          | 40.00                    | 16.79                    | 23.21          |
| 58.50              | 6.87                                                                                                                                                                                                                                                                                                                                                                                                                                       | V                 | 1.0           | 13.31              | 1.13          | 40.00                    | 21.31                    | 18.69          |
| 81.90              | 12.24                                                                                                                                                                                                                                                                                                                                                                                                                                      | V                 | 1.0           | 9.47               | 1.35          | 40.00                    | 23.05                    | 16.95          |
| 138.60             | 7.18                                                                                                                                                                                                                                                                                                                                                                                                                                       | V                 | 1.0           | 13.00              | 1.77          | 43.50                    | 21.95                    | 21.55          |
| 199.40             | 8.44                                                                                                                                                                                                                                                                                                                                                                                                                                       | H                 | 1.3           | 10.07              | 2.16          | 43.50                    | 20.67                    | 22.83          |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                            |                   |               |                    |               |                          |                          |                |
| Remark             | H : Horizontal, V : Vertical TEST MODE : BT BLE (CH : 19 - 2 440 MHz)<br><br>*Checked in all 3 axis and the maximum measured data were reported.( Worst data is X axis of position)<br>*CL = Cable Loss(In case of below 1 000 MHz)<br>*Result Value = Reading + Ant Factor + Cable loss<br>*The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz. |                   |               |                    |               |                          |                          |                |

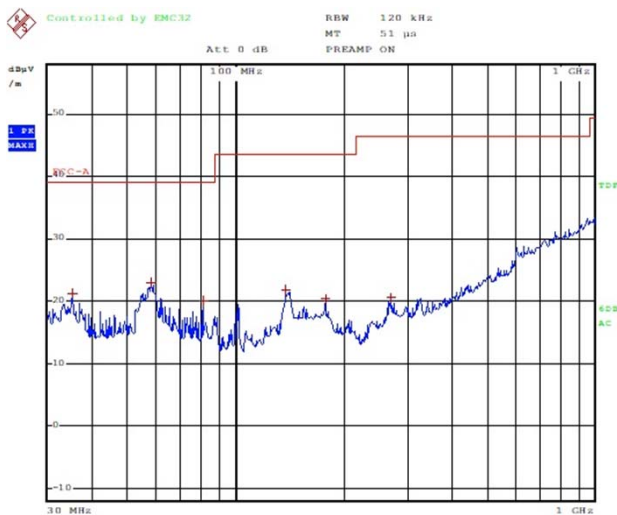
## 10.4-3 Restricted Band Edges(BLE 2M)

Polarity:Horizontal



ESTR-22-00190

Polarity:Vertical



ESTR-22-00190

## 10.4-4 Test Data(BLE 1M Low)

Test Date : 1-Aug-22

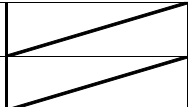
Measurement Distance : 3 m

| Frequency<br>(MHz)            | Reading<br>(dBμV)                                                                                      | Position<br>(V/H) | Height<br>(m) | Correction Factor  |                        | Duty Cycle<br>Correction(dB<br>) | Result Value      |                    |                |
|-------------------------------|--------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|------------------------|----------------------------------|-------------------|--------------------|----------------|
|                               |                                                                                                        |                   |               | Ant Factor<br>(dB) | AMP &<br>Cable<br>(dB) |                                  | Limit<br>(dBμV/m) | Result<br>(dBμV/m) | Margin<br>(dB) |
| PEAK(RBW: 1 MHz   VBW: 3 MHz) |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
| 2390.00                       | 48.34                                                                                                  | H                 | 1.6           | 27.54              | -28.39                 |                                  | 74.00             | 47.49              | 26.51          |
| 2390.00                       | 46.75                                                                                                  | V                 | 1.6           | 27.54              | -28.39                 |                                  | 74.00             | 45.90              | 28.10          |
| 4804.00                       | 45.29                                                                                                  | H                 | 1.5           | 31.30              | -25.75                 |                                  | 74.00             | 50.84              | 23.16          |
| 4804.00                       | 44.78                                                                                                  | V                 | 1.5           | 31.30              | -25.75                 |                                  | 74.00             | 50.33              | 23.67          |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
| AV(RBW: 1 MHz   VBW: 3 MHz)   |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
| 2390.00                       | 34.72                                                                                                  | H                 | 1.6           | 27.54              | -28.39                 | 2.05                             | 54.00             | 35.92              | 18.08          |
| 2390.00                       | 35.02                                                                                                  | V                 | 1.6           | 27.54              | -28.39                 | 2.05                             | 54.00             | 36.22              | 17.78          |
| 4804.00                       | 34.03                                                                                                  | H                 | 1.5           | 31.30              | -25.75                 | 2.05                             | 54.00             | 41.63              | 12.37          |
| 4804.00                       | 34.12                                                                                                  | V                 | 1.5           | 31.30              | -25.75                 | 2.05                             | 54.00             | 41.72              | 12.28          |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
| Remark                        | H : Horizontal,   V : Vertical   TEST MODE : CH : 0 – 2 402 MHz (x postion)                            |                   |               |                    |                        |                                  |                   |                    |                |
|                               | *The TX signal wasn't detected from 3th harmonics.                                                     |                   |               |                    |                        |                                  |                   |                    |                |
|                               | *Checked in all 3 axis and the maximum measured data were reported.( Worst data is X axis of position) |                   |               |                    |                        |                                  |                   |                    |                |
|                               | *Total = Reading Value + Antenna Factor + Cable Loss – Amp Gain + Duty Cycle Correction                |                   |               |                    |                        |                                  |                   |                    |                |
|                               | *This test was radiated up to 26.5 GHz but no noise was measured.                                      |                   |               |                    |                        |                                  |                   |                    |                |

## 10.4-5 Test Data(BLE 1M Middle)

Test Date : 1-Aug-22

Measurement Distance : 3 m

| Frequency<br>(MHz)            | Reading<br>(dB $\mu$ V)                                                                                | Position<br>(V/H) | Height<br>(m) | Correction Factor  |                        | Duty Cycle<br>Correction<br>(dB)                                                   | Result Value            |                          |                |
|-------------------------------|--------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|------------------------|------------------------------------------------------------------------------------|-------------------------|--------------------------|----------------|
|                               |                                                                                                        |                   |               | Ant Factor<br>(dB) | AMP &<br>Cable<br>(dB) |                                                                                    | Limit<br>(dB $\mu$ V/m) | Result<br>(dB $\mu$ V/m) | Margin<br>(dB) |
| PEAK(RBW: 1 MHz   VBW: 3 MHz) |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
| 4880.00                       | 45.79                                                                                                  | H                 | 1.5           | 31.30              | -25.67                 |  | 74.00                   | 51.42                    | 22.58          |
| 4880.00                       | 44.65                                                                                                  | V                 | 1.6           | 31.30              | -25.67                 |                                                                                    | 74.00                   | 50.28                    | 23.72          |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
| AV(RBW: 1 MHz   VBW: 3 MHz)   |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
| 4880.00                       | 34.18                                                                                                  | H                 | 1.5           | 31.30              | -25.67                 | 2.05                                                                               | 54.00                   | 41.86                    | 12.14          |
| 4880.00                       | 34.29                                                                                                  | V                 | 1.6           | 31.30              | -25.67                 | 2.05                                                                               | 54.00                   | 41.97                    | 12.03          |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
| Remark                        | H : Horizontal,   V : Vertical   TEST MODE : CH : 19 – 2 440 MHz (x postion)                           |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               | *The TX signal wasn't detected from 3th harmonics.                                                     |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               | *Checked in all 3 axis and the maximum measured data were reported.( Worst data is X axis of position) |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               | *Total = Reading Value + Antenna Factor + Cable Loss – Amp Gain + Duty Cycle Correction                |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               | *This test was radiated up to 26.5 GHz but no noise was measured.                                      |                   |               |                    |                        |                                                                                    |                         |                          |                |

## 10.4-6 Test Data(BLE 1M High)

Test Date : 1-Aug-22

Measurement Distance : 3 m

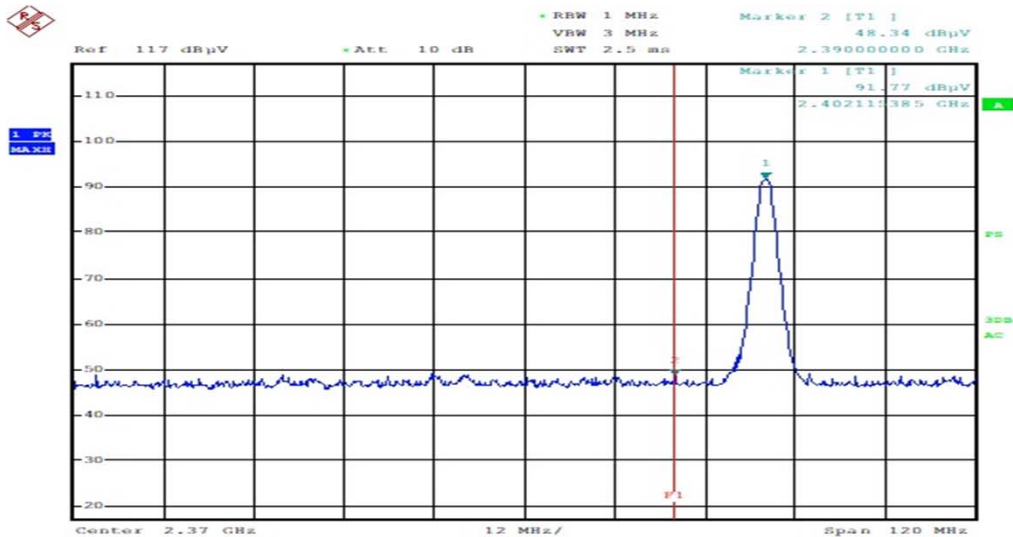
| Frequency<br>(MHz)             | Reading<br>(dB $\mu$ W)                                                                                | Position<br>(V/H) | Height<br>(m) | Correction Factor  |                     | Duty Cycle<br>Correction<br>(dB) | Result Value            |                          |                |
|--------------------------------|--------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|---------------------|----------------------------------|-------------------------|--------------------------|----------------|
|                                |                                                                                                        |                   |               | Ant Factor<br>(dB) | AMP & Cable<br>(dB) |                                  | Limit<br>(dB $\mu$ W/m) | Result<br>(dB $\mu$ W/m) | Margin<br>(dB) |
| PEAK(RBW: 1 MHz    VBW: 3 MHz) |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
| 2483.50                        | 54.67                                                                                                  | H                 | 1.6           | 27.42              | -28.28              | <div></div>                      | 74.00                   | 53.81                    | 20.19          |
| 2483.50                        | 51.08                                                                                                  | V                 | 1.8           | 27.42              | -28.28              | <div></div>                      | 74.00                   | 50.22                    | 23.78          |
| 4960.00                        | 46.53                                                                                                  | H                 | 1.6           | 31.48              | -25.59              | <div></div>                      | 74.00                   | 52.42                    | 21.58          |
| 4960.00                        | 45.25                                                                                                  | V                 | 1.5           | 31.48              | -25.59              | <div></div>                      | 74.00                   | 51.14                    | 22.86          |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
| AV(RBW: 1 MHz    VBW: 3 MHz)   |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
| 2483.50                        | 41.57                                                                                                  | H                 | 1.6           | 27.42              | -28.28              | 2.05                             | 54.00                   | 42.76                    | 11.24          |
| 2483.50                        | 38.69                                                                                                  | V                 | 1.8           | 27.42              | -28.28              | 2.05                             | 54.00                   | 39.88                    | 14.12          |
| 4960.00                        | 34.65                                                                                                  | H                 | 1.6           | 31.48              | -25.59              | 2.05                             | 54.00                   | 42.59                    | 11.41          |
| 4960.00                        | 34.58                                                                                                  | V                 | 1.5           | 31.48              | -25.59              | 2.05                             | 54.00                   | 42.52                    | 11.48          |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
| Remark                         | H : Horizontal,    V : Vertical    TEST MODE : CH : 39 – 2 480 MHz (x postion)                         |                   |               |                    |                     |                                  |                         |                          |                |
|                                | *The TX signal wasn't detected from 3th harmonics.                                                     |                   |               |                    |                     |                                  |                         |                          |                |
|                                | *Checked in all 3 axis and the maximum measured data were reported.( Worst data is X axis of position) |                   |               |                    |                     |                                  |                         |                          |                |
|                                | *Total = Reading Value + Antenna Factor + Cable Loss – Amp Gain + Duty Cycle Correction                |                   |               |                    |                     |                                  |                         |                          |                |
|                                | *This test was radiated up to 26.5 GHz but no noise was measured.                                      |                   |               |                    |                     |                                  |                         |                          |                |

## 10.4-7 Restricted Band Edges(BLE 1M)

Band Edges(CH Low)

Detector mode:Peak

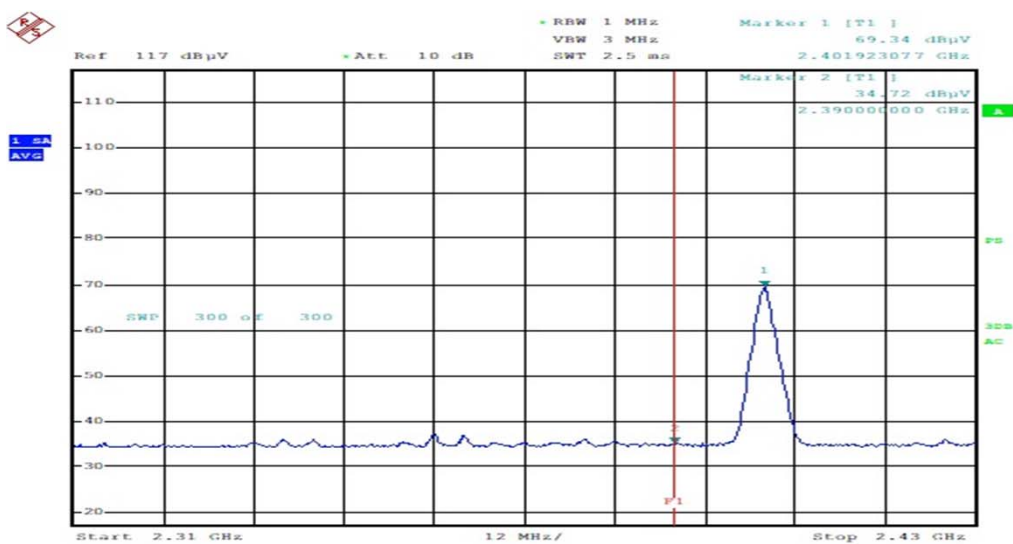
Polarity:Horizontal



ESTR-22-00190

Detector mode:Average

Polarity:Horizontal

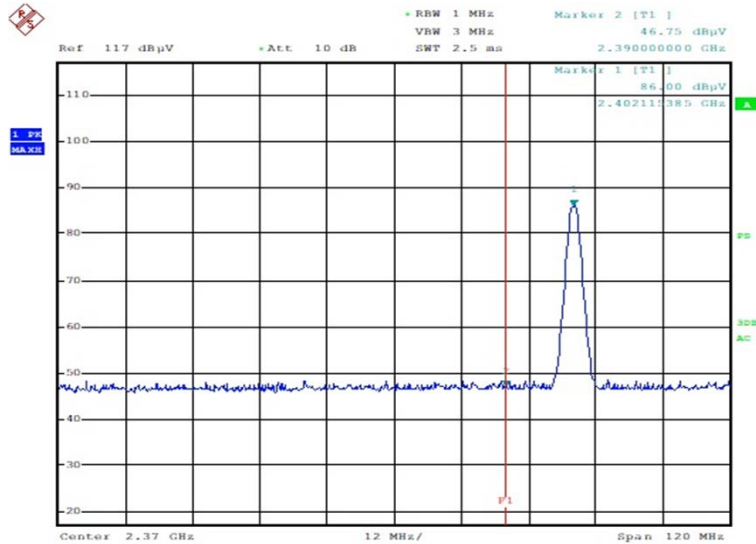


ESTR-22-00190

Band Edges(CH Low)

Detector mode:Peak

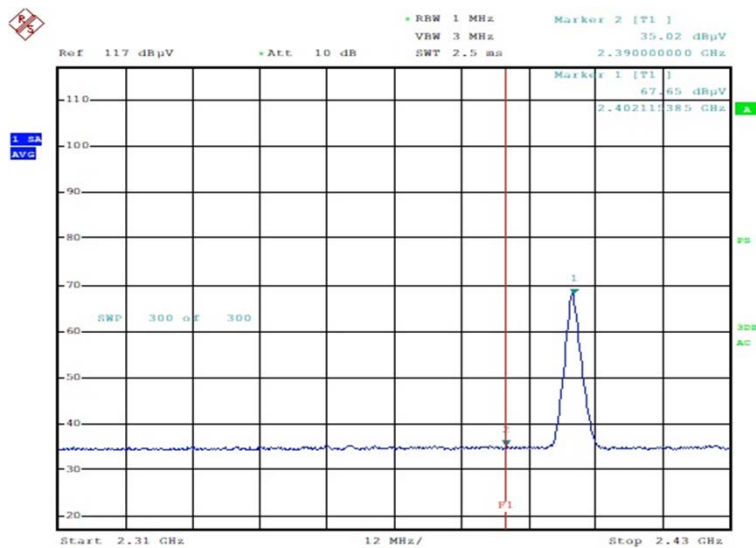
Polarity:Vertical



ESTR-22-00190

Detector mode:Average

Polarity:Vertical

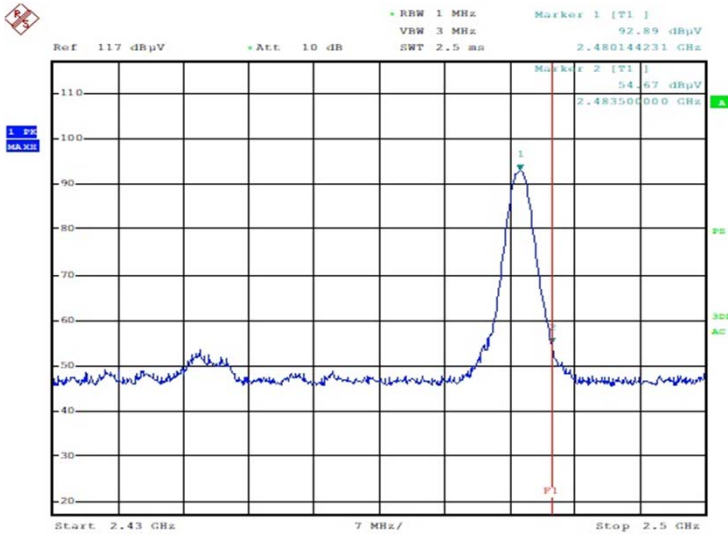


ESTR-22-00190

Band Edges(CH High)

Detector mode:Peak

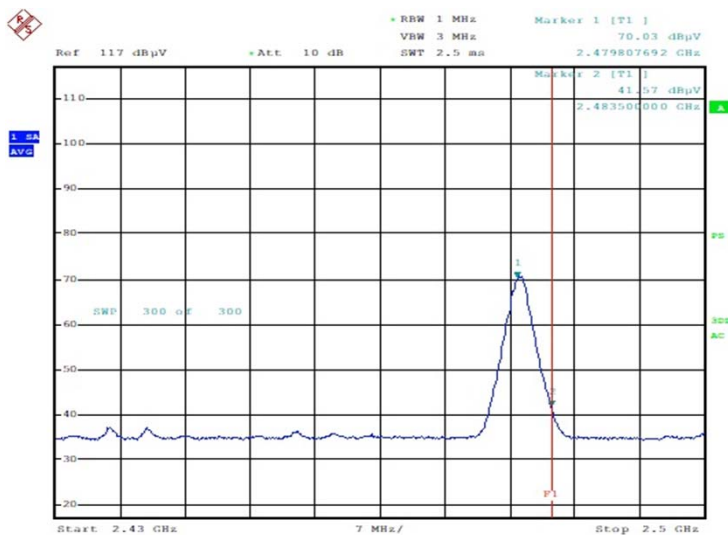
Polarity:Horizontal



ESTR-22-00190

Detector mode:Average

Polarity:Horizontal

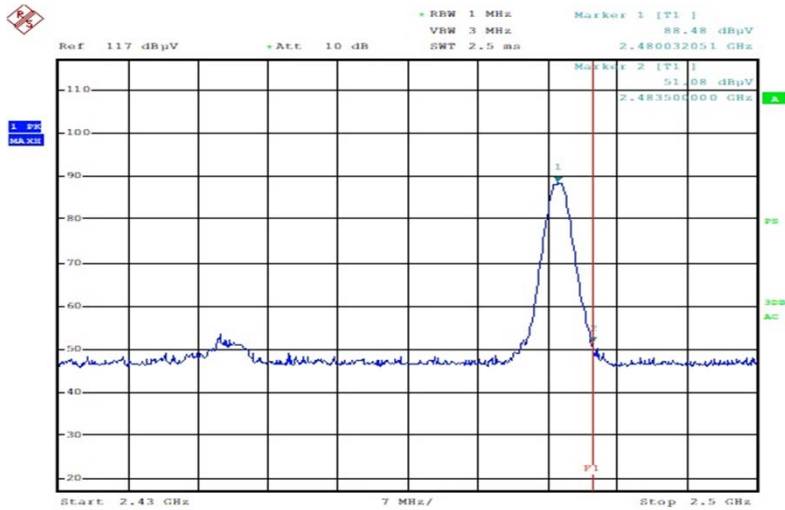


ESTR-22-00190

Band Edges(CH High)

Detector mode:Peak

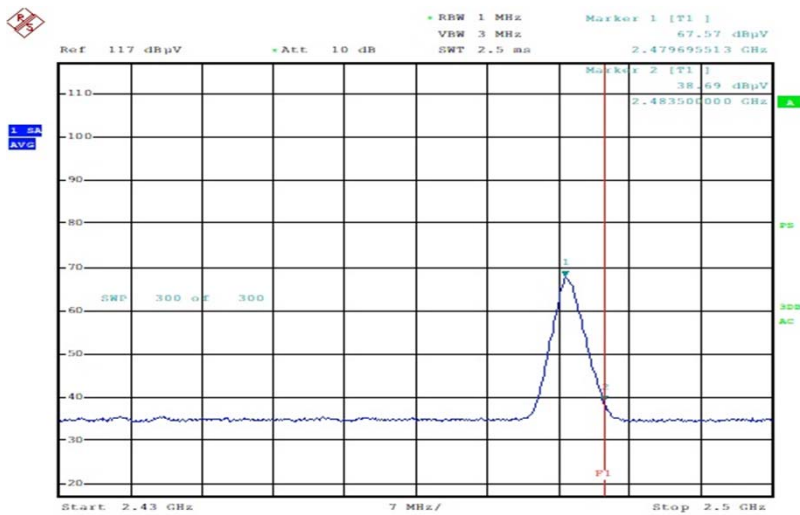
Polarity:Vertical



ESTR-22-00190

Detector mode:Average

Polarity:Vertical

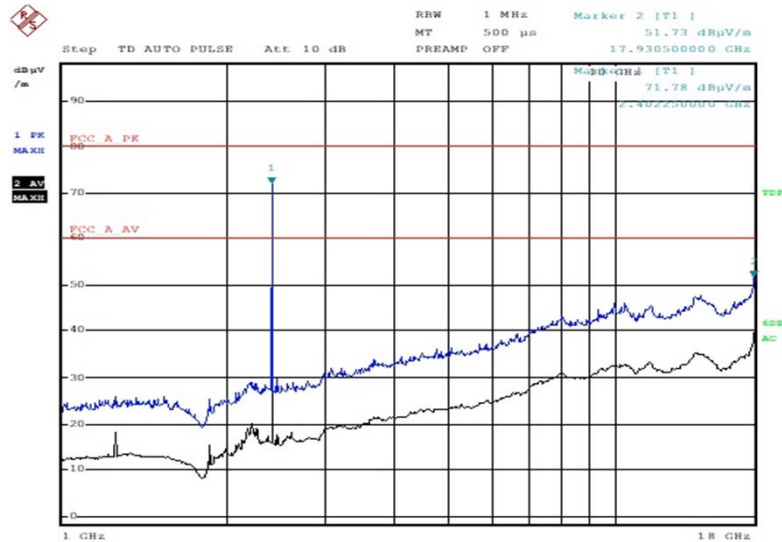


ESTR-22-00190

## 10.4–8 Restricted Band Edges(BLE 1M)

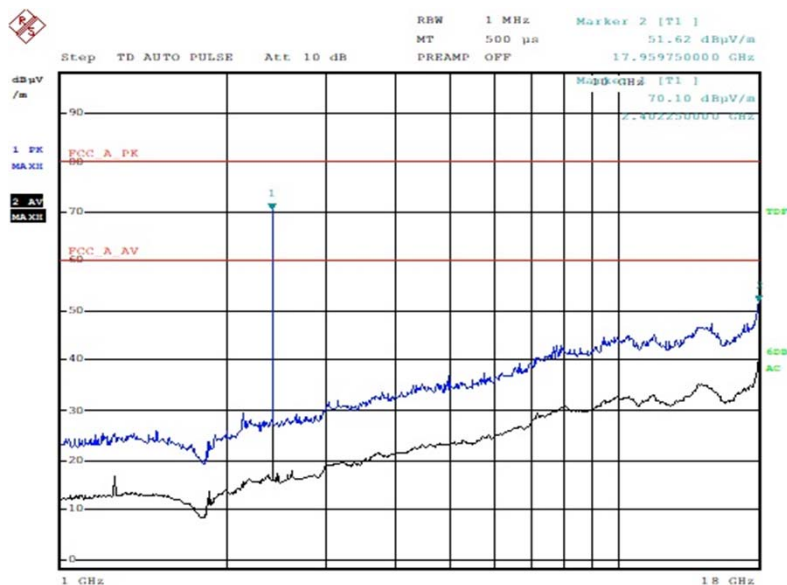
Band Edges(CH Low)

Polarity:Horizontal



ESTR-22-00190

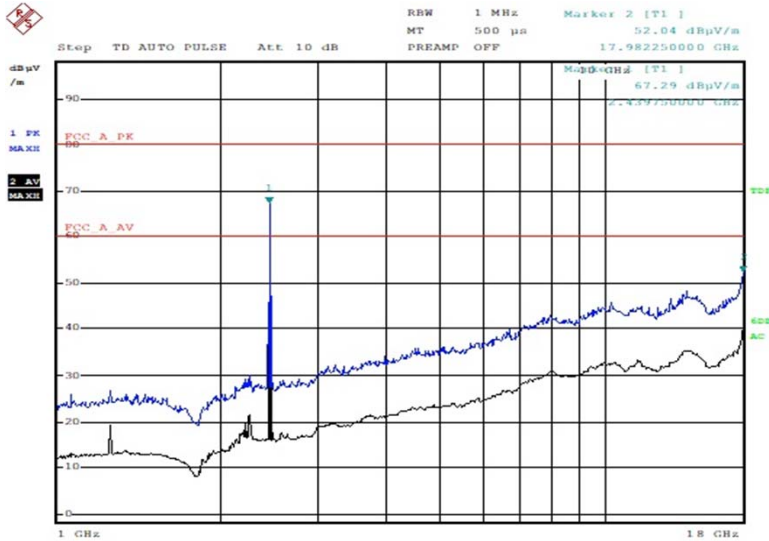
Polarity:Vertical



ESTR-22-00190

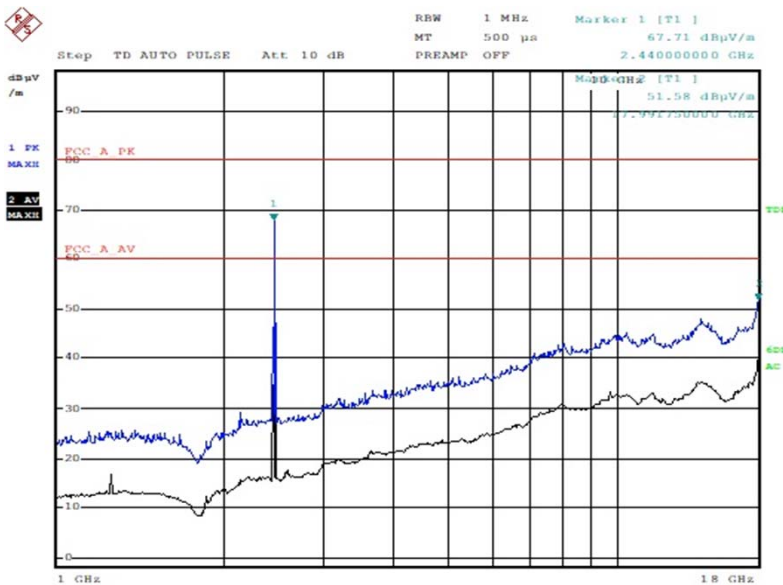
Band Edges(CH Middle)

Polarity:Horizontal



ESTR-22-00190

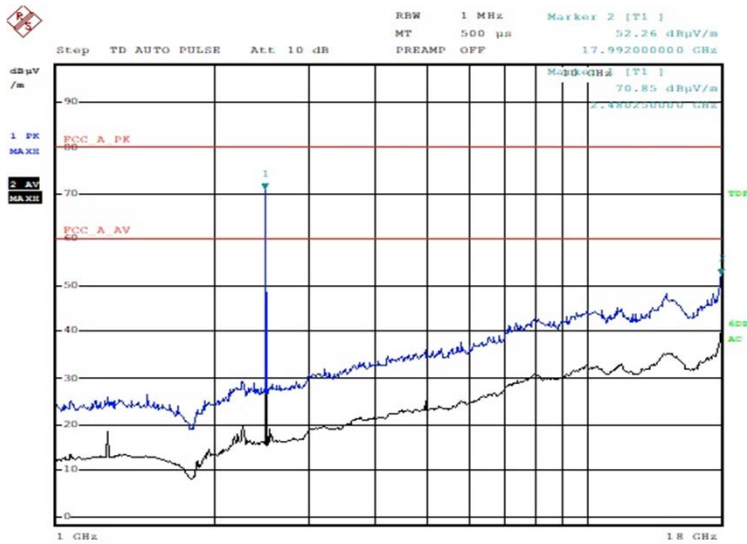
Polarity:Vertical



ESTR-22-00190

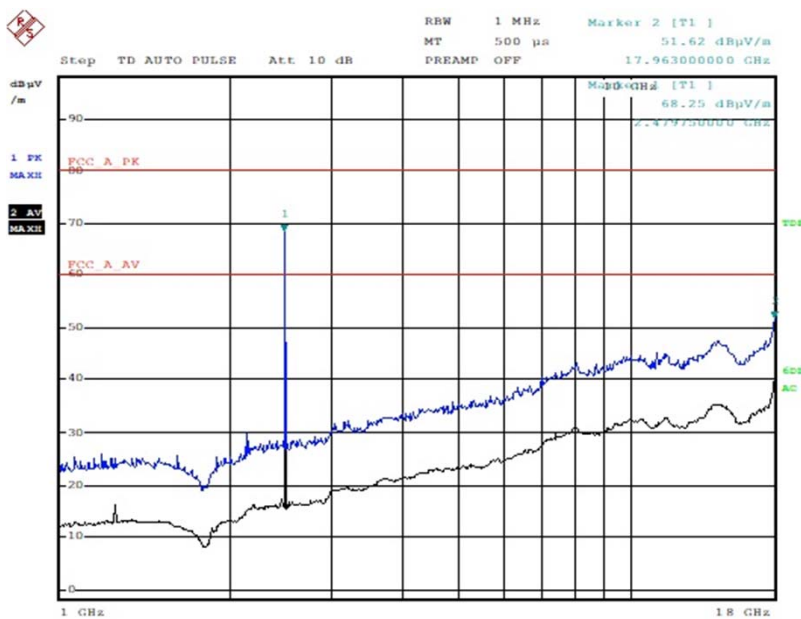
Band Edges(CH High)

Polarity:Horizontal



ESTR-22-00190

Polarity:Vertical



ESTR-22-00190

## 10.4-9 Test Data(BLE 2M Low)

Test Date : 2-Aug-22

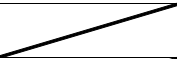
Measurement Distance : 3 m

| Frequency<br>(MHz)            | Reading<br>(dBμV)                                                                                      | Position<br>(V/H) | Height<br>(m) | Correction Factor  |                        | Duty Cycle<br>Correction<br>(dB) | Result Value      |                    |                |
|-------------------------------|--------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|------------------------|----------------------------------|-------------------|--------------------|----------------|
|                               |                                                                                                        |                   |               | Ant Factor<br>(dB) | AMP &<br>Cable<br>(dB) |                                  | Limit<br>(dBμV/m) | Result<br>(dBμV/m) | Margin<br>(dB) |
| PEAK(RBW: 1 MHz   VBW: 3 MHz) |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
| 2390.00                       | 47.31                                                                                                  | H                 | 1.6           | 27.54              | -28.39                 |                                  | 74.00             | 46.46              | 27.54          |
| 2390.00                       | 46.61                                                                                                  | V                 | 1.6           | 27.54              | -28.39                 |                                  | 74.00             | 45.76              | 28.24          |
| 4804.00                       | 44.32                                                                                                  | H                 | 1.5           | 31.30              | -25.75                 |                                  | 74.00             | 49.87              | 24.13          |
| 4804.00                       | 44.27                                                                                                  | V                 | 1.5           | 31.30              | -25.75                 |                                  | 74.00             | 49.82              | 24.18          |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
| AV(RBW: 1 MHz   VBW: 3 MHz)   |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
| 2390.00                       | 34.57                                                                                                  | H                 | 1.6           | 27.54              | -28.39                 | 4.85                             | 54.00             | 38.57              | 15.43          |
| 2390.00                       | 34.80                                                                                                  | V                 | 1.6           | 27.54              | -28.39                 | 4.85                             | 54.00             | 38.80              | 15.20          |
| 4804.00                       | 34.09                                                                                                  | H                 | 1.5           | 31.30              | -25.75                 | 4.85                             | 54.00             | 44.49              | 9.51           |
| 4804.00                       | 34.25                                                                                                  | V                 | 1.5           | 31.30              | -25.75                 | 4.85                             | 54.00             | 44.65              | 9.35           |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
|                               |                                                                                                        |                   |               |                    |                        |                                  |                   |                    |                |
| Remark                        | H : Horizontal,   V : Vertical   TEST MODE : CH : 0 – 2 402 MHz (x postion)                            |                   |               |                    |                        |                                  |                   |                    |                |
|                               | *The TX signal wasn't detected from 3th harmonics.                                                     |                   |               |                    |                        |                                  |                   |                    |                |
|                               | *Checked in all 3 axis and the maximum measured data were reported.( Worst data is X axis of position) |                   |               |                    |                        |                                  |                   |                    |                |
|                               | *Total = Reading Value + Antenna Factor + Cable Loss – Amp Gain + Duty Cycle Correction                |                   |               |                    |                        |                                  |                   |                    |                |
|                               | *This test was radiated up to 26.5 GHz but no noise was measured.                                      |                   |               |                    |                        |                                  |                   |                    |                |

## 10.4-10 Test Data(BLE 2M Middle)

Test Date : 2-Aug-22

Measurement Distance : 3 m

| Frequency<br>(MHz)            | Reading<br>(dB $\mu$ V)                                                                                | Position<br>(V/H) | Height<br>(m) | Correction Factor  |                        | Duty Cycle<br>Correction<br>(dB)                                                   | Result Value            |                          |                |
|-------------------------------|--------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|------------------------|------------------------------------------------------------------------------------|-------------------------|--------------------------|----------------|
|                               |                                                                                                        |                   |               | Ant Factor<br>(dB) | AMP &<br>Cable<br>(dB) |                                                                                    | Limit<br>(dB $\mu$ V/m) | Result<br>(dB $\mu$ V/m) | Margin<br>(dB) |
| PEAK(RBW: 1 MHz   VBW: 3 MHz) |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
| 4880.00                       | 46.59                                                                                                  | H                 | 1.5           | 31.30              | -25.67                 |  | 74.00                   | 52.22                    | 21.78          |
| 4880.00                       | 46.23                                                                                                  | V                 | 1.6           | 31.30              | -25.67                 |                                                                                    | 74.00                   | 51.86                    | 22.14          |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
| AV(RBW: 1 MHz   VBW: 3 MHz)   |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
| 4880.00                       | 34.29                                                                                                  | H                 | 1.5           | 31.30              | -25.67                 | 4.85                                                                               | 54.00                   | 44.77                    | 9.23           |
| 4880.00                       | 34.53                                                                                                  | V                 | 1.6           | 31.30              | -25.67                 | 4.85                                                                               | 54.00                   | 45.01                    | 8.99           |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               |                                                                                                        |                   |               |                    |                        |                                                                                    |                         |                          |                |
| Remark                        | H : Horizontal,   V : Vertical   TEST MODE : CH : 19 – 2 440 MHz (x postion)                           |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               | *The TX signal wasn't detected from 3th harmonics.                                                     |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               | *Checked in all 3 axis and the maximum measured data were reported.( Worst data is X axis of position) |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               | *Total = Reading Value + Antenna Factor + Cable Loss – Amp Gain + Duty Cycle Correction                |                   |               |                    |                        |                                                                                    |                         |                          |                |
|                               | *This test was radiated up to 26.5 GHz but no noise was measured.                                      |                   |               |                    |                        |                                                                                    |                         |                          |                |

## 10.4-11 Test Data(BLE 2M High)

Test Date : 2-Aug-22

Measurement Distance : 3 m

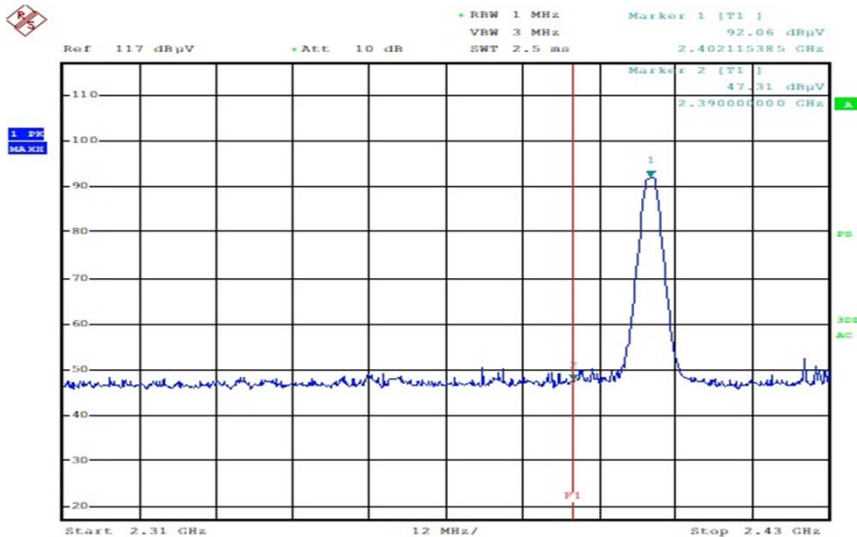
| Frequency<br>(MHz)             | Reading<br>(dB $\mu$ W)                                                                                | Position<br>(V/H) | Height<br>(m) | Correction Factor  |                     | Duty Cycle<br>Correction<br>(dB) | Result Value            |                          |                |
|--------------------------------|--------------------------------------------------------------------------------------------------------|-------------------|---------------|--------------------|---------------------|----------------------------------|-------------------------|--------------------------|----------------|
|                                |                                                                                                        |                   |               | Ant Factor<br>(dB) | AMP & Cable<br>(dB) |                                  | Limit<br>(dB $\mu$ W/m) | Result<br>(dB $\mu$ W/m) | Margin<br>(dB) |
| PEAK(RBW: 1 MHz    VBW: 3 MHz) |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
| 2483.50                        | 57.47                                                                                                  | H                 | 1.6           | 27.42              | -28.28              |                                  | 74.00                   | 56.61                    | 17.39          |
| 2483.50                        | 53.48                                                                                                  | V                 | 1.8           | 27.42              | -28.28              |                                  | 74.00                   | 52.62                    | 21.38          |
| 4960.00                        | 45.91                                                                                                  | H                 | 1.6           | 31.48              | -25.59              |                                  | 74.00                   | 51.80                    | 22.20          |
| 4960.00                        | 44.62                                                                                                  | V                 | 1.5           | 31.48              | -25.59              |                                  | 74.00                   | 50.51                    | 23.49          |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
| AV(RBW: 1 MHz    VBW: 3 MHz)   |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
| 2483.50                        | 38.84                                                                                                  | H                 | 1.6           | 27.42              | -28.28              | 4.85                             | 54.00                   | 42.83                    | 11.17          |
| 2483.50                        | 37.10                                                                                                  | V                 | 1.8           | 27.42              | -28.28              | 4.85                             | 54.00                   | 41.09                    | 12.91          |
| 4960.00                        | 34.19                                                                                                  | H                 | 1.6           | 31.48              | -25.59              | 4.85                             | 54.00                   | 44.93                    | 9.07           |
| 4960.00                        | 34.14                                                                                                  | V                 | 1.5           | 31.48              | -25.59              | 4.85                             | 54.00                   | 44.88                    | 9.12           |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
|                                |                                                                                                        |                   |               |                    |                     |                                  |                         |                          |                |
| Remark                         | H : Horizontal,    V : Vertical    TEST MODE : CH : 39 – 2 480 MHz (x postion)                         |                   |               |                    |                     |                                  |                         |                          |                |
|                                | *The TX signal wasn't detected from 3th harmonics.                                                     |                   |               |                    |                     |                                  |                         |                          |                |
|                                | *Checked in all 3 axis and the maximum measured data were reported.( Worst data is X axis of position) |                   |               |                    |                     |                                  |                         |                          |                |
|                                | *Total = Reading Value + Antenna Factor + Cable Loss – Amp Gain + Duty Cycle Correction                |                   |               |                    |                     |                                  |                         |                          |                |
|                                | *This test was radiated up to 26.5 GHz but no noise was measured.                                      |                   |               |                    |                     |                                  |                         |                          |                |

## 10.4–12 Restricted Band Edges(BLE 2M)

Band Edges(CH Low)

Detector mode:Peak

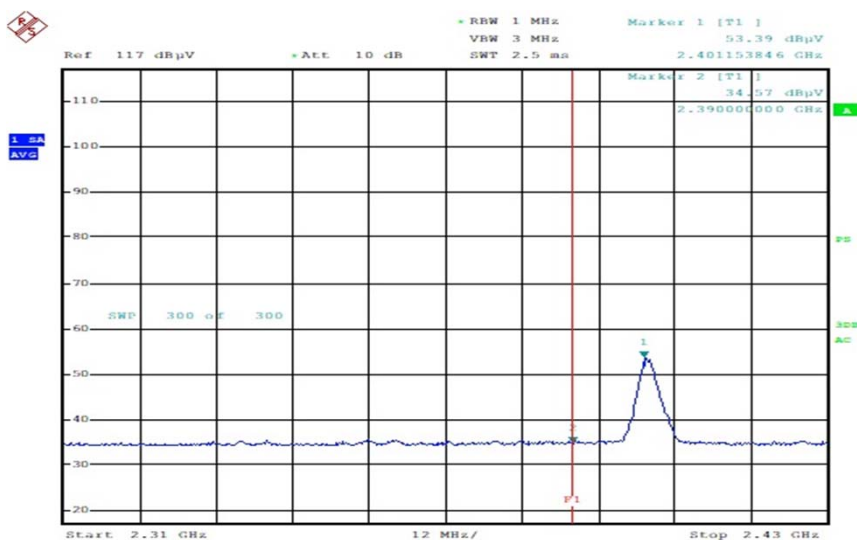
Polarity:Horizontal



ESTR-22-00190

Detector mode:Average

Polarity:Horizontal

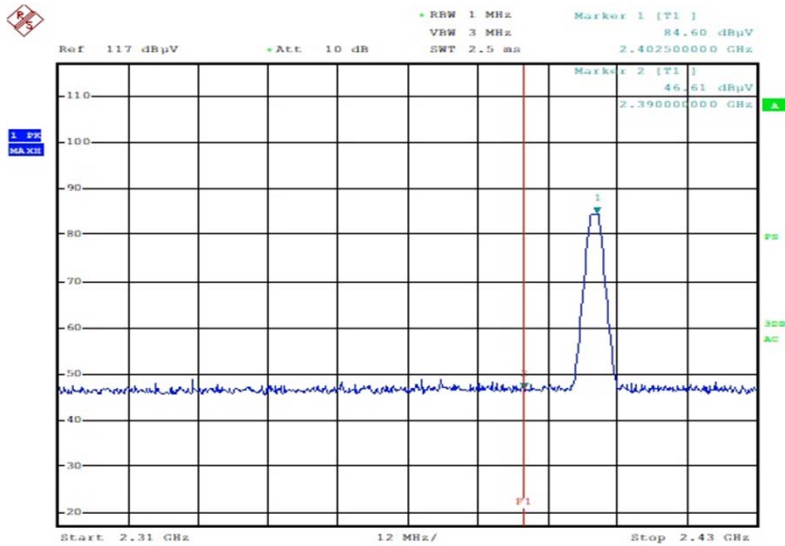


ESTR-22-00190

Band Edges(CH Low)

Detector mode:Peak

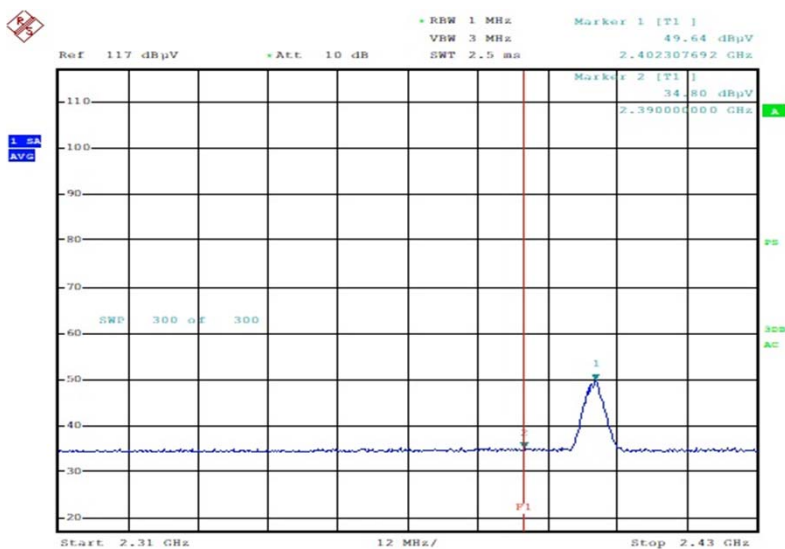
Polarity:Vertical



ESTR-22-00190

Detector mode:Average

Polarity:Vertical

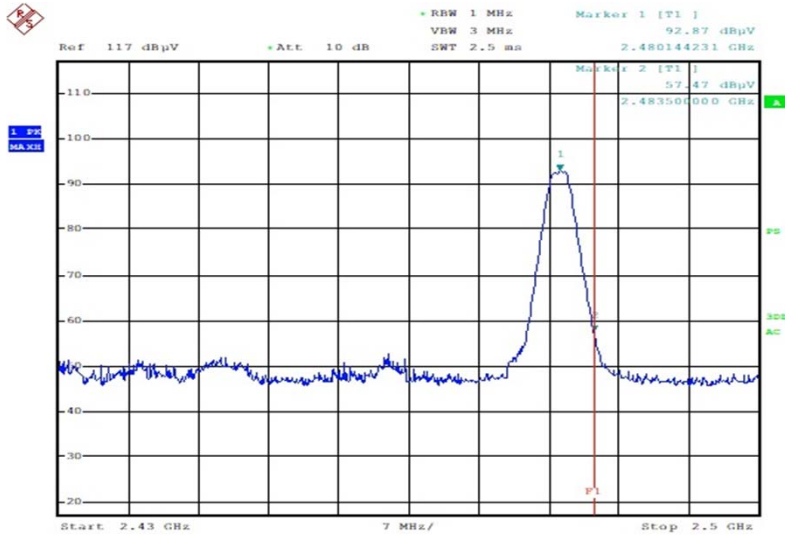


ESTR-22-00190

Band Edges(CH High)

Detector mode:Peak

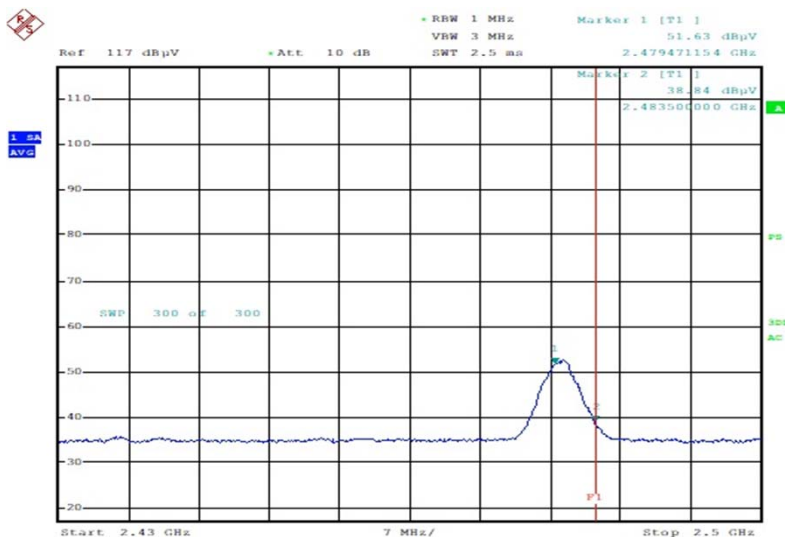
Polarity:Horizontal



ESTR-22-00190

Detector mode:Average

Polarity:Horizontal

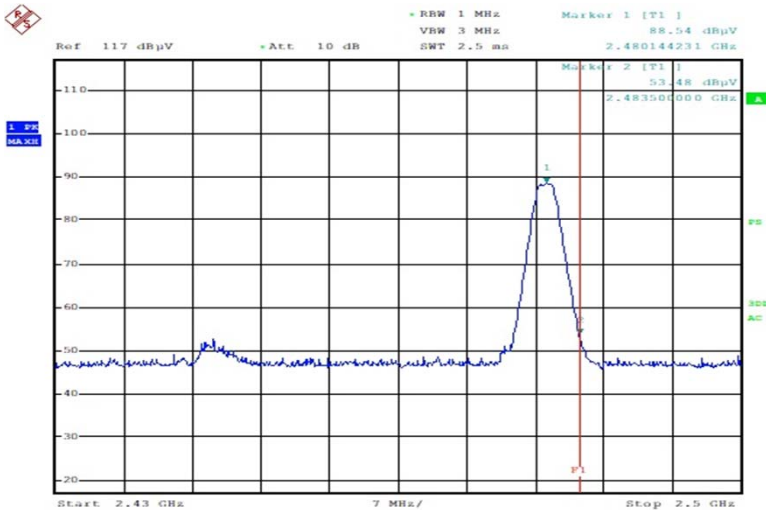


ESTR-22-00190

Band Edges(CH High)

Detector mode:Peak

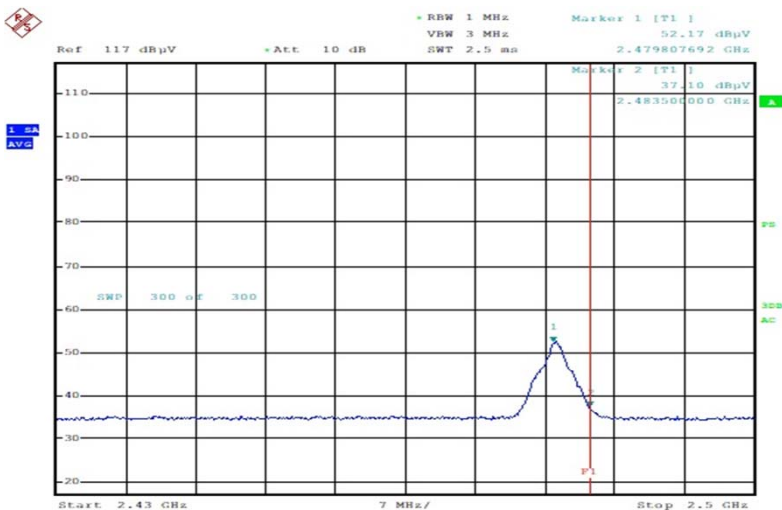
Polarity:Vertical



ESTR-22-00190

Detector mode:Average

Polarity:Vertical

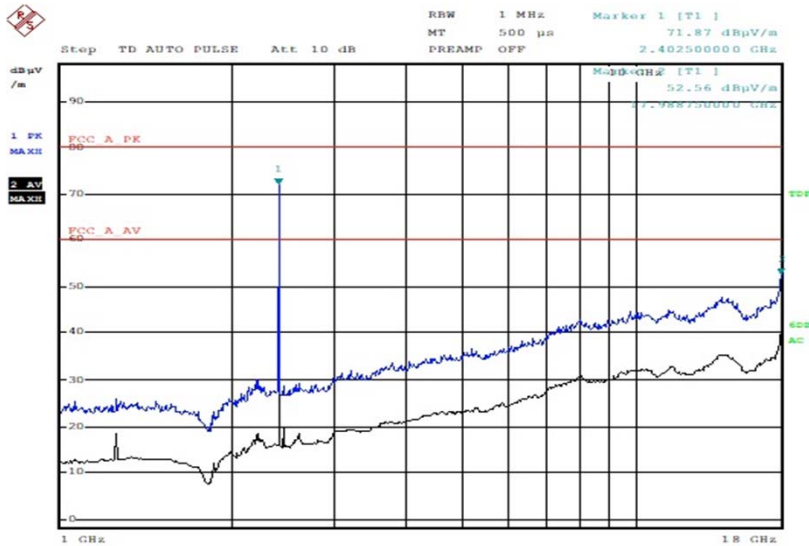


ESTR-22-00190

## 10.4–13 Restricted Band Edges(BLE 2M)

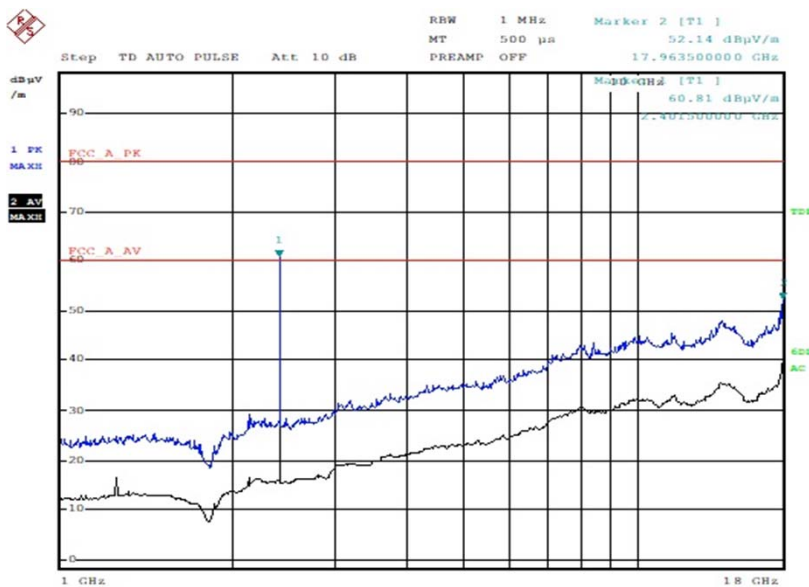
Band Edges(CH Low)

Polarity:Horizontal



ESTR-22-00190

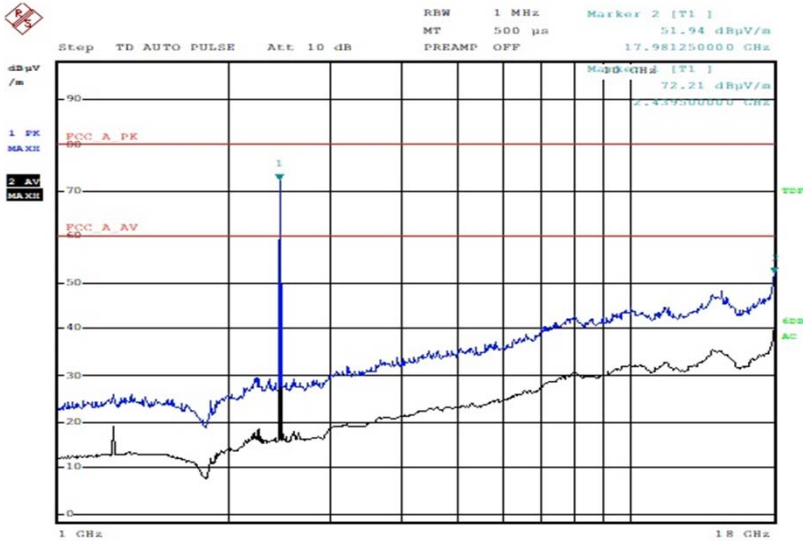
Polarity:Vertical



ESTR-22-00190

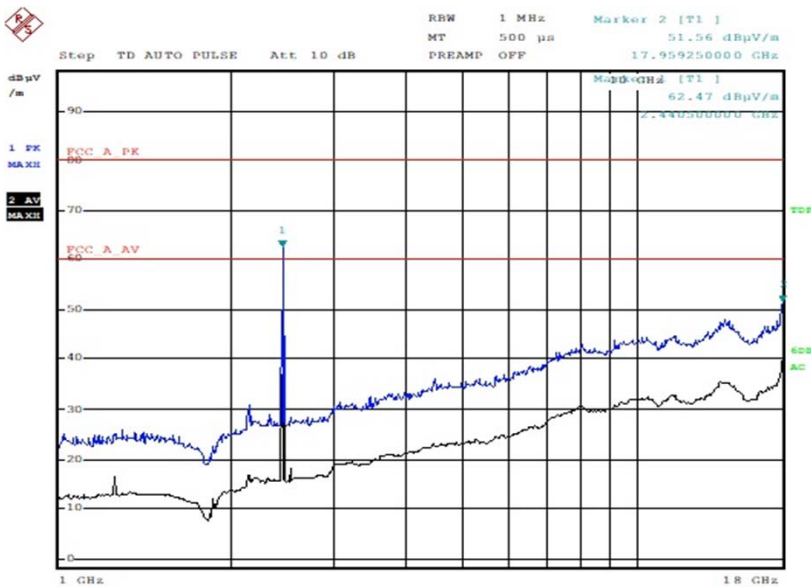
Band Edges(CH Middle)

Polarity:Horizontal



ESTR-22-00190

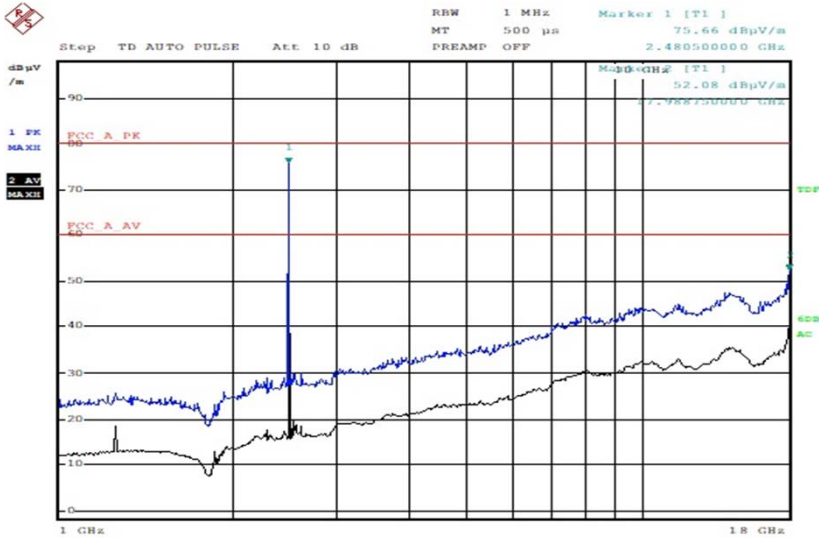
Polarity:Vertical



ESTR-22-00190

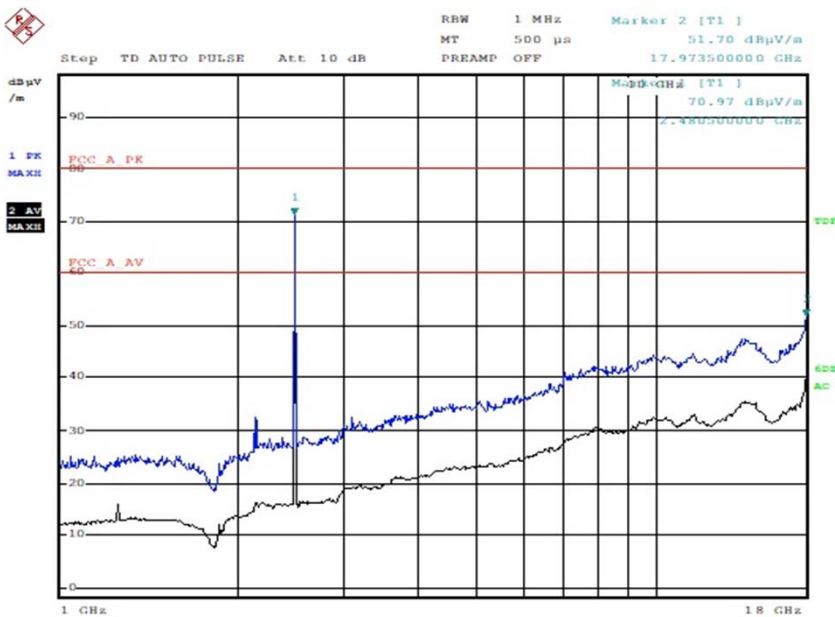
Band Edges(CH High)

Polarity:Horizontal



ESTR-22-00190

Polarity:Vertical



ESTR-22-00190

## 11. Measurement of conducted disturbance

The continuous disturbance voltage of AC Mains in the frequency from 0.15 MHz to 30 MHz was measured in accordance to FCC PART 15.207. The test setup was made according to ANSI C 63.10 (2009) in a shielded room. The EUT was placed on a non-conductive table at least 0.8 m above the ground plan. A grounded vertical reference plane was positioned in a distance of 0.4 m from the EUT. The distance from the EUT to other metal surfaces was at least 0.8 m. The EUT was only earthen by its power cord through the line impedance stabilizing network. The power cord has been bundled to a length of 1.0 m. The test receiver with Quasi Peak detector complies with CISPR 16.

### 11.1 Measurement equipments

| Equipment Name | Type    | Manufacturer    | Serial No. | Next Calibration date |
|----------------|---------|-----------------|------------|-----------------------|
| TEST RECEIVER  | ESPI    | Rohde & Schwarz | 100005     | 29-Jun-23             |
| LISN           | ESH3-Z5 | Rohde & Schwarz | 836679/025 | 29-Jun-23             |
| Pulse Limiter  | ESH3Z2  | Rohde & Schwarz | NONE       | 29-Jun-23             |

### 11.2 Environmental Condition

Test Place : Shielded Room

Test mode : N/A

Temperature (°C) : °C

Humidity (% R.H.) : R.H.

## 11.3 Test Data

Test Date : N/A

| Frequency<br>(MHz) | Correction Factor                                                                                            |               | Line<br>(H/N) | Quasi-peak Value      |                         |                        | Average Value         |                         |                |
|--------------------|--------------------------------------------------------------------------------------------------------------|---------------|---------------|-----------------------|-------------------------|------------------------|-----------------------|-------------------------|----------------|
|                    | Lisn<br>(dB)                                                                                                 | Cable<br>(dB) |               | Limit<br>(dB $\mu$ V) | Reading<br>(dB $\mu$ V) | Result<br>(dB $\mu$ V) | Limit<br>(dB $\mu$ V) | Reading<br>(dB $\mu$ V) | Result<br>(dB) |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
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|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
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|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
|                    |                                                                                                              |               |               |                       |                         |                        |                       |                         |                |
| Remark             | H : Hot Line, N : Neutral Line<br>*Correction Factor = Lisn + Cable<br>*Result = Correction Factor + Reading |               |               |                       |                         |                        |                       |                         |                |

## Appendix 1. Special diagram

\*CONDUCTED EMISSION : N/A

\* HOT LINE

\* NEUTRAL LINE

## Appendix 2. Antenna information

### 1. Antenna information

antenna type : Intergrated PCB Antenna.

antenna location : Integnal

antenna gain : 2.32 dBi

No temporary RF connector provided