# FCC / IC Test Report

FOR:

# Telit

Model Name:

BL871E2-HI

Product Description:

Bluetooth Module

FCC ID: RFR-BL871
IC ID: 23249-BL871

Applied Rules and Standards:
47 CFR Part 15.247 (DTS)
RSS-247 Issue 1 (DTS) & RSS-Gen Issue 4

REPORT #: EMC_TELIT_005_17001_15.247_BT_DTS

DATE: 09/15/2017


A2LA Accredited

IC recognized #
3462B-1

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*CETECOM* Inc. is a Delaware Corporation with Corporation number: 2905571

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## 1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

| Company | Description | Model # |
|---|---|---|
| Telit | Bluetooth module | BL871E2-HI |

Responsible for Testing Laboratory:

| Date | Section | Name | Signature |
|---|---|---|---|
| 09/15/2017 | Compliance | Dr. Peter Nevermann (Director Radio Communications and EMC) | |

Responsible for the Report:

| Date | Section | Name | Signature |
|---|---|---|---|
| 09/15/2017 | Compliance | Cindy Li (EMC Engineer) | Cindy Li Digitally signed by Cindy Li DN: cn=Cindy Li, o=CETECOM Inc., ou=EMC, email=cindy.li@cetecom.com, c=US Date: 2017.10.06 09:47:16 -07'00' |

# 2 Administrative Data

## 2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

| | |
|---|---|
| Company Name: | CETECOM Inc. |
| Department: | Compliance |
| Street Address: | 411 Dixon Landing Road |
| City/Zip Code | Milpitas, CA 95035 |
| Country | USA |
| Telephone: | +1 (408) 586 6200 |
| Fax: | +1 (408) 586 6299 |
| Director Radio Com. and EMC: | Peter Nevermann |
| Responsible Project Leader: | Josephine Mena |

## 2.2 Identification of the Client

| | |
|---|---|
| Applicant's Name: | Telit |
| Street Address: | 27422 Portola Parkway, Suite 320 |
| City/Zip Code: | Foothill Ranch, CA 92610 |
| Country: | USA |
| Contact Person: | Terry Dawson |
| Phone No. | 949 540 1274 |
| e-mail: | Terry.Dawson@telit.com |

## 2.3 Identification of the Manufacturer

| | |
|---|---|
| Manufacturer's Name: | Same as client |
| Manufacturers Address: | |
| City/Zip Code: | |
| Country: | |

# 3 Equipment Under Test (EUT)

## 3.1 EUT Specifications

| | |
|---|---|
| Model No: | BL871E2-HI |
| HW Version : | R1 |
| SW Version : | CC2564C_07 |
| FCC ID: | RFR-BL871 |
| IC ID: | 23249-BL871 |
| PMN: | BL871E2-HI |
| HVIN: | R1 |
| FVIN: | CC2564C_07 |
| Product Description: | BT/BTLE Module |
| Frequency Range / number of channels: | Nominal band: 2400 MHz – 2483.5 MHz;<br>Center to center: 2402 MHz (ch 0) – 2480 MHz (ch 39), 40 channels |
| Type(s) of Modulation: | Bluetooth version 4.2, Low Energy, using Dynamic Sequence Spread Spectrum with GFSK modulation. |
| Modes of Operation: | Bluetooth LE in both advertising and connected mode of operation |
| Antenna Information as declared: | max gain -1.53 dBi |
| Max. Peak Output Power: | Conducted Power 8.93 dBm |
| Power Supply/ Rated Operating Voltage Range: | Dedicated Battery Pack Vmin: 2.2 VDC/ Vnom: 3.3 VDC / Vmax: 4.8 VDC |
| Operating Temperature Range: | -40 ºC to +85 ºC |
| Other Radios included in the device: | Bluetooth Basic / EDR: GFSK, π /4 DQPSK, 8DPSK |
| Sample Revision: | ☐Prototype Unit; ■Production Unit; ☐Pre-Production |

## 3.2 EUT Sample details

| EUT # | Serial Number | HW Version | SW Version | Notes/Comments |
|---|---|---|---|---|
| 1 | N/A | R1 | CC2564C_07 | Radiated and AC Conducted Emissions |
| 2 | N/A | R1 | CC2564C_07 | Conducted RF |

## 3.3 Accessory Equipment (AE) details

| AE # | Type | Model | Manufacturer | Serial Number |
|---|---|---|---|---|
| 1 | Test Jig for conducted | N/A | N/A | N/A |
| 2 | Test Jig for radiated | N/A | N/A | N/A |
| 3 | 5V USB Power Adapter | A1385 | Apple | N/A |

## 3.4 Test Sample Configuration

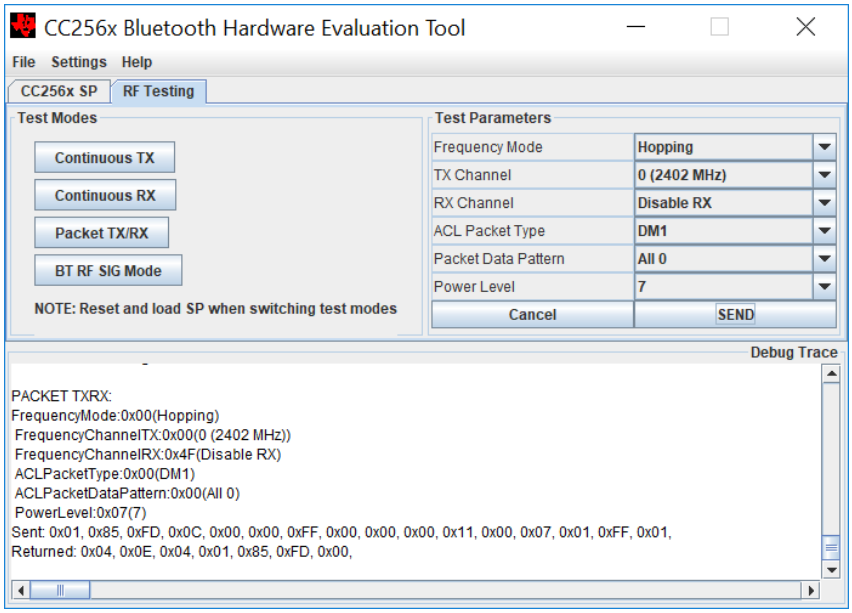
| EUT Set-up # | Combination of AE used for test set up | Comments |
|---|---|---|
| 1 | EUT#2 + AE#1 | The radio of the EUT was configured to a fixed channel transmission with 100% duty cycle using software that is not available to the end user. The measurement equipment was connected to the 50 ohm RF port of the EUT. |
| 2 | EUT#1 + AE#2 | The radio of the EUT was configured to a fixed channel transmission with 100% duty cycle using software that is not available to the end user. The internal antenna was integrated. |
| 3 | EUT#1 + AE#3 | The radio of the EUT was configured to a fixed channel transmission with 100% duty cycle using software that is not available to the end user. The internal antenna was connected. The EUT was connected to the AC mains through a USB charger. |

## 3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and 100% duty cycle. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

The EUT were configured by “CC256x Bluetooth Hardware Evaluation Tool” provided by client (not available to the end user), the highest power level was selected by using this tool.

CC256x Bluetooth Hardware Evaluation Tool:



## 4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

Testing procedures are based on 558074 D01 DTS Meas Guidance v04 – "GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247" - April 5, 2017, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.

## 5 Measurement Results Summary

| Test Specification | Test Case | Temperature and Voltage Conditions | Mode | Pass | NA | NP | Result |
|---|---|---|---|---|---|---|---|
| §15.247(a)(1)<br>RSS-247 5.2(1) | Emission Bandwidth | Nominal | BTLE | ■ | ☐ | ☐ | Complies |
| §15.247(e)<br>RSS-247 5.2(2) | Power Spectral Density | Nominal | BTLE | ■ | ☐ | ☐ | Complies |
| §15.247(b)(1)<br>RSS-247 5.4(4) | Maximum Conducted Output Power and EIRP | Nominal | BTLE | ■ | ☐ | ☐ | Complies |
| §15.247(d)<br>RSS-247 5.5 | Band edge compliance Unrestricted Band Edges | Nominal | BTLE | ■ | ☐ | ☐ | Complies |
| §15.247; 15.209; 15.205<br>RSS-Gen 8.9; 8.10 | Band edge compliance Restricted Band Edges | Nominal | BTLE | ■ | ☐ | ☐ | Complies |
| §15.247(d); §15.209<br>RSS-Gen 6.13 | TX Spurious emissions-Radiated | Nominal | BTLE | ■ | ☐ | ☐ | Complies |
| §15.207(a)<br>RSS Gen 8.8 | AC Conducted Emissions | Nominal | BTLE | ■ | ☐ | ☐ | Complies |

Note: NA= Not Applicable; NP= Not Performed.

# 6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

| | |
|---|---|
| 9 kHz to 30 MHz | ±2.5 dB (Magnetic Loop Antenna) |
| 30 MHz to 1000 MHz | ±2.0 dB (Biconilog Antenna) |
| 1 GHz to 40 GHz | ±2.3 dB (Horn Antenna) |

Conducted measurement

| | |
|---|---|
| 150 kHz to 30 MHz | ±0.7 dB (LISN) |
| RF conducted measurement | ±0.5 dB |

According to TR 102 273 a multiplicative propagation of error is assumed for RF measurement systems. For this reason the RMS method is applied to dB values and not to linear values as appropriate for additive propagation of error. Also used: http://physics.nist.gov/cuu/Uncertainty/typeb.html. The above calculated uncertainties apply to direct application of the Substitution method. The Substitution method is always used when the EUT comes closer than 3 dB to the limit.

## 6.1 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

## 6.2 Dates of Testing:

08/17/2017 - 09/08/2017

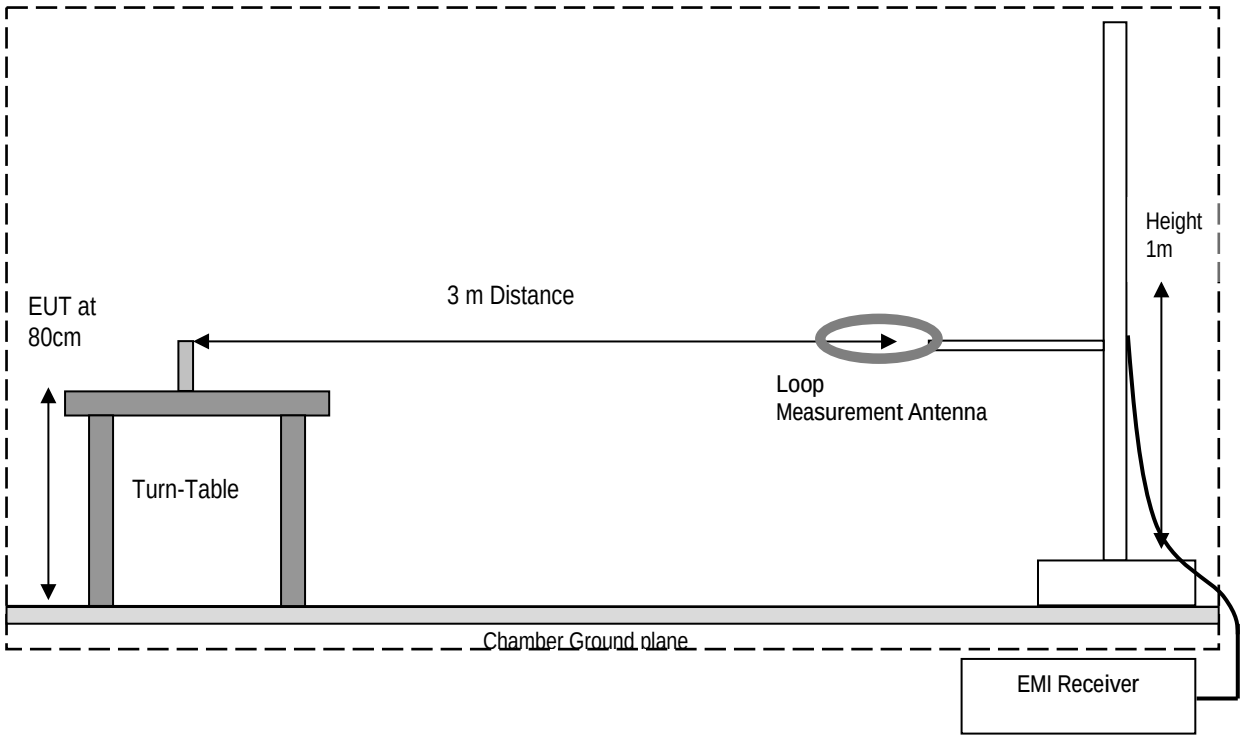
# 7 Measurement Procedures

## 7.1 Radiated Measurement

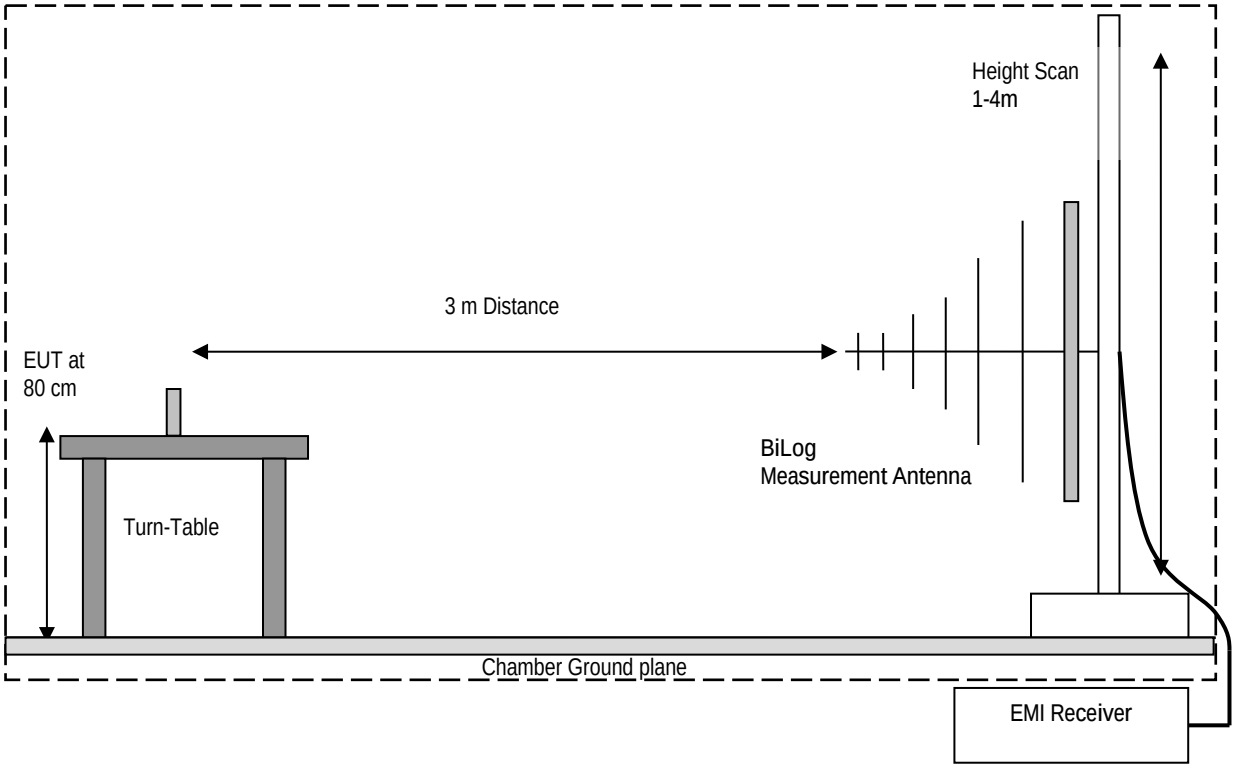
The radiated measurement is performed according to ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

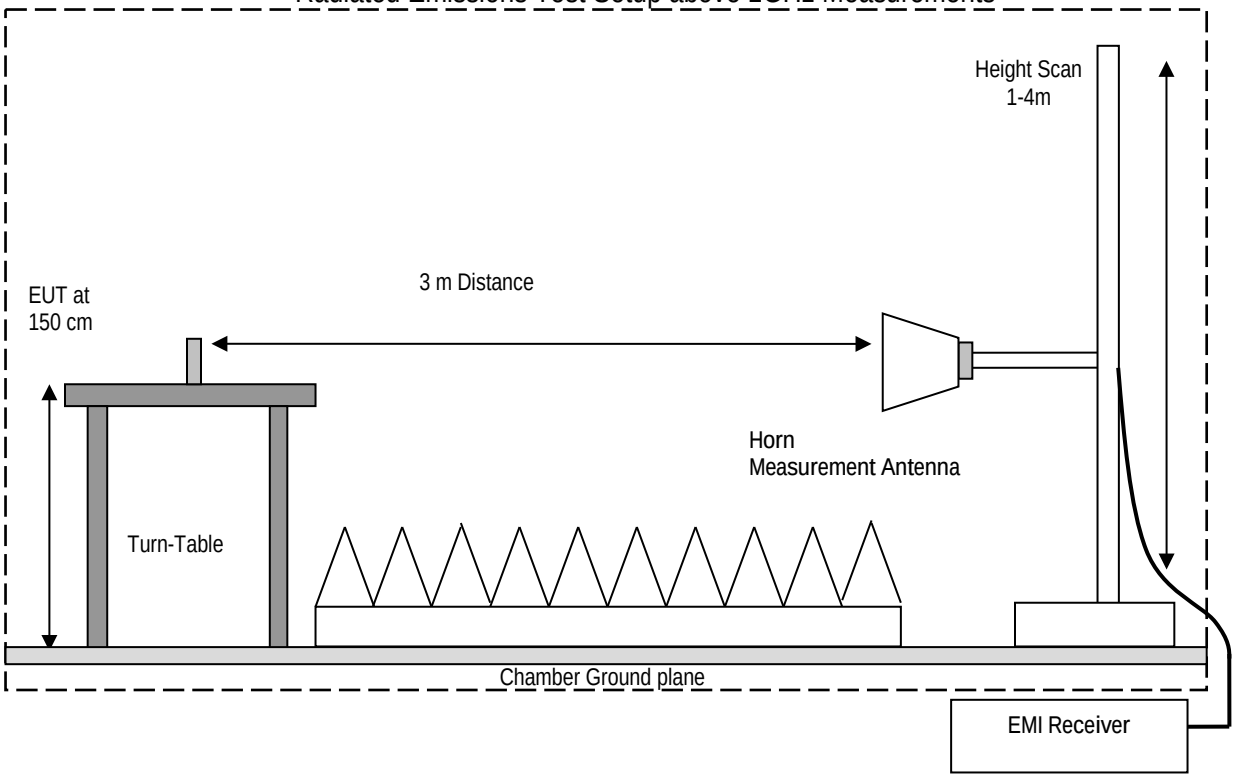
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements




Radiated Emissions Test Setup above 1GHz Measurements



### 7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

FS (dBµV/m) = Measured Value on SA (dBµV)- Cable Loss (dB)+ Antenna Factor (dB/m)

Example:

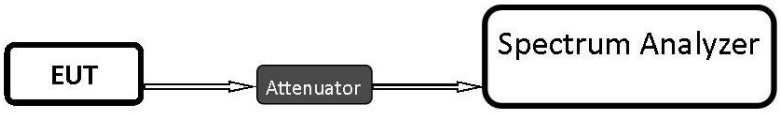
| Frequency (MHz) | Measured SA (dBµV) | Cable Loss (dB) | Antenna Factor Correction (dB) | Field Strength Result (dBµV/m) |
|---|---|---|---|---|
| 1000 | 80.5 | 3.5 | 14 | 98.0 |

## 7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.10 (2013)

## 7.3 RF Conducted Measurement Procedure

Testing procedures are based on 558074 D01 DTS Meas Guidance v04 – "GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247" - April 5, 2017, by the Federal Communications Commission, Office of Engineering and Technology, Laboratory Division.




- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.
- Calculate the conducted power by taking into account attenuation of the cable and the attenuator

# 8 Test Result Data

## 8.1 Maximum Peak Conducted Output Power

### 8.1.1 Measurement according to FCC 558074 D01 DTS Meas Guidance v04

Spectrum Analyzer settings:

- RBW ≥ DTS bandwidth
- VBW ≥ 3 x RBW
- Span ≥ 3 x RBW
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use peak marker function to determine the peak amplitude level

### 8.1.2 Limits:

Maximum Peak Output Power:

- FCC §15.247 (b)(1): 1 W
- IC RSS-247: 1 W

### 8.1.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input | Antenna Gain |
|---|---|---|---|---|
| 23° C | 1 | GFSK continuous fixed channel | 3.3 VDC | -1.53dBi |

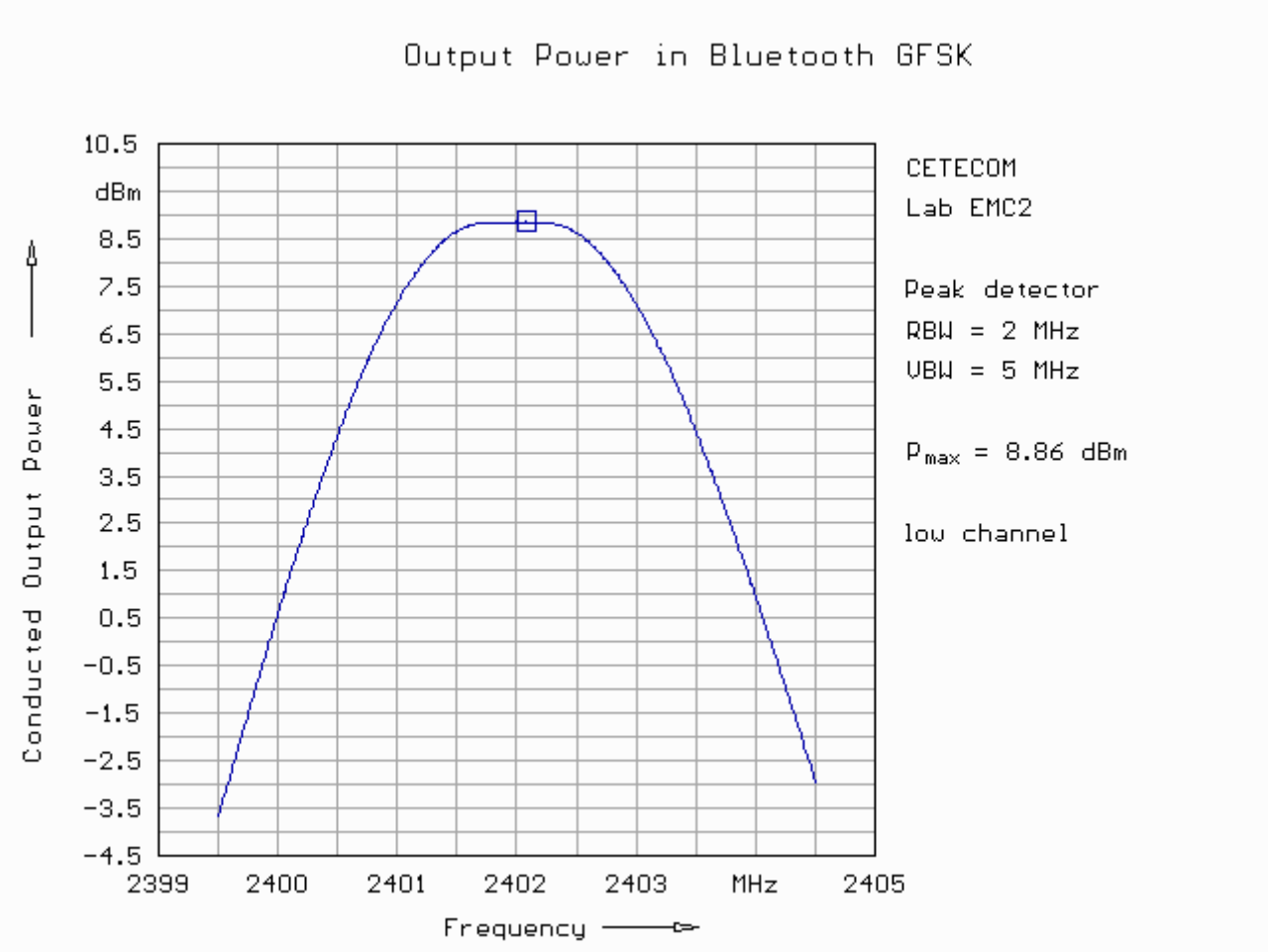
### 8.1.4 Measurement result:

Attenuation of cable and attenuator (already taken into account): 12.7 dB

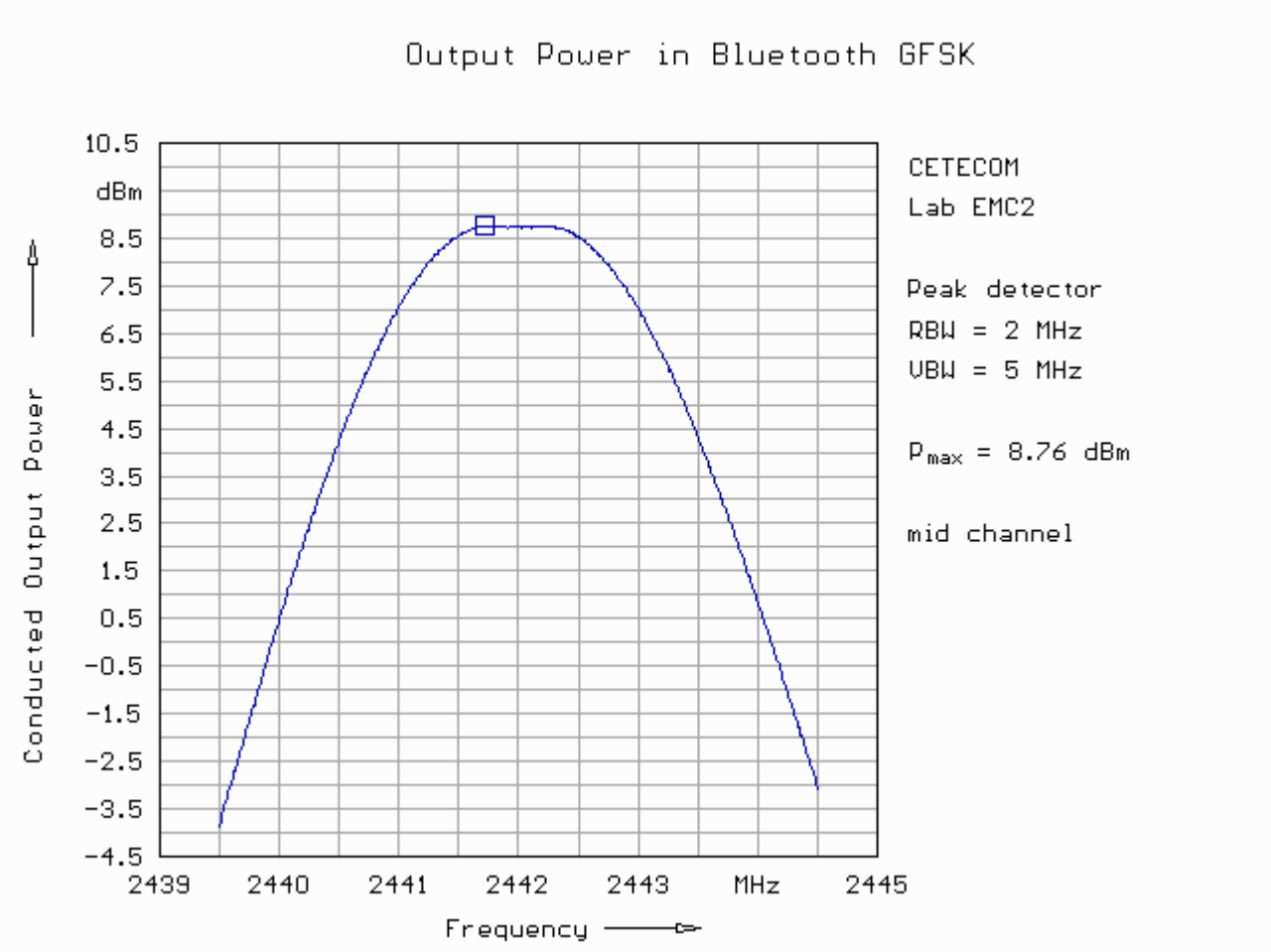
| Plot # | Frequency (MHz) | Maximum Peak Conducted Output Power (dBm) | EIRP (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|
| 1 | 2402 | 8.86 | 7.33 | 30 (Pk) / 36 (EIRP) | Pass |
| 2 | 2442 | 8.76 | 7.23 | 30 (Pk) / 36 (EIRP) | Pass |
| 3 | 2480 | 8.93 | 7.4 | 30 (Pk) / 36 (EIRP) | Pass |

### 8.1.5 Measurement Plots:

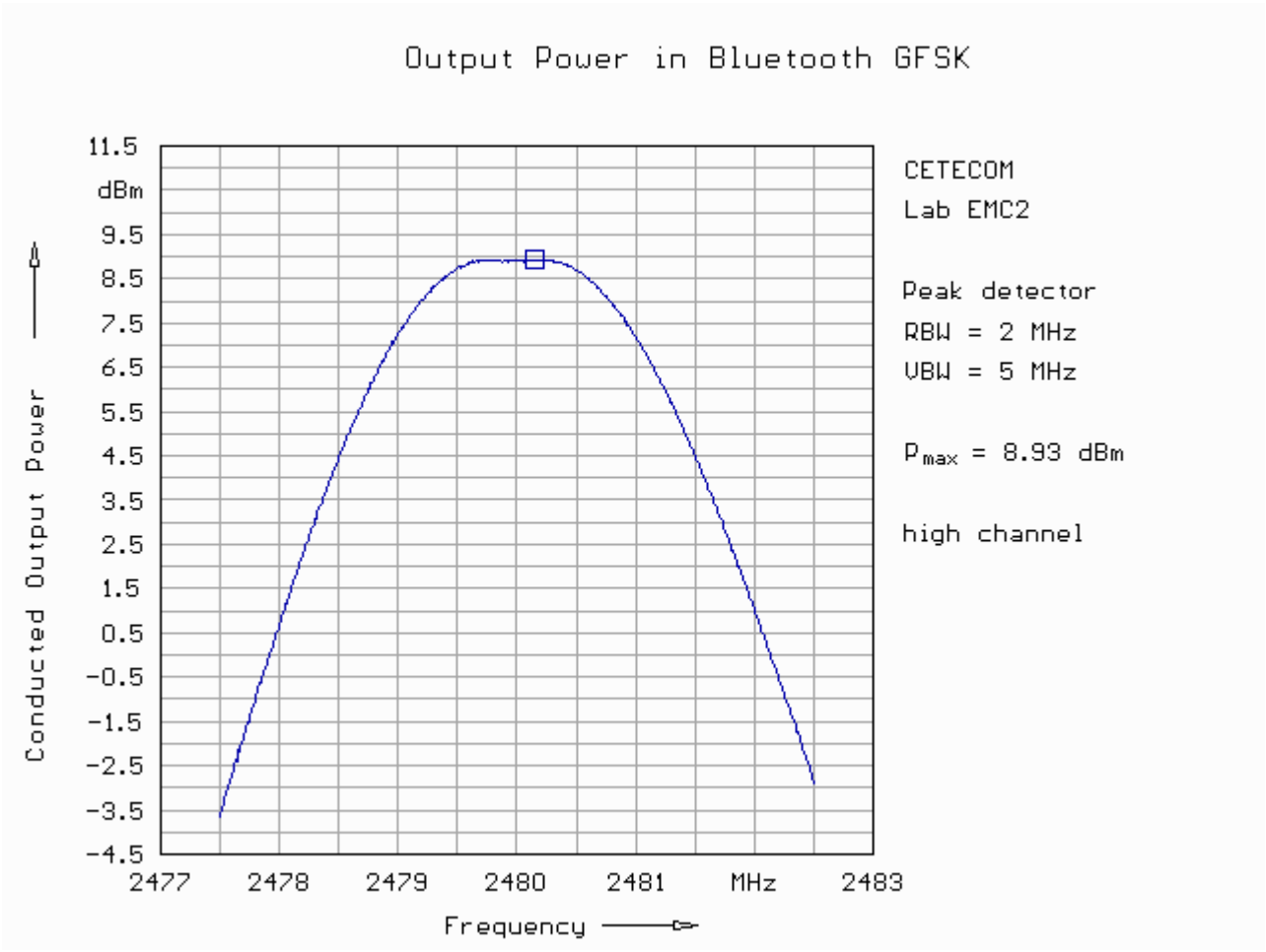
| Plot #1 | |
|---|---|
| Low channel | Modulation/Packet Type: BTLE |



| Plot #2 | |
|---|---|
| Mid channel | Modulation/Packet Type: BTLE |



| Plot #3 | |
|---|---|
| High channel | Modulation/Packet Type: BTLE |



## 8.2 Power Spectral Density

### 8.2.1 Measurement according to FCC 558074 D01 DTS Meas Guidance v04

Spectrum Analyzer settings for Peak PSD method:

- Set analyzer center frequency to DTS channel center frequency
- Set the span to 1.5 x DTS bandwidth
- Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz
- Set the VBW ≥ 3 x 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

### 8.2.2 Limits:

FCC§15.247(e) & RSS-247 5.2(2)

- For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### 8.2.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input | Antenna Gain |
|---|---|---|---|---|
| 23° C | 1 | GFSK continuous fixed channel | 3.3 VDC | -1.53dBi |

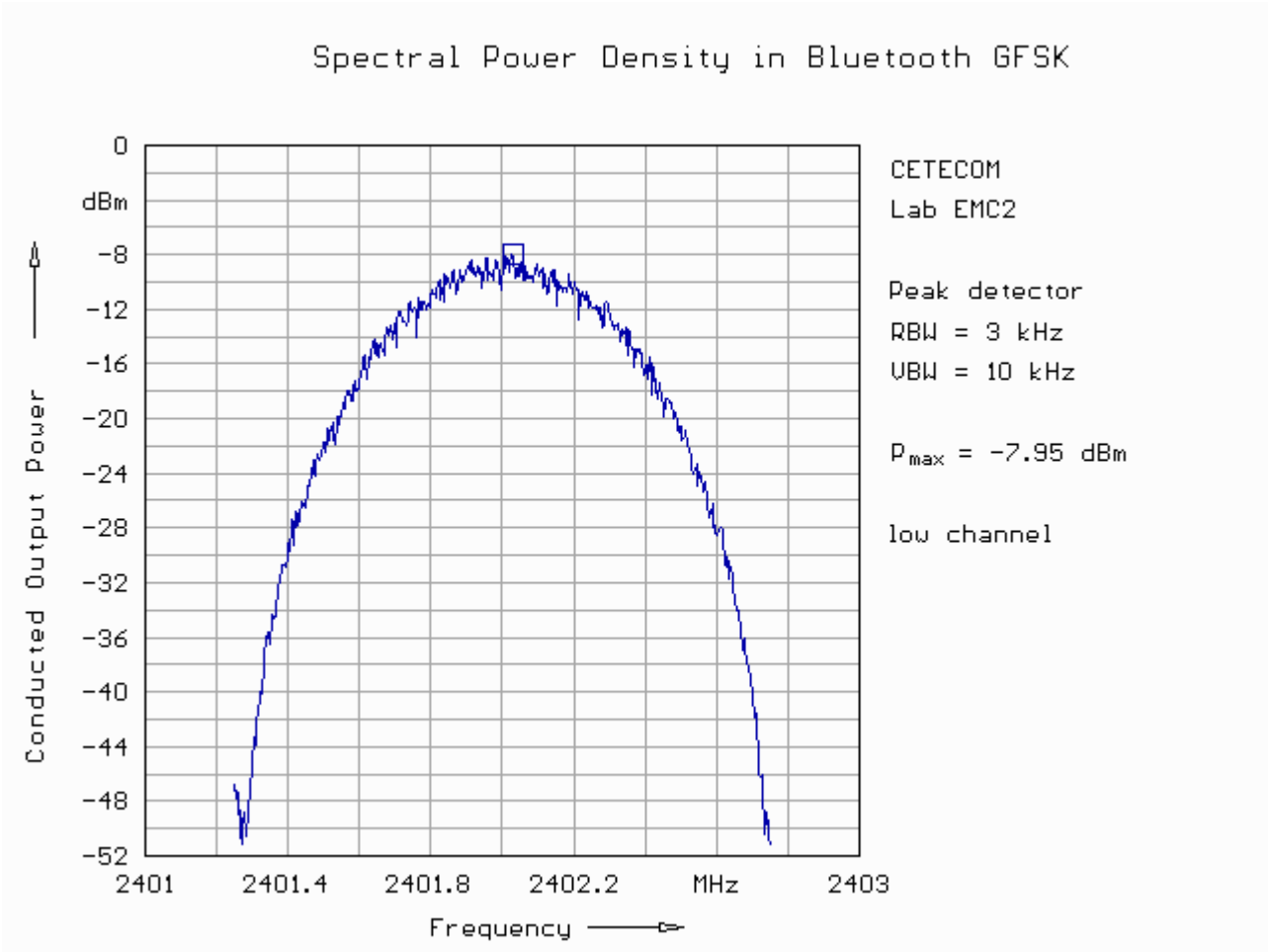
### 8.2.4 Measurement result:

Attenuation of cable and attenuator (already taken into account): 12.7 dB

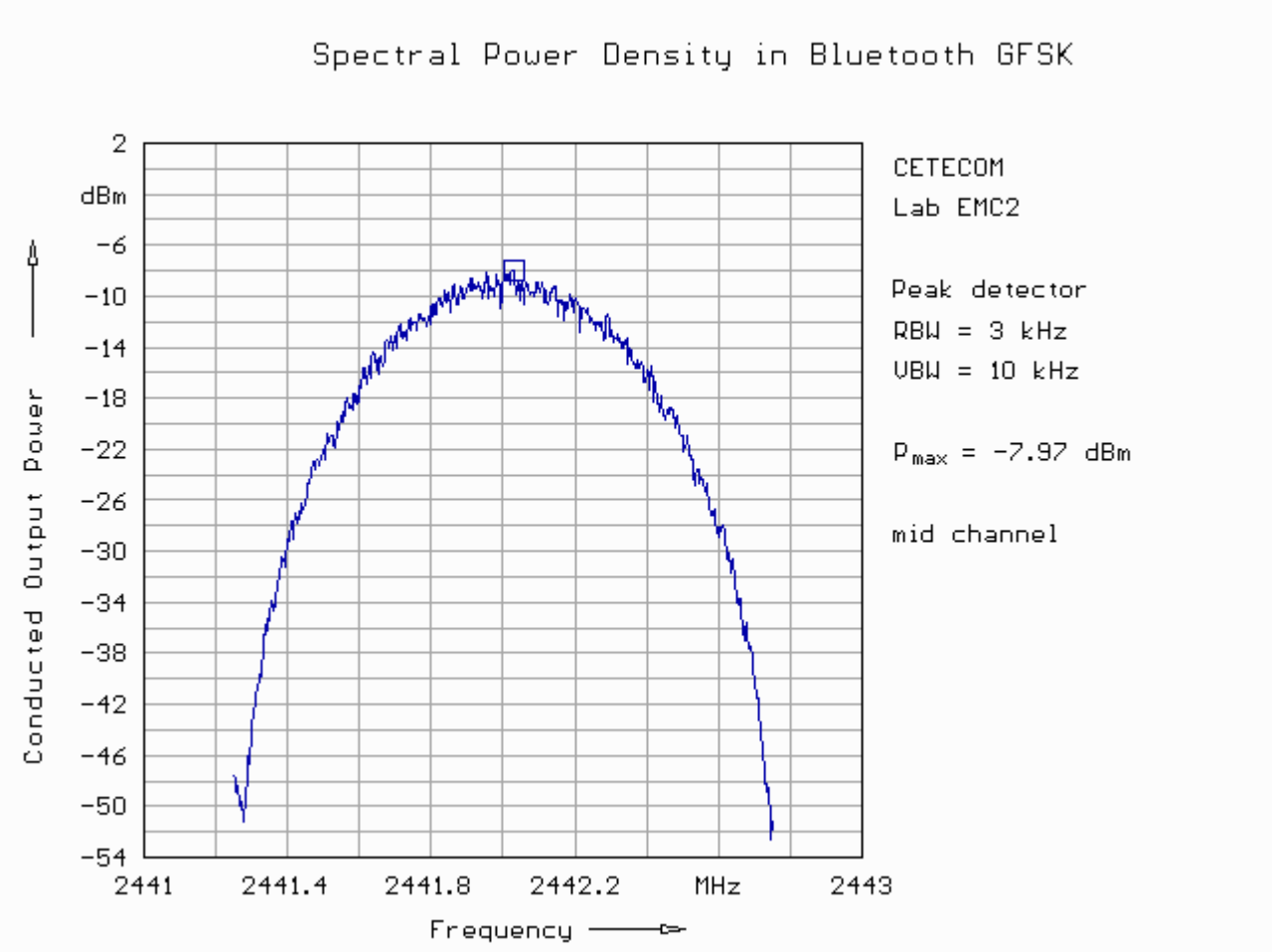
| Plot # | Frequency (MHz) | Maximum Power Spectral Density (dBm/3 kHz) | PSD Adjusted for Antenna Gain (dBm/3 kHz) | Limit ( dBm / 3 kHz ) | Result |
|---|---|---|---|---|---|
| 4 | 2402 | -7.95 | -9.48 | 8 | Pass |
| 5 | 2442 | -7.97 | -9.5 | 8 | Pass |
| 6 | 2480 | -7.79 | -9.32 | 8 | Pass |

## 8.2.5 Measurement Plots:

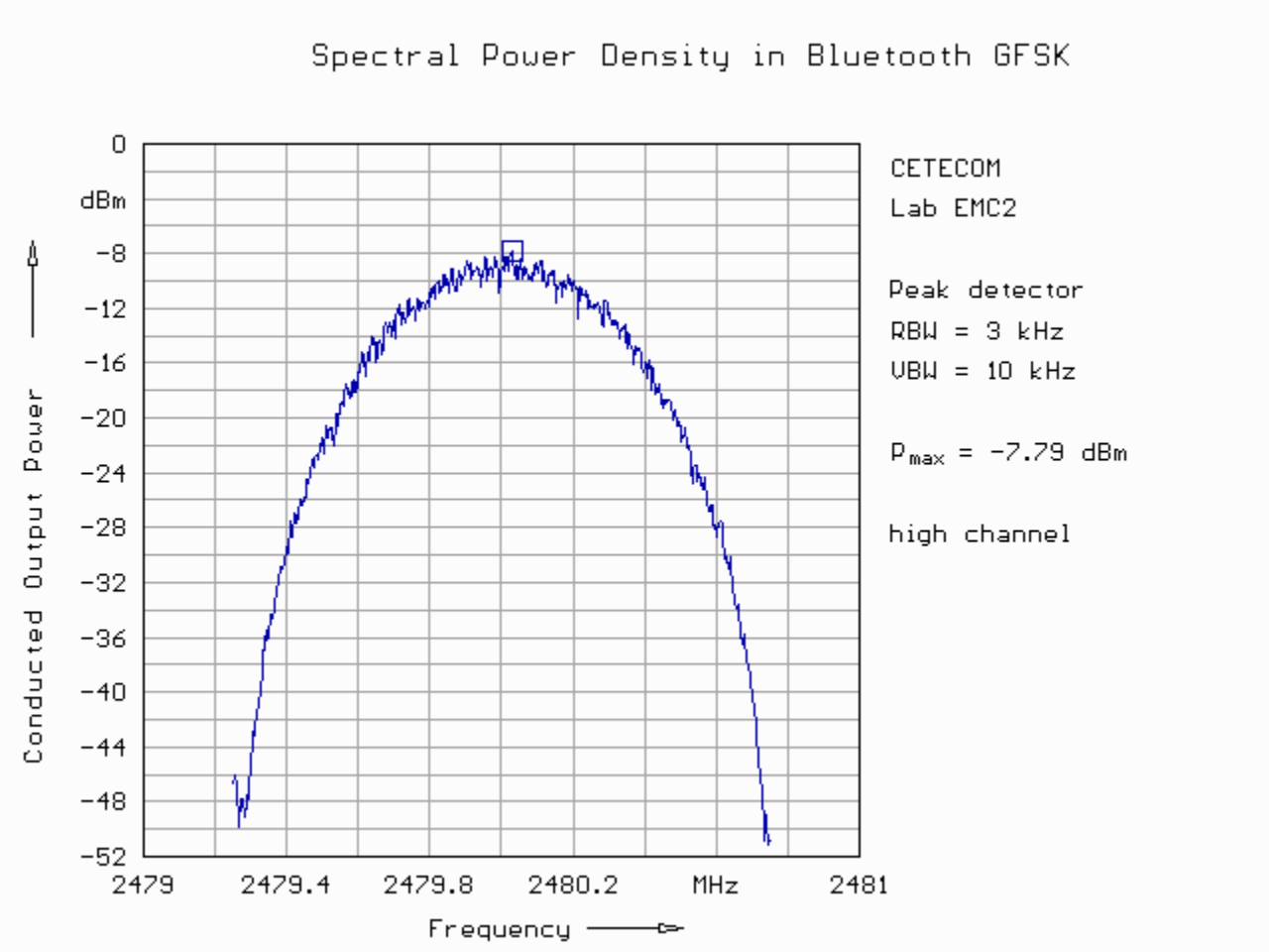
| Plot #4 | |
|---|---|
| Low channel | Modulation/Packet Type: BTLE |



| Plot #5 | |
|---|---|
| Mid channel | Modulation/Packet Type: BTLE |



| Plot #6 | |
|---|---|
| High channel | Modulation/Packet Type: BTLE |



## 8.3 Band Edge Compliance

### 8.3.1 Measurement according to FCC 558074 D01 DTS Meas Guidance v04

Spectrum Analyzer settings for band edge:

- Set the center frequency and span to encompass frequency range to be measured
- RBW = 100 kHz
- VBW ≥ 3 x RBW
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- Allow trace to fully stabilize
- Use the peak marker function to determine the maximum amplitude level
- Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge

### 8.3.2 Limits non restricted band:

FCC§15.247 (d)

- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB.

Spectrum Analyzer settings for restricted band:

- Peak measurements are made using a peak detector and RBW=1 MHz

### 8.3.3 Limits restricted band §15.247/15.209/15.205 and RSS-Gen 8.9/8.10

- *PEAK LIMIT= 74 dBµV/m @3m =-21.23 dBm
- *AVG LIMIT= 54 dBµV/m @3m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205 & RSS-Gen 8.10
- Measurements with a peak detector were used to show compliance to average limits, thus showing compliance to both peak and average limits.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

(b)

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| [1]0.495-0.505 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.17725-4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.20725-4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475-156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2690-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3600-4400 | Above 38.6 |
| 13.36-13.41 | | | |

### 8.3.4 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input | Antenna Gain |
|---|---|---|---|---|
| 23° C | 1 | GFSK continuous fixed channel | 3.3 VDC | -1.53 dBi |

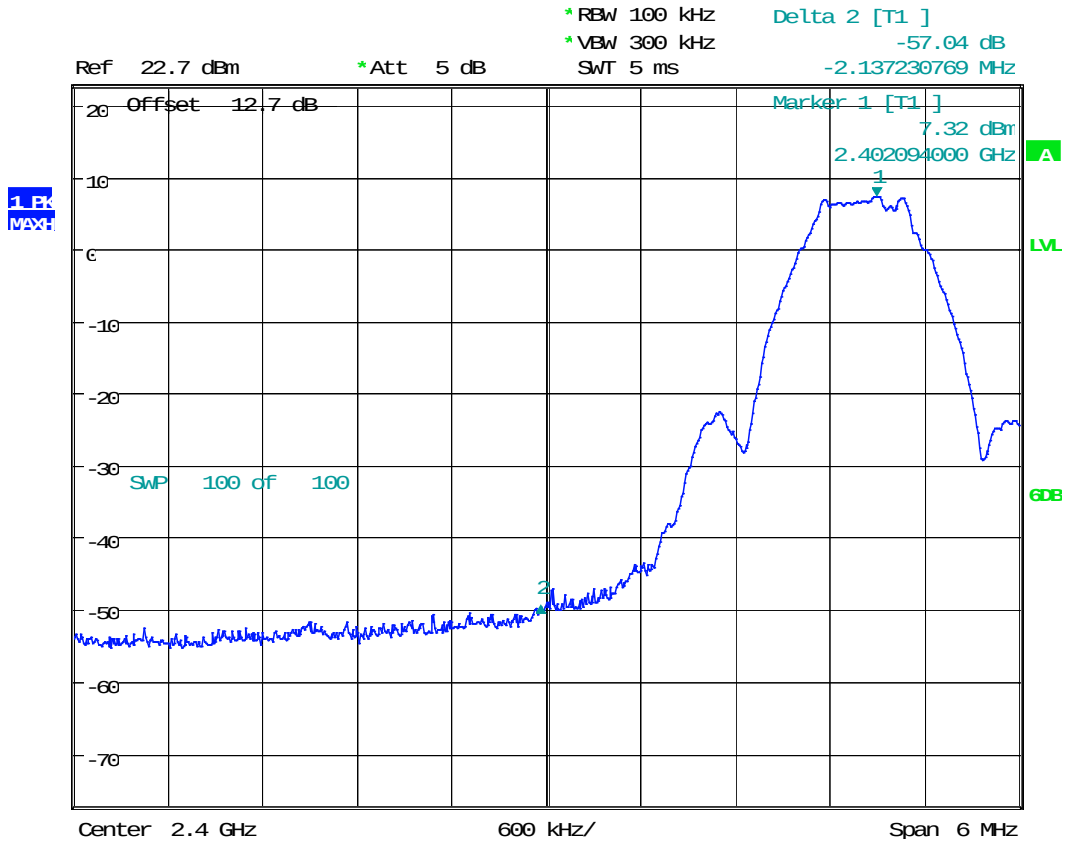
### 8.3.5 Measurement result:

| Plot # | EUT operating mode | Band Edge | Band Edge Delta (dBc) | Limit (dBc) | Result |
|---|---|---|---|---|---|
| 7 | GFSK continuous fixed channel | Lower, Non-restricted | -57.04 | 20 | Pass |

| Plot # | EUT operating mode | Band Edge | Measured Peak Value (dBm) | Corrected by duty cycle | Corrected by Antenna Gain (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|
| 8 | GFSK continuous fixed channel | Upper Restricted peak | -45.12 | NA | -46.65 | -21.23 Peak | Pass |
| 9 | GFSK continuous fixed channel | Upper Restricted Average | -53.87 | NA | -55.4 | -41.23 AVG | Pass |

## 8.3.6 Measurement Plots:

| Plot #7 | |
|---|---|
| Low channel / 2402 MHz | Modulation/Packet Type: BTLE |

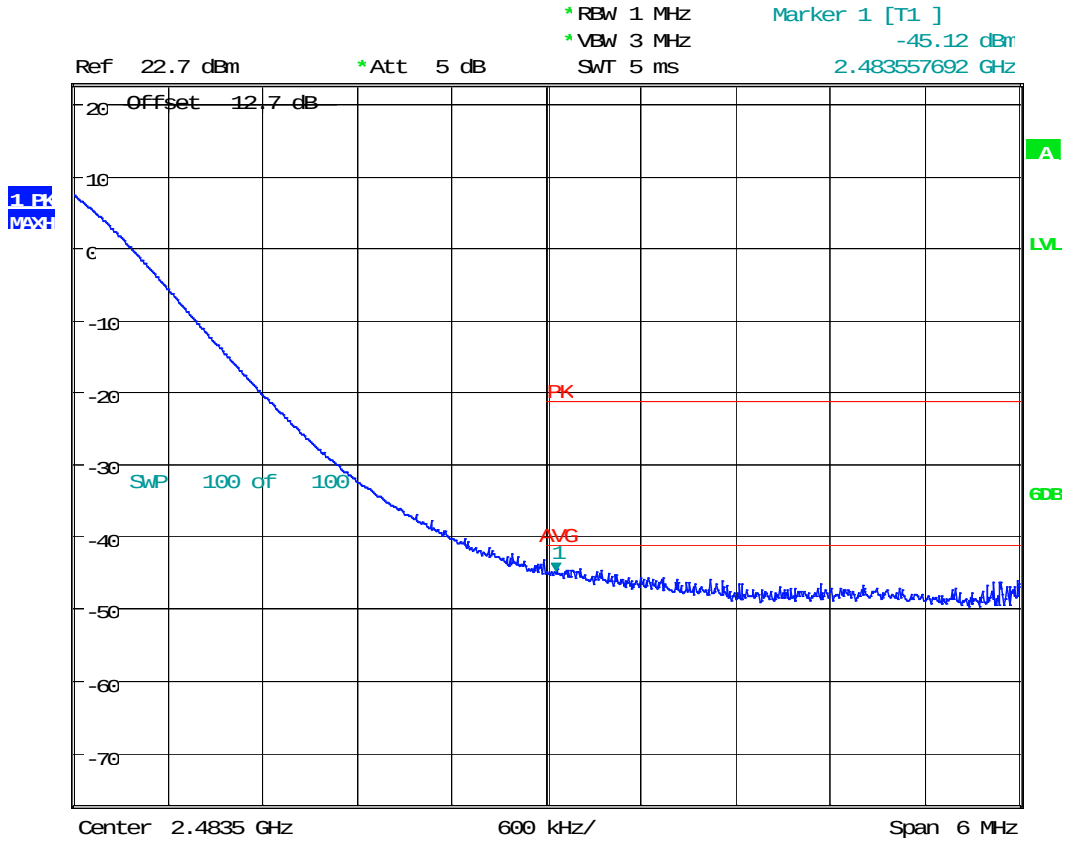



low

Date: 28.AUG.2017 14:08:15

## Plot #8

| High channel 2480 MHz | Modulation/Packet Type: BTLE |
|---|---|

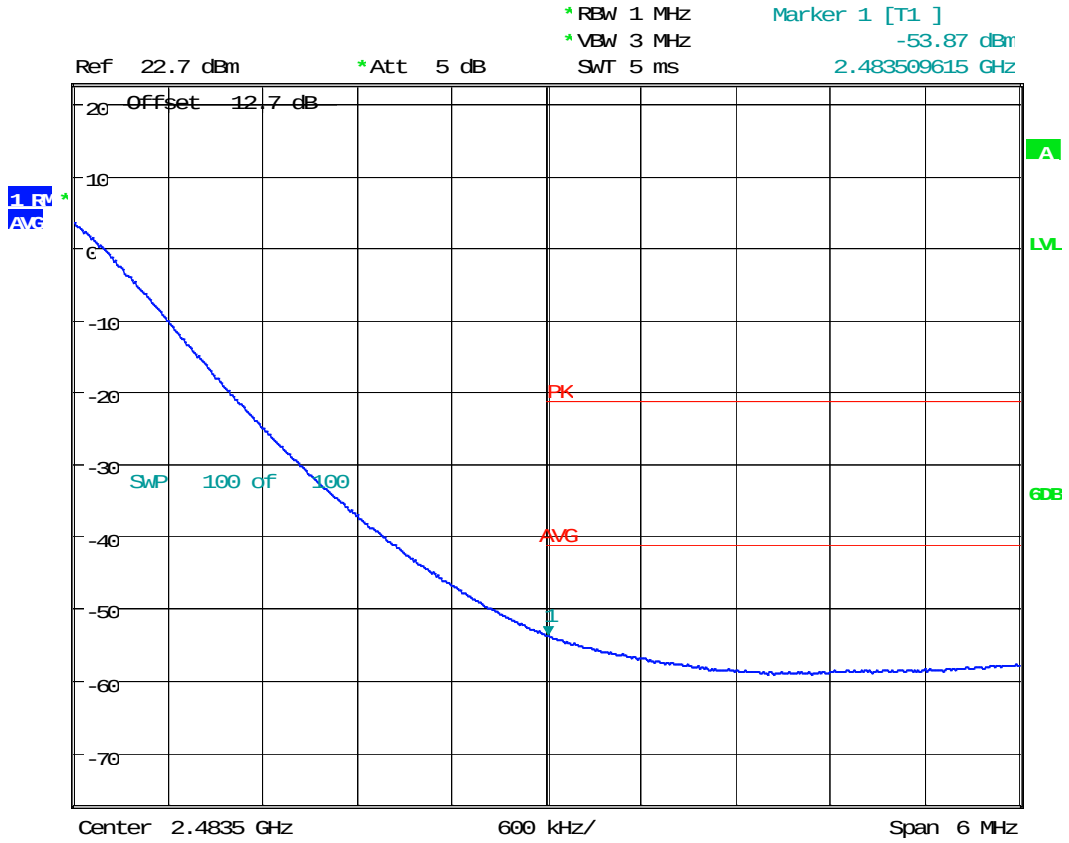



low

Date: 28.AUG.2017 14:12:53

## Plot #9

| High channel 2480 MHz | Modulation/Packet Type: BTLE |
|---|---|




low

Date: 28.AUG.2017 14:19:06

## 8.4 Emission Bandwidth 6 dB and 99% Occupied Bandwidth

### 8.4.1 Measurement according to FCC 558074 D01 DTS Meas Guidance v04

Spectrum Analyzer settings:

- Set RBW = 100 kHz
- Set the video bandwidth (VBW) ≥ 3 x RBW
- Detector = Peak
- Trace mode = Max hold
- Sweep = Auto couple
- Allow the trace to stabilize
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### 8.4.2 Limits:

FCC §15.247(a)(1) and RSS-247 5.2(1)

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

### 8.4.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input |
|---|---|---|---|
| 22° C | 1 | GFSK continuous fixed channel | 3.3 VDC |

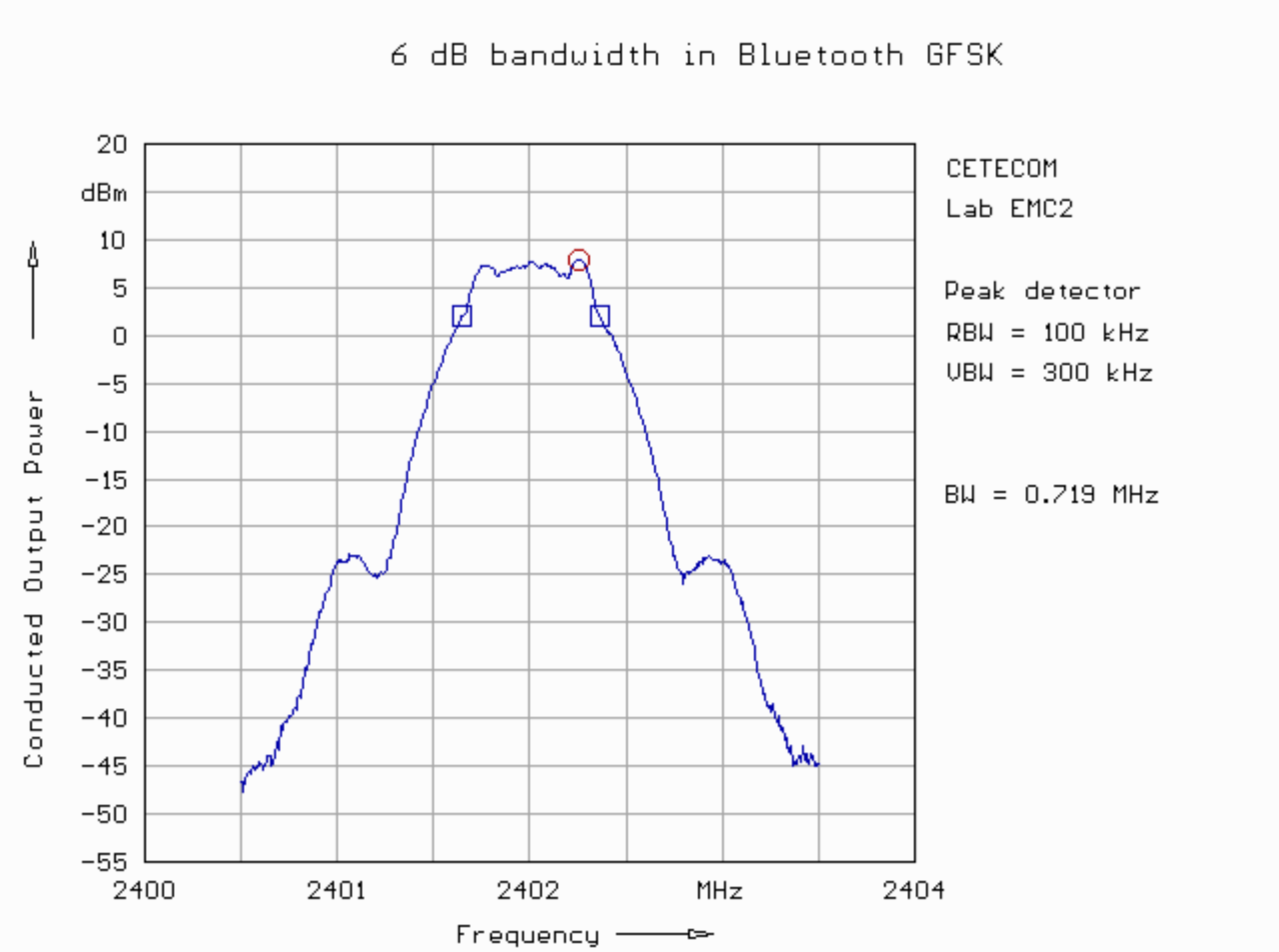
### 8.4.4 Measurement result:

| Plot # | Frequency (MHz) | 6 dB Emissions Bandwidth (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|
| 10 | 2402 | 0.719 | > 0.5 | Pass |
| 11 | 2442 | 0.708 | > 0.5 | Pass |
| 12 | 2480 | 0.718 | > 0.5 | Pass |

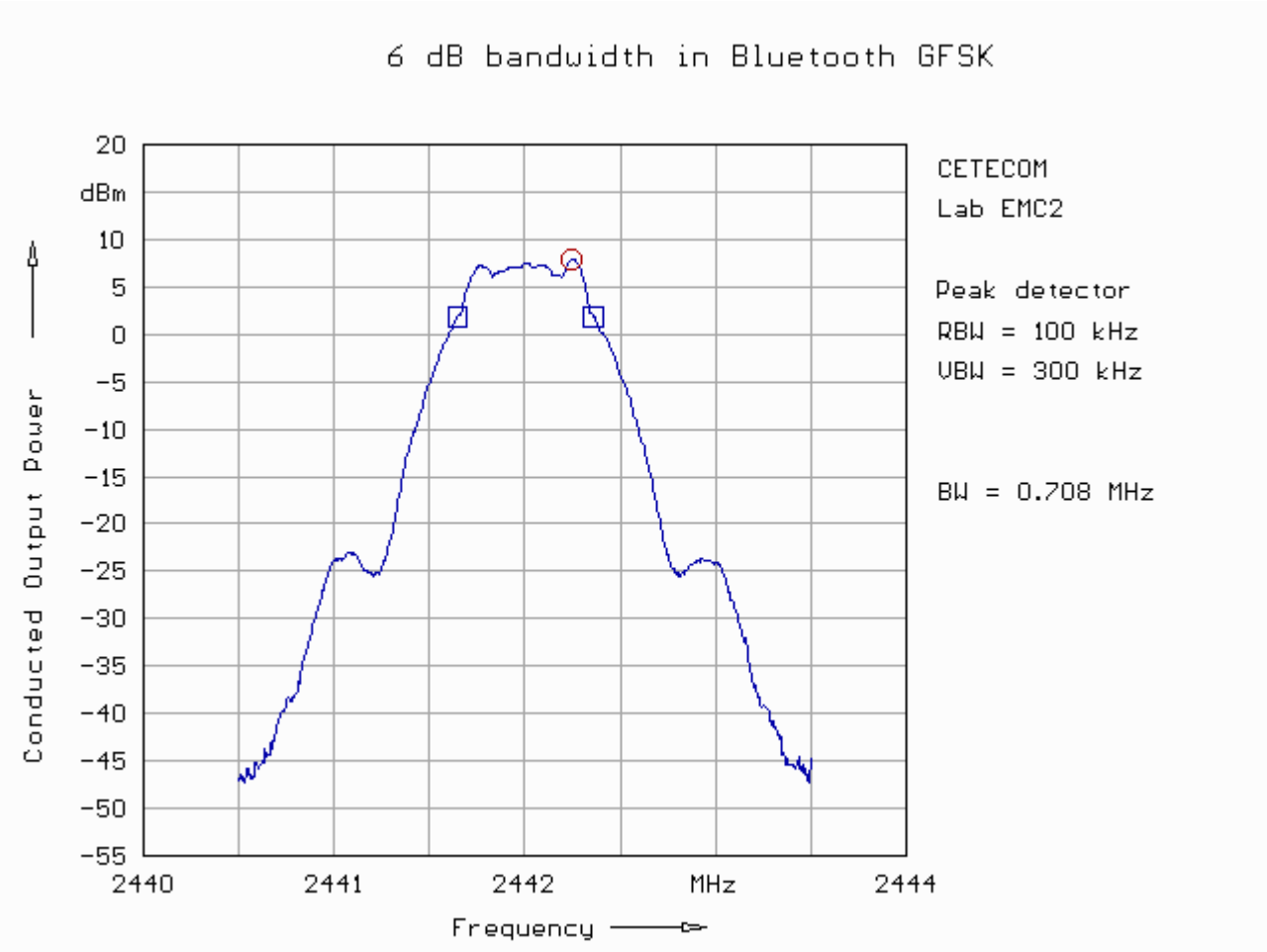
| Plot # | Frequency (MHz) | 99% Occupied Bandwidth (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|
| 13 | 2402 | 1.05 | > 0.5 | Pass |
| 14 | 2441 | 1.04 | > 0.5 | Pass |
| 15 | 2480 | 1.04 | > 0.5 | Pass |

### 8.4.5 Measurement Plots:

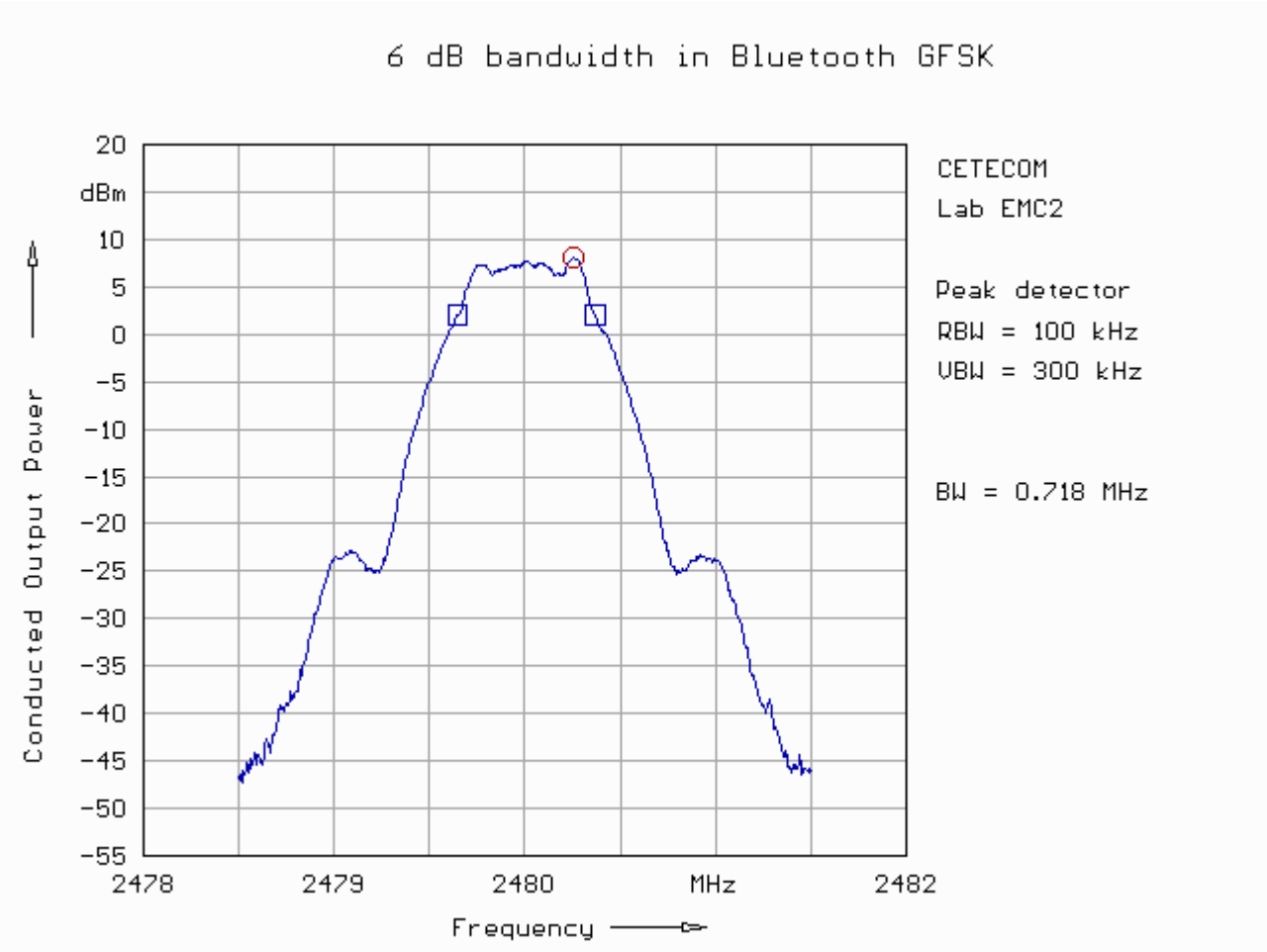
| Plot #10 | |
|---|---|
| Low channel | Mode: BTLE |



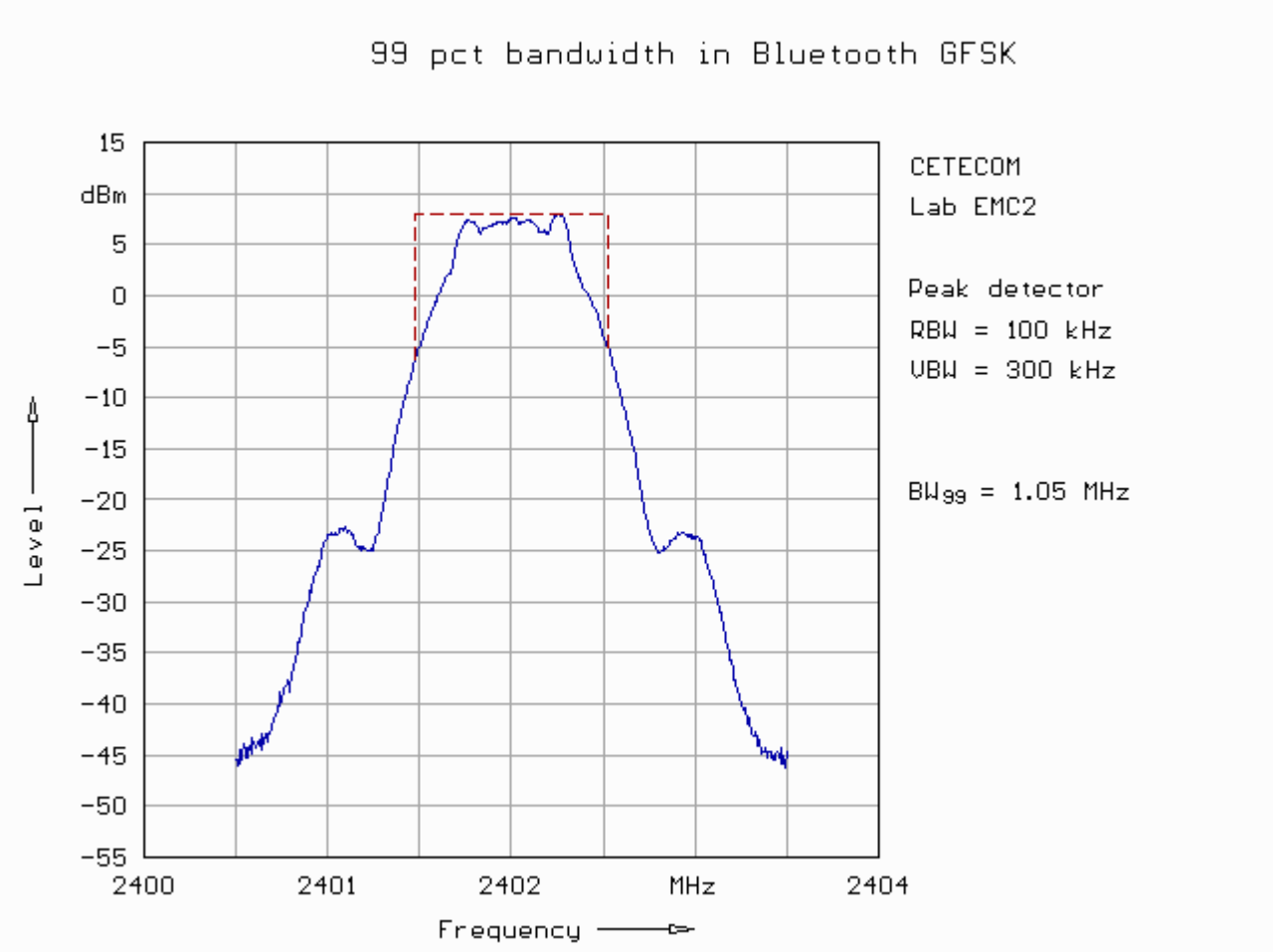
| Plot #11 | |
|---|---|
| Mid channel | Mode: BTLE |



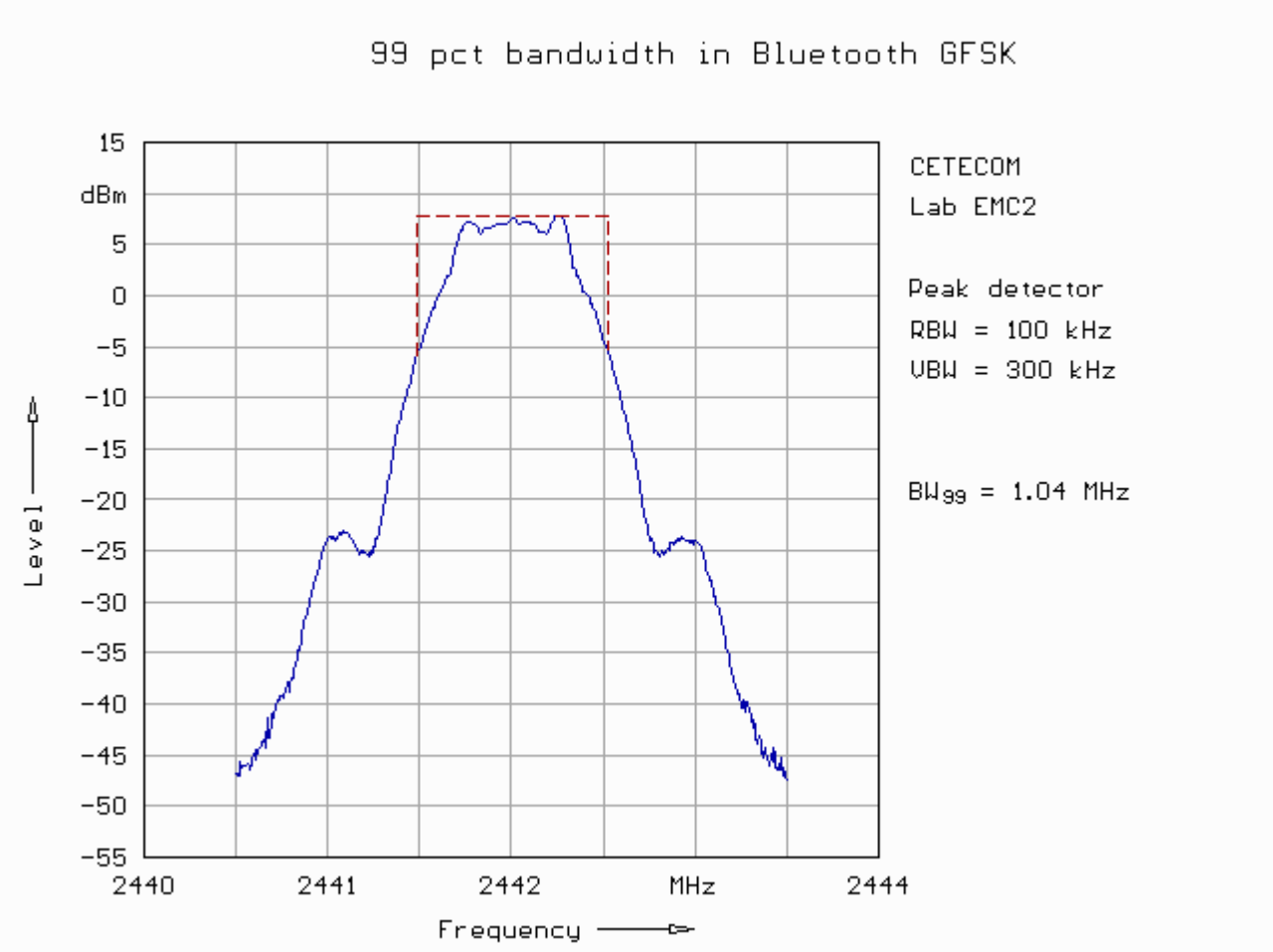
| Plot #12 | |
|---|---|
| High channel | Mode: BTLE |



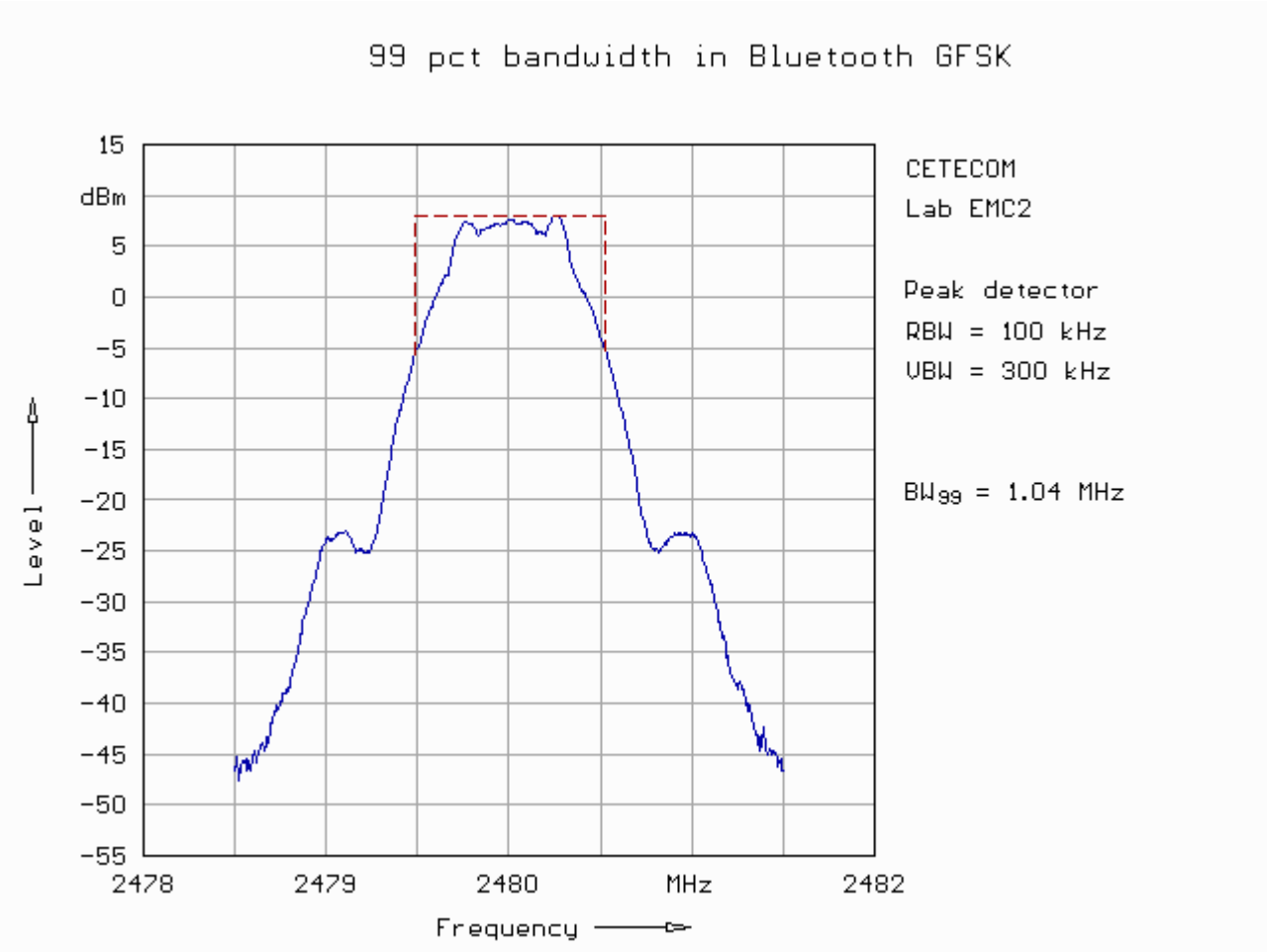
| Plot #13 | |
|---|---|
| Low channel | Mode: BTLE |



| Plot #14 | |
|---|---|
| Mid channel | Mode: BTLE |



| Plot #15 | |
|---|---|
| High channel | Mode: BTLE |



## 8.5 Radiated Transmitter Spurious Emissions and Restricted Bands

### 8.5.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = 40 log (D/d) = 40 log (300m / 3m) = 80dB

### 8.5.2 Limits:

FCC §15.247

- In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

FCC §15.209 & RSS-Gen 8.9

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency of emission (MHz) | Field strength (µV/m) | Measurement Distance (m) | Field strength @ 3m (dBµV/m) |
|---|---|---|---|
| 0.009–0.490 | 2400/F(kHz) / --------- | 300 | - |
| 0.490–1.705 | 24000/F(kHz) / -------- | 30 | - |
| 1.705–30.0 | 30 / (29.5) | 30 | - |
| 30–88 | 100 | 3 | 40 dBµV/m |
| 88–216 | 150 | 3 | 43.5 dBµV/m |
| 216–960 | 200 | 3 | 46 dBµV/m |
| Above 960 | 500 | 3 | 54 dBµV/m |

FCC §15.205 & RSS-Gen 8.10

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| [1]0.495-0.505 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.17725-4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.20725-4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475-156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2690-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3600-4400 | Above 38.6 |
| 13.36-13.41 | | | |

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
  *PEAK LIMIT= 74 dBµV/m
  *AVG. LIMIT= 54 dBµV/m

### 8.5.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input |
|---|---|---|---|
| 23° C | 2 | GFSK continuous fixed channel | 3.3 VDC |

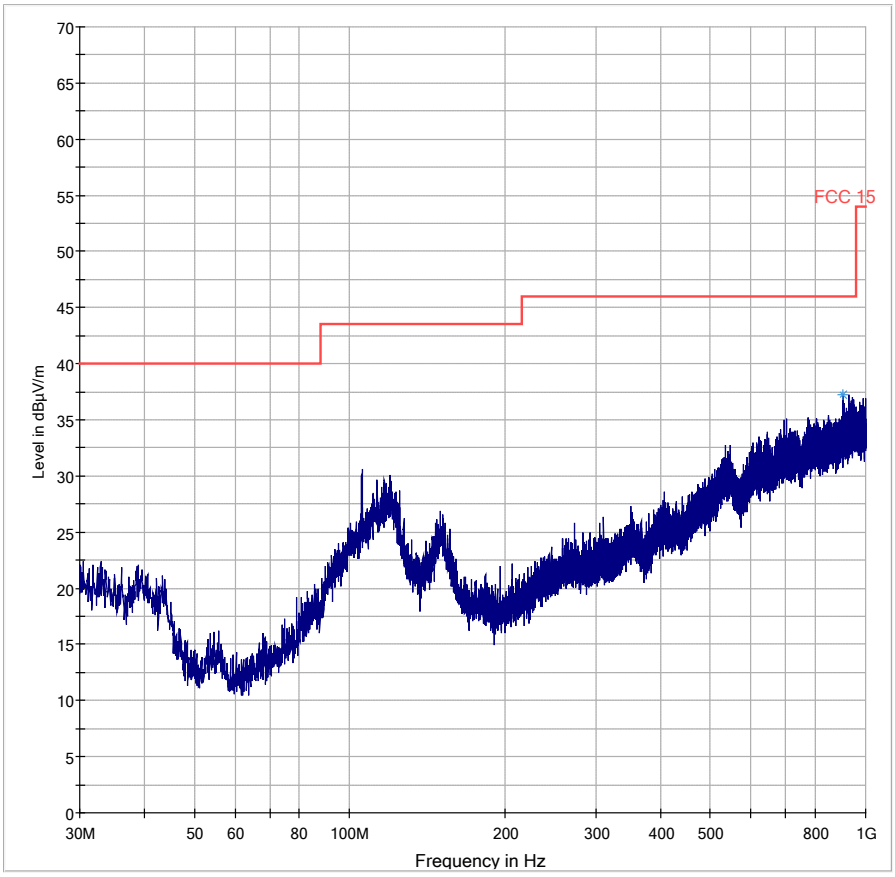
### 8.5.4 Measurement result:

| Plot # | Channel # | Scan Frequency | Limit | Result |
|---|---|---|---|---|
| 16-18 | Low | 30 MHz – 18 GHz | See section 8.5.2 | Pass |
| 19-23 | Mid | 9 kHz – 26 GHz | See section 8.5.2 | Pass |
| 24-26 | High | 30 MHz – 18 GHz | See section 8.5.2 | Pass |

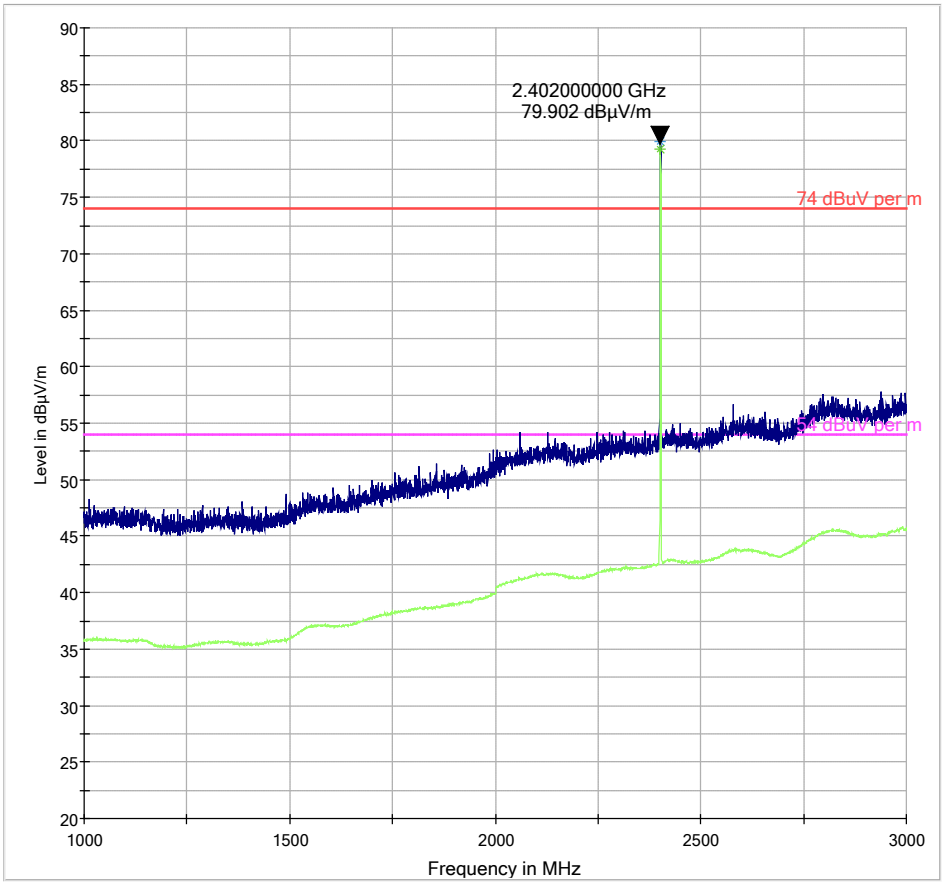
### 8.5.5 Measurement Plots:

Plot #16 Radiated Emissions: 30 MHz – 1GHz

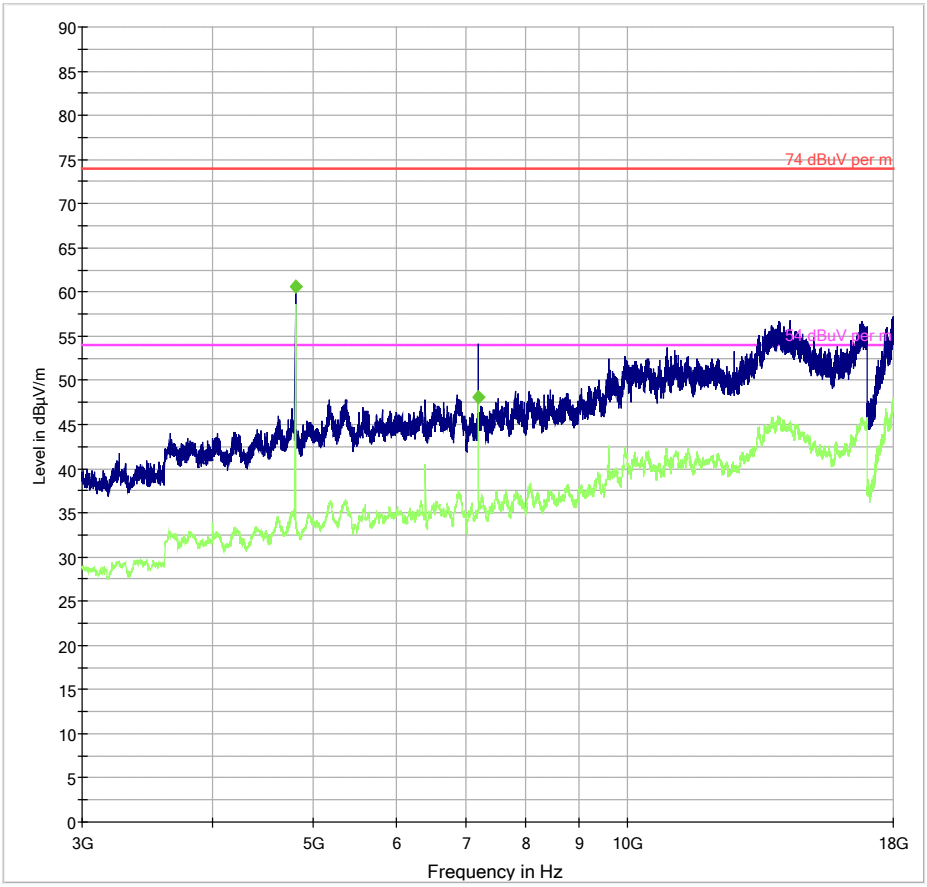
| Modulation: BT LE | Channel: Low | 100% Duty Cycle |
|---|---|---|



| Plot #97 Radiated Emissions: 1-3 GHz | | |
|---|---|---|
| Modulation: BT LE | Channel: Low | 100% Duty Cycle |



| Plot #18 Radiated Emissions: 3-18 GHz | | |
|---|---|---|
| Modulation: BT LE | Channel: Low | 100% Duty Cycle |

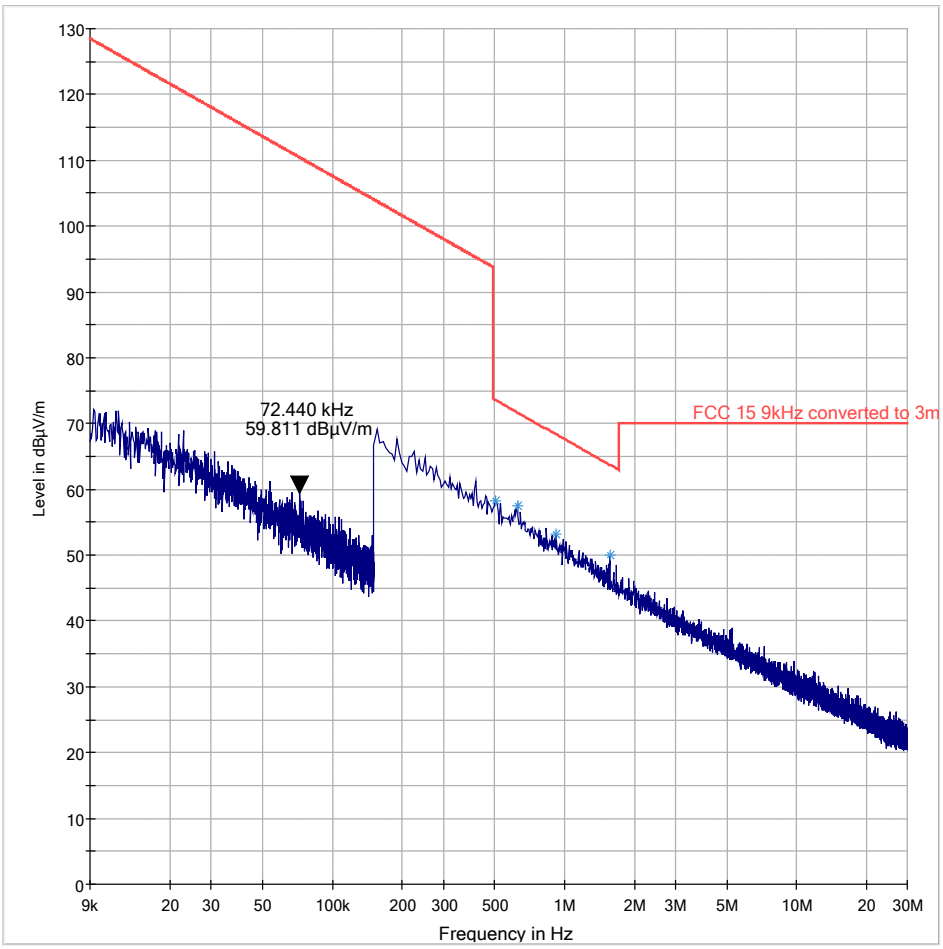



## Final Result 2

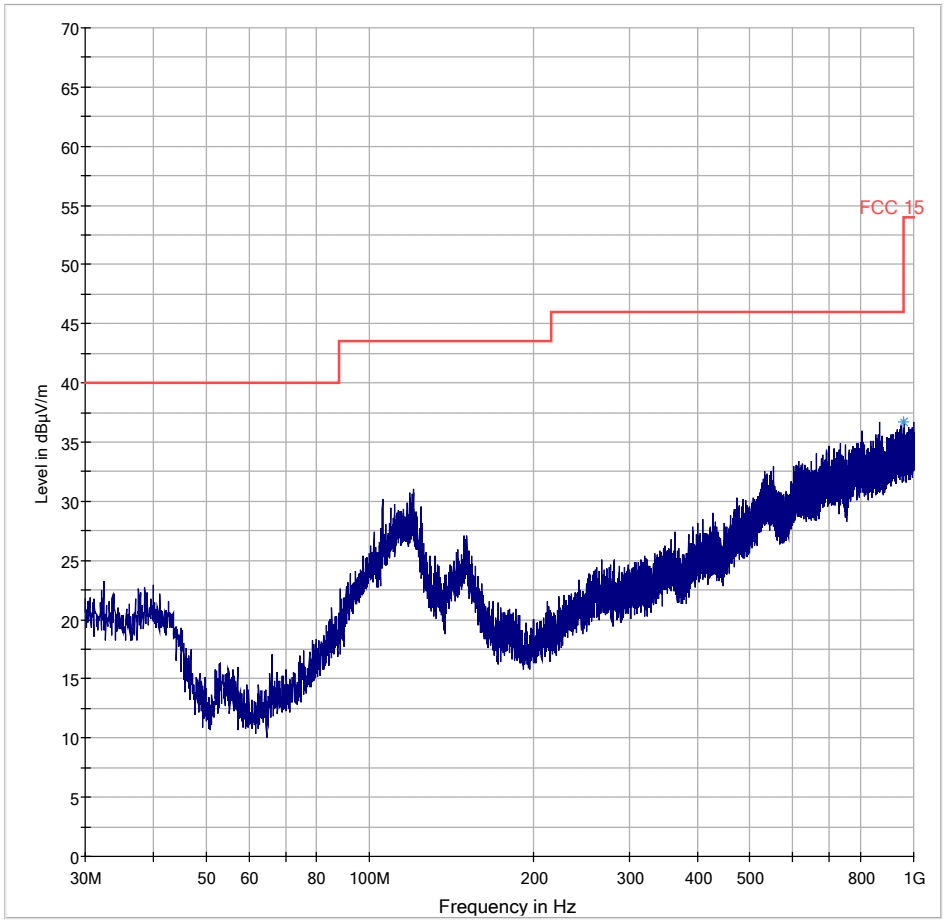
| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|---|---|---|---|---|---|---|---|---|---|
| 4804.000000 | 60.6 | 100.0 | 1000.000 | 225.0 | V | 23.0 | -19.6 | -6.6 | 54.0 |
| 7207.000000 | 48.1 | 100.0 | 1000.000 | 220.0 | V | 251.0 | -13.7 | 5.9 | 54.0 |

Note: According to FCC15.35(c), a duty cycle correction factor is applied here.
For BTLE advertising mode, maximum duty cycle will be 5%, which is 26dB. Hence this margin could cover the highest spurious above.

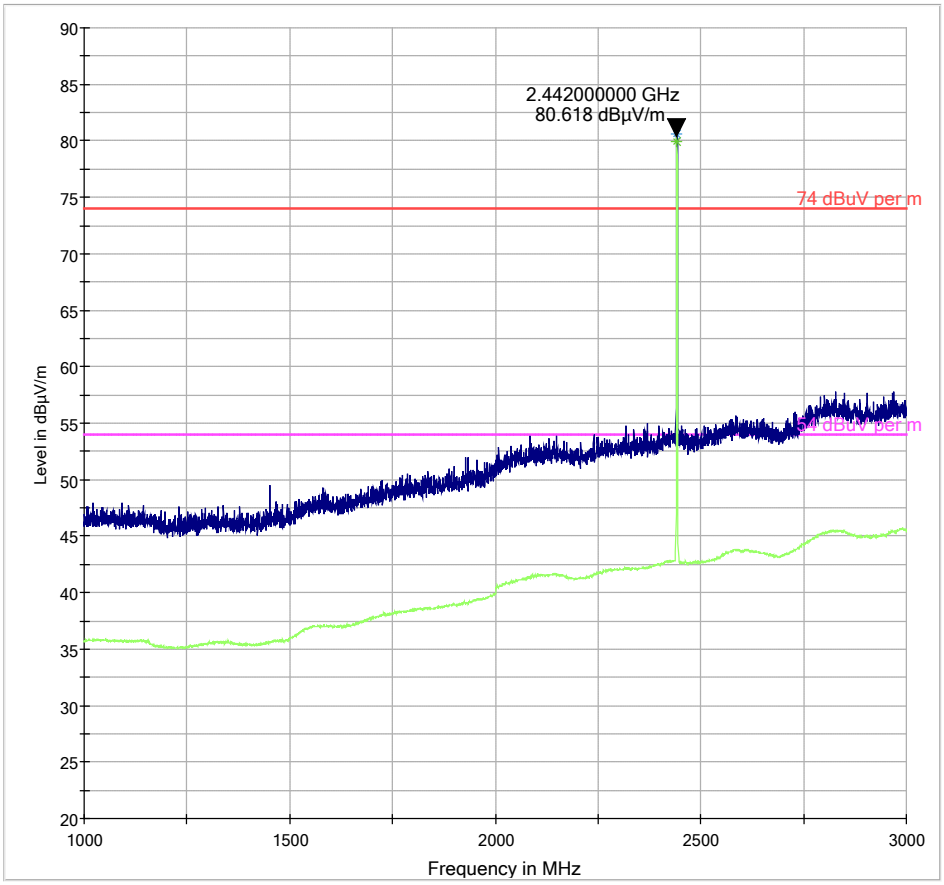
| Plot #10 Radiated Emissions: 9 KHz – 30 MHz | | |
|---|---|---|
| Modulation: BT LE | Channel: Mid | 100% Duty Cycle |



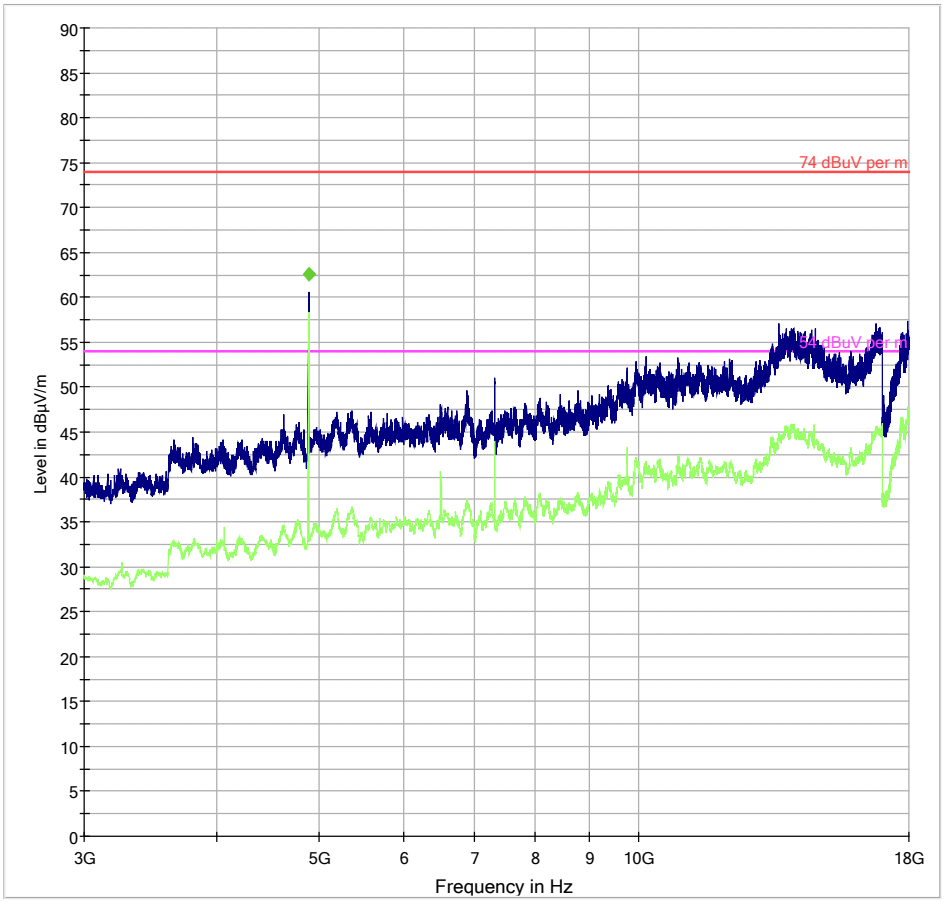
| Plot #20 Radiated Emissions: 30 MHz – 1GHz | | |
|---|---|---|
| Modulation: BT LE | Channel: Mid | 100% Duty Cycle |



| Plot #21 Radiated Emissions: 1-3 GHz | | |
|---|---|---|
| Modulation: BT LE | Channel: Mid | 100% Duty Cycle |



| Plot #22 Radiated Emissions: 3-18 GHz | | |
|---|---|---|
| Modulation: BT LE | Channel: Mid | 100% Duty Cycle |

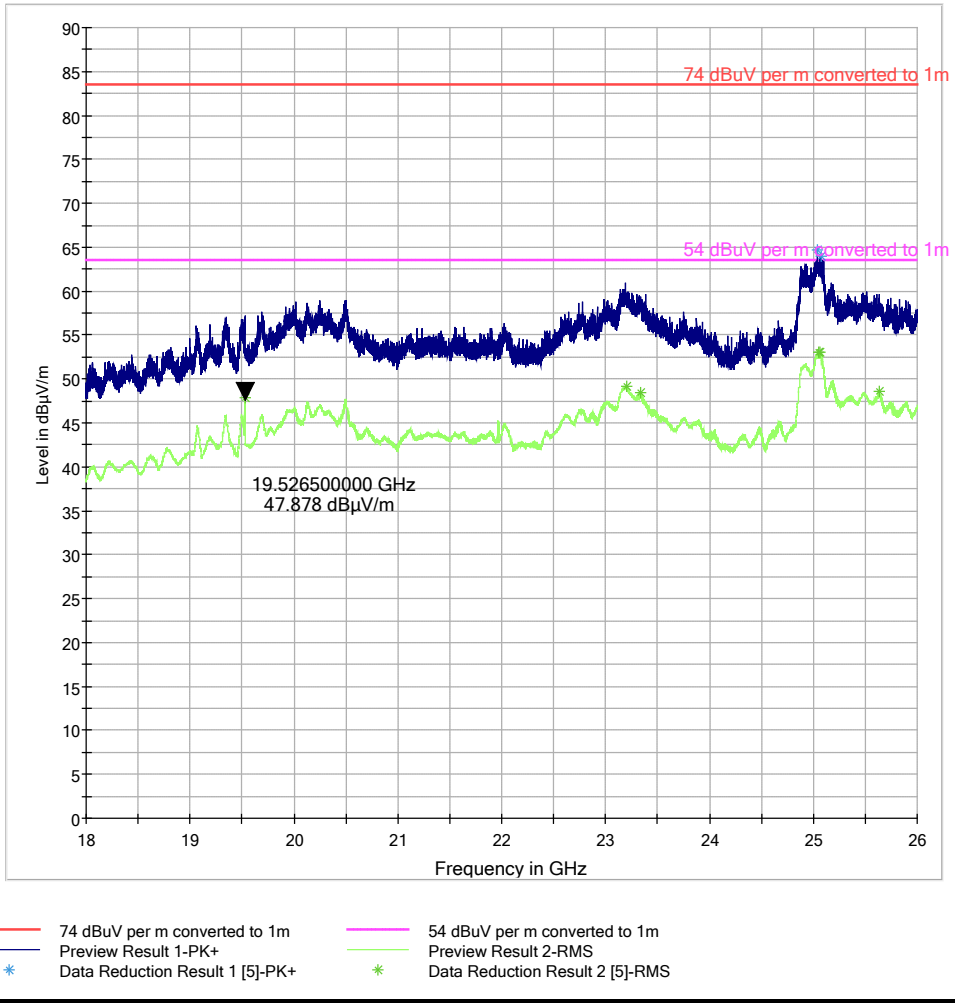



## Final Result 2

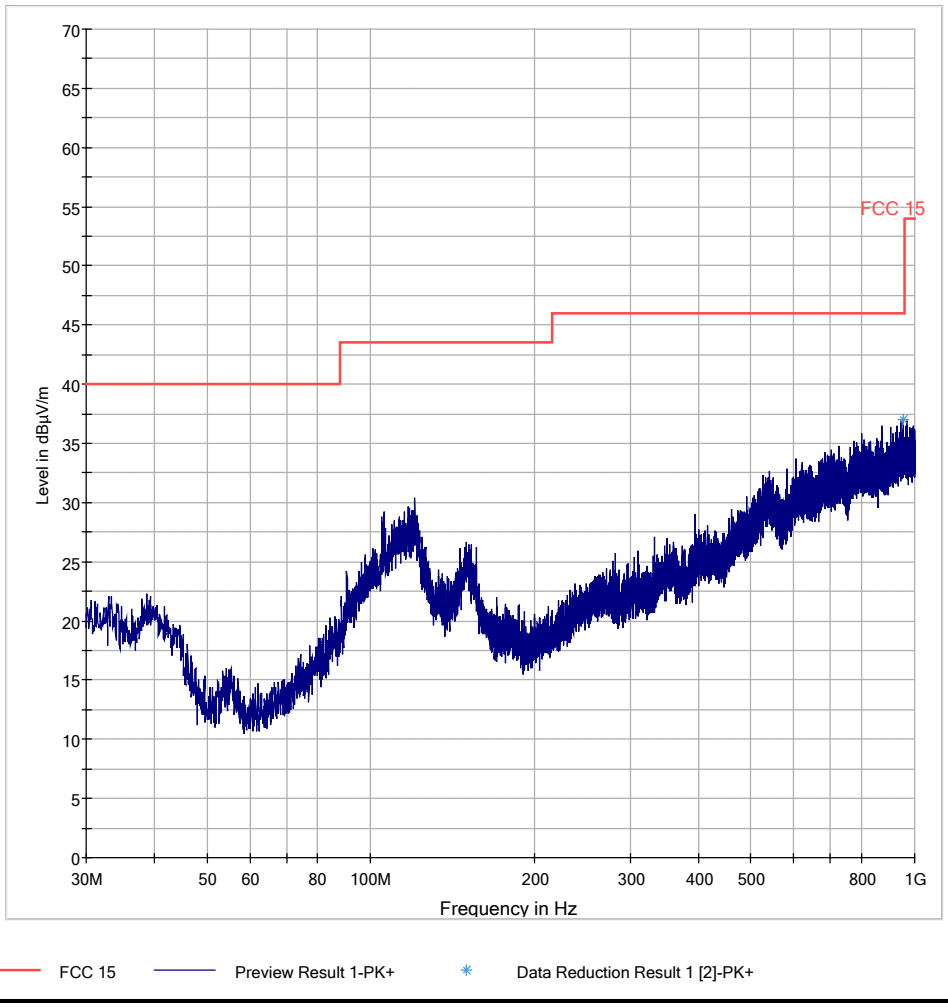
| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|---|---|---|---|---|---|---|---|---|---|
| 4884.000000 | 62.6 | 100.0 | 1000.000 | 225.0 | V | 32.0 | -20.0 | -8.6 | 54.0 |

Note: According to FCC15.35(c), a duty cycle correction factor is applied here.
For BTLE advertising mode, maximum duty cycle will be 5%, which is 26dB. Hence this margin could cover the highest spurious above.

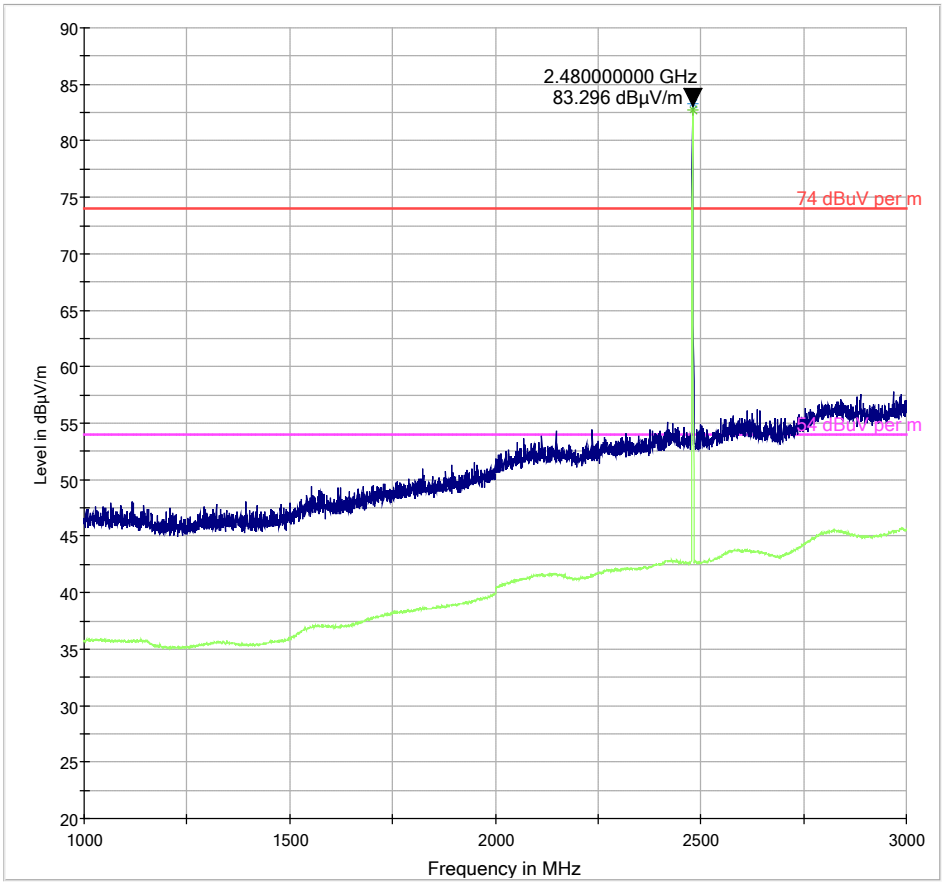
| Plot #23 Radiated Emissions: 18-26 GHz | | |
|---|---|---|
| Modulation: BT LE | Channel: Mid | 100% Duty Cycle |



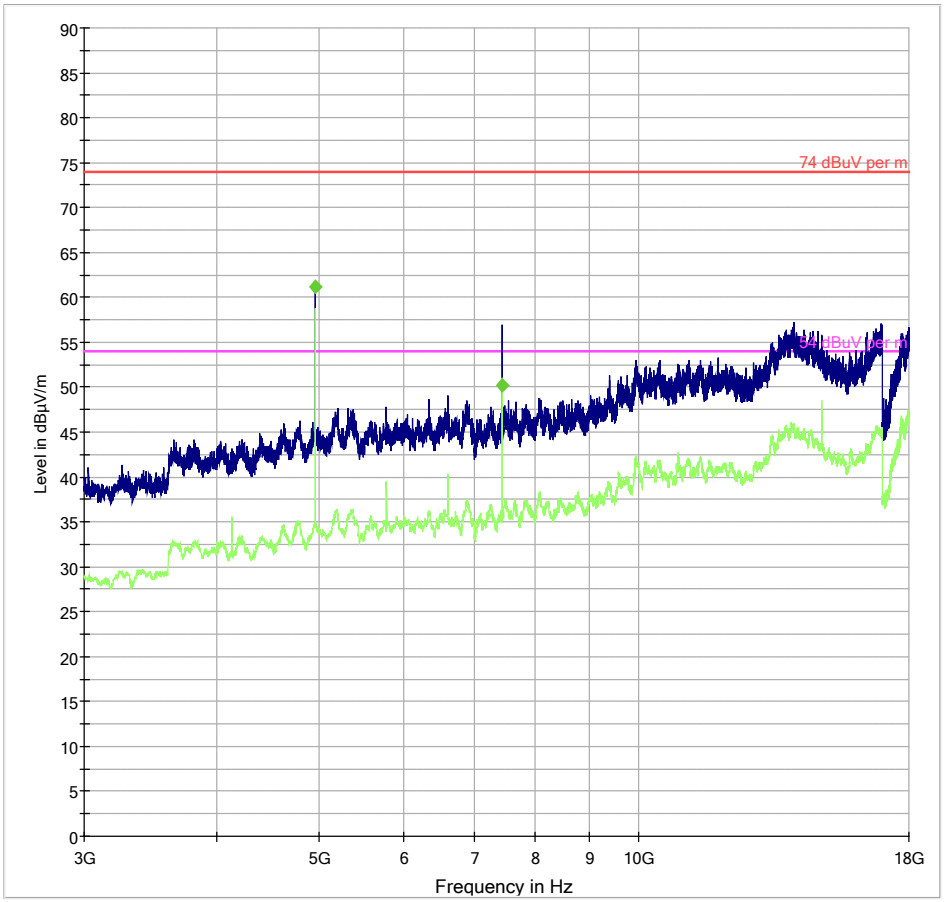
| Plot #25 Radiated Emissions: 30 MHz – 1GHz | | |
|---|---|---|
| Modulation: BT LE | Channel: High | 100% Duty Cycle |



| Plot #25 Radiated Emissions: 1-3 GHz and Restricted Bands | | |
|---|---|---|
| Modulation: BT LE | Channel: High | 100% Duty Cycle |



| Plot #26 Radiated Emissions: 3-18 GHz | | |
|---|---|---|
| Modulation: GFSK | Channel: High | 100% Duty Cycle |




## Final Result 2

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|---|---|---|---|---|---|---|---|---|---|
| 4960.000000 | 61.1 | 100.0 | 1000.000 | 220.0 | V | 34.0 | -19.4 | -7.1 | 54.0 |
| 7441.000000 | 50.2 | 100.0 | 1000.000 | 219.0 | V | 267.0 | -12.5 | 3.8 | 54.0 |

Note: According to FCC15.35(c), a duty cycle correction factor is applied here.
For BTLE advertising mode, maximum duty cycle will be 5%, which is 26dB. Hence this margn could cover the highest spurious above.

## 8.6 AC Power Line Conducted Emissions

### 8.6.1 Measurement according to ANSI C63.10 (2013)

Analyzer Settings:

- RBW = 9 KHz (CISPR Bandwidth)
- Detector: Peak / Average for Pre-scan
- Quasi-Peak/Average for Final Measurements

### 8.6.2 Limits: §15.207 & RSS-Gen 8.8

FCC §15.207(a) & RSS-Gen 8.8

- Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between frequency ranges.

| Frequency of emission (MHz) | **Conducted limit (dBμV)** | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15–0.5 | 66 to 56* | 56 to 46* |
| 0.5–5 | 56 | 46 |
| 5–30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

### 8.6.3 Test conditions and setup:

| Ambient Temperature © | EUT Set-Up # | EUT operating mode | Power line (L1, L2, L3, N) | Power Input |
|---|---|---|---|---|
| 22 | 3 | BT LE continuous fixed channel | Line & Neutral | 110V / 60Hz |

### 8.6.4 Measurement Result:

| Plot # | Port | EUT Set-Up #: | EUT operating mode | Scan Frequency | Limit | Result |
|---|---|---|---|---|---|---|
| 27 | AC Mains | 3 | BT LE continuous fixed channel | 150 kHz – 30 MHz | See section 8.6.2 | Pass |

### 8.6.5 Measurement Plots:

Plot #27

## EUT Information

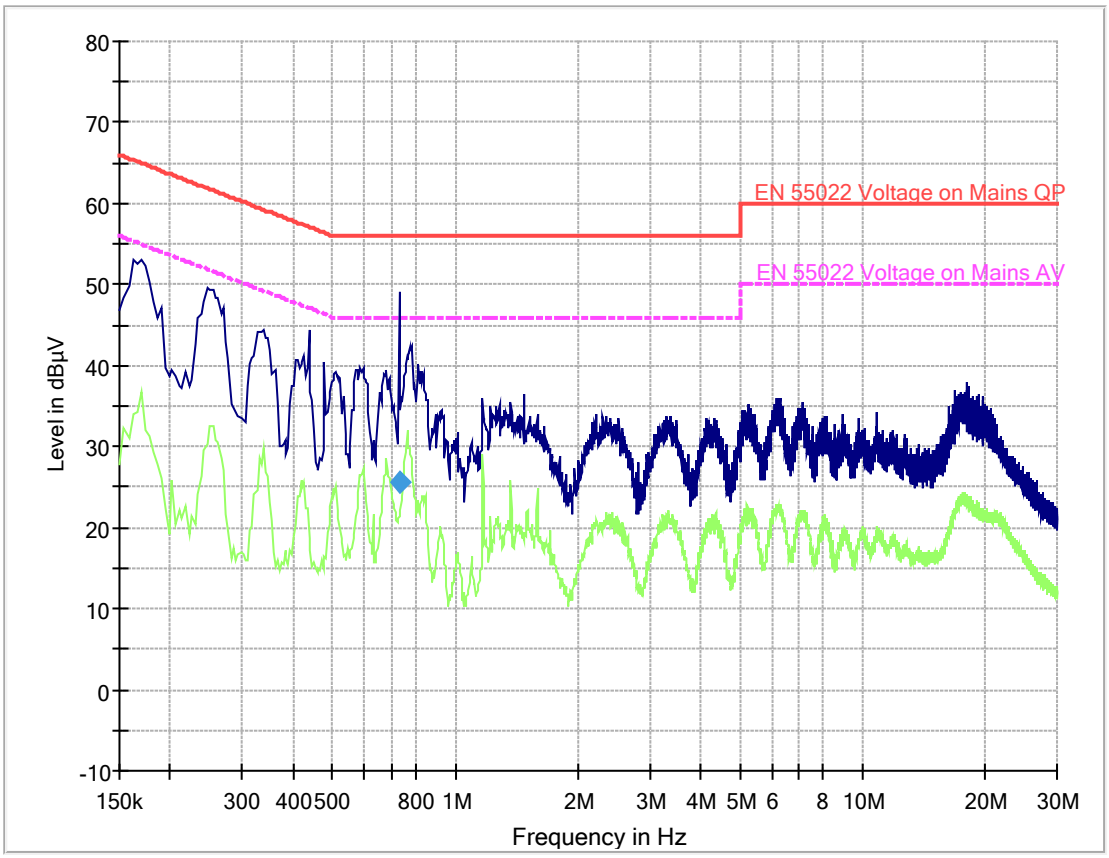
EUT Name: BL871E2-HI
Manufacturer: Telit

## Final Result 1

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|---|---|
| 0.730000 | 25.7 | 500.0 | 9.000 | GN | N | 0.5 | 30.3 | 56.0 | |

*Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.*

CISPR 22 Mains Conducted FCC_LISN




EN 55022 Voltage on Mains QP
Preview Result 1-PK+
Final Result 1-QPK
EN 55022 Voltage on Mains AV
Preview Result 2-AVG

## 9 Test setup photos

Setup photos are included in supporting file name: "EMC_TELIT_005_17001_15.247_BT_Setup_Photos.pdf"

## 10 Test Equipment And Ancillaries Used For Testing

| Equipment Type | Manufacturer | Model | Serial # | Calibration Cycle | Last Calibration Date |
|---|---|---|---|---|---|
| Biconlog Antenna | EMCO | 3142E | 166067 | 3 years | 6/28/2017 |
| Loop Antenna | ETS Lindgren | 6507 | 161344 | 3 years | 2/13/2015 |
| Horn Antenna | EMCO | 3115 | 35111 | 3 years | 7/24/2015 |
| Horn Antenna | ETS Lindgren | 3116 | 70497 | 3 years | 7/22/2015 |
| Compact Digital Barometer | Control Company | 35519-055 | 91119547 | 2 Years | 6/20/2017 |
| Spectrum Analyzer | R&S | FSU26 | 200065 | 3 years | 7/3/2017 |
| Spectrum Analyzer | R&S | FSU26 | 200302 | 3 years | 7/4/2015 |
| LISN Line Impedance Stabilization Network | FCC | FCC-LISN-50-25-2-08 | 8014 | 1 Year | 11/10/2016 |
| Thermometer Humidity | Dickson | TM320 AY1072 | 0528 | 1 Year | 11/2/2016 |

Note: Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

## 11 Revision History

| Date | Report Name | Changes to report | Report prepared by |
|---|---|---|---|
| 09/15/2017 | EMC_TELIT-005-17001_15.247_BT_DTS | Initial version | Cindy Li |