GENTEX CORPORATION

# Technical Report to the FCC and ISED Regarding Gentex Corporation

## Model: eSight-01
## FCC ID: NZLESIGHT01
## ISED: 4112A-ESIGHT01

## Emission Designator: 2M11L1D
## 9/11/2024

A report concerning approval for Gentex Corporation Homelink® model eSight-01
Please issue grant immediately upon review.


Measurements Made and Report Prepared by:

Patricia Szeszulski
Digitally signed by Patricia Szeszulski
Date: 2024.09.24 09:23:41 -04'00'

Patricia Szeszulski
Laboratory Validation Engineer I
Gentex Corporation

Measurements Reviewed by:

Daniel Brasier
Digitally signed by Daniel Brasier
Date: 2024.09.24 09:50:42 -04'00'

Dan Brasier
Laboratory Development Engineer II
Gentex Corporation

Report Submitted by:

brian.miller
Digitally signed by brian.miller
Date: 2024.09.11 07:44:39 -04'00'

Brian Miller
Laboratory Group Leader – Regulatory II
Gentex Corporation

Report Approved by:

Jason Vargo Laboratory Lab Manager I
Digitally signed by Jason Vargo Laboratory Lab Manager I
Date: 2024.09.24 09:38:59 -04'00'

Jason Vargo
Laboratory Manager I
Gentex Corporation

# Test Report Revision

| REV Number | Date | Author | Description |
|---|---|---|---|
| **1.0** | 6/19/2024 | Patricia Szeszulski | Initial Release |
| **2.0** | 8/15/2024 | Patricia Szeszulski | Updated per reviewer comments |
| **3.0** | 8/22/2024 | Patricia Szeszulski | Updated table on page 45 updated RSS-247 to issue 3. |
| | | | |

Results relate only to the items tested as received.

Compliance has been evaluated based on the Lab Manual section 7.6.2. The decision rule used regarding measurement uncertainty was to determine results solely on whether the measured values met the defined acceptance criteria without factoring in measurement uncertainty values.

# 1. General Information

## 1.1. Product Description

The product is a handheld wireless Bluetooth remote control operating in the 2402 to 2480 MHz band using an integral antenna. The remote is used to issue and receive commands and is powered via two AAA batteries.

The antenna system is an integral part of the unit. It cannot be altered nor replaced by the user.

## 1.2. Related Grants

This device will have functionality that is covered under 47 CFR 15 B. The device will have an FCC ID # of NZLESIGHT01 and an ISED ID # of 4112A-ESIGHT01 under both rule parts. Separate reports were submitted for functionality covered under 47 CFR 15 B requirements.

## 1.3. Test Methodology

Radiated Emissions testing was performed according to ANSI C63.10:2013. The power source for this product is two AAA batteries.

Conducted measurements were performed using the same power source.

Measurements were performed per FCC OET KDB 558074.

## 1.4. Test Facility

The 3-meter semi-anechoic chamber where these measurements were taken, is located on the grounds of Gentex Corporation's Corporate Labs, in the city of Zeeland, county of Ottawa, state of Michigan, United States of America.

For radiated measurements above 1 GHz, RF absorbing material is placed between the antenna and EUT in accordance with ANSI C63.4:2014 Section 5.5 and chamber manufacturer's instructions.

The 3m chamber has been added to our A2LA scope of accreditation on 05/20/2016 and includes accreditation to ANSI C63.4:2014 and ANSI C63.10:2013. The report filed with ISED, dated February 11, 2015, was accepted via a letter dated February 11, 2015. Our 3m chamber is registered with the ISED under Site# 4112A-2 and FCC under registration number 357351.

| Corporate Mailing/Shipping Address | Site Address |
|---|---|
| Gentex Corporation | Gentex Corporation |
| 600 N. Centennial Street | 380 Riley Street |
| Zeeland, MI 49464 | Zeeland, MI 49423 |

## 1.5. Accreditation

The Gentex Corporate EMC Lab is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation (A2LA). Our laboratory scope and accreditation certificate #2529.01 are available from their web site www.a2la.org. Our scope of accreditation covers ANSI C63.4:2014, ANSI C63.10:2013, and Radiated Emissions at 3m, FCC 47 CFR Part 15, ISED RSS-210, and ISED RSS-247 Issue 3.

# 2. Product Labeling

## 2.1. Identifiers

The FCC Identifier assigned is FCC ID: NZLESIGHT01. The ISED certification number is 4112A-ESIGHT01. These identifiers will be labeled on the product housing.

The label will be placed within the battery compartment on the non-removable portion of the device.

Because of the small size of the device, the following statements will appear in the user's manual. Refer to attachment "Users Manual.pdf" for the entire text of the user's manual.

> "This device complies with FCC rules Part 15 and with ISED RSS-247 Issue 3. Operation is subject to the following two conditions:
> (1) This device may not cause harmful interference,
> (2) This device must accept any interference that may be received including interference that may cause undesired operation.
>
> WARNING: The transmitter has been tested and complies with FCC and ISED rules. Changes or modifications not expressly approved by the party responsible for the compliance could void the user's authority to operate the device."

The term "ISED:" before the certification/registration number only signifies that ISED technical specifications were met.

ISED: 4112A-ESIGHT01 FCC ID: NZLESIGHT01 MODEL: eSight-01

## 2.2. Label Drawing and Location on Product

The label drawing and location of the label on the assembly is included in the "Label Location.pdf" attachment.

# 3. Test Configuration

Radiated Emission measurements presented in the report were made in accordance with ANSI C63.10:2013. The EUT was placed on a 1 x 1.5m non-metallic table elevated 80cm above a conducting ground plane for measurements below 1GHz and elevated to 1.5m for measurements above 1GHz.

For radiated measurements above 1 GHz, RF absorbing material is placed between the antenna and EUT in accordance with ANSI C63.4:2014 Section 5.5 and chamber manufacturer's instructions.

For conducted measurements, a non-metallic table approximately 80cm x 90cm, 85cm above the floor was used.

# 4. Powerline Conducted Emissions Measurements

Powerline Conducted Measurements are not required for this product as the part is powered via two AAA batteries.

# Emissions Data

## 4.1. Date(s) Tested: 8/12/2024-8/14/2024

## 4.2. Test Method Deviations: None

## 4.3. Temperature and Humidity conditions

| | Measured Value | Unit |
|---|---|---|
| Temperature | 22.1-23 | ºC |
| Humidity | 43.8-46.7 | %R.H. |

| Measurement | | Margin | Frequency | Mode |
|---|---|---|---|---|
| Worst Case Spurious Emission | 50.08 dBuV/m | 3.92 dB | 4960 MHz | LE 2M |
| Maximum Peak Conducted Output Power | 7.73 dBm | 22.27dB | 2440 MHz | LE 2M |
| Maximum 6dB Bandwidth | 724 kHz | 224 kHz | 2402 MHz | LE 1M |
| Maximum 99% bandwidth | 2.11 MHz | - | 2440 MHz | LE 2M |
| Maximum Power Spectral Density | 7.59 dBm | 0.41 dB | 2440 MHz | LE 1M |

## 4.4. Summary of Results (Part 15.247)

- **DTS (6dB) Bandwidth:** Per FCC 15.247(a)(2) and RSS-247 paragraph 5.2 (a), the minimum 6dB bandwidth shall be at least 500kHz for all systems using digital modulation techniques.
- **Band Edge Measurement Requirement:** Per section 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).

- **Measurement Uncertainty:** The standard uncertainty of measurement has been determined in accordance with the ISO Guide to the Expression of Uncertainty in Measurements. The estimation of measurement uncertainty reported is the expanded uncertainty for a coverage factor of k=2.26 and confidence interval of approximately 95%.

Expanded Uncertainty $U_{(k=2.26)}$ is as follows:

- Radiated Emissions – Bicon (30-250 MHz): 4.1 dB
- Radiated Emissions – LPA (250-1000 MHz): 5.0 dB
- Radiated Emissions – DRWG (26.5 GHz): 4.2 dB
- Conducted Emissions: 1.04 dB
- Frequency: 0.007 ppm

## 4.5. Test Equipment Setup and Procedure

### 4.5.1. Test Equipment

| Equipment used | | | |
|---|---|---|---|
| **ID / Serial #** | **Manufacturer** | **Description** | **Cal / PM Due Date** |
| 6595 | Rohde and Schwarz | EMI Receiver | 11/13/2024 |
| CF GCL | Megaphase/Pasternack | 3m Chamber Port and Cables | 4/30/2025 |
| 8893 | Com-Power | AH-118 Horn | 4/22/2027 |
| H6192 | EMCO | 3148 Log Periodic RX | 5/13/2027 |
| 7257 | ETS-Lindgren | Model 3116C 10-40GHx | 5/10/2025 |
| Tower 2 | ETS-Lindgren | 2171B Boresight Tower | VBU |
| PJ2246 | ETS-Lindgren | Shielded Enclosure | 9/30/2024 |
| 8292 | Omega | iBTHX-W Virtual | 10/2/2024 |
| HL5 Transceiver-GCL | Gentex | Default Receiver | VBU |
| 6539 | Stanley | Tape Measure | 6/19/2026 |
| H4554 | 87V | Multimeter | 1/11/2025 |
| S/N:419726 | AIM TTI | PL303-P | VBU |
| S/N:2053240 | Miteq | AMF-4D-00501800-24-10P | 12/31/2024 |
| SW30 | Gentex | 3m Chamber Software | 3/31/2025 |
| SW48 | Gentex | Gentex Emissions Measurement Software | 3/31/2025 |
| CBL146 | Megaphase | EMC2-S1S1-72 | 10/31/2024 |
| CBL 119 | Megaphase | KB18-N1S1-36 | 4/30/2025 |
| CBL 149 | Megaphase | GC19-S1S1-72 | 10/31/2024 |
| S/N:2053240 | Miteq | AMF-4D-00501800-24-10P | 10/21/2024 |
| AT25 | Pasternack | PE7004-3, 3dB fixed, DC - 18GHz, 2W | 1/31/2025 |
| AT30 | Pasternack | PE7004-3, 3dB fixed, DC - 18GHz, 2W | 1/31/2025 |
| FLT009 | Mini-Circuits | ZHFG-K4000+ High Pass Filter 4500 to 18000MHz | VBU |

## 4.5.2. Test Equipment Setup and Procedure

EMI Receiver Settings Emissions:

| | |
|---|---|
| Detector Function | : Peak |
| Resolution Bandwidth | :100kHz (below 1GHz) |
| | :1MHz (above 1GHz) |
| Video Bandwidth: | :300kHz (below 1GHz) |
| | :3MHz (above 1GHz) |

EMI Receiver (in Spectrum Analyzer mode) Settings Occupied Bandwidth:

| | |
|---|---|
| Detector | : Peak |
| Resolution Bandwidth | :1 MHz (to determine peak level) |
| | :10 kHz (to determine occupied bandwidth) |
| Video Bandwidth | :3 MHz (to determine peak level) |
| | :30 kHz (to determine occupied bandwidth) |

Spectrum Analyzer Settings for Conducted measurements:

| | |
|---|---|
| Detector Function | : Peak |
| Resolution Bandwidth | :120kHz (below 1GHz) |
| | :1MHz (above 1GHz) |
| Video Bandwidth: | :300kHZ (below 1GHz) |
| | :3MHz (above 1GHz) |

For the testing, the EUT was placed at the center of a non-conducting table 80cm above the ground plane pursuant to ANSI C63.10:2013 for stand-alone equipment.

Equipment is placed in all three orthogonal orientations, End, Side, and Flat. These orientations are described below in Figure 6.2.3. See setup photos for further information.

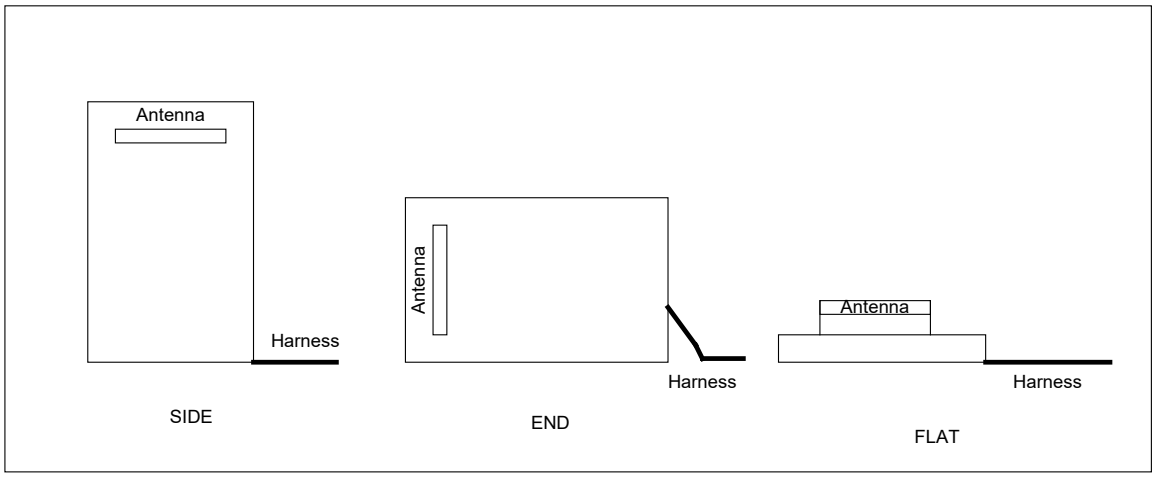



**Figure 6.2.3 EUT Orthogonal Orientations**

While in the prescribed orientation, the vertical antenna positioner sweeps in elevation from 1 to 4m in height until the operator finds the peak. The 3m turntable is then rotated through 360 degrees until a peak is found. The table is stopped at the peak location and the peak in elevation re-verified. Procedure is repeated for applicable

orientations/measurement antenna polarizations. Radiated testing was performed in all three orientations.

### 4.6. Measured Data – See Appendix A

# 5. Formulas and Sample Calculations

## 5.1. Calculation of ISED Limits from RSS-247 and 47 CFR Part 15.247

The Peak Tx Spurious Emissions limit for the fundamental is given by:
Limit dBuV/m= 1W ERP = 127.38 dBuV/m, which is the fundamental limit.

The Rx Spurious Emissions limit for the fundamental is given by:
Limit dBuV/m= 20*Log(200uV/m) =46.0dBuV/m

The Rx Spurious Emissions limit for the harmonics is given by**:**
Limit dBuV/m= 20*Log(500uV/m) =54.0dBuV/m

# Appendix A

## 1. Radiated (Tx) Measurements

### 1. DUT Transmitting at 2402MHz (Fundamental)

**Peak/Average Measurement - 2402MHz Mode LE 1M**

| Frequency (MHz) | Orientation (Flat/End/Side) | Measurement Polarization (H/V) | Peak Measurement (dBuV/m) | Peak Limit (dBuV/m) | Margin (dB) | Average Measurement (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2402 | Flat | H | 106.79 | 127.3 | 20.51 | 104.78 | - | - |
| 4804 | Side | V | 56.1 | 74.0 | 17.90 | 48.08 | 54.0 | 5.92 |
| 7206 | Flat | H | 53.9 | 74.0 | 20.10 | 41.22 | 54.0 | 12.78 |
| 9608 | Flat | 74 | 55.9 | 74.0 | 18.10 | 42.5 | 54.0 | 11.50 |
| 12010 | End | H | 59.91 | 74.0 | 14.09 | 47.42 | 54.0 | 6.58 |
| 14412 | End | V | 62.1 | 74.0 | 11.90 | 49.31 | 54.0 | **4.69** |
| 16814 | Flat | V | 55.27 | 74.0 | 18.73 | 42.32 | 54.0 | 11.68 |
| 19216 | End | V | 52.24 | 74.0 | 21.76 | 39.65 | 54.0 | 14.35 |
| 21618 | Flat | H | 50.81 | 74.0 | 23.19 | 39.24 | 54.0 | 14.76 |
| 24020 | Flat | V | 53.4 | 74.0 | 20.60 | 40.44 | 54.0 | 13.56 |

**Peak/Average Measurement - 2402MHz Mode LE 2M**

| Frequency (MHz) | Orientation (Flat/End/Side) | Measurement Polarization (H/V) | Peak Measurement (dBuV/m) | Peak Limit (dBuV/m) | Margin (dB) | Average Measurement (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2402 | Flat | H | 107.11 | 127.3 | 20.19 | 101.09 | - | - |
| 4804 | Flat | H | 55.8 | 74.0 | 18.20 | 45.96 | 54.0 | 8.04 |
| 7206 | Flat | V | 53.14 | 74.0 | 20.86 | 40.77 | 54.0 | 13.23 |
| 9608 | Flat | H | 55.05 | 74.0 | 18.95 | 42.53 | 54.0 | 11.47 |
| 12010 | Flat | V | 59.97 | 74.0 | 14.03 | 47.32 | 54.0 | 6.68 |
| 14412 | Flat | V | 61.83 | 74.0 | 12.17 | 49.36 | 54.0 | **4.64** |
| 16814 | End | V | 55.04 | 74.0 | 18.96 | 42.32 | 54.0 | 11.68 |
| 19216 | Side | H | 51.94 | 74.0 | 22.06 | 39.66 | 54.0 | 14.34 |
| 21618 | End | V | 50.68 | 74.0 | 23.32 | 39.29 | 54.0 | 14.71 |
| 24020 | End | V | 52.34 | 74.0 | 21.66 | 41.23 | 54.0 | 12.77 |

# DUT Transmitting at 2440MHz (Fundamental)

**Peak/Average Measurement - 2440MHz Mode LE 1M**

| Frequency (MHz) | Orientation (Flat/End/Side) | Measurement Polarization (H/V) | Peak Measurement (dBuV/m) | Peak Limit (dBuV/m) | Margin (dB) | Average Measurement (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2440 | Flat | H | 106.67 | 127.3 | 20.63 | 104.4 | - | - |
| 4880 | Flat | H | 58.07 | 74.0 | 15.93 | 49.8 | 54.0 | **4.20** |
| 7320 | Side | H | 53.14 | 74.0 | 20.86 | 40.97 | 54.0 | 13.03 |
| 9760 | End | V | 55.18 | 74.0 | 18.82 | 42.9 | 54.0 | 11.10 |
| 12200 | Flat | H | 60.11 | 74.0 | 13.89 | 47.68 | 54.0 | 6.32 |
| 14640 | Flat | H | 61.69 | 74.0 | 12.31 | 49.17 | 54.0 | 4.83 |
| 17080 | Flat | V | 55.41 | 74.0 | 18.59 | 42.84 | 54.0 | 11.16 |
| 19520 | Side | H | 52.16 | 74.0 | 21.84 | 39.58 | 54.0 | 14.42 |
| 21960 | Side | H | 51.37 | 74.0 | 22.63 | 38.73 | 54.0 | 15.27 |
| 24400 | Side | V | 54.14 | 74.0 | 19.86 | 42.87 | 54.0 | 11.13 |

**Peak/Average Measurement - 2440MHz Mode LE 2M**

| Frequency (MHz) | Orientation (Flat/End/Side) | Measurement Polarization (H/V) | Peak Measurement (dBuV/m) | Peak Limit (dBuV/m) | Margin (dB) | Average Measurement (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2440 | Flat | H | 107.06 | 127.3 | 20.24 | 102.01 | - | - |
| 4880 | Side | V | 57.63 | 74.0 | 16.37 | 48.64 | 54.0 | 5.36 |
| 7320 | Flat | V | 53.49 | 74.0 | 20.51 | 41.1 | 54.0 | 12.90 |
| 9760 | Side | V | 55.16 | 74.0 | 18.84 | 43.05 | 54.0 | 10.95 |
| 12200 | Flat | V | 61.14 | 74.0 | 12.86 | 47.49 | 54.0 | 6.51 |
| 14640 | Flat | H | 62.09 | 74.0 | 11.91 | 49.81 | 54.0 | **4.19** |
| 17080 | End | V | 56.97 | 74.0 | 17.03 | 42.83 | 54.0 | 11.17 |
| 19520 | End | H | 51.72 | 74.0 | 22.28 | 39.65 | 54.0 | 14.35 |
| 21960 | End | H | 51.43 | 74.0 | 22.57 | 38.8 | 54.0 | 15.20 |
| 24400 | End | V | 52.38 | 74.0 | 21.62 | 40.6 | 54.0 | 13.40 |

# DUT Transmitting at 2480MHz (Fundamental)

**Peak/Average Measurement - 2480MHz Mode LE 1M**

| Frequency (MHz) | Orientation (Flat/End/Side) | Measurement Polarization (H/V) | Peak Measurement (dBuV/m) | Peak Limit (dBuV/m) | Margin (dB) | Average Measurement (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2480 | Side | H | 106.41 | 127.3 | 20.89 | 104.12 | - | - |
| 4960 | Flat | H | 57.03 | 74.0 | 16.97 | 49.62 | 54.0 | **4.38** |
| 7440 | End | V | 54.01 | 74.0 | 19.99 | 41.38 | 54.0 | 12.62 |
| 9920 | Flat | V | 55.7 | 74.0 | 18.30 | 43.21 | 54.0 | 10.79 |
| 12400 | Side | V | 60.22 | 74.0 | 13.78 | 47.69 | 54.0 | 6.31 |
| 14880 | Side | V | 62.09 | 74.0 | 11.91 | 49.57 | 54.0 | 4.43 |
| 17360 | Flat | H | 55.64 | 74.0 | 18.36 | 42.8 | 54.0 | 11.20 |
| 19840 | Flat | V | 52.22 | 74.0 | 21.78 | 40.59 | 54.0 | 13.41 |
| 22320 | Side | V | 51.84 | 74.0 | 22.16 | 39.89 | 54.0 | 14.11 |
| 24800 | End | H | 53.24 | 74.0 | 20.76 | 40.85 | 54.0 | 13.15 |

**Peak/Average Measurement - 2480MHz Mode LE 2M**

| Frequency (MHz) | Orientation (Flat/End/Side) | Measurement Polarization (H/V) | Peak Measurement (dBuV/m) | Peak Limit (dBuV/m) | Margin (dB) | Average Measurement (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 2480 | Flat | H | 105.53 | 127.3 | 21.77 | 103.41 | - | - |
| 4960 | Side | H | 58.32 | 74.0 | 15.68 | 50.08 | 54.0 | **3.92** |
| 7440 | Flat | V | 53.79 | 74.0 | 20.21 | 41.52 | 54.0 | 12.48 |
| 9920 | Flat | V | 56.43 | 74.0 | 17.57 | 42.99 | 54.0 | 11.01 |
| 12400 | End | H | 61.19 | 74.0 | 12.81 | 49.58 | 54.0 | 4.42 |
| 14880 | Flat | V | 62.05 | 74.0 | 11.95 | 49.6 | 54.0 | 4.40 |
| 17360 | Flat | H | 55.31 | 74.0 | 18.69 | 42.84 | 54.0 | 11.16 |
| 19840 | Side | V | 52.33 | 74.0 | 21.67 | 41.36 | 54.0 | 12.64 |
| 22320 | End | V | 52.35 | 74.0 | 21.65 | 38.92 | 54.0 | 15.08 |
| 24800 | Flat | V | 52.65 | 74.0 | 21.35 | 40.8 | 54.0 | 13.20 |

# 2. Conducted Emissions

## 1. 99% Bandwidth

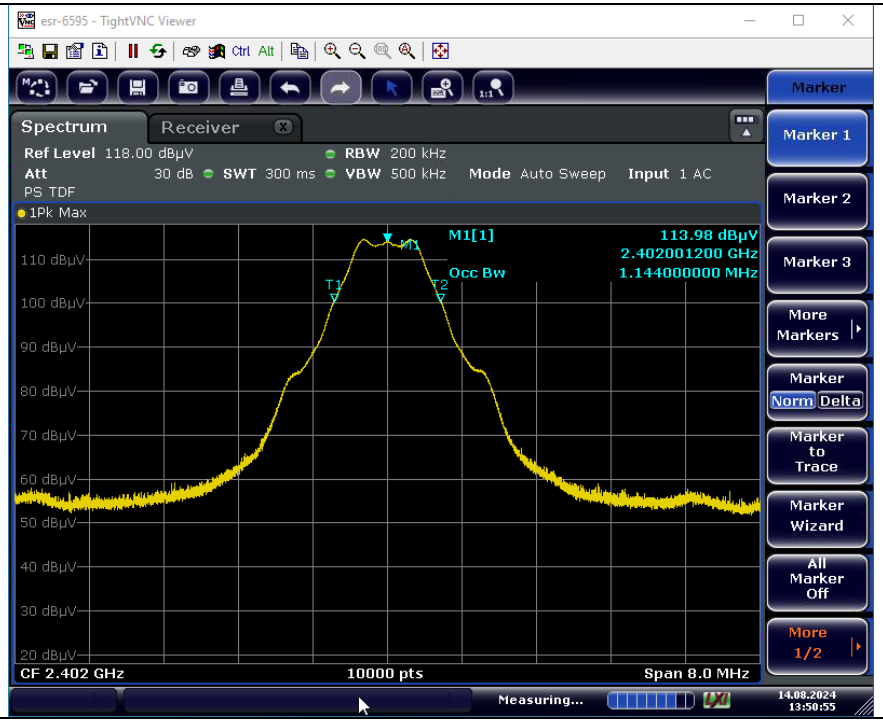
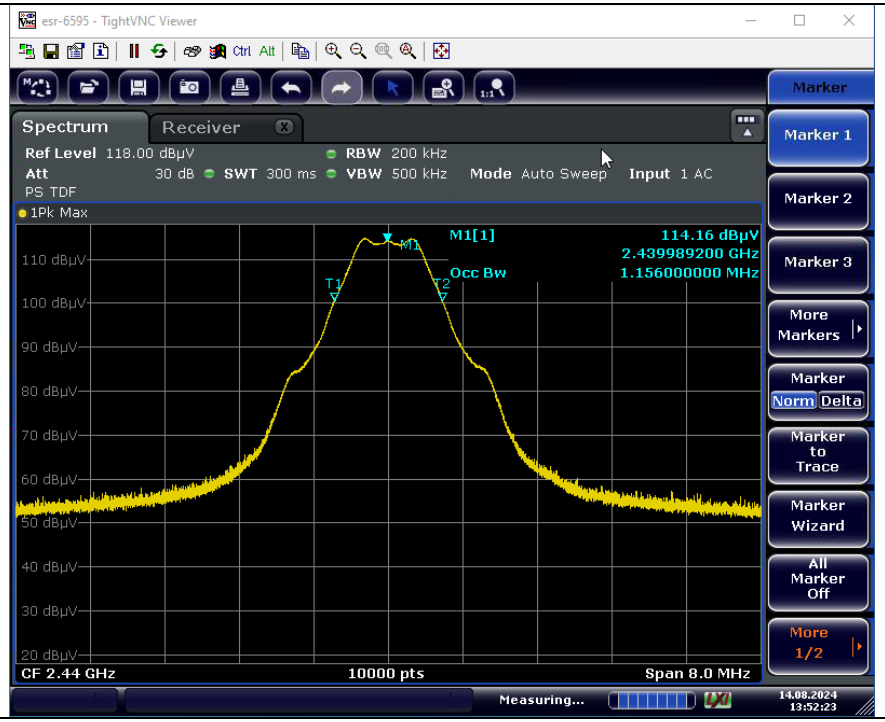
**Measurement Settings:**
Frequency Span: 2-5 times the OBW
RBW: 1 to 5% of the OBW
VBW: 3 times the RBW
Detector: Peak
Trace Max Hold

This Measurements is a conducted measurement. Prior to the measurement the EUT is placed into a continuous transmit mode via an HCI cable attached to the EUT.

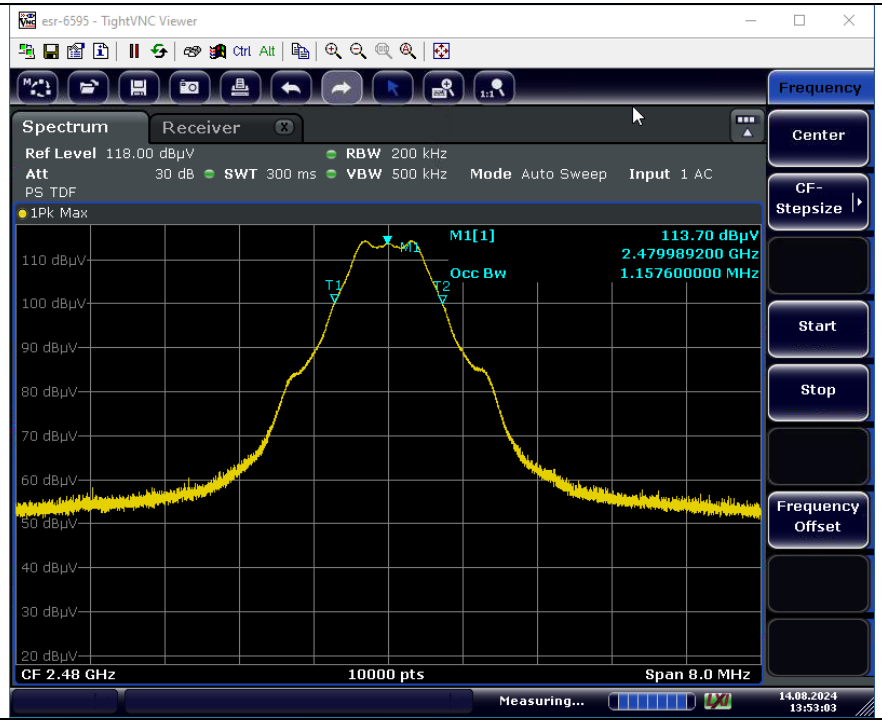
In the measurement of the 99% bandwidth, the transmit frequency was set to the low, middle, and high channels and modes LE 1M and LE 2M.

**99% Bandwidth Mode LE 1M**

| Channel # | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| 0 | 2402 | 1.144 |
| 19 | 2440 | 1.156 |
| 39 | 2480 | 1.157 |

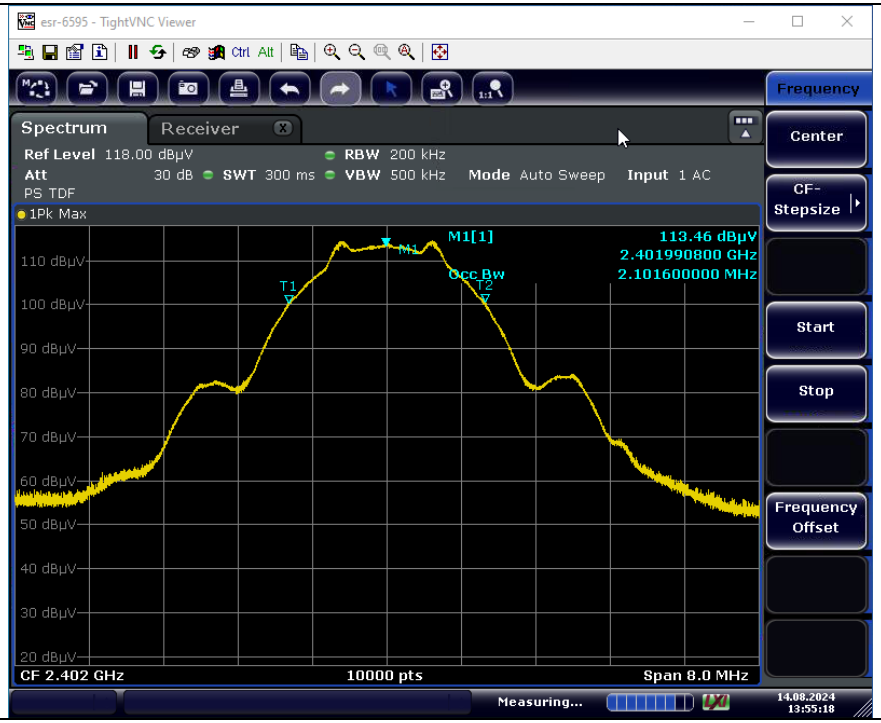
| 2402 MHz Mode LE 1M | 2440 MHz Mode LE 1M |
|---|---|
|  |  |

**2480 MHz Mode LE 1M**

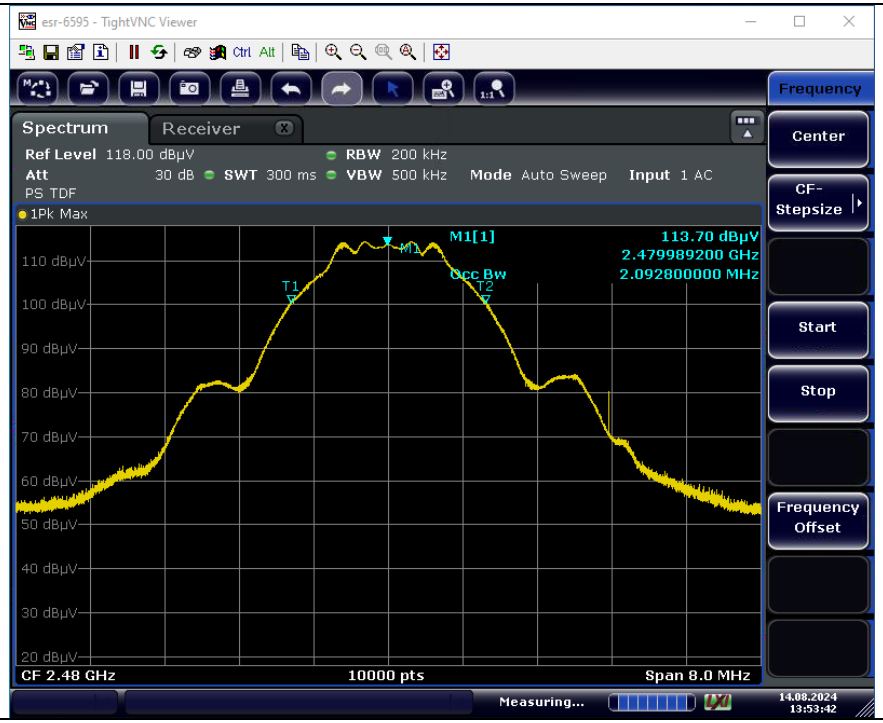



**99% Bandwidth Mode LE 2M**

| Channel # | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| 0 | 2402 | 2.101 |
| 19 | 2440 | 2.11 |
| 39 | 2480 | 2.092 |

| 2402 MHz Mode LE 2M | 2440 MHz Mode LE 2M |
|---|---|
|  | |

## 2480 MHz Mode LE 2M



## 2. 6dB Bandwidth

**Measurement Settings:**
RBW: in the range of 1 to 5% of the OBW but not less than 100kHz
VBW: Equal to or greater than 3 times the RBW
Span: Greater than the DTS bandwidth
Sweep time: No faster than the coupled (auto) time
Detector: Peak
Trace mode: Max Hold

**6dB Bandwidth Requirement:** Per 15.247(a)(2), systems using digital modulation may operate in the 2400-2483.5 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz

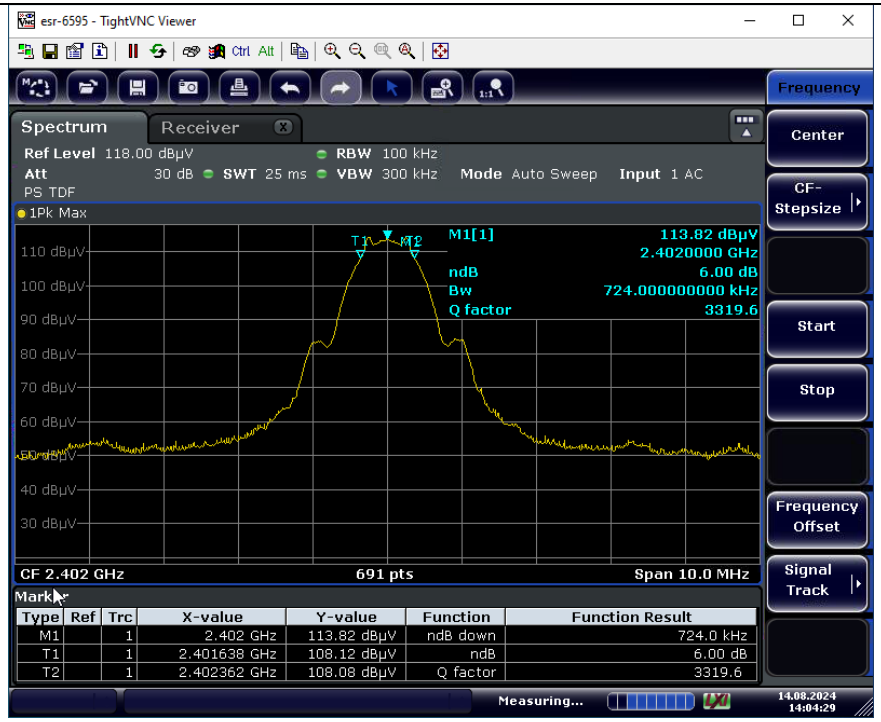
This measurement is a conducted measurement performed with the receiver per test method ANSI C63.10 section 11.8. Prior to measurement the EUT is placed into a continuous transmit mode via an HCI cable attached to the EUT.

In the measurement of the 6dB bandwidth, the transmit frequency was set to low, middle, and high channels and modes LE 1M and LE 2M.

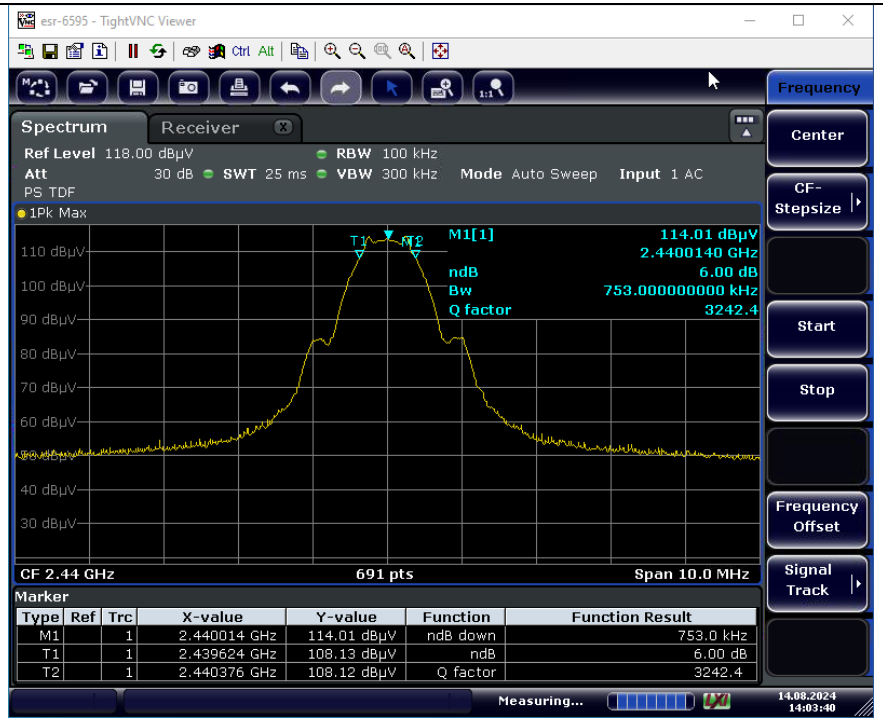
**6dB Bandwidth Mode LE 1M**

| Channel # | Frequency (MHz) | 6dB Bandwidth (kHz) | Limit (kHz) | Margin |
|---|---|---|---|---|
| 0 | 2402 | 724 | >500 | 224 |
| 19 | 2440 | 753 | >500 | 253 |
| 39 | 2480 | 753 | >500 | 253 |

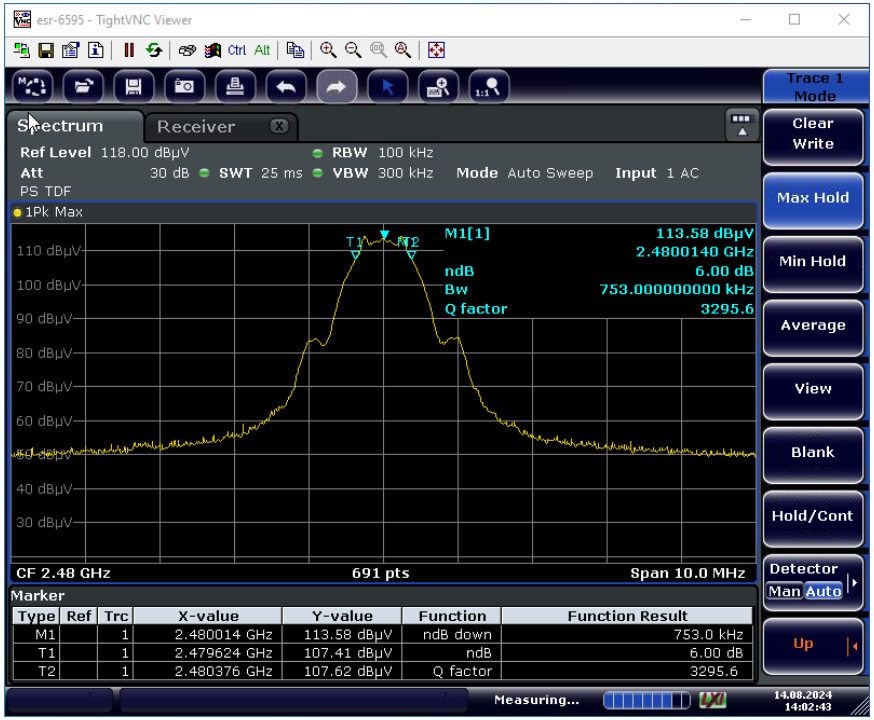
## 2402 MHz Mode LE 1M




## 2440 MHz Mode LE 1M

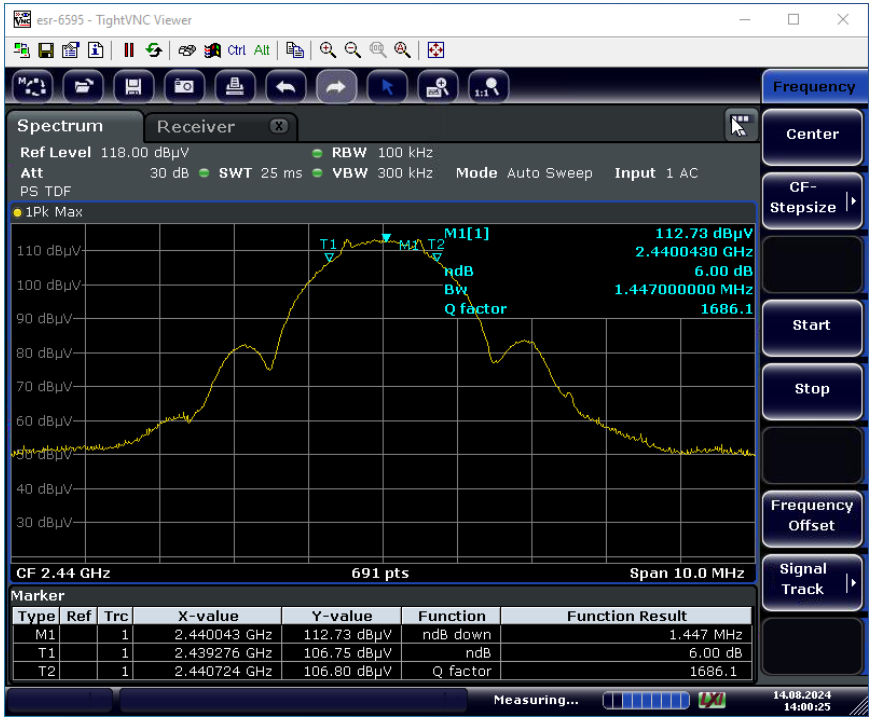


## 2480 MHz Mode LE 1M

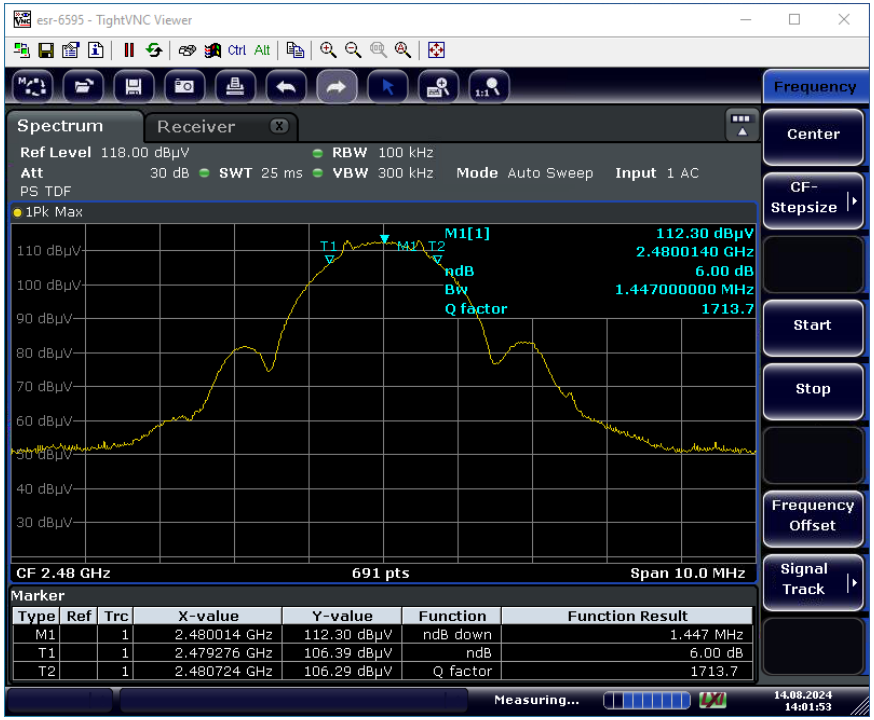


**6dB Bandwidth Mode LE 2M**

| Channel # | Frequency (MHz) | 6dB Bandwidth (kHz) | Limit (kHz) | Margin |
|---|---|---|---|---|
| 0 | 2402 | 1389 | >500 | 889 |
| 19 | 2440 | 1447 | >500 | 947 |
| 39 | 2480 | 1447 | >500 | 947 |

| 2402 MHz Mode LE 2M | 2440 MHz Mode LE 2M |
|---|---|
| |  |

## 2480 MHZ Mode LE 2M



## 3. Peak Output Power

**Measurement Settings:**
RBW: Greater than the worst case DTS occupied bandwidth
VBW: Equal to or greater than 3 times the RBW
Span: Equal to or greater than 3 times the RBW
Sweep time no faster than coupled (auto) time
Detector: Peak

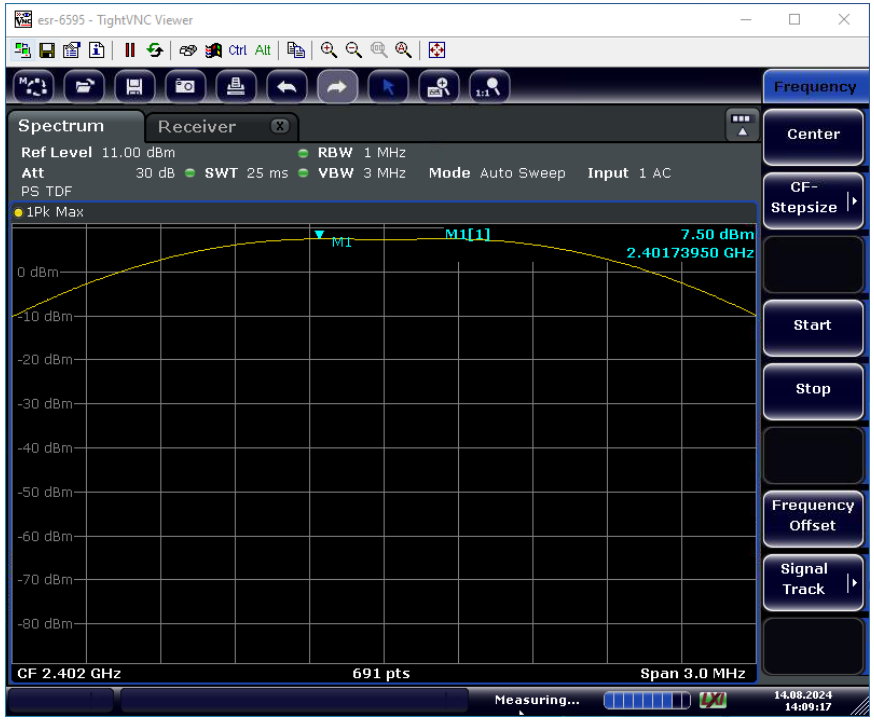
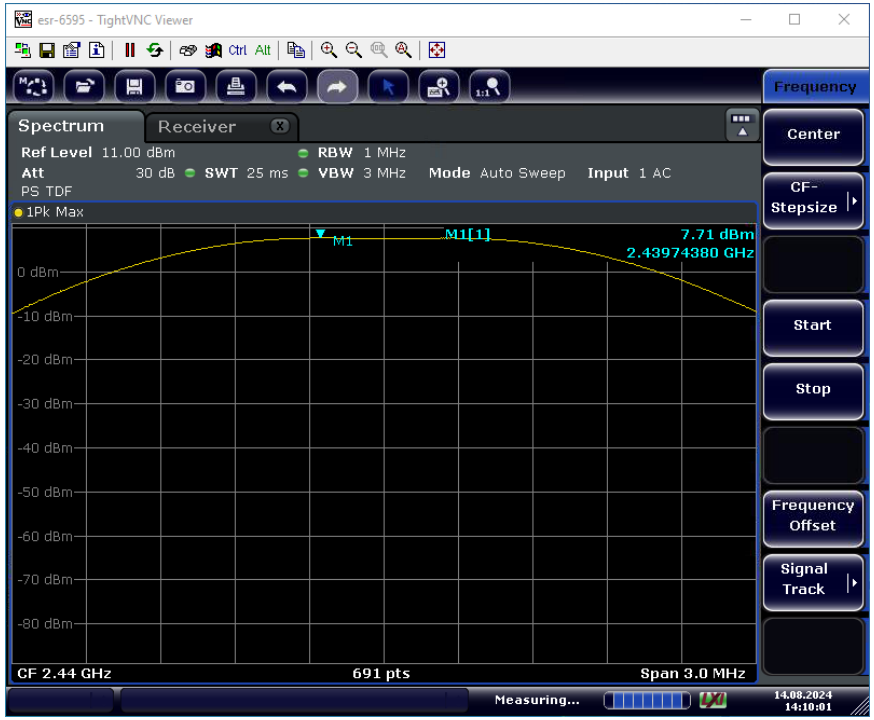
**Peak Output Power Requirement:** Per 15.247(b)(3) The maximum Peak Conducted Output Power of the intentional radiator shall not exceed the 1W (30dBm) for systems using digital modulation in the 2400-2483.5MHz

This measurement is a conducted measurement performed with the receiver per test method ANSI C63.10 section 11.9. Prior to measurement the EUT is placed into a continuous transmit mode via a HCI cable attached to the EUT.

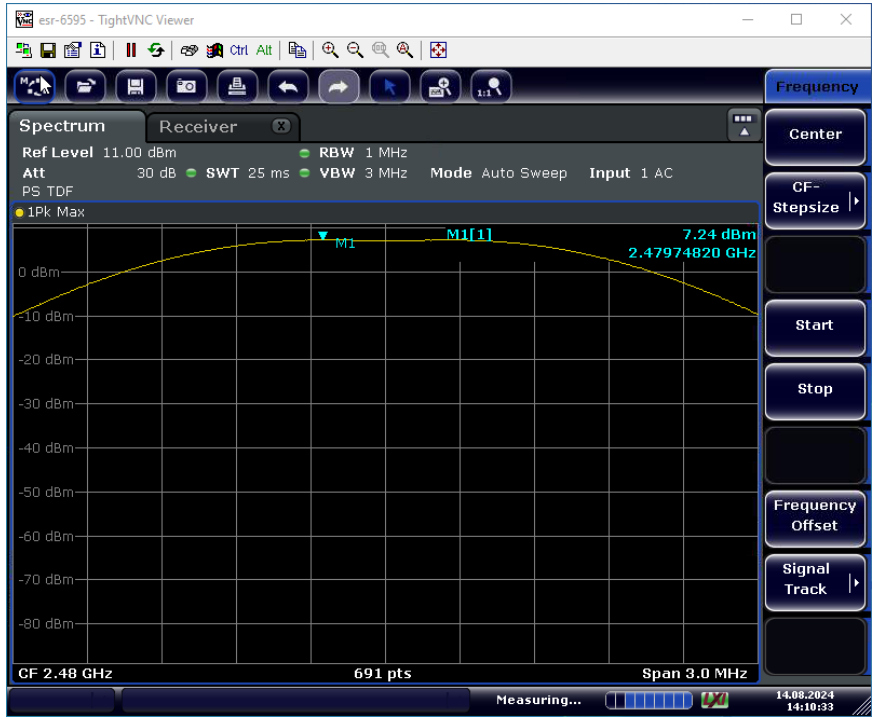
In the measurement of the Peak Output Power, the transmit frequency was set to low, middle, and high channels and modes LE 1M and LE 2M.

**Peak Output Power Mode LE 1M**

| Channel # | Frequency (MHz) | Power Output (dBm) | Limit (dBm) | Margin |
|---|---|---|---|---|
| 0 | 2402 | 7.5 | 30 | -22.5 |
| 19 | 2440 | 7.71 | 30 | -22.29 |
| 39 | 2480 | 7.24 | 30 | -22.76 |

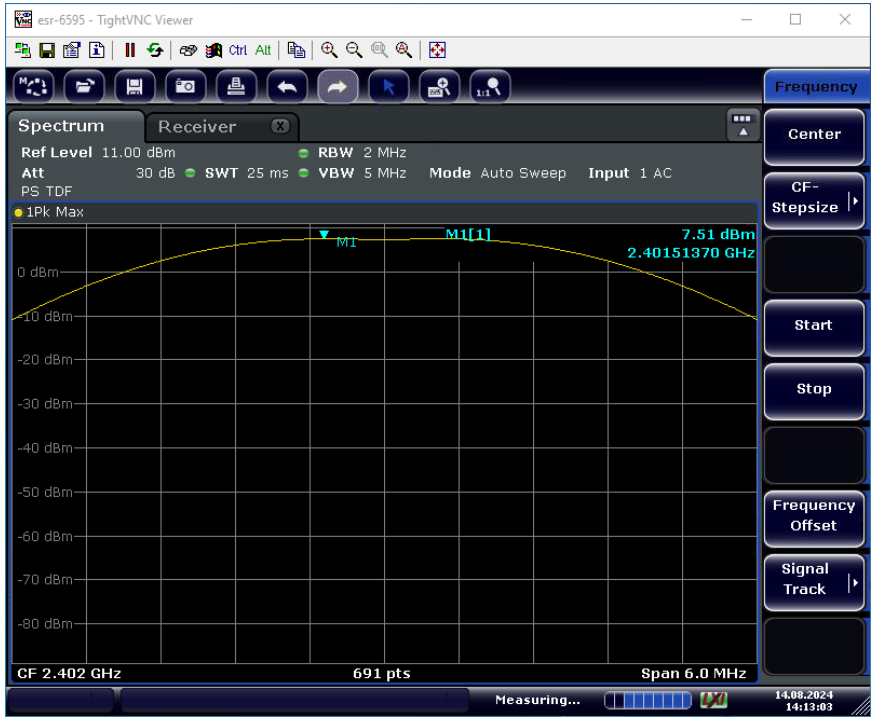
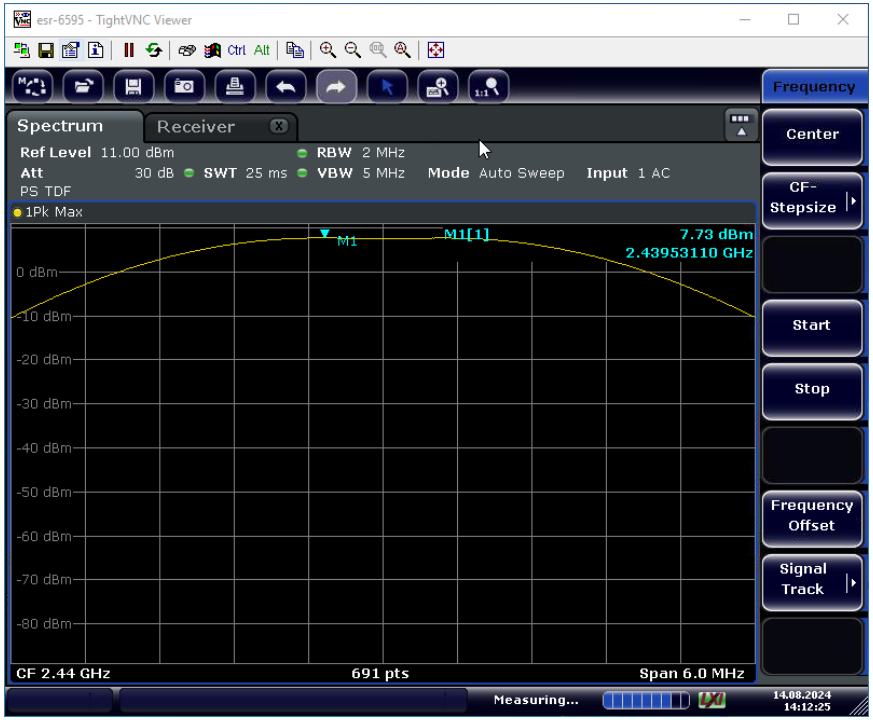
| 2402 MHz Mode LE 1M | 2440 MHz Mode LE 1M |
|---|---|
|  |  |

## 2480 MHz Mode LE 1M

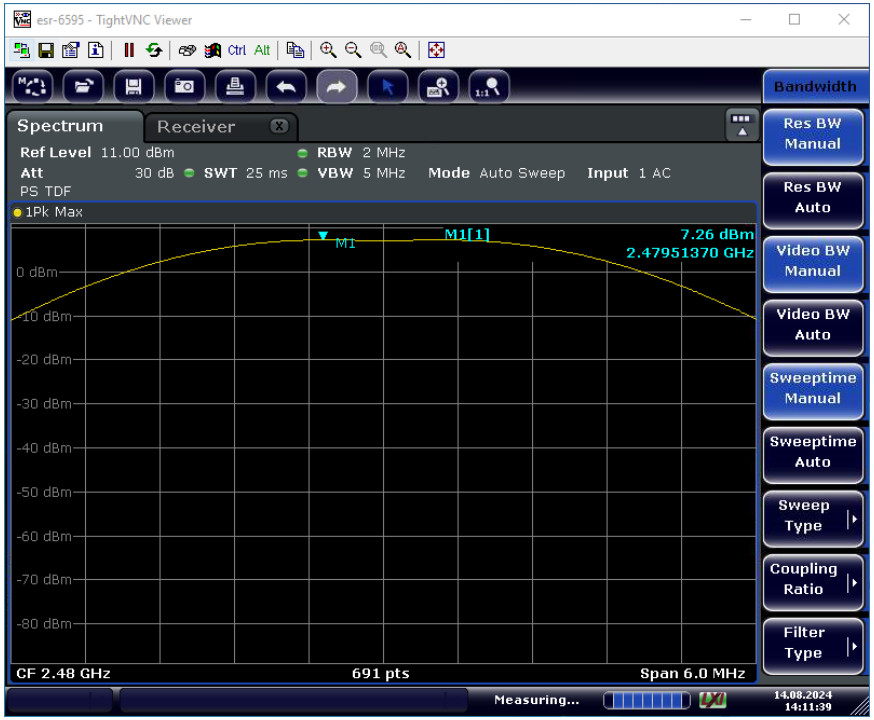


**Peak Output Power Mode LE 2M**

| Channel # | Frequency (MHz) | Power Output (dBm) | Limit (dBm) | Margin |
|---|---|---|---|---|
| 0 | 2402 | 7.51 | 30 | -22.49 |
| 19 | 2440 | 7.73 | 30 | -22.27 |
| 39 | 2480 | 7.26 | 30 | -22.74 |

| 2402 MHz Mode LE 2M | 2440 MHz Mode LE 2M |
|---|---|
|  |  |

## 2480 MHz Mode LE 2M



# 4. Power Spectral Density

**Measurement Settings:**
Span: Greater than 1.5 times the DTS bandwidth
RBW: set to between 3kHz and 100kHz
VBW: Equal to or greater than 3 times the RBW
Sweep time: No faster than the coupled (auto) time
Detector: Peak
Trace mode: Max hold

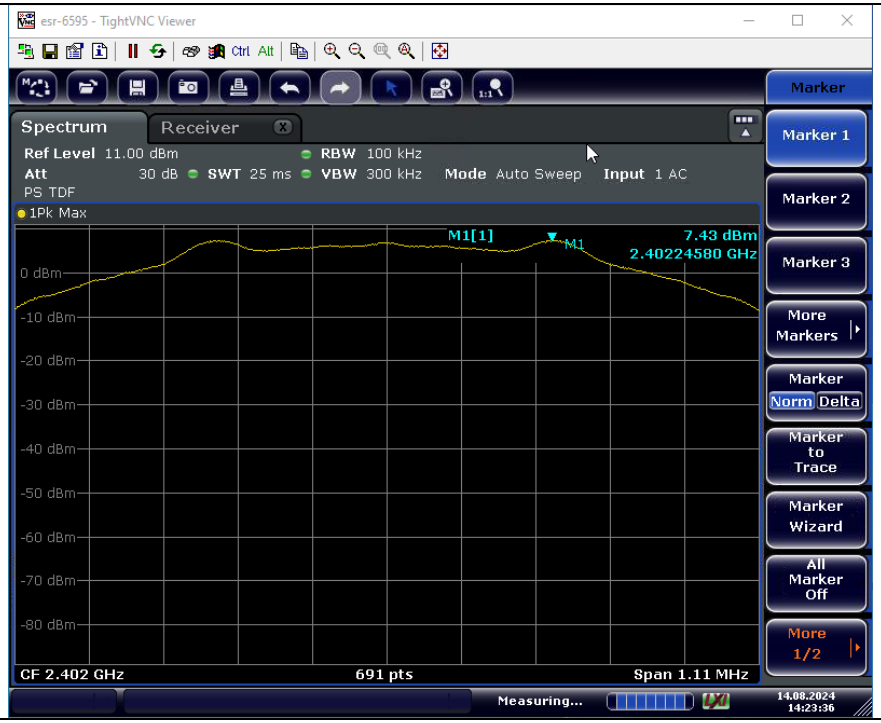
**Power Spectral Density requirement:** Per 15.247(e) for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission. The same method of determining the conducted output power shall be used to determine the power spectral density.

This measurement is a conducted measurement performed with the receiver per test method ANSI C63.10 section 11.10. Prior to measurement the EUT is placed into a continuous transmit mode via a HCI cable attached to the EUT.

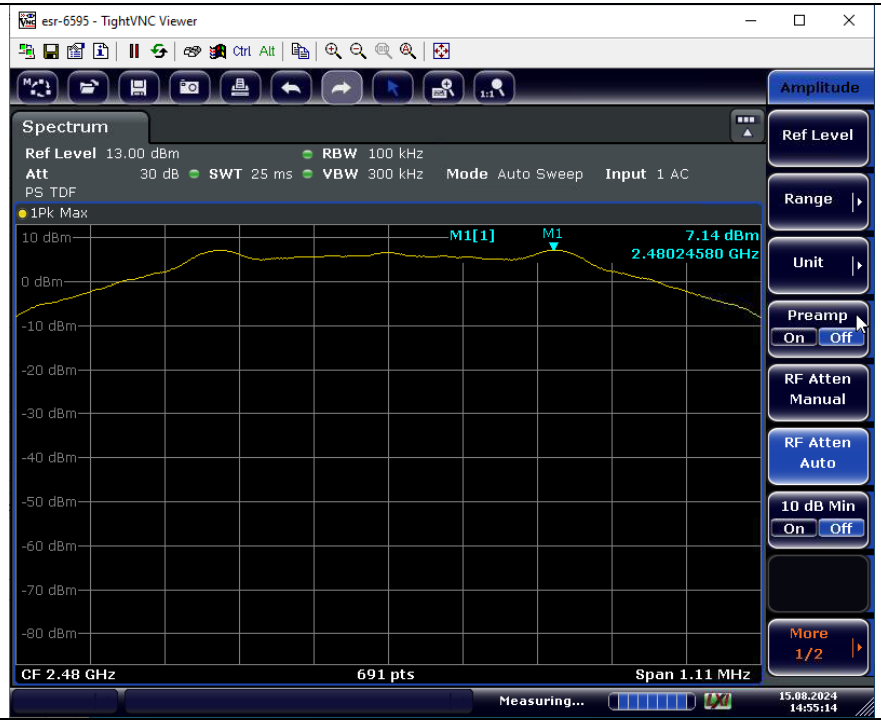
In the measurement of the power spectral density, the transmit frequency was set to low, middle, and high channels and modes LE 1M and LE 2M

**Power Spectral Density Mode LE 1M**

| Channel # | Frequency (MHz) | Measurement PPSD (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 0 | 2402 | 7.43 | 8 | -0.57 |
| 19 | 2440 | 7.59 | 8 | -0.41 |
| 39 | 2480 | 7.08 | 8 | -0.92 |

| 2402 MHz Mode LE 1M | 2440 MHz Mode LE 1M |
|---|---|
|  | |

## 2480 MHz Mode LE 1M

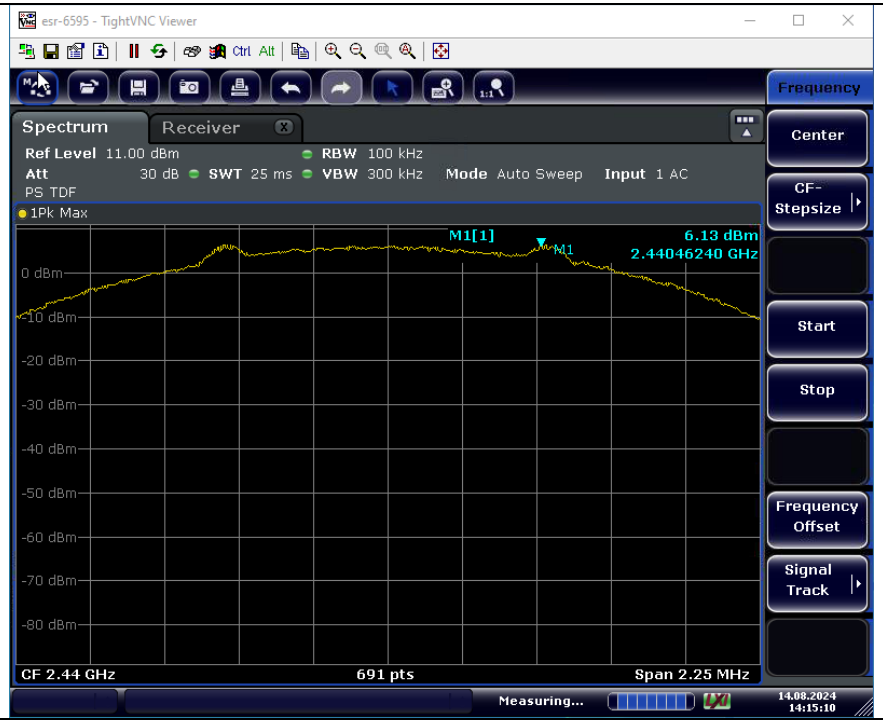


**Power Spectral Density Mode LE 2M**

| Channel # | Frequency (MHz) | Measurement PPSD (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 0 | 2402 | 6.12 | 8 | -1.88 |
| 19 | 2440 | 6.13 | 8 | -1.87 |
| 39 | 2480 | 5.87 | 8 | -2.13 |

**2402 MHz Mode LE 2M**

**2440 MHz Mode LE 2M**



## 2480 MHz Mode LE 2M

## 5. Conducted Emissions Sweep – 30MHz to 25GHz

**Measurement Settings:**
Sweep 1: Peak - 100 kHz
Start Frequency: 30MHz
End Frequency: 1000MHz
Detector: Peak
Sweep Mode: FFT
Attenuator: 5dB
Pre-Amp: On
Max Hold Trace Mode: Off
Bandwidth Filter: EMI (6dB)
RBW: 100kHz
Step Size: Auto (25kHz)
Dwell Time: 10ms

**Measurement Settings:**
Sweep 2: Peak – 1000kHz
Start Frequency: 1000MHz
End Frequency: 18000MHz
Detector: Peak
Sweep Mode: FFT
Attenuator: 5dB
Pre-Amp: On
Max Hold Trace Mode: Off
Bandwidth Filter: EMI (6dB)
RBW: 1000kHz
Step Size: Auto (250kHz)
Dwell Time: 10ms

**Measurement Settings:**
Sweep 2: Peak – 1000kHz
Start Frequency: 18000MHz
End Frequency: 26000MHz
Detector: Peak
Sweep Mode: FFT
Attenuator: 5dB
Pre-Amp: On
Max Hold Trace Mode: Off
Bandwidth Filter: EMI (6dB)
RBW: 1000kHz
Step Size: Auto (250kHz)
Dwell Time: 10ms

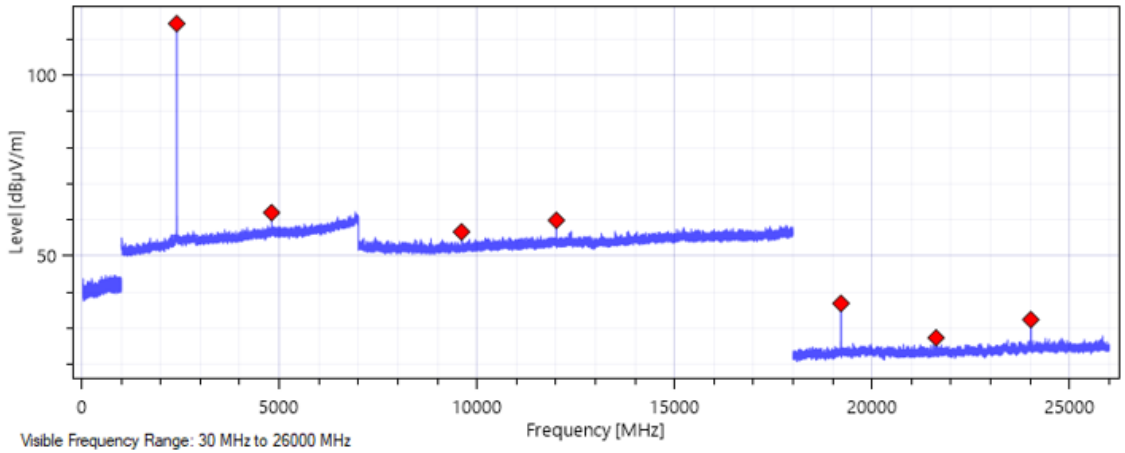
Per section 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the 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).

This measurement is a conducted measurement performed with a receiver per test method ANSI C63.10 section 11.10. Prior to measurement the EUT is placed into a continuous transmit mode via a HCI cable attached to the EUT.

The emissions sweep was performed with the transmitter set separately at 2402MHz, 2440MHz, and 2480MHz in modes LE 1M and LE 2M. For each of the sweeps, the emissions were below the limit.

| Channel # | Mode | Frequency (MHz) | Worst Case Delta (dB) | Limit (dBm) | Margin |
|---|---|---|---|---|---|
| 0 | LE 1M | 2402 | 52.373 | 20 | 32.373 |
| 0 | LE 2M | 2402 | 52.647 | 20 | 32.647 |
| 19 | LE 1M | 2440 | 53.067 | 20 | 33.067 |
| 19 | LE 2M | 2440 | 53.038 | 20 | 33.038 |
| 39 | LE 1M | 2480 | 52.836 | 20 | 32.836 |
| 39 | LE 2M | 2480 | 52.452 | 20 | 32.452 |

## Peak Measurement - 2402MHz LE 1M




**Test Profile:** BLE Emissions Sweep for ANSI C63.10

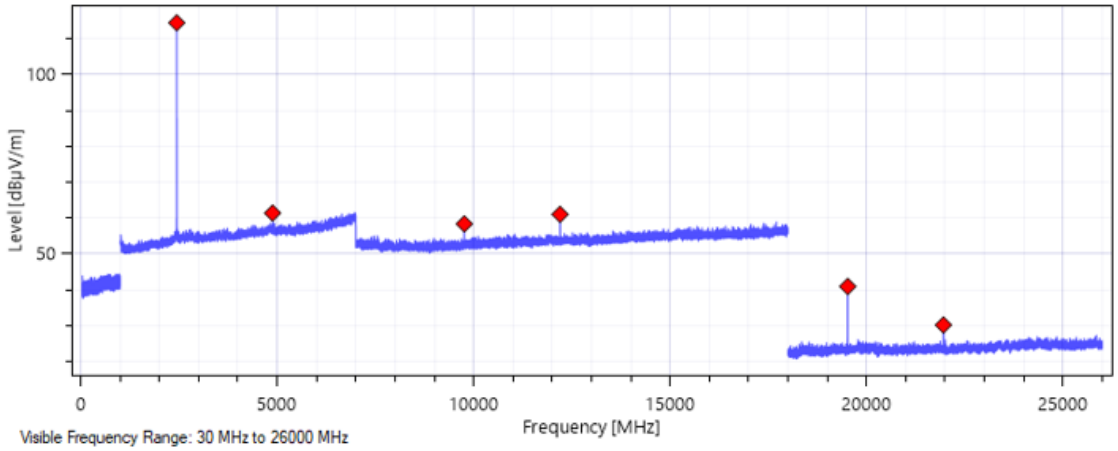
**Trace: 2402 1M, Band: Band 2 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 2,401.750000 | 114.429 | No Limit at Frequency | No Limit at Frequency |
| 4,803.500000 | 62.056 | No Limit at Frequency | No Limit at Frequency |
| 9,609.000000 | 56.719 | No Limit at Frequency | No Limit at Frequency |
| 12,011.250000 | 59.938 | No Limit at Frequency | No Limit at Frequency |

**Trace: 2402 1M 18, Band: Band 3 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 19,214.000000 | 36.903 | No Limit at Frequency | No Limit at Frequency |
| 21,620.250000 | 27.397 | No Limit at Frequency | No Limit at Frequency |
| 24,017.500000 | 32.419 | No Limit at Frequency | No Limit at Frequency |

## Peak Measurement - 2440MHz LE 1M




**Test Profile:** BLE Emissions Sweep for ANSI C63.10

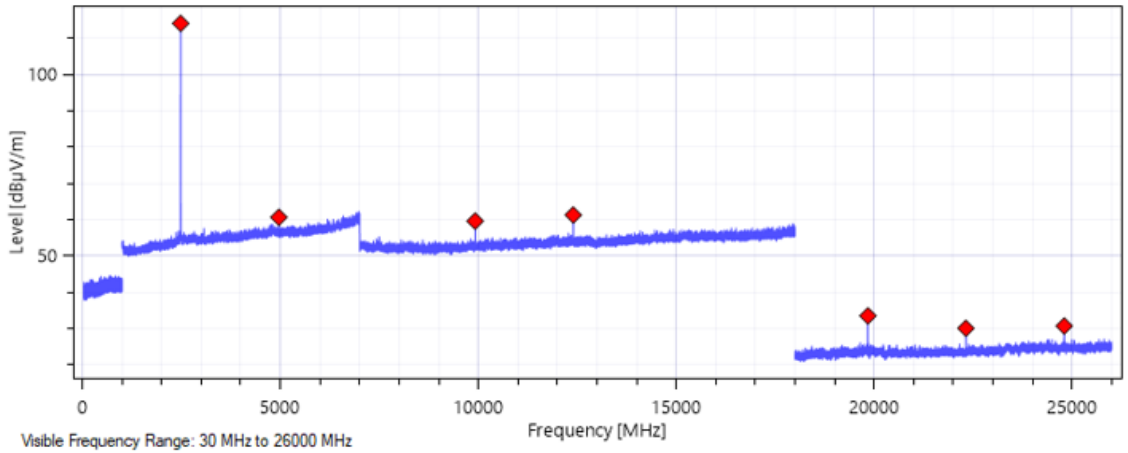
**Trace: 2440 1M, Band: Band 2 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 2,439.750000 | 114.49 | No Limit at Frequency | No Limit at Frequency |
| 4,879.750000 | 61.423 | No Limit at Frequency | No Limit at Frequency |
| 9,761.000000 | 58.399 | No Limit at Frequency | No Limit at Frequency |
| 12,198.750000 | 61.048 | No Limit at Frequency | No Limit at Frequency |

**Trace: 2440 1M 18, Band: Band 3 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 19,522.000000 | 40.941 | No Limit at Frequency | No Limit at Frequency |
| 21,957.500000 | 30.188 | No Limit at Frequency | No Limit at Frequency |

## Peak Measurement - 2480MHz LE 1M




**Test Profile:** BLE Emissions Sweep for ANSI C63.10

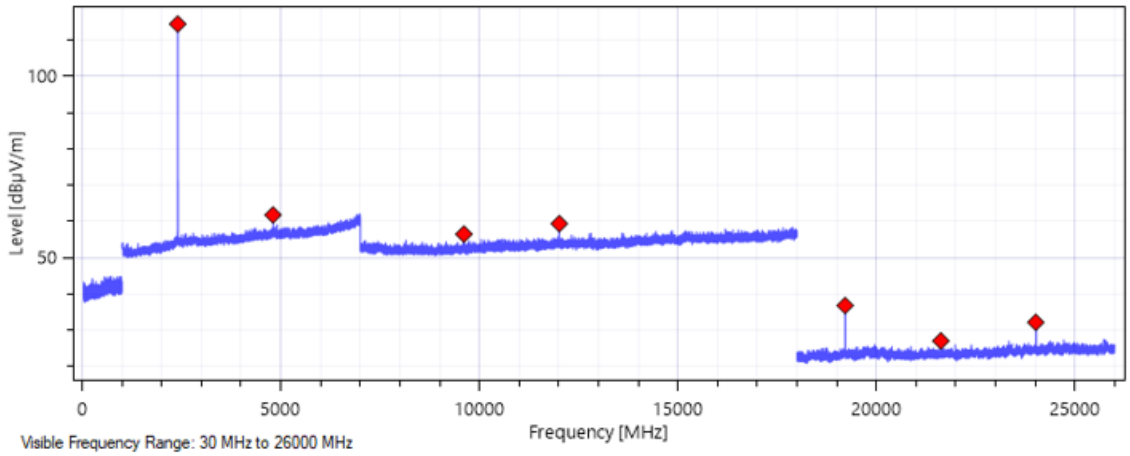
**Trace: 2480 1M, Band: Band 2 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 2,479.750000 | 114.13 | No Limit at Frequency | No Limit at Frequency |
| 4,959.500000 | 60.648 | No Limit at Frequency | No Limit at Frequency |
| 9,919.000000 | 59.604 | No Limit at Frequency | No Limit at Frequency |
| 12,398.750000 | 61.294 | No Limit at Frequency | No Limit at Frequency |

**Trace: 2480 1M 18, Band: Band 3 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 19,842.000000 | 33.473 | No Limit at Frequency | No Limit at Frequency |
| 22,317.750000 | 30.042 | No Limit at Frequency | No Limit at Frequency |
| 24,802.500000 | 30.677 | No Limit at Frequency | No Limit at Frequency |

## Peak Measurement - 2402MHz LE 2M




**Test Profile:** BLE Emissions Sweep for ANSI C63.10

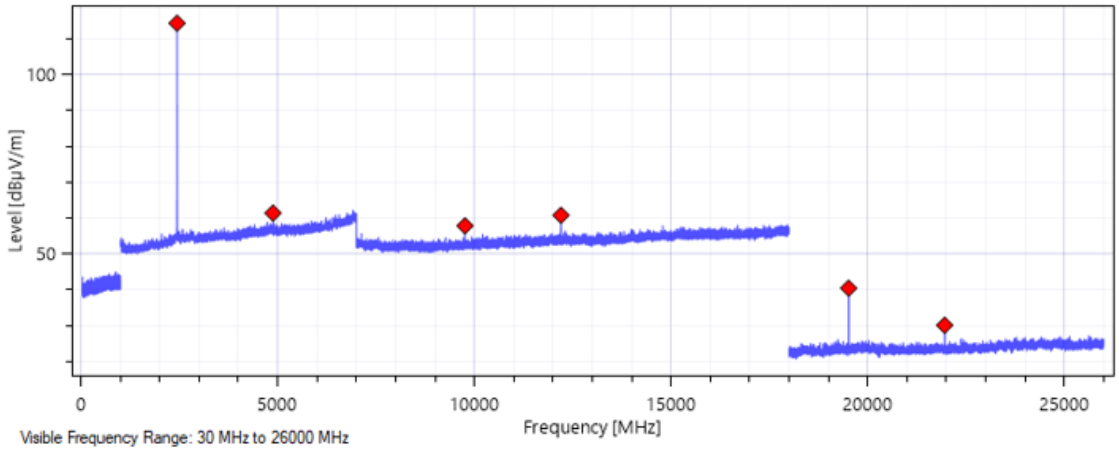
**Trace: 2402 2M, Band: Band 2 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 2,401.500000 | 114.427 | No Limit at Frequency | No Limit at Frequency |
| 4,803.000000 | 61.78 | No Limit at Frequency | No Limit at Frequency |
| 9,610.000000 | 56.507 | No Limit at Frequency | No Limit at Frequency |
| 12,012.500000 | 59.368 | No Limit at Frequency | No Limit at Frequency |

**Trace: 2402 2M 18, Band: Band 3 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 19,212.000000 | 36.809 | No Limit at Frequency | No Limit at Frequency |
| 21,622.500000 | 27.057 | No Limit at Frequency | No Limit at Frequency |
| 24,015.250000 | 32.18 | No Limit at Frequency | No Limit at Frequency |

## Peak Measurement - 2440MHz LE 2M




**Test Profile:** BLE Emissions Sweep for ANSI C63.10

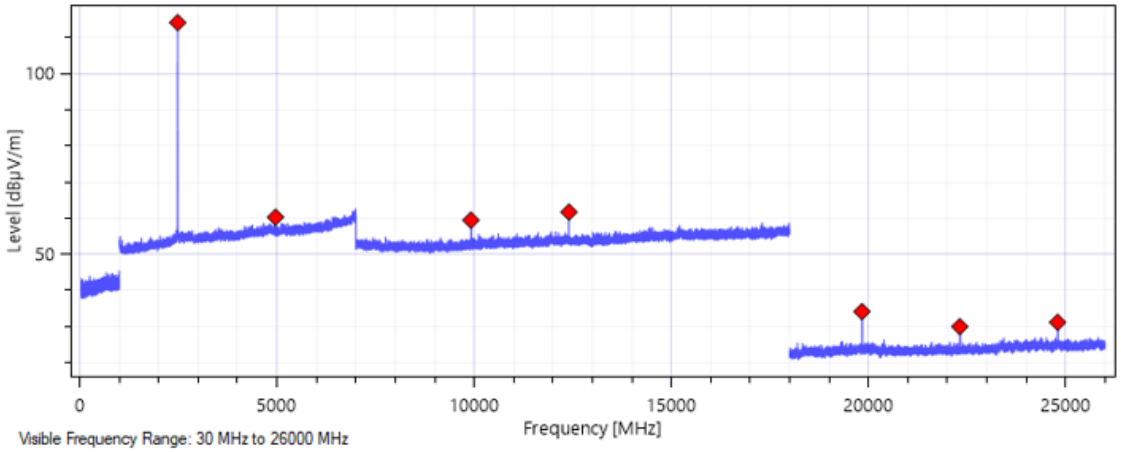
**Trace: 2440 2M, Band: Band 2 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 2,440.500000 | 114.472 | No Limit at Frequency | No Limit at Frequency |
| 4,881.000000 | 61.434 | No Limit at Frequency | No Limit at Frequency |
| 9,762.000000 | 57.886 | No Limit at Frequency | No Limit at Frequency |
| 12,202.500000 | 60.82 | No Limit at Frequency | No Limit at Frequency |

**Trace: 2440 2M 18, Band: Band 3 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 19,516.250000 | 40.453 | No Limit at Frequency | No Limit at Frequency |
| 21,955.500000 | 30.113 | No Limit at Frequency | No Limit at Frequency |

## Peak Measurement - 2480MHz LE 2M




**Test Profile:** BLE Emissions Sweep for ANSI C63.10

**Trace: 2480 2M, Band: Band 2 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 2,479.500000 | 114.152 | No Limit at Frequency | No Limit at Frequency |
| 4,961.000000 | 60.27 | No Limit at Frequency | No Limit at Frequency |
| 9,918.250000 | 59.453 | No Limit at Frequency | No Limit at Frequency |
| 12,402.500000 | 61.7 | No Limit at Frequency | No Limit at Frequency |

**Trace: 2480 2M 18, Band: Band 3 (Peak Detector)**

| Frequency (MHz) | Level (dBµV/m) | Limit (dBµV/m) | Margin (dBµV/m) |
|---|---|---|---|
| 19,836.000000 | 34.139 | No Limit at Frequency | No Limit at Frequency |
| 22,315.500000 | 29.982 | No Limit at Frequency | No Limit at Frequency |
| 24,795.000000 | 31.172 | No Limit at Frequency | No Limit at Frequency |

# 6. Band Edge Measurement

**Measurement Settings:**
RBW:100kHz
VBW: 3x RBW
Sweep time: No faster than Coupled (auto) time
Detector: Peak
Trace: Max Hold

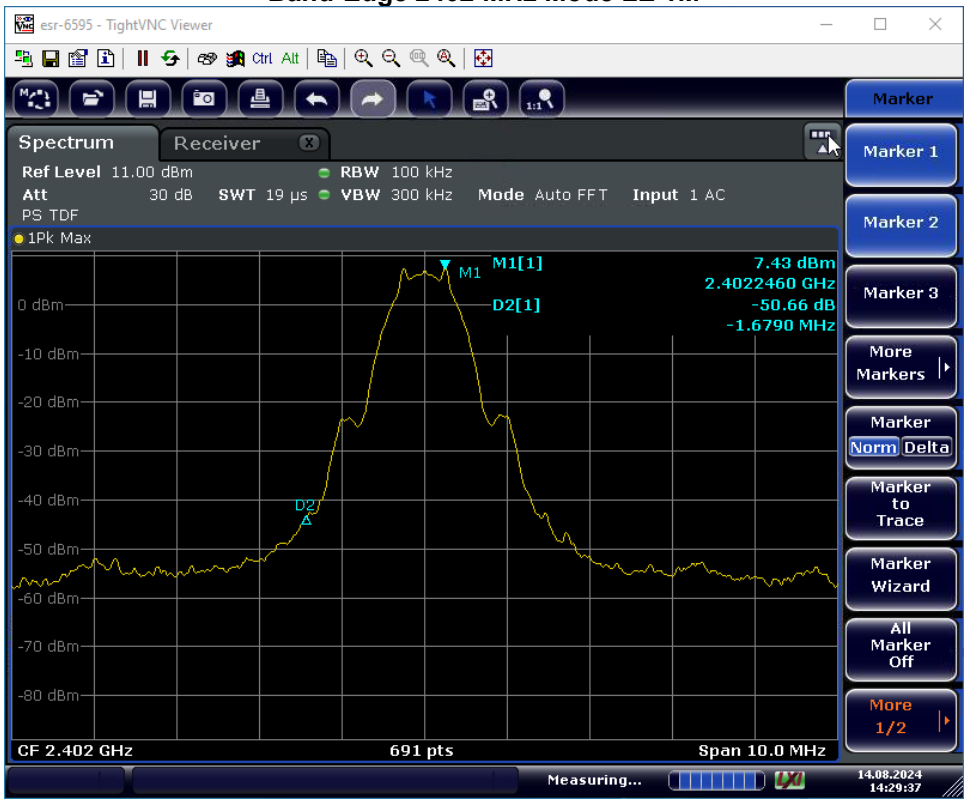
Per section 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the 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).

This measurement is a conducted measurement performed with a receiver. Prior to measurement the EUT is placed into a continuous transmit mode via a HCI cable attached to the EUT.

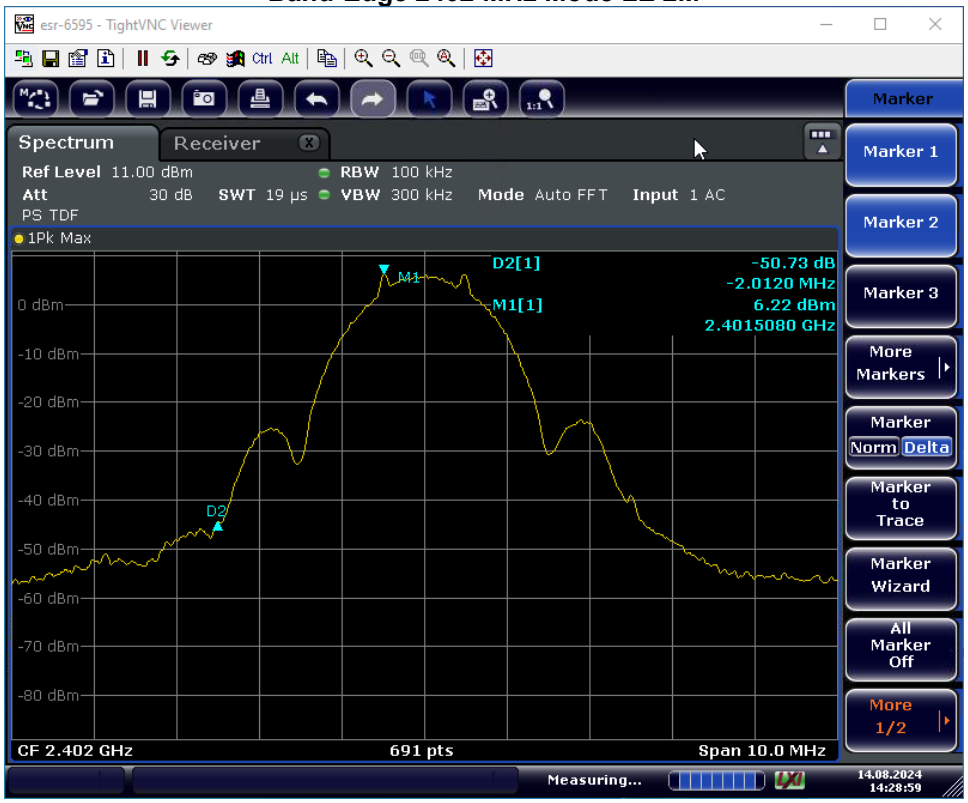
The band edge measurement was performed with the transmitter set separately at 2402MHz and 2480MHz in modes LE 1M and LE 2M. For each of the measurements the emissions were greater than 40dB below the peak of the signal.

| Channel # | Center Frequency | Mode | Worst Case OOB Delta from Peak Fundamental (dBc) | Minimum Requirement (dB) | Margin (dB) |
|---|---|---|---|---|---|
| 0 | 2402 | LE 1M | -50.66 | 20 | 30.66 |
| 0 | 2402 | LE 2M | -50.73 | 20 | 30.73 |
| 39 | 2480 | LE 1M | -53.67 | 20 | 33.67 |
| 39 | 2480 | LE 2M | -44.58 | 20 | 24.58 |

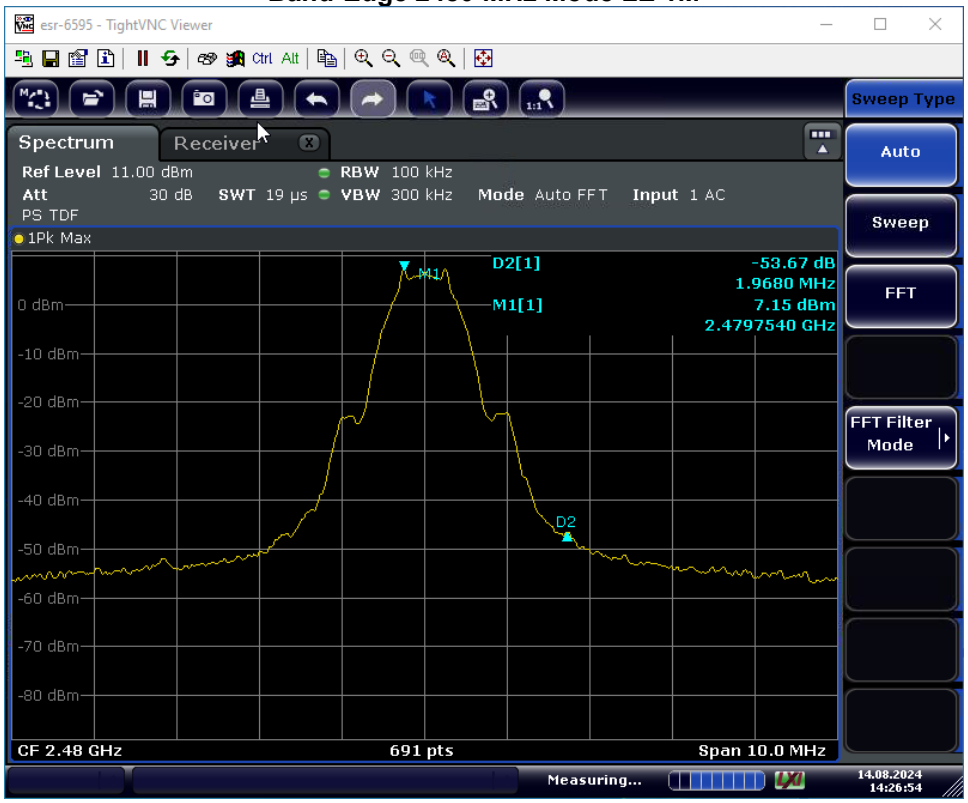
**Band-Edge 2402 MHz Mode LE 1M**



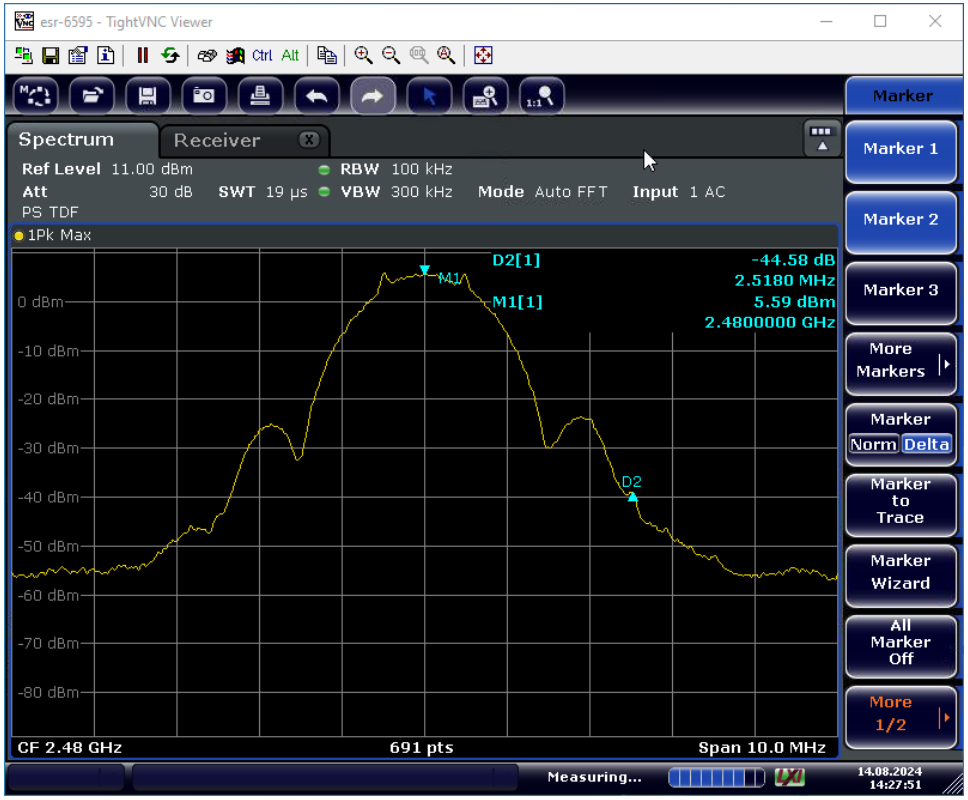
**Band-Edge 2402 MHz Mode LE 2M**



**Band-Edge 2480 MHz Mode LE 1M**



## Band-Edge 2480 MHz Mode LE 2M



# 7. Restricted Band-Edge Measurement

**Measurement Settings:**
RBW:1MHz
VBW: 3x RBW
Sweep time: No faster than Coupled (auto) time
Detector: Peak and Average
Trace: Max Hold

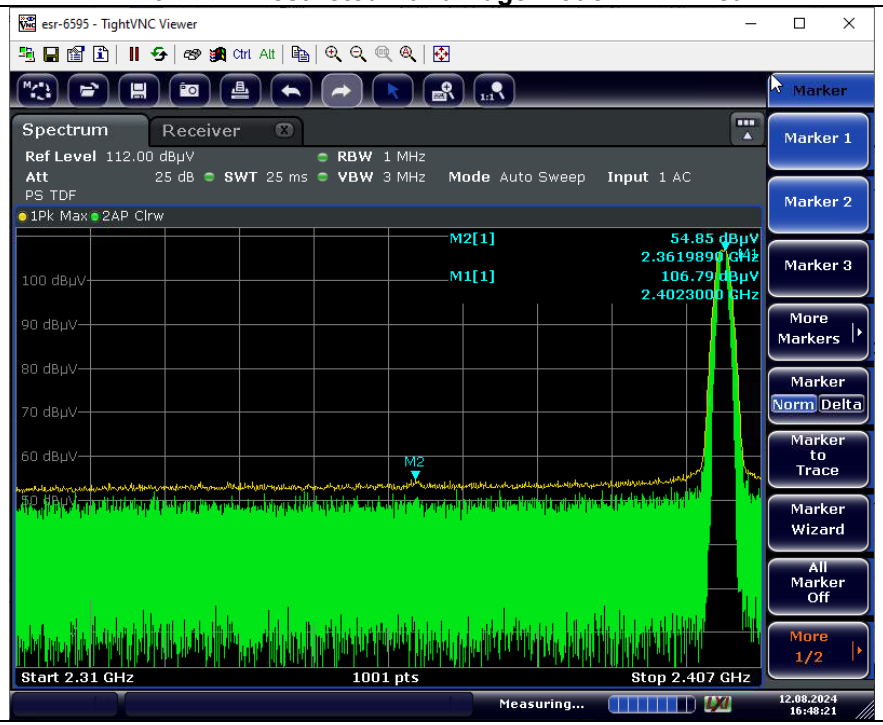
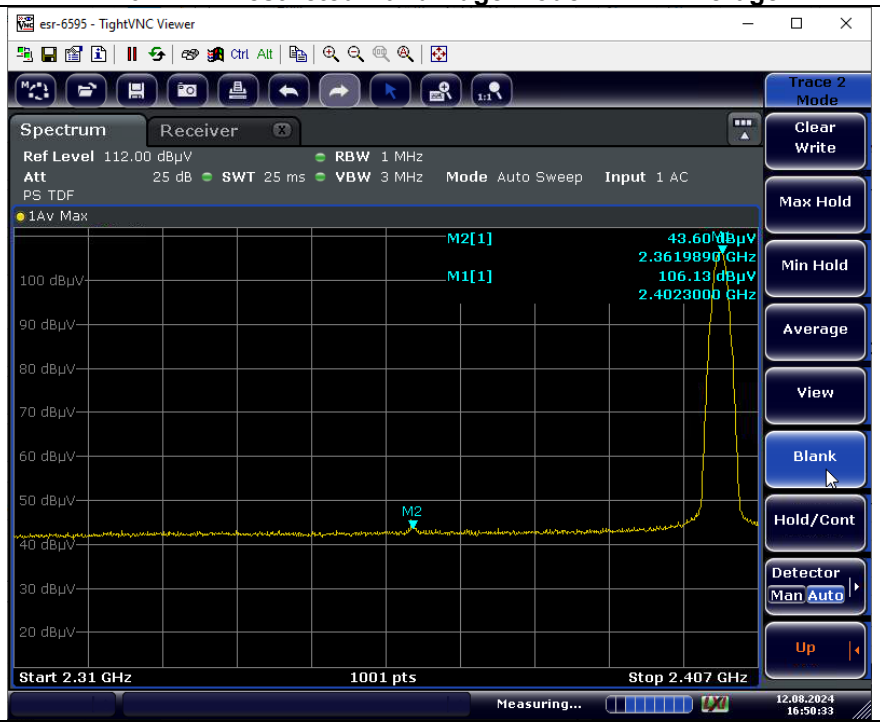
Per section 15.205 only spurious emissions are permitted in the frequency bands 2310-2390MHz and 2483.5-2500MHz and shall not exceed the limits shown in 15.209.

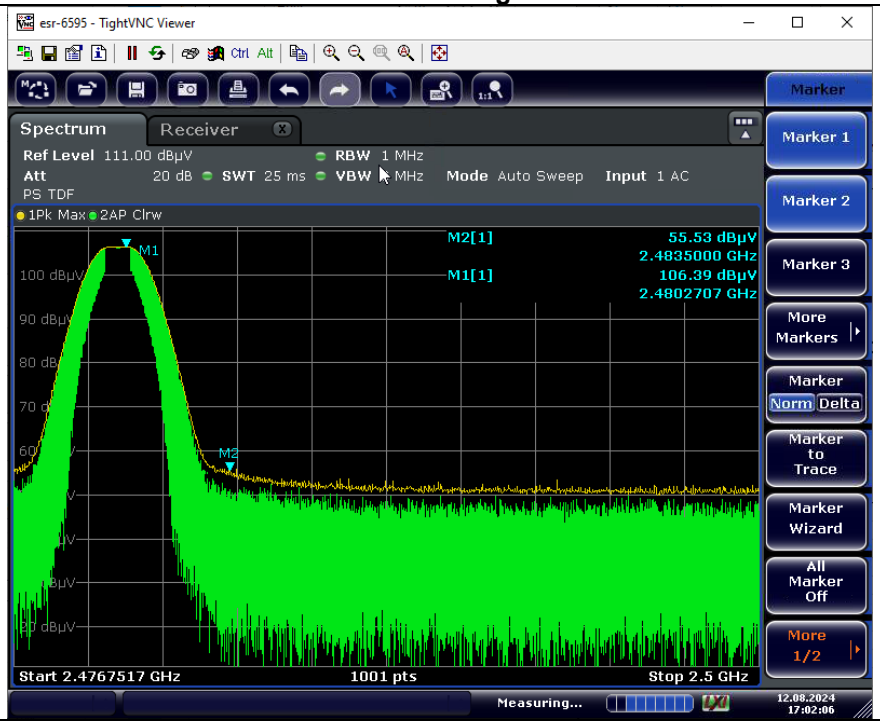
This measurement is a conducted measurement performed with a receiver. Prior to measurement the EUT is placed into a continuous transmit mode via a HCI cable attached to the EUT.

The restricted band edge measurement was performed with the transmitter set separately at 2402MHz and 2480MHz in modes LE 1M and LE 2M. For each of the measurements the emissions were below the limit.

**Restricted Band-Edge Mode LE 1M**

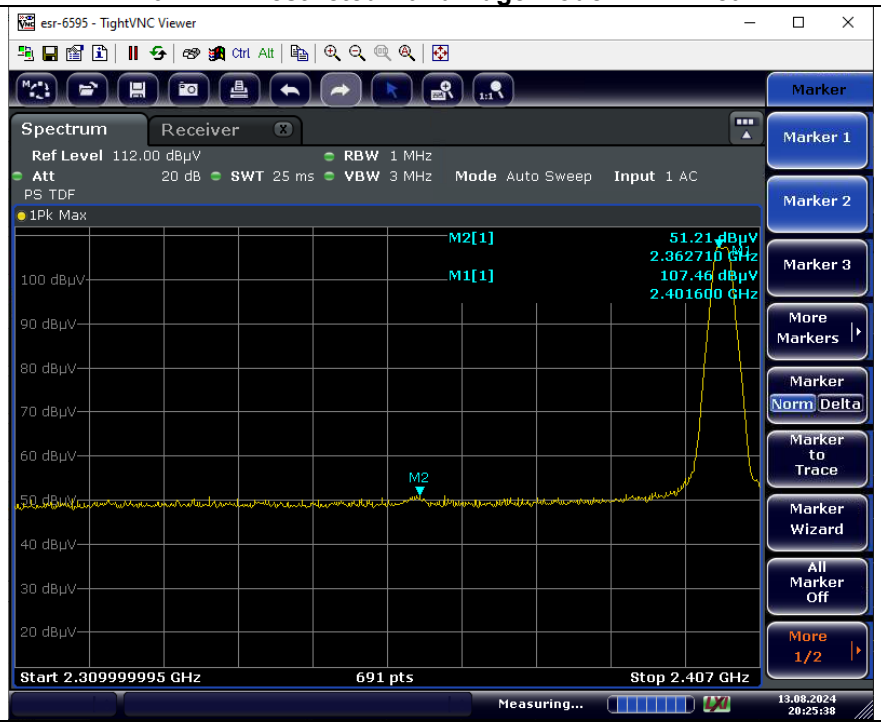
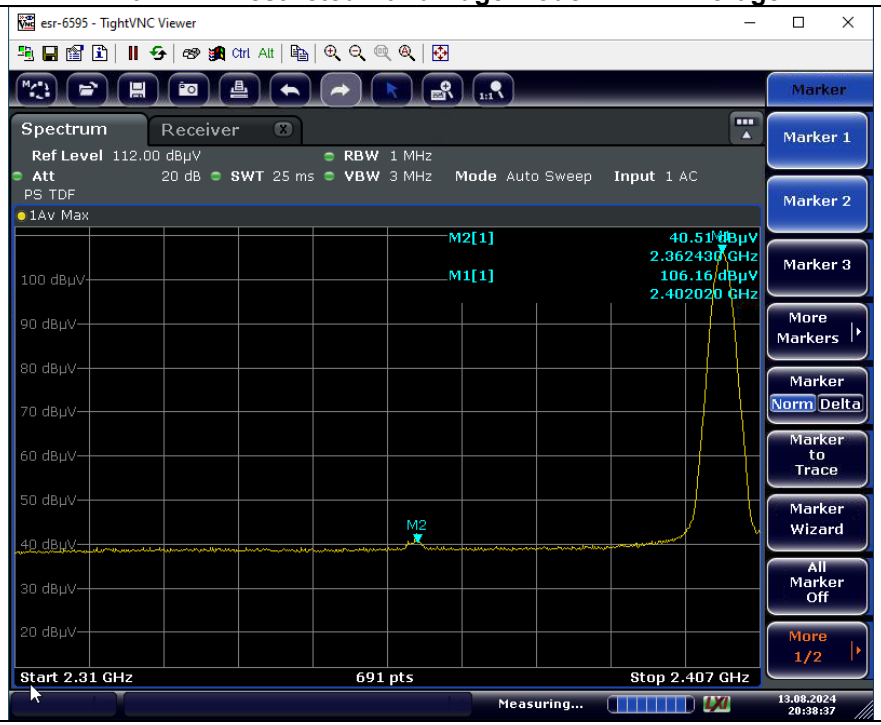
| Measurement Frequency (MHz) | Measurement (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 2361.9 | 54.85 | 74 | 19.15 | Peak |
| 2361.9 | 43.6 | 54 | 10.4 | Average |
| 2483.5 | 55.53 | 74 | 18.47 | Peak |
| 2483.5 | 44.08 | 54 | 9.92 | Average |

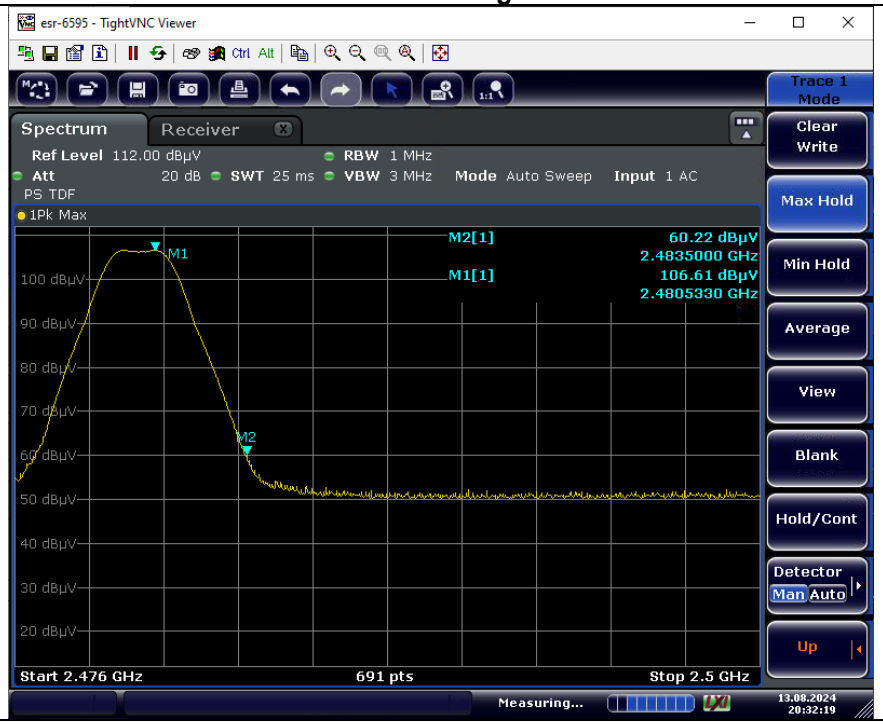
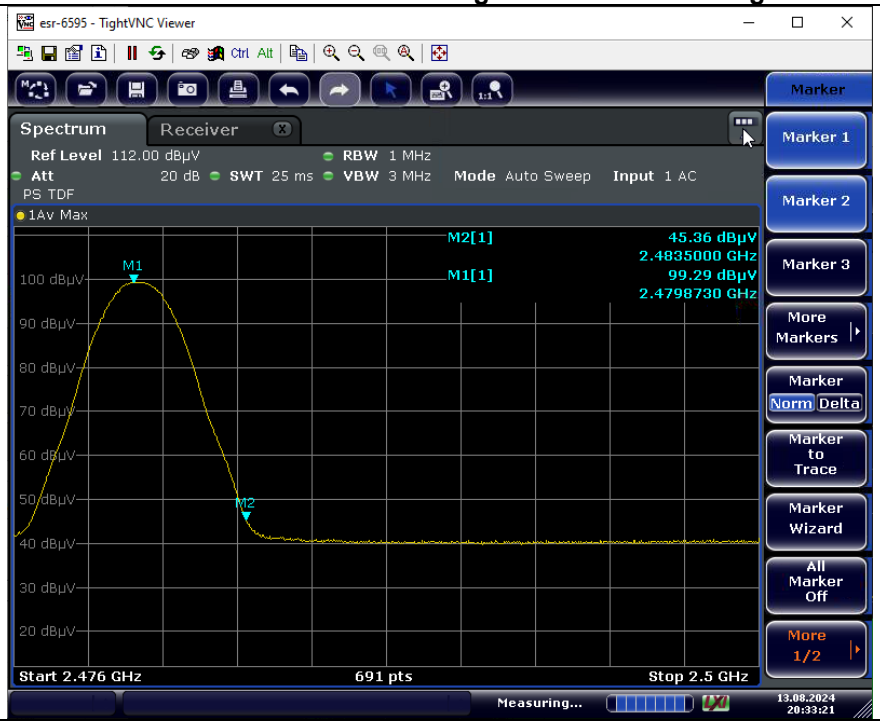
| 2402 MHz Restricted Band Edge Mode LE 1M Peak | 2402 MHz Restricted Band Edge Mode LE 1M Average |
|---|---|
|  |  |

| 2480 MHz Restricted Band Edge Mode LE 1M Peak | 2480 MHz Restricted Band Edge Mode LE 1M Average |
|---|---|
|  | |

**Restricted Band Edge Measurement Mode LE 2M**

| Measurement Frequency (MHz) | Measurement (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---|---|---|---|---|
| 2362 | 51.21 | 74 | 22.79 | Peak |
| 2362 | 40.51 | 54 | 13.49 | Average |
| 2483.5 | 60.22 | 74 | 13.78 | Peak |
| 2483.5 | 45.36 | 54 | 8.64 | Average |

| 2402 MHz Restricted Band Edge Mode LE 2M Peak | 2402 MHz Restricted Band Edge Mode LE 2M Average |
|---|---|
|  |  |

| 2480 MHz Restricted Band Edge Mode LE 2M Peak | 2480 MHz Restricted Band Edge Mode LE 2M Average |
|---|---|
|  |  |