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## TEST REPORT

Test report no.: 1-6411-23-01-34\_TR1-R01



### Testing laboratory

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#### Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS).

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number:

D-PL-12047-01-00.

ISED Testing Laboratory Recognized Listing Number: DE0001

FCC designation number: DE0002

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FCC - Title 47 CFR Part 15

FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

RSS - 247 Issue 3

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

For further applied test standards please refer to section 3 of this test report.

### Test Item

**Kind of test item:** Connected Infotainment Box / ConneCtivity Unit 3

**Model name:** CIBCCU3

**FCC ID:** 2AJW5CIBCCU3

**ISED certification number:** 21979-CIBCCU3

Frequency: 2400 MHz to 2483.5 MHz

Technology tested: Bluetooth® LE

Antenna: Integrated antenna

Power supply: 12.0 V DC by external power supply

Temperature range: -30°C to +70°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### Test report authorized:

Marco Bertolino  
Supervisor Radio Services  
Radio Labs

### Test performed:

Andreas Curette  
Lab Manager  
Radio Labs

## 1 Table of contents

<b>1</b>	<b>Table of contents</b>	<b>2</b>
<b>2</b>	<b>General information</b>	<b>3</b>
2.1	Notes and disclaimer	3
2.2	Application details	3
2.3	Test laboratories sub-contracted	3
<b>3</b>	<b>Test standard/s, references and accreditations</b>	<b>4</b>
<b>4</b>	<b>Reporting statements of conformity – decision rule</b>	<b>5</b>
<b>5</b>	<b>Test environment</b>	<b>6</b>
<b>6</b>	<b>Test item</b>	<b>6</b>
6.1	General description	6
6.2	Additional information	6
<b>7</b>	<b>Description of the test setup</b>	<b>7</b>
7.1	Shielded semi anechoic chamber	8
7.2	Shielded fully anechoic chamber	9
7.3	Radiated measurements > 18 GHz	10
7.4	Conducted measurements Bluetooth system	11
<b>8</b>	<b>Sequence of testing</b>	<b>12</b>
8.1	Sequence of testing radiated spurious 9 kHz to 30 MHz	12
8.2	Sequence of testing radiated spurious 30 MHz to 1 GHz	13
8.3	Sequence of testing radiated spurious 1 GHz to 18 GHz	14
8.4	Sequence of testing radiated spurious above 18 GHz	15
<b>9</b>	<b>Measurement uncertainty</b>	<b>16</b>
<b>10</b>	<b>Summary of measurement results</b>	<b>17</b>
<b>11</b>	<b>Additional comments</b>	<b>18</b>
<b>12</b>	<b>Measurement results</b>	<b>19</b>
12.1	System gain	19
12.2	Power spectral density	20
12.3	DTS bandwidth – 6 dB bandwidth	21
12.4	Occupied bandwidth – 99% emission bandwidth	22
12.5	Maximum output power	23
12.6	Band edge compliance radiated	24
12.7	TX spurious emissions conducted	26
12.8	Spurious emissions radiated below 30 MHz	27
12.9	Spurious emissions radiated 30 MHz to 1 GHz	30
12.10	Spurious emissions radiated above 1 GHz	32
<b>13</b>	<b>Observations</b>	<b>34</b>
<b>14</b>	<b>Glossary</b>	<b>35</b>
<b>15</b>	<b>Document history</b>	<b>36</b>

## 2 General information

### 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. cetecom advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### 2.2 Application details

Date of receipt of order:	2024-05-27
Date of receipt of test item:	2024-10-02
Start of test:*	2024-10-09
End of test:*	2025-03-24
Person(s) present during the test:	-/-

\*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

### 2.3 Test laboratories sub-contracted

None

### 3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15	-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 3	August 2023	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 5 incl. Amendment 1 & 2	February 2021	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus
Guidance	Version	Description
KDB 558074 D01	v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
ANSI C63.4a-2017	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2020	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

## 4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.

The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."

### measured value, measurement uncertainty, verdict



## 5 Test environment

Temperature	: T <sub>nom</sub> T <sub>max</sub> T <sub>min</sub>	+22 °C during room temperature tests No tests under extreme temperature conditions performed. No tests under extreme temperature conditions performed.
Relative humidity content	: 42 %	
Barometric pressure	: 1016 hpa	
Power supply	: V <sub>nom</sub> V <sub>max</sub> V <sub>min</sub>	12.0 V DC by external power supply No tests under extreme voltage conditions performed. No tests under extreme voltage conditions performed.

## 6 Test item

### 6.1 General description

Kind of test item	: Connected Infotainment Box / ConneCtivity Unit 3
Model name	: CIBCCU3
HMN	: -/
PMN	: CIBCCU3
HVIN	: CIBCCU3
FVIN	: -/
S/N serial number	: Rad. 24241640001000000 (Sample 1) Cond. 24322250001000000 (sample 3)
Hardware status	: AAA2426300400
Software status	: SP32
Frequency band	: 2400 MHz to 2483.5 MHz
Type of radio transmission	: Use of frequency spectrum
Type of modulation	: GFSK
Number of channels	: 40
Antenna	: Integrated antenna
Power supply	: 12.0 V DC by external power supply
Temperature range	: -30°C to +70°C

### 6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report:

1-6411-23-01-01\_TR1-A101-R01  
1-6411-23-01-01\_TR1-A102-R01  
1-6411-23-01-01\_TR1-A104-R01

## 7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

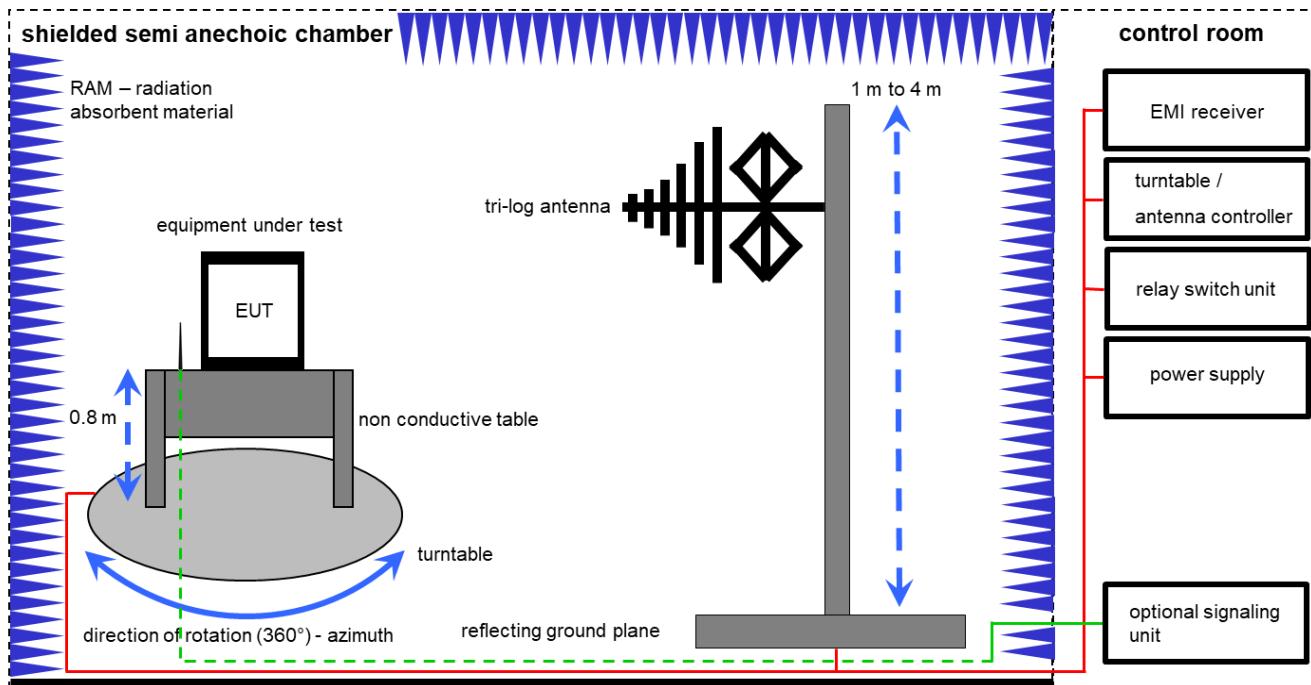
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

### Agenda: Kind of Calibration

k/cal	calibration / calibrated	EK	limited calibration
Ne/cnn	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
Ev/chk	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlk!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress
cpu	check prior usage		

## 7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter; EMC32 software version: 10.59.00

FS = UR + CL + AF

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

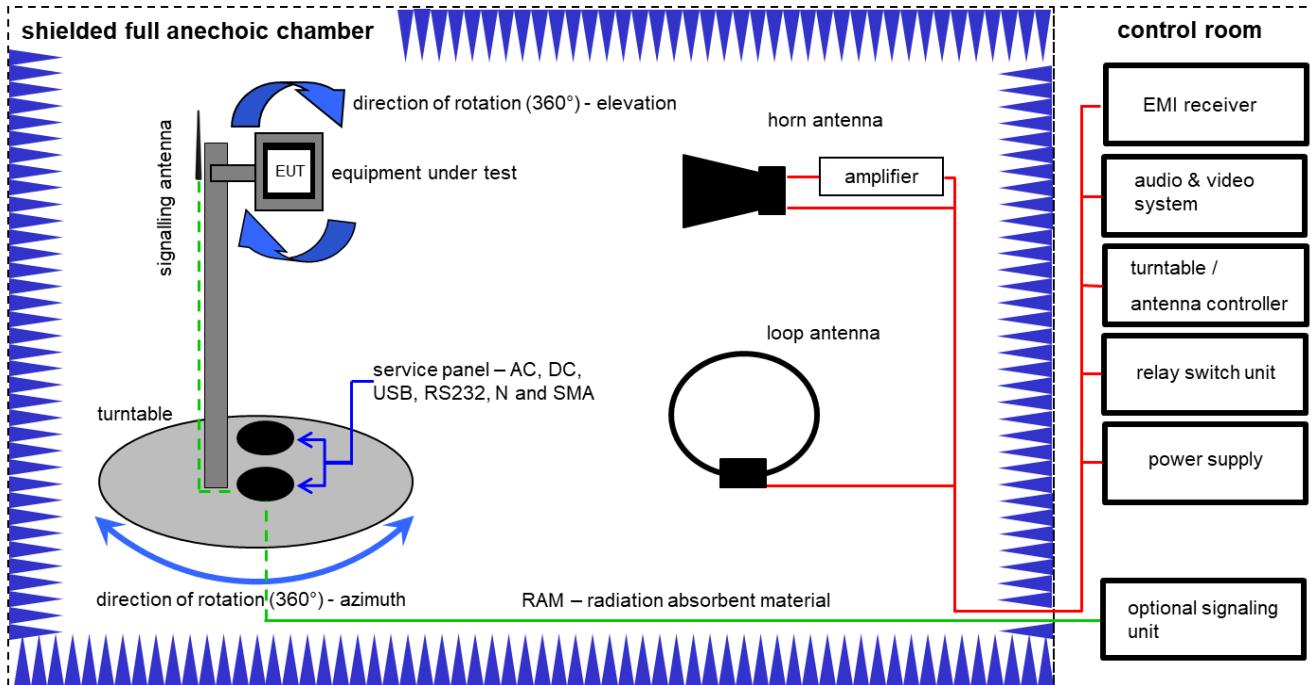
*Example calculation:*

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

**Equipment table:**

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Semi anechoic chamber	Semi anechoic chamber 3000023	MEC Import: MWB AG	-/-	40797	cnn	-/-	-/-
2	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz VULB9163	Schwarzbeck Mess-Elektronik OHG / Schönau	371	40798	cal	11.07.2024	11.07.2026
3	A	Turntable	Turntable 2089-4.0	EMCO Elektronik GmbH / Gilching	-/-	40799	cnn	-/-	-/-
4	A	Switch-Unit	Switch-Unit 3488A	Hewlett Packard	2719A14505	50160	cpu	-/-	-/-
5	A	Power Supply	Power Supply 6032A	Hewlett Packard	2920A04466	50161	cnn	-/-	-/-
6	A	Antenna Tower	Antenna Tower 2175	ETS-Lindgren GmbH / Taufkirchen	64762	50279	cnn	-/-	-/-
7	A	Positioning Controller	Positioning Controller 2090	ETS-Lindgren GmbH / Taufkirchen	64672	50280	cnn	-/-	-/-
8	A	EMI Test Receiver	EMI Test Receiver ESR3	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102587	50417	cal	05.12.2024	05.12.2025

## 7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter

FS = UR + CA + AF

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

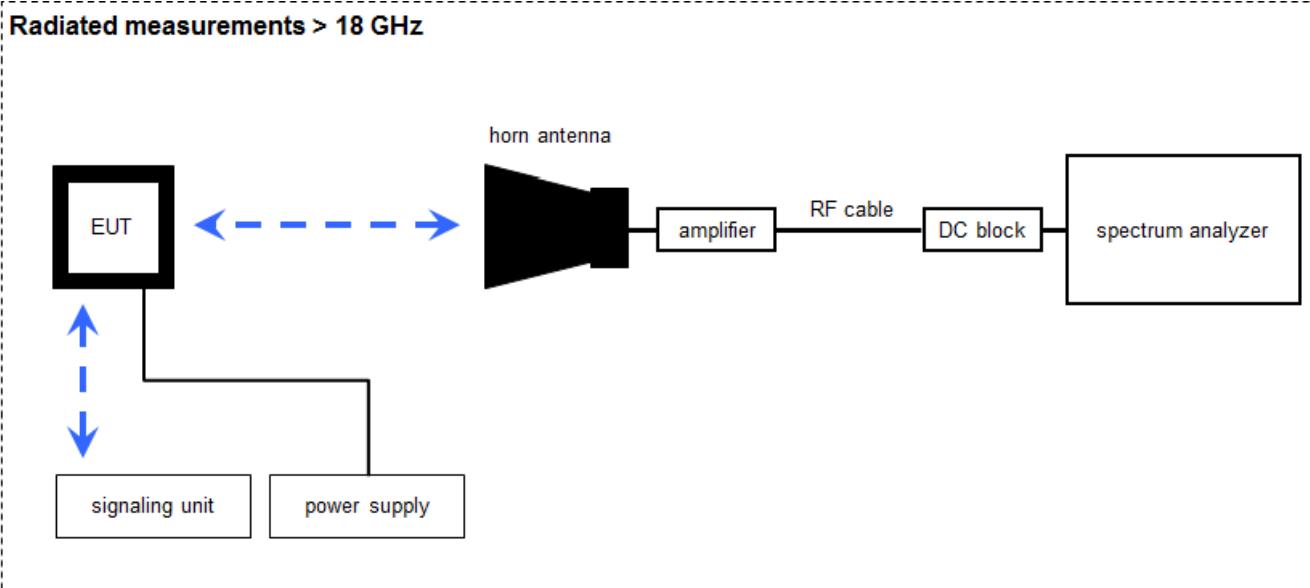
Example calculation:

$$\text{FS [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-35.8) \text{ [dB]} + 32.9 \text{ [dB/m]} = 37.1 \text{ [dB}\mu\text{V/m]} (71.61 \mu\text{V/m})$$

Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B, C	EMI Test Receiver	EMI Test Receiver ESR26	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101376	40301	cal	06.12.2024	06.12.2025
2	A, C	Double-Ridged Waveguide Horn Antenna	Double-Ridged Waveguide Horn Antenna 3115	EMCO Elektronik GmbH / Gilching	9107-3696	40342	cal	20.03.2023	19.03.2025
3	C	Highpass Filter	Highpass Filter WHK1.1/15G-10SS	Wainwright Instruments GmbH / Andechs	37	40362	cnn	-/-	-/-
4	C	Highpass Filter	Highpass Filter WHKX7.0/18G-8SS	Wainwright Instruments GmbH / Andechs	18	40364	cpu	-/-	-/-
5	C	Band Reject Filter	Band Reject Filter WRCG2400/2483-2375/2505-50/10SS	Wainwright Instruments GmbH / Andechs	26	40367	cpu	-/-	-/-
6	A, C	Broadband Amplifier 0.5-18 GHz	Broadband Amplifier 0.5-18 GHz CBLU5184540	MEC Import: CERNEX	22050	40374	cpu	-/-	-/-
7	A, B, C	4U RF Switch Platform	4U RF Switch Platform L4491A	Agilent Technologies Deutschland GmbH / Böblingen	MY50000032	40376	cnn	-/-	-/-
8	A, B, C	NEXIO EMV-Software	NEXIO EMV-Software BAT EMC V2022.0.32.0	MEC Import: NEXIO	-/-	40383	cnn	-/-	-/-
9	A, B, C	Anechoic chamber	Anechoic chamber	MEC Import: TDK	-/-	40385	cnn	-/-	-/-
10	A, B, C	Power Supply	Power Supply HMP2020	Rohde & Schwarz Messgerätebau GmbH / Memmingen	120626	40410	cal	02.05.2023	31.05.2025
11	B	Active Loop Antenna	Active Loop Antenna 6502	EMCO Elektronik GmbH / Gilching	2210	50044	cal	02.08.2023	02.08.2025

### 7.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

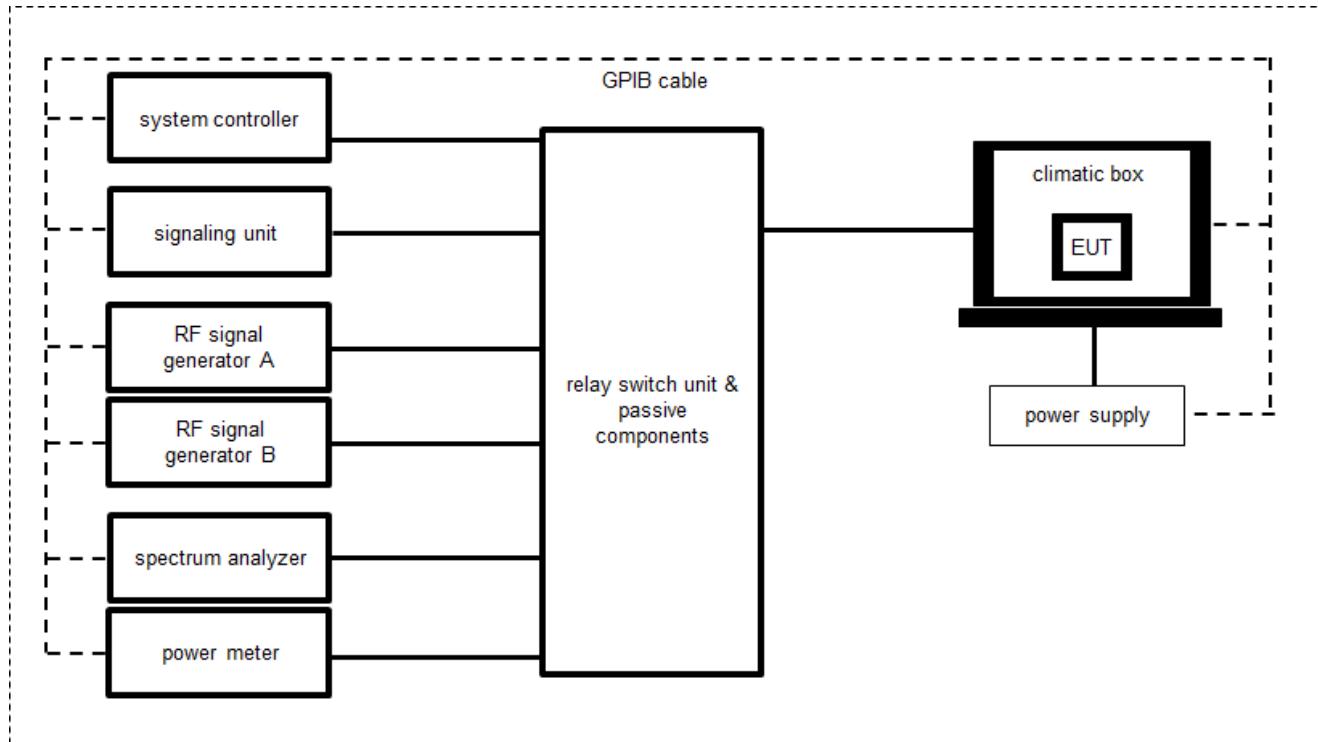
Example calculation:

$$FS \text{ [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-60.1) \text{ [dB]} + 36.74 \text{ [dB/m]} = 16.64 \text{ [dB}\mu\text{V/m]} (6.79 \mu\text{V/m})$$

#### Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal analyzer	Signal analyzer FSV30	Rohde & Schwarz Messgerätebau GmbH / Memmingen	1321.3008K30/103170	18373	cal	15.01.2025	15.01.2027
2	A	Tester Software RadioStar (C.BER2 for BT LE Conformance) System V 5.x, C.BER2 V 1.2.x.x	Tester Software RadioStar (C.BER2 for BT LE Conformance) System V 5.x, C.BER2 V 1.2.x.x	cetecom advanced GmbH / Saarbrücken	1	40407	cnn	-/-	-/-
3	A	USM	Switch Matrix	cetecom advanced GmbH / Saarbrücken	A001	40338	chk	30.01.2024	31.01.2025
4	A	Power supply	Power supply HMP2020	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102123	40401	cal	04.12.2024	04.12.2026
5	A	Microwave System Amplifier, 0.5-26.5 GHz	Microwave System Amplifier, 0.5-26.5 GHz 83017A	Hewlett Packard	00419	40014	cpu	-/-	-/-
6	A	Std. Gain Horn Antenna 18.0-26.5 GHz	Std. Gain Horn Antenna 18.0-26.5 GHz 638	Narda Microwave	8205	40085	cal	24.01.2024	31.01.2026

## 7.4 Conducted measurements Bluetooth system



OP = AV + CA  
(OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:

$$\text{OP [dBm]} = 6.0 \text{ [dBm]} + 11.7 \text{ [dB]} = 17.7 \text{ [dBm]} (58.88 \text{ mW})$$

**Equipment table:**

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal analyzer	Signal analyzer FSV30	Rohde & Schwarz Messgerätebau GmbH / Memmingen	1321.3008K3 0/103170	18373	cal	15.01.2025	15.01.2027
2	A	Signal generator	Signal generator SMB100A	Rohde & Schwarz Messgerätebau GmbH / Memmingen	1406.6000k0 3/180587	40307	cal	12.12.2023	31.12.2026
3	A	Wideband Radio Communication Tester	Wideband Radio Communication Tester CMW270	Rohde & Schwarz Messgerätebau GmbH / Memmingen	1201.0002k7 5/102550	40329	cal	06.12.2023	31.12.2025
4	A	USM	Switch Matrix	cetecom advanced GmbH / Saarbrücken	A001	40338	chk	30.01.2024	31.01.2025
5	A	Hygro-Thermometer	Hygro-Thermometer -/, 5-45°C, 20-100%F	Adolf Thies GmbH & Co. KG, Meteorologie - Umweltmesstechnik / Göttingen	without	40353	chk	15.09.2022	14.09.2024
6	A	Power supply	Power supply HMP2020	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102123	40401	cal	04.12.2024	04.12.2026
7	A	Tester Software RadioStar (C.BER2 for BT LE Conformance)	Tester Software RadioStar (C.BER2 for BT LE Conformance) System V 5.x, C.BER2 V 1.2.x.x	cetecom advanced GmbH / Saarbrücken	1	40407	cnn	-/-	-/-

## 8 Sequence of testing

### 8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premasurement\*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

#### Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

\*Note: The sequence will be repeated three times with different EUT orientations.

## 8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premereasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position  $\pm 45^\circ$  and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 8.4 Sequence of testing radiated spurious above 18 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

### Premereasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

### Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

## 9 Measurement uncertainty

<b>Measurement uncertainty</b>	
<b>Test case</b>	<b>Uncertainty</b>
Antenna gain	± 3 dB
Spectrum bandwidth	± 21.5 kHz absolute; ± 15.0 kHz relative
Maximum output power	± 1 dB
Detailed conducted spurious emissions @ the band edge	± 1 dB
Band edge compliance radiated	± 3 dB
Band edge compliance conducted	± 1.5 dB
Spurious emissions conducted	± 3 dB
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 4.1 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB

## 10 Summary of measurement results

<input checked="" type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input type="checkbox"/>	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15 RSS - 247, Issue 3	See table!	2025-05-27	-/-

Test specification clause	Test case	Guideline	Temperature conditions	Power source voltages	Mode	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (4)	System gain	-/-	Nominal	Nominal	1 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(e) RSS - 247 / 5.2 (b)	Power spectral density	KDB 558074 DTS clause: 8.4	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(a)(2) RSS - 247 / 5.2 (a)	DTS bandwidth – 6 dB bandwidth	KDB 558074 DTS clause: 8.2	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
RSS Gen clause 4.6.1	Occupied bandwidth	-/-	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(b)(3) RSS - 247 / 5.4 (4)	Maximum output power	KDB 558074 DTS clause: 8.3.1.1	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance cond. & rad.	KDB 558074 DTS clause: 8.7.2 or 8.7.3	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5	TX spurious emissions conducted	KDB 558074 DTS clause: 8.5	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.209(a) RSS - Gen	Spurious emissions radiated below 30 MHz	-/-	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
15.247(d) RSS - 247 / 5.5 §15.109 RSS - Gen	Spurious emissions radiated 30 MHz to 1 GHz	-/-	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5 §15.109 RSS - Gen	Spurious emissions radiated above 1 GHz	-/-	Nominal	Nominal	1 Msps 2 Msps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.107(a) §15.207	Conducted emissions below 30 MHz (AC conducted)	-/-	Nominal	Nominal	1 Msps	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-

**Note:** C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

## 11 Additional comments

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Reference documents: 1-6411-23-01-34\_TR1-A201-R1  
CIBCCU3\_Homologation instructions.pdf

Special test descriptions: None

Configuration descriptions:

Bluetooth Low Energy	
Longest Supported payload (37 – 255 Byte)	Tx: 255, RX: 255
LE 1M PHY supported	Yes
LE 2M PHY supported	No
Stable Modulation Index supported (SMI)	No
LE Coded PHY supported (S=2)	No
LE Coded PHY supported (S=8)	No

Test mode:  Bluetooth LE Test mode enabled  
(EUT is controlled by CMW)

Special software is used.  
EUT is transmitting pseudo random data by itself

Antennas and transmit operating modes:  Operating mode 1 (single antenna)
 

- *Equipment with 1 antenna,*
- *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
- *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*

Operating mode 2 (multiple antennas, no beamforming)
 

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.*

Operating mode 3 (multiple antennas, with beamforming)
 

- *Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.*
- *In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.*

## 12 Measurement results

### 12.1 System gain

**Limits:**

FCC	ISED
6 dBi / > 6 dBi output power and power density reduction required	

**Results:**

T <sub>nom</sub>	V <sub>nom</sub>	lowest channel 2402 MHz	middle channel 2441 MHz	highest channel 2480 MHz
Gain [dBi] Declared		4.3	3.6	2.7

## 12.2 Power spectral density

### Description:

Measurement of the power spectral density of a digital modulated system.

Measurement parameters	
External result file	1-6411-23-01-34_TR1-A201-R1 FCC Part 15.247 Peak Power Spectral Density DTS
Test setup	See sub clause 7.4 setup A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	ISED
Power spectral density	
For digitally modulated systems the transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0-second duration.	

### Results:

	Frequency		
	2402 MHz (2404 MHz for 2 Msps)	2440 MHz	2480 MHz (2478 MHz for 2 Msps)
<b>Power spectral density [dBm / 3kHz] 1 Msps</b>	-16.88	-16.99	-16.17

## 12.3 DTS bandwidth – 6 dB bandwidth

### Description:

Measurement of the 6 dB bandwidth of the modulated signal.

Measurement parameters	
External result file	1-6411-23-01-34_TR1-A201-R1 FCC Part 15.247 Bandwidth 6dB DTS
Test setup	See sub clause 7.4 setup A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	ISED
DTS bandwidth – 6 dB bandwidth	
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

### Results:

	Frequency		
	2402 MHz (2404 MHz for 2 Msps)	2440 MHz	2480 MHz (2478 MHz for 2 Msps)
<b>6 dB bandwidth [kHz] 1 Msps</b>	661	660	659

## 12.4 Occupied bandwidth – 99% emission bandwidth

### Description:

Measurement of the 99% bandwidth of the modulated signal acc. RSS-GEN.

Measurement parameters	
External result file	1-6411-23-01-34_TR1-A201-R1 FCC Part 15.247 Bandwidth 99PCT-20dB
Test setup	See sub clause 7.4 setup A
Measurement uncertainty	See sub clause 9

### Usage:

-/-	ISED
Occupied bandwidth – 99% emission bandwidth	
OBW is necessary for emission designator	

### Results:

	Frequency		
	2402 MHz (2404 MHz for 2 Msps)	2440 MHz	2480 MHz (2478 MHz for 2 Msps)
<b>99% bandwidth [kHz] 1 Msps</b>	1029	1028	1028

## 12.5 Maximum output power

### Description:

Measurement of the maximum output power conducted. EUT in single channel mode.

Measurement parameters	
External result file	1-6411-23-01-34_TR1-A201-R1 FCC Part 15.247 Maximum Peak Conducted Output Power DTS
Test setup	See sub clause 7.4 setup A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	ISED
Maximum output power	
Conducted: 1.0 W – antenna gain max. 6 dBi	

### Results:

	Frequency		
	2402 MHz (2404 MHz for 2 Msps)	2440 MHz	2480 MHz (2478 MHz for 2 Msps)
<b>Maximum output power conducted [dBm] 1 Msps</b>	-1.17	-1.41	-0.45

## 12.6 Band edge compliance radiated

### Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to single channel mode and the transmit frequency 2402 MHz for the lower restricted band and 2480 MHz for the upper restricted band. Measurement distance is 3m.

Measurement parameters	
Detector	Peak / RMS
Sweep time	Auto
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Span	Lower Band: 2300 – 2400 MHz higher Band: 2480 – 2500 MHz
Trace mode	Max hold
Test setup	See sub clause 7.2 setup A
Measurement uncertainty	See sub clause 9

### Limits:

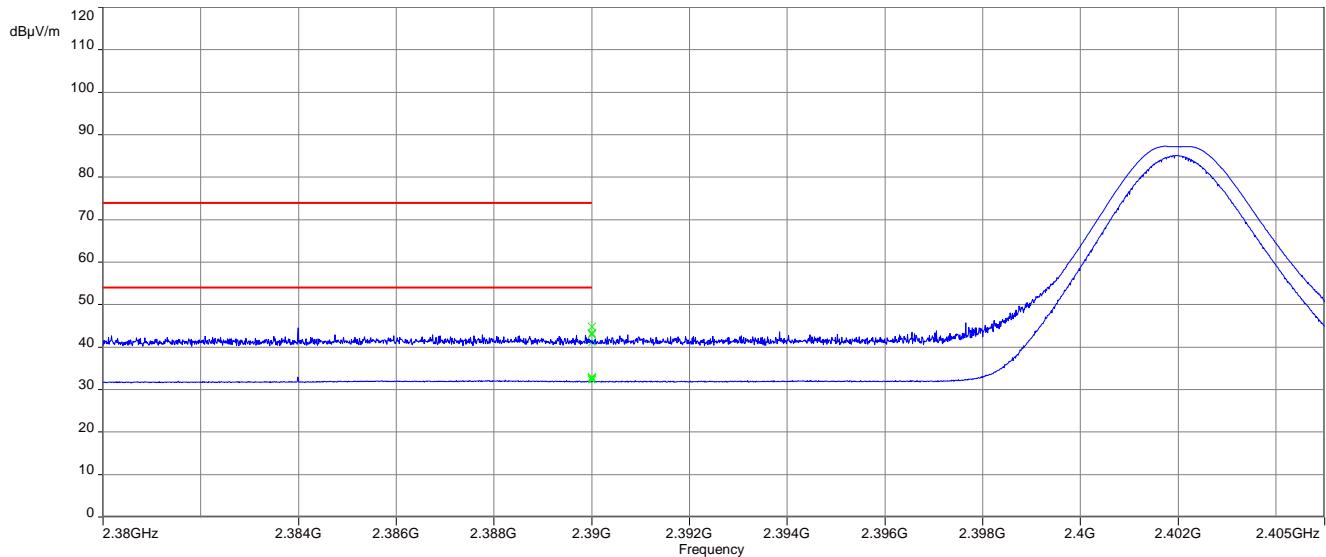
FCC	ISED
Band edge compliance radiated	
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).	
54 dB $\mu$ V/m AVG 74 dB $\mu$ V/m Peak	

### Result:

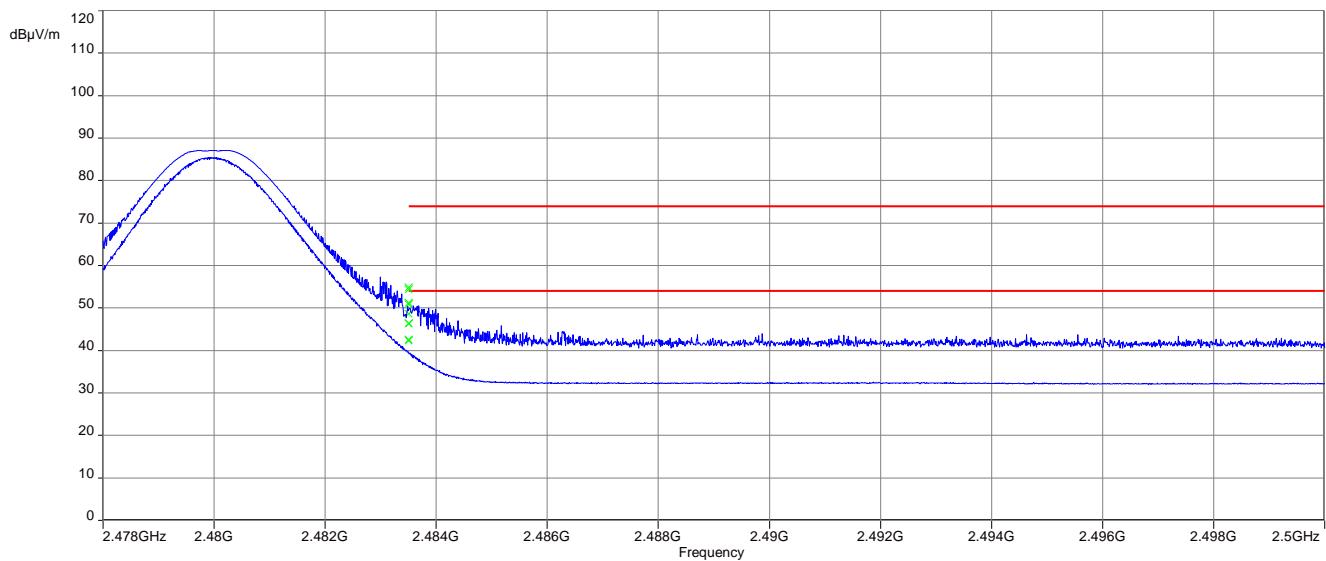
Scenario	Band edge compliance radiated [dB $\mu$ V/m]
Data rate	1 Msps
Lower restricted band	33.0 dB $\mu$ V/m AVG 44.8 dB $\mu$ V/m Peak
Upper restricted band	46.5 dB $\mu$ V/m AVG 54.8 dB $\mu$ V/m Peak

**Plots:**

**Plot 1: Lower restricted band, 1 Msps**



**Plot 2: Upper restricted band, 1 Msps**



## 12.7 TX spurious emissions conducted

### Description:

Measurement of the conducted spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit frequencies are 2402 MHz, 2440 MHz and 2480 MHz.

Measurement parameters	
External result file	1-6411-23-01-34_TR1-A201-R1 FCC Part 15.247 TX Spurious Conducted
Test setup	See sub clause 7.4 setup A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	ISED
TX spurious emissions conducted	
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. Attenuation below the general limits specified in Section 15.209(a) is not required	

**Results:** Compliant (see external result file)

## 12.8 Spurious emissions radiated below 30 MHz

### Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit frequencies are 2402 MHz, 2440 MHz and 2480 MHz. The limits are recalculated to a measurement distance of 3 m according the ANSI C63.10.

Measurement parameters	
Detector	Peak / Quasi peak
Sweep time	Auto
Resolution bandwidth	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth	F < 150 kHz: 1 kHz F > 150 kHz: 30 kHz
Span	9 kHz to 30 MHz
Trace mode	Max hold
Test setup	See sub clause 7.2 setup B
Measurement uncertainty	See sub clause 9

### Limits:

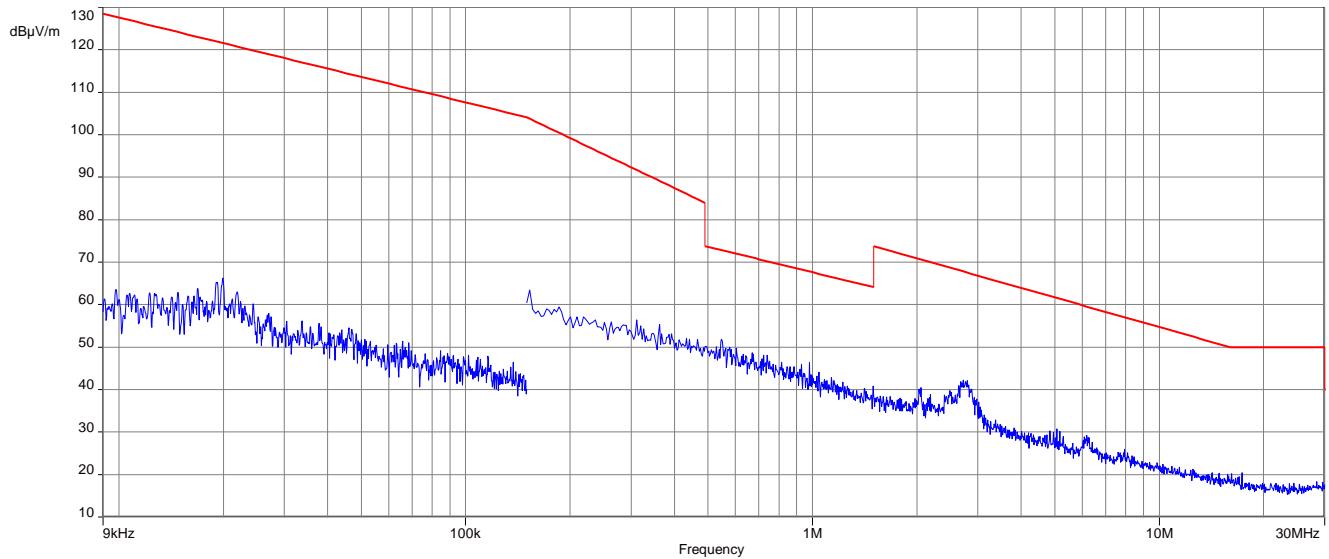
FCC	ISED	
TX spurious emissions radiated below 30 MHz		
Frequency (MHz)	Field strength ( $\mu$ V/m)	Measurement distance (m)
0.009 – 0.490	$2400/F(\text{kHz})$	300
0.490 – 1.705	$24000/F(\text{kHz})$	30
1.705 – 30.0	30	30

### Results:

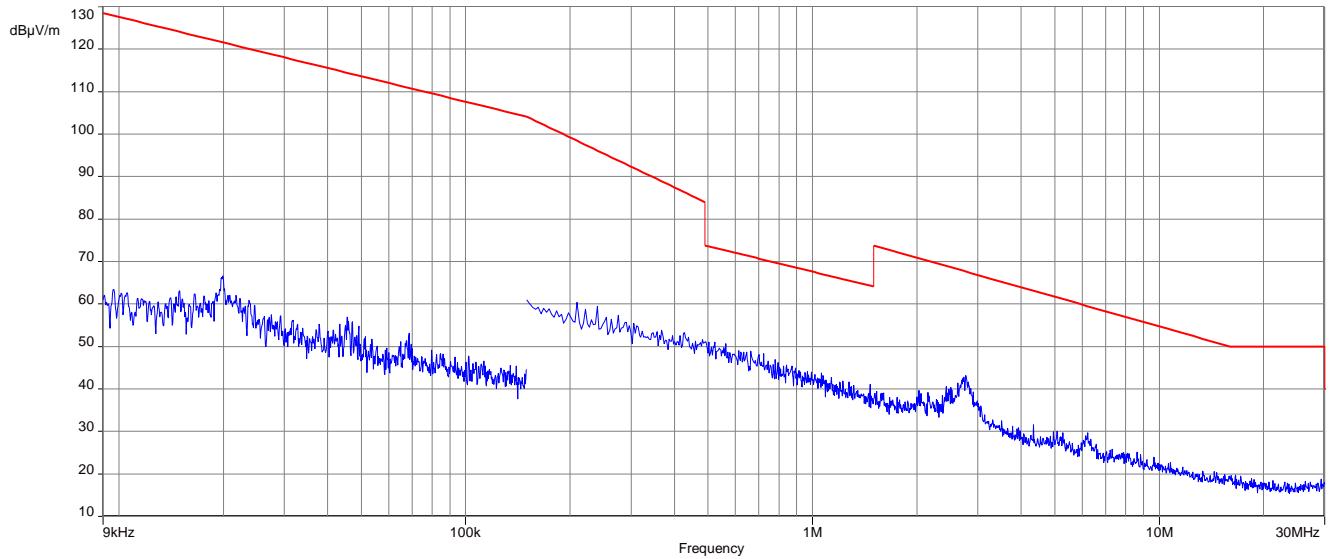
TX spurious emissions radiated below 30 MHz [ $\text{dB}\mu\text{V/m}$ ]		
F [MHz]	Detector	Level [ $\text{dB}\mu\text{V/m}$ ]
All detected emissions are more than 20 dB below the limit.		

**Plots:**

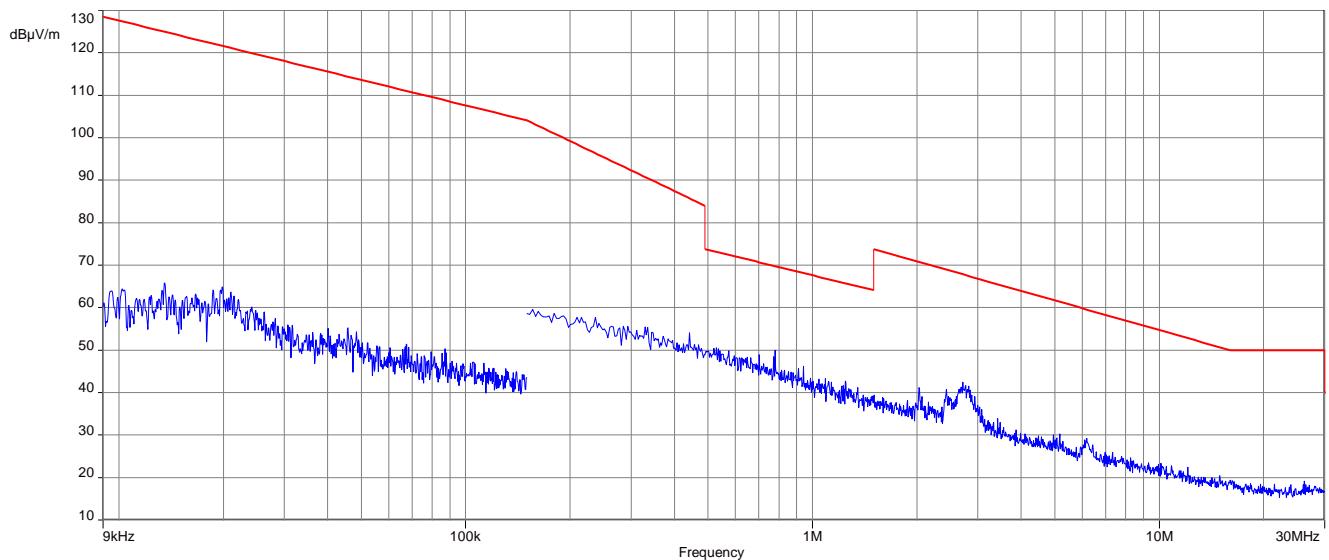
**Plot 1: 9 kHz to 30 MHz, 2402 MHz, transmit mode, 1 Msps**



**Plot 2: 9 kHz to 30 MHz, 2440 MHz, transmit mode, 1 Msps**



**Plot 3: 9 kHz to 30 MHz, 2480 MHz, transmit mode, 1 Msps**



## 12.9 Spurious emissions radiated 30 MHz to 1 GHz

### Description:

Measurement of the radiated spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit frequencies are 2402 MHz, 2440 MHz and 2480 MHz.

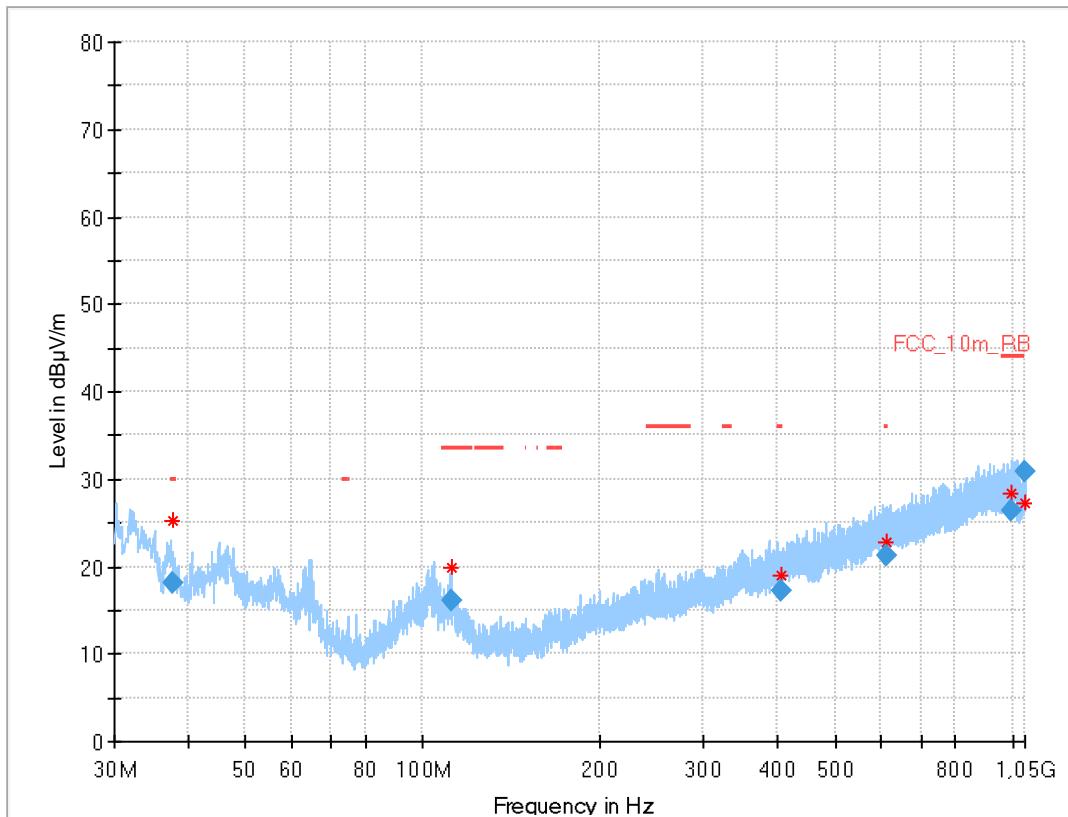
Measurement parameters	
Detector	Peak / Quasi Peak
Sweep time	Auto
Resolution bandwidth	120 kHz
Video bandwidth	3 x RBW
Span	30 MHz to 1 GHz
Trace mode	Max hold
Measured modulation	GFSK
Test setup	See sub clause 7.1 setup A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	ISED															
TX spurious emissions radiated																
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. Attenuation below the general limits specified in Section 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)).																
§15.209																
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Frequency (MHz)</th><th style="text-align: center;">Field strength (dB<math>\mu</math>V/m)</th><th style="text-align: center;">Measurement distance (m)</th></tr> </thead> <tbody> <tr> <td style="text-align: center;">30 - 88</td><td style="text-align: center;">30.0</td><td style="text-align: center;">10</td></tr> <tr> <td style="text-align: center;">88 - 216</td><td style="text-align: center;">33.5</td><td style="text-align: center;">10</td></tr> <tr> <td style="text-align: center;">216 - 960</td><td style="text-align: center;">36.0</td><td style="text-align: center;">10</td></tr> <tr> <td style="text-align: center;">Above 960</td><td style="text-align: center;">54.0</td><td style="text-align: center;">3</td></tr> </tbody> </table>		Frequency (MHz)	Field strength (dB $\mu$ V/m)	Measurement distance (m)	30 - 88	30.0	10	88 - 216	33.5	10	216 - 960	36.0	10	Above 960	54.0	3
Frequency (MHz)	Field strength (dB $\mu$ V/m)	Measurement distance (m)														
30 - 88	30.0	10														
88 - 216	33.5	10														
216 - 960	36.0	10														
Above 960	54.0	3														

**Plots:** Transmit mode

**Plot 1:** 30 MHz to 1 GHz, TX mode, vertical & horizontal polarization, 1 Msps, valid for all channels



**Final results:**

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.799	18.01	30.0	12.0	1000	120.0	131.0	V	260	14
111.590	16.07	33.5	17.4	1000	120.0	109.0	V	-21	13
406.940	17.20	36.0	18.8	1000	120.0	165.0	H	22	18
612.790	21.32	36.0	14.7	1000	120.0	170.0	H	-16	22
998.827	26.38	44.0	17.6	1000	120.0	170.0	H	249	26
1049.800	30.75	44.0	13.3	1000	120.0	170.0	H	112	27

## 12.10 Spurious emissions radiated above 1 GHz

### Description:

Measurement of the radiated spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit frequencies are 2402 MHz, 2440 MHz and 2480 MHz.

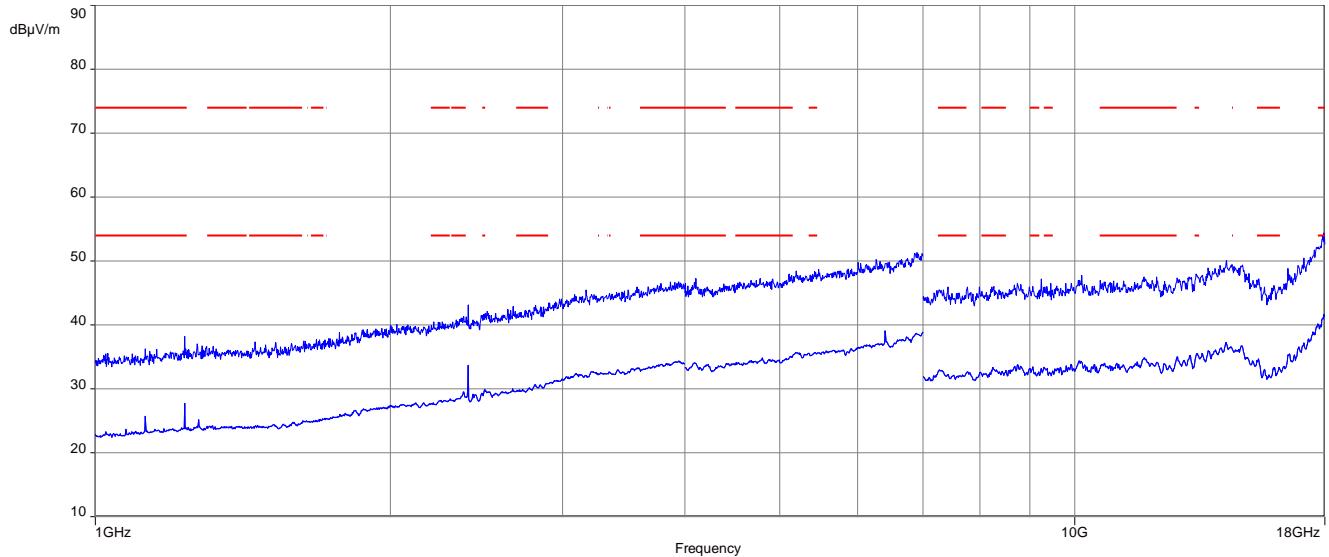
Measurement parameters	
Detector	Peak / RMS
Sweep time	Auto
Resolution bandwidth	1 MHz
Video bandwidth	3 x RBW
Span	1 GHz to 26 GHz
Trace mode	Max hold
Measured modulation	GFSK
Test setup	See sub clause 7.2 setup C (1 GHz - 18 GHz) See sub clause 7.3 setup A (18 GHz - 26 GHz)
Measurement uncertainty	See sub clause 9

### Limits:

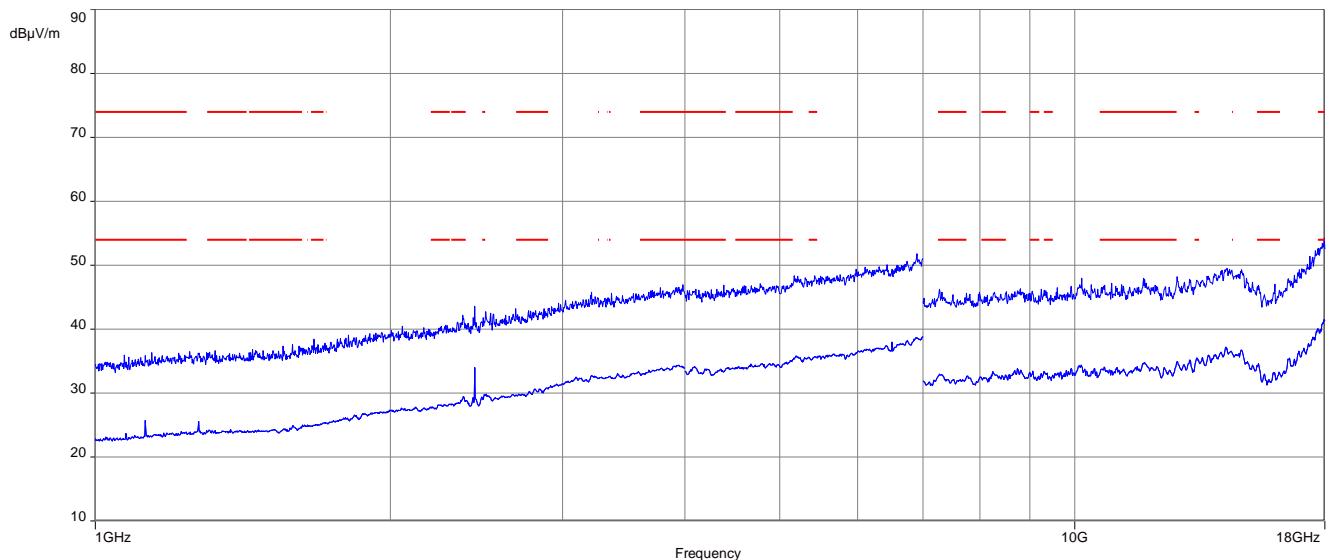
FCC	ISED		
TX spurious emissions radiated			
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 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)).			
§15.209			
Frequency (MHz)		Field strength (dB $\mu$ V/m)	Measurement distance (m)
Above 960		54.0 (Average)	3
Above 960		74.0 (Peak)	3

### Results: Transmitter mode, 1 Msps

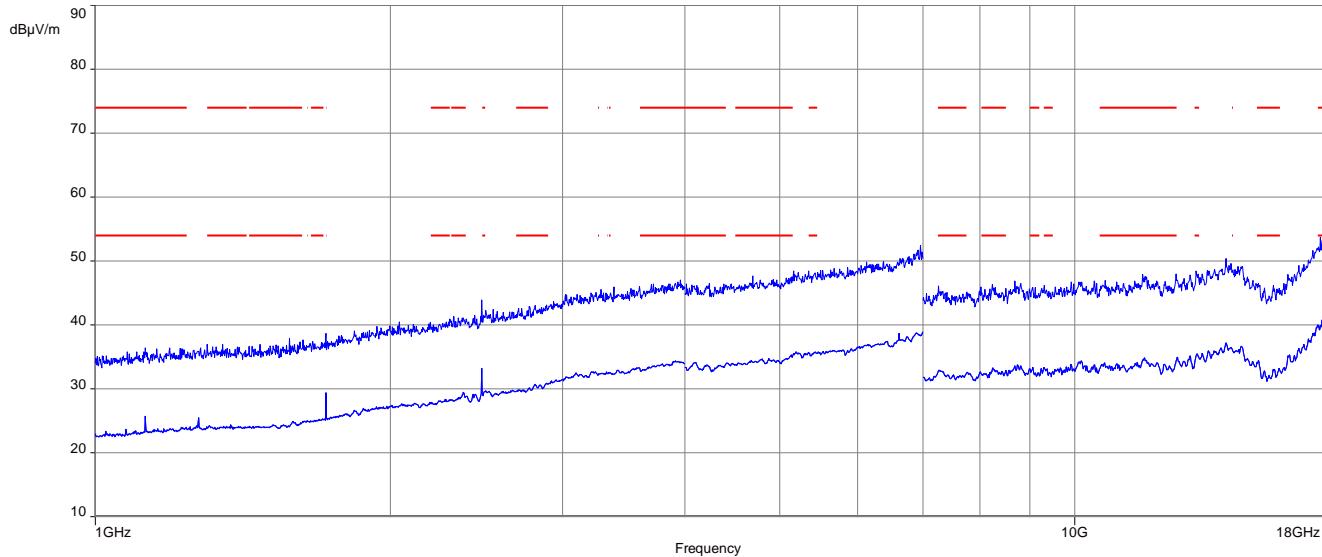
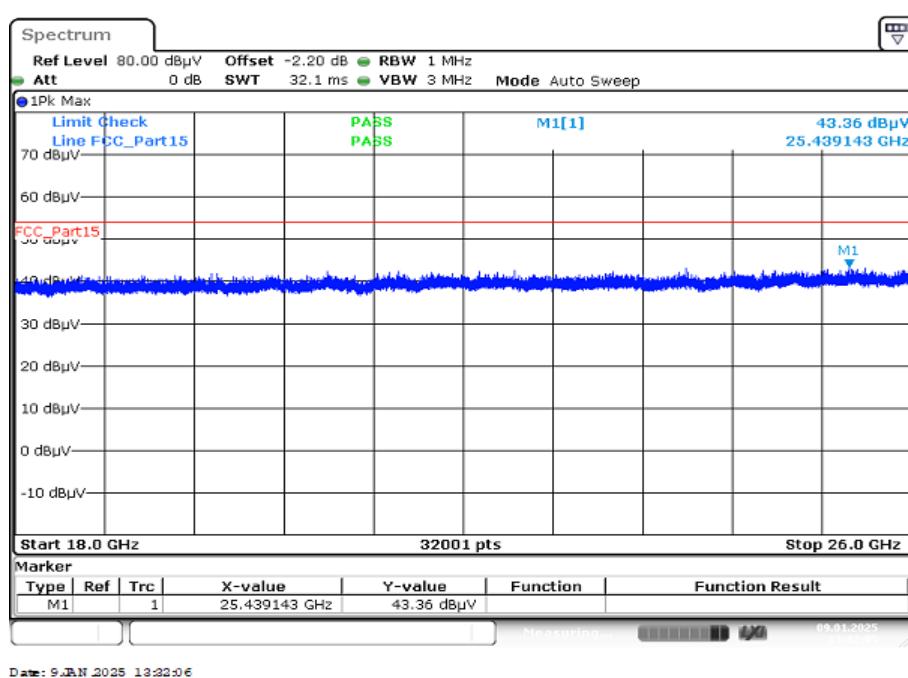
TX spurious emissions radiated [dB $\mu$ V/m]								
2402 MHz			2440 MHz			2480 MHz		
F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]
All detected emissions are more than 20 dB below the limit.								
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-

**Plots:** Transmitter mode**Plot 1:** 1 GHz to 18 GHz, TX mode, 2402 MHz, vertical & horizontal polarization, 1 Msps

The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 2:** 1 GHz to 18 GHz, TX mode, 2440 MHz, vertical & horizontal polarization, 1 Msps

The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 3:** 1 GHz to 18 GHz, TX mode, 2480 MHz, vertical & horizontal polarization, 1 Msps**Plot 4:** 18 GHz to 26 GHz, TX mode, vertical & horizontal polarization, 1 Msps, valid for all channels

## 13 Observations

No observations except those reported with the single test cases have been made.

## 14 Glossary

<b>AVG</b>	Average
<b>C</b>	Compliant
<b>C/N<sub>0</sub></b>	Carrier to noise-density ratio, expressed in dB-Hz
<b>CAC</b>	Channel availability check
<b>CW</b>	Clean wave
<b>DC</b>	Duty cycle
<b>DFS</b>	Dynamic frequency selection
<b>DSSS</b>	Dynamic sequence spread spectrum
<b>DUT</b>	Device under test
<b>EN</b>	European Standard
<b>ETSI</b>	European Telecommunications Standards Institute
<b>EMC</b>	Electromagnetic Compatibility
<b>EUT</b>	Equipment under test
<b>FCC</b>	Federal Communications Commission
<b>FCC ID</b>	Company Identifier at FCC
<b>FHSS</b>	Frequency hopping spread spectrum
<b>FVIN</b>	Firmware version identification number
<b>GNSS</b>	Global Navigation Satellite System
<b>GUE</b>	GNSS User Equipment
<b>HMN</b>	Host marketing name
<b>HVIN</b>	Hardware version identification number
<b>HW</b>	Hardware
<b>IC</b>	Industry Canada
<b>Inv. No.</b>	Inventory number
<b>MC</b>	Modulated carrier
<b>NA</b>	Not applicable
<b>NC</b>	Not compliant
<b>NOP</b>	Non occupancy period
<b>NP</b>	Not performed
<b>OBW</b>	Occupied bandwidth
<b>OC</b>	Operating channel
<b>OCW</b>	Operating channel bandwidth
<b>OFDM</b>	Orthogonal frequency division multiplexing
<b>OOB</b>	Out of band
<b>OP</b>	Occupancy period
<b>PER</b>	Packet error rate
<b>PMN</b>	Product marketing name
<b>PP</b>	Positive peak
<b>QP</b>	Quasi peak
<b>RLAN</b>	Radio local area network
<b>S/N or SN</b>	Serial number
<b>SW</b>	Software
<b>UUT</b>	Unit under test
<b>WLAN</b>	Wireless local area network

## 15 Document history

Version	Applied changes	Date of release
R01	Initial release	2025-05-27

##### END OF TEST REPORT #####