

Test Report

Verified code: 662675

Report No.: E202309059135-01-6

Customer: Kräemer Automotive Systems GmbH

Address: Obere Wässere 6-8 72764 Reutlingen Germany

Sample Name: Bentley Infotainment System(BIS)

Sample Model: KR-BIS

Receive Sample Date: Sep.22,2023

Test Date: Jan.08,2024 ~ May.06,2024

Reference Document: 47 CFR, FCC Part 15 Subpart C
RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators

Test Result: Pass

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GRG METROLOGY & TEST GROUP CO., LTD.

Issued Date: 2024-07-23

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E202309059135-01-6	Original Issue	2024-05-21

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1. TEST RESULT SUMMARY

Technical Requirements		
47 CFR, FCC Part 15 Subpart C 15.247 ANSI C63.10-2020 KDB 558074 D01 15.247 measurement guidance v05r02		
Limit / Severity	Item	Result
§15.203	Antenna Requirement	Pass ¹⁾
§15.207(a)	Conducted Emission	N/A ²⁾
§15.247(d)&15.205& 15.209	Radiated Spurious Emission	Pass
§15.247(b)(3)	Maximum Peak Output Power	Pass
§15.247(e)	Power Spectral Density	Pass
§15.247(a)(2)	6dB bandwidth	Pass
§15.247(d)	Conducted band edges and Spurious Emission	Pass
§15.247(d)&15.205& 15.209	Restricted bands of operation	Pass

Note:

- 1) The antenna is Ceramics antenna. The max gain of antenna is 2.47dBi.which accordance 15.203.is considered sufficient to comply with the provisions of this section.
- 2) Test is not applicable to this Equipment. This EUT is no AC mains power ports.

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2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name: Kräemer Automotive Systems GmbH
Address: Obere Wässere 6-8 72764 Reutlingen Germany

2.2 MANUFACTURER

Name: Kräemer Automotive Systems GmbH
Address: Obere Wässere 6-8 72764 Reutlingen Germany

2.3 FACTORY

Name : Huizhou Foryou General Electronics Co., Ltd.
Address : No.2 District A, Foryou Industry Park, No. 1 North Shangxia Road, Dongjiang
Hi tech Industry Park, 516005 Huizhou city, Guangdong Province, China(PROC)

2.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: Bentley Infotainment System(BIS)
Model No.: KR-BIS
Trade Mark: BENTLEY
FCC ID: 2AD6S-KRBIS
Power supply: DC 12V, 15A
Frequency Band: 2402MHz-2480MHz
Transmit Power: GFSK for 1Mbps:4.32dBm
Modulation type: GFSK for 1Mbps
Channel space: 2MHz
Antenna Specification: Ceramics antenna with 2.47dBi gain (Max.)
Temperature Range: -20 °C ~ 60 °C
Hardware Version: V0.1
Software Version: V00.00.01
Sample No: E202309059135-01-0001, E202309059135-01-0002

Note : The EUT antenna gain is provided by the applicant. This report is made solely on the basis of such data and/or information. We accept no responsibility for the authenticity and completeness of the above data and information and the validity of the results and/or conclusions.

2.5 CHANNELIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
*00	2402	10	2422	20	2442	30	2462
01	2404	11	2424	21	2444	31	2464
02	2406	12	2426	22	2446	32	2466
03	2408	13	2428	23	2448	33	2468
04	2410	14	2430	24	2450	34	2470
05	2412	15	2432	25	2452	35	2472
06	2414	16	2434	26	2454	36	2474
07	2416	17	2436	27	2456	37	2476
08	2418	18	2438	28	2458	38	2478
09	2420	*19	2440	29	2460	*39	2480

* is the test frequency

2.6 TEST OPERATION MODE

Mode No.	Description of the modes
1	Bluetooth (BLE) fixed frequency transmitting

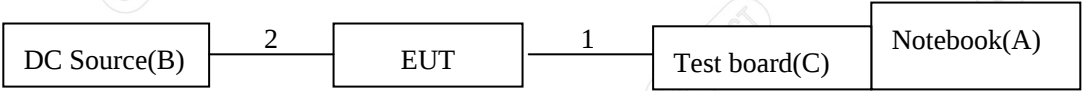
2.7 LOCAL SUPPORTIVE

No.	Name of Equipment	Manufacturer	Model	Serial Number
A	Notebook	DELL	Latitude3400	8RZFJW2
B	DC source	KEYSIGHT	E36131A	MY59001135
C	Test board	/	/	/

No.	Cable Type	Qty.	Shielded Type	Ferrite Core(Qty.)	Length
1	Serial cable	1	No	0	0.3m
2	DC cable	1	Yes	0	0.8m

Note: The notebook is just used to produce fixed frequency transmitting.

2.8 CONFIGURATION OF SYSTEM UNDER TEST



Test software:

Software version	Test level
RTLB TAPP	default

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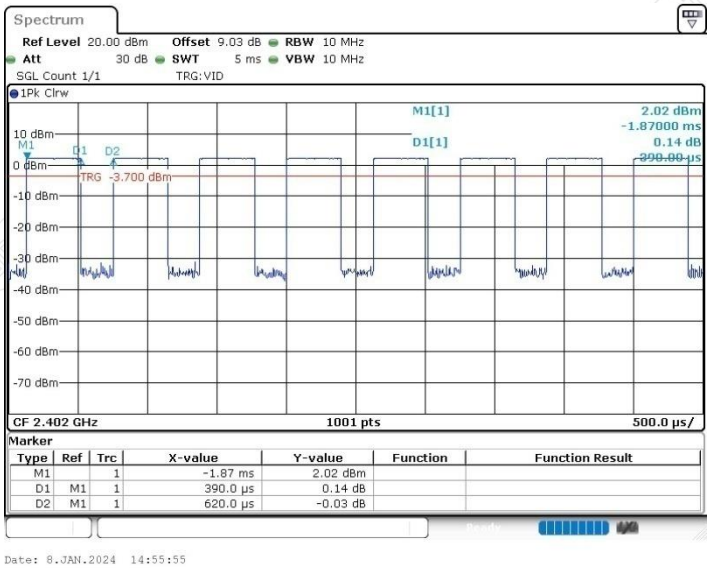
2.9 DUTY CYCLE

Environment: 20.1℃/68%RH/101.0kPa
Tested By: Huang Tianmei

Voltage: DC 12V
Date: 2024-01-08

Test Mode	Antenna	Frequency [MHz]	ON Time [ms]	Period [ms]	DC [%]	T [s]
BLE_1M	Ant1	2402	0.39	0.62	62.90	0.00039

BLE_1M_2402MHz



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3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of GRG METROLOGY & TEST GROUP CO., LTD.

Add.: No.1301 Guangang Road Xinlan Community, Guanlan Street, Longhua District
Shenzhen, 518110, People's Republic of China

P.C.: 518110

Tel : 0755-61180008

Fax: 0755-61180008

3.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

USA A2LA(Certificate #2861.01)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada ISED (Company Number: 24897, CAB identifier:CN0069)

USA FCC (Registration Number: 759402, Designation Number:CN1198)

Copies of granted accreditation certificates are available for downloading from our web site,
<http://www.grgtest.com>

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4. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Emission	X	9kHz~30MHz	4.4dB ¹⁾
	Y	9kHz~30MHz	4.4dB ¹⁾
	Z	9kHz~30MHz	4.4dB ¹⁾
	Horizontal	30MHz~200MHz	4.6dB ¹⁾
		200MHz~1000MHz	4.8dB ¹⁾
		1GHz~18GHz	5.0dB ¹⁾
		18GHz~26.5GHz	5.2dB ¹⁾
	Vertical	30MHz~200MHz	4.7dB ¹⁾
		200MHz~1000MHz	4.7dB ¹⁾
		1GHz~18GHz	5.1dB ¹⁾
		18GHz~26.5GHz	5.4dB ¹⁾

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.80dB
Power spectral density conducted	0.80dB
Occupied channel bandwidth	0.40dB
Unwanted emission, conducted	0.70dB
Humidity	6.0%
Temperature	2.0°C

Note:

¹⁾ This uncertainty represents an expanded uncertainty expressed at approximately the 95%.
This uncertainty represents an expanded uncertainty factor of $k=2$.

5. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Radiated Spurious Emission&Restricted bands of operation				
Test S/W	EZ	CCS-03A1		
Loop Antenna	Schwarzbeck	FMZB 1513-60	1513-60-56	2024-07-15
Loop Antenna	Schwarzbeck	FMZB 1513-60	1513-60-56	2025-05-07
Preamplifier	SHIRONG ELECTRONIC	DLNA-30M1G-G40	20200928001	2025-01-30
Bi-log Antenna	Schwarzbeck	VULB9160	VULB9160-3402	2024-10-06
Horn Antenna	Schwarzbeck	BBHA 9120D	02143	2024-09-23
Test Receiver	R&S	ESR26	101758	2024-09-22
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-497	2024-09-18
Amplifier	Tonscend	TAP01018048	AP20E8060075	2025-03-01
Amplifier	Tonscend	TAP184050	AP20E806071	2025-03-01
Amplifier	SHIRONG ELECTRONIC	DLNA-1G18G-G40	20200928005	2024-08-17
Test S/W	Tonscend	JS36-RE/2.5.1.5		
6dB Bandwidth&Conducted band edges and Spurious Emission&Power Spectral Density				
Spectrum Analyzer	R&S	FSV30	1321.3008K30-104381-rH	2024-10-13
Automatic control unit	TONSCEND	JS0806-2	2018060317	2024-08-04
BT/WIFI System	Tonscend	JS1120-3		
Maximum peak output power				
Pulse power sensor	Anristu	MA2411B	1126150	2024-02-12
Pulse power sensor	Anristu	MA2411B	1126150	2025-01-11
Power meter	Anristu	ML2495A	1204003	2024-02-12
Power meter	Anristu	ML2495A	1204003	2025-01-11

Note:

1. The calibration cycle of the above instruments is 12 months.

6. RADIATED SPURIOUS EMISSIONS

6.1 LIMITS

In any 100kHz 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 20dB below that in the 100kHz 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. Attenuation below the general limits specified in §15.209(a) is not required.

Frequency (MHz)	Quasi-peak($\mu\text{V/m}$)	Measurement distance(m)	Quasi-peak(dB $\mu\text{V/m}$)@distance 3m
0.009-0.490	2400/F(kHz)	300	128.5~93.8
0.490-1.705	24000/F(kHz)	30	73.8~63
1.705-30.0	30	30	69.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

NOTE:

- (1) The emission limits for the ranges 9-90kHz and 110-490kHz are based on measurements employing a linear average detector.
- (2) The lower limit shall apply at the transition frequencies.
- (3) Above 18GHz test distance is 1m, so the Peak Limit=74+20*log(3/1)=83.54 (dB $\mu\text{V/m}$).
The Avg Limit=54+20*log(3/1)=63.54 (dB $\mu\text{V/m}$).

6.2 TEST PROCEDURES

a) Sequence of testing 9kHz to 30MHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 0.8m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were positioned to simulate fixed frequency transmitting conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3meter.
- The EUT was set into operation.

Pre measurement:

- The turntable rotates from 0 ° to 360 °.
- The antenna height is 1.0 meter.
- The antenna is polarized X,Y and Z.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

- Identified emissions during the pre measurement the software maximizes by rotating the turntable

position (0 ° to 360 °) and by rotating the elevation axes (0 ° to 360 °).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QP detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement and the limit will be stored.

b) Sequence of testing 30MHz to 1GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8m 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 were positioned to simulate fixed frequency transmitting conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 ° to 360 °.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 4 meter.

--- 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 will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of pre measurement the software maximize the peaks by changing turntable rotates from 0 ° to 360 ° and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

c) Sequence of testing 1GHz to 18GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate fixed frequency transmitting conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

- The turntable rotates from 0 °to 360 °.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 4 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of pre measurement the software maximize the peaks by changing turntable rotates from 0 °to 360 °and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

d) Sequence of testing above 18GHz**Setup:**

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate fixed frequency transmitting conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

Pre measurement:

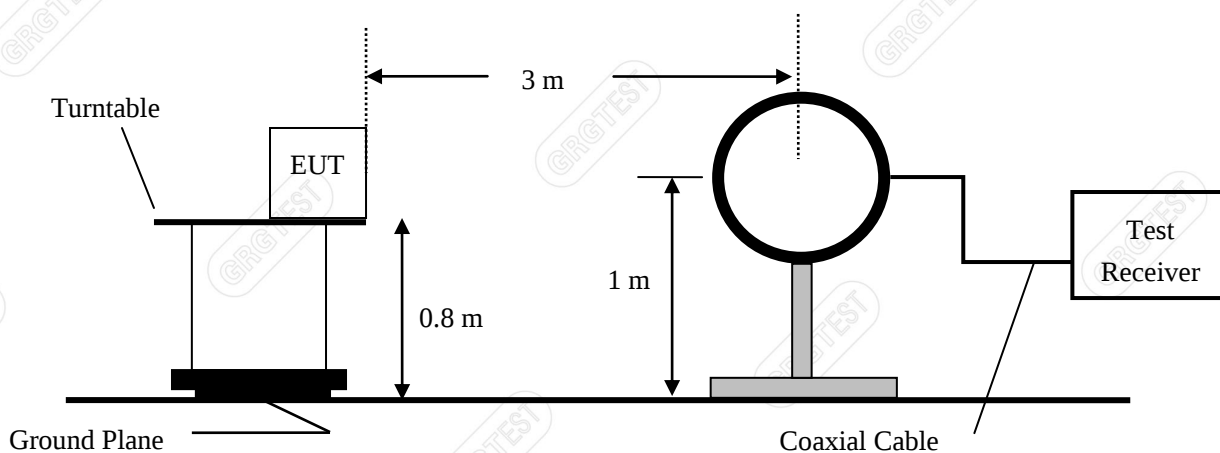
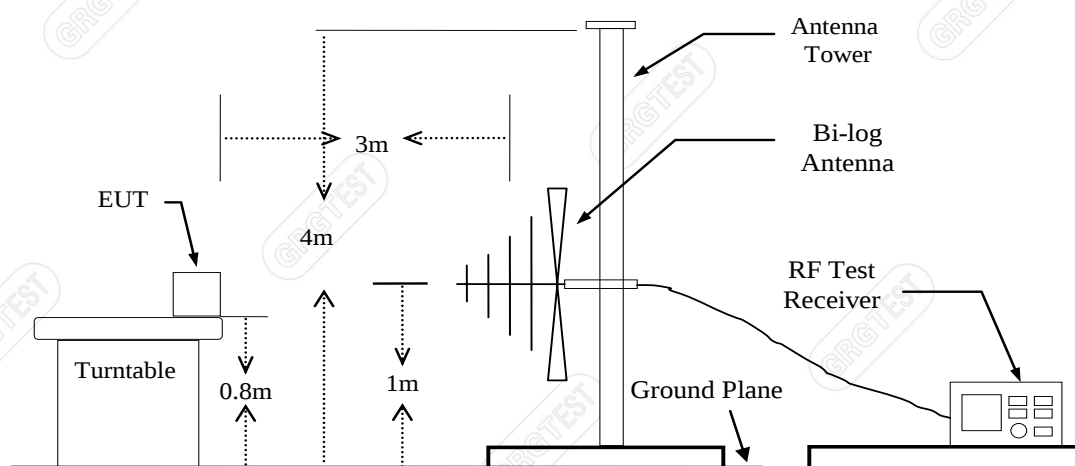
- The turntable rotates from 0 °to 360 °.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 4 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of pre measurement the software maximize the peaks by changing turntable rotates from 0 °to 360 °and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

NOTE:

- (1).The frequency from 9kHz to 150kHz, Set RBW=300Hz(for Peak&AVG), VBW=300Hz(for Peak&AVG). The frequency from 150kHz to 30MHz, Set RBW=9kHz, VBW=9kHz, (for QP Detector).
- (2).The frequency from 30MHz to 1GHz, Set RBW=120kHz, VBW=300kHz, (for QP Detector).
- (3).The frequency above 1GHz, for Peak detector: Set RBW=1MHz,VBW=3MHz.
- (4). The frequency above 1GHz, for Avg detector: Set RBW=1MHz,if the EUT is configured to transmit with duty cycle $\geq 98\%$, set $VBW \leq RBW/100$ (i.e.,10kHz) but not less than 10 Hz. If the EUT duty cycle is $< 98\%$, set $VBW \geq 1/T$, Where T is defined in section 2.9.

6.3 TEST SETUP**Figure 1. 9kHz to 30MHz radiated emissions test configuration****Figure 2. 30MHz to 1GHz radiated emissions test configuration**

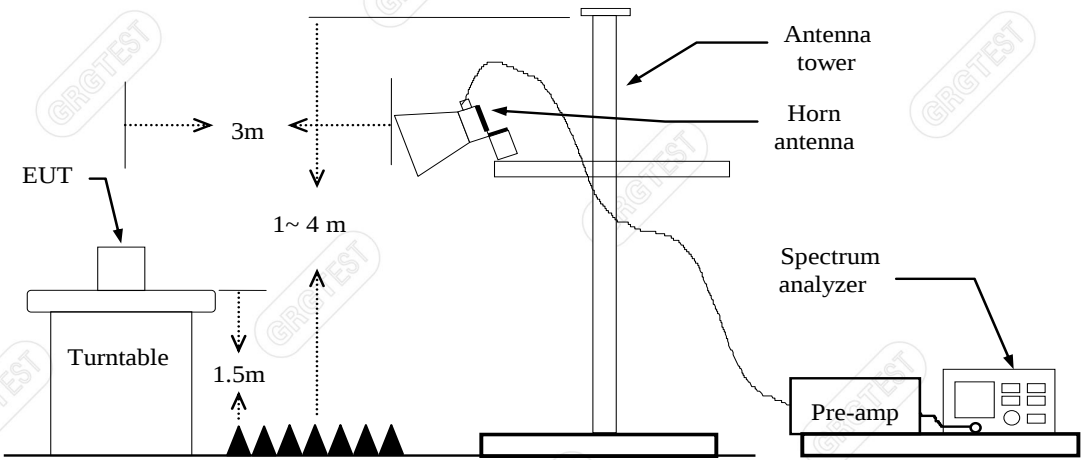


Figure 3. 1GHz to 18GHz radiated emissions test configuration

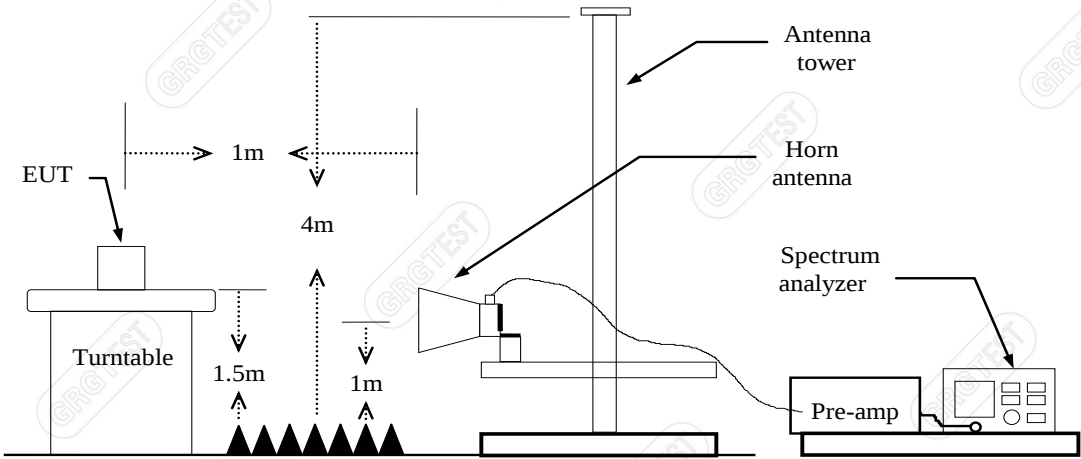


Figure 4. 18GHz to 26.5GHz radiated emissions test configuration

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6.4 DATA SAMPLE**30MHz to 1GHz**

Frequency (MHz)	Reading (dBuV)	Correct Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (deg.)	Heigh (cm)	Detectortype
XXX.XXXX	48.49	-9.91	38.58	47.00	-8.42	100	108	QP

Frequency (MHz) = Emission frequency in MHz

Reading (dBuV) = Uncorrected Analyzer / Receiver reading

Correct Factor (dB/m) = Antenna factor + Cable loss – Amplifier gain

Result (dBuV/m) = Reading (dBuV) + Correct Factor (dB/m)

Limit (dBuV/m) = Limit stated in standard

Margin (dB) = Result (dBuV/m)-Limit (dBuV/m)

Peak = Peak Reading

QP = Quasi-peak Reading

1GHz-18GHz

No.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Remark
xxx	xxxx	78.01	55.30	-22.71	74.00	18.70	100	50	Horizontal	Peak
xxx	xxxx	66.37	43.66	-22.71	54.00	10.34	100	50	Horizontal	AVG

Above 18GHz

NO.	Freq. [MHz]	Reading [dBμV/m]	Level for 1m [dBμV/m]	Level for 3m [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Remark
xxx	xxxx	54.49	42.38	32.84	-12.11	74	41.16	100	211	Horizontal	Peak
xxx	xxxx	43.99	31.88	22.34	-12.11	54	31.66	100	211	Horizontal	AVG

Frequency (MHz) = Emission frequency in MHz

Reading (dBuV/m) = Uncorrected Analyzer / Receiver reading

Factor (dB) = Antenna factor + Cable loss – Amplifier gain

Level for 1m (dBuV/m) = Reading (dBuV/m) + Factor (dB)

Level for 3m (dBuV/m) = Level for 1m (dBuV/m) + 20*log(1/3)

Limit (dBuV/m) = Limit stated in standard

Margin (dB) = Limit (dBuV/m) – Level (dBuV/m)

Polarity = Antenna polarization

Peak = Peak Reading

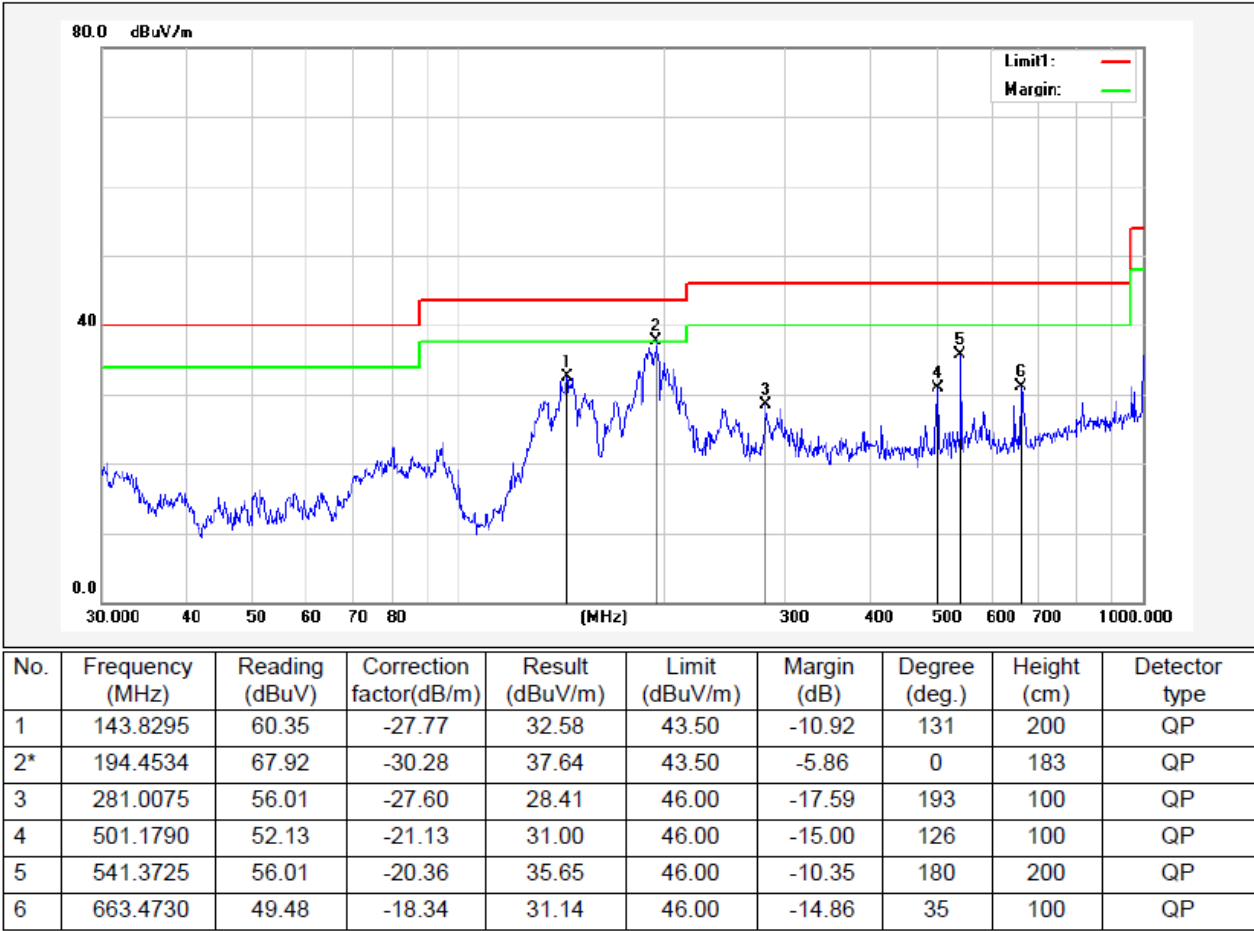
AVG = Average Reading

6.5 TEST RESULTS

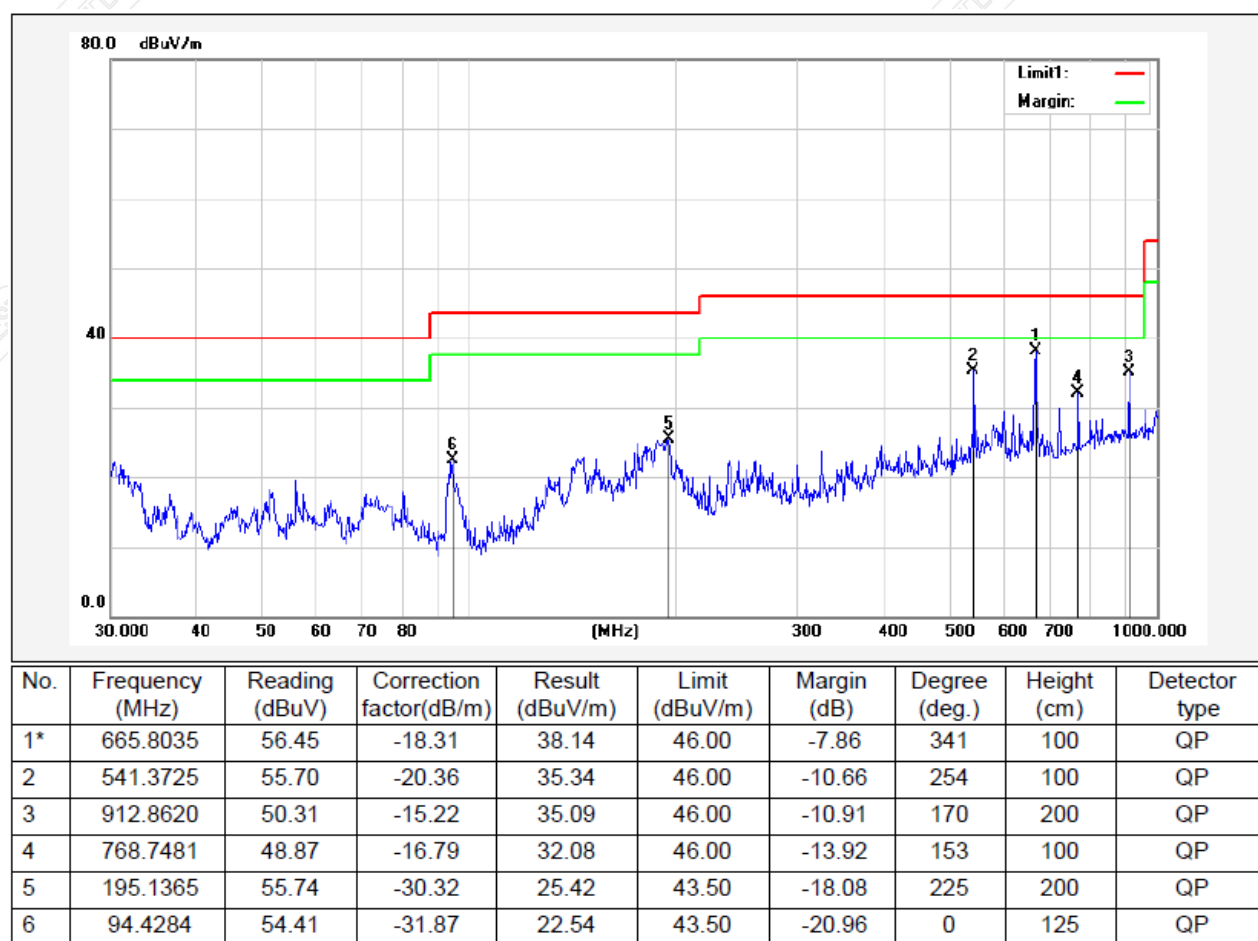
Below 1GHz

Note: Pre-scan all modes, only the worst case(TX_BLE_1M_2440MHz) is recorded in this report.

EUT Name:	Bentley Infotainment System(BIS)	Test Mode:	Mode 1
Model:	KR-BIS	Sample No:	E202309059135-01-0002
Power supply:	DC 12V	Environmental Conditions:	23.1℃/56%RH/101.0kPa
Test Engineer:	Zhang Zishan	Test Date:	2024-05-06
Frequency	2440MHz(TX_BLE_1M)	Polarity:	Horizontal



EUT Name:	Bentley Infotainment System(BIS)	Test Mode:	Mode 1
Model:	KR-BIS	Sample No:	E202309059135-01-0002
Power supply:	DC 12V	Environmental Conditions:	23.1℃/56%RH/101.0kPa
Test Engineer:	Zhang Zishan	Test Date:	2024-05-06
Frequency	2440MHz(TX_BLE_1M)	Polarity:	Vertical

**Remark:**

- 1 No emission found between lowest internal used/generated frequency to 30MHz.
- 2 Radiated emissions measured in frequency range from 9kHz to 1GHz were made with an instrument using Quasi-peak detector mode.
- 3 The IF bandwidth of Receiver between 30MHz to 1GHz was 120kHz.

1GHz-18GHz:

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Mode: TX/ BLE_1M
Lowest Frequency (2402MHz)
Environment: 23.1℃/56%RH/101.0kPa
Tested By:Zhang Zishan

Voltage: DC 12V
Date: 2024-05-06

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1162.4000	54.47	45.41	-9.06	74.00	28.59	200	302	Horizontal
2	1739.6000	54.25	47.40	-6.85	74.00	26.60	100	59	Horizontal
3	3325.5000	55.05	41.73	-13.32	74.00	32.27	100	194	Horizontal
4	3999.0000	51.87	41.54	-10.33	74.00	32.46	100	165	Horizontal
5	7297.5000	44.48	45.65	1.17	74.00	28.35	100	152	Horizontal
6	15658.5000	38.60	51.12	12.52	74.00	22.88	200	271	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	15658.5000	12.52	29.87	42.39	54.00	11.61	200	271	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1163.6000	55.97	46.03	-9.94	74.00	27.97	200	275	Vertical
2	1751.6000	54.16	47.27	-6.89	74.00	26.73	200	360	Vertical
3	4000.5000	58.67	47.85	-10.82	74.00	26.15	100	245	Vertical
4	5991.0000	51.13	47.54	-3.59	74.00	26.46	100	178	Vertical
5	11397.0000	37.27	49.57	12.30	74.00	24.43	100	325	Vertical
6	17983.5000	37.68	51.16	13.48	74.00	22.84	100	232	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	11397.0000	12.30	27.13	39.43	54.00	14.57	100	325	Vertical
2	17999.8650	13.48	26.10	39.58	54.00	14.42	149	277	Vertical

Mode: TX/ BLE_1M
Middle Frequency (2440MHz)
Environment: 23.1℃/56%RH/101.0kPa
Tested By:Zhang Zishan

Voltage: DC 12V
Date: 2024-05-06

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1162.4000	53.97	44.91	-9.06	74.00	29.09	200	302	Horizontal
2	1739.6000	53.75	46.90	-6.85	74.00	27.10	100	59	Horizontal
3	2478.6000	48.90	47.92	-0.98	74.00	26.08	200	116	Horizontal
4	7297.5000	44.48	45.65	1.17	74.00	28.35	100	152	Horizontal
5	8737.5000	41.99	47.38	5.39	74.00	26.62	200	338	Horizontal
6	15658.5000	38.10	50.62	12.52	74.00	23.38	200	271	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	15658.5000	12.52	28.77	41.29	54.00	12.71	200	271	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1163.6000	55.47	45.53	-9.94	74.00	27.97	200	275	Vertical
2	1751.6000	53.66	46.77	-6.89	74.00	26.73	200	360	Vertical
3	4000.5000	58.17	47.35	-10.82	74.00	26.65	100	245	Vertical
4	5991.0000	51.13	47.54	-3.59	74.00	26.46	100	178	Vertical
5	11361.0000	36.73	48.33	11.60	74.00	25.67	200	83	Vertical
6	17983.5000	37.18	50.66	13.48	74.00	23.34	100	232	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	11397.0100	12.33	27.22	39.52	54.00	14.48	200	178	Vertical
2	17999.8720	13.47	26.53	40.01	54.00	13.99	200	178	Vertical

Mode: TX/ BLE_1M

Highest Frequency (2480MHz)

Environment: 23.1°C/56%RH/101.0kPa

Tested By:Zhang Zishan

Voltage: DC 12V

Date: 2024-05-06

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1161.6000	56.25	47.19	-9.06	74.00	26.81	100	96	Horizontal
2	1662.6000	52.95	45.46	-7.49	74.00	28.54	100	56	Horizontal
3	3322.5000	54.67	41.33	-13.34	74.00	32.67	100	155	Horizontal
4	9217.5000	40.76	47.96	7.20	74.00	26.04	200	101	Horizontal
5	12150.0000	36.11	50.30	14.19	74.00	23.70	100	302	Horizontal
6	15886.5000	39.04	50.33	11.29	74.00	23.67	200	235	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	12150.0000	14.19	29.47	43.66	54.00	10.34	100	302	Horizontal
2	15886.5000	11.29	26.18	37.47	54.00	16.53	200	235	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1662.6000	54.26	45.99	-8.27	74.00	28.01	100	339	Vertical
2	3325.5000	59.53	46.61	-12.92	74.00	27.39	100	48	Vertical
3	3997.5000	57.44	46.63	-10.81	74.00	27.37	100	250	Vertical
4	4782.0000	54.05	46.81	-7.24	74.00	27.19	100	356	Vertical
5	10941.0000	39.77	50.48	10.71	74.00	23.52	200	194	Vertical
6	17998.5000	37.31	50.78	13.47	74.00	23.22	100	318	Vertical

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	10941.0000	10.71	30.14	40.85	54.00	13.15	200	194	Vertical
2	17998.5000	13.47	27.05	40.52	54.00	13.48	100	318	Vertical

Remark:

- 1 Measuring frequencies from 1GHz to the 10th harmonic of highest fundamental frequency.
- 2 Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
- 3 Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
- 4 Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “ N/A ” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

18GHz to 26.5GHz

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Note: Pre-scan all modes, only the worst case(TX/BLE_1M_2480MHz) is recorded in this report.

Mode: TX/ BLE_1M

Lowest Frequency (2480MHz)

Environment: 23.1°C/56%RH/101.0kPa

Tested By: Zhang Zishan

Voltage: DC 12V

Date: 2024-05-06

Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV/m]	Level for 1m [dBμV/m]	Level for 3m [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18087.9750	56.70	45.07	35.53	-11.63	74	38.47	150	161	Horizontal
2	19374.4500	56.67	45.68	36.14	-10.99	74	37.86	150	238	Horizontal
3	20256.7500	55.73	45.07	35.53	-10.66	74	38.47	150	142	Horizontal
4	22910.8750	54.00	45.00	35.46	-9.00	74	38.54	150	277	Horizontal
5	24728.6000	53.75	45.66	36.12	-8.09	74	37.88	150	122	Horizontal
6	26232.2500	54.06	46.21	36.67	-7.85	74	37.33	150	348	Horizontal

Suspected Data List

NO.	Freq. [MHz]	Reading [dBμV/m]	Level for 1m [dBμV/m]	Level for 3m [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	18311.1000	56.95	45.39	35.85	-11.56	74	38.15	150	7	Vertical
2	19992.8250	55.14	44.28	34.74	-10.86	74	39.26	150	354	Vertical
3	21455.6750	54.46	44.41	34.87	-10.05	74	39.13	150	213	Vertical
4	22221.1000	54.72	45.02	35.48	-9.70	74	38.52	150	239	Vertical
5	23458.7000	54.04	45.31	35.77	-8.73	74	38.23	150	7	Vertical
6	26263.2750	53.93	46.15	36.61	-7.78	74	37.39	150	168	Vertical

Remark:

- 1 Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- 2 Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
- 3 Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- 4 Above 18G test distance is 1m, so the Level for 3m= Level for 1m + 20*log(1/3)

7. 6dB BANDWIDTH

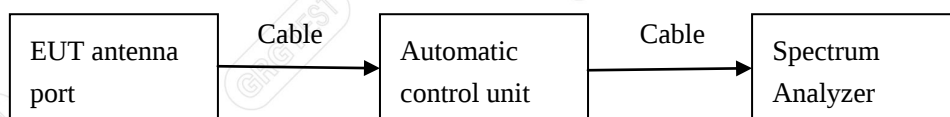
7.1 LIMITS

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

7.2 TEST PROCEDURES

- Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the Automatic power measuring unit.
- Set resolution bandwidth (RBW) = 100kHz. Set the video bandwidth (VBW) $\geq 3 \times$ RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 6dB bandwidth value.
- Repeat above procedures until all frequencies measured were complete.

7.3 TEST SETUP



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7.4 TEST RESULTS

Environment: 20.1℃/68%RH/101.0kPa
Tested By: Huang Tianmei

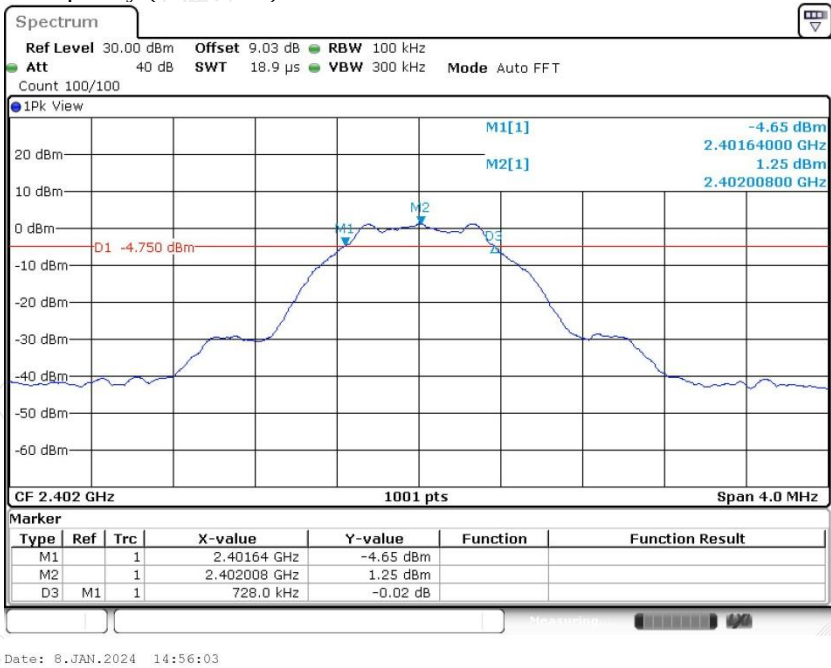
Voltage: DC 12V
Date: 2024-01-08

BLE_1M

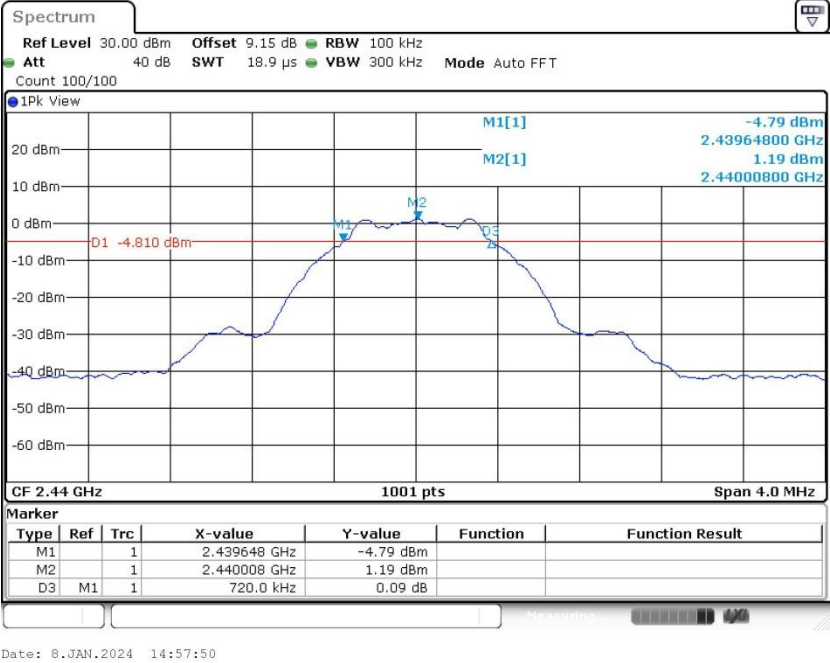
Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Lowest	2402	728	≥500	PASS
Middle	2440	720		PASS
Highest	2480	724		PASS

BLE_1M

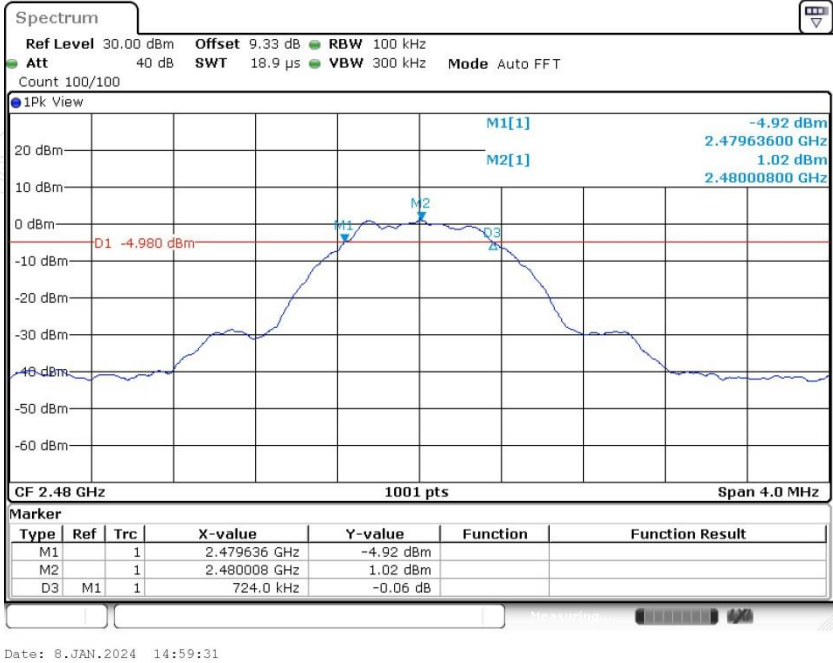
Lowest Frequency (2402MHz)



Middle Frequency (2440 MHz)



Highest Frequency (2480MHz)



8. MAXIMUM PEAK OUTPUT POWER

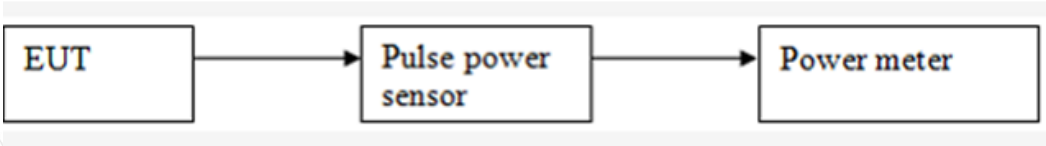
8.1 LIMITS

The maximum Peak output power measurement is 1W

8.2 TEST PROCEDURES

- a) RF output of EUT was connected to the broadband peak RF power meter by RF cable. The path loss was compensated to the results for each measurement.
- b) Set to the maximum power setting and enable the EUT transmit continuously.
- c) Measure the conducted output power and record the results in the test report.

8.3 TEST SETUP



8.4 TEST RESULTS

Environment: 20.1°C/68%RH/101.0kPa
Tested By: Huang Tianmei

Voltage: DC 12V
Date: 2024-01-08

BLE_1M

Channel	Frequency (MHz)	Measured Channel Power (dBm)	Limit	Peak/ Average	Result
Lowest	2402	4.32	1W (30dBm)	Peak	Pass
Middle	2440	4.04			Pass
Highest	2480	4.03			Pass

9. POWER SPECTRAL DENSITY

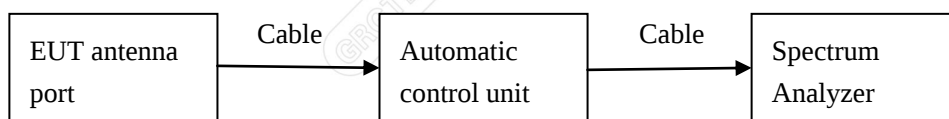
9.1 LIMITS

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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

9.2 TEST PROCEDURES

- a) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer.
- b) Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- c) The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:
 - a) Set analyzer center frequency to DTS channel center frequency.
 - b) Set the span to at least 1.5 times the DTS bandwidth.
 - c) Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
 - d) Set the VBW $\geq [3 \times \text{RBW}]$.
 - e) Detector = peak
 - f) Sweep time = auto couple.
 - g) Trace mode = max hold.
 - h) Allow trace to fully stabilize.
 - i) Use the peak marker function to determine the maximum amplitude level within the RBW.
 - j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.
- d) Repeat above procedures until all frequencies measured were complete.

9.3 TEST SETUP



9.4 TEST RESULTS

Environment: 20.1℃/68%RH/101.0kPa
Tested By: Huang Tianmei

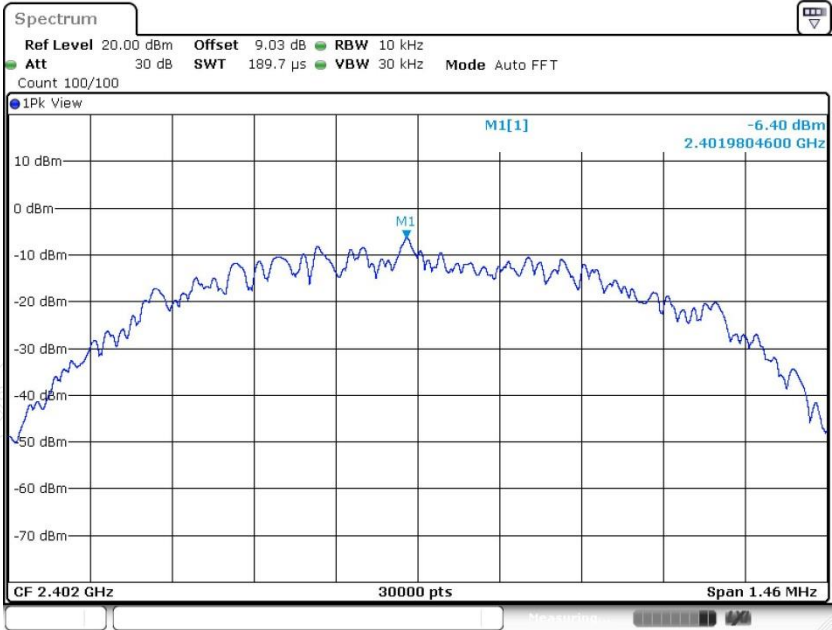
Voltage: DC 12V
Date: 2024-01-08

BLE_1M

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Test Result
Lowest	2402	-6.40	8.00	PASS
Middle	2440	-6.30		PASS
Highest	2480	-6.76		PASS

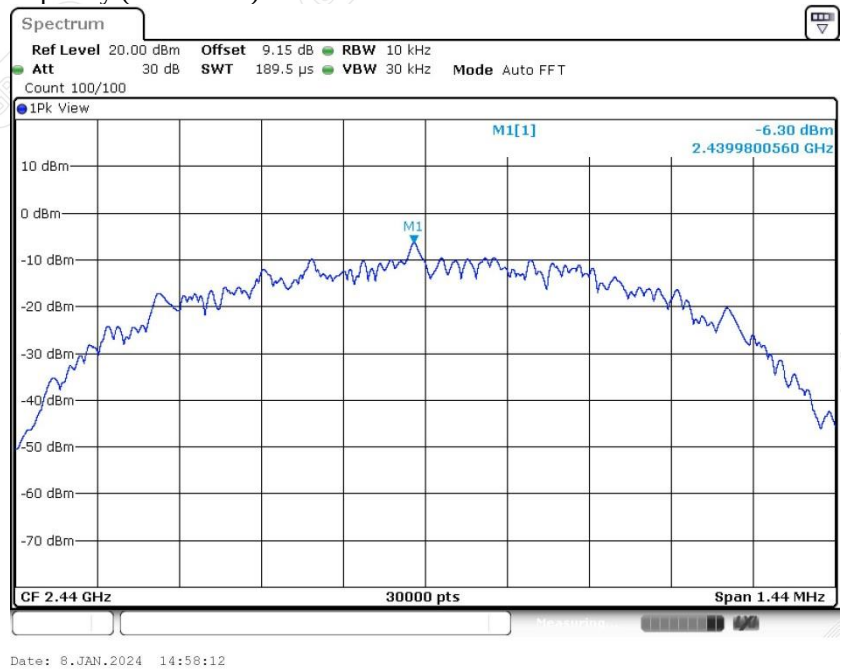
BLE_1M

Lowest Frequency (2402MHz)

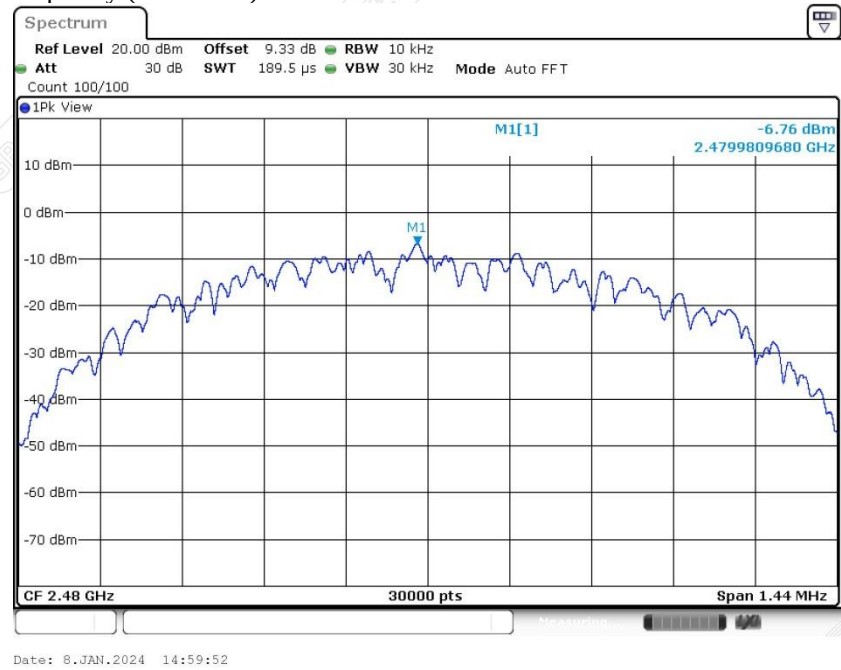


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Middle Frequency (2440 MHz)



Highest Frequency (2480MHz)



10. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

10.1 LIMITS

In any 100kHz 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 20dB below that in the 100kHz 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.

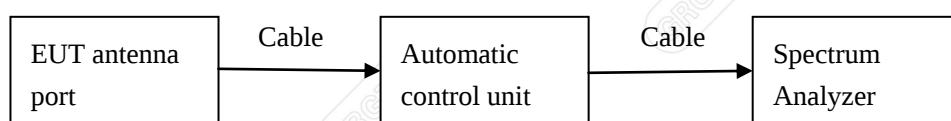
10.2 TEST PROCEDURES

Test procedures follow KDB 558074 D01 15.247 Measurement Guidance v05r02.

Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.

- Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.
- Set the spectrum analyzer: RBW =100kHz; VBW =300kHz, Frequency range = 30MHz to 26.5GHz; Sweep = auto; Detector Function = Peak. Trace = Max, hold.
- Measure and record the results in the test report.
- The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

10.3 TEST SETUP



10.4 TEST RESULTS

Environment: 20.1°C/68%RH/101.0kPa
Tested By: Huang Tianmei

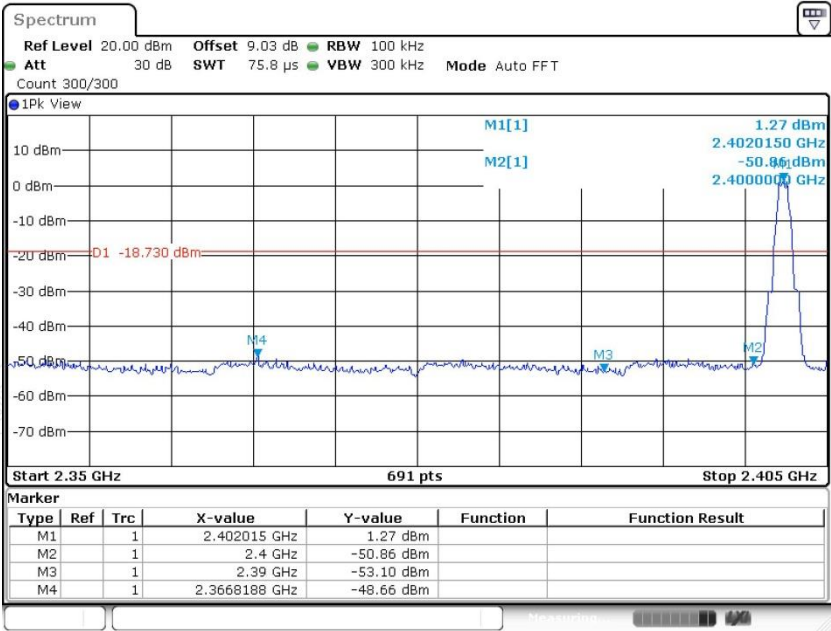
Voltage: DC 12V
Date: 2024-01-08

Band edge measurements

TestMode	Antenna	ChName	Freq(MHz)	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	Low	2402	1.27	-48.66	≤-18.73	PASS
		High	2480	1.00	-47.77	≤-19	PASS

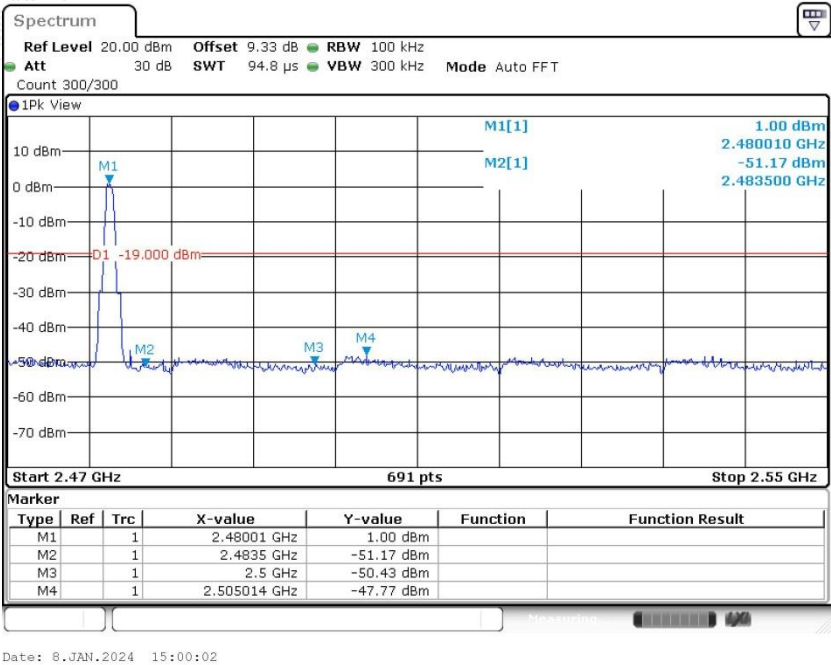
BLE_1M

Lowest Frequency (2402MHz)
2.35GHz-2.405GHz



Date: 8.JAN.2024 14:56:35

Highest Frequency (2480MHz)
2.47GHz-2.55GHz



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Conducted Spurious Emission

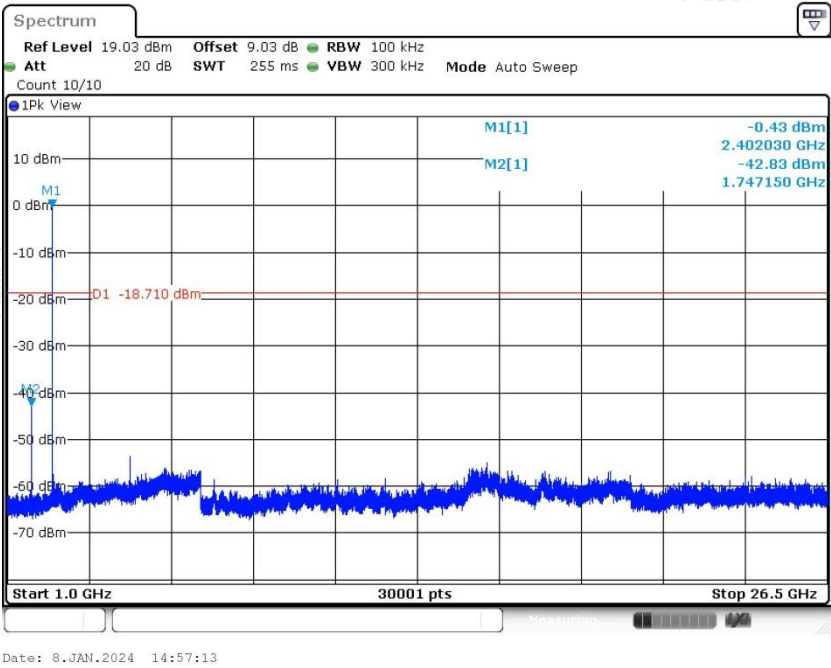
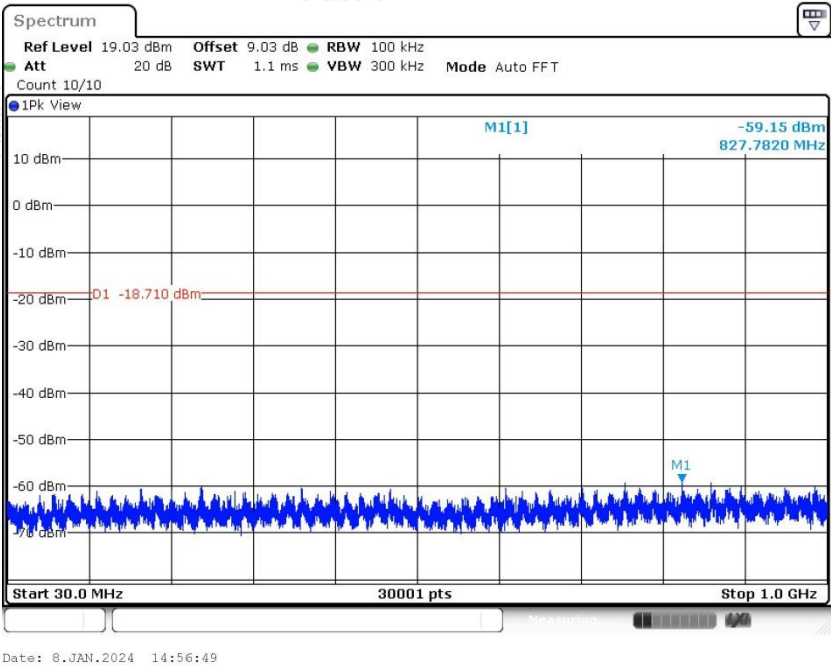
TestMode	Antenna	Freq(MHz)	FreqRange [MHz]	RefLevel [dBm]	Result[dBm]	Limit[dBm]	Verdict
BLE_1M	Ant1	2402	Reference	1.29	1.29	---	PASS
			30~1000	1.29	-59.15	≤-18.71	PASS
			1000~26500	1.29	-42.83	≤-18.71	PASS
		2440	Reference	1.18	1.18	---	PASS
			30~1000	1.18	-58.57	≤-18.82	PASS
			1000~26500	1.18	-40.17	≤-18.82	PASS
		2480	Reference	0.96	0.96	---	PASS
			30~1000	0.96	-40.77	≤-19.04	PASS
			1000~26500	0.96	-40.76	≤-19.04	PASS
			1000~26500	1.29	1.29	---	PASS

BLE_1M

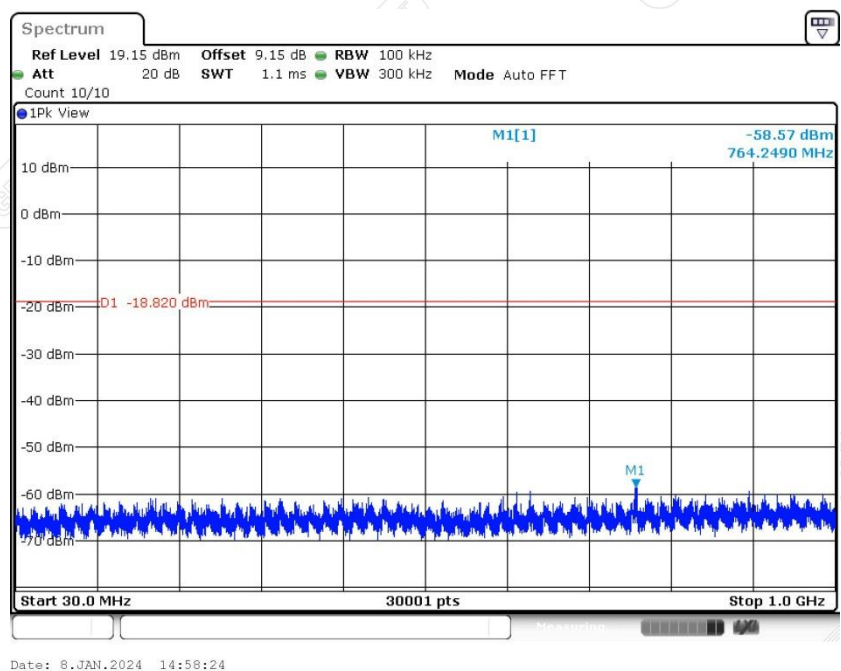
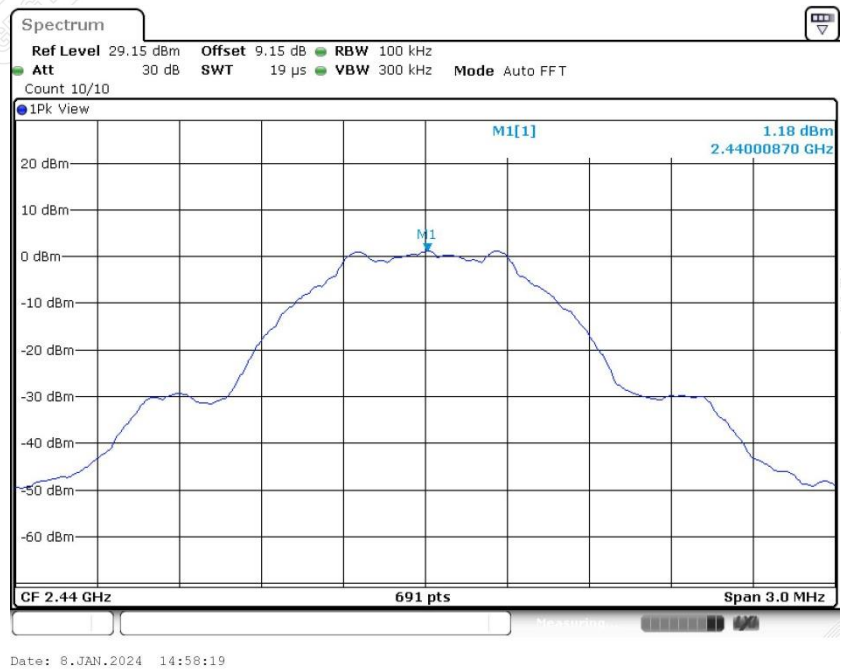
Lowest Frequency (2402MHz)

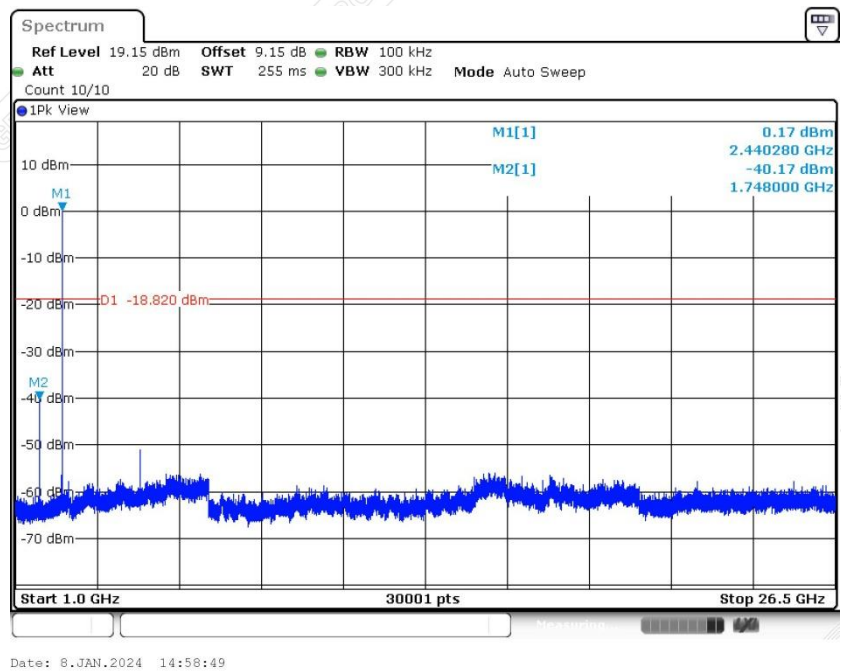


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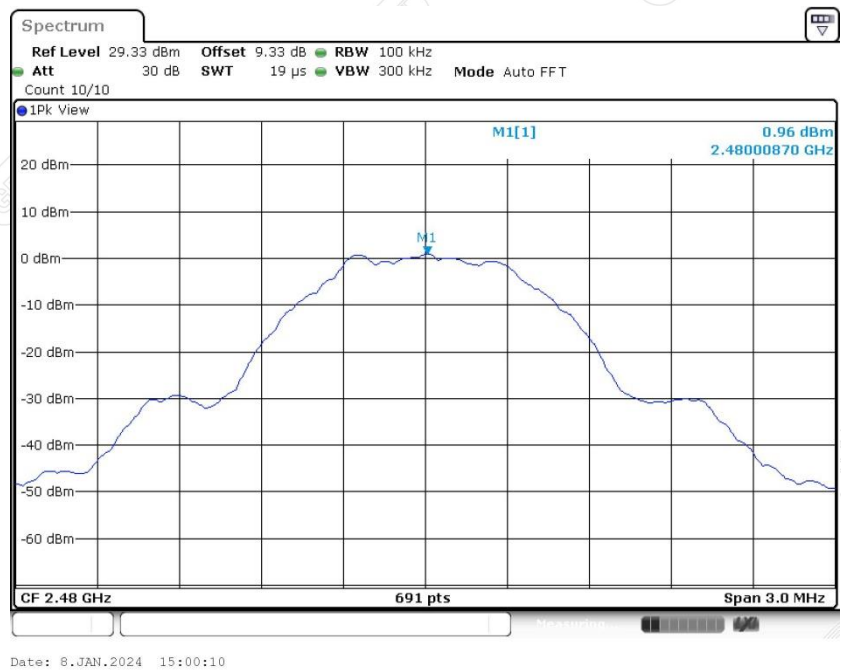


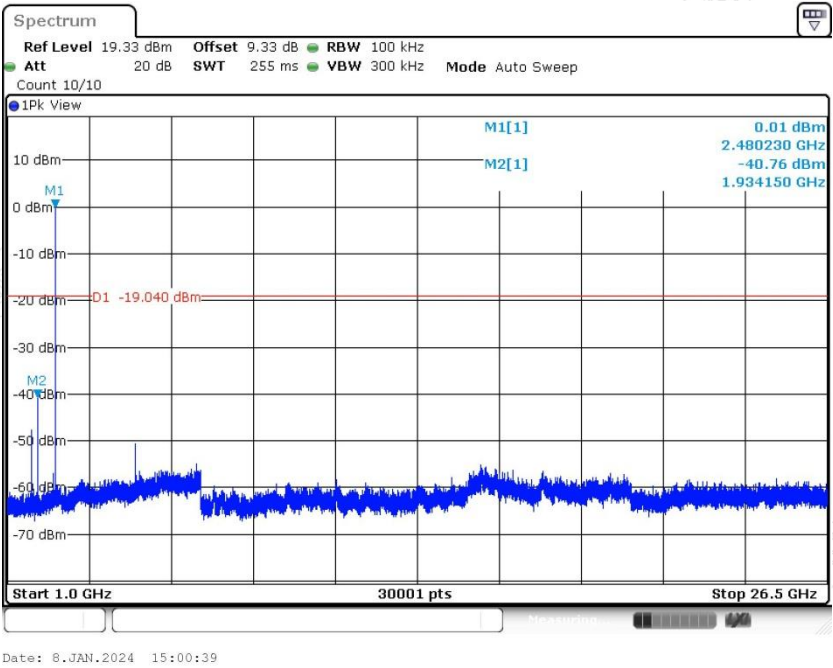
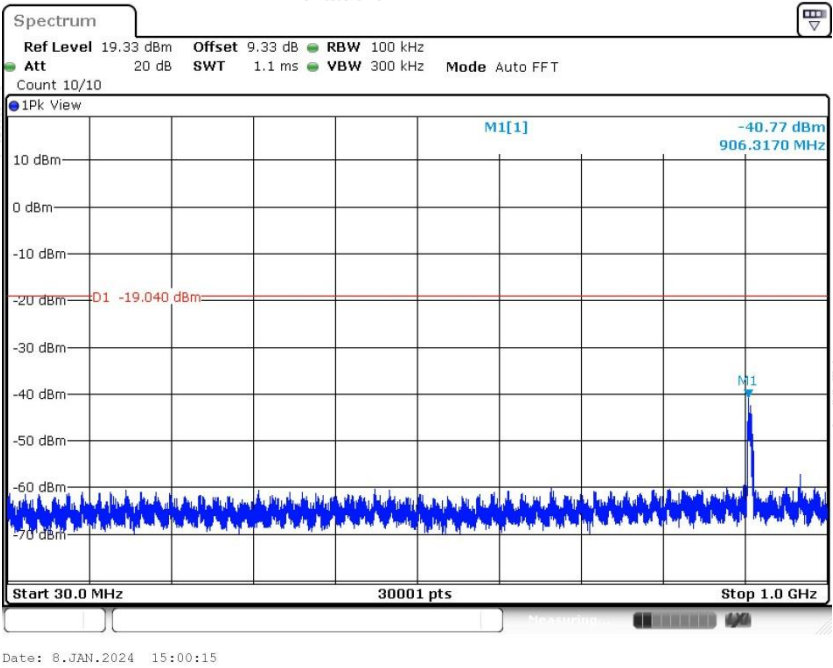
Middle Frequency (2440MHz)





Highest Frequency (2480MHz)





11. RESTRICTED BANDS OF OPERATION

11.1 LIMITS

Section 15.247(d) 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)).

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	2655 - 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	
13.36 - 13.41			

Frequency (MHz)	Quasi-peak(μ V/m)	Measurement distance(m)	Quasi-peak(dB μ V/m)@distance 3m
0.009-0.490	2400/F(kHz)	300	128.5~93.8
0.490-1.705	24000/F(kHz)	30	73.8~63
1.705-30.0	30	30	69.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

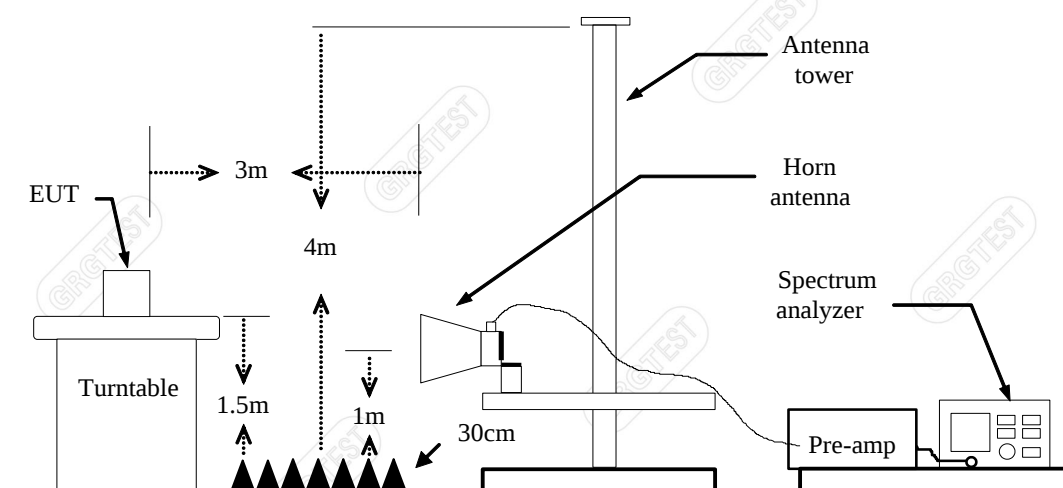
11.2 TEST PROCEDURES

Test procedures follow KDB 558074 D01 15.247 Meas Guidance v05r02.

- a) The EUT is placed on a turntable, which is 1.5m above the ground plane.
- b) The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- c) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
- d) Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
 - a) PEAK: RBW=1MHz / VBW=1MHz / Sweep=AUTO.
 - b) AVERAGE: RBW=1MHz / VBW=1/T / Sweep=AUTO.

If the EUT is configured to transmit with duty cycle $\geq 98\%$, set $VBW \leq RBW/100$ (i.e., 10kHz) but not less than 10 Hz. If the EUT duty cycle is $< 98\%$, set $VBW \geq 1/T$, Where T is defined in section 2.9.
- e) Repeat the procedures until all the PEAK and AVERAGE versus polarization are measured.

11.3 TEST SETUP

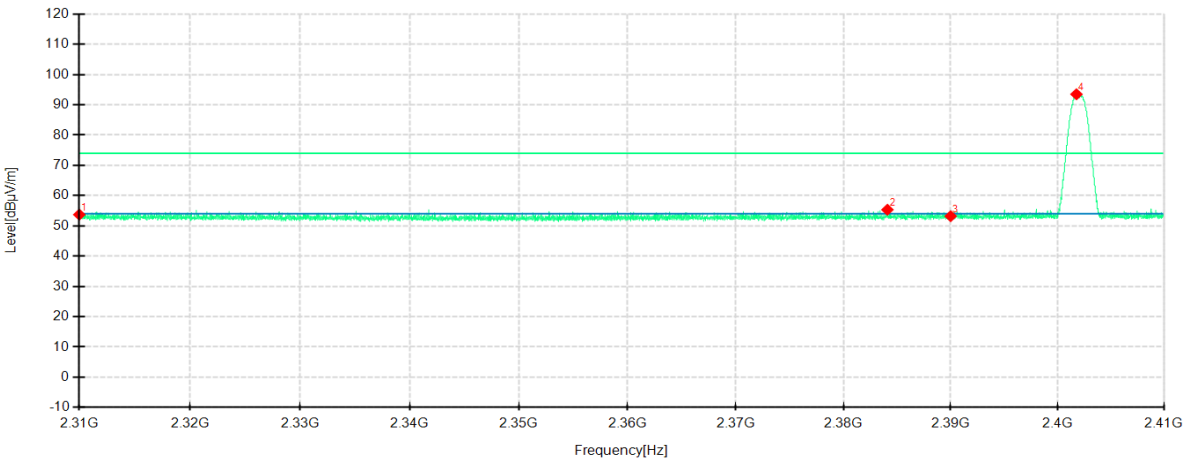


11.4 TEST RESULTS

Equipment:	Bentley Infotainment System(BIS)	Test Date	2024-05-06
Model No.:	KR-BIS	Test Engineer:	Zhang Zishan
Test Voltage:	DC 12V	Environmental Conditions	23.1℃/56%RH/101.0kPa

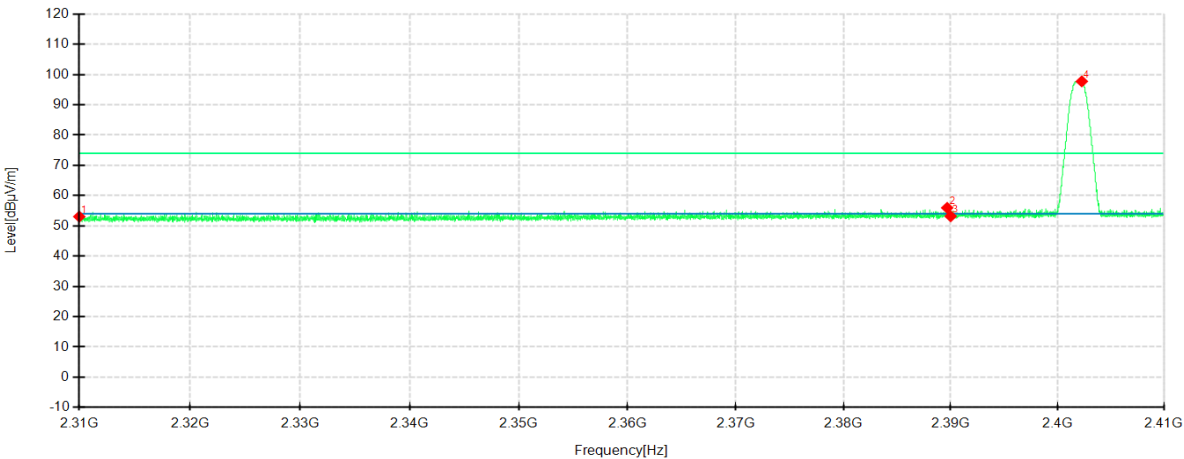
BLE 1M
Lowest Frequency
Frequency 2402MHz
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310.0000	58.68	53.72	-4.96	74.00	20.28	100	314	Horizontal	/
2	2384.1000	61.15	55.34	-5.81	74.00	18.66	100	198	Horizontal	/
3	2390.0000	59.05	53.22	-5.83	74.00	20.78	200	252	Horizontal	/
4	2401.7750	99.36	93.49	-5.87	74.00	-19.49	200	18	Horizontal	No limit
1	2310.0000	58.72	53.06	-5.66	74.00	20.94	100	20	Vertical	/
2	2389.6750	61.37	55.96	-5.41	74.00	18.04	100	360	Vertical	/
3	2390.0000	58.59	53.18	-5.41	74.00	20.82	200	146	Vertical	/
4	2402.2750	103.11	97.75	-5.36	74.00	-23.75	200	237	Vertical	No limit

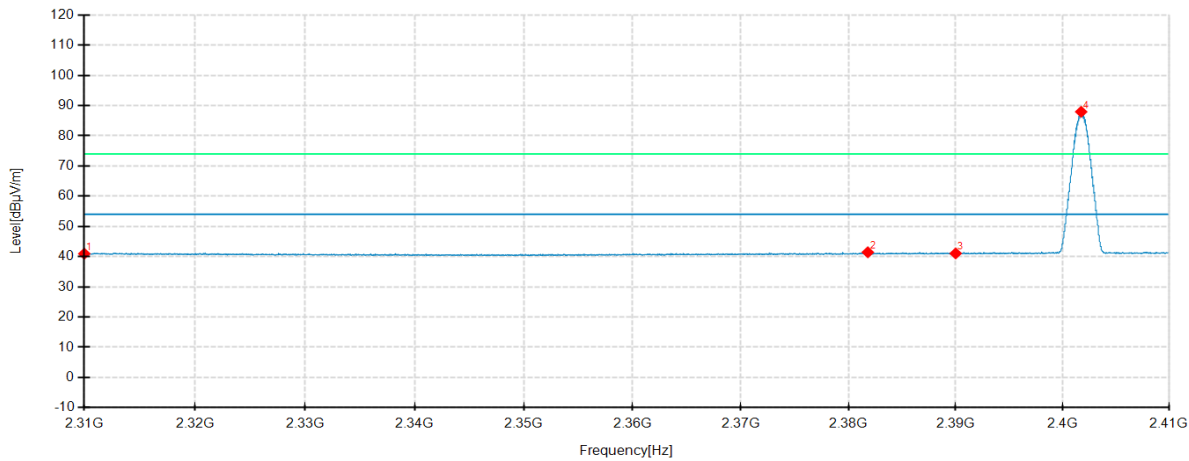
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Lowest Frequency

Frequency 2402MHz

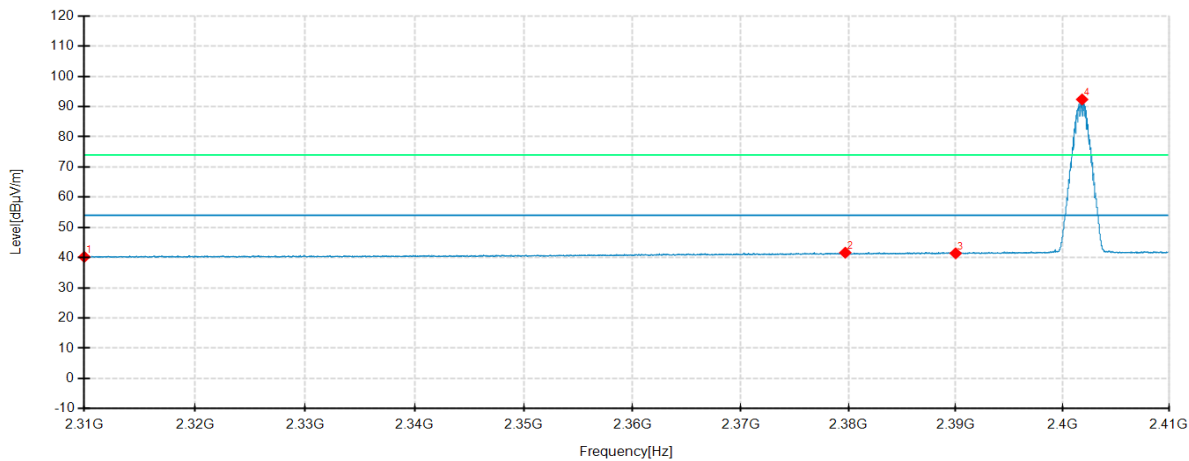
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

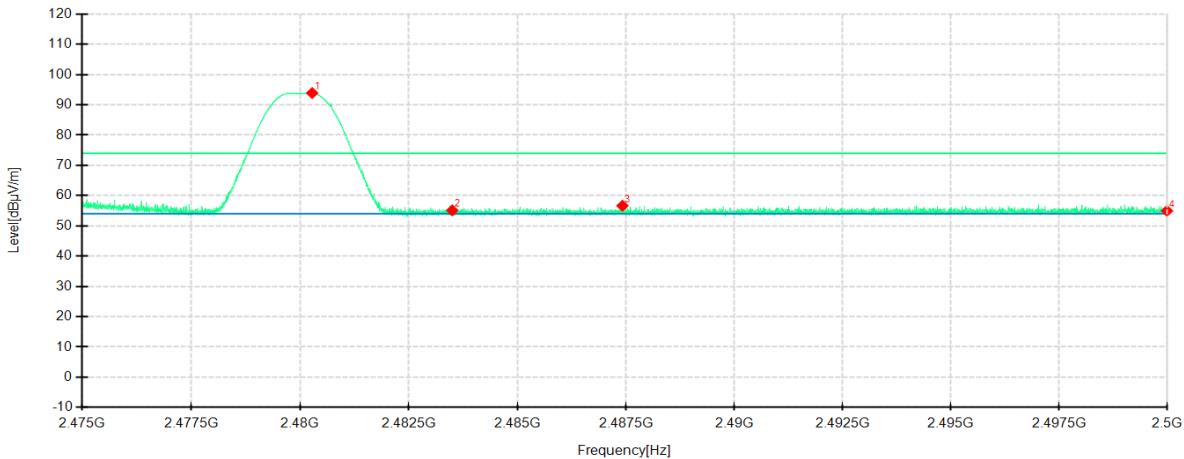
Polarity: Vertical



No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBμV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310.0000	45.92	40.96	-4.96	54.00	13.04	200	280	Horizontal	/
2	2381.8125	47.24	41.44	-5.80	54.00	12.56	200	189	Horizontal	/
3	2390.0000	46.90	41.07	-5.83	54.00	12.93	100	211	Horizontal	/
4	2401.7500	93.83	87.96	-5.87	54.00	-33.96	100	6	Horizontal	No limit
1	2310.0000	45.91	40.25	-5.66	54.00	13.75	100	111	Vertical	/
2	2379.7125	47.08	41.63	-5.45	54.00	12.37	200	133	Vertical	/
3	2390.0000	46.84	41.43	-5.41	54.00	12.57	100	21	Vertical	/
4	2401.8375	97.73	92.37	-5.36	54.00	-38.37	200	237	Vertical	No limit

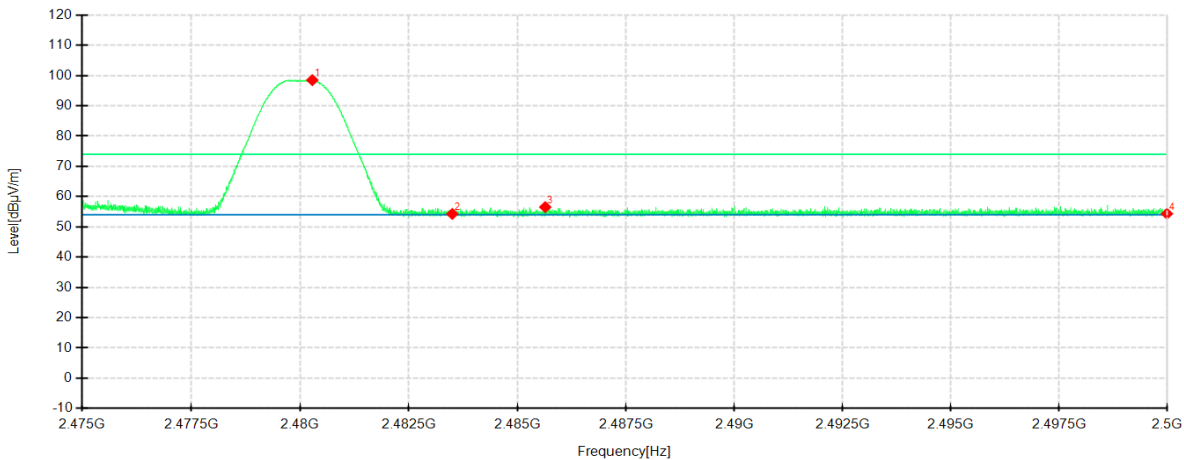
Highest Frequency
Frequency 2480MHz
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



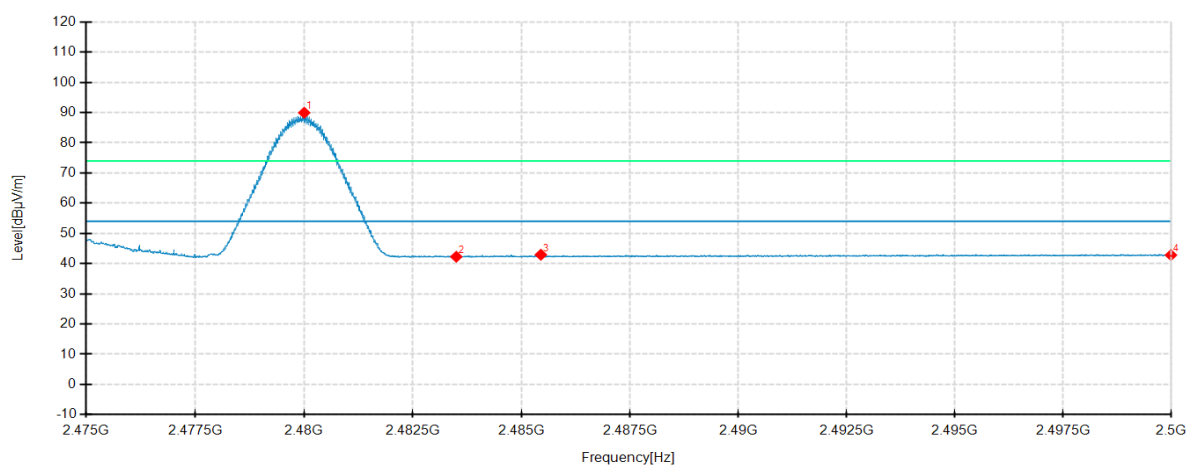
No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2480.2781	99.06	93.90	-5.16	74.00	-19.90	100	16	Horizontal	No limit
2	2483.5000	60.23	55.13	-5.10	74.00	18.87	200	318	Horizontal	/
3	2487.4188	61.68	56.65	-5.03	74.00	17.35	200	112	Horizontal	/
4	2500.0000	59.77	54.98	-4.79	74.00	19.02	200	280	Horizontal	/
1	2480.2813	103.54	98.49	-5.05	74.00	-24.49	200	314	Vertical	No limit
2	2483.5000	59.32	54.29	-5.03	74.00	19.71	100	71	Vertical	/
3	2485.6406	61.57	56.54	-5.03	74.00	17.46	200	104	Vertical	/
4	2500.0000	59.33	54.34	-4.99	74.00	19.66	100	20	Vertical	/

Highest Frequency

Frequency 2480MHz

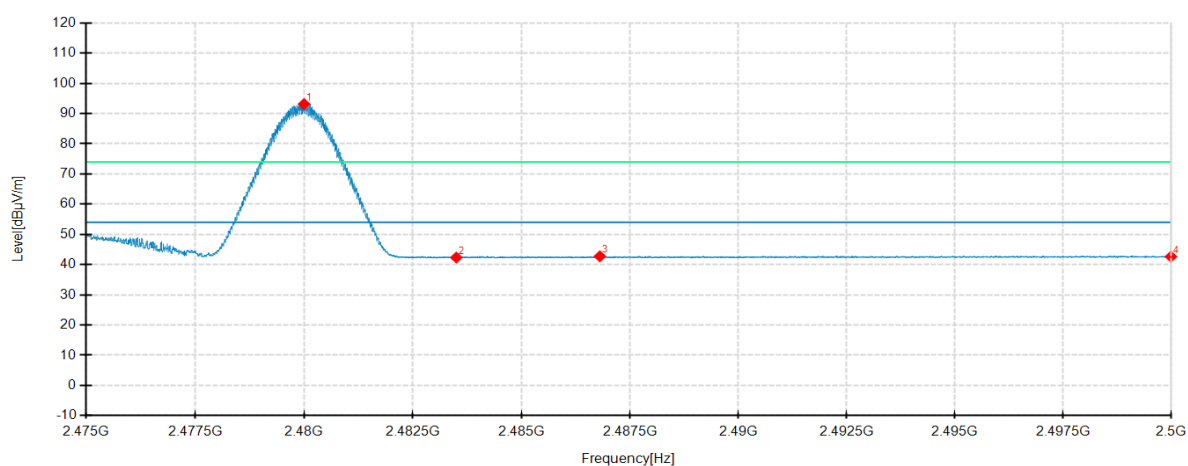
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

Polarity: Vertical



No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBμV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2480.0031	95.12	89.95	-5.17	54.00	-35.95	100	16	Horizontal	No limit
2	2483.5000	47.39	42.29	-5.10	54.00	11.71	200	254	Horizontal	/
3	2485.4469	48.00	42.94	-5.06	54.00	11.06	200	267	Horizontal	/
4	2500.0000	47.61	42.82	-4.79	54.00	11.18	100	4	Horizontal	/
1	2480.0000	98.21	93.16	-5.05	54.00	-39.16	200	302	Vertical	No limit
2	2483.5000	47.39	42.36	-5.03	54.00	11.64	100	22	Vertical	/
3	2486.8063	47.80	42.77	-5.03	54.00	11.23	200	341	Vertical	/
4	2500.0000	47.64	42.65	-4.99	54.00	11.35	200	212	Vertical	/

Remark: Max field strength in 3m distance. No any other emission which falls in restricted bands can be detected and be reported.

APPENDIX A. PHOTOGRAPH OF THE TEST CONNECTION DIAGRAM

Please refer to the attached document E202309059135-01-20 FCC ISED-Test Photo.

APPENDIX B. PHOTOGRAPH OF THE EUT

Please refer to the attached document E202309059135-01-21 EUT photo.

----- End of Report -----