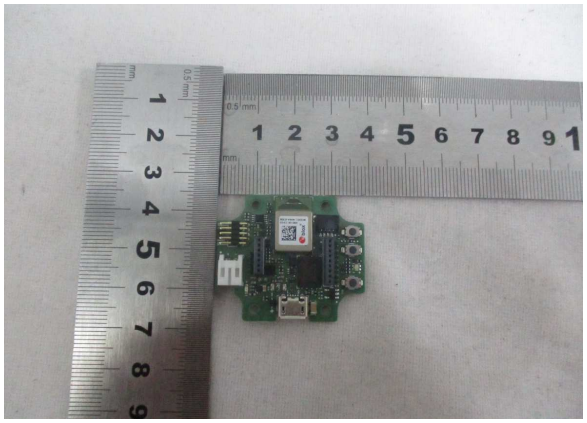
Prüfbericht-Nr.: *Test report no.:*	**CN23VHXH 001**	**Auftrags-Nr.:** *Order no.:*	**244512362**	**Seite 1 von 38** *Page 1 of 38*
Kunden-Referenz-Nr.: *Client reference no.:*	**N/A**	**Auftragsdatum:** *Order date:*	**2023-05-04**	
Auftraggeber: *Client:*	**Bosch Sensortec GmbH** Gerhard-Kindler-Strasse 9, 72770 Reutlingen, Germany			
Prüfgegenstand: *Test item:*	**Application Board 3.1**			
Bezeichnung / Typ-Nr.: *Identification / Type no.:*	**APP 3.1**			
Auftrags-Inhalt: *Order content:*	**TÜV Rheinland EMC service**			
Prüfgrundlage: *Test specification:*	**FCC 47 CFR Part 15, Subpart B:2021 Class B** **ICES-003:2020**			
Wareneingangsdatum: *Date of sample receipt:*	**2023-04-27**			
Prüfmuster-Nr.: *Test sample no:*	**A003464626-001/-002**			
Prüfzeitraum: *Testing period:*	**Refer to test report**			
Ort der Prüfung: *Place of testing:*	**Refer to clause 1.1**			
Prüflaboratorium: *Testing laboratory:*	**TÜV Rheinland (Shanghai) Co., Ltd.**			
Prüfergebnis*: *Test result*:*	**Pass**			



geprüft von: *tested by:*	Jessie Xu	**genehmigt von:** *authorized by:*	Hexiong Liu
Datum: *Date:* 2023-07-20		**Ausstellungsdatum:** *Issue date:* 2023-07-20	
Stellung / Position:	Sachverständige(r)/Expert	**Stellung** / Position:	Sachverständige(r)/Expert

Sonstiges / *Other:* Refer to clause 2.2 for further information

Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:* Prüfmuster vollständig und unbeschädigt *Test item complete and undamaged*

* Legende:	P(ass) = entspricht o.g. Prüfgrundlage(n)	F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
** Legend:*	*P(ass) = passed a.m. test specification(s)*	*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
This test report only relates to the above mentioned test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.
V05

Anmerkungen
Remarks

1	Alle eingesetzten Prüfmittel waren zum angegebenen Prüfzeitraum gemäß eines festgelegten Kalibrierungsprogramms unseres Prüfhauses kalibriert. Sie entsprechen den in den Prüfprogrammen hinterlegten Anforderungen. Die Rückverfolgbarkeit der eingesetzten Prüfmittel ist durch die Einhaltung der Regelungen unseres Managementsystems gegeben. Detaillierte Informationen bezüglich Prüfkonditionen, Prüfequipment und Messunsicherheiten sind im Prüflabor vorhanden und können auf Wunsch bereitgestellt werden. *The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system.* *Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.*
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4	Die Entscheidungsregel für Konformitätserklärungen basierend auf numerischen Messergebnisen in diesem Prüfbericht basiert auf der "Null-Grenzwert-Regel" und der "Einfachen Akzeptanz" gemäß ILAC G8:2019 und IEC Guide 115:2021, es sei denn, in der auf Seite 1 dieses Berichts genannten angewandten Norm ist etwas anderes festgelegt oder vom Kunden gewünscht. Dies bedeutet, dass die Messunsicherheit nicht berücksichtigt wird und daher auch nicht im Prüfbericht angegeben wird. Zu weiteren Informationen bezueglich des Risikos durch diese Entscheidungsregel siehe ILAC G8:2019. The decision rule for statements of conformity, based on numerical measurement results, in this test report is based on the “Zero Guard Band Rule” and “Simple Acceptance” in accordance with ILAC G8:2019 and IEC Guide 115:2021, unless otherwise specified in the applied standard mentioned on Page 1 of this report or requested by the customer. This means that measurement uncertainty is not taken in account and hence also not declared in the test report. For additional information to the resulting risk based of this decision rule please refer to ILAC G8:2019.

TEST SUMMARY

5.1.1 CONDUCTED EMISSION
Result:
Passed
5.2.1 RADIATED EMISSION (30-1000 MHz)
Result:
Passed
5.2.2 RADIATED EMISSION (1-18 GHz)
Result:
Passed

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1 Test Sites

1.1 Test Facilities

Laboratory: TÜV Rheinland (Shanghai) Co., Ltd.
Address: No.177, 178, Lane 777 West Guangzhong Road, Jing'an District, Shanghai, China

The used test equipment is in accordance with CISPR 16-1 series standards for measurement of radio interference.

Refer to Clause 7 for test and measurement instruments.

2 General Product Information

2.1 Product Function and Intended Use

The EUT (equipment under test) is an ordinary application board which contains Bluetooth module. For the further information, refer to the user's manual.

2.2 Ratings and System Details

Rated input	:	DC 5V (USB)
Protection class	:	III

2.3 Independent Operation Modes

The basic operation modes are: "On" and "Off".

2.4 Description of interconnecting cables

N/A

2.5 Noise Generating and Noise Suppressing Parts

Refer to the circuit diagram for further information.

2.6 Highest frequency generated or used in the device or on which the device operates or tunes

The highest frequency used in the EUT is 2480 MHz.

2.7 Submitted Documents

Circuit diagrams, user's manuals and labels.

3 Test Set-up and Operation Modes

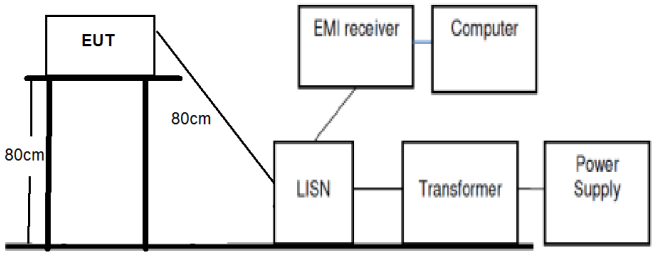
3.1 Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible emission level. The test conditions were adapted accordingly in reference to the instructions for use.

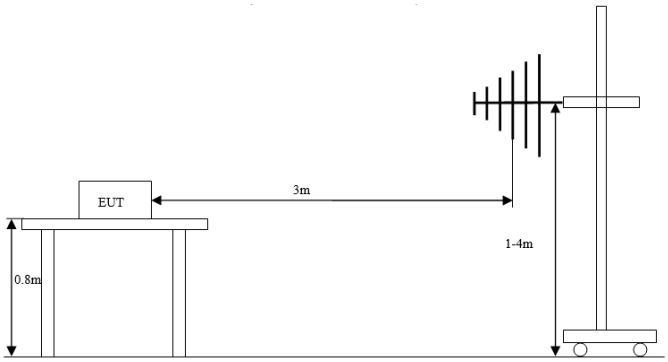
Refer to the related paragraph of this report.
The sequence of testing:
1. Radiated emission tests were performed on 2023-05-29;
2. Conducted emission tests were performed on 2023-05-29~2023-05-30.

3.2 Equipment and cable arrangement

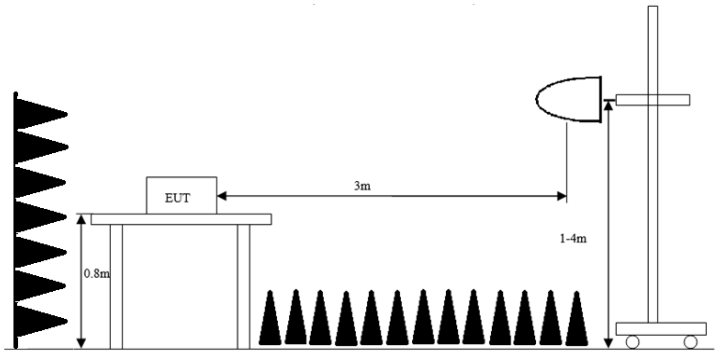
Block diagrams for radiated emission tests are as follows:



(Conducted emission)



(Radiated emission 30-1000 MHz)



(Radiated emission 1-18 GHz)

Also refer to photographs on clause 6 for test setups for both conducted emission test and radiated emission tests.

3.3 Test Software

During the test, the software “Development Desktop 2.0” was used.

3.4 Special Accessories and Auxiliary Equipment

During the test, the sensor shuttle board (Model: BMI088) was embedded in EUT, and EUT connected with the adapter and computer (Brand: ThinkPad, model: T450) by the USB port respectively.

3.5 Countermeasures to achieve EMC Compliance

No other special measure is employed to achieve the requirement.

4 Conformity Decision Rule

For all EMI tests included in this report, as measurement uncertainties are less than the values U_{CISPR} given in CISPR 16-4-2, compliance with the limits is determined by comparing measurement results directly with corresponding limits without taking into consideration of measurement uncertainties.

5 Test Results E M I S S I O N

5.1 Emission in the Frequency Range up to 30 MHz

5.1.1 Conducted Emission

Result:	**Passed**

Date of testing	:	2023-05-29
Test procedure	:	FCC 47 CFR Part 15, Subpart B:2021, ICES-003:2020, ANSI C63.4-2014 and CISPR 16-2-1
Frequency range	:	0.15 – 30 MHz
Limits	:	Quasi-peak limit: 0.15 – 0.5 MHz, 66 to 56 dBµV (decrease with the logarithm of frequency); 0.5 – 5 MHz, 56 dBµV; 5 – 30 MHz, 60 dBµV Average limit: 0.15 – 0.5 MHz, 56 to 46 dBµV (decrease with the logarithm of frequency); 0.5 – 5 MHz, 46 dBµV; 5 – 30 MHz, 50 dBµV
Bandwidth of EMI receiver for final measurement	:	9 kHz
Measurement time for final measurement	:	1 s
Kind of test site	:	Shielded room
Input voltage	:	AC 120 V, 60 Hz for AC adapter
Operational mode	:	Mode 1: EUT powered with adapter via USB cable and communicated by BT Mode 2: EUT powered with computer via USB cable and communicated by BT Mode 3: EUT powered and communicated with computer via the USB cable
Ambient condition	:	Temperature: 21.5 °C; Relative humidity: 57.3 %
Expanded measurement uncertainty (k=2)	:	3.39 dB

The measurement setup was made according to ANSI C63.4-2014 in a shielded room.

The measurement equipment like test receivers, quasi-peak detector and artificial mains network (AMN) are in compliance with CISPR 16-1 series standards.

The tested object was set-up on a wooden support. The EUT was set 0.8 m away from the AMN. The cord longer than necessary to be connected to the AMN was folded forth and back parallel so as to form a bundle with a length between 0.3 m and 0.4 m.

The disturbance voltage test was performed on the neutral line and phase line of the power supply of the EUT respectively.

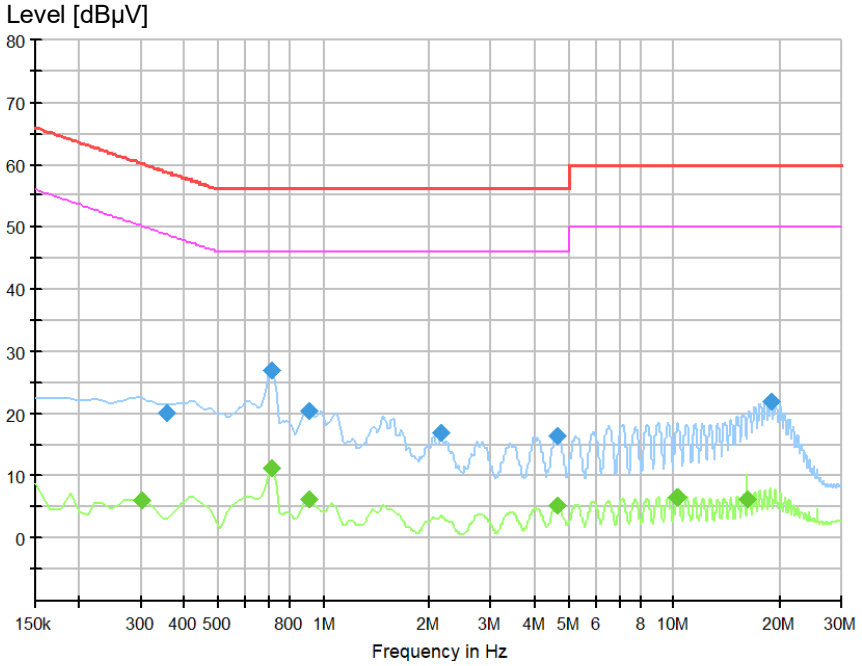
The following figures and tables were those measured by an automatic measuring system. Both quasi-peak and average measurements were performed. In the following spectral diagram, "♦" means Quasi-Peak Value and "♦" means Average Value results.

Notes on following tables of conducted emission results and conversions:

Level (dBµV): final measurement results by using quasi-peak detector and average detector
Transd (dB): transducer factor including cable loss, insertion loss of artificial mains network and gain of pre-amplifier (if used)

Margin: Limit (dBµV) - Level (dBµV)

Figure 1: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L for mode 1



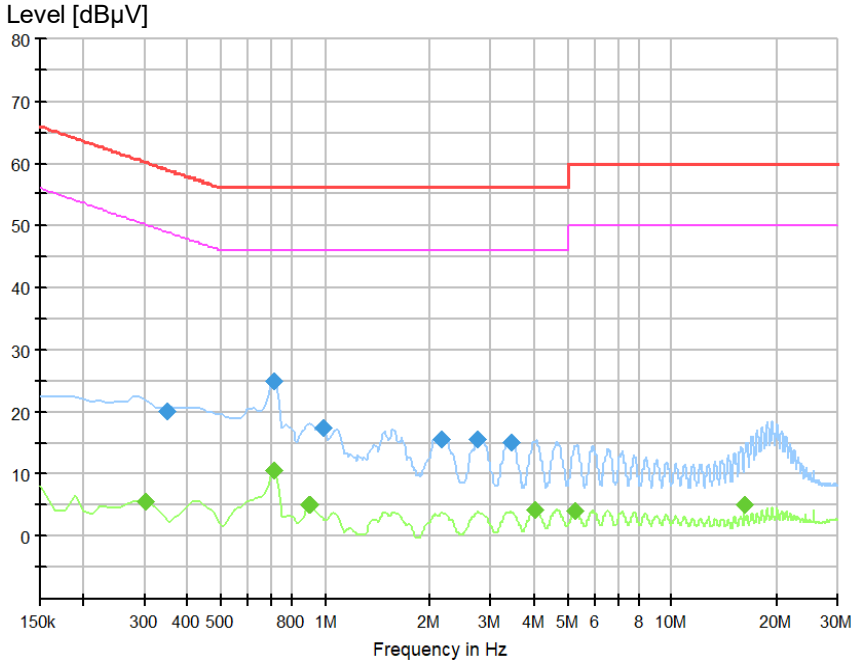
Final quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.358125	20.21	58.77	38.56	1000.0	9.000	L1	OFF	9.8
0.706875	26.89	56.00	29.11	1000.0	9.000	L1	OFF	9.8
0.909375	20.36	56.00	35.64	1000.0	9.000	L1	OFF	9.8
2.158125	16.84	56.00	39.16	1000.0	9.000	L1	OFF	9.9
4.655625	16.48	56.00	39.52	1000.0	9.000	L1	OFF	9.9
18.819375	21.89	60.00	38.11	1000.0	9.000	L1	OFF	10.2

Final average measurement result:

Frequency (MHz)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.301875	6.11	50.19	44.08	1000.0	9.000	L1	OFF	9.8
0.706875	11.44	46.00	34.56	1000.0	9.000	L1	OFF	9.8
0.909375	6.41	46.00	39.59	1000.0	9.000	L1	OFF	9.8
4.644375	5.33	46.00	40.67	1000.0	9.000	L1	OFF	9.9
10.235625	6.57	50.00	43.43	1000.0	9.000	L1	OFF	10.2
16.119375	6.33	50.00	43.67	1000.0	9.000	L1	OFF	10.2

Figure 2: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N for mode 1



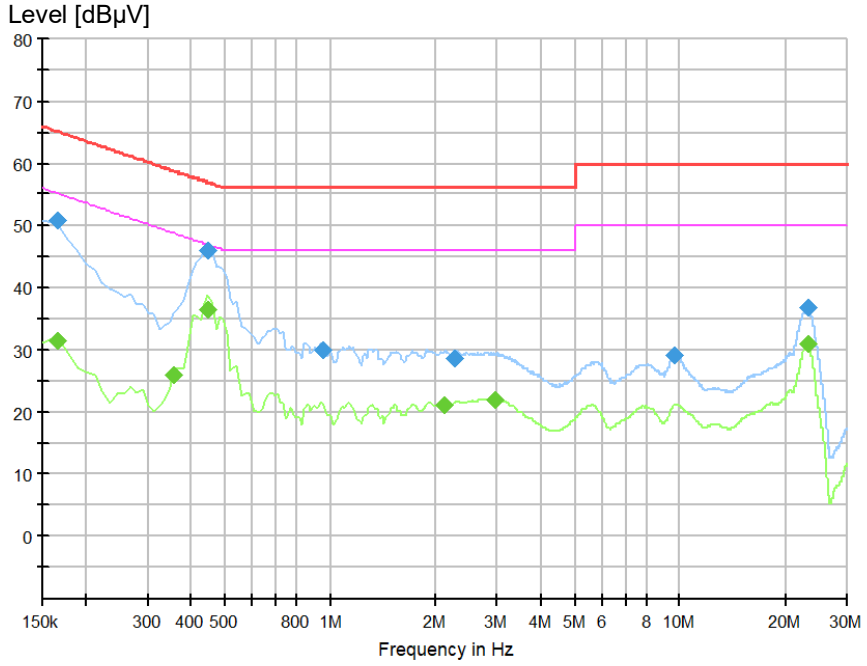
Final quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.346875	20.08	59.04	38.95	1000.0	9.000	N	OFF	9.8
0.706875	25.00	56.00	31.00	1000.0	9.000	N	OFF	9.8
0.976875	17.35	56.00	38.65	1000.0	9.000	N	OFF	9.8
2.169375	15.69	56.00	40.31	1000.0	9.000	N	OFF	9.8
2.743125	15.57	56.00	40.43	1000.0	9.000	N	OFF	9.9
3.406875	15.04	56.00	40.96	1000.0	9.000	N	OFF	9.9

Final average measurement result:

Frequency (MHz)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.301875	5.64	50.19	44.55	1000.0	9.000	N	OFF	9.8
0.706875	10.50	46.00	35.50	1000.0	9.000	N	OFF	9.8
0.898125	5.08	46.00	40.92	1000.0	9.000	N	OFF	9.8
4.003125	4.26	46.00	41.74	1000.0	9.000	N	OFF	9.9
5.240625	4.20	50.00	45.80	1000.0	9.000	N	OFF	9.9
16.108125	5.10	50.00	44.90	1000.0	9.000	N	OFF	10.2

Figure 3: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L for mode 2



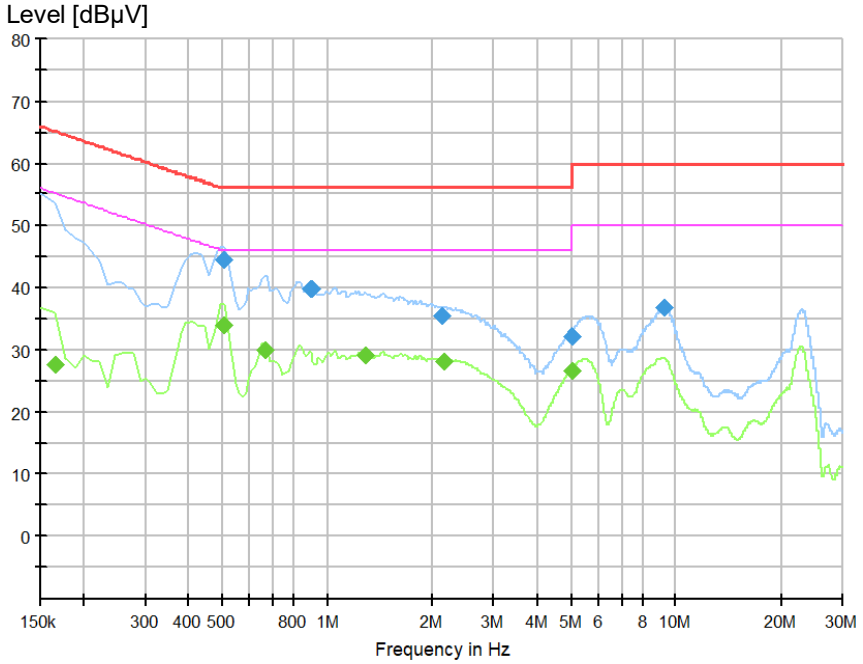
Final quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.166875	50.89	65.12	14.23	1000.0	9.000	L1	OFF	9.8
0.448125	46.17	56.91	10.74	1000.0	9.000	L1	OFF	9.8
0.954375	30.06	56.00	25.94	1000.0	9.000	L1	OFF	9.8
2.259375	28.77	56.00	27.23	1000.0	9.000	L1	OFF	9.9
9.684375	29.27	60.00	30.73	1000.0	9.000	L1	OFF	10.2
23.206875	36.81	60.00	23.19	1000.0	9.000	L1	OFF	10.3

Final average measurement result:

Frequency (MHz)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.166875	31.50	55.12	23.62	1000.0	9.000	L1	OFF	9.8
0.358125	26.03	48.77	22.74	1000.0	9.000	L1	OFF	9.8
0.448125	36.42	46.91	10.49	1000.0	9.000	L1	OFF	9.8
2.113125	21.13	46.00	24.87	1000.0	9.000	L1	OFF	9.8
2.945625	21.83	46.00	24.17	1000.0	9.000	L1	OFF	9.9
23.150625	31.05	50.00	18.95	1000.0	9.000	L1	OFF	10.3

Figure 4: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N for mode 2



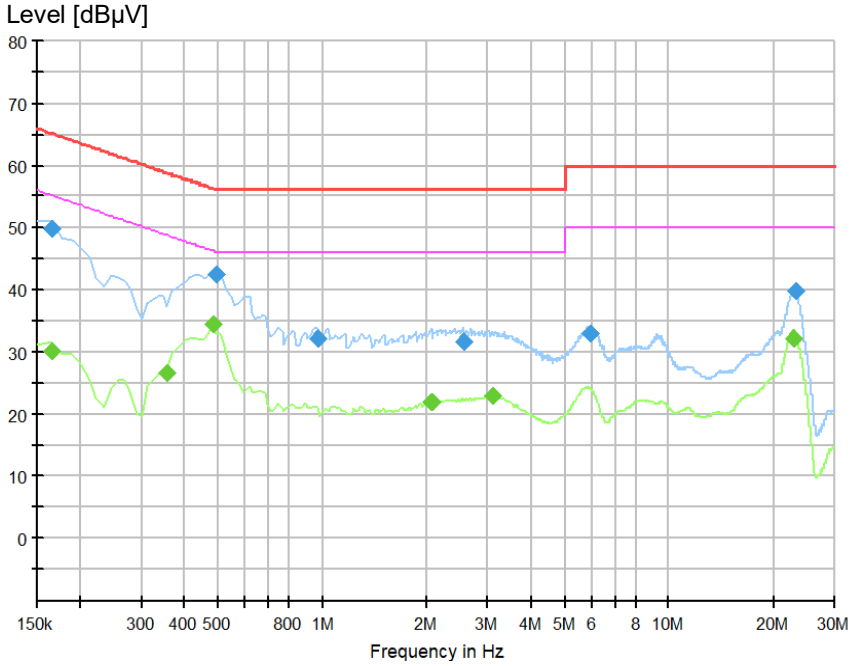
Final quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.504375	44.53	56.00	11.47	1000.0	9.000	N	OFF	9.8
0.898125	39.85	56.00	16.15	1000.0	9.000	N	OFF	9.8
2.124375	35.51	56.00	20.49	1000.0	9.000	N	OFF	9.8
4.993125	32.26	56.00	23.74	1000.0	9.000	N	OFF	9.9
9.245625	36.83	60.00	23.17	1000.0	9.000	N	OFF	10.2

Final average measurement result:

Frequency (MHz)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.166875	27.73	55.12	27.39	1000.0	9.000	N	OFF	9.8
0.504375	34.00	46.00	12.00	1000.0	9.000	N	OFF	9.8
0.661875	30.05	46.00	15.95	1000.0	9.000	N	OFF	9.8
1.280625	29.30	46.00	16.70	1000.0	9.000	N	OFF	9.8
2.169375	28.13	46.00	17.87	1000.0	9.000	N	OFF	9.8
4.993125	26.69	46.00	19.31	1000.0	9.000	N	OFF	9.9

Figure 5: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, L for mode 3



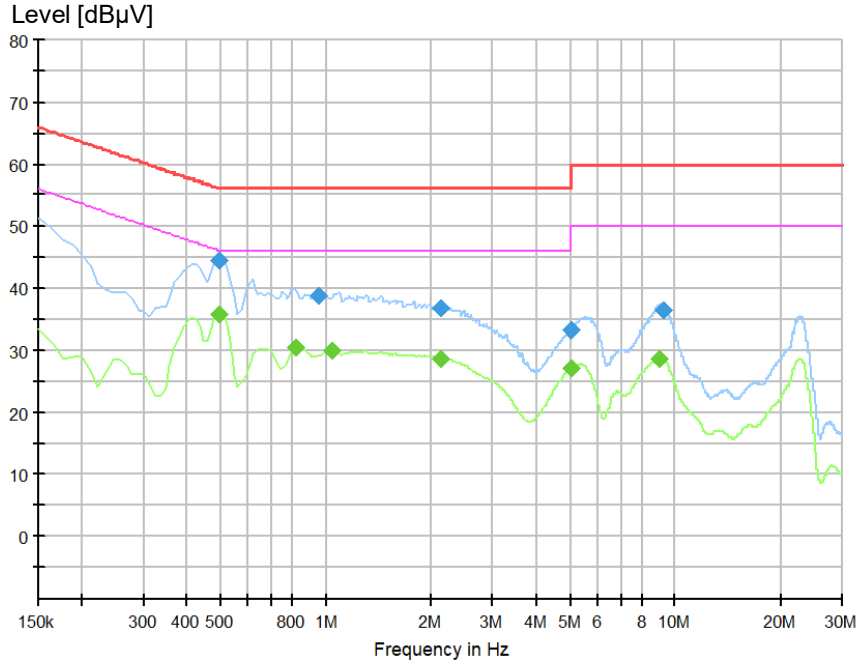
Final quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.166875	49.80	65.12	15.31	1000.0	9.000	L1	OFF	9.8
0.493125	42.55	56.12	13.56	1000.0	9.000	L1	OFF	9.8
0.965625	32.13	56.00	23.87	1000.0	9.000	L1	OFF	9.8
2.551875	31.81	56.00	24.19	1000.0	9.000	L1	OFF	9.9
5.960625	32.98	60.00	27.02	1000.0	9.000	L1	OFF	9.9
23.116875	39.71	60.00	20.29	1000.0	9.000	L1	OFF	10.3

Final average measurement result:

Frequency (MHz)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.166875	30.30	55.12	24.82	1000.0	9.000	L1	OFF	9.8
0.358125	26.80	48.77	21.97	1000.0	9.000	L1	OFF	9.8
0.481875	34.40	46.31	11.91	1000.0	9.000	L1	OFF	9.8
2.068125	21.81	46.00	24.19	1000.0	9.000	L1	OFF	9.8
3.080625	22.81	46.00	23.19	1000.0	9.000	L1	OFF	9.9
22.891875	32.13	50.00	17.87	1000.0	9.000	L1	OFF	10.3

Figure 6: Spectral Diagrams, Conducted Emission, 150 kHz – 30 MHz, N for mode 3



Final quasi-peak measurement result:

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.493125	44.45	56.12	11.66	1000.0	9.000	N	OFF	9.8
0.954375	38.80	56.00	17.20	1000.0	9.000	N	OFF	9.8
2.135625	36.78	56.00	19.22	1000.0	9.000	N	OFF	9.8
4.993125	33.12	56.00	22.88	1000.0	9.000	N	OFF	9.9
9.200625	36.58	60.00	23.42	1000.0	9.000	N	OFF	10.2

Final average measurement result:

Frequency (MHz)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.493125	35.74	46.12	10.38	1000.0	9.000	N	OFF	9.8
0.819375	30.55	46.00	15.45	1000.0	9.000	N	OFF	9.8
1.033125	29.93	46.00	16.07	1000.0	9.000	N	OFF	9.8
2.124375	28.64	46.00	17.36	1000.0	9.000	N	OFF	9.8
4.993125	27.09	46.00	18.91	1000.0	9.000	N	OFF	9.9
9.043125	28.62	50.00	21.38	1000.0	9.000	N	OFF	10.2

5.2 Emission in the Frequency Range above 30 MHz

5.2.1 Radiated Emission (30-1000 MHz)

Result:	**Passed**

Date of testing	:	2023-05-29
Test procedure	:	FCC 47 CFR Part 15, Subpart B:2021, ICES-003:2020, ANSI C63.4-2014 and CISPR 16-2-3
Product classification	:	Class B
Frequency range	:	30 – 1000 MHz
Limits	:	Quasi-peak limits (3 m distance) (See Note 1) 30 – 88 MHz, 40 dBµV/m; 88 – 216 MHz, 43.5 dBµV/m; 216 – 960 MHz, 46 dBµV/m; Above 960 MHz, 54 dBµV/m.
Bandwidth of EMI receiver for final measurement	:	120 kHz
Measurement time for final measurement	:	1 s
Kind of test site	:	Semi-anechoic chamber
Input voltage	:	AC 120 V, 60 Hz for adapter DC 5 V for module
Operational mode	:	Mode 1: EUT powered with adapter via USB cable and communicated by BT. Mode 2: EUT powered with computer via USB cable and communicated by BT Mode 3: EUT powered and communicated with computer via the USB cable.
Ambient condition	:	Temperature: 22.6 °C; Relative humidity: 51.7 %
Expanded measurement uncertainty (k=2)	:	5.49 dB

The radiated disturbance test was carried out in a semi-anechoic chamber. The test distance from the receiving antenna to the EUT is 3 m. The normalized site attenuation of the semi-anechoic chamber is regularly calibrated to ensure the radiated disturbance test results are valid. During the test, the EUT was placed on the 80 cm wooden support above the reference ground plane. The wooden support was rotated 360° around and the height of the antenna was varied from 1 m to 4 m to find the maximum disturbance. The test was performed with the antenna both in its horizontal and vertical polarizations.

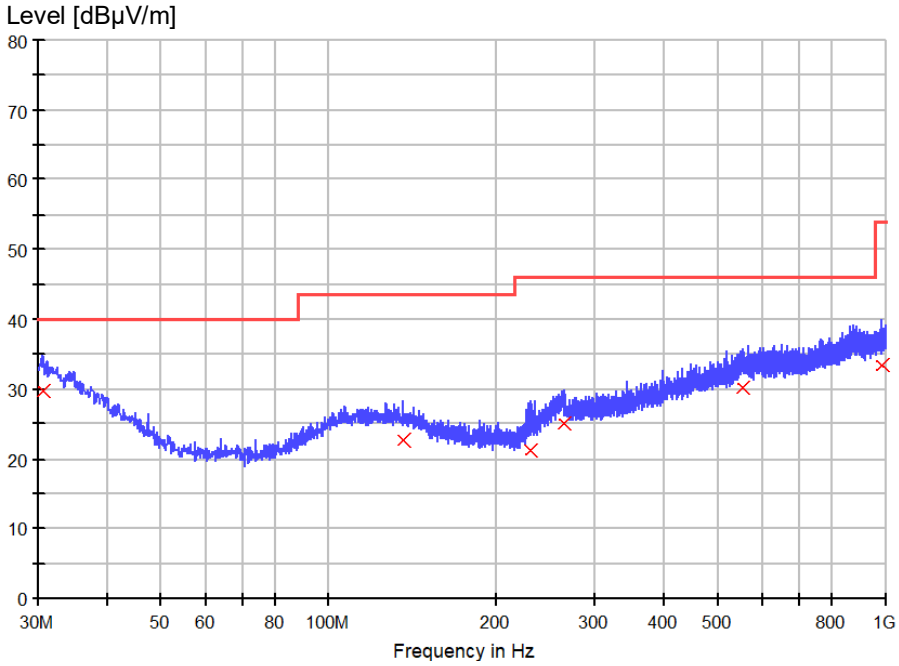
The following figures and tables were those measured by an automatic measurement system. A preview test was firstly performed with peak detector. The final test was performed with quasi-peak at those critical frequencies during the preview test. In the following spectral diagram, "×" means quasi-peak test results.

Note 1: The class B limits of FCC 47 CFR Part 15, Subpart B:2021 is stricter than those ICES-003:2020 Table 2 for 3 m test distance. Therefore, the former limits are used in following figures and tables.

Notes on following tables of radiated emission results and conversions:

QuasiPeak (dBµV/m): final measurement results by using quasi-peak detector
Corr. (dB): correction factor including: antenna factor, cable loss, and gain of pre-amplifier (if used)
Margin: Limit (dBµV/m) - QuasiPeak (dBµV/m)

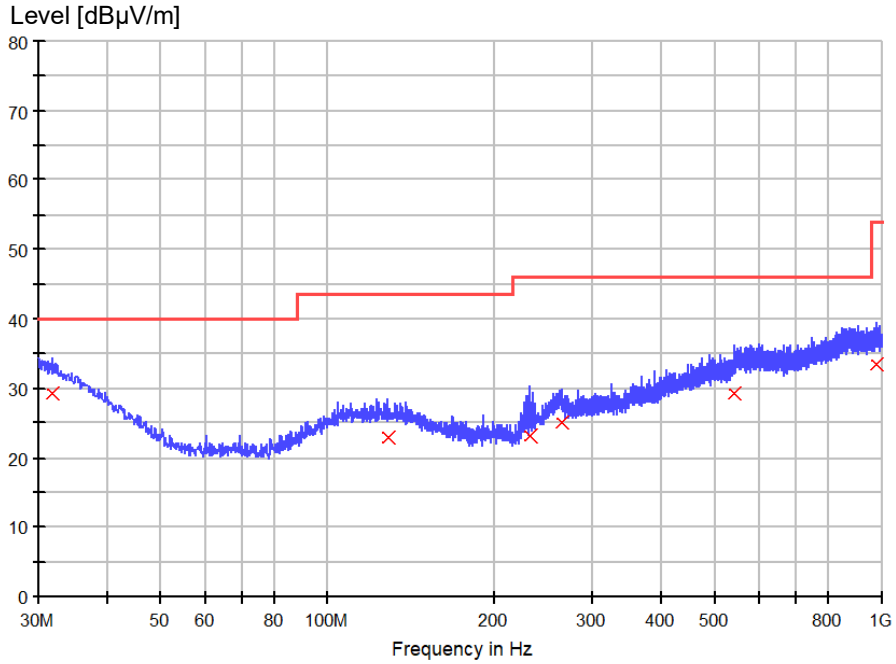
Figure 7: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Horizontal polarization for mode 1



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
30.727500	29.6	120.000	100.0	H	-180.0	25.0	10.4	40.0
135.851250	22.7	120.000	100.0	H	-180.0	18.4	20.8	43.5
230.305000	21.2	120.000	100.0	H	-180.0	16.9	24.8	46.0
264.012500	25.0	120.000	100.0	H	-180.0	20.7	21.0	46.0
553.072500	30.3	120.000	100.0	H	-180.0	26.4	15.7	46.0
987.753750	33.5	120.000	100.0	H	-180.0	28.9	20.5	54.0

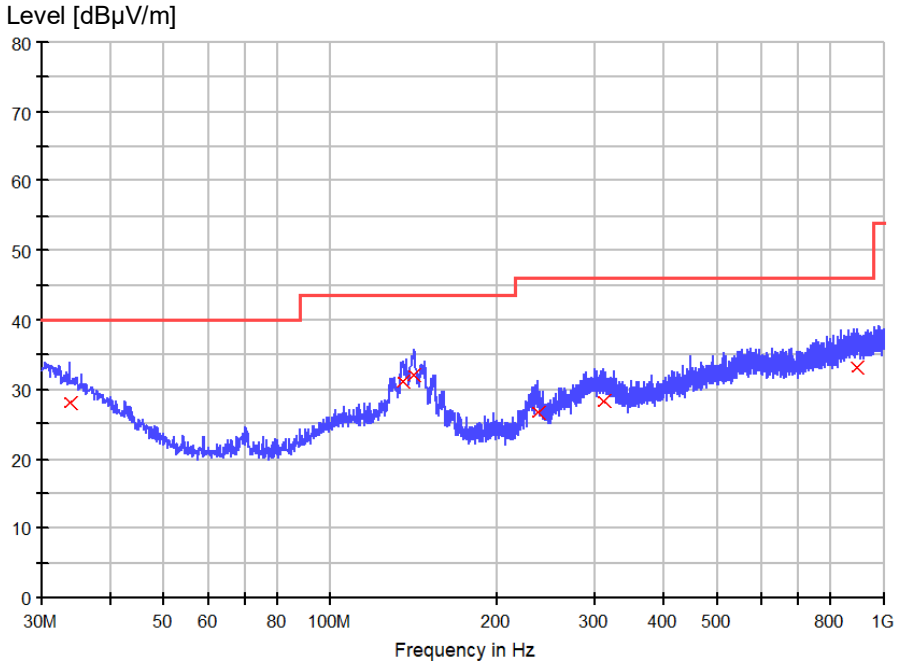
Figure 8: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Vertical polarization for mode 1



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
31.818750	29.2	120.000	100.0	V	180.0	24.6	10.8	40.0
128.333750	23.0	120.000	100.0	V	180.0	18.7	20.5	43.5
232.366250	23.2	120.000	100.0	V	-25.0	17.2	22.8	46.0
264.133750	25.0	120.000	100.0	V	-180.0	20.7	21.0	46.0
540.705000	29.3	120.000	100.0	V	180.0	25.5	16.7	46.0
979.993750	33.4	120.000	100.0	V	180.0	28.8	20.7	54.0

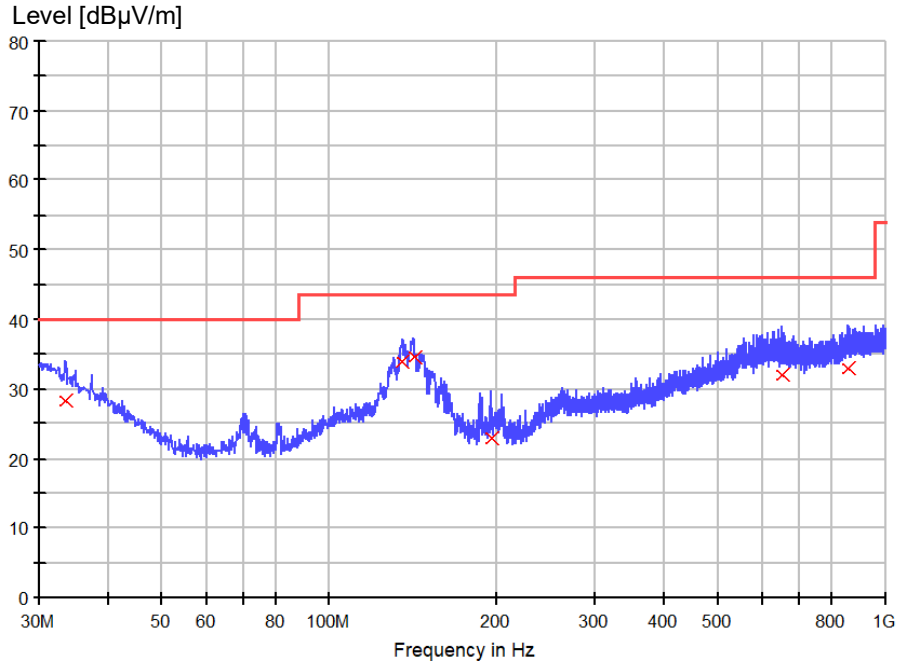
Figure 9: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Horizontal polarization for mode 2



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
33.637500	28.0	120.000	100.0	H	180.0	23.5	12.0	40.0
134.881250	31.1	120.000	100.0	H	180.0	18.4	12.4	43.5
141.186250	32.0	120.000	100.0	H	180.0	18.1	11.5	43.5
236.973750	26.6	120.000	100.0	H	180.0	17.8	19.4	46.0
310.451250	28.4	120.000	100.0	H	180.0	20.3	17.6	46.0
893.057500	33.3	120.000	100.0	H	180.0	28.3	12.7	46.0

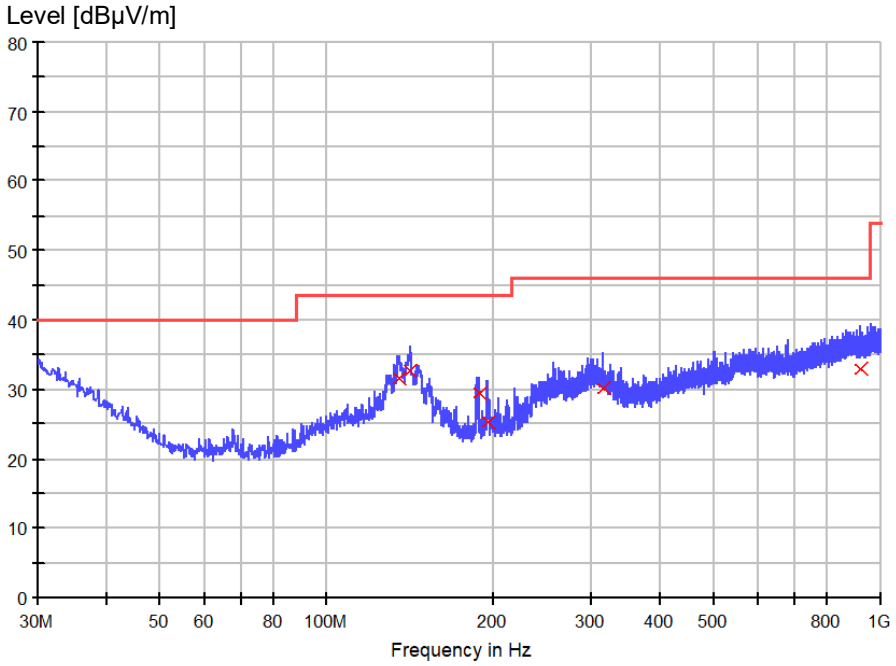
Figure 10: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Vertical polarization for mode 2



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
33.516250	28.2	120.000	100.0	V	-180.0	23.5	11.8	40.0
135.730000	33.9	120.000	100.0	V	-57.0	18.4	9.6	43.5
141.913750	34.6	120.000	100.0	V	102.0	17.9	8.9	43.5
195.142500	22.9	120.000	100.0	V	-66.0	16.1	20.6	43.5
650.436250	32.1	120.000	100.0	V	-180.0	26.3	13.9	46.0
859.471250	32.9	120.000	100.0	V	-180.0	28.0	13.1	46.0

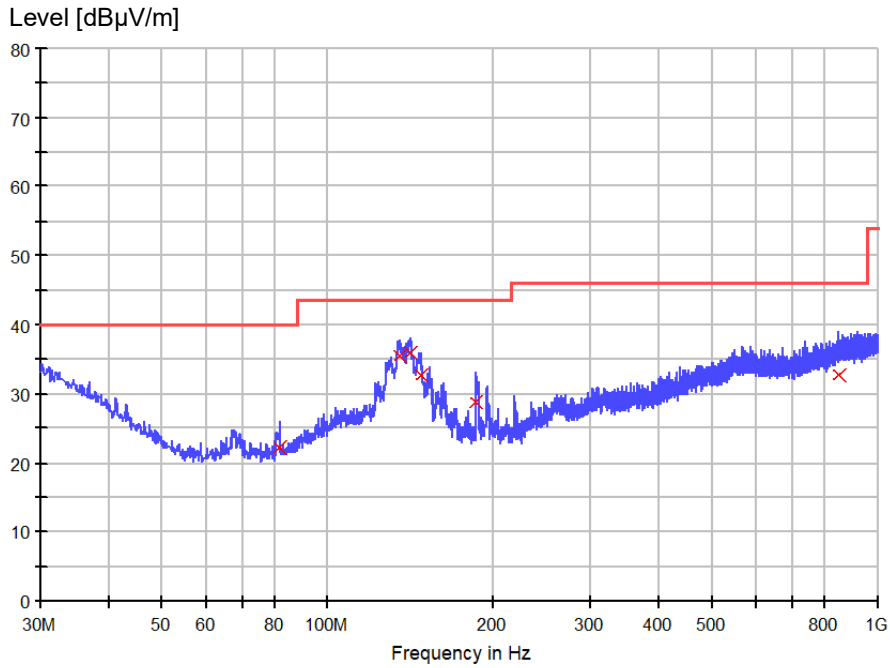
Figure 11: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Horizontal polarization for mode 3



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
135.002500	31.6	120.000	100.0	H	-60.0	18.4	11.9	43.5
141.671250	32.8	120.000	100.0	H	-166.0	18.0	10.7	43.5
188.231250	29.5	120.000	100.0	H	-54.0	15.8	14.0	43.5
195.870000	25.2	120.000	100.0	H	-102.0	16.1	18.3	43.5
316.028750	30.3	120.000	100.0	H	-19.0	20.5	15.7	46.0
921.308750	32.9	120.000	100.0	H	-180.0	28.1	13.1	46.0

Figure 12: Spectral Diagrams, Radiated Emission, 30 MHz – 1000 MHz, Vertical polarization for mode 3



Final quasi-peak measurement results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - QPK (dB)	Limit - QPK (dBµV/m)
81.895000	22.1	120.000	100.0	V	57.0	13.9	17.9	40.0
135.608750	35.6	120.000	100.0	V	-176.0	18.4	7.9	43.5
141.065000	36.0	120.000	100.0	V	-80.0	18.1	7.5	43.5
147.370000	32.7	120.000	100.0	V	-180.0	17.5	10.8	43.5
186.170000	28.7	120.000	100.0	V	77.0	15.8	14.8	43.5
849.407500	32.7	120.000	100.0	V	-180.0	27.9	13.3	46.0

5.2.2 Radiated Emission (1-18 GHz)

Result:	**Passed**

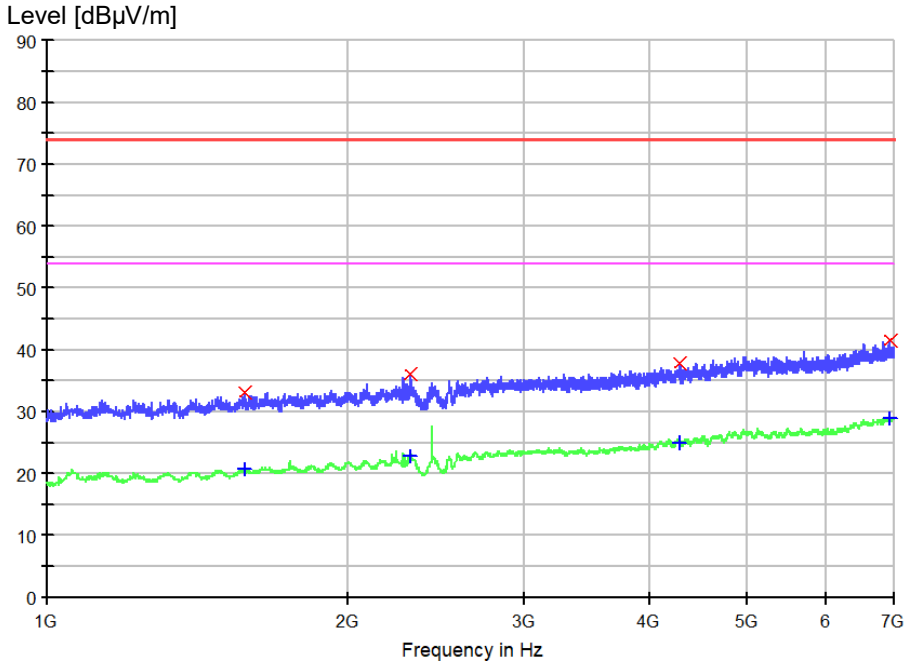
Date of testing	:	2023-05-30
Port	:	Enclosure
Test procedure	:	FCC 47 CFR Part 15, Subpart B:2021, ICES-003:2020, ANSI C63.4-2014 and CISPR 16-2-3
Product classification	:	Class B
Limit	:	MaxPeak limits (3 m distance): 1–18 GHz, 74 dBµV/m Average limits (3 m distance): 1–18 GHz, 54 dBµV/m
Frequency range	:	1 – 18 GHz (see Note 2)
Kind of test site	:	Semi-anechoic chamber with RF absorber material on the ground plane.
Test distance	:	3 m
Test voltage	:	AC 120 V, 60 Hz for adapter DC 5 V for module
Operational mode	:	Mode 1: EUT powered with adapter via USB cable and communicated by BT. Mode 2: EUT powered with computer via USB cable and communicated by BT
Earthing	:	No earthing
Ambient condition	:	Temperature: 22.6 °C; Relative humidity: 51.7 %
Expanded measurement uncertainty (*k*=2)	:	5.17 dB (1 GHz~6 GHz) 5.12 dB (6 GHz~18 GHz)

The radiated disturbance test was carried out in a fully anechoic room. The test distance from the receiving antenna to the EUT is 3 m. The normalized site attenuation of the fully-anechoic chamber is regularly calibrated to ensure the radiated disturbance test results are valid. During the test, the EUT was placed on an 80 cm supporting table. And the supporting table was rotated 360° around and the height of the antenna was varied from 1 m to 4 m to find the maximum disturbance. The test was performed with the antenna both in its horizontal and vertical polarizations.

The following figures and tables were those measured by an automatic measurement system. The final test was performed with peak detector and average detector at those critical frequencies during the preview test. In the following figure, "× (red)" means measurement results with peak detector and "+ (blue)" means measurement results with average detector.

Note 2: The highest frequency in the EUT is 2480 MHz. According to FCC Part 15 subpart B §15.33 (b) (1) and Table 3 of ICES-003:2020, the upper frequency for radiated emission measurement is 18 GHz.

Figure 13: Spectral Diagrams and measurement results, 1 GHz – 7 GHz, horizontal polarization for mode 1



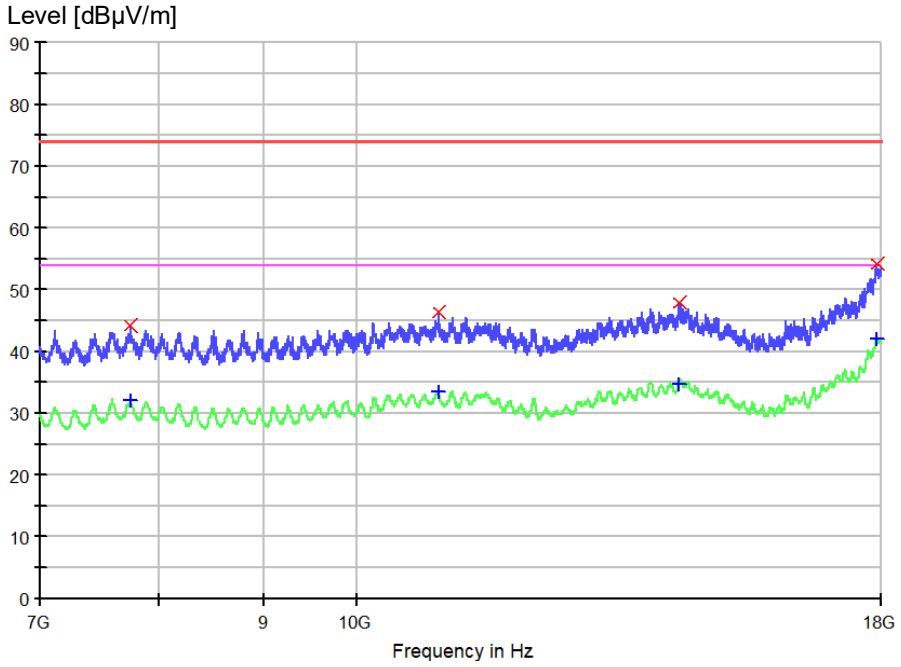
Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
1573.750000	33.2	1000.000	100.0	H	-180.0	-18.9	40.8	74.0
2306.500000	36.0	1000.000	100.0	H	-180.0	-16.6	38.0	74.0
4290.250000	38.0	1000.000	100.0	H	-180.0	-11.9	36.0	74.0
6952.750000	41.7	1000.000	100.0	H	-180.0	-7.5	32.3	74.0

Final average measurement result:

Frequency (MHz)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - AVG (dB)	Limit - AVG (dBµV/m)
1573.750000	20.8	1000.000	100.0	H	-180.0	-18.9	33.2	54.0
2306.500000	23.0	1000.000	100.0	H	-180.0	-16.6	31.0	54.0
4290.250000	24.9	1000.000	100.0	H	-180.0	-11.9	29.1	54.0
6952.750000	28.9	1000.000	100.0	H	-180.0	-7.5	25.1	54.0

Figure 14: Spectral Diagrams and measurement results, 7 GHz – 18 GHz, horizontal polarization for mode 1



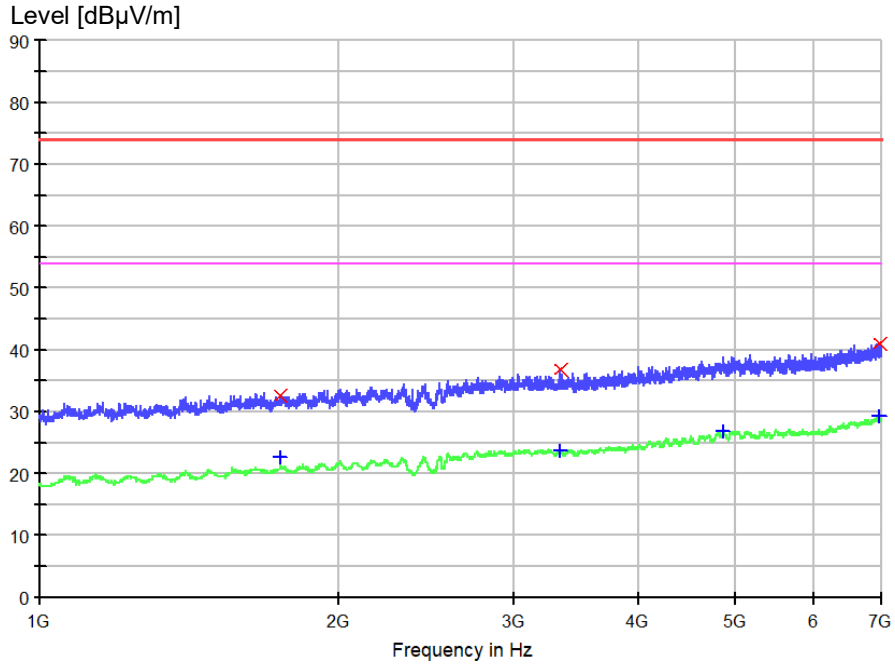
Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
7752.125000	44.1	1000.000	100.0	H	180.0	-5.4	29.9	74.0
10964.125000	46.2	1000.000	100.0	H	180.0	-0.9	27.8	74.0
14343.875000	47.9	1000.000	100.0	H	180.0	2.4	26.1	74.0
17931.250000	54.2	1000.000	100.0	H	180.0	11.4	19.8	74.0

Final average measurement result:

Frequency (MHz)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - AVG (dB)	Limit - AVG (dBµV/m)
7752.125000	32.0	1000.000	100.0	H	180.0	-5.4	22.0	54.0
10964.125000	33.5	1000.000	100.0	H	180.0	-0.9	20.5	54.0
14343.875000	34.8	1000.000	100.0	H	180.0	2.4	19.2	54.0
17931.250000	42.0	1000.000	100.0	H	180.0	11.4	12.0	54.0

Figure 15: Spectral Diagrams and measurement results, 1 GHz – 7 GHz, vertical polarization for mode 1



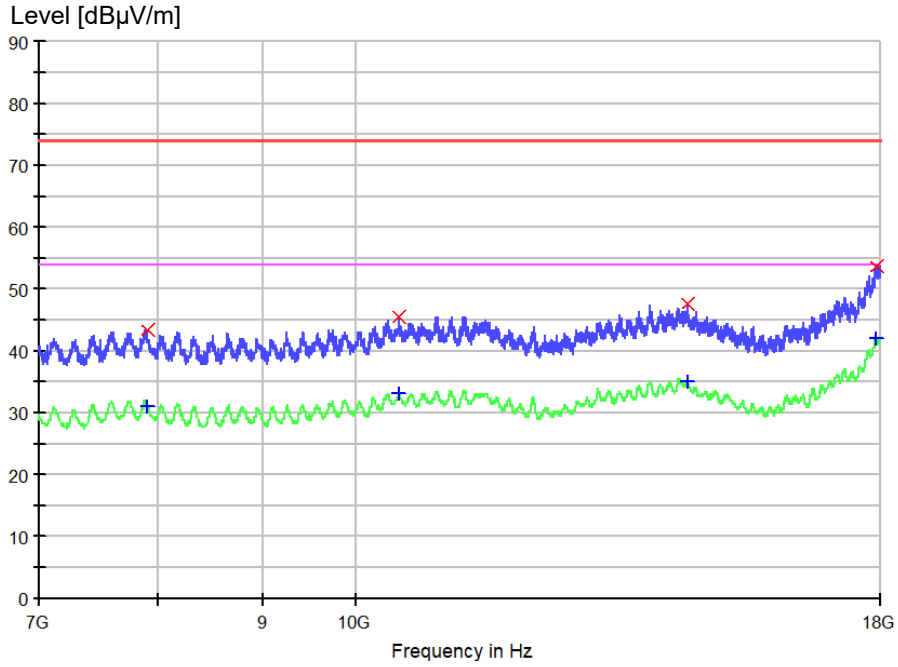
Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
1745.500000	32.8	1000.000	100.0	V	-180.0	-18.4	41.3	74.0
3340.000000	36.8	1000.000	100.0	V	-180.0	-14.1	37.2	74.0
4863.250000	-39.0	1000.000	100.0	V	-180.0	-10.6	113.0	74.0
6961.750000	41.0	1000.000	100.0	V	-180.0	-7.4	33.0	74.0

Final average measurement result:

Frequency (MHz)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - AVG (dB)	Limit - AVG (dBµV/m)
1745.500000	22.7	1000.000	100.0	V	-180.0	-18.4	31.3	54.0
3340.000000	23.8	1000.000	100.0	V	-180.0	-14.1	30.2	54.0
4863.250000	26.7	1000.000	100.0	V	-180.0	-10.6	27.3	54.0
6961.750000	29.3	1000.000	100.0	V	-180.0	-7.4	24.7	54.0

Figure 16: Spectral Diagrams and measurement results, 7 GHz –18 GHz, vertical polarization for mode 1



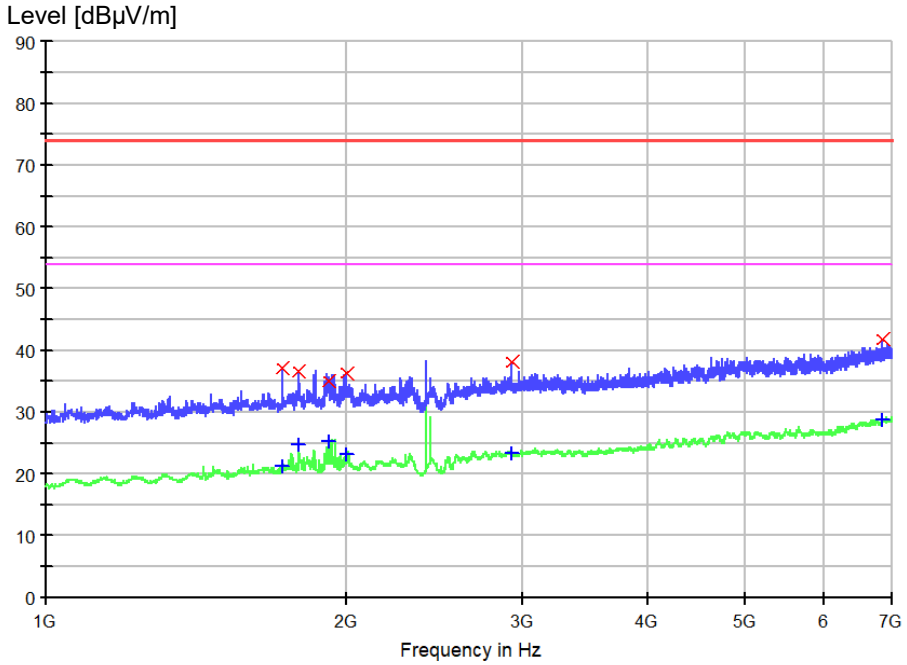
Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
7913.000000	43.4	1000.000	100.0	V	-180.0	-5.0	30.6	74.0
10484.250000	45.5	1000.000	100.0	V	-180.0	-1.8	28.5	74.0
14502.000000	47.5	1000.000	100.0	V	-180.0	2.5	26.5	74.0
17932.625000	53.6	1000.000	100.0	V	-180.0	11.4	20.4	74.0

Final average measurement result:

Frequency (MHz)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - AVG (dB)	Limit - AVG (dBµV/m)
7913.000000	31.1	1000.000	100.0	V	-180.0	-5.0	22.9	54.0
10484.250000	33.1	1000.000	100.0	V	-180.0	-1.8	20.9	54.0
14502.000000	35.1	1000.000	100.0	V	-180.0	2.5	18.9	54.0
17932.625000	42.1	1000.000	100.0	V	-180.0	11.4	11.9	54.0

Figure 17: Spectral Diagrams and measurement results, 1 GHz – 7 GHz, horizontal polarization for mode 2



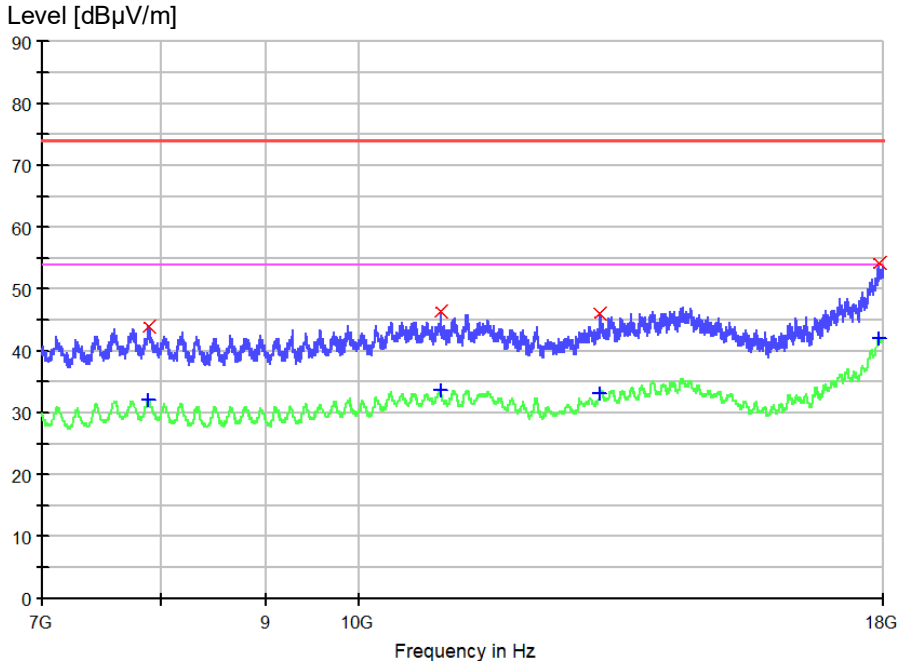
Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
1726.750000	37.1	1000.000	100.0	H	180.0	-18.4	36.9	74.0
1786.750000	36.5	1000.000	100.0	H	180.0	-18.3	37.6	74.0
1921.750000	35.1	1000.000	100.0	H	180.0	-17.8	38.9	74.0
1996.750000	36.4	1000.000	100.0	H	180.0	-17.5	37.6	74.0
2920.000000	38.2	1000.000	100.0	H	180.0	-14.8	35.8	74.0
6860.500000	41.9	1000.000	100.0	H	180.0	-7.9	32.1	74.0

Final average measurement result:

Frequency (MHz)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - AVG (dB)	Limit - AVG (dBµV/m)
1726.750000	21.4	1000.000	100.0	H	180.0	-18.4	32.6	54.0
1786.750000	24.7	1000.000	100.0	H	180.0	-18.3	29.3	54.0
1921.750000	25.3	1000.000	100.0	H	180.0	-17.8	28.7	54.0
1996.750000	23.1	1000.000	100.0	H	180.0	-17.5	30.9	54.0
2920.000000	23.5	1000.000	100.0	H	180.0	-14.8	30.5	54.0
6860.500000	28.6	1000.000	100.0	H	180.0	-7.9	25.4	54.0

Figure 18: Spectral Diagrams and measurement results, 7 GHz – 18 GHz, horizontal polarization for mode 2



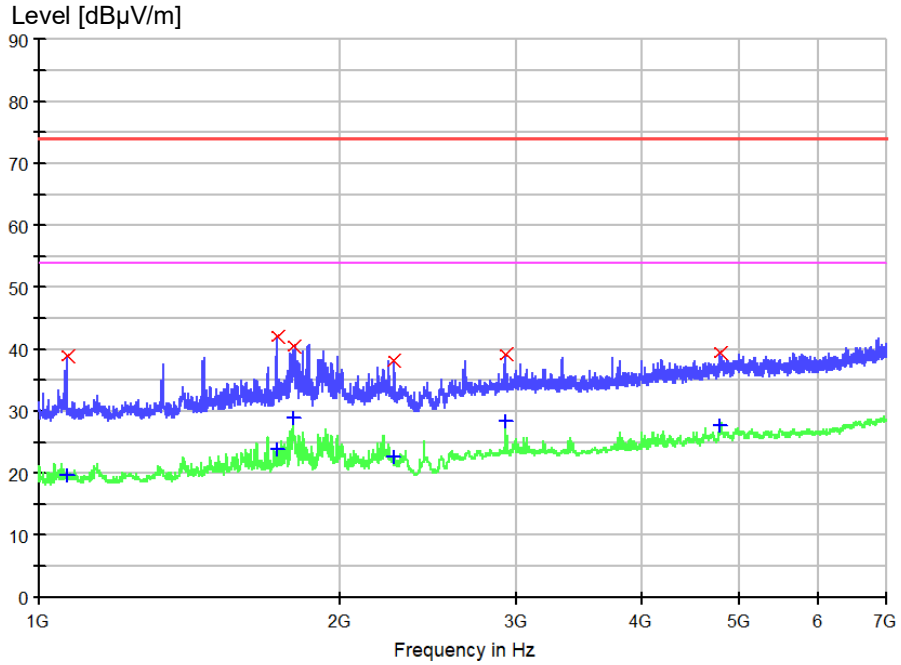
Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
7893.750000	44.0	1000.000	100.0	H	-180.0	-5.1	30.0	74.0
10951.750000	46.3	1000.000	100.0	H	-180.0	-0.9	27.7	74.0
13107.750000	46.2	1000.000	100.0	H	-180.0	-0.9	27.8	74.0
17918.875000	54.1	1000.000	100.0	H	-180.0	11.1	19.9	74.0

Final average measurement result:

Frequency (MHz)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
7893.750000	32.2	1000.000	100.0	H	-180.0	-5.1	30.0	74.0
10951.750000	33.6	1000.000	100.0	H	-180.0	-0.9	27.7	74.0
13107.750000	33.1	1000.000	100.0	H	-180.0	-0.9	27.8	74.0
17918.875000	42.2	1000.000	100.0	H	-180.0	11.1	19.9	74.0

Figure 19: Spectral Diagrams and measurement results, 1 GHz – 7 GHz, vertical polarization for mode 2



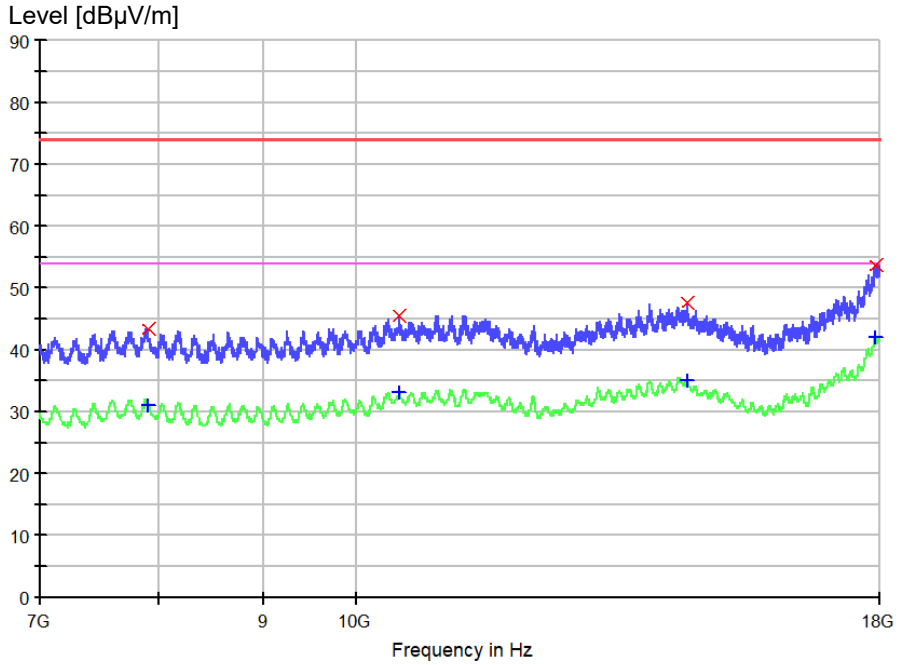
Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
1066.000000	38.9	1000.000	100.0	V	-180.0	-21.0	35.1	74.0
1731.250000	42.1	1000.000	100.0	V	-180.0	-18.4	31.9	74.0
1796.500000	40.6	1000.000	100.0	V	-180.0	-18.3	33.4	74.0
2259.250000	38.1	1000.000	100.0	V	-180.0	-16.7	35.9	74.0
2926.000000	39.1	1000.000	100.0	V	-180.0	-14.8	34.9	74.0
4788.250000	39.5	1000.000	100.0	V	-180.0	-10.7	34.5	74.0

Final average measurement result:

Frequency (MHz)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - AVG (dB)	Limit - AVG (dBµV/m)
1066.000000	19.9	1000.000	100.0	V	-180.0	-21.0	34.1	54.0
1731.250000	24.0	1000.000	100.0	V	-180.0	-18.4	30.0	54.0
1796.500000	29.0	1000.000	100.0	V	-180.0	-18.3	25.0	54.0
2259.250000	22.7	1000.000	100.0	V	-180.0	-16.7	31.3	54.0
2926.000000	28.5	1000.000	100.0	V	-180.0	-14.8	25.5	54.0
4788.250000	27.7	1000.000	100.0	V	-180.0	-10.7	26.3	54.0

Figure 20: Spectral Diagrams and measurement results, 7 GHz –18 GHz, vertical polarization for mode 2



Final maxpeak measurement result:

Frequency (MHz)	MaxPeak (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
7913.000000	43.4	1000.000	100.0	V	-180.0	-5.0	30.6	74.0
10484.250000	45.5	1000.000	100.0	V	-180.0	-1.8	28.5	74.0
14502.000000	47.5	1000.000	100.0	V	-180.0	2.5	26.5	74.0
17932.625000	53.6	1000.000	100.0	V	-180.0	11.4	20.4	74.0

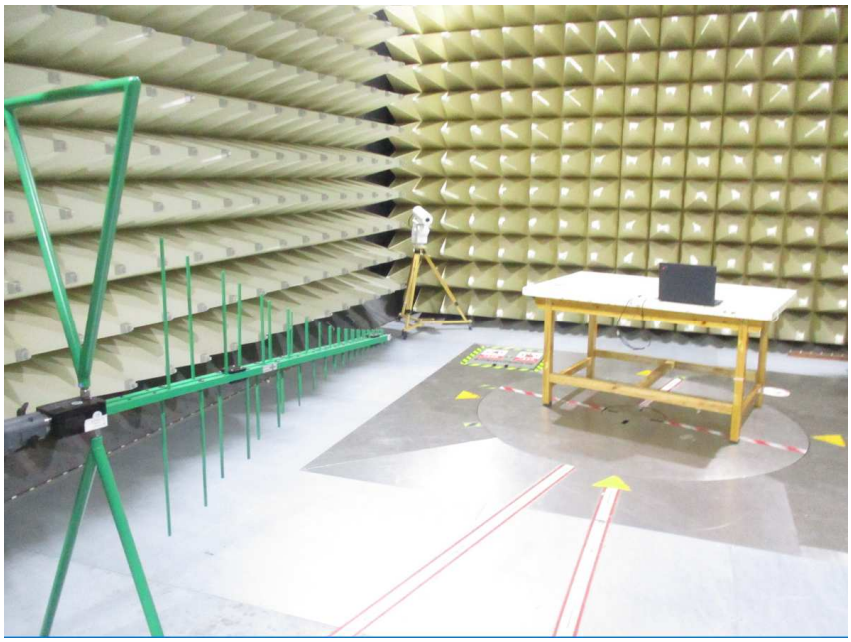
Final average measurement result:

Frequency (MHz)	Average (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Margin - AVG (dB)	Limit - AVG (dBµV/m)
7913.000000	31.1	1000.000	100.0	V	-180.0	-5.0	22.9	54.0
10484.250000	33.1	1000.000	100.0	V	-180.0	-1.8	20.9	54.0
14502.000000	35.1	1000.000	100.0	V	-180.0	2.5	18.9	54.0
17932.625000	42.1	1000.000	100.0	V	-180.0	11.4	11.9	54.0

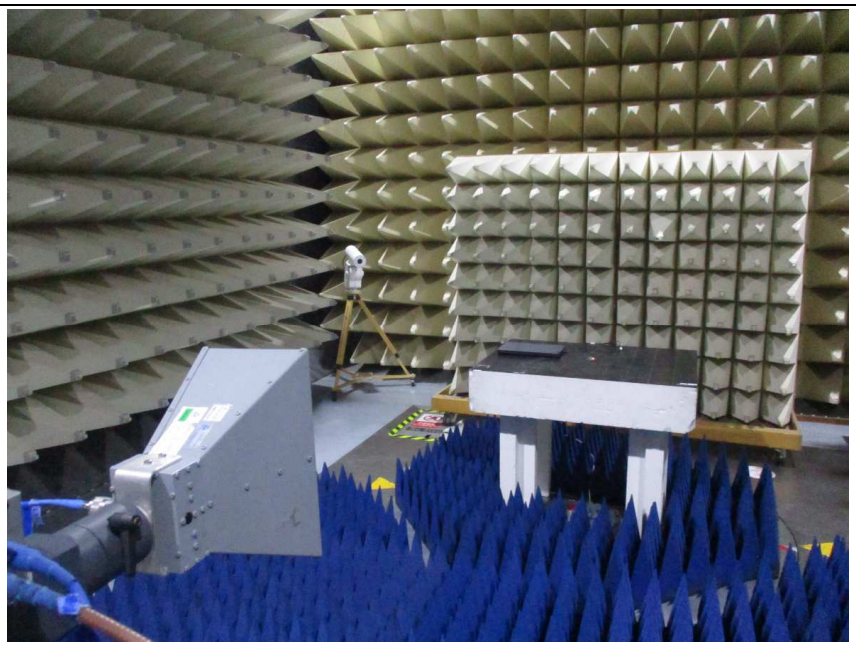
6 Photographs of the Test Set-Up

Photograph 1: Set-up for measurement of conducted emission

Photograph 2: Set-up for measurement of radiated emission



(30-1000 MHz)



(1-18 GHz)

7 List of Test and Measurement Instruments

Equip.	Description	Model	Manufacturer	Last Date DD.MM.YYYY	Due Date DD.MM.YYYY
9023229	EMI test receiver	ESR3	Rohde&Schwarz	11.08.2022	11.08.2023
G1811403	Artificial mains network	ENV216	Rohde&Schwarz	19.10.2022	19.10.2023
G1824248	Dual display multimeter	F45	Fluke	08.10.2022	08.10.2024
G1811378	3m semi-anechoic chamber	SAC3	Frankonia	10.06.2021	10.06.2024
G1811391	EMI test receiver	ESCI	Rohde&Schwarz	29.09.2022	29.09.2023
G1811425	Bilog antenna	CBL 6112D	Teseq	20.04.2023	20.04.2026
G1822702	Spectrum analyser	FSV40	Rohde&Schwarz	06.05.2023	06.05.2025
G1825371	Preamplifier	EMC051845SE	Taiwan EMCI	14.05.2021	14.05.2023
G1822694	Double ridged broadband horn antenna	BBHA 9120 D	Schwarzbeck	24.03.2021	24.03.2026

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End of test report