Prüfbericht-Nr.: *Test Report No.:*	**JP21FRBC 001**	**Auftrags-Nr.:** *Order No.:*	**150243527**	**Seite 1 von 45** *Page 1 of 45*
Kunden-Referenz-Nr.: *Client Reference No.:*	N/A	**Auftragsdatum:** *Order Date:*	2021-06-02	
Auftraggeber: *Client:*	New Japan Radio 1-1, Fukuoka 2-Chome Fujimino City Saitama, 356-8510 Japan			
Prüfgegenstand: *Test Item:*	K-Band Doppler Sensor Module (Movement Sensor)			
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	NJR4266F3C2	**Serien-Nr.:** *Serial No.:*	Sample01	
Auftrags-Inhalt: *Order Content:*	Radio Testing			
Prüfgrundlage: *Test Specification:*	FCC 47 CFR Part 15, Subpart C, Section 15.245 ANSI C63.10-2013 RSS-Gen (Issue 5): 2018+Amendment 1:2019 RSS-210 (Issue 10): 2019+Amendment 1:2020 ANSI C63.10-2013			

Wareneingangsdatum: *Date of Receipt:*	2021-07-16, 2021-07-20	-/-
Prüfmuster-Nr.: *Test Sample No.:*	A003093437, A003095132	
Prüfzeitraum: *Testing Period:*	2021-07-19 to 2021-08-25	
Ort der Prüfung: *Place of Testing:*	Yokohama EMC Laboratory	
Prüflaboratorium: *Testing Laboratory:*	TÜV Rheinland Japan Ltd.	
Prüfergebnis*: *Test Result*:*	Pass	

zusammengestellt von: *compiled by:*	T. Nagata	**genehmigt von:** *authorized by:*	P. Zhang
Datum: *Date:* 2021-08-27	Takeshi Nagata	**Ausstellungsdatum:** *Issue date:* 2021-08-27	Pin Zhang
Stellung */ Position:*	Inspector	**Stellung** */ Position:*	Reviewer

Sonstiges */ Other:*

Zustand des Prüfgegenstandes bei Anlieferung: Prüfmuster vollständig und unbeschädigt
Condition of the Test Item at Delivery: *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*

REVISIONS

Report No.	Issue date	Changes / Remarks
JP21FRBC 001	2021-08-27	Original document (Test report for Intentional radiator aspects)

Contents

1. General Remarks

1.1 Test Specifications

Table 1: Test Summary

Test	Specifications	Result
Emission: FCC 47 CFR Part 15, Subpart C, Section 15.245 ANSI C63.10-2013 RSS-210 (Issue 10): 2019+Amendment 1:2020 RSS-Gen (Issue 5): 2018+Amendment 1:2019 ANSI C63.10-2013		
Supply Voltage Requirements FCC §15.31(e)	See the section 5.1.1.	Pass
Antenna Requirements FCC §15.203	See the section 5.1.2.	Pass
Restricted Bands of Operation FCC §15.205 RSS-Gen §8.10	See the section 5.1.3.	Pass
Duty Cycle	-/-	Reference
20dB Bandwidth FCC §15.215 (c)	20dB bandwidth shall be contained within the designated frequency band.	Pass
99% Bandwidth RSS-Gen §6.7 and §8.11	-/-	Reference
Field Strength of Fundamental Requirements FCC §15.245(b) (i) and (ii) RSS-210 §Annex F, Table F1	2500mV/m (128dBuV/m) at 3m distance	Pass
Radiated Spurious Emissions of Transmitter Requirements FCC §15.209 and RSS-210 §7.1, 7.2, 7.3, RSS-Gen §8.1	9kHz – 40GHz 40GHz – 100GHz 3m below 1GHz 3m above 1GHz 2nd and 3rd Harmonics: 7.5mV/m (77.5dBuV/m) at 3m distance	Pass
Conducted Emission on AC Power Ports of Transmitter Requirements FCC §15.207 RSS-Gen §8	150kHz - 30MHz	Pass

1.2 Complementary Materials

There is no attachment to this test report.

2. Test Sites

2.1 Test Facilities

TÜV Rheinland Japan Ltd. – Global Technology Assessment Center
4-25-2 Kita-Yamata, Tsuzuki-ku, Yokohama 224-0021, Japan

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

The test facility is recognized by the Federal Communications Commission (FCC) as Accredited Testing Laboratory under designation number JP0017.

The test facility is recognized by Innovation, Science and Economic Development Canada (ISED) as Wireless Device Testing Laboratory under ISED number 3466B and CAB identifier JP0011.

The test facility is accredited by VLAC (member of ILAC) under number VLAC-017 according to ISO/IEC 17025:2017.

2.2 List of Test and Measurement Instruments

Table 2: List of Test and Measurement Equipment

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
For Transmitter and Receiver Radiated Spurious Emission (above 40GHz)							
Spectrum Analyzer	Agilent	E4447A	MY48250005	BT-8267	1 year	2020-12-14	2021-12-14
Harmonic Mixer 40-60GHz	Agilent	11970U	MY30030222	BT-8348	1 year	2020-12-02	2021-12-02
Horn Antenna 40-60GHz (RX)	Custom Microwave Inc.	HO19R	-/-	BT-8334	N/A	N/A	N/A
Harmonic Mixer 50-75GHz	Agilent	11970V	MY30033072	BT-8367	1 year	2020-12-02	2021-12-02
Horn Antenna 50-75GHz (RX)	Custom Microwave Inc.	HO15R	-/-	BT-8336	N/A	N/A	N/A
Harmonic Mixer 75-110GHz	Agilent	11970W	MY25210462	BT-8350	1 year	2020-12-02	2021-12-02
Horn Antenna 75-110GHz (RX)	Custom Microwave Inc.	HO10R	-/-	BT-8338	N/A	N/A	N/A
For Power Port Conducted Emission (CE)							
Conducted Emission Measurement Software	Toyo Corporation	EP9/CE	Ver. 4.2.010	RF-0810	1 year	2021-02-16	2022-02-16
EMI Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2021-03-12	2022-03-12
LISN	Rohde & Schwarz	ENV216	100276	RF-0016	1 year	2021-05-19	2022-05-19

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
LISN	Rohde & Schwarz	ENV216	101958	RF-0708	1 year	2021-05-19	2022-05-19
For Radiated Emission (RE)							
EMI Receiver	Rohde & Schwarz	ESU 8	100025	RF-0020	1 year	2021-03-12	2022-03-12
EMI Receiver	Rohde & Schwarz	ESU 40	100029	RF-0021	1 year	2020-08-17	2021-08-17
EMI Receiver	Rohde & Schwarz	ESW 44	101751	RF-0809	1 year	2020-09-28	2021-09-28
RF Selector (10m Chamber)	Toyo Corporation	NS4900	0703-182	RF-0029	1 year	2021-02-16	2022-02-16
Loop Antenna with Amplifier, 9kHz-30MHz	Rohde & Schwarz	HFH2-Z2	100139	RF-0048	1 year	2021-04-27	2022-04-27
Trilog Antenna No. 2, 30-1000MHz	Schwarzbeck	VULB 9168	9168-475	RF-0462	1 year	2021-05-18	2022-05-18
5dB Attenuator	Pasternack	PE7047-5	-/-	RF-0731	1 year	2021-05-18	2022-05-18
Biconical Antenna, 30-300MHz	Schwarzbeck	BBA9106-VHBB912	00235-00963	RF-0784	1 year	2021-03-09	2022-03-09
5dB Attenuator	Pasternack	PE7047-5	-/-	RF-0732	1 year	2021-03-09	2022-03-09
Log-Periodic Antenna, 300-1000MHz	Schwarzbeck	UHALP 9108 A1	UHALP 9108-A 0845	RF-0287	1 year	2021-03-09	2022-03-09
3dB Attenuator	Pasternack	PE7047-3	-/-	RF-0733	1 year	2021-03-09	2022-03-09
Low Noise Preamplifier, 9kHz-1GHz	TSJ	MLA-10K01-B01-35	1370750	RF-0253	1 year	2021-01-06	2022-01-06
Low Pass Filter, DC-1GHz	R&K	LP1000CH 3	12104001	RF-0515	1 year	2021-01-06	2022-01-06
Horn Antenna, 1-8GHz	Schwarzbeck	BBHA 9120 D	1059	RF-0553	1 year	2021-04-03	2022-04-03
Microwave Preamplifier, 1-8GHz	Toyo Corporation	TPA0108-40	0634	RF-0052	1 year	2021-01-06	2022-01-06
Horn Antenna with Preamplifier, 8-18GHz (RX)	Toyo Corporation	HAP06-18W	00000025	RF-0065	1 year	2021-04-03	2022-04-03
High Pass Filter, 8-18GHz	Micro-Tronics	HPM50107	006	RF-0334	1 year	2021-04-03	2022-04-03
Horn Antenna with Preamplifier, 18-26.5GHz (RX)	Toyo Corporation	HAP18-26N	00000010	RF-0070	1 year	2021-04-03	2022-04-03
Horn Antenna with Preamplifier, 26.5 -40GHz (RX)	Toyo Corporation	HAP26-40N	00000007	RF-0069	1 year	2021-04-03	2022-04-03
Preamplifier, 26.5-40GHz	Toyo Corporation	HAP2640-S	-/-	RF-0258	1 year	2021-03-17	2022-03-17
Constant Voltage Constant Frequency Stabilizers and Power Accessories							
CVCF (Shielded Room)	NF Corporation	ES2000S	9075612	RF-0210	1 year	2021-03-12	2022-03-12
CVCF Booster (Shielded Room)	NF Corporation	ES2000B	9074403	RF-0211	1 year	2021-03-12	2022-03-12
CVCF (10m Chamber)	NF Corporation	ES2000U	9067307	RF-0212	1 year	2021-03-12	2022-03-12

Kind of Equipment	Manufacturer	Model Name	Serial Number	Equip. ID	Cal. Interval	Cal. Date	Next Cal.
CVCF Booster (10m Chamber)	NF Corporation	ES2000B	9074408	RF-0213	1 year	2021-03-12	2022-03-12
DC Power Supply	Hewlett Packard	6653A	3640A03102	RF-0004	N/A	N/A	N/A
DC Power Supply	Agilent	E3646A	MY50350007	RF-0412	N/A	N/A	N/A
True RMS Multimeter	Fluke	87V	97680450	RF-0282	1 year	2021-03-23	2022-03-23

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2017 has been confirmed before testing.

2.3 Measurement Uncertainty

Table 3: Emission Measurement Uncertainty

Measurement Type	Frequency	Uncertainty
Conducted Emission on Power Ports	150kHz - 30MHz	±2.0dB
Radiated Emission – Semi Anechoic Chamber	30MHz - 1GHz	±3.8dB at 3m ±5.0dB at 10m
	1GHz - 40GHz	±4.5dB at 3m
Radiated Emission (MMW)	40GHz - 50GHz	±4.6dB
	50GHz - 75GHz	±5.0dB
	75GHz – 110GHz	±5.0dB

Note:

The measurement instrumentation uncertainty (MIU) was determined according to CISPR 16-4-2. All MIU values mentioned in the above table are smaller than the uncertainty budgets specified by CISPR 16-4-2, therefore compliance for all emission measurements is deemed to occur if no measured disturbance level exceeds the disturbance limit.

3. General Product Information

3.1 Product Function and Intended Use

The **EUT** (**E**quipment **U**nder **T**est) is K-band movement sensor module based on the Doppler Effect. Although the module incorporates transmitter and receiver, they can only be operated simultaneously.

The radio product is designed to be used in vending machine, home security system, automatic on/off switch for luminarias etc. to detect some moving objects. It incorporates a MCU which processes the radar output to improve detection accuracy and stability and enable communication with the host. The EUT emits un-modulated carrier and has 5 types of duty cycle (1%, 2%, 3%, 7.7%, 100%) to meet requirement of different detection distances and power consumption.

3.2 Ratings and System Details

Carrier Field Strength:	104.23dBµV/m @3m, Average
Antenna gain:	+9.3dBi
Antenna type:	Pattern antenna (printed on PCB)
Antenna mounting type:	Internal
Frequency range:	24.075 - 24.175GHz
Nominal Frequency:	24.125GHz
Number of channels:	1 (Fixed)
Modulation type:	No modulation (5 types of duty cycle)
FCC classification:	FDS
System Input Voltage:	DC 3.3/5.0V
Typical Nominal Voltage:	DC 3.3/5.0V
Input Current:	50mA
Protection Class:	III
Test voltage:	DC 3.3/5.0V (For EUT) AC 120V (For AC Adapter) **(*)**
Test frequency:	60Hz (For AC Adapter) **(*)**

Note: **(*)** Two typical rating of off-the-shelf AC Adapters were used.

3.3 Noise Generating and Noise Suppressing Parts

The highest frequency generated or used by the EUT is 24.175GHz for fundamental component as intentional radiator portion.

3.4 Submitted Documents and Information

Following document has been submitted by the client:

Instruction for the testing

Following information provided in this test report has been submitted by the client:

- client name and address;
- EUT identification, ratings, system details, and description of product function and intended use;
- information related to noise generating and noise suppressing parts (if any).

Note:
Actual test modes for each test item in this test report were specified by the customer.

4. Test Setup and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209 and 15.245.

The test methods, which have been used, are based on ANSI C63.10.

For details, see under each test item.

4.2 Operation Modes

The operation mode used for testing is:

A. Intended operation: transmission and receiving at the nominal frequency.

The operation mode is coupled with the following configurations:

1. Continuous Transmission (Duty Cycle: 100%)
2. Intermittent Transmission (Duty Cycle: 7.7%, Burst Period: 143us, On-time: 11us) **(*)**

Note: **(*)** For the 4 types of intermittent transmission (1%, 2%, 3% and 7.7%), they transmit the same burst (i.e. the same Tx power with the same On-time), with the only difference being the repetition time. Therefore, duty cycle of 7.7% was chosen as the representative because the highest the duty cycle facilitates faster testing.

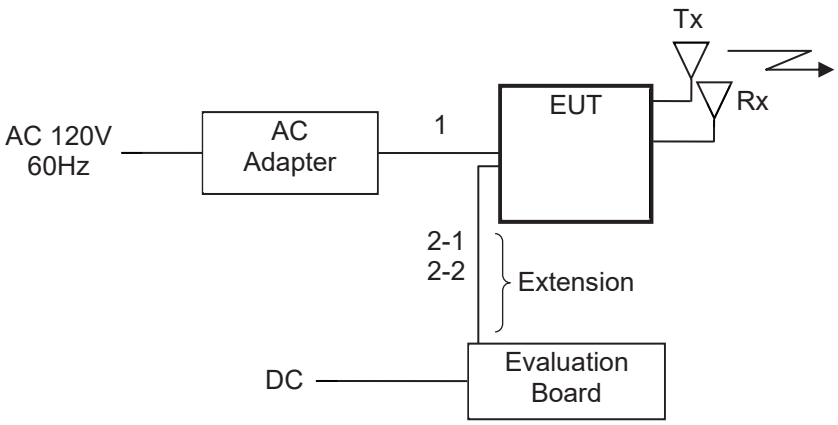
4.3 Physical Configuration for Testing

The EUT was tested on a stand-alone basis and the test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10.

Figure 1: Block Diagram

For AC Power Line Conducted Emission of Transmitter



For Other Test Items of Transmitter

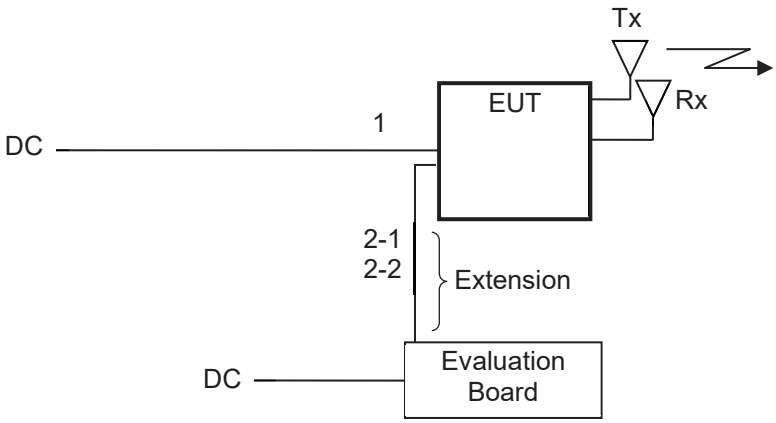


Table 4: Interfaces present on the EUT

No.	Interface	Cable Length for Testing, Shielding	Interface Classification
1.	DC cable	2.0m, Un-shielded	AC input power port **(*)**
2-1.	Analog Range Setting	1.3m, Un-shielded	Signal port **(*)**
2-2.	Digital Output (Detect)	1.3m, Un-shielded	Signal port **(*)**

Note:

(*) The EUT is directly plugged onto an end user's PCB. In order to enable testing, interface cables were extended for the testing purpose.
For more details, refer to section: Photographs of the Test Set-Up.

4.4 Test Software

The EUT was provided by the manufacturer with suitable software to allow operation in all the required mode.

Software used for testing is;

- NJR4266_Control_001 version 1.0.0.0 by New Japan Radio

These software were running on the laptop computer connected to the EUT. It was used to enable the test operation mode listed in section 4.2 as appropriate.

4.5 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. Product: Laptop PC
   Manufacturer: Lenovo
   Model: ThinkPad L560
   Rated Voltage: DC 20V
   Input Current: Un-specified
   Protection Class: III
   Serial Number: B028858

2. Product: AC Adapter for Laptop PC
   Manufacturer: Lenovo
   Model: ADLX45NCC2A
   Rated Voltage: AC 100-240V
   Input Current: 1.3A
   Frequency: 50-60Hz
   Rated Voltage: DC 20V
   Output Current: 2.25A
   Protection Class: II
   Serial Number: 8SSA10E75794C1SG73W2583 REV:100

3. Product: AC Adapter for EUT (DC 3.3V)
   Manufacturer: UNIFIVE
   Model: US303320
   Rated Voltage: AC 100-240V
   Input Current: 0.3A
   Frequency: 50/60Hz
   Protection Class: II
   Serial Number: K01-0187443

4. Product: AC Adapter for EUT (DC 5V)
   Manufacturer: FUJIFILM
   Model: AC-5VN
   Rated Voltage: AC 100-240V
   Input Current: 20VA
   Frequency: 50/60Hz
   Protection Class: II
   Serial Number: 9944

5. Product: Evaluation Board
   Manufacturer: New Japan Radio
   Model: NJR4266K
   Rated Voltage: DC 5V
   Protection Class: III

4.6 Countermeasures to achieve Compliance

No additional measures were employed to achieve compliance.

5. Test Results RADIO

5.1 Technical Requirements

5.1.1 Supply Voltage Requirements

RESULT: **Pass**

Requirements:

FCC §15.31(e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Verdict:

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the supply voltage requirements.

5.1.2 Antenna Requirements

RESULT: **Pass**

Requirements:

FCC §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Verdict:

The antenna is permanently attached to the PCB board and is not able to be replaced. Hence it complies with the antenna requirements.

5.1.3 Restricted Bands of Operation

RESULT: **Pass**

Requirements:

FCC §15.205 and RSS-Gen §8.10

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT operation frequency range is 24.075 - 24.175GHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

5.2 Radiated Measurements

5.2.1 Duty Cycle

RESULT: **Reference**

Date of testing: 2021-07-21

Ambient temperature: 22°C
Relative humidity: 59%
Atmospheric pressure: 1010hPa

Requirements:

N/A, this test item was performed as reference.

Test procedure:

ANSI C63.10-2013

Table 5: Duty Cycle

Configuration	On Time Duration [us]	Period of the Pulse Train [us]	Total On Time [%]
1	10000000	10000000	100
2	12.019231	143.4295	8.38

Figure 2: Duty Cycle, Configuration 1, DC 3.3V

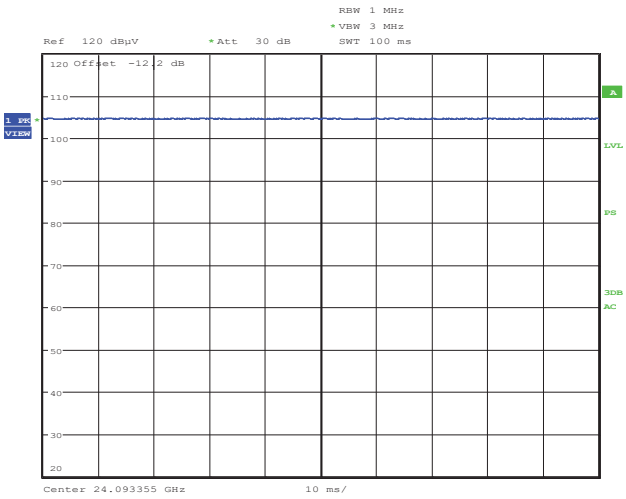
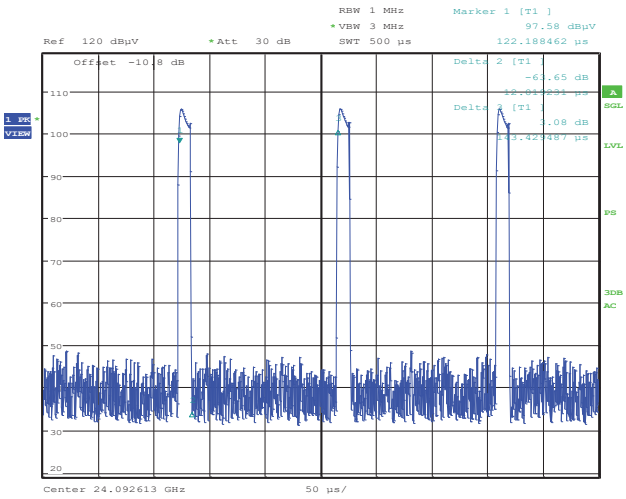


Figure 3: Duty Cycle, Configuration 2, DC 3.3V



5.2.2 20dB Bandwidth

RESULT: **Pass**

Date of testing:	2021-07-21
Ambient temperature:	22°C
Relative humidity:	59%
Atmospheric pressure:	1010hPa

Requirements:

FCC §15.215(c) and §15.245

The 20dB bandwidth of the emission shall be contained within the frequency band (24.075 - 24.175GHz) designated in the rule section under which the equipment is operated.

Test procedure:

ANSI C63.10 §6.9.2

The EUT was placed on non-conductive table raised 1.5m above the ground plane in a semi-anechoic chamber.

The 20dB bandwidth was measured with a horn antenna connected to a spectrum using a peak detector with the following settings:

- RBW = 500Hz, VBW = 2kHz for configuration 1;
- RBW = 50kHz, VBW = 200kHz for Mode A configuration 2.

Markers were placed at the lowest and highest intersections of the trace with a 20dBc line to obtain the value of the emission bandwidth.

Table 6: 20dB Bandwidth Edge Frequencies

20dB Bandwidth Edge Side	Edge Frequency [GHz]	Limit [GHz]	Margin [MHz]
Lower side	24.093305764	24.075	18.30576
Higher side	24.093322855	24.175	81.67715

Table 7: 20dB Bandwidth

Configuration	20dB Bandwidth [MHz]	Remark
1	0.028201025566	0.5 / 28.201025566 (kHz) =1.77 (%)
2	2.788461538	0.05 / 2.788461538 (MHz) =1.79 (%)

Figure 4: 20dB Bandwidth, Configuration 1

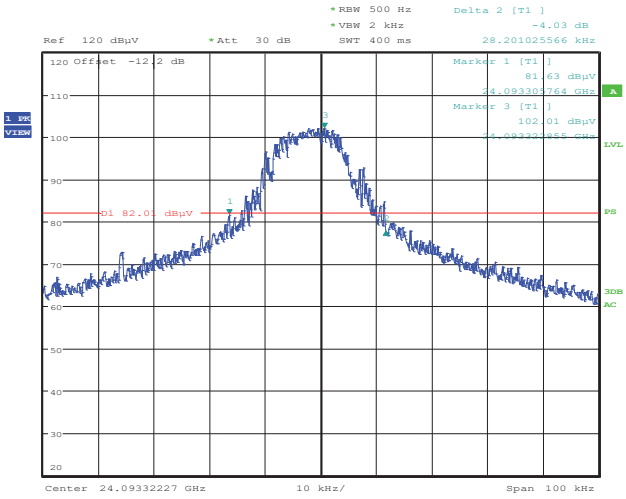


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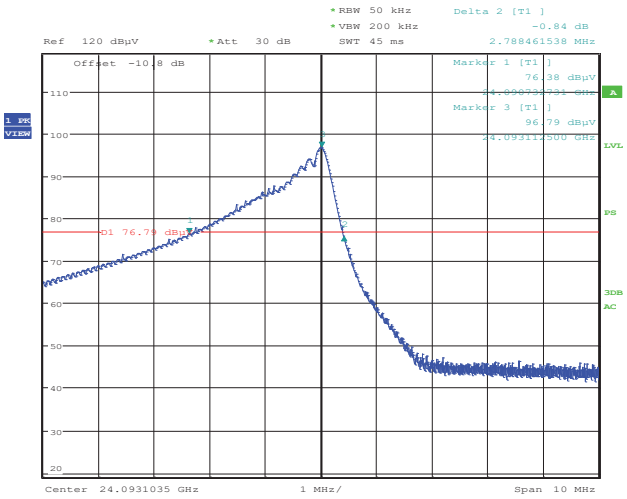
Figure 5: 20dB Bandwidth, Configuration 2



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5.2.3 99% Bandwidth

RESULT: **Reference**

Date of testing:	2021-07-21
Ambient temperature:	22°C
Relative humidity:	59%
Atmospheric pressure:	1010hPa

RSS-Gen §6.7 and §8.11

The 99% bandwidth shall be reported and shall lie entirely outside the restricted bands and the prohibited TV bands of 54-72MHz, 76-88MHz, 174-216MHz, 470-608MHz and 614-806MHz, unless otherwise indicated.

Test procedure:

ANSI C63.10 §6.9.3

The EUT was placed on non-conductive table raised 1.5m above the ground plane in a semi-anechoic chamber.

The 99% bandwidth was measured with a horn antenna connected to a spectrum using a peak detector instead of sample detector with the following settings:

RBW = 500Hz, VBW = 2kHz for configuration 1;

RBW = 50kHz, VBW = 200kHz for configuration 2.

Markers were placed at the lowest and highest intersections of the trace by 99% OBW function to obtain the value of the emission bandwidth.

Table 8: 99% Bandwidth Edge Frequencies

99% Bandwidth Edge Side	Edge Frequency [GHz]	Limit [GHz]	Margin [MHz]
Lower side	24.093315615	24.075	18.31562
Higher side	24.09334175	24.175	81.65825

Table 9: 99% Bandwidth

Configuration	99% Bandwidth [MHz]	Remark
1	0.0254600	0.5 / 25.4600 (kHz)= 1.96%
2	3.684000	0.05 / 3.684000 (MHz) = 1.36%

Note: Gray shading data is the widest 99% OBW in this test report.

Figure 6: 99% Bandwidth, Configuration 1

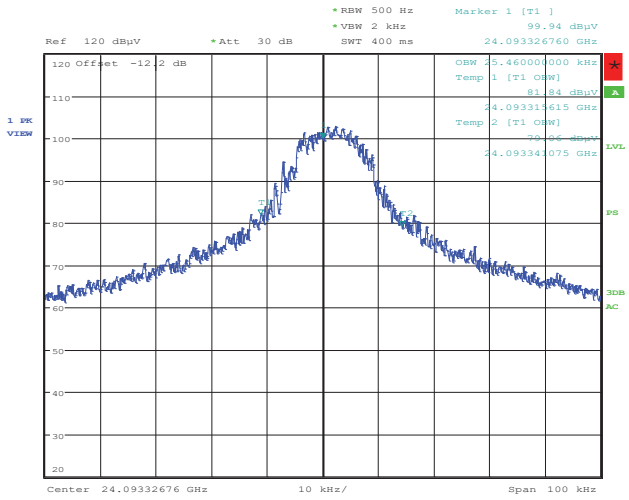

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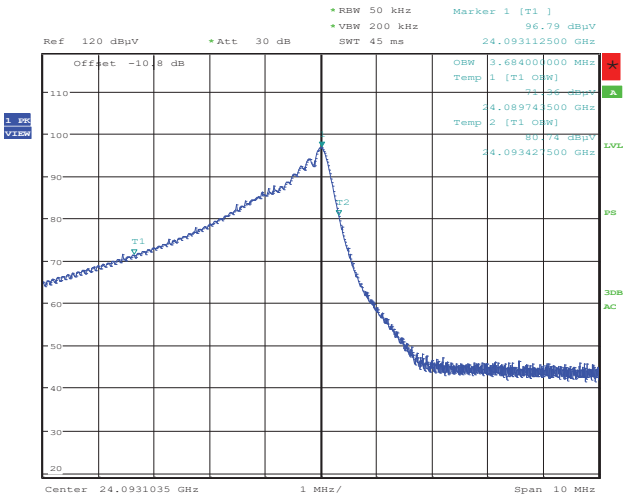
Figure 7: 99% Bandwidth, Configuration 2



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5.2.4 Field Strength of Fundamental

RESULT: **Pass**

Date of testing:	2021-08-25
Ambient temperature:	18°C
Relative humidity:	59%
Atmospheric pressure:	1004hPa
Measurement distance:	3m
Kind of test site:	Semi Anechoic Chamber

Requirements:

FCC §15.245(b)(1) to (4) and RSS-210 Annex F

The field strength of fundamental shall not exceed the level specified in FCC 15.245(b). The field strength of fundamental shall not exceed the level specified in RSS-210 Annex F, Table F1.

Test procedure:

ANSI C63.10 §6.3 and §6.6

The EUT was placed on a non-conductive table raised 1.5m above the ground plane. Measurements were made at 3m distance. The EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level.

Measurements were taken using both horizontal and vertical antenna polarizations for 3 EUT orientations (X, Y, Z).

Measurements were performed using a spectrum analyzer with a suitable span to encompass the maximum point of the fundamental and using the following settings:

RBW = 1MHz, VBW = 3MHz, linear voltage average and peak detector.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report. In the spectra here below, the upper trace corresponds to the peak measurement and the lower trace corresponds to the average measurement.

Table 10: Field Strength of Fundamental, Average Data

Conf.	Freq. [MHz]	EUT / Ant. Orient.	Reading Level AV [dBµV]	Factor [dB/m]	Average Level [dBµV/m]	Average Limit [dBµV/m]	Margin [dB]	DC Input [V]
1	24093.08700	Y/V	115.93	-11.7	104.23	128	23.77	3.3
1	24091.69800	Y/V	115.77	-11.7	104.07	128	23.93	5.0
2	24092.25900	Y/V	114.58	-11.7	102.88	128	25.12	3.3
2	24092.439000	Y/V	113.69	-11.7	101.99	128	26.01	5.0

Note: Average limit in dBµV/m is calculated as follows: Average limit = 20 × Log_{10}(2500000µV/m).
Gray shading data is the highest E-field strength in this test report.

Table 11: Field Strength of Fundamental, Peak Data

Conf.	Freq. [MHz]	EUT / Ant. Orient.	Reading Level PK [dBµV]	Factor [dB/m]	Peak Level [dBµV/m]	Peak Limit [dBµV/m]	Margin [dB]	DC Input [V]
1	24094.3213255	Y/V	115.94	-11.7	104.24	148	43.76	3.3
1	24092.877564	Y/V	115.78	-11.7	104.08	148	43.92	5.0
2	24092.501500	Y/V	116.77	-11.7	104.65	148	43.35	3.3
2	24092.439000	Y/V	115.89	-11.7	104.19	148	43.81	5.0

Note: Peak limit in dBµV/m is calculated as follows: Peak limit = Average limit + 20dB.

Figure 8: Field Strength of Fundamental, Spectral Diagram, Configuration 1, DC 3.3V

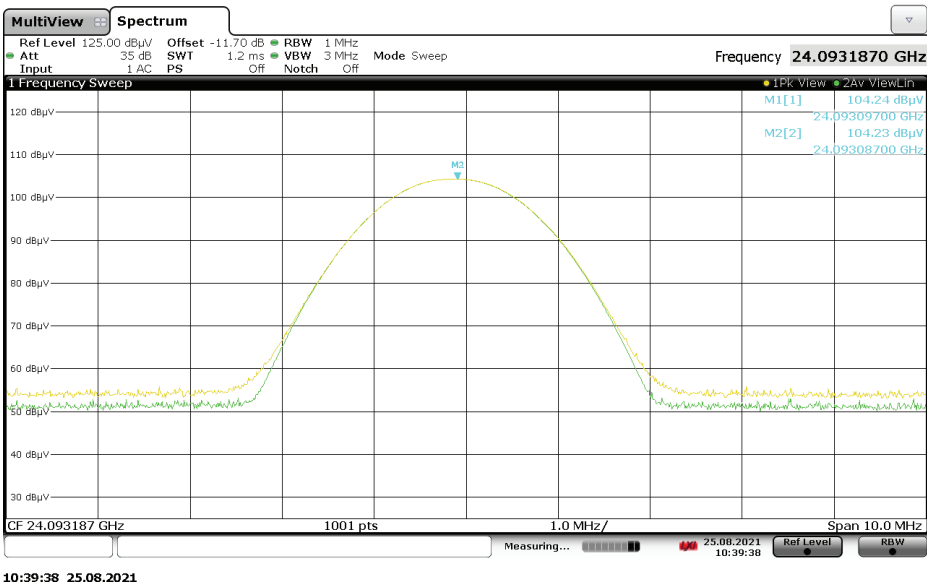

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Figure 9: Field Strength of Fundamental, Spectral Diagram, Configuration 1, DC 5V

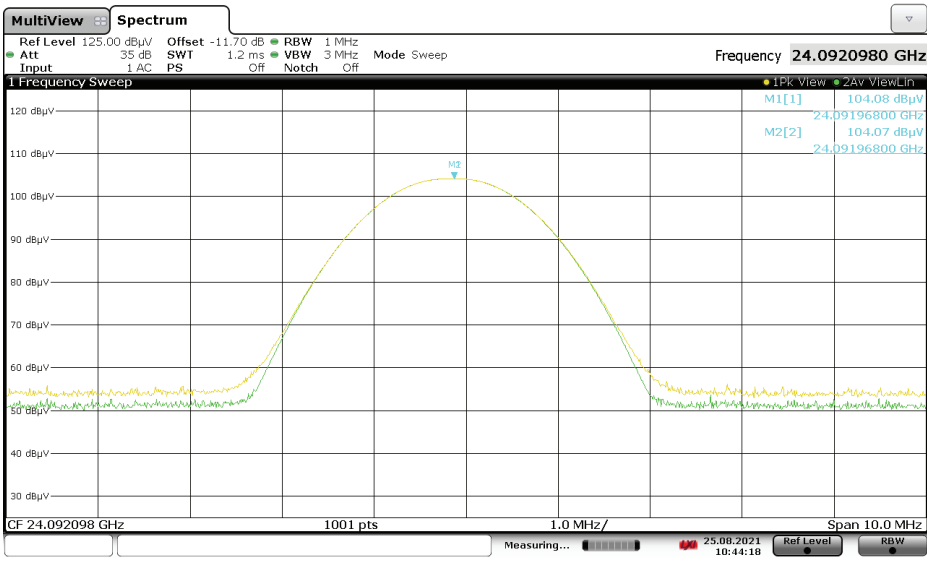

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Figure 10: Field Strength of Fundamental, Spectral Diagram, Configuration 2, DC 3.3V

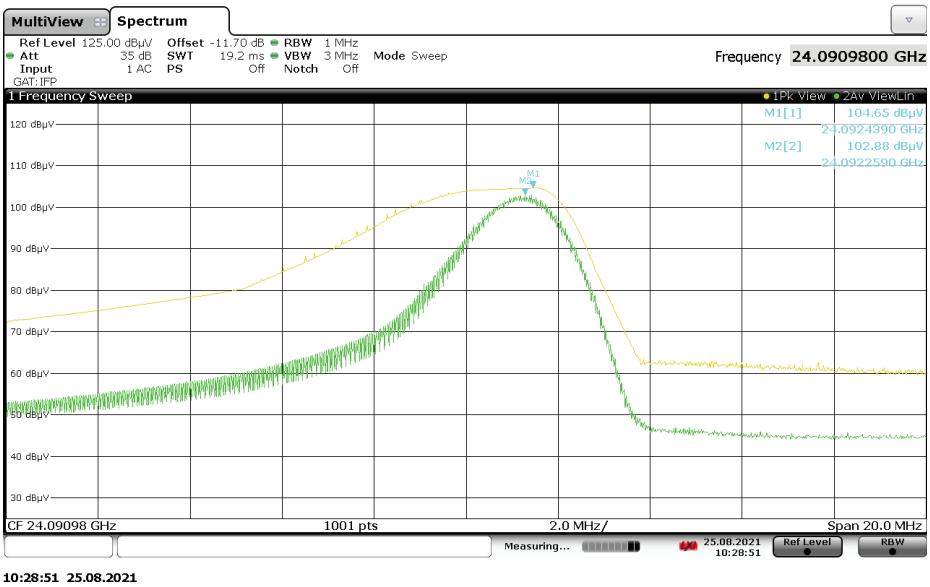

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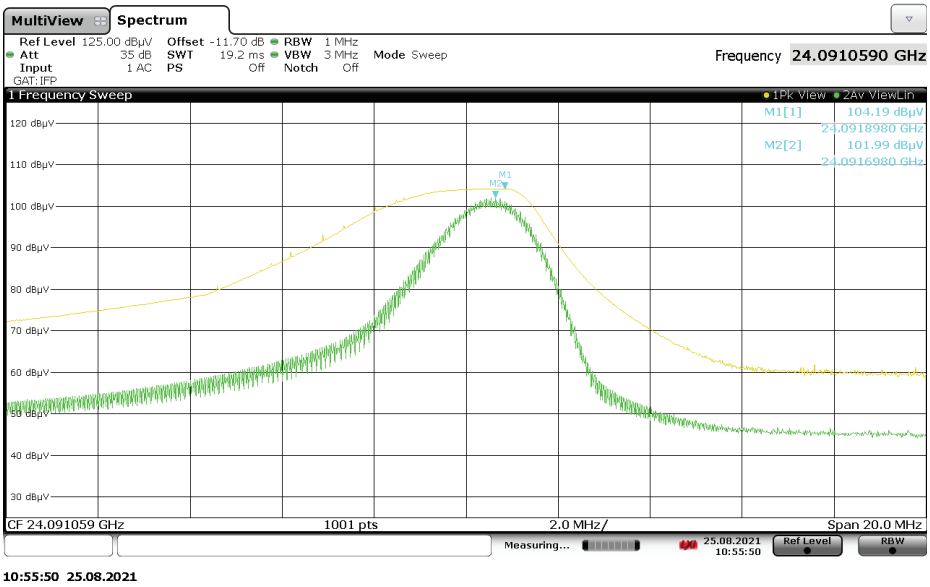
Figure 11: Field Strength of Fundamental, Spectral Diagram, Configuration 2, DC 5V



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5.2.5 Radiated Spurious Emissions of Transmitter

RESULT: **Pass**

Date of testing:	2021-07-19, 2021-07-20, 2021-07-21 2021-07-29, 2021-08-02
Ambient temperature:	20, 19, 22, 22, 20°C
Relative humidity:	58, 59, 59, 58, 59%
Atmospheric pressure:	1010, 1011, 1010, 997, 1005hPa
Frequency range:	9kHz - 100GHz
Equipment classification:	Class B
Measurement distance:	3m below 1GHz 3m above 1GHz 0.3m above 40GHz
Kind of test site:	Semi Anechoic Chamber
Test mode applied:	A
Test configuration applied:	1, 2

Requirements:

FCC §15.205, §15.209, §15.245, RSS-Gen §8.9 and §8.10 and RSS-210 Annex F.

Radiated emissions which fall in the restricted bands, as defined in FCC §15.205(a) and RSS-Gen §8.10 (table 7), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen §8.9 (tables 5 and 6).

Test procedure:

ANSI C63.10 §6.3, 6.4, 6.5, 6.6, 6.10, 9 and RSS-Gen §6.13 and 8.1

The EUT was placed on a non-conductive table. The table height was 0.8m for measurements below 1GHz and 1.5m for measurements above 1GHz. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 9kHz to 100GHz. Final radiated emission measurements were made at 3m distance below 1GHz, at 3m distance above 1GHz and 0.3m above 40GHz.

At each frequency selected for final measurement, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For emissions between 30MHz and 1GHz, measurements were performed with a receiver operating in the CISPR quasi-peak detection mode. The receiver's 6dB bandwidth was set to 120kHz. For emissions above 1GHz, measurements were

performed with a spectrum analyzer using the following settings: for peak field strength: RBW = 1MHz & VBW = 3MHz; for average field strength: RBW = 1MHz & VBW = 10Hz.

Absorbers have been placed on the floor between the EUT and the measuring antenna for testing above 1GHz.

Final measurements were performed at the both configurations.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

No spurious emission was found in the range from 9kHz to 30MHz.

No spurious emission other than the second was found in the range from 40GHz to 100GHz.

Table 12: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Configuration 1

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
59.730	Y/V	42.6	-25.2	17.4	40.0	22.6	100	305
61.720	Y/V	38.4	-25.2	13.2	40.0	26.8	116	319
120.074	Y/H	41.1	-23.6	17.5	43.5	26.0	167	238
185.114	Y/H	42.4	-20.2	22.2	43.5	21.3	182	86
193.660	Y/H	42.0	-19.7	22.3	43.5	21.2	172	112
294.450	Y/H	30.5	-14.5	16.0	46.0	30.0	199	212
768.519	Y/V	31.1	-13.4	17.7	46.0	28.3	116	38

Note: Level QP = Reading QP + Factor, dB(uV/m) = 20 × Log_{10}(uV/m)

Table 13: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Configuration 1

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBµV]	Factor [dB(1/m)]	Level AV [dBµV/m]	Limit [dBµV/m]	Margin AV [dB]	Height [cm]	Angle [°]
1294.572	Y/H	39.9	-17.7	22.2	54.0	31.8	196	74
3084.426	Y/V	39.5	-14.3	25.2	54.0	28.8	158	241
7332.210	Y/V	39.1	-4.1	35.0	54.0	19.0	101	183
16908.774	Y/V	38.3	-5.0	33.3	54.0	20.7	151	149
19711.512	Y/V	39.1	-11.3	27.8	54.0	26.2	198	231
20943.230	Y/V	38.8	-10.7	28.1	54.0	25.9	193	157
22371.034	Y/H	39.6	-11.0	28.6	54.0	25.4	170	165
25331.950	Y/V	42.5	-13.1	29.4	54.0	24.6	174	189
35289.112	Y/V	53.1	-22.5	30.6	54.0	23.4	116	119

Note: Level AV = Reading AV + Factor, dB(uV/m) = 20 × Log_{10}(uV/m)

Table 14: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Configuration 1

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBµV]	Factor [dB(1/m)]	Level PK [dBµV/m]	Limit [dBµV/m]	Margin PK [dB]	Height [cm]	Angle [°]
1294.572	Y/H	53.7	-17.7	36.0	74.0	38.0	196	74
3084.426	Y/V	54.6	-14.3	40.3	74.0	33.7	158	241
7332.210	Y/V	53.6	-4.1	49.5	74.0	24.5	101	183
16908.774	Y/V	52.4	-5.0	47.4	74.0	26.6	151	149
19711.512	Y/V	52.0	-11.3	40.7	74.0	33.3	198	231
20943.230	Y/V	51.3	-10.7	40.6	74.0	33.4	193	157
22371.034	Y/H	52.5	-11.0	41.5	74.0	32.5	170	165
25331.950	Y/V	55.8	-13.1	42.7	74.0	31.3	174	189
35289.112	Y/V	67.0	-22.5	44.5	74.0	29.5	116	119

Note: Level PK = Reading PK + Factor, dB(uV/m) = 20 × Log_{10}(uV/m)

Table 15: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Configuration 2

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
59.726	Z/V	40.8	-25.2	15.6	40.0	24.4	100	315
137.581	Z/V	45.2	-22.6	22.6	43.5	20.9	100	181
157.608	Z/V	43.5	-21.9	21.6	43.5	21.9	111	202
193.665	Z/H	45.6	-19.7	25.9	43.5	17.6	177	104
455.840	Z/V	36.2	-17.0	19.2	46.0	26.8	144	182
994.665	Z/V	30.8	-9.3	21.5	54.0	32.5	201	359

Note: Level QP = Reading QP + Factor, dB(uV/m) = 20 × Log_{10}(uV/m)

Table 16: Radiated Emission, Average Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Configuration 2

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBµV]	Factor [dB(1/m)]	Level AV [dBµV/m]	Limit [dBµV/m]	Margin AV [dB]	Height [cm]	Angle [°]
2186.521	Y/V	39.5	-15.3	24.2	54.0	29.8	132	101
5108.209	Y/V	39.1	-9.1	30.0	54.0	24.0	130	311
7749.477	Y/H	38.8	-4.2	34.6	54.0	19.4	173	330
16510.493	Y/V	38.3	-5.7	32.6	54.0	21.4	179	80
19336.994	Y/H	39.6	-11.5	28.1	54.0	25.9	194	162
21502.430	Y/V	39.1	-10.6	28.5	54.0	25.5	188	62
23001.016	Y/V	41.1	-11.4	29.7	54.0	24.3	159	297
26230.898	Y/V	41.2	-12.7	28.5	54.0	25.5	167	9
38105.876	Y/H	52.3	-22.5	29.8	54.0	24.2	165	72

Note: Level AV = Reading AV + Factor, dB(uV/m) = 20 × Log_{10}(uV/m)

Table 17: Radiated Emission, Peak Data, 1 - 40GHz, Horizontal and Vertical Antenna Orientations, Configuration 2

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBµV]	Factor [dB(1/m)]	Level PK [dBµV/m]	Limit [dBµV/m]	Margin PK [dB]	Height [cm]	Angle [°]
2186.521	Y/V	53.3	-15.3	38.0	74.0	36.0	132	101
5108.209	Y/V	53.1	-9.1	44.0	74.0	30.0	130	311
7749.477	Y/H	53.1	-4.2	48.9	74.0	25.1	173	330
16510.493	Y/V	52.9	-5.7	47.2	74.0	26.8	179	80
19336.994	Y/H	53.0	-11.5	41.5	74.0	32.5	194	162
21502.430	Y/V	52.1	-10.6	41.5	74.0	32.5	188	62
23001.016	Y/V	54.6	-11.4	43.2	74.0	30.8	159	297
26230.898	Y/V	54.7	-12.7	42.0	74.0	32.0	167	9
38105.876	Y/H	66.3	-22.5	43.8	74.0	30.2	165	72

Note: Level PK = Reading PK + Factor, dB(uV/m) = 20 × Log_{10}(uV/m)

Table 18: Radiated Emissions of the Harmonics of Fundamental, Average Data

Conf.	Frequency [MHz]	EUT / Antenna Orientation	Reading PK (*) [dBµV/m]	Distance Conversion Factor [dB]	Level AV at 3m [dBµV/m]	Limit at 3m [dBµV/m]	Margin AV [dB]
1	48186.907	Y/V	81.87 at 0.3m	-20	61.87	77.5	15.63
2	48186.907	Y/V	81.87 at 0.3m	-20	61.87	77.5	15.63

Note: **(*)** Peak measurement data was used against Average limit instead of average measurement data.

Level AV at 3m = Reading AV + Distance Conversion Factor

Each Distance Conversion Factor was considered for 2nd, 3rd and 4th harmonics measurement by the following formula.

Distance conversion factor = $20 \times \text{Log}_{10}$ (d / 3), where d = measurement distance in m;

– Distance conversion factor = $20 \times \text{Log}_{10}$ (0.3 / 3) = -20 [dB] for 2nd, 3rd and 4th harmonics.

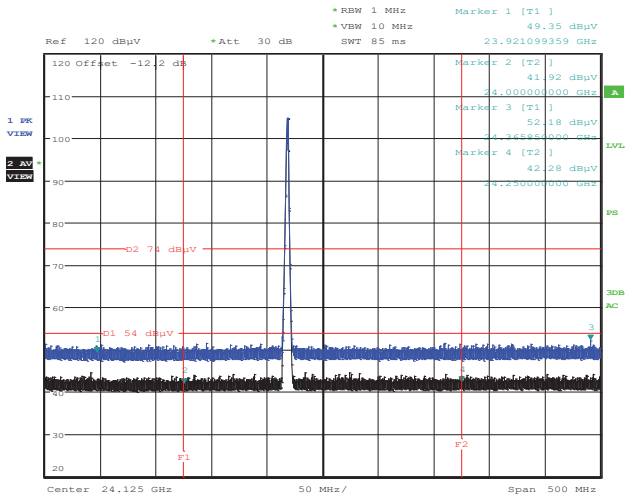
3rd and 4th harmonics were not observed.

Table 19: Radiated Emissions at Band Edge, Average and Peak Data, Horizontal and Vertical Antenna Orientations

Conf.	EUT / Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
1	Y/V	41.92	49.35	54.0	74.0	12.08	24.65
2	Y/V	43.66	52.65	54.0	74.0	10.34	21.35

Note: Gray shading data is the highest spurious emission with its margin of 10.34dB in this test report.

Figure 12: Radiated Emissions at Band Edge, Spectral Diagram, Configuration 1



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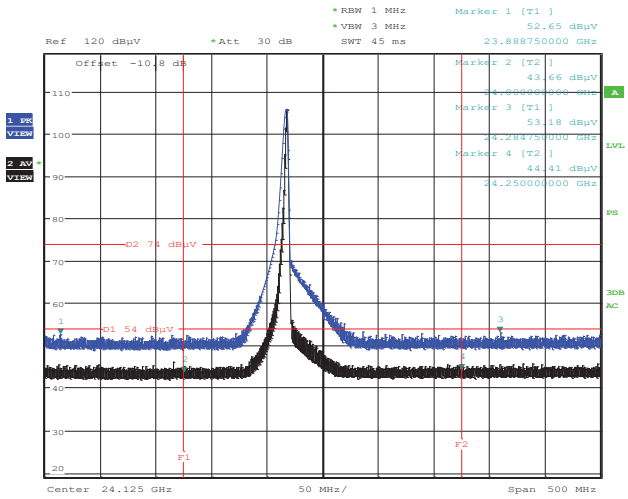
Note: The upper trace shows the peak value and the lower trace shows the average value.

Figure 13: Radiated Emissions at Band Edge, Spectral Diagram, Configuration 2



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Note: The upper trace shows the peak value and the lower trace shows the average value.

5.3 AC Power Line Conducted Measurements

5.3.1 AC Power Line Conducted Emission of Transmitter

RESULT: **Pass**

Date of testing:	2021-07-30
Ambient temperature:	20°C
Relative humidity:	59%
Atmospheric pressure:	998hPa
Frequency range:	0.15 - 30MHz
Equipment classification:	Class B
Kind of test site:	Shielded Room
Test mode applied:	A
Test configuration applied:	1, 2

Requirements:

FCC §15.207 and RSS-Gen §8.8

The AC power line conducted emission on any frequency within the band 150kHz to 30MHz shall not exceed the limits specified in FCC §15.207 and RSS-Gen §8.8 (table 4).

Test procedure:

ANSI C63.10 §6.2 and RSS-Gen §8.1

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The AC adapter of the EUT was connected to a Line Impedance Stabilization Network (LISN).

The physical arrangement of the test system and associated cabling was varied to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed with a receiver operating in the CISPR quasi-peak and average detection modes. The receiver’s 6dB bandwidth was set to 9kHz.

Pre-checks have been performed at the two types of AC Adapter (DC 3.3V and 5V) to determine which mode produces the highest emission level.

Final measurements were performed for the worst case configuration 1 at DC 3.3V.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

Table 20: AC Power Line Conducted Emission, 0.15 - 30MHz, Quasi Peak and Average Data, Phase N (N) and L1 (L), Configuration 1, 3.3V

Freq. [MHz]	Phase	Reading QP [dBµV]	Reading AV [dBµV]	Factor [dB]	Level QP [dBµV]	Level AV [dBµV]	Limit QP [dBµV]	Limit AV [dBµV]	Margin QP [dB]	Margin AV [dB]
0.1500	N	30.9	15.3	9.8	40.7	25.1	66.0	56.0	25.3	30.9
0.2450	N	20.4	11.3	9.8	30.2	21.1	61.9	51.9	31.7	30.8
0.5750	N	10.2	5.8	9.8	20.0	15.6	56.0	46.0	36.0	30.4
13.7350	N	17.0	12.5	10.7	27.7	23.2	60.0	50.0	32.3	26.8
0.1540	L1	28.2	14.7	9.8	38.0	24.5	65.8	55.8	27.8	31.3
0.4450	L1	17.9	13.5	9.8	27.7	23.3	57.0	47.0	29.3	23.7
0.6920	L1	7.4	3.5	9.8	17.2	13.3	56.0	46.0	38.8	32.7
13.6190	L1	19.3	14.7	10.5	29.8	25.2	60.0	50.0	30.2	24.8

Note: Level QP = Reading QP + Factor, Level AV = Reading AV + Factor

The AC Adapter (Manufacturer: UNIFIVE, Model: US303320) was used.

7. List of Tables

8. List of Figures

9. List of Photographs

– End of test report –