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RADIO TEST REPORT – 466497-2TRFWL

Type of assessment:

Final product testing

Applicant:

Maximus Systems (4458664 Canada Inc)

Product:

RFID Card Reader

Model:

7000-0024

FCC ID:

2A7II-RFID115

ISED certification number:

IC: 28688-RFID115

Specifications:

- FCC 47 CFR Part 15, Subpart C
- RSS-210, Issue 10, December 2019

Date of issue: August 4, 2022

Nimish Kapoor, EMC/RF Specialist
Tested by

Signature

Fahar A Sukkoor, EMC/RF Specialist
Reviewed by

Signature

Company name	Nemko Canada Inc.			
Facilities	*Ottawa site:* 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	*Montréal site:* 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	*Cambridge site:* 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2 Tel: +1 519 650 4811	*Almonte site:* 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0 Tel: +1 613 256-9117 Fax: +1 613 256-8848
Test site registration	**Organization**	**Recognition numbers and location**		
	FCC/ISED	FCC: CA2040; IC: 2040A-4 (Ottawa/Almonte); FCC: CA2041; IC: 2040G-5 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

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Section 1. Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C	Intentional Radiators
RSS-210, Issue 10, December 2019	Licence-Exempt Radio Apparatus: Category I Equipment

1.2 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5, March 2019	General Requirements for Compliance of Radio Apparatus

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies In full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Date of issue	Details of changes made to test report
TRF	August 4, 2022	Original report issued

Section 2. Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

The following modifications were performed by client: Capacitor C12 was changed from 560 pF to 470 pF to tune the RFID transmit frequency near the targeted 125 kHz.

2.2 Technical judgment

None.

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3. Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (1060 mbar)

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

3.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 4. Measurement uncertainty

4.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Table 4.1-1: *Measurement uncertainty calculations*

Test name	Measurement uncertainty, ±dB
All antenna port measurements	0.55
Occupied bandwidth	4.45
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 5. Information provided by the applicant

5.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

5.2 Applicant/Manufacture

Name	Maximus Systems (4458664 Canada Inc)
Address	1250, Rue Marie-Victorin, Saint-Bruno-De-Montarville, Québec, J3V 6B8, Canada DA

5.3 EUT information

Product	RFID Card Reader
Model	7000-0024
Serial number	SQ1550832
Part number	7000-0024
Software details	PCB115, V1
Power supply requirements	DC: 12.4 V coming from Master Controller through RS-485 communication port
Product description and theory of operation	The RFID card reader role is to scan RFID card and communicate the card information to the Maximus master controller. If the owner of the card is allowed to enter the facility, the controller will unlock the door. The RFID card reader also send audio beeps and visual indicator feedback to the user after every successful scan of the card.

5.4 Radio technical information

Frequency band	123.15 kHz
Frequency Min (MHz)	One Channel 123.15 kHz
Frequency Max (MHz)	One Channel 123.15 kHz
Field strength, dBµV/m @ 3 m	79.142 dBµV/m
Measured BW (kHz), 99% OBW	2.12 kHz
Type of modulation	FDX: AM
Antenna information	Manufacturer: Brownsburg Electronics, MN: KS16038, Type: Coil, Gain: 0 dB

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	Maximum operating temperature +55°C, Minimum operating temperature -25°C
Transmitter state	Continuously scanning for card presence and if card is detected, read the card information continuously as long as the card is present. After card removal, repeat the scanning for card presence.

5.5.2 EUT setup configuration

Table 5.5-1: *EUT sub assemblies*

Description	Brand name	Model, Part number, Serial number, Revision level
RFID Card Reader	Maximus	SN: SQ1550832, PN/MN: 7000-0024

Table 5.5-2: *EUT interface ports*

Description	Qty.
Terminal Block (screw connection) for cable with RS-485	1

Table 5.5-3: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
Master Controller	Maximus	SN: SQ2022294, PN/MN: 7000-0020
Chain Disk Controller	Maximus	SN: SQ2002858, PN/MN: 7000-0013
Bin Scale Brain	Maximus	SN: SQ2004249, PN/MN: 7000-0007
Bin Scale Junction Box	Maximus	SN: SQ2004252, PN/MN: 7000-0008
ESF Module	Maximus	SN: SQ2004248, PN/MN: 7000-0052*
Load Cell	PTGlobal	PN: 40P0100T000XXX, MN: PT4000-100 lb.
Ethernet Router	Ubiquiti Networks	MN: airRouter 802.11n

Notes: *The ESF Module has variants as 7000-0048, 7000-0049, 7000-0050 and 7000-0052. The difference is that RFID Module Is not present in 7000-0050 and 7000-0051 and is available in other three models and Paint Output is only present in Model 7000-0052.Heat mat output is available only in 7000-0048 and 7000-0050

Table 5.5-4: *Inter-connection cables*

Cable description	From	To	Length (m)
Shielded Communication Cable	RFID Card Reader	ESF Module	>30
Shielded Communication Cable	ESF Module	Bin Scale Brain	>30
Shielded Communication Cable	Bin Scale Brain	Bin Scale Junction Box	>30
Shielded Communication Cable	Bin Scale Brain	Chain Disk Controller	>30
Shielded Communication Cable	Chain Disk Controller	Master Controller	>30
Shielded Signal Cable	Bin Scale Junction Box	Load Cell	<10
Shielded Signal Cable	Chain Disk Controller	Switches	>30
Ethernet Cable	Master Controller	Ethernet Router	>30
Shielded Signal Cable	Master Controller	Temperature Sensor	>30
AC Power Cable	Master Controller	AC Mains	>30
AC Power Cable	ESF Module	AC Mains	>30

EUT setup configuration, continued

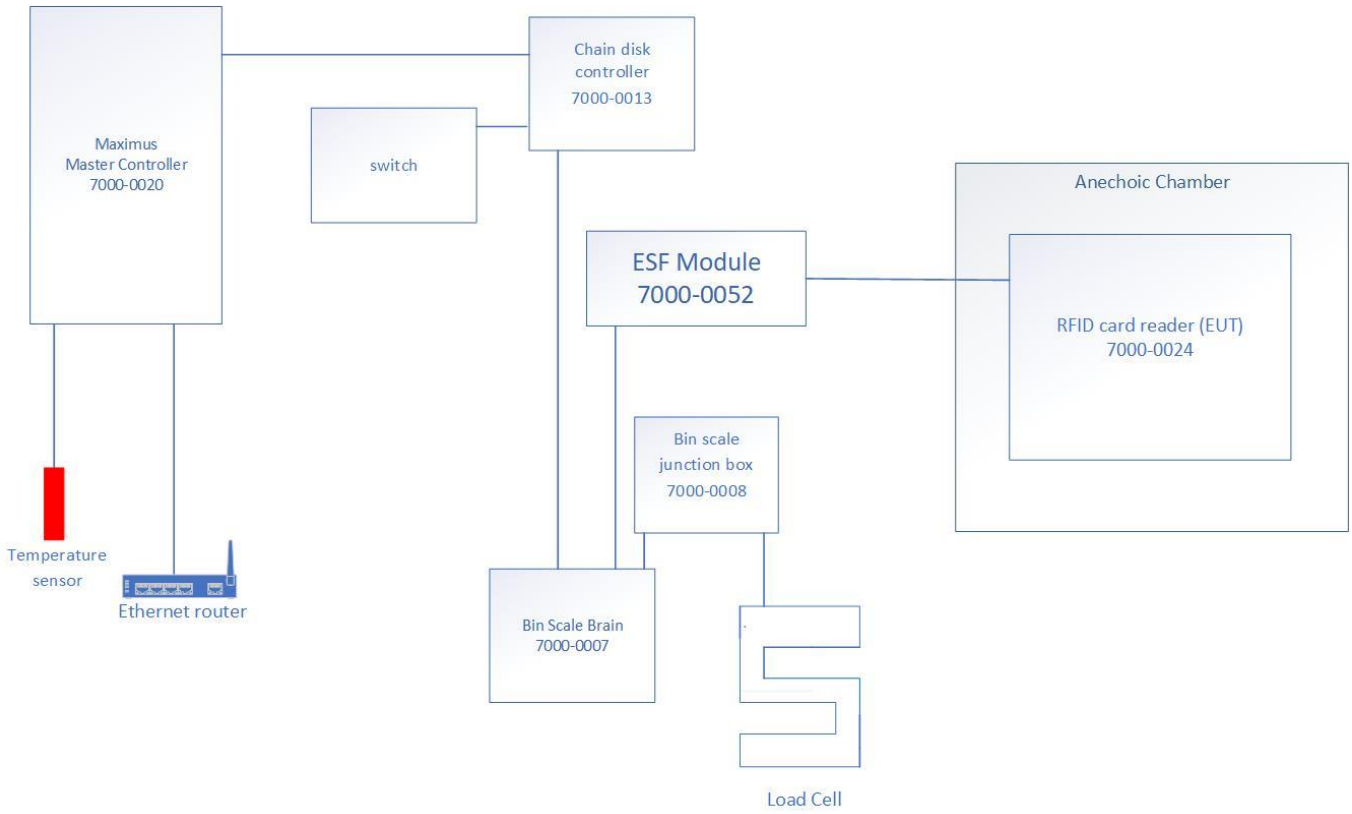


Figure 5.5-1: *Block diagram*

Section 6. Summary of test results

6.1 Testing location

Test location (s)	Montreal

6.2 Testing period

Test start date	May 17, 2022	Test end date	May 24, 2022

6.3 Sample information

Receipt date	May 17, 2022	Nemko sample ID number(s)	4664970001

6.4 FCC Part 15 Subpart A and C, general requirements test results

Table 6.4-1: *FCC general requirements results*

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass
§15.215(c)	Emission bandwidth	Pass
§15.209(a)	Radiated emission limits; general requirements.	Pass

Notes: EUT is taking 12.4 VDC coming from Master Controller though RS-485 communication cable. Master controller is powered by an AC Input

6.5 ISED RSS-Gen, Issue 5, test results

Table 6.5-1: *RSS-Gen requirements results*

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
6.9	Operating bands and selection of test frequencies	Pass
8.8	AC power line conducted emissions limits	Pass
6.7	Occupied bandwidth	Pass

Notes: [1]According to sections 5.2 and 5.3 of RSS-Gen, Issue 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.
EUT is taking 12.4 VDC coming from Master Controller though RS-485 communication cable. Master controller is powered by an AC Input

6.6 ISED RSS-210, Issue 10, test results

Table 6.6-1: *RSS-210 results*

Section	Test description	Verdict
7.1	Emissions falling within restricted frequency bands	Pass
7.2	General field strength limits	Pass
7.3	Transmitters with wanted and unwanted emissions that are within the general field strength limits	Pass
7.4	Cordless telephones	Not applicable

Notes: [1] EUT is not a cordless telephone

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber (Emissions)	TDK	SAC-3	FA002532e	1 year	April 1, 2023
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
3 Phase AC Power Supply	apc AC Power	AFC-33045T	FA002677	—	VOU
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	March 3, 2023
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	March 24, 2023
Active loop antenna (0.01–30 MHz)	Com-Power	AL-130	FA002722	1 year	March 11, 2023
Spectrum analyzer	Rohde & Schwarz	FSV 40	FA002731	1 year	March 3, 2023
Temperature chamber	Thermotron	S-4	FA002534	1 year	July 13, 2022
Multimeter	AMPPROBE	AM-530	FA002537	1 year	March 23, 2023
3 Phase 15 kVA, Harmonics, Flicker and Dips system	TESEQ	ProfLine 2115-400	FA002516	1 year	March 8, 2023
LISN	Rohde & Schwarz	ENV216	FA002514	1 year	March 4, 2023
Four Line V-Network	TESEQ	NNB 52	FA002339	1 year	November 12, 2022

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 Variation of power source

8.1.1 References, definitions and limits

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.

8.1.2 Test summary

Verdict	Pass		
Tested by	Nimish Kapoor	Test date	May 24, 2022

8.1.3 Observations, settings and special notes

None

8.1.4 Test data

EUT Power requirements:	☐ AC	☒ DC (powered by a module)	☐ Battery	
If EUT is an AC or a DC powered, was the noticeable output power variation observed?	☐ YES	☒ NO	☐ N/A	
If EUT is battery operated, was the testing performed using fresh batteries?	☐ YES	☐ NO	☒ N/A	
If EUT is rechargeable battery operated, was the testing performed using fully charged batteries?	☐ YES	☐ NO	☒ N/A	

8.2 Number of frequencies

8.2.1 References, definitions and limits

FCC §15.31:

(m) Measurements on intentional radiators or receivers shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 8.2-1: *Frequency Range of Operation*

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

8.2.2 Test summary

Verdict	Pass		
Tested by	Nimish Kapoor	Test date	May 19, 2022

8.2.3 Observations, settings and special notes

None

8.2.4 Test data

Table 8.2-2: *Test channels selection*

Start of Frequency range, kHz	End of Frequency range, kHz	Frequency range bandwidth, kHz	One channel, kHz
119	140	21.0	123.15

8.3 Antenna requirement

8.3.1 References, definitions and limits

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

RSS-Gen, Clause 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.
For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

8.3.2 Test summary

Verdict	Pass		
Tested by	Nimish Kapoor	Test date	May 19, 2022

8.3.3 Observations, settings and special notes

None

8.3.4 Test data

Must the EUT be professionally installed?	☒ YES	☐ NO	
Does the EUT have detachable antenna(s)?	☐ YES	☒ NO	
If detachable, is the antenna connector(s) non-standard?	☐ YES	☐ NO	☒ N/A

Table 8.3-1: *Antenna information*

Antenna type	Manufacturer	Model number	Connector type
Coil	Brownsburg Electronics	KS16038	N/A

8.4 AC power line conducted emissions limits

8.4.1 References, definitions and limits

FCC §15.207:

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

ANSI C63.10, Clause 6.2:

If the EUT normally receives power from another device that in turn connects to the public utility ac power lines, measurements shall be made on that device with the EUT in operation to demonstrate that the device continues to comply with the appropriate limits while providing the EUT with power. If the EUT is operated only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines (600 VAC or less) to operate the EUT (such as an adapter), then ac power-line conducted measurements are not required.
For direct current (dc) powered devices where the ac power adapter is not supplied with the device, an "off-the-shelf" unmodified ac power adapter shall be used. If the device is supposed to be installed in a host (e.g., the device is a module or PC card), then it is tested in a typical compliant host.

RSS-Gen, Clause 8.8:

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in table below.
Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

Table 8.4-1: *Conducted emissions limit*

	Conducted limit, dBµV	
Frequency of emission, MHz	**Quasi-peak**	**Average****
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Notes: * - The level decreases linearly with the logarithm of the frequency.
** - A linear average detector is required.

8.4.2 Test summary

Verdict	Pass		
Tested by	Nimish Kapoor	Test date	May 20 & 24, 2022

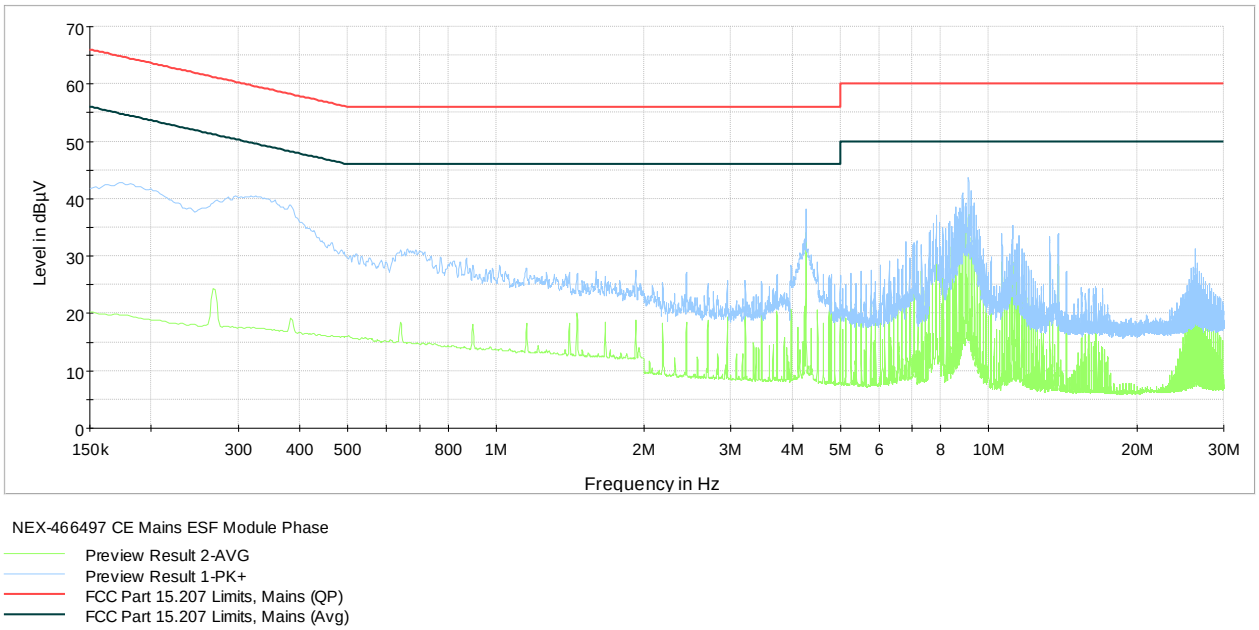
8.4.3 Observations, settings and special notes

Port under test – Coupling device	AC input power of ESF and Main Frame Module – Artificial Mains Network (AMN)
EUT power input during test	120 V_{AC}, 60 Hz
EUT setup configuration	Table top
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 10 dB or above the limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.
Additional notes:	– The EUT was set up as tabletop configuration per ANSI C63.10-2013 measurement procedure. – The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance. Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB) – Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

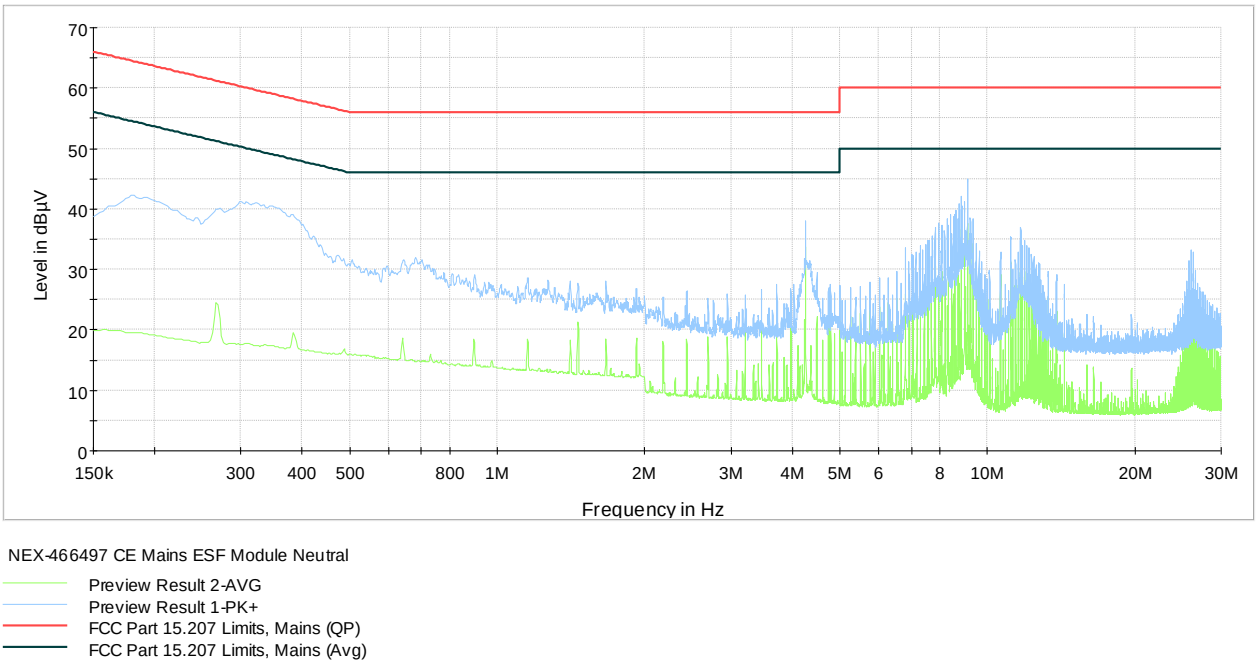
Receiver settings:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average (Preview), Quasi-peak and CAverage (Final)
Trace mode	Max Hold
Measurement time	100 ms (Preview), 160 ms (Final)

8.4.4 Test data

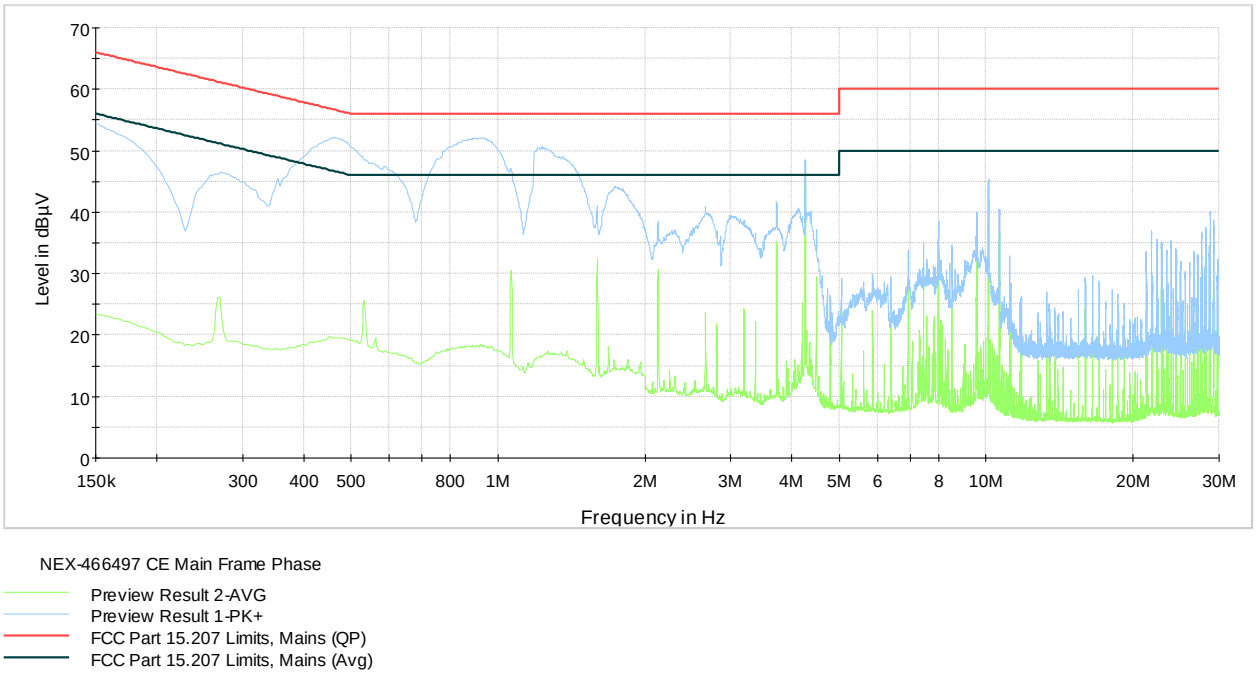


Plot 8.4-1: *Conducted emissions on phase line [ESF Module]*

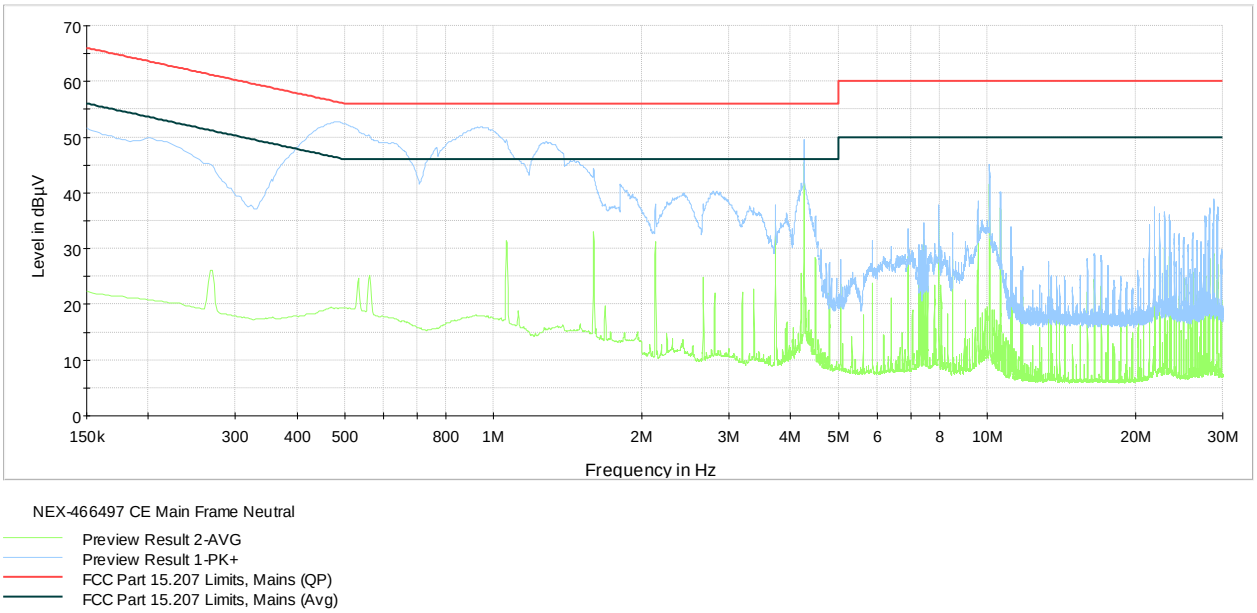


Plot 8.4-2: *Conducted emissions on neutral line [ESF Module]*

Test data, continued



Plot 8.4-3: *Conducted emissions on phase line [Master Controller Module]*



Plot 8.4-4: *Conducted emissions on neutral line [Master Controller Module}*

8.5 Radiated emission limits, general requirements

8.5.1 References, definitions and limits

FCC §15.209:

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

ANSI C63.10, Clause 4.1.4.2:

Specific detector functions and bandwidths for unlicensed wireless device measurements

4.1.4.2.1 Frequencies less than or equal to 1000 MHz

At any frequency or frequencies less than or equal to 1000 MHz, measurements shall be made with the CISPR quasi-peak detector and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrument using the CISPR quasi-peak detector are given in CISPR 16-1-1:2010. Where average limits are specified, an average detector shall be used. Where peak limits are also specified, the peak emission shall also be measured with instrumentation properly adjusted for factors, such as pulse desensitization. As an alternative to CISPR quasi-peak measurements or average measurements, a test laboratory may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function as long as the equivalent or greater bandwidths as indicated for CISPR quasi-peak measurements or average measurements, as applicable, are employed.

Pulse-modulated devices with a pulse repetition frequency of 20 Hz or less have additional requirements.

4.1.4.2.2 Frequencies above 1000 MHz

Unless otherwise stated, on any frequency or frequencies above 1000 MHz, measurements shall be made with measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. Peak measurements can apply to the total peak emission level radiated by the device (i.e., the total peak power level) depending on the applicable regulatory requirement. Note that the use of a pulse desensitization correction factor might be needed to determine the total peak emission level.

RSS-210:

7.3 Transmitters whose wanted and unwanted emissions fall within the general field strength limits specified in RSS-Gen may operate licence-exempt in any of the frequency bands, other than the restricted frequency bands listed in RSS-Gen and the TV bands 54-72 MHz, 76-88 MHz, 174-216 MHz and 470-602 MHz, and shall be certified under RSS-210. Under no circumstances shall the level of any unwanted emissions exceed the level of the fundamental emissions.

Table 8.5-1: *FCC §15.209 and RSS-Gen – Radiated emission limits*

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test
As per Section 8.1 of RSS-Gen, the emission limits for the frequency range 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

References, definitions and limits, continued

Table 8.5-2: *ISED restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	Above 38.6
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in this table and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

Table 8.5-3: *FCC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
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	2690–2900	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	Above 38.6
13.36–13.41			

8.5.2 Test summary

Verdict	Pass		
Tested by	Nimish Kapoor	Test date	May 20, 2022

8.5.3 Observations, settings and special notes

The spectrum was searched from 9 kHz to the frequency of 1 GHz.
Radiated measurements were performed at a distance of 3 m.
The spectral plots within this section are a summation of vertical and horizontal scans. The spectral plots within this section have been corrected with all relevant transducer factors.

Spectrum analyser settings for radiated measurements within restricted bands 9 kHz – 150 kHz:

Resolution bandwidth	200 Hz
Video bandwidth	1 kHz
Detector mode	Average
Trace mode	Max Hold

Spectrum analyser settings for radiated measurements within restricted bands 150 kHz – 30 MHz:

Resolution bandwidth	10 kHz
Video bandwidth	30 kHz
Detector mode	Average
Trace mode	Max Hold

Spectrum analyser settings for radiated measurements within restricted bands 30 MHz - 1 GHz:

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Detector mode	Peak (Preview) and Quasi-peak (Final)
Trace mode	Max Hold

8.5.4 Test data

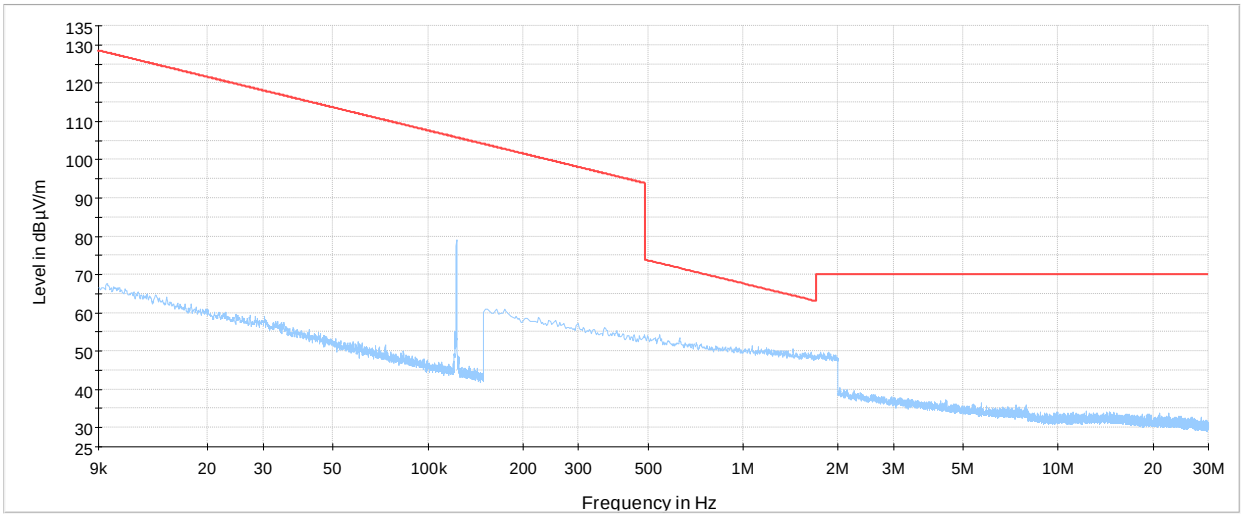


Figure 8.5-1: *Spurious emissions 9 kHz – 30 MHz*

Table 8.5-1: *Radiated field strength measurement results*

Frequency, kHz	Peak field strength, dBµV/m @ 3 m	Peak limit, dBµV/m @ 3 m	Margin, dB
123.150	79.1	105.8	26.7

Test data, continued

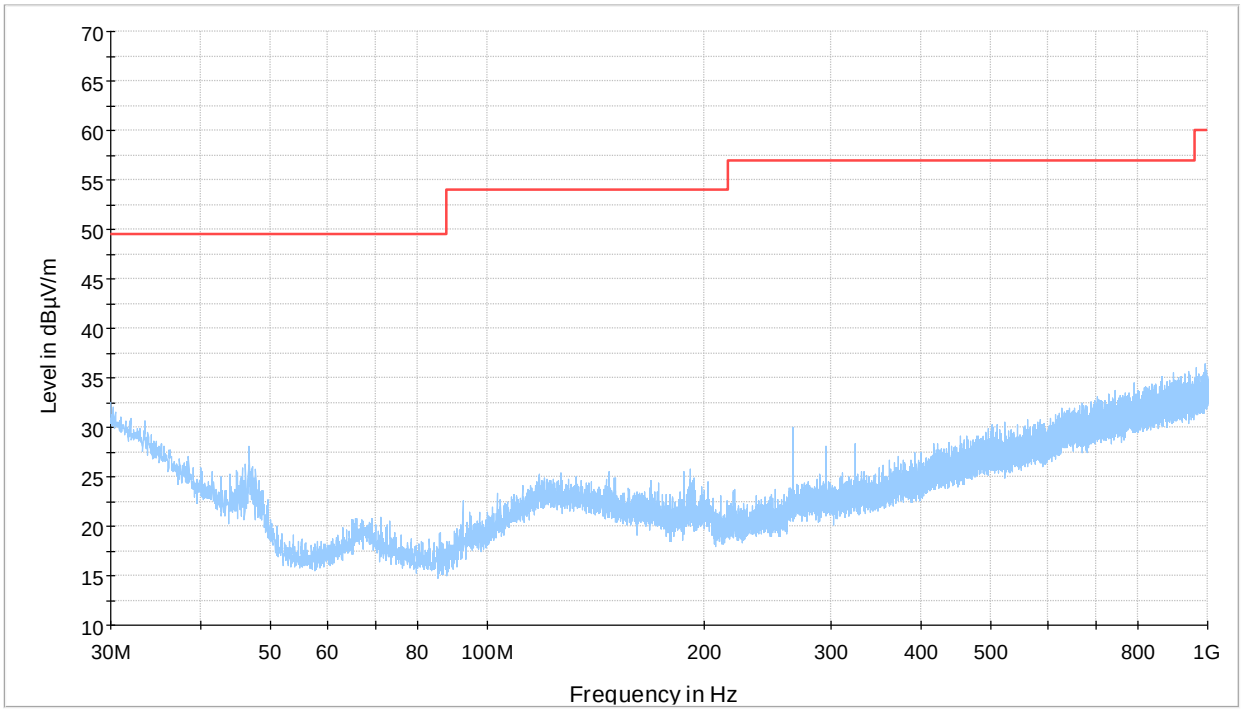


Figure 8.5-2: *Spurious emissions 30 MHz – 1 GHz*

Note: As per FCC 15.209 (f), In accordance with § 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device

8.6 Emission bandwidth

8.6.1 References, definitions and limits

FCC §15.215:

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

RSS-Gen, Clause 6.7:

Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

8.6.2 Test summary

Verdict	Pass		
Tested by	Nimish Kapoor	Test date	May 24, 2022

8.6.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	≥ 1 % of emission bandwidth
Video bandwidth	≥ 3 × RBW
Frequency span	Wider than emission bandwidth
Detector mode	Peak

8.6.4 Test data

Table 8.6-1: *Occupied bandwidth measurement result*

Frequency, kHz	20 dB BW, kHz	99% BW, kHz
123.33	2.51	2.12

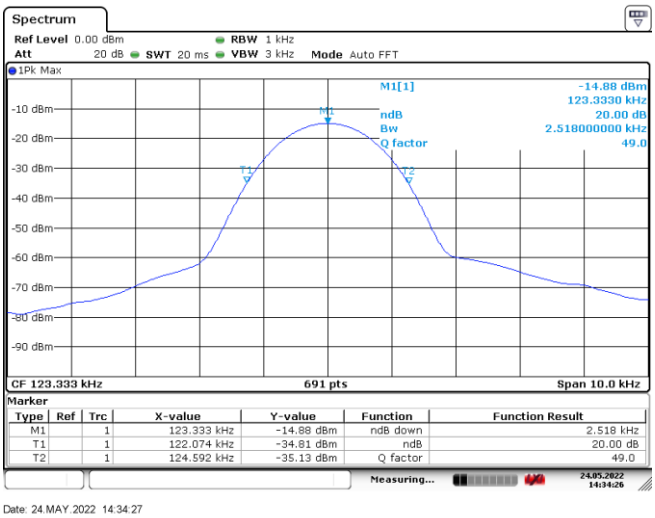


Figure 8.6-1: *20 dB occupied bandwidth*

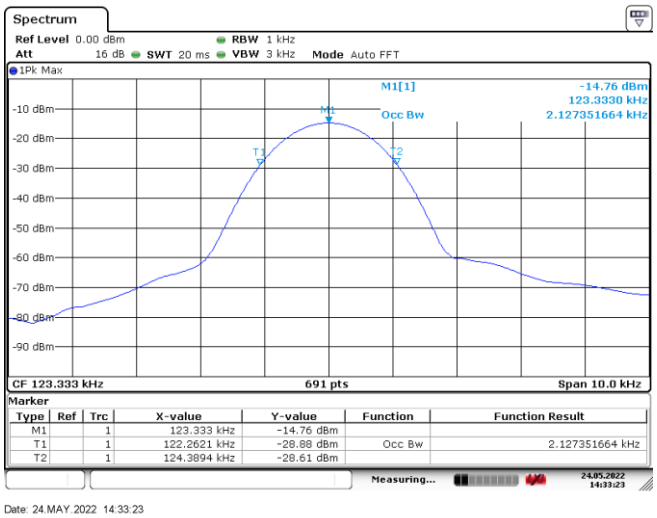
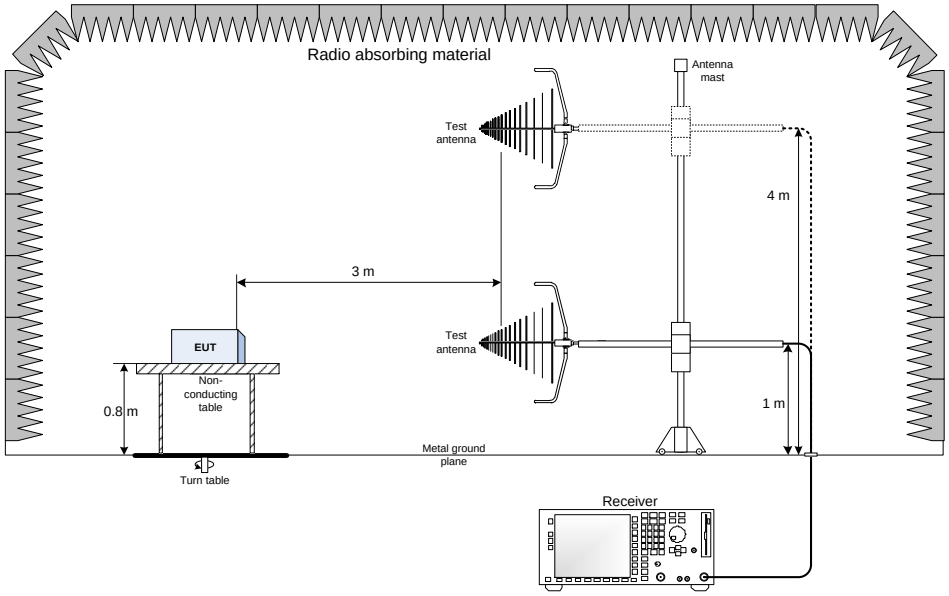


Figure 8.6-2: *99 % occupied bandwidth*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up