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RADIO TEST REPORT – 405737-1R2TRFWL

Type of assessment:

Final product testing

Applicant:

GSI Electronics

Product name (type):

Pig RFID reader apparatus with telecommunication functionality using LFID @ 134.2 KHz

Model:

EDGE GSF LFID Antenna

Model variant(s):

EDGE ESF LFID Antenna

FCC ID:

2AFLZGSFLFID

IC Registration number:

11880A-GSFLFID

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.209
- RSS-210, Issue 10, December 2019

Date of issue: January 28, 2021

Redwanul Rasel, EMC/RF Specialist
Tested by

Signature

Yong Huang, EMC/RF Specialist
Reviewed by

Signature

Lab locations

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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 Applicant and manufacturer

Company name	GSI Electronics
Address	5200 Armand-Frappier St-Hubert, Quebec Canada, J3Z 1G5

1.2 Test specifications

FCC 47 CFR Part 15 Subpart C, §15.209	Radiated emission limits; general requirements.
RSS-GEN, Issue 10, December 2019	Transmitter Emission Limits for Licence-Exempt Radio Apparatus

1.3 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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 1.5 below. 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 Exclusions

None.

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	October 6, 2020	Original report issued
TRFR1	October 23, 2020	Radiated spurious emissions below 30 MHz plot update
TRFR2	January 28, 2021	Specifications as RSS-210, Issue 10, December 2019 updated

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.215(c)	20 dB bandwidth	Pass
§15.209	Radiated emission limits; general requirements.	Pass

Notes: EUT is 24 Vdc powered device through 100-240 VAC Pig feeder apparatus.

2.2 ISED RSS-GEN, Issue 5, test results

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
8.8	AC power- line conducted emissions limits	Pass
8.9	Transmitter Emission Limits for License-Exempt Radio Apparatus	Pass

Notes: According to sections 5.2 and 5.3 of RSS-Gen, Issue 10, the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

EUT is 24 Vdc powered device through 100-240 VAC Pig feeder apparatus.

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	August 31, 2018
Nemko sample ID number	Item # 2

3.2 EUT information

Product name	Pig RFID reader apparatus with telecommunication functionality using LFID @ 134.2 KHz
Model	EDGE GSF LFID Antenna
Serial number	0684809

3.3 Technical information

All used IC test site(s) Reg. number	2040G-5
RSS number and Issue number	RSS-GEN, Issue 10, December 2019
Operating frequency	134.2 kHz
Modulation type	FSK (HDX protocol) and ASK (FDX protocol)
Occupied bandwidth (99 %)	2.243 kHz
Power requirements	24 V_{DC} through 100-240 V_{AC} Pig feeder apparatus
Antenna information	The EUT uses a non-detachable coil antenna to the intentional radiator

3.4 Product description and theory of operation

Sows wear RFID tags.
- When they are hungry, they spot an empty stall with an open door.
- The stall contains an RFID tag reader (EDGE GSF LFID ANTENNA), a feed pan and a water nipple
- In each stall there is a computerized feeder device (EDGE GSF + EDGE GSF LFID ANTENNA)
- The feeder (EDGE GSF) delivers the exact amount of feed the sow is allowed to eat for this meal. Several parameters can be set for each sow.

EDGE GSF LFID ANTENNA generates short magnetic pulses that wirelessly charge a capacitor inside an HDX or FDX tag. When the charge field turns off, the tag uses the stored power to send the tag number back to the reader without interference from the reader. The EDGE GSF LFID ANTENNA uses two different modulations: FSK (HDX protocol) and ASK (FDX protocol). It can read two protocols: HDX protocol and FDX protocol. The EDGE GSF LFID ANTENNA alternates many times between two modulations during a second for transmission and reception process.

3.5 EUT exercise details

Methods used to exercise the EUT and all relevant ports:

− The EUT was configured in accordance with customer supplied “Telecommunication” software loads to exercise all ports as applicable
− EDGE GSF LFID ANTENNA was in continuous transmit mode

Configuration details:
- The EUT was in the anechoic chamber. The EUT was connected on the EDGE GSF Feeder outside of anechoic chamber
− The EUT setup in a configuration that was expected to produce the highest amplitude emissions relative to the limit and that satisfy normal operation/installation practice by the end user.
− The type and construction of cables used in the measurement set-up were consistent with normal or typical use.
− The EUT was setup in a manner that was consistent with its typical arrangement and use.

Monitoring details:
− The overall system operation was monitored visually for any changes in programmed state or operations.

3.6 EUT setup diagram

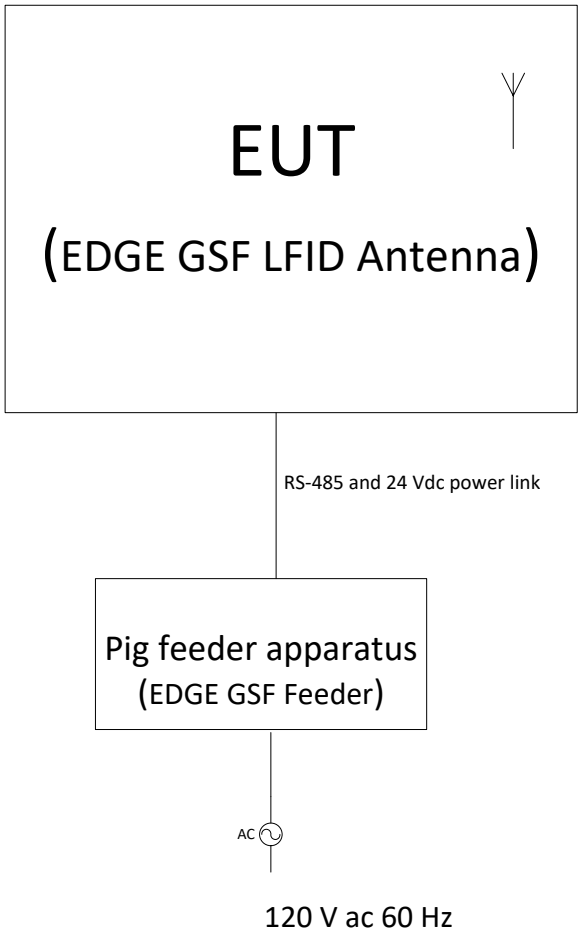


Figure 3.6-1: *Setup diagram*

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

As per customer, the antenna could read and transmit both. One second one modulation, another second for the another one. There are many transmissions in one second. Can be read both type RFID tags. FSK (HDX protocol) and ASK (FDX protocol) both modulation were tested at the same time as per client.

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 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.

5.2 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 6. Measurement uncertainty

6.1 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.

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

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	2 year	February 25, 2022
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
3 Phase AC Power Supply	apc AC Power	AFC-33045T	FA002677	—	VOU
Power Meter	HIOKI	PW3337	FA002727	1 year	February 21, 2021
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	June 1, 2021
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	January 28, 2021
Active loop antenna (0.01–30 MHz)	Com-Power	AL-130	FA002722	1 year	March 1, 2021
LISN	Rohde & Schwarz	ENV216	FA002514	1 year	February 5, 2021
50 Ω coax cable	C.C.A.	None	FA002603	1 year	February 4, 2021
50 Ω coax cable	C.C.A.	None	FA002605	—	VOU

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

Section 8. Testing data

8.1 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

8.1.1 Definitions and limits

FCC:
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.

IC:
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.

8.1.1 Definitions and limits, Continued

Table 8.1-1: *Conducted emissions limit*

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

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

8.1.2 Test summary

Test start date	September 14, 2020
Test engineer	Redwanul Rasel
Verdict	Pass

8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

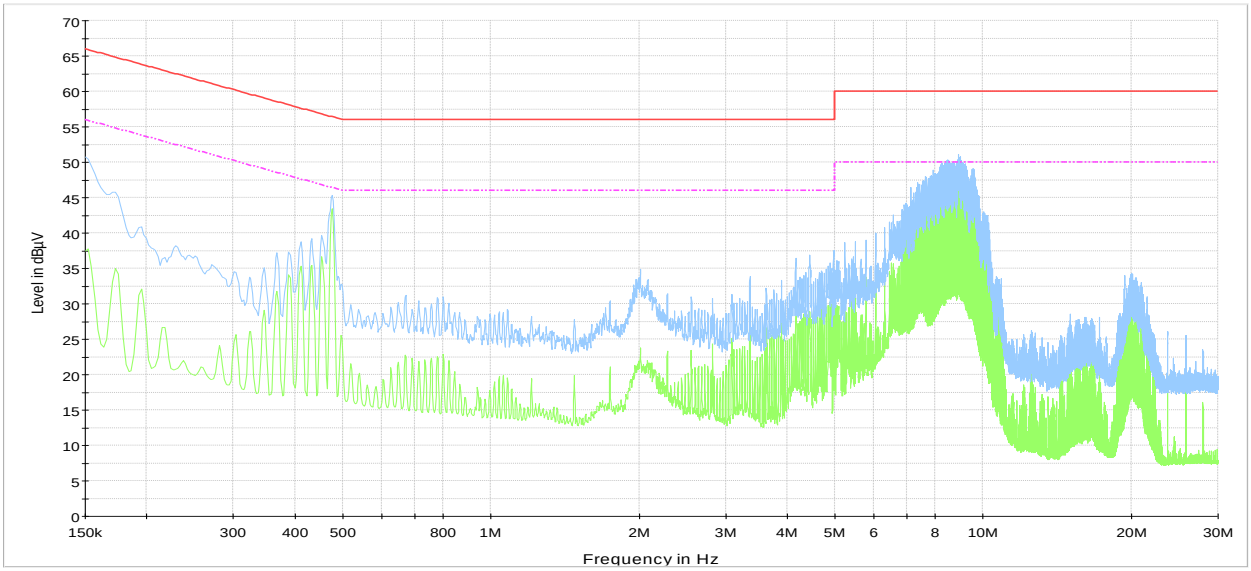
A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Tests were performed according to KDB 174176: (1) perform the AC power-line conducted tests with the antenna connected to determine compliance with Section 15.207 limits outside the transmitter's fundamental emission band; (2) retest with a dummy load in lieu of the antenna to determine compliance with Section 15.207 limits within the transmitter's fundamental emission band.

Test receiver settings:

Frequency span	150 kHz to 30 MHz
Detector mode	Peak and Average (preview mode); Quasi-Peak (final measurements)
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold
Measurement time	100 ms

8.1.4 Test data



Plot 8.1-1: *Conducted emissions on phase line*

Table 8.1-2: *Quasi-Peak conducted emissions results on phase line*

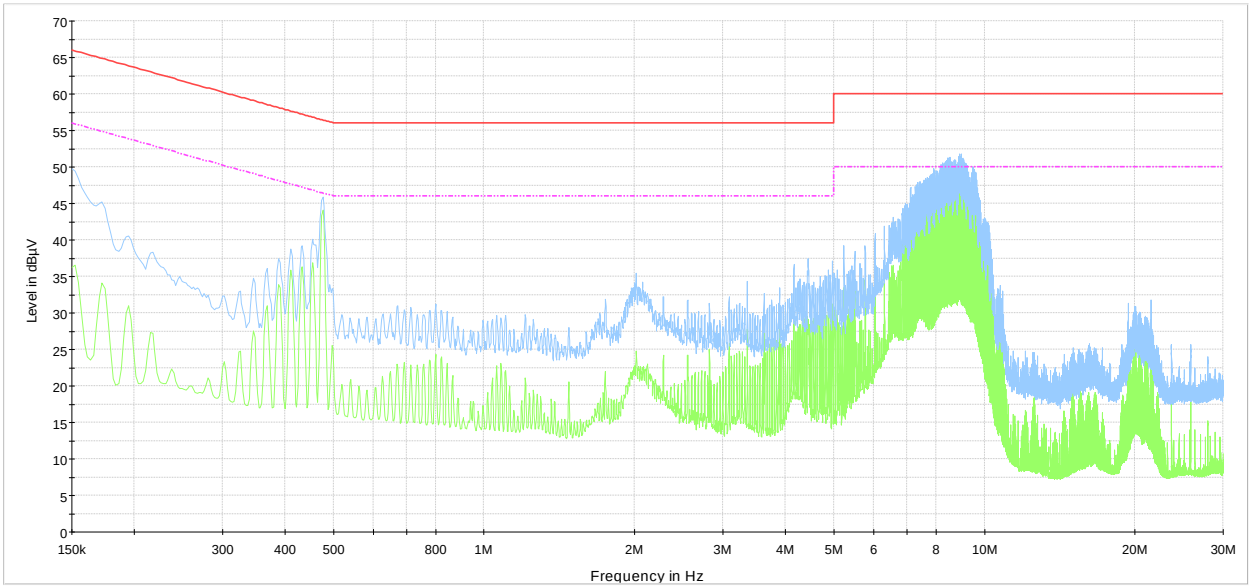
Frequency, MHz	Q-Peak result, dBµV	Correction, dB	Margin, dB	Limit, dBµV
0.1703	39.0	10.2	25.9	64.9
0.4763	43.7	10.0	12.7	56.4
4.1618	33.6	10.0	22.4	56.0
4.9695	33.4	10.0	22.6	56.0
9.0398	49.6	10.3	10.4	60.0
20.0800	25.4	10.6	34.6	60.0

Table 8.1-3: *Average conducted emissions results on phase line*

Frequency, MHz	Average result, dBµV	Correction, dB	Margin, dB	Limit, dBµV
0.1725	35.2	10.2	19.6	54.8
0.4763	43.3	10.0	3.1	46.4
4.1640	29.2	10.0	16.8	46.0
4.9695	30.7	10.0	15.3	46.0
9.0398	47.7	10.3	2.3	50.0
20.0800	22.6	10.6	27.4	50.0

Note: 39.0 dBµV = 18.7 dBµV (receiver reading) + 10.1 dB (LISN factor IL) + 0.2 dB (cable loss) + 10 dB (attenuator)

8.1.4 Test data, Continued



Plot 8.1-2: *Conducted emissions on neutral line*

Table 8.1-4: *Quasi-Peak conducted emissions results on neutral line*

Frequency, MHz	Q-Peak result, dBµV	Correction, dB	Margin, dB	Limit, dBµV
0.1725	38.9	10.3	25.9	64.8
0.1928	34.1	10.1	29.8	63.9
0.4763	44.3	10.1	12.1	56.4
4.4430	31.4	10.1	24.6	56.0
8.4795	28.8	10.3	31.2	60.0
9.6000	24.7	10.3	35.3	60.0

Table 8.1-5: *Average conducted emissions results on neutral line*

Frequency, MHz	Average result, dBµV	Correction, dB	Margin, dB	Limit, dBµV
0.1725	34.3	10.3	20.5	54.8
0.1950	30.8	10.1	23.0	53.8
0.4763	44.0	10.1	2.4	46.4
4.4430	25.1	10.1	20.9	46.0
8.4795	21.8	10.3	28.2	50.0
9.6000	17.8	10.3	32.2	50.0

Note: 38.9 dBµV = 18.6 dBµV (receiver reading) + 10.1 dB (LISN factor IL) + 0.2 dB (cable loss) + 10 dB (attenuator)

8.2 FCC 15.215(c) and RSS-Gen 6.7 Occupied bandwidth (or 99% emission bandwidth) and 20 dB bandwidth

8.2.1 Definitions and limits

FCC
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. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. 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.

IC
When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

8.2.2 Test summary

Test start date	September 11, 2020
Test engineer	Redwanul Rasel
Verdict	Pass

8.2.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	1 KHz
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.2.4 Test data

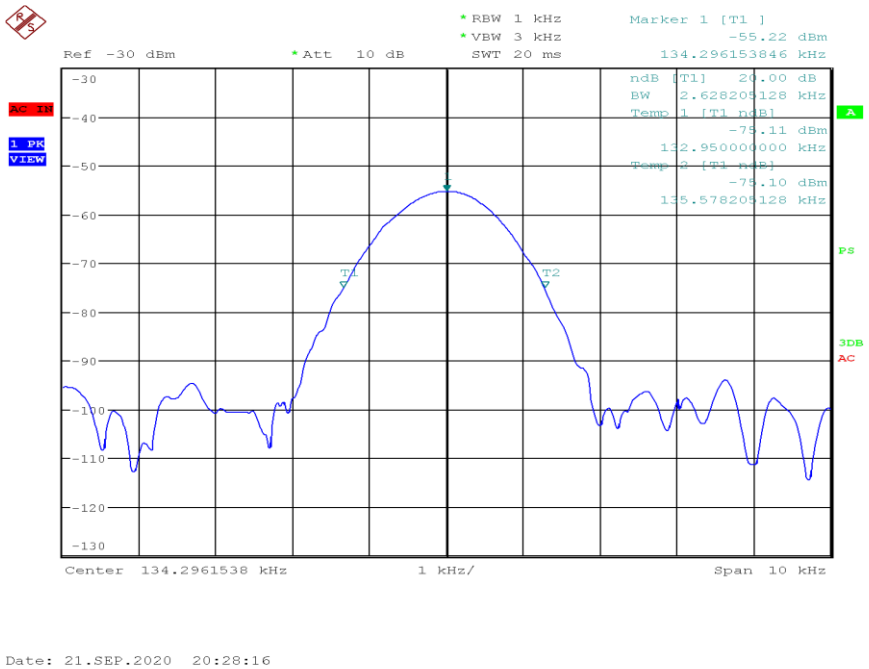


Figure 8.2-1: *20 dB bandwidth*

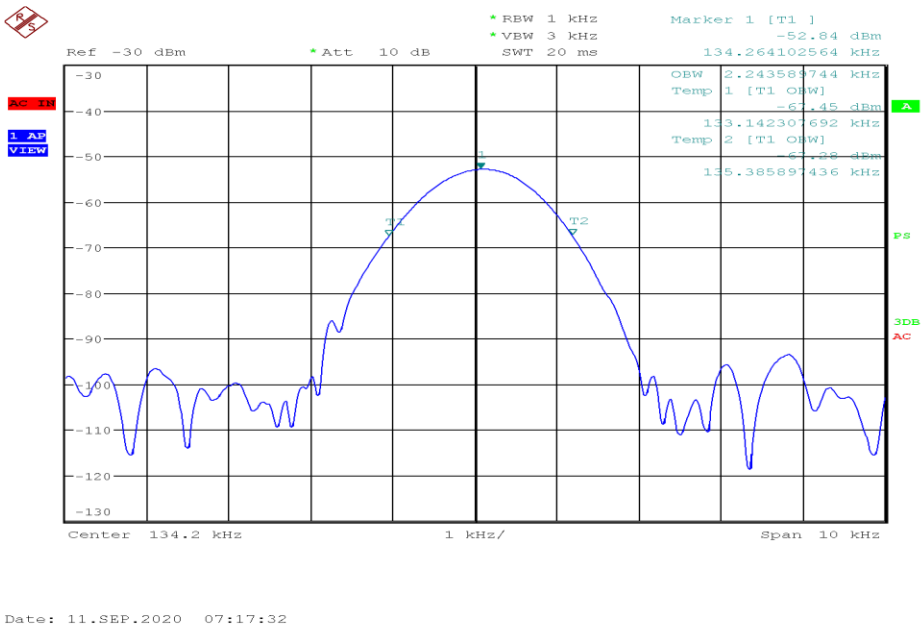


Figure 8.2-2: *99% dB bandwidth*

8.3 FCC 15.209 and RSS-GEN section 8.9 Radiated emission limits; general requirements

8.3.1 Definitions and limits

FCC:
(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, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit.
Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device.

ISED:
Except when the requirements applicable to a given device state otherwise, emissions from licence‑exempt transmitters shall comply with the field strength limits shown in Table below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 8.3-1: *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

Table 8.3-2: *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 Table 8.3-2 and above 38.6 GHz are designated for license-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 8.3-3: *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			

8.3.2 Test summary

Test start date	September 8 and 11, 2020
Test engineer	Redwanul Rasel
Verdict	Pass

8.3.3 Observations, settings and special notes

The spectrum was searched from 9 kHz to 30 MHz.
Radiated measurements were performed at a distance of 3 m.

Spectrum analyzer settings for frequencies below 150 kHz:

Detector mode	Quasi-Peak
Resolution bandwidth	300 Hz
Video bandwidth	9 kHz
Trace mode	Max Hold
Measurement time	100 ms

Spectrum analyzer settings for frequencies from 150 kHz to 30 MHz:

Detector mode	Quasi-Peak
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold
Measurement time	100 ms

8.3.4 Test data

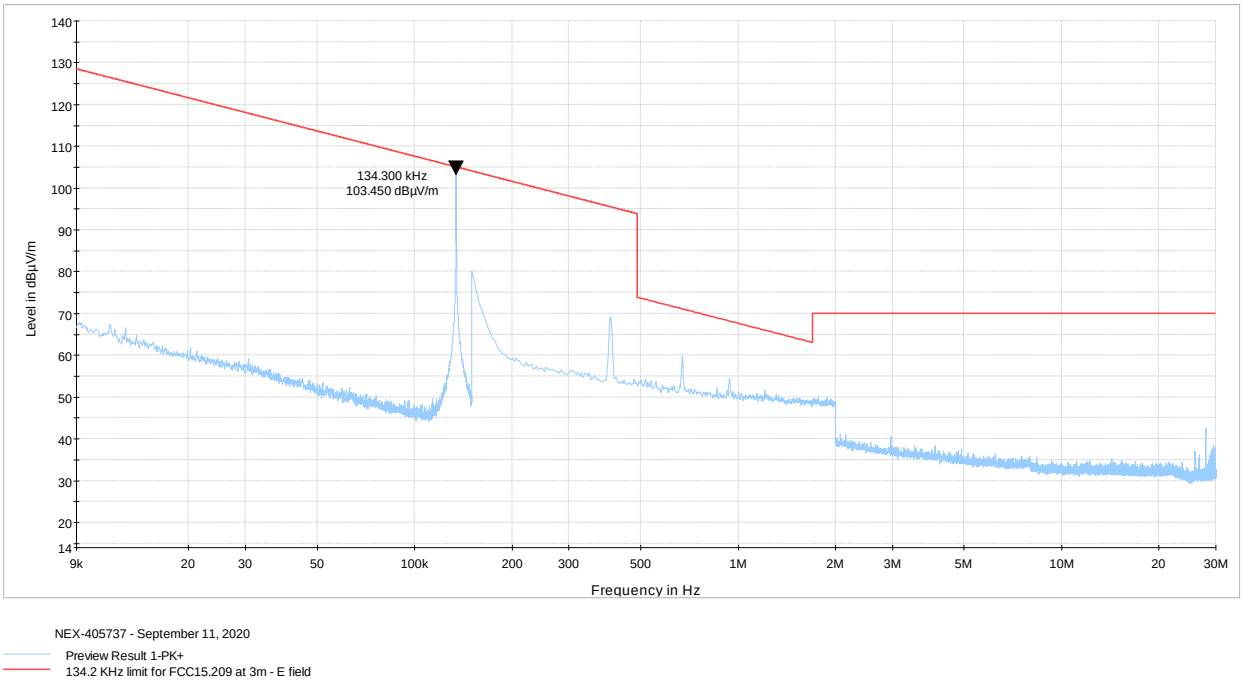


Figure 8.3-1: *Radiated spurious emissions below 30 MHz*

Note: Emissions on 134.3 kHz is from intentional transmission of EUT.

8.3.4 Test data, Continued

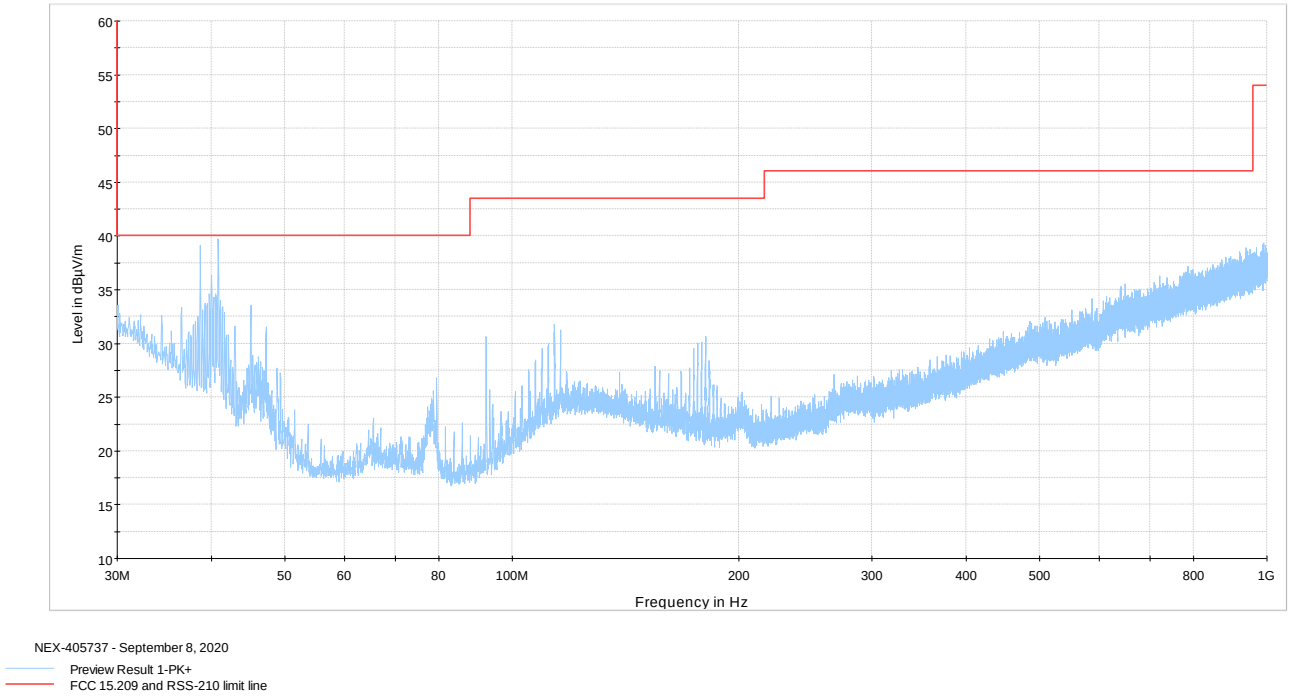


Figure 8.3-2: *Radiated spurious emissions 30 MHz – 1 GHz*

Table 8.3-4: *Radiated field strength measurement results*

Frequency, MHz	Quasi-Peak Field strength, dBµV/m		Margin, dB
	Measured	Limit	
113.86	28.1	43.5	15.4
937.64	29.8	46.0	16.2

Note: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Note : As per FCC 15.209, only restricted band were assessed in the tabular data.

Section 9. EUT photos

9.1 External photos

Figure 9.1-1: *Front view photo*

Figure 9.1-2: *Rear view photo*

Figure 9.1-3: *Side view photo*

Figure 9.1-4: *Side view photo*

Figure 9.1-5: *Top view photo*

Figure 9.1-6: *Bottom view photo*

(End of the test report)