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Clever First Aid CMKE Connected First Aid Cabinet

tested to the

47 Code of Federal Regulations

Part 15 - Radio Frequency Devices

Subpart C – Intentional Radiators

Section 15.225 – Operation in the band 13.110 -14.010 MHz

Section 15.247 - Operation in the band 902 – 928 MHz

for

Clever First Aid Ltd

This Test Report is issued with the authority of:

Andrew Cutler - General Manager

ACCREDITED
IANZ
TESTING LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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1. COMPLIANCE STATEMENT

The **Clever First Aid CMKE Connected First Aid Cabinet** complies with FCC Part 15 Sections 15.225 and 15.247 as an Intentional Radiator when the methods as described in ANSI C63.10 - 2013 are applied.

2. RESULT SUMMARY

The results of testing carried out between April 14th and 21st 2023 and between October 18th and November 8th, 2023 and on 9th January 2024 are summarised below.

Clause	Parameter	Result
15.201	Equipment authorisation requirement	Certification of this transmitter is required.
15.203	Antenna requirement	Not applicable. Antennas are integral to the devices.
15.204	External PA and antenna modifications	Noted.
15.205	Restricted bands of operation	Complies.
15.207	Conducted limits	Complies.
15.209	Radiated emission limits - Emissions < 30 MHz	Complies
15.209	Radiated emission limits – Emissions > 30 MHz	Complies
15.225	Radiated emission limits - Fundamental	Complies
15.225	Frequency stability	Complies
15.247 (a)(1)	Hopping channel separation	Complies
15.247 (a)(1)(i)	Channel occupancy / Bandwidth	Complies
15.247 (b)(1)(2)	Peak output power	Complies
15.247 (b)(4)	Antenna gain less than 6 dBi	Not applicable. Antennas are integral.
15.247 (d)	Out of band emissions	Complies
15.247 (e)	Spectral density	Not applicable. FHSS device.
15.247 (f)	Hybrid Systems	Not applicable. FHSS device.
15.247 (g)	Use of all channels	Not applicable – All channels available are used.
15.247 (h)	Intelligent frequency hopping	Not applicable – Intelligent frequency hopping not used.
15.247 (i)	Radio frequency hazards	Complies

3. ATTESTATION

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The client selected the test sample.

The report relates only to the sample tested.

Report Revision Table

Version	Change Made	Date
230208.3	Initial Issue – Compliant Test Report	11/01/24

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

All compliance statements have been made with respect of the specification limit with no reference to the measurement uncertainty.

All testing was carried out as per the standard in the worst-case configuration with no deviations being applied.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.

Andrew Cutler
General Manager
EMC Technologies NZ Ltd

4. CLIENT INFORMATION

Company Name	Clever First Aid Ltd
Street Address	Unit 2, 585 Wairakei Road Burnside
City	Christchurch
Country	New Zealand.
Contact	Mr Matthew Claridge

5. TEST SAMPLE DESCRIPTION

Brand Name	Clever First Aid
Model Number	CMKE
Product	Connected First Aid Cabinet
Manufacturer	Clever Fist Aid Ltd
Country of Origin	New Zealand
Serial Number	EP31, EP32 (Two identical samples provided)
Modules Installed	Raspberry Pi CM4102008 Bluetooth with JCW410 antenna FCC ID: 2ABCB-RPICM4 Quectel BG96 Mini PCIe Cellular modem with JCG410L antenna. FCC ID: XMR20707BG96 Quectel EG21 Cellular modem module with JCG410L antenna FCC ID: XMR201906EG21G Phychips RED4S 900 MHz RFID with a custom designed PCB dipole antenna. FCC ID: Y3D-RED4S ST25R39118 Chip NFC Transmitter with custom loop antenna FCC ID: Module not FCC certified.

Frequencies in Use

Raspberry Pi device: CPU operating frequency 1.5 GHz

The 900 MHz RFID device would normally be configured to hop on 50 channels with a 200 kHz channel spacing in the band of 915 – 928 MHz

For testing purposes the device was hoping continuously on 6 channels between 917.5 MHz and 926.7 MHz.

The Bluetooth device was configured to operate in the 2400 – 2483.5 MHz advertising on 2402 MHz, 2426 MHz and 2480 MHz.

NFC device operates on 13.560 MHz

The Cellular devices are capable of operating in a number of cellular bands between 700 – 2600 MHz.

When testing was carried out on the Cellular devices they were observed operating in the 900 MHz cellular bands.

Description of Test Sample.

The product tested is an inventory managed first aid cabinet.

It uses a combination of UHF 900 MHz RFID and NFC 13.560 MHz RFID technologies with additional sensors to track user interactions and the contents of the cabinet.

Once an inventory scan is completed the data is uploaded to the clients cloud database using the Cellular or Bluetooth modem

The stock is tagged with a combination of UHF and NFC passive tags

Testing was carried out when the unit was fully stocked.

The software architecture is designed so that only one radio is on at a time.

To the test specific radios a plug in remote was supplied that attached to an external port which allows testing of the selected radio.

The device was powered at 12 Vdc using an external power supply that was powered at 120 Vac from the Public AC mains supply.

The following selections were made possible using the supplied test control box:

- ➔ NFC: System will scan through all antennas
- ➔ UHF: System will constantly scan antenna no 2 which has been identified as having the highest gain.

  All 16 UHF antennas in the antenna kit are the same simple dipole however antenna 2 has the lowest coax losses and it is positioned near the top of the kit facing forward.

Description of Test Sample (Continued).

- ➔ Bluetooth: System will periodically (once per second) broadcast its UID over the Bluetooth band in "Advertising mode"

- ➔ Cellular mode: System will attempt to initiate a data connection with the nearest Cellular operator and then repeatedly pings google.com.

FCC certification issues that have been noted.

The NFC module has not been certified and therefore has been fully tested for certification purposes.

All other modules have FCC single use modular certifications with NO simultaneous transmissions are possible.

The 900 MHz RFID module has modular certification however a custom use antenna has been attached.

Testing has also been carried out on this module in order to verify compliance using this antenna configuration.

The Bluetooth module is operated in Bluetooth mode only (WiFi not enabled) and has been installed in accordance with the modules manufacturer's installation instructions.

Verification measurements were made when this device was operating.

This device will sold when either the BG96 or the EG21 cellular modem.

Both of the Cellular modules have been installed in accordance with the modules manufacturer's installation instructions.

Verification measurements were made when this device was operating.

When the product is sold it is sold with all nodules installed.

Software in the product allows only one module to be active at a time with NO simultaneous transmissions possible.

Once the cabinet is installed the Cellular module is activated.

If the cabinet detects any activity, for example the door opening and closing, the Cellular modem is deactivated with a full inventory scan carried out first by the NFC module and then by the RFID module.

The Bluetooth module is generally only used during the installation of a Cabinet to communicate with the installer during the process.

After installation the Bluetooth module is de-activated

Testing of each module was carried out on an individual basis.

6. TEST RESULTS

Standard

The sample was tested in accordance with 47 CFR Part 15 Subpart C and in particular sections 15.225 and 15.247

Methods and Procedures

The following measurement methods and procedures have been applied:

- ANSI C63.10 – 2013

Section 15.201: Equipment authorisation requirement

Certification as detailed in Subpart J of Part 2 is required for this device.

Section 15.203: Antenna requirement

This product uses a number of modules with various antennas that are all internal to the overall product that cannot be easily removed.

Result: Complies

Section 15.204: External radio frequency power amplifiers and antenna modifications

The device is NOT supplied with an external power amplifier and the user manual defines the types of antennas that can be used with this device.

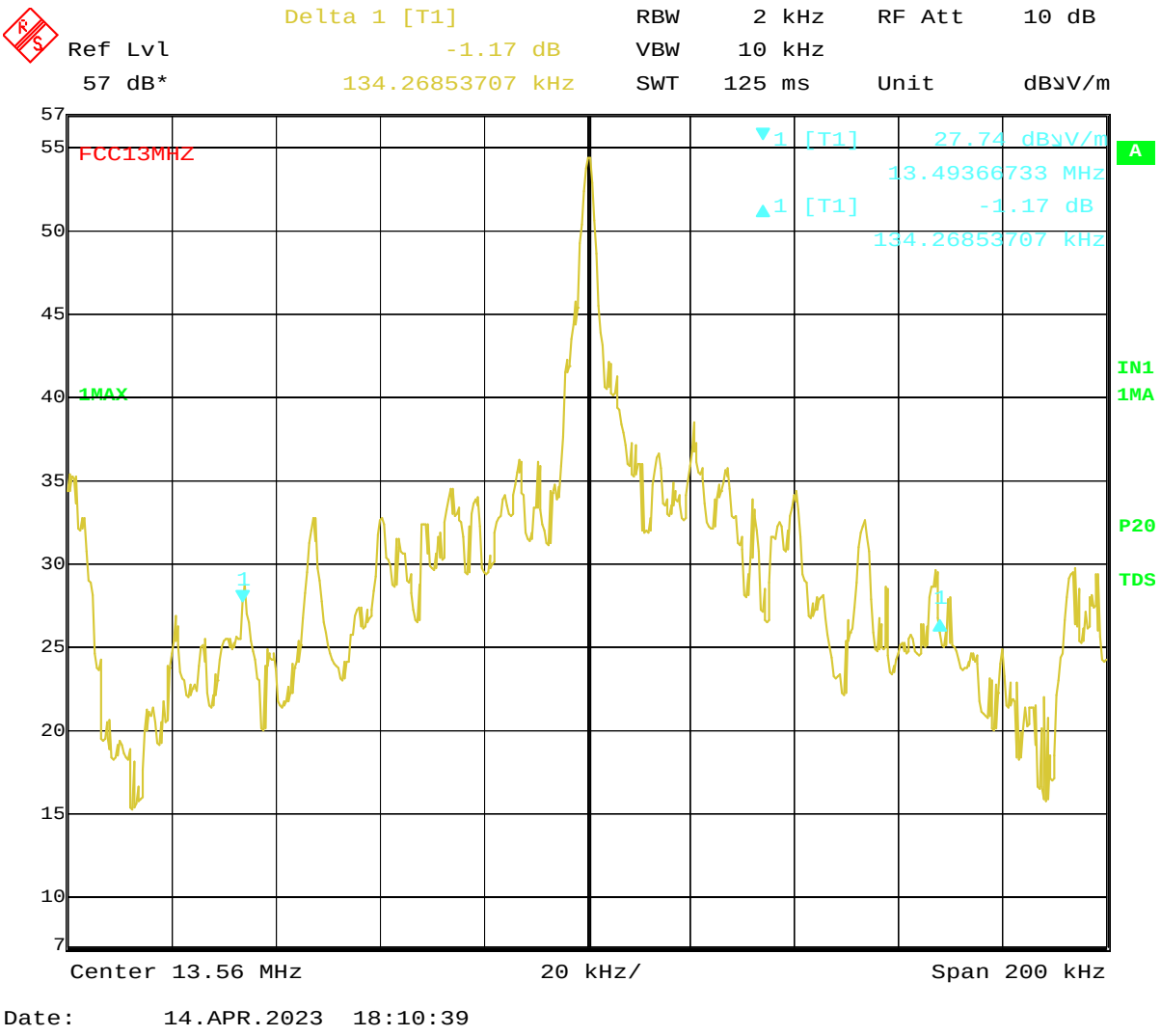
Result: Complies.

Section 15.205: Restricted bands of operation

The device transmits on a nominal frequency of 13.560 MHz.

13.560 MHz transmissions would fall into the 13.110 – 14.010 MHz band that is covered by Section 15.225.

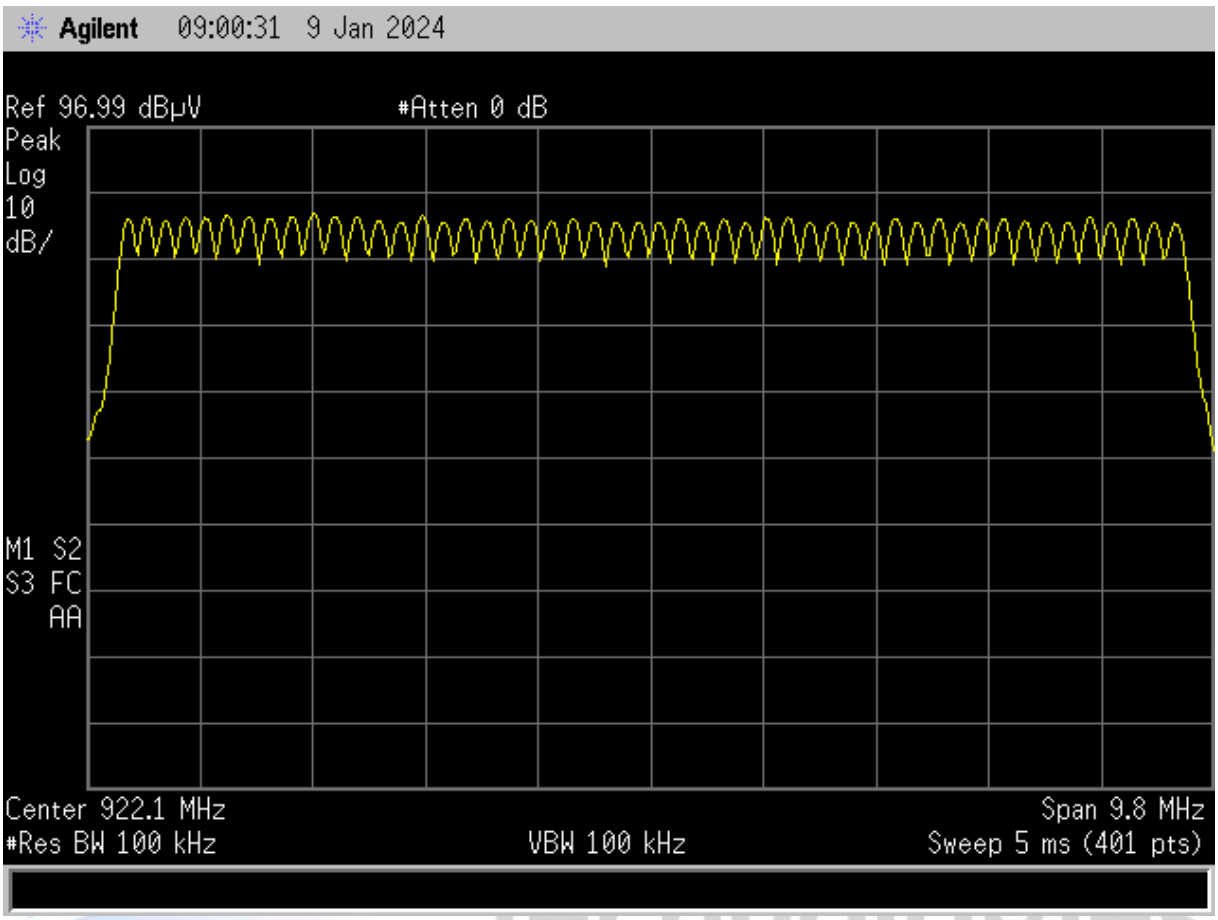
The -26 dB occupied bandwidth was measured to be 134.2685 kHz.



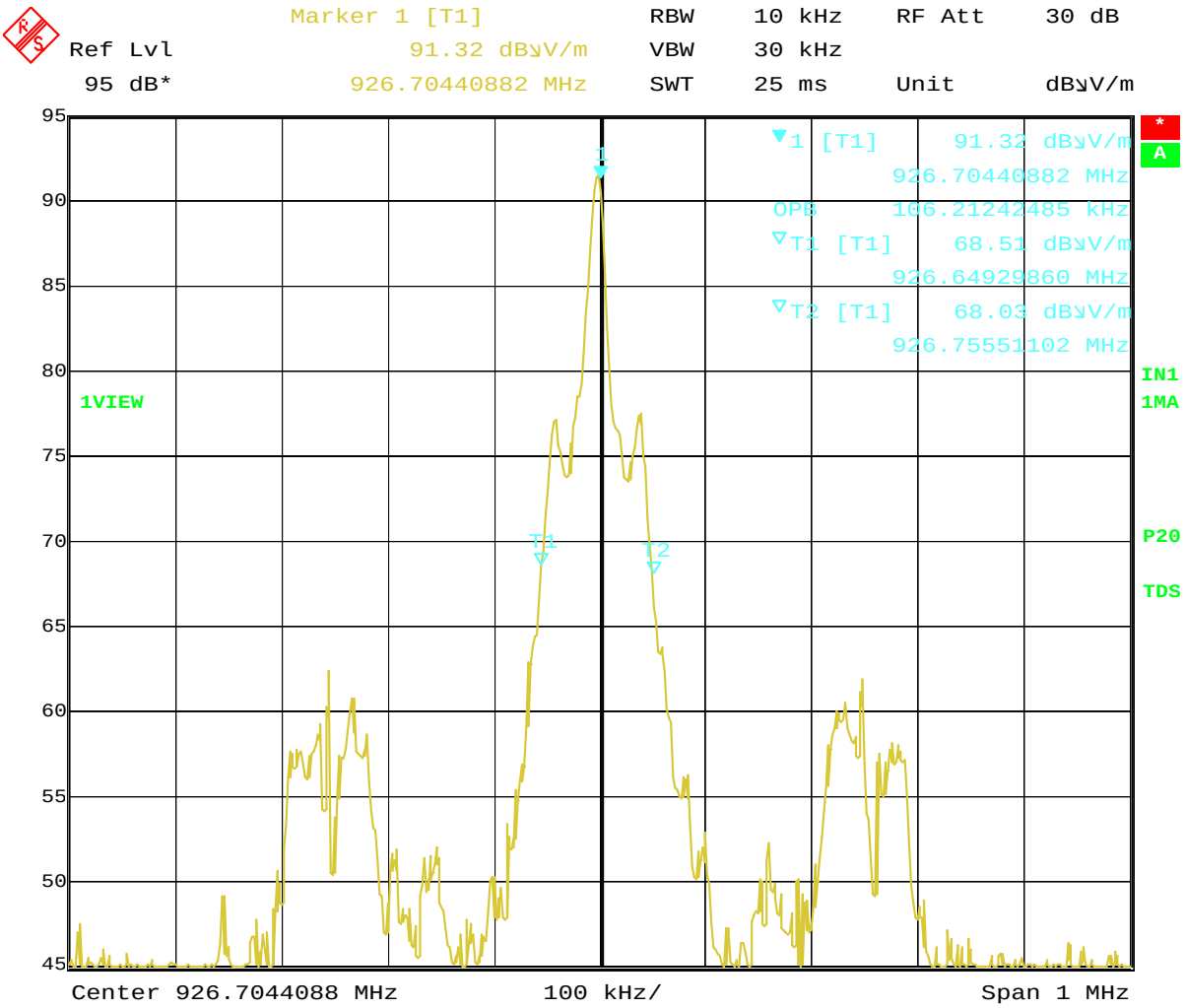
Result: Complies.

Section 15.205: Restricted bands of operation

The 900 MHz RFID device was observed operating between 917.5 – 926.7 MHz as shown below



When operating on 927.6 MHz the 99% power bandwidth of the was measured to be 106.2125 kHz



Result: Complies.

Section 15.205: Restricted bands of operation

The Bluetooth device observed operating on 2402, 2426 and 2480 MHz in the 2400 – 2483.5 MHz band.

No plot taken however manual observations to confirmed this.

Also no specific measurements were made on either of the Cellular devices as they operate in licensed bands that fall outside of Section 15.205

However both devices were observed operating in various cellular bands.

Result: Complies

Conducted Emissions Testing

Conducted Emissions testing was carried out over the frequency range of 150 kHz to 30 MHz which was carried out at the laboratory's MacKelvie Street premises in a 2.4 m x 2.4 m x 2.4 m screened room

As it is possible for this device to be directly or indirectly connected to the Public AC mains supply testing was carried out using a representative AC power supply system that was powered at 120 Vac 60 Hz which supplied DC to the device under test.

Testing was carried out when configured in NFC, RFID, Bluetooth and Cellular modem modes (EG21 and BG96).

Testing was carried out when the NFC Card Reader, which operates on 13.560 MHz, was operating normally with the internal antenna connected.

The device was placed on top of the emissions table, which is 0.8 m x 0.8 m, 80 cm above the screened room floor which acts as the horizontal ground plane.

In addition the device was positioned 40 cm away from the screened room wall which acts as the vertical ground plane.

The artificial mains network was bonded to the screened room floor.

At all times the device was kept more than 80 cm from the artificial mains network.

The supplied plot is combined plot showing the worst case quasi peak and average results of both the phase and neutral lines to the representative AC power supply.

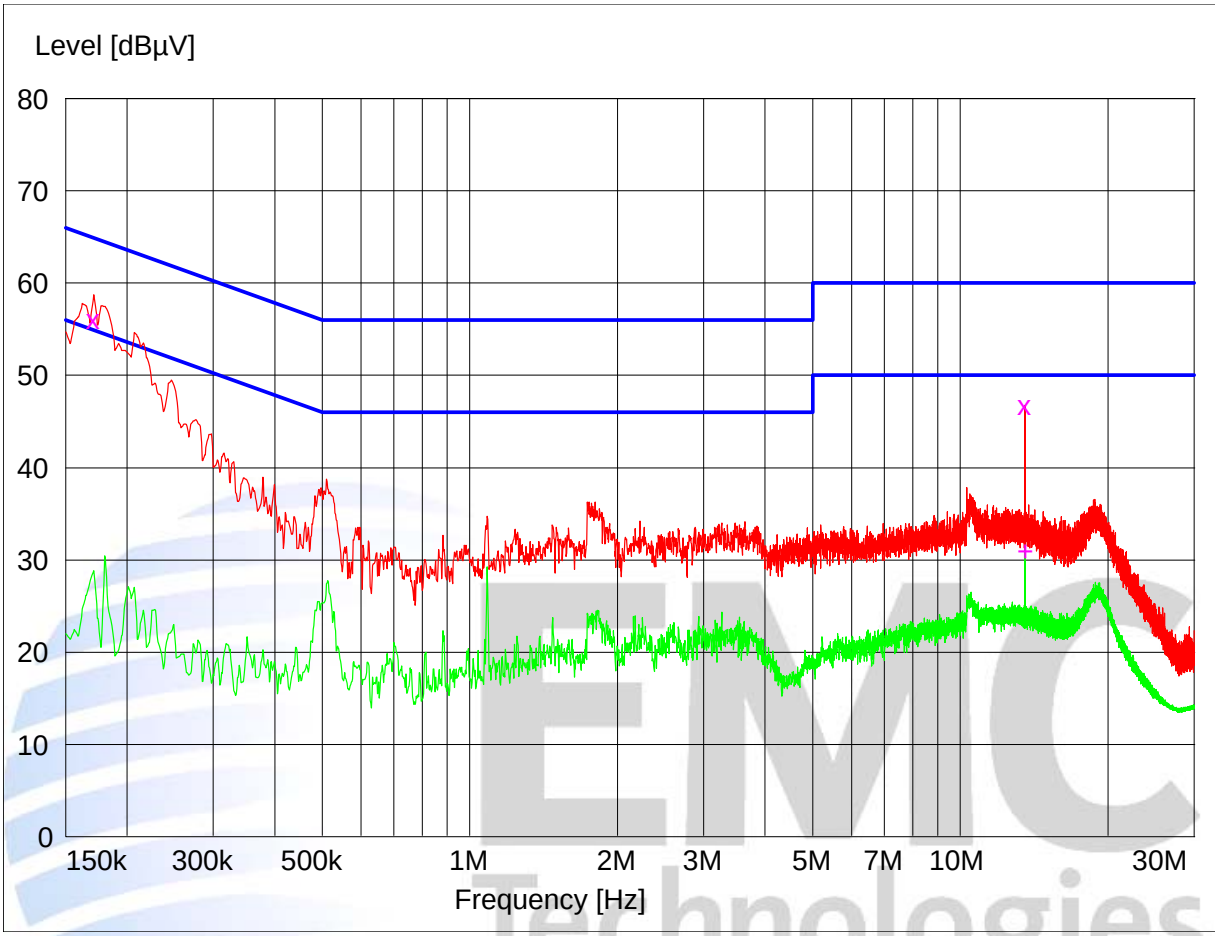
Quasi peak and average detectors have been used with resolution bandwidths of 9 kHz.

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- AC Mains port (0.15-30 MHz) ± 2.8 dB

Conducted Emissions – AC Input Power Port

Setup:	Test carried out when powered at 120 VAC when operating in NFC mode.

Peak ---	Average --	Quasi Peak X	Average +



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.171000	56.10	64.9	8.8	L1	
13.560500	46.80	60.0	13.2	N	*46.8*

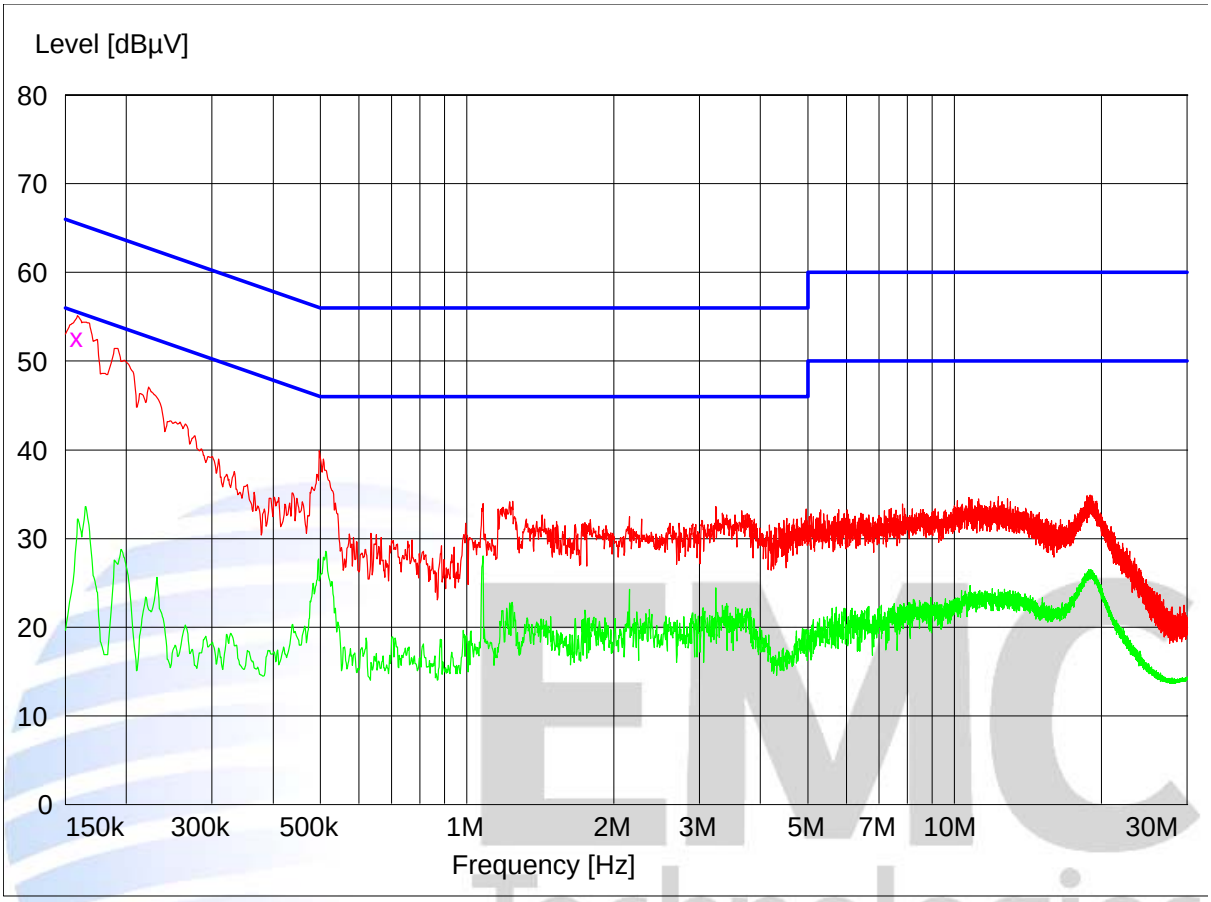
Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
13.556000	30.90	50.0	19.1	L1	*41.2*

Conducted Emissions – AC Input Power Port

Setup:	Test carried out when powered at 120 VAC when operating in RFID mode.

Peak ---	Average --	Quasi Peak X	Average +



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.159000	52.70	65.5	12.8	N	

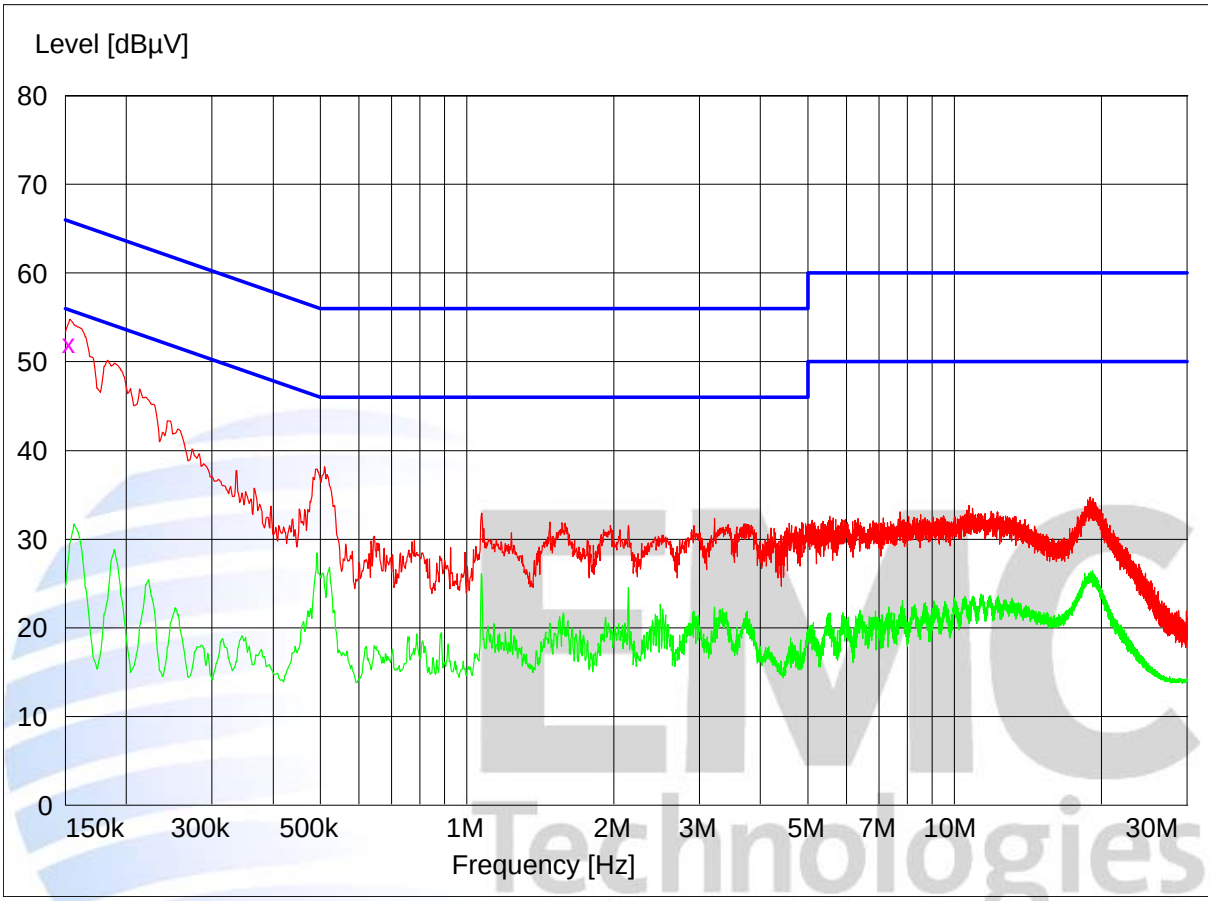
Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin dB	Phase	Rechecks dBµV
	No emissions observed within 15 dB of the limit				

Conducted Emissions – AC Input Power Port

Setup:	Test carried out when powered at 120 VAC when operating in Bluetooth mode.

Peak ---	Average --	Quasi Peak X	Average +



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.153000	52.10	65.8	13.7	L1	

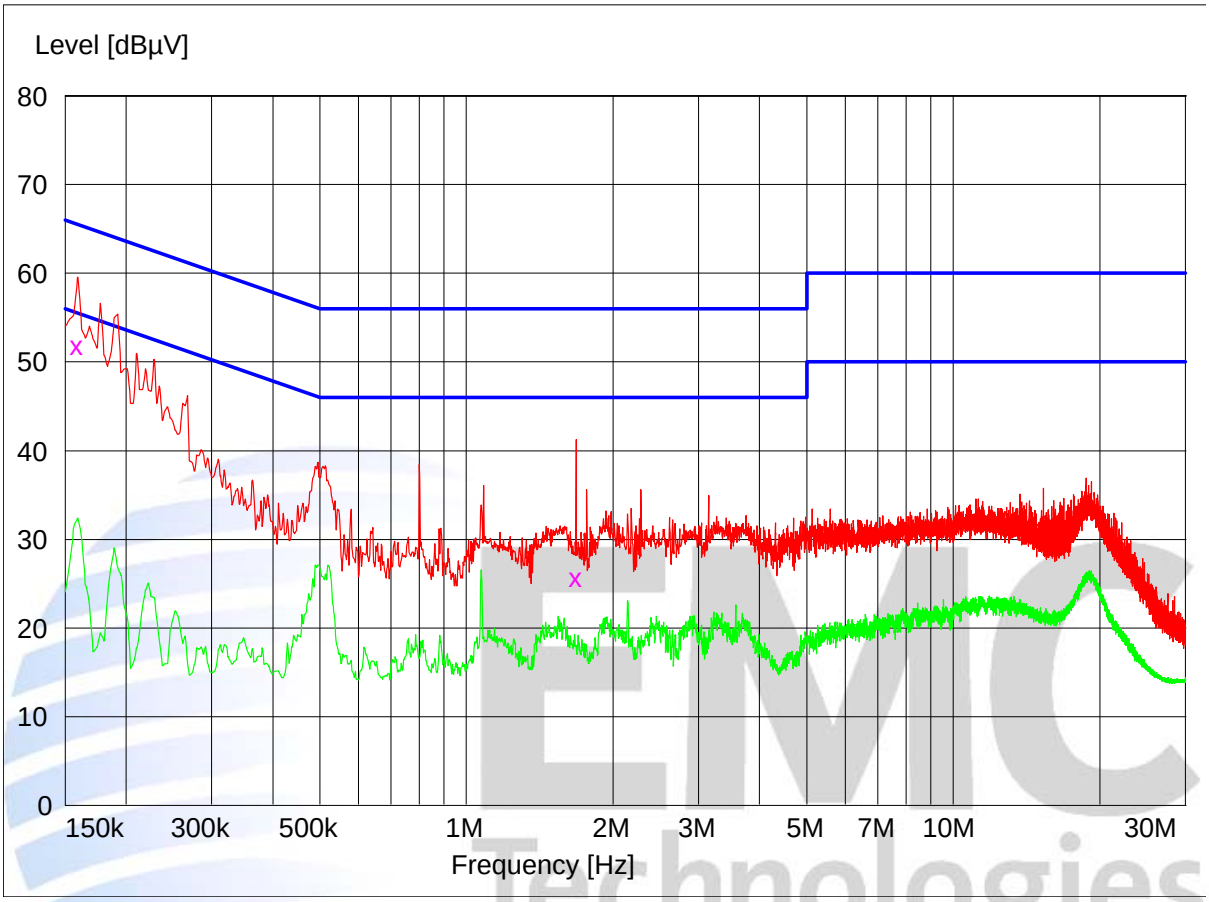
Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
	No emissions observed within 15 dB of the limit				

Conducted Emissions – AC Input Power Port

Setup:	Test carried out when powered at 120 VAC when the BG96 Cellular Modem was operating.

Peak ---	Average --	Quasi Peak X	Average +



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.159000	51.90	65.5	13.6	L1	*52.2*
1.680000	25.70	56.0	30.3	L1	*25.7*

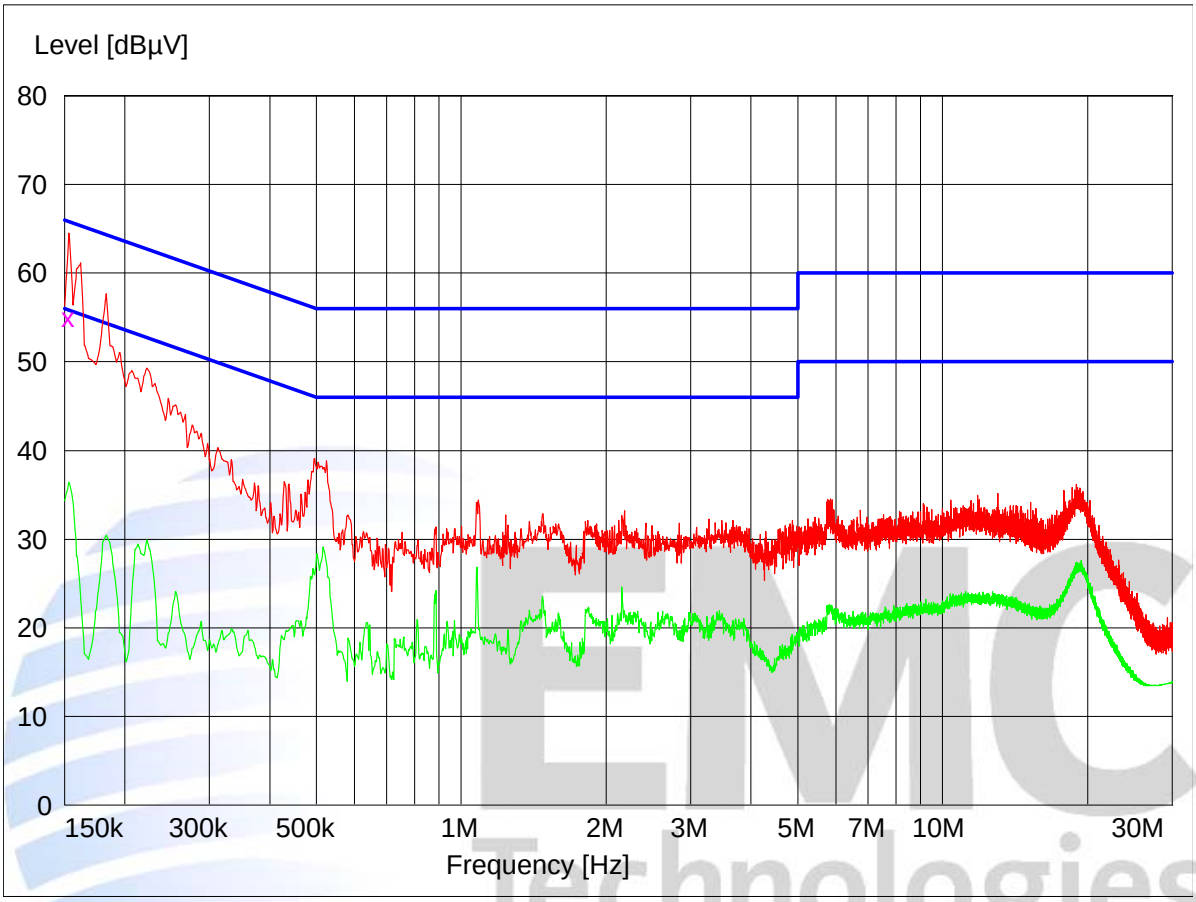
Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
	No emissions observed within 15 dB of the limit				

Conducted Emissions – AC Input Power Port

Setup:	Device tested when powered at 120 VAC 60 Hz when the EG21 Cellular Modem was operating.

Peak ---	Average --	Quasi Peak X	Average +



Final Quasi-Peak Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
0.153000	55.00	65.8	10.8	N	

Final Average Measurements

Frequency (MHz)	Level (dBµV)	Limit (dBµV)	Margin (dB)	Phase	Rechecks (dBµV)
	No emissions detected within 15 dB of the limit				

Section 15.209: Radiated emission limits, general requirements

Radiated emission testing was carried out over the frequency range of 150 kHz to 12500 MHz as the device contains a Bluetooth device operating in the 2400 – 2483.5 MHz band.

Testing was carried out at the laboratory's open area test site - located at 670 Kawakawa-Orere Road, RD5, Papakura, New Zealand.

Before testing was carried out a receiver self-calibration was undertaken along with a check of all cables and programmed antenna factors were carried out.

Testing was carried out using a representative AC power supply at 120 VAC 60 Hz that powered the device under test.

The device tested when placed in the centre of the test table flat 0.8 m above the test site ground plane.

All interconnecting cables were bundled in 40 cm long bundles.

Testing was carried out when configured in NFC, RFID, Bluetooth and Cellular modem modes (EG21 and BG96).

When an emission is located, it is positively identified and its maximum level is found by rotating the automated turntable, and by varying the antenna height, where appropriate, with an automated antenna tower.

Below 30 MHz a magnetic loop is used with the centre of the loop being 1 metre above the ground with measurements being made using a Quasi Peak detector at a distance of 10 metres.

Above 30 MHz the emission is measured in both vertical and horizontal antenna polarisations at a distance of 3 metres.

Below 1000 MHz a Quasi Peak detector with a 120 kHz bandwidth is used.

Above 1000 MHz an Average detector and a Peak detector with bandwidths of 1 MHz are used.

The emission level was determined in field strength by taking the following into consideration:

Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB/m) + Coax Loss (dB)

For example, if an emission of 30 dBµV was observed at 30 MHz.

45.5 dBµV/m = 30.0 dBµV + 14 dB/m + 1.5 dB

Section 15.209: 13.560 MHz transmitter below 30 MHz spurious emission measurements

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
27.120	13.6	48.6	35.0	Pass

The NFC device was transmitting continuously on 13.560 MHz.

Magnetic loop measurements were made at a distance of 10 metres.

Measurement receiver with a quasi-peak detector with a 9 kHz bandwidth was used.

The 30 metre limit has been scaled by a factor of 40 dB per decade, as per section 15.31 (f) (2).

The limit at 27.120 MHz when measured at 30 metres is 30 uV/m or 29.54 dBuV/m.

Therefore the scaled limit at 10 metres will be 48.6 dBuV/m.

The spurious emission observed does not exceed the level of the fundamental emission.

No other low frequency spurious emissions were detected from the device when measurements were attempted from 10 kHz - 30.0 MHz

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (10 kHz – 30 MHz) ± 4.8 dB

Section 15.209: Spurious Emissions

Measurements between 30 – 1000 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

NFC device

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Detector
31.880	33.5	-	40.0	6.5	Pass	Quasi Peak
35.320	30.1	-	40.0	9.9	Pass	Quasi Peak
36.800	30.1	-	40.0	9.9	Pass	Quasi Peak
38.720	30.3	-	40.0	9.7	Pass	Quasi Peak
40.680	28.3	-	40.0	11.7	Pass	Quasi Peak
41.720	29.2	-	40.0	10.8	Pass	Quasi Peak
45.000	27.2	-	40.0	12.8	Pass	Quasi Peak
54.240	30.6	-	40.0	9.4	Pass	Quasi Peak
81.360	23.5	19.1	40.0	16.5	Pass	Quasi Peak
189.840	27.8	-	43.5	15.7	Pass	Quasi Peak
298.320	29.9	31.1	46.0	14.9	Pass	Quasi Peak
325.440	38.0	35.6	46.0	8.0	Pass	Quasi Peak
352.560	35.1	-	46.0	10.9	Pass	Quasi Peak
379.680	33.0	-	46.0	13.0	Pass	Quasi Peak
393.240	37.1	-	46.0	8.9	Pass	Quasi Peak
406.760	36.4	39.4	46.0	6.6	Pass	Quasi Peak
420.360	36.8	-	46.0	9.2	Pass	Quasi Peak
433.920	37.8	40.6	46.0	5.4	Pass	Quasi Peak
461.040	37.3	40.7	46.0	5.3	Pass	Quasi Peak
488.160	38.9	39.5	46.0	6.5	Pass	Quasi Peak
515.280	39.9	41.5	46.0	4.5	Pass	Quasi Peak
528.840	-	37.0	46.0	9.0	Pass	Quasi Peak
542.400	37.0	42.7	46.0	3.3	Pass	Quasi Peak
555.960	-	38.4	46.0	7.6	Pass	Quasi Peak
569.520	-	37.5	46.0	8.5	Pass	Quasi Peak
583.080	38.5	38.7	46.0	7.3	Pass	Quasi Peak
610.200	38.0	-	46.0	8.0	Pass	Quasi Peak

All other emissions detected had a margin to the limit that exceeded at least 15 dB when measurements were made between 30 - 1000 MHz using both vertical and horizontal polarisations.

Result: Complies
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 – 1000 MHz) ± 4.1 dB

Section 15.209: Spurious Emissions

Measurements between 30 - 12500 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

RFID Device

Frequency (MHz)	Vertical (dBuV/m)	Hort (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result	Antenna	Detector
31.000	-	37.1	40.0	2.9	Pass	Horizontal	Quasi Peak
31.200	33.5	-	40.0	6.5	Pass	Vertical	Quasi Peak
39.000	23.5	-	40.0	16.5	Pass	Vertical	Quasi Peak
45.440	22.5	-	40.0	17.5	Pass	Vertical	Quasi Peak
46.000	23.1	-	40.0	16.9	Pass	Vertical	Quasi Peak
49.400	23.6	-	40.0	16.4	Pass	Vertical	Quasi Peak
52.600	21.1	-	40.0	18.9	Pass	Vertical	Quasi Peak
56.300	17.1	-	40.0	22.9	Pass	Vertical	Quasi Peak
65.760	15.1	-	40.0	24.9	Pass	Vertical	Quasi Peak

900 MHz RFID Transmitter spurious emission measurements have been recorded in the Section 15.247(d) results section of this report.

All other general emissions detected had a margin to the limit that exceeded at least 15 dB when measurements were made between 30 - 12500 MHz using both vertical and horizontal polarisations.

Result: Complies.
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 - 12500 MHz) ± 4.1 dB

Section 15.209: Spurious Emissions

Measurements between 30 - 12500 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

Bluetooth Device

Frequency (MHz)	Vertical (dBuV/m)	Hort (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result	Antenna	Detector
30.880	28.3	-	40.0	11.7	Pass	Vertical	Quasi Peak
37.280	20.9	-	40.0	19.1	Pass	Vertical	Quasi Peak

The Bluetooth device was observed advertising on 2402, 2427 and 2480 MHz as shown below.

Limits as per FCC part 15 section 15.249 have been applied for information purposes.

Frequency MHz	Vertical dBuV/m	Horizontal dBuV/m	Limit dBuV/m	Margin dB	Result	Antenna	Detector
2402.000	82.5	81.2	114.0	31.5	Pass	Vertical	Peak
2402.000	43.5	42.2	94.0	50.5	Pass	Vertical	Average
-	-	-	-	-	-	-	-
2426.000	84.5	83.5	114.0	29.5	Pass	Vertical	Peak
2426.000	45.5	44.5	94.0	48.5	Pass	Vertical	Average
-	-	-	-	-	-	-	-
2480.000	85.5	82.5	114.0	28.5	Pass	Vertical	Peak
2480.000	46.5	43.5	94.0	47.5	Pass	Vertical	Average

Verification measurements were made of the harmonic emissions from the product up to 12,500 MHz.

No harmonics emissions were detected when the device was operation in Bluetooth mode between 30 MHz – 12500 MHz when either vertical or horizontal polarisations was used.

Result: Complies.
Measurement uncertainty with a confidence interval of 95% is:
- Free radiation tests (30 - 12500 MHz) ± 4.1 dB

Section 15.209: Spurious Emissions

Measurements between 30 - 12500 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

Model no EG21 Cellular Transmitting Device

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result	Antenna	Detector
31.000	29.1	37.9	40.0	2.1	Pass	Horizontal	Quasi Peak
50.400	22.1	-	40.0	17.9	Pass	Vertical	Quasi Peak
48.000	22.6	-	40.0	17.4	Pass	Vertical	Quasi Peak
84.600	17.1	-	40.0	22.9	Pass	Vertical	Quasi Peak
108.400	22.5	-	40.0	17.5	Pass	Vertical	Quasi Peak
109.320	22.4	-	40.0	17.6	Pass	Vertical	Quasi Peak
109.440	-	23.1	40.0	16.9	Pass	Horizontal	Quasi Peak

The following spurious emissions were observed when transmitting on 914.400 MHz

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result	Antenna	Detector
1828.800	59.1	64.5	74.0	9.5	Pass	Horizontal	Peak
1828.800	50.5	43.1	54.0	3.5	Pass	Vertical	Average
2743.200	57.1	59.9	74.0	14.1	Pass	Horizontal	Peak
2743.200	45.3	42.1	54.0	8.7	Pass	Vertical	Average
3657.600	-	-	74.0	-	Pass	Vert/Hort	Peak
3657.600	-	-	54.0	-	Pass	Vert/Hort	Average
4572.000	-	-	74.0	-	Pass	Vert/Hort	Peak
4572.000	-	-	54.0	-	Pass	Vert/Hort	Average
5486.400	-	-	74.0	-	Pass	Ver /Hort	Peak
5486.400	-	-	54.0	-	Pass	Vert/Hort	Average
6400.800	-	-	74.0	-	Pass	Vert/Hort	Peak
6400.800	-	-	54.0	-	Pass	Vert/Hort	Average
7315.200	-	-	74.0	-	Pass	Vert/Hort	Peak
7315.200	-	-	54.0	-	Pass	Vert/Hort	Average
8229.600	-	-	74.0	-	Pass	Vert/Hort	Peak
8229.600	-	-	54.0	-	Pass	Vert/Hort	Average
9144.000	-	-	74.0	-	Pass	Vert/Hort	Peak
9144.000	-	-	54.0	-	Pass	Vert/Hort	Average

Results: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 - 12500 MHz) ± 4.1 dB

Section 15.209: Spurious Emissions

Measurements between 30 - 12500 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

Model no BG96 Cellular Transmitting Device

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result	Antenna	Detector
45.600	34.0	-	40.0	6.0	Pass	Vertical	Quasi Peak
68.680	21.0	-	40.0	19.0	Pass	Vertical	Quasi Peak
87.700	21.2	-	40.0	18.8	Pass	Vertical	Quasi Peak
234.000	31.8	-	46.0	14.2	Pass	Vertical	Quasi Peak
239.900	28.8	-	46.0	17.2	Pass	Vertical	Quasi Peak
1743.200	-	47.2	54.0	6.8	Pass	Horizontal	Average
3050.800	-	57.5	74.0	16.5	Pass	Horizontal	Peak
4278.000	-	57.6	74.0	16.4	Pass	Horizontal	Peak
4278.000	-	47.2	54.0	6.8	Pass	Horizontal	Average

The following spurious emissions were observed when transmitting on 910.680 MHz

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Result	Antenna	Detector
1821.360	-	50.9	74.0	23.1	Pass	Horizontal	Peak
1821.360	-	43.5	54.0	10.5	Pass	Horizontal	Average
2732.040	-	-	74.0	-	Pass	Vert/Hort	Peak
2732.040	-	-	54.0	-	Pass	Vert/Hort	Average
3642.720	-	-	74.0	-	Pass	Vert/Hort	Peak
3642.720	-	-	54.0	-	Pass	Vert/Hort	Average
4553.400	-	-	74.0	-	Pass	Vert/Hort	Peak
4553.400	-	-	54.0	-	Pass	Vert/Hort	Average
5464.080	-	-	74.0	-	Pass	Ver /Hort	Peak
5464.080	-	-	54.0	-	Pass	Vert/Hort	Average
6374.760	-	-	74.0	-	Pass	Vert/Hort	Peak
6374.760	-	-	54.0	-	Pass	Vert/Hort	Average
7285.440	-	-	74.0	-	Pass	Vert/Hort	Peak
7285.440	-	-	54.0	-	Pass	Vert/Hort	Average
8196.120	-	-	74.0	-	Pass	Vert/Hort	Peak
8196.120	-	-	54.0	-	Pass	Vert/Hort	Average
9106.800	-	-	74.0	-	Pass	Vert/Hort	Peak
9106.800	-	-	54.0	-	Pass	Vert/Hort	Average

Results: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 - 12500 MHz) ± 4.1 dB

Section 15.225: Fundamental emission:

Measurements were made using a magnetic loop antenna and a receiver with a Quasi Peak detector using a 9 kHz bandwidth.

Measurements were made at a distance of 10 metres with the limit being determined by using the extrapolation factor of 40 dB per decade limit, as detailed in section 15.31 f (2).

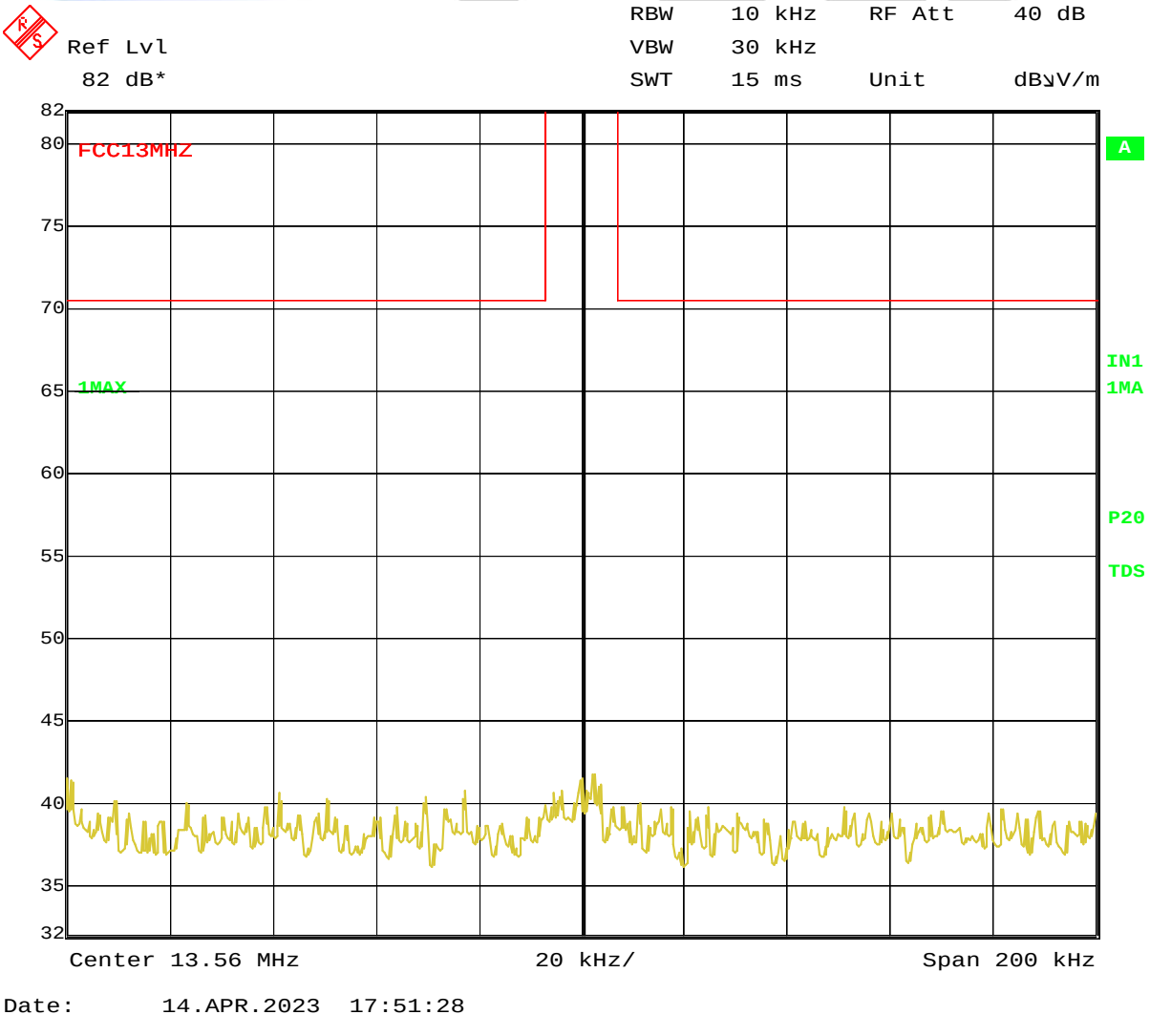
The limit at 30 m at 13.560 MHz is 15,848 uV/m or 84.0 dBuV/m.

Applying the extrapolation factor of 40 dB/ per decade, the limit at 10 m is 103.1 dBuV/m.

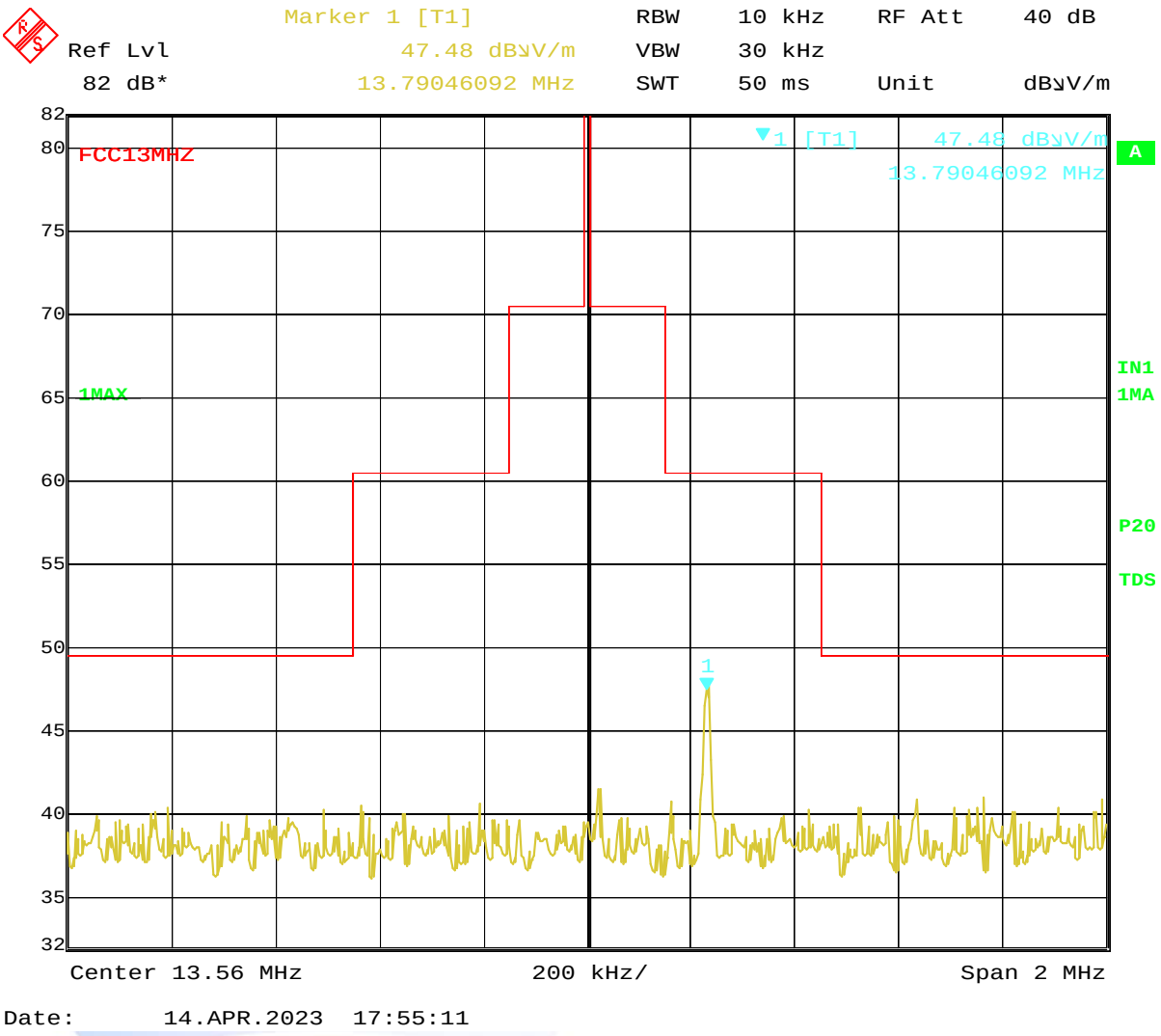
The 24 Vdc supply to the device was varied by +/- 15% to determine whether a change in field strength would occur.

Voltage (Vdc)	Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
20.4	13.560	33.1	103.1	70.0
24.0	13.560	33.1	103.1	70.0
27.6	13.560	33.1	103.1	70.0

Spectrum analyser plot showing the carrier and modulation peaks within +/- 100 kHz.



Spectrum analyser plot showing the carrier and modulation peaks within +/- 1000 kHz



Measurement was made at the open area test site

The emission at 13.7904 MHz was confirmed to be an ambient and not from the device under test.

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (100 kHz – 30 MHz) ± 4.8 dB

Section 15.225: Frequency tolerance:

The frequency tolerance of the carrier is required to be +/- 0.01% of operating frequency when the temperature is varied between -20 degrees C and +50 degrees C.

The device operates nominally on 13.560 MHz which gives a frequency tolerance of +/- 1,356.0 Hz.

Temperature (°C)	Frequency (MHz)	Difference (Hz)
50.0	13.559 905	-95
40.0	13.559 892	-108
30.0	13.559 896	-104
20.0	13.559 900	-100
10.0	13.559 905	-95
0.0	13.559 926	-74
-10.0	13.559 959	-41
-20.0	13.559 976	-24

As a worst case scenario the 12 Vdc supply to the device was varied by +/- 15% at 20 degrees C (ambient).

Voltage (Vdc)	Frequency (MHz)	Difference (Hz)
10.2	13.559 900	-100
12.0	13.559 900	-100
13.8	13.559 900	-100

The frequency tolerance above has been calculated by subtracting the Measured Frequency from the Nominal Frequency (13.560 MHz).

Result: Complies.

Measurement uncertainty with a confidence interval of 95% is:
Frequency tolerance ± 50 Hz

Section 15.247(a)(1) + (a)(1)(i)

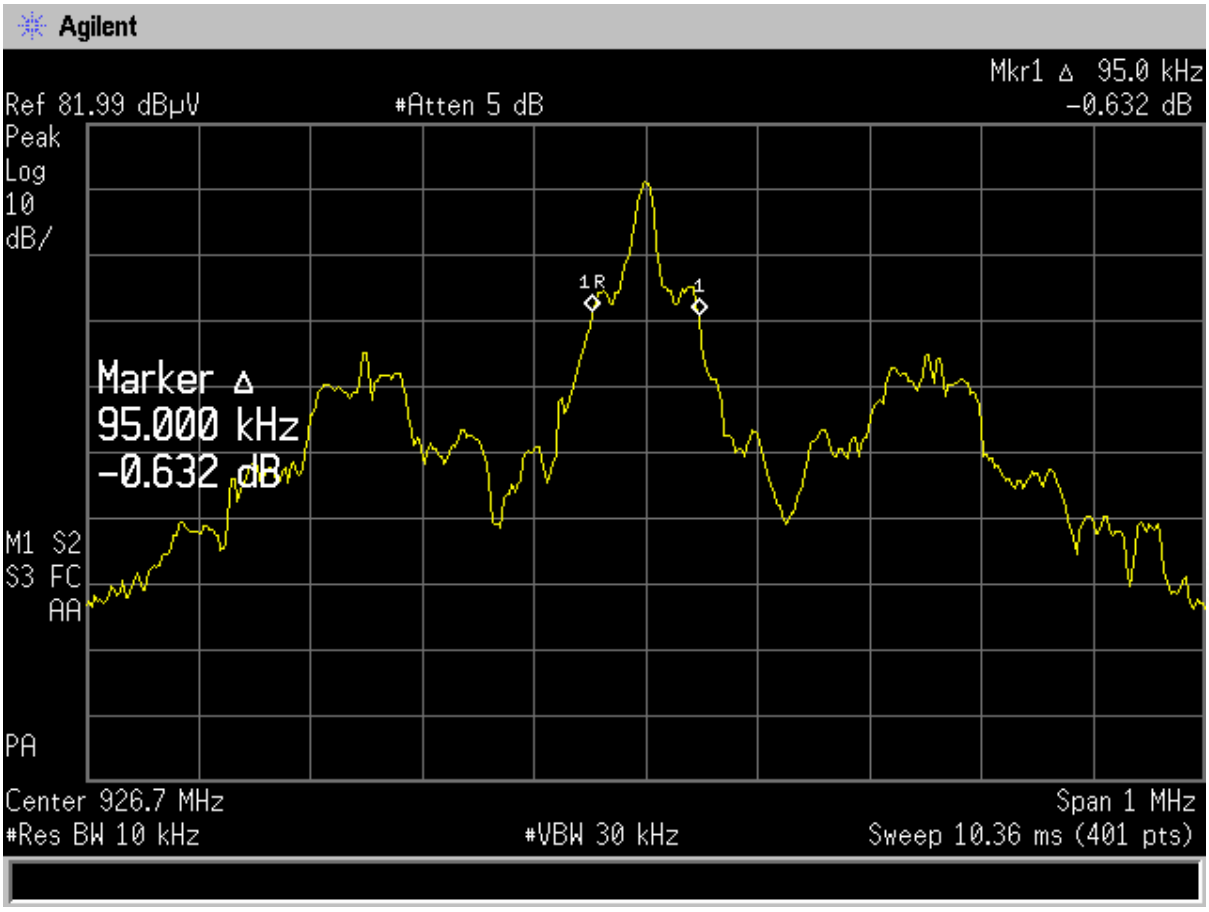
The 900 MHz RFID device in this product operates using Frequency Hopping Spread Spectrum (FHSS) modulation.

The hopping channels are required to be separated by a minimum of 25 kHz or the 20 dB bandwidth whichever is greater.

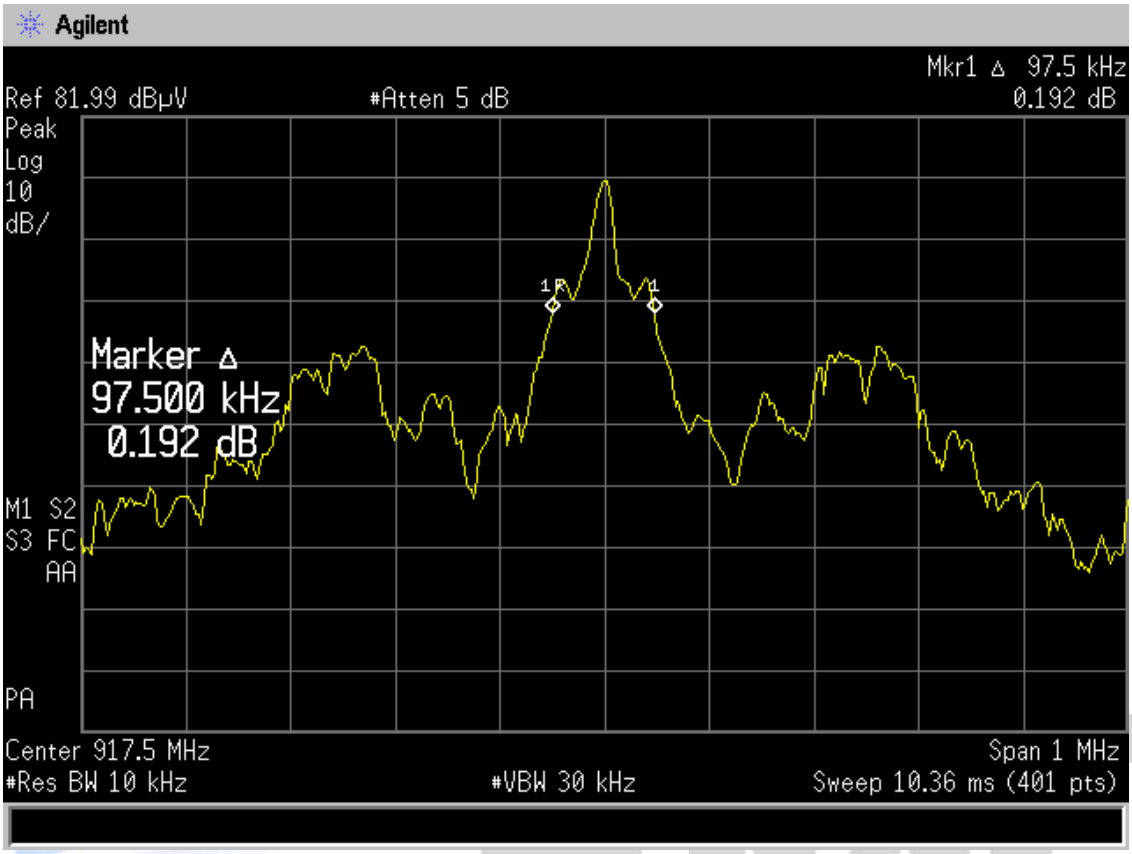
In the 902 – 928 MHz band if the 20 dB bandwidth is less than 250 kHz then at least 50 channels should be used.

The -20 dB bandwidth at 917.5 MHz was 95 kHz and at 926.7 MHz it was 97.5 kHz.

917.500 MHz

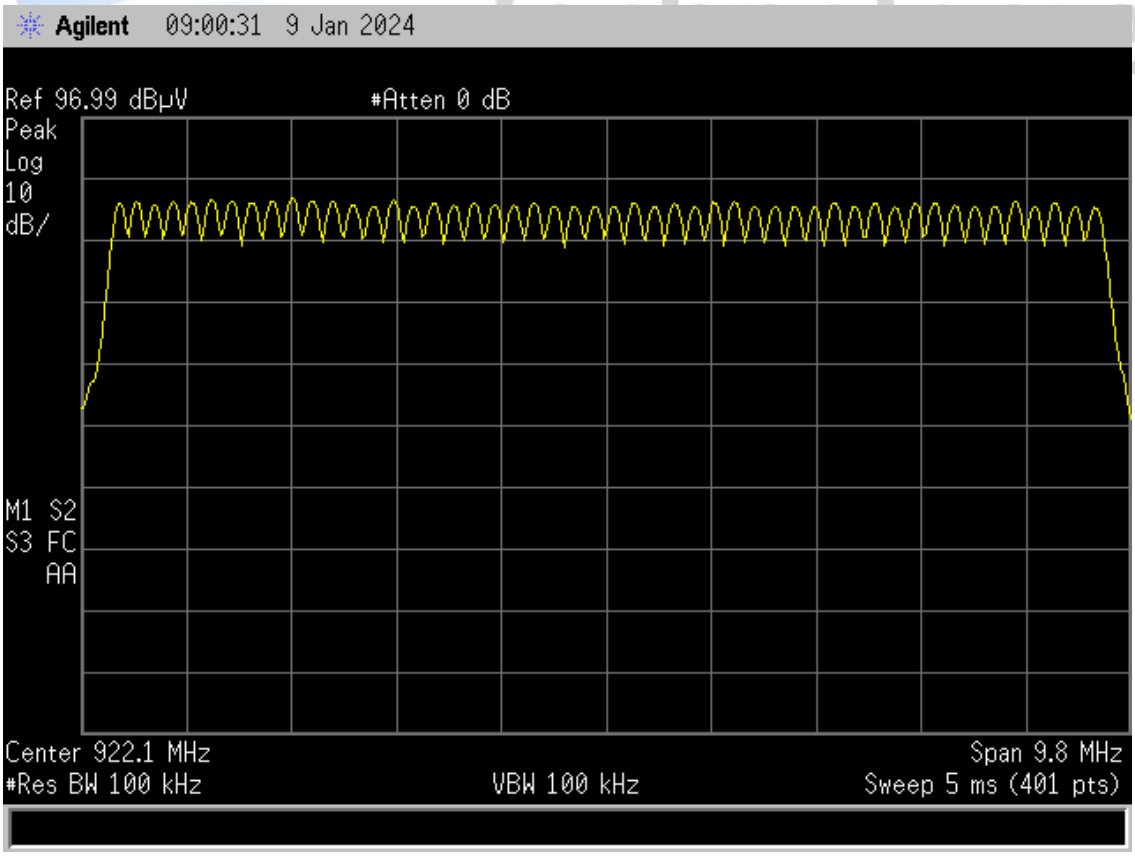


926.700 MHz



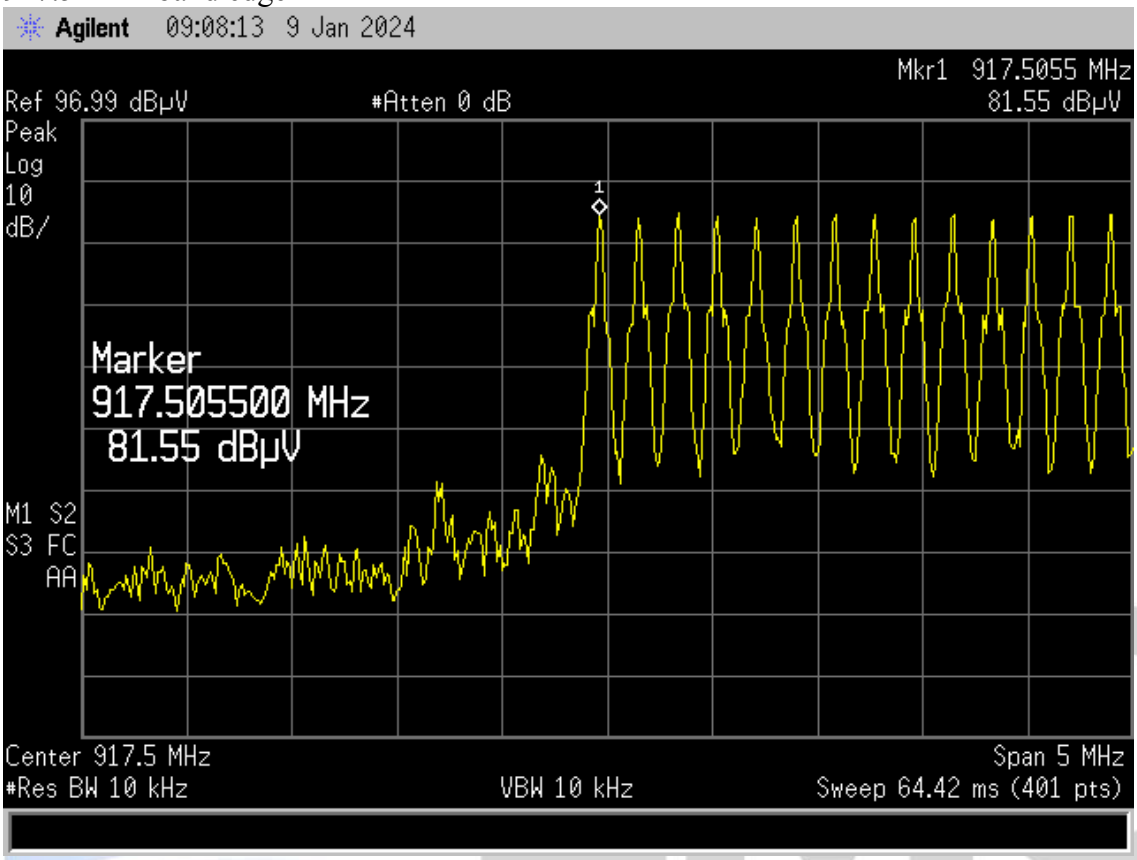
As the 20 dB bandwidth is less than 250 kHz 50 or more channels need to be used

The test sample supplied was set up to hop over 50 channels which can be seen below

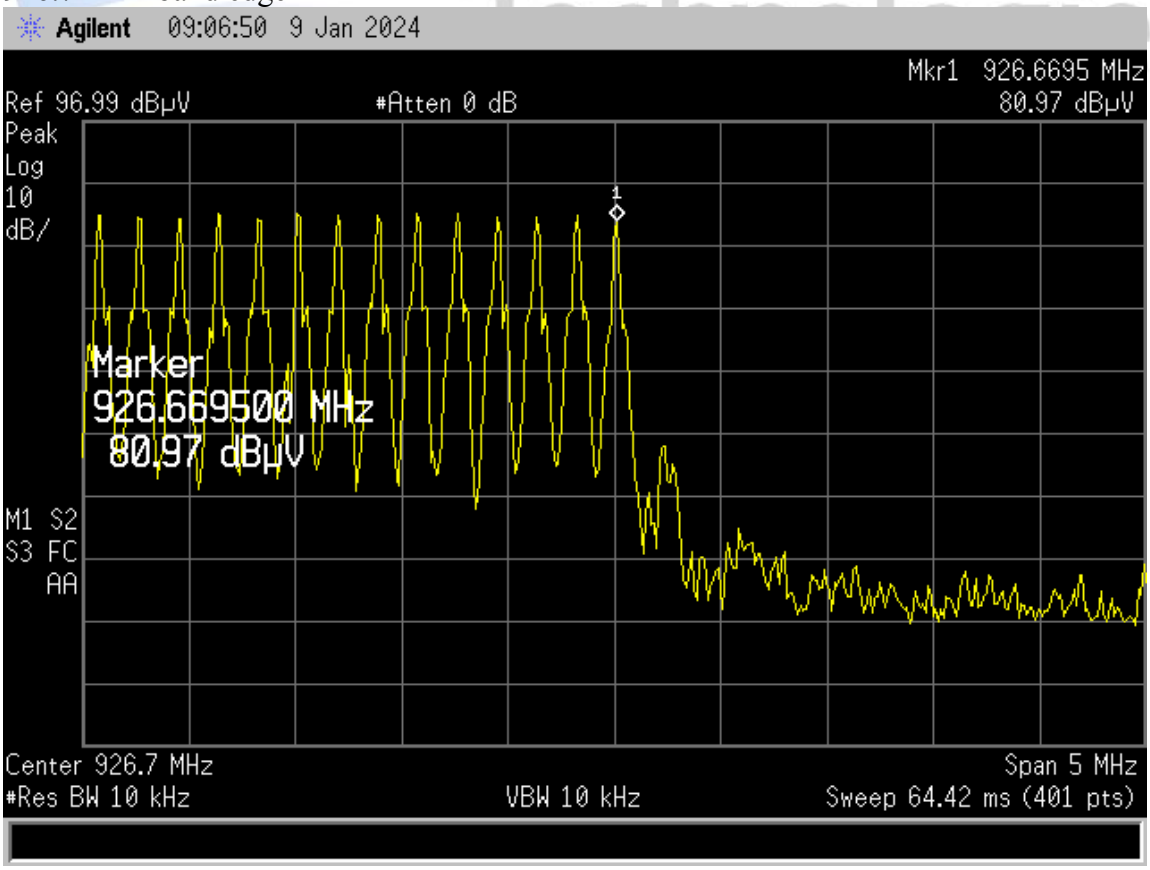


Device was observed operating between 917.500 MHz and 926.700 MHz with a channel spacing of 187.5 kHz.

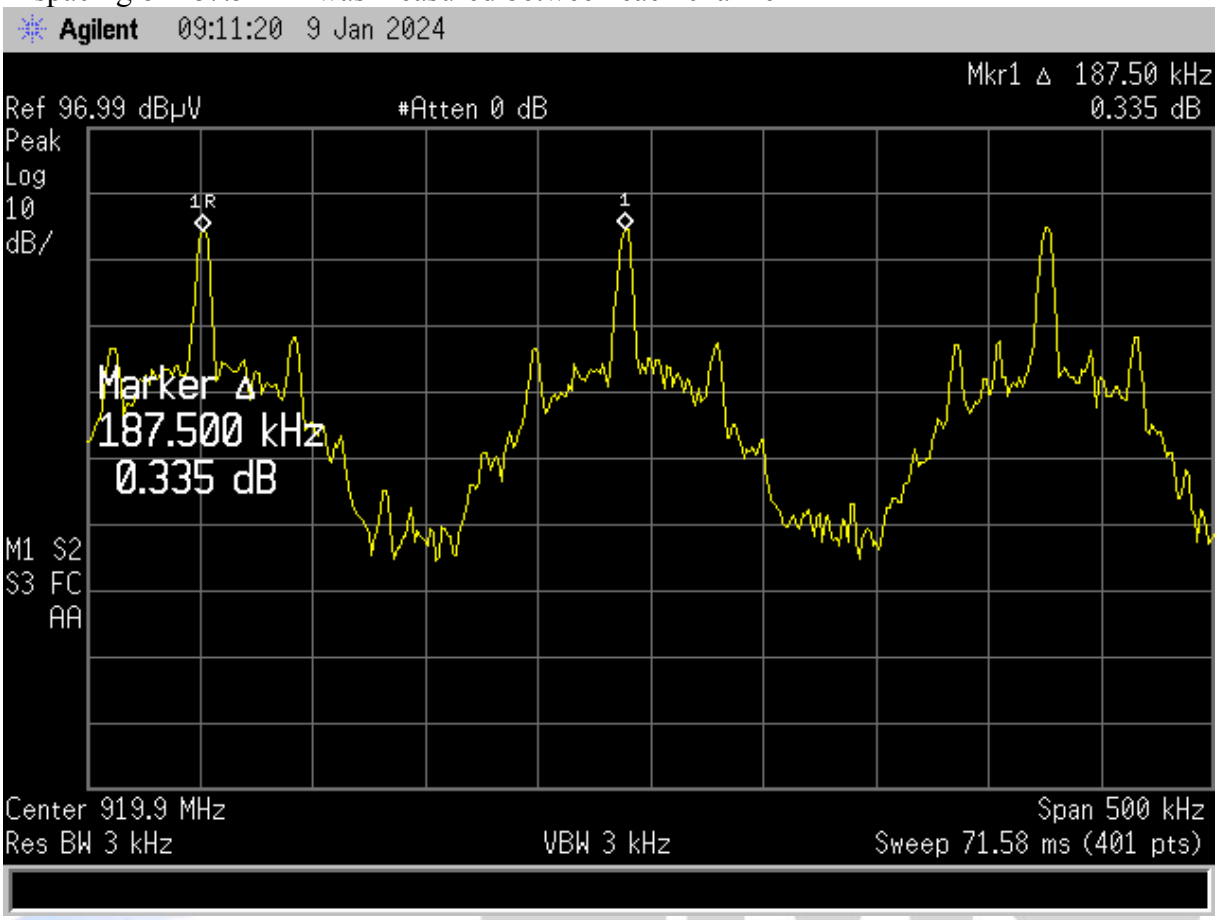
917.5 MHz band edge



926.7 MHz band edge



A spacing of 187.5 kHz was measured between each channel



In addition the average time of occupancy on any frequency shall not be treater than 400 ms within a 20 second period if the 20 dB bandwidth is less than 250 kHz and if 50 or more channels are in use

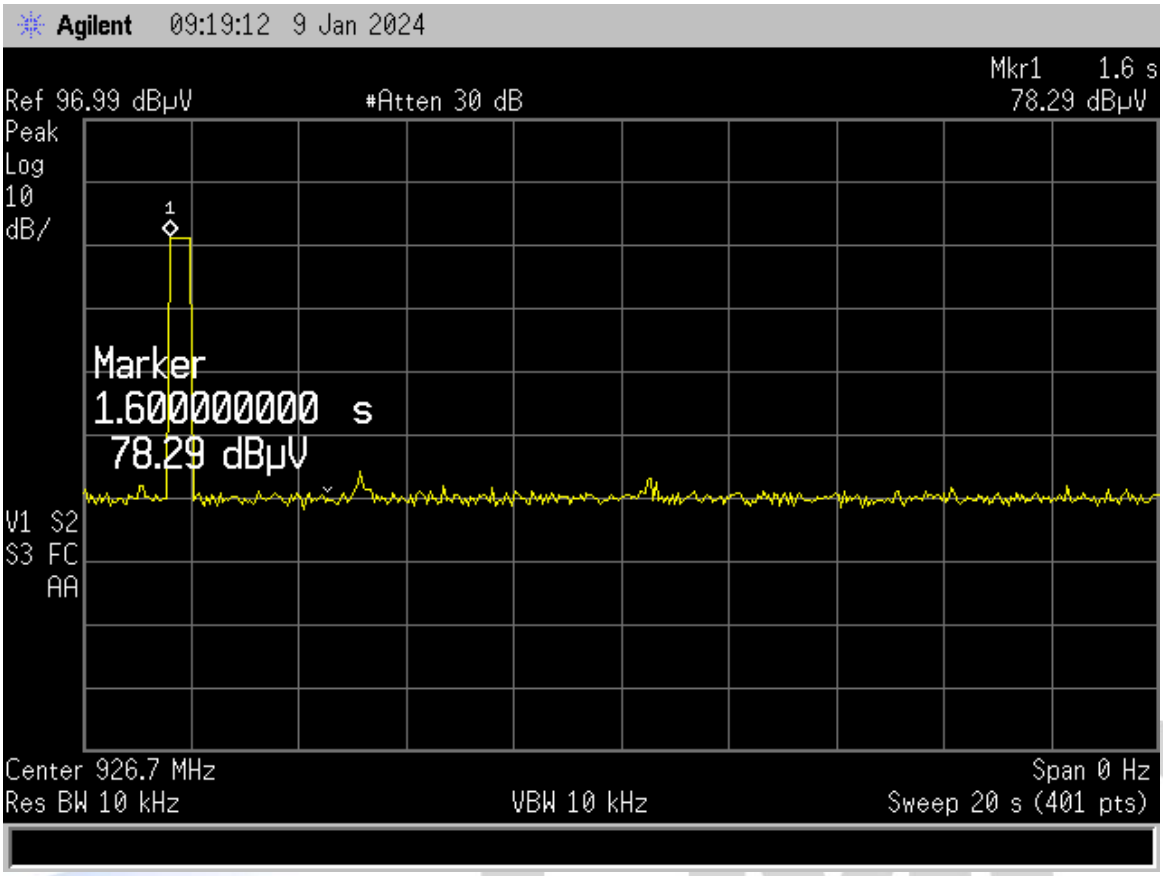
When observations were made on 926.700 MHz the transmitter was observed to operate once in a 20 second period.

Each of the transmissions were observed to be approximately 385 ms long

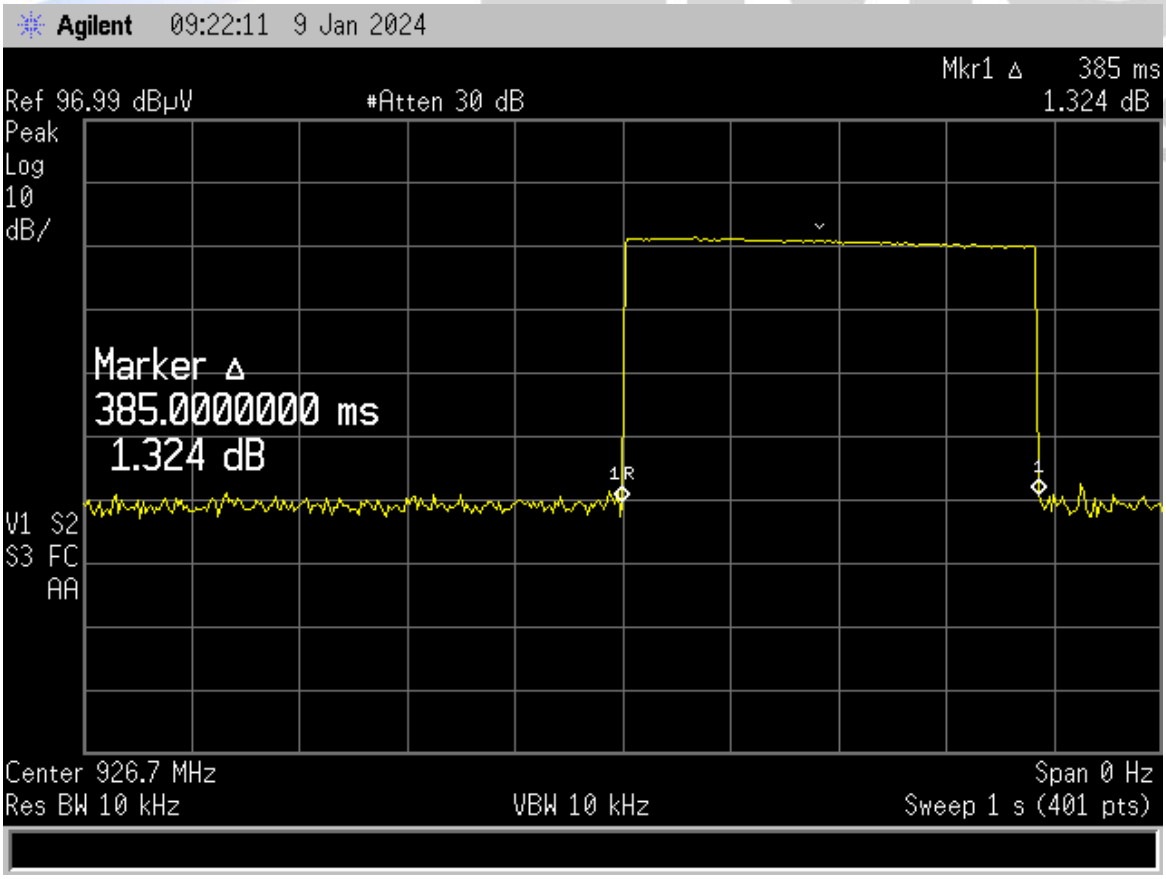
Therefore the 20 second average occupancy will be 1 x 395 ms = 395 ms

The plots demonstrating these measurements are shown below.

1 transmission in 20 seconds



Transmission time = 385 ms



Result: Complies

Section 15.247(b) (1) + (2) – Peak output power

Conducted Power

As the 900 MHz RFID device does not have an antenna port that is easily accessible radiated measurements have been made and compared against the conducted power limit.

Radiated measurements were made on a low, middle and high frequency at the test site.

Measurements were made using a measuring receiver using a peak detector with a 1 MHz bandwidth.

Frequency (MHz)	Level (dBuV/m)	Level (dBm)	Limit (dBm)	Antenna Polarity	Margin (dB)	Result
917.475	96.3	1.1	30.0	Horizontal	28.9	Pass
917.475	99.5	4.3	30.0	Vertical	25.7	Pass
-	-	-	-	-	-	-
920.500	97.2	2.0	30.0	Horizontal	28.0	Pass
920.500	99.4	4.2	30.0	Vertical	25.8	Pass
-	-	-	-	-	-	-
923.700	96.1	0.9	30.0	Horizontal	29.1	Pass
923.700	98.3	3.1	30.0	Vertical	26.9	Pass
-	-	-	-	-	-	-
926.700	95.7	0.5	30.0	Horizontal	29.5	Pass
926.700	97.9	2.7	30.0	Vertical	27.3	Pass

The device was powered at 120 VAC and was placed standing upright on top of the test table being 80 cm above the test site ground plane.

Measurements being made using both vertical and horizontal polarisations using a test distance of 3 metres with the device being rotated and height scanned.

A limit of 1 watt (+30.0 dBm) has been applied to this device.

Result: Complies.
Measurement Uncertainty: ± 4.1 dB

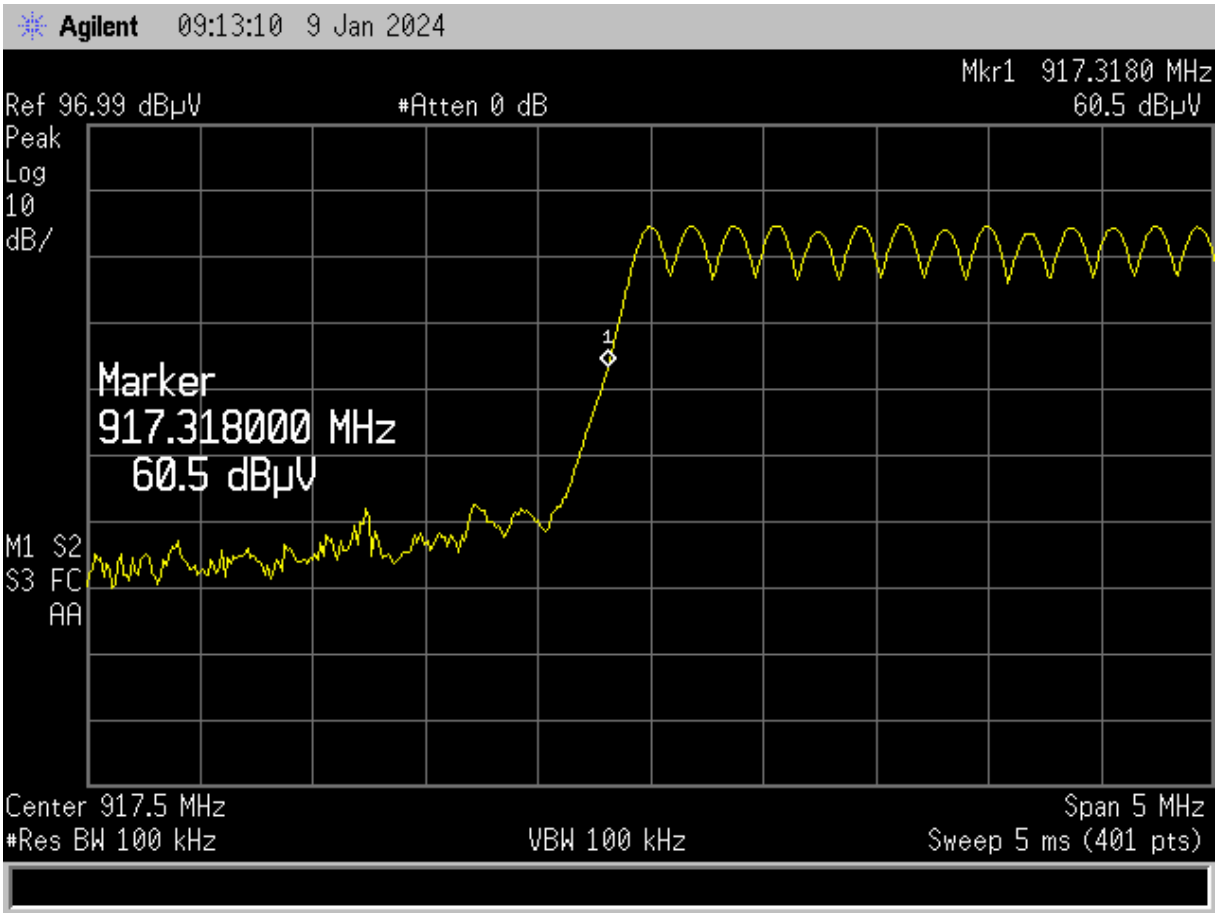
Section 15.247 (d) – Out of band emissions

Band edge measurements:

Measurements were made on the 900 MHz RFID device that was observed operating between 917.450 – 926.700 MHz

At the band edges of 902 and 928 MHz all emissions are required to be attenuated by more than 20 dB relative to the highest 100 kHz resolution bandwidth emission level observed in the band of operation.

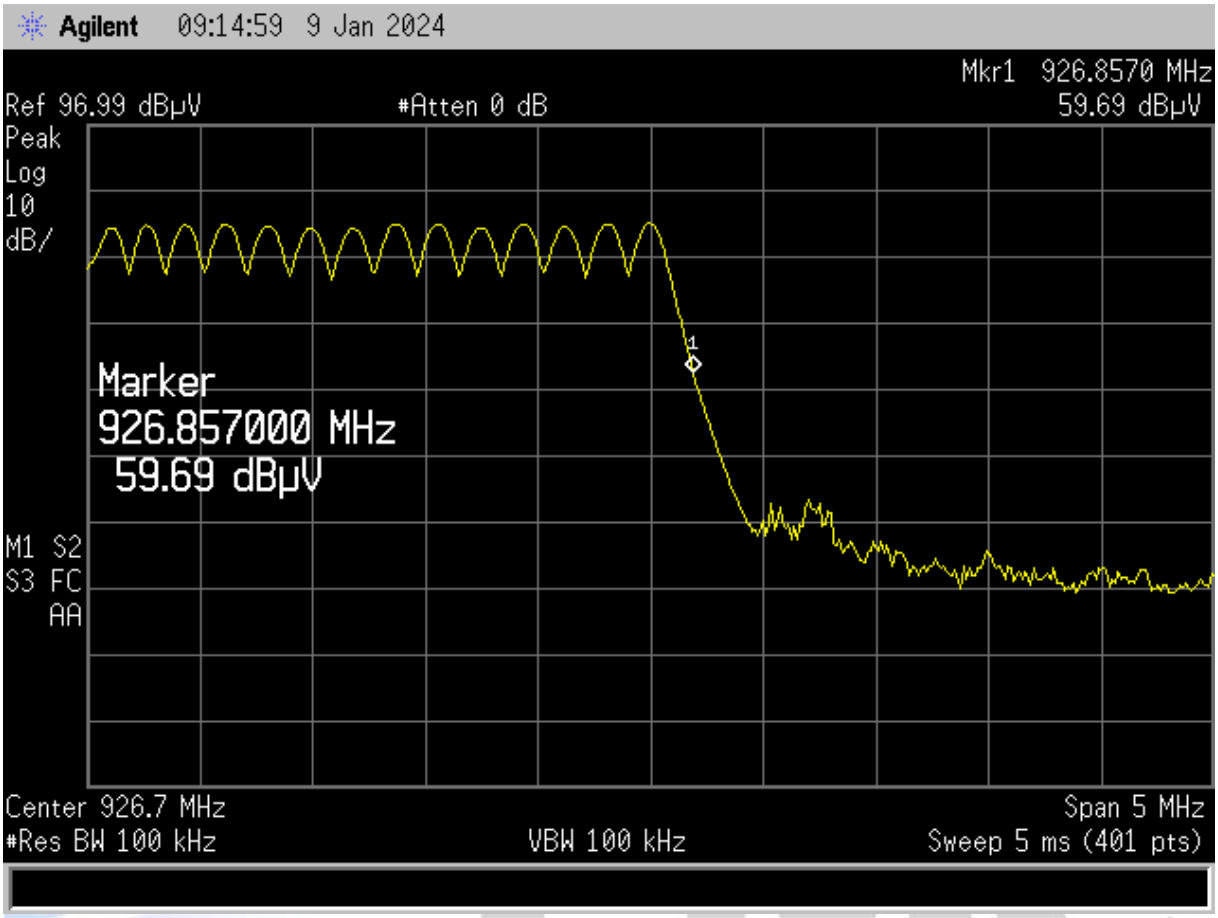
917.500 MHz



-20 dBc Band edge = 917.318 MHz.
Band edge = 902.000 MHz

Result: Complies

926.700 MHz



-20 dBc Band edge = 926.857 MHz
Band edge = 928.000 MHz

Result: Complies.

Section 15.247(d) – Out of band radiated spurious emissions

Testing was carried out on the 900 MHz RFID transmitter over the frequency range of 30 MHz to 10 GHz.

The device was powered 120 VAC when placed vertically upright on top of the test table which is 80 cm above the test site ground plane.

Measurements being made using both vertical and horizontal polarisations using a test distance of 3 metres with the device being rotated and height scanned

Testing was carried out as using the methods and limits as defined in FCC Part 15 sections 15.209 and 15.247 at the same time.

The worst case 15.209 limits were applied.

Below 1000 MHz measurements were made using a Qusai Peak detector with a bandwidth of 120 kHz.

Above 1000 MHz measurements mere made using a Peak detector and where appropriate an Average detector which both had a bandwidth of 1 MHz

During the test, a number of ambient emissions are identified (list of which can be provided upon request).

The emission level is determined in field strength by taking the following into consideration:

Level (dBµV/m) = Receiver Reading (dBµV) + Antenna Factor (dB/m) + Coax Loss (dB)

For example, if an emission of 30 dBµV was observed at 30 MHz.

45.5 dBµV/m = 30.0 dBµV + 14 dB/m + 1.5 dB

Result: Complies.
Measurement uncertainty: ± 4.1 dB

Section 15.247(d) – Out of band radiated spurious emissions

900 MHz RFID transmitter measurements between 30 - 12500 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

Transmitting on 917.450 MHz

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Detector
1834.950	45.4	47.4	74.0	26.6	Horizontal	Peak
1834.950	41.5	39.5	54.0	12.5	Vertical	Average
2752.425	50.6	51.6	74.0	22.4	Horizontal	Peak
2752.425	44.7	43.6	54.0	9.3	Vertical	Average
3669.900	-	-	74.0	-	Vert / Hort	Peak
3669.900	-	-	54.0	-	Vert / Hort	Average
4587.375	54.1	-	74.0	19.9	Vertical	Peak
4587.375	45.0	-	54.0	9.0	Vertical	Average
5504.850	-	-	74.0	-	Vert / Hort	Peak
5504.850	-	-	54.0	-	Vert / Hort	Average
6422.325	-	-	74.0	-	Vert / Hort	Peak
6422.325	-	-	54.0	-	Vert / Hort	Average
7339.800	-	-	74.0	-	Vert / Hort	Peak
7339.800	-	-	54.0	-	Vert / Hort	Average
8257.275	-	-	74.0	-	Vert / Hort	Peak
8257.275	-	-	54.0	-	Vert / Hort	Average
9174.750	-	-	74.0	-	Vert / Hort	Peak
9174.750	-	-	54.0	-	Vert / Hort	Average

Results: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 - 12500 MHz) ± 4.1 dB

Section 15.247(d) – Out of band radiated spurious emissions

900 MHz RFID transmitter measurements between 30 - 12500 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

Transmitting on 923.700 MHz

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Detector
1847.400	46.4	47.9	74.0	26.1	Horizontal	Peak
1847.400	42.5	40.0	54.0	11.5	Vertical	Average
2771.100	51.6	52.1	74.0	21.9	Horizontal	Peak
2771.100	45.7	44.1	54.0	8.3	Vertical	Average
3694.800	-	-	74.0	-	Vert / Hort	Peak
3694.800	-	-	54.0	-	Vert / Hort	Average
4618.500	54.1	-	74.0	19.9	Vertical	Peak
4618.500	45.0	-	54.0	9.0	Vertical	Average
5542.200	-	-	74.0	-	Vert / Hort	Peak
5542.200	-	-	54.0	-	Vert / Hort	Average
6465.900	-	-	74.0	-	Vert / Hort	Peak
6465.900	-	-	54.0	-	Vert / Hort	Average
7389.600	-	-	74.0	-	Vert / Hort	Peak
7389.600	-	-	54.0	-	Vert / Hort	Average
8313.300	-	-	74.0	-	Vert / Hort	Peak
8313.300	-	-	54.0	-	Vert / Hort	Average
9237.000	-	-	74.0	-	Vert / Hort	Peak
9237.000	-	-	54.0	-	Vert / Hort	Average

Results: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 - 12500 MHz) ± 4.1 dB

Section 15.247(d) – Out of band radiated spurious emissions

900 MHz RFID transmitter measurements between 30 - 12500 MHz have been made at a distance of 3 metres.

The limits as described in Section 15.209 have been applied.

Transmitting on 926.700 MHz

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna	Detector
1853.400	44.4	45.9	74.0	28.1	Horizontal	Peak
1853.400	40.5	38	54.0	13.5	Vertical	Average
2780.100	49.6	50.1	74.0	23.9	Horizontal	Peak
2780.100	43.7	42.1	54.0	10.3	Vertical	Average
3706.800	-	-	74.0	-	Vert / Hort	Peak
3706.800	-	-	54.0	-	Vert / Hort	Average
4633.500	50.1	-	74.0	23.9	Vertical	Peak
4633.500	43.0	-	54.0	11.0	Vertical	Average
5560.200	-	-	74.0	-	Vert / Hort	Peak
5560.200	-	-	54.0	-	Vert / Hort	Average
6486.900	-	-	74.0	-	Vert / Hort	Peak
6486.900	-	-	54.0	-	Vert / Hort	Average
7413.600	-	-	74.0	-	Vert / Hort	Peak
7413.600	-	-	54.0	-	Vert / Hort	Average
8340.300	-	-	74.0	-	Vert / Hort	Peak
8340.300	-	-	54.0	-	Vert / Hort	Average
9267.000	-	-	74.0	-	Vert / Hort	Peak
9267.000	-	-	54.0	-	Vert / Hort	Average

Results: Complies

Measurement uncertainty with a confidence interval of 95% is:

- Free radiation tests (30 - 12500 MHz) ± 4.1 dB

Section 15.247(i) – Radio Frequency Hazard Information

All transmitters in this device are required to be operated in a manner that ensures that the public is not exposed to harmful levels of RF energy.

Software in the product allows only one transmitter module to be active at a time with NO simultaneous transmissions possible with each device operating on an individual basis.

An assessment has been carried on each device.

NFC Transmitter

The RF Exposure Procedures as defined in KDB 447498 D04 have been applied.

When tested the 13.560 MHz transmitter had a field strength of 33.1 dBuV/m (Quasi Peak detector) that was measured at a test distance of 10 metres.

This gives a calculated transmitter power of 0.007 uW.

Calculations were made using the formula:

Power (watts) = ((field strength (V/m) x distance (metres)) ^{2})/30

In normal use the transmitter in this device may come in close contact with the human body, the hand, when cards are placed in or near the device when a transaction is carried out.

As the radiated power is below 1 mW this transmitter will be below the SAR testing threshold and therefore no further action will be required.

Bluetooth Transmitter

The Bluetooth transmitter has been installed in accordance with the module manufacturer's installation instructions.

The equipment grant for this device shows a transmitter power of 4.5 mW.

As per clause 4.3.1 a) the 1-g the SAR test exclusion threshold has been calculated to be:

[(transmitter power (mW)) / separation distance (mm)] x [√F(GHz) =< 3.0

[4.5 mW / distance (mm)] x [√ 2.402] = 3.0

4.5 / (3.0 / 2.480) = 3.72 mm

The SAR test excursion can be applied as the distance less than 5 mm has been calculated.

900 MHz RFID Device

As per Section 15.247 (i) Spread spectrum transmitters operating in the 902 – 928 MHz band are required to comply with CFR 47, Section 1.1307(b)(1).

In accordance with this section, FCC KDB 447498 D04 and also Section 2.1091, this device has been defined as a mobile device whereby a distance of 20 cm or greater can normally be maintained between the user and the device antenna.

This grant power for this device is listed at 0.483 W

Calculations have been made using General Population (Uncontrolled Exposure) limits that are defined in Section 1.1310.

- General Population / Uncontrolled exposure is (f/1500) mW/cm^2

As this radio can operate over the range of 917 to 928 MHz the lowest frequency of operation which will give the worst case result.

The power density at 917 MHz gives 0.611 mW/cm^2

The client advises that the antenna has a gain of 1

A worst case scenario duty cycle of 100% has been used for the calculations.

The minimum distance from the antenna at which the MPE is met is calculated from the following

Field strength in V/m (FS),
Transmit power in watts from the FCC Grant (P),
Transmit antenna gain (G),
Transmitter duty cycle (DC),
Separation distance in metres (D)

The calculation is as follows:

$FS = (\sqrt{}(30 * P * G * DC)) / D$
$D = (\sqrt{}(30 * P * G * DC)) / FS$

Power Density = 0.611 $mW/cm^2 = E^2/3770$

$E = \sqrt{}\ 0.611*3770$

E = 48.0 V/m
D = (√ (30 * 0.438* 1* 1)) / 48.0
D = 0.0755 metres or 7.5 cm

Result: Complies if a safe distance of at least 20 cm is applied to this device.

Cellular Device

Two models of cellular module can be used in this device.

These modules have been installed in-accordance with the manufacturer's module installation instructions.

Software in the product allows only one transmitter module to be active at a time with NO simultaneous transmissions possible with each device operating on an individual basis.

As per the Equipment Authorisation Grant for both modules the antenna has been positioned with a separation distance of at least 20 cm from all persons.

Result: Complies

7. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial No	Asset Ref	Cal Due	Period
Aerial Controller	EMCO	1090	9112-1062	RFS 3710	N/A	N/A
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708	N/A	N/A
Loop Antenna	EMCO	6502	9003-2485	3798	12 Feb 2024	3 years
Biconical Antenna	Schwarzbeck	BBA 9106	11042021A	3698	22 Nov 2024	3 years
Heliax cable	Andrews	L6PNM-RPD	22869	Oats Cable	22 Dec 2023	1 year
Horn Antenna	EMCO	3115	9511-4629	E1526	03 Mar 2025	3 years
Log Periodic	Schwarzbeck	VUSLP 9111	9111-112	EMC4025	15 Nov 2024	3 years
Mains Network	Rohde & Schwarz	ESH 2-Z5	881362/034	3628	02 Jun 2024	3 years
Measurement Receiver	Rohde & Schwarz	ESIB-40	100171	R-27-1	06 Oct 2024	3 years
Measurement Receiver	Rohde & Schwarz	ESHS 10	828404/005	RFS 3728	23 Nov 2023	3 years
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709	N/A	N/A
VHF Balun	Schwarzbeck	VHA 9103	9594	3697	22 Nov 2024	3 years
Power Supply	APT	7008	4170003	-	Not applicable	N/a
Thermal chamber	Contherm	M180F	86025	N/a	Not applicable	N/a
Thermometer	DSIR	RT200	35	EMC4029	9 April 2024	5 years

All test equipment was within calibration at the time of testing.

8. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd designation as a FCC Accredited Laboratory by International Accreditation New Zealand, designation number: NZ0002 under the APEC TEL MRA.

All testing was carried out in accordance with the terms of EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

All measurement equipment has been calibrated in accordance with the terms of the EMC Technologies (NZ) Ltd International Accreditation New Zealand (IANZ) Accreditation to NZS/ISO/IEC 17025.

International Accreditation New Zealand has International Laboratory Accreditation Council (ILAC) Mutual Recognition Arrangements for testing and calibration with various accreditation bodies in a number of economies.

This includes NATA (Australia), UKAS (UK), SANAS (South Africa), NVLAP (USA), A2LA (USA), SWEDAC (Sweden).

Further details can be supplied on request.