Report on the FCC Testing of the ON Semiconductor Model: Sigfox Goodie RCZ2 In accordance with FCC 47 CFR Part 15C

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FCC ID: 2APLJSFRC2

COMMERCIAL-IN-CONFIDENCE

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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Michael Ingerl	2018-09-18	
Authorised Signatory	Markus Biberger	2018-09-18	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT
The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Michael Ingerl	2018-09-18	

Laboratory Accreditation
DAkkS Reg. No. D-PL-11321-11-02

Laboratory recognition
Registration No. BNetzA-CAB-16/21-15

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C.

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VAT ID No. DE129484267
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Product Service

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	2018-05-15
2	Changed Applicant	2018-07-18
3	Added Exposure of Humans to RF Fields Test. (Test were be done but it was forgotten to added in the Report)	2018-08-20
4	Recalculated the MPE (SAR Limit) from Exposure of Humans to RF Fields Test.	2018-08-30
5	Recalculated the EIRP from the Exposure of Humans to RF Fields Test.	2018-09-18

Table 1

1.2 Introduction

Applicant	ON Semiconductor
Manufacturer	ON Semiconductor
Model Number(s)	Sigfox Goodie RCZ2
Serial Number(s)	---
Hardware Version(s)	---
Software Version(s)	---
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C
Test Plan/Issue/Date	---
Order Number Date	5091061 2018-04-02
Date of Receipt of EUT	2018-04-03
Start of Test	2018-04-23
Finish of Test	2018-04-25
Name of Engineer(s)	Michael Ingerl
Related Document(s)	ANSI C63.10 (2013)

Product Service

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: DC Powered via USB and Conducted - Transmitting continuously				
2.1	15.247 (b), 5.4 and 6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013) KDB 662911 D01 v02r02
2.2	15.247 (a)(2), 5.2 and 6.6	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(1) and 5.1	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.4	15.247 (a)(1) and 5.1	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2013)
2.5	15.247 (a)(1) and 5.1	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2013)
2.6	15.247 (a)(1) and 5.1	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2013)
2.7	15.247 (d), 5.5 and N/A	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.8	15.205 N/A and 8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
Configuration and Mode: DC Powered by battery - Transmitting continuously				
2.9	15.209, 4.3 and 6.13	Field Strength of any Emission	Pass	ANSI C63.10 (2013)
2.10	15.107 and 6.1	Exposure of Humans to RF Fields	Pass	ANSI C63.4: 2014

Table 2

Product Service

1.4 Product Information

1.4.1 Technical Description

Passive Infrared (PIR) Alarm System based on Sigfox Protocol for IoT Application

1.5 Deviations from the Standard

none

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: ---			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing Test Laboratory.

Test Name	Name of Engineer(s)
Configuration and Mode: DC Powered via USB and Conducted - Transmitting continuously	
Maximum Conducted Output Power	Michael Ingerl
Emission Bandwidth	Michael Ingerl
Frequency Hopping Systems - 20 dB Bandwidth	Michael Ingerl
Frequency Hopping Systems - Number of Hopping Channels	Michael Ingerl
Frequency Hopping Systems - Channel Separation	Michael Ingerl
Frequency Hopping Systems - Average Time of Occupancy	Michael Ingerl
Authorised Band Edges	Michael Ingerl
Restricted Band Edges	Michael Ingerl
Configuration and Mode: DC Powered by battery - Transmitting continuously	
Field Strength of any Emission	Michael Ingerl
Exposure of Humans to RF Fields	Michael Ingerl

Table 4

Office Address:

Äußere Frühlingstraße 45
94315 Straubing
Germany

2 Test Details

2.1 Maximum Conducted Output Power

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)

2.1.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.1.3 Date of Test

2018-04-23

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.9.1.1.

2.1.5 Environmental Conditions

Ambient Temperature 20,0 °C
Relative Humidity 31,0 %

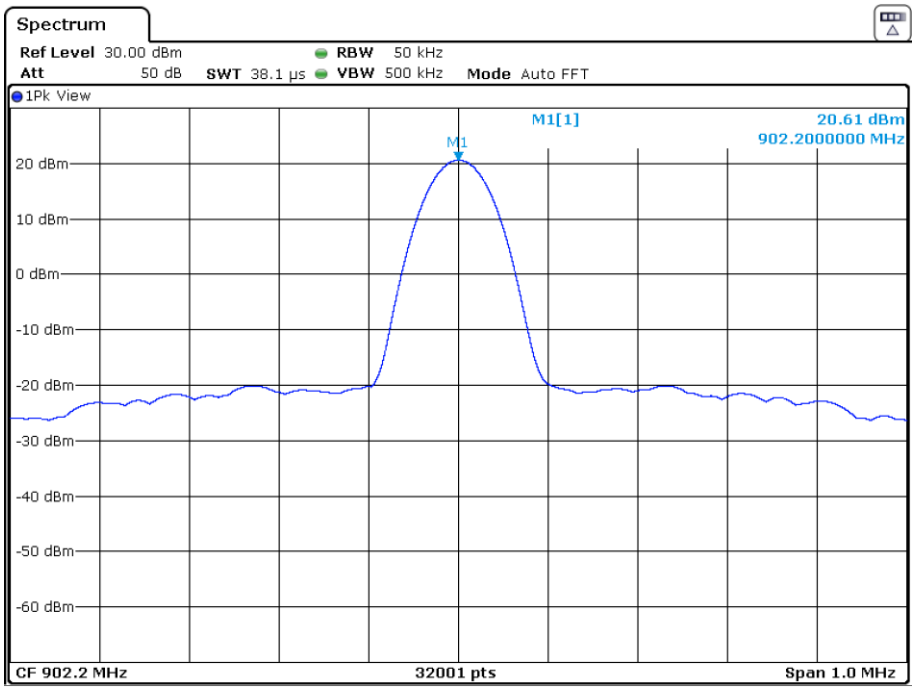
2.1.6 Test Results

DC Powered via USB and Conducted - Transmitting continuously

Frequency (MHz)	Power (dBm)
902.2	20.61
903.4	20.66
904.6	20.73

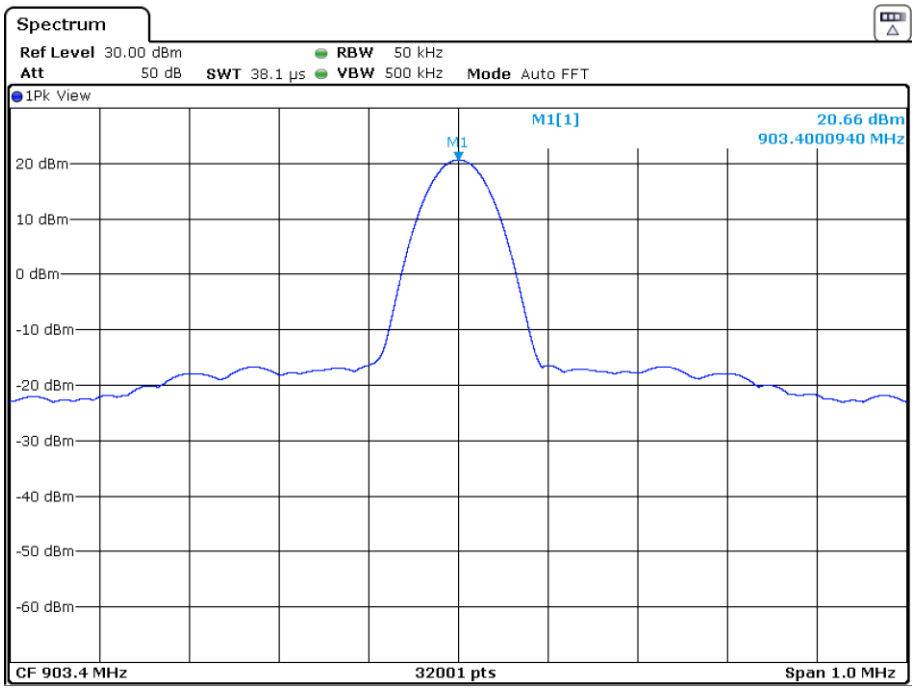
Table 5

Product Service



Date: 17.APR.2018 14:02:52

Figure 1 – 902.2 MHz – Conducted Output Power



Date: 17.APR.2018 14:07:23

Figure 2 - 903.4 MHz – Conducted Output Power

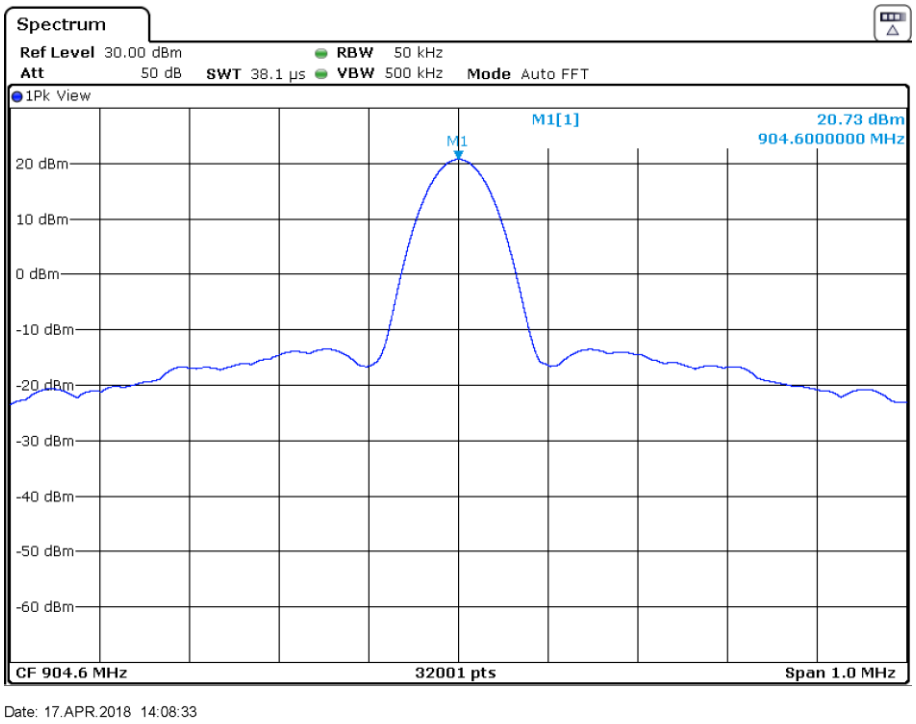


Figure 3 - 904.6 MHz – Conducted Output Power

FCC 47 CFR Part 15, Limit Clause 15.247

For frequency hopping systems operating in the 902–928 MHz band: 1 watt (30 dBm) for systems employing at least 50 hopping channels; and, 0.25 watts (24 dBm) for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

2.1.7 Test Location and Test Equipment Used

This test was carried out in non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31

Table 6

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

2.2 Emission Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)

2.2.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.2.3 Date of Test

2018-04-23

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.2.

2.2.5 Environmental Conditions

Ambient Temperature 20,0 °C
Relative Humidity 31,0 %

2.2.6 Test Results

DC Powered via USB and Conducted - Transmitting continuously

Frequency (MHz)	99% Occupied Bandwidth (MHz)
902.2	20.92
903.4	20.90
904.6	20.91

Table 7

6 dB Bandwidth (MHz)
2.68

Table 8

Product Service

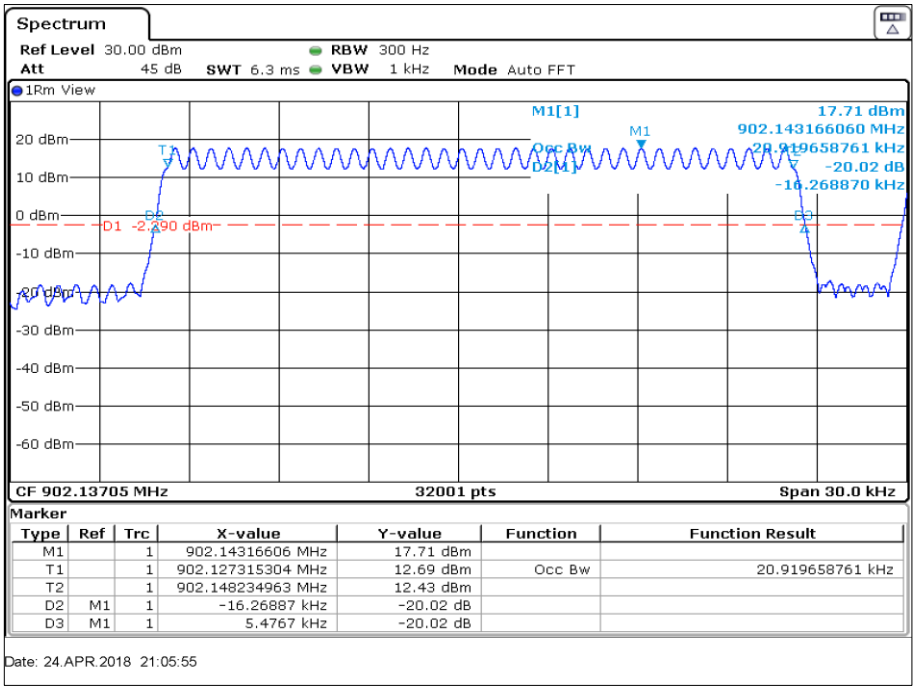


Figure 4 – 902.2 MHz – 99% Occupied Bandwidth

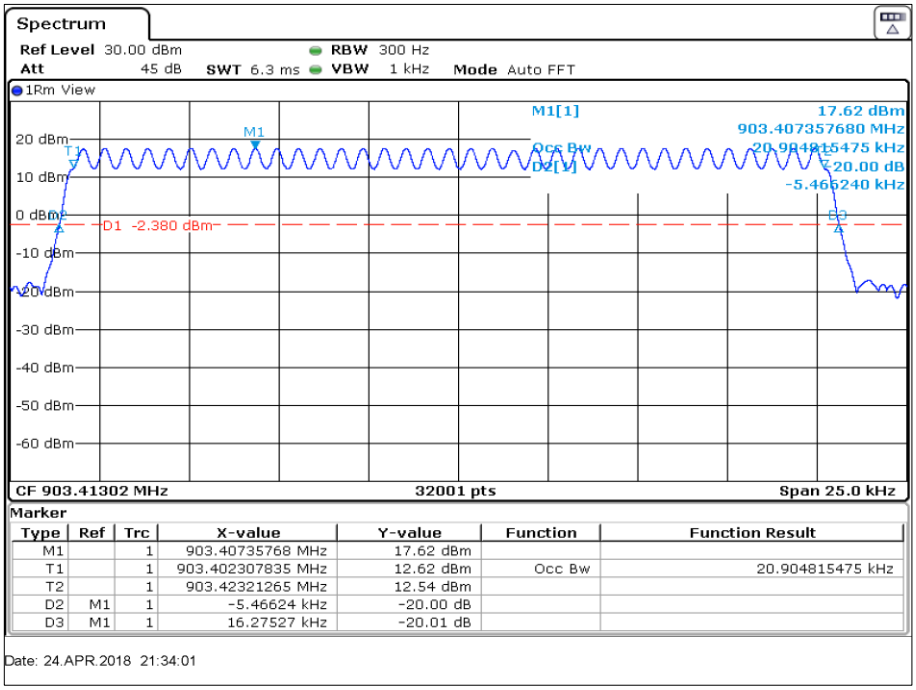
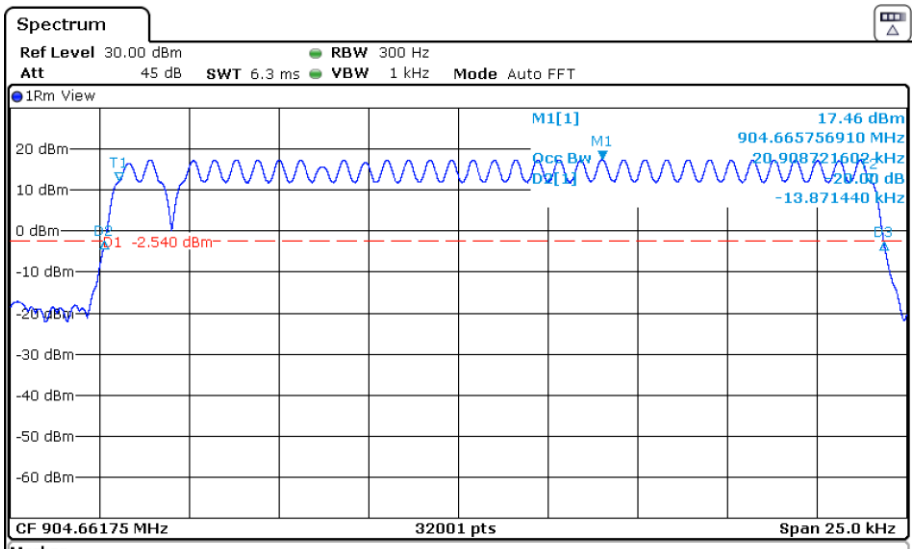


Figure 5 – 903.4 MHz – 99% Occupied Bandwidth

Product Service

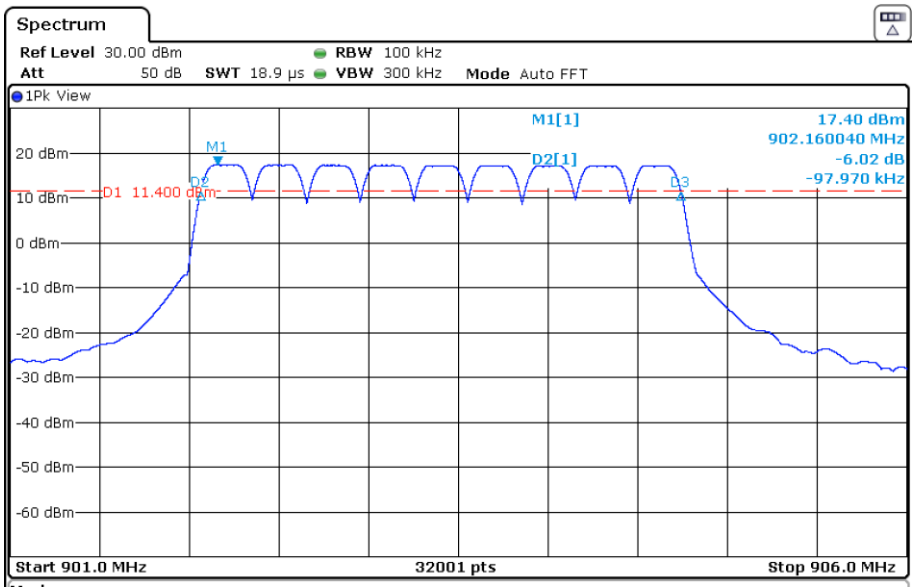


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	904.66575691 MHz	17.46 dBm		
T1		1	904.652299514 MHz	12.28 dBm	Occ Bw	20.908721602 kHz
T2		1	904.673208236 MHz	12.06 dBm		
D2	M1	1	-13.87144 kHz	-20.00 dB		
D3	M1	1	7.84819 kHz	-20.02 dB		

Date: 24.APR.2018 21:46:38

Figure 6 – 904.6 MHz – 99% Occupied Bandwidth



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	902.16004 MHz	17.40 dBm		
D2	M1	1	-97.97 kHz	-6.02 dB		
D3	M1	1	2.57914 MHz	-6.01 dB		

Date: 4.MAY.2018 12:03:29

Figure 7 – 6 dB Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2)

The minimum 6 dB Bandwidth shall be at least 500 kHz.

2.2.7 Test Location and Test Equipment Used

This test was carried out in non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31

Table 9

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

2.3 Frequency Hopping Systems - 20 dB Bandwidth

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)

2.3.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.3.3 Date of Test

2018-04-23

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.1.

2.3.5 Environmental Conditions

Ambient Temperature	20,0 °C
Relative Humidity	31,0 %

2.3.6 Test Results

DC Powered via USB and Conducted - Transmitting continuously

20 dB Bandwidth (MHz)
2.79

Table 10

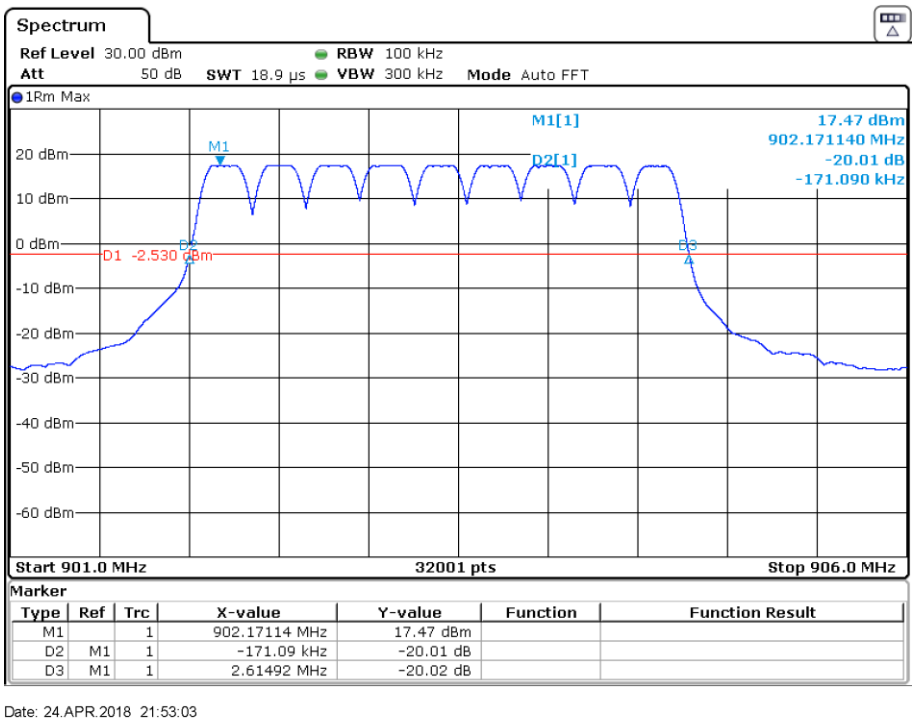


Figure 8 – 20 dB Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i)

The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

2.3.7 Test Location and Test Equipment Used

This test was carried out in non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31

Table 11

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

2.4 Frequency Hopping Systems - Number of Hopping Channels

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)

2.4.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.4.3 Date of Test

2018-04-23

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.3.

2.4.5 Environmental Conditions

Ambient Temperature	20,0 °C
Relative Humidity	31,0 %

2.4.6 Test Results

<u>DC Powered via USB and Conducted - Transmitting continuously</u>

Number of Hopping Channels: 54

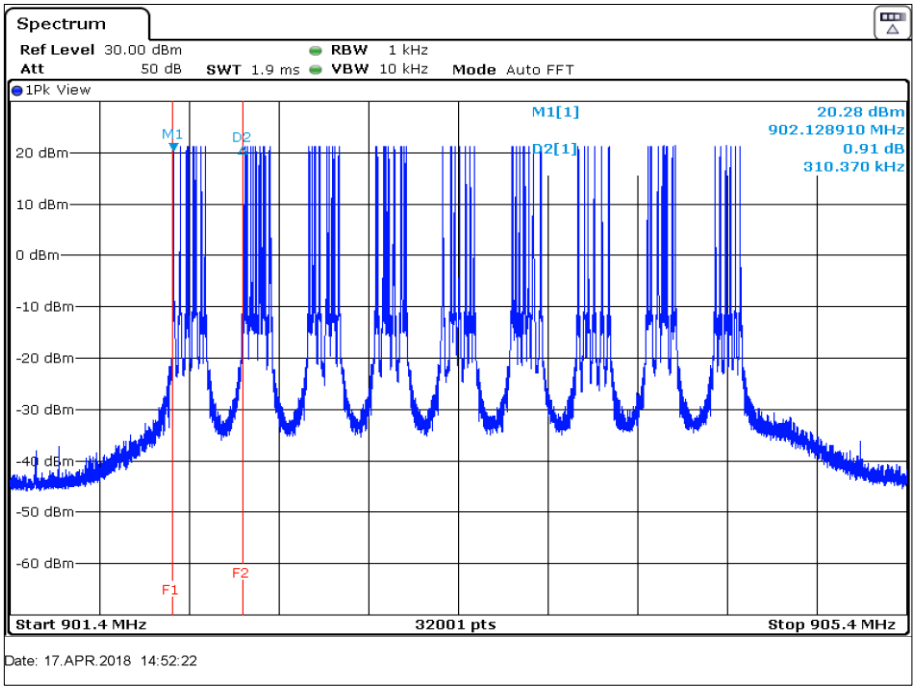


Figure 9 - Macro Channel

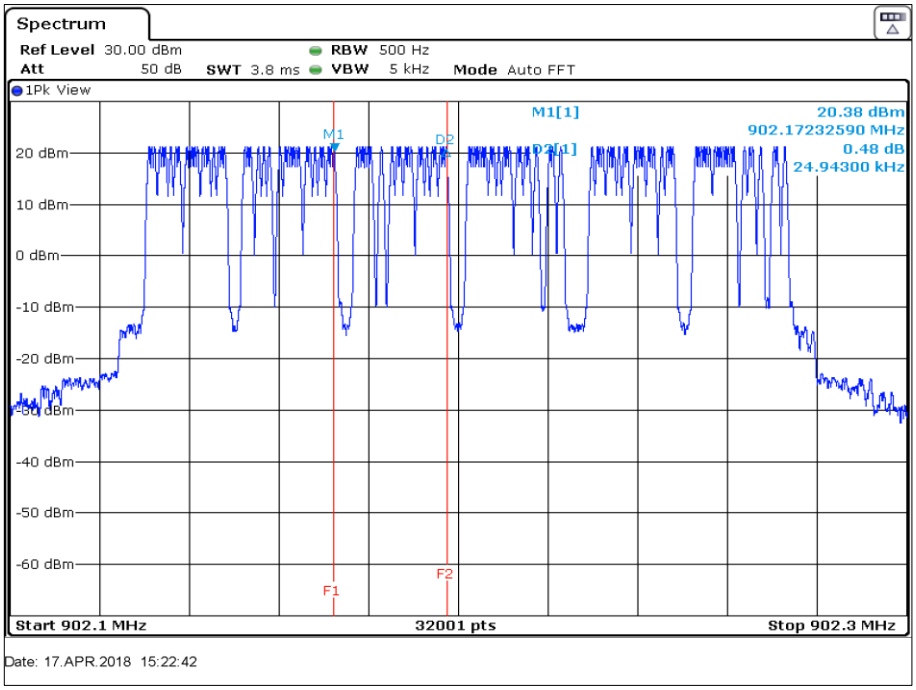


Figure 10 - Micro Channel

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i)

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

2.4.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31

Table 12

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

2.5 Frequency Hopping Systems - Channel Separation

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)

2.5.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.5.3 Date of Test

2018-04-23

2.5.4 Test Method

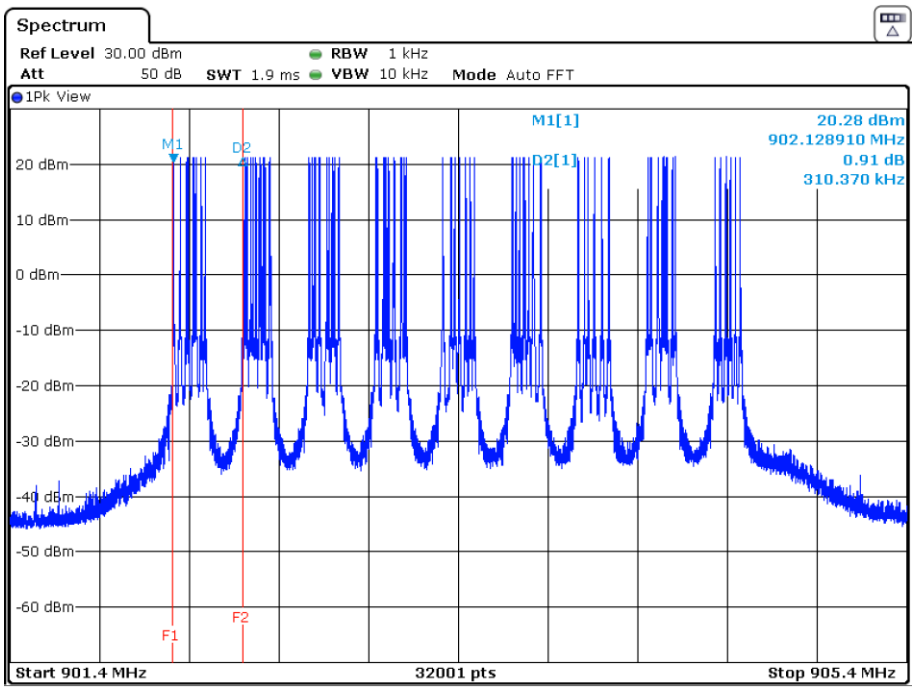
The test was performed in accordance with ANSI C63.10, clause 7.8.2.

2.5.5 Environmental Conditions

Ambient Temperature	20,0 °C
Relative Humidity	31,0 %

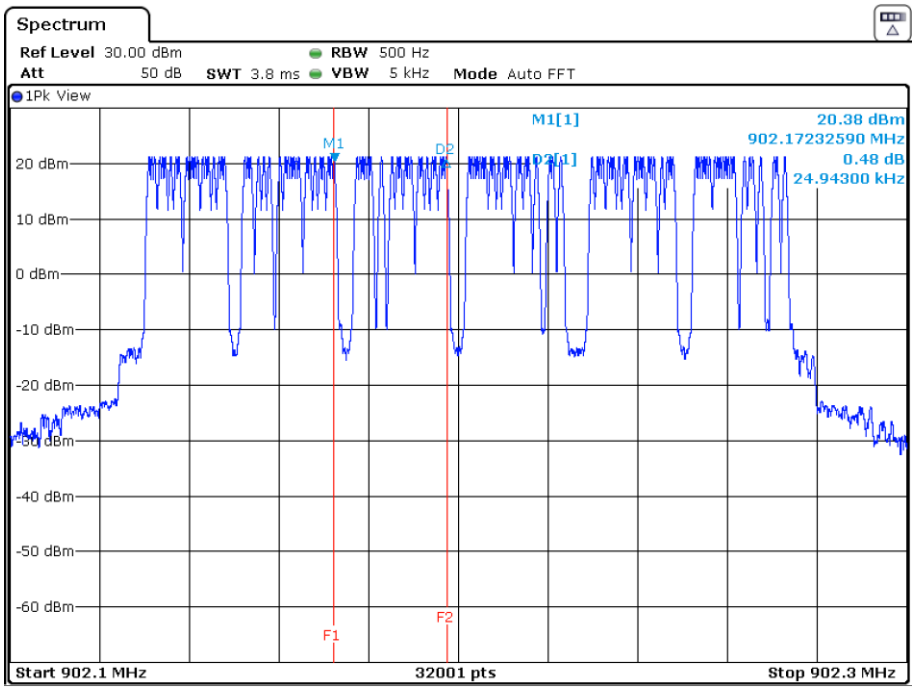
2.5.6 Test Results

<u>DC Powered via USB and Conducted - Transmitting continuously</u>



Date: 17.APR.2018 14:52:22

Figure 11 - Macro Channel



Date: 17.APR.2018 15:22:42

Figure 12 - Micro Channel

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

2.5.7 Test Location and Test Equipment Used

This test was carried out in non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31

Table 13

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

2.6 Frequency Hopping Systems - Average Time of Occupancy

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)

2.6.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.6.3 Date of Test

2018-04-23

2.6.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.4.

2.6.5 Environmental Conditions

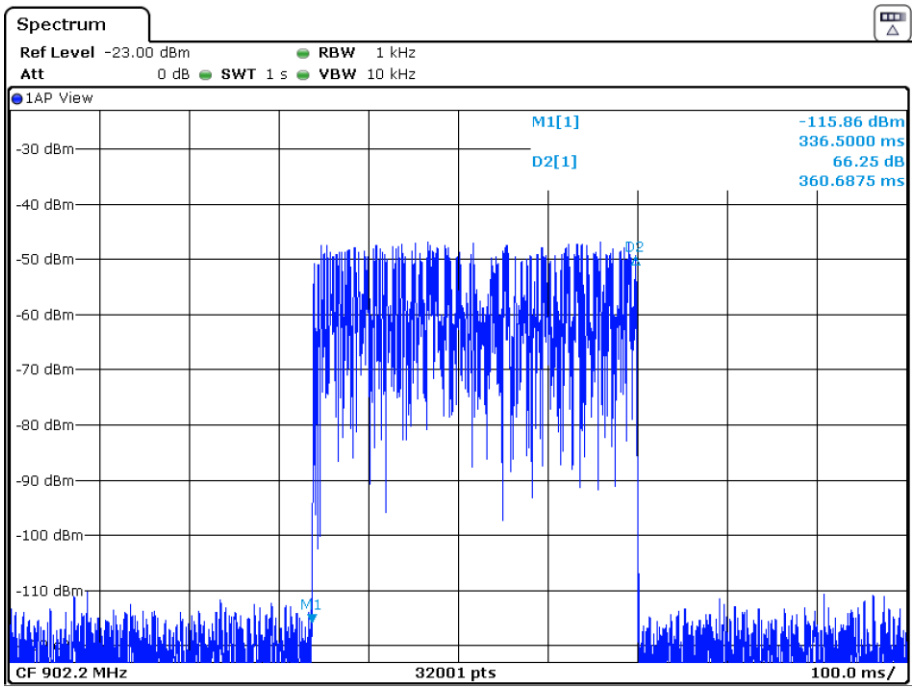
Ambient Temperature 20,0 °C
Relative Humidity 31,0 %

2.6.6 Test Results

DC Powered via USB and Conducted - Transmitting continuously

Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
360	1	360 ms

Table 14



Date: 17.APR.2018 16:49:50

Figure 13 – Dwell Time

FCC 47 CFR Part 15, Limit Clause (a)(1)(i)

For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

2.6.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31

Table 15

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

2.7 Authorised Band Edges

2.7.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d)

2.7.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.7.3 Date of Test

2018-04-23

2.7.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

2.7.5 Environmental Conditions

Ambient Temperature 20,0 °C
Relative Humidity 31,0 %

2.7.6 Test Results

DC Powered via USB and Conducted - Transmitting continuously

Measured Frequency (MHz)	Peak Level (dBm)
902.00	-2.54
904.79	-2.55

Table 16

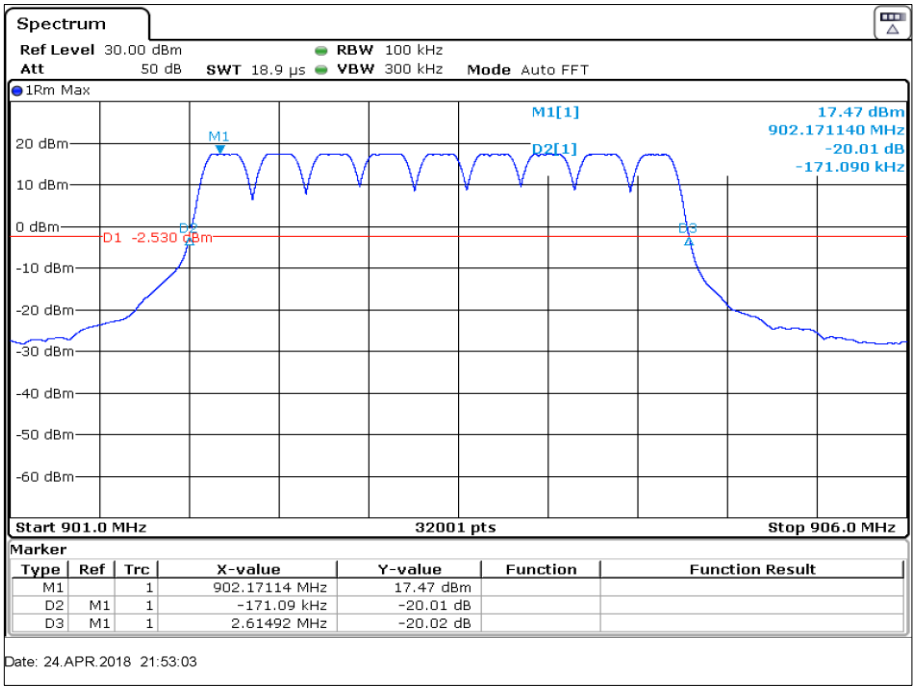


Figure 14

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

2.7.7 Test Location and Test Equipment Used

This test was carried out in Non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31

Table 17

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

2.8 Restricted Band Edges

2.8.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205

2.8.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.8.3 Date of Test

2018-04-23

2.8.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5.

Plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3. These are shown for information purposes and were used to determine the worst case measurement point. Final average measurements were then taken in accordance with ANSI C63.10 clause 4.1.4.2.2. to obtain the measurement result recorded in the test results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

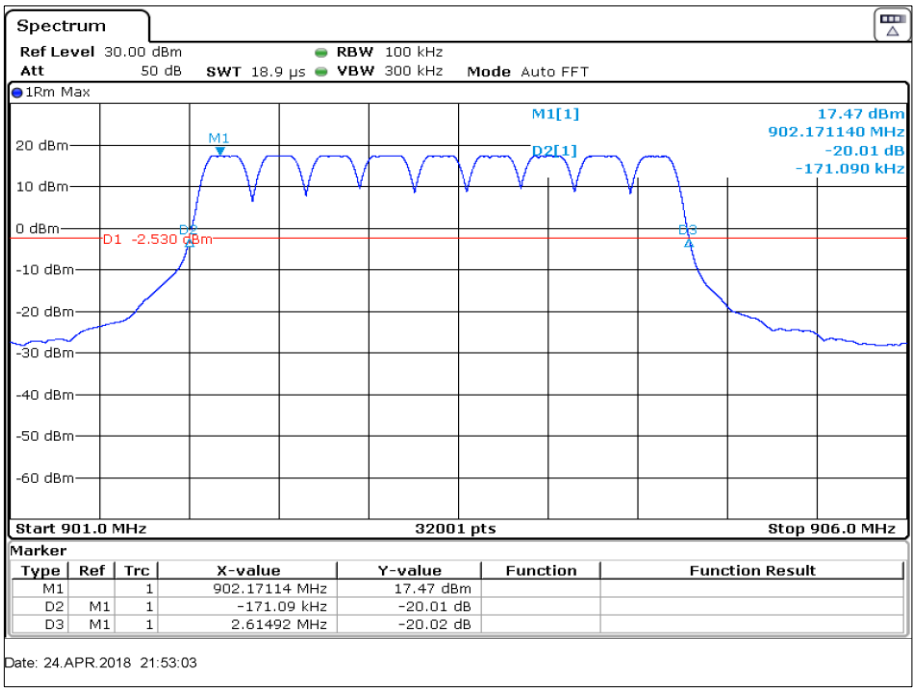
2.8.5 Environmental Conditions

Ambient Temperature	20,0 °C
Relative Humidity	31,0 %

Product Service

2.8.6 Test Results

DC Powered via USB and Conducted - Transmitting continuously



No restricted band in the range.

FCC 47 CFR Part 15, Limit Clause 15.205

§ 15.205 **47 CFR Ch. I (10–1–17 Edition)**

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 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	([2])
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

2.8.7 Test Location and Test Equipment Used

This test was carried out in non shielded room.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31

Table 18

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

2.9 Field Strength of any Emission

2.9.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.209

2.9.2 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.9.3 Date of Test

2018-04-25

2.9.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.4.
Measurements were made at a distance of 3 m. The limit lines shown on the plot were extrapolated from either 300 m or 30 m to the measurement distance of 3 m in accordance with ANSI C63.10 Clause 6.4.4.2.
For any emissions detected within 20 dB of the limit, a final measurement was made and recorded in the table below. The detector used for these measurements was a quasi-peak detector except for emissions within the bands 9 kHz to 90 kHz and 110 kHz to 490 kHz where a CISPR average detector was used.

2.9.5 Environmental Conditions

Ambient Temperature	22,0 °C
Relative Humidity	32,0 %

2.9.6 Test Results

DC Powered by battery - Transmitting continuously

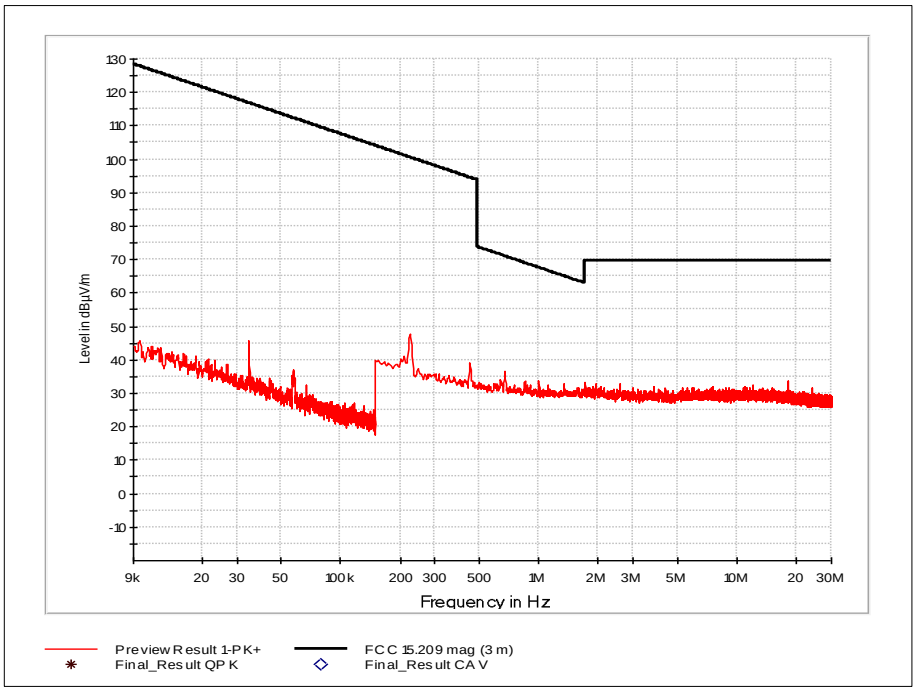


Figure 15 - 902.2 MHz - 9 kHz to 30 MHz

Product Service

Final Results 1:

Frequency MHz	QuasiPeak dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB
878,215000	39,10	46,00	6,90	1000,0	120,000	115,0	V	173,0	25,1
902,190000	113,60	---	---	1000,0	120,000	107,0	V	-193,0	25,5
927,270000	45,27	46,00	0,73	1000,0	120,000	272,0	V	135,0	25,6
950,190000	45,37	46,00	0,63	1000,0	120,000	103,0	V	-184,0	25,7

Table 19 - Emissions Results - 30 MHz to 1 GHz

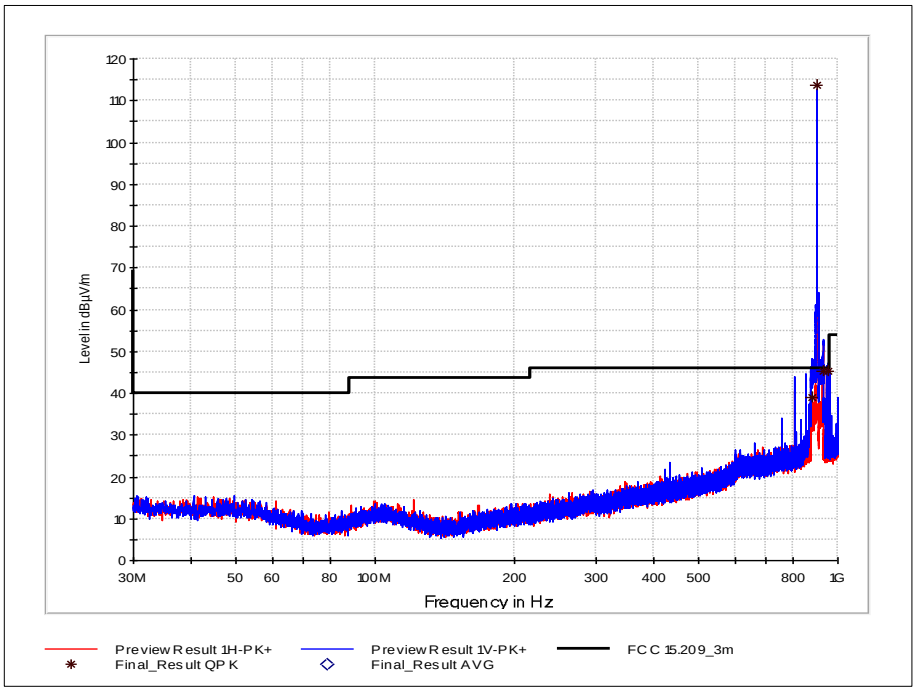


Figure 16 - 902.2 MHz - 30 MHz to 1 GHz

Product Service

Final Results 1:

Frequency *MHz*	*MaxPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
2706,500000	71,40	73,97	2,57	1000,0	1000,000	142,0	H	142,0	35,8

Table 20 - Emissions Results – 1 GHz to 8 GHz

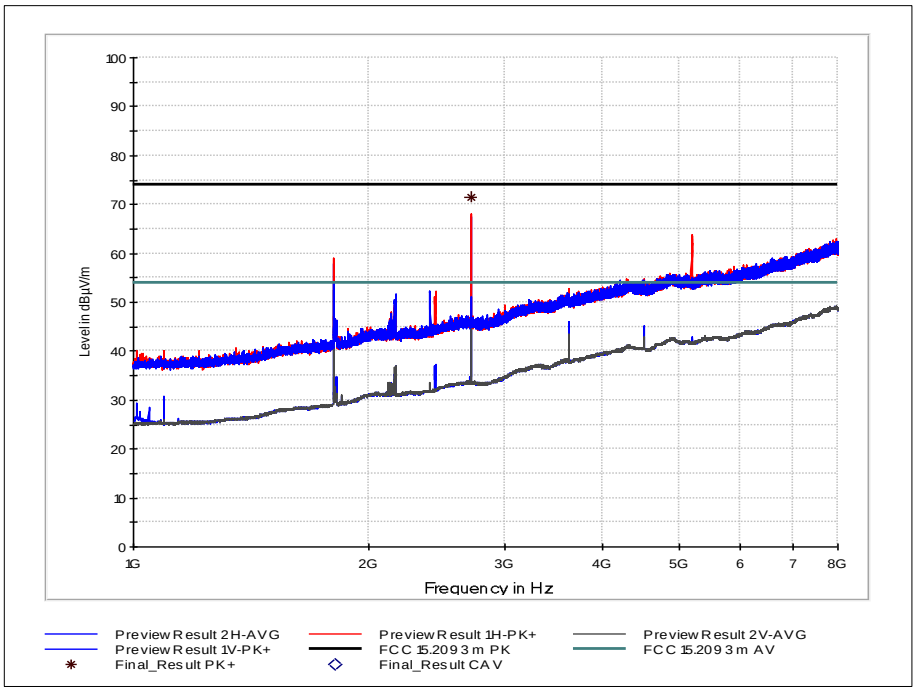


Figure 17 - 902.2 MHz - 1 GHz to 8 GHz

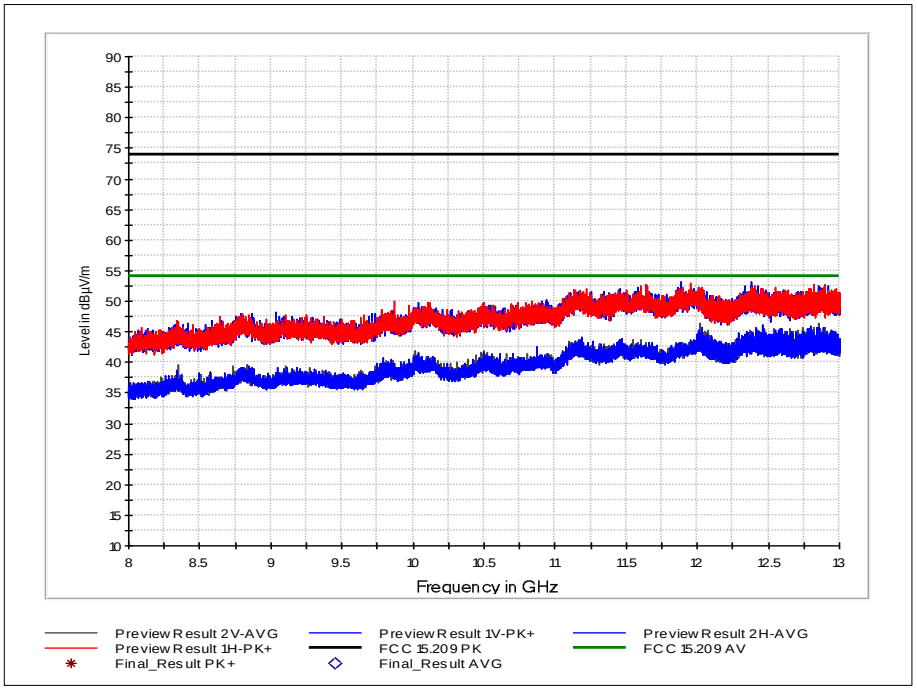


Figure 18 - 902.2 MHz - 8 GHz to 12.75 GHz

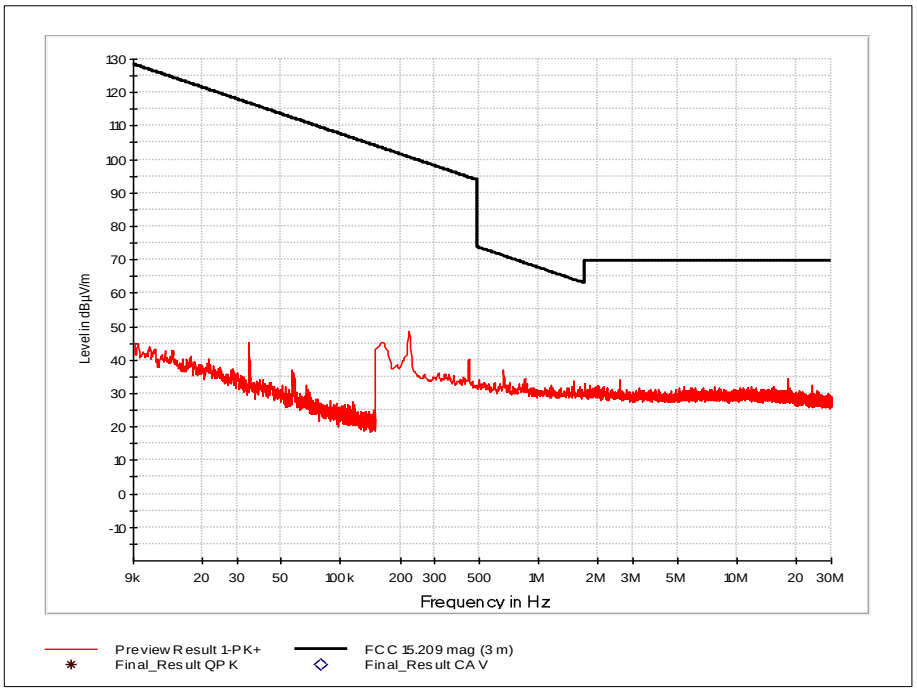


Figure 19 - 903.4 MHz - 9 kHz to 30 MHz

Product Service

Final Results 1:

Frequency *MHz*	*QuasiPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
877,140000	45,49	46,00	0,51	1000,0	120,000	117,0	V	-93,0	25,5
903,390000	111,65	---	---	1000,0	120,000	105,0	V	-84,0	25,5
927,150000	45,26	46,00	0,74	1000,0	120,000	275,0	V	-95,0	25,6
957,600000	45,50	46,00	0,50	1000,0	120,000	113,0	V	-92,0	25,1

Table 21 - Emissions Results - 30 MHz to 1 GHz

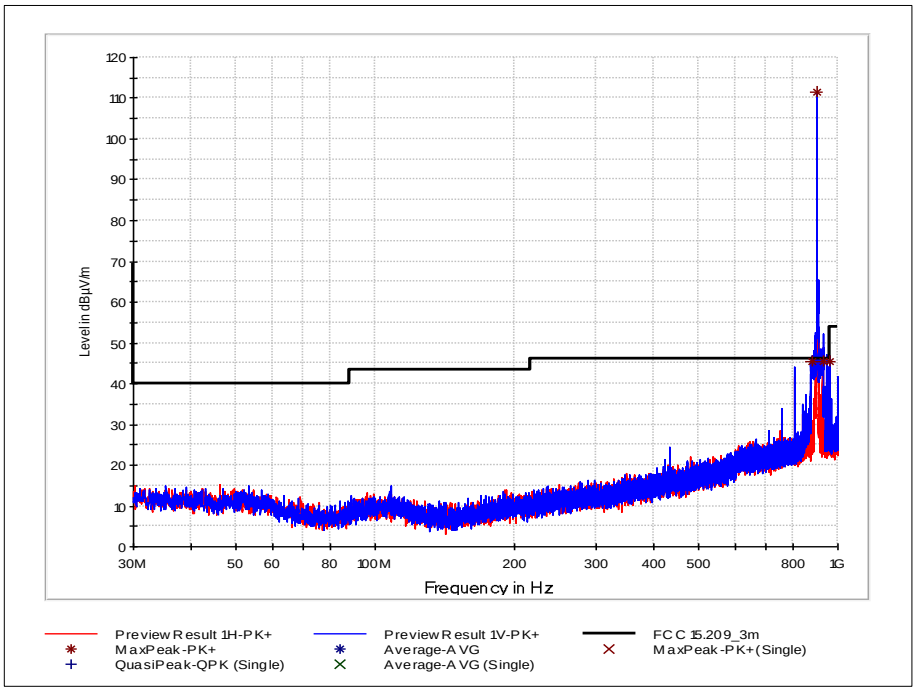


Figure 20 - 903.4 MHz - 30 MHz to 1 GHz

Product Service

Final Results 1:

Frequency MHz	MaxPeak dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB
2710,250000	70,05	73,97	3,92	1000,0	1000,000	142,0	H	139,0	35,8

Table 22 - Emissions Results - 30 MHz to 1 GHz

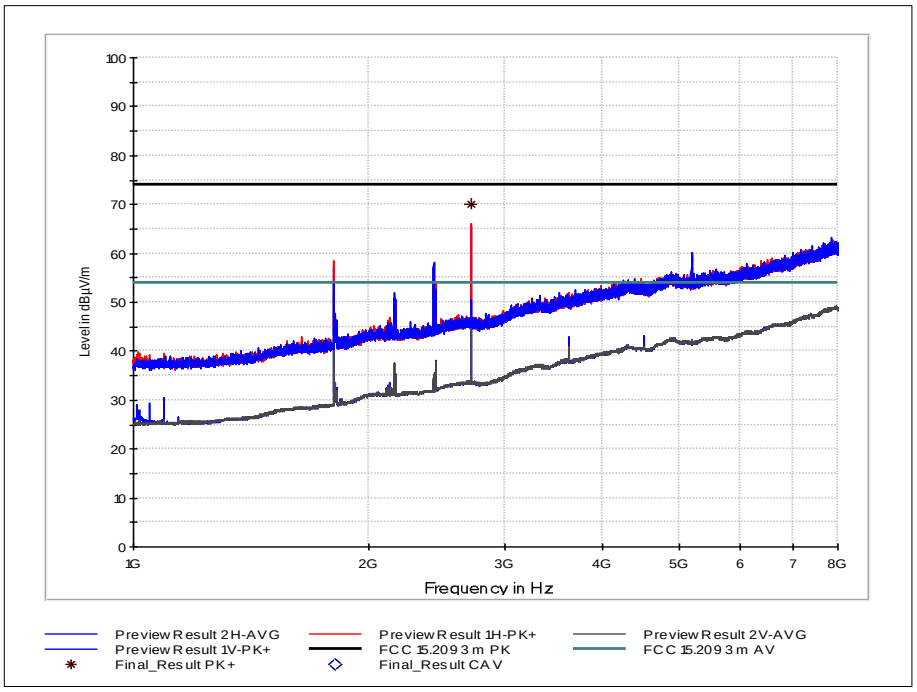


Figure 21 - 903.4 MHz - 1 GHz to 8 GHz

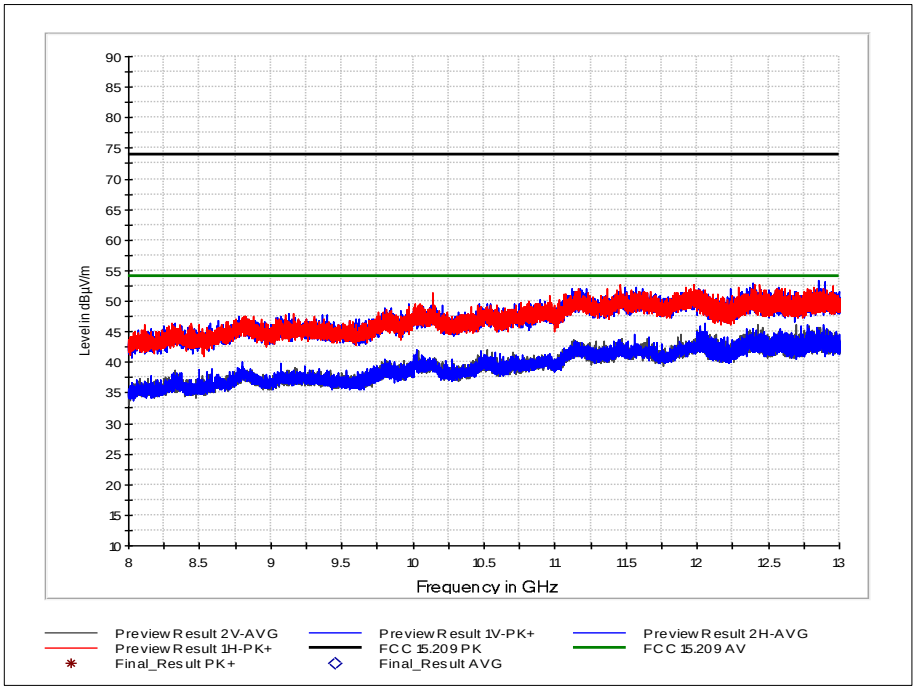


Figure 22 - 903.4 MHz - 8 GHz to 12.75 GHz

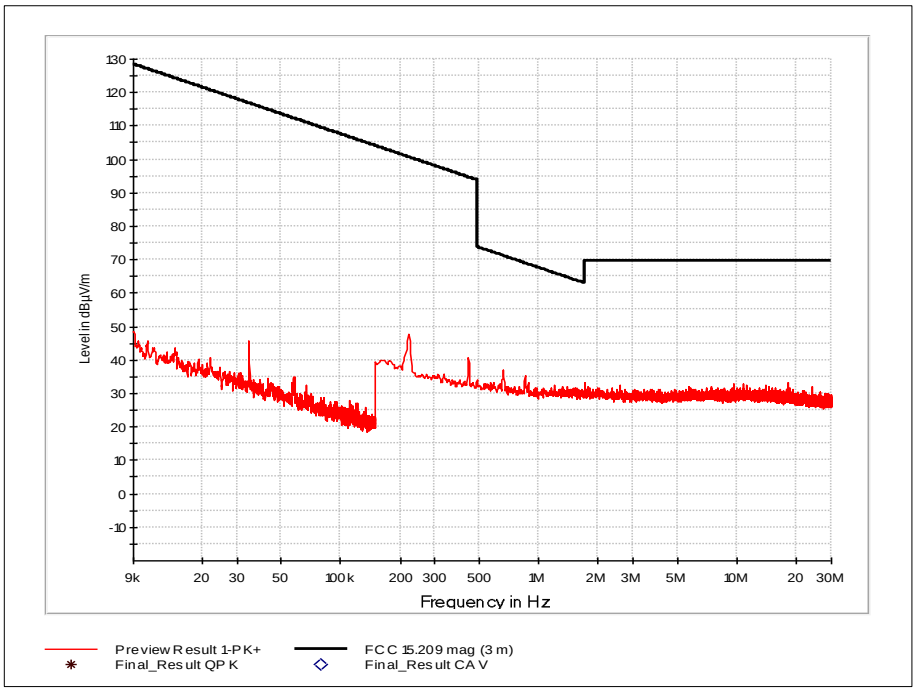


Figure 23 - 904.6 MHz - 9 kHz to 30 MHz

Product Service

Final Results 1:

Frequency MHz	QuasiPeak dBµV/m	Limit dBµV/m	Margin dB	Meas. Time ms	Bandwidth kHz	Height cm	Pol	Azimuth deg	Corr. dB
882,450000	45,17	46,00	0,83	1000,0	120,000	103,0	V	-103,0	25,1
904,590000	111,51	---	---	1000,0	120,000	100,0	V	-90,0	25,5
927,150000	45,61	46,00	0,39	1000,0	120,000	104,0	V	-104,0	25,6
930,945000	45,43	46,00	0,57	1000,0	120,000	114,0	V	-114,0	25,6
957,630000	44,79	46,00	1,21	1000,0	120,000	108,0	V	-108,0	25,7

Table 23 - Emissions Results - 30 MHz to 1 GHz

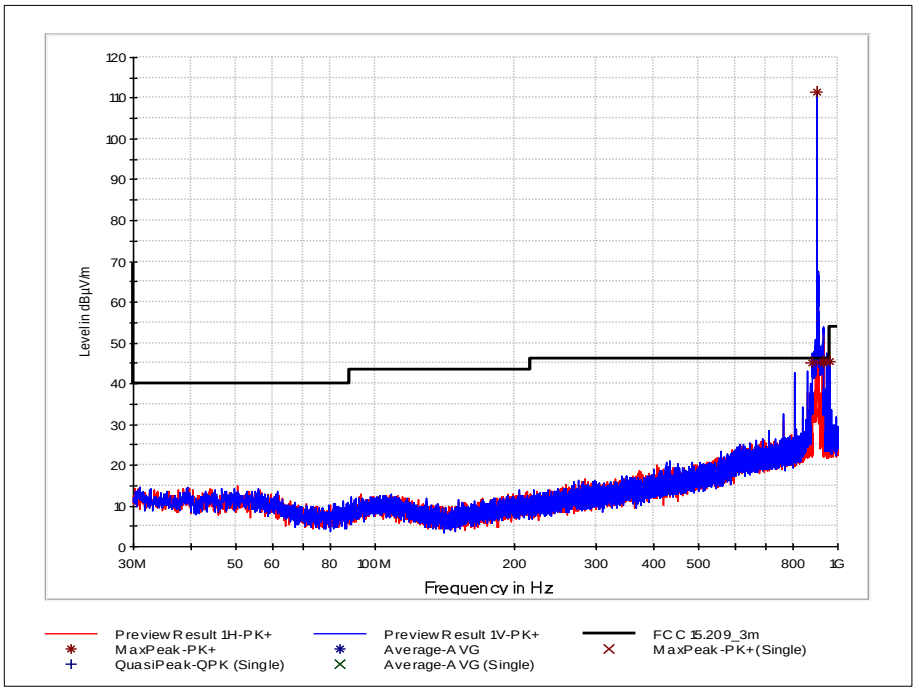


Figure 24 - 904.6 MHz - 30 MHz to 1 GHz

Product Service

Final Results 1:

Frequency *MHz*	*MaxPeak* *dBµV/m*	*Limit* *dBµV/m*	*Margin* *dB*	*Meas. Time* *ms*	*Bandwidth* *kHz*	*Height* *cm*	*Pol*	*Azimuth* *deg*	*Corr.* *dB*
2713,750000	69,75	73,97	4,22	1000,0	1000,000	191,0	H	-151,0	35,8

Table 24

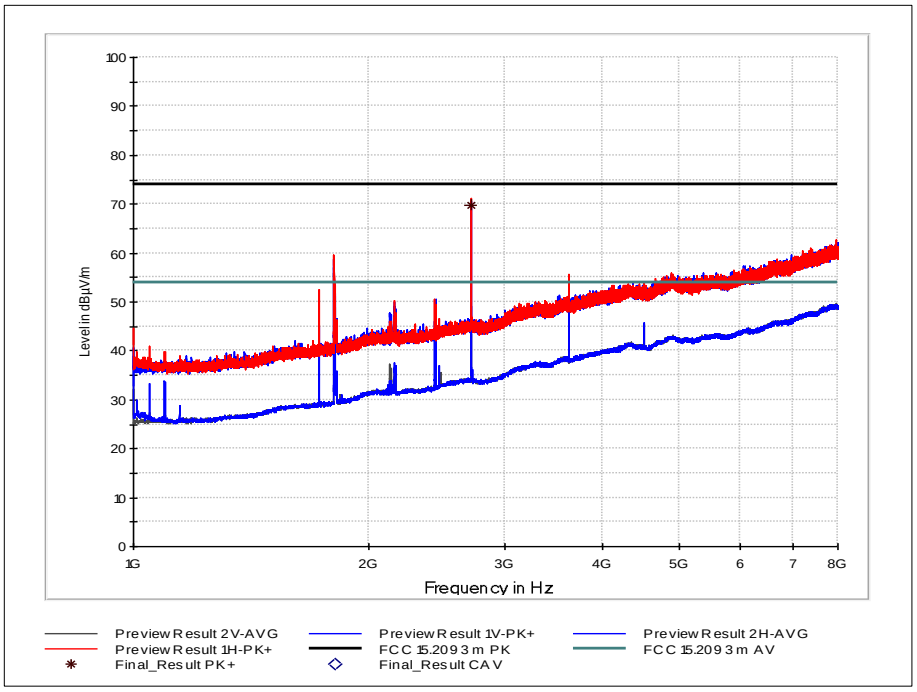


Figure 25 - 904.6 MHz - 1 GHz to 8 GHz

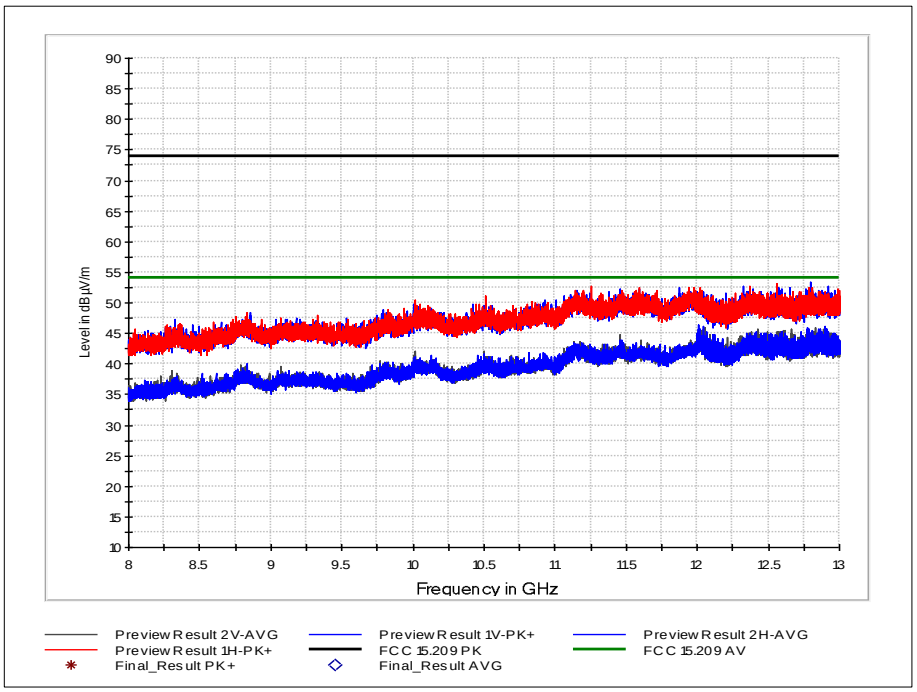


Figure 26 - 904.6 MHz - 8 GHz to 12.75 GHz

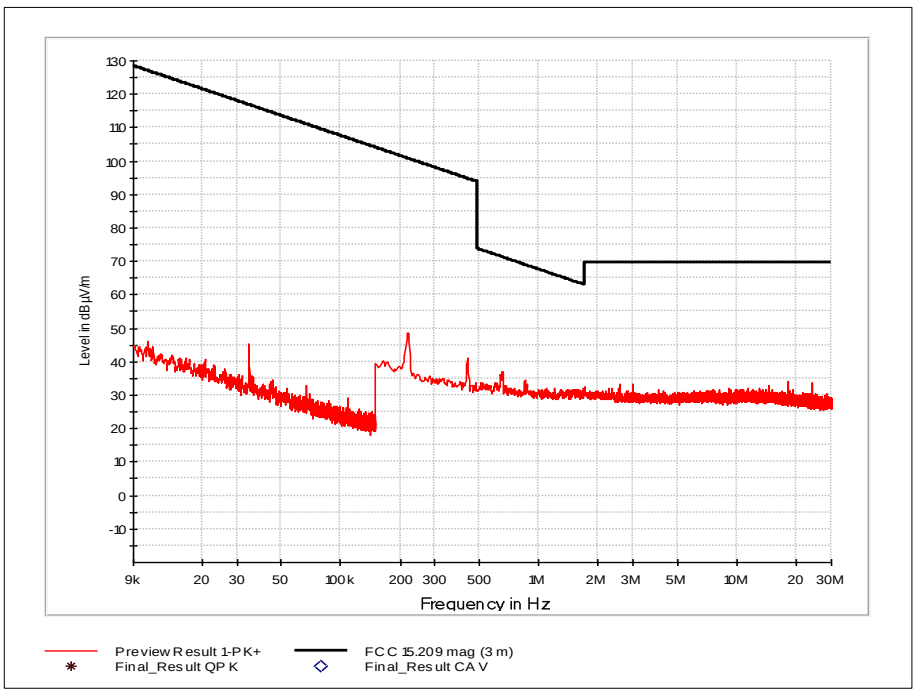


Figure 27 – Receiving Mode - 9 kHz to 30 MHz

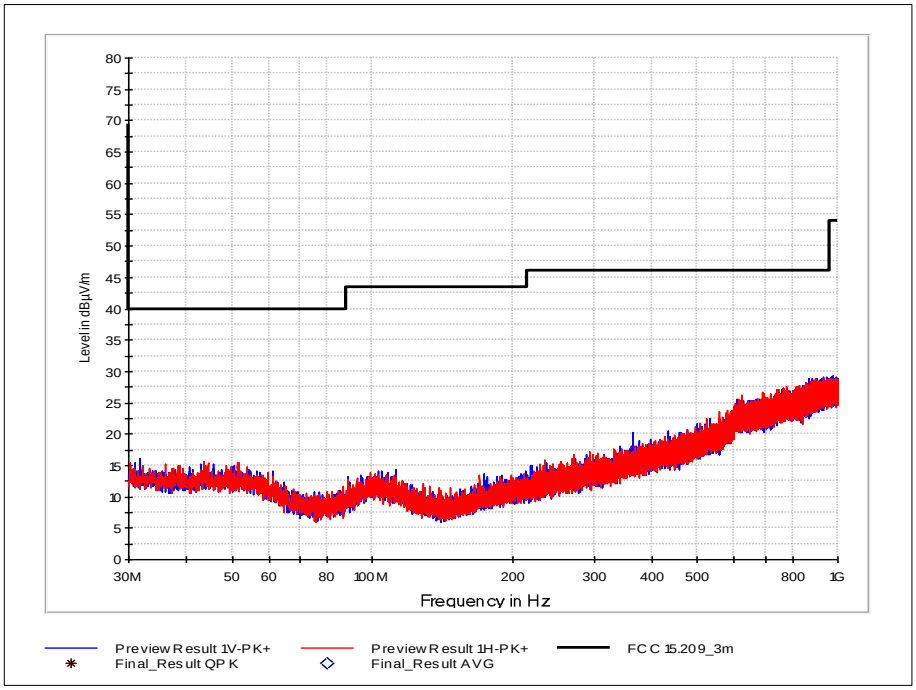


Figure 28 – Receiving Mode - 30 MHz to 1 GHz

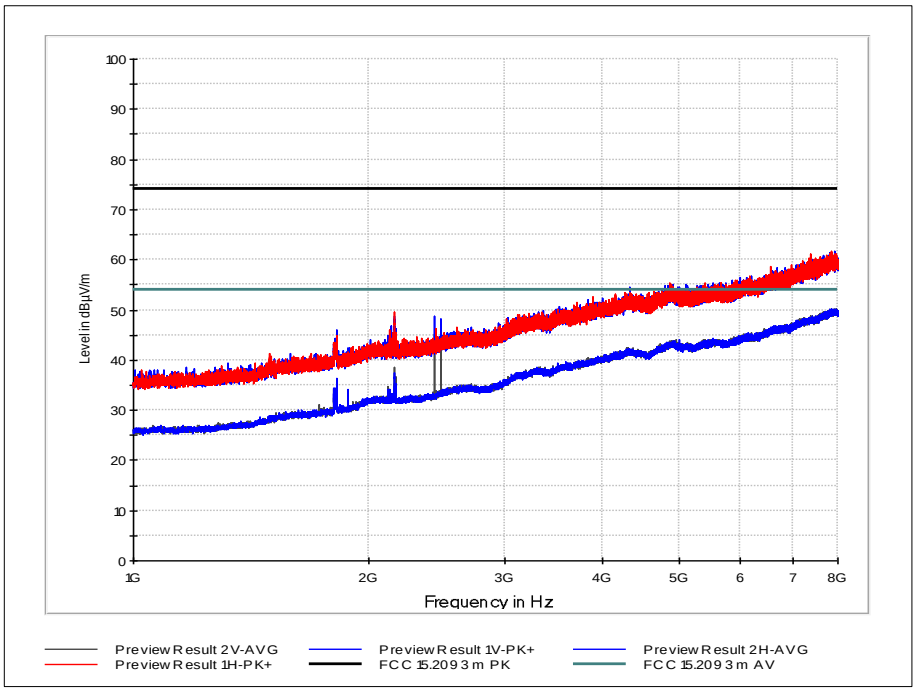


Figure 29 – Receiving Mode - 1 GHz to 8 GHz

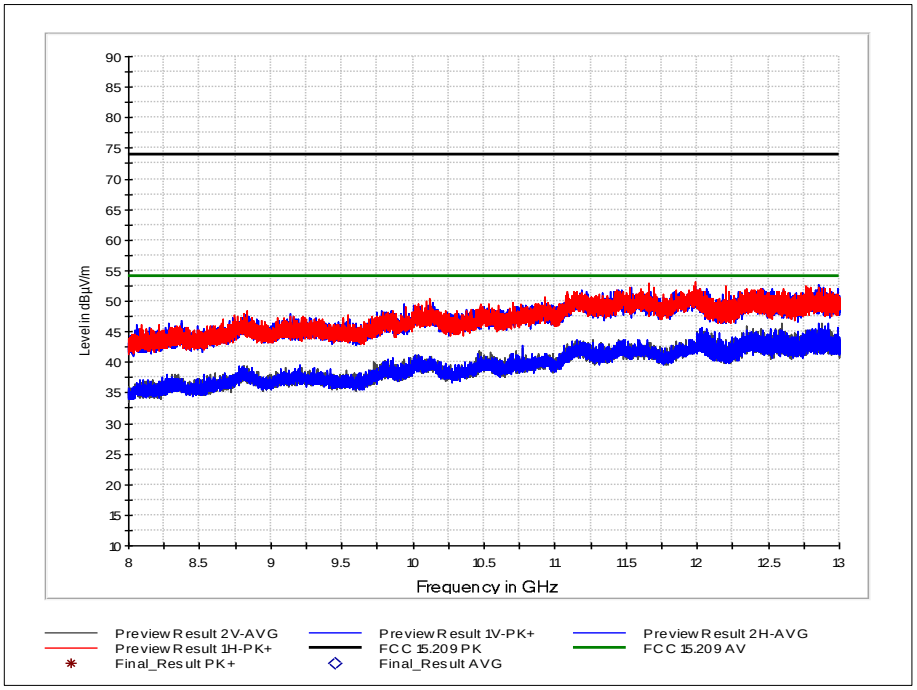


Figure 30 – Receiving Mode - 8 GHz to 12.75 GHz

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 to 0.490	2400/F (kHz)	300
0.490 to 1.705	24000/F (kHz)	30
1705 to 30	30	30
30 to 88	100**	3
88 to 216	150**	3
216 to 960	200**	3
Above 960	500	3

Table 25 - FCC Limit

NOTE: The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission.

2.9.7 Test Location and Test Equipment Used

This test was carried out in Semi anechoic room - cabin no. 8.

Instrument	Manufacturer	Type No	T-ID	Calibration Period (months)	Calibration Due
Loop antenna	Rohde & Schwarz	HFH2-Z2	18876	24	2018-07-31
TRILOG Antenna	Schwarzbeck	VULB 9163	19691	24	2020-12-31
EMI test receiver	Rohde & Schwarz	ESW26	28268	12	2018-06-30

Table 26

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

Product Service

2.10 Exposure of Humans to RF Fields

2.10.1 Specification Reference

FCC 47 CFR Part 15B and ICES-003, Clause 15.107 and 6.1

2.10.2 Guide

IC RSS-102 Issue 5, section 2.5

2.10.3 Equipment Under Test and Modification State

Sigfox Goodie RCZ2, S/N: --- - Modification State 0

2.10.4 Date of Test

2018-04-25

2.10.5 Test Results

Detailed results are shown below.

Exposure of Humans to RF Fields	Applicable	Declared by applicant	Measured	Exemption
The antenna is				
☐ detachable				
The conducted output power (CP in watts) is measured at the antenna connector: CP = **..... W**			☐	
The effective isotropic radiated power (EIRP in watts) is calculated using				
☐ the numerical antenna gain: G = **.....** $EIRP = G \cdot CP \Rightarrow EIRP$ = **..... W**		☐		
☐ the field strength[1] in V/m: FS = **..... V/m** $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **..... W**			☐	
with: Distance between the antennas in m: D = **..... m**			☐	
☒ not detachable				
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by:				

[1] The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses.
If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

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$$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = \mathbf{59.8\ mW}$$ with: Field strength in V/m: $FS = \mathbf{0.44}$ Distance between the two antennas in m: $D = \mathbf{3}$			☒ ☒	
Selection of output power				
The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.): $TP = \mathbf{59.8\ mW}$				

Exposure of Humans to RF Fields (continued)	Applicable	Declared by applicant	Measured	Exemption
Separation distance between the user and the transmitting device is				
☐ less than or equal to 20 cm ☒ greater than 20 cm		☐		
Transmitting device is				
☐ in the vicinity of the human head ☐ body-worn		☐		

Product Service

SAR evaluation				

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in the table.

For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in the table, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

Frequency (MHz)	Exemption limits (mW)[2] at separation distance of									
	≤5 mm	10 mm	15 mm	20 mm	25 mm	30 mm	35 mm	40 mm	45 mm	≥50 mm
≤300 [3]	71	101	132	162	193	223	254	284	315	345
450	52	70	88	106	123	141	159	177	195	213
835	17	30	42	55	67	80	92	105	117	130
1900	7	10	18	34	60	99	153	225	316	431
2450	4	7	15	30	52	83	123	173	235	309
3500	2	6	16	32	55	86	124	170	225	290
5800	1	6	15	27	41	56	71	85	97	106

[2] The excemption limit in the table are based on measurements and simulations on half-wave dipole antennas at separaton distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from alinear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from athird order polynomial fit.

[3] Transmitters operating between 3 kHz and 10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in IC RSS-102, issue 5, section 4.

Carrier frequency:	f	=	**902.2 MHz**			
Distance:	d	=	**20 cm**			
Transmitter output power:	TP	=	**105.61 mW**			
Limit:	TP_{limit}	=	**148.99 mW**			☒
☐ SAR evaluation is documented in test report no. …						

2.10.6 Test Location and Test Equipment Used

This test was carried out in a non shielded room and Semi anechoic room - cabin no. 8.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Electromagnetic radiation meter	Narda Safety	EMR-200	19590	36	2019-10-31
Electric field probe	Narda Safety	Type 8.3	19591	36	2019-10-31
Magnetic field probe	Narda Safety	Type 12.1	19592	36	2019-10-31
TRILOG Antenna	Schwarzbeck	VULB 9163	19691	24	2020-12-31
EMI test receiver	Rohde & Schwarz	ESW26	28268	12	2018-06-30

Table 27

3 Photographs

3.1 Equipment Under Test (EUT)

Figure 31 - Test setup for radiated emission

Figure 32 - Test setup for radiated emission

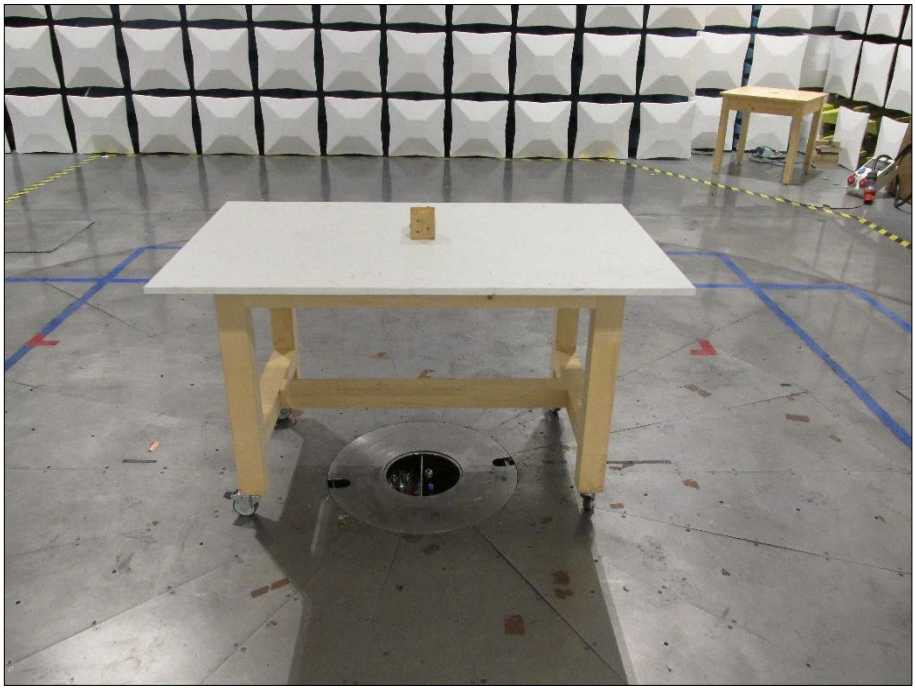

Figure 33 - Test setup for radiated emission

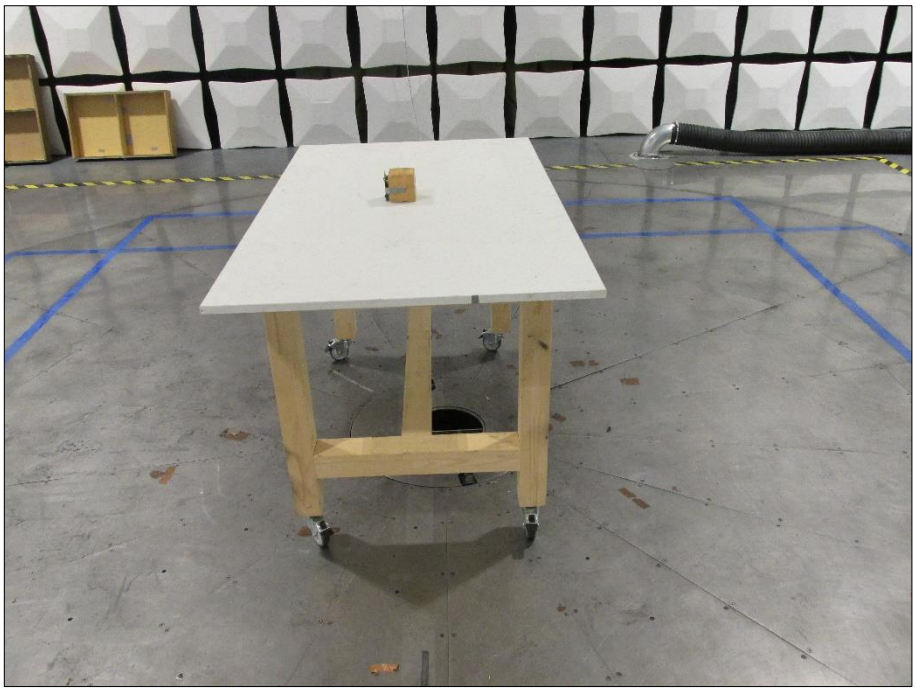

Figure 34 - Test setup for radiated emission

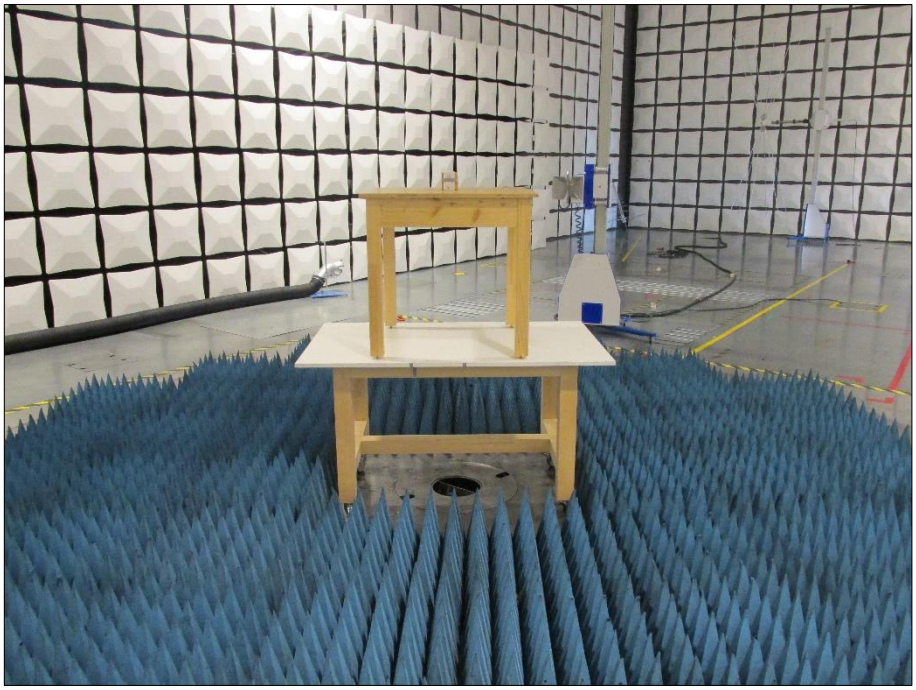

Figure 35 - Test setup for radiated emission (FAR)

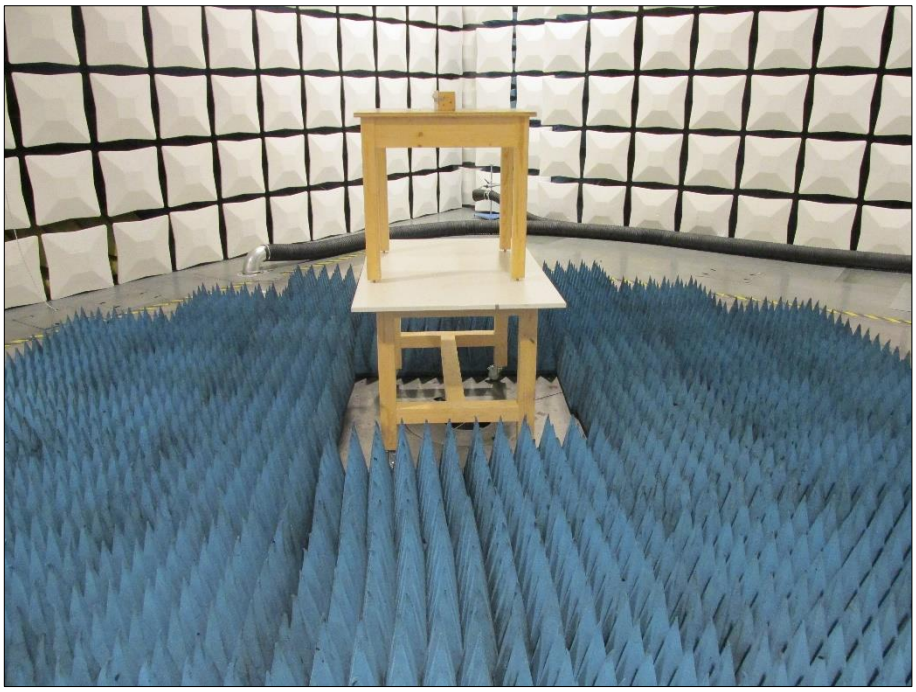

Figure 36 - Test setup for radiated emission (FAR)

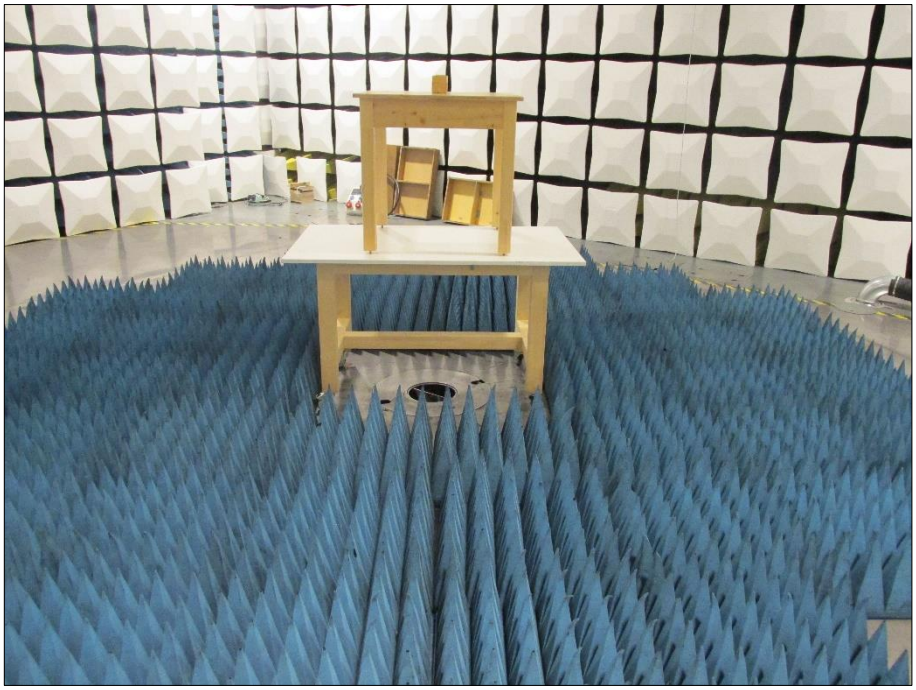

Figure 37 - Test setup for radiated emission (FAR)

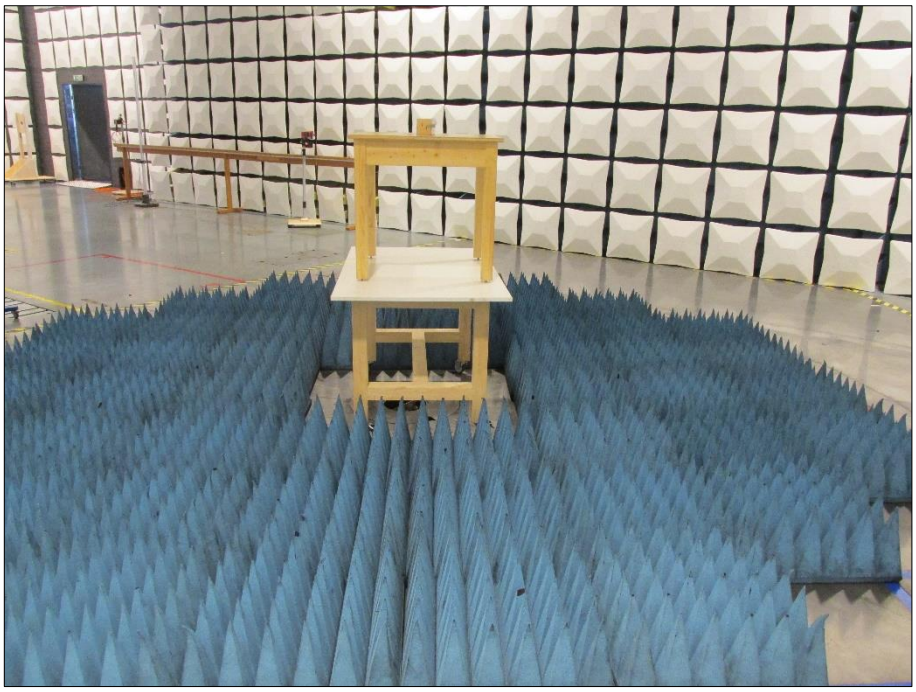

Figure 38 - Test setup for radiated emission (FAR)

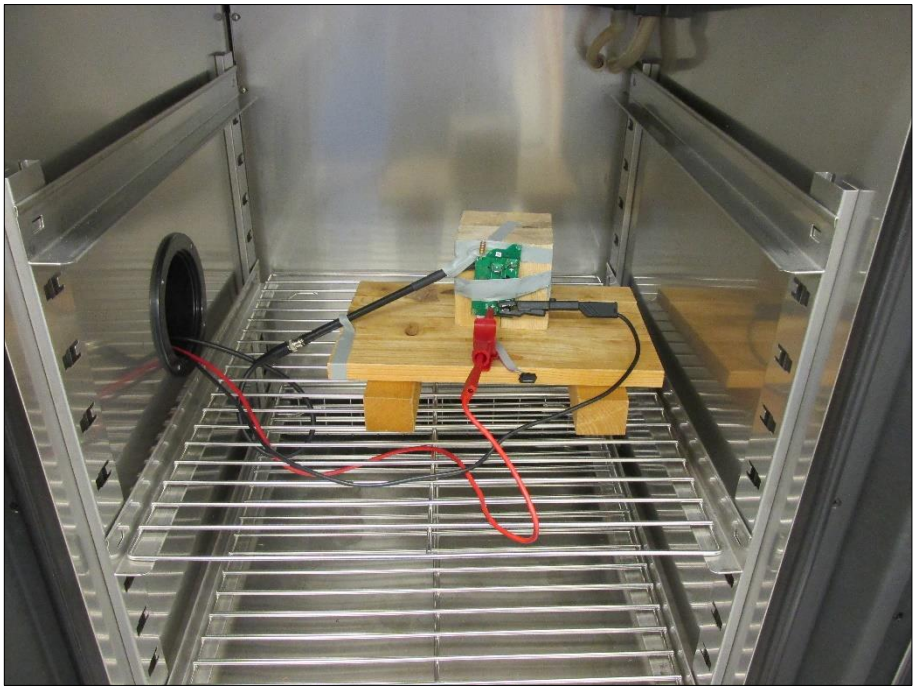

Figure 39 - Test setup for carrier frequeny stability

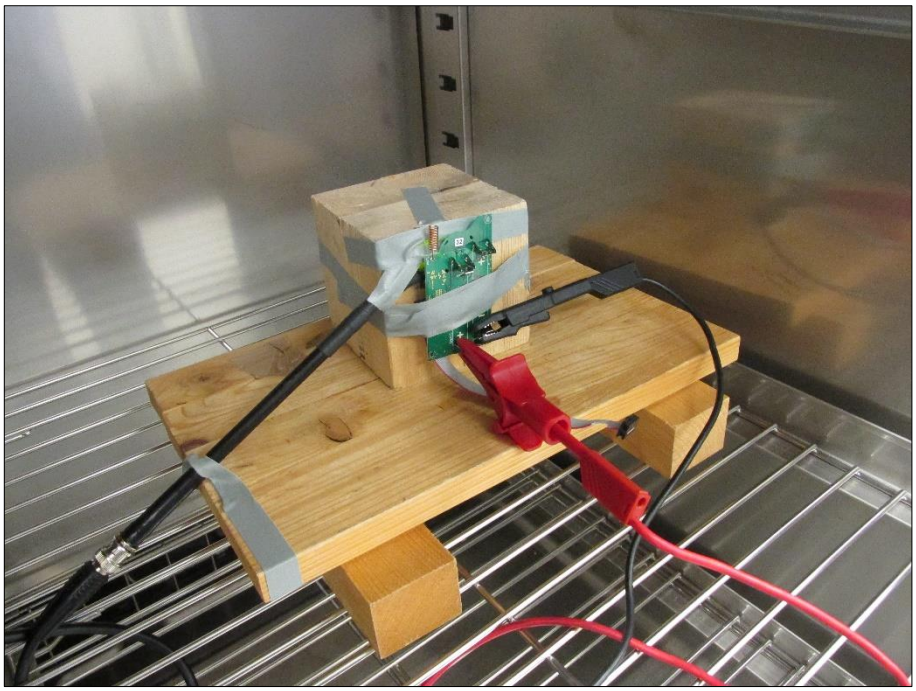

Figure 40 - Test setup for carrier frequeny stability

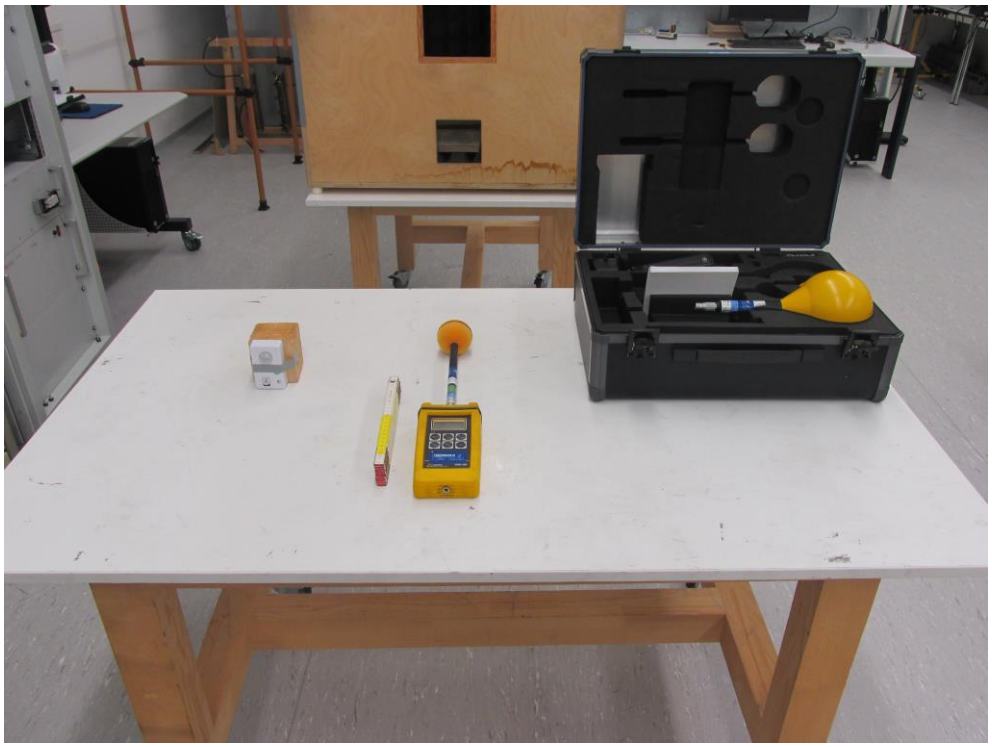

Figure 41 - Test setup for Exposure of Humans to RF Fields

4 Test Equipment Information

4.1 General Test Equipment Used

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSV40	20219	12	2019-01-31
Climatic test chamber	ESPEC	PL-2J	18843	24	2019-03-31
Loop antenna	Rohde & Schwarz	HFH2-Z2	18876	24	2018-07-31
TRILOG Antenna	Schwarzbeck	VULB 9163	19691	24	2020-12-31
EMI test receiver	Rohde & Schwarz	ESW26	28268	12	2018-06-30
Electromagnetic radiation meter	Narda Safety	EMR-200	19590	36	2019-10-31
Electric field probe	Narda Safety	Type 8.3	19591	36	2019-10-31
Magnetic field probe	Narda Safety	Type 12.1	19592	36	2019-10-31

Table 28

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment
N/A - Not Applicable

5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Radio Testing			
Test Name	kp	Expanded Uncertainty	Note
Occupied Bandwidth	2.0	±1.14 %	2
RF-Frequency error	1.96	±1 · 10-7	7
RF-Power, conducted carrier	2	±0.079 dB	2
RF-Power uncertainty for given BER	1.96	+0.94 dB / -1.05	7
RF power, conducted, spurious emissions	1.96	+1.4 dB / -1.6 dB	7
RF power, radiated			
25 MHz – 4 GHz	1.96	+3.6 dB / -5.2 dB	8
1 GHz – 18 GHz	1.96	+3.8 dB / -5.6 dB	8
18 GHz – 26.5 GHz	1.96	+3.4 dB / -4.5 dB	8
40 GHz – 170 GHz	1.96	+4.2 dB / -7.1 dB	8
Spectral Power Density, conducted	2.0	±0.53 dB	2
Maximum frequency deviation			
300 Hz – 6 kHz	2	±2,89 %	2
6 kHz – 25 kHz	2	±0.2 dB	2
Maximum frequency deviation for FM	2	±2,89 %	2
Adjacent channel power 25 MHz – 1 GHz	2	±2.31 %	2
Temperature	2	±0.39 K	4
(Relative) Humidity	2	±2.28 %	2
DC- and low frequency AC voltage			
DC voltage	2	±0.01 %	2
AC voltage up to 1 kHz	2	±1.2 %	2
Time	2	±0.6 %	2

Table 29

Radio Interference Emission Testing			
Test Name	kp	Expanded Uncertainty	Note
Conducted Voltage Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB	1
Discontinuous Conducted Emission			
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB	1
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB	1
Conducted Current Emission			
9 kHz to 200 MHz	2	± 3.5 dB	1
Magnetic Fieldstrength			
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB	1
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB	1
Radiated Emission			
Test distance 1 m (ALSE)			
9 kHz to 150 kHz	2	± 4.6 dB	1
150 kHz to 30 MHz	2	± 4.1 dB	1
30 MHz to 200 MHz	2	± 5.2 dB	1
200 MHz to 2 GHz	2	± 4.4 dB	1
2 GHz to 3 GHz	2	± 4.6 dB	1
Test distance 3 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 5.0 dB	1
1 GHz to 6 GHz	2	± 4.6 dB	1
Test distance 10 m			
30 MHz to 300 MHz	2	± 4.9 dB	1
300 MHz to 1 GHz	2	± 4.9 dB	1
Radio Interference Power			
30 MHz to 300 MHz	2	± 3.5 dB	1
Harmonic Current Emissions			4
Voltage Changes, Voltage Fluctuations and Flicker			4

Table 30

Immunity Testing			
Test Name	kp	Expanded Uncertainty	Note
Electrostatic Discharges			4
Radiated RF-Field			
Pre-calibrated field level	2	+32.2 / -24.3 %	5
Dynamic feedback field level	2.05	+21.2 / -17.5 %	3
Electrical Fast Transients (EFT) / Bursts			4
Surges			4
Conducted Disturbances, induced by RF-Fields			
via CDN	2	+15.1 / -13.1 %	6
via EM clamp	2	+42.6 / -29.9 %	6
via current clamp	2	+43.9 / -30.5 %	6
Power Frequency Magnetic Field	2	+20.7 / -17.1 %	2
Pulse Magnetic Field			4
Voltage Dips, Short Interruptions and Voltage Variations			4
Oscillatory Waves			4
Conducted Low Frequency Disturbances			
Voltage setting	2	± 0.9 %	2
Frequency setting	2	± 0.1 %	2
Electrical Transient Transmission in Road Vehicles			4

Table 31

Note 1:
The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 2:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 3:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2.05, providing a level of confidence of p = 95.45%
Note 4:
It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95%confidence.
Note 5:
The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 6:
The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 7:
The expanded uncertainty reported according ETSI TR 100 028 V1.4.1 (all parts) to is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%
Note 8:
The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%