

FCC ID: 2AB76NC1000C1

(12 appendices)

Test object: NC1000C-9, Mesh Network Module**Summary**

See Appendix 1 for general information and Appendix 12 for photos.
Emission measurements as specified below have been performed.

Standard	Compliant	Appendix	Remarks
FCC 47 CFR Part 15 C	Yes		Note 1
15.247 Operation within the band 902-928 MHz			
IC RSS-247, Issue 2, February 2017/ IC RSS-Gen Issue 5 March 2019	Yes		Note 1
DTSS, Operation within the band 902-928 MHz			
Duty cycle measurements	N/A	2	
15.247 (a) (2) / RSS-247 5.2 (a), 6 dB bandwidth	Yes	3	
15.247 (b) (3) / RSS-247 5.4 (d), Maximum peak conducted power	Yes	4	
15.247 (d) / RSS-247 5.5/RSS-Gen 8.10, Restricted bands of operation and 20 dB below fundamental	Yes	5	
15.247 (e) / RSS-247 5.2 (b), Power spectral density	Yes	6	
15.247 (i) / RSS-102 2.5.1, RF Exposure	Yes	7	
15.215 (c), 20 dB bandwidth	Yes	8	
15.207 / RSS-Gen 8.8, AC power line conducted emissions	Yes	9	
2.1049 / RSS-Gen 6.7, Occupied bandwidth	Yes	10	
15.247 (d) / RSS-247 5.5/RSS-Gen 8.10, Band Edge	Yes	11	Note 1

Note 1: Operating Band limited to 902.6 – 927.4 MHz.

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Purpose of test

The tests were performed to verify that NC1000C-9 meets the electromagnetic compatibility requirements of FCC 47 CFR part 15 C and IC RSS-Gen/RSS-247.

The used semi-anechoic chamber is compliant with the requirements of section 2.948 of the FCC rules with the designation number DK0002, as a facility accepted for certification under parts 15 and 18. The site complies with RSS Gen and is accepted by Innovation, Science and Economic Development Canada for the performance of radiated measurements, ISED CAB identifier DK0001.

Changes in revisions

6P02721-3 rev. 3 supersedes 6P02721-3 rev. 2 issued 2019-06-07

Changes:

Conducted emission test was added.

Model name changed to “NC1000C-9” and description changed to “Mesh Network Module”.

Reasoning that the test object is tested as DTS.

6P02721-3 rev. 2 supersedes 6P02721-3 rev. 1 issued 2019-02-19

Changes:

The following test was retested: “*Restricted bands of operation and 20 dBc below fundamental measurements according to FCC 47 CFR part 15.247 (d) / RSS-247 5.5/RSS-Gen 8.10*”

References to FCC, RSS and KDB’s updated to newest versions.

Calibration dates updated.

6P02721-3 rev. 1 supersedes 6P02721-3 issued 2016-12-06

Changes: Test laboratory name and contact person changed, FCC ID updated.

Test object

Mesh Network Module:	NC1000C-9
Antenna connector	U. FI
Antenna:	Pulse Electronics W5017
Antenna gain:	2 dBi
Operating frequency band:	Transmit: 902 to 928 MHz Receive: 902 to 928 MHz
Supported frequency band:	Transmit: 902.6 and 927.4 MHz Receive: 902.6 and 927.4 MHz
Frequencies used during test:	Transmit: 902.6, 915 and 927.4 MHz Receive: 902.6, 915 and 927.4 MHz
Modulation:	2-FSK
Data rate:	250 kbaud
Power supply:	3.6 Volt battery. External PSU during test
Battery type:	Li-SOCl ₂
Software	TI Test software

Radiated tests

The test object was powered the USB PC connection board (CC Debugger, TI Instruments), for controlling the test object.

Justification measurements were performed with rotation of the EUT through three orthogonal axes to determine which orientation the NC1000C-9 had the highest emission levels, see photos in Appendix 12.

During the radiated tests the PC was placed inside the semi-anechoic chamber on the floor. during the test.

AC power line conducted emission

AC power line conducted emission test was performed with the NC1000C-9 powered by a representative power supply. As the NC1000C-9 can be powered from different power supplies, an AC/DC adapter was chosen together with the client as a representative setup. The test was done on the AC Power port of the AC/DC adapter.

RF conducted tests and justifications measurements:

The test object was tested stand alone as a module. The module was powered by a separate external DC Power supply, 3.6 V DC, which was powered with 120 V AC/60 Hz, The PC Connection board was powered via USB from a PC laptop, which was also powered with 120 V AC/60 Hz.

Preliminary conducted RF tests were performed with the NC1000C-9 at mid channel (915 MHz). The measurements were then done at 2-FSK, 250 kbaud. See Appendix 4, if not otherwise stated.

Measurement equipment

Description	Model	ID tag	Cal. due
Analyzer 20Hz-26.5GHz	ESI	20763	2019-12-10
Antenna, Broadband, 30MHz-3GHz	HL562	19830	2019-04-14
Antenna Horn 1 – 18 GHz	BBHA 9120 D	20031	2022-04-15
Antenna Log Per 0.3 - 1 GHz	3148	50083	2019-04-14
Multimeter	34401A	14880	2017-02-25
Analyzer 20Hz-26.5GHz	ESIB 26	18880	2020-15-19
V-network Two Line	ESH3-Z5	20682	2020-02-25

Operational test mode

The test was performed with continuous transmission, if not otherwise stated, and with normal modulation.

A programmable test sample was used. With a laptop PC the test sample could be configured for different power levels. The EUT was tested placed on a development PCB interfacing to a Laptop PC via USB.

Test in conducted mode was done by attaching RF test cable via U.FI to SMA antenna adapter. The test was performed with continuous transmission with normal modulation and maximum output power, if other not stated.

The following were set in the PC s/w TI SmartRF Studio 7, if not otherwise stated:

Power: +10 dBm)
Modulation: 2-FSK
Baud: 250kBaud
Deviation: 165kHz
Xtal Frequency: 26 MHz

The designated Frequency Band is 902 – 928 MHz. The Frequency Range tested is 902.6 – 927.4 MHz. The device supports 251 channels (with 98.983765 kHz spacing) from 902.609741 – 927.355682 MHz, from which 16 channels can be selected for actual use.

According to §15.247(a)(1)(i) For frequency hopping systems operating in the 902-928 MHz band: 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.

Because the NC1000C-9 only uses 16 channels then it does not fulfill the requirements of a DSS (Frequency Hopping Spread Spectrum system) and is thus considered a DTS (Digital Transmission System).

Ancillary and/or support equipment

Laptop PC, Lenovo R500	SP equipment
TI SmartRF Studio 7	Client software
915MHzFSK	Client software
NC1000 Development Board	Client equipment

120 VAC 60 Hz equipment

Description	Supplier	Model	ID tag
Oscillator 10Hz-1MHz	B&O	TG7	11199
Multimeter	Hewlett Packard	34401A	14880
Audio power amplifier	img Stage Line	STA-3000	50027

Uncertainties

	Frequency [MHz]	Polarization	Expanded Uncertainty [dB] (k=2)
Radiated Emission AEC 30 – 3000 MHz (CISPR 16-4) HL562 Antenna	30 – 200	Vertical	4.73
	200 – 3000	Vertical	4.97
	30 – 200	Horizontal	4.72
	200 – 3000	Horizontal	5.08
Radiated Emission AEC 1 – 18 GHz (CISPR 16-4)	1000 – 18000	Vertical	3.76
	1000 – 18000	Horizontal	3.77
Conducted emission	0.01 - 30		3.44

Compliance evaluation is based on a shared risk principle with respect to the measurement uncertainty.

Reservation

The test results in this report apply only to the particular test object as declared in the report.

Delivery of test object

The test object was delivered: 2016-04-04

The test object for supplementary tests was delivered: 2019-05-14

Test engineers

Ruben Hansen, David Busk, Søren Søltoft

Duty cycle measurements

Test not applicable, the EUT was set to continuous transmission (100% duty cycle) and with normal modulation.

6 dB bandwidth measurements according to FCC 47 CFR part 15.247 (a) (2) / RSS-247 5.2 (1)

Date 2016-12-06	Temperature 23 °C ± 3 °C	Humidity 21 % ± 5 %
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Test set-up and procedure

The measurements were performed according to ANSI C63.10-2013 sec. 11.8.1 and the KDB 558074 D01 DTS Meas Guidance v05r02, April 2, 2019, clause 8.2.

Conducted measurements were performed with the ESI26 at the antenna connector and with continuous transmission and with 2-FSK modulation, see the results.

Measurement equipment	SP number
Test site RF Room	
Signal Analyser R&S ESI26	18880
Lenovo R500 Laptop	
EUT Power supply via Laptop USB	
Temperature and humidity meter CAN	14395

Results

Final test, 6 dB measurements with modulation 2-FSK, 250kBaud, 165kHz Dev., can be found in the diagrams below:

Diagram 1	902.6 MHz	6 dBW = 583 kHz
Diagram 2	915.0 MHz	6 dBW = 589 kHz
Diagram 3	927.4 MHz	6 dBW = 580 kHz

Limits

According to 47CFR 15.247(a)(2), the minimum 6 dB bandwidth shall be at least 500 kHz.

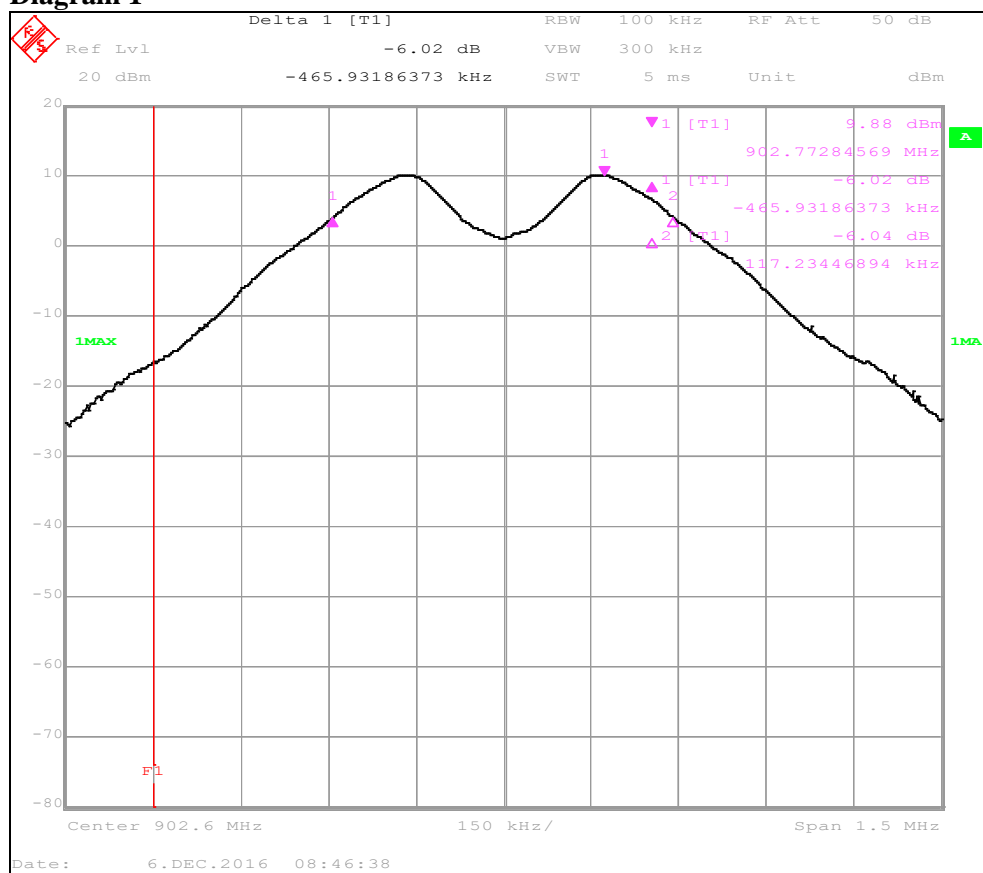
According to RSS-247 5.2 (a), the minimum 6 dB bandwidth shall be 500 kHz.

Complies?	Yes
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Appendix 3

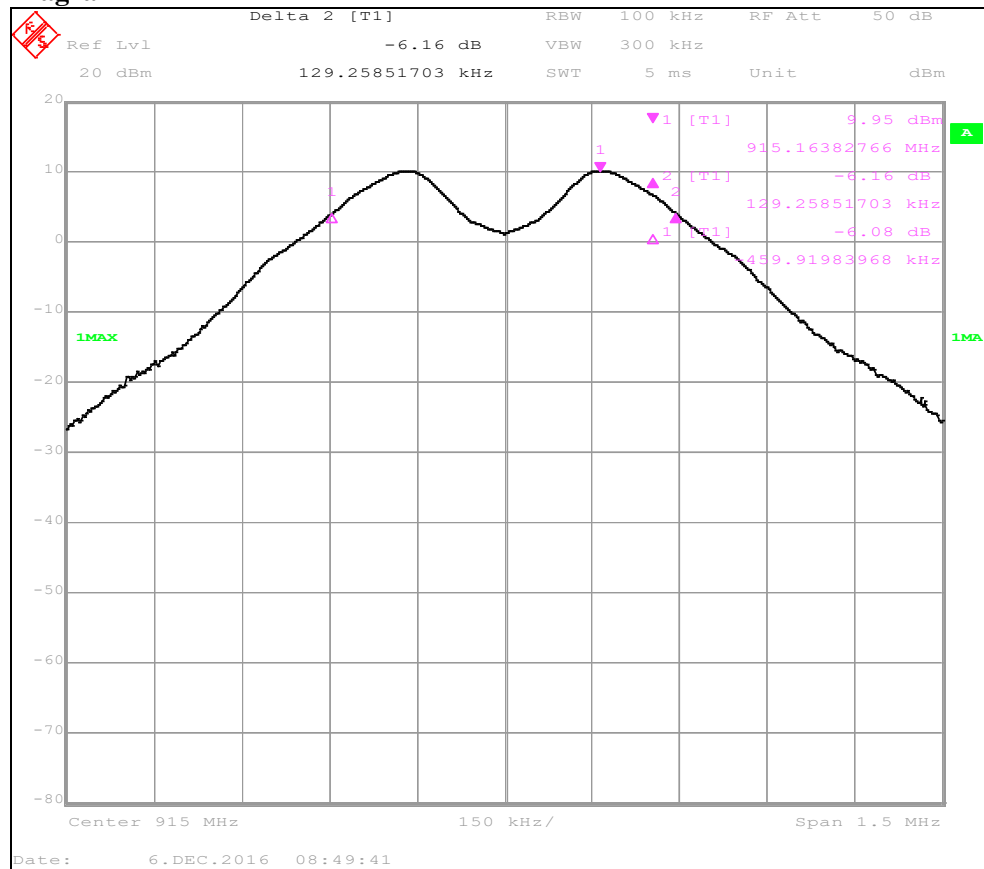
Diagram 1



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Appendix 3

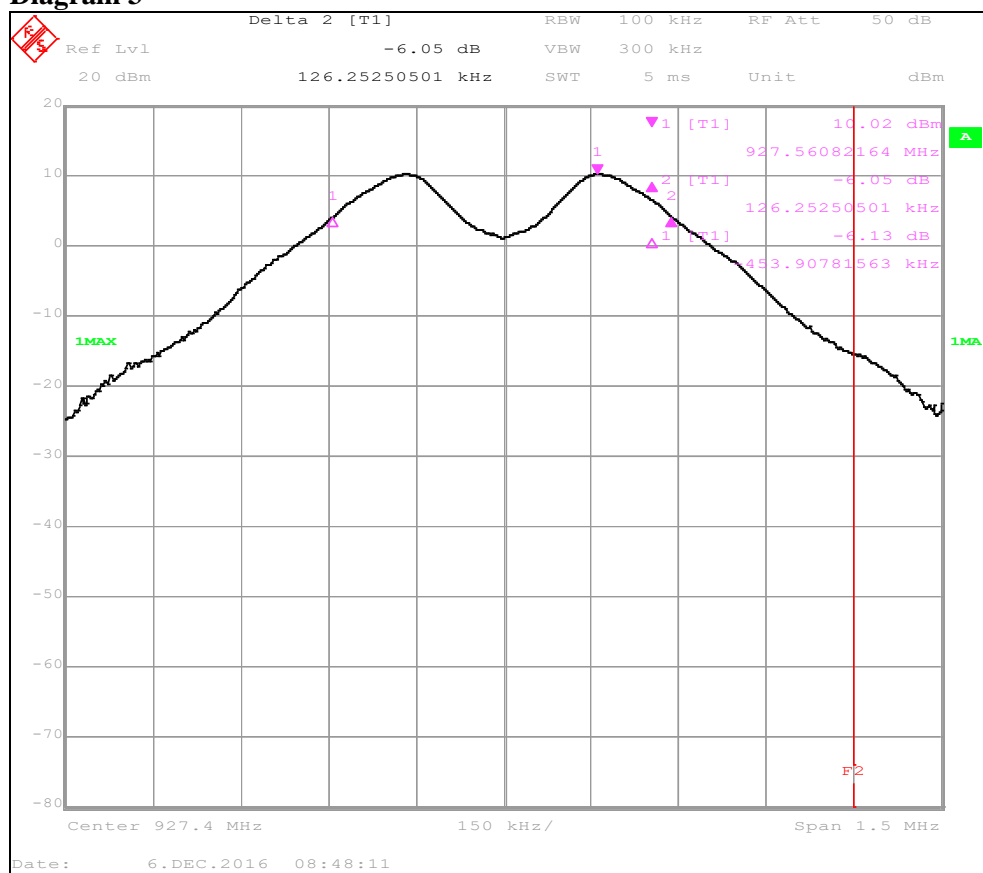
Diagram 2



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Appendix 3

Diagram 3



Maximum peak conducted output power measurements according to FCC 47 CFR part 15.247 (b) (3) / RSS-247 5.4 (a)

Date	Temperature	Humidity
2016-08-29	24 °C ± 3 °C	50 % ± 5 %

Test set-up and procedure

Both peak and RMS measurements were performed. The RMS values were used for the RF exposure evaluation.

The measurements were performed according to ANSI C63.10-2013 and the KDB 558074 D01 DTS Meas Guidance v05r02, April 2, 2019. Peak measurements were measured according to clause 11.9.1.1 in ANSI C63.10-2013.

Conducted measurements were performed at the antenna connector of NC1000C-9 with continuous transmission and with 2-FSK modulation.

Measurement equipment	SP number
Test site RF Room	-
Signal Analyser R&S ESI26	18880
Lenovo R500 Laptop	-
Multimeter Agilent	14880
HP 6632A Power Supply	11386
Temperature and humidity meter CAN	14395

Results

Final test with peak detector on NC1000C-9, powered by the external power supply, maximum conducted peak output power, 2-FSK, 250 kbaud can be found in the diagrams below:

Diagram 1	902.6 MHz	3.6 V DC
Diagram 2	915.0 MHz	3.6 V DC
Diagram 3	927.4 MHz	3.6 V DC

Final test, 2-FSK, 250 kbaud, RBW= 1 MHz (greater than 6 dB BW)

		Max peak output power Peak (dBm)		
		902.6 MHz	915 MHz	927.4 MHz
T _{nom} 24°C	V _{max} 3.6 V DC	10.42	10.54	10.81
T _{nom} 24°C	V _{min} 2.0 V DC Note 1	10.24	10.43	10.60

Final test with RMS detector on NC1000C-9, powered by the external power supply, maximum conducted peak output power, 2-FSK, 250 kbaud can be found in the diagrams below:

Diagram 4	902.6 MHz	3.6 V DC
Diagram 5	915.0 MHz	3.6 V DC
Diagram 6	927.4 MHz	3.6 V DC

Final test, 2-FSK, 250 kbaud, RBW= 1 MHz (greater than 6 dB BW)

		Max peak output power RMS (dBm)		
		902.6 MHz	915 MHz	927.4 MHz
T _{nom} 24°C	V _{max} 3.6 V DC	10.33	10.51	10.73
T _{nom} 24°C	V _{min} 2.0 V DC Note 1	10.14	10.36	10.56

Note 1: According 47CFR 15.31(e), for intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery-operated equipment, the equipment tests shall be performed using a new battery. USB Supply voltage was disconnected, and power supply was added by external power supply. Manufacturer specification for supply range is 2.0 – 3.6 Volt

Limits

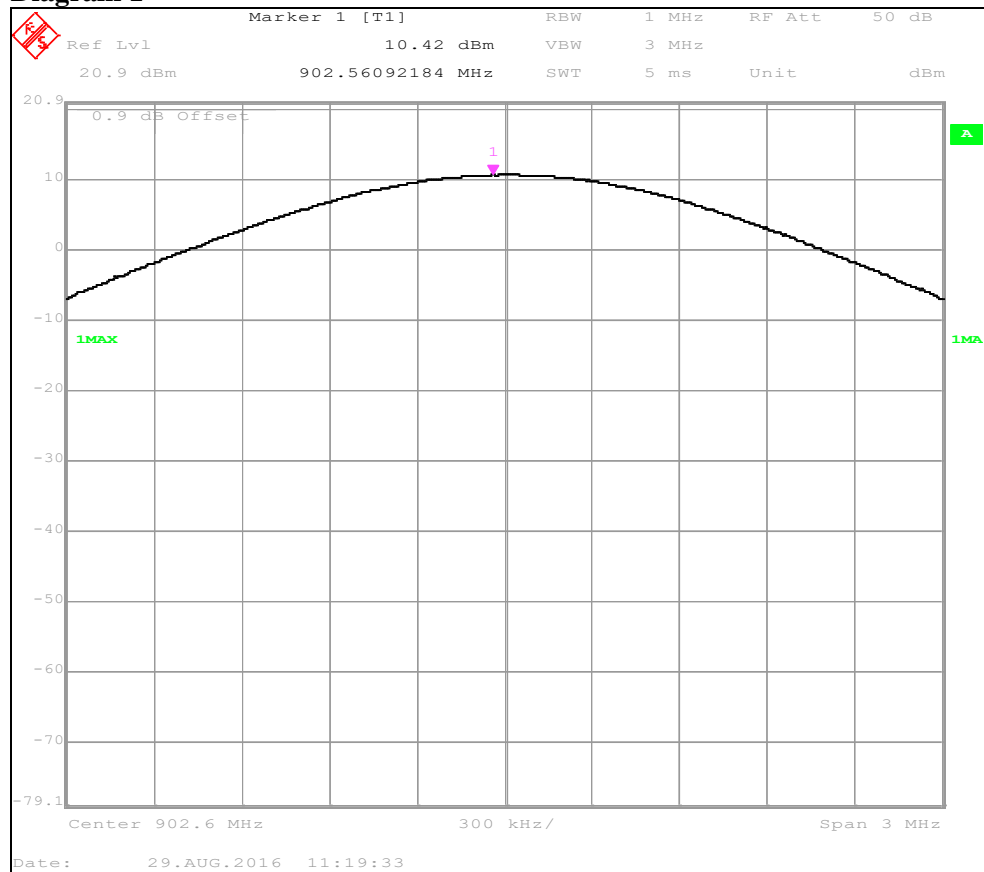
According to 47CFR 15.247(b)(3), for systems using digital modulation in the 902-928 MHz band: 1 Watt (30 dBm).

According to RSS-247 5.4 (d), For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

Complies?	YES
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Appendix 4

Diagram 1



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Appendix 4

Diagram 2

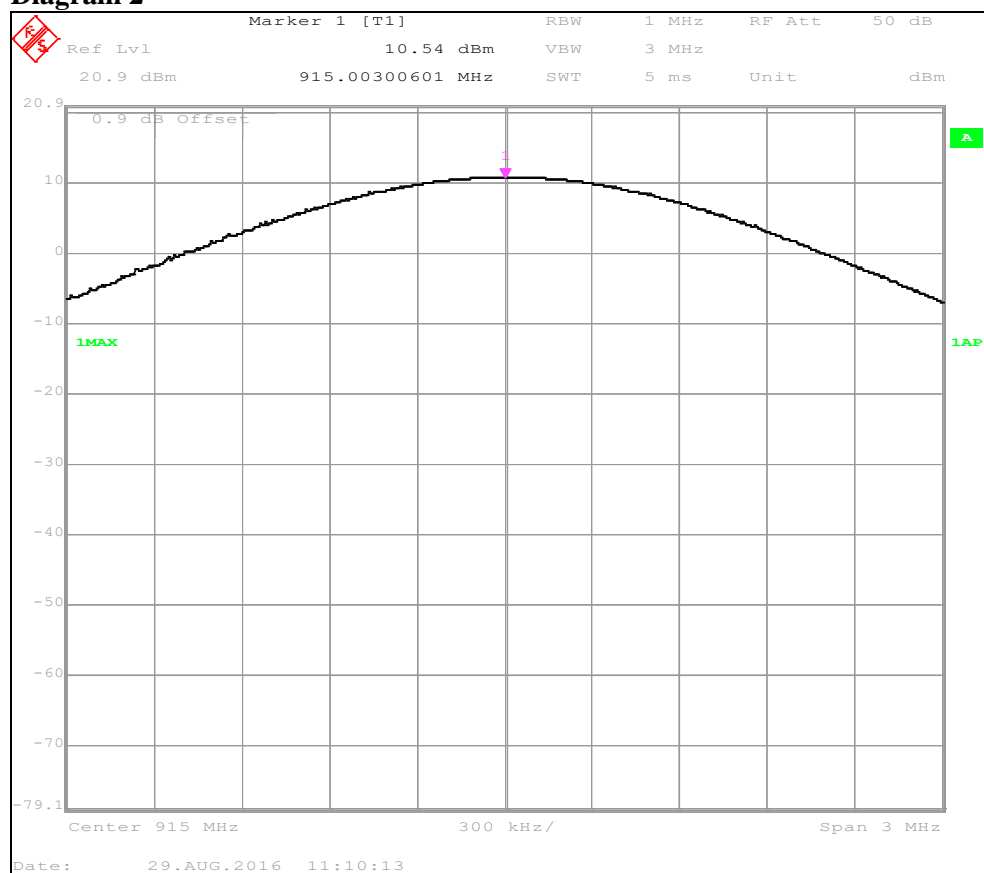
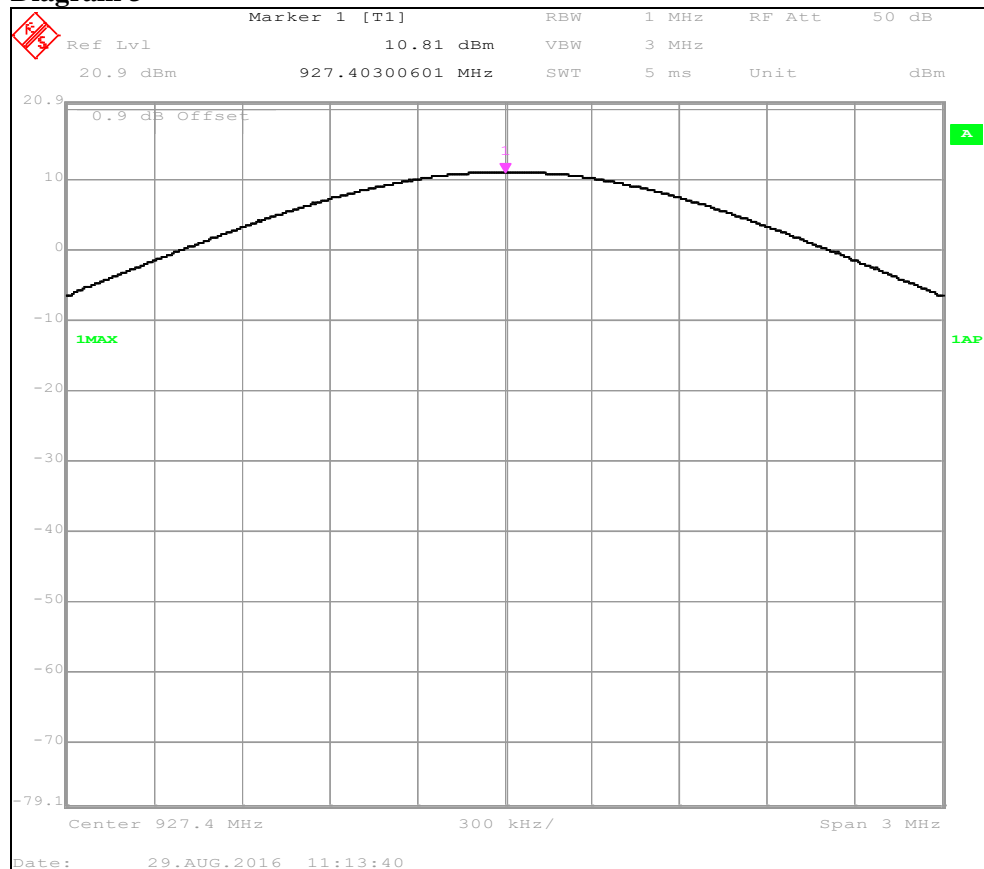


Diagram 3



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Appendix 4

Diagram 4

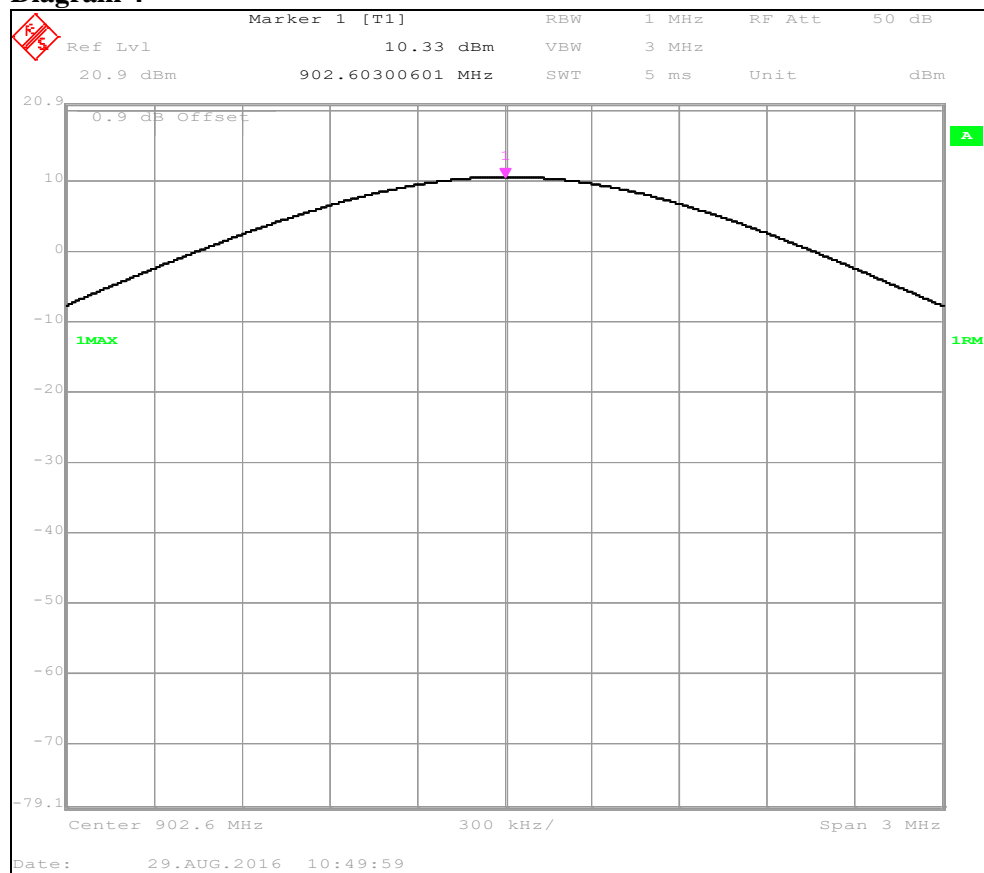


Diagram 5

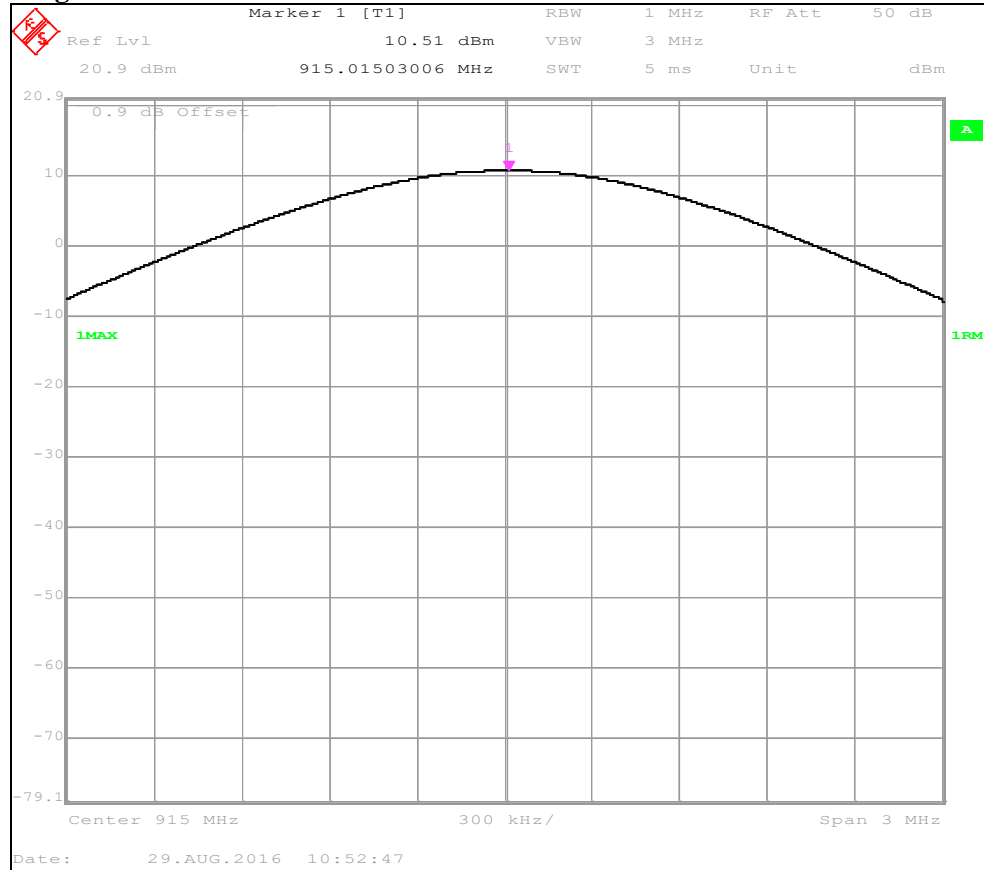
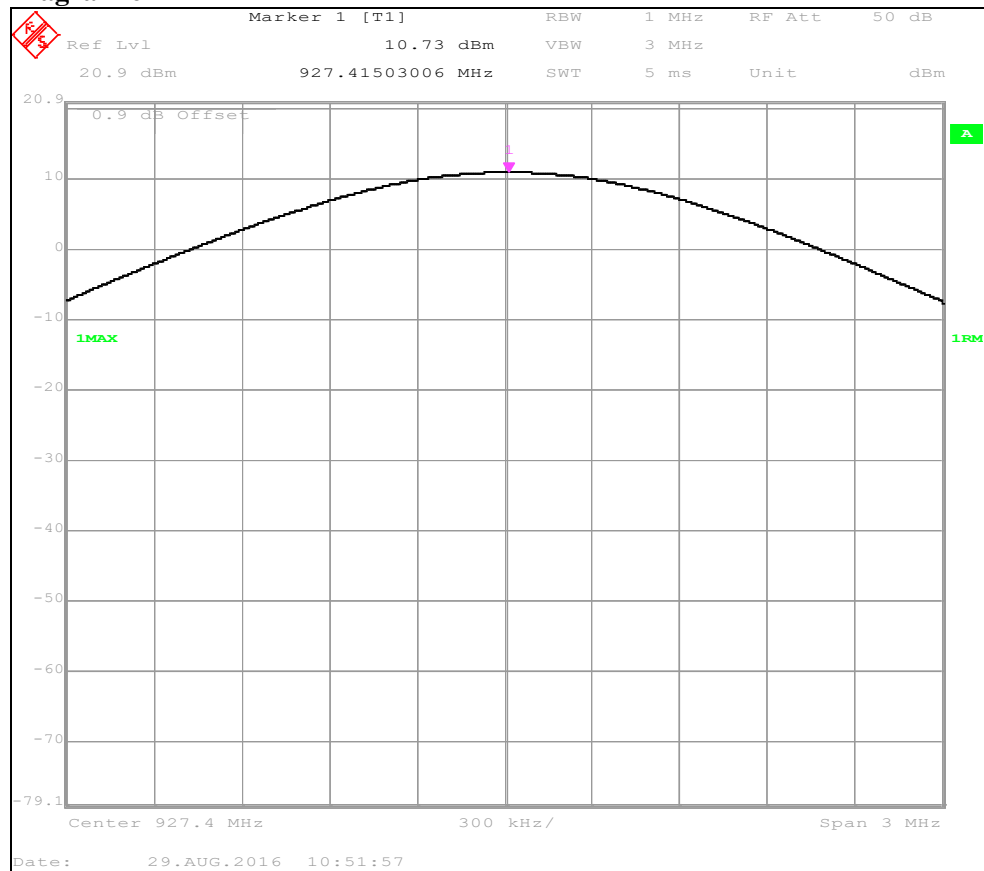


Diagram 6



Restricted bands of operation and 20 dBc below fundamental measurements according to FCC 47 CFR part 15.247 (d) / RSS-247 5.5/RSS-Gen 8.10

Date 2019-05-28	Temperature 22 °C ± 3 °C	Humidity 45 % ± 5 %
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Test set-up and procedure

The measurements were performed according to ANSI C63.10-2013 and the KDB 558074 D01 DTS Meas Guidance v05r02, April 2, 2019.

Justification measurements were performed with rotation of the EUT through three orthogonal axes to determine which orientation the NC1000C-9 had the highest emission levels, see photos in Appendix 12.

The test was performed with the NC1000C-9 with continuous transmission and with modulation 2-FSK, 250 kbaud.

The test of radiated emission was performed in a semi anechoic chamber. The measurements were performed with both horizontal and vertical polarizations of the antenna. The antenna distance during the measurements was 3.0 m in the frequency range 30 MHz-10 GHz. The EUT height above the reference ground plane was 0.8 m in the frequency range 30-1000 MHz and 1.5 m in the frequency range 1-10 GHz.

The measurement procedure is as follows:

1. A pre-measurement is performed with peak detector. The test object is measured in eight directions with the antenna in the frequency range 30-1000 MHz and in sixteen directions at frequencies above 1 GHz, with the antenna at three heights, 1.0 m, 1.5 m and 2.0 m.
2. If the emission is close or above the limit during the pre-measurement, the test object is scanned 360 degrees and the antenna height scanned from 1 to 4 m for maximum response. Then the emission is measured with the quasi-peak detector on frequencies below 1 GHz and with the average detector above 1 GHz.

The following RBW were used:

30 MHz-1 GHz: RBW=100 kHz

1-10 GHz: RBW=1 MHz

Test set-up photos during the tests can be found in Appendix 12.

Test equipment.

Description	Supplier	Model	ID tag
Analyzer 20Hz-26.5GHz	Rohde & Schwarz	ESI	20763
Antenna, Broadband, 30MHz-3GHz	Rohde & Schwarz	HL562	19830
Antenna Horn 1 – 18 GHz	Schwarzbeck	BBHA 9120 D	20031

Results

The pre-measurement emission spectra for the worst case configuration can be found in the diagrams below:

Diagram 1:	915 MHz, EUT in pos “1”, vertical and horizontal polarization
Diagram 2:	30-1000 MHz, 902.6 MHz, EUT in pos “1”, vertical and horizontal polarization
Diagram 3:	1 – 3 GHz, EUT on 902.6 MHz in pos “1”, vertical and horizontal polarization
Diagram 4:	3 - 10 GHz, EUT on 902.6 MHz in pos “1”, vertical and horizontal polarization

Note: Worst-case plots are attached.

The highest detected levels during the final measurement in the frequency range 30 MHz-10 GHz are listed in the tables below.

Restricted bands:

902.6 MHz, EUT in pos “1”:

30 – 1000 MHz Quasi Peak

Frequency (MHz)	QuasiPeak (dB μ V/m)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Margin (dB)	Limit (dBc)	Comment
37.155070	23.8	100.000	100.1	V	198.0	16.2	40.0	
74.638537	21.9	100.000	149.0	V	47.0	18.1	40.0	
163.437495	24.3	100.000	100.0	V	344.0	19.2	43.5	
165.683146	13.7	100.000	279.0	V	91.0	29.8	43.5	
328.869038	17.4	100.000	157.8	V	209.0	28.6	46.0	

902.6 MHz, EUT in pos “1”:

1 – 10 GHz Peak

Frequency (MHz)	MaxPeak (dB μ V/m)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Margin (dB)	Limit (dB μ V/m)	Comment
1396.785571	45.1	1000.000	155.1	H	124.0	28.9	74.0	
2389.881563	46.2	1000.000	155.1	V	303.0	27.8	74.0	
2708.218838	48.5	1000.000	155.3	V	194.0	25.5	74.0	
3611.012425	49.6	1000.000	155.1	V	175.0	24.4	74.0	
4513.826052	57.4	1000.000	155.0	V	150.0	16.6	74.0	
9027.652104	48.7	1000.000	155.1	V	169.0	25.3	74.0	

1 – 10 GHz Average

Frequency (MHz)	Average (dB μ V/m)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Margin (dB)	Limit (dB μ V/m)	Comment
1396.785571	26.4	1000.000	155.1	H	124.0	27.6	54.0	
2389.881563	28.8	1000.000	155.1	V	303.0	25.2	54.0	
2708.218838	39.5	1000.000	155.3	V	194.0	14.5	54.0	
3611.012425	42.1	1000.000	155.1	V	175.0	11.9	54.0	
4513.826052	50.1	1000.000	155.0	V	150.0	3.9	54.0	
9027.652104	38.0	1000.000	155.1	V	169.0	16.0	54.0	

20 dBc below fundamental measurements:

902.6 MHz, EUT in pos “1”:

1 – 10 GHz Peak

Frequency (MHz)	MaxPeak (dB μ V/m)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Margin (dB)	Limit (dBc)	Comment
1804.711222	59.4	100.000	154.8	V	69.0	31.6	20	
5416.639679	43.7	100.000	154.8	V	212.0	47.3	20	
5996.602004	37.8	100.000	155.1	V	108.0	53.2	20	

Limits

According to 47CFR 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

According to RSS-247 5.5, modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

According to RSS-Gen 8.10, Restricted bands, identified in Table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

- (a) Fundamental components of modulation of license-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287;
- (b) Unwanted emissions that fall into restricted bands of Table 7 shall comply with the limits specified in table 5 and table 6.
- (c) Unwanted emissions that do not fall within the restricted frequency bands of Table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

Complies?	Yes
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Appendix 5

Diagram 1

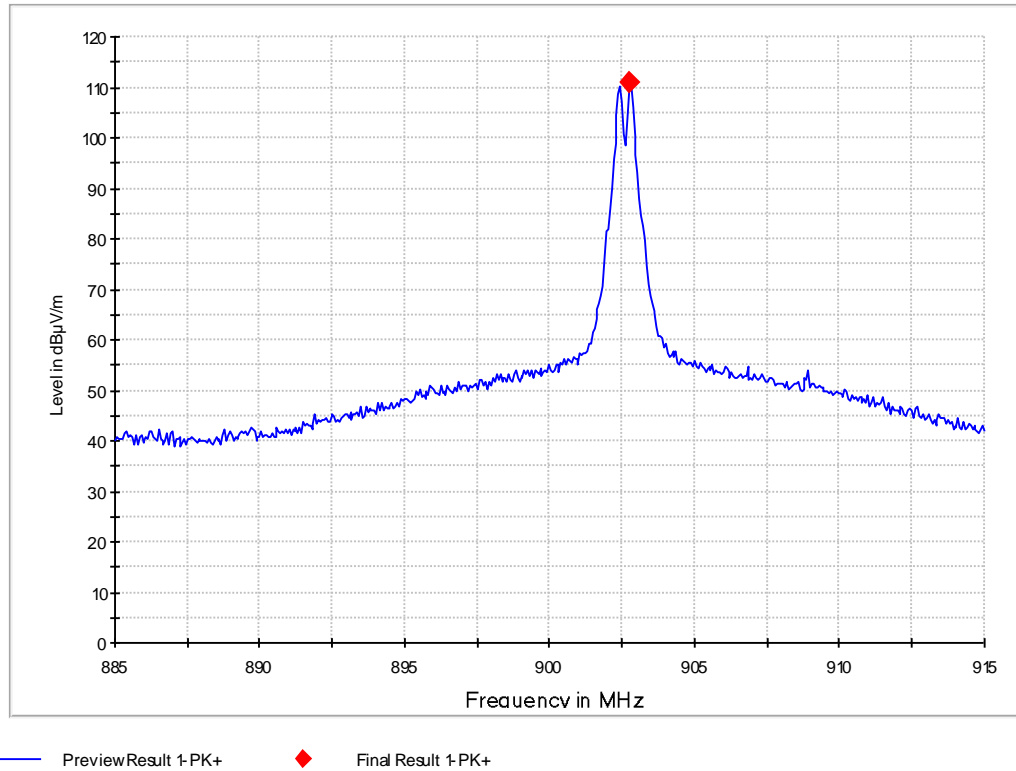


Diagram 2

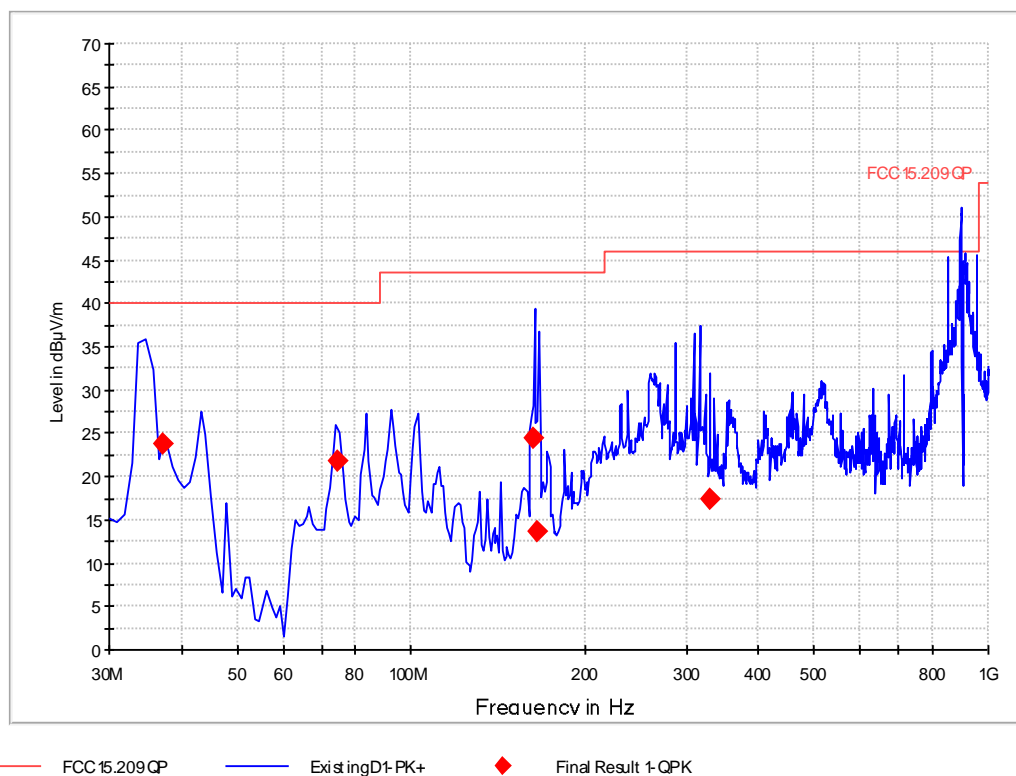


Diagram 3

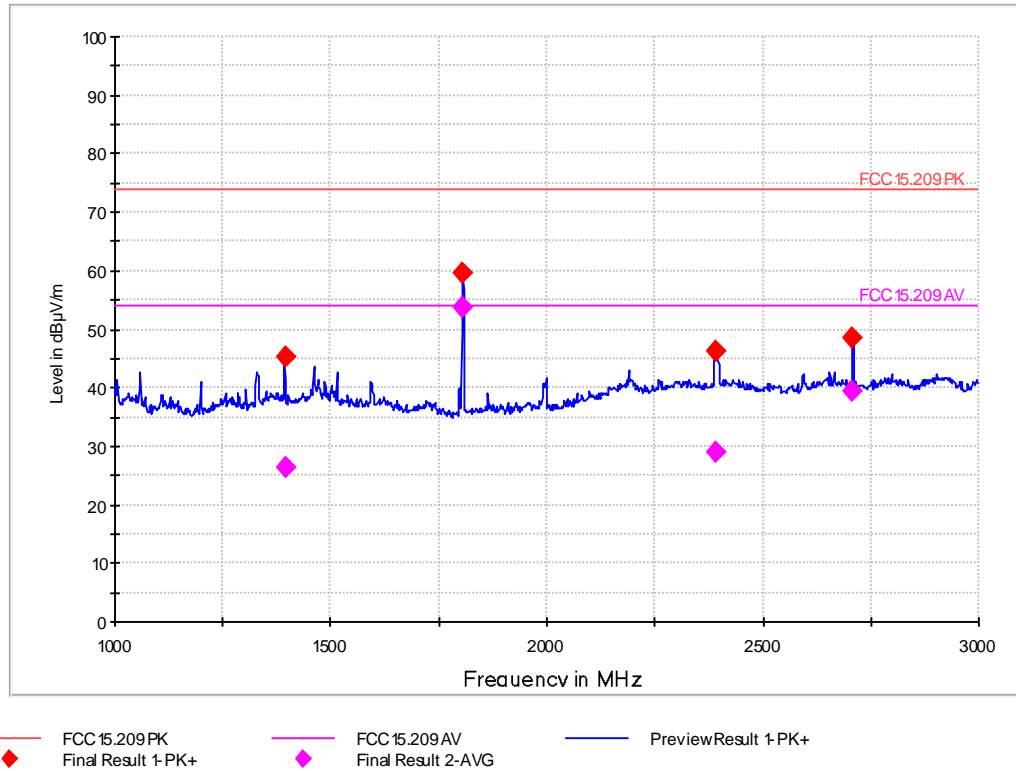
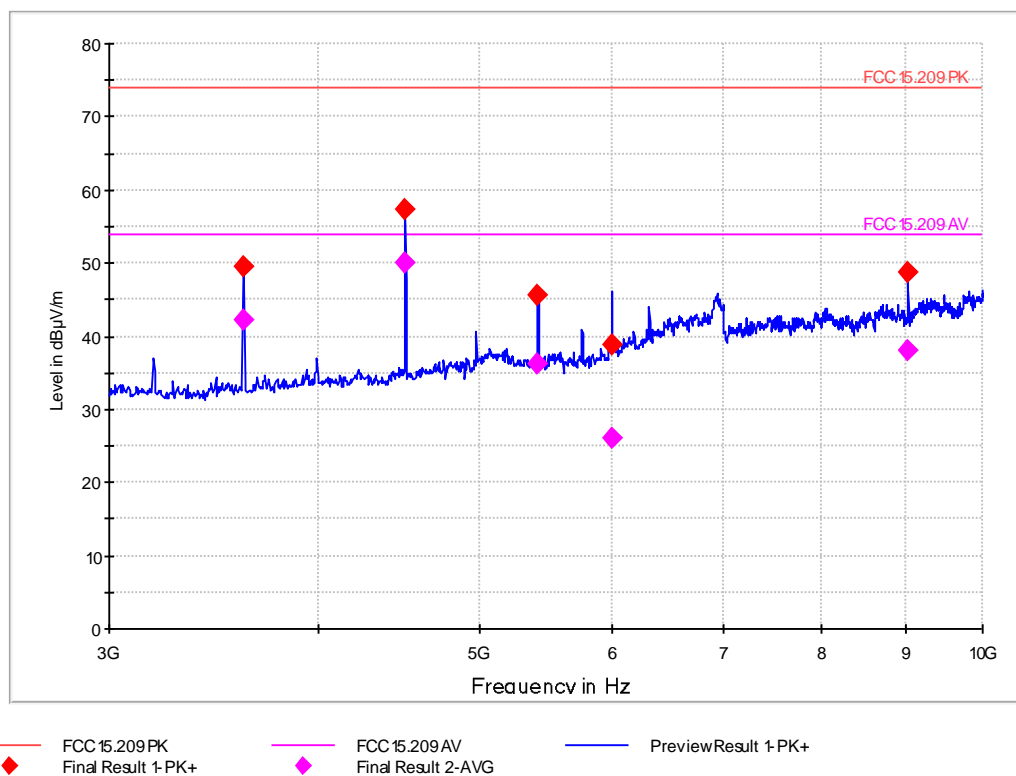


Diagram 4



Power spectral density measurements according to FCC 47 CFR part 15.247 (e) / RSS-247 5.2 (b)

Date 2016-04-19	Temperature 24 °C ± 3 °C	Humidity 25 % ± 5 %
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Test set-up and procedure

The measurements were performed according to ANSI C63.10-2013 sec 11.10.2 and the KDB 558074 D01 DTS Meas Guidance v05r02, April 2, 2019.

Conducted measurements were performed with the NC1000C-9 at the antenna connector and with continuous transmission and with 2-FSK modulation.

Measurement equipment	SP number
Test site RF Room	
Signal Analyser R&S ESI26	18880
Lenovo R500 Laptop	
Multimeter Agilent	14880
HP 6632A Power Supply	11386
Temperature and humidity meter CAN	14395

Results

The final measurements with 2-FSK, 250 kBaud can be found in the diagrams below:
RBW=3 kHz

Diagram 1	902.6 MHz	Power spectral density = 7.28 dBm
Diagram 2	915.0 MHz	Power spectral density = 7.43 dBm
Diagram 3	927.4 MHz	Power spectral density = 6.45 dBm

Limits

According to 47CFR 15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

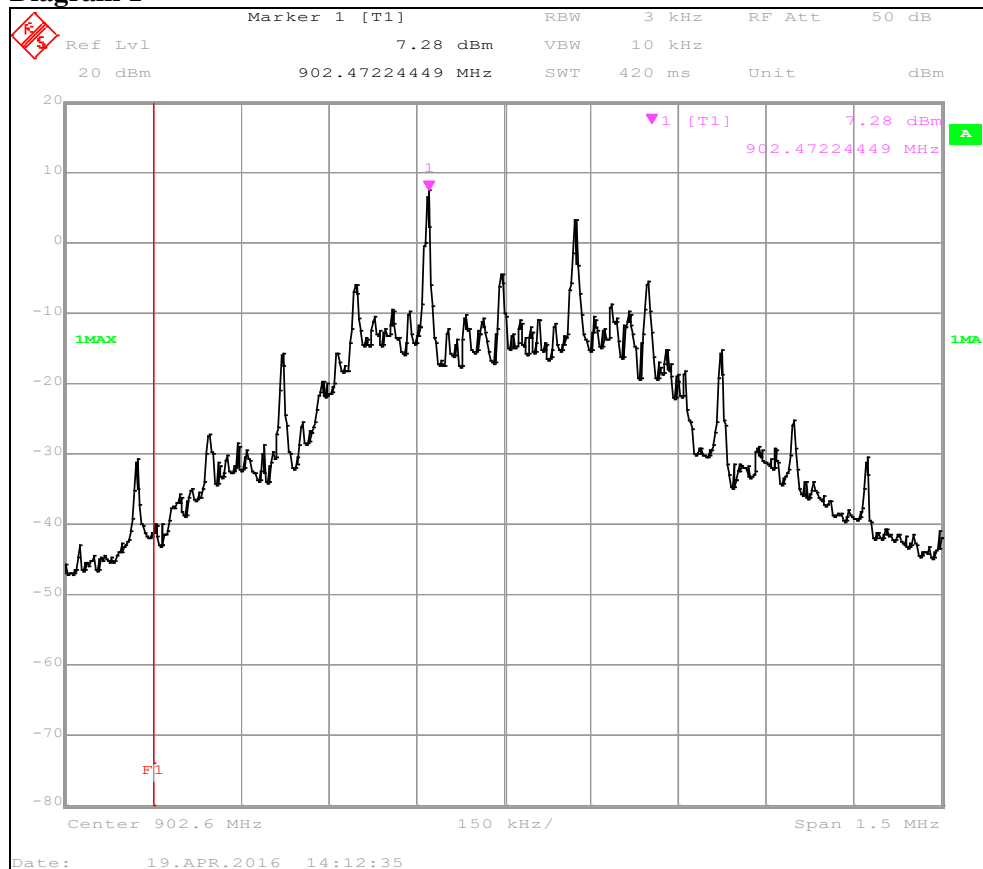
According to RSS-247 5.2 (b), The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Complies?	YES
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Appendix 6

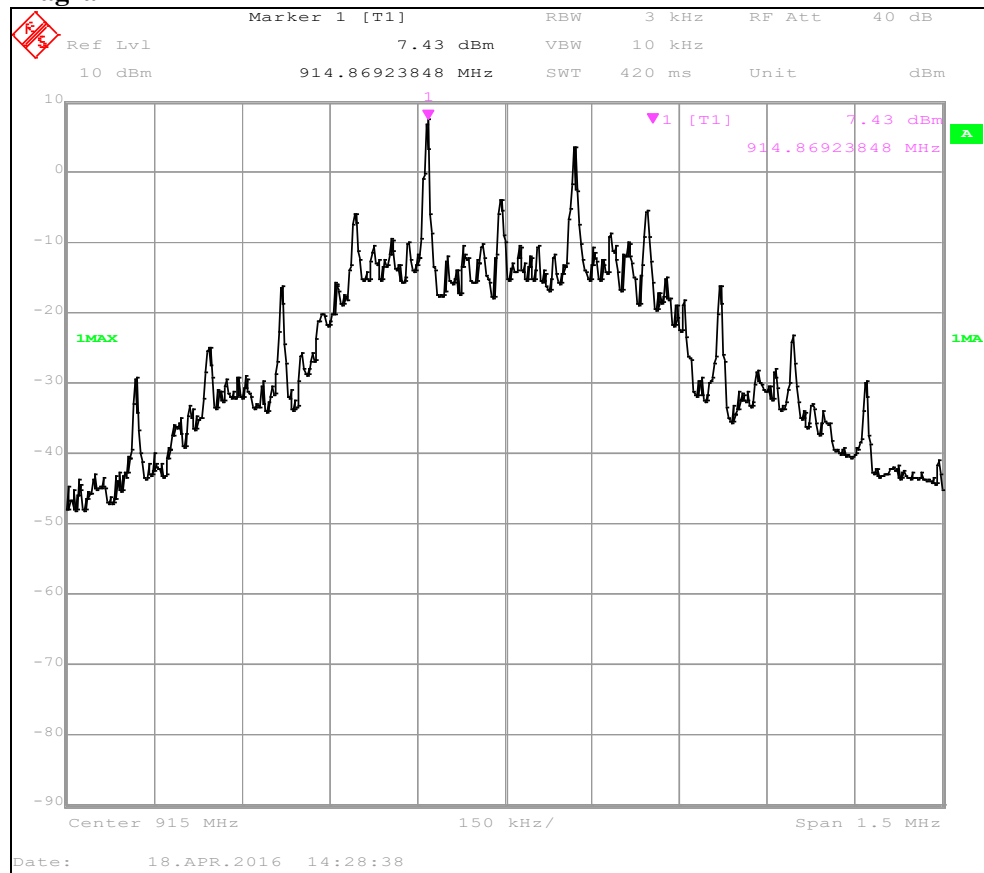
Diagram 1



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Appendix 6

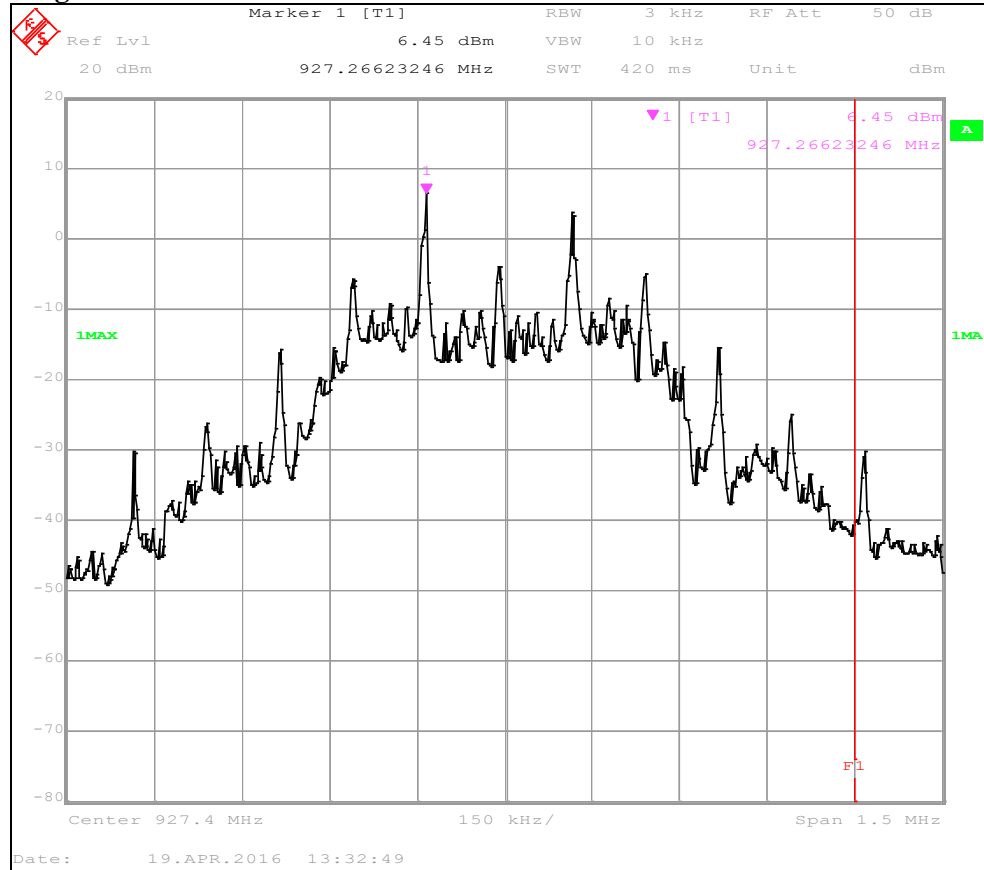
Diagram 2



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Appendix 6

Diagram 3



RF exposure evaluation: 2.1093 Portable devices FCC 47 CFR part 15.247 (i) / KDB 447498 / RSS-102 2.5.1

Date 2016-04-20	Temperature 24 °C ± 3 °C	Humidity 20 % ± 5 %
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Procedure

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1093 this device has been defined as a portable device to be used within 20 centimeters of the body of the user.

Results

Standalone SAR exclusion:

Step 1:

The following formula was used to calculate the RF exposure SAR exclusion threshold,
 $Thld = [P_{out} / r] \times [\sqrt{f}]$

where,

Thld= SAR exclusion threshold

Pout = Maximum output power measured with RMS detector, in mW

r = minimum test separation distance, in mm

f=frequency, in GHz

Tune-up tolerance= + 0.5 to -7.0 dB

Frequency f, (GHz)	Maximum output power Pout with RMS det, (mW)	Distance r, (mm)	Exclusion threshold Thld	Limit Threshold 1-g SAR	Limit Threshold 10-g SAR
0.928	14.03 Note 1	5	2.7	< 3	< 7.5

Note 1: The maximum measured RMS level was 10.73 dBm (2-PSK, 250kbaud). According to RSS-102 cl. 2.5.1 the RMS value shall be adjusted for tune-up tolerance, thus 11.47 dBm (14.03 mW) was used as Maximum output power Pout in the table above.

Limits

FCC 2.1093 / KDB 447498 (v06) 4.3.1:

4.3.1 Standalone SAR exclusion:

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \times [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

2) At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B.

- [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm) \times ($f(\text{MHz})/150$)] mW, at 100 MHz to 1500 MHz
- [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm) $\times 10$] mW at > 1500 MHz and ≤ 6 GHz

IC RSS-102 Issue 5 cl. 2.5.1 Exemption from Routine Evaluation Limits – 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 Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤ 5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	193 mW
450	141 mW	159 mW	177 mW	195 mW	123 mW
835	80 mW	92 mW	105 mW	117 mW	67 mW
1900	99 mW	153 mW	225 mW	316 mW	60 mW
2450	83 mW	123 mW	173 mW	235 mW	52 mW
3500	86 mW	124 mW	170 mW	225 mW	55 mW
5800	56 mW	71 mW	85 mW	27 mW	41 mW

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, 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.

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.

Complies?	YES
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20 dB bandwidth measurements according to FCC 47 CFR part 15.215 (c)

Date 2016-08-30	Temperature 24 °C ± 3 °C	Humidity 25 % ± 5 %
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Test set-up and procedure

The measurements were performed according to ANSI C63.10-2013.

Conducted measurements were performed with the NC1000C-9 at the antenna connector and with continuous transmission and with modulation 2-FSK, 250 kBaud.

Measurement equipment	SP number
Test site RF Room	-
Signal Analyser R&S ESI26	18880
Lenovo R500 Laptop	-
Multimeter Agilent	14880
HP 6632A Power Supply	11386
Temperature and humidity meter CAN	14395

Results

The final measurements with modulation 2-FSK, 250 kBaud, can be found in the diagrams below:

Diagram 1:	902.6 MHz	20 dB BW = 799 kHz
Diagram 2:	915 MHz	20 dB BW = 803 kHz
Diagram 3:	927.4 MHz	20 dB BW = 799 kHz

Limits

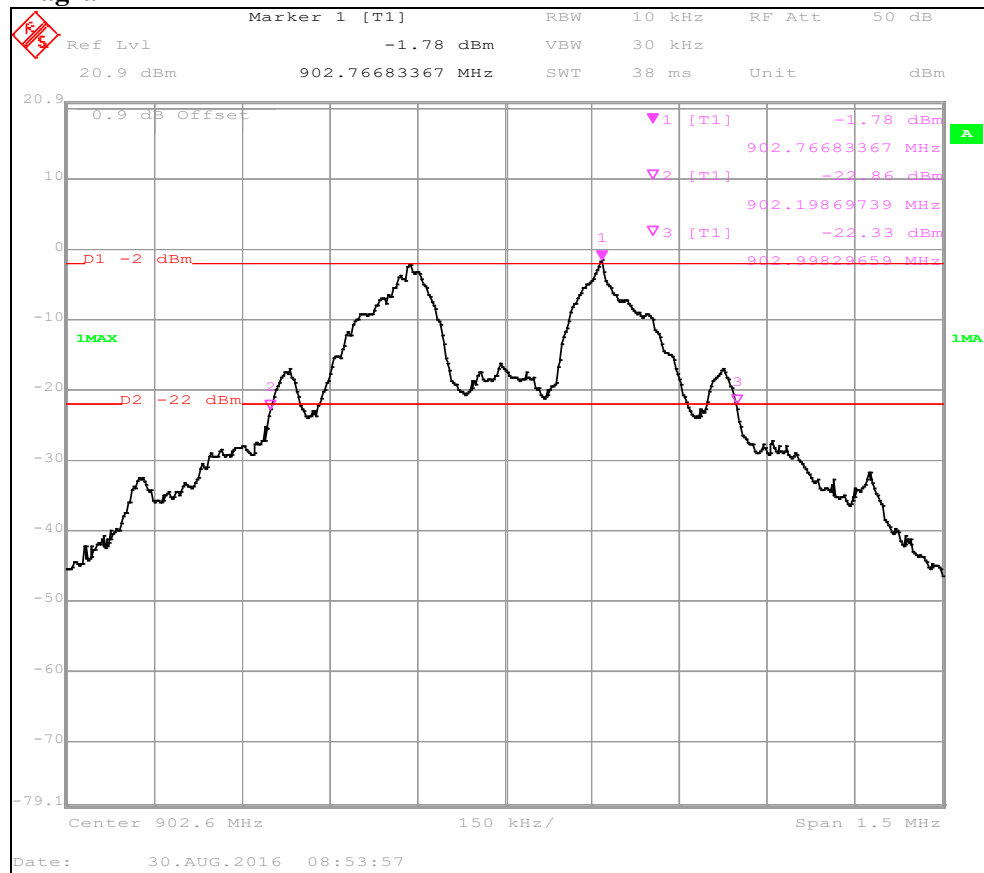
According to 47CFR 15.215(c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. 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.

Complies?	YES
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2AB76NC1000C1

Appendix 9

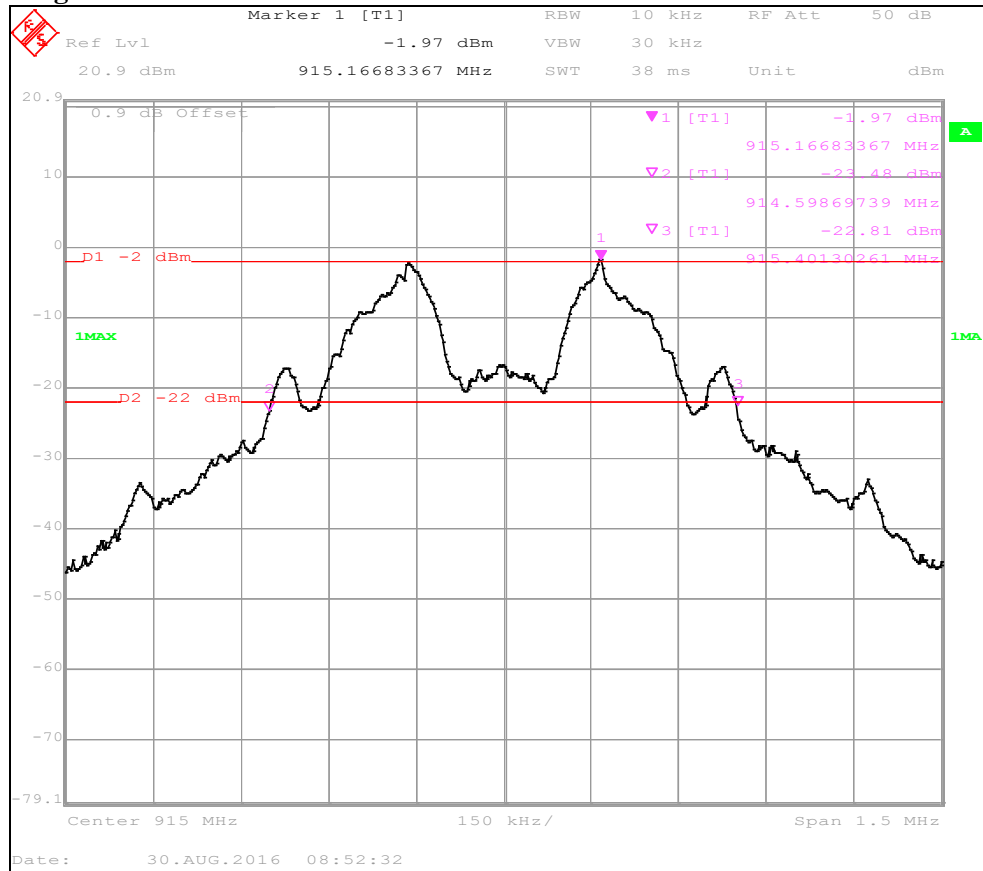
Diagram 1



2AB76NC1000C1

Appendix 9

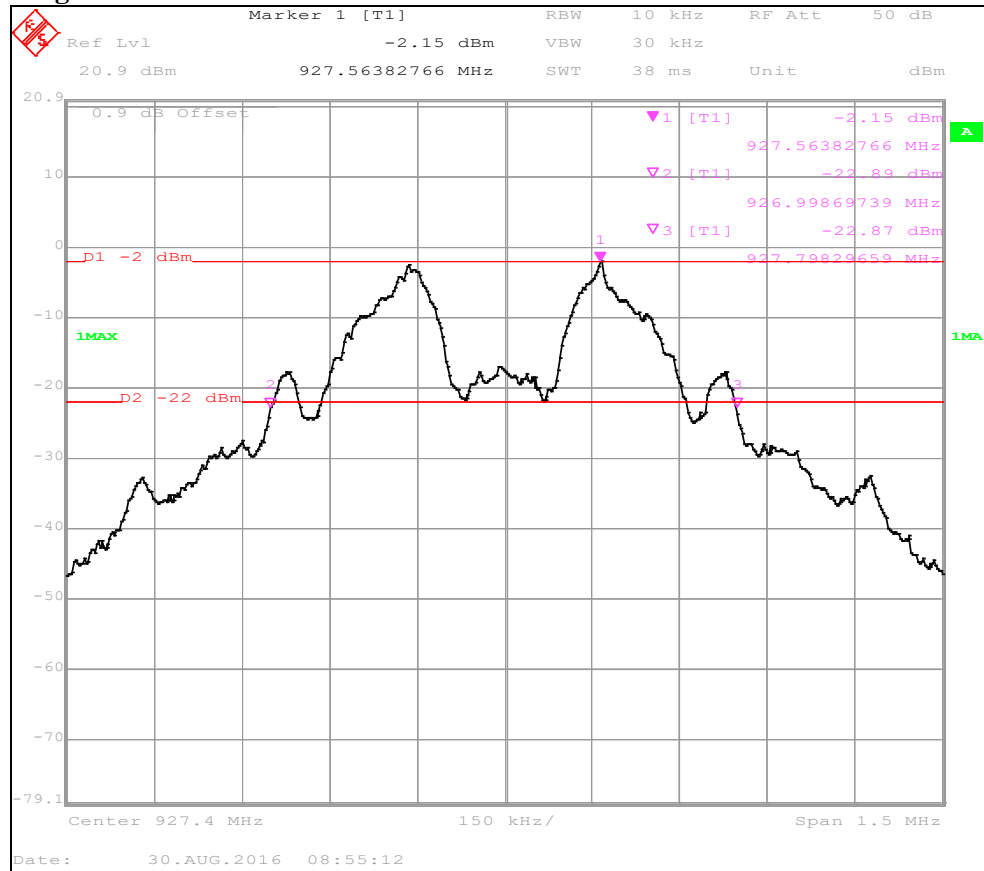
Diagram 2



2AB76NC1000C1

Appendix 9

Diagram 3



AC power line conducted emission according to FCC 47 CFR part 15.207 / RSS-Gen 8.8

Date 2019-12-12	Temperature 19 °C ± 3 °C	Humidity 52 % ± 5 %
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Test set-up and procedure

The measurements were performed according to ANSI C63.10-2013.

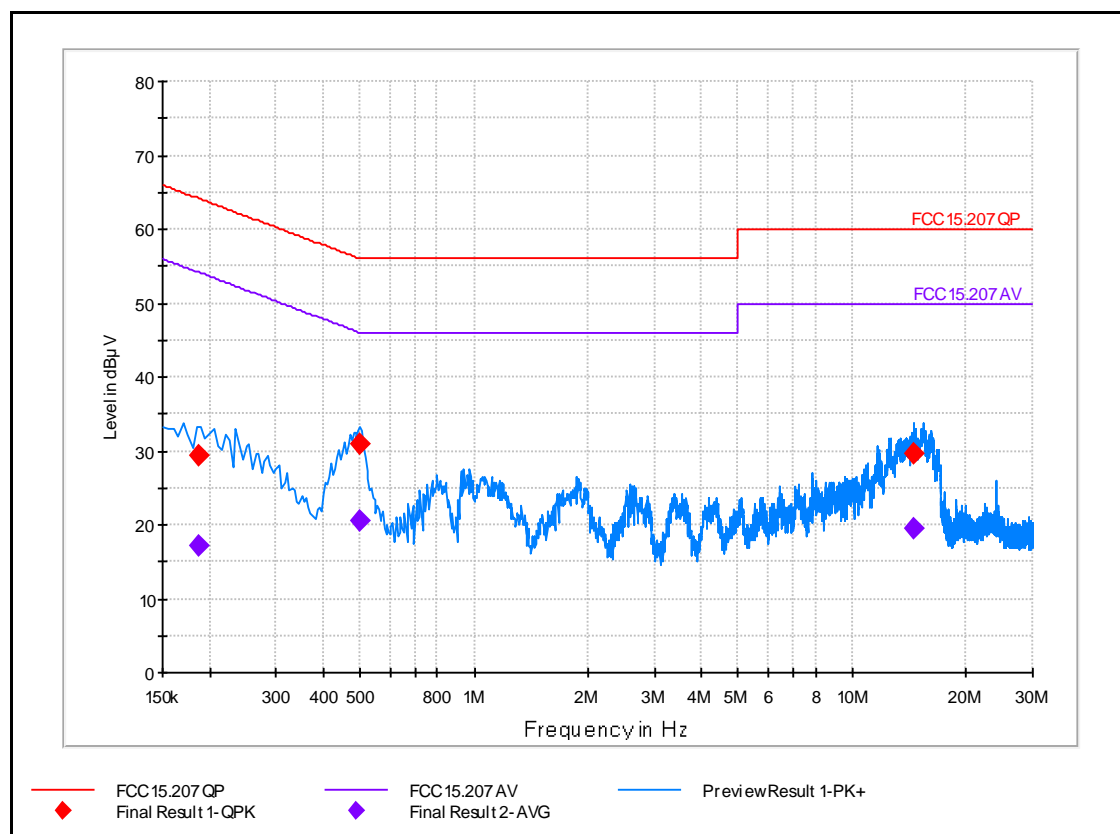
Conducted emission test was performed with the NC1000C-9 powered by a representative power supply. As the NC1000C-9 can be powered from different power supplies, an AC/DC adapter was chosen together with the client as a representative setup.

The test was done on the AC Power port of the AC/DC adapter. The AC/DC adapter had the following specifications: Manufacturer: HTC, Model: TC P900-EU, P/N: 79H00129-00M, S/N: 3DTA1431002451.

Measurement equipment	SP number
Pulse Limiter 9KHz-30MHz	13513
Receiver EMI Test 20Hz-26.5GHz	18880
V-network Two Line	20682

Results

The final measurements for AC power line conducted emission can be found in the diagram and tables below:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Margin (dB)	Limit (dBμV)
0.186700	29.3	9.000	N	34.90	64.20
0.501400	30.8	9.000	L1	25.20	56.00
14.584300	29.5	9.000	L1	30.50	60.00

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Margin (dB)	Limit (dBμV)
0.186700	17.0	9.000	N	37.20	54.20
0.501400	20.5	9.000	L1	25.50	46.00
14.584300	19.6	9.000	L1	30.40	50.00

Limits

According to 47CFR 15.207(a), Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms 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.

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

Complies?	YES
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Occupied bandwidth measurements according to 47CFR 2.1049 / RSS-Gen 6.7

Date 2016-04-19	Temperature 24 °C ± 3 °C	Humidity 24 % ± 5 %
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Test set-up and procedure

The measurements were performed according to ANSI C63.10-2013.

Conducted measurements were performed with the NC1000C-9 at the antenna connector and with continuous transmission and with modulation 2-FSK, 250 kBaud.

Measurement equipment	SP number
Test site RF Room	
Signal Analyser R&S ESI26	18880
Lenovo R500 Laptop	
Multimeter Agilent	14880
HP 6632A Power Supply	11386
Temperature and humidity meter CAN	14395

Results

The final measurements with modulation 2-FSK, 250kBaud can be found in the diagrams below:

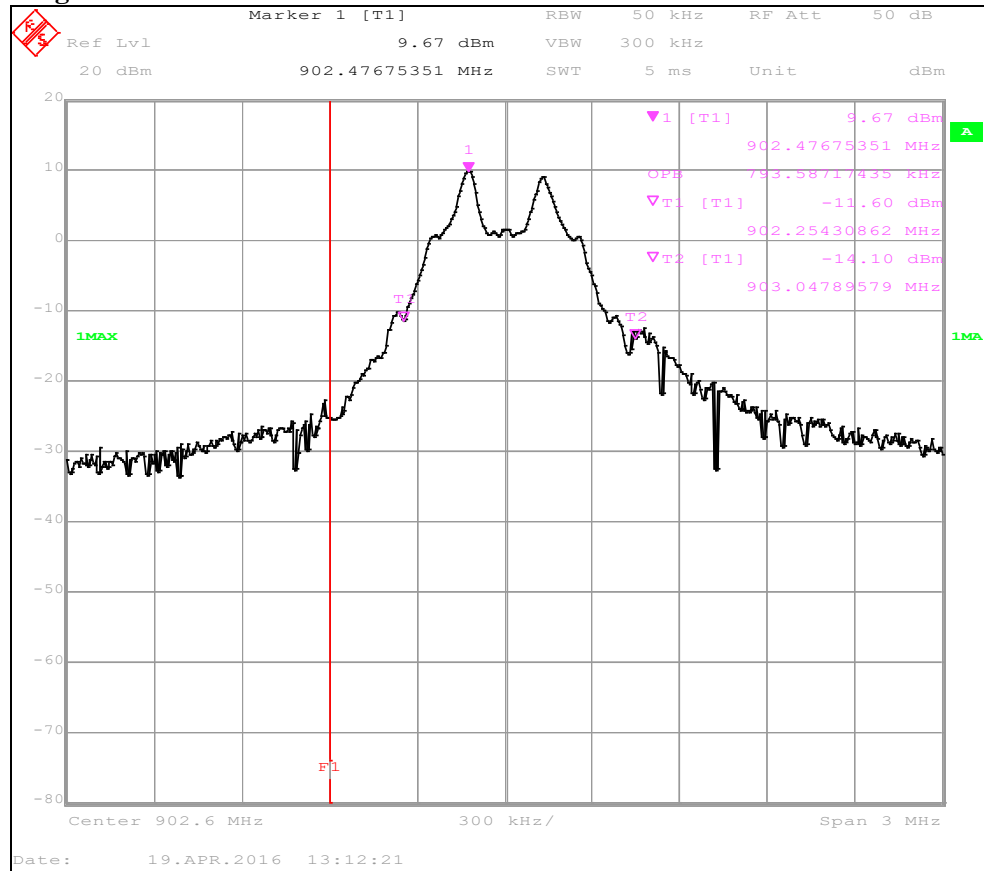
Diagram 1	902.6 MHz	OBW = 793 kHz (99%)
Diagram 2	915 MHz	OBW = 763 kHz (99%)
Diagram 3	927.4 MHz	OBW = 679 kHz (99%)

Complies?	YES
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2AB76NC1000C1

Appendix 10

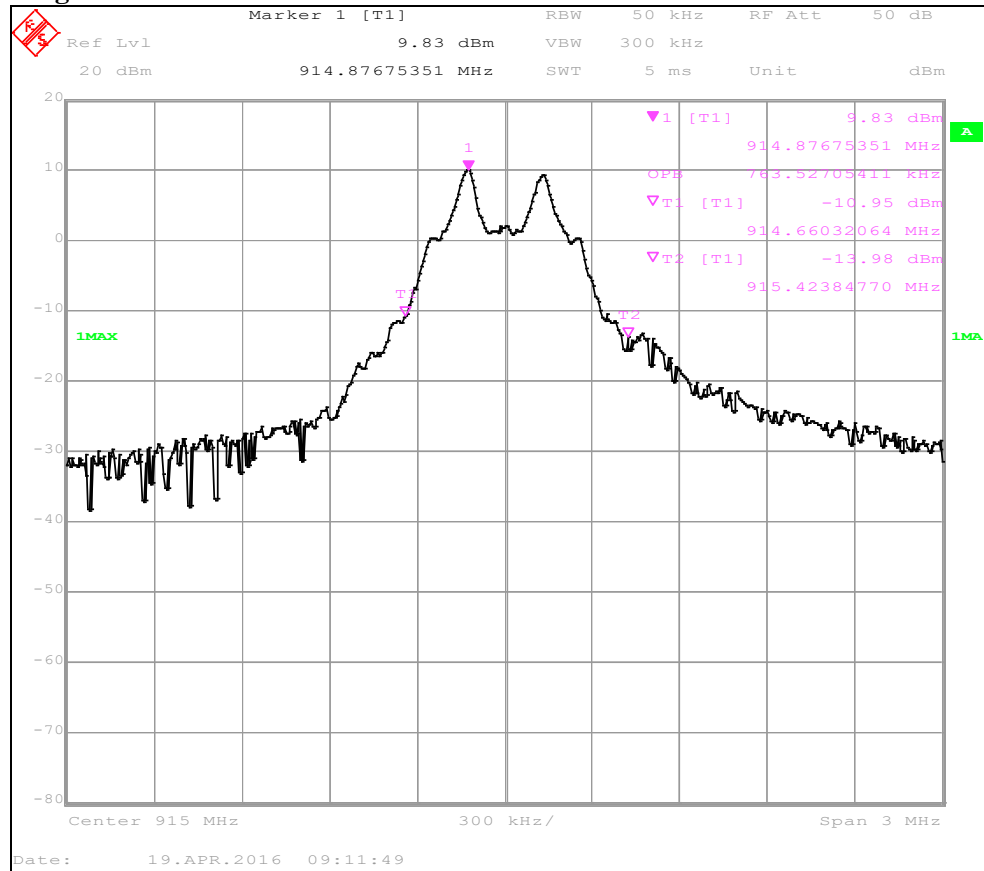
Diagram 1



2AB76NC1000C1

Appendix 10

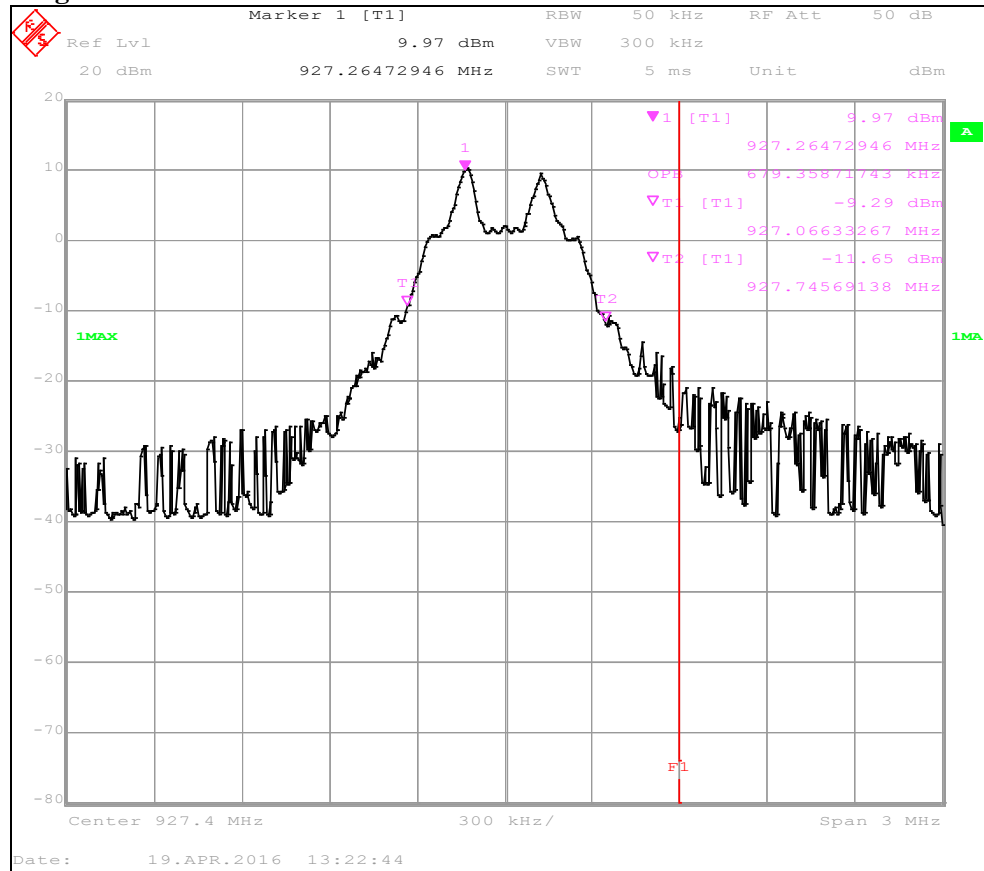
Diagram 2



2AB76NC1000C1

Appendix 10

Diagram 3



Band edge measurements according to FCC 47 CFR part 15.247 (d) / KDB 558074 / RSS-247 5.5 / RSS-Gen 8.10

Date	Temperature	Humidity
2016-08-30	23 °C ± 3 °C	27 % ± 5 %

Test set-up and procedure

The measurements were performed according to ANSI C63.10-2013 and KDB 558074 D01 DTS Meas Guidance v05r02, April 2, 2019.

Average levels were measured according to ANSI C63.10 sec 11.13.3.3 with trace mode in Max hold and RMS Averaging Detector.

Radiated measurements at the restricted bands were performed in a semi anechoic chamber. The measurements were performed with both horizontal and vertical polarizations of the antenna. The antenna distance during the measurements was 3.0 m in the frequency range 30 MHz-10 GHz.

The EUT height above the reference ground plane was 0.8 m in the frequency range 30-1000 MHz and 1.5 m in the frequency range 1-10 GHz.

Conducted measurements were performed with the NC1000C-9 at the antenna connector and with continuous transmission and with modulation 2-FSK, 250 kBaud.

Test set-up photos during the tests can be found in Appendix 12.

Measurement equipment	SP number
Test site RF Room	
Signal Analyser R&S ESI26	18880
Lenovo R500 Laptop	
Multimeter Agilent	14880
HP 6632A Power Supply	11386
Temperature and humidity meter CAN	14395

Results

Operation band 902-928 MHz

Diagram 1	902 MHz	Band edge at 614 MHz (restricted band)
Diagram 2	902.6 MHz	Band edge at 902.6 MHz (20 dBc) *
Diagram 3	927.4 MHz	Band edge at 927.4 MHz (20 dBc) *
Diagram 4	928 MHz	Band edge at 960 MHz (restricted band)

Note 1: Operating Band limited to 902.6 – 927.4 MHz

Final measurements:

902 MHz:

Frequency (MHz)	QP level (dB μ V/m)	QP Limit (dB μ V/m)	dBc, peak det (limit=20dBc)	Polarization
614.00 *)	< 46	46	N/A	Horizontal
902.6 **)	N/A	N/A	28.7	Vertical

*) Restricted band

**) 20 dBc

928 MHz:

Frequency (MHz)	QP level (dB μ V/m)	QP Limit (dB μ V/m)	dBc, peak det (limit=20dBc)	Polarization
927.4 **)	N/A	N/A	28.7	Vertical
960.00 *)	<54	54.0	N/A	Horizontal

*) Restricted band

**) 20 dBc

Limits

Band edge at 614 MHz and 960 MHz (Restricted bands):

According to 47CFR 15.247(d), In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

According to RSS-Gen 8.10, Restricted bands, identified in Table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

- (a) Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 7 except for apparatus complying under RSS-287;
- (b) Unwanted emissions that fall into restricted bands of Table 7 shall comply with the limits specified in in table 5 and table 6.
- (c) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

Band edge at 902 MHz and 928 MHz (Non restricted bands):

According to 47CFR 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

According to RSS-247 5.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the

100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Complies?	Yes
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2AB76NC1000C1

Appendix 11

Diagram 1

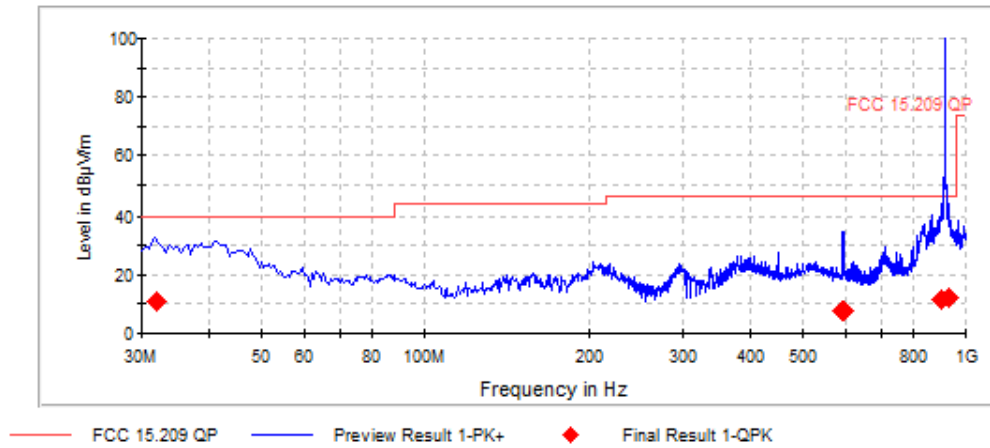


Diagram 2

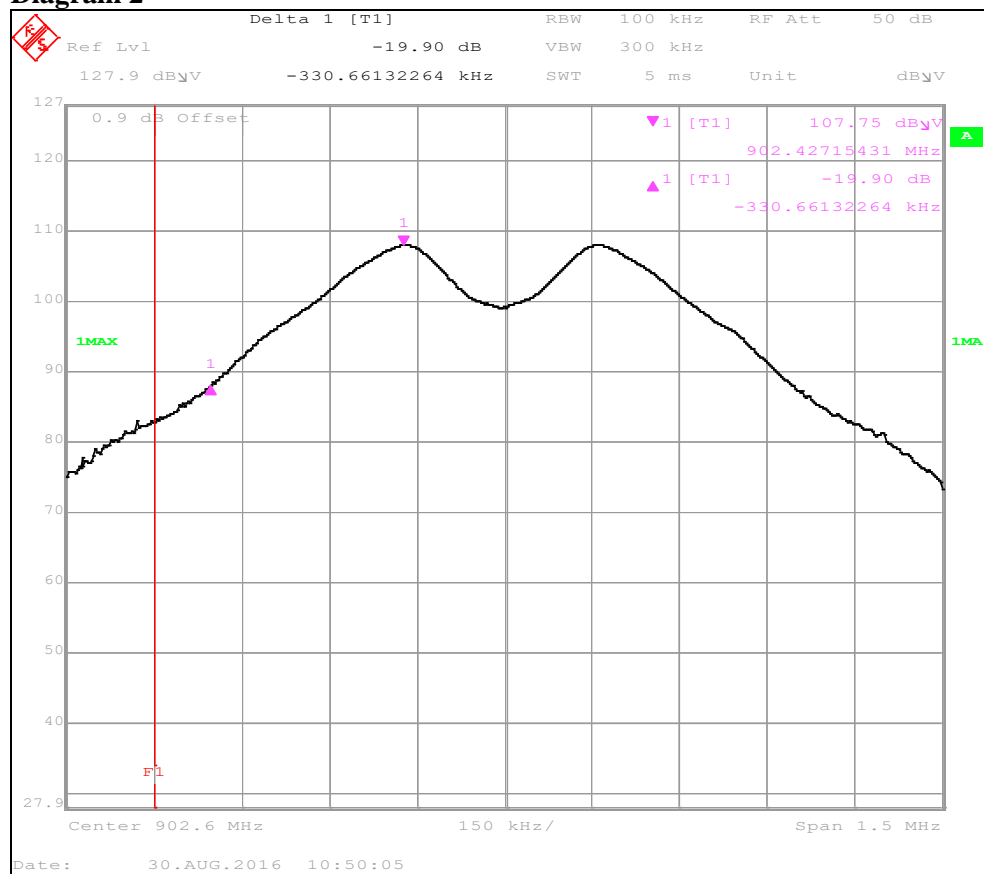


Figure 1 Frequencyline F1 @ 902 MHz

2AB76NC1000C1

Appendix 11

Diagram 3

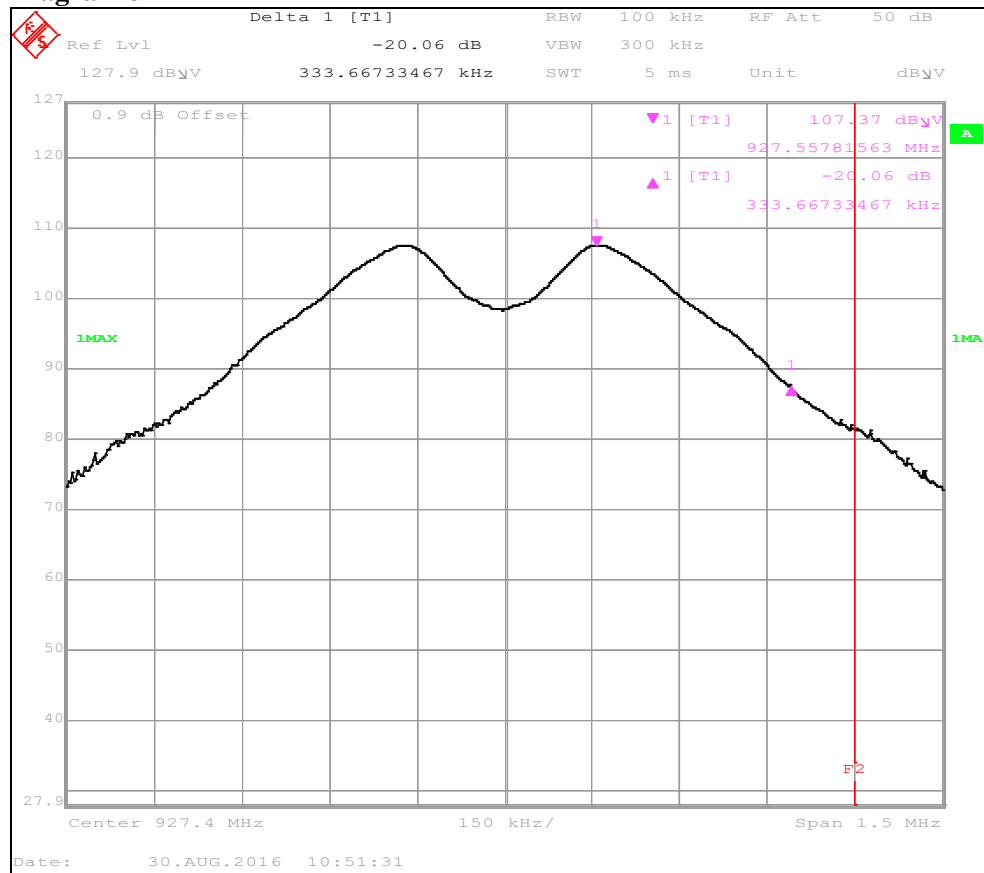
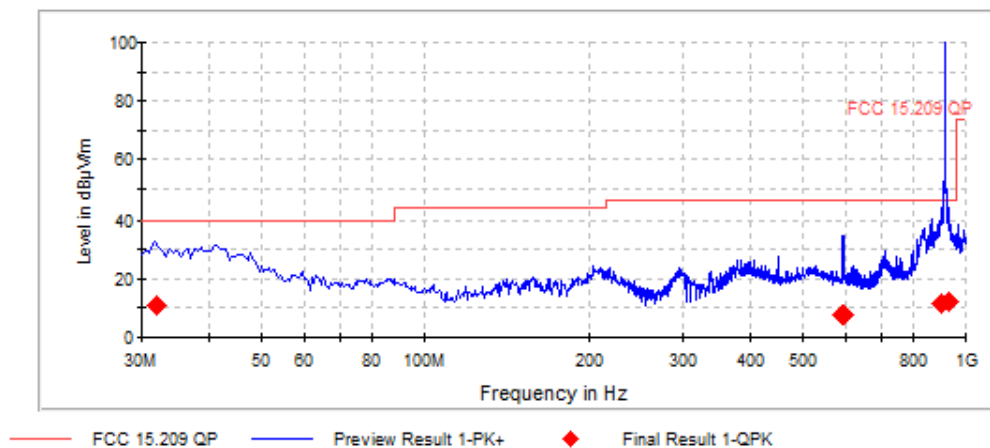


Figure 2 Frequencyline F2 @ 928 MHz

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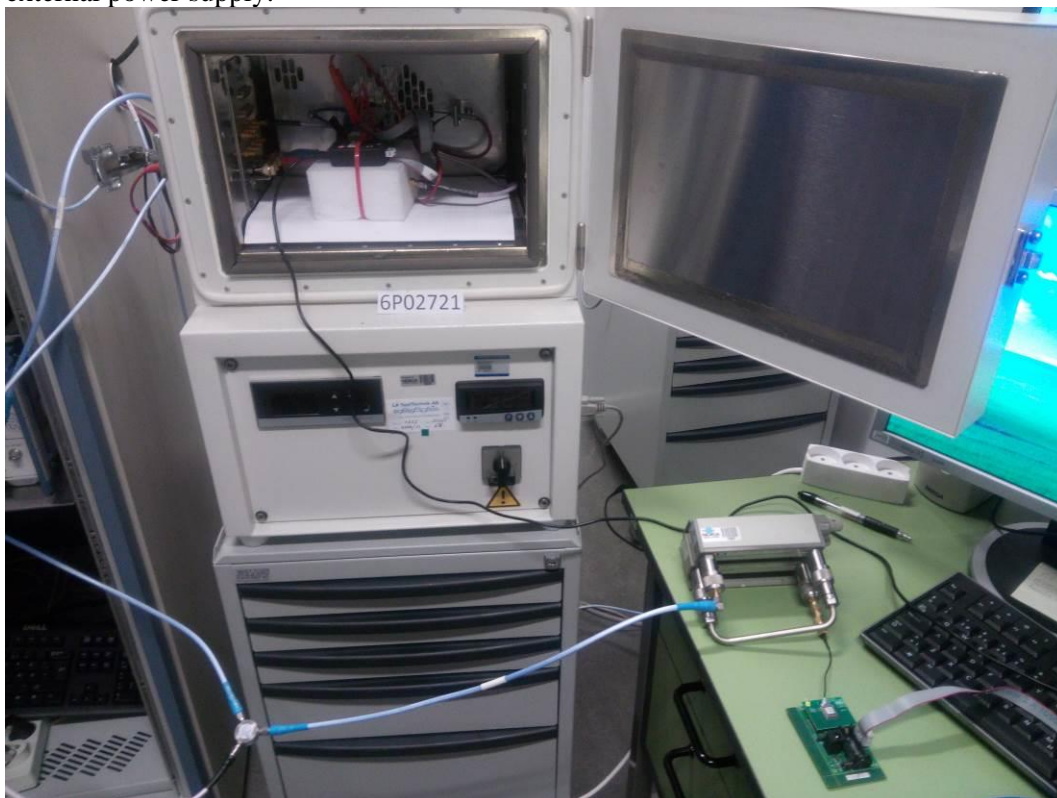
Appendix 11

Diagram 4



Photos

The test set-up during all the conducted RF tests can be seen in the pictures below, powered by the external power supply.

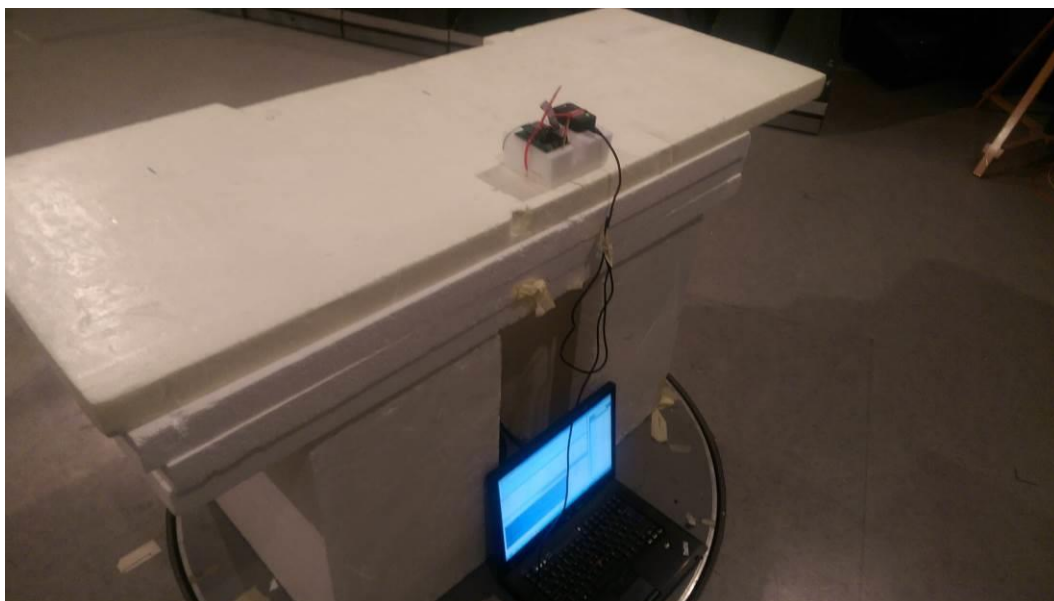


The test set-up during the AC power line conducted emission test can be seen in the picture below, powered by the external power supply.



The test set-up during all the radiated tests can be seen in the pictures below.

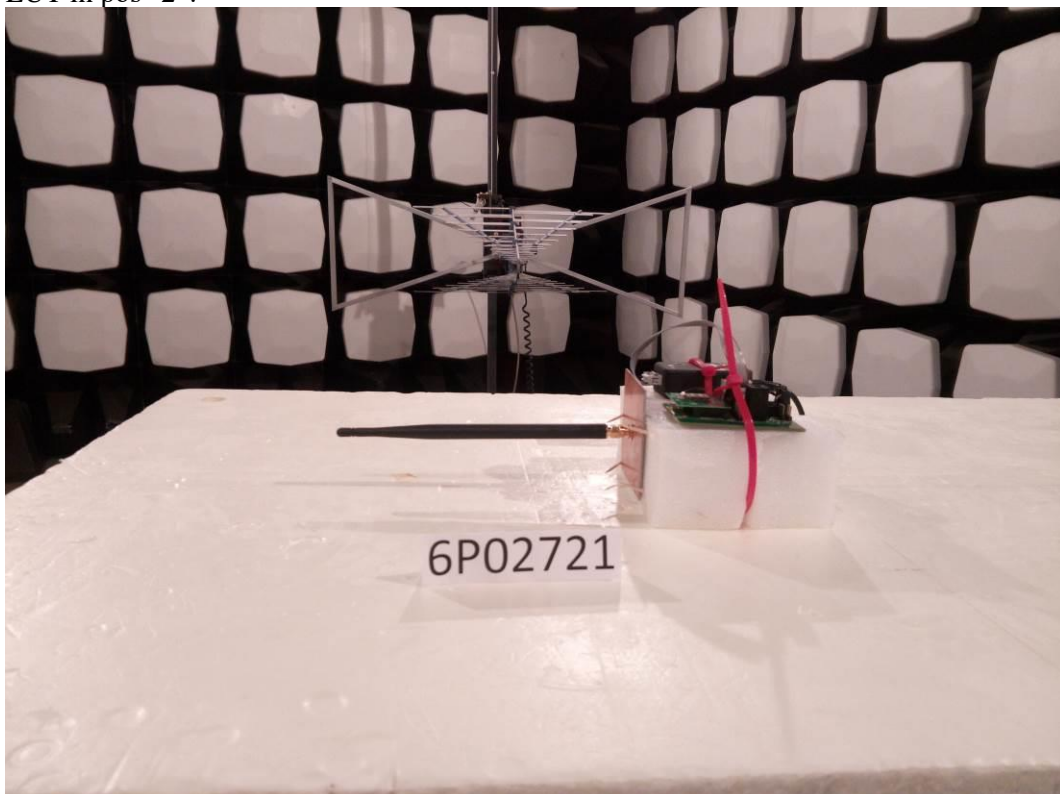
EUT set-up (measurements below 1 GHz):



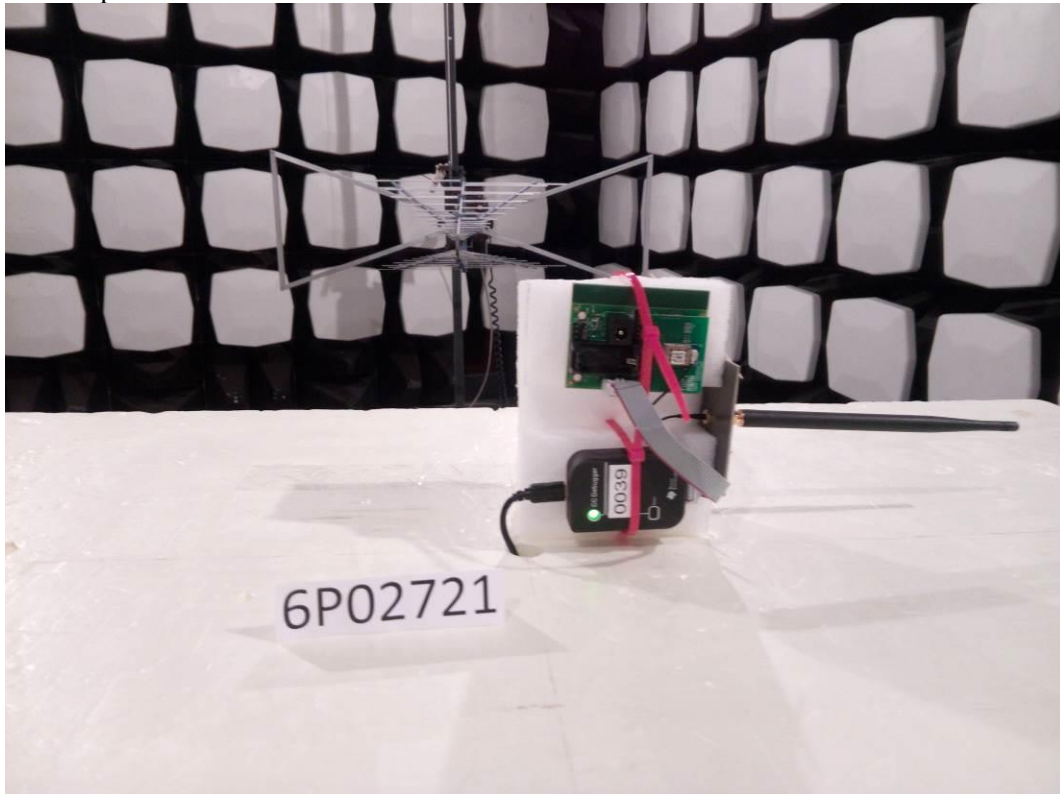
EUT in pos “1”:



EUT in pos “2”:



EUT in pos “3”:



30-1000 MHz:



1-10 GHz:

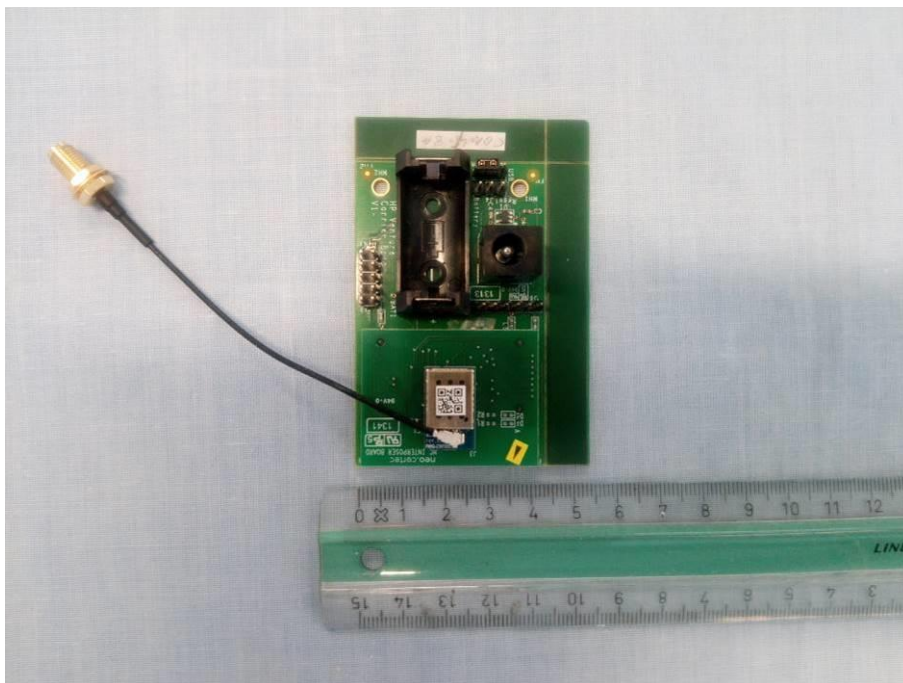
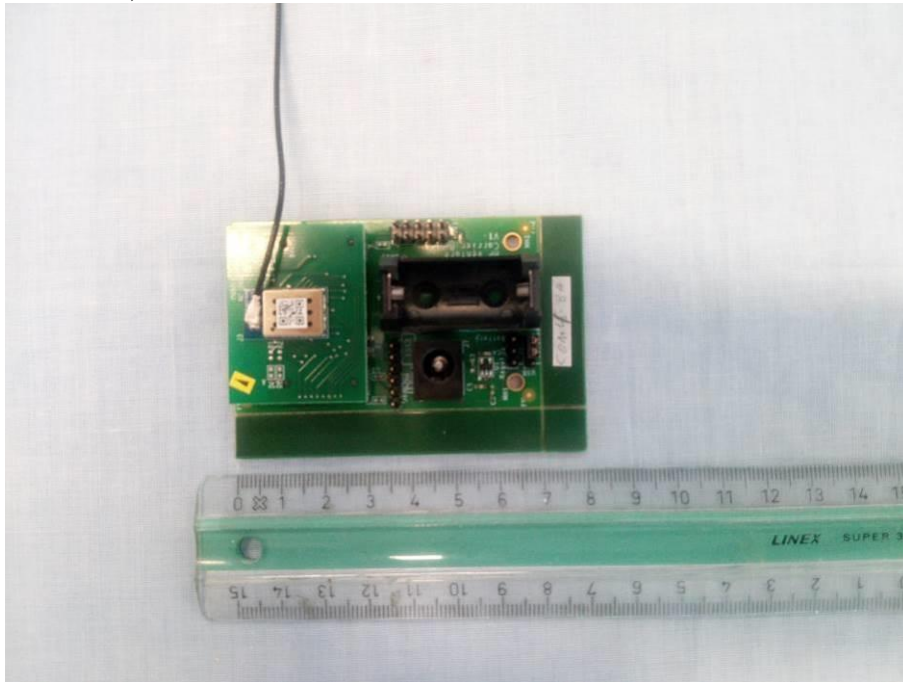


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Appendix 12

EUT, radiated sample

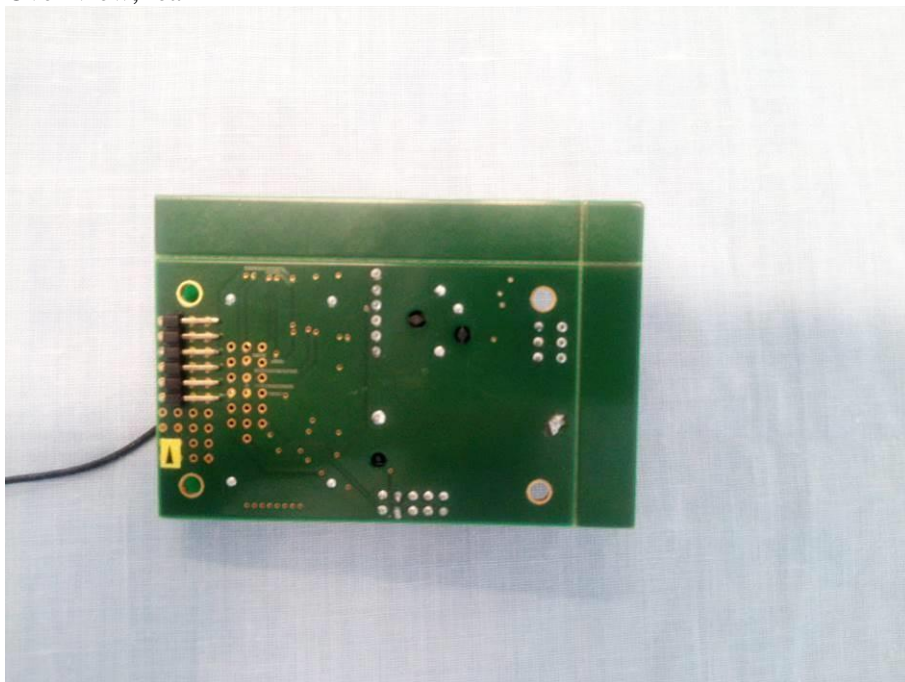
Over view, front



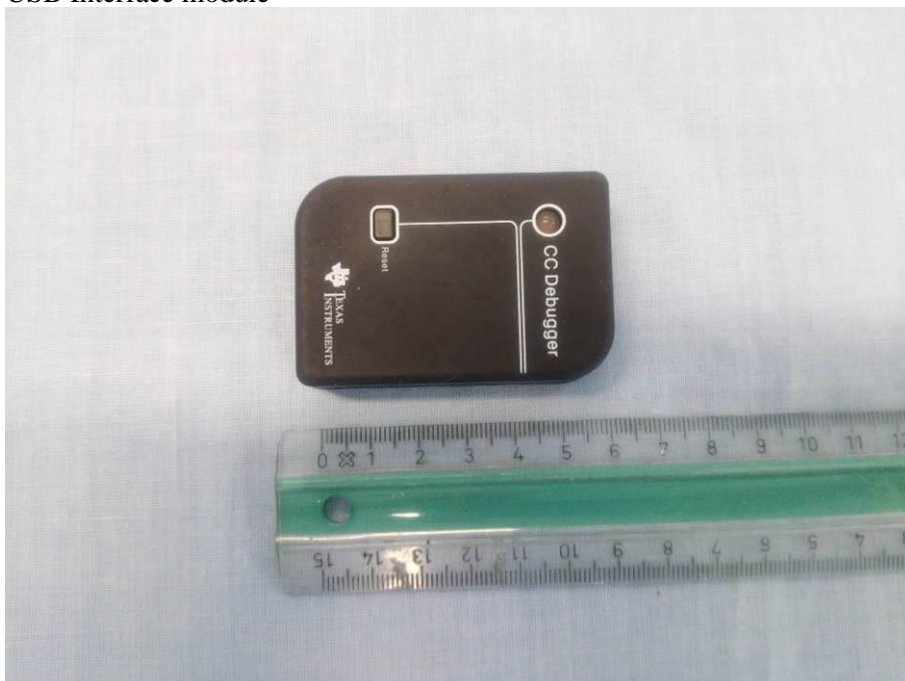
2AB76NC1000C1

Appendix 12

Over-view, rear



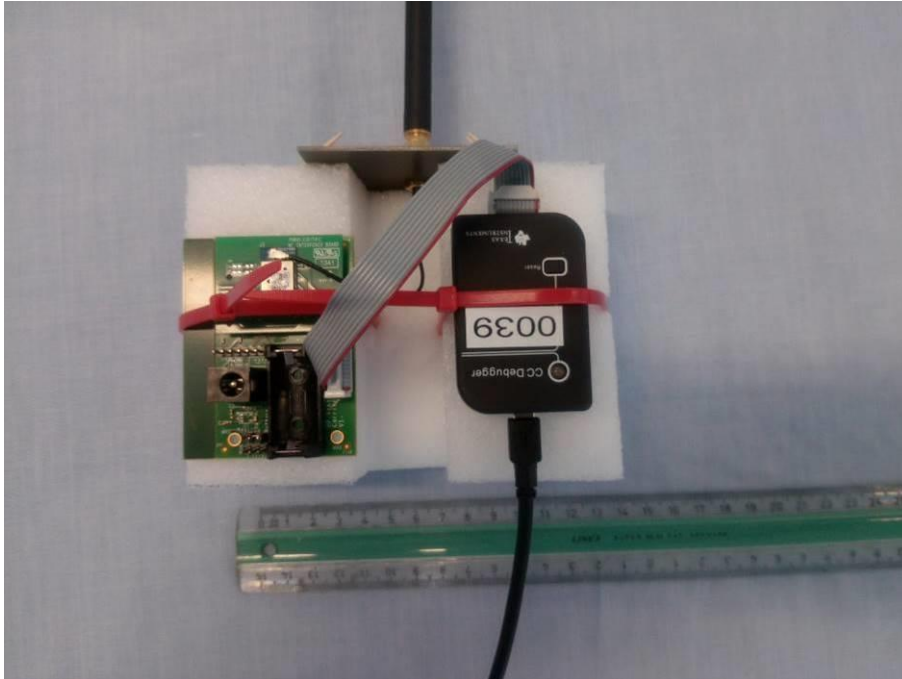
USB Interface module



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Appendix 12

Combination of units



Antenna

