ilac-MRA ENAC ENSAYOS Nº 51/LE147

FCC LISTED, REGISTRATION NUMBER: 720267

ISED LISTED REGISTRATION NUMBER 4621A-2

Informe de ensayo nº:
Test report No:

NIE: 55231RRF.002

Test report
REFERENCE STANDARD:
USA FCC Part 15.225 and Part 15.209 & CANADA RSS-210

Identificación del objeto ensayado.....: Identification of item tested	Electronic Cylinder including all mechanical variants
Marca .....: Trademark	SALTO Neo
Modelo y/o referencia tipo .....: Model and /or type reference	N0B (Type reference: G1824)
Other identification of the product .....:	FCC ID: UKCN0B IC: 10088A-N0B
Final HW version .....:	1.0
Final SW version .....:	Control Firmware: 0158 Motor Firmware: 0148 BGM111 Firmware: 0136
Características .....: Features	Contains a certified Bluetooth module (BGM111)
Solicitante.....: Applicant	SALTO Systems, S.L. Arkotz 9, Polígono Lanbarren 20180, Oiartzun, Gipuzkoa, SPAIN
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 15.225 (10–1–17 Edition): Operation within the band 13.110 -14.010. USA FCC Part 15.209 (10–1–17 Edition): Radiated emission limits, general requirements. CANADA RSS-210 Issue 9 (August 2016). CANADA RSS-Gen Issue 4 (November 2014). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Resultado.....: Summary	IN COMPLIANCE
Aprobado por (nombre / cargo y firma) .....: Approved by (name / position & signature)	A. Llamas RF Lab. Manager Firmado digitalmente por ALEJANDRO LLAMAS RODRIGUEZ Fecha: 2018.09.14 10:20:42 +02'00'
Fecha de realización .....: Date of issue	2018-09-14
Formato de informe No......: Report template No	FDT08_20

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Competences and guarantees

DEKRA Testing and Certification is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjuction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

DEKRA Testing and Certification is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: ISED 4621A-2.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

DEKRA Testing and Certification is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
55231C/004	Electronic cylinder	N0B / Type reference G1824	---	2018/06/21

1. Sample S/01 has undergone following test(s).

   All radiated tests indicated in appendix A.

Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
55231C/008	Electronic cylinder with SMA connector	N0B / Type reference G1824	---	2018/07/19

1. Sample S/02 has undergone following test(s).

   All conducted tests for ISO14443A indicated in appendix A.

Sample S/03 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
55231C/007	Electronic cylinder with SMA connector	N0B / Type reference G1824	---	2018/07/19

1. Sample S/03 has undergone following test(s).

   All conducted tests for ISO15693 indicated in appendix A.

Test sample description

The test sample consists of a new generation electronic cylinder, with Bluetooth Smart (BGM111 module) and ISO14443A & ISO15693 standard based technology - Mifare.

Identification of the client

SALTO Systems, S.L.
Arkotz 9, Polígono Lanbarren
20180, Oiartzun, Gipuzkoa, SPAIN

Testing period

The performed test started on 2018-06-22 and finished on 2018-07-19.

The tests have been performed at DEKRA Testing and Certification.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Remarks and comments

1: Tests have been performed by the technical personnel: Carlos Alberto Contreras, Carolina Postigo and Jose Alberto Aranda.

2: Used instrumentation.

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Spectrum analyser Rohde & Schwarz FSV40	2017/07	2019/07
2.	Climatic chamber HERAEUS VM 04/35	2018/06	2020/06
3.	DC power supply R&S NGPE 40/40	2018/02	2021/02

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2017/04	2020/04
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	EMI Test Receiver R&S ESU 26	2018/02	2020/02
5.	RF pre-amplifier 30 MHz-6 GHz Bonn Elektronik BLNA 0360-01N	2017/07	2018/07
6.	Active Loop Antenna 9 kHz-30 MHz Schwarzbeck FMZ 1519B	2018/01	2021/01
7.	Antenna tripod EMCO 11968C.	N.A.	N.A.

Testing verdicts

Not applicable ..... :	N/A
Pass ..... :	P
Fail ..... :	F
Not measured ..... :	N/M

FCC PART 15/RSS-210 PARAGRAPH	VERDICT			
	NA	**P**	**F**	**NM**
15.225 Subclause (a) / RSS-210 Clause B.6 (a). Field strength of emissions within the band 13.553 MHz -13.567 MHz		P		
15.225 Subclause (b) / RSS-210 Clause B.6 (b). Field strength of emissions within the band 13.410 - 13.553 MHz and 13.567 – 13.710 MHz		P		
15.225 Subclause (c) / RSS-210 Clause B.6 (c). Field strength of emissions within the band 13.110 - 13.410 MHz and 13.710 – 14.010 MHz		P		
15.225 Subclause (d) / RSS-210 Clause B.6 (d). Field strength of emissions outside of the band 13.110 MHz -14.010 MHz		P		
15.225 Subclause (e) / RSS-210 Clause B.6. Frequency tolerance of the carrier signal		P		

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TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 6.0 Vdc

Vmin = 5.1 Vdc

Vmax = 6.9 Vdc

The subscripts nom, min and max indicate voltage test conditions (nominal, minimum and maximum respectively).

Type of power supply = DC voltage from batteries.

Type of antenna = Integral antenna

Operating Temperature Range (ºC):

T_{nom} = +15 to + 35

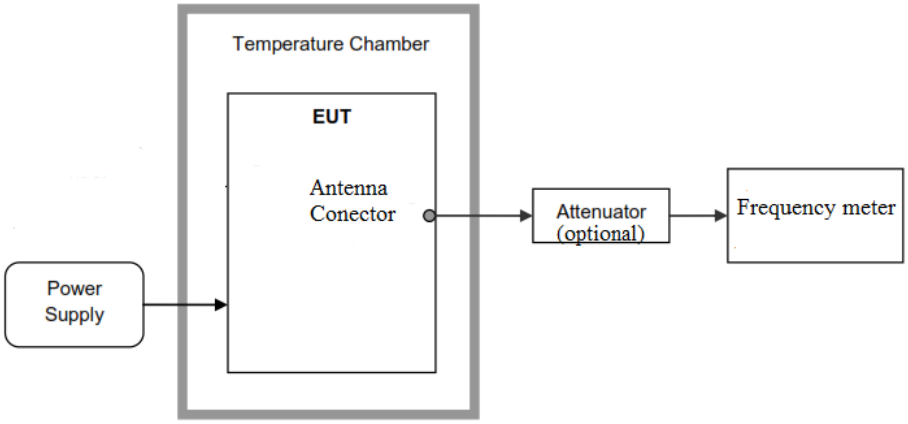
TEST FREQUENCIES:

Nominal Operating frequency: 13.56 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is directly connected to the spectrum analyzer.

For frequency stability test the EUT was placed inside a climatic chamber and connected to a frequency meter using a low loss cable. An external DC power supply was connected to the EUT for voltage variation test.



RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Loop antenna for the range between 9 kHz to 30 MHz and Bilog antenna for the range between 30 MHz to 200 MHz) is situated at a distance of 3 m.

For radiated emissions in the range 9 kHz to 30 MHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 40 dB per decade is used to normalize the measured data for determining compliance.

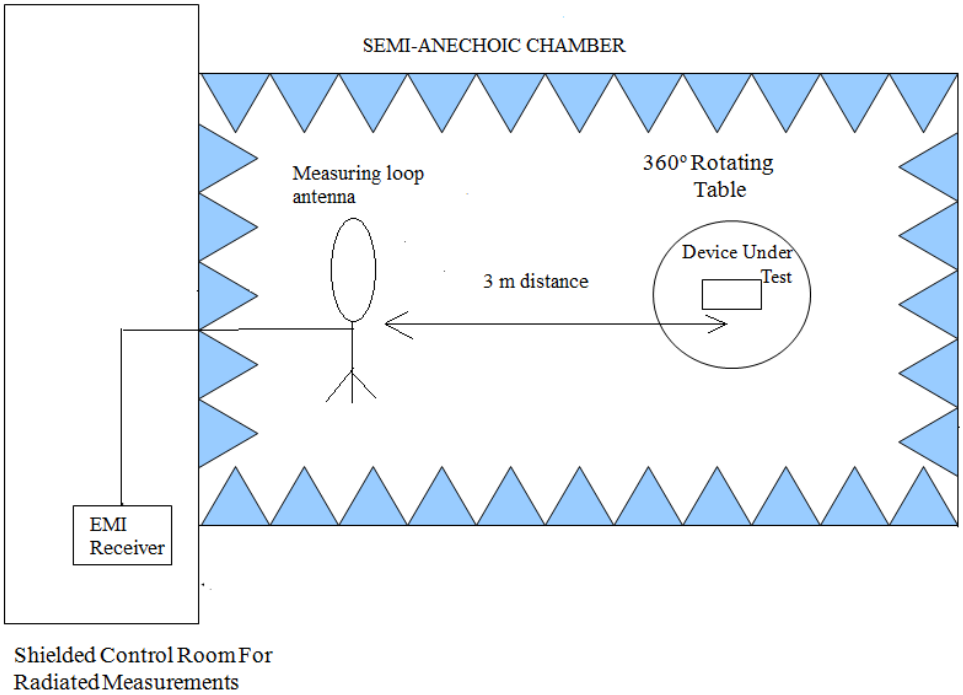
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and in the range between 30 MHz and 200 MHz the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

In the range between 9 kHz and 30 MHz the measurements were made in the three different orientation planes of the loop antenna to determine the maximum received field.

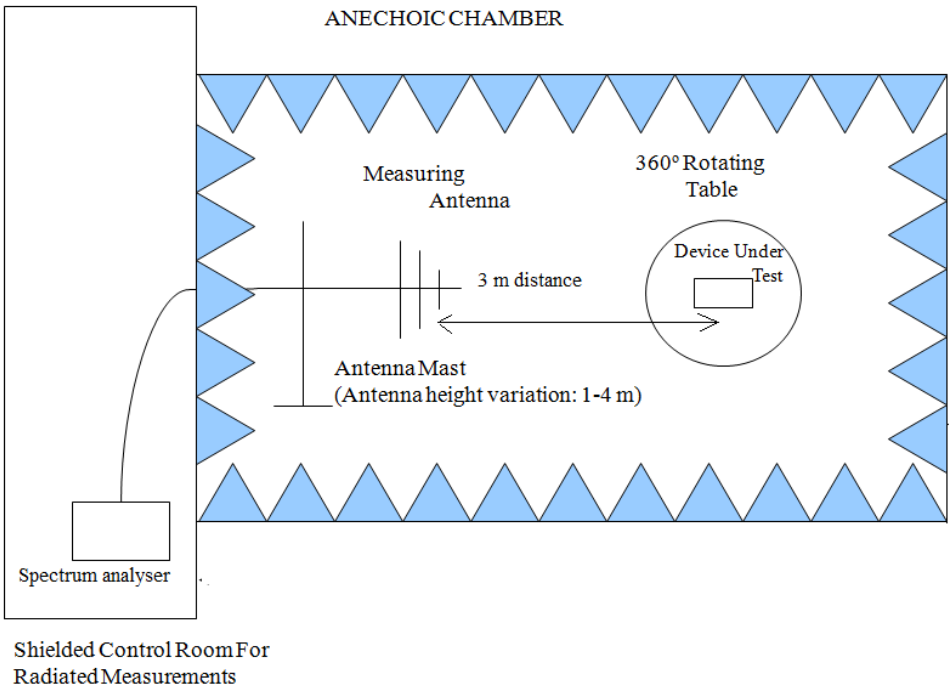
In the range between 30 MHz and 200 MHz the measurements were made in both horizontal and vertical planes of polarization.

The test was performed with the equipment transmitting first with only the 13.56 MHz radio and repeated with the 2.4 GHz BT LE radio transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained.

Radiated measurements setup 9 kHz to 30 MHz.



Radiated measurements setup 30 MHz to 200 MHz.



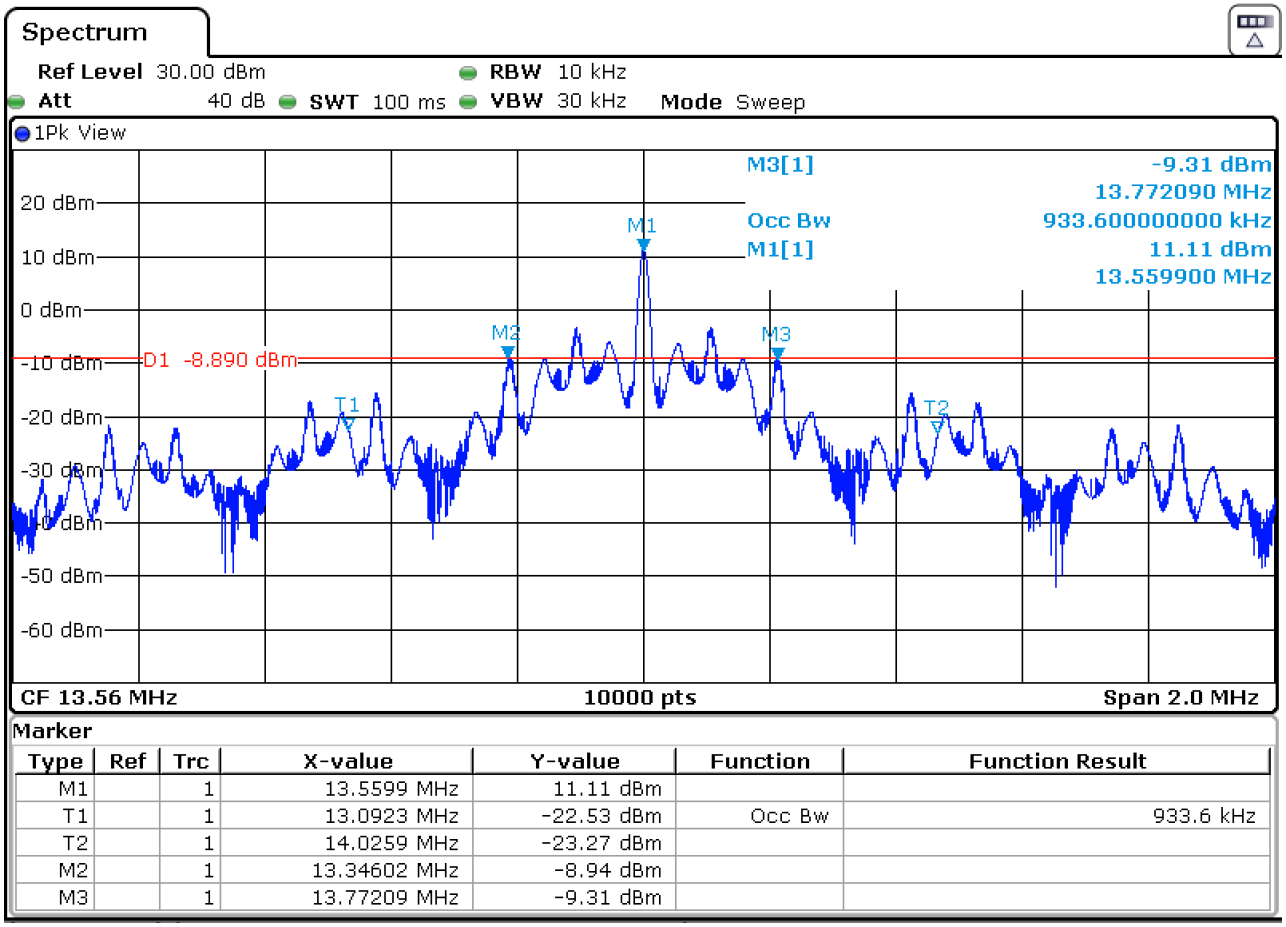
Occupied Bandwidth and 20 dB Bandwidth

RESULTS

99 % Occupied Bandwidth and 20 dB Bandwidth (see next plots).

NFC ISO 14443A

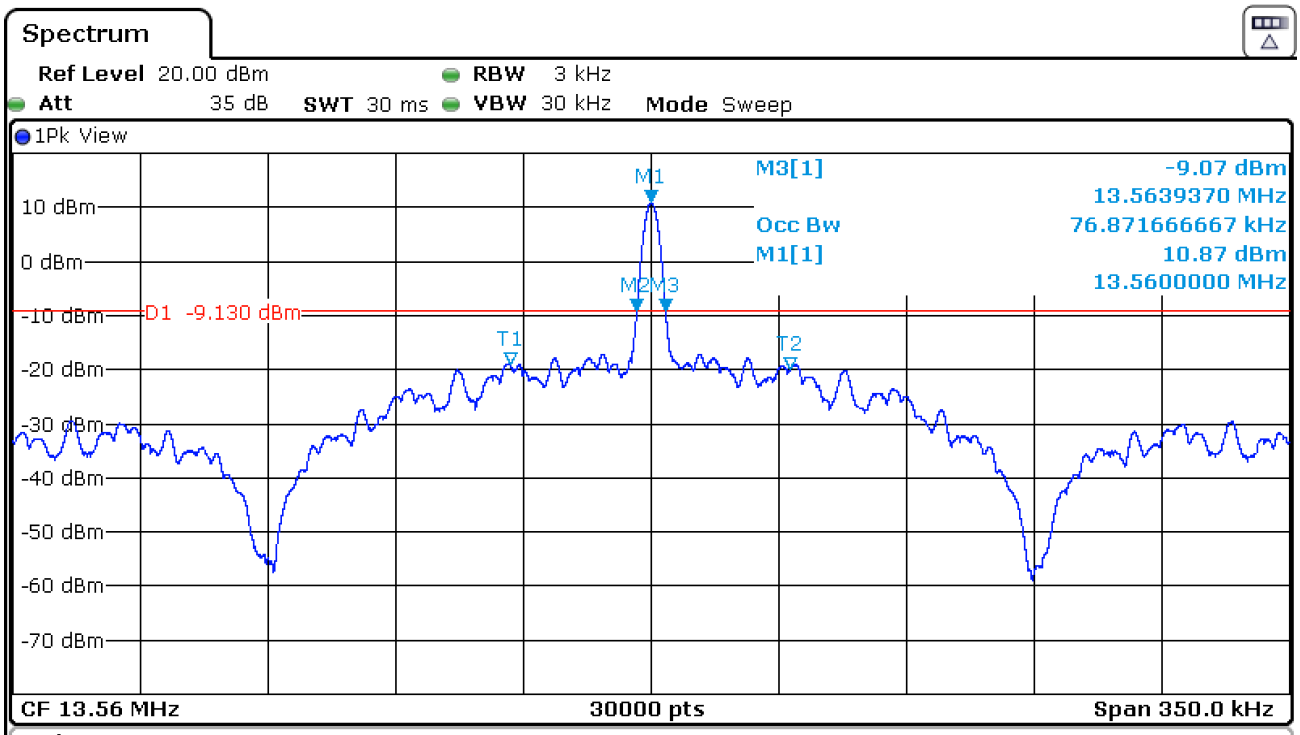
Operation mode	99% occupied bandwith (kHz)	20 dB bandwidth (kHz)
NFC	933.6	426.1
Measurement uncertainty (kHz)	<±1.20	



Verdict: PASS

NFC ISO 15693

Operation mode	99% occupied bandwith (kHz)	20 dB bandwidth (kHz)
NFC	76.9	7.9
Measurement uncertainty (kHz)	<±1.20	



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	13.56 MHz	10.87 dBm		
T1		1	13.5213542 MHz	-19.14 dBm	Occ Bw	76.871666667 kHz
T2		1	13.5982258 MHz	-19.80 dBm		
M2		1	13.556039 MHz	-9.12 dBm		
M3		1	13.563937 MHz	-9.07 dBm		

Verdict: PASS

Section 15.225 Subclause (a) / RSS-210 Clause B.6 (a). Field strength of emissions within the band 13.553 MHz -13.567 MHz

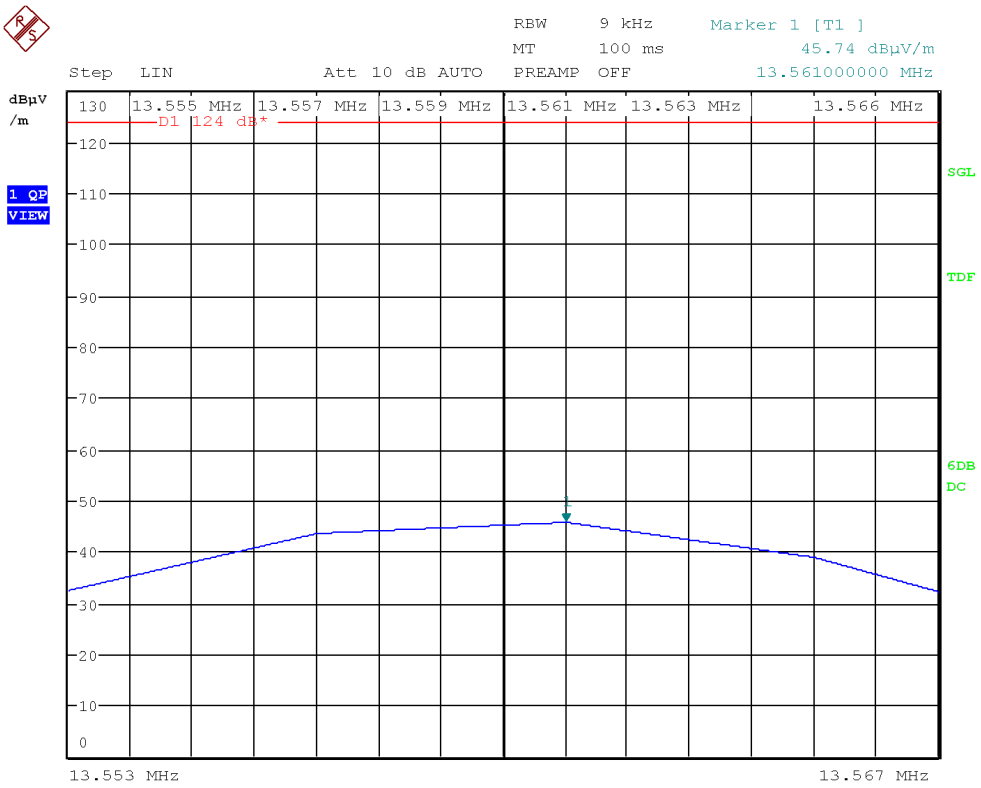
SPECIFICATION

The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts/meter (84 dBµV/m) at 30 meters.

RESULTS

Measurement distance: 3 meters

NFC ISO 14443A

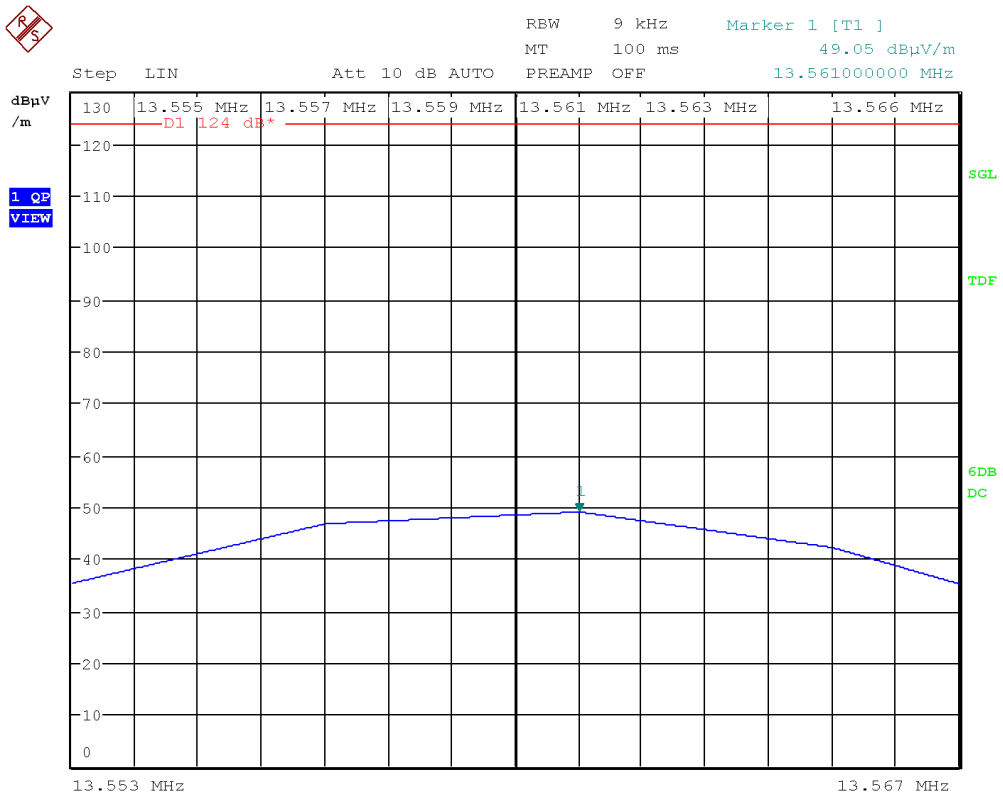


Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.561	45.74	5.74
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

NFC ISO 15693



Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.561	49.05	9.05
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

Section 15.225 Subclause (b) / RSS-210 Clause B.6 (b). Field strength of emissions within the band 13.410 MHz -13.553 MHz and 13.567 MHz -13.710 MHz

SPECIFICATION

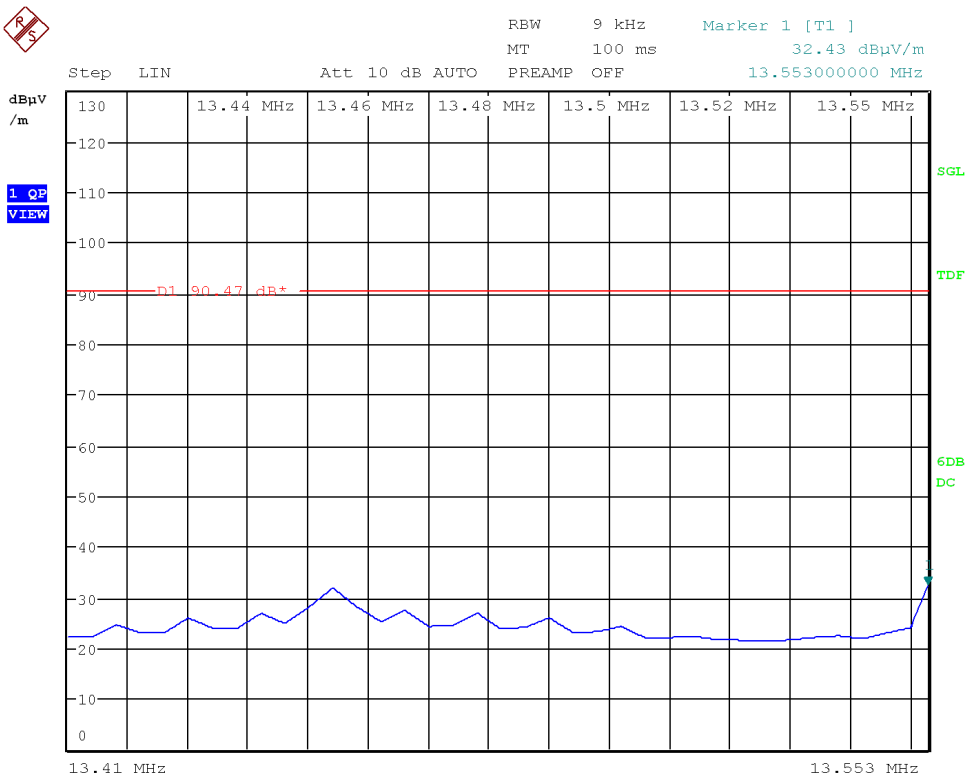
Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter (50.47 dBµV/m) at 30 meters.

RESULTS

Band 13.410-13.553 MHz

Measurement distance: 3 meters.

NFC ISO 14443A

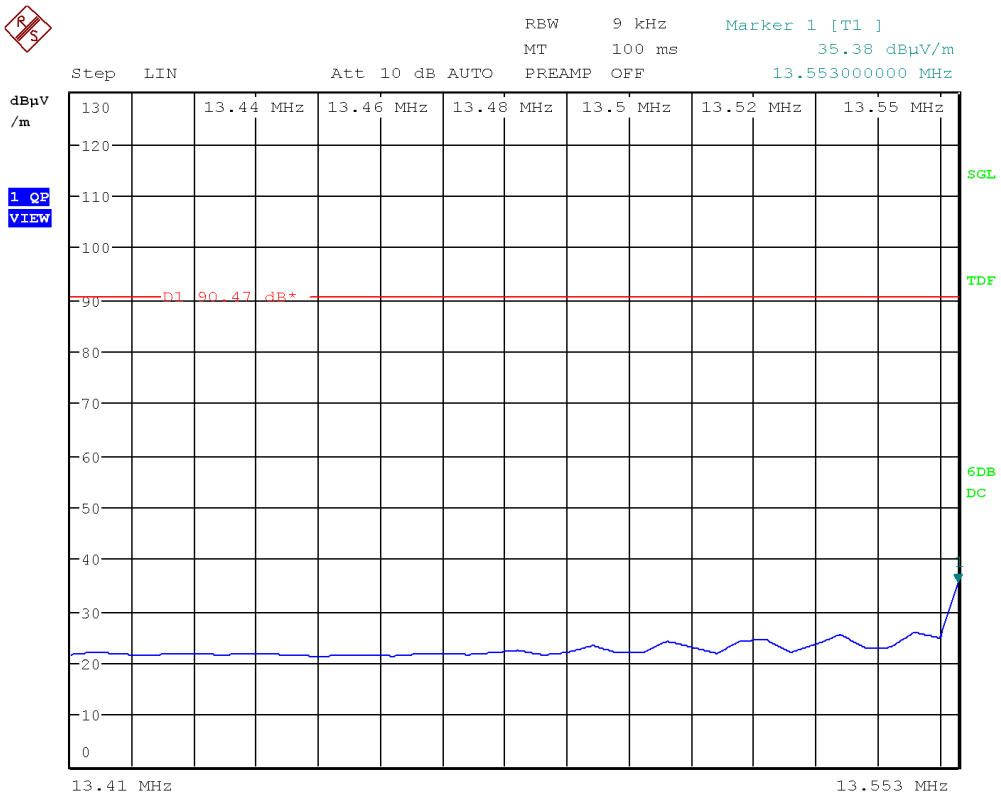


Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.553	32.43	-7.57
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

NFC ISO 15693



Note: The limit shown in the above plot is extrapolated to 3 meters

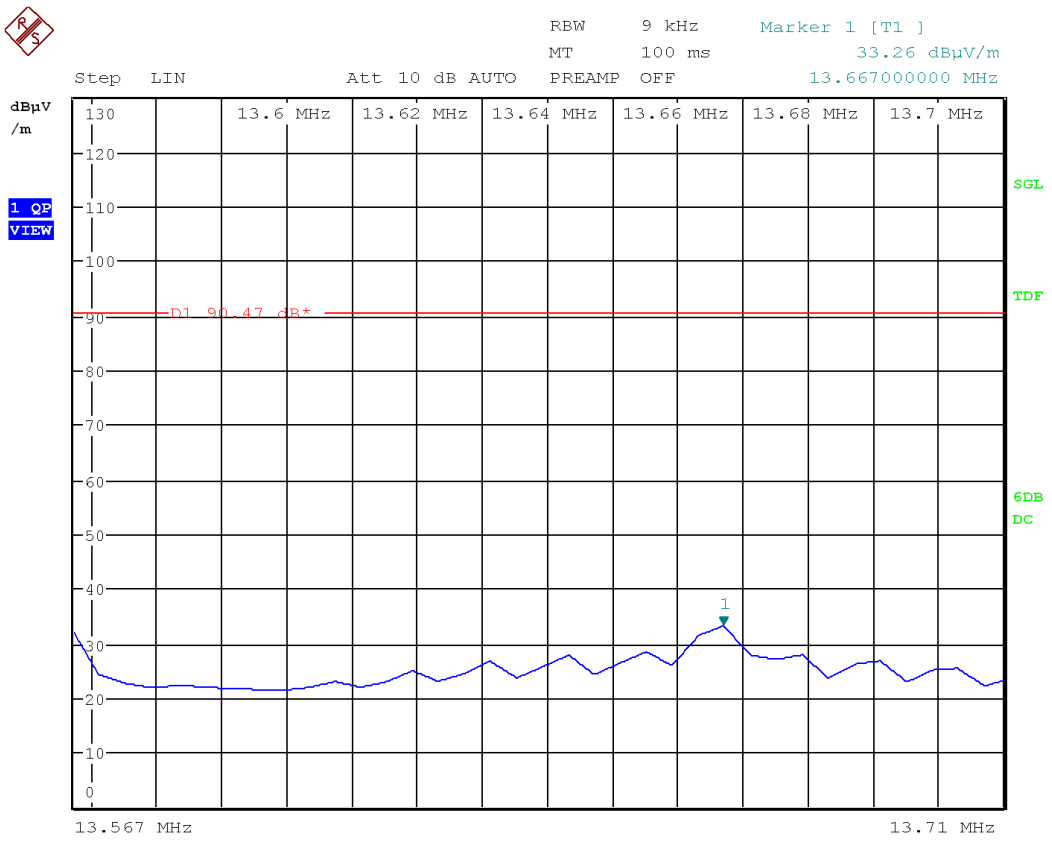
Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.553	35.38	-4.62
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

Band 13.567-13.710 MHz

Measurement distance: 3 meters.

NFC ISO 14443A

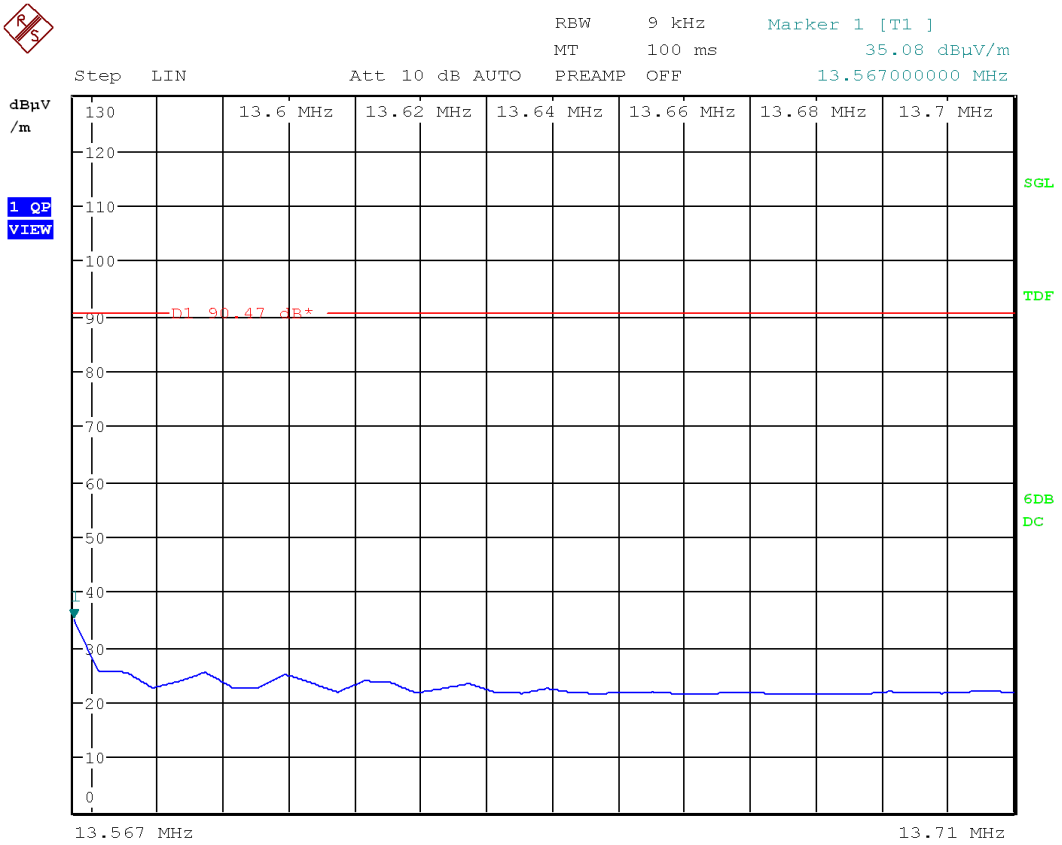


Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.667	33.26	-6.74
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

NFC ISO 15693



Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.567	35.08	-4.92
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

Section 15.225 Subclause (c) / RSS-210 Clause B.6 (c). Field strength of emissions within the band 13.110 MHz -13.410 MHz and 13.710 MHz -14.010 MHz

SPECIFICATION

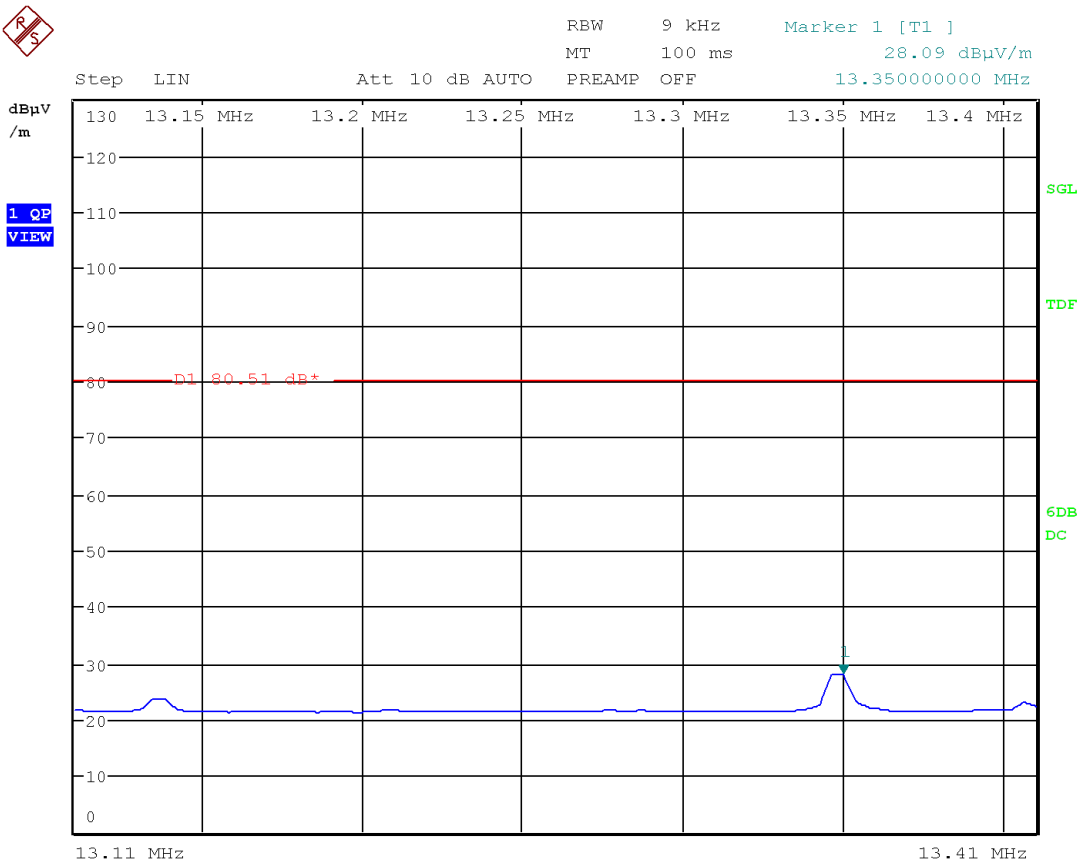
Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz, the field strength of any emissions shall not exceed 106 microvolts/meter (40.51 dBµV/m) at 30 meters.

RESULTS

Band 13.110-13.410 MHz

Measurement distance: 3 meters.

NFC ISO 14443A

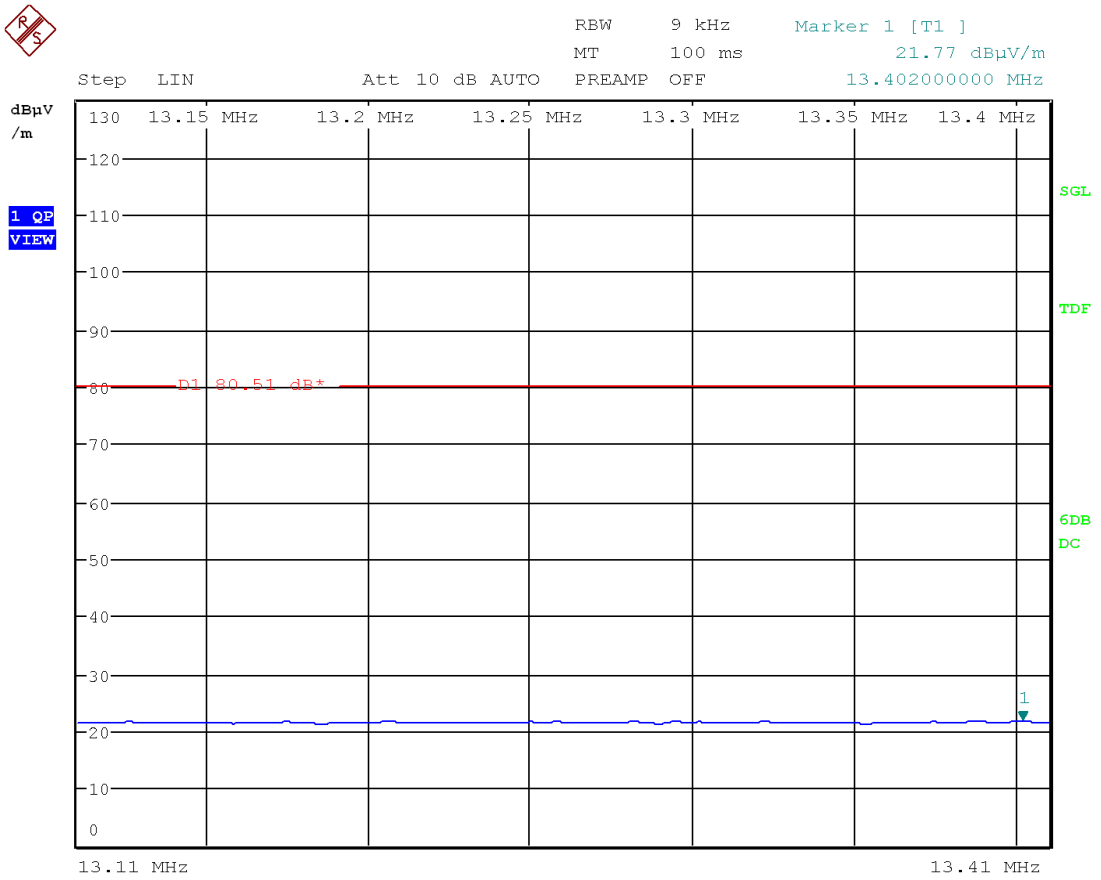


Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.350	28.09	-11.91
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

NFC ISO 15693



Note: The limit shown in the above plot is extrapolated to 3 meters

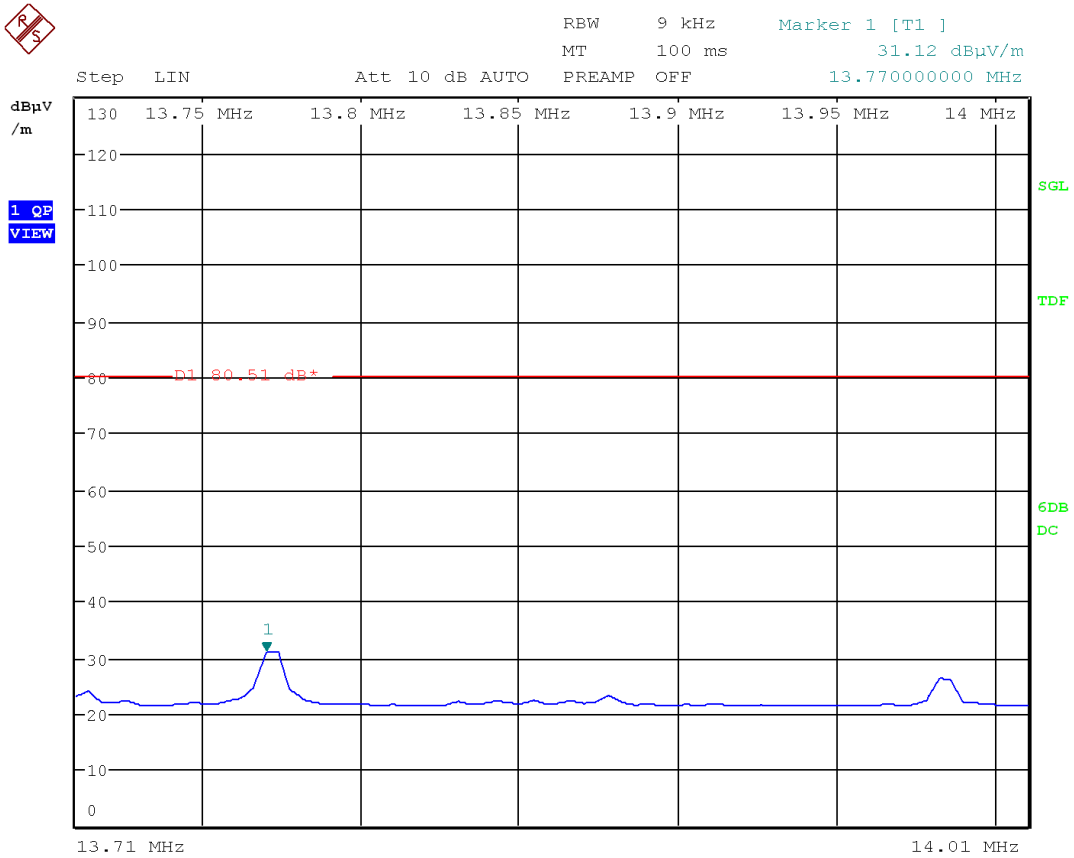
Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.402	21.77	-18.23
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

Band 13.710-14.010 MHz

Measurement distance: 3 meters.

NFC ISO 14443A

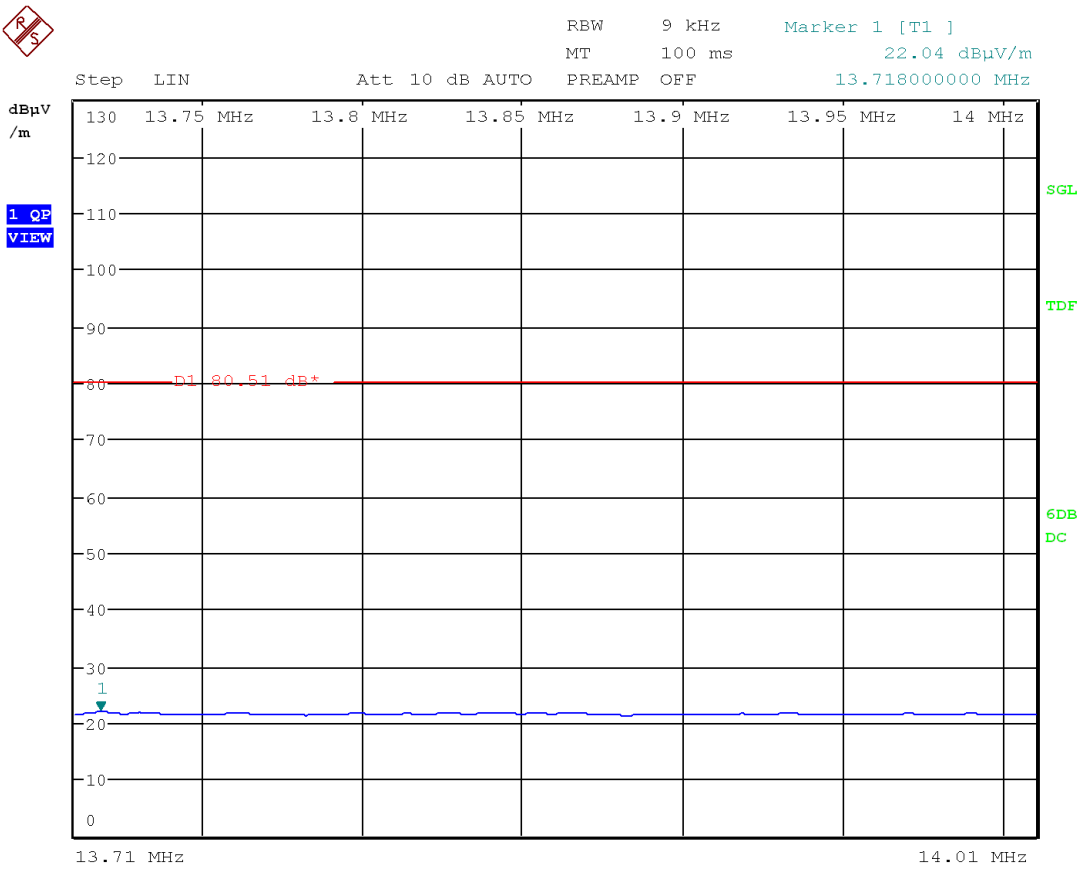


Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.770	31.12	-8.88
Measurement uncertainty (dB)	±3.61	

Verdict: PASS

NFC ISO 15693



Note: The limit shown in the above plot is extrapolated to 3 meters

Frequency (MHz)	Maximum field strength (dBµV/m) measured at 3 m (quasi-peak detector)	Maximum field strength (dBµV/m) extrapolated to 30 m (40 dB/decade)
13.718	22.04	-17.96
Measurement uncertainty (dB)	±3.61	

Verdict: PASS

Section 15.225 Subclause (d) / RSS-210 Clause B.6 (d). Field strength of emissions outside of the band 13.110 MHz -14.010 MHz

SPECIFICATION

Field strength of any emissions appearing outside of the band 13.110 MHz - 14.010 MHz band shall not exceed the general radiated emission limits in 15.209/RSS-Gen:

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	29.54	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

RESULTS:

All tests were performed in a semi-anechoic chamber at a distance of 3 m.

The spectrum was inspected from 9 kHz to 200 MHz searching for spurious signals.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifier gain.

The tests were performed with the equipment transmitting first with only NFC mode and then repeated with the 2.4 GHz BT-LE and NFC transmitting simultaneously to check the impact of the co-location of the other radio interfaces. The results and plots below show the worst results obtained.

NFC ISO 14443A

Frequency range 9 kHz-30 MHz.

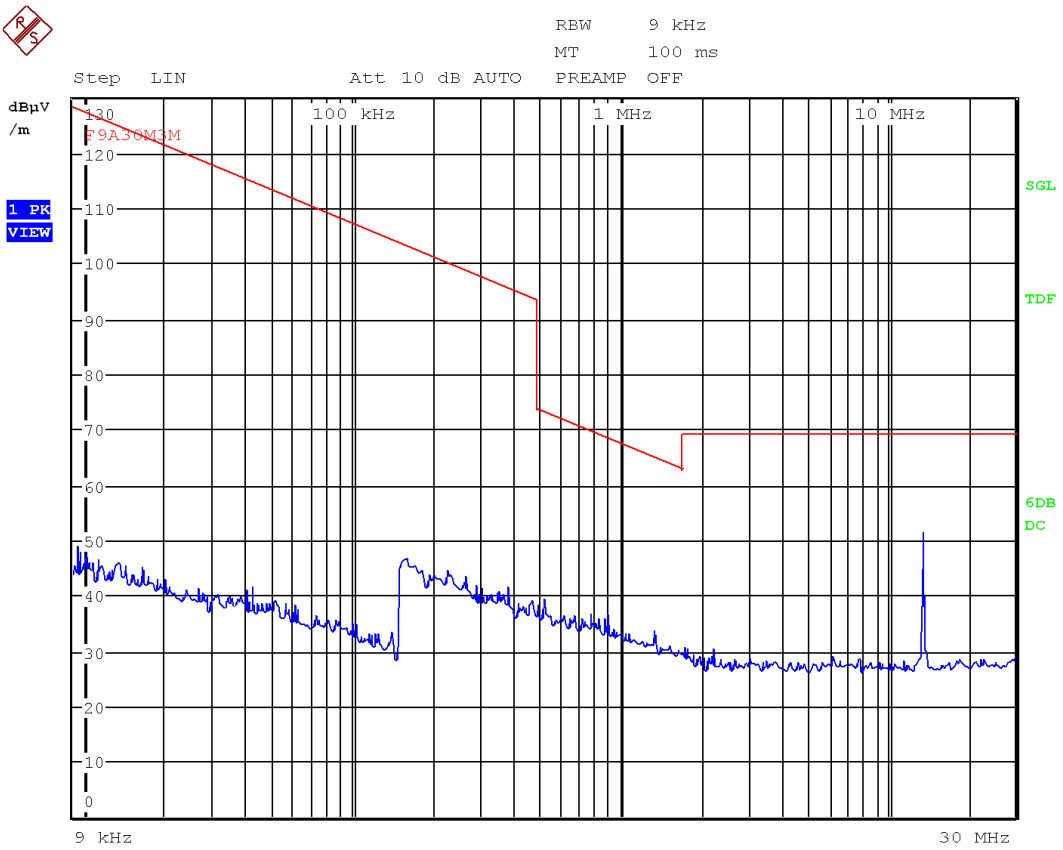
No spurious signals were found at less than 20 dB below the limit.

Frequency range 30 MHz-200 MHz

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
30.9265	V	Quasi-peak	28.30	± 3.88
38.5935	V	Quasi-peak	23.40	± 3.88
45.3595	V	Quasi-peak	20.60	± 3.88

Verdict: PASS

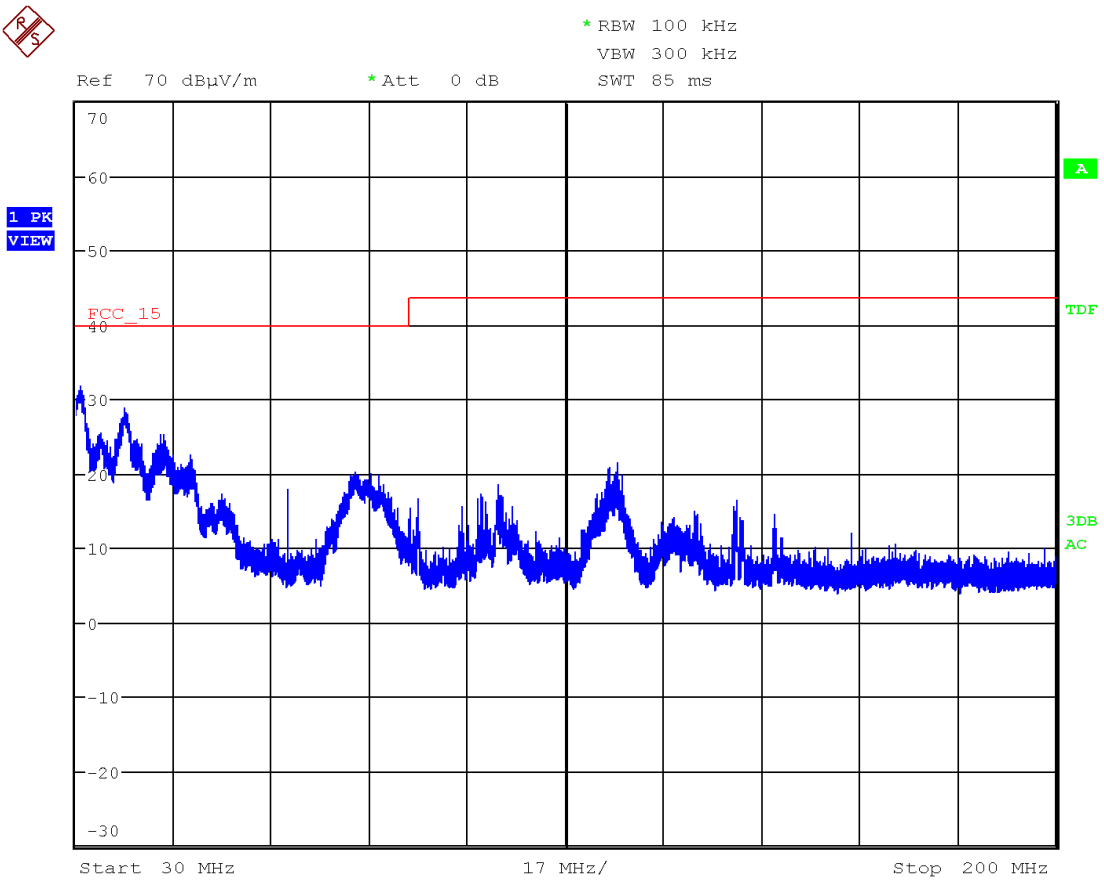
FREQUENCY RANGE 9 kHz-30 MHz.



Note: The limits shown in the above plot are extrapolated to 3 meters. The highest peak corresponds to the carrier level.

Resolution bandwidth:
200 Hz for 9 kHz ≤ f ≤ 150 kHz
9 kHz for 150 kHz ≤ f ≤ 30 MHz

FREQUENCY RANGE 30 MHz to 200 MHz.



Note: The above plot shows the results of the scan using peak detector.

NFC ISO 15693

Frequency range 9 kHz-30 MHz.

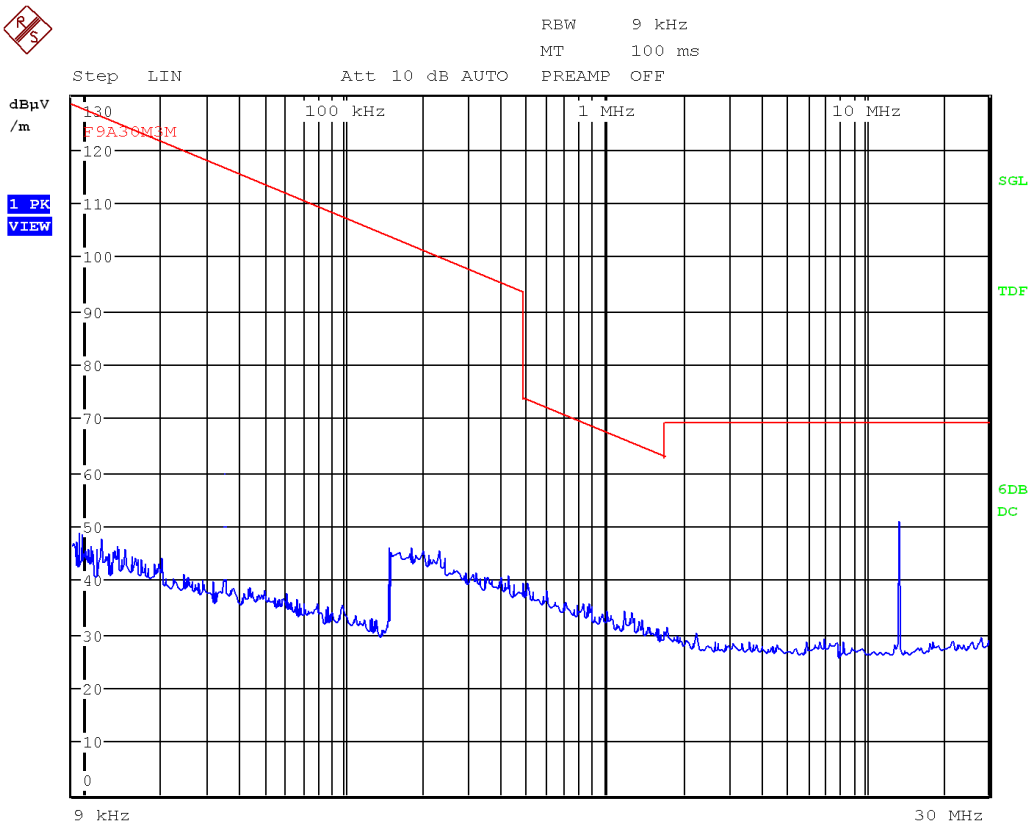
No spurious signals were found at less than 20 dB below the limit.

Frequency range 30 MHz-200 MHz

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
30.8415	V	Quasi-peak	29.40	± 3.88
38.4405	V	Quasi-peak	26.30	± 3.88
44.9855	V	Quasi-peak	22.80	± 3.88
78.3480	V	Quasi-peak	15.60	± 3.88

Verdict: PASS

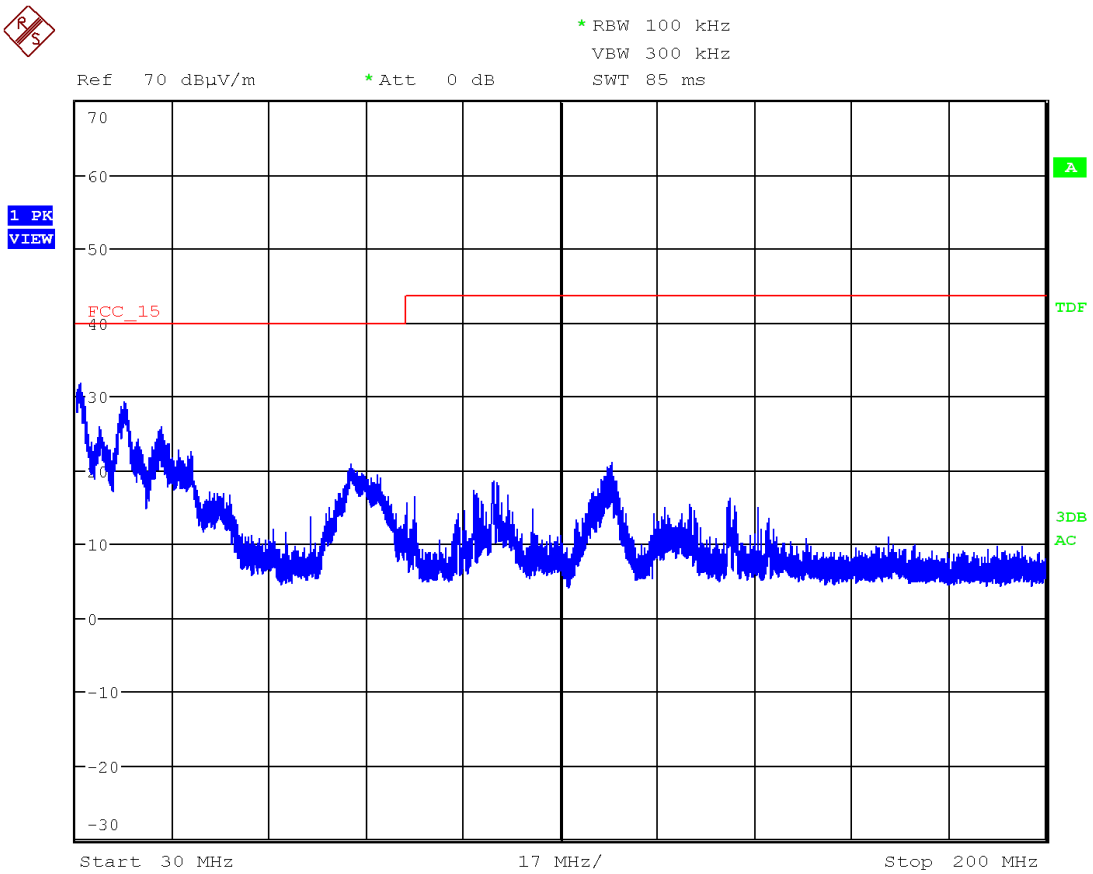
FREQUENCY RANGE 9 kHz-30 MHz.



Note: The limits shown in the above plot are extrapolated to 3 meters. The highest peak corresponds to the carrier level.

Resolution bandwidth:
200 Hz for 9 kHz ≤ f ≤ 150 kHz
9 kHz for 150 kHz ≤ f ≤ 30 MHz

FREQUENCY RANGE 30 MHz to 200 MHz.



Note: The above plot shows the results of the scan using peak detector.

Section 15.225 Subclause (e) / RSS-210 Clause B.6. Frequency tolerance of the carrier signal

SPECIFICATION

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

RESULTS

Nominal operating frequency: 13.56 MHz

NFC mode ISO 14443A

Frequency stability over temperature variations.

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (%)
+50	0.300000	0.002212
+40	0.300000	0.002212
+30	0.300000	0.002212
+20	0.100000	0.000737
+10	0.300000	0.002212
0	0.100000	0.000737
-10	0.100000	0.000737
-20	0.100000	0.000737

Frequency stability over voltage variations.

DC Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (%)
Vmax	6.9	0.100000	0.000737
Vmin	5.1	0.300000	0.002212

Verdict: PASS

NFC mode ISO 15693

Frequency stability over temperature variations.

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (%)
+50	0.029000	0.000214
+40	0.041000	0.000302
+30	0.041000	0.000302
+20	0.029000	0.000214
+10	0.006000	0.000044
0	0.041000	0.000302
-10	0.053000	0.000391
-20	0.053000	0.000391

Frequency stability over voltage variations.

DC Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (%)
Vmax	6.9	0.029000	0.000214
Vmin	5.1	0.029000	0.000214

Verdict: PASS