DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

ISED LISTED
REGISTRATION NUMBER
4621A-2

Test report No:
NIE: 57508RRF.001

Test report

USA FCC Part 15.225, 15.209
CANADA RSS-210, RSS-Gen

Identification of item tested	Energy Control Unit (ECU)
Trademark	ENKOA
Model and /or type reference	iSWITCH Multibox Offline
Other identification of the product	HW version: PCB power supply V1.4 / PCB Control V1.5 SW version: 0.194. FCC ID: 2ASEQDEMTXABA0S. IC: 24733-DEMTXABA0S.
Features	Not provided data
Applicant	ENKOA SYSTEM, S.L. Pol. Erramone 45 20850, Mendaro, Gipuzkoa, SPAIN
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 5 (April 2018). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	A. Llamas RF Lab. Manager Firmado digitalmente por ALEJANDRO LLAMAS RODRIGUEZ Fecha: 2019.07.10 14:49:29 +02'00'
Date of issue	2019-07-10
Report template No	FDT08_21

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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 FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

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.

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.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification.
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.

Data provided by the client

The sample consists of an Energy Control Unit (ECU).

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: The client.

Sample M/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
57508/002	Energy Control Unit (ECU)	iSWITCH Multibox Offline	--	2018/10/18
57508/004	Energy Control Unit (ECU)	iSWITCH Multibox Offline	--	2018/10/18
57508/009	Card	--	--	2018/10/18

1. Sample M/01 has undergone the following test(s):

All conducted tests indicated in Appendix A.

Sample M/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
57508/003	Energy Control Unit (ECU)	iSWITCH Multibox Offline	--	2018/10/18

2. Sample M/02 has undergone the following test(s):

All radiated tests indicated in Appendix A.

Test sample description

<table>
<tr><td rowspan="2">Ports…… :</td><td rowspan="2">Port name and description</td><td colspan="5">Cable</td></tr>
<tr><td colspan="2">Specified length [m]</td><td colspan="2">Attached during test</td><td>Shielded</td></tr>
<tr><td></td><td>---</td><td colspan="2"></td><td colspan="2">☐</td><td>☐</td></tr>
<tr><td>Supplementary information to the ports…… :</td><td colspan="6">---</td></tr>
<tr><td rowspan="2">Rated power supply ……:</td><td colspan="2" rowspan="2">Voltage and Frequency</td><td colspan="5">Reference poles</td></tr>
<tr><td>L1</td><td>L2</td><td>L3</td><td>N</td><td>PE</td></tr>
<tr><td></td><td>☒</td><td>AC: 110 – 230, 50-60Hz</td><td>☒</td><td>☐</td><td>☐</td><td>☒</td><td>☐</td></tr>
<tr><td>Rated Power ……:</td><td colspan="6">2 W nominal (input power consumption)</td></tr>
<tr><td>Clock frequencies ……:</td><td colspan="6">Internal RC microcontroller 4 MHz / transceiver xtal 27.12 MHz</td></tr>
<tr><td>Other parameters……:</td><td colspan="6">---</td></tr>
<tr><td>Software version ……:</td><td colspan="6">V0.194</td></tr>
</table>

Hardware version.....:	Power supply PCB V1.4; Control PCB V1.5.		
Dimensions in cm (W x H x D)....:	8x8x3.2 (without accessory); 8x8x3.47 (with surface accessory)		
Mounting position.....:	☒ Wall/Ceiling mounted equipment		
Modules/parts .....:	Module/parts of test item	Type	Manufacturer
	Surface accessory	---	ENKOA
Accessories (not part of the test item) .....:	Description	Type	Manufacturer
	---	---	---
Documents as provided by the applicant.....:	Description	File name	Issue date
	---	---	---

(3) Only for Medical Equipment

Copy of marking plate:

Identification of the client

ENKOA SYSTEM, S.L.
Pol. Erramone 45
20850, Mendaro, Gipuzkoa, SPAIN

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2018-10-18
Date (finish)	2018-10-19

Document history

Report number	Date	Description
57508RRF.001	2019-07-10	First release

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 %

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 %

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. = 35 %

Remarks and comments

The tests have been performed by the technical personnel: Miguel Ángel Torres, José Gabriel Pendón, Francisco José Alcaide, Carlos Alberto Contreras.

Used instrumentation:

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Chamber HERAEUS VMT 04/35	2018/06	2020/06
2.	Spectrum Analyzer PSA 3Hz-26.5 GHz AGILENT TECHNOLOGIES E4440A	2017/10	2019/10
3.	Radiocommunication Analyzer ROHDE AND SCHWARZ CMTA84	2018/10	2021/10
4.	AC Power Supply 135/270 V, 5/10/20/40 A ELGAR CS-AC35(351SL)	2016/05	2019/05

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	EMI Test Receiver ROHDE AND SCHWARZ ESR7	2017/08	2019/08
3.	Active Loop Antenna HEWLETT PACKARD 11966A	2018/06	2020/06
4.	RF Pre-amplifier, 38 dB, 30 MHz-6 GHz BONN ELEKTRONIK BLNA 0360-01N	2018/07	2019/07
5.	Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2018/07	2021/07

Testing verdicts

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

Summary

FCC PART 15 PARAGRAPH / RSS-247 Requirement – Test case	Verdict	Remark
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	
Supplementary information and remarks: None.		

Appendix A: Test results.

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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 17

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 19

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TEST CONDITIONS

POWER SUPPLY (V):

V nominal: 110 Vac

Type of power supply: AC voltage from the mains

Type of antenna: Integrated PCB antenna.

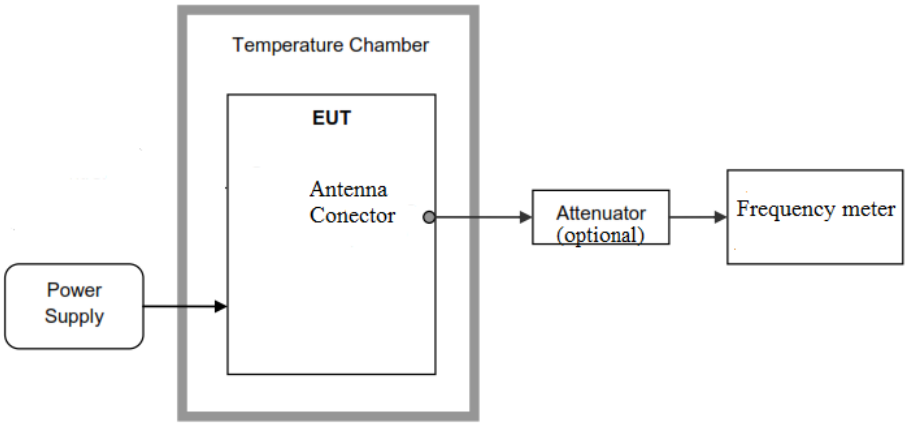
TEST FREQUENCIES:

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.

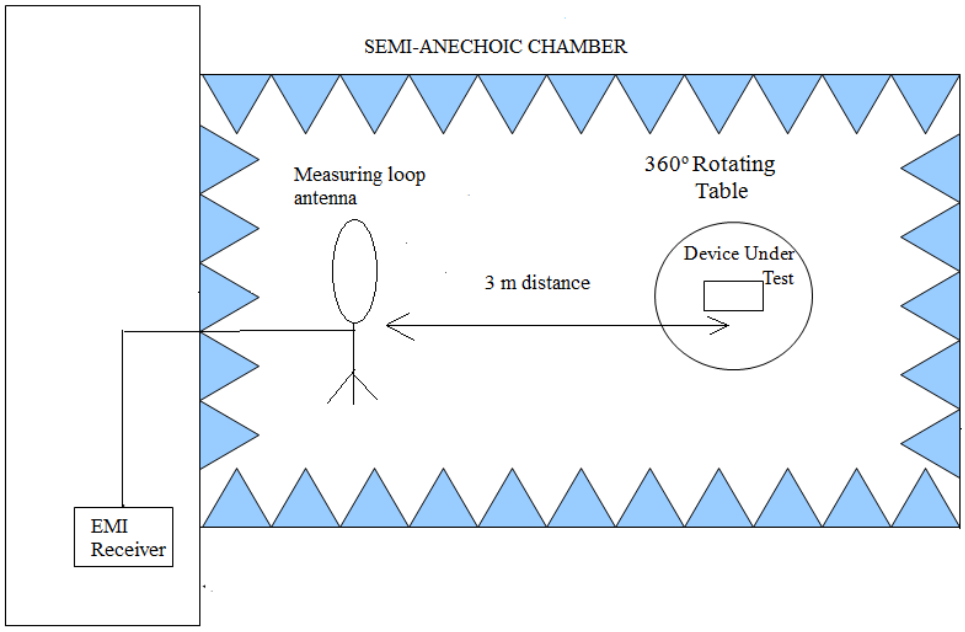
For frequency stability test the EUT was placed inside a climatic chamber and connected to a frequency meter using a low loss cable. An external DC power supply was connected to the EUT for voltage variation test.



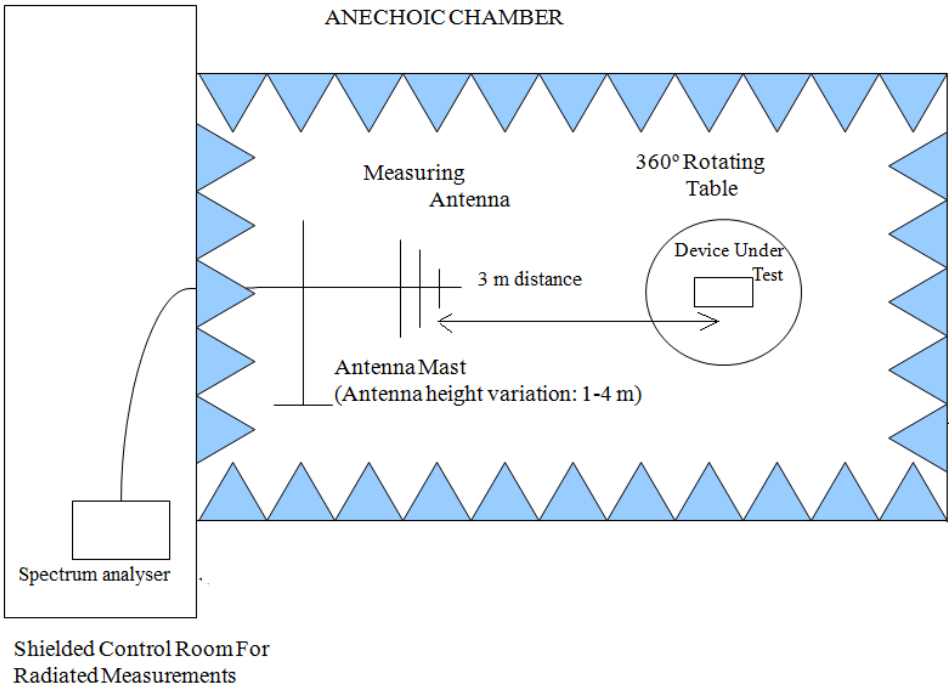
RADIATED MEASUREMENTS

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.

Radiated measurements setup 9 kHz to 30 MHz.



Radiated measurements setup 30 MHz to 200 MHz.

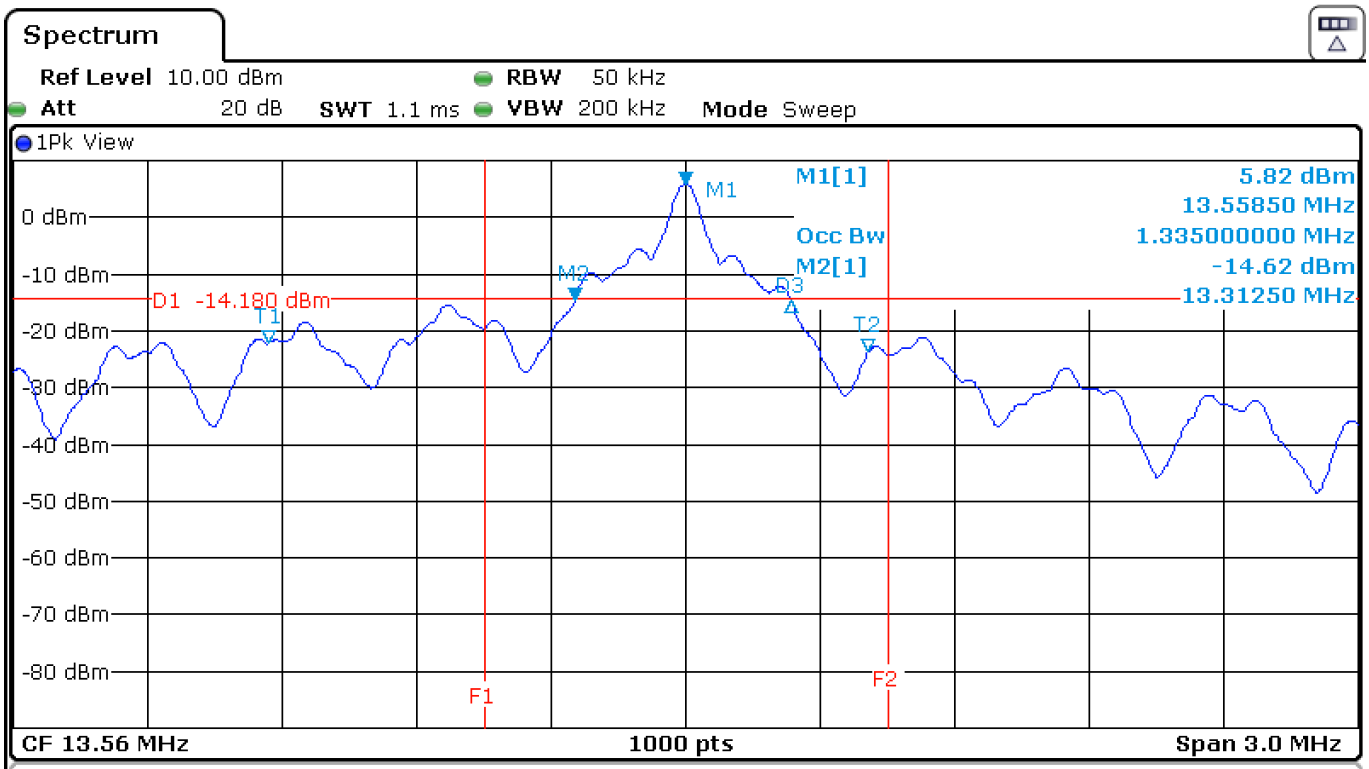


Occupied Bandwidth

RESULTS:

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

Operation mode	99% occupied bandwidth (kHz)	20 dB bandwidth (kHz)
NFC	1335	483
Measurement uncertainty (kHz)	<±1.20	



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	13.5585 MHz	5.82 dBm		
T1		1	12.6315 MHz	-22.10 dBm	Occ Bw	1.335 MHz
T2		1	13.9665 MHz	-23.77 dBm		
M2		1	13.3125 MHz	-14.62 dBm		
D3	M2	1	483.0 kHz	0.09 dB		

Verdict: PASS

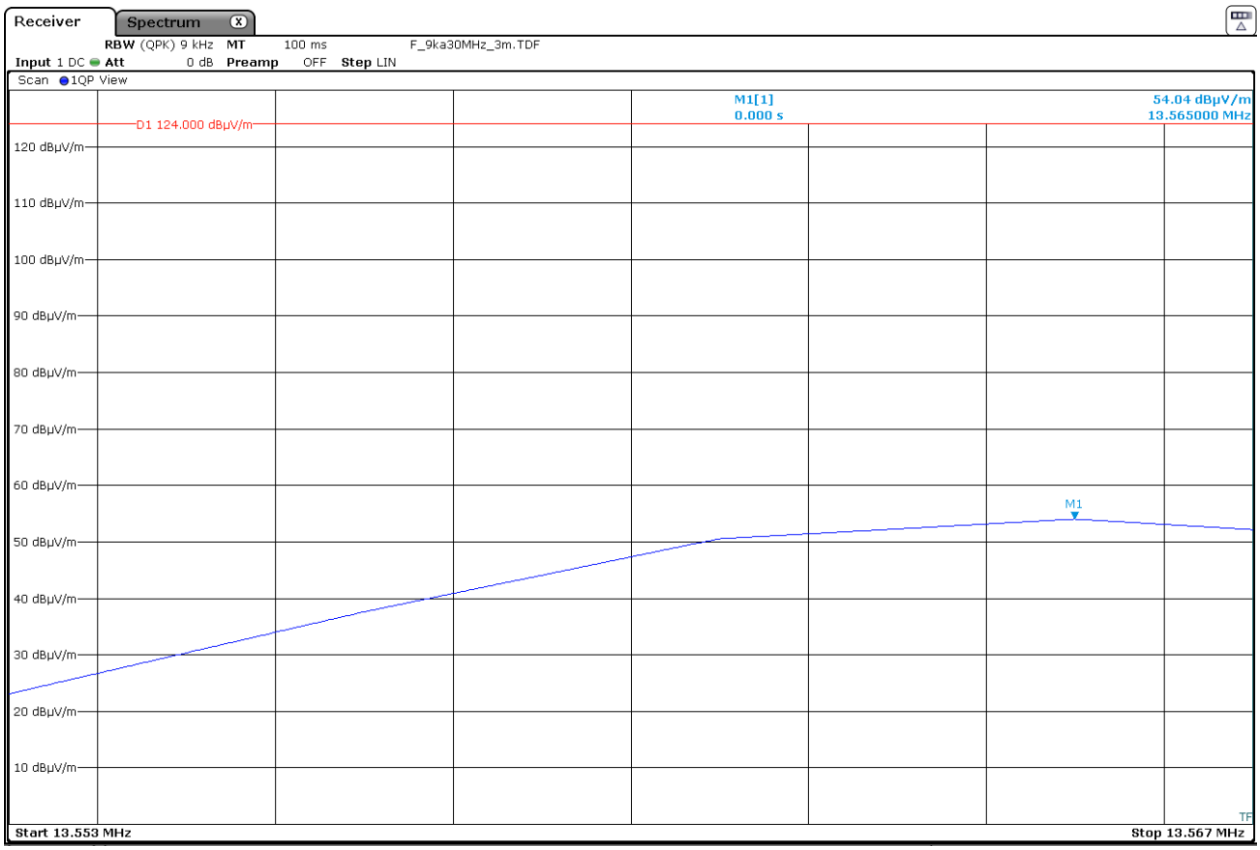
Section 15.225 Subclause (a) / RSS-210 Clause B.6 (a). Field strength of emissions within the band 13.553 MHz -13.567 MHz

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.



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)
13.565	54.04	14.04
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

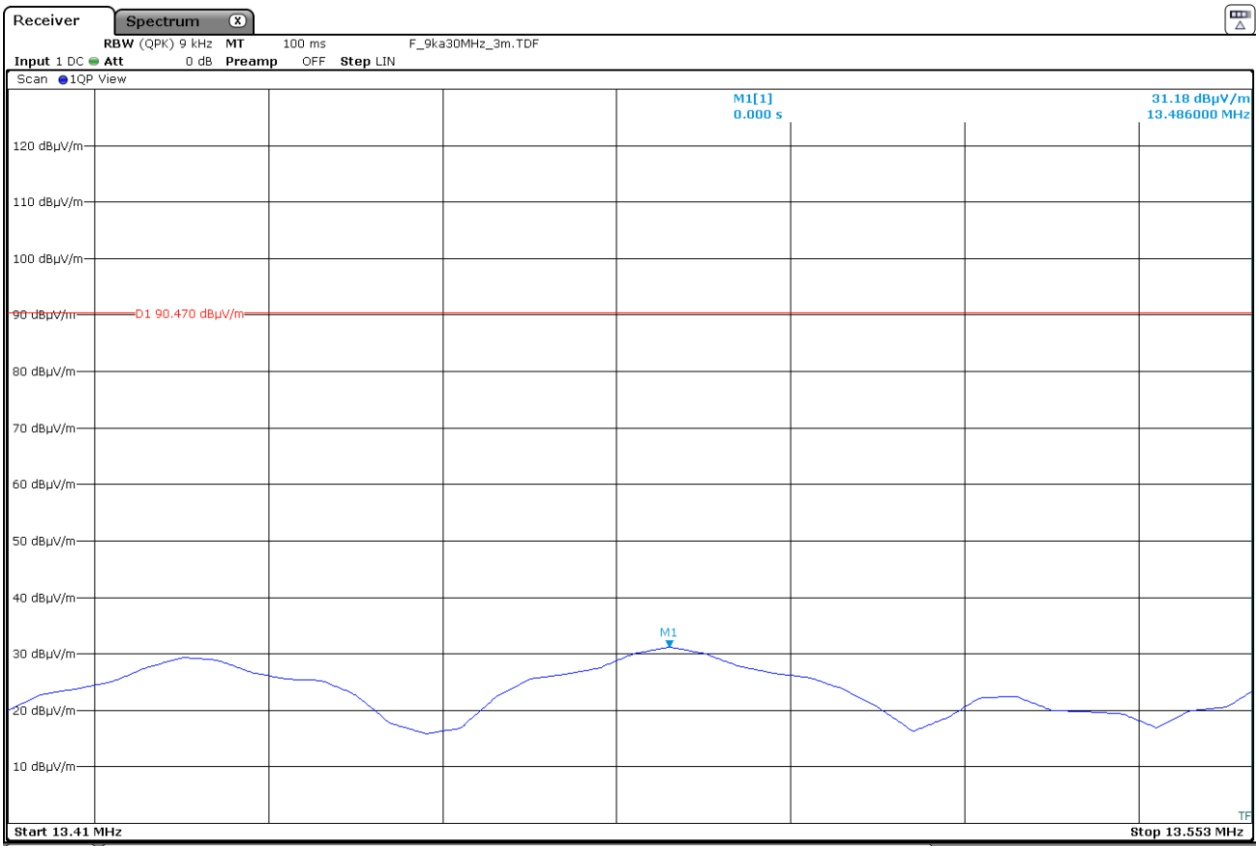
SPECIFICATION:

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:

Measurement distance: 3 meters.

- Band 13.410-13.553 MHz

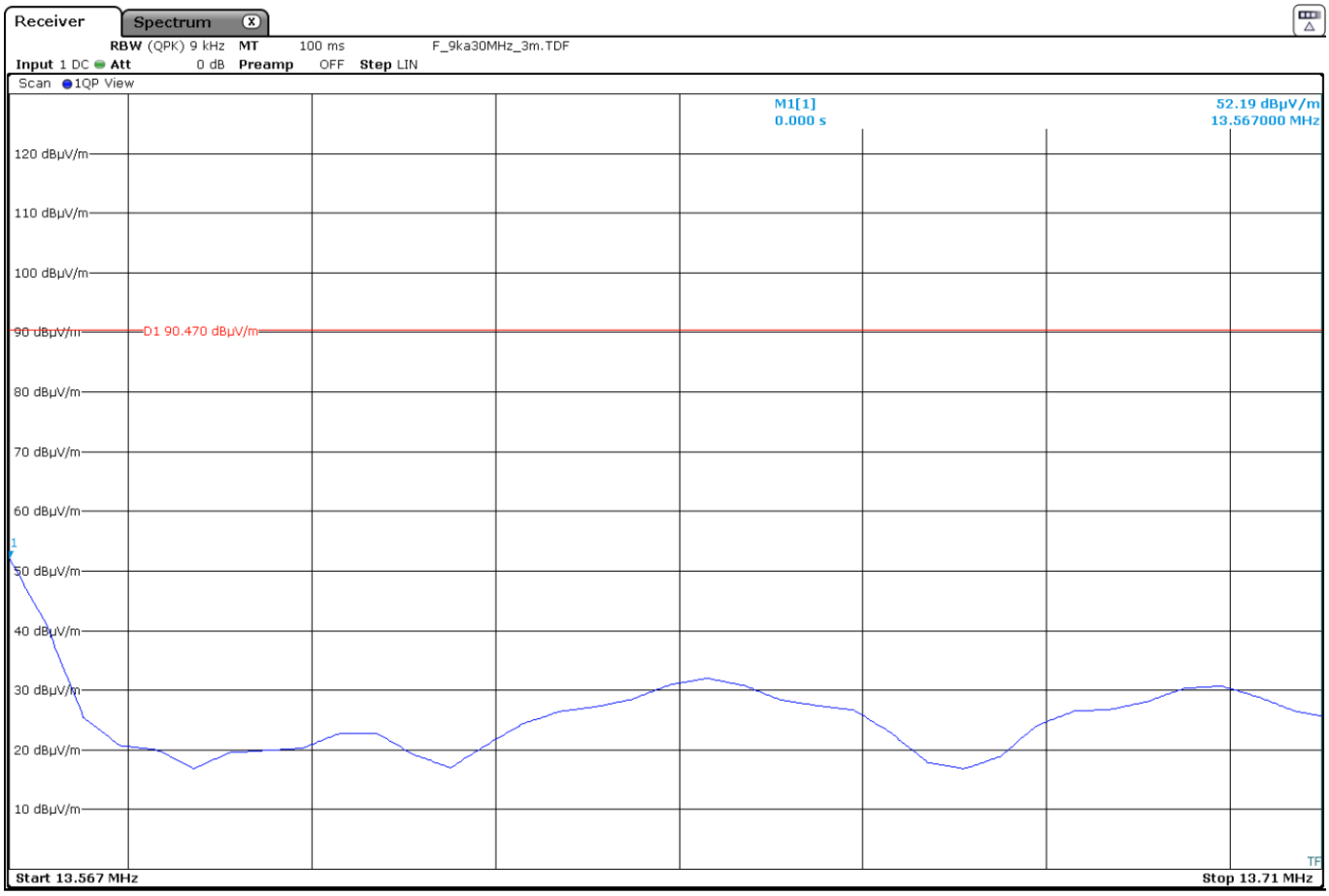


Note: The limit shown in the above plot is extrapolated to 3 meters

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)
13.486	31.18	-8.82
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

- Band 13.567-13.710 MHz



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	52.19	12.19
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

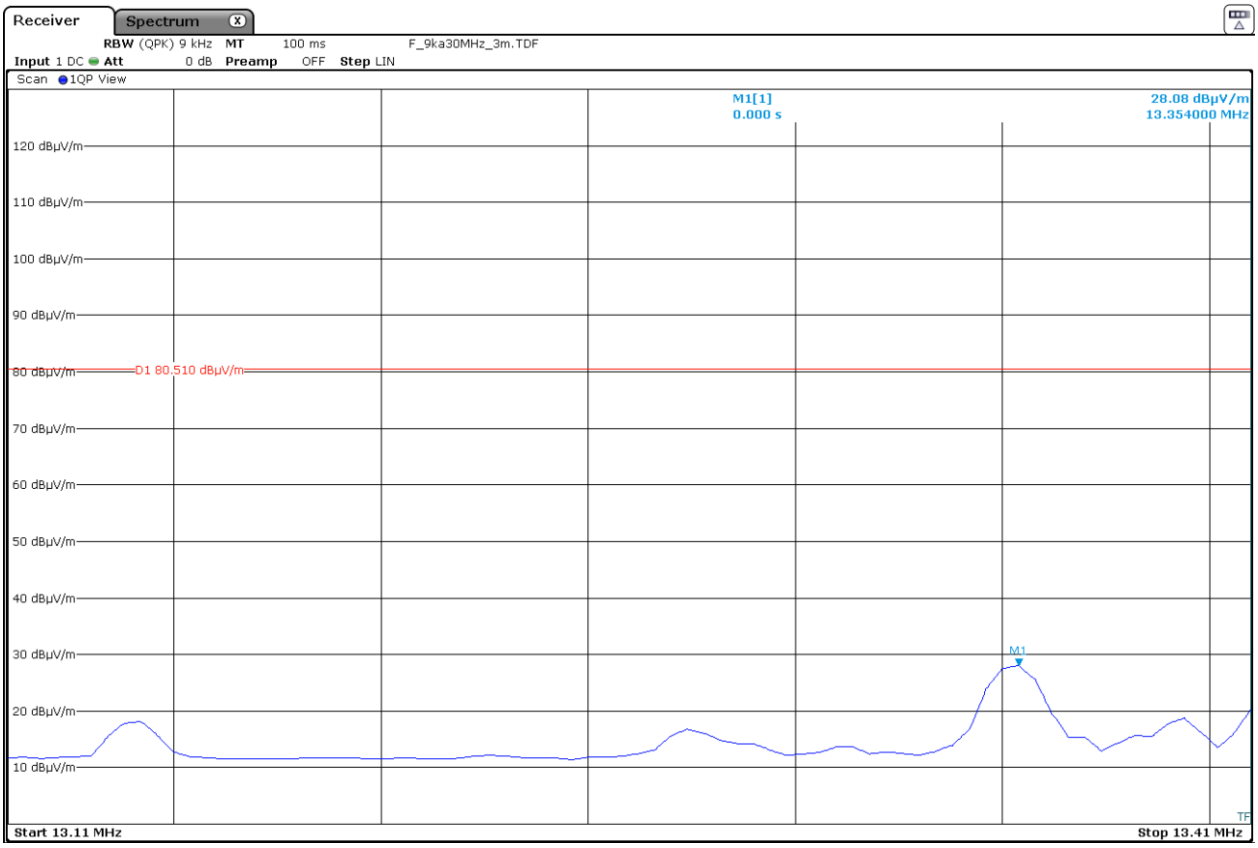
SPECIFICATION:

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:

Measurement distance: 3 meters.

- Band 13.110-13.410 MHz

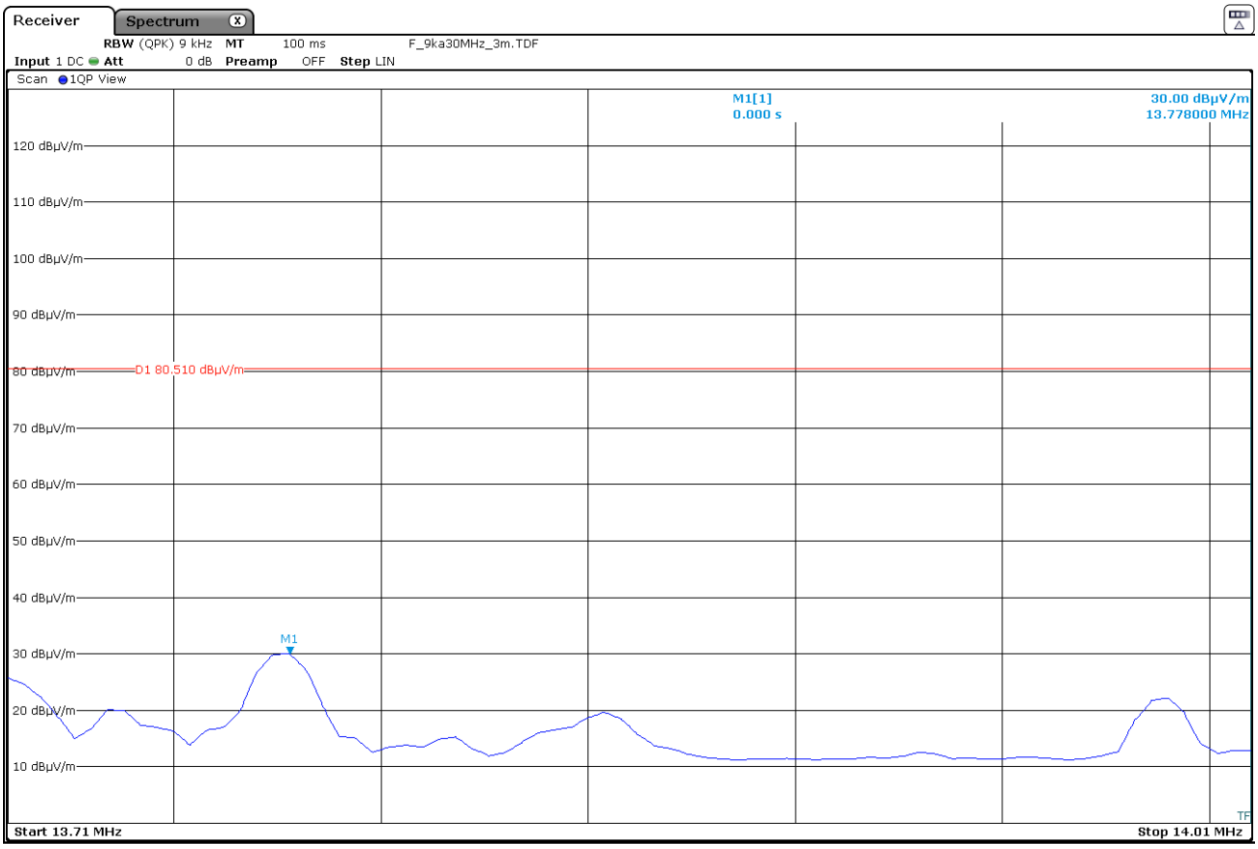


Note: The limit shown in the above plot is extrapolated to 3 meters

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)
13.354	28.08	-11.92
Measurement uncertainty (dB)	<±3.61	

Verdict: PASS

- Band 13.710-14.010 MHz



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)
13.778	30.00	-10.00
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:

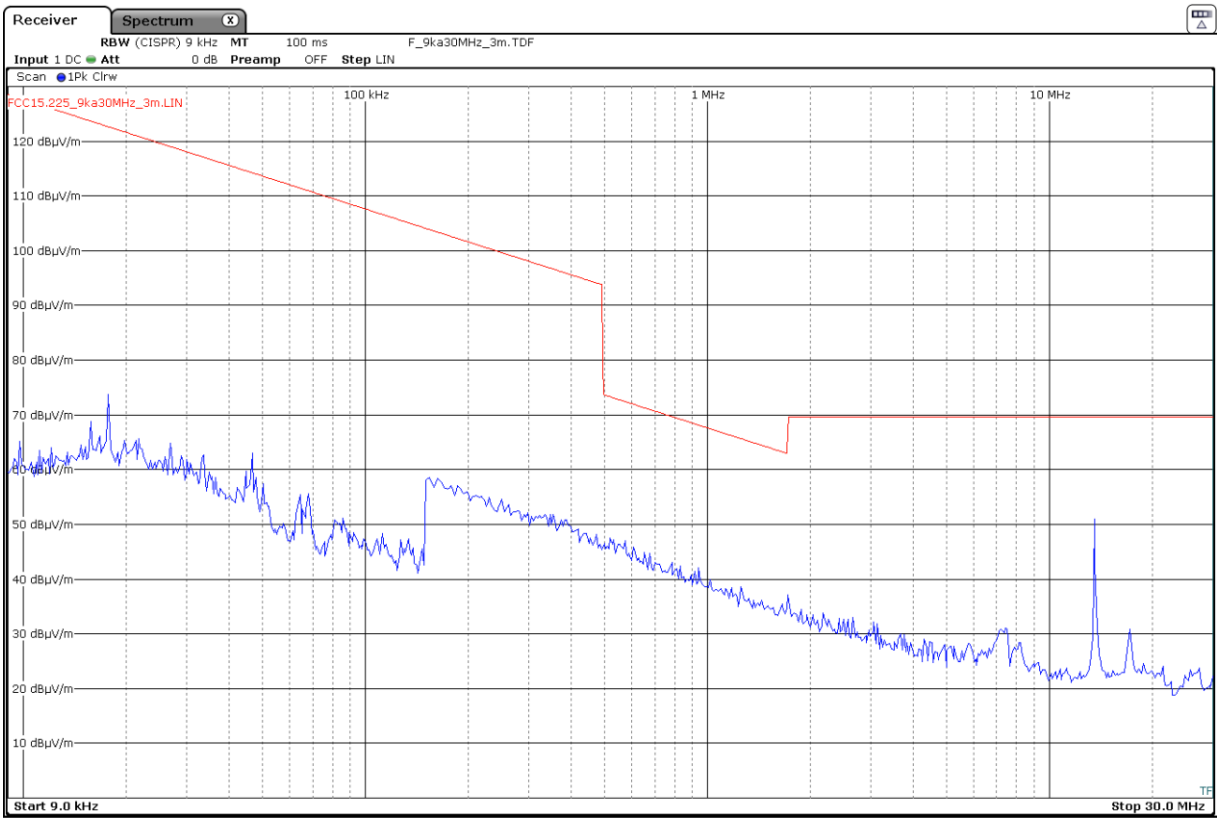
All tests were performed in a semi-anechoic chamber at a distance of 3 m.

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.

- Frequency range 9 kHz-30 MHz:

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

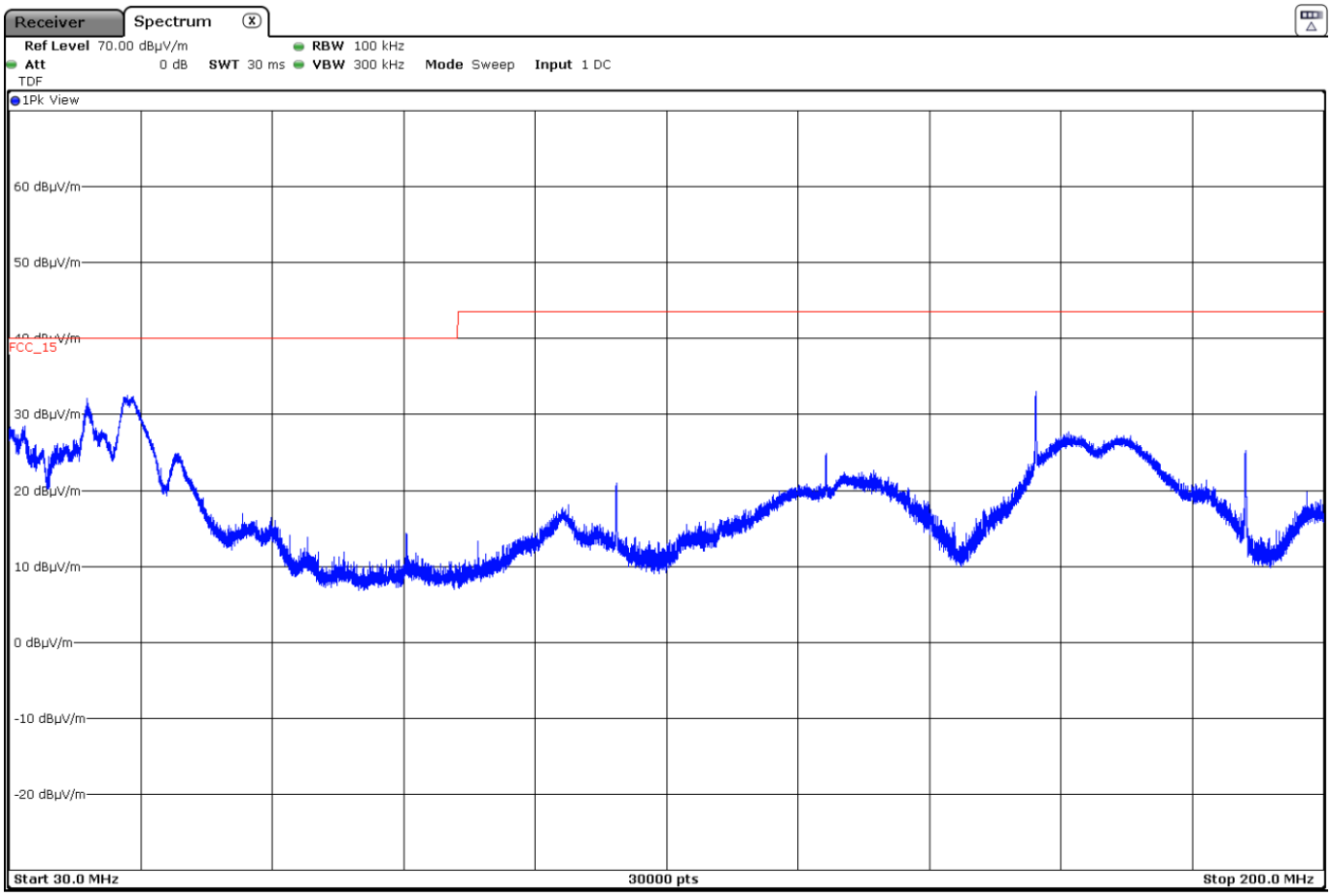


Note: The limits shown in the above plot are extrapolated to 3 meters. The highest peak corresponds to the carrier level.

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

- Frequency range 30 MHz-200 MHz

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
40.0328	V	Quasi-peak	29.1	± 3.88
45.2802	V	Quasi-peak	29.9	± 3.88
135.6522	H	Quasi-peak	23.7	± 3.88
162.7785	V	Quasi-peak	32.2	± 3.88
173.8228	H	Quasi-peak	30.6	± 3.88
189.9218	V	Quasi-peak	23.6	± 3.88



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

Verdict: PASS

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.

- Frequency stability over temperature variations:

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (%)
+50	765	0.005642
+40	741	0.005465
+30	737	0.005435
+20	739	0.005450
+10	745	0.005494
0	744	0.005487
-10	724	0.005339
-20	683	0.005037

- Frequency stability over voltage variations:

AC Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (%)
Vmax	126.5	742	0.005472
Vmin	93.5	743	0.005479

Verdict: PASS