

TEST REPORT

of

FCC Part 15 Subpart C §15.225

FCC ID: 2AV76-NMOK-100W

1. Equipment Under Test : WIRELESS POWER CHARGING SYSTEM
2. Model Name : NMOK-100W
3. Variant Model Name(s) : (-)
4. Applicant : NIDEC MOBILITY KOREA CORPORATION
5. Manufacturer : NIDEC MOBILITY KOREA CORPORATION
6. Date of Receipt : 2020.03.06
7. Date of Test(s) : 2020.03.20 ~ 2020.04.22
8. Date of Issue : 2020.04.22

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

- 1) The results of this test report are effective only to the items tested.
- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.

Tested by:



Jinhyoung Cho

Technical
Manager:



Hyunhae You

SGS Korea Co., Ltd. Gunpo Laboratory



Table of Contents

	Page
1. General Information -----	3
2. Radiated Emissions -----	6
3. Frequency Stability -----	16
4. 20 dB Bandwidth -----	21

1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

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1.2. Details of Applicant

Applicant : NIDEC MOBILITY KOREA CORPORATION

Address : 790-12, Bogaewonsam-ro, Bogae-myeon, Anseong-si, Gyeonggi-do, South Korea, 17507

Contact Person : Nam, Sang-il

Phone No. : +82 2 850 5789

1.3. Details of manufacturer

Applicant : Same as applicant

Address : Same as applicant

1.4. Description of EUT

Kind of Product	WIRELESS POWER CHARGING SYSTEM
Model Name	NMOK-100W
Power Supply	DC 13.5 V
Frequency Range	13.56 MHz (NFC)
Modulation Technique	ASK
Number of Channel	1 channel
Antenna Type	Loop coil Antenna

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMBV100A	259067	Jun. 10, 2019	Annual	Jun. 10, 2020
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 11, 2019	Annual	Sep. 11, 2020
Spectrum Analyzer	R&S	FSV30	103210	Dec. 05, 2019	Annual	Dec. 05, 2020
DC Power Supply	Agilent	U8002A	MY53150029	Jun. 10, 2019	Annual	Jun. 10, 2020
Temperature Chamber	ESPEC CORP.	PL-1J	15000793	Jun. 10, 2019	Annual	Jun. 10, 2020
Preamplifier	H.P.	8447F	2944A03909	Aug. 07, 2019	Annual	Aug. 07, 2020
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22, 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	396	Mar. 21, 2019	Biennial	Mar. 21, 2021
Test Receiver	R&S	ESU26	100109	Feb. 18, 2020	Annual	Feb. 18, 2021
Antenna Mast	Innco systems GmbH	MM4640-XP-ET	MA4640/536/ 38330516/L	N.C.R.	N/A	N.C.R.
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO300/963/ 38330516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	SUCOFLEX	104 (3 m)	MY3258414	Jan. 28, 2020	Semi-annual	Jul. 28, 2020
Coaxial Cable	SUCOFLEX	104 (10 m)	MY3145814	Jan. 28, 2020	Semi-annual	Jul. 28, 2020

1.6. Support Equipment

Description	Manufacturer	Model	FCC ID
Mobile Phone	Samsung Electronics Co., Ltd.	SM-G955N	A3LSMG955N

1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

Applied standard : FCC Part15 subpart C		
Section	Test item(s)	Result
15.225(a)(b)(c)(d) 15.209	Radiated Emission, Spurious Emission and Field Strength of Fundamental	Complied
15.225(e)	Frequency Stability	Complied
15.215(c)	20 dB Bandwidth	Complied
15.207	AC Power Line Conducted Emissions	N/A ¹⁾

Note;

1) The AC power line test was not performed because the EUT use battery power for operation and which do not operate from the AC power lines.

1.8. Sample calculation

Where relevant, the following sample calculation is provided:

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB) + Cable loss (dB) - amplifier (dB)

1.9. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty (dB)
Occupied Bandwidth	± 9.66 kHz
Radiated Disturbance, 9 kHz to 30 MHz	± 3.59 dB
Radiated Disturbance, below 1 GHz	± 5.88 dB

Uncertainty figures are valid to a confidence level of 95 %.

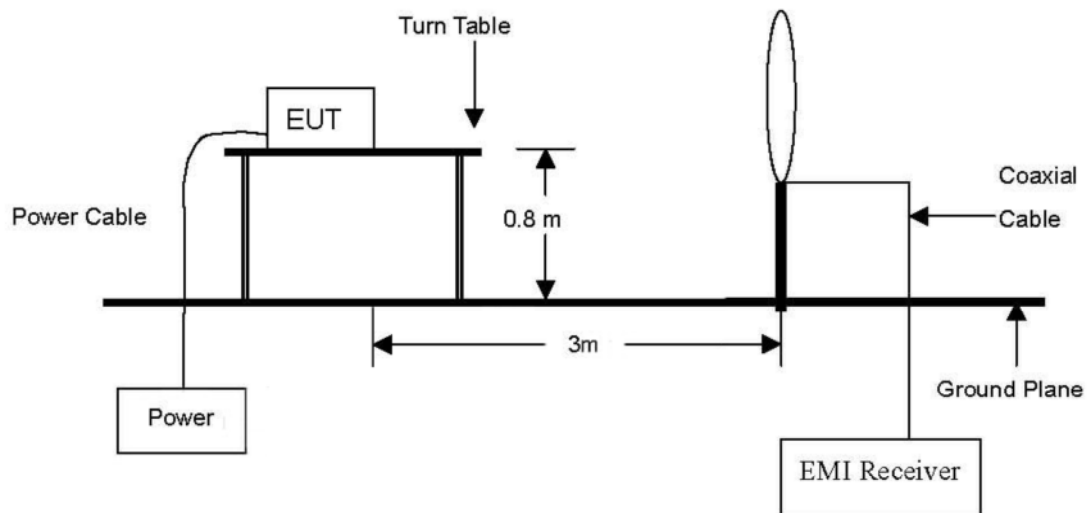
1.10. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501-RF-RTL000573	2020.04.22	Initial

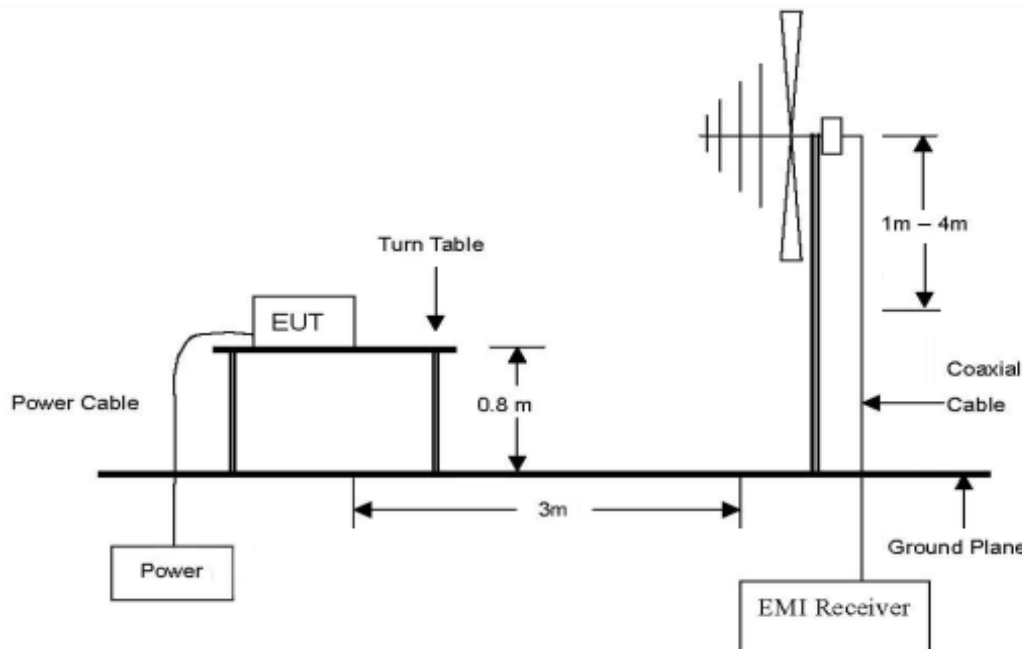
2. Radiated Emissions

2.1. Test Setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz.



2.2. Limit

According to §15.225,

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15 848 microvolts/meter at 30 meters.
- (b) 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 at 30 meters.
- (c) 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 at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

According to §15.209,

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

2.3.1. Test Procedures for emission below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to Quasi peak Detect Function with Maximum Hold Mode.

2.3.2. Test Procedures for emission above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The antenna is a Trilog Broadband antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

2.4. Test Result

Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions.

- Fundamental within the band 13.553 MHz - 13.567 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30 m	Limit (dB μ V/m) at 30 m	Margin (dB)
13.560	41.61	Peak	H	18.66	0.99	61.26	21.26	84.00	62.74

- Spurious emission within the bands 13.410 MHz - 13.553 MHz and 13.567 MHz - 13.710 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30 m	Limit (dB μ V/m) at 30 m	Margin (dB)
13.553	34.44	Peak	H	18.66	0.99	54.09	14.09	50.47	36.38
13.567	37.21	Peak	H	18.66	0.99	56.86	16.86	50.47	33.61

- Spurious emission within the bands 13.110 MHz - 13.410 MHz and 13.710 MHz - 14.010 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30 m	Limit (dB μ V/m) at 30 m	Margin (dB)
13.351	24.27	Peak	H	18.67	0.99	43.93	3.93	40.51	36.58
13.772	20.60	Peak	H	18.65	1.00	40.25	0.25	40.51	40.26

- Spurious emission within the bands 9 kHz - 13.110 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30 m	Limit (dB μ V/m) at 30 m	Margin (dB)
13.054	15.50	Peak	H	18.68	0.98	35.16	-4.84	29.54	34.38

- Spurious emission within the bands 14.010 MHz - 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total		Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	Ant. Factor (dB/m)	Cable loss (dB)	Actual (dB μ V/m) at 3 m	Actual (dB μ V/m) at 30 m	Limit (dB μ V/m) at 30 m	Margin (dB)
Above 14.010	Not detected	-	-	-	-	-	-	-	-

Remark;

1. Fundamental limit (μ V/m) = $20 \log(15\ 848) = 84.00$ dB μ V/m.
2. 30 m distance compensation = $40 \log(3/30) = -40$ dB μ V/m.
3. “*” means the restricted band.
4. If the spurious emissions are in the restricted band, the limit complied with §15.209.
5. All data were recorded using a spectrum analyzer employing a peak detector.
If PK results were meet Quasi-peak limit, Quasi-peak measurements were omitted.

- Spurious emission above 30 MHz

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m) at 3 m	Limit (dBμV/m) at 3 m	Margin (dB)
40.67	34.90	Peak	V	20.10	-26.56	28.44	40.00	11.56
81.37	40.90	Peak	V	12.11	-25.55	27.46	40.00	12.54
135.61	39.80	Peak	V	14.20	-25.27	28.73	43.50	14.77
189.85	41.20	Peak	H	16.19	-25.12	32.27	43.50	11.23
352.61	36.70	Peak	H	20.94	-24.76	32.88	46.00	13.12
888.01	32.90	Peak	V	27.86	-22.18	<u>38.58</u>	46.00	7.42
Above 900.00	Not detected	-	-	-	-	-	-	-

Remark;

1. Radiated spurious emission measurement as below.
 (Actual = Reading + AF + AMP + CL)
2. According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

- Test Plots

- Fundamental within the band 13.553 MHz - 13.567 MHz



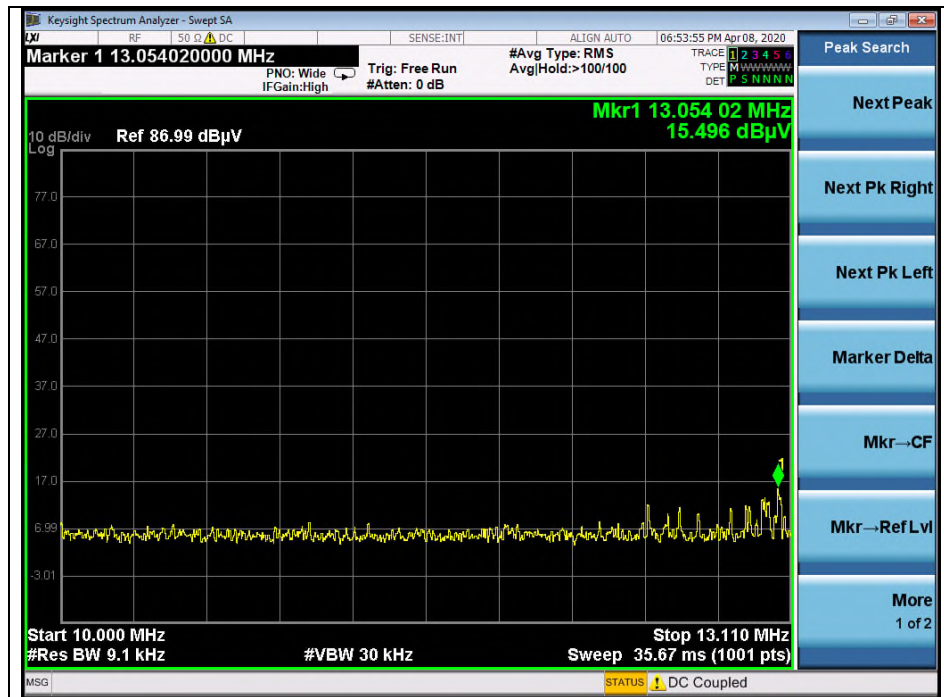
- Spurious emission within the bands 13.410 MHz - 13.553 MHz and 13.567 MHz - 13.710 MHz



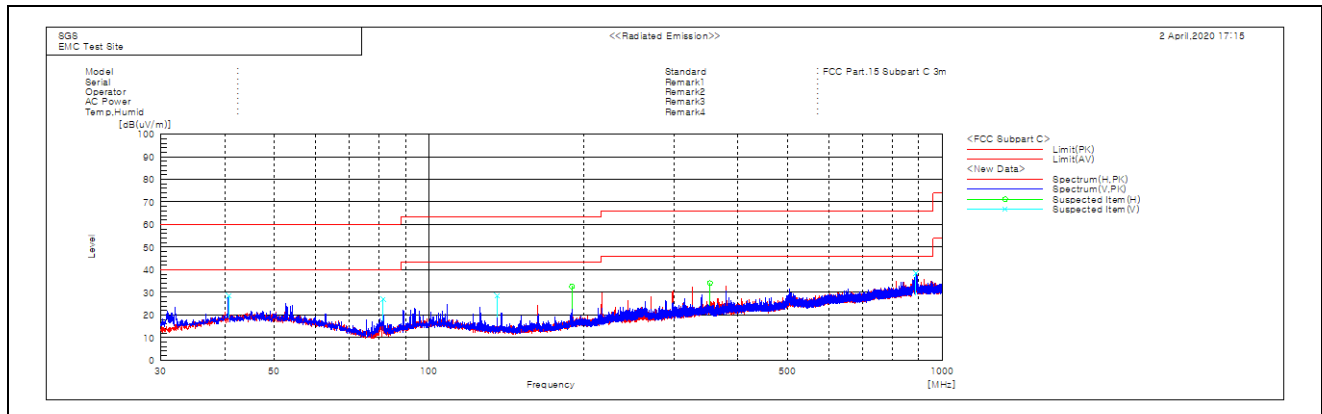
- Spurious emission within the bands 13.110 MHz - 13.410 MHz and 13.710 MHz - 14.010 MHz



- Spurious emission within the bands 1.705 MHz - 13.110

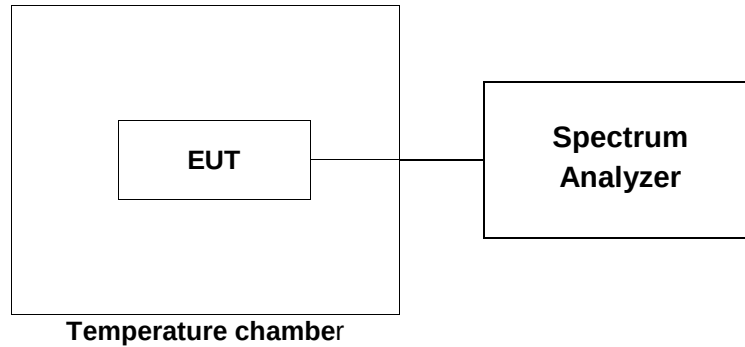


- Spurious emission above 30 MHz



3. Frequency Stability

3.1. Test Setup



3.2. Limit

According to §15.225(e), 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 battery operated equipment, the equipment tests shall be performed using a new battery.

3.3. Test Procedures

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the environment into appropriate environment.
4. Set the spectrum analyzer as RBW = 100 Hz, VBW = 100 Hz, Span = 10 kHz, Sweep time = auto.
5. Mark the peak frequency and measure the frequency tolerance using frequency counter function.
6. Repeat until all the results are investigated.

3.4. Test Result

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

Operating Frequency : 13 560 000 Hz
 Deviation Limit : ± 0.01 % = ± 1 356 Hz

Startup

Temperature Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
13.5	-20	13 560 857	857	0.006 320
	-10	13 560 828	828	0.006 106
	0	13 560 767	767	0.005 656
	+10	13 560 735	735	0.005 420
	+20	13 560 776	776	0.005 723
	+30	13 560 750	750	0.005 531
	+40	13 560 735	735	0.005 420
	+50	13 560 718	718	0.005 295

Voltage Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
115 % (15.525)	+20	13 560 737	737	0.005 435
85 % (11.475)	+20	13 560 740	740	0.005 457

2 minutes

Temperature Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
13.5	-20	13 560 860	860	0.006 342
	-10	13 560 831	831	0.006 128
	0	13 560 773	773	0.005 701
	+10	13 560 744	744	0.005 487
	+20	13 560 770	770	0.005 678
	+30	13 560 750	750	0.005 531
	+40	13 560 732	732	0.005 398
	+50	13 560 718	718	0.005 295

Voltage Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
115 % (15.525)	+20	13 560 734	734	0.005 413
85 % (11.475)	+20	13 560 740	740	0.005 457

5 minutes

Temperature Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
13.5	-20	13 560 860	860	0.006 342
	-10	13 560 834	834	0.006 150
	0	13 560 784	784	0.005 782
	+10	13 560 744	744	0.005 487
	+20	13 560 758	758	0.005 590
	+30	13 560 747	747	0.005 509
	+40	13 560 729	729	0.005 376
	+50	13 560 715	715	0.005 273

Voltage Variations

Power (V _{d.c})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
115 % (15.525)	+20	13 560 734	734	0.005 413
85 % (11.475)	+20	13 560 737	737	0.005 435

10 minutes

Temperature Variations

Power (V _{d.c.})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
3.85	-20	13 560 863	863	0.006 364
	-10	13 560 834	834	0.006 150
	0	13 560 802	802	0.005 914
	+10	13 560 753	753	0.005 553
	+20	13 560 753	753	0.005 553
	+30	13 560 744	744	0.005 487
	+40	13 560 724	724	0.005 339
	+50	13 560 712	712	0.005 251

Voltage Variations

Power (V _{d.c.})	Temperature (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
115 % (15.525)	+20	13 560 734	734	0.005 413
85 % (11.475)	+20	13 560 737	737	0.005 435

4. 20 dB Bandwidth

4.1. Test Setup



4.2. Limit

None; for reporting purposes only.

4.3. Test Procedures

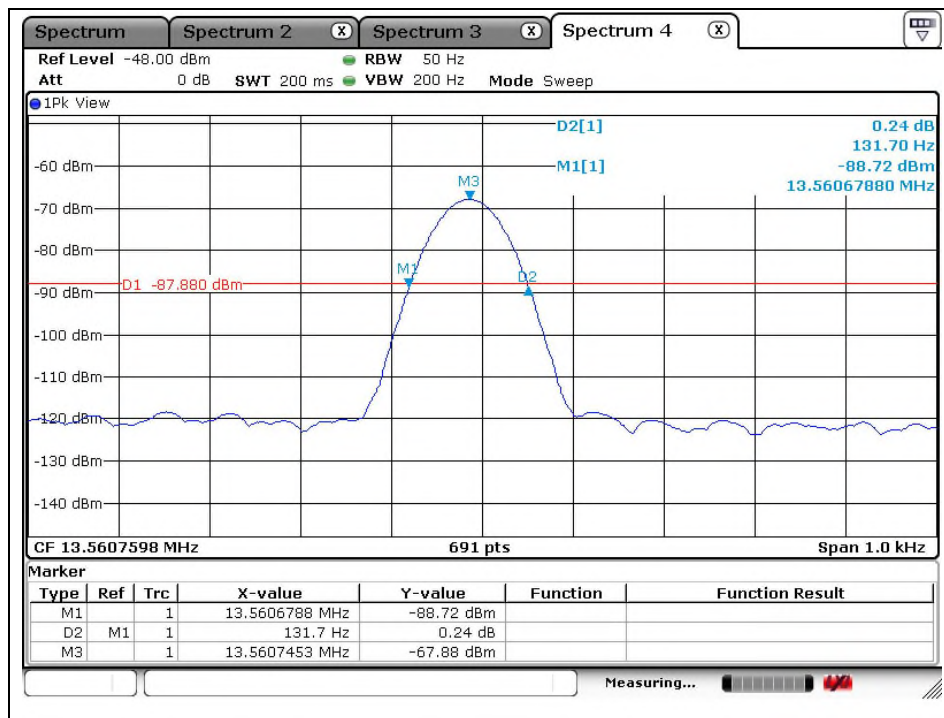
1. Span = set to capture all products of the modulation process, including the emission skirts.
 RBW = 50 Hz, VBW = 200 Hz, Sweep = auto, Detector = peak, Trace = max hold.
2. The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.

4.4. Test Result

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

Frequency (MHz)	20 dB Bandwidth (kHz)
13.560	0.132

- Test plot



-End of the Test report-