Test Report No. 9412334074

Applicant: LifeWatch Technologies Ltd.

Equipment Under Test:

ECG Mini

Models: FGL-00030

FCC ID: SQ6ECGMINI

From The Standards Institution
Of Israel
Industry Division
Electronics & Telematics Laboratory
EMC Branch

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

ACLASS Accreditation Services
Certificate Number: AT-1359

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Electronics: Tel: 972-3-6465050 Fax: 972-3-7454026 - Alarms Systems Section: Tel: 972-3-6465370 Fax: 972-3-6467262

Applicant:	LifeWatch Technologies Ltd.
Address:	2 Pekeris St., P.O.Box 527, Rehovot, 76100 Israel
Sample for test selected by:	The customer
The date of tests:	1 March 2015

Description of Equipment Under Test (EUT):	ECG Mini.
Models:	FGL-00030
Software version of brain unit	1.2.0.0
Hardware version of brain unit	PAL-00157 rev.0E
Manufactured by:	LifeWatch Technologies Ltd.

Reference Documents:

❖ CFR 47 FCC: Rules and Regulations; Part 15. "Radio frequency devices";
Subpart C: "Intentional radiators" (2015).
Section 15.209. "Radiated emission limits, general requirements".
"Radiated Emission Limits, Additional Provisions";
Section 15.249. "Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and 24.0 - 24.25 GHz".

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This Test Report contains 27 pages and may be used only in full.	This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.

Table of Contents

1. EUT Description and operation

1.1. General description:

* Note: the customer supplied all information in clause below.

The EUT, a Main Processing Unit (Brain, p/n FGL-00030), plugs into a cradle on the Patch with a 8-pin connector. The Brain receives the power from the Patch's 1.4V battery. The Brain transmits data to the Gateway application using the RF component.
The device uses NORDIC nRF24L01 single chip 2.4 GHz transceiver operating in 2400-2483.5 MHz frequency band.

Type of modulation:	GFSK
Output power:	programmed as 0, -6, -12 or -18 dBm
Antenna type:	Internal on PCB

The EUT external view is presented in photo # 1.

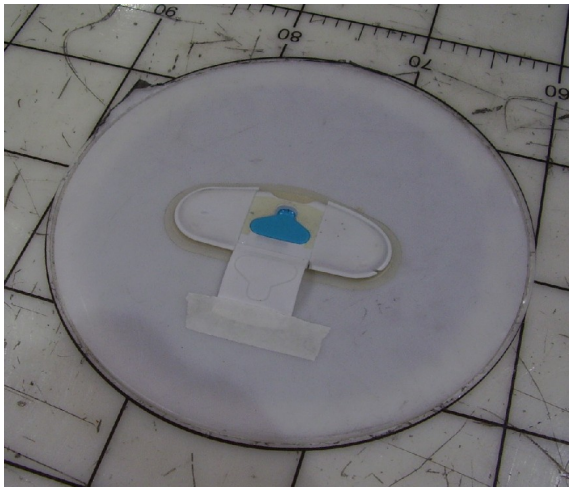


Photo 1. Brain inside patch view.

2. Test summary

Parameter	FCC Part 15 Reference paragraph	Verdict
Test of field strength emission from intentional radiators	"Radiated Emission Limits, Additional Provisions"; Section 15.249.	Comply

Electronics & Telematics Laboratory

March 2015

Name: Eng. Yuri Rozenberg
Position: Head of EMC Branch

Name: Michael Feldman
Position: Test Technician

Measurement uncertainty.

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error.
The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.
In the following table the uncertainty calculation is given.

Type of disturbance Test description	Calculated uncertainty U_{LAB}
Radiated disturbance	
electric field strength in a SAR at 3 m distance	
9kHz – 30MHz	±2.54 dB
30 MHz – 1.0 GHz	±4.32 dB
electric field strength in a FAR at 3 m distance	
1.0 – 18 GHz.	±4.47 dB
18 – 40 GHz.	±2.78 dB

Normative References.

FCC 47 CFR Part 15, Subpart C, 2015	Radio Frequency Devices Subpart C – Intentional Radiators
ANSI C63.4: 2009	American National Standard for Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10: 2009	American National Standard for Testing of Unlicensed Wireless Devices.

2.1. Potential emission sources:

The potential emission sources are detailed in Table 1.

Table 1. Potential emission sources

Frequency	Location
16.384 MHz	Microcontroller oscillator
16.0 MHz	RF Lo oscillator
2404 - 2480 MHz	RF signal

2.2. EUT setup and operation:

Test was performed in continuous transmission mode at three points - low - 2404 MHz, middle - 2440 MHz and top - 2480 MHz of 2400 – 2483.5 MHz frequency band.

3. Measurements and derived results

3.1. Location of the Test Site:

Radiated test was conducted at the EMC laboratory of the Standards Institution of Israel in Tel-Aviv.

3.2. Test condition:

Temperature: 22 °C. Humidity: 49 %. Atmospheric pressure: 1009 mbar.

3.3. Radiated emission test.

3.3.1. General:

Per FCC Part 15 Subpart C Sections 15.209, 15.249.

- Initial scans were made using a peak detector but still using the appropriate ANSI IF bandwidth.
- A tolerance limit was set 10 dB below the specification limit. Levels above the tolerance limit were retested using the Peak, QP or Average detectors.

3.3.2. Radiated emission measurements:

Preliminary investigation was performed from the lowest radio frequency signal generated in the equipment up to ten harmonic of a carrier frequency.
The final radiated emission measurements were performed in the semi Anechoic chamber at the 1 or 3 m test distances. Test was started with a new fresh battery. Measured voltage was 1.4VDC. The EUT was operated in continue transmition mode. The transmitter was installed on a turn - table. Active Loop, Biconilog and Double Ridged Guide antennas were used. The measurements were performed at three axis of EUT at frequencies that were found previously and at which the signal level was 10 dB below the limit or less. The levels were maximized by rotating turntable through 360° and changing antenna-to-EUT polarization from vertical to horizontal. The worse case result was noted in tables.

3.3.3. Radiated emission test results:

Final result measurements are presented in tables and plots ## 1 - 22 in section 3.4.5.

3.4. Test of field strength emission from intentional radiator.

3.4.1. General:

Per FCC Part 15 Subpart C clause 15.249.

3.4.2. Requirements:

The field strength emissions from intentional radiators operated according to section 15.249 (a) shall comply with the follow limits.

Table 2. Section 15.249 limit.

Specified field strength limit of Fundamental dBμV/m	Specified field strength limit of Harmonics dBμV/m
94.0	54.0

Note: The field strength for frequencies above 1000 MHz based on average limits.
The field strength of emissions radiated on any frequency outside of the specified band, except for harmonics shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emissions limits in section 15.209 whichever is lesser attenuation.

3.4.3. Test procedure:

The test was conducted according to clause 15.249.

3.4.4. Test summary:

The tested unit meets the standard requirement.

3.4.5. Test results:

Radiated emission result at carrier frequencies.

Carrier frequency, MHz	Antenna polarization.	Peak Ampl. dBµV/m	Specified limit dBµV/m	Margin dB	Reference to plot #
2404.0	Horizontal	93.6	94.0	0.4	1
2440.0	Horizontal	93.5	94.0	0.5	2
2480.0	Horizontal	90.5	94.0	3.5	3

Spurious emission result.

Carrier frequency 2404 MHz.

Freq. MHz	Antenna pol. V/H	Peak Ampl dBμV/m	Peak Ampl limit, dBμV/m	Margin dB	Avg Ampl. dBμV/m	Specified @3m limit, dBμV/m	Margin dB	Ref. to plot #
2399.9	H	70.6	74.0	2.4	47.0	54.0	7.0	7
7690	H	58.0	74.0	16.0	47.4	54.0	6.6	9
14410	H	73.3	*84.0	10.7	-	-	-	10
14660	H	-	-	-	61.7	*64.0	2.3	10

Carrier frequency 2440 MHz.

Freq. MHz	Antenna pol. V/H	Peak Ampl dBμV/m	Peak Ampl limit, dBμV/m	Margin dB	Avg Ampl. dBμV/m	Specified @3m limit, dBμV/m	Margin dB	Ref. to plot #
2398.6	H	55.4	74.0	8.6	-	-	-	12
2365.0	H	-	-	-	41.8	54	12.2	12
2838.3	H	54.9	74	9.1	-	-	-	13
2984.0	H	-	-	-	44.1	54	9.9	13
9916	H	57.9	74	6.0	-		-	14
9342	H	-	-		45.3	54	8.7	14
14780	H	73.5	*84	10.5	-	-		15
14610	H	-	-	-	61.4	*64.0	2.6	15

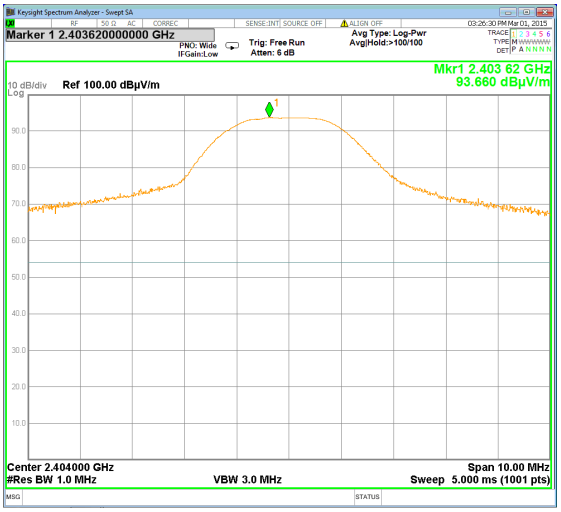
* Limit 1m test distance.

Carrier frequency 2480 MHz.

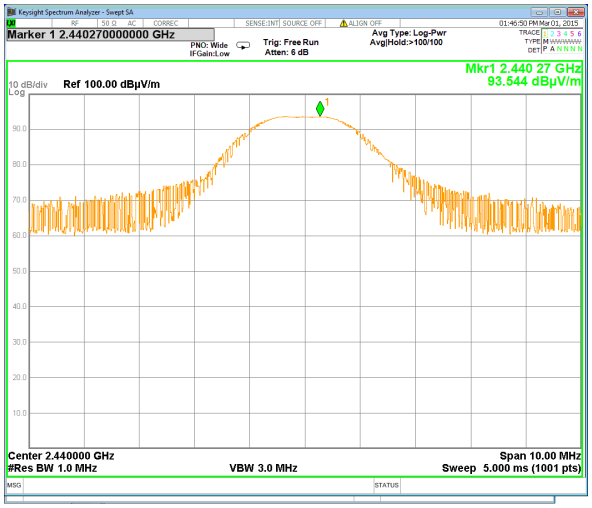
Freq. MHz	Antenna pol. V/H	Peak Ampl dBμV/m	Peak Ampl limit, dBμV/m	Margin dB	Avg Ampl. dBμV/m	Specified @3m limit, dBμV/m	Margin dB	Ref. to plot #
2390.2	H	51.8	74.0	12.2	41.4	54.0	12.6	17
2483.6	H	65.8	74.0	8.2	45.9	54.0	8.1	19
9454	H	56.9	74.0	7.1	-	-	-	20
9363	H	-	-		45.1	54.0	8.9	20
14270	H	73.0	*84.0	11.0	-	-	-	21
14375	H	-	-	-	61.6	*64.0	2.4	21

* Limit 1m test distance.

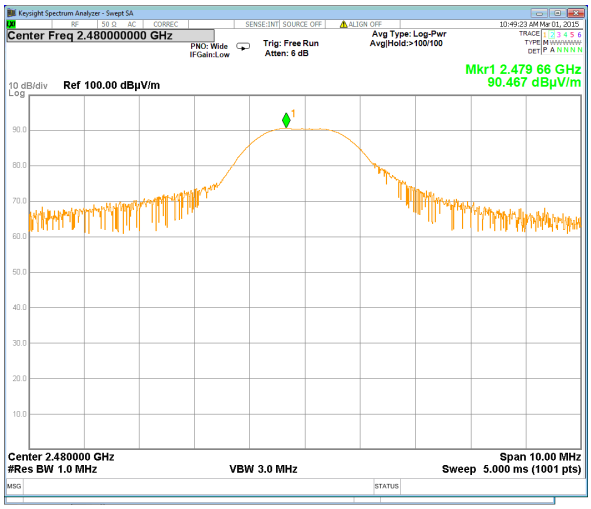
Fundamental frequency test.



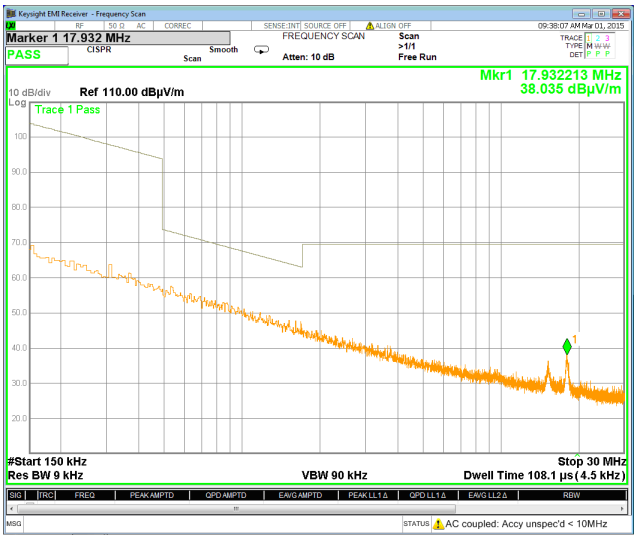
Plot # 1.



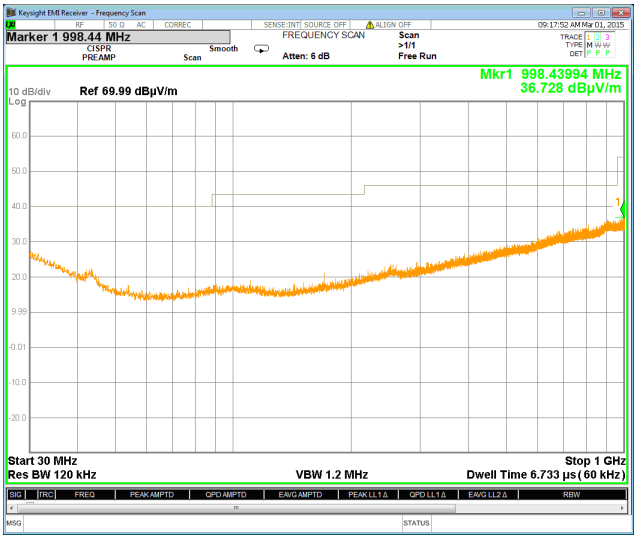
Plot # 2.



Plot # 3.

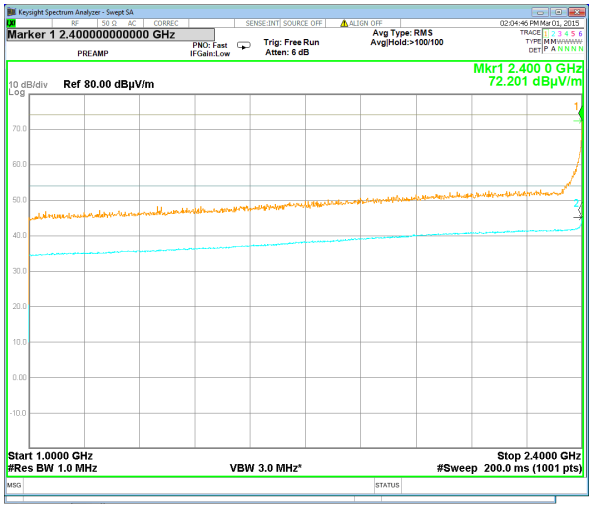


Plot # 4. Spurious emissions scan 0.15 MHz – 30 MHz.

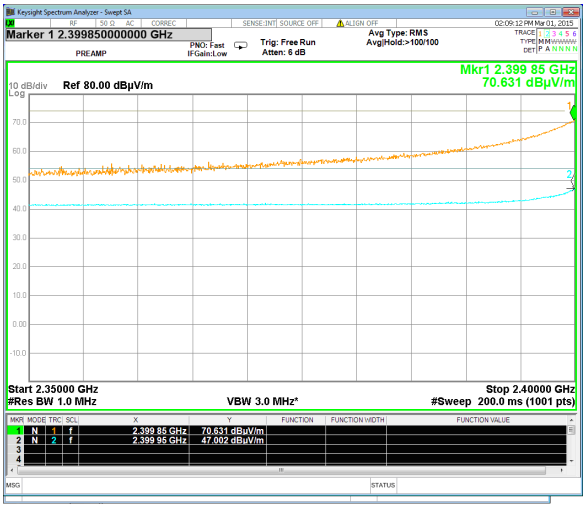


Plot # 5. Spurious emissions scan 30 MHz – 1000 MHz.

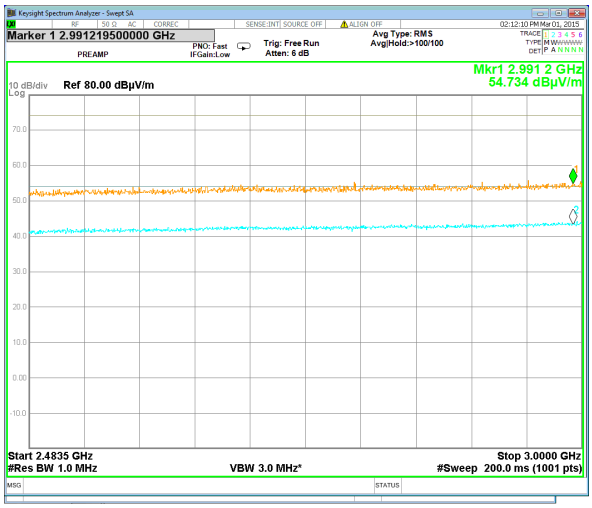
Carrier frequency 2404 MHz.



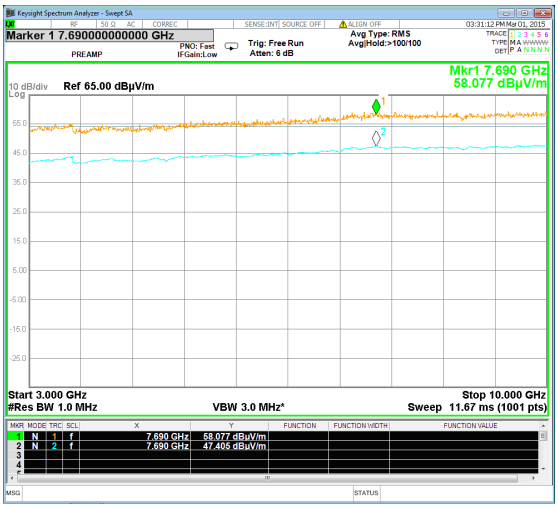
Plot # 6.



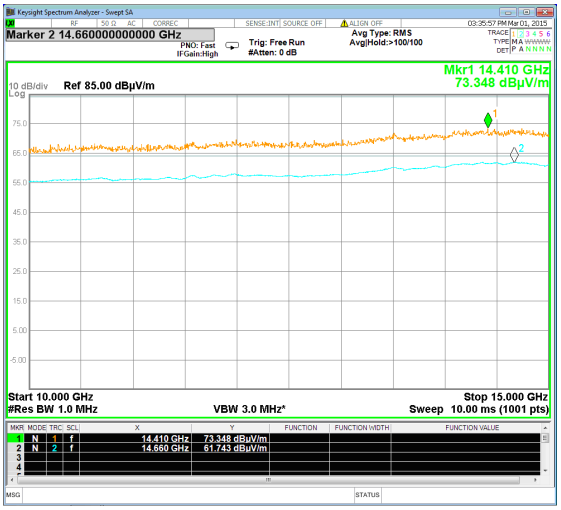
Plot # 7.



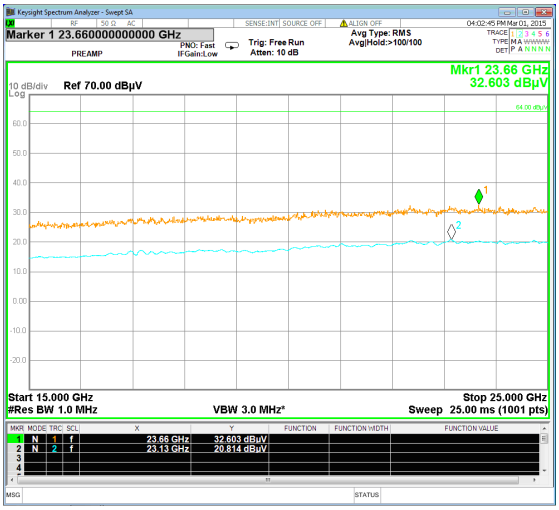
Plot # 8.



Plot # 9.

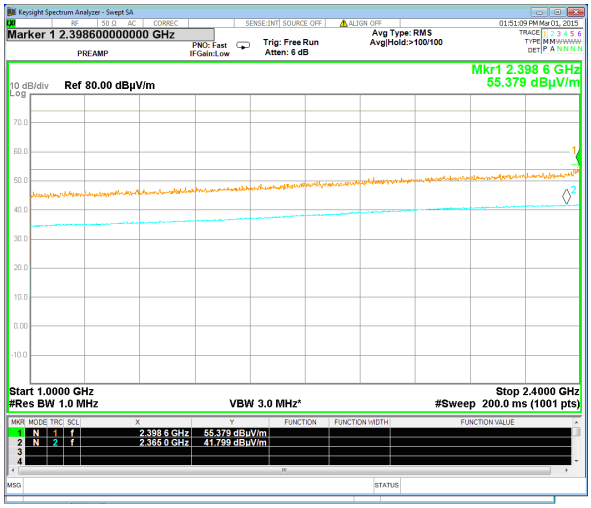


Plot # 10. Test distance =1m



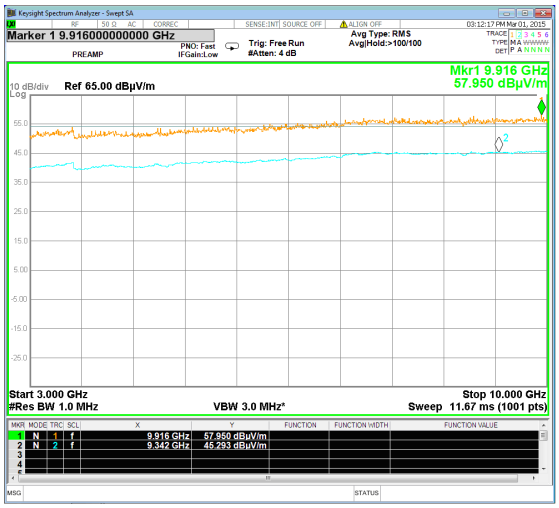
Plot # 11. Test distance =1m

Carrier frequency 2440 MHz.

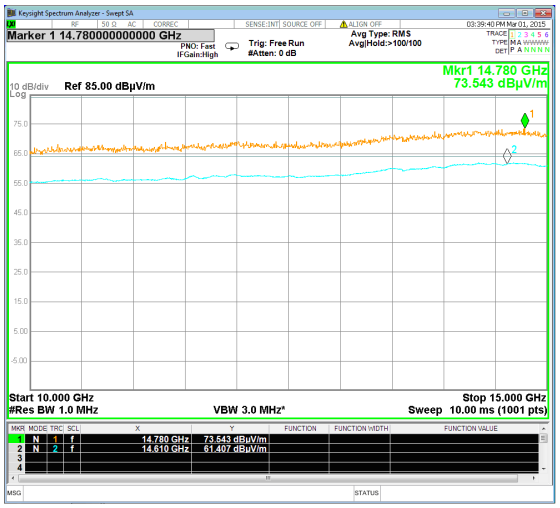


Plot # 12.

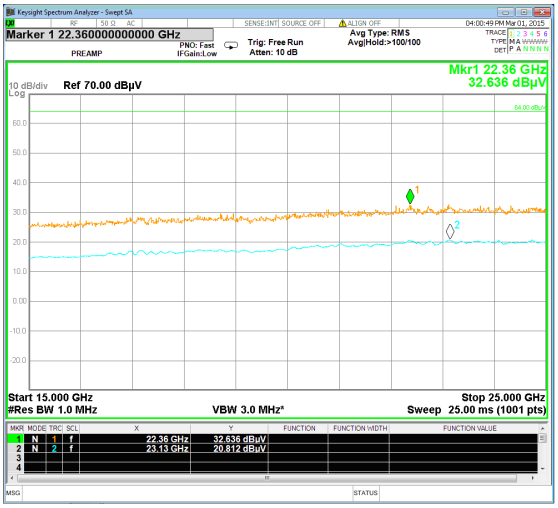
Plot # 13.



Plot # 14.

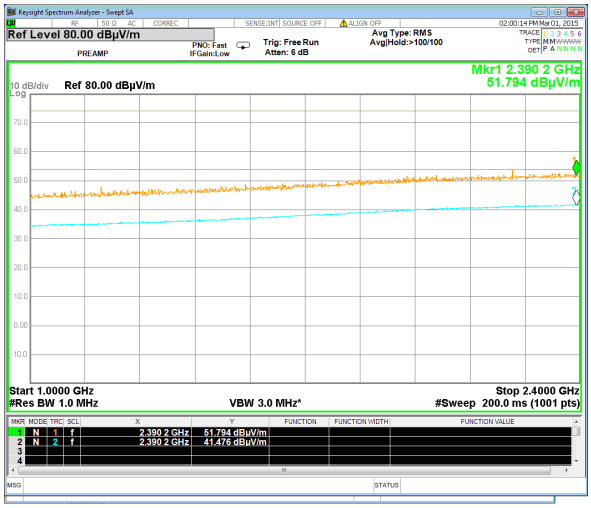


Plot # 15. Test distance =1m

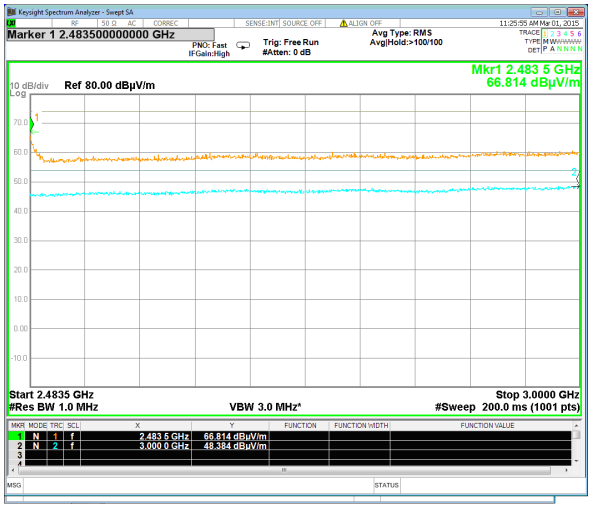


Plot # 16. Test distance =1m

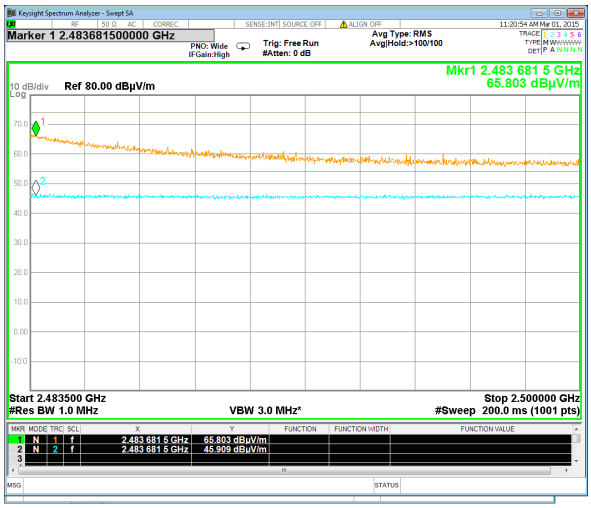
Carrier frequency 2480 MHz.



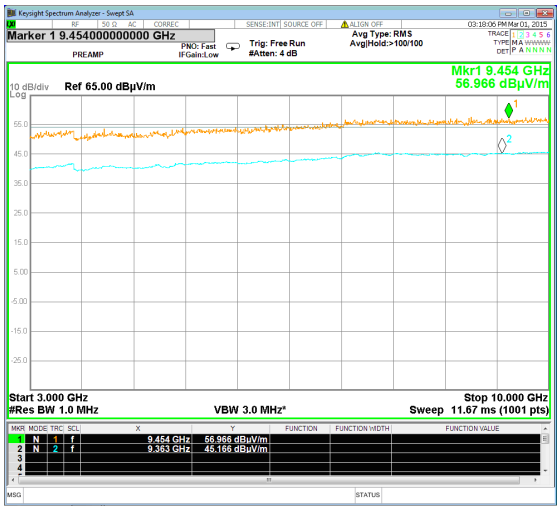
Plot # 17.



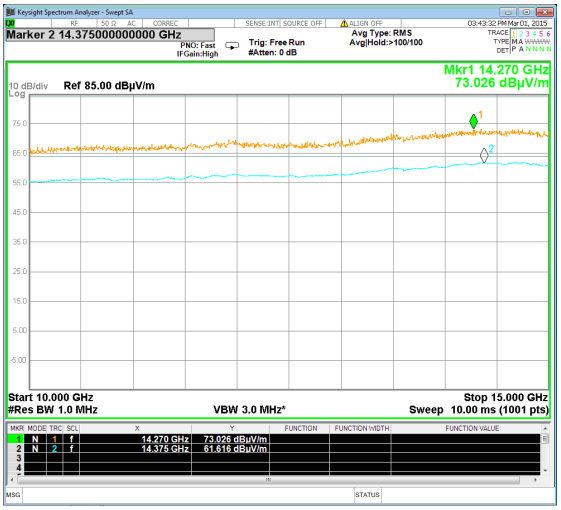
Plot # 18.



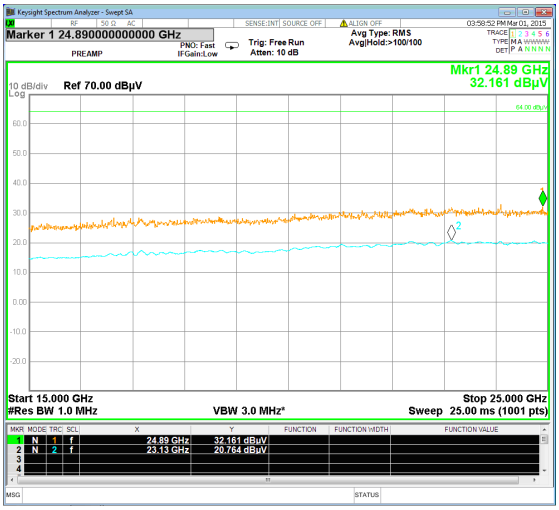
Plot # 19.



Plot # 20.



Plot # 21. Test distance =1m.



Plot # 22. Test distance =1m.

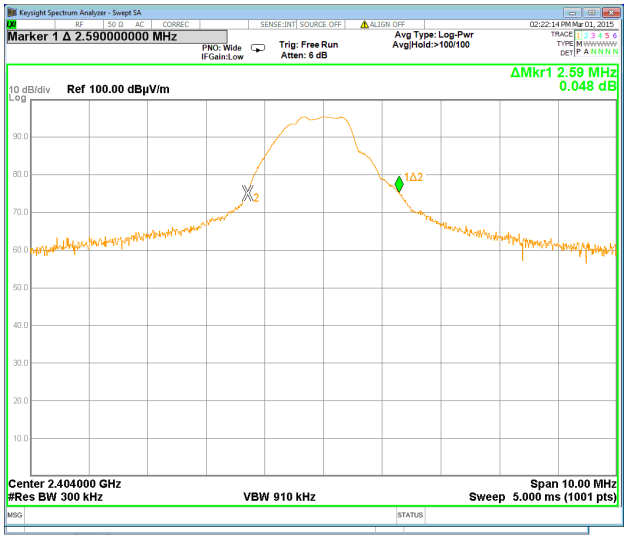
3.5. Test of occupied bandwidth per 15.215(c)

3.5.1. Requirements:

Intentional radiator must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band.

3.5.2. Test results:

Test result presented in plot below.



Plot # 23. Occupied bandwidth test result

3.5.3. Test summary:

20 dB occupied bandwidth is 2.59 MHz.
The tested unit meets the standard requirement.

4. Appendix 1. Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding one year.

Test equipment used

No	Description	Manufacturer information			Due Calibration date
		Name	Model	Serial No	
1	MXE EMI Receiver 20 Hz -26.5 GHz	Agilent	N9038A	SII 650114	February 2016
2	Double Ridged Guide Antenna 0.75 – 18 GHz	ETS-Lindgren	3115	00143138	December 2015
3	Broadband Horn antenna 15 – 40 GHz	Schwarzbeck Mess-Electronik	BBHA 9170	9170-341	December 2015
4	Double Ridged Waveguide Horn Antenna 1 – 18 GHz	ETS-Lindgren	3117	00139055	December 2015
5	Antenna Biconilog 30 – 6000 MHz	ETS-Lindgren	31142D	0146490	December 2015
6	Spectrum analyzer 9 kHz-6.0 GHz	Rohde&Schwarz	FSL	SII5912	May 2015
7	EMI Analyser 9 kHz - 26.5 GHz	HP	E7405A	SII 4944	May 2015
8	Attenuator 3 dB DC – 12.4 GHz	HP	8491A	50469	October 2015
9	LISN 9 kHz – 30 MHz	FCC	LISN 250-32-4-16	SII5023	October 2015
10	Transient limiter 0.009-200 MHz	HP	11947A	3107105	August 2015
11	Cable RF 1m	Huber-Suhner	Sucoflex 104PE	21325/4PE	October 2015
12	Cable RF 4m	Huber-Suhner	Sucoflex 104PE	21329/4PE	October 2015
13	Cable RF 0.5m	Huber-Suhner	Multiflex 141	520201	October 2015
14	Active Loop antenna 1.0 kHz – 30 MHz	ETS-Lindgren	6507	00144641	December 2015

5. Appendix 2: Antenna Factor and Cable Loss

Cable Loss. Mast 6 m set cable.

Point	Frequency, MHz	Cable Loss, dB	Point	Frequency, MHz	Cable Loss, dB
1	30	0.3	21	1000	2.5
2	50	0.4	22	1100	2.6
3	100	0.6	23	1200	2.8
4	150	0.8	24	1300	2.9
5	200	1.0	25	1400	3.1
6	250	1.1	26	1500	3.2
7	300	1.2	27	1600	3.3
8	350	1.3	28	1700	3.5
9	400	1.5	29	1800	3.6
10	450	1.6	30	1900	3.7
11	500	1.7	31	2000	3.9
12	550	1.8	32	2100	4.0
13	600	1.9	33	2200	4.1
14	650	1.9	34	2300	4.2
15	700	2.0	35	2400	4.4
16	750	2.1	36	2500	4.6
17	800	2.1	37	2600	4.7
18	850	2.2	38	2700	4.8
19	900	2.3	39	2800	4.9
20	950	2.4	40	2900	5.0

Antenna factor
Biconilog Antenna, ETS-Lindgren mod. 31142D, S/N: 0146490 3m calibration.

No.	f / MHz	AF / dB/m	f / MHz	AF / dB/m	f / MHz	AF / dB/m
1	30	18.7	250	12.0	2750	31.0
2	35	15.7	300	13.8	3000	31.2
3	40	12.9	400	16.2	3250	32.7
4	45	10.6	500	18.6	3500	34.5
5	50	9.0	600	20.2	3750	34.3
6	60	7.3	700	21.8	4000	34.5
7	70	7.7	800	22.9	4250	35.3
8	80	8.2	900	24.1	4500	35.5
9	90	9.2	1000	24.8	4750	36.1
10	100	9.4	1250	26.9	5000	37.4
11	120	8.5	1500	30.2	5250	38.4
12	140	8.5	1750	28.5	5000	39.9
13	160	9.1	2000	28.9	5750	38.2
14	180	10.5	2250	29.8	6000	39.1
15	200	10.9	2500	32.5		

Antenna Factor
Double Ridged Guide Antenna mfr ETS-Lindgren model 3115 1m calibration

Point	Frequency (MHz)	Antenna Factor (dB/m)
1	1000	23.7
2	2000	28.5
3	3000	29.6
4	4000	32.5
5	4500	32.6
6	5000	33.5
7	6000	36.1
8	6500	36.5
9	7000	37.3
10	7500	38.0
11	8000	37.3
12	8500	37.9
13	9000	38.1
14	9500	38.5
15	10000	38.7
16	10500	38.8
17	11000	38.6
18	11500	38.8
19	12000	38.9
20	12500	39.3
21	13000	40.2
22	13500	40.8
23	14000	40.6
24	14500	40.4
25	15000	39.6
26	15500	39.5
27	16000	39.8
28	16500	40.4
29	17000	41.3
30	17500	42.8
31	18000	43.2

Cable Loss
Type: Sucoflex 104PE; Ser.No.21329/4PE; 4 m length

Point	Frequency, GHz	Cable Loss, dB
1	0.0-1.0	1.7
2	1.0– 3.5	3.2
3	3.5– 5.5	4.0
4	5.5 – 7.5	4.7
5	7.5 – 9.5	5.3
6	9.5 – 10.5	5.6
7	10.5 – 12.5	6.2
8	12.5 – 14.5	6.8
9	14.5 – 16.5	7.5
10	16.5 – 18.0	8.1

Active Loop antenna mfr.ETS-Lindgren mod. 6507 S/N 144641.

Frequency, MHz	Magnetic Antenna factor dBS/m	Electric Antenna factor dB/m
0.009	-20.0	31.5
0.010	-21.0	30.5
0.020	-26.7	24.9
0.075	-32.4	19.1
0.100	-32.7	18.8
0.150	-32.9	18.6
0.250	-33.0	18.5
0.500	-33.0	18.5
0.750	-33.0	18.5
1.000	-32.8	18.7
2.000	-32.7	18.8
3.000	-32.9	18.7
4.000	-33.2	18.3
5.000	-33.4	18.2
10.000	-34.0	17.6
15.000	--34.2	17.3
20.000	-34.4	17.1
25.000	-34.8	16.7
30.000	-35.0	16.5

6. Appendix 3: Test setups photo.

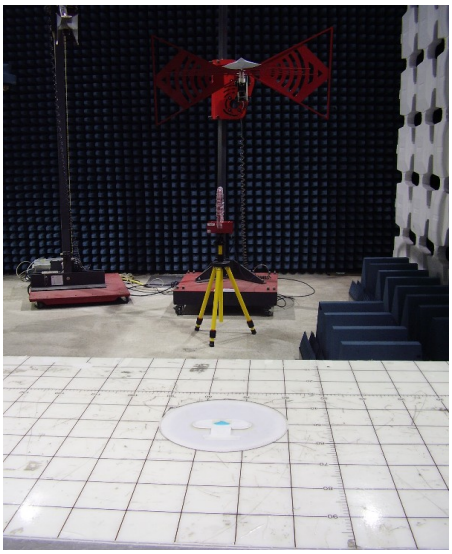


Photo 2.

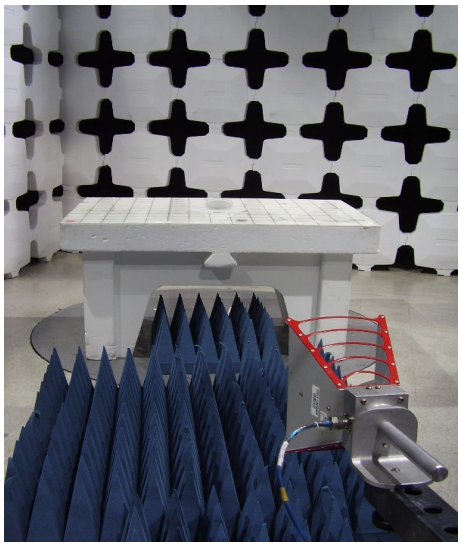


Photo 3.

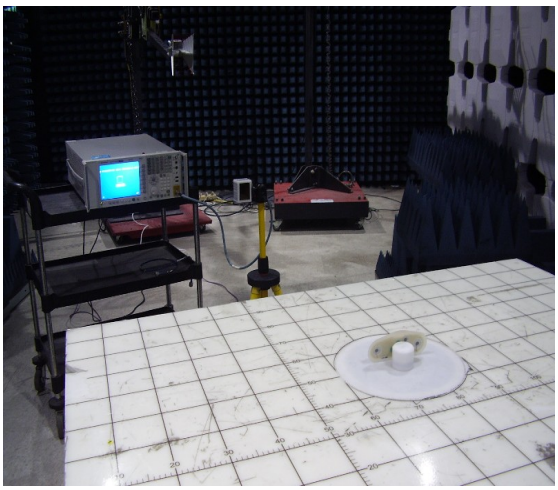


Photo 4.