Test Report No. 7012308011

For Theranica Bio-Electronics Ltd.

Equipment Under Test:

Nerivio transceiver

Model: FGD000075
FCC ID: 2AOH8-NM

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

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Certificate Number: AT-1359

42 Chaim Levanon St. Tel-Aviv 69977 Israel. Management: Tel: 972-3-6467800 Fax: 972-3-6467779 www.sii.org.il
Electronics: Tel: 972-3-6465050 Fax: 972-3-7454026 - Alarms Systems Section: Tel: 972-3-6465370 Fax: 972-3-6467262

Table of Contents

1. Applicant information

Applicant:	Theranica Bio-Electronics Ltd..
Address:	45 Ha-Omanut St., Netanya, 4250438 Israel
Sample for test selected by:	The customer
The date of tests:	1, 6 April 2020

Equipment under test information

Description of Equipment Under Test (EUT):	Nerivio transceiver
Model:	FGD000075
Software version of radio unit:	FW Version 3.2.0.1
Hardware version:	ELC-PCA-010-3.0
Manufactured by:	Theranica Bio-Electronics Ltd.

2. Test performance

Location:	SII EMC Section
Purpose of test:	Apparatus compliance verification in accordance with emission requirements
Test specifications:	47CFR part 15.247, 15.205, 15.207, 15.209 and part 1 §1.1310

Normative References.

FCC 47 CFR Part 15, Subpart C, 2019	Radio Frequency Devices Subpart C – Intentional Radiators
ANSI C63.4: 2014	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: 2013	American National Standard for Testing of Unlicensed Wireless Devices.
FCC OET KDB 558074, April 2019	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

3. Summary of test:

The EUT was found to comply with requirements of: 47CFR Part 15, §§ 15.247, 15.205, 15.207 and 15.209**.**

Transmitter characteristics	Subclause
Minimum 6 dB bandwidth	15.247(a)(2)
Maximum output power	15.247(b)(3)
Peak power spectral density	15.247(e)
Out of band spurious emissions radiated	15.205, 15.247(d)
Unwanted radiated emissions below 1 GHz	15.209

Electronics and
Telematics Laboratory

4 May 2020

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

Name: Michael Feldman.
Position: Test engineer.

Measurement uncertainty.

The test equipment was 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.

Test description	Calculated uncertainty U_{LAB}
Conducted measurements	
Frequency error	37.6 Hz
Spurious emission	± 2.98 dB
Radiated emissions	
Electric field strength in a SAR at 3 m distance 30 MHz – 1.0 GHz	±4.32 dB
Electric field strength in a FAR at 3 m distance 1.0 GHz – 18 GHz	± 4.47 dB
Substitution measurements	
In a FAR at 3 m distance 1.0 GHz – 18 GHz	± 3.41 dB

4. Equipment under test description.

*The applicant provided description.

4.1 General description

Nerivio (the EUT) is a wearable, battery-powered device for the acute treatment of migraines with or without aura. Nerivio is operated via a mobile application. The Nerivio uses standard BLE 4.2 for communication utilizing off-the-shelf Cypress controller.
Device powered from internal 3.0 VDC Li-polymer battery.
.

EUT technical characteristics

Transmitter technical characteristics:		Note
Assigned frequency band	2400 MHz – 2483.5 MHz	
Operating frequency range:	2402 MHz – 2480 MHz	
DTS transmitter:	BLE 4.2	
Types of modulation:	GFSK	
Declare temperature range:	0°C - 40°C	Normal indoor use
Antenna information		
Type	Manufacturer/Model	Antenna gain, dBi
BT antenna	Cypress. MIFA PCB printed	1.6

Test report No: 7012308011	**Page 7 of 28 Pages**
Title: Nerivio transceiver	
Model: FGD000075	**FCC ID: 2AOH8-NM**

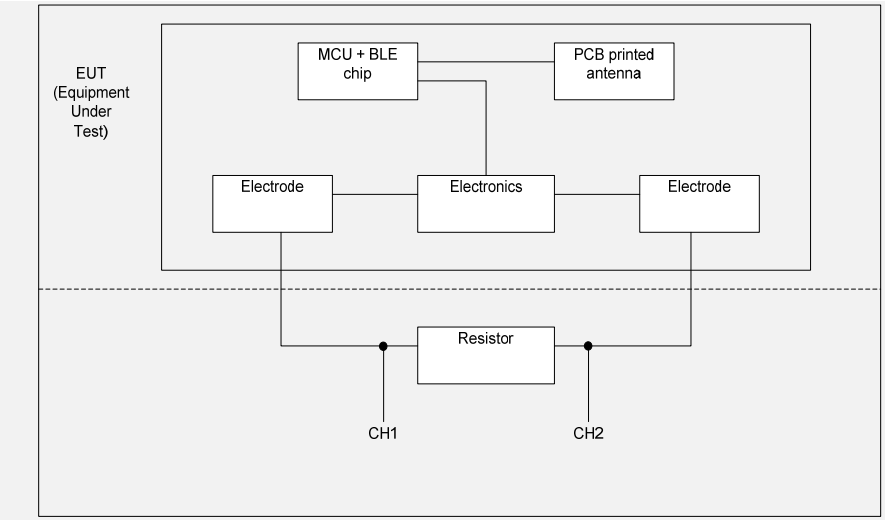


Figure 1. Nerivio transceiver block diagram.

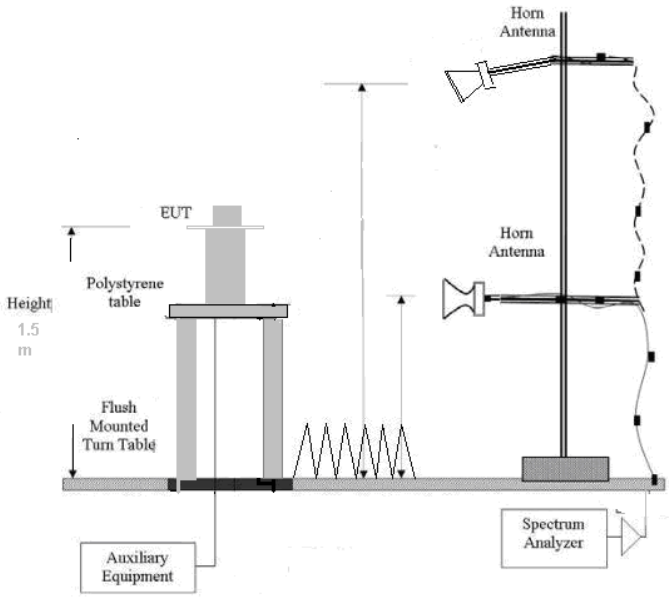


Fig.2. RE test setup above 1 GHz.

5. Test results

5.1 Transmitter characteristics

5.1.1 Transmitter 6 dB occupied bandwidth.

Method of measurement	**ANSI C63.10 subclause 11.8.2**	
Operating Frequency Range	**2402– 2480 MHz**	
Detector used	**Peak**	
Resolution bandwidth	**100 kHz**	
Video bandwidth	**> 3 x RBW.**	
Trace mode	**Max Hold.**	
Sweep time:	**Auto couple.**	
Ambient Temperature 22^0 C	**Relative Humidity 53%**	**Air Pressure 1010 hPa**

The minimum 6 dB occupied bandwidth shall be at least 500 kHz.

Carrier frequency, MHz	Measured 6 dB occupied bandwidth, kHz	6 dB occupied bandwidth limit, kHz	Reference to plot #
2402	658	500	1
2440	665	500	2
2480	663	500	3

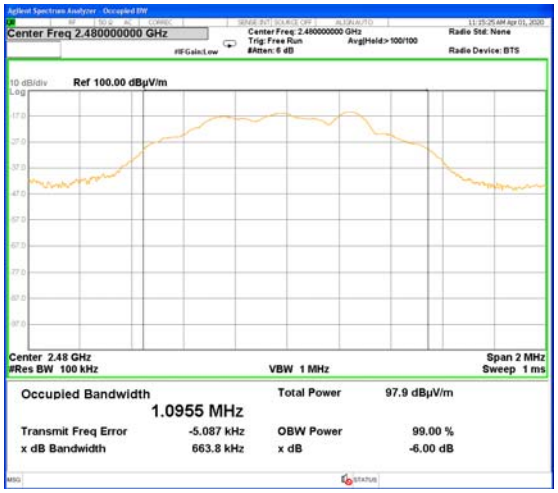
TEST EQUIPMENT USED:

1	3	14				

Test report No: 7012308011	**Page 9 of 28 Pages**
Title: Nerivio transceiver	
Model: FGD000075	**FCC ID: 2AOH8-NM**

Plot # 1.

Plot # 2.



Plot # 3.

5.1.2 Maximum conducted output power test.

Method of measurement	**ANSI C63.10 subclause 11.9.2.2**	
Operating Frequency Range	**2402– 2480 MHz**	
Detector used	**RMS**	
Resolution bandwidth	**1 MHz**	
Video bandwidth	**3 x RBW.**	
Trace mode	**Max Hold.**	
Ambient Temperature 23^0 C	**Relative Humidity 53%**	**Air Pressure 1010 hPa**

For Digital Transmit System the peak conducted output power in the 2400 – 2483.5 MHz band shall not exceed 1W (30 dBm) with antennas gain that do not exceed 6 dBi.

Carrier frequency, MHz	Field strength, dBµV/m	99% power OBW, MHz	**EIR power, dBm	*Conducted output power, dBm	Conducted power limit, dBm	Reference to plot #
2402	88.5	1.12	-6.3	-7.9	30	4
2440	93.0	1.12	-1.8	-3.4	30	5
2480	91.2	1.12	-3.6	-5.2	30	6

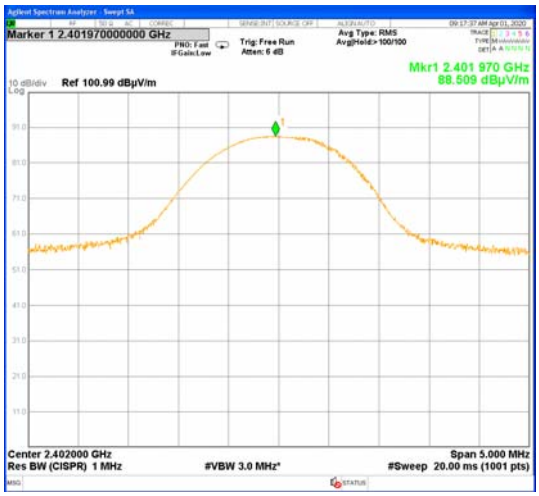
*The maximum conducted output power = EIR power – Antenna gain. Where antenna gain = 1.6 dBi.
**EIR power = (E Field strength (dBµV/m@3m) - 95.2) +10Log (99% OBW).

Measured field straight level was converted to EIRP level. The EIRP calculation provided after verification according to substitution test method. EUT was replaced by generator and substitution antenna. Result calculated from generator output level, substitution antenna gain and loss of connected cable was used for EIRP calculation. Transmitter was operated at continuous transmit mode at bottom, middle and top of the 2402 – 2480 MHz frequency band and at maximum output power and maximum data bit rate.

TEST EQUIPMENT USED:

1	2	3	5	8	9	13

Test report No: 7012308011	**Page 11 of 28 Pages**
Title: Nerivio transceiver	
Model: FGD000075	**FCC ID: 2AOH8-NM**



Plot # 4. Carrier frequency – 2402 MHz

Plot # 5. Carrier frequency – 2440 MHz

Plot # 6. Carrier frequency – 2480 MHz

5.1.3 Power spectral density test

Method of measurement	**ANSI C63.10 subclause 11.10.2**		
Operating Frequency Range	**2402– 2480 MHz**		
Detector used	**Peak**		
Resolution bandwidth	**30 kHz**		
Video bandwidth	**>3 x RBW.**		
Trace mode	**Max Hold.**		
Ambient Temperature 23^0 C	**Relative Humidity 53%**	**Air Pressure 1010 hPa**	

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.

Carrier frequency, MHz	Field strength, dBµV/m	*EIR power, dBm	**Conducted PSD dBm	Conducted PSD limit, dBm/3 kHz	Reference to plot #
2402	84.9	-10.3	-19.3	8	7
2440	90.5	-4.7	-13.7	8	8
2480	88.3	-6.9	-15.9	8	9

**The conducted to antenna PSD:
EIR power – Antenna gain. Where antenna gain = 1.6 dBi.
*EIRP = E Field strength (dBµV/m@3m) - 95.2. Correction of RBW/3 KHz accounted in calculation.
Calculation of EIRP performed after verification by substitution method.

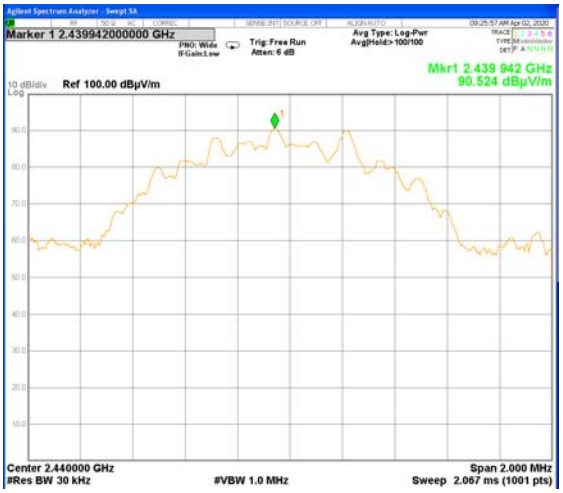
TEST SUMMARY

EUT maximum output power result is below PSD limit per 47 CFR 15.247 (e).
The EUT was found complies with standard requirement.

TEST EQUIPMENT USED:

1	3	14				

Plot # 7. Carrier frequency – 2402 MHz



Plot # 8. Carrier frequency – 2440 MHz

Plot # 9. Carrier frequency – 2480 MHz

5.1.4 Radiated emissions test according to §§ 15.247(d), 15.205(a)

Method of measurement	**ANSI C63.10 sub clauses 11.11/ 11.12**	
Operating Frequency Range	**2402– 2480 MHz**	
Detector used:	**Trace 1 – Peak; Trace 2 - RMS**	
Resolution bandwidth	**100 kHz /1 MHz**	
Video bandwidth	**3x RBW.**	
Trace mode:	**Trace 1 – Max hold; Trace 2 – Power averaging.**	
Ambient Temperature 23^0 C	**Relative Humidity 53%**	**Air Pressure 1010 hPa**

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 a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
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).

Carrier frequency 2402 MHz

Frequency, MHz	Radiated emissions, dBµV/m	Peak limit, dBµV/m	Avg limit, dBµV/m	Margin, dB	Note	Note	Reference to plot#
2348.3	51.5	74	-	>20	*RB	Detector peak	10
2348.3	38.8	-	54	14.2	RB	Detector average	10
2400.0	54.0	68.9	-	14.9	Band edge	Detector peak.	11
5058.0	55.8	74.0	-	18.2	RB	Detector peak	12
5058.0	43.7	-	54	10.3	RB	Detector average	12
7728.0	56.6	74.0	-	17.4	RB	Detector peak	13
7728.0	46.0	-	54.0	8.0	RB	Detector average	13

*RB – restricted band

Carrier frequency 2440 MHz

Frequency, MHz	Radiated emissions, dBµV/m	Peak limit, dBµV/m	Avg limit, dBµV/m	Margin, dB	Note	Note	Reference to plot#
2324.7	49.6	74	-	>20	RB	Detector peak	15
2326.0	39.5	-	54	14.5	RB	Detector average	15
2400	50.1	71.1	-	>20	Band edge	Detector peak.	16
5036.0	51.5	74	-	>20	RB	Detector peak	17
5036.0	41.0	-	54	13.0	RB	Detector average	17

Carrier frequency 2480 MHz

Frequency, MHz	Radiated emissions, dBµV/m	Peak limit, dBµV/m	Avg limit, dBµV/m	Margin, dB	Note	Note	Reference to plot#
2374.7	51.6	74	-	>20	*RB	Detector peak	20
2374.7	40.5	-	54	13.5	RB	Detector average.	20
2400.0	54.9	69.6	-	14.6	Band edge	Detector peak.	21
2483.7	62.3	74	-	11.7	RB	Detector peak	22
2483.7	42.1	-	54	11.9	RB	Detector average	22
4586.0	49.0	74	-	15.0	RB	Detector peak	23
4586.0	38.0	-	54	16.0	RB	Detector average	23

*RB – restricted band

TEST SUMMARY

All emissions outside of the 2400 – 2483.5 MHz frequency band founded below 15.247(d) limits.

TEST EQUIPMENT USED:

1	3	4	10	13	14	

Carrier frequency – 2402 MHz.

Plot # 10

Plot # 11

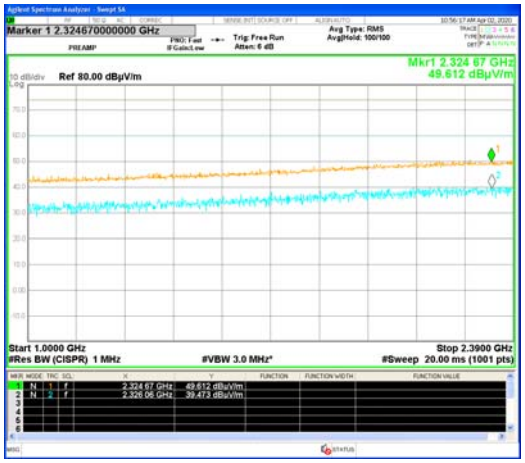
Plot # 12

Plot # 13

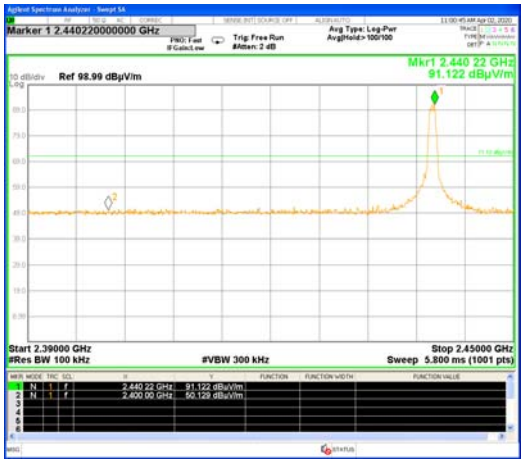
Plot # 14.

Test report No: 7012308011	**Page 17 of 28 Pages**
Title: Nerivio transceiver	
Model: FGD000075	**FCC ID: 2AOH8-NM**

Carrier frequency - 2440 MHz.



Plot # 15



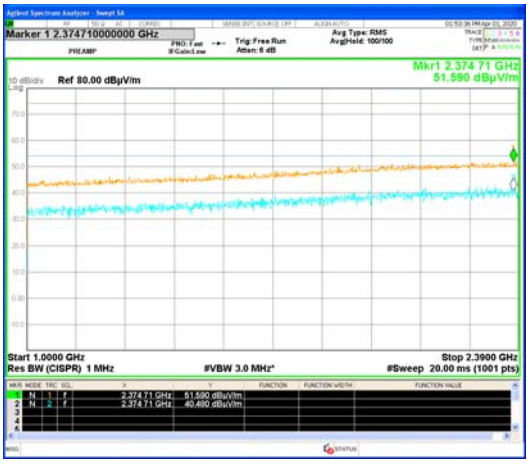
Plot # 16

Plot # 17

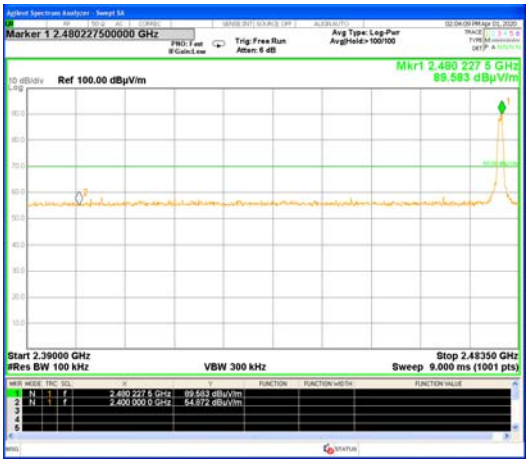
Plot # 18

Plot # 19.

Carrier frequency 2480 MHz.



Plot # 20



Plot # 21

Plot # 22

Plot # 23

Plot # 24.

Plot # 25

5.1.5 Radiated emissions test according to § 15.209

Method of measurement	**ANSI C63.10 §6.5**	
Detectors used	**CISPR Quasi-Peak**	
Resolution bandwidth	**9 kHz/120 kHz**	
Video bandwidth	**>3 x RBW.**	
Trace mode	**Free run**	
Ambient Temperature 24^0 C	**Relative Humidity 53%**	**Air Pressure 1010 hPa**

TEST DESCRIPTION:

The measurements were performed at 3 m test distance in Anechoic chamber. The EUT was arranged on a polystyrene table 0.8 m height and placed on the turn - table.
The Active Loop antenna in 150 kHz to 30 MHz frequency band and Biconilog antenna in 30 MHz – 1.0 GHz frequency band were used. The emission level was maximized by initially rotating turntable through 360°, varying the antenna height between 1 m and 4 m, rerouting EUT cables and changing antenna polarization from vertical to horizontal.

REQUIREMENTS:

EUT radiated emission shall not exceed value required in section 15.209

TEST RESULT:

Test results presented in a table below and in plots ## 26, 27.

TEST EQUIPMENT USED:

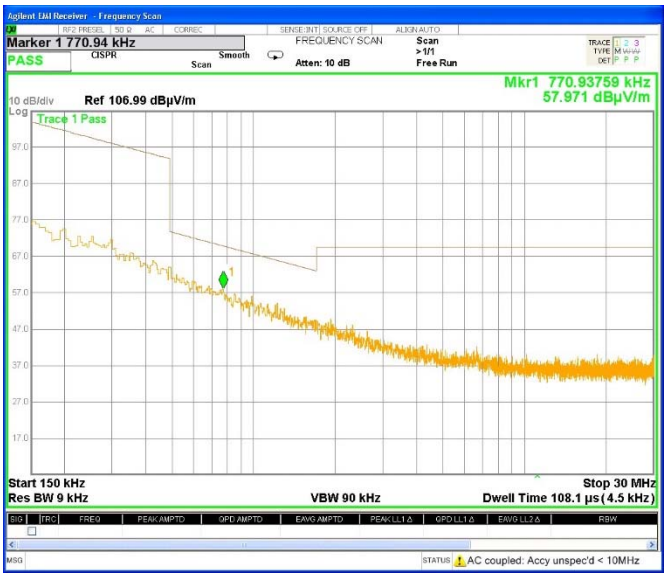
1	6	13	15			

Radiated emission test results.

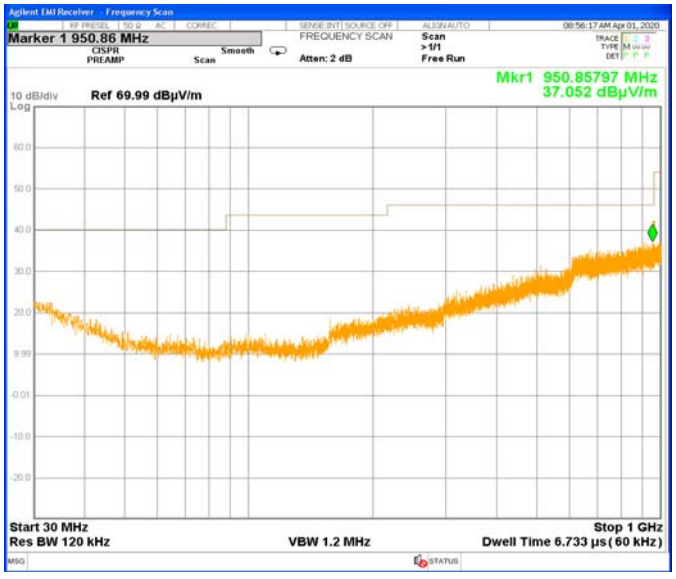
Frequency (MHz)	Antenna polariz. V/H	Antenna Height m	Turn-table Angle (°)	Emission Level Note 1 dBμV/m	Limit @ 3m dBμV/m	Margin Note 2 dB	Results
950.8	H	1.4	54	37.0	46.0	9.0	Pass

Note 1:	Emission level = E Reading (dBμV) + Cable loss (dB) + Antenna Factor (dB/m). For Cable Loss and Antenna Factor refer to Appendix 2.
Note 2:	Margin (dB) = Limit (dBμV/m) – Emission level (dBμV/m)

Test report No: 7012308011	**Page 21 of 28 Pages**
Title: Nerivio transceiver	
Model: FGD000075	**FCC ID: 2AOH8-NM**



Plot # 26. Investigation result in 0.15 – 30 MHz frequency range.



Plot # 27. Investigation result in 30 - 1000 MHz frequency range.

APPENDIX A Test equipment used.

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	April 2020
2	Cable RF 1m	Huber-Suhner	Sucoflex 104	21325/4PE	October 2020
3	Double Ridged Guide Antenna 0.75 – 18 GHz	ETS-Lindgren	3115	00143138	December 2020
4	Broadband Horn antenna 15 – 40 GHz	Schwarzbeck Mess-Electronik	BBHA 9170	9170-341	December 2020
5	Double Ridged Waveguide Horn Antenna 1 – 18 GHz	ETS-Lindgren	3117	00139055	December 2020
6	Antenna Biconilog 26 – 6000 MHz	ETS-Lindgren	31142D	0146490	December 2020
7	Spectrum analyzer 20 Hz-40 GHz	Rohde&Schwarz	ESU 40	100168	November 2020
8	MXG Signal Generator 100 KHz - 20 GHz	Agilent	N5183A	6501148	May 2020
9	Attenuator 3 dB DC – 12.4 GHz	HP	8491A	50469	October 2020
10	USB preamplifier 2 GHz – 50 GHz	Keysight	U7227F	MY55380004	January 2021
11	LISN 9 kHz – 30 MHz	FCC	LISN 250-32-4-16	SII5023	October 2020
12	Transient limiter 0.009-200 MHz	HP	11947A	3107105	August 2020
13	Cable RF 4m	Huber-Suhner	Sucoflex 104PE	21329/4PE	October 2019
14	Cable RF 0.5m	Huber-Suhner	Multiflex 141	520201	October 2019
15	Active Loop antenna 1.0 kHz – 30 MHz	ETS-Lindgren	6507	00144641	December 2019

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 3 m calibration.

f / MHz	AF / dB/m	f / MHz	AF / dB/m	f / MHz	AF / dB/m
30	18.7	250	12.0	2750	31.0
35	15.7	300	13.8	3000	31.2
40	12.9	400	16.2	3250	32.7
45	10.6	500	18.6	3500	34.5
50	9.0	600	20.2	3750	34.3
60	7.3	700	21.8	4000	34.5
70	7.7	800	22.9	4250	35.3
80	8.2	900	24.1	4500	35.5
90	9.2	1000	24.8	4750	36.1
100	9.4	1250	26.9	5000	37.4
120	8.5	1500	30.2	5250	38.4
140	8.5	1750	28.5	5000	39.9
160	9.1	2000	28.9	5750	38.2
180	10.5	2250	29.8	6000	39.1
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	1500	25.5
3	2000	28.5
4	2500	28.1
5	3000	29.6
6	3500	31.1
7	4000	32.5
8	4500	32.5
9	5000	33.5
10	5500	34.7
11	6000	36.1
12	6500	36.5
13	7000	37.3
14	7500	38.0
15	8000	37.3
16	8500	37.9
17	9000	38.1
18	9500	38.5
19	10000	38.7
20	10500	38.8
21	11000	38.6
22	11500	38.8
23	12000	38.9
24	12500	39.3
25	13000	40.2
26	13500	40.6
27	14000	40.6
28	14500	40.4
29	15000	39.6
30	15500	39.5
31	16000	39.8
32	16500	40.4
33	17000	41.3
34	17500	42.6
35	18000	43.2

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

Point	Frequency (GHz)	Cable Loss (dB)
0	0.0-1.8	1.67
1	1.8 – 3.6	2.39
2	3.6 – 5.4	3.04
3	5.4-7.2	3.58
4	7.2-9.0	4.06
5	9.0-10.8	4.49
6	10.8-12.6	4.91
7	12.6-14.4	5.31
8	14.4-16.2	5.66
9	16.2-18.00	6.01

Antenna Factor
Broadband Horn Antenna model BBHA 9170 1m calibration

Point	Frequency (GHz)	Antenna Factor (dB/m)
1	15.0	38.5
2	16.0	37.7
3	17.0	38.1
4	18.0	37.9
5	19.0	38.0
6	20.0	38.0
7	21.0	37.9
8	22.0	38.2
9	23.0	39.6
10	24.0	39.6
11	25.0	39.3
12	26.0	39.5
13	27.0	39.6
14	28.0	39.6
15	30.0	40.1
16	32.0	41.2
17	34.0	41.5
18	35.0	41.9
19	36.0	42.2
20	38.0	43.8
21	40.0	43.2

Antenna Factor
For Antenna Loop MFR ETS Lindgren, Type/Model 6507, S/N: 00144641

No.	Frequency MHz	Magnetic antenna factor, dBS/m	Electric antenna factor, dB/m
1	9	-21.5	30.0
2	10	-22.0	29.5
3	20	-27.7	23.8
4	50	-32.2	19.4
5	75	-33.0	18.5
6	100	-33.4	18.2
7	150	-33.6	17.9
8	250	-33.7	17.9
9	500	-33.8	17.8
10	750	-33.8	17.7
11	1000	-33.8	17.7
12	2000	-33.7	17.9
13	3000	-33.8	17.8
14	4000	-34.0	17.5
15	5000	-34.3	17.2
16	10000	-35.2	16.4
17	15000	-35.8	15.8
18	20000	-36.0	15.6
19	25000	-36.2	15.3
20	30000	-36.4	15.2

APPENDIX B Photo of the test setups.

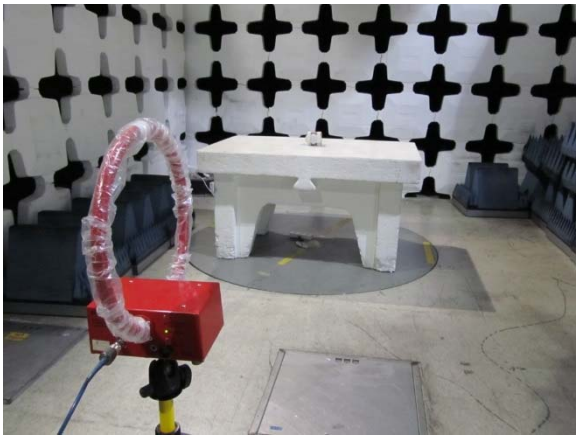


Photo 1.

Photo 2.

Photo 3.

Photo 4.

APPENDIX C Abbreviations and acronyms.

The following abbreviations and acronyms are applicable to this test report:

AC	alternating current
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
EBW	emission bandwidth.
EMC	electromagnetic compatibility
EUT	equipment under test
GHz	gigahertz
H	height
Hz	hertz
kHz	kilohertz
L	length
LNA	low noise amplifier
m	meter
Mbps	megabit per second
MHz	megahertz
NA	not applicable
OFDM	Orthogonal Frequency Division Multiple Access
PRBS	pseudo random binary sequence
QP	quasi-peak
RF	radio frequency
RE	radiated emission
SA	spectrum analyzer
rms	root mean square
W	width