CVRx, INC.
TEST REPORT

SCOPE OF WORK
EMC TESTING – MODEL 9020 PROGRAMMER SYSTEM

REPORT NUMBER
104584704BOX-015

ISSUE DATE	**[REVISED DATE]**
05/13/2021	Original Issue

DOCUMENT CONTROL NUMBER
Non-Specific Radio Report Shell Rev. August 2020

EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 104584704BOX-015
Project Number: G104584704

Report Issue Date: 05/13/2021

Model(s) Tested: 9020 Programmer System
Model(s) Partially Tested: None
Model(s) Not Tested but declared equivalent by the client: None

Standards: CFR47 FCC Part 95, Subpart I:2021
RSS-243 Issue 3 February 2010
FCC Part 15B:2021
ISED ICES-003 Issue 7 October 2020
RSS-GEN Issue 5 April 2018

Tested by:
Intertek
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
CVRx, Inc.
9201 W Broadway Ave. Ste 650
Minneapolis, MN 55445-1925
USA

Report prepared by Vathana Ven

Vathana Ven/EMC Staff Engineer

Report reviewed by

Kouma Sinn/EMC Staff Engineer

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	--
4	Description of Equipment Under Test and Variant Models	--
5	System Setup and Method	--
6	Field Strength Measurements FCC §95.3569(a), §95.2567(a)(1) RSS-243 Section 5.4	Pass
7	Authorized Bandwidth FCC §95.2573(a) RSS-243 Section 5.1	Pass
8	Transmitter Unwanted Emissions FCC §95.2579 RSS-243 Sections 5.5, 5.6	Pass
9	Frequency Accuracy FCC §95.2565 RSS-243 Sections 5.3	Pass
10	The MICS Communication Sessions (Threshold Power Levels, Monitoring System Bandwidth, Scan Cycle Time, Minimum Channel Monitoring Period, Channel Access, Discontinuation of a MICS Session, and Use of Pre-Scanned Alternate Channel) FCC §95.2559(1-6) RSS-243 Sections 5.7	Pass
11	Radiated Emissions (Digital parts and Receiver) FCC Part 15 Subpart B: 2021 ISED ICES-003 Issue 7 October 2020 RSS-GEN Issue 5 April 2018	Pass
12	AC Mains Conducted Emissions FCC Part 15 Subpart B: 2021 ISED ICES-003 Issue 7 October 2020	Pass
13	Revision History	---

3 Client Information

This EUT was tested at the request of:

Client: CVRx, Inc.
9201 W Broadway Ave. Ste 650
Minneapolis, MN 55445-1925
USA

Contact: Bart Carey
Telephone: 763-416-2346
Fax: None
Email: bcarey@cvrx.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: CVRx, Inc.
9201 W Broadway Ave. Ste 650
Minneapolis, MN 55445-1925
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
9020 Programmer Interface	CVRx, Inc.	9020	SWO4960016

Receive Date:	03/09/2021
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The Model 9020 Programmer System is the external equipment part of an Active Implantable Medical Device (AIMD) intended to provide Baroreflex Activation Therapies. The Programmer System allows input of therapy parameters and retrieves information regarding the status of the Implantable Pulse Generator (IPG).

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
5VDC	3A	N/A	N/A

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Normal Operation in communication with an IPG
2	Transmitted mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	9020 IPG Application Launcher (2.0.0.1)
2	Houston_1p2_PI_Manual_Test.vi version: 9020 PI V1.00

Radio/Receiver Characteristics	
Frequency Band(s)	402-405 MHz
Modulation Type(s)	FSK
Maximum Field Strength	85.05 dB(uV/m)
Test Channels	Channel 4 = 403.35 MHz
Occupied Bandwidth	238.282 kHz
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	N/A
Equipment Type	Standalone
Antenna Type and Gain	Integral antenna, Gain = -2.2 dBi

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

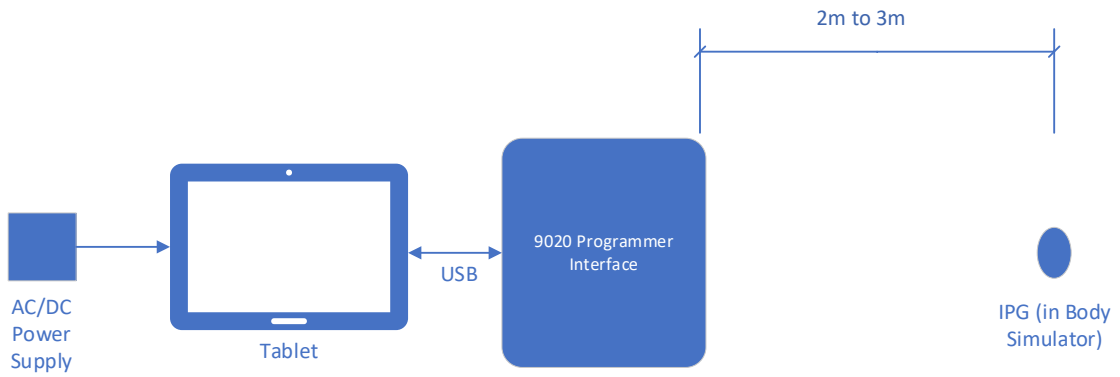
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	USB	1	None	None	Tablet
2	Power adapter cable	2	None	None	AC mains

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Tablet	Microsoft	Surface G0 2	Not labeled
Power Supply	Microsoft	1735	X935920

5.1 Method:

Configuration as required by CFR47 FCC Part 95, Subpart I:2021, RSS-243 Issue 3 February 2010, ANSI C63.26:2015, FCC Part 15B:2021, ISED ICES-003 Issue 7 October 2020, RSS-GEN Issue 5 April 2018, and ANSI C63.4:2014.

5.2 EUT Block Diagram:



6 Field Strength Measurements

6.1 Method

Tests are performed in accordance with FCC §95.2567(a)(1), FCC §95.3569(a), RSS-243 Section 5.4, and ANSI C63.26.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	5.0 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.9 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.1 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS42'	Weather Station Vantage Vue	Davis	6250	MS191212003	02/24/2021	02/24/2022
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/07/2020	05/07/2021
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	09/21/2020	09/21/2021
145108'	Receiver	Rhode & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
HS002'	Pre-amp to under floor cable	Huber & Suhner	SucoFlex 106A	HS002	11/25/2020	11/25/2021
145-406'	10m Track A In-floor Cable #1	Huber + Suhner	sucoflex 160-19220mm	001	07/13/2020	07/13/2021
IW001'	Receiver to floor cable	Insulated Wire	2801-NPS	001	10/07/2020	10/07/2021
IW006'	Pre-amp to antenna cable	Insulated Wire	2800-NPS	IW006	11/25/2020	11/25/2021

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

6.3 Results:

The sample tested was found to Comply.

FCC §95.3569(a), §95.2567(a)(1)

§95.2567 MedRadio radiated power limits.

Each MedRadio transmitter type must be designed such that the MedRadio equivalent isotropically radiated power (M-EIRP) does not exceed the limits in this section. Compliance with these limits must be determined as set forth in §95.2569.

(a) *Transmitters subject to frequency monitoring—401-406 MHz.* For MedRadio transmitters that are not excepted under §95.2559(b) from the frequency monitoring requirements of §95.2559(a):

(1) The M-EIRP within any 300 kHz bandwidth within the 402-405 MHz band must not exceed 25 microwatts.

§95.2569 MedRadio field strength measurements.

Compliance with MedRadio equivalent isotropic radiated power (M-EIRP) limits can be determined by measuring the radiated field strength from the transmitter type, in accordance with the rules in this section.

(a) Radiated field strength values corresponding to the M-EIRP limits in §95.2567 are given in the table in this paragraph, for an open area test site, and for a test site equivalent to free space, such as a fully anechoic test chamber. Field strength is measured at a distance of 3 meters from the equipment under test.

M-EIRP limit	Open area (mV/m)	Free space (mV/m)
1 mW	115.1	57.55
25 μW	18.2	9.1
250 nW	1.8	0.9
100 nW	1.2	0.6

(b) Compliance with the maximum transmitter power requirements in §95.2567 is based on measurements using a peak detector function and measured over an interval of time when transmission is continuous and at its maximum power level. In lieu of using a peak detector function, measurement procedures that have been found to be acceptable to the FCC in accordance with §2.947 of this chapter may be used to demonstrate compliance.

RSS-243 Section 5.4

5.4 Transmitter Output Power

The maximum average e.i.r.p. for MICS transmitters is 25 microwatts.

6.4 Setup Photographs:

6.5 Test Data:

Radiated Emissions

Company: CVRX
Model #: 9020 Programmer
Serial #: SWO4960016
Engineers: Vathana Ven
Project #: G104584704
Standard: FCC Part 95, Subpart I
Receiver: R&S ESI (145-108) 06-08-2021
PreAmp: NONE.
PreAmp Used? (Y or N): N
Date(s): 04/10/21
Location: 10M Chamber
Limit Distance (m): 3
Test Distance (m): 3
Voltage/Frequency: 120VAC 60Hz
Antenna & Cables: N
Antenna: 145-145__10M horizontal__6-14-2020.txt 145-145__10M horizontal__6-14-2020.txt
Cable(s): IW001, IW002, IW006, 145-414
Barometer: DS42
Temp/Humidity/Pressure: 21 deg C 18% 1002 mB
Bands: N, LF, HF, SHF
Filter: NONE
Frequency Range: 30-1000 MHz

Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth	FCC
04/10/2021, Note: Reduced power, Power register was set to 13, 45 degrees position												
PK	H	403.35020	61.00	21.29	2.49	0.00	0.00	84.78	85.20	-0.42	300kHz/1 MHz	RB
PK	V	403.35020	52.15	21.84	2.49	0.00	0.00	76.48	85.20	-8.72	300kHz/1 MHz	RB
04/10/2021, Note: Reduced power, Power register was set to 21, Normal position												
PK	H	403.35020	61.27	21.29	2.49	0.00	0.00	85.05	85.20	-0.15	300kHz/1 MHz	RB
PK	V	403.35020	53.80	21.84	2.49	0.00	0.00	78.13	85.20	-7.07	300kHz/1 MHz	RB

Test Personnel: Vathana Ven VSV
Supervising/Reviewing Engineer: (Where Applicable) Kouma Sinn KPS
Product Standard: FCC Part 95, Subpart I RSS-243
Input Voltage: 120VAC 60Hz
Pretest Verification w/ BB Source: **Yes**

Test Date: 04/10/2021
Limit Applied: See section 6.3
Ambient Temperature: 21 ºC
Relative Humidity: 18 %
Atmospheric Pressure: 1002 mbars

Deviations, Additions, or Exclusions: None

7 Authorized Bandwidth

7.1 Method

Tests are performed in accordance with FCC §95.2573(a), RSS-243 Section 5.1, ANSI C63.26.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	5.0 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.9 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.1 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS42'	Weather Station Vantage Vue	Davis	6250	MS191212003	02/24/2021	02/24/2022
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/07/2020	05/07/2021
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	09/21/2020	09/21/2021
145108'	Receiver	Rhode & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
HS002'	Pre-amp to under floor cable	Huber & Suhner	SucoFlex 106A	HS002	11/25/2020	11/25/2021
145-406'	10m Track A In-floor Cable #1	Huber + Suhner	sucoflex 160-19220mm	001	07/13/2020	07/13/2021
IW001'	Receiver to floor cable	Insulated Wire	2801-NPS	001	10/07/2020	10/07/2021
IW006'	Pre-amp to antenna cable	Insulated Wire	2800-NPS	IW006	11/25/2020	11/25/2021

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

7.3 Results:

The sample tested was found to Comply.

FCC §95.2573(a)

§95.2573 MedRadio authorized bandwidths.

Each MedRadio transmitter type must be designed such that the MedRadio emission bandwidth does not exceed the applicable authorized bandwidth set forth in this section.

(a) For MedRadio transmitters operating in the 402-405 MHz band, the maximum authorized bandwidth is 300 kHz. Such transmitters must not use more than 300 kHz of bandwidth (total) during a MedRadio communications session. This provision does not preclude full duplex or half duplex communications provided that the total bandwidth of all of the channels employed in a MedRadio communications session does not exceed 300 kHz.

RSS-243 Section 5.1

5.1 Channelling Arrangement

MICS devices shall be designed to operate on a minimum of 9 channels evenly spaced across the 402-405 MHz band. Blood glucose monitoring MICS transmit-only devices without insulin injection capabilities that lack such frequency agility and can operate on only one channel of less than 150 kHz centered at 402.142 MHz, may nevertheless be certified until March 20, 2013[3] provided they operate at a power level of less than 10 microwatts e.i.r.p. and with a total duty cycle of 0.005% or less. MITS devices shall be designed to operate on a single frequency in the 403.5-403.8 MHz band. MEDS devices shall be designed to operate on a minimum of 18 channels evenly distributed across the 401-402 MHz and 405-406 MHz bands if their e.i.r.p. is above 250 nanowatts. MEDS Low Power Low Duty Cycle (LPLDC) devices in the 401-401.85 MHz or 405-406 MHz are permitted to operate on only a single channel if their e.i.r.p. is below 250 nanowatts.

The maximum channel bandwidth permitted is 300 kHz for MICS band devices, 150 kHz for the MEDS band devices operating in 401.85-402 MHz, and 100 kHz[4] for MEDS band devices operating in the 401-401.85 MHz or 405-406 MHz. Lesser bandwidths down to 25 kHz are permitted for any device.

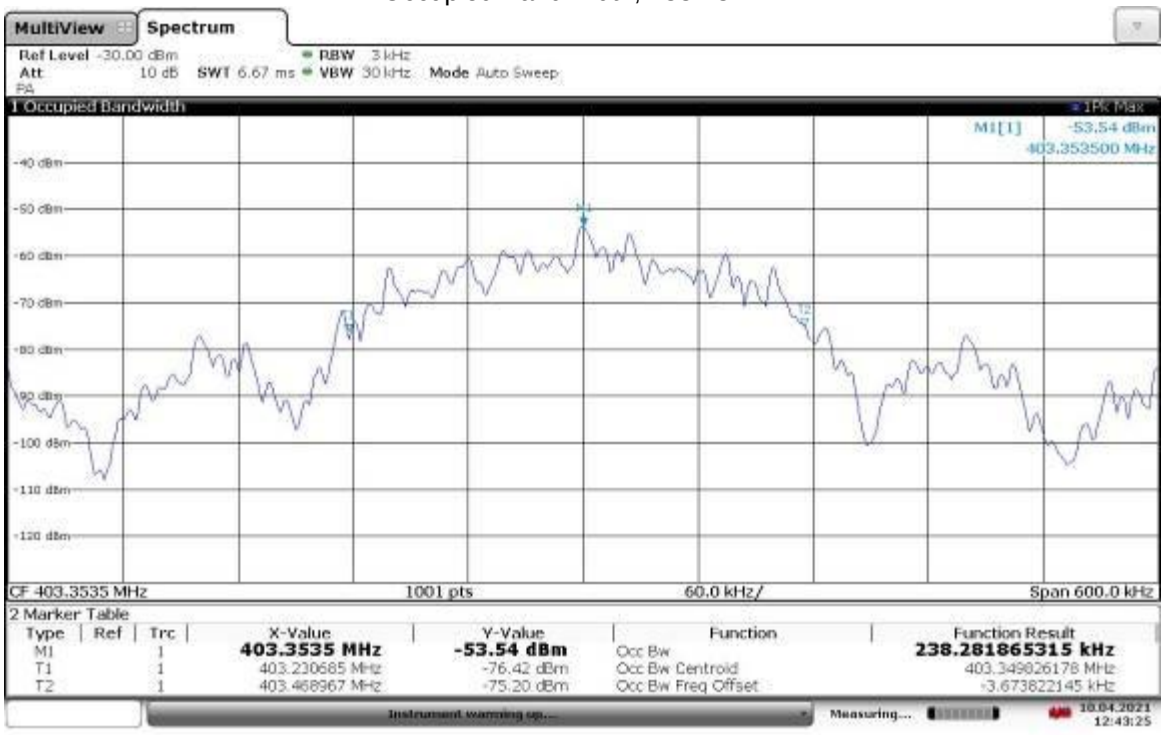
7.4 Setup Photographs:

7.5 Plots/Data:

Authorized Bandwidth, 20 dB Bandwidth, 225.97 kHz

12:42:43 10.04.2021

Occupied Band width, 238.28 kHz



12:43:26 10.04.2021

Test Personnel:	Vathana Ven VSV	Test Date:	04/10/2021
Supervising/Reviewing Engineer: (Where Applicable)	Kouma Sinn KPS		
Product Standard:	FCC Part 95, Subpart I RSS-243	Limit Applied:	See section 7.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	21 ºC
Pretest Verification w/ BB Source:	**Yes**	Relative Humidity:	18 %
		Atmospheric Pressure:	1002 mbars

Deviations, Additions, or Exclusions: None

8 Transmitter Unwanted Emissions

8.1 Method

Tests are performed in accordance with FCC §95.2579(a-c), RSS-243 Section 5.5(a-b), ANSI C63.26.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	5.0 dB	6.3 dB
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Radiated Emissions, 3m	6-15 GHz	5.1 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS42'	Weather Station Vantage Vue	Davis	6250	MS191212003	02/24/2021	02/24/2022
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/07/2020	05/07/2021
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	09/21/2020	09/21/2021
145108'	Receiver	Rhode & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
HS002'	Pre-amp to under floor cable	Huber & Suhner	SucoFlex 106A	HS002	11/25/2020	11/25/2021
145-406'	10m Track A In-floor Cable #1	Huber + Suhner	sucoflex 160-19220mm	001	07/13/2020	07/13/2021
IW001'	Receiver to floor cable	Insulated Wire	2801-NPS	001	10/07/2020	10/07/2021
IW006'	Pre-amp to antenna cable	Insulated Wire	2800-NPS	IW006	11/25/2020	11/25/2021
PRE12'	Pre-amp, 1-18GHz	Com-Power	PAM-118A	18040117	12/07/2020	12/07/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/03/2020	08/03/2021
145-414'	3m Track A cables	Huber + Suhner	3m Track A cables	multiple	06/25/2020	06/25/2021

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010
BAT-EMC	Nexio	3.18.0.16 (10M)

8.3 Results:

The sample tested was found to Comply.

FCC §95.3579(a-c)

§95.2579 MedRadio unwanted emissions limits.

Unwanted emission field strength limits and attenuation requirements apply to each MedRadio transmitter type, as set forth in this section and part 2.

(a) *Field strength limits.* The field strengths of unwanted emissions from each MedRadio transmitter type, measured at a distance of 3 meters, must not exceed the field strength limits shown in the table in this paragraph for the indicated frequency ranges, if the frequencies of these emissions are:

(1) More than 250 kHz outside of the 402-405 MHz band (for devices designed to operate in the 402-405 MHz band);

(2) More than 100 kHz outside of either the 401-402 MHz or 405-406 MHz bands (for devices designed to operate in the 401-402 MHz or 405-406 MHz bands);

(3) In the 406.000-406.100 MHz band (for devices designed to operate in the 401-402 MHz or 405-406 MHz bands); or

(4) More than 2.5 MHz outside of the 413-419 MHz, 426-432 MHz, 438-444 MHz or 451-457 MHz bands (for devices designed to operate in these four bands).

(5) More than 2.5 MHz outside of the 2360-2400 MHz band (for devices designed to operate in the 2360-2400 MHz band).

Frequency range (MHz)	Field strength (μV/m)
30-88	100
88-216	150
216-960	200
960 and above	500

Note to table in paragraph (a)(5): At the boundaries between frequency ranges, the tighter limit (lower field strength) applies. Below 1 GHz, field strength is measured using a CISPR quasi-peak detector. Above 1 GHz, field strength is measured using an average detector with a minimum reference bandwidth of 1 MHz. *See also* part 2, subpart J of this chapter.

(b) *Harmonic emissions.* Radiated unwanted emissions from a MedRadio transmitter type must be measured to at least the tenth harmonic of the highest fundamental frequency emitted.

(c) *Attenuation requirements, 402-405 MHz.* For MedRadio transmitter types designed to operate in the 402-405 MHz band, unwanted emissions must be attenuated below the maximum permitted transmitter output power by at least:

(1) 20 dB, on any frequency within the 402-405 MHz band that is more than 150 kHz away from the center frequency of the occupied bandwidth;

(2) 20 dB, on any frequency between 401.750 MHz and 402.000 MHz, and on any frequency between 405 MHz and 405.250 MHz.

RSS-243 Section 5.5 (a-b)

5.5 Transmitter Unwanted Emissions

(a) Emissions from MICS devices more than 250 kHz outside of the 402-405 MHz band shall not exceed the field strength limits specified in Table 1.

Table 1 – Field Strength Limits for MICS Transmitter Unwanted Emissions

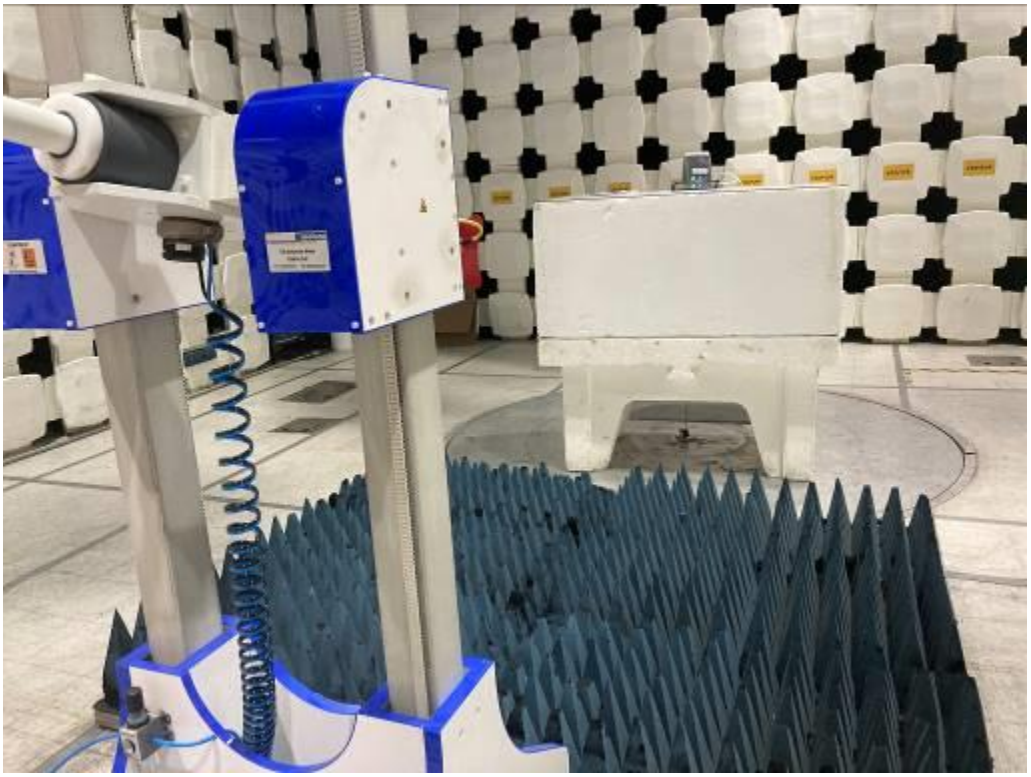
Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30-88	100
88-216	150
216-960	200
960 and above	500
Note: At band edges, the tighter limit applies.	

(b) Emissions within the 402-405 MHz MICS band which are more than 150 kHz away from the centre frequency of the spectrum, and the transmissions that occupy up to 250 kHz above and below the band shall be attenuated at least 20 dB below the maximum transmitter output power.

8.4 Setup Photographs:

30-1000 MHz

1-5 GHz



8.5 Test Data:

30-1000 MHz
Radiated Emissions

Company: CVRX | Antenna & Cables: N | Bands: N, LF, HF, SHF
Model #: 9020 Programmer | Antenna: 145-145__10M horizontal__6-14-2020.txt 145-145__10M horizontal__6-14-2020.txt
Serial #: SWO4960016 | Cable(s): IW001, IW002, IW006, 145-414 NONE.
Engineers: Vathana Ven | Location: 10M Chamber | Barometer: DS42 | Filter: NONE
Project #: G104584704 | Date(s): 04/10/21
Standard: FCC Part 95, Subpart I | Temp/Humidity/Pressure: 21 deg C 18% 1002 mB
Receiver: R&S ESI (145-108) 06-08-2021 | Limit Distance (m): 3
PreAmp: NONE. | Test Distance (m): 3
PreAmp Used? (Y or N): N | Voltage/Frequency: 120VAC 60Hz | Frequency Range: 30-1000 MHz
Net = Reading (dBuV/m) + Antenna Factor (dB1/m) + Cable Loss (dB) - Preamp Factor (dB) - Distance Factor (dB)
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; NF = Noise Floor, RB = Restricted Band; Bandwidth denoted as RBW/VBW

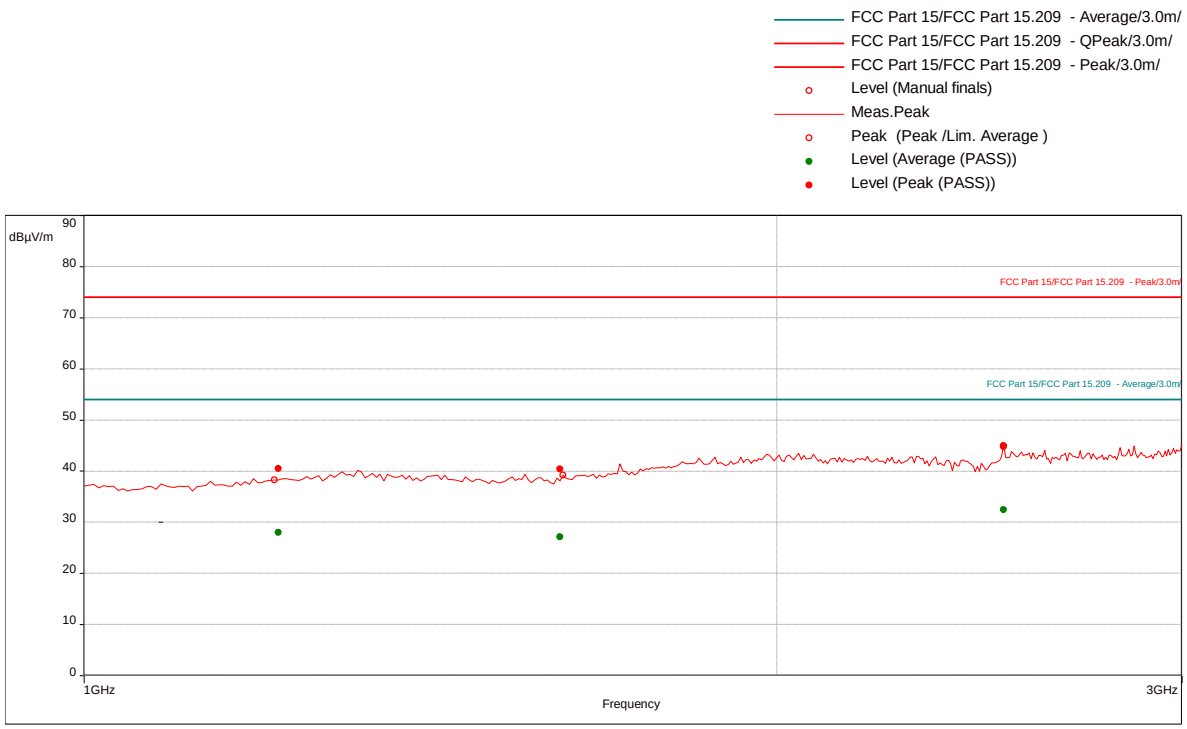
Detector Type	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB	Bandwidth
Note: Spurious emissions 30-1000MHz with EUT tilted 45 degrees											
QP	V	100.00000	8.46	16.16	1.32	0.00	0.00	25.94	43.50	-17.56	120kHz/300 kHz
QP	V	136.69000	7.84	19.40	1.32	0.00	0.00	28.56	43.50	-14.94	120kHz/300 kHz
QP	V	200.00000	8.46	18.50	1.76	0.00	0.00	28.72	43.50	-14.78	120kHz/300 kHz
QP	H	291.78000	13.35	19.40	2.22	0.00	0.00	34.97	46.00	-11.03	120kHz/300 kHz
QP	H	401.75000	10.50	21.80	2.38	0.00	0.00	34.68	46.00	-11.32	120kHz/300 kHz
QP	H	405.33600	10.32	22.00	2.38	0.00	0.00	34.70	46.00	-11.30	120kHz/300 kHz

1 - 3 GHz

Test Information:

Date and Time	4/4/2021 10:57:07 AM
Client and Project Number	CVRX_G104584704
Engineer	Vathana Ven
Temperature	21 deg C
Humidity	18%
Atmospheric Pressure	1002 mB
Comments	RE 1 to 3 GHz_120VAC 60Hz_400MHz in Tx mode

Graph:



Results:

Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1214.473684	40.47	74.00	-33.53	269.00	2.20	Vertical	1000000.00	-21.14
1610.526316	40.38	74.00	-33.62	253.00	1.00	Horizontal	1000000.00	-20.77
2507.631579	44.73	74.00	-29.27	253.00	1.55	Vertical	1000000.00	-14.77

Average (PASS) (3)

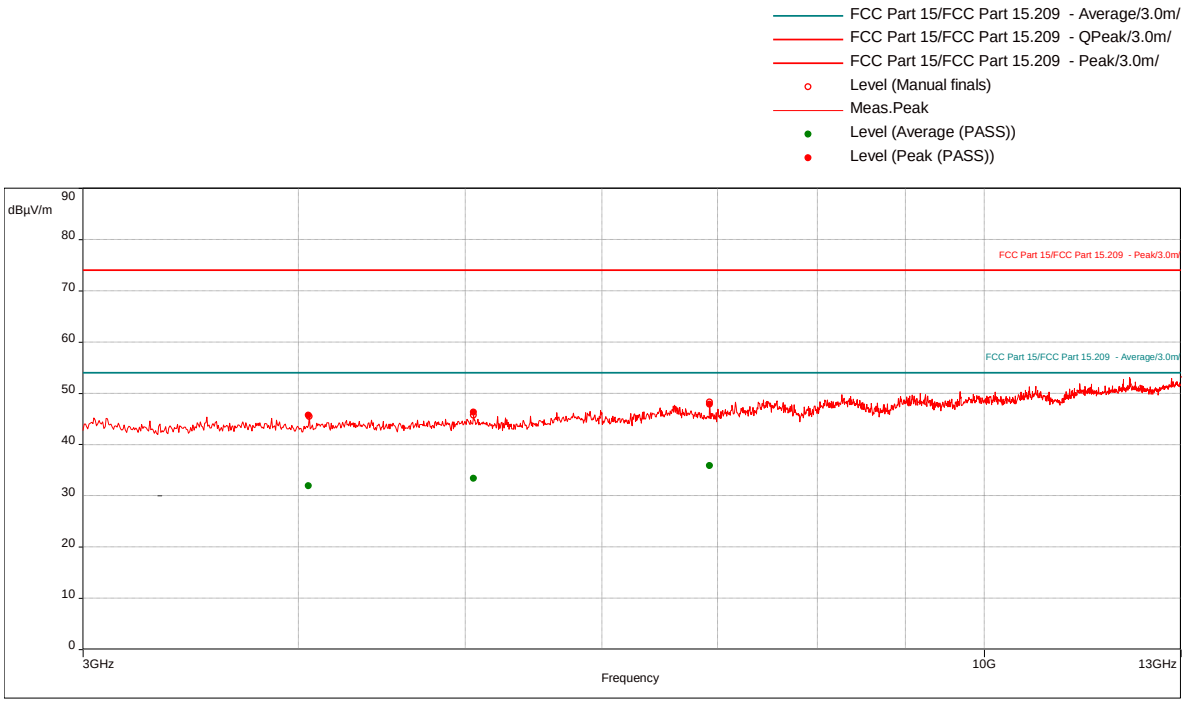
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1214.473684	28.02	54.00	-25.98	269.00	2.20	Vertical	1000000.00	-21.14
1610.526316	27.16	54.00	-26.84	253.00	1.00	Horizontal	1000000.00	-20.77
2507.631579	32.45	54.00	-21.55	253.00	1.55	Vertical	1000000.00	-14.77

3 – 13 GHz

Test Information:

Date and Time	4/4/2021 11:23:29 AM
Client and Project Number	CVRX_G104584704
Engineer	Vathana Ven
Temperature	21 deg C
Humidity	18%
Atmospheric Pressure	1002 mB
Comments	RE 3 to 13 GHz_120VAC 60Hz_400MHz in Tx mode

Graph:



Results:

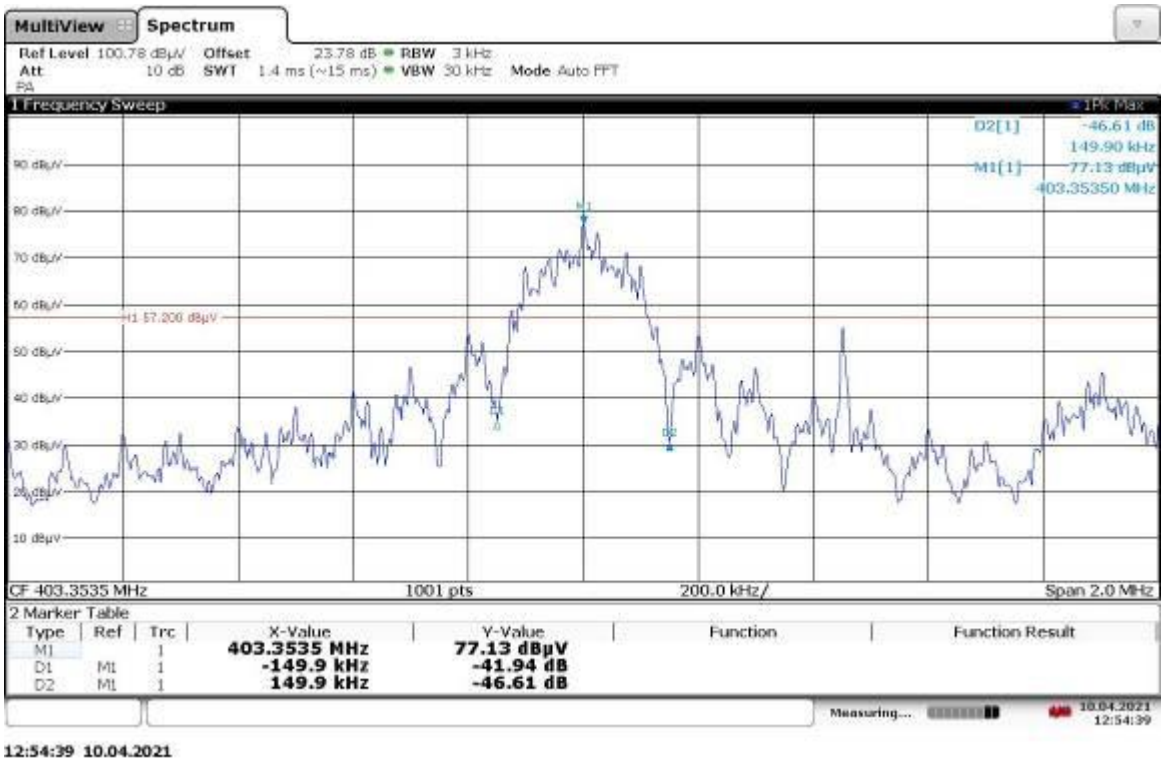
Peak (PASS) (3)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4056.578947	45.71	74.00	-28.29	179.00	1.05	Vertical	1000000.00	-12.02
5055.789474	46.32	74.00	-27.68	157.00	1.90	Vertical	1000000.00	-10.23
6928.157895	47.83	74.00	-26.17	305.00	3.20	Horizontal	1000000.00	-6.77

Average (PASS) (3)

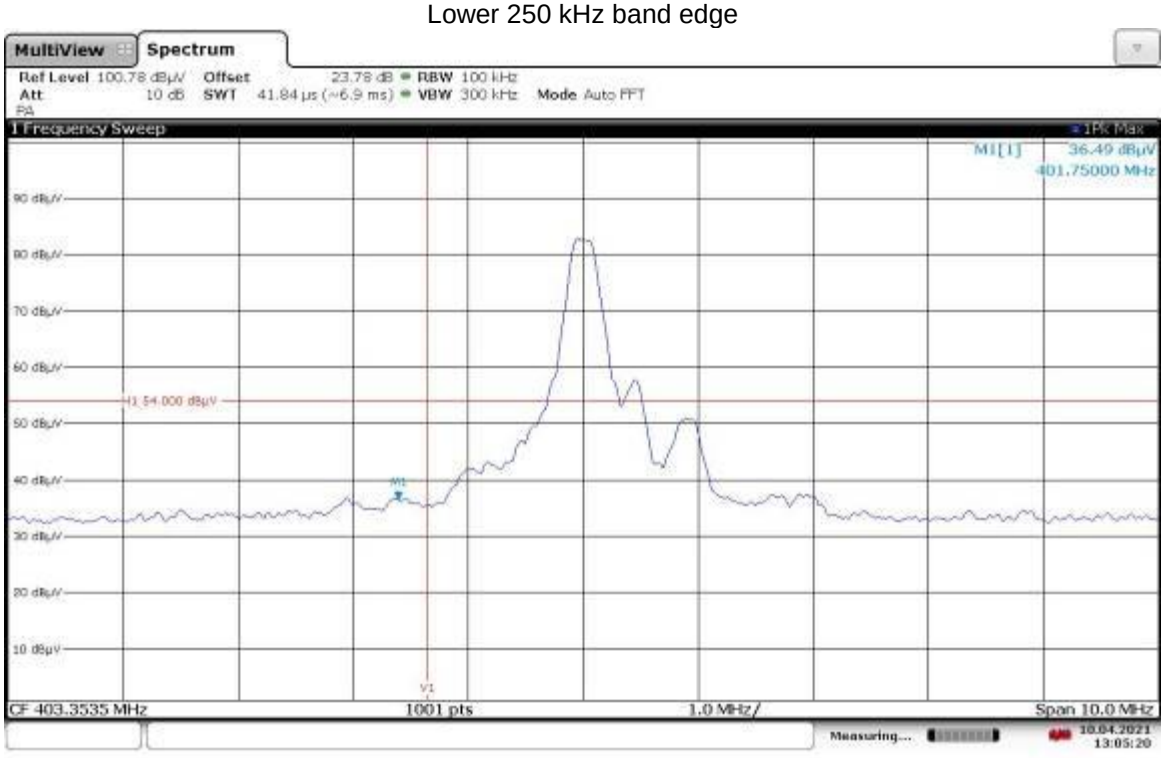
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
4056.578947	31.89	54.00	-22.11	179.00	1.05	Vertical	1000000.00	-12.02
5055.789474	33.41	54.00	-20.59	157.00	1.90	Vertical	1000000.00	-10.23
6928.157895	35.83	54.00	-18.17	305.00	3.20	Horizontal	1000000.00	-6.77

Emissions outside 150 kHz offset from the intended frequency



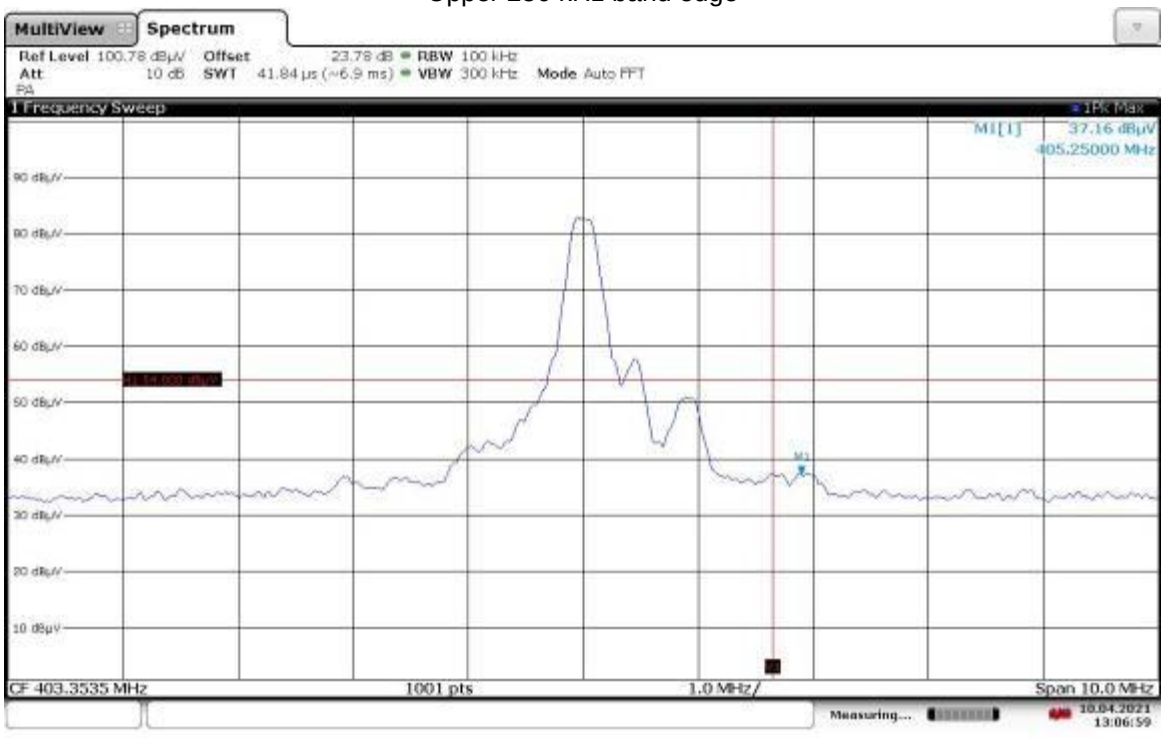
12:54:39 10.04.2021

Lower 250 kHz band edge



13:05:21 10.04.2021

Upper 250 kHz band edge



13:07:00 10.04.2021

Test Personnel:	Vathana Ven VSV	Test Date:	04/04/2021
Supervising/Reviewing Engineer: (Where Applicable)	Kouma Sinn KPS		
Product Standard:	FCC Part 95, Subpart I RSS-243	Limit Applied:	See section 8.3
Input Voltage:	120VAC 60Hz	Ambient Temperature:	21 ºC
Pretest Verification w/ BB Source:	**Yes**	Relative Humidity:	18 %
		Atmospheric Pressure:	1002 mbars

Deviations, Additions, or Exclusions: None

9 Frequency Accuracy

9.1 Method

Tests are performed in accordance with FCC §95.2565, RSS-243 Section 5.3, ANSI C63.26.

TEST SITE: Safety Lab

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV005'	Weather Station Vantage Vue	Davis	6250	MS191218083	02/07/2021	02/07/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/27/2020	10/27/2021
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	01/22/2021	01/22/2022
CBLHF2012 -2M-2'	2m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252675002	02/10/2021	02/10/2022
SAF1153'	Freezing Rain\Icing\Temp\Humidity\ -73deg C to +190deg C, 95% humidity, Ice Freezing Rain	Cincinnati Sub-Zero	CTH-(FR)64-6-6-SC/AC	12-CT15628	11/18/2020	11/18/2021
147239'	Digital Multimeter (Full Color)	Fluke	187	89300561	02/06/2021	02/06/2022
146029'	DC Power Supply (0-30 volts 3 amps)	Electro Industries	DIGI 35A	M12/EM 1127-01	VBU	Verified

Software Utilized:

Name	Manufacturer	Version
EMI Boxborough.xls	Intertek	08/27/2010

9.3 Results:

The sample tested was found to Comply.

FCC §95.3565

§95.2565 MedRadio frequency accuracy.

Each MedRadio transmitter type must be designed to maintain a frequency stability of ±100 ppm of the operating frequency over the applicable temperature range set forth in this section. Frequency stability testing shall be performed over the appropriate temperature range.

(a) 25 °C to 45 °C in the case of medical implant transmitters; and

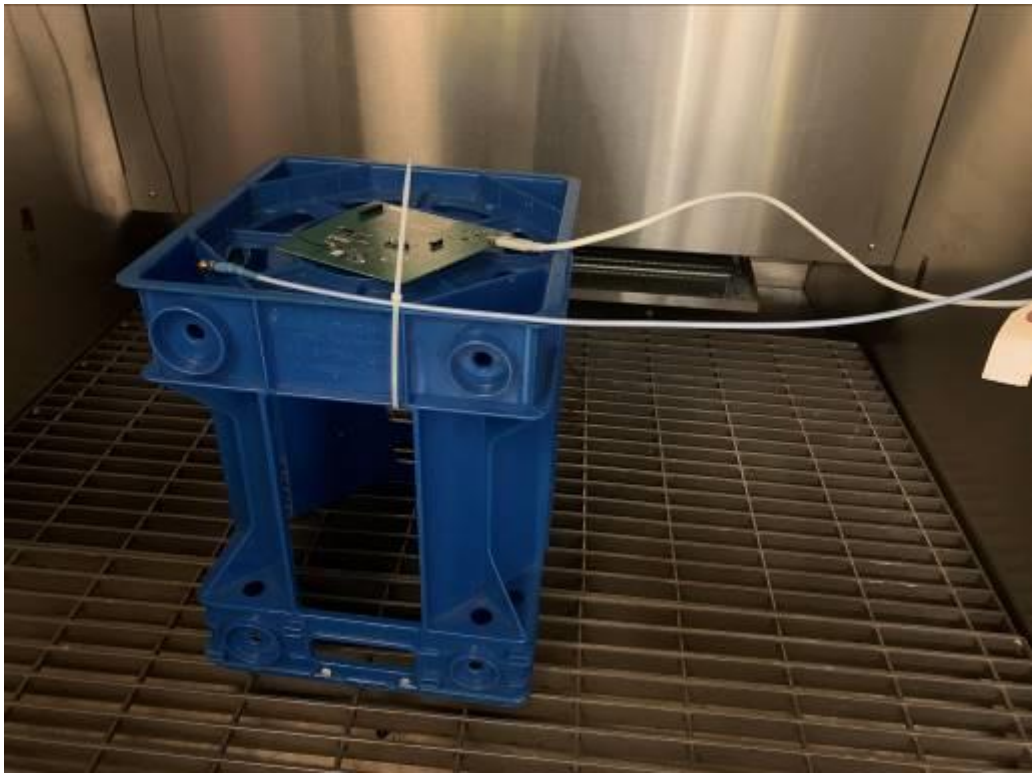
(b) 0 °C to 55 °C in the case of MedRadio programmer/control transmitters and medical body-worn transmitters.

RSS-243 Section 5.4

5.3 Frequency Stability

The carrier frequency shall not depart from the reference frequency in excess of ±100 parts per million.

9.4 Setup Photographs:



9.5 Test Data:

Frequency Stability

Company: CVRx
Model #: 9020 Programmer
Serial #: SWO4960016
Engineer(s): Kouma Sinn
Project #: G104584704
Standard: FCC Part 95
Limit: 100 PPM
Nominal f: 403.35 MHz
Date(s): 05/07/21
Location: Safety Lab

Test Equipment Used:
CEN001 CBLFH2012-5M-2 ROS005-1
146-029 147-239 SAF1153

Voltage: 5 VDC

Frequency drift due to lower extreme (4.75VDC) and upper extreme (5.25VDC) voltages

%	Voltage Volts	Frequency MHz	Deviation kHz	Limit kHz
-5%	4.75	403.354175	-0.04	40.34
+0%	5	403.354215	0	40.34
+5%	5.25	403.351550	-2.665	40.34

Frequency drift due temperature

Temp Celsius	Frequency MHz	Deviation kHz	Limit kHz	Nominal Voltage
-30	403.365896	11.681	40.34	5V
-20	403.364278	10.063	40.34	5V
-10	403.361711	7.496	40.34	5V
0	403.358114	3.899	40.34	5V
10	403.357742	3.527	40.34	5V
20	403.354215	0	40.34	5V
30	403.347395	-6.82	40.34	5V
40	403.343499	-10.716	40.34	5V
50	403.340022	-14.193	40.34	5V

Test Personnel: Kouma Sinn KPS
Test Date: 05/07/2021
Supervising/Reviewing Engineer: (Where Applicable) Vathana Ven VSV
Product Standard: FCC Part 95, Subpart I RSS-243
Limit Applied: See section 9.3
Input Voltage: 120VAC 60Hz to 5VDC
Ambient Temperature: 21 ºC
Relative Humidity: 18 %
Atmospheric Pressure: 1002 mbars
Pretest Verification w/ BB Source: **N/A**

Deviations, Additions, or Exclusions: None

10 MICS Operations

10.1 Method

Tests are performed in accordance with FCC §95.2559, RSS-243 Section 5.7, ANSI C63.26.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV005'	Weather Station Vantage Vue	Davis	6250	MS191218083	02/07/2021	02/07/2022
ROS005-1'	Signal and Spectrum Analyzer	Rohde and Shwartz	FSW43	100646	10/27/2020	10/27/2021
CEN001'	DC-40GHz attenuator 20dB	Centric RF	C411-20	CEN001	01/22/2021	01/22/2022
CBLHF2012-2M-2'	2m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252675002	02/10/2021	02/10/2022
ROS005-2'	Signal Generator	Rohde & Schwartz	SMB-100A	178319	10/23/2020	10/23/2021
ROS005-3'	Vector Signal Generator	Rodhe and Schwarz	SMBV100A	261345	11/02/2020	11/02/2021
ANT1C'	BROADBAND ANTENNA	Compliance Design	B300	00668	05/20/2020	05/20/2021
CBLHF2012-5M-2	5m 9kHz-40GHz Coaxial Cable - SET2	Huber & Suhner	SF102	252676002	02/19/2021	02/19/2022
CBL030'	High Frequency Cable 40GHz	Megaphase	TM40 K1K1 80	CBL030	01/22/2021	01/22/2022

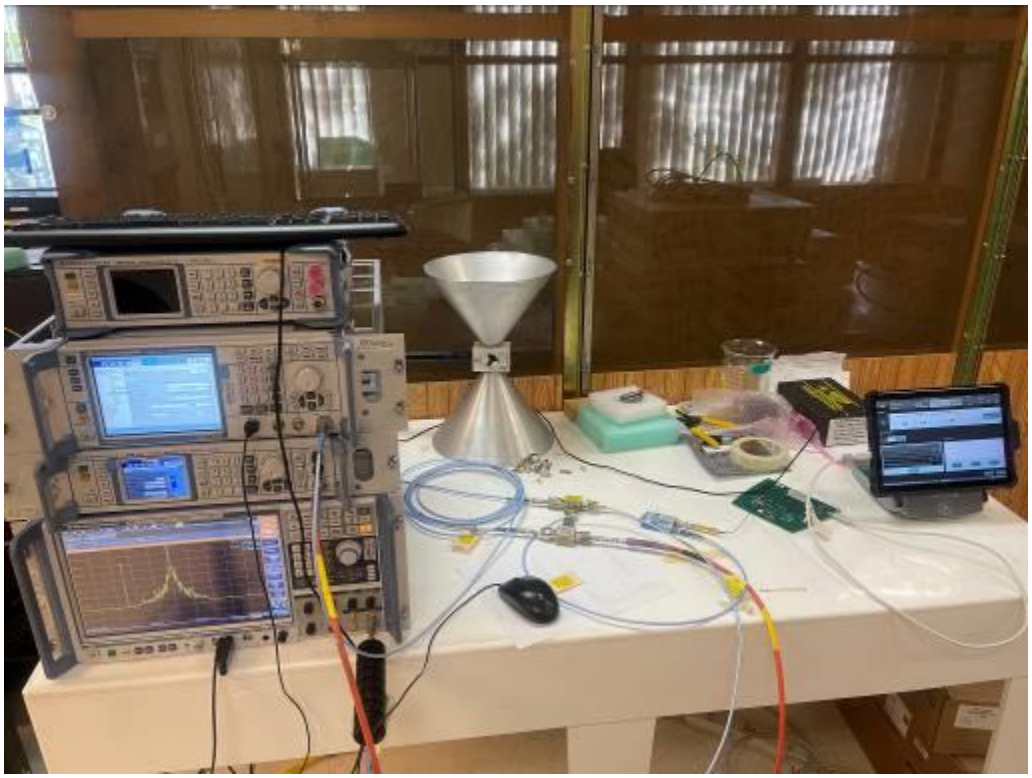
Software Utilized:

Name	Manufacturer	Version
None	--	--

10.3 Results:

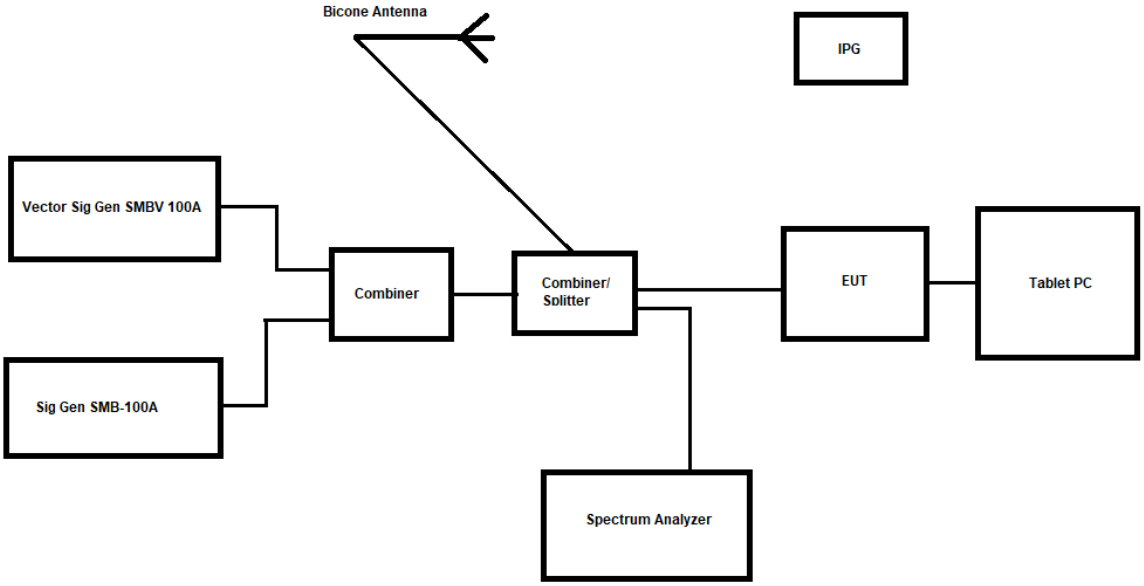
The sample tested was found to Comply.

10.4 Setup Photograph:



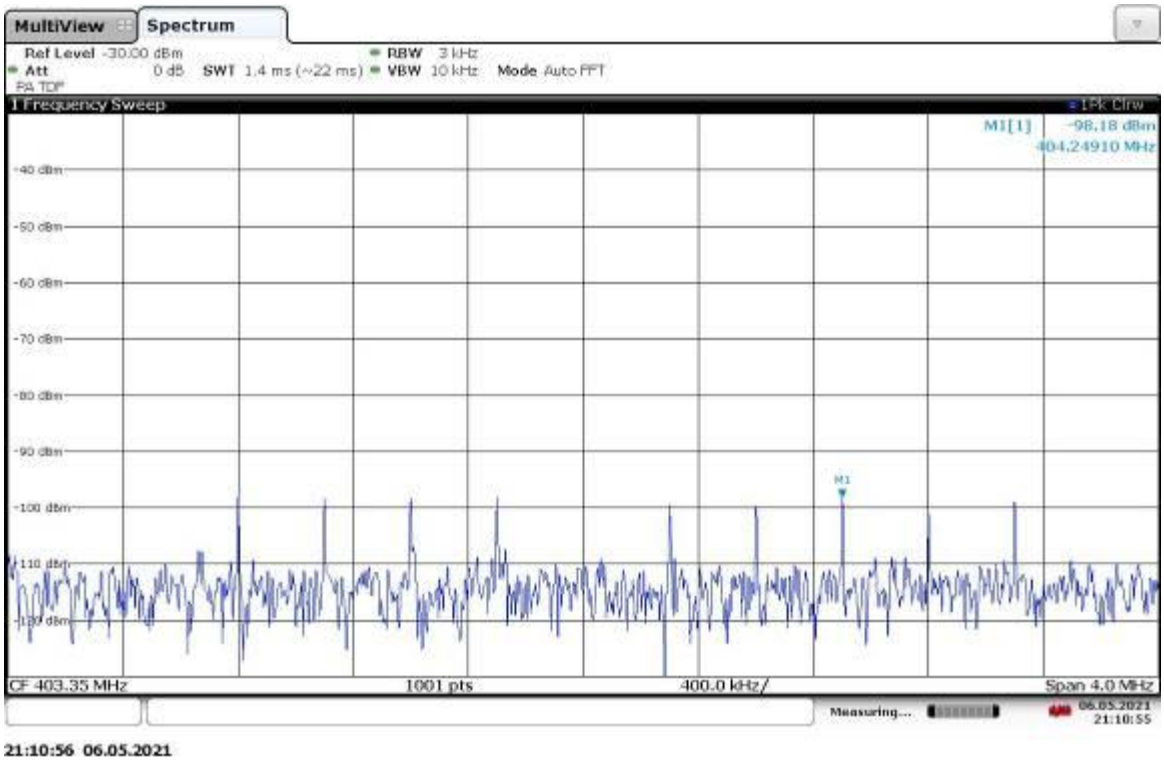
10.5 Plots/Data:

Test Setup Diagram



System Threshold Power Levels

The MICS communication sessions must meet operating requirements for Threshold Power Levels, Monitoring System Bandwidth, Scan Cycle Time, Minimum Channel Monitoring Period, Channel Access, Discontinuation of a MICS session, and Use of Pre-Scanned Alternate Channel.
For these tests, a blocking band was created using the vector signal generator. Ten unmodulated carriers were generated using the vector signal generator (SMBV100A). A carrier at channel 4 (403.35 MHz) was turned off to create a notch. Below is an example plot of the blocking band at the EUT, including a single notch in the center.



System Threshold Power Levels

The monitoring threshold power level shall not be greater the calculated level given by the equation below.

The monitoring threshold power level, $P_{MT,}$ in dBm, is calculated using the following formula.

P_{MT} = 10 log B−150 (dBm/Hz) + G

Where:

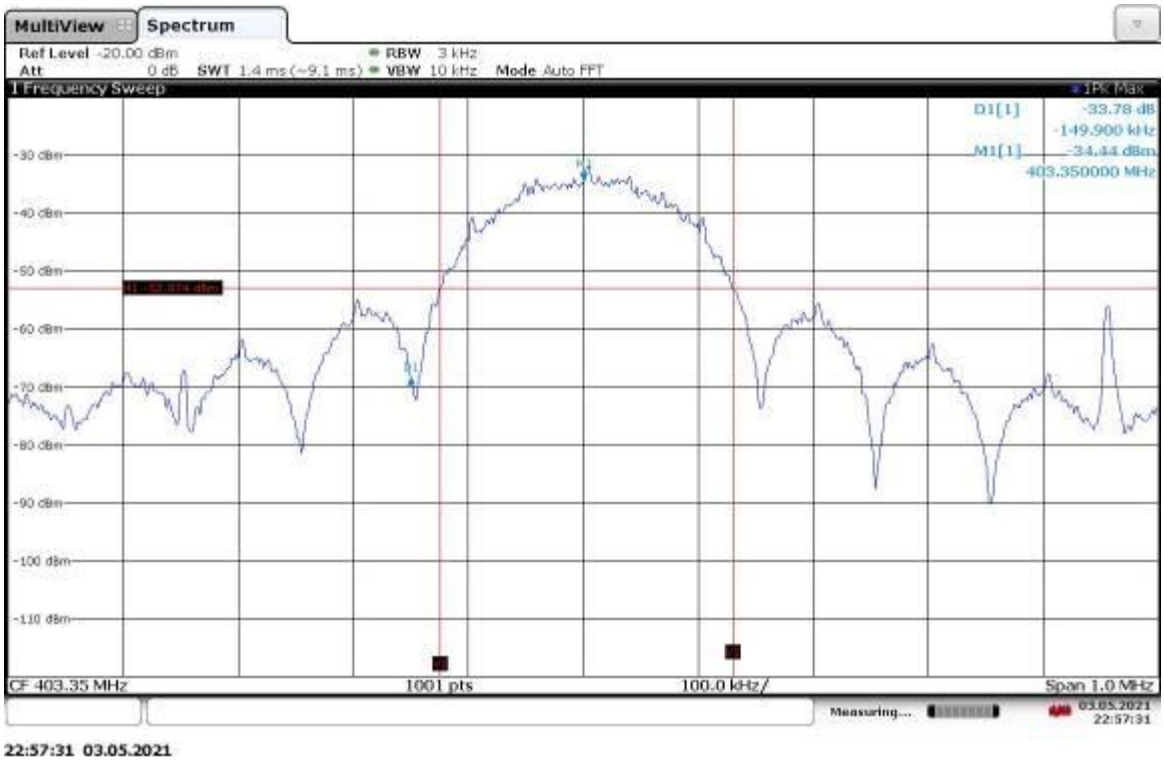
B is the MedRadio emission bandwidth in Hertz of the MedRadio communications session transmitter having the widest emission; and,

G is the MedRadio programmer/control transmitter monitoring system antenna gain, in decibels, relative to the gain of an isotropic antenna (dBi).

Calculated Threshold Power: 10 log(238.282 kHz) -150+(-2)= -98.4dBm

The blocking band was set to -95.4dBm (3dB above the calculated threshold level), with a notch left open at 403.35MHz. A tone was introduced at the center of the notch at -104.4dBm using a 2nd signal generator (SMB-100A), and was stepped up to the threshold level, -98.1dBm. At each step, MICS communication session was initiated and the selected channel was observed.

Measured Minimum Threshold Power: -99.85 dBm



Plot of MICS session

Monitoring System Bandwidth

The monitoring system bandwidth measured at its 20dB down points shall be equal to, or greater than the emissions bandwidth of the intended transmission.

The blocking band was set to -95.4dBm (3dB above the calculated threshold level), with a notch left open at 403.35MHz. A tone was introduced at the frequencies corresponding to the 20dB down points of the fundamental emission, and was increased until the EUT no longer transmitted on the central frequency. At each step, a MICS communication session was initiated and the selected channel was observed. The difference between the values at which the EUT detects the center channel emission and the channel edge emissions should be less than 20dB in order for the order for the monitoring system bandwidth to be wider than the emission bandwidth.

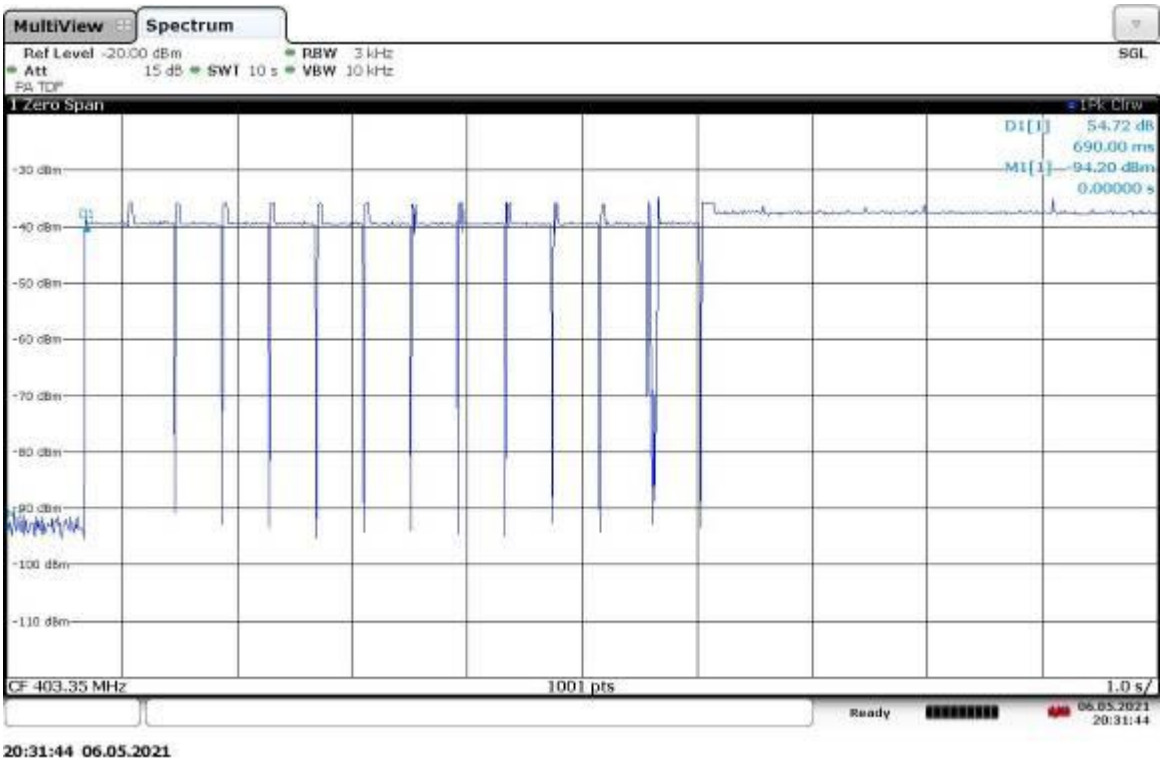
F_{low} = 403.2251MHz
F_{high} = 403.4499MHz

Pa= -100.5 dBm
Pb= -86.5 dBm
Pc= -85.9 dBm
D1= Pa-Pb= -100.5-(-86.5) = 14 dB
D2= Pa-Pc= -100.5-(-85.9) = 14.6 dB
D1 and D2 are both less than 20dB

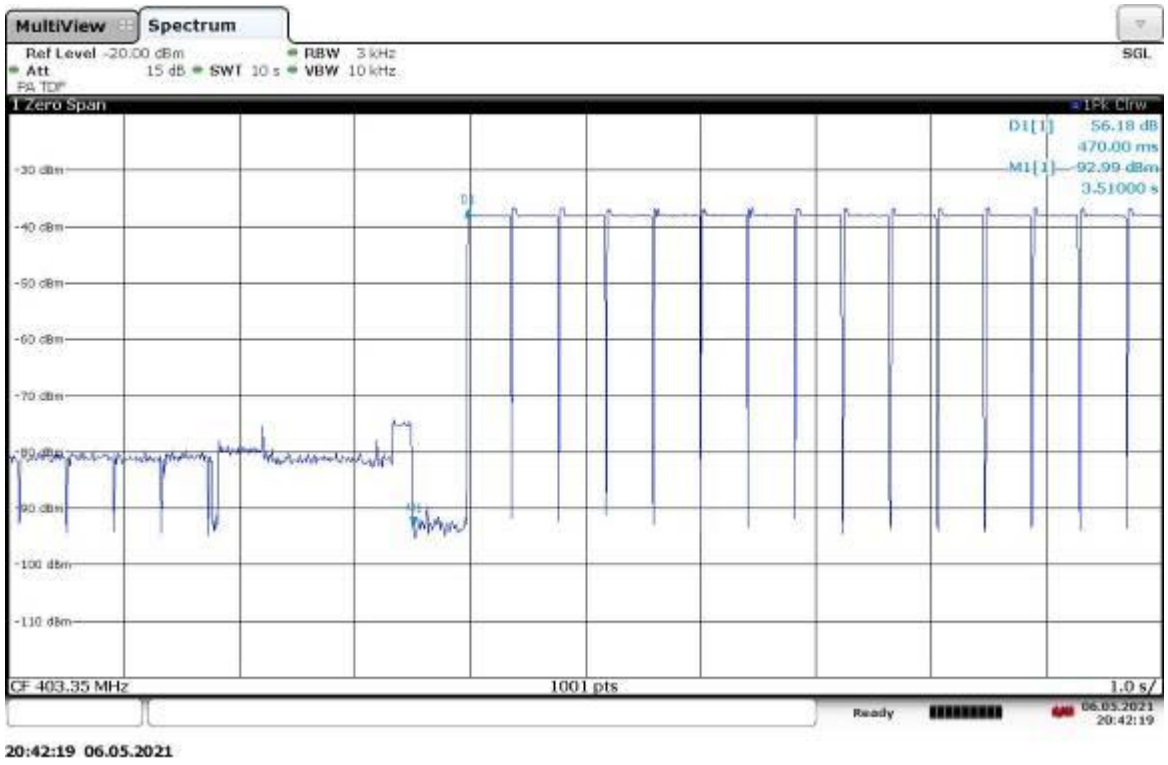
Scan Cycle Time

Within 5 seconds prior to initiating a communications session, circuitry associated with a medical implant programmer transmitter shall monitor all the channels in the 402-405MHz frequency band.
The blocking band was set to -95.4dBm (3dB above the calculated threshold level), with a notch left open at 403.35MHz. A tone was introduced at the center of the notch at -92.1dBm. The tone was removed and a MICS communications session was initiated. The time elapsed between removal of the CW tone and the start of the MICS session was recorded. The highest value was: 0.69 sec.

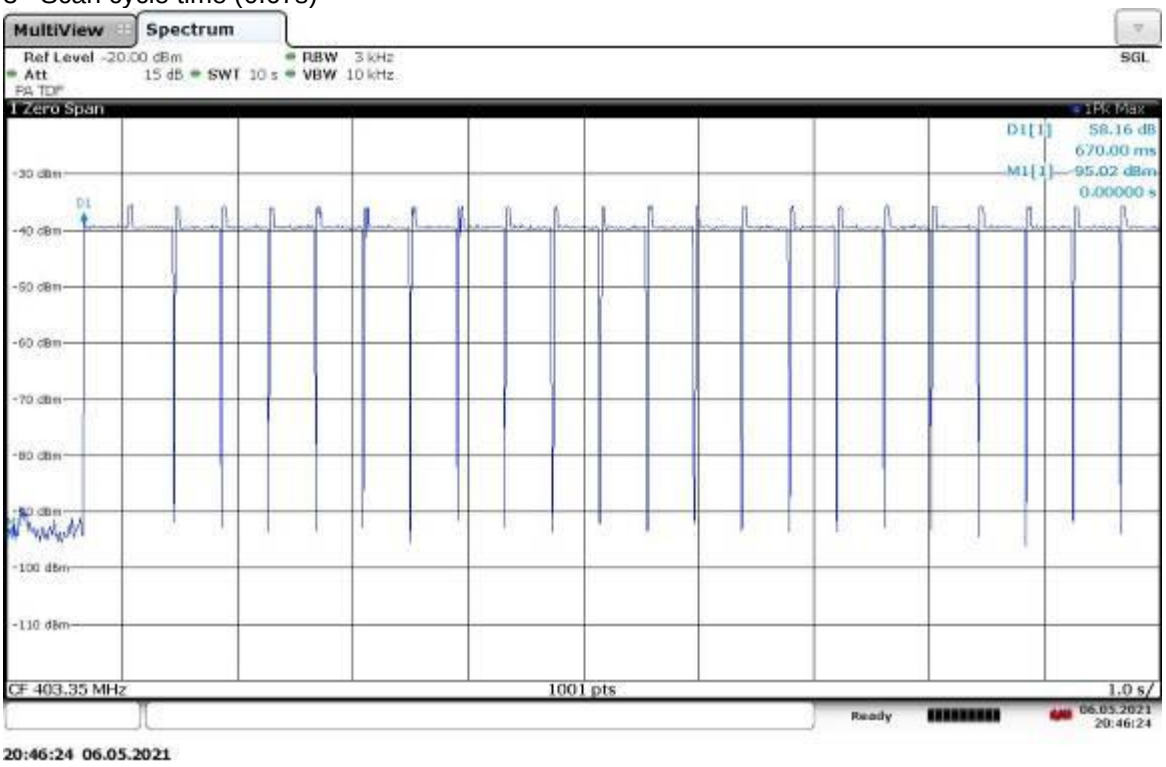
1st Scan cycle time (0.69s)



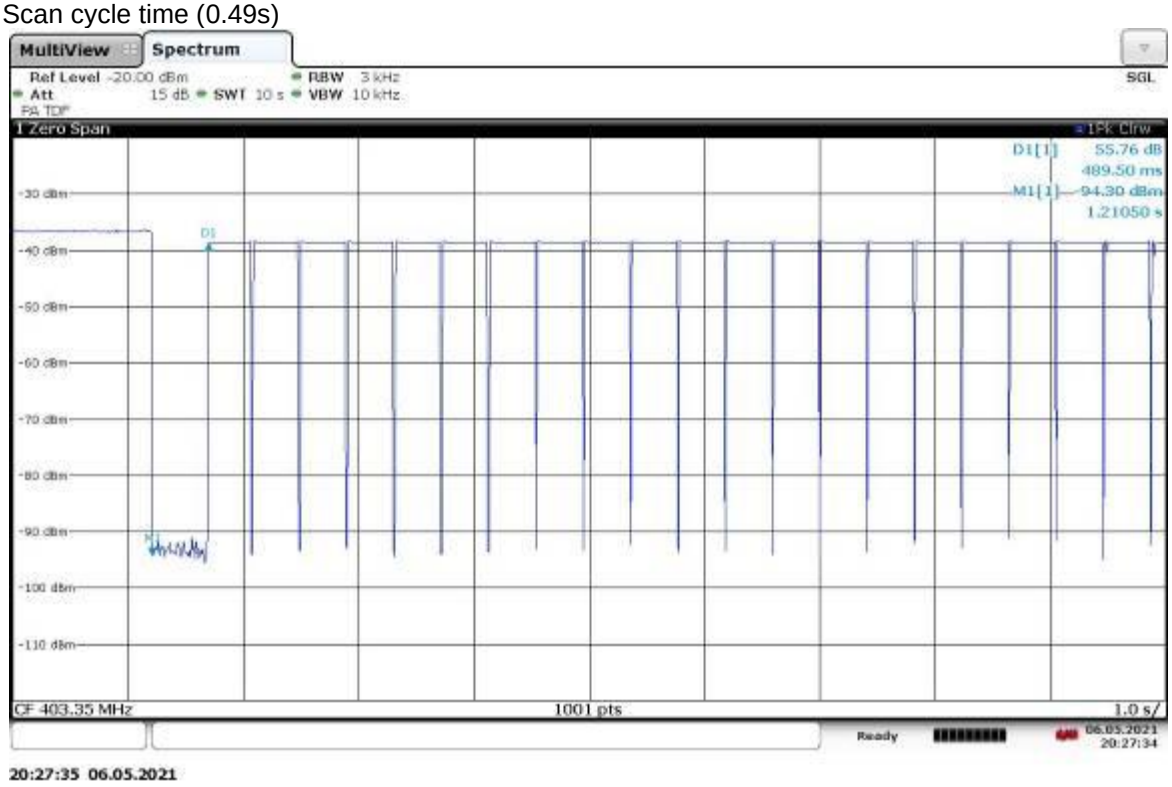
2nd Scan cycle time (0.47s)



3rd Scan cycle time (0.67s)



4rd Scan cycle time (0.49s)



Minimum Channel Monitoring Period

Each MICS channel shall be monitored for a minimum of 10 milliseconds during each scan cycle of 5 seconds or less.

The blocking band was set to -79.49dBm, with a notch left open at 403.35MHz. A tone was introduced at the center of the notch at -82.9dBm. A MICS communication session was initiated and it was verified that the EUT did not select a channel in the blocking band over several attempts.

The out of operating region disturbance signal was modulated with 0.1 ms pulse whose repetition frequency was adjusted to 100Hz corresponding to a silent period between pulses of 9.9 ms. This condition was monitored for several times, at least 10 attempts, and it was verified that the EUT did not select a channel in the blocking band over several attempts.

Channel Access

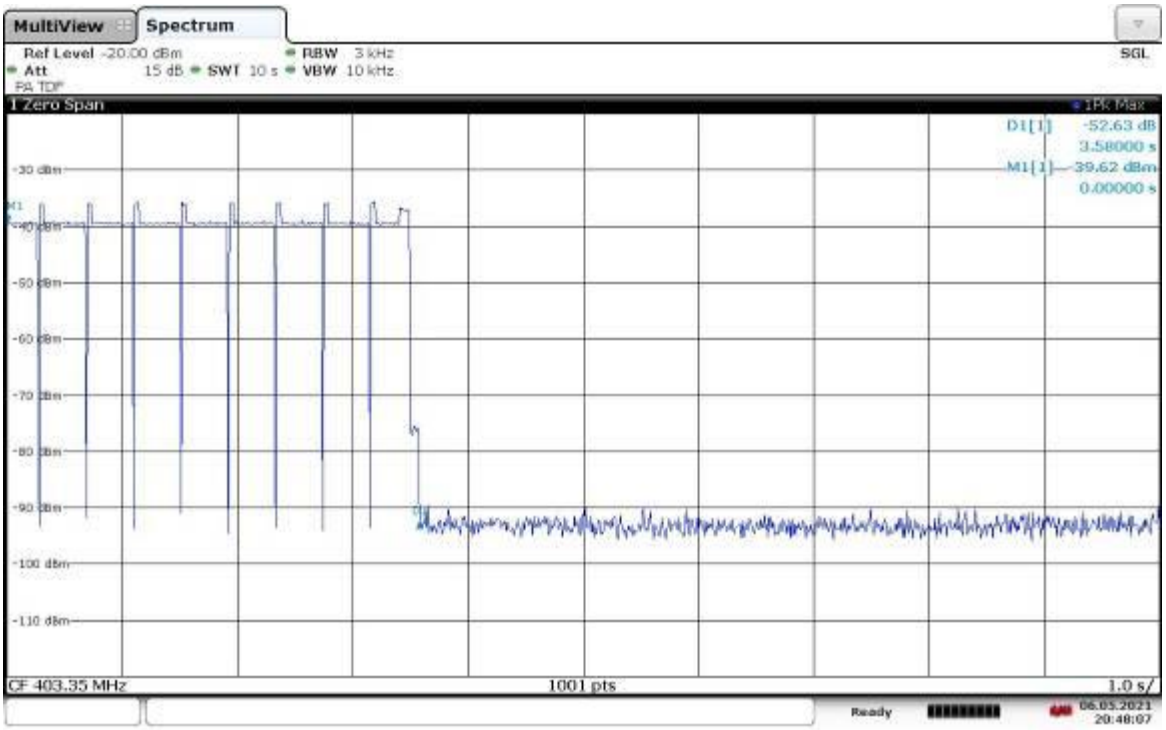
Immediate access is permitted on any channel having an ambient power level that is below the maximum threshold. If no channel having an ambient power below the maximum threshold is available, the equipment under test shall access and transmit on the least interfered channel.

The blocking band was set to -88.4 dBm (10dB above the calculated threshold level), with a notch left open at 403.35MHz. A second notch was created at channel 1(402.45MHz) by lowering the blocking tones at channel 1 by 7dB. A tone was introduced at the center of the channel at -101.4dB (3dB below the calculated threshold). A MICS communication session was then initiated and it was verified that the EUT transmitted only on the center frequency through several attempts. The CW tone at center frequency was then increased to - 92.4dBm, and it was verified that the EUT transmitter only channel 1 over 10+ attempts.

Discontinuation of a MICS session

MICS shall cease transmission in the event the communication session is interrupted for a period of 5 seconds or more.

A MICS communication session was initiated, and the MICS implant was caused to cease transmission during the session. The time from when the implant ceased transmission until the programmer ceased communication was 3.6 seconds, as shown in the plot below. Communication was set on channel 2 (402.75MHz). Interference was introduced to block the implant transmission.



Test Personnel:	Vathana Ven VSV	Test Date:	04/06/2021
Supervising/Reviewing Engineer: (Where Applicable)	Kouma Sinn KPS		
Product Standard:	FCC Part 95, Subpart I RSS-243	Limit Applied:	See section 10.3
Input Voltage:	120VAC 60Hz		
		Ambient Temperature:	23 ºC
Pretest Verification w/ Artifact:	N/A	Relative Humidity:	16 %
		Atmospheric Pressure:	1015 mbars

Deviations, Additions, or Exclusions: None

11 Radiated Emissions (Digital parts and Receiver)

11.1 Method

Tests are performed in accordance with FCC Part 15B, ISED ICES-003.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	5.0 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.9 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.1 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

Alternately, when BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the “Level” column.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS42'	Weather Station Vantage Vue	Davis	6250	MS191212003	02/24/2021	02/24/2022
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/07/2020	05/07/2021
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	09/21/2020	09/21/2021
145108'	Receiver	Rhode & Schwarz	ESIB40	100209	06/08/2020	06/08/2021
HS002'	Pre-amp to under floor cable	Huber & Suhner	SucoFlex 106A	HS002	11/25/2020	11/25/2021
145-406'	10m Track A In-floor Cable #1	Huber + Suhner	sucoflex 160-19220mm	001	07/13/2020	07/13/2021
IW001'	Receiver to floor cable	Insulated Wire	2801-NPS	001	10/07/2020	10/07/2021
IW006'	Pre-amp to antenna cable	Insulated Wire	2800-NPS	IW006	11/25/2020	11/25/2021
PRE12'	Pre-amp, 1-18GHz	Com-Power	PAM-118A	18040117	12/07/2020	12/07/2021
ETS002'	1-18GHz DRG Horn Antenna	ETS Lindgren	3117	00143260	08/03/2020	08/03/2021
145-414'	3m Track A cables	Huber + Suhner	3m Track A cables	multiple	06/25/2020	06/25/2021

Software Utilized:

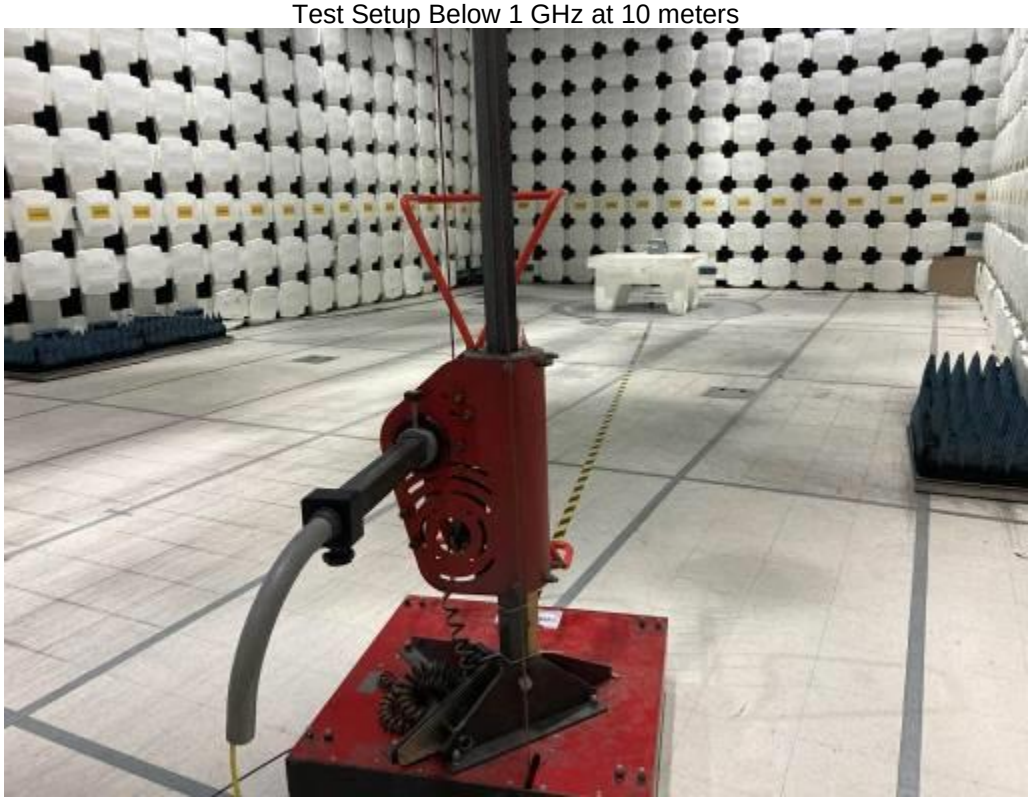
Name	Manufacturer	Version
BAT-EMC	Nexio	3.18.0.16 (10M)

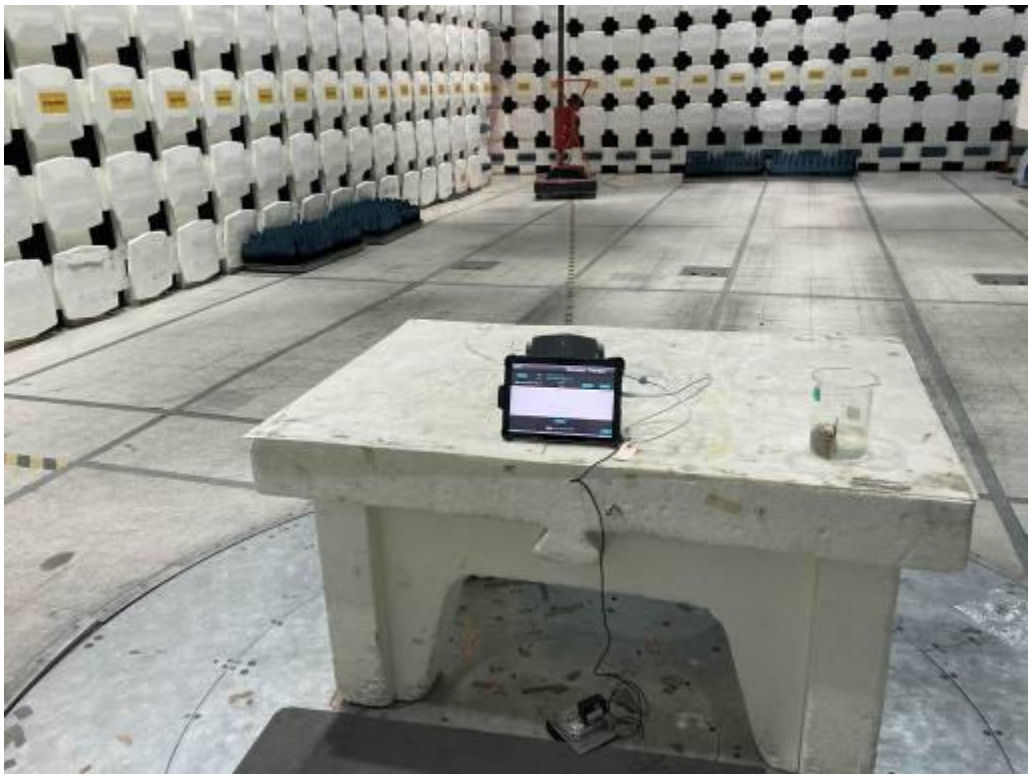
11.3 Results:

The sample tested was found to Comply.

11.4 Setup Photographs:

Test Setup Below 1 GHz at 10 meters





Test Setup Above 1 GHz at 3 meters

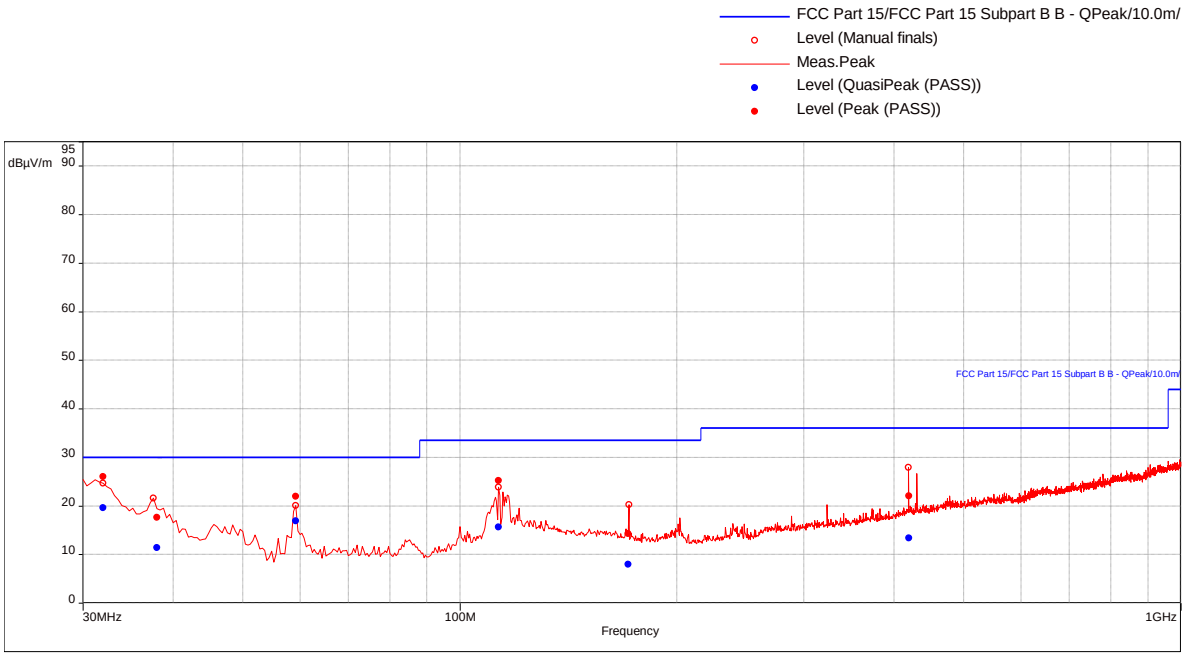
11.5 Plots/Data:

30-1000 MHz

Test Information:

Date and Time	3/21/2021 10:46:05 AM
Client and Project Number	CVRX_G104584704
Engineer	Vathana Ven
Temperature	21 deg C
Humidity	18%
Atmospheric Pressure	1002 mB
Comments	RE 30-1000MHz_120VAC 60Hz_FCC

Graph:



Results:

QuasiPeak (PASS) (6)

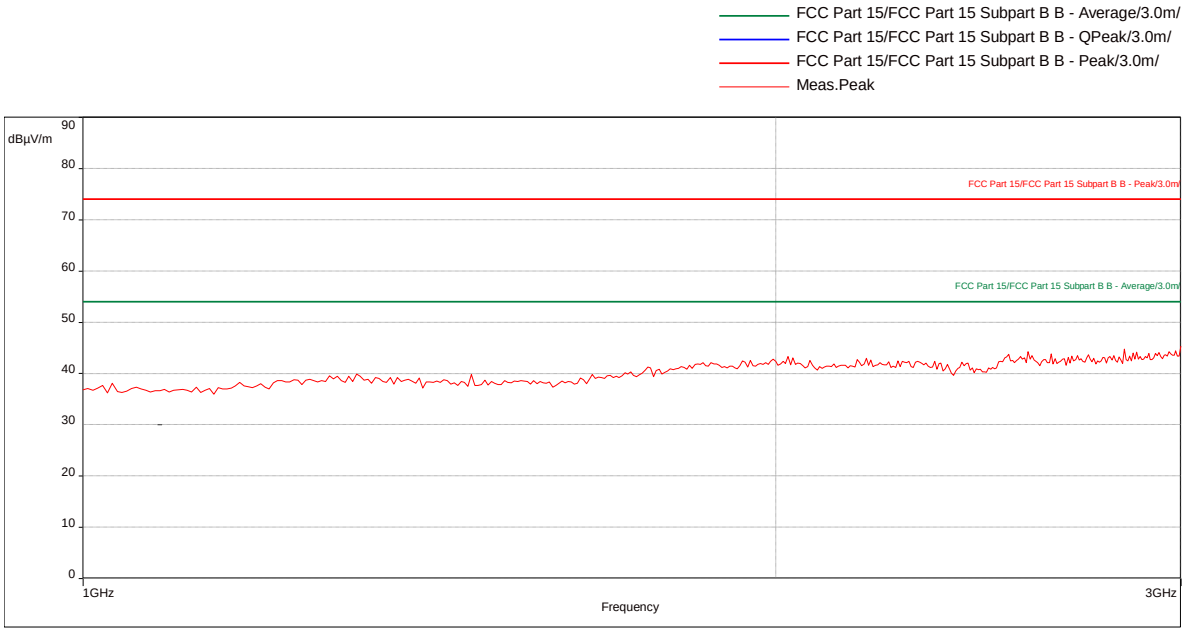
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
32	19.64	30.00	-10.36	25.00	3.11	Vertical	120000.00	-13.71
37.82105263	11.36	30.00	-18.64	0.00	2.64	Vertical	120000.00	-18.09
59.13684211	16.89	30.00	-13.11	17.00	1.51	Vertical	120000.00	-25.86
113.3578947	15.66	33.50	-17.84	320.00	2.23	Vertical	120000.00	-19.53
171.2526316	7.98	33.50	-25.52	261.00	3.86	Vertical	120000.00	-20.76
419.5473684	13.34	36.00	-22.66	144.00	1.00	Vertical	120000.00	-15.07

1 - 3 GHz

Test Information:

Date and Time	4/4/2021 12:30:57 PM
Client and Project Number	CVRX_G104584704
Engineer	Vathana Ven
Temperature	21 deg C
Humidity	18%
Atmospheric Pressure	1002 mB
Comments	RE 1 to 3 GHz_120VAC 60Hz_Mode 2_normal mode

Graph:



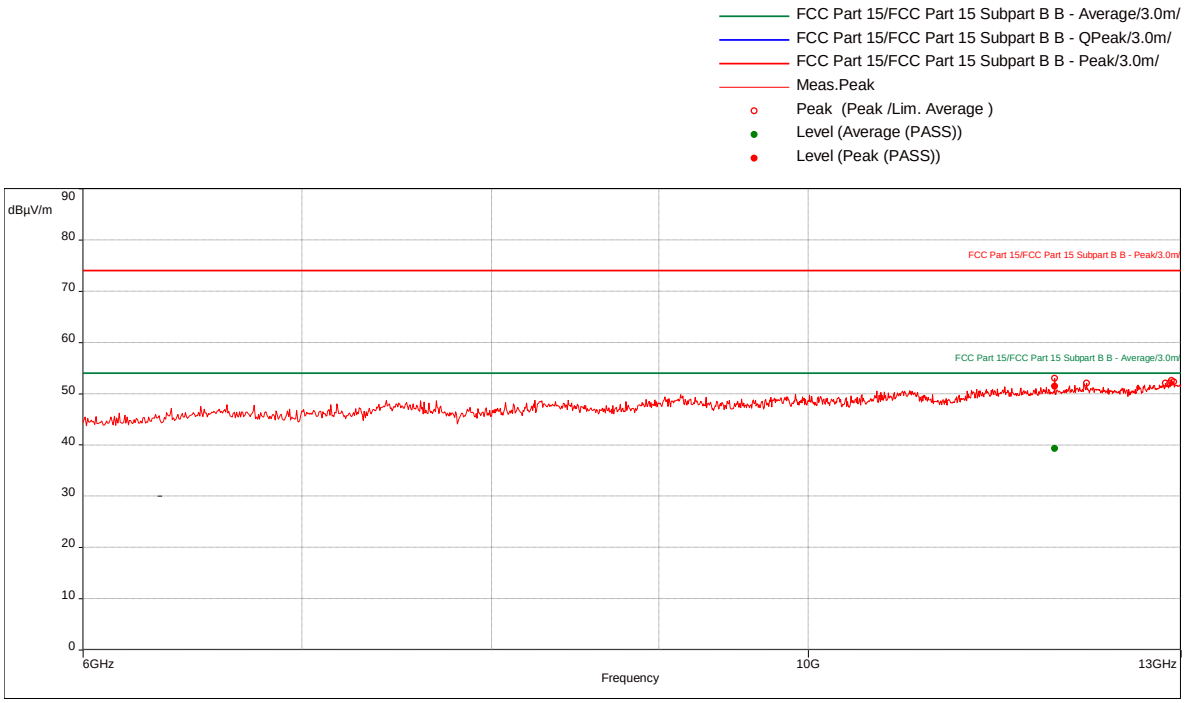
Results: No emissions were detected.

3 – 13 GHz

Test Information:

Date and Time	4/4/2021 12:20:23 PM
Client and Project Number	CVRX_G104584704
Engineer	Vathana Ven
Temperature	21 deg C
Humidity	18%
Atmospheric Pressure	1002 mB
Comments	RE 6 to 13 GHz_120VAC 60Hz_Mode 2_normal mode

Graph:



Results:

Peak (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
11896.84211	51.41	74.00	-22.59	328.00	2.30	Vertical	1000000.00	0.62

Average (PASS) (1)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
11896.84211	39.28	54.00	-14.72	328.00	2.30	Vertical	1000000.00	0.62

Test Personnel:	Vathana Ven VJV	Test Date:	03/21/2021, 04/04/2021
Supervising/Reviewing Engineer: (Where Applicable)	Kouma Sinn KPS		
Product Standard:	FCC Part 15B ISED ICES-003	Limit Applied:	Class B
Input Voltage:	120VAC 60Hz	Ambient Temperature:	21 ºC
Pretest Verification w/ BB Source:	**Yes**	Relative Humidity:	18 %
		Atmospheric Pressure:	1002 mbars

Deviations, Additions, or Exclusions: None

12 AC Mains Conducted Emissions

12.1 Method

Tests are performed in accordance with FCC Part 15B, ISED ICES-003, ANSI C63.4.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
AC Line Conducted Emissions	150 kHz - 30 MHz	1.2 dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	2.8 dB	5.0dB
AC Line Conducted Emissions	9 kHz - 150 MHz	2.2 dB	3.4 dB

As shown in the table above our conducted emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV/m

When BAT-EMC Emission Software is used, the “Level” includes all losses and gains and is compared directly in the “Margin” column to the “Limit”. The “Correction” includes LISN Factor, Attenuator, and Cable Loss. These are already accounted for in the “Level” column.

12.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV005'	Weather Station	Davis	6250	MS191218083	02/07/2021	02/07/2022
NAR006'	EMI CISPR Receiver	NARDA	PMM 9010	696WW30303	03/23/2020	03/23/2021
LISN32'	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191955	05/07/2020	05/07/2021
DS23'	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS23	10/30/2020	10/30/2021
CBL042'	3ft BNC to BNC cable	Hosiwell	Coax RG-58	CBL042	06/11/2020	06/11/2021
FLU12'	Digital Multimeter	Fluke	87-5	23500627	01/12/2021	01/12/2022

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.20.0.17

12.3 Results:

The sample tested was found to Comply.

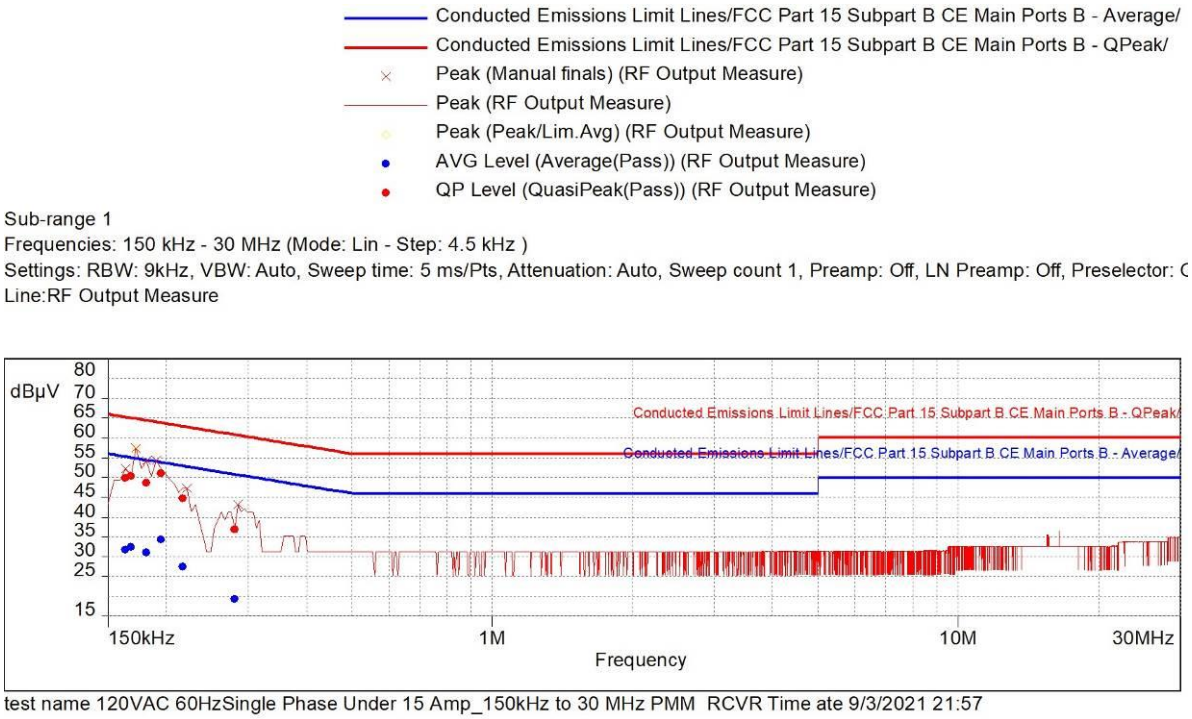
12.4 Setup Photographs:

12.5 Plots/Data:

Test Information:

Date and Time	3/9/2021 9:37:50 PM
Client and Project Number	CVRx G104584704
Engineer	Paul Bacchiocchi
Temperature	22C
Humidity	18%
Atmospheric Pressure	1019mbar
Comments	120VAC 60HzSingle Phase Under 15 Amp_150kHz to 30 MHz PMM RCVR

Graph:



Results:

QuasiPeak(Pass) (6)

Frequency (MHz)	SR	QP Level (dBµV)	QP Limit (dBuV)	QP Margin (dB)	Line	RBW	Meas.Time	Correction (dB)
0.1643	1	49.84	65.28	-15.45	Neutral	9k	0.01	20.26
0.1677	1	50.29	65.06	-14.77	Neutral	9k	0.01	20.25
0.1829	1	48.65	64.42	-15.77	Neutral	9k	0.01	20.24
0.1931	1	51.03	63.82	-12.79	Neutral	9k	0.01	20.23
0.2172	1	44.70	62.91	-18.21	Neutral	9k	0.01	20.22
0.28	1	36.84	60.80	-23.96	Neutral	9k	0.01	20.22

Average(Pass) (6)

Frequency (MHz)	SR	AVG Level (dBµV)	AVG Limit (dBuV)	AVG Margin (dB)	Line	RBW	Meas.Time	Correction (dB)
0.1643	1	31.79	55.28	-23.50	Neutral	9k	0.01	20.26
0.1677	1	32.39	55.06	-22.67	Neutral	9k	0.01	20.25
0.1829	1	31.06	54.42	-23.36	Neutral	9k	0.01	20.24
0.1931	1	34.25	53.82	-19.57	Neutral	9k	0.01	20.23
0.2172	1	27.54	52.91	-25.37	Neutral	9k	0.01	20.22
0.28	1	19.23	50.80	-31.57	Neutral	9k	0.01	20.22

Test Personnel:	Paul Bacchiocchi	Test Date:	03/09/2021
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC Part 15B ISED ICES-003	Limit Applied:	Class B
Input Voltage:	120VAC 60Hz		
		Ambient Temperature:	22 ºC
Pretest Verification w/ signal generator:	**Yes**	Relative Humidity:	18 %
		Atmospheric Pressure:	1019 mbars

Deviations, Additions, or Exclusions: None

13 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	05/13/2021	104584704BOX-015	VFV	KPS	Original Issue