



FCC Part 15, Subpart C, Section 15.247

Test Report

On

Communications Management Unit
FCC ID: 2ADEPCMUE5-B

Customer Name: IONX, LLC

Customer P.O.: 4500634650

Date of Report: August 27, 2019

Test Report No.: R-3052P-1

Test Start Date: July 8, 2019

Test Finish Date: July 17, 2019

Test Technician: M. Nowak, S. Macdonald

Approved By: D. Rybicki

Report Prepared By: P. Harris



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Technical Information

Report Number:	R-3052P-1
Customer:	IONX, LLC
Address:	300 Willowbrook Lane, Suite 320
	West Chester, PA 19382
Manufacturer:	IONX, LLC
Manufacturer Address:	300 Willowbrook Lane, Suite 320
	West Chester, PA 19382
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S, CMU-E5X
FCC ID:	2ADEPCMUE5-B
Type:	2.405 to 2.48 GHz Frequency Hopping Spread Spectrum Transceiver
	7.2 V Provided by 2 D Lithium Thionyl Chloride Batteries for CMU-E5S
Power Requirements:	7.2 V Provided by 8 D Lithium Thionyl Chloride Batteries for CMU-E5X
Frequency of Operation:	2405 - 2480 MHz
Equipment Class:	DSS
Equipment Use:	Mobile

Test Specification:

FCC Rules and Regulations Part 15, Subpart C, Section 15.247

Test Procedure:

ANSI C63.10:2013

Test Facility:

Retlif Testing Laboratories
3131 Detwiler Road
Harleysville, PA 19438

FCC Designation Number: US2321

Table 1 - Tests Performed

FCC Part 15, Subpart C	Test Method
15.247(a)(1)	Channel Separation
15.247(a)(2)	Occupied Bandwidth
15.247(b)(3)	Power Output
15.247(d)	Antenna Port, Conducted Emissions
15.247(a)(1)(iii)	Number of Channels and Occupancy Time
15.247(d)	Spurious Emissions, 30 MHz to 25 GHz
15.247(d)/15.209(a)	Field Strength of Spurious Emissions (Digital Device)

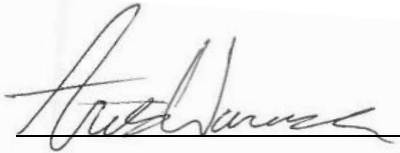


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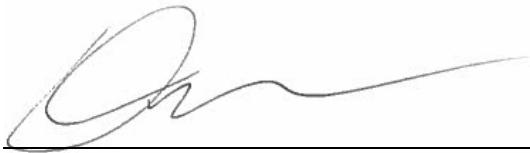
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Certification and Signatures

We certify that this report is a true representation of the results obtained from the tests of the equipment stated. We further certify that the measurements shown in this report were made in accordance with the procedures indicated and vouch for the qualifications of all Retlif Testing Laboratories personnel taking them.



Arik L. Warwick
Senior Test Technician



David M. Rybicki
Laboratory Supervisor

Non-Warranty Provision

The testing services have been performed, findings obtained and reports prepared in accordance with generally accepted laboratory principles and practices. This warranty is in lieu of all others, either expressed or implied.

Non-Endorsement

This test report contains only findings and results arrived at after employing the specific test procedures and standards listed herein. It is not intended to constitute a recommendation, endorsement or certification of the product or material tested. This report must not be used by the client to claim product endorsement by ANSI National Accreditation Board (ANAB).



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Requirements and Test Results

Requirement:

FCC Section 15.247 (a)(1), Channel Separation and 20 dB Bandwidth

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Results:

- The carrier frequencies were separated by greater than the maximum 20 dB Occupied Bandwidth, which complies with the requirements specified above.

FCC Section 15.247 (a)(1)(iii), Number of Channels and Occupancy Time

Frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Results:

- The Frequency Hopping System used 15 channels of operation and had an average time of occupancy on any channel less than 0.4 seconds within a period of six (6) seconds.



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Requirements and Test Results (con't)

FCC Section 15.247 (b)(1) and (4), Peak Conducted Output Power

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(4) The conducted output power limit specified in Paragraph (b) of Section 15.247 is based on the use of antenna with directional gains that do not exceed 6 dBi. Except as shown in Paragraph (c) of Section 15.247, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in Paragraph (b)(1), (b)(2) and (b)(3) of Section 15.247, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Results:

- The peak conducted output power was less than 0.125 W and contains an antenna with a directional gain of 6 dBi or less.

FCC Section 15.247(d) – Unwanted Emissions, Antenna Terminal Out of Band / Band Edge Conducted Emissions

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 either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Paragraph (b)(3) of Section 15.247, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. 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) (see Section 15.205(c)).

Results:

- All measured out of band/band edge conducted emissions were below the specified limits and the device was found to meet the requirements of 15.247 (d).



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Requirements and Test Results (con't)

FCC Section 15.247 (d), Spurious Emissions

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 either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Paragraph (b)(3) of Section 15.247, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. 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) (see Section 15.205(c)).

FCC Section 15.247 (a), Field Strength of Spurious Radiation

Operation under the provisions of Section 15.247 is limited to frequency hopping and digitally modulated intentional radiators that comply with the provisions stated in Section 15.247(a)(1).

FCC Section 15.209(a), Radiated Emission Limits, General Requirements

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 2.

Table 2 - Radiated Emission Limits

Frequency of Emission (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 to 88	100	3
88 to 216	150	3
216 to 960	200	3
Above 960	500	3

Results:

- The field strength of spurious radiated emissions did not exceed the limits specified in Table 2.



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Requirements and Test Results (con't)

FCC Section 15.247 (i), RF Exposure Limits

Spread Spectrum Transmitters operating under 15.247 are categorically excluded from routine environmental evaluation for demonstrating RF exposure compliance with respect to MPE or SAR limits however per 15.247(i) must be operated in a manner that ensures the public is not exposed to RF energy levels in excess of the commission's guidelines. The user/installation manual contains the proper cautionary statements and specifies that the device be installed and operated so that a minimum separation distance of 20 cm will be maintained. Based on the transmitter power and maximum antenna gain (see calculation below) the 20 cm separation distance exceeds the calculated distance for acceptable MPE power density levels to meet both the Occupational/Controlled Exposure and the General Population/Uncontrolled Exposure requirements of FCC Part 1.1310. The calculation below uses the more stringent General Population MPE Limits.

$$S = \frac{PG}{4\pi D^2}$$

D = Minimum Separation Distance in cm

S = Max Allowed Power Density = 1 mW/cm² / 0.57 mW/cm²

P = Max Power Input to Antenna = 8 dBm = 6.31mW / 31.5 dBm = 1.413 W

G = Max Power Gain of Antenna = 5 dBi = 3.16 numeric / 2.5 dBi = 1.78 numeric

Note: The left equation below is for the worst case 2405 - 2480 MHz transmitter while the right equation is for the cellular transmitter based on information found under modular approval for FCC ID RI7ME910C1WW.

Solving for D:

$$1 = \frac{6.31 \times 3.16}{4\pi D^2} = \frac{19.94}{12.57 D^2}$$

$$D^2 = \frac{19.94}{12.57 \times 1}$$

$$D = \sqrt{\frac{19.94}{12.57}} = \sqrt{1.59}$$

$$D = 1.26 \text{ cm}$$

$$0.57 = \frac{1413 \times 1.78}{4\pi D^2} = \frac{2515.14}{12.57 D^2}$$

$$D^2 = \frac{2515.14}{12.57 \times 0.57}$$

$$D = \sqrt{\frac{2515.14}{7.16}} = \sqrt{351.28}$$

$$D = 18.74 \text{ cm}$$

Max % MPE – 87.5%*

*In accordance with KDB 447498 D01 v06, section 7.2 Transmitters used in mobile device exposure conditions for simultaneous transmission operations, excel spreadsheet for simple antenna configurations.



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Equipment Lists

FCC Section 15.247(a)(1) Channel Separation

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
713	ROHDE & SCHWARZ	RECEIVER, EMI	20 Hz - 26.5 GHz	ESIB26	3/25/2019	3/31/2020
713E	MICRO-COAX	CABLE, COAXIAL	6 FEET	UFB311A1-0720- 50U50U	10/9/2018	10/31/2019
8496	NARDA MICROWAVE	ATTENUATOR, COAXIAL	10 dB, DC - 11 GHz, 20 W	768-10	6/11/2019	6/30/2020

FCC Section 15.247 (a)(1)(iii) Number of Channels and Occupancy Time

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
713	ROHDE & SCHWARZ	RECEIVER, EMI	20 Hz - 26.5 GHz	ESIB26	3/25/2019	3/31/2020
713E	MICRO-COAX	CABLE, COAXIAL	6 FEET	UFB311A1-0720- 50U50U	10/9/2018	10/31/2019
8496	NARDA MICROWAVE	ATTENUATOR, COAXIAL	10 dB, DC - 11 GHz, 20 W	768-10	6/11/2019	6/30/2020

FCC Section 15.247 (b)(3) Peak Conducted Output Power

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
713	ROHDE & SCHWARZ	RECEIVER, EMI	20 Hz - 26.5 GHz	ESIB26	3/25/2019	3/31/2020
713E	MICRO-COAX	CABLE, COAXIAL	6 FEET	UFB311A1-0720- 50U50U	10/9/2018	10/31/2019
8496	NARDA MICROWAVE	ATTENUATOR, COAXIAL	10 dB, DC - 11 GHz, 20 W	768-10	6/11/2019	6/30/2020



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**FCC Section 15.247 (d)
Spurious Emissions, 30 MHz to 25 GHz**

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
127A	ETS / EMCO	ANTENNA, BICONICAL	20 - 200 MHz	3104	5/6/2019	11/30/2020
3207	ETS / EMCO	ANTENNA, ACTIVE LOOP	9 kHz - 30 MHz	6502	5/13/2019	5/31/2020
713	ROHDE & SCHWARZ	RECEIVER, EMI	20 Hz - 26.5 GHz	ESIB26	3/25/2019	3/31/2020
713D	MICRO-COAX	CABLE, COAXIAL	3 FT.	UFB311A1-0360-50U50U	10/5/2018	10/31/2019
713E	MICRO-COAX	CABLE, COAXIAL	6 FEET	UFB311A1-0720-50U50U	10/9/2018	10/31/2019
8016	ETS / EMCO	ANTENNA, LOG PERIODIC	200 MHz - 1 GHz	3146	2/7/2018	8/31/2019
8018	ETS / EMCO	ANTENNA, DOUBLE RIDGED GUIDE	1 - 18 GHz	3115	5/11/2018	11/30/2019
8300	RETLIF	OPEN AREA TEST SITE, ATTENUATION	3/10 Meter OATS	RPA	3/28/2018	3/31/2020
8300C	UNKNOWN	CABLE, COAXIAL	3/10 METER	3 METER CABLE	10/30/2018	10/31/2019
8317	AGILENT / HP	PRE-AMPLIFIER	1 - 26.5 GHz, 30 dB	8449B	5/28/2019	5/31/2020
8337	MICROLAB / FXR	ANTENNA, HIGH GAIN HORN	18 - 26.5 GHz	K638AF	No Calibration Required	
8644	AGILENT / HP	ANALYZER, SPECTRUM	100 Hz - 22 GHz	85662A	9/18/2018	9/30/2019
8644A	AGILENT / HP	ANALYZER, SPECTRUM	100 Hz - 22.5 GHz	8566B	9/18/2018	9/30/2019
8644B	AGILENT / HP	ANALYZER, RF PRESELECTOR	20 Hz - 2 GHz	85685A	9/28/2018	9/30/2019
8644C	AGILENT / HP	ANALYZER, QUASI-PEAK ADAPTOR	100 Hz - 22 GHz	85650A	9/24/2018	9/30/2019
8668	DIGI-SENSE	HYGROMETER	0 - 50 deg. c, 10 - 90 % RH	20250-31	3/26/2019	9/30/2019

**FCC Section 15.247 (d)
Antenna Port, Conducted Emissions**

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
032G	MICROLAB / FXR	FILTER, HIGH PASS	3 GHz	HA-30N	7/3/2018	7/31/2019
713	ROHDE & SCHWARZ	RECEIVER, EMI	20 Hz - 26.5 GHz	ESIB26	3/25/2019	3/31/2020
713E	MICRO-COAX	CABLE, COAXIAL	6 FEET	UFB311A1-0720-50U50U	10/9/2018	10/31/2019
8457	GENERAL TECHNICS	COMPUTER, CONTROL	N/A		No Calibration Required	
8496	NARDA MICROWAVE	ATTENUATOR, COAXIAL	10 dB, DC - 11 GHz, 20 W	768-10	6/11/2019	6/30/2020



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**FCC Section 15.247 (d) / 15.209(a)
Field Strength of Spurious Emissions**

EN	Manufacturer	Description	Range	Model No.	Cal Date	Due Date
127A	ETS / EMCO	ANTENNA, BICONICAL	20 - 200 MHz	3104	5/6/2019	11/30/2020
3207	ETS / EMCO	ANTENNA, ACTIVE LOOP	9 kHz - 30 MHz	6502	5/13/2019	5/31/2020
713	ROHDE & SCHWARZ	RECEIVER, EMI	20 Hz - 26.5 GHz	ESIB26	3/25/2019	3/31/2020
713D	MICRO-COAX	CABLE, COAXIAL	3 FT.	UFB311A1-0360-50U50U	10/5/2018	10/31/2019
713E	MICRO-COAX	CABLE, COAXIAL	6 FEET	UFB311A1-0720-50U50U	10/9/2018	10/31/2019
8016	ETS / EMCO	ANTENNA, LOG PERIODIC	200 MHz - 1 GHz	3146	2/7/2018	8/31/2019
8018	ETS / EMCO	ANTENNA, DOUBLE RIDGED GUIDE	1 - 18 GHz	3115	5/11/2018	11/30/2019
8300	RETLIF	OPEN AREA TEST SITE, ATTENUATION	3/10 Meter OATS	RPA	3/28/2018	3/31/2020
8300C	UNKNOWN	CABLE, COAXIAL	3/10 METER	3 METER CABLE	10/30/2018	10/31/2019
8317	AGILENT / HP	PRE-AMPLIFIER	1 - 26.5 GHz, 30 dB	8449B	5/28/2019	5/31/2020
8337	MICROLAB / FXR	ANTENNA, HIGH GAIN HORN	18 - 26.5 GHz	K638AF	No Calibration Required	
8644	AGILENT / HP	ANALYZER, SPECTRUM	100 Hz - 22 GHz	85662A	9/18/2018	9/30/2019
8644A	AGILENT / HP	ANALYZER, SPECTRUM	100 Hz - 22.5 GHz	8566B	9/18/2018	9/30/2019
8644B	AGILENT / HP	ANALYZER, RF PRESELECTOR	20 Hz - 2 GHz	85685A	9/28/2018	9/30/2019
8644C	AGILENT / HP	ANALYZER, QUASI-PEAK ADAPTOR	100 Hz - 22 GHz	85650A	9/24/2018	9/30/2019
8668	DIGI-SENSE	HYGROMETER	0 - 50 deg. c, 10 - 90 % RH	20250-31	3/26/2019	9/30/2019



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**FCC Section 15.247(a)(1)
Test Data, Channel Separation**

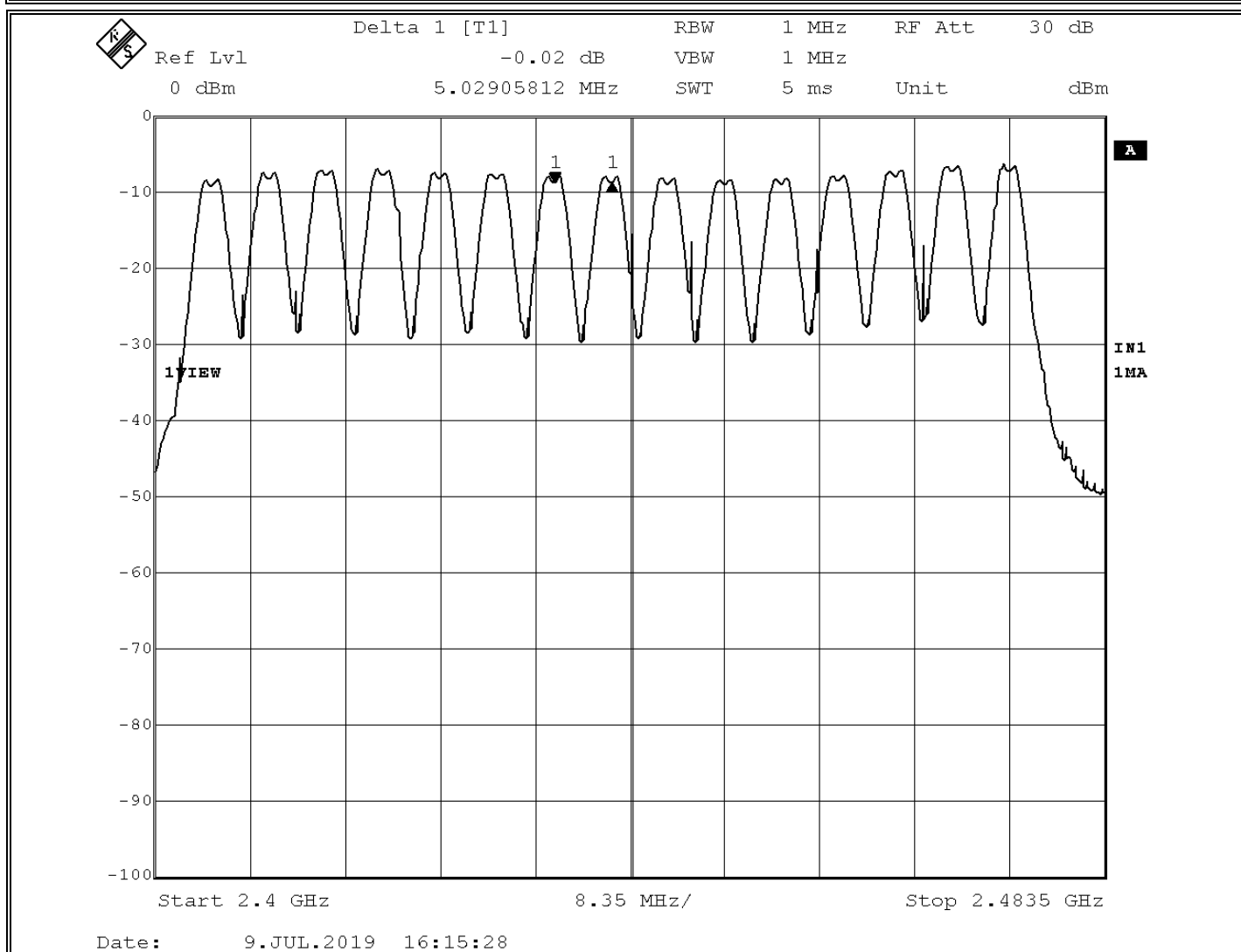


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Part 15.247(a)(1)
Method:	ANSI C63.10, Section 7.8.2 Carrier frequency separation
Job Number/Customer:	R - 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Continuously Transmitting a RF Signal
Technician:	S. Macdonald
Date(s):	7/09/19
Temperature:	22.6 °C
Relative Humidity:	50.9 %
Detector:	Max Hold
Test Condition:	Normal



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FCC Section 15.247 (a)(1))(iii)
Test Data, Number of Channels and Occupancy Time

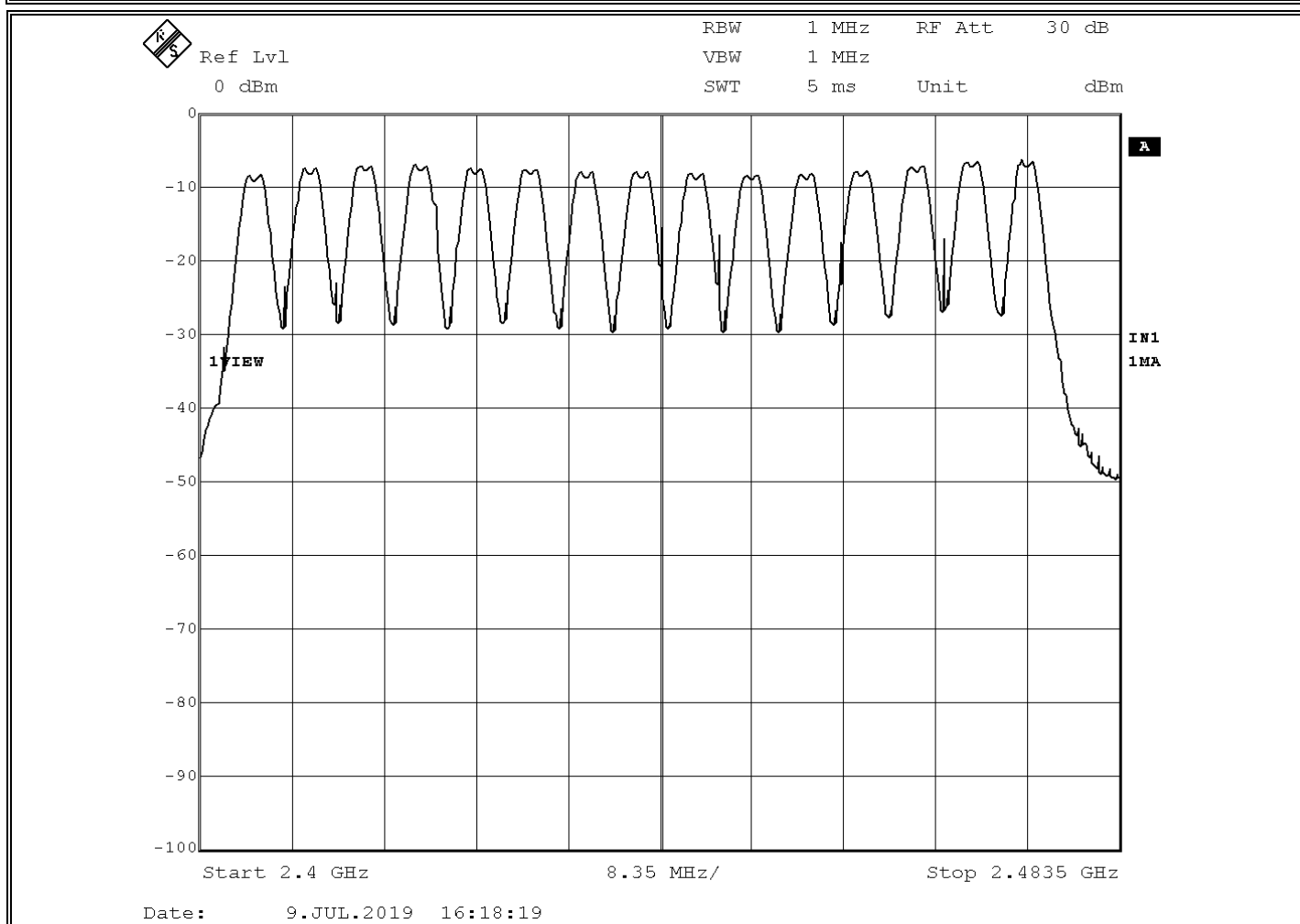


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Part 15.247(a)(1)(iii)
Method:	ANSI C63.10, Section 7.8.3 Number of hopping frequencies
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Continuously Transmitting a RF Signal
Date(s):	7/09/19
Technician:	S. Macdonald
Temperature:	22.6 °C
Relative Humidity:	50.9 %
Detector:	Max Hold
Test Condition:	Normal
Note:	Number of channels = 15

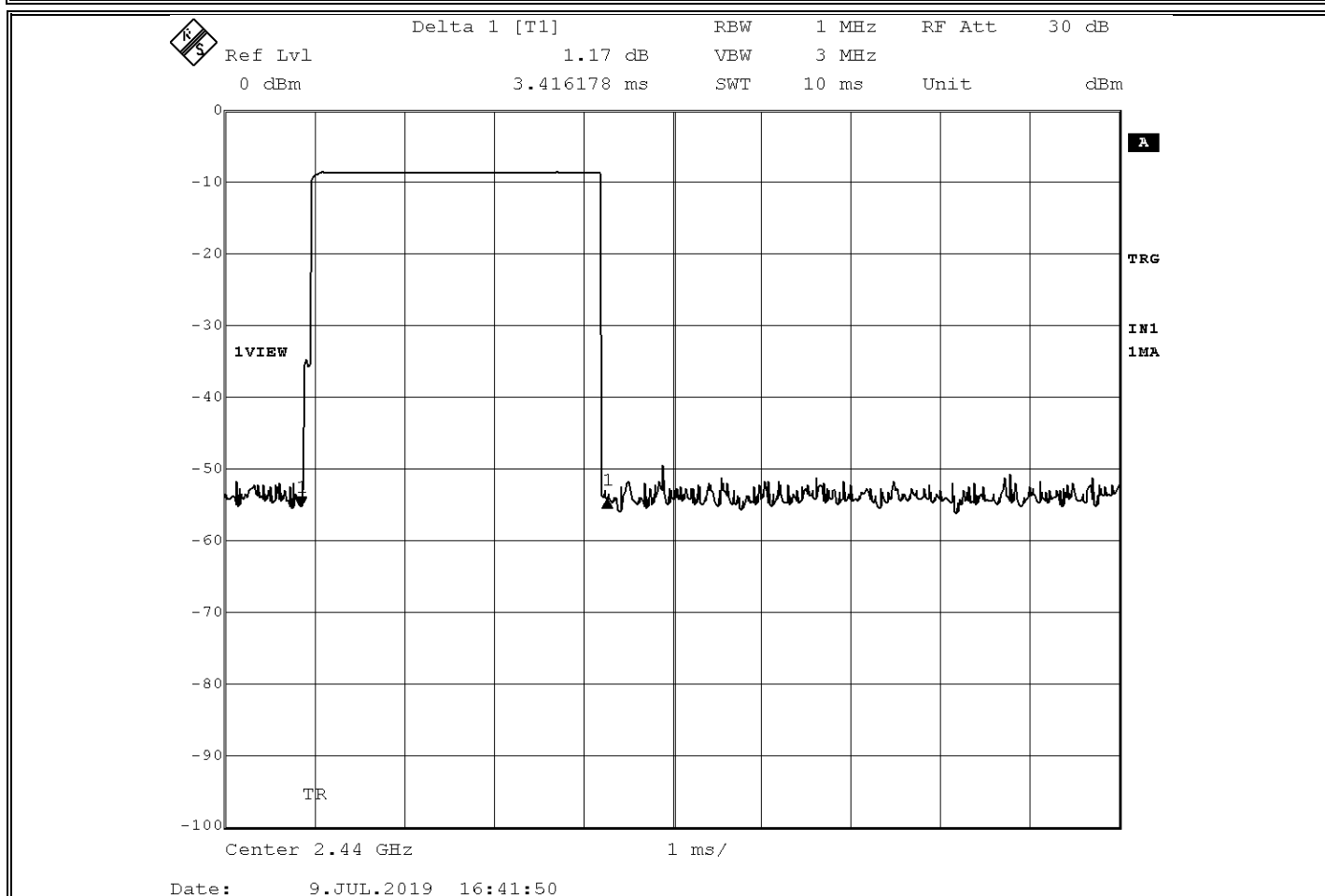


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Part 15.247(a)(1)(iii)
Method:	ANSI C63.10, Section 7.8.4 Time of occupancy (dwell time)
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Continuously Transmitting a RF Signal
Technician:	S. Macdonald
Date(s):	7/09/19
Temperature:	22.6 °C
Relative Humidity:	50.9 %
Detector:	Max Hold
Test Condition:	Normal
Note:	Transmit time per hop = 3.42 ms

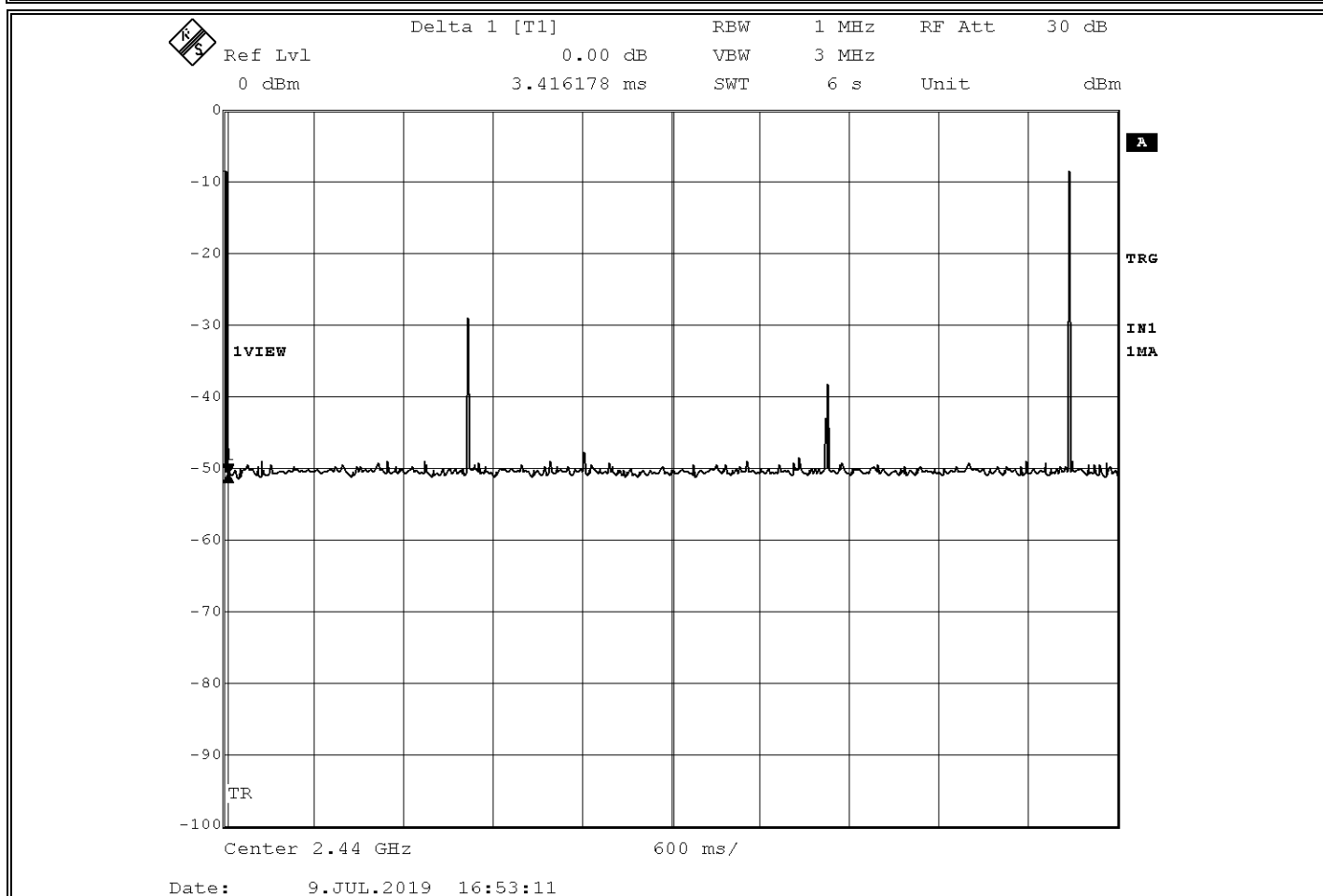


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Part 15.247(a)(1)(iii)
Method:	ANSI C63.10, Section 7.8.4 Time of occupancy (dwell time)
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Continuously Transmitting a RF Signal
Technician:	S. Macdonald
Date(s):	7/09/19
Temperature:	22.6 °C
Relative Humidity:	50.9 %
Detector:	Max Hold
Test Condition:	Normal
Note:	Number of hops = 4, sweep time = 6 s, transmit time per hop = 3.42 ms Time of occupancy = 3.42 ms x 4 x ((0.4 x 15)/6) = 13.68 ms (limit = 400 ms)



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FCC Section 15.247 (b)(3)
Test Data, Peak Conducted Output Power

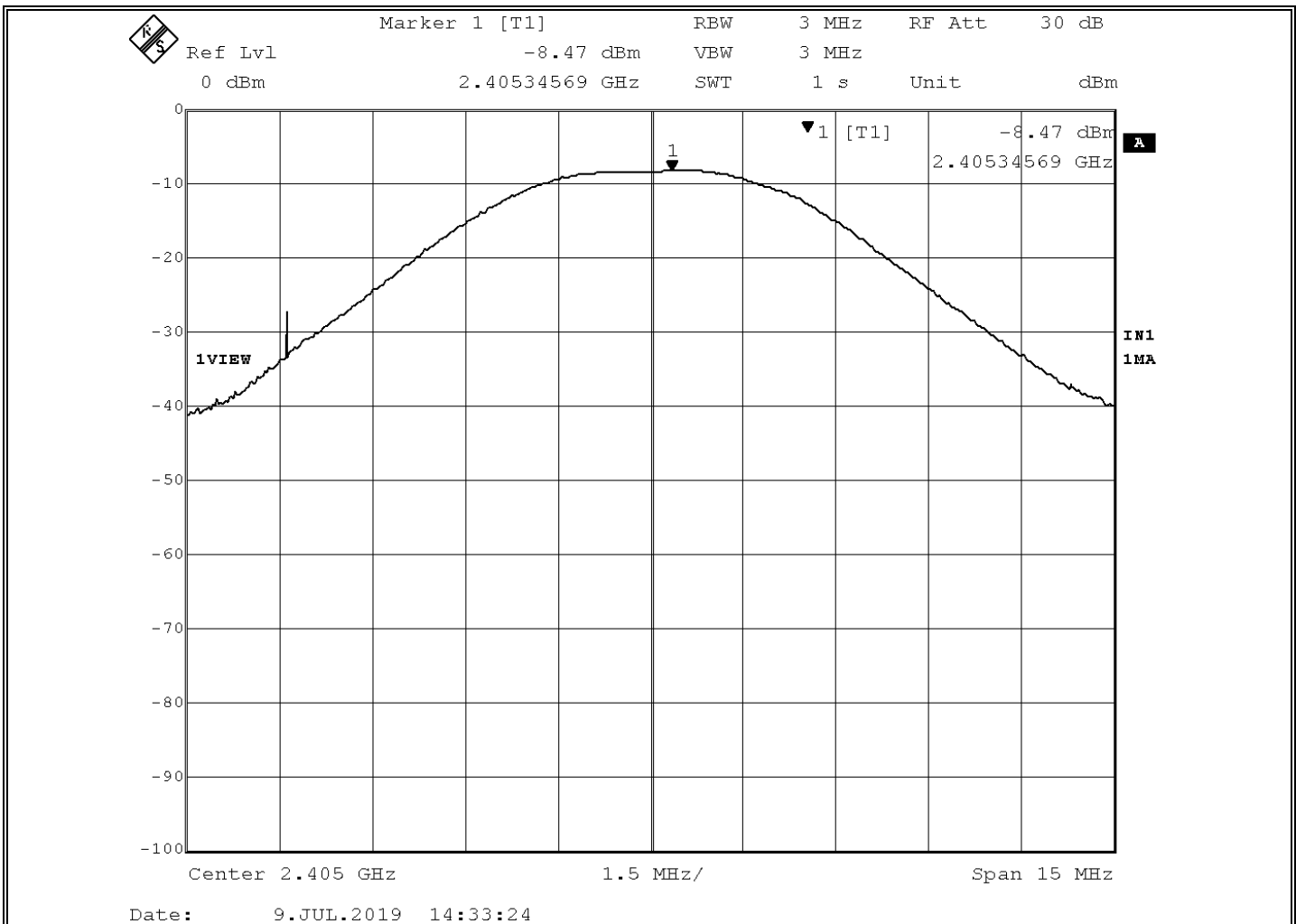


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 7.8.5 Output power test procedure for frequency hopping spread-spectrum (FHSS) devices
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Transmitting modulated signal at 2.405 GHz
Technician:	S. Macdonald
Date(s):	7/09/19
Temperature:	22.6 °C
Relative Humidity:	50.9 %
Notes:	10 dB attenuator factor = 10.18 dB, Cable factor = 0.59 dB, total correction factor – 10.18 dB + 0.59 dB = 10.77 dB Peak Power Output = -8.47 dBm + 10.77 dB = 2.3 dBm (1.70 mW)

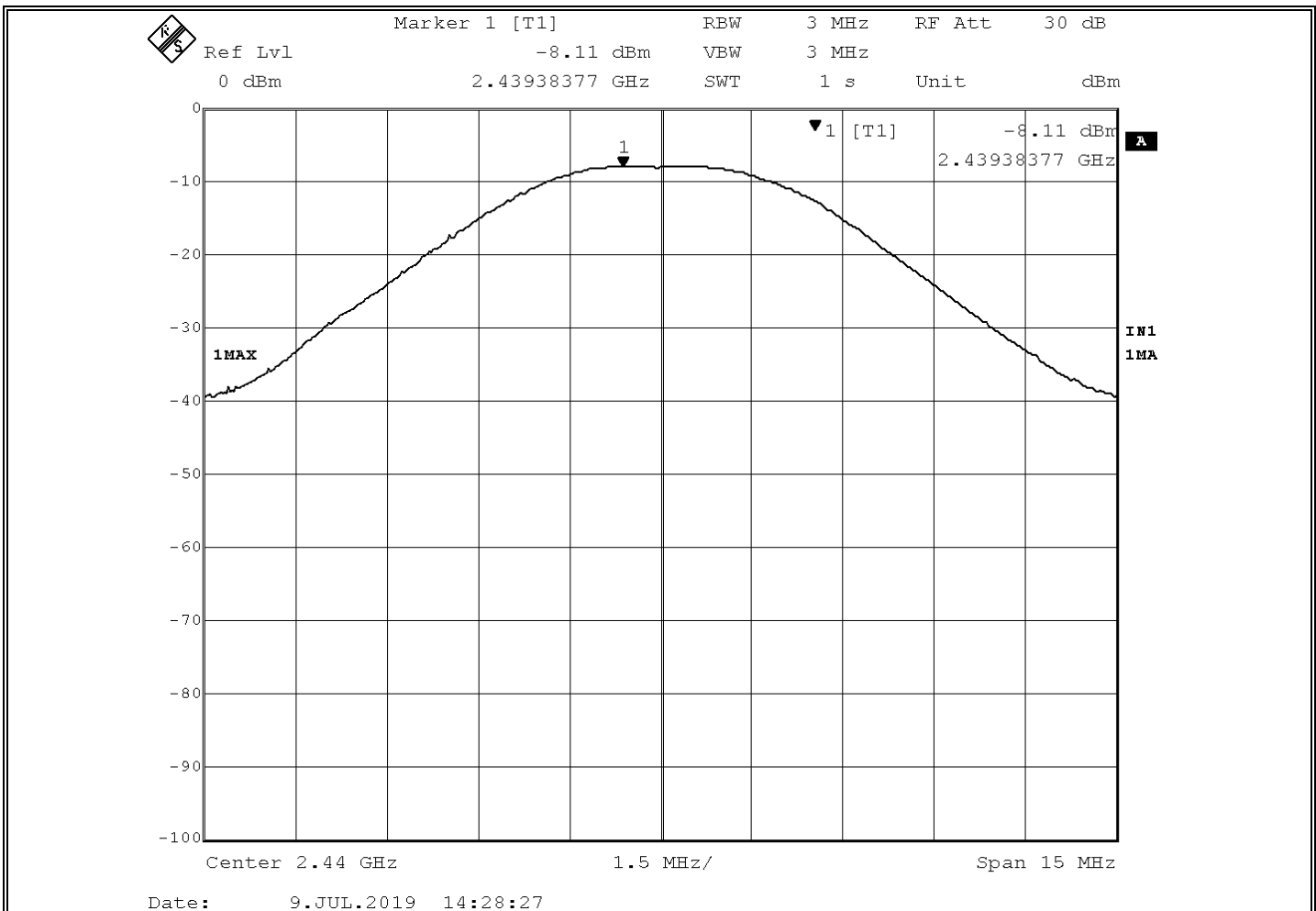


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EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 7.8.5 Output power test procedure for frequency hopping spread-spectrum (FHSS) devices
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Transmitting modulated signal at 2.440 GHz
Technician:	S. Macdonald
Date(s):	7/09/19
Temperature:	22.6 °C
Relative Humidity:	50.9 %
Notes:	10 dB attenuator factor = 10.18 dB, Cable factor = 0.59 dB, total correction factor – 10.18 dB + 0.59 dB = 10.77 dB Peak Power Output = -8.11 dBm + 10.77 dB = 2.66 dBm (1.84 mW)

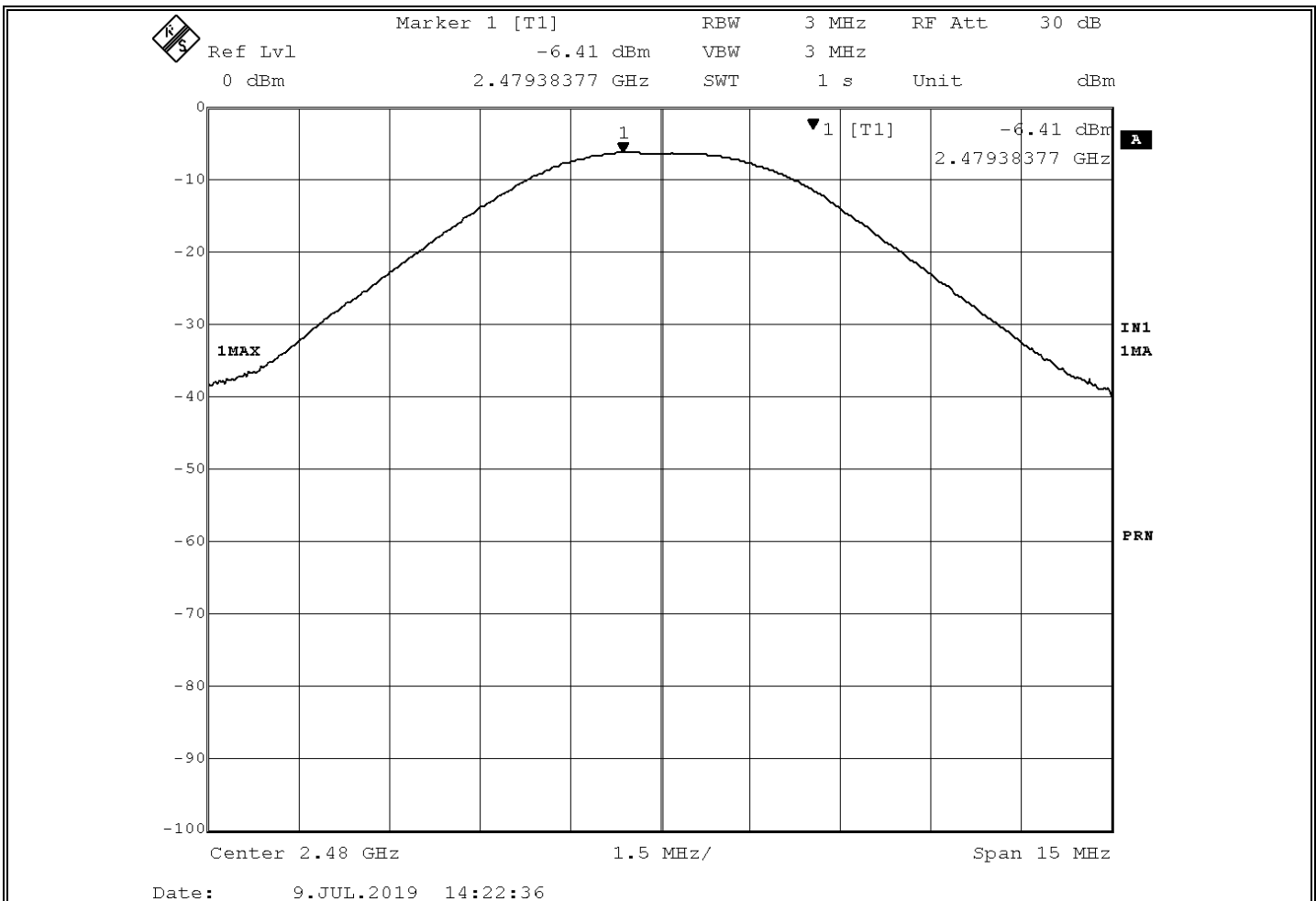


Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Paragraph: 15.247 (b)(3)
Method:	ANSI C63.10, Section 7.8.5 Output power test procedure for frequency hopping spread-spectrum (FHSS) devices
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Transmitting modulated signal at 2.480 GHz
Technician:	S. Macdonald
Date(s):	7/09/19
Temperature:	22.6 °C
Relative Humidity:	50.9 %
Notes:	10 dB attenuator factor = 10.18 dB, Cable factor = 0.61 dB, total correction factor – 10.18 dB + 0.61 dB = 10.79 dB Peak Power Output = -6.41 dBm + 10.79 dB = 4.38 dBm (2.74 mW)



Retlif Testing Laboratories

Report No. R-3052P-1

FCC Section 15.247 (d)
Test Data, Antenna Port, Conducted Emissions



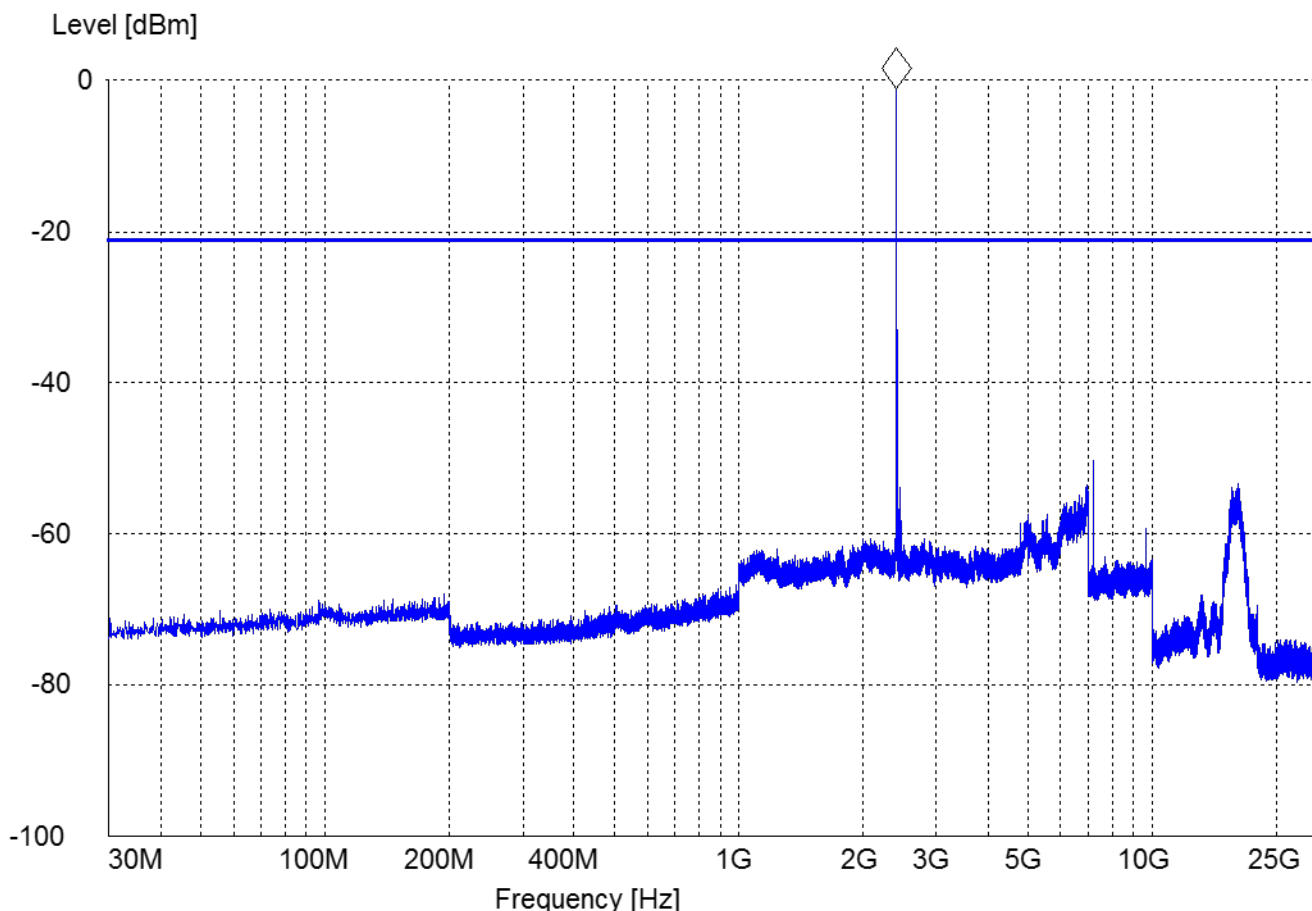
Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Part 15.247(d)
Method:	ANSI C63.10, Section 7.8.8 Conducted spurious emissions test
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Transmitting modulated signal at 2.405 GHz
Technician:	S. Macdonald
Date(s):	7/10/19
Temperature:	22.7 °C
Relative Humidity:	50.1 %
Detector:	Max Hold
Test Condition:	Normal
Note:	Limit set to 20 dB below the maximum measured power. (-21.15 dBm)

Marker: 2.4053 GHz -1.15 dBm



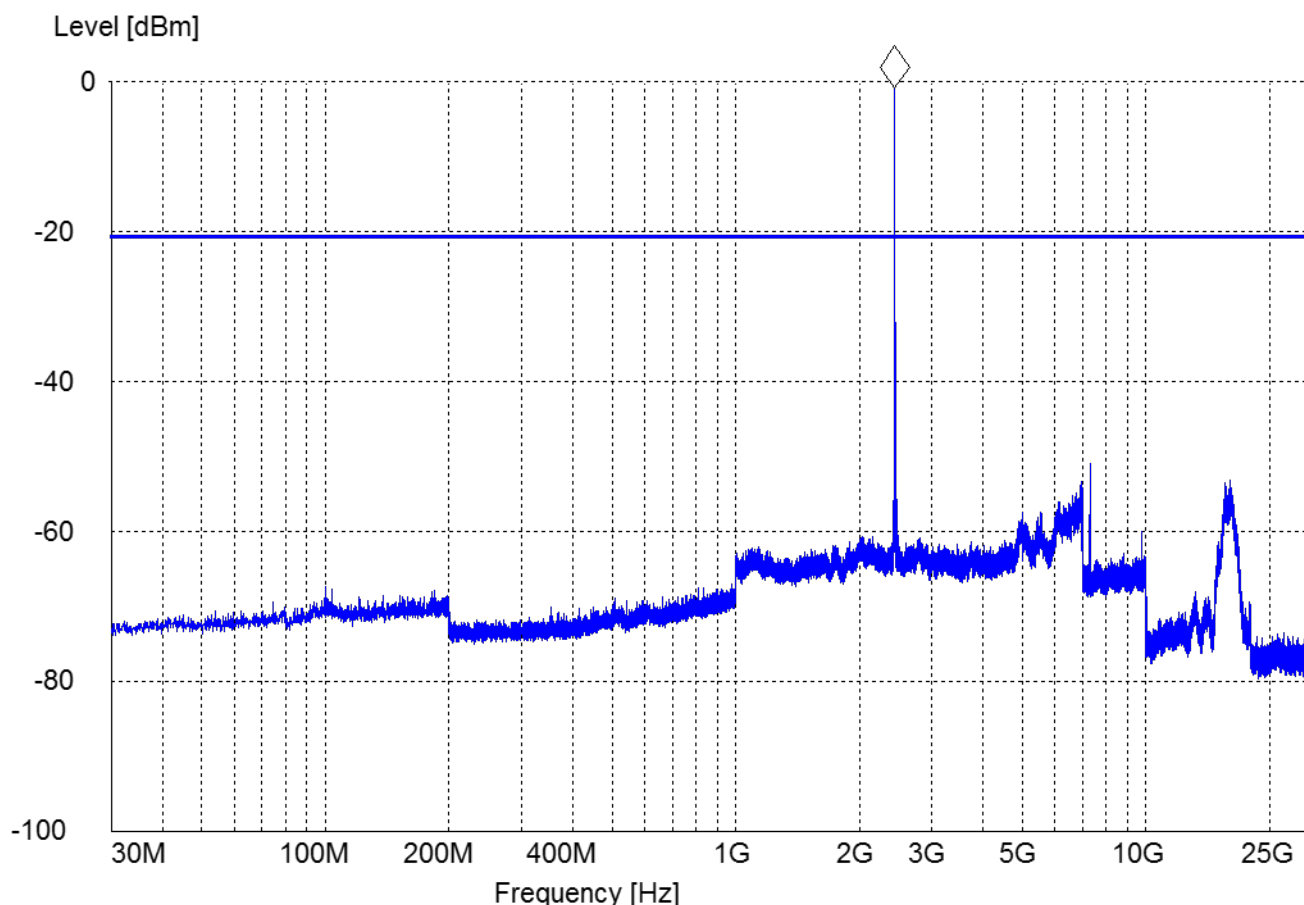
Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Part 15.247(d)
Method:	ANSI C63.10, Section 7.8.8 Conducted spurious emissions test
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Transmitting modulated signal at 2.440 GHz
Technician:	S. Macdonald
Date(s):	7/10/19
Temperature:	22.7 °C
Relative Humidity:	50.1 %
Detector:	Max Hold
Test Condition:	Normal
Note:	Limit set to 20 dB below the maximum measured power. (-20.74 dBm)

Marker: 2.4403 GHz -0.74 dBm



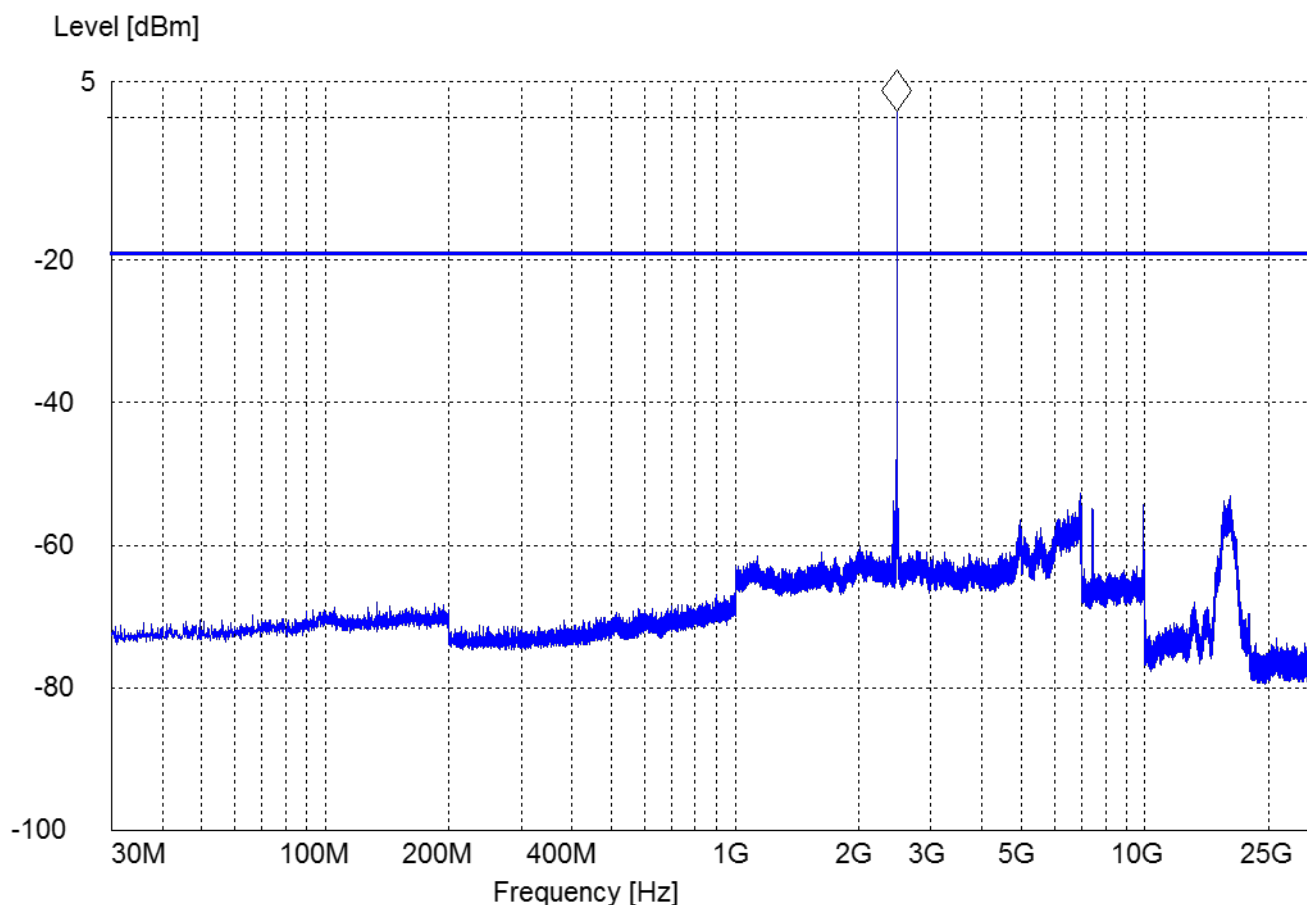
Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C Part 15.247(d)
Method:	ANSI C63.10, Section 7.8.8 Conducted spurious emissions test
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	PCBAC3-05-NA-4-0-1
Serial Number:	0039
Operating Mode:	Transmitting modulated signal at 2.480 GHz
Technician:	S. Macdonald
Date(s):	7/10/19
Temperature:	22.7 °C
Relative Humidity:	50.1 %
Detector:	Max Hold
Test Condition:	Normal
Note:	Limit set to 20 dB below the maximum measured power. (-19.11 dBm)

Marker: 2.4803 GHz 0.89 dBm



Retlif Testing Laboratories

Report No. R-3052P-1

FCC Section 15.247 (a) / 15.209(a)
Test Data, Field Strength of Spurious Emissions



Retlif Testing Laboratories

Report No. R-3052P-1

**FCC Part 15, Subpart C, Section 15.209 (d)
Test Data, Radiated Emissions, 9 kHz to 25 GHz**



Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.209(d), Radiated Emissions
Method:	ANSI C63.10, Section 6, Standard Test Methods
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	C05S2NC-NA4011
Serial Number:	E5B001000B
Operating Mode:	Continuously Transmitting Cellular Modem and 2.4 GHz Radio Simultaneously
Technician:	M. Nowak
Date(s):	07/16/19
Temperature:	26.4 °C
Relative Humidity:	55.0 %
Detector:	Quasi-peak
Test Distance:	3m

Notes: The frequency range was scanned from 9 kHz to 30 MHz

The emissions observed from the EUT do not exceed the specified limits. The two highest readings relative to the limit are presented.

*Noise floor measurement, minimum sensitivity of measurement system.

Frequency	Antenna Position	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Converted to 300m	Converted Reading	Limit at 30 m
MHz	(Par/Perp) / Height	Degrees	dBuV	dB	dBuV/m	dBuV/m	uV/m	uV/m
0.009								266.67
0.490								4.89
Frequency	Antenna Position	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Converted to 30m	Converted Reading	Limit at 30 m
MHz	(Par/Perp) / Height	Degrees	dBuV	dB	dBuV/m	dBuV/m	uV/m	uV/m
0.490								48.98
1.705								14.08
1.705								30.00
*14.80	Par / 1.00	180.0	8.5	10.4	18.9	-	8.82	
*25.00	Par / 1.00	180.0	3.9	7.7	11.6	-	3.81	
30.00								30.00



Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.209(d), Radiated Emissions
Method:	ANSI C63.10, Section 6, Standard Test Methods
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	C05S2NC-NA4011
Serial Number:	E5B001000B
Operating Mode:	Continuously Transmitting Cellular Modem and 2.4 GHz Radio Simultaneously
Technician:	M. Nowak
Date(s):	07/16/19
Temperature:	26.4 °C
Relative Humidity:	55.0 %
Detector:	Quasi-peak
Test Distance:	3m

Notes: The frequency range was scanned from 30 MHz to 1 GHz

The emissions observed from the EUT do not exceed the specified limits. The six highest readings relative to the limit are presented.

*Noise floor measurement, minimum sensitivity of measurement system,

Frequency	Antenna Pol /Height	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
MHz	(V/H) / (m)	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
30.00							100
*35.00	H / 1.00	180.0	-0.4	12.5	12.1	4.03	
88.00							100
88.00							150
*110.00	H / 1.00	180.0	7.2	13.2	20.4	10.48	
*195.00	H / 1.00	180.0	-0.9	18.8	17.9	7.86	
*215.00	H / 1.00	180.0	3.1	13.1	16.2	6.46	
216.00							150
216.00							200
*605.00	H / 1.00	180.0	2.2	22.6	24.8	17.38	
960.00							200
960.00							500
*995.00	H / 1.00	180.0	-2.0	29.6	27.6	23.99	
1000.00							500



Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.209(d), Radiated Emissions
Method:	ANSI C63.10, Section 6, Standard Test Methods
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	C05S2NC-NA4011
Serial Number:	E5B001000B
Operating Mode:	Continuously Transmitting Cellular Modem and 2.4 GHz Radio Simultaneously
Technician:	M. Nowak
Date(s):	07/16/19
Temperature:	26.4 °C
Relative Humidity:	55.0 %
Detector:	Peak
Test Distance:	3m

Notes: The frequency range was scanned from 1 GHz to 25 GHz

The emissions observed from the EUT do not exceed the specified limits. The seven highest readings relative to the limit are presented.

*Noise floor measurement, minimum sensitivity of measurement system,

Frequency	Antenna Pol /Height	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) / (m)	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
1.0							500
*1.05	H / 1.00	180.0	43.9	-9.8	34.1	50.70	
*2.95	H / 1.00	180.0	41.7	-3.7	38.0	79.44	
*5.95	H / 1.00	180.0	42.2	2.1	44.3	164.06	
*10.00	H / 1.00	180.0	40.4	6.1	46.5	211.35	
*19.56	H / 1.00	180.0	43.9	2.2	46.1	201.84	
*22.00	H / 1.00	180.0	45.7	1.9	47.6	239.88	
*24.45	H / 1.00	180.0	46.6	0.7	47.3	231.74	
25.0							500



Retlif Testing Laboratories

Report No. R-3052P-1

**FCC Part 15, Subpart C, Section 15.247 (d)
Test Data, Radiated Emissions, 30 MHz to 25 GHz**



Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.247(d), Radiated Emissions
Method:	ANSI C63.10, Section 6, Standard Test Methods
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	C05S2NC-NA4011
Serial Number:	E5B001000B
Operating Mode:	Continuously Transmitting Cellular Modem and 2.4 GHz Radio Simultaneously
Technician:	M. Nowak
Date(s):	07/16/19
Temperature:	26.4 °C
Relative Humidity:	55.0 %
Detector:	Quasi-peak
Test Distance:	3m

Notes: The frequency range was scanned from 30 MHz to 1 GHz

The emissions observed from the EUT do not exceed the specified limits. The six highest readings relative to the limit are presented.

*Noise floor measurement, minimum sensitivity of measurement system,

Frequency	Antenna Pol /Height	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
MHz	(V/H) / (m)	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
30.00							100
*35.00	H / 1.00	180.0	-0.4	12.5	12.1	4.03	
88.00							100
88.00							150
*110.00	H / 1.00	180.0	7.2	13.2	20.4	10.48	
*195.00	H / 1.00	180.0	-0.9	18.8	17.9	7.86	
*215.00	H / 1.00	180.0	3.1	13.1	16.2	6.46	
216.00							150
216.00							200
*605.00	H / 1.00	180.0	2.2	22.6	24.8	17.38	
960.00							200
960.00							500
*995.00	H / 1.00	180.0	-2.0	29.6	27.6	23.99	
1000.00							500



Retlif Testing Laboratories

Report No. R-3052P-1

EMISSIONS TEST DATA SHEET

Test Specification:	FCC Part 15, Subpart C, Section 15.247(d), Radiated Emissions
Method:	ANSI C63.10, Section 6, Standard Test Methods
Job Number/Customer:	R – 3052P-1 / IONX, LLC
Test Sample:	Communications Management Unit
Model Number:	CMU-E5S
Part Number:	C05S2NC-NA4011
Serial Number:	E5B001000B
Operating Mode:	Continuously Transmitting Cellular Modem and 2.4 GHz Radio Simultaneously
Technician:	M. Nowak
Date(s):	07/16/19
Temperature:	26.4 °C
Relative Humidity:	55.0 %
Detector:	Peak
Test Distance:	3m

Notes: The frequency range was scanned from 1 GHz to 25 GHz

The emissions observed from the EUT do not exceed the specified limits. The seven highest readings relative to the limit are presented.

*Noise floor measurement, minimum sensitivity of measurement system,

Frequency	Antenna Pol /Height	EUT Orientation	Meter Reading	Correction Factor	Corrected Reading	Converted Reading	Limit
GHz	(V/H) / (m)	Degrees	dBuV	dB	dBuV/m	uV/m	uV/m
1.0							500
*1.05	H / 1.00	180.0	43.9	-9.8	34.1	50.70	
*2.95	H / 1.00	180.0	41.7	-3.7	38.0	79.44	
*5.95	H / 1.00	180.0	42.2	2.1	44.3	164.06	
*10.00	H / 1.00	180.0	40.4	6.1	46.5	211.35	
*19.56	H / 1.00	180.0	43.9	2.2	46.1	201.84	
*22.00	H / 1.00	180.0	45.7	1.9	47.6	239.88	
*24.45	H / 1.00	180.0	46.6	0.7	47.3	231.74	
25.0							500



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Report No. R-3052P-1