

Testing Tomorrow's Technology

Application

For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

And

Innovation Science and Economic Development Canada Certification per IC RSS-Gen, General Requirements for Radio Apparatus and RSS-247, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices

For the

Matrix Design Group, LLC.

Model: MX3-IZ

FCC ID: USKCTRL-10000616

IC: 11898A-10000616

UST Project: 20-0146

Issue Date: July 31, 2020

Total Pages in This Report: 45

3505 Francis Circle Alpharetta, GA 30004 PH: 770-740-0717 Fax: 770-740-1508 www.ustech-lab.com

Page 1 of 45



I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: Man Shasia

Title: Compliance Engineer – President

Date: July 31, 2020



TESTING NVLAP LAB CODE 200162-0

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Testing Tomorrow's Technology

MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Matrix Design Group, LLC.

MODEL: MX3-IZ

FCC ID: USKCTRL-10000616

IC: 11898A-10000616

DATE: July 31, 2020

This report concerns (check one): Original grant \boxtimes Class II change \square

Equipment type: 2.4 GHz Transmitter Module

Technical:

IEEE 802.15.4

Operating Freq: <u>2405-2470 MHz</u> Type of Modulation: <u>O-QPSK</u>

Data/Bit Rate: 250 kbps

Antenna Gain: +1.8 dBi

Maximum Output Power: +18.8 dBm (77mW)

EUT firmware number: 5.6.5.1

Power setting:<u>18</u> Software used to program EUT: fcc_controller_v3200.mx

Report prepared by:

US Tech 3505 Francis Circle Alpharetta, GA 30004 Phone Number: (770) 740-0717 Fax Number: (770) 740-1508

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lssu	e Date:	July 31, 2020	
Test	Report Nu	mber: 20-01146	
IC:		11898A-10000616	
FCC	ID:	USKCTRL-10000616	
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ISED Agency Agreement Internal Photographs External Photographs Antenna Photographs Theory of Operation RF Exposure Installation Manual

1 General Information

1.1 Purpose of this Report

This report is prepared as a means of conveying test results and information concerning the suitability of this exact product for public distribution according to the FCC Rules and Regulations Part 15, Section 247 and Industry Canada RSS-247.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on March 25, 2020 in good operating condition.

1.3 Product Description

The Matrix Design Group, LLC, Model MX3-IZ is the main device of the MX3 Proximity Detection system that will be used in mines to meet the MSHA proximity detection role. The purpose of the EUT is to provide a practical, mine-duty system that will automatically warn personnel when they are entering a potentially hazardous area around a machine. The system must be able to disable some or all machine functions if a particular zone is breached. The proximity detection system detects when a person enters a dangerous area around a given machine and changes machine operation accordingly.

Radio: 2.4 GHz ZigBee (IEEE 802.15.4) Range: 2405 – 2470 MHz ISM band Modulation: O-QPSK RF Output Power: 18.84 dBm Data Rate (Max): 250 kbps

1.4 Configuration of Tested System

The Test Sample was tested per ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014) for FCC subpart A Digital equipment Verification requirements. Also, ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices was used as a test procedure guide.

A list of the EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC under designation number US5301. Additionally, this site has been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittals

The Equipment under Test (EUT) is subject to the following FCC/IC authorizations:

a) Certification under section 15.247/IC RSS-247 as a transmitter.

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
FCC ID:	USKCTRL-10000616
IC:	11898A-10000616
Test Report Number:	20-0146
Issue Date:	July 31, 2020
Customer:	Matrix Design Group, LLC.
Model:	MX3-IZ

1.7 Test Results

In our opinion, and as indicated by the test results documented following, when tested in the configuration as described in this report, the EUT meets the applicable requirements of FCC and IC, including: FCC Parts 2.902, 15.207, 15.209, 15.247, RSS GEN, and RSS-247.

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EUT	MODEL	SERIAL	FCC/IC ID:	CABLES
MANUFACTURER	NUMBER	NUMBER		P/D
Controller Matrix Design Group, LLC	MX3-IZ	001A57- 0062CA	FCC ID: USKCTRL- 10000616 IC ID:11898A- 10000616	P/U
PERIPHERAL	MODEL	SERIAL	FCC/IC ID:	CABLES
MANUFACTURER	NUMBER	NUMBER		P/D
Antenna See antenna details				

U= Unshielded S= Shielded P= Power D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	8/17/2020 2 yr.
SPECTRUM ANALYZER	DSA815	RIGOL	DSA8A18030 0138	12/10/2021 2 yr.
LOOP ANTENNA	6502	EMCO	9810-3246	4/06/2022 2 yr
BICONICAL ANTENNA	3110B	EMCO	9306-1708	6/27/2021 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	2/01/2021 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT- PACKARD	1937A02980	5/13/2021
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT- PACKARD	3008A00480	5/13/2021
HIGH PASS FILTER	H3R020G2	Mini-circuits Inc	001DC9528	5/11/2021
8 dB ATTENUATOR	VAT-8 15542	Mini-circuits Inc	3 0519	6/30/2021
LISN x2	9247-50-TS- 50-N	Solar Electronics	955824 and 955825	5/11/2021

Table 2. Test Instruments

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

FCC Part 15 Certification/ RSS 210 USKCTRL-10000616 11898A-10000616 20-0146 July 31, 2020 Matrix Design Group, LLC. MX3-IZ

2.2 Modifications to EUT Hardware

For compliance to CFR 15.207, Conducted Limits, US Tech made the following modifications:

- Added a Schaffner, Model FN2030, AC/DC line filter to the 24 VDC input power rail at the connector side of EUT.

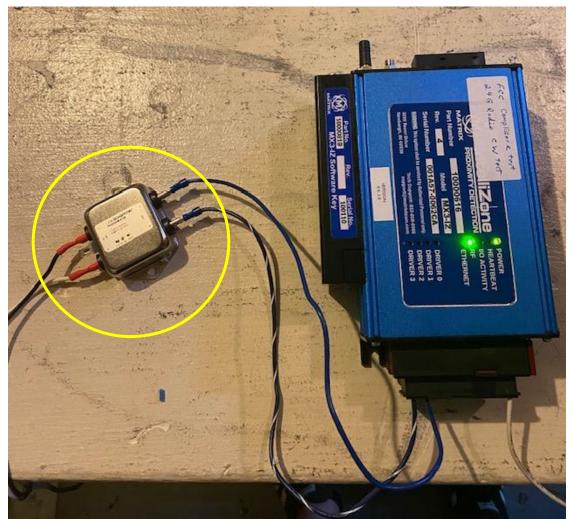


Figure 1. Modification to EUT

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
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IC:	11898A-10000616
Test Report Number:	20-0146
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Model:	MX3-IZ

2.3 Number of Measurements for Intentional Radiators (CFR 15.31(m),RSS-Gen 6.8)

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

 Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the Device Operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates at 2405 to 2470 MHz, 3 test frequencies were used.

2.4 Frequency Range of Radiated Measurements (CFR 15.33, RSS-Gen 6.13)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz or to 5 times the highest internal clock frequency.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35, RSS-Gen 6.9)

The radiated and conducted emissions limits shown herein are based on the following:

2.5.1 Detector Function and Associated Bandwidth

For frequencies below 1000 MHz, the limits herein are based upon measuring instruments employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

For frequencies above 1000 MHz, radiated limits are based upon measuring instruments employing an average detector function. When average radiated emissions are specified there is also a corresponding peak limit requirement of 20 dB greater than the average limit. Peak measurements shall be made using the peak detector function of the measuring instrument. For all measurements above 1000 MHz, the resolution bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

NOTE: If the transmitter was programmed to transmit at >98% duty cycle, then, wherever applicable (where the detection mode was AVG) the duty cycle factor calculated will be applied.

FCC ID: USKCTRL-1000616 IC: 11898A-1000616 Test Report Number: 20-0146 Issue Date: July 31, 2020
Test Report Number:20-0146Issue Date:July 31, 2020
Issue Date: July 31, 2020
Oustanaan Matrix Daalan Oraya 110
Customer: Matrix Design Group, LLC.
Model: MX3-IZ

2.6 EUT Antenna Requirements (CFR 15.203, RSS-Gen 6.7)

This equipment is not available to the general public and will only be installed by a professional installer working for an approved utility. The equipment therefore meets the intent of the above requirement. Only the antennas listed in Table 4 will be used with this module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dBi	TYPE OF CONNECTOR
Antenna	Taoglas	Monopole	GW.26.0111	1.8	SMA(M)

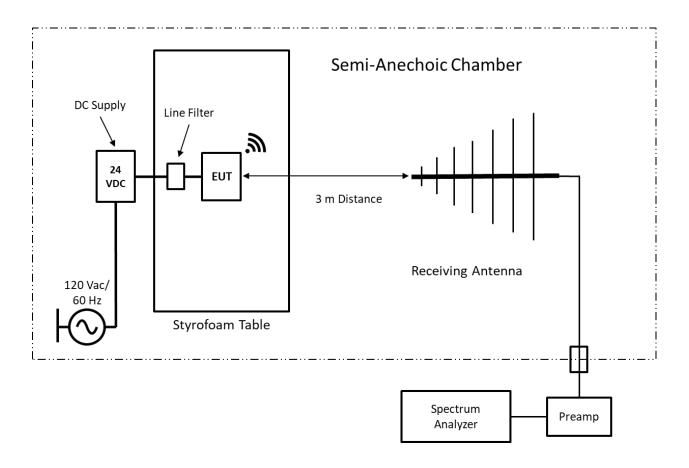


Figure 2. Block Diagram of Test Configuration

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
FCC ID:	USKCTRL-10000616
IC:	11898A-10000616
Test Report Number:	20-0146
Issue Date:	July 31, 2020
Customer:	Matrix Design Group, LLC.
Model:	MX3-IZ

2.7 Restricted Bands of Operation (CFR 15.205, RSS-Gen 8.10)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious cannot exceed the limits of 15.209. Radiated harmonics and other spurious emissions are examined for this requirement. See paragraph 2.10 of the test report.

2.8 Transmitter Duty Cycle (CFR 15.35 (c), RSS-Gen 6.10)

When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification.

In this case, no duty cycle correction factor was used.

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
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IC:	11898A-10000616
Test Report Number:	20-0146
Issue Date:	July 31, 2020
Customer:	Matrix Design Group, LLC.
Model:	MX3-IZ

2.9 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207, RSS-Gen 8.8)

Table 5. Transmitter Power Line Conducted Emissions Test Data, Par	t 15.207
150 kHz to 30 MHz	

		150	kHz to 30 MHz	Z			
Т	est: FCC Part 1	Client: Ma	atrix Design G	roup, LLC.			
	Project: 2	20-0146		Γ	Model: MX3-IZ		
Frequency (MHz)	• •		Results (dBuV)	AVG Limits (dBuV)	Margin (dB)	Detector PK, QP, or AVG	
		120 Va	c / 60 Hz, Pha	ise			
0.1523	32.12	0.08	32.20	55.9	23.7	PK	
0.7525	29.68	0.23	29.91	46.0	16.1	PK	
1.9066	29.47	0.29	29.76	46.0	16.2	PK	
5.7166	29.98	0.31	30.29	50.0	19.7	PK	
12.0830	38.39	0.67	39.06	50.0	10.9	PK	
18.1330	37.80	0.95	38.75	50.0	11.3	PK	
24.1830	37.14	1.19	38.33	50.0	11.7	PK	
		120 Va	c / 60 Hz, Neu	tral			
0.1815	30.19	0.13	30.32	54.4	24.1	PK	
0.7983	31.00	0.08	31.08	46.0	14.9	PK	
1.1333	29.80	0.51	30.31	46.0	15.7	PK	
6.6666	30.39	0.47	30.86	50.0	19.1	PK	
18.0830	35.23	1.31	36.54	50.0	13.5	PK	
20.0000	33.21	1.45	34.66	50.0	15.3	PK	

Sample Calculation at: 0.1523 MHz

Magnitude of Measured Frequency	32.12	dBuV
+Antenna Factor + Cable Loss	0.08	dB
Corrected Result	32.20	dBuV/m

Test Date: July 20, 2020

Tested By	111.	
Signature: _	wan Mu	Name: <u>Mark Afroozi</u>

 US Tech Test Report:
 FCC Part 15 Certification/ RSS 210

 FCC ID:
 USKCTRL-10000616

 IC:
 11898A-10000616

 Test Report Number:
 20-0146

 Issue Date:
 July 31, 2020

 Customer:
 Matrix Design Group, LLC.

 Model:
 MX3-IZ

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d), RSS-247, 5.1,5.5)

For measurements of radiated spurious emissions, the EUT was placed into a continuous transmit mode of operation (>98% or max level possible duty cycle) and tested per ANSI C63.10:2013. The EUT was tested in three orthogonal positions to find the maximum emission position.

Radiated emissions were evaluated between the frequency range of 9 kHz (or lowest frequency used/generated by the device) up to the tenth harmonic of the device (not greater than 40 GHz). In the band below 150 kHz, a resolution bandwidth (RBW) of 200 Hz was used. In the band from 150 kHz to 30 MHz, a RBW of 9 kHz was used. Emissions below 1 GHz were tested with a RBW of 120 kHz and emissions above 1 GHz were tested with a RBW of 1 MHz. All video bandwidth settings were at least three times the RBW value.

The EUT was investigated per CFR 15.209, general requirements for unwanted spurious emissions. The conducted spurious method as described below was used to investigate all other emissions radiating from the antenna port.

2.10.1 Fundamental and Harmonic Emissions

Table 0. A	veraye na	adiated Funda		паппопіс	LIIIISSIOIIS		
Test: FCC Part 15, Para 15.209, 15.247(d)				Clie	ent: Matrix Desi	gn Group, L	LC.
	Projec	:t: 20-0146			Model: M	X3-IZ	
Frequency (MHz)	Test Data (dBuv)	AF+CA-AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
			Ch 0 – L	_ow			
2405	69.52	31.31	100.83		3.0m/HORZ		AVG
4810	41.67	4.03	45.70	54.0	3.0m/HORZ	8.3	AVG
7215	51.58	10.41	* 52.49	54.0	1.0m/HORZ	1.5	AVG
9620	47.35	9.67	* 47.52	54.0	1.0m/HORZ	6.5	AVG
			Ch 9 – I	Mid			
2450	66.56	31.35	97.91		3.0m/HORZ		AVG
4900	42.25	4.34	46.59	54.0	3.0m/HORZ	7.4	AVG
7350	53.06	9.48	* 53.04	54.0	3.0m/HORZ	1.0	AVG
9800	50.84	9.88	* 51.22	54.0	3.0m/HORZ	2.8	AVG
	Ch 13 – High						
2470	72.10	31.26	103.36		3.0m/HORZ		AVG
4940	42.54	5.91	48.45	54.0	3.0m./HORZ	5.6	AVG
7410	47.77	11.83	50.10	54.0	1.0m./HORZ	3.9	AVG
9880	51.98	10.95	53.43	54.0	1.0m./HORZ	0.6	AVG
12350	40.09	12.25	42.84	54.0	1.0m./HORZ	11.2	AVG

Table 6. Average Radiated Fundamental & Harmonic Emissions

*Measurements taken above 6 GHz are performed at a distance of 1m (vs. 3m). This correction includes an additional factor of -9.5 dB to account for this change.

1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

2. The EUT was placed in its normal operating position and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98% or max level possible. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the table above represents worst case emissions.

Sample Calculation at 2405 MHz:

Magnitude of Measured Frequency	69.52	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	31.31	dB/m
Corrected Result	100.83	dBuV/m

Test Date: March 25, 2020

ul Fazal Tested By Signature:

Name: Afzal Fazal

Test: FCC Part 15, Para 15.209, 15.247(d)			Client: Matrix Design Group, LLC.				
	Projec	:t: 20-0146			Model: M	X3-IZ	
Frequency (MHz)	Test Data (dBuv)	AF+CA-AMP (dB/m)	Results (dBuV/m)	Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector Mode
			Ch 0 – L	_ow			
2405	79.53	31.31	110.84		3.0m./HORZ		PK
4810	55.03	4.03	59.06	74.0	3.0m./HORZ	14.9	PK
7215	67.14	10.41	* 68.05	74.0	3.0m./HORZ	6.0	PK
9620	64.17	9.67	* 64.34	74.0	1.0m./HORZ	9.7	PK
			Ch 9 – I	Mid	•		•
2450	77.42	31.35	108.77		3.0m./HORZ		PK
4900	56.25	4.34	60.59	74.0	3.0m./HORZ	13.4	PK
7350	68.55	9.48	* 68.53	74.0	3.0m./HORZ	5.5	PK
9800	66.81	9.88	* 67.19	74.0	1.0m./HORZ	6.8	PK
	Ch 13 – High						
2470	82.47	31.26	113.73		3.0m./HORZ		PK
4940	55.89	5.91	61.80	74.0	3.0m./HORZ	12.2	PK
7410	63.44	11.83	65.77	74.0	1.0m./HORZ	8.2	PK
9880	68.58	10.95	70.03	74.0	1.0m./HORZ	4.0	PK
12350	55.82	12.25	42.84	54.0	1.0m./HORZ	11.2	AVG

Table 7. Peak Radiated Fundamental & Harmonic Emissions

*Measurements taken above 6 GHz are performed at a distance of 1m (vs. 3m). This correction includes an additional factor of -9.5 dB to account for this change.

1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic

2. The EUT was placed in its normal operating position and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98% or max level possible. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at 2405 MHz:

Magnitude of Measured Frequency	79.53	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	31.31	dB/m
Corrected Result	110.84	dBuV/m

Test Date: March 25, 2020

zal Fazal **Tested By** Signature:

Name: Afzal Fazal

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
FCC ID:	USKCTRL-10000616
IC:	11898A-10000616
Test Report Number:	20-0146
Issue Date:	July 31, 2020
Customer:	Matrix Design Group, LLC.
Model:	MX3-IZ

2.10.2 Spurious Emissions other than Fundamental and Harmonics

The EUT was placed into a mode representative of normal operation and spurious emissions measurements were performed. The antenna port was terminated with a 50 ohm load during testing.

Table 8. Intentional Radiator, Spurious Radiated Emissions (CFR 15.209), 9 kHz to 30 MHz

9 kHz to 30 MHz							
Test: FCC Part 15, Para 15.209Client: Matrix Design Group, LLC.							
Project: 20-0146 Model: MX3-IZ							
Frequency (MHz)	Test Data (dBuv)	AF+CA-AMP (dB/m)	Results (dBuV/m)	Limite Distance/			
15.75	49.87	5.22	55.09	69.5	3.0 m	14.5	PK
24.27 42.23 1.96 44.19 69.5 3.0 m 25.4 PK							
All other emissions detected were attenuated more than 20 dB below the applicable limits.							

SAMPLE CALCULATION at 15.75 MHz:

Magnitude of Measured Frequency	49.87	dBuV
+ Cable Loss+Antenna Factor - Amp Gain	5.22	dB
Corrected Result	55.09	dBuV

Test Date: July 9, 2020

Tested By	1/1	
Signature: _	man Mi	Name <u>: Mark Afroozi</u>

Table 9. Intentional Radiator, Spurious Radiated Emissions (CFR 15.209), 30 MHz to 1000 MHz

	30 MHz to 1000 MHz with Class B Limits							
Τe	Test: FCC Part 15, Para 15.209Client: Matrix Design Group, LLC.						LC.	
Project: 20-0146				Model: M	X3-IZ			
Frequency (MHz)	Test Data (dBuv)	AF+CA-AMP (dB/m)	Results (dBuV/m)	Sults Limits Distance/ Margin			Detector PK, or QP	
97.25	45.88	-16.14	29.74	43.5	3m./HORZ	13.8	PK	
97.14	51.10	-15.04	36.06	43.5	3m./VERT	7.4	PK	
132.75	46.19	-13.62	32.57	43.5	3m./HORZ	10.9	PK	
196.48	47.67	-10.13	37.54	43.5	3m./HORZ	6.0	PK	
266.75	55.44	-12.47	42.97	46.0	3m./HORZ	3.0	QP	
392.83	47.90	-9.18	38.72	46.0	3m./HORZ	7.3	QP	
700.02	42.74	-2.06	40.68	46.0	3m./HORZ	5.3	QP	
799.86	44.33	-1.76	42.57	46.0	3m./HORZ	3.4	QP	

SAMPLE CALCULATION at 97.25 MHz:

Magnitude of Measured Frequency	45.88	dBuV
+ Cable Loss+Antenna Factor - Amp Gain	-16.14	dB
Corrected Result	29.74	dBuV

Test Date: July 29, 2020

Tested By Signature: 0.44

Name: Mark Afroozi

Table 10. Intentional Radiator, Spurious Radiated Emissions (CFR 15.209), 1 GHz to 12.5 GHz

	1 GHz to 12.5 GHz with Class B Limits						
Te	Test: FCC Part 15, Para 15.209Client: Matrix Design Group, LLC.						
Project: 20-0146					Model: M	X3-IZ	
Frequency (MHz)Test Data (dBuv)AF+CA-AMP (dB/m)Results (dBuV/m)AVG LimitsAntenna Distance/ (dBuV/m)Margin (dB)				Detector PK, or AVG			
1067.03	57.05	-10.94	46.11	54.0	3.0m./HORZ	7.9	PK
1333.17	54.92	-9.89	45.03	54.0	3.0m./HORZ	9.0	PK
2330.67	32.75	-6.10	26.65	54.0	3.0m./HORZ	27.3	AVG
3514.00	45.65	-0.93	44.72	54.0	3.0m./HORZ	9.3	PK
AI	All other emissions detected were more than 20 dB below the applicable limits.						

SAMPLE CALCULATION at 1067.03 MHz:

Magnitude of Measured Frequency	57.05	dBuV
+ Cable Loss+Antenna Factor - Amp Gain	-10.94	dB
Corrected Result	46.11	dBuV

Test Date: March 25, 2020

Tested By

al Fazal Signature:

Name: Afzal Fazal

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
FCC ID:	USKCTRL-10000616
IC:	11898A-10000616
Test Report Number:	20-0146
Issue Date:	July 31, 2020
Customer:	Matrix Design Group, LLC.
Model:	MX3-IZ

2.10.3 Conducted Spurious Emissions

Conducted Spurious measurements: The EUT was put into a continuoustransmit mode of operation (>98% or max level possible duty cycle) and tested per ANSI C63.10-2013 for conducted out of band emissions emanating from the antenna port over the frequency range of 9 kHz or lowest operating clock frequency to ten times the highest operating clock frequency. A conducted scan was performed on the EUT to identify and record the spurious signals that were related to the transmitter.

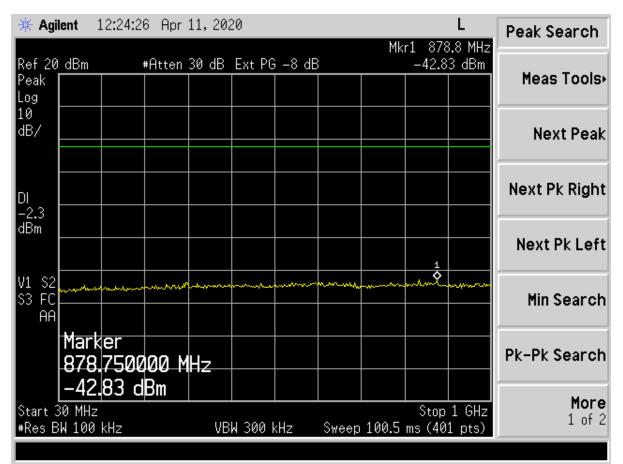


Figure 3. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz

🔆 Agilent	12:23:16 Apr :	11,2020		L	Peak Search
Ref 20 dBm Peak Log	#Atten	30 dB Ext PG	Mki 3 dB	1 25.00 GHz -31.12 dBm	Meas Tools•
10 dB/					Next Peak
DI					Next Pk Right
VI S2	n mun hn	han	manna		Next Pk Left
S3 FC	llor				Min Search
25.	ker 000000000 1.12 dBm	GHz			Pk-Pk Search
Start 1 GHz #Res BW 1 N		VBW 3 MHz	Sweep 240	Stop 25 GHz ms (401 pts)	More 1 of 2

Figure 4. Conducted Spurious Emissions, Low Channel, 1 – 25 GHz

Note: Large emission seen is the fundamental frequency.

	Peak Search
Mkr1 973.3 MHz Ref 20 dBm #Atten 30 dB Ext PG -8 dB -44.06 dBm Peak Log	Meas Tools•
10 dB/	Next Peak
-2.7	Next Pk Right
dBm	Next Pk Left
V1 S2 S3 FC AA	Min Search
Marker 973.325000 MHz -44.06 dBm	Pk-Pk Search
Start 30 MHz Stop 1 GHz #Res BW 100 kHz VBW 300 kHz Sweep 100.5 ms (401 pts)	More 1 of 2

Figure 5. Conducted Spurious Emissions Mid Channel, 30 MHz – 1 GHz

🔆 Agilent 12:16:43 Apr	11,2020	L	Peak Search
Ref 20 dBm #Atten 3	30 dB Ext PG —8 dB	Mkr1 23.74 GHz -32.03 dBm	
Peak Log			Meas Tools+
10 dB/			Next Peak
DI			Next Pk Right
dBm	man and the second		Next Pk Left
V1 S2 S3 FC AA			Min Search
Marker 23.740000000	GHz		Pk-Pk Search
-32.03 dBm Start 1 GHz #Res BW 1 MHz	VBW 3 MHz Swee	Stop 25 GHz p 240 ms (401 pts)	More 1 of 2

Figure 6. Conducted Spurious Emissions Mid Channel, 1 – 25 GHz

Note: Large emission seen is the fundamental frequency.

🔆 Agile	ent 12:27:46 A	pr 11, 2020		L Mkr1 842.4 MHz	Peak Search
Ref 20 Peak Log	dBm #Att	en 30 dB Ext P	G8 dB	-43.44 dBm	Meas Tools⊦
10 dB/					Next Peak
DI -2.2					Next Pk Right
dBm -				1	Next Pk Left
V1 S2 S3 FC AA	and the second		- marine - M - Marine - Ma	ala and a second and	Min Search
	Marker 842.375000	MHz			Pk-Pk Search
Start 30	-43,44 dBm 0 MHz √ 100 kHz	VBW 300	kHz Sweep	Stop 1 GHz 100.5 ms (401 pts)	More 1 of 2

Figure 7. Conducted Spurious Emissions High Channel, 30 MHz – 1 GHz

🔆 Agilent	12:26:38 Apr 3	11,2020			L Peak Search
Ref 20 dBm Peak Log	#Atten 3	30 dB Ext P(G -8 dB	Mkr1 25.0 31.28	0 GHz dBm Meas Tools∙
10 dB/					Next Peak
DI					Next Pk Right
۵۵m ۱۹۹۳ ۷1 S2	m m m m m m m m m m m m m m m m m m m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	man	-	Next Pk Left
S3 FC AA Mar	tor				Min Search
25.	000000000 L.28 dBm	GHz			Pk-Pk Search
Start 1 GHz #Res BW 1 M		VBW 3 M	Hz Swe	Stop 25 ep 240 ms (401	

Figure 8. Conducted Spurious Emissions High Channel, 1 – 25 GHz

Note: Large emission seen is the fundamental frequency.

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
FCC ID:	USKCTRL-10000616
IC:	11898A-10000616
Test Report Number:	20-0146
Issue Date:	July 31, 2020
Customer:	Matrix Design Group, LLC.
Model:	MX3-IZ

2.11 Band Edge Measurements (CFR 15.247(d), RSS-247, 5.5)

Band edge measurements were made following the guidelines in ANSI 63.10-2013 for the DTS device with the EUT initially operating on the lowest channel and then operating on the highest channel within its band of operation. Radiated measurements are performed for each antenna to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB when compared to its highest in-band value (contained in a 100 kHz band).

To capture the band edge, set the spectrum analyzer frequency span large enough (usually around 2 MHz) to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. Radiated measurements are performed with RBW = 100 kHz. The VBW is set \geq RBW. See figure and calculations below for more detail.

FCC Part 15 Certification/ RSS 210 USKCTRL-10000616 11898A-10000616 20-0146 July 31, 2020 Matrix Design Group, LLC. MX3-IZ

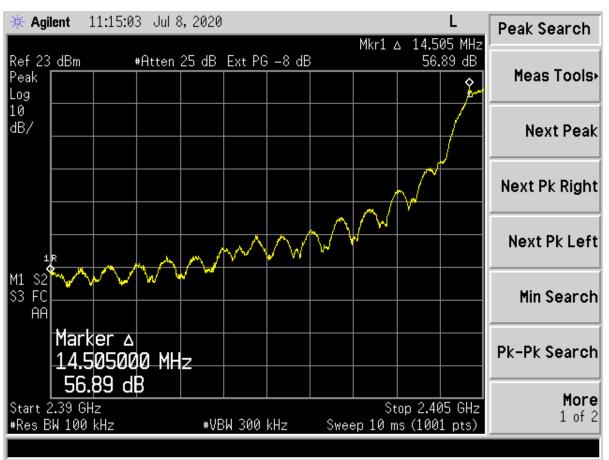


Figure 9. Band Edge Compliance, Low Channel Marker-Delta Method

Measured Delta (from Figure 11)	56.89	dBm
Limit (20 dB from fundamental)	20.00	dBm
Band Edge Margin	36.89	dB

Test Date: July 8, 2020

Tested by: Signature:

Name: Mark Afroozi

FCC Part 15 Certification/ RSS 210 USKCTRL-10000616 11898A-10000616 20-0146 July 31, 2020 Matrix Design Group, LLC. MX3-IZ

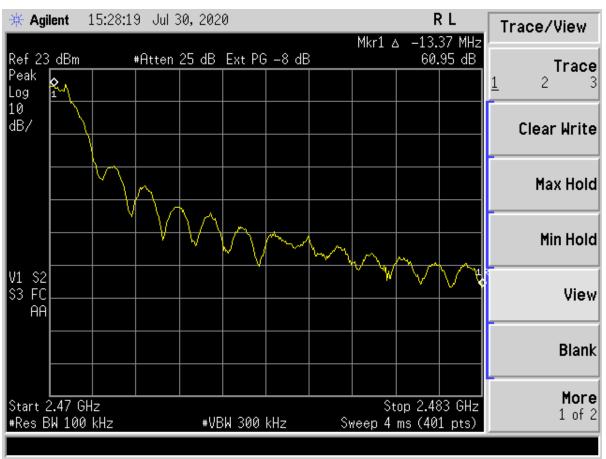


Figure 10. Band Edge Compliance, High Channel Marker-Delta Method

Measured Delta (from Figure 13)	60.95	dBm
Limit (20 dB from fundamental)	20.00	dBm
Band Edge Margin	40.95	dB

Test Date: July 30, 2020

Tested by: Signature:

Name: Mark Afroozi

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
FCC ID:	USKCTRL-10000616
IC:	11898A-10000616
Test Report Number:	20-0146
Issue Date:	July 31, 2020
Customer:	Matrix Design Group, LLC.
Model:	MX3-IZ

2.12 99% and 20 dB Bandwidth (CFR 15.247(a)(1)(i), RSS-Gen 6.6)

These measurements were performed while the EUT was in a constant transmit mode. The RBW was set to 100 kHz and with the VBW \geq RBW. The results of this test are given in Table and Figures following.

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Table 11. Occupied Bandwidth (99% & 20 dB)

Frequency (MHz)	6 dB Bandwidth (MHz)	CFR 15.247(a)(1)(i) Minimum Limit (MHz)	99% Occupied Bandwidth (MHz)
2405	1.642	0.500	2.758
2450	1.633	0.500	3.114
2470	1.678	0.500	3.301

Test Date: July 30, 2020 Tested by: Signature: nu

Name: Mark Afroozi

Test Date: April 11, 2020 Tested by:

il Fazal Signature:

Name: Afzal Fazal

★ Agilent 13:38:28 Apr 11, 2020	Meas Setup
Ch Freq 2.405 GHz Trig Free Occupied Bandwidth	Avg Number 10 On Off
Span 6.000000000 MHz Ref 20 dBm #Atten 30 dB Ext PG -8 dB	Avg Mode Exp Repeat
*Peak Log 10	0n Max Hold
dB/	Occ BW % Pwr 99.00 %
Center 2.405 GHz Span 6 MHz #Res BW 300 kHz VBW 1 MHz Sweep 5 ms (401 pts)	OBW Span 6.00000000 MHz
Occupied Bandwidth Осс ВИ % Рыг 99.00 % 2.7580 MHz × dB -6.00 dB	x dB -6.00 dB
Transmit Freq Error -102.895 kHz × dB Bandwidth 1.642 MHz	Optimize Ref Level

Figure 11. 99% & 6 dB Bandwidth – Low Channel

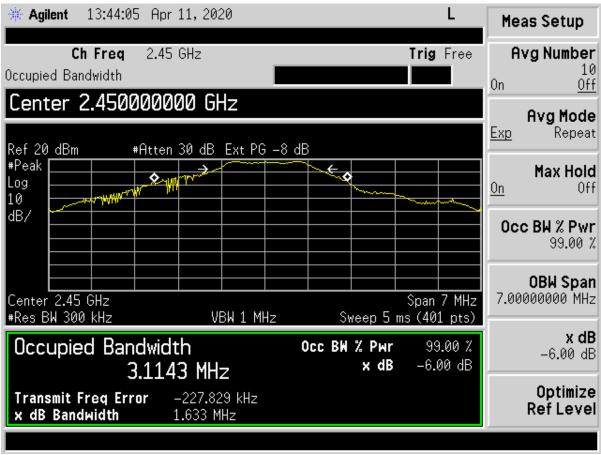


Figure 12. 99% & 6 dB Bandwidth – Mid Channel

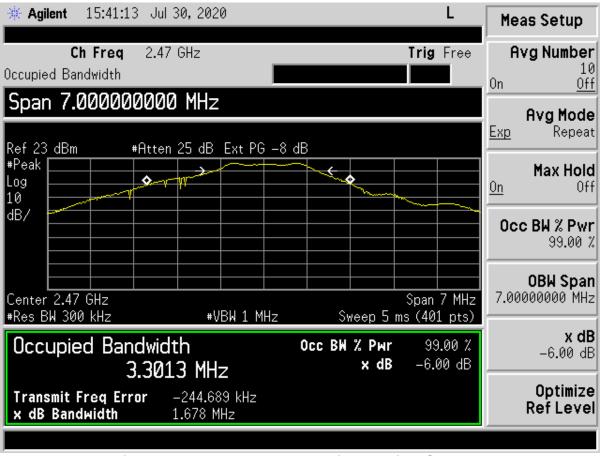


Figure 13. 99% & 6 dB Bandwidth – High Channel

US Tech Test Report:	FCC Part 15 Certification/ RSS 210
FCC ID:	USKCTRL-10000616
IC:	11898A-10000616
Test Report Number:	20-0146
Issue Date:	July 31, 2020
Customer:	Matrix Design Group, LLC.
Model:	MX3-IZ

2.13 Maximum Peak Conducted Output Power (CFR 15.247(b)(1), RSS-247 5.1)

Peak power within the band 902 - 928 MHz was measured per ANSI C63.10-2013 as an Antenna Conducted test with a spectrum analyzer. For these measurements the EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. An 8 dB attenuator was used at the RF input port of the spectrum analyzer and attenuator loss was accounted for. Peak antenna conducted output power is tabulated in the table below.

Table 12. Peak Antenna Conducted Output Power per Part 15.247 (b) (2)

Frequency of Fundamental (MHz)	Raw Test Data dBm	Converted Data (mW)	FCC Limit (mW Maximum)
2405	17.86	61.094	1000
2450	17.96	62.517	1000
2470	18.84	76.560	1000

Test Date: July 8, 2020 Tested by: Signature: ___

Name: Mark Afroozi

Test Date: April 11, 2020 Tested by:

Facul Signature:

Name: Afzal Fazal

** Agilent 13:20:19 Apr	11,2020	L	Peak Search
Ref 20 dBm #Atten Peak Log	30 dB Ext PG -8 dB	Mkr1 2.40535 GHz 17.86 dBm	Meas Tools•
10 dB/			Next Peak
WW			Next Pk Right
			Next Pk Left
V1 S2 S3 FC AA			Min Search
Marker 2.405350000 17.86 dBm	GHz		Pk-Pk Search
Center 2.405 GHz #Res BW 3 MHz	VBW 3 MHz	Span 20 MHz Sweep 4 ms (401 pts)	More 1 of 2

Figure 14. Peak Antenna Conducted Output Power, Low Channel

🔆 Agi	lent (13:18:3	8 Apr	11,202	20				0.454	L	Peak Search
Ref 20 Peak Log	dBm		#Atten	30 dB	Ext PG	-8 dE	3	Mkr1)30 GHz 96 dBm	Meas Tools•
10 dB/											Next Peak
											Next Pk Right
											Next Pk Left
V1 S2 S3 FC AA											Min Search
		0300	1000 D	GHz							Pk-Pk Search
	⊥7. ∵2.45 (3₩ 3 MH		BW	VI	BW 3 M	 Hz	SI	veep 4		 20 MHz)1 pts)	More 1 of 2
ļ											

Figure 15. Peak Antenna Conducted Output Power, Mid Channel

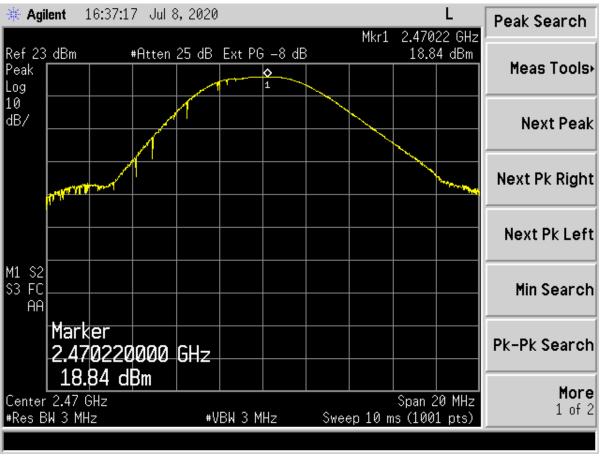


Figure 16. Peak Antenna Conducted Output Power, High Channel

2.14 Power Spectral Density (CFR 15.247(e))

The transmitter was placed into a continuous mode of operation at all applicable frequencies. The measurements were performed per the procedures of ANSI C63.10-2013. The RBW was set to 3 kHz and the Video Bandwidth was set to \geq RBW. The trace capture time was set to (Span/3 kHz).

In accordance with 15.247 (e), the power spectral density shall be no greater than +8 dBm per any 3 kHz band.

Results are shown in the table and figures below. All are less than +8 dBm per 3 kHz band.

Note: dBm/Hz correct to dBm/kHz using the following formula, 10 log $RBW_{ref}/RBW_{measured}$.

Frequency (MHz)	Results (dBm/3 kHz)	FCC Limit (dBm/3 kHz)
2405	4.77	8.00
2450	5.89	8.00
2470	6.12	8.00

Table 13. Power Spectral Density (CFR 15.247(e))

Test Date: July 8, 2020 Tested by:	
Signature:	Name: <u>Mark Afroozi</u>
Test Date: April 11, 2020 Tested by:	

Signature: <u>Abul Faral</u>

Name: Afzal Fazal

₩ Agilent 13:56:16 Apr 11, 2020 L	Peak Search
Ch Freq 2.405 GHz Trig Free Channel Power	Meas Tools•
Marker 2.405090000 GHz Mkr1 2.4050900 GHz Ref 20 dBm #Atten 30 dB Ext PG -8 dB 4.769 dBm	Next Peak
*Peak Log	Next Pk Right
	Next Pk Left
Center 2.405 GHz Span 3 MHz #Res BW 3 kHz #VBW 30 kHz Sweep 334.4 ms (401 pts)	Min Search
Channel Power Power Spectral Density	Pk-Pk Search
22.32 dBm /2.0000 MHz -40.69 dBm/Hz	More 1 of 2

Figure 17. Power Spectral Density - Low Channel

★ Agilent 13:53:57 Apr 11, 2020	Peak Search
Ch Freq 2.45 GHz Trig Free Channel Power	Meas Tools+
Marker 2.450090000 GHz Mkr1 2.4500900 GHz Ref 20 dBm #Atten 30 dB Ext PG -8 dB 5.89 dBm	Next Peak
#Peak Log 10	Next Pk Right
	Next Pk Left
Center 2.45 GHz Span 3 MHz #Res BW 3 kHz VBW 10 kHz Sweep 343.1 ms (401 pts)	Min Search
Channel Power Spectral Density	Pk-Pk Search
22.80 dBm /2.0000 MHz -40.21 dBm/Hz	More 1 of 2

Figure 18. Power Spectral Density - Mid Channel

FCC Part 15 Certification/ RSS 210 USKCTRL-10000616 11898A-10000616 20-0146 July 31, 2020 Matrix Design Group, LLC. MX3-IZ

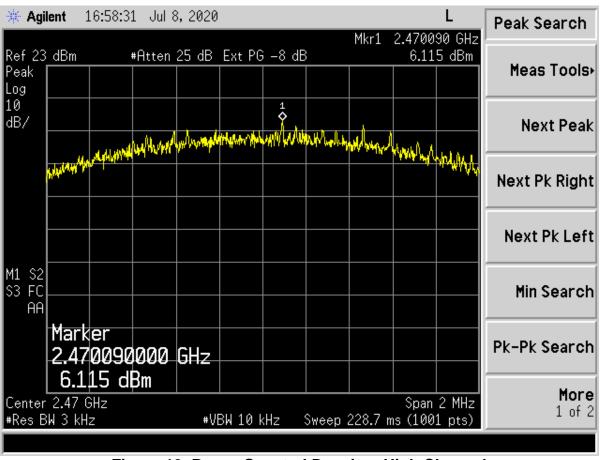


Figure 19. Power Spectral Density - High Channel

2.15 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2. A coverage factor of k=2 was used to give a level of confidence of approximately 95%. This value includes all elements of measurement.

2.15.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is \pm 2.85 dB.

2.15.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is \pm 5.40 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is \pm 5.19 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is \pm 5.08 dB.

3 Conclusions

The EUT meets the requirements of Part 15.247 and RSS-247 based on the test results presented in this test report.