Report on the FCC and ISED Testing of the

iKeyless, LLC
Model FDSSL-G000
FCC ID: X32-FDSSG000
IC: 8797A-FDSSG000

In accordance with:
CFR Title 47 FCC Part 15 §15.231
ISED Canada RSS-210

Prepared for: iKeyless, LLC
828 E. Market St
Louisville KY 40206 USA

America

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Document Number: NC72148666.1 | Issue: 2

SIGNATURE			
NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
James Morris	Service Line Manager, EMC Central	Authorized Signatory	27 June 2019

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD America, Inc. document control rules.

FCC Accreditation Designation Number US1148 New Brighton, MN Test Laboratory	Innovation, Science, and Economic Development Canada Accreditation Site Number 4512A New Brighton, MN Test Laboratory

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C §15.231, ISED RSS-210 Issue 9 (2016).

A2LA Cert. No. 2955.11

ACCREDITATION
Our A2LA Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our A2LA Accreditation.

Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Table 1.1-1 – Modification Record

Issue	Description of Change	Date of Issue
1	First Issue	16 May 2019
2	References to EUT height changed from 0.8 meters to 1.5 meters. Section 2.5.4 and Figure 4-2	27 June 2019

1.2 Introduction

Manufacturer	iKeyless, LLC
Applicant's Email Address	fluaire@ikeyless.com
Model Number(s)	FDSSL-G000
Serial Number(s)	n/a
Hardware Version(s)	n/a
Software Version(s)	n/a
Number of Samples Tested	4
Test Specification/Issue/Date	FCC 47 CFR Part 15C §15.231. Current as of May 1 2019 ISED RSS-210 Issue 9 August 2016
Order Number	72148666
Date	14 Apr 2019
Date of Receipt of EUT	24 Apr 2019
Start of Test	25 Apr 2019
Finish of Test	26 Apr 2019
Name of Engineer(s)	Greg Jakubowski

1.3 Summary of Results

A summary of the tests carried out in accordance with the specifications shown below.

Table 1.3-1 – Summary of Results

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 15C	RSS-210			
2.1	15.203		Antenna requirement	Pass	
2.2	15.207	8.8	Conducted Disturbance at Mains Terminals	Pass	ANSI C63.10: 2013
2.3	15.231(a)	A.1.1	Periodic operation	Pass	ANSI C63.10: 2013
2.4	15.231(c)	A.1.3	Occupied bandwidth	Pass	ANSI C63.10: 2013
2.5	15.231(b)	A.1.2	Radiated emissions	Pass	ANSI C63.10: 2013

1.4 Declaration of Build Status

EQUIPMENT DESCRIPTION	
Model Name/Number	FDSSL-G000
Part Number	n/a
Hardware Version	n/a
Software Version	n/a
FCC ID (if applicable)	FCC ID: X32-FDSSG000
ISED ID (if applicable)	IC: 8797A-FDSSG000
Technical Description (Please provide a brief description of the intended use of the equipment)	315 MHz intentional radiator. Key FOB.

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	**315 MHz (Intentional)**
Lowest frequency generated or used in the device or on which the device operates or tunes	125 kHz
Class B Digital Device (Use in commercial, industrial or business environment) ☐ Class B Digital Device (Use in residential environment only) ☐	

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	☐	☐	
External DC	Nominal Voltage		Maximum Current
Battery	Nominal Voltage		Battery Operating End Point Voltage
	3.3		n/a

EXTREME CONDITIONS
Maximum & minimum temperatures (Unspecified)

Ancillaries
Please list all ancillaries which will be used with the device.

1.5 Product Information

1.5.1 Technical Description

The Equipment Under Test (EUT) was a 315 MHz Key fob

A full description and detailed product specification details are available from the manufacturer.

See Separate Photo Exhibit

Figure 1.5.1-1 - Front View of the EUT

1.5.2 Modes of Operation

The tested modes of operation were with both ASK & FSK modulations and both normal or continuous pulse trains.

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

Table 1.7-1 – Modification Record

Modification State	Description of Modification	Modification Fitted By
1.7.1	PCB antenna replaced with short coax & an SMA connector for some specific conducted measurements.	Manufacturer

1.8 Test Location

TÜV SÜD conducted the following tests at our New Brighton, MN Test Laboratory.

141 14th Street NW
New Brighton, MN 55112 USA

2 Test Details

2.1 Antenna Requirements

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.203.
Equipment Under Test and Modification State As shown in §1.2

2.1.2 Conclusion

The antenna is a non-detachable PCB antenna therefore satisfying part 15.203. The antenna gain is -13.0 dBi.

2.2 Power Line Conducted Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 15C, §15.207
ISED RSS-210, Clause 8.8

2.2.2 Conclusion

The EUT is battery powered with no provisions to connect to the public mains. Therefore, no power line conducted emissions were performed.

2.3 Periodic Operation

2.3.1 Specification Reference

FCC 47 CFR Part 15C, §15.231(a)
ISED RSS-210, Clause A.1.1

2.3.2 Equipment Under Test and Modification State

As shown in §1.2 with modifications as shown in §1.7.

2.3.3 Date of Test

26 Apr 2019

2.3.4 Test Methodology

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

The transmitter was activated manually with a single button press. Pulse train characteristics were evaluated in the time domain using a spectrum analyzer in zero span and varied sweep times.

2.3.5 Environmental Conditions

The EUT was evaluated within the temperature and humidity range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient temperature range of 20°C to 40°C and humidity range of 30% to 80%.

2.3.6 Test Results

Pass:
The transmitter is automatically deactivated within 5 seconds of being released.
Detailed results with ASK modulation are shown in figures 2.3.6-1 through 2.3.6-6
Detailed results with FSK modulation are shown in figures 2.3.6-7 through 2.3.6-11

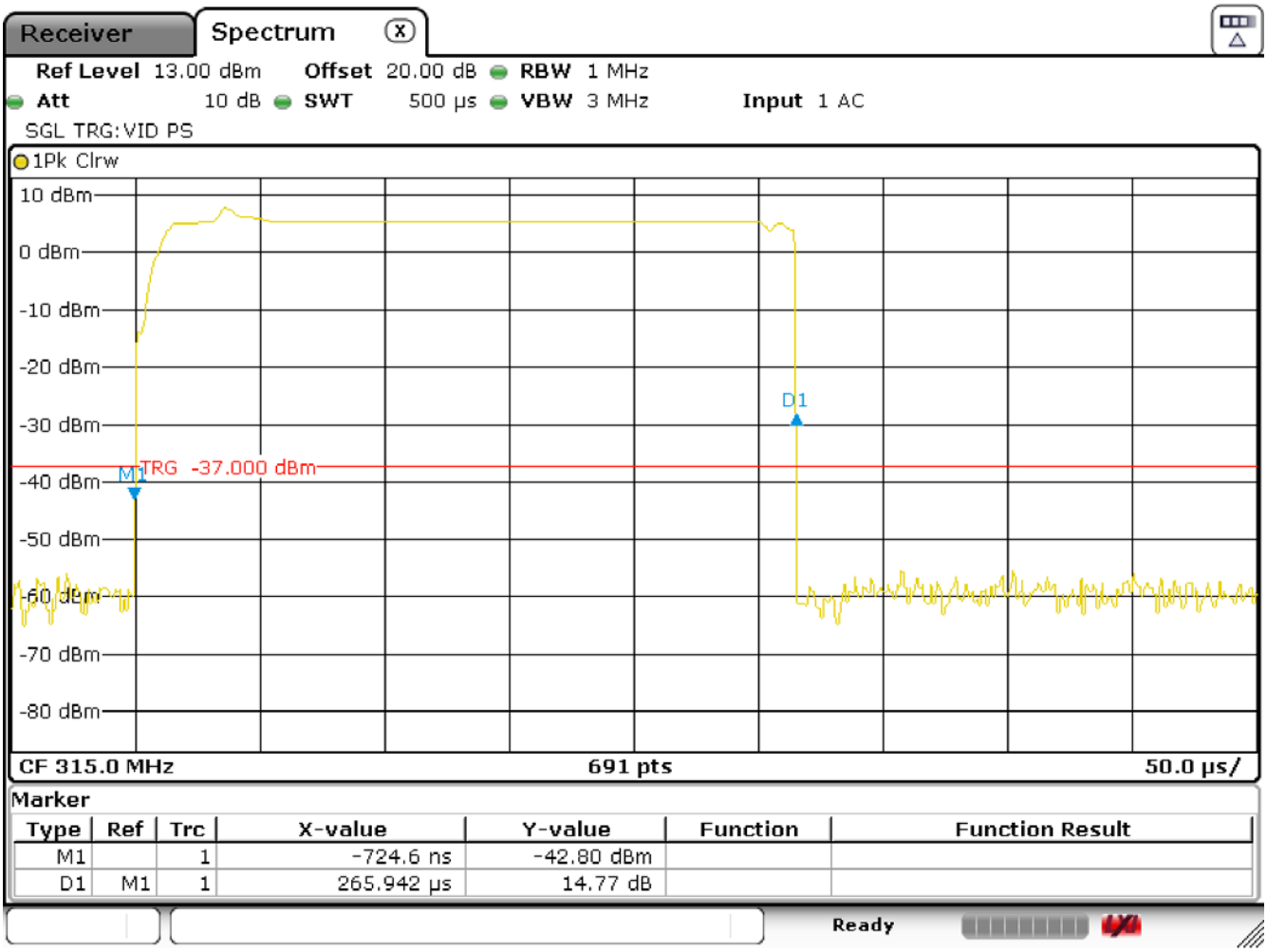

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Figure 2.3.6-1. 500 µs span. ASK modulation

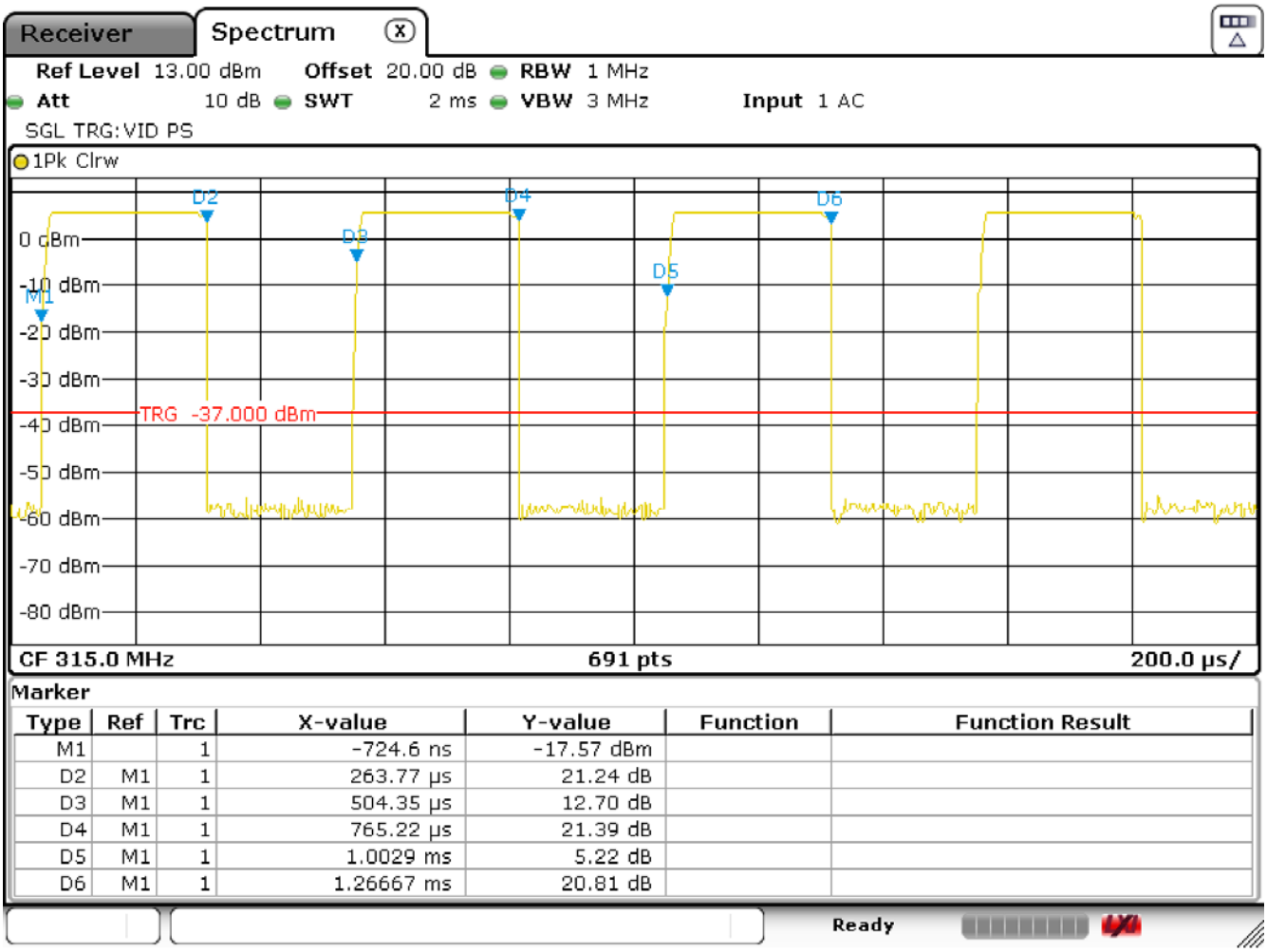

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Figure 2.3.6-2. 2 ms span. ASK modulation

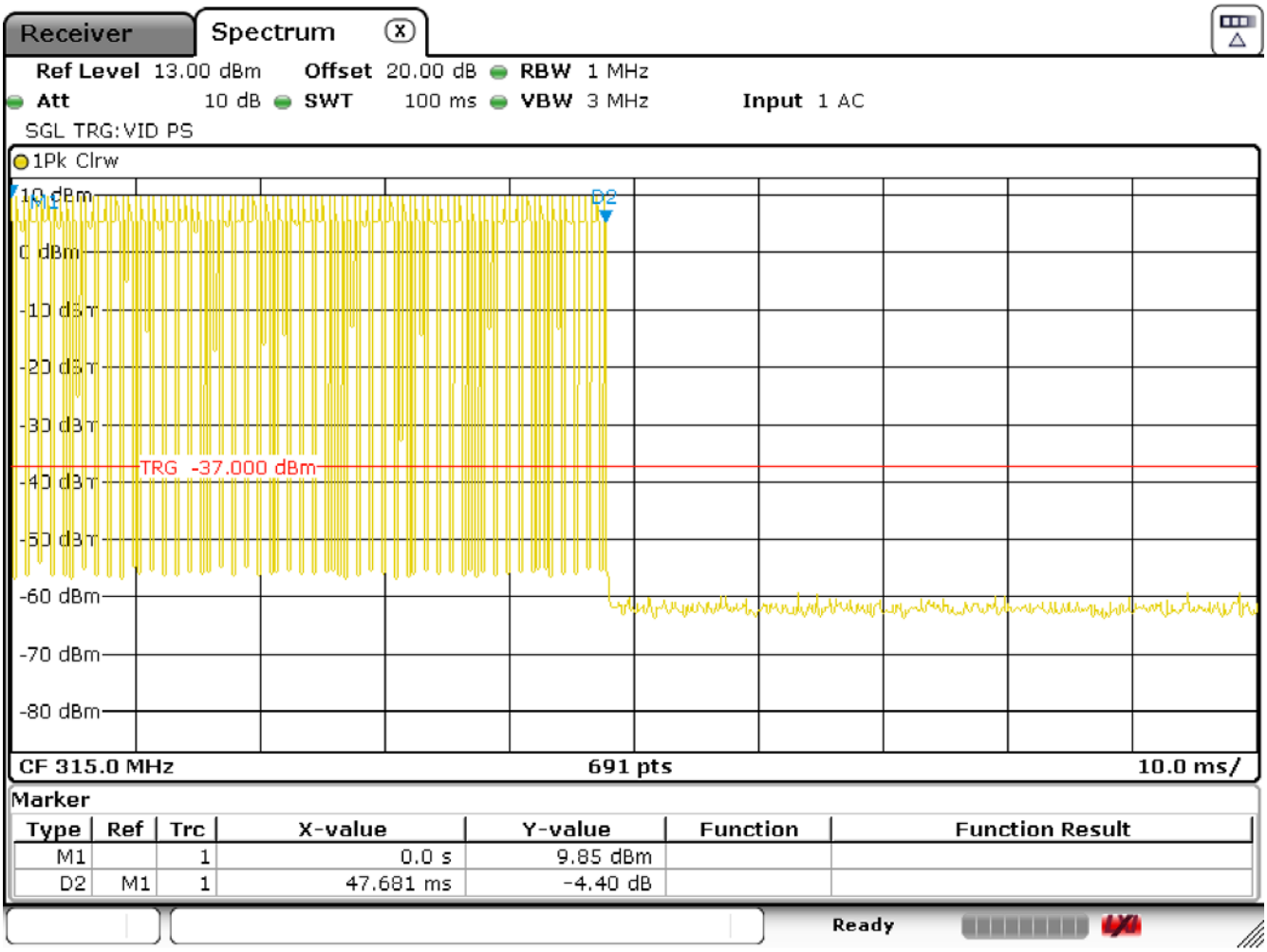

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Figure 2.3.6-3. 100 ms span. ASK modulation

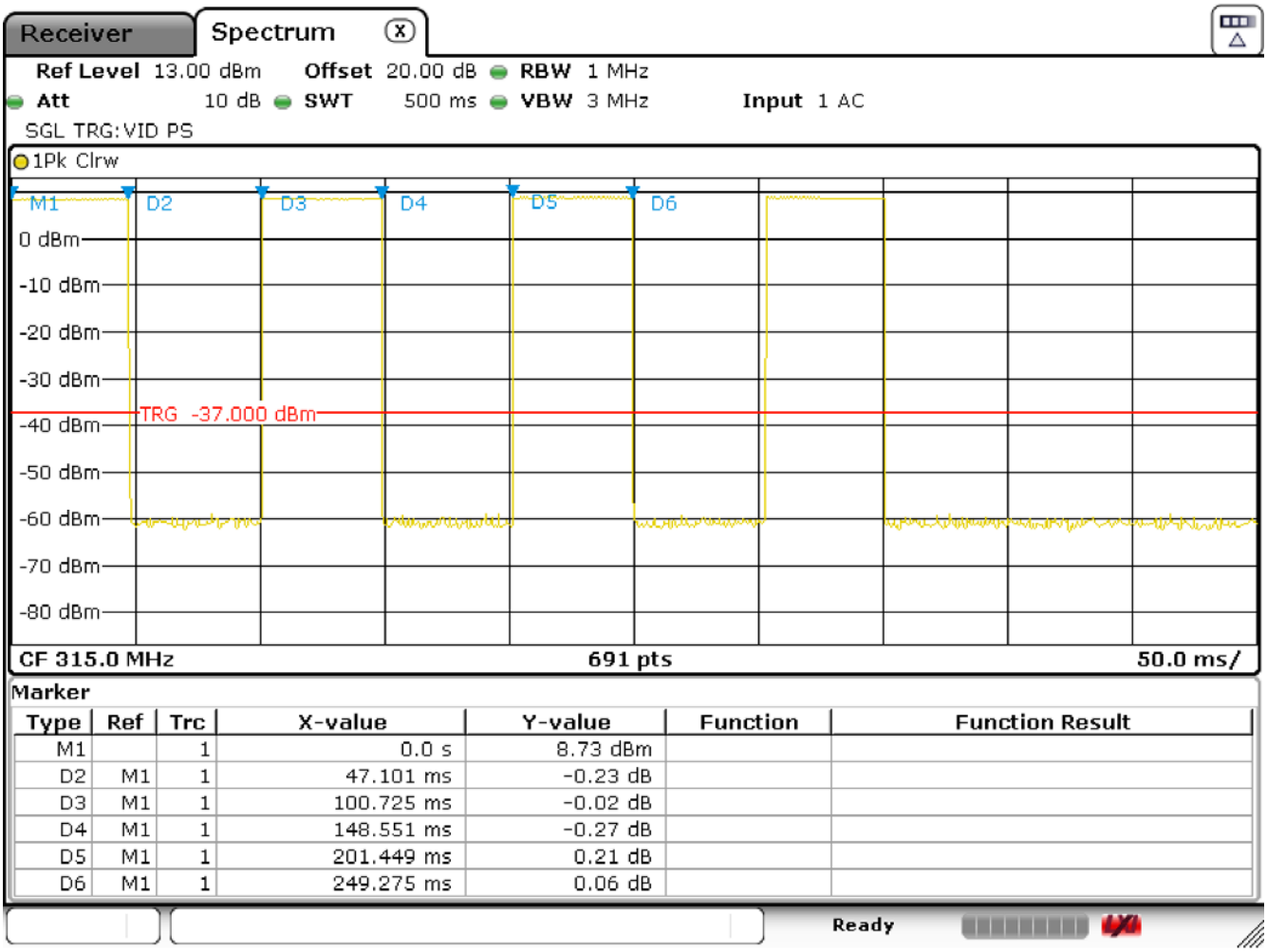

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Figure 2.3.6-4. 500 ms span. ASK modulation

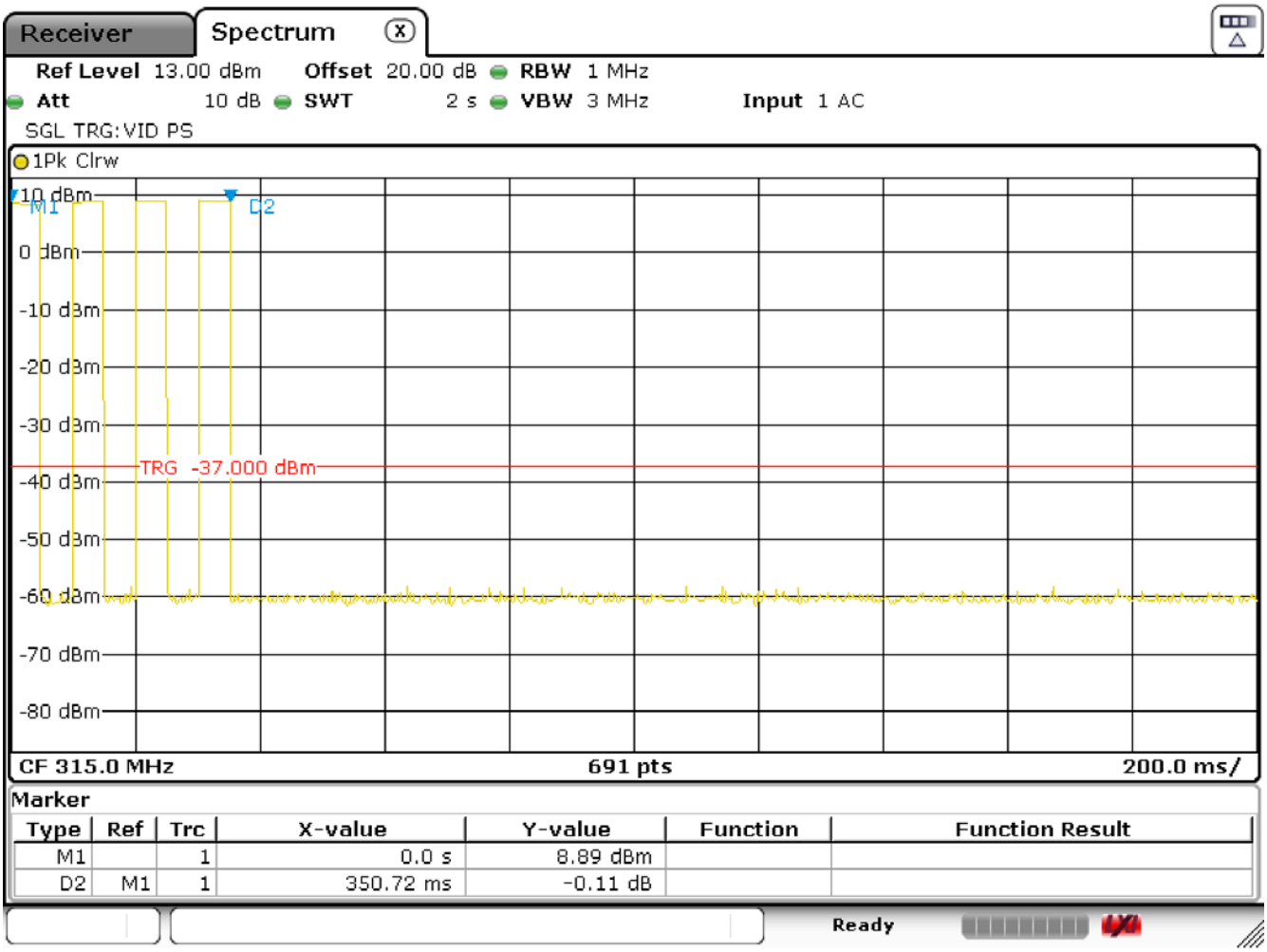

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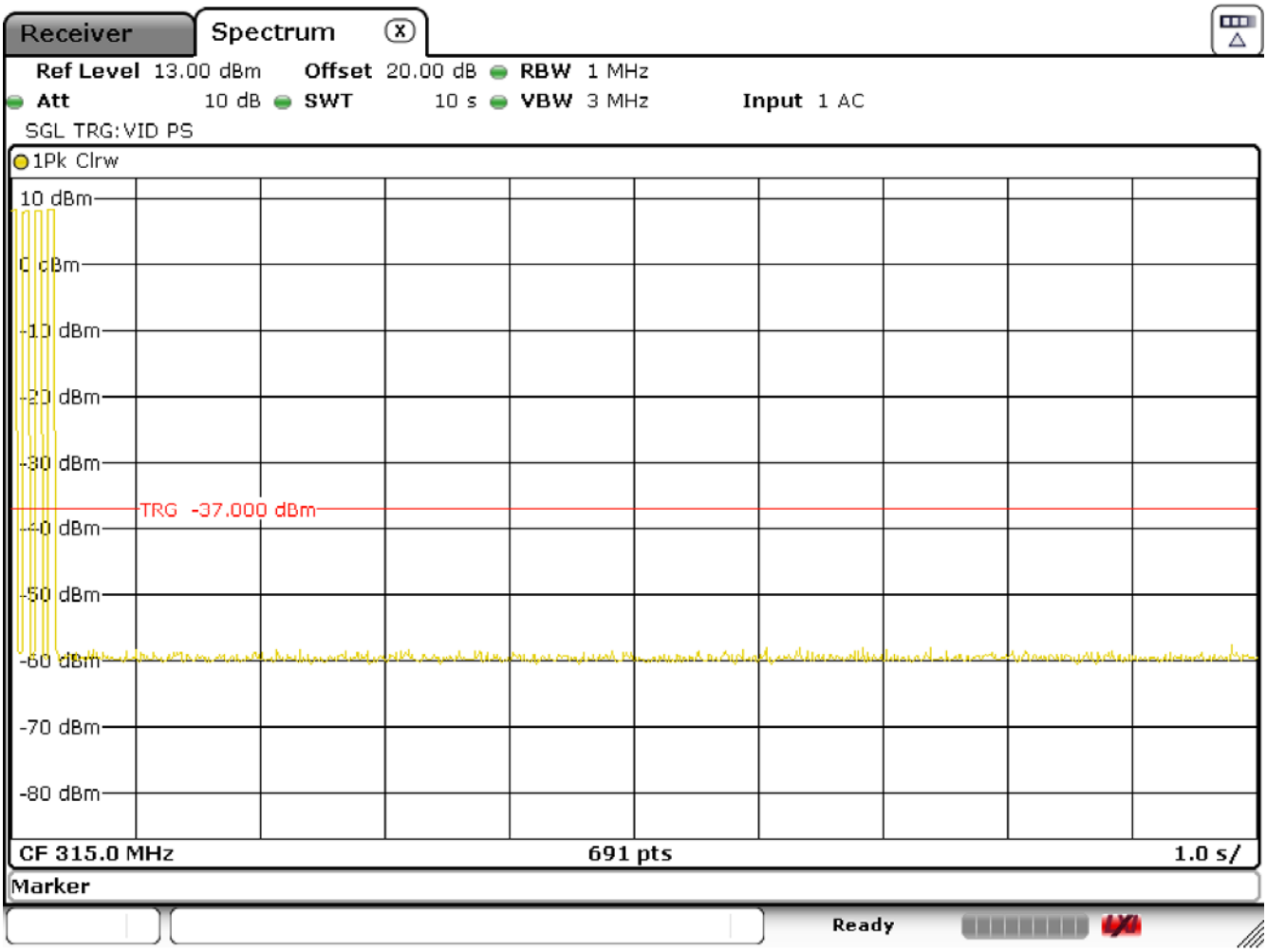
Figure 2.3.6-5. 2 s span. ASK modulation



Date: 26.APR.2019 12:54:25

Figure 2.3.6-6. 10 s span. ASK modulation

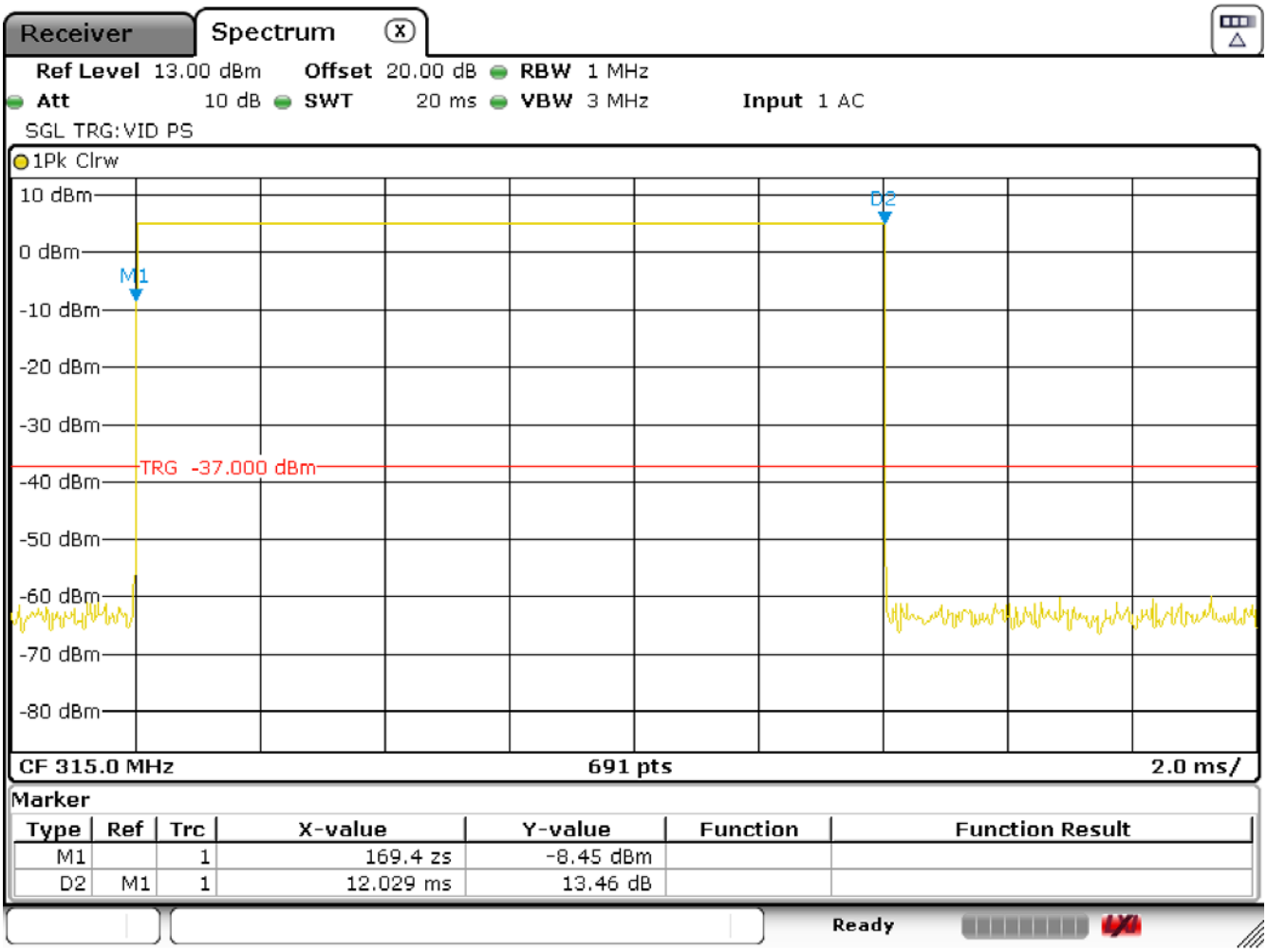


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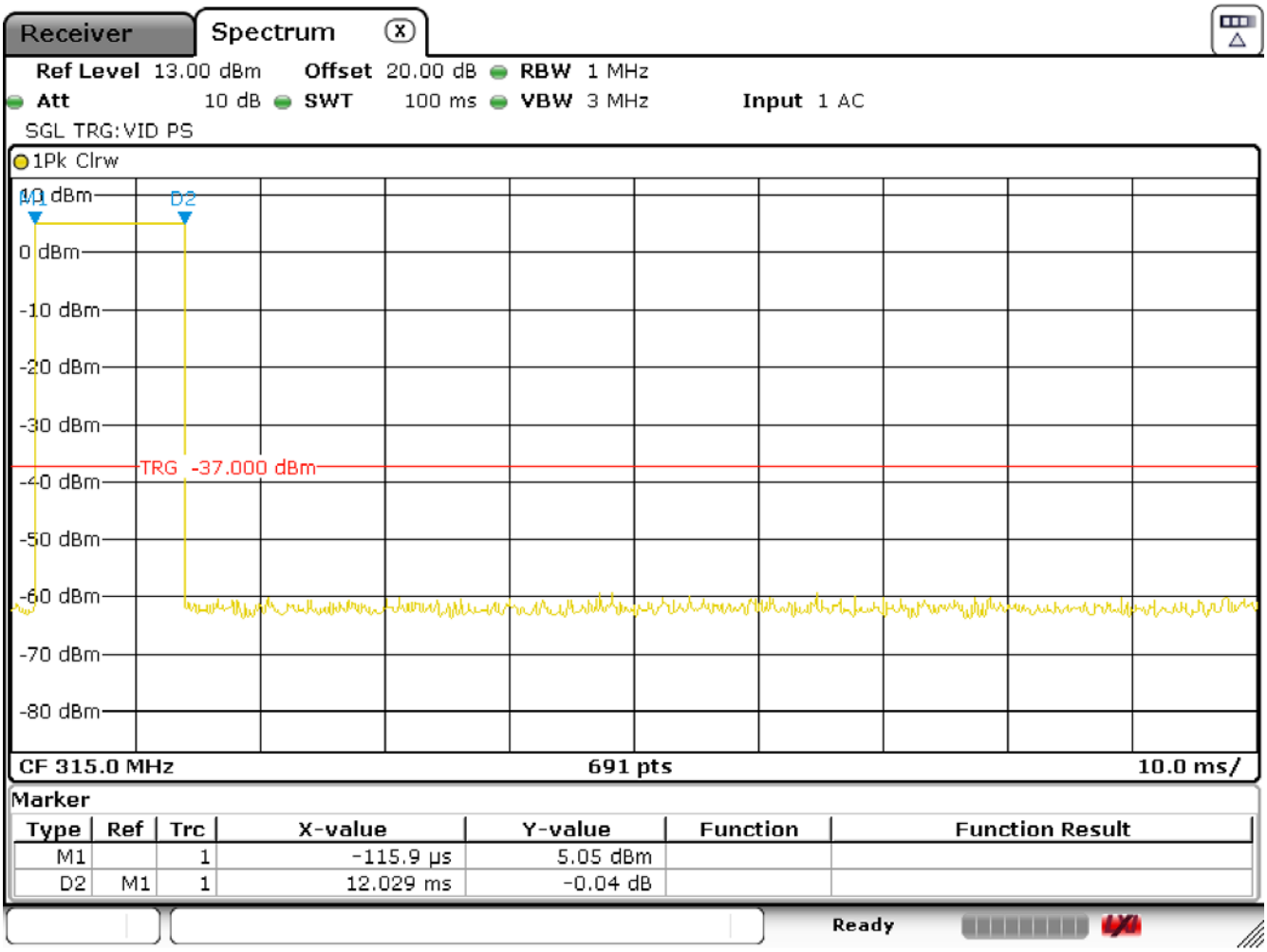
Figure 2.3.6-7. 20 ms span. FSK modulation



Date: 26.APR.2019 13:10:30

Figure 2.3.6-8. 100 ms span. FSK modulation

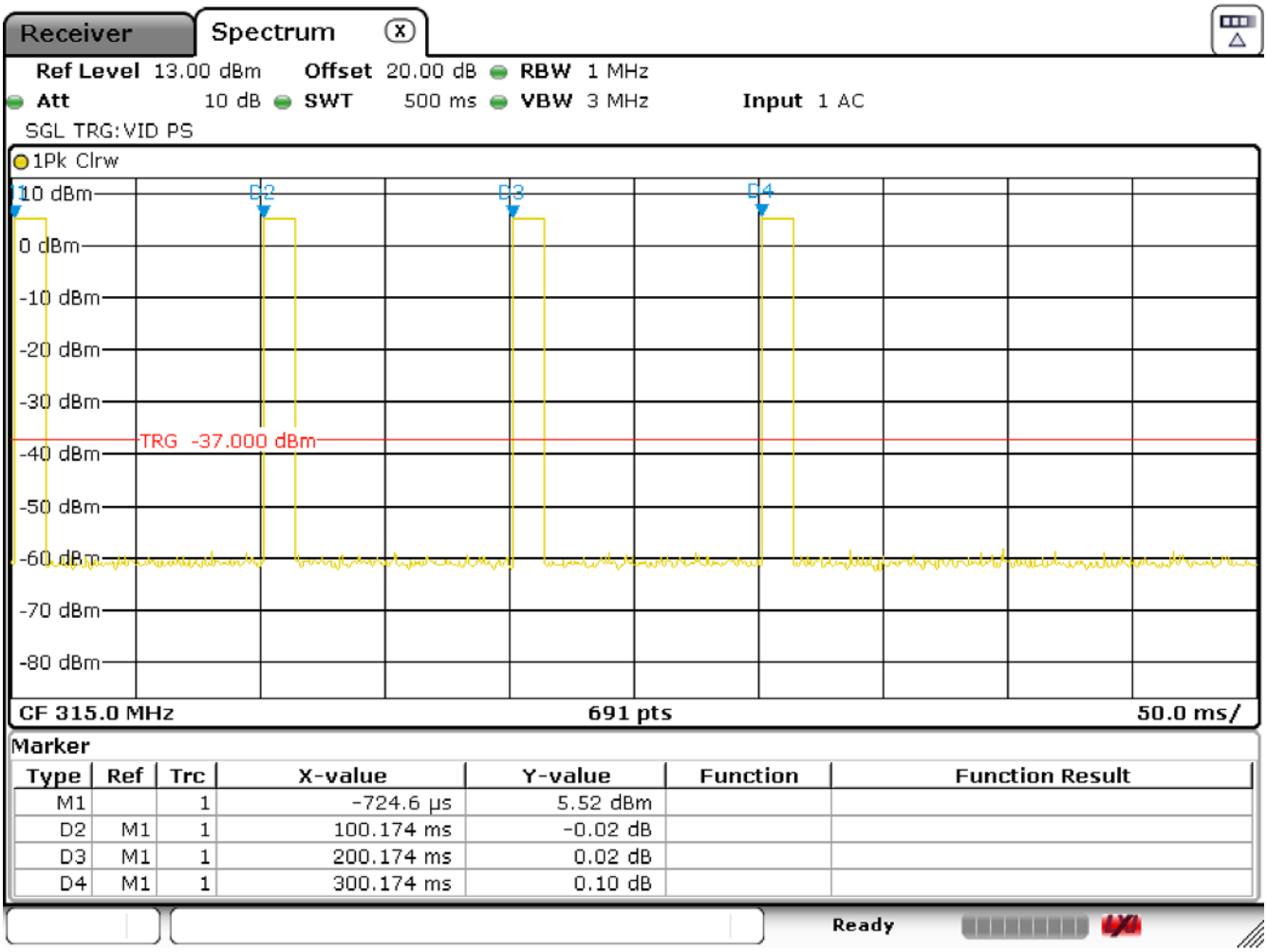


Figure 2.3.6-9. 500 ms span. FSK modulation

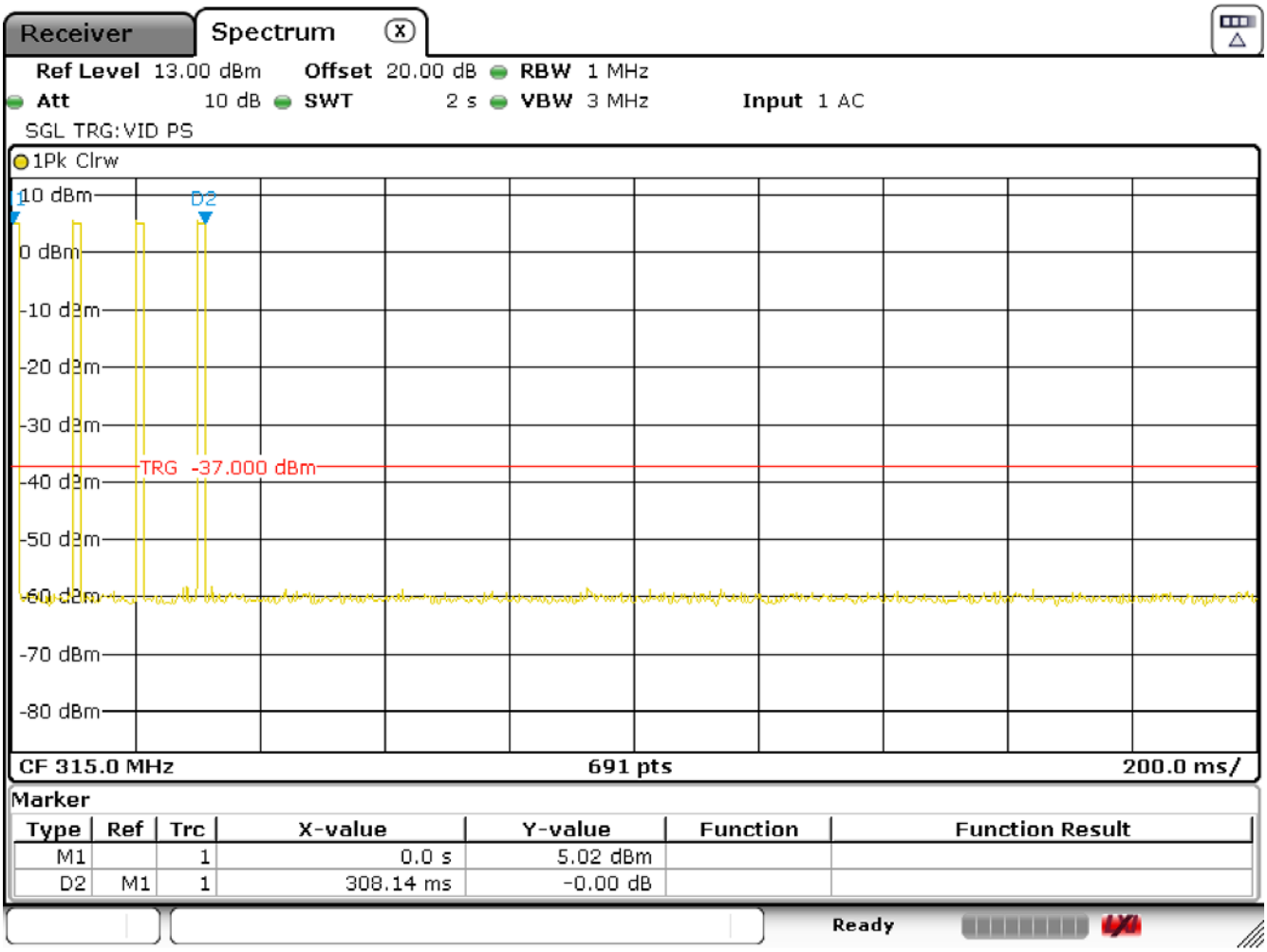


Figure 2.3.6-10. 2 s span. FSK modulation

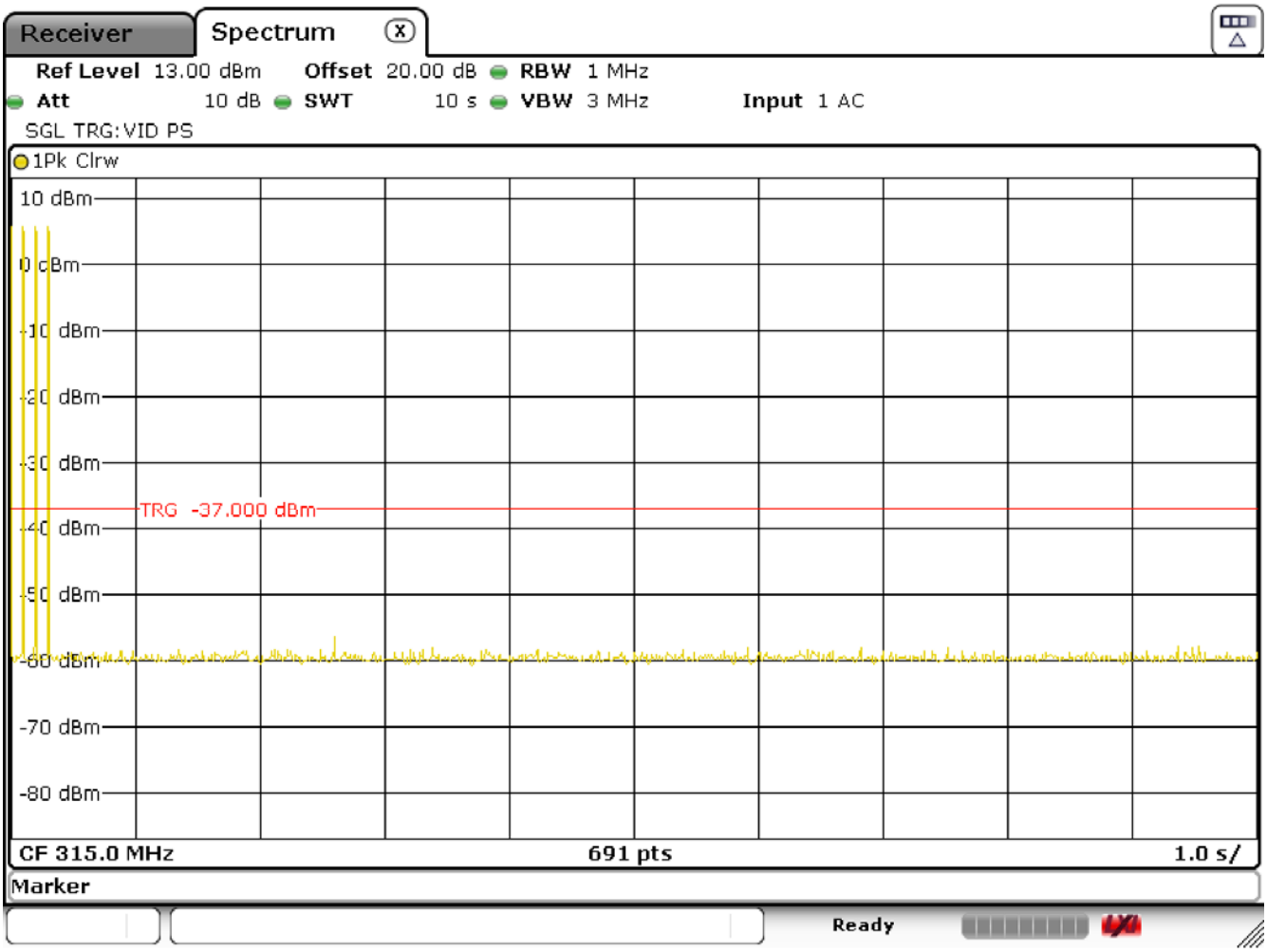


Figure 2.3.6-11. 10 s span. FSK modulation

2.3.7 Test Photos

See separate photo exhibit

Photo 2.3.7-1. Conducted measurements

2.3.8 Test Equipment

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE11500	Ametek	Power Supply	XHR33-33	1725A02285	Y	N/A	N/A
WRLE10998	Rohde & Schwarz	Receiver, 20 Hz-26.5 GHz	ESU 26	100379	G	12/13/2018	12/13/2019
WRLE11398	Meca	Attenuator, 20dB	603-20-1F18	11398	B	06/07/2018	06/07/2019

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment

Table 2.3.8-1. Conducted test Equipment

2.4 Occupied Bandwidth

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.231(c)
ISED RSS-210 Clause A.1.3

2.4.2 Equipment Under Test and Modification State

As shown in §1.2 with modifications if any as shown in §1.7.

2.4.3 Date of Test

26 Apr 2019

2.4.4 Test Methodology

20 dB Bandwidth:
RBW set to approximately 1-5% of the OBW. Trace set to max hold, peak detector. The delta function of the markers was used to determine the 20 dB BW.

99% Occupied BW:
The occupied BW measurement function of the analyzer was used. Span was set to capture all products of the modulation process including sidebands. RBW set to 1-5% OBW. Peak detector

2.4.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.4.6 Test Results

Pass:
0.25% of the 315 MHz fundamental transmit frequency is 787 kHz. The bandwidth measurements are less than 0.25% of the fundamental transmit frequency.

Detailed results are shown in table 2.4.6-1 and figures 2.4.6-1 through 2.4.6-4

Modulation	99% OBW (kHz)	20dB BW (kHz)
ASK	28.08	20.55
FSK	143.27	130.25

Table 2.4.6-1. Bandwidths

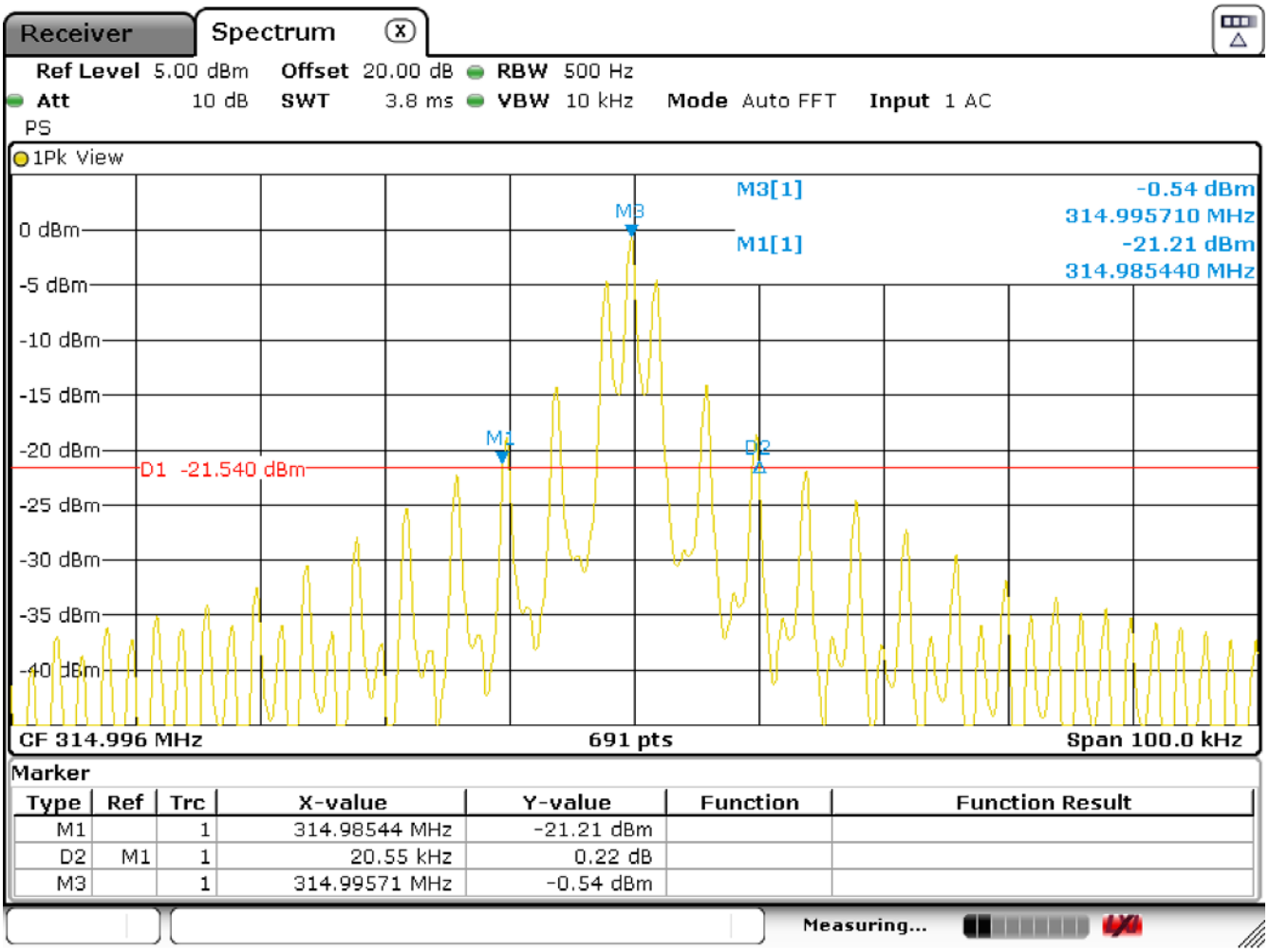


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Figure 2.4.6-1. ASK modulation. 20dB BW

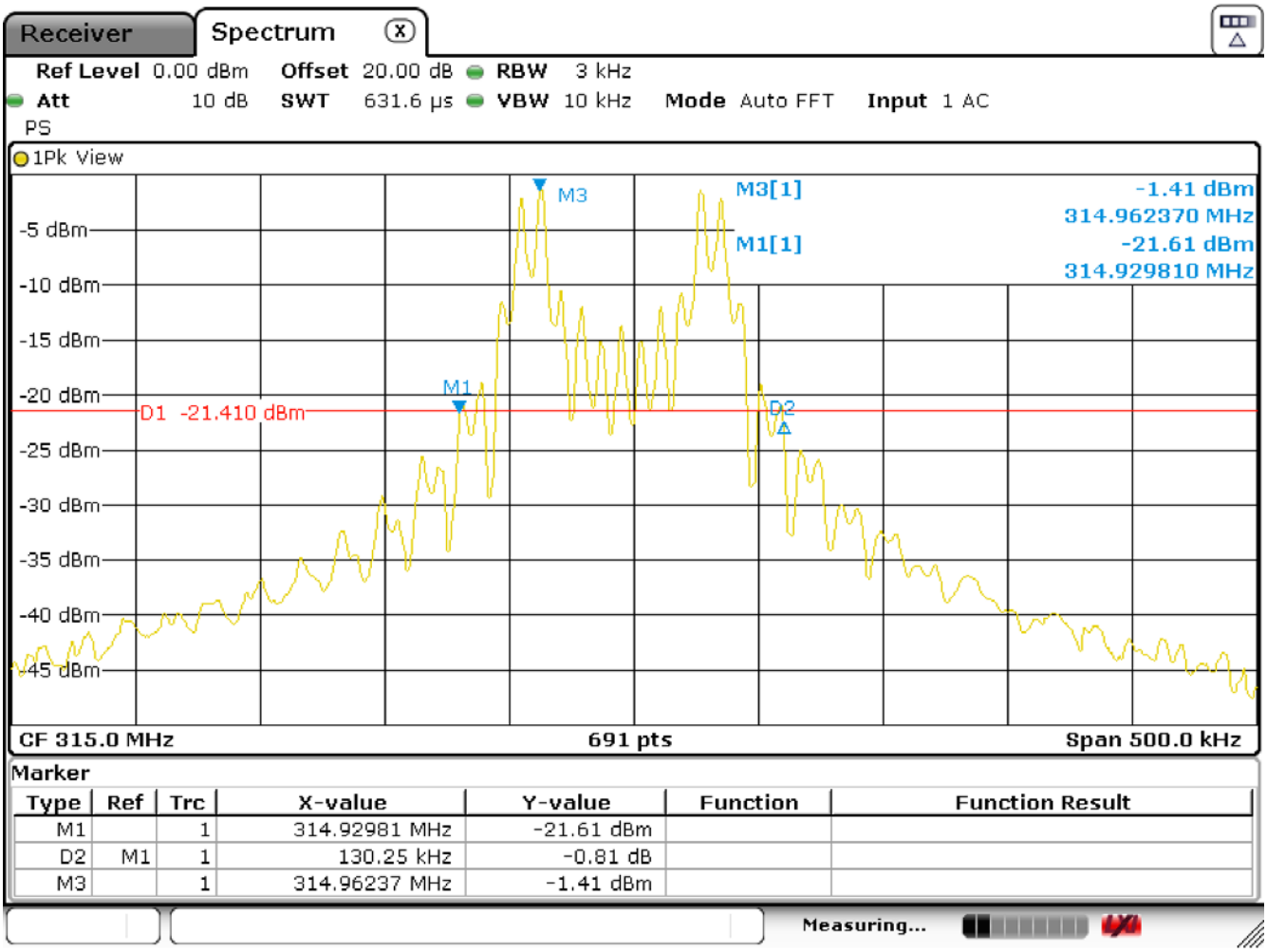

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Figure 2.4.6-2. FSK modulation. 20dB BW

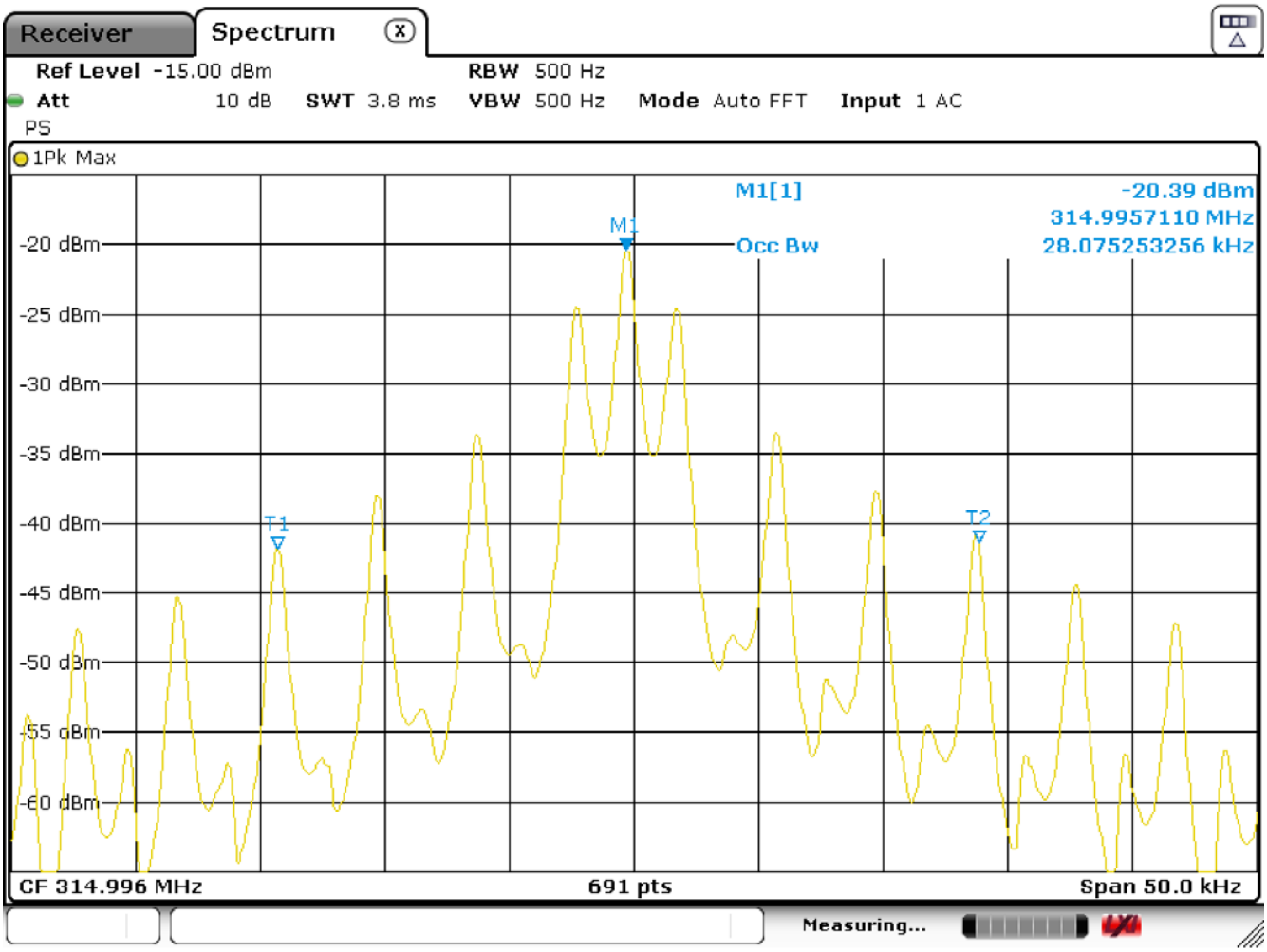

Figure 2.4.6-3. ASK modulation. 99% OBW

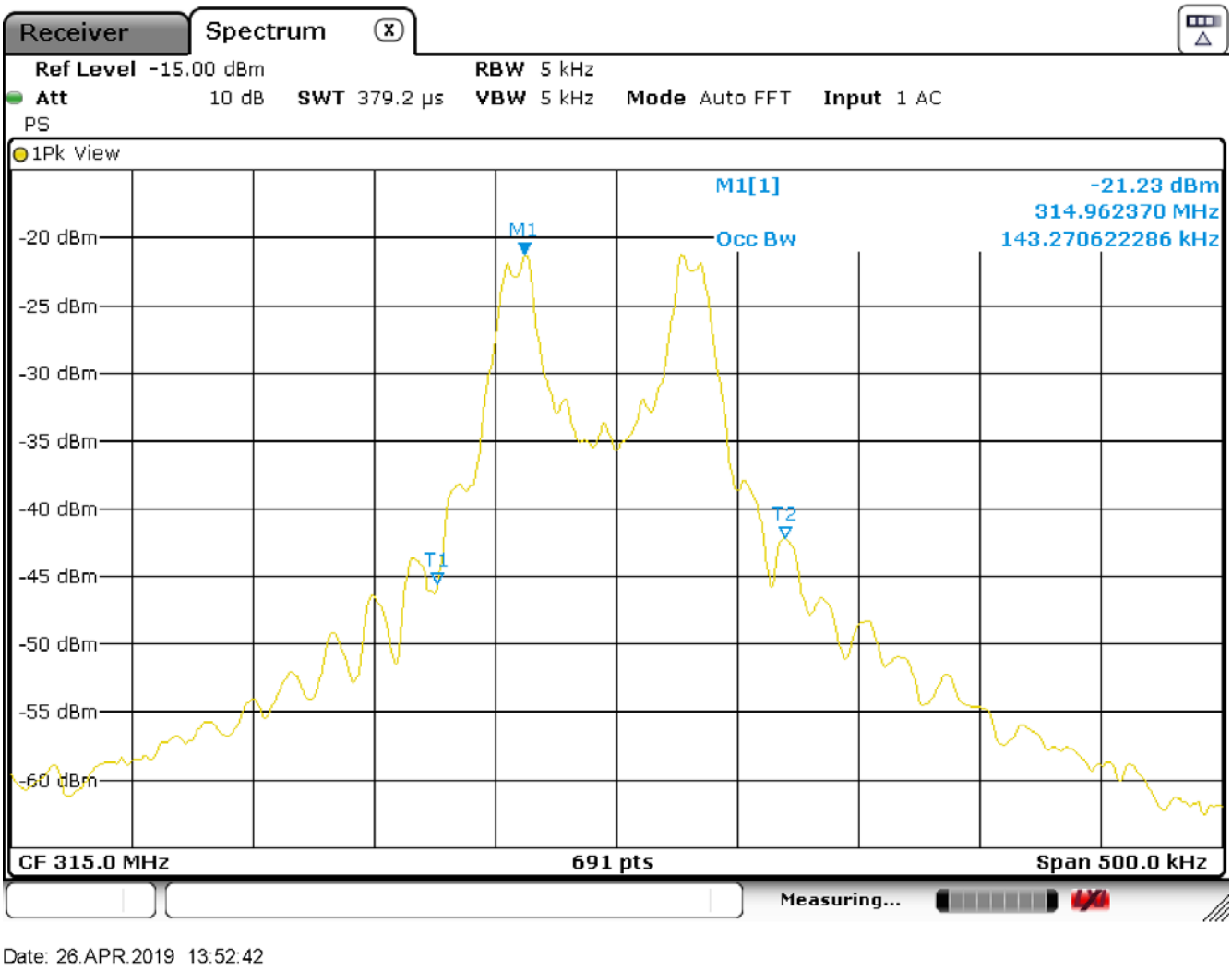

Figure 2.4.6-4. FSK modulation. 99% OBW

2.4.7 Test Photos

See separate photo exhibit

Photo 2.4.7-1. Bandwidth measurements

2.4.8 Test Equipment

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE11500	Ametek	Power Supply	XHR33-33	1725A02285	Y	N/A	N/A
WRLE10998	Rohde & Schwarz	Receiver, 20 Hz-26.5 GHz	ESU 26	100379	G	12/13/2018	12/13/2019
WRLE11398	Meca	Attenuator, 20dB	603-20-1F18	11398	B	06/07/2018	06/07/2019

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment

Table 2.4.8-1. Bandwidth Measurement Test Equipment

2.5 Radiated Emissions

2.5.1 Specification Reference

FCC 47 CFR Part 15C, §15.231
ISED RSS-210, Clause A.1.2

2.5.2 Equipment Under Test and Modification State

As shown in §1.2 with modifications if any as shown in §1.7.

2.5.3 Date of Test

25 Apr 2019

2.5.4 Test Methodology

Tests were performed using the Standard test methods in ANSI C63.10-2013. Section 6. The frequency range investigated was 10 kHz to 3.2 GHz. Lowest operating frequency is 125 kHz. Measurements made using BAT-EMC (v3.18) automated software. Reported level is the actual field strength level which includes applicable correction factors. Measurements were made with the DUT mounted in 3 orthogonal axes and using both ASK & FSK modulations. Continuous transmit mode. The EUT was rotated 360° to maximize each emission.
The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive table at 0.8 m or 1.5 m above a reference ground plane using a measurement distance of 3m. A pre-scan of the EUT emissions profile was made while varying the antenna-to-EUT azimuth and antenna-to-EUT polarization using a peak detector; measurements were taken at a 3m distance. Using the pre-scan list of the highest emissions detected, their bearing and associated antenna polarization, the EUT was then formally measured using a Quasi-peak, Peak and Average detector as appropriate. The readings were maximized by adjusting the antenna height, polarization and turntable azimuth, in accordance with the specification. The EUT was assessed against the limits specified in FCC 47 CFR Part 15.231 and ISED RSS-210, clause A.1.2.

2.5.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

2.5.6 Test Results

Pass:

10 kHz – 30 MHz;
Peak levels compared to the QP/Avg limit. No discernible emissions detected regardless of modulation type or orthogonal axes of the device or loop antenna. See table & figure 2.5.6-1

Frequency (MHz)	Pk Level (dBuV)	QP/Avg Limit (dBuV)	Margin (dB)	Azimuth (º)
0.524	49.63	73.21	-23.58	95
0.744	45.94	70.19	-24.25	54
0.902	44.42	68.52	-24.1	336

Table 2.5.6-1. Typical noise floor levels

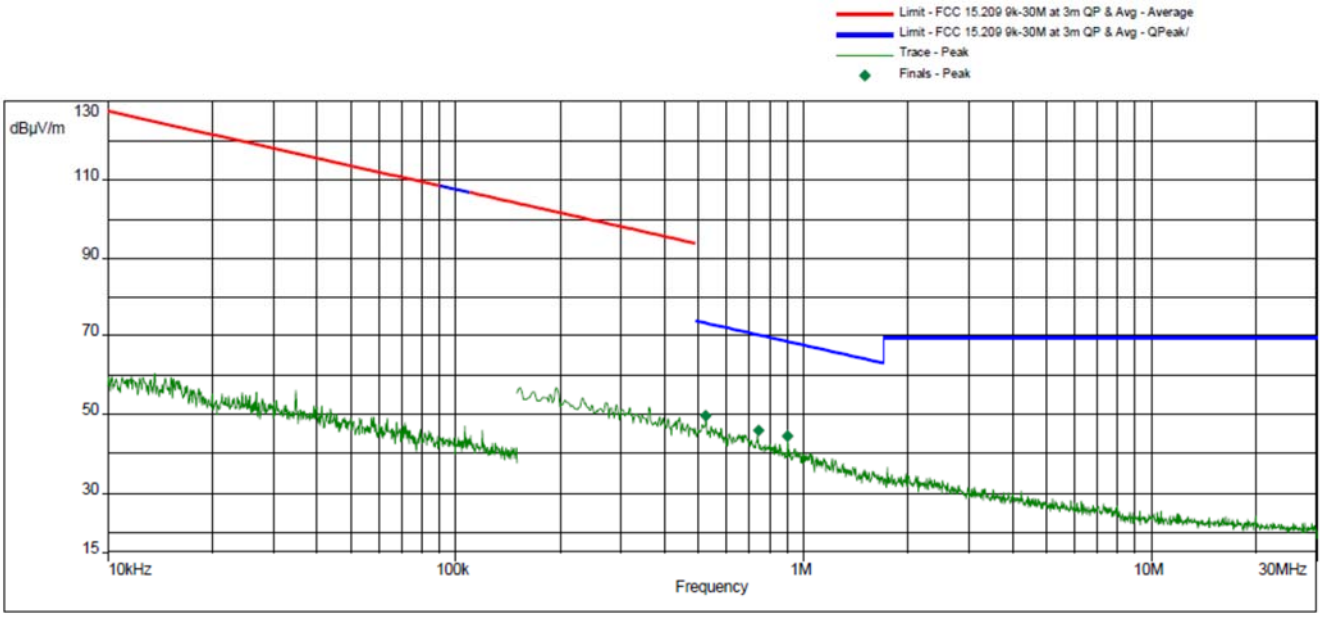

Figure 2.5.6-1. Typical noise floor scan

30 MHz – 1 GHz;
See tables and figures 2.5.6-2 through 2.5.6-7

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity
315.0183MHz	70.64	75.6	-4.96	360	1.05	Horizontal
629.9917MHz	29.68	55.6	-25.92	238	1	Vertical
9459MHz	29	55.6	-26.6	175	2.29	Vertical

Table 2.5.6-2. ASK modulation. X position.

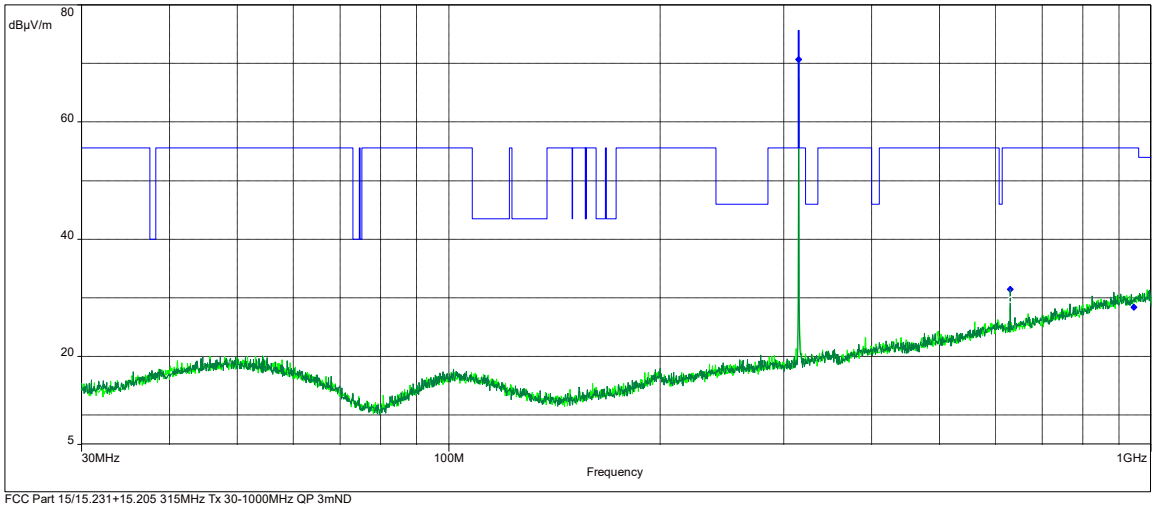

Figure 2.5.6-2. ASK modulation. X position.

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity
314.9957MHz	70.36	75.6	-5.24	19	1.21	Horizontal
630.0053MHz	28.88	55.6	-26.72	111	1	Vertical
944.9889MHz	23.19	55.6	-32.41	163	2.29	Vertical

Table 2.5.6-3. ASK modulation. Y position.

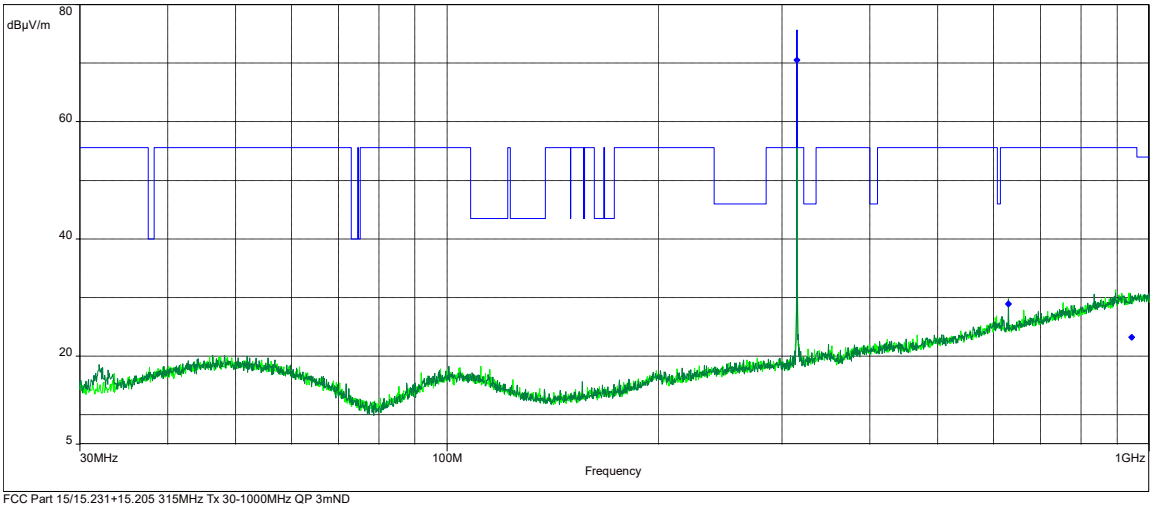

Figure 2.5.6-3. ASK modulation. Y position.

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (º)	Height (m)	Polarity
314.996MHz	75.45	75.6	-0.15	244	1	Horizontal
629.999MHz	29.94	55.6	-25.66	245	1.28	Horizontal
945.033MHz	23.22	55.6	-32.38	286	3.79	Horizontal

Table 2.5.6-4. ASK modulation. Z position.

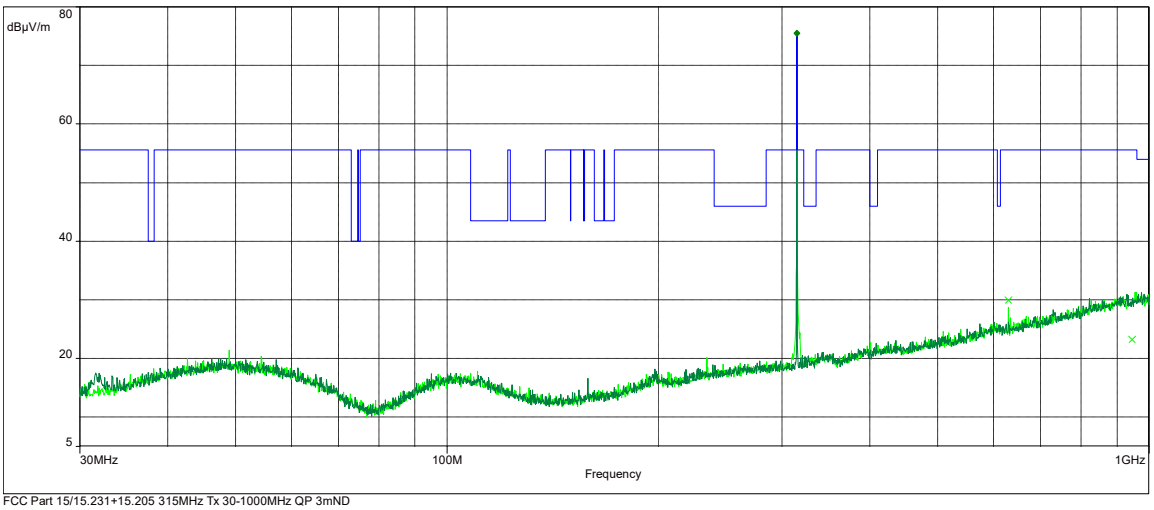

Figure 2.5.6-4. ASK modulation. Z position.

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity
315.02794MHz	70.09	75.6	-5.51	5	1.21	Horizontal
629.91984MHz	28.05	55.6	-27.55	60	1.05	Vertical
944.97736MHz	23.17	55.6	-32.43	169	1.28	Vertical

Table 2.5.6-5. FSK modulation. X position.

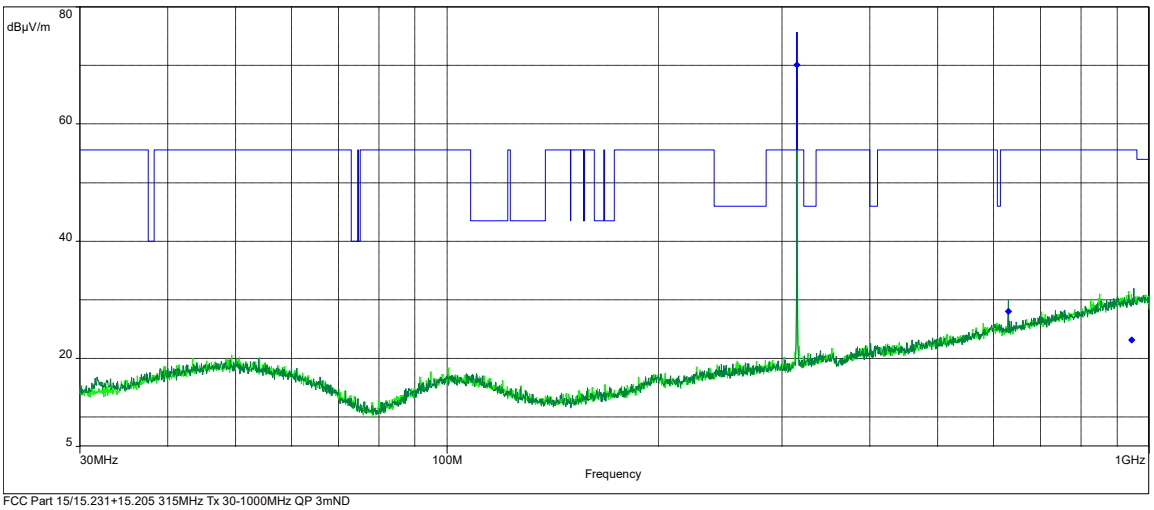

Figure 2.5.6-5. FSK modulation. X position.

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity
315.02811MHz	70.54	75.6	-5.06	19	1.05	Horizontal
629.92016MHz	28.41	55.6	-27.19	88	1	Vertical
945.03477MHz	23.12	55.6	-32.48	350	1.63	Vertical

Table 2.5.6-6. FSK modulation. Y position.

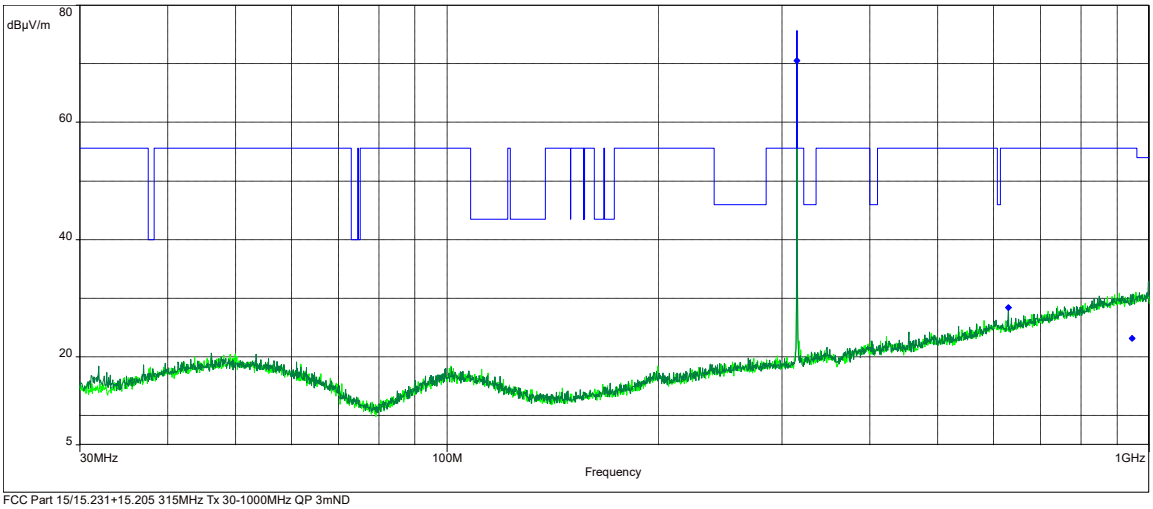

Figure 2.5.6-6. FSK modulation. Y position.

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity
315.02811MHz	75.24	75.6	-0.36	247	1	Horizontal
630.04024MHz	28.22	55.6	-27.38	86	1.28	Horizontal
945.01875MHz	23.11	55.6	-32.49	350	1.51	Horizontal

Table 2.5.6-7. FSK modulation. Z position.

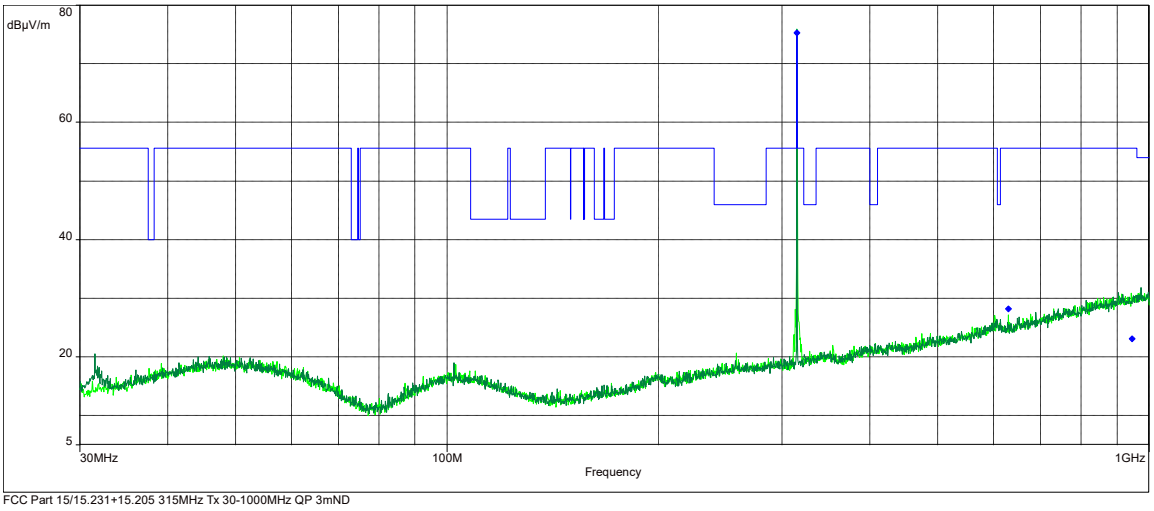

Figure 2.5.6-7. FSK modulation. Z position.

1 – 3.2 GHz;
No discernible emissions were detected.
See table & figure 2.5.6-8

Frequency	Peak Level (dBuV)	Peak Limit (dBuV)	Peak Margin (dB)	Average Level (dBuV)	Average Limit (dBuV)	Average Margin (dB)	Azimuth (°)	Height (m)	Polarity
2.8844311GHz	42.65	74.00	-31.35	29.18	54.00	-24.82	212.00	1.21	Vertical
3.0525748GHz	42.87	74.00	-31.13	29.49	54.00	-24.51	272.00	1.97	Vertical
3.1264903GHz	43.29	74.00	-30.71	29.31	54.00	-24.69	293.00	3.57	Horizontal
3.1707044GHz	43.00	74.00	-31.00	29.03	54.00	-24.97	217.00	1.86	Horizontal

Table 2.5.6-8. Typical peak detector pre-scan. 1-3.2 GHz. §15.209 limit. ASK Z position

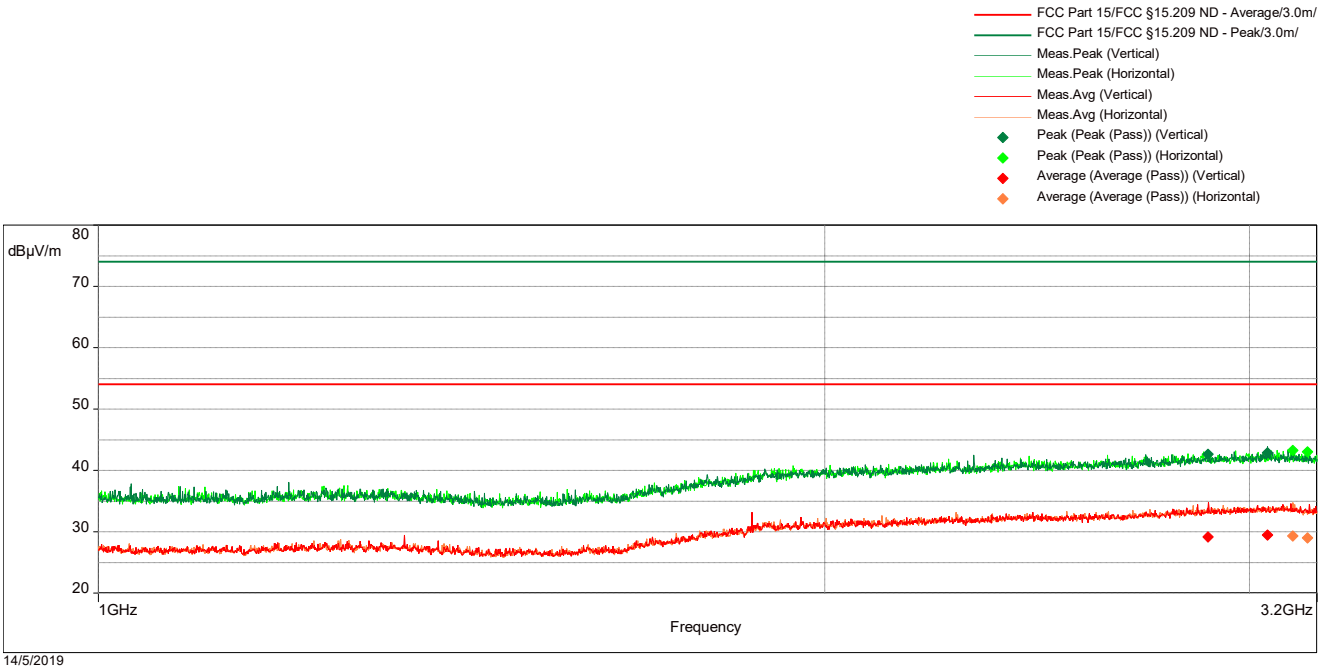

Figure 2.5.6-8. Typical peak detector pre-scan. 1-3.2 GHz. §15.209 limit. ASK Z position

2.5.7 Test Photos

See separate photo exhibit
Picture 2.5.7-1. Radiated emissions 0.009 – 30 MHz

See separate photo exhibit
Picture 2.5.7-2. Radiated emissions 30 – 1000 MHz

See separate photo exhibit
Picture 2.5.7-3. Radiated emissions 1 – 3.2 GHz

See separate photo exhibit
Photo 2.5.7-4. Radiated emissions. Position X

See separate photo exhibit

Photo 2.5.7-5. Radiated emissions. Position Y

See separate photo exhibit

Photo 2.5.7-6. Radiated emissions. Position Z

2.5.8 Test Equipment

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE11141	Hewlett-Packard	Preamplifier, 0.1 to 1300 MHz	8447D	2944A08773	B	01/04/2019	01/04/2020
WRLE02418	EMCO/EMC Test	Antenna, Loop	6502	2215	G	09/25/2018	09/25/2019
WRLE10998	Rohde & Schwarz	Receiver, 20 Hz-26.5 GHz	ESU 26	100379	G	12/13/2018	12/13/2019
WRLE11252	Pasternack	Cable, SMA 3ft	PE300-36	1252	B	09/17/2018	09/17/2019
WRLE11519	Com-Power Corp.	Preamp, 500 MHz-18 GHz	PAM-118A	18040002	B	01/04/2019	01/04/2020
NBLE11614	Teledyne Storm Microwave	Cable, N 3m	90-195-3MTR	182984-003	B	11/01/2018	11/01/2019
NBLE11618	Teledyne Storm Microwave	Cable, N 8m	90-195-8MTR	182982-004	B	11/01/2018	11/01/2019
NBLE11630	ETS-Lindgren	Antenna, 1-18 GHz	3117	00218816	B	08/25/2018	08/25/2019
NBLE11645	SCHWARZBECK	Antenna, Trilog Broadband, 30-7000 MHz	VULB 9162	0254	G	03/18/2019	03/18/2021

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

Table 2.5.8-1. Radiated Emissions Test Equipment

2.6 Test Location

The tests were carried out in New Brighton, MN
Test Area: 3mSAC

3 Measurement Uncertainty

The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. This test system for 30 MHz – 1000 MHz has a measurement uncertainty of ±5.88 dB and above 1 GHz a measurement uncertainty of ±4.47 dB. The measurement uncertainty values for radiated emissions meet the requirements as expressed in CISPR 16-4-2. The equipment comprising the test systems is calibrated on an annual basis.

4 Diagram of Test Set-ups

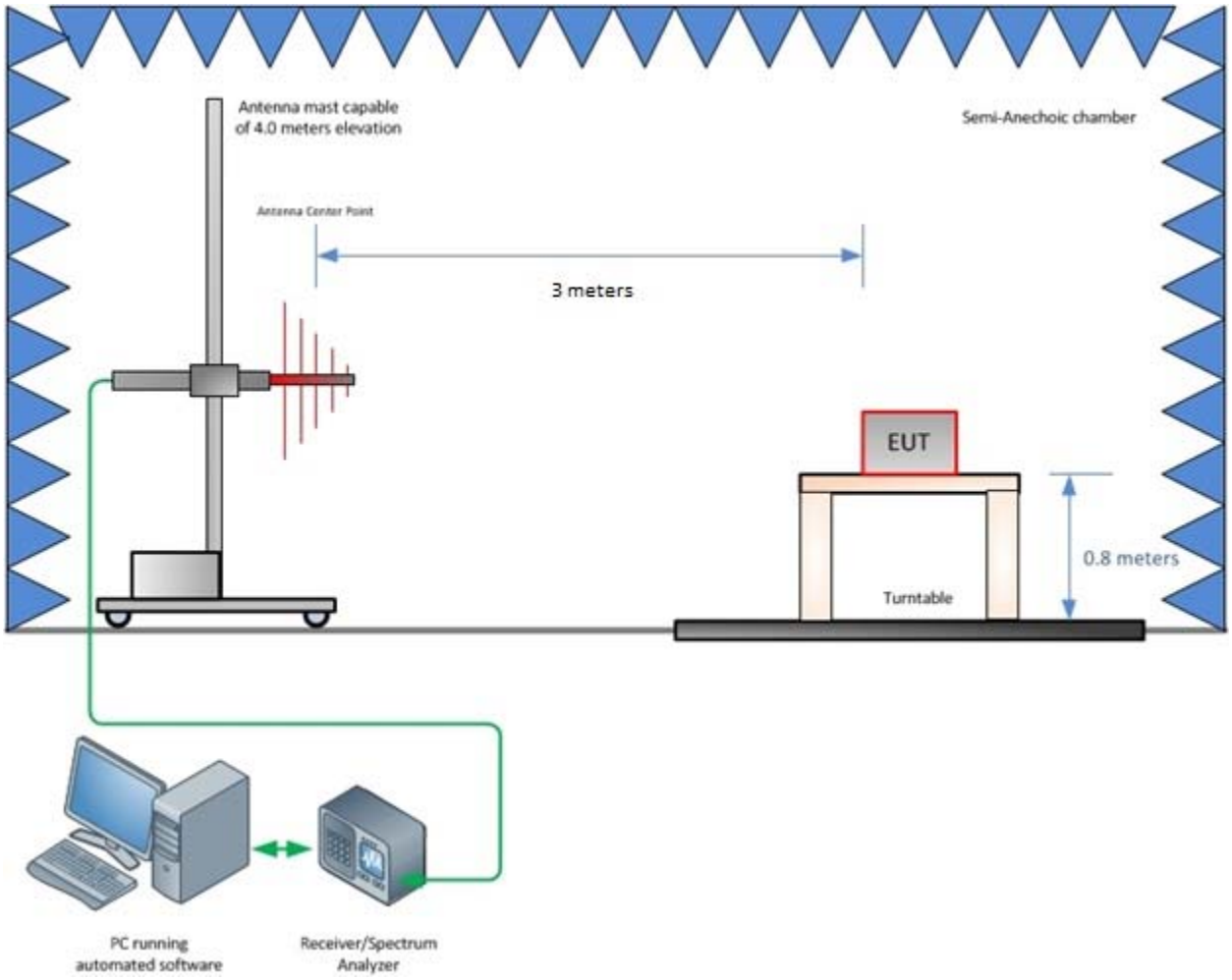

Figure 4-1 - Radiated Emissions Test Setup up to 1 GHz

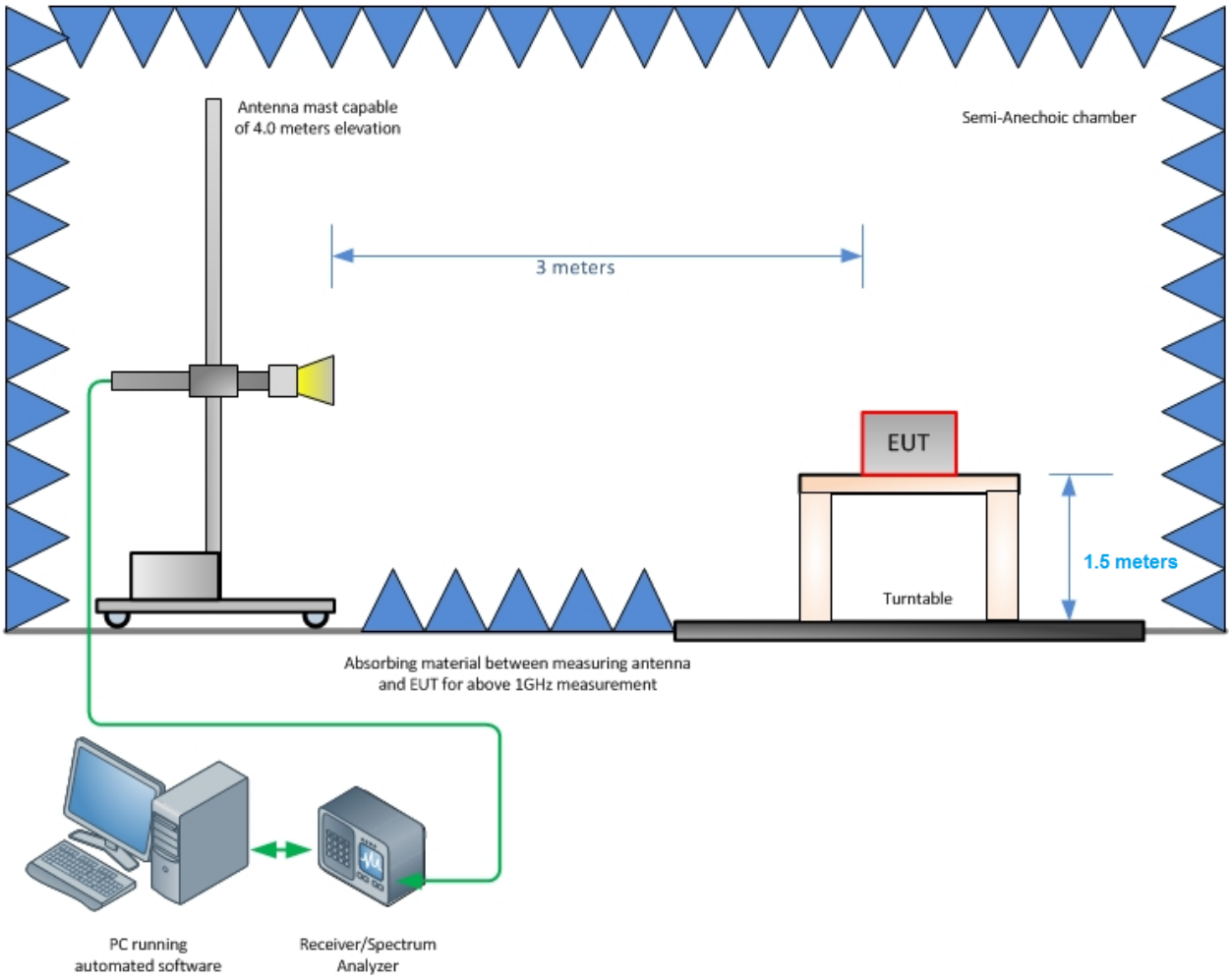

Figure 4-2 - Radiated Emissions Test Setup above 1 GHz

5 Accreditation, Disclaimers and Copyright

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