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FCC/ISED Test Report

Prepared for:	**Digital Monitoring Products**
Address:	**2500 North Partnership Blvd. Springfield, MO 6582**
Product:	**PC0114R9**
FCC ID:	**CCKPC0114R9**
IC:	**5251A-PC0114R9**
Test Report No:	**R20201019-20-E1C**
Approved by:	 **Nic S. Johnson, NCE** **Technical Manager** **iNARTE Certified EMC Engineer #EMC-003337-NE**
DATE:	**5 May 2021**
Total Pages:	**48**

ilac-MRA A2LA ACCREDITED TESTING LABORATORY CERTIFICATE NO. 1953.01

REVISION PAGE

Rev. No.	Date	Description
0	31 December 2020	Original – NJohnson Prepared by KVepuri
A	5 February 2021	Corrected results in Section 4.0 and power limits.
B	19 March 2021	Updated 3rd table on Page 9. Updated duty cycle correction factor to match measurements in Section 4.6
C	5 May 2021	Added FCC Id and IC.

CONTENTS

1.0 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

(1) US Code of Federal Regulations, Title 47, Part 15
(2) ISED RSS-Gen, Issue 5
(3) ISED RSS-247, Issue 2

ANSI C63.10-2013 was used as a test method, with guidance from KBD 558074 D01 v05

SUMMARY			
Standard Section	**Test Type and Limit**	**Result**	**Remark**
FCC 15.203	Unique Antenna Requirement	Pass	PCB antenna
FCC 15.35 RSS-Gen, 6.10	Duty cycle of pulsed emissions	Informative only	Duty cycle was applied
FCC 15.209 RSS-Gen, 7.1	Receiver Radiated Emissions	Pass	Meets the requirement of the limit.
FCC 15.247(a)(1)(i) RSS-247, 5.1(c)	Minimum Bandwidth, Limit: Min. 250kHz	Pass	Meets the requirement of the limit.
FCC 15.247(b)(1) RSS-247, 5.1	Maximum Peak Output Power, Limit: Max. 24 dBm	Pass	Meets the requirement of the limit.
FCC 15.209 RSS-Gen, 8.9 RSS-247, 5.5	Transmitter Radiated Emissions	Pass	Meets the requirement of the limit.
FCC 15.247(a) (1) (i) RSS-247, 5.1(c)	Frequency hopping system, Limit: Max. 0.4 Seconds in 20 Second Period	Pass	Meets the requirement of the limit.
FCC 15.209, 15.205 RSS-Gen, 8.9 RSS-247, 5.5	Band Edge Measurement, Limit: 20dB less than the peak value of fundamental frequency	Pass	Meets the requirement of the limit.
FCC 15.207 RSS-Gen. 8.8	Conducted AC Emissions	Pass	Meets the requirement of the limit.

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary

The Equipment Under Test (EUT) was PC0114R9 a Wireless transmitter manufactured by DMP wireless devices. It operates in the 902 to 928 MHz ISM band and has transmit and receive capabilities.

EUT	PC0114R9
FCC ID:	CCKPC0114R9
IC:	5251A-PC0114R9
EUT Received	11/9/2020
EUT Tested	11/18/2020 - 12/21/2020
Serial No.	00221 (Assigned by test lab)
Operating Band	902 – 928 MHz
Device Type	FHSS
Power Supply	MG ELECTRONICS Model: ST-12500W Input: 100-240V, 50/60Hz, 0.2A Output: 12V,0.5A
Antenna	PCB Antenna

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

2.2 DESCRIPTION OF TEST MODES

The EUT operates on, and was tested at the frequencies below:

Channel	Frequency
Low	905.6
Middle	915.0
High	924.4

These are the only three representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the lowest, highest and one channel in the middle.

2.3 DESCRIPTION OF SUPPORT UNITS

None

3.0 LABORATORY DESCRIPTION

3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

A2LA Certificate Number: 1953.01
FCC Accredited Test Site Designation No: US1060
Industry Canada Test Site Registration No: 4294A-1
NCC CAB Identification No: US0177

Environmental conditions varied slightly throughout the tests:
Relative humidity of 35 ± 4%
Temperature of 22 ± 3° Celsius

3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Nic Johnson	Technical Manager	Review of Results
2	Karthik Vepuri	EMC Test Engineer	Testing and Report
3	Fox Lane	EMC Test Technician	Testing and Report

Notes:
All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.

3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)	N9038A	MY59050109	April 23, 2019	April 23, 2021
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	May 5, 2020	May 5, 2022
SunAR RF Motion	JB1	A091418	March 6, 2020	March 6, 2021
EMCO Horn Antenna	3115	6415	March 16, 2020	March 16, 2022
Com-Power LISN	LI-220C	20070017	September 22, 2020	September 22, 2021
Rohde & Schwarz Preamplifier**	TS-PR18	3545700803	April 14, 2020	April 14, 2022
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
MiniCircuits High Pass Filter*	VHF-1320+	15542	April 14, 2020	April 14, 2022
RF Cable (preamplifier to antenna)*	MFR-57500	01-07-002	April 14, 2020	April 14, 2022
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	April 14, 2020	April 14, 2022
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3874	April 14, 2020	April 14, 2022
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	April 14, 2020	April 14, 2022
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	April 14, 2020	April 14, 2022
N connector bulkhead (control room)*	PE9128	NCEEBH2	April 14, 2020	April 14, 2022
TDK Emissions Lab Software	V11.25	700307	NA	NA
Com-Power Single Phase LISN	LI-220C	20070017	September 22, 2020	September 22, 2022

*Internal Characterization

**2 year calibration cycle

Notes:
All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

4.0 DETAILED RESULTS

Radio Measurements								
CHANNEL	Occupied Bandwidth (kHz)	20 dB Bandwidth (kHz)	Peak EIRP OUTPUT POWER* (dBm)	Peak EIRP OUTPUT POWER (mW)	RESULT	Cable loss	Antenna Factor	Uncorrected PEAK OUTPUT POWER (dBm)
Low	71.22	72.02	25.13	325.84	PASS	4.10	26.50	-17.237
Mid	71.91	72.10	27.12	515.23	PASS	4.07	26.60	-15.318
High	70.45	70.52	28.59	722.60	PASS	4.04	26.60	-13.821
20 dB Bandwidth Limit = 500 kHz max			Peak Output Power Limit = 30 dBm; *Duty Cycle Factor -6.02 is applied					

Unrestricted Band-Edge							
CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBm)	Relative Fundamental (dBm)	Measurement Type	Delta (dB)	Min Delta (dB)	Result
Low	902.00	-83.65	-19.03	Continuous	64.62	20.00	PASS
Low	902.00	-83.65	-18.16	Hopping	65.49	20.00	PASS
High	928.00	-76.06	-14.31	Continuous	61.75	20.00	PASS
High	928.00	-76.06	-14.38	Hopping	61.68	20.00	PASS

Peak measurements vs QP Limit- Restricted Band-Edge									
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result	Cable loss	Antenna Factor	Uncorrected out of band (dBm)
Low	608-614 MHz	35.43	Continuous	46.02	10.59	PASS	4.10	26.50	-102.175
Low	608-614 MHz	35.74	Hopping	46.02	10.28	PASS	4.10	26.50	-101.856
High	960-1000MHz	39.20	Continuous	53.98	14.79	PASS	4.04	26.60	-98.445
High	960-1000MHz	37.84	Hopping	53.98	16.14	PASS	4.04	26.60	-99.797
*Limit shown is the peak limit taken from FCC Part 15.209; Peak values are compared to average limit to show compliance.									

4.1 DUTY CYCLE

Manufacturer declared duty cycle:
See Section 4.6. On time = 31ms. Maximum allowed period per FCC Part 15.35 is 100ms. Duty Cycle Correction Factor to be applied to spurious emissions is 31 / 100 ms = 31% = -10.17 dB

4.2 RADIATED EMISSIONS

Test Method: ANSI C63.10:2013, Section 6.5, 6.6

Limits for radiated emissions measurements:

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (μV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 * log * Emission level (μV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

Test procedures:

a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements form 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

h. The orientation with the worst-case emissions was used for final measurements.

i. Receive mode emissions were tested and found to be within the measurement noise floor of the test laboratory

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:

No deviation.

Test setup:

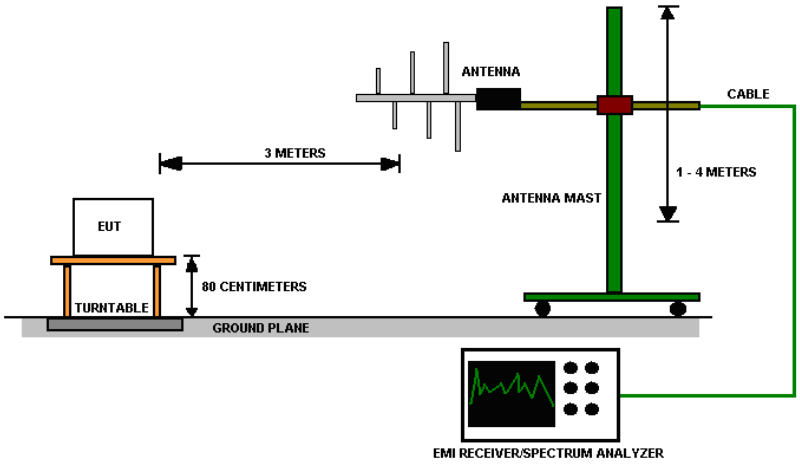


Figure 1 - Radiated Emissions Test Setup

EUT operating conditions
The EUT was powered by 12 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:

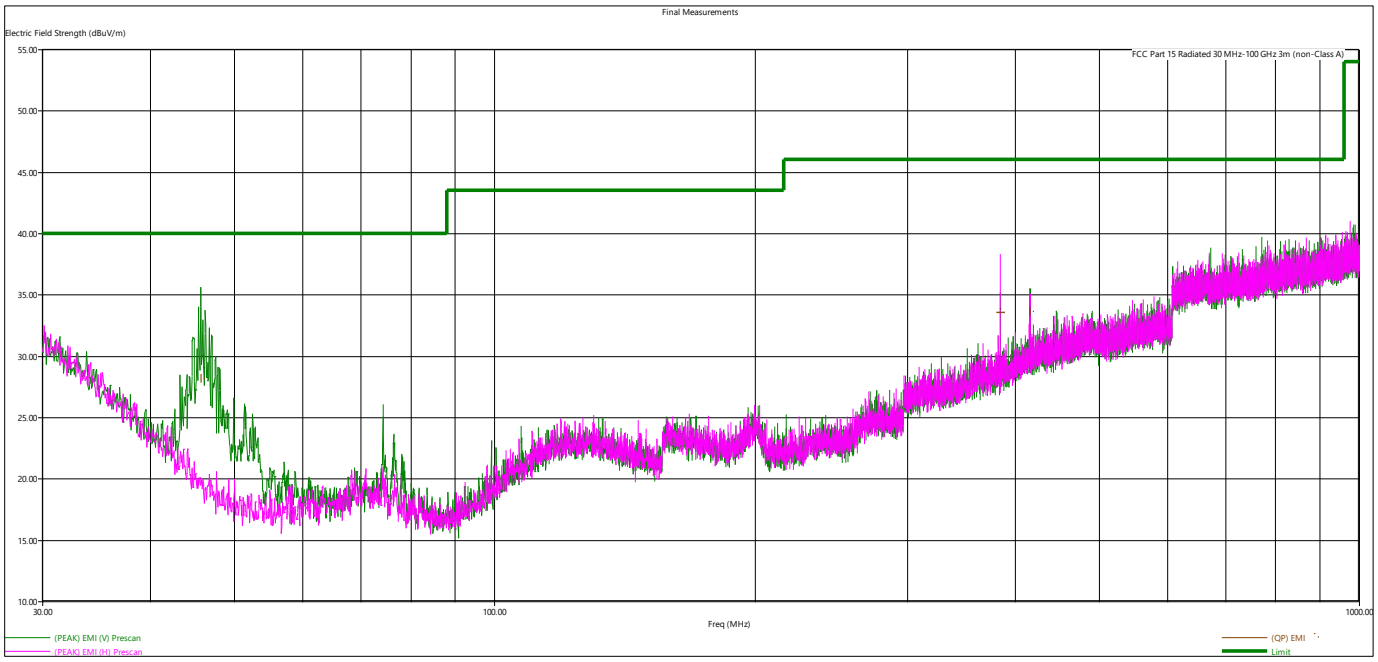


Figure 2 - Radiated Emissions Plot, 30 MHz-1 GHz, Receive Mode

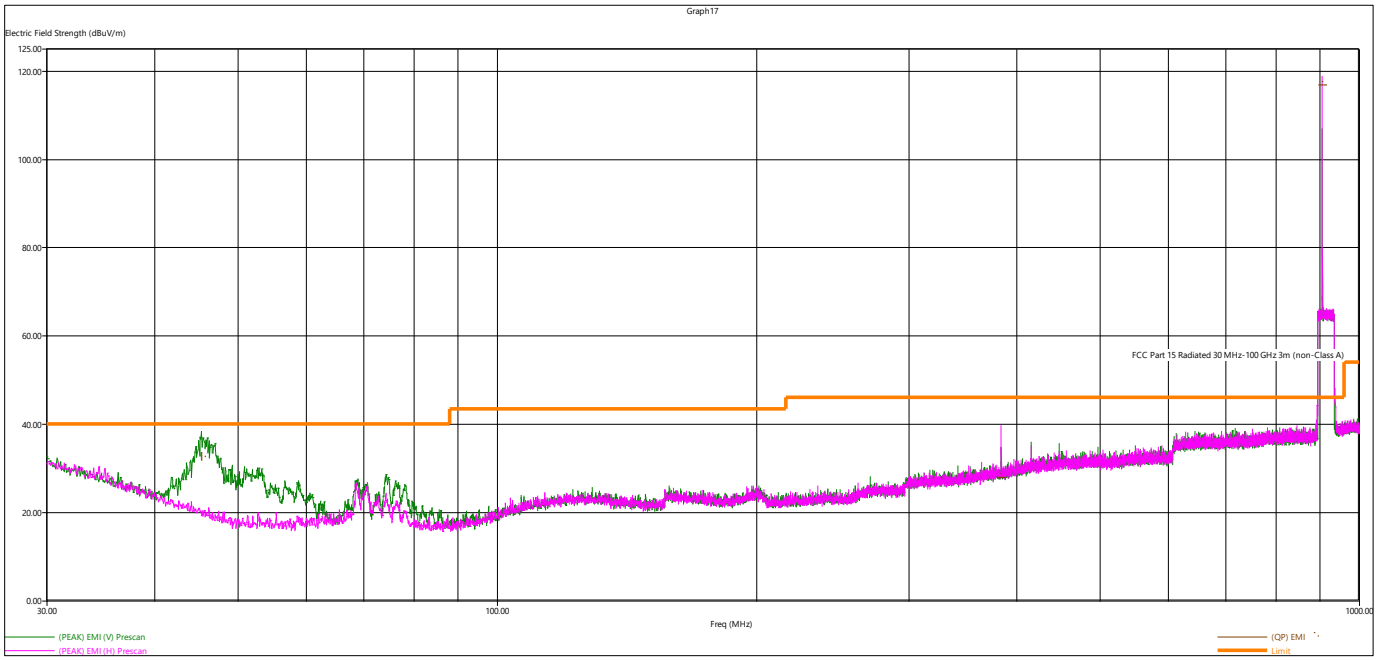


Figure 3 - Radiated Emissions Plot, 30 MHz-1 GHz Low Channel

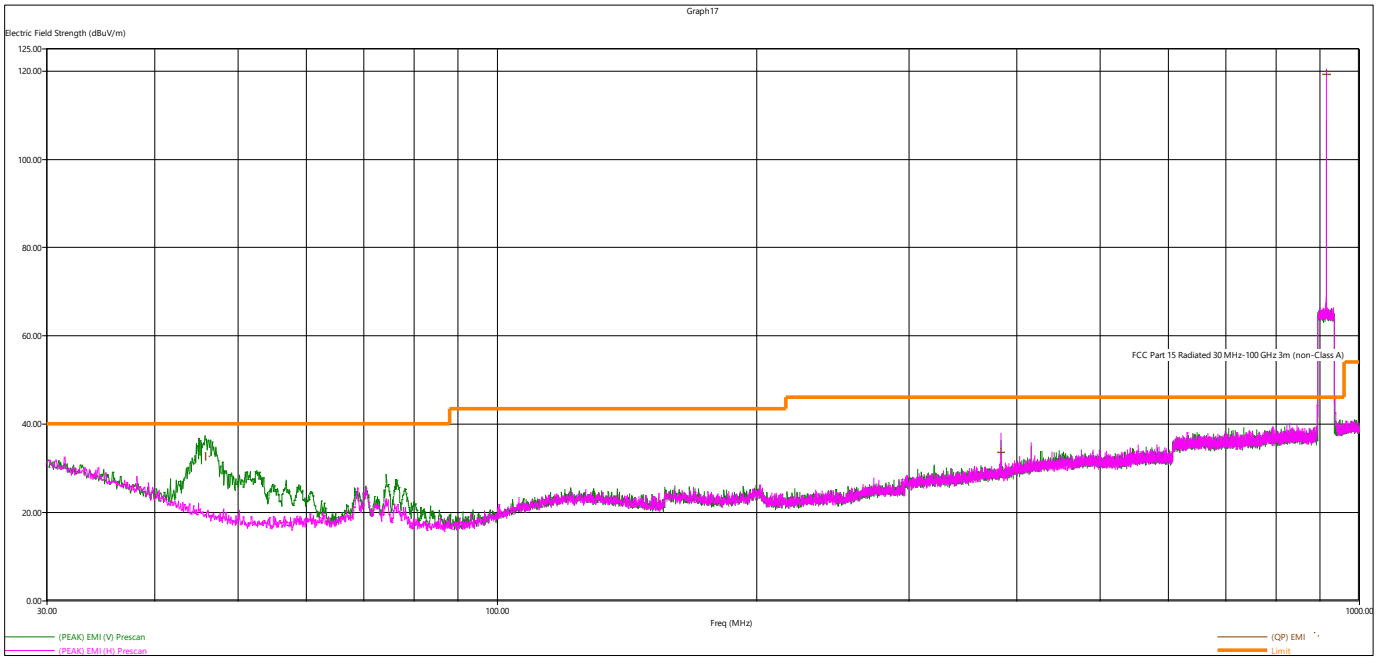


Figure 4 - Radiated Emissions Plot, 30 MHz-1 GHz, Mid Channel

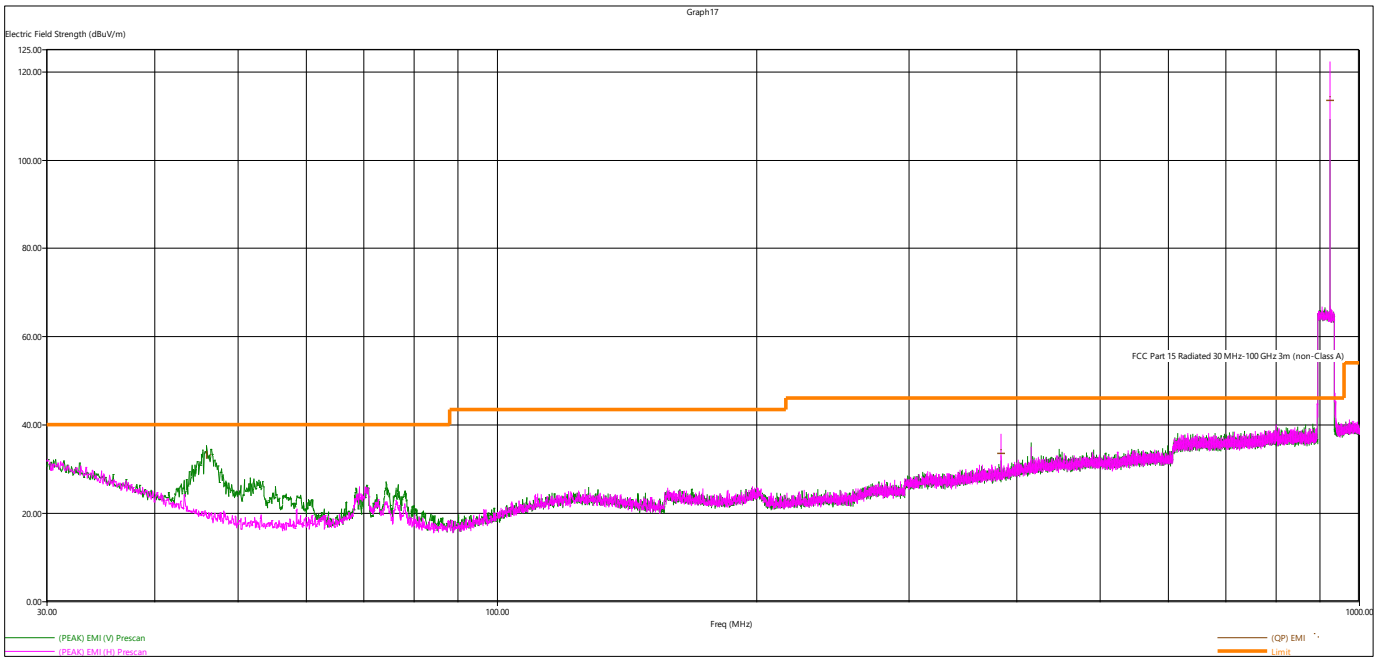


Figure 5 - Radiated Emissions Plot, 30 MHz-1 GHz High Channel

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. The EUT was measured in both the horizontal and vertical orientation. It was found that the Horizontal position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

Quasi-Peak Measurements, 30 MHz -1 GHz							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**		
383.968800	33.50	46.02	12.52	176	358	H	Rx
45.852000	28.09	40.00	11.91	100	5	V	Rx
415.986960	33.62	46.02	12.40	248	295	V	Rx
384.012720	27.85	46.02	18.17	127	235	H	Low
45.351600	32.58	40.00	7.42	105	144	V	Low
905.571520	116.77	NA	NA	104	56	H	Low
383.988720	33.43	46.02	12.59	178	360	H	Mid
45.875520	32.58	40.00	7.42	116	179	V	Mid
914.977840	118.91	NA	NA	103	57	H	Mid
383.998080	33.33	46.02	12.69	129	3	H	High
46.008000	33.02	40.00	6.98	106	6	V	High
924.425200	113.24	NA	NA	104	21	H	High

Peak Measurements, 1 GHz -10 GHz							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**		
1811.280000	55.86	73.98	18.12	199	28	H	Low
2716.870000	47.25	73.98	26.73	170	73	H	Low
3622.414000	54.27	73.98	19.71	197	288	V	Low
4528.232000	46.47	73.98	27.51	109	205	V	Low
1829.990000	51.57	73.98	22.41	194	37	H	Mid
2745.060000	45.55	73.98	28.43	126	359	H	Mid
3660.016000	53.19	73.98	20.79	214	128	V	Mid
1848.720000	49.69	73.98	24.29	244	41	H	High
2772.880000	43.29	73.98	30.69	146	74	H	High
3697.538000	51.90	73.98	22.08	206	126	V	High

Average Measurements, 1 GHz- 10 GHz							
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**	**Channel**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**		
1811.280000	45.69	53.98	8.29	199	28	H	Low
2716.870000	37.08	53.98	16.9	170	73	H	Low
3622.414000	44.1	53.98	9.88	197	288	V	Low
4528.232000	36.3	53.98	17.68	109	205	V	Low
1829.990000	41.4	53.98	12.58	194	37	H	Mid
2745.060000	35.38	53.98	18.6	126	359	H	Mid
3660.016000	43.02	53.98	10.96	214	128	V	Mid
1848.720000	39.52	53.98	14.46	244	41	H	High
2772.880000	33.12	53.98	20.86	146	74	H	High
3697.538000	41.73	53.98	12.25	206	126	V	High

The EUT was maximized in all 3 orthogonal axis.
The worst-case (X axis) is shown in the table above.
Average Level = Peak Level – 10.17 dB (Duty Cycle Correction Factor from section 4.1)

4.3 PEAK OUTPUT POWER

Test Method: ANSI C63.10, Section(s) 7.8.5

Limits of bandwidth measurements:
For an FHSS system with 50 channels or more, the output power is required to be less than 1 W or 30 dBm.

EIRP was calculated from field strength measurements using ANSI C63.10:2013, Section 9.5, Equation (22). The field strength was measured at a 3m distance and maximized.

Test procedures:
All measurements were taken at a distance of 3m from the EUT.

The EUT was maximized in all 3 orthogonal positions in a similar manner as described in Section 4.2.

Deviations from test standard:
No deviation.

Test setup:

See Section 4.2

EUT operating conditions:
The EUT was powered by 12 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:
Refer to section 4.0 for the results table.

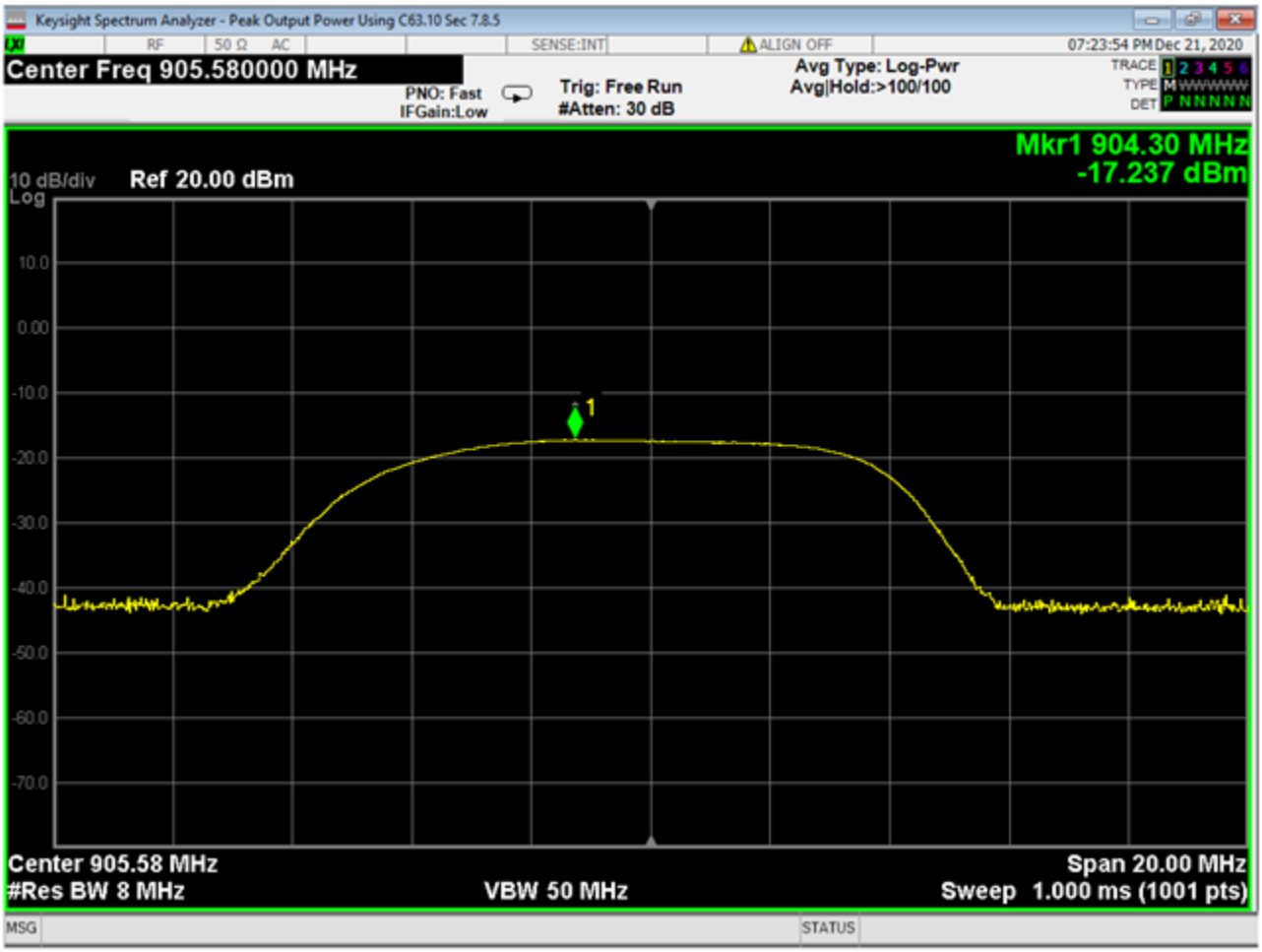


Figure 6 – Output Power, Low Channel.

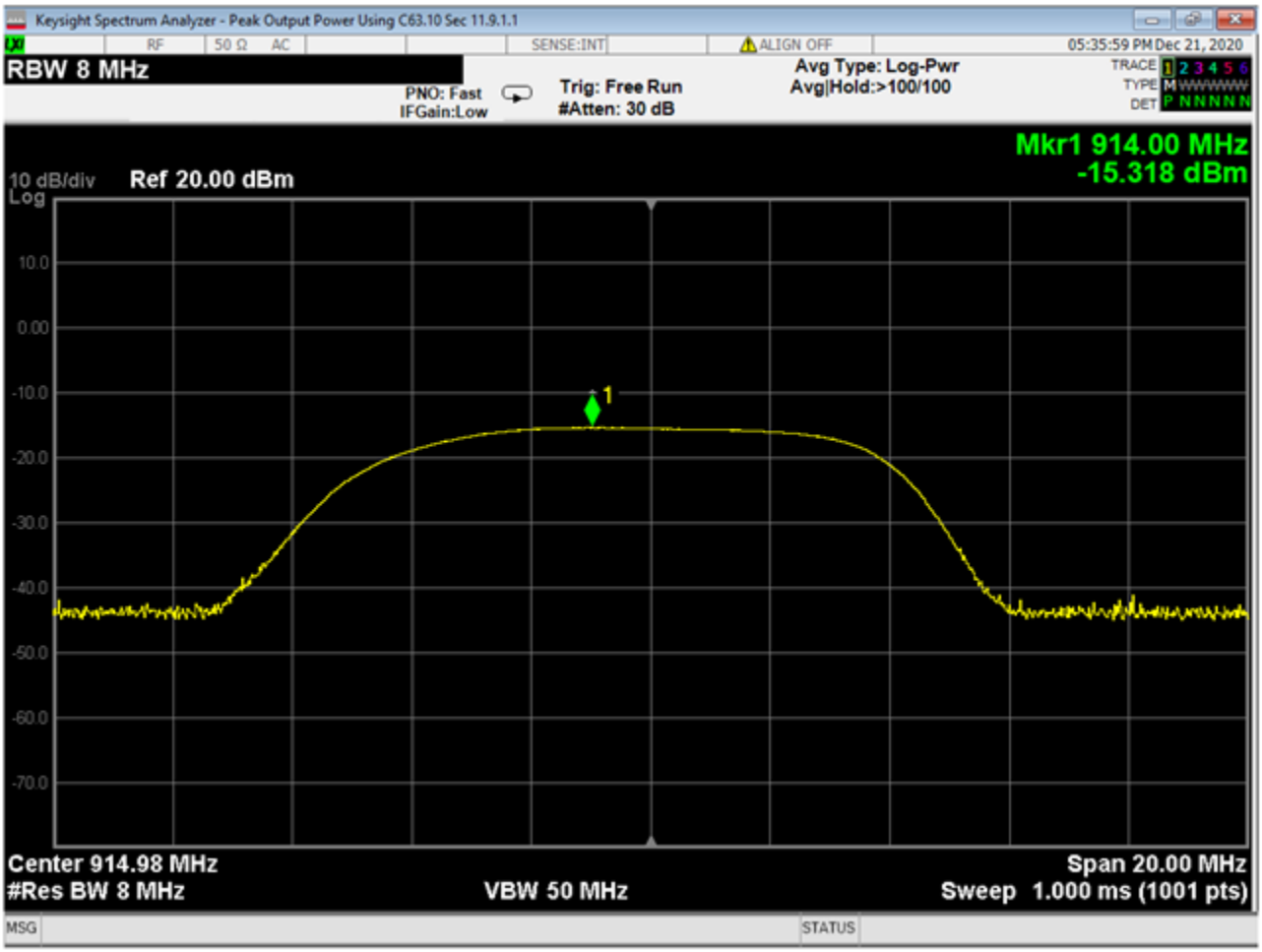


Figure 7 – Output Power, Mid Channel

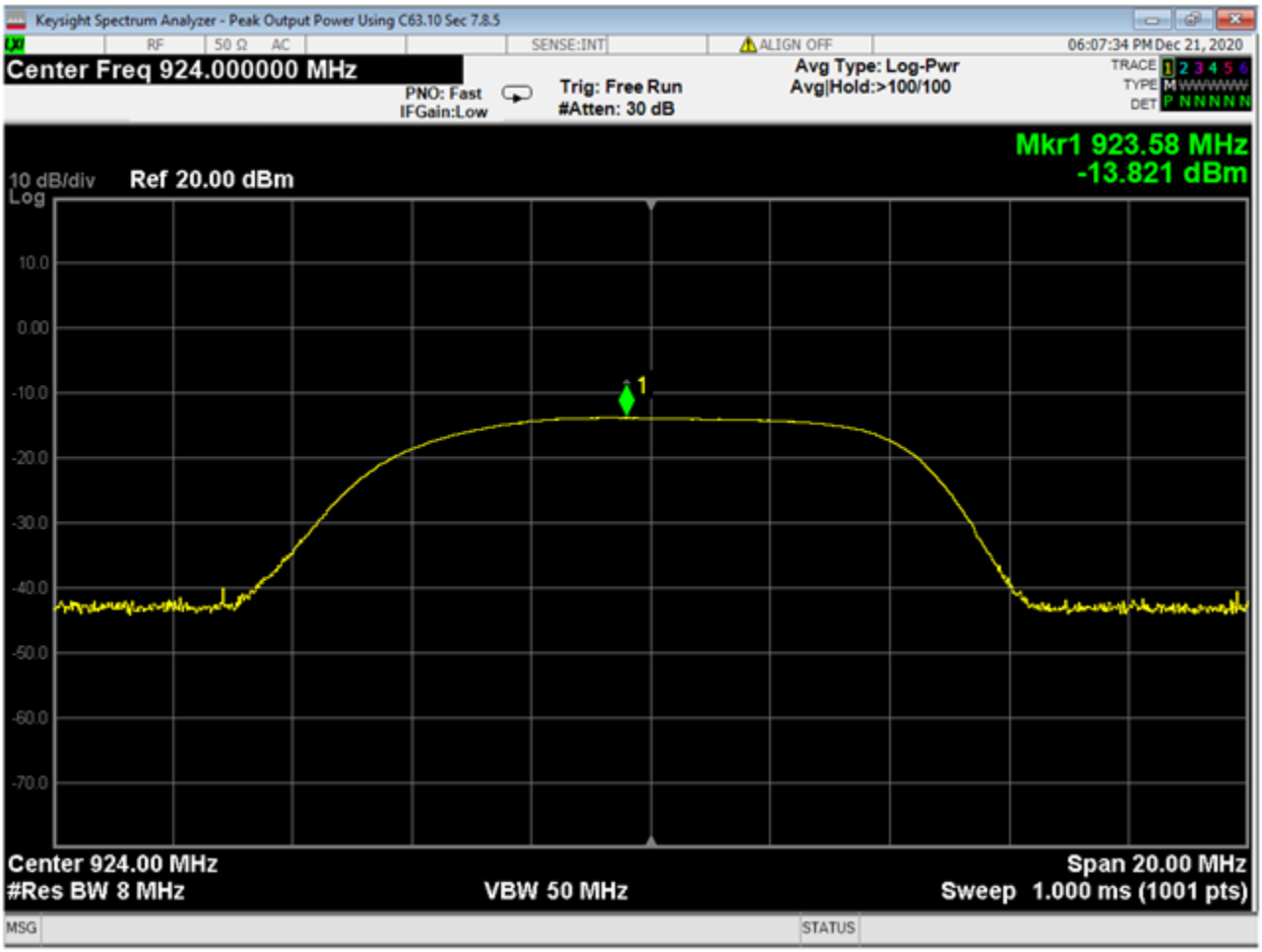


Figure 8 – Output Power, High Channel

4.4 BANDWIDTH

Test Method: ANSI C63.10, Section(s) 6.9.2 (20 dB BW)
ANSI C63.10, Section(s) 6.9.3 (99% BW)

Limits of bandwidth measurements:
From FCC Part 15.247 (1) (i) and RSS-247 5.1(c)

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

Test procedures:
Bandwidth measurement was taken at a distance of 3m from the EUT. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3 kHz RBW and 10 kHz VBW.

The 20dB bandwidth is defined as the bandwidth of which is higher than peak power minus 20dB.

The 99% occupied bandwidth was measured using the test receiver's occupied bandwidth function.

Test setup:

All the measurements were done at 3m test distance while an operator was trying to activate the hopping sequence manually. See Section 4.3 for more details.

Deviations from test standard:
No deviation.

Test setup:

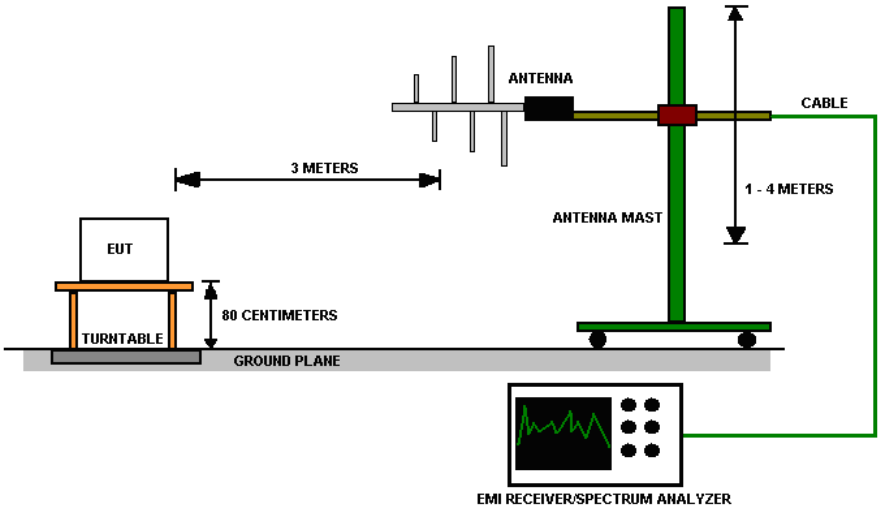


Figure 9 - Bandwidth Measurements Test Setup

EUT operating conditions:

The EUT was powered by 12 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:

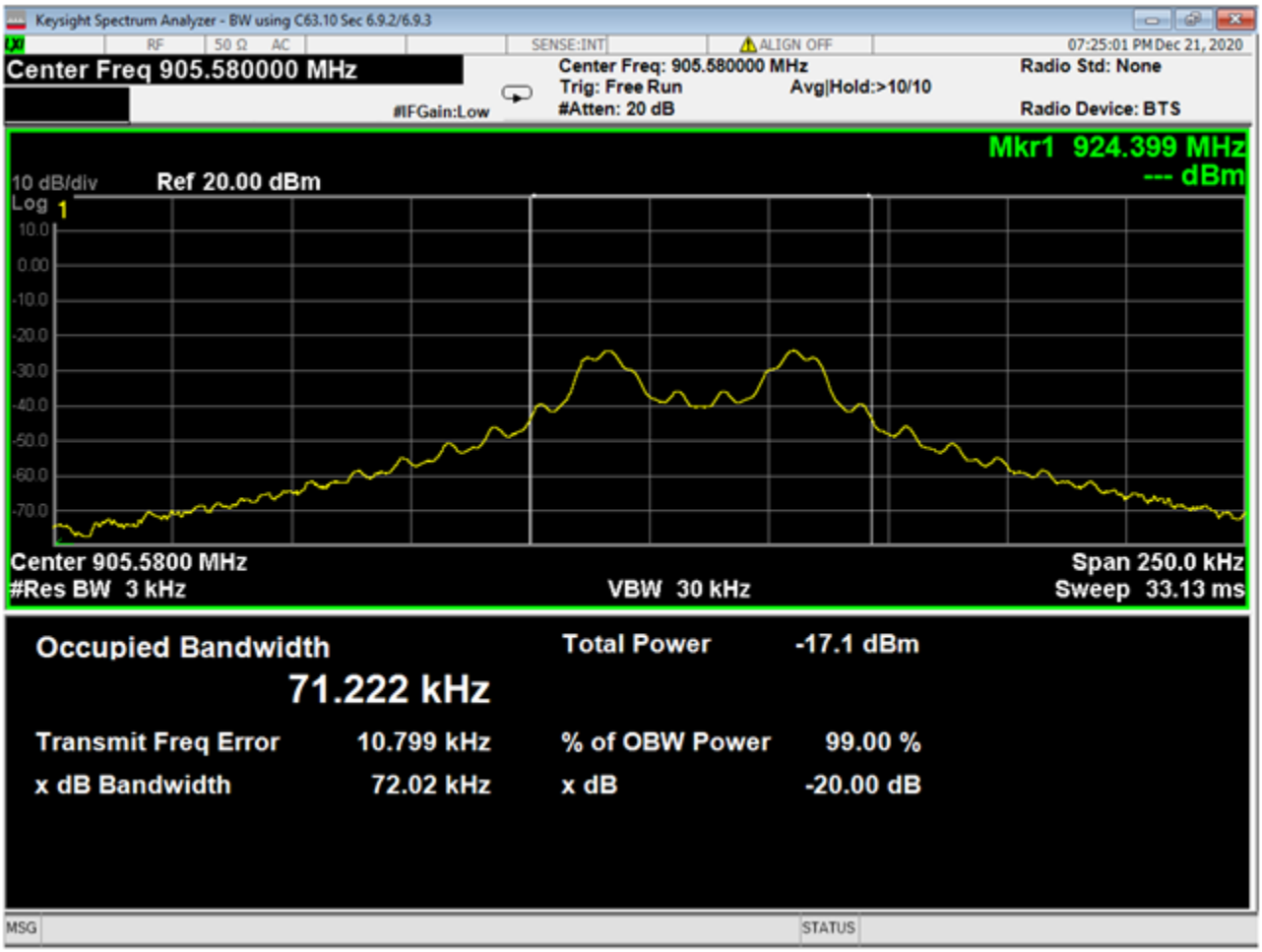


Figure 10 –Bandwidth, Low Channel

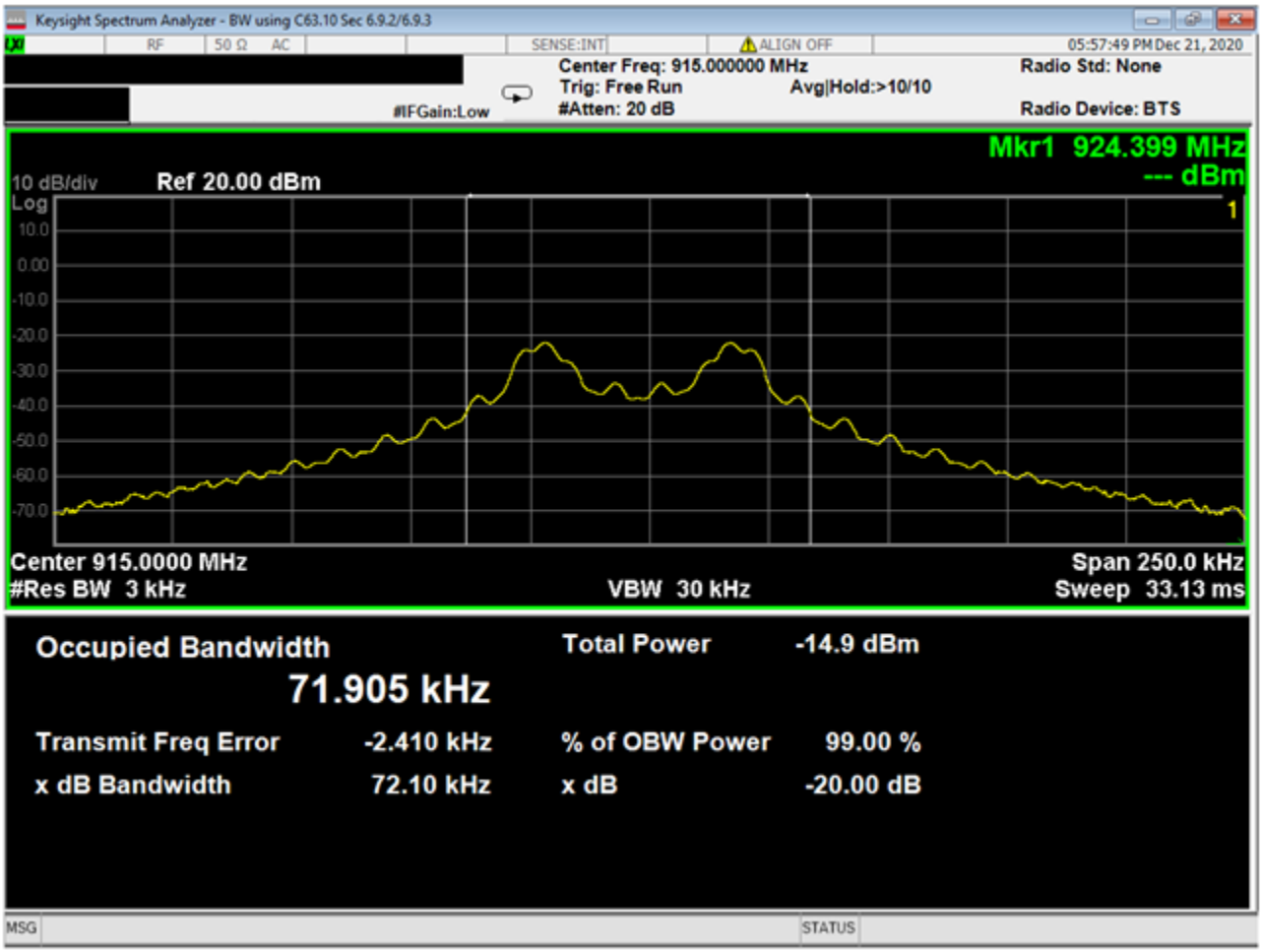


Figure 11 - Bandwidth, Mid Channel

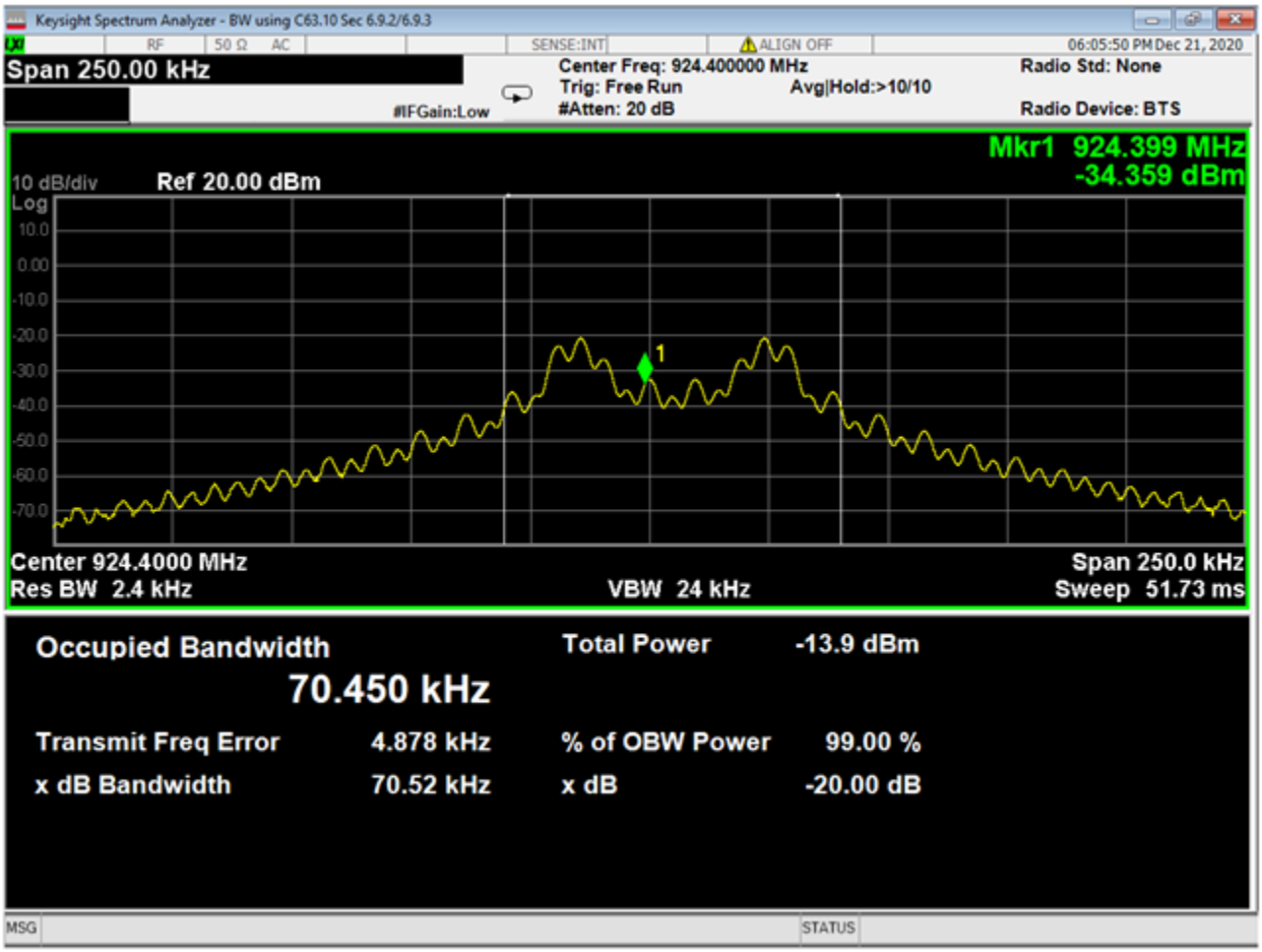


Figure 12 - Bandwidth, High Channel

4.5 BANDEDGES

Test Method: ANSI C63.10, Section(s) 6.10.6

Limits of bandedge measurements:
For emissions outside of the allowed band of operation (902 – 928MHz), the emission level needs to be 20dB under the maximum fundamental field strength. However, if the emissions fall within one of the restricted bands from 15.205 the field strength levels need to be under that of the limits in 15.209.

Test procedures:
The EUT was tested in the same method as described in section *4.4 - Bandwidth*. The EUT was oriented as to produce the maximum emission levels. The resolution bandwidth was set to 30kHz and the EMI receiver was used to scan from the bandedge to the fundamental frequency with a quasi-peak detector. The highest emissions level beyond the bandedge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209.

Deviations from test standard:
No deviation.

Test setup:
All the measurements were done at 3m test distance while an operator was trying to activate the hopping sequence manually.

EUT operating conditions:
The EUT was powered by 12 VDC unless specified and set to transmit continuously on the lowest frequency channel, and the highest frequency channel.

Test results:
Refer to section 4.0 for the results table.

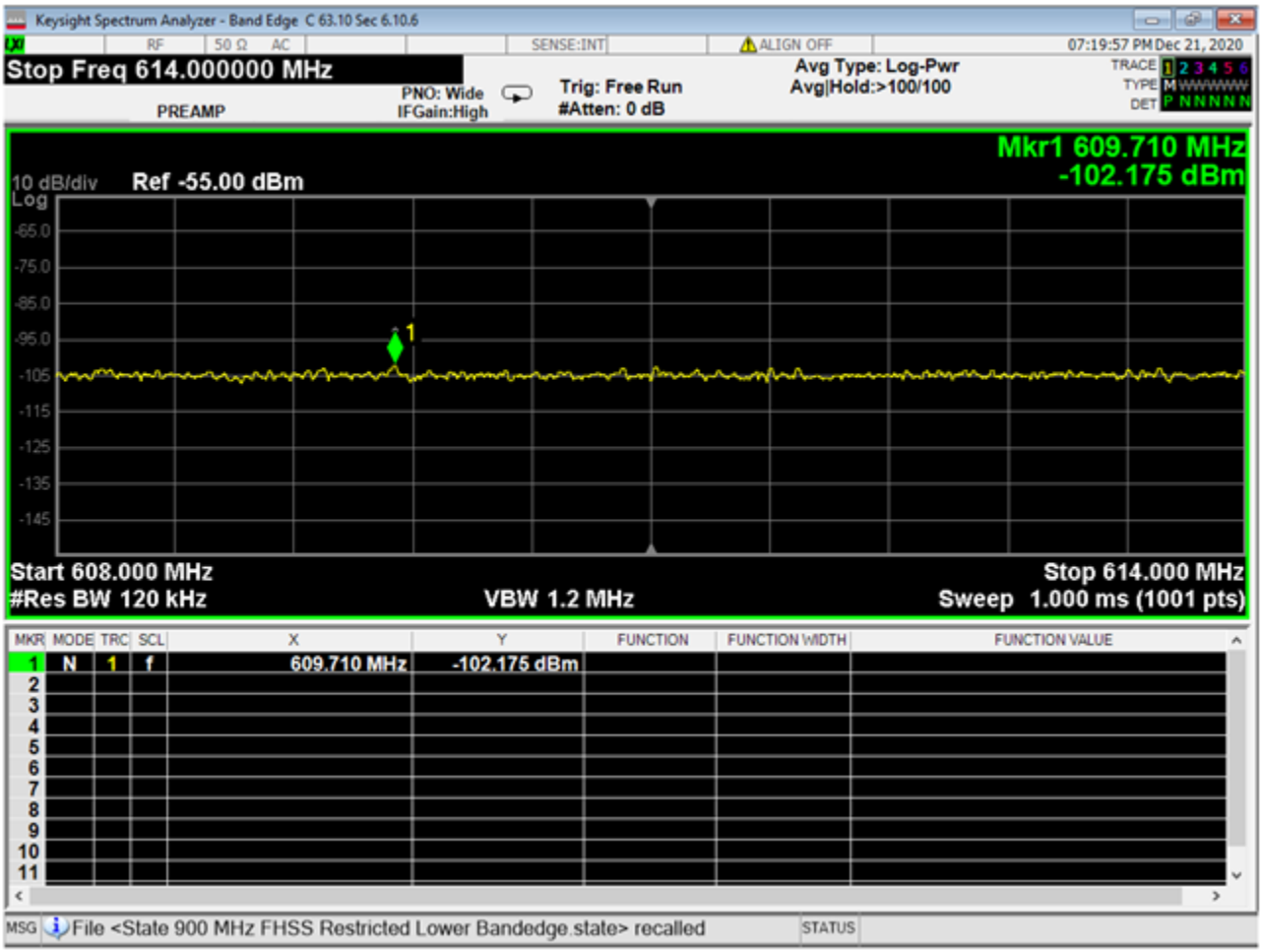


Figure 13 - Band-edge Measurement, Low Channel, Restricted Frequency, Continuous Transmit

The plot shows an uncorrected measurement, used for relative measurements only.

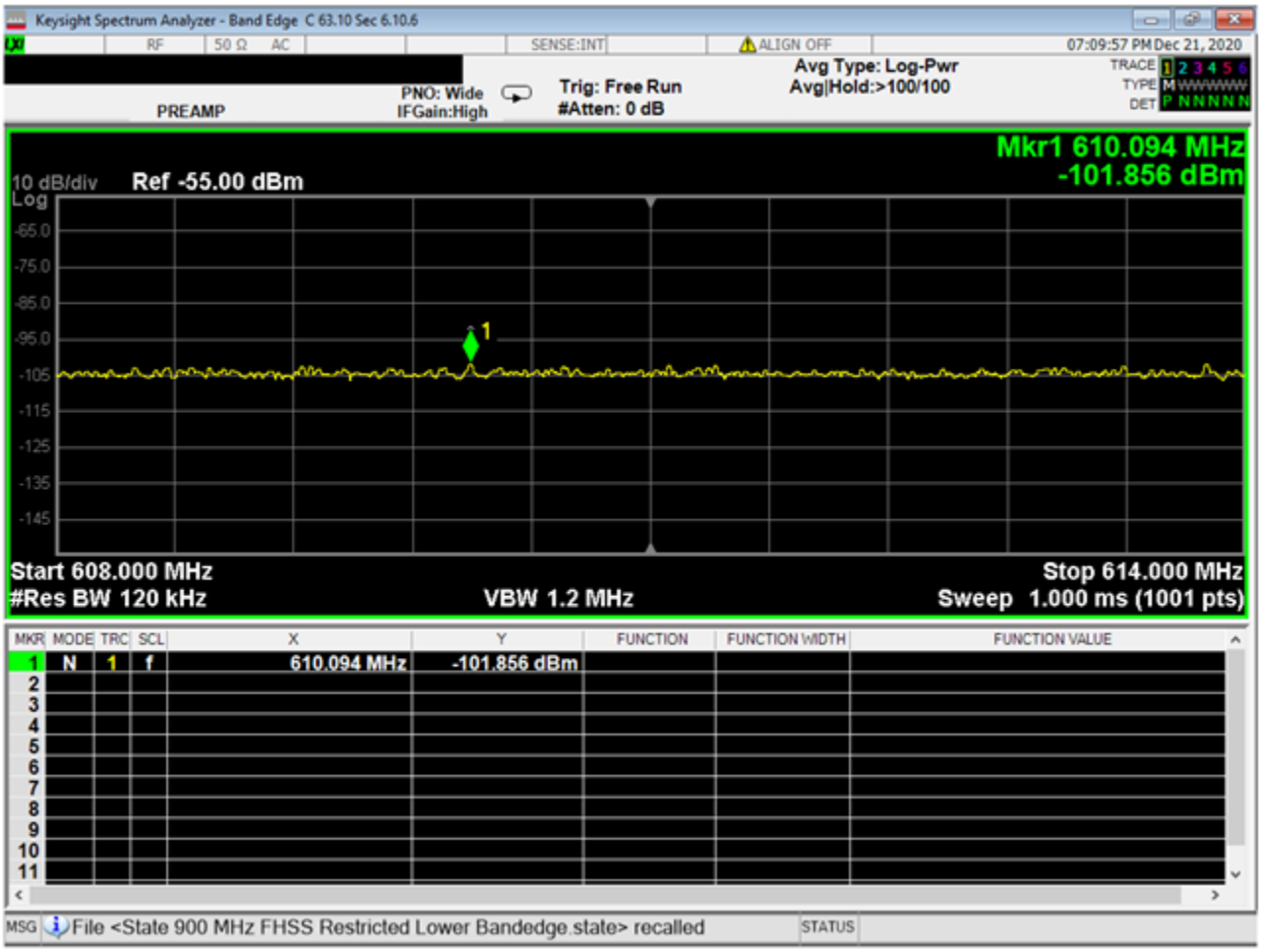


Figure 14 - Band-edge Measurement, Low Channel, Restricted Frequency, Hopping

The plot shows an uncorrected measurement, used for relative measurements only.

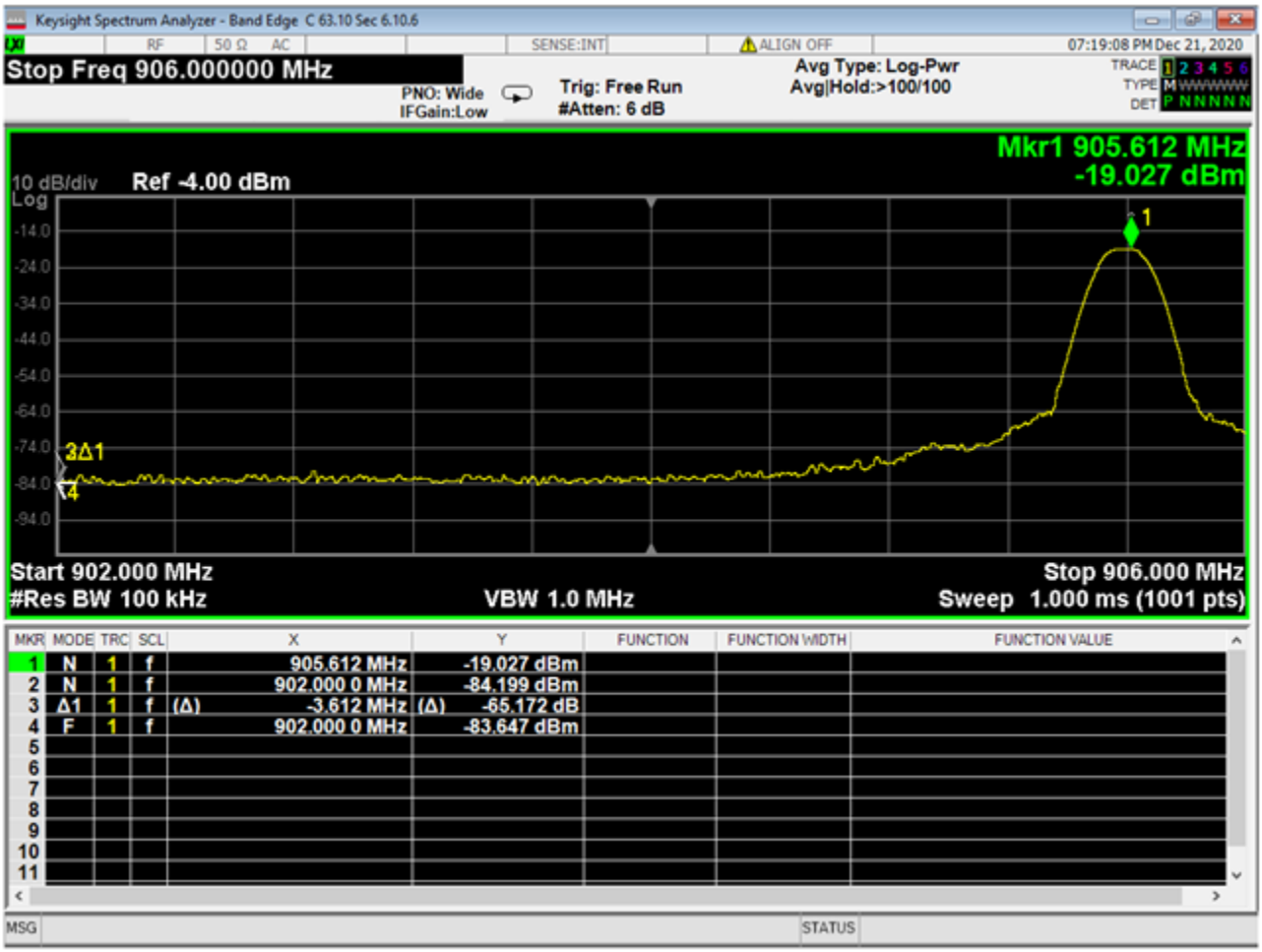


Figure 15 - Band-edge Measurement, Low Channel, Fundamental, Continuous Transmit

The plot shows an uncorrected measurement, used for relative measurements only.

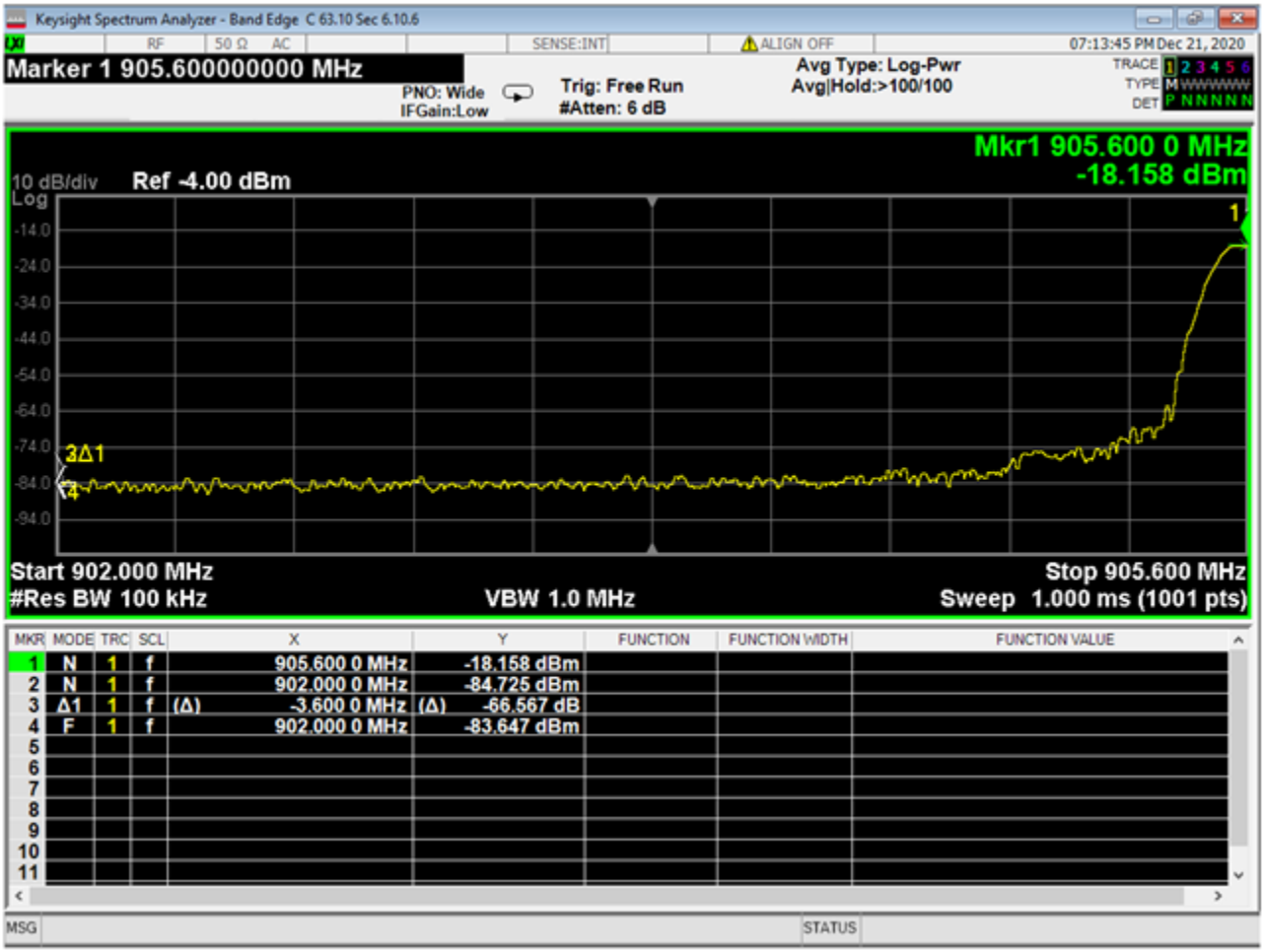


Figure 16 - Band-edge Measurement, Low Channel, Fundamental, Hopping Transmit

The plot shows an uncorrected measurement, used for relative measurements only.

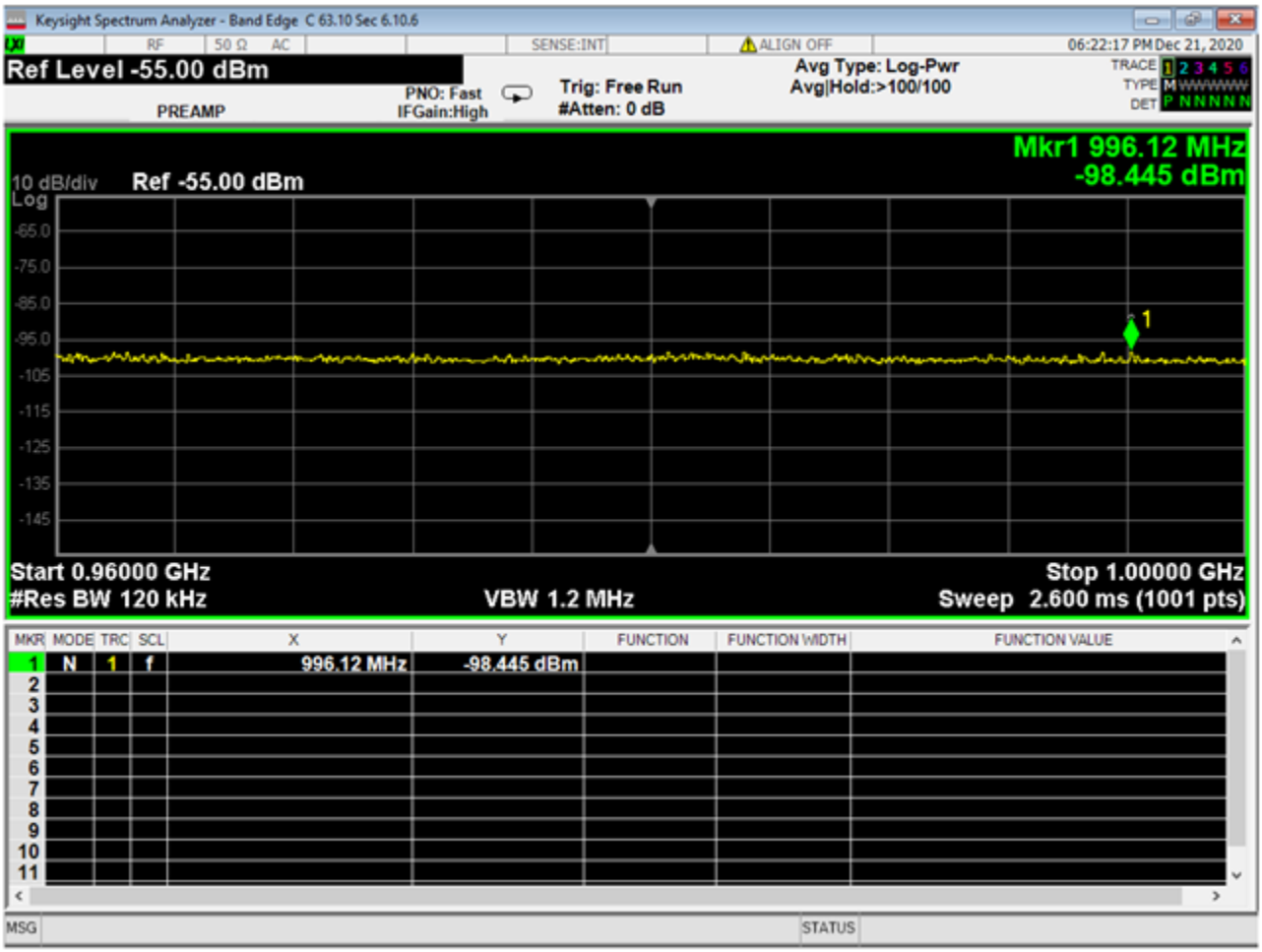


Figure 17 - Band-edge Measurement, High Channel, Restricted Frequency, Continuous Transmit

The plot shows an uncorrected measurement, used for relative measurements only.

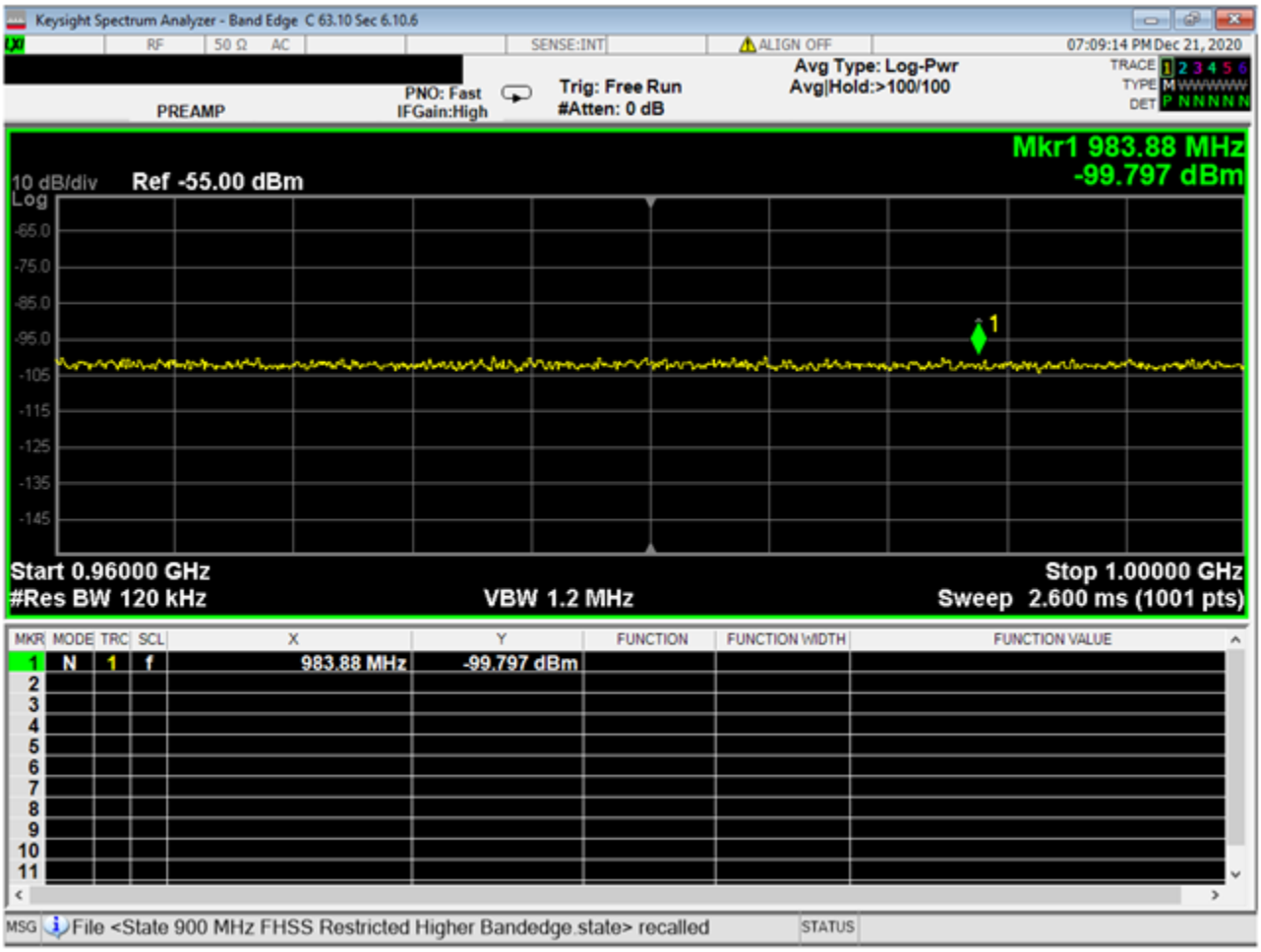


Figure 18 - Band-edge Measurement, High Channel, Restricted Frequency, Hopping

The plot shows an uncorrected measurement, used for relative measurements only.

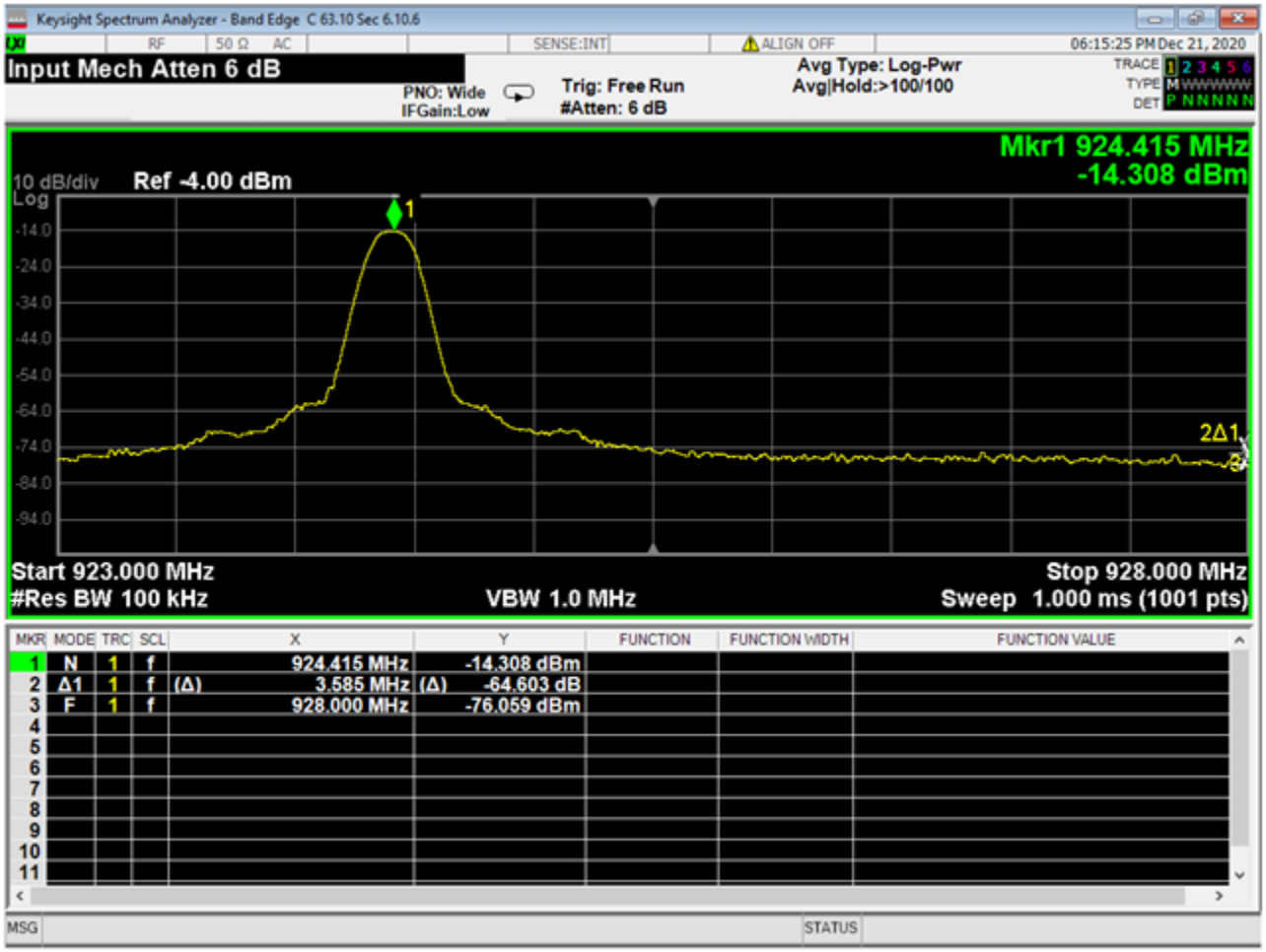


Figure 19 - Band-edge Measurement, High Channel, Fundamental, Continuous Transmit

The plot shows an uncorrected measurement, used for relative measurements only.

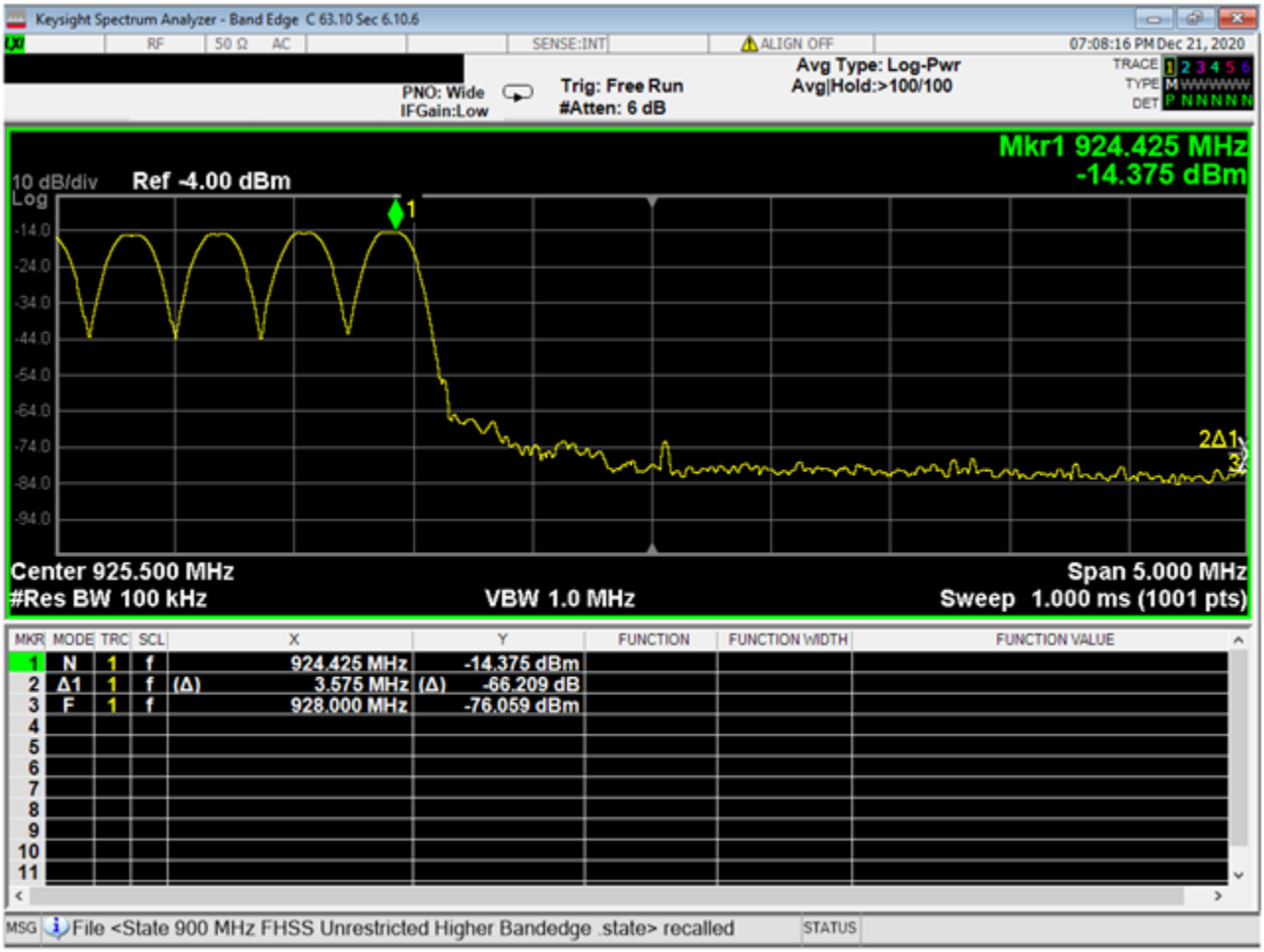


Figure 20 - Band-edge Measurement, High Channel, Fundamental, Hopping Transmit

The plot shows an uncorrected measurement, used for relative measurements only.

4.6 CARRIER FREQUENCY SEPERATION, NUMBER OF HOPPING CHANNELS, TIME OF OCCUPANCY

Test Method: ANSI C63.10, Section 7.8.2, 7.8.3, 7.8.4

Limits for Time of Occupancy
Average time of occupancy on any frequency should not to exceed 0.4 seconds within a 20 second period.

Test procedures:
The method from FCC DA 00-705

All measurements were taken at a distance of 3m from the EUT.

Test setup:
All the measurements were done at 3m test distance while an operator was trying to activate the hopping sequence manually.

EUT operating conditions:
The EUT was powered by 12 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.
Test results:
The EUT only transmits at most 13 packets per 20 s period and each packet is 30.56 ms. 13 x 30.56 = 0.39 sec <0.4 sec -Pass.

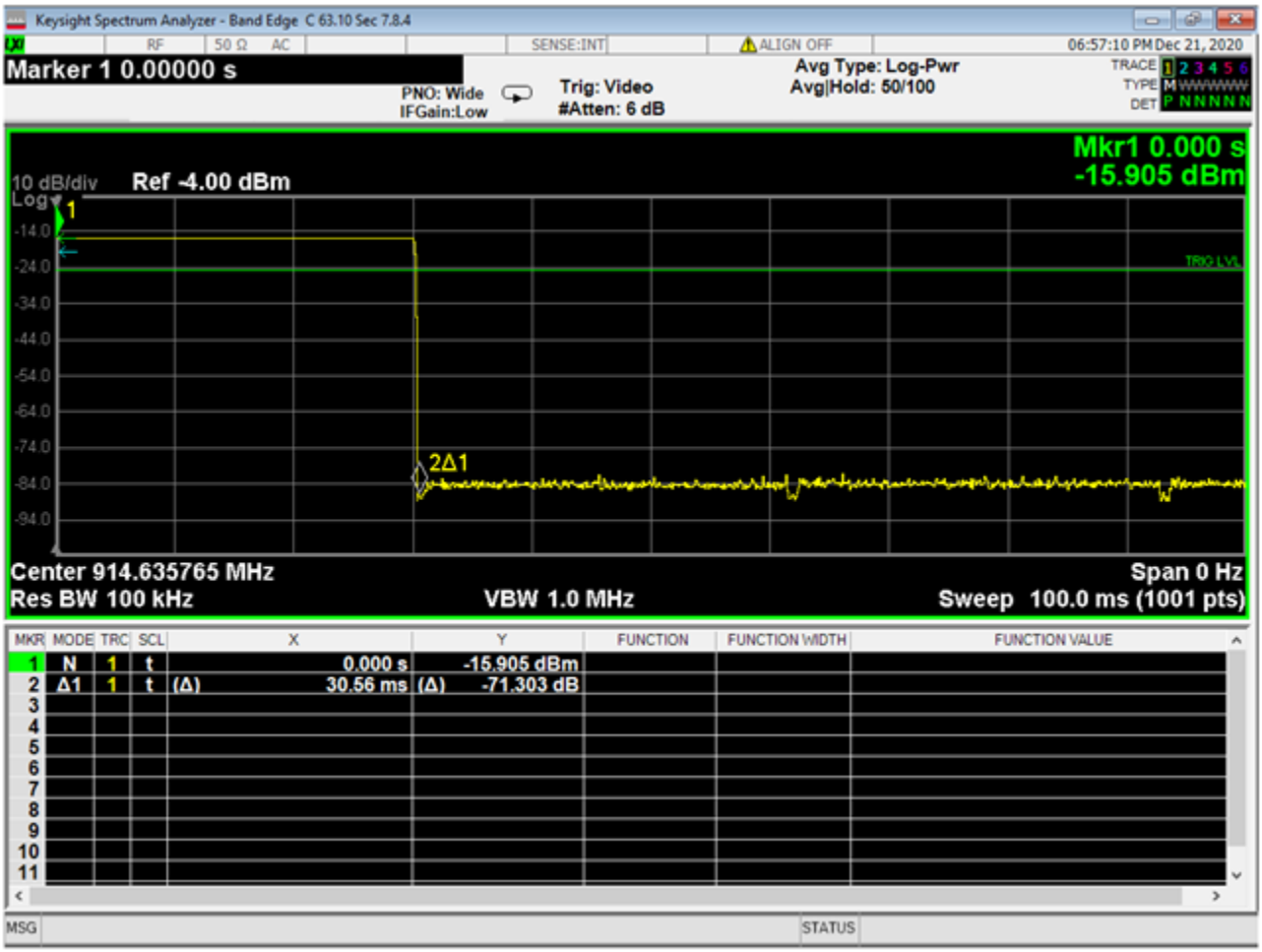


Figure 21 – On time, 30.56ms

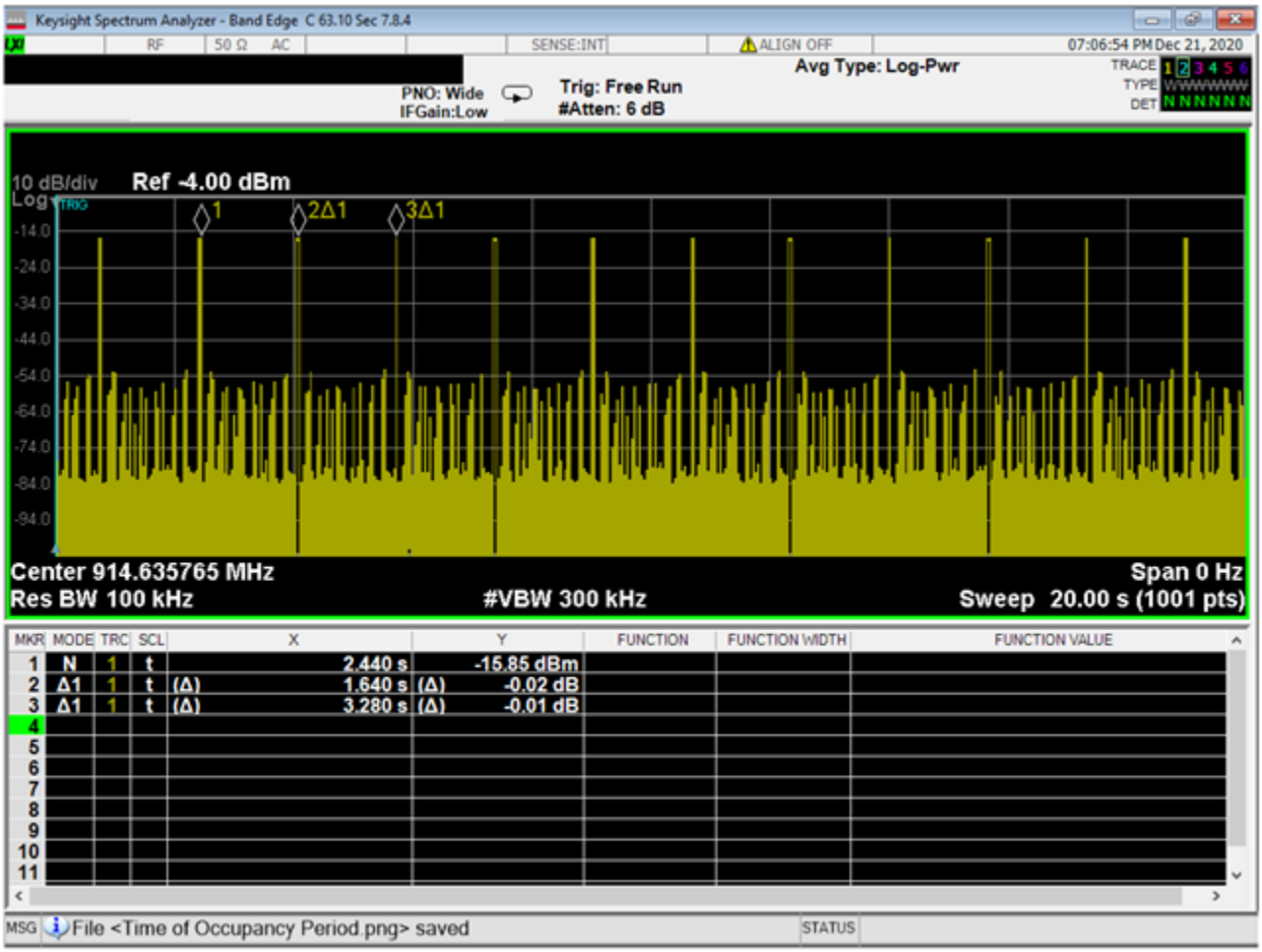


Figure 22 – Period, 1.6 sec.

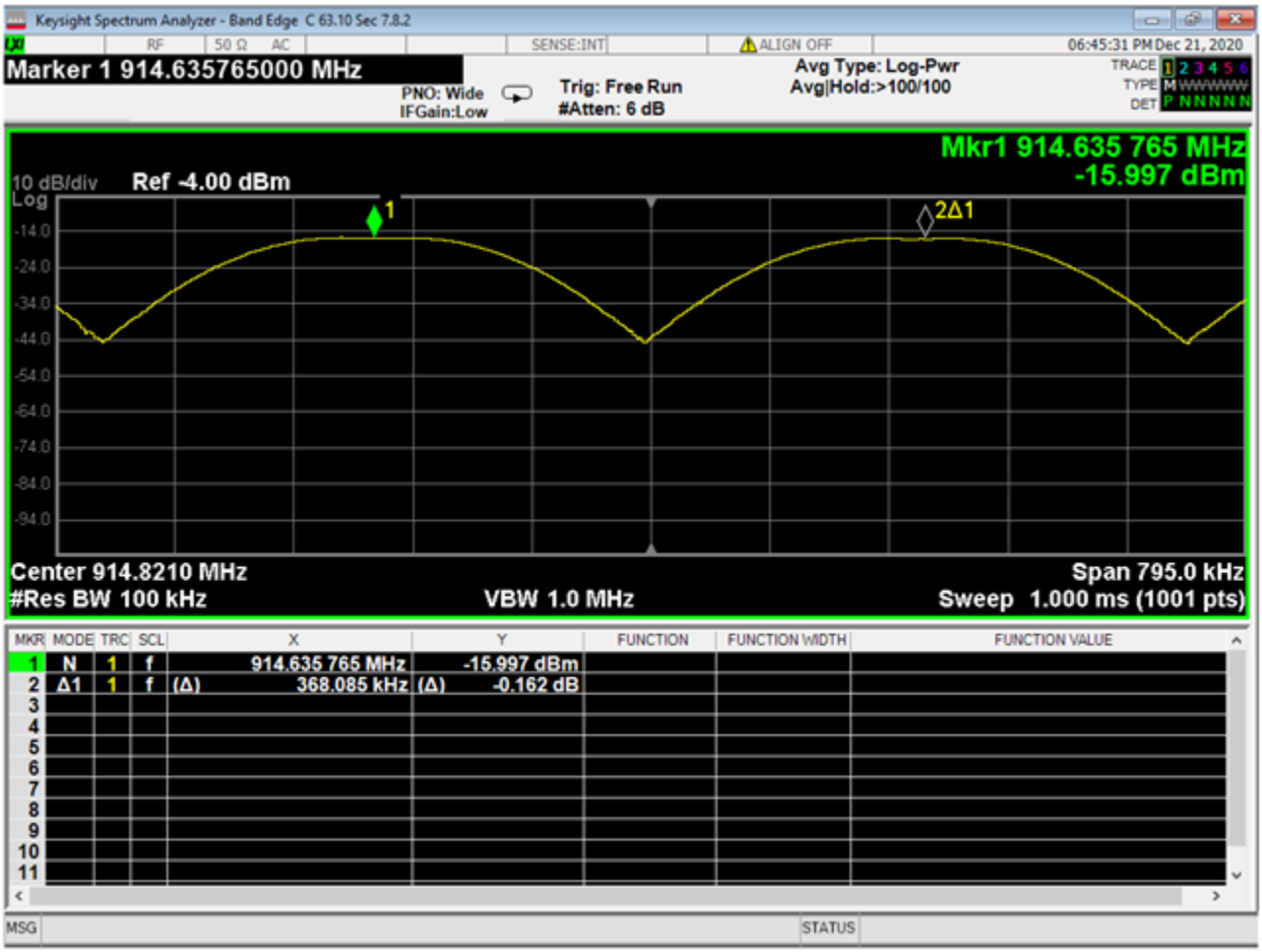


Figure 23 – Frequency Separation, 368.085 kHz

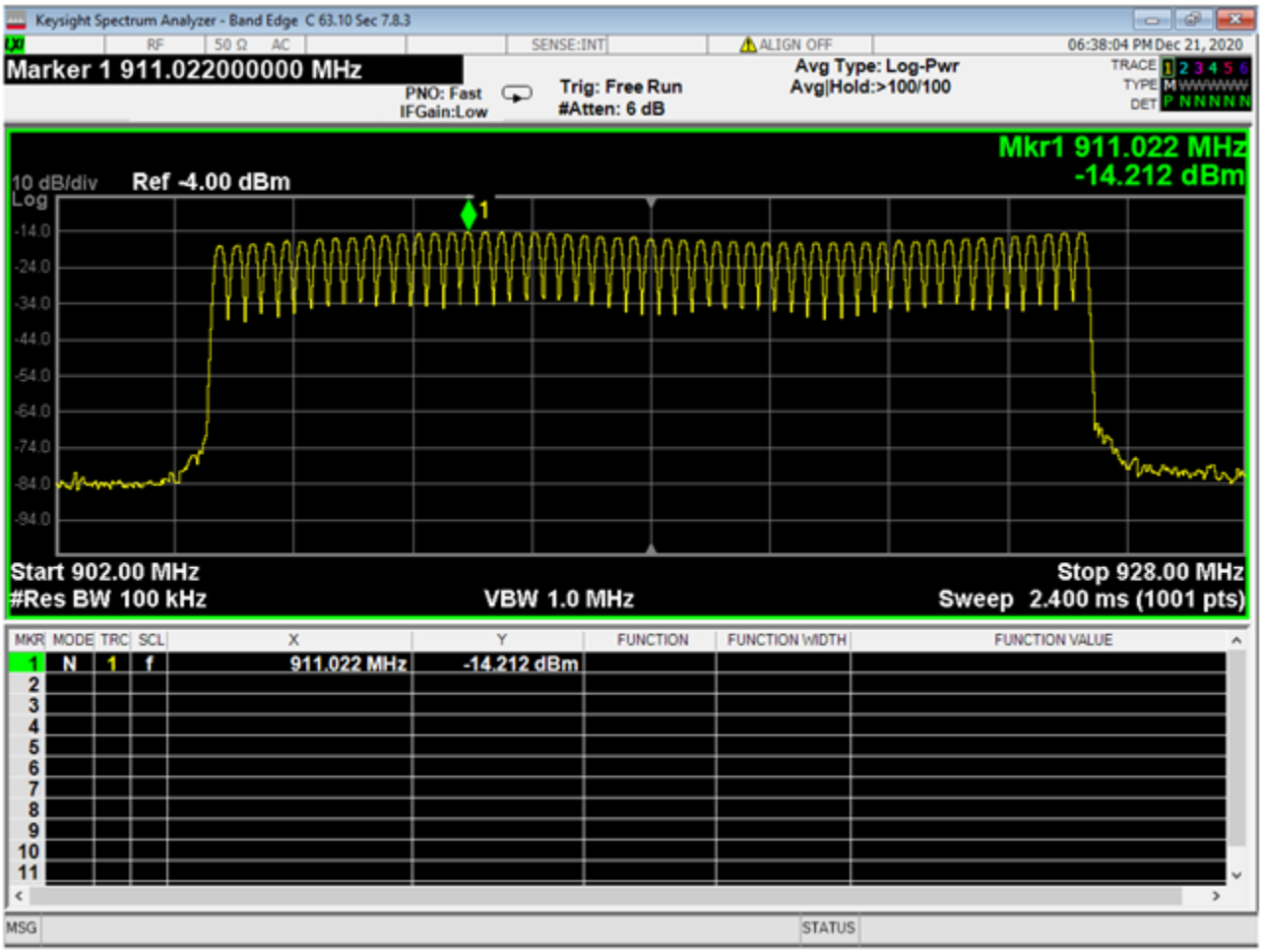


Figure 24 – Hop Count, 53 Hops

4.7 CONDUCTED AC MAINS EMISSIONS

Test Method: ANSI C63.10-2013, Section(s) 6.2

Limits for conducted emissions measurements:

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

Notes:
1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

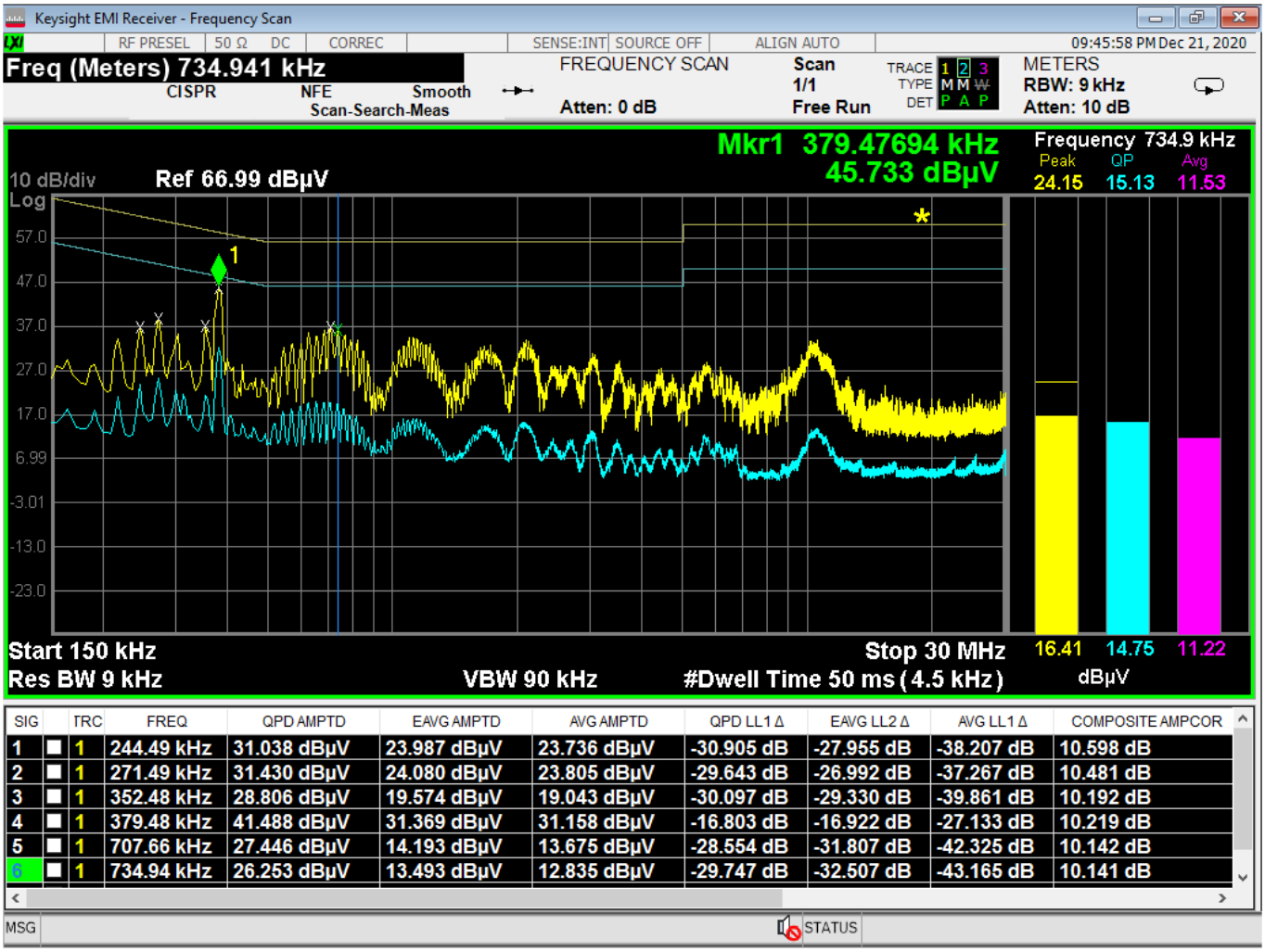
Test Procedures:

a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
d. Results were compared to the 15.207 limits.

Deviation from the test standard:
No deviation

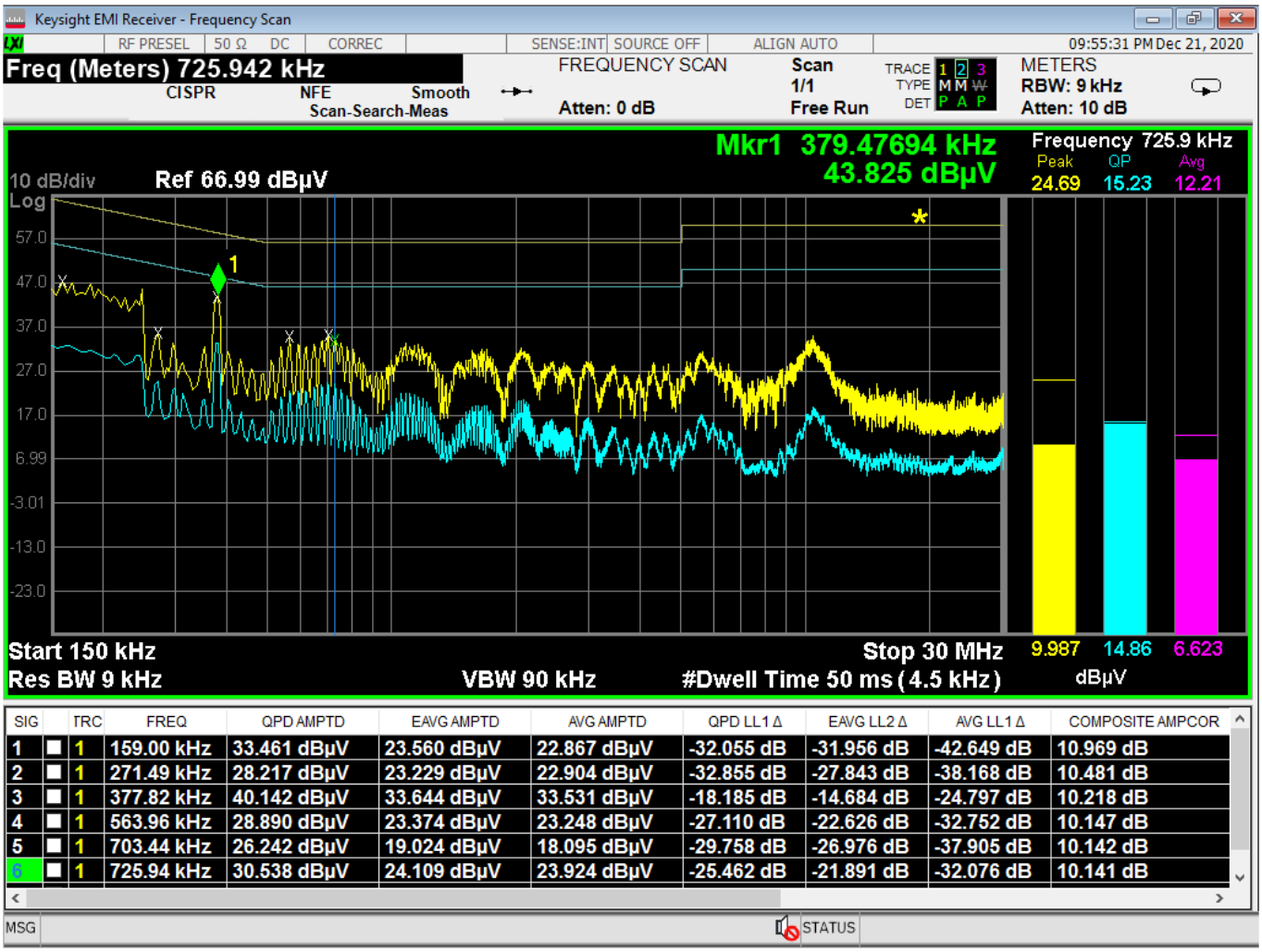
EUT operating conditions:
The EUT was powered by 12 VDC unless specified and set to transmit continuously on the middle channel.

Test Results:



SIG	TRC	FREQ	QPD AMPTD	EAVG AMPTD	AVG AMPTD	QPD LL1 Δ	EAVG LL2 Δ	AVG LL1 Δ	COMPOSITE AMPCOR
1	1	244.49 kHz	31.038 dBµV	23.987 dBµV	23.736 dBµV	-30.905 dB	-27.955 dB	-38.207 dB	10.598 dB
2	1	271.49 kHz	31.430 dBµV	24.080 dBµV	23.805 dBµV	-29.643 dB	-26.992 dB	-37.267 dB	10.481 dB
3	1	352.48 kHz	28.806 dBµV	19.574 dBµV	19.043 dBµV	-30.097 dB	-29.330 dB	-39.861 dB	10.192 dB
4	1	379.48 kHz	41.488 dBµV	31.369 dBµV	31.158 dBµV	-16.803 dB	-16.922 dB	-27.133 dB	10.219 dB
5	1	707.66 kHz	27.446 dBµV	14.193 dBµV	13.675 dBµV	-28.554 dB	-31.807 dB	-42.325 dB	10.142 dB
6	1	734.94 kHz	26.253 dBµV	13.493 dBµV	12.835 dBµV	-29.747 dB	-32.507 dB	-43.165 dB	10.141 dB

Figure 25 - Conducted Emissions, Line



SIG	TRC	FREQ	QPD AMPTD	EAVG AMPTD	AVG AMPTD	QPD LL1 Δ	EAVG LL2 Δ	AVG LL1 Δ	COMPOSITE AMPCOR
1	1	159.00 kHz	33.461 dBµV	23.560 dBµV	22.867 dBµV	-32.055 dB	-31.956 dB	-42.649 dB	10.969 dB
2	1	271.49 kHz	28.217 dBµV	23.229 dBµV	22.904 dBµV	-32.855 dB	-27.843 dB	-38.168 dB	10.481 dB
3	1	377.82 kHz	40.142 dBµV	33.644 dBµV	33.531 dBµV	-18.185 dB	-14.684 dB	-24.797 dB	10.218 dB
4	1	563.96 kHz	28.890 dBµV	23.374 dBµV	23.248 dBµV	-27.110 dB	-22.626 dB	-32.752 dB	10.147 dB
5	1	703.44 kHz	26.242 dBµV	19.024 dBµV	18.095 dBµV	-29.758 dB	-26.976 dB	-37.905 dB	10.142 dB
6	1	725.94 kHz	30.538 dBµV	24.109 dBµV	23.924 dBµV	-25.462 dB	-21.891 dB	-32.076 dB	10.141 dB

Figure 26 - Conducted Emissions, Neutral

APPENDIX A: SAMPLE CALCULATION

Field Strength Calculation

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

FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBμV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBμV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 254.1 μV/m

AV is calculated by the taking the 20*log(T_{on}/100) where T_{on} is the maximum transmission time in any 100ms window.

EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

EIRP (Watts) = [Field Strength (V/m) x antenna distance (m)]^2 / 30
Power (watts) = 10^[Power (dBm)/10] / 1000
Voltage (dBµV) = Power (dBm) + 107 (for 50Ω measurement systems)
Field Strength (V/m) = 10^[Field Strength (dBµV/m) / 20] / 10^6
Gain = 1 (numeric gain for isotropic radiator)
Conversion from 3m field strength to EIRP (d=3):

EIRP = [FS(V/m) x d^2]/30 = FS [0.3] for d = 3

EIRP(dBm) = FS(dBµV/m) – 10(log 10^9)+ 10log[0.3] = FS(dBµV/m) - 95.23

10log(10^9) is the conversion from micro to milli

APPENDIX B – MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	30MHz – 18GHz	±3.30 dB

Expanded uncertainty values are calculated to a confidence level of 95%.

REPORT END