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Test Report

Prepared for: **RealmFive, Inc.**

Address: **3300 Folkways Cir.**
Lincoln, NE 68504

Product: **SID-Flex**

Test Report No: **R20171017-22-04A**

Approved By:

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Nic S. Johnson, NCE
Technical Manager
iNARTE Certified EMC Engineer #EMC-003337-NE

DATE: **12 June 2023**

Total Pages: **52**

REVISION PAGE

Rev. No.	Date	Description
0	24 October 2018	Original – NJohnson Prepared by KVepuri
A	12 June 2023	Added note to pg 46

CONTENTS

1.0 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARDS AND REGULATIONS		
Standard Section	**Test Type**	**Result**
FCC Part 15.35 RSS Gen, Issue 4, Section 6.10	Duty Cycle	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Peak output power	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 4, Section 7.1	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 4, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass
FCC 15.247(a) (1) (i) RSS-247, 5.1(c)	Frequency Hopping System	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 11.13	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 4, Section 7.1	Conducted Emissions	Not applicable. Battery power only, no charger.
FCC 15.203	Unique Antenna Requirement	Pass

See Section 4 for details on the test methods used for each test.

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

EUT	SID-Flex
EUT Received	11 October 2018
EUT Tested	11 October 2018- 12 October 2018
Serial No.	NCEETEST1 (Assigned)
Operating Band	902.0 – 928.0 MHz
Device Type	Hybrid
Power Supply	Internal Battery/ Solar Powered

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	902.3
Middle	908.5
High	914.9

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

All testing was performed by Karthik Vepuri of NCEE Labs. The results were reviewed by Nic Johnson.

3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Rohde & Schwarz Test Receiver	ES126	100037	30 Jan 2018	30 Jan 2019
EMCO Biconilog Antenna	3142B	1647	02 Aug 2017	02 Aug 2018**
EMCO Horn Antenna	3115	6416	26 Jan 2018	26 Jan 2020
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	09 Mar 2018*	09 Mar 2019*
Trilithic High Pass Filter	6HC330	23042	09 Mar 2018*	09 Mar 2019*
Mini Circuits 1700 – 5000Mhz High Pass Filter***	15542	31618	16 April 2018*	16 April 2019*
RF Cable (preamplifier to antenna)	MFR-57500	01-07-002	09 Mar 2018*	09 Mar 2019*
RF Cable (antenna to 10m chamber bulkhead)	FSCM 64639	01E3872	09 Mar 2018*	09 Mar 2019*
RF Cable (10m chamber bulkhead to control room bulkhead)	FSCM 64639	01E3874	09 Mar 2018*	09 Mar 2019*
RF Cable (Control room bulkhead to RF switch)	FSCM 64639	01E3871	09 Mar 2018*	09 Mar 2019*
RF Cable (RF switch to test receiver)	FSCM 64639	01F1206	09 Mar 2018*	09 Mar 2019*
RF switch – Rohde and Schwarz	TS-RSP	1113.5503.14	09 Mar 2018*	09 Mar 2019*
N connector bulkhead (10m chamber)	PE9128	NCEEBH1	09 Mar 2018*	09 Mar 2019*
N connector bulkhead (control room)	PE9128	NCEEBH2	09 Mar 2018*	09 Mar 2019*

*Internal Characterization
**Extended cal

4.0 DETAILED RESULTS

4.1 DUTY CYCLE

Not applicable

4.2 RADIATED EMISSIONS

Test Method: ANSI C63.10:2013, Section 6.5, 6.6, 11.11, 11.12

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 only one axis as it is intended to be placed in one orientation only. The results are presented in that axis.

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:

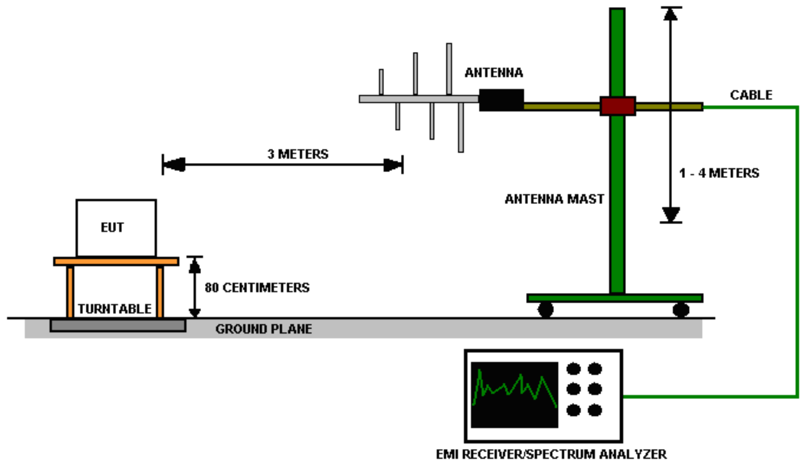

Figure 1 - Radiated Emissions Test Setup

EUT operating conditions

The EUT was powered by 6.4 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:

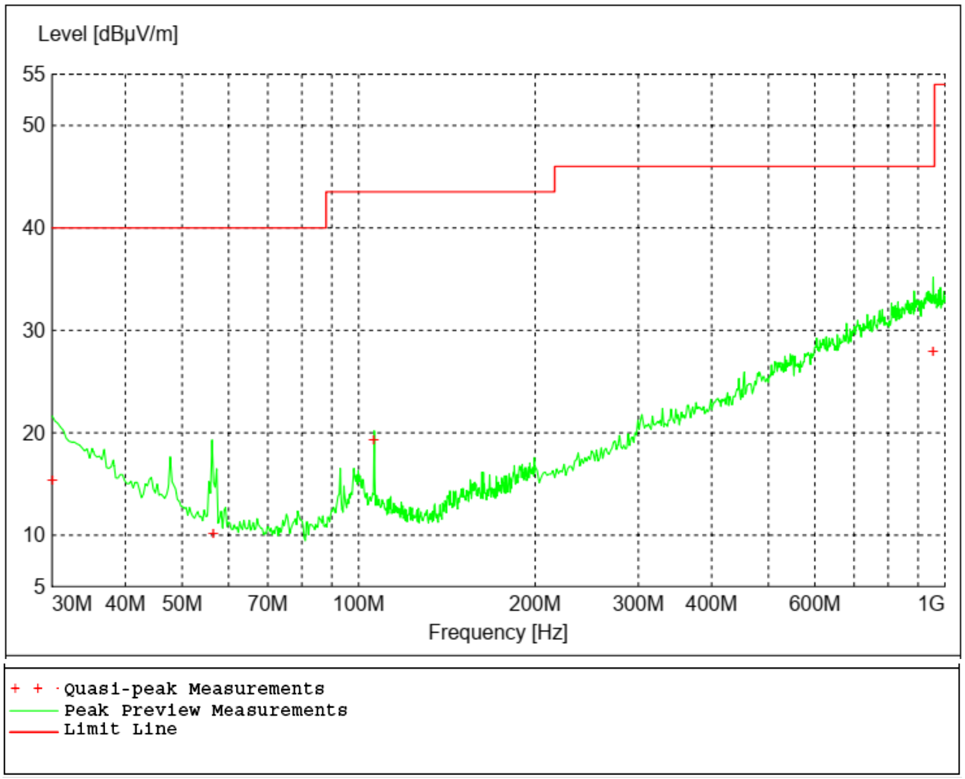

Figure 2 - Radiated Emissions Plot, Receive

Table 1 - Radiated Emissions Quasi-peak Measurements, Receive

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm.	Angle deg.	Pol
30.060000	15.31	40.00	24.70	145	349	HORI
56.520000	10.13	40.00	29.90	100	50	VERT
106.260000	19.27	43.50	24.30	309	304	VERT
954.480000	27.95	46.00	18.10	100	128	HORI
30.060000	15.31	40.00	24.70	145	349	HORI
56.520000	10.13	40.00	29.90	100	50	VERT

Table 2 - Radiated Emissions Peak Measurements vs. Average Limit, Receive

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm.	Angle deg.	Pol
1795.000000	34.57	54.00	19.40	175	336	VERT
2697.000000	33.57	54.00	20.40	219	103	HORI

Peak measurements were compared to average limit and found to be compliant so average measurements were not performed

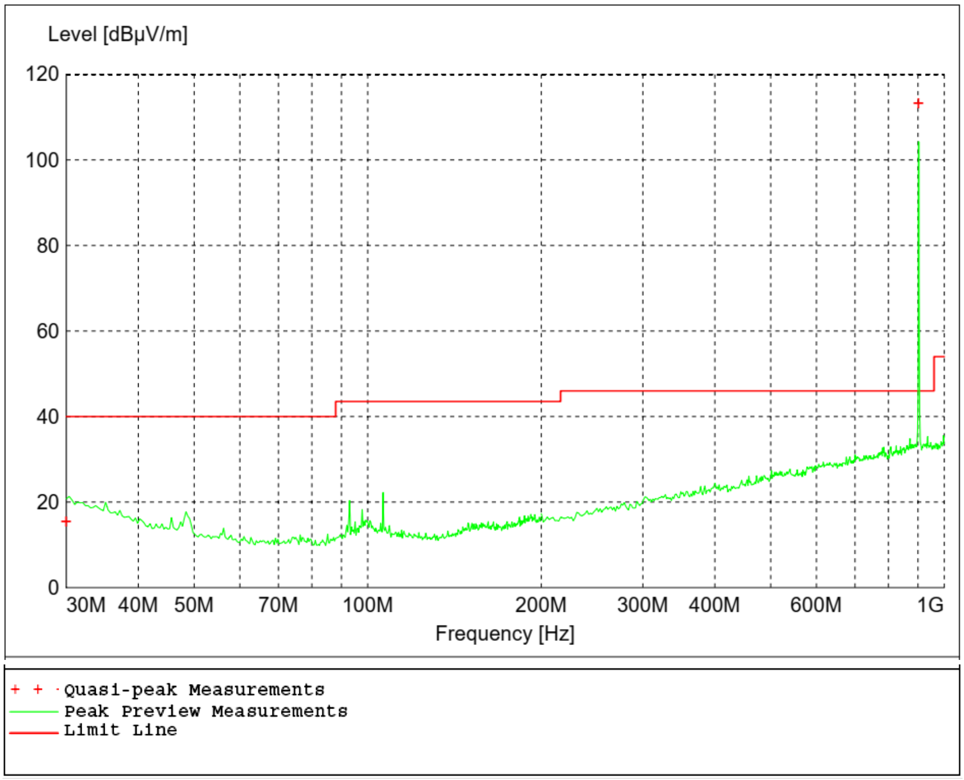

Figure 3 - Radiated Emissions Plot, Low Channel

Table 3 - Radiated Emissions Quasi-peak Measurements, Low Channel

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm.	Angle deg.	Pol
30.000000	15.35	40.00	24.70	397	284	HORI
902.300000	113.15	NA	NA	203	61	HORI

Table 4 - Radiated Emissions Peak Measurements vs. Average Limit, Low Channel

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm.	Angle deg.
1804.600000*	50.02	93.15	43.13	164	226
2707.000000	46.42	54.00	7.60	211	221
3609.200000	45.60	54.00	8.40	278	221

Peak measurements were compared to average limit and found to be compliant so average measurements were not performed

*Unrestricted band

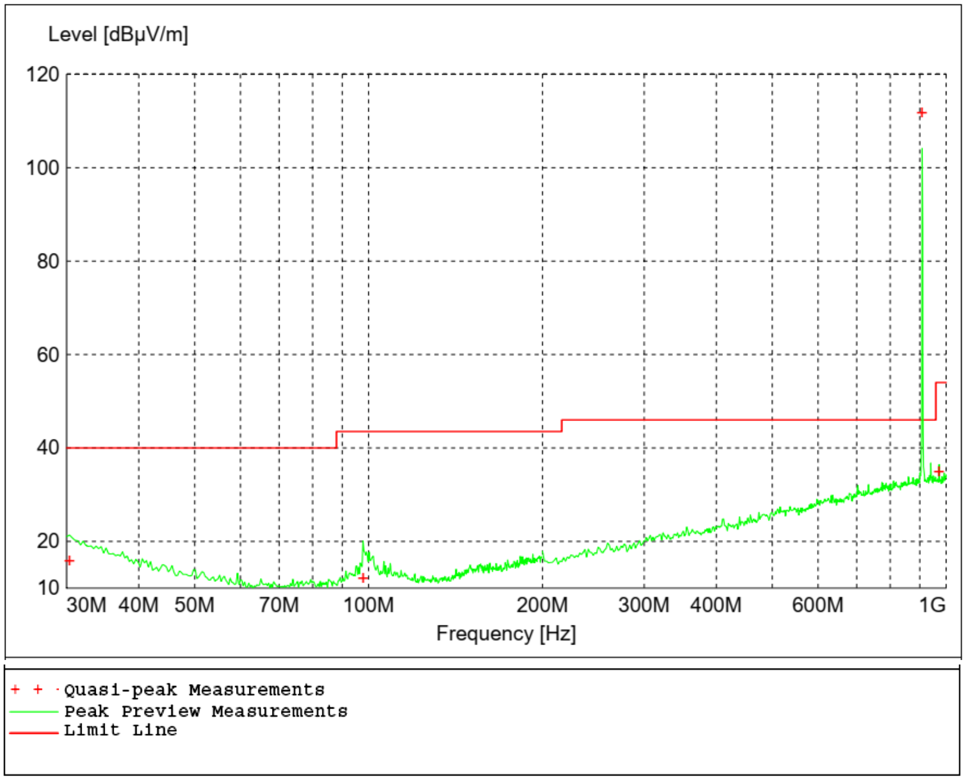

Figure 4 - Radiated Emissions Plot, Mid Channel

Table 5 - Radiated Emissions Quasi-peak Measurements, Mid Channel

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm.	Angle deg.	Pol
30.360000	15.82	40.00	24.20	163	197	VERT
97.920000	12.17	43.50	31.40	250	232	VERT
908.500000	111.78	NA	NA	107	329	VERT
972.480000	35.07	54.00	18.90	100	196	VERT

Table 6 - Radiated Emissions Peak Measurements vs. Average Limit, Mid Channel

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm.	Angle deg.	Pol
1817.000000*	55.10	91.78	36.68	160	231	HORI
2725.600000	50.06	54.00	3.90	237	223	HORI
3634.000000	45.37	54.00	8.60	298	216	HORI
4551.600000	44.15	54.00	9.80	399	204	HORI
5453.800000	43.22	54.00	10.80	100	4	VERT

Peak measurements were compared to average limit and found to be compliant so average measurements were not performed

*Unrestricted band

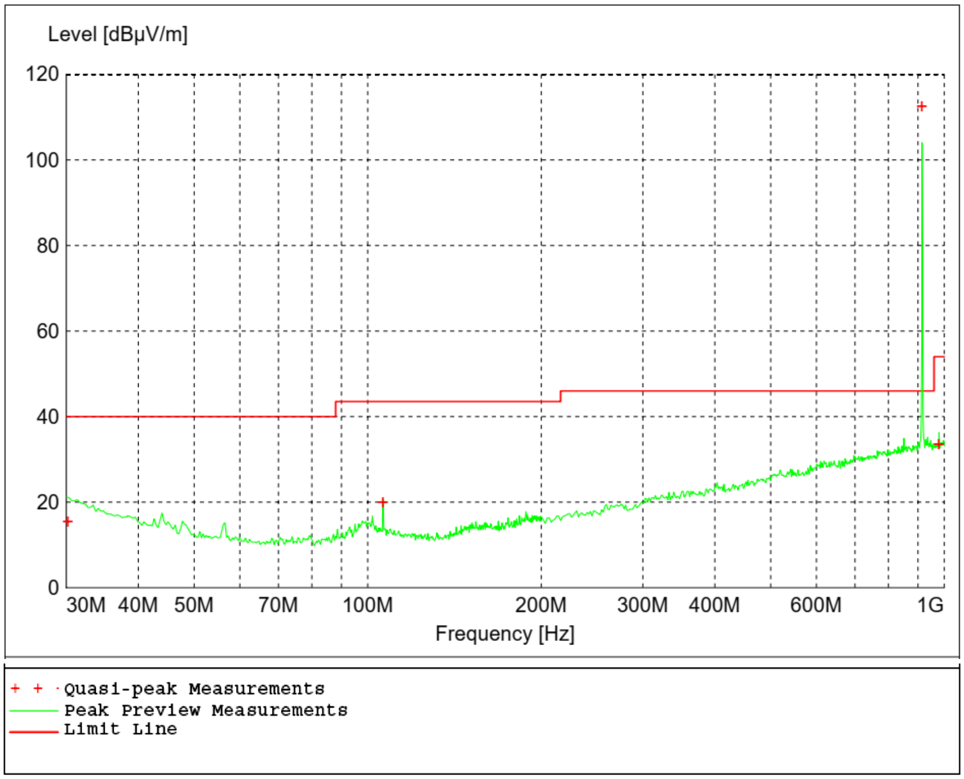

Figure 5 - Radiated Emissions Plot, High Channel

Table 7 - Radiated Emissions Quasi-peak Measurements, High Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBμV/m	dBμV/m	dB	cm.	deg.	
30.180000	15.37	40.00	24.60	300	211	HORI
106.260000	20.08	43.50	23.40	302	0	VERT
914.900000	112.58	NA	NA	200	60	HORI
978.960000	33.40	54.00	20.60	109	212	VERT

Table 8 - Radiated Emissions Peak Measurements vs. Average Limit, High Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dBμV/m	dBμV/m	dB	cm.	deg.	
1829.800000*	56.87	92.58	35.71	197	233	VERT
2744.600000	47.78	54.00	6.20	204	221	VERT
3659.800000	44.99	54.00	9.00	247	201	VERT
4570.000000	43.98	54.00	10.00	194	331	VERT
5494.000000	44.21	54.00	9.80	138	144	HORI

Peak measurements were compared to average limit and found to be compliant so average measurements were not performed

*Unrestricted band

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 all 3 orthagonal axis. It was found that the Y-axis produced the highest emissions, and this orientation was used for all testing. See the test setup photo exhibit for details on the orientations.

4.3 PEAK OUTPUT POWER

Test Method: ANSI C63.10, Section(s) 11.9.1.1

Limits of bandwidth measurements:
The maximum allowed peak output power is 30 dBm.

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

Deviations from test standard:
No deviation.

Test setup:

See Section 4.2

EUT operating conditions:
The EUT was powered by 6.4 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:

Peak Output Power

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK OUTPUT POWER (dBm)	Method	RESULT
Low	902.3	19.23	EIRP	Pass
Middle	908.5	18.53	EIRP	Pass
High	914.9	18.81	EIRP	Pass

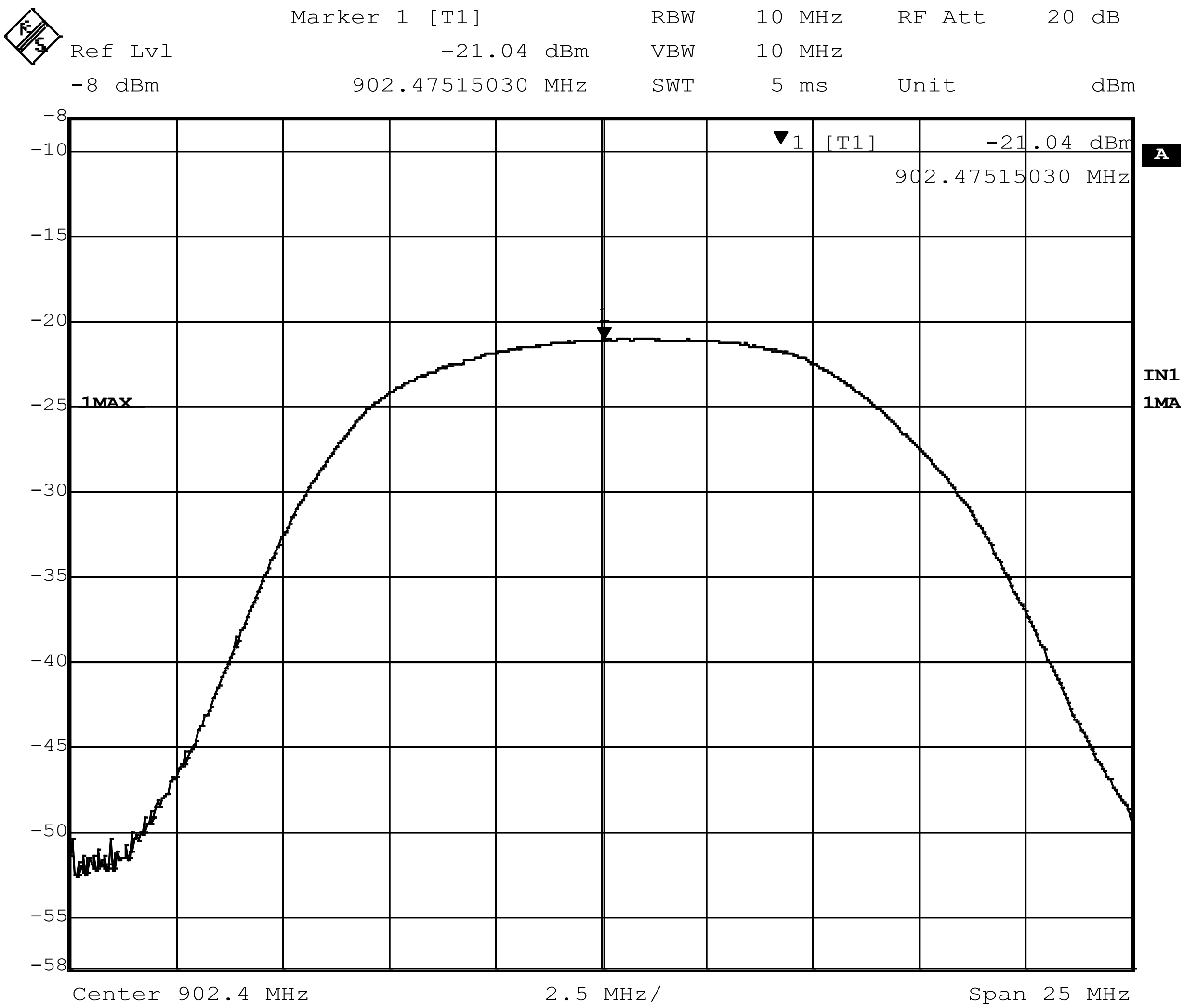

Figure 6 – Output Power, Low Channel

Maximum power = -21.04 dBm + 107 + CL + AF - 95.23 = 19.23dBm

CL = cable loss = 4.70 dB
AF = antenna factor = 23.80 dB
107 = conversion from dBm to dBμV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBμV/m) to EIRP (dBm) at a 3m measurement distance.

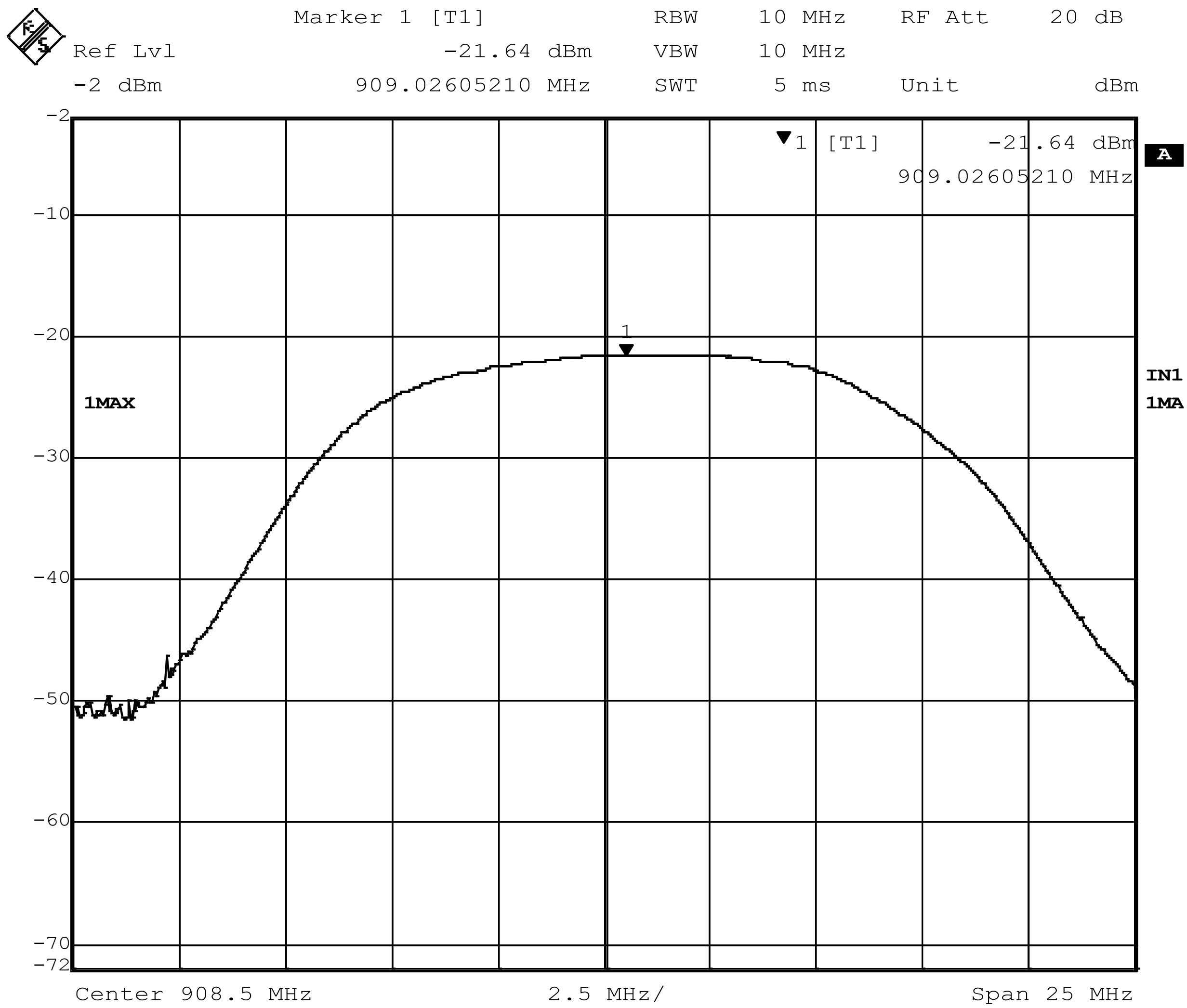

Figure 7 - Output Power, Mid Channel

Maximum power = -21.64 dBm + 107 + CL + AF - 95.23 = 18.53 dBm

CL = cable loss = 4.80 dB
AF = antenna factor = 23.60 dB
107 = conversion from dBm to dBμV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBμV/m) to EIRP (dBm) at a 3m measurement distance.

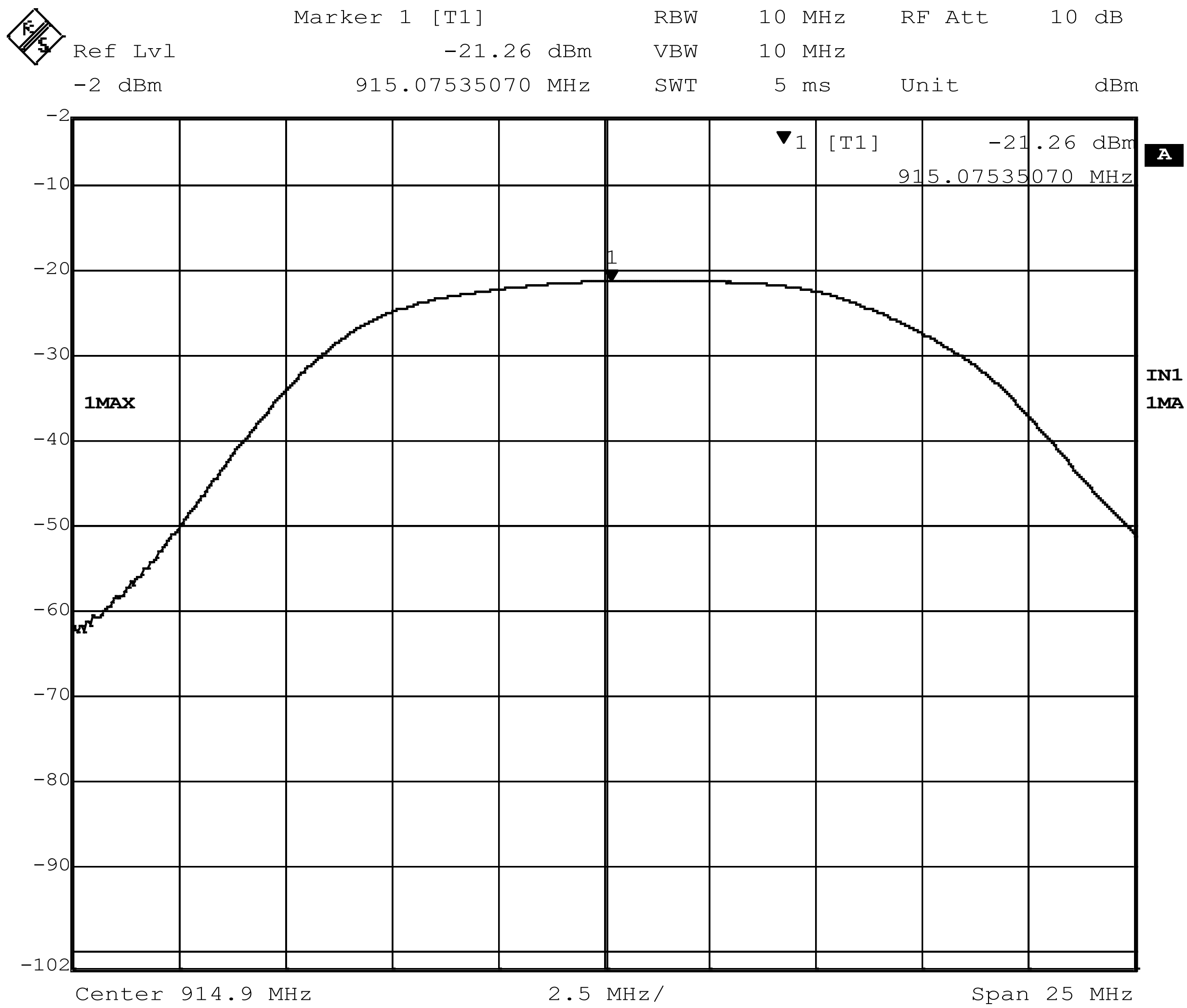

Figure 8 - Output Power, High Channel

Maximum power = -22.44 dBm + 107 + CL + AF - 95.23 = 18.81 dBm

CL = cable loss = 4.80 dB
AF = antenna factor = 23.50 dB
107 = conversion from dBm to dBμV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBμV/m) to EIRP (dBm) at a 3m measurement distance.

4.4 BANDWIDTH

Test Method: ANSI C63.10, Section(s) 11.8.1

Limits of bandwidth measurements:
The Bandwidth measurements were reported for informational purposes only.

Test procedures:
The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 300 kHz VBW.

The 99% occupied is defined as the bandwidth at which 99% of the signal power is found. This corresponds to 20dB down from the maximum power level. Automated software was used to make this measurement. .

The 6 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

Deviations from test standard:
No deviation.

Test setup:

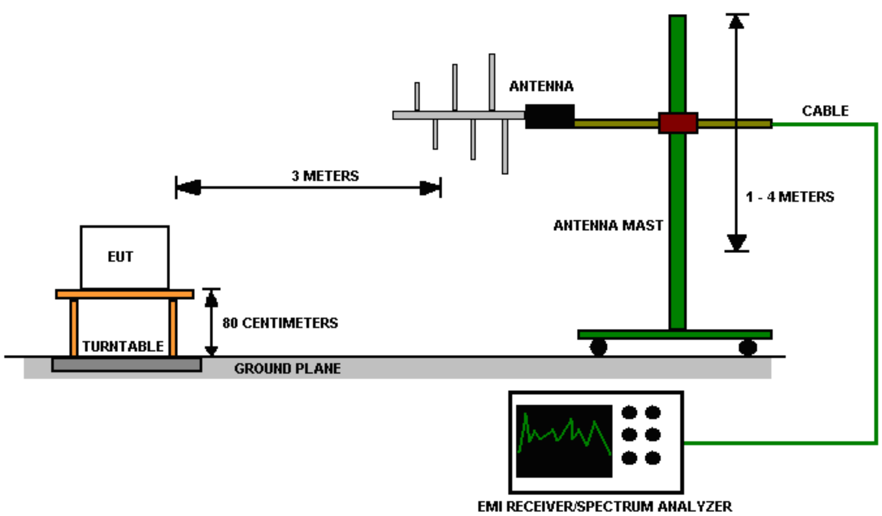

Figure 9 - Bandwidth Measurements Test Setup

EUT operating conditions:
The EUT was powered by 6.4 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:

99% Occupied Bandwidth

CHANNEL	CHANNEL FREQUENCY (MHz)	99% Occupied BW (kHz)
1	902.3	186.37
2	908.5	185.37
3	914.9	184.37

6dB Bandwidth

CHANNEL	CHANNEL FREQUENCY (MHz)	6 dB BW (kHz)
1	902.3	169.34
2	908.5	169.34
3	914.9	168.34

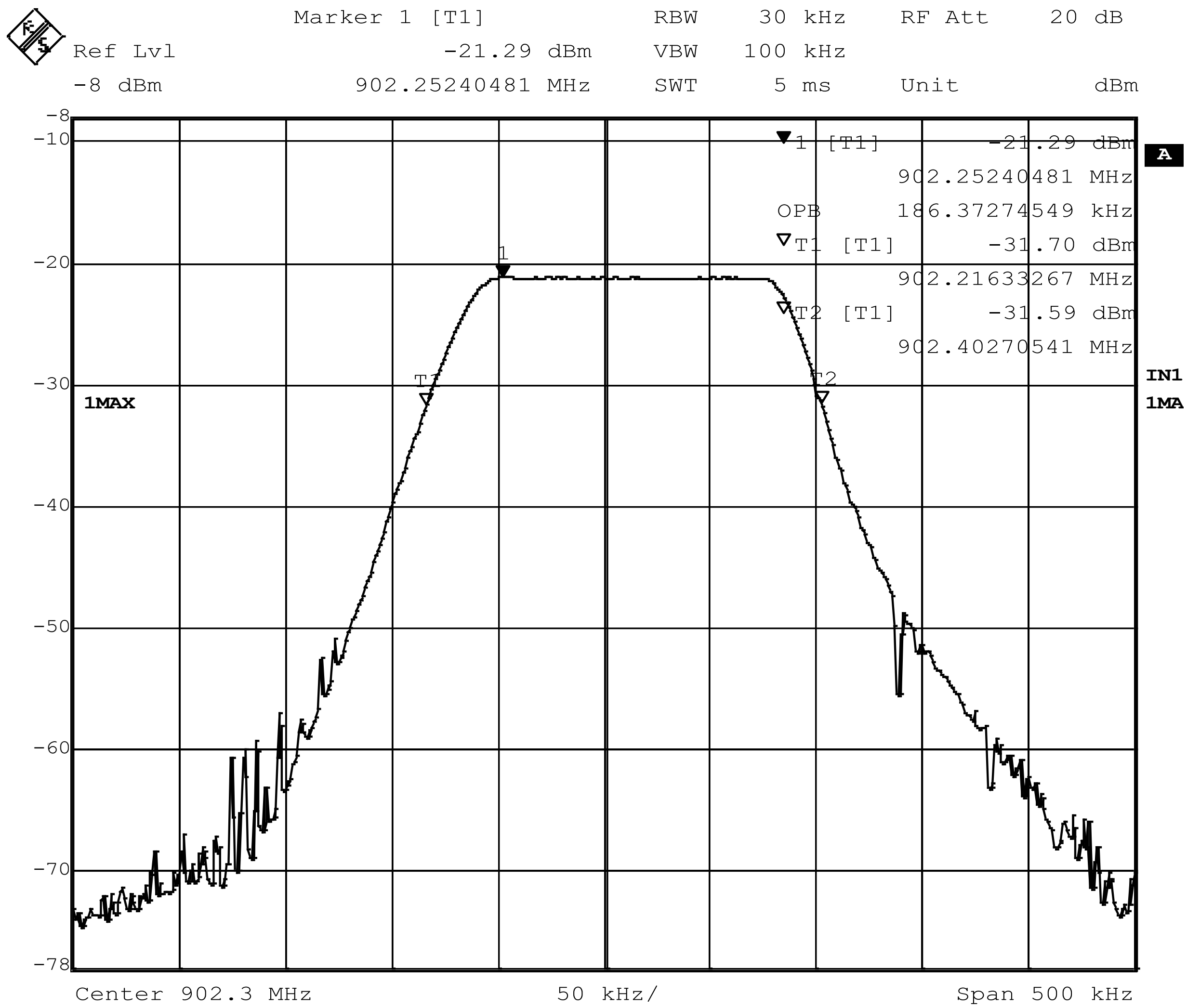

Figure 10 - 99% Occupied Bandwidth, Low Channel

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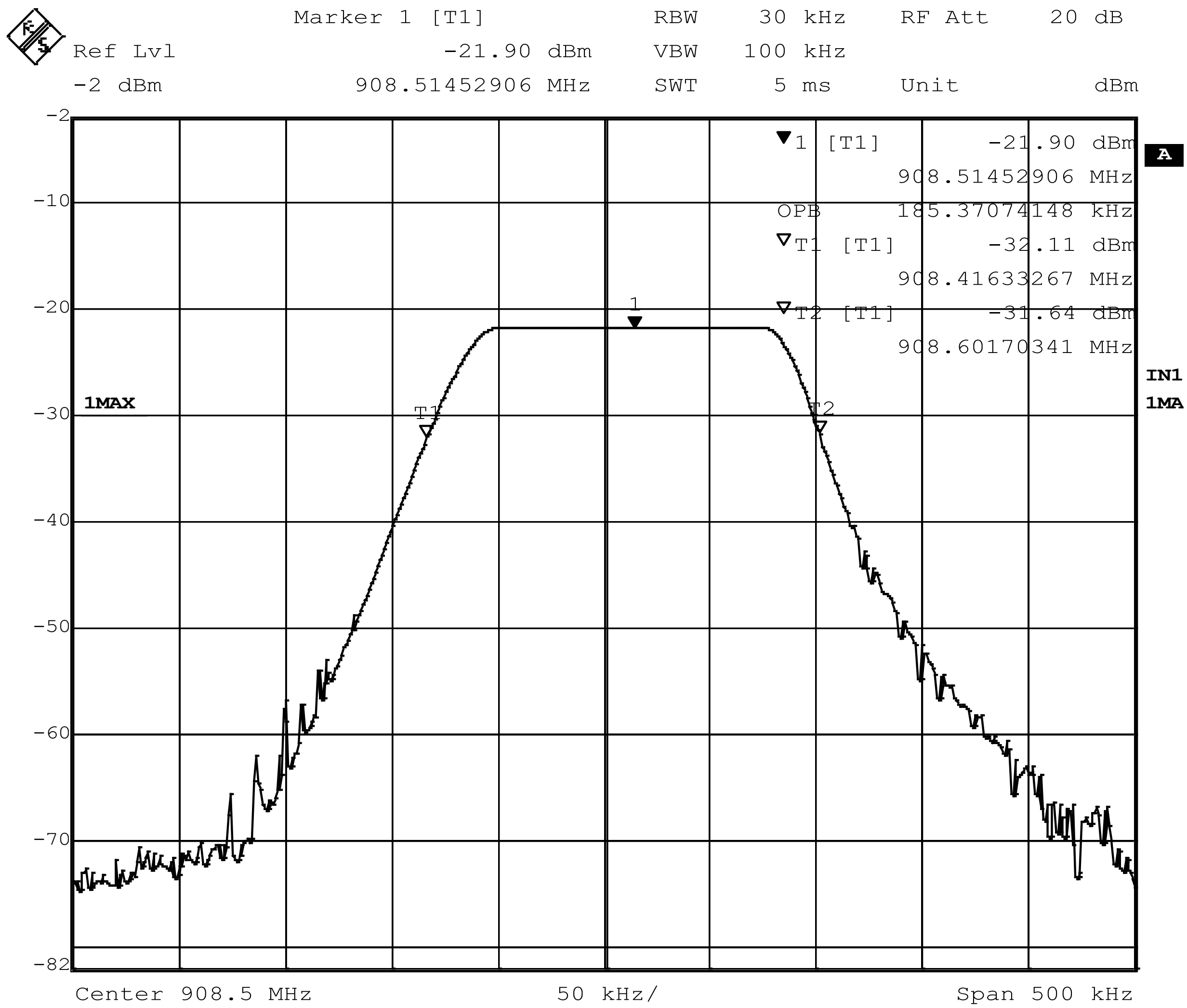

Figure 11 - 99% Occupied Bandwidth, Mid Channel

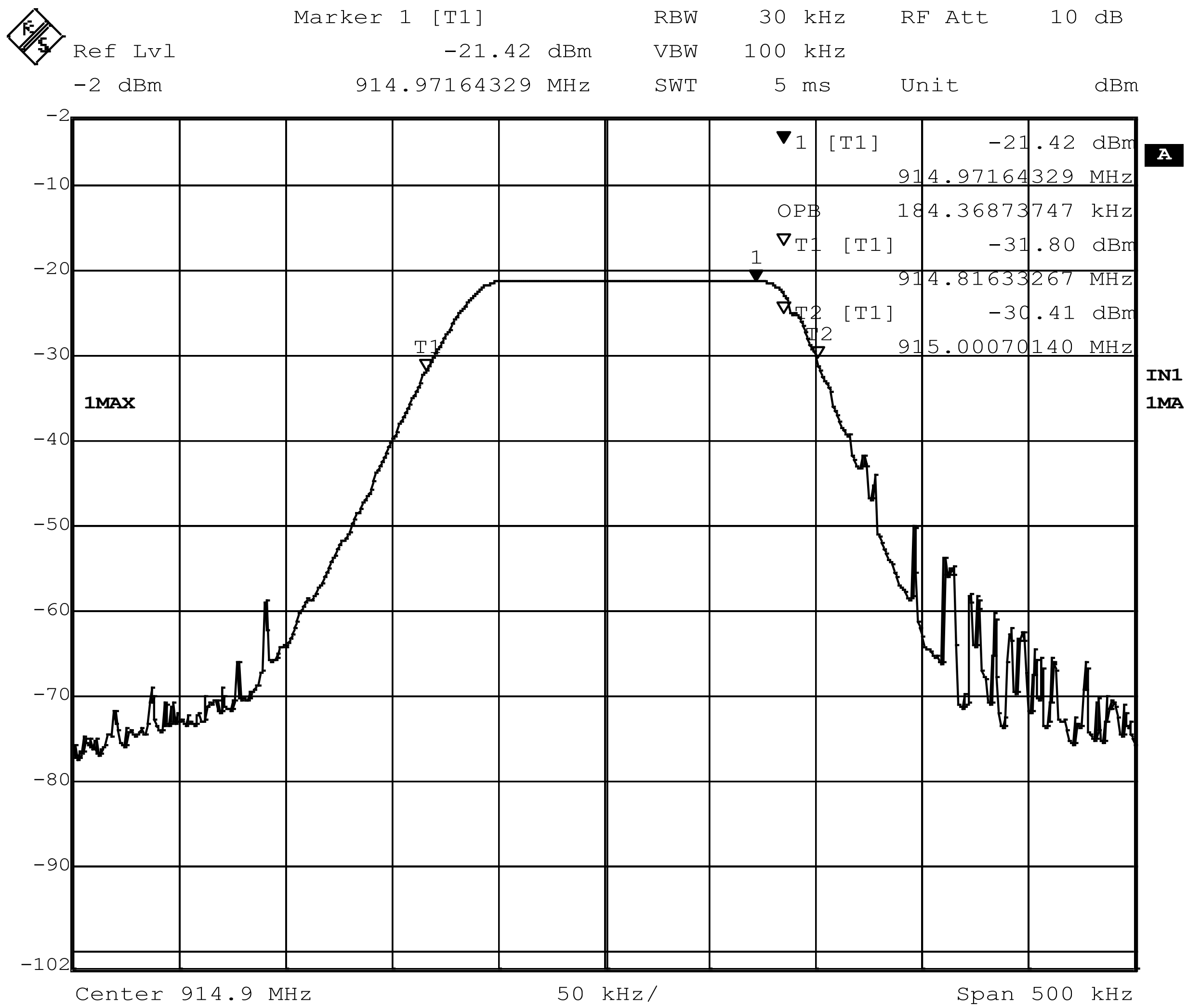

Figure 12 - 99% Occupied Bandwidth, High Channel

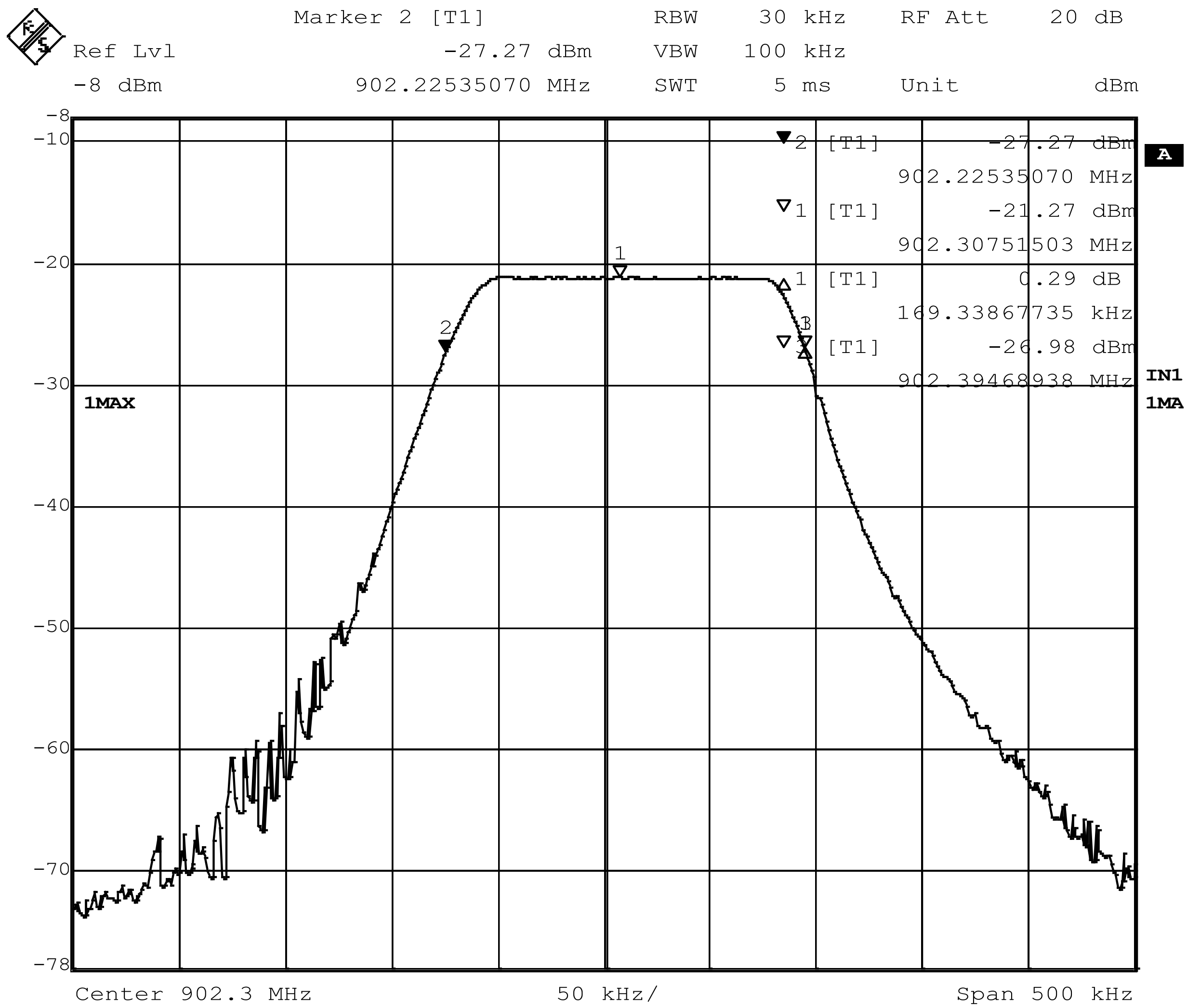

Figure 13 - 6dB Bandwidth, Low Channel

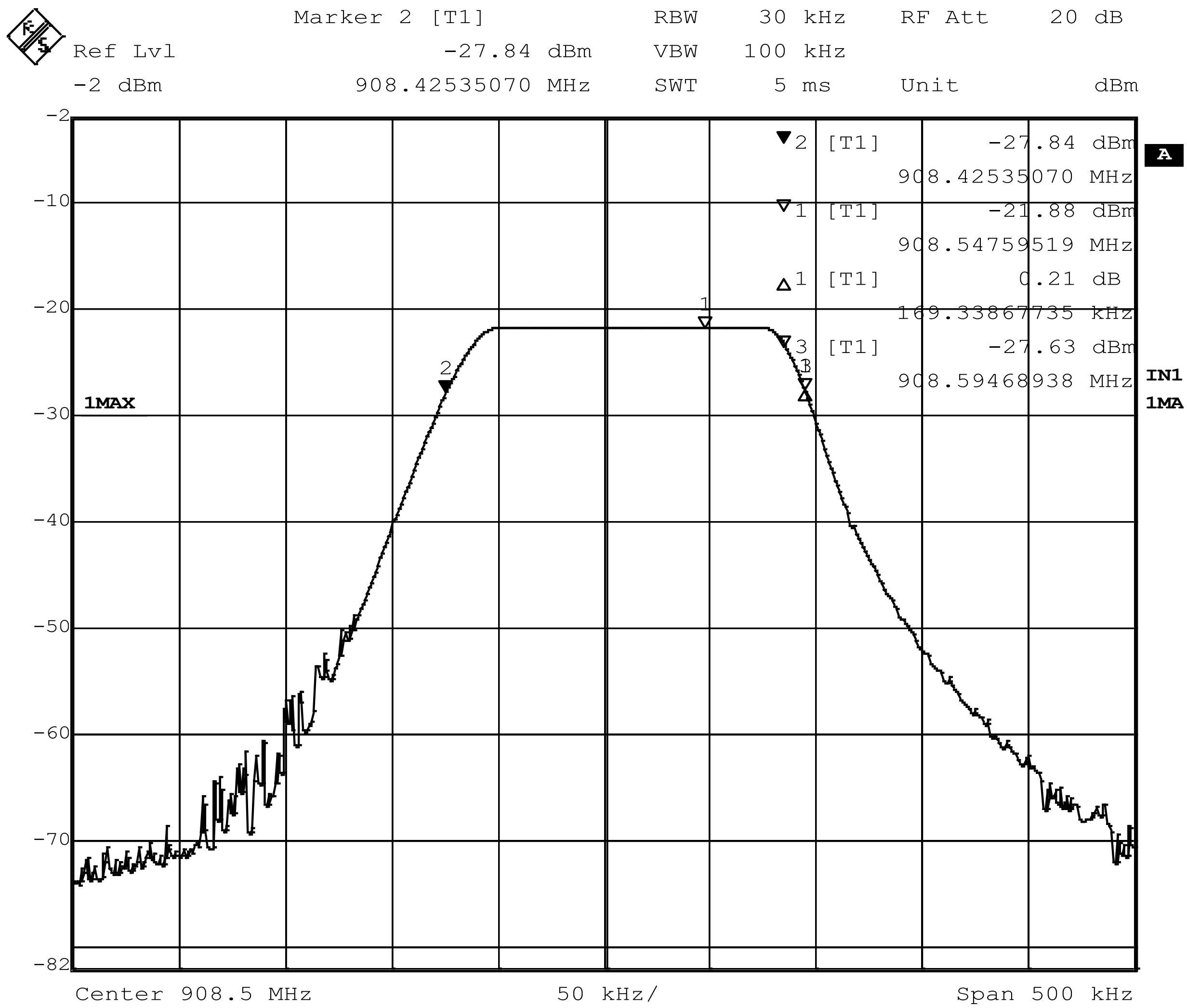

Figure 14 - 6dB Bandwidth, Mid Channel

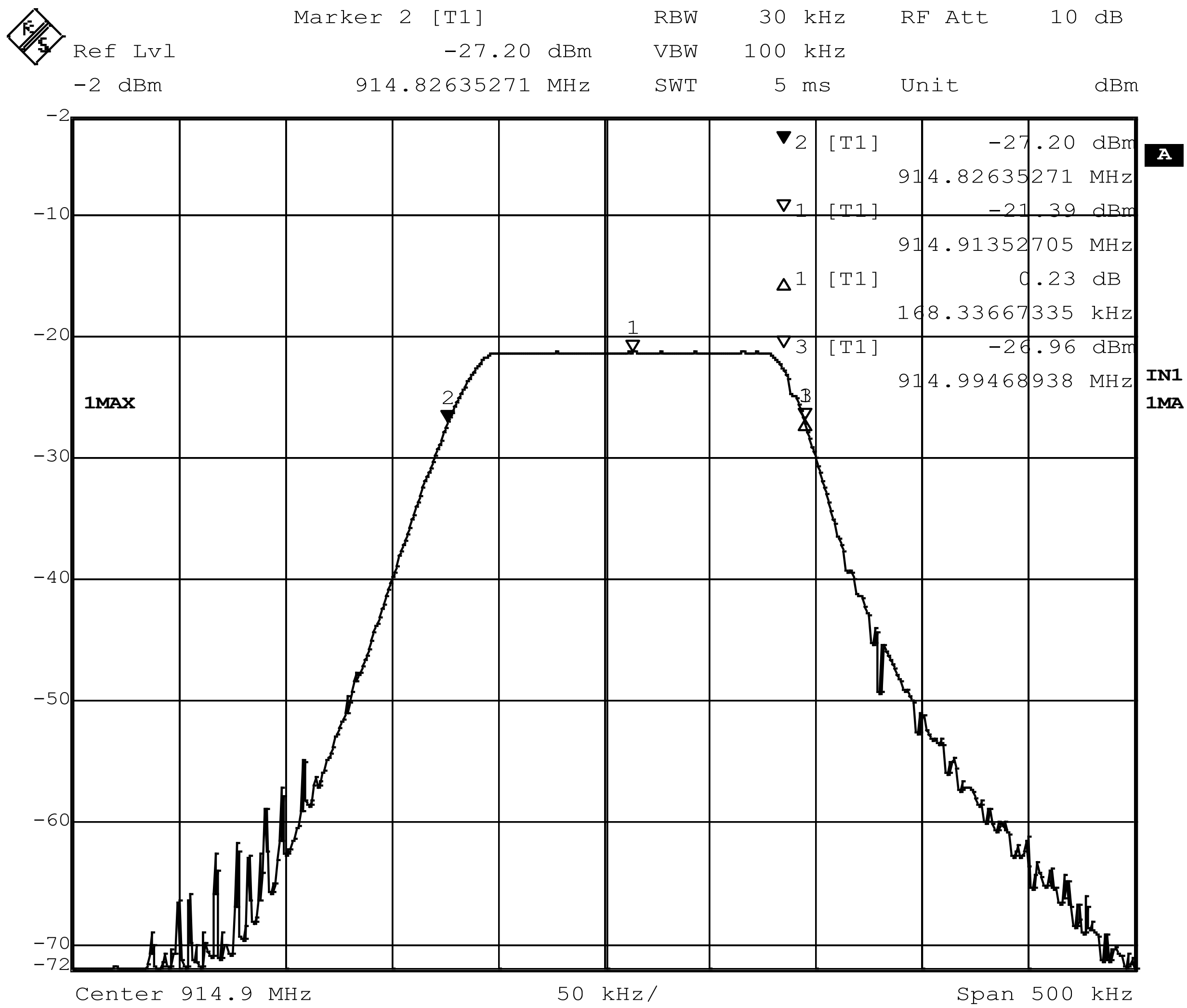

Figure 15 - 6dB Bandwidth, High Channel

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 100 kHz and the EMI receiver was used to scan from the bandedge to the fundamental frequency with a 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:
See Section 4.2

EUT operating conditions:
The EUT was powered by 6.4 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:

Highest Out of Band Emissions, Restricted Band

CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level dBm	Relative Fundamental Level (dBm)	Delta	Min (dBc)	Result
Low, Continuous	614.0	-102.02	-21.08	80.94	67.15	PASS
High, Continuous	960.0	-99.11	-21.16	77.95	66.58	PASS
Low Hopping	614.0	-102.01	-20.94	81.07	67.15	PASS
High, Hopping	960.0	-99.11	-21.24	77.87	66.58	PASS

Highest Out of Band Emissions, Unrestricted bands

CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level dBm	Relative Fundamental Level (dBm)	Delta	Min (dBc)	Result
Low, Continuous	902.0	-54.52	-21.08	33.44	20.00	PASS
High, Continuous	928.0	-79.55	-21.16	58.39	20.00	PASS
Low Hopping	902.0	-54.96	-20.94	34.02	20.00	PASS
High, Hopping	928.0	-80.03	-21.24	58.79	20.00	PASS

*Minimum delta = [highest fundamental peak field strength from Section 4.2] – [Part 15.209 radiated emissions limit.]

From Section 4.2

Fundamental average field strength at 902.3 MHz for low channel = 113.15 dBμV/m
Fundamental average field strength at 914.9 MHz for high channel = 112.58 dBμV/m

Low channel minimum delta = 113.15 – 46.0 dBμV/m = 67.15 dBc
High channel minimum delta = 112.58 – 46.0 dBμV/m = 66.58 dBc

Measurements do not include correction factors and are intended to be relative measurements only.

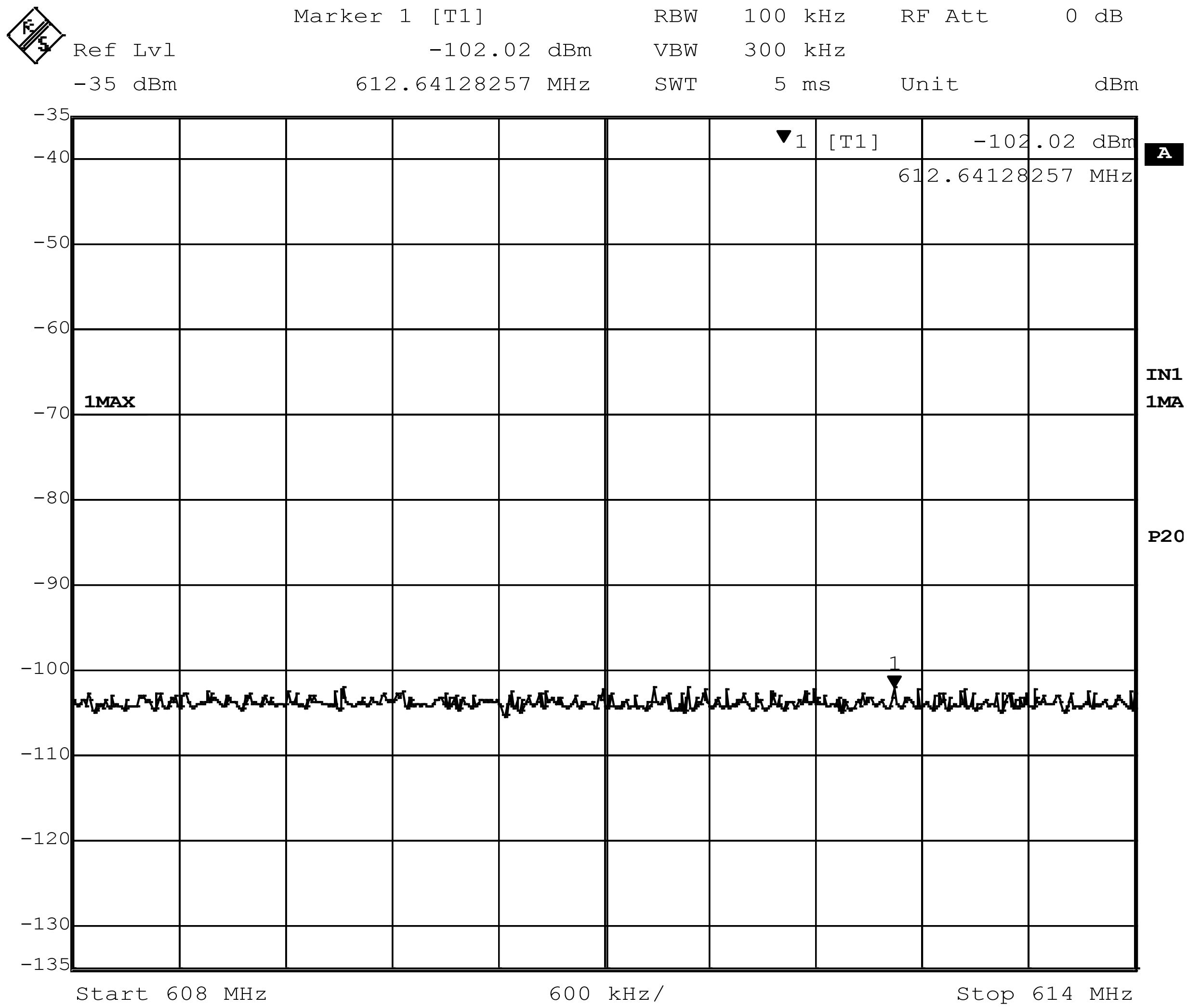

Figure 16 - Band-edge Measurement, Low Channel, Restricted Frequency, Continuous Transmit

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

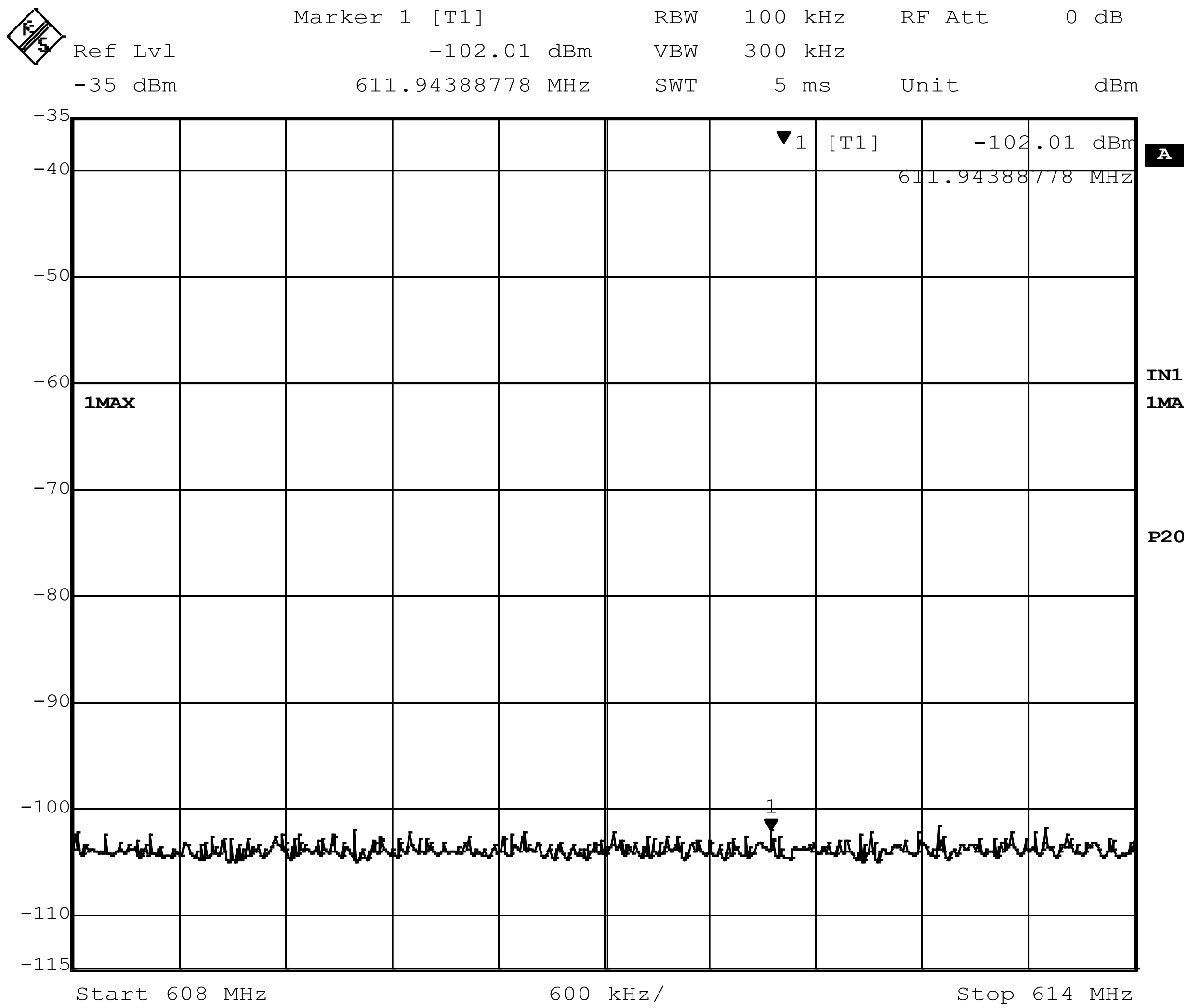

Figure 17 - Band-edge Measurement, Low Channel, Restricted Frequency, Hopping

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

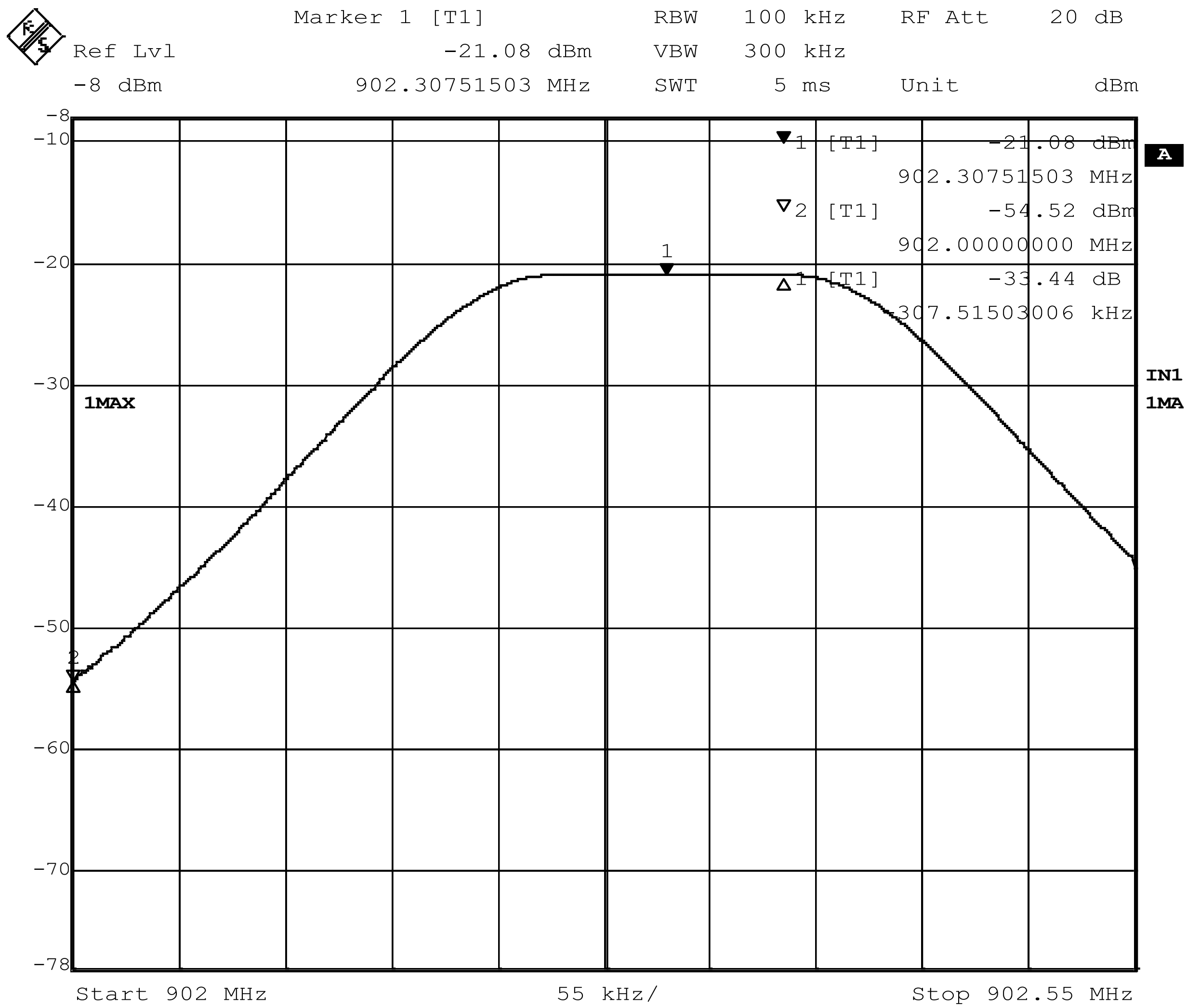

Figure 18 - Band-edge Measurement, Low Channel, Fundamental, Continuous Transmit

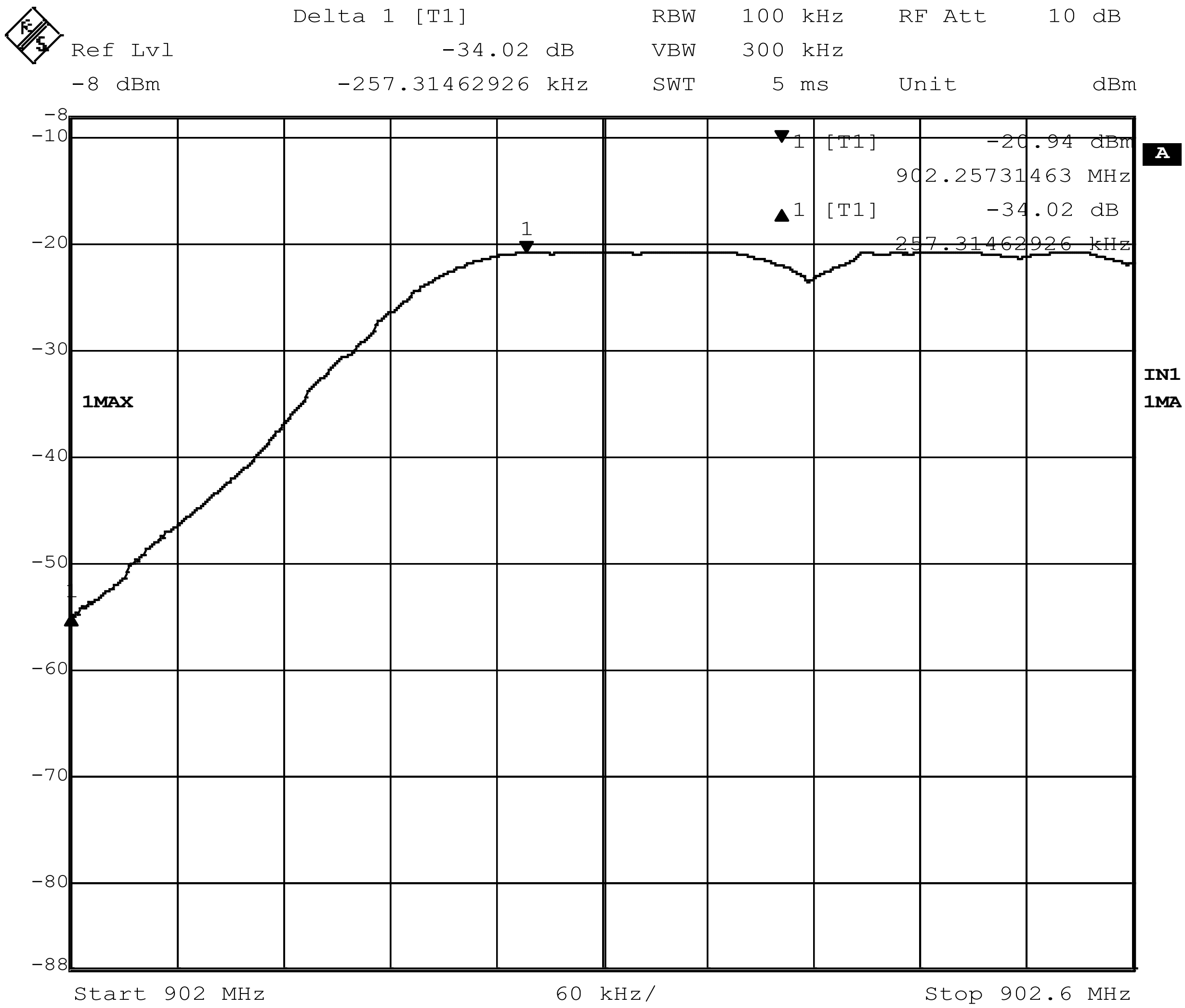

Figure 19 - Band-edge Measurement, Low Channel, Fundamental, Hopping Transmit

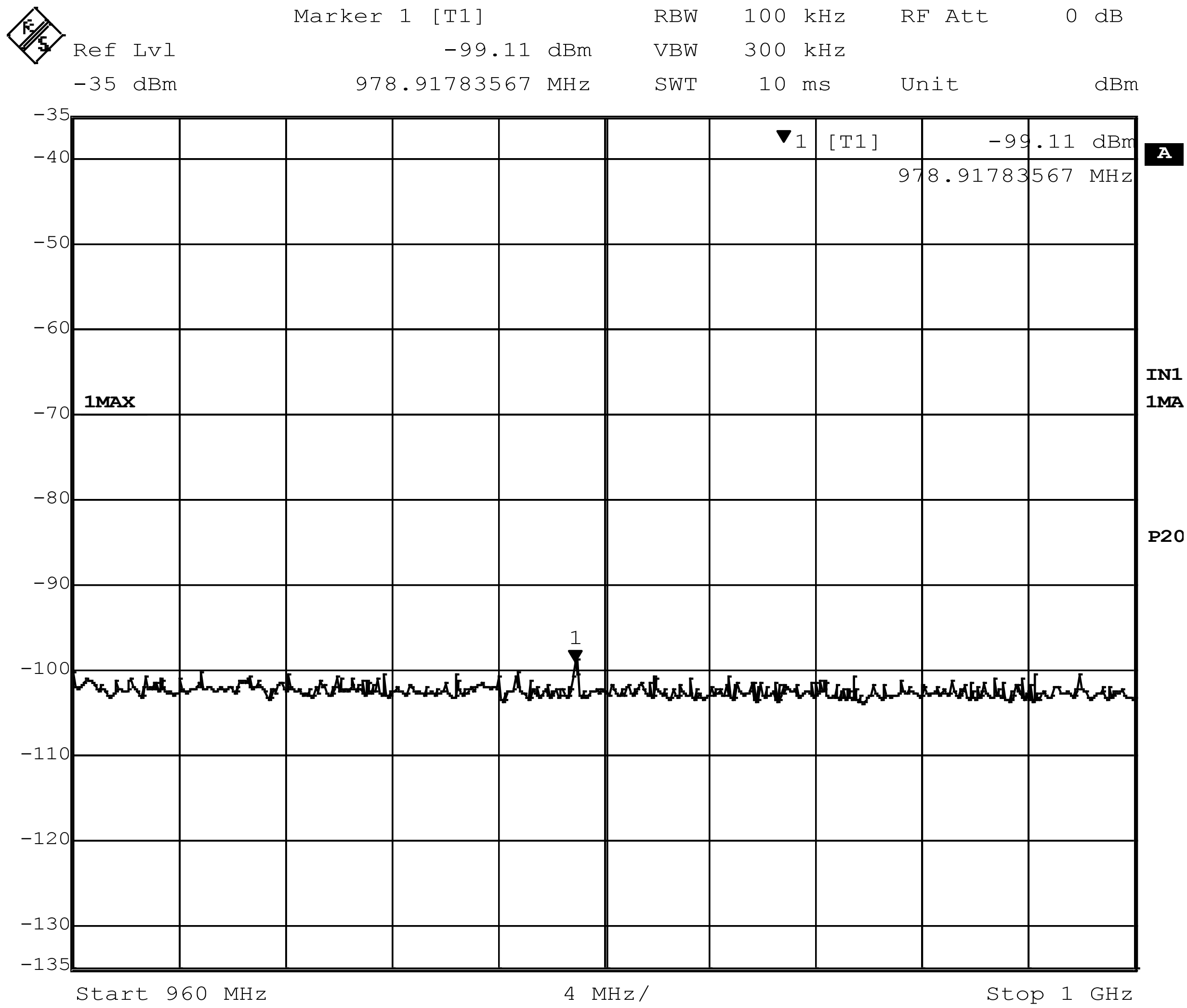

Figure 20 - Band-edge Measurement, High Channel, Restricted Frequency, Continuous Transmit

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

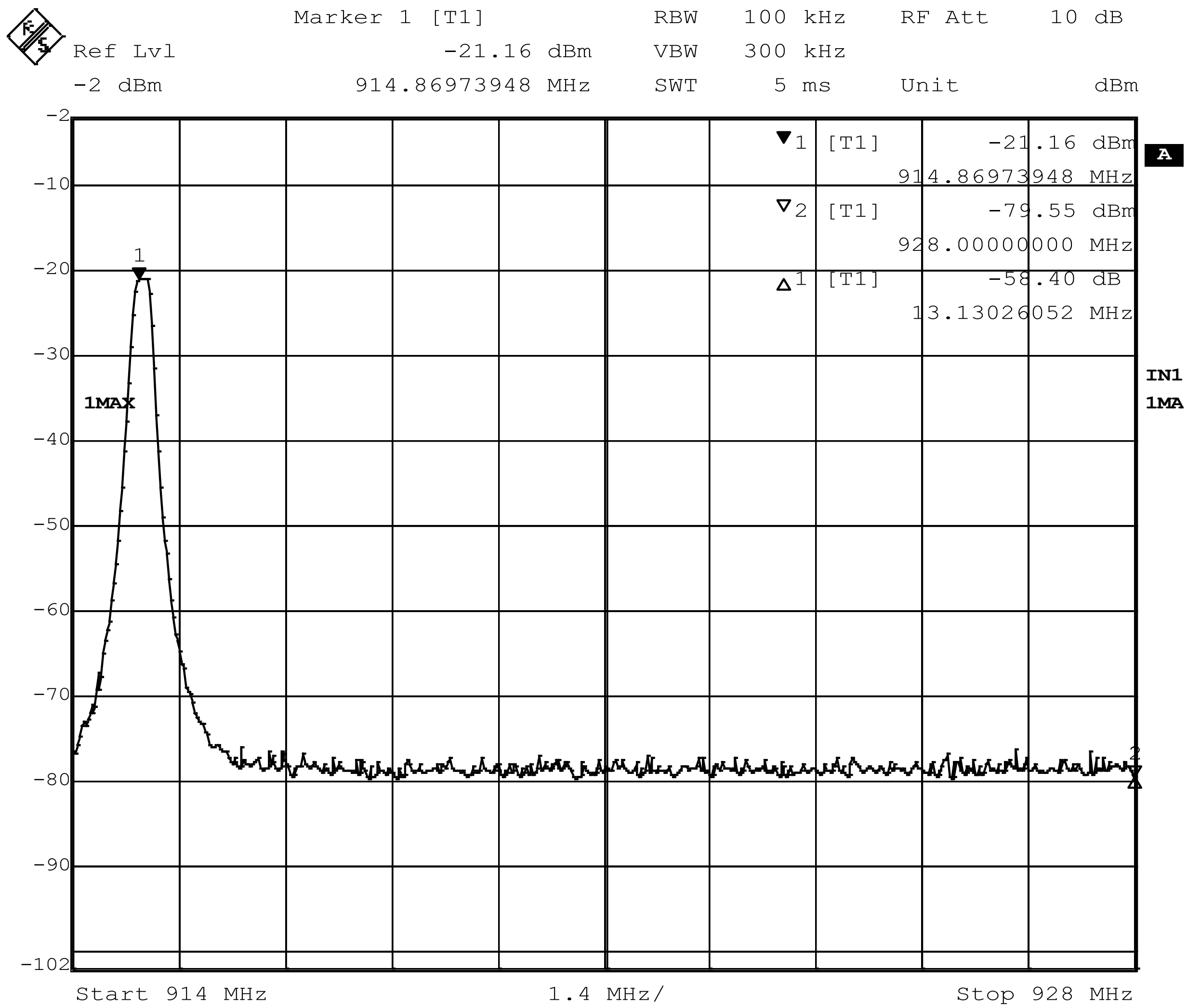

Figure 21 - Band-edge Measurement, High Channel, Fundamental, Continuous Transmit

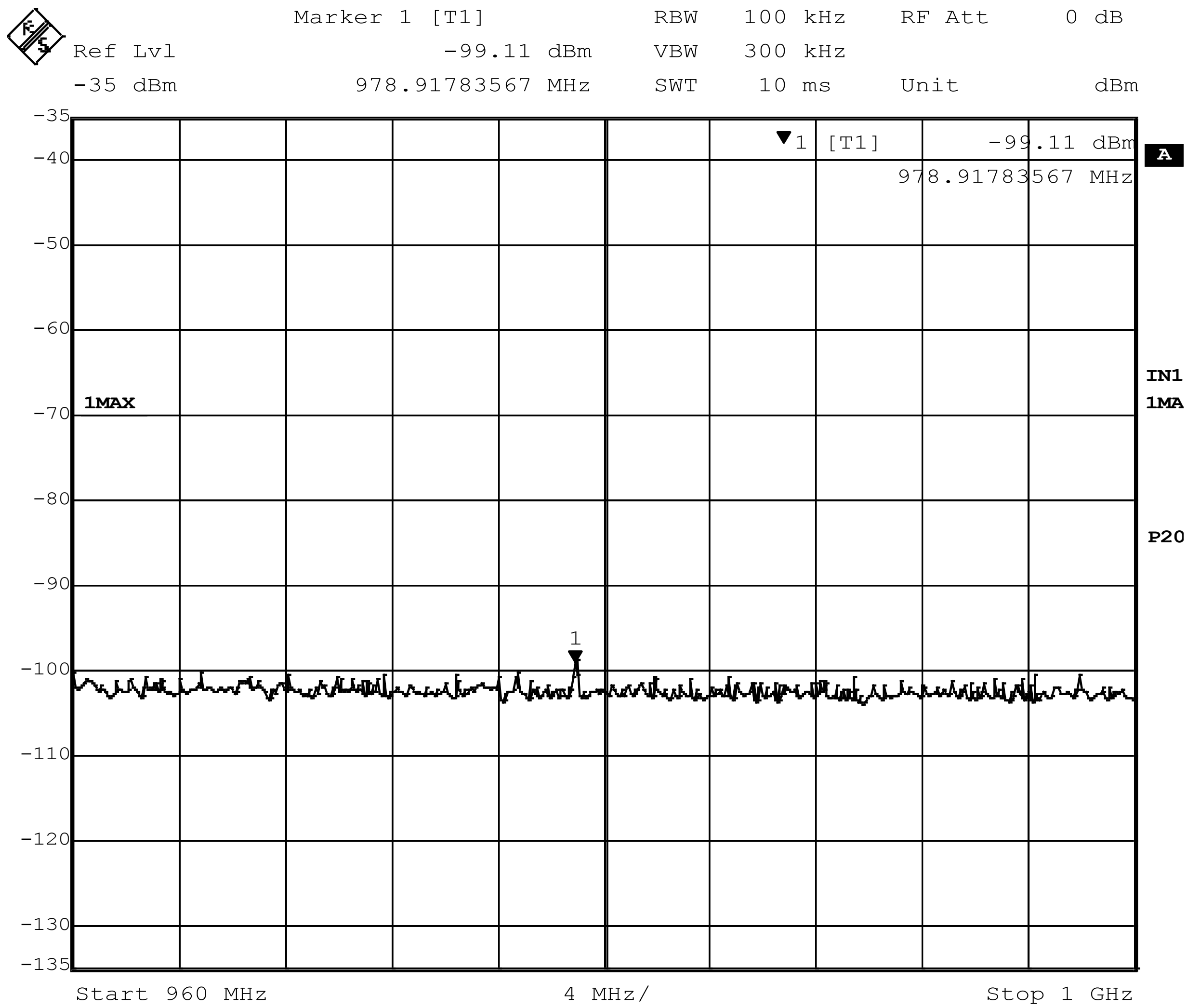

Figure 22 - Band-edge Measurement, High Channel, Restricted Frequency, Hopping

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

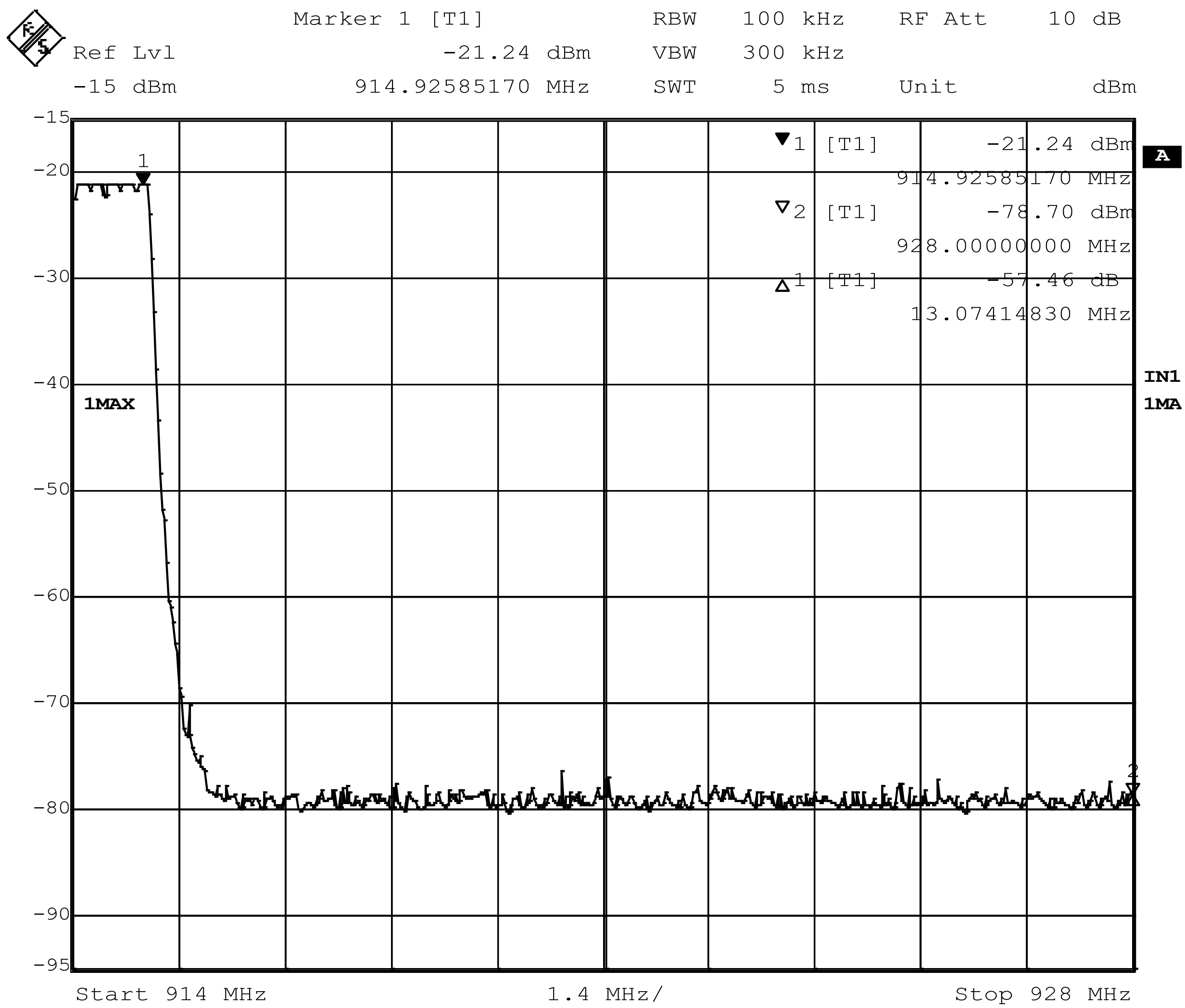

Figure 23 - Band-edge Measurement, High Channel, Fundamental, Hopping Transmit

4.6 POWER SPECTRAL DENSITY

Test Method: ANSI C63.10, Section 11.10.2

Limits of power measurements:
The maximum PSD allowed is 8 dBm.

Test procedures:
1. The EUT was tested at 3m test distance.

2. The resolution bandwidth was set to 3 kHz and the video bandwidth was set to 10 kHz to capture the signal. The analyzer used a peak detector in max hold mode.

Test setup:
See Section 4.2

EUT operating conditions:
The EUT was powered by 6.4 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:

Power Spectral Density

CHANNEL FREQUENCY (MHz)	EIRP RF POWER LEVEL IN # KHz BW (dBm)	Method	MAXIMUM POWER LIMIT (dBm)	RESULT
902.3	3.92	EIRP	8	Pass
908.5	3.44	EIRP	8	Pass
914.9	3.75	EIRP	8	Pass

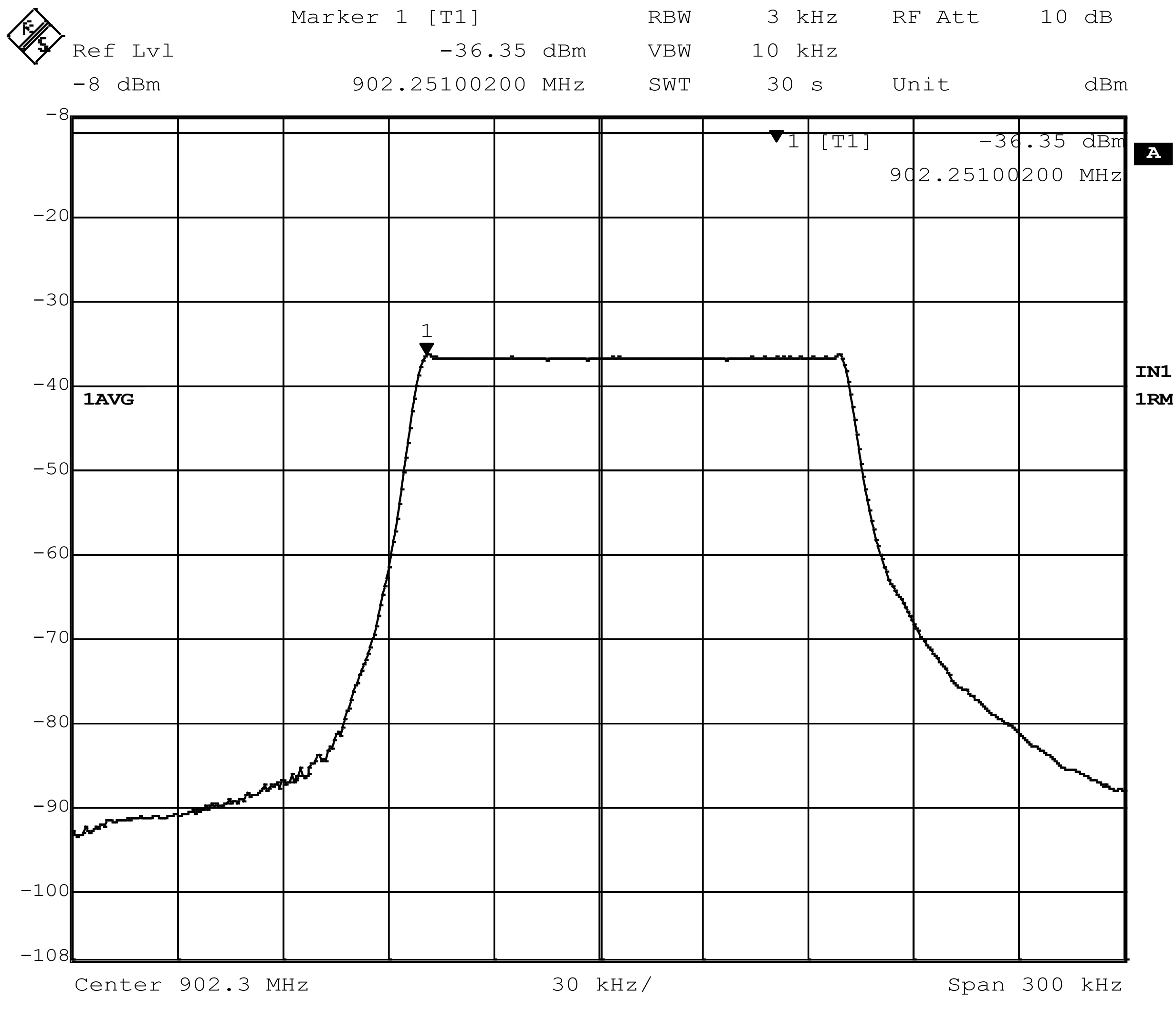

Figure 24 - Power Spectral Density, Low Channel

Maximum power = -36.35 dBm + 107 + CL + AF - 95.23 = 3.92 dBm

CL = cable loss = 4.70 dB
AF = antenna factor = 23.80 dB
107 = conversion from dBm to dBμV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBμV/m) to EIRP (dBm) at a 3m measurement distance.

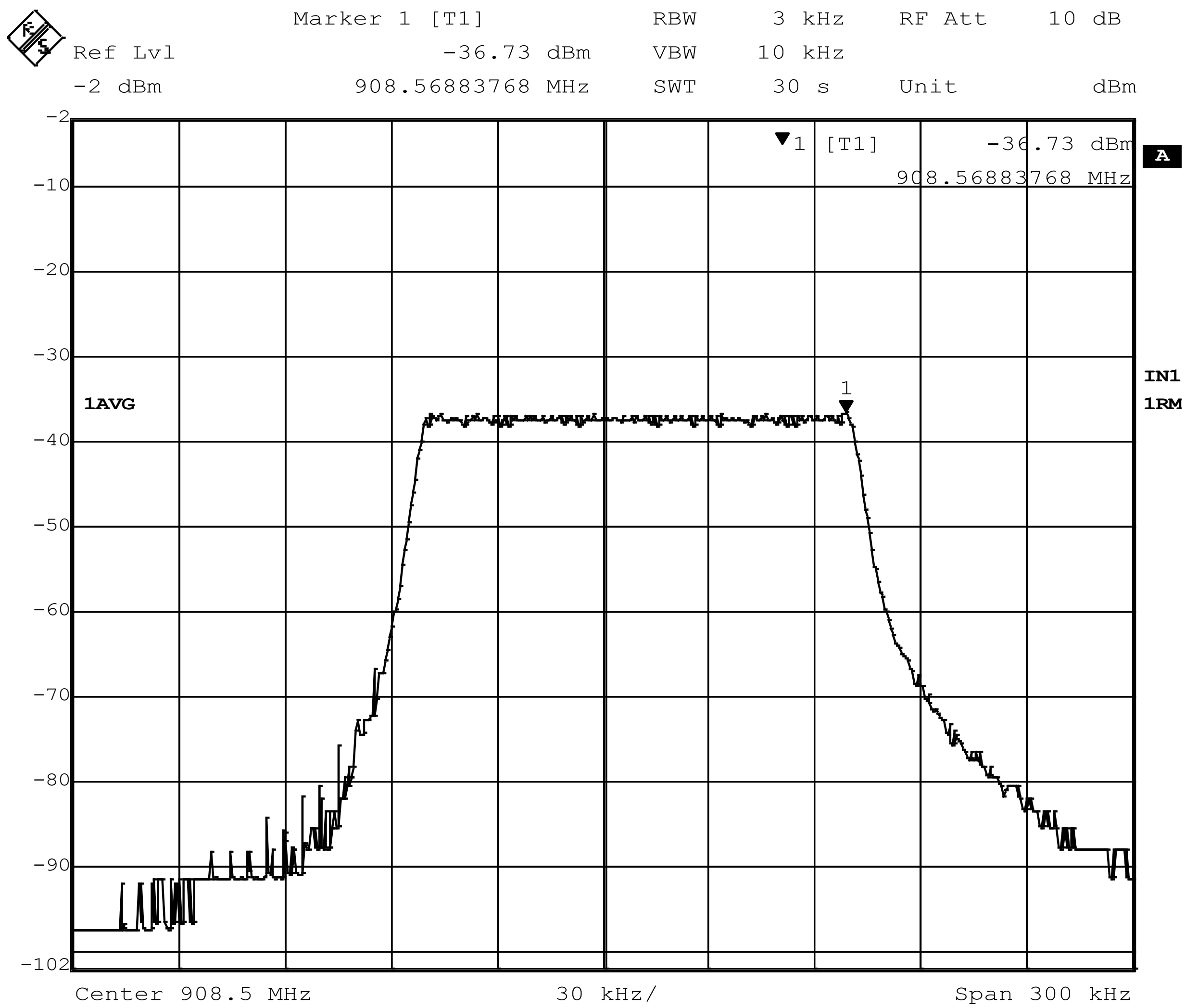

Figure 25 - Power Spectral Density, Mid Channel

Maximum power = -36.73 dBm + 107 + CL + AF - 95.23 = 3.44 dBm

CL = cable loss = 4.80 dB
AF = antenna factor = 23.60 dB
107 = conversion from dBm to dBμV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBμV/m) to EIRP (dBm) at a 3m measurement distance.

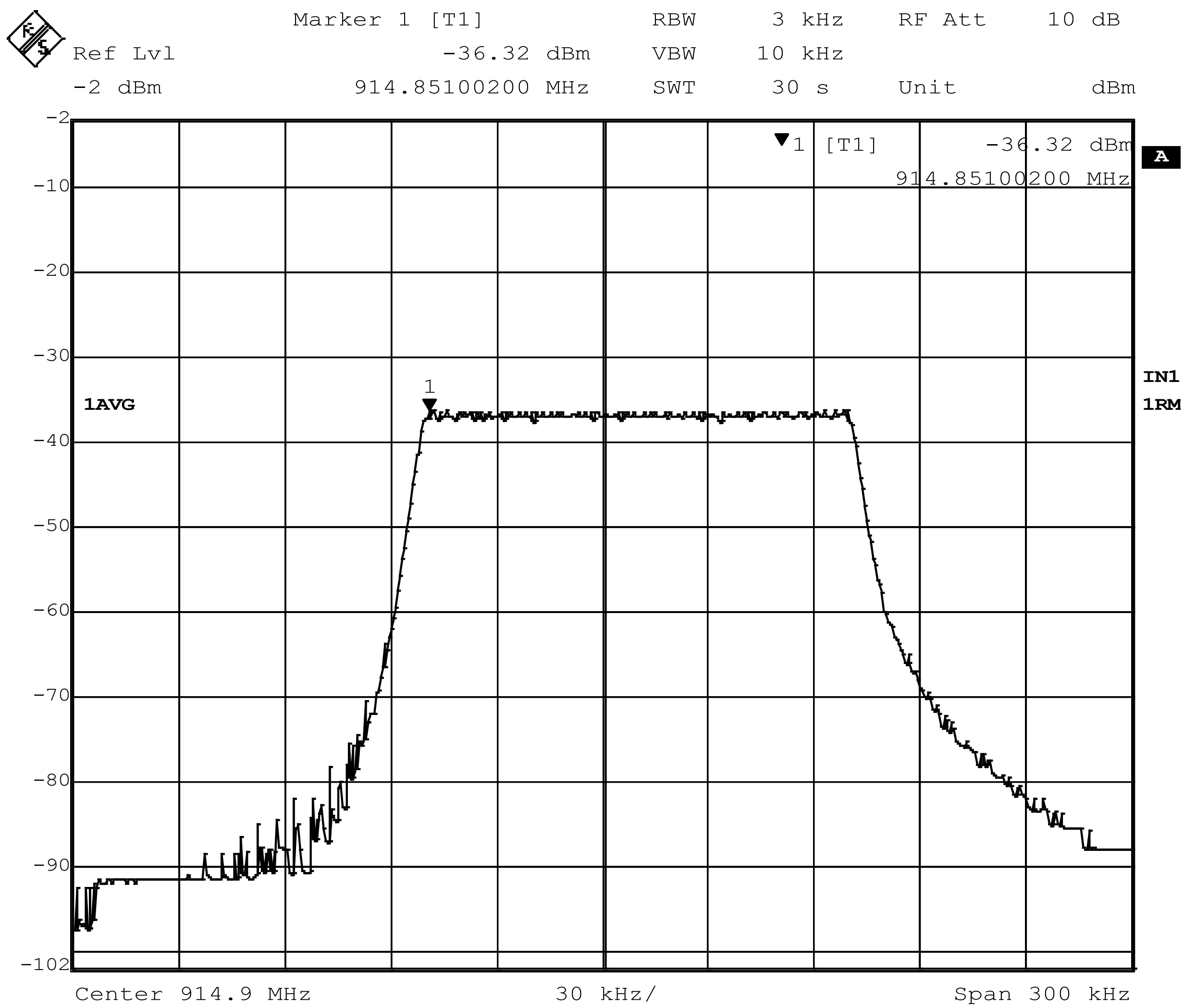

Figure 26 - Power Spectral Density, High Channel

Maximum PSD= -36.32 dBm + 107 + CL + AF - 95.23 = 3.75 dBm

CL = cable loss = 4.80 dB
AF = antenna factor = 23.50 dB
107 = conversion from dBm to dBμV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBμV/m) to EIRP (dBm) at a 3m measurement distance.

4.7 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
The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4.

64 x 0.4 = 25.6 seconds

Test procedures:
The method from FCC DA 00-705

Test setup:
See Section 4.2

EUT operating conditions:
The EUT was powered by 6.4 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:

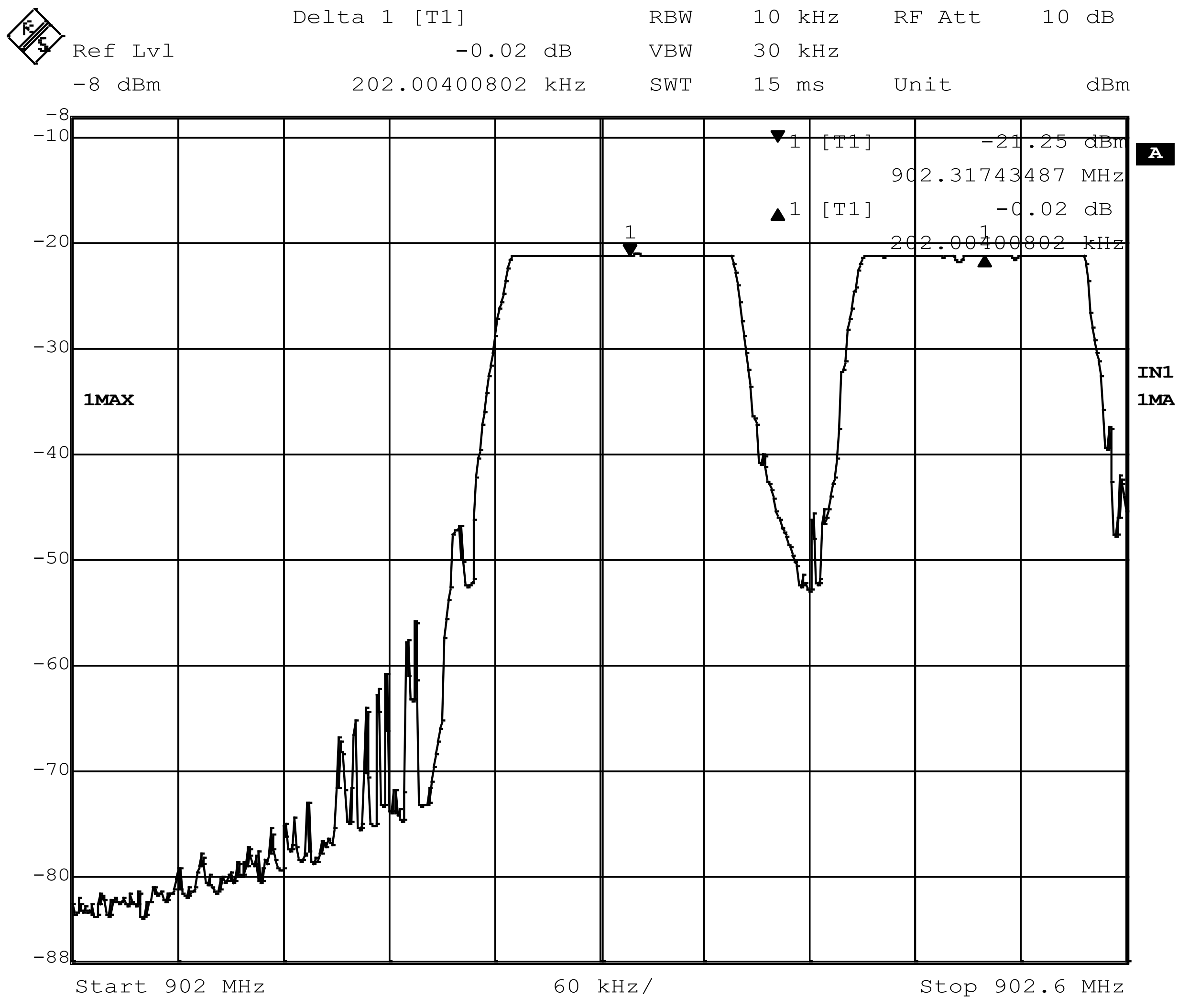

Figure 27 – Frequency Separation, 202.00 kHz

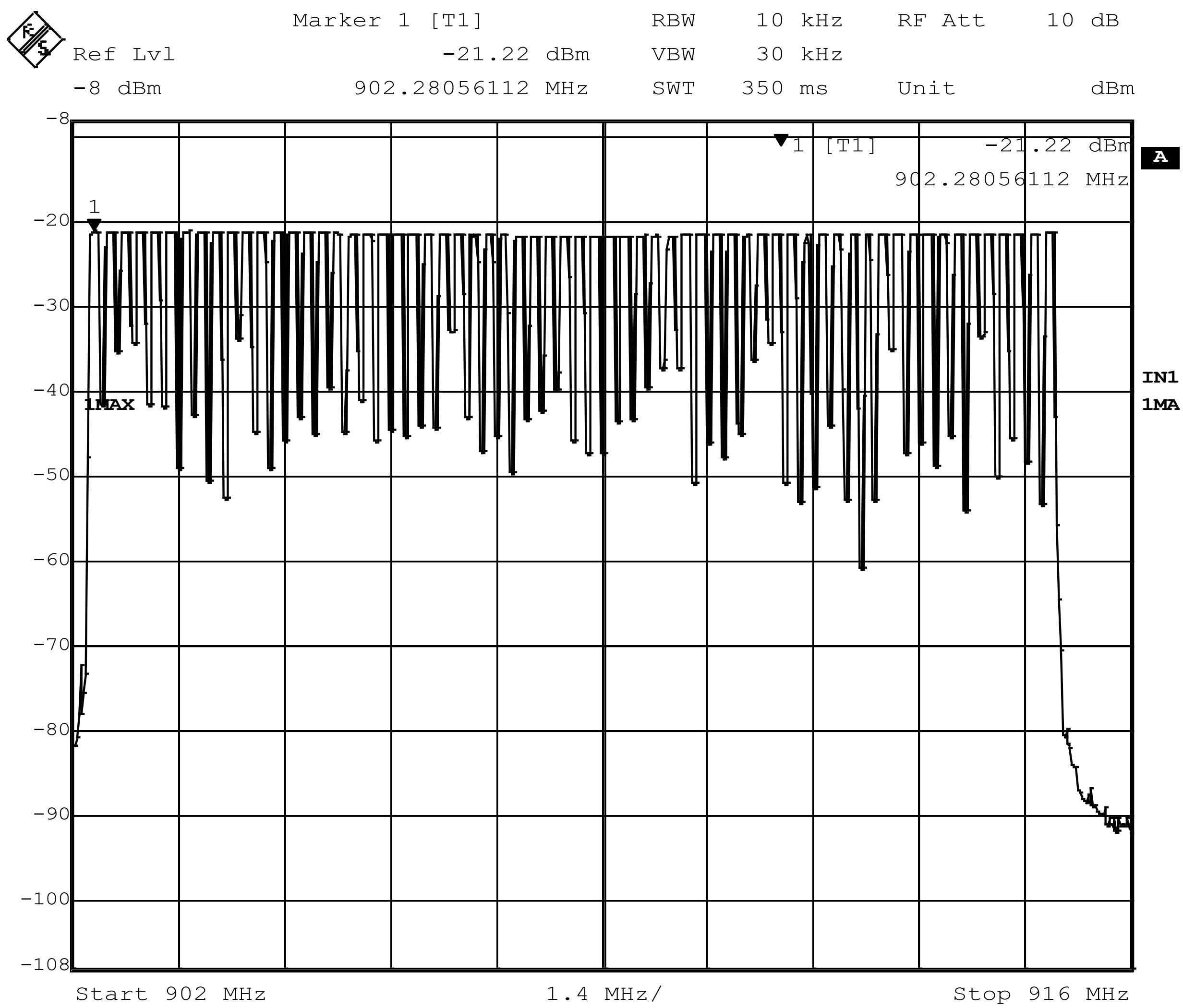

Figure 28 – Hop Count, 64 Hops

Note: All 64 channels were tested, but final FW will include only 6 channels.

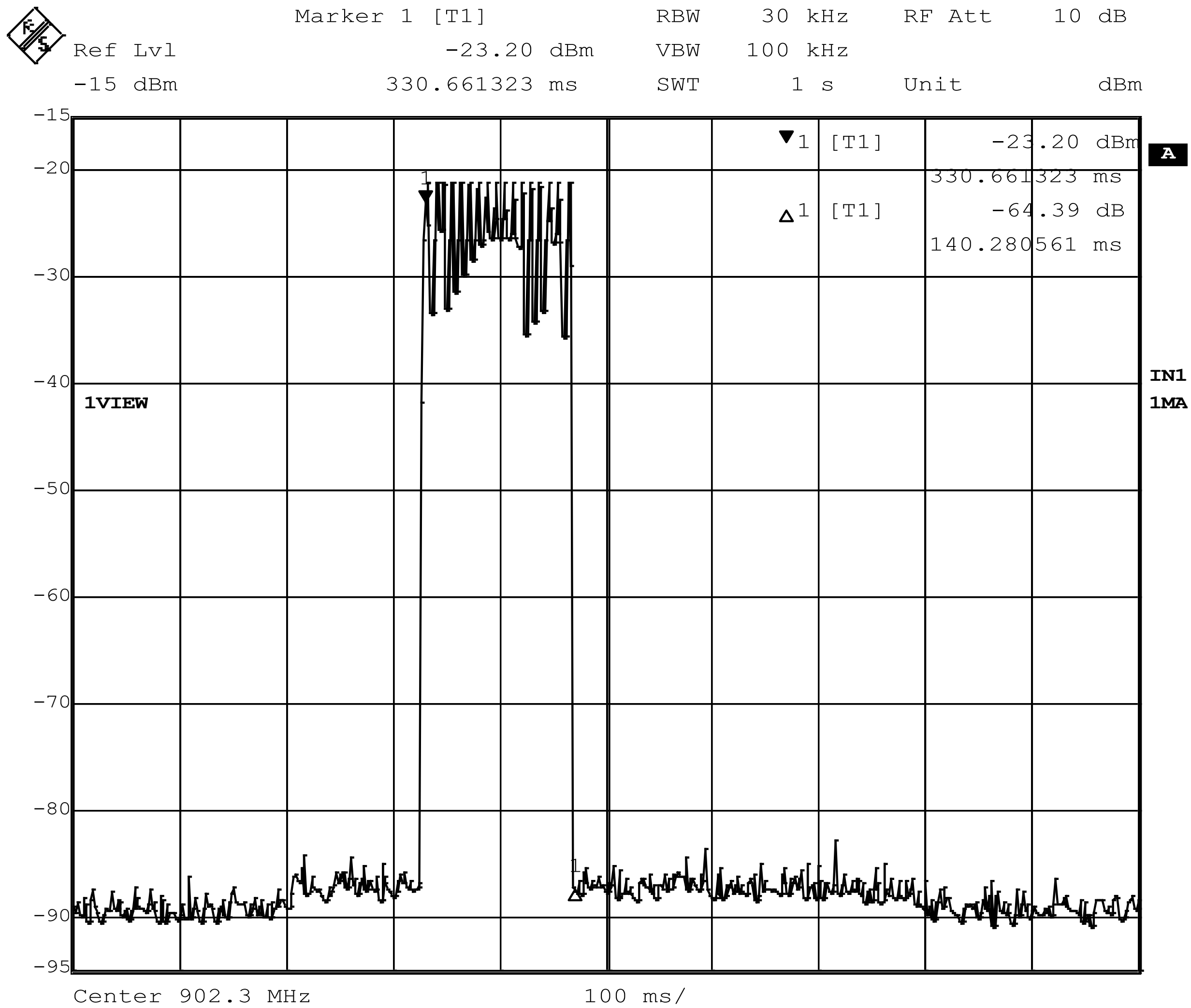

Figure 29 – Time of Occupancy, On Time, 140.28 ms

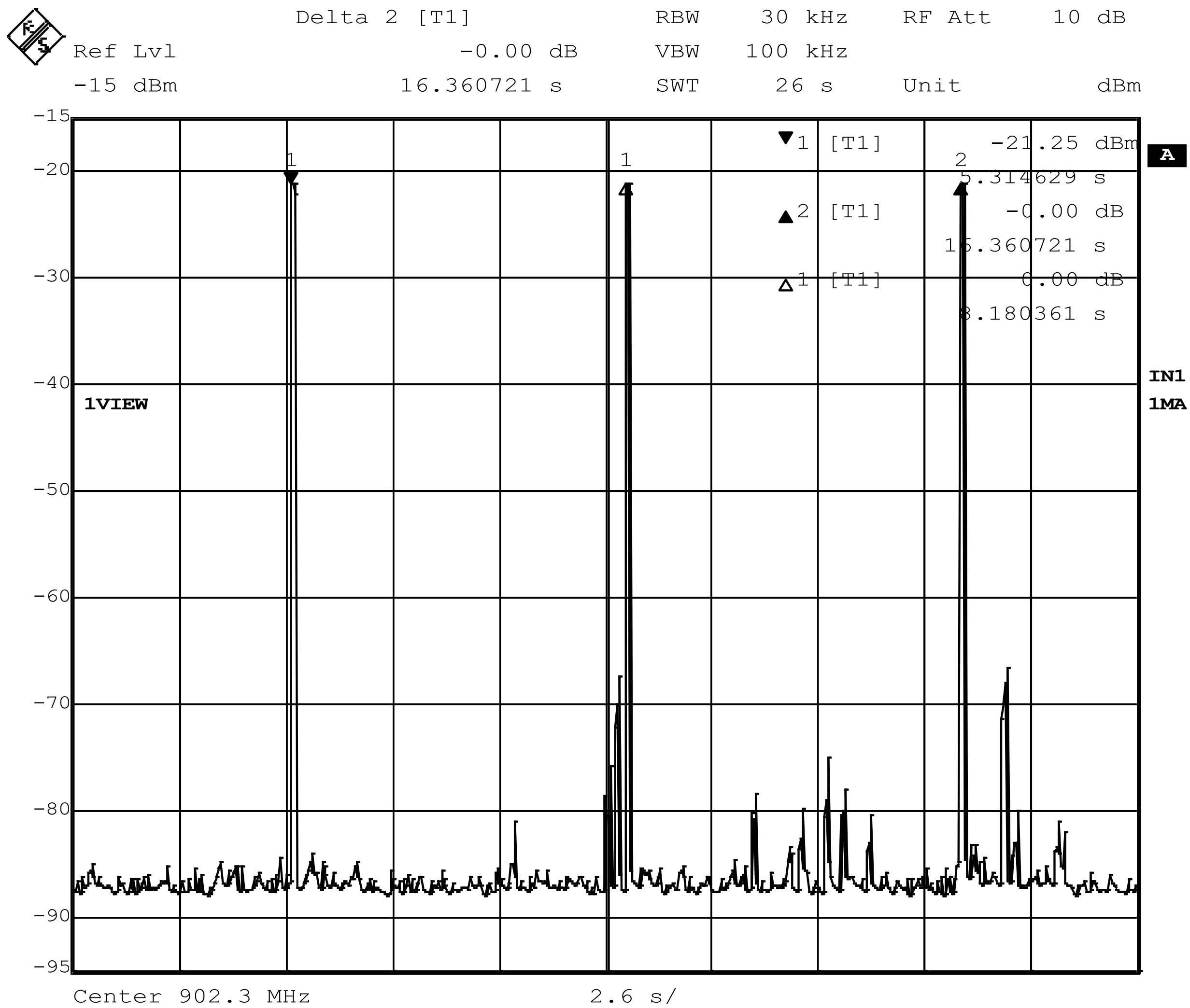

Figure 30 – Time of Occupancy, Period

*Maximum of 2 transmissions can occur in a given channel in any 10 s so the average time of occupancy is 140.28 ms x 2 =280.56 ms = 0.28 s < 0.4 s – Pass

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