Total Quality. Assured.

Astera LED Technology Gmbh

TEST REPORT

SCOPE OF WORK
FCC TESTING–AX5

REPORT NUMBER
190312016SZN-002

ISSUE DATE **[REVISED DATE]**

11 April 2019 [----------]

PAGES
60

DOCUMENT CONTROL NUMBER
FCC ID 247_b

101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community,
GuanHu Subdistrict, LongHua District, Shenzhen, P.R. China

Tel: (86 755) 8601 6288
Fax: (86 755) 8601 6751
www.intertek.com

Total Quality. Assured.

TEST REPORT

Intertek Report No.: 190312016SZN-002

Astera LED Technology Gmbh

Application
For
Certification

FCC ID: X55AX5

AX5

Model: AX5

Report No.: 190312016SZN-002

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-17]

Prepared and Checked by:

Damon Wang
Project Engineer

Approved by:

Kidd Yang
Technical Supervisor
Date: 11 April 2019

LIST OF EXHIBITS

MEASUREMENT/TECHNICAL REPORT

AX5

Model: AX5

FCC ID: X55AX5

This report concerns (check one) Original Grant ___X___ Class II Change _____

Equipment Type: DSS - Part 15 Spread Spectrum Transmitter

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes _____ No ___X___

If yes, defer until : _____
date

Company Name agrees to notify the Commission by: _____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes _____ No ___X___

If no, assumed Part 15, Subpart C for intentional radiator - the new 47 CFR [10-01-17] Edition] provision.

Report prepared by:

Damon Wang
Intertek Testing Services Shenzhen Ltd. Longhua Branch
101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, Shenzhen, P.R. China
Tel: (86 755) 8601 6288 Fax: (86 755) 8601 6751

Table of Contents

List of attached file

Exhibit type	File Description	Filename
Test Report	Test Report	report.pdf
Test Setup Photo	Conducted Emission	conducted photos.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
External Photo	External Photo	external photos.pdf
Internal Photo	Internal Photo	internal photos.pdf
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
Operation Description	Technical Description	descri.pdf
ID Label/Location	Label Artwork and Location	label.pdf
User Manual	User Manual	manual.pdf
Cover Letter	Confidentiality Letter	request.pdf
Cover Letter	Letter of Agency	agency.pdf

EXHIBIT 1

SUMMARY OF TEST RESULTS

EXHIBIT 1

GENERAL DESCRIPTION

1.0 General Description

1.1 Product Description

The Equipment Under Test (EUT) is a AX5 operating at 917.00-922.20MHz. The EUT is powered by rechargeable battery (DC 18V, 10050mAh) which can be charged by 1.8A/115V AC~1.0A/230V AC. For more detailed features description, please refer to the user's manual.

Type of Modulation: GFSK
Antenna Type: Integral Antenna
Antenna Gain: 0 dBi

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

This is an application for certification of a transceiver for the AX5 operating at 917.00-922.20 MHz, and related report for FCC SDOC is subjected to report number: 190312015SZN-001.

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements was performed according to the procedures in ANSI C63.10: 2013. Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

1.4 Test Facility

The Semi-anechoic chamber and shielding room used to collect the radiated data and conducted data are **Intertek Testing Services Shenzhen Ltd. Longhua Branch** and located at 101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, Shenzhen, P.R. China. This test facility and site measurement data have been fully placed on file with the FCC (Registration Number: CN1188).

EXHIBIT 2

SYSTEM TEST CONFIGURATION

2.0 System Test Configuration

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.10: 2013.

The EUT was powered by a rechargeable battery (DC 18V, 10050mAh) which was charged by AC 120V/60Hz during the test.

For maximizing emissions below 30 MHz, the EUT was rotated through 360°, the centre of the loop antenna was placed 1 meter above the ground, and the antenna polarization was changed. For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.0.

The rear of unit shall be flushed with the rear of the table.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on a turn table, which enabled the engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

The EUT exercise program (provided by client) used during testing was designed to exercise the various system components in a manner similar to a typical use.

2.3 Special Accessories

No special accessory attached.

2.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

2.5 Equipment Modification

Any modifications installed previous to testing by Astera LED Technology Gmbh will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Longhua Branch.

2.6 Support Equipment List and Description

This product was tested in the following configuration:

Description	Manufacturer	Model No.
Detachable power cord (unshielded, 100cm)	N/A	N/A
XLR connect cable (unshielded, 100cm)	N/A	N/A
XLR connect cable (unshielded, 150cm)	N/A	N/A
XLR connect cable (unshielded, 150cm)	N/A	N/A
Controller	ASTERA	ART7

EXHIBIT 3

TEST RESULTS

3.0 Test Results

Data is included worst-case configuration (the configuration which resulted in the highest emission levels).

3.1 Radiated Test Results

A sample calculation, configuration photographs and data tables of the emissions are included.

3.1.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV

Where FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

Assume a receiver reading of 62.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 62.0 dBµV
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0 dB

AV = -10 dB

FS = 62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32 dBµV/m

Level in µV/m = Common Antilogarithm [(32 dBµV/m)/20] = 39.8 µV/m

3.1.2 Radiated Emission Configuration Photograph

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

3.1.3 Radiated Emissions- FCC section 15.209

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission

at 49.885 MHz

Judgement: Passed by 7.9 dB

TEST PERSONNEL:

Sign on file

Damon Wang ,Project Engineer
Typed/Printed Name

March 23, 2019
Date

Applicant: Astera LED Technology Gmbh
Worst Case Model: AX5
Worst Case Operating Mode: Transmitting (917MHz)

Date of Test: March 23, 2019

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	110.025	36.1	20.0	10.3	26.4	43.5	-17.1
Horizontal	222.060	36.1	20.0	12.0	28.1	46.0	-17.9
Horizontal	660.015	36.8	20.0	17.0	33.8	46.0	-12.2
Vertical	49.885	43.5	20.0	8.6	32.1	40.0	-7.9
Vertical	108.085	42.2	20.0	10.2	32.4	43.5	-11.1
Vertical	207.995	24.0	20.0	27.6	31.6	43.5	-11.9

NOTES:

1. Quasi-Peak detector is used for frequency below 1GHz.
2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. All emissions are below the QP limit.

3.1.4 Transmitter Spurious Emissions (Radiated) - FCC section 15.209

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission
at
1839.2 MHz

Judgement: Passed by 13.7 dB

TEST PERSONNEL:

Sign on file

Damon Wang, Project Engineer
Typed/Printed Name

March 23, 2019
Date

Applicant: Astera LED Technology Gmbh Date of Test: March 23, 2019
Worst Case Model: AX5
Worst Case Operating Mode: Transmitting (Channel 0-917.00MHz)

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	**917.000	87.6	36.7	28.5	79.4	--	--
Horizontal	*1834.000	60.8	36.5	26.5	50.8	74.0	-23.2
Horizontal	*2751.000	39.4	35.6	39.5	43.3	74.0	-30.7

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	**917.000	87.6	36.7	28.5	13.9	65.5	--	--
Horizontal	*1834.000	60.8	36.5	26.5	13.9	36.9	54.0	-22.6
Horizontal	*2751.000	39.4	35.6	39.5	13.9	29.4	54.0	-19.7

NOTES:

1. Peak detector data unless otherwise stated.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna used for the emission over 1000MHz.

* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

** Fundamental emission was measured for determining band-edge compliance of using delta measurement technique.

Applicant: Astera LED Technology Gmbh Date of Test: March 23, 2019
Worst Case Model: AX5
Worst Case Operating Mode: Transmitting (Channel 26-919.60MHz)

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	*1839.200	48.1	36.5	39.5	51.1	74.0	-22.9
Horizontal	*2758.800	39.6	35.6	39.5	43.5	74.0	-30.5

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	*1839.200	48.1	36.5	39.5	13.9	37.2	54.0	-16.8
Horizontal	*2758.800	39.6	35.6	39.5	13.9	29.6	54.0	-24.4

NOTES:
1. Peak detector data unless otherwise stated.
2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna used for the emission over 1000MHz.

* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Applicant: Astera LED Technology Gmbh Date of Test: March 23, 2019
Worst Case Model: AX5
Worst Case Operating Mode: Transmitting (Channel 52-922.20MHz)

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	**922.200	87.5	36.7	28.5	79.3	--	--
Horizontal	*1844.400	47.9	36.5	39.5	50.9	74.0	-23.1
Horizontal	*2766.600	39.5	35.6	39.5	43.4	74.0	-30.6

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	**922.200	87.5	36.7	28.5	13.9	65.4	--	--
Horizontal	*1844.400	47.9	36.5	39.5	13.9	37.0	54.0	-17.0
Horizontal	*2766.600	39.5	35.6	39.5	13.9	29.5	54.0	-24.5

NOTES:

1. Peak detector data unless otherwise stated.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna used for the emission over 1000MHz.

* Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

** Fundamental emission was measured for determining band-edge compliance of using delta measurement technique.

3.2 Conducted Emission at Mains Terminal

3.2.1 Conducted Emissions Configuration Photograph

For electronic filing, the worst case conducted emission configuration photograph is saved with filename: conducted photos.pdf.

3.2.2 Conducted Emissions

Worst Case Conducted Configuration
at
0.978 MHz

Judgement: Passed by 10.1 dB

TEST PERSONNEL:

Sign on file

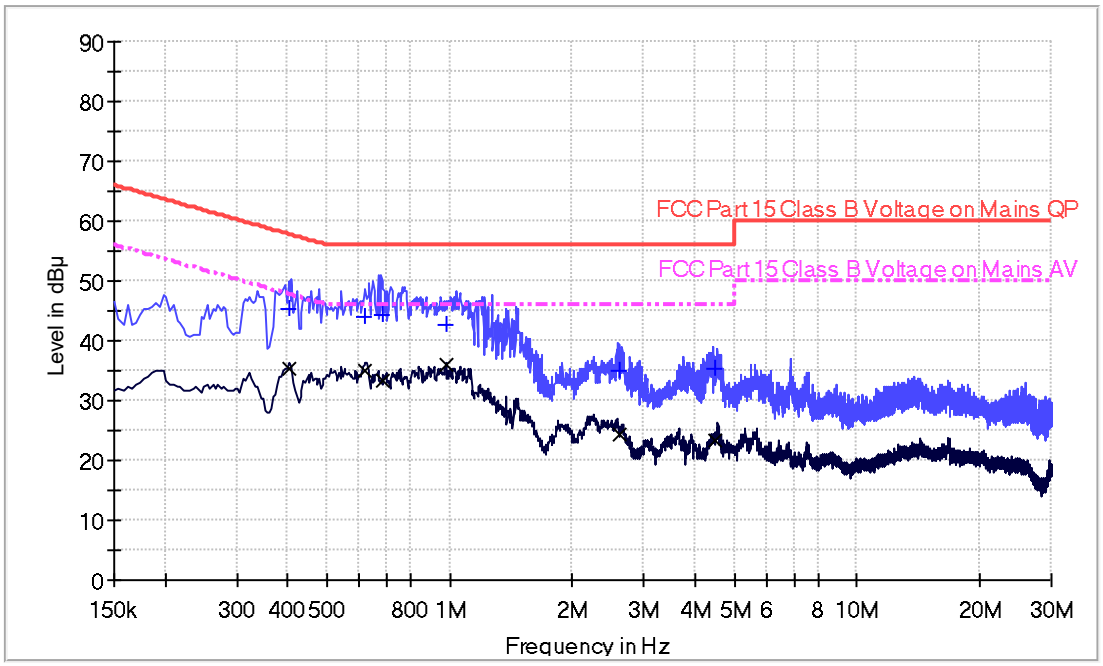
Damon Wang, Project Engineer
Typed/Printed Name

23 March 2019
Date

Applicant: Astera LED Technology Gmbh Date of Test: 23 March 2019
Worst Case Model: AX5
Worst Case Operating Mode: Transmitting (Channel 0-917.00MHz)

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Result Table QP

Frequency (MHz)	QuasiPeak (dB¦ÌV)	Line	Corr. (dB)	Margin (dB)	Limit (dB¦ÌV)
0.402000	45.2	L1	9.7	12.6	57.8
0.622000	44.0	L1	9.7	12.0	56.0
0.686000	44.5	L1	9.7	11.5	56.0
0.978000	42.7	L1	9.7	13.3	56.0
2.600000	35.0	L1	9.7	21.0	56.0
4.470000	35.5	L1	9.8	20.5	56.0

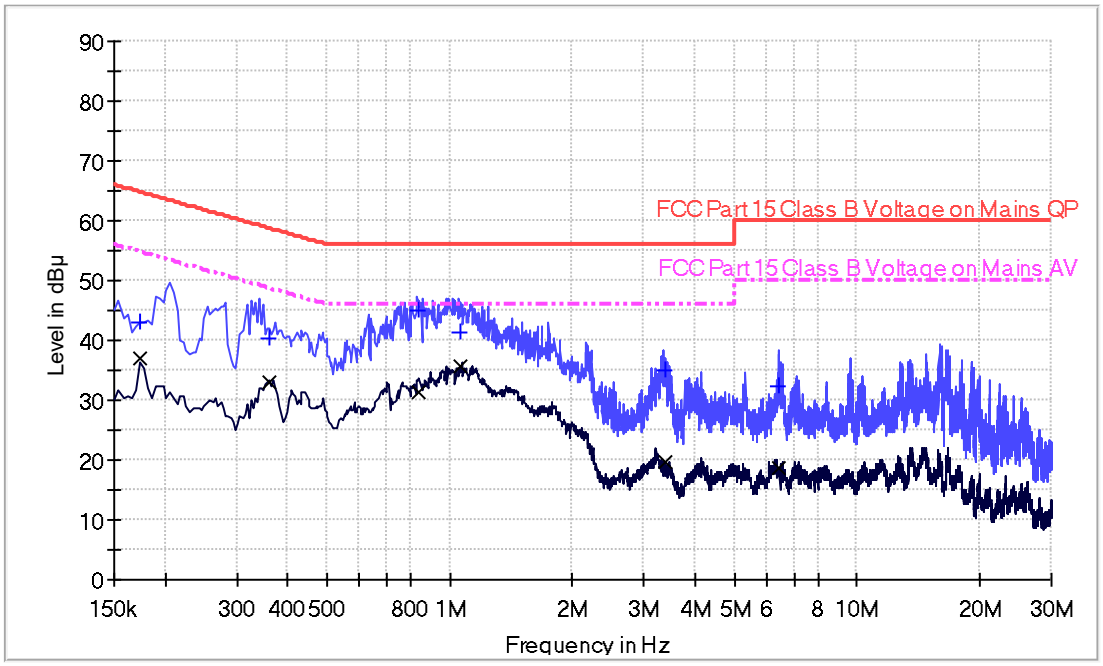
Result Table AV

Frequency (MHz)	Average (dB¦ÌV)	Line	Corr. (dB)	Margin (dB)	Limit (dB¦ÌV)
0.402000	35.2	L1	9.7	12.6	47.8
0.622000	35.1	L1	9.7	10.9	46.0
0.686000	33.5	L1	9.7	12.5	46.0
0.978000	35.9	L1	9.7	10.1	46.0
2.600000	24.3	L1	9.7	21.7	46.0
4.470000	23.4	L1	9.8	22.6	46.0

Applicant: Astera LED Technology Gmbh
Date of Test: 23 March 2019
Worst Case Model: AX5
Worst Case Operating Mode: Transmitting (Channel 0-917.00MHz)

Conducted Emission Test – FCC

Pursuant to 15.207 Emissions Requirement



Result Table QP

Frequency (MHz)	QuasiPeak (dB¦ìV)	Line	Corr. (dB)	Margin (dB)	Limit (dB¦ìV)
0.174000	42.9	N	9.7	21.9	64.8
0.362000	40.5	N	9.7	18.2	58.7
0.838000	45.0	N	9.7	11.0	56.0
1.062000	41.3	N	9.7	14.7	56.0
3.380000	35.0	N	9.8	21.0	56.0
6.438000	32.2	N	9.8	27.8	60.0

Result Table AV

Frequency (MHz)	Average (dB¦ìV)	Line	Corr. (dB)	Margin (dB)	Limit (dB¦ìV)
0.174000	36.9	N	9.7	17.9	54.8
0.362000	33.0	N	9.7	15.7	48.7
0.838000	31.5	N	9.7	14.5	46.0
1.062000	35.6	N	9.7	10.4	46.0
3.380000	19.8	N	9.8	26.2	46.0
6.438000	18.6	N	9.8	31.4	50.0

3.3 Peak Power

Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(2).
The antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for RBW > 20dB bandwidth and power was read directly in dBm.

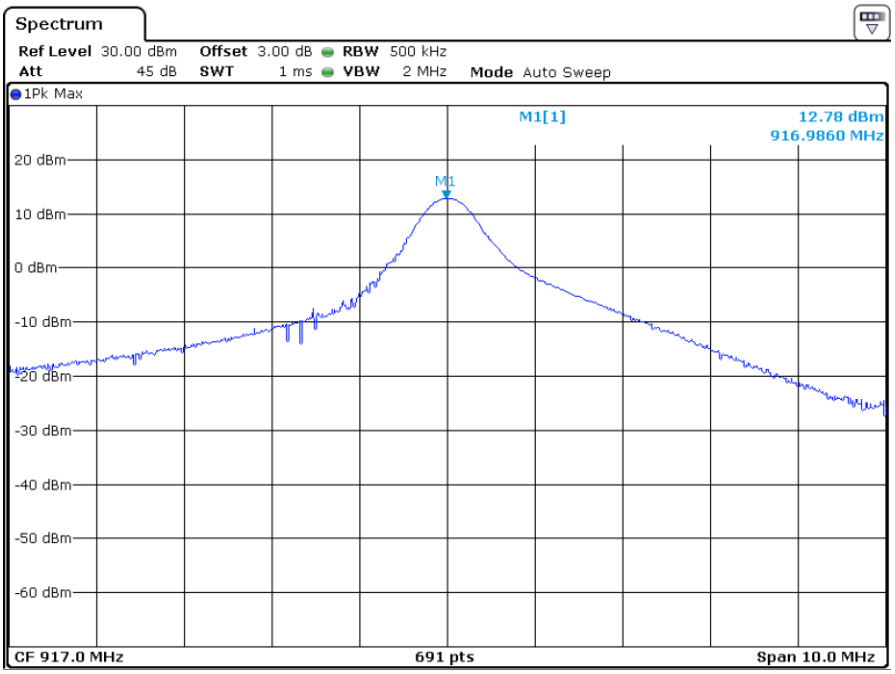
For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels.

Antenna Gain = 0dBi			
Modulation Type	Frequency (MHz)	Output Power (dBm)	Output Power (mW)
GFSK	917.00	12.78	18.97
	919.60	12.77	18.92
	922.20	12.70	18.62

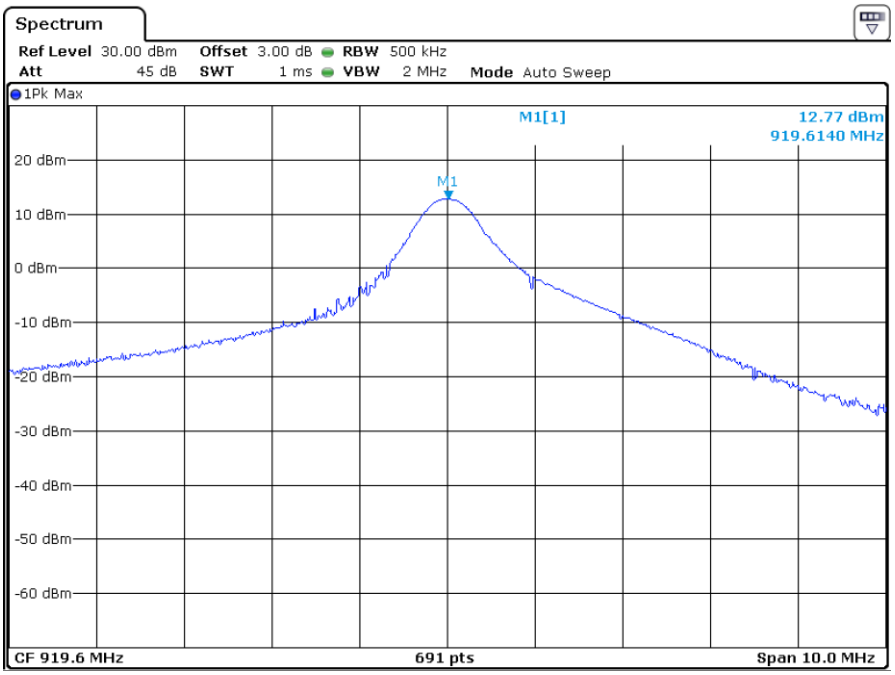
Please refer to the below plots.

Modulation Type: GFSK

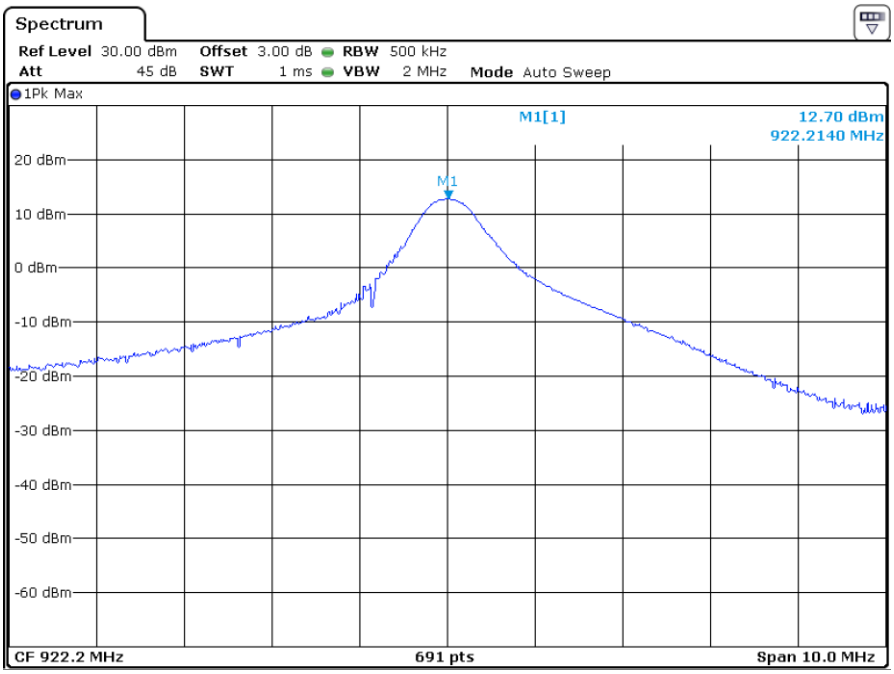
CH00 917.00 MHz



CH26 919.60 MHz



CH52 922.20 MHz



3.4 20dB Bandwidth

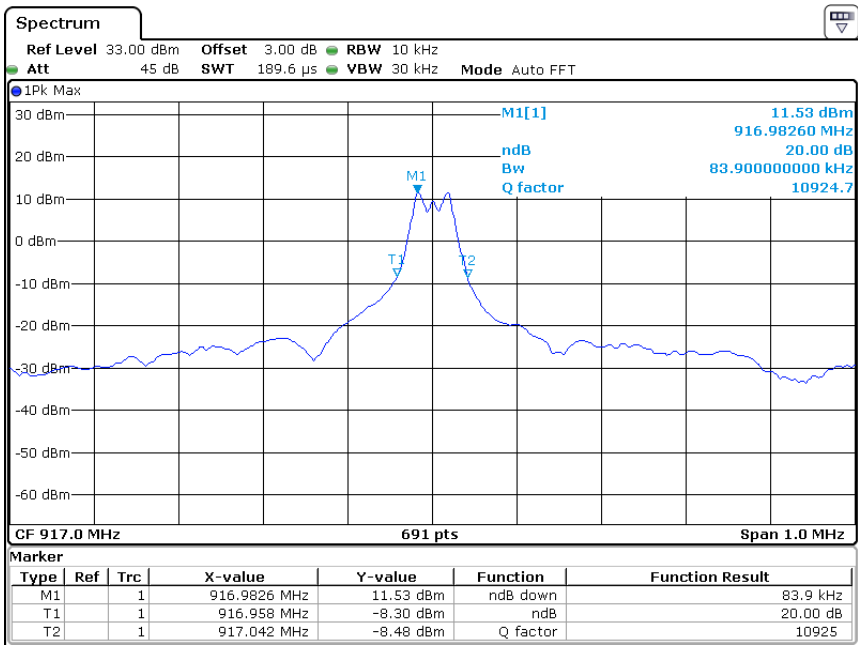
Maximum 20dB RF Bandwidth, FCC Rule 15.247(a) (1):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. Use the spectrum 20dB down delta function to measure the bandwidth.

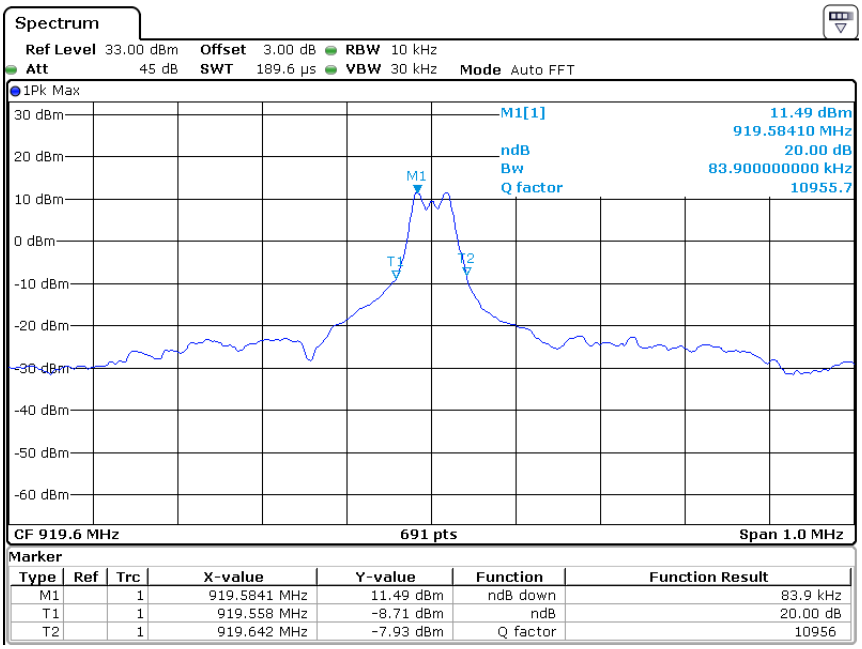
Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (KHz)
917.00	83.9	500
919.60	83.9	500
922.20	85.4	500

Modulation Type: GFSK

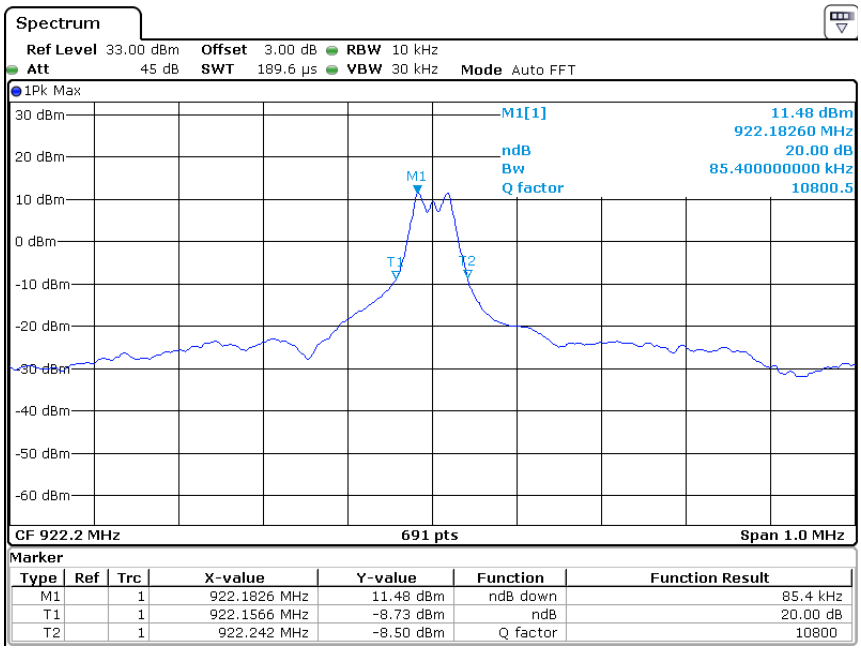
CH0 917.00 MHz



CH26 919.60MHz



CH52 922.20MHz



3.5 Channel Number (Number of Hopping Frequencies)

Minimum Number of Hopping Frequencies, FCC Rule 15.247(a) (1) (iii):

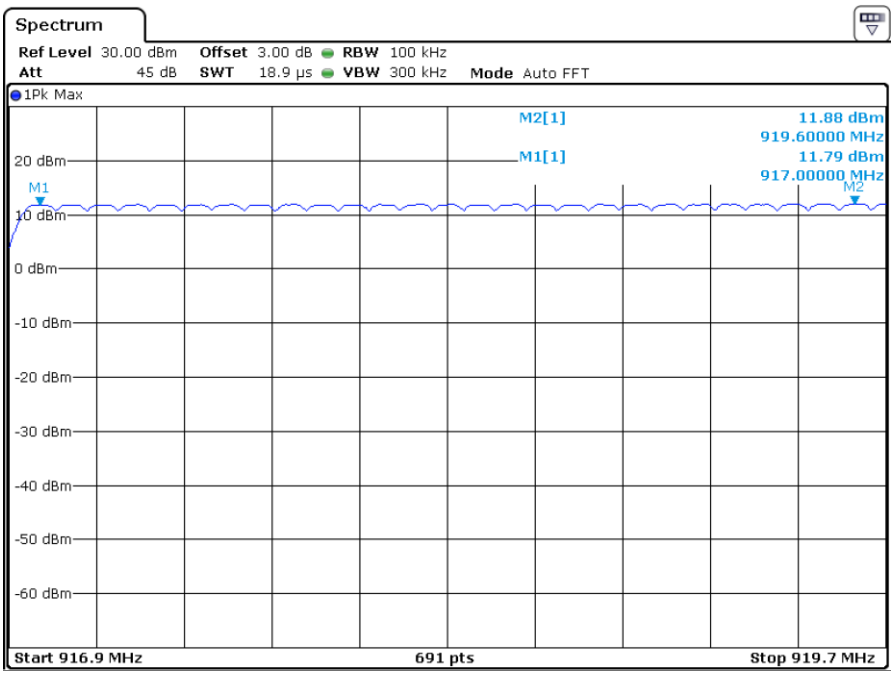
The RF passband of the EUT was divided into 3 approximately equal bands. With the analyzer set to MAX HOLD readings were taken for 2-3 minutes. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

Note: For frequency hopping systems operating in the 902–928 MHz band: if the 20dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

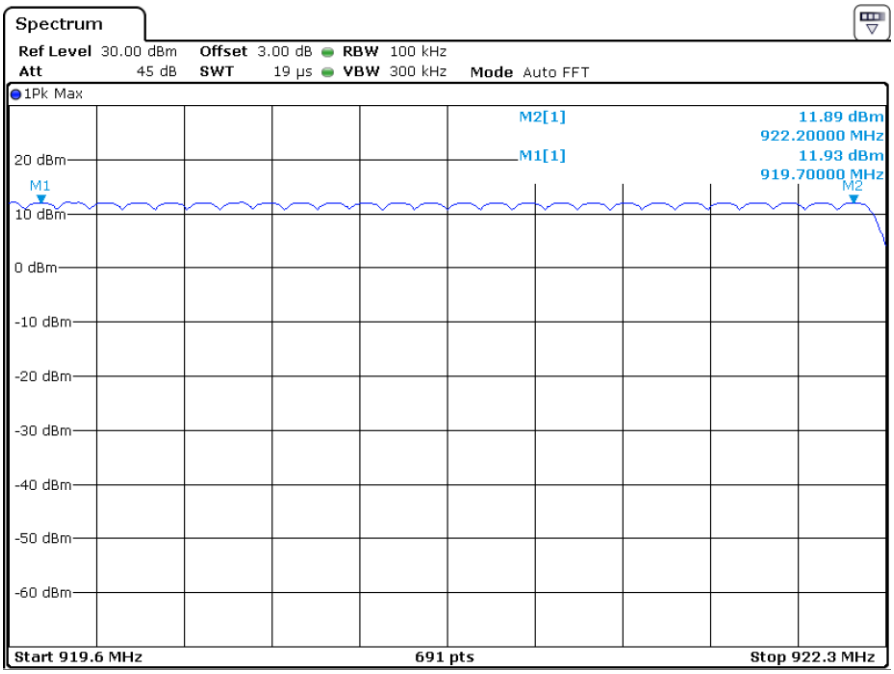
Number of hopping channels =	53

Modulation Type: GFSK

CH00-CH26



CH27-CH52


Spectrum
Ref Level 30.00 dBm Offset 3.00 dB RBW 100 kHz
Att 45 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M2[1] 11.89 dBm
922.20000 MHz
M1[1] 11.93 dBm
919.70000 MHz
M1
M2
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
Start 919.6 MHz
691 pts
Stop 922.3 MHz

3.6 Channel Separation (Carrier Frequency Separation)

Minimum Hopping Channel Carrier Frequency Separation, FCC Ref: 15.247(a)(1):

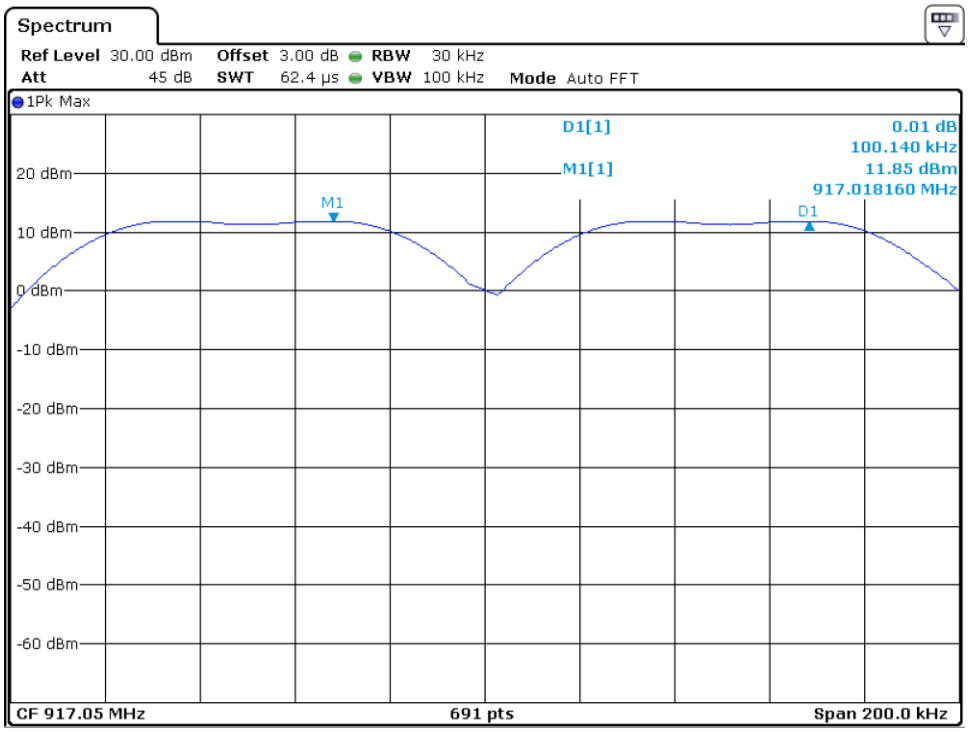
Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and compared against the limit:

Not less than 20dB bandwidth: 85.4kHz

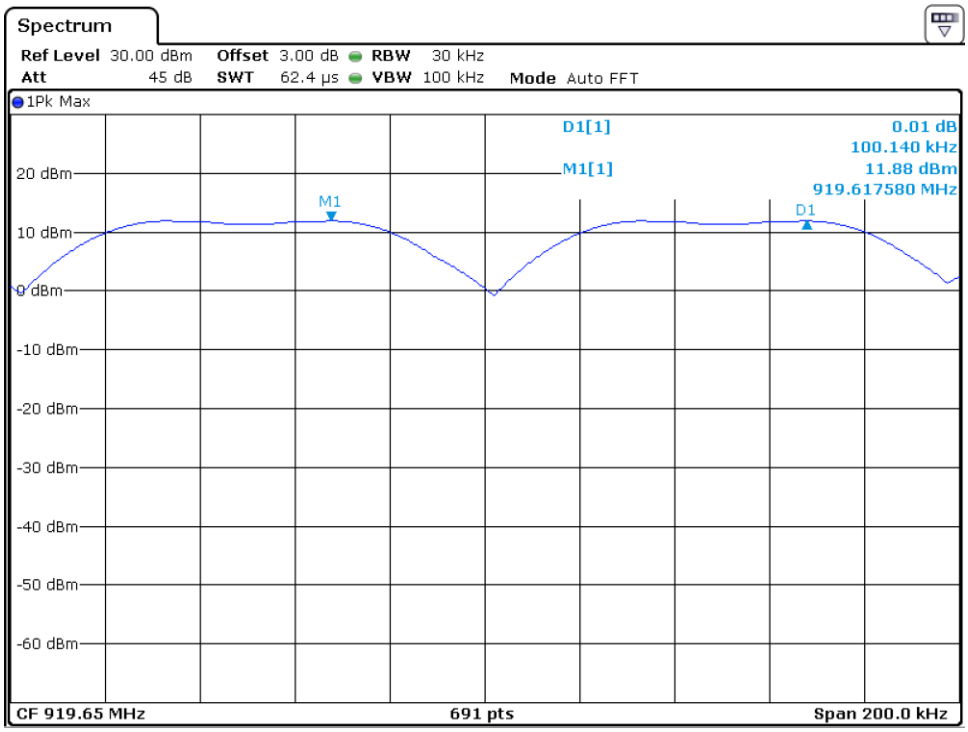
Channel	Channel Separation (KHz)	Limit (KHz)
Low	100.140	85.4
Mid	100.140	85.4
High	100.140	85.4

Modulation Type: GFSK

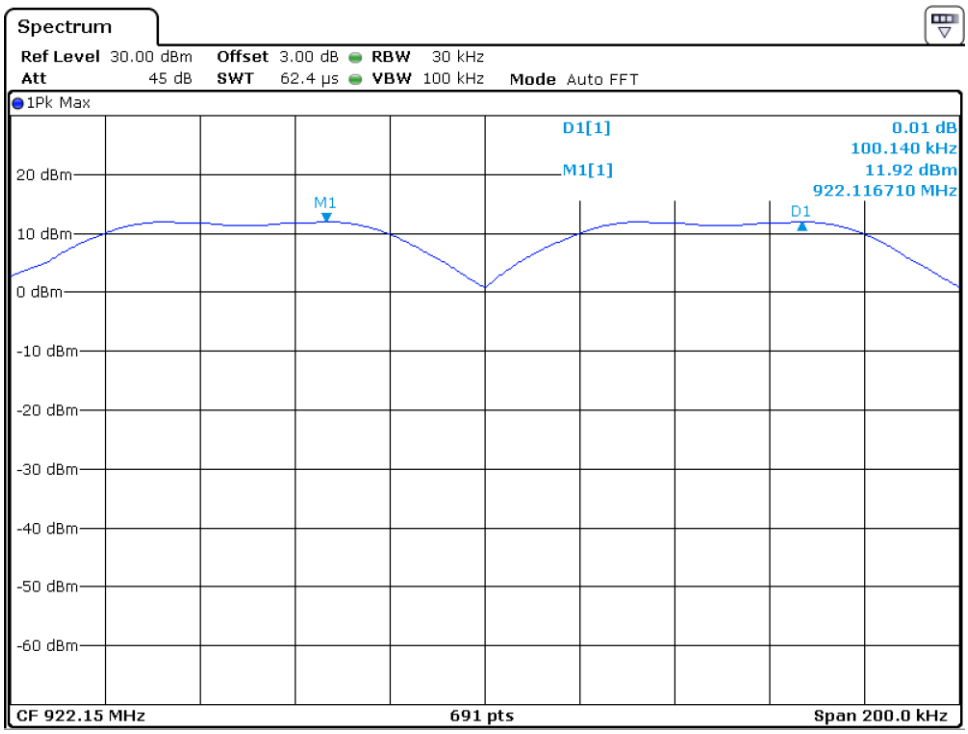
CH0 917.00 MHz



CH26 919.60MHz



CH52 922.20MHz



3.7 Dwell Time (Time of Occupancy)

Average Channel Occupancy Time, FCC Ref: 15.247(a)(1)(i):

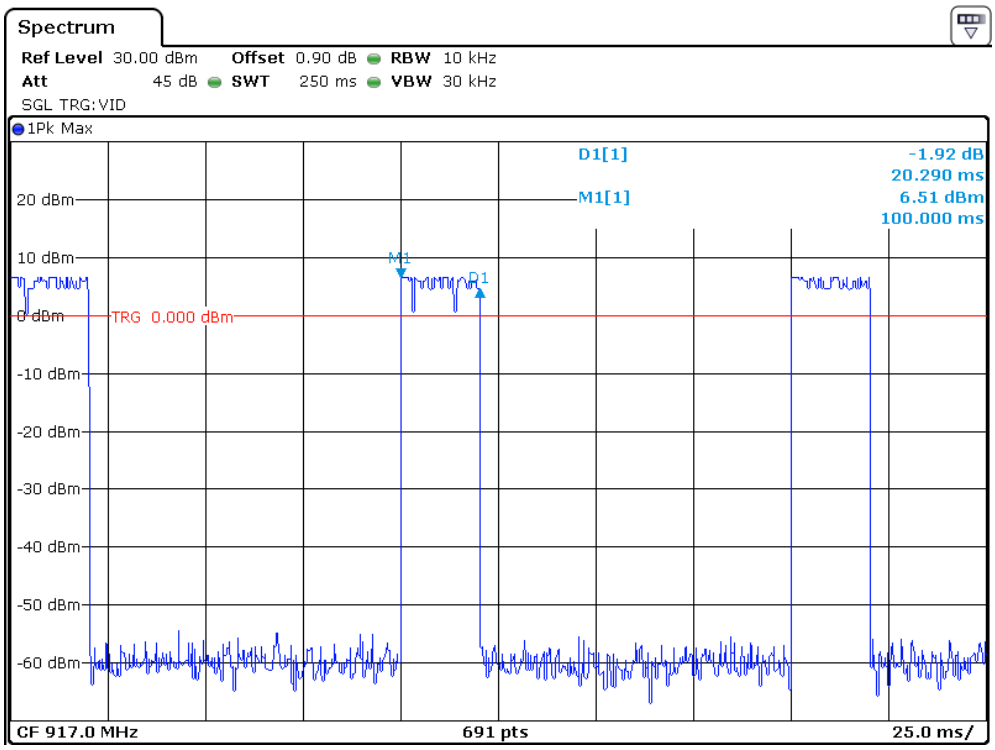
The spectrum analyzer center frequency was set to one of the known hopping channels. The SWEEP was set to 20s, the SPAN was set to ZERO SPAN, and the TRGGER was set to VIDEO. The time duration of the transmissions so captured was measured with the MARKER DELTA function.

Note: For frequency hopping systems operating in the 902–928 MHz band: if the 20dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

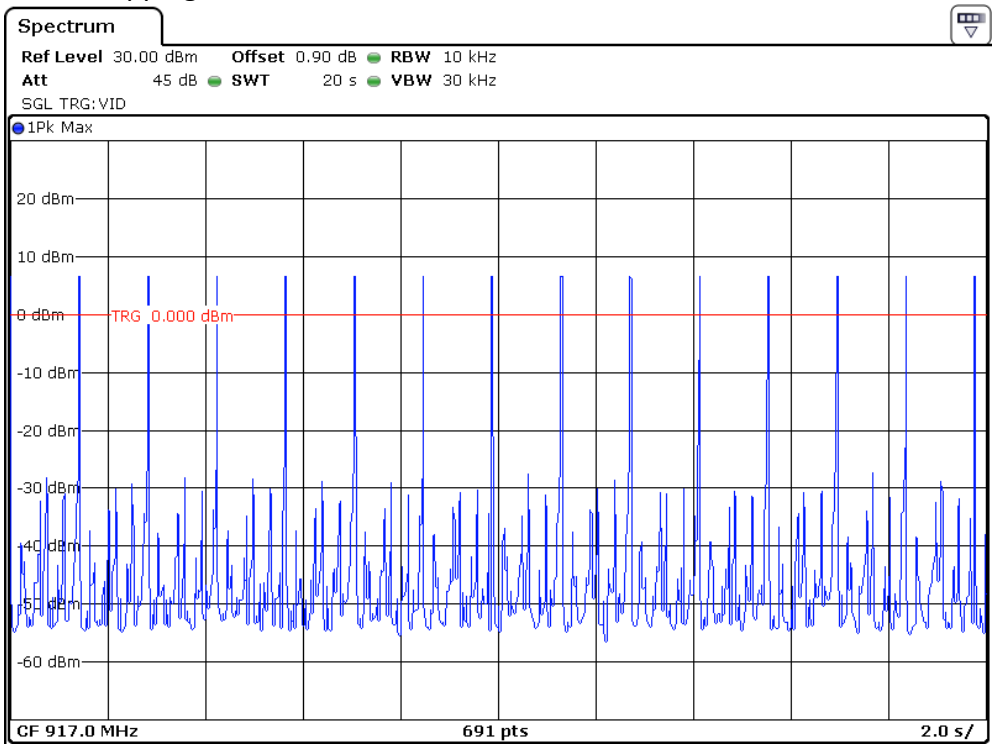
Frequency (MHz)	Dwell time Per Hop (s)	Number of hopping channels in 20s	Dwell time (s)	Limit (s)
917.00	0.0203	14	0.28	0.4
919.60	0.0203	14	0.28	0.4
922.20	0.0203	14	0.28	0.4

Modulation Type: GFSK

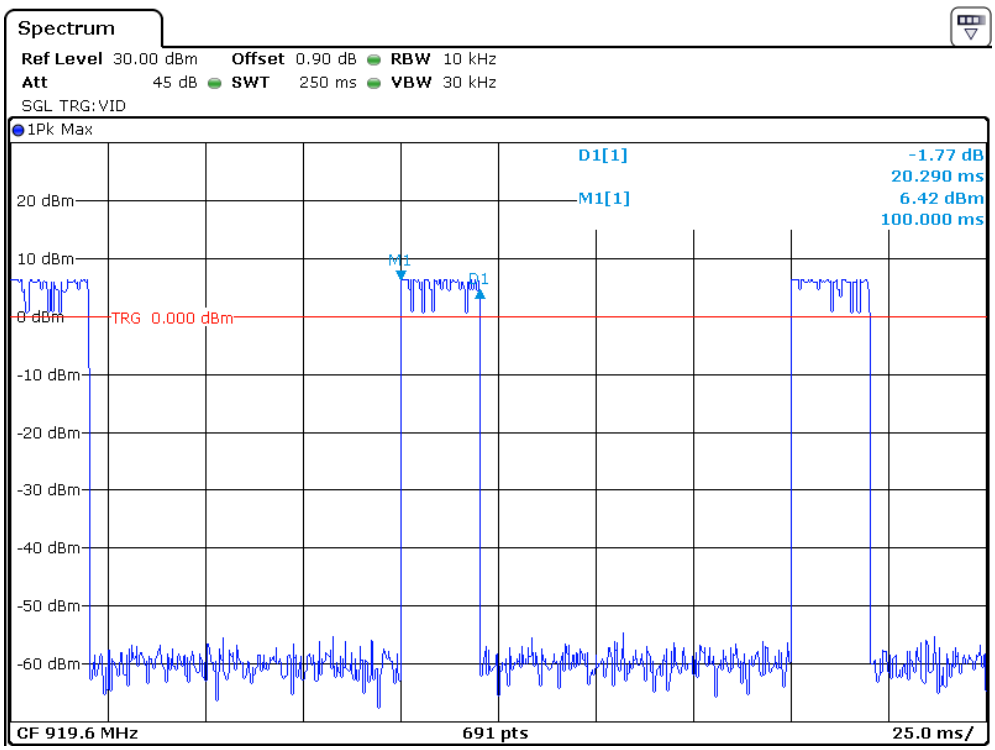
CH0 917.00 MHz



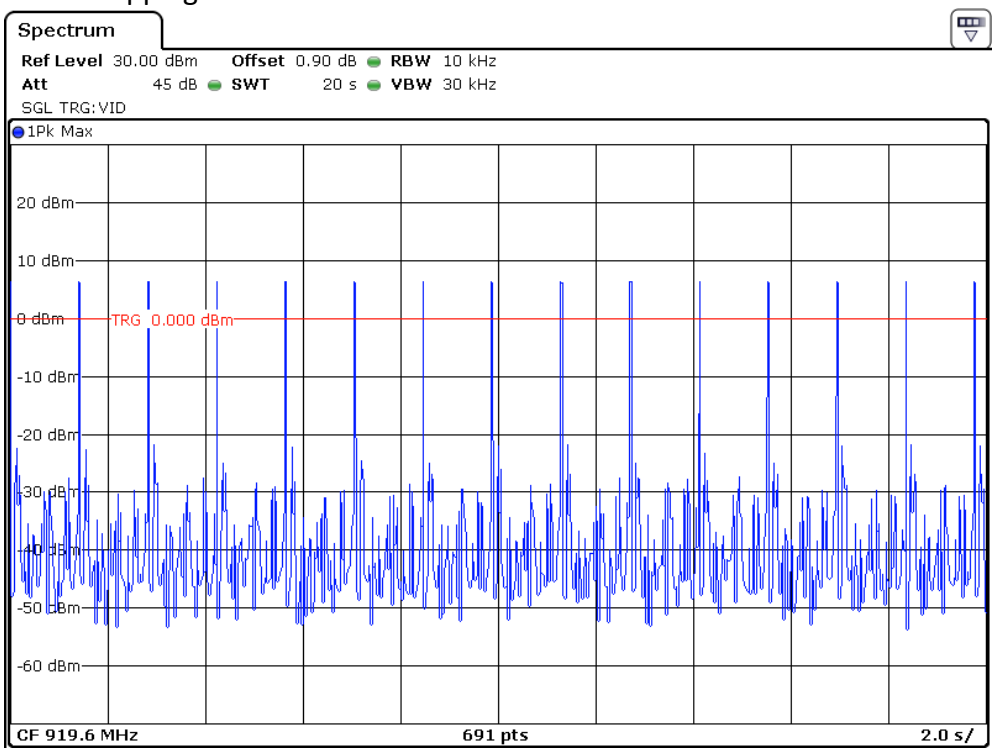
The number of hopping channels in 20s:



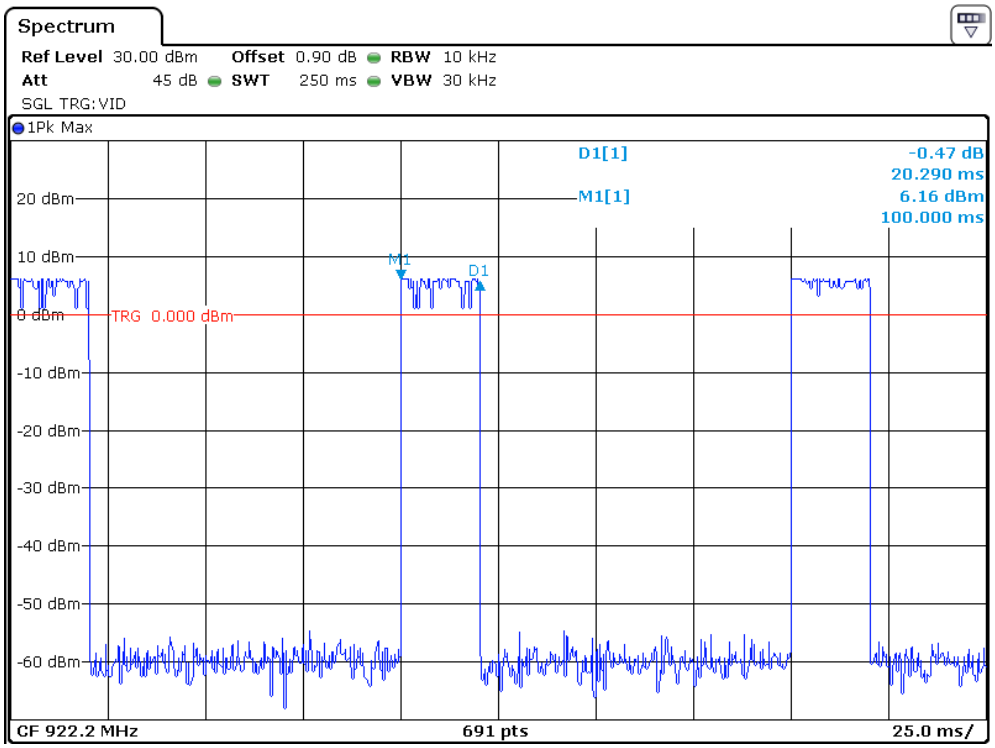
CH26 919.60MHz



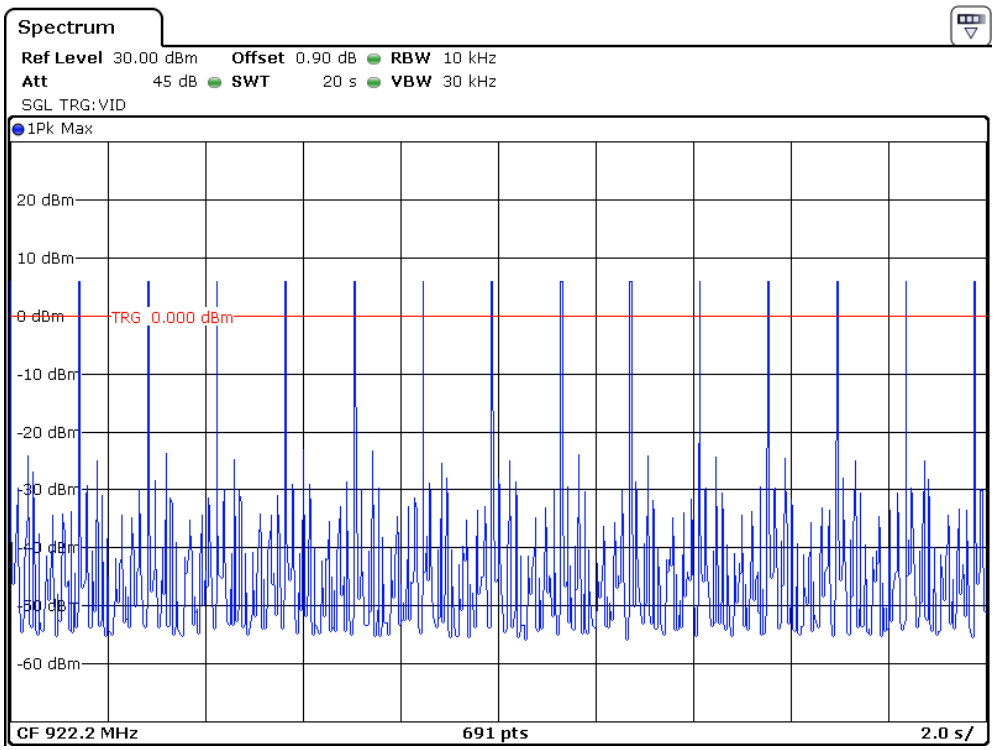
The number of hopping channels in 20s:



CH52 922.20MHz



The number of hopping channels in 20s:

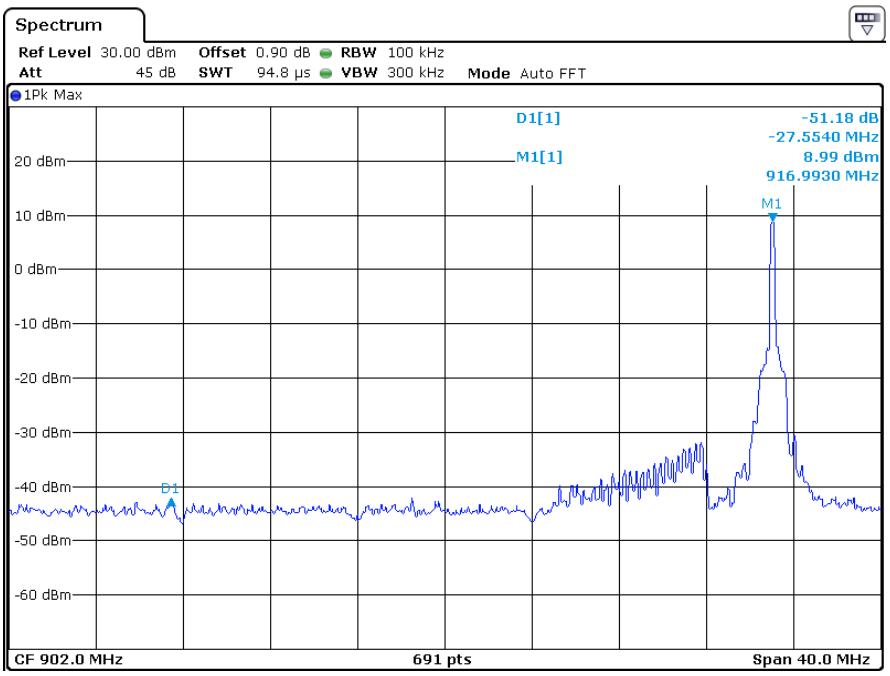


3.8 Band Edge

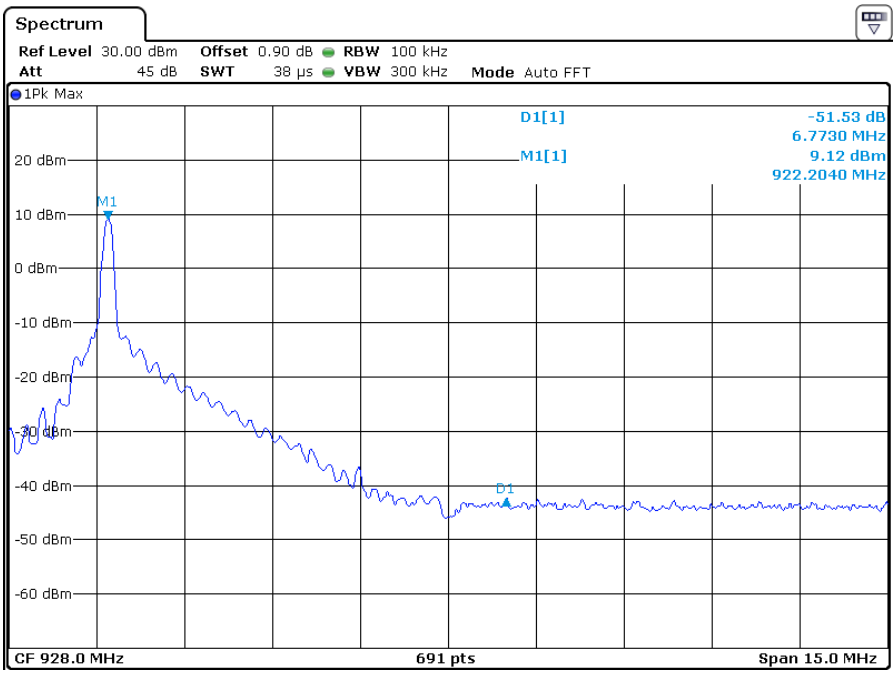
Out of Band Conducted Emissions, FCC Rule 15.247(d):

In any 100 KHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission.

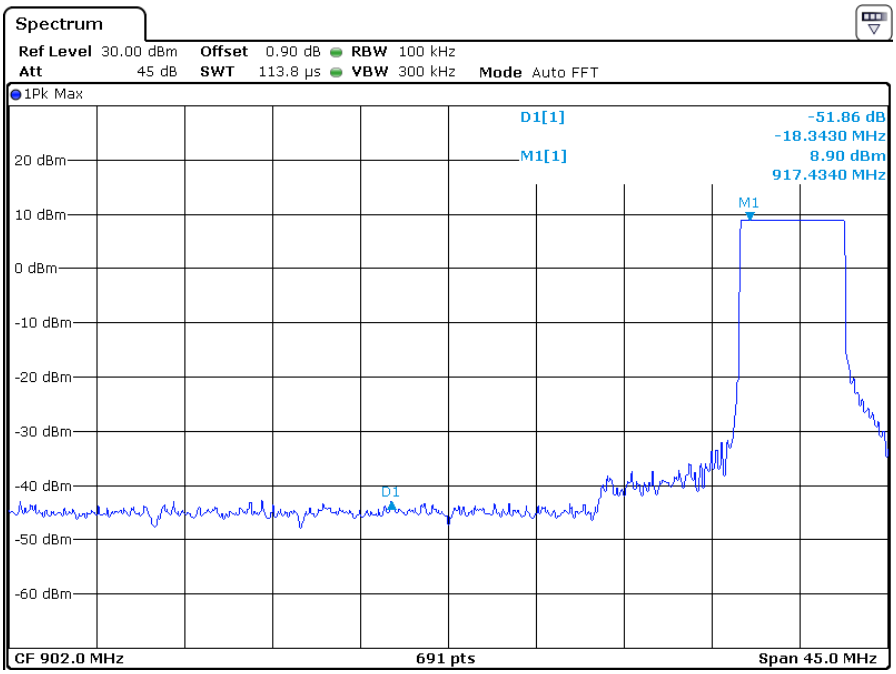
Transmit on Single Channel
CH0 917.00 MHz

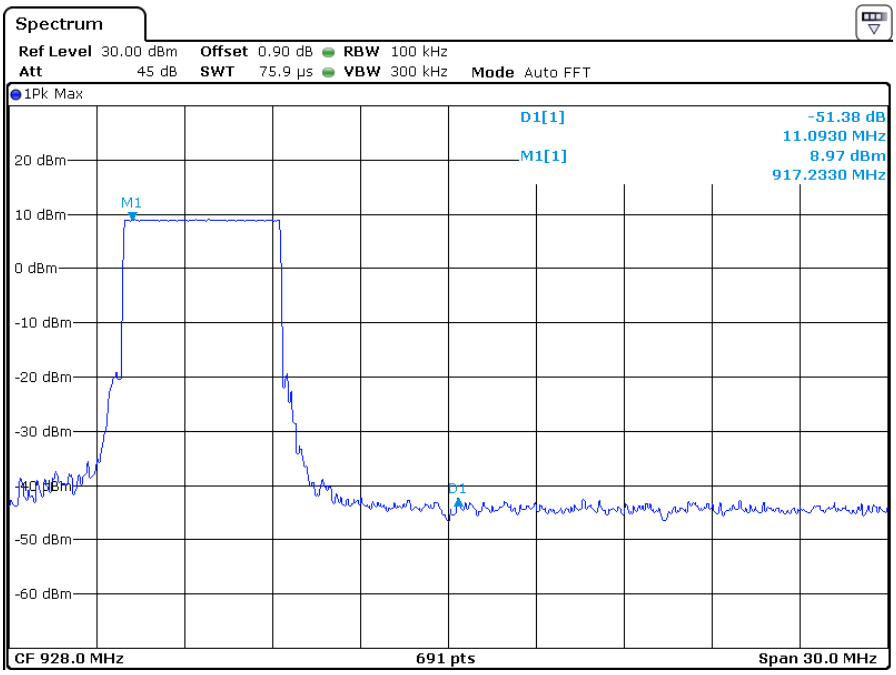


CH52 922.20MHz



Hopping mode





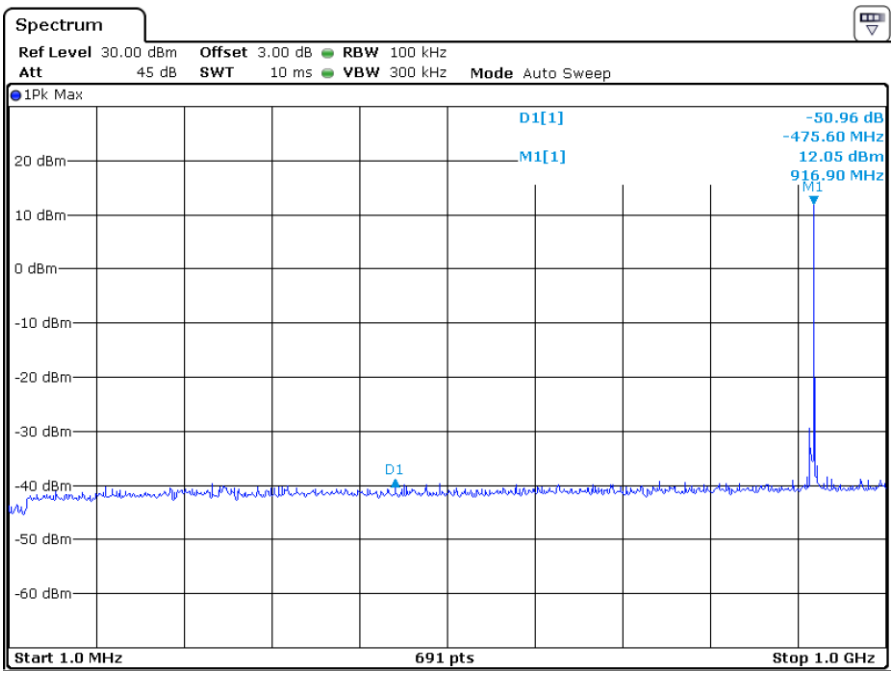
3.9 Transmitter Spurious Emissions (Conducted)

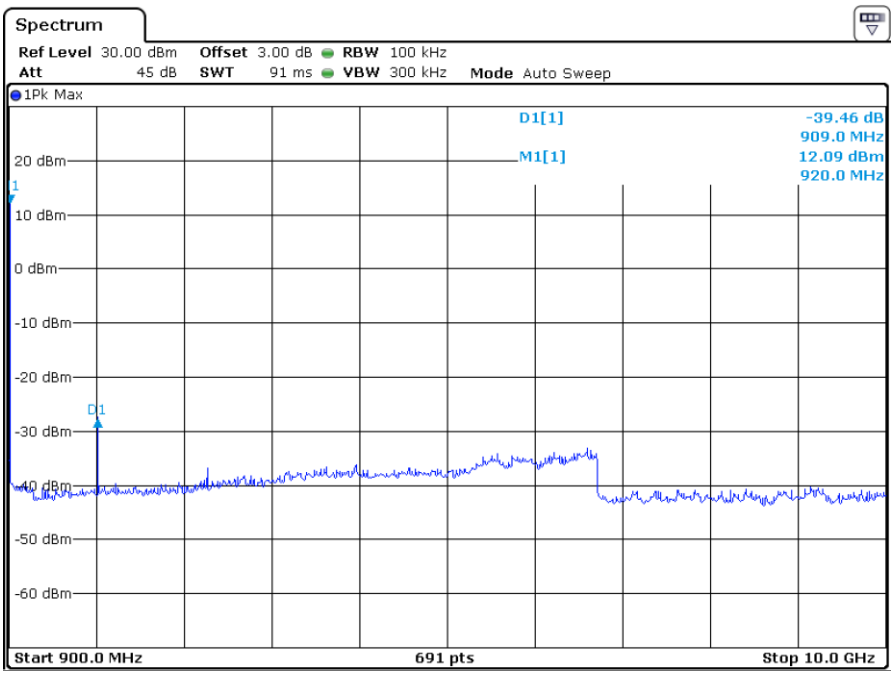
Out of Band Conducted Spurious Emissions, FCC Rule 15.247(d):

All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20 dB below the highest level of the desired power in the passband.

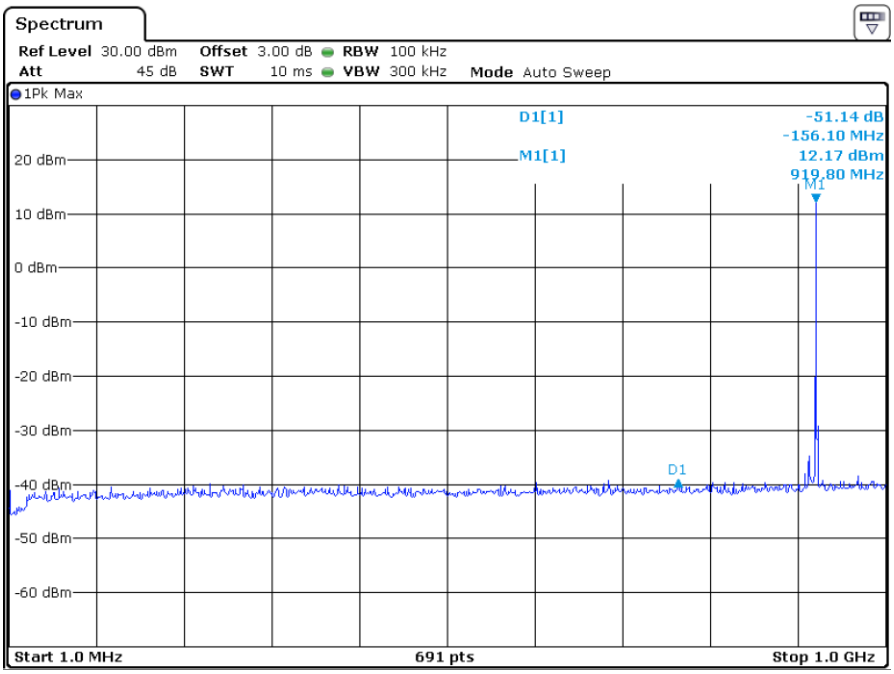
Modulation Type: GFSK

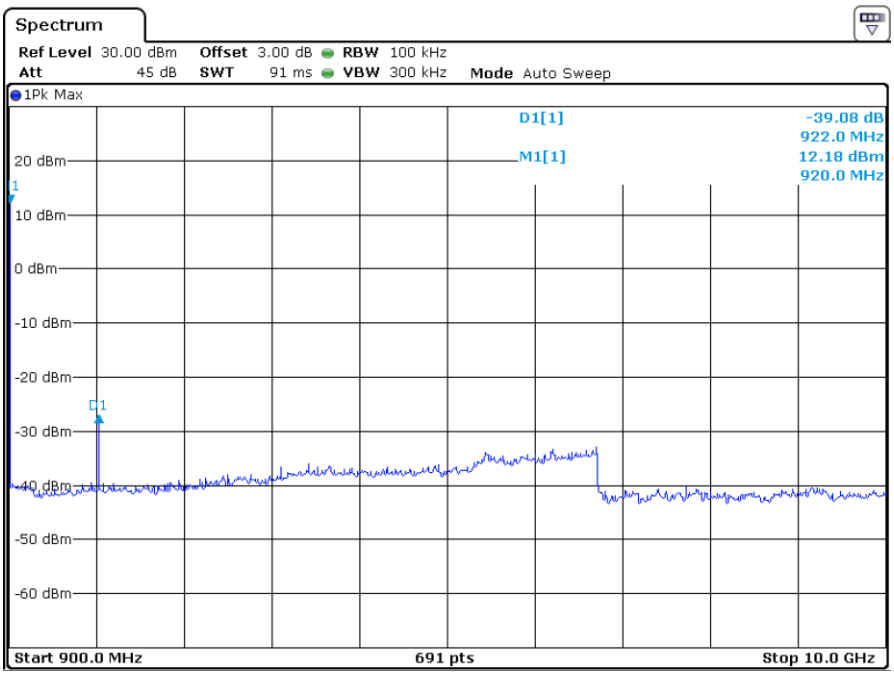
CH0 917.00 MHz



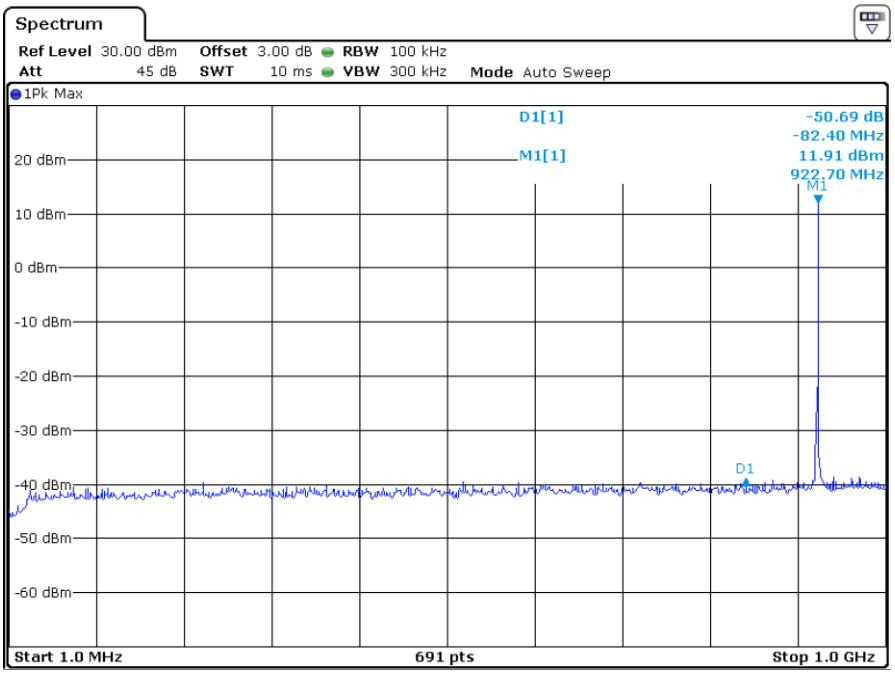


CH26 919.60MHz





CH52 922.20MHz



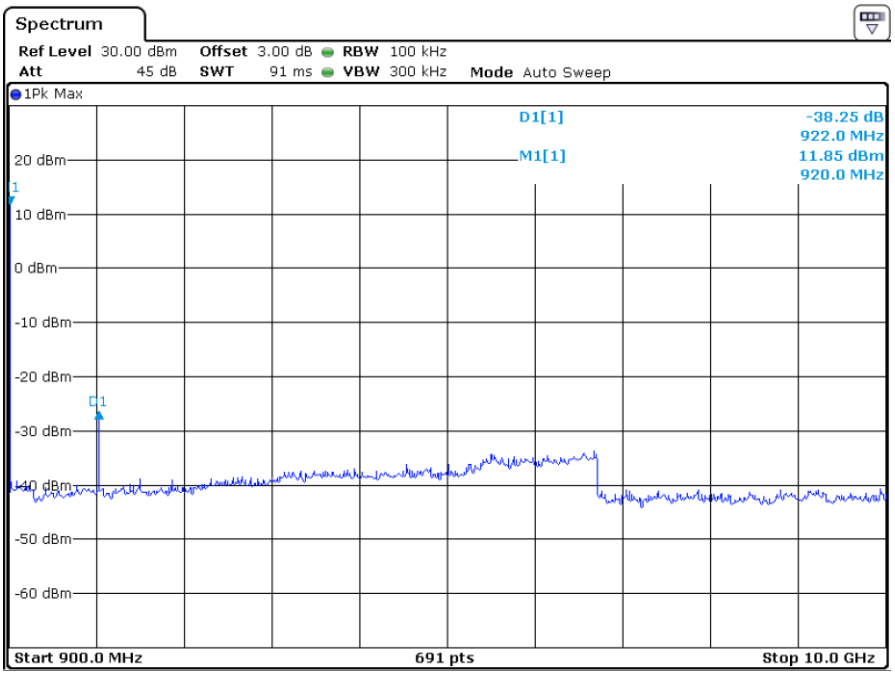


EXHIBIT 4

EQUIPMENT PHOTOGRAPHS

4.0 Equipment Photographs

For electronic filing, the photographs are saved with filename: external photos.pdf & internal photos.pdf.

EXHIBIT 5

PRODUCT LABELLING

5.0 Product Labeling

For electronic filing, the FCC ID label artwork and location is saved with filename: label.pdf.

EXHIBIT 6

TECHNICAL SPECIFICATIONS

6.0 Technical Specifications

For electronic filing, the block diagram and circuit diagram are saved with filename: block.pdf and circuit.pdf respectively.

EXHIBIT 7

INSTRUCTION MANUAL

7.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

EXHIBIT 8

MISCELLANEOUS INFORMATION

8.0 Miscellaneous Information

This miscellaneous information includes details of the test procedure and calculation of factor such as pulse desensitization.

.

8.1 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device.

8.2 Calculation of Average Factor

Averaging factor in dB = 20 log (duty cycle)

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The time period over which the duty cycle is measured is 100 milliseconds, or the repetition cycle, whichever is a shorter time frame. The worst case (highest percentage on) duty cycle is used for the calculation. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

A plot of the worst-case duty cycle as detected in this manner are saved with filename: af.pdf

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 100 ms

Effective period of the cycle = 20.290 ms

DC = 20.290 ms / 100 ms = 0.2029 or 20.29%

Therefore, the averaging factor is found by $20 \log_{10} 0.2029 = -13.9$ dB

8.3 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.10: 2013.

The transmitting equipment under test (EUT) is placed on a styrene turntable which is four feet in diameter and approximately 0.8 meter up to 1GHz and 1.5 meter above 1GHz in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjusted through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 150 kHz to 30 MHz.

Detector function for conducted emissions is in QP & AV mode and IFBW setting is 9 kHz from the frequency band 150 kHz to 30MHz.

8.3 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements are made as described in ANSI C63.10: 2013.

The IF bandwidth used for measurement of radiated signal strength was 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

EXHIBIT 9

CONFIDENTIALITY REQUEST

9.0 Confidentiality Request

For electronic filing, the confidentiality request of the tested EUT is saved with filename: request.pdf.

EXHIBIT 10

TEST EQUIPMENT LIST

10.0 Test Equipment List

.

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-12	BiConiLog Antenna	ETS	3142E	00166158	14-Sep-2018	14-Sep-2019
SZ185-01	EMI Receiver	R&S	ESCI	100547	04-Jan-2019	04-Jan-2020
SZ061-08	Horn Antenna	ETS	3115	00092346	14-Sep-2018	14-Sep-2019
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	11-May-2018	11-May-2019
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	05-Jun-2018	05-Jun-2019
SZ056-06	Spectrum Analyzer	R&S	FSV 40	101101	05-Jun-2018	05-Jun-2019
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	15-Jan-2019	15-Jan-2020
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	15-Dec-2018	15-Dec-2020
SZ062-02	RF Cable	RADIALL	RG 213U	--	29-Oct-2018	29-Oct-2019
SZ062-05	RF Cable	RADIALL	0.04-26.5GHz	--	29-Oct-2018	29-Oct-2019
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	29-Oct-2018	29-Oct-2019
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	05-Jun-2018	05-Jun-2019
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	26-Oct-2018	26-Oct-2019
SZ187-01	Two-Line V-Network	R&S	ENV216	100072	26-Oct-2018	26-Oct-2019
SZ187-02	Two-Line V-Network	R&S	ENV216	100073	04-Jul-2018	04-Jul-2019
SZ188-03	Shielding Room	ETS	RFD-100	4100	16-Jan-2017	16-Jan-2020

---END---