FCC TEST REPORT

Product Name:	two way radio
Trade Mark:	BLACKFIN
Model No.:	WT-1004
Report Number:	181217004RFC-1
Test Standards:	FCC 47 CFR Part 95 FCC 47 CFR Part 2
FCC ID:	2AMXI-WT-1004
Test Result:	PASS
Date of Issue:	January 8, 2019

Prepared for:

Ningbo Zhonghai Electrical Appliances Co.,Ltd
Jishan Industrial District,Ningbo Zhejiang China

Prepared by:

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Date: January 8, 2019

UnionTrust Laboratories UnionTrust * Certified *

Version

Version No.	Date	Description
V1.0	January 8, 2019	Original

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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Ningbo Zhonghai Electrical Appliances Co.,Ltd
Address of Applicant:	Jishan Industrial District,Ningbo Zhejiang China
Manufacturer:	Ningbo Zhonghai Electrical Co.,Ltd
Address of Manufacturer:	Jishan Industrial District,Xidian Town,Ninghai City,Ningbo Zhejiang China

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	two way radio
Model No.:	WT-1004
Add. Model No.:	N/A
Trade Mark:	BLACKFIN
DUT Stage:	Identical Prototype
Software Version:	N/A
Hardware Version:	N/A
Sample Received Date:	December 18, 2018
Sample Tested Date:	December 20, 2018 to December 30, 2018

1.2.2 Description of Accessories

Battery	
Trade Mark:	FB
Model No.:	FB-43AAAJ600mAh 1.2V
Battery Type:	Ni MH battery
Rated Voltage:	1.2 Vdc *3
Limited Charge Voltage:	1.4 Vdc
Rated Capacity:	600 mAh
Manufacturer:	SHENZHEN FB ELCTRONIC CO., LTD

Cable	
Trade Mark:	N/A
Model No.:	N/A
Description:	USB Micro-B Plug Cable
Cable Type:	Shielded without ferrite
Length:	0.8 Meter

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Range:	FRS:	462.5625 MHz to 462.7125 MHz
		467.5625 MHz to 467.7125 MHz
		462.5500 MHz to 462.7250 MHz
Rated Output Power:	FRS (See Note 1):	0.5W(27dBm)
Modulation Type:	FRS:	FM
Channel Separation:	FRS:	12.5 KHz
Emission Designator:	FRS:	8K01F3E
Maximum Transmitter Power (ERP):	FRS:	26.46dBm
Number of Channels:	22	
Antenna Type:	Integral Antenna	
Antenna Gain:	2 dBi	
Normal Test Voltage:	3.6 Vdc	
Extreme Test Voltage:	3.0 to 4.0 Vdc	
Extreme Test Temperature:	-20 °C to +55 °C	
Note 1: The EUT only supports voice communication.		

1.4 OTHER INFORMATION

Operation Frequency Each of Channel					
FRS		FRS		FRS	
Channel	**Frequency**	**Channel**	**Frequency**	**Channel**	**Frequency**
1	462.5625 MHz	8	467.5625 MHz	15	462.5500 MHz
2	462.5875 MHz	9	467.5875 MHz	16	462.5750 MHz
3	462.6125 MHz	10	467.6125 MHz	17	462.6000 MHz
4	462.6375 MHz	11	467.6375 MHz	18	462.6250 MHz
5	462.6625 MHz	12	467.6625 MHz	19	462.6500 MHz
6	462.6875 MHz	13	467.6875 MHz	20	462.6750 MHz
7	462.7125 MHz	14	467.7125 MHz	21	462.7000 MHz
				22	462.7250 MHz

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested independently

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
--	--	--	--	--

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.30 Meter	UnionTrust

1.6 TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.
Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China
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Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

IC-Registration No.: 21600-1
The 3m Semi-anechoic chamber of Shenzhen UnionTrust Quality and Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 21600-1.

A2LA-Lab Certificate No.: 4312.01
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC Accredited Lab.
Designation Number: CN1194
Test Firm Registration Number: 259480

1.8 DEVIATION FROM STANDARDS

None.

1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Radiated Spurious emissions 30MHz-1GHz	±4.5 dB
2	Radiated Spurious emissions 1GHz-18GHz	±4.4 dB

2. TEST SUMMARY

FCC 47 CFR Part 95 Test Cases			
Test Item	**Test Requirement**	**Test Method**	**Result**
Maximum Transmitter Power	FCC 47 CFR Part 95.567 FCC 47 CFR Part 2.1046(a)	ANSI/TIA-603-E-2016	PASS
Modulation Limit	FCC 47 CFR Part 95.575 FCC 47 CFR Part 2.1047(a)(b)	ANSI/TIA-603-E-2016	PASS
Audio Frequency Response	FCC CFR Part 95.1775 FCC 47 CFR Part 2.1047(a)	ANSI/TIA-603-E-2016	PASS
Audio Low Pass Filter Response	FCC 47 CFR Part 95.1775(e)	ANSI/TIA-603-E-2016	PASS
Emission Bandwidth	FCC 47 CFR Part 95.573	ANSI/TIA-603-E-2016	PASS
Emission Mask	FCC 47 CFR Part 95.579	ANSI/TIA-603-E-2016	PASS
Transmitter Radiated Spurious Emission	FCC 47 CFR Part 95.579	ANSI/TIA-603-E-2016	PASS
Spurious Emission On Antenna Port	FCC 47 CFR Part 95.579	ANSI/TIA-603-E-2016	N/A Note 1, 2
Frequency Stability	FCC 47 CFR Part 95.565 FCC 47 CFR Part 2.1055 (a)(1)	ANSI/TIA-603-E-2016	PASS

Note:

1) N/A: In this whole report not application.
2) The EUT is Integral Antenna.

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☒	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 03, 2018	Dec. 03, 2021
☒	Receiver	R&S	ESIB26	100114	Nov. 24, 2018	Nov. 24, 2019
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	Dec. 03, 2018	Dec. 03, 2019
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Dec. 08, 2018	Dec. 08, 2019
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	Dec. 08, 2018	Dec. 08, 2019
☒	Preamplifier	HP	8447F	2805A02960	Nov. 24, 2018	Nov. 24, 2019
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	May 22, 2018	May 22, 2019
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☒	Test Software	Audix	e3	Software Version: 9.160333		

Conducted RF test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
☒	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Nov. 24, 2018	Nov. 24, 2019
☒	RF COMMUNITION TEST SET	HP	8920A	3813A10206	Nov.10, 2018	Nov.09, 2019
☒	Oscilloscope	Tektronix	TDS3032B	B013680	Sep.18, 2018	Sep.17, 2019
☒	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Jan. 05, 2018	Jan. 04, 2020
☒	DC Source	KIKUSUI	PWR400L	LK003024	NA	NA
☒	Temp & Humidity chamber	Votisch	VT4002	58566133290020	Jun. 15, 2018	Jun. 14, 2019

4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Test Environment	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
TN/VN	+15 to +35	3.6	20 to 75
TL/VN	-20	3.6	20 to 75
TH/VN	+55	3.6	20 to 75
TN/VH	25	4.0	20 to 75
TN/VL	25	3.3	20 to 75

Remark:

1) The EUT just work in such extreme temperature of -20 °C to +55 °C and the extreme voltage of 3.0 V to 4.0 V, so here the EUT is tested in the temperature of -20 °C to +55 °C and the voltage of 3.0 V to 4.0 V.
2) VN: Normal Voltage; TN: Normal Temperature;
TL: Low Extreme Test Temperature; TH: High Extreme Test Temperature;
VL: Low Extreme Test Voltage; VH: High Extreme Test Voltage.

4.2 TEST CHANNELS

Operation Mode	Frequency Range	Test RF Channel Lists		
FRS	462.5625 MHz to 462.7125 MHz	**Lowest**	**Middle**	**Highest**
		Channel 1	Channel 4	Channel 7
		462.5625 MHz	462.6375 MHz	462.7125 MHz
	467.5625 MHz to 467.7125 MHz	**Lowest**	**Middle**	**Highest**
		Channel 8	Channel 11	Channel 14
		467.5625 MHz	467.6375 MHz	467.7125 MHz
	462.5500 MHz to 462.7250 MHz	**Lowest**	**Middle**	**Highest**
		Channel 15	Channel 19	Channel 22
		462.5500 MHz	462.6500 MHz	462.7250 MHz

4.3 EUT TEST STATUS

Mode	Description
FRS	Keep the EUT in continuously transmitting with modulation or single carrier test single.

4.4 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by a 3.6Vdc Ni MH battery. Only the worst case data were recorded in this test report.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. Video bandwidth was 3 times greater than resolution bandwidth.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 30 MHz to the tenth harmonic of the highest fundamental frequency. The spurious emissions more than 20 dB below the permissible value are not reported.

5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2 Subpart J	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 95	Personal Radio Service
3	ANSI/TIA-603-E-2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

5.2 MAXIMUM TRANSMITTER POWER (EFFECTIVE RADIATED POWER)

Test Requirement: FCC 47 CFR Part 95.567
FCC 47 CFR Part 2.1046(a)

Test Method: ANSI/TIA-603-E-2016, Section 2.2.17

Limit:

For FRS

Each FRS transmitter type must be designed such that the effective radiated power (ERP) on channels 8 through 14 does not exceed 0.5 Watts and the ERP on channels 1 through 7 and 15 through 22 does not exceed 2.0 Watts.

For GMRS

This section contains transmitting power limits for GMRS stations. The maximum transmitting power depends on which channels are being used and the type of station.

(a) 462/467 MHz main channels. The limits in this paragraph apply to stations transmitting on any of the 462 MHz main channels or any of the 467 MHz main channels. Each GMRS transmitter type must be capable of operating within the allowable power range. GMRS licensees are responsible for ensuring that their GMRS stations operate in compliance with these limits.

(1) The transmitter output power of mobile, repeater and base stations must not exceed 50 Watts.

(2) The transmitter output power of fixed stations must not exceed 15 Watts.

(b) 462 MHz interstitial channels. The effective radiated power (ERP) of mobile, hand-held portable and base stations transmitting on the 462 MHz interstitial channels must not exceed 5 Watts.

(c) 467 MHz interstitial channels. The effective radiated power (ERP) of hand-held portable units transmitting on the 467 MHz interstitial channels must not exceed 0.5 Watt. Each GMRS transmitter type capable of transmitting on these channels must be designed such that the ERP does not exceed 0.5 Watt.

Test Procedure:

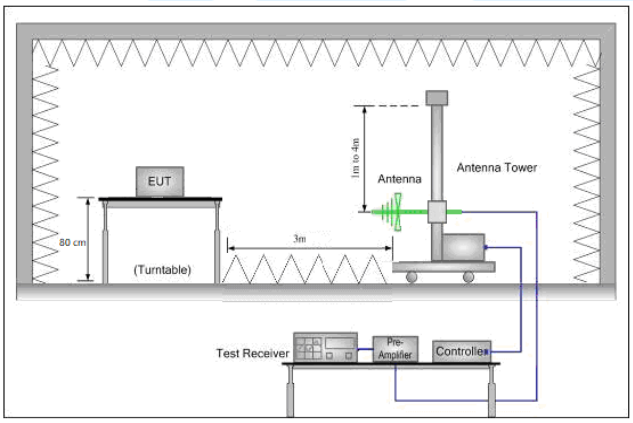
Test procedure as below:

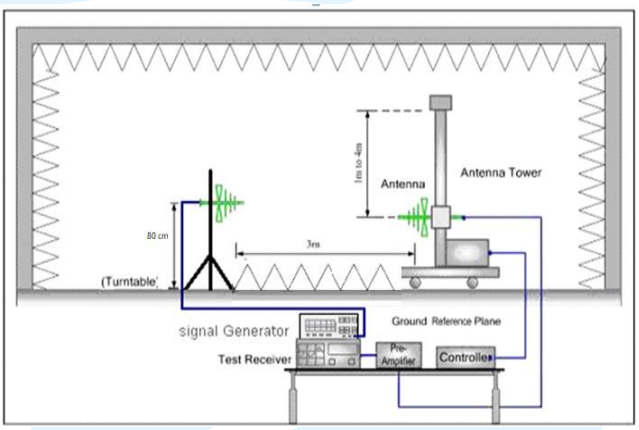
1) EUT was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The disturbance of the transmitter was maximized on the test receiver display by raising and lowering from 1m to 4m the receive antenna and by rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made. The radiated emission measurements of all transmit frequencies in all channels were measured with peak detector.
2) A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
3) The EUT is then put into continuously transmitting mode at its maximum power level during the test.Set Test Receiver or Spectrum RBW=100kHz,VBW=300kHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (Pr).
4) The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed

to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

5) A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
The measurement results are obtained as described below: Power(EIRP)=PMea- PAg - Pcl - Ga
The measurement results are amend as described below:
Power(EIRP)=PMea- Pcl - Ga
6) This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
7) ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.
8) Test the EUT in the lowest channel, the middle channel the Highest channel

Test Setup:





Instruments Used: Refer to section 3 for details
Test Mode: Unmodulated Transmitter mode
Test Results: Refer to APPENDIX A.

5.3 MODULATION LIMIT

Test Requirement: FCC 47 CFR Part 95.575

Test Method: ANSI/TIA-603-E-2016, Section 2.2.3

Limit:

For FRS

Each FRS transmitter type must be designed such that the peak frequency deviation does not exceed 2.5 kHz, and the highest audio frequency contributing substantially to modulation must not exceed 3.125 kHz.

For GMRS

Each GMRS transmitter type must be designed to satisfy the modulation requirements in this section. Operation of GMRS stations must also be in compliance with these requirements.

(a) Main channels. The peak frequency deviation for emissions to be transmitted on the main channels must not exceed ± 5 kHz.

(b) 462 MHz interstitial channels. The peak frequency deviation for emissions to be transmitted on the 462 MHz interstitial channels must not exceed ± 5 kHz.

(c) 467 MHz interstitial channels. The peak frequency deviation for emissions to be transmitted on the 467 MHz interstitial channels must not exceed ± 2.5 kHz, and the highest audio frequency contributing substantially to modulation must not exceed 3.125 kHz.

Test Procedure:

a) Connect the equipment as illustrated.

b) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.

c) Set the test receiver to measure peak positive deviation. Set the audio bandwidth for ≤0.25 Hz to ≥15,000 Hz. Turn the de-emphasis function off.

d) Apply a 1000 Hz modulating signal to the transmitter from the audio frequency generator, and adjust the level to obtain 60% of full rated system deviation.

e) Increase the level from the audio frequency generator by 20 dB in one step (rise time between the 10% and 90% points shall be 0.1 second maximum).

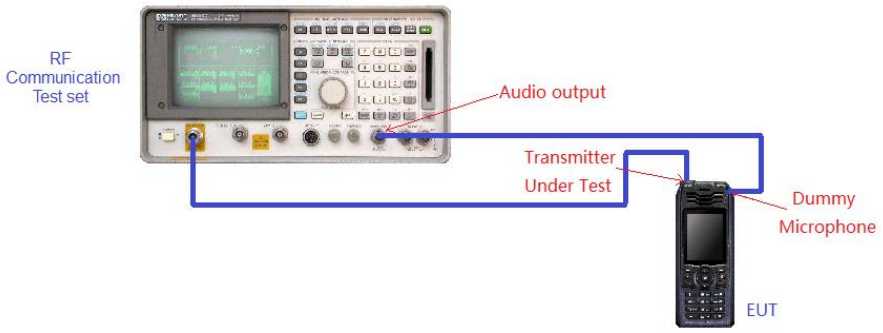
f) Measure both the instantaneous and steady-state deviation at and after the time of increasing the audio input level.

g) With the level from the audio frequency generator held constant at the level obtained in step e), slowly vary the audio frequency from 300 Hz to 3000 Hz and observe the steady-state deviation. Record the maximum deviation.

h) Set the test receiver to measure peak negative deviation and repeat steps d) through g).

i) The values recorded in steps g) and h) are the modulation limiting.

Test Setup:



Instruments Used: Refer to section 3 for details

Test Mode: Modulated Transmitter mode

Test Results: Refer to APPENDIX B.

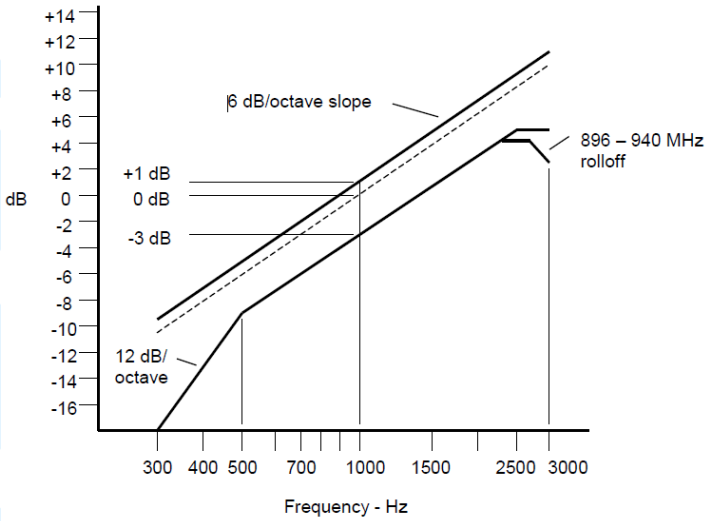
5.4 AUDIO FREQUENCY RESPONSE

Test Requirement: FCC CFR Part 95.1775

Test Method: ANSI/TIA-603-E-2016, Section 2.2.6

Limit:

Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

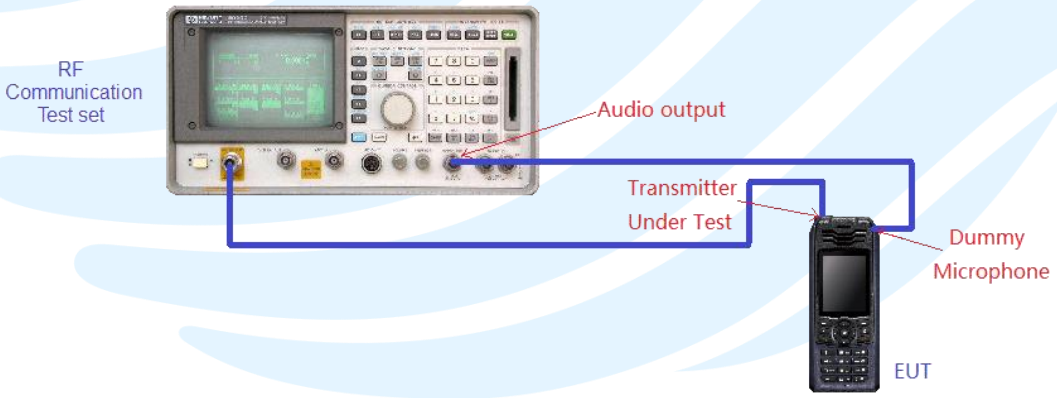


An additional 6 dB per octave attenuation is allowed from 2500 Hz to 3000 Hz in equipment operating in the 25 MHz to 869 MHz range.

Test Procedure:

1) Configure the EUT as shown in figure.
2) Adjust the audio input for 20% of rated system deviation at 1kHz using this level as a reference.
3) Vary the Audio frequency from 300Hz to 3 kHz and record the frequency deviation.
4) Audio Frequency Response =20log10 (V_{FREQ}/V_{REF}).

Test Setup:



Instruments Used: Refer to section 3 for details

Test Mode: Modulated Transmitter mode

Test Results: Refer to APPENDIX C

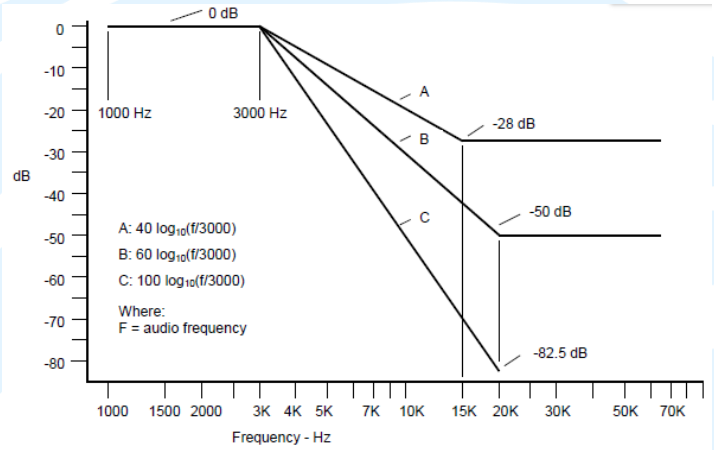
5.5 AUDIO LOW PASS FILTER RESPONSE

Test Requirement: FCC 47 CFR Part 95.1775(e)

Test Method: ANSI/TIA-603-E-2016, Section 2.2.15

Limit:

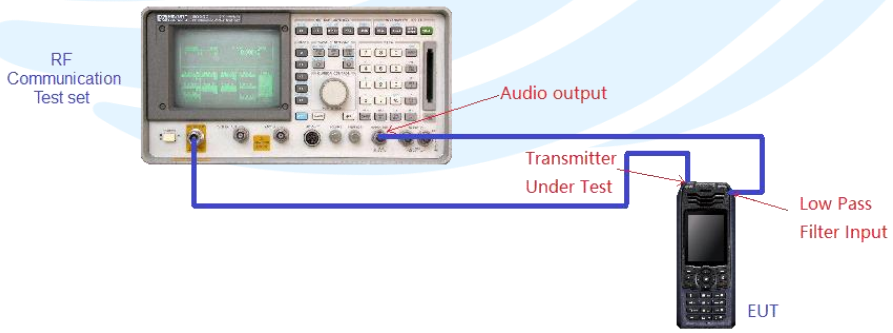
Each GMRS transmitter, except a mobile station transmitter with a power output of 2.5 W or less, must automatically prevent a greater than normal audio level from causing overmodulation. The transmitter also must include audio frequency low pass filtering, unless it complies with the applicable paragraphs of § 95.631 (without filtering.) The filter must be between the modulation limiter and the modulated stage of the transmitter. At any frequency (f in kHz) between 3 and 20 kHz, the filter must have an attenuation of at least 60 log10 (f/3) dB greater than the attenuation at 1 kHz. Above 20 kHz, it must have an attenuation of at least 50 dB greater than the attenuation at 1 kHz.



Test Procedure:

a) Connect the equipment as illustrated.
b) Connect the audio frequency generator as close as possible the input of the post limiter low pass filter within the transmitter under test.
c) Connect the audio spectrum analyzer to the output of the post limiter low pass filter within the transmitter under test.
d) Apply a 1000 Hz tone from the audio frequency generator and adjust the level per manufacturer's specifications.
e) Record the dB level of the 1000 Hz spectral line on the audio spectrum analyzer as LEV_{REF}.
f) Set the audio frequency generator to the desired test frequency between 3000 Hz and the upper low pass filter limit.
g) Record audio spectrum analyzer levels, at the test frequency in step f).
h) Record the dB level on the audio spectrum analyzer as LEV_{FREQ} .
i) Calculate the audio frequency response at the test frequency as:
low pass frequency response = LEV_{FREQ} - LE_{VREF}
j) Repeat steps f) through i) for all the desired test frequencies.

Test Setup:



Instruments Used: Refer to section 3 for details

Test Results: Refer to APPENDIX D

5.6 FREQUENCY STABILITY

Test Requirement: FCC 47 CFR Part 95.565

Test Method: ANSI/TIA-603-E-2016, Section 2.2.2

Limit:

For FRS

Each FRS transmitter type must be designed such that the carrier frequencies remain within 2.5 ppm

For GMRS

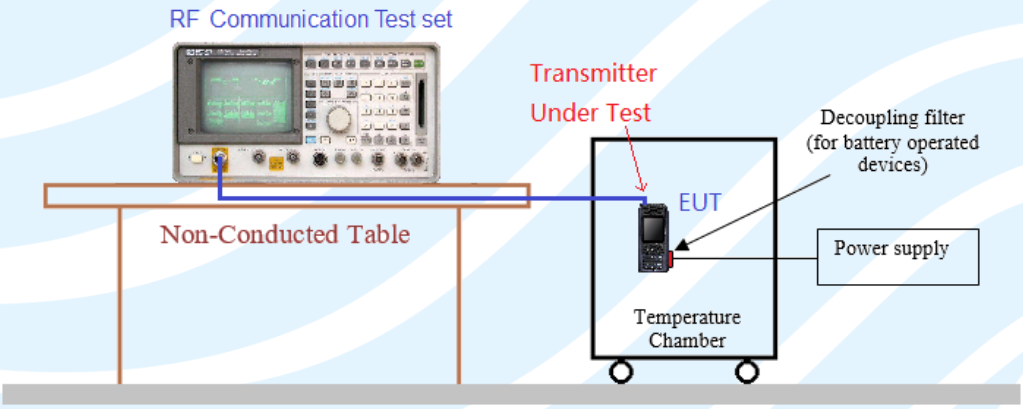
The carrier frequency of each GMRS transmitter transmitting an emission with an occupied bandwidth of 12.5 kHz or less must remain within 2.5 ppm

The carrier frequency of each GMRS transmitter transmitting an emission with an occupied bandwidth greater than 12.5 kHz must remain within 5 ppm.

Test Procedure:

1. According to FCC Part 2 Section 2.1055 (a)(1), the frequency stability shall be measured with variation of ambient temperature from -20°C to +50°C centigrade.
2. According to FCC Part 2 Section 2.1055 (d) (2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacture.
3. Vary primary supply voltage from 3.0 V to 4.0 V.
4. The EUT was set in the climate chamber and connected to an external DC power supply. The RF output was directly connected to Spectrum Analyzer or RF Communication Test set The coupling loss of the additional cables was recorded and taken in account for all the measurements. After temperature stabilization (approx. 20 min for each stage), the frequency for the lower, the middle and the highest frequency range was recorded. For Frequency stability Vs. Voltage the EUT was connected to a DC power supply and the voltage was adjusted in the required ranges. The result was recorded.

Test Setup:



Instruments Used: Refer to section 3 for details

Test Mode: Unmodulated Transmitter mode

Test Results: Refer to APPENDIX E

5.7 EMISSION BANDWIDTH

Test Requirement: FCC 47 CFR Part 95.573

Test Method: ANSI/TIA-603-E-2016, Section 2.2.11

Limits:

For FRS

Each FRS transmitter type must be designed such that the occupied bandwidth does not exceed 12.5 kHz.

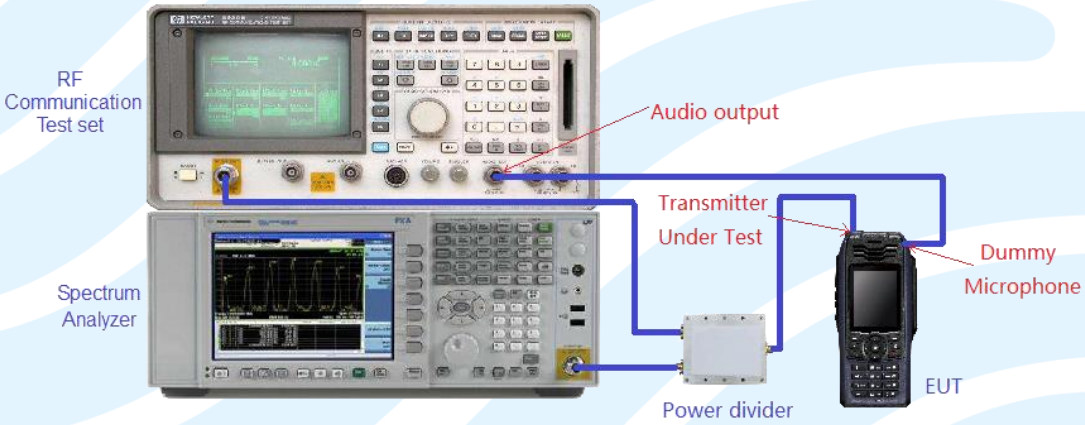
For GMRS

Each GMRS transmitter type must be designed such that the occupied bandwidth does not exceed the authorized bandwidth for the channels used. Operation of GMRS stations must also be in compliance with these requirements.

(a) Main channels. The authorized bandwidth is 20 kHz for GMRS transmitters operating on any of the 462 MHz main channels (see §95.1763(a)) or any of the 467 MHz main channels (see §95.1763(c)).

(b) Interstitial channels. The authorized bandwidth is 20 kHz for GMRS transmitters operating on any of the 462 MHz interstitial channels (see §95.1763(b)) and is 12.5 kHz for GMRS transmitters operating on any of the 467 MHz interstitial channels (see §95.1763(d)).

Test Setup:



Test Procedures:

1) The EUT was modulated by 2.5 kHz sine wave audio signal; the level of the audio signal employed is 16dB greater than that necessary to produce 50% of rated system deviation.
   Rated system deviation is 2.5kHz and 5kHz).
2) Spectrum set as follow:
   Centre frequency = fundamental frequency, span=50kHz,
   RBW=100Hz, VBW=300Hz, Sweep = auto, Detector function = peak, Trace = max hold
3) Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth
4) Measure and record the results in the test report.

Equipment Used: Refer to section 3 for details.

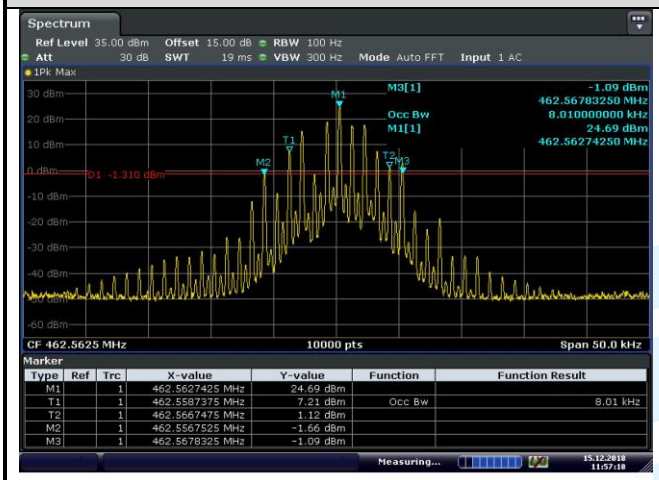
Test Result: Pass

The measurement data as follows:

Operation Mode	Channel	Frequency (KHz)	26 dB Bandwidth (KHz)	99% Bandwidth (KHz)	26 dB Bandwidth Limit	Pass / Fail
FRS	1	462.6525	11.080	8.010	≤ 12.5 kHz	Pass
	4	462.6375	11.110	8.010	≤ 12.5 kHz	Pass
	7	462.7125	11.111	8.005	≤ 12.5 kHz	Pass
	8	467.5625	11.065	8.005	≤ 12.5 kHz	Pass
	11	467.6375	11.080	8.010	≤ 12.5 kHz	Pass
	14	467.7125	11.085	8.005	≤ 12.5 kHz	Pass
	15	462.5500	11.095	8.010	≤ 20 kHz	Pass
	19	462.6500	11.095	7.995	≤ 20 kHz	Pass
	22	462.7250	11.080	8.010	≤ 20 kHz	Pass

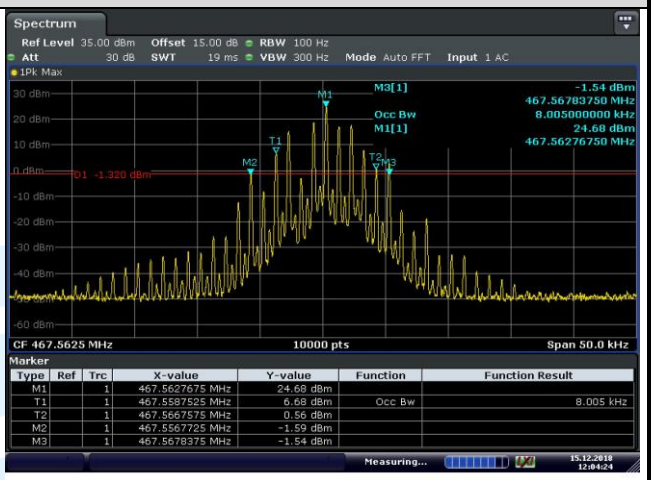
The test plot as follows:

Channel 1



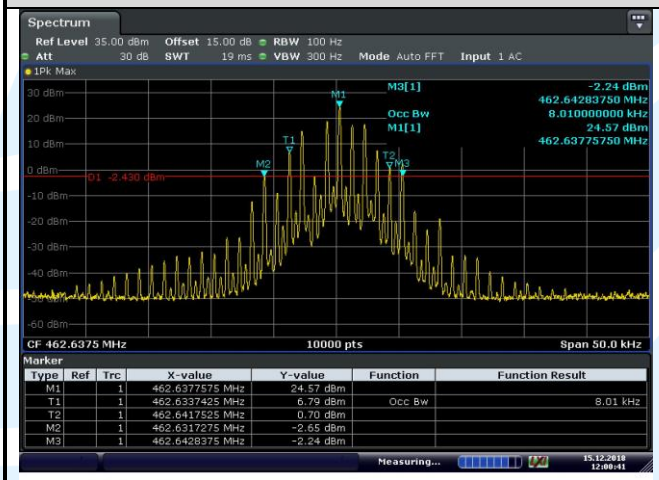
Date: 15.DEC.2018 11:57:19

Channel 8



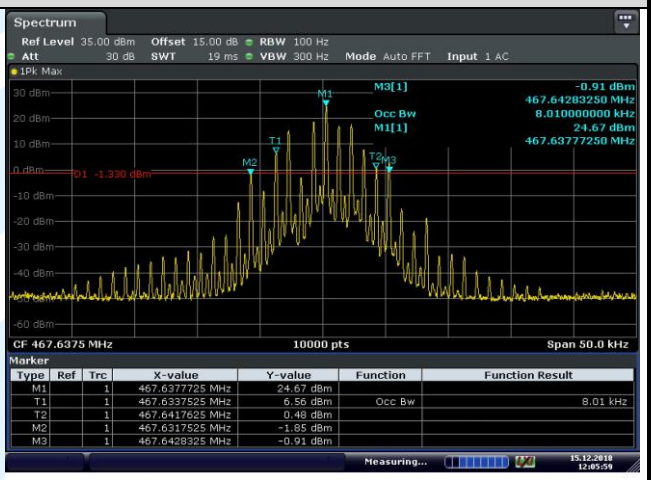
Date: 15.DEC.2018 12:04:25

Channel 4



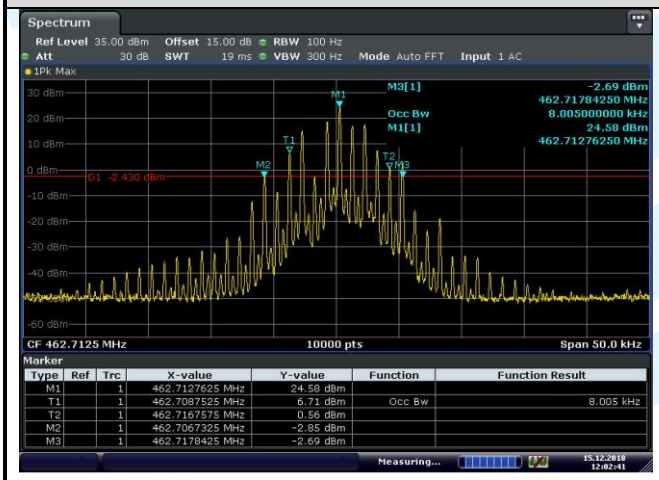
Date: 15.DEC.2018 12:00:42

Channel 11



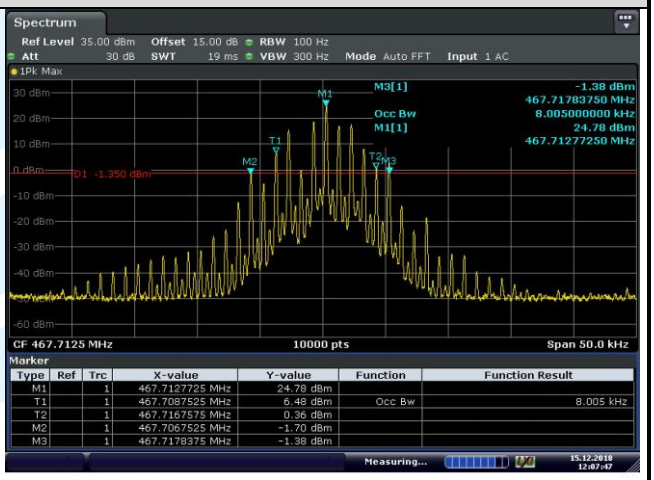
Date: 15.DEC.2018 12:05:59

Channel 7

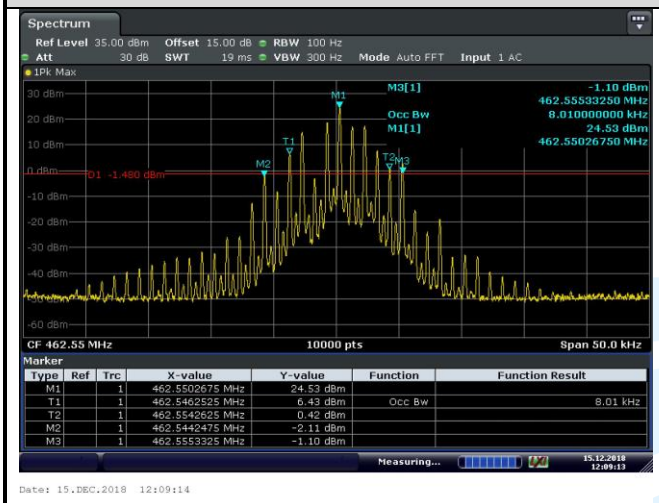
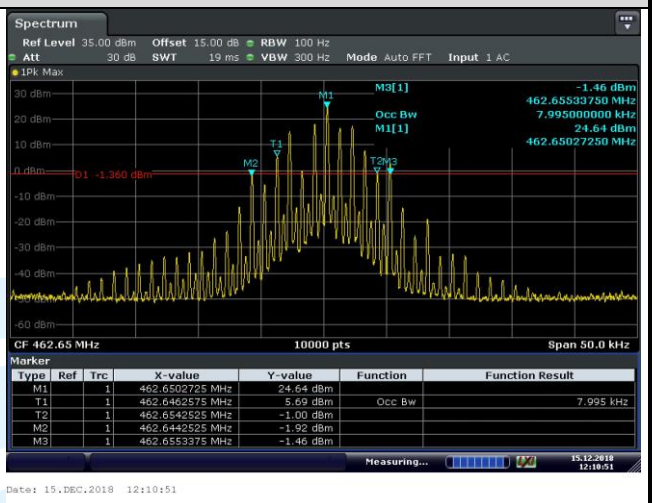
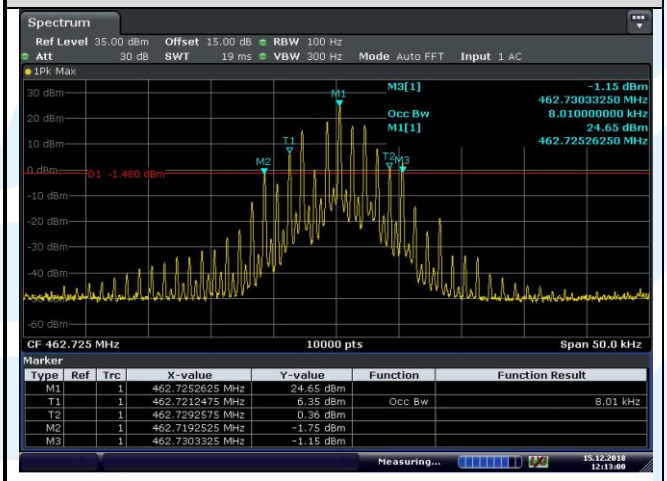


Date: 15.DEC.2018 12:02:42

Channel 14



Date: 15.DEC.2018 12:07:47

Channel 15	Channel 19
	
Date: 15.DEC.2018 12:09:14	Date: 15.DEC.2018 12:10:51
Channel 22	
	N/A
Date: 15.DEC.2018 12:13:01	

5.8 EMISSION MASK

Test Requirement: FCC 47 CFR Part 95.579

Test Method: ANSI/TIA-603-E-2016, Section 2.2.11

Limits:

For FRS

The power of unwanted emissions must be attenuated below the carrier power output in Watts (P) by at least:

1) 25 dB (decibels) in the frequency band 6.25 kHz to 12.5 kHz removed from the channel center frequency.
2) 35 dB in the frequency band 12.5 kHz to 31.25 kHz removed from the channel center frequency.
3) 43 + 10 log (P) dB in any frequency band removed from the channel center frequency by more than 31.25 kHz.

For GMRS

Each GMRS transmitter type must be designed to comply with the applicable unwanted emissions limits in this section.

(a) Emission masks. Emission masks applicable to transmitting equipment in the GMRS are defined by the requirements in the following table. The numbers in the attenuation requirements column refer to rule paragraph numbers under paragraph (b) of this section.

Emission types filter	Attenuation requirements
A1D, A3E, F1D, G1D, F2D, F3E, G3E with audio filter	(1), (2), (7)
A1D, A3E, F1D, G1D, F3E, G3E without audio filter	(3), (4), (7)
H1D, J1D, R1D, H3E, J3E, R2E	(5), (6), (7)

(1) Filtering noted for GMRS transmitters refers to the requirement in §95.1775(e).

(2) Unwanted emission power may be measured as either mean power or peak envelope power, provided that the transmitter output power is measured the same way.

(b) Attenuation requirements. The power of unwanted emissions must be attenuated below the transmitter output power in Watts (P) by at least:

(1) 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.

(2) 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.

(3) 83 log (fd ÷ 5) dB on any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz up to and including 10 kHz.

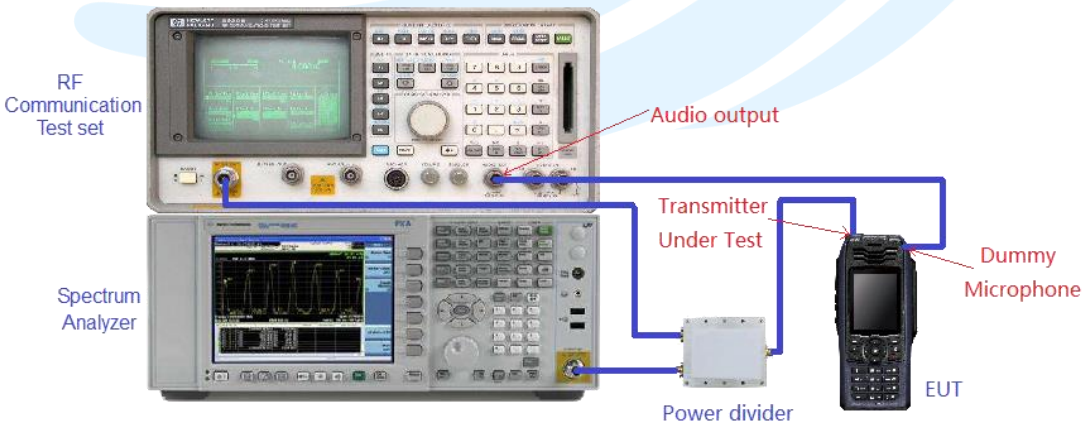
(4) 116 log (fd ÷ 6.1) dB or 50 + 10 log (P) dB, whichever is the lesser attenuation, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz), of more than 10 kHz up to and including 250% of the authorized bandwidth.

(5) 25 dB on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 150% of the authorized bandwidth.

(6) 35 dB on any frequency removed from the center of the authorized bandwidth by more than 150% up to and including 250% of the authorized bandwidth.

(7) 43 + 10 log (P) dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

Test Setup:



Test Procedures:

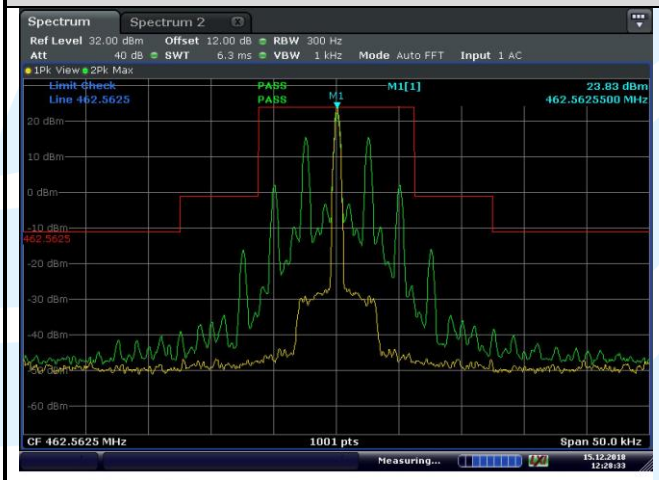
5) Connect the equipment as illustrated.
6) Spectrum set as follow:
   Centre frequency = fundamental frequency, span=125kHz for 12.5kHz channel spacing, RBW=300Hz, VBW=1000Hz, Sweep = auto, Detector function = peak, Trace = max hold
7) Key the transmitter, and set the level of the unmodulated carrier to a full scale reference line. This is the 0dB reference for the measurement.
   Modulate the transmitter with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of rated system deviation (Rated system deviation is 2.5 kHz for 12.5kHz channel spacing).
8) The input level shall be established at the frequency of maximum response of the audio modulating circuit. Transmitters employing digital modulation techniques that bypass the limiter and the audio low-pass filter shall be modulated as specified by the manufacturer
9) Measure and record the results in the test report.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

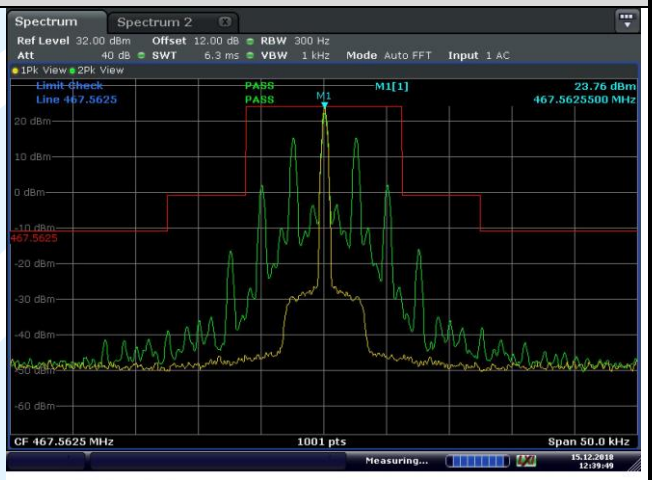
The test plot as follows:

Channel 1



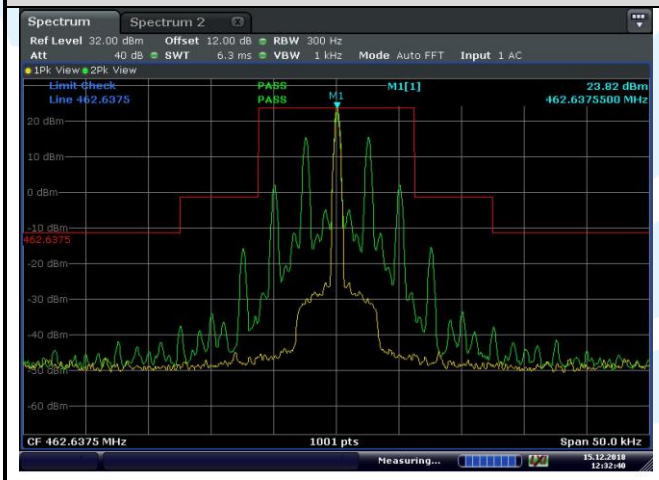
Date: 15.DEC.2018 12:28:34

Channel 8



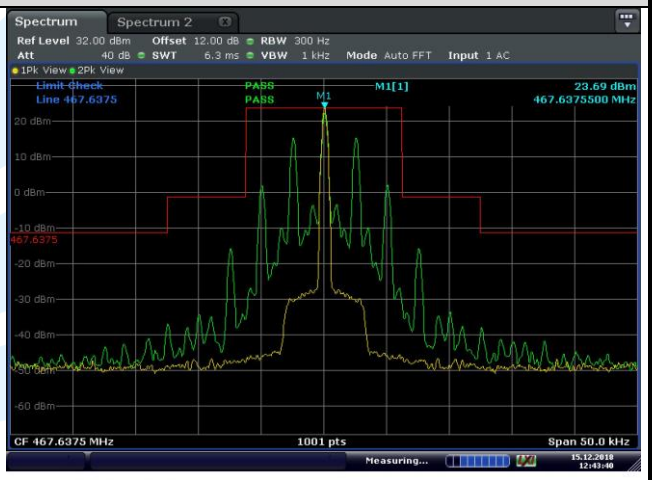
Date: 15.DEC.2018 12:39:50

Channel 4

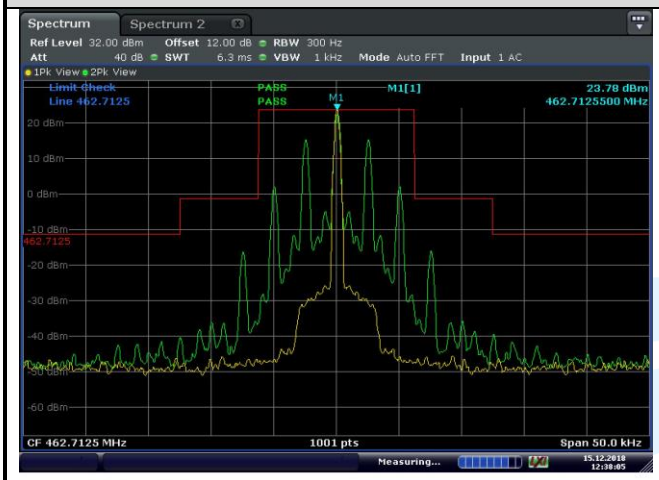
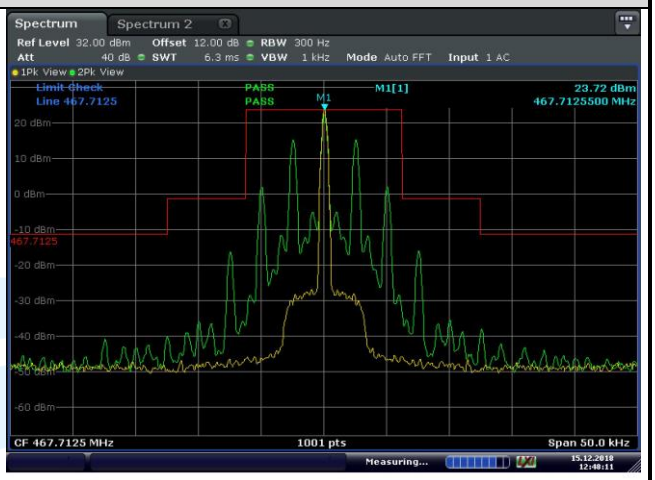
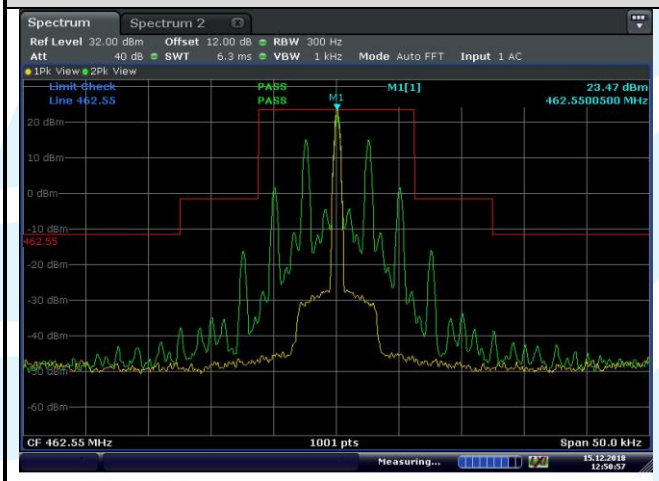
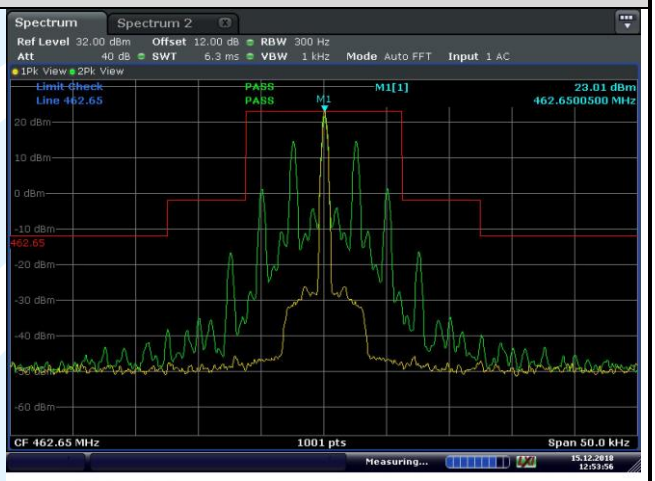
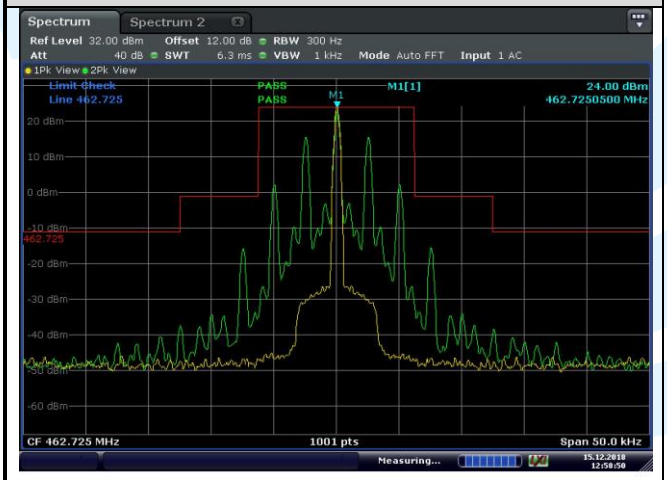


Date: 15.DEC.2018 12:32:41

Channel 11



Date: 15.DEC.2018 12:43:41

Channel 7	Channel 14
 Date: 15.DEC.2018 12:38:06	 Date: 15.DEC.2018 12:48:11
Channel 15	**Channel 19**
 Date: 15.DEC.2018 12:50:58	 Date: 15.DEC.2018 12:53:57
Channel 22	N/A
 Date: 15.DEC.2018 12:58:50	

5.9 TRANSMITTER RADIATED SPURIOUS EMISSION

Test Requirement: FCC 47 CFR Part 95.579

Test Method: ANSI/TIA-603-E-2016, Section 2.2.12

Limit:

For FRS

The power of unwanted emissions must be attenuated below the carrier power output in Watts (P) by at least:

1) 25 dB (decibels) in the frequency band 6.25 kHz to 12.5 kHz removed from the channel center frequency.
2) 35 dB in the frequency band 12.5 kHz to 31.25 kHz removed from the channel center frequency.
3) 43 + 10 log (P) dB in any frequency band removed from the channel center frequency by more than 31.25 kHz.

For GMRS

Each GMRS transmitter type must be designed to comply with the applicable unwanted emissions limits in this section.

(a) Emission masks. Emission masks applicable to transmitting equipment in the GMRS are defined by the requirements in the following table. The numbers in the attenuation requirements column refer to rule paragraph numbers under paragraph (b) of this section.

Emission types filter	Attenuation requirements
A1D, A3E, F1D, G1D, F2D, F3E, G3E with audio filter	(1), (2), (7)
A1D, A3E, F1D, G1D, F3E, G3E without audio filter	(3), (4), (7)
H1D, J1D, R1D, H3E, J3E, R2E	(5), (6), (7)

(1) Filtering noted for GMRS transmitters refers to the requirement in §95.1775(e).

(2) Unwanted emission power may be measured as either mean power or peak envelope power, provided that the transmitter output power is measured the same way.

(b) Attenuation requirements. The power of unwanted emissions must be attenuated below the transmitter output power in Watts (P) by at least:

(1) 25 dB (decibels) on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth.

(2) 35 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 250% of the authorized bandwidth.

(3) 83 log (fd ÷ 5) dB on any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz up to and including 10 kHz.

(4) 116 log (fd ÷ 6.1) dB or 50 + 10 log (P) dB, whichever is the lesser attenuation, on any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz), of more than 10 kHz up to and including 250% of the authorized bandwidth.

(5) 25 dB on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 150% of the authorized bandwidth.

(6) 35 dB on any frequency removed from the center of the authorized bandwidth by more than 150% up to and including 250% of the authorized bandwidth.

(7) 43 + 10 log (P) dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

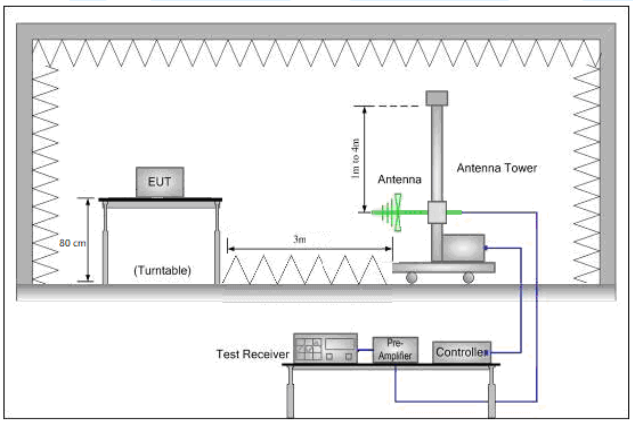
Test Procedure:

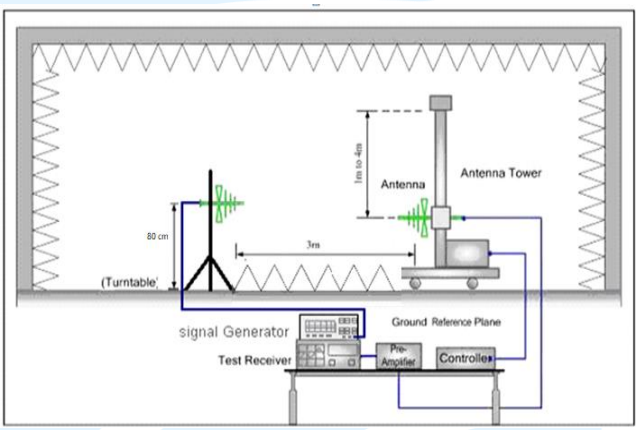
Test procedure as below:

1) EUT was placed on a 0.8 or 1.5 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The disturbance of the transmitter was maximized on the test receiver display by raising and lowering from 1m to 4m the receive antenna and by rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made. The radiated emission measurements of all transmit frequencies in all channels were measured with peak detector.
2) A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
3) The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz, VBW=3MHz for above 1GHz and RBW=100kHz,VBW=300kHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (Pr).

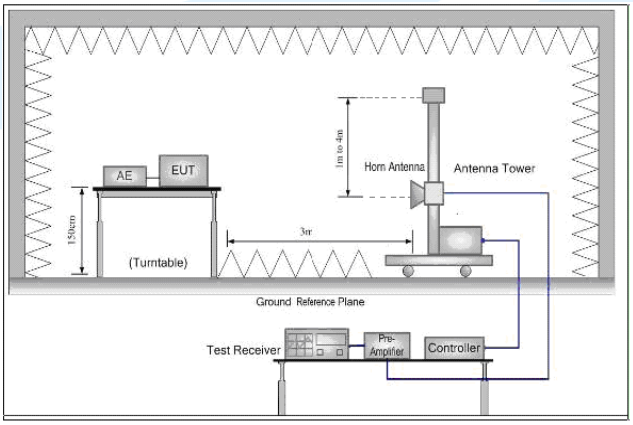
4) The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
5) A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
The measurement results are obtained as described below: Power(EIRP)=PMea- PAg - Pcl - Ga
The measurement results are amend as described below:
Power(EIRP)=PMea- Pcl - Ga
6) This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
7) ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.
8) Test the EUT in the lowest channel, the middle channel the Highest channel

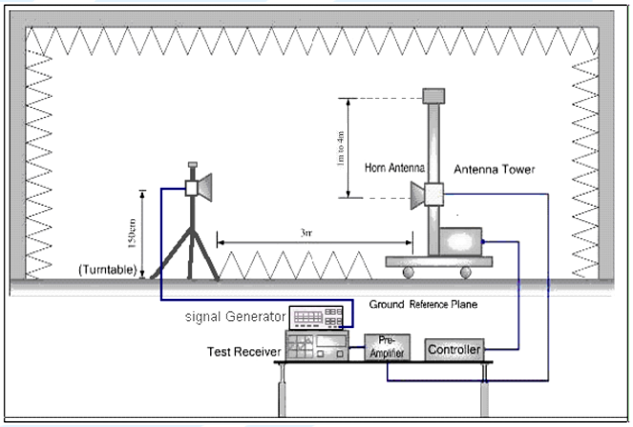
Test Setup:





ERP Test Setup





EIRP Test Setup

Instruments Used: Refer to section 3 for details

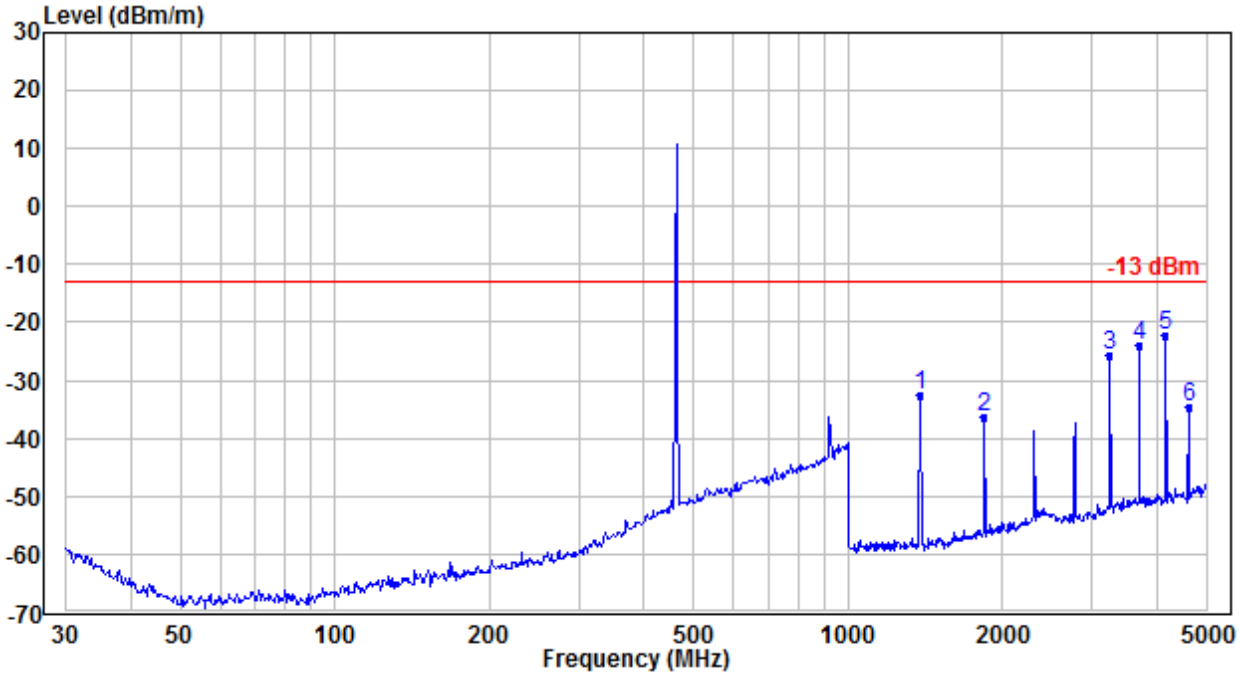
Test Mode: Unmodulated Transmitter mode

Test Results: Pass

The measurement data as follows:

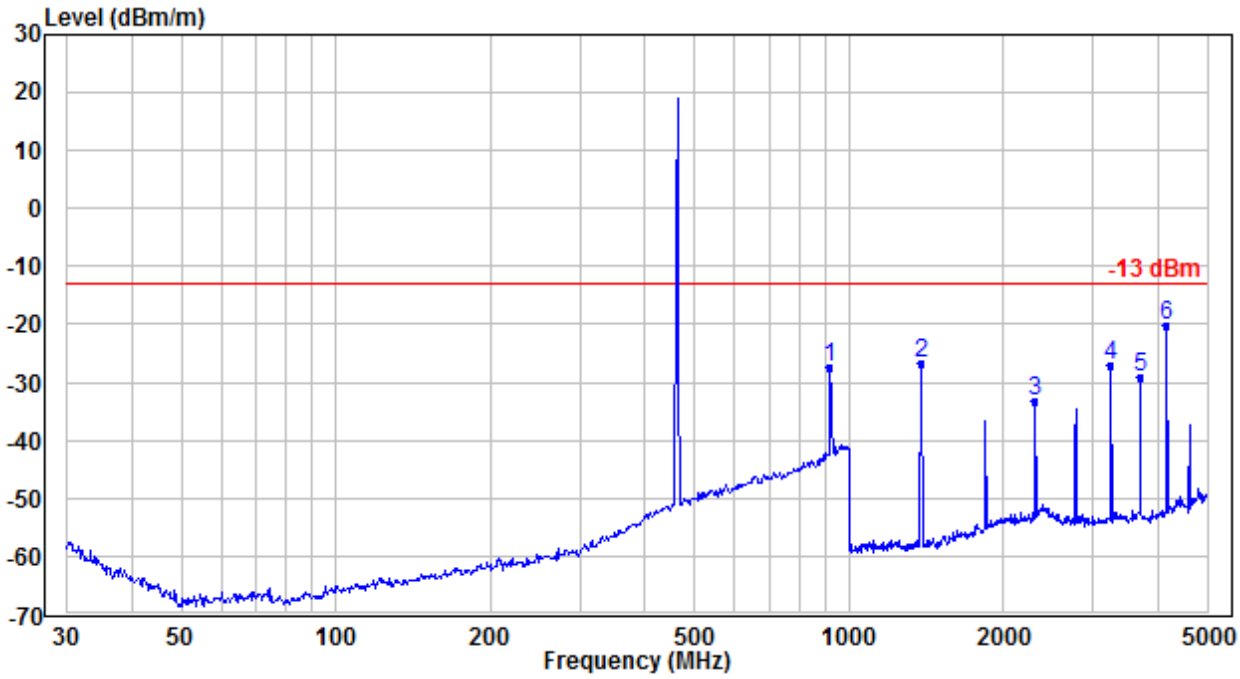
Spurious emissions test data (30MHz to 6 GHz):
Channel 1

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1383.281	-80.87	48.42	-32.45	-13.00	19.45	Peak
2	1843.246	-86.20	49.76	-36.44	-13.00	23.44	Peak
3	3239.489	-84.35	58.54	-25.81	-13.00	12.81	Peak
4	3701.352	-84.80	60.93	-23.87	-13.00	10.87	Peak
5	4171.645	-84.37	62.03	-22.34	-13.00	9.34	Peak
6	4622.037	-97.46	62.97	-34.49	-13.00	21.49	Peak

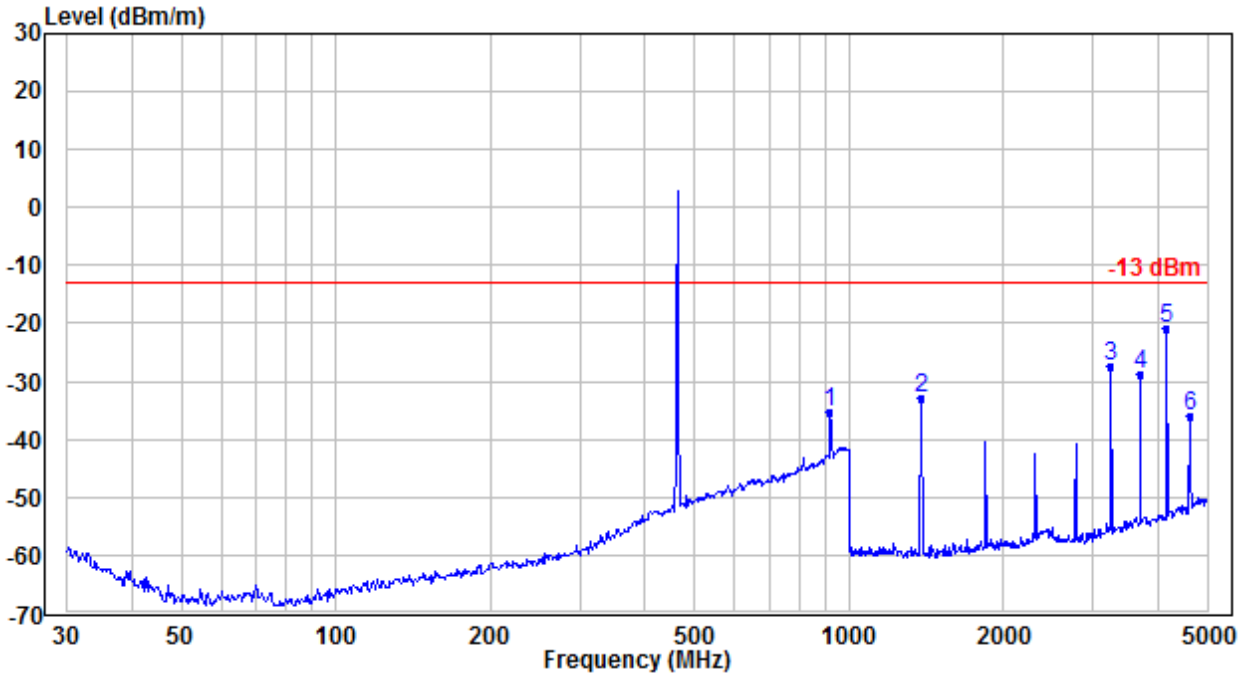
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-72.32	45.06	-27.26	-13.00	14.26	Peak
2	1383.281	-75.09	48.42	-26.67	-13.00	13.67	Peak
3	2309.620	-84.96	51.78	-33.18	-13.00	20.18	Peak
4	3239.489	-85.60	58.54	-27.06	-13.00	14.06	Peak
5	3701.352	-90.11	60.93	-29.18	-13.00	16.18	Peak
6	4171.645	-82.03	62.03	-20.00	-13.00	7.00	Peak

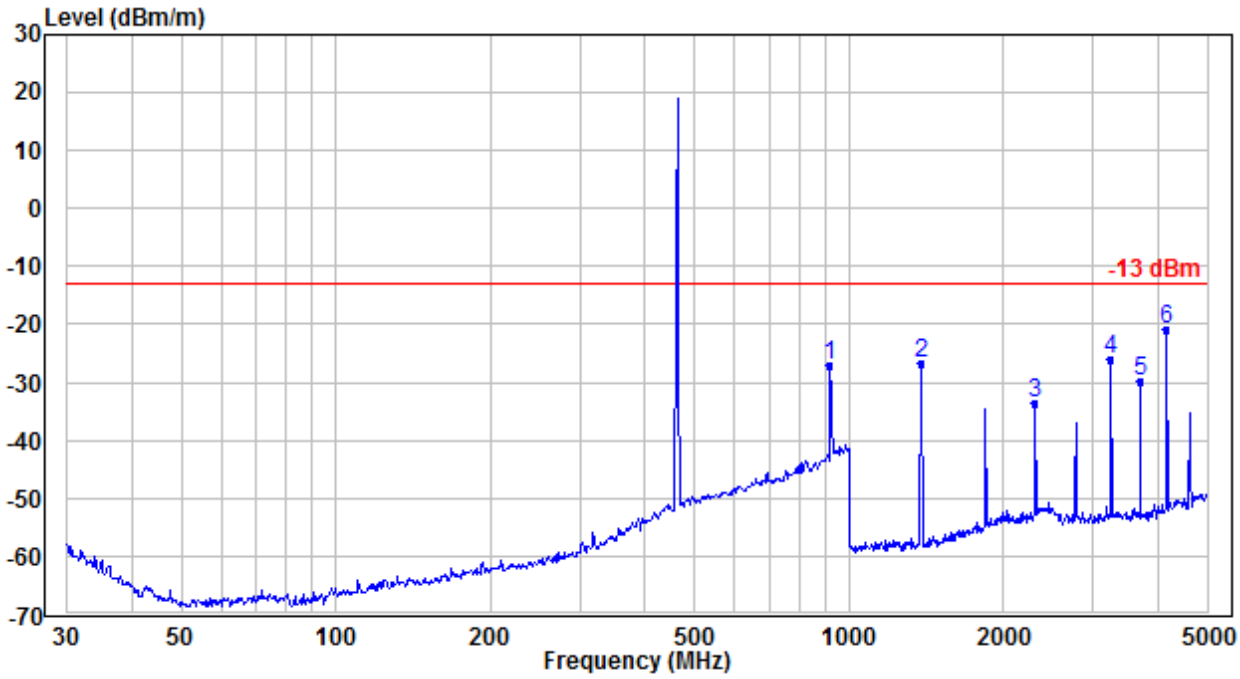
Channel 4

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-80.18	45.06	-35.12	-13.00	22.12	Peak
2	1383.281	-81.21	48.42	-32.79	-13.00	19.79	Peak
3	3250.579	-86.01	58.58	-27.43	-13.00	14.43	Peak
4	3701.352	-89.70	60.93	-28.77	-13.00	15.77	Peak
5	4171.645	-82.90	62.03	-20.87	-13.00	7.87	Peak
6	4622.037	-98.92	62.97	-35.95	-13.00	22.95	Peak

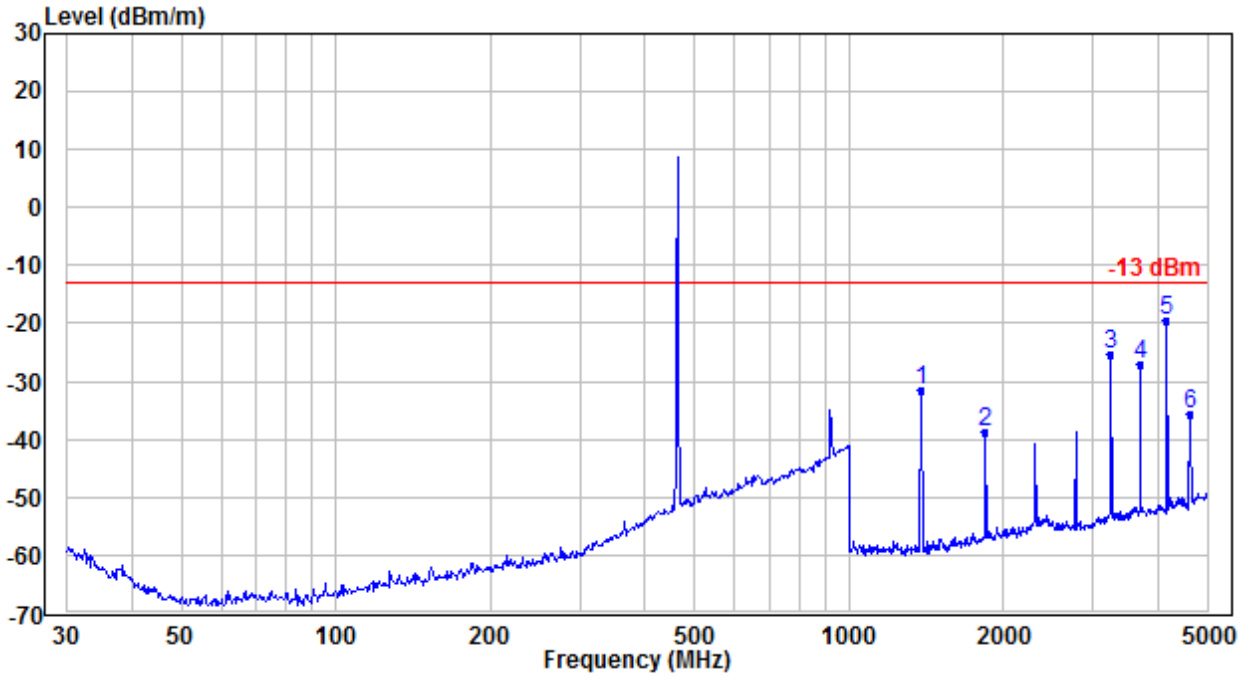
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-72.18	45.06	-27.12	-13.00	14.12	Peak
2	1383.281	-75.20	48.42	-26.78	-13.00	13.78	Peak
3	2309.620	-85.52	51.78	-33.74	-13.00	20.74	Peak
4	3250.579	-84.68	58.58	-26.10	-13.00	13.10	Peak
5	3701.352	-90.58	60.93	-29.65	-13.00	16.65	Peak
6	4171.645	-82.92	62.03	-20.89	-13.00	7.89	Peak

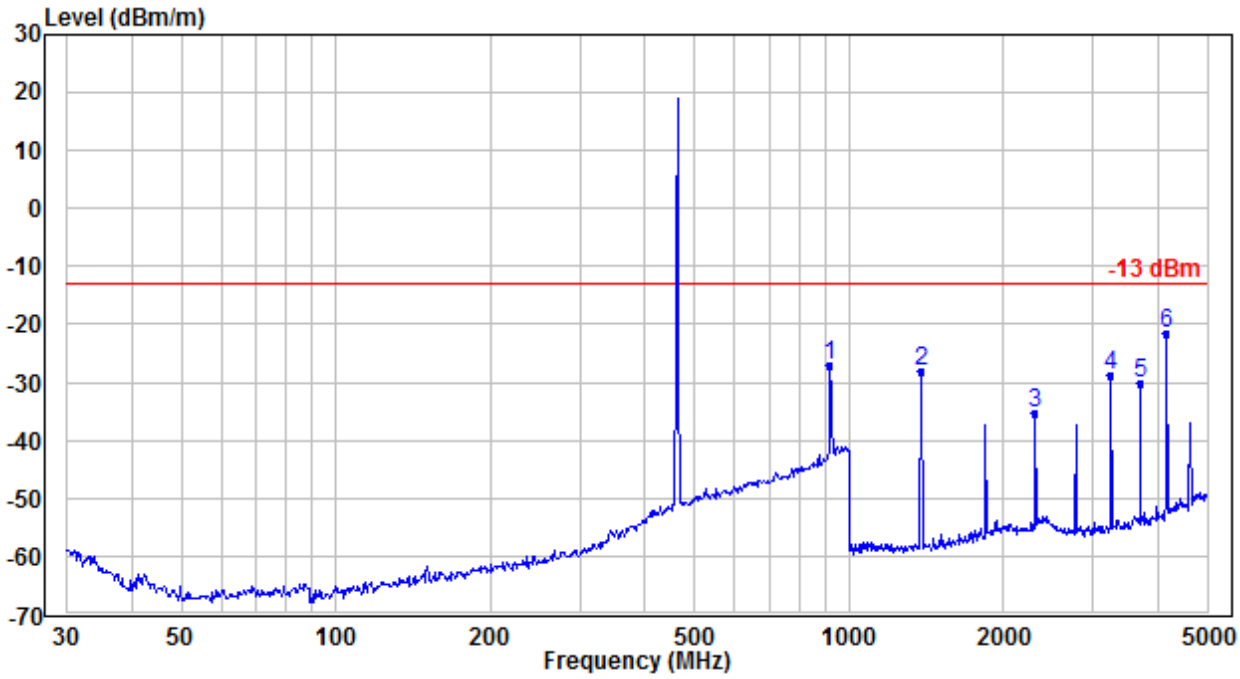
Channel 7

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1388.017	-80.10	48.45	-31.65	-13.00	18.65	Peak
2	1849.556	-88.44	49.75	-38.69	-13.00	25.69	Peak
3	3250.579	-83.86	58.58	-25.28	-13.00	12.28	Peak
4	3701.352	-88.08	60.93	-27.15	-13.00	14.15	Peak
5	4171.645	-81.50	62.03	-19.47	-13.00	6.47	Peak
6	4622.037	-98.49	62.97	-35.52	-13.00	22.52	Peak

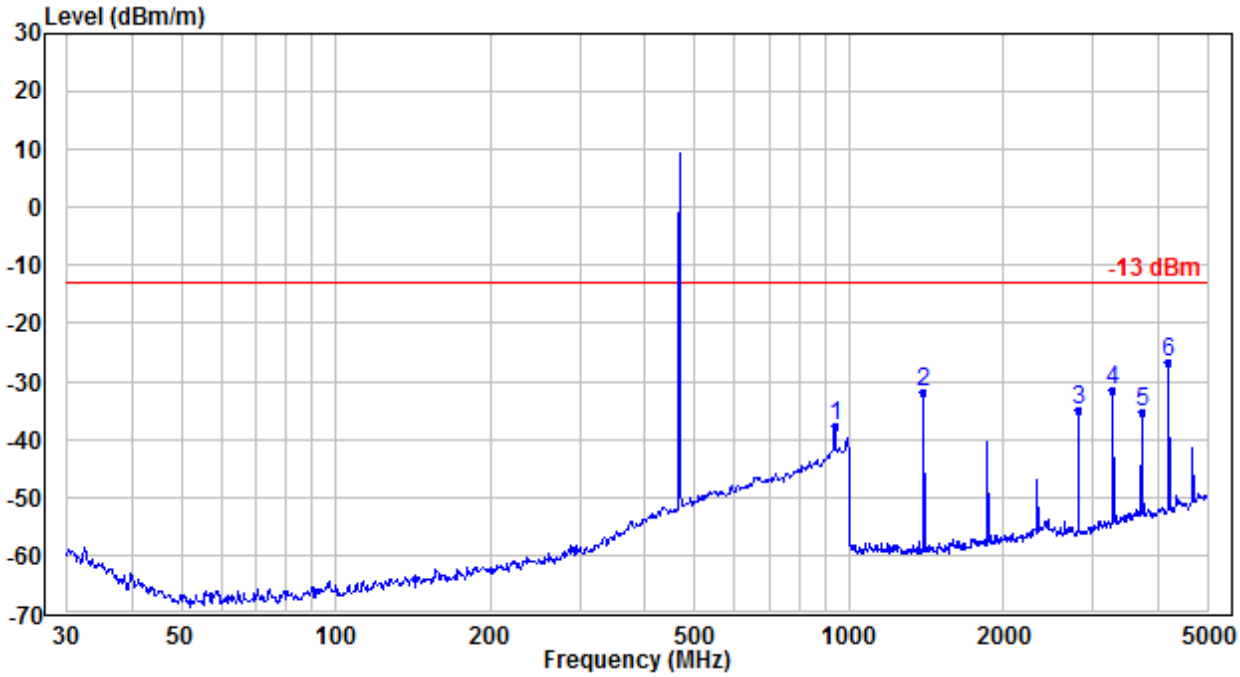
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-72.20	45.06	-27.14	-13.00	14.14	Peak
2	1388.017	-76.45	48.45	-28.00	-13.00	15.00	Peak
3	2309.620	-87.20	51.78	-35.42	-13.00	22.42	Peak
4	3250.579	-87.47	58.58	-28.89	-13.00	15.89	Peak
5	3701.352	-91.17	60.93	-30.24	-13.00	17.24	Peak
6	4171.645	-83.55	62.03	-21.52	-13.00	8.52	Peak

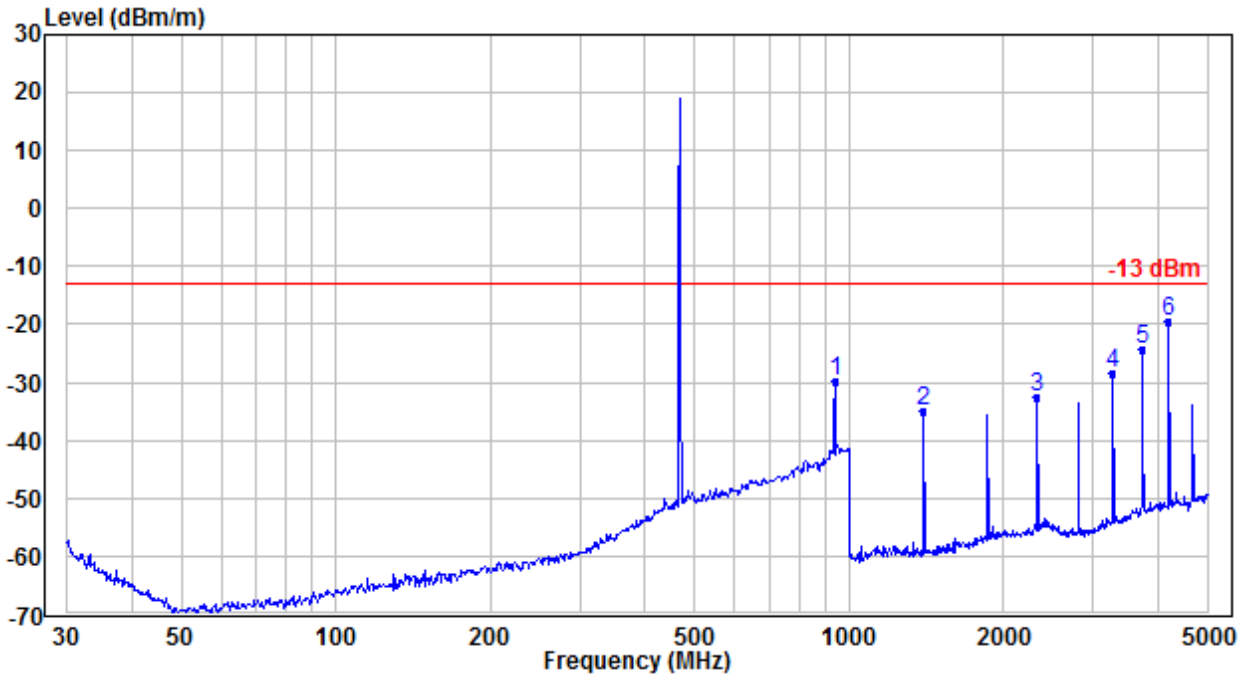
Channel 8

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	940.147	-83.18	45.33	-37.85	-13.00	24.85	Peak
2	1402.320	-80.26	48.53	-31.73	-13.00	18.73	Peak
3	2806.338	-90.28	55.43	-34.85	-13.00	21.85	Peak
4	3272.873	-90.32	58.82	-31.50	-13.00	18.50	Peak
5	3739.495	-96.20	61.07	-35.13	-13.00	22.13	Peak
6	4214.635	-88.69	62.05	-26.64	-13.00	13.64	Peak

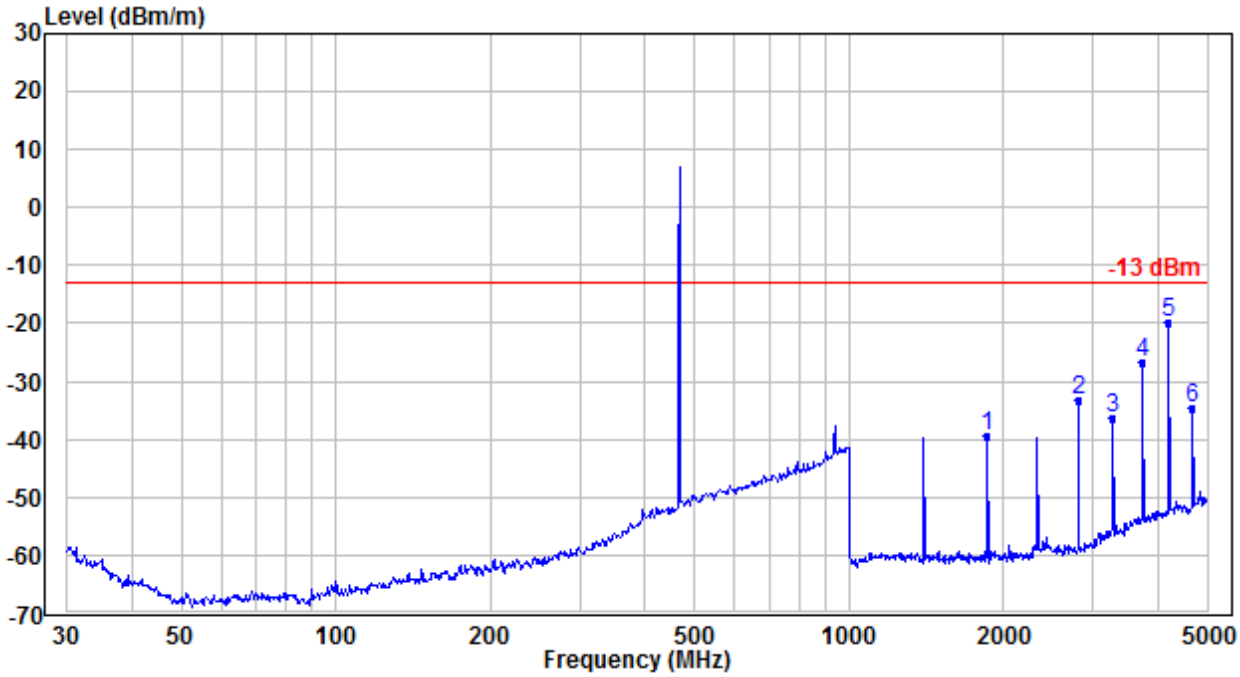
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	940.147	-75.23	45.33	-29.90	-13.00	16.90	Peak
2	1402.320	-83.45	48.53	-34.92	-13.00	21.92	Peak
3	2333.422	-84.57	52.07	-32.50	-13.00	19.50	Peak
4	3272.873	-87.38	58.82	-28.56	-13.00	15.56	Peak
5	3739.495	-85.33	61.07	-24.26	-13.00	11.26	Peak
6	4214.635	-81.43	62.05	-19.38	-13.00	6.38	Peak

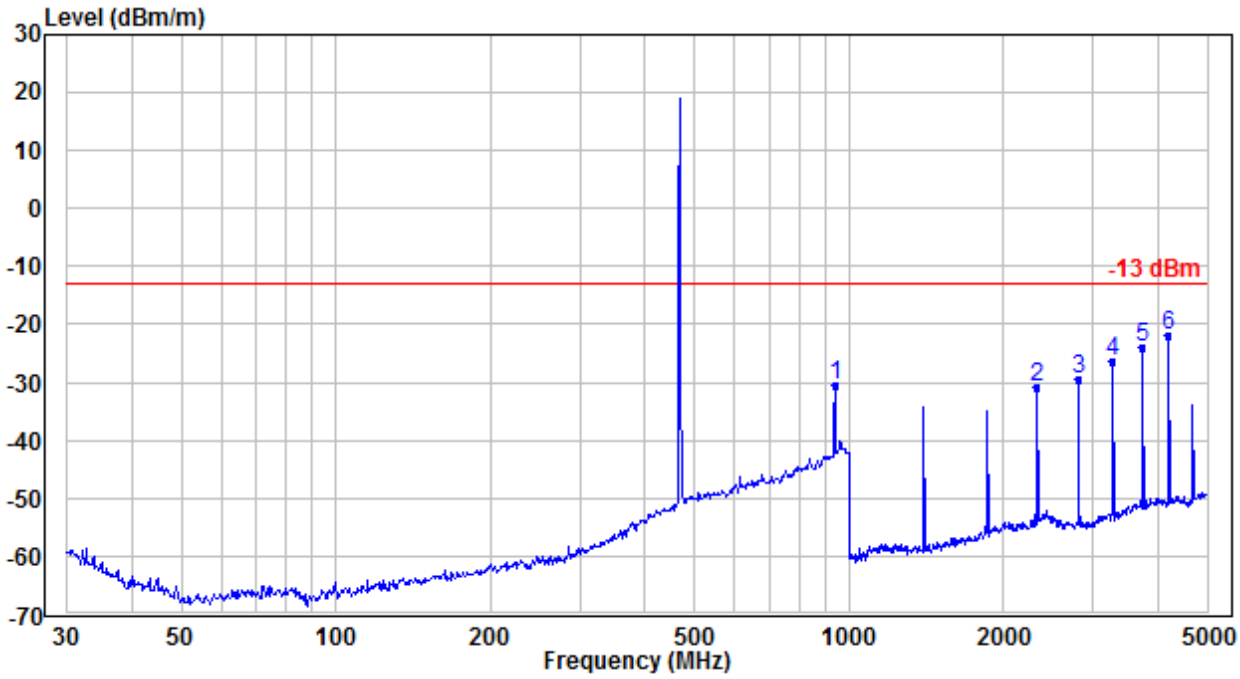
Channel 11

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1868.616	-89.23	49.81	-39.42	-13.00	26.42	Peak
2	2806.338	-88.80	55.43	-33.37	-13.00	20.37	Peak
3	3272.873	-95.02	58.82	-36.20	-13.00	23.20	Peak
4	3739.495	-87.71	61.07	-26.64	-13.00	13.64	Peak
5	4214.635	-81.74	62.05	-19.69	-13.00	6.69	Peak
6	4685.654	-98.04	63.42	-34.62	-13.00	21.62	Peak

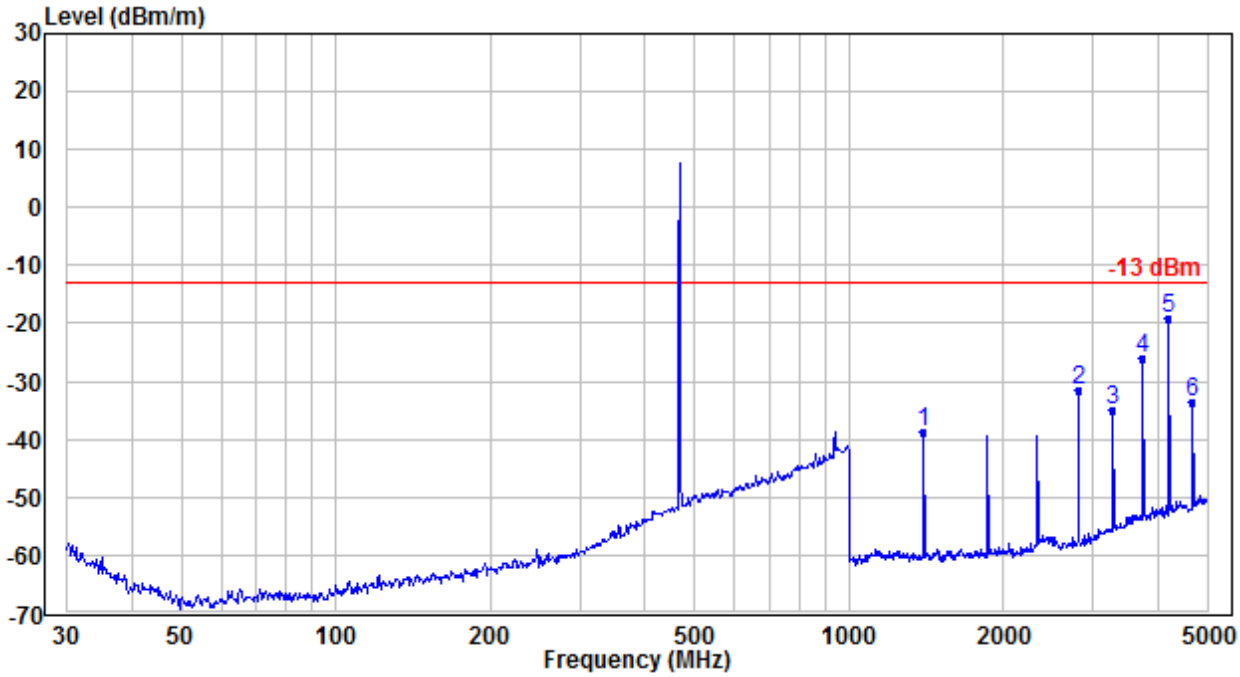
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	940.147	-75.73	45.33	-30.40	-13.00	17.40	Peak
2	2333.422	-82.81	52.07	-30.74	-13.00	17.74	Peak
3	2806.338	-84.96	55.43	-29.53	-13.00	16.53	Peak
4	3272.873	-85.04	58.82	-26.22	-13.00	13.22	Peak
5	3739.495	-85.00	61.07	-23.93	-13.00	10.93	Peak
6	4214.635	-84.03	62.05	-21.98	-13.00	8.98	Peak

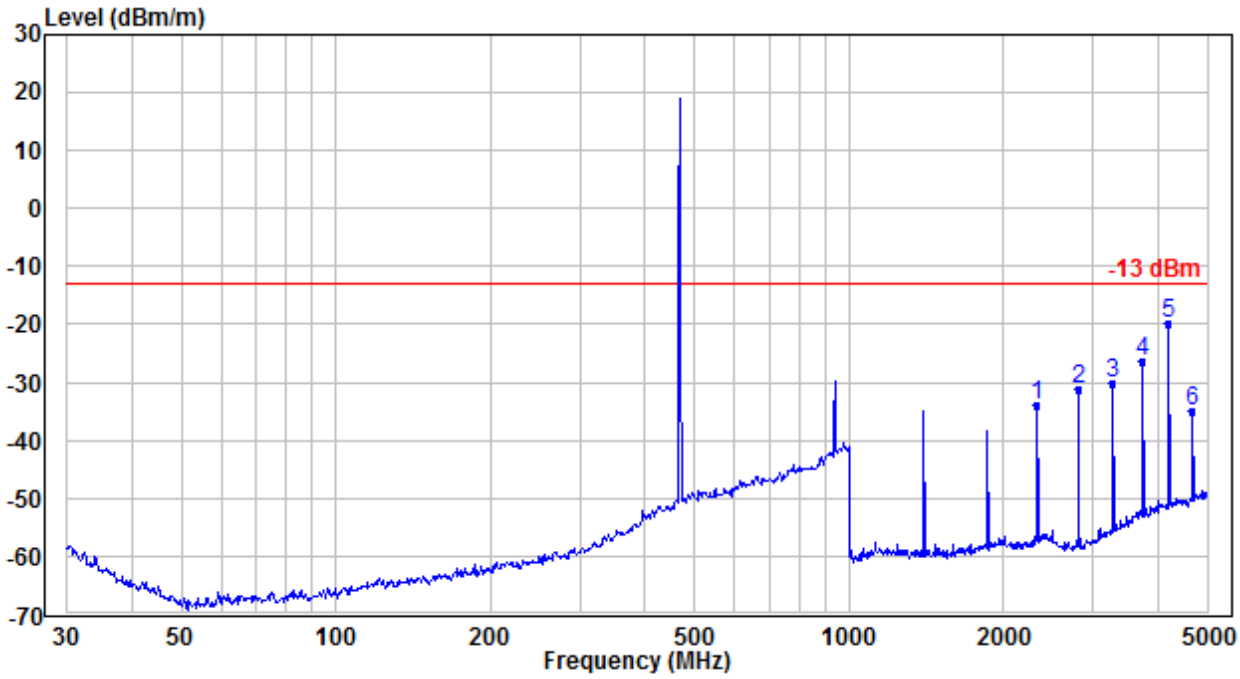
Channel 14

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	1402.320	-87.16	48.53	-38.63	-13.00	25.63	Peak
2	2806.338	-86.93	55.43	-31.50	-13.00	18.50	Peak
3	3272.873	-93.83	58.82	-35.01	-13.00	22.01	Peak
4	3739.495	-87.20	61.07	-26.13	-13.00	13.13	Peak
5	4214.635	-81.23	62.05	-19.18	-13.00	6.18	Peak
6	4685.654	-97.14	63.42	-33.72	-13.00	20.72	Peak

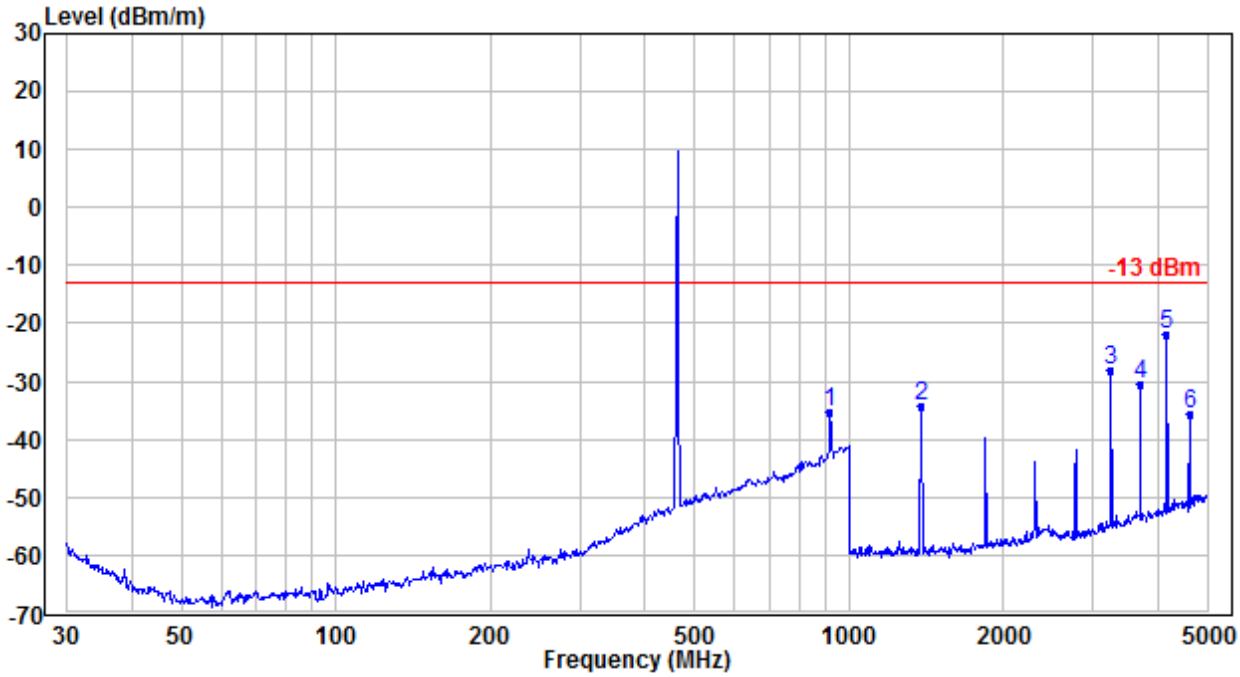
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	2333.422	-86.12	52.07	-34.05	-13.00	21.05	Peak
2	2806.338	-86.46	55.43	-31.03	-13.00	18.03	Peak
3	3272.873	-88.86	58.82	-30.04	-13.00	17.04	Peak
4	3739.495	-87.54	61.07	-26.47	-13.00	13.47	Peak
5	4214.635	-81.76	62.05	-19.71	-13.00	6.71	Peak
6	4685.654	-98.43	63.42	-35.01	-13.00	22.01	Peak

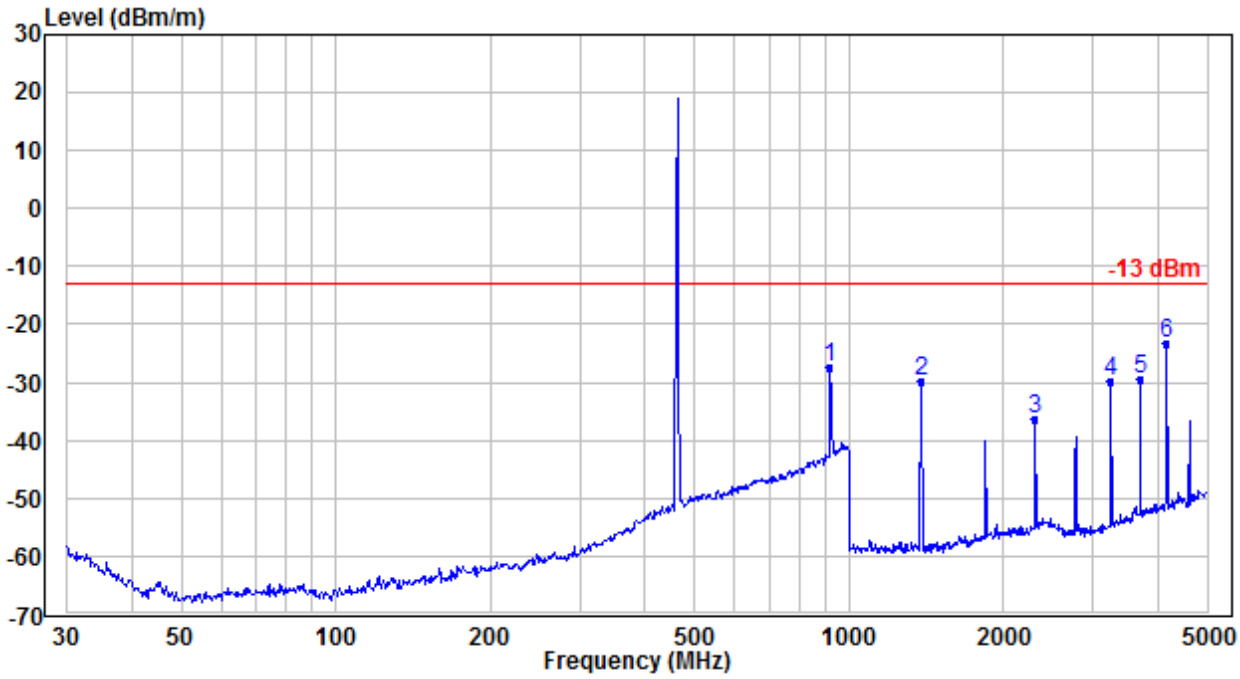
Channel 15

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-80.36	45.06	-35.30	-13.00	22.30	Peak
2	1383.281	-82.60	48.42	-34.18	-13.00	21.18	Peak
3	3239.489	-86.46	58.54	-27.92	-13.00	14.92	Peak
4	3701.352	-91.24	60.93	-30.31	-13.00	17.31	Peak
5	4171.645	-84.08	62.03	-22.05	-13.00	9.05	Peak
6	4622.037	-98.49	62.97	-35.52	-13.00	22.52	Peak

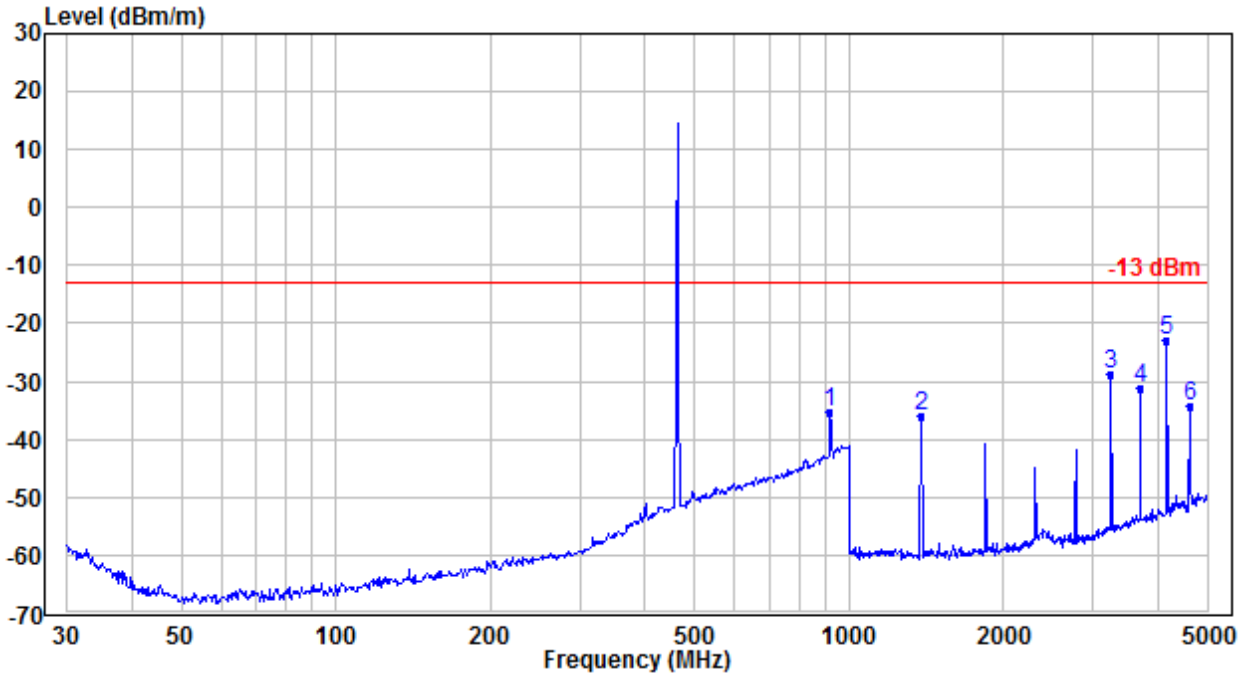
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-72.47	45.06	-27.41	-13.00	14.41	Peak
2	1383.281	-78.13	48.42	-29.71	-13.00	16.71	Peak
3	2309.620	-88.27	51.78	-36.49	-13.00	23.49	Peak
4	3239.489	-88.39	58.54	-29.85	-13.00	16.85	Peak
5	3701.352	-90.32	60.93	-29.39	-13.00	16.39	Peak
6	4171.645	-85.27	62.03	-23.24	-13.00	10.24	Peak

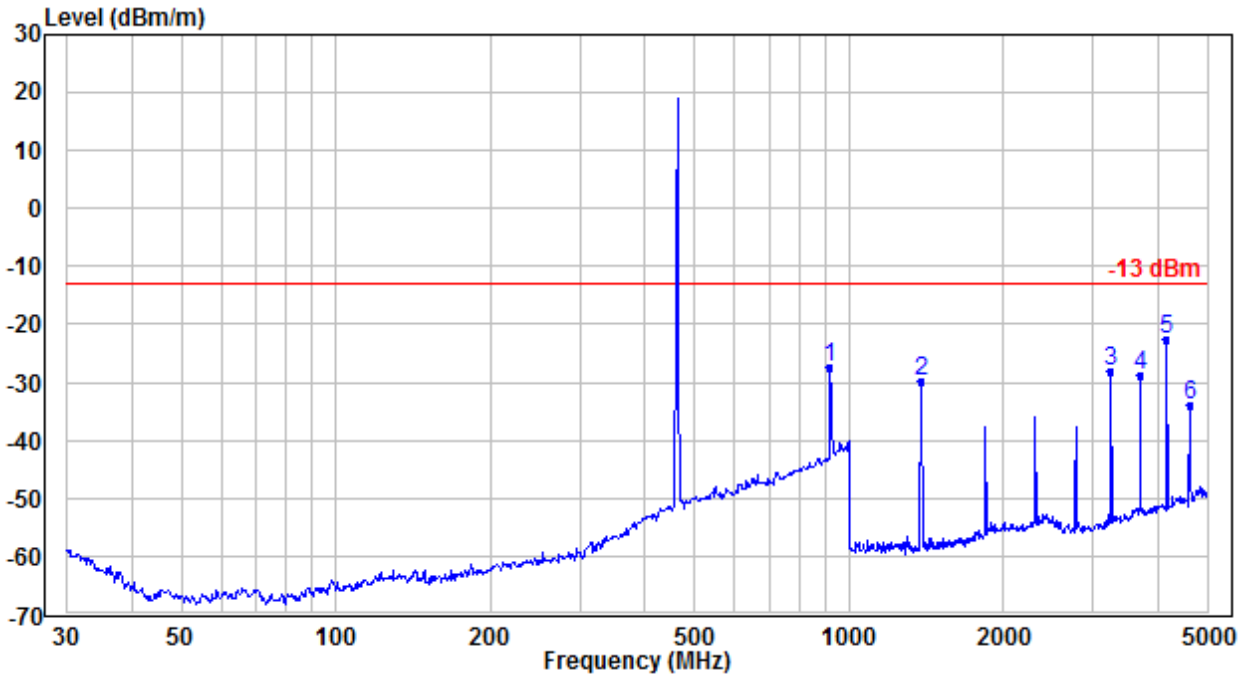
Channel 19

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-80.30	45.06	-35.24	-13.00	22.24	Peak
2	1383.281	-84.35	48.42	-35.93	-13.00	22.93	Peak
3	3250.579	-87.33	58.58	-28.75	-13.00	15.75	Peak
4	3701.352	-92.25	60.93	-31.32	-13.00	18.32	Peak
5	4171.645	-84.86	62.03	-22.83	-13.00	9.83	Peak
6	4622.037	-97.07	62.97	-34.10	-13.00	21.10	Peak

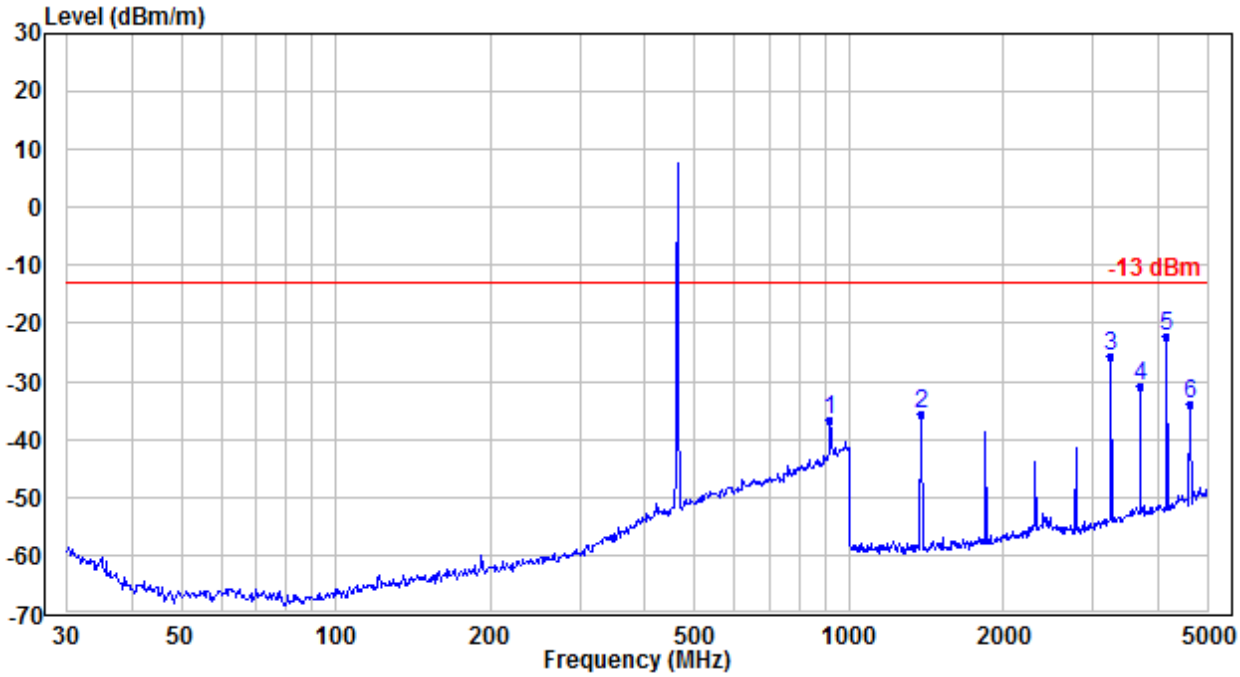
Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-72.48	45.06	-27.42	-13.00	14.42	Peak
2	1383.281	-78.37	48.42	-29.95	-13.00	16.95	Peak
3	3250.579	-86.60	58.58	-28.02	-13.00	15.02	Peak
4	3701.352	-89.75	60.93	-28.82	-13.00	15.82	Peak
5	4171.645	-84.72	62.03	-22.69	-13.00	9.69	Peak
6	4622.037	-97.03	62.97	-34.06	-13.00	21.06	Peak

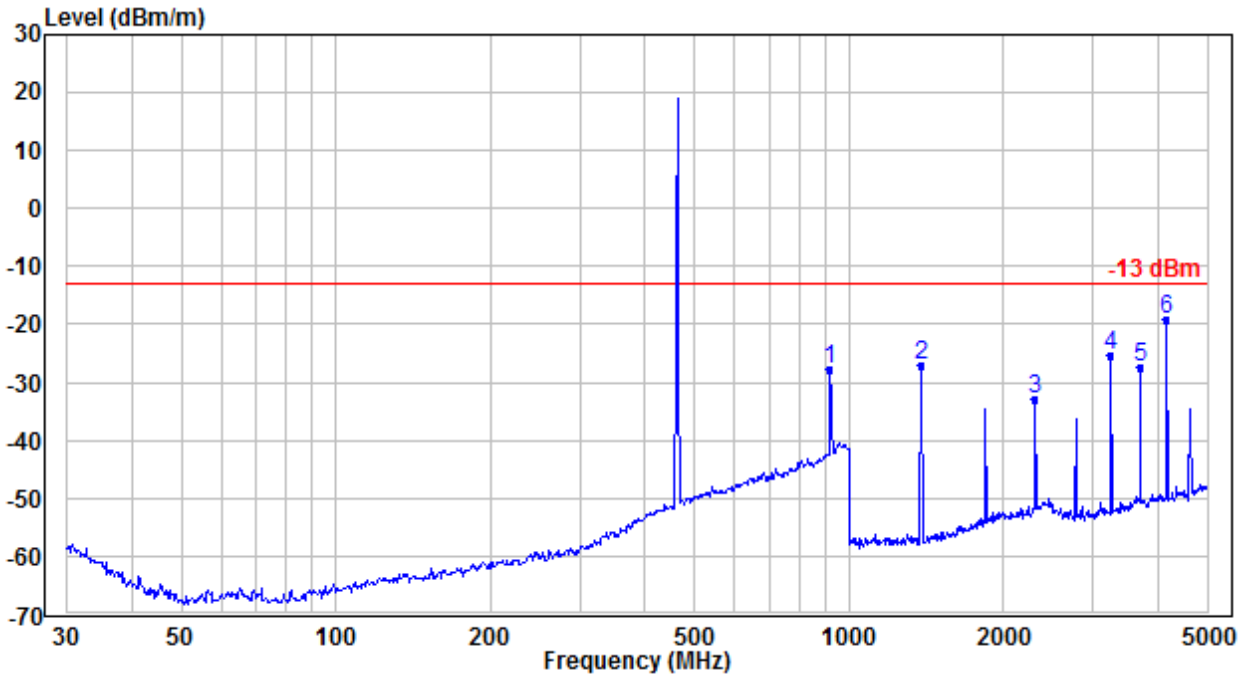
Channel 22

Horizontal



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-81.72	45.06	-36.66	-13.00	23.66	Peak
2	1388.017	-84.08	48.45	-35.63	-13.00	22.63	Peak
3	3250.579	-84.35	58.58	-25.77	-13.00	12.77	Peak
4	3701.352	-91.82	60.93	-30.89	-13.00	17.89	Peak
5	4171.645	-84.19	62.03	-22.16	-13.00	9.16	Peak
6	4622.037	-96.95	62.97	-33.98	-13.00	20.98	Peak

Vertical



No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB)	Result (dBm)	Limit (dBm)	Margin (dB)	Remark
1	921.066	-72.93	45.06	-27.87	-13.00	14.87	Peak
2	1388.017	-75.46	48.45	-27.01	-13.00	14.01	Peak
3	2309.620	-84.55	51.78	-32.77	-13.00	19.77	Peak
4	3250.579	-83.86	58.58	-25.28	-13.00	12.28	Peak
5	3701.352	-88.34	60.93	-27.41	-13.00	14.41	Peak
6	4171.645	-81.31	62.03	-19.28	-13.00	6.28	Peak

APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***

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