FCC TEST REPORT

Certification

Applicant Name: Bird Technologies Group	**Date of Issue:** August 20, 2019
Address: 30303 Aurora Rd. Solon, OH 44139	**Test Site/Location:** EMCE Engineering 1726 Ringwood Avenue San Jose, California USA
	Report No.: EMCE-R-1908-F001-1

FCC ID:	**EZZDMR604**
APPLICANT:	**Bird Technologies Group**

Model:	DMR604
EUT Type:	Bi-Directional Amplifier
ERP Output Power:	33 dBm (2 W)
Frequency Range:	Uplink : 462.4125 MHz Downlink : 467.4125 MHz
FCC Rule Part(s):	CFR 47 Part 2, Part 90

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

Steve In
Test Engineer
Certification Division

Billy Kim
Technical Manager
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Version

TEST REPORT NO.	DATE	DESCRIPTION
EMCE-R-1908-F001	August 20, 2019	- First Approval Report
EMCE-R-1908-F001-1	September 06, 2019	- Update the frequency stability table on page 21

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1. EUT DESCRIPTION

Model	DMR604
EUT Type	Bi-Directional Amplifier
Power Supply	100 ~ 240 VAC
Max. Conducted Output Power	Uplink : 25 dBm
	Downlink : 25 dBm
Max. ERP Output Power	Uplink : 33 dBm
	Downlink : 33 dBm
Modulation Type	FM 6.25 kHz , FM 12.5 kHz
Emission Designator (See 47 CFR 2.201 & 2.202)	4K00F3E, 11K2F3E
Antenna Specification	10 dBi
Firmware Version	-
Hardware Version	-
Date(s) of Tests	August 01, 2019 ~ August 15, 2019

Port	Frequency	Modulation
SERVICE	462.4125 MHz	FM 6.25 kHz FM 12.5 kHz
DONOR	467.4125 MHz	FM 6.25 kHz FM 12.5 kHz

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2. METHODOLOGY

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as Part 90.219 – Use of signal boosters, and KDB 935210 D05 Indus Booster Basic Meas v01r03 Measurement Guidance for Industrial and Non-consumer Signal Booster, Repeater, and Amplifier Devices.

3. DESCRIPTION OF TEST MODES

The EUT was operated in a manner representative of the typical usage of the equipment.
During all testing, system components were manipulated within the confines of typical usage to maximize each emission.
The device does not supply antenna(s) with the system, so the dummy loads were connected to the RF output ports for radiated spurious emission testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards.
Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC (Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at 1726 Ringwood Avenue, San Jose, California 95131, USA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

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6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Radiated Disturbance (9 kHz ~ 30 MHz)	3.20
Radiated Disturbance (30 MHz ~ 1 GHz)	4.73
Radiated Disturbance (1 GHz ~ 18 GHz)	5.21

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7. DESCRIPTION OF TESTS

7.1. Input/output power and amplifier gain

Test Requirements:

§ 2.1046 Measurements required: RF power output:

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8).The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

(b) For single sideband, independent sideband, and single channel, controlled carrier radio telephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 90.219 Use of signal boosters.

(e) Device Specifications. In addition to the general rules for equipment certification in §90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

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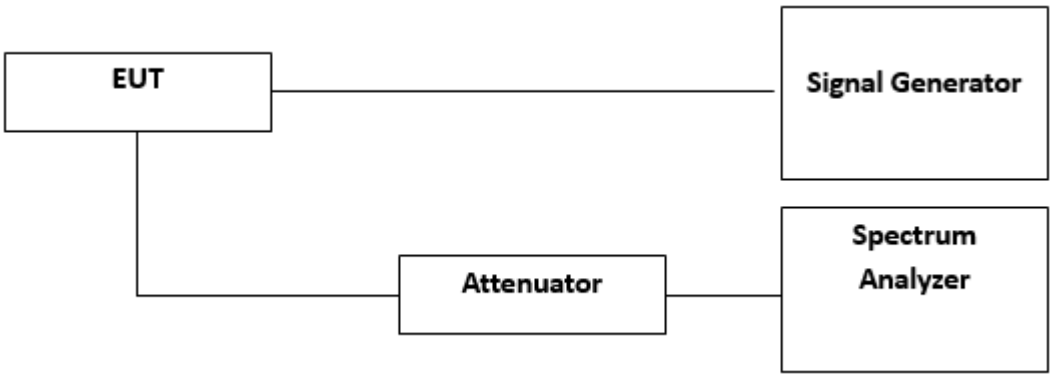
Test Configuration



Test Procedure

Measurements were in accordance with the test methods section 3.5.2 of KDB 935210 D05 v01r03.

a) Configure the signal generator for CW operation, instead of AWGN,

b) Select the spectrum analyzer positive peak detector, instead of the power averaging (rms) detector,

Power measurement Method :

c) Activate the max hold function, instead of the trace averaging function,

d) Use in conjunction with the guidance in 4.5.3.

e) Set the frequency span to at least 1 MHz.

f) Set RBW = 100 kHz.

g) Set VBW ≥ 3 × RBW.

h) Set the detector to PEAK, and trace mode to MAX HOLD.

i) Place a marker on the peak of the signal, and record the value as the maximum power.

j) Repeat step e) but with the EUT in place.

k) EUT gain may be calculated as described in 4.5.5.

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7.2. Input-versus-output signal comparison: Occupied Bandwidth

Test Requirement(s):

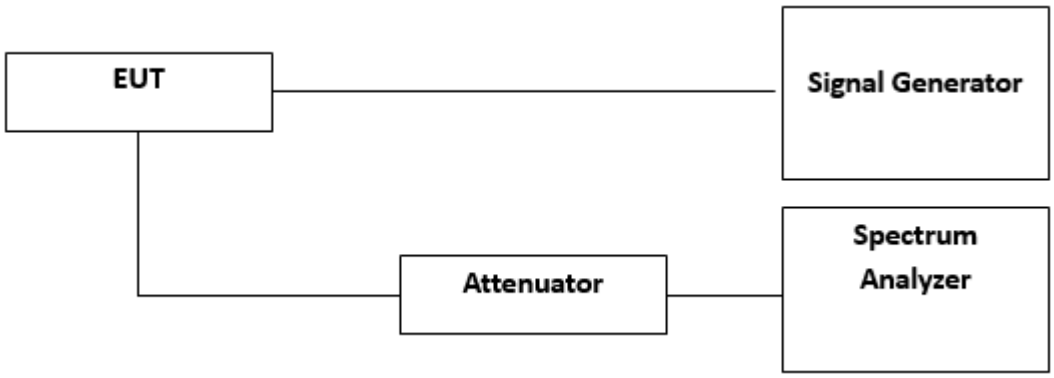
§ 2.1049 Measurements required: Occupied bandwidth:

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to

0.5 percent of the total mean power radiated by a given emission shall be measured

under the specified conditions of § 2.1049 (a) through (i) as applicable.

Test Configuration



Test Procedures:

Measurements were in accordance with the test methods section 3.4 of KDB 935210 D05 v01r03

Test is 99% OBW measured and used.

a) The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

b) The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

c) The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

d) The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

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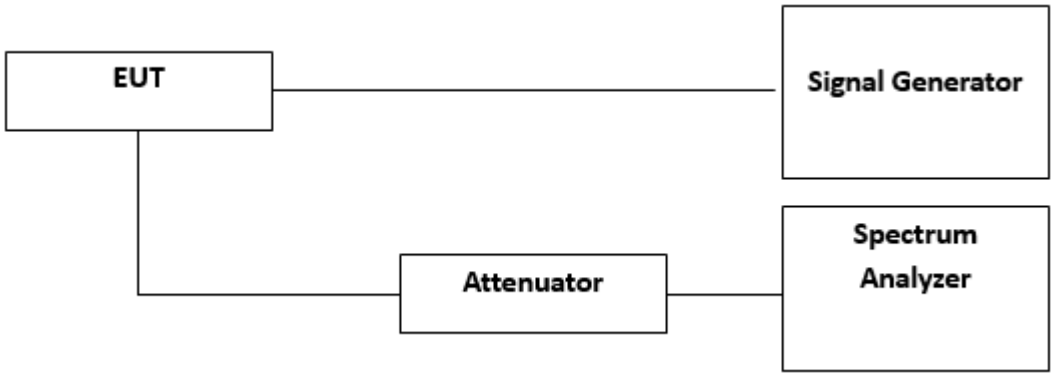
7.3. OUT OF BAND REJECTION

Test Requirement(s):

Out of Band Rejection – Test for rejection of out of band signals. Filter freq. response plots are acceptable.

Test Configuration



Test Procedure

Test Procedures:

Adjust the internal gain control of the EUT to the maximum gain for which equipment certification is sought.

a) Connect a signal generator to the input of the EUT.

b) Configure a swept CW signal with the following parameters:

c) Frequency range = ± 250 % of the manufacturer's specified pass band.

d) The CW amplitude shall be 3 dB below the AGC threshold (see 4.2), and shall not activate the AGC threshold throughout the test.

e) Dwell time = approximately 10 ms.

f) Frequency step = 50 kHz.

g) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation.

h) Set the RBW of the spectrum analyzer to between 1 % and 5 % of the manufacturer's rated passband, and VBW = 3 × RBW.

i) Set the detector to Peak and the trace to Max-Hold.

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j) After the trace is completely filled, place a marker at the peak amplitude, which is designated as f0, and with two additional markers (use the marker-delta method) at the 20 dB bandwidth (i.e., at the points where the level has fallen by 20 dB).

k) Capture the frequency response plot for inclusion in the test report.

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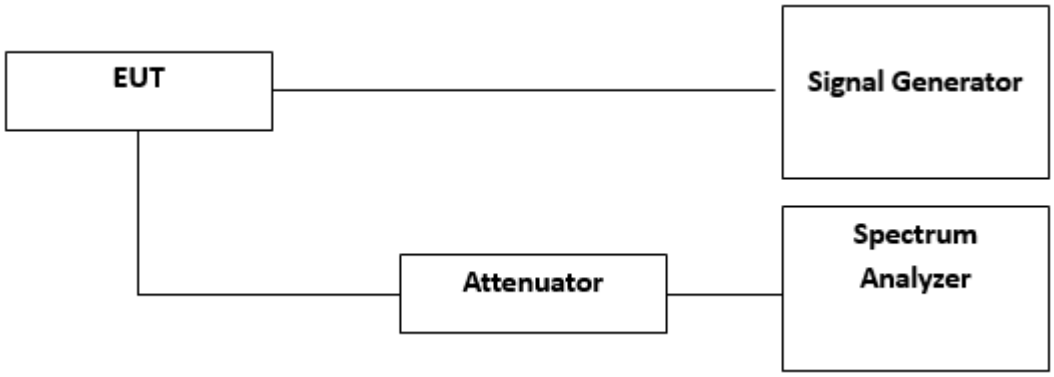
7.4. Noise Figure Measurements

Test Requirement(s):

§ 90.219 Use of signal boosters:

(e) (2) The noise figure of a signal booster must not exceed 9 dB in either direction.

Test Configuration



Test Procedure

Test Procedures:

a) A spectrum analyzer was connected to MU output port

b) The input was terminated

c) The spectrum analyzer was set to 100 trace average in the RMS average mode

d) A peak reading was recorded

e) The noise figure was calculated using the following formula

NF= Max reading - (-174dBm/Hz +10*log10(RBW)+ Booster gain) Note: 174= Thermal noise for 1Hz RBW at room temperature

RBW= Resolution Bandwidth of Spectrum Analyzer in Hz

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7.5. Emission Mask & Adjacent channel power limits

Limit

Test Requirement(s):

§ 90.210 Emission masks:

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (o) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating under this part.

APPLICABLE EMISSION MASKS

Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25[1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174[2]	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512[2 5]	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854	B	H
809-824/854-869[3 5]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925[4]		

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All other bands	B	C

Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (fd2/11) dB or 50 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd−2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

Emission Mask E—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 kHz removed from f0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd−3 kHz) or 55 + 10 log

(P) or 65 dB, whichever is the lesser attenuation.

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(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

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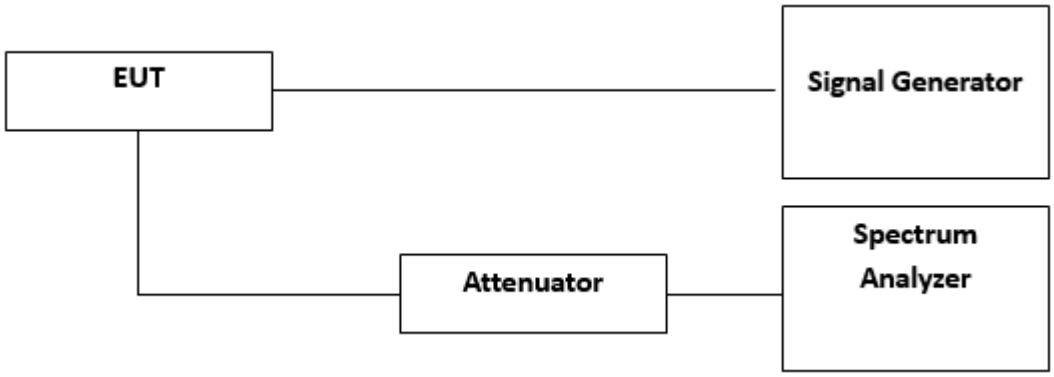
Test Configuration



Test Procedures:

Measurements were in accordance with the test methods section 4.4 of KDB 935210 D05 v01r03

4.4 Input-versus-output signal comparison

Compliance with the emission mask of the EUT output shall be measured for the public safety service signal types as specified in 4.1.

Refer to the applicable regulatory requirements (e.g., § 90.210) for emission mask specifications.

a) Connect a signal generator to the input of the EUT.

b) Configure the signal generator to transmit the appropriate test signal associated with the public safety emission designation (see Table 1).

c) Configure the signal level to be just below the AGC threshold (see results from 4.2).

d) Connect a spectrum analyzer to the output of the EUT using appropriate attenuation as necessary.

e) Set the spectrum analyzer center frequency to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be between 2 times to 5 times the EBW (or OBW).

f) The nominal resolution bandwidth (RBW) shall 300 Hz for 16K0F3E and 100 Hz for all other emissions types.

g) Set the reference level of the spectrum analyzer to accommodate the maximum input amplitude level.

h) Set spectrum analyzer detection mode to peak, and trace mode to max hold.

i) Allow the trace to fully stabilize.

j) Confirm that the signal is contained within the appropriate emissions mask.

k) Use the marker function to determine the maximum emission level and record the associated frequency as f0.

l) Capture the emissions mask plot for inclusion in the test report (output signal spectra).

m) Measure the EUT input signal power (signal generator output signal) directly from the signal generator using power measurement guidance provided in KDB Publication 971168 (input signal spectra).

n) Compare the spectral plot of the output signal (determined in step k), to the input signal (determined in step l) to affirm they are similar (in passband and rolloff characteristic features and relative spectral locations).

o) Repeat the procedure for both test signals with the input signal amplitude set 3 dB above the AGC threshold.

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p) Repeat steps b) to n) for all authorized operational bands and emissions types (see applicable regulatory specifications, e.g., §90.210).

q) Include all accumulated spectral plots depicting EUT input signal and EUT output signal in the test report and note any observed dissimilarities.

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7.6. SPURIOUS AND HARMONIC EMISSION AT ANTENNA TERMINAL

Test Requirement(s):

§ 2.1051 Measurements required:

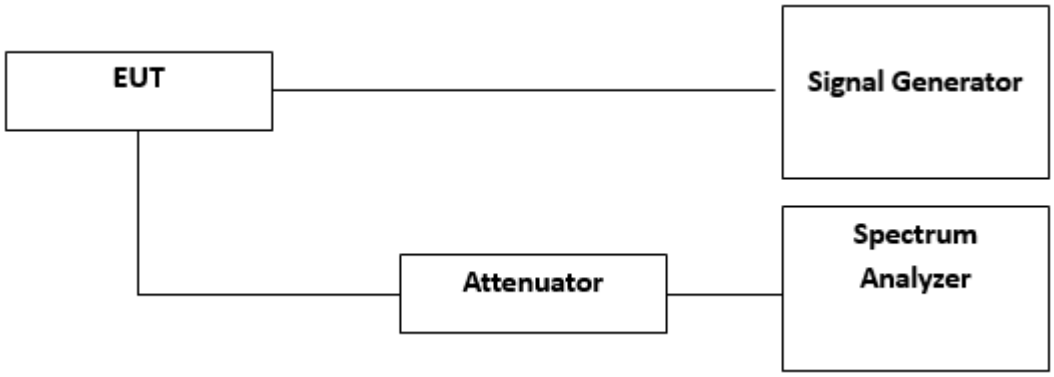
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 90.219 Use of signal booters.

Device Specifications. In addition to the general rules for equipment certification in §90.203(a)(2) and part 2, subpart J of this chapter, a signal booster must also meet the rules in this paragraph.

Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth.

Test Configuration



Test Procedures:

Test Method: KDB 935210 D05 Indus Booster Basic Meas v01r03 section 4.7.3

a) Connect a signal generator to the input of the EUT.

b) Configure the signal generator to produce a CW signal.

c) Set the frequency of the CW signal to the center channel of the EUT passband.

d) Set the output power level so that the resultant signal is just below the AGC threshold (see 4.2).

e) Connect a spectrum analyzer to the output of the EUT, using appropriate attenuation as necessary.

f) Set the RBW = 100 kHz. (i.e., for 30 MHz to 1 GHz PLMRS and/or PSRS booster devices)

g) Set the VBW = 3 × RBW.

h) Set the Sweep time = auto-couple.

i) Set the detector to PEAK.

j) Set the spectrum analyzer start frequency to 30 MHz (or the lowest radio frequency signal generated

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in the EUT, without going below 9 kHz if the EUT has additional internal clock frequencies), and the stop frequency to 10 times the highest allowable frequency of the EUT passband.

k) Select MAX HOLD, and use the marker peak function to find the highest emission(s) outside the passband. (This could be either at a frequency lesser or greater than the passband frequencies.)

l) Capture a plot for inclusion in the test report.

m) Repeat steps c) to l) for each authorized frequency band/block of operation.

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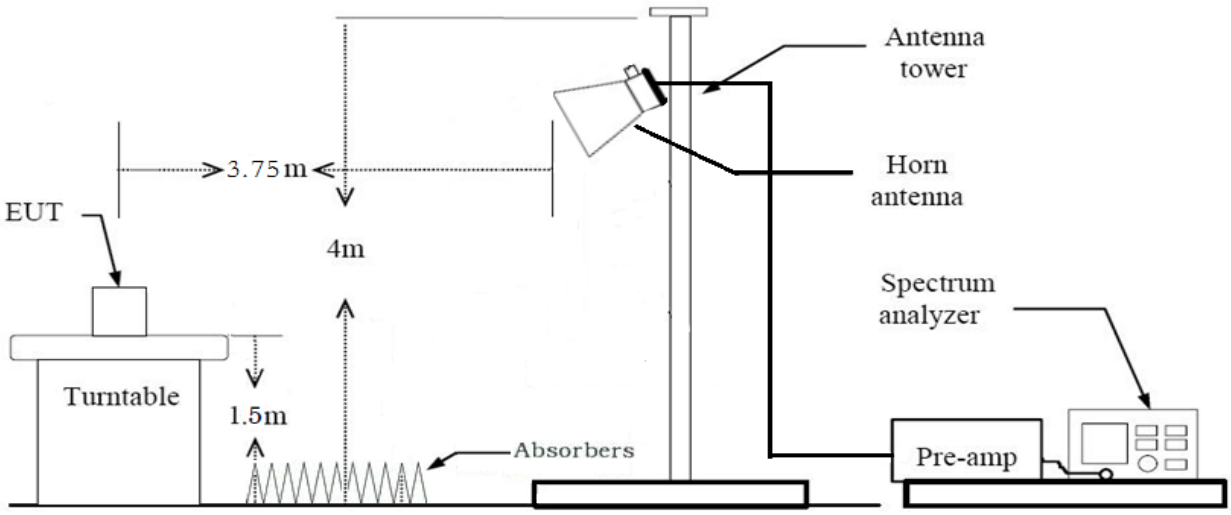
7.7. RADIATED SPURIOUS EMISSIONS

Test Requirement(s):

FCC §90.219 (e)(3)

Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth

Test Configuration



Note :

1. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
2. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Test Procedures:

As required by 47 CFR 2.1053, field strength of radiated spurious measurements were made in accordance with the procedures of ANSI/TIA-603-C-2004 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a 3 meter semi-anechoic chamber.

The EUT was set at a distance of 3m from the receiving antenna. The EUT's RF ports were terminated to 50ohm load. The EUT was set to transmit at the low, mid and high channels of the transmitter frequency range at its maximum power level. The EUT was rotated about 360and the receiving antenna scanned from 1-3m in order to capture the maximum emission. A calibrated antenna source was positioned in place of the EUT and the previously recorded signal was duplicated. The maximum EIRP of the emission was calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps were carried. out with the receiving antenna in both vertical and horizontal polarization. Harmonic emissions up to the 10th or 40GHz, whichever was the lesser, were investigated.

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7.8. FREQUENCY STABILITY OVER TEMPERATURE AND VOLTAGE VARIATIONS

Test Requirements:

§ 90.213 Frequency stability.

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Minimum Frequency Stability [Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations (ppm)	Mobile stations (ppm)	
		Over 2 watts output power	2 watts or less output power
Below 25	100	100	200
25-50	20	20	50
72-76	5	-	50
150-174	5	5	[4]50
216-220	1.0	-	1.0
220-222[12]	0.1	1.5	1.5
421-512	2.5	5	5
806-809	1.0	1.5	1.5
809-824	1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928[13]	2.5	2.5	2.5
929-930	1.5	-	-
935-940	0.1	1.5	1.5
1427-1435	300	300	300
Above 2450	-	-	-

(b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

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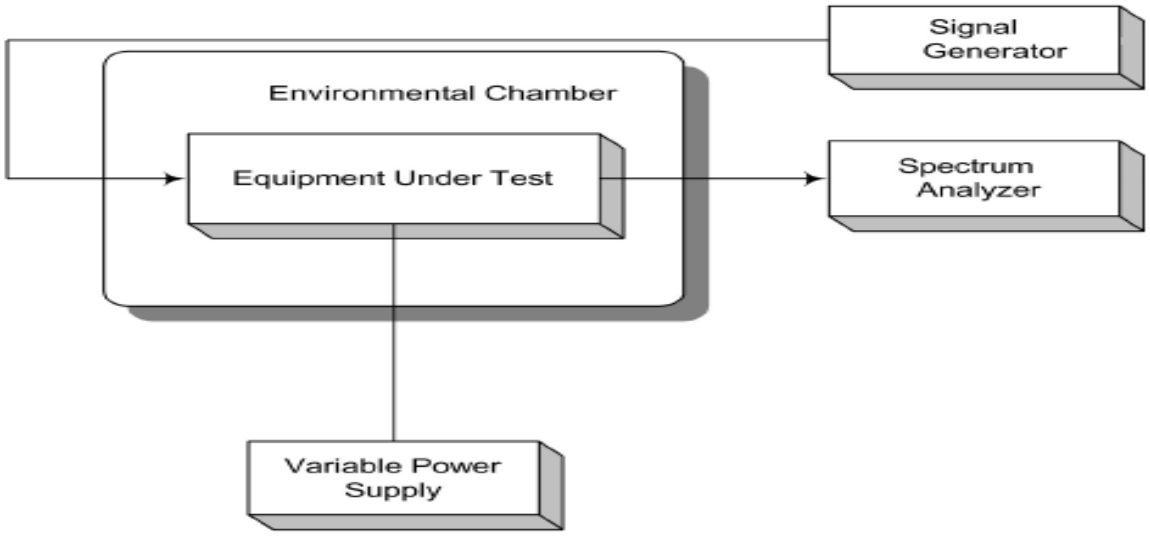
Test Configuration



Test Procedures:

As required by 47 CFR 2.1055, Frequency Stability measurements were made at the RF output terminals using a Spectrum Analyzer.

The EUT was placed in the Environmental Chamber.

A CW signal was injected into the EUT at the appropriate RF level. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations.

The frequency drift was investigated for every 10 °C increment until the unit is

stabilized then recorded the reading in tabular format with the temperature range of -25 to 55 °C.

Voltage supplied to EUT is 110 Vac reference temperature was done at 20°C.

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Factors for frequency

Freq [MHz]	Factor [dB]
30	20.13
100	20.31
200	20.21
300	20.16
400*	20.22
500	20.15
600	20.26
700	20.17
800	20.23
900	20.21
1000	20.19
2000	20.38
2400	20.42
2500	20.51
3000	20.53
4000	20.61
5000	20.97
6000	20.73
7000	21.01
8000	20.88
9000	21.11
10000	21.21

Note : 1. '*' is fundamental frequency range.

2. Factor = Attenuator loss + Cable loss + EUT Cable loss

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8. SUMMARY TEST OF RESULTS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 90

Description	Reference (FCC)	Results
Input/output power and amplifier gain	§2.1046; §90.219(e)(1)	Compliant
Input-versus-output signal comparison: Occupied Bandwidth	§2.1049 §90.219 (e)(4)(ii)	Compliant
Emission Mask & Adjacent channel power	§90.219 (e)(4)(iii), §90.210 & §90.221	Compliant
Intermodulation	§90.219 (d)(6)	Compliant
Spurious emissions at antenna terminals	§2.1051; §90.219(e)(3)	Compliant
Noise Figure Measurements	§90.219 (e)(2)	Compliant
Out-of-band Rejection	§90.219	Compliant
Frequency Stability	§2.1055; §90.213	Compliant
Radiated spurious emission	§2.1053; §90.219(e)(3)	Compliant

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9. TEST RESULT

9.1 INPUT/OUTPUT POWER AND AMPLIFIER GAIN

▣ TEST RESULTS

Frequency (MHz)	AGC threshold (dBm)	Input Power (dBm)	Conducted Output Power (dBm)	Max Gain (dB)	Max Antenna Gain (dBi)	ERP (dBm)	Limit (dBm)
462.4125	AGC	-61.5	24.630	86.130	10	32.480	37
	AGC+3dB	-58.5	24.621	83.121	10	32.471	37
467.4125	AGC	-59.6	24.518	84.118	10	32.368	37
	AGC+3dB	-56.6	24.463	81.063	10	32.313	37

Note:
ERP= Measured Conducted Output Power (dBm) + Antenna Gain (dBi) - 2.15 (dB)

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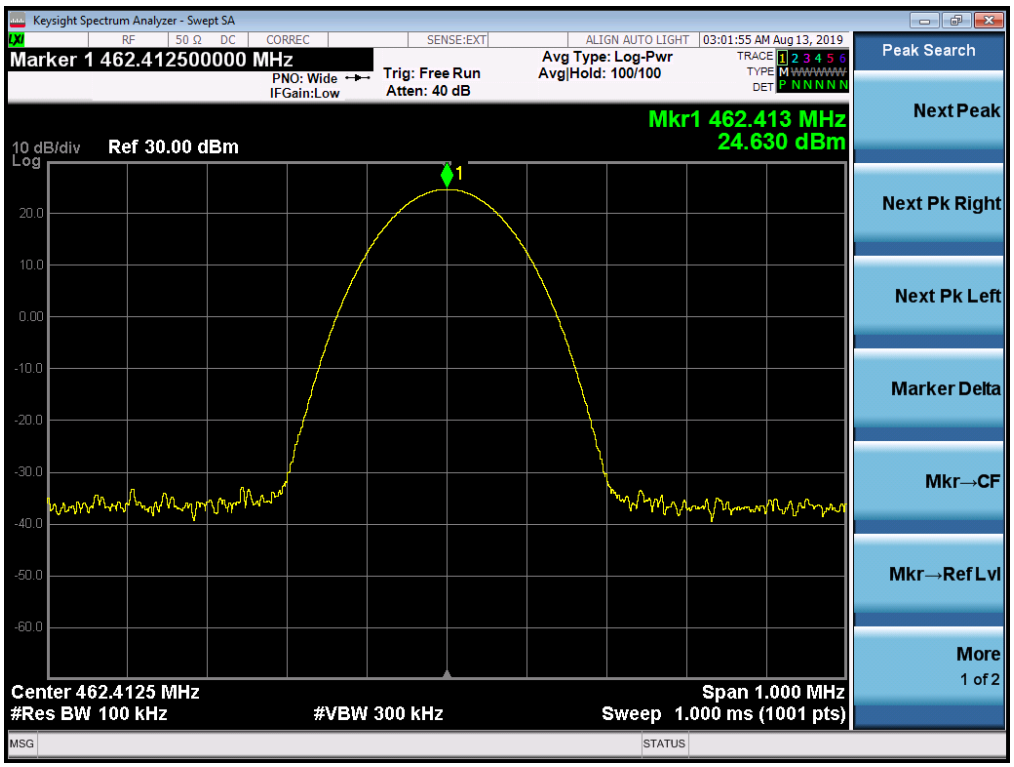
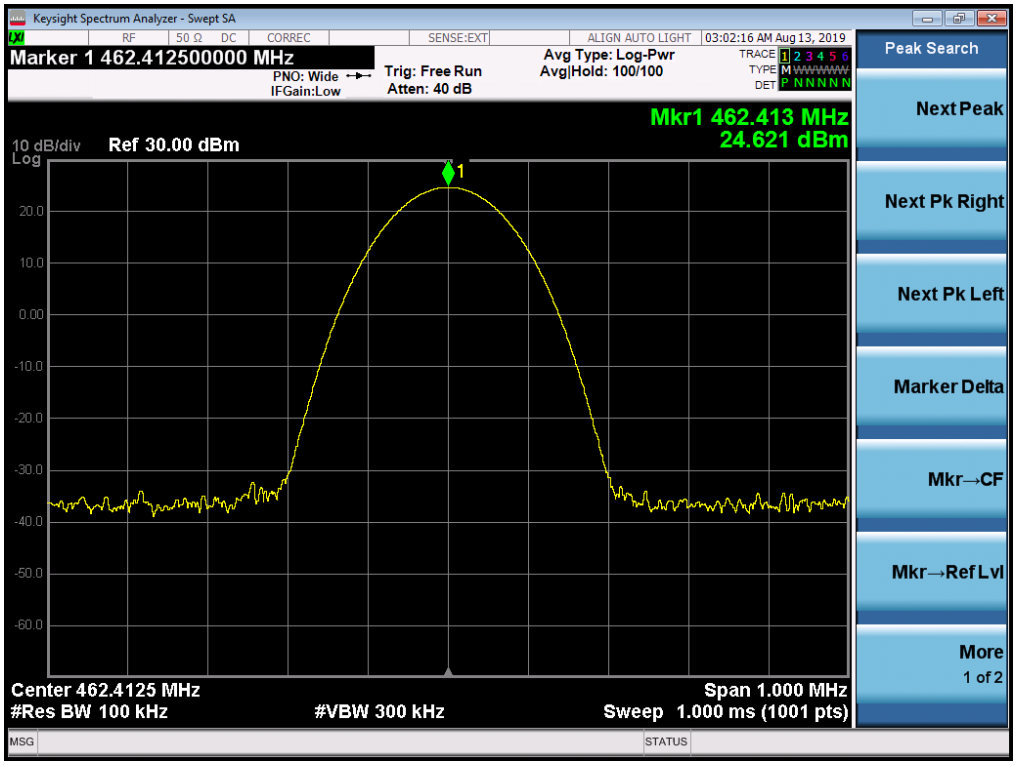
▣ Test Plots

462.4125 MHz_AGC



462.4125 MHz_AGC +3 dB



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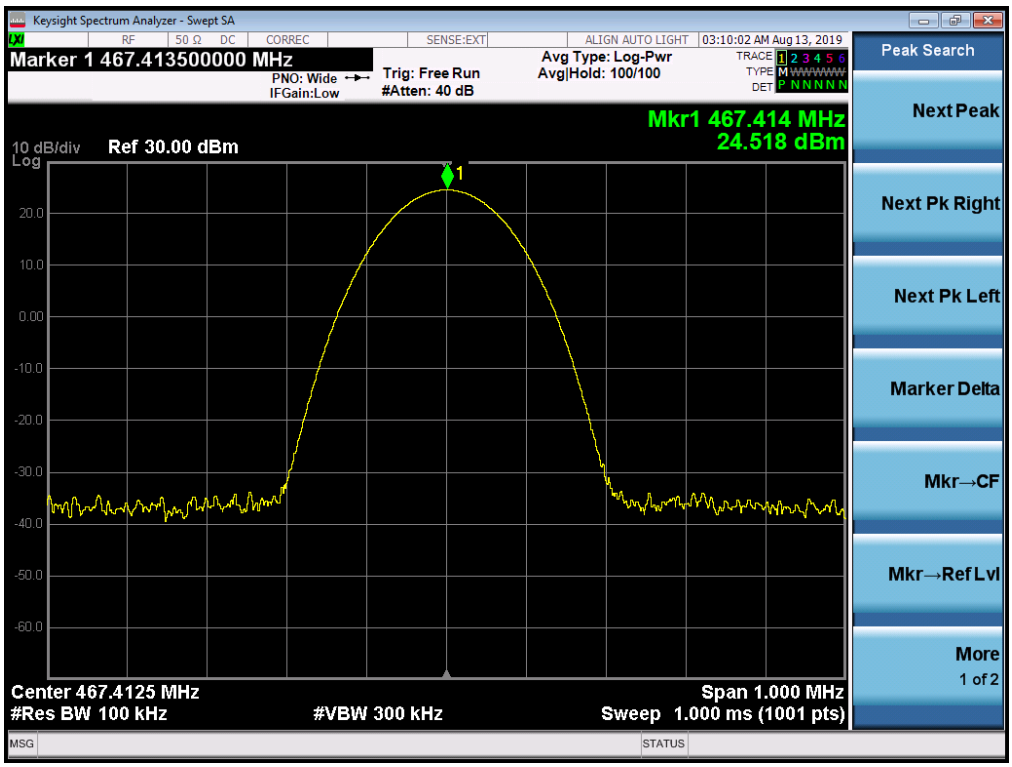
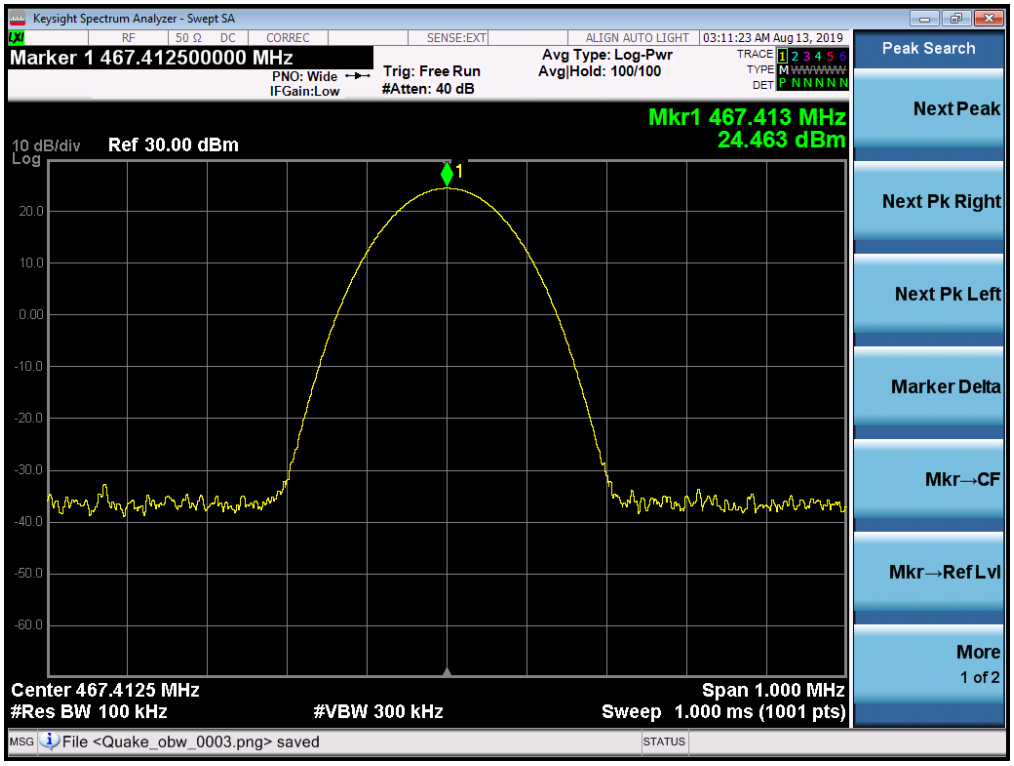
467.4125 MHz_AGC



467.4125 MHz_AGC +3 dB



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9.2 INPUT-VERSUS-OUTPUT SIGNAL COMPARISON:OCCUPIED BANDWIDTH

▣ TEST RESULTS

Signal Type	Frequency (MHz)	Input Signal Level	Input		Output	
			99% OBW (kHz)	26db Band width (kHz)	99% OBW (kHz)	26db Band width (kHz)
FM 6.25k	462.5	AGC	4.023	4.162	4.017	4.160
		AGC+3dB	4.023	4.162	4.017	4.160
FM 12.5k	462.5	AGC	7.909	8.151	7.890	8.150
		AGC+3dB	7.910	8.152	7.890	8.150
FM 6.25k	467.5	AGC	4.020	4.160	4.015	4.039
		AGC+3dB	4.019	4.160	4.019	4.041
FM 12.5k	467.5	AGC	7.896	8.148	7.869	8.147
		AGC+3dB	7.898	8.149	7.868	8.147

The retransmitted signals meet the requirements of § 90.213.

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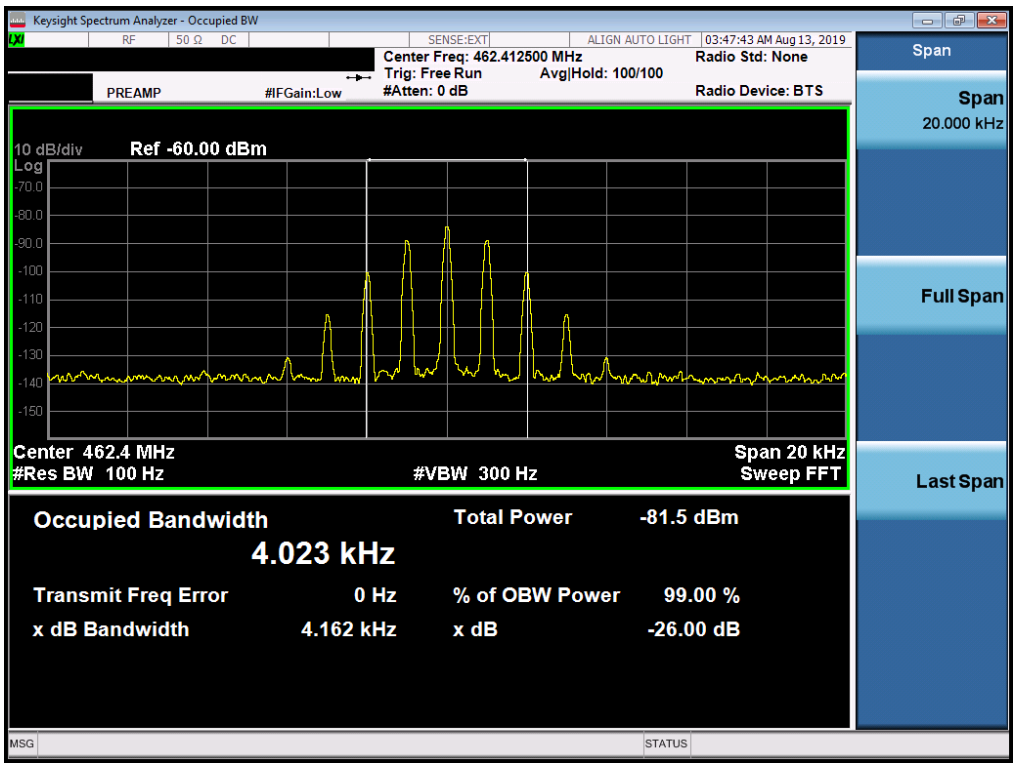
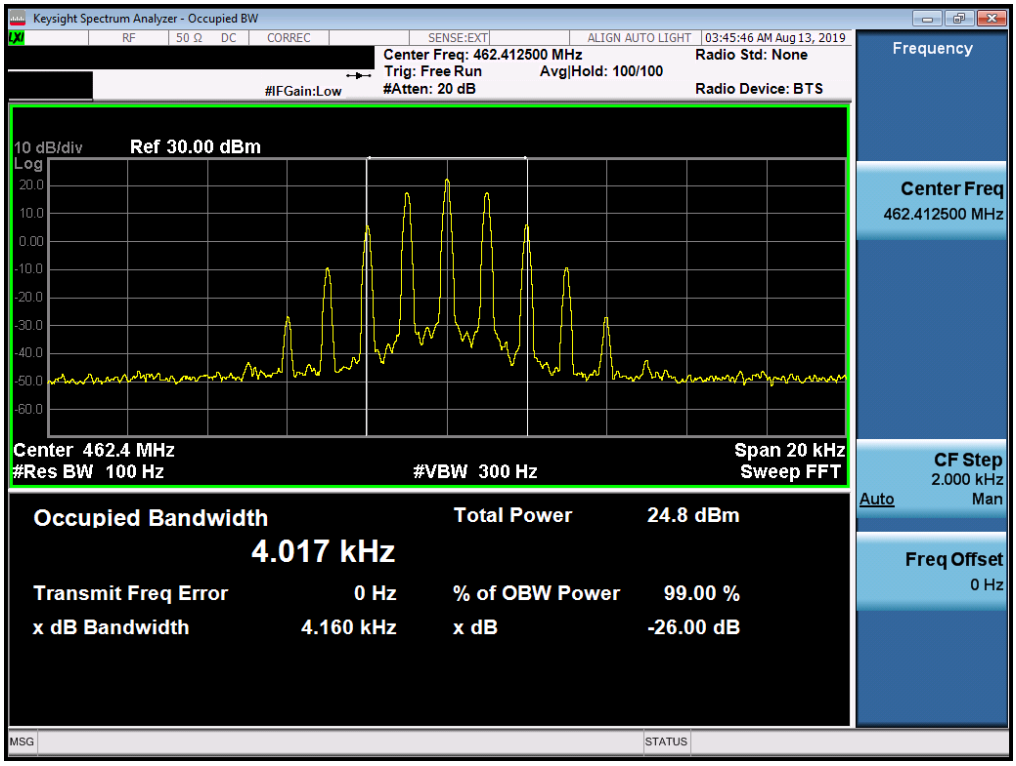
▣ Test Plots

462.4125 MHz 6.25 kHz Input Signal



462.4125 MHz 6.25 kHz Output Signal



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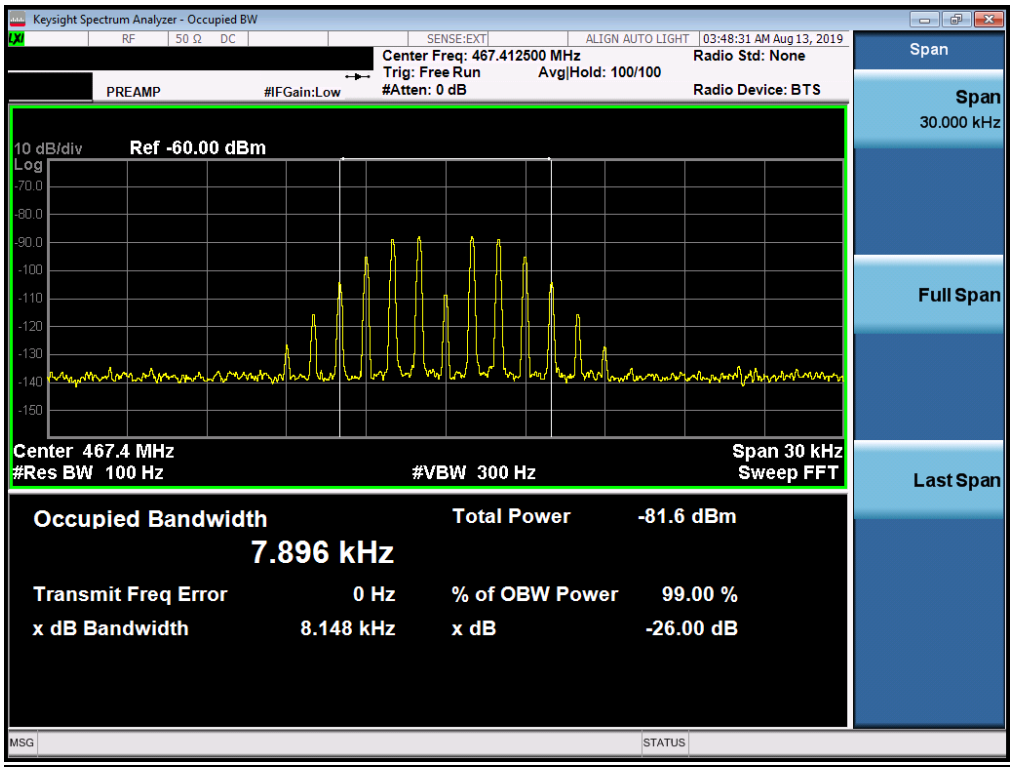
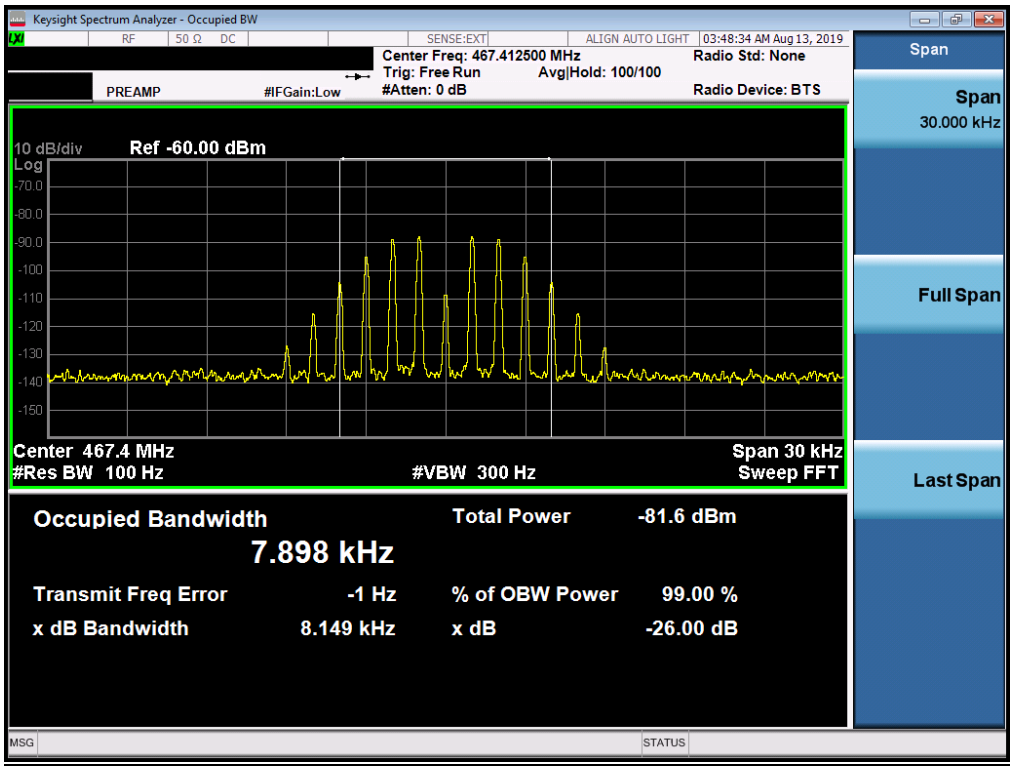
467.4125 MHz 12.5 kHz Input Signal



467.4125 MHz 12.5 kHz Output Signal



Note:

Plot of worst case are only reported.

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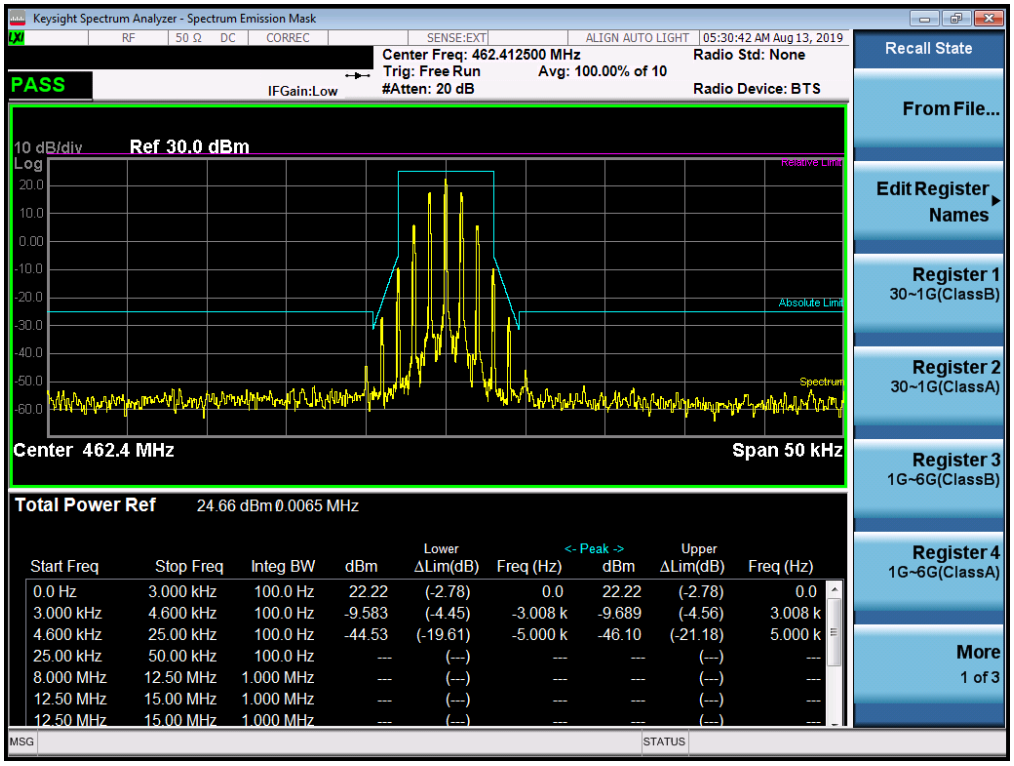
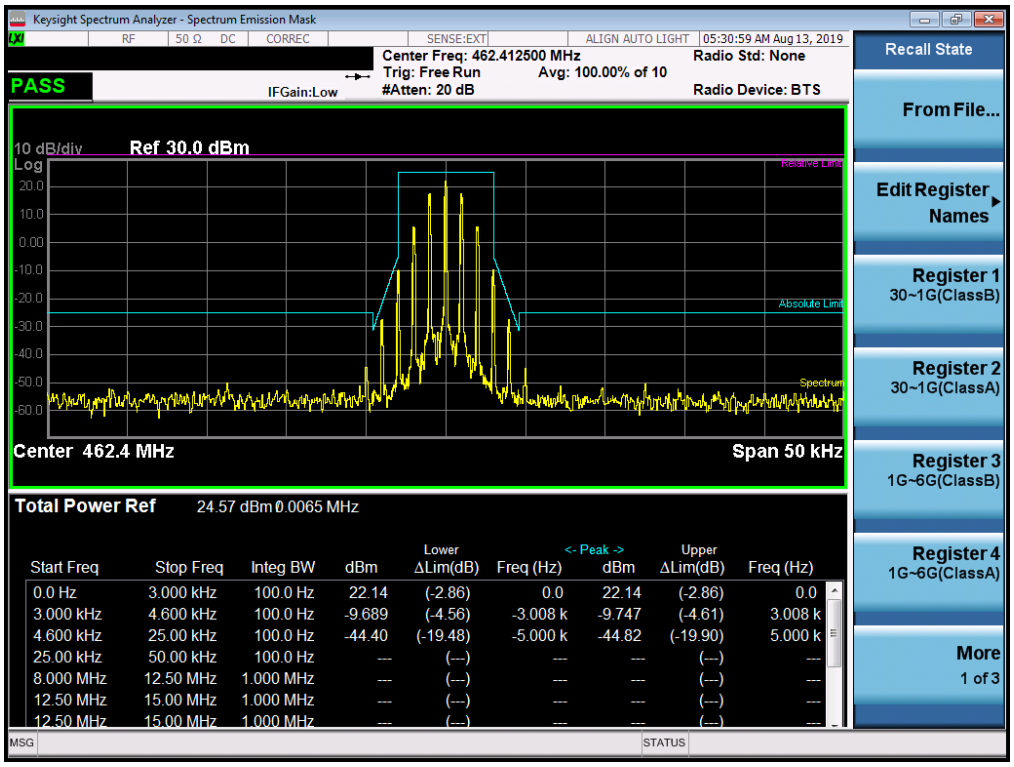
9.3 EMISSION MASK & ADJACENT CHANNEL POWER

▣ Test Plots

462.4125 MHz_FM 6.25 K AGC



462.4125 MHz_FM 6.25 K AGC +3



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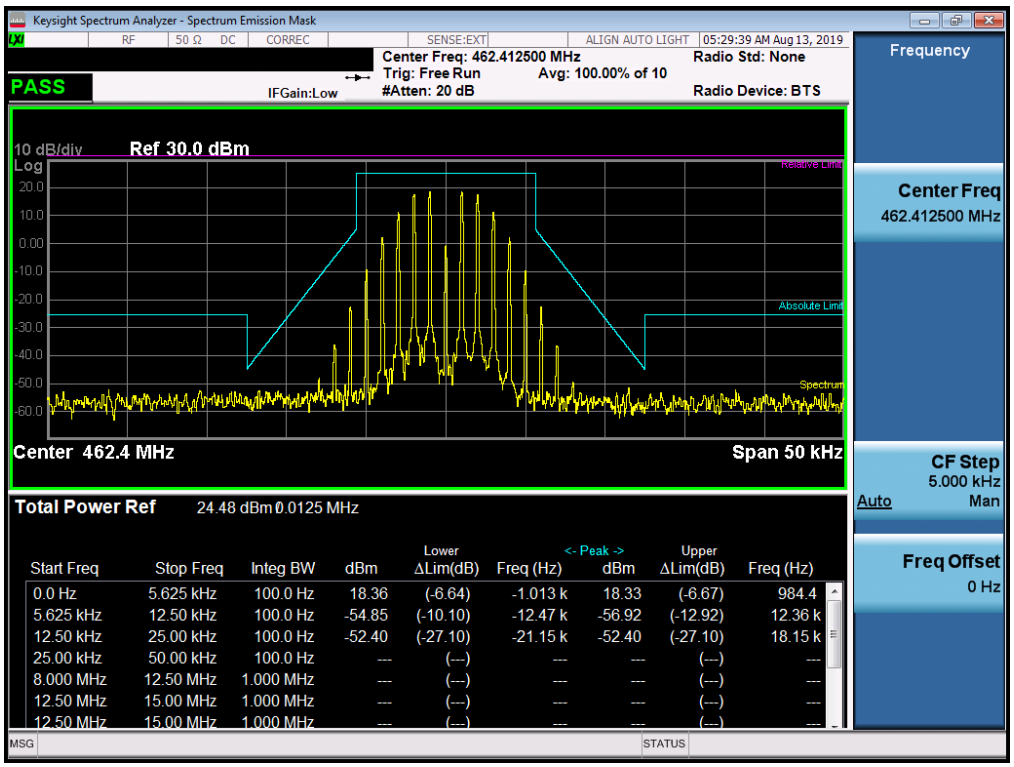
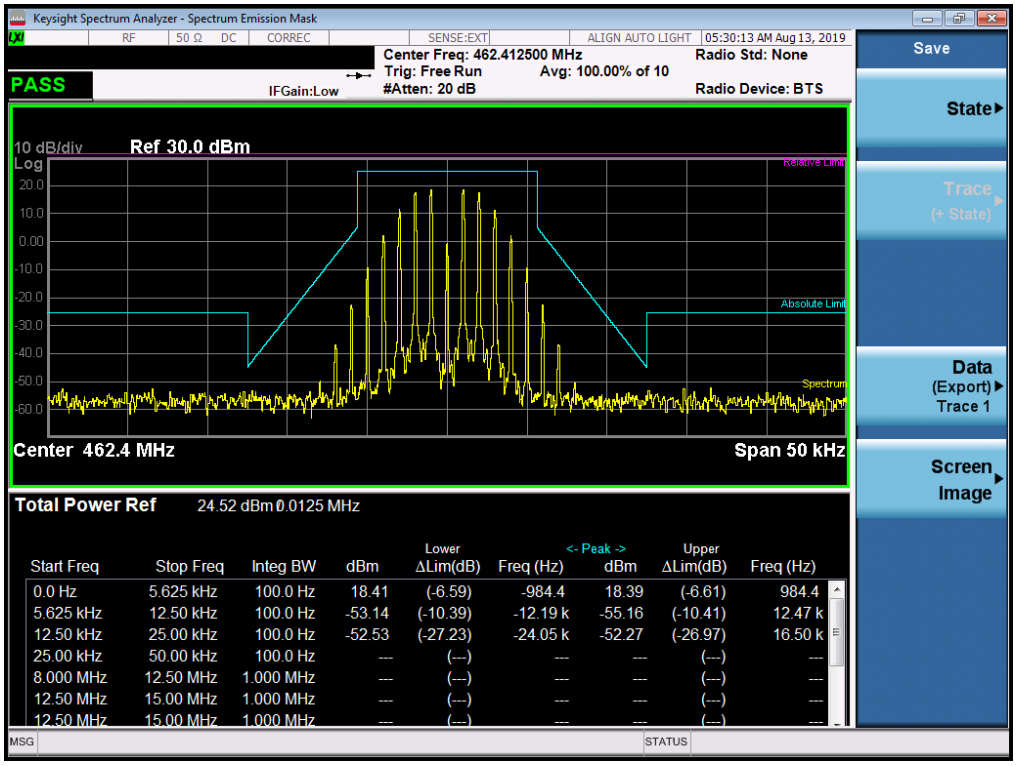
462.4125 MHz_FM 12.5 K AGC



462.4125 MHz_FM 12.5 K AGC+3



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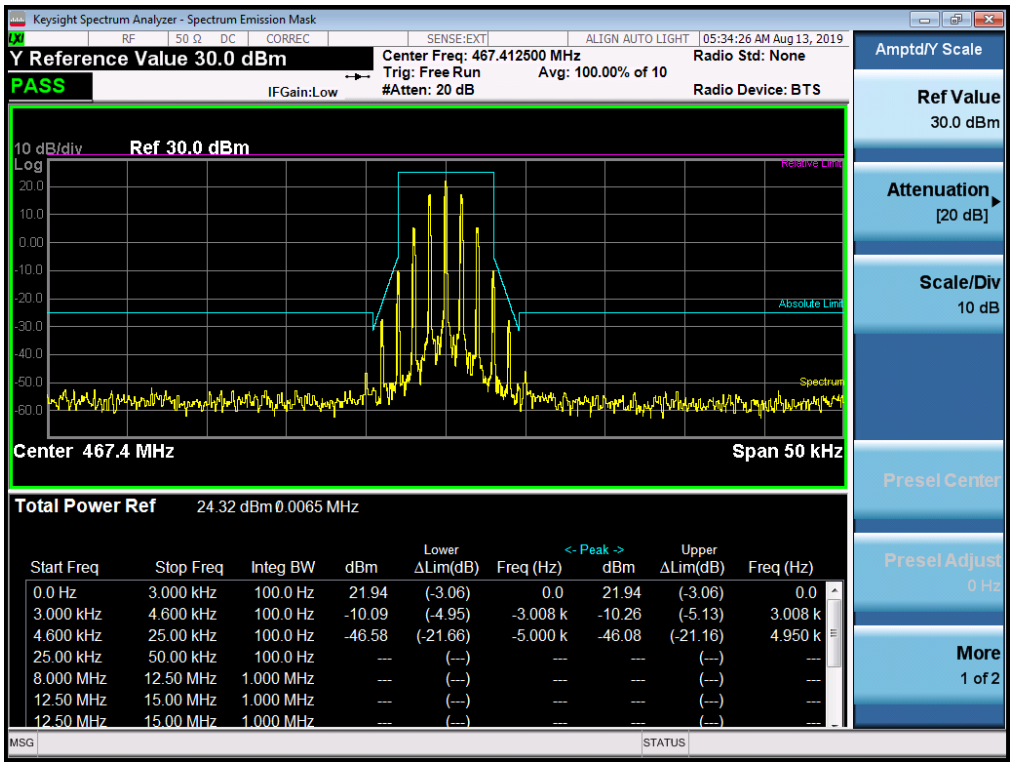
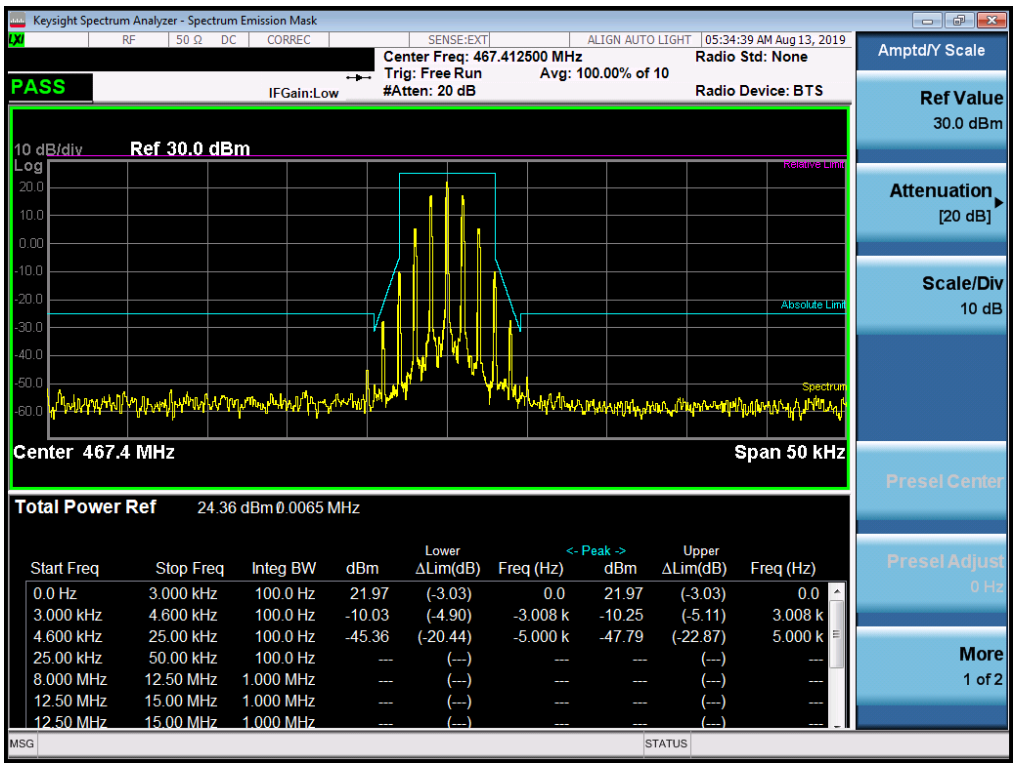
467.4125 MHz_FM 6.25 K AGC



467.4125 MHz_FM 6.25 K AGC +3



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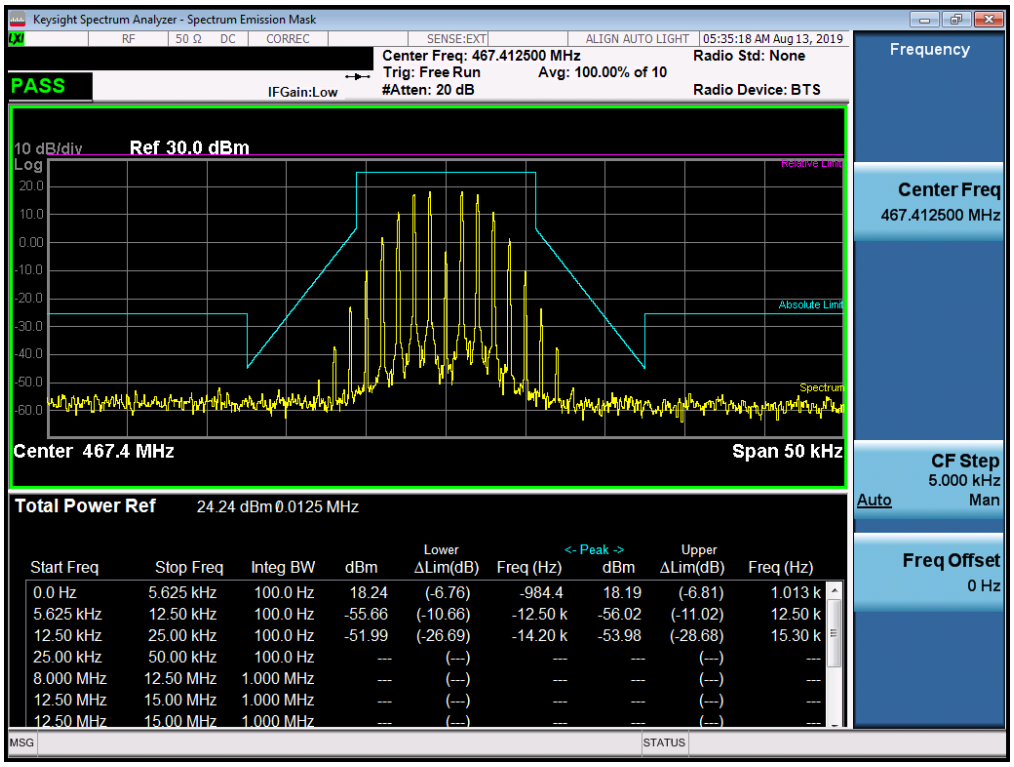
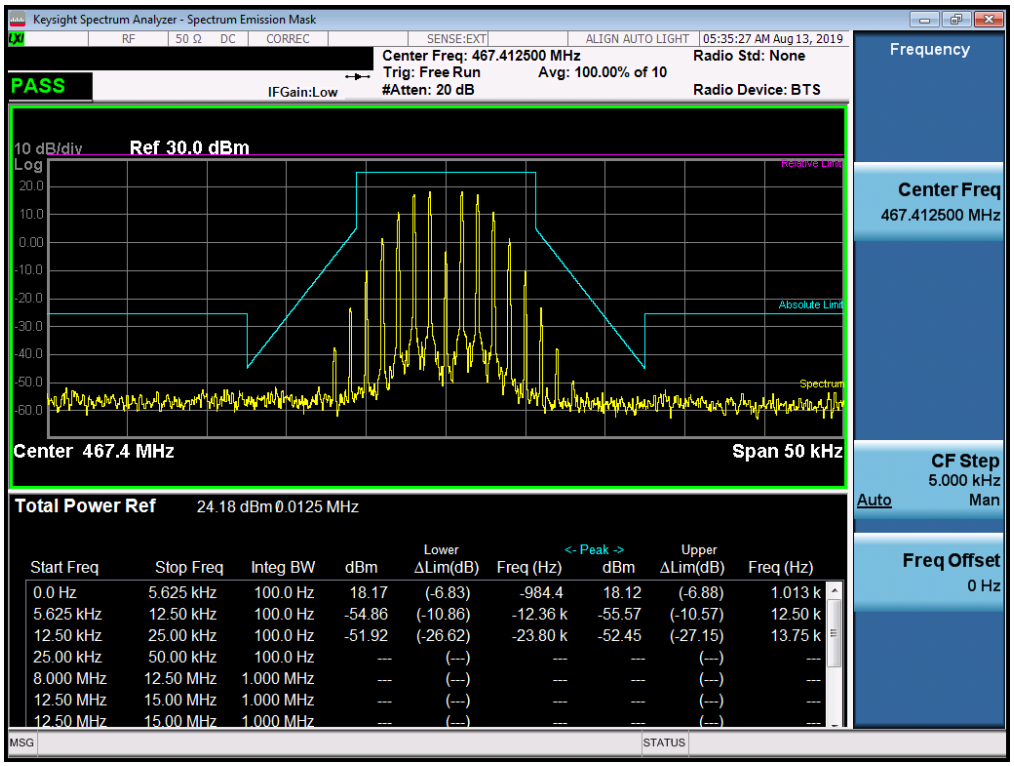
467.4125 MHz_FM 12.5 K AGC



Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	18.24	(-6.76)	-984.4	18.19	(-6.81)	1.013 k
5.625 kHz	12.50 kHz	100.0 Hz	-55.66	(-10.66)	-12.50 k	-56.02	(-11.02)	12.50 k
12.50 kHz	25.00 kHz	100.0 Hz	-51.99	(-26.69)	-14.20 k	-53.98	(-28.68)	15.30 k
25.00 kHz	50.00 kHz	100.0 Hz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

467.4125 MHz_FM 12.5 K AGC+3



Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	18.17	(-6.83)	-984.4	18.12	(-6.88)	1.013 k
5.625 kHz	12.50 kHz	100.0 Hz	-54.86	(-10.86)	-12.36 k	-55.57	(-10.57)	12.50 k
12.50 kHz	25.00 kHz	100.0 Hz	-51.92	(-26.62)	-23.80 k	-52.45	(-27.15)	13.75 k
25.00 kHz	50.00 kHz	100.0 Hz	---	(---)	---	---	(---)	---
8.000 MHz	12.50 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

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9.4 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

▣ TEST RESULTS

462.4125 MHz Conducted Spurious Emissions

Frequency [MHz]	Test Result		
	Measured Level [dBm]	Limit [dBm]	Pass/Fail
3844	-35.144	-13	Pass

467.4125 MHz Conducted Spurious Emissions

Frequency [MHz]	Test Result		
	Measured Level [dBm]	Limit [dBm]	Pass/Fail
3780	-34.596	-13	Pass

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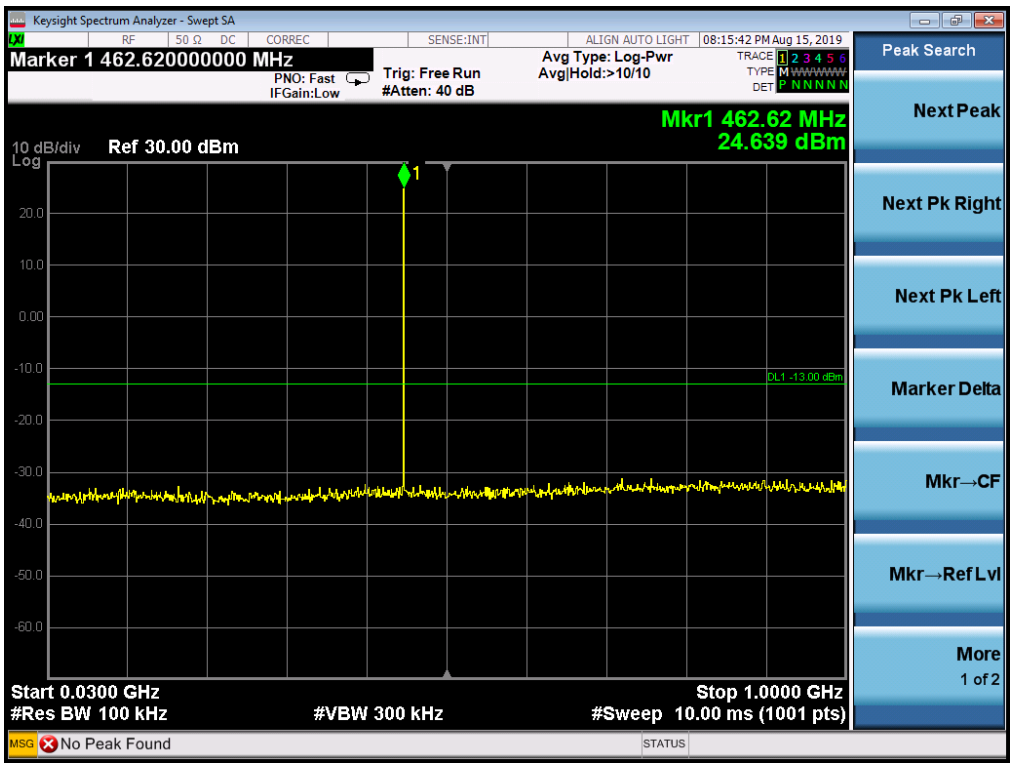
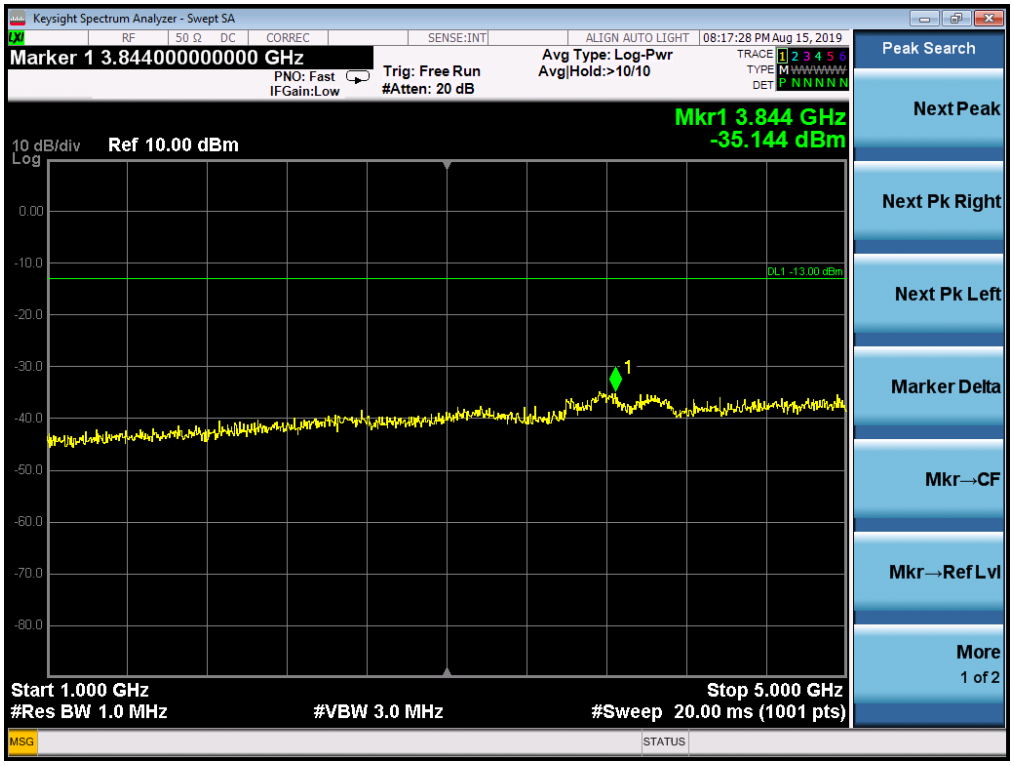
▣ RESULT PLOTS

462.4125 MHz



462.4125 MHz



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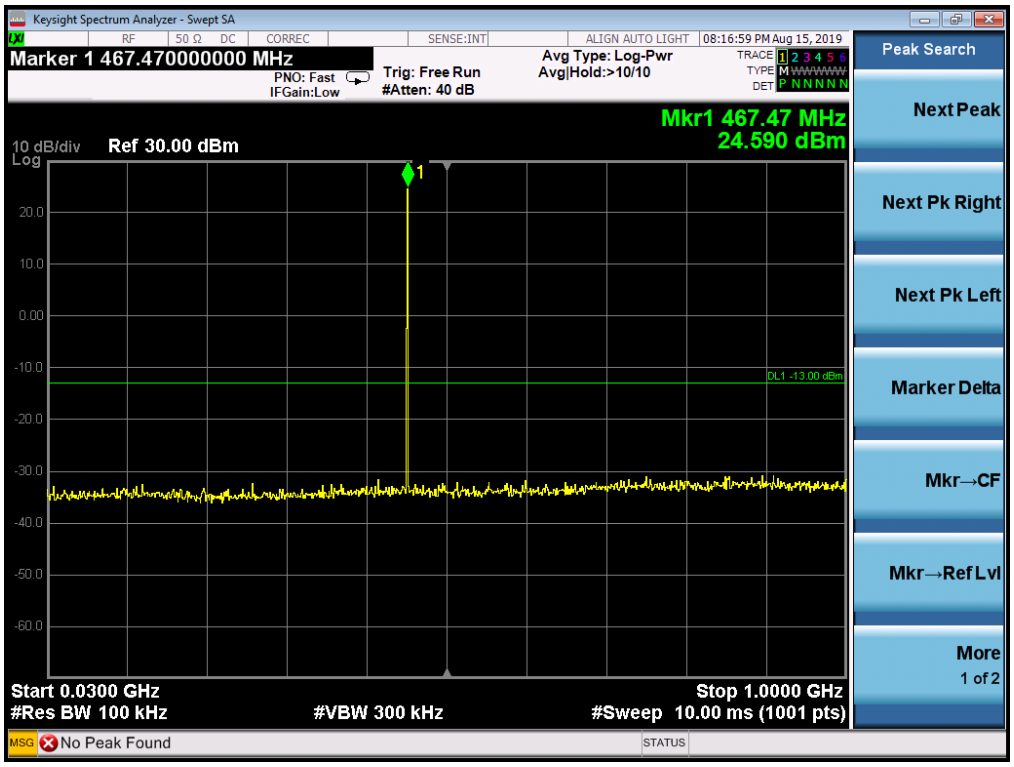
467.4125 MHz



467.4125 MHz

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9.5 INTERMODULATION

▣ TEST RESULTS

462.4125 MHz INTERMODULATION

Frequency [kHz]	AGC Level	Test Result		
		Measured Level [dBc]	Limit [dBc]	Pass/Fail
6.25	AGC	-22.989	-13	Pass
6.25	AGC +3	-22.086	-13	Pass
12.5	AGC	-20.675	-13	Pass
12.5	AGC +3	-21.337	-13	Pass

467.4125 MHz INTERMODULATION

Frequency [kHz]	AGC Level	Test Result		
		Measured Level [dBc]	Limit [dBc]	Pass/Fail
6.25	AGC	-24.771	-13	Pass
6.25	AGC +3	-24.55	-13	Pass
12.5	AGC	-22.856	-13	Pass
12.5	AGC +3	-22.923	-13	Pass

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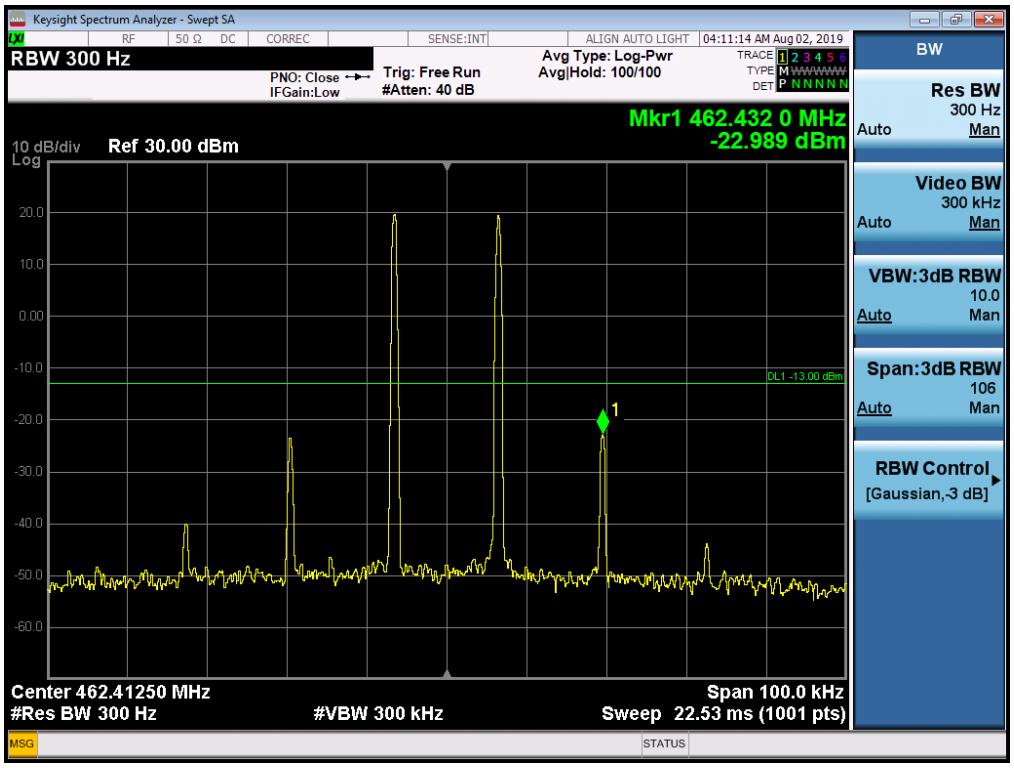
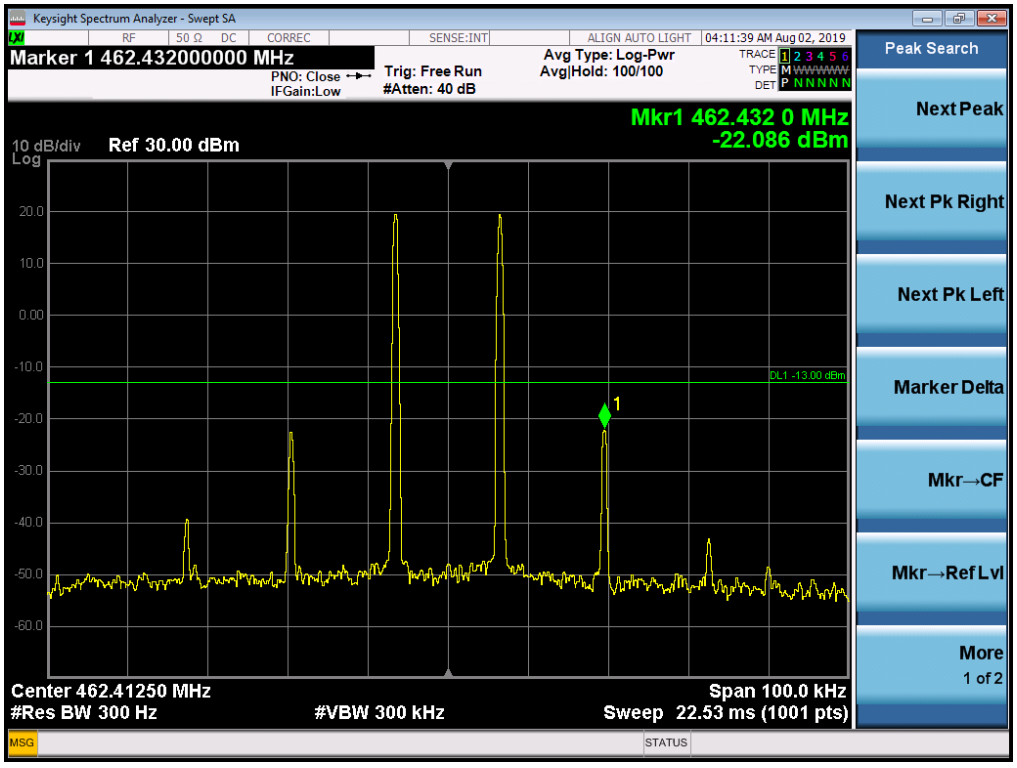
▣ Test Plots

462.4125 MHz - 6.25 kHz AGC



462.4125 MHz - 6.25 kHz AGC +3



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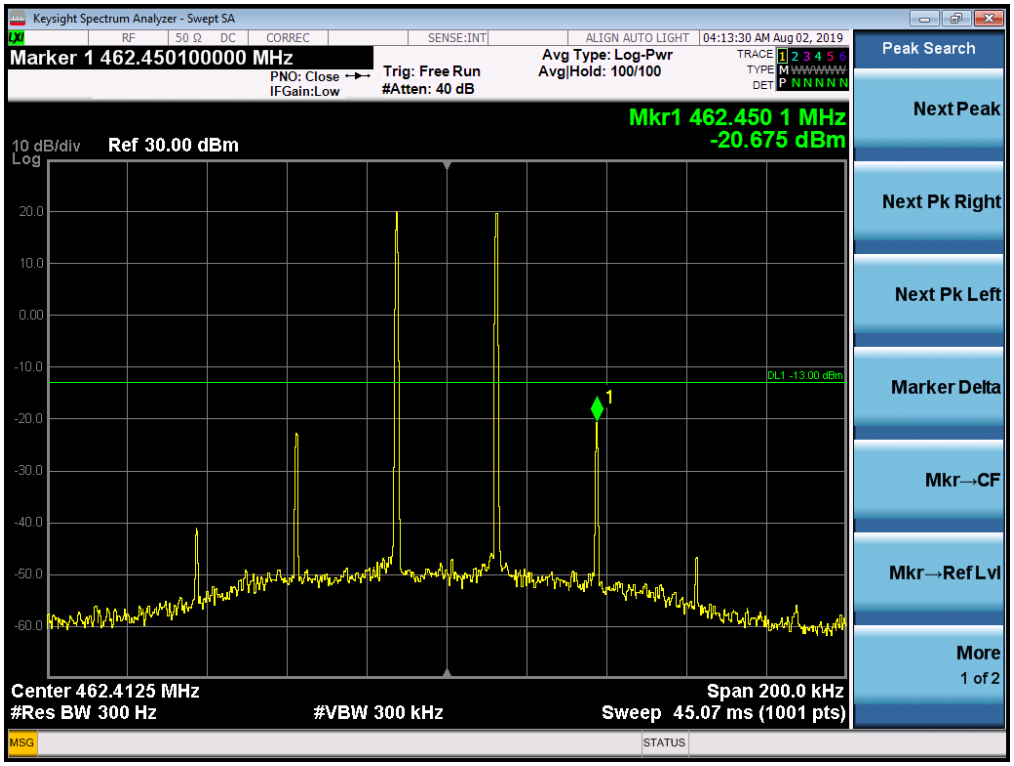
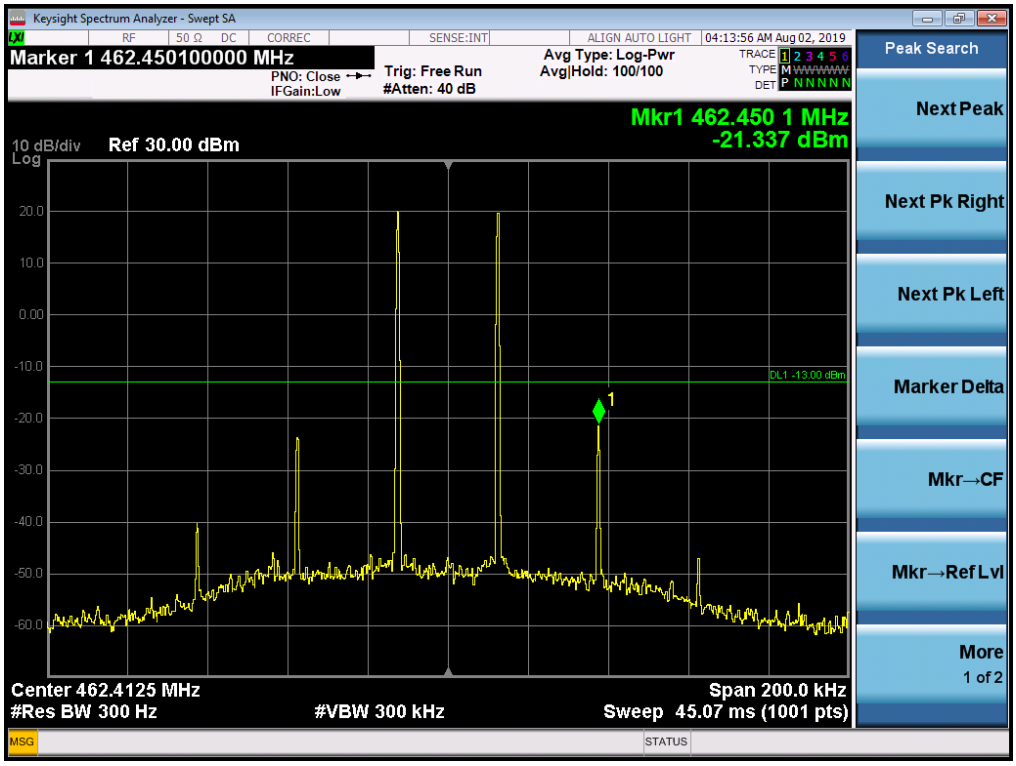
462.4125 MHz – 12.5 kHz AGC



462.4125 MHz – 12.5 kHz AGC+3



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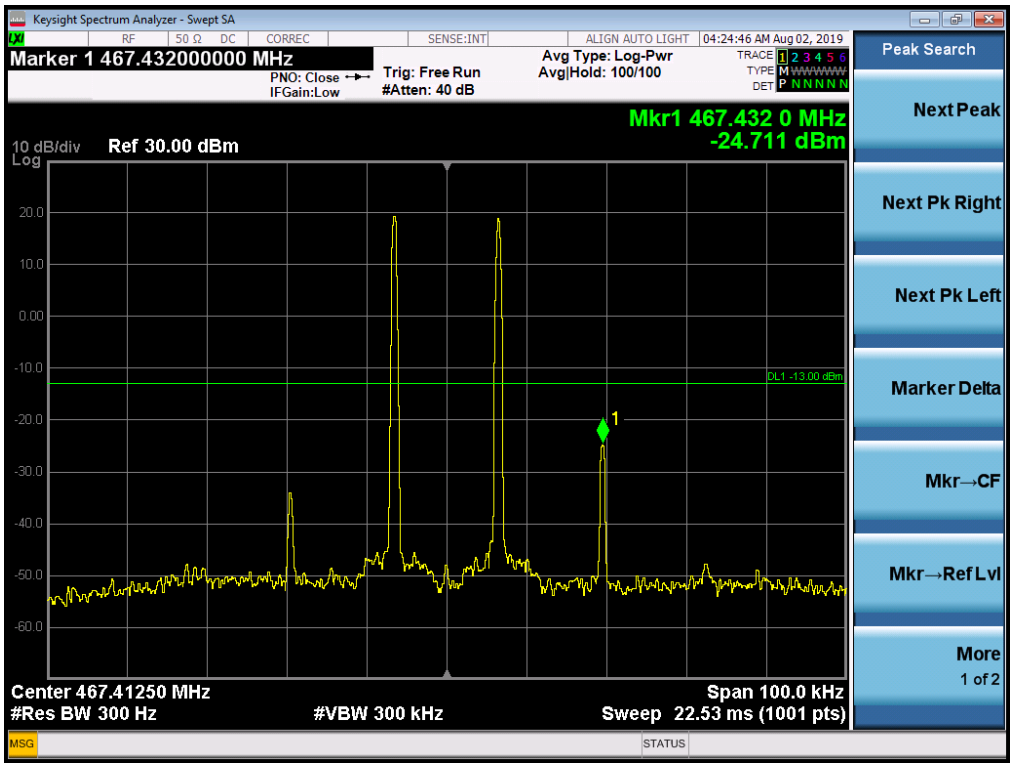
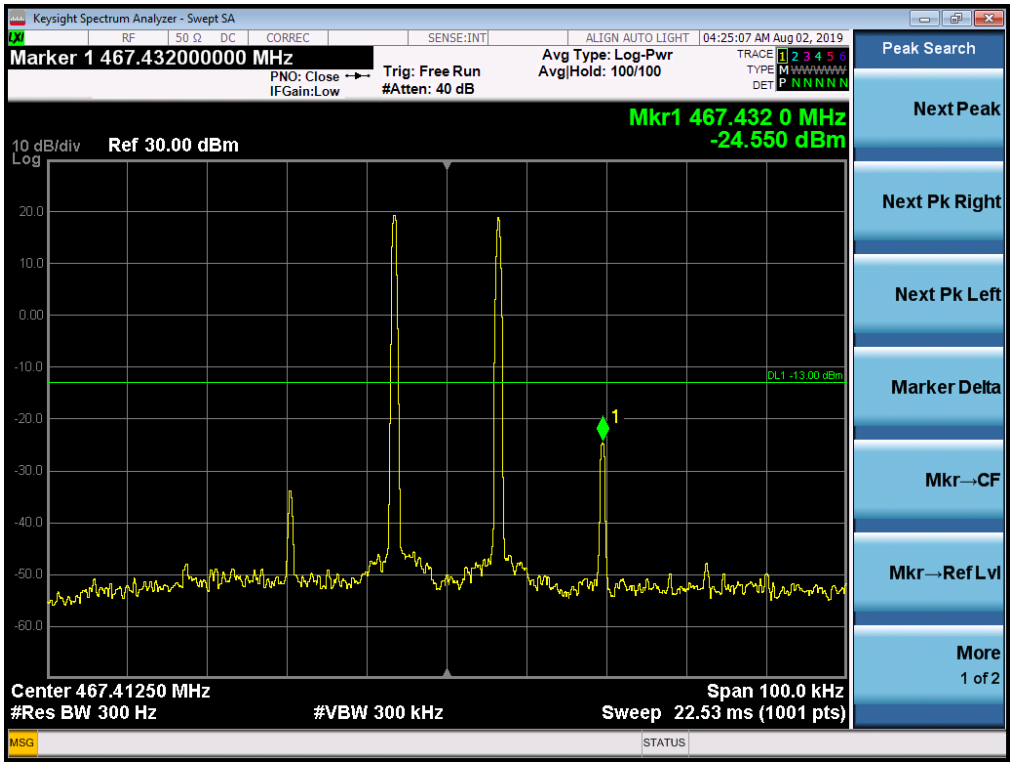
467.4125 MHz - 6.25 kHz AGC



467.4125 MHz - 6.25 kHz AGC+3



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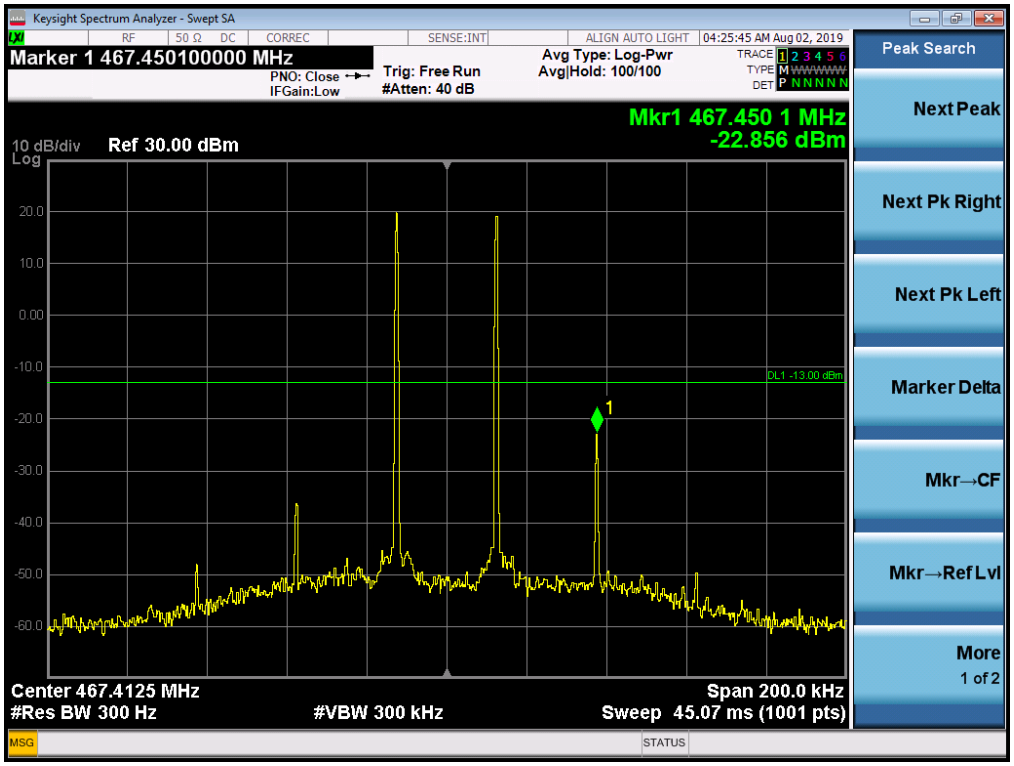
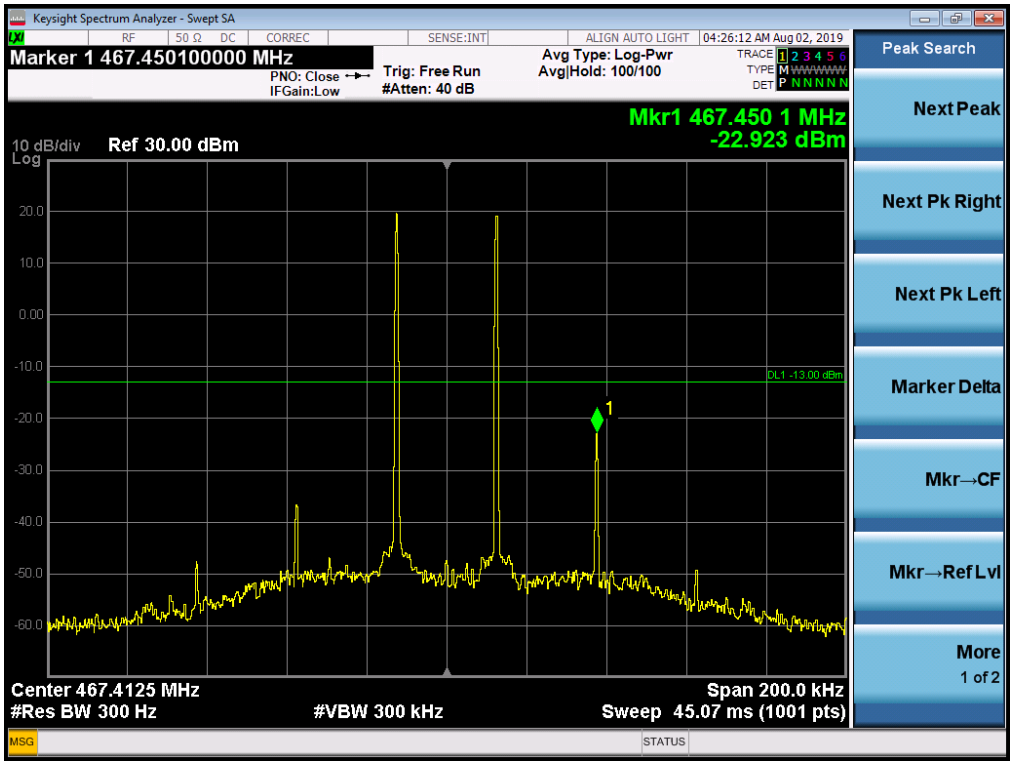
467.4125 MHz – 12.5 kHz AGC



467.4125 MHz – 12.5 kHz AGC+3



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9.6 NOISE FIGURE MEASUREMENTS

▣ TEST RESULTS

Frequency (MHz)	Max Reading (dBm/MHz)	Booster Gain (dB)	Bandwidth Factor (dB)	Thermal Noise (dBm/MHz)	Noise Figure (dB)	Limit (dB)
462.4125	-32.940	86.130	50	174	4.930	9
467.4125	-34.826	84.118	50	174	5.056	9

Note: Noise Figure=Max reading-(-174dBm/Hz+10*Log_{10}(RBW)+booster gain)

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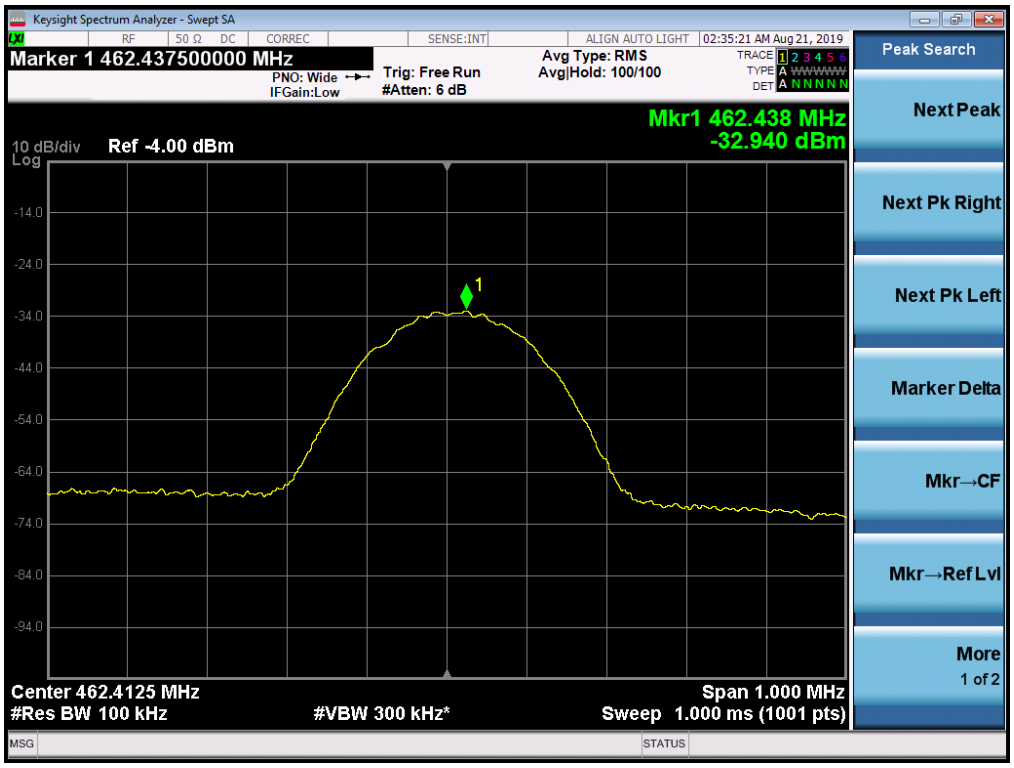
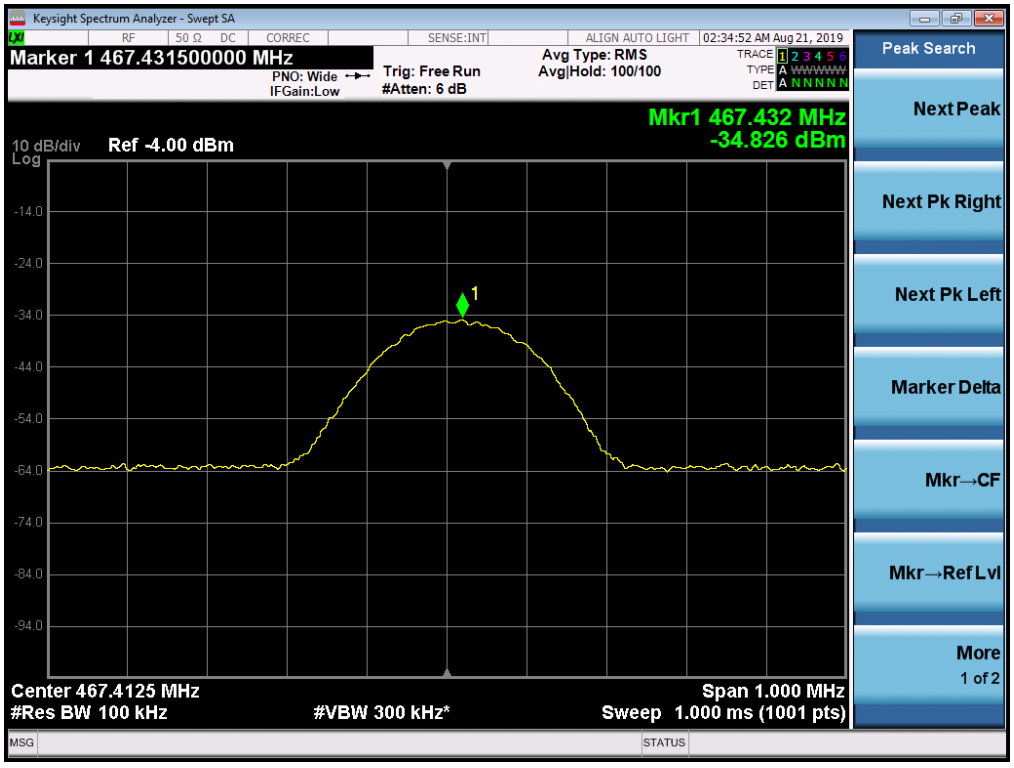
▣ Test Plots

462.4125 MHz



467.4125 MHz



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9.7 OUT-OF-BAND REJECTION

▣ TEST RESULTS

TEST CONDITIONS:	OUT-OF-BAND REJECTION (MHz)	
	Lowest Frequency	Highest Frequency
462.4125 MHz	462.308	462.528
Range	462.308 ~ 462.528	
Pass Band	462.2875 ~ 462.5375	

TEST CONDITIONS:	OUT-OF-BAND REJECTION (MHz)	
	Lowest Frequency	Highest Frequency
467.4125 MHz	467.307	467.537
Range	467.307 ~ 467.537	
Pass Band	467.2875 ~ 467.5375	

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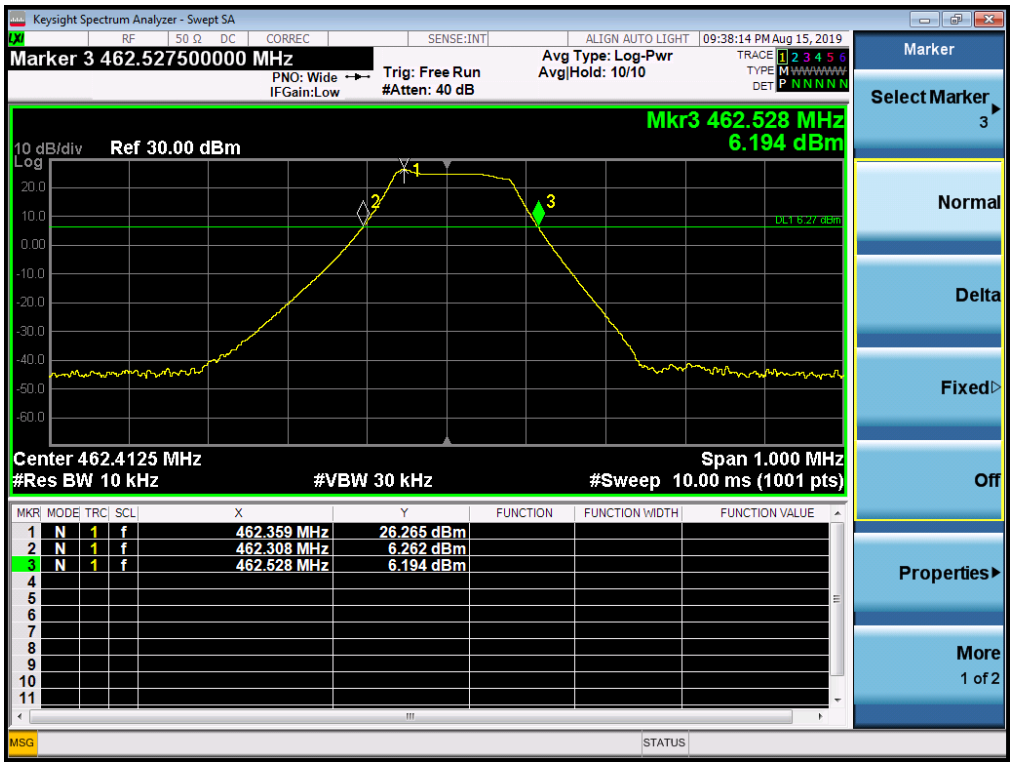
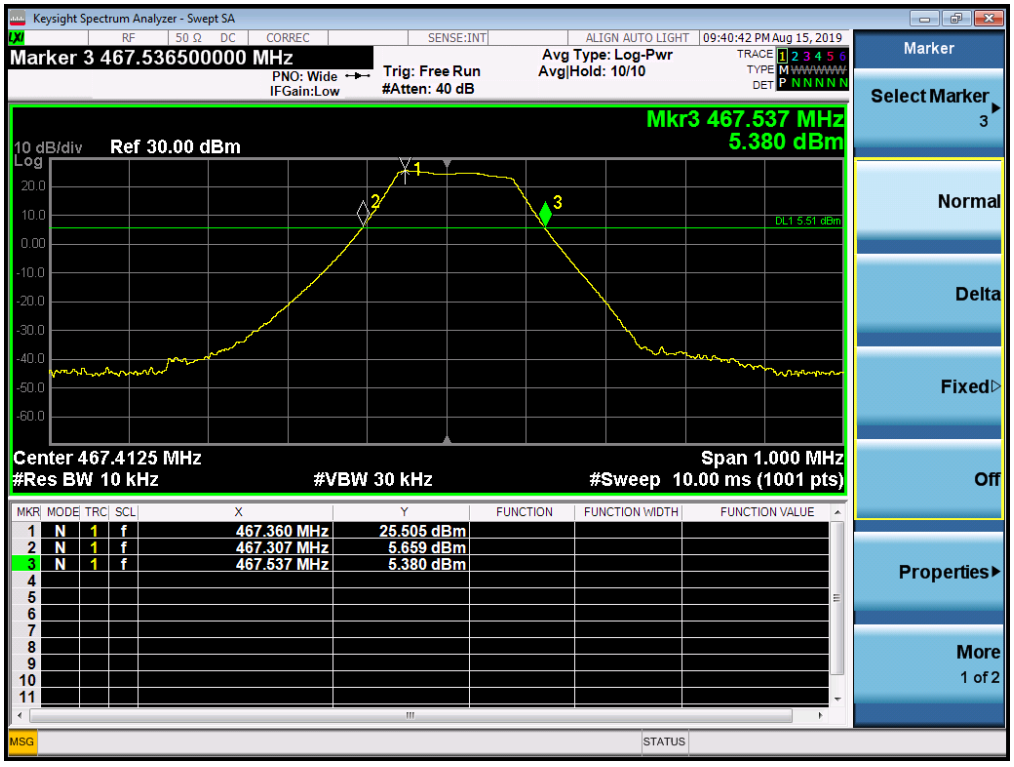
462.4125 MHz



467.4125 MHz



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9.8 FREQUENCY STABILITY AND VOLTAGE

▣ TEST RESULTS

Reference: 120 Vac at 22°C **Freq.** = 462.4125 MHz

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	ppm
Nomal	+22(Ref)	462 412 500	0.0	0.0000
	-25	462 412 500.2	0.2	0.0004
	-20	462 412 500.2	0.2	0.0004
	-10	462 412 500.1	0.1	0.0002
	0	462 412 500.2	0.2	0.0004
	+10	462 412 500.2	0.2	0.0004
	+30	462 412 499.9	-0.1	-0.0002
	+40	462 412 499.8	-0.2	-0.0004
	+50	462 412 499.8	-0.2	-0.0004
	+55	462 412 500.1	0.1	0.0002
High	+22	462 412 500.2	0.2	0.0004
Low	+22	462 412 499.8	-0.2	-0.0004

Reference: 120 Vac at 22°C **Freq.** = 467.4125 MHz

Voltage (%)	Temp. (℃)	Frequency (Hz)	Frequency Error (Hz)	ppm
Nomal	+22(Ref)	467 412 500	0.0	0.0000
	-25	467 412 500.1	0.1	0.0002
	-20	467 412 500.1	0.1	0.0002
	-10	467 412 499.8	-0.2	-0.0004
	0	467 412 499.9	-0.1	-0.0002
	+10	467 412 499.8	-0.2	-0.0004
	+30	467 412 500.1	0.1	0.0002
	+40	467 412 500.1	0.1	0.0002
	+50	467 412 499.8	-0.2	-0.0004
	+55	467 412 499.9	-0.1	-0.0002
High	+22	467 412 500.2	0.2	0.0004
Low	+22	467 412 499.8	-0.2	-0.0004

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9.9 RADIATED SPURIOUS EMISSIONS

▣ TEST RESULTS

Frequency (MHz)	Polarization	Reading (dBuV)	Path loss dB	Level (dBuV)	Conversion dBuV to dBm	Limit (dBm)	Margin (dB)	Detector
33.6	H	30.6	1.7	32.3	-74.7	-13	61.7	Peak
462.4	V	36.7	-5.6	31.1	-75.9	-13	62.9	Peak
462.4	H	36.0	-5.0	31.0	-76	-13	63	Peak
2399.9	H	65.1	-2.5	62.6	-44.4	-13	31.4	Peak
2410.2	V	72.1	-2.5	69.6	-37.4	-13	24.4	Peak

Notes:

1. The absolute levels of the spurious emissions were measured by the substitution.

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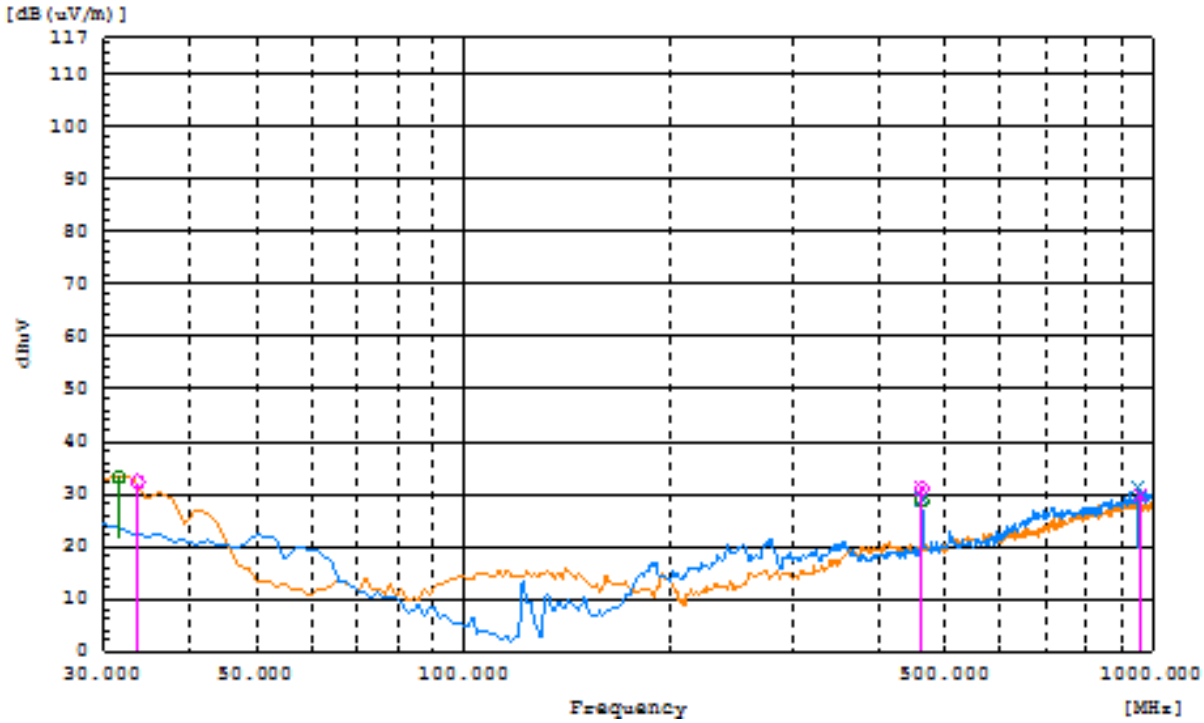
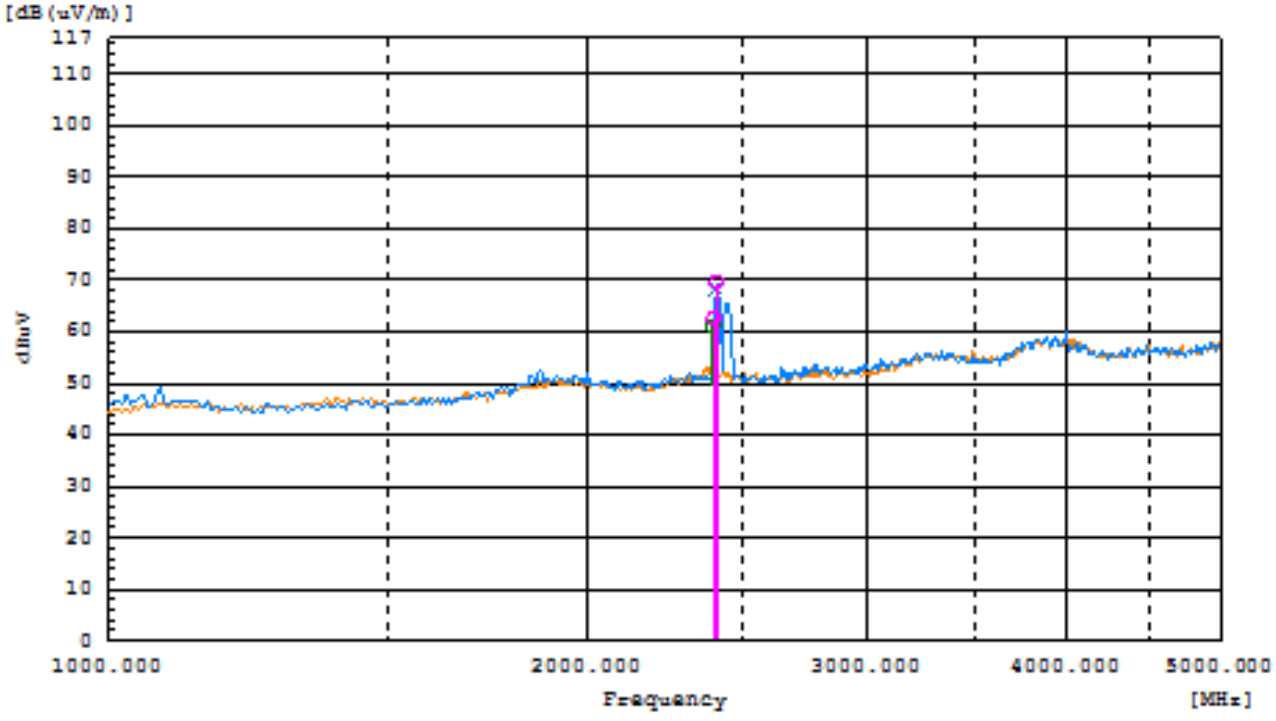
▣ Test Plots





Note:

Plot of worst case are only reported.

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10. LIST OF TEST EQUIPMENT

No.	Instrument	Model No.	Due to Calibration	Manufacture	Serial No.
☒	Signal Analyzer (20 Hz ~ 40.0 GHz)	ESU40	2019-12-20	ROHDE & SCHWARZ	100529
☒	Signal Analyzer (3 ㎐ ~ 40 ㎓)	N9020A	2019-11-09	AGILENT	MY52091291
☒	BI-LOG Antenna (30 MHz ~ 1 GHz)	JB6	2020-11-29	Sunol	A071116
☒	Attenuator (20 dB, DC ~ 26.5 GHz)	8493C	2019-12-20	HP	09072
☒	DC power supply	6655A	2020-01-23	HP	KR94907553
☒	POWER AMP (1 GHz ~ 18 GHz)	CBLU1183540B-01	2020-01-18	CERNEX	27974
☒	POWER AMP (0.3GHz ~ 1GHz)	PAM-103A	2020-01-18	Com-Power Corporation	18020005
☒	Horn Antenna (1 GHz ~ 18 GHz)	DRH-118	2020-05-24	Sunol	A070516
☒	Signal Generation (0.1 MHz ~ 990 MHz)	8656B	2019-08-29	HP	3334U13637
☒	Temp & Humidity Chamber	TH-ME	2019-09-07	JEIO TECH	5070515
☒	Frequency Counter	53181A	2020-08-02	AGILENT	MY40002090

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

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11. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	EMCE-R-1908-F001

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