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Test report

308107-4TRFWL

Date of issue: February 5, 2018

Applicant:

Electronic Systems Technology, Inc
415 N. Quay Street Building B-1
Kennewick, WA 99336

Product:

Radius + VHF (Signal Amplifier)

Model:

Radius+ VHF

FCC ID: ENPRADPVHF IC Registration number: 2163A-RADPVHF

Specification:

FCC 47 CFR Part 90

PRIVATE LAND MOBILE RADIO SERVICES

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com

Tested by	Mark Phillips, Sr. EMC Test Engineer
Reviewed by	Juan Manuel Gonzalez, EMC/Wireless Business Development Manager
Review date	February 5, 2018
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.

Copyright notification

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Electronic Systems Technology, Inc.
Address	415 N. Quay Street, Bldg. B-1
City	Kennewick
State	WA
Postal/Zip code	99336
Country	USA

1.2 Test specifications

FCC 47 CFR Part 90	PRIVATE LAND MOBILE RADIO SERVICES
KDB 935210 D05	MEASUREMENTS GUIDANCE FOR INDUSTRIAL AND NON-CONSUMER SIGNAL BOOSTER, REPEATER, AND AMPLIFIER DEVICES
KDB 935210 D02	SIGNAL BOOSTERS BASIC CERTIFICATION REQUIREMENTS
ANSI C63.26-2015	COMPLIANCE TESTING OF TRANSMITTERS USED IN LICENSED RADIO SERVICES

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

1.4 Exclusions

None

1.5 Test report revision history

Revision #	Details of changes made to test report
1TRF	Original report issued
2TRF	Update section 3.4 Product description and theory of operation / revise the model to: Radius+ VHF and product name to: Radius + VHF / 195M TNB System.
3TRF	Add equipment class in section 3.3 and update product description in section 3.4, add antenna gain and re-calculate ERP in section 8.1.4, add KDB and ANSI references to section 1.2,add note #2 in section 2.1 & update Radiated emissions test set up diagram with 1.5 m for above 1 GHz measurements, added section 8.25 “Input Vs Output per KDB935210 D05 and ANSI 63.24 note in section 9.1.
4TRF	Added KDB 935210 DO5 justification notes for clauses 4.2/4.6/4.7.1/4.7.2 and added amplifier characterization plots to cover clause 4.3 of KDB 935210 DO5 (Out of Band Rejection)

Section 2. Summary of test results

2.1 FCC Part 90 Subpart I—General Technical Standards / Test results

Part	Test description	Verdict
§90.205	Power and antenna height limits.	Pass
§90.207	Types of emissions.[1]	Not applicable
§90.209	Bandwidth limitations.	Pass
§90.210	Emission masks	Pass
§90.212	Provisions relating to the use of scrambling devices and digital voice modulation[1]	Not applicable
§90.213	Frequency stability. [2]	Not tested
§90.214	Transient frequency behavior. [1]	Not applicable
§90.215	Transmitter measurements. [1]	Not applicable
§90.221	Adjacent channel power limits. [1]	Not applicable

Notes:

All above tests were performed in accordance with customer test plan.

[1]EUT is a 25 Watt Power Amplifier working in the 150-174 MHz range. The Transceiver model 195M (used as auxiliary equipment) does not support voice.

[2]Not performed. The EUT is a power amplifier that do not processes an input signal in a manner that can influence the output signal frequency and do not alter the input signal (as per section 3.7 of KDB935210 D05). This test was performed in the transceiver (195M).

2.2 KDB935210 D05—General Requirements, PLMRS/PSRS REPEATER/AMPLIFIER AND INDUSTRIAL BOOSTER DEVICES

Part	Test description	Verdict
§ 4.1	General[1]	Pass
§4.2	Measuring AGC threshold.[2]	Not applicable
§4.3	Out-of-band rejection.[3]	Pass
§4.4	Input-versus-output signal comparison[4]	Pass
§4.5	Input/output power and amplifier/booster gain.[5]	Pass
§4.6	Noise figure measurements. [6]	Not applicable
§4.7.1 /4.7.2	Measuring out-of-band/out-of-block (including intermodulation) and spurious emissions[7]	Not applicable
§4.7.3	EUT Spurious emissions conducted measurements. [8]	Pass
§4.8	Frequency stability measurements. [9]	Not applicable
§4.9	Spurious emissions radiated measurements[10]	Pass

Notes:

[1]The test signals used to cover table 1 of KDB935210 D05 came from the Auxiliary device (195M Transceiver as noted in section 3.5 of this report).

[2]EUT doesn't support AGC function.

[3]See section 8.2.5 for test results.

[4]See section 8.2.6 for test results.

[5]See section 8.1.1 for test results.

[6]Test N/A: The amplifier does not repeat RF signals from over-the-air sources but only functions if it is directly connected to the transmitter.

[7]Test N/A: Intermodulation-product spurious emission measurements are not required for single-channel boosters that cannot accommodate two simultaneous signals within the passband.

[8] See section 8.3.4 for test results.

[9]Test N/A. The EUT is a power amplifier that do not processes an input signal in a manner that can influence the output signal frequency and do not alter the input signal (as per section 3.7 of KDB935210 D05). This test was performed in the transceiver (195M).

[10] See section 8.3.4 for test results.

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	07/10/2017
Nemko sample ID number	EMC11014

3.2 EUT information

Product name	Radius + VHF (Signal Amplifier)
Model	Radius + VHF
Serial number	M-24395

3.3 Technical information

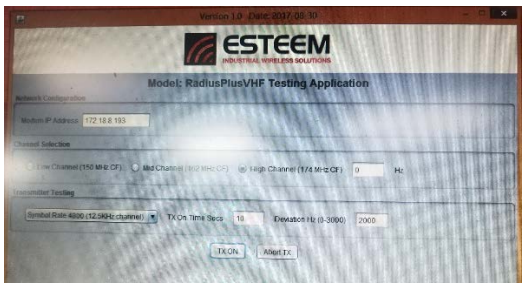
Operating band	150-174 MHz
Modulation type	N/A
Power requirements	13.8VDC (powered with Power supply SEC1212 138W DC Supply S/N 03051-1429-0473 120VAC 60Hz 2.5A)
Emission designator	N/A
Gain	25W
Antenna information	10.15dBi
Equipment Class	AMP

3.4 Product description and theory of operation

EUT is a 25 Watt Power Amplifier working in the 150-174 MHz band.

3.5 EUT exercise details

EUT was programmed with Radius VHF Plus EMC Test Application V 1.0 in the 3 representative channels (L/M/H) and with a deviation value of 1500 for 6.25KHz channels and 2000 for 12.5KHz channels:



The test signal for the amplifier (EUT) is provided by a 195M transceiver.

3.6 EUT setup diagram

Figure 3.6-1: Setup diagram

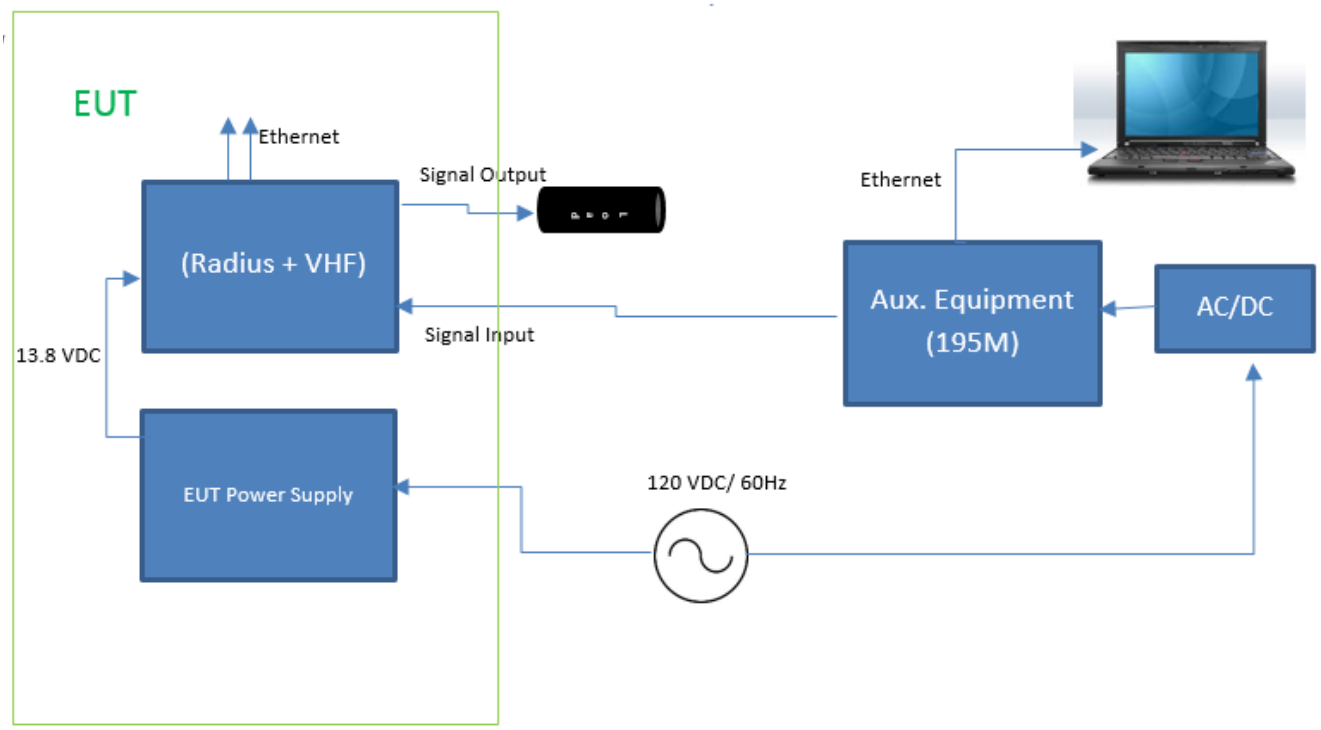


Table 3.6-1: Support equipment

Description	Brand name	Model/Part number	Serial number	Rev.
VHF Transceiver	ESTEEM	195M	M-24393	
195M power Supply	AC Adapter30dB Attenuator	A3-60S12R-U	R00071200015	
30dB Attenuator	N/A	50-A-FFN-30	N/A	
Bandpass Filter	Telonic	TTF-250-5-5EE	N255-1	
Laptop	Dell	PP20L	EST tag 000749	

Table 3.6-2: Inter-connection cables

Cable description	From	To	Length (m)
Coax. Cable	VHF Transceiver	VHF Amplifier	≈0.3

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Table 7.1-2: Conducted disturbance at mains port equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Test Receiver	Rohde & Schwarz	ESCI 7	E1026	1 yr.	5/23/2018
Two Line V-Network	Rohde & Schwarz	ENV216	E1019	1 yr.	6/28/2018

Notes: None

Table 7.1-3: Radiated disturbance equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 yr.	4-28-2018
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	1 yr.	11-28-2017
Antenna, Horn	EMCO	3115	1033	1 yr.	7-27-2018

Notes: None

Table 7.1-4: Antenna conducted port equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Spectrum Analyzer	Rohde & Schwarz	FSV40	E1120	1 yr.	7-27-2018
Power Sensor	ETS	7002-006	E1061	1 yr.	1-18-2018
Signal Generator	Marconi	2024	1771	1 yr.	12-21-2018

Notes: None

Table 7.1-5: Radiated/Conducted disturbance test software details

Manufacturer of Software	Details
Rohde-Schwarz	EMC 32 V10.0

Notes: None

Section 8. Testing data

8.1 FCC §90.205 RF Output Power

8.1.1 Definitions and limits

Applicants for licenses must request and use no more power than the actual power necessary for satisfactory operation. Except where otherwise specifically provided for, the maximum power that will be authorized to applicants whose license applications for new stations are filed after August 18, 1995 is as follows:
(a) Below 25 MHz. For single sideband operations (J3E emission), the maximum transmitter peak envelope power is 1000 watts.
(b) 25-50 MHz. The maximum transmitter output power is 300 watts.
(c) 72-76 MHz. The maximum effective radiated power (ERP) for stations operating on fixed frequencies is 300 watts. Stations operating on mobile-only frequencies are limited to one watt transmitter output power.
(**d) 150-174 MHz. (**1) The maximum allowable station ERP is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 1. Applicants requesting an ERP in excess of that listed in table 1 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.
(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table 1 will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 37 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.
(3) An applicant for a station with a service area radius greater than 40 km (25 mi) must justify the requested service area radius, which will be authorized only in accordance with table 1, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

TABLE 1—150-174MHZ—MAXIMUM ERP/REFERENCE HAAT FOR A SPECIFIC SERVICE AREA RADIUS

	Service area radius (km)									
	3	**8**	**13**	**16**	**24**	**32**	**40**	**48[4]**	**64[4]**	**80[4]**
Maximum ERP (w)[1]	1	28	178	[2]500	[2]500	[2]500	500	[2]500	[2]500	[2]500
Up to reference HAAT (m)[3]	15	15	15	15	33	65	110	160	380	670

[1]Maximum ERP indicated provides for a 37 dBu signal strength at the edge of the service area per FCC Report R-6602, Fig. 19 (See §73.699, Fig. 10).
[2]Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 37 dBu.
[3]When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: $ERP_{allow} = ERP_{max} \times (HAAT_{ref} / HAAT_{actual})^2$.
[4]Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 37 dBu.

8.1.2 Test summary

Test date	October 3, 2017	Temperature	21 °C
Test engineer	Mark Phillips, Sr. EMC Test Engineer	Air pressure	1002 mbar
Verdict	Pass*	Relative humidity	58 %

8.1.3 Observations, settings and special notes

Test performed with Power sensor.
*EUT Service area radius= Per customer declaration the service area radius of the device is determined by the needs of the end customer and the professional installer but it should be limited to > 13KM to meet the requirements of table 1of this section.

8.1.4 Test data

Table 8.1-1: RF Output power results

Channel /Rate	150MHz 12.5KHz	162MHz 12.5KHz	174MHz 12.5KHz
Output (dBm)	**44.06**	43	41.53
Input (dBm)	36.49	35.93	36.44
gain(dB)	7.57	7.07	5.09

Channel / Rate	150MHz 6.25KHz	162MHz 6.25KHz	174MHz 6.25KHz
Output (dBm)	**44.08**	43.13	41.52
Input (dBm)	36.5	35.92	36.42
gain(dB)	7.58	7.21	5.1

Frequency, MHz / Rate KHz	Conducted Power , dBm	Conducted Power , Watts	Antenna Gain	ERP (Watts)	ERP Limit (Watts)	Margin (Watts)
150MHz / 12.5KHz	**44.06**	**25.58585887**	**10.15dBi**	**35.73585887**	**178**	**142.2641411**
150MHz / 6.25KHz	**44.08**	**25.46830253**	**10.15dBi**	**35.61830253**	**178**	**142.3816975**

8.2 FCC §90.209 Bandwidth limitations.

8.2.1 Definitions and limits

(a) Each authorization issued to a station licensed under this part will show an emission designator representing the class of emission authorized. The designator will be prefixed by a specified necessary bandwidth. This number does not necessarily indicate the bandwidth occupied by the emission at any instant. In those cases where §2.202 of this chapter does not provide a formula for the computation of necessary bandwidth, the occupied bandwidth, as defined in part 2 of this chapter, may be used in lieu of the necessary bandwidth.

(b) The maximum authorized single channel bandwidth of emission corresponding to the type of emission specified in §90.207 is as follows:
(1) For A1A or A1B emissions, the maximum authorized bandwidth is 0.25 kHz. The maximum authorized bandwidth for type A3E emission is 8 kHz.
(2) For operations below 25 MHz utilizing J3E emission, the bandwidth occupied by the emission shall not exceed 3000 Hz. The assigned frequency will be specified in the authorization. The authorized carrier frequency will be 1400 Hz lower in frequency than the assigned frequency. Only upper sideband emission may be used. In the case of regularly available double sideband radiotelephone channels, an assigned frequency for J3E emissions is available either 1600 Hz below or 1400 Hz above the double sideband radiotelephone assigned frequency.
(3) For all other types of emissions, the maximum authorized bandwidth shall not be more than that normally authorized for voice operations.
(4) Where a frequency is assigned exclusively to a single licensee, more than a single emission may be used within the authorized bandwidth. In such cases, the frequency stability requirements of §90.213 must be met for each emission.
(5) Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following table.

STANDARD CHANNEL SPACING/BANDWIDTH

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
Below 25[2]		
25-50	20	20
72-76	20	20
150-174	[1]7.5	[1 3]20/11.25/6
216-220[5]	6.25	20/11.25/6
220-222	5	4
406-512[2]	[1]6.25	[136]20/11.25/6
806-809/851-854	12.5	20
809-824/854-869	25	[6]20
896-901/935-940	12.5	13.6
902-928[4]		
929-930	25	20
1427-1432[5]	12.5	12.5
[3]2450-2483.5[2]		
Above 2500[2]		

[1]For stations authorized on or after August 18, 1995.
[2]Bandwidths for radiolocation stations in the 420-450 MHz band and for stations operating in bands subject to this footnote will be reviewed and authorized on a case-by-case basis.
[3]Operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25 kHz channel bandwidth will be authorized a 6 kHz bandwidth. All stations must operate on channels with a bandwidth of 12.5 kHz or less beginning January 1, 2013, unless the operations meet the efficiency standard of §90.203(j)(3).
[4]The maximum authorized bandwidth shall be 12 MHz for non-multilateration LMS operations in the band 909.75-921.75 MHz and 2 MHz in the band 902.00-904.00 MHz. The maximum authorized bandwidth for multilateration LMS operations shall be [5].75 MHz in the 904.00-909.75 MHz band; 2 MHz in the 919.75-921.75 MHz band; 5.75 MHz in the 921.75-927.25 MHz band and its associated 927.25-927.50 MHz narrowband forward link; and 8.00 MHz if the 919.75-921.75 MHz and 921.75-927.25 MHz bands and their associated 927.25-927.50 MHz and 927.50-927.75 MHz narrowband forward links are aggregated.
5See §90.259.
[6]Operations using equipment designed to operate with a 25 kHz channel bandwidth may be authorized up to a 22 kHz bandwidth if the equipment meets the Adjacent Channel Power limits of §90.221.

8.2.2 Test summary

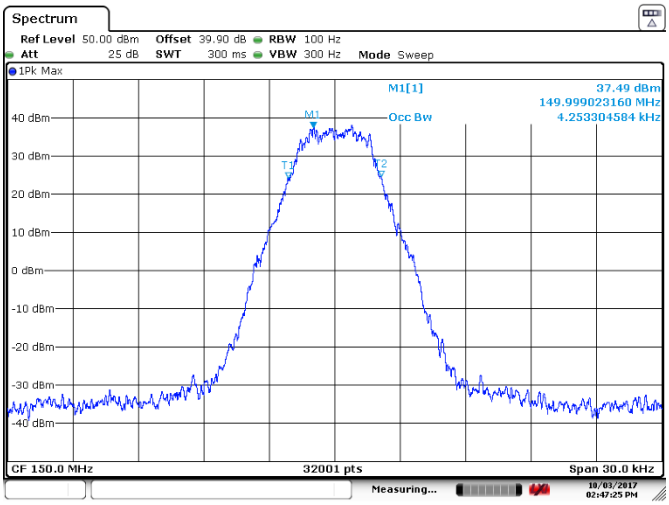
Test date	October 2 & 3, 2017	Temperature	21 -23°C
	February 5, 2018		
Test engineer	Mark Phillips, Sr. EMC Test Engineer	Air pressure	1000-1002 mbar
Verdict	Pass	Relative humidity	55-58 %

8.2.3 Observations, settings and special notes

None

8.2.4 Test data Bandwidth limitations.

OBW ch150 MHz 6.2KHz dev 1500



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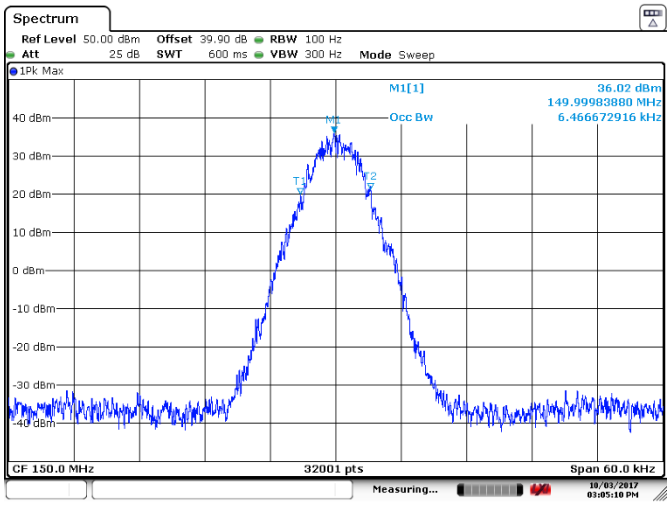
OBW ch150 MHz 12.5KHz dev 2000



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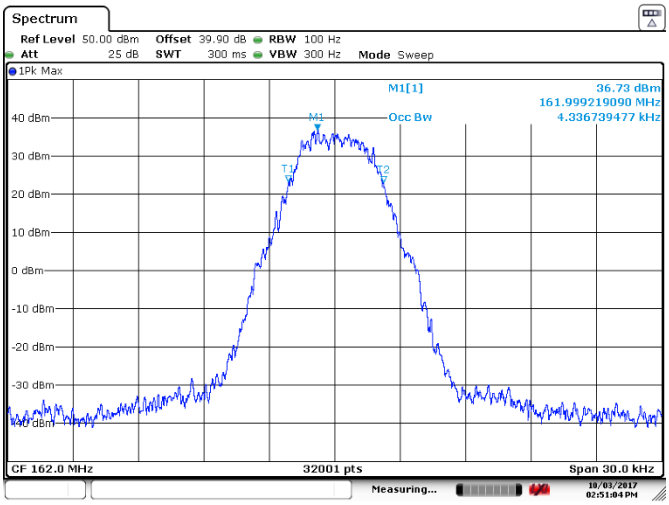
OBW ch162 MHz 6.25KHz dev 1500



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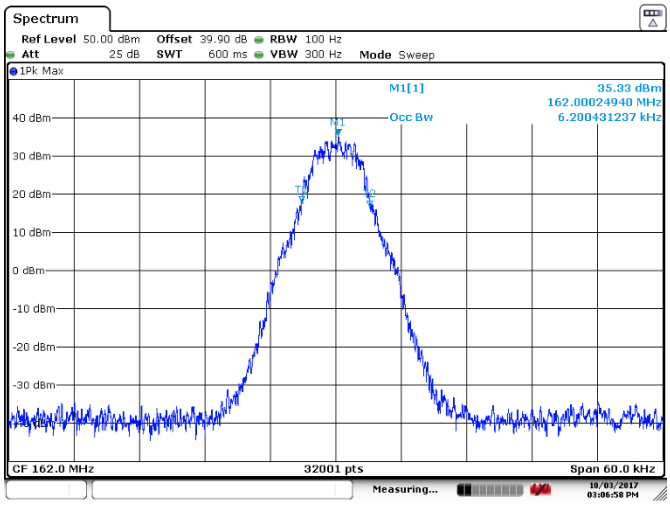
OBW ch162 MHz 12.5KHz dev 2000



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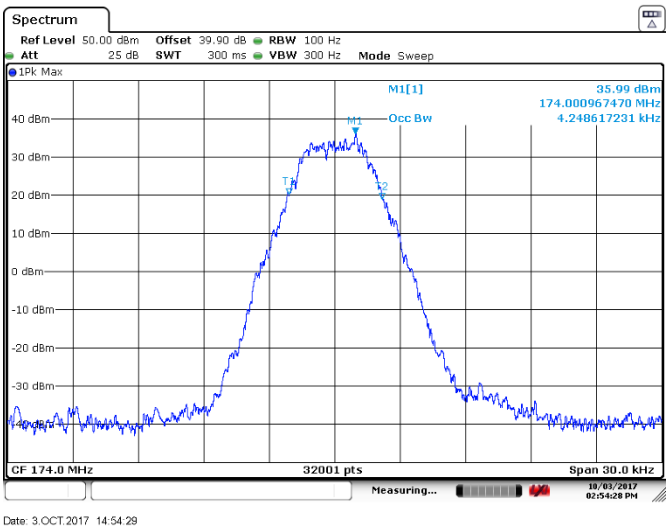
OBW ch174 MHz 6.25KHz dev 1500



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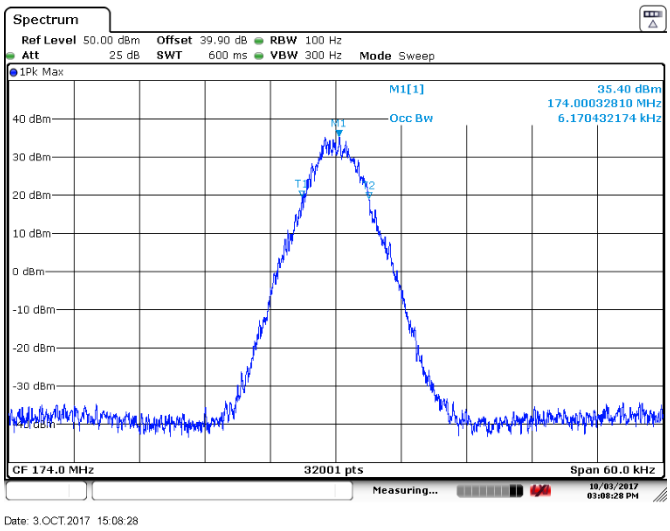


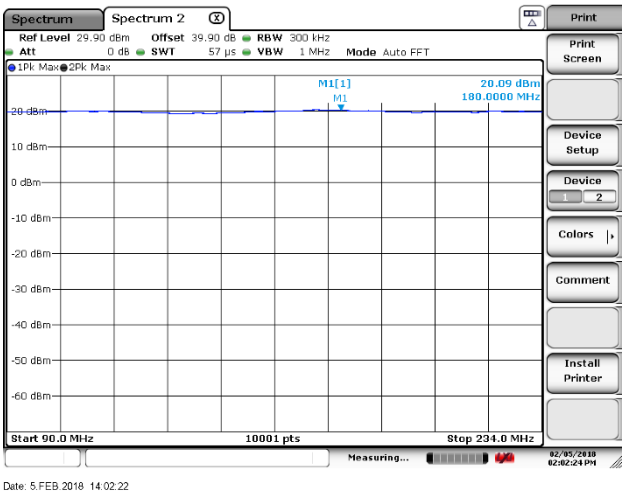
Date: 3.OCT.2017 15:08:28

Summary:

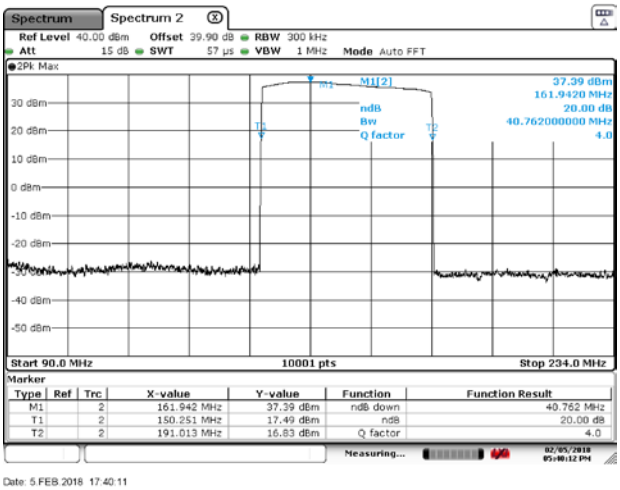
Channel /Rate	OBW 150MHz	OBW 162MHz	OBW 174MHz	OBW Limit	OBW Margin
12.5KHz	**6.46KHz**	6.20KHz	6.17KHz	11.25KHz	4.79 KHz
6.25KHz	4.25KHz	**4.33KHz**	4.24KHz	6KHz	1.67 KHz

8.2.5 Out-of-band rejection

Per KDB935210 D05 a CW signal of ± 250 % of the passband must we swept to determine the Out of Band rejection:



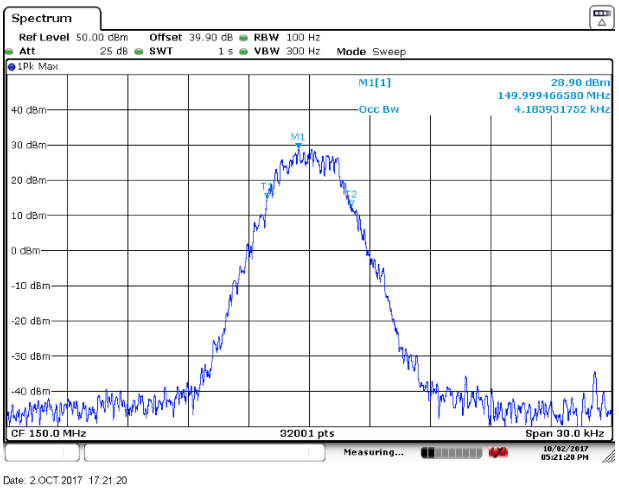
Input CW Signal from signal generator.



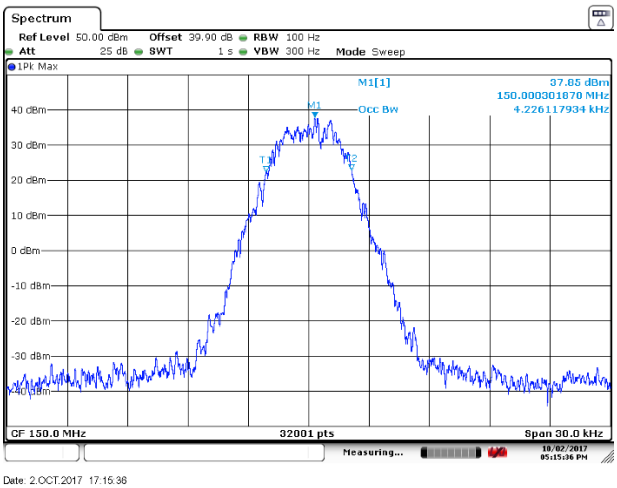
Amplifier Output

8.2.6 Input-versus-output signal comparison

Additionally, an Input-Versus-Output signal comparison was performed as per KDB935210 D05 and found that signals are similar in passband and roll off characteristics and relative spectral locations as below. Since the EUT doesn't have a AGC the test was only performed with the original signal provided by a 195M transceiver. All channels verified see below plots for a representative 150MHZ Channel/6.25KHz:



Input Signal (provided by 195M Transceiver)



Output Signal (Amplifier Output)

8.3 FCC §90.210 Emission masks.

8.3.1 Definitions and limits

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[6]	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]		
All other bands	B	C

[1]Equipment using single sideband J3E emission must meet the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.
[2]Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.
[3]Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691 of this chapter.
[4]DSRCS Roadside Units equipment in the 5850-5925 MHz band is governed under subpart M of this part.
[5]Equipment may alternatively meet the Adjacent Channel Power limits of §90.221.
[6]Transmitters utilizing analog emissions that are equipped with an audio low-pass filter must meet Emission Mask B. All transmitters utilizing digital emissions and those transmitters using analog emissions without an audio low-pass filter must meet Emission Mask H.

(d) 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.

(e) 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.
(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.

(o) *Instrumentation.* The reference level for showing compliance with the emission mask shall be established, except as indicated in §§90.210 (d), (e), and (k), using standard engineering practices for the modulation characteristic used by the equipment under test. When measuring emissions in the 150-174 MHz and 421-512 MHz bands the following procedures will apply. 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 frequencies more than 50 kHz removed from

the edge of the authorized bandwidth a resolution of at least 100 kHz must be used for frequencies below 1000 MHz. Above 1000 MHz the resolution bandwidth of the instrumentation must be at least 1 MHz. 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, then an alternate procedure may be used provided prior Commission approval is obtained.

8.3.2 Test summary

Test date	September 29th to October 3rd 2017	Temperature	21 °C
Test engineer	Mark Phillips, Sr. EMC Test Engineer	Air pressure	1002 mbar
Verdict	Pass	Relative humidity	58 %

8.3.3 Observations, settings and special notes

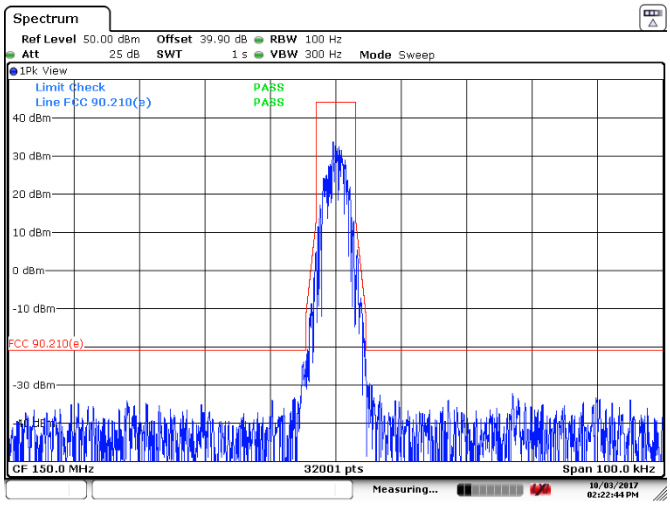
Low, Mid, and High channels were investigated.
Spectrum Analyzer settings were:

Span	100KHz
Detector mode	Peak
Resolution bandwidth	100 Hz
Video bandwidth	3X RBW
Trace mode	A sufficient number of sweeps were measured to ensure that the emission profile is developed and within limits.

8.3.4 Test data

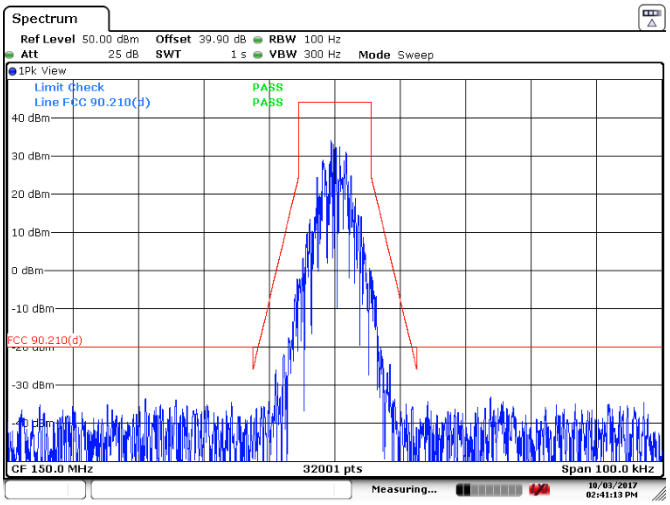
Table 8.3-1: Emissions Mask results

Emissions Mask ch150 MHz 6.2KHz dev 1500



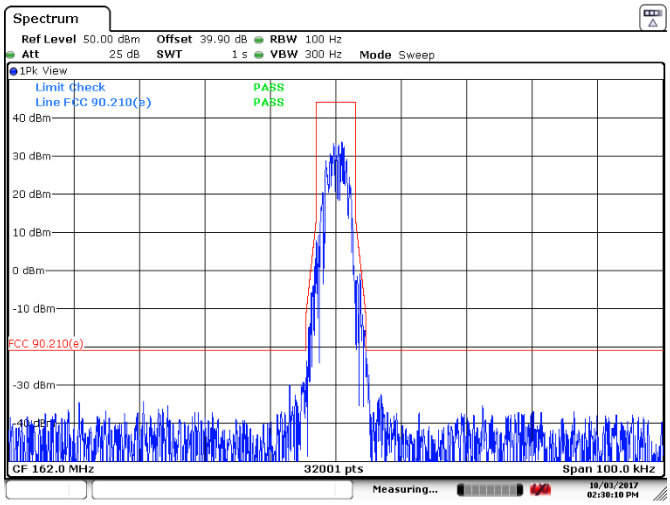
Date: 3.OCT.2017 14:22:44

Emissions Mask ch150 MHz 12.5KHz dev 2000



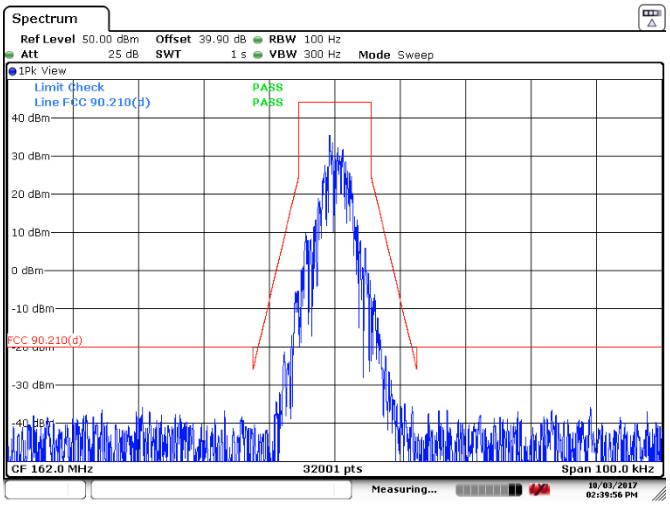
Date: 3.OCT.2017 14:41:13

Emissions Mask ch162 MHz 6.25KHz dev 1500



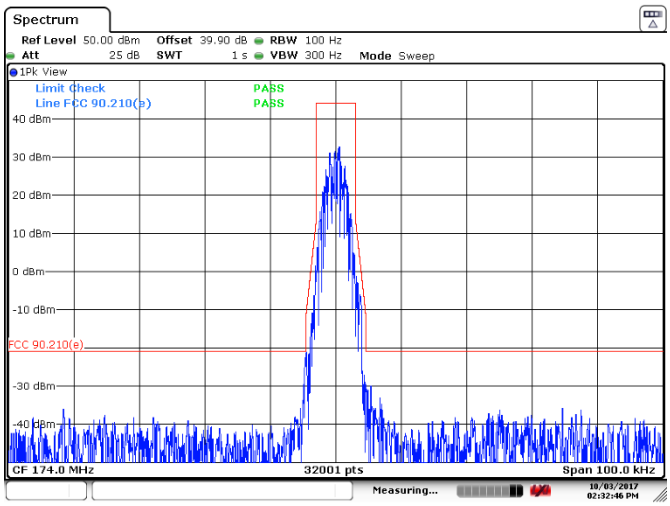
Date: 3.OCT.2017 14:30:10

Emissions Mask ch162 MHz 12.5KHz dev 2000



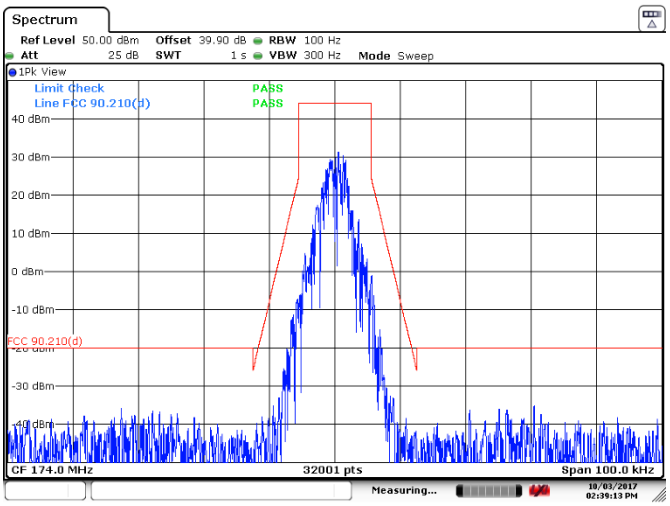
Date: 3.OCT.2017 14:39:56

Emissions Mask ch174 MHz 6.25KHz dev 1500



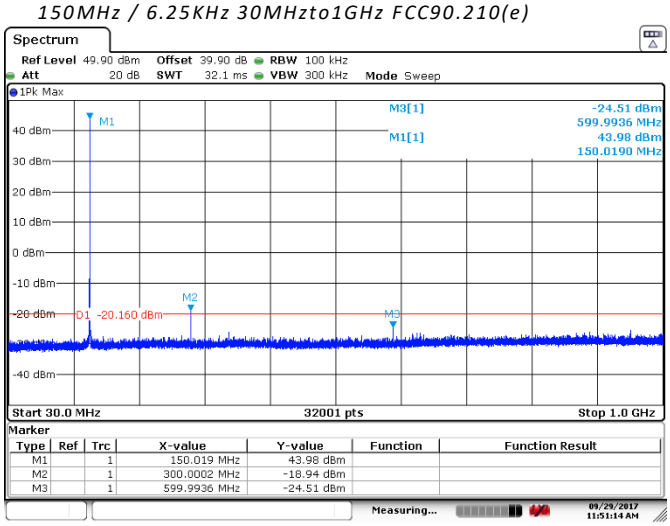
Date: 3.OCT.2017 14:32:46

Emissions Mask ch174 MHz 12.5KHz dev 2000



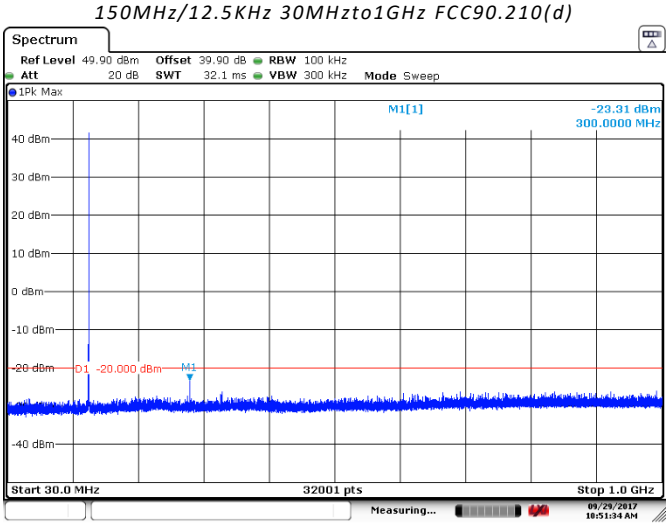
Date: 3.OCT.2017 14:39:14

150MHz / 6.25KHz 30MHzto1GHz FCC90.210(e)



Date: 29.SEP.2017 11:51:14

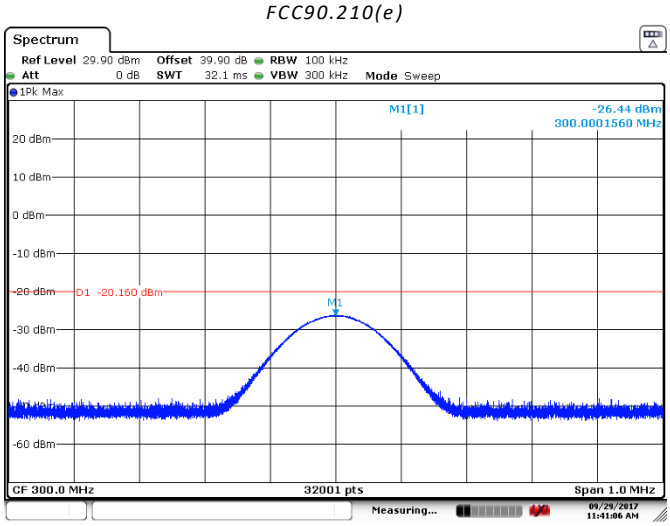
150MHz/12.5KHz 30MHzto1GHz FCC90.210(d)



Date: 29.SEP.2017 10:51:35

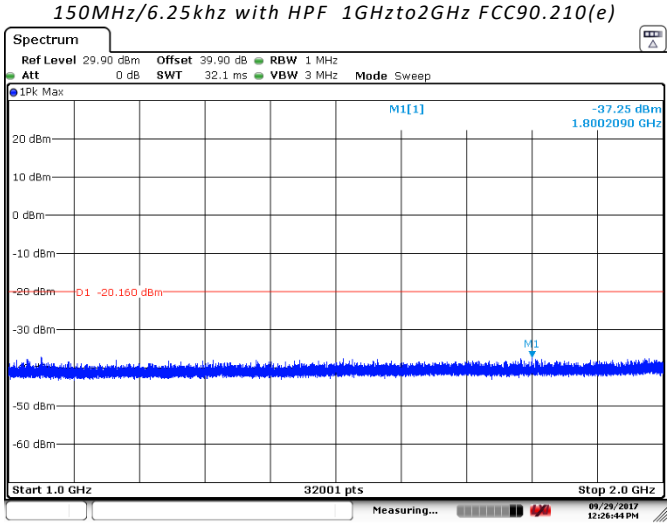
Note.- *The test was repeated with a tunable filter in the fundamental frequency (150MHZ) to evaluate the second Harmonic (300MHz) and it passed with > 6dB margin.(see 1st plot of next page)*

150MHz/6.25khz 2nd Harmonic with Tunable filter FCC90.210(e)



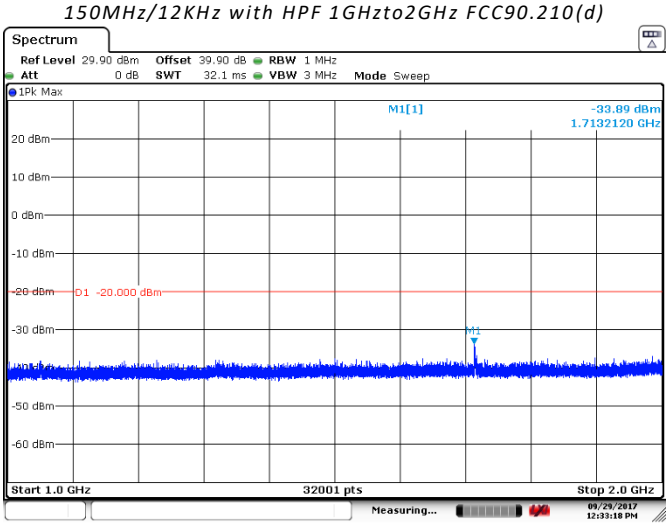
Date: 29.SEP.2017 11:41:06

150MHz/6.25khz with HPF 1GHzto2GHz FCC90.210(e)



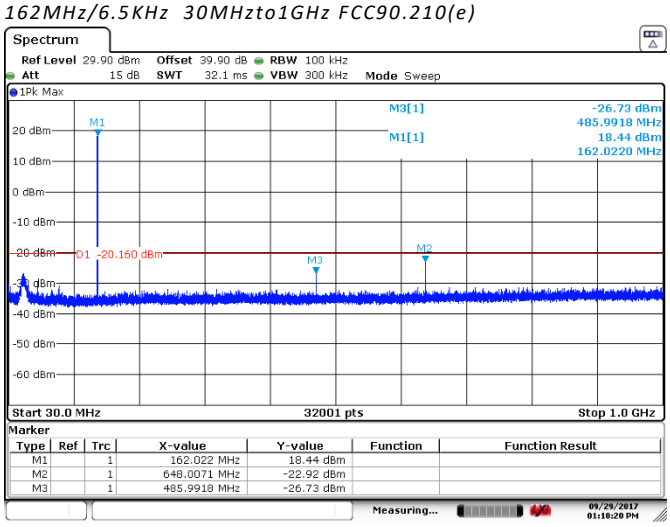
Date: 29.SEP.2017 12:26:44

150MHz/12KHz with HPF 1GHzto2GHz FCC90.210(d)



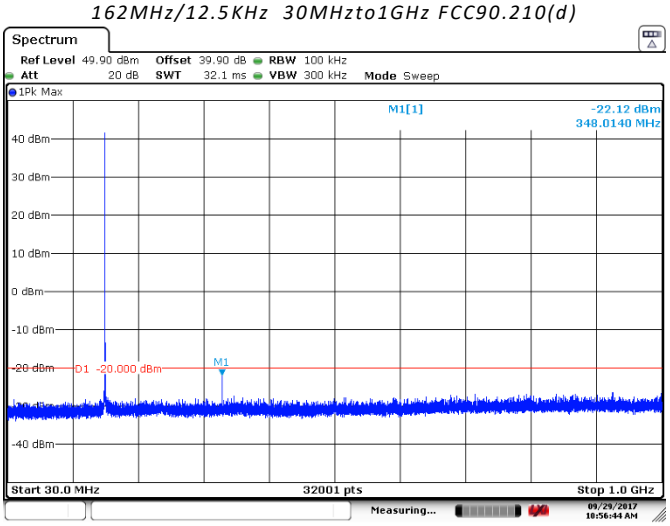
Date: 29.SEP.2017 12:33:18

162MHz/6.5KHz 30MHzto1GHz FCC90.210(e)



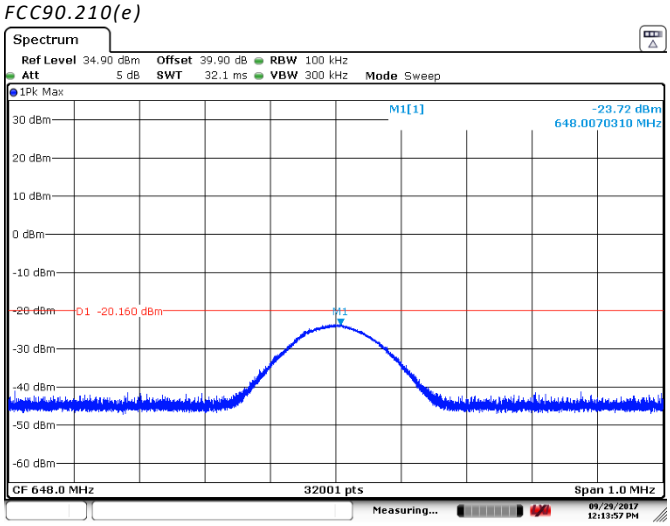
Date: 29.SEP.2017 13:10:21

162MHz/12.5KHz 30MHzto1GHz FCC90.210(d)



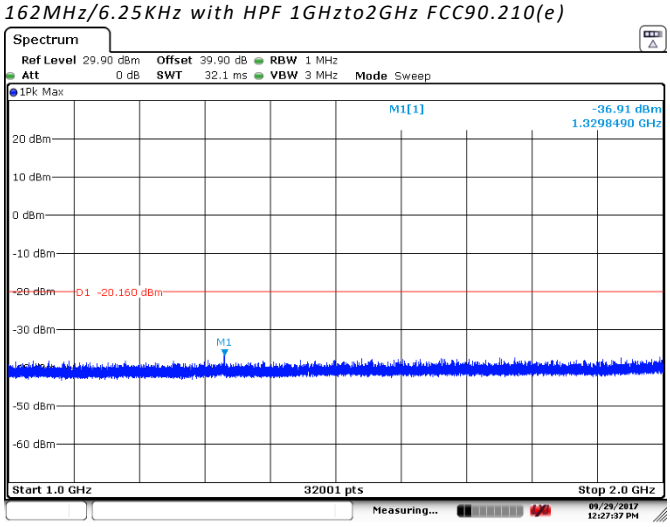
Date: 29.SEP.2017 10:56:43

162MHz/6.5KHz 4th harmonic verification with filter FCC90.210(e)



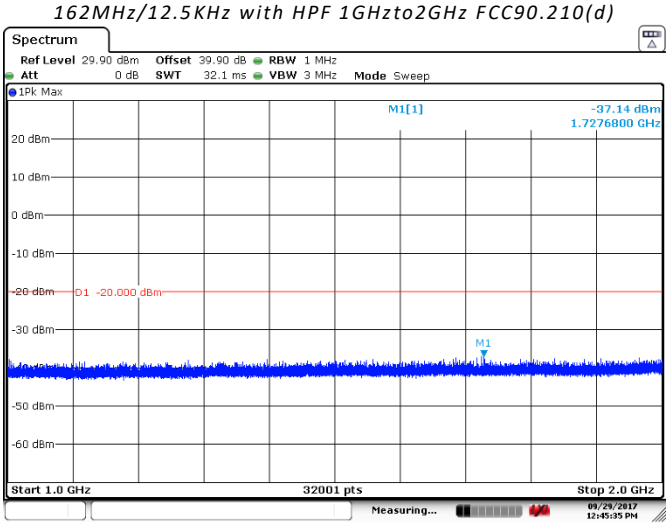
Date: 29.SEP.2017 12:13:57

162MHz/6.25KHz with HPF 1GHzto2GHz FCC90.210(e)



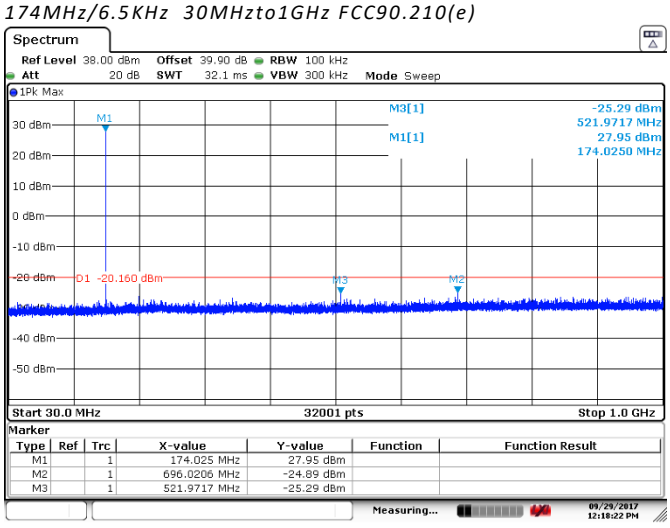
Date: 29.SEP.2017 12:27:37

162MHz/12.5KHz with HPF 1GHzto2GHz FCC90.210(d)



Date: 29.SEP.2017 12:45:35

174MHz/6.5KHz 30MHzto1GHz FCC90.210(e)

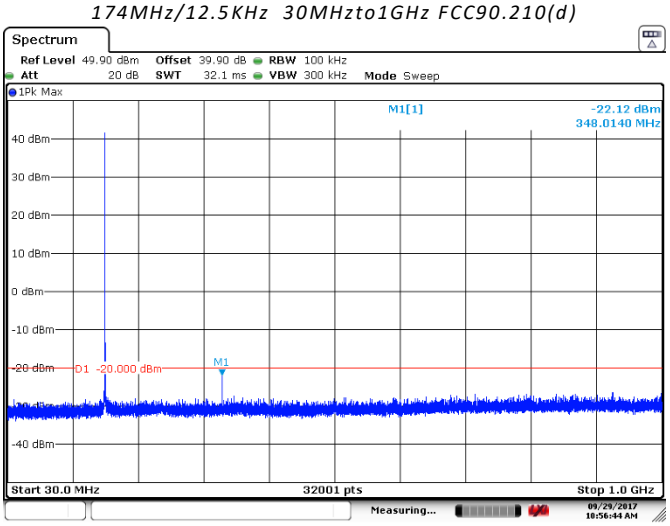


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	174.025 MHz	27.95 dBm		
M2		1	696.0206 MHz	-24.89 dBm		
M3		1	521.9717 MHz	-25.29 dBm		

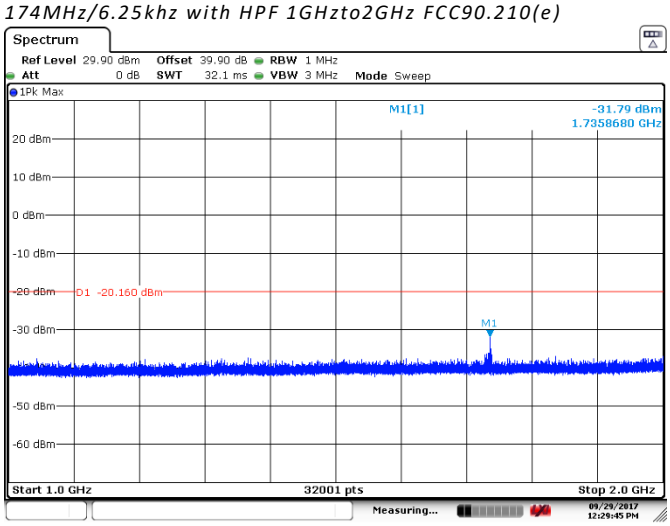
Date: 29.SEP.2017 12:18:23

174MHz/12.5KHz 30MHzto1GHz FCC90.210(d)



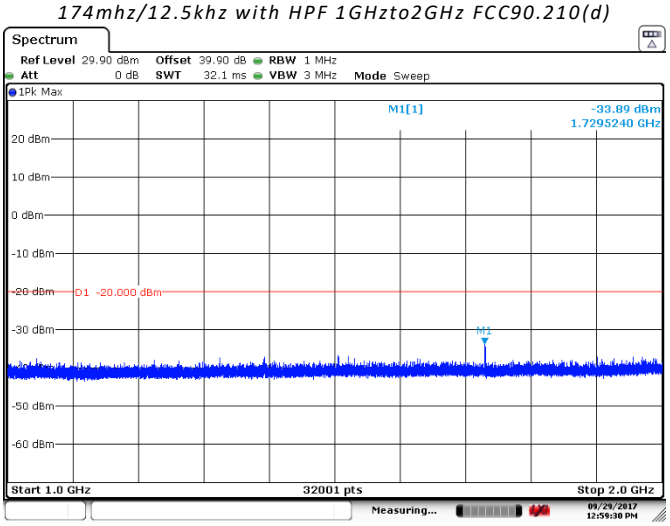
Date: 29.SEP.2017 10:56:43

174MHz/6.25khz with HPF 1GHzto2GHz FCC90.210(e)



Date: 29.SEP.2017 12:29:45

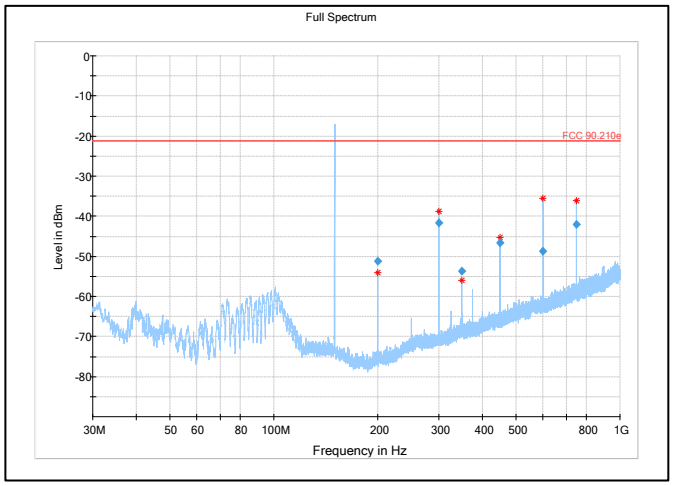
174mhz/12.5khz with HPF 1GHzto2GHz FCC90.210(d)



Date: 29.SEP.2017 12:59:31

Radiated Emissions Worst case (low and High Channel)

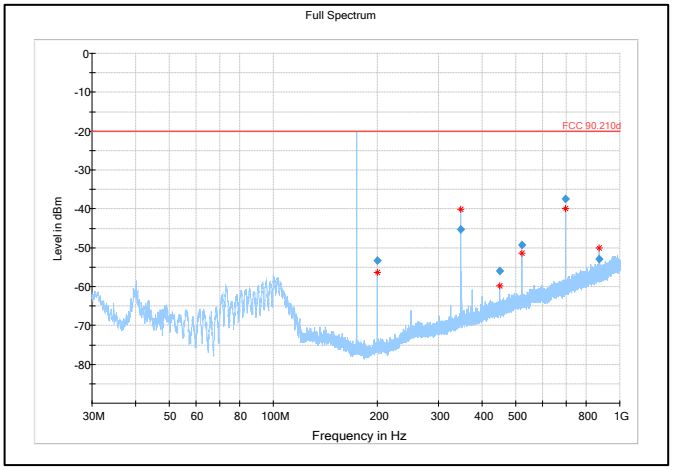
Radiated Emissions CH150MHz/6.25KHz with filter 30MHzto1GHz FCC90.210(e)



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
200.012500	-51.21	-21.25	29.96	20000.0	120.000	165.4	H	127.0	-84.7
300.011000	-41.71	-21.25	20.46	20000.0	120.000	111.7	H	0.0	-80.1
350.023000	-53.65	-21.25	32.40	20000.0	120.000	108.7	H	221.0	-78.1
449.981500	-46.70	-21.25	25.45	20000.0	120.000	101.7	H	13.0	-75.5
599.992000	-48.66	-21.25	27.41	20000.0	120.000	101.9	H	280.0	-72.1
750.042500	-42.00	-21.25	20.75	20000.0	120.000	218.4	H	331.0	-69.2

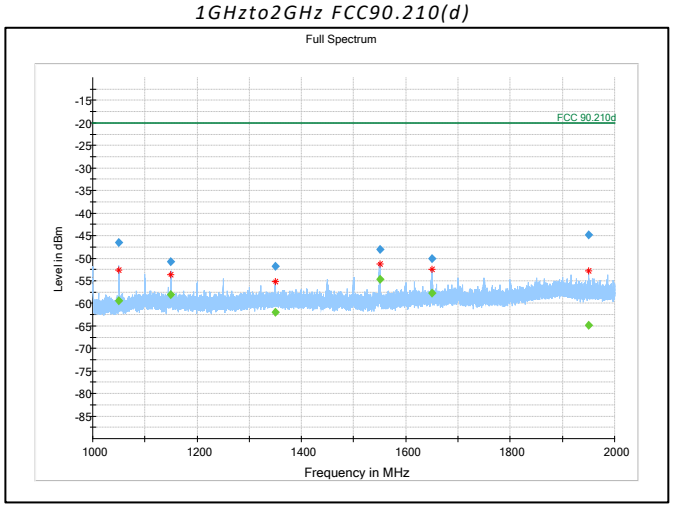
Radiated Emissions CH174MHz/12.5khz with filter 30MHzto1GHz FCC90.210(d)



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
200.004000	-53.27	-20.00	33.27	20000.0	120.000	126.3	H	130.0	-84.7
347.986000	-45.29	-20.00	25.29	20000.0	120.000	103.2	H	81.0	-78.2
449.981500	-56.06	-20.00	36.06	20000.0	120.000	189.7	H	130.0	-75.5
522.012500	-49.24	-20.00	29.24	20000.0	120.000	112.6	V	149.0	-73.6
696.013500	-37.48	-20.00	17.48	20000.0	120.000	193.7	H	215.0	-70.5
870.071500	-52.87	-20.00	32.87	20000.0	120.000	236.9	H	288.0	-67.4

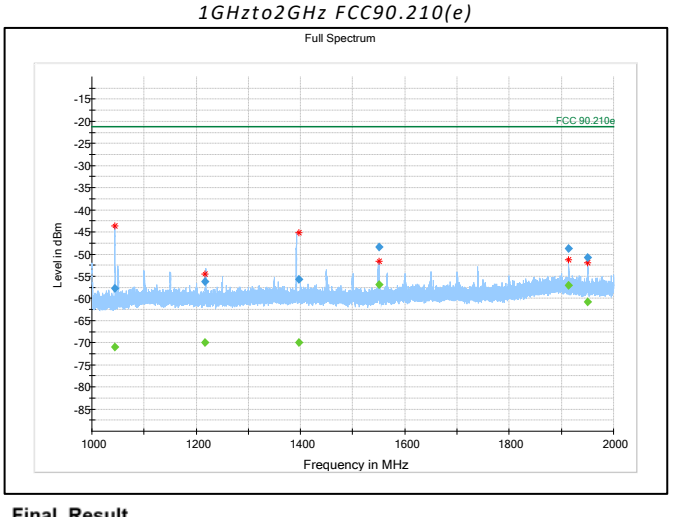
Radiated Emissions CH150MHz/12KHz with HPF 1GHzto2GHz FCC90.210(d)



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1050.066667	-46.50	---	0.00	46.50	10000.0	1000.000	129.3	V	158.0	-95.9
1050.066667	---	-59.41	-20.00	39.41	10000.0	1000.000	129.3	V	158.0	-95.9
1149.766667	---	-58.12	-20.00	38.12	10000.0	1000.000	109.6	V	343.0	-95.7
1149.766667	-50.68	---	0.00	50.68	10000.0	1000.000	109.6	V	343.0	-95.7
1350.100000	-51.82	---	0.00	51.82	10000.0	1000.000	100.1	H	247.0	-95.7
1350.100000	---	-62.01	-20.00	42.01	10000.0	1000.000	100.1	H	247.0	-95.7
1549.933333	-48.07	---	0.00	48.07	10000.0	1000.000	109.2	H	42.0	-95.5
1549.933333	---	-54.75	-20.00	34.75	10000.0	1000.000	109.2	H	42.0	-95.5
1649.900000	---	-57.69	-20.00	37.69	10000.0	1000.000	100.1	H	136.0	-95.0
1649.900000	-50.07	---	0.00	50.07	10000.0	1000.000	100.1	H	136.0	-95.0
1949.733333	-44.77	---	0.00	44.77	10000.0	1000.000	162.2	V	313.0	-92.7
1949.733333	---	-64.82	-20.00	44.82	10000.0	1000.000	162.2	V	313.0	-92.7

Radiated Emissions CH174MHz/6.25KHz with HPF 1GHzto2GHz FCC90.210(e)

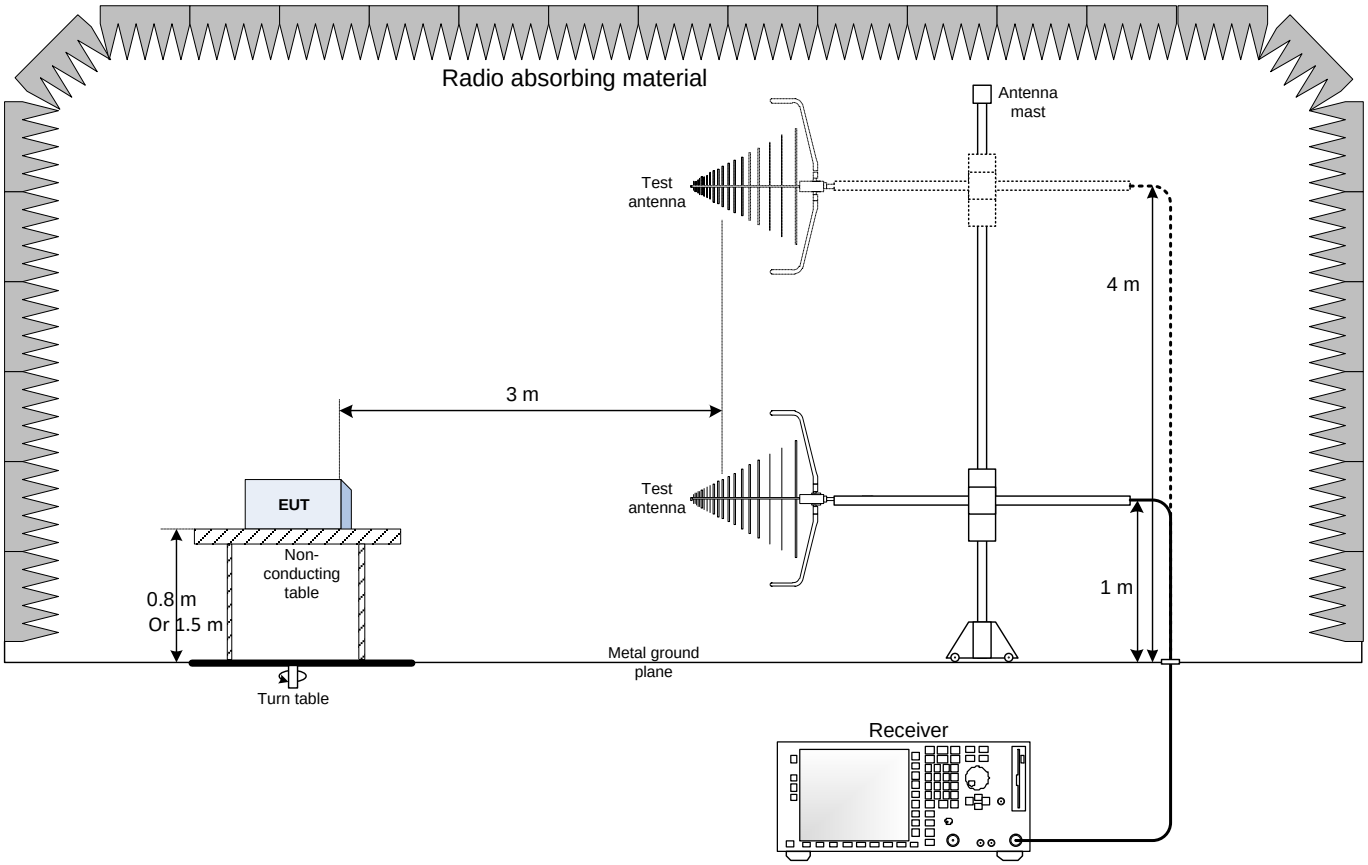


Final_Result

Frequency (MHz)	MaxPeak (dBm)	Average (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1043.833333	---	-70.97	-21.25	49.72	10000.0	1000.000	385.1	V	208.0	-95.9
1043.833333	-57.65	---	-1.25	56.40	10000.0	1000.000	385.1	V	208.0	-95.9
1217.133333	---	-70.03	-21.25	48.78	10000.0	1000.000	261.4	V	238.0	-95.6
1217.133333	-56.25	---	-1.25	55.00	10000.0	1000.000	261.4	V	238.0	-95.6
1396.966667	---	-69.97	-21.25	48.72	10000.0	1000.000	117.1	H	254.0	-95.6
1396.966667	-55.65	---	-1.25	54.40	10000.0	1000.000	117.1	H	254.0	-95.6
1550.333333	---	-56.80	-21.25	35.55	10000.0	1000.000	147.4	H	145.0	-95.5
1550.333333	-48.41	---	-1.25	47.16	10000.0	1000.000	147.4	H	145.0	-95.5
1913.966667	---	-57.01	-21.25	35.76	10000.0	1000.000	110.6	V	340.0	-92.7
1913.966667	-48.74	---	-1.25	47.49	10000.0	1000.000	110.6	V	340.0	-92.7
1950.233333	---	-60.86	-21.25	39.61	10000.0	1000.000	107.4	H	233.0	-92.7
1950.233333	-50.77	---	-1.25	49.52	10000.0	1000.000	107.4	H	233.0	-92.7

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



Note.- Per ANSI C63.26-2015 for radiated emissions measurements performed at frequencies less than or equal to 1 GHz, the EUT shall be placed on a RF-transparent table or support at a nominal height of 80 cm above the reference ground plane and for radiated measurements performed at frequencies above 1 GHz, the EUT shall be placed on an RF transparent table or support at a nominal height of 1.5 m above the ground plane.