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RADIO TEST REPORT

Report No: STS2111213W01

Issued for

BTECH (BaoFeng Tech)

702 N Industrial Ave Arlington South Dakota United States
57212

Product Name:	GMRS mobile radio
Brand Name:	BTECH
Model Name:	GMRS-20V2
Series Model:	N/A
FCC ID:	2AGND20V2G
Test Standard:	FCC Part 95

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**TEST REPORT CERTIFICATION**

Applicant's Name.....: BTECH (BaoFeng Tech)
Address: 702 N Industrial Ave Arlington South Dakota United States
57212
Manufacturer's Name: BTECH (BaoFeng Tech)
Address: 702 N Industrial Ave Arlington South Dakota United States
57212

Product Description

Product Name.....: GMRS mobile radio
Brand Name.....: BTECH
Model Name: GMRS-20V2
Series Model.....: N/A

Test Standards.....: FCC Part 95

Test Procedure.....: TIA 603-E

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test.....:

Date of receipt of test item.....: 30 Nov. 2021

Date of performance of tests: 30 Nov. 2021 ~ 22 Feb. 2022

Date of Issue.....: 22 Feb. 2022

Test Result.....: **Pass**

Testing Engineer :

(Chris chen)

Technical Manager :

(Sean she)

Authorized Signatory :

(Vita Li)





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**Revision History**

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	22 Feb. 2022	STS2111213W01	ALL	Initial Issue





1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part 95			
Standard Section	Test Item	Judgment	Remark
FCC Part 95.1767	Transmitter Output Power and Effective Radiated Power (e.r.p)	PASS	--
FCC Part 95.1773	Authorized Bandwidth	PASS	--
FCC Part 95.1779	Emission Mask	PASS	--
FCC Part 95.1779	Transmitter Radiated Spurious Emission	PASS	--
FCC Part 95.1779	Spurious Emission On Antenna Port	PASS	--
FCC Part 95.1765	Frequency Stability	PASS	--
FCC Part 95.1775	AUDIO LOW PASS FILTER RESPONSE	PASS	--
FCC Part 95.1775	Audio Frequency Response	PASS	--
FCC Part 95.1775	Modulation Requirements	PASS	--
FCC Part 15.207	AC power-line Conducted Emission	N/A	--

NOTE: (1) "N/A" denotes test is not applicable in this Test Report.

(2) All tests are according to TIA 603-E.



1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD

Add. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China

FCC test Firm Registration Number: 625569

IC test Firm Registration Number: 12108A

A2LA Certificate No.: 4338.01

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately **95 %**.

No.	Item	Uncertainty
1	RF output power, conducted	$\pm 0.87\text{dB}$
2	Unwanted Emissions, conducted	$\pm 2.895\text{dB}$
3	All emissions, radiated 9K-30MHz	$\pm 3.80\text{dB}$
4	All emissions, radiated 30M-1GHz	$\pm 4.09\text{dB}$
5	All emissions, radiated 1G-6GHz	$\pm 4.92\text{dB}$
6	All emissions, radiated >6G	$\pm 5.49\text{dB}$
7	Conducted Emission (9KHz-30MHz)	$\pm 2.73\text{dB}$



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	GMRS mobile radio	
Brand Name	BTECH	
Model Name	GMRS-20V2	
Series Model	N/A	
Model Difference	N/A	
Operation Frequency Range:	462MHz-467MHz Please refer to the note 3	
Channel Separation	25KHz	
Modulation Type	GMRS	F3E
Emission types	GMRS	15K1F3E
Rating	Input: 13.8V	
Hardware version number	FSSM_U2.3	
Software version number	VW2106	
Connecting I/O Port(s)	Please refer to the note 1	

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.

2. Table for filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	BTECH	GMRS-V2	Dipole antenna	N/A	0	Antenna



3. Channel List

Channel	Frequency(MHz)	Channel	Frequency(MHz)	Channel	Frequency(MHz)
1	462.5625	11	467.6375	21	462.7000
2	462.5875	12	467.6625	22	462.7250
3	462.6125	13	467.6875	23	467.5500
4	462.6375	14	467.7125	24	467.5750
5	462.6625	15	462.5500	25	467.6000
6	462.6875	16	462.5750	26	467.6250
7	462.7125	17	462.6000	27	467.6500
8	467.5625	18	462.6250	28	467.6750
9	467.5875	19	462.6500	29	467.7000
10	467.6125	20	462.6750	30	467.7250

Test channel:

Channel	Frequency(MHz)	Low Power	High Power
4	462.6375	Support	Not support
19	462.6500	Support	Support
27	467.6500	Support	Support

Note: Per FCC GMRS Radio Guidelines; Channels 1-7 are limited to Low Power - 5watt output
Per FCC GMRS Mobile Radio Guidelines Channels 8-14 transmitting is disabled, Only hand-held portable units may transmit on these 7 channels; they can receive and monitor communications, but GMRS mobile radios cannot transmit on these channels. 8-14 channel bandwidth is narrowband, 1-7/15-30 is wideband.



2.2 DESCRIPTION OF THE TEST MODES

To investigate the maximum EMI emission characteristics generated from EUT, the test system was pre-scanning tested based on the consideration of following EUT operation mode or test configuration mode which possibly have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

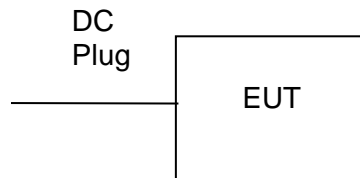
Pretest Mode	Description
Mode 1	GMRS CH4 Low Power TX Mode
Mode 2	GMRS CH19 Low Power TX Mode
Mode 3	GMRS CH19 High Power TX Mode
Mode 4	GMRS CH27 Low Power TX Mode
Mode 5	GMRS CH27 High Power TX Mode

For Radiated Emission	
Final Test Mode	Description
Mode 1	GMRS CH4 Low Power TX Mode
Mode 3	GMRS CH19 High Power TX Mode
Mode 5	GMRS CH27 High Power TX Mode



2.3 BLOCK DIAGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



2.4 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
N/A	N/A	N/A	N/A	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
N/A	N/A	N/A	N/A	N/A	N/A

Note:

- (1) For detachable type I/O cable should be specified the length in cm in 『Length』 column.



2.5 EQUIPMENTS LIST

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2021.10.11	2023.10.10
Pre-Amplifier (0.1M-3GHz)	EM	EM330	060665	2021.10.08	2022.10.07
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2021.09.30	2022.09.29
Signal Analyzer	R&S	FSV 40-N	101823	2021.09.30	2022.09.29
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08
Turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
AC Power Source	APC	KDF-11010G	F214050035	N.C.R	N.C.R
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

RF Connected Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Signal Generator	Agilent	N5182A	MY46240556	2021.09.30	2022.09.29
Signal Analyzer	Agilent	N9020A	MY51110105	2021.03.04	2022.03.03
Universal Radio communication tester	R&S	CMU200	111058	2021.09.29	2022.09.28
Audio analyzer	R&S	UPL	N/A	2021.03.04	2022.03.03
Intercom comprehensive tester	HP	8920A	348A05658	2021.03.04	2022.03.03
Temperature & Humidity	HH660	Mieo	N/A	2021.10.09	2022.10.08
Temperature& Humidity test chamber	Safety test	AG80L	171200018	2021.03.04	2022.03.03
Programmable power supply	Agilent	E3642A	MY40002025	2021.10.08	2022.10.07
Attenuator	HP	8494B	DC-18G	2021.04.28	2022.04.27
AC Power Source	APC	KDF-11010G	F214050035	N.C.R	N.C.R
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			



3. FIELD STRENGTHS AND RADIATED SPURIOUS EMISSION

3.1 RADIATED EMISSION LIMITS

In case the emission fall within the restricted band specified on 15.205 limit in the followed

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:

(a) If the equipment operates below 10 GHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

Particular attention should be paid to harmonics and sub-harmonics of the carrier frequency, as well as to those frequencies removed from the carrier by multiples of the oscillator frequency.

Radiation at the frequencies of multiplier stages should also be checked.

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

$43 + 10 \log (\text{Pwatts})$

Calculation: Limit (dBm) = $EL - 43 - 10 \log_{10} (\text{TP})$

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P (dBm).

Limit (dBm) = $P (\text{dBm}) - 43 - 10 \log (\text{Pwatts}) = -13 \text{ dBm}$

LIMITS OF RESTRICTED FREQUENCY BANDS

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			



Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

Spectrum Parameter	Setting
Detector	Peak
Attenuation	Auto
Start Frequency	30 MHz
Stop Frequency	10th carrier harmonic

3.2 TEST PROCEDURE

1. EUT was placed on a 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 height of receiving antenna is 1.0 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in three 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 BW=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 (P_{Mea}) 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 (P_{Mea}) 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 (P_{cl}), the Substitution Antenna Gain (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test. The measurement results are obtained as described below:

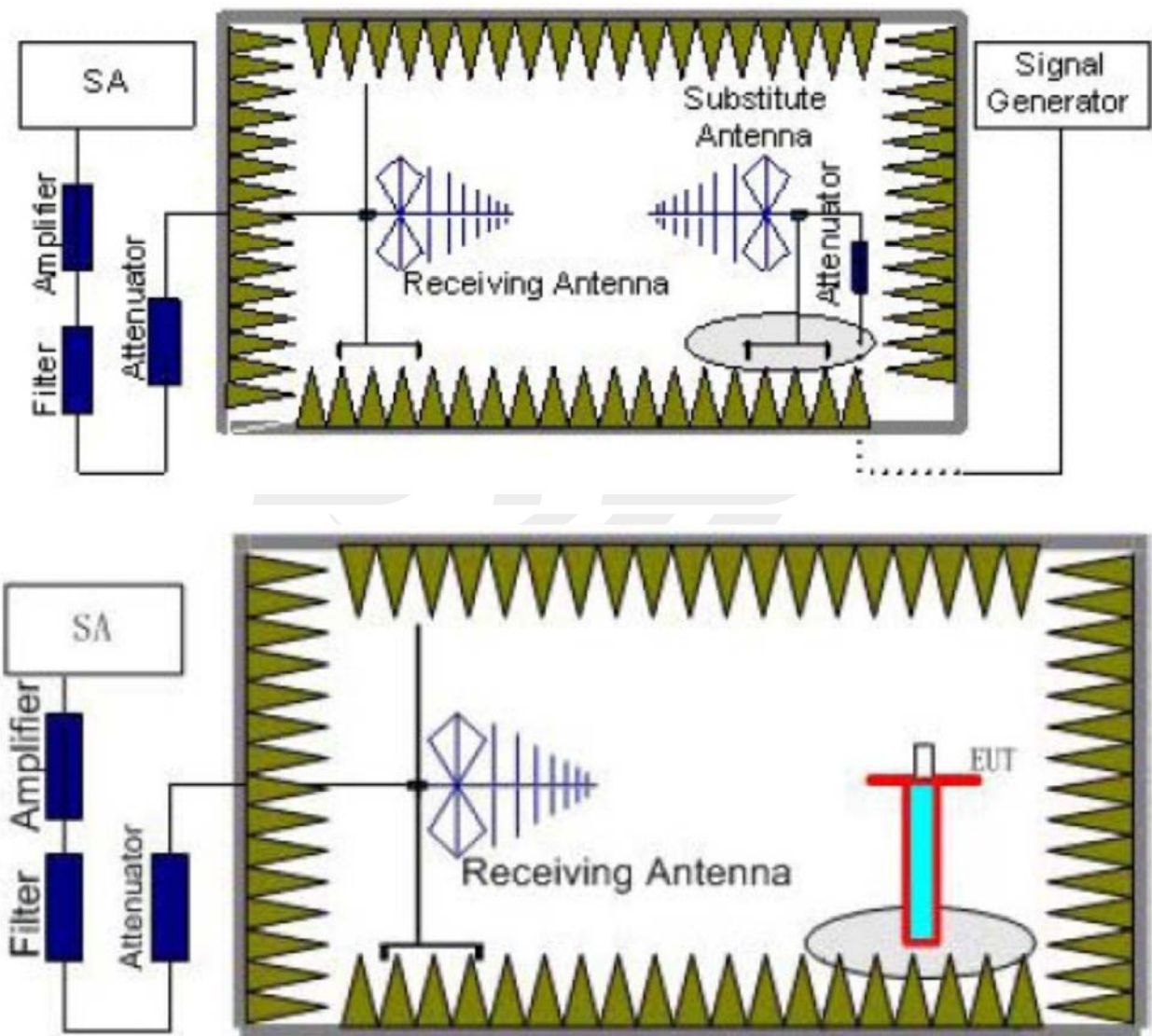
$$\text{Power(EIRP)} = P_{\text{Mea}} - P_{\text{Ag}} - P_{\text{cl}} + G_a$$

We used signal generator which signal level can up to 33dBm,so we not used power Amplifier for substitution test; The measurement results are amend as described below:

$$\text{Power(EIRP)} = P_{\text{Mea}} - P_{\text{cl}} + G_a$$

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, $\text{ERP} = \text{EIRP} - 2.15\text{dBi}$

3.3 TEST SETUP



3.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

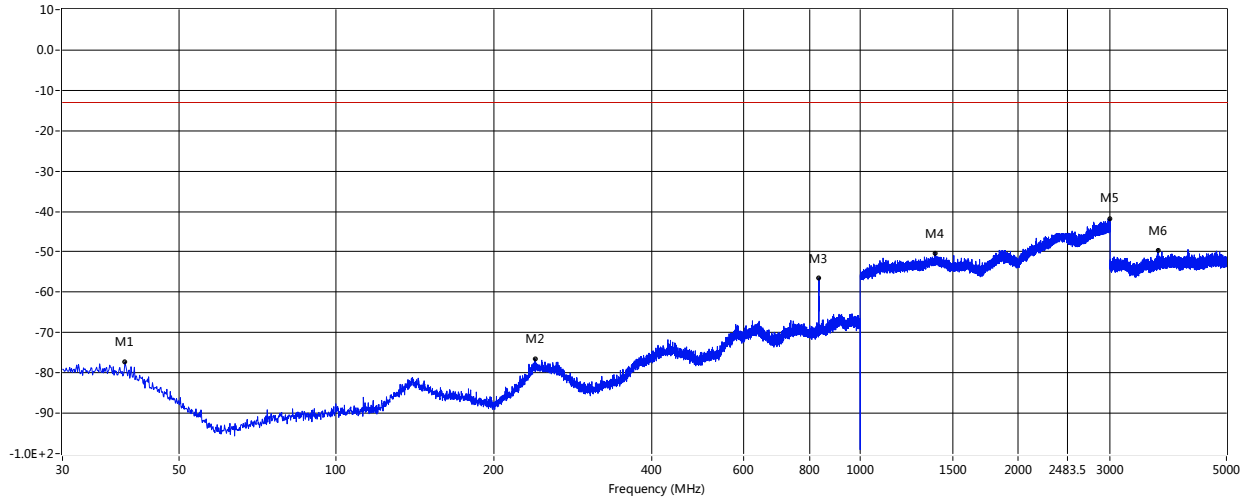


3.5 TEST RESULT

Note: All mode has been tested, only shown the worst case in this report.

Temperature:	23.4 °C	Relative Humidity:	60%
Test Mode:	Mode 1	Phase :	Horizontal

RSE_FCC Test Case_FCC 95 30MHz-5GHz-H

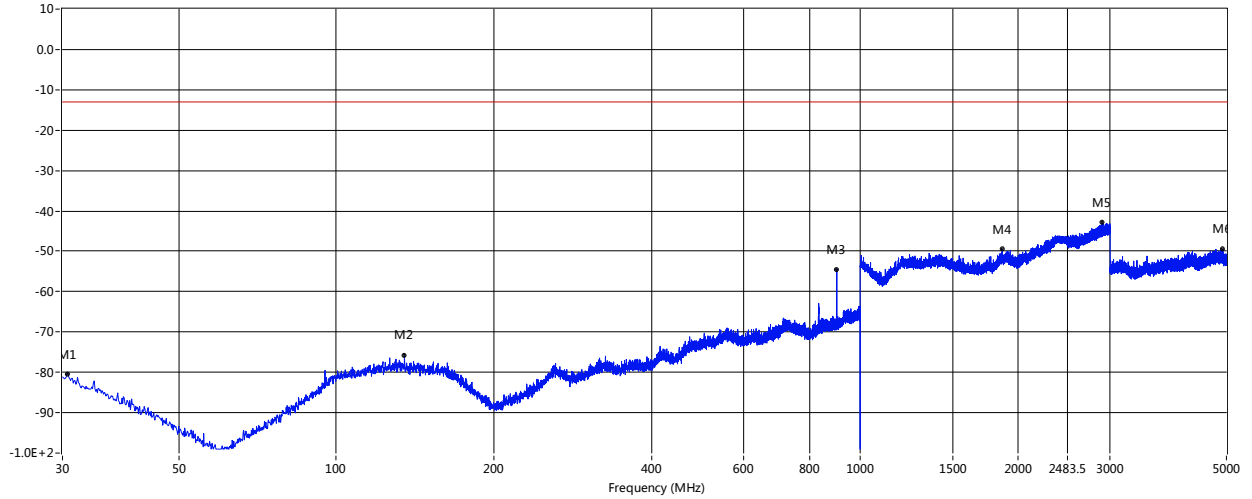


Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
39.458	-77.34	-1.84	-13.0	-64.34	2.80	Horizontal	Vertical	Pass
239.399	-76.50	-0.97	-13.0	-63.50	1.40	Horizontal	Vertical	Pass
833.402	-56.53	6.99	-13.0	-43.53	267.40	Horizontal	Vertical	Pass
1390.250	-50.31	14.03	-13.0	-37.31	239.40	Horizontal	Vertical	Pass
2998.000	-41.83	21.24	-13.0	-28.83	272.20	Horizontal	Vertical	Pass
3701.500	-49.64	3.66	-13.0	-36.64	166.40	Horizontal	Vertical	Pass



Temperature:	23.4 °C	Relative Humidity:	60%
Test Mode:	Mode 1	Phase:	Vertical

RSE_FCC Test Case_FCC 95 30MHz-5GHz-V

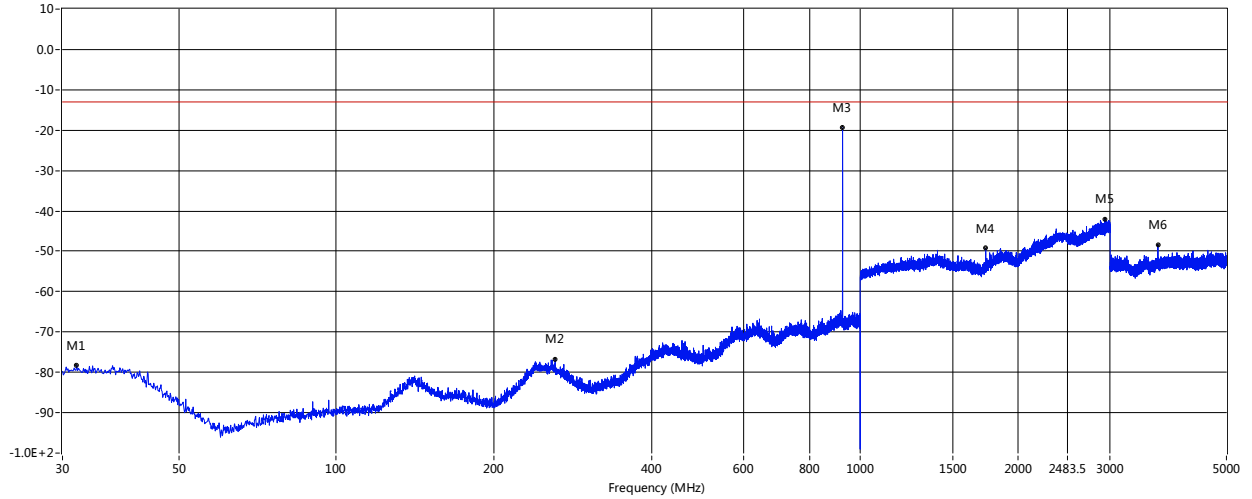


Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
30.242	-81.60	-3.83	-13.0	-68.60	115.00	Vertical	Vertical	Pass
134.881	-75.73	-1.33	-13.0	-62.73	233.00	Vertical	Vertical	Pass
901.909	-54.50	8.26	-13.0	-41.50	233.00	Vertical	Vertical	Pass
1866.250	-49.45	13.87	-13.0	-36.45	190.40	Vertical	Vertical	Pass
2898.250	-42.89	20.23	-13.0	-29.89	208.30	Vertical	Vertical	Pass
4921.500	-49.46	5.56	-13.0	-36.46	285.10	Vertical	Vertical	Pass



Temperature:	23.4 °C	Relative Humidity:	60%
Test Mode:	Mode 3	Phase :	Horizontal

RSE_FCC Test Case_FCC 95 30MHz-5GHz-H

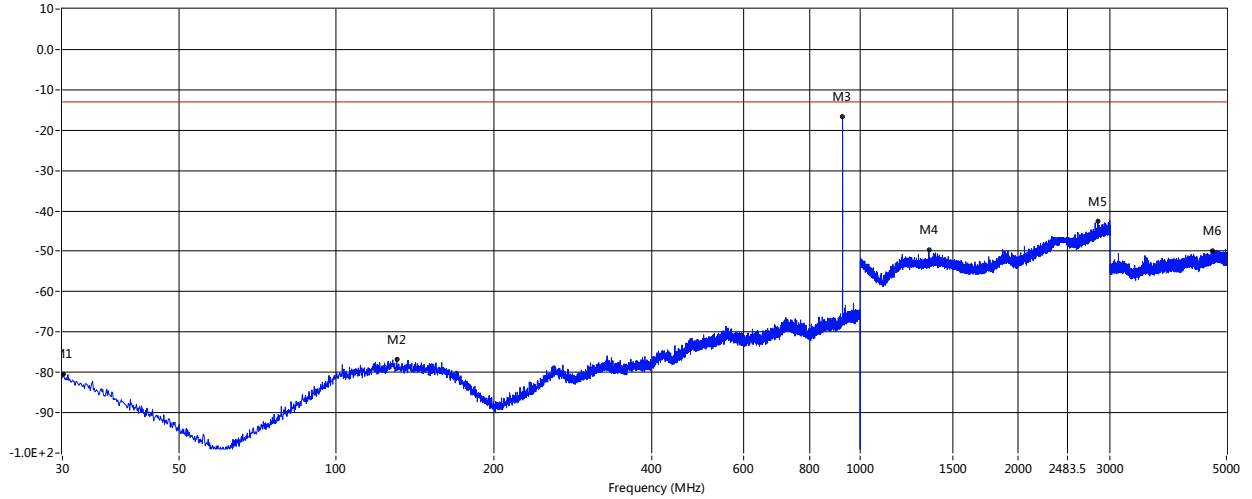


Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
31.940	-78.30	-1.90	-13.0	-65.30	8.50	Horizontal	Vertical	Pass
261.466	-76.89	-1.74	-13.0	-63.89	266.50	Horizontal	Vertical	Pass
925.431	-19.43	9.22	-13.0	-6.43	58.90	Horizontal	Vertical	Pass
1736.000	-49.27	12.30	-13.0	-36.27	309.60	Horizontal	Vertical	Pass
2931.750	-42.04	20.86	-13.0	-29.04	174.90	Horizontal	Vertical	Pass
3701.000	-48.36	3.66	-13.0	-35.36	150.20	Horizontal	Vertical	Pass



Temperature:	23.4 °C	Relative Humidity:	60%
Test Mode:	Mode 3	Phase:	Vertical

RSE_FCC Test Case_FCC 95 30MHz-5GHz-V

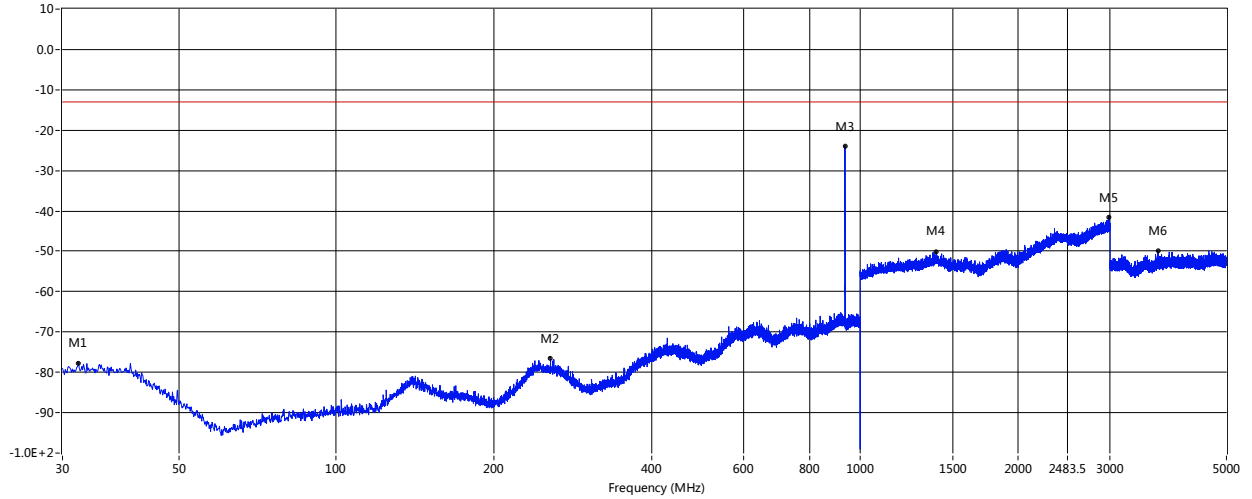


Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
30.000	-81.39	-3.68	-13.0	-68.39	102.00	Vertical	Vertical	Pass
130.395	-76.81	-1.50	-13.0	-63.81	208.30	Vertical	Vertical	Pass
925.431	-16.72	9.28	-13.0	-3.72	332.10	Vertical	Vertical	Pass
1352.250	-49.59	13.42	-13.0	-36.59	13.50	Vertical	Vertical	Pass
2841.500	-42.68	19.94	-13.0	-29.68	203.40	Vertical	Vertical	Pass
4712.750	-49.79	5.16	-13.0	-36.79	0.00	Vertical	Vertical	Pass



Temperature:	23.4 °C	Relative Humidity:	60%
Test Mode:	Mode 5	Phase :	Horizontal

RSE_FCC Test Case_FCC 95 30MHz-5GHz-H

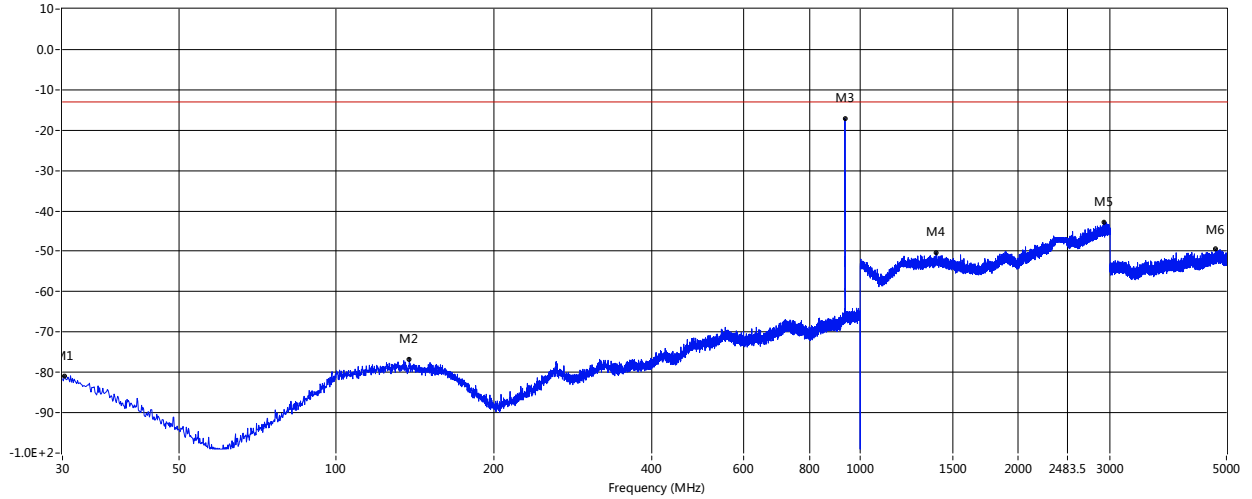


Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
32.182	-77.70	-1.90	-13.0	-64.70	0.00	Horizontal	Vertical	Pass
256.374	-76.65	-1.39	-13.0	-63.65	145.00	Horizontal	Vertical	Pass
935.374	-24.07	8.52	-13.0	-11.07	284.20	Horizontal	Vertical	Pass
1396.000	-50.11	14.11	-13.0	-37.11	342.30	Horizontal	Vertical	Pass
2983.500	-41.55	21.16	-13.0	-28.55	214.10	Horizontal	Vertical	Pass
3701.500	-49.91	3.66	-13.0	-36.91	145.90	Horizontal	Vertical	Pass



Temperature:	23.4 °C	Relative Humidity:	60%
Test Mode:	Mode 5	Phase:	Vertical

RSE_FCC Test Case_FCC 95 30MHz-5GHz-V



Frequency (MHz)	Result (dBm)	Factor (dB)	PK Limit (dBm)	Over Limit (dB)	Table (o)	ANT	EUT	Verdict
30.242	-80.91	-3.83	-13.0	-67.91	186.10	Vertical	Vertical	Pass
137.791	-76.76	-1.22	-13.0	-63.76	336.80	Vertical	Vertical	Pass
935.374	-17.12	9.89	-13.0	-4.12	0.00	Vertical	Vertical	Pass
1396.750	-50.28	13.80	-13.0	-37.28	160.40	Vertical	Vertical	Pass
2918.500	-42.70	20.28	-13.0	-29.70	282.70	Vertical	Vertical	Pass
4767.250	-49.46	5.36	-13.0	-36.46	159.10	Vertical	Vertical	Pass



4. SPURIOUS EMISSION ON ANTENNA PORT

4.1 LIMIT

43 + 10 log (Pwatts)

Calculation: Limit (dBm) = EL-43-10log10 (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is P(dBm).

Limit (dBm) = P(dBm)-43-10 log (Pwatts) = -13 dBm

4.2 TEST PROCEDURE

1. The EUT was connected to the spectrum analyzer through sufficient attenuation.
2. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range.
3. Set EUT as digital data mode.
4. Set RBW 30kHz, VBW 100 kHz in the frequency band 30MHz to 1GHz, while set RBW=1MHz. VBW=3MHz from the 1GHz to 10th Harmonic.

4.3 TEST SETUP



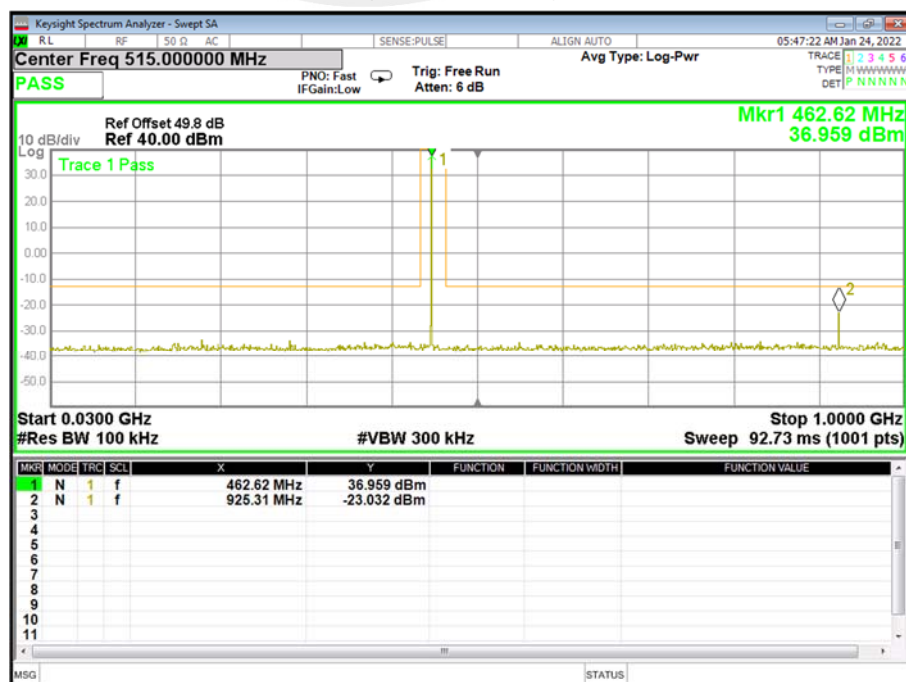
4.4 EUT OPERATION CONDITIONS

TX mode.

4.5 TEST RESULT

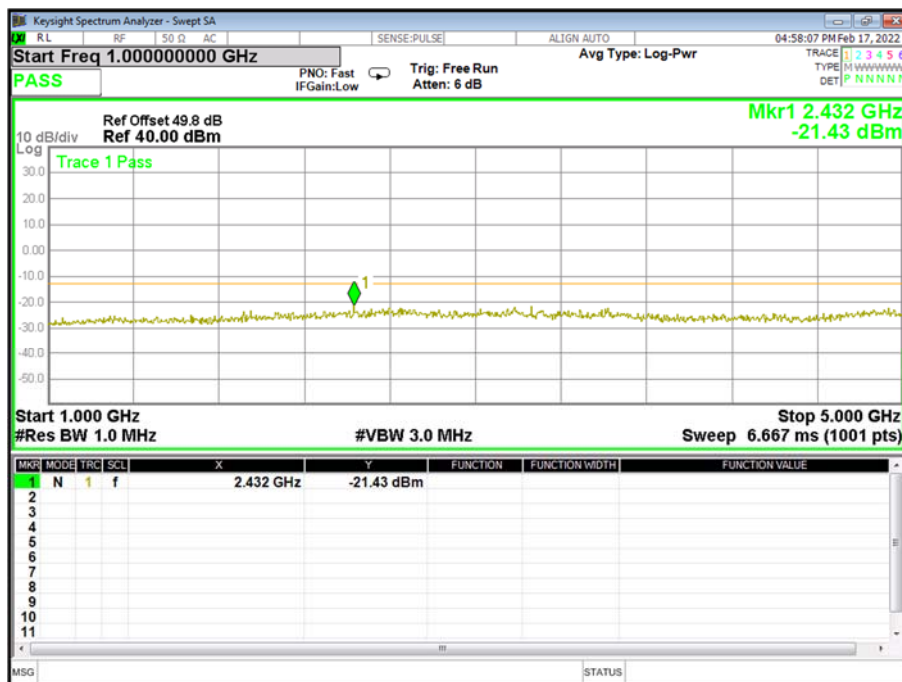
Note: All mode has been tested, only shown the worst case in this report.

Mode 1
(30MHz-1GHz)



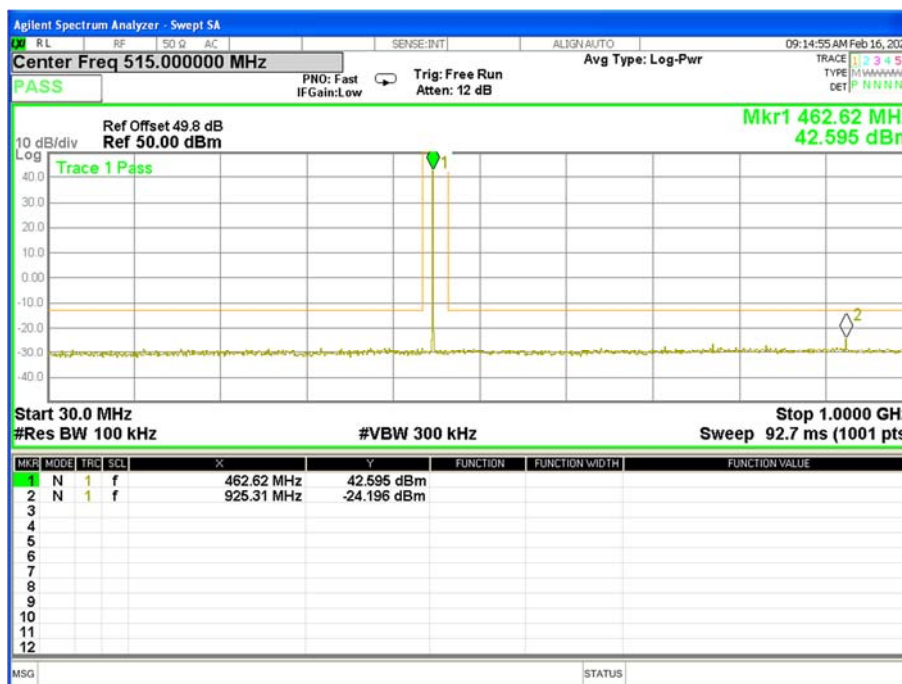


(1GHz-5GHz)



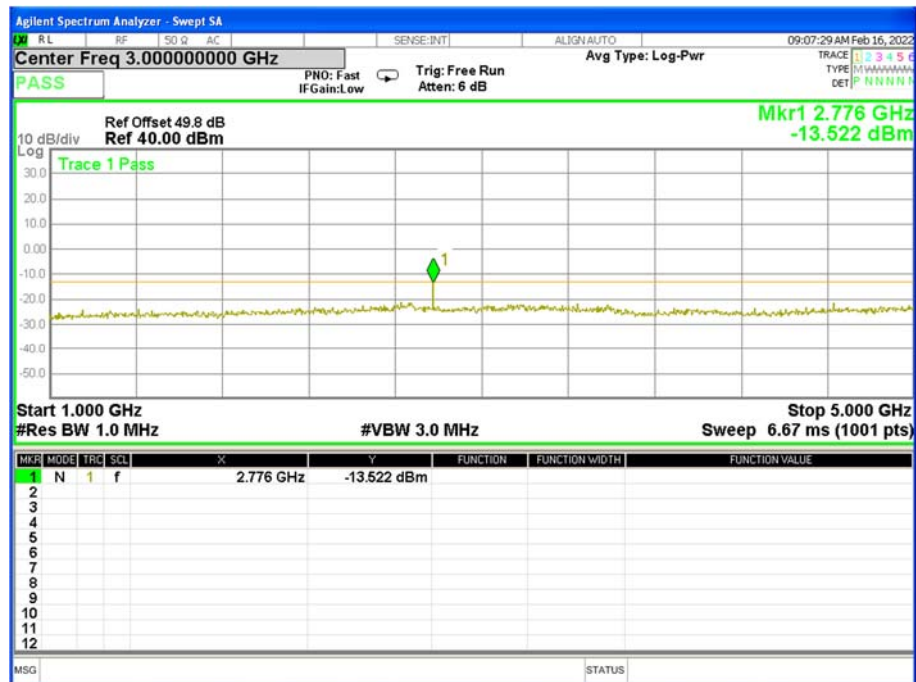
Mode 3

(30MHz-1GHz)



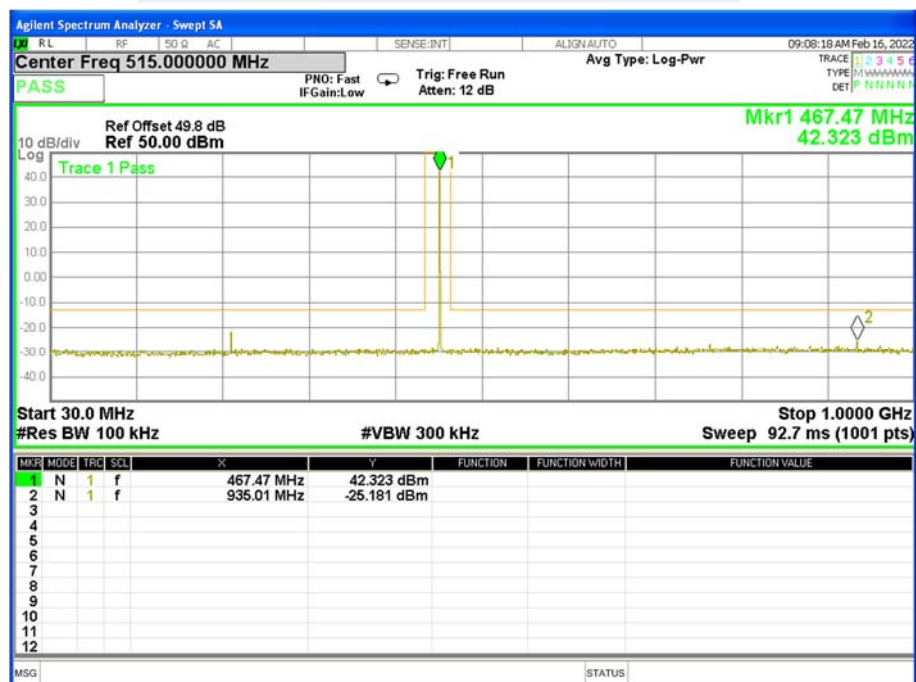


Mid channel(1GHz-5GHz)



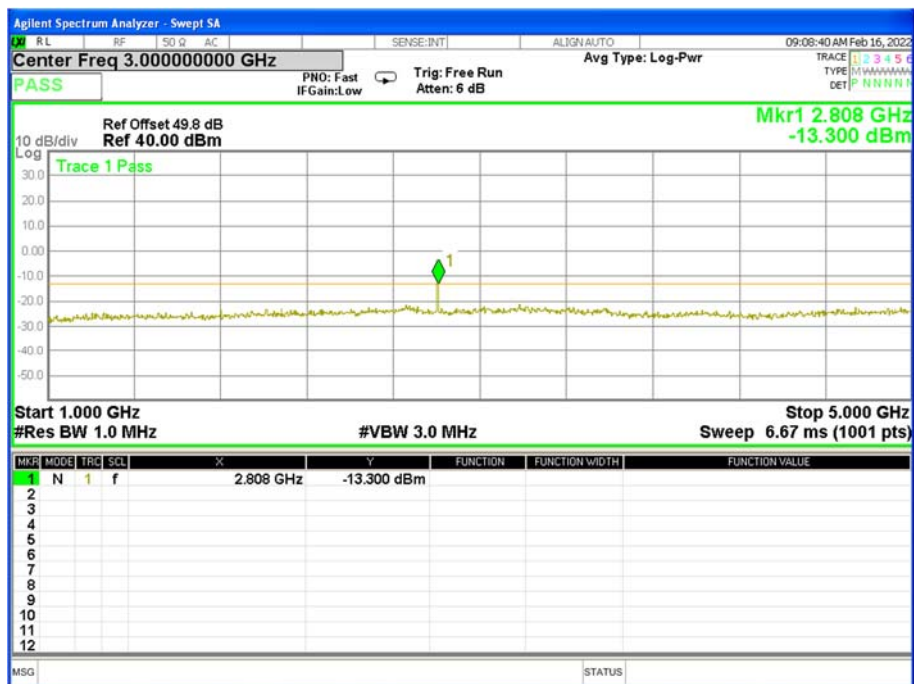
Mode 5

(30MHz-1GHz)





(1GHz-5GHz)



5. BANDWIDTH TEST

5.1 LIMIT

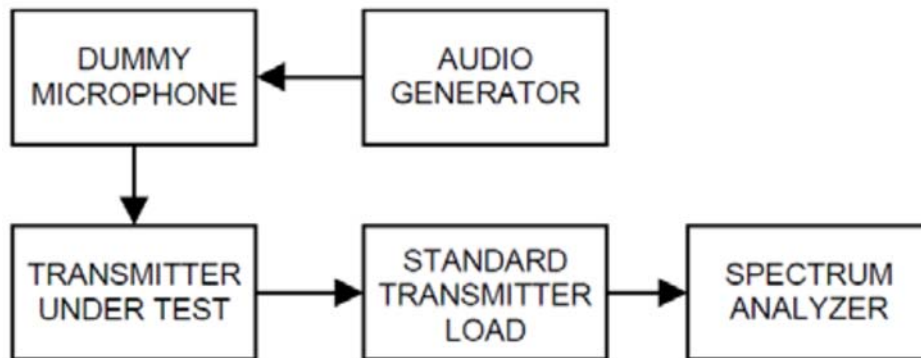
GMRS:

- (a) Main channels. The authorized bandwidth is 20 kHz for GMRS transmitters operating on any of the 462 MHz main channels or any of the 467 MHz main channels.
- (b) Interstitial channels. The authorized bandwidth is 20 kHz for GMRS transmitters operating on any of the 462 MHz interstitial channels and is 12.5 kHz for GMRS transmitters operating on any of the 467 MHz interstitial channels.

5.2 TEST PROCEDURE

1. The EUT was connected to the spectrum analyzer through sufficient attenuation.
2. Set EUT as digital data mode.
3. Set SPA Center Frequency=fundamental frequency, RBW=100Hz, VBW=1KHz, span =15KHz.
4. Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth.

5.3 TEST SETUP



5.4 EUT OPERATION CONDITIONS

TX mode.

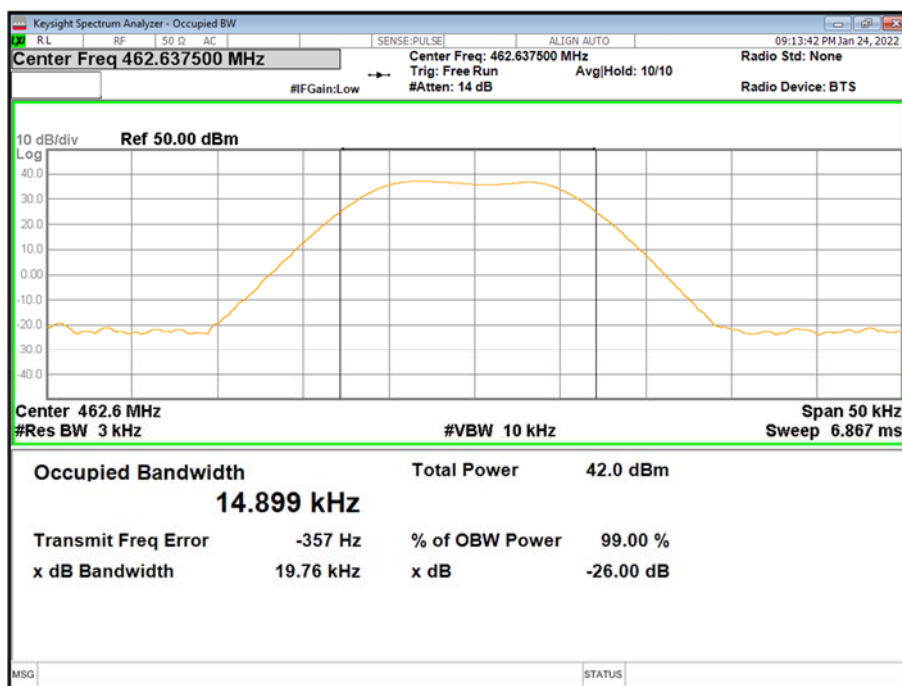


5.5 TEST RESULTS

Note: All mode has been tested, only shown the worst case in this report.

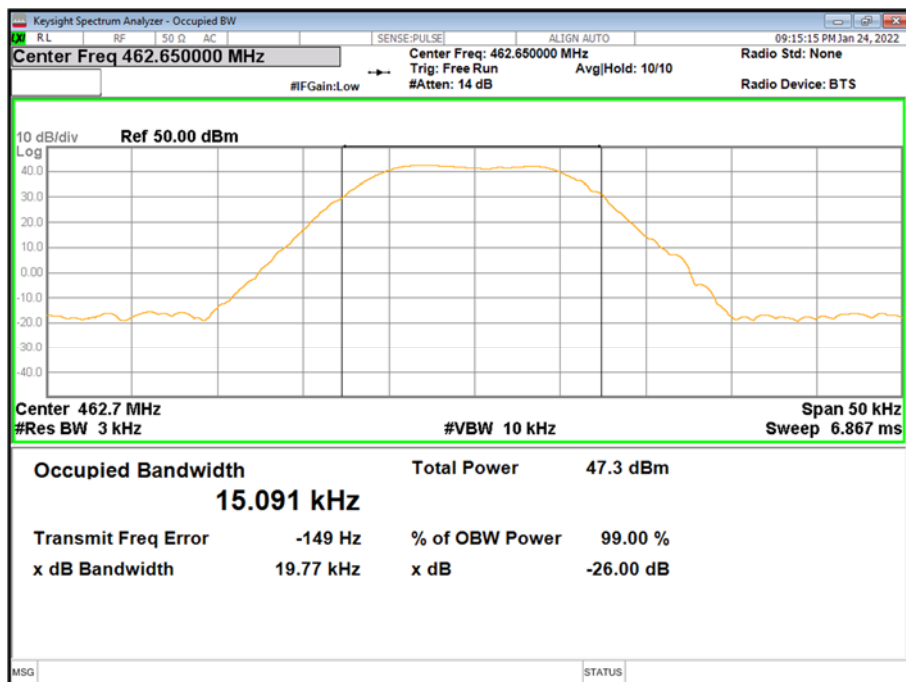
Operation Mode	Test Channel	Test Frequency(MHz)	99% Occupied Bandwidth(KHz)	26dB Bandwidth (KHz)	Limits (KHz)	Result
GMRS	4	462.6375	14.899	19.76	20	Pass
	19	462.6500	15.091	19.77	20	Pass
	27	467.6500	14.902	19.73	20	Pass

CH4

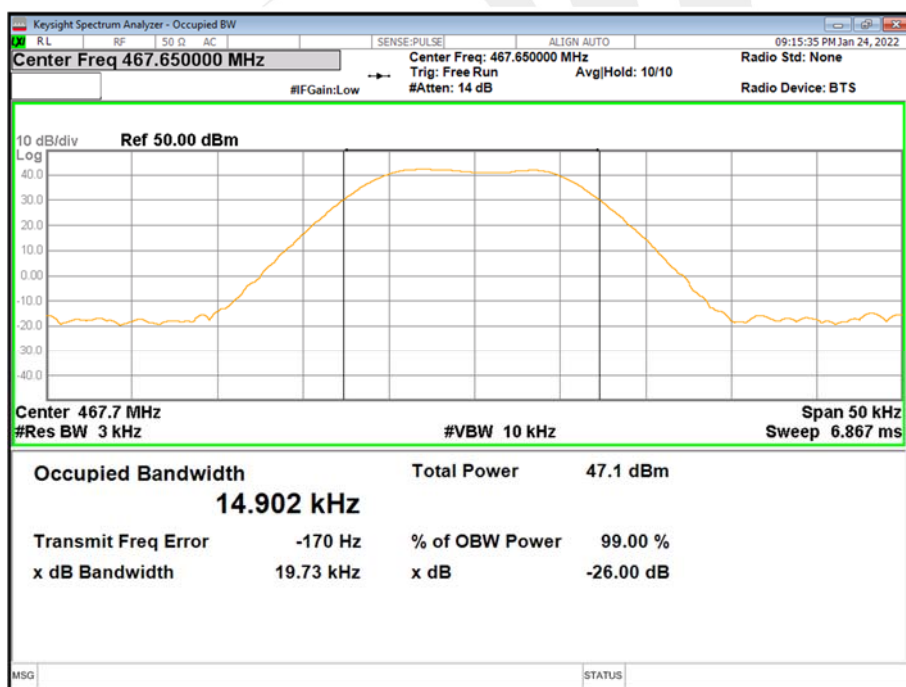




CH19_High Power



CH27_High Power





6. TRANSMITTER OUTPUT POWER AND EFFECTIVE RADIATED POWER (E.R.P)

6.1 LIMIT

GMRS:

(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.

6.2 TEST PROCEDURE

The procedure of conducted power is as follows:

Measurements shall be made to establish the radio frequency power delivered by the transmitter the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted bellow:

If the power output is adjustable, measurements shall be made for the highest and lowest power levels. The EUT connect to the Spectrum Analyzer through 30 dB attenuator.

The procedure of effective radiated power is as follows:

1. EUT was placed on a 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 height of receiving antenna is 1.0 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in three 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 BW=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 (P_{Mea}) 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 (P_{Mea}) 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 (P_{cl}), the Substitution Antenna Gain (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test. The measurement results are obtained as described below:

$$\text{Power(EIRP)} = P_{\text{Mea}} - P_{\text{Ag}} - P_{\text{cl}} + G_a$$

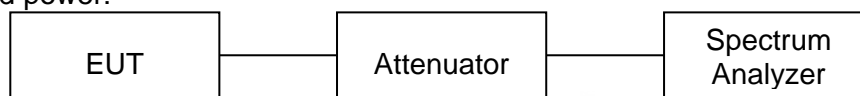
We used signal generator which signal level can up to 33dBm, so we not used power Amplifier for substitution test; The measurement results are amend as described below:

$$\text{Power(EIRP)} = P_{\text{Mea}} - P_{\text{cl}} + G_a$$

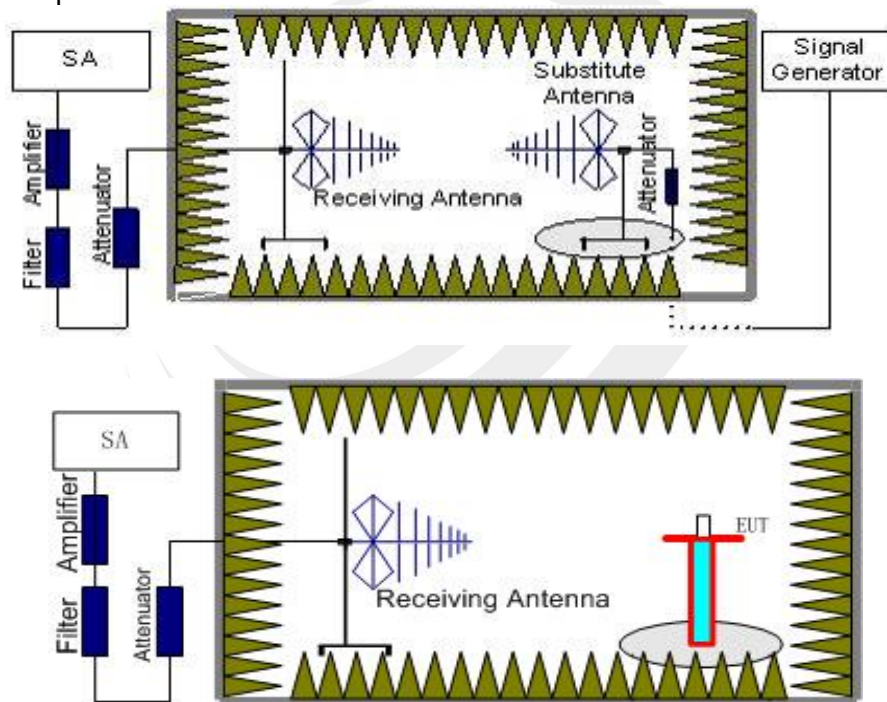
6. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power
7. ERP can be calculated from EIRP by subtracting the gain of the dipole,
 $\text{ERP} = \text{Reading} - \text{Cable loss} + \text{Antenna Gain} - 2.15$

6.3 TEST SETUP

Conducted power:



Effective radiated power:





6.4 TEST RESULTS

Effective radiated power:

Low Power:

Operation Mode	Test Channel	Test Frequency(MHz)	Reading (dBm)	Cable Loss(dB)	Antenna Gain(dBi)	ERP (dBm)	ERP (W)	Limit (W)	Polarization	Result
GMRS	4	462.6375	34.57	1.49	6.00	36.93	4.93	5	V	Pass
			33.65	1.49	6.00	36.01	3.99	5	H	Pass
	19	462.6500	34.61	1.49	6.00	36.97	4.98	50	V	Pass
			33.76	1.49	6.00	36.12	4.09	50	H	Pass
	27	467.6500	34.62	1.49	6.00	36.98	4.99	50	V	Pass
			33.79	1.49	6.00	36.15	4.12	50	H	Pass
Note:ERP=Reading - Cable loss + Antenna Gain - 2.15										

High Power:

Operation Mode	Test Channel	Test Frequency(MHz)	Reading (dBm)	Cable Loss(dB)	Antenna Gain(dBi)	ERP (dBm)	ERP (W)	Limit (W)	Polarization	Result
GMRS	19	462.6500	40.29	1.49	6.00	42.65	18.41	50	V	Pass
			39.99	1.49	6.00	42.35	17.18	50	H	Pass
	27	467.6500	40.07	1.49	6.00	42.43	17.50	50	V	Pass
			39.87	1.49	6.00	42.23	16.71	50	H	Pass
Note:ERP=Reading - Cable loss + Antenna Gain - 2.15										

7. EMISSION MASK

7.1 LIMIT

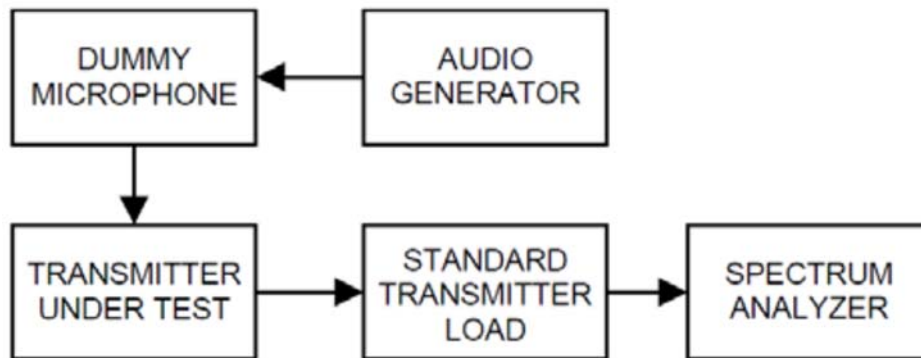
GMRS:

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

7.2 TEST PROCEDURE

- The EUT was connected to the spectrum analyzer through sufficient attenuation.
- Set EUT as digital data mode.
- Set SPA Center Frequency=fundamental frequency, RBW=300Hz, VBW=3KHz, span =120KHz.

7.3 TEST SETUP



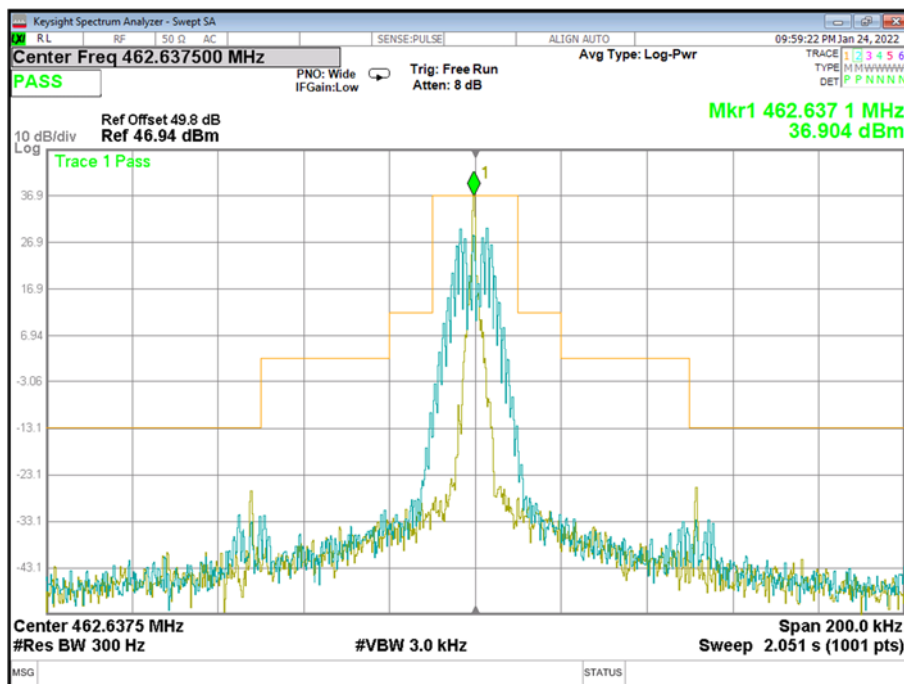
7.4 EUT OPERATION CONDITIONS

TX mode.

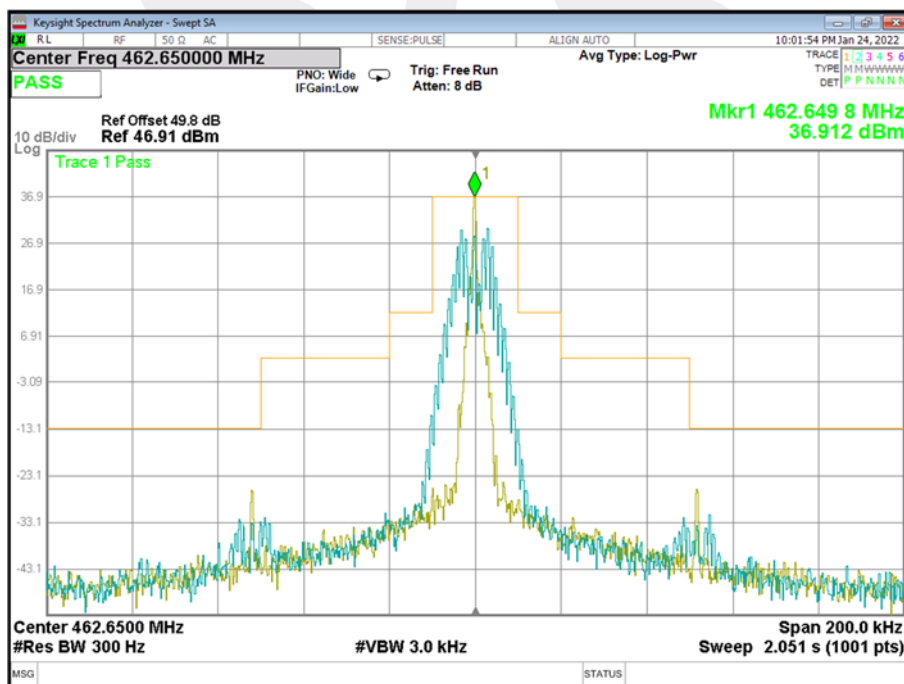


7.5 TEST RESULT

Mode 1

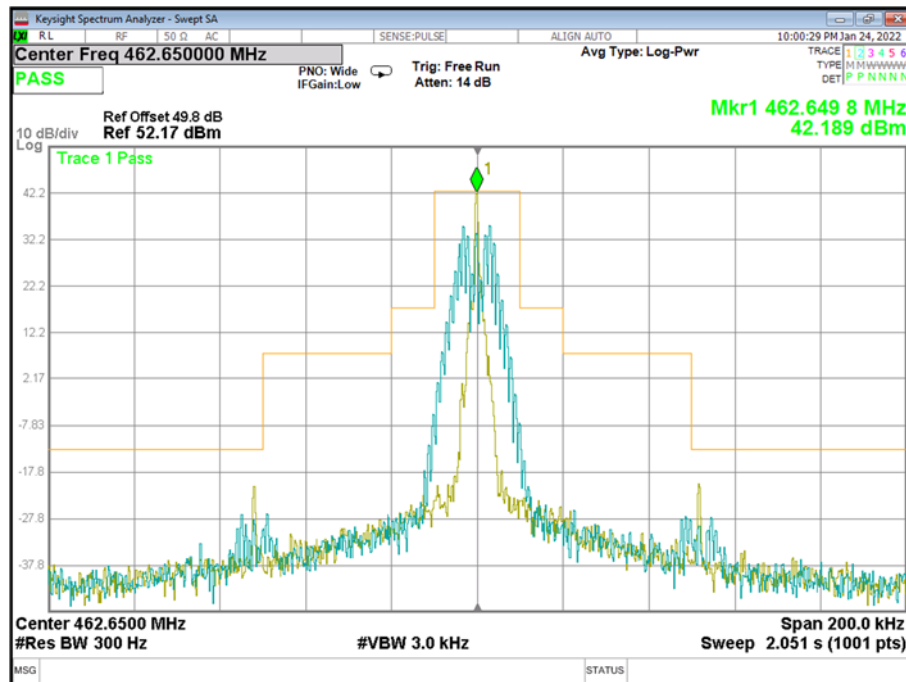


Mode 2

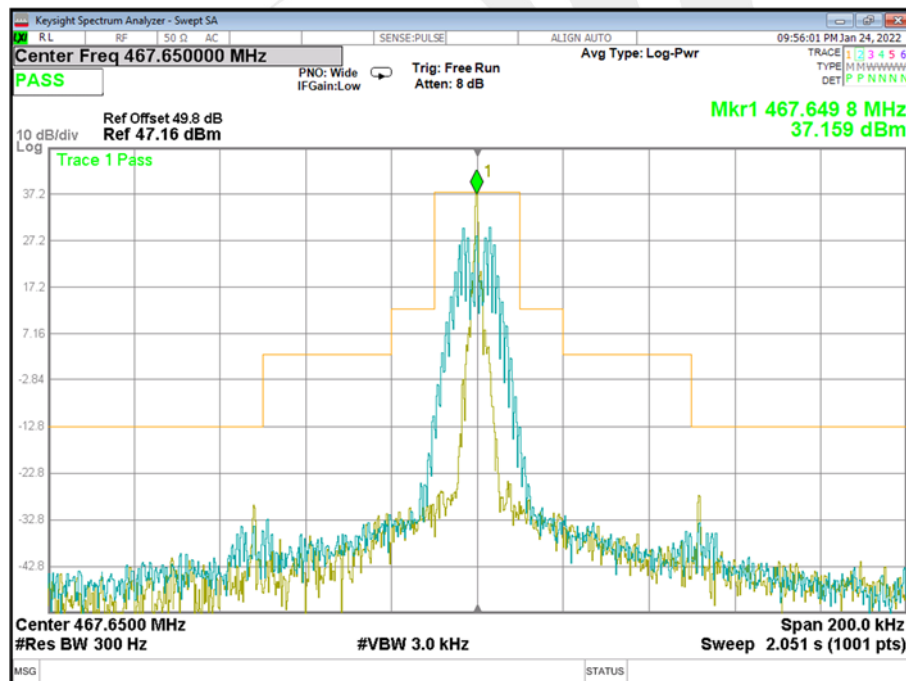




Mode 3

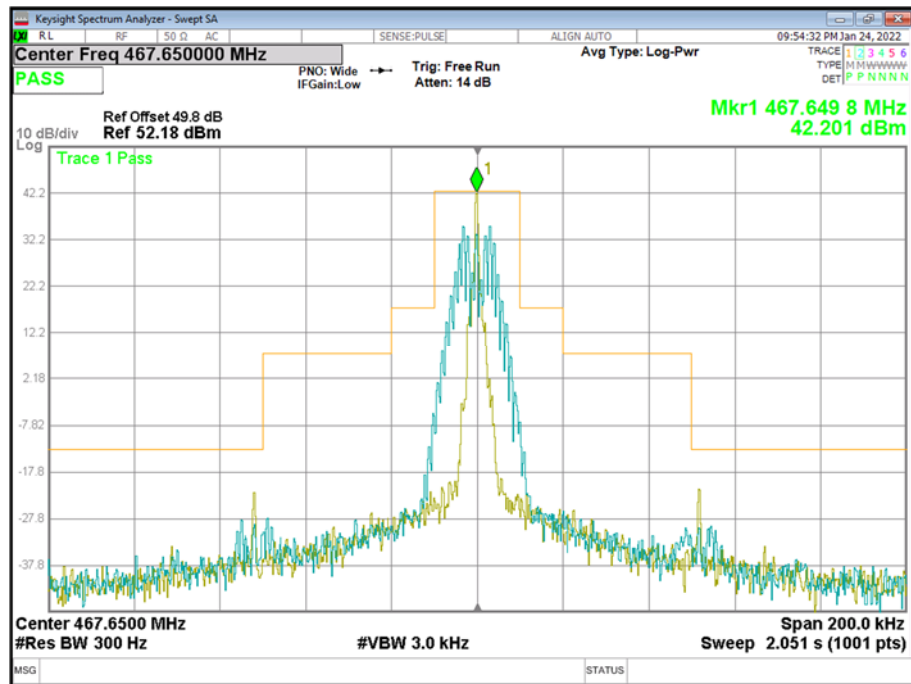


Mode 4





Mode 5



8. FREQUENCY STABILITY

8.1 LIMIT

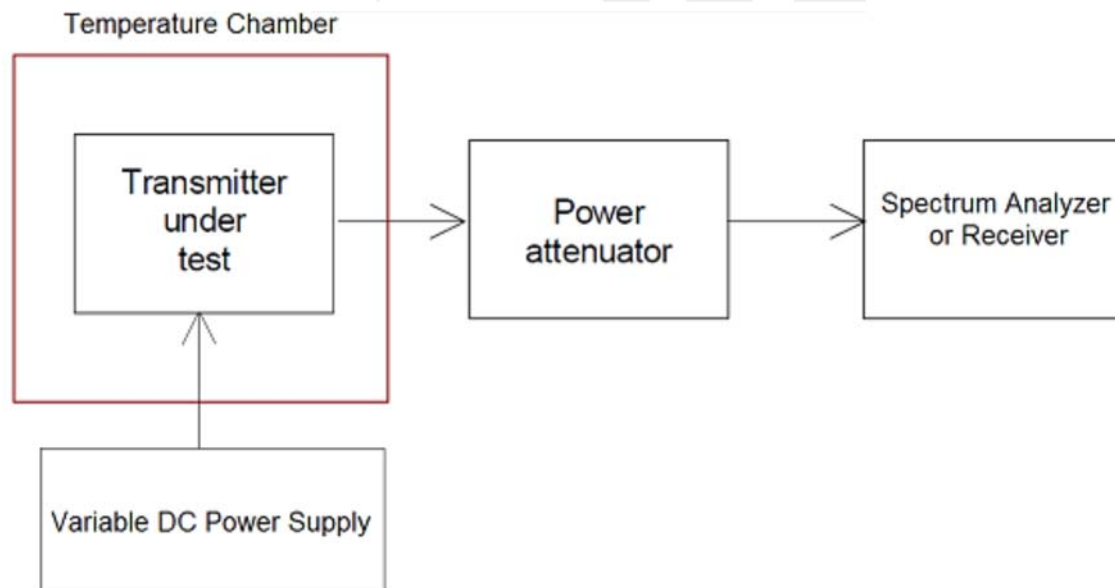
(a) The carrier frequency of each GMRS transmitter transmitting an emission with an occupied bandwidth greater than 12.5 kHz must remain within 5 parts-per-million (ppm) of the channel center frequencies listed in under normal operating conditions.

(b) 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 of the channel center frequencies listed in under normal operating conditions.

8.2 TEST PROCEDURE

1. The frequency stability shall be measured with variation of ambient temperature from -30°C to $+50^{\circ}\text{C}$
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 3.15V to 4.26V.
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. 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

8.3 TEST SETUP



8.4 EUT OPERATION CONDITIONS

TX mode.



8.5 TEST RESULT

Note: All mode has been tested, only shown the worst case in this report.

GMRS_Channl 4(462.6375MHz)						
Voltage	Temperature (°C)	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency error (ppm)	Limit	Result
Normal Voltage	-30	462.6375	462.6373	-0.4323	±5ppm	Pass
	-20	462.6375	462.6369	-1.2969		
	-10	462.6375	462.6371	-0.8646		
	0	462.6375	462.6369	-1.2969		
	10	462.6375	462.6369	-1.2969		
	20	462.6375	462.6372	-0.6485		
	30	462.6375	462.6372	-0.6485		
	40	462.6375	462.6372	-0.6485		
	50	462.6375	462.6374	-0.2162		
Maximum Voltage	20	462.6375	462.6372	-0.6485		
BEP	20	462.6375	462.6373	-0.4323		

GMRS_Channl 19(462.6500MHz)_High Power						
Voltage	Temperature (°C)	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency error (ppm)	Limit	Result
Normal Voltage	-30	462.6500	462.6499	-0.2161	±5ppm	Pass
	-20	462.6500	462.6498	-0.4323		
	-10	462.6500	462.6495	-1.0807		
	0	462.6500	462.6495	-1.0807		
	10	462.6500	462.6497	-0.6484		
	20	462.6500	462.6499	-0.2161		
	30	462.6500	462.6498	-0.4323		
	40	462.6500	462.6497	-0.6484		
	50	462.6500	462.6497	-0.6484		
Maximum Voltage	20	462.6500	462.6495	-1.0807		
BEP	20	462.6500	462.6496	-0.8646		



GMRS_Channl 27(467.6500MHz) _High Power						
Voltage	Temperature (°C)	Nominal Frequency (MHz)	Measured Frequency (MHz)	Frequency error (ppm)	Limit	Result
Normal Voltage	-30	467.6500	467.6499	-0.2138	±5ppm	Pass
	-20	467.6500	467.6495	-1.0692		
	-10	467.6500	467.6497	-0.6415		
	0	467.6500	467.6496	-0.8553		
	10	467.6500	467.6497	-0.6415		
	20	467.6500	467.6498	-0.4277		
	30	467.6500	467.6495	-1.0692		
	40	467.6500	467.6496	-0.8553		
	50	467.6500	467.6499	-0.2138		
Maximum Voltage	20	467.6500	467.6494	-1.2830		
BEP	20	467.6500	467.6498	-0.4277		

9. MODULATION LIMIT

9.1 LIMIT

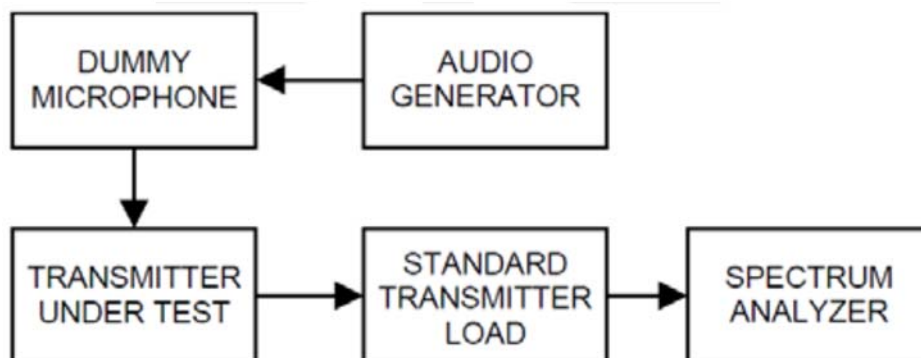
GMRS:

- (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.

9.2 TEST PROCEDURE

1. Connect the equipment as illustrated.
2. Adjust the transmitter per the manufacturer's procedure for full rated system deviation
3. Set the test receiver to measure peak positive deviation. Set the audio bandwidth for ≤ 0.25 Hz to $\geq 15,000$ Hz. Turn the de-emphasis function off
4. 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, this level is as a reference (0dB) and vary the input level from -20 to $+20$ dB.
5. Measure both the instantaneous and steady-state deviation at and after the time of increasing the audio input level
6. Repeat step 4-5 with input frequency changing to 300Hz, 1004Hz, 1500Hz and 2500Hz in sequence.

9.3 TEST SETUP

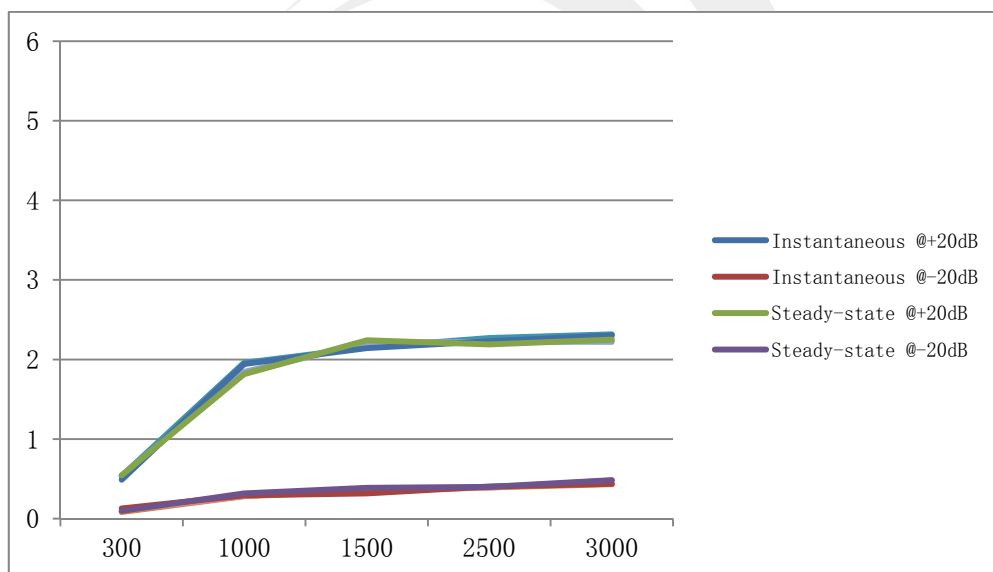




9.4 TEST RESULT

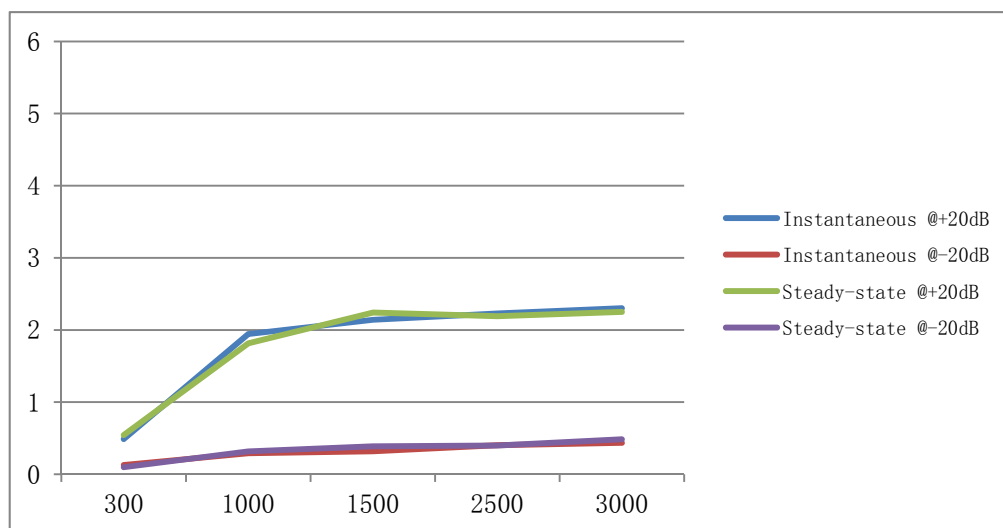
Note: All mode has been tested, only shown the worst case in this report.

GMRS_Channl 4(462.6375MHz)						
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit (kHz)	Result
	Deviation (@+20dB) (kHz)	Deviation (@-20dB) (kHz)	Deviation (@+20dB) (kHz)	Deviation (@-20dB) (kHz)		
300	0.535	0.082	0.539	0.099	±5	Pass
1000	1.96	0.283	1.845	0.284		
1500	2.153	0.348	2.206	0.361		
2500	2.271	0.391	2.222	0.39		
3000	2.315	0.432	2.221	0.48		



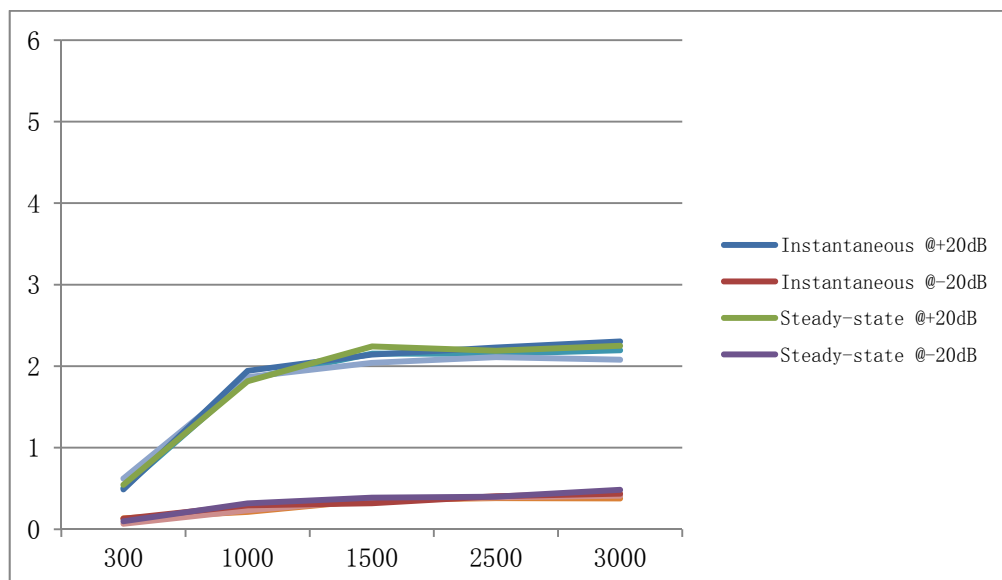


GMRS_Channl 19(462.6500MHz)_High Power						
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit (kHz)	Result
	Deviation (@+20dB) (kHz)	Deviation (@-20dB) (kHz)	Deviation (@+20dB) (kHz)	Deviation (@-20dB) (kHz)		
300	0.489	0.129	0.545	0.097	±5	Pass
1000	1.943	0.292	1.816	0.318		
1500	2.142	0.317	2.241	0.386		
2500	2.228	0.403	2.189	0.398		
3000	2.302	0.436	2.249	0.483		





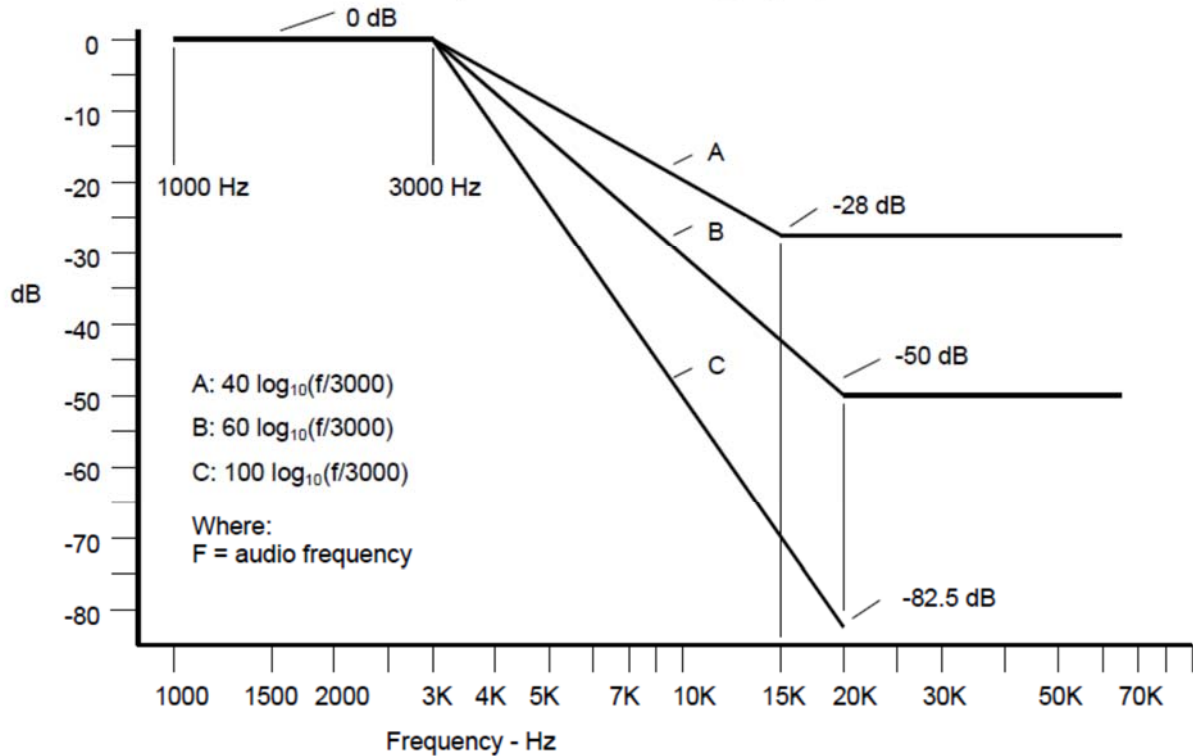
GMRS_Channl 27(467.6500MHz)_High Power						
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit (kHz)	Result
	Deviation (@+20dB) (kHz)	Deviation (@-20dB) (kHz)	Deviation (@+20dB) (kHz)	Deviation (@-20dB) (kHz)		
300	0.507	0.134	0.621	0.067	±5	Pass
1000	1.843	0.211	1.866	0.231		
1500	2.153	0.357	2.041	0.354		
2500	2.152	0.381	2.11	0.39		
3000	2.194	0.376	2.079	0.409		



10. AUDIO LOW PASS FILTER RESPONSE

10.1 LIMIT

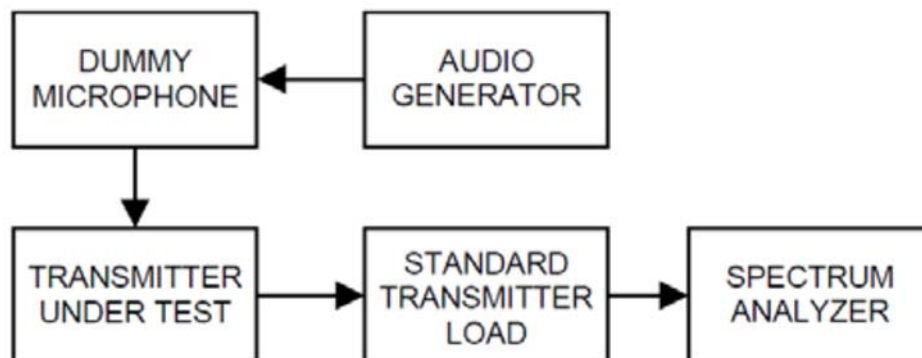
The filter must be between the modulation limiter and the modulated stage of the transmitter. At any frequency (f in kHz) between 3 and 20 kHz, the filter must have an attenuation of at least $60 \log_{10}(f/3)$ dB greater than the attenuation at 1 kHz. Above 20 kHz, it must have an attenuation of at least 50 dB greater than the attenuation at 1 kHz



10.2 TEST PROCEDURE

1. Configure the EUT as shown in figure
2. Apply a 1000 Hz tone from the audio signal generator and adjust the level per manufacturer's specifications. Record the dB level of the 1000 Hz tone as LEV_{REF} .
3. Set the audio signal generator to the desired test frequency between 3000 Hz and the upper low pass filter limit. Record the dB level at the test frequency as LEV_{FREQ}
4. Calculate the audio frequency response at the test frequency as:
 low pass filter response = $LEV_{FREQ} - LEV_{REF}$

10.3 TEST SETUP

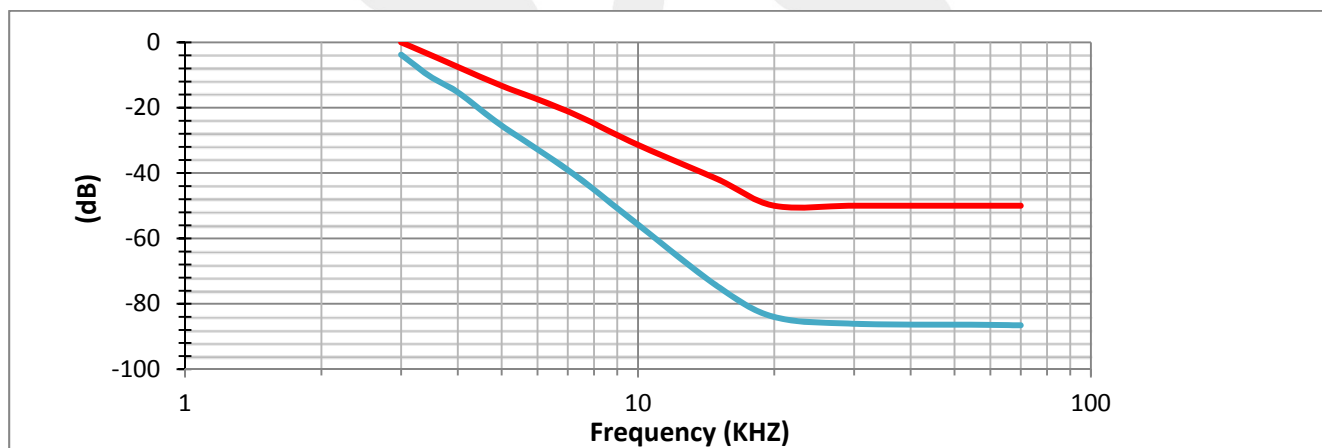




10.4 TEST RESULT

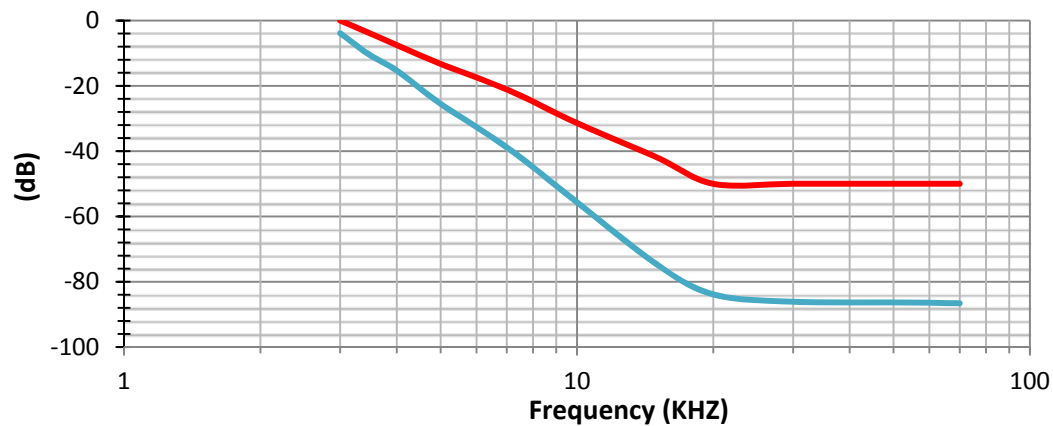
Note: All mode has been tested, only shown the worst case in this report.

GMRS_Channl 4(462.6375MHz)			
Audio Frequency(KHz)	Limit	Response Attenuation(dB)	Result
3	0	-3.79	PASS
3.5	-4	-10.70	
4	-7.5	-15.25	
5	-13.3	-25.49	
7	-21.1	-39.02	
10	-31.4	-55.78	
15	-41.9	-74.69	
20	-50	-84.04	
30	-50	-86.12	
50	-50	-86.38	
70	-50	-86.59	



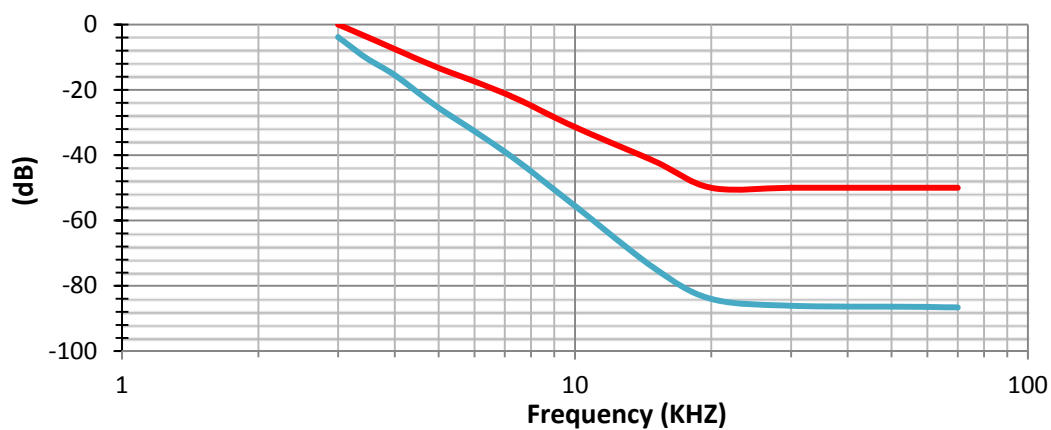


GMRS_Channl 19(462.6500MHz)_High Power			
Audio Frequency(KHz)	Limit	Response Attenuation(dB)	Result
3	0	-3.88	PASS
3.5	-4	-10.68	
4	-7.5	-15.30	
5	-13.3	-25.51	
7	-21.1	-38.82	
10	-31.4	-55.67	
15	-41.9	-74.65	
20	-50	-83.87	
30	-50	-86.13	
50	-50	-86.33	
70	-50	-86.59	





GMRS_Channel 27(467.6500MHz)_High Power			
Audio Frequency(KHz)	Limit	Response Attenuation(dB)	Result
3	0	-3.87	PASS
3.5	-4	-10.69	
4	-7.5	-15.47	
5	-13.3	-25.50	
7	-21.1	-38.95	
10	-31.4	-55.56	
15	-41.9	-74.70	
20	-50	-84.03	
30	-50	-86.14	
50	-50	-86.40	
70	-50	-86.64	

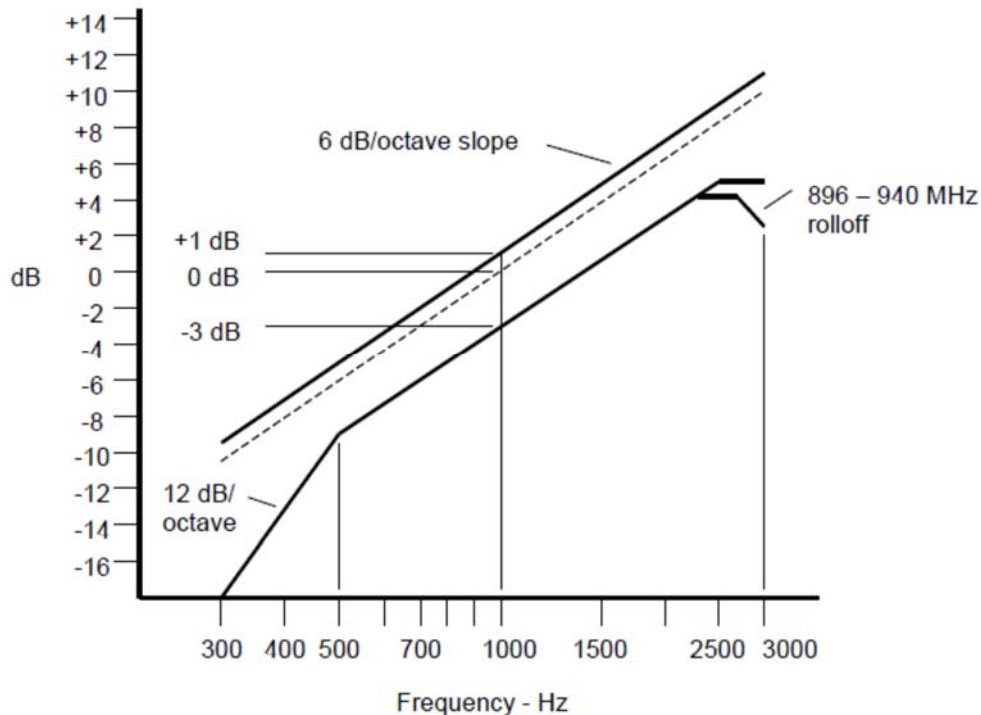


11. AUDIO FREQUENCY RESPONSE

11.1 LIMIT

FCC Part 2.1047(a):

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.

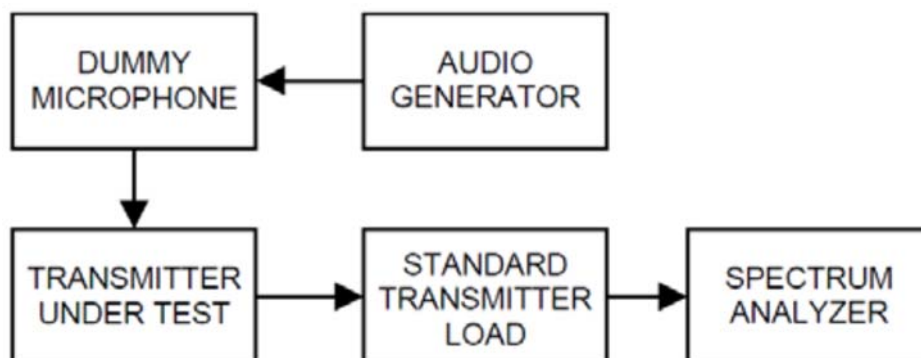


An additional 6 dB per octave attenuation is allowed from 2500 Hz to 3000 Hz in equipment operating in the 25 MHz to 869 MHz range

11.2 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 = $20\log_{10} (V_{FREQ}/V_{REF})$.

11.3 TEST SETUP

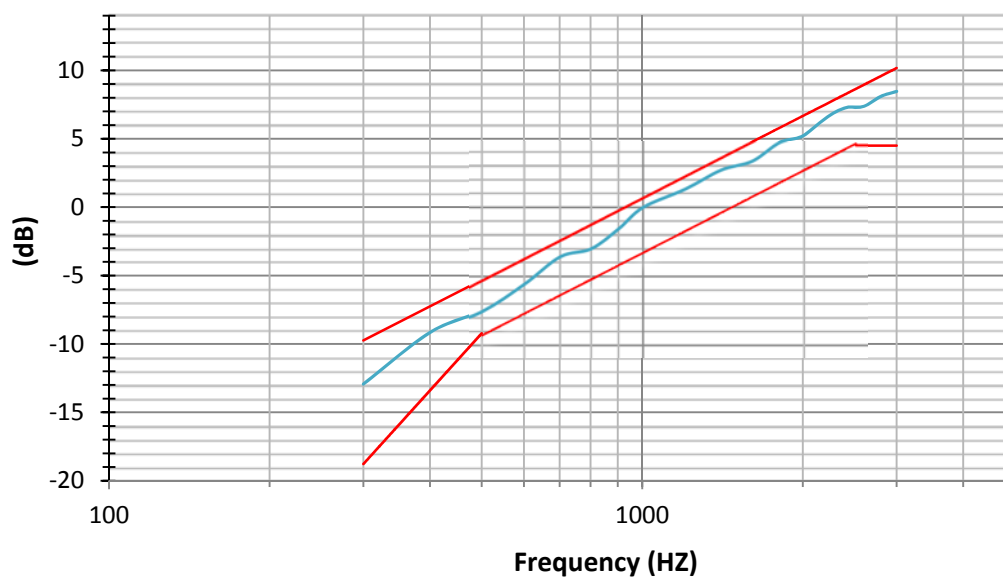




11.4 TEST RESULT

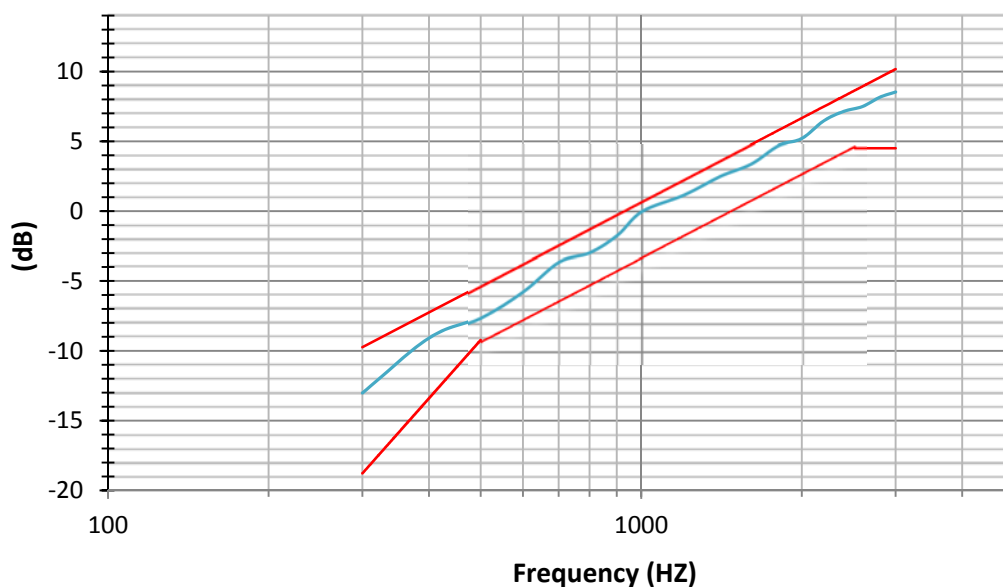
Note: All mode has been tested, only shown the worst case in this report.

GMRS_CH 4(462.6375MHz)		
Audio Frequency(Hz)	Audio Frequency Response(dB)	Result
300	-12.93	PASS
400	-9.16	
500	-7.56	
600	-5.57	
700	-3.58	
800	-3.00	
900	-1.56	
1000	0.00	
1200	1.33	
1400	2.71	
1600	3.35	
1800	4.70	
2000	5.20	
2200	6.46	
2400	7.26	
2600	7.36	
2800	8.09	
3000	8.46	



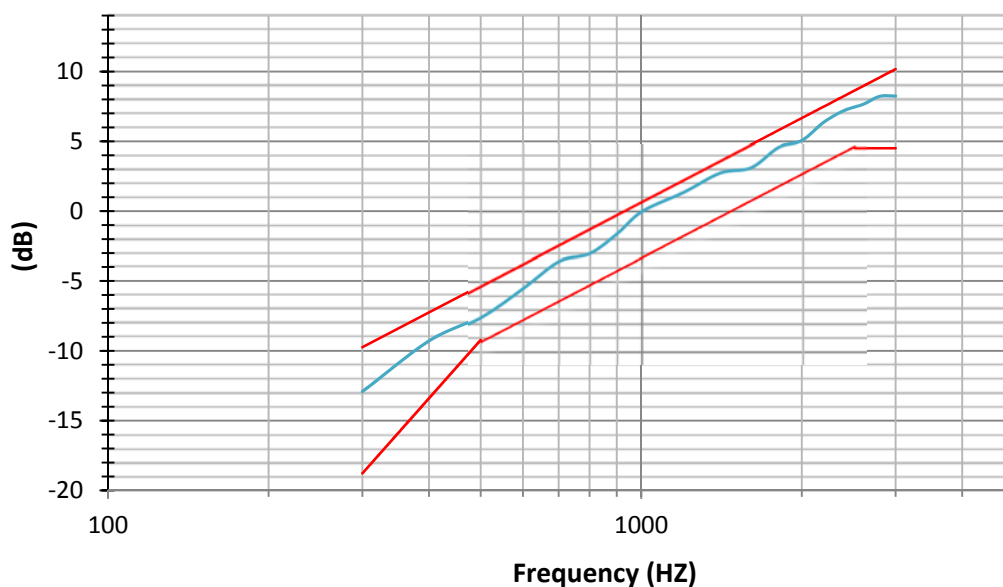


GMRS_Channl 19(462.6500MHz)		
Audio Frequency(Hz)	Audio Frequency Response(dB)	Result
300	-13.02	PASS
400	-9.08	
500	-7.57	
600	-5.69	
700	-3.58	
800	-2.93	
900	-1.69	
1000	0.00	
1200	1.18	
1400	2.50	
1600	3.38	
1800	4.69	
2000	5.20	
2200	6.47	
2400	7.15	
2600	7.49	
2800	8.15	
3000	8.53	





GMRS_Channl 27(467.6500MHz)		
Audio Frequency(Hz)	Audio Frequency Response(dB)	Result
300	-12.92	PASS
400	-9.29	
500	-7.54	
600	-5.45	
700	-3.53	
800	-2.98	
900	-1.56	
1000	0.00	
1200	1.39	
1400	2.74	
1600	3.12	
1800	4.57	
2000	5.06	
2200	6.37	
2400	7.2	
2600	7.63	
2800	8.22	
3000	8.24	





12. CONDUCTED EMISSION MEASUREMENT

12.1 POWER LINE CONDUCTED EMISSION LIMITS

The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

FREQUENCY (MHz)	Conducted Emission limit (dBuV)	
	Quasi-peak	Average
0.15 -0.5	66 - 56 *	56 - 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of “*” marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

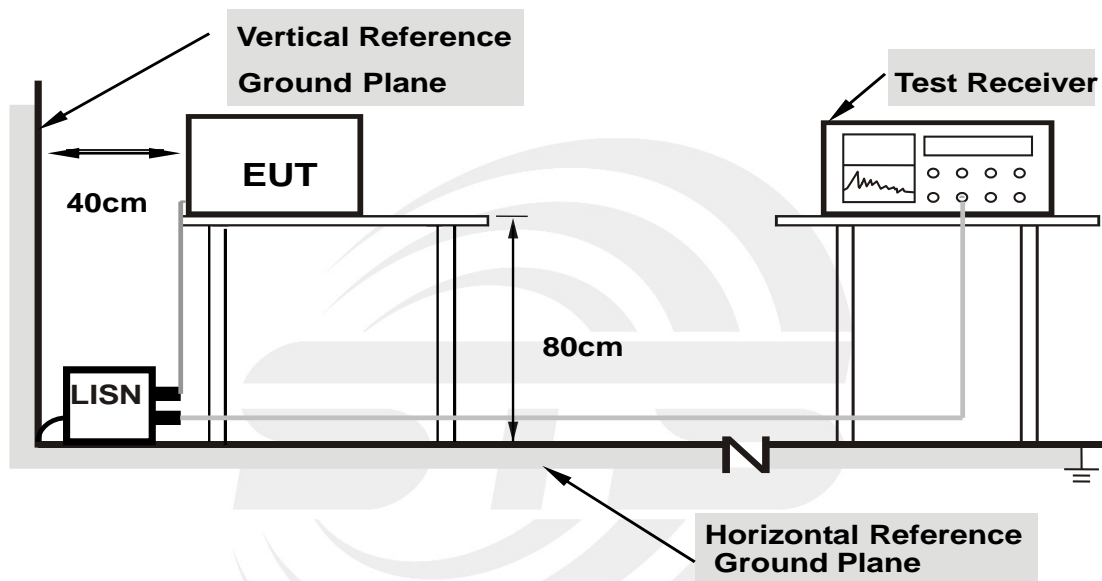
The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

12.2 TEST PROCEDURE

- The EUT is 0.8 m from the horizontal ground plane and 0.4 m from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments are powered from additional LISN(s). The LISN provides 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN is at least 80 cm from the nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

12.3 TEST SETUP



Note: 1. Support units were connected to second LISN.

2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes support units.

12.4 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

12.5 TEST RESULT

Temperature:	N/A	Relative Humidity:	N/A
Test Voltage:	N/A	Phase:	L/N
Test Mode:	N/A		

Note: EUT is only power by DC Power, So it is not applicable for this test.



APPENDIX 1- PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

*****END OF THE REPORT*****

