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Dates of Tests: Mar 13 ~ Mar 22, 2019
 Test Report S/N: LR500111905I
 Test Site : LTA CO., LTD.

RF TEST REPORT

FCC ID

2ASP2KHA-900T

APPLICANT

KUNYOONG IBC CO., LTD.

Device Category	:	Private Land Mobile Radio Service
Manufacturing Description	:	VHF Transceiver
Manufacturer	:	KUNYOONG IBC CO., LTD.
Trade name	:	KUNYOONG
Model name	:	KHA-900T
Serial number	:	Identical prototype
FCC Rule Part(s)	:	§2, §90
Frequency Range	:	216 ~ 217 MHz
RF Output Power	:	0.02 W
Channel Separation	:	6.25kHz
Emission Designators:	:	6K25F3E
Data of issue	:	Mar 20, 2019

This test report is issued under the authority of:

The test was supervised by:

Ja-Beom Koo, Manager

Eun-Hwan Jung, Test Engineer

This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. This report must not be used by the applicant to claim product endorsement by NVLAP or any agency of the U.S. Government.

TABLE OF CONTENTS

1. GENERAL INFORMATION	3
2. INFORMATION'S ABOUT TEST ITEM	4
3. TEST REPORT	5
3.1 SUMMARY OF TESTS	5
3.2 TEST RESULTS	6
3.2.1 RF EXPOSURE	6
3.2.2 RF OUTPUT POWER	7
3.2.3 Modulation Characteristic	8
3.2.4 OCCUPIED BANDWIDTH & EMISSION MASK	10
3.2.5 SPURIOUS EMISSIONS AT ANTENNA TERMINALS	13
3.2.6 RADIATED SPURIOUS EMISSIONS	15
3.2.7 FREQUENCY STABILITY	17
APPENDIX	
APPENDIX TEST EQUIPMENT USED FOR TESTS	18

1. General information

1-1 Test Performed

Company name : LTA Co., Ltd.
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Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the “General requirements for the competent of calibration and testing laboratory”.

1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2019-09-30	ECT accredited Lab.
RRA	KOREA	KR0049	-	EMC accredited Lab.
FCC	U.S.A	649054	Updating	FCC CAB
VCCI	JAPAN	C-4948,	2020-09-10	VCCI registration
VCCI	JAPAN	T-2416,	2020-09-10	VCCI registration
VCCI	JAPAN	R-4483(10 m),	2020-10-15	VCCI registration
VCCI	JAPAN	G-847	2022-06-13	VCCI registration
IC	CANADA	5799A-1	2019-06-15	IC filing
KOLAS	KOREA	NO.551	2021-08-20	KOLAS accredited Lab.

2. Information about test item

2-1 Client & Manufacturer

Company name : KUNYOONG IBC CO., LTD.
Address : Rm.1311 Digitalempire Bldg., 1130 Beoman-ro, Geumcheon-gu, Seoul
08595, Korea
TEL / FAX : +82-2-563-5260/ +82-2-561-5928

2-2 Equipment Under Test (EUT)

Trade name : KUNYOONG IBC CO., LTD.
Model name : KHA-900T
Date of receipt : Mar 20, 2019
EUT condition : Identical prototype
Frequency Range : 216 ~ 217 MHz
RF output power : 0.02W
Channel Separation : 6.25 kHz
Power Source : DC 3.7 V
Firmware version : V1.0

2-3 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	216.1	216.5	217.0

3. Test Report

3.1 Summary of tests

FCC Rules	Description of Test	Results
§1.1307(b); §2.1093	RF Exposure	C
§2.1046; §90.205	RF Output Power	C
§2.1047; §90.207	Modulation Characteristic	C
§2.1049; §90.209; §90.210	Occupied Bandwidth & Emission Mask	C
§2.1051; §90.210	Spurious Emission at Antenna Terminal	C
§2.1053;	Spurious Radiated Emissions	C
§2.1055; §90.213	Frequency Stability	C
§90.214	Transient Frequency Behavior	NA ³

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

Note 3: Exclusion targets in frequency band..

The sample was tested according to the following specification :

- FCC Part2, Part 90
- ANCI C 63.4-2014
- TIA/EIA-603-E

3.2 TEST RESULTS

3.2.1 RF EXPOSURE

Applicable Standard :

According to FCC §1.1307(b) and §2.1093, portable device operates Part 90 should be subjected to routine environmental evaluation for RF exposure prior or equipment authorization or use.

Result : Compliance.

3.2.2 RF OUTPUT POWER

Applicable Standard : FCC §2.1046 and §90.205

Test Procedure

Conducted RF Output Power:

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The spectrum analyzer is setting:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

Sweep = auto

VBW = 300 kHz

Detector function = peak

Trace = max hold

Test Result : Compliance.

Measurement Data: Transmitting

Modulation	Channel Separation (kHz)	Frequency (MHz)	Power Level	Output Power (dBm)	Output Power (w)	Result
Digital	6.25	216.1	0.02 W	10.06	0.010	Pass
	6.25	216.5	0.02 W	9.05	0.008	Pass
	6.25	217.0	0.02 W	9.49	0.009	Pass

3.2.3 Modulation Characteristic

Applicable Standard : FCC§2.1047(a),(b)

- (a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- (b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

Test Procedure

Test Method : TIA -603-E 2.2.6, 2.2.3

NOTE : The Low Pass Filter is digital, and has no 'input' or 'output' as found in the method of measurement, above. Testing has been altered accordingly to show the operation of the filter..

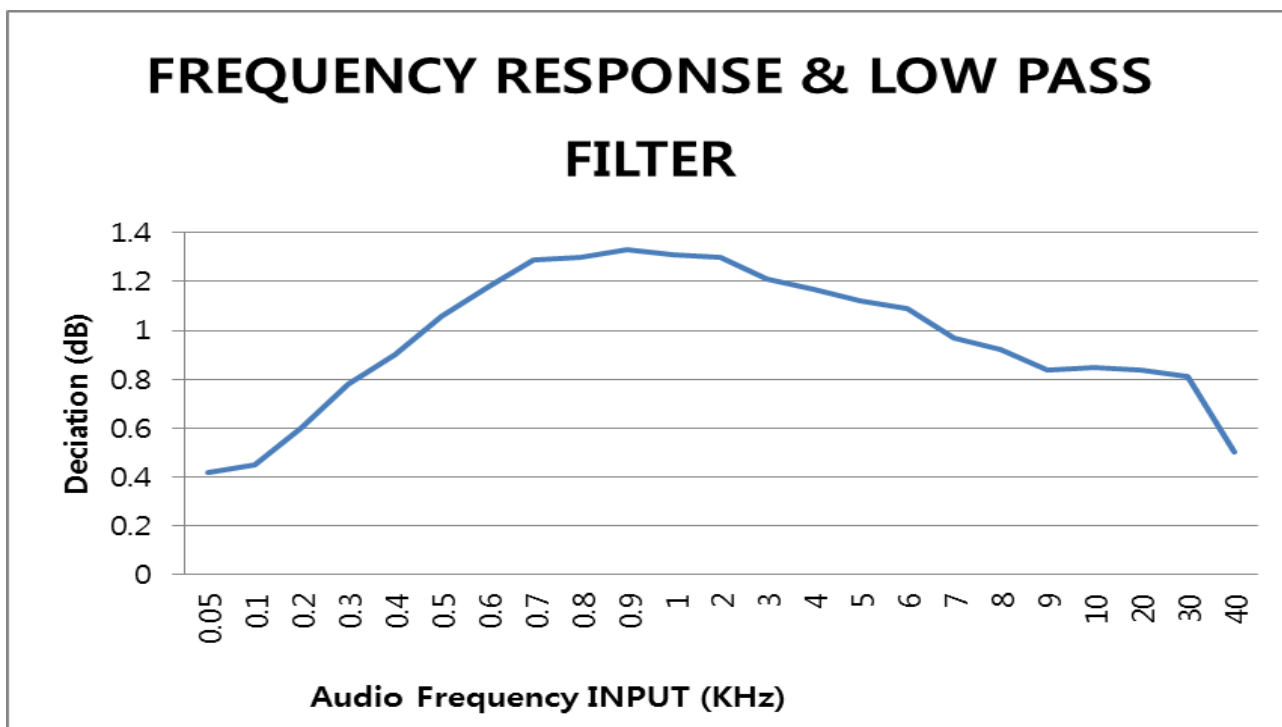
NOTE : Testing deviates from TIA 603-E 2.2.6.2.2 and 2.2.15. The Audio Frequency Response and Low Pass Filter Response plot data has been taken simultaneously using the Modulation Meter reading of Deviation (KHz), satisfying the requirements above.

NOTE : The test method is not sufficient to meet the standard of FCC Pt. 21047 alone. Deviation(KHz), as recorded from test equipment, has been converted into percentage as required above.

Test Result : Compliance.

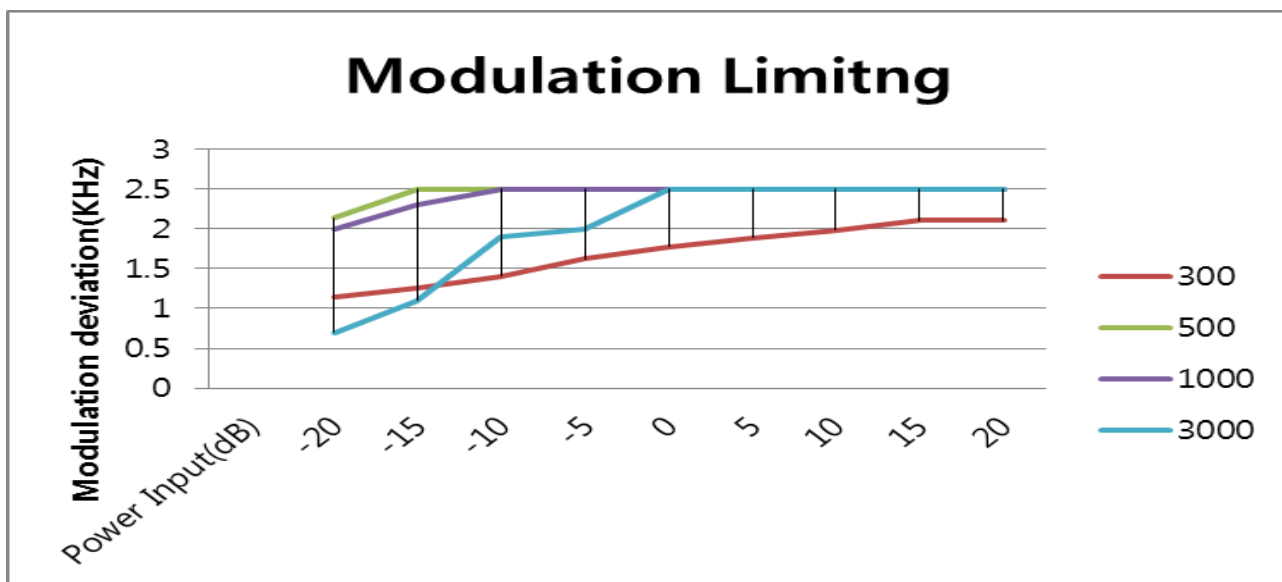
Measurement Data: FREQUENCY RESPONSE & LOW PASS FILTER

(Carrier Frequency : 216.5 MHz, Channel Separation : 6.25 kHz)



Measurement Data: Modulation Limitng

(Carrier Frequency : 216.5 MHz, Channel Separation : 6.25 kHz)



3.2.4 OCCUPIED BANDWIDTH & EMISSION MASK

Applicable Standard : FCC §2.1049, §90.209 and §90.210

Emission Mask B - For transmitters that are equipped with an audio lowpass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

- (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB..

Analog :

In this case, the maximum modulating frequency is 3.0 kHz with a 2.5 kHz deviation

$$BW = 2(M+D) = 2*(3.0 \text{ kHz} + 2.5 \text{ kHz}) = 11 \text{ kHz} \rightarrow 11K0$$

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 100 Hz and the spectrum was recorded in the frequency band ± 50 kHz from the carrier frequency.

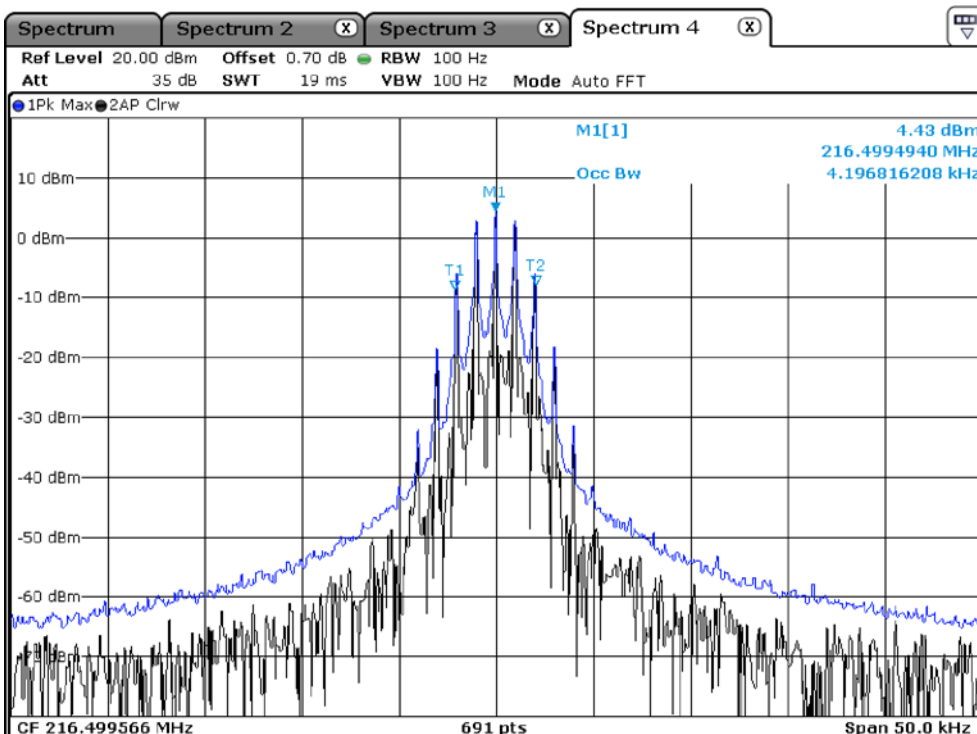
Test Result : Compliance.

Measurement Data: Transmitting

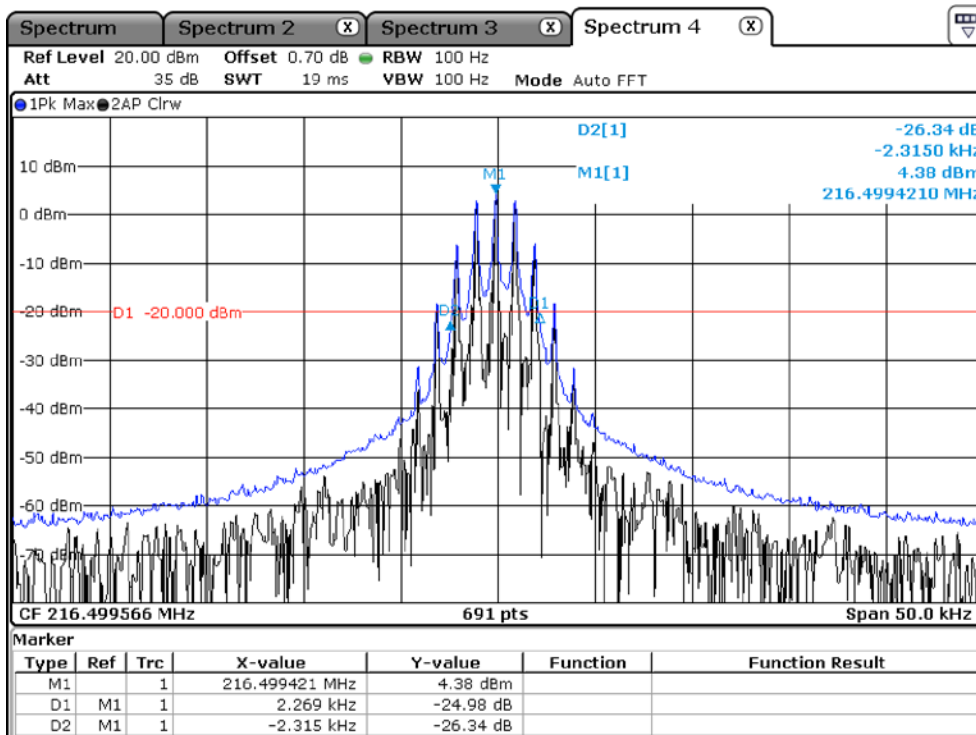
Modulation	Frequency (MHz)	Channel Space (kHz)	Power Level	99% Occupied Bandwidth (kHz)	26dB Emissions Bandwidth (kHz)	FCC Limit (kHz)
Analog	216.5	6.25	0.02 W	4.20	4.57	6.00

Digital Modulation :

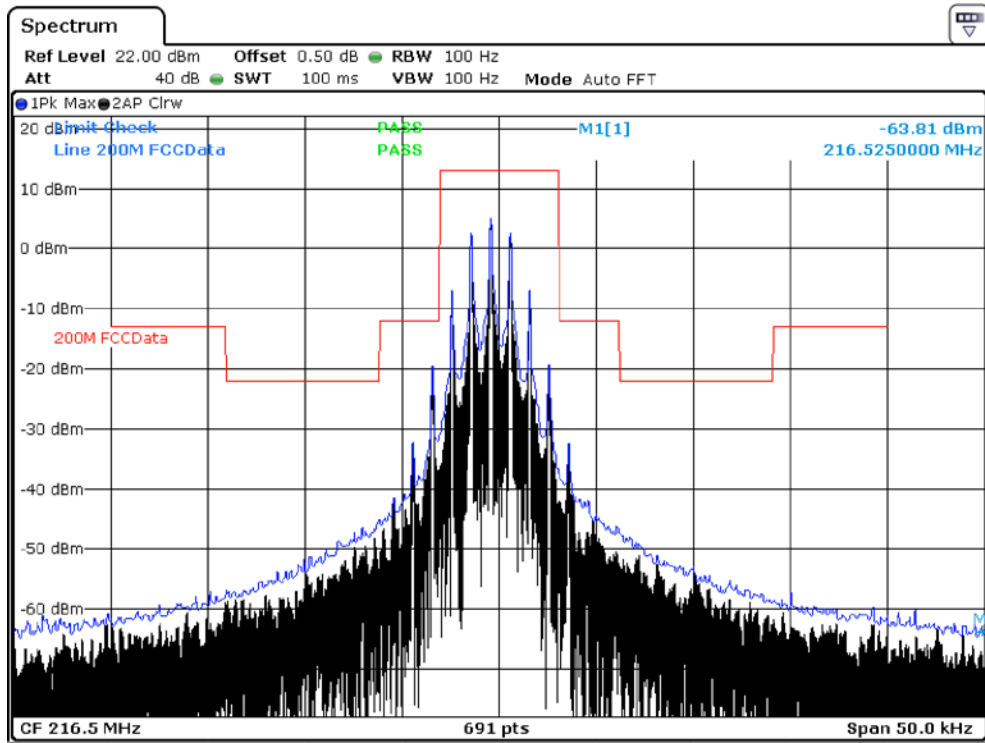
99% Occupied Bandwidth



26 dB Emissions Bandwidth 6.25 kHz, 216.5 MHz (0.02 W)



Emission Mask B with 0.02 W 6.25 kHz, 216.5 MHz



3.2.5 SPURIOUS EMISSIONS AT ANTENNA

Applicable Standard

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

- (1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz.
- (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
- (4) Other types of equipment as required, when deemed necessary by the Commission.

Test Procedure

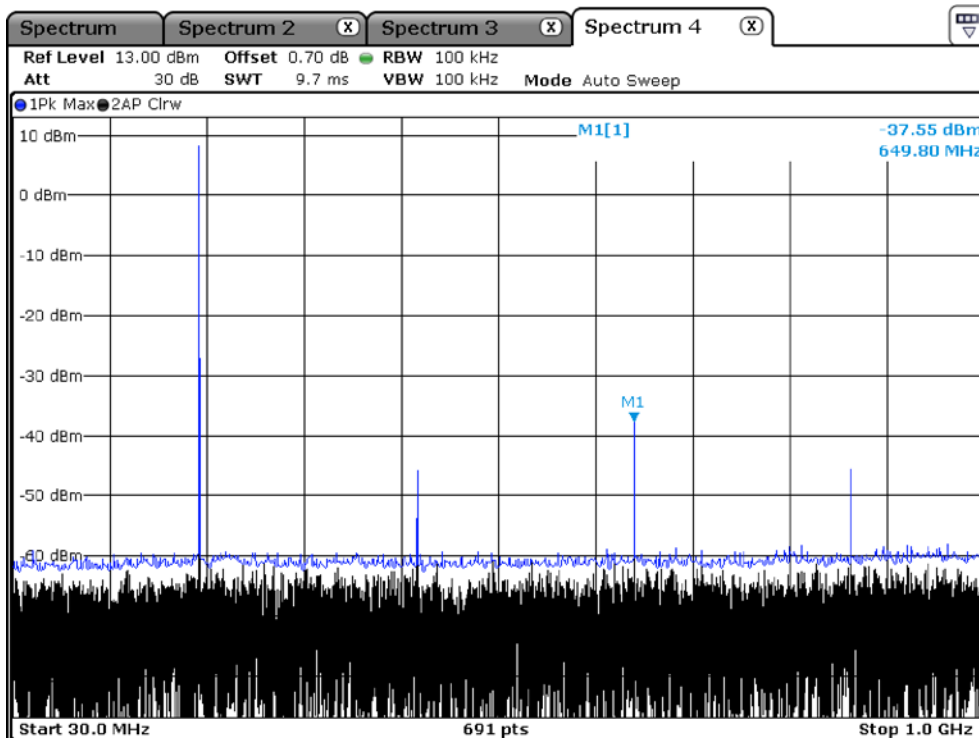
The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz for below 1 GHz, and 1 MHz for above 1 GHz. sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Result : Compliance.

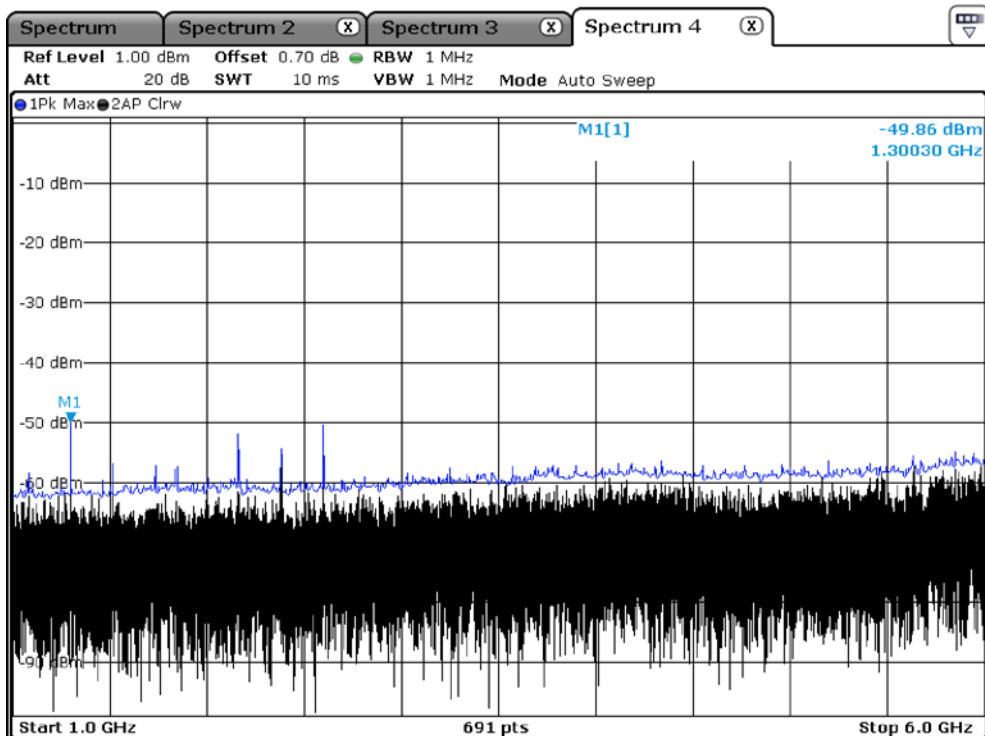
Modulation	Frequency (MHz)	Channel Space (kHz)	Maximum Conducted Spurious Emissions Below 1 GHz		Maximum Conducted Spurious Emissions Above 1 GHz		FCC Limit
			Frequency (MHz)	Results (dBm)	Frequency (MHz)	Results (dBm)	
Analog (0.02W)	216.5	6.25	649.80	-37.55	1300.03	-49.86	-13 dBm

Analog Modulation :

30 MHz – 1 GHz, Spacing Channel 6.25 kHz, 216.5 MHz



1 GHz – 6 GHz, Spacing Channel 12.5 kHz, 155.01 MHz



3.2.6 RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053 and §90.210

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to teeth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = $10 \lg(\text{TXpwr in Watts}/0.001)$ -the absolute level

Spurious attenuation limit in dB = $50 + 10 \lg_{10}(\text{power out in Watts})$ for EUT with a 12.5 kHz channel bandwidth.

Spurious attenuation limit in dB = $55 + 10 \lg_{10}(\text{power out in Watts})$ for EUT with a 6.25 kHz channel bandwidth.

Test Result : Compliance.

Measurement Data: Transmitting

30 MHz – 2GHz

Frequency (MHz)	Receiver Reading (dB μ V)	Turn Table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	FCCpart90	
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)		Limit (dBm)	Margin (dB)
Analog Modulation 216.5 MHz, Channel Spacing 6.25 KHz										
186.17	42.20	351	4.0	H	-48.77	1.79	12.98	-37.58	-20	17.58
246.80	48.60	0	4.0	H	-40.06	1.86	11.34	-30.58	-20	10.58
433.04	48.69	351	2.2	H	-44.33	1.97	10.04	-36.26	-20	16.26
155.74	40.68	63	1.0	V	-37.06	2.31	12.23	-27.14	-20	7.14
186.17	48.49	243	1.0	V	-46.22	4.16	22.66	-27.72	-20	7.72
246.80	41.50	243	1.0	V	-44.09	4.96	24.37	-24.68	-20	4.68
1 GHz ~ 2GHz	● Noise floor									

Note : Absolute Level = SG Level-Cable loss + Antenna Gain

Margin = Limit – Absolute Level

3.2.7 FREQUENCY STABILITY

Applicable Standard

FCC §2.1055 and §90.213

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

For Digital Modulation

Reference Frequency : 216.5 MHz, Limit : ± 2.5 ppm, 6.25 kHz			
Test Environment		Frequency Measure with Time Elapsed	
Temperature ($^{\circ}$ C)	Power Supplied (V _{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	3.7	216.499421	0.302
40	3.7	216.499421	0.302
30	3.7	216.499411	0.367
20	3.7	216.499469	0.407
10	3.7	216.499422	0.374
0	3.7	216.499413	0.368
-10	3.7	216.499468	0.406
-20	3.7	216.499475	0.412
-30	3.7	216.499481	0.417
Frequency Stability versus Input Voltage			
20	2.5	216.499469	0.407

APPENDIX
TEST EQUIPMENT USED FOR TESTS

	Use	Description	Model No.	Serial No.	Manufacturer	Interval	Last Cal. Date
1	■	Signal Analyzer (9 kHz ~ 30 GHz)	FSV30	100757	R&S	1 year	2019-09-07
2		Signal Generator (~3.2 GHz)	8648C	3623A02597	HP	1 year	2020-03-20
3		SYNTHESIZED CW GENERATOR	83711B	US34490456	HP	1 year	2020-03-20
4		Attenuator (3 dB)	8491A	37822	HP	1 year	2019-09-07
5		Attenuator (10 dB)	8491A	63196	HP	1 year	2019-09-07
6	■	EMI Test Receiver (~7 GHz)	ESCI7	100722	R&S	1 year	2019-09-07
7		RF Amplifier (~1.3 GHz)	8447D OPT 010	2944A07684	HP	1 year	2019-09-07
8		RF Amplifier (1~26.5 GHz)	8449B	3008A02126	HP	1 year	2019-03-21
9		Horn Antenna (1~18 GHz)	3115	00114105	ETS	2 year	2020-08-04
10		DRG Horn (Small)	3116B	81109	ETS-Lindgren	2 year	2020-03-18
11		DRG Horn (Small)	3116B	133350	ETS-Lindgren	2 year	2020-03-18
12	■	TRILOG Antenna	VULB 9160	9160-3237	SCHWARZBECK	2 year	2021-03-20
13		Temp.Humidity Data Logger	SK-L200TH II A	00801	SATO	1 year	2020-03-20
14		Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-	-
15	■	DC Power Supply	6674A	3637A01657	Agilent	-	-
17	■	Power Meter	EPM-441A	GB32481702	HP	1 year	2020-03-20
18	■	Power Sensor	8481A	3318A94972	HP	1 year	2019-09-07
19		Audio Analyzer	8903B	3729A18901	HP	1 year	2019-09-07
20		Modulation Analyzer	8901B	3749A05878	HP	1 year	2019-09-07
21		TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	1 year	2019-09-07
22		Stop Watch	HS-3	812Q08R	CASIO	2 year	2020-03-18
23		LISN	KNW-407	8-1430-1	Kyoritsu	1 year	2019-09-07
24		Two-Lime V-Network	ESH3-Z5	893045/017	R&S	1 year	2020-03-18
25		UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	1 year	2020-03-18
26		Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	1 year	2020-03-18
27		Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	1 year	2020-03-18
28		OSP120 BASE UNIT	OSP120	101230	R&S	1 year	2020-03-18
29		Signal Generator(100 kHz ~ 40 GHz)	SMB100A03	177621	R&S	1 year	2020-03-18
30	■	Signal Analyzer (10 Hz ~ 40 GHz)	FSV40	101367	R&S	1 year	2020-03-18
31	■	Active Loop Antenna	FMZB 1519	1519-031	SCHWARZBECK	2 year	2021-02-26