74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

FCC REPORT

FCC Class II Permissive Change

Applicant Name:
SAMSUNG Electronics Co., Ltd.

Address:
129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

Date of Issue:
January 30, 2019

Location of test lab:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-RF-1901-FC033

FCC ID:	**A3LMTP02P-41A**
APPLICANT:	**SAMSUNG Electronics Co.,Ltd.**

Model: MTP02P-41A

EUT Type: MMU(MTP02P)

Frequency Ranges: 2 496 MHz ~ 2 690 MHz

Tx Output Power: 160 W (2.5 W x 64 port)

Emission Designator:

Mode	Emission Designator	
	QPSK (G7D)	16QAM/64QAM/256QAM (W7D)
LTE 20 MHz	18M0G7D	18M0W7D
LTE 15 MHz	13M6G7D	13M6W7D

Date of Test: January 19, 2019 ~ January 30, 2019

FCC Rule Part(s): CFR 47 Part 2, Part 27

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

Report prepared by : Kwang Il Yoon
Engineer of telecommunication testing center

Approved by : Jong Seok Lee
Manager of telecommunication testing center

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1901-FC033	January 30, 2019	- First Approval Report

Table of Contents

1. GENERAL INFORMATION

1.1. APPLICANT INFORMATION

Company Name	Samsung Electronics Co., Ltd.
Company Address	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

1.2. PRODUCT INFORMATION

EUT Type	MMU(MTP02P)
Power Supply	-48 VDC, 27 A
Emission Designator	

Mode	Emission Designator	
	QPSK (G7D)	16QAM/64QAM/256QAM (W7D)
LTE 20 MHz	18M0G7D	18M0W7D
LTE 15 MHz	13M6G7D	13M6W7D

Frequency Range	2 496 MHz ~ 2 690 MHz
Tx Output Power	160 W (2.5 W x 64 port)
Channel Bandwidths	LTE 20 MHz, LTE 15 MHz
Modulation Type	QPSK, 16QAM, 64QAM, 256QAM
Antenna Specification	Service Beam Gain: 23 ± 0.5 dBi (32 Tx maximum gain condition)

1.3. TEST INFORMATION

FCC Rule Parts	CFR 47 Part 2, Part 27
Measurement standards	ANSI C63.26-2015, KDB 662911 D01 v02r01
Place of Test	HCT CO., LTD. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

2. FACILITIES AND ACCREDITATIONS

2.1. FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4 (Version: 2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 07, 2015 (Registration Number: 90661).

2.2. EQUIPMENT

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

3. TEST SPECIFICATIONS

3.1. STANDARDS

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 2, Part 27

Description	Reference	Results
RF Output Power	§2.1046, §27.50(h)	Compliant
Occupied Bandwidth	§2.1049	N/A
Unwanted Conducted Emissions	§2.1051, §27.53(m)	Compliant
Radiated Emissions	§2.1053, §27.53	Compliant
Frequency Stability	§2.1055, §27.54	Compliant

Note:

1. Refer to existing report 'HCT-RF-1805-FC048-R1' for data not included.
2. The differences between "MTP02P-41" and "MTP02P-41A" are

   Change #1: Adding 60 MHz Channel Bandwidths for 5G NR

   Change #2: MMU Changed

   - UVLO (Under Voltage Lockout) changed
   - VCXO for reference clock changed from 122.88 MHz to 30.72 MHz

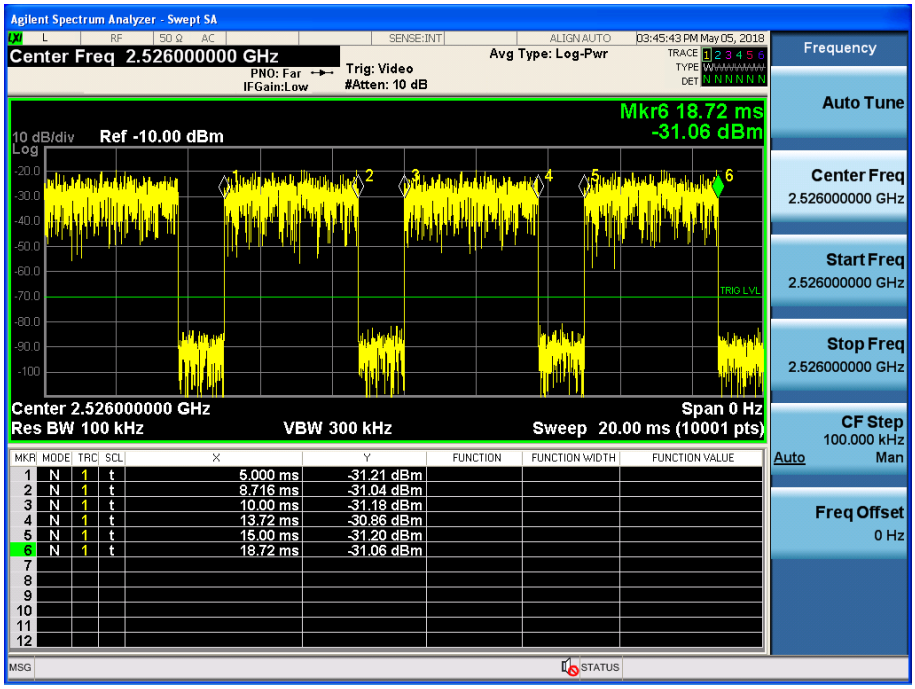
   Change #3: Antenna Changed

   - Remove isolation wall
   - Add shield can
3. The data from that application has been verified through appropriate spot checks to demonstrate compliance for this device as shown in the test results. The spot check test results are the only worst case. (Port 31, 20 MHz + 20 MHz + 20 MHz / 3 Carriers, 64QAM)

3.2. MODE OF OPERATION DURING THE TEST

- The EUT was operated in a manner representative of the typical usage of the equipment.
- During all testing, system components were manipulated within the confines of typical usage to maximize each emission.
- All LTE modulation types (QPSK, 16QAM, 64QAM, 256QAM) supported by the EUT have been tested.
- Unwanted conducted emissions were performed on one port with a maximum output power level.
- The dummy loads were connected to the RF output ports for radiated spurious emission testing.
- Because of the EUT using LTE-TDD technology, it cannot be configured to transmit continuously and measurement instrument cannot be configured to measure only during active transmissions. So we perform the measurement using duty cycle method.

Measurement Result of MTP02P-41A Transmit On/Off Timing



- The EUT duty cycle is calculated according to ANSI C63.26 - 5.2.4.3.4.

Duty Cycle = On-time / Transmitter period = 3.72 / 5 = 0.744

Duty Correction = 10 log (1/duty cycle) = 10 log (1/0.744) = 1.284 dB

This duty correction factor is applied to output power measurement and unwanted conducted emissions.

- The tests results in plots are already including the actual value of loss for the attenuator and cable combination. Please check correction factors below table.
- The factor table contains additional 1.2 dB correction for test jig provide by applicant.

▣ Correction Factor for In-Band Measurement

Port	Factor (dB)						
	2 300 MHz	2 400 MHz	2 500 MHz	2 600 MHz	2 700 MHz	2 800 MHz	2 900 MHz
0	34.969	35.090	35.099	35.127	35.264	35.252	35.309
1	34.961	35.031	35.030	35.056	35.188	35.124	35.185
2	34.897	34.977	34.982	34.998	35.108	35.066	35.115
3	34.806	34.838	34.835	34.828	34.918	34.872	34.932
4	34.935	35.035	35.041	35.022	35.099	35.049	35.175
5	35.216	35.334	35.334	35.329	35.447	35.416	35.446
6	35.149	35.274	35.279	35.317	35.410	35.396	35.444
7	34.903	34.974	34.990	35.025	35.171	35.147	35.214
8	35.126	35.243	35.262	35.345	35.395	35.388	35.434
9	35.129	35.252	35.277	35.320	35.467	35.463	35.534
10	35.080	35.179	35.193	35.225	35.334	35.342	35.425
11	35.035	35.140	35.169	35.236	35.371	35.368	35.409
12	35.128	35.254	35.275	35.309	35.425	35.474	35.563
13	35.089	35.179	35.196	35.182	35.298	35.260	35.324
14	35.080	35.214	35.219	35.290	35.378	35.416	35.501
15	35.090	35.239	35.196	35.286	35.329	35.328	35.403
16	34.980	35.092	35.101	35.162	35.264	35.249	35.283
17	35.025	35.124	35.097	35.117	35.226	35.169	35.215
18	35.057	35.160	35.192	35.239	35.355	35.358	35.397
19	35.087	35.178	35.194	35.199	35.264	35.204	35.241
20	35.152	35.274	35.282	35.342	35.441	35.441	35.544
21	35.116	35.161	35.178	35.259	35.310	35.285	35.372
22	35.236	35.404	35.399	35.446	35.587	35.598	35.716
23	34.981	35.091	35.113	35.125	35.269	35.245	35.341
24	35.270	35.419	35.412	35.463	35.598	35.597	35.682
25	34.806	34.864	34.903	34.907	35.069	35.042	35.128
26	34.886	34.981	34.963	34.977	35.115	35.072	35.142
27	35.179	35.314	35.319	35.415	35.511	35.499	35.567
28	34.985	35.104	35.095	35.099	35.221	35.192	35.268
29	35.261	35.399	35.371	35.475	35.578	35.571	35.645

Port	Factor (dB)						
	2 300 MHz	2 400 MHz	2 500 MHz	2 600 MHz	2 700 MHz	2 800 MHz	2 900 MHz
30	35.100	35.185	35.199	35.328	35.382	35.384	35.462
31	36.727	36.903	36.920	37.034	37.233	37.260	37.372
32	34.969	35.065	35.076	35.045	35.196	35.180	35.253
33	34.941	35.050	35.035	35.081	35.219	35.204	35.294
34	34.916	34.970	35.000	35.021	35.143	35.132	35.187
35	35.145	35.237	35.250	35.311	35.428	35.428	35.493
36	35.160	35.282	35.299	35.354	35.446	35.452	35.526
37	35.028	35.139	35.139	35.159	35.311	35.306	35.384
38	34.937	35.014	35.017	35.071	35.141	35.133	35.192
39	34.901	34.991	34.990	35.032	35.147	35.128	35.205
40	35.131	35.205	35.235	35.321	35.378	35.398	35.444
41	34.869	34.962	34.940	34.958	35.099	35.086	35.152
42	34.853	34.966	34.947	34.946	35.069	35.051	35.141
43	34.706	34.758	34.773	34.761	34.864	34.850	34.947
44	34.818	34.914	34.887	34.878	35.021	34.993	35.039
45	35.046	35.184	35.141	35.223	35.339	35.354	35.396
46	34.999	35.130	35.093	35.110	35.237	35.224	35.292
47	35.052	35.162	35.143	35.201	35.292	35.291	35.384
48	34.845	34.935	34.936	34.928	35.041	35.019	35.101
49	34.991	35.102	35.094	35.111	35.279	35.272	35.333
50	35.035	35.167	35.146	35.171	35.326	35.325	35.395
51	35.061	35.205	35.209	35.224	35.351	35.349	35.402
52	35.022	35.142	35.144	35.234	35.318	35.344	35.436
53	34.810	34.858	34.896	34.907	34.976	34.941	35.077
54	34.942	35.076	35.027	35.053	35.171	35.161	35.254
55	35.068	35.195	35.180	35.190	35.334	35.330	35.400
56	34.853	34.966	34.953	34.958	35.092	35.101	35.198
57	34.985	35.077	35.089	35.103	35.244	35.243	35.328
58	35.128	35.298	35.274	35.279	35.434	35.450	35.542
59	34.98	35.105	35.071	35.137	35.248	35.244	35.288
60	34.935	35.070	35.026	35.035	35.145	35.141	35.252
61	34.929	35.047	35.000	34.974	35.067	35.069	35.095
62	35.143	35.243	35.255	35.328	35.409	35.421	35.483
63	35.673	35.822	35.820	35.888	36.028	36.007	36.135

▣ Correction Factor for Out-of-Band Measurement

Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)	Frequency (MHz)	Factor (dB)
50	30.62	1 000	31.75	11 000	34.40	21 000	38.42
100	31.15	2 000	31.00	12 000	33.85	22 000	38.13
200	30.63	3 000	31.76	13 000	36.71	23 000	39.31
300	30.64	4 000	32.32	14 000	35.66	24 000	40.94
400	30.70	5 000	33.02	15 000	36.23	25 000	43.30
500	30.85	6 000	33.38	16 000	35.44	26 000	44.34
600	31.21	7 000	33.61	17 000	35.71	26 500	42.95
700	31.39	8 000	34.34	18 000	36.13		
800	31.50	9 000	35.02	19 000	36.69		
900	31.61	10 000	34.62	20 000	37.91		

3.3. MAXIMUM MEASUREMENTUNCERTAINTY

The value of the measurement uncertainty for the measurement of each parameter.

Coverage factor *k* = 2, Confidence levels of 95 %

Description	Condition	Uncertainty
RF Output Power	-	± 0.72 dB
Occupied Bandwidth	OBW ≤ 20 MHz	± 52 kHz
Unwanted Conducted Emissions	-	± 1.08 dB
Radiated Emissions	f ≤ 1 GHz f > 1 GHz	± 4.80 dB ± 6.07 dB
Frequency Stability	-	± 1.22 x 10^{-6}

3.4. STANDARDS ENVIRONMENTAL TEST CONDITIONS

Temperature :	+15 ℃ to +35 ℃
Relative humidity:	30 % to 60 %
Air pressure	860 mbar to 1 060 mbar

4. TEST EQUIPMENTS

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Agilent	N9020A / Spectrum Analyzer	04/24/2018	Annual	US46220219
Agilent	N9020A / Spectrum Analyzer	07/06/2018	Annual	MY51110020
Agilent	N9030A / Spectrum Analyzer	07/31/2018	Annual	MY51110068
KEYSIGHT	N9030B /Spectrum Analyzer	08/29/2018	Annual	MY55480167
AGILENT	8498A / Coaxial Attenuator	02/19/2018	Annual	51162
AGILENT	6674A / DC Power Supply	08/02/2018	Annual	3501A00901
KIKUSUI	PWR800L / DC Power Supply	02/27/2018	Annual	RE001149
Rohde&Schwarz	SMB100A / RF Signal Generator	07/19/2018	Annual	177633
KEITHLEY	S46 / Switch System	N/A	N/A	1088024
KEITHLEY	S46 / Switch System	N/A	N/A	1088025
NANGYEUL CO., LTD.	NY-THR18750 / Temperature and Humidity Chamber	10/30/2018	Annual	NY-2009012201A
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Emco	2090 / Controller	N/A	N/A	060520
Ets	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	08/23/2018	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	08/31/2018	Biennial	9168-0895
Schwarzbeck	BBHA 9120D / Horn Antenna	06/30/2017	Biennial	9120D-1300
Rohde & Schwarz	FSP / Spectrum Analyzer	09/19/2018	Annual	836650/016
Wainwright Instruments	WHKX10-900-1000-15000-40SS	07/20/2018	Annual	5
CERNEX	CBLU1183540 / Power Amplifier	07/10/2018	Annual	22964

5. RF OUTPUT POWER

FCC Rules

Test Requirements:

§ 2.1046 Measurements required: RF power output.

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

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

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

§ 27.50 Power limits and duty cycle.

(h) The following power limits shall apply in the BRS and EBS:

(1) Main, booster and base stations.

(i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

(ii) If a main or booster station sectorizes or otherwise uses one or more transmitting antennas with a non-omnidirectional horizontal plane radiation pattern, the maximum EIRP in dBW in a given direction shall be determined by the following formula: EIRP = 33 dBW + 10 log(X/Y) dBW + 10 log(360/beamwidth) dBW, where X is the actual channel width in MHz, Y is either (i) 6 MHz if prior to transition or the station is in the MBS following transition or (ii) 5.5 MHz if the station is in the LBS and UBS following transition, and beamwidth is the total horizontal plane beamwidth of the individual transmitting antenna for the station or any sector measured at the half-power points.

Test Procedures:

The measurement is performed in accordance with Section 5.2.4.4.2 of ANSI C63.26.

a) Set span to 2 × to 3 × the OBW.

b) Set RBW = 1% to 5% of the OBW.

c) Set VBW ≥ 3 × RBW.

d) Set number of measurement points in sweep ≥ 2 × span / RBW.

e) Sweep time:

1) Set = auto-couple, or

2) Set ≥ [10 × (number of points in sweep) × (transmission symbol period)] for single sweep (automation-compatible) measurement.

f) Detector = power averaging (rms).

g) Set sweep trigger to “free run.”

h) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

i) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band or channel power measurement function with band/channel limits set equal to the OBW band edges. If the instrument does not have a band or channel power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

j) Add 10 log (1/duty cycle) to the measured power level to compute the average power during continuous transmission.

Note:

1) Test was performed with test jig provided by applicant.
2) The conducted emission level is measured at each antenna port and then summed mathematically to determine the total emission level from the device.
3) Maximum ERP is sufficient level to pass the limit.
4) Sum data is in a tolerance of specification provided from manufacturer.

RF Output power tolerance: ±1 dB (each port)

Maximum output power for one port: 3.147 W (33.98 dBm + 1 dB)

*Maximum output sum power: 3.147 W * 64 = 201.408 W*

Measured sum maximum power: 172.691 W

The measured value is lower than the specification value.

Test Results:

20 MHz + 20 MHz + 20 MHz Bandwidth / 3 Carriers

Port	Modulation	Channel	Frequency (MHz)	Measured Output Power	
				(dBm)	(W)
Port 31	64QAM	Low	2426.00	34.44	2.78
		Middle	2593.00	34.50	2.82
		High	2660.00	34.11	2.58

* Because the results corrected by duty cycle are recorded, they do not match the test plot.

* This test report only contains the worst case plot data for each port and modulation.

EIRP Calculation

Item	Formula	Value (dBm)
27.50(h)(1)(ii) Limit	33 dBW + 10 log(X/Y) dBW + 10 log(360/beamwidth) dBW = 33 dBW + 10 log(15/6) dBW + 10log(360/14) dBW	81.081
Total power of port 0 to 15	Sum all measured power value of W units	49.395
Sum ANT gain port 0 to 15	Total power + Antenna gain = 49.395 dBm + 23.5 dBi	72.895
Total power of port 15 to 31	Sum all measured power value of W units	49.329
Sum ANT gain port 15 to 31	Total power + Antenna gain = 49.329 dBm + 23.5 dBi	72.829
Final Calculated EIRP	Sum port 0 to 63 (with Antenna gain)	75.873

* EIRP Limit was described only for the worst case.

* EIRP Calculation was performed for point of having maximum output power.

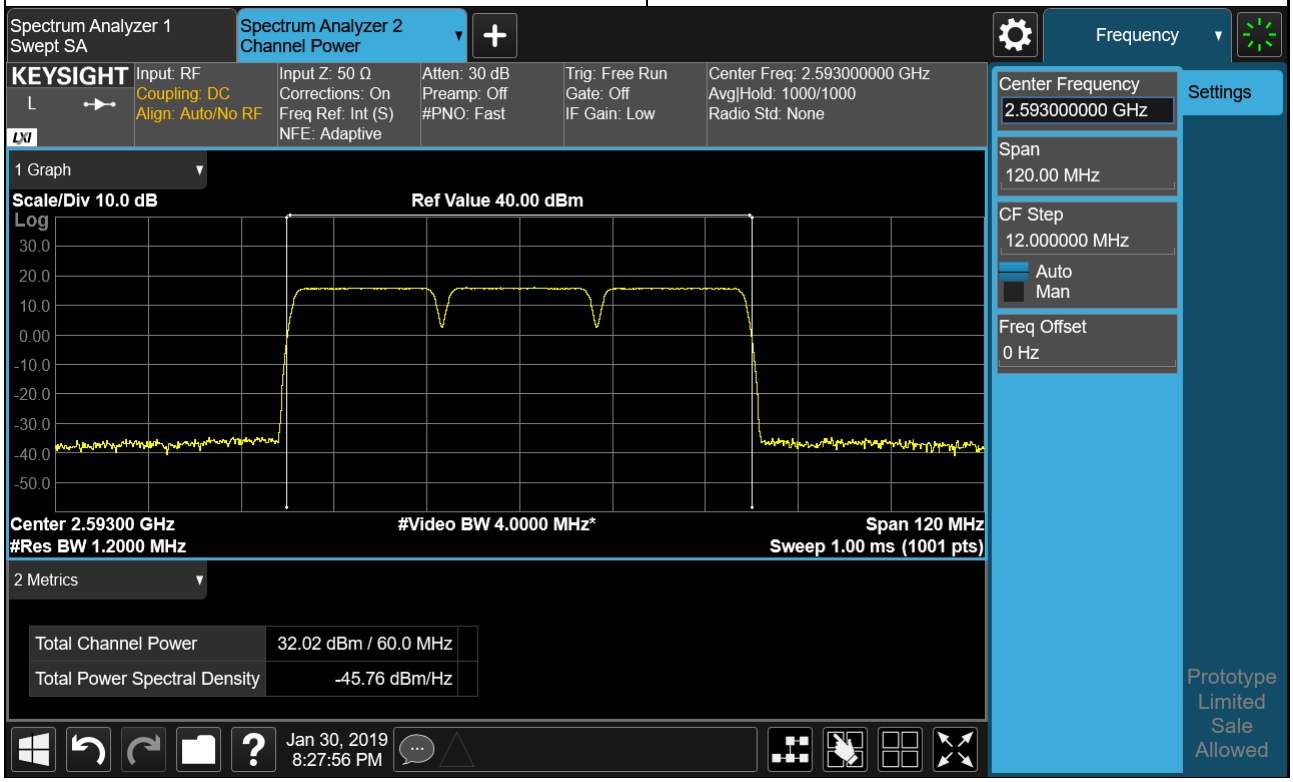
- Port 31, 20 MHz + 20 MHz + 20 MHz / 3 Carriers, 64QAM, Middle channel.

* Antenna gain and horizontal beamwidth were quoted from manufacturer's specification

- Antenna gain (32 port) = Maximum service beam gain = 23.5 dBi
- Total horizontal plane beamwidth (maximum) = 14 °

Plots of Output Power - 20 MHz + 20 MHz + 20 MHz Bandwidth / 3 Carriers

Port 31	
Modulation:	**64QAM**
Channel:	**Middle**



6. UNWANTED CONDUCTED EMISSIONS

FCC Rules

Test Requirements:

§ 2.1051 Measurements required: Spurious emissions at antenna terminals.

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

§ 27.53 Emission limits.

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(2) For digital base stations, the attenuation shall be not less than 43 + 10 log (P) dB, unless a documented interference complaint is received from an adjacent channel licensee with an overlapping Geographic Service Area. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS No. 1 on the same terms and conditions as adjacent channel BRS or EBS licensees. Provided that a documented interference complaint cannot be mutually resolved between the parties prior to the applicable deadline, then the following additional attenuation requirements shall apply:

Test Procedures:

The measurement is performed in accordance with Section 5.7.3 and 5.7.4 of ANSI C63.26.

5.7.3 Out-of-band unwanted emissions measurements

a) Set the spectrum analyzer center frequency to the block, band, or channel edge frequency.

b) Set the span wide enough to capture the fundamental emission closest to the authorized block or band edge, and to include all modulation products that spill into the immediately adjacent frequency band. In some cases, it may be possible to set the center frequency and span so as to encompass the fundamental emission and the unwanted out-of-band (band-edge) emissions on either side of the authorized block, band, or channel. This can be accomplished with a single (slow) sweep, if adequate overload protection and sufficient dynamic range can be maintained.

c) Set the number of points in sweep ≥ 2 × span / RBW.

d) Sweep time should be auto for peak detection. For rms detection the sweep time should be

set as follows:

1) Omitted

2) Omitted

3) If the device cannot be configured to transmit continuously (duty cycle < 98%) and a freerunning sweep must be used, set the sweep time so that the averaging is performed over multiple on/off cycles by setting the sweep time > (number of points in sweep) × (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by [10 log (1/duty cycle)]. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation ≤ ±2%).

4) Omitted

e) The test report shall include the plots of the measuring instrument display and the measured data.

f) See Annex I for example emission mask plots.

5.7.4 Spurious unwanted emission measurements

a) Set the spectrum analyzer start frequency to the lowest frequency generated by the EUT, without going below 9 kHz, and the stop frequency to the lower frequency covered by the measurements previously performed in 5.7.3. As an alternative, the stop frequency can be set to the value specified in 5.1.1, depending on the EUT operating range, if the resulting plot can clearly demonstrate compliance for all frequencies not addressed by the out-of-band emissions measurements performed as per 5.7.3.

b) When using an average power (rms) detector, ensure that the number of points in the sweep ≥ 2 × (span / RBW). This may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the spectrum analyzer capabilities. This requirement does not apply to peak-detected power measurements. When average power is specified by the applicable regulation, a peak-detector can be utilized for preliminary measurements to accommodate wider frequency spans. Any emissions found in the preliminary measurement to exceed the applicable limit(s) shall be further examined using a power averaging (rms) detector with the minimum number of measurement points as defined above.

c) The sweep time should be set to auto-couple for performing peak-detector measurements. For measurements that use a power averaging (rms) detector, the sweep time shall be set as described for out-of-band emissions measurements in item d) of 5.7.3.

d) Identify and measure the highest spurious emission levels in each frequency range. It is not necessary to re-measure the out-of-band emissions as a part of this test. Record the frequencies and amplitudes corresponding to the measured emissions and capture the data plots.

e) Repeat step b) through step d) for the upper spurious emission frequency range if not already captured by a wide span measurement performed as per the alternative provided in step a). The upper frequency for this measurement is defined in 5.1.1 as a function of the EUT operating

range.

f) Compare the results with the corresponding limit in the applicable regulation.

g) The test report shall include the data plots of the measuring instrument display and the measured data.

Note:

1) In 9 kHz to 30 MHz band, RBW narrower than reference bandwidth is used. So following correction factor is applied.

   - 10 log [(reference bandwidth)/(resolution bandwidth)]
   - 9 kHz to 150 kHz applied 1 kHz RBW, 10 log (1 kHz / 1MHz) = 30 dB
   - 150 kHz to 30 MHz applied 100 kHz RBW, 10 log (10 kHz / 1 MHz) = 20 dB
   - Because of test equipment's noise specification, we used N9030A signal analyzer for these bands.

2) Due to 64x64 MIMO operations, a correction has been added to the limit according to KDB 662911 D01 v02r01.

   - MIMO correction: 10 log(N_{ANT}) = 10 log(64) = 18.062 dB

3) Since the EUT cannot be configured to transmit continuously and a free-running sweep must be used, duty correction has been added in accordance with 5.7.3 d) 3) of ANSI C63.26-2015.

   - Duty Correction = 10 log (1/duty cycle) = 10 log (1/0.744) = 1.284 dB

4) For the same reason as above 3), Sweep time is calculated as follows.

   - Sweep time > number of point in sweep x transmit period = 1001 x 5 ms = 5005 ms

5) Because the emission limit is calculated by MIMO-Summing, only one output port that measured maximum output power is tested as the worst condition.

   - Port 31, 20 MHz + 20 MHz + 20 MHz / 3 Carriers, 64QAM

6) Only MIMO correction was applied to the result table limit.

   - Limit = -13 dB -18.062 dB = -31.062 dB

7) All corrections including RBW, MIMO, and Duty Cycle were applied to the plot limit.

   - Limit for 9 kHz to 150 kHz = -13 dB -18.062 dB - 1.284 dB - 30 dB = -62.346 dB
   - Limit for 150 kHz to 30 MHz = -13 dB -18.062 dB - 1.284 dB - 20 dB = -52.346 dB
   - Limit for other bands = -13 dB -18.062 dB - 1.284 dB = -32.346 dB

Test Results:

Band edge of 20 MHz + 20 MHz + 20 MHz Bandwidth / 3 Carriers

Port	Modulation	Point	Frequency (MHz)	Measured band edge (dBm)
Port 31	64QAM	Left	2496.00	-36.937
		Right	2690.00	-39.619

* Because the results corrected by duty cycle are recorded, they do not match the test plot.

Emission below 1 GHz of 20 MHz + 20 MHz + 20 MHz Bandwidth / 3 Carriers

Port	Modulation	Channel	Frequency (MHz)	Measured emission (dBm)		
				9 kHz ~ 150 kHz	150 kHz ~ 30 MHz	30 MHz ~ 1 GHz
Port 31	64QAM	Low	2 526.00	-40.008	-58.587	-65.923
		Middle	2 593.00	-41.007	-49.722	-49.863
		High	2 660.00	-40.789	-60.629	-53.883

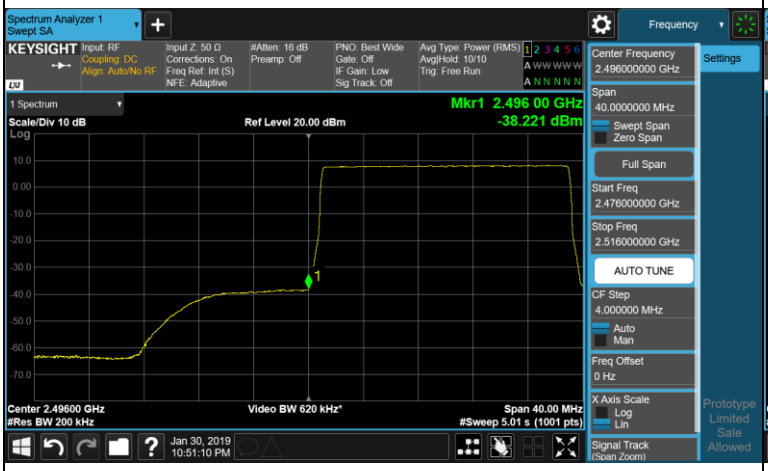
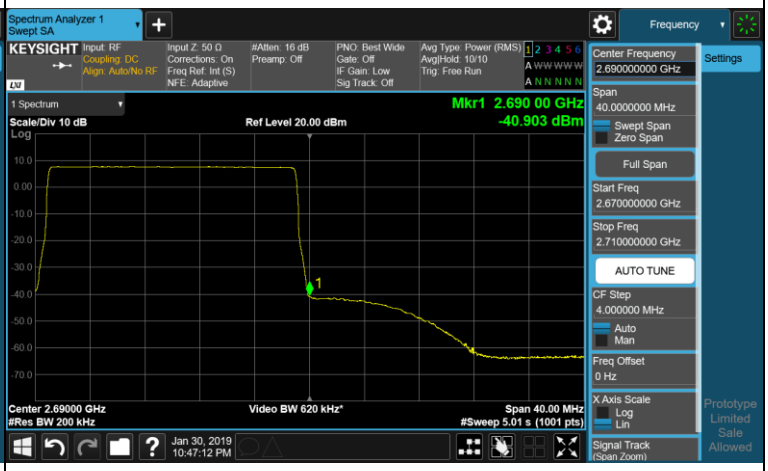
* Because the results corrected by duty cycle and RBW are recorded, they do not match the test plot.

Emission above 1 GHz of 20 MHz + 20 MHz + 20 MHz Bandwidth / 3 Carriers

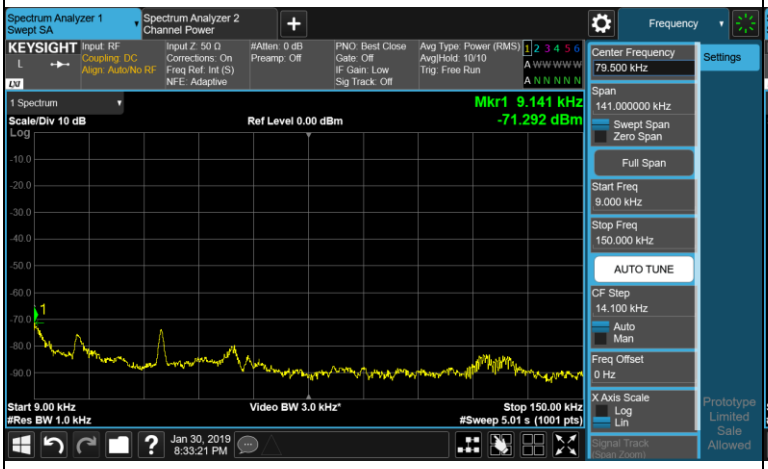
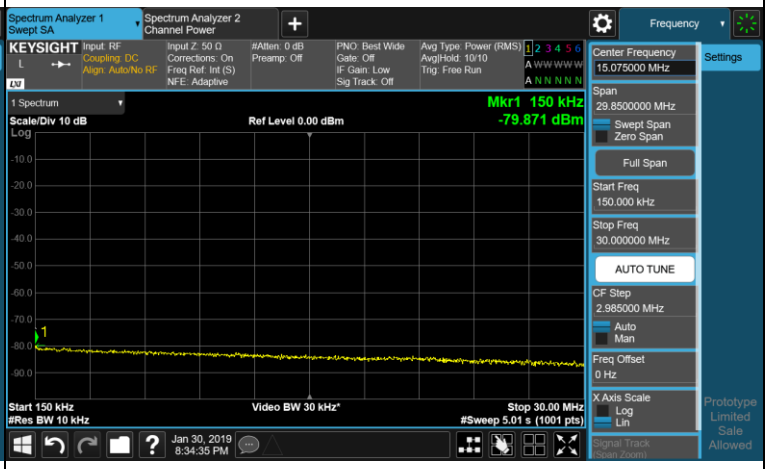
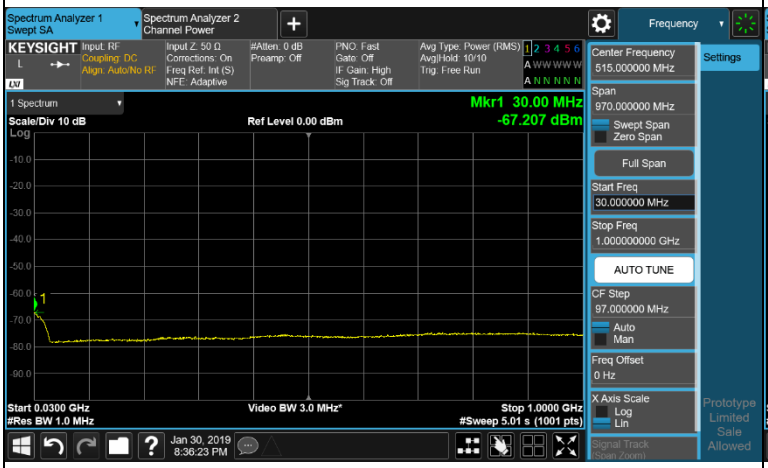
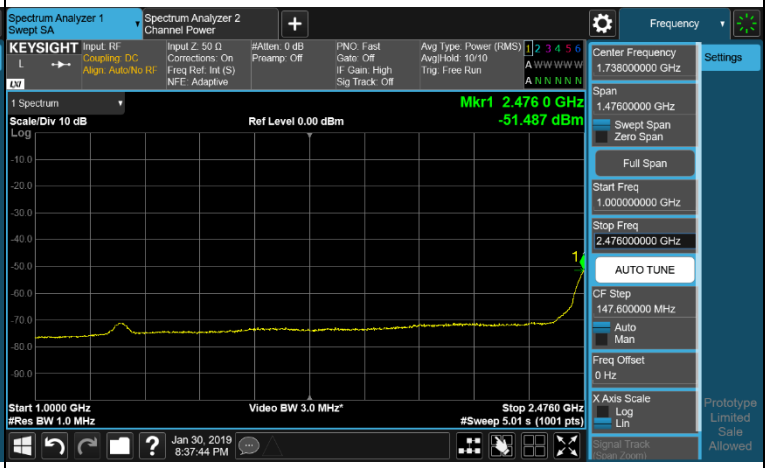
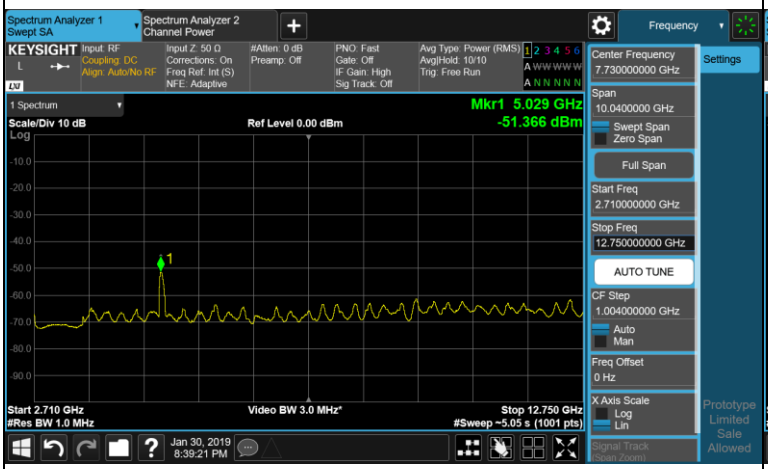
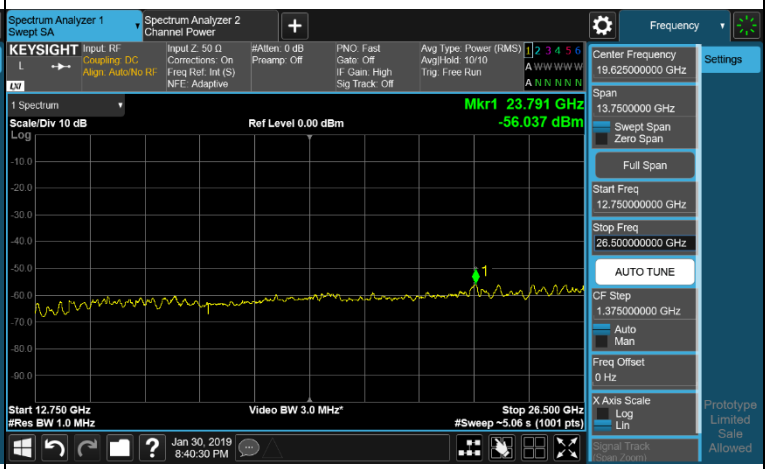
Port	Modulation	Channel	Frequency (MHz)	Measured emission (dBm)		
				1 GHz ~ 2.486 GHz	2.970 GHz ~ 12.75 GHz	12.75 GHz ~ 26.5 GHz
Port 31	64QAM	Low	2 526.00	-50.203	-50.082	-54.753
		Middle	2 593.00	-63.225	-56.596	-54.503
		High	2 660.00	-65.664	-54.105	-54.787

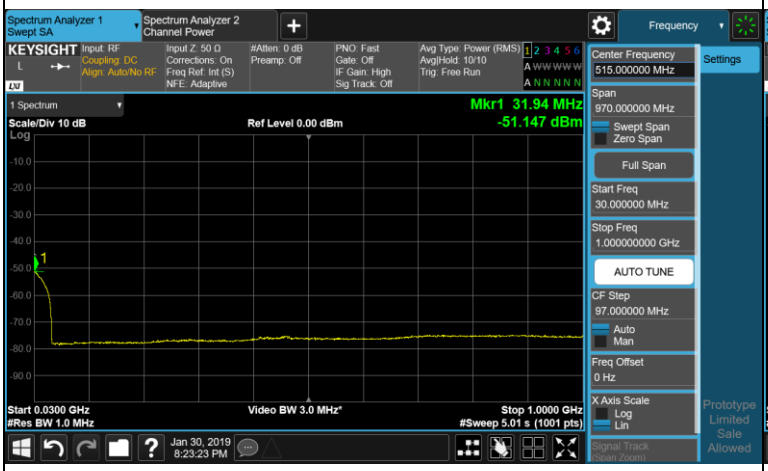
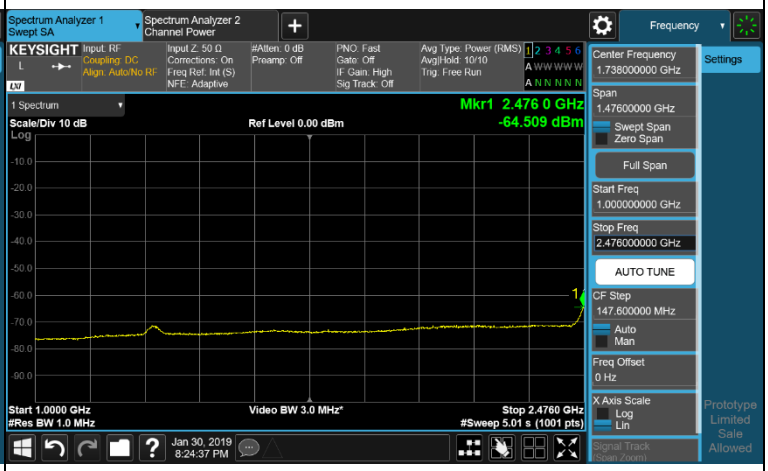
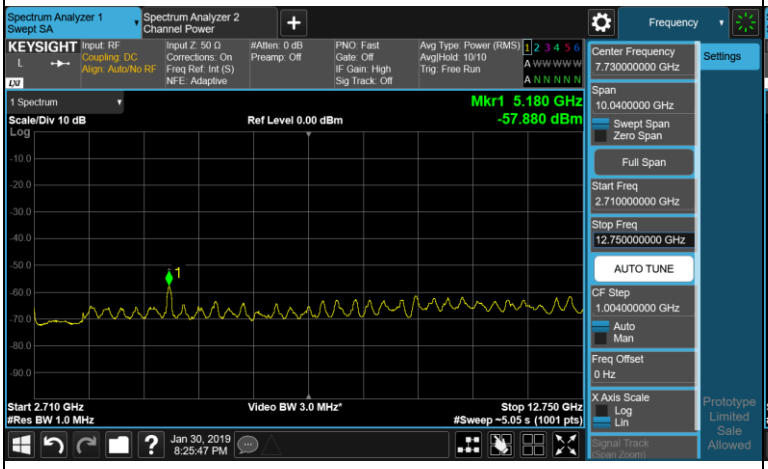
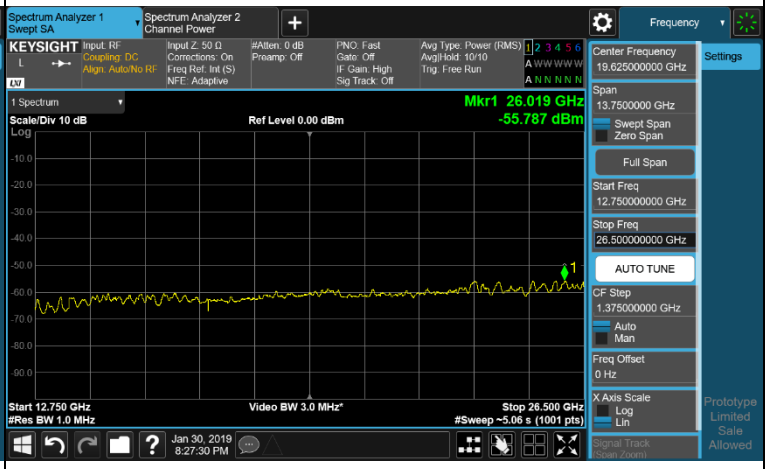
* Because the results corrected by duty cycle are recorded, they do not match the test plot.

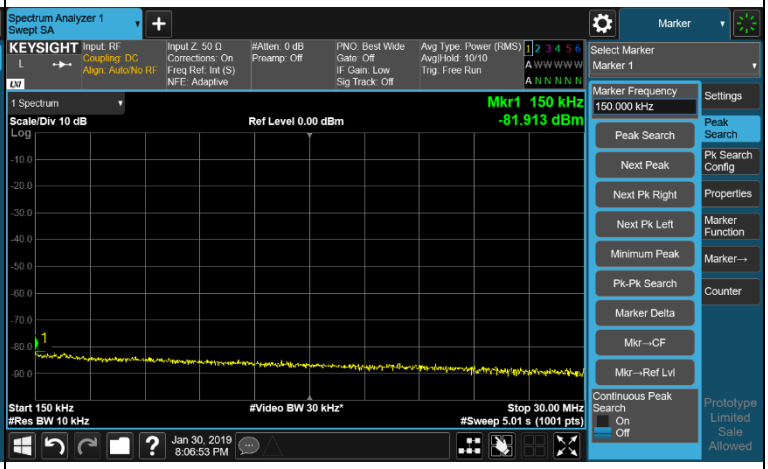
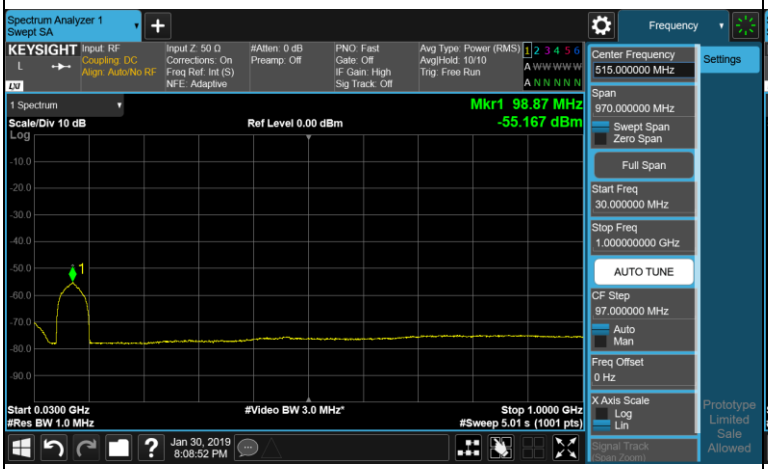
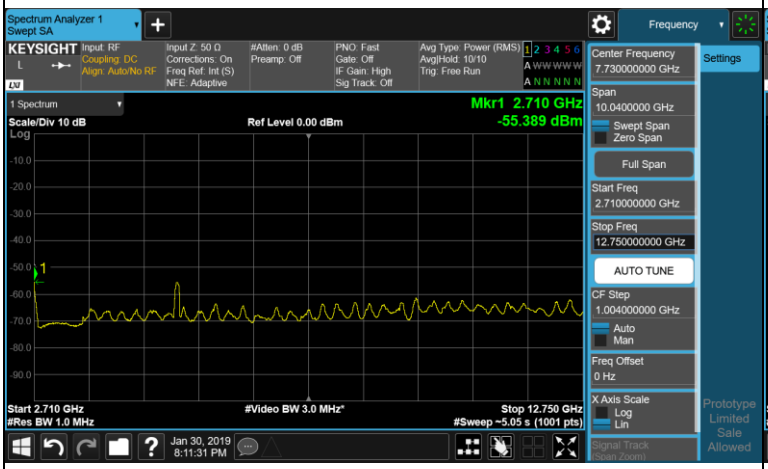
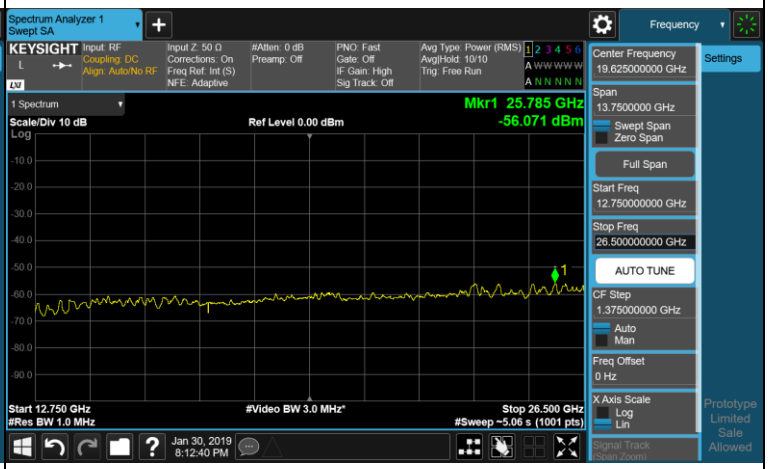
Plots of Band edge - 20 MHz + 20 MHz + 20 MHz Bandwidth / 3 Carriers

Port 31			
Modulation:	**64QAM**	**Modulation:**	**64QAM**
Item:	**Left band edge**	**Item:**	**Right band edge**
			

Plots of Unwanted Conducted Emission - 20 MHz + 20 MHz + 20 MHz Bandwidth / 3 Carriers

Port 31, 64QAM, Low	
9 kHz ~ 150 kHz	150 kHz ~ 30 MHz
	
30 MHz ~ 1 GHz	1 GHz ~ 2.476 GHz
	
2.710 GHz ~ 12.75 GHz	12.75 GHz ~ 26.5 GHz
	

Port 31, 64QAM, Middle	
9 kHz ~ 150 kHz	**150 kHz ~ 30 MHz**
	
30 MHz ~ 1 GHz	**1 GHz ~ 2.476 GHz**
	
2.710 GHz ~ 12.75 GHz	**12.75 GHz ~ 26.5 GHz**
	

Port 31, 64QAM, High	
9 kHz ~ 150 kHz	**150 kHz ~ 30 MHz**
	
30 MHz ~ 1 GHz	**1 GHz ~ 2.476 GHz**
	
2.710 GHz ~ 12.75 GHz	**12.75 GHz ~ 26.5 GHz**
	

7. RADIATED EMISSIONS

FCC Rules

Test Requirements:

§ 2.1053 Measurements required: Field strength of spurious radiation.

(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 Procedures:

The measurement is performed in accordance with Section 5.5.4 and 5.5.3.2 of ANSI C63.26.

a) Place the EUT in the center of the turntable. The EUT shall be configured to transmit into the standard non-radiating load (for measuring radiated spurious emissions), connected with cables of minimal length unless specified otherwise. If the EUT uses an adjustable antenna, the antenna shall be positioned to the length that produces the worst case emission at the fundamental operating frequency.

b) Each emission under consideration shall be evaluated:

1) Raise and lower the measurement antenna in accordance 5.5.2, as necessary to enable detection of the maximum emission amplitude relative to measurement antenna height.

2) Rotate the EUT through 360° to determine the maximum emission level relative to the axial

position.

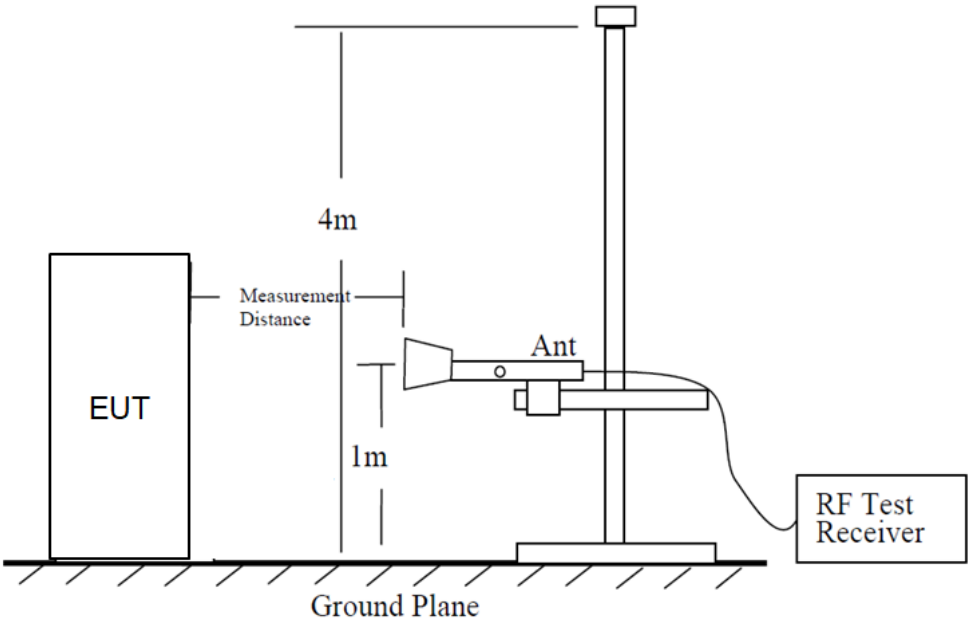
3) Return the turntable to the azimuth where the highest emission amplitude level was observed.

4) Vary the measurement antenna height again through 1 m to 4 m again to find the height associated with the maximum emission amplitude.

5) Record the measured emission amplitude level and frequency using the appropriate RBW.

c) Repeat step b) for each emission frequency with the measurement antenna oriented in both the horizontal and vertical polarizations to determine the orientation that gives the maximum emissions amplitude.

Test Setup:



Note:

1) According to SVSWR requirement in ANSI 63.4 (2014), we performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor (reference distance: 3 m).
2) Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
3) Position for testing is set according to floor-standing EUTs of ANSI C63.26 - 5.5.2.3.2

Test Result:

Ch.	Frequency (MHz)	Measured Level (dBuV/m)	Measured Power (dBm)	Ant. Factor (dB/m)	C.L (dB)	A.G. (dB)	D.F. (dB)	Pol.	Result (dBm)
No Critical Peaks Found									

* C.L.: Cable Loss / A.G.: Ant. Gain / D.F.: Distance Factor (3.75 m)

8. FREQUENCY STABILITY

FCC Rules

Test Requirements:

§ 2.1055 Measurements required: Frequency stability.

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

§ 27.54 Frequency stability.

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Test Procedures:

The measurement is performed in accordance with Section 5.6.4 and 5.6.5 of ANSI C63.26.

5.6.4 Frequency stability over variations in temperature

a) Supply the EUT with a nominal 60 Hz ac voltage, dc voltage, or install a new or fully charged battery in the EUT.

b) If possible a dummy load should be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, the EUT should be placed in the center of the chamber with the antenna adjusted to the shortest length possible.

c) Turn on the EUT, and tune it to the center frequency of the operating band.

d) Couple the transmitter output to the measuring instrument through a suitable attenuator and coaxial cable. If connection to the EUT output is not possible, make the measurement by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away).

NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or regulatory authority is the recommended measuring instrument.

e) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). Adjust the detector bandwidth and span settings to achieve a resolution capable of accurate frequency measurements over the applicable frequency stability limits.

f) Turn the EUT off, and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.

g) Set the temperature control on the chamber to the highest temperature specified in the regulatory requirements for the type of device, and allow the oscillator heater and the chamber

temperature to stabilize. Unless otherwise instructed by the regulatory authority, this temperature should be 50 °C.

h) While maintaining a constant temperature inside the environmental chamber, turn on the EUT and allow sufficient time for the EUT temperature to stabilize.

i) Measure the frequency.

j) Switch off the EUT, but do not switch off the oscillator heater.

k) Lower the chamber temperature to the next level that is required by the standard and allow the temperature inside the chamber to stabilize. Unless otherwise instructed by the regulators, this temperature step should be 10 °C.

l) Repeat step h) through step k) down to the lowest specified temperature. Unless otherwise instructed by the regulators, this temperature should be −30 °C. When the frequency stability limit is stated as being sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point shall be established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation shall be identified as f_L and f_H respectively. The worst-case frequency offset determined in the above methods shall be added or subtracted from the values of f_L and f_H and the resulting frequencies must remain within the band.

m) Omitted

5.6.5 Frequency stability when varying supply voltage

a) Couple the transmitter output to the measuring instrument through a suitable attenuator and coaxial cable. If connection to the EUT output is not possible make the measurement by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away)

b) Supply the EUT with nominal ac or dc voltage. The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

c) Turn on the EUT, and couple its output to a frequency counter or other frequency-measuring instrument.

d) Tune the EUT to the center frequency of the operating band. Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument, but is strong enough to allow measurement of the operating or fundamental frequency of the EUT). Adjust the detector bandwidth and span settings to achieve a resolution capable of accurate frequency measurements over the applicable frequency stability limits.

NOTE—An instrument that has an adequate level of accuracy as specified by the procuring or regulatory authority is the recommended measuring instrument.

e) Measure the frequency.

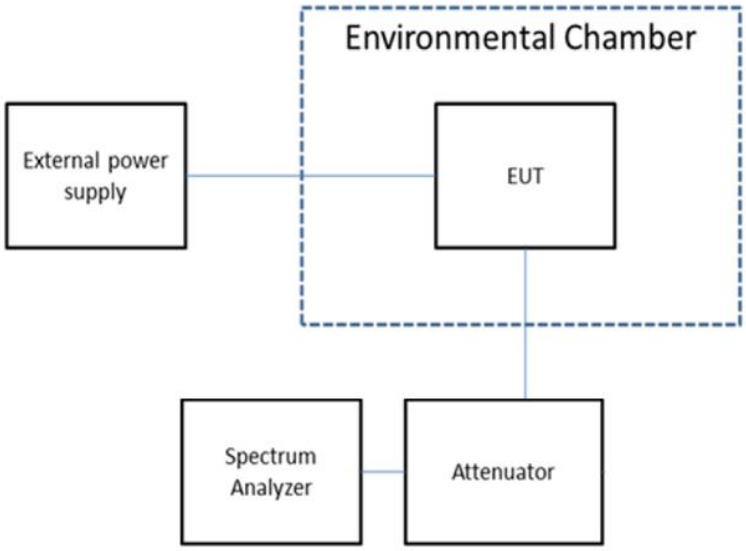
f) Unless otherwise specified, vary primary supply voltage from 85% to 115% of the nominal value for other than hand carried battery equipment.

g) For hand carried, battery powered equipment, reduce the primary ac or dc supply voltage to the battery operating end point, which shall be specified by the manufacturer.

h) Repeat the frequency measurement.

NOTE—For band-edge compliance, it can be required to make these measurements at the low and high channel of the operating band.

Test Setup:



Note:

1) The results of the frequency stability test shown above the frequency deviation measured values are very small and similar trend for each port, so we are attached only the worst case data.

Test Results:

Reference: Voltage = DC -48 V at 20°C, Frequency = 2 593.0 MHz

Voltage (%)	Temp.(℃)	Frequency (Hz)	Frequency Error (Hz)	Deviation (Hz)	ppm
100 %	+20(Ref)	2593 000 119	119.280	0.000	0.00000
	-30	2593 000 118	118.240	-1.040	-0.00040
	-20	2593 000 121	121.360	2.080	0.00080
	-10	2593 000 118	118.360	-0.920	-0.00035
	0	2593 000 119	119.250	-0.030	-0.00001
	+10	2593 000 119	118.690	-0.590	-0.00023
	+30	2593 000 121	120.660	1.380	0.00053
	+40	2593 000 119	119.250	-0.030	-0.00001
	+50	2593 000 118	118.330	-0.950	-0.00037
115 %	+20	2593 000 120	120.360	1.080	0.00042
85 %	+20	2593 000 120	120.250	0.970	0.00037

10. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-1901-FC032-P
2	HCT-RF-1901-FC033-P