

TEST REPORT

 CTK Co., Ltd. The Power Leader of Global Regulatory Certification	CTK Co., Ltd. (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2021-00287 Page (1) / (292) Pages	
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1. Client

- Name : Samsung Electronics Co., Ltd.
- Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey
- Date of Receipt : 2021-01-13

2. Manufacturer

- Name : Samsung Electronics Co., Ltd.
- Address : 416, Maetan 3-Dong, Yeongtong-Gu, Suwon-Si, Gyeonggi-Do, 16677, Korea

3. Use of Report : For FCC Certification

4. Test Sample / Model: RF4402d-D1A

5. Date of Test : 2021-01-19 to 2021-01-23

6. Test Standard(method) used : FCC 47 CFR Part 2, 27

7. Testing Environment: Temp.: (25 ± 1) °C, Humidity: (40 ± 1) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by  Bong-jun, Jang: (Signature)	Technical Manager  Young-taek, Lee: (Signature)
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2021-01-26

Republic of KOREA **CTK Co., Ltd.**



CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
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Report No.:
CTK-2021-00287
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REPORT REVISION HISTORY

Date	Revision	Page No
2018-10-29	Issued (CTK-2018-03329)	All
2021-01-26	Issued (CTK-2021-00287)	All
	Addition of Bandwidth	
	2Carrier: 15 MHz + 15 MHz	
	3Carrier: 20 MHz + 5 MHz + 5 MHz, 15 MHz +5 MHz + 5 MHz	

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1. General Information

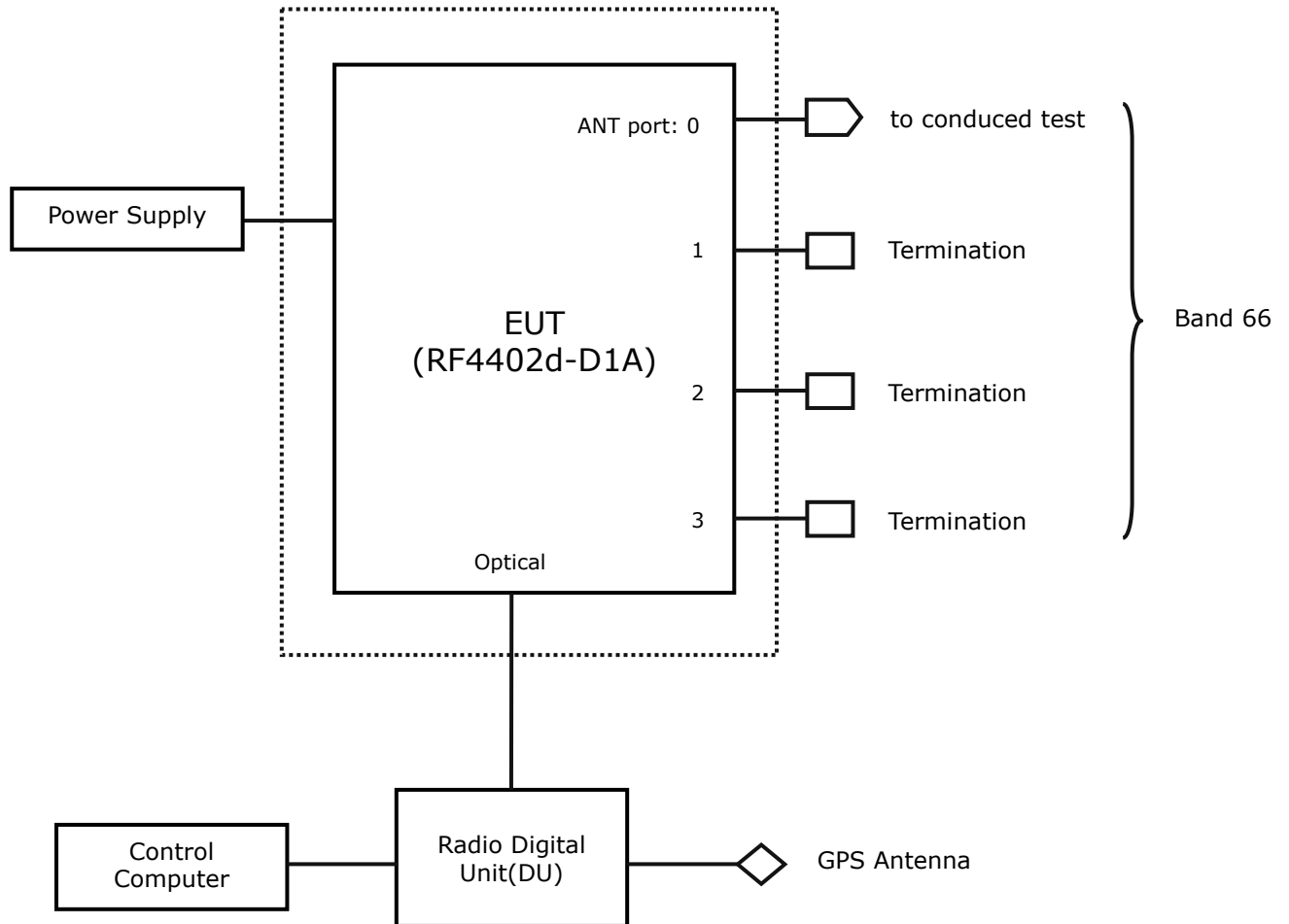
1.1 Client Information

Company	Samsung Electronics Co., Ltd.
Contact Point	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Contact Person	Name : Kim, Jong-in E-mail : jered.kim@samsung.com Tel : +82-31-279-3096

1.2 Product Information

FCC ID	A3LRF4402D-D1A
Product Description	RRU (RF4402d)
Model name	RF4402d-D1A
Power Supply	-48 Vdc
Operating Frequency	- Band 66 DL : 2 110 MHz- 2 180 MHz, UL 1 710 MHz - 1 780 MHz
RF Output Power	- Band 66 Multi(2 Carrier) 4Tx(Contiguous)BW 15 MHz + BW 15 MHz : 120 W(path 30 W *4) 4Tx(Non-Contiguous)BW 15 MHz/BW 15 MHz : 120 W(path 30 W *4) Multi(3 Carrier) 4Tx(Contiguous)BW 20 MHz + 5 MHz + BW 5 MHz : 120 W(path 30 W *4) 4Tx(Non-Contiguous)BW 20 MHz + BW 5 MHz / BW 5 MHz : 120 W(path 30 W *4) 4Tx(Contiguous)BW 15 MHz + 5 MHz + BW 5 MHz : 120 W(path 30 W *4) 4Tx(Non-Contiguous)BW 15 MHz + BW 5 MHz / BW 5 MHz : 120 W(path 30 W *4)
Channel Bandwidth	5 MHz, 15 MHz, 20 MHz
Modulation Type	QPSK, 16QAM, 64QAM, 256QAM
FCC Rule	Part 2 : FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS Part 27 : MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES KDB Publication 662911 D01 Multiple Transmitter Output v02r01

1.3 Configurations



2. Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	8737A-2
KOREA	NRRA	KR0025

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

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.

Section	Test Items	Results
§2.1046, §27.50(d)(2)	RF output power	Compliant
§2.1049	Occupied bandwidth	Compliant
§2.1051, §27.53(h)	Spurious Emissions at Antenna Terminals	Compliant
§2.1051, §27.53(h)	Band edge	Compliant
§2.1051, §27.53(h)	Spurious Radiated Emissions	Compliant
§2.1055(a)(1), §27.54	Frequency Stability over Temperature variation	Compliant
§2.1055(d), §27.54	Frequency Stability over Voltage variation	Compliant

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments. During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation(QPSK, 16QAM, 64QAM, 256QAM) modes were tests. The results are only attached worst cases.

Operating band and Frequency range

Band 66	Transmit	2 110 MHz to 2 180 MHz
	Receive	1 710 MHz to 1 780 MHz

Operating Configurations

Supported configurations	Multi carrier
Spectrum Operation	Contiguous, Non-contiguous

Multi 2 carrier rated total output power as a sum of all carriers(15MHz + 15MHz)

Type	Bandwidth positions		1st FA	2nd FA	Power Sum	Total (sum)
Contiguous	Bottom	Bandwidth	15 MHz	15 MHz		
		Frequency	2 117.5 MHz	2 132.5 MHz		
		Output Power	15 W	15 W	30 W	120 W
	Middle	Bandwidth	15 MHz	15 MHz		
		Frequency	2 137.5 MHz	2 152.5 MHz		
		Output Power	15 W	15 W	30 W	120 W
	Top	Bandwidth	15 MHz	15 MHz		
		Frequency	2 157.5 MHz	2 172.5 MHz		
		Output Power	15 W	15 W	30 W	120 W
Non-Contiguous	Bottom / Top	Bandwidth	15 MHz	15 MHz		
		Frequency	2 117.5 MHz	2 172.5 MHz		
		Output Power	15 W	15 W	30 W	120 W

Multi 3 carrier rated total output power as a sum of all carriers(20MHz+5MHz+5MHz)

Type	Bandwidth positions		1 st FA	2 nd FA	3 rd FA	Power Sum	Total (sum)
Contiguous	Bottom	Bandwidth	20 MHz	5 MHz	5 MHz		
		Frequency	2 120 MHz	2 132.5 MHz	2 137.5 MHz		
		Output Power	20 W	5 W	5 W	30 W	120 W
	Middle	Bandwidth	20 MHz	5 MHz	5MHz		
		Frequency	2 140 MHz	2 152.5 MHz	2 157.5 MHz		
		Output Power	20 W	5 W	5 W	30 W	120 W
	Top	Bandwidth	20 MHz	5 MHz	5MHz		
		Frequency	2 160 MHz	2 172.5 MHz	2 177.5 MHz		
		Output Power	20 W	5 W	5 W	30 W	120 W
Non-Contiguous	Bottom / Top	Bandwidth	20 MHz	5 MHz	5MHz		
		Frequency	2 120 MHz	2 132.5 MHz	2 177.5 MHz		
		Output Power	20 W	5 W	5 W	30 W	120 W

Multi 3 carrier rated total output power as a sum of all carriers(15MHz+5MHz+5MHz)							
Type	Bandwidth positions		1 st FA	2 nd FA	3 rd FA	Power Sum	Total (sum)
Contiguous	Bottom	Bandwidth	15 MHz	5 MHz	5 MHz		
		Frequency	2 117.5 MHz	2 127.5 MHz	2 132.5 MHz		
		Output Power	18 W	6 W	6 W	30 W	120 W
	Middle	Bandwidth	15 MHz	5 MHz	5MHz		
		Frequency	2 140 MHz	2 150 MHz	2 155 MHz		
		Output Power	18 W	6 W	6 W	30 W	120 W
	Top	Bandwidth	15 MHz	5 MHz	5MHz		
		Frequency	2 162.5 MHz	2 172.5 MHz	2 177.5 MHz		
		Output Power	18 W	6 W	6 W	30 W	120 W
Non-Contiguous	Bottom / Top	Bandwidth	15 MHz	5 MHz	5MHz		
		Frequency	2 117.5 MHz	2 127.5 MHz	2 177.5 MHz		
		Output Power	18 W	6 W	6 W	30 W	120 W

3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor $k = 2$, Confidence levels of 95 %

Description	Uncertainty
Conducted RF output power	1.5 dB
Occupied bandwidth	0.1 MHz
Spurious emission at antenna terminals	3.0 dB
Radiated spurious emissions ($f \leq 1$ GHz)	4.0 dB
Radiated spurious emissions ($f > 1$ GHz)	5.0 dB
Frequency stability	0.1 kHz

3.4 Standards Environmental Test conditions

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

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4. RF output power

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 follows. 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.

- (d) (2) The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to:
 - (ii) An EIRP of 1640 watts/MHz when transmitting with an emission bandwidth greater than 1 MHz.
- (5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

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Test Procedures :

According to FCC §2.1046 (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). The electrical characteristics of the radio frequency load attached to the output terminals when this is made shall be stated.

- 1) The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The lost of the cables the test system is calibrated to correct the reading.
- 2) The spectrum analyzer was set to RMS Detector function and Average mode.
- 3) The resolution bandwidth of the spectrum analyzer was comparable to the emission bandwidth.
- 4) The conducted emission level is measured at each antenna port and then summed mathmatically to determine the total emission level from the device.

Note 1 : The conducted emission level is measured at each antenna port and then summed mathematically to determine the total emission level from the device.

Note 2: Maximun EIRP is sufficient level to pass the limit.

Note 3 : Sum data is in a tolerance of specification provided from manufacturer.

Note 4 : If applicable, the EIRP[W] = $10^{((\text{channel power[dBm]} + \text{Antenna Gain[dBi]})/10)} / 10^{-3}$

Note 5: EIRP does not exceed the reference value even if the maximum antenna gain is applied according to Note 1.

Note 6 : PSD(Power Spectral Density) dBm/MHz = dBm/Hz + $10\log(10^6)$

Maximum output power for one port :

BW 15 MHz + 15 MHz : **44.771 dBm (30 W)**

BW 20 MHz + 5 MHz + 5 MHz, 15 MHz + 5 MHz + 5 MHz: **44.771 dBm (30 W)**

Maximum output sum power :

BW 15 MHz + 15 MHz : **50.792 dBm (120 W(path 30 W * 4))**

BW 20 MHz + 5 MHz +5 MHz, 15 MHz +5 MHz +5 MHz: **50.792 dBm (120 W(path 30 W * 4))**

Measured sum maximum power : **50.74 dBm (118.49 W)**

Test Results :

Test Data : BW 15 MHz + 15 MHz, Multi 2carrier

Type	Channel	Modulation	Output Power [dBm]				Total Power	
			Test antenna port				[dBm]	[W]
			0	1	2	3		
Contiguous	Bottom	QPSK	44.74	44.27	44.33	44.63	50.52	112.66
		16QAM	44.82	44.34	44.37	44.65	50.57	114.03
		64QAM	44.64	44.29	44.40	44.72	50.54	113.15
		256QAM	44.63	44.38	44.41	44.71	50.56	113.64
	Middle	QPSK	44.35	44.30	43.99	44.49	50.31	107.32
		16QAM	44.36	44.24	44.09	44.41	50.30	107.09
		64QAM	44.39	44.26	44.00	44.49	50.31	107.39
		256QAM	44.47	44.29	44.06	44.39	50.33	107.79
	Top	QPSK	44.58	44.45	44.23	44.64	50.50	112.16
		16QAM	44.62	44.40	44.44	44.80	50.59	114.51
		64QAM	44.49	44.19	44.14	44.55	50.37	108.81
		256QAM	44.49	44.47	44.43	44.80	50.57	114.04

Type	Channel	Modulation	Output Power [dBm]				Total Power	
			Test antenna port				[dBm]	[W]
			0	1	2	3		
Non-Contiguous	Bottom	QPSK	41.24	40.93	41.10	41.37	47.18	52.28
		16QAM	41.16	40.91	41.05	41.27	47.12	51.52
		64QAM	41.22	41.16	41.38	41.55	47.35	54.33
		256QAM	41.32	41.15	41.28	41.57	47.35	54.37
	Top	QPSK	41.37	41.00	41.03	41.55	47.26	53.26
		16QAM	41.30	41.03	40.99	41.46	47.22	52.72
		64QAM	41.35	41.28	41.30	41.72	47.44	55.42
		256QAM	41.46	41.26	41.20	41.73	47.44	55.44
	Bottom + Top	QPSK					50.23	105.55
	Bottom + Top	16QAM					50.18	104.25
	Bottom + Top	64QAM					50.40	109.76
	Bottom + Top	256QAM					50.41	109.80

Test Data : BW 20 MHz + 5 MHz + 5 MHz, Multi 3carrier

Type	Channel	Modulation	Output Power [dBm]				Total Power	
			Test antenna port				[dBm]	[W]
			0	1	2	3		
Contiguous	Bottom	QPSK	44.35	43.90	44.04	44.42	50.20	104.79
		16QAM	44.54	44.15	44.34	44.64	50.44	110.72
		64QAM	44.59	44.14	44.27	44.68	50.45	110.82
		256QAM	44.64	44.11	44.22	44.62	50.42	110.27
	Middle	QPSK	44.72	44.39	44.20	44.71	50.53	113.01
		16QAM	44.64	44.23	44.05	44.57	50.40	109.64
		64QAM	44.57	44.25	44.15	44.59	50.41	110.02
		256QAM	44.54	44.27	44.20	44.59	50.42	110.25
	Top	QPSK	44.68	44.30	44.27	44.84	50.55	113.50
		16QAM	44.76	44.53	44.46	44.79	50.66	116.36
		64QAM	44.81	44.32	44.49	44.95	50.67	116.69
		256QAM	44.72	44.47	44.48	44.86	50.66	116.31

Type	Channel	Modulation	Output Power [dBm]				Total Power	
			Test antenna port				[dBm]	[W]
			0	1	2	3		
Non-Contiguous	Bottom	QPSK	43.53	43.41	43.40	43.88	49.58	90.78
		16QAM	43.77	43.54	43.61	43.80	49.70	93.37
		64QAM	43.84	43.50	43.70	43.99	49.78	95.10
		256QAM	43.72	43.52	43.60	43.83	49.69	93.10
	Top	QPSK	36.79	36.71	36.57	37.06	42.81	19.08
		16QAM	36.92	36.74	36.64	36.99	42.85	19.25
		64QAM	36.99	36.68	36.75	37.17	42.92	19.60
		256QAM	37.04	36.86	36.81	37.17	42.99	19.92
	Bottom + Top	QPSK					50.41	109.87
	Bottom + Top	16QAM					50.52	112.62
	Bottom + Top	64QAM					50.60	114.70
	Bottom + Top	256QAM					50.53	113.02

Test Data : BW 15 MHz + 5 MHz + 5 MHz, Multi 3carrier

Type	Channel	Modulation	Output Power [dBm]				Total Power	
			Test antenna port				[dBm]	[W]
			0	1	2	3		
Contiguous	Bottom	QPSK	43.81	44.36	44.56	44.74	50.40	109.69
		16QAM	43.84	44.34	44.45	44.65	50.35	108.41
		64QAM	43.80	44.34	44.38	44.66	50.33	107.81
		256QAM	43.86	44.36	44.39	44.63	50.34	108.13
	Middle	QPSK	43.83	44.74	44.55	44.86	50.53	113.07
		16QAM	43.92	44.62	44.54	44.87	50.52	112.77
		64QAM	43.90	44.60	44.53	44.85	50.50	112.32
		256QAM	43.90	44.63	44.60	44.90	50.54	113.33
	Top	QPSK	44.65	44.61	44.45	44.74	50.63	115.73
		16QAM	44.75	44.67	44.57	44.87	50.74	118.49
		64QAM	44.67	44.57	44.41	44.85	50.65	116.11
		256QAM	44.58	44.51	44.32	44.70	50.55	113.51

Type	Channel	Modulation	Output Power [dBm]				Total Power	
			Test antenna port				[dBm]	[W]
			0	1	2	3		
Non-Contiguous	Bottom	QPSK	43.46	43.33	43.48	43.75	49.53	89.71
		16QAM	43.63	42.96	43.56	43.66	49.48	88.76
		64QAM	43.43	43.12	43.63	43.61	49.47	88.57
		256QAM	43.43	43.44	43.49	43.58	49.51	89.25
	Top	QPSK	37.58	37.48	37.34	37.90	43.60	22.91
		16QAM	37.74	37.04	37.48	37.86	43.56	22.71
		64QAM	37.51	37.18	37.55	37.77	43.53	22.53
		256QAM	37.37	37.46	37.37	37.75	43.51	22.44
	Bottom + Top	QPSK					50.52	112.62
	Bottom + Top	16QAM					50.47	111.47
	Bottom + Top	64QAM					50.46	111.10
	Bottom + Top	256QAM					50.48	111.69

Test Plot at Output Power

**BW 15MHz+15MHz, Multi 2 carrier(Contiguous), Bottom
ANT 0**

QPSK



16QAM



64QAM



256QAM



ANT 1

QPSK



16QAM



64QAM



256QAM



ANT 2

QPSK



16QAM



64QAM



256QAM



ANT 3

QPSK



16QAM



64QAM



256QAM



**BW 15MHz+15MHz, Multi 2 carrier(Contiguous), Middle
ANT 0**

QPSK



16QAM



64QAM



256QAM



ANT 1

QPSK



16QAM



64QAM



256QAM



ANT 2

QPSK



16QAM



64QAM



256QAM



ANT 3

QPSK



16QAM



64QAM



256QAM



**BW 15MHz+15MHz, Multi 2 carrier(Contiguous), Top
ANT 0**

QPSK



16QAM



64QAM



256QAM



ANT 1

QPSK



16QAM



64QAM



256QAM



ANT 2

QPSK



16QAM



64QAM



256QAM



ANT 3

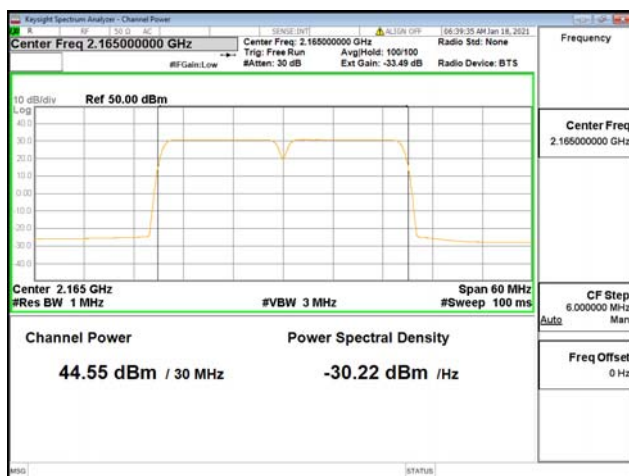
QPSK



16QAM



64QAM



256QAM



**BW 15MHz+15MHz, Multi 2 carrier(Non-Contiguous), Bottom
ANT 0**

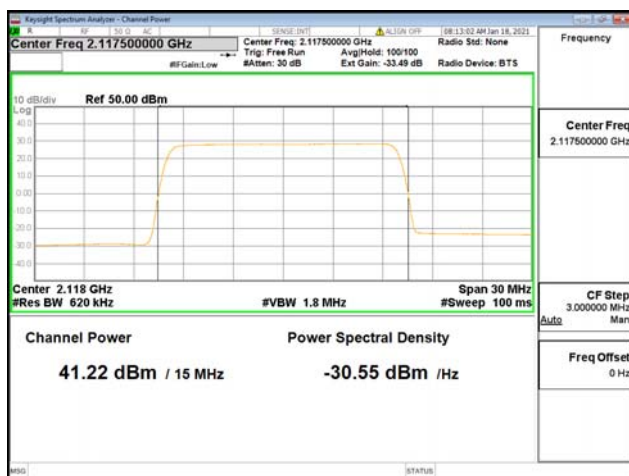
QPSK



16QAM



64QAM



256QAM



ANT 1

QPSK



16QAM



64QAM



256QAM



ANT 2

QPSK



16QAM



64QAM



256QAM



ANT 3

QPSK



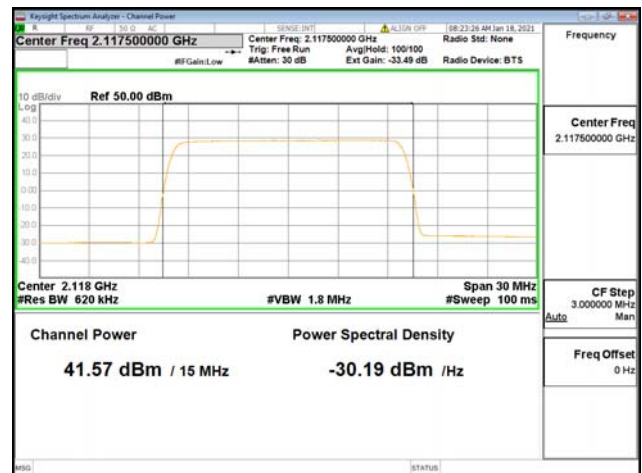
16QAM



64QAM



256QAM



**BW 15MHz+15MHz, Multi 2 carrier(Non-Contiguous), Top
ANT 0**

QPSK



16QAM



64QAM



256QAM

