

TEST REPORT



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-2020-01891
Page (1) / (51) Pages

1. Client

- Name : Samsung Electronics Co Ltd
- Address : 19 Chapin Rd, Building D. Pine Brook, New Jersey, United States
- Date of Receipt : 2020-04-13

2. Manufacturer

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

3. Use of Report : For FCC Certification

4. Test Sample / Model: RF4420d-D1A



5. Date of Test : 2020-04-13 to 2020-05-19

6. Test Standard(method) used : FCC 47 CFR Part 2, 90

7. Testing Environment: Temp.: (24 ± 1) °C, Humidity: (43 ± 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)
-------------	---	--

2019-05-20

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



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-2020-01891
Page (2) / (51) Pages

REPORT REVISION HISTORY

Date	Revision	Page No
2019-05-20	Issued (CTK-2020-01891)	all

This report shall not be reproduced except in full, without the written approval of CTK Co., Ltd. This document may be altered or revised by CTK Co., Ltd. personnel only, and shall be noted in the revision section of the document. Any alteration of this document not carried out by CTK Co., Ltd. will constitute fraud and shall nullify the document.



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-2020-01891
Page (3) / (51) Pages

CONTENTS

1. General Information.....	4
2. Facility and Accreditations.....	6
2.1 Test Facility	6
2.2 Laboratory Accreditations and Listings.....	6
2.3 Calibration Details of Equipment Used for Measurement.....	6
3. Test Specifications	7
3.1 Standards	7
3.2 Mode of operation during the test	7
3.3 Maximum Measurement Uncertainty	9
3.4 Standards Environmental Test conditions	9
4. RF output power.....	10
5. Occupied Bandwidth	17
6. Spurious Emission at Antenna Terminal.....	23
7. Radiated Spurious Emission	45
8. Frequency Stability	49
APPENDIX A – Test Equipment Used For Tests	51



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-2020-01891
Page (4) / (51) Pages

1. General Information

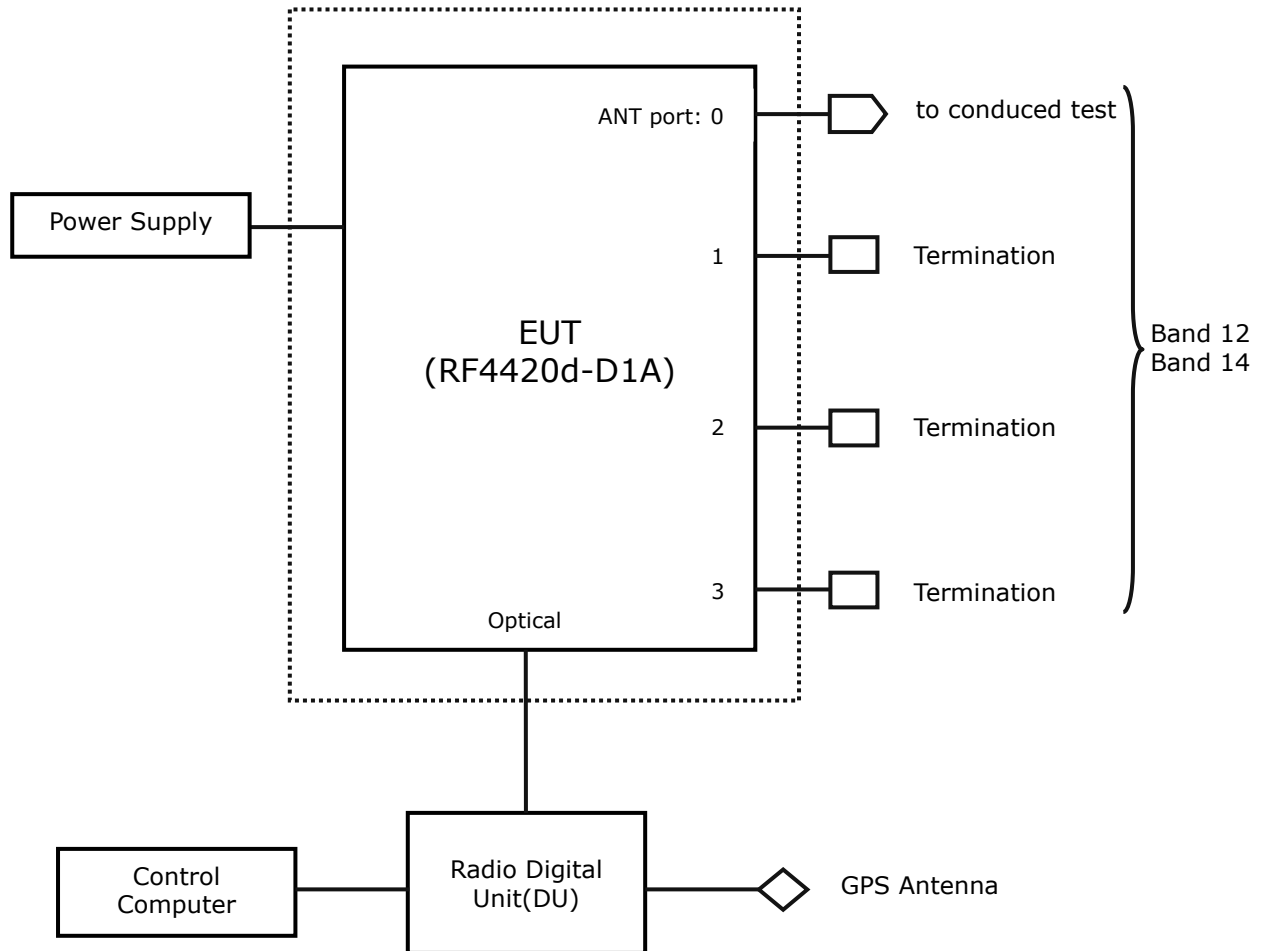
1.1 Client Information

Company	Samsung Electronics Co., Ltd.
Contact Point	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Republic 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	A3LRF4420D-D1A
Product Description	RRU(RF4420d)
Model name	RF4420d-D1A
Power Supply	-48 Vdc
Operating Frequency	- Band 12 DL : 729 MHz- 744 MHz, UL 699 MHz - 714 MHz - Band 14 DL : 758 MHz- 768 MHz, UL 788 MHz - 798 MHz
RF Output Power	- Band 12 BW 5 MHz : 20 W / path(Total 4 path = 80 W) BW 10 MHz : 40 W / path(Total 4 path = 160 W) BW 15 MHz : 40 W / path(Total 4 path = 160 W) - Band 14 BW 10 MHz : 40 W / path(Total 4 path = 160 W) - Band 12 + Band 14 BW 5 MHz + BW 10 MHz : 60 W / path(Total 4 path = 240 W) BW 10 MHz + BW 10 MHz : 80 W / path(Total 4 path = 320 W) BW 15 MHz + BW 10 MHz : 80 W / path(Total 4 path = 320 W)
Channel Bandwidth	- Band 12 : 5 MHz, 10 MHz, 15 MHz - Band 14 : 10 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 Part 90 : PRIVATE LAND MOBILE RADIO SERVICES KDB Publication 662911 D01 Multiple Transmitter Output v02r01

1.3 Configurations





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-2020-01891
Page (6) / (51) Pages

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.



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-2020-01891
Page (7) / (51) Pages

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 90.

Section	Test Items	Results
§2.1046, §90.542(a)(3)	RF output power	Compliant
§2.1049	Occupied bandwidth	Compliant
§2.1051, §90.543(e)(f)	Spurious Emissions at Antenna Terminals	Compliant
§2.1051, §90.543(e)	Band edge	Compliant
§2.1053, §90.543(e)	Spurious Radiated Emissions	Compliant
§2.1055(a)(1), §90.539(d)	Frequency Stability over Temperature variation	Compliant
§2.1055(d), §90.539(d)	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.



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-2020-01891
Page (8) / (51) Pages

Operating band and Frequency range

Band 14	Transmit	758 MHz - 768 MHz
	Receive	788 MHz - 798 MHz

Operating Configurations

Supported configurations	Single carrier
Spectrum Operation	-

Single carrier rated total output power as a sum of all carriers

Band type	Bandwidth	Positions	Frequency [MHz]	Power [W]	Output port	Total Power(sum)[W]
Band 14	10 MHz	Middle	763	40	4 TX	160



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-2020-01891
Page (9) / (51) Pages


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

 <p>CTK Co., Ltd. The Prime Leader of Global Regulatory Certification</p>	<p>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</p>	<p>Report No.: CTK-2020-01891 Page (10) / (51) Pages</p>	
---	--	--	--

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.

§90.542 Broadband transmitting power limits.

- (a) The following power limits apply to the 758-768/788-798 MHz band:
- (3) Fixed and base stations transmitting a signal in the 758-768 MHz band with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.



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-2020-01891
Page (11) / (51) Pages

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 loss of the cables in 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 mathematically 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: Maximum ERP is sufficient level to pass the limit.

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

Maximum output power for one port : **46.02 dBm (40 W)**

Maximum output sum power : **52.041 dBm (160 W)**

Measured sum maximum power : **52.32 dBm (170.61 W)**



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-2020-01891
Page (12) / (51) Pages

Test Results :

Test Data :BW 10MHz

Channel	Modulation	Output Power [dBm]				Total Power	
		Test antenna port				[dBm]	[W]
		0	1	2	3		
Middle	QPSK	46.02	46.37	46.30	46.27	52.26	168.27
	16QAM	46.04	46.36	46.32	46.34	52.29	169.43
	64QAM	46.03	46.42	46.30	46.30	52.29	169.43
	256QAM	46.06	46.41	46.33	46.38	52.32	170.61



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-2020-01891
 Page (13) / (51) Pages

Test Plot at Output Power

**BW 10MHz, Middle
 ANTO**

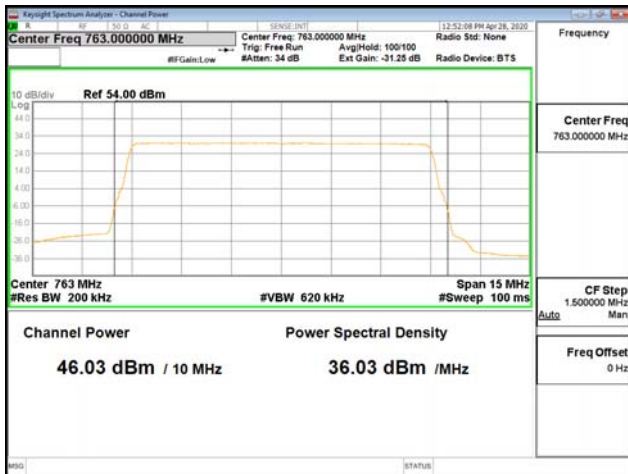
QPSK



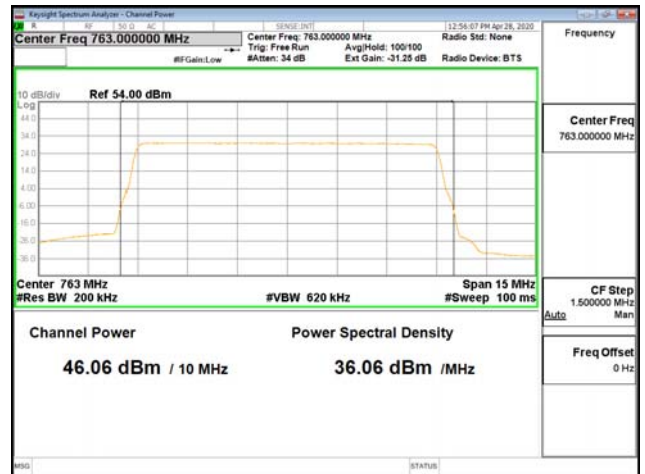
16QAM



64QAM



256QAM





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

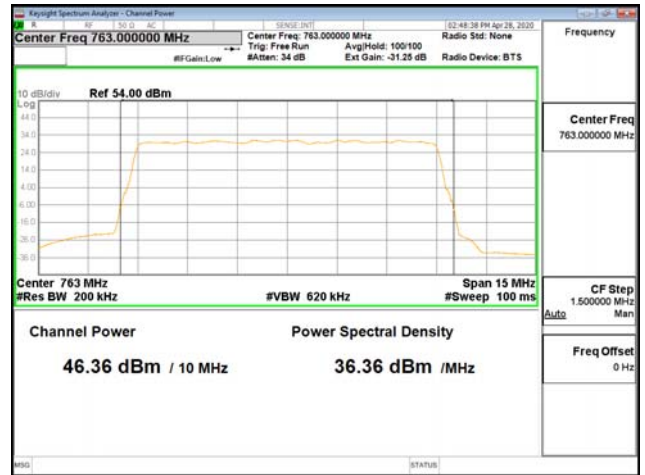
Report No.:
 CTK-2020-01891
 Page (14) / (51) Pages

ANT1

QPSK



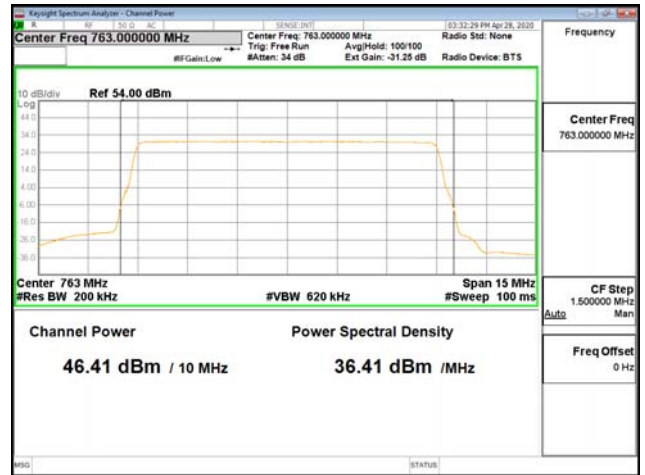
16QAM



64QAM



256QAM





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

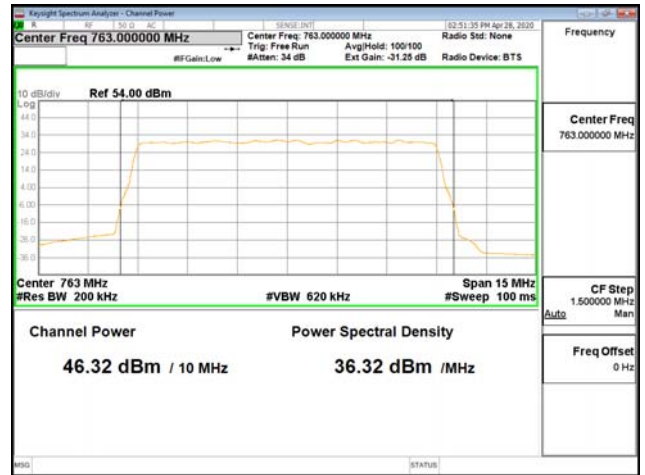
Report No.:
 CTK-2020-01891
 Page (15) / (51) Pages

ANT2

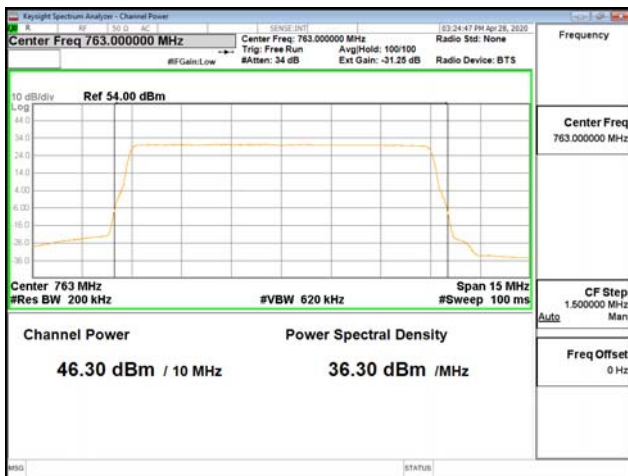
QPSK



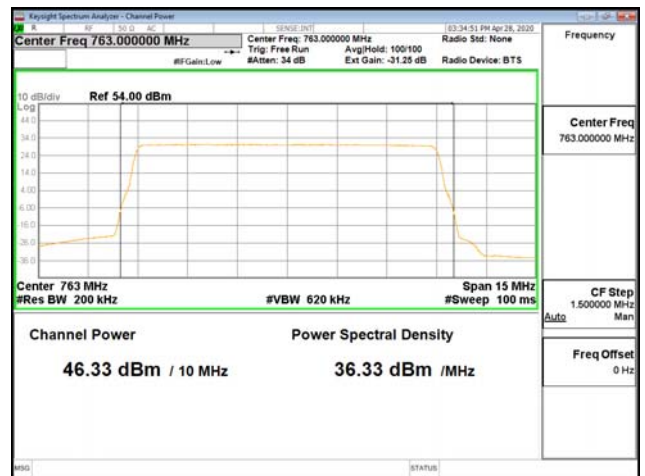
16QAM



64QAM



256QAM





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

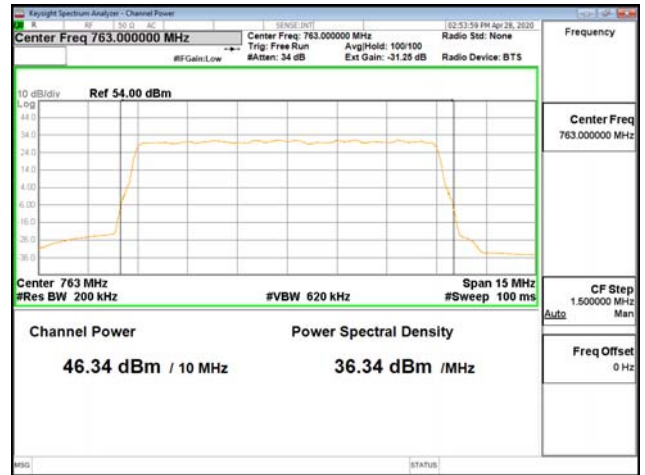
Report No.:
 CTK-2020-01891
 Page (16) / (51) Pages

ANT3

QPSK



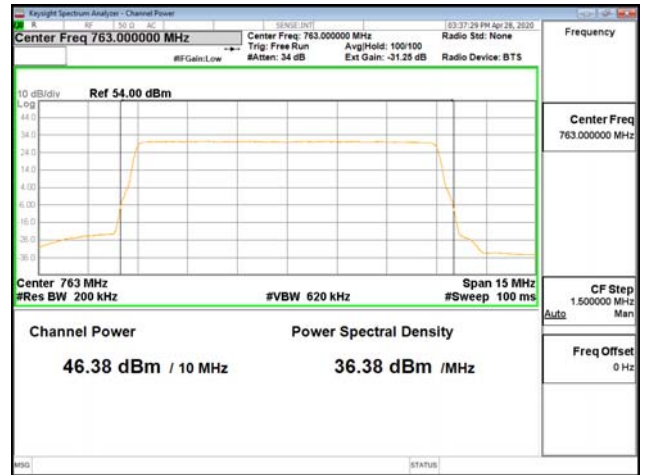
16QAM




64QAM



256QAM



 <p>CTK Co., Ltd. The Prime Leader of Global Regulatory Certification</p>	<p>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</p>	<p>Report No.: CTK-2020-01891 Page (17) / (51) Pages</p>	
---	--	--	--

5. Occupied Bandwidth

Test Requirements :

§ 2.1049 Measurements required : Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049(a) through (i) as applicable.

Test Procedures :

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation. The EUT was connected to a spectrum analyzer enabled with an occupied bandwidth in accordance with FCC Part 2.1049. The occupied bandwidth was measured from the fundamental emission at the bottom, middle and top channels. The occupied bandwidth was measured using the built in occupied bandwidth function of the spectrum analyzer. It was set to measure the bandwidth where 99% of the signal power was contained. The analyzer automatically configures the measurement bandwidths to make an accurate measurement based on the channel bandwidth and channel spacing of the EUT.



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-2020-01891
Page (18) / (51) Pages

Test Results :

Test Data : BW 10MHz

Channel	Modulation	Occupied Bandwidth(MHz)			
		Test antenna port			
		0	1	2	3
Middle	QPSK	8.97	8.97	8.97	8.97
	16QAM	8.96	8.96	8.95	8.96
	64QAM	8.97	8.97	8.97	8.97
	256QAM	8.97	8.97	8.97	8.97



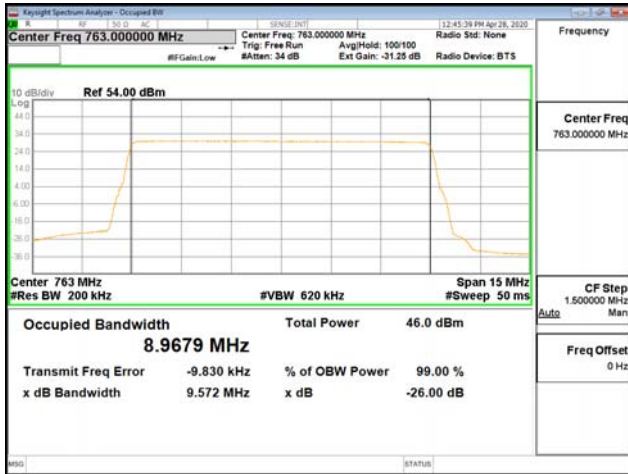
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (19) / (51) Pages

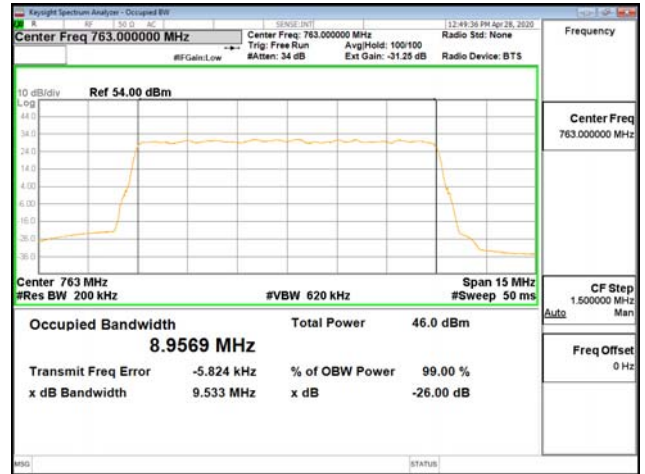
Test Plot at Occupied Bandwidth

**BW 10MHz, Middle
 ANTO**

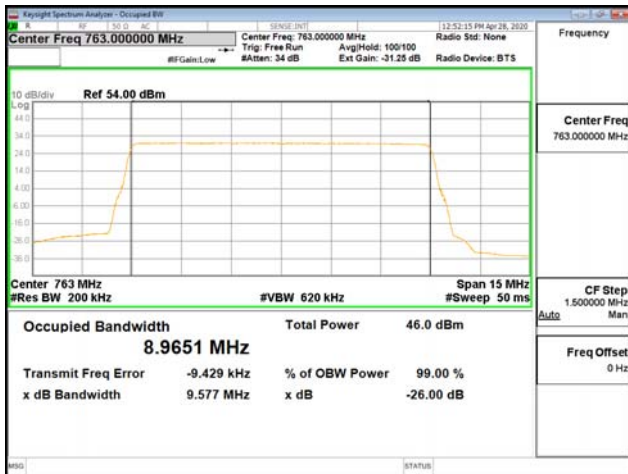
QPSK



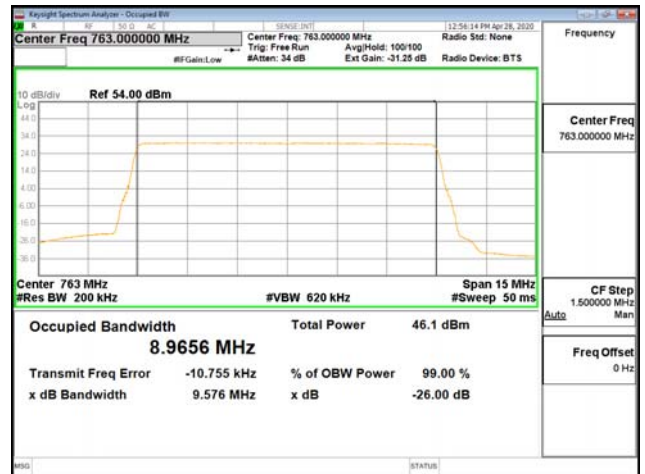
16QAM



64QAM



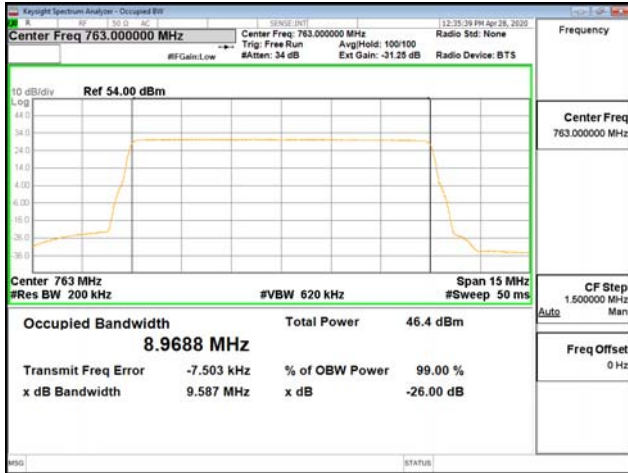
256QAM



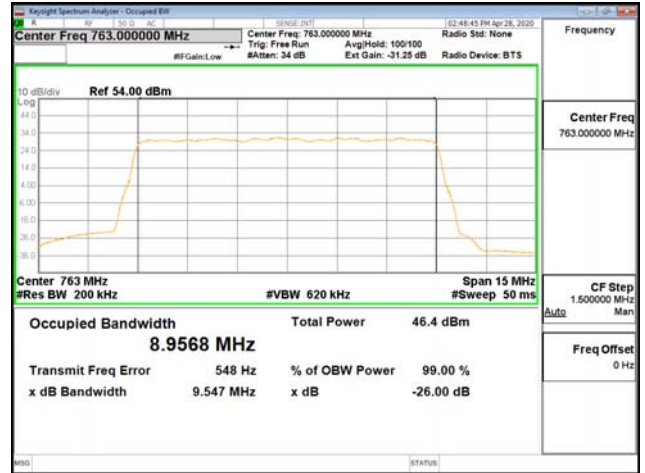


ANT1

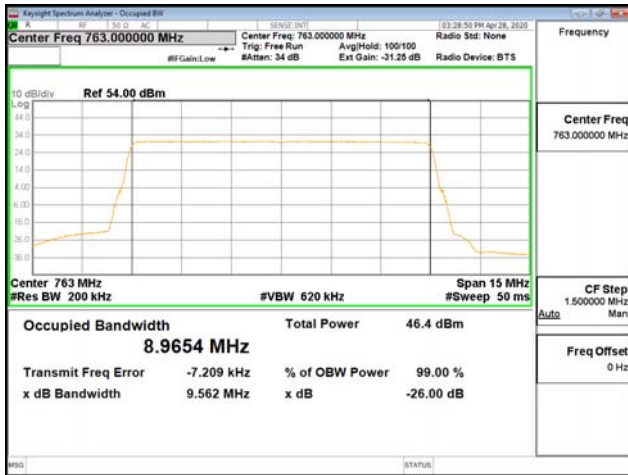
QPSK



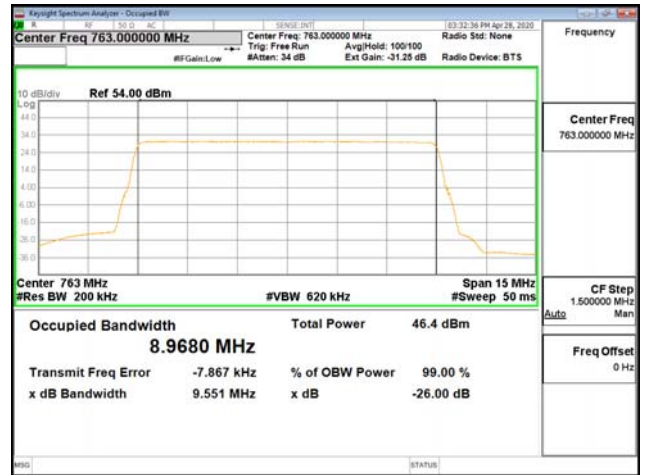
16QAM



64QAM



256QAM



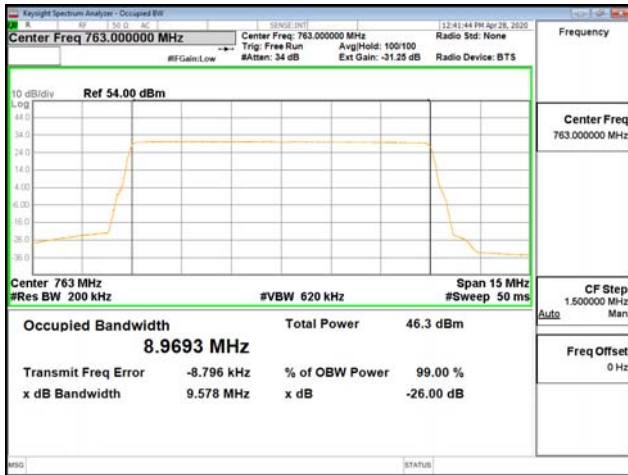


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

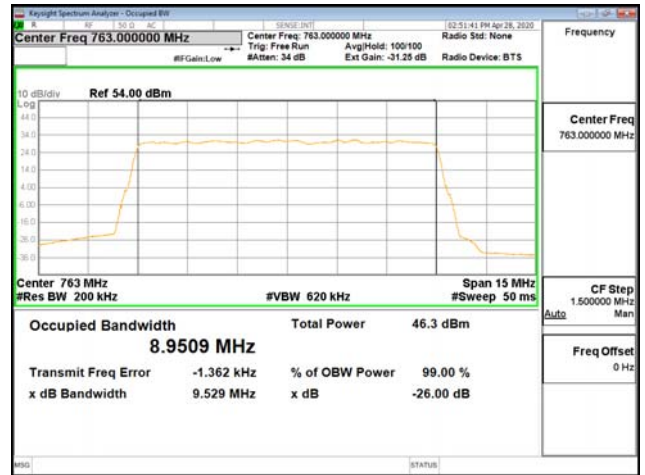
Report No.:
 CTK-2020-01891
 Page (21) / (51) Pages

ANT2

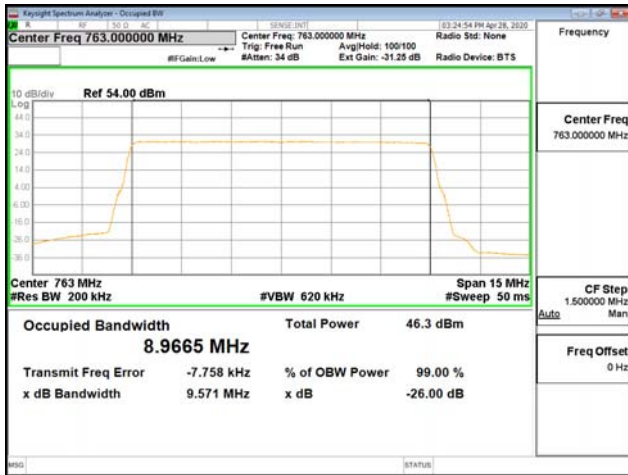
QPSK



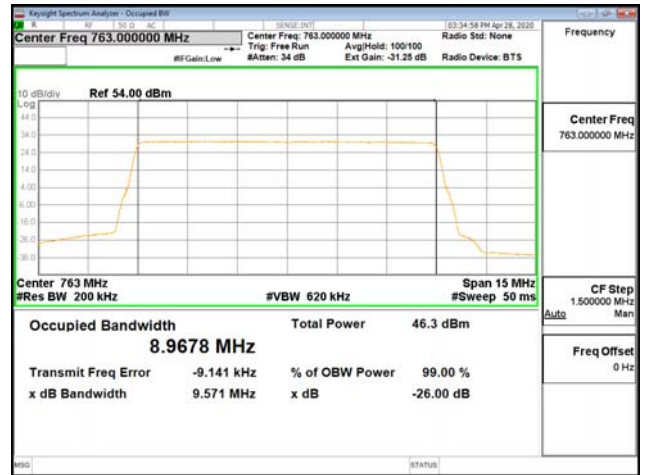
16QAM



64QAM



256QAM



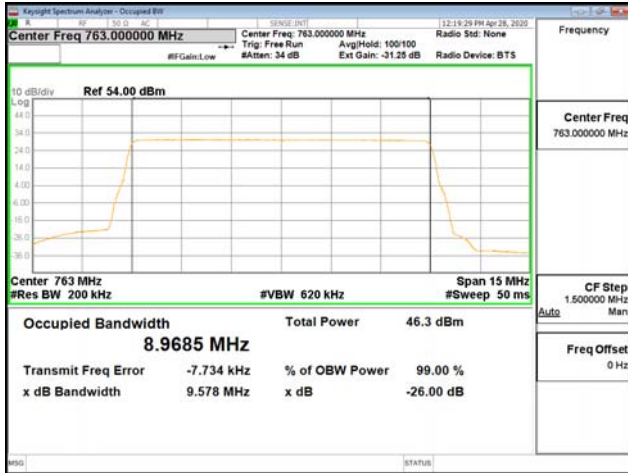


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

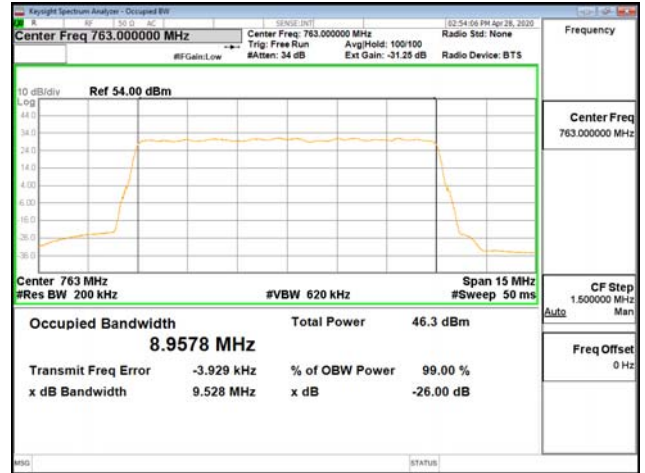
Report No.:
 CTK-2020-01891
 Page (22) / (51) Pages

ANT3

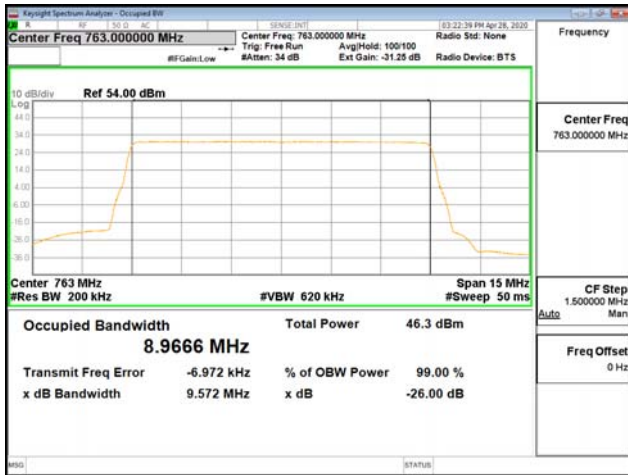
QPSK



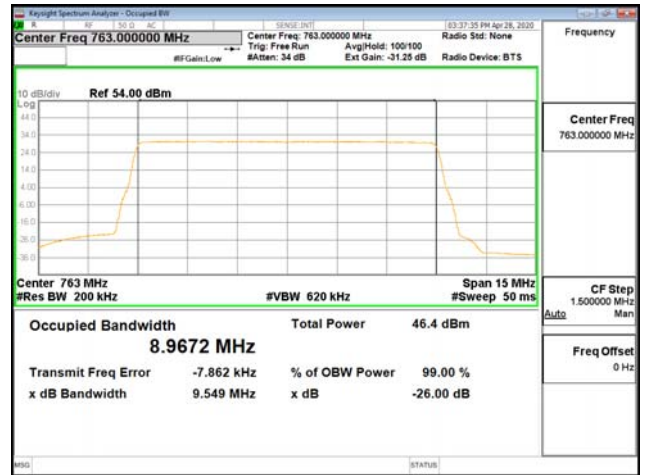
16QAM



64QAM



256QAM





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-2020-01891
Page (23) / (51) Pages

6. Spurious Emission at Antenna Terminal

§ 90.543 Emission limits

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than $76 + 10 \log (P)$ dB in a 6.25 kHz band segment, for base and fixed stations.

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than $65 + 10 \log (P)$ dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least $43 + 10 \log (P)$ dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

**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-2020-01891
Page (24) / (51) Pages

Test Procedures :

The RF Output of the transceiver was connected to a spectrum analyzer through appropriate attenuation.

The resolution bandwidth of the spectrum analyzer was set at 100 kHz(below 1 GHz), 1 MHz(Above 1 GHz). Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Notes :

1. In 9 kHz - 10 kHz and 150 kHz - 30 MHz bands, RBW was reduced to 1% and 10% of the reference bandwidth for measuring unwanted emission level(typically, 100 kHz if the authorized frequency band is below 1 GHz) and power was integrated.(1% = +20 dB, 10% = +10 dB)
2. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its at maximum power, and at the appropriate frequencies.

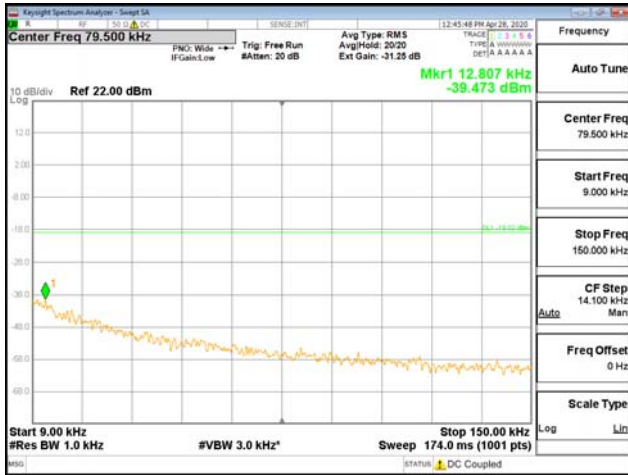
All modulation types were investigated to determine the worst case configuration.

All modulation types of operation were investigated and the worst case configuration results are reported in this section. (Worst case : QPSK, 256QAM)

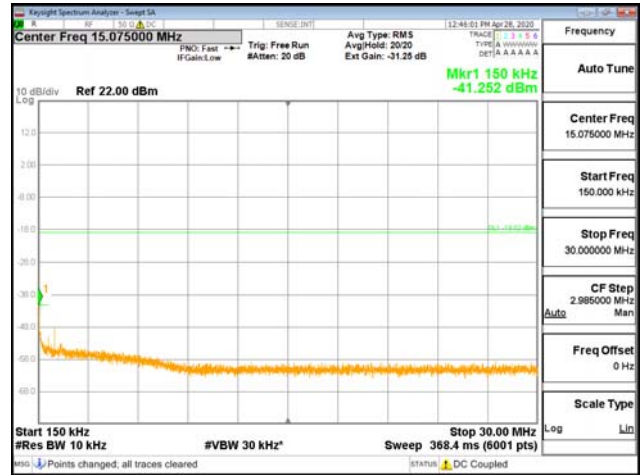
Test Plot at Spurious Emissions

BW 10MHz, Middle, QPSK
ANTO

9 kHz - 150 kHz



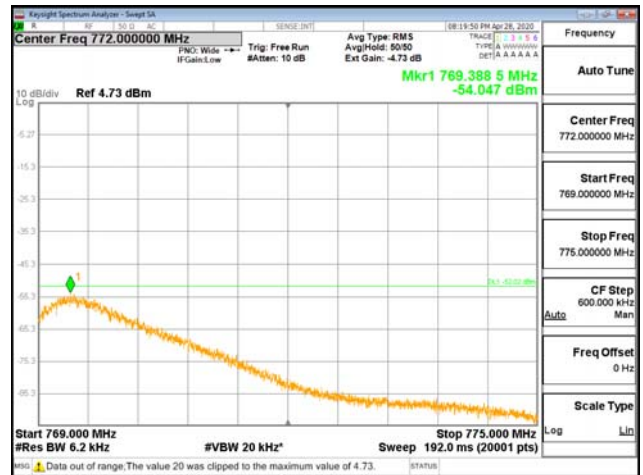
150 kHz - 30 MHz



30 MHz - 758 MHz



769 MHz - 775 MHz

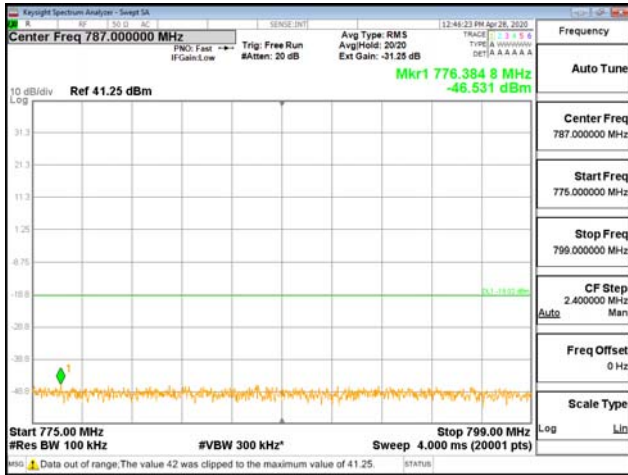




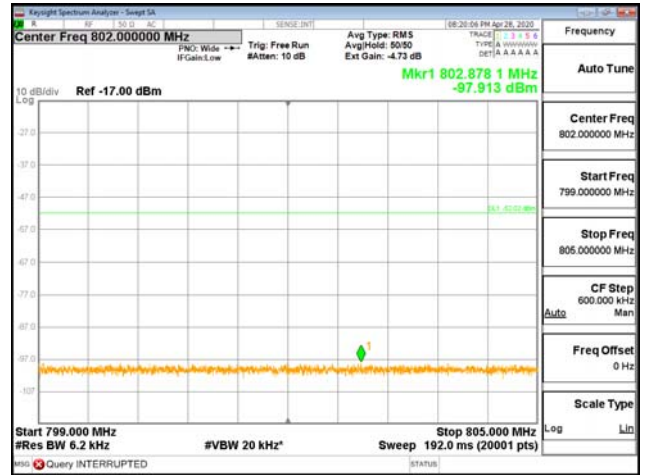
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (26) / (51) Pages

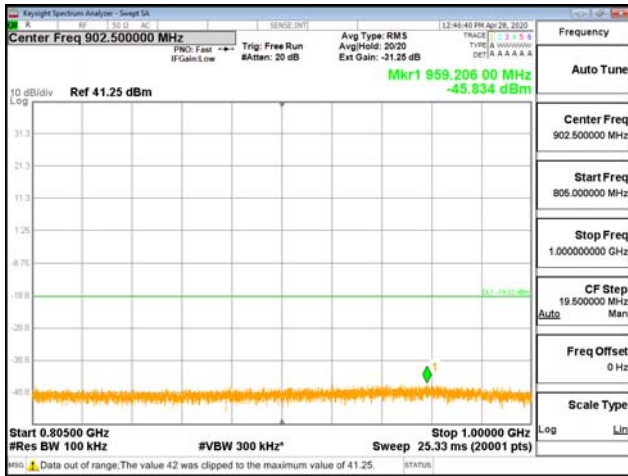
775 MHz - 799 MHz



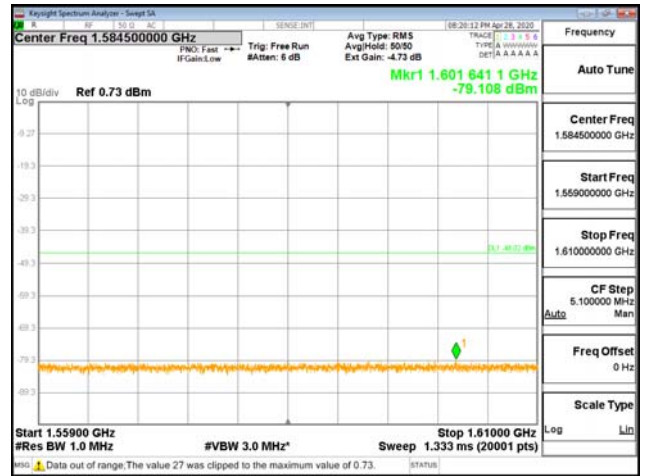
799 MHz - 805 MHz



805 MHz - 1000 MHz



1559 MHz - 1610 MHz



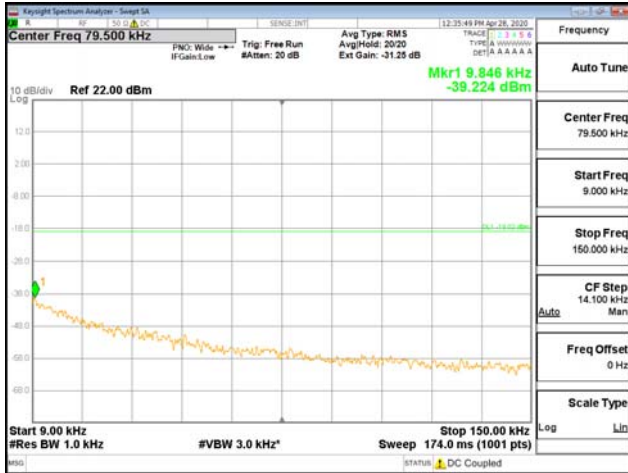


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

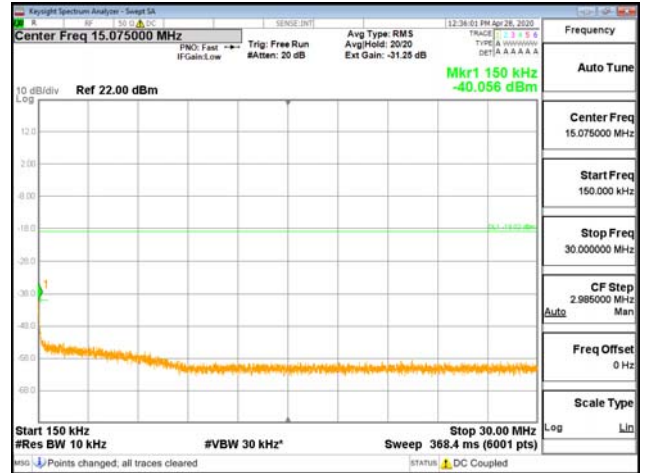
Report No.:
 CTK-2020-01891
 Page (27) / (51) Pages

ANT1

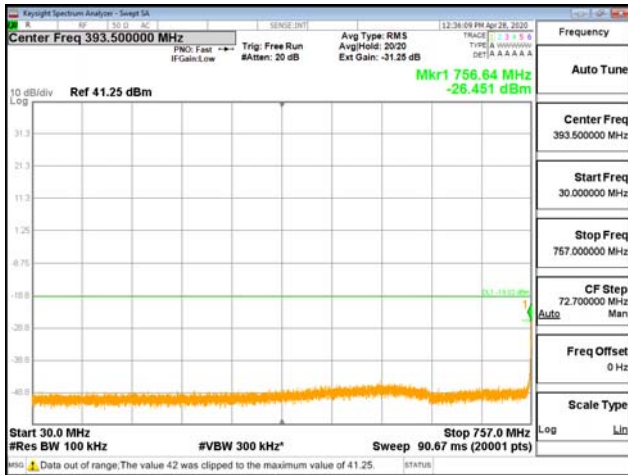
9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 758 MHz



769 MHz - 775 MHz

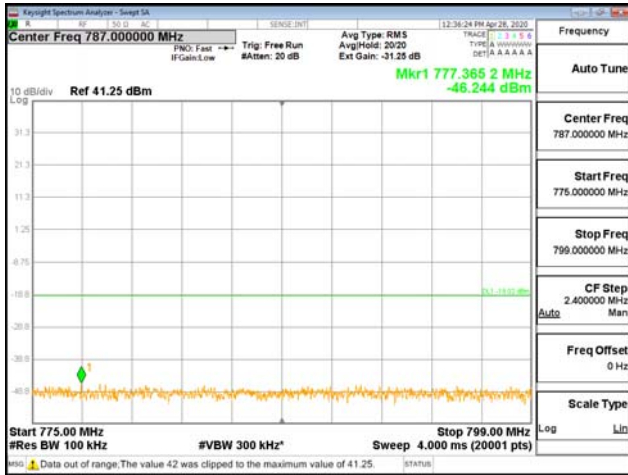




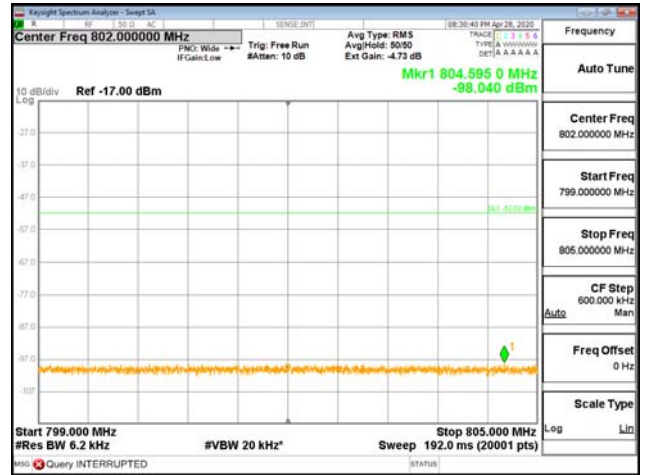
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (28) / (51) Pages

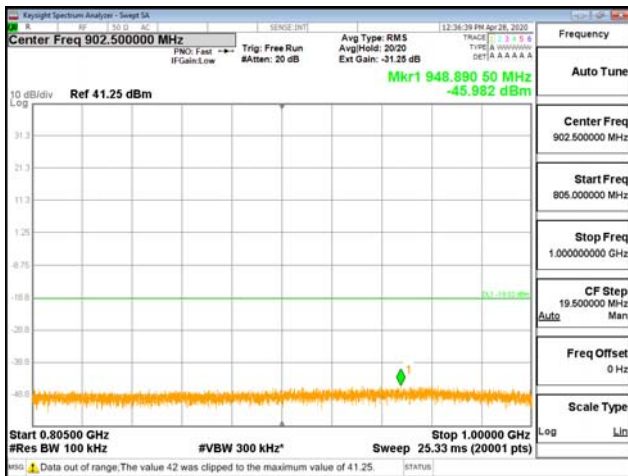
775 MHz - 799 MHz



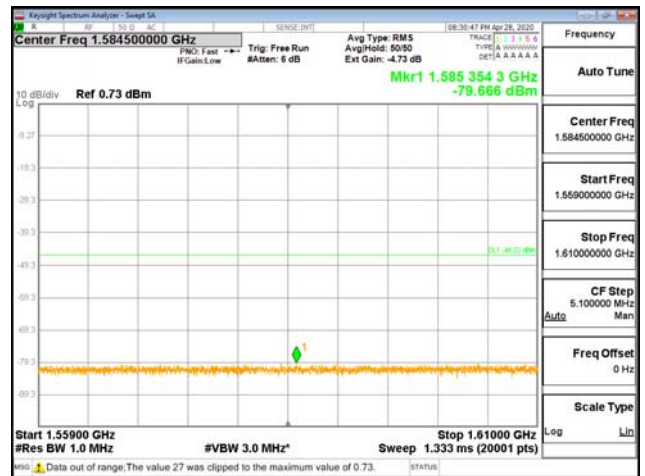
799 MHz - 805 MHz



805 MHz - 1000 MHz



1559 MHz - 1610 MHz



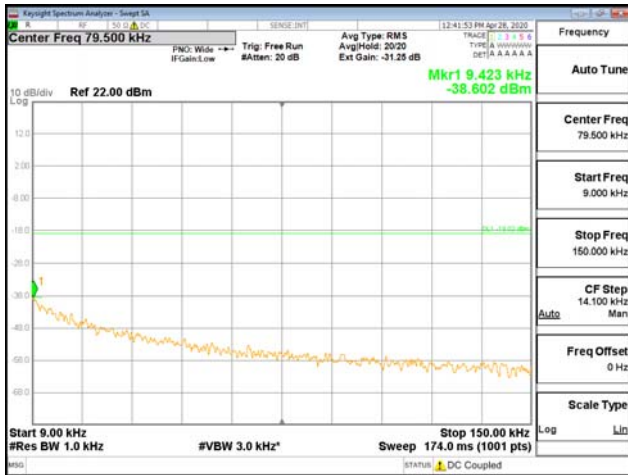


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

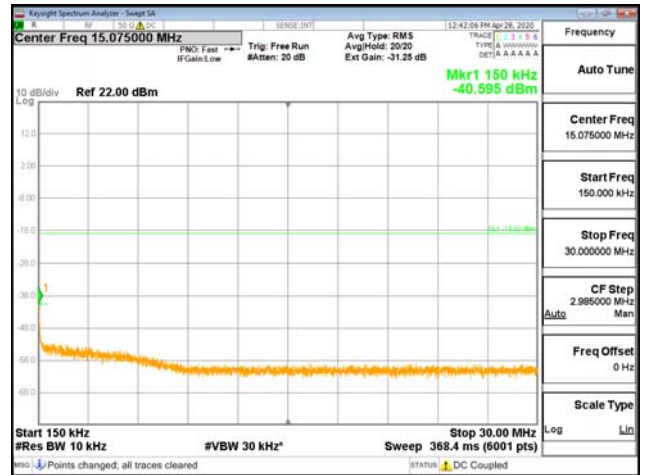
Report No.:
 CTK-2020-01891
 Page (29) / (51) Pages

ANT2

9 kHz - 150 kHz



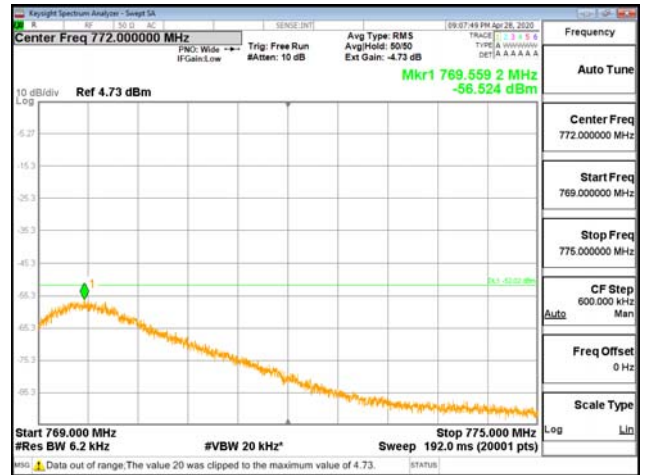
150 kHz - 30 MHz



30 MHz - 758 MHz



769 MHz - 775 MHz

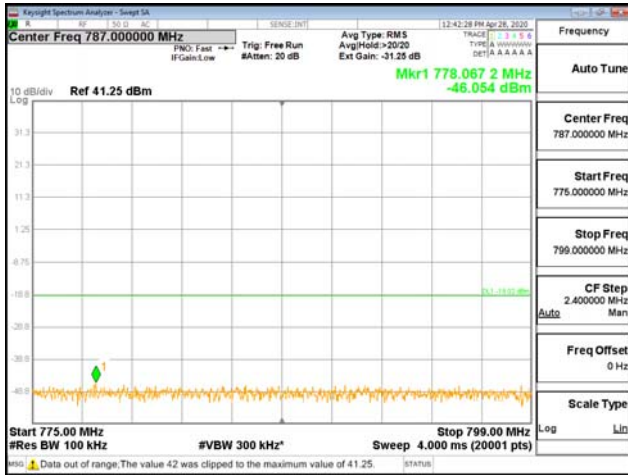




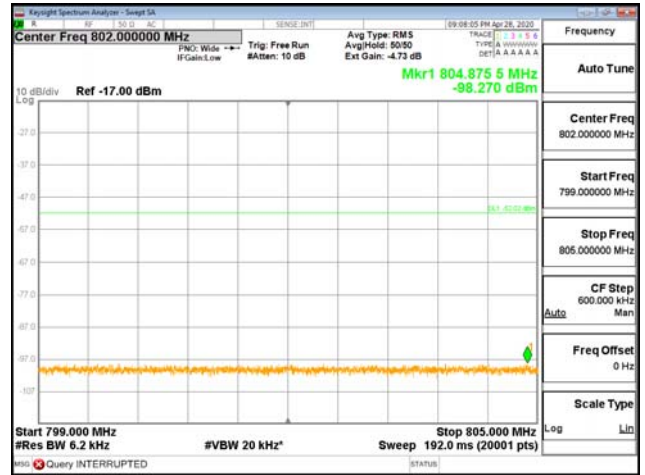
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (30) / (51) Pages

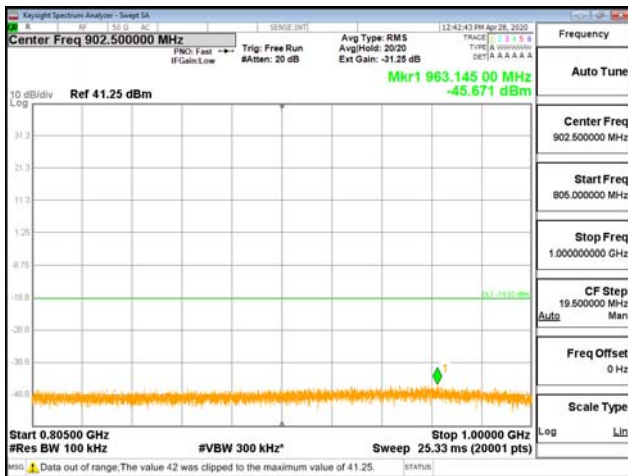
775 MHz - 799 MHz



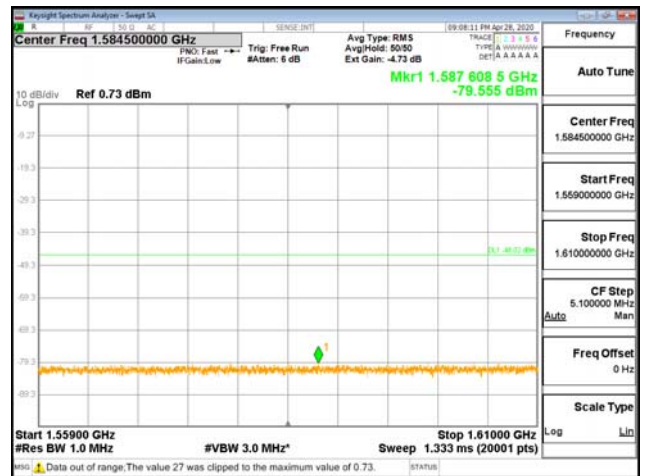
799 MHz - 805 MHz



805 MHz - 1000 MHz



1559 MHz - 1610 MHz



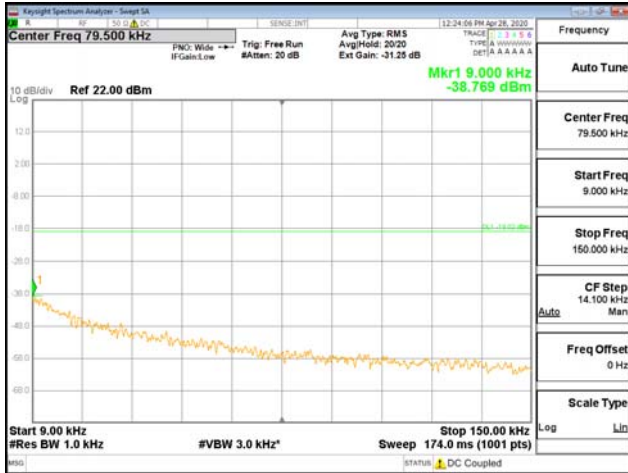


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

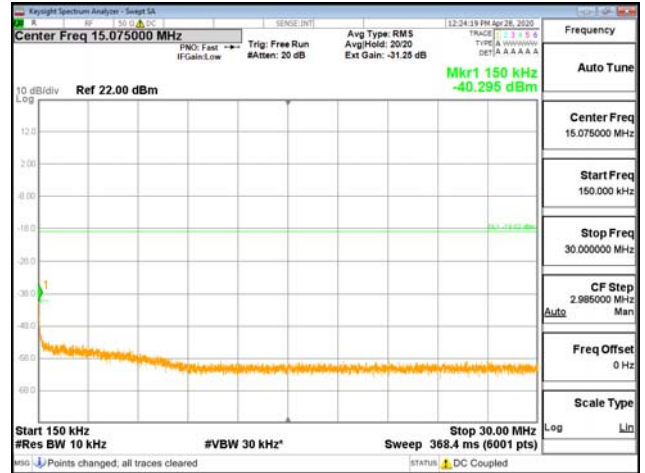
Report No.:
 CTK-2020-01891
 Page (31) / (51) Pages

ANT3

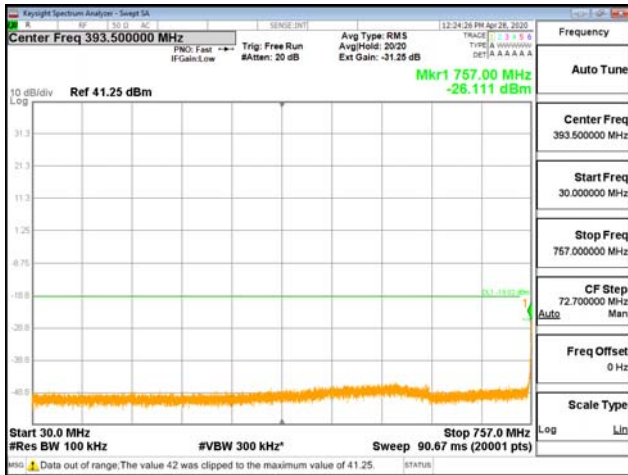
9 kHz - 150 kHz



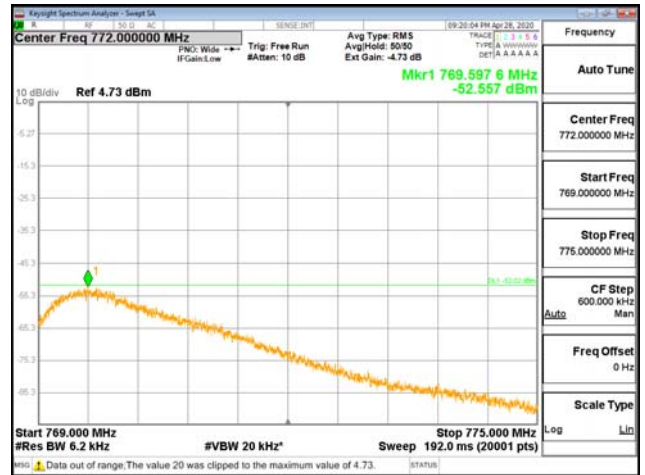
150 kHz - 30 MHz



30 MHz - 758 MHz



769 MHz - 775 MHz

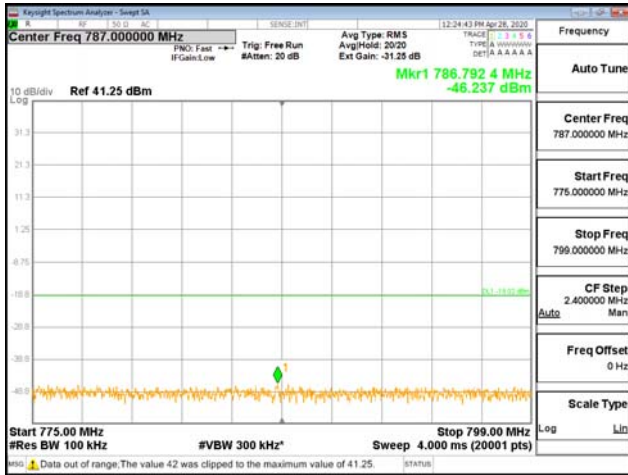




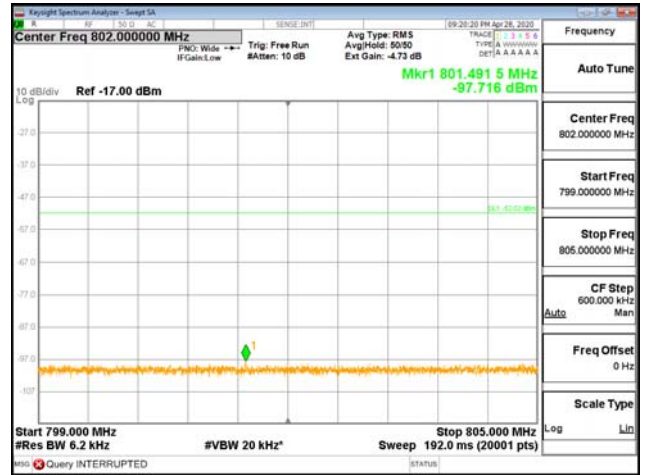
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (32) / (51) Pages

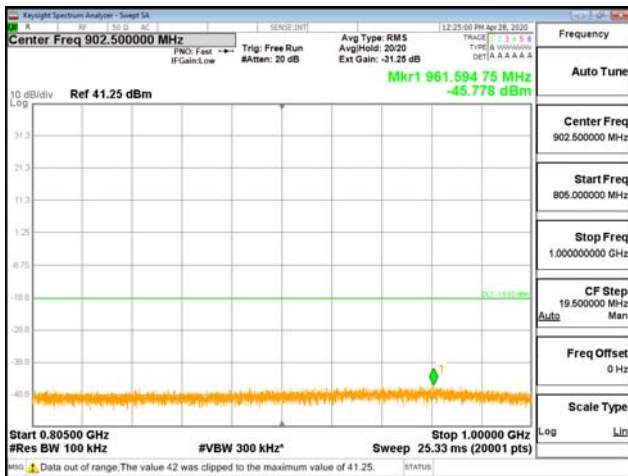
775 MHz - 799 MHz



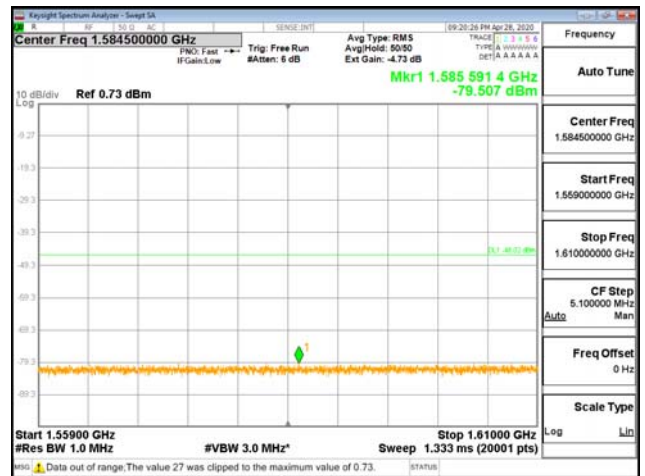
799 MHz - 805 MHz



805 MHz - 1000 MHz



1559 MHz - 1610 MHz



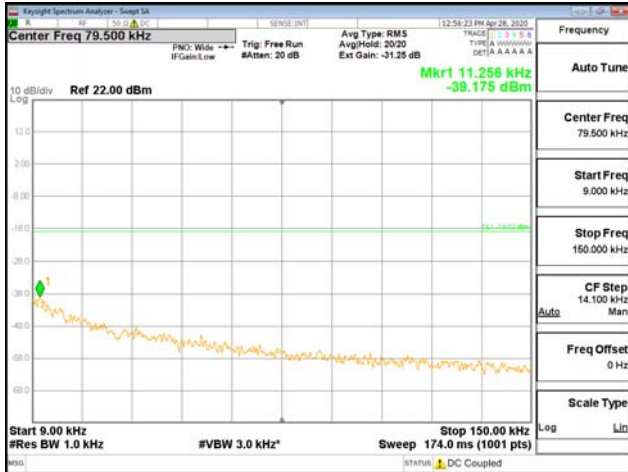


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

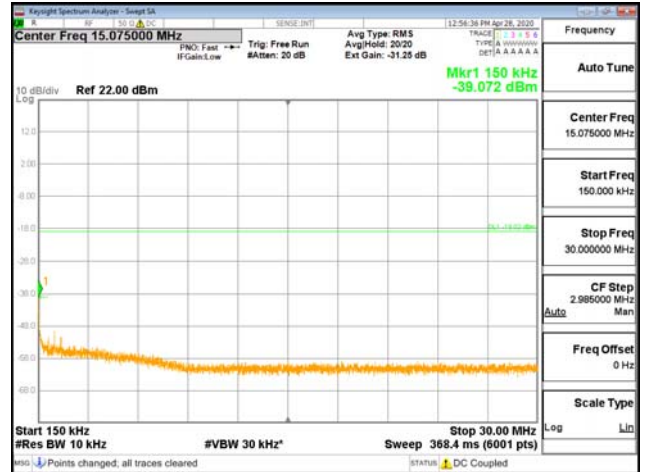
Report No.:
 CTK-2020-01891
 Page (33) / (51) Pages

**BW 10MHz, Middle, 256QAM
 ANTO**

9 kHz - 150 kHz



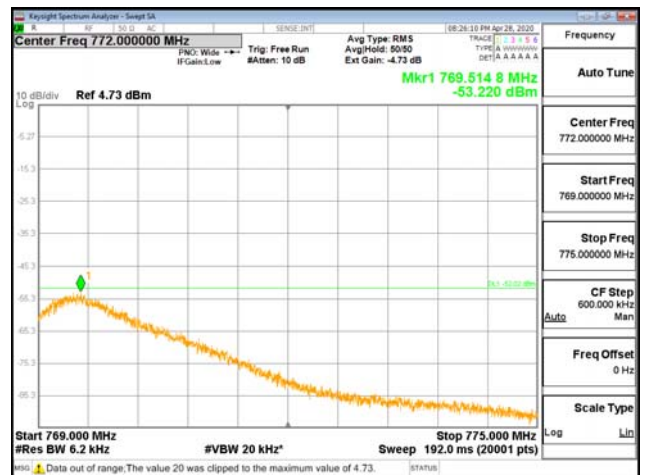
150 kHz - 30 MHz



30 MHz - 758 MHz



769 MHz - 775 MHz

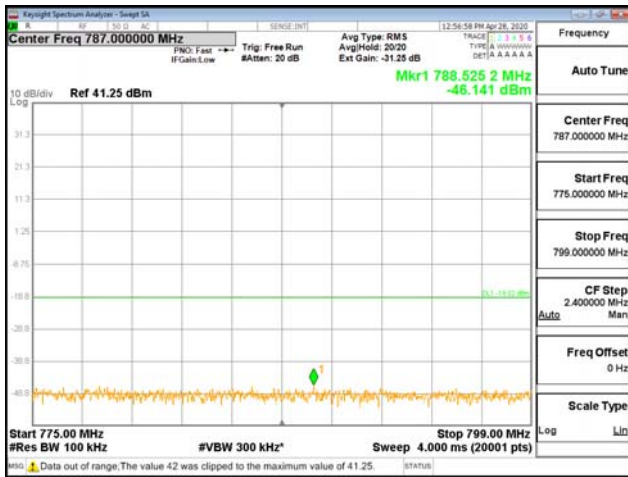




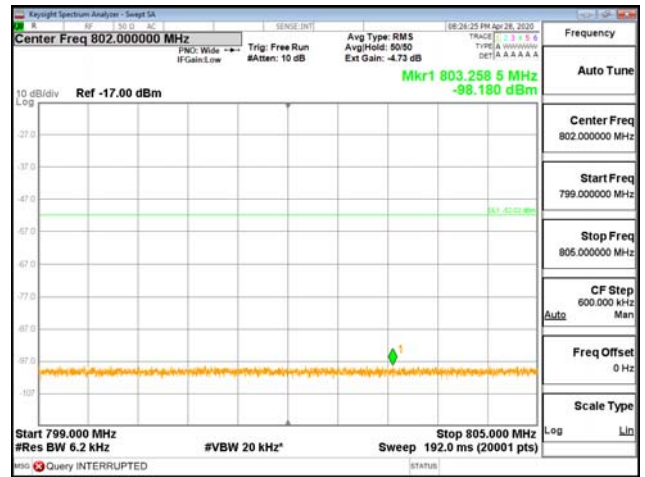
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (34) / (51) Pages

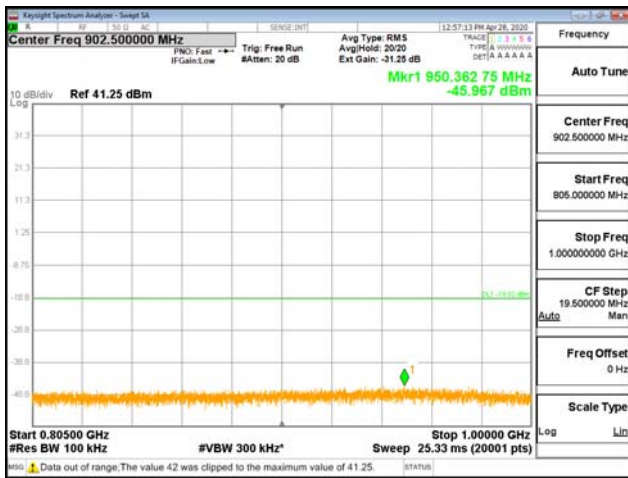
775 MHz - 799 MHz



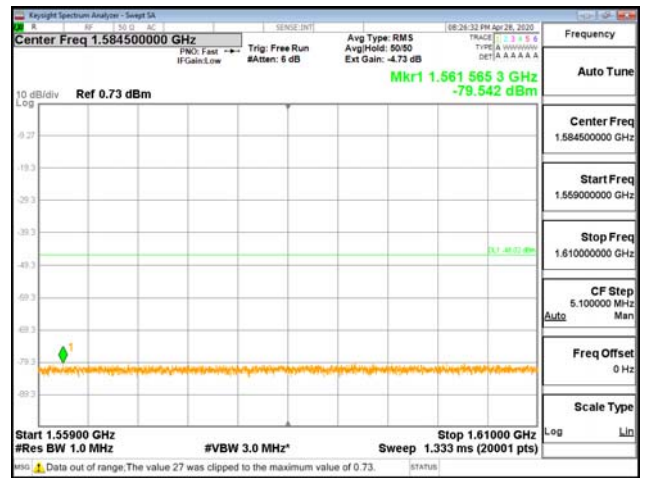
799 MHz - 805 MHz



805 MHz - 1000 MHz



1559 MHz - 1610 MHz



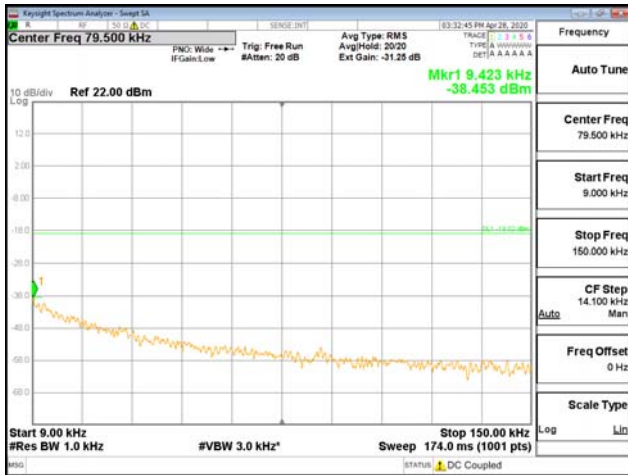


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

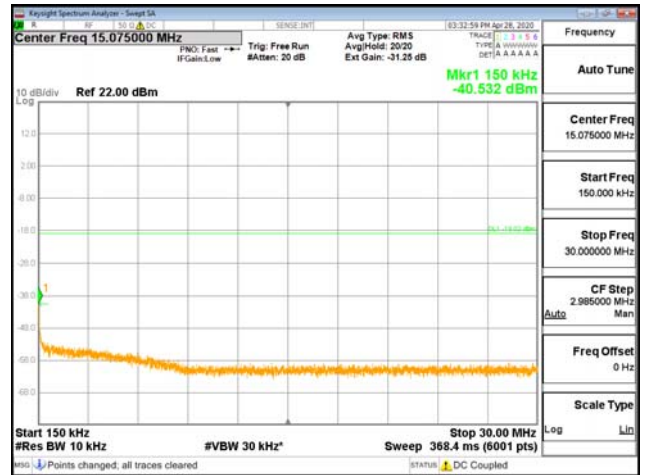
Report No.:
 CTK-2020-01891
 Page (35) / (51) Pages

ANT1

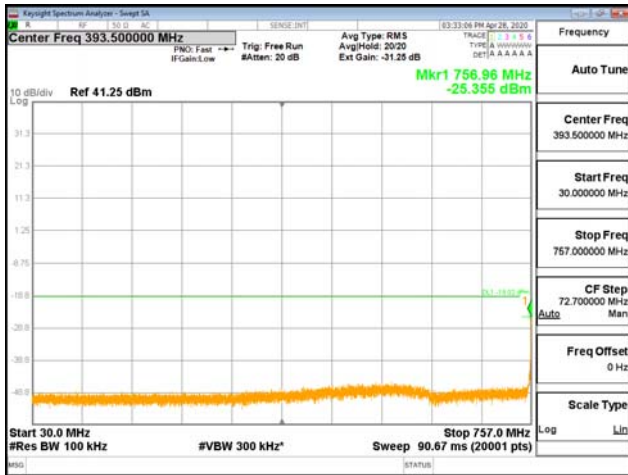
9 kHz - 150 kHz



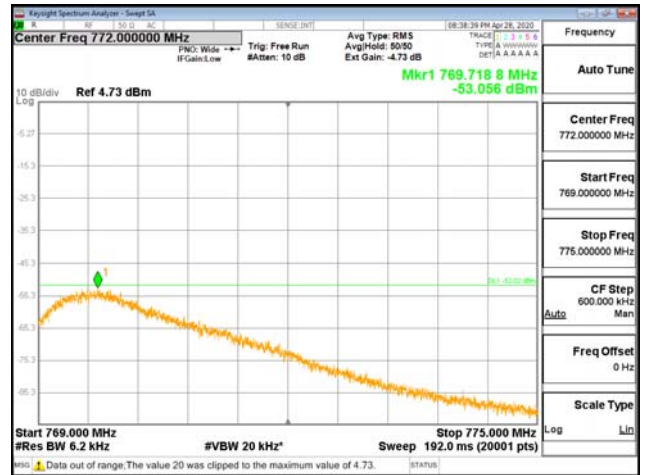
150 kHz - 30 MHz



30 MHz - 758 MHz



769 MHz - 775 MHz

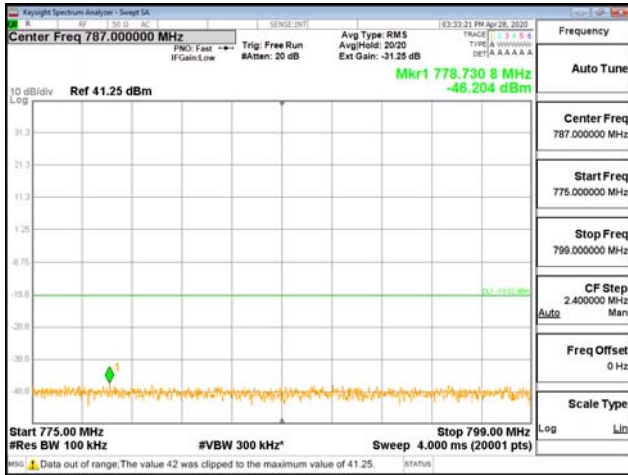




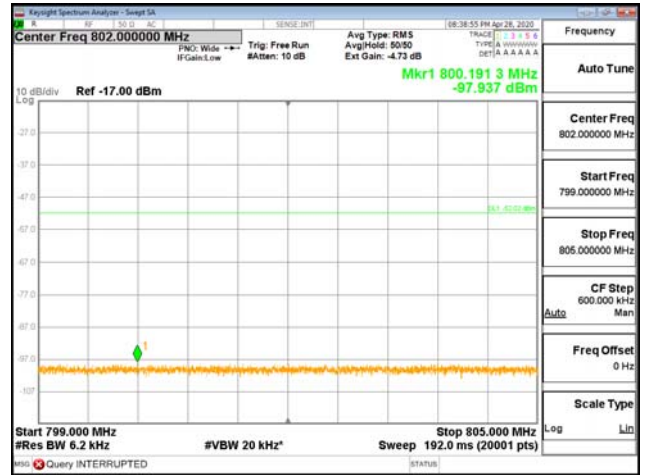
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (36) / (51) Pages

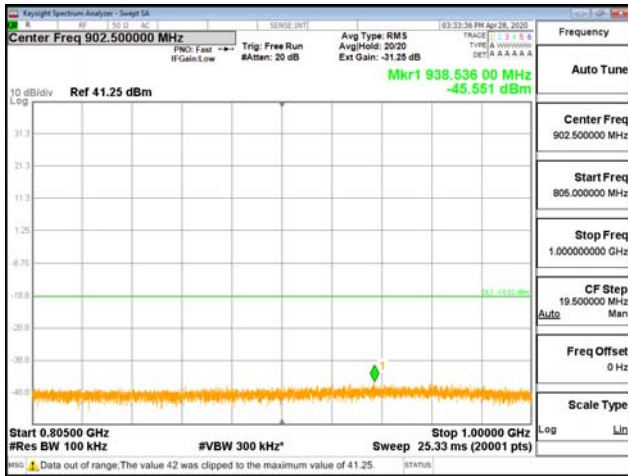
775 MHz - 799 MHz



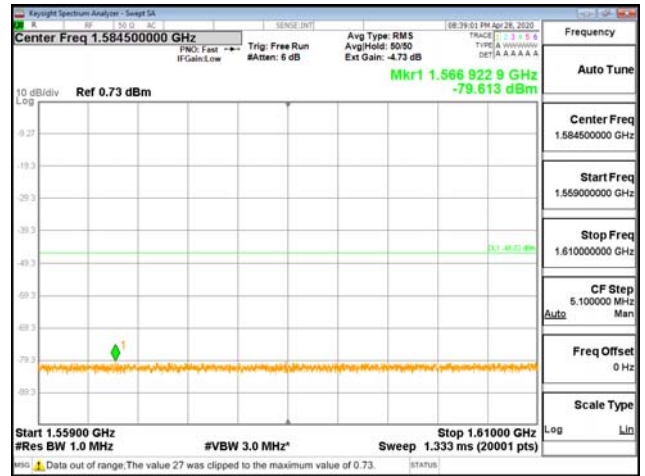
799 MHz - 805 MHz



805 MHz - 1000 MHz



1559 MHz - 1610 MHz



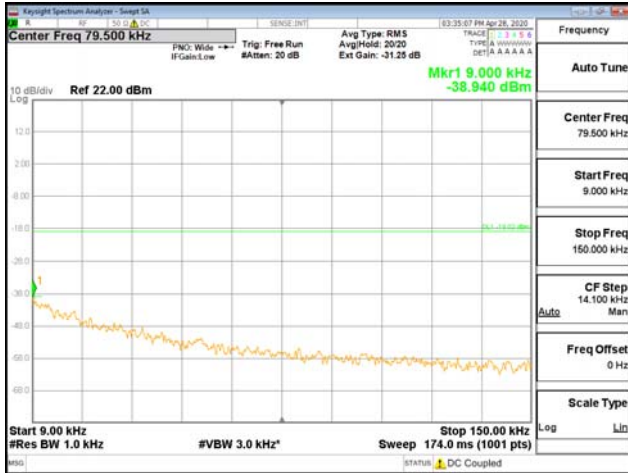


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

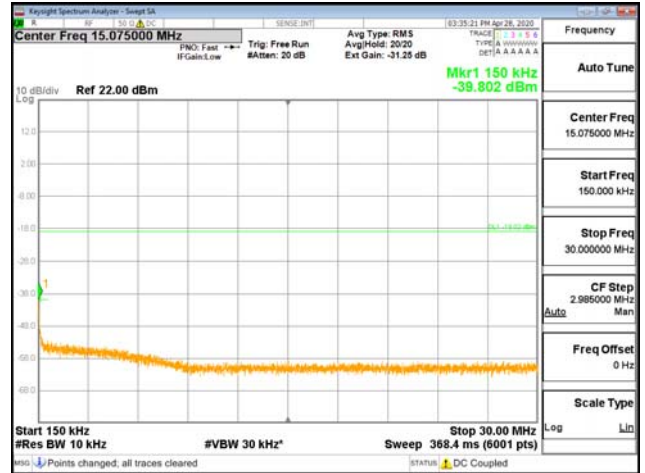
Report No.:
 CTK-2020-01891
 Page (37) / (51) Pages

ANT2

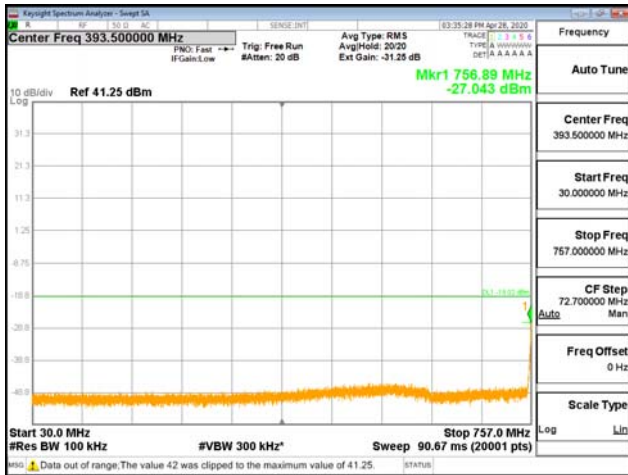
9 kHz - 150 kHz



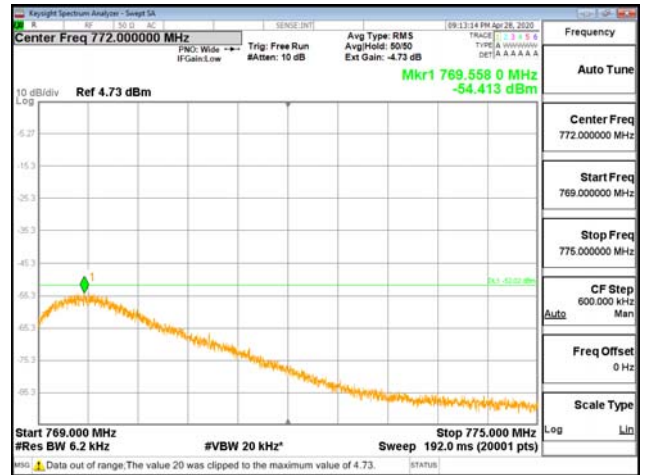
150 kHz - 30 MHz



30 MHz - 758 MHz



769 MHz - 775 MHz

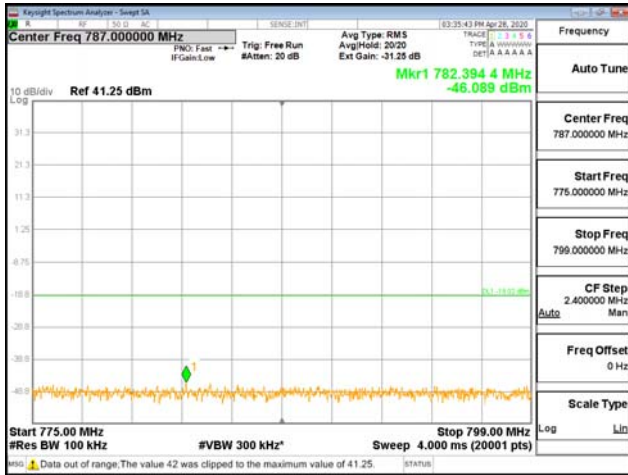




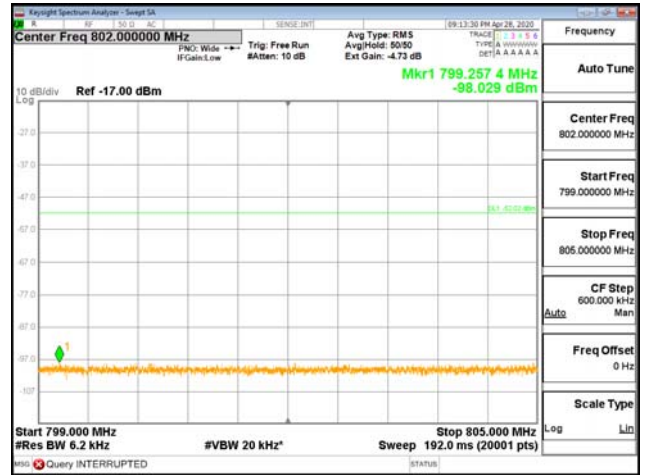
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (38) / (51) Pages

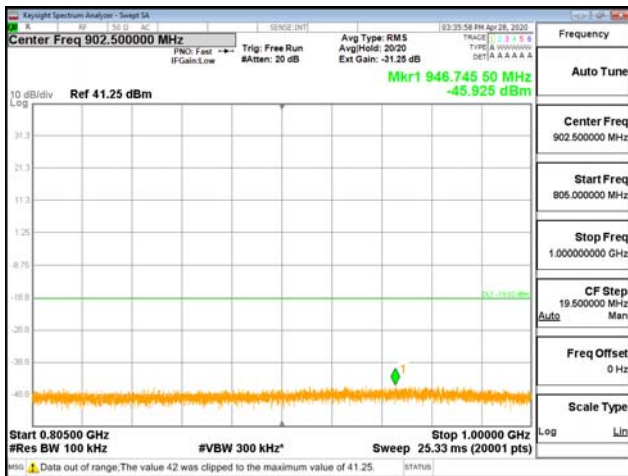
775 MHz - 799 MHz



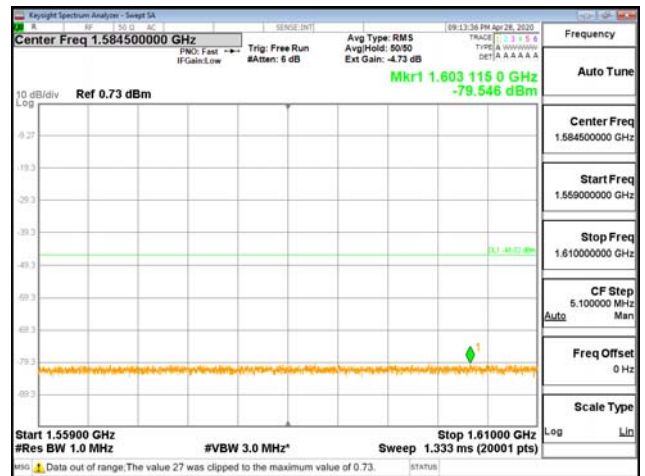
799 MHz - 805 MHz



805 MHz - 1000 MHz



1559 MHz - 1610 MHz



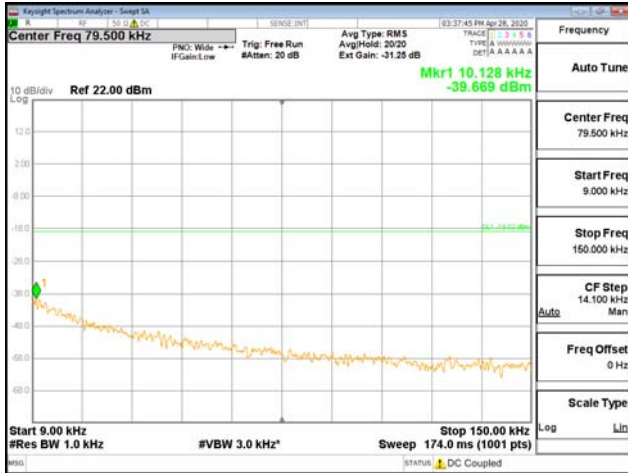


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

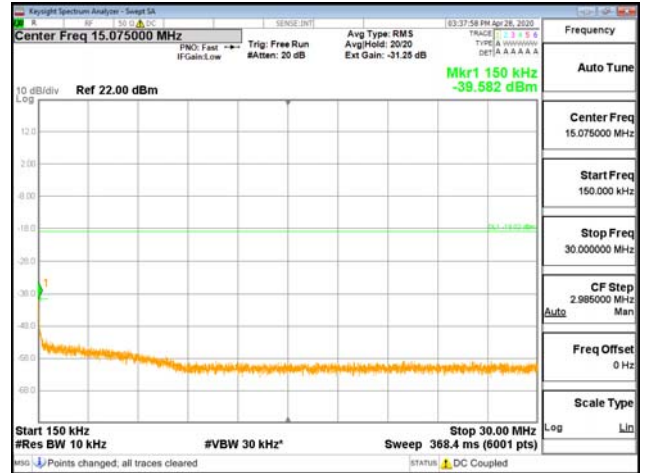
Report No.:
 CTK-2020-01891
 Page (39) / (51) Pages

ANT3

9 kHz - 150 kHz



150 kHz - 30 MHz



30 MHz - 758 MHz



769 MHz - 775 MHz

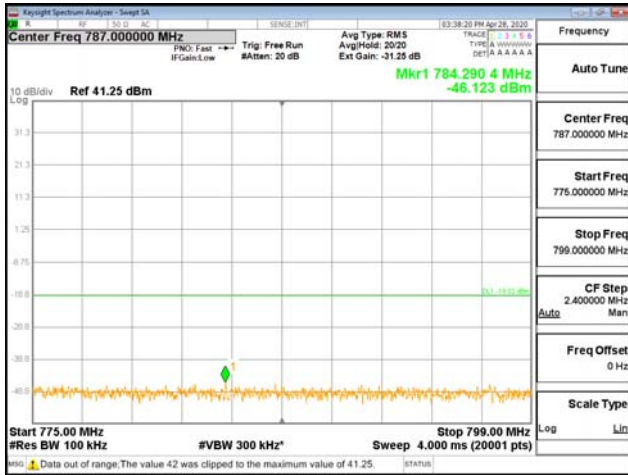




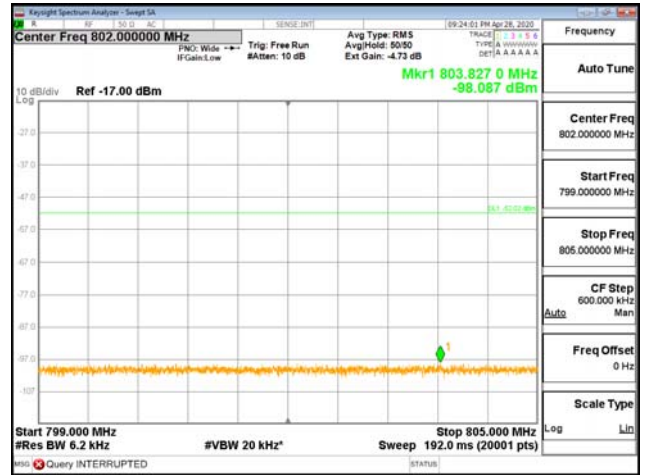
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (40) / (51) Pages

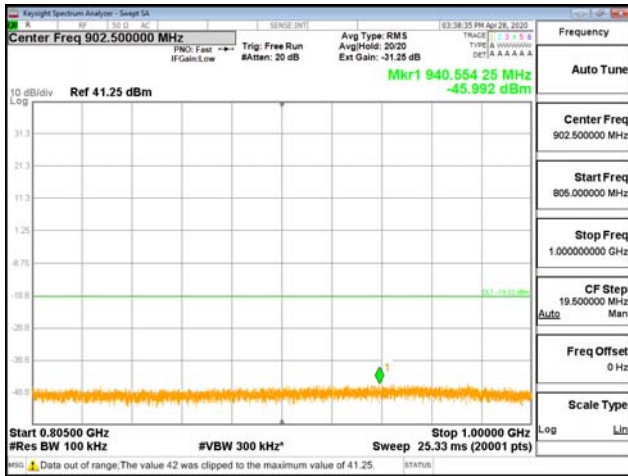
775 MHz - 799 MHz



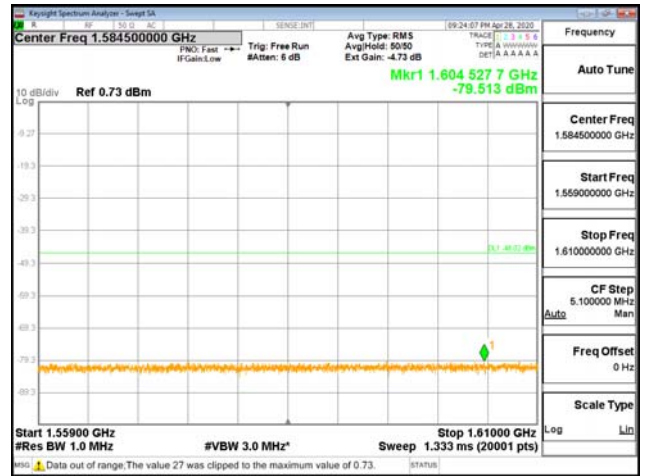
799 MHz - 805 MHz



805 MHz - 1000 MHz



1559 MHz - 1610 MHz





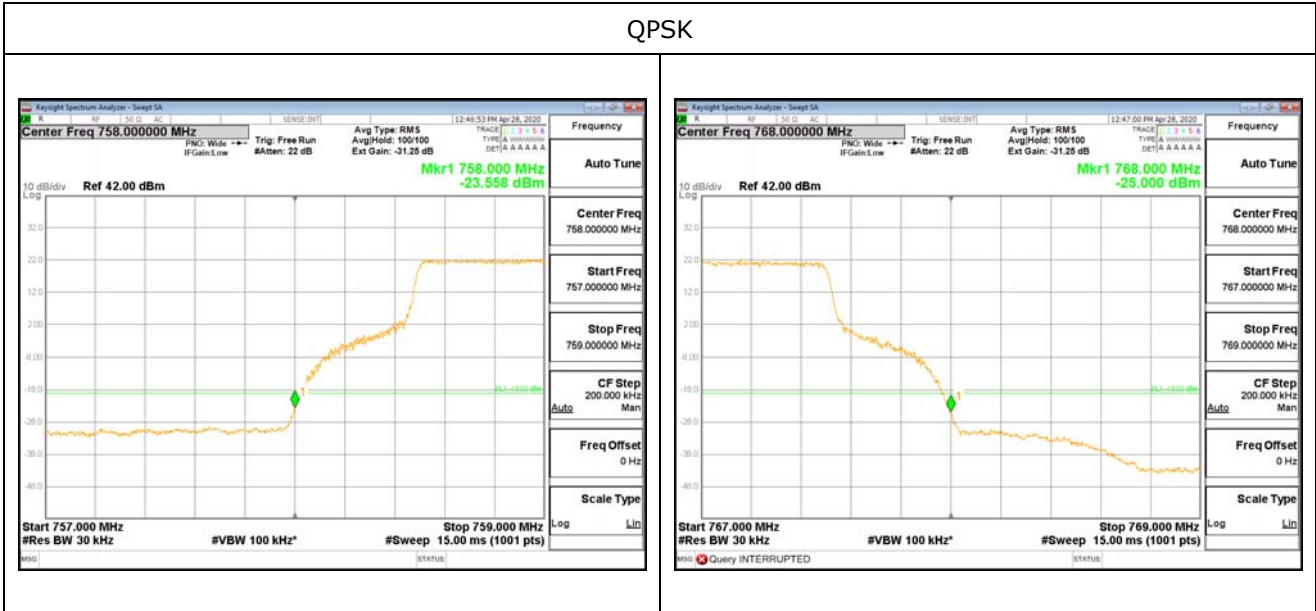
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (41) / (51) Pages

Test Plot at Band Edge

BW 10MHz
 ANTO

QPSK



256QAM



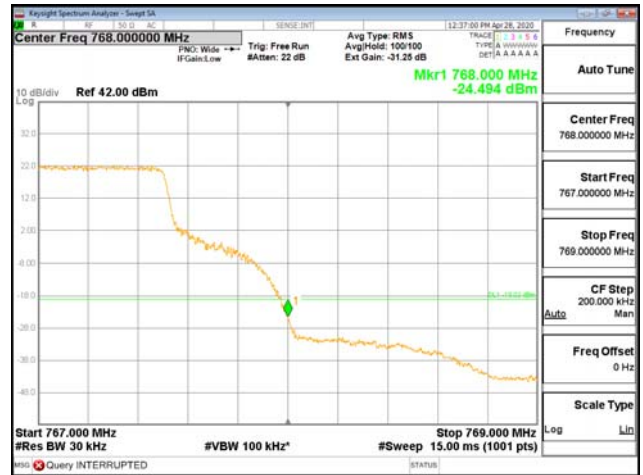
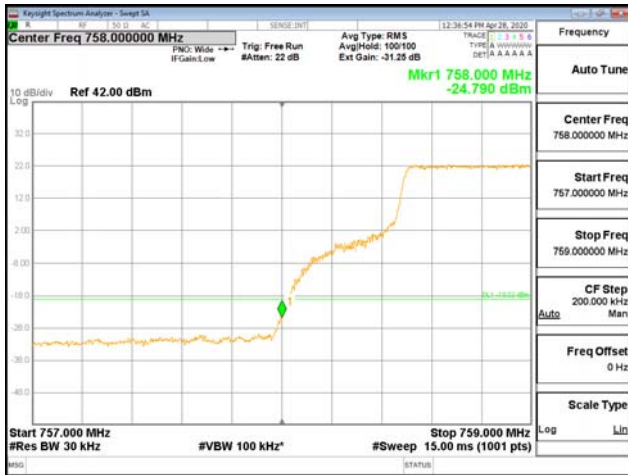


CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu,
Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

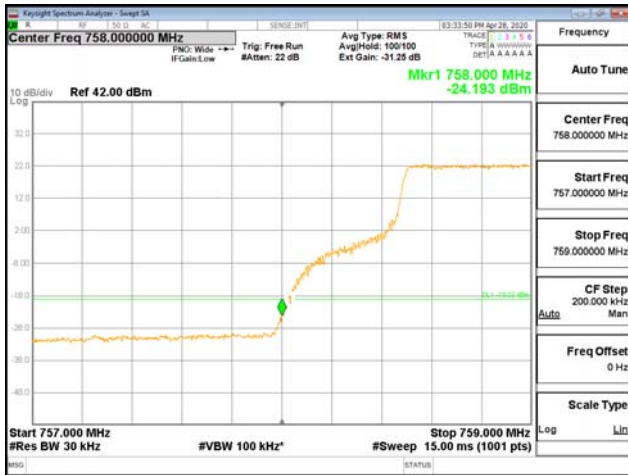
Report No.:
CTK-2020-01891
Page (42) / (51) Pages

ANT1

QPSK



256QAM





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

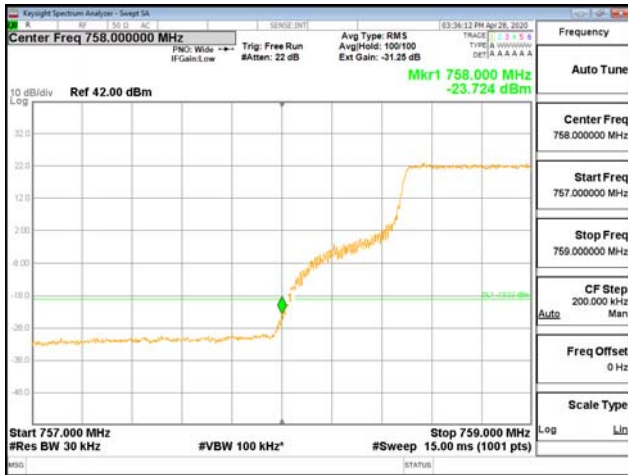
Report No.:
CTK-2020-01891
Page (43) / (51) Pages

ANT2

QPSK



256QAM



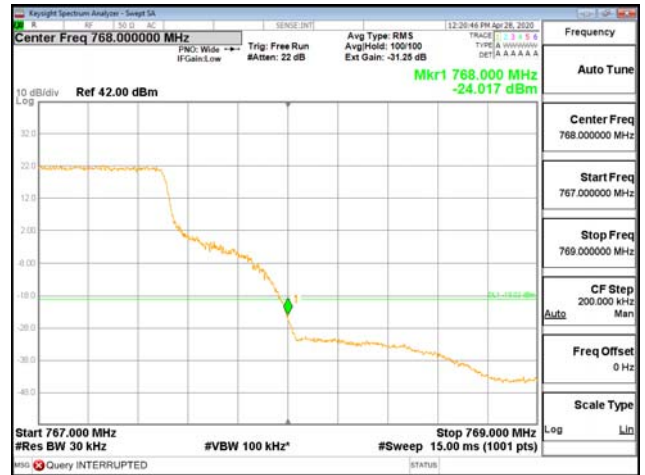
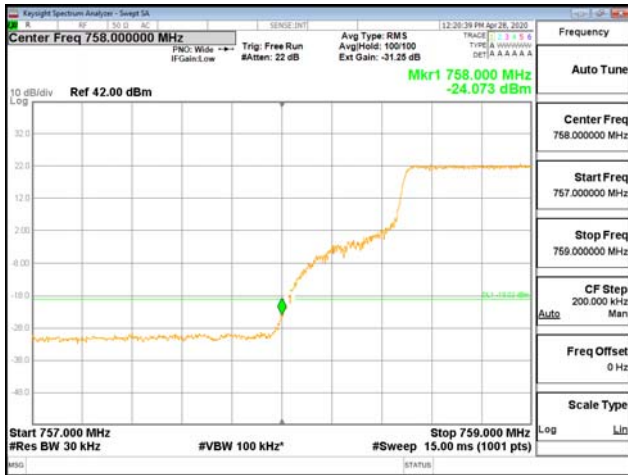


CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

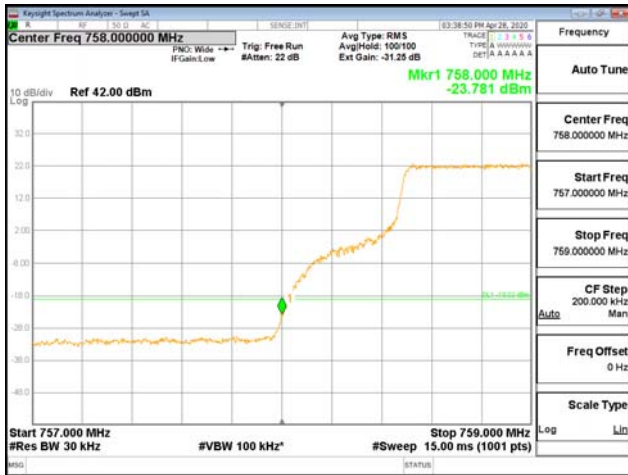
Report No.:
 CTK-2020-01891
 Page (44) / (51) Pages


ANT3

QPSK



256QAM



 <p>CTK Co., Ltd. The Prime Leader of Global Regulatory Certification</p>	<p>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</p>	<p>Report No.: CTK-2020-01891 Page (45) / (51) Pages</p>	
---	--	--	--

7. Radiated Spurious Emission

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.

§ 90.543 Emission limits

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

- (3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least $43 + 10 \log (P)$ dB.

Test Procedures :

The EUT was placed on a non-conductive rotating platform 1 meters high in a fully anechoic chamber. The radiated emission at the fundamental frequency was measured at 3 m with a test antenna. The maximum emission was recorded from analyzer power level (LVL) from the 360 degrees rotation of the turntable.

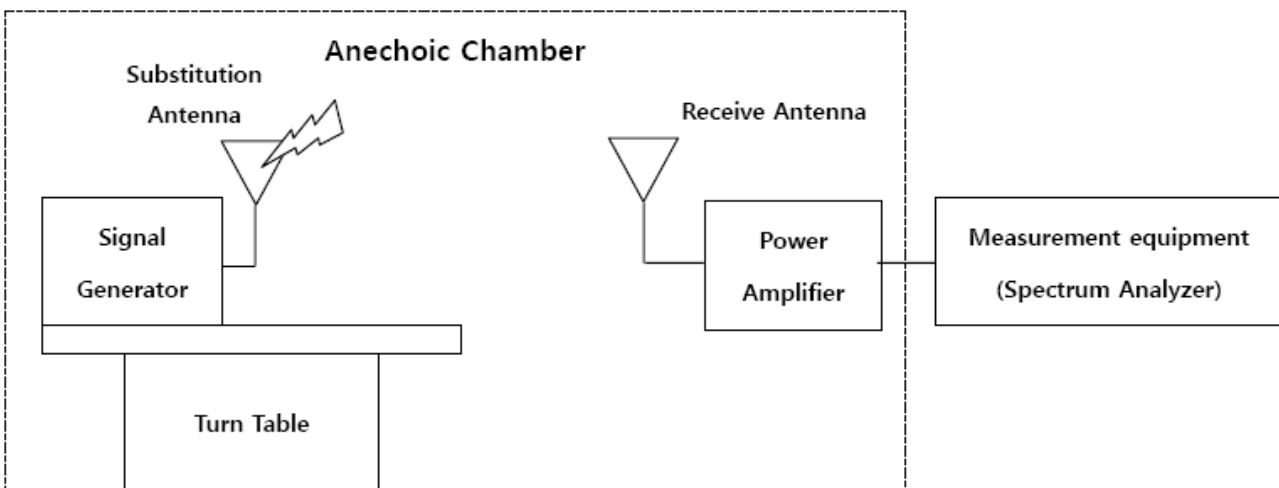
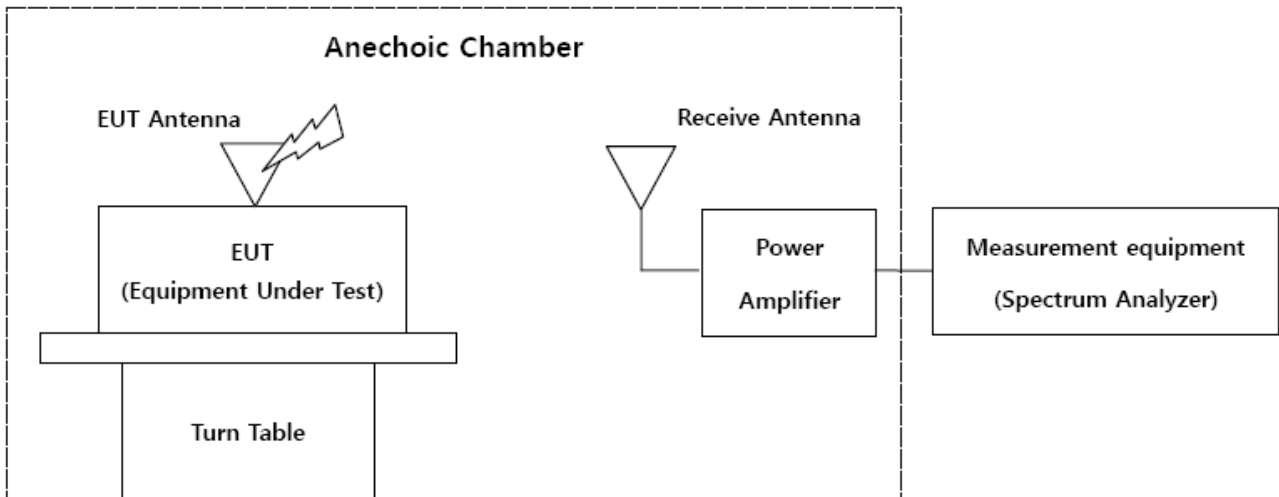
Effective Isotropic Radiated Power (EIRP) was measured by substitution method according to TIA/EIA-603-C.

The EUT was replaced by substitution antenna at same location, and then a known power from S.G. was applied into the dipole antenna through a Tx cable, and then recorded the maximum Analyzer reading through raised and lowered the test antenna.

The space loss (in dB) = S.G. - Tx Cable loss + Substitution antenna gain - Analyzer reading.

The spectrum was searched from 30 MHz to 10th harmonic.

Test Setup :





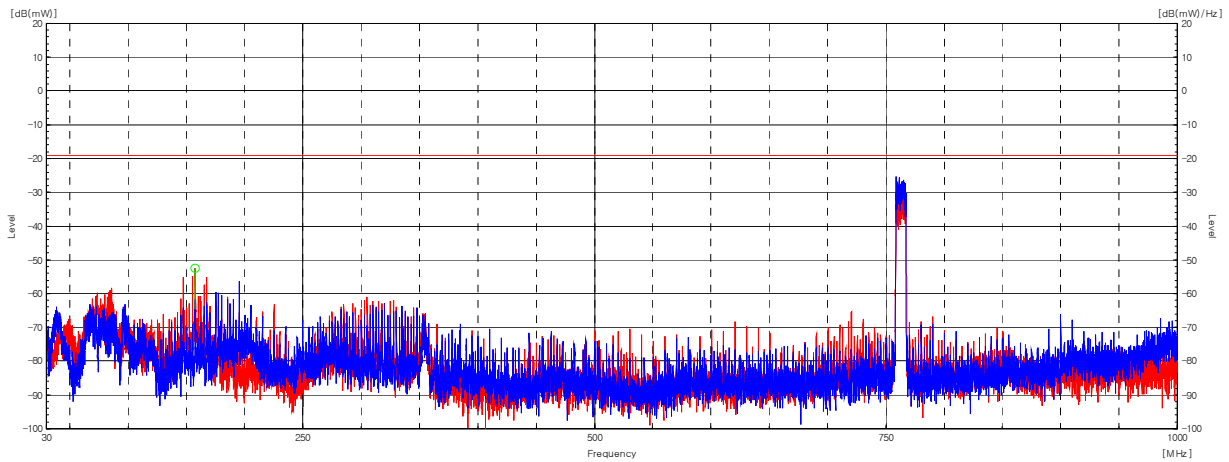
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501

Report No.:
 CTK-2020-01891
 Page (47) / (51) Pages

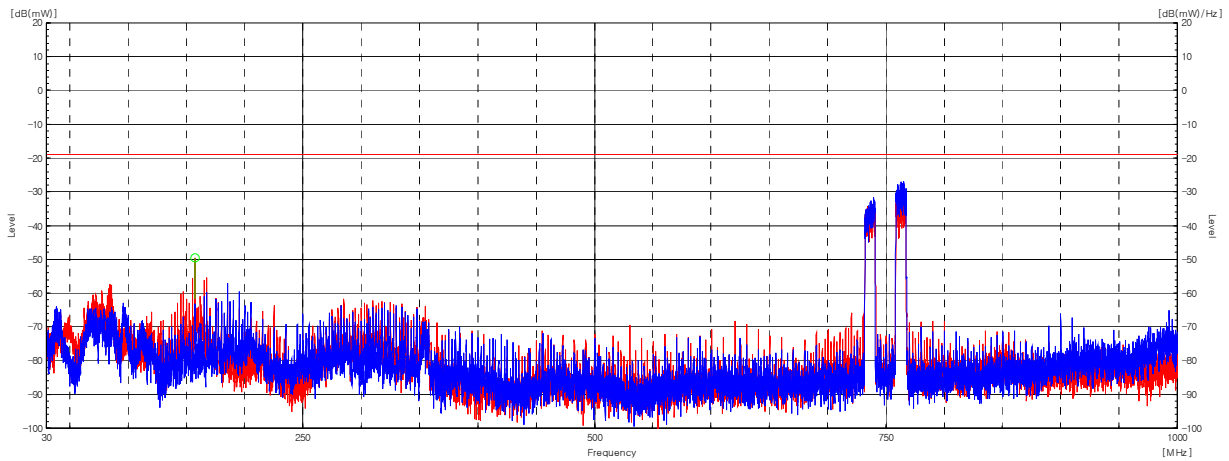
Test Results :

- * We have done all test case. Test data was only the worst case.
- * In all test cases, the measurement results in the following measurement bands are similar.
 (30 MHz - 1 GHz, 1 GHz - 18 GHz)

Frequency range	30 MHz - 1 GHz
Test mode	Band 14
Channel bandwidth	10 MHz



Frequency range	30 MHz - 1 GHz
Test mode	Band 12 + Band 14
Channel bandwidth	10 MHz + 10 MHz

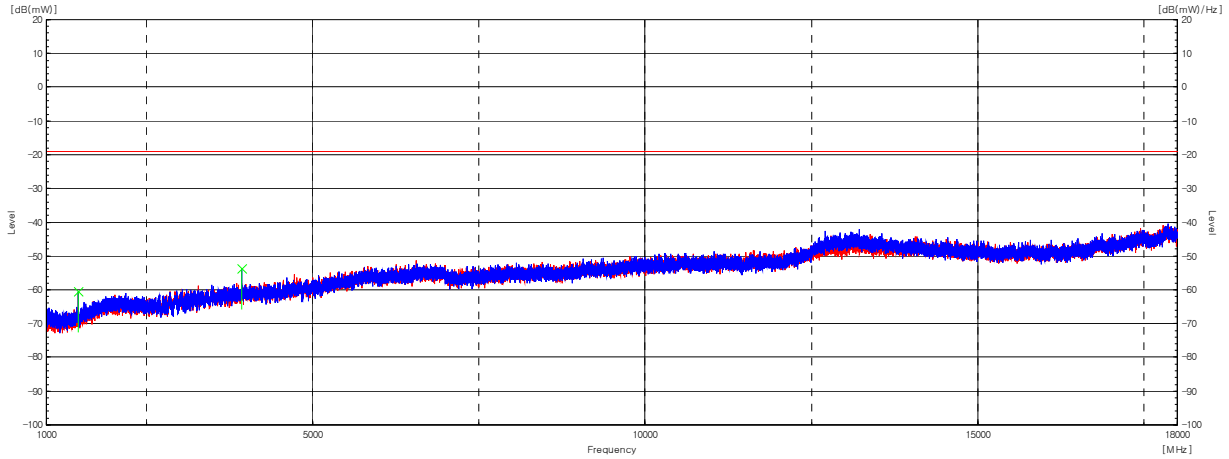




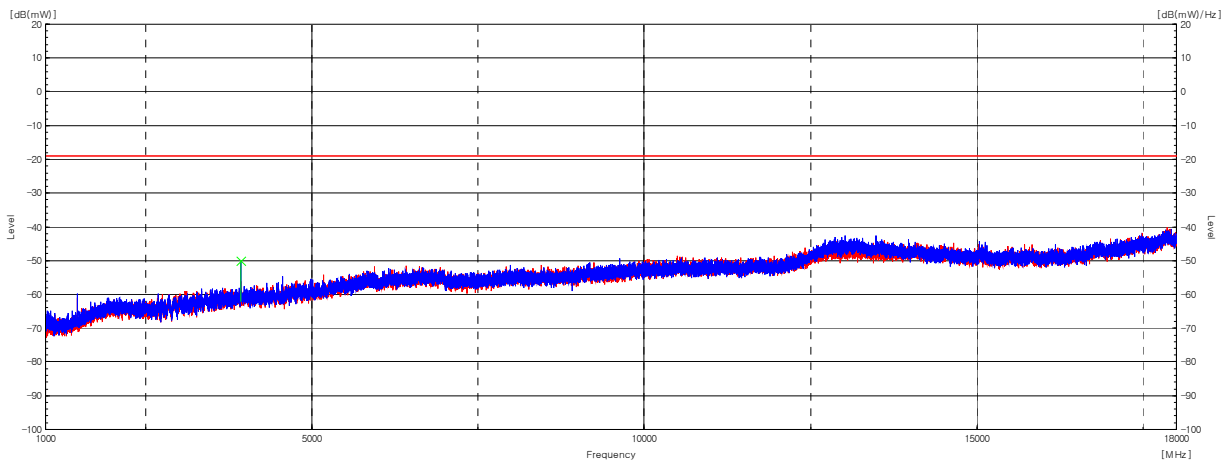
CTK Co., Ltd.
 (Ho-dong), 113, Yejik-ro, Cheoin-gu,
 Yongin-si, Gyeonggi-do, Korea
 Tel: +82-31-339-9970
 Fax: +82-31-624-9501


Report No.:
 CTK-2020-01891
 Page (48) / (51) Pages

Frequency range	1 GHz - 18 GHz
Test mode	Band 14
Channel bandwidth	10 MHz



Frequency range	1 GHz - 18 GHz
Test mode	Band 12 + Band 14
Channel bandwidth	15 MHz + 10 MHz



 <p>CTK Co., Ltd. The Prime Leader of Global Regulatory Certification</p>	<p>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</p>	<p>Report No.: CTK-2020-01891 Page (49) / (51) Pages</p>	
---	--	--	--

8. Frequency Stability

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 $+50^{\circ}$ centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
 - (2) From -20° to $+50^{\circ}$ centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.
 - (3) From 0° to $+50^{\circ}$ centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.
- (b) The frequency stability shall be measured with variation of primary supply voltage as follows:
- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

§ 90.539 Frequency stability

Transmitters designed to operate in 769-775 MHz and 799-805 MHz frequency bands must meet the frequency stability requirements in this section.

- (d) The frequency stability of base transmitters operating in the wideband segment must be 1 part per million or better.

Test Procedures :

- (a) Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.
- (b) The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.
- (c) The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the $\pm 0.5^{\circ}\text{C}$ during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.



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-2020-01891
 Page (50) / (51) Pages

Test Results :

Test Data at output Antenna Port 0

Operating frequency	763
Channel bandwidth	10 MHz
Reference voltage / temperature	-48 Vdc / 20 °C
Modulation type	256QAM

Voltage (%)	Temperature (°C)	Frequency (Hz)	Frequency Error (Hz)	Frequency Error (ppm)
100	+20(Ref)	763 000 007	6.9	0.0000
	-30	763 000 006	6.1	-0.0011
	-20	763 000 006	6.2	-0.0009
	-10	763 000 007	7.3	0.0005
	0	763 000 007	6.9	0.0000
	+10	763 000 006	6.4	-0.0007
	+30	763 000 006	6.1	-0.0010
	+40	763 000 006	6.3	-0.0008
	+50	763 000 007	6.7	-0.0003
115	+20	763 000 007	7.0	0.0001
85	+20	763 000 007	6.9	0.0000

Note:

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.



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-2020-01891
 Page (51) / (51) Pages

APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Due Date
1	MXA Signal Analyzer	Agilent	N9020A	MY50200096	2021-02-26
2	EMI Test Receiver	R&S	ESCI7	100814	2020-10-22
3	Bilog Antenna	Schaffner	CBL6111C	2551	2021-04-17
4	Biconical Antenna	SCHWARZBECK	VUBA 9117	9117-280	2020-10-29
5	6dB Attenuator	R&S	DNF	272.4110.50-1	2021-03-03
6	AMPLIFIER	SONOMA	310	291721	2021-01-22
7	Horn Antenna	ETS-Lindgren	3115	00078894	2020-12-10
8	Horn Antenna	ETS-Lindgren	3115	00078895	2021-04-13
9	Signal Generator	R&S	SMB100A	175528	2021-04-28
10	PREAMPLIFIER	Agilent	8449B	3008A02011	2020-11-25
11	Fixed Attenuator(30 dB, 300W)	BIRD	300-WA-MFN-30	0204911	2021-02-26
12	Fixed Attenuator(30 dB, 300W)	BIRD	300-WA-MFN-30	0205048	2021-02-26
13	Fixed Attenuator(30 dB, 300W)	BIRD	300-WA-MFN-30	0204910	2021-02-26
14	Fixed Attenuator(30 dB, 300W)	BIRD	300-WA-MFN-30	0205092	2021-02-26
15	Temp & Humidity Chamber	Kunpoong	INNOTECH CO., Ltd.	201801002A-001	2021-04-17
16	DC POWER SUPPLY	Agilent	6674A	MY41001477	2021-02-26
17	System Power Supply	HP	6032A	3440A-10521	2021-01-16