



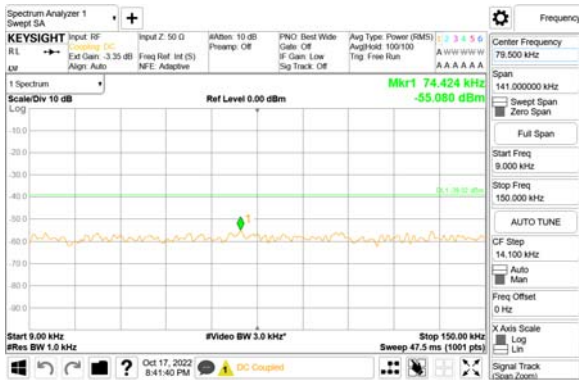
# CTK Co., Ltd.

(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si,  
Gyeonggi-do, 449-100, Korea  
Tel: +82-31-339-9970  
Fax: +82-31-624-9501

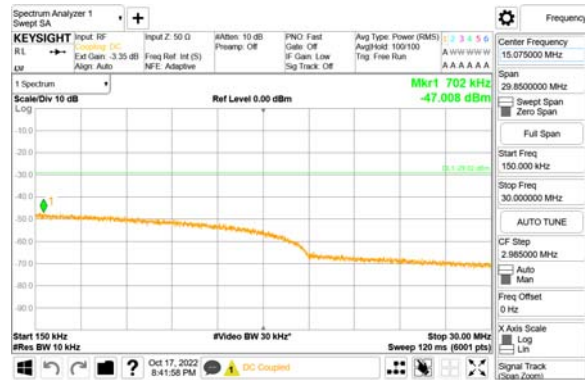
REPORT No.:  
CTK-2022-02665  
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## ANT3

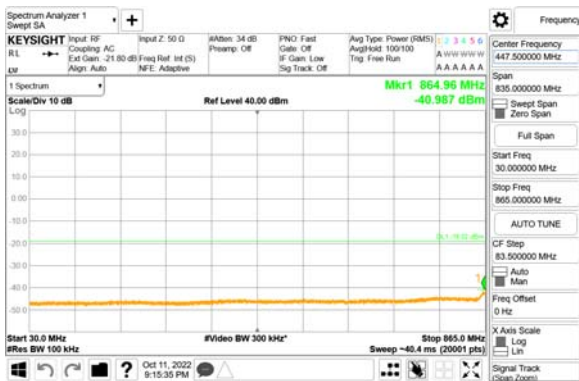
9 kHz - 150 kHz



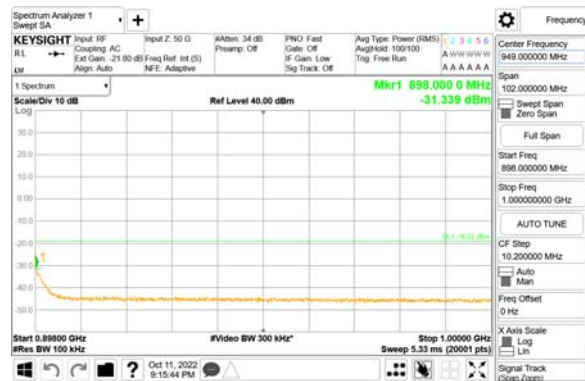
150 kHz - 30 MHz



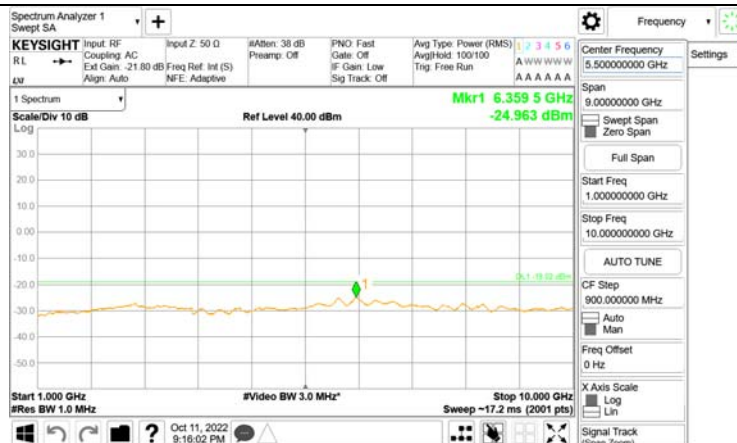
30 MHz - 865 MHz



898 MHz - 1 GHz



1 GHz - 10 GHz





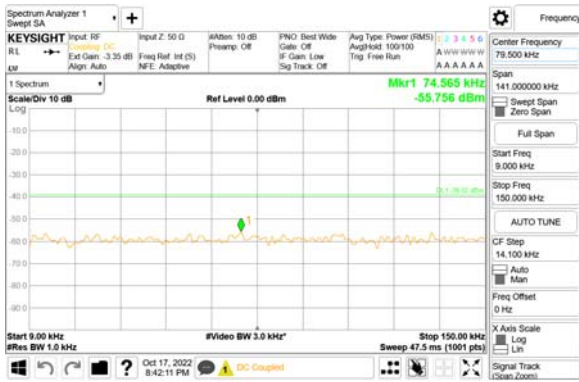
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## ANT4

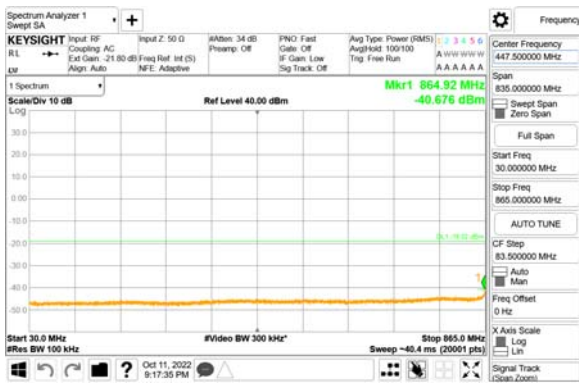
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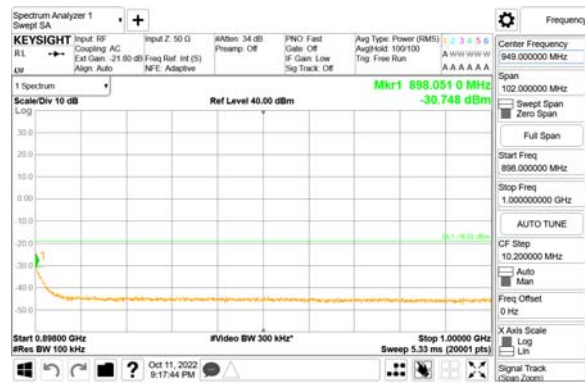
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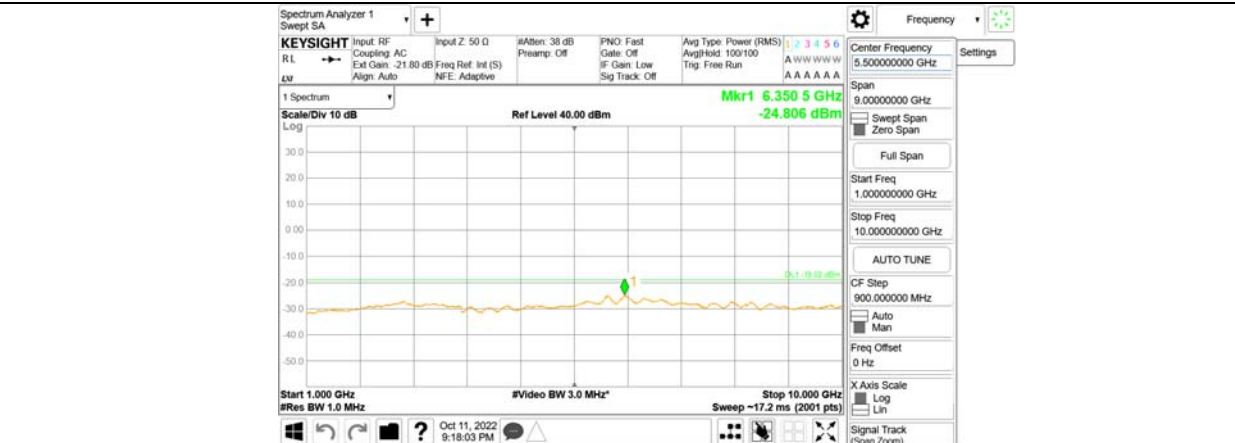
30 MHz - 865 MHz



898 MHz - 1 GHz



1 GHz - 10 GHz



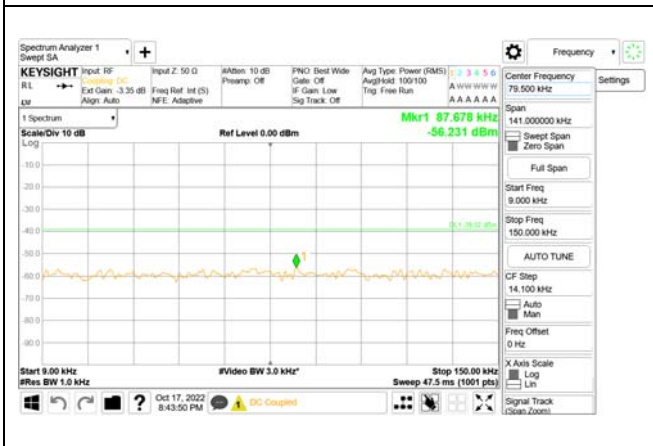


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**5G NR, Multi carrier 5 MHz + 20 MHz, Middle Channel, 256QAM  
ANT1**

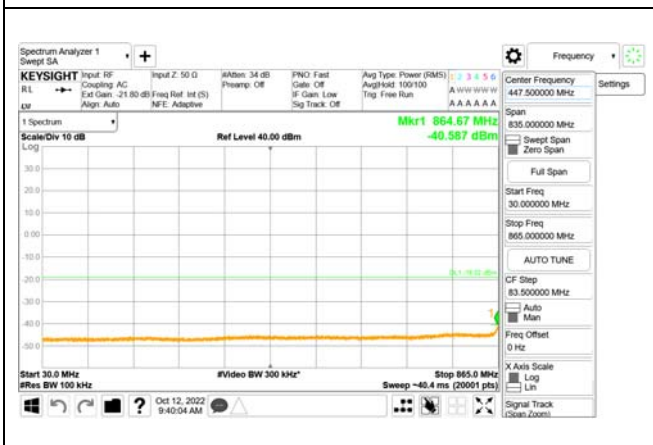
9 kHz - 150 kHz



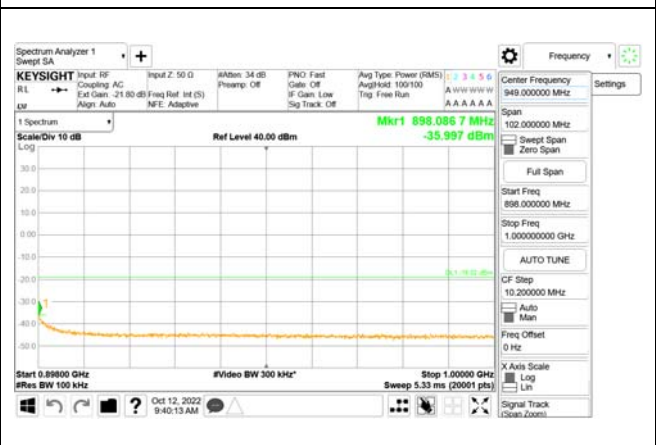
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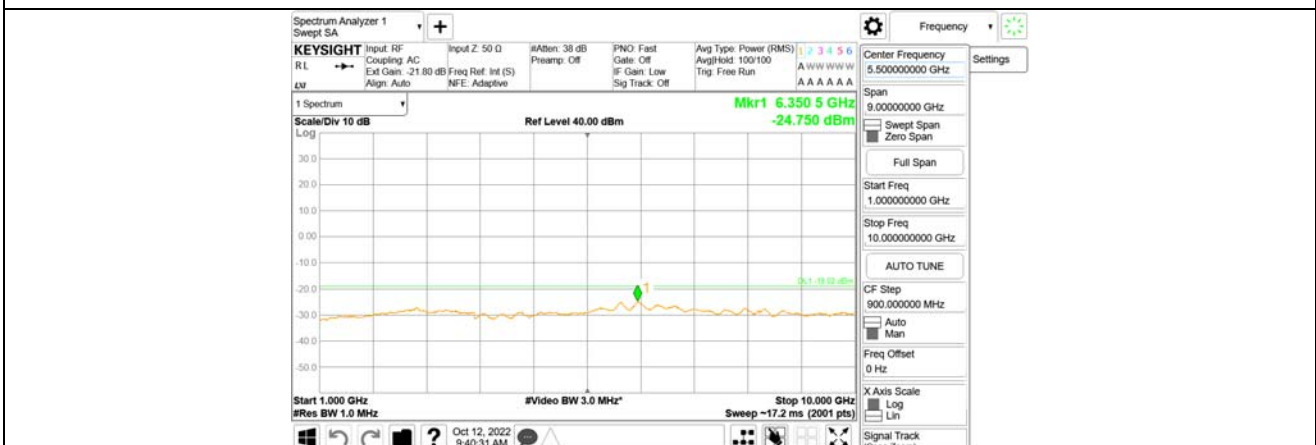
30 MHz - 865 MHz



898 MHz - 1 GHz



1 GHz - 10 GHz





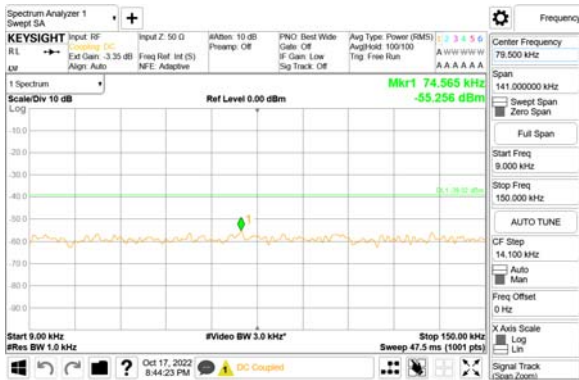
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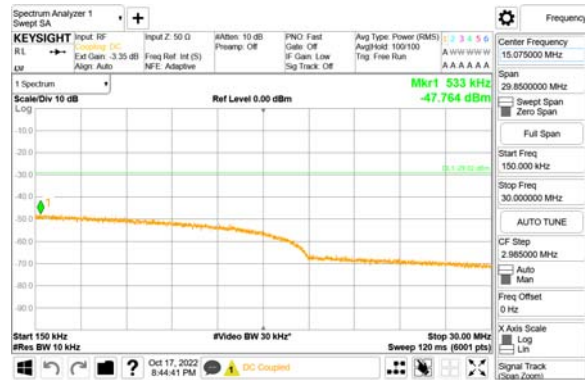
REPORT No.:  
CTK-2022-02665  
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## ANT2

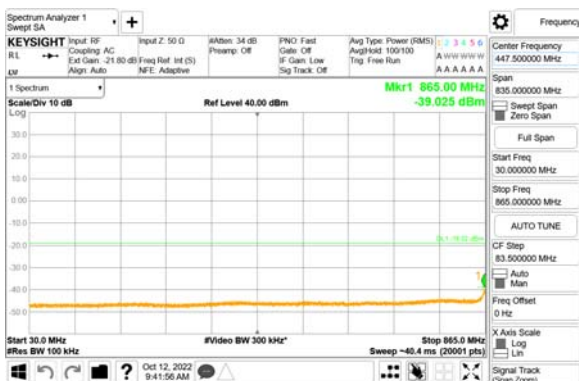
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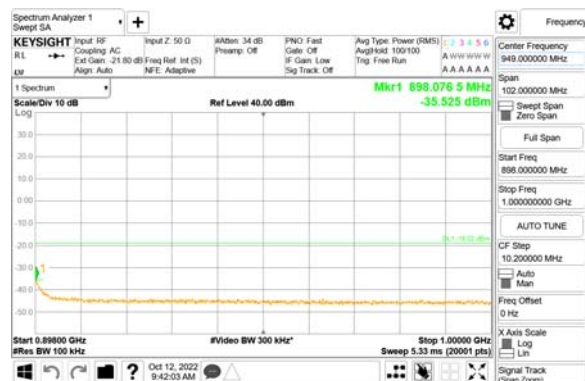
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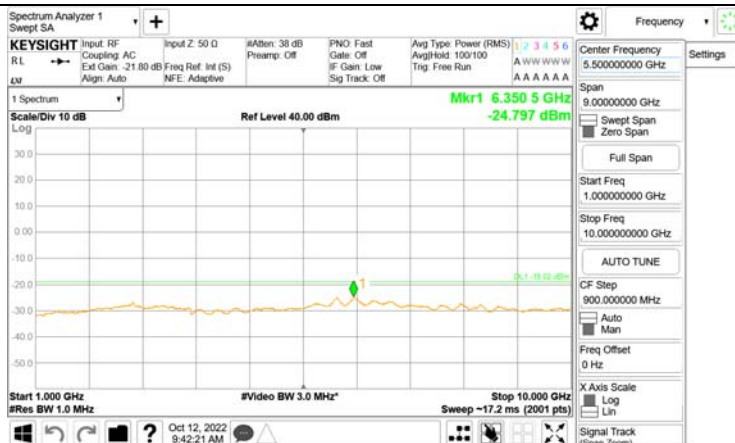
30 MHz - 865 MHz



898 MHz - 1 GHz

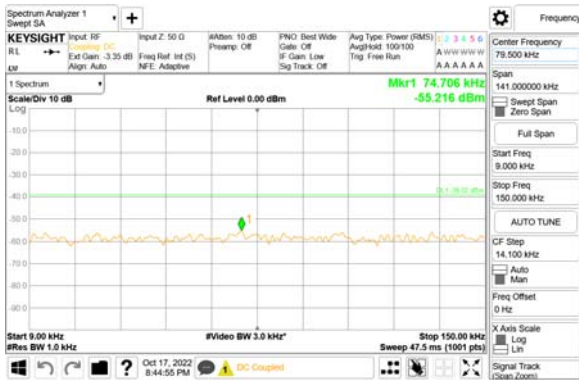


1 GHz - 10 GHz

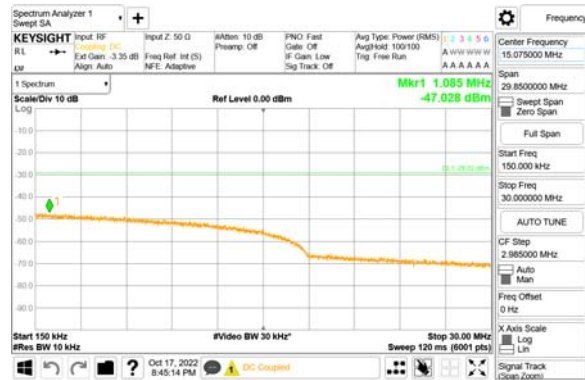


**ANT3**

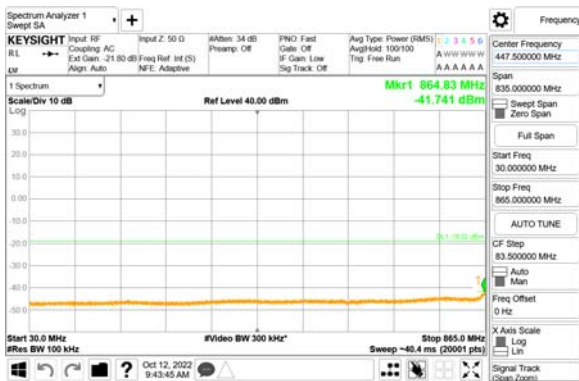
9 kHz - 150 kHz



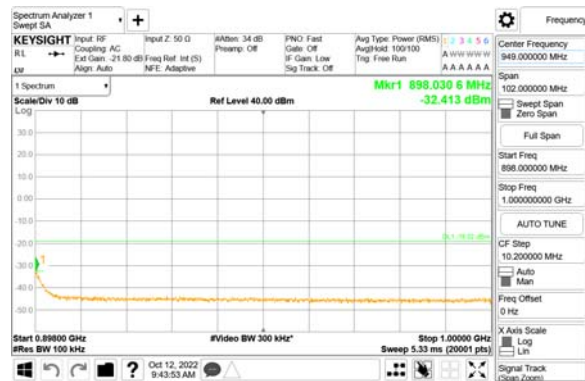
150 kHz - 30 MHz



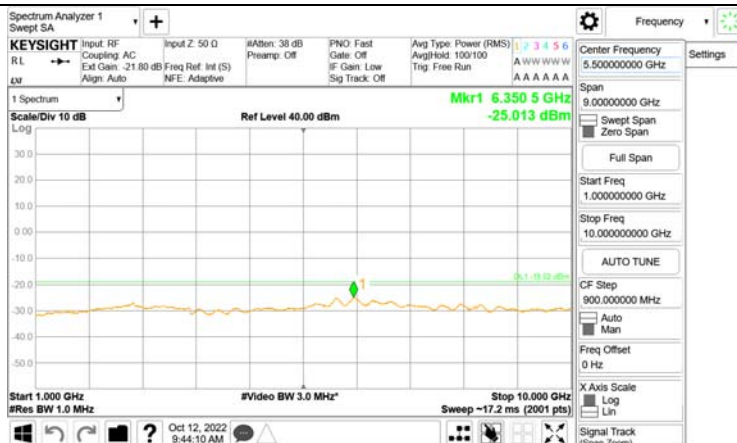
30 MHz - 865 MHz



898 MHz - 1 GHz



1 GHz - 10 GHz





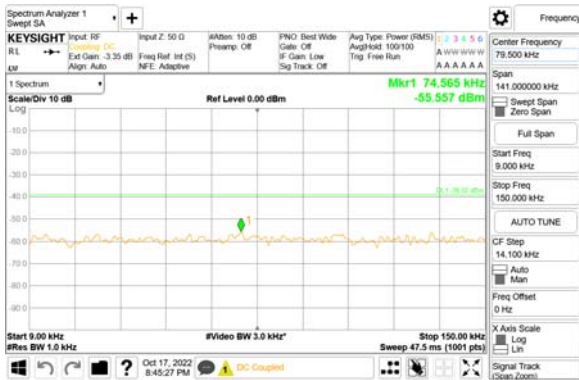
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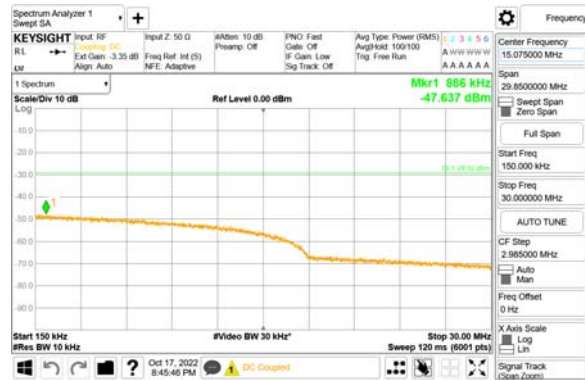
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## ANT4

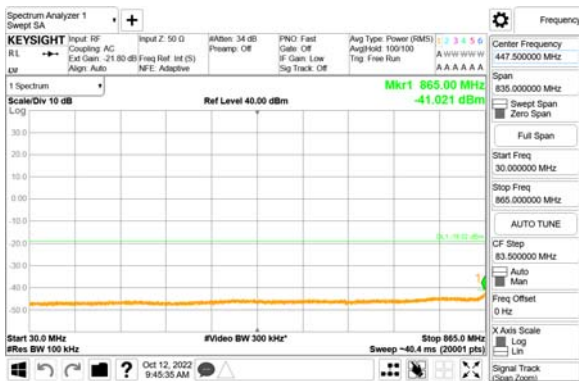
9 kHz - 150 kHz



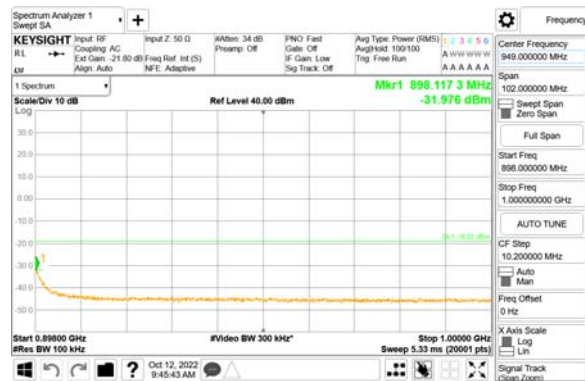
150 kHz - 30 MHz



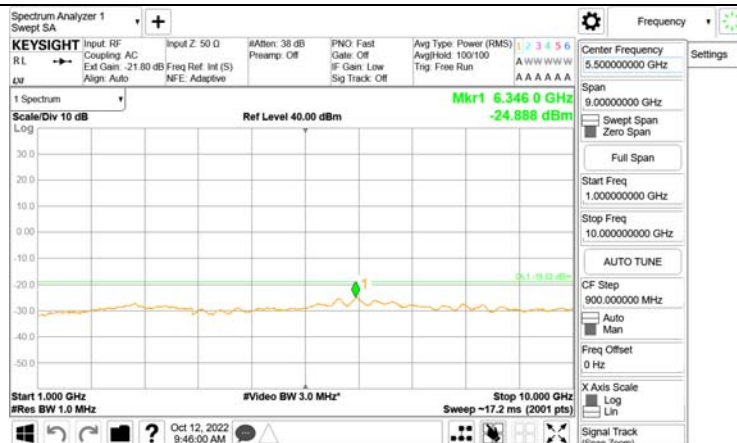
30 MHz - 865 MHz




898 MHz - 1 GHz



1 GHz - 10 GHz



 <p>CTK Co., Ltd. The Power Center of Global Equipment Connection</p>	<p><b>CTK Co., Ltd.</b> (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-100, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501</p>	<p>REPORT No.: CTK-2022-02665 Page (245) / (293) Pages</p>	
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## 8. Band edge Emissions at Antenna Terminals

### 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.

#### § 22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

- (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.
- (b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:
  - (1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.
  - (2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.
- (c) Alternative out of band emission limit. Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.
- (d) Interference caused by out of band emissions. If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

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**Test Procedures :**

The measurement is performed in according with Section 5.7.3 of ANSI C63.26.

- 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  $\geq 2 \times \text{span} / 1 \text{ RBW}$ .
- d) Sweep time should be auto for peak detection. For rms detection the sweep time should be set as follows:
  - 1) If the device can be configured to transmit continuously (duty cycle  $\geq 98\%$ ), set the (sweep time)  $> (\text{number of points in sweep}) \times (\text{symbol period})$  (e.g., by a factor of  $10 \times \text{symbol period} \times \text{number of points}$ ). Increasing the sweep time (i.e., slowing the sweep speed) will allow for averaging over multiple symbols
  - 2) If the device cannot transmit continuously (duty cycle  $< 98\%$ ), a gated sweep shall be used when possible (i.e., gate triggered such that the analyzer only sweeps when the device is transmitting at full power), set the sweep time  $> (\text{number of points in sweep}) \times (\text{symbol period})$  but the sweep time shall always be maintained at a value that is less than or equal to the minimum transmission time.
  - 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  $> (\text{number of points in sweep}) \times (\text{transmitter period})$  (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by  $[10 \log (I / \text{duty cycle})]$ . This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation  $\leq \pm 2\%$ ).
  - 4) If the device cannot be configured to transmit continuously and a free-running sweep must be used, and if the transmissions exhibit a non-constant duty cycle (duty cycle variations  $> \pm 2\%$ ), set the sweep time so that the averaging is performed over the on-period by setting the sweep time  $> (\text{symbol period}) \times (\text{number of points})$ , while also maintaining the sweep time  $< (\text{transmitter on-time})$ . The trace mode shall be set to max hold, since not every display point will be averaged only over just the on-time. Thus, multiple sweeps (e.g., 100) in maximum hold are necessary to ensure that the maximum power is measured.
- e) The test report shall include the plots of the measuring instrument display and the measured data.
- f) See Annex 1 for example emission mask plots.



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**Notes :**

1. Due to 64 x 64 MIMO operation, limit is **-19.02 dBm** (-13 dBm - 10\*Log(4)) per KDB Publication 662911 D01 Multiple Transmitter Output v02r01.
2. According to § 22.917(b)(1), the bandwidth located just outside the frequency block may be applied with a Resolution Bandwidth of 1%.  
i.e.: Adjacent bandwidth of 5 MHz:  $5 \text{ MHz} * 0.01 = \mathbf{50 \text{ kHz(RBW)}}$   
Adjacent bandwidth of 20 MHz:  $20 \text{ MHz} * 0.01 = \mathbf{200 \text{ kHz(RBW)}}$
3. The highest power level measured in a narrower RBW (relative to the specified reference bandwidth) can be scaled by applying a correction factor determined from:  $10 \log [(reference \text{ bandwidth}) / (resolution \text{ or measurement bandwidth})]$ .  
Band Edge correction factor:  $10 \log(200\text{kHz}/100\text{kHz})=3.01 \text{ dBm}$   
i.e.: **(-22.03 dBm = -19.02 dBm - 10 log(200 kHz/100 kHz))**  
Band edge correction factor value compensation to the limit value.
4. 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.

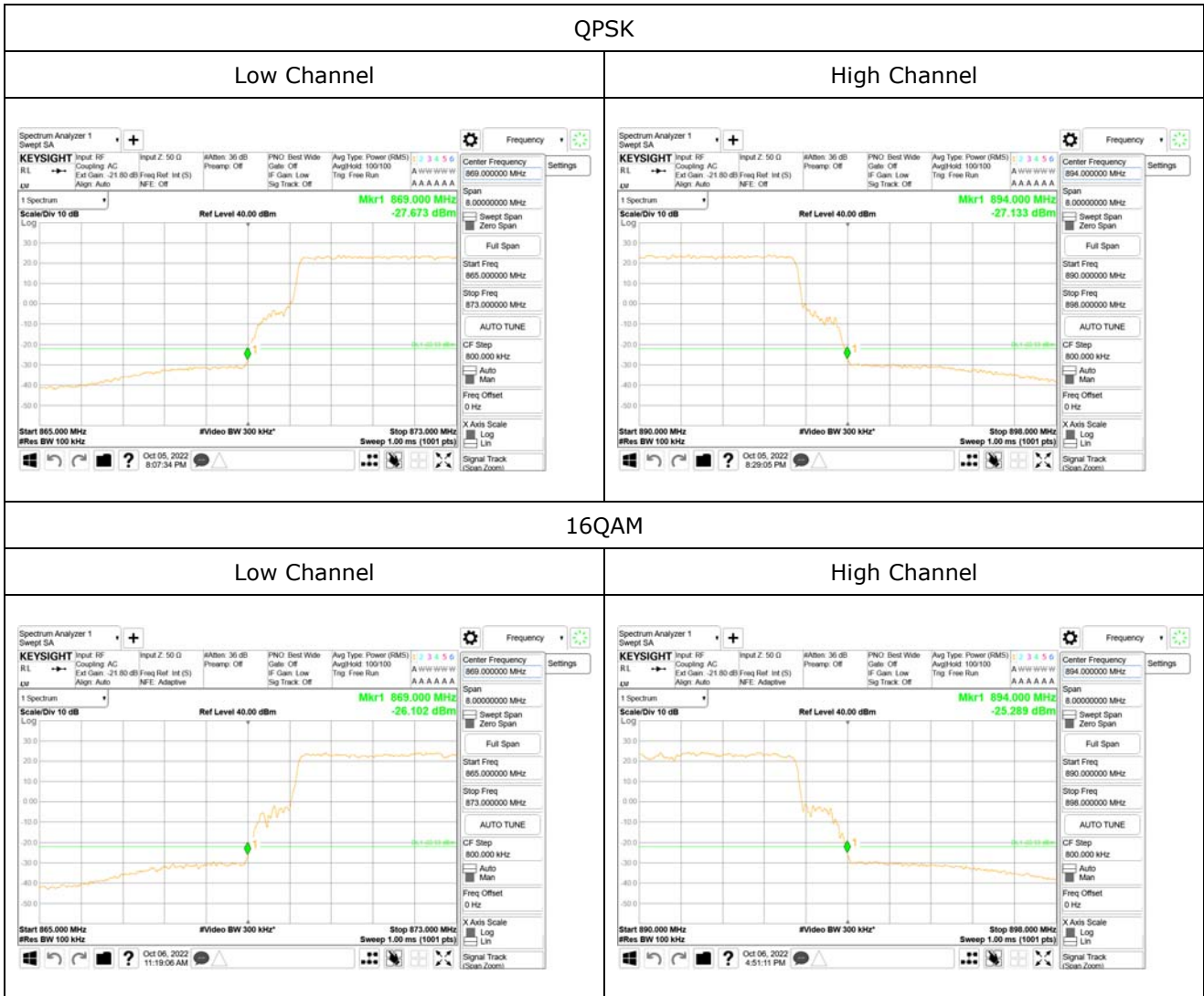


**Test Results : Band edge Emissions at Antenna Terminals**

**Test Data : Single carrier**

**Test plot at Band edge Emissions at Antenna Terminals**

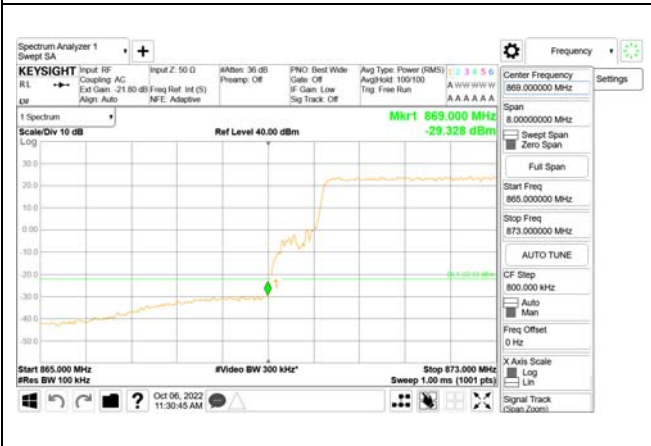
**LTE, Single carrier 20 MHz  
ANT1**



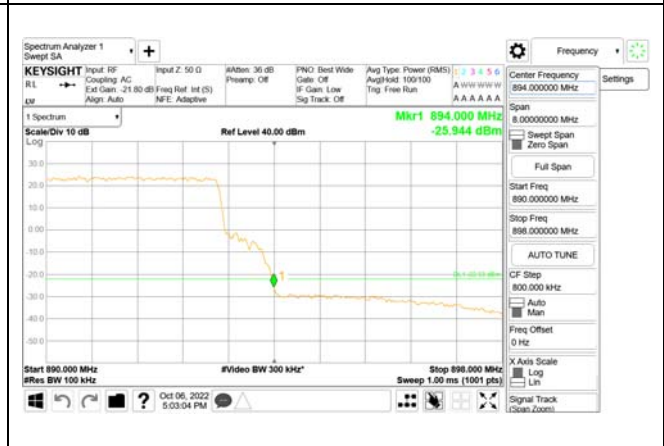


64QAM

Low Channel

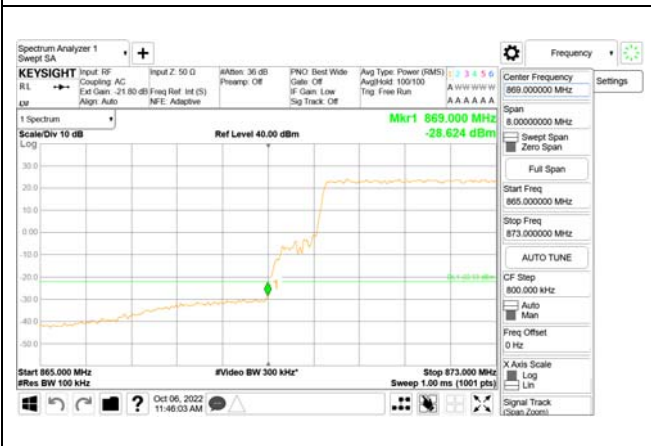


High Channel

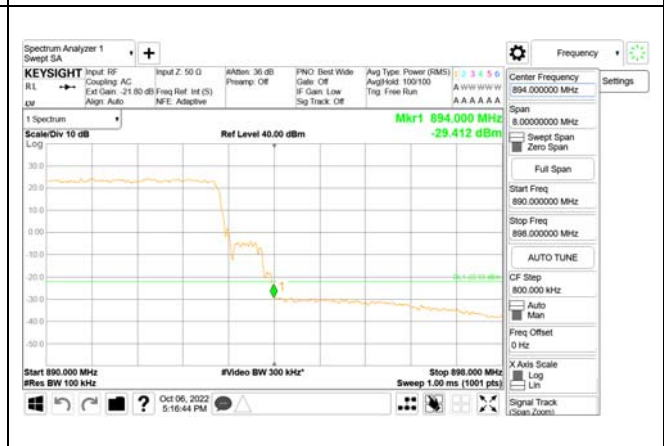


256QAM

Low Channel



High Channel





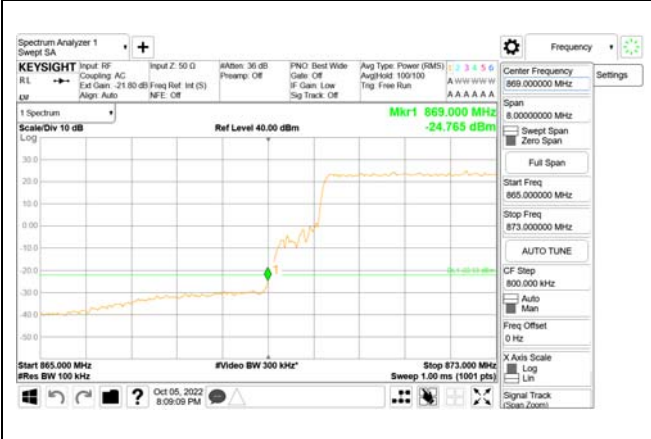
**CTK Co., Ltd.**  
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si,  
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### ANT2

### QPSK

#### Low Channel

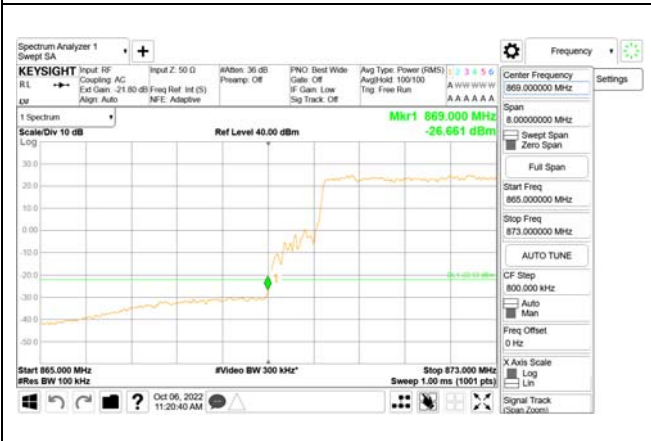


#### High Channel

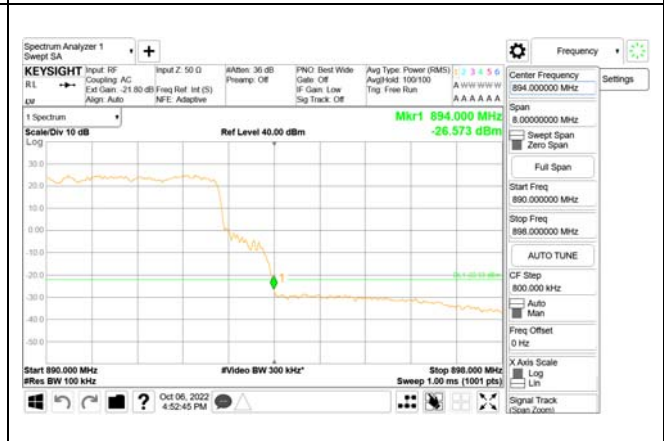


### 16QAM

#### Low Channel



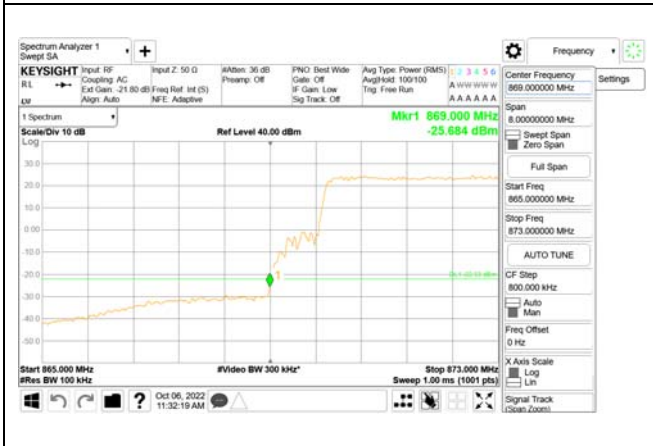
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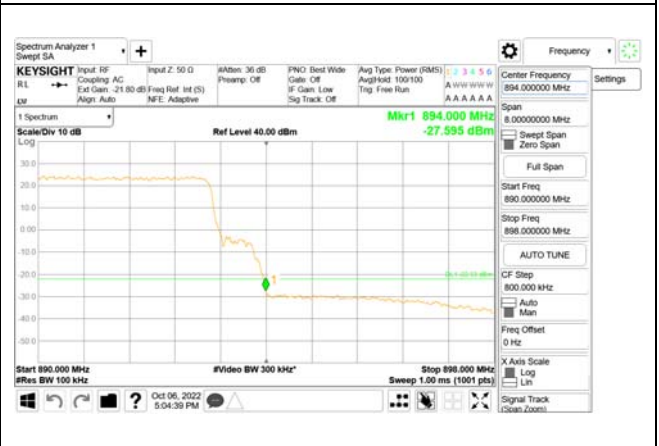


### 64QAM

#### Low Channel

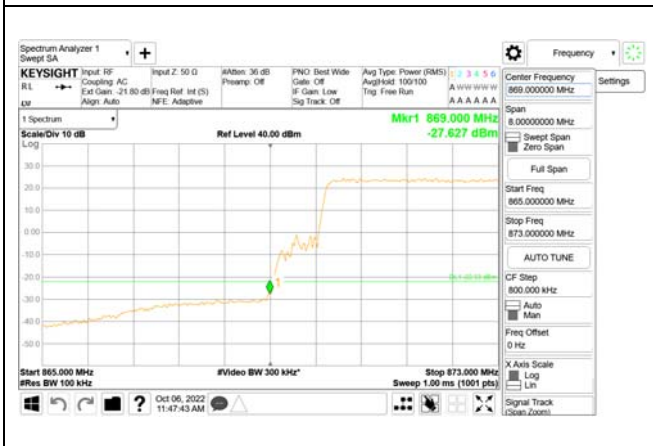


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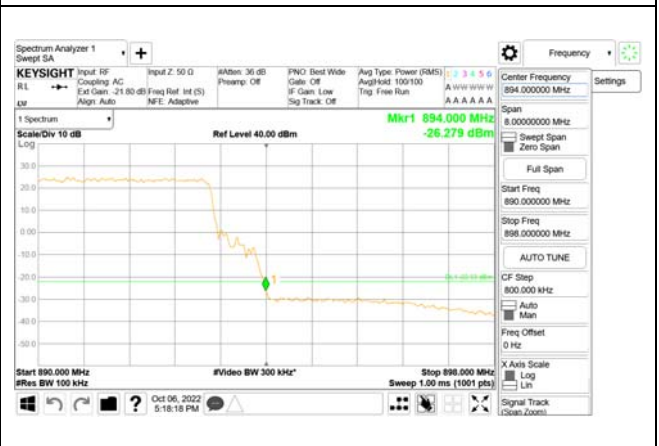


### 256QAM

#### Low Channel



#### High Channel





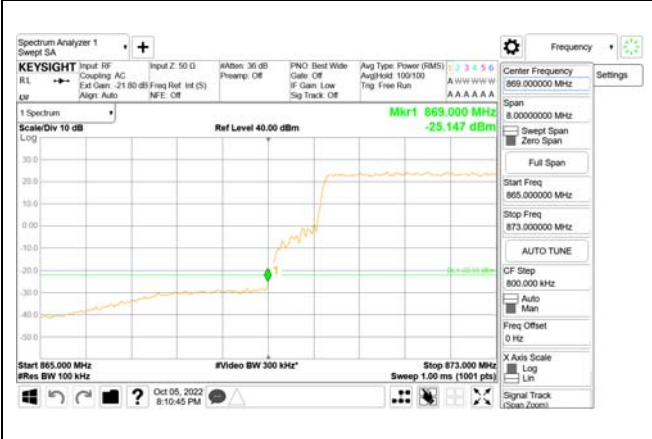
**CTK Co., Ltd.**  
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### ANT3

### QPSK

#### Low Channel

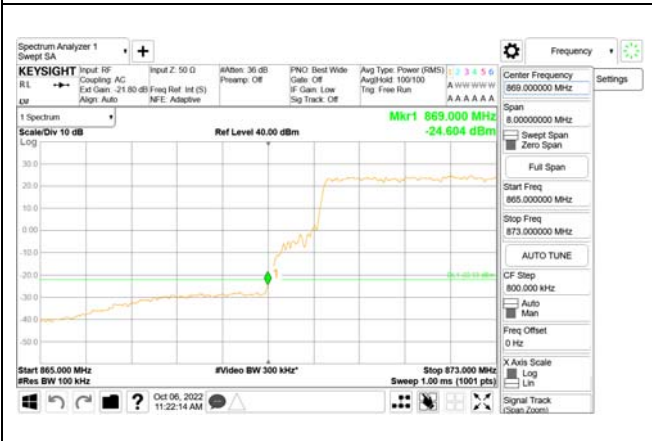


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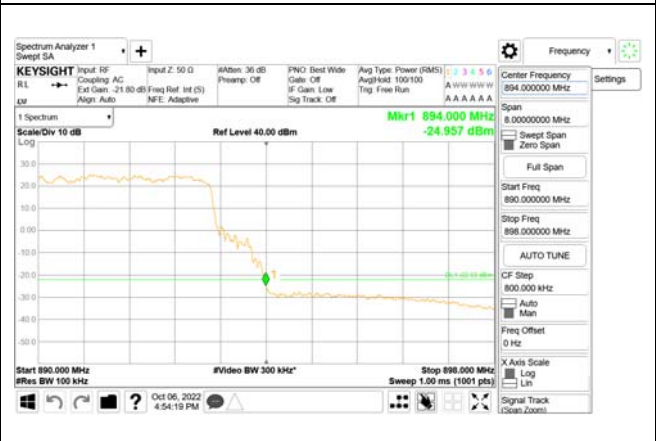


### 16QAM

#### Low Channel



#### High Channel

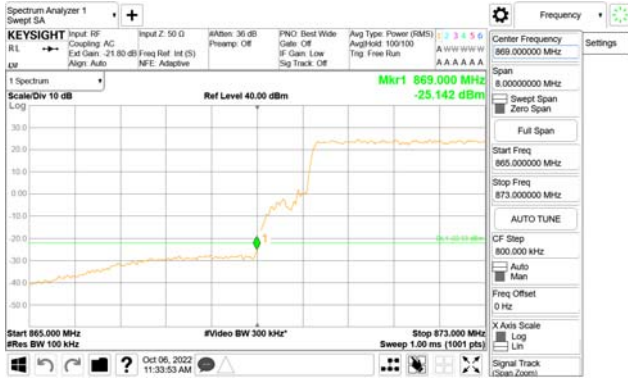




### 64QAM

#### Low Channel

#### High Channel



### 256QAM

#### Low Channel

#### High Channel





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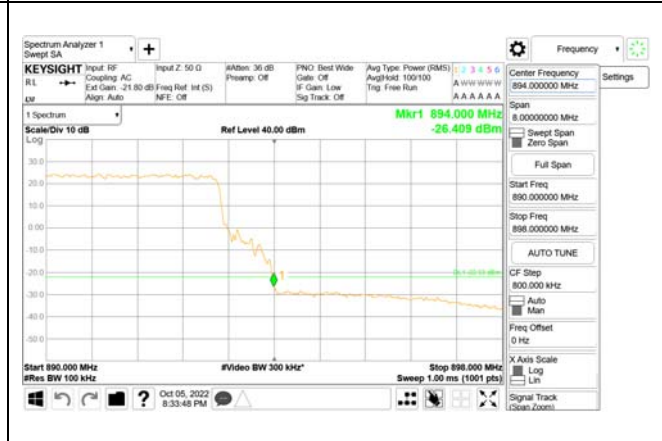
### ANT4

### QPSK

#### Low Channel

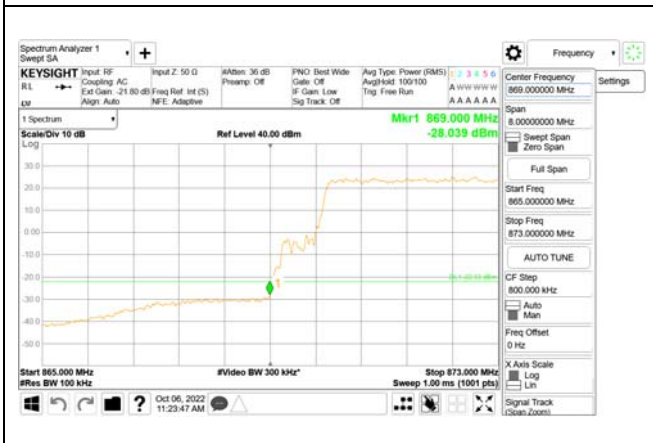


#### High Channel

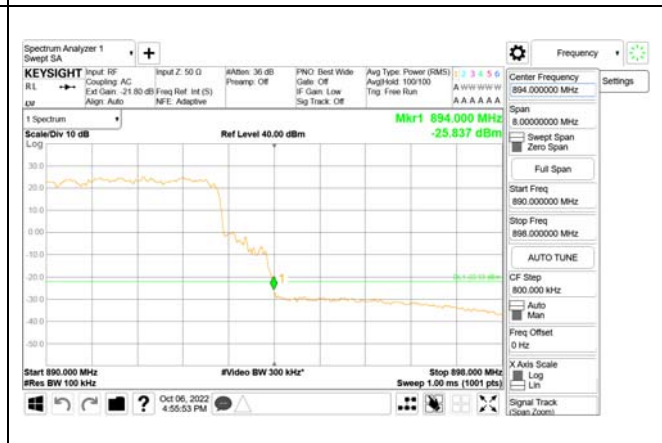


### 16QAM

#### Low Channel



#### High Channel

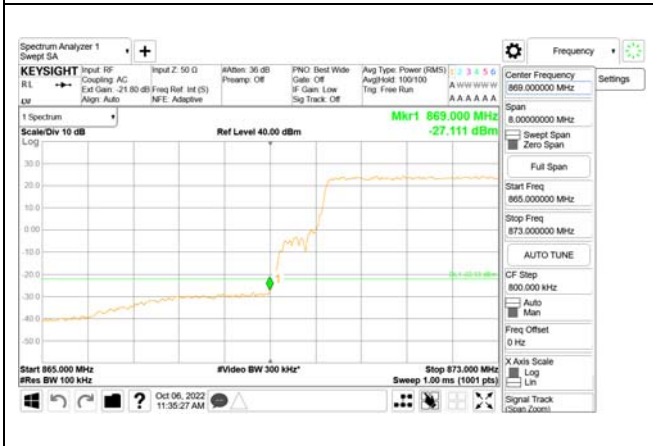




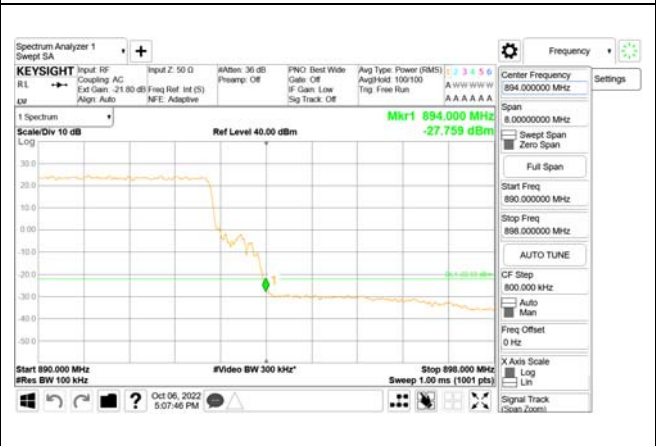


### 64QAM

#### Low Channel

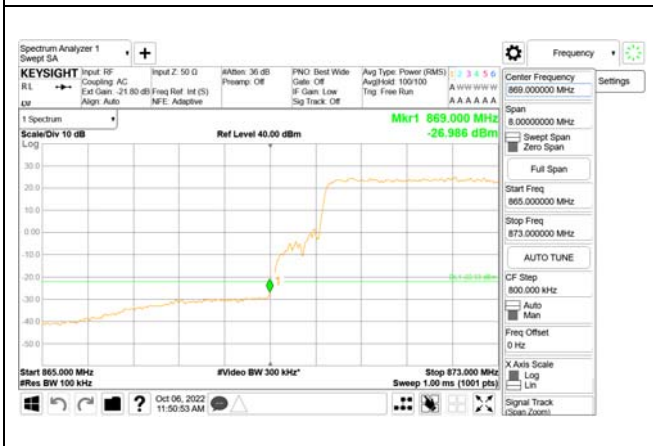


#### High Channel

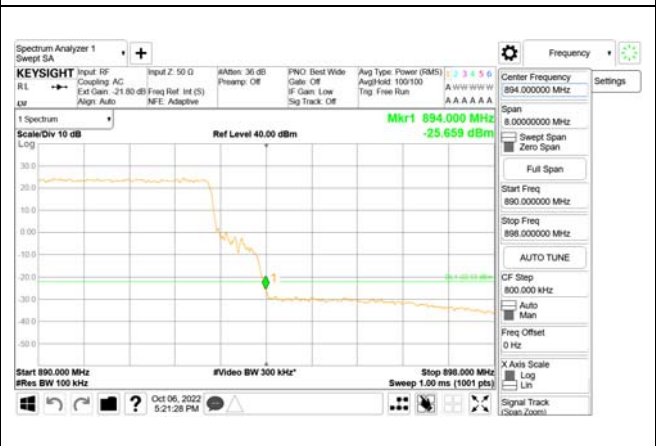


### 256QAM

#### Low Channel



#### High Channel





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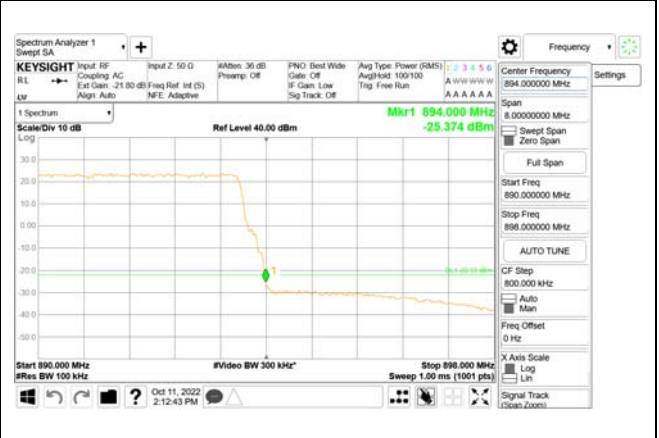
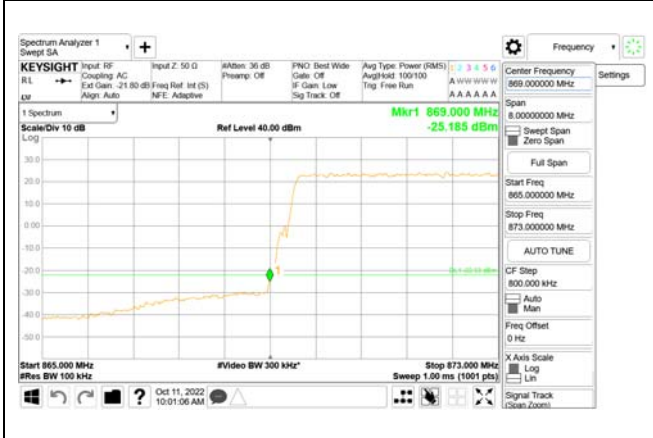
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**5G NR, Single carrier 20 MHz  
ANT1**

**QPSK**

**Low Channel**

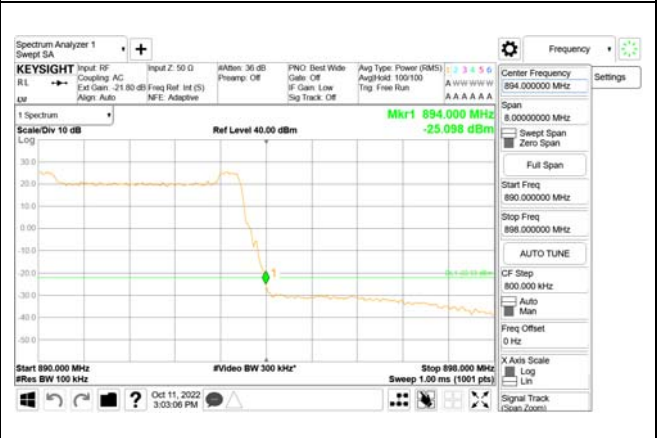
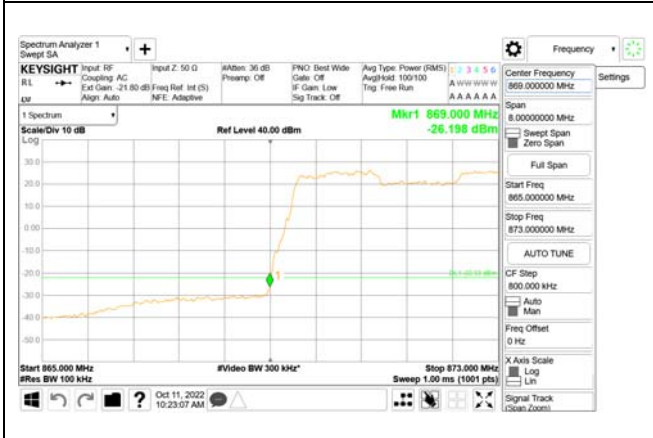
**High Channel**



**16QAM**

**Low Channel**

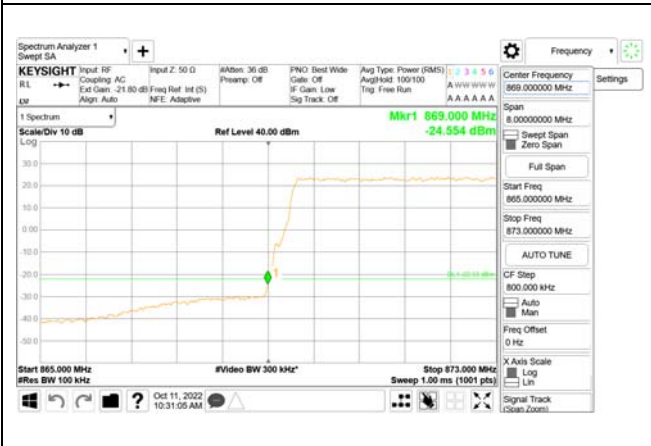
**High Channel**



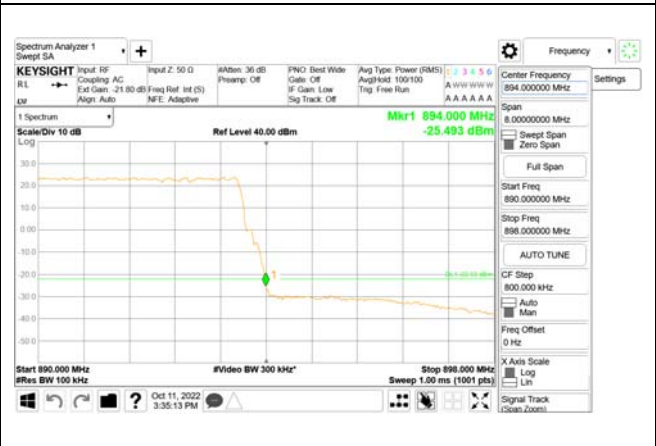


### 64QAM

#### Low Channel

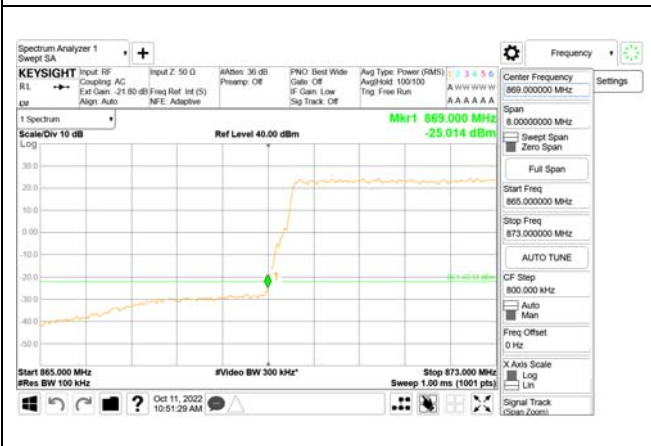


#### High Channel

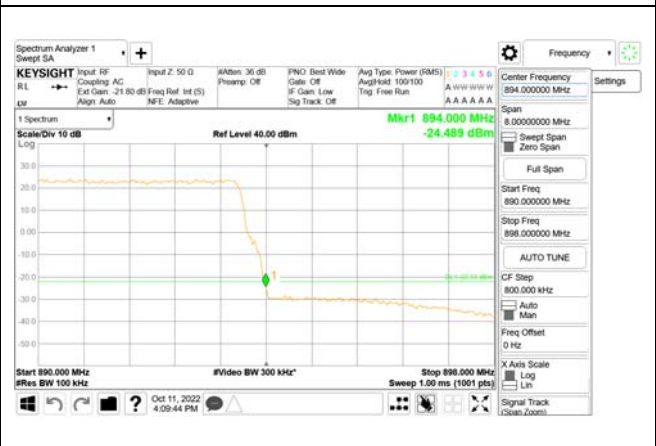


### 256QAM

#### Low Channel



#### High Channel





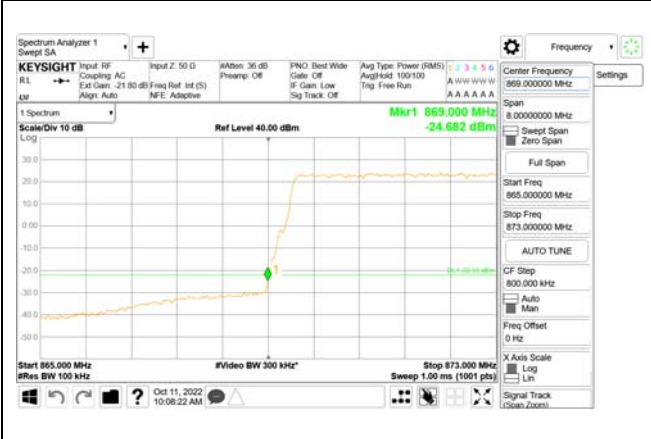
**CTK Co., Ltd.**  
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si,  
Gyeonggi-do, 449-100, Korea  
Tel: +82-31-339-9970  
Fax: +82-31-624-9501

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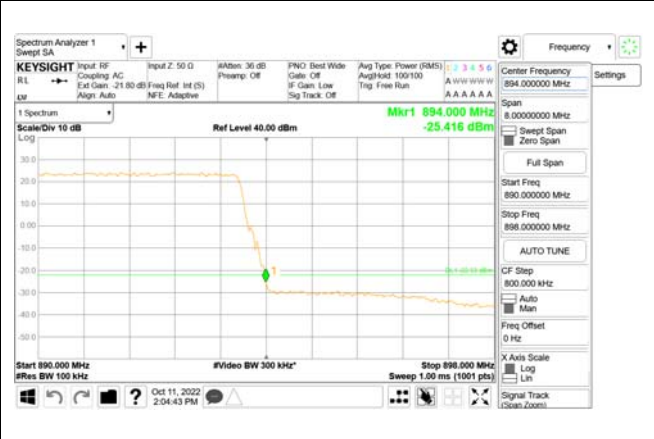
### ANT2

### QPSK

#### Low Channel

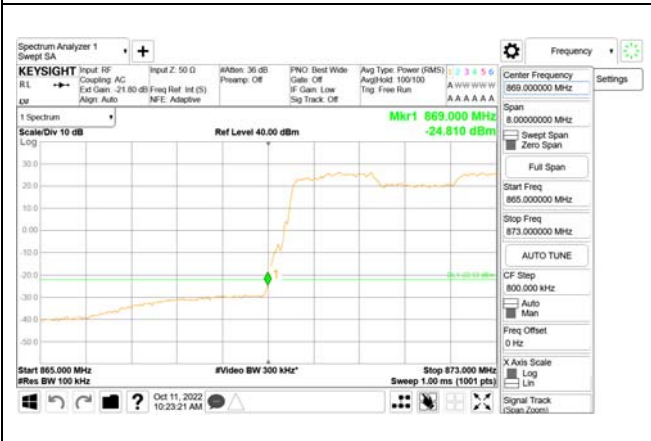


#### High Channel

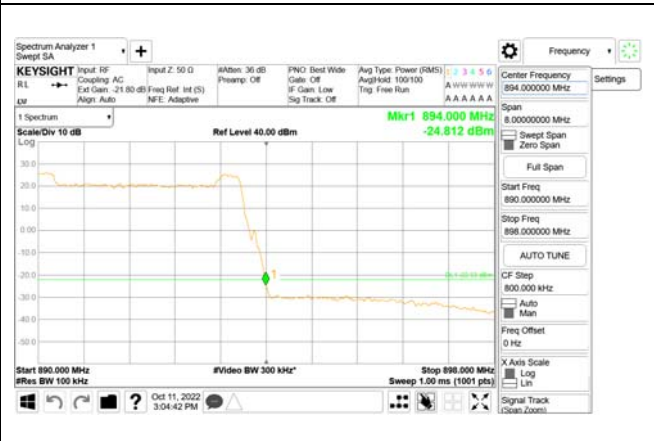


### 16QAM

#### Low Channel



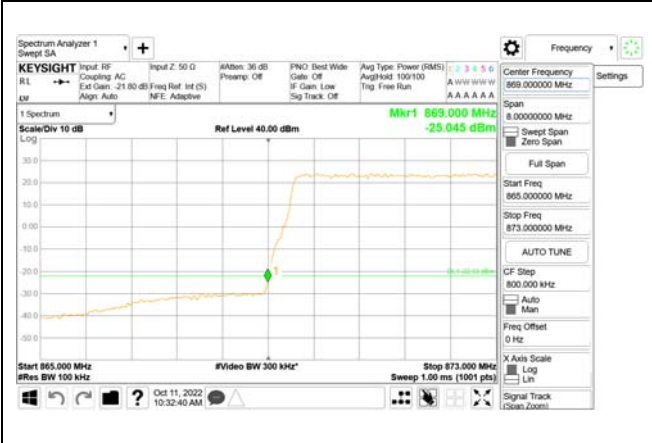
#### High Channel



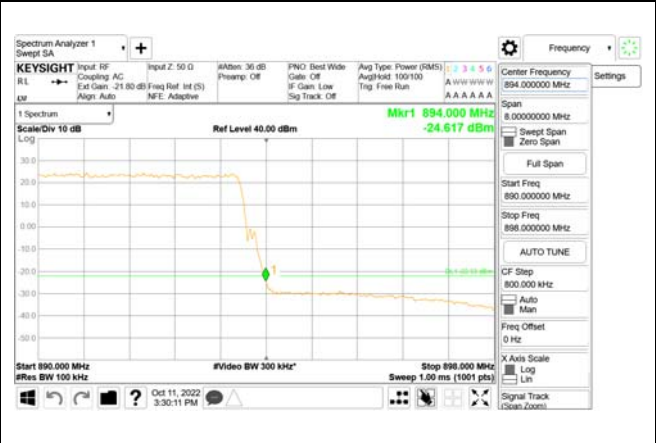


64QAM

Low Channel

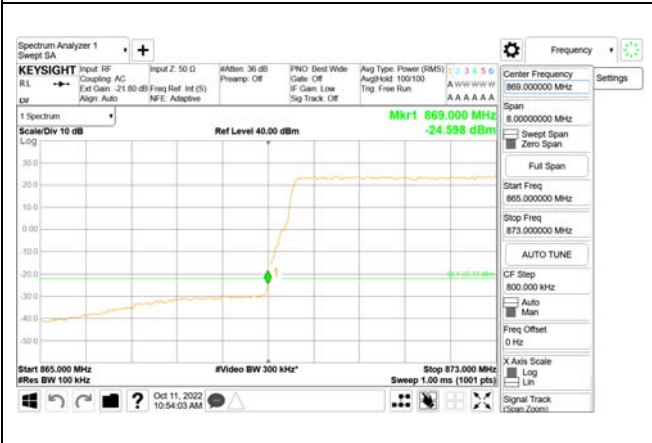


High Channel



256QAM

Low Channel



High Channel





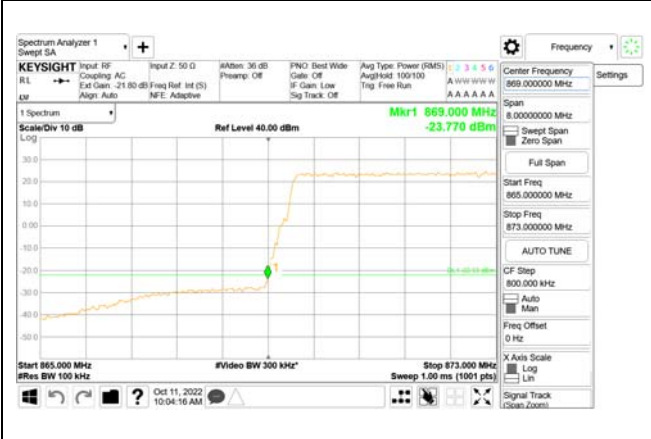
**CTK Co., Ltd.**  
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Gyeonggi-do, 449-100, Korea  
Tel: +82-31-339-9970  
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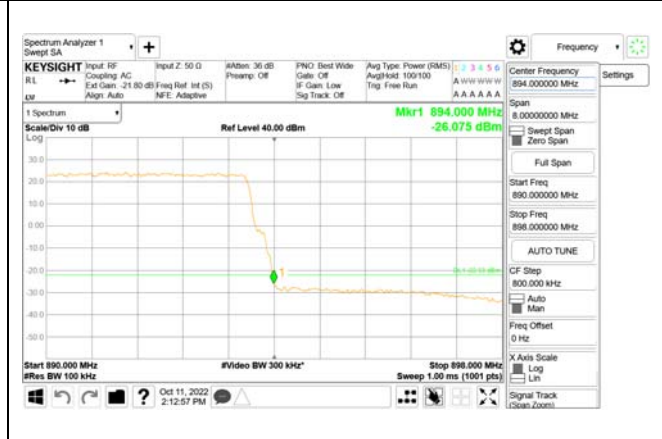
### ANT3

### QPSK

#### Low Channel

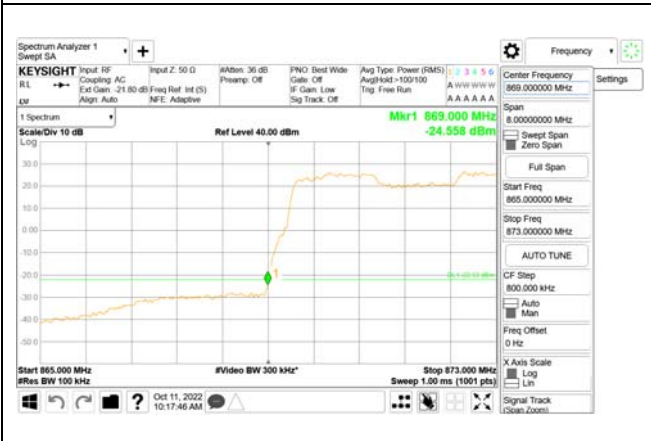


#### High Channel

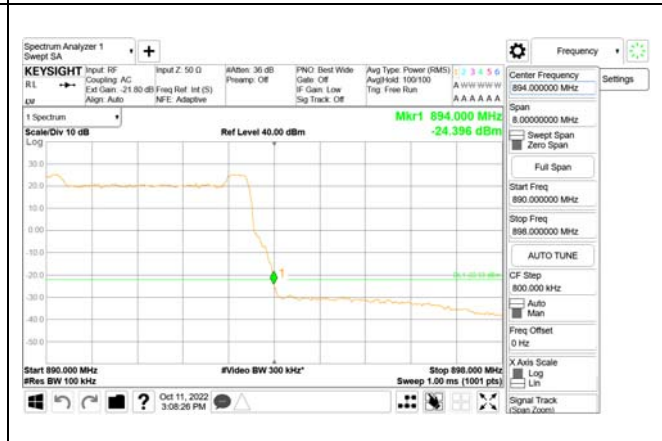


### 16QAM

#### Low Channel



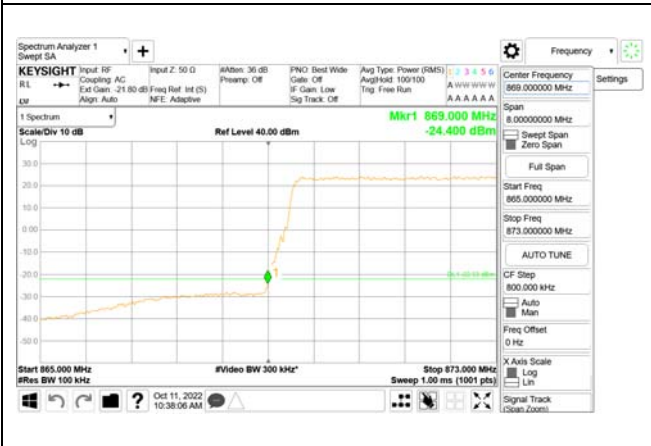
#### High Channel



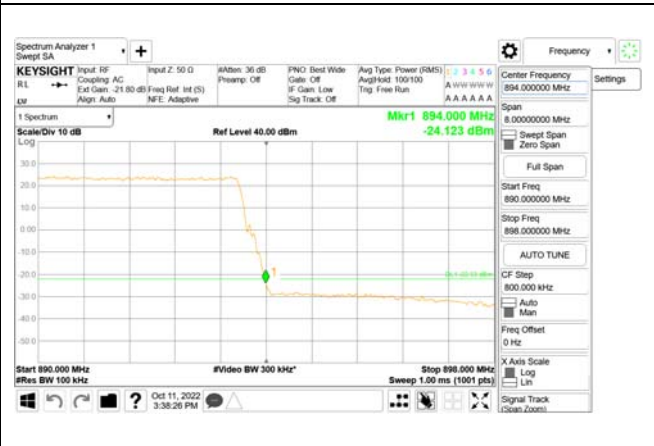


### 64QAM

#### Low Channel

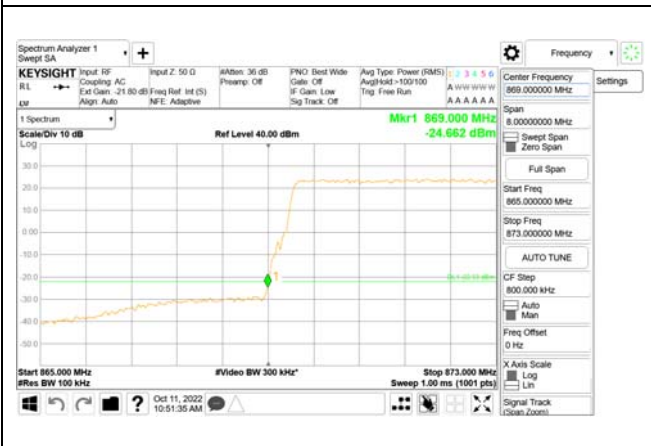


#### High Channel

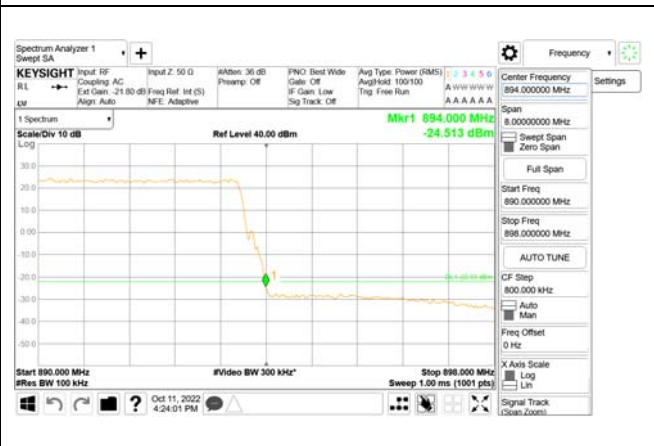


### 256QAM

#### Low Channel



#### High Channel





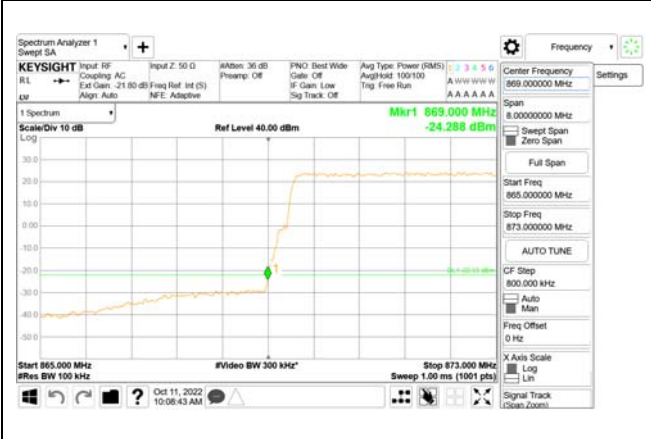
**CTK Co., Ltd.**  
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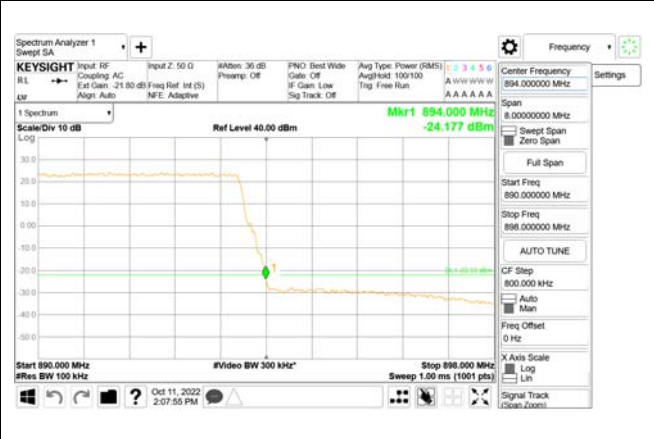
### ANT4

### QPSK

#### Low Channel

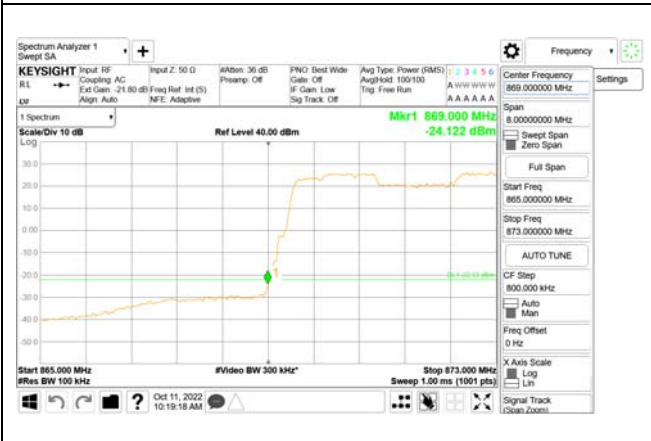


#### High Channel

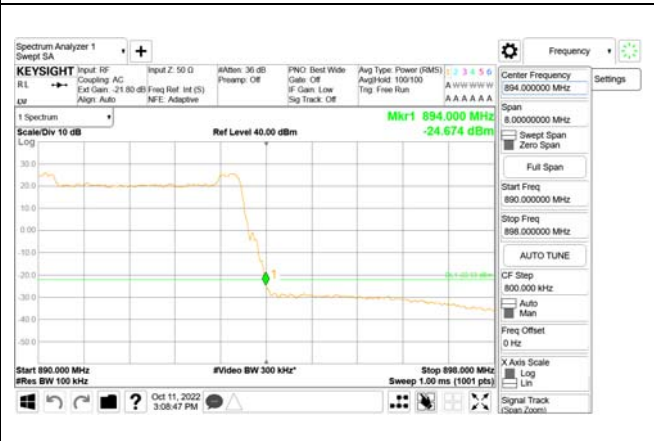


### 16QAM

#### Low Channel



#### High Channel

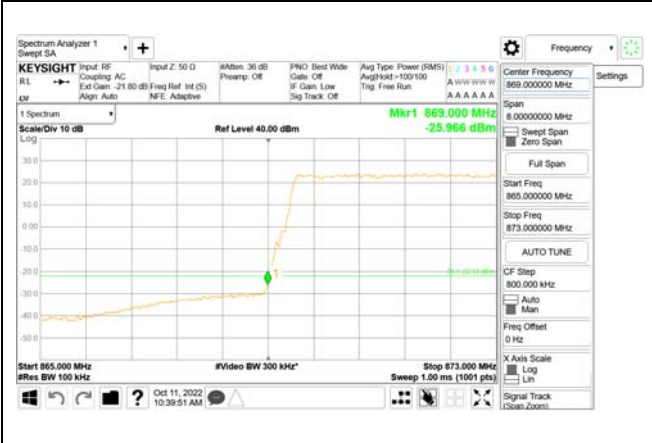




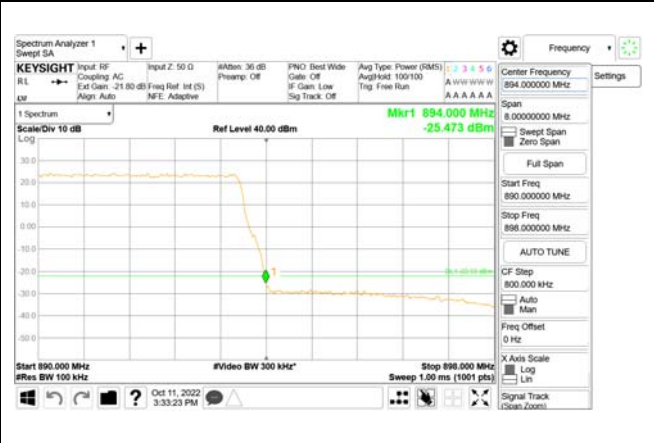


### 64QAM

#### Low Channel

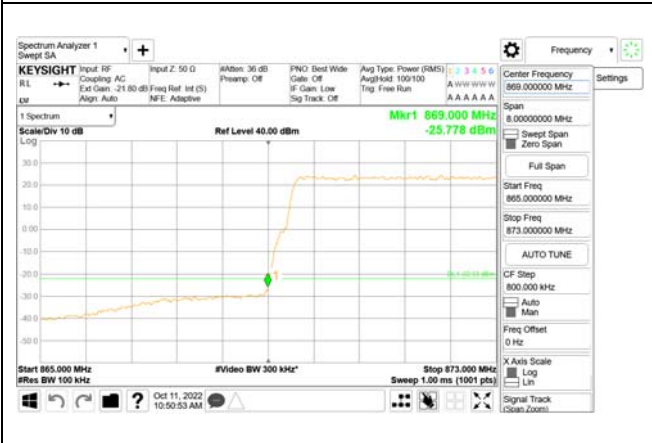


#### High Channel

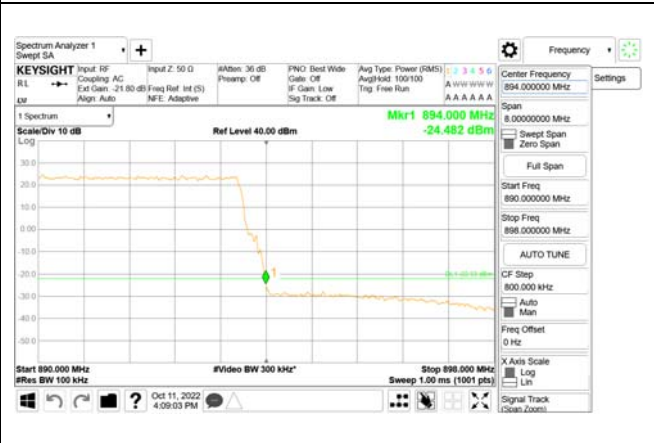


### 256QAM

#### Low Channel



#### High Channel





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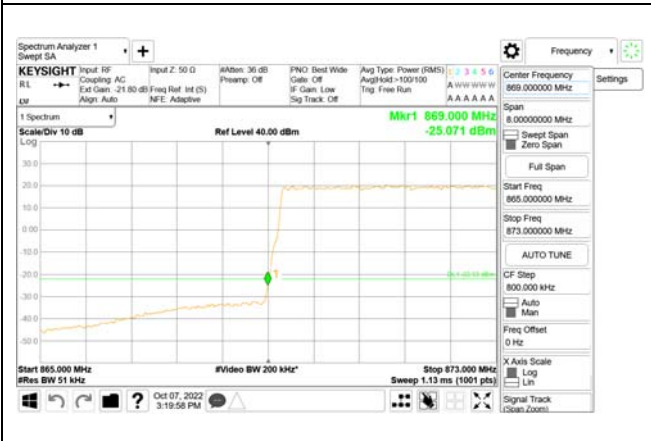
Test Data : Multi carrier

LTE, Multi carrier 5 MHz + 20 MHz

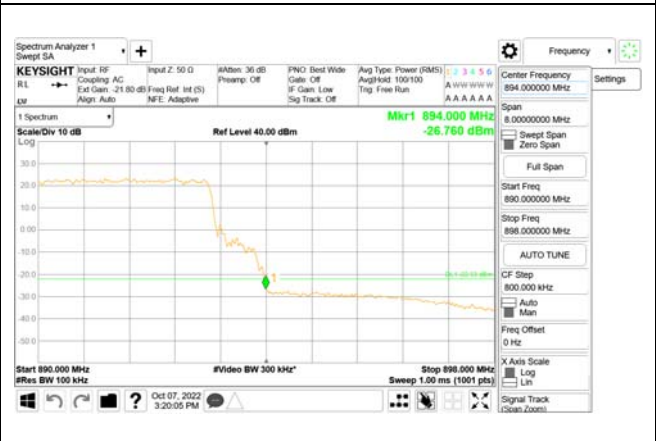
ANT1

QPSK

Low Channel

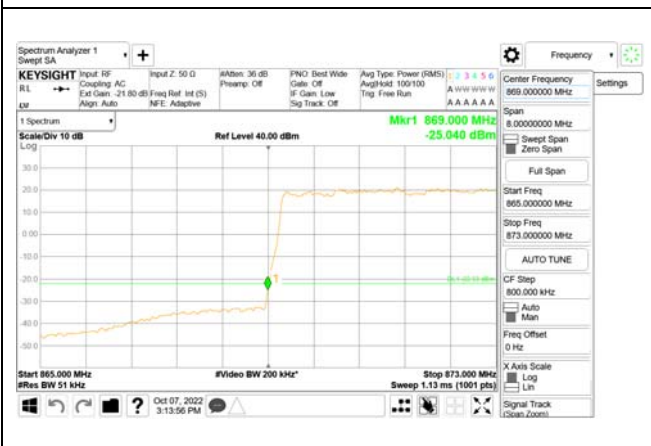


High Channel

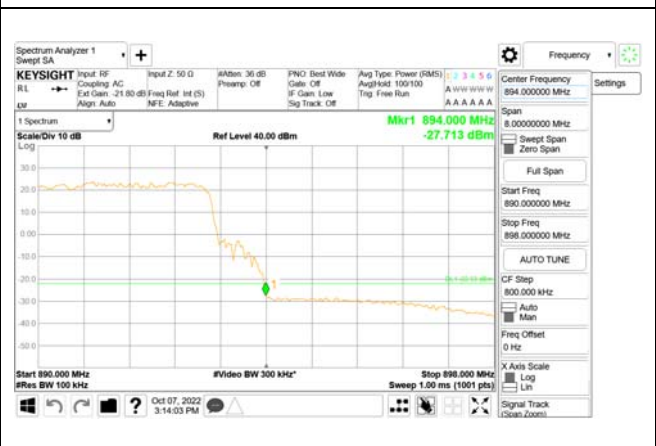


16QAM

Low Channel



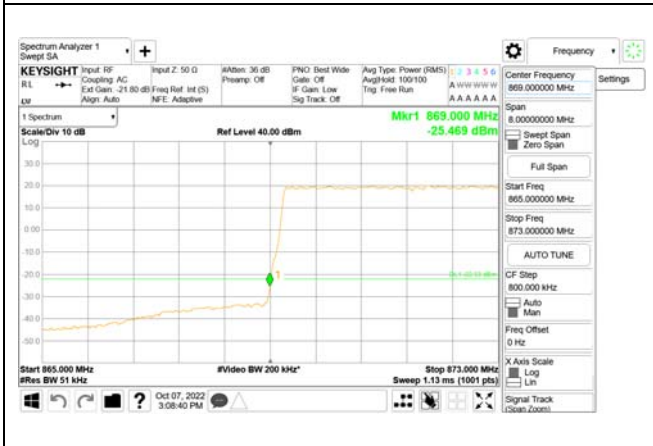
High Channel



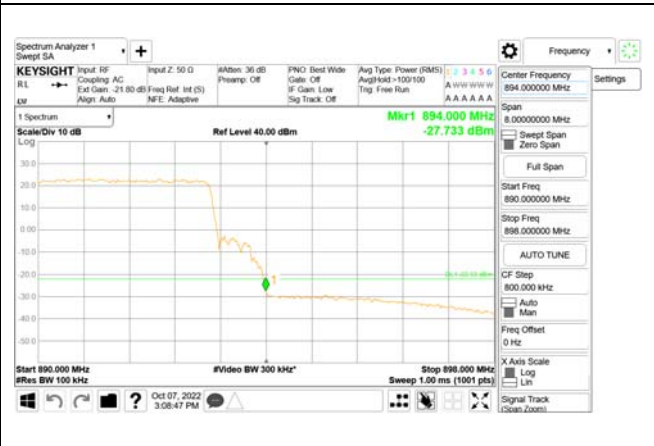


### 64QAM

#### Low Channel

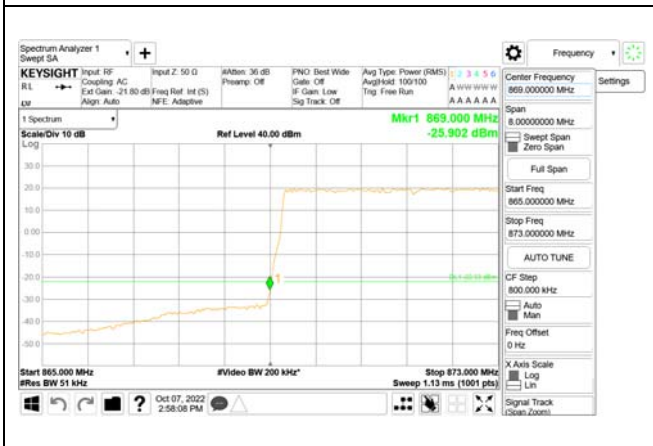


#### High Channel

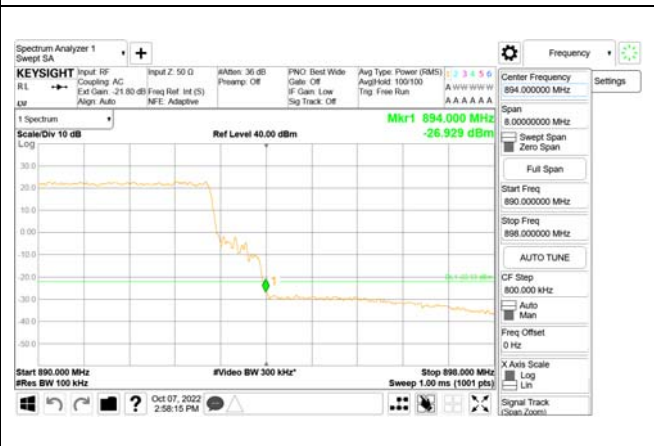


### 256QAM

#### Low Channel



#### High Channel





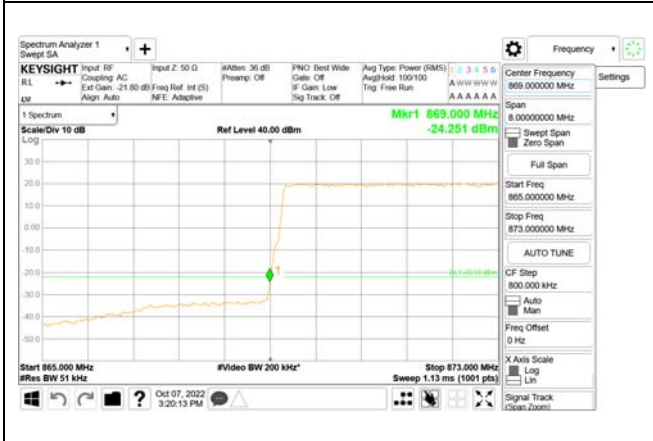
**CTK Co., Ltd.**  
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si,  
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Tel: +82-31-339-9970  
Fax: +82-31-624-9501

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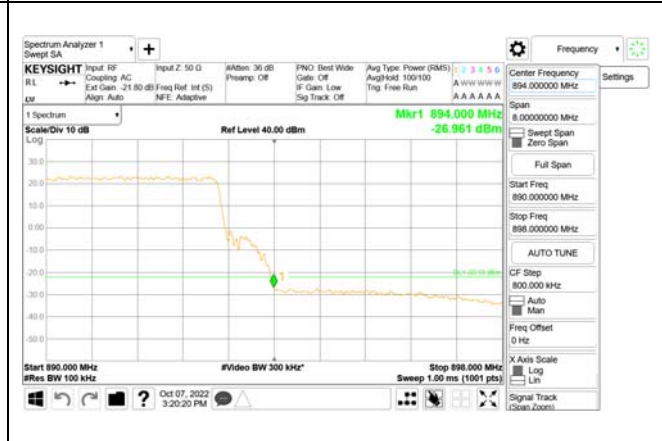
### ANT2

### QPSK

#### Low Channel

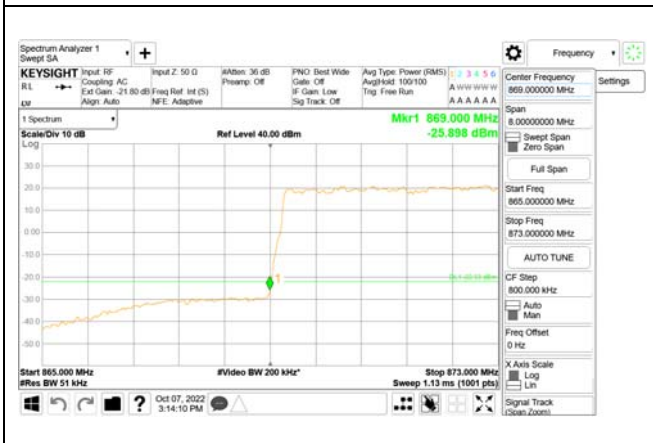


#### High Channel



### 16QAM

#### Low Channel



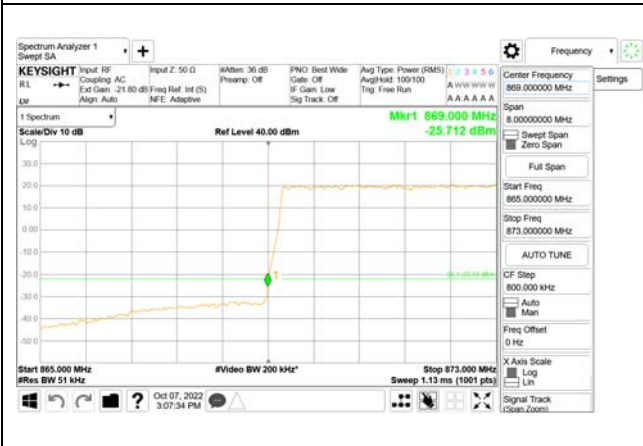
#### High Channel



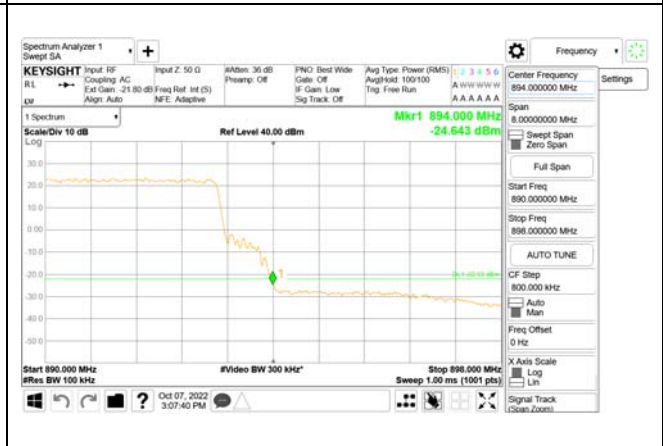


### 64QAM

#### Low Channel

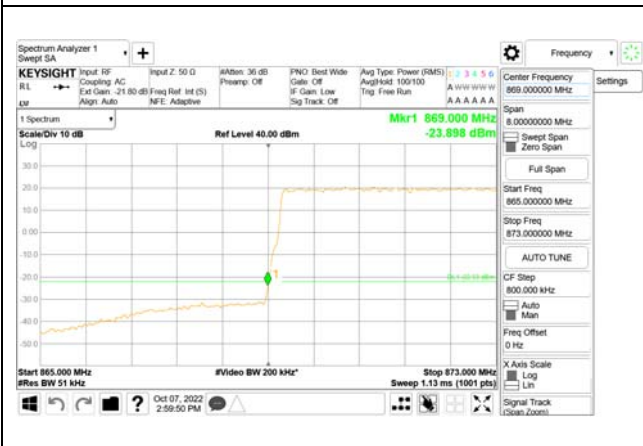


#### High Channel

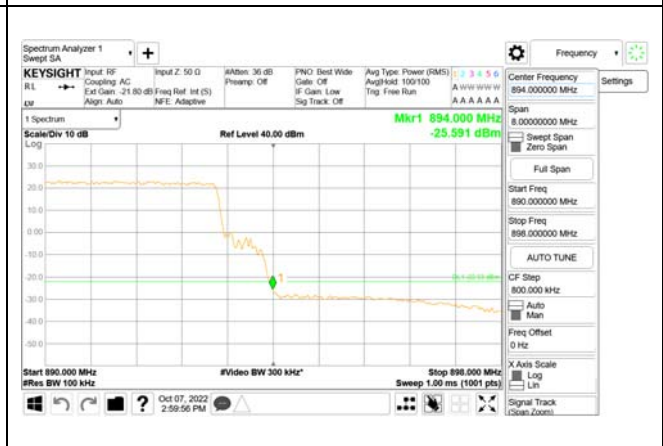


### 256QAM

#### Low Channel



#### High Channel





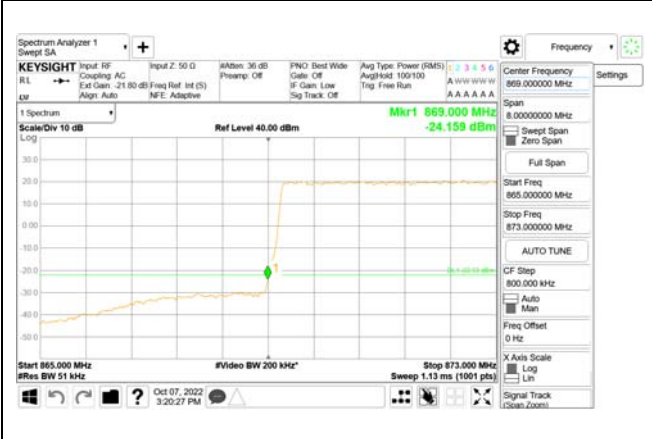
**CTK Co., Ltd.**  
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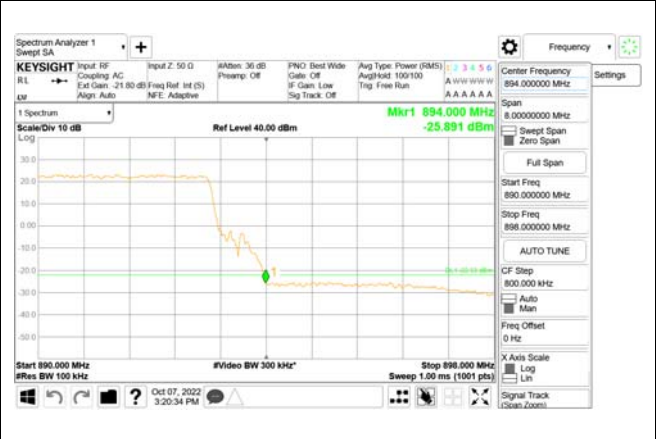
### ANT3

### QPSK

#### Low Channel

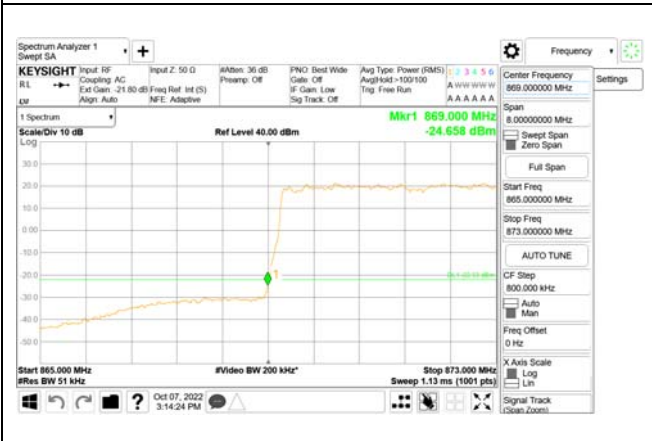


#### High Channel

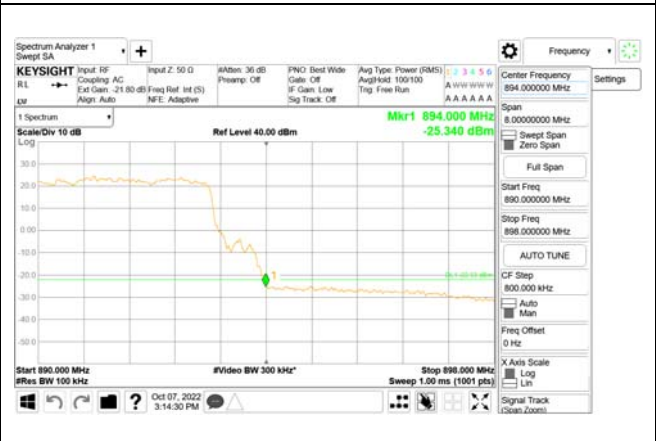


### 16QAM

#### Low Channel



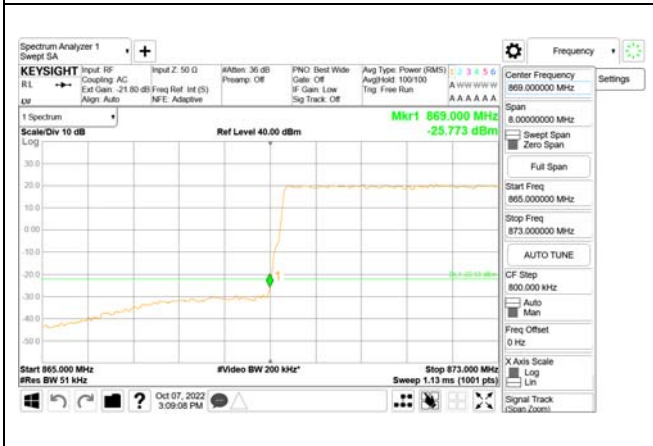
#### High Channel



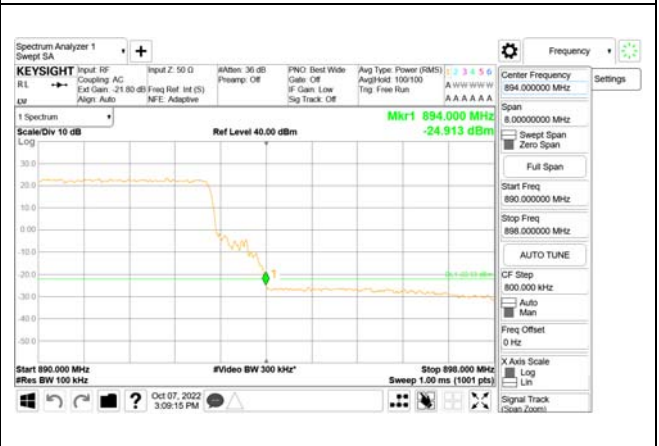


### 64QAM

#### Low Channel

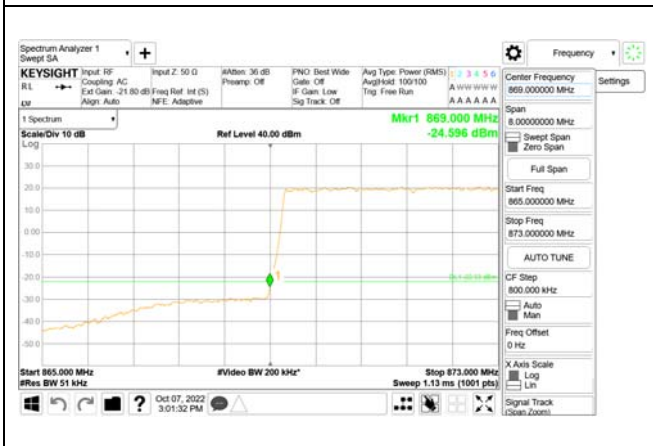


#### High Channel

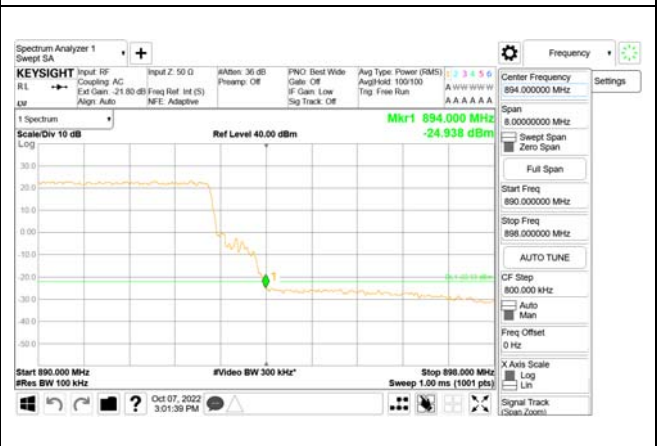


### 256QAM

#### Low Channel



#### High Channel





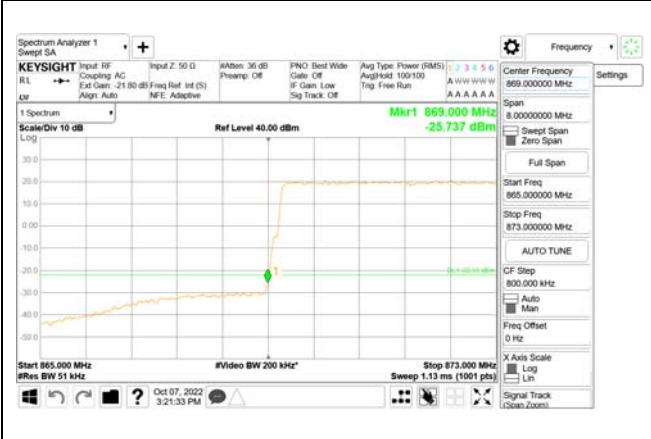
**CTK Co., Ltd.**  
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Tel: +82-31-339-9970  
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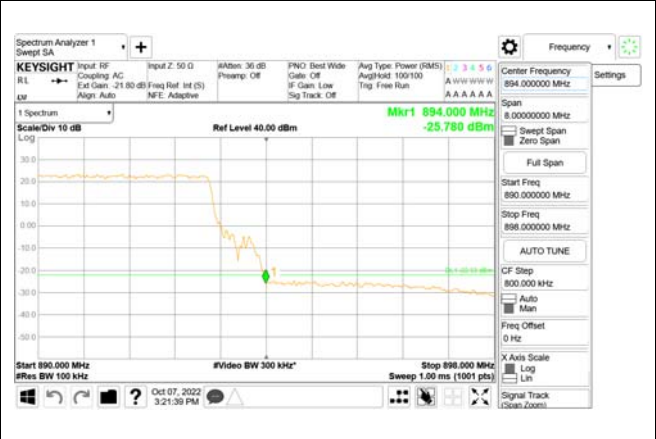
### ANT4

### QPSK

#### Low Channel

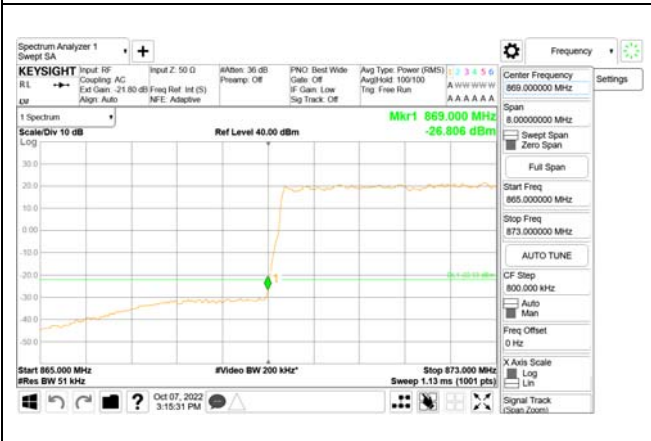


#### High Channel

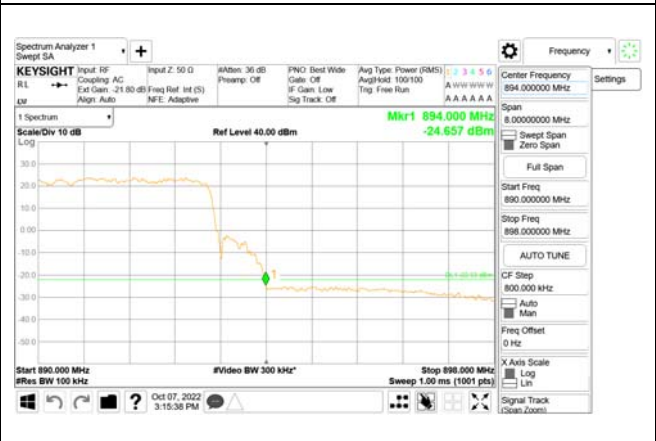


### 16QAM

#### Low Channel



#### High Channel

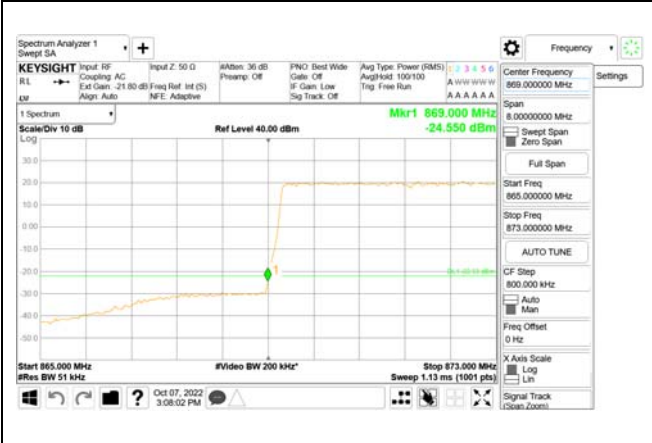




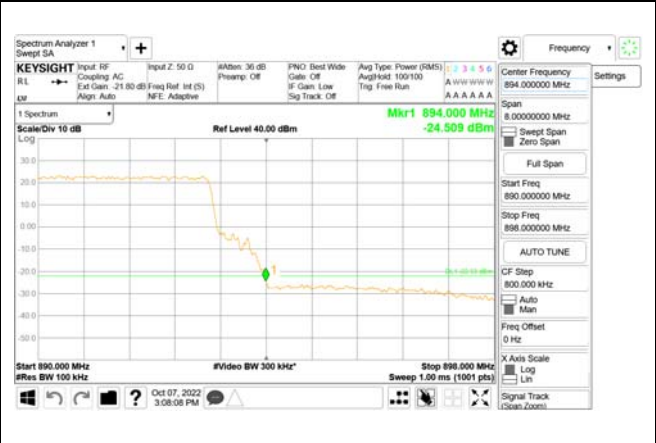


### 64QAM

#### Low Channel

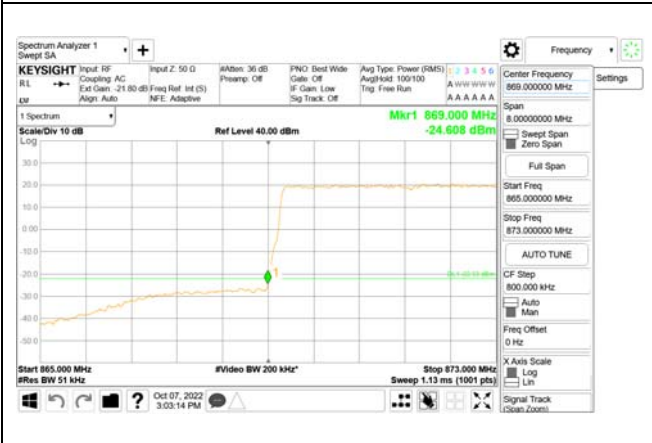


#### High Channel

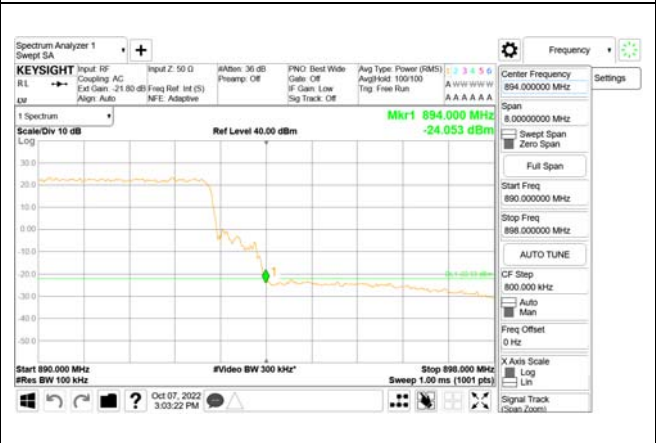


### 256QAM

#### Low Channel



#### High Channel





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Fax: +82-31-624-9501

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Test Data : Multi carrier

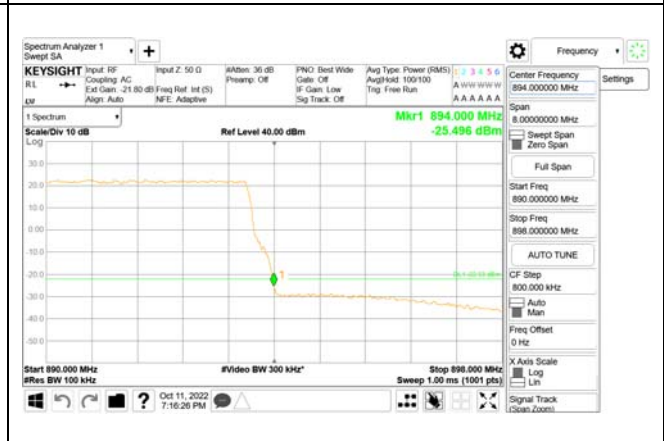
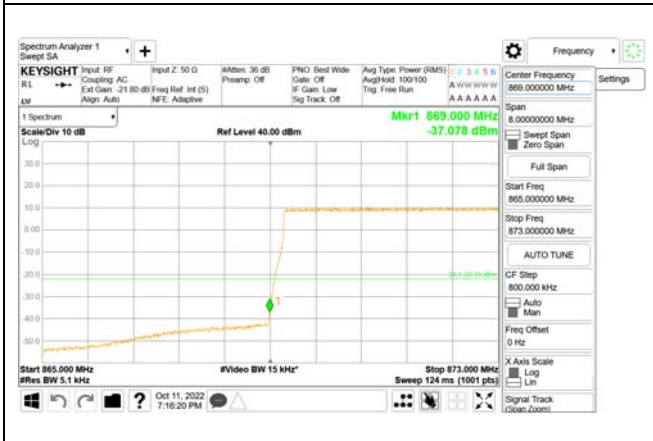
5G NR, Single carrier 5 MHz + 20 MHz

ANT1

QPSK

Low Channel

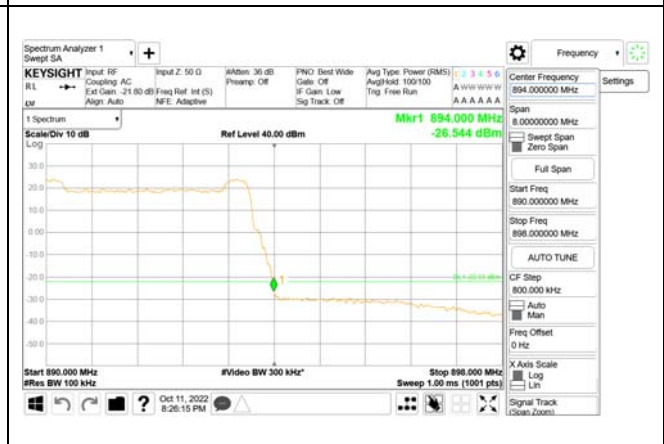
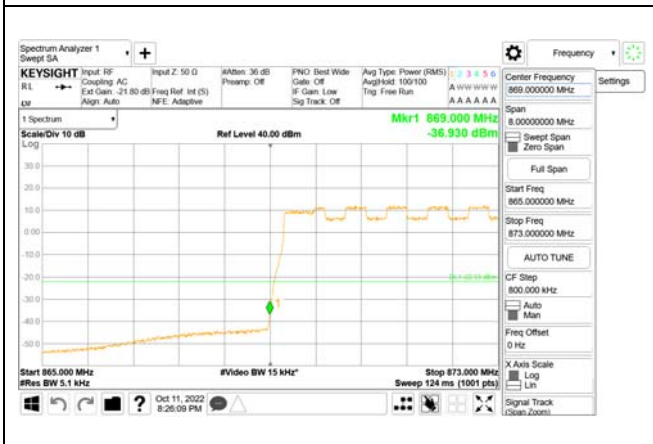
High Channel



16QAM

Low Channel

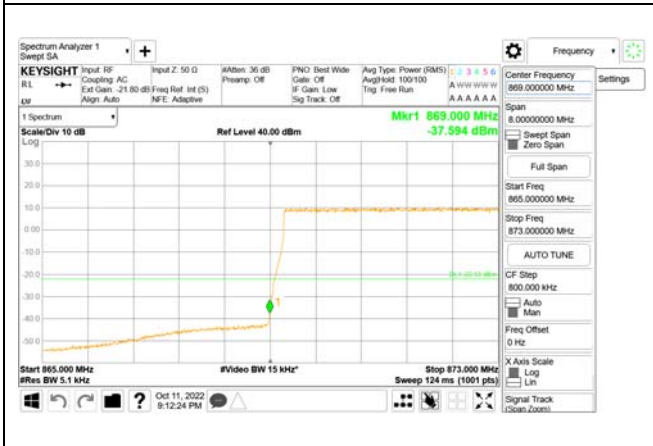
High Channel



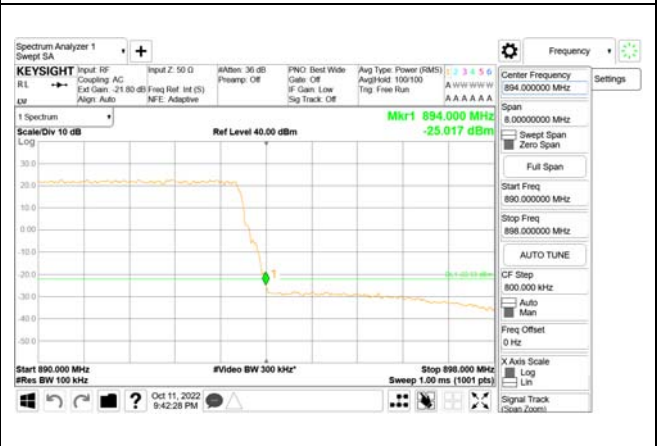


### 64QAM

#### Low Channel

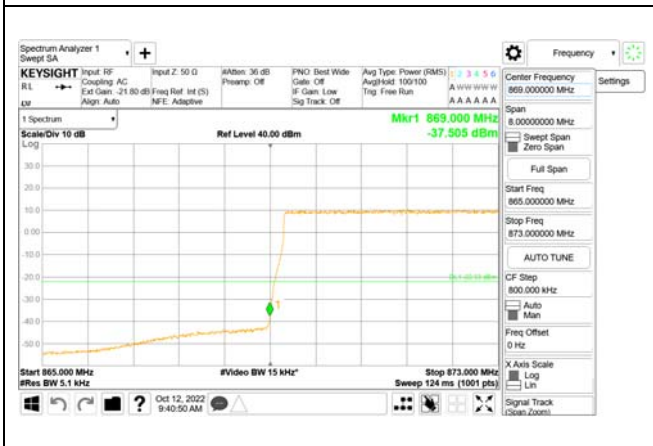


#### High Channel

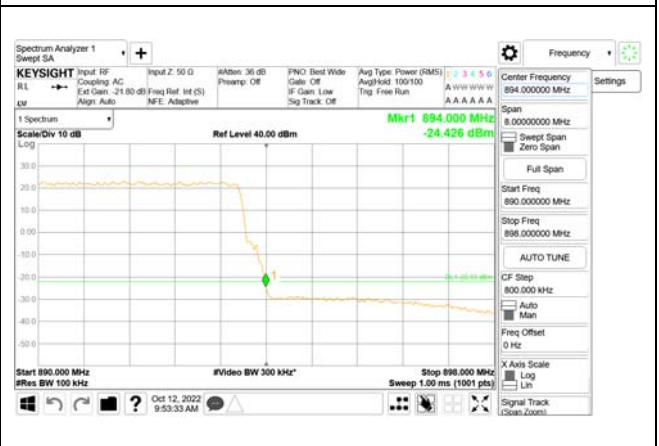


### 256QAM

#### Low Channel



#### High Channel





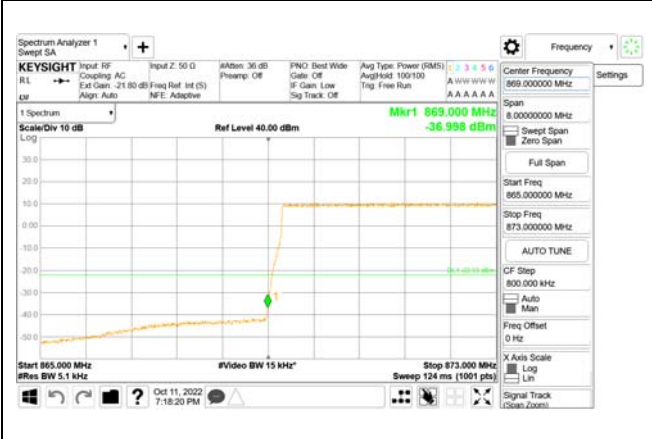
**CTK Co., Ltd.**  
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Tel: +82-31-339-9970  
Fax: +82-31-624-9501

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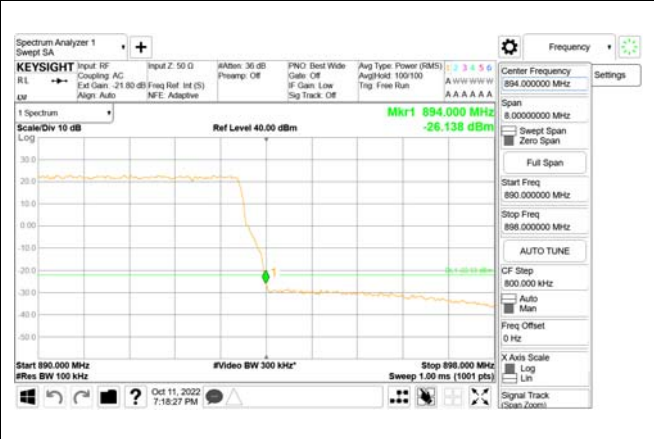
### ANT2

### QPSK

#### Low Channel

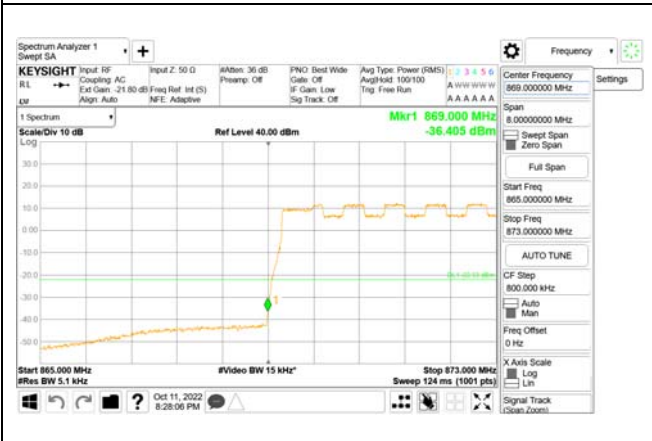


#### High Channel

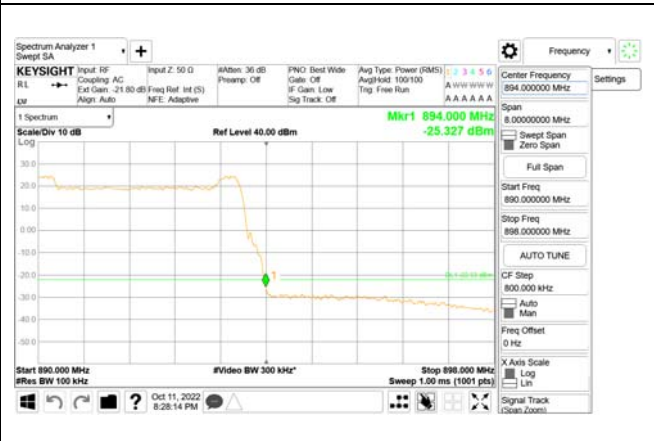


### 16QAM

#### Low Channel



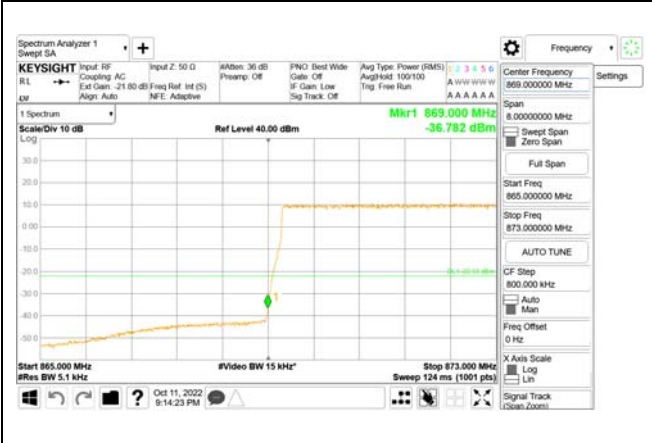
#### High Channel



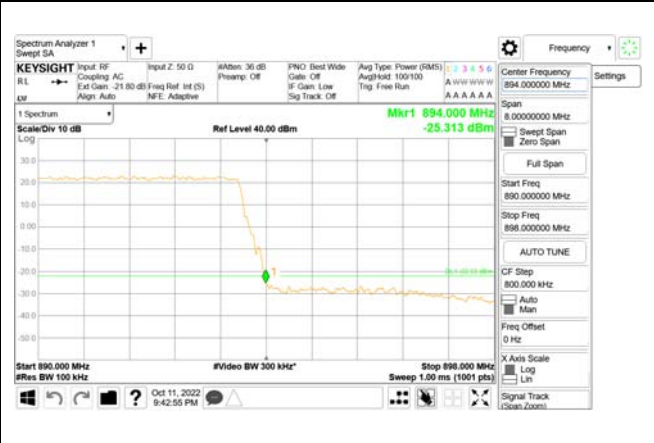


64QAM

Low Channel

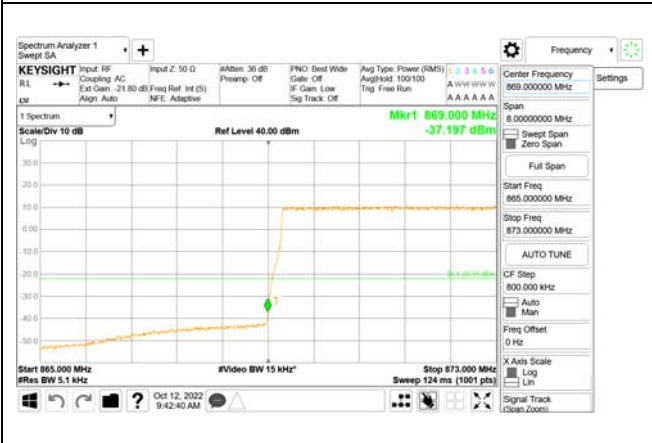


High Channel

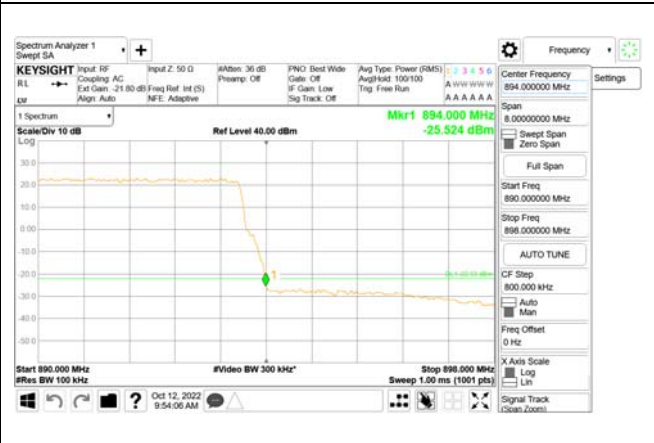


256QAM

Low Channel



High Channel





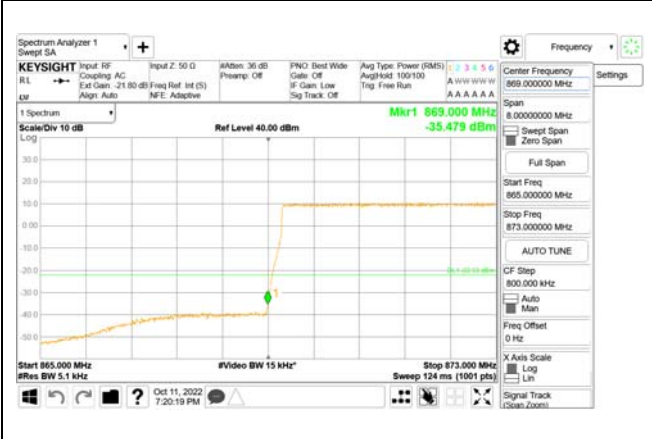
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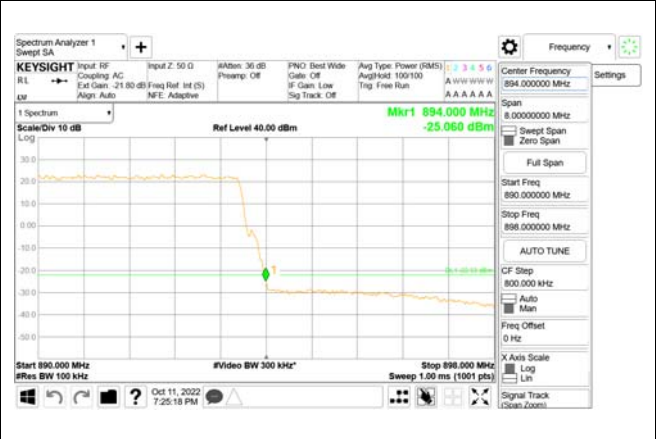
### ANT3

### QPSK

#### Low Channel

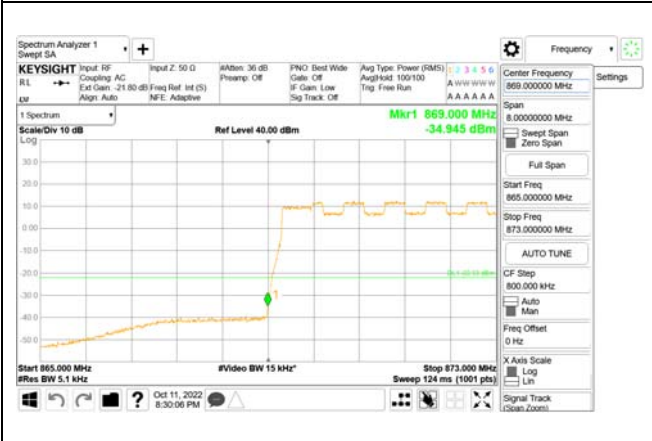


#### High Channel

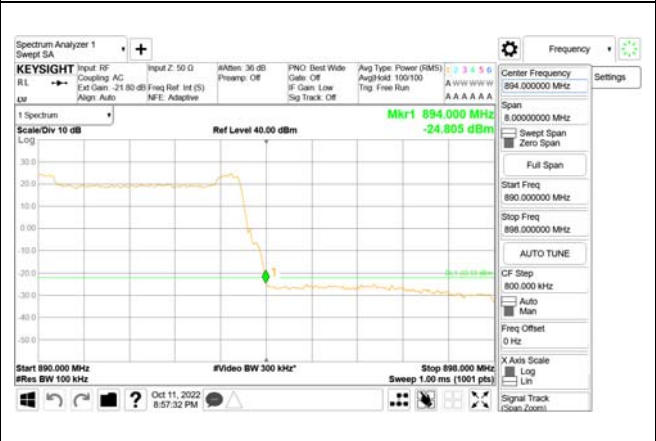


### 16QAM

#### Low Channel



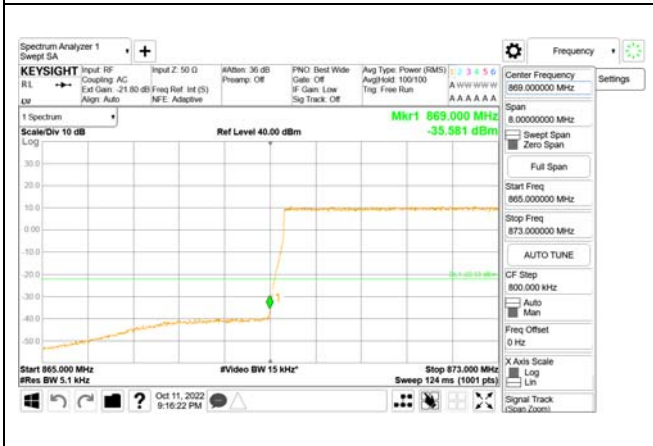
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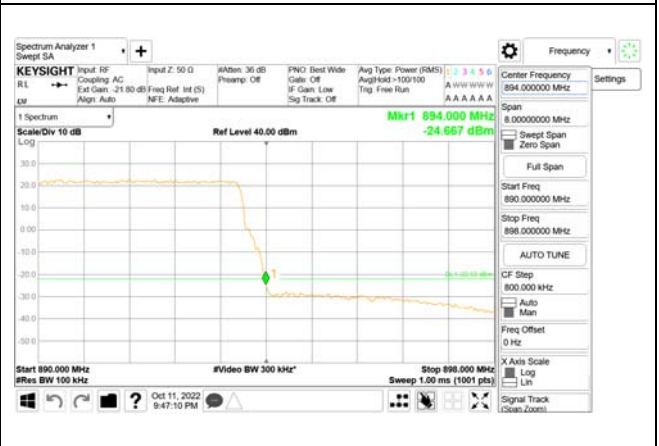


### 64QAM

#### Low Channel

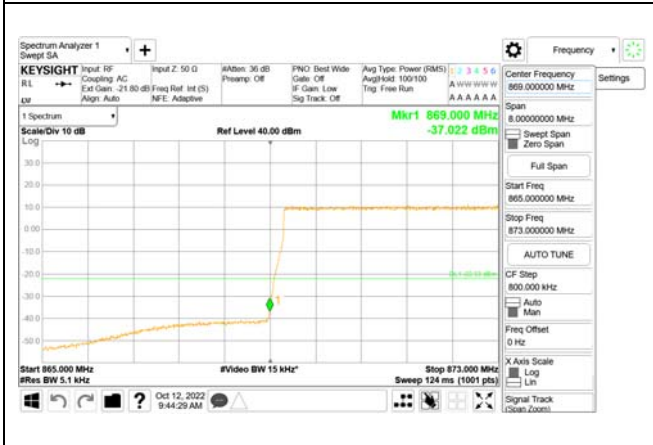


#### High Channel

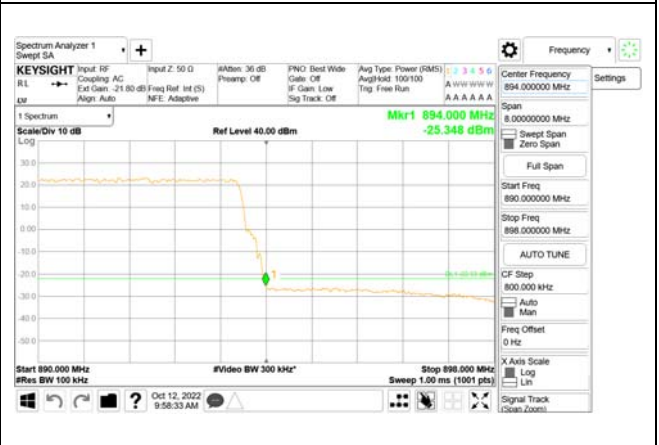


### 256QAM

#### Low Channel



#### High Channel





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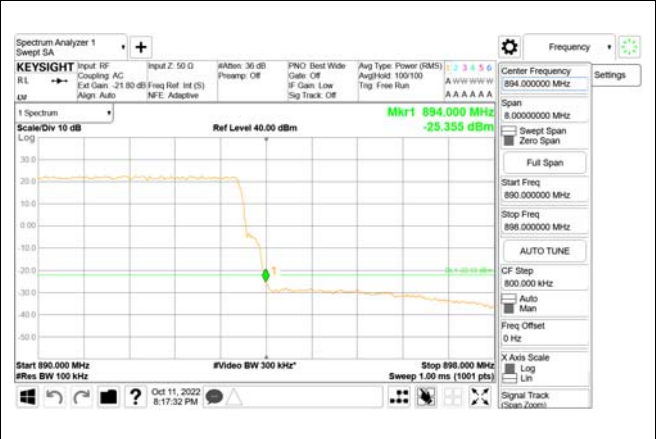
### ANT4

### QPSK

#### Low Channel

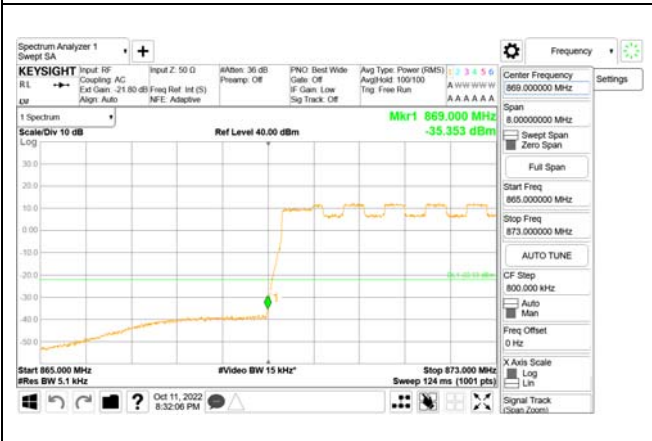


#### High Channel

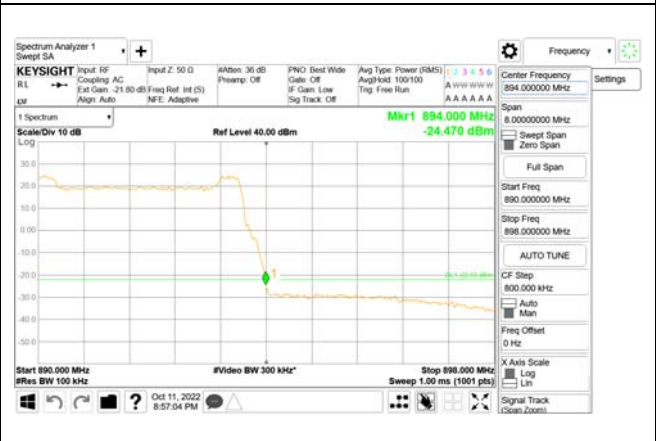


### 16QAM

#### Low Channel



#### High Channel

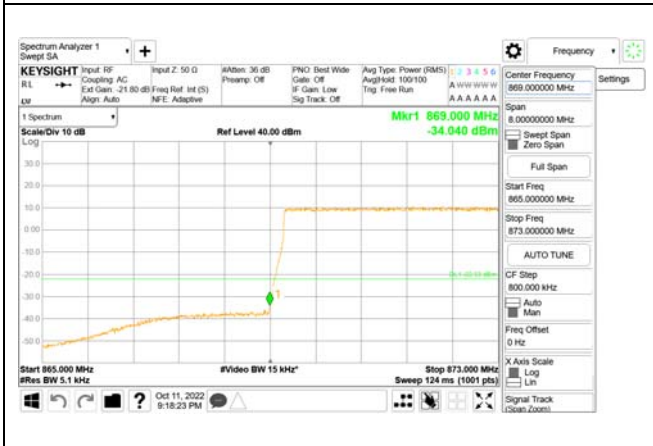




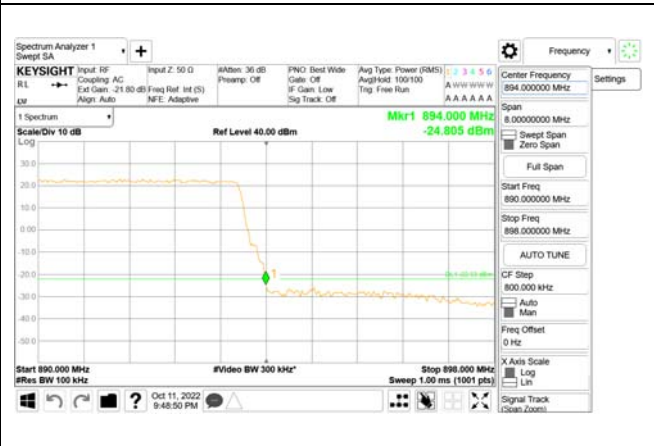


### 64QAM

#### Low Channel

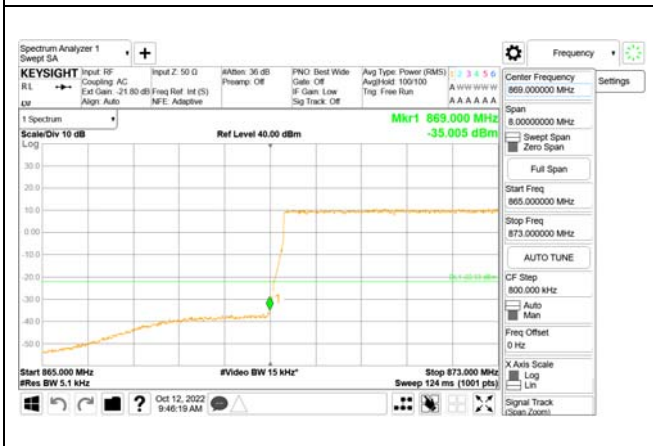


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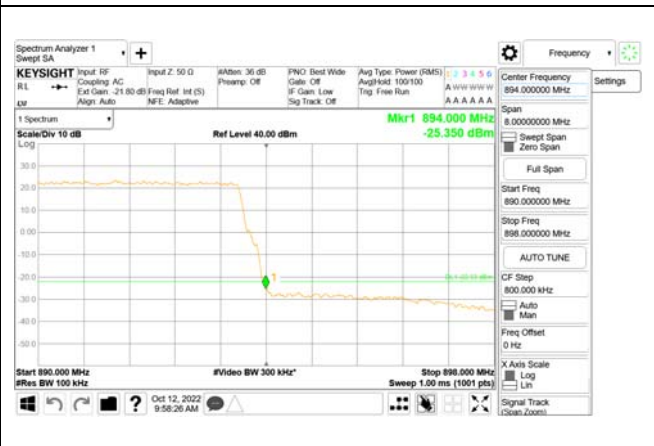



### 256QAM

#### Low Channel



#### High Channel



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## 9. 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.

#### § 22.917 Emission limitations for cellular equipment.

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

- (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.
- (b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:
  - (1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.
  - (2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.
- (c) Alternative out of band emission limit. Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.
- (d) Interference caused by out of band emissions. If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

**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.

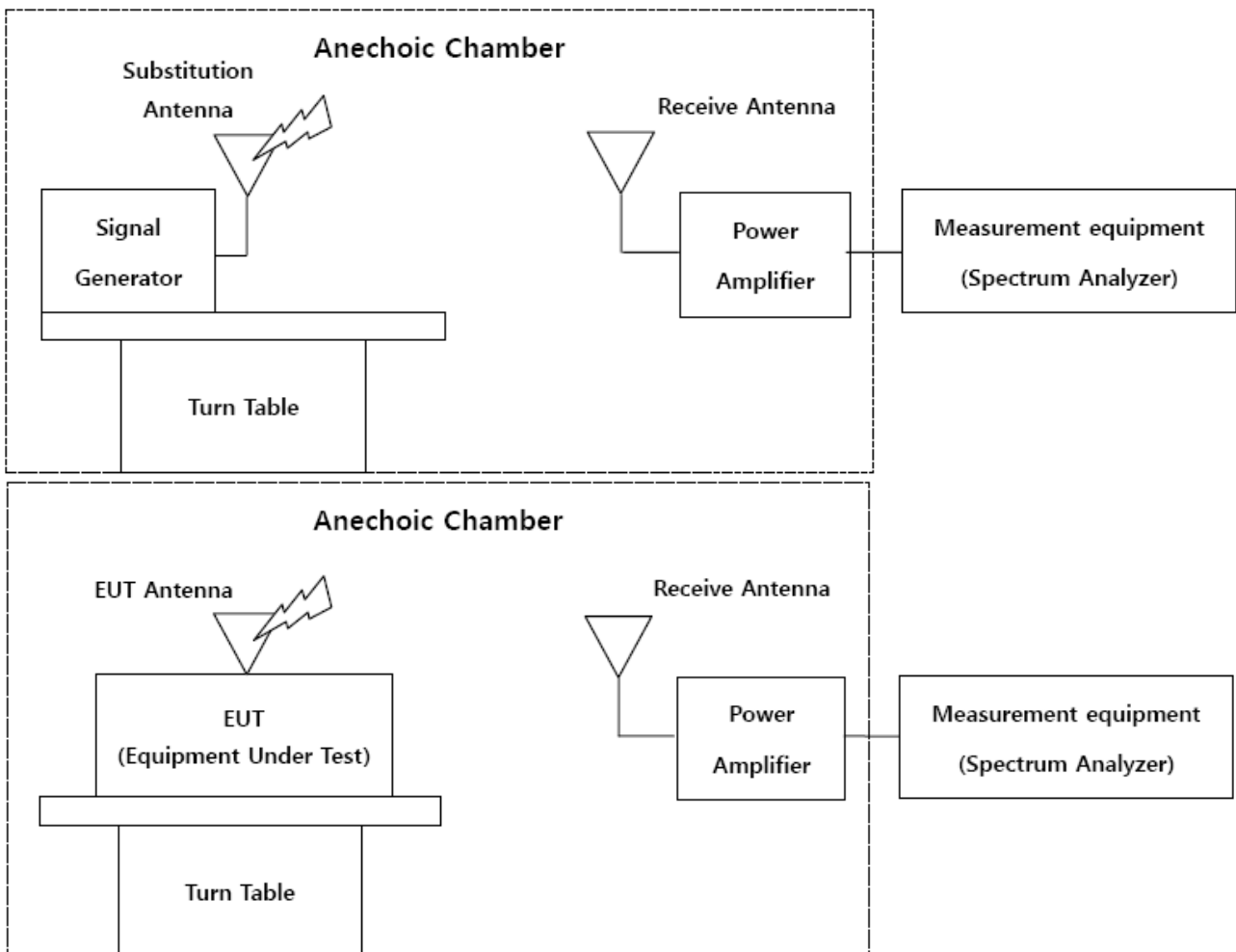
The space loss (in dB) = S.G. - Tx Cable loss + Substitution antenna gain - Analyzer reading.

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

**Notes :**

1. Due to 64 x 64 MIMO operation, limit is **-19.02 dBm** (-13 dBm - 10\*Log(4)) per KDB Publication 662911 D01 Multiple Transmitter Output v02r01.

**Test Setup :**





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## Test Results : Radiated Spurious emission

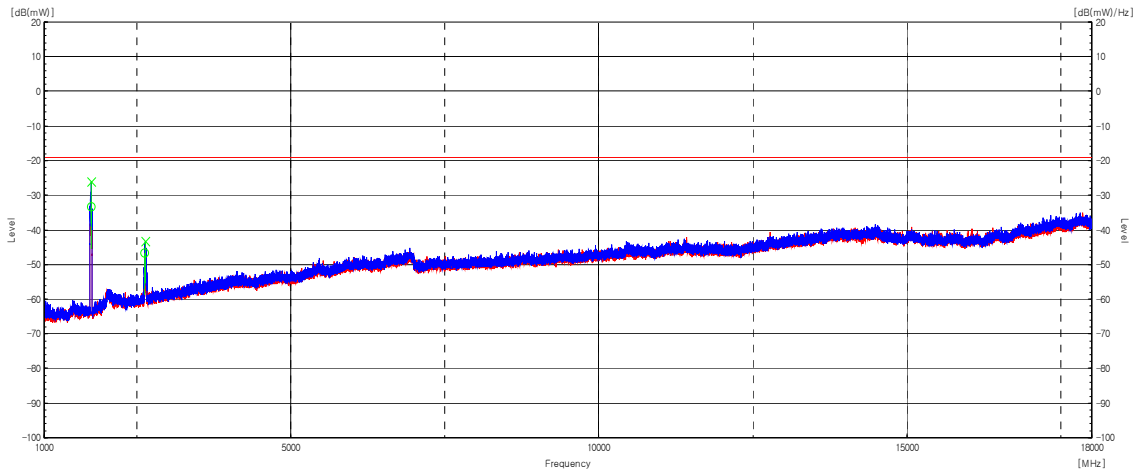
### Test Data : Single carrier

- \* We have done all test case. Test data was only the worst case(QPSK, 256QAM).
- \* In all test cases, the measurement results in the following measurement bands are similar. (30 MHz - 1 GHz, 1 GHz - 10 GHz)

Frequency range	30 MHz - 1 GHz
Modulation	QPSK
Test mode	LTE_Single Carrier_Middle
Channel bandwidth	20 MHz

Frequency [MHz]	Pol.	Reading PK [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	EIRP[dBm]	Limit[dBm]	Margin[dB]	Remark
The emissions above 1 GHz were 20 dB lower than the limit.								

Frequency range	1 GHz - 10 GHz
Modulation	QPSK
Test mode	LTE_Single Carrier_Middle
Channel bandwidth	20 MHz



Frequency[MHz]	Pol	Reading [dB(mW)]	Space Loss [dB]	Level [dB(mW)]	Limit [dB(mW)]	Margin [dB]
1759.900	H	-39.1	5.8	-33.3	-19	14.3
1760.467	V	-32.2	6.2	-26.0	-19	7.0
2634.267	H	-56.2	9.6	-46.6	-19	27.6
2645.033	V	-53.7	10.3	-43.4	-19	24.4



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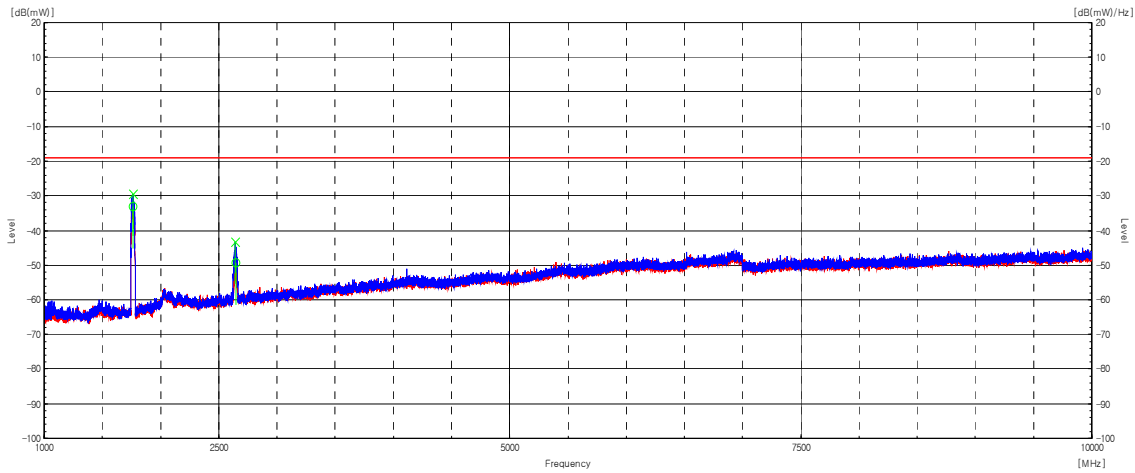
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Frequency range	30 MHz - 1 GHz
Modulation	256QAM
Test mode	LTE_Single Carrier_Middle
Channel bandwidth	20 MHz

Frequency [MHz]	Pol.	Reading PK [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	EIRP[dBm]	Limit[dBm]	Margin[dB]	Remark
The emissions above 1 GHz were 20 dB lower than the limit.								

Frequency range	1 GHz - 10 GHz
Modulation	256QAM
Test mode	LTE_Single Carrier_Middle
Channel bandwidth	20 MHz



Frequency[MHz]	Pol	Reading [dB(mW)]	Space Loss [dB]	Level [dB(mW)]	Limit [dB(mW)]	Margin [dB]
1763.300	H	-38.9	5.8	-33.1	-19	14.1
1763.867	V	-35.6	6.2	-29.4	-19	10.4
2641.633	V	-53.5	10.3	-43.2	-19	24.2
2647.300	H	-58.9	9.6	-49.3	-19	30.3



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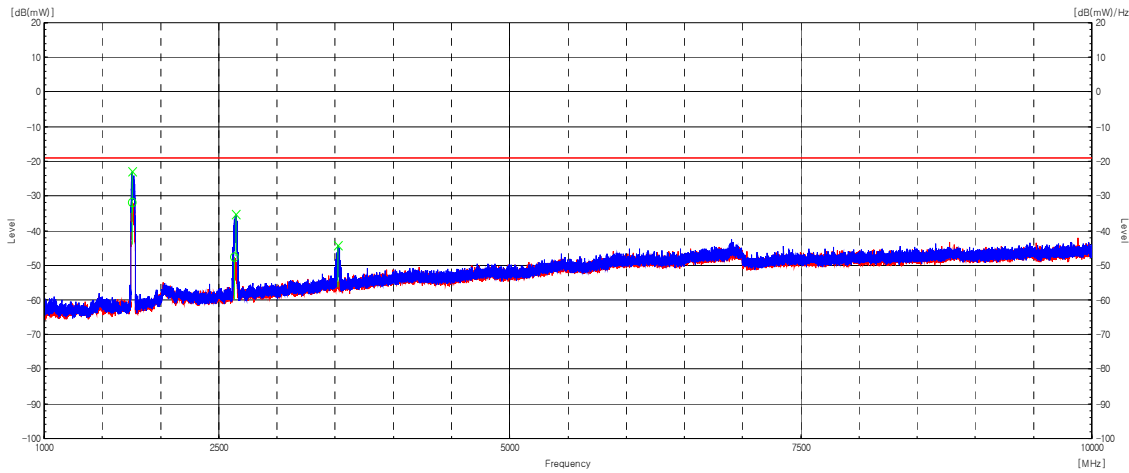
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Frequency range	30 MHz - 1 GHz
Modulation	QPSK
Test mode	5G NR_Single Carrier_Middle
Channel bandwidth	20 MHz

Frequency [MHz]	Pol.	Reading PK [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	EIRP[dBm]	Limit[dBm]	Margin[dB]	Remark
The emissions above 1 GHz were 20 dB lower than the limit.								

Frequency range	1 GHz - 10 GHz
Modulation	QPSK
Test mode	5G NR_Single Carrier_Middle
Channel bandwidth	20 MHz



Frequency[MHz]	Pol	Reading [dB(mW)]	Space Loss [dB]	Level [dB(mW)]	Limit [dB(mW)]	Margin [dB]
1758.1	H	-37.6	5.8	-31.8	-19	12.8
1758.4	V	-29	6.2	-22.8	-19	3.8
2632.6	H	-57.3	9.6	-47.7	-19	28.7
2647	V	-45.5	10.3	-35.2	-19	16.2
3523	V	-56.8	12.6	-44.2	-19	25.2



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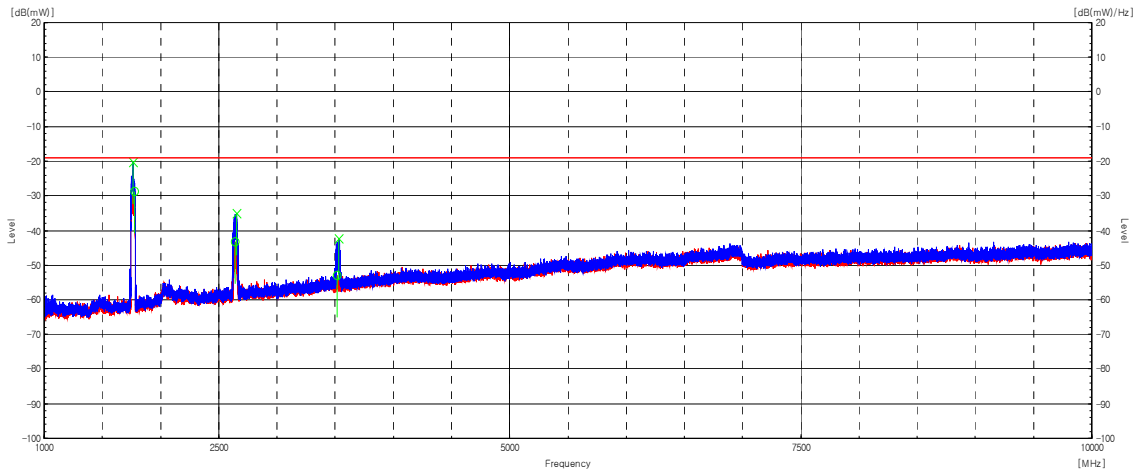
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Frequency range	30 MHz - 1 GHz
Modulation	256QAM
Test mode	5G NR_Single Carrier_Middle
Channel bandwidth	20 MHz

Frequency [MHz]	Pol.	Reading PK [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	EIRP[dBm]	Limit[dBm]	Margin[dB]	Remark
The emissions above 1 GHz were 20 dB lower than the limit.								

Frequency range	1 GHz - 10 GHz
Modulation	256QAM
Test mode	5G NR_Single Carrier_Middle
Channel bandwidth	20 MHz



Frequency[MHz]	Pol	Reading [dB(mW)]	Space Loss [dB]	Level [dB(mW)]	Limit [dB(mW)]	Margin [dB]
1764.7	V	-26.4	6.2	-20.2	-19	1.2
1777.0	H	-34.6	5.8	-28.8	-19	9.8
2642.2	H	-52.9	9.6	-43.3	-19	24.3
2651.8	V	-45.4	10.3	-35.1	-19	16.1
3520.3	H	-65.1	12.0	-53.1	-19	34.1
3531.1	V	-54.8	12.5	-42.3	-19	23.3



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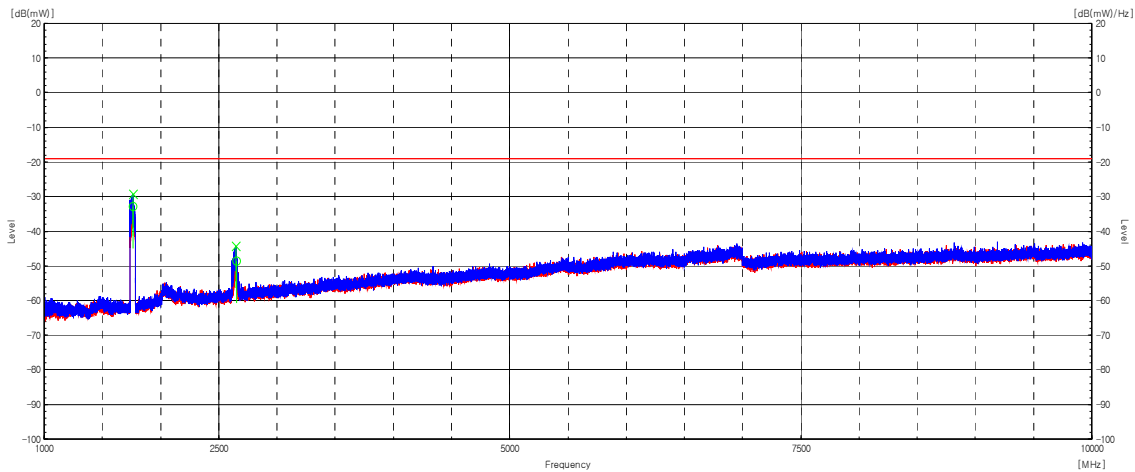
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- \* We have done all test case. Test data was only the worst case(QPSK, 256QAM).
- \* In all test cases, the measurement results in the following measurement bands are similar. (30 MHz - 1 GHz, 1 GHz - 10 GHz)

Frequency range	30 MHz - 1 GHz
Modulation	QPSK
Test mode	LTE_Multi Carrier_Middle
Channel bandwidth	5 MHz + 20 MHz

Frequency [MHz]	Pol.	Reading PK [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	EIRP[dBm]	Limit[dBm]	Margin[dB]	Remark
The emissions above 1 GHz were 20 dB lower than the limit.								

Frequency range	1 GHz - 10 GHz
Modulation	QPSK
Test mode	LTE_Multi Carrier_Middle
Channel bandwidth	5 MHz + 20 MHz



Frequency[MHz]	Pol	Reading [dB(mW)]	Space Loss [dB]	Level [dB(mW)]	Limit [dB(mW)]	Margin [dB]
1761.1	V	-35.3	6.2	-29.1	-19	10.1
1761.7	H	-38.6	5.8	-32.8	-19	13.8
2646.1	V	-54.7	10.3	-44.4	-19	25.4
2655.1	H	-58.3	9.7	-48.6	-19	29.6





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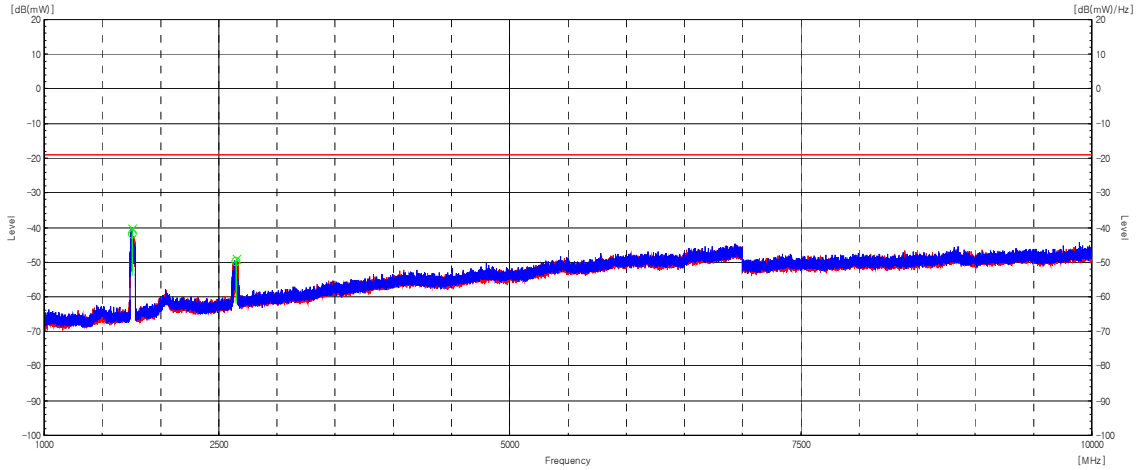
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Frequency range	30 MHz - 1 GHz
Modulation	256QAM
Test mode	LTE_Multi Carrier_Middle
Channel bandwidth	5 MHz + 20 MHz

Frequency [MHz]	Pol.	Reading PK [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	EIRP[dBm]	Limit[dBm]	Margin[dB]	Remark
The emissions above 1 GHz were 20 dB lower than the limit.								

Frequency range	1 GHz - 10 GHz
Modulation	256QAM
Test mode	LTE_Multi Carrier_Middle
Channel bandwidth	5 MHz + 20 MHz



Frequency[MHz]	Pol	Reading [dB(mW)]	Space Loss [dB]	Level [dB(mW)]	Limit [dB(mW)]	Margin [dB]
1756.3	H	-47.6	5.8	-41.8	-19	22.8
1759.9	V	-46.6	6.2	-40.4	-19	21.4
2645.8	H	-59.3	9.6	-49.7	-19	30.7
2650.9	V	-59.3	10.3	-49.0	-19	30.0



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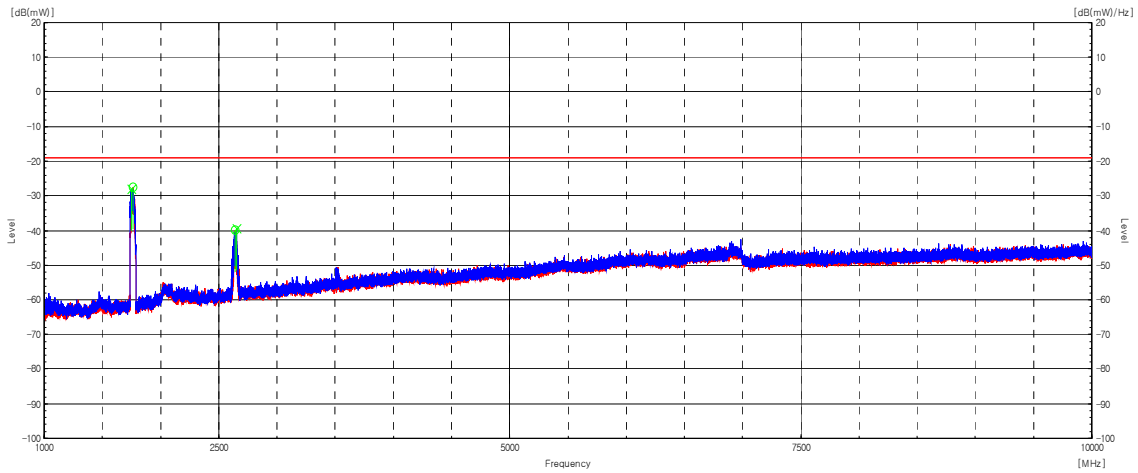
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Frequency range	30 MHz - 1 GHz
Modulation	QPSK
Test mode	5G NR_Multi Carrier_Middle
Channel bandwidth	5 MHz + 20 MHz

Frequency [MHz]	Pol.	Reading PK [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	EIRP[dBm]	Limit[dBm]	Margin[dB]	Remark
The emissions above 1 GHz were 20 dB lower than the limit.								

Frequency range	1 GHz - 10 GHz
Modulation	QPSK
Test mode	5G NR_Multi Carrier_Middle
Channel bandwidth	5 MHz + 20 MHz



Frequency[MHz]	Pol	Reading [dB(mW)]	Space Loss [dB]	Level [dB(mW)]	Limit [dB(mW)]	Margin [dB]
1749.7	V	-34.1	6.2	-27.9	-19	8.9
1764.4	H	-33.4	5.8	-27.6	-19	8.6
2639.8	H	-49.4	9.6	-39.8	-19	20.8
2653.0	V	-49.7	10.3	-39.4	-19	20.4



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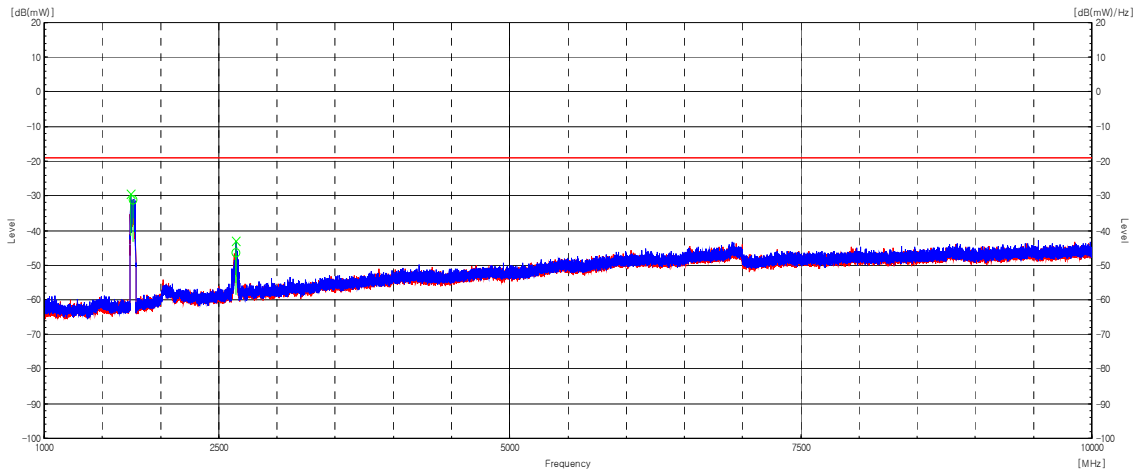
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Frequency range	30 MHz - 1 GHz
Modulation	256QAM
Test mode	5G NR_Multi Carrier_Middle
Channel bandwidth	5 MHz + 20 MHz

Frequency [MHz]	Pol.	Reading PK [dBuV]	c.f [dB(1/m)]	Level PK [dB(uV/m)]	EIRP[dBm]	Limit[dBm]	Margin[dB]	Remark
The emissions above 1 GHz were 20 dB lower than the limit.								

Frequency range	1 GHz - 10 GHz
Modulation	256QAM
Test mode	5G NR_Multi Carrier_Middle
Channel bandwidth	5 MHz + 20 MHz



Frequency[MHz]	Pol	Reading [dB(mW)]	Space Loss [dB]	Level [dB(mW)]	Limit [dB(mW)]	Margin [dB]
1744.0	V	-35.6	6.2	-29.4	-19	10.4
1763.2	H	-37.0	5.8	-31.2	-19	12.2
2647.6	H	-55.9	9.6	-46.3	-19	27.3
2647.9	V	-53.4	10.3	-43.1	-19	24.1

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## 10. 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° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
  - (2) From - 20° to + 50° 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° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.
- (d) 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.

### Test Procedures :

- (a) Device is placed at the Temp & Humidity Chamber. The Temp & Humidity Chamber 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.

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**Test Results : Frequency Stability****Test Data : Single carrier****Test Data at output Antenna Port 1**

Operating frequency	881.5 MHz
Channel bandwidth	LTE Single Carrier 20 MHz
Reference voltage / temperature	-48 Vdc / 20 °C
Modulation type	QPSK

Voltage (%)	Temperature (°C)	Frequency (Hz)	Frequency Error(Hz)	Deviation (Hz)	Frequency Error (ppm)
100	+20(Ref)	881 499 993	-7.2	0.0	0.0000
	-30	881 499 996	-4.5	2.7	0.0031
	-20	881 499 992	-8.1	-0.9	-0.0010
	-10	881 499 991	-9.5	-2.3	-0.0026
	0	881 499 993	-7.1	0.1	0.0002
	+10	881 499 993	-7.3	-0.1	-0.0001
	+30	881 499 992	-7.9	-0.7	-0.0007
	+40	881 499 994	-6.4	0.8	0.0010
	+50	881 499 994	-6.3	0.9	0.0011
115	+20	881 499 993	-6.9	0.3	0.0004
85	+20	881 499 992	-7.9	-0.7	-0.0007

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**Test Data at output Antenna Port 1**

Operating frequency	881.5 MHz
Channel bandwidth	5G NR Single Carrier 20 MHz
Reference voltage / temperature	-48 Vdc / 20 °C
Modulation type	QPSK

Voltage (%)	Temperature (°C)	Frequency (Hz)	Frequency Error(Hz)	Deviation (Hz)	Frequency Error (ppm)
100	+20(Ref)	881 499 993	-7.2	0.0	0.0000
	-30	881 499 992	-8.3	-1.1	-0.0012
	-20	881 499 992	-8.5	-1.3	-0.0015
	-10	881 499 994	-6.4	0.8	0.0009
	0	881 499 992	-7.6	-0.4	-0.0005
	+10	881 499 994	-6.1	1.1	0.0012
	+30	881 499 993	-6.9	0.3	0.0003
	+40	881 499 993	-7.0	0.2	0.0002
	+50	881 499 992	-7.9	-0.7	-0.0008
115	+20	881 499 992	-7.6	-0.4	-0.0005
85	+20	881 499 994	-6.2	1.0	0.0011

**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.

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## APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Due Date
1	MXA Signal Analyzer	Agilent	N9020B	MY57431080	2023-03-28
2	Spectrum Analyzer	R&S	FSV40	101574	2023-01-12
3	EMI TEST RECEIVER	R&S	ESW44	102039	2023-05-04
4	BILOG ANTENNA	TESEQ	CBL6111D	60654	2023-09-03
5	6dB Attenuator	PASTERNAK	PE7AP006-06	L20210504000023	2023-08-10
6	Double Ridged Guide Antenna	ETS-Lindgren	3115	00078894	2022-12-03
7	Double Ridged Guide Antenna	ETS-Lindgren	3115	00078895	2023-04-14
8	AMPLIFIER	SONOMA INSTRUMENT	310N	411011	2023-08-10
9	OPT H64 AMPLIFIER	HP	8447F	3113A06814	2023-01-12
10	PREAMPLIFIER	Agilent	8449B	3008A02307	2023-01-14
11	Signal Generator	R&S	SMB100A	175528	2023-03-25
12	Temp & Humidity Chamber	ESPEC CORP.	EBE-2E20W6P3T-38	3015007507	2023-06-24
13	DC POWER SUPPLY	Agilent	6674A	MY41001477	2023-01-06
14	RF Switch system	INSJOY	RFX0132R	RFS02	2023-10-13
15	RF Coaxial Attenuator	BIRD	300-WA-FFN-30	0204911	2023-01-12
16	RF Coaxial Attenuator	BIRD	300-WA-FFN-30	0205048	2023-01-12
17	RF Coaxial Attenuator	BIRD	300-WA-FFN-30	0204910	2023-01-12
18	RF Coaxial Attenuator	BIRD	300-WA-FFN-30	0205092	2023-01-12
19	ATTENUATOR	DELTAOHM	100W 3 dB	09208032F	2023-03-30