

RF MEASUREMENT REPORT

FCC ID: XMR2022EM060KGL
Application: Quectel Wireless Solutions Company Limited
Product: LTE-A Cat 6 M.2 Module
Model No.: EM060K-GL
Brand Name: Quectel
FCC Rule Part(s): Part 96
Test Procedure(s): ANSI C63.26: 2015
Result: Complies
Test Date: 2022-09-08 ~ 2022-09-16

Reviewed By:

Sunny Sun

Approved By:

Robin Wu



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.26-2015. Test results reported herein relate only to the item(s) tested.

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Revision History

Report No.	Version	Description	Issue Date	Note
2209RSU021-U1	Rev. 01	Initial Report	2022-09-19	Valid

Note: EM060K-GL and EM120K-GL support the same bands, use the same chips, share the same software and hardware design, and the differences are category and DL MIMO. This report is based on FCC ID “XMR2022EM120KGL” to spot check EIRP, Band Edge, Conducted Spurious Emission test items.

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1.4. Product Information

Product Name	LTE-A Cat 6 M.2 Module
Model No.	EM060K-GL
Brand Name	Quectel
IMEI	867228050009702
UTRA Specification	Band 2, 4, 5
E-UTRA Specification	FDD Band: 2, 4, 5, 7, 12, 13, 14, 17, 25, 26, 30, 66, 71 TDD Band: 38, 41, 46, 48
GNSS Specification	GPS, GLONASS, Bei Dou, Galileo
Supply Voltage	3.135 ~ 4.4Vdc, typical 3.7Vdc
Operating Temperature:	-25 ~ 75 °C
Remark: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.	

1.5. Radio Specification

TDD Tx & Rx Frequency Range	Band 48: 3550 ~ 3700 MHz
Modulation	UL up to 16QAM, DL up to 64QAM
Device Type	End User Device

1.6. Description of Available Antennas

Technology	Frequency Range (MHz)	Antenna Type	MaxPeak Gain (dBi)
LTE Band 48	3550 ~ 3700	Dipole	-4.29

Note: The typical antennas use to calculate the ERP (EIRP).

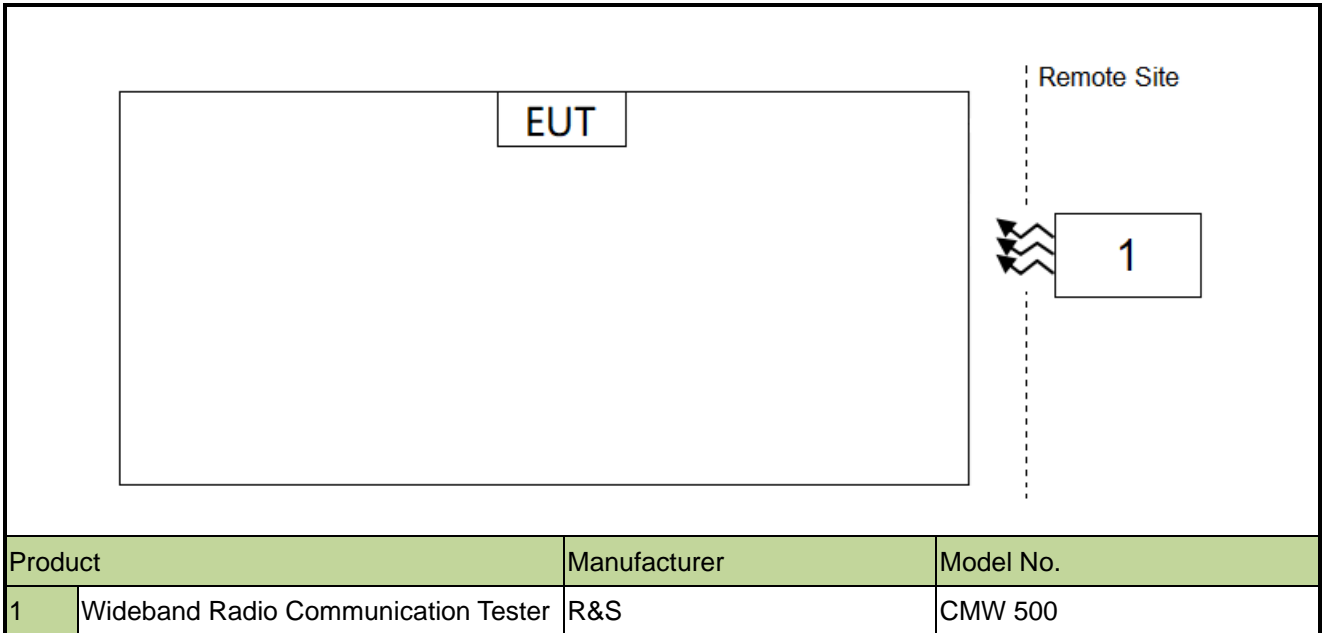
1.7. Test Methodology

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ANSI C63.26:2015
- FCC CFR 47 Part Part 96
- FCC KDB 971168 D01 v03r01: Power Meas License Digital Systems
- FCC KDB 971168 D02 v02r01: Misc Rev Approv License Devices
- FCC KDB 412172 D01 v01r01: Determining ERP and EIRP
- WINNF-TS-0122 V1.0.0: Test and Certification for Citizens Broadband Radio Service (CBRS);
Conformance and Performance Test Technical Specification; CBSD/DP as Unit Under Test (UUT)

2. Test Configuration

2.1. Test System Connection Diagram



2.2. Test Environment Condition

Ambient Temperature	15 ~ 35°C
Relative Humidity	20% ~ 75%RH

3. Measuring Instrument

Instrument	Manufacturer	Model No.	Asset No.	Cali. Interval	Cali. Due Date	Test Site
Thermohygrometer	testo	608-H1	MRTSUE06362	1 year	2023-02-15	WZ-SR6
Shielding Room	HUAMING	WZ-SR6	MRTSUE06443	N/A	N/A	WZ-SR6
Signal Analyzer	Keysight	N9020B	MRTSUE06583	1 year	2022-10-10	WZ-SR6
Signal Generator	Keysight	N5173B	MRTSUE06606	1 year	2022-11-29	WZ-SR6
5G Wireless Test Platform	Keysight	E7515B	MRTSUE06942	1 year	2023-03-03	WZ-SR6
Radio Communication Analyzer	Anritsu	MT8821C	MRTSUE06960	1 year	2023-07-08	WZ-SR6

Software	Version	Function
EMI Software	V3.0.0	EMI Test Software

4. Decision Rules and Measurement Uncertainty

4.1. Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.2. Measurement Uncertainty

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

Radiated Spurious Emissions
Measurement Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): Horizontal: 9kHz ~ 300MHz: 5.04dB 300MHz ~ 1GHz: 4.95dB 1GHz ~ 40GHz: 6.40dB Vertical: 9kHz ~ 300MHz: 5.24dB 300MHz ~ 1GHz: 6.03dB 1GHz ~ 40GHz: 6.40dB
Conducted Spurious Emissions
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.78dB
Output Power
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.13dB
Occupied Bandwidth
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.28%
Frequency Stability
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 76.2Hz

5. Test Result

5.1. Summary

FCC Part Section(s)	Test Description	Test Condition	Verdict
96.41(b)	Equivalent Isotropic Radiated Power	Conducted	Pass
2.105196.41(e)	Spurious Emissions; Band Edge Emissions		Pass

Notes:

- 1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 2) Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations the worst-case was found.
- 3) All supported modulation types were evaluated. The worst-case emission of modulation was selected. Therefore, Band Edge & Conducted Spurious Emission were presented worst case in the test report.

5.2. Equivalent Isotropically Radiated Power Measurement

5.2.1. Test Limit

The maximum effective isotropic radiated power (EIRP) End User Device is 23dBm/10MHz

5.2.2. Test Procedure

ANSI C63.26-2015 - Section 5.2.4.4.2 & 5.2.5.5

5.2.3. Test Setting

When the fundamental condition for average power measurements cannot be realized (i.e., the EUT can not be configured to transmit at full-power on a continuous basis (i.e., duty cycle < 98%) and the instrumentation cannot be configured to measure only during active full-power transmissions), then the following procedure can be used if the EUT duty cycle is constant (i.e., duty cycle variations are less than or equal to $\pm 2\%$).

- a) Set span to 2 × to 3 × the OBW.
- b) Set RBW = 1% to 5% of the OBW.
- c) Set VBW $\geq 3 \times$ RBW.
- d) Set number of measurement points in sweep $\geq 2 \times$ span / RBW.
- e) Sweep time:
 - 1) Set = auto-couple, or
 - 2) Set $\geq [10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ for single sweep (automation-compatible) measurement.
- f) Detector = power averaging (rms).
- g) Set sweep trigger to “free run.”
- h) Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.
- i) Using the marker function to identify the maximum PSD.
- j) Add $10 \log (1/\text{duty cycle})$ to the measured power level to compute the average power during continuous transmission. For example, add $[10 \log (1/0.25)] = 6 \text{ dB}$ if the duty cycle is a constant 25%.

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation (1) as follows:

$$\text{ERP or EIRP} = P_{\text{Meas}} + G_T \quad (1)$$

where

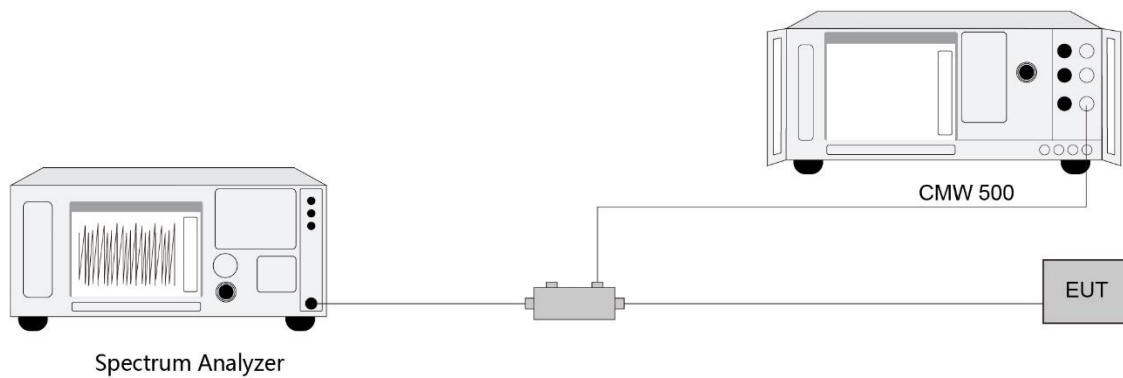
ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Meas} , e.g., dBm or dBW)

P_{Meas} measured transmitter output power or PSD, in dBm or dBW

G_T gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

For devices utilizing multiple antennas, see 6.4 for guidance with respect to determining the effective array transmit antenna gain term to be used in the above equation.

5.2.4. Test Setup



5.2.5. Test Result

Refer to Appendix A.1.

5.3. Band Edge Measurement

5.3.1. Test Limit

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 maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated, and the worst-case configuration results are reported in this section.

The conducted power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0-10 megahertz above the upper SAS-assigned channel edge and within 0-10 megahertz below the lower SAS-assigned channel edge. At all frequencies greater than 10 megahertz above the upper SAS assigned channel edge and less than 10 MHz below the lower SAS assigned channel edge, the conducted power of any emission shall not exceed -25 dBm/MHz. The conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40 dBm/MHz.

5.3.2. Test Procedure

ANSI C63.26-2015 - Section 5.7

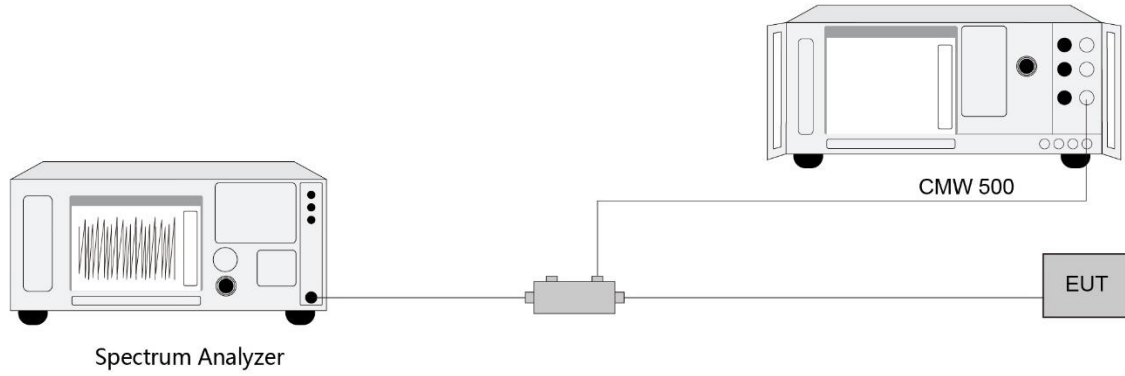
5.3.3. Test Setting

1. Set the analyzer frequency to low, middle, high channel.
2. $RBW \geq$ The nominal RBW shall be in the range of 1% of the anticipated OBW (in the 1MHz band immediately outside and adjacent to the band edge). For improvement of the accuracy in the measurement of the average power of a noise-like emission, a RBW narrower than the specified reference bandwidth can be used (generally limited to no less than 1% of the OBW), provided that a subsequent integration is performed over the full required measurement bandwidth. This integration should be performed using the spectrum analyzer's band power functions.
3. $VBW \geq 3*RBW$
4. Sweep time = auto
5. Detector = power averaging (rms)
6. Set sweep trigger to "free run."
7. User gate triggered such that the analyzer only sweeps when the device is transmitting at full power
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time,

increase the sweep time.

- 9. Used power integration when using a measurement bandwidth smaller than the specified bandwidth.

5.3.4. Test Setup



5.3.5. Test Result

Refer to Appendix A.2.

5.4. Conducted Spurious Emissions Measurement

5.4.1. Test Limit

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. 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 maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. All modes of operation were investigated, and the worst-case configuration results are reported in this section.

The conducted power of any emissions below 3530MHz or above 3720MHz shall not exceed -40dBm/MHz.

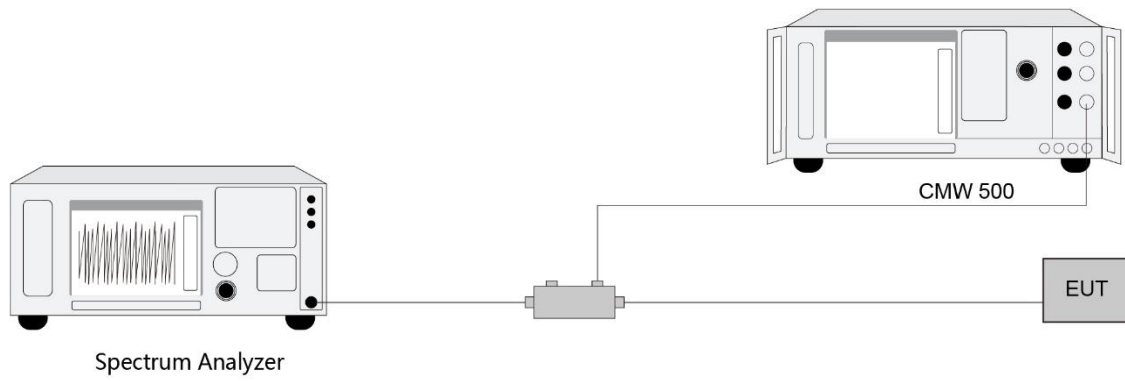
5.4.2. Test Procedure

ANSI C63.26-2015 - Section 5.7

5.4.3. Test Setting

1. Set the analyzer frequency to low, mid, high channel.
2. RBW = 1MHz
3. VBW \geq 3*RBW
4. Sweep time = auto
5. Detector = power averaging (rms)
6. Set sweep trigger to "free run."
7. User gate triggered such that the analyzer only sweeps when the device is transmitting at full power.
8. Trace average at least 100 traces in power averaging (rms) mode if sweep is set to auto-couple. To accurately determine the average power over the on and off time of the transmitter, it can be necessary to increase the number of traces to be averaged above 100, or if using a manually configured sweep time, increase the sweep time.

5.4.4. Test Setup



5.4.5. Test Result

Refer to Appendix A.3.

Appendix A - Test Result

A.1 Equivalent Isotropically Radiated Power Test Result

Test Site	WZ-SR6	Test Engineer	Cloud Guo
Test Date	2022/09/07 ~ 2022/09/08	Test Band	Band 48

Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm/10MHz)	EIRP (dBm/10MHz)	Limit (dBm/10MHz)
QPSK						
3552.5	5	1	0	23.71	19.42	<23.00
3625.0				24.27	19.98	<23.00
3697.5				24.32	20.03	<23.00
3552.5	5	1	12	23.14	18.85	<23.00
3625.0				23.46	19.17	<23.00
3697.5				23.54	19.25	<23.00
3552.5	5	1	24	23.19	18.90	<23.00
3625.0				23.70	19.41	<23.00
3697.5				23.84	19.55	<23.00
3552.5	5	25	0	22.30	18.01	<23.00
3625.0				22.55	18.26	<23.00
3697.5				22.66	18.37	<23.00
3555.0	10	1	0	23.11	18.82	<23.00
3625.0				22.94	18.65	<23.00
3695.0				22.99	18.70	<23.00
3555.0	10	1	24	23.40	19.11	<23.00
3625.0				23.24	18.95	<23.00
3695.0				23.35	19.06	<23.00
3555.0	10	1	49	23.47	19.18	<23.00
3625.0				23.30	19.01	<23.00
3695.0				23.34	19.05	<23.00
3555.0	10	50	0	22.71	18.42	<23.00
3625.0				22.60	18.31	<23.00
3695.0				22.62	18.33	<23.00

Note: The EIRP (dBm/10MHz) = Output Power (dBm/10MHz) + Antenna Gain (dBi)

Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm/10MHz)	EIRP (dBm/10MHz)	Limit (dBm/10MHz)
QPSK						
3557.5	15	1	0	23.66	19.37	<23.00
3625.0				23.53	19.24	<23.00
3692.5				24.11	19.82	<23.00
3557.5	15	1	37	23.77	19.48	<23.00
3625.0				23.67	19.38	<23.00
3692.5				23.31	19.02	<23.00
3557.5	15	1	74	23.42	19.13	<23.00
3625.0				23.26	18.97	<23.00
3692.5				23.82	19.53	<23.00
3557.5	15	75	0	21.51	17.22	<23.00
3625.0				21.45	17.16	<23.00
3692.5				21.48	17.19	<23.00
3560.0	20	1	0	23.85	19.56	<23.00
3625.0				23.78	19.49	<23.00
3690.0				23.95	19.66	<23.00
3560.0	20	1	50	23.36	19.07	<23.00
3625.0				23.24	18.95	<23.00
3690.0				23.41	19.12	<23.00
3560.0	20	1	99	23.78	19.49	<23.00
3625.0				23.59	19.30	<23.00
3690.0				23.61	19.32	<23.00
3560.0	20	100	0	20.43	16.14	<23.00
3625.0				20.27	15.98	<23.00
3690.0				20.37	16.08	<23.00

Note: The EIRP (dBm/10MHz) = Output Power (dBm/10MHz) + Antenna Gain (dBi)

Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	EIRP (dBm/ dBm)	Limit (dBm/ dBm)
QPSK						
3552.5	5	1	0	23.22	18.93	N/A
3625.0				23.45	19.16	N/A
3697.5				23.55	19.26	N/A
3552.5	5	1	12	23.20	18.91	N/A
3625.0				23.33	19.04	N/A
3697.5				23.52	19.23	N/A
3552.5	5	1	24	23.26	18.97	N/A
3625.0				23.34	19.05	N/A
3697.5				23.56	19.27	N/A
3552.5	5	25	0	22.30	18.01	N/A
3625.0				22.43	18.14	N/A
3697.5				22.72	18.43	N/A
3555.0	10	1	0	23.33	19.04	N/A
3625.0				23.31	19.02	N/A
3695.0				23.67	19.38	N/A
3555.0	10	1	24	23.28	18.99	N/A
3625.0				23.25	18.96	N/A
3695.0				23.53	19.24	N/A
3555.0	10	1	49	23.30	19.01	N/A
3625.0				23.32	19.03	N/A
3695.0				23.52	19.23	N/A
3555.0	10	50	0	22.36	18.07	N/A
3625.0				22.55	18.26	N/A
3695.0				22.71	18.42	N/A

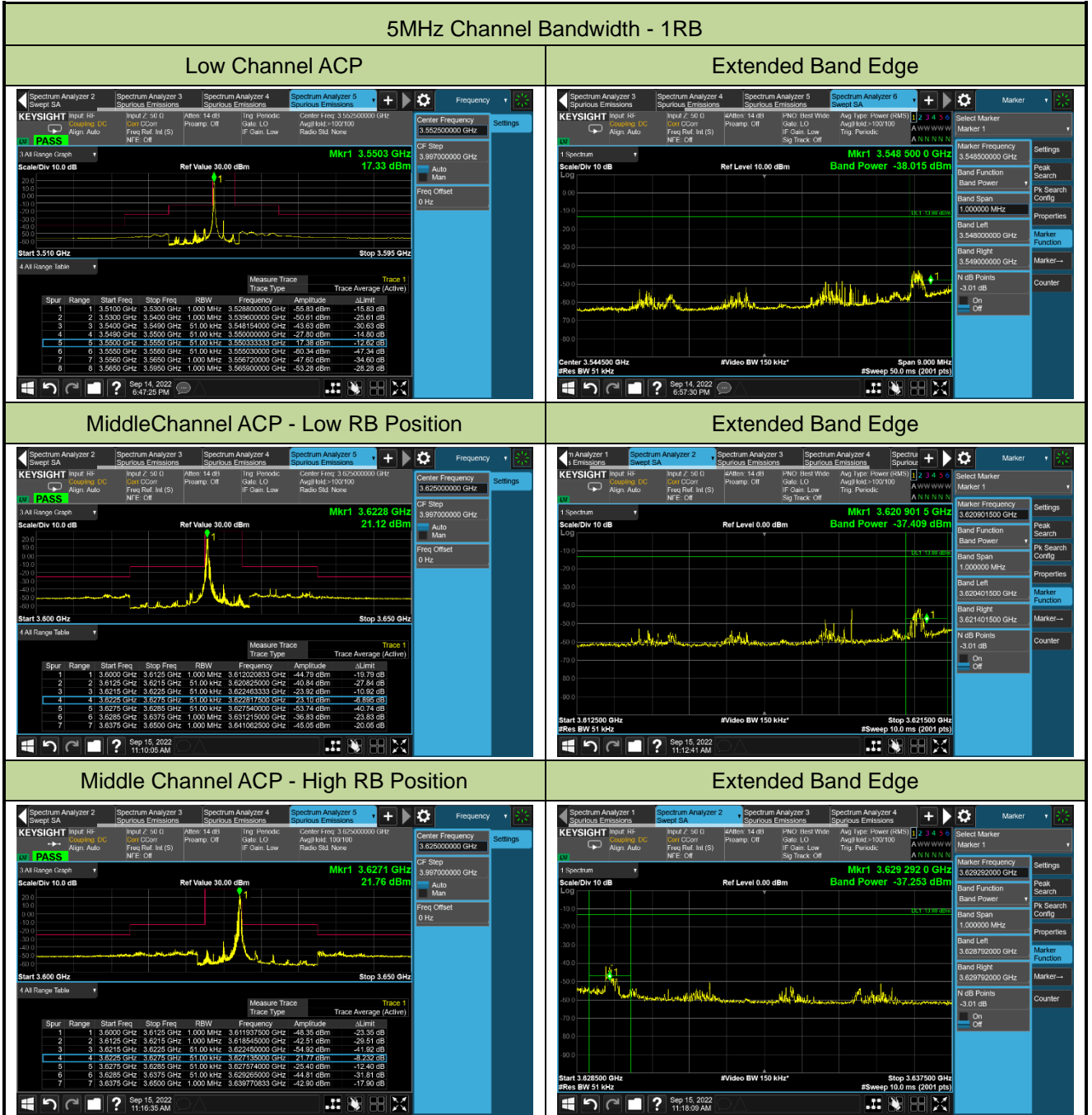
Note: The EIRP (dBm) = Output Power (dBm) + Antenna Gain (dBi)

Frequency (MHz)	Channel Bandwidth (MHz)	RB Size	RB Offset	Output Power (dBm)	EIRP (dBm/ dBm)	Limit (dBm/ dBm)
QPSK						
3557.5	15	1	0	23.31	19.02	N/A
3625.0				23.48	19.19	N/A
3692.5				23.56	19.27	N/A
3557.5	15	1	37	23.33	19.04	N/A
3625.0				23.30	19.01	N/A
3692.5				23.48	19.19	N/A
3557.5	15	1	74	23.43	19.14	N/A
3625.0				23.44	19.15	N/A
3692.5				23.70	19.41	N/A
3557.5	15	75	0	22.34	18.05	N/A
3625.0				22.45	18.16	N/A
3692.5				22.68	18.39	N/A
3560.0	20	1	0	23.38	19.09	N/A
3625.0				23.50	19.21	N/A
3690.0				23.64	19.35	N/A
3560.0	20	1	50	23.32	19.03	N/A
3625.0				23.29	19.00	N/A
3690.0				23.51	19.22	N/A
3560.0	20	1	99	23.43	19.14	N/A
3625.0				23.34	19.05	N/A
3690.0				23.56	19.27	N/A
3560.0	20	100	0	22.38	18.09	N/A
3625.0				22.48	18.19	N/A
3690.0				22.70	18.41	N/A

Note: The EIRP (dBm) = Output Power (dBm) + Antenna Gain (dBi)

A.2 Band Edge Test Result

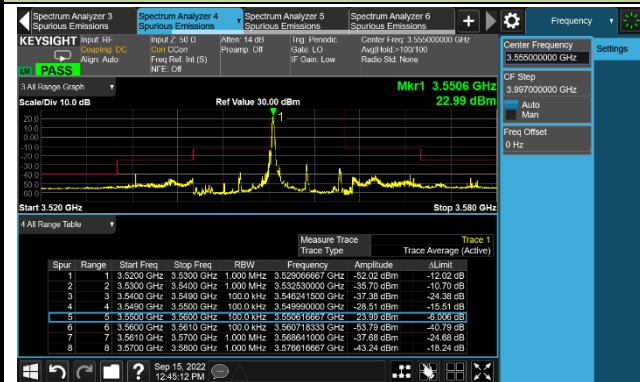
Test Site	WZ-SR6	Test Engineer	Cloud Guo
Test Date	2022/09/14 ~ 2022/09/16	Test Band	Band 48



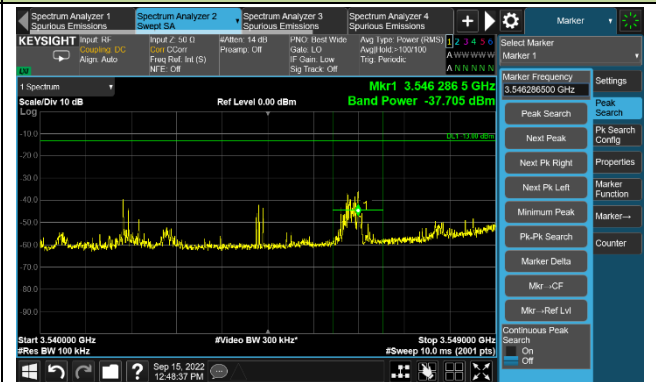


10MHz Channel Bandwidth - 1RB

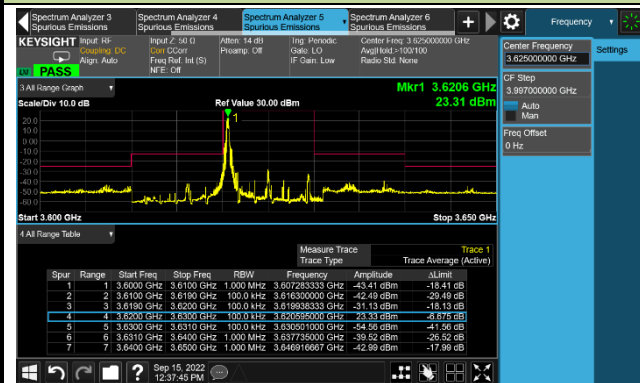
Low Channel ACP



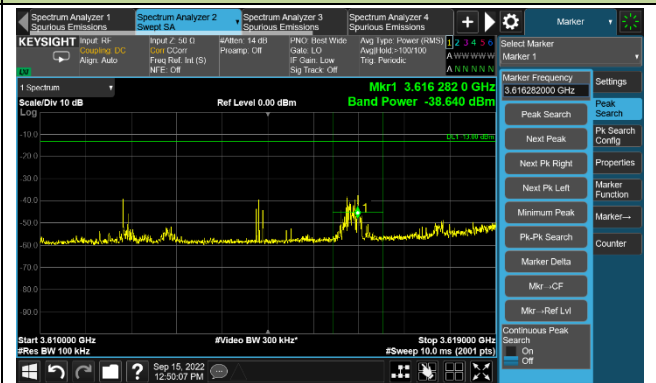
Extended Band Edge



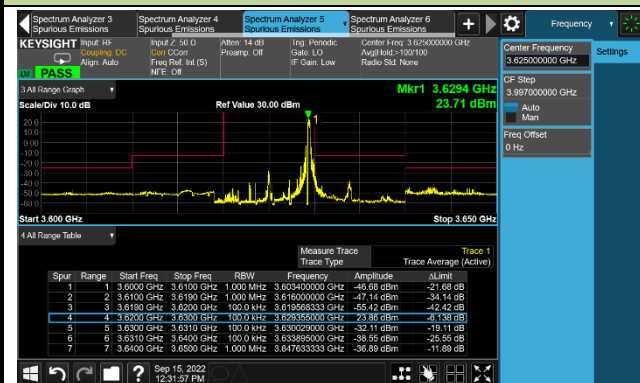
MiddleChannel ACP - Low RB Position



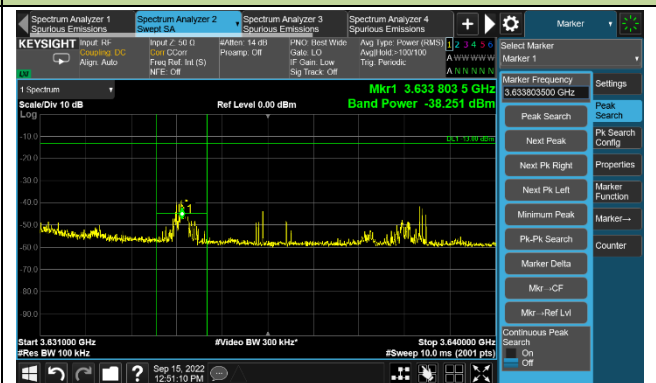
Extended Band Edge



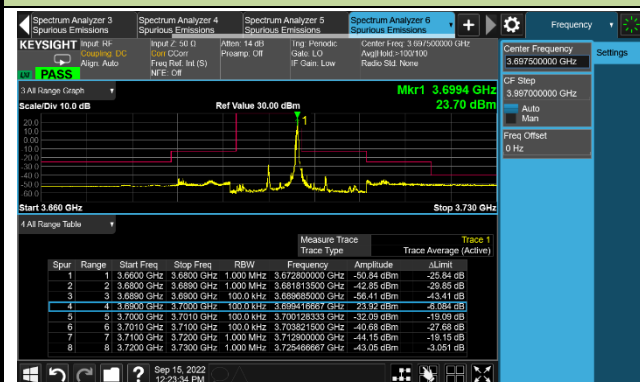
MiddleChannel ACP - High RB Position



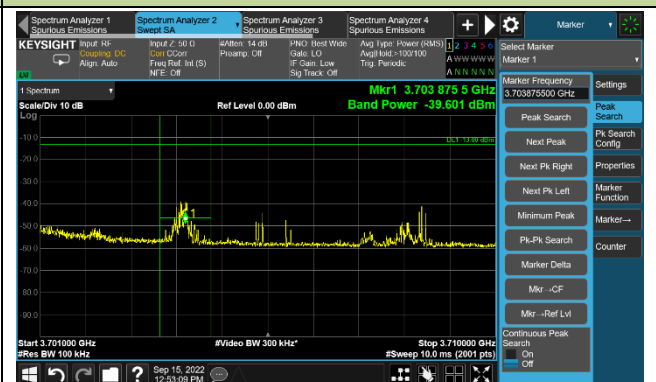
Extended Band Edge



High Channel ACP

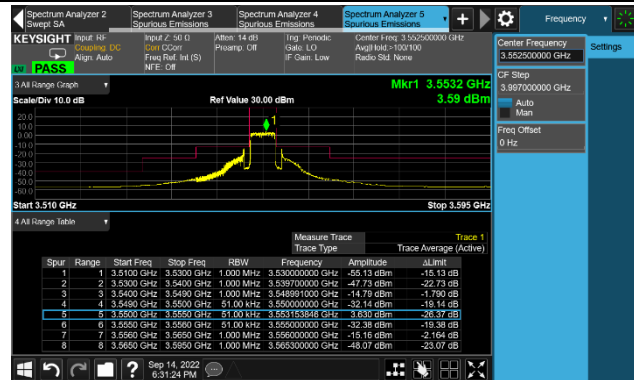


Extended Band Edge

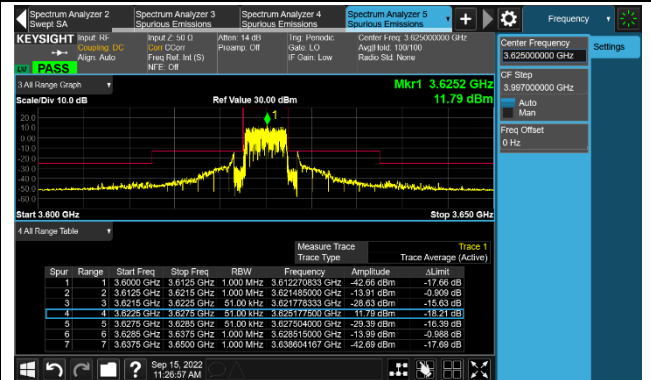


5MHz Channel Bandwidth - Full RB

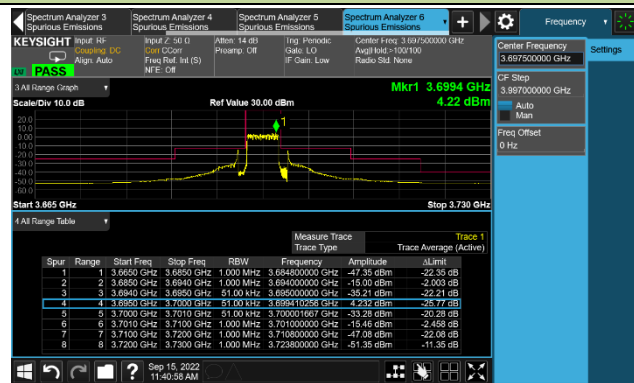
Low Channel ACP



Middle Channel ACP

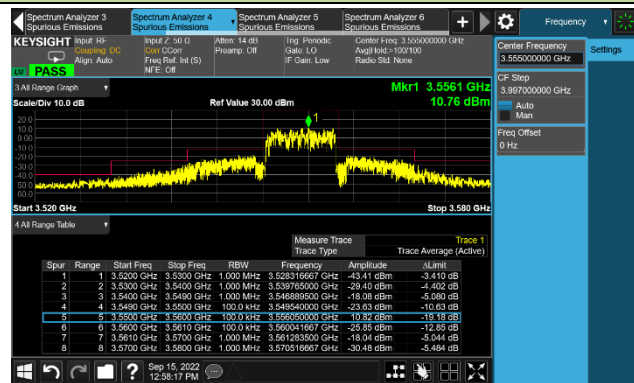


High Channel ACP

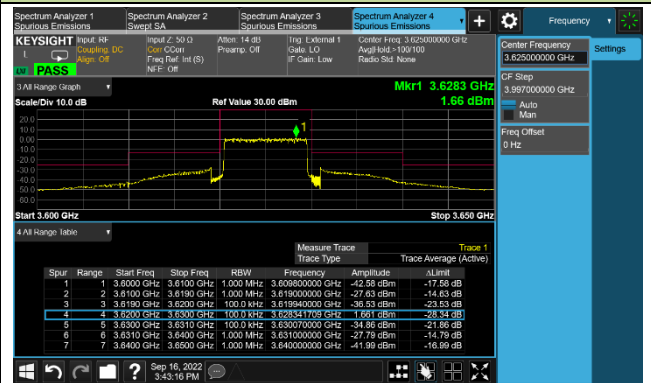


10MHz Channel Bandwidth - Full RB

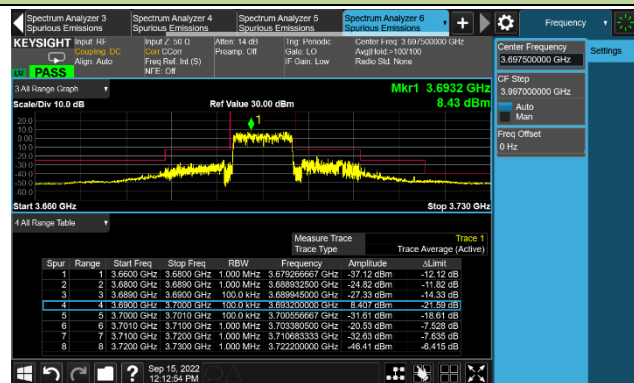
Low Channel ACP



Middle Channel ACP

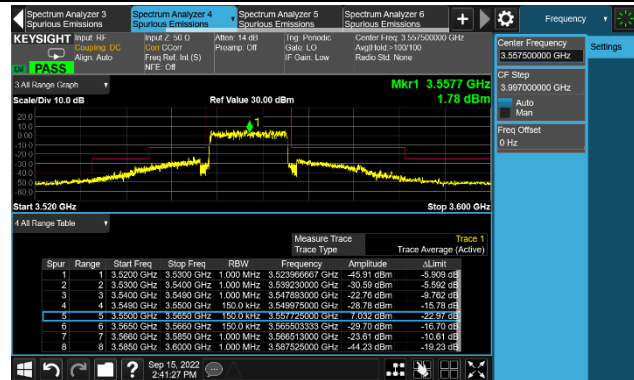


High Channel ACP

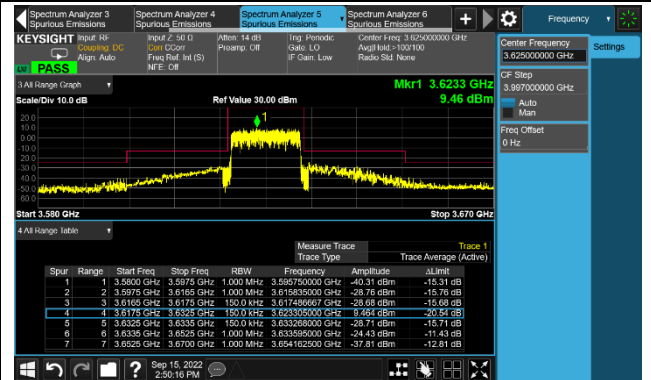


15MHz Channel Bandwidth - Full RB

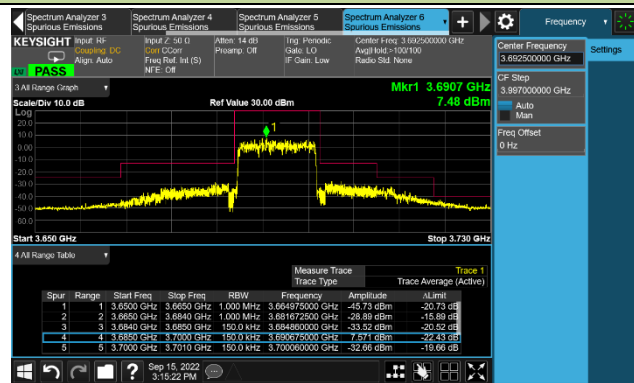
Low Channel ACP



Middle Channel ACP

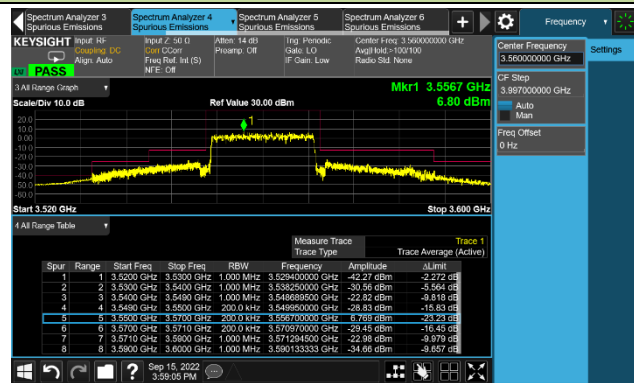


High Channel ACP

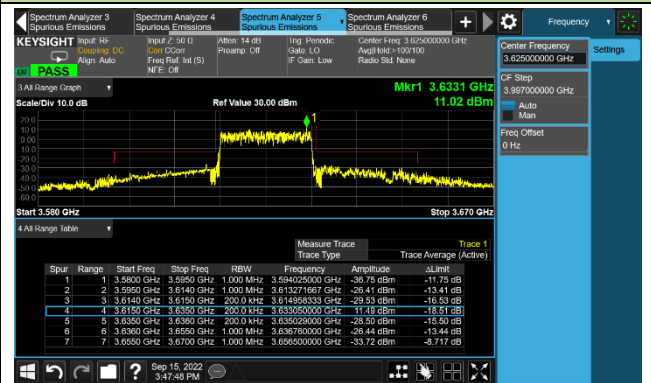


20MHz Channel Bandwidth - Full RB

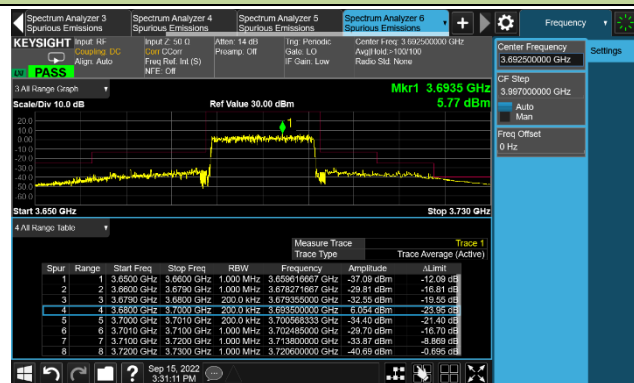
Low Channel ACP



Middle Channel ACP



High Channel ACP



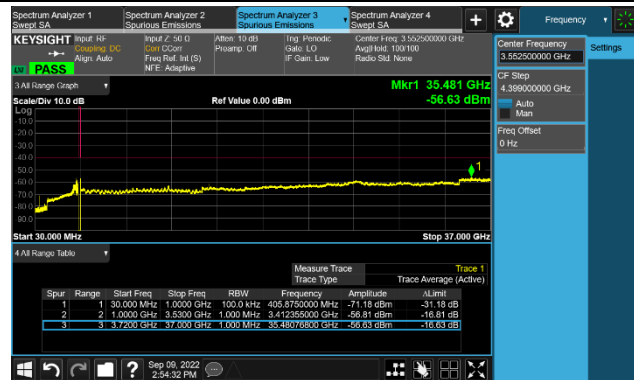
A.3 Conducted Spurious Emissions Test Result

Test Site	WZ-SR6	Test Engineer	Cloud Guo
Test Date	2022/09/09	Test Band	Band 48

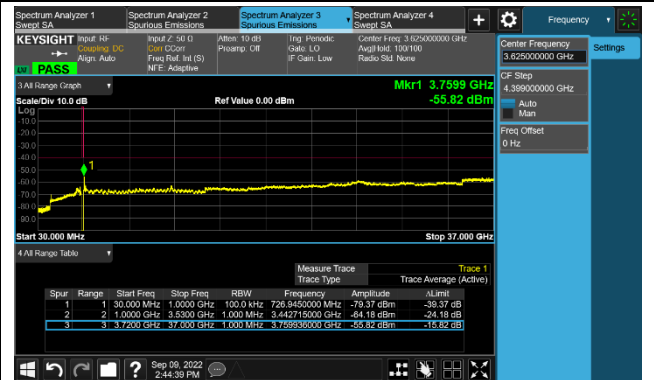
Frequency (MHz)	Channel Bandwidth (MHz)	Frequency Range (MHz)	Max Spurious Emissions (dBm/MHz)	Limit (dBm/MHz)	Result
QPSK					
3552.5	5	30 ~ 37000	-56.63	≤ -40.00	Pass
3625.0	5	30 ~ 37000	-55.82	≤ -40.00	Pass
3697.5	5	30 ~ 37000	-56.23	≤ -40.00	Pass
3555.0	10	30 ~ 37000	-44.22	≤ -40.00	Pass
3625.0	10	30 ~ 37000	-42.53	≤ -40.00	Pass
3695.0	10	30 ~ 37000	-49.72	≤ -40.00	Pass
3557.5	15	30 ~ 37000	-47.62	≤ -40.00	Pass
3625.0	15	30 ~ 37000	-46.71	≤ -40.00	Pass
3692.5	15	30 ~ 37000	-49.27	≤ -40.00	Pass
3550.0	20	30 ~ 37000	-44.47	≤ -40.00	Pass
3625.0	20	30 ~ 37000	-43.76	≤ -40.00	Pass
3690.0	20	30 ~ 37000	-56.19	≤ -40.00	Pass

5MHz Channel Bandwidth

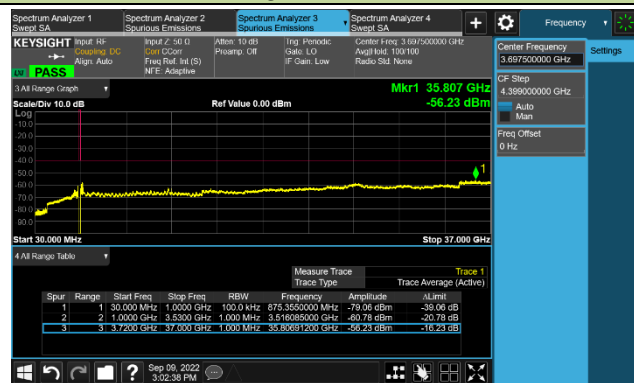
Low Channel



Middle Channel

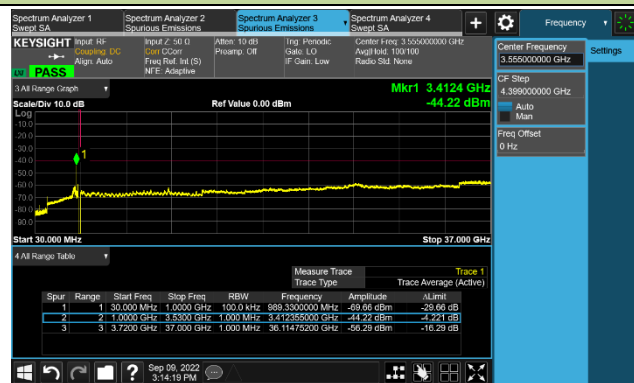


High Channel

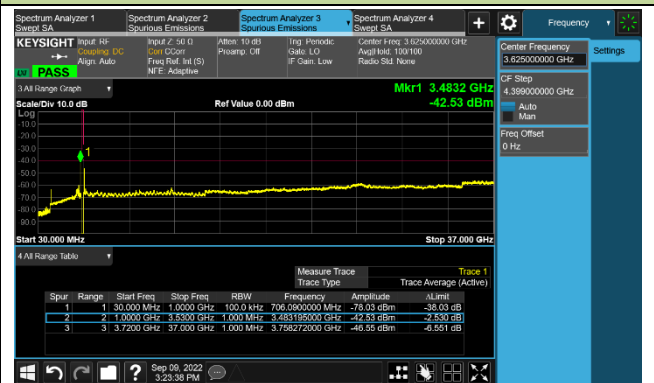


10MHz Channel Bandwidth

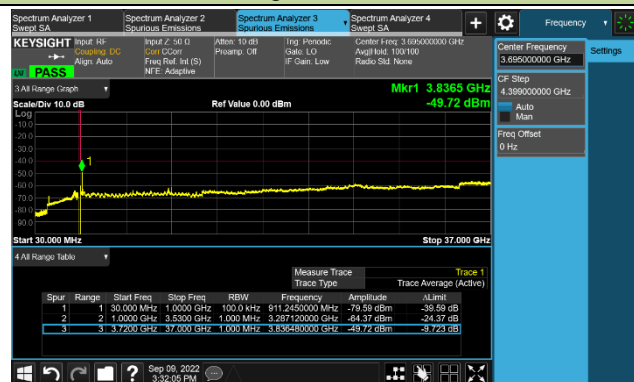
Low Channel



Middle Channel



High Channel





Appendix B - Test Setup Photograph

Refer to "2209RSU021-UT" file.

Appendix C - EUT Photograph

Refer to "2209RSU021-UE" file.