SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch

TEST REPORT

Application No.:	ZEWA2310000147RG
Applicant:	Quectel Wireless Solutions Co., Ltd.
Address of Applicant:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Manufacturer:	Quectel Wireless Solutions Co., Ltd.
Address of Manufacturer:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
EUT Description:	5G Sub-6 GHz M.2 Module
Model No.:	RM520N-GL
Trade Mark:	Quectel
FCC ID:	XMR2023RM520NGL
Standards:	47 CFR Part 2 47 CFR Part 96
Date of Receipt:	2022/05/15 (for report FYCR220600021102) 2023/04/19 (for report ZEWM2306000841RG02) 2023/09/26 (for report ZEWA2310000147RG02)
Date of Test:	2022/05/22 to 2022/07/22 (for report FYCR220600021102) 2023/05/09 to 2023/06/19 (for report ZEWM2306000841RG02) 2023/10/04 to 2023/10/30 (for report ZEWA2310000147RG02)
Date of Issue:	2023/10/31
Test Result :	**PASS ***

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Authorized Signature:

Keny Xu
Laboratory Manager

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1 Version

Revision Record				
Version	***Chapter***	***Date***	***Modifier***	***Remark***
01		2023/10/31		Original

Prepared By	Jack Huang **(Jack Huang) / Test Engineer**
Checked By	Flora Wang **(Flora Wang) / Reviewer**

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2 Test Summary

2.1 NR Band n48

3550-3700MHz:

Test Item	FCC Rule No.	Requirements	Test Result	Verdict
Effective (Isotropic) Radiated Power Output Data	§2.1046, §96.41	EIRP ≤ 23dBm/10MHz	Section 1 of Appendix B.50	Pass
Peak-Average Ratio	§96.41	FCC: Limit≤13 dB	Section 2 of Appendix B.50	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Section 3 of Appendix B.50	Pass
Adjacent Channel Leakage Ratio	§96.41	the Adjacent Channel Leakage Ratio for End User Devices shall be at least 30 dB.	Section 4 of Appendix B.50	Pass
Band Edges Compliance	§2.1051, §96.41	for channel and frequency assignments made by a CBSD to End User Devices, the conducted power of any End User Device emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0 to B megahertz (where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B megahertz below the lower CBSD-assigned channel edge.	Section 5 of Appendix B.50	Pass
Spurious Emission at Antenna Terminals	§2.1051, §96.41	for channel and frequency assignments made by a CBSD to End User Devices, the conducted power of any End User Device emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0 to B megahertz (where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B megahertz below the lower CBSD-assigned channel edge. At all frequencies greater than B megahertz above the upper CBSD assigned channel edge and less than B megahertz below the lower CBSD-assigned channel edge, the conducted	Section 6 of Appendix B.50	Pass

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		power of any End User Device emission shall not exceed −25 dBm/MHz. (2) Additional protection levels. Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.		
Field Strength of Spurious Radiation	§2.1053, §96.41	for channel and frequency assignments made by a CBSD to End User Devices, the conducted power of any End User Device emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed −13 dBm/MHz within 0 to B megahertz (where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B megahertz below the lower CBSD-assigned channel edge. At all frequencies greater than B megahertz above the upper CBSD assigned channel edge and less than B megahertz below the lower CBSD-assigned channel edge, the conducted power of any End User Device emission shall not exceed −25 dBm/MHz. (2) Additional protection levels. Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.	Section 7 of Appendix B.50	Pass
Frequency Stability	§2.1055, §96.41	Within authorized bands of operation/ frequency block.	Section 8 of Appendix B.50	Pass

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Remark for report ZEWM2306000841RG02 issue on 2023/06/21:
This test report (Report No.: ZEWM2306000841RG02 issue on 2023/06/21) is based on the original test report (Report No.: FYCR220600021102 issue on 2022/08/29).
Review this report and original report, this report just changing the parts according to the declaration letter from client.
Considering to the difference, pre-scan were performed on the sample in this report to find the items which can be influential to the result in the original test report for fully retest.
The Effective (Isotropic) Radiated Power Output Data were fully tested in this report, and other items data please refer to the test report FYCR220600021102. The FCC ID is XMR2022RM520NGL has been certified, and the test report issued by Compliance Certification Services（Kunshan）Inc. Shenzhen branch. on 2022/08/29.

Remark for report ZEWA2310000147RG02 issue on 2023/10/31:
This test report (Report No.: ZEWA2310000147RG02 issue on 2023/10/31) is based on the original test report (Report No.: ZEWM2306000841RG02 issue on 2023/06/21).
Review this report and original report, this report just changing the parts according to the declaration letter from client.
Considering to the difference, pre-scan were performed on the sample in this report to find the items which can be influential to the result in the original test report for fully retest.
Therefore in this report the Field Strength of Spurious Radiation of NR Band n48, Power of NR Band n48(SA&MIMO) and all items of NR Band n48(SA&MIMO) 30MHz were tested, and other test data in this report are based on the previous report with report number ZEWM2306000841RG02 issue on 2023/06/21.

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3 General Information

3.1 Details of Client

Applicant:	Quectel Wireless Solutions Co., Ltd.
Address of Applicant:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233
Manufacturer:	Quectel Wireless Solutions Co., Ltd.
Address of Manufacturer:	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

3.2 Test Location

Company:	SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch
Address:	No. 1 Workshop, M-10, Middle section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China
Post code:	518057
Test engineer:	Jinhua Wei

3.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

- **VCCI**

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

- **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

- **FCC –Designation Number: CN1336**

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch has been recognized as an accredited testing laboratory.

Designation Number: CN1336.

Test Firm Registration Number: 787754

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3.4 General Description of EUT

EUT Description:	5G Sub-6 GHz M.2 Module		
Model No.:	RM520N-GL		
Trade Mark:	Quectel		
Hardware Version:	R1.0		
Software Version:	RM520NGLAAR03A01M4G		
Power Supply:	DC 3.7V		
IMEI:	RF Conducted	868371050414016	
	RSE	868371050432802	
Feature:	UL 2*2 MIMO: NR Band n48		
Antenna Type:	PIFA Antenna		
Antenna Gain:	NR Band n48:	1dBi (Ant0)	1dBi (Ant2)
	Note: The antenna gain are derived from the gain information report provided by the manufacturer.		
RF Cable:	9kHz ~ 30MHz (0.3dB)	30MHz ~ 1000MHz (0.6dB)	1000MHz ~ 2000MHz (0.8dB)
	2000MHz ~ 4000MHz (1.1dB)	4000MHz ~ 6000MHz (1.8dB)	6000MHz ~ 12750MHz (2.6dB)
	Above 12750MHz (3.5dB)		
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MIMO Model:

FCC KDB 662911 D01 Multiple Transmitter Output v02r01
If all antennas have the same gain, G_{ANT}, Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

- For power measurements on IEEE 802.11 devices:
  Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
  Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};
  Array Gain = 5 log(N_{ANT}/N_{SS}=1) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

Unequal antenna gains, with equal transmit powers. For antenna gains given by G1, G2, …, GN dBi

- If transmit signals are correlated, then
  Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]
- If all transmit signals are completely uncorrelated, then
  Directional gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10})/N_{ANT}]$ dBi

Band	ANT Gain0 (dBi)	ANT Gain2 (dBi)	Directional gain (dBi)
NR Band n48:	1	1	1

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3.5 Test Mode

Test Mode	Test Modes Description
NR/TM1	NR system, DFT-s-Pi/2-BPSK modulation
NR/TM2	NR system, DFT-s-QPSK modulation
NR/TM3	NR system, DFT-s-16QAM modulation
NR/TM4	NR system, DFT-s-64QAM modulation
NR/TM5	NR system, DFT-s-256QAM modulation
NR/TM6	NR system, CP-QPSK modulation
NR/TM7	NR system, CP-16QAM modulation
NR/TM8	NR system, CP-64QAM modulation
NR/TM9	NR system, CP-256QAM modulation
Remark: The test mode(s) are selected according to relevant radio technology specifications.	

3.6 Test Environment

Environment Parameter	101.0 kPa Selected Values During Tests	
Relative Humidity	44-46 % RH Ambient	
Value	Temperature(℃)	Voltage(V)
NTNV	22-23	3.7
LTLV	-30	3.135
LTHV	-30	4.4
HTLV	50	3.135
HTHV	50	4.4
Remark: NV: Normal Voltage LV: Low Extreme Test Voltage HV: High Extreme Test Voltage NT: Normal Temperature LT: Low Extreme Test Temperature HT: High Extreme Test Temperature		

3.7 Description of Support Units

Description	Manufacturer	Model No.
Test auxiliary PCB board	Quectel	N/A
Remark: all above the information of table are provided by client.		

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3.8 Technical Specification

Characteristics	Description			
Radio System Type	☒ SA ☒ NSA			
Supported Frequency Range	Band	TX	RX	
	NR Band n48	3550 to 3700 MHz	3550 to 3700 MHz	
	NR CA: n48A-n66A;n2A-n48A;n5A-n48A;n48A-n70A;n48A-n71A;n25A-n48A; ENDC: DC_2A_n48A;DC_5A_n48A;DC_13A_n48A;DC_66A_n48A; DC_48A_n5A; DC_48A_n66A; DC_48A_n25A; DC_48A_n71A; DC_48A_n12A;			
Supported Channel Bandwidth	NR Band n48 (3550-3700)	SCS 30kHz:		
		☒10 MHz	☒20 MHz	☒30 MHz ☒40 MHz
Designation of Emissions (Remark: the necessary bandwidth of which is the worst value from the measured occupied bandwidths for each type of channel bandwidth configuration.)	NR Band n48 (3550-3700)	DFT-s-Pi/2-BPSK	CP-16QAM	
		SCS 30kHz:		
		26M8G7D	27M8W7D	

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3.9 Test Frequencies

3.9.1 Reference test frequencies for NR operating band n48

3.9.1.1 Test frequencies for NR operating band n48 and SCS 30 kHz

3550-3700:

CBW [MHz]	Range		Carrier centre [MHz]	Carrier centre [ARFCN]	SS block SCS [kHz]
10	Downlink & Uplink	Low	3555	637000	30
		Mid	3624.99	641666	
		High	3694.98	646332	
20	Downlink & Uplink	Low	3560.01	637334	30
		Mid	3624.99	641666	
		High	3690	646000	
30	Downlink & Uplink	Low	3565.02	637668	30
		Mid	3624.99	641666	
		High	3684.99	645666	
40	Downlink & Uplink	Low	3570	638000	30
		Mid	3624.99	641666	
		High	3679.98	645332	

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4 Description of Tests

4.1 Conducted Output Power

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 5.2.1

The transmitter output was connected to a calibrated coaxial cable, attenuator and power meter, the other end of which was connected to a Base Station Simulator. The Base Station Simulator was set to force the EUT to its maximum power setting. The power output at the transmitter antenna port was determined by adding the value of the cable insertion loss to the power reading. The tests were performed at three frequencies (low channel, middle channel and high channel) and on the highest power levels, which can be setup on the transmitters.

Remark: Reference test setup 1

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4.2 Effective (Isotropic) Radiated Power of Transmitter

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 5.8.4

Calculate power in dBm by the following formula:

ERP (dBm) = Conducted Power (dBm) + antenna gain (dBd)

EIRP(dBm) = Conducted Power (dBm) + antenna gain (dBi)

EIRP=ERP+2.15dB

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4.3 Occupied Bandwidth

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 4.2 & 4.3

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. The transmitter output was connected to a calibrated coaxial cable, attenuator and Spectrum analyser, the other end of which was connected to a Base Station Simulator. The Base Station Simulator was set to force the EUT to its maximum power setting. The tests were performed at three frequencies (low channel, middle channel and high channel).The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual. The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

Remark: Reference test setup 1

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

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4.4 Band Edge at Antenna Terminals

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 6.0

The transmitter output was connected to a calibrated coaxial cable, attenuator and Spectrum analyser, the other end of which was connected to a Base Station Simulator. The Base Station Simulator was set to force the EUT to its maximum power setting. The tests were performed at two frequencies (low channel and high channel).in the 1MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of 100kHz or 1% of the emission bandwidth of the fundamental emission of the transmitter may be employed. The EUT emission bandwidth is measured as the width of the signal between two points, outside of which all emission are attenuated at least 26dB below the transmitter power. The video bandwidth of the spectrum analyzer was set at thrice the resolution bandwidth. Detector Mode was set to rms.

Remark: Reference test setup 1

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW $\geq$ 1% of the emission bandwidth
4. VBW $\geq$ 3 x RBW
5. Detector = RMS
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = trace average for continuous emissions, max hold for pulse emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

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4.5 Spurious And Harmonic Emissions at Antenna Terminal

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 6.0

The transmitter output was connected to a calibrated coaxial cable, attenuator and Spectrum analyzer, the other end of which was connected to a Base Station Simulator. The Base Station Simulator was set to force the EUT to its maximum power setting. The tests were performed at three frequencies (low channel and high channel).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. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log(P) dB. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, 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. 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 emission are attenuated at least 26 dB below the transmitter power.

Remark: Reference test setup 1

Test Settings

1. Start frequency was set to 9kHz and stop frequency was set to at least 10* the fundamental frequency(Separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissinos, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

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4.6 Peak-Average Ratio

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 5.7.2

A peak to average ratio measurement is performed at the conducted port of the EUT. For WCDMA signals, the spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level. For GSM signals, an average and a peak trace are used on a spectrum analyzer to determine the largest deviation between the average and the peak power of the EUT in a bandwidth greater than the emission bandwidth. The traces are generated with the spectrum analyzer set to zero span mode.

Remark: Reference test setup 1

Test Settings

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW > Emission bandwidth of signal
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

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4.7 Field Strength of Spurious Radiation

Measurement Procedure: FCC KDB 971168 D01 V03r01 Section 5.8

Below 1GHz test procedure as below:

1). The EUT was powered ON and placed on a 80cm high table in the chamber. The antenna of the transmitter was extended to its maximum length.

2). The disturbance of the transmitter was maximized on the test receiver display by raising and lowering from 1m to 4m (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) the receive antenna and by rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.

3). Steps 1) and 2) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.

4). Test the EUT in the lowest channel, the middle channel ,the Highest channel.

5). The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, Only the test worst case mode is recorded in the report.

6). Repeat above procedures until all frequencies measured was complete.

E (dBμV/m) = Measured amplitude level (dBμV) + (Cable Loss (dB) + Antenna Factor (dB/m) – AMP(dB))

EIRP (dBm) = E (dBμV/m) + 20 log D − 104.8; where D is the measurement distance in meters

Above 1GHz test procedure as below:

1) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber

2) Calculate power in dBm by the following formula:

E (dBμV/m) = Measured amplitude level (dBμV) + (Cable Loss (dB) + Antenna Factor (dB/m) – AMP(dB))

EIRP (dBm) = E (dBμV/m) + 20 log D − 104.8; where D is the measurement distance in meters

3). Test the EUT in the lowest channel, the middle channel the Highest channel

4). The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, Only the test worst case mode is recorded in the report.

5). Repeat above procedures until all frequencies measured was complete

Remark1: Reference test setup 2

Remark2: The emission below 18G were measured at a 3m test distance, while emissions above 18GHz were measured at a 1m test distance. At a measurement distance of 1 meter the limit line was increased by 20*LOG(3/1) = 9.54 dB.

Remark: Reference test setup 2

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & AMP. The basic equation with a sample calculation is as follows:

AF = Antenna Factor(dB/m)

Factor = Cable Factor(dB) - Preamplifier (dB)

Level = Reading Level + AF + Factor -95.26

Margin = Limit – Level

2) Scan from 9kHz to 40GHz, The disturbance between 9KHz to 30MHz and 18GHz to 40GHz was very low, and the harmonics were the highest point could be found when testing, so only the harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

3) All modes have been tested, but only the worst case data displayed in this report.

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4.8 Frequency Stability / Temperature Variation

Measurement Procedure:

Frequency stability testing is performed in accordance with the guidelines of FCC KDB 971168 D01 V03r01; Section 9

. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

Specification – The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ±0.00025% (±2.5 ppm) of the center frequency.

Time Period and Procedure:

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Remark: Reference test setup 3

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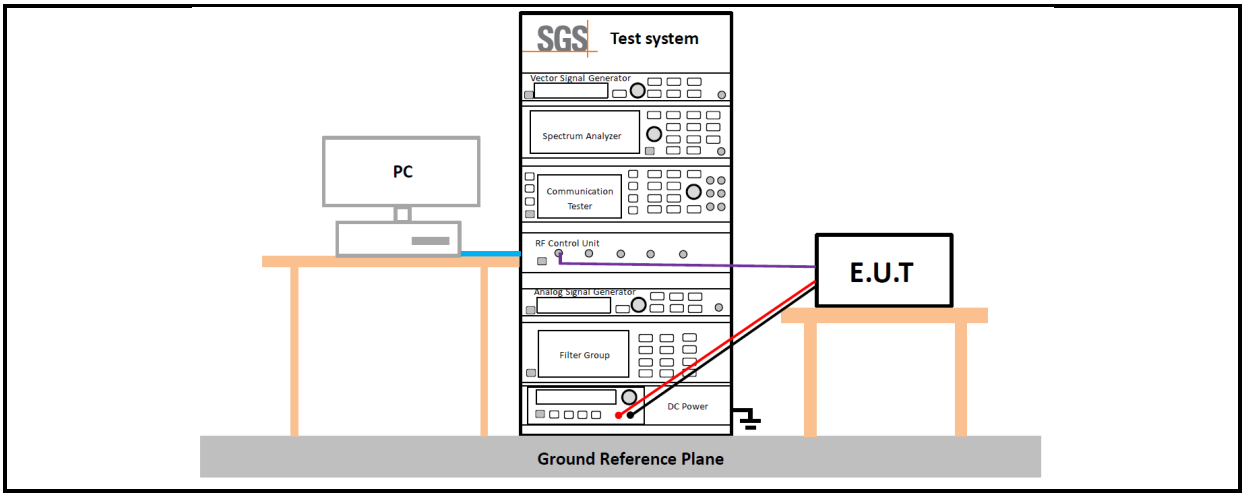
4.9 Test Setups

4.9.1 Test Setup 1



4.9.2 Test Setup 2

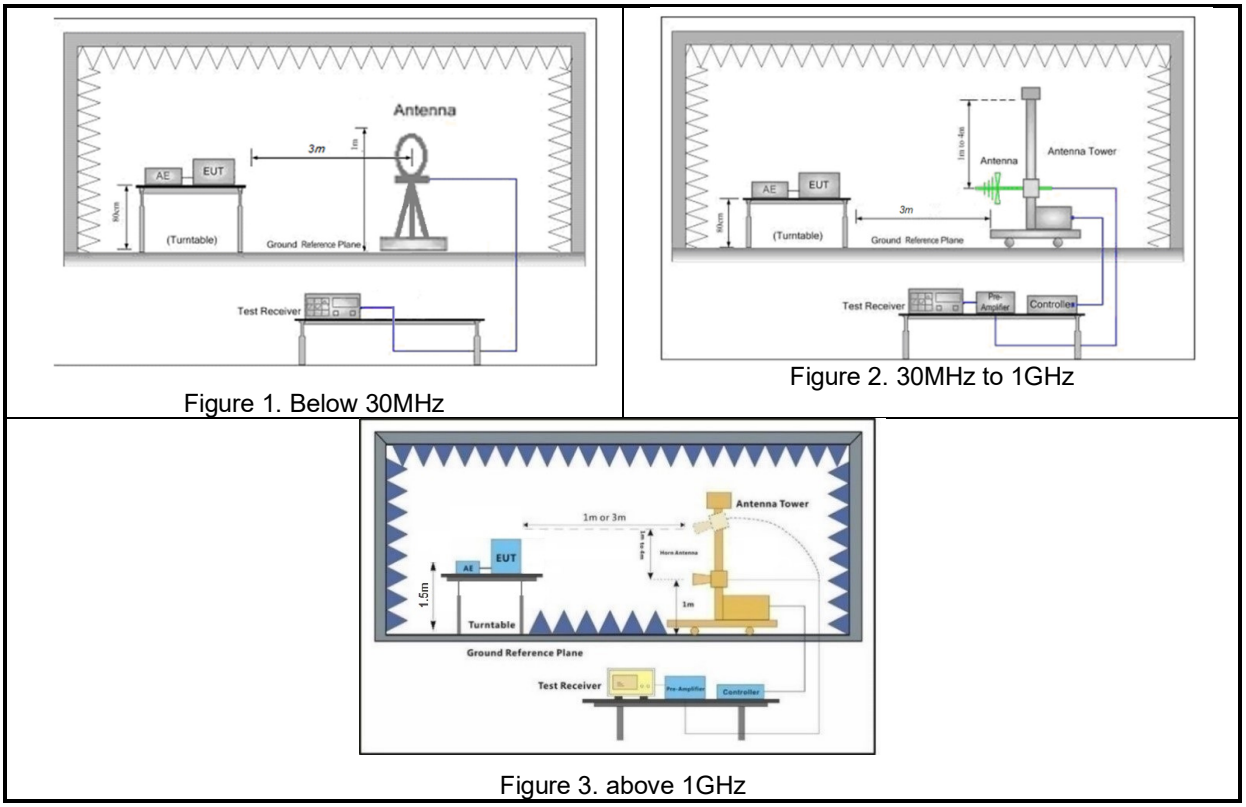


Figure 1. Below 30MHz

Figure 2. 30MHz to 1GHz

Figure 3. above 1GHz

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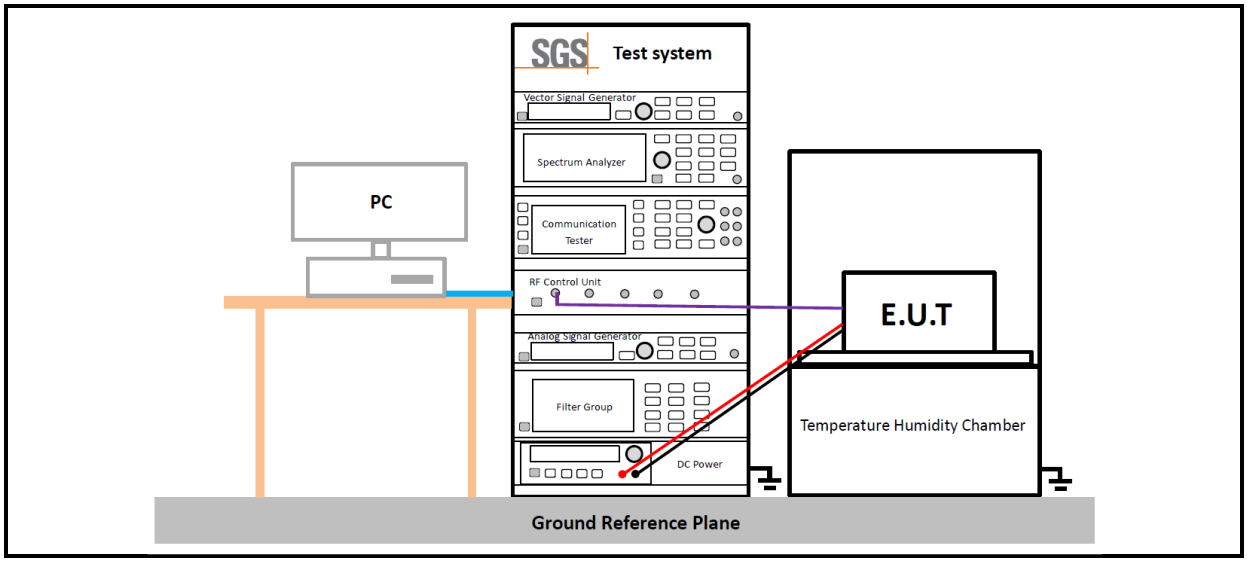
4.9.3 Test Setup 3



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4.10 Test Conditions

Transmit Output Power Data - Average Power, Total	
Test Case	**Test Conditions**
Test Environment	Ambient Climate & Rated Voltage
Test Setup	Test Setup 1
RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
Test Mode	NR/TM1; NR/TM2; NR/TM3; NR/TM4; NR/TM5; NR/TM6; NR/TM7; NR/TM8; NR/TM9
Peak-to-Average Ratio	
Test Case	**Test Conditions**
Test Environment	Ambient Climate & Rated Voltage
Test Setup	Test Setup 1
RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
Test Mode	NR/TM5; NR/TM9
Bandwidth - Occupied Bandwidth	
Test Case	**Test Conditions**
Test Environment	Ambient Climate & Rated Voltage
Test Setup	Test Setup 1
RF Channels (TX)	M (M= middle channel)
Test Mode	NR/TM1; NR/TM2; NR/TM3; NR/TM4; NR/TM5; NR/TM6; NR/TM7; NR/TM8; NR/TM9
Bandwidth - Emission Bandwidth	
Test Case	**Test Conditions**
Test Environment	Ambient Climate & Rated Voltage
Test Setup	Test Setup 1
RF Channels (TX)	M (M= middle channel)
Test Mode	NR/TM1; NR/TM2; NR/TM3; NR/TM4; NR/TM5; NR/TM6; NR/TM7; NR/TM8; NR/TM9
Adjacent Channel Leakage Ratio	
Test Case	**Test Conditions**
Test Environment	Ambient Climate & Rated Voltage
Test Setup	Test Setup 1
RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
Test Mode	NR/TM1
Band Edges Compliance	
Test Case	**Test Conditions**

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Test Environment	Ambient Climate & Rated Voltage
Test Setup	Test Setup 1
RF Channels (TX)	L, H (L= low channel, H= high channel)
Test Mode	NR/TM1; NR/TM6
Spurious Emission at Antenna Terminals	
Test Case	**Test Conditions**
Test Environment	Ambient Climate & Rated Voltage
Test Setup	Test Setup 1
RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
Test Mode	NR/TM1
Field Strength of Spurious Radiation	
Test Case	**Test Conditions**
Test Environment	Ambient Climate & Rated Voltage
Test Setup	Test Setup 2
RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
Test Mode	NR/TM1 Remark: All bandwidth and modulation of NR have been pre tested, and only the worst results are reflected in the report.
Frequency Stability	
Test Case	**Test Conditions**
Test Environment	(1) -30 °C to +50 °C with step 10 °C at Rated Voltage (2) VL, VN and VH of Rated Voltage at Ambient Climate.
Test Setup	Test Setup 3
RF Channels (TX)	M (M= middle channel)
Test Mode	NR/TM1; NR/TM6 The report only show the bandwidth with the worst case.

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5 Main Test Instruments

RF conducted test (for report ZEWM2306000841RG02)					
Test Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. date (yyyy/mm/dd)**	**Cal.Due date (yyyy/mm/dd)**
Signal Generator	Rohde & Schwarz	SMR20	SZ-WRG-M-034	2022/09/22	2023/09/21
Signal Generator	Keysight	N5182B	SZ-WRG-M-015	2023/02/16	2024/02/15
Spectrum Analyzer	Keysight	N9020A	SZ-WRG-M-018	2022/05/31	2023/05/30
				2023/05/25	2024/05/24
Radio Communication Tester	Anritsu	MT8821C	SZ-WRG-M-014	2022/09/22	2023/09/21
Radio Communication Tester	Anritsu	MT8000A	SZ-WRG-M-013	2022/09/22	2023/09/21
DC power supply	HYELEC	HY3005B	SZ-WRG-M-024	2022/09/22	2023/09/21
Humidity/ Temperature Indicator	Shanghai Meteorological Industry Factory	HTC-1	SZ-WRG-M-022	2023/02/17	2024/02/16
Programmable Temperature & Humidity Chamber	Votsch Industrietechnik GmbH	VT 4002	SZ-WRG-M-075	2022/06/09	2023/06/08
				2023/05/25	2024/05/24
RF Control Unit	Tonscend	JS0806-1	SZ-WRG-A-019	NCR	NCR
BandRejectFilter Group	Tonscend	JS0806-F	SZ-WRG-A-020	NCR	NCR
Test Software	Tonscend	TS1120 V2.4.1	N/A	NCR	NCR
Signal &Spectrum Analyzer	Rohde & Schwarz	FSV	SZ-WRG-M-048	2023/02/16	2024/02/15

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RF conducted test (for report ZEWA2310000147RG02)					
Test Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. date (yyyy/mm/dd)**	**Cal.Due date (yyyy/mm/dd)**
Signal Generator	Rohde & Schwarz	SMR 20	SZ-WRG-M-034	2023/09/14	2024/09/13
MXG Vector Signal Generator	Keysight	N5182B	SZ-WRG-M-015	2023/02/16	2024/02/15
Spectrum Analyzer	Keysight	N9020A	SZ-WRG-M-018	2023/05/25	2024/05/24
Radio Communication Tester	Anritsu	MT8821C	SZ-WRG-M-014	2023/09/14	2024/09/13
Radio Communication Tester	Anritsu	MT8000A	SZ-WRG-M-013	2023/09/14	2024/09/13
Digital Multimeter	VICTOR	VC890C	374464013173	2023/02/06	2024/02/05
DC power supply	HYELEC	HY3005B	SZ-WRG-M-024	2023/09/14	2024/09/13
Programmable Temperature & Humidity Chamber	Votsch Industrietechnik GmbH	VT 4002	SZ-WRG-M-017	2022/12/22	2023/12/21
Humi/ Temp Indicator	Shanghai Meteorological Industry Factory	HTC-1	SZ-WRG-M-022	2023/02/17	2024/02/16

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Radiated spurious emissions (for report ZEWA2310000147RG02)					
Test Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. date (yyyy/mm/dd)**	**Cal.Due date (yyyy/mm/dd)**
EMI TEST RECEIVER	Rohde & Schwarz	ESR	SZ-WRG-M-047	2023/02/16	2024/02/15
Signal &Spectrum Analyzer	Rohde & Schwarz	FSV	SZ-WRG-M-048	2023/02/16	2024/02/15
Low Noise Amplifier 9K-3GHz	Tonscend	TAP9K3G32	SZ-WRG-M-049	2023/02/16	2024/02/15
Low Noise Amplifier 30M-8GHz	Tonscend	TAP30M8G30	SZ-WRG-M-050	2023/02/16	2024/02/15
Low Noise Amplifier 1G-18GHz	Tonscend	TAP01018050	SZ-WRG-M-051	2023/02/16	2024/02/15
Low Noise Amplifier 18G-40GHz	Tonscend	TAP18040048	SZ-WRG-M-052	2023/02/16	2024/02/15
Active Loop Antenna 9kHz-30MHz	SCHWARZBECK	FMZB 1519B	SZ-WRG-M-053	2022/01/16	2024/01/15
TRILOG Breitband Antenne 30MHz-1GHz	SCHWARZBECK	VULB 9168	SZ-WRG-M-054	2022/01/16	2024/01/15
Double Ridge Horn Antenna 1GHz-18GHz	SCHWARZBECK	BBHA 9120 D	SZ-WRG-M-055	2022/01/16	2024/01/15
SHF-EHF Horn 15GHz-40GHz	SCHWARZBECK	BBHA 9170	SZ-WRG-M-056	2022/01/16	2024/01/15
Radio Communication Tester	STARPOINT	SP9500	SZ-WRG-M-057	2023/01/10	2024/01/09
RSE Test Software	Tonscend	JS32-RSE V4.0.0	SZ-WRG-S-058	NCR	NCR
RE Test Software	Tonscend	JS36-RSE V5.0.0.1	SZ-WRG-S-059	NCR	NCR
Radio Communication Tester	Anritsu	MT8821C	SZ-WRG-M-042	2023/05/25	2024/05/24

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6 Measurement Uncertainty

For a 95% confidence level (k = 2), the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 as following:

No.	Item	Measurement Uncertainty
1	Radio Frequency	± 9.84Hz
2	Duty cycle	± 0.185%
3	Occupied Bandwidth	± 0.20%
4	RF conducted power	± 0.42dB
5	RF power density	± 1.97dB
6	Conducted Spurious emissions	± 0.42dB
7	Radiated Spurious emission test(UE)	±4.8dB (30MHz-1GHz)
		±4.68dB (1GHz-6GHz)
		±4.52dB (6GHz-18GHz)
		±5.26dB (18GHz-40GHz)

Remark:
The U_{lab} (lab Uncertainty) is less than $U_{cispr/ETSI}$ (CISPR/ETSI Uncertainty), so the test results
– compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
– non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

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7 Appendixes

Appendix A.3	WWAN Setup Photos-part96
Appendix B.50	NR Band n48(3550-3700)

---End of Report---

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