

FCC TEST REPORT

Product Name: Handheld Smart Terminal

Trade Mark:



or RHINO

Model No.: T5se

Add. Model No.: N/A

Report Number: 220412017RFM-2

Test Standards: FCC 47 CFR Part 90 Subpart R

FCC ID: 2AUOUT5SE

Test Result: PASS

Date of Issue: August 8, 2022

Prepared for:

Rhino Mobility LLC

8 The Green, Suite A, Dover, Delaware, 19901, USA

Prepared by:

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August 8, 2022

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Version

Version No.	Date	Description
V1.0	August 8, 2022	Original



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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Rhino Mobility LLC
Address of Applicant:	8 The Green, Suite A, Dover, Delaware,19901, USA
Manufacturer:	Rhino Mobility LLC
Address of Manufacturer:	8 The Green, Suite A, Dover, Delaware,19901, USA

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	Handheld Smart Terminal		
Model No.:	T5se		
Add. Model No.:	N/A		
Trade Mark:	 or RHINO		
DUT Stage:	Identical Prototype		
EUT Supports Function: (Provided by the customer)	UTRA Bands:	Band II/ Band IV/ Band V	
	E-UTRA Bands:	FDD Band 2/ Band 4/ Band 5/ Band 7/ Band 12/ Band 13/ Band 14/ Band 17/ Band 25/ Band 26/ Band 30/ Band 66/ Band 71	
		TDD Band 41	
	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
		Bluetooth V4.2	
	5 GHz U-NII Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac
	RNSS Bands:	1559 MHz to 1610 MHz	GPS/ Galileo/ GLONASS
NFC:	13.553 MHz to 13.567 MHz		
Software Version:	T5se(001)_20220624 (Provided by the customer)		
Hardware Version:	AL_Z06_MB_V12 (Provided by the customer)		
Sample Received Date:	April 13, 2022		
Sample Tested Date:	April 15, 2022 to June 27, 2022		
Note: The T5se have two LCD modules from different vendors. This report has evaluated and pre-testing of two batches of LCD modules, with only the worst data recorded in the report.			
Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.			

1.2.2 Description of Accessories

Adapter	
Model No.:	XY-PP018U1
Input:	100-240 V~50/60 Hz 0.5A
Output:	3.6-6.0 V $\Rightarrow$ 3.0A, 6.0-9.0 V $\Rightarrow$ 2.0A, 9.0-12.0 V $\Rightarrow$ 1.5A
AC Cable:	N/A
DC Cable:	N/A

Internal Battery	
Model No.:	BPT5se
Battery Type:	Lithium-ion Rechargeable Battery
Rated Voltage:	3.85 Vdc
Limited Charge Voltage:	4.4 Vdc
Rated Capacity:	3000 mAh

External Battery Pack	
Model No.:	T5SE-EBAT-3K-BLK
Battery Type:	Lithium-ion Rechargeable Battery
Rated Voltage:	3.85 Vdc
Limited Charge Voltage:	4.4 Vdc
Rated Capacity:	3030 mAh

Cable	
Description:	USB Type-C Plug Cable
Cable Type:	Shielded without ferrite
Length:	1 Meter

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1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Support Networks:	LTE		
Type of Modulation:	LTE Band 14:	QPSK, 16QAM, 64QAM	
Frequency Range:	LTE Band 14 (Channel Bandwidth: 5 MHz):	790.5-795.5 MHz	
	LTE Band 14 (Channel Bandwidth: 10 MHz):	793 MHz	
Max RF Output Power:	LTE Band 14 (Channel Bandwidth: 5 MHz):	24.15 dBm	
	LTE Band 14 (Channel Bandwidth: 10 MHz):	24.36 dBm	
Type of Emission:	LTE Band 14 QPSK	Channel Bandwidth: 5 MHz	4M55G7D
		Channel Bandwidth: 10 MHz	9M02G7D
	LTE Band 14 16QAM	Channel Bandwidth: 5 MHz	4M54W7D
		Channel Bandwidth: 10 MHz	9M00W7D
	LTE Band 14 64QAM	Channel Bandwidth: 5 MHz	4M54W7D
		Channel Bandwidth: 10 MHz	8M99W7D
IEMI:	Radiated: 354657110011383		
	Conducted: 354657110011581, 354657110011771		
Antenna Type: (Provided by the customer)	LDS Antenna		
Antenna Gain: (Provided by the customer)	-0.69 dBi		
Normal Test Voltage:	3.85 Vdc		
Extreme Test Voltage:	3.4 to 4.4Vdc		
Extreme Test Temperature:	-30 °C to +50 °C		

1.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
--	--	--	--	--

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.3 Meter	UnionTrust

1.5 TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China, China 518109

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1.6 TEST FACILITY

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

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories

CAB identifier: CN0032

FCC Accredited Lab.

Designation Number: CN1194

Test Firm Registration Number: 259480

1.7 DEVIATION FROM STANDARDS

None.

1.8 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.9 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.10 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product 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.

No.	Item	Measurement Uncertainty
1	Conducted Output Power	±0.7 dB
2	99%&26dB Bandwidth	±1.86 %
3	Emission Mask	±2.7 dBm
4	Spurious emissions at antenna terminals	±2.7 dBm
5	Field strength of spurious radiation	30 MHz-1 GHz: ±4.9 dB 1 GHz-18 GHz: ±4.8 dB 18 GHz-40 GHz: ±5.1 dB
6	Frequency stability	±6.5 x 10 ⁻⁸
7	Humidity	±3.9 %
8	Temperature	±0.62 °C
9	DC Voltages	±0.68 %

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2. TEST SUMMARY

FCC 47 CFR Part 90 Subpart R Test Cases			
Test Item	Test Requirement	Test Method	Result
Effective Radiated Power (ERP)	FCC 47 CFR Part 2.1046 & FCC 47 CFR Part 90.542(a)(7)	KDB 412172 D01	PASS
Conducted Output Power	FCC 47 CFR Part 2.1046	ANSI C63.26-2015, Clause 5.2	PASS
99%&26dB Bandwidth	FCC 47 CFR Part 2.1049	ANSI C63.26-2015, Clause 5.4	PASS
Emission Mask	FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.543	ANSI C63.26-2015, Clause 5.7	PASS
Spurious emissions at antenna terminals	FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.543	ANSI C63.26-2015, Clause 5.7	PASS
Field strength of spurious radiation	FCC 47 CFR Part 2.1053 & FCC 47 CFR Part 90.543	ANSI C63.26-2015, Clause 5.5	PASS
Frequency stability	FCC 47 CFR Part 2.1055 & FCC 47 CFR Part 90.539	ANSI C63.26-2015, Clause 5.6	PASS
Peak-to-average power ratio (PAPR)	N/A	ANSI C63.26-2015, Clause 5.2.3.4	PASS
Disclaimer and Explanations: The declared of product specification and data (e.g. antenna gain, RF specification, etc) for EUT presented in the report are provided by the customer, and the customer takes all the responsibilities for the accuracy of product specification.			

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	Euroshiedpn-CT001270-1317	22-Jan-2021	21-Jan-2024
☒	Receiver	R&S	ESIB26	100114	5-Nov-2021	4-Nov-2022
☐	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	15-Apr-2022	14-Apr-2023
☐	Loop Antenna	ETS-LINDGREN	6502	00202525	11-Nov-2021	10-Nov-2023
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	11-Nov-2021	10-Nov-2023
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	11-Nov-2021	10-Nov-2023
☒	Preamplifier	HP	8447F	2805A02960	5-Nov-2021	4-Nov-2022
☐	Broadband Antenna (Pre-amplifier)	ETS-LINDGREN	3142E-PA	00201891	30-Apr-2021	29-Apr-2023
☐	6dB Attenuator	Talent	RA6A5-N-18	18103002	5-Nov-2021	4-Nov-2022
☐	Horn Antenna	ETS-LINDGREN	3117	00164202	11-Nov-2021	10-Nov-2023
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	17-Apr-2022	16-Apr-2024
☒	Pre-amplifier	ETS-LINDGREN	00118385	00201874	6-Nov-2021	5-Nov-2022
☐	Horn Antenna	ETS-LINDGREN	3116C	00200180	17-Apr-2022	16-Apr-2024
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	14-Nov-2020	13-Nov-2022
☒	Pre-amplifier	ETS-LINDGREN	00118384	00202652	17-Nov-2020	16-Nov-2022
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☒	Test Software	Audix	e3	Software Version: 9.160323		

RF Conducted Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☐	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	15-Apr-2022	14-Apr-2023
☒	EXA Spectrum Analyzer	KEYSIGHT	N9020A	MY51286807	5-Nov-2021	4-Nov-2022
☐	Spectrum analyzer	R&S	FSV40-N	101653	15-Apr-2022	14-Apr-2023
☒	DC Source	KIKUSUI	PWR400L	LK003024	20-Aug-2021	19-Aug-2022
☐	Temp & Humidity chamber	Espec	GL(U)04KA(W)	16921H201P3	20-Aug-2021	19-Aug-2022
☒	Temp & Humidity chamber	Votisch	VT4002	58566133290020	15-Apr-2022	14-Apr-2023
☐	Wideband Radio Communication Tester	R&S	CMW500	119583	15-Apr-2022	14-Apr-2023
☒	Wideband Radio Communication Tester	R&S	CMW500	120932	15-Apr-2022	14-Apr-2023

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4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

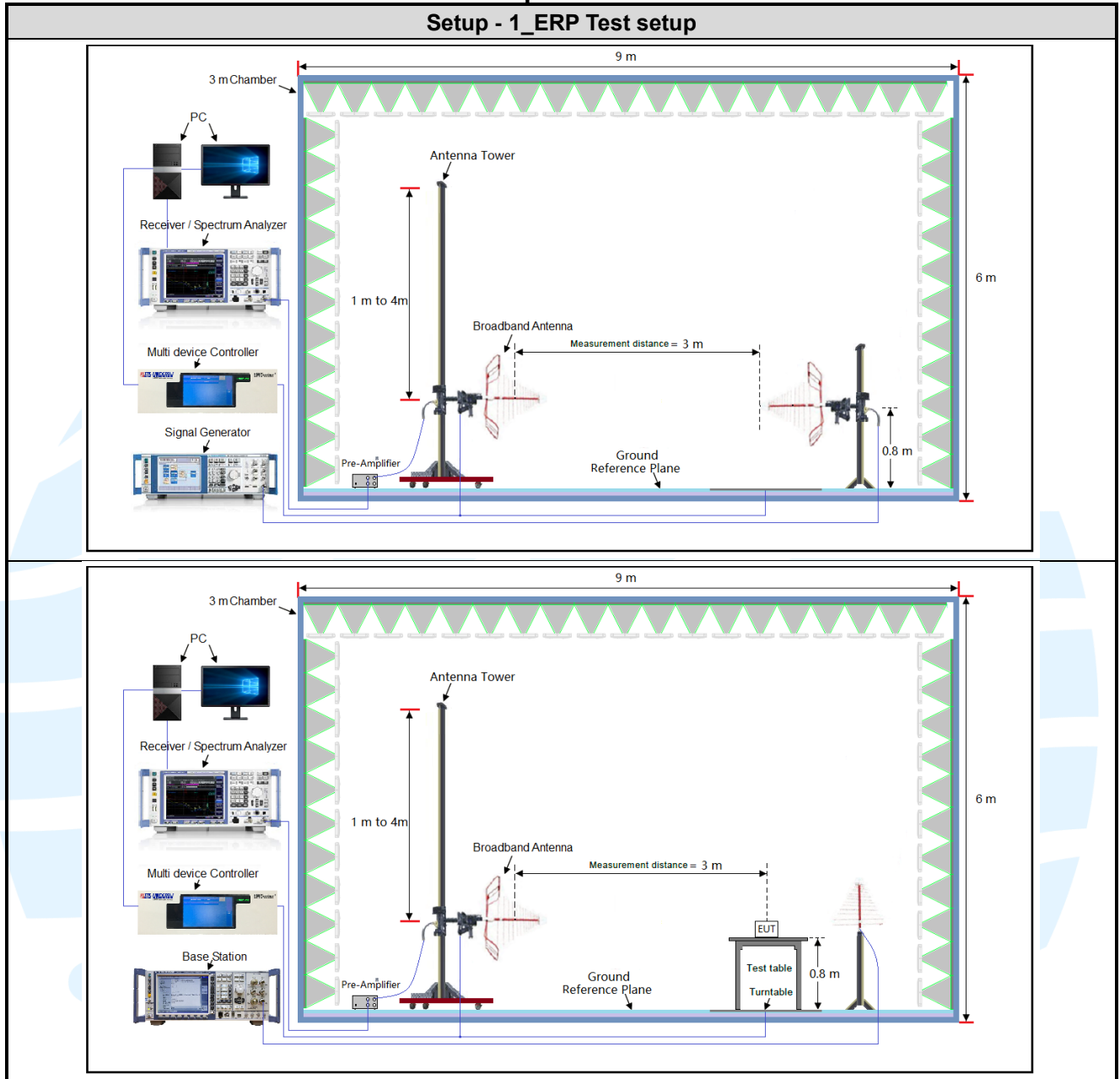
Test Environment	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
TN/VN	+15 to +35	3.85	20 to 75
TL/VL	-30	3.4	20 to 75
TH/VL	+50	3.4	20 to 75
TL/VH	-30	4.4	20 to 75
TH/VH	+50	4.4	20 to 75

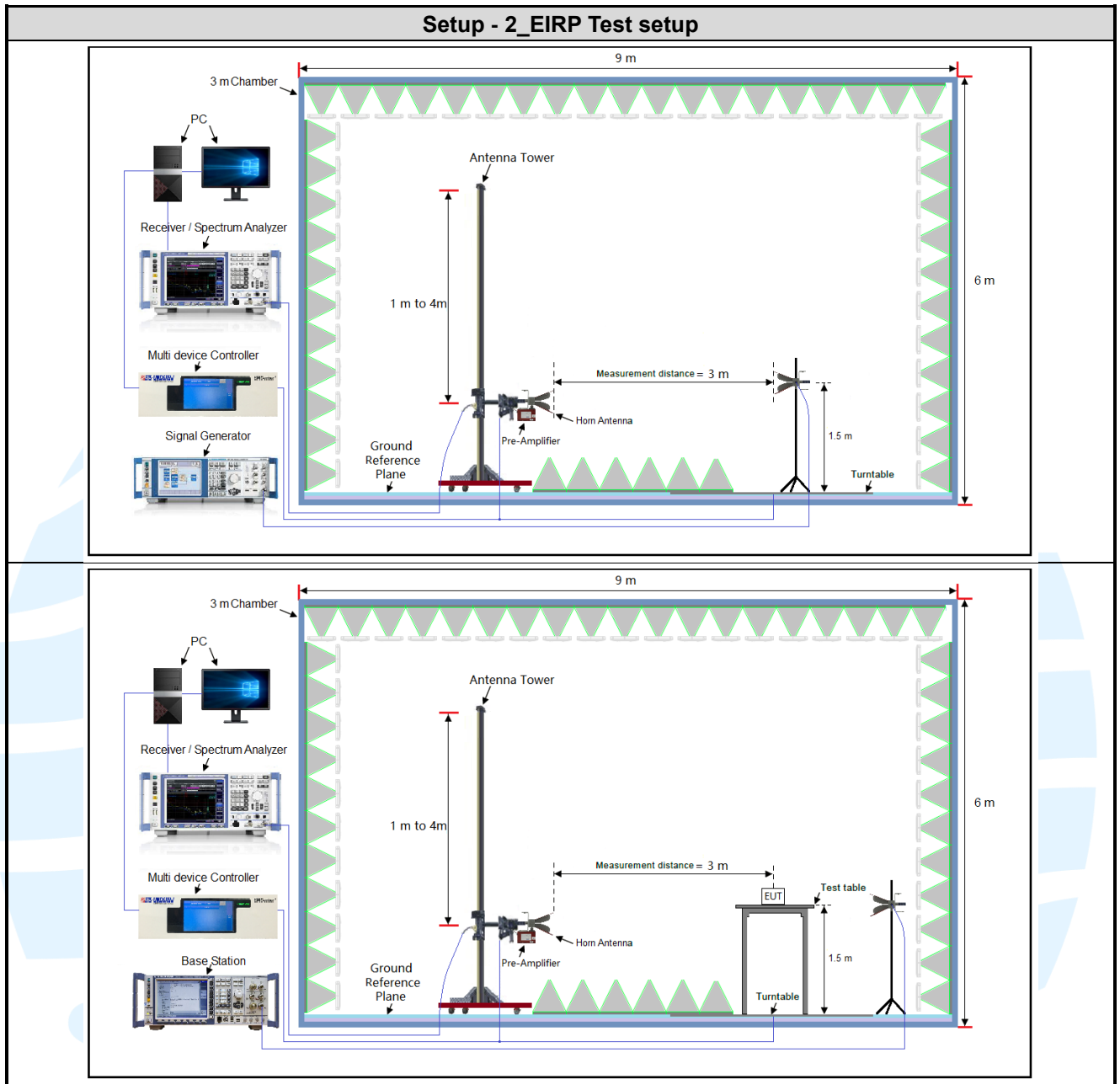
Remark:

- 1) The EUT just work in such extreme temperature of -30 °C to +50 °C and the extreme voltage of 3.4 V to 4.4 V, so here the EUT is tested in the temperature of -30 °C to +50 °C and the voltage of 3.4 V to 4.4 V.
- 2) VN: Normal Voltage; TN: Normal Temperature;
TL: Low Extreme Test Temperature; TH: High Extreme Test Temperature;
VL: Low Extreme Test Voltage; VH: High Extreme Test Voltage.

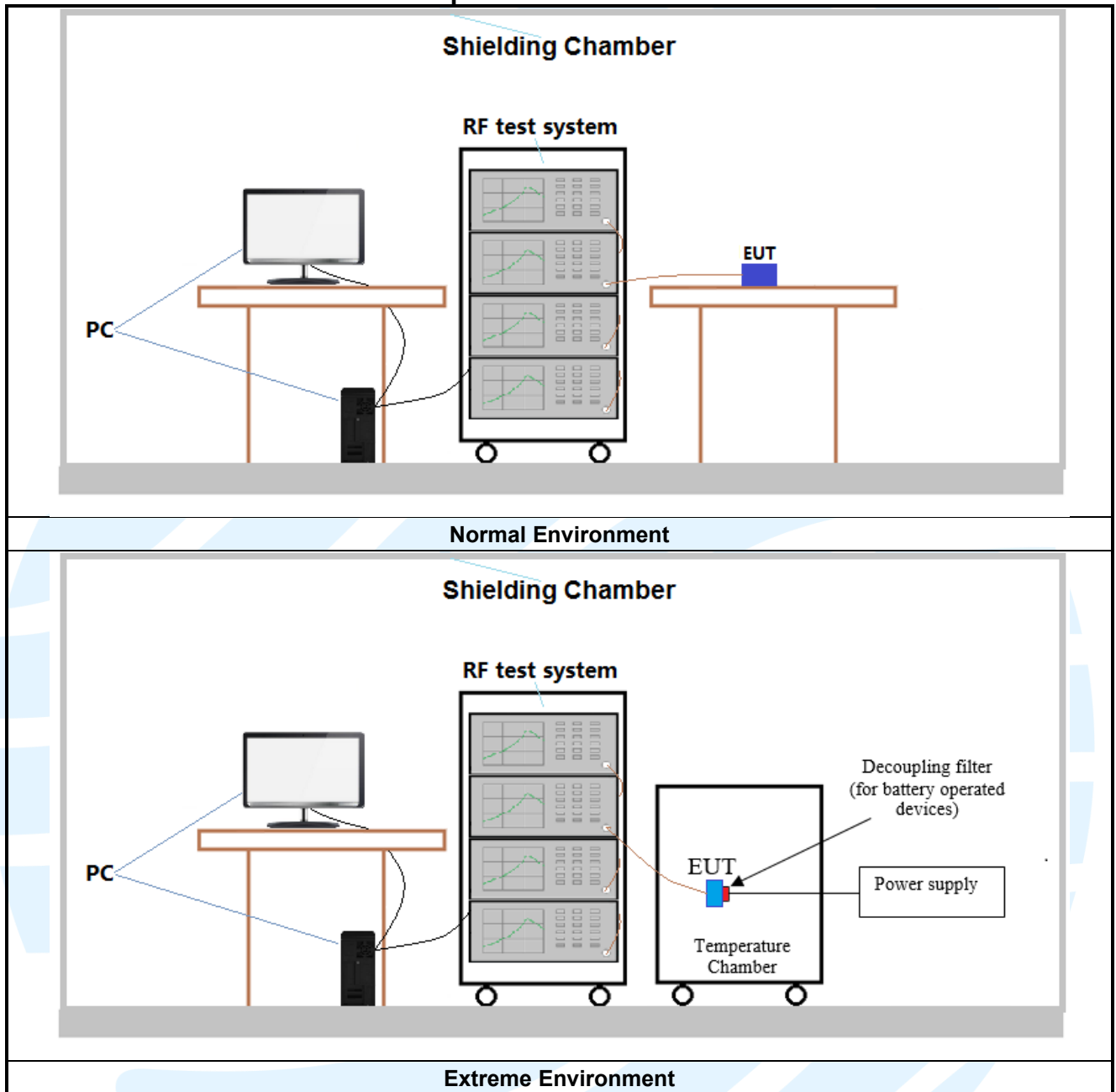
4.2 TEST SETUP

4.2.1 For Radiated Emissions test setup





4.2.2 For Conducted RF test setup



4.3 TEST CHANNELS

Band	Test Frequency ID	Bandwidth (MHz)	Number [UL]	Frequency of Uplink (MHz)
TX: 788 MHz to 798 MHz	Low Range	5	23305	790.5
		10	23330	793
	Middle Range	5/10	23330	793
	High Range	5	23355	795.5
		10	23330	793

4.4 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by a 3.85V battery. Only the worst-case data were recorded in this test report.

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, X/Y/Z axis, and antenna ports.

All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000MHz. The resolution is 1 MHz or greater for frequencies above 1000MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.5 PRE-SCAN

During all testing, EUT is in link mode with base station emulator at maximum power level. LTE worse case mode applicability and tested channel detail as below:

Item	Channel Bandwidth (MHz)						Modulation			RB #			Test Channel		
	1.4	3	5	10	15	20	QPSK	16QAM	64QAM	1	Half	Full	L	M	H
LTE Band 14															
Conducted output power	☐	☐	☒	☒	☐	☐	☒	☒	☒	☒	☒	☒	☒	☒	☒
Peak-to-average ratio	☐	☐	☐	☒	☐	☐	☒	☒	☒	☐	☐	☒	☐	☒	☐
99%&26dB Bandwidth	☐	☐	☒	☒	☐	☐	☒	☒	☒	☐	☐	☒	☒	☒	☒
Band Edge at antenna terminals	☐	☐	☒	☒	☐	☐	☒	☒	☒	☒	☐	☒	☒	☐	☒
Spurious emissions at antenna terminals	☐	☐	☒	☒	☐	☐	☒	☒	☒	☒	☐	☐	☒	☒	☒
Field strength of spurious radiation	☐	☐	☒	☒	☐	☐	☒	☐	☐	☒	☐	☐	☒	☒	☒
Frequency stability	☐	☐	☐	☒	☐	☐	☒	☐	☐	☐	☐	☒	☐	☒	☐
Remark: The mark "☒" means is chosen for testing; The mark "☐" means is not chosen for testing; The mark "--" means is not supported bandwidth.															

5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 90	Private Land Mobile Radio Services
3	ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
4	KDB 412172 D01 Determining ERP and EIRP v01r01	Guidelines for determining the effective radiated power (ERP) and isotropically radiated power (EIRP) of an RF transmitting system

5.2 CONDUCTED OUTPUT POWER AND ERP

Test Requirement: FCC 47 CFR Part 2.1046

Test Method: ANSI C63.26-2015, Clause 5.2

Limit:

- **Conducted Output Power:** No Limit
- **Effective Radiated Power (ERP):** Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

Test Procedure:

- **Conducted Output Power:** The EUT was set up for the maximum power with CMW500, and LTE link data modulation and link up with simulator. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

- **Effective Radiated Power (ERP)**
According to KDB 412172 D01 Power Approach,
➤ **ERP or EIRP = $P_T + G_T - L_c$**
➤ **ERP = EIRP -2.15**

where

- **P_T** = transmitter output power, expressed in dBW, dBm, or PSD;
- **G_T** = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);
- **L_c** = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

Test Setup: Refer to section 4.2.2 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Link mode

Test Results: Pass

Conducted Output Power:

Conducted Power (dBm)											
Modulation			QPSK			16QAM			64QAM		
Band	Bandwidth (MHz)	RB	5305	5330	5355	5305	5330	5355	5305	5330	5355
			790.5	793	795.5	790.5	793	795.5	790.5	793	795.5
14	5	1@0	24.15	24.06	24.05	23.14	23.20	22.92	22.20	22.32	22.10
		1@12	24.14	24.10	24.08	23.12	23.06	22.95	22.19	22.16	22.02
		1@24	24.06	24.04	24.10	22.98	23.05	22.98	22.02	22.12	21.99
		12@0	23.14	23.20	23.20	22.11	22.23	22.17	21.26	21.30	21.31
		12@7	23.18	23.22	23.20	22.16	22.16	22.11	21.24	21.18	21.19
		12@13	23.21	23.22	23.22	22.16	22.17	22.07	21.20	21.19	21.22
		25@0	23.24	23.16	23.19	22.32	22.20	22.23	21.38	21.34	21.30
Band	Bandwidth (MHz)	RB	--	5330	--	--	5330	--	--	5330	--
			--	793	--	--	793	--	--	793	--
14	10	1@0	--	24.29	--	--	23.31	--	--	22.33	--
		1@25		24.36			23.34			22.43	
		1@49		24.25			23.25			22.42	
		25@0		23.45			22.33			21.35	
		25@12		23.24			22.19			21.29	
		25@25		23.28			22.19			21.21	
		50@0		23.27			22.20			21.33	

$$\text{ERP, (G}_T - \text{L}_C) = -0.69 \text{ dB}$$

Channel	LTE Band 14 Maximum ERP (dBm)				LTE Band 14 Maximum ERP (W)				Result
	QPSK	16QAM	64QAM	Limit (dBm)	QPSK	16QAM	64QAM	Limit (W)	
Channel Bandwidth: 5MHz									
Lowest	21.31	20.30	19.36	34.77	0.1352	0.1072	0.0863	3	Pass
Middle	21.26	20.36	19.48	34.77	0.1337	0.1086	0.0887	3	Pass
Highest	21.26	20.14	19.26	34.77	0.1337	0.1033	0.0843	3	Pass
Channel Bandwidth: 10MHz									
Middle	21.52	20.50	19.59	34.77	0.1419	0.1122	0.0910	3	Pass

Note: The maximum ERP/EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

5.399%&26DB BANDWIDTH**Test Requirement:** FCC 47 CFR Part 2.1049**Test Method:** ANSI C63.26-2015, Clause 5.4**Limit:** No Limit**Test Procedure:**

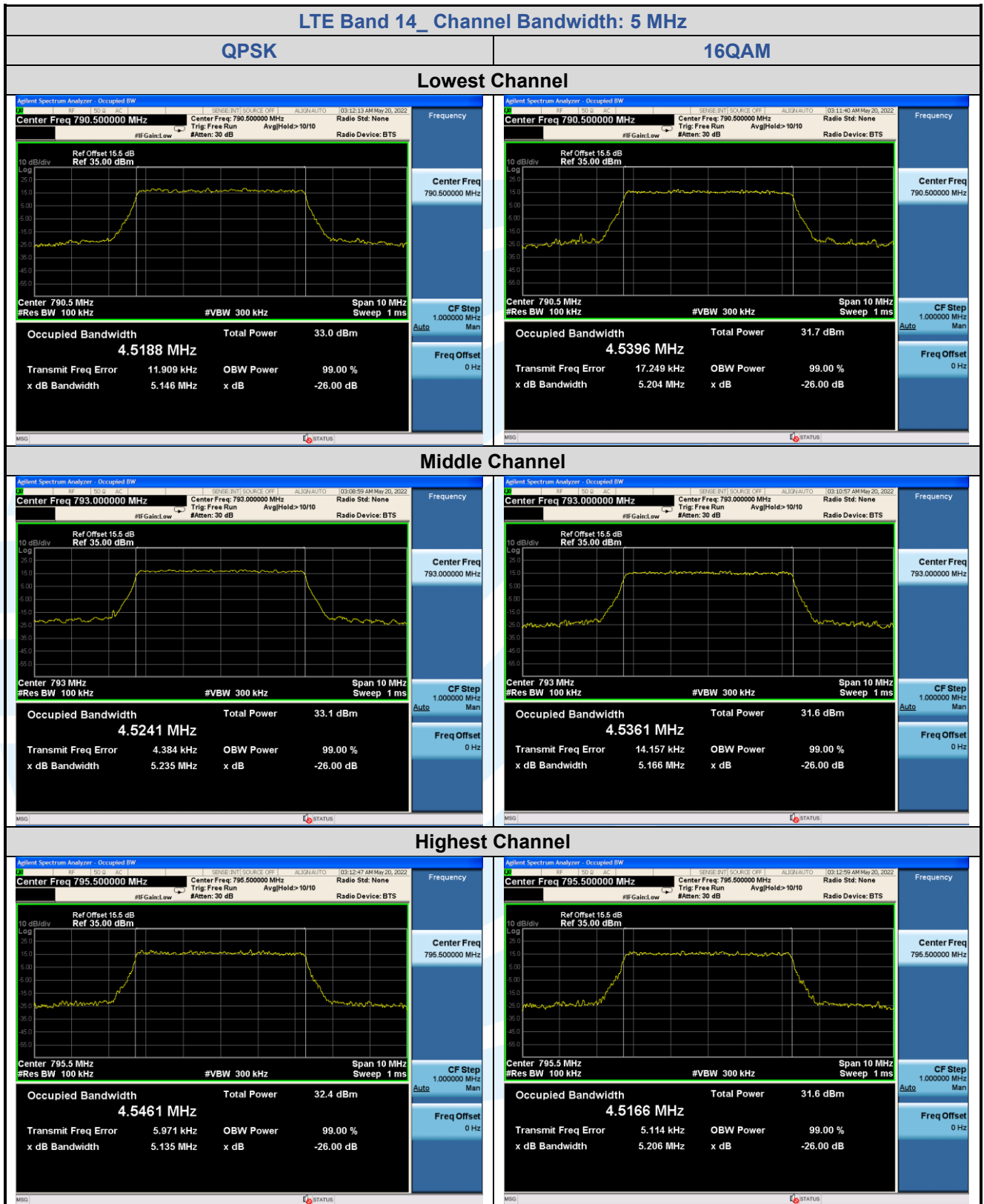
The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer. The occupied bandwidth was measured with the spectrum analyzer at the low, middle and high channel in each band. The 99% and -26dB bandwidths was also measured and recorded.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.2.2 for details.**Instruments Used:** Refer to section 3 for details**Test Mode:** Link mode**Test Results:** Pass

LTE Band 14								
Channel	RB Configuration		26 dB BW (MHz)			99% BW (MHz)		
	Size	Offset	QPSK	16QAM	64QAM	QPSK	16QAM	64QAM
Channel Bandwidth: 5 MHz								
Lowest	25	0	5.146	5.204	5.186	4.5188	4.5396	4.5407
Middle	25	0	5.235	5.166	5.158	4.5241	4.5361	4.5185
Highest	25	0	5.135	5.206	5.168	4.5461	4.5166	4.5352
Channel Bandwidth: 10 MHz								
Middle	50	0	10.15	10.04	10.11	9.0169	9.0020	8.9936

The test plot as follows:



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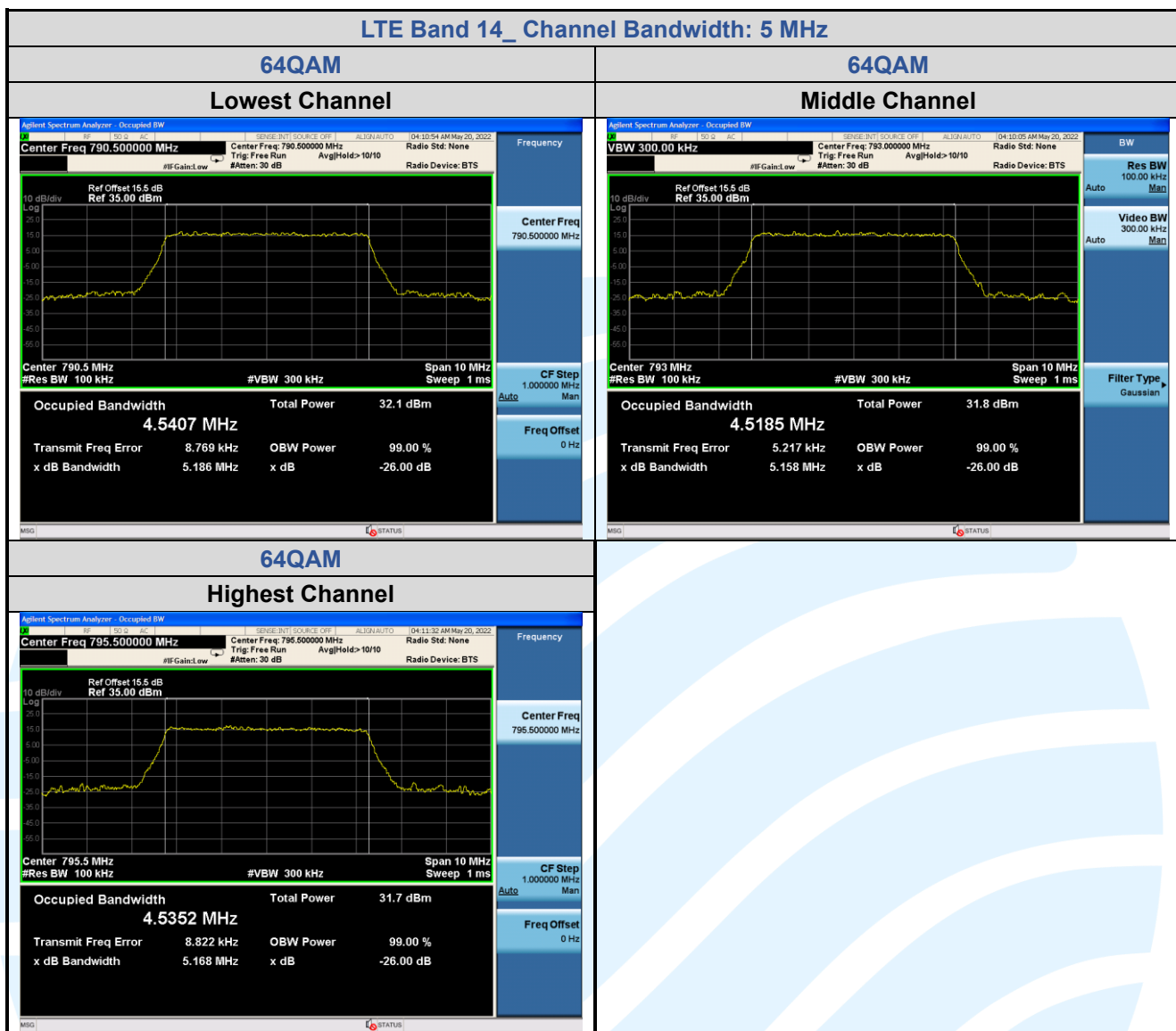
Tel: +86-755-28230888

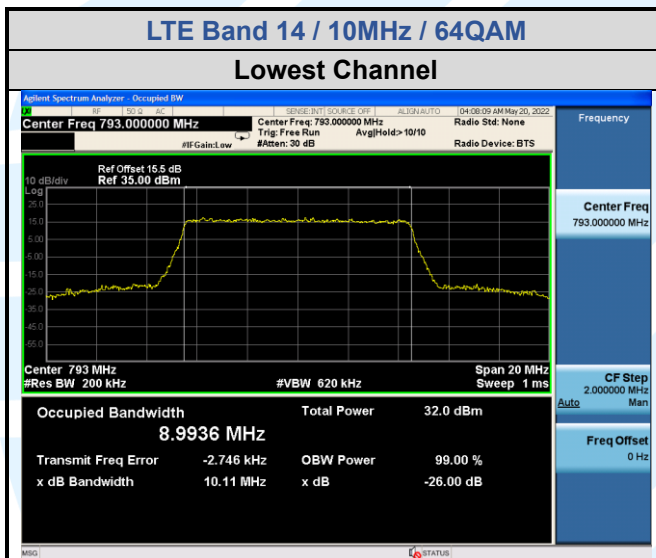
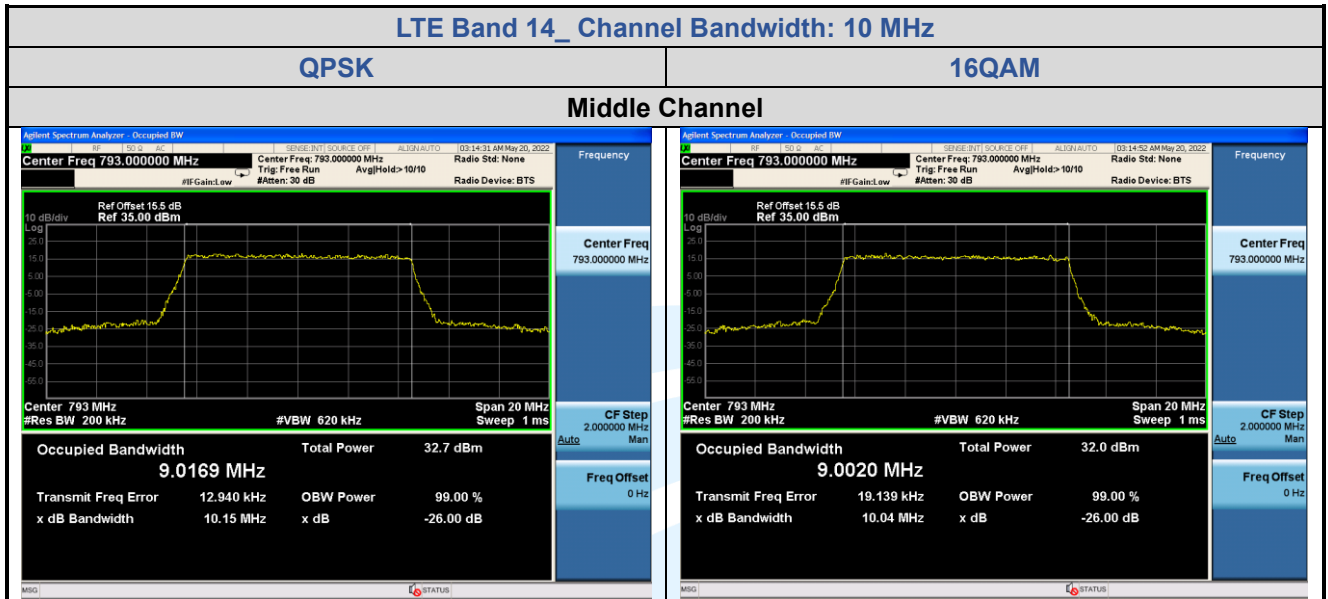
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5.4 EMISSION MASK

Test Requirement: FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.691

Test Method: ANSI C63.26-2015, Clause 5.7

Limit:

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

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

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

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

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

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

Test Procedure:

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer.

For each band edge measurement:

- 1) Set the spectrum analyzer span to include the low or high channels.
- 2) Set the emissions mask of low or high channels.
- 3) Set resolution bandwidth to at least 1% of emission bandwidth and the VBW set 3 times of RBW.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

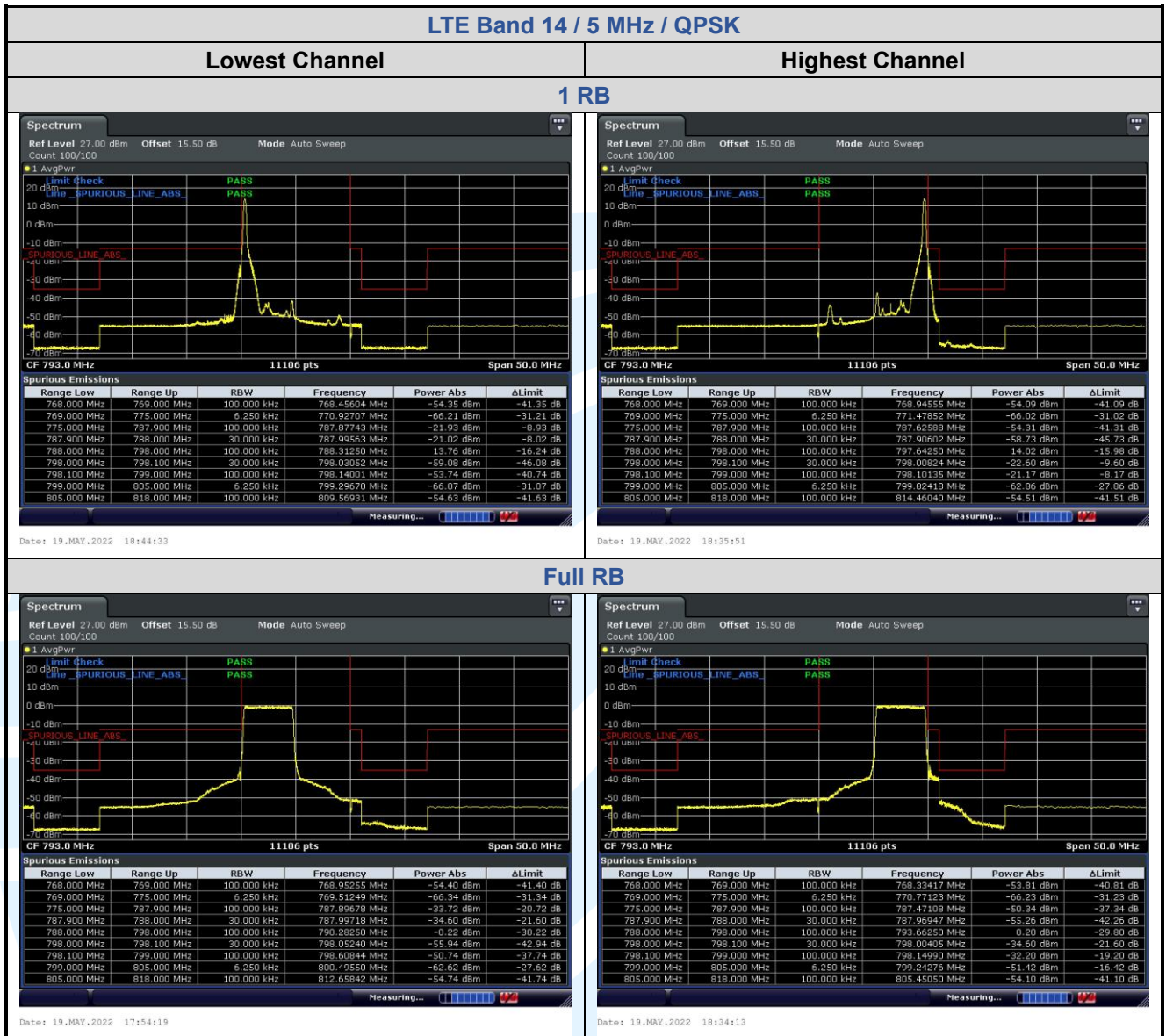
Test Setup: Refer to section 4.2.2 for details.

Instruments Used: Refer to section 3 for details

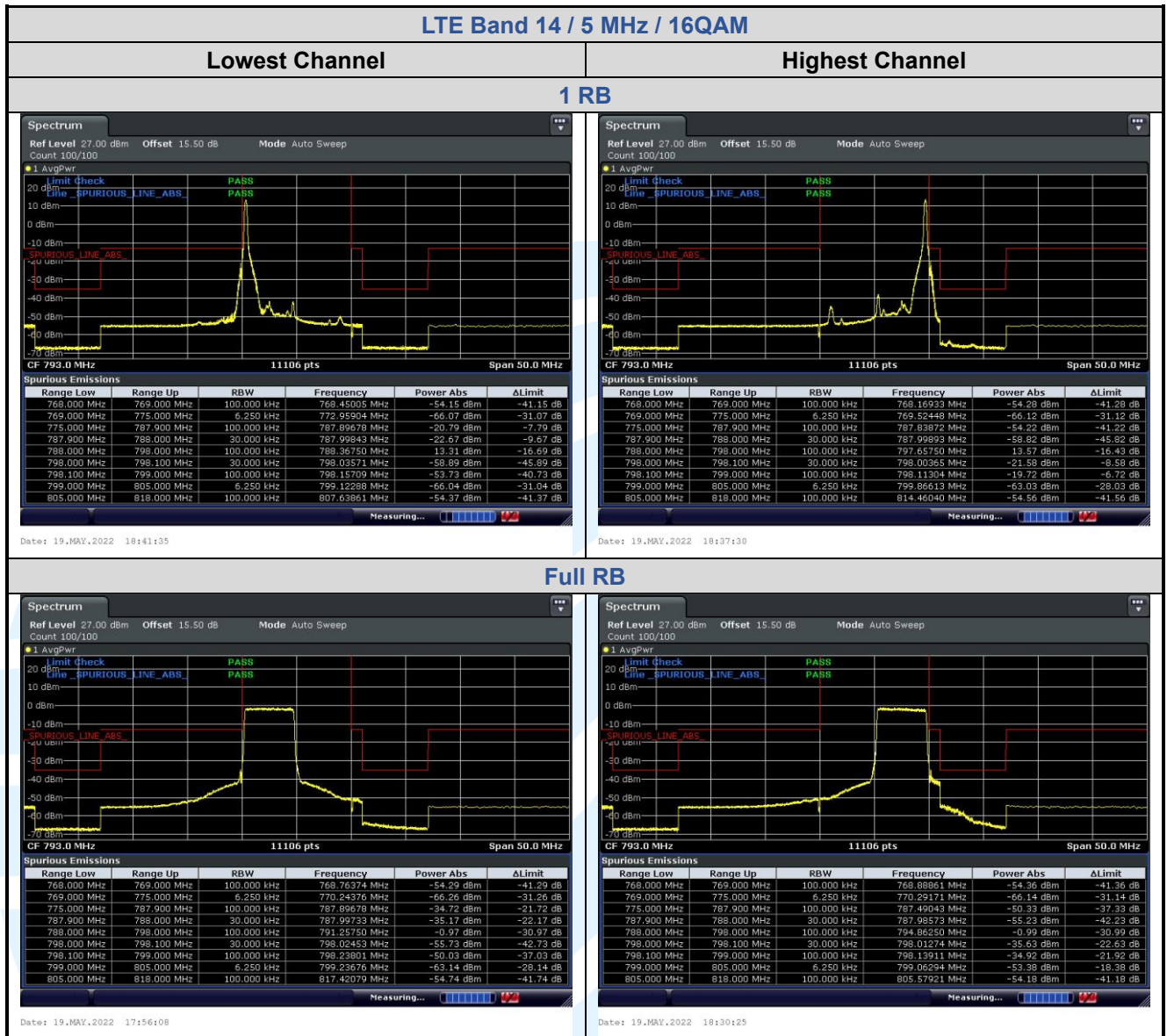
Test Mode: Link mode

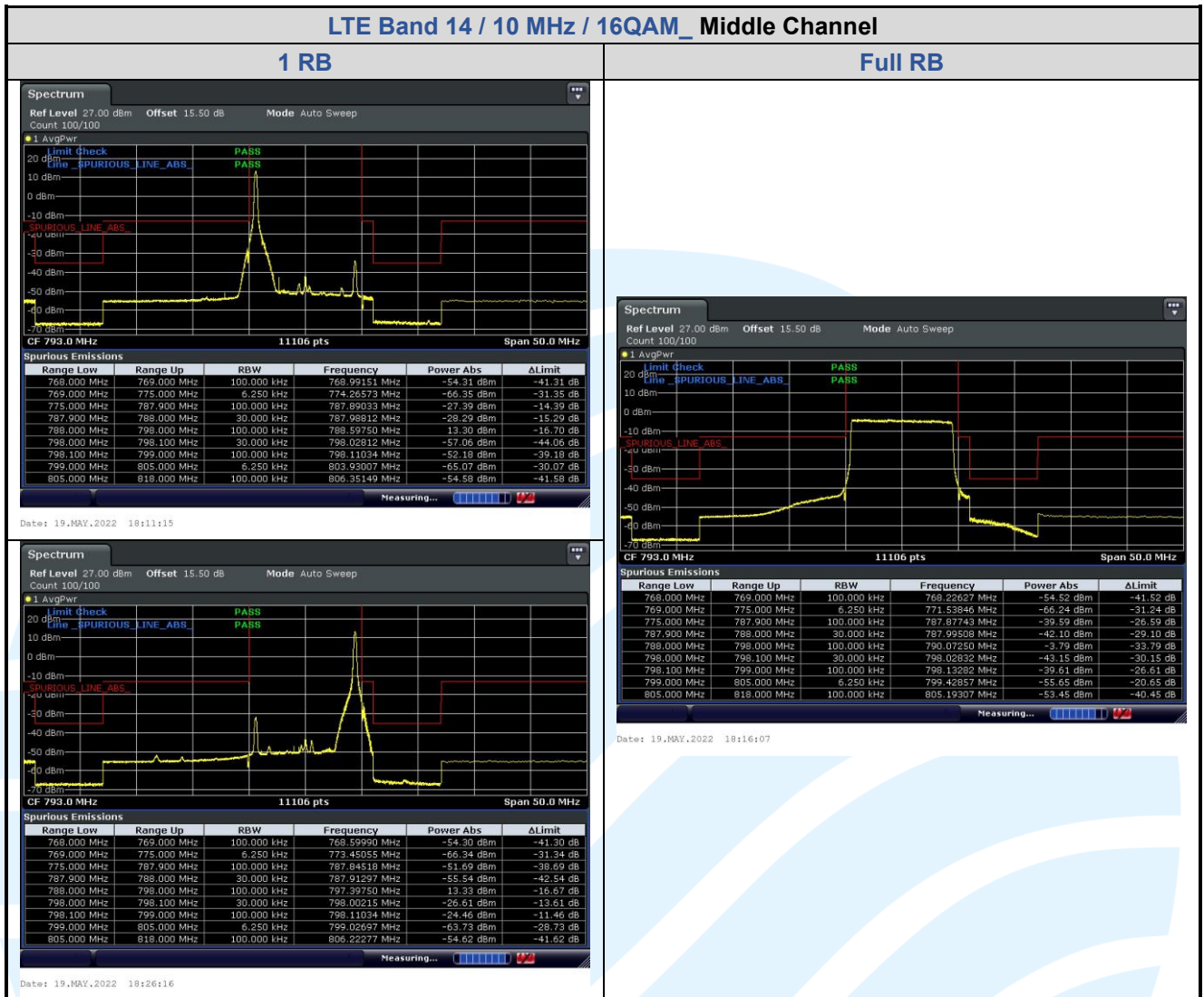
Test Results: Pass

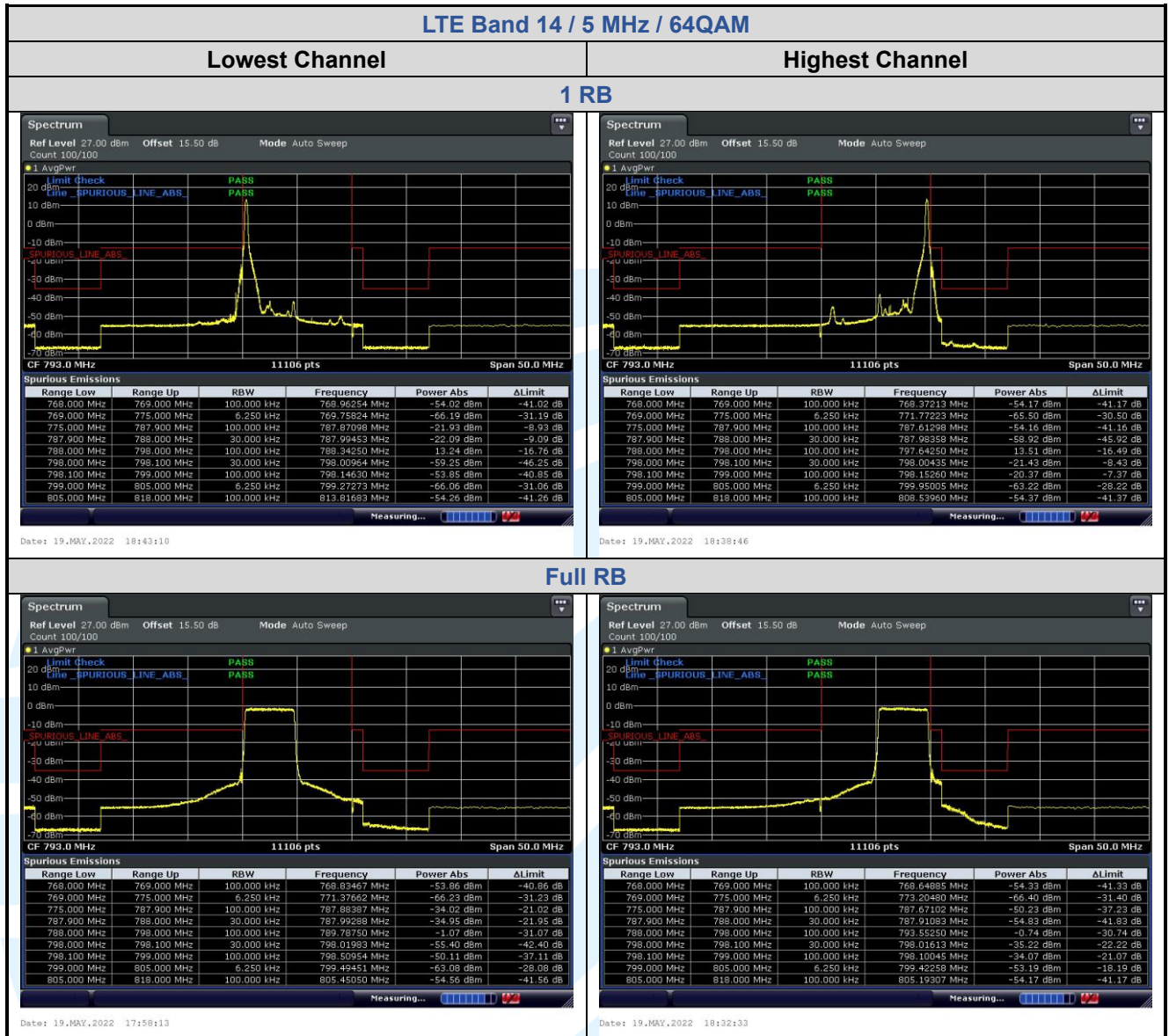
The test plot as follows:

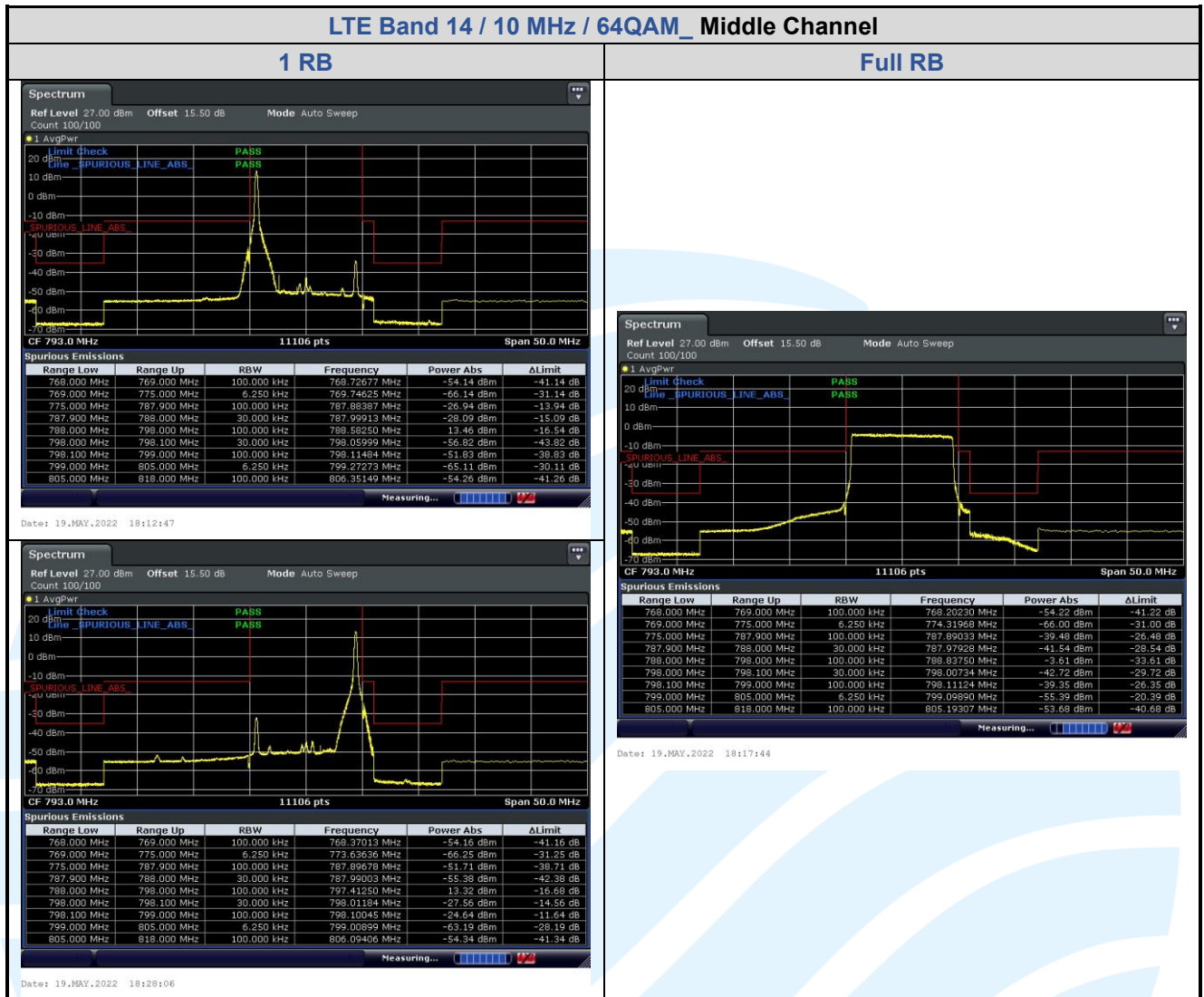












5.5 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Test Requirement: FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.543

Test Method: ANSI C63.26-2015, Clause 5.7

Limit:

The minimum permissible attenuation level of any spurious emissions is $43 + 10 \log (P)$ dB where transmitting power (P) in Watts.

Test Procedure:

The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range. b. Measuring frequency range is from 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Set RBW & VBW to 100 kHz for the measurement below 1 GHz, and 1 MHz for the measurement above 1 GHz.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.2.2 for details.

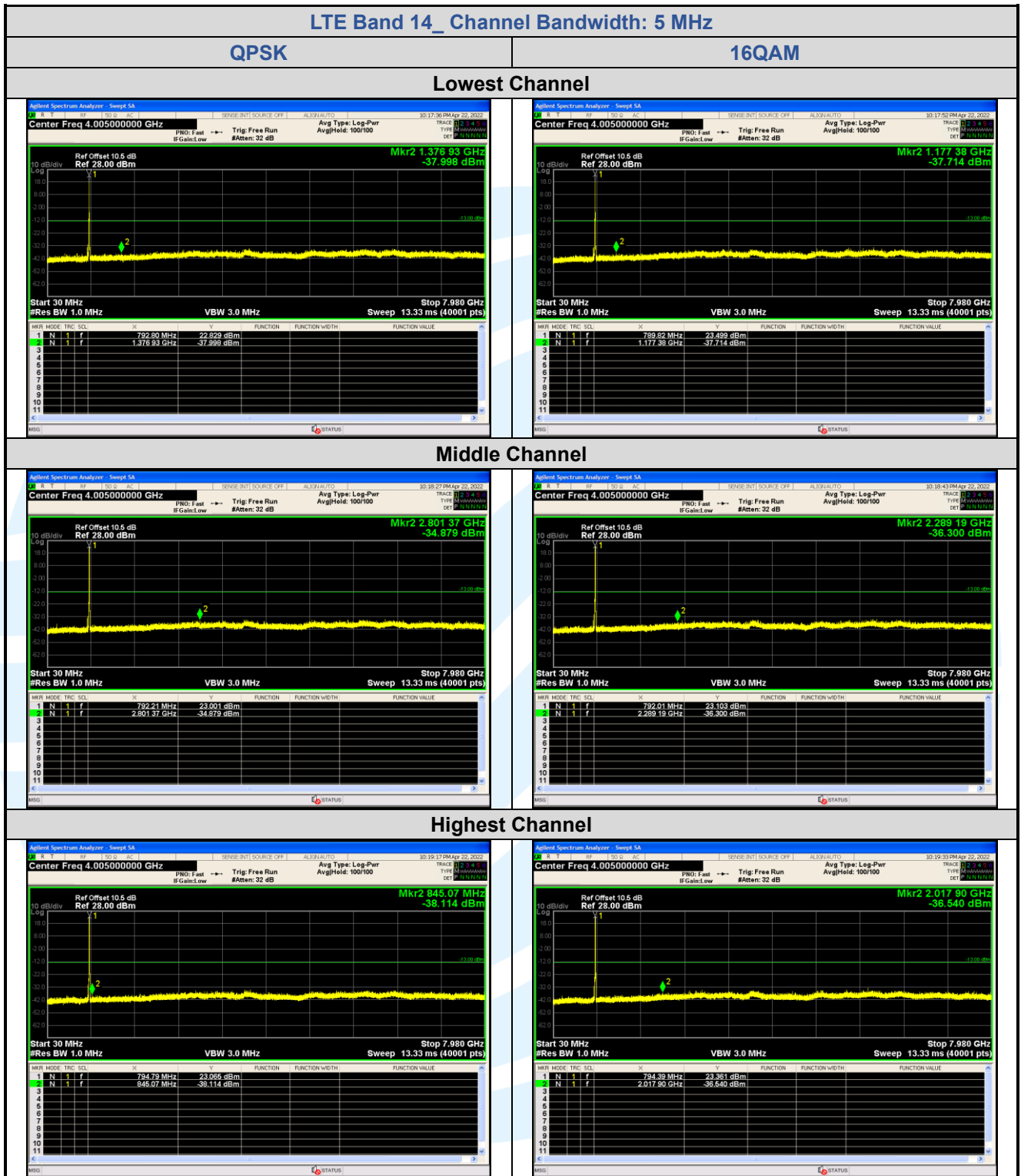
Instruments Used: Refer to section 3 for details

Test Mode: Link mode

Test Results: Pass

Test Data: Please refer to Appendix A

The test plot as follows:



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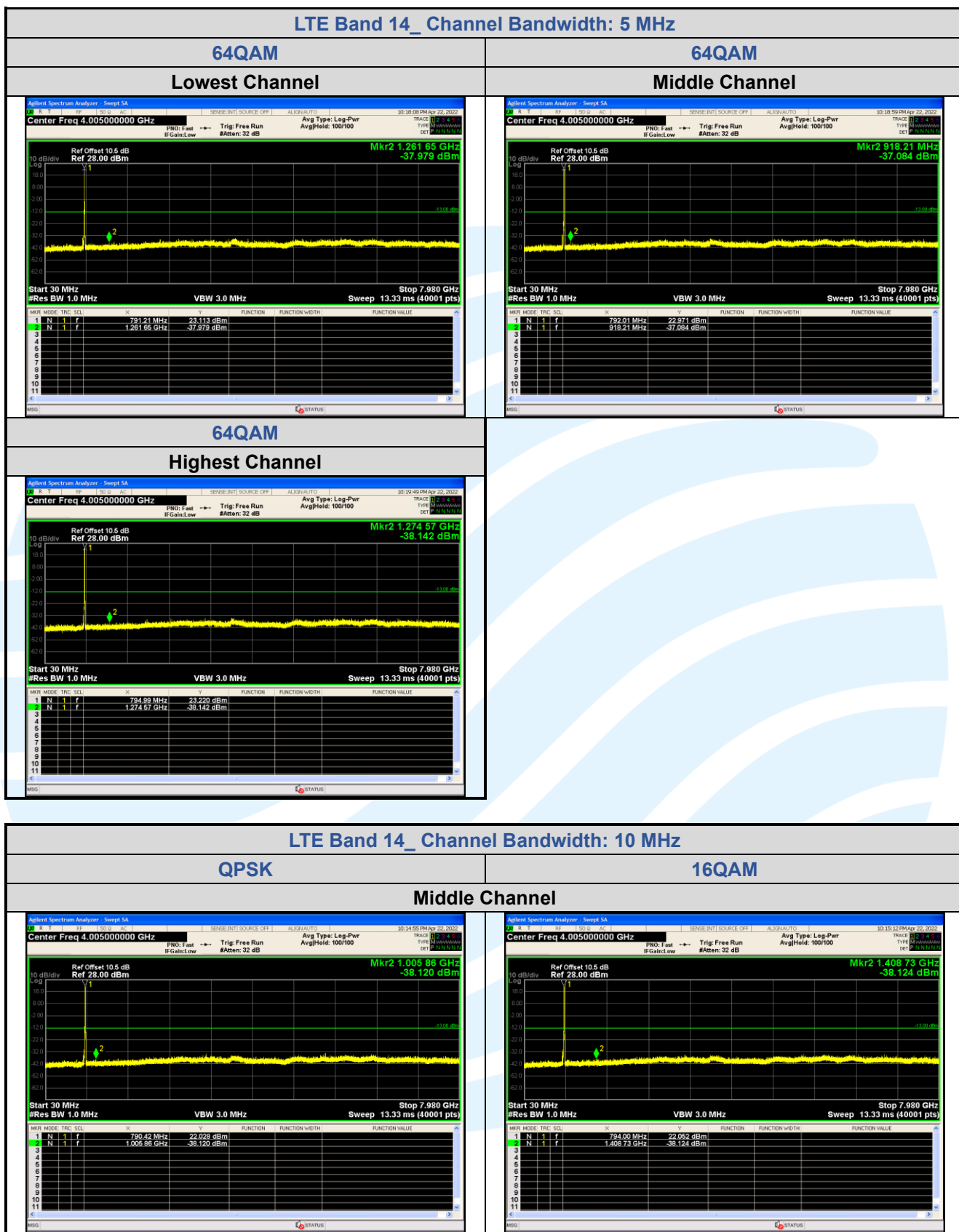
Tel: +86-755-28230888

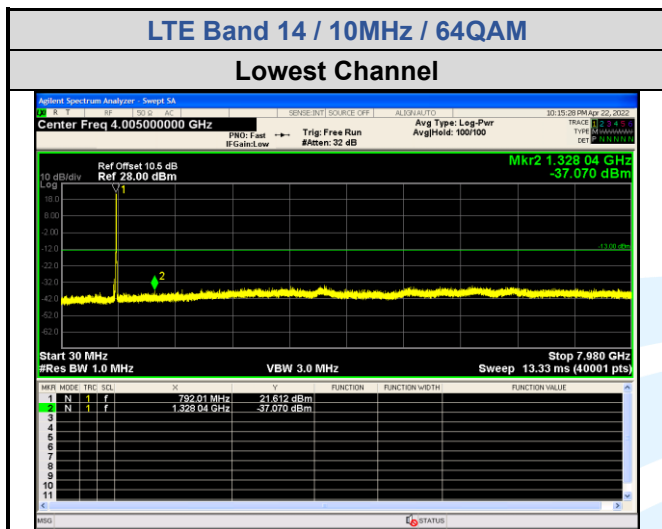
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Note: Radiated data in section 5.6 compliance with narrowband limits for GPS 1559-1610MHz band.

5.6 FIELD STRENGTH OF SPURIOUS RADIATION

Test Requirement: FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.543

Test Method: ANSI C63.26-2015, Clause 5.5

Limits:

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

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

Test Setup: Refer to section 4.2.1 for details.

Test Procedures:

1. Scan up to 10th harmonic, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.

Test procedure as below:

- 1) The EUT was powered ON and placed on a 0.8/1.5m high table at a 3 meter semi/fully Anechoic Chamber. The antenna of the transmitter was extended to its maximum length. Modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.
- 2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 3) The disturbance of the transmitter was maximized on the test receiver display by raising and lowering from 1m to 4m the receive antenna and by rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
- 4) Steps 1) to 3) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
- 5) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
- 6) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 3) is obtained for this set of conditions.
- 7) The output power into the substitution antenna was then measured.
- 8) Steps 6) and 7) were repeated with both antennas polarized.
- 9) Calculate power in dBm by the following formula:

$$\text{ERP(dBm)} = \text{Pg(dBm)} - \text{cable loss (dB)} + \text{antenna gain (dBd)}$$

$$\text{EIRP(dBm)} = \text{Pg(dBm)} - \text{cable loss (dB)} + \text{antenna gain (dBi)}$$

$$\text{EIRP} = \text{ERP} + 2.15\text{dB}$$

where:

Pg is the generator output power into the substitution antenna.

- 10) Test the EUT in the lowest channel, the middle channel the Highest channel
- 11) The radiation measurements are performed in X, Y, Z axis positioning for EUT operation mode, and found the Y axis positioning which it is worse case.
- 1) Repeat above procedures until all frequencies measured was complete.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

The measurement data as follows:

No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB/m)	Result (dBm)	Limit (dBm)	Margin (dB)	Ant. Pol.
LTE Band 14 / 5 MHz / QPSK _ Lowest Channel							
1	488.326	-88.1	35.7	-52.5	-13.0	-39.5	Horizontal
2	765.648	-88.4	41.0	-47.4	-13.0	-34.4	Horizontal
3	919.132	-87.9	42.9	-45.0	-13.0	-32.0	Horizontal
4	1581	-66.2	-0.2	-66.4	-40.0	-26.4	Horizontal
5	2371.5	-66.2	3.2	-63.0	-13.0	-50.0	Horizontal
6	590.351	-89.1	38.0	-51.2	-13.0	-38.2	Vertical
7	744.427	-87.9	40.8	-47.1	-13.0	-34.1	Vertical
8	958.714	-87.7	43.0	-44.6	-13.0	-31.6	Vertical
9	1581	-65.4	-0.2	-65.6	-40.0	-25.6	Vertical
10	2371.5	-66.0	3.2	-62.8	-13.0	-49.8	Vertical
LTE Band 14 / 5 MHz / QPSK _ Middle Channel							
1	582.112	-89.7	37.5	-52.2	-13.0	-39.2	Horizontal
2	679.435	-89.4	39.8	-49.5	-13.0	-36.5	Horizontal
3	945.334	-87.7	43.0	-44.7	-13.0	-31.7	Horizontal
4	1586	-67.5	-0.2	-67.6	-40.0	-27.6	Horizontal
5	2379	-66.7	3.3	-63.4	-13.0	-50.4	Horizontal
6	573.988	-89.4	37.5	-51.9	-13.0	-38.9	Vertical
7	693.91	-88.6	40.3	-48.3	-13.0	-35.3	Vertical
8	906.304	-87.8	42.8	-45.0	-13.0	-32.0	Vertical
9	1586	-65.7	-0.2	-65.9	-40.0	-25.9	Vertical
10	2379	-65.6	3.3	-62.3	-13.0	-49.3	Vertical
LTE Band 14 / 5 MHz / QPSK _ Highest Channel							
1	665.261	-88.8	39.8	-49.0	-13.0	-36.0	Horizontal
2	723.793	-88.7	40.7	-48.0	-13.0	-35.0	Horizontal
3	986.044	-87.5	43.3	-44.2	-13.0	-31.2	Horizontal
4	1591	-64.3	-0.2	-64.4	-40.0	-24.4	Horizontal
5	2386.5	-65.8	3.3	-62.5	-13.0	-49.5	Horizontal
6	458.399	-90.3	34.9	-55.4	-13.0	-42.4	Vertical
7	655.977	-88.5	39.5	-49.0	-13.0	-36.0	Vertical
8	932.141	-87.5	42.9	-44.6	-13.0	-31.6	Vertical
9	1591	-64.8	-0.2	-64.9	-40.0	-24.9	Vertical
10	2386.5	-65.8	3.3	-62.6	-13.0	-49.6	Vertical

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No.	Frequency (MHz)	Reading (dBm)	Correction factor (dB/m)	Result (dBm)	Limit (dBm)	Margin (dB)	Ant. Pol.
LTE Band 14 / 10 MHz / QPSK_ Middle Channel							
1	346.074	-89.1	32.6	-56.5	-13.0	-43.5	Horizontal
2	651.383	-88.3	39.4	-48.9	-13.0	-35.9	Horizontal
3	932.141	-86.5	42.9	-43.6	-13.0	-30.6	Horizontal
4	1586	-64.7	-0.2	-64.9	-40.0	-24.9	Horizontal
5	2379	-66.2	3.3	-62.9	-13.0	-49.9	Horizontal
6	542.61	-89.2	37.1	-52.1	-13.0	-39.1	Vertical
7	660.602	-88.8	39.6	-49.3	-13.0	-36.3	Vertical
8	919.132	-87.3	42.9	-44.5	-13.0	-31.5	Vertical
9	1586	-64.7	-0.2	-64.9	-40.0	-24.9	Vertical
10	2379	-65.7	3.3	-62.4	-13.0	-49.4	Vertical

Note: Emissions in the GPS band were wideband emissions therefore the -40 dBm/MHz limit was used.

5.7 FREQUENCY STABILITY

Test Requirement: FCC 47 CFR Part 2.1055, FCC 47 CFR Part 90.539

Test Method: ANSI C63.26-2015, Clause 5.6

Limits:

The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 parts per million or better when AFC is locked to a base station, and 5 parts per million or better when AFC is not locked.

Test Setup: Refer to section 4.2.2 for details.

Test Procedures:

- 1) Use CMW 500 with Frequency Error measurement capability.
 - a) Temp. = -30° to +50°C
 - b) Voltage = low voltage, 3.4 Vdc, Normal, 3.85 Vdc and High voltage, 4.4 Vdc.

2) Frequency Stability vs Temperature:

The EUT is placed inside a temperature chamber. The temperature is set to 20°C and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured. The temperature is increased by 10 degrees, allowed to stabilize and soak, and then the measurement is repeated. This is repeated until +50°C is reached.

3) Frequency Stability vs Voltage:

The peak frequency error is recorded (worst-case).

Equipment Used: Refer to section 3 for details.

Test Result: Pass

Modulation	Channel/ Frequency (MHz)	Voltage (Vdc)	Temperature (°C)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Pass/ Fail
LTE Band 14 / 10MHz / Full RB							
QPSK	23330 / 793	VL	TN	-5	-0.0063	± 1.25	Pass
		VN		-6	-0.0076		Pass
		VH		-7	-0.0088		Pass
		VN	50	-4	-0.0050		Pass
			40	-7	-0.0088		Pass
			30	-6	-0.0076		Pass
			20	-2	-0.0025		Pass
			10	-6	-0.0076		Pass
			0	-4	-0.0050		Pass
			-10	-6	-0.0076		Pass
			-20	-6	-0.0076		Pass
			-30	-7	-0.0088		Pass

5.8 PEAK-TO-AVERAGE RATIO

Test Method: ANSI C63.26-2015, Clause 5.2.3.4

Limit: In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB

Test Procedure:

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer.

- Set resolution/measurement bandwidth $\geq$ signal's occupied bandwidth
- Set the number of counts to a value that stabilizes the measured CCDF curve
- Record the maximum PAPR level associated with a probability of 0.1 %

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.2.2 for details.

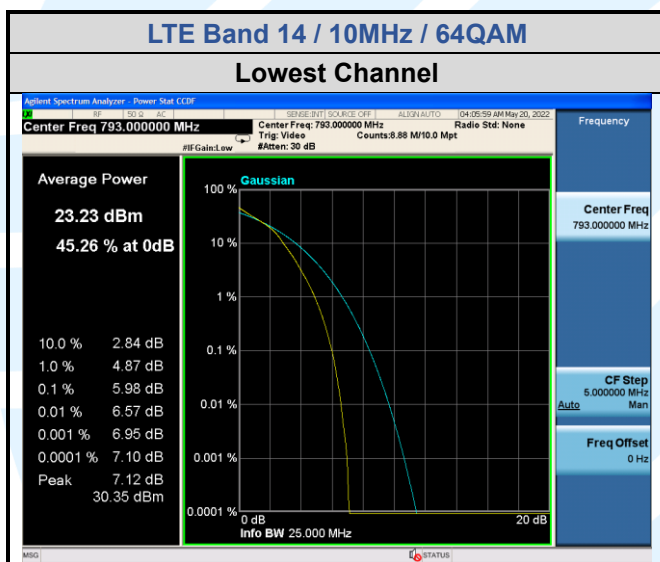
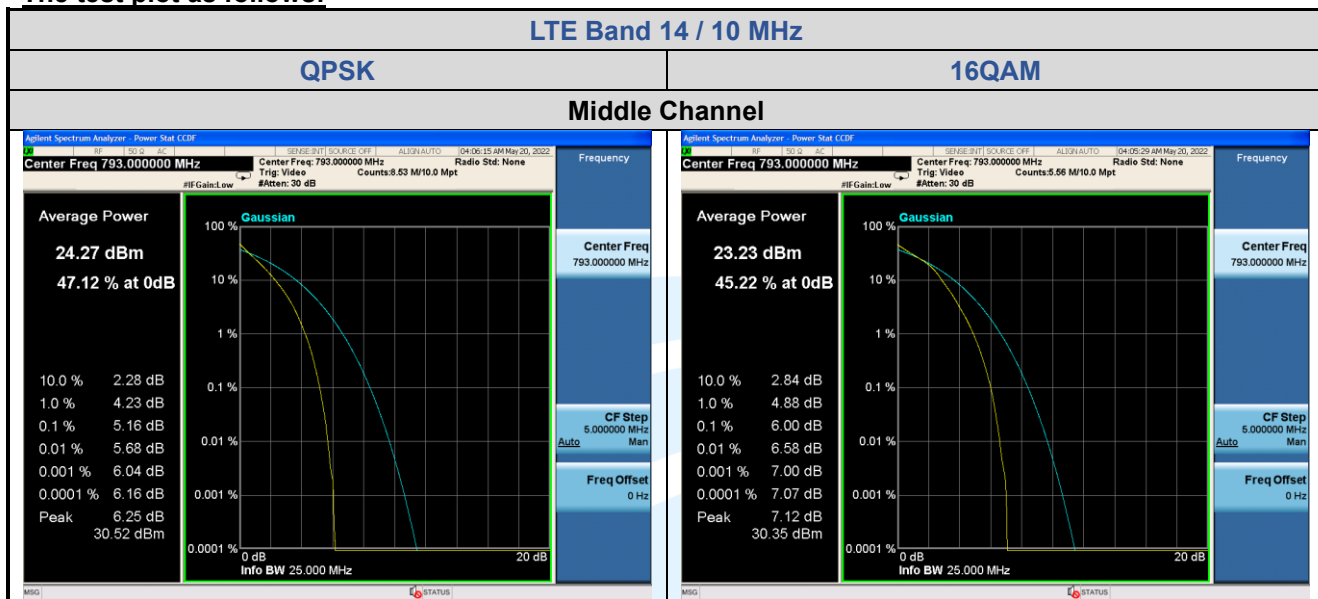
Instruments Used: Refer to section 3 for details

Test Mode: Link mode

Test Results: Pass

LTE Band 14 Peak-to-average ratio (dB)						
Channel	RB Configuration	Channel Bandwidth: 10 MHz			Limit (dB)	Result
		QPSK	16QAM	64QAM		
Middle	Full RB	5.16	4.88	5.98	13	Pass

The test plot as follows:



APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***

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