

CERTIFICATION TEST REPORT

Report Number. : 4790748041-E5V4

Applicant : SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA

Model : SM-F946U, SM-F946U1

FCC ID : A3LSMF946U

EUT Description : GSM/WCDMA/LTE 5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax,
NFC, WPT and UWB

Test Standard(s) : FCC CFR47 PART 96

Date Of Issue:

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: GSM/WCDMA/LTE 5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, NFC, WPT and UWB.

MODEL NUMBER: SM-F946U, SM-F946U1

SERIAL NUMBER: R3CW20L0JZE, R3CW20NZV7D, R3CW20Nzt2K, R3CW20NZ4CT (CONDUCTED); R3CW20P0BMZ, R3CW20P0AZT, R3CW30K7FDD (RADIATED);

DATE TESTED: 2023-03-13 - 2023-05-15;

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 96	Complies

UL KOREA LTD. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL KOREA LTD. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL KOREA LTD. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL KOREA LTD. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL KOREA LTD. By:



Seokhwan Hong
Suwon Lab Engineer
UL KOREA LTD.

Tested By:



Yeonhee Lim
Suwon Lab Engineer
UL KOREA LTD.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 96.
3. ANSI TIA-603-E, 2016
4. ANSI C63.26, 2015
5. KDB 971168 D01 Power Meas License Digital Systems v03r01
6. KDB 412172 D01 Determining ERP and EIRP v01r01

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

218 Maeyeong-ro	
<input checked="" type="checkbox"/>	Chamber 1(3m semi-anechoic chamber)
<input checked="" type="checkbox"/>	Chamber 2(3m semi-anechoic chamber)
<input type="checkbox"/>	Chamber 3(3m semi-anechoic chamber)
<input checked="" type="checkbox"/>	Chamber 4(3m Full-anechoic chamber)
<input type="checkbox"/>	Chamber 5(3m Full-anechoic chamber)

UL KOREA LTD. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at <https://www.iasonline.org/wp-content/uploads/2017/05/TL-637-cert-New.pdf>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\text{EIRP} = \text{PSA reading with EUT worst orientation (dBm)} + \text{Path loss (dB)} - \text{cable loss (between the SG and substitution antenna)} + \text{Substitution Antenna Factor (dBi)}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	2.80 dB
Radiated Disturbance, 30 MHz to 1 GHz	3.92 dB
Radiated Disturbance, 1 GHz to 18 GHz	5.06 dB
Radiated Disturbance, Above 18 GHz	6.02 dB

Uncertainty figures are valid to a confidence level of 95%.

4.4. DECISION RULE

Decision rule for statement(s) of conformity is based on Procedure 2, Clause 4.4.3 in IEC Guide 115:2021.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE 5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax, NFC, WPT and UWB. This test report addresses the WWAN operational mode.

Representative model	Difference	Derivative model
		SM-F946U1
SM-F946U	Hardware	Same as SM-F946U
	Software	Different U.I

Thus, SM-F946U was set for final test.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum average radiated EIRP output powers as follows:

LTE Band 48

FCC Part 96							
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 48	3560 - 3690	20	QPSK	22.99	199.07	21.25	133.35
			16QAM	22.13	163.31	20.71	117.76
			64QAM	20.97	125.03		
			256QAM	17.95	62.37		
	3557.5 -3692.5	15	QPSK	22.98	198.61	20.89	122.74
			16QAM	22.51	178.24	20.83	121.06
			64QAM	21.46	139.96		
			256QAM	18.26	66.99		
	3555 - 3695	10	QPSK	23.24	210.86	21.59	144.21
			16QAM	22.62	182.81	20.62	115.35
			64QAM	21.65	146.22		
			256QAM	18.55	71.61		
	3552.5 - 3697.5	5	QPSK	23.25	211.35	21.44	139.32
			16QAM	22.66	184.50	20.24	105.68
			64QAM	21.74	149.28		
			256QAM	18.49	70.63		

LTE Band 48 (UL CA)

Part 96			
EIRP Limit (dBm)	23.0	ANT Gain (dBi)	-3.6

Frequency Range (MHz)	Bandwidth (MHz)	Modulation	Output Power				
			Conducted Average Power (dBm)	Antenna Gain dBi	EIRP Average Power		Margin
					dBm	mW	
3550 ~ 3700	40MHz (20+20)	QPSK	22.42	-3.60	18.82	76.21	-4.18
		16QAM	21.61		18.01	63.24	-4.99
	35MHz (15+20)	QPSK	23.06		19.46	88.31	-3.54
		16QAM	22.04		18.44	69.82	-4.56
	30MHz (10+20)	QPSK	22.39		18.79	75.68	-4.21
		16QAM	21.54		17.94	62.23	-5.06
	25MHz (5+20)	QPSK	22.31		18.71	74.30	-4.29
		16QAM	21.45		17.85	60.95	-5.15

NR Band n48

FCC Part 96								
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Mode	Conducted		Radiated	
					Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
n48	3570 ~ 3679.98	40	DFT-s OFDM	$\pi/2$ BPSK	23.80	239.88		
				QPSK	23.81	240.44	20.14	103.28
				16QAM	22.72	187.07	19.61	91.41
				64QAM	21.06	127.64		
				256QAM	18.91	77.80		
	CP-OFDM	QPSK	22.04	159.96				
	3565.02 ~ 3684.99	30	DFT-s OFDM	$\pi/2$ BPSK	23.53	225.42		
				QPSK	23.55	226.46	20.44	110.66
				16QAM	22.29	169.43	19.79	95.28
				64QAM	21.07	127.94		
				256QAM	18.85	76.74		
	CP-OFDM	QPSK	21.96	157.04				
	3624.99 ~ 3690	20	DFT-s OFDM	$\pi/2$ BPSK	23.55	226.46		
				QPSK	23.55	226.46	20.18	104.23
				16QAM	22.38	172.98	19.65	92.26
				64QAM	21.02	126.47		
				256QAM	18.84	76.56		
	CP-OFDM	QPSK	22.01	158.85				
	3557.52 ~ 3692.49	15	DFT-s OFDM	$\pi/2$ BPSK	23.57	227.51		
				QPSK	23.56	226.99	20.02	100.46
16QAM				22.35	171.79	19.47	88.51	
64QAM				21.01	126.18			
256QAM				18.83	76.38			
CP-OFDM	QPSK	21.98	157.76					
3555 ~ 3694.98	10	DFT-s OFDM	$\pi/2$ BPSK	23.54	225.94			
			QPSK	23.60	229.09	20.27	106.41	
			16QAM	22.33	171.00	19.61	91.41	
			64QAM	20.96	124.74			
			256QAM	18.78	75.51			
CP-OFDM	QPSK	21.94	156.31					

NR Band n48(SRS1)

FCC Part 96						
Band	Frequency Range [MHz]	BandWidth [MHz]	Conducted		Radiated (ANT D)	
			Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
n48	3570.00 ~ 3679.98	40	19.49	88.92		
	3565.02 ~ 3684.99	30	19.83	96.16	15.33	34.12
	3560.00 ~ 3690.00	20	19.27	84.53		
	3575.52 ~ 3692.49	15	19.54	89.95		
	3555.00 ~ 3694.98	10	19.64	92.04		

NR Band n48(SRS2)

FCC Part 96						
Band	Frequency Range [MHz]	BandWidth [MHz]	Conducted		Radiated (ANT G)	
			Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
n48	3570.00 ~ 3679.98	40	23.76	237.68	18.58	72.11
	3565.02 ~ 3684.99	30	23.71	234.96		
	3560.00 ~ 3690.00	20	23.52	224.91		
	3575.52 ~ 3692.49	15	23.59	228.56		
	3555.00 ~ 3694.98	10	23.53	225.42		

NR Band n48(SRS3)

FCC Part 96						
Band	Frequency Range [MHz]	BandWidth [MHz]	Conducted		Radiated (ANT A)	
			Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
n48	3570.00 ~ 3679.98	40	20.39	109.40		
	3565.02 ~ 3684.99	30	20.67	116.68		
	3560.00 ~ 3690.00	20	20.81	120.50	17.02	50.35
	3575.52 ~ 3692.49	15	20.77	119.40		
	3555.00 ~ 3694.98	10	20.59	114.55		

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a internal antenna for the supported bands with a maximum peak gain as follow:

Frequency (MHz)	Peak Gain (dBi)
LTE Band 48/ NR Band n48 3550 ~ 3700 MHz	-3.60 (ANT F)_Main
	-5.30 (ANT D)
	-4.50 (ANT G)
	-5.80 (ANT A)

5.4. WORST-CASE ORIENTATION

Following modes should be considered as worst-case scenario for all other measurements.

For all LTE Band 48, the worst-case scenario for all measurements is based on the average conducted output power measurement investigation results. Output power measurements were measured on QPSK, 16QAM, 64QAM and 256QAM modulations. However, the out of band emissions and spurious radiation were only performed on bandwidth and RB offset(with RB size 1) with the highest power in QPSK.

For all 5G NR Band n48, the worst-case scenario for all measurements is based on the Average conducted output power measurement investigation results. Output power measurements were measured on $\pi/2$ BPSK, QPSK, 16QAM, 64QAM and 256QAM modulations. It was found that QPSK and 16QAM results were worst case.

Both SA and NSA Modes were tested and worst case is reported. the out of band emissions and spurious radiation were only performed on bandwidth and RB offset(with RB size 1) with the highest conducted power.

- NR Worst case

BAND	NSA or SA
n48	NSA

This device supports SRS (sounding reference signal) 1, 2, 3 Mode for NR TDD bands. For each SRS 1, 2 and 3, Conducted power and radiated measurement were performed through FTM Mode provide by the customer. The worst-case scenario for all measurements is based on the average conducted output power measurement investigation results. SRS1,2,3 the worstcase scenario was radiated tested and reported

● Conducted Spurious Emission

Highest output power setting for each bands				
LTE Band	Frequency (MHz)	Bandwidth (MHz)	RB size	RB offset
48	3552.5	5	1	0
	3625.0		1	24
	3697.5		1	12
NR Band	Frequency (MHz)	Bandwidth (MHz)	RB size	RB offset
48	3570.0	40	1	104
	3625.0		1	104
	3680.0		1	104

● Radiated Spurious Emission

Highest output power setting for each bands				
LTE Band	Frequency (MHz)	Bandwidth (MHz)	RB size	RB offset
48	3555.0	10	1	0
	3625.0		1	25
	3695.0		1	25
NR Band	Frequency (MHz)	Bandwidth (MHz)	RB size	RB offset
48	3565.0	30	1	76
	3625.0		1	76
	3685.0		1	76

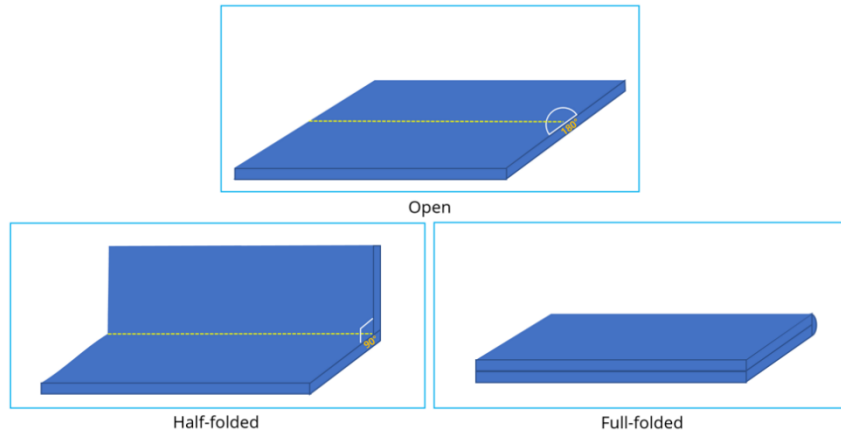
● Uplink CA

Highest conducted output power setting for each bands					
LTE Band	Component Carrier	Frequency (MHz)	Bandwidth (MHz)	RB size	RB offset
48C	PCC	3560.0	20	1	99
	SCC	3580.0	20	1	0

For LTE anchor, the band with highest output power was chosen among the possible combinations with NR Bands.

NR Band	LTE Band
48	2, <u>66</u>

The fundamental and radiated spurious emission were investigated in three orthogonal orientations X, Y and Z, it was determined that below orientation was worst-case orientation for each band.



Band	ANT	EIRP			RSE		
		X	Y	Z	X	Y	Z
LTE B48	B	Open	-	-	-	-	Open
NR n48	B	-	Half-folded	-	-	-	Open
	D	Open	-	-	Open	-	-
	G	Open	-	-	Open	-	-
	A	Open	-	-	-	-	Open
LTE B48C(UL CA)	B				-	-	Open

Note : For EIRP testing, the EUT didn't attached with travel adapter. But radiated spurious testing, the EUT attached with travel adapter for the worst case condition. The EUT is continuously communicated with the call box during the tests.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacture	Model	Serial Number	FCC ID
Charger	SAMSUNG	EP-TA800	R37N9QP4SL9DK3	N/A
Data Cable	SAMSUNG	WBR0062M	GH39-02112A	N/A

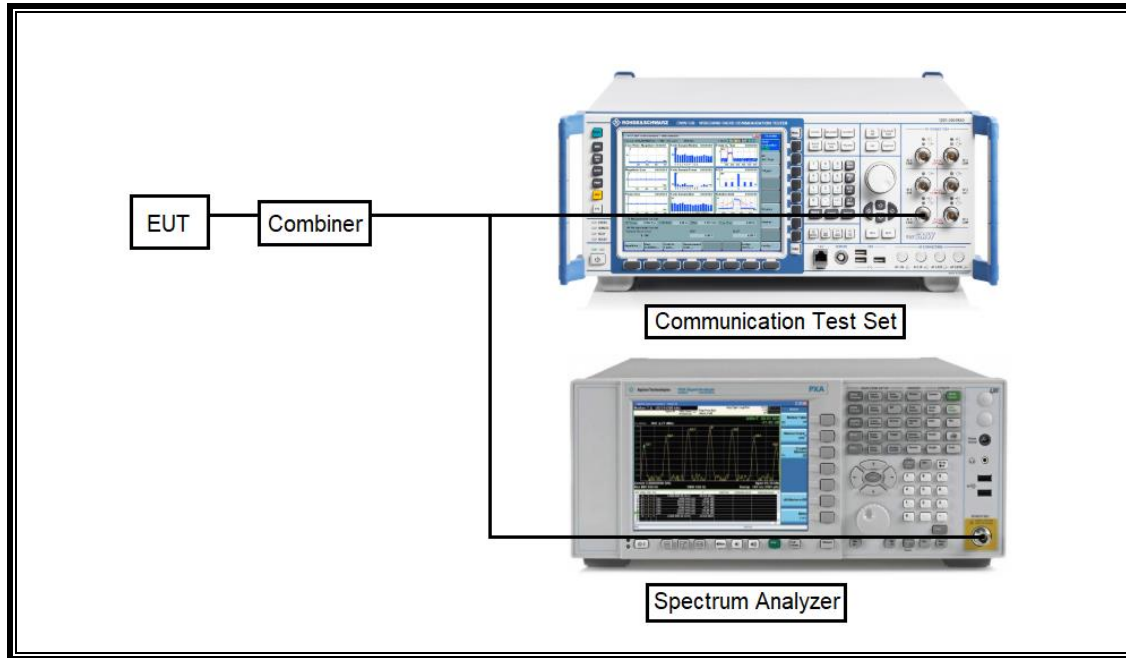
I/O CABLE

I/O Cable List						
Cable No.	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC Power	1	C Type	Shielded	1.0 m	N/A

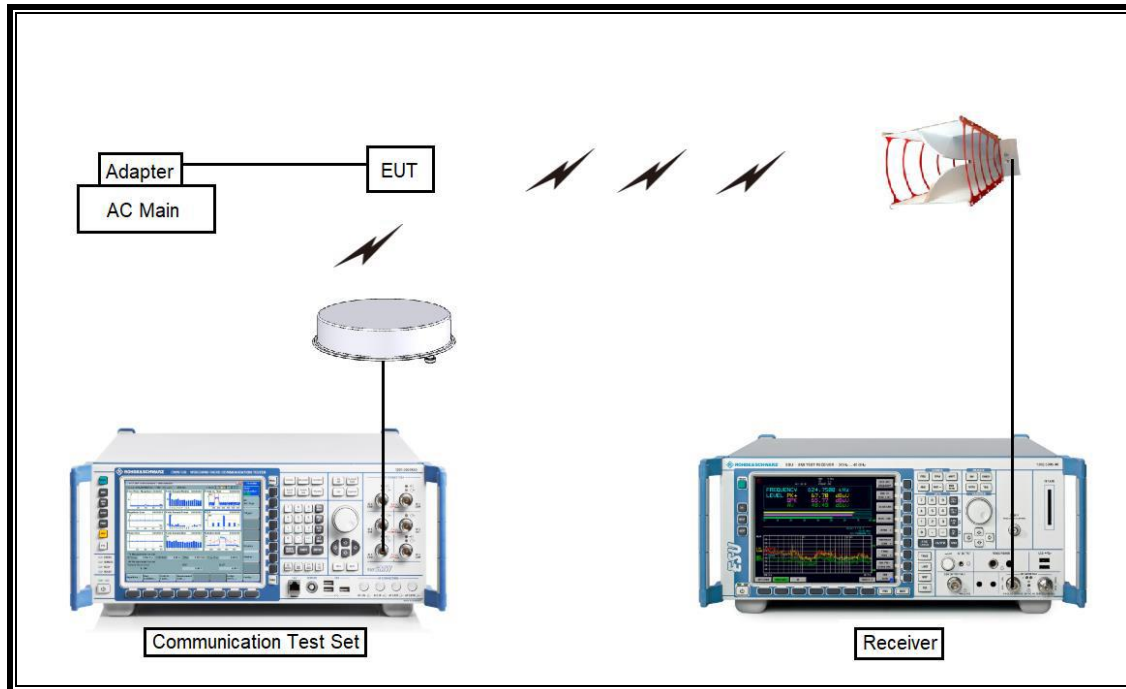
TEST SETUP

The EUT is continuously communicated with the call box during the tests.

SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)



SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	Manufacturer	Model	S/N	Cal Due
Antenna, Tuned Dipole 400-1000 MHz	ETS	3121D DB4	00164753	2025-01-17
Directional Antenna	Cobham	FPA3-0.8-6.0R/1329	110367-0003	N/A
Directional Antenna	Cobham	FPA3-0.8-6.0R/1329	80108-0004	N/A
Antenna, Horn, 40 GHz	ETS	3116C	00168645	2023-10-13
Preamplifier	ETS	3115-PA	00167475	2023-08-04
Preamplifier	ETS	3116C-PA	00168841	2023-08-04
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	2024-08-15
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	845	2024-08-15
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	2024-08-15
Antenna, Horn, 18 GHz	ETS	3115	00161451	2024-08-21
Antenna, Horn, 18 GHz	ETS	3117	00168717	2024-08-21
Communications Test Set	R&S	CMW500	169796	2024-01-05
DC Power Supply	Agilent / HP	E3640A	MY54226395	2023-08-02
Preamplifier, 1000 MHz	Sonoma	310N	341282	2023-08-02
Preamplifier, 1000 MHz	Sonoma	310N	351741	2023-08-02
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	2029169	2023-08-01
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	2023-08-01
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	2023-08-03
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	2023-08-01
Spectrum Analyzer, 44 GHz	KEYSIGHT	N9030B	MY60070693	2024-01-09
EMI Test Receive, 40 GHz	R&S	ESU40	100439	2023-08-02
EMI Test Receive, 40 GHz	R&S	ESU40	100457	2023-07-29
High Pass Filter 1.2GHz	Micro-Tronics	HPM50108-02	G005	2023-08-01
High Pass Filter 1.2GHz	Micro-Tronics	HPM50108-02	G006	2023-08-01
High Pass Filter 2.8GHz	Micro-Tronics	HPM50111-02	010	2023-08-01
High Pass Filter 2.8GHz	Micro-Tronics	HPM50111-02	011	2023-08-01
High Pass Filter 4GHz	Micro-Tronics	HPM50118-02	G001	2023-08-01
High Pass Filter 4GHz	Micro-Tronics	HPM50118-02	G002	2023-08-01
Attenuator	PASTERNAK	PE7087-10	A009	2023-08-03
Attenuator	PASTERNAK	PE7087-10	A001	2023-08-03
Attenuator	PASTERNAK	PE7087-10	A008	2023-08-03
Attenuator	PASTERNAK	PE7004-10	2	2023-08-01
Attenuator	PASTERNAK	PE7395-10	A011	2023-08-03
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	2023-10-06
Temperature Chamber	ESPEC	SH-642	93001109	2023-08-01
Power Splitter	MINI-CIRCUITS	WA1534	UL003	2024-01-09
Power Splitter	MINI-CIRCUITS	WA1534	UL004	2024-01-09
UXM 5G Wireless Test Platform	KEYSIGHT	E7515B	MY57510655	2024-01-09
UXM 5G Wireless Test Platform	KEYSIGHT	E7515B	MY58010202	2024-01-27
UXM 5G Wireless Test Platform	KEYSIGHT	E7515B	MY58460570	2023-12-08
UL Software				
Description	Manufacturer	Model	Version	
Antenna port test software	UL	CLT	Ver 3.4	
Radiated software	UL	UL EMC	Ver 9.5	
Antenna port test software (5G NR FR1)	UL	UL iM	Ver 1.06	

7. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
2.1049	Occupied Bandwidth(99%)	N/A	Conducted	Complies
2.1046	Conducted output power	N/A		Complies
2.1051 96.41(e)(ii)	Out of band emissions	Section 9.2 & 9.3		Complies
2.1055	Frequency Stability	Fundamental emissions stay within authorized frequency block		Complies
96.47	End user device additional requirements (CBSD Protocol)	Section 9.5		Not performed ^{Note}
96.41(b)	Equivalent Isotropic Radiated Power	23 dBm/10 MHz	Radiated	Complies
2.1053 96.41(e)	Radiated Spurious Emission	-40 dBm/MHz		Complies

Note. Please refer to CBSD Protocol test report. See the Section 9.5

8. CONDUCTED RESULTES

8.1. CONDUCTED AND EIRP VERIFICATION

Test Procedurer

TIA-603-E Clause 2.2.17
KDB 971168 Section 5.6

$$\text{EIRP} = P_{\text{Meas}} + G_{\text{T}} - L_{\text{C}}$$

where:

EIRP = effective or equivalent radiated power, respectively (expressed in the same units as P_{Meas} , typically dBW or dBm);

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

G_{T} = gain of the transmitting antenna, in dBi (EIRP);

L_{C} = signal attenuation in the connecting cable between the transmitter and antenna, in dB.2

RESULTS

EUT includes different power levels for head use configuration and body use configuration and the below tables contain the highest of all configurations average conducted output powers as follows:

LTE Band 48

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				
				Measured Pwr (dBm)			MPR	Tune-up Limit
				55340	55990	56640		
				3560 MHz	3625 MHz	3690 MHz		
20 MHz	QPSK	1	0	21.83	22.47	22.85	0.0	24.0
		1	49	22.08	22.50	22.99	0.0	24.0
		1	99	22.13	22.55	22.88	0.0	24.0
		50	0	21.17	21.90	22.03	1.0	23.0
		50	24	21.20	21.50	21.87	1.0	23.0
		50	50	21.37	20.61	21.92	1.0	23.0
	100	0	21.50	21.57	21.74	1.0	23.0	
	16QAM	1	0	20.83	21.45	21.95	1.0	23.0
		1	49	21.03	21.43	21.94	1.0	23.0
		1	99	21.10	21.67	22.13	1.0	23.0
		50	0	20.22	20.42	20.86	2.0	22.0
		50	24	20.14	20.40	20.84	2.0	22.0
		50	50	20.31	20.51	20.95	2.0	22.0
	100	0	20.25	20.52	20.83	2.0	22.0	
	64QAM	1	0	20.03	20.35	20.77	2.0	22.0
		1	49	20.14	20.67	20.95	2.0	22.0
		1	99	20.17	20.72	20.97	2.0	22.0
		50	0	19.12	19.45	19.85	3.0	21.0
		50	24	19.26	19.53	19.92	3.0	21.0
		50	50	19.24	19.55	19.95	3.0	21.0
	100	0	19.25	19.48	19.85	3.0	21.0	
	256QAM	1	0	17.22	17.55	17.79	5.0	19.0
		1	49	17.25	17.49	17.80	5.0	19.0
		1	99	17.33	17.55	17.89	5.0	19.0
50		0	17.09	17.54	17.79	5.0	19.0	
50		24	17.26	17.65	17.93	5.0	19.0	
50		50	17.27	17.70	17.95	5.0	19.0	
100	0	17.21	17.54	17.80	5.0	19.0		
BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
				55315	55990	56665		
				3557.5 MHz	3625 MHz	3692.5 MHz		
				15 MHz	QPSK	1	0	22.08
1	37	22.06	22.57			22.98	0.0	24.0
1	74	22.18	22.67			22.97	0.0	24.0
36	0	21.08	21.54			22.06	1.0	23.0
36	20	21.14	21.51			22.07	1.0	23.0
36	39	21.23	21.65			22.05	1.0	23.0
75	0	21.18	21.49		21.98	1.0	23.0	
16QAM	1	0	21.28		21.87	22.51	1.0	23.0
	1	37	21.41		21.84	22.38	1.0	23.0
	1	74	21.47		21.88	22.45	1.0	23.0
	36	0	20.12		20.58	21.05	2.0	22.0
	36	20	20.23		20.56	21.00	2.0	22.0
	36	39	20.28		20.68	21.13	2.0	22.0
75	0	20.13	20.57		21.00	2.0	22.0	
64QAM	1	0	20.32		20.80	21.22	2.0	22.0
	1	37	20.34		20.71	21.46	2.0	22.0
	1	74	20.20		20.75	21.32	2.0	22.0
	36	0	19.00		19.63	19.97	3.0	21.0
	36	20	19.20		19.55	19.98	3.0	21.0
	36	39	19.15		19.73	20.13	3.0	21.0
75	0	19.24	19.66		20.00	3.0	21.0	
256QAM	1	0	17.21		17.69	18.11	5.0	19.0
	1	37	17.35		17.50	18.26	5.0	19.0
	1	74	17.32		17.93	18.20	5.0	19.0
	36	0	17.08	17.55	17.99	5.0	19.0	
	36	20	17.13	17.65	17.94	5.0	19.0	
	36	39	17.16	17.65	18.10	5.0	19.0	
75	0	17.13	17.54	18.02	5.0	19.0		

BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit	
				55290	55990	56690			
				3555 MHz	3625 MHz	3695 MHz			
10 MHz	QPSK	1	0	22.23	22.77	23.05	0.0	24.0	
		1	25	22.37	22.72	23.24	0.0	24.0	
		1	49	22.40	22.87	23.19	0.0	24.0	
		25	0	21.34	21.68	22.14	1.0	23.0	
		25	12	21.37	21.74	22.31	1.0	23.0	
		25	25	21.38	21.79	22.15	1.0	23.0	
	16QAM	50	0	21.30	21.68	22.23	1.0	23.0	
		1	0	21.58	21.88	22.62	1.0	23.0	
		1	25	21.68	22.12	22.62	1.0	23.0	
		1	49	21.79	22.03	22.58	1.0	23.0	
		25	0	20.36	20.78	21.14	2.0	22.0	
		25	12	20.48	20.79	21.22	2.0	22.0	
	64QAM	25	25	20.43	20.97	21.17	2.0	22.0	
		50	0	20.38	20.72	21.23	2.0	22.0	
		1	0	20.46	20.82	21.59	2.0	22.0	
		1	25	20.56	21.20	21.53	2.0	22.0	
		1	49	20.56	20.96	21.65	2.0	22.0	
		25	0	19.39	19.79	20.12	3.0	21.0	
	256QAM	25	12	19.43	19.67	20.30	3.0	21.0	
		25	25	19.31	19.86	20.27	3.0	21.0	
		50	0	19.22	19.80	20.32	3.0	21.0	
		1	0	17.11	17.97	18.43	5.0	19.0	
		1	25	17.47	18.11	18.55	5.0	19.0	
		1	49	17.56	17.92	18.31	5.0	19.0	
5 MHz	QPSK	25	0	17.20	17.60	18.09	5.0	19.0	
		25	12	17.42	17.70	18.26	5.0	19.0	
		25	25	17.45	17.77	18.29	5.0	19.0	
		50	0	17.31	17.64	18.15	5.0	19.0	
		16QAM	1	0	22.25	22.54	23.18	0.0	24.0
			1	12	22.16	22.62	23.25	0.0	24.0
	1		24	22.06	22.63	23.21	0.0	24.0	
	12		0	21.04	21.58	22.19	1.0	23.0	
	12		7	21.24	21.67	22.14	1.0	23.0	
	12		13	21.19	21.76	22.11	1.0	23.0	
	64QAM	25	0	21.22	21.61	22.20	1.0	23.0	
		1	0	21.45	22.00	22.49	1.0	23.0	
		1	12	21.79	22.17	22.66	1.0	23.0	
		1	24	21.81	21.94	22.66	1.0	23.0	
		12	0	20.38	20.65	21.26	2.0	22.0	
		12	7	20.22	20.68	21.38	2.0	22.0	
	256QAM	12	13	20.30	20.83	21.32	2.0	22.0	
		25	0	20.17	20.64	21.21	2.0	22.0	
		1	0	20.59	21.02	21.65	2.0	22.0	
		1	12	20.81	21.05	21.74	2.0	22.0	
		1	24	20.52	20.90	21.39	2.0	22.0	
		12	0	19.21	19.70	20.30	3.0	21.0	
	16QAM	12	7	19.19	19.82	20.47	3.0	21.0	
		12	13	19.19	19.94	20.37	3.0	21.0	
25		0	19.32	19.71	20.27	3.0	21.0		
1		0	17.39	17.53	18.08	5.0	19.0		
1		12	17.50	17.78	18.37	5.0	19.0		
1		24	17.53	17.51	18.49	5.0	19.0		
QPSK	12	0	17.26	17.68	18.25	5.0	19.0		
	12	7	17.24	17.74	18.28	5.0	19.0		
	12	13	17.32	17.85	18.22	5.0	19.0		
	25	0	17.25	17.68	18.17	5.0	19.0		

LTE Band 48C (UL CA)

Bandwidth	PCC Frequency (MHz)	SCC1 Frequency (MHz)	PCC RB	PCC RB	SCC1 RB	SCC1 RB	Conducted Average Power (dBm)	
			Size	Offset	Size	Offset	QPSK	16QAM
40MHz (20MHz / 20MHz)	3560	3579.8	1	99	1	0	22.34	21.46
			1	0	1	99	14.04	14.18
			100	0	100	0	20.45	19.45
	3615.1	3634.9	1	99	1	0	22.42	21.60
			1	0	1	99	14.03	14.09
			100	0	100	0	20.45	19.51
	3670.2	3690	1	99	1	0	22.36	21.61
			1	0	1	99	13.90	14.23
			100	0	100	0	20.42	19.50

Bandwidth	PCC Frequency (MHz)	SCC1 Frequency (MHz)	PCC RB	PCC RB	SCC1 RB	SCC1 RB	Conducted Average Power (dBm)	
			Size	Offset	Size	Offset	QPSK	16QAM
35MHz (15MHz / 20MHz)	3557.5	3574.6	1	74	1	0	23.06	22.04
			1	0	1	99	14.88	13.87
			75	0	100	0	20.66	19.47
	3615.2	3632.3	1	74	1	0	22.19	21.23
			1	0	1	99	15.05	14.23
			75	0	100	0	20.55	19.48
	3672.9	3690.0	1	74	1	0	22.72	21.84
			1	0	1	99	14.21	13.68
			75	0	100	0	20.84	19.80

Bandwidth	PCC Frequency (MHz)	SCC1 Frequency (MHz)	PCC RB	PCC RB	SCC1 RB	SCC1 RB	Conducted Average Power (dBm)	
			Size	Offset	Size	Offset	QPSK	16QAM
30MHz (10MHz / 20MHz)	3555.0	3569.4	1	49	1	0	22.15	21.29
			1	0	1	99	13.70	13.85
			50	0	100	0	20.25	19.27
	3615.4	3629.8	1	49	1	0	22.20	21.43
			1	0	1	99	14.09	14.25
			50	0	100	0	20.51	19.47
	3675.6	3690.0	1	49	1	0	22.39	21.54
			1	0	1	99	13.90	14.11
			50	0	100	0	20.45	19.46

Bandwidth	PCC Frequency (MHz)	SCC1 Frequency (MHz)	PCC RB	PCC RB	SCC1 RB	SCC1 RB	Conducted Average Power (dBm)	
			Size	Offset	Size	Offset	QPSK	16QAM
25MHz (5MHz / 20MHz)	3552.5	3564.2	1	24	1	0	22.23	21.36
			1	0	1	99	13.70	13.79
			25	0	100	0	20.30	19.35
	3615.6	3627.3	1	24	1	0	22.28	21.45
			1	0	1	99	13.93	14.10
			25	0	100	0	20.47	19.61
	3678.3	3690.0	1	24	1	0	22.31	21.25
			1	0	1	99	13.90	13.97
			25	0	100	0	20.35	19.41

NR Band n48

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					638000	641666	645332		
					3570 MHz	3624.99 MHz	3679.98 MHz		
40 MHz	DFT-s-OFDM	π/2 BPSK	1	1	22.82	23.12	23.56	0.0	24.0
			1	53	22.88	23.39	23.68	0.0	24.0
			1	104	23.05	23.51	23.80	0.0	24.0
			50	0	21.83	22.36	22.63	0.5	23.5
			50	28	22.85	23.29	23.72	0.0	24.0
			50	56	21.98	22.44	22.73	0.5	23.5
		100	0	21.93	22.34	22.64	0.5	23.5	
		QPSK	1	1	22.76	23.06	23.54	0.0	24.0
			1	53	22.82	23.35	23.64	0.0	24.0
			1	104	23.01	23.49	23.81	0.0	24.0
			50	0	21.86	22.30	22.29	1.0	23.0
			50	28	22.92	23.33	22.64	0.0	24.0
			50	56	22.03	22.49	22.73	1.0	23.0
		16QAM	100	n48	21.91	22.35	22.66	1.0	23.0
			1	1	21.69	22.02	22.50	1.0	23.0
		64QAM	1	53	21.74	22.28	22.62	1.0	23.0
			1	104	21.96	22.41	22.72	1.0	23.0
		256QAM	1	1	20.31	20.60	21.06	2.5	21.5
256QAM	1	1	18.12	18.49	18.91	4.5	19.5		
CP-OFDM	QPSK	1	1	21.29	21.62	22.04	1.5	22.5	
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					637668	641666	645666		
					3565.02 MHz	3624.99 MHz	3684.99 MHz		
30 MHz	DFT-s-OFDM	π/2 BPSK	1	1	22.71	23.19	23.46	0.0	24.0
			1	39	22.66	23.19	23.44	0.0	24.0
			1	76	22.76	23.26	23.53	0.0	24.0
			36	0	21.73	22.22	22.52	0.5	23.5
			36	21	22.76	23.23	23.52	0.0	24.0
			36	42	21.89	22.35	22.59	0.5	23.5
		75	0	21.72	22.28	22.55	0.5	23.5	
		QPSK	1	1	22.69	23.18	23.48	0.0	24.0
			1	39	22.63	23.17	23.46	0.0	24.0
			1	76	22.78	23.27	23.54	0.0	24.0
			36	0	21.74	22.26	22.52	1.0	23.0
			36	21	22.71	23.23	23.55	0.0	24.0
			36	42	21.9	22.37	22.65	1.0	23.0
		75	0	21.72	22.29	22.55	1.0	23.0	
		16QAM	1	1	21.59	22.07	22.29	1.0	23.0
		64QAM	1	1	20.19	20.71	21.07	2.5	21.5
		256QAM	1	1	18.03	18.54	18.85	4.5	19.5
		CP-OFDM	QPSK	1	1	21.19	21.69	21.96	1.5
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					641666	641666	646000		
					3624.99 MHz	3624.99 MHz	3690 MHz		
20 MHz	DFT-s-OFDM	π/2 BPSK	1	1	22.67	23.21	23.51	0.0	24.0
			1	26	22.64	23.19	23.47	0.0	24.0
			1	49	22.77	23.27	23.52	0.0	24.0
			25	0	21.69	22.26	22.53	0.5	23.5
			25	13	22.74	23.27	23.55	0.0	24.0
			25	26	21.85	22.34	22.59	0.5	23.5
		50	0	21.73	22.28	22.57	0.5	23.5	
		QPSK	1	1	22.68	23.18	23.48	0.0	24.0
			1	26	22.58	23.16	23.47	0.0	24.0
			1	49	22.78	23.25	23.55	0.0	24.0
			25	0	21.75	22.3	22.55	1.0	23.0
			25	13	22.73	23.26	23.55	0.0	24.0
			25	26	21.85	22.38	22.6	1.0	23.0
		50	0	21.77	22.28	22.56	1.0	23.0	
		16QAM	1	1	21.56	22.08	22.38	1.0	23.0
		64QAM	1	1	20.21	20.71	21.02	2.5	21.5
		256QAM	1	1	18.02	18.55	18.84	4.5	19.5
		CP-OFDM	QPSK	1	1	21.19	21.7	22.01	1.5

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					637168	641666	646166		
					357.52 MHz	3624.99 MHz	3692.49 MHz		
15 MHz	DFT-s-OFDM	π/2 BPSK	1	1	22.65	23.18	23.5	0.0	24.0
			1	19	22.63	23.18	23.47	0.0	24.0
			1	36	22.78	23.28	23.57	0.0	24.0
			18	0	21.73	22.25	22.55	0.5	23.5
			18	10	22.7	23.26	23.57	0.0	24.0
			18	20	21.75	22.31	22.58	0.5	23.5
		QPSK	36	0	21.74	22.27	22.55	0.5	23.5
			1	1	22.63	23.18	23.44	0.0	24.0
			1	19	22.57	23.13	23.44	0.0	24.0
			1	36	22.79	23.26	23.56	0.0	24.0
			18	0	21.7	22.24	22.55	1.0	23.0
			18	10	22.7	23.25	23.53	0.0	24.0
		16QAM	18	20	21.76	22.31	22.62	1.0	23.0
			36	0	21.73	22.27	22.58	1.0	23.0
1	1		21.54	22.07	22.35	1.0	23.0		
1	1		20.16	20.69	21.01	2.5	21.5		
256QAM	1	1	18.03	18.53	18.83	4.5	19.5		
	1	1	21.17	21.68	21.98	1.5	22.5		
10 MHz	DFT-s-OFDM	π/2 BPSK	1	1	22.57	23.14	23.4	0.0	24.0
			1	12	22.57	23.15	23.43	0.0	24.0
			1	22	22.57	23.18	23.54	0.0	24.0
			12	0	21.64	22.17	22.46	0.5	23.5
			12	6	22.63	23.18	23.48	0.0	24.0
			12	12	21.66	22.21	22.52	0.5	23.5
		QPSK	24	0	21.65	22.21	22.5	0.5	23.5
			1	1	22.58	23.1	23.42	0.0	24.0
			1	12	22.54	23.14	23.45	0.0	24.0
			1	22	22.57	23.19	23.6	0.0	24.0
			12	0	21.67	22.24	22.5	1.0	23.0
			12	6	22.68	23.21	23.49	0.0	24.0
		16QAM	12	12	21.66	22.25	22.53	1.0	23.0
			24	0	21.63	22.21	22.55	1.0	23.0
1	1		21.5	22.02	22.33	1.0	23.0		
1	1		20.13	20.65	20.96	2.5	21.5		
256QAM	1	1	17.92	18.47	18.78	4.5	19.5		
	1	1	21.13	21.63	21.94	1.5	22.5		
CP-OFDM	QPSK	1	1	21.13	21.63	21.94	1.5	22.5	

NR Band n48 (SRS1)

BW (MHz)	RB Allocation	RB offset	Maximum Average Power (dBm)				
			SRS1			Tune-up Limit	
			Measured Pwr (dBm)				MPR
40 MHz	1	1	638000	641666	645332	MPR	20.0
			3570 MHz	3624.99 MHz	3679.98 MHz		
			19.49	19.32	19.27	0.0	
30 MHz	1	1	637668	641666	645666	MPR	
			3565.02 MHz	3624.99 MHz	3684.99 MHz		
			19.52	19.83	19.28	0.0	
20 MHz	1	1	637333	641666	646000	MPR	
			3560 MHz	3624.99 MHz	3690 MHz		
			19.27	19.25	19.09	0.0	
15 MHz	1	1	637168	641666	646166	MPR	
			3557.52 MHz	3624.99 MHz	3692.49 MHz		
			19.54	19.38	19.47	0.0	
10 MHz	1	1	637000	641666	646332	MPR	
			3555 MHz	3624.99 MHz	3694.98 MHz		
			19.37	19.64	18.92	0.0	

NR Band n48 (SRS2)

BW (MHz)	RB Allocation	RB offset	Maximum Average Power (dBm)				
			SRS2			Tune-up Limit	
			Measured Pwr (dBm)				MPR
40 MHz	1	1	638000	641666	645332	MPR	24.0
			3570 MHz	3624.99 MHz	3679.98 MHz		
			23.76	23.13	23.63	0.0	
30 MHz	1	1	637668	641666	645666	MPR	
			3565.02 MHz	3624.99 MHz	3684.99 MHz		
			23.71	23.31	23.61	0.0	
20 MHz	1	1	637333	641666	646000	MPR	
			3560 MHz	3624.99 MHz	3690 MHz		
			23.51	23.41	23.52	0.0	
15 MHz	1	1	637168	641666	646166	MPR	
			3557.52 MHz	3624.99 MHz	3692.49 MHz		
			23.59	23.49	23.36	0.0	
10 MHz	1	1	637000	641666	646332	MPR	
			3555 MHz	3624.99 MHz	3694.98 MHz		
			23.53	23.35	23.52	0.0	

NR Band n48 (SRS3)

BW (MHz)	RB Allocation	RB offset	Maximum Average Power (dBm)				
			SRS3			Tune-up Limit	
			Measured Pwr (dBm)				MPR
40 MHz	1	1	638000	641666	645332	MPR	21.0
			3570 MHz	3624.99 MHz	3679.98 MHz		
			20.26	20.39	19.63	0.0	
30 MHz	1	1	637668	641666	645666	MPR	
			3565.02 MHz	3624.99 MHz	3684.99 MHz		
			20.67	20.09	19.43	0.0	
20 MHz	1	1	637333	641666	646000	MPR	
			3560 MHz	3624.99 MHz	3690 MHz		
			20.37	20.81	20.54	0.0	
15 MHz	1	1	637168	641666	646166	MPR	
			3557.52 MHz	3624.99 MHz	3692.49 MHz		
			20.77	20.67	19.60	0.0	
10 MHz	1	1	637000	641666	646332	MPR	
			3555 MHz	3624.99 MHz	3694.98 MHz		
			20.59	19.95	19.43	0.0	

8.2. PEAK TO AVERAGE RATIO

Test Procedure

Per KDB 971168 D01 Power Meas License Digital Systems v03r01;

The transmitter output was connected to a CMW500 Test Set and configured to operate at maximum power. The PAR were measured on the Spectrum Analyzer.

Test Spec

In addition, when the transmitter power is measured in terms of average value, the peak-to-average ratio of the power shall not exceed 13 dB.

NOTE

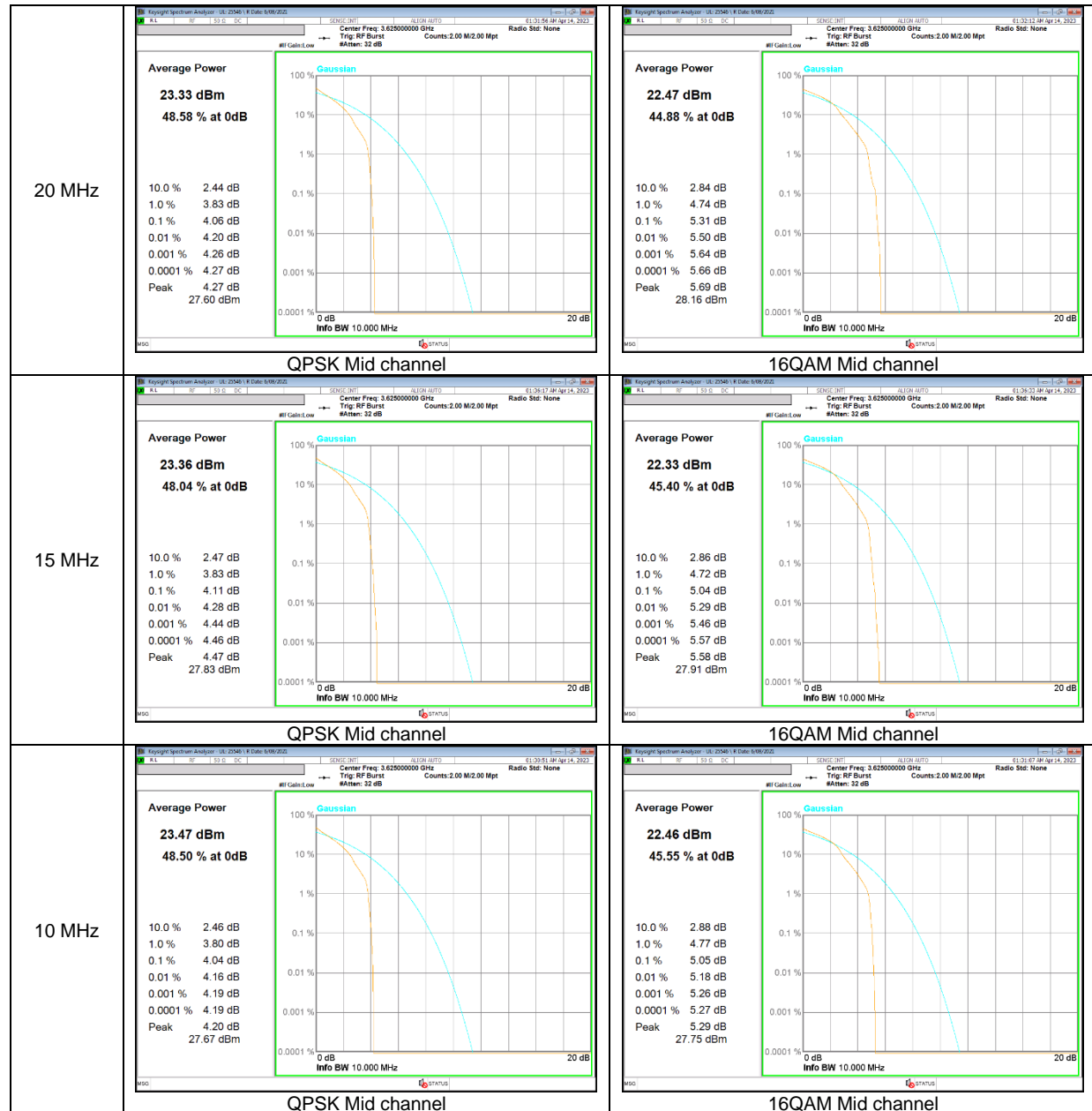
5G NR: All Waveforms (CP-OFDM vs DFT-s_OFDM) and modulations ($\pi/2$ BPSK, QPSK, 16QAM, 64QAM, 256QAM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

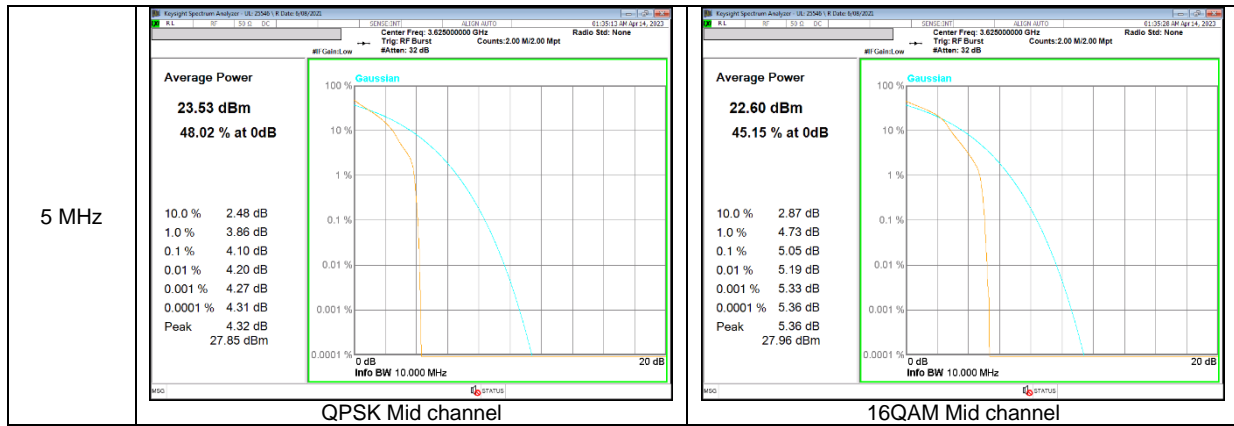
RESULTS

See the following pages.

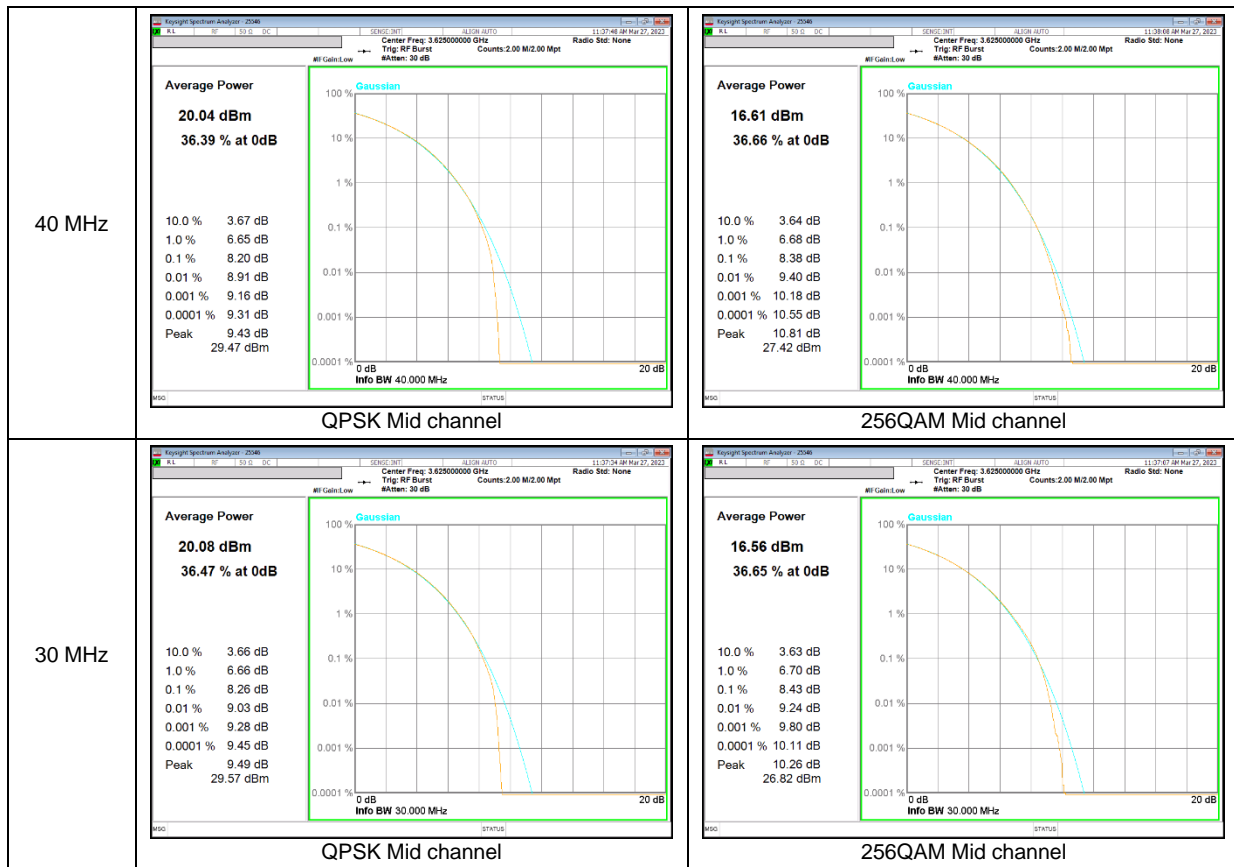
8.2.1. CONDUCTED PEAK TO AVERAGE RESULT

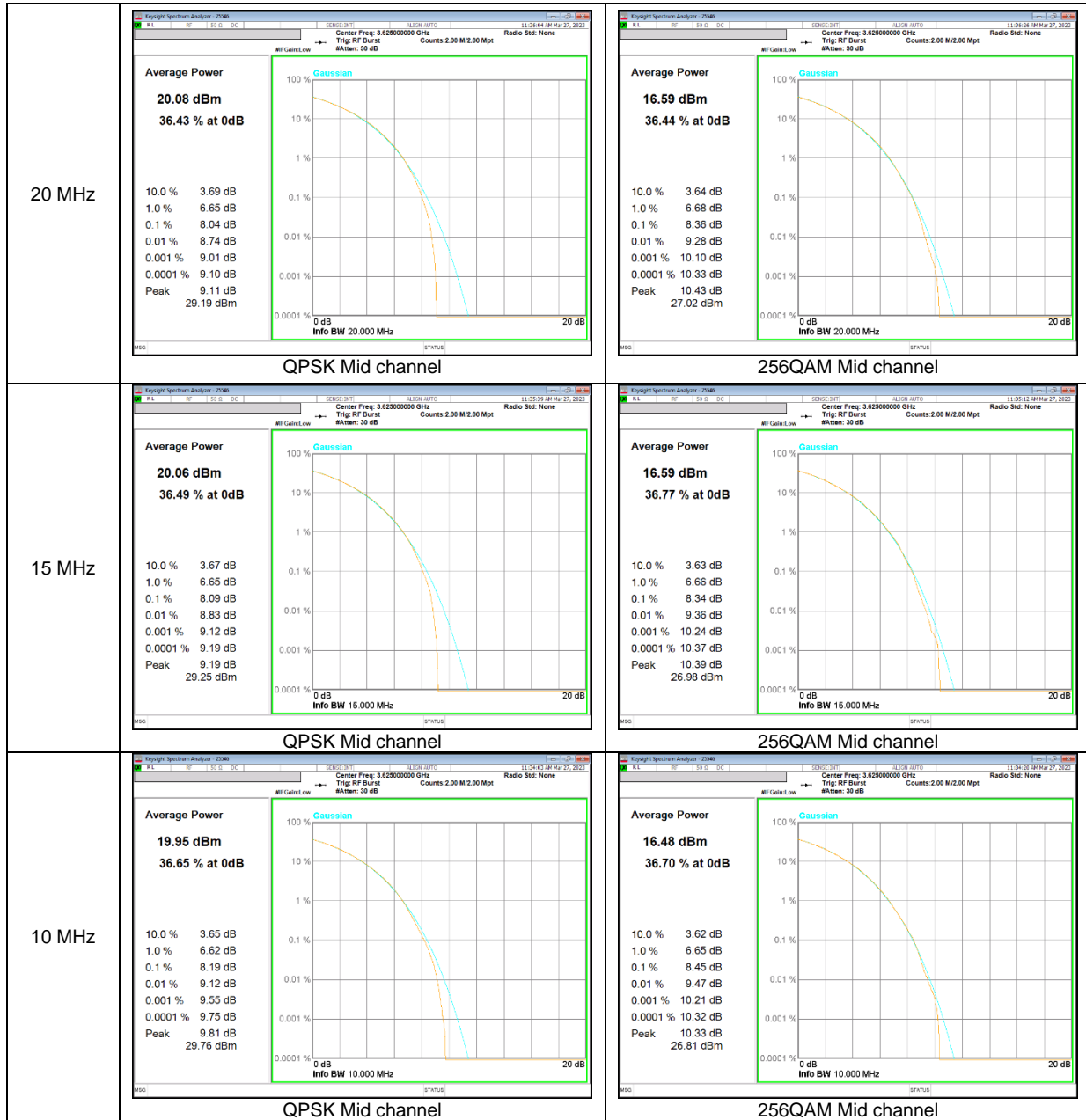
LTE Band 48





NR Band n48 CP-OFDM





8.3. OCCUPIED BANDWIDTH

RULE PART(S)

FCC: §2.1049

LIMITS

For reporting purposes only

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 -26dB bandwidth was also measured and recorded.

(KDB 971168 D01 Power Meas License Digital Systems v03r01)

OCCUPIED BANDWIDTH RESULTS

See the following pages.

- LTE Band 48

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B48	20M	QPSK	3625.0	17.865	19.27
		16QAM		17.854	18.87
	15M	QPSK		13.386	14.26
		16QAM		13.459	14.50
	10M	QPSK		8.977	9.71
		16QAM		8.905	9.53
	5M	QPSK		4.465	4.99
		16QAM		4.476	4.97

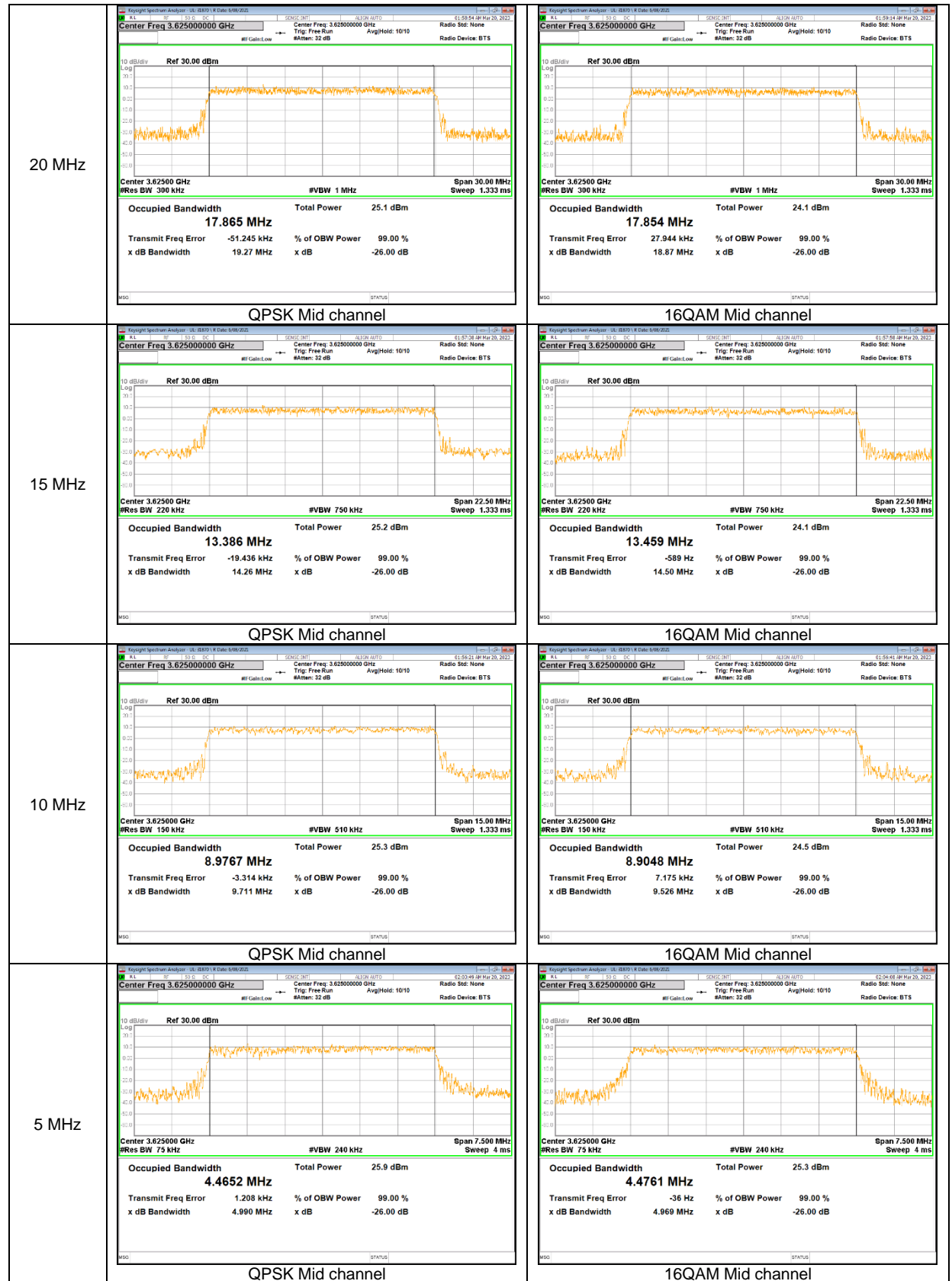
- LTE Band 48C

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B48 UL CA	20+20	QPSK	3625.0	36.313	39.02
		16QAM		36.708	38.88
	15+20	QPSK		31.676	33.71
		16QAM		31.791	33.67

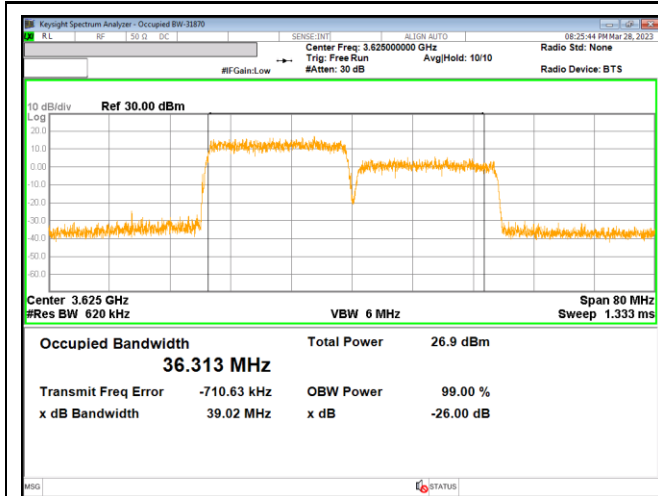
- NR Band n48

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
NR n48	40M	QPSK	3624.99	37.844	39.83
		16QAM		37.770	39.38
	30M	QPSK		27.925	29.68
		16QAM		27.868	29.67
	20M	QPSK		18.236	19.28
		16QAM		18.198	19.21
	15M	QPSK		13.580	14.45
		16QAM		13.585	15.11
	10M	QPSK		8.618	9.38
		16QAM		8.604	9.75

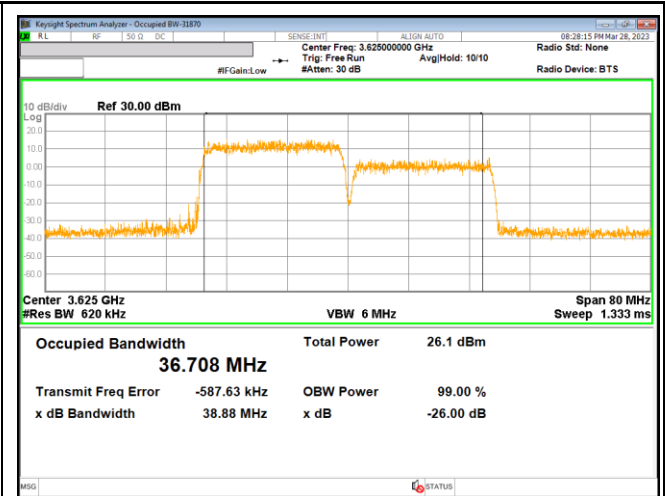
LTE Band 48



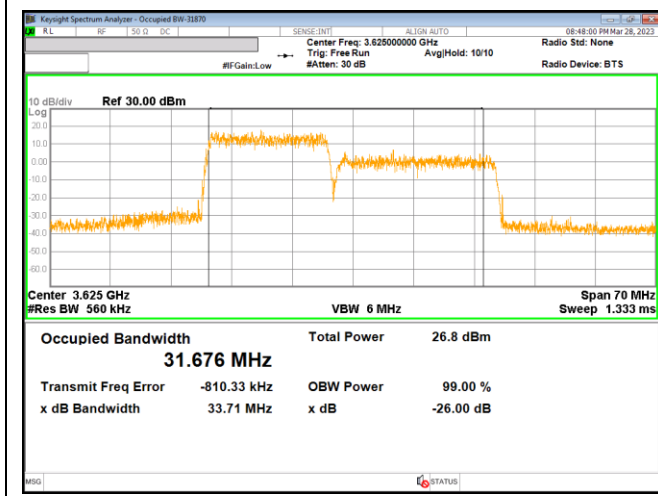
LTE Band 48C (UL CA)



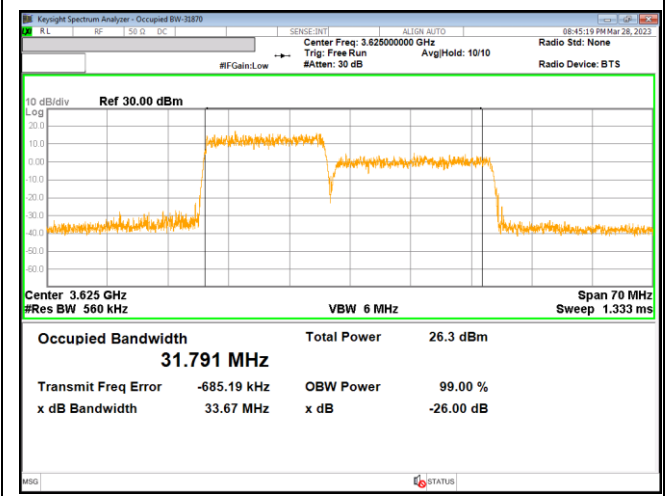
LTE B48 20MHz + 20MHz QPSK RB100-0 + RB100-0



LTE B48 20MHz + 20MHz 16QAM RB100-0 + RB100-0

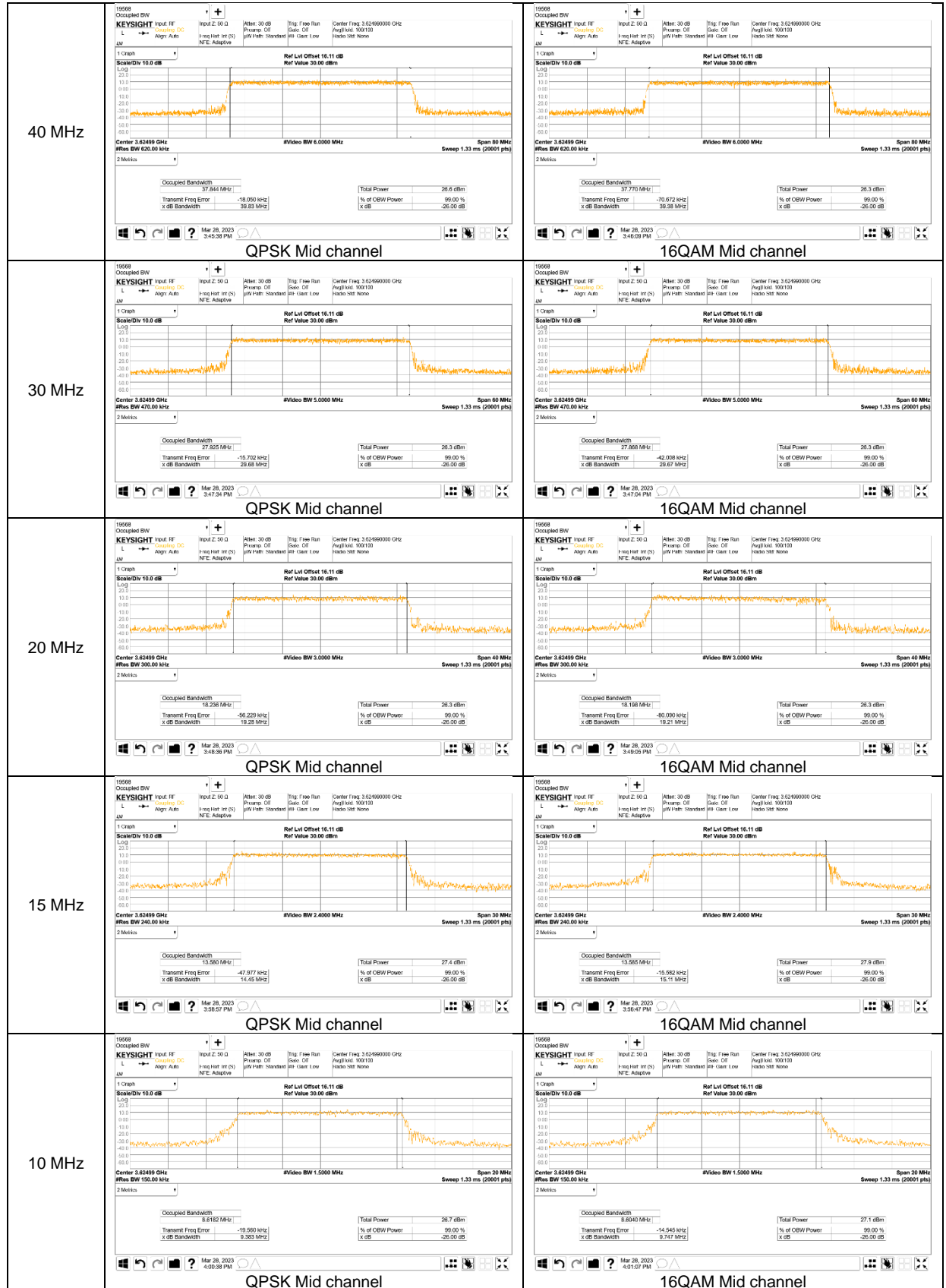


LTE B48 15MHz + 20MHz QPSK RB100-0 + RB100-0



LTE B48 15MHz + 20MHz 16QAM RB100-0 + RB100-0

NR Band n48 CP-OFDM



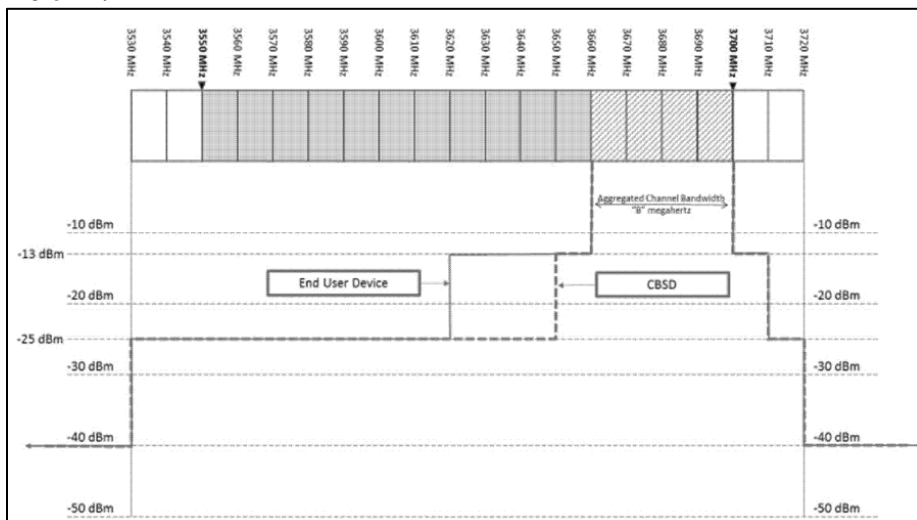
8.4. BAND EDGE EMISSIONS

RULE PART(S)

FCC: §2.1051 and §96.41(e)(1) (ii) & (e)(2).

LIMITS

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. Notwithstanding the emission limits in this paragraph, the Adjacent Channel Leakage Ratio for End User Devices shall be at least 30 dB. The conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40 dBm/MHz.



TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01

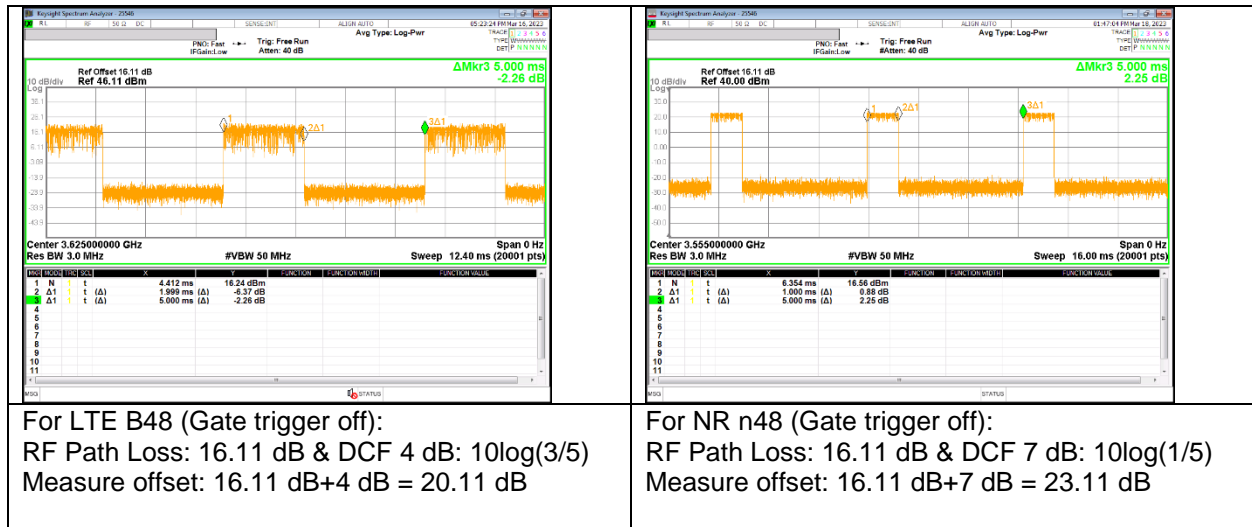
The transmitter output was connected to a CMW500 Test Set and configured to operate at maximum power. The band edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

- Set the RBW = 1 ~ 1.5 % of OBW (Typically limited to a minimum RBW of 1% of the OBW)
- Set VBW $\geq 3 \times$ RBW;
- Set span ≥ 1.5 times the OBW;
- Sweep time = Auto;
- Detector = RMS;
- Ensure that the number of measurement points $\geq 2 \times$ Span/RBW;
- Trace mode = Average (100);

NOTE1 (A-MPR)

[LTE Band 48C] A-MPR is implemented in this EUT per the A-MPR specification in 3GPP TS 36.101 (Table 6.2.4A,10-1, Table 6.2.4A,10-2). Conducted output power verification data are shown Appendix A. Also only Emission mask test item were performed A-MPR condition. Also only Emission mask test item were performed A-MPR condition.

NOTE2



NOTE3

Please refer to section 5.4 for bandwidth and RB setting about LTE, 5G NR bands.

NOTE4

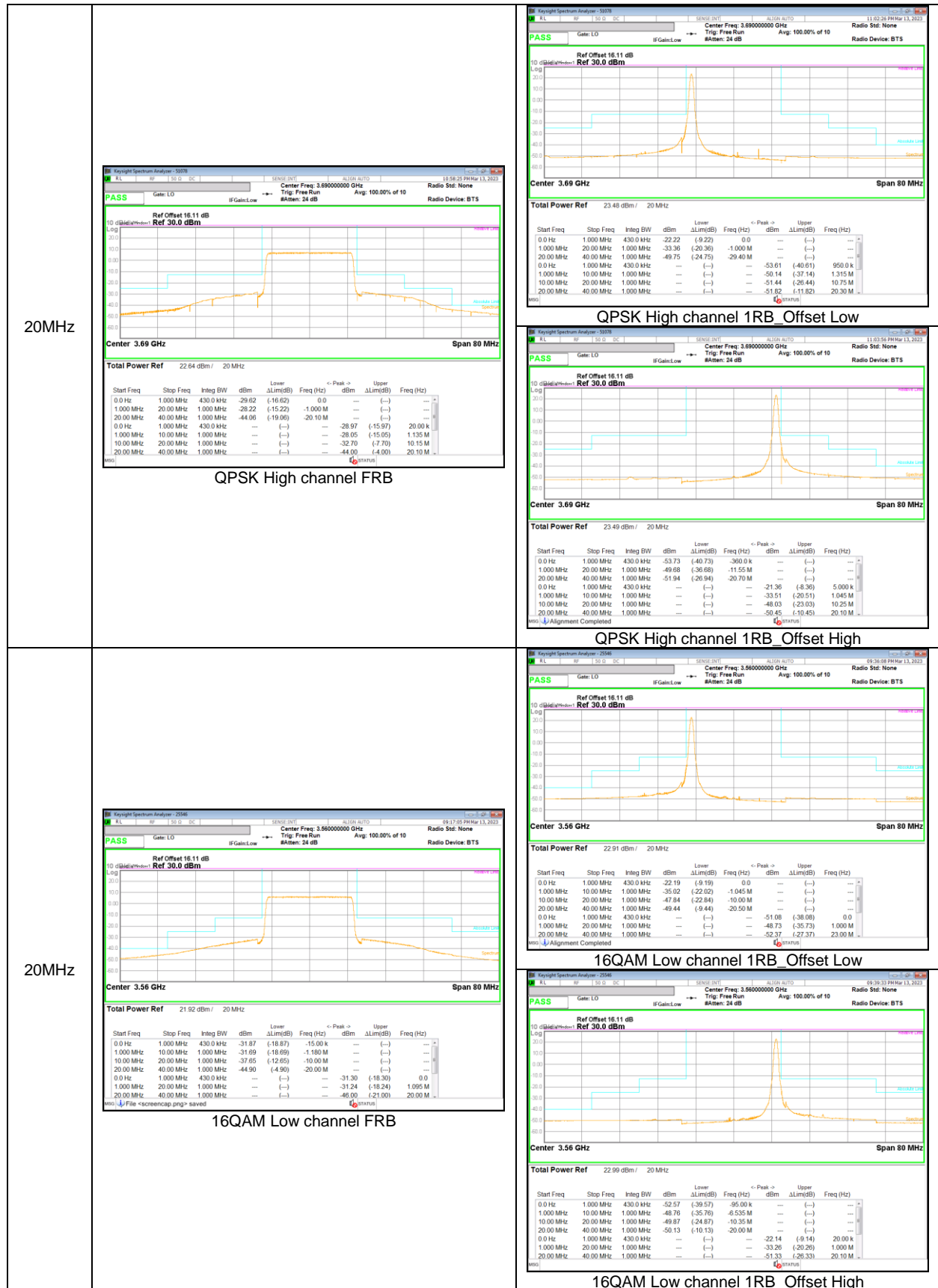
5G NR: All Waveforms (CP-OFDM vs DFT-s_OFDM) and modulations ($\pi/2$ BPSK, QPSK, 16QAM, 64QAM, 256QAM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

RESULTS

See the following pages.

LTE Band 48







20MHz



15MHz





