CERTIFICATION TEST REPORT

Report Number. : 4790841160-E2V3

Applicant	:	SAMSUNG ELECTRONICS CO., LTD. 129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI, GYEONGGI-DO, 16677, KOREA
Model	:	SC-55D, SCG22
FCC ID	:	A3LSMF946JPN
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 22 SUBPART H FCC CFR47 PART 90 SUBPART S

Date Of Issue:
2023-07-10

Prepared by:
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Suwon Test Site: UL KOREA LTD. Suwon Laboratory
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IAS ACCREDITED
Testing Laboratory
TL-637

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2023-06-30	Initial issue	Yeonghwan Hong
V2	2023-07-06	Updated to address TCB's question	Yeonghwan Hong
V3	2023-07-10	Updated to address TCB's question	Yeonghwan Hong

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TABLE OF CONTENTS

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_22/90(05)
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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:	SC-55D, SCG22
SERIAL NUMBER:	R3CW408V07D, R3CW408V0NP (CONDUCTED); R3CW408V7JJ, R3CW408VA8J (RADIATED);
DATE TESTED:	2023-05-23 - 2023-06-27;

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 22H and 90S	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:

Yeonghwan Hong
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 22.
3. FCC CFR 47 Part 90.
4. ANSI TIA-603-E, 2016
5. ANSI C63.26, 2015
6. KDB 971168 D01 Power Meas License Digital Systems v03r01

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
☒ Chamber 1(3m semi-anechoic chamber)
☒ Chamber 2(3m semi-anechoic chamber)
☐ Chamber 3(3m semi-anechoic chamber)
☐ Chamber 4(3m Full-anechoic chamber)
☐ 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:

ERP = PSA reading with EUT worst orientation (dBm) + Path loss (dB) – cable loss(between the SG and substitution antenna)
(Path loss = Signal generator output – PSA reading with substitution antenna)

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, 18 GHz to 40 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.

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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
		SCG22
SC-55D	Hardware	Same as SC-55D.
	Software	Supported WWAN Band is different.

Thus, SC-55D was set for final test.

5.2. MAXIMUM OUTPUT POWER

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

GSM

FCC Part 22								
Band	Frequency Range [MHz]	Modulation	Conducted		Radiated (ANT A+B)		Radiated (ANT A)	
			Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
GSM850	824.00 ~ 849.00	GPRS	**32.20**	**1659.59**	**28.91**	778.04	**21.49**	**140.93**
		EGPRS	27.14	517.61	23.96	248.89	17.56	57.02

WCDMA

FCC Part 22								
Band	Frequency Range [MHz]	Modulation	Conducted		Radiated (ANT A+B)		Radiated (ANT A)	
			Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 5	824.00 ~ 849.00	Rel. 99	**24.53**	**283.79**	**21.78**	**150.66**	**19.58**	**90.78**
		HSDPA	23.53	225.42	20.80	120.23	18.46	70.15

LTE Band 5

FCC Part 22									
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated (ANT A+B)		Radiated (ANT A)	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 5	829.00 ~ 844.00	10	QPSK	24.31	269.77	**21.04**	**127.06**	18.68	73.79
			16QAM	23.56	226.99	20.05	101.16	17.73	59.29
			64QAM	22.49	177.42				
	826.50 ~ 846.50	5	QPSK	24.29	268.53	20.91	123.31	**19.08**	**80.91**
			16QAM	24.14	259.42	19.89	97.50	18.22	66.37
			64QAM	22.72	187.07				
	825.50 ~ 847.50	3	QPSK	**24.35**	**272.27**	20.89	122.74	19.00	79.43
			16QAM	23.59	228.56	19.82	95.94	18.13	65.01
			64QAM	22.66	184.50				
	824.70 ~ 848.30	1.4	QPSK	24.17	261.22	20.88	122.46	18.85	76.74
			16QAM	23.38	217.77	19.86	96.83	17.81	60.39
			64QAM	22.77	189.23				

LTE Band 26 (Part90)

FCC Part 90									
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated (ANT A+B)		Radiated (ANT A)	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 26	821.50	15	QPSK	24.00	251.19	18.82	76.21	19.59	90.99
			16QAM	23.45	221.31	17.72	59.16	18.61	72.61
			64QAM	22.27	168.66				
	819.00	10	QPSK	**24.10**	**257.04**	18.69	73.96	19.85	96.61
			16QAM	24.02	252.35	17.63	57.94	18.82	76.21
			64QAM	22.40	173.78				
	816.50 ~ 821.50	5	QPSK	24.06	254.68	18.93	78.16	**19.93**	**98.40**
			16QAM	23.46	221.82	17.71	59.02	18.87	77.09
			64QAM	22.43	174.98				
	815.50 ~ 822.50	3	QPSK	24.01	251.77	19.01	79.62	19.89	97.50
			16QAM	23.39	218.27	18.09	64.42	18.91	77.80
			64QAM	22.47	176.60				
	814.70 ~ 823.30	1.4	QPSK	**24.10**	**257.04**	**19.36**	**86.30**	19.83	96.16
			16QAM	23.36	216.77	18.44	69.82	18.74	74.82
			64QAM	22.33	171.00				

LTE Band 26 (Straddle)

Straddle									
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated (ANT A+B)		Radiated (ANT A)	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 26	824.00	15	QPSK	23.88	244.34	18.83	76.38	18.08	64.27
			16QAM	23.19	208.45	17.72	59.16	17.17	52.12
			64QAM	22.08	161.44				
		10	QPSK	**24.08**	**255.86**	19.30	85.11	18.23	66.53
			16QAM	23.27	212.32	18.24	66.68	17.21	52.60
			64QAM	22.36	172.19				
		5	QPSK	24.03	252.93	19.80	95.50	18.64	73.11
			16QAM	23.57	227.51	18.82	76.21	17.64	58.08
			64QAM	22.47	176.60				
		3	QPSK	24.05	254.10	**20.12**	**102.80**	**18.98**	**79.07**
			16QAM	23.44	220.80	19.22	83.56	18.03	63.53
			64QAM	22.51	178.24				
		1.4	QPSK	23.50	223.87	19.60	91.20	17.87	61.24
			16QAM	22.60	181.97	18.73	74.64	16.89	48.87
			64QAM	21.89	154.53				

LTE Band 26 (Part22)

FCC Part 22									
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated (ANT A+B)		Radiated (ANT A)	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 26	831.50 ~ 841.50	15	QPSK	24.01	251.77	20.22	105.20	18.30	67.61
			16QAM	23.48	222.84	19.65	92.26	17.85	60.95
			64QAM	22.35	171.79				
	829.00 ~ 844.00	10	QPSK	24.17	261.22	21.20	131.83	**19.09**	**81.10**
			16QAM	23.38	217.77	19.95	98.86	17.97	62.66
			64QAM	22.46	176.20				
	826.50 ~ 846.50	5	QPSK	24.17	261.22	**21.55**	**142.89**	18.73	74.64
			16QAM	23.69	233.88	20.46	111.17	17.88	61.38
			64QAM	22.64	183.65				
	825.50 ~ 847.50	3	QPSK	23.97	249.46	21.34	136.14	19.06	80.54
			16QAM	23.39	218.27	20.37	108.89	18.02	63.39
			64QAM	22.48	177.01				
	824.70 ~ 848.30	1.4	QPSK	**24.18**	**261.82**	20.80	120.23	18.44	69.82
			16QAM	23.48	222.84	19.58	90.78	17.64	58.08
			64QAM	22.50	177.83				

NR Band n5

FCC Part 22										
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Mode	Conducted		Radiated (ANT A+B)		Radiated (ANT A)	
					Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
n5	834.00 - 839.00	20	DFT-s OFDM	π/2 BPSK	24.01	251.77				
				QPSK	24.07	255.27	20.34	108.14	19.17	82.60
				16QAM	23.74	236.59	18.85	76.74	17.93	62.09
				64QAM	22.45	175.79				
				256QAM	20.38	109.14				
			CP-OFDM	QPSK	23.01	199.99				
	831.50 - 841.50	15	DFT-s OFDM	π/2 BPSK	24.51	282.49				
				QPSK	24.51	282.49	**20.52**	**112.72**	**19.38**	**86.70**
				16QAM	23.53	225.42	18.98	79.07	18.06	63.97
				64QAM	22.30	169.82				
				256QAM	20.18	104.23				
			CP-OFDM	QPSK	22.97	198.15				
	829.00 - 844.00	10	DFT-s OFDM	π/2 BPSK	24.47	279.90				
				QPSK	24.49	281.19	20.00	100.00	18.92	77.98
				16QAM	23.71	234.96	18.74	74.82	17.89	61.52
				64QAM	22.48	177.01				
				256QAM	20.16	103.75				
			CP-OFDM	QPSK	22.88	194.09				
	826.50 - 846.50	5	DFT-s OFDM	π/2 BPSK	24.50	281.84				
				QPSK	**24.52**	**283.14**	20.18	104.23	19.14	82.04
				16QAM	23.61	229.61	18.68	73.79	18.11	64.71
				64QAM	22.45	175.79				
				256QAM	20.24	105.68				
			CP-OFDM	QPSK	22.97	198.15				

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)
GSM850 / WCDMA Band 5 / LTE Band 5, 26 / NR Band n5 814 - 849 MHz	-4.5 (ANT A) -5.8 (ANT A+B)

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5.4. WORST-CASE ORIENTATION

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

- GSM GPRS/EGPRS
- UMTS REL 99/HSDPA

For LTE Bands 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 and 64QAM 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 5G NR Band n26 the worst-case scenario for all measurements is based on the average conducted output power measurement investigation results. Output power measurements were measured on π/2 BPSK, QPSK, 16QAM, 64QAM and 256QAM modulations. It was found QPSK and 16QAM results were worst case as below.

As a result of comparing SA mode and NSA, the conducted & radiated power of SA mode is higher than that of NSA mode, so test was performed in SA mode.
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.

This device supports AFS (Adaptive Frame Switching) Mode for below 1GHz Bands.
The adaptive frame switching (AFS) mode of device operates only in the radiated state.
So both folded and open modes were tested and worst data is reported.

Condition	Antenna
Open, Half folded, Full folded	A+B
Full folded (Grip)	A

- Conducted Spurious Emission

Highest conducted output power setting for each bands				
LTE Band	**Frequency (MHz)**	**Bandwidth (MHz)**	**RB size**	**RB offset**
5	825.50	3	1	8
	836.50		1	8
	847.50		1	8
26 (Part 90)	819.00	10	1	25
26 (Straddle)	824.00	10	1	0
26 (Part 22)	814.70	1.4	1	3
	823.30		1	3
	831.50		1	0
	848.30		1	1
NR Band	**Frequency (MHz)**	**Bandwidth (MHz)**	**RB size**	**RB offset**
5	826.50	5	1	1
	836.50		1	1
	846.50		1	1

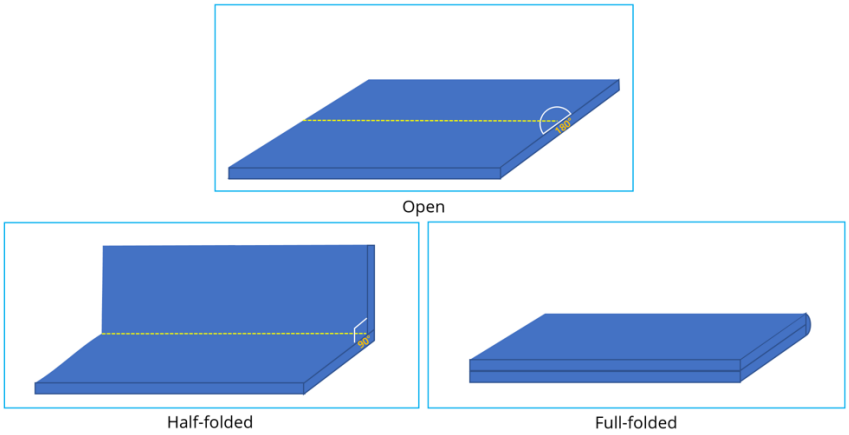
- Radiated Spurious Emission (ANT A+B)

Highest ERP setting for each bands				
LTE Band	**Frequency (MHz)**	**Bandwidth (MHz)**	**RB size**	**RB offset**
5	829.00	10	1	0
	836.50		1	0
	844.00		1	49
26 (Part 90)	814.70	1.4	1	3
	823.30		1	3
26 (Straddle)	824.00	3	1	8
26 (Part 22)	826.50	5	1	12
	831.50		1	12
	846.50		1	12
NR Band	**Frequency (MHz)**	**Bandwidth (MHz)**	**RB size**	**RB offset**
5	831.50	15	1	40
	836.50		1	40
	841.50		1	40

- Radiated Spurious Emission (ANT A)

Highest ERP setting for each bands				
LTE Band	**Frequency (MHz)**	**Bandwidth (MHz)**	**RB size**	**RB offset**
5	826.50	5	1	12
	836.50		1	12
	846.50		1	12
26 (Part 90)	816.50	5	1	12
	821.50		1	12
26 (Straddle)	824.00	3	1	8
26 (Part 22)	829.00	10	1	25
	831.50		1	25
	844.00		1	25
NR Band	**Frequency (MHz)**	**Bandwidth (MHz)**	**RB size**	**RB offset**
5	831.50	15	1	40
	836.50		1	40
	841.50		1	40

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



Band	ANT	ERP			RSE		
		X	Y	Z	X	Y	Z
GSM 850	A+B	-	-	Half-folded	-	-	Half-folded
	A	-	-	Full-folded	-	-	Full-folded
WCDMA B5	A+B	-	-	Half-folded	-	-	Half-folded
	A	-	-	Full-folded	-	-	Full-folded
LTE B5	A+B	-	-	Half-folded	-	-	Half-folded
	A	-	-	Full-folded	-	-	Full-folded
LTE B26	A+B	-	-	Half-folded	-	-	Open
	A	-	-	Full-folded	-	-	Full-folded
NR n5	A+B	-	-	Half-folded	-	-	Half-folded
	A	-	-	Full-folded	-	-	Full-folded

Note1: In order to change the antenna settings of the EUT, the test was performed by updating the xml file to the EUT's WWAN chipset.
Note2: For ERP 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.

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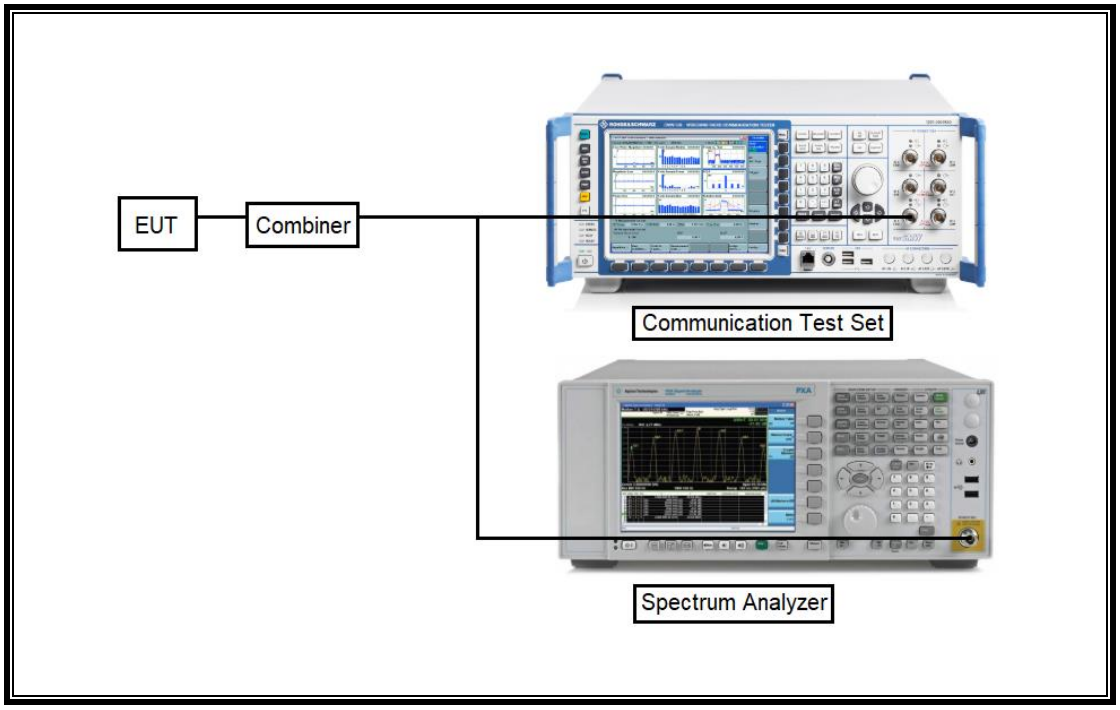
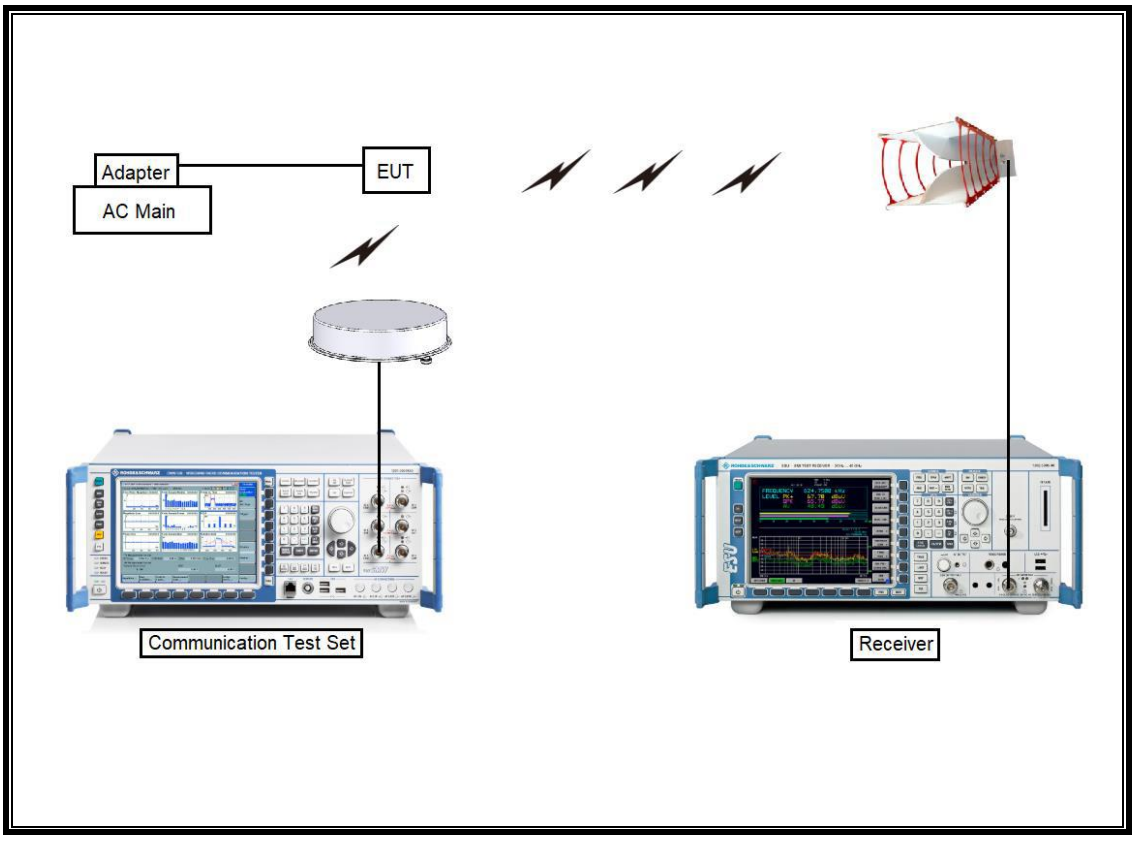
SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)



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	PASTERNACK	PE7087-10	A009	2023-08-03
Attenuator	PASTERNACK	PE7087-10	A001	2023-08-03
Attenuator	PASTERNACK	PE7087-10	A008	2023-08-03
Attenuator	PASTERNACK	PE7004-10	2	2023-08-01
Attenuator	PASTERNACK	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 Band width (99%)	N/A	Conducted	Pass
22.917(a)	Band Edge / Conducted Spurious Emission	-13dBm		Pass
		-35 dBm		Pass
90.691	Emission mask	Section 9.2.2		Pass
2.1046	Conducted output power	N/A		Pass
90.635(b)		50 dBm		Pass
22.355 90.213	Frequency Stability	2.5PPM		Pass
22.913(a)(5)	Effective Radiated Power	38.5dBm	Radiated	Pass
90.635(b)		34.77dBm		Pass
22.917(a) 90.691(a)	Radiated Spurious Emission	-13dBm		Pass

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_22/90(05)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

8. CONDUCTED RESULTS

8.1. CONDUCTED OUTPUT POWER

Test Procedure

Per KDB 971168 D01 Power Meas License Digital Systems v03r01;

The transmitter output was connected to either CMW500 Test Set or E7515B Test set and configured to operate at maximum power.

NOTE

5G NR: All Waveforms (CP-OFDM vs DFT-s_OFDM) and modulations (π/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.

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_22/90(05)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

8.1.1. CONDUCTED AVERAGE OUTPUT POWER

GSM

Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Pmax Average Power (dBm)			
					Measured		Tune-up Limit	
					Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr
GSM (Voice)	CS1	1	128	824.20	32.20	23.17	33.0	24.0
			190	836.60	32.10	23.07		
			251	848.80	32.04	23.01		
GPRS (GMSK)	CS1	1	128	824.20	32.18	23.15	33.0	24.0
			190	836.60	32.04	23.01		
			251	848.80	32.02	22.99		
		2	128	824.20	30.57	24.55	32.5	**26.5**
			190	836.60	30.77	24.75		
			251	848.80	30.58	24.56		
		3	128	824.20	28.80	24.54	30.5	26.2
			190	836.60	28.80	24.54		
			251	848.80	28.84	24.58		
		4	128	824.20	27.01	24.00	28.5	25.5
			190	836.60	27.64	24.63		
			251	848.80	27.70	24.69		
EGPRS (8PSK)	MCS5	1	128	824.20	26.41	17.38	28.0	19.0
			190	836.60	27.05	18.02		
			251	848.80	27.14	18.11		
		2	128	824.20	24.77	18.75	26.0	20.0
			190	836.60	24.93	18.91		
			251	848.80	24.90	18.88		
		3	128	824.20	22.96	18.70	24.0	19.7
			190	836.60	22.57	18.31		
			251	848.80	23.02	18.76		
		4	128	824.20	21.86	18.85	23.0	20.0
			190	836.60	22.12	19.11		
			251	848.80	22.28	19.27		

WCDMA B5

Mode		UL Ch No.	Freq. (MHz)	Pmax Average Power (dBm)		
				Measured Pwr	MPR	Tune-up Limit
Release 99	Rel 99 (RMC, 12.2 kbps)	4132	826.40	24.53	N/A	25.5
		4183	836.60	24.21		
		4233	846.60	24.32		
HSDPA	Subtest 1	4132	826.40	23.53	0	24.5
		4183	836.60	23.22		
		4233	846.60	23.32		
	Subtest 2	4132	826.40	23.50	0	24.5
		4183	836.60	23.21		
		4233	846.60	23.31		
	Subtest 3	4132	826.40	23.02	0.5	24.0
		4183	836.60	22.71		
		4233	846.60	22.83		
	Subtest 4	4132	826.40	23.00	0.5	24.0
		4183	836.60	22.71		
		4233	846.60	22.82		
HSUPA	Subtest 1	4132	826.40	23.47	0	24.5
		4183	836.60	23.16		
		4233	846.60	23.28		
	Subtest 2	4132	826.40	21.47	2	22.5
		4183	836.60	21.17		
		4233	846.60	21.28		
	Subtest 3	4132	826.40	22.48	1	23.5
		4183	836.60	22.17		
		4233	846.60	22.25		
	Subtest 4	4132	826.40	21.51	2	22.5
		4183	836.60	21.18		
		4233	846.60	21.27		
	Subtest 5	4132	826.40	23.09	0	24.5
		4183	836.60	22.75		
		4233	846.60	22.86		
DC-HSDPA	Subtest 1	4132	826.40	23.52	0	24.5
		4183	836.60	23.23		
		4233	846.60	23.25		
	Subtest 2	4132	826.40	23.51	0	24.5
		4183	836.60	23.22		
		4233	846.60	23.27		
	Subtest 3	4132	826.40	23.02	0.5	24.0
		4183	836.60	22.71		
		4233	846.60	22.76		
	Subtest 4	4132	826.40	23.01	0.5	24.0
		4183	836.60	22.71		
		4233	846.60	22.76		

LTE Band 5

BW (MHz)	Mode	RB Allocation	RB offset	Pmax Average Power (dBm)				
				Measured Pwr (dBm)			MPR	Tune-up Limit
				20450	20525	20600		
				829.00 MHz	836.50 MHz	844.00 MHz		
10 MHz	QPSK	1	0	24.31	24.18	23.99	0.0	25.5
		1	25	24.30	24.12	24.17	0.0	25.5
		1	49	24.16	24.11	24.19	0.0	25.5
		25	0	23.36	23.14	23.07	1.0	24.5
		25	12	23.24	23.13	23.20	1.0	24.5
		25	25	23.19	23.12	23.16	1.0	24.5
		50	0	23.23	23.14	23.16	1.0	24.5
	16QAM	1	0	23.56	23.44	23.36	1.0	24.5
		1	25	23.50	23.44	23.41	1.0	24.5
		1	49	23.34	23.44	23.42	1.0	24.5
		25	0	22.38	22.16	22.08	2.0	23.5
		25	12	22.26	22.16	22.17	2.0	23.5
		25	25	22.23	22.16	22.17	2.0	23.5
		50	0	22.22	22.13	22.18	2.0	23.5
	64QAM	1	0	22.49	22.20	22.29	2.0	23.5
		1	25	22.40	22.20	22.35	2.0	23.5
		1	49	22.33	22.24	22.35	2.0	23.5
		25	0	21.23	21.08	21.00	3.0	22.5
		25	12	21.13	21.09	21.13	3.0	22.5
		25	25	21.07	21.05	21.08	3.0	22.5
		50	0	21.12	21.05	21.05	3.0	22.5
BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
				20425	20525	20625		
				826.50 MHz	836.50 MHz	846.50 MHz		
5 MHz	QPSK	1	0	24.27	24.10	24.14	0.0	25.5
		1	12	24.29	24.15	24.14	0.0	25.5
		1	24	24.15	24.03	24.05	0.0	25.5
		12	0	23.29	24.07	24.09	1.0	24.5
		12	7	23.24	24.08	24.11	1.0	24.5
		12	13	23.22	24.09	24.11	1.0	24.5
		25	0	23.19	23.08	23.11	1.0	24.5
	16QAM	1	0	24.14	23.42	23.41	1.0	24.5
		1	12	23.49	23.43	23.41	1.0	24.5
		1	24	23.36	23.32	23.31	1.0	24.5
		12	0	23.15	23.17	23.20	2.0	23.5
		12	7	23.18	23.17	23.24	2.0	23.5
		12	13	23.17	23.19	23.25	2.0	23.5
		25	0	22.11	22.08	22.10	2.0	23.5
	64QAM	1	0	22.65	22.35	22.54	2.0	23.5
		1	12	22.72	22.40	22.66	2.0	23.5
		1	24	22.62	22.36	22.59	2.0	23.5
		12	0	21.54	21.17	21.18	3.0	22.5
		12	7	21.47	21.16	21.27	3.0	22.5
		12	13	21.41	21.16	21.25	3.0	22.5
		25	0	21.32	21.25	21.22	3.0	22.5

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_22/90(05)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
				20415	20525	20635		
				825.50 MHz	836.50 MHz	847.50 MHz		
3 MHz	QPSK	1	0	24.27	23.95	24.06	0.0	25.5
		1	8	24.35	24.03	24.13	0.0	25.5
		1	14	24.22	23.94	24.03	0.0	25.5
		8	0	23.34	23.04	23.07	1.0	24.5
		8	4	23.33	23.07	23.09	1.0	24.5
		8	7	23.25	23.04	23.15	1.0	24.5
		15	0	23.31	23.00	23.04	1.0	24.5
	16QAM	1	0	23.59	23.36	23.37	1.0	24.5
		1	8	23.59	23.46	23.48	1.0	24.5
		1	14	23.45	23.33	23.43	1.0	24.5
		8	0	22.36	22.11	22.12	2.0	23.5
		8	4	22.39	22.13	22.14	2.0	23.5
		8	7	22.29	22.13	22.21	2.0	23.5
		15	0	22.33	22.08	22.07	2.0	23.5
	64QAM	1	0	22.56	22.41	22.45	2.0	23.5
		1	8	22.66	22.46	22.47	2.0	23.5
		1	14	22.52	22.27	22.45	2.0	23.5
		8	0	21.46	21.19	21.17	3.0	22.5
		8	4	21.50	21.20	21.22	3.0	22.5
		8	7	21.42	21.22	21.30	3.0	22.5
		15	0	21.45	21.16	21.23	3.0	22.5

BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
				20407	20525	20643		
				824.70 MHz	836.50 MHz	848.30 MHz		
1.4 MHz	QPSK	1	0	24.11	24.09	24.16	0.0	25.5
		1	3	24.15	24.13	24.17	0.0	25.5
		1	5	24.11	24.12	24.13	0.0	25.5
		3	0	24.12	24.13	24.09	0.0	25.5
		3	1	24.12	24.10	24.10	0.0	25.5
		3	3	24.11	24.10	24.13	0.0	25.5
		6	0	24.11	24.11	24.12	1.0	24.5
	16QAM	1	0	23.29	23.31	23.33	1.0	24.5
		1	3	23.33	23.38	23.33	1.0	24.5
		1	5	23.34	23.31	23.30	1.0	24.5
		3	0	23.24	23.27	23.28	1.0	24.5
		3	1	23.29	23.29	23.30	1.0	24.5
		3	3	23.29	23.28	23.31	1.0	24.5
		6	0	23.20	23.21	23.22	2.0	23.5
	64QAM	1	0	22.67	22.43	22.47	2.0	23.5
		1	3	22.77	22.43	22.54	2.0	23.5
		1	5	22.61	22.36	22.45	2.0	23.5
		3	0	22.49	22.20	22.37	2.0	23.5
		3	1	22.54	22.24	22.36	2.0	23.5
		3	3	22.49	22.24	22.38	2.0	23.5
		6	0	21.29	21.15	21.32	3.0	22.5

LTE Band 26

BW (MHz)	Mode	RB Allocation	RB offset	Pmax Maximum Average Power (dBm)				MPR	Tune-up Limit
				Measured Pwr (dBm)					
				26765	26790	26865	26965		
				821.50 MHz	824.00 MHz	831.50 MHz	841.50 MHz		
15 MHz	QPSK	1	0	23.98	23.76	23.87	23.98	0.0	25.5
		1	37	24.00	23.80	24.01	23.96	0.0	25.5
		1	74	23.97	23.88	23.89	23.85	0.0	25.5
		36	0	22.99	22.94	23.10	23.13	1.0	24.5
		36	20	23.05	23.01	23.20	23.09	1.0	24.5
		36	39	23.03	23.00	23.19	23.15	1.0	24.5
		75	0	23.09	23.11	23.13	23.17	1.0	24.5
	16QAM	1	0	23.37	23.07	23.26	23.40	1.0	24.5
		1	37	23.45	23.11	23.48	23.43	1.0	24.5
		1	74	23.31	23.19	23.30	23.27	1.0	24.5
		36	0	21.98	21.95	22.10	22.13	2.0	23.5
		36	20	22.03	22.02	22.12	22.11	2.0	23.5
		36	39	22.05	22.07	22.19	22.15	2.0	23.5
		75	0	22.08	22.00	22.15	22.12	2.0	23.5
	64QAM	1	0	22.24	21.99	22.22	22.35	2.0	23.5
		1	37	22.23	22.00	22.30	22.23	2.0	23.5
		1	74	22.27	22.08	22.25	22.20	2.0	23.5
		36	0	21.01	20.97	21.14	21.13	3.0	22.5
		36	20	21.06	21.03	21.12	21.11	3.0	22.5
		36	39	21.06	21.12	21.23	21.17	3.0	22.5
		75	0	21.06	21.10	21.14	21.13	3.0	22.5
BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)				MPR	Tune-up Limit
				26740	26790	26865	26990		
				819.00 MHz	824.00 MHz	831.50 MHz	844.00 MHz		
10 MHz	QPSK	1	0	24.03	24.08	24.06	24.09	0.0	25.5
		1	25	24.10	23.92	24.17	24.16	0.0	25.5
		1	49	23.99	23.94	24.08	24.07	0.0	25.5
		25	0	23.07	23.05	23.12	23.11	1.0	24.5
		25	12	23.17	23.15	23.16	23.15	1.0	24.5
		25	25	23.15	23.11	23.19	23.20	1.0	24.5
		50	0	23.13	23.08	23.13	23.12	1.0	24.5
	16QAM	1	0	23.31	23.04	23.38	23.34	1.0	24.5
		1	25	24.02	23.09	23.37	23.32	1.0	24.5
		1	49	23.33	23.27	23.33	23.32	1.0	24.5
		25	0	22.21	22.15	22.24	22.17	2.0	23.5
		25	12	22.20	22.23	22.20	22.18	2.0	23.5
		25	25	22.25	22.18	22.28	22.24	2.0	23.5
		50	0	22.12	21.62	22.14	22.13	2.0	23.5
	64QAM	1	0	22.38	22.11	22.45	22.38	2.0	23.5
		1	25	22.40	22.36	22.46	22.41	2.0	23.5
		1	49	22.29	22.26	22.43	22.33	2.0	23.5
		25	0	21.11	21.03	21.21	21.18	3.0	22.5
		25	12	21.23	21.18	21.22	21.20	3.0	22.5
		25	25	21.20	21.17	21.26	21.23	3.0	22.5
		50	0	21.20	20.79	21.24	21.16	3.0	22.5

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_22/90(05)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)				MPR	Tune-up Limit
				26715	26790	26865	27015		
				816.50 MHz	824.00 MHz	831.50 MHz	846.50 MHz		
5 MHz	QPSK	1	0	23.96	23.95	24.07	24.08	0.0	25.5
		1	12	24.06	24.03	24.16	24.17	0.0	25.5
		1	24	23.97	23.94	24.09	24.02	0.0	25.5
		12	0	23.00	23.02	23.12	23.08	1.0	24.5
		12	7	23.12	23.15	23.14	23.22	1.0	24.5
		12	13	23.10	23.05	23.17	23.17	1.0	24.5
		25	0	23.08	23.07	23.10	23.18	1.0	24.5
	16QAM	1	0	23.35	23.34	23.50	23.55	1.0	24.5
		1	12	23.46	23.57	23.57	23.69	1.0	24.5
		1	24	23.36	23.48	23.49	23.56	1.0	24.5
		12	0	22.01	22.00	22.13	22.20	2.0	23.5
		12	7	22.11	22.15	22.16	22.29	2.0	23.5
		12	13	22.09	22.13	22.20	22.27	2.0	23.5
		25	0	22.10	21.73	22.16	22.11	2.0	23.5
	64QAM	1	0	22.37	22.40	22.45	22.60	2.0	23.5
		1	12	22.43	22.47	22.58	22.64	2.0	23.5
		1	24	22.32	22.33	22.50	22.58	2.0	23.5
		12	0	21.15	20.95	21.12	21.25	3.0	22.5
		12	7	21.27	20.99	21.13	21.37	3.0	22.5
		12	13	21.23	20.91	21.21	21.31	3.0	22.5
		25	0	21.20	21.05	21.20	21.25	3.0	22.5
BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)				MPR	Tune-up Limit
				26705	26790	26865	27025		
				815.50 MHz	824.00 MHz	831.50 MHz	847.50 MHz		
3 MHz	QPSK	1	0	23.85	23.95	23.89	23.06	0.0	25.5
		1	8	23.90	24.05	23.91	23.90	0.0	25.5
		1	14	23.95	23.90	23.97	23.97	0.0	25.5
		8	0	23.92	22.95	23.95	23.91	1.0	24.5
		8	4	23.92	23.09	23.94	23.92	1.0	24.5
		8	7	23.91	23.09	23.95	23.92	1.0	24.5
		15	0	23.92	23.06	23.95	23.93	1.0	24.5
	16QAM	1	0	23.26	23.26	23.26	23.30	1.0	24.5
		1	8	23.27	23.44	23.30	23.39	1.0	24.5
		1	14	23.39	23.39	23.37	23.33	1.0	24.5
		8	0	23.03	22.09	23.03	23.00	2.0	23.5
		8	4	23.03	22.24	23.04	23.04	2.0	23.5
		8	7	23.02	22.24	23.03	23.08	2.0	23.5
		15	0	23.01	22.18	23.02	23.01	2.0	23.5
	64QAM	1	0	22.26	22.35	22.42	22.34	2.0	23.5
		1	8	22.47	22.51	22.48	22.44	2.0	23.5
		1	14	22.36	22.41	22.39	22.31	2.0	23.5
		8	0	21.12	21.01	21.25	21.15	3.0	22.5
		8	4	21.19	21.10	21.27	21.25	3.0	22.5
		8	7	21.19	21.21	21.32	21.25	3.0	22.5
		15	0	21.15	20.95	21.19	21.23	3.0	22.5

BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)				MPR	Tune-up Limit
				26697	26790	26865	27033		
				814.70 MHz	824.00 MHz	831.50 MHz	848.30 MHz		
1.4 MHz	QPSK	1	0	23.99	23.39	24.07	24.03	0.0	25.5
		1	3	24.02	23.34	24.18	23.99	0.0	25.5
		1	5	23.99	23.30	24.13	23.87	0.0	25.5
		3	0	24.06	23.45	24.09	24.13	1.0	24.5
		3	1	24.06	23.43	24.10	24.13	1.0	24.5
		3	3	24.10	23.50	24.17	24.15	1.0	24.5
		6	0	22.54	22.24	22.61	22.63	1.0	24.5
	16QAM	1	0	23.32	22.39	23.39	23.31	1.0	24.5
		1	3	23.36	22.60	23.48	23.39	1.0	24.5
		1	5	23.27	22.46	23.44	23.35	1.0	24.5
		3	0	23.17	22.42	23.23	23.27	2.0	23.5
		3	1	23.15	22.29	23.23	23.20	2.0	23.5
		3	3	23.19	22.42	23.34	23.20	2.0	23.5
		6	0	22.07	21.01	22.18	22.20	2.0	23.5
	64QAM	1	0	22.32	21.89	22.26	22.44	2.0	23.5
		1	3	22.33	21.83	22.42	22.50	2.0	23.5
		1	5	22.26	21.87	22.30	22.34	2.0	23.5
		3	0	22.11	21.31	22.21	22.31	3.0	22.5
		3	1	22.12	21.11	22.23	22.26	3.0	22.5
		3	3	22.13	21.25	22.33	22.32	3.0	22.5
		6	0	21.07	21.10	21.22	21.29	3.0	22.5

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NR Band n5

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Pmax Average Power (dBm)			MPR	Tune-up Limit
					Measured Pwr (dBm)				
					166800	167300	167800		
					834.00 MHz	836.50 MHz	839.00 MHz		
20 MHz	DFT-s-OFDM	π/2 BPSK	1	1	23.92	23.79	23.78	0.0	25.0
			1	53	23.83	23.87	23.85	0.0	25.0
			1	104	23.97	23.29	23.04	0.0	25.0
			50	0	23.96	23.95	23.89	0.5	24.5
			50	28	23.97	23.99	23.96	0.0	25.0
			50	56	23.96	23.97	23.48	0.5	24.5
			100	0	24.01	23.96	23.91	0.5	24.5
		QPSK	1	1	23.87	23.80	23.80	0.0	25.0
			1	53	23.83	23.90	23.81	0.0	25.0
			1	104	23.88	23.25	23.01	0.0	25.0
			50	0	23.71	23.61	23.61	1.0	24.0
			50	28	23.97	24.07	24.02	0.0	25.0
			50	56	23.94	23.42	23.58	1.0	24.0
			100	0	23.75	23.69	23.64	1.0	24.0
		16QAM	1	1	23.64	23.61	23.74	1.0	24.0
			1	53	23.59	23.61	23.74	1.0	24.0
			1	104	23.44	22.36	22.20	1.0	24.0
		64QAM	1	1	22.42	22.45	22.38	2.5	22.5
		256QAM	1	1	20.26	20.32	20.38	4.5	20.5
	CP-OFDM	QPSK	1	1	23.01	22.85	22.88	1.5	23.5
BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					166300	167300	168300		
					831.50 MHz	836.50 MHz	841.50 MHz		
15 MHz	DFT-s-OFDM	π/2 BPSK	1	1	23.89	24.39	23.89	0.0	25.0
			1	40	23.91	24.36	23.95	0.0	25.0
			1	77	23.74	24.51	23.45	0.0	25.0
			36	0	23.23	24.05	24.00	0.5	24.5
			36	22	23.89	24.50	23.84	0.0	25.0
			36	43	23.24	24.11	23.23	0.5	24.5
			75	0	23.43	24.05	23.25	0.5	24.5
		QPSK	1	1	23.90	24.33	23.88	0.0	25.0
			1	40	23.91	24.36	23.95	0.0	25.0
			1	77	23.74	24.45	23.80	0.0	25.0
			36	0	23.12	23.60	23.06	1.0	24.0
			36	22	24.01	24.51	24.01	0.0	25.0
			36	43	23.03	23.69	23.23	1.0	24.0
			75	0	23.05	23.54	23.28	1.0	24.0
		16QAM	1	1	22.78	23.53	22.74	1.0	24.0
		64QAM	1	1	21.65	22.30	21.65	2.5	22.5
		256QAM	1	1	19.24	20.18	19.23	4.5	20.5
	CP-OFDM	QPSK	1	1	22.30	22.97	22.59	1.5	23.5

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					165800	167300	168800		
					829.00 MHz	836.50 MHz	844.00 MHz		
10 MHz	DFT-s-OFDM	π/2 BPSK	1	1	23.80	24.47	23.90	0.0	25.0
			1	26	23.90	24.43	23.91	0.0	25.0
			1	50	23.81	24.46	23.60	0.0	25.0
			25	0	23.50	23.92	23.23	0.5	24.5
			25	14	23.94	24.45	23.92	0.0	25.0
			25	27	23.39	23.90	23.74	0.5	24.5
			50	0	23.43	23.87	23.65	0.5	24.5
		QPSK	1	1	23.81	24.49	23.90	0.0	25.0
			1	26	23.82	24.47	23.92	0.0	25.0
			1	50	23.81	24.48	23.30	0.0	25.0
			25	0	23.01	23.40	23.02	1.0	24.0
			25	14	23.96	24.41	24.01	0.0	25.0
			25	27	22.97	23.26	23.23	1.0	24.0
			50	0	23.02	23.46	23.15	1.0	24.0
		16QAM	1	1	22.78	23.71	22.98	1.0	24.0
		64QAM	1	1	21.72	22.48	22.21	2.5	22.5
		256QAM	1	1	19.49	20.16	19.85	4.5	20.5
	CP-OFDM	QPSK	1	1	22.27	22.88	22.35	1.5	23.5

BW (MHz)	Modulation	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
					165300	167300	169300		
					826.50 MHz	836.50 MHz	846.50 MHz		
5 MHz	DFT-s-OFDM	π/2 BPSK	1	1	24.50	24.48	24.42	0.0	25.0
			1	13	24.50	24.41	23.75	0.0	25.0
			1	23	24.48	24.48	23.46	0.0	25.0
			12	0	23.95	23.96	23.58	0.5	24.5
			12	7	24.41	24.38	23.78	0.0	25.0
			12	13	23.91	23.84	23.19	0.5	24.5
			25	0	23.90	23.87	23.27	0.5	24.5
		QPSK	1	1	24.52	24.41	24.18	0.0	25.0
			1	13	24.37	24.30	23.51	0.0	25.0
			1	23	24.37	24.32	23.25	0.0	25.0
			12	0	23.46	23.43	23.05	1.0	24.0
			12	7	24.42	24.35	23.66	0.0	25.0
			12	13	23.47	23.31	22.65	1.0	24.0
			25	0	23.41	23.34	22.74	1.0	24.0
		16QAM	1	1	23.61	23.58	23.36	1.0	24.0
		64QAM	1	1	22.45	22.39	22.28	2.5	22.5
		256QAM	1	1	20.21	20.19	20.24	4.5	20.5
	CP-OFDM	QPSK	1	1	22.95	22.96	22.97	1.5	23.5

8.2. PEAK TO AVERAGE RATIO

Test Procedure

Per KDB 971168 D01 Power Meas License Digital Systems v03r01;

The transmitter output was connected to either CMW500 Test Set or E7515B 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

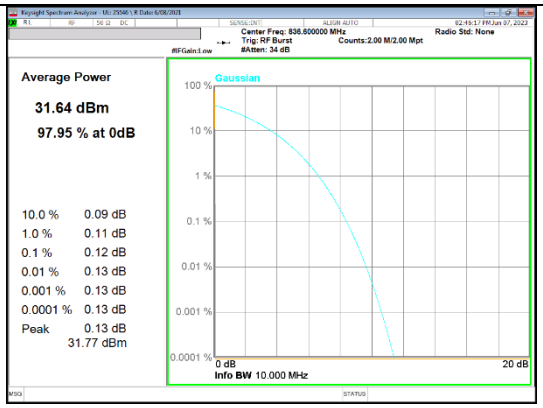
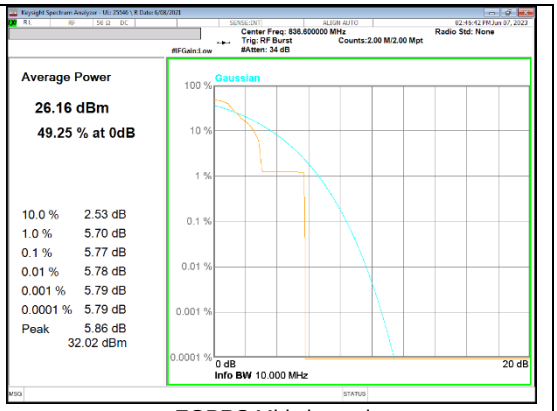
5G NR: All Waveforms (CP-OFDM vs DFT-s_OFDM) and modulations (π/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

RESULTS

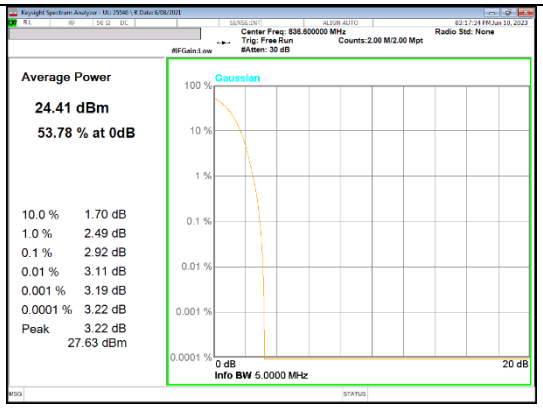
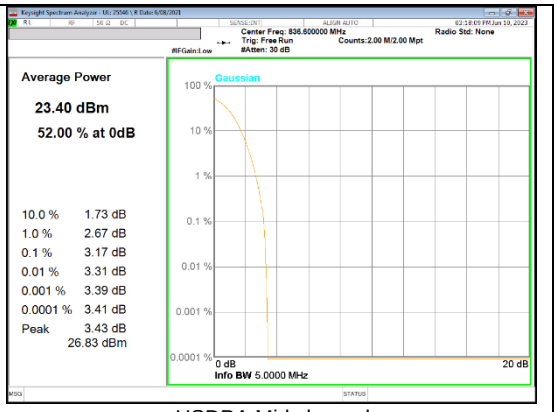
See the following pages.

8.2.1. CONDUCTED PEAK TO AVERAGE RESULT

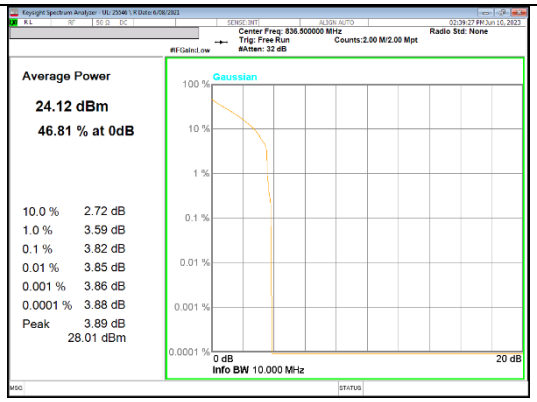
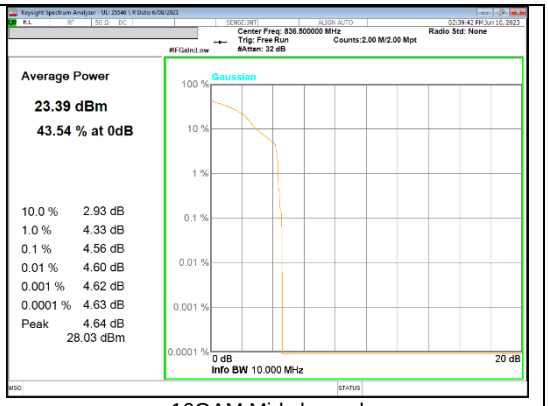
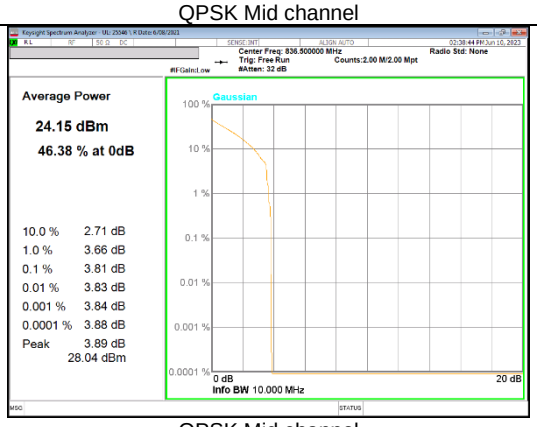
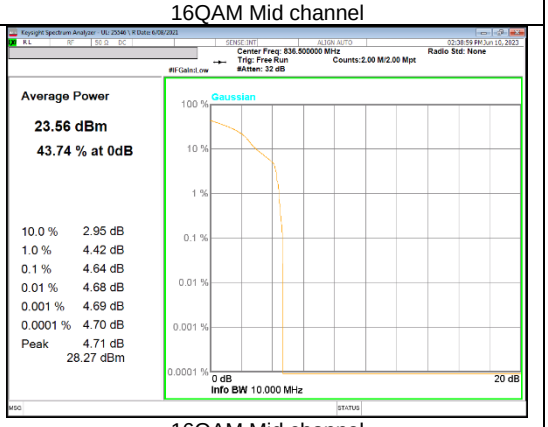
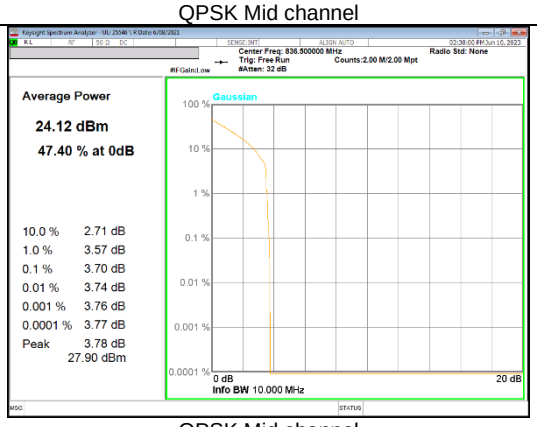
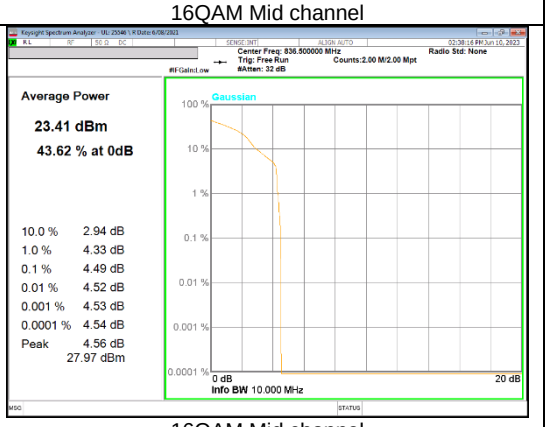
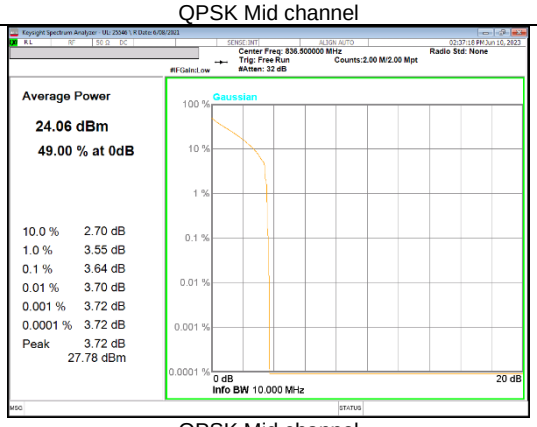
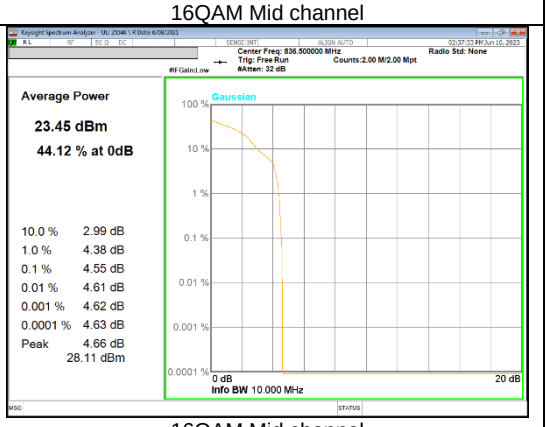
GSM

GSM 850	 GPRS Mid channel	 EGPRS Mid channel

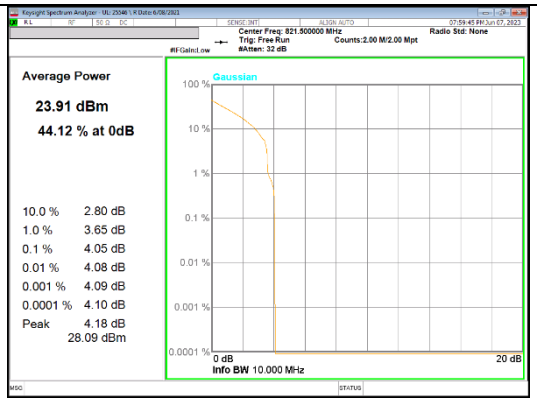
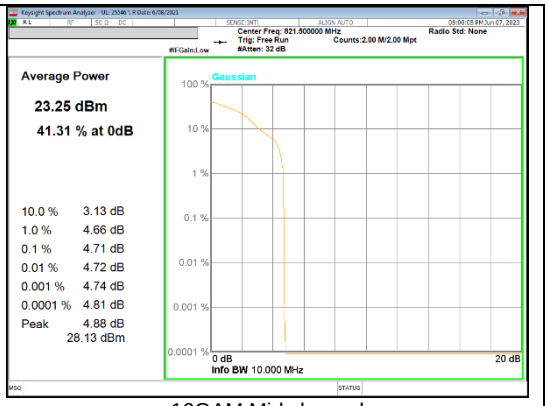
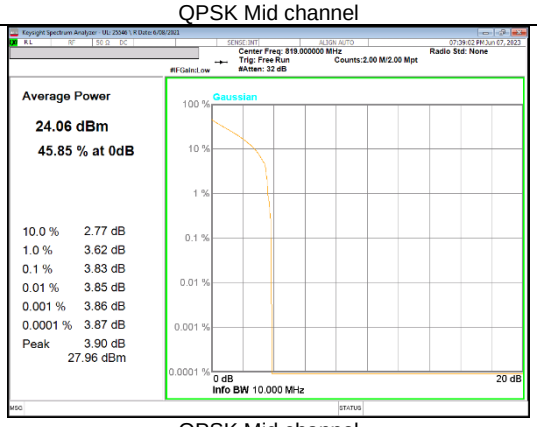
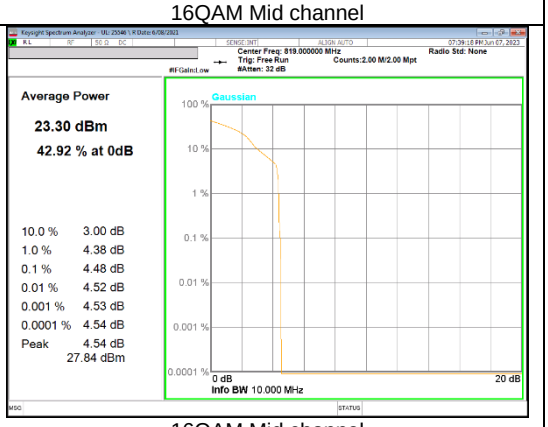
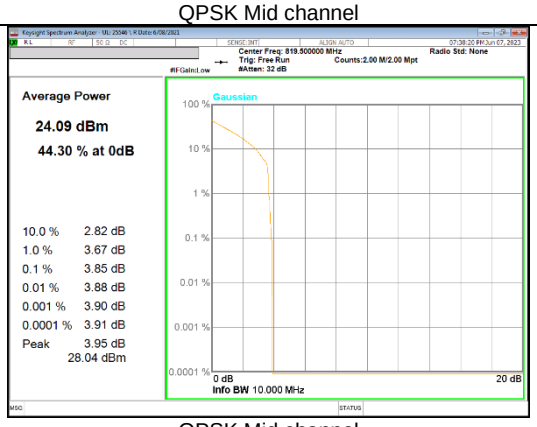
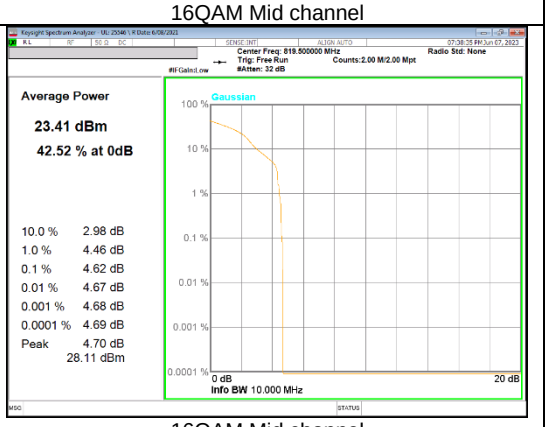
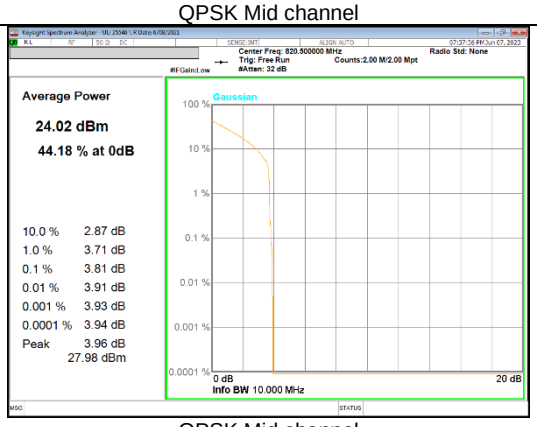
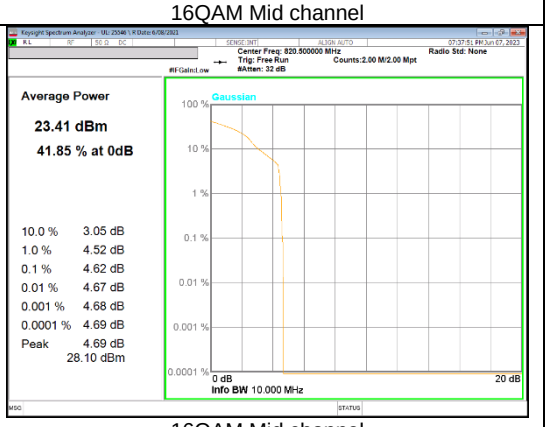
WCDMA

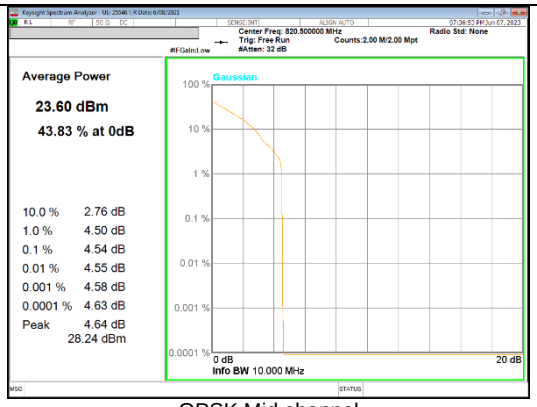
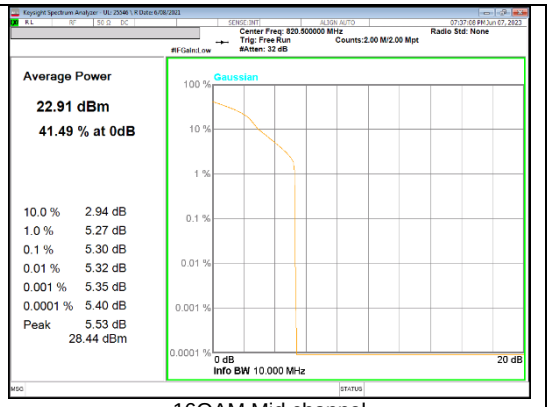
Band 5	 REL99 Mid channel	 HSDPA Mid channel

LTE Band 5

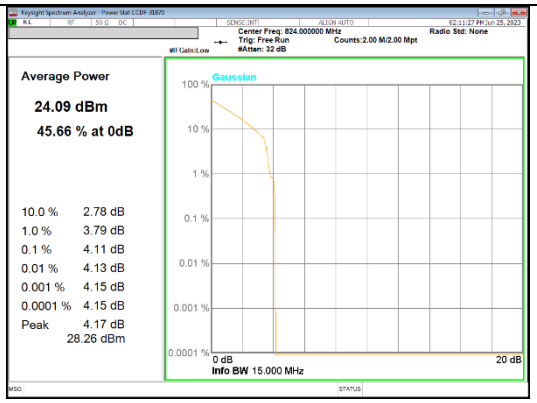
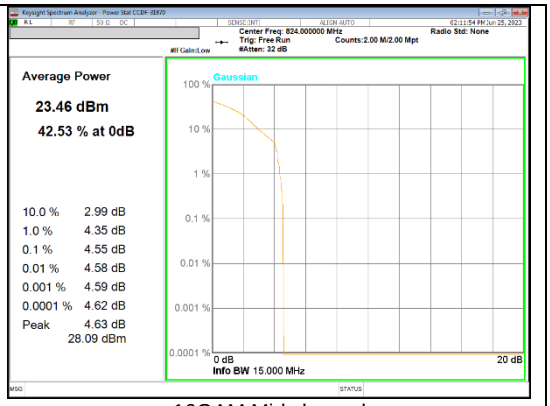
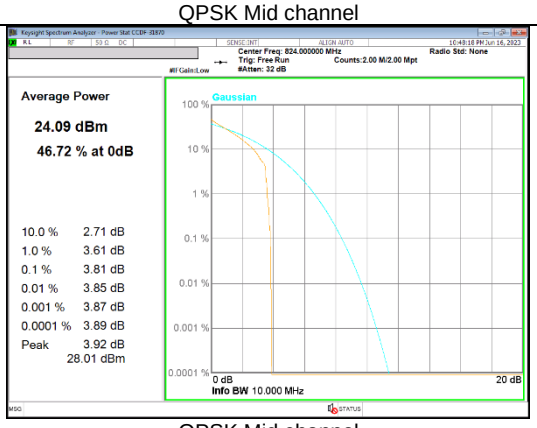
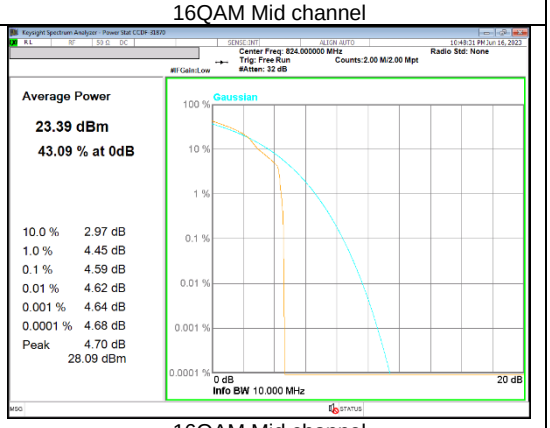
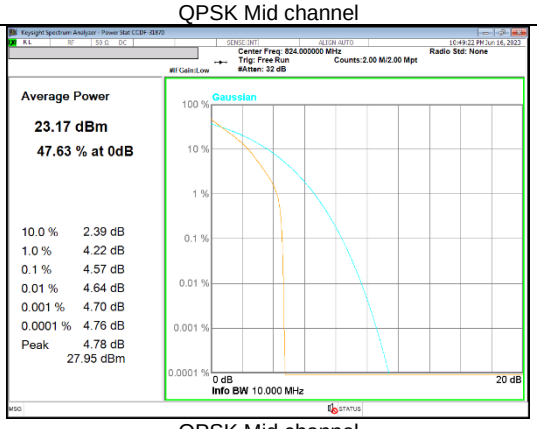
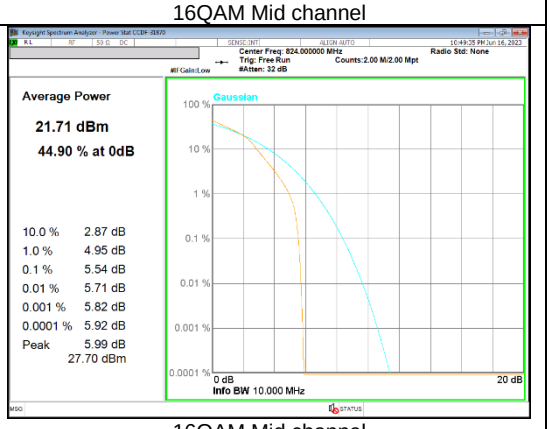
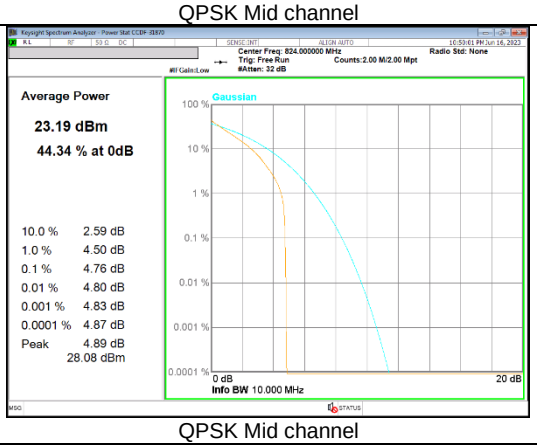
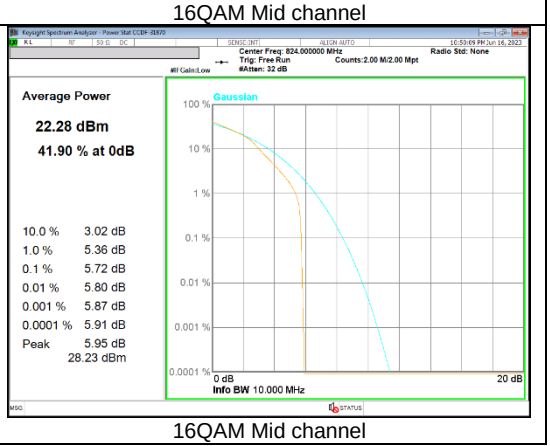
10 MHz	 QPSK Mid channel	 16QAM Mid channel
5 MHz	 QPSK Mid channel	 16QAM Mid channel
3 MHz	 QPSK Mid channel	 16QAM Mid channel
1.4 MHz	 QPSK Mid channel	 16QAM Mid channel

LTE Band 26 (Part 90)

15 MHz	 QPSK Mid channel	 16QAM Mid channel
10 MHz	 QPSK Mid channel	 16QAM Mid channel
5 MHz	 QPSK Mid channel	 16QAM Mid channel
3 MHz	 QPSK Mid channel	 16QAM Mid channel

1.4 MHz		
	QPSK Mid channel	16QAM Mid channel

LTE Band 26 (Straddle)

15 MHz	 QPSK Mid channel	 16QAM Mid channel
10 MHz	 QPSK Mid channel	 16QAM Mid channel
5 MHz	 QPSK Mid channel	 16QAM Mid channel
3 MHz	 QPSK Mid channel	 16QAM Mid channel

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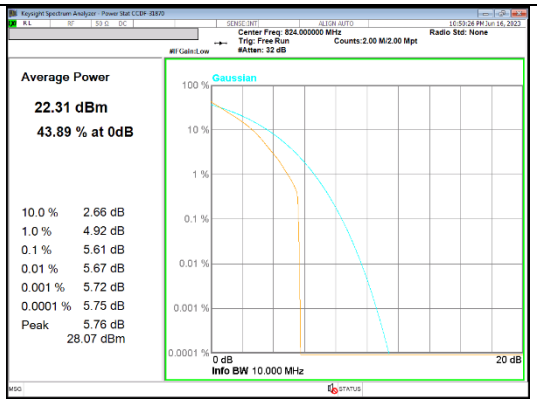
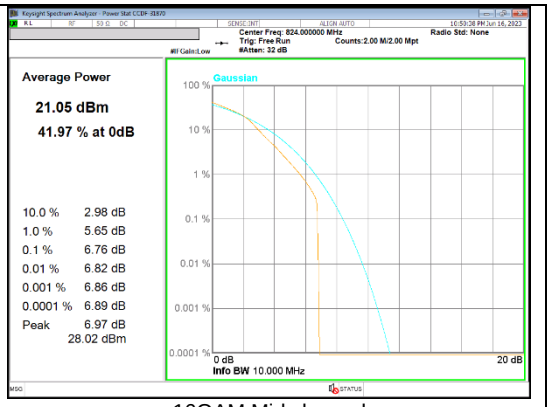
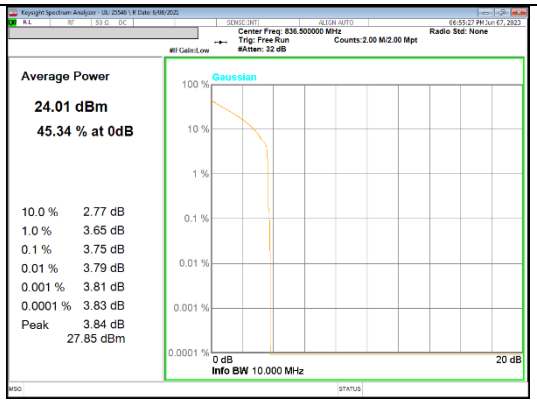
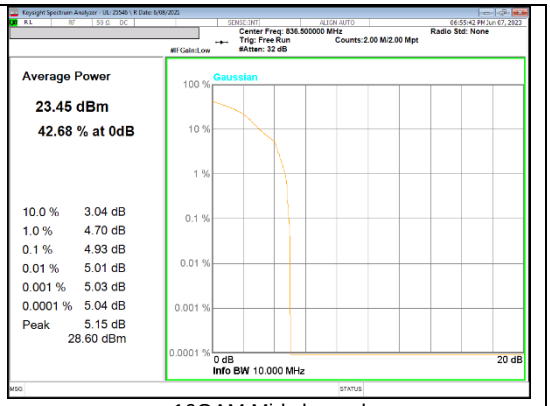
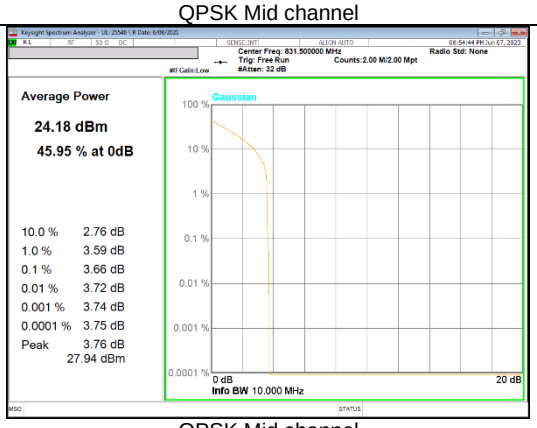
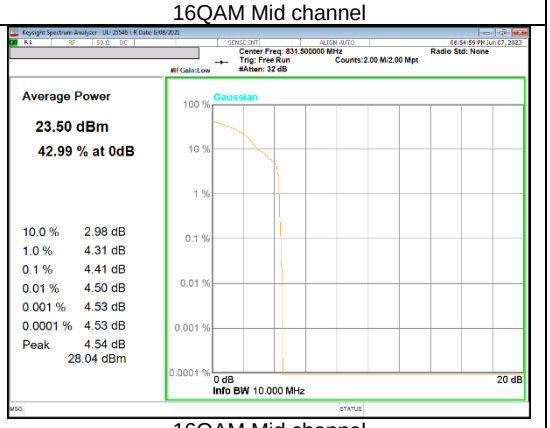
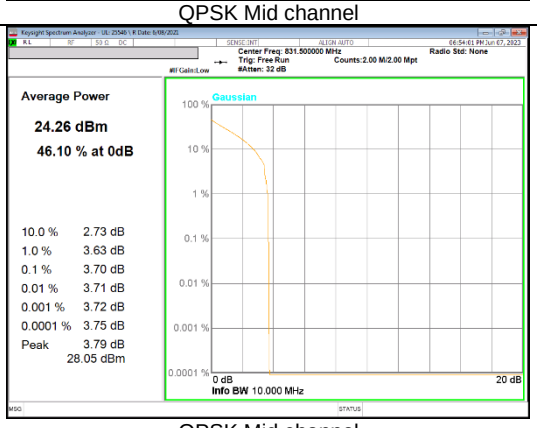
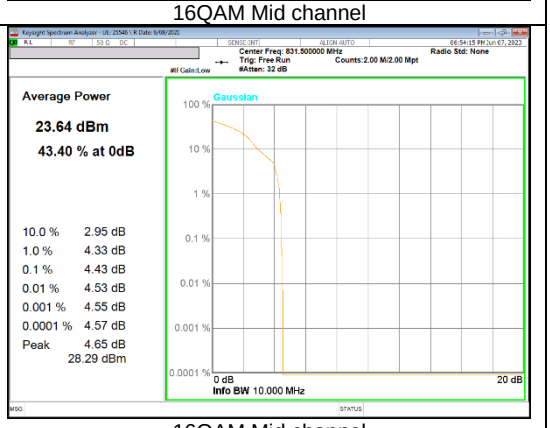
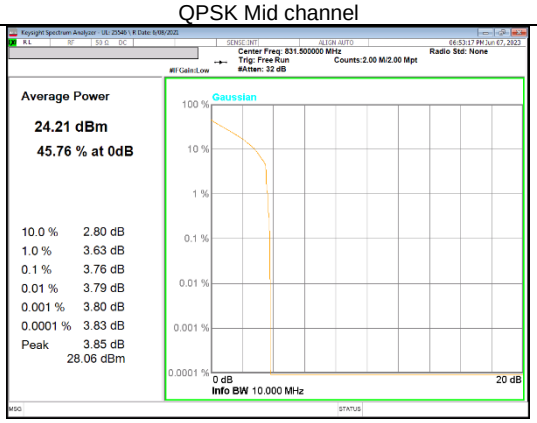
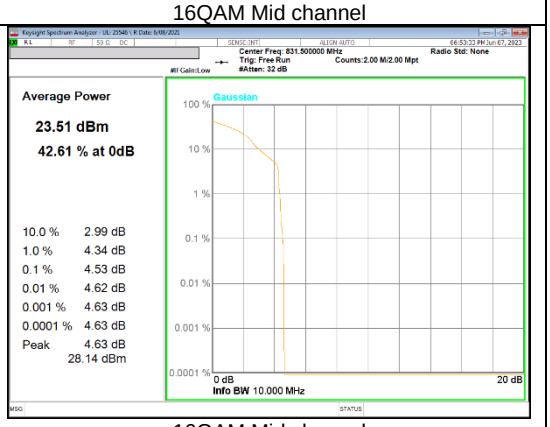
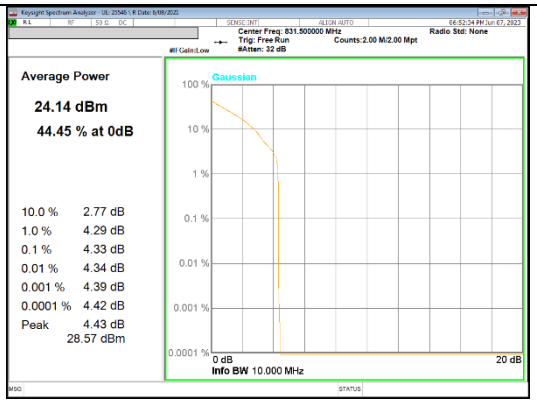
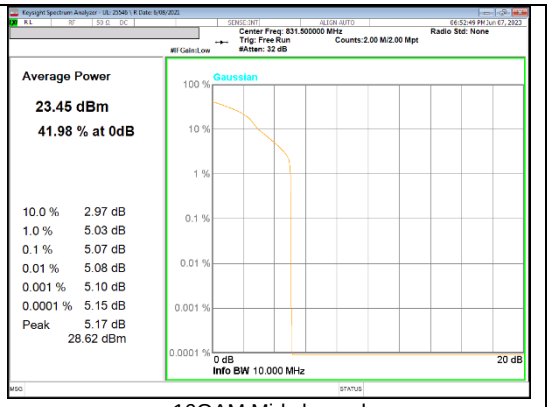
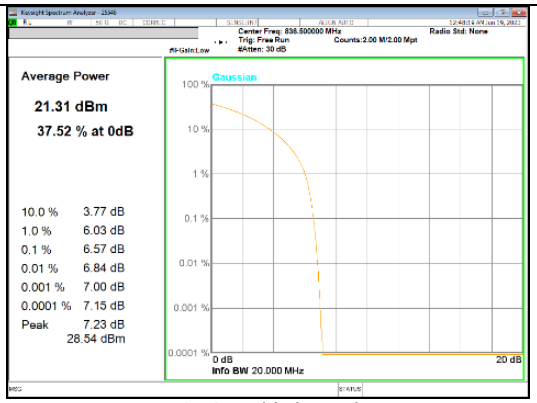
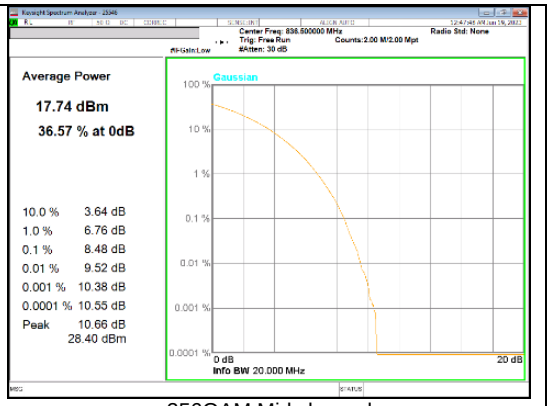
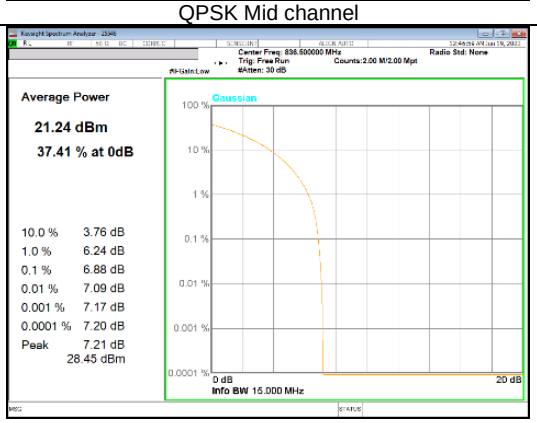
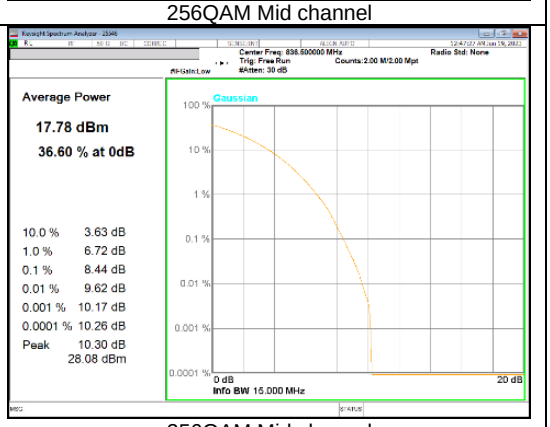
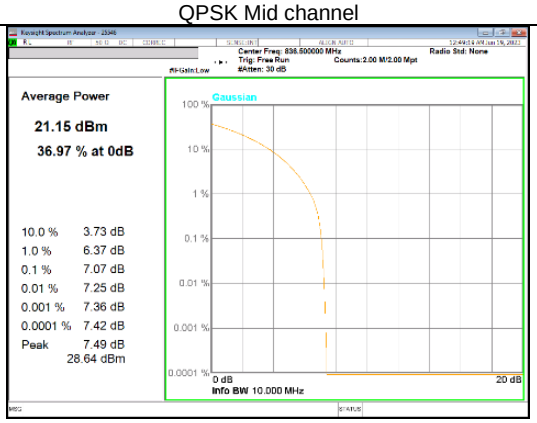
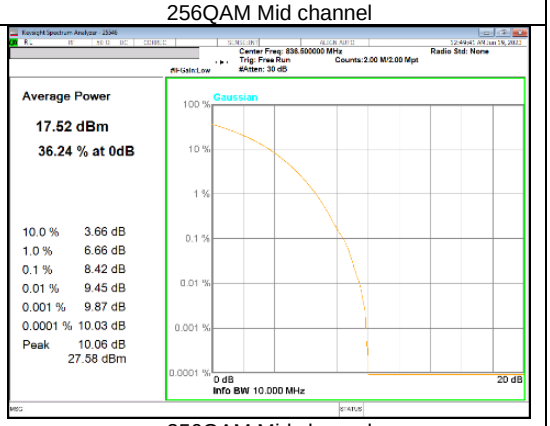
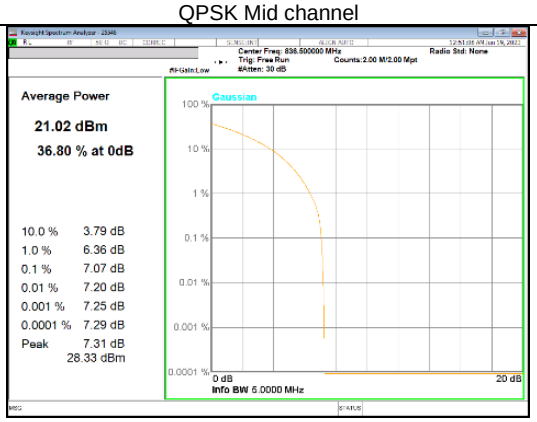
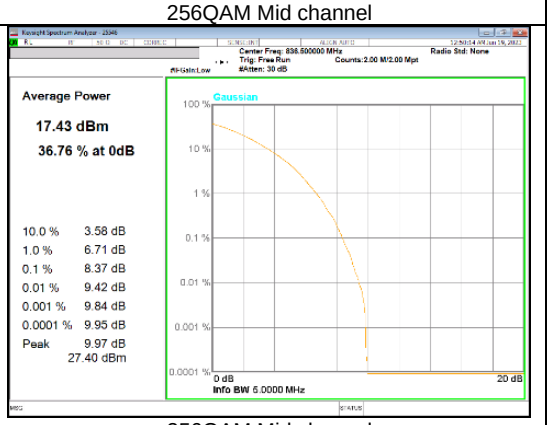
1.4 MHz	 QPSK Mid channel	 16QAM Mid channel

LTE Band 26 (Part 22)

15 MHz	 QPSK Mid channel	 16QAM Mid channel
10 MHz	 QPSK Mid channel	 16QAM Mid channel
5 MHz	 QPSK Mid channel	 16QAM Mid channel
3 MHz	 QPSK Mid channel	 16QAM Mid channel

1.4 MHz		
	QPSK Mid channel	16QAM Mid channel

NR Band n5 CP-OFDM

20 MHz	 QPSK Mid channel	 256QAM Mid channel
15 MHz	 QPSK Mid channel	 256QAM Mid channel
10 MHz	 QPSK Mid channel	 256QAM Mid channel
5 MHz	 QPSK Mid channel	 256QAM Mid channel

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 middle channel in each band. The -26dB bandwidth was also measured and recorded.

(KDB 971168 D01 Power Meas License Digital Systems v03r01)

RESULTS

See the following pages.

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- **GSM**

Band	Modulation	f [MHz]	99% BW (kHz)	-26dB BW (kHz)
850	GPRS	836.60	240.500	311.500
	EGPRS		241.890	311.700

- **WCDMA**

Band	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
B5	Rel.99	836.60	4.144	4.691
	HSDPA		4.148	4.697

- LTE Band 5

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B5	10M	QPSK	836.50	8.961	9.836
		16QAM		8.963	9.902
	5M	QPSK	836.50	4.501	5.096
		16QAM		4.494	5.021
	3M	QPSK	836.50	2.700	3.034
		16QAM		2.704	3.049
	1.4M	QPSK	836.50	1.090	1.328
		16QAM		1.096	1.382

- LTE Band 26 (Part 90)

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B26	15M	QPSK	821.50	13.410	14.820
		16QAM		13.394	14.750
	10M	QPSK	819.00	8.957	9.774
		16QAM		8.945	9.906
	5M	QPSK	819.50	4.497	5.092
		16QAM		4.490	5.023
	3M	QPSK	820.50	2.695	3.037
		16QAM		2.699	3.035
	1.4M	QPSK	820.50	1.089	1.336
		16QAM		1.093	1.327

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- LTE Band 26 (Straddle)

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B26	15M	QPSK	824.00	13.448	14.670
		16QAM		13.418	14.610
	10M	QPSK		8.955	9.790
		16QAM		8.949	9.608
	5M	QPSK		4.479	5.030
		16QAM		4.487	4.991
	3M	QPSK		2.689	2.996
		16QAM		2.692	2.996
	1.4M	QPSK		1.087	1.326
		16QAM		1.091	1.338

- LTE Band 26 (Part 22)

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B26	15M	QPSK	836.50	13.434	14.720
		16QAM		13.422	14.730
	10M	QPSK	831.50	8.951	9.814
		16QAM		8.960	9.875
	5M	QPSK	831.50	4.498	5.094
		16QAM		4.497	5.122
	3M	QPSK	831.50	2.669	2.906
		16QAM		2.699	3.075
	1.4M	QPSK	831.50	1.090	1.324
		16QAM		1.094	1.345

- NR Band n5

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
NR n5	20M	QPSK	836.50	18.951	19.920
		16QAM		18.934	19.830
	15M	QPSK	836.50	14.114	14.940
		16QAM		14.157	15.050
	10M	QPSK	836.50	9.284	10.040
		16QAM		9.301	10.110
	5M	QPSK	836.50	4.467	5.018
		16QAM		4.500	5.118

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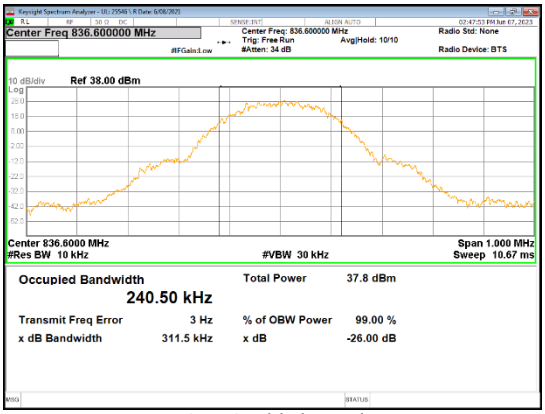
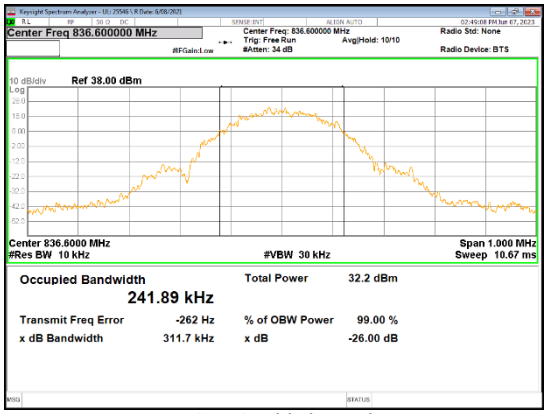
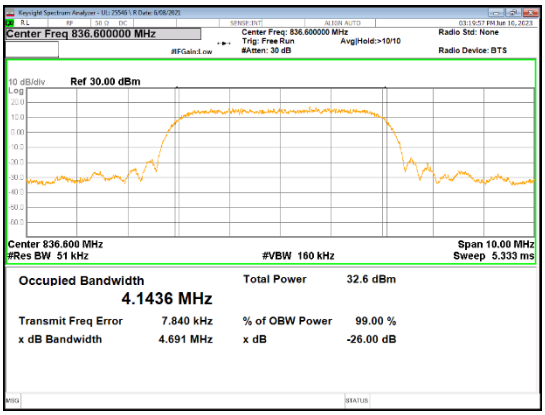
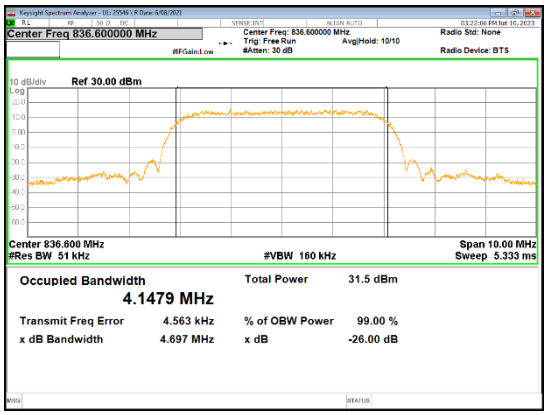
8.3.1. OCCUPIED BANDWIDTH RESULTS

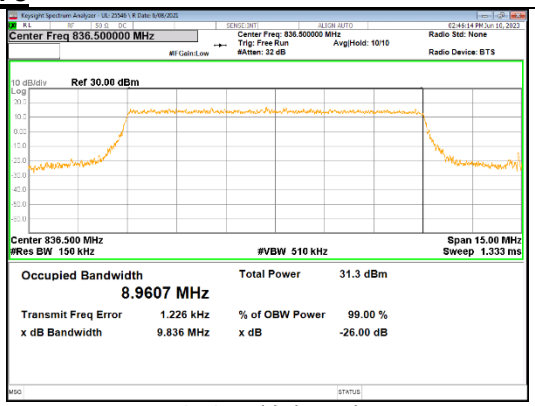
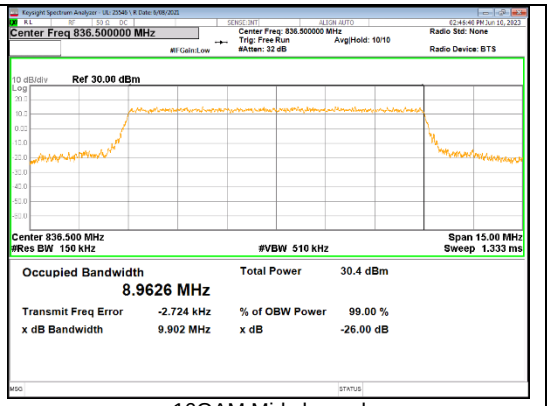
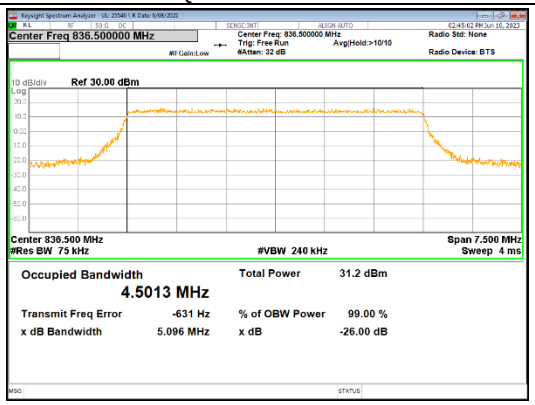
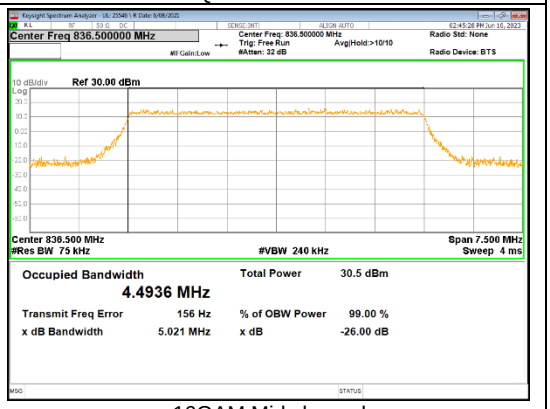
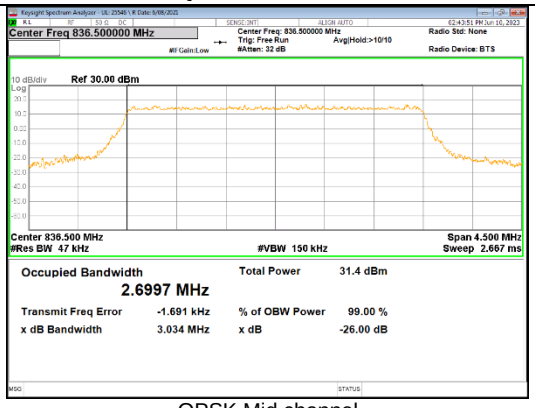
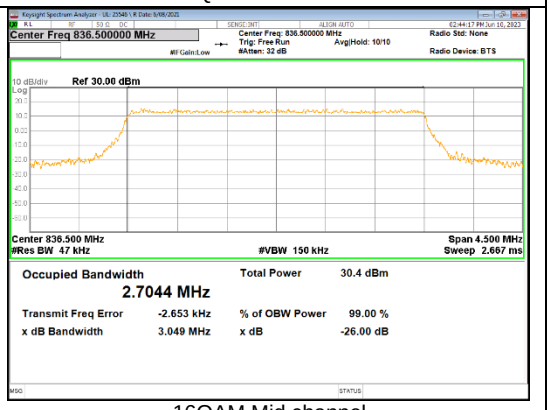
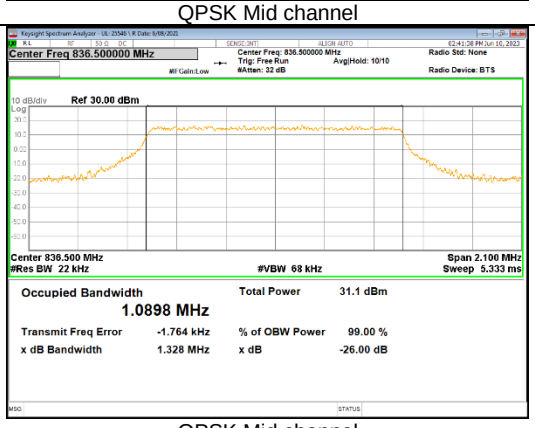
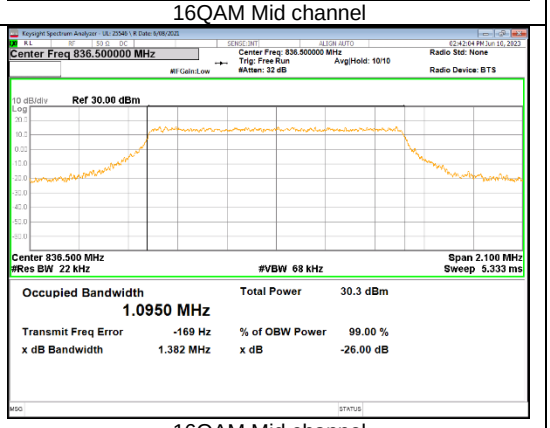
GSM 850

GSM 850	 GPRS Mid channel	 EGPRS Mid channel

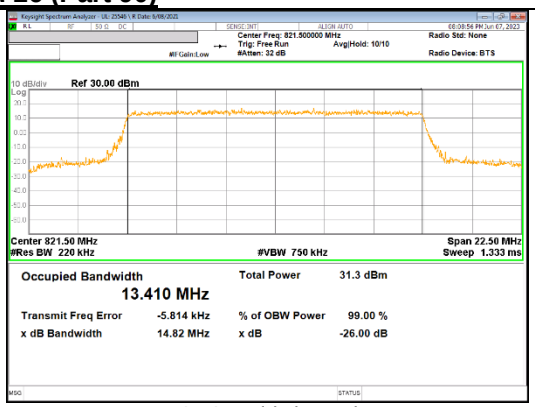
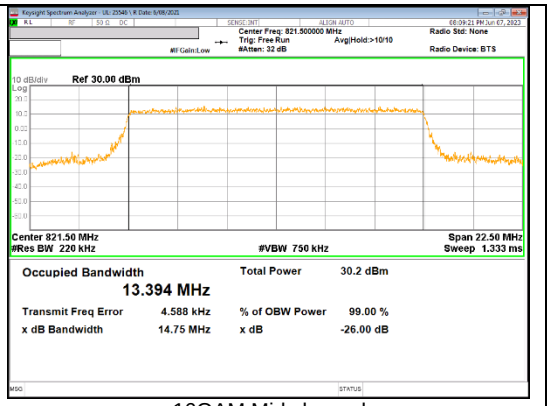
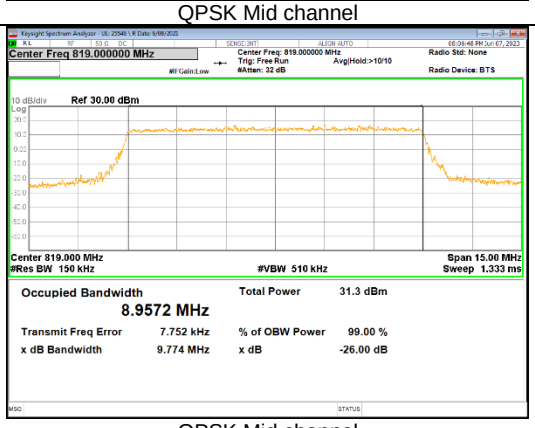
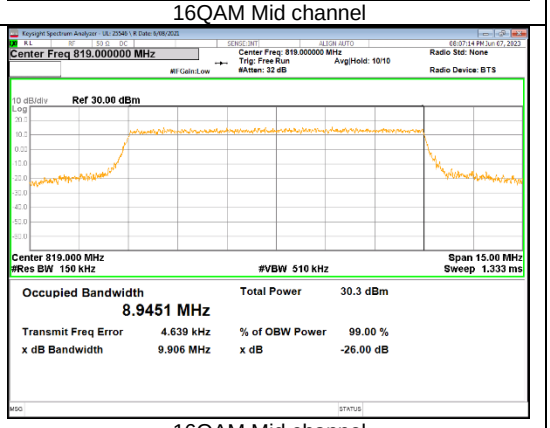
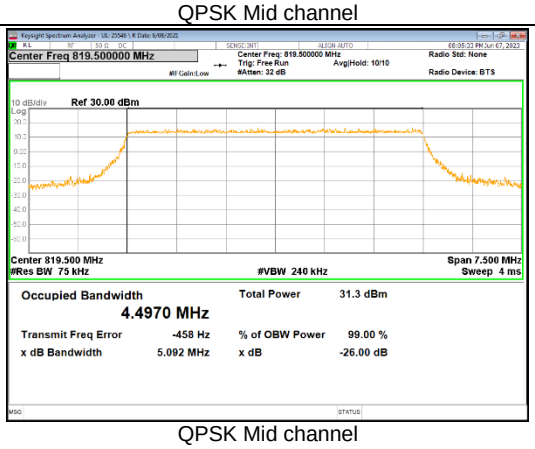
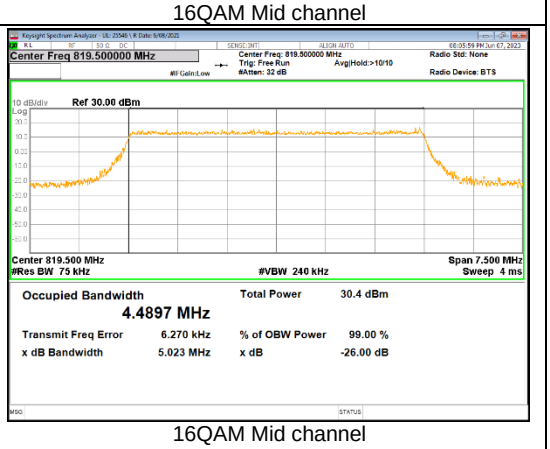
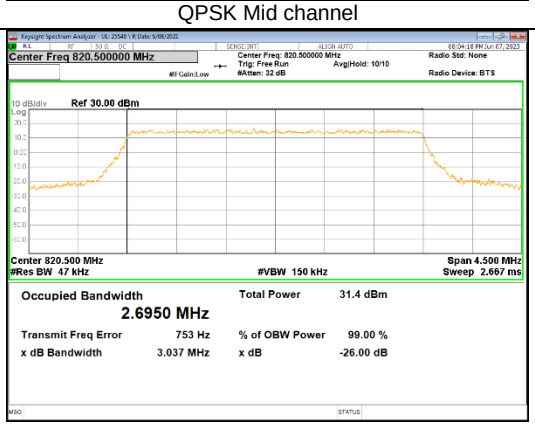
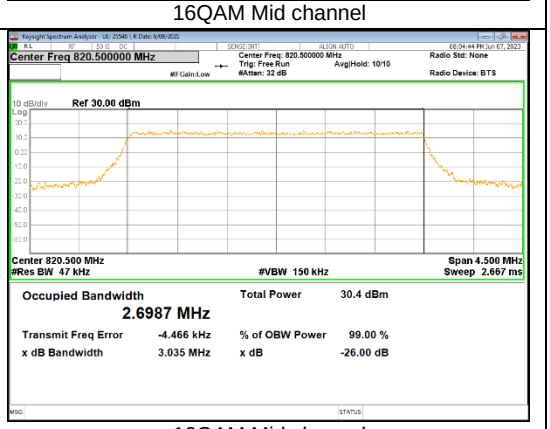
WCDMA Band 5

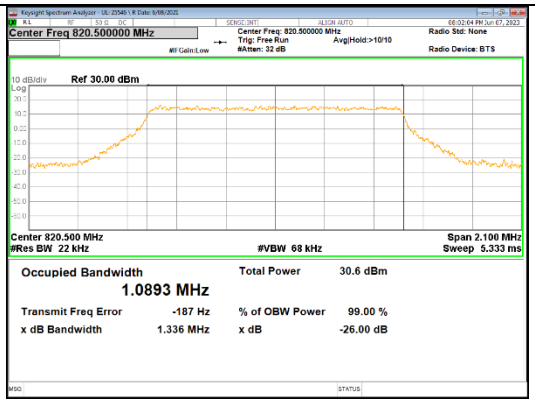
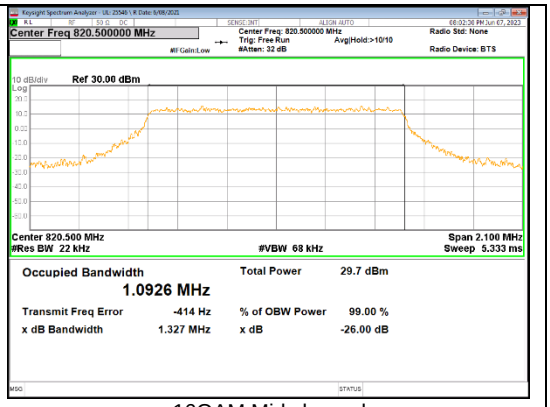
Band 5	 REL99 Mid channel	 HSDPA Mid channel

LTE Band 5

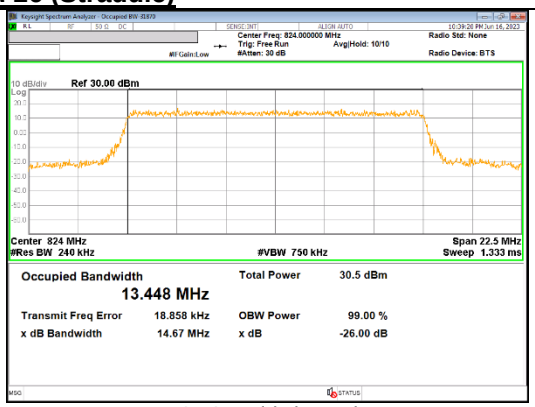
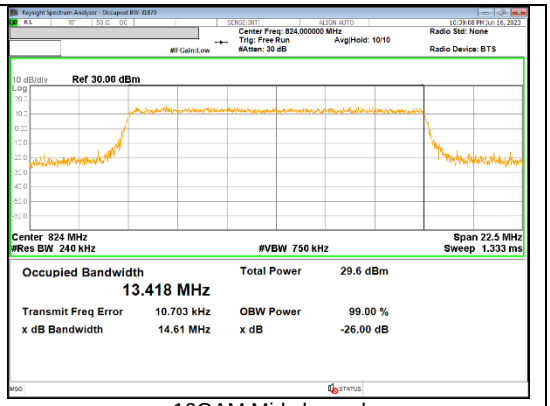
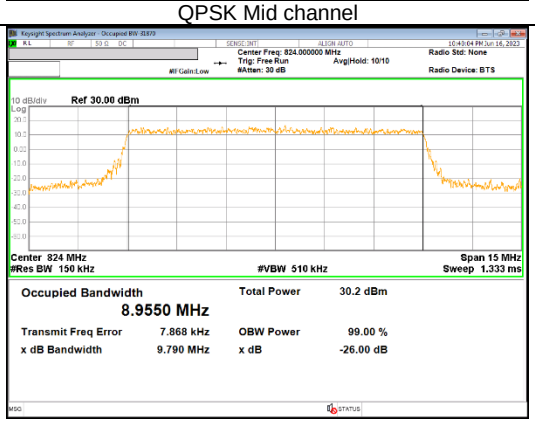
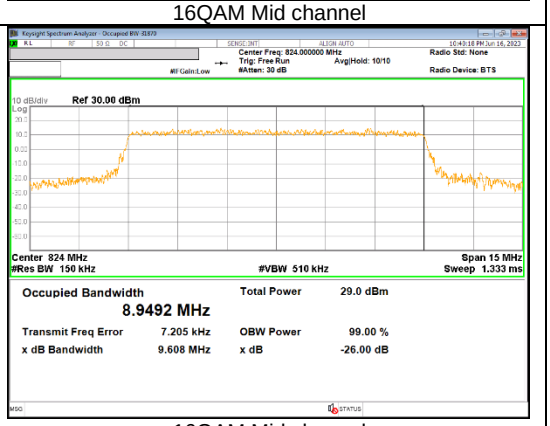
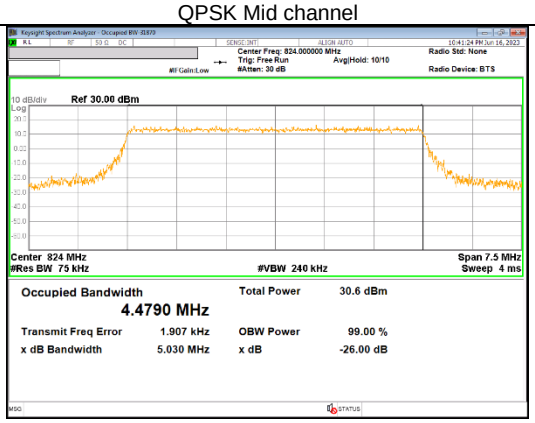
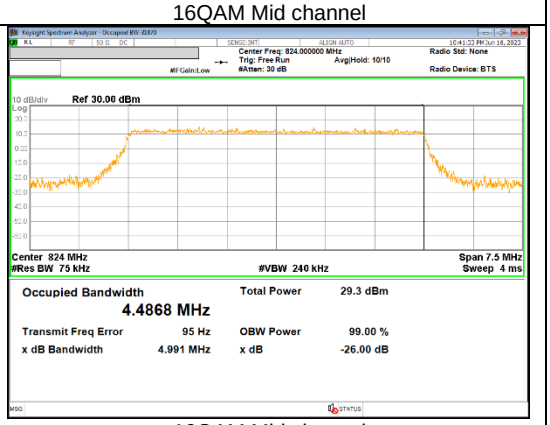
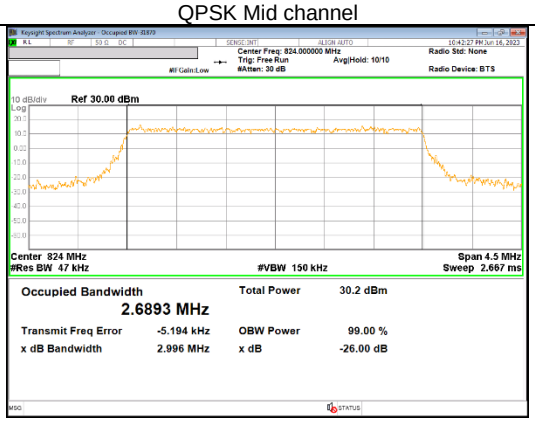
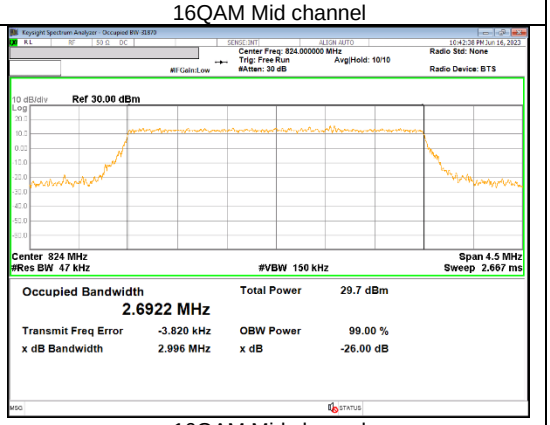
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel
3MHz	 QPSK Mid channel	 16QAM Mid channel
1.4MHz	 QPSK Mid channel	 16QAM Mid channel

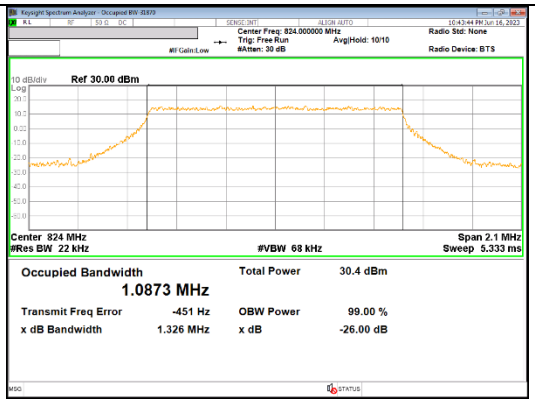
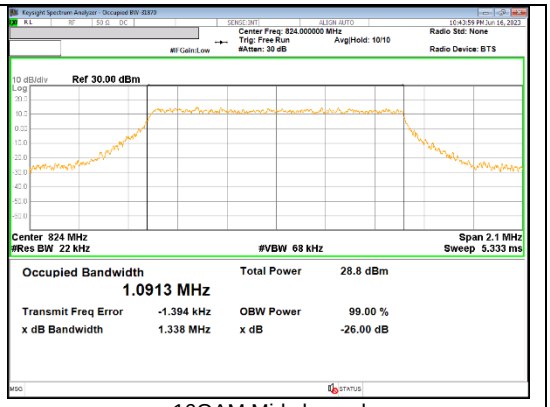
LTE Band 26 (Part 90)

15MHz	 QPSK Mid channel	 16QAM Mid channel
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel
3MHz	 QPSK Mid channel	 16QAM Mid channel

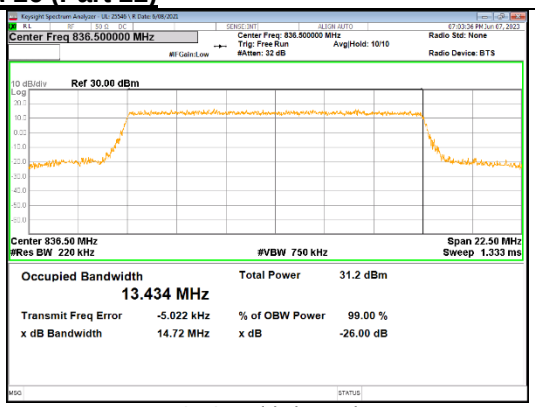
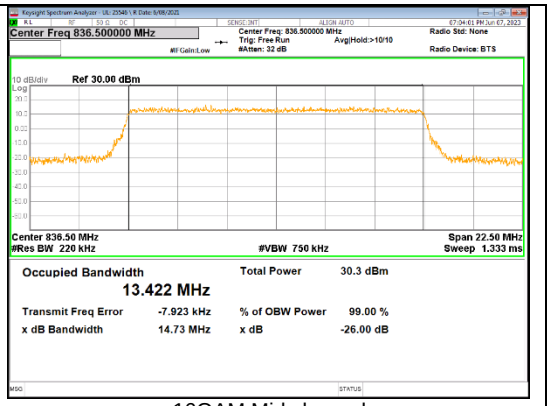
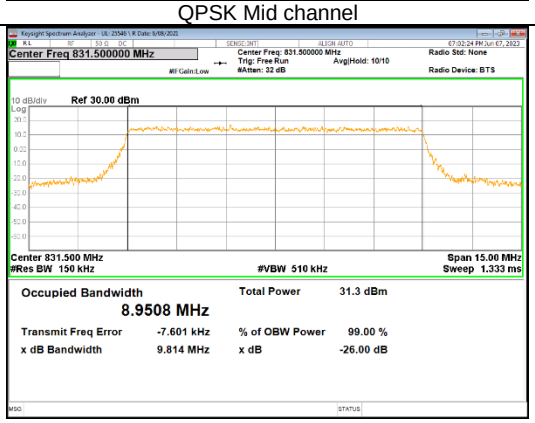
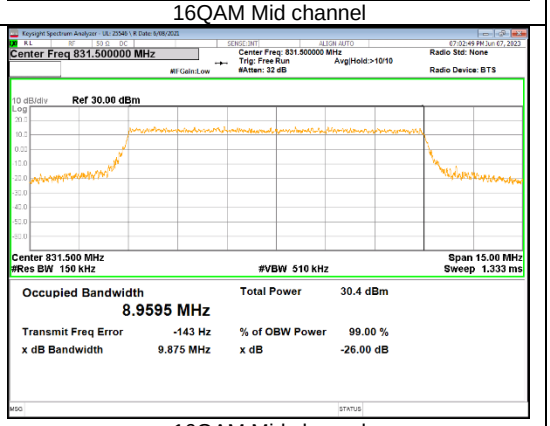
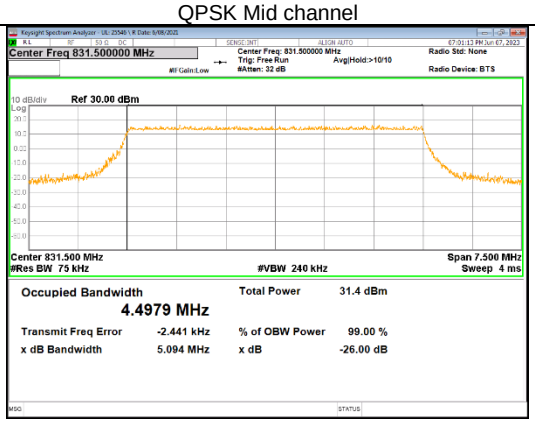
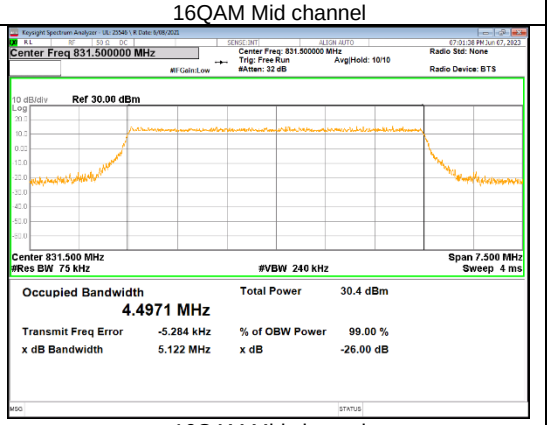
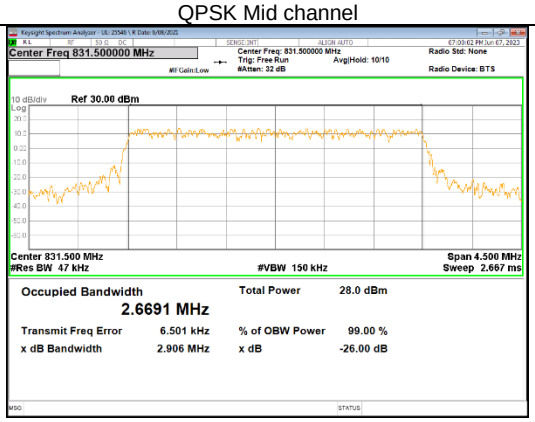
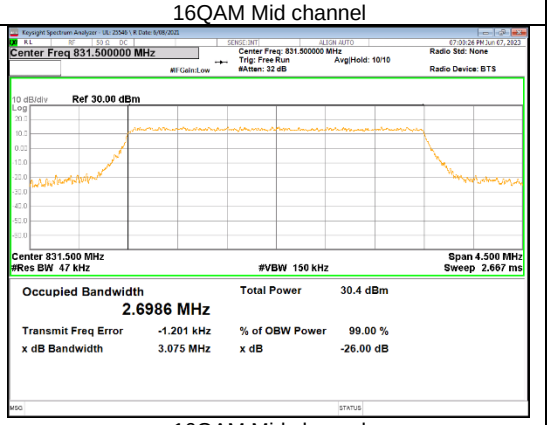
1.4MHz		
	QPSK Mid channel	16QAM Mid channel

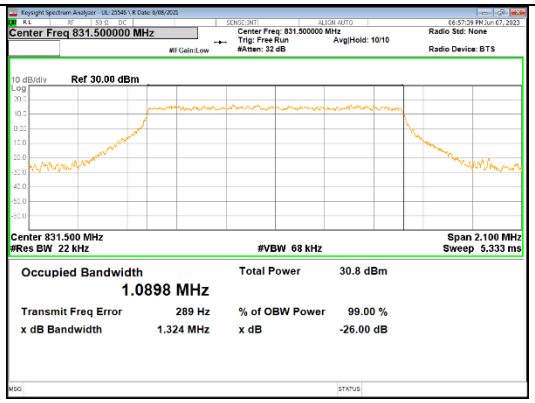
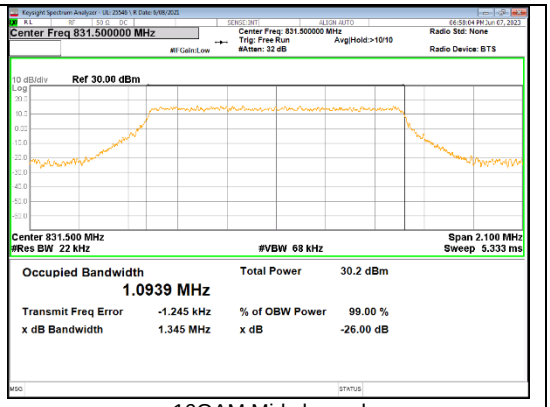
LTE Band 26 (Straddle)

15MHz	 QPSK Mid channel	 16QAM Mid channel
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel
3MHz	 QPSK Mid channel	 16QAM Mid channel

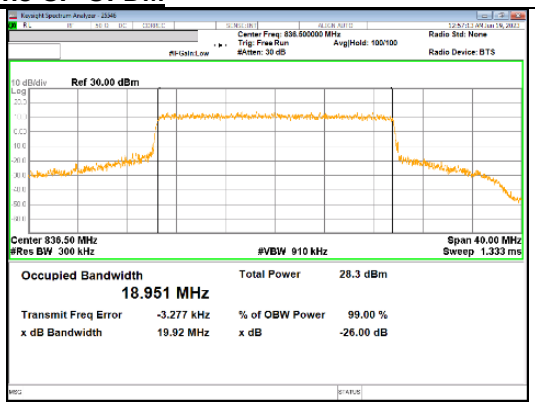
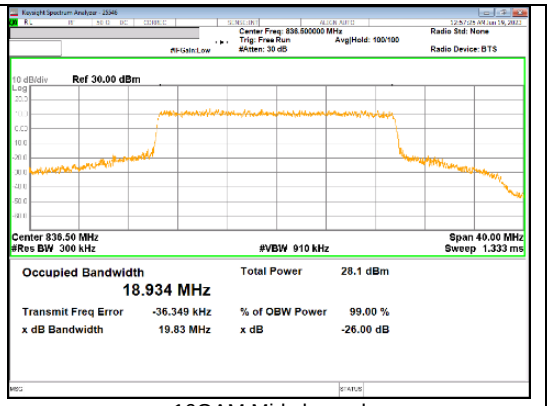
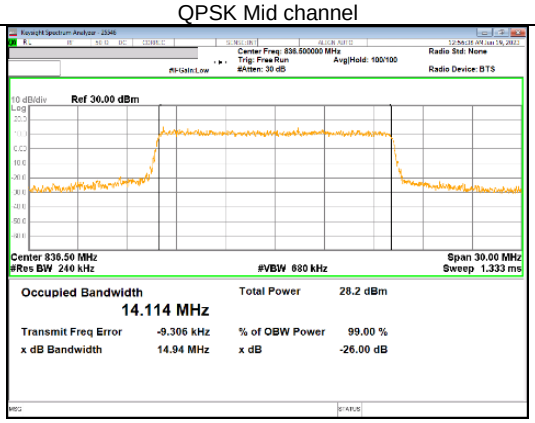
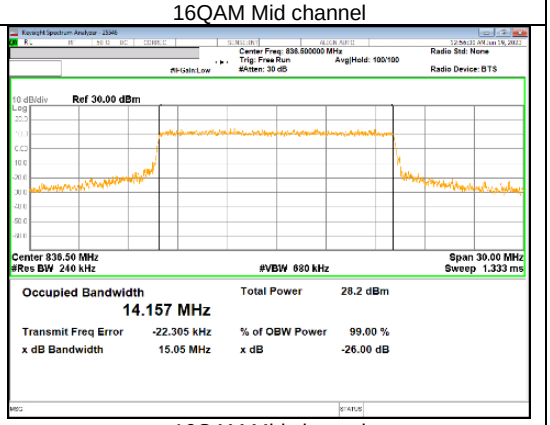
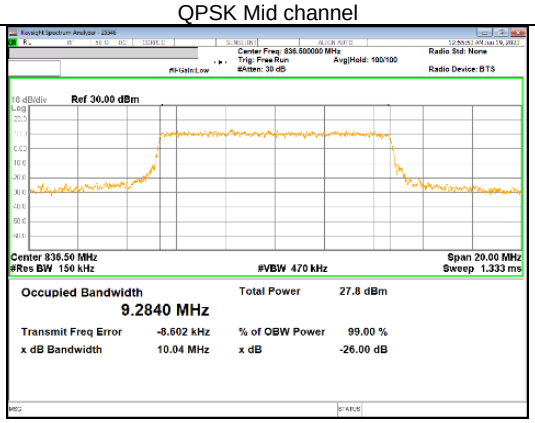
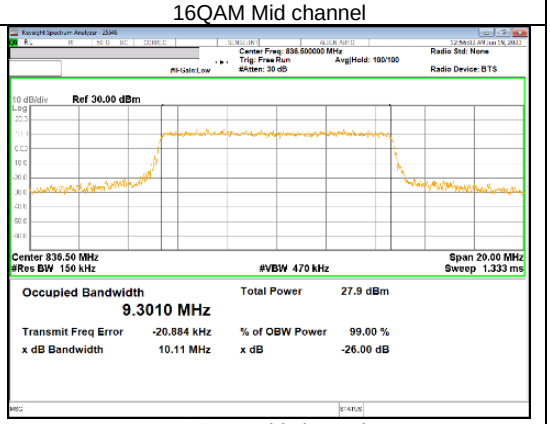
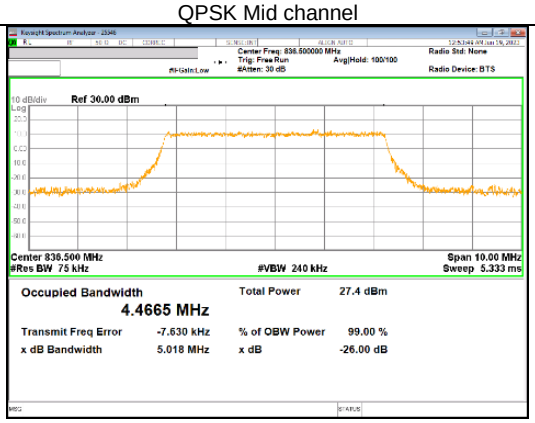
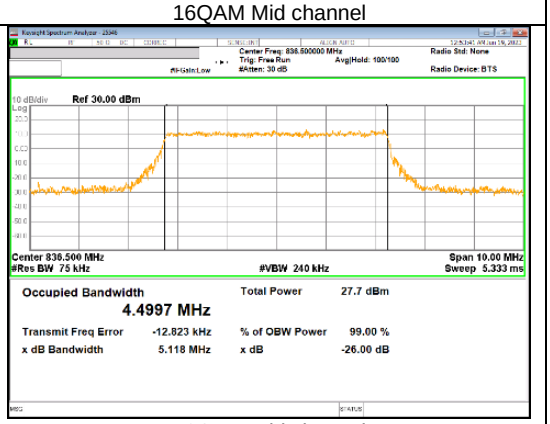
1.4MHz		
	QPSK Mid channel	16QAM Mid channel

LTE Band 26 (Part 22)

15MHz	 QPSK Mid channel	 16QAM Mid channel
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel
3MHz	 QPSK Mid channel	 16QAM Mid channel

1.4MHz		
	QPSK Mid channel	16QAM Mid channel

NR Band n5 CP-OFDM

20 MHz	 QPSK Mid channel	 16QAM Mid channel
15 MHz	 QPSK Mid channel	 16QAM Mid channel
10 MHz	 QPSK Mid channel	 16QAM Mid channel
5 MHz	 QPSK Mid channel	 16QAM Mid channel

8.4. BAND EDGE EMISSIONS

RULE PART(S)

FCC: §22.359, §22.917 and 90.691

LIMITS

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

Part 90.691:
(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

UL KOREA LTD. Suwon Laboratory FORM ID: FCC_22/90(05)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01
The transmitter output was connected to either CMW500 Test Set or E7515B 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.

GSM

a) Set the RBW = 1 - 5% of OBW(GSM850 – 8.2KHz)
b) Set VBW ≥ 3 × RBW;
c) Set span ≥ 1.5 times the OBW;
d) Sweep time = 1S ;
e) Detector = RMS;
f) Ensure that the number of measurement points ≥ 2*Span/RBW;
g) Trace mode = Average(100);
h) Add duty cycle correction factor (9dB)

WCDMA/LTE/5G NR

a) Set the RBW = 1 - 1.5 % of OBW(Typically limited to a minimum RBW of 1% of the OBW)
b) Set VBW ≥ 3 × RBW;
c) Set span ≥ 1.5 times the OBW;
d) Sweep time = Auto;
e) Detector = RMS;
f) Ensure that the number of measurement points ≥ 2*Span/RBW;
g) Trace mode = Average (100);

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NOTE1

Note that the spurious emissions outside of the channel include narrowband signals. These signals are all below the -13dBm / -25dBm limits. Although the measurement bandwidth is less than the reference bandwidth of 1MHz no addental correction is applied as ANSI C63.26 section 4.2.3 only requires the correction to be applied when the OBW of the emission being measured is wider than the measurement bandwidth (Where the OBW of the signal under measurement is less than the RBW of the measuring instrument, no bandwidth correction or integration will be required.) Plots for low and high channels show the level of the emission measured with the reduced bandwidth and the level of the same emission measured using the integration method over the 1MHz reference bandwidth are very close, indicating the emissions are narrowband.

NOTE2

For Band-Edge extended:

CH BW (MHz)	RB Used (kHz)	CF for emissions more than 100kHz	CF for emissions more than 1MHz
1.4	15	+8.2 dB	+18.2 dB
3	30	+5.2 dB	+15.2 dB
5	51	+2.9 dB	+12.9 dB
10	100	N/A	+10.0 dB
15	150	N/A	+8.2 dB
20	200	N/A	+7.0 dB

For the band edge value measured in [RB Used], even if [CF for emissions reference bandwidth 100kHz/1MHz] is applied, it is below -13dBm.

NOTE3

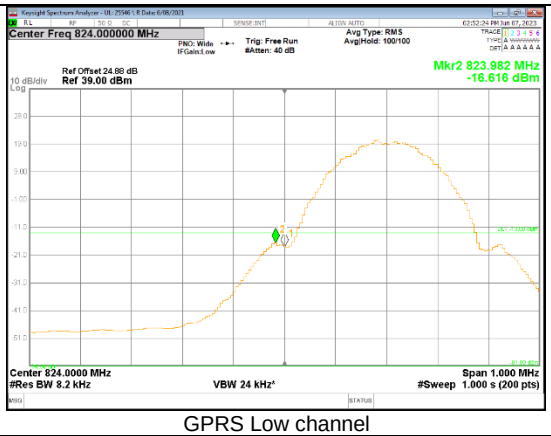
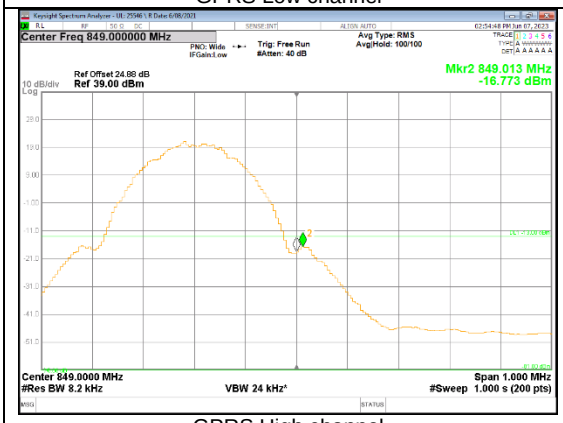
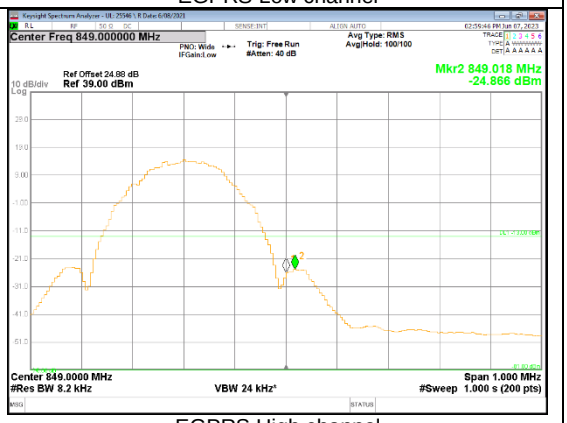
5G NR: All Waveforms (CP-OFDM vs DFT-s_OFDM) and modulations (π/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

RESULTS

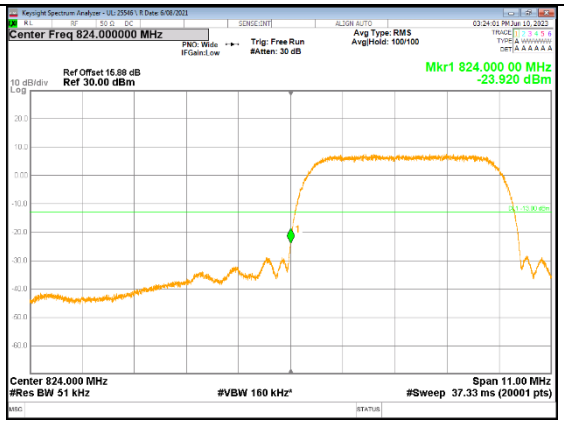
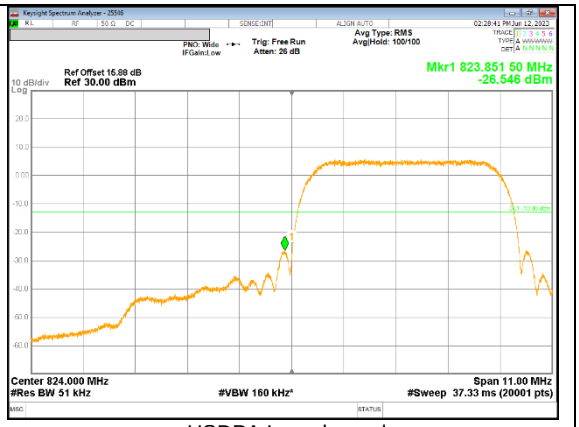
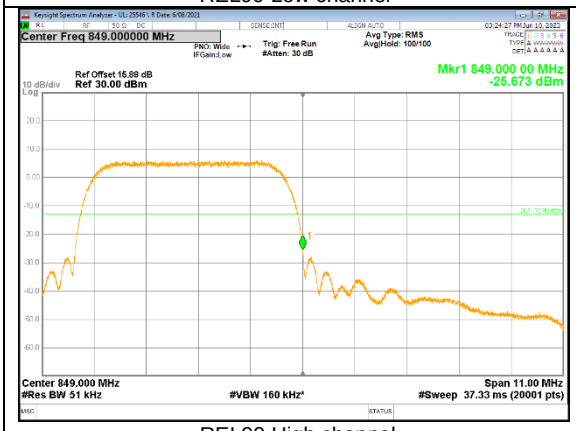
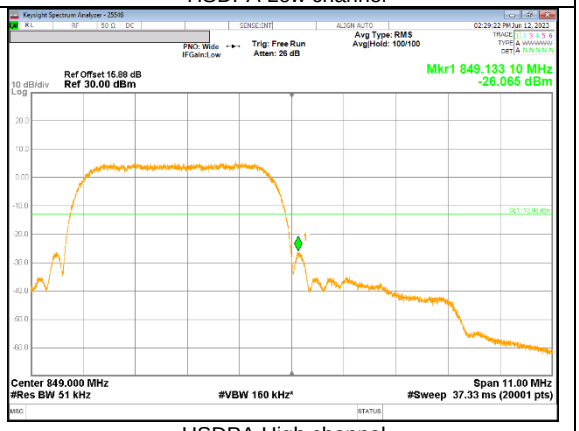
See the following pages.

8.4.1. BAND EDGE RESULT

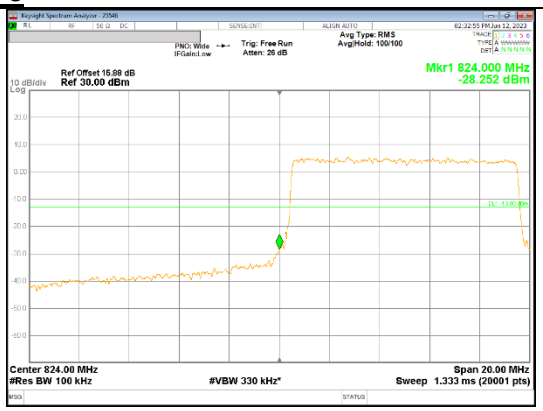
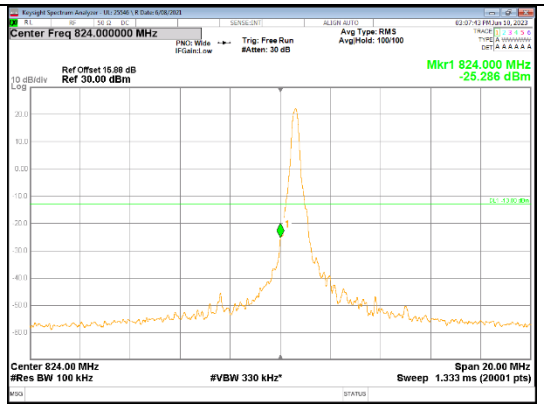
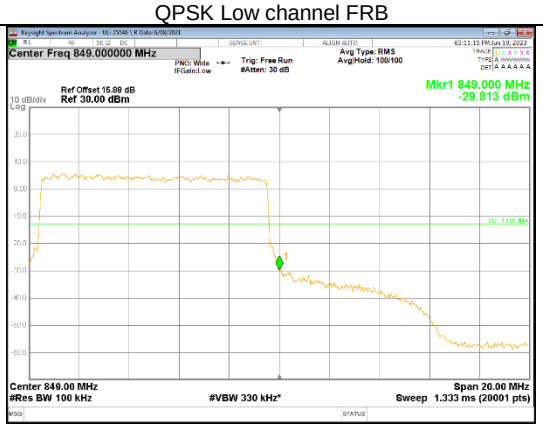
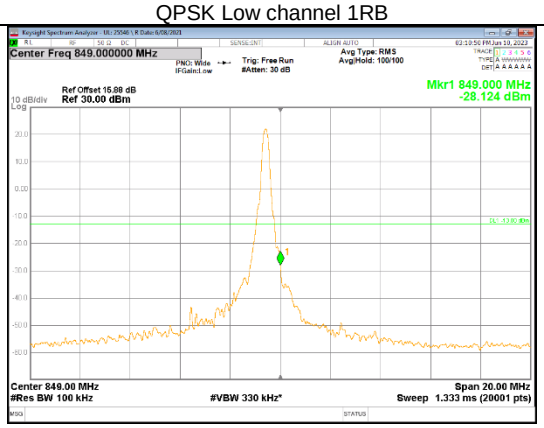
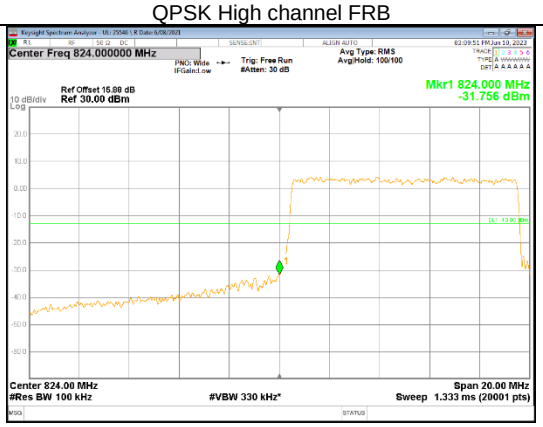
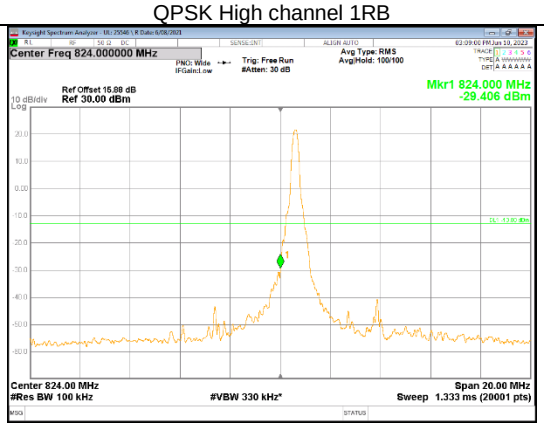
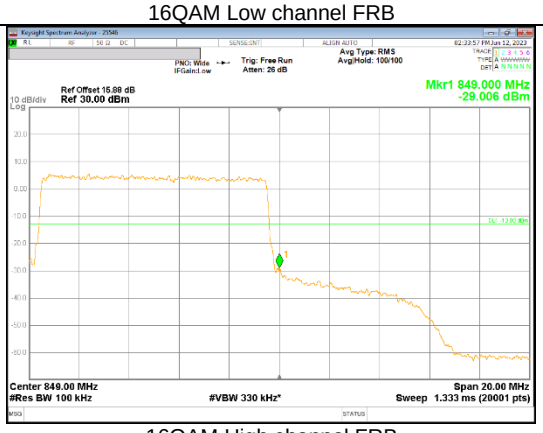
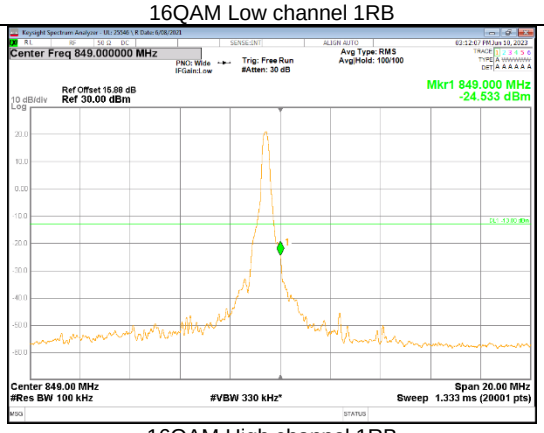
GSM

GSM 850	 GPRS Low channel	 EGPRS Low channel
	 GPRS High channel	 EGPRS High channel

WCDMA

Band 5	 REL99 Low channel	 HSDPA Low channel
	 REL99 High channel	 HSDPA High channel

LTE Band 5

10MHz	 QPSK Low channel FRB	 QPSK Low channel 1RB
	 QPSK High channel FRB	 QPSK High channel 1RB
	 16QAM Low channel FRB	 16QAM Low channel 1RB
	 16QAM High channel FRB	 16QAM High channel 1RB