CERTIFICATION TEST REPORT

Report Number. : 4790047184-E2V1

Applicant	:	SAMSUNG ELECTRONICS CO., LTD. 129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI, GYEONGGI-DO, 16677, KOREA
Model	:	NP545XLA
FCC ID	:	A3LNP545XLA1
EUT Description	:	WCDMA/LTE/5G NR Laptop + BT/BLE, DTS/UNII a/b/g/n/ac/ax
Test Standard(s)	:	FCC CFR47 PART 22 SUBPART H FCC CFR47 PART 24 SUBPART E FCC CFR47 PART 27 SUBPART L,N FCC CFR47 PART 90 SUBPART S

Date Of Issue:
2021-09-06

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IAS ACCREDITED
Testing Laboratory
TL-637

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2021-09-06	Initial issue	Yeonhee Lim

UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_22/24/27/90 (04)
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION:	WCDMA/LTE/5G NR Tablet + BT/BLE, DTS/UNII a/b/g/n/ac/ax
MODEL NUMBER:	NP545XLA
SERIAL NUMBER:	GE5J930R700055E (CONDUCTED); GE5J930R700039H, GE5J930R700040V (RADIATED)
DATE TESTED:	2021-08-11 – 2021-08-31;

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 22H, 24E, 27 L,N and 90 S	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:

Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:

Yeonhee Lim
Suwon Lab Technician
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 24.
4. FCC CFR 47 Part 27.
5. FCC CFR 47 Part 90.
6. ANSI TIA-603-E, 2016
7. ANSI C63.26, 2015
8. KDB 971168 D01 Power Meas License Digital Systems v03r01
9. 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
☒ Chamber 1
☒ Chamber 2
☐ Chamber 3

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:

EIRP = PSA reading with EUT worst orientation (dBm) + Path loss (dB) – cable loss(between the SG and substitution antenna) + Substitution Antenna Factor (dBi)

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	3.01 dB
Radiated Disturbance, 30 MHz to 1 GHz	4.26 dB
Radiated Disturbance, 1 GHz to 18 GHz	5.90 dB
Radiated Disturbance, Above 18 GHz	5.49 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 115:2007.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

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

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum average radiated ERP / EIRP output powers as follows:
Note : Conducted output power results were excerpted from RF exposure test report (4790047184-S1 FCC Report SAR).

LTE Band 25

FCC Part 24							
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 25	1860.0~1905.0	20	QPSK	24.09	256.45	25.85	384.59
			16QAM	23.49	223.36	25.16	328.10
			64QAM	22.46	176.20		
			256QAM	18.71	74.25		
	1857.5 ~ 1907.5	15	QPSK	24.01	251.53	**26.37**	**433.51**
			16QAM	23.42	219.90	25.14	326.59
			64QAM	22.50	177.79		
			256QAM	18.91	77.80		
	1855.0 ~ 1910.0	10	QPSK	23.93	247.33	25.82	381.94
			16QAM	23.45	221.19	24.73	297.17
			64QAM	22.40	173.82		
			256QAM	18.94	78.38		
	1852.5 ~ 1912.5	5	QPSK	**24.11**	**257.48**	26.18	414.95
			16QAM	23.35	216.09	25.14	326.59
			64QAM	22.48	177.08		
			256QAM	18.73	74.67		
	1851.5 ~ 1913.5	3	QPSK	24.05	254.32	25.60	363.08
			16QAM	23.20	208.93	24.68	293.76
			64QAM	22.40	173.89		
			256QAM	18.98	79.13		
	1850.7 ~ 1914.3	1.4	QPSK	23.95	248.31	26.07	404.58
			16QAM	23.41	219.49	25.20	331.13
			64QAM	22.47	176.73		
			256QAM	18.71	74.38		

LTE Band 26 (Part 90)

FCC Part 90							
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 26	821.5	15	QPSK	23.72	235.27	23.12	205.12
			16QAM	22.81	191.20	22.43	174.98
			64QAM	22.16	164.61		
			256QAM	18.84	76.57		
	819.0	10	QPSK	23.89	244.91	23.33	215.28
			16QAM	23.27	212.16	22.40	173.78
			64QAM	22.22	166.89		
			256QAM	18.83	76.32		
	816.5 ~ 821.5	5	QPSK	**23.91**	**246.30**	**23.44**	**220.80**
			16QAM	23.47	222.34	22.41	174.18
			64QAM	22.25	167.71		
			256QAM	18.84	76.62		
	815.5 ~ 822.5	3	QPSK	23.71	235.23	23.40	218.78
			16QAM	23.32	214.74	22.41	174.18
			64QAM	22.08	161.41		
			256QAM	18.86	76.97		
	814.7 ~ 823.3	1.4	QPSK	23.68	233.49	23.36	216.77
			16QAM	23.05	201.97	22.48	177.01
			64QAM	22.16	164.27		
			256QAM	18.84	76.52		

LTE Band 26 (Straddle)

Straddle							
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 26	824	15	QPSK	**24.34**	**271.64**	23.11	204.64
			16QAM	23.58	228.03	22.17	164.82
			64QAM	22.33	171.00		
			256QAM	18.85	76.74		
		10	QPSK	23.77	238.23	23.12	205.12
			16QAM	23.21	209.41	22.45	175.79
			64QAM	22.20	165.96		
			256QAM	18.88	77.27		
		5	QPSK	23.95	248.31	23.00	199.53
			16QAM	22.94	196.79	21.99	158.12
			64QAM	22.15	164.06		
			256QAM	18.79	75.68		
		3	QPSK	23.75	237.14	23.22	209.89
			16QAM	23.56	226.99	22.47	176.60
			64QAM	22.48	177.01		
			256QAM	18.83	76.38		
		1.4	QPSK	23.92	246.60	**23.24**	**210.86**
			16QAM	22.65	184.08	22.55	179.89
			64QAM	22.04	159.96		
			256QAM	18.84	76.56		

LTE Band 26 (Part 22)

FCC Part 22							
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 26	831.5 ~ 841.5	15	QPSK	23.71	234.91	23.07	202.77
			16QAM	23.13	205.75	22.24	167.49
			64QAM	22.39	173.26		
			256QAM	18.61	72.66		
	829.0 ~ 844.0	10	QPSK	**23.88**	**244.27**	23.07	202.77
			16QAM	22.97	198.19	22.29	169.43
			64QAM	22.29	169.43		
			256QAM	18.71	74.37		
	826.5 ~ 846.5	5	QPSK	23.87	243.81	23.00	199.53
			16QAM	23.40	219.00	22.25	167.88
			64QAM	22.24	167.56		
			256QAM	18.81	76.03		
	825.5 ~ 847.5	3	QPSK	23.60	229.09	23.06	202.30
			16QAM	22.81	190.99	22.21	166.34
			64QAM	22.18	165.30		
			256QAM	18.83	76.33		
	824.7 ~ 848.3	1.4	QPSK	23.55	226.26	**23.12**	**205.12**
			16QAM	23.01	199.94	22.60	181.97
			64QAM	22.25	167.79		
			256QAM	18.69	73.97		

LTE Band 41 (PC2)

FCC Part 27							
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 41	2506.0 ~ 2680.0	20	QPSK	26.03	401.08	30.26	1061.70
			16QAM	25.38	345.37	30.02	1004.62
			64QAM	24.48	280.54		
			256QAM	21.37	136.97		
	2503.5 ~ 2682.5	15	QPSK	**26.10**	**407.28**	**30.73**	**1183.04**
			16QAM	25.36	343.39	30.35	1083.93
			64QAM	24.37	273.43		
			256QAM	21.34	136.13		
	2501.0 ~ 2685.0	10	QPSK	26.05	402.71	30.48	1116.86
			16QAM	25.47	352.25	30.21	1049.54
			64QAM	24.37	273.43		
			256QAM	21.50	141.18		
	2498.5 ~ 2687.5	5	QPSK	26.06	404.02	30.68	1169.50
			16QAM	25.42	348.41	30.14	1032.76
			64QAM	24.49	281.19		
			256QAM	21.56	143.22		

LTE Band 71

FCC Part 27							
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Conducted		Radiated	
				Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
Band 71	673.0 ~ 688.0	20	QPSK	24.19	262.51	**22.96**	**197.70**
			16QAM	23.11	204.78	22.03	159.59
			64QAM	22.43	174.82		
			256QAM	19.31	85.31		
	670.5 ~ 690.5	15	QPSK	23.84	241.88	22.68	185.35
			16QAM	22.79	190.12	22.10	162.18
			64QAM	22.49	177.45		
			256QAM	19.49	88.92		
	668.0 ~693.0	10	QPSK	24.33	270.93	22.73	187.50
			16QAM	23.65	231.83	21.65	146.22
			64QAM	22.52	178.62		
			256QAM	19.48	88.72		
	665.5 ~ 695.5	5	QPSK	**24.44**	**277.69**	22.86	193.20
			16QAM	23.24	210.64	22.05	160.32
			64QAM	22.63	183.18		
			256QAM	19.43	87.70		

NR Band n25

FCC Part 24								
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Mode	Conducted		Radiated	
					Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
n25	1860.0~1905.0	20	DFT-s OFDM	π/2 BPSK	23.85	242.53		
				QPSK	23.82	240.84	26.41	437.52
				16QAM	23.04	201.53	25.45	350.75
				64QAM	21.55	142.79		
				256QAM	19.47	88.41		
			CP-OFDM	QPSK	22.38	173.09		
	1857.5~1907.5	15	DFT-s OFDM	π/2 BPSK	23.85	242.48		
				QPSK	23.73	235.96	23.71	234.96
				16QAM	23.08	203.41	23.56	226.99
				64QAM	21.44	139.32		
				256QAM	19.42	87.58		
			CP-OFDM	QPSK	22.22	166.72		
	1855.0~1910.0	10	DFT-s OFDM	π/2 BPSK	23.83	241.48		
				QPSK	23.81	240.33	24.39	274.79
				16QAM	23.11	204.44	24.21	263.63
				64QAM	21.45	139.64		
				256QAM	19.38	86.70		
			CP-OFDM	QPSK	22.23	167.21		
	1852.5~1912.5	5	DFT-s OFDM	π/2 BPSK	**23.85**	**242.66**		
				QPSK	23.79	239.38	**26.58**	**454.99**
				16QAM	22.87	193.64	25.54	358.10
				64QAM	21.52	141.87		
				256QAM	19.51	89.29		
			CP-OFDM	QPSK	22.19	165.49		

NR Band n41 (PC2)

FCC Part 27								
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Mode	Conducted		Radiated	
					Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
n41	2546~2640	100	DFT-s OFDM	π/2 BPSK	26.17	414.00		
				QPSK	26.18	414.95	**31.12**	**1294.20**
				16QAM	25.20	331.13	31.05	1273.50
				64QAM	23.86	243.22		
				256QAM	21.64	145.88		
			CP-OFDM	QPSK	24.64	291.07		
	2541~2645	90	DFT-s OFDM	π/2 BPSK	26.44	440.55		
				QPSK	26.34	430.53	31.01	1261.83
				16QAM	25.64	366.44	30.99	1256.03
				64QAM	23.98	250.03		
				256QAM	21.82	152.05		
			CP-OFDM	QPSK	24.78	300.61		
	2536~2650	80	DFT-s OFDM	π/2 BPSK	26.34	430.53		
				QPSK	26.23	419.76	30.95	1244.51
				16QAM	25.57	360.58	30.92	1235.95
				64QAM	23.90	245.47		
				256QAM	21.75	149.62		
			CP-OFDM	QPSK	24.84	304.79		
	2526~2660	60	DFT-s OFDM	π/2 BPSK	26.41	437.52		
				QPSK	26.44	440.55	31.11	1291.22
				16QAM	25.47	352.37	30.65	1161.45
				64QAM	23.98	250.03		
				256QAM	21.83	152.41		
			CP-OFDM	QPSK	24.75	298.54		
	2521~2665	50	DFT-s OFDM	π/2 BPSK	26.37	433.51		
				QPSK	26.44	440.55	30.83	1210.60
				16QAM	25.61	363.92	30.82	1207.81
				64QAM	24.35	272.27		
				256QAM	21.93	155.96		
			CP-OFDM	QPSK	24.77	299.92		
	2516~2670	40	DFT-s OFDM	π/2 BPSK	26.71	468.81		
				QPSK	26.73	470.98	30.85	1216.19
				16QAM	25.72	373.25	30.85	1216.19
				64QAM	24.29	268.53		
				256QAM	22.13	163.31		
			CP-OFDM	QPSK	25.21	331.89		
	2511~2675	30	DFT-s OFDM	π/2 BPSK	**26.80**	**478.63**		
				QPSK	**26.80**	**478.63**	30.86	1218.99
				16QAM	25.87	386.37	30.85	1216.19
				64QAM	24.13	258.82		
				256QAM	22.42	174.58		
			CP-OFDM	QPSK	25.11	324.34		
	2506~2680	20	DFT-s OFDM	π/2 BPSK	26.36	432.51		
				QPSK	26.34	430.53	30.40	1096.48
				16QAM	25.52	356.45	30.38	1091.44
				64QAM	24.02	252.35		
				256QAM	21.95	156.68		
			CP-OFDM	QPSK	24.82	303.39		

NR Band n71

FCC Part 27								
Band	Frequency Range [MHz]	BandWidth [MHz]	Modulation	Mode	Conducted		Radiated	
					Avg [dBm]	Avg [mW]	Avg [dBm]	Avg [mW]
n71	673~688	20	DFT-s OFDM	π/2 BPSK	23.84	242.03		
				QPSK	**23.87**	**244.04**	22.40	173.78
				16QAM	23.23	210.18	21.35	136.46
				64QAM	21.64	145.92		
				256QAM	19.57	90.66		
			CP-OFDM	QPSK	22.39	173.30		
	670.5~690.5	15	DFT-s OFDM	π/2 BPSK	23.40	218.96		
				QPSK	23.34	215.58	**22.44**	**175.39**
				16QAM	22.68	185.53	21.82	152.05
				64QAM	21.12	129.53		
				256QAM	19.13	81.92		
			CP-OFDM	QPSK	21.92	155.43		
	668~693	10	DFT-s OFDM	π/2 BPSK	23.53	225.67		
				QPSK	23.42	219.69	22.35	171.79
				16QAM	22.84	192.49	21.25	133.35
				64QAM	21.26	133.68		
				256QAM	19.24	84.00		
			CP-OFDM	QPSK	21.98	157.78		
	665.5~695.5	5	DFT-s OFDM	π/2 BPSK	23.78	238.78		
				QPSK	23.39	218.08	22.43	174.98
				16QAM	22.84	192.25	21.74	149.28
				64QAM	21.32	135.37		
				256QAM	19.31	85.24		
			CP-OFDM	QPSK	21.89	154.49		

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

Frequency (MHz)	Peak Gain (dBi)
LTE Band 26 824 ~ 849 MHz	-0.01
LTE Band 25 / NR Band n25 1850 ~ 1910 MHz	2.37
LTE Band 41 / NR Band n41 2496 ~ 2690 MHz	4.27
LTE Band 71 / NR Band n71 663 ~ 698 MHz	-0.36

5.4. WORST-CASE ORIENTATION

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

For all 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, 64QAM and 256QAM modulations. It was found that QPSK and 16QAM results were worst case.

LTE Band 41 FCC were tested on HPUE mode since it is high power.(Power class 2)

For all 5G NR 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, 64QAM and 256QAM modulations. It was found that QPSK and 16QAM results were worst case. Both NSA and SA modes were tested and there is no difference between the two modes.

All testing was performed using QPSK and 16QAM modulations to represent the worst case. However, 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 in QPSK.

A-MPR

A-MPR is implemented in this EUT when operating on HPUE per the A-MPR specification in 3GPP TS 36.101 (Table 6.2.4-4a). Conducted output power verification data are shown Section 9.2.2. Also only Emission mask test item were performd A-MPR condition (Especially low channel side)

LTE Band 41(PC3)

LTE Band 41 (PC3, Frequency range: 2496-2690 MHz) is covered by LTE Band 41 (PC2) (Frequency range: 2496-2690 MHz) due to overlapping frequency range, same channel bandwidth and maximum tune-up limit is higher than LTE Band 41(PC3).

5G NR Band 41(PC3)

5G NR Band 41 (PC3, Frequency range: 2496-2690 MHz) is covered by 5G NR Band 41 (PC2) (Frequency range: 2496-2690 MHz) due to overlapping frequency range, same channel bandwidth and maximum tune-up limit is higher than 5G NR Band 41(PC3).

Highest power setting for each bands				
LTE Band	**Frequency (MHz)**	**Bandwidth (MHz)**	**RB size**	**RB offset**
25	1852.5	5	1	24
	1880.0		1	24
	1912.5		1	0
26(Part 90)	816.5	5	1	0
	821.5		1	12
26(Straddle)	824.0	10	1	25
26(Part 22)	829.0	10	1	0
	831.5		1	0
	844.0		1	0
41(PC2)	2506.0	20	1	99
	2593.0		1	49
	2680.0		1	49
71	665.5	5	1	0
	680.5		1	12
	695.5		1	12

NR Band	Frequency (MHz)	Bandwidth (MHz)	RB size	RB offset
25	1852.5	5	1	13
	1882.5		1	13
	1912.5		1	13
41(PC2)	2511.0	30	1	76
	2593.0		1	1
	2675.0		1	1
71	673.0	20	1	1
	680.5		1	1
	688.0		1	1

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

NR Band	LTE Anchor
n25	**B12**
n41(PC3)	**B2**, B66
n41(PC2)	**Stand alone**
n71	**B2**, B66

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i. Worst Axis Condition

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

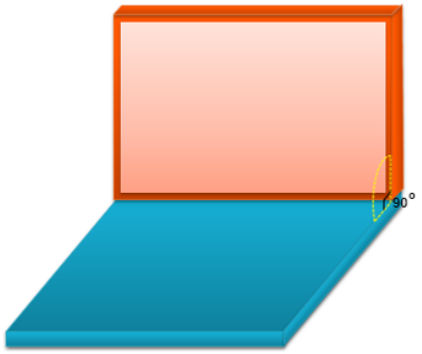
Band	ERP/EIRP		RSE	
	X	Y	X	Y
LTE B25	Laptop	-	Laptop	-
LTE B26	Laptop	-	Laptop	-
LTE B41(PC2)	Laptop	-	Laptop	-
LTE B71	Laptop	-	Laptop	-
NR n25	-	Laptop	Laptop	-
NR n41	Laptop	-	Laptop	-
NR n71	Laptop	-	Laptop	-

Note : For ERP/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.

ii. Foldable Condition

The Fundamental of the EUT was investigated two foldable conditions(Fold, Laptop).

Fold



Laptop(90 degree)

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Charger	SAMSUNG	EP-TA800	R37R32A00XADK3	N/A
Data Cable	SAMSUNG	EP-DW767JWE	N/A	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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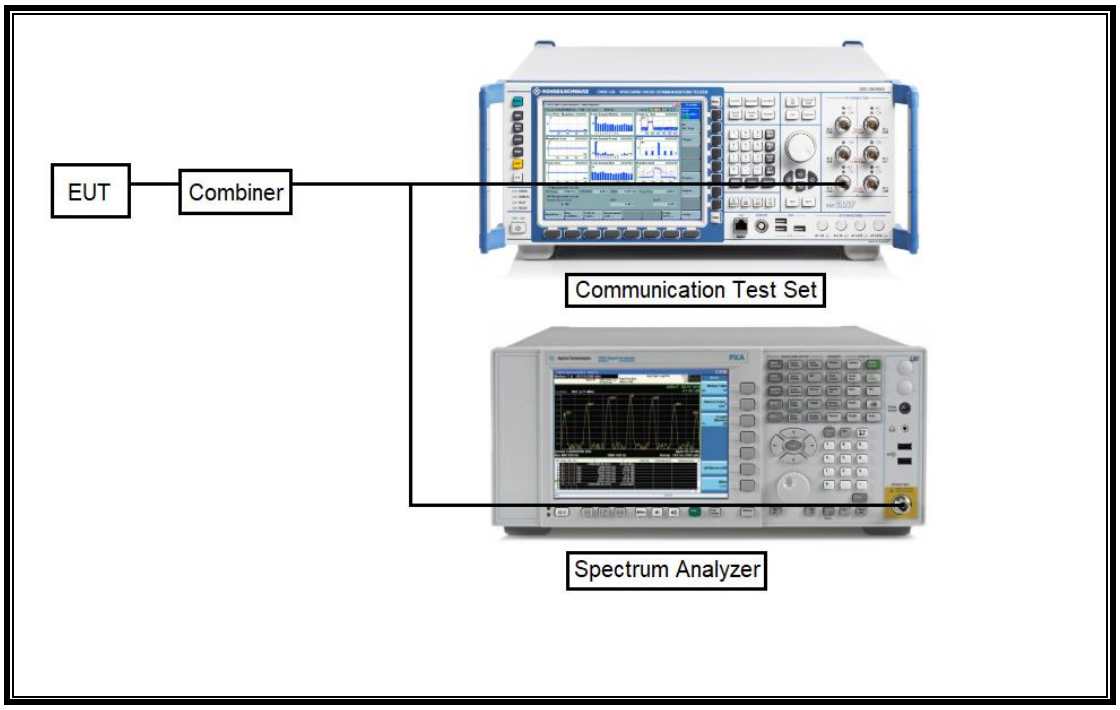
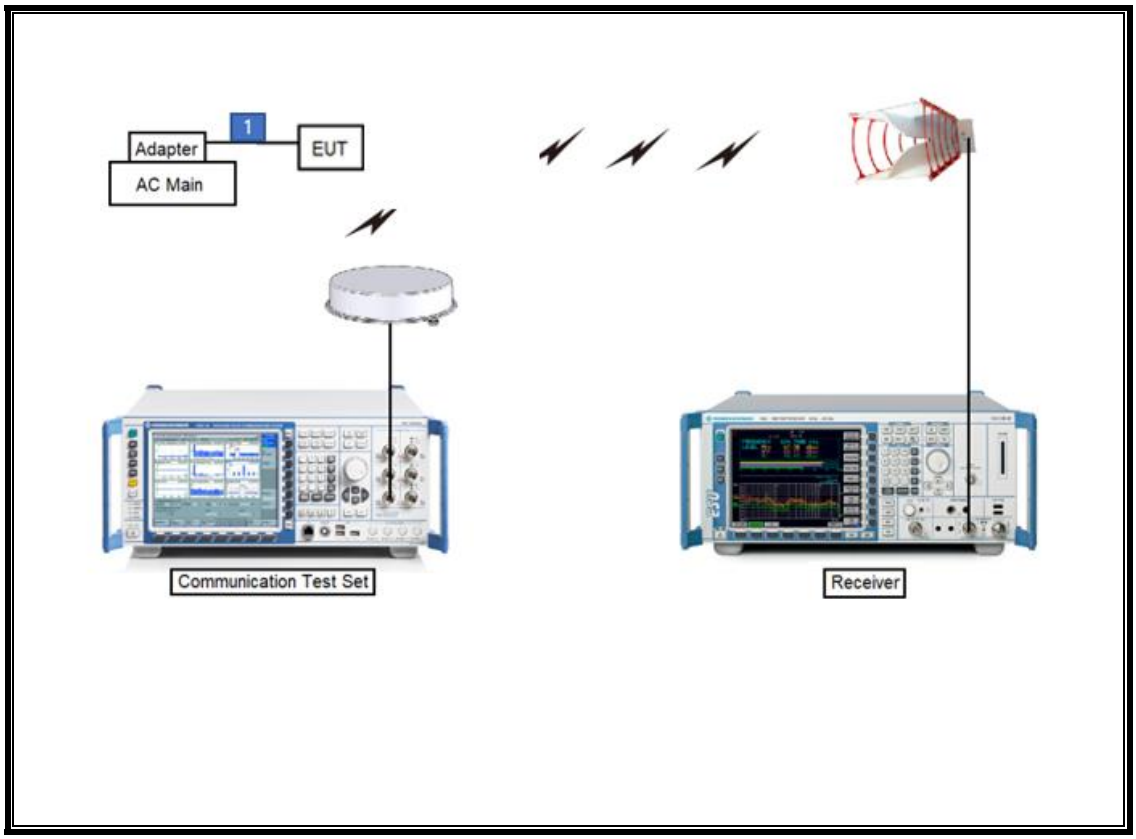
SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)



SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)



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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	2023-02-08
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	00166155	2022-08-04
Antenna, Horn, 40 GHz	ETS	3116C	00168645	2021-10-02
Preamplifier	ETS	3116C-PA	00168841	2022-08-04
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	2022-08-19
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	845	2022-08-13
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	2022-08-13
Antenna, Horn, 18 GHz	ETS	3115	00167211	2022-07-27
Antenna, Horn, 18 GHz	ETS	3115	00161451	2022-08-15
Antenna, Horn, 18 GHz	ETS	3117	00168724	2022-07-27
Antenna, Horn, 18 GHz	ETS	3117	00168717	2022-08-15
Communications Test Set	R&S	CMW500	169796	2022-01-27
DC Power Supply	Agilent / HP	E3640A	MY54226395	2022-08-02
Preamplifier, 1000 MHz	Sonoma	310N	341282	2022-08-02
Preamplifier, 1000 MHz	Sonoma	310N	370599	2022-08-02
Preamplifier, 1000 MHz	Sonoma	310N	351741	2022-08-02
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	2022-08-02
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	2029168	2022-08-02
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	2022-08-02
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	2022-08-04
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	2022-08-04
EMI Test Receive, 40 GHz	R&S	ESU40	100439	2022-08-02
EMI Test Receive, 40 GHz	R&S	ESU40	100457	2022-08-02
High Pass Filter 1.2GHz	Micro-Tronics	HPM50108-02	G005	2022-08-03
High Pass Filter 1.2GHz	Micro-Tronics	HPM50108-02	G006	2022-08-02
High Pass Filter 2.8GHz	Micro-Tronics	HPM50111-02	010	2022-08-03
High Pass Filter 2.8GHz	Micro-Tronics	HPM50111-02	011	2022-08-02
High Pass Filter 4GHz	Micro-Tronics	HPM50118-02	G001	2022-08-03
High Pass Filter 4GHz	Micro-Tronics	HPM50118-02	G002	2022-08-02
Attenuator	PASTERNACK	PE7087-10	A009	2022-08-03
Attenuator	PASTERNACK	PE7087-10	A001	2022-08-03
Attenuator	PASTERNACK	PE7087-10	A008	2022-08-03
Attenuator	PASTERNACK	PE7004-10	2	2022-08-02
Attenuator	PASTERNACK	PE7395-10	A011	2022-08-03
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	2021-10-02
Temperature Chamber	ESPEC	SH-642	93001109	2022-08-02
Power Splitter	MINI-CIRCUITS	WA1534	UL001	2022-01-27
Power Splitter	MINI-CIRCUITS	WA1534	UL002	2022-01-27

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 1.04

7. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
2.1049	Occupied Bandwidth(99%)	N/A	Conducted	Pass
22.917(a) 24.238(a) 27.53(g)	Band Edge / Conducted Spurious Emission	-13 dBm		Pass
27.53(m)	Conducted Spurious Emission	-25 dBm		Pass
27.53(m)	Emission mask	Section 9.2.2.		Pass
2.1046	Conducted output power	N/A		Pass
22.355 24.235 90.213(a) 27.54	Frequency Stability	2.5ppm		Pass
22.913(a)(5)	Effective Radiated Power	38.5 dbm	Radiated	Pass
27.50(c)(10)		34.77 dBm		Pass
24.232(c) 27.50(h)(2)	Equivalent Isotropic Radiated Power	33 dBm		Pass
22.917(a) 24.238(a) 27.53(g)	Radiated Spurious Emission	-13 dBm		Pass
27.53(m)		-25 dBm		Pass

8. 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.

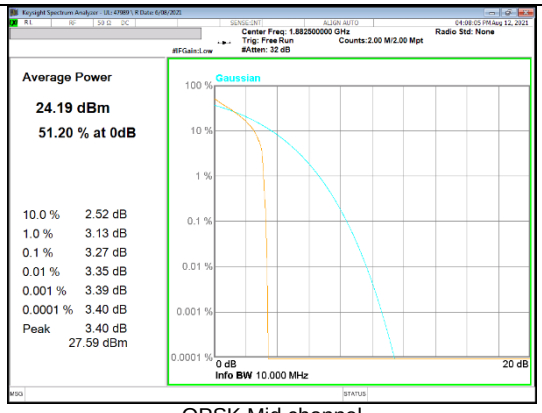
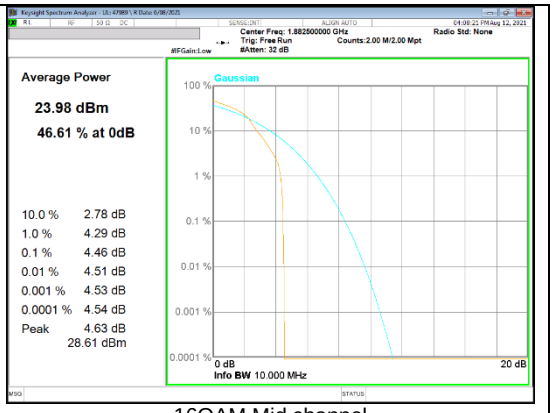
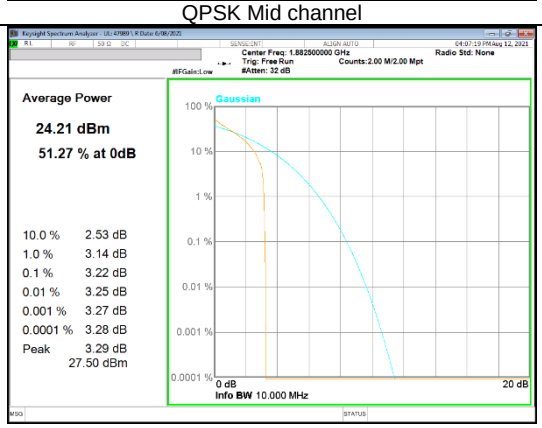
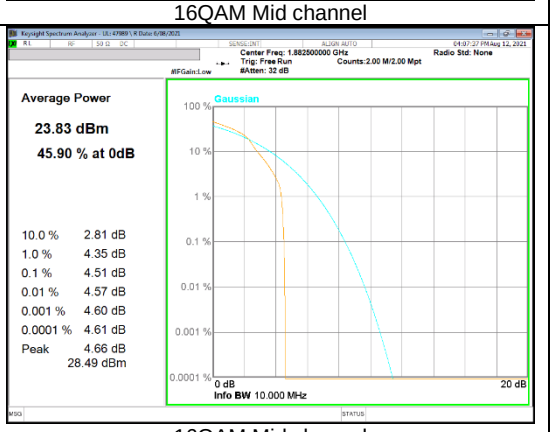
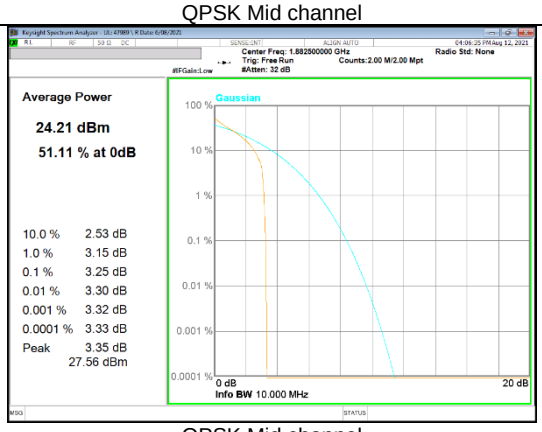
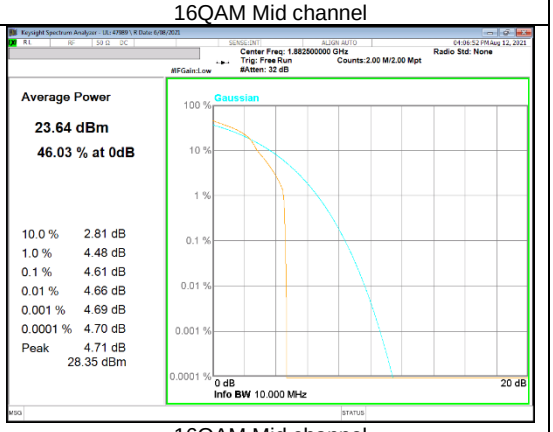
NOTE

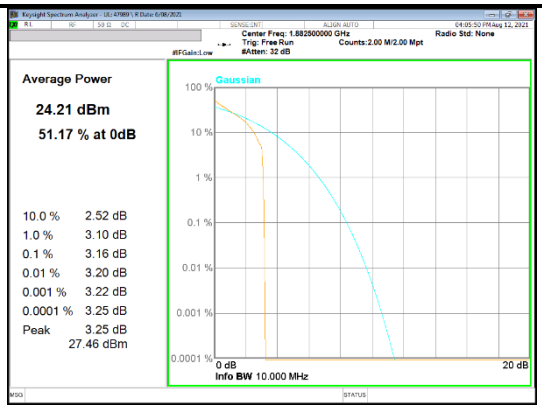
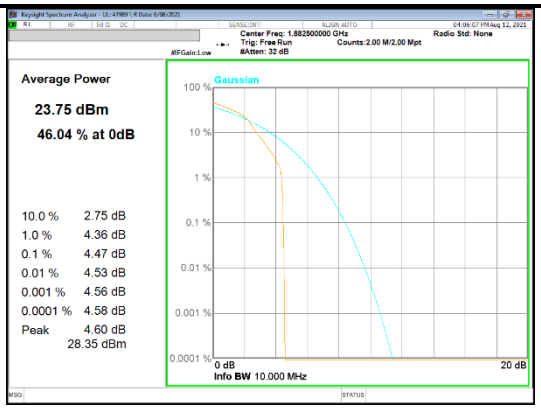
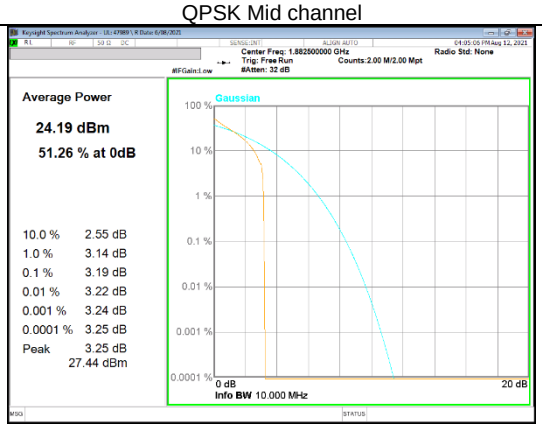
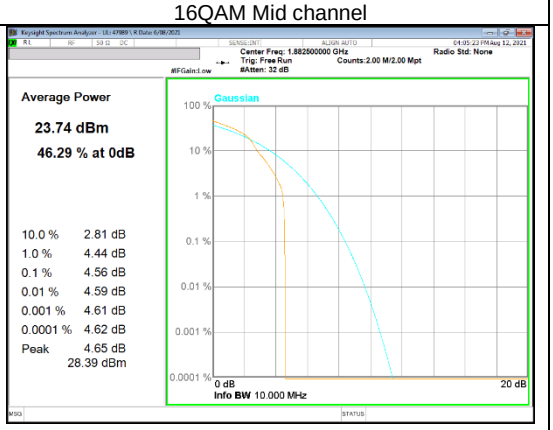
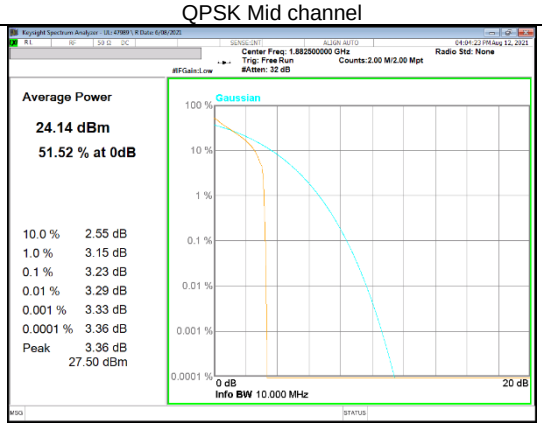
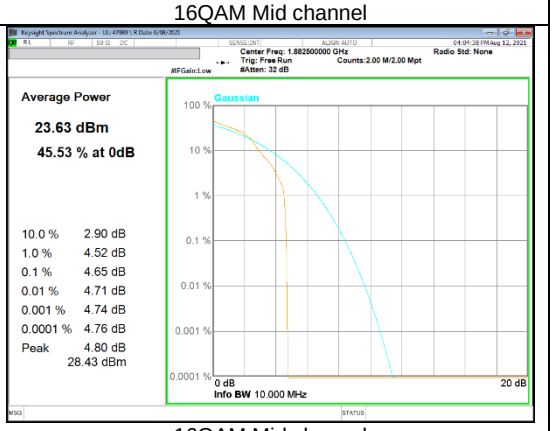
5G NR: All Waveforms (CP-OFDM vs DFT-s OFDM) and modulations (QPSK, 16QAM, 64QAM, 256QAM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

RESULTS

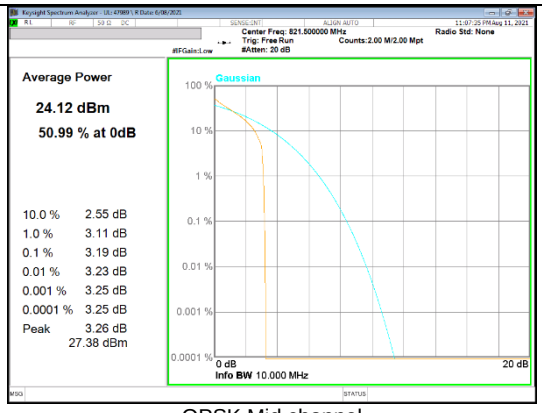
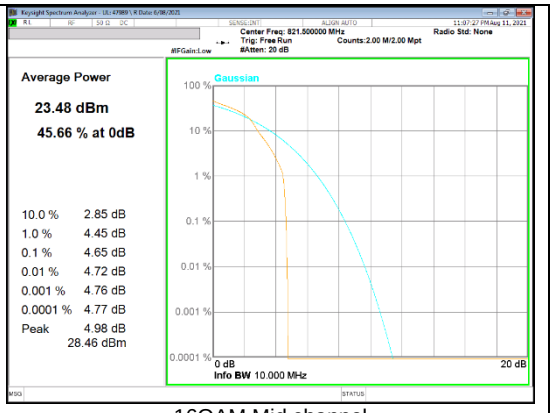
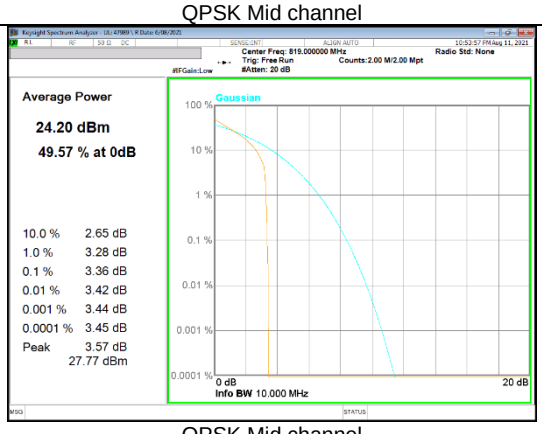
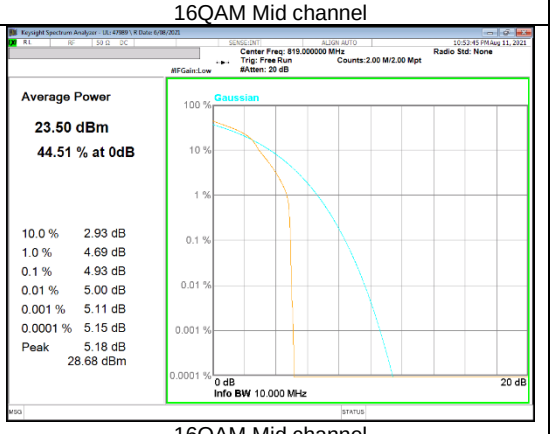
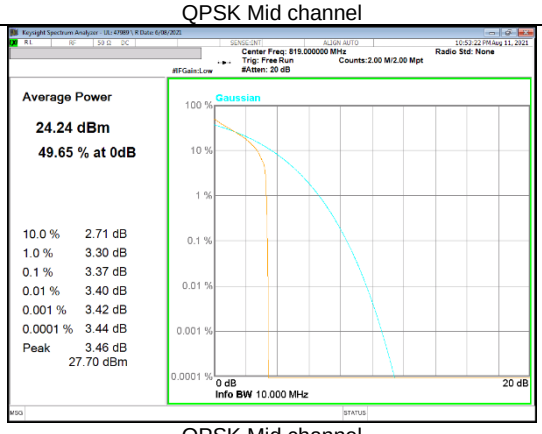
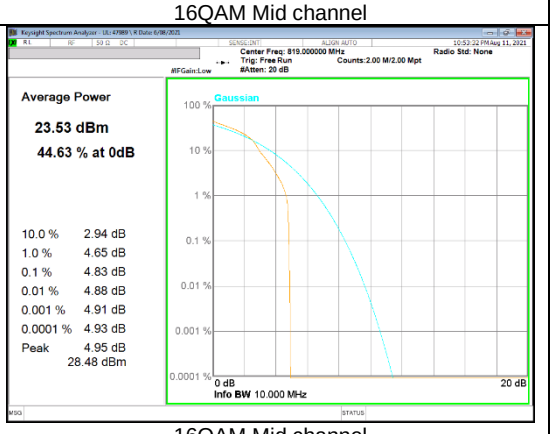
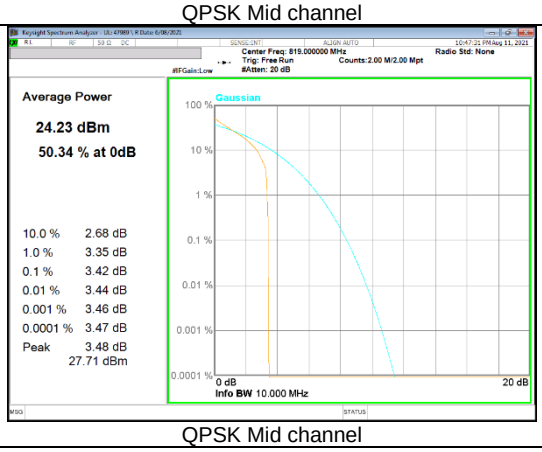
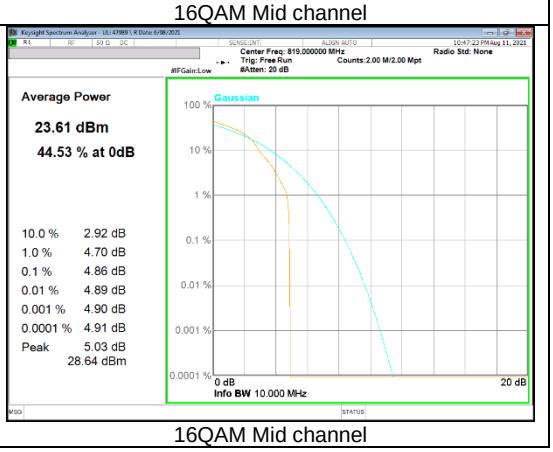
8.1. CONDUCTED PEAK TO AVERAGE RESULT

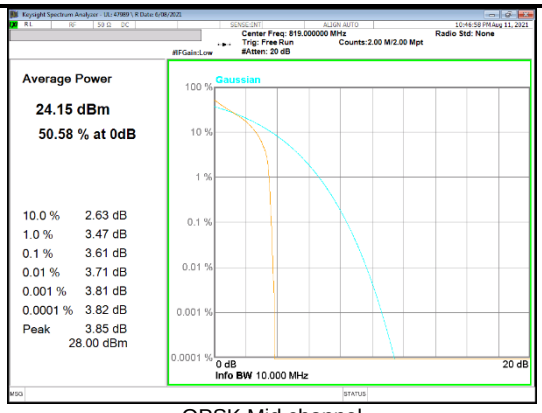
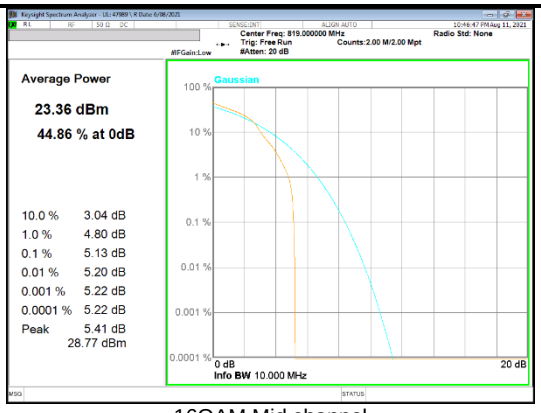
LTE Band 25

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

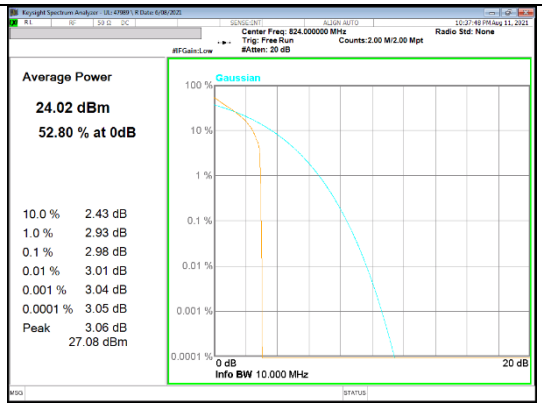
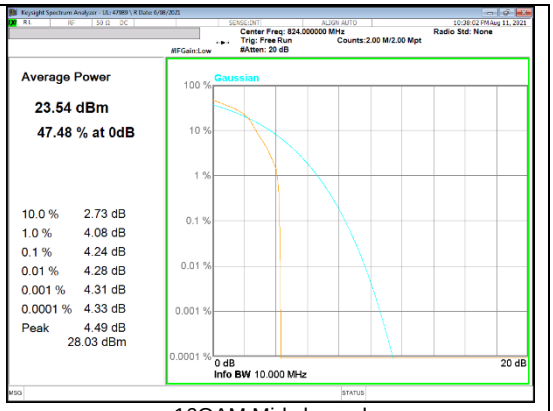
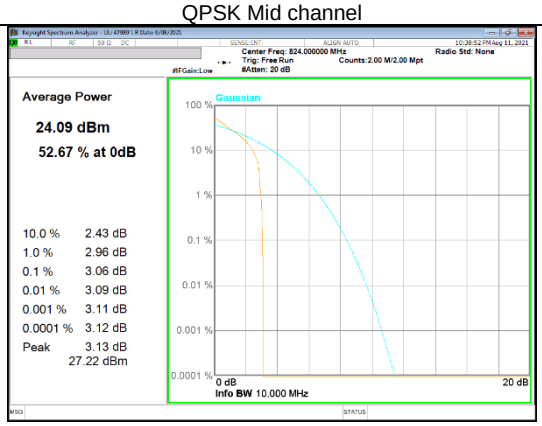
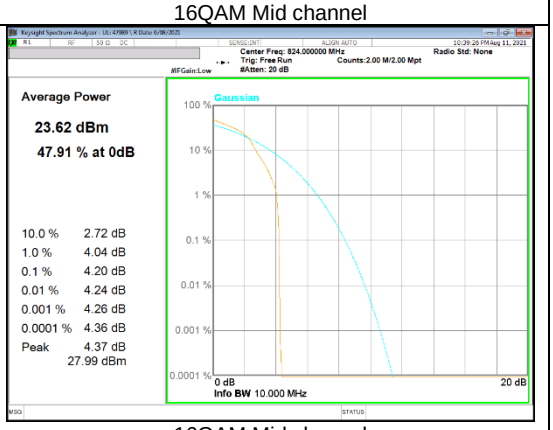
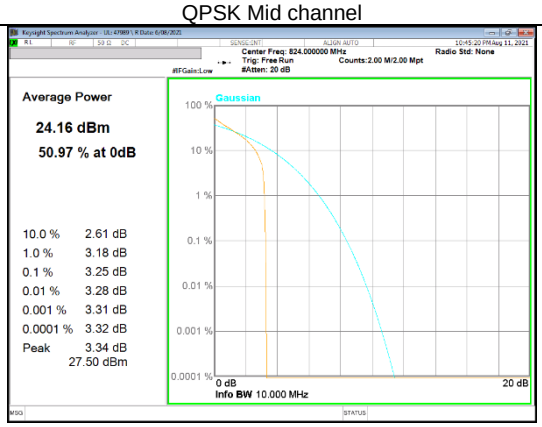
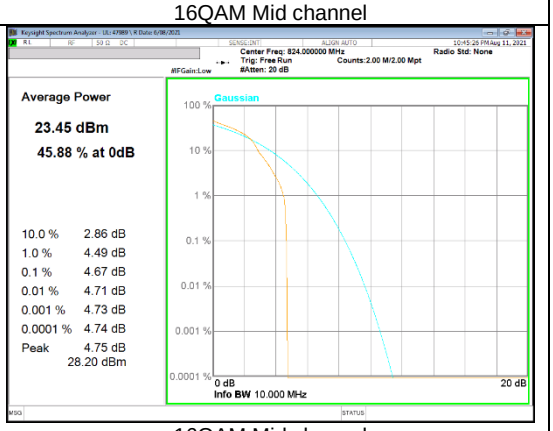
5 MHz	 QPSK Mid channel	 16QAM Mid channel
3 MHz	 QPSK Mid channel	 16QAM Mid channel
1.4 MHz	 QPSK Mid channel	 16QAM Mid channel

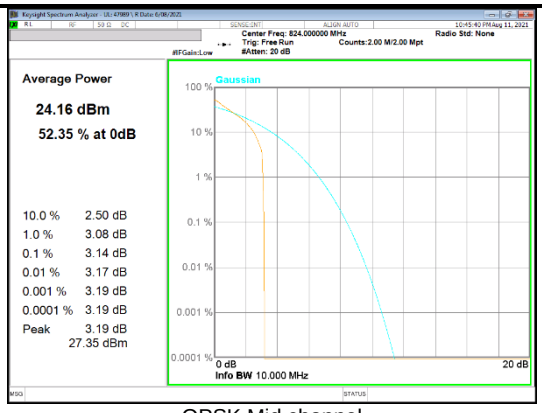
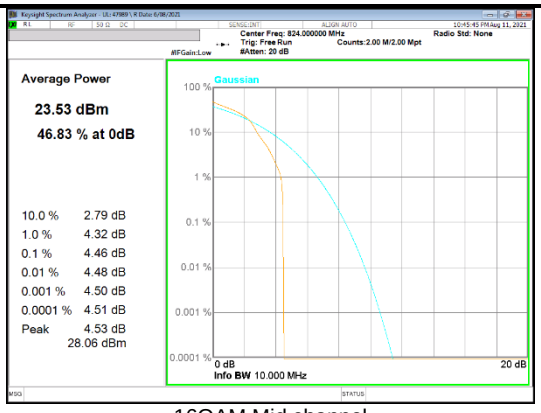
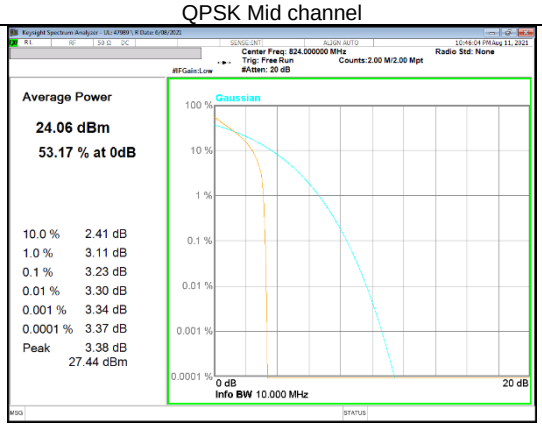
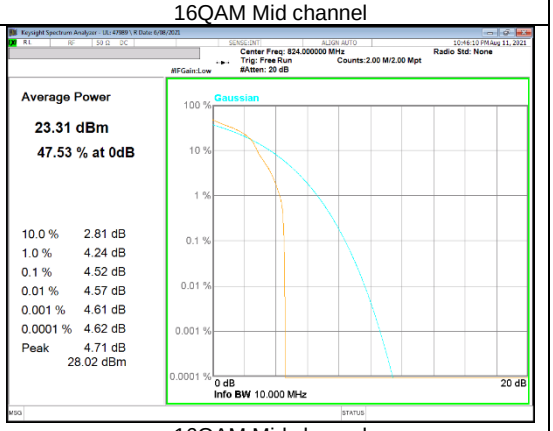
LTE Band 26 (Part 90)

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

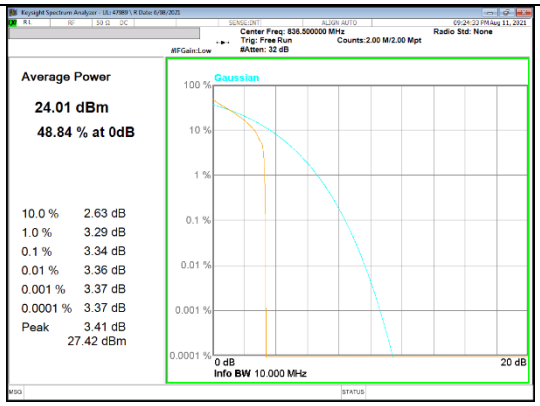
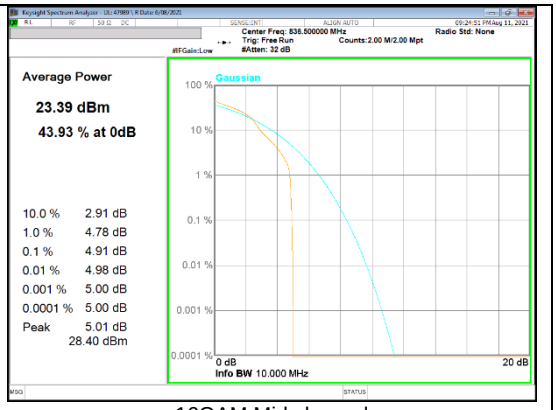
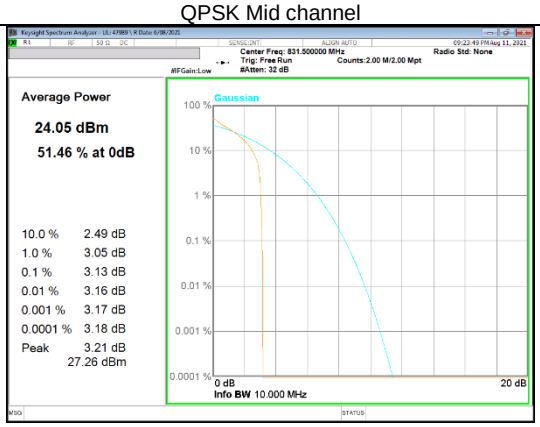
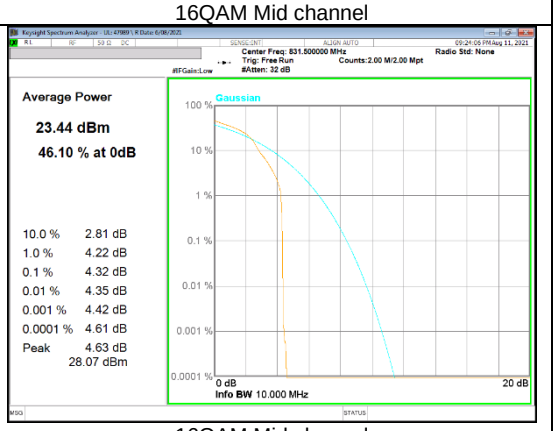
1.4 MHz		
	QPSK Mid channel	16QAM Mid channel

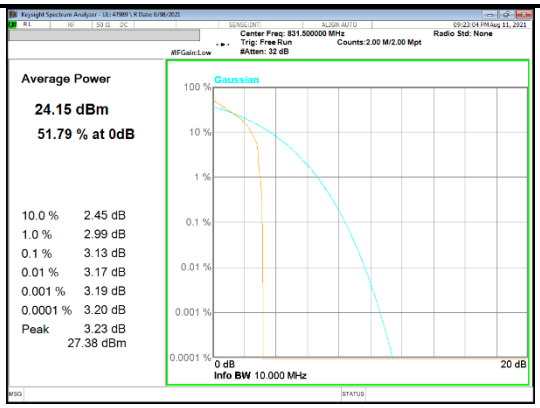
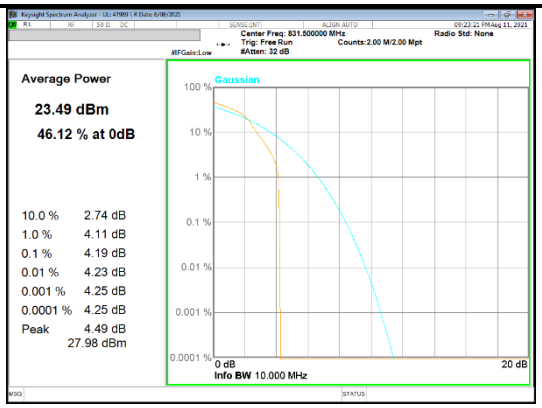
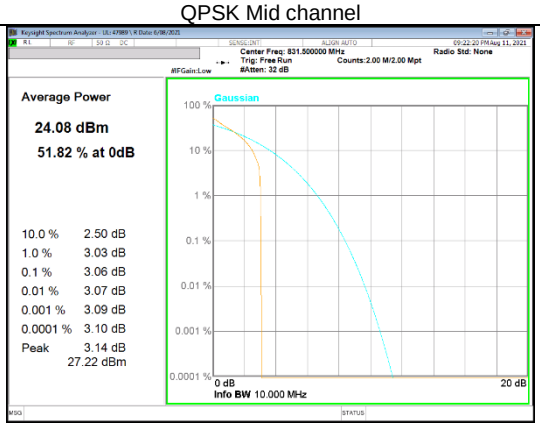
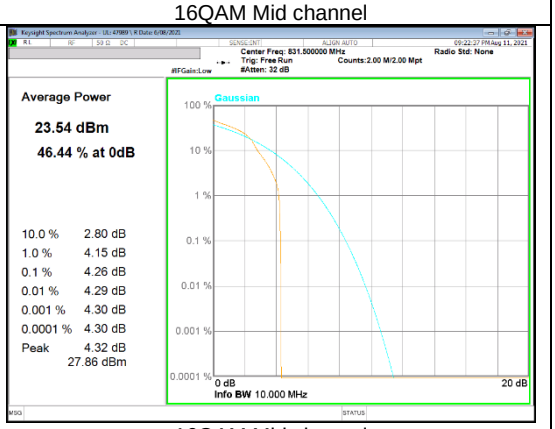
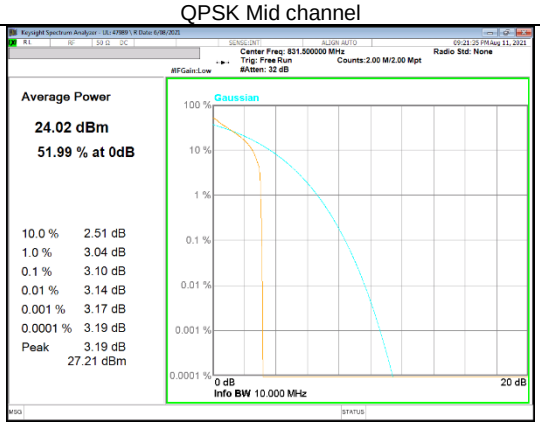
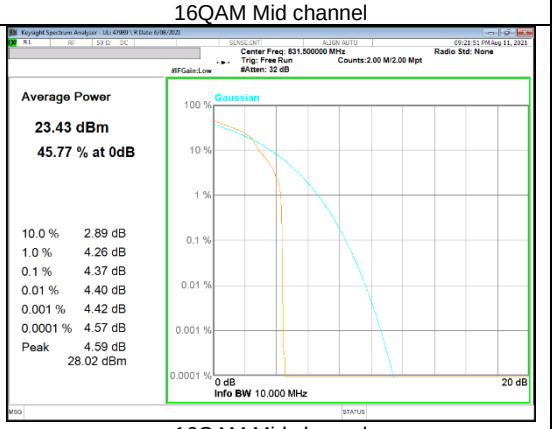
LTE Band 26 (Straddle)

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

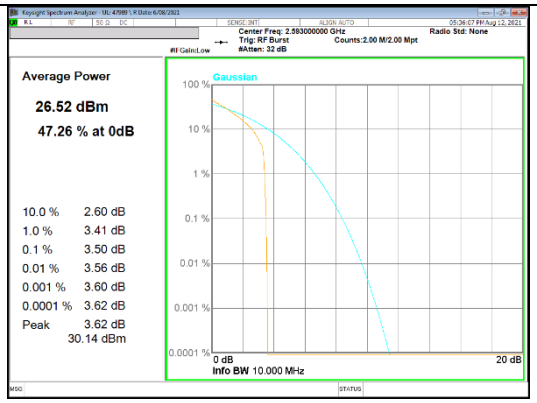
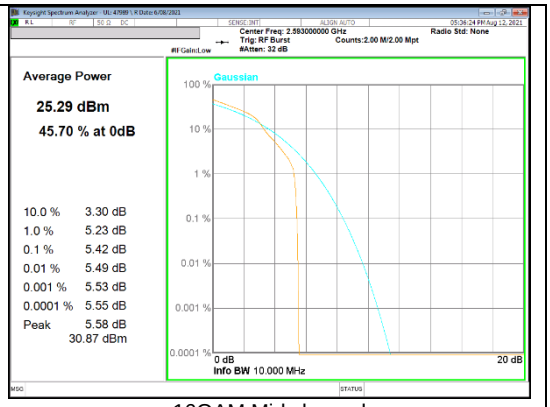
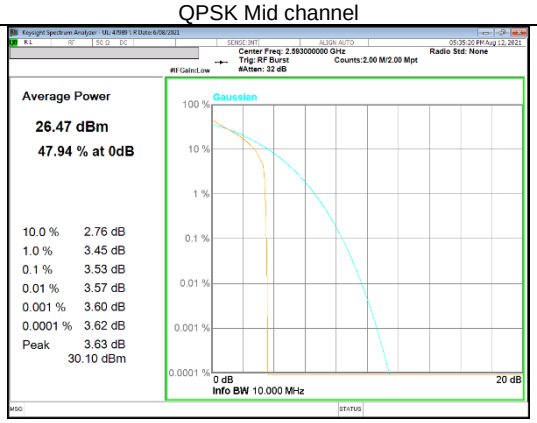
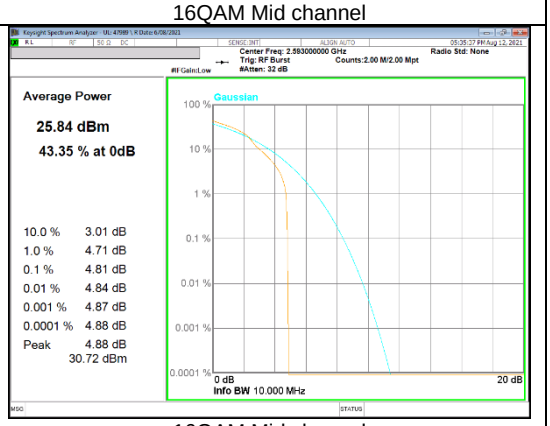
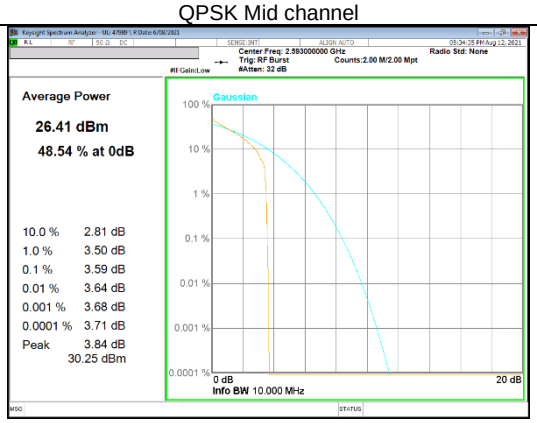
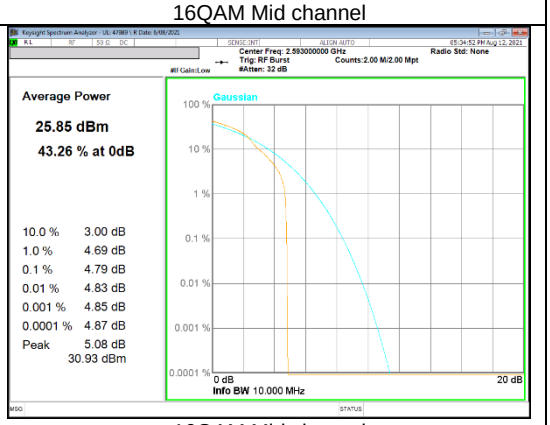
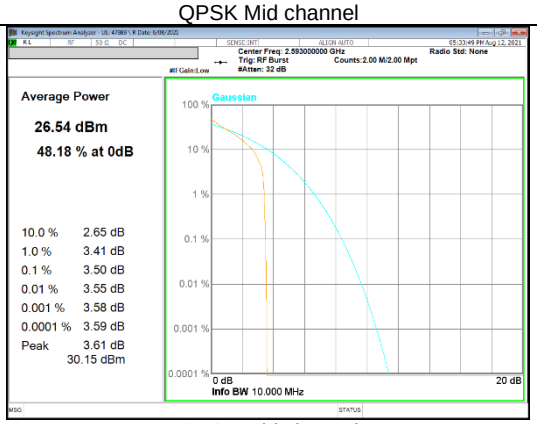
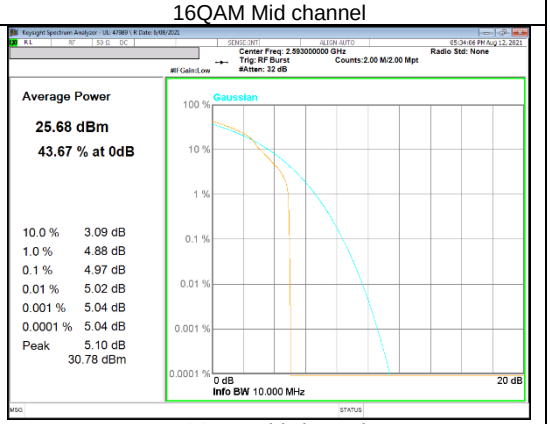
3 MHz	 QPSK Mid channel	 16QAM Mid channel
1.4 MHz	 QPSK Mid channel	 16QAM Mid channel

LTE Band 26 (Part 22)

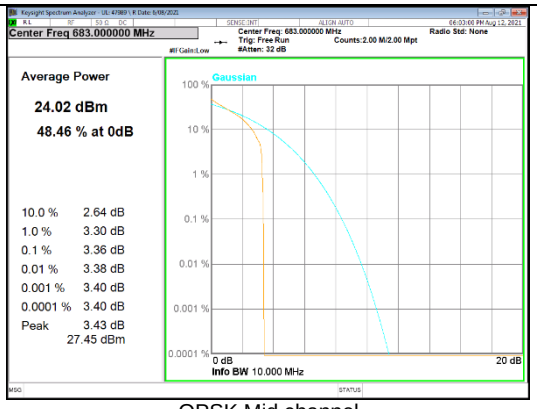
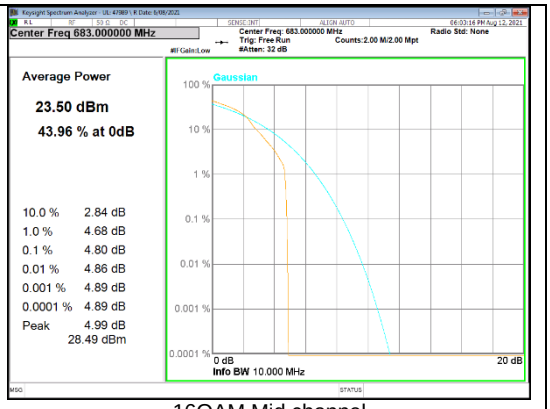
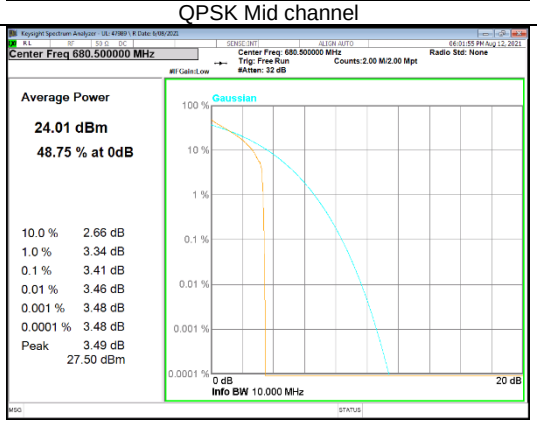
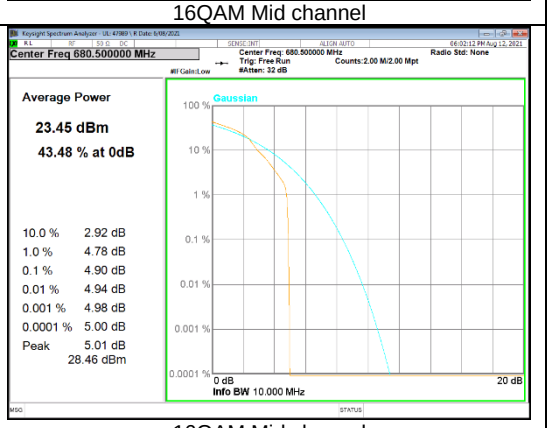
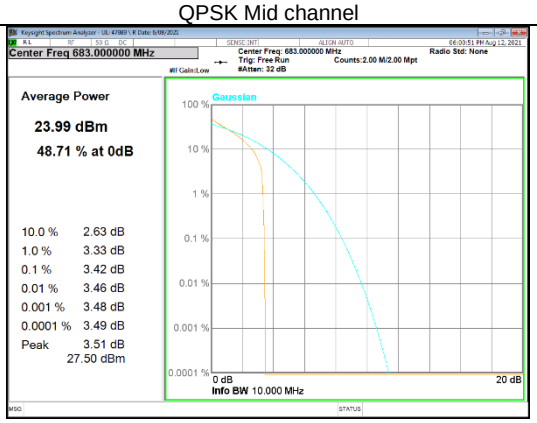
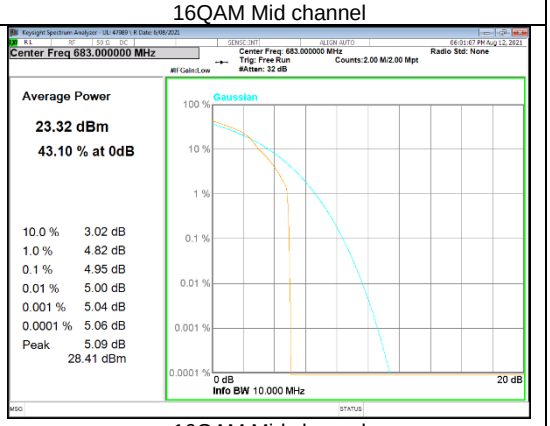
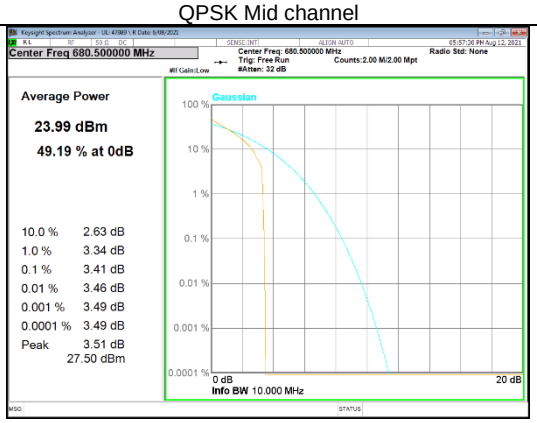
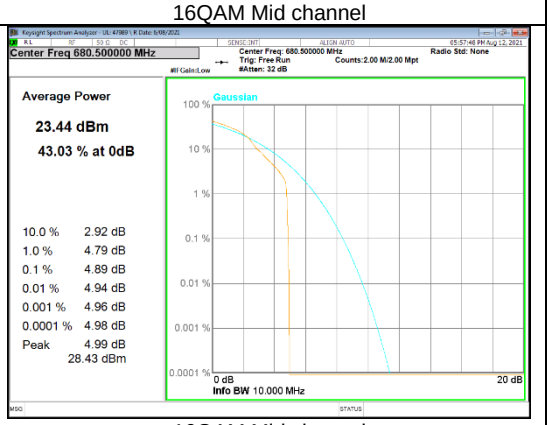
15 MHz	 QPSK Mid channel	 16QAM Mid channel
10 MHz	 QPSK Mid channel	 16QAM Mid channel

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

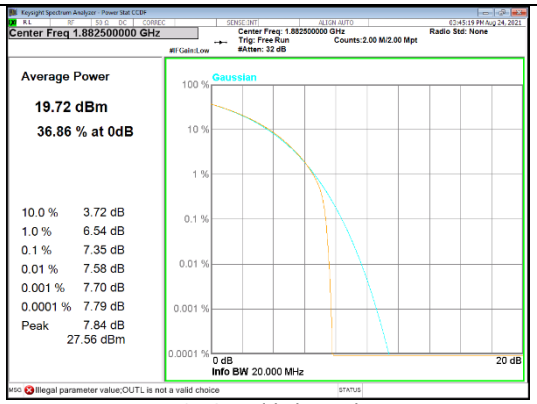
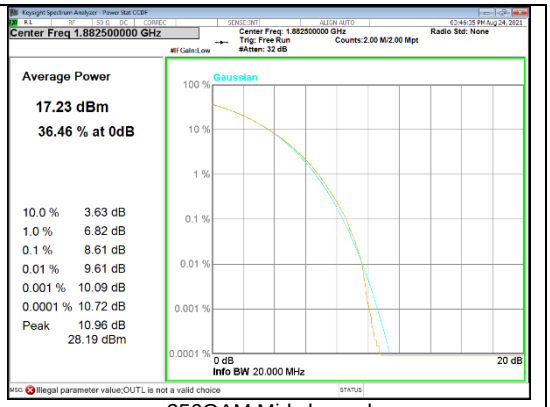
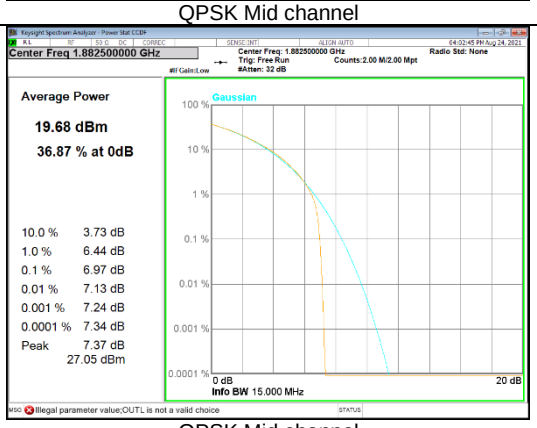
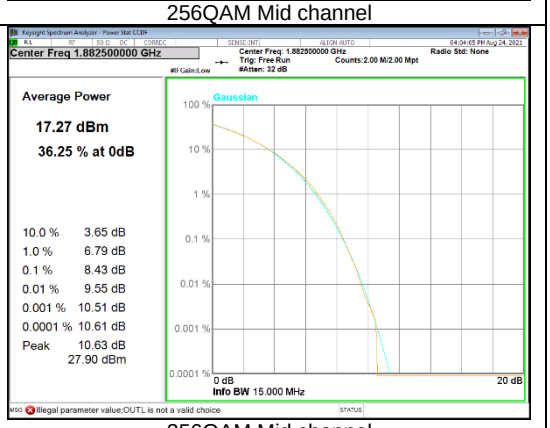
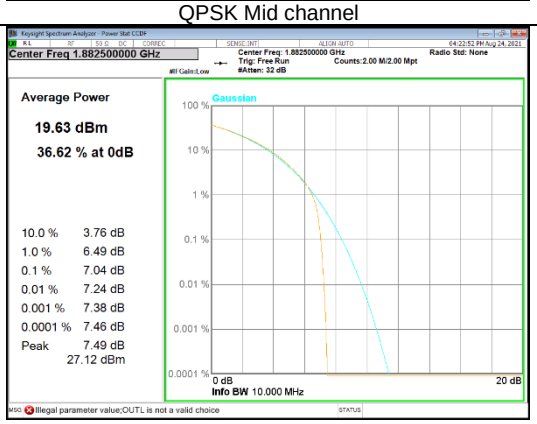
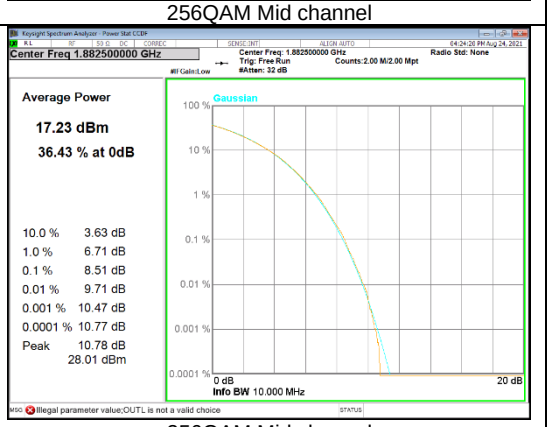
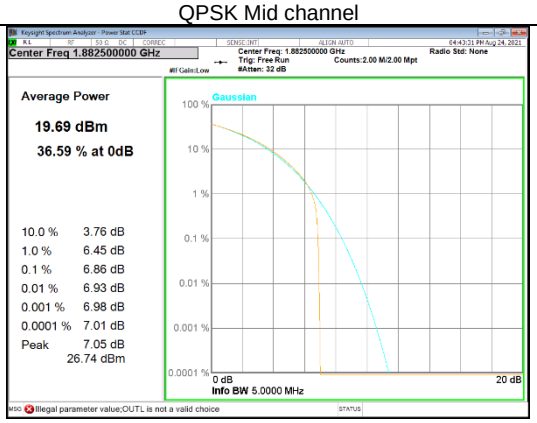
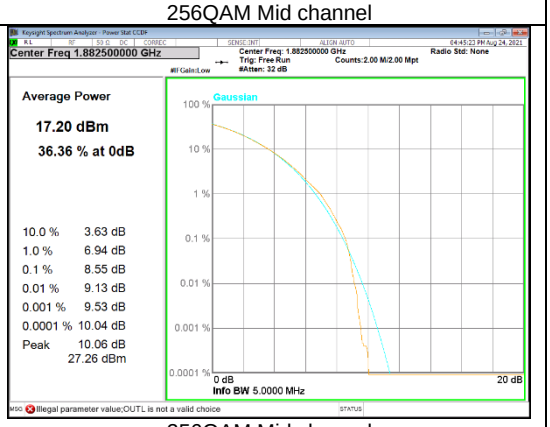
LTE Band 41 (PC2)

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

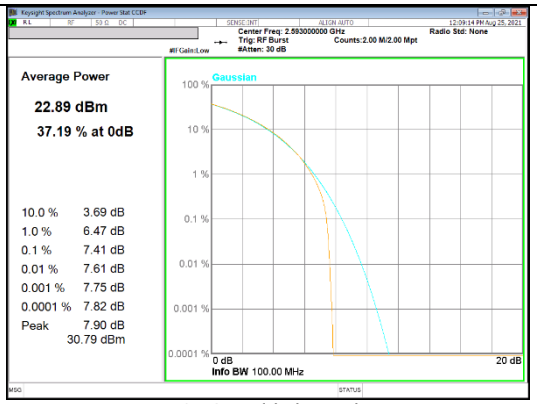
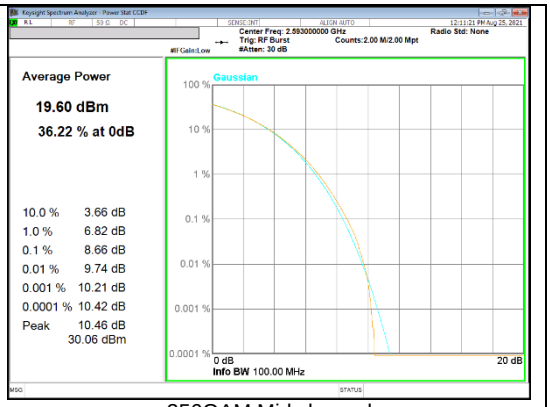
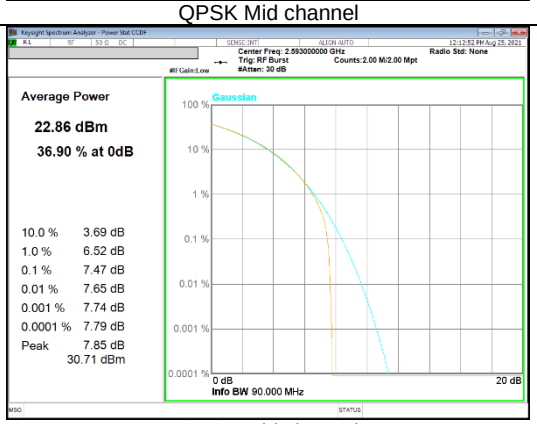
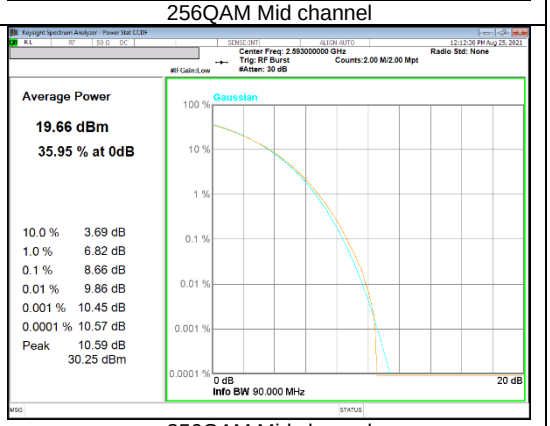
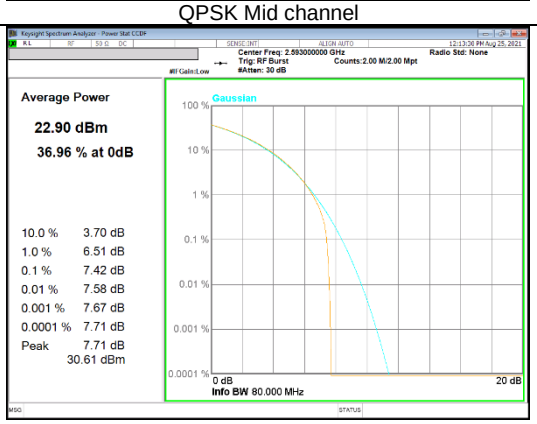
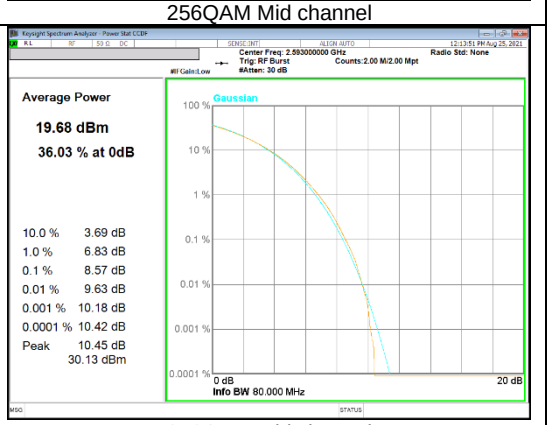
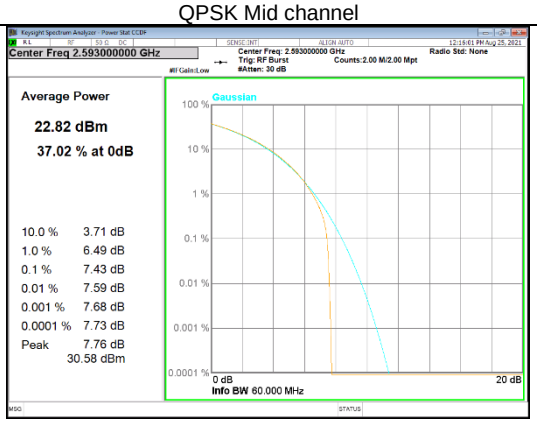
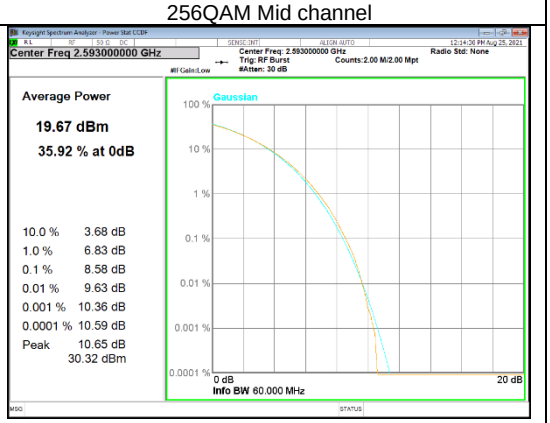
LTE Band 71

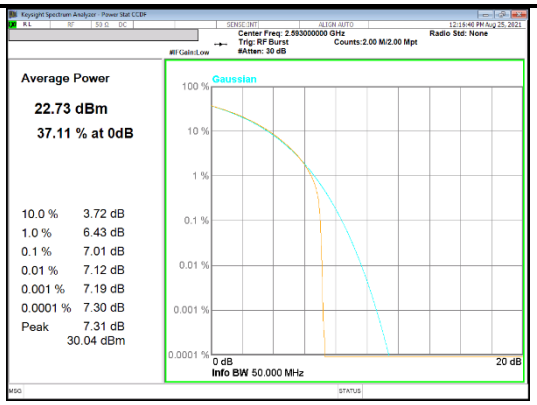
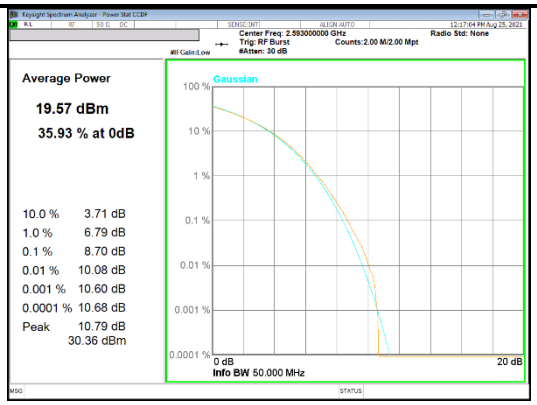
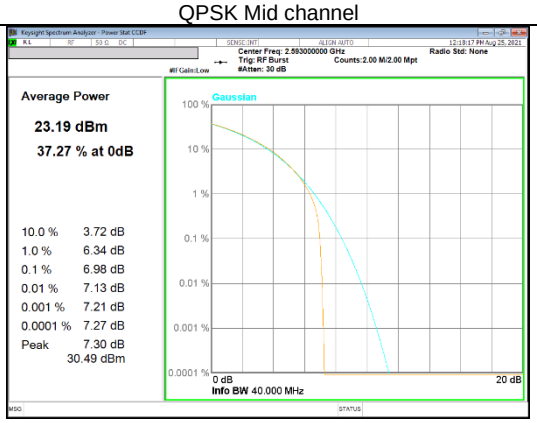
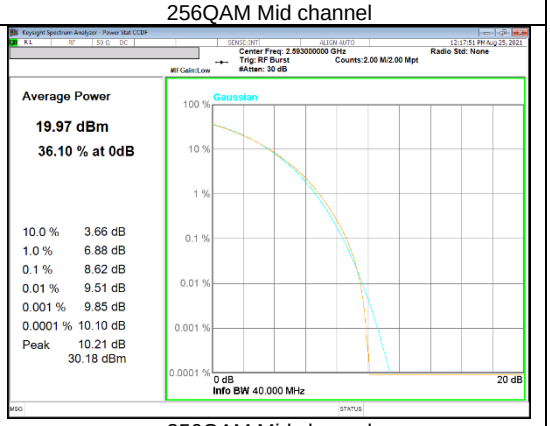
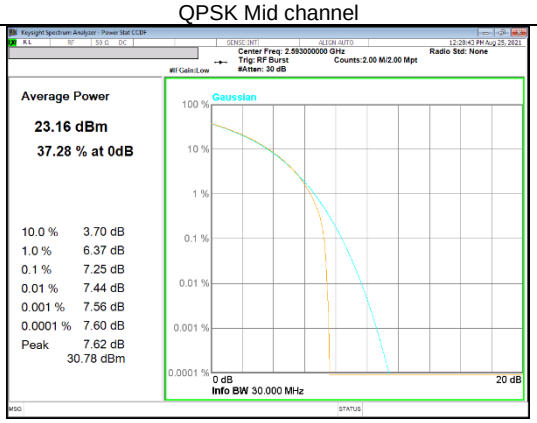
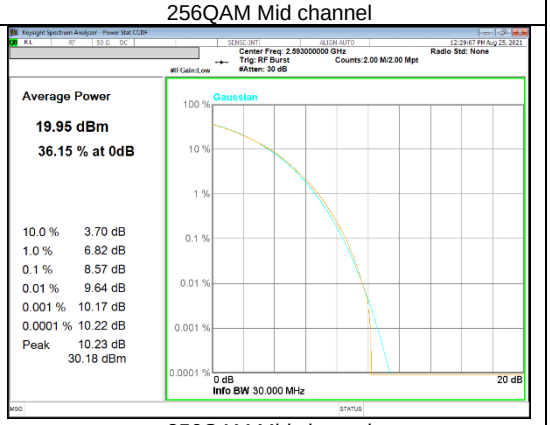
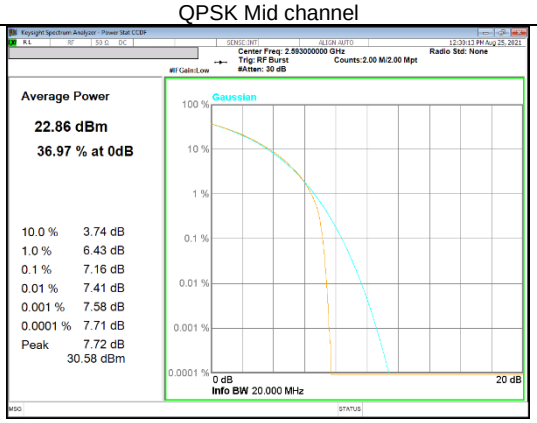
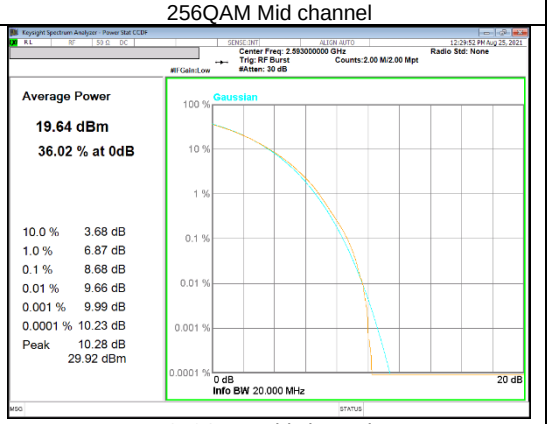
20 MHz	 QPSK Mid channel	 16QAM Mid channel
15 MHz	 QPSK Mid channel	 16QAM Mid channel
10 MHz	 QPSK Mid channel	 16QAM Mid channel
5 MHz	 QPSK Mid channel	 16QAM Mid channel

NR Band 25 CP-OFDM

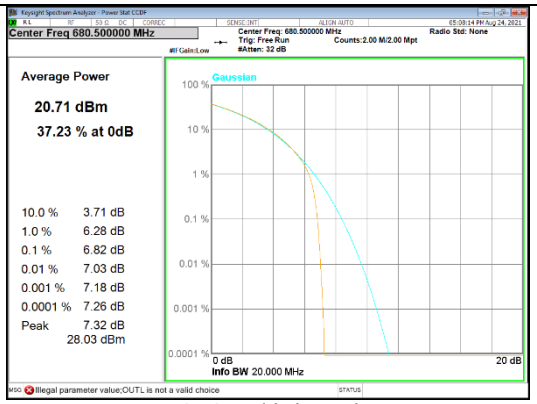
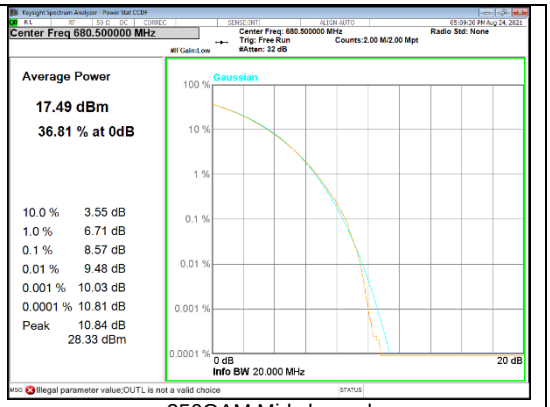
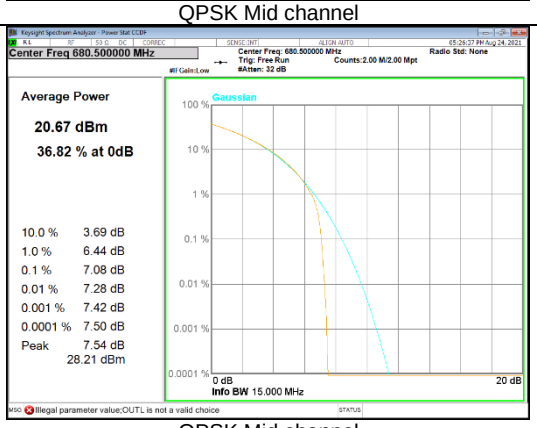
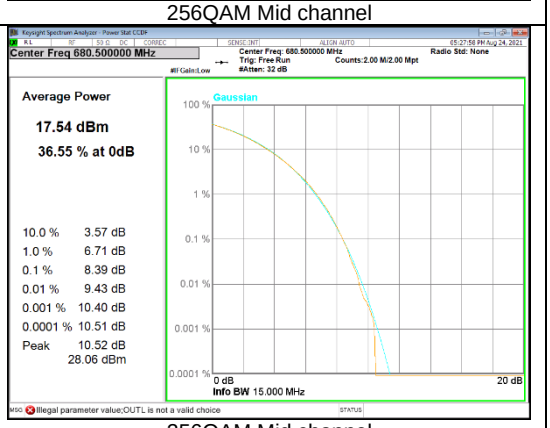
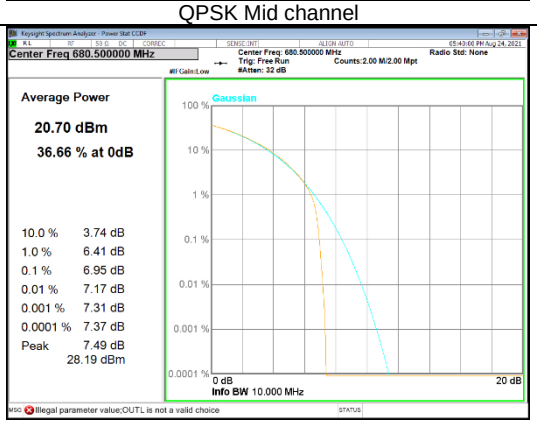
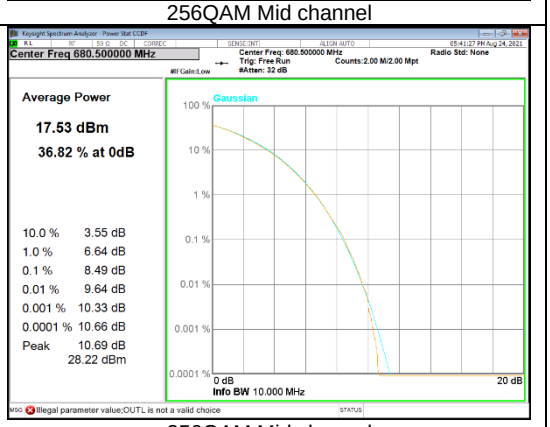
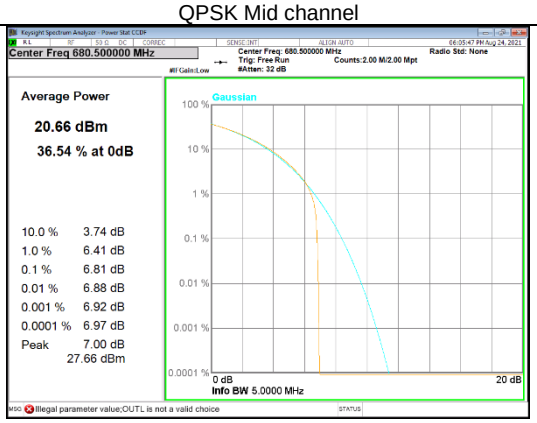
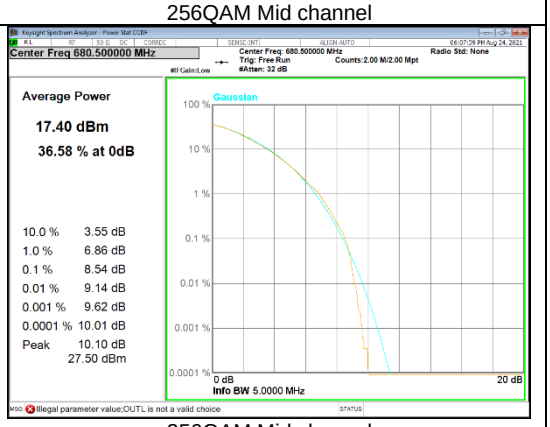
20 MHz	 QPSK Mid channel	 256QAM Mid channel
15 MHz	 QPSK Mid channel	 256QAM Mid channel
10 MHz	 QPSK Mid channel	 256QAM Mid channel
5 MHz	 QPSK Mid channel	 256QAM Mid channel

NR Band 41 CP-OFDM

100 MHz	 QPSK Mid channel	 256QAM Mid channel
90 MHz	 QPSK Mid channel	 256QAM Mid channel
80 MHz	 QPSK Mid channel	 256QAM Mid channel
60 MHz	 QPSK Mid channel	 256QAM Mid channel

50 MHz	 QPSK Mid channel	 256QAM Mid channel
40 MHz	 QPSK Mid channel	 256QAM Mid channel
30 MHz	 QPSK Mid channel	 256QAM Mid channel
20 MHz	 QPSK Mid channel	 256QAM Mid channel

NR Band 71 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

9. LIMITS AND CONDUCTED RESULTS

9.1. 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)

NOTE

5G NR: All Waveforms (CP-OFDM vs DFT-s OFDM) and modulations (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 25

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B25	20M	QPSK	1883.0	17.87	19.14
		16QAM		17.89	19.25
	15M	QPSK	1883.0	13.43	14.54
		16QAM		13.39	14.56
	10M	QPSK	1883.0	8.94	9.82
		16QAM		8.94	9.68
	5M	QPSK	1883.0	4.57	4.88
		16QAM		4.54	4.93
	3M	QPSK	1883.0	2.70	3.01
		16QAM		2.73	2.99
	1.4M	QPSK	1883.0	1.11	1.24
		16QAM		1.10	1.24

- **LTE Band 26 (Part 90)**

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B26 (Part 90)	15M	QPSK	821.5	13.39	14.50
		16QAM		13.39	14.44
	10M	QPSK	819	8.94	9.71
		16QAM		8.93	9.75
	5M	QPSK	819	4.50	4.93
		16QAM		4.48	4.92
	3M	QPSK	819	2.69	2.99
		16QAM		2.69	2.99
	1.4M	QPSK	819	1.09	1.23
		16QAM		1.09	1.24

- **LTE Band 26 (Straddle)**

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B26 (Straddle)	15M	QPSK	824	13.38	14.40
		16QAM		13.37	14.45
	10M	QPSK	824	8.93	9.74
		16QAM		8.95	9.70
	5M	QPSK	824	4.48	4.92
		16QAM		4.47	4.90
	3M	QPSK	824	2.69	3.01
		16QAM		2.69	3.00
	1.4M	QPSK	824	1.09	1.24
		16QAM		1.08	1.23

- **LTE Band 26 (Part 22)**

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B26 (Part 22)	15M	QPSK	831.5	13.43	14.57
		16QAM		13.43	14.47
	10M	QPSK	831.5	8.95	9.68
		16QAM		8.94	9.68
	5M	QPSK	831.5	4.49	4.93
		16QAM		4.49	4.91
	3M	QPSK	831.5	2.69	3.00
		16QAM		2.69	3.00
	1.4M	QPSK	831.5	1.08	1.22
		16QAM		1.08	1.23

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- LTE Band 41 (PC2)

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B41	20M	QPSK	2593	17.90	19.17
		16QAM		17.86	19.16
	15M	QPSK	2593	13.40	14.59
		16QAM		13.43	14.46
	10M	QPSK	2593	8.99	9.74
		16QAM		8.95	9.70
	5M	QPSK	2593	4.49	5.01
		16QAM		4.47	4.90

- LTE Band 71

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
LTE B71	20M	QPSK	680.5	17.85	19.32
		16QAM		17.84	19.21
	15M	QPSK	680.5	13.42	14.55
		16QAM		13.44	15.38
	10M	QPSK	680.5	8.95	9.69
		16QAM		8.96	9.70
	5M	QPSK	680.5	4.50	4.90
		16QAM		4.48	4.91

- NR Band 25 CP-OFDM

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
NR n25	20M	QPSK	1883.0	18.93	19.92
		16QAM		18.94	19.75
	15M	QPSK	1883.0	14.13	14.84
		16QAM		14.15	14.89
	10M	QPSK	1883.0	9.28	9.88
		16QAM		9.27	9.84
	5M	QPSK	1883.0	4.46	4.92
		16QAM		4.47	4.93

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- NR Band 41 CP-OFDM

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
NR n41	100M	QPSK	2593.0	96.33	100.40
		16QAM		96.14	100.40
	90M	QPSK	2593.0	87.35	90.92
		16QAM		87.28	91.02
	80M	QPSK	2593.0	77.22	80.80
		16QAM		77.09	80.54
	60M	QPSK	2593.0	57.72	60.24
		16QAM		57.66	60.24
	50M	QPSK	2593.0	47.43	49.65
		16QAM		47.45	49.67
	40M	QPSK	2593.0	37.82	39.70
		16QAM		37.81	39.78
	30M	QPSK	2593.0	27.84	29.36
		16QAM		27.85	29.22
	20M	QPSK	2593.0	18.27	19.36
		16QAM		18.20	19.47

- NR Band 71 CP-OFDM

Band	BW	Modulation	f [MHz]	99% BW (MHz)	-26dB BW (MHz)
NR n71	20M	QPSK	680.5	18.92	19.77
		16QAM		18.92	19.79
	15M	QPSK	680.5	14.11	14.87
		16QAM		14.10	14.98
	10M	QPSK	680.5	9.30	9.94
		16QAM		9.27	9.87
	5M	QPSK	680.5	4.47	4.93
		16QAM		4.48	4.91

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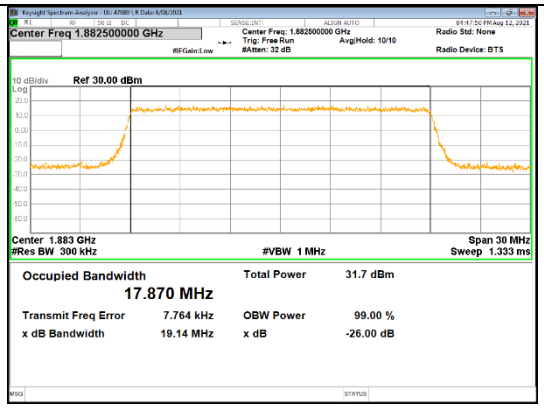
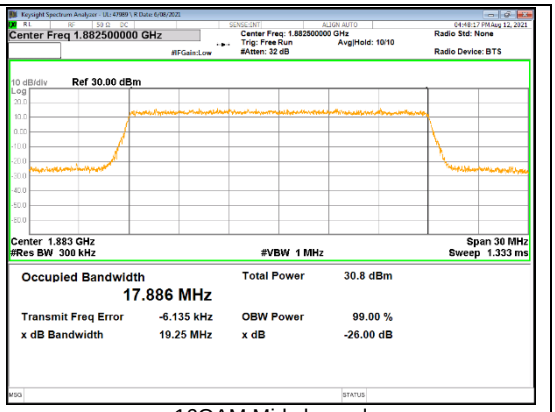
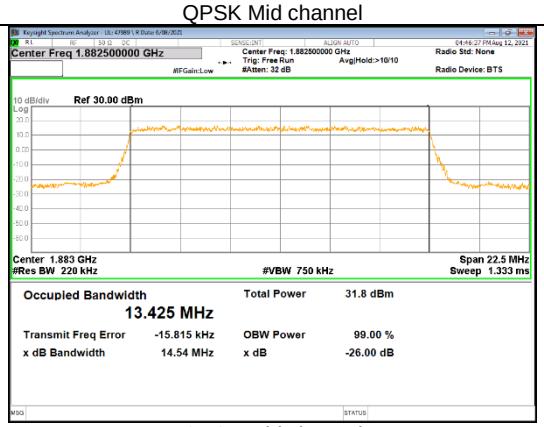
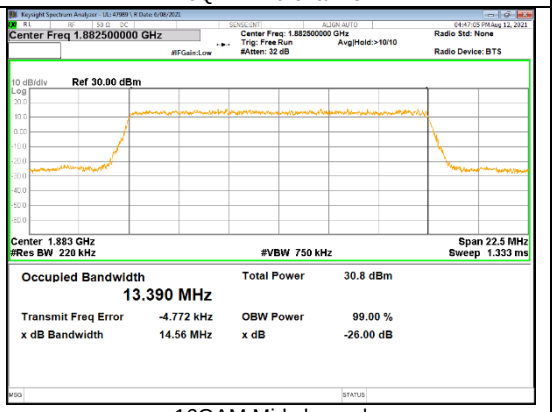
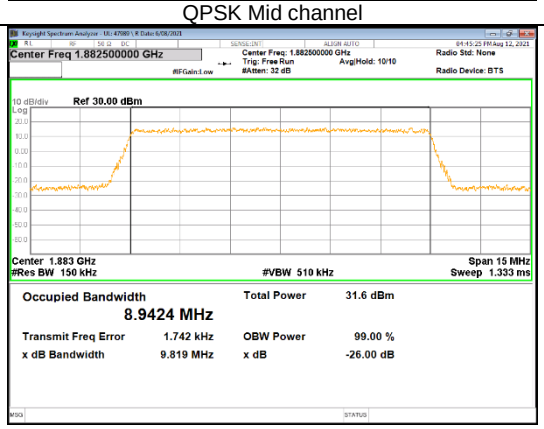
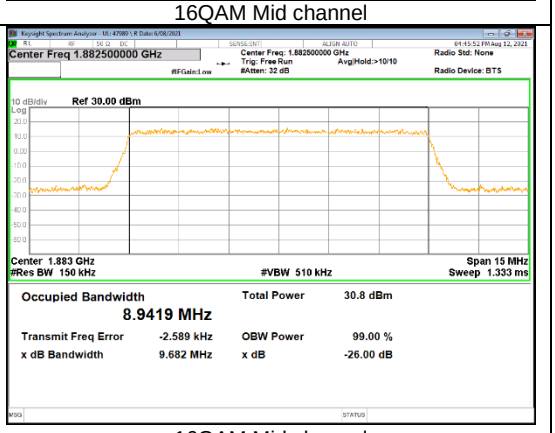
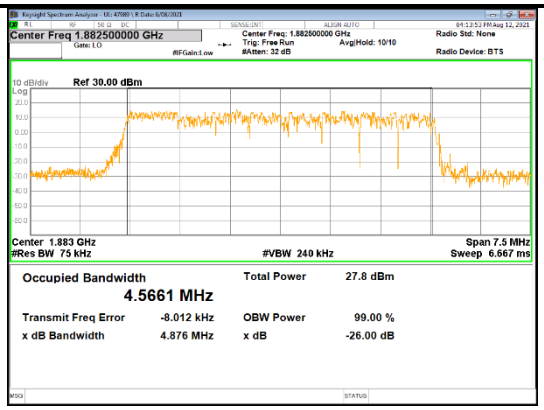
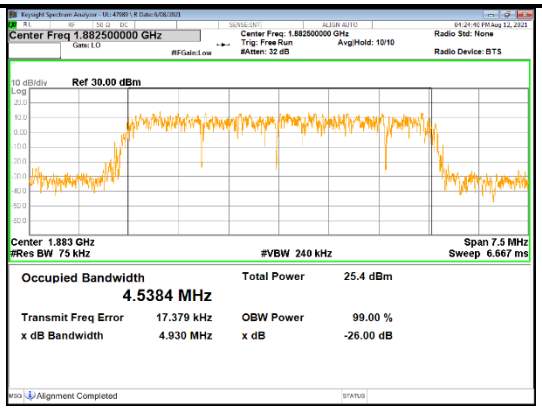
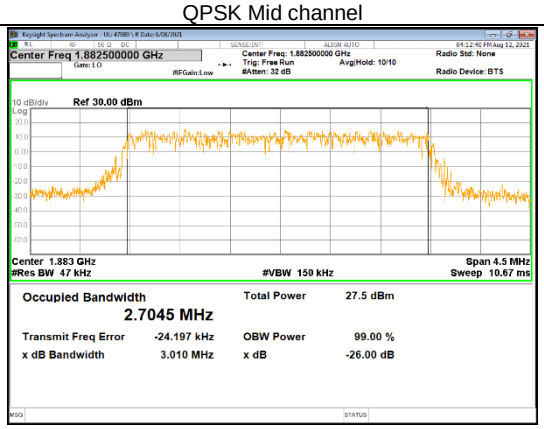
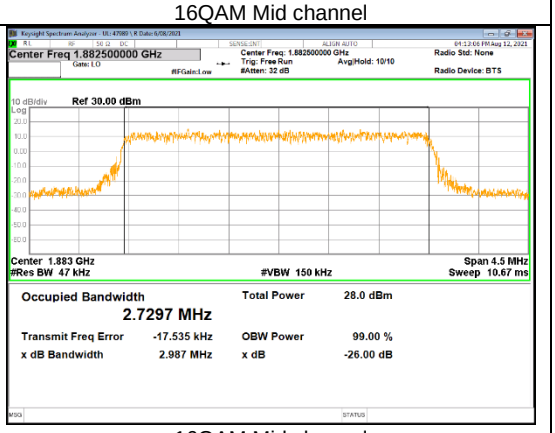
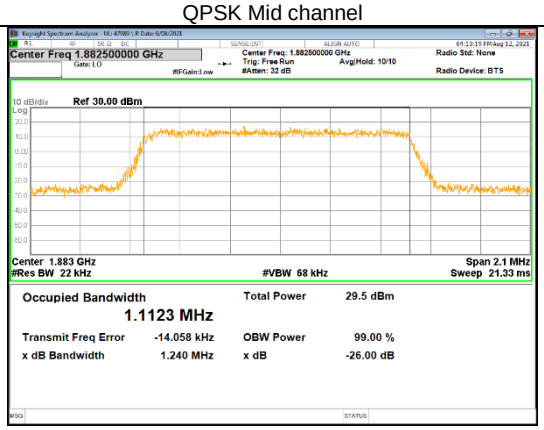
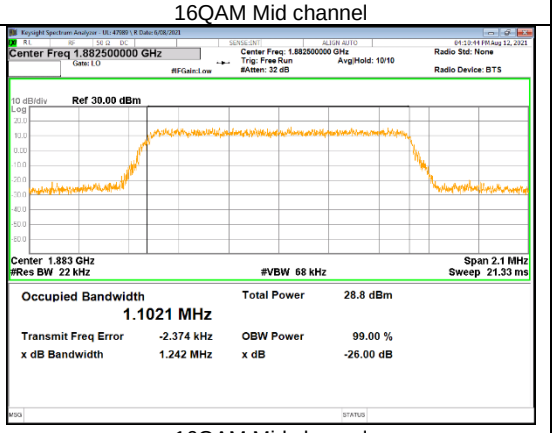
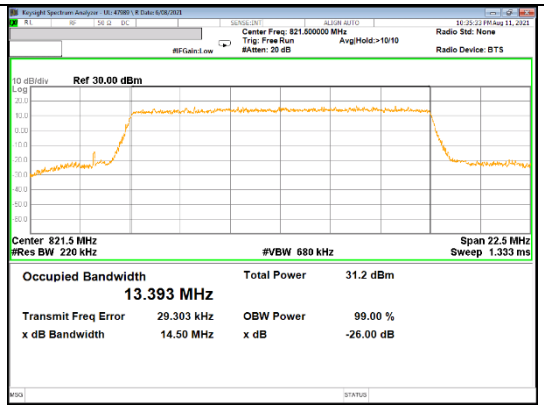
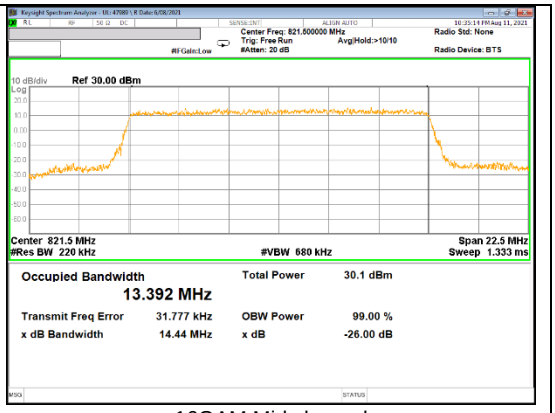
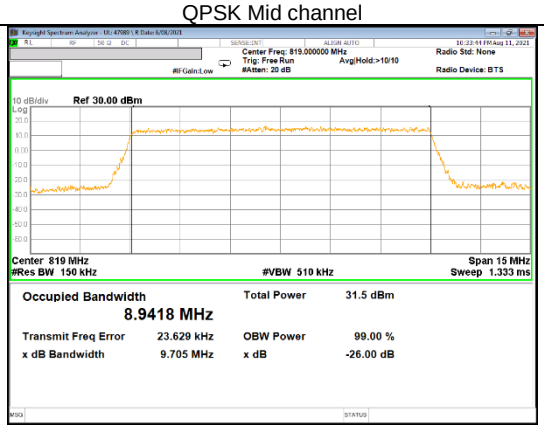
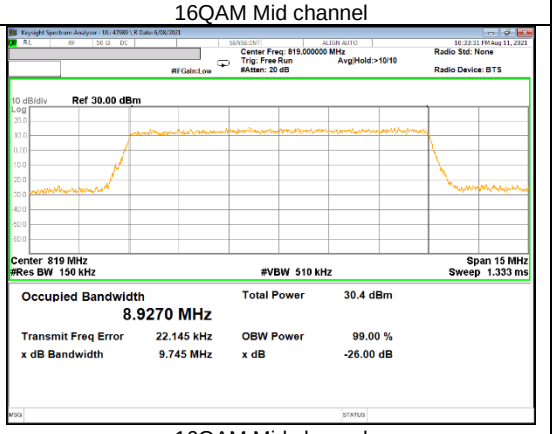
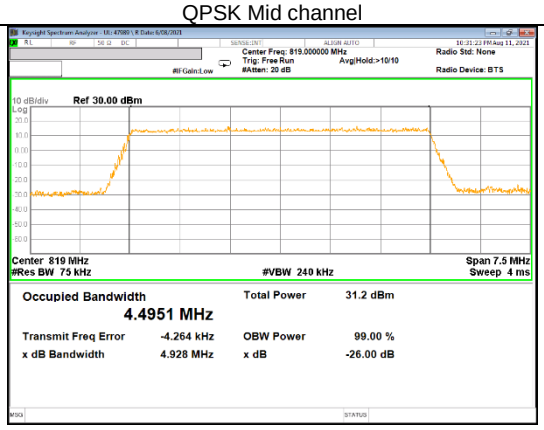
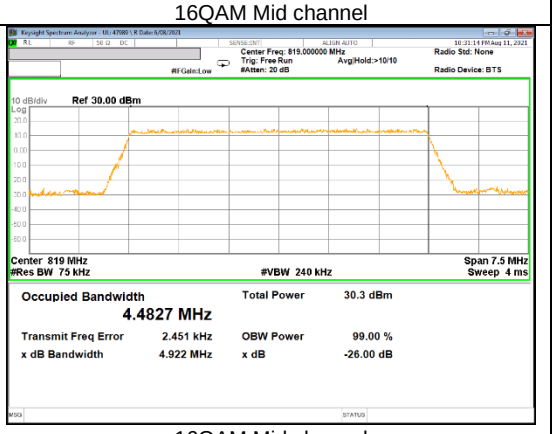
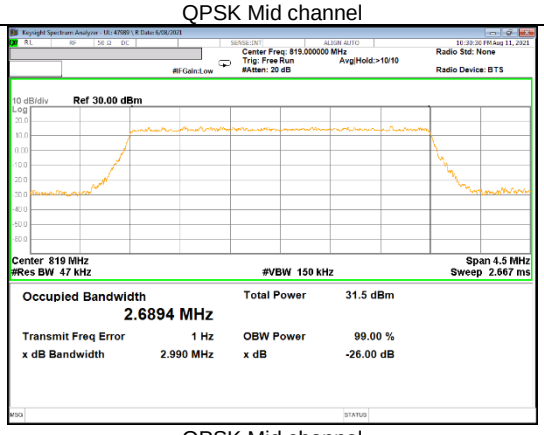
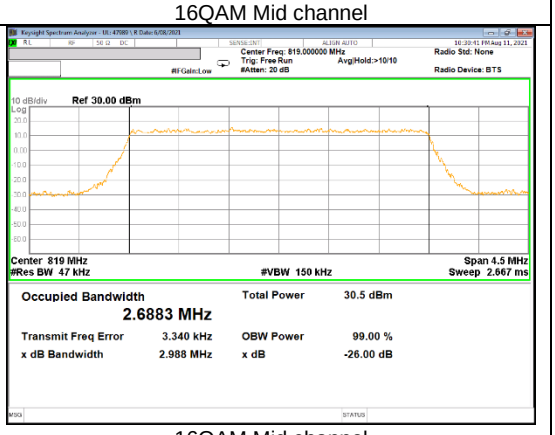
9.1.1. OCCUPIED BANDWIDTH RESULTS

LTE Band 25

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

LTE Band 26 (Part90)

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