

C2PC TEST REPORT

Report Number: 14790372-E7V2

Applicant : APPLE, INC
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

Model : A2482 (Parent Model, Full Test)
A2631, A2633, A2634, A2635 (Variant Models)

Brand : APPLE

FCC ID : BCG-E3997A (Parent Model)
BCG-E3999A, BCG-E4031A, BCG-E4032A (Variant Models)

EUT Description : SMARTPHONE

Test Standard(s) : FCC CFR47 PART 2, PART 96

Date Of Issue:
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Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	6/21/2023	Initial Review	Mengistu Mekuria
V2	6/22/2023	Addressed All TCB Questions at Section 5.4, 6.3, and 6.8	Mengistu Mekuria

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1. ATTESTATION OF TEST RESULTS

Applicant Name and Address	APPLE, INC 1 APPLE PARK WAY CUPERTINO, CA 95014, U.S.A.
Model	A2482 (Parent Model) A2631, A2633, A2634, A2635 (Variant Models)
Brand	APPLE
FCC ID	BCG-E3997A (PARENT MODEL) BCG-E3999A, BCG-E4031A, BCG-E4032A (Variant Models)
EUT Description	SMARTPHONE
Serial Number	CQF9R4NQNJ (CONDUCTED) AND XWGGFJ25JV (RADIATED)
Sample Receipt Date	FEBRUARY 19, 2021
Date Tested	FEBRUARY 19, 2021 to JUNE 10, 2021
Applicable Standards	FCC CFR47 PART2, PART 96
Test Results	COMPLIES

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released By:	Reviewed By:	Prepared By:
		
Mengistu Mekuria Senior Test Engineer UL Verification Services Inc.	John Thompson Laboratory Engineer UL Vérification Services Inc.	Sintia Andean Laboratory Engineer UL Verification Services Inc.

2. SUMMARY OF TEST RESULTS

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

Requirement Description	Band	Requirement Clause Number (FCC)	Result	Remarks
Equivalent Isotropic Radiated	48	96.41 (b)	Complies	

Requirement Description	Requirement Clause Number (FCC)	Result	Remarks
Occupied Bandwidth	2.1049	Complies	
Band Edge and Emission Mask	96.41(e)	Complies	
Out of Band Emissions	96.41(e)	Complies	
Frequency Stability	2.1055	Complies	
Peak-to-Average Ratio	96.41 (g)	Complies	
Field Strength of Spurious Radiation	96.41(e)	Complies	

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with the following:

- ANSI C63.26:2015
- FCC CFR 47 Part 2, Part 96
- [FCC KDB 971168 D01 v03r01](#): Power Meas License Digital Systems
- [FCC KDB 971168 D02 v02r01](#): Misc Rev Approv License Devices
- [FCC KDB 412172 D01 v01r01](#): Determining ERP and EIRP

4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, certification #0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input checked="" type="checkbox"/>	Building 1: 47173 Benicia Street, Fremont, CA 94538, USA	US0104	2324A	208313
<input checked="" type="checkbox"/>	Building 2: 47266 Benicia Street, Fremont, CA 94538, USA	US0104	22541	208313
<input type="checkbox"/>	Building 4: 47658 Kato Rd, Fremont, CA 94538, USA	US0104	2324B	208313

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	U _{Lab}
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB
Occupied Channel Bandwidth	±1.22 %
Temperature	±2.26%
Supply voltages	±0.57 %
Time	±3.39 %

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

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

$$\text{Field Strength (dBuV/m)} = \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Preamp Gain (dB)}$$
$$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$$

6. EQUIPMENT UNDER TEST

6.1. DESCRIPTION OF EUT

The Apple iPhone is a smartphone with multimedia functions (music, application support, and video), cellular GSM, GPRS, EGPRS, UMTS, LTE, 5G, CDMA, IEEE 802.11a/b/g/n/ac/ax, Bluetooth, Ultra-Wideband, GPS and NFC. All models support at least one UICC based SIM. The second SIM is either an UICC based p-SIM (physical SIM) or e-SIM (electronic SIM). The device supports a built-in inductive charging transmitter and receiver. The rechargeable battery is not user accessible.

Testing was performed on the parent model and is used to support the application for the parent and variants identified in this report based on the test plan submitted and approved via KDB inquiry by the FCC.

6.2. INTRODUCTION

This application for certification is leveraging the data reuse procedures from KDB 484596 D01 based on reference FCC ID: BCG-E3997A to cover variant model FCC ID: BCG-E3999A, FCC ID: BCG-E4031A, and FCC ID: BCG-E4032A. The major difference between the parent/reference model and the variant model is the depopulation in the variant model of the mmWave transmitter, and some LTE and 5G NR Bands. All other circuitry and features are identical. The data reuse test plan was approved via manufacturer KDB inquiry.

6.3. MODEL DIFFERENCES

The manufacturer hereby declares the following for models A2482, A2631, A2633, A2634, A2635.

A2482, A2631, A2633, A2634, and A2635 are highly similar, with the only differences being listed on the table below:

Model	FCC ID	Model Changes
A2482	BCG-E3997A	Reference model
A2631	BCG-E3999A	Variant model. Removed FR2 from the reference model
A2633	BCG-E4031A	Variant model. Removed FR2, LTE B11/14/21/29/71, and 5G n71 from the reference model
A2634/A2635	BCG-E4032A	Variant model. Removed FR2, LTE B11/14/21/29/53/71, MSS, and 5G NR n53/n71 from the reference Model.

*Note:

They have the same PCB layout, design, common components, antennas, antenna locations and housing cases.

More specifically, their cellular modem, Wi-Fi, BT, NFC, WPT and UWB transmitters are identical, and removal of cellular bands is done by software and depopulation of band-specific components associated with the removed bands.

Spot check verification has been done on models A2631, A2633, A2634 and A2635 in accordance with the test plan approved via KDB inquiry. Comparison of the models, upper deviation is within 0.5dB range, and all tests are under FCC Technical Limits. The results documented for model A2482 may be applied as representative to models A2631, A2633, A2634 and A2635.

6.4. MAXIMUM OUTPUT POWER

EIRP/ERP TEST PROCEDURE

ANSI C63.26:2015

KDB 971168 D01 Section 5.6

$$\text{ERP/EIRP} = \text{PMeas} + \text{GT} - \text{LC}$$

where: ERP/EIRP = effective or equivalent radiated power, respectively (expressed in the same units as PMeas, typically dBW or dBm);

PMeas = measured transmitter output power or PSD, in dBm or dBW;

GT = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);

LC = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

For devices utilizing multiple antennas, KDB 662911 provides guidance for determining the effective array transmit antenna gain term to be used in the above equation.

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

5G NR n48 (Ant 7)

Part 96								
EIRP Limit (W)		0.20						
Antenna Gain (dBi)		-1.00						
Bandwidth (MHz)	Modulation	Low Frequency (MHz)	Upper Frequency (MHz)	Conducted Average (dBm)	EIRP Average (dBm)	EIRP Average (W)	99% BW (kHz)	Emission Designator
10.0	BPSK	3590.0	3660.0	23.49	22.49	0.177	8590	8M59G7W
	QPSK			23.50	22.50	0.178	8605	8M61G7W
	16QAM			23.49	22.49	0.177	8567	8M57D7W
20.0	BPSK	3595.0	3655.0	23.49	22.49	0.177	17795	17M8G7W
	QPSK			23.49	22.49	0.177	17860	17M9G7W
	16QAM			23.50	22.50	0.178	17825	17M8D7W
40.0	BPSK	3600.0	3650.0	23.49	22.49	0.177	35606	35M6G7W
	QPSK			23.49	22.49	0.177	35659	35M7G7W
	16QAM			23.47	22.47	0.177	35610	35M6D7W

6.5. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR A2631

A2631 SPOT CHECK RESULTS							
Technology	Worst Mode	Test Item	Measured	Original Model: A2482	Sub Model: A2631	Delta (dB)	Remarks
			Frequency (MHz)	FCC ID: BCG-E3997A Power (dBm)	FCC ID: BCG-E3999A Power (dBm)		
5G NR n48	QPSK @ 40 MHz BW	Cond Power	3550-3700	25.20	25.20	0.00	Ant9

6.6. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR A2633

A2633 SPOT CHECK RESULTS							
Technology	Worst Mode	Test Item	Measured	Original Model: A2482	Sub Model: A2633	Delta (dB)	Remarks
			Frequency (MHz)	FCC ID: BCG-E3997A Power (dBm)	FCC ID: BCG-E3931A Power (dBm)		
5G NR n48	QPSK @ 40 MHz BW	Cond Power	3550-3700	25.20	25.20	0.00	Ant9

6.7. SPOT CHECK VERIFICATION RESULTS SUMMARY FOR A2634 AND A2635

A2634 SPOT CHECK RESULTS							
Technology	Worst Mode	Test Item	Measured	Original Model: A2482	Sub Model: A2634/A2635	Delta (dB)	Remarks
			Frequency (MHz)	FCC ID: BCG-E3997A Power (dBm)	FCC ID: BCG-E3932A Power (dBm)		
5G NR n48	QPSK @ 40 MHz BW	Cond Power	3550-3700	25.20	25.20	0.00	Ant9

6.8. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was version 0.21.02-1.

6.9. MAXIMUM ANTENNA GAIN

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

LTE Bands	ANT 1 Antenna Gain (dBi)	ANT 2 Antenna Gain (dBi)	ANT 3 Antenna Gain (dBi)	ANT 4 Antenna Gain (dBi)	ANT 7 Antenna Gain (dBi)	ANT 8 Antenna Gain (dBi)	ANT 9 Antenna Gain (dBi)
5G NR n48, 3550 – 3700 MHz				-3.3	-1.0	-8.6	-4.4

6.10. WORST-CASE CONFIGURATION AND MODE

The EUT supports the different LTE and 5G NR Bands. However, this report only applied to 5G NR n48.

BPSK modulation applied only for 5G NR frequencies and has the same tune up power as QPSK modulations.

The DFT-s-OFDM and CP-OFDM waveforms were investigated, and DFT-s-OFDM was found to be the worst case.

For 5G NRs, conducted spurious emission tests were conducted on wider bandwidth with inner 1RB since this is the worst bandwidth and the highest output power.

The worst-case scenario for all measurements is based on an engineering evaluation and QPSK was observed as the worst one and set for all conducted and radiated. Output power measurements were measured on QPSK, 16QAM, 64QAM, 256QAM, and BPSK, modulations. For testing purposes emissions on sections 8 and 9 were measured while QPSK was set at or above target power for all bands. Conducted tests were performed on the worst-case antenna because it has the highest conducted power. For bands 48 ANT9 is the worst-case antenna.

The EUT was investigated in three orthogonal orientations X/Y/Z on all ANT4, ANT7, ANT8 and ANT 9 antennas to determine the worst-case orientation. The following table exhibit the worst-case orientation for different frequency bands. The full tests of the EUT have made upon the orientations that shown in the table below.

Frequency Bands	ANT1	ANT2	ANT3	ANT4	ANT7	ANT8	ANT9
3300 – 3980 MHz	N/A	N/A	N/A	Y	X	X	Y

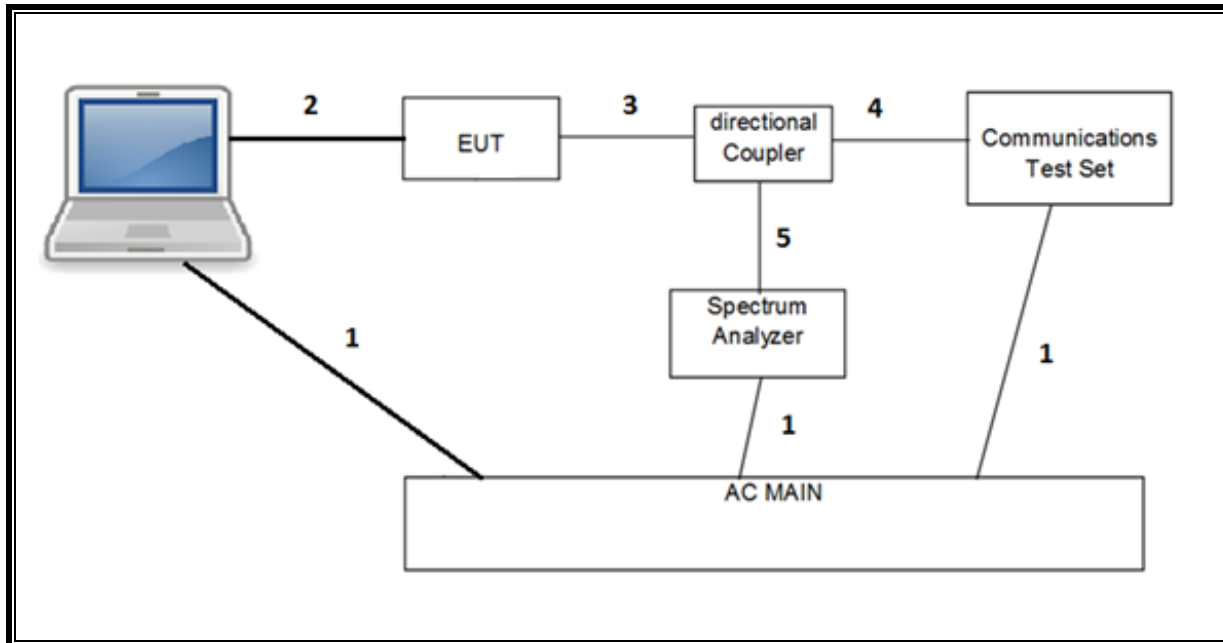
Radiated spurious emissions were investigated from 9kHz to 30MHz, 30MHz-1GHz and above 1GHz. There were no emissions found with less than 20dB of margin from 9kHz to 1GHz.

For simultaneous transmission of multiple channels in the 2.4GHz/5GH WLAN, UWB, and Cellular bands, tests were conducted for various configurations having the highest power, least separation in frequencies and widest operation bandwidths. No noticeable new emission was found.

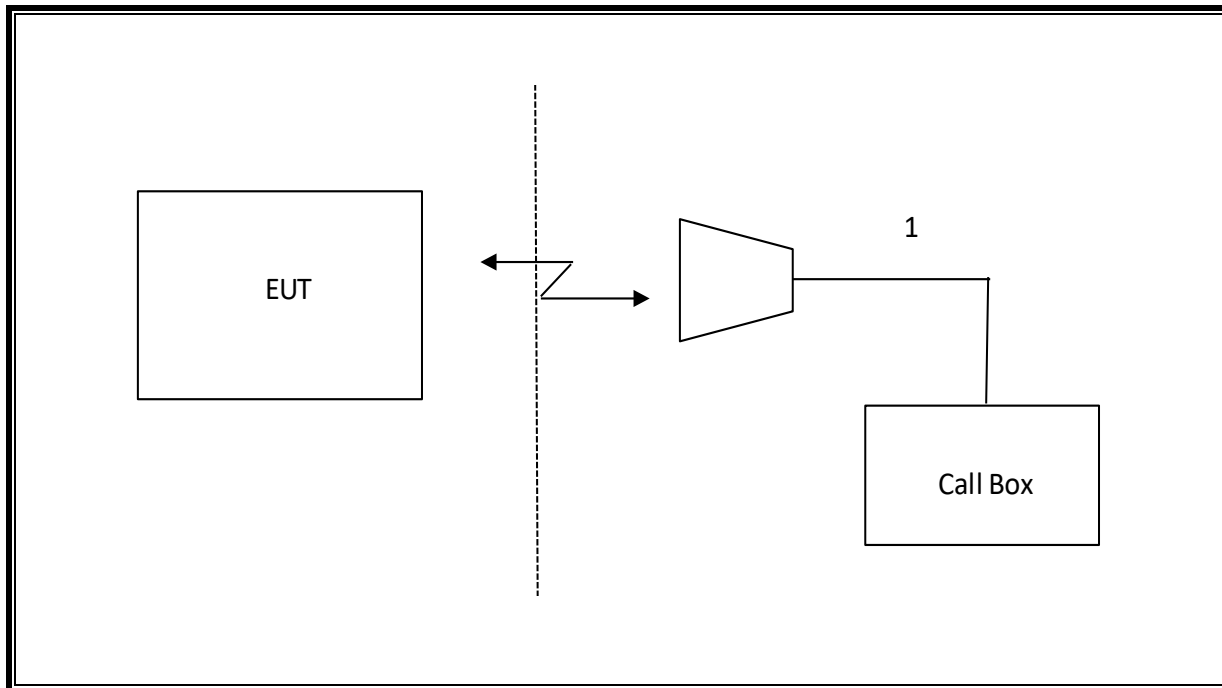
6.11. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC		
Laptop	A1398	C02PM012G3QD	QDS-BRCM1069	A1398		
AC/DC adapter	PA-1450-BA1	B123	N/A	PA-1450-BA1		
I/O CABLES (RF CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	3	US 115V	Un-shielded	2.0	N/A
2	USB	1	DC	Un-shielded	1.0	N/A
3	RF In/Out	1	EUT	Un-shielded	0.6	N/A
4	RF In/Out	1	Communication Test Set	Un-shielded	1.2	N/A
5	RF In/Out	1	Barrel	N/A	N/A	N/A
I/O CABLES (RF RADIATED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	RF In/Out	1	Antenna	Un-shielded	5.0	N/A

CONDUCTED SETUP



RADIATED SETUP



7. 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	Asset	Cal Due
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T136	7/21/2022
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T899	9/14/2021
RF Amplifier, 1-18GHz	MITEQ	AFS42-00101800-25-S-42	T1165	6/12/2022
Amplifier, 100KHz to 1GHz, 32dB	Keysight Technologies Inc	8447D	T15	1/14/2022
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	T1450	1/21/2022
Antenna, Horn 1-18GHz	ETS Lindgren	3117	80403	5/26/2022
RF Device, Active, Amplifier	AMPLICAL	AMP1G18-35	205885	6/1/2022
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	T907	1/27/2022
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	PRE0213833	2/16/2022
RF Device, Active, Amplifier	AMPLICAL	AMP0.1G18-47-20	206055	5/13/2022
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	201500	2/26/2022
Chamber, Environmental	Cincinnati Sub Zero	ZPHS-8-3.5-SCT/WC	T754	6/21/2022
Filter, BRF 3400 to 3800MHz	MICRO-TRONICS	BRM50711-02	T1792	6/23/2022
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T449	4/22/2022
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight Technologies Inc	8449B	T404	4/19/2022
Antenna, Horn 26.5 to 40GHz	A.R.A.	MWH-2640/B	PRE0182201	4/22/2022
Amplifier, 26 - 40GHz	MITEQ	TTA2640-35-HG	T1864	4/19/2022
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	T1454	1/27/2022
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	T1271	1/20/2022
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	T1228	4/13/2022
Power Meter, P-series single channel	Keysight Technologies Inc	N1912A	T1245	1/21/2022
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	T1226	2/19/2022
Antenna, Active Loop 9KHz to 30MHz	EMCO	6502	T35	11/23/2021
UL AUTOMATION SOFTWARE				
CLT Software	UL	UL RF	Ver 3.2.5, 4/13/2021	
Power Measurement Software	UL	UL RF	Ver 3.1.2 5/17/2021	
Radiated test software	UL	UL RF	Ver 9.5, 4/14/2021	

NOTES:

* Testing is completed before equipment expiration date.

8. RF OUTPUT POWER VERIFICATION

CONDUCTED OUTPUT POWER MEASUREMENT PROCEDURE

All LTE bands conducted average power is obtained from the CMW500 telecommunication test set.

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS136.101 specification.

UE Power Class: 3 (23 +/- 2dBm). Band 41 UE Power Class: 2 (26 +/-2 dBm). The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS136.101.

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3

Modulation	Channel bandwidth / Transmission bandwidth (N _{RB})						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2
64 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 2
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 3
256 QAM	≥ 1						≤ 5

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS138.521-1 specification.

The allowed MPR for SRS, PUCCH formats 0, 1, 3 and 4, and PRACH shall be as specified for QPSK modulated DFTs-

OFDM of equivalent RB allocation. The allowed MPR for PUCCH format 2 shall be as specified for QPSK modulated CP-OFDM of equivalent RB allocation.

Table 6.2.3-1: Maximum power reduction (MPR) for power class 3

Modulation		MPR (dB)		
		Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM	Pi/2 BPSK	≤ 3.5 ¹	≤ 1.2 ¹	≤ 0.2 ¹
		≤ 0.5 ²		0 ²
	Pi/2 BPSK w Pi/2 BPSK DMRS	≤ 0.5 ²		0 ²
	QPSK	≤ 1		0
	16 QAM	≤ 2		≤ 1
	64 QAM	≤ 2.5		
CP-OFDM	256 QAM	≤ 4.5		
	QPSK	≤ 3		≤ 1.5
	16 QAM	≤ 3		≤ 2
	64 QAM	≤ 3.5		
	256 QAM	≤ 6.5		
NOTE 1: Applicable for UE operating in TDD mode with Pi/2 BPSK modulation and UE indicates support for UE capability <i>powerBoosting-pi2BPSK</i> and if the IE <i>powerBoostPi2BPSK</i> is set to 1 and 40 % or less slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. The reference power of 0dB MPR is 26dBm. NOTE 2: Applicable for UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79 with Pi/2 BPSK modulation and if the IE <i>powerBoostPi2BPSK</i> is set to 0 and if more than 40% of slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79.				

Table 6.2.3-2: Maximum power reduction (MPR) for power class 2

Modulation		MPR (dB)		
		Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM	Pi/2 BPSK	≤ 3.5	≤ 0.5	0
	QPSK	≤ 3.5	≤ 1	0
	16 QAM	≤ 3.5	≤ 2	≤ 1
	64 QAM	≤ 3.5	≤ 2.5	
	256 QAM	≤ 4.5		
CP-OFDM	QPSK	≤ 3.5	≤ 3	≤ 1.5
	16 QAM	≤ 3.5	≤ 3	≤ 2
	64 QAM	≤ 3.5		
	256 QAM	≤ 6.5		

The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS136.101 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of “NS_01”.

Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)

Network Signalling value	Requirements (subclause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	N/A
NS_03	6.6.2.2.1	2, 4, 10, 23, 25, 35, 36, 66, 70	3	>5	≤ 1
			5	>6	≤ 1
			10	>6	≤ 1
			15	>8	≤ 1
20	>10	≤ 1			
NS_04	6.6.2.2.2, 6.6.3.3.19	41	5, 10, 15, 20	Table 6.2.4-4, Table 6.2.4-4a	

The allowed A-MPR values specified below in Table 6.2.3.3.1-1 of 3GPP TS 38.521-1 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of “NS_01”.

Table 6.2.3.3.1-1: Additional maximum power reduction (A-MPR)

Network signalling label	Requirements (subclause)	NR Band	Channel bandwidth (MHz)	Resources blocks (N_{RB})	A-MPR (dB)
NS_01		Table 5.2-1	5, 10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100	Table 5.3.2-1	N/A
NS_03	6.5.2.3.3.3	n2, n25, n66, n70, n86			Clause 6.2.3.3.7
NS_03U	6.5.2.3.3.3, 6.5.2.4.2.3	n2, n25, n66, n86			Clause 6.2.3.3.7
NS_04	6.5.2.3.3.2, 6.5.3.3.3.1	n41	10, 15, 20, 40, 50, 60, 80, 90, 100		Clause 6.2.3.3.2

RESULTS

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

8.1. 5G NR n48

Test Engineer ID:	10646	Test Date:	5/26/2021
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OUTPUT POWER FOR 5G NR n48 (10.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Conducted Average (dBm)											
				ANT 7			ANT 8			ANT 9			ANT 4		
				637000	641666	646333	637000	641666	646333	637000	641666	646333	637000	641666	646333
10.0	BPSK	1	0	23.49	23.48	23.30	22.29	22.68	22.46	24.65	24.15	24.11	21.60	21.87	22.01
		1	1	23.45	23.42	23.38	22.85	23.09	22.99	25.19	24.78	24.59	22.48	22.30	22.70
		1	22	23.30	23.40	23.39	22.75	23.20	22.90	25.17	24.77	24.42	22.44	22.14	22.49
		1	23	23.45	23.48	23.36	22.27	22.60	22.43	24.52	24.35	24.27	21.88	21.51	21.99
		12	6	23.36	23.38	23.46	22.70	23.07	22.83	24.84	24.82	24.56	22.34	21.98	22.35
		24	0	23.38	23.47	23.33	22.25	22.58	22.38	24.37	24.03	24.02	21.71	21.46	21.72
		1	0	23.50	23.39	23.49	21.70	22.04	21.95	23.94	23.78	23.82	21.55	20.94	21.66
		1	1	23.44	23.33	23.45	22.73	23.03	23.02	25.20	24.42	24.70	22.55	22.30	22.48
	QPSK	1	22	23.43	23.43	23.46	22.74	23.14	22.91	25.19	24.76	25.07	22.66	22.19	22.48
		1	23	23.33	23.48	23.47	21.79	22.09	21.84	24.14	23.86	23.37	21.40	21.33	21.60
		12	6	23.42	23.42	23.45	22.77	23.08	22.87	24.89	24.62	24.51	22.24	22.17	22.48
		24	0	23.45	23.41	23.49	21.73	22.10	21.87	23.89	23.52	23.48	21.24	21.15	21.22
		1	0	23.44	23.43	23.38	20.95	21.16	21.15	23.41	23.02	23.12	20.91	20.36	20.83
		1	1	23.43	23.33	23.34	21.82	22.18	22.05	24.38	23.63	24.07	21.61	21.42	21.75
		1	22	23.33	23.48	23.38	21.76	22.12	21.90	24.30	24.06	24.01	21.76	21.47	21.87
		1	23	23.31	23.49	23.45	20.84	21.16	21.01	23.37	23.01	23.26	20.63	20.54	20.78
	16QAM	12	6	23.47	23.39	23.36	21.75	22.10	21.86	23.81	23.59	23.41	21.19	20.99	21.34
		24	0	23.24	23.37	23.49	20.75	21.08	20.85	23.02	22.63	22.53	20.29	20.10	20.23
		1	0	23.43	23.44	23.42	20.70	20.99	20.93	22.84	22.30	22.25	20.19	19.38	20.25
		1	1	23.24	23.31	23.40	20.72	21.04	20.96	22.84	22.34	22.26	19.90	19.85	20.05
		1	22	23.22	23.34	23.39	20.64	21.09	20.80	23.01	22.55	22.34	19.72	19.82	19.91
		1	23	23.23	23.46	23.39	20.75	20.99	20.79	22.81	22.65	22.27	20.15	19.94	20.06
		12	6	22.74	23.11	22.97	20.21	20.56	20.32	22.33	22.08	21.96	19.68	19.53	19.70
		24	0	22.72	23.09	22.96	20.22	20.55	20.33	22.34	22.04	21.93	19.70	19.42	19.74
	64QAM	1	0	21.05	20.99	21.14	18.28	18.54	18.43	20.63	20.38	20.18	17.91	17.82	18.15
		1	1	20.87	21.14	21.14	18.27	18.64	18.49	20.81	20.18	20.28	18.04	17.71	18.06
		1	22	20.74	21.18	21.00	18.35	18.59	18.36	20.65	20.28	20.37	17.92	17.68	18.10
		1	23	20.87	21.15	21.02	18.20	18.66	18.37	20.59	20.37	20.22	17.89	17.77	18.13
		12	6	20.75	21.12	20.98	18.23	18.63	18.34	20.25	20.07	19.97	17.78	17.60	17.74
		24	0	20.85	21.15	21.04	18.25	18.60	18.37	20.47	20.04	20.01	17.78	17.54	17.86

OUTPUT POWER FOR 5G NR n48 (20.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Conducted Average (dBm)											
				ANT 7			ANT 8			ANT 9			ANT 4		
				637333	641666	646000	637333	641666	646000	637333	641666	646000	637333	641666	646000
20.0	BPSK	1	0	23.31	23.49	23.43	22.17	22.61	22.45	24.33	24.08	24.34	22.24	21.99	22.10
		1	1	23.38	23.45	23.39	22.70	23.20	22.96	25.20	24.59	24.62	22.69	22.40	22.55
		1	49	23.35	23.31	23.49	22.71	23.06	22.83	24.86	24.62	24.70	22.70	22.12	22.50
		1	50	23.48	23.44	23.34	22.19	22.56	22.30	24.25	23.94	24.01	22.19	21.84	21.92
		25	12	23.41	23.34	23.33	22.67	23.09	22.87	24.75	24.47	24.48	22.46	22.04	22.45
		50	0	23.35	23.37	23.39	22.20	22.55	22.36	24.23	23.85	23.90	21.89	21.68	21.99
		1	0	23.36	23.31	23.47	21.68	22.00	21.90	23.96	23.56	23.66	21.88	21.28	21.73
		1	1	23.47	23.48	23.33	22.65	23.18	22.95	24.90	24.63	24.74	22.58	22.28	22.63
	QPSK	1	49	23.39	23.42	23.42	22.74	23.09	22.79	24.84	24.55	24.42	22.63	22.43	22.39
		1	50	23.44	23.40	23.31	21.67	22.01	21.77	23.74	23.47	23.51	21.80	21.47	21.56
		25	12	23.35	23.32	23.41	22.68	23.09	22.90	24.72	24.56	24.55	22.43	22.24	22.47
		50	0	23.49	23.48	23.36	21.71	22.07	21.88	23.71	23.33	23.37	21.27	21.25	21.40
		1	0	23.36	23.41	23.48	20.85	21.13	21.07	23.20	22.64	23.20	21.01	20.50	20.87
		1	1	23.34	23.49	23.44	21.90	22.25	21.92	24.39	23.62	24.03	21.76	21.53	21.86
		1	49	23.50	23.31	23.48	21.71	22.24	22.00	24.38	23.80	23.82	21.81	21.45	21.66
		1	50	23.35	23.43	23.43	20.68	21.11	21.04	23.17	22.80	22.83	21.07	20.86	20.50
	16QAM	25	12	23.43	23.34	23.44	21.72	22.11	21.87	23.81	23.47	23.63	21.38	21.27	21.47
		50	0	23.18	23.33	23.45	20.71	22.07	20.92	22.80	22.34	22.46	20.45	20.34	20.42
		1	0	23.09	23.31	23.34	20.55	21.09	20.85	22.43	22.16	22.35	20.36	19.95	20.25
		1	1	23.06	23.37	23.33	20.63	21.11	20.77	22.83	22.12	22.56	20.23	20.19	20.29
		1	49	23.09	23.44	23.26	20.62	21.00	20.76	22.56	22.25	22.05	20.29	20.18	20.16
		1	50	23.06	23.36	23.21	20.58	20.95	20.72	22.61	22.13	22.04	20.38	19.89	20.22
		25	12	22.67	23.07	22.99	20.24	20.65	20.44	22.27	21.94	22.03	19.83	19.82	20.03
		50	0	22.60	23.01	22.94	20.18	20.57	20.37	22.14	21.87	21.79	19.85	19.72	19.96
	256QAM	1	0	20.72	21.14	20.94	18.23	18.56	18.37	20.60	19.87	20.25	18.19	17.87	18.15
		1	1	20.74	21.18	21.05	18.19	18.81	18.41	20.58	19.96	20.42	18.37	18.30	18.28
		1	49	20.74	21.07	20.89	18.20	18.56	18.30	20.66	19.93	20.30	18.07	18.21	18.25
		1	50	20.74	20.96	20.89	18.21	18.55	18.36	20.57	20.18	20.21	18.15	17.76	18.09
		25	12	20.63	21.01	20.94	18.20	18.59	18.38	20.30	20.00	19.97	17.84	17.72	18.03
		50	0	20.68	21.10	20.98	18.26	18.65	18.48	20.31	19.93	19.90	17.93	17.83	18.00

OUTPUT POWER FOR 5G NR n48 (40.0 MHz)

Bandwidth (MHz)	Modulation	RB Allocation	RB Offset	Conducted Average (dBm)											
				ANT 7			ANT 8			ANT 9			ANT 4		
				638000	641666	645333	638000	641666	645333	638000	641666	645333	638000	641666	645333
40.0	BPSK	1	0	23.39	23.32	23.45	22.35	22.54	22.62	24.39	23.94	24.24	22.17	21.93	22.12
		1	1	23.39	23.44	23.49	22.82	23.06	23.16	25.01	24.65	24.85	22.62	22.25	22.68
		1	104	23.40	23.42	23.38	22.95	23.19	22.97	24.87	24.83	24.56	22.68	22.46	22.59
		1	105	23.31	23.46	23.36	22.43	22.67	22.47	24.28	24.22	23.97	22.25	21.94	22.04
		50	25	23.36	23.48	23.42	22.61	23.03	22.94	24.70	24.50	24.49	22.31	22.19	22.63
		100	0	18.10	23.44	23.43	15.93	22.57	22.51	17.73	23.99	24.10	15.58	21.78	22.08
	QPSK	1	0	23.38	23.35	23.40	21.79	22.04	22.16	24.00	23.70	23.71	21.83	21.28	21.68
		1	1	23.48	23.42	23.34	22.79	23.05	23.14	25.07	24.55	24.61	22.51	22.32	22.70
		1	104	23.45	23.49	23.43	22.90	23.20	22.95	25.20	24.76	24.49	22.44	22.53	22.69
		1	105	23.39	23.45	23.36	21.88	22.10	21.93	24.02	23.54	23.57	21.63	21.46	21.68
		50	25	23.40	23.34	23.47	22.62	23.04	22.95	24.67	24.49	24.54	22.31	22.23	22.66
		100	0	18.06	23.49	23.33	15.90	22.08	22.00	17.70	23.54	23.61	15.54	21.11	21.63
	16QAM	1	0	23.31	23.36	23.39	20.93	21.15	21.36	23.20	22.69	23.06	20.89	20.47	20.72
		1	1	23.32	23.36	23.46	21.97	22.12	22.32	24.31	23.53	24.09	21.69	21.57	22.02
		1	104	23.35	23.42	23.43	21.97	22.24	22.02	24.24	23.89	23.85	21.84	21.53	21.76
		1	105	23.43	23.39	23.44	21.09	21.29	21.03	23.20	23.01	22.98	20.76	20.73	20.72
		50	25	23.36	23.38	23.35	21.67	22.05	21.98	23.75	23.53	23.60	21.37	21.21	21.62
		100	0	18.07	23.47	23.41	15.92	21.09	21.00	17.68	22.56	22.58	15.58	20.27	20.59
	64QAM	1	0	23.11	23.36	23.46	20.71	20.95	21.01	22.94	22.33	22.31	20.06	19.98	20.27
		1	1	23.09	23.32	23.37	20.67	21.03	21.01	22.66	21.95	22.24	20.20	19.82	20.33
		1	104	23.27	23.33	23.41	20.82	21.09	20.89	22.75	22.23	22.59	19.93	19.92	20.05
		1	105	23.24	23.44	23.39	20.81	20.96	20.89	22.70	22.82	22.17	20.40	20.12	20.29
		50	25	22.49	22.95	23.00	20.12	20.52	20.43	22.21	21.97	22.06	19.76	19.71	20.05
		100	0	18.06	23.02	23.03	15.88	20.58	20.49	17.70	22.07	22.20	15.51	19.71	20.15
	256QAM	1	0	20.64	21.09	21.11	18.22	18.57	18.67	20.86	20.18	20.40	18.16	17.89	18.19
		1	1	20.71	21.01	20.95	18.18	18.65	18.67	20.77	20.24	20.44	18.19	17.93	18.40
		1	104	20.69	21.06	20.97	18.43	18.63	18.49	20.76	20.42	20.29	18.21	18.29	18.06
		1	105	20.86	21.03	20.81	18.35	18.60	18.31	20.57	20.30	20.28	18.38	18.10	18.37
		50	25	20.60	21.02	21.04	18.22	18.60	18.54	20.24	20.09	20.17	17.86	17.73	18.19
		100	0	18.10	21.03	21.06	15.93	18.61	18.50	17.67	20.02	20.11	15.65	17.71	18.08

9. CONDUCTED TEST 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 middle channel in each band. The 99% and -26dB bandwidths was also measured and recorded.

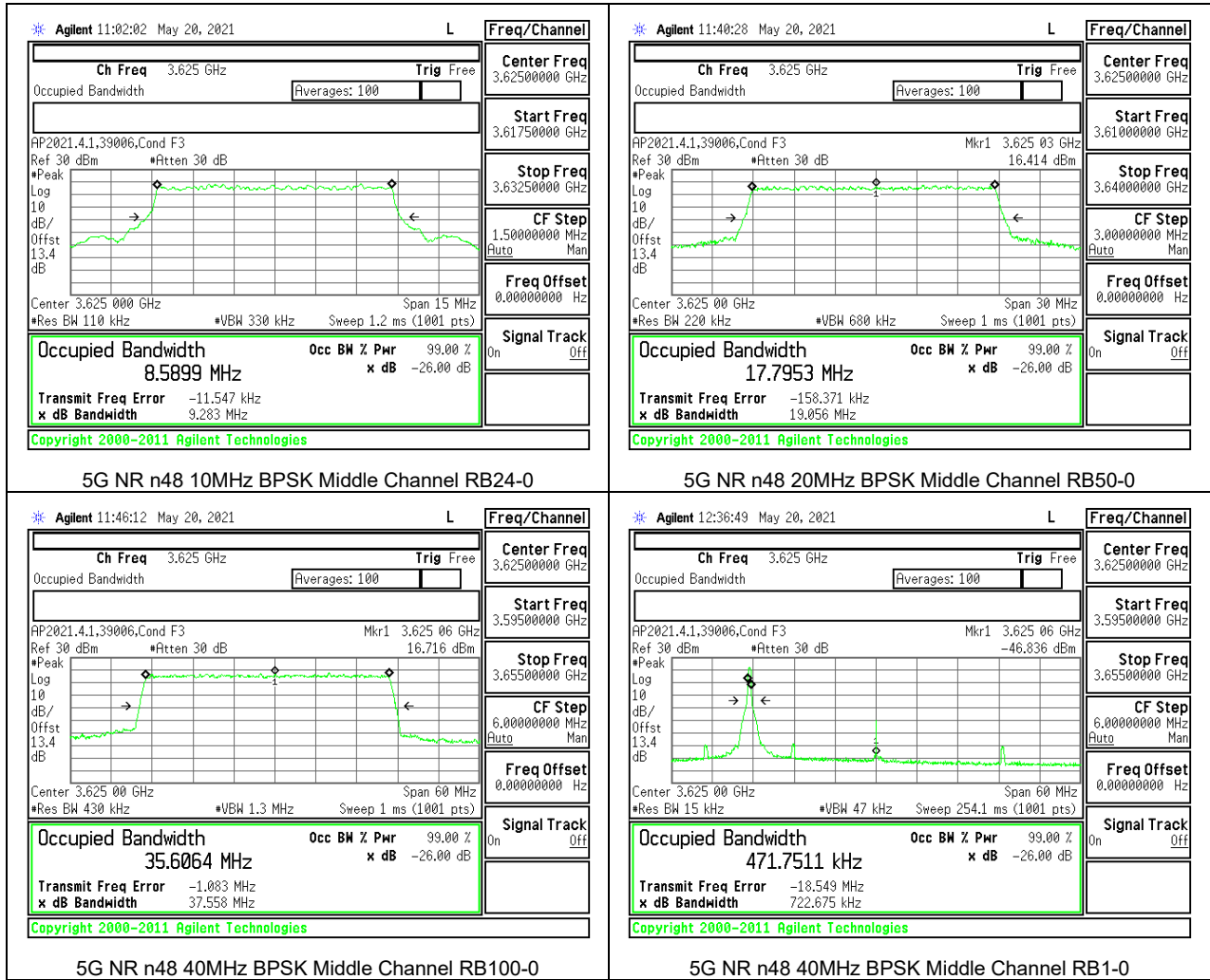
RESULTS

There is no limit required and power is the same for low, middle and high channel; therefore, only middle channel was tested. Worst-case plots (highest bandwidth) are reported only.

5G NR n48

Band	Mode	RB Allocation/RB Offset	f(MHz)	99% BW (MHz)	-26dB BW (MHz)
5G NR n48	10MHz, BPSK	24/0	3625.0	8.590	9.28
	10MHz, QPSK			8.605	9.37
	10MHz, 16QAM			8.567	9.33
	20MHz, BPSK	50/0		17.795	19.06
	20MHz, QPSK			17.860	19.19
	20MHz, 16QAM			17.825	18.96
	40MHz, BPSK	100/0		35.606	37.56
	40MHz, QPSK			35.659	37.35
	40MHz, 16QAM			35.610	37.52
	40MHz, BPSK			1/0	0.472

9.1.1. 5G NR n48



9.2. EMISSION MASK AND ADJACENT CHANNEL POWER

TEST PROCEDURE (5G NR n48)

(i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (i.e., 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(ii) When measuring unwanted emissions to demonstrate compliance with the limits, the CBSD and End User Device nominal carrier frequency/channel shall be adjusted as close to the licensee's authorized frequency block edges, both upper and lower, as the design permits.

(iii) Compliance with emission limits shall be demonstrated using either average (RMS)-detected or peak-detected power measurement techniques.

RESULTS

9.2.1. 5G NR n48 ADJACENT CHANNEL POWER

LIMITS

FCC: §96.41

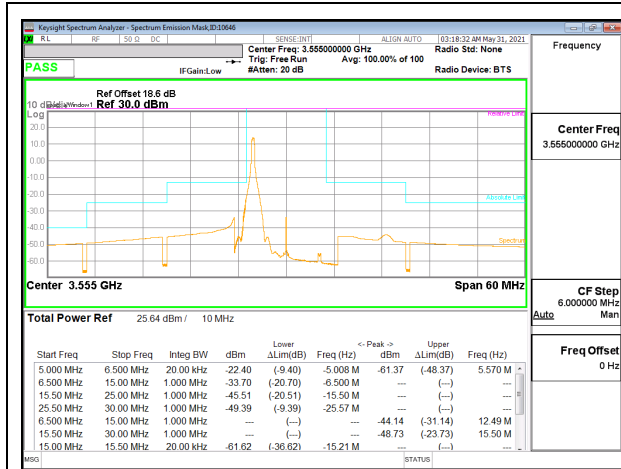
(e) 3.5 GHz Emissions and Interference Limits—

(1) General protection levels

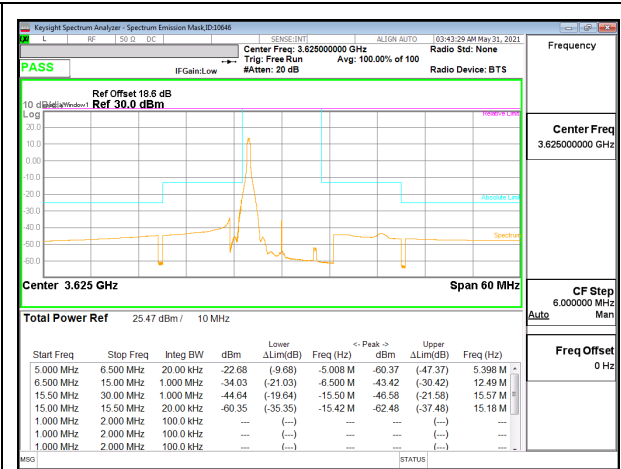
(ii) Except as otherwise specified in paragraph (e)(2) of this section, for channel and frequency assignments made by a CBSD to End User Devices, the conducted power of any End User Device emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0 to B megahertz (where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B megahertz below the lower CBSD-assigned channel edge. At all frequencies greater than B megahertz above the upper CBSD assigned channel edge and less than B megahertz below the lower CBSD-assigned channel edge, the conducted power of any End User Device emission shall not exceed -25 dBm/MHz. Notwithstanding the emission limits in this paragraph, the Adjacent Channel Leakage Ratio for End User Devices shall be at least 30 dB.

(2) Additional protection levels. Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed -25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed -40 dBm/MHz.

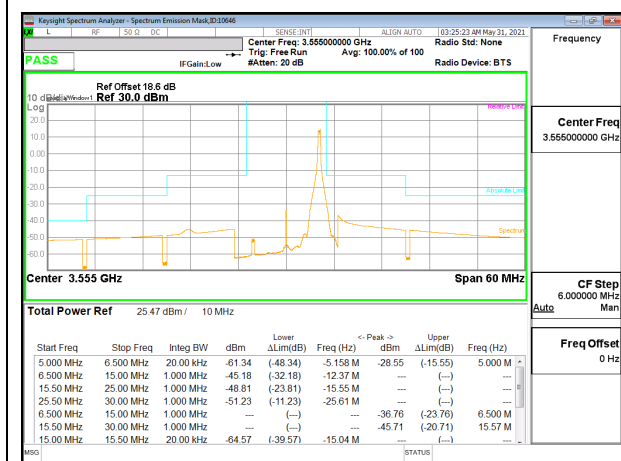
5G NR n48 EMISSION MASK



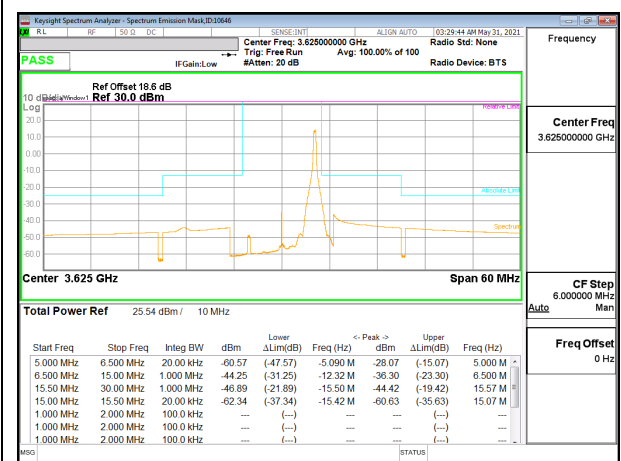
5G NR n48 10MHz BPSK Low Channel RB1-0



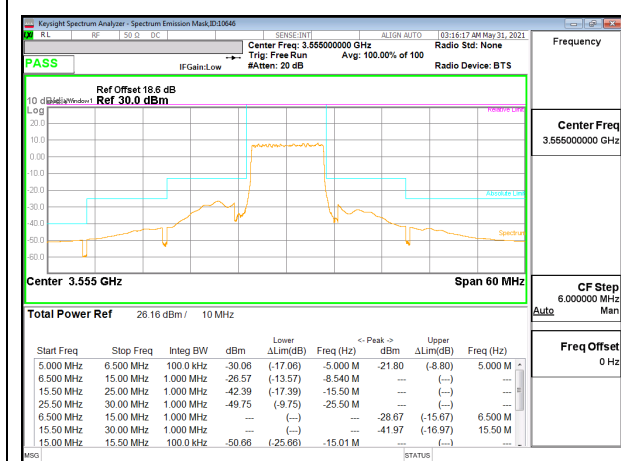
5G NR n48 10MHz BPSK Middle Channel RB1-0



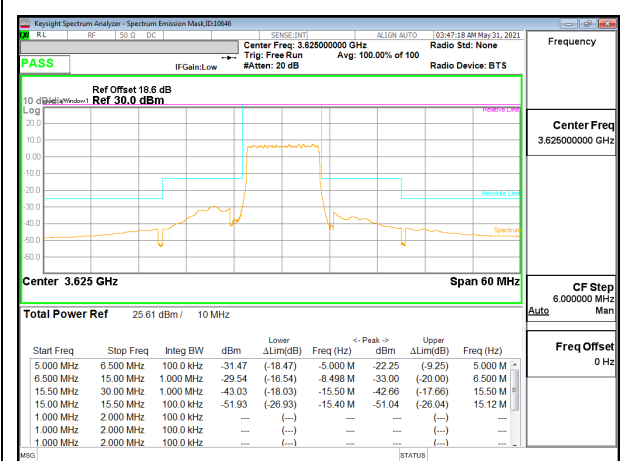
5G NR n48 10MHz BPSK Low Channel RB1-23



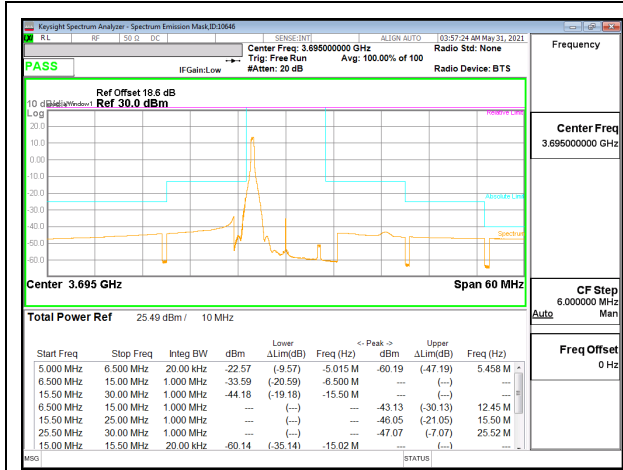
5G NR n48 10MHz BPSK Middle Channel RB1-23



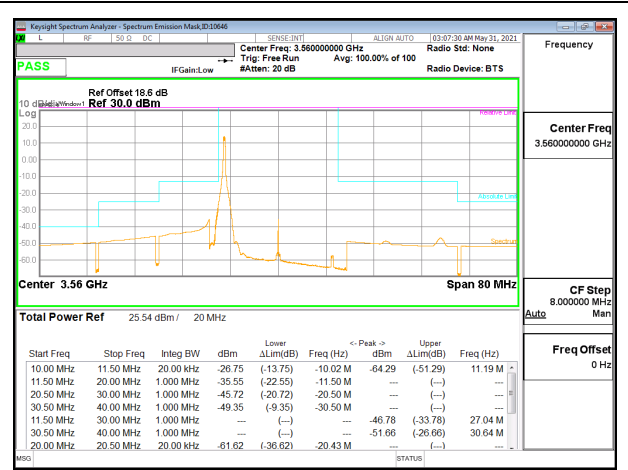
5G NR n48 10MHz BPSK Low Channel RB24-0



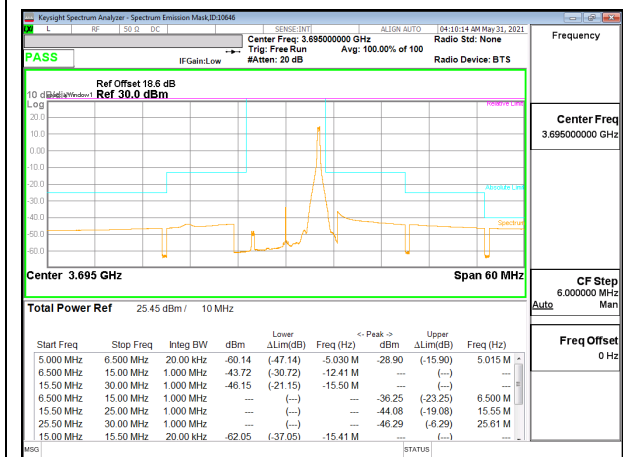
5G NR n48 10MHz BPSK Middle Channel RB24-0



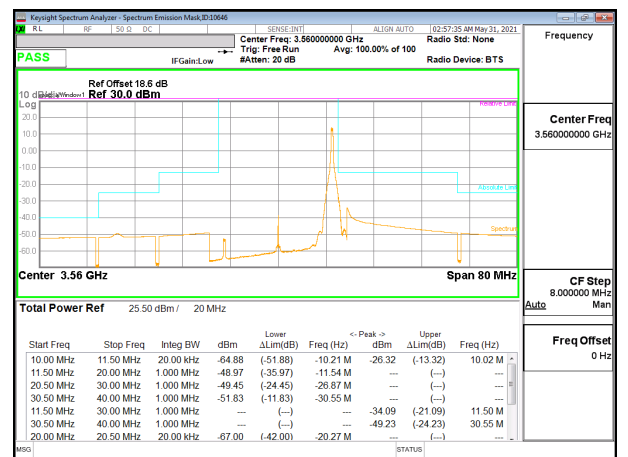
5G NR n48 10MHz BPSK High Channel RB1-0



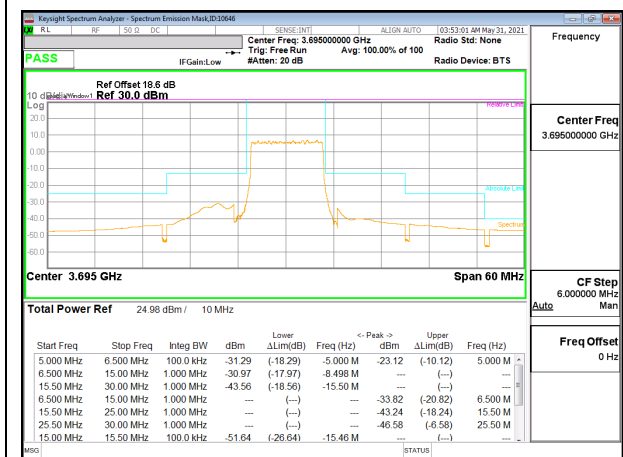
5G NR n48 20MHz BPSK Low Channel RB1-0



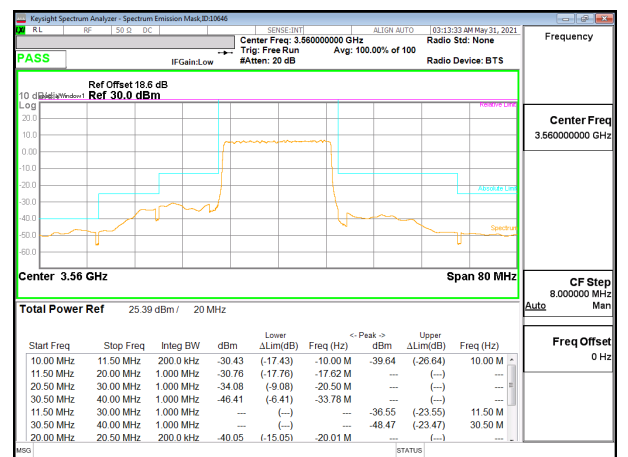
5G NR n48 10MHz BPSK High Channel RB1-23



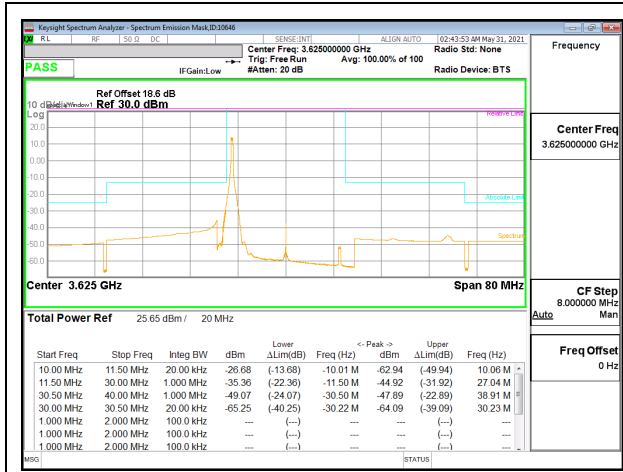
5G NR n48 20MHz BPSK Low Channel RB1-50



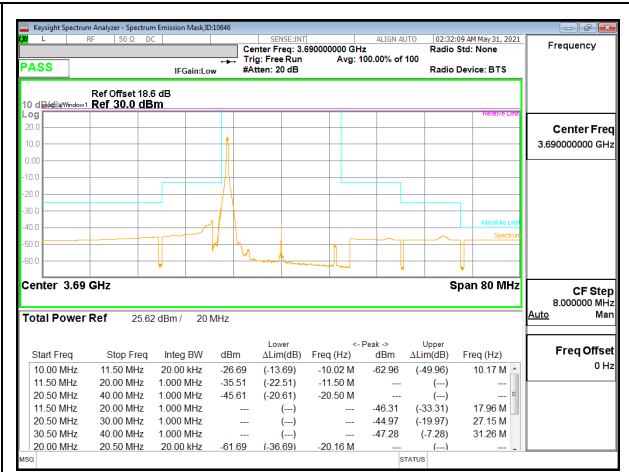
5G NR n48 10MHz BPSK High Channel RB24-0



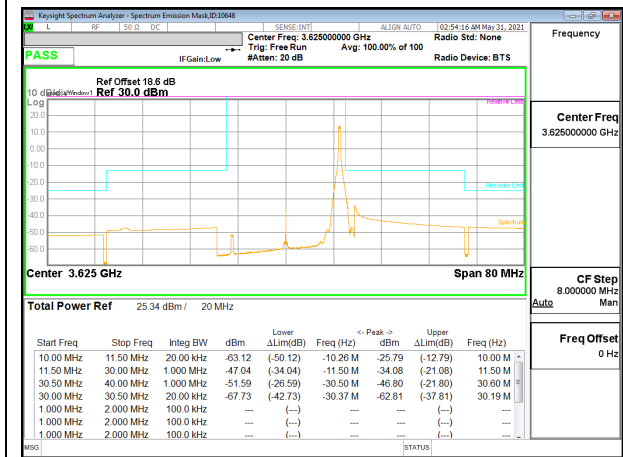
5G NR n48 20MHz BPSK Low Channel RB50-0



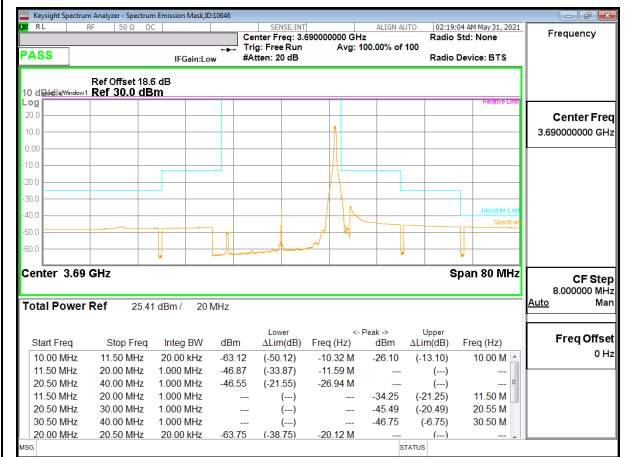
5G NR n48 20MHz BPSK Middle Channel RB1-0



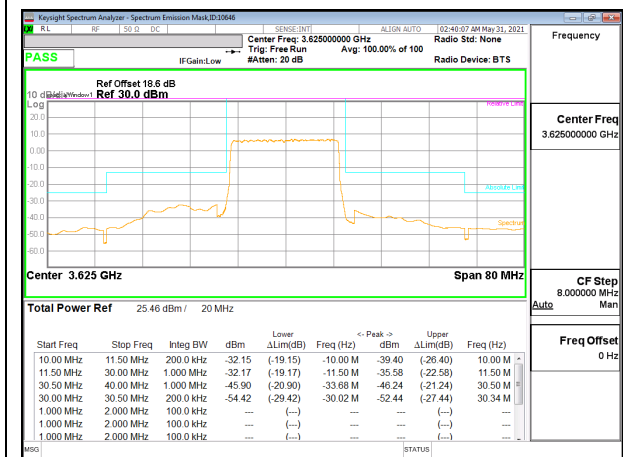
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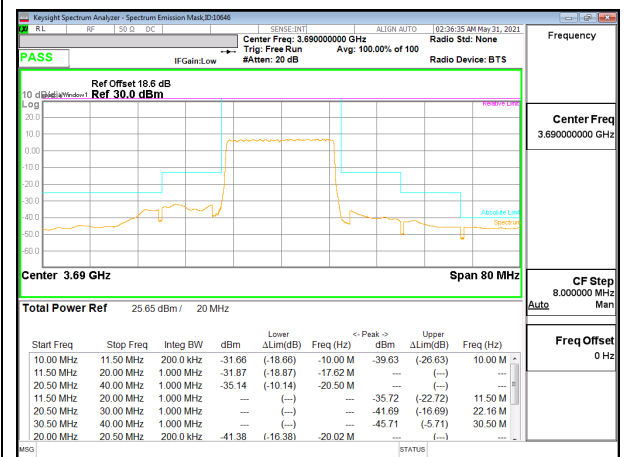
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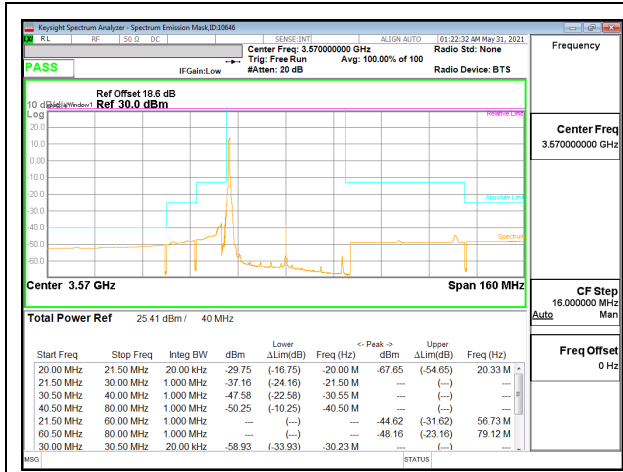
5G NR n48 20MHz BPSK High Channel RB1-50



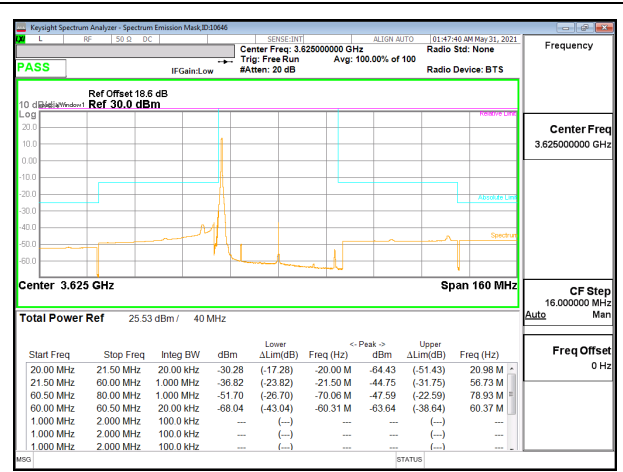
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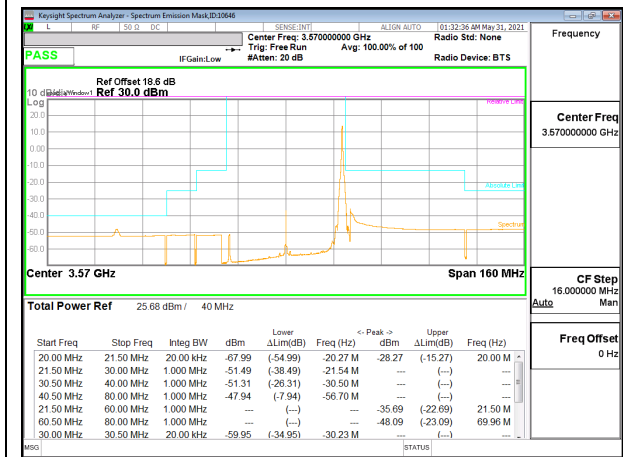
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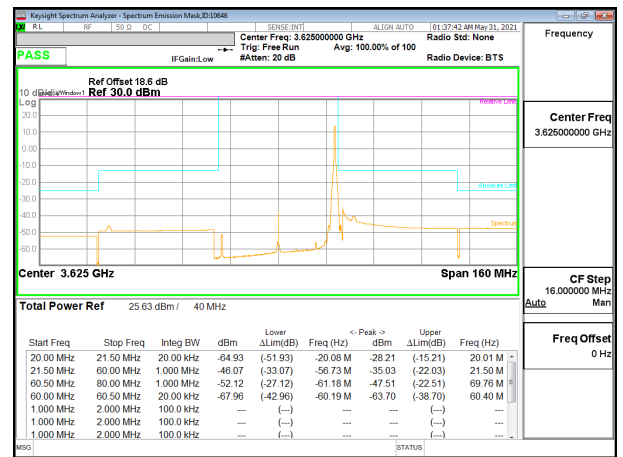
5G NR n48 40MHz BPSK Low Channel RB1-0



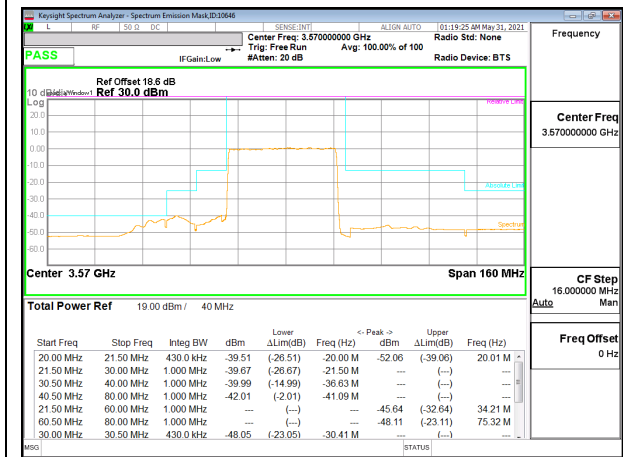
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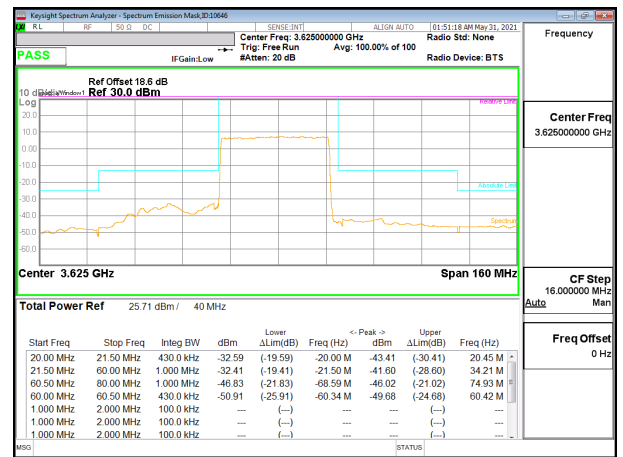
5G NR n48 40MHz BPSK Low Channel RB1-105



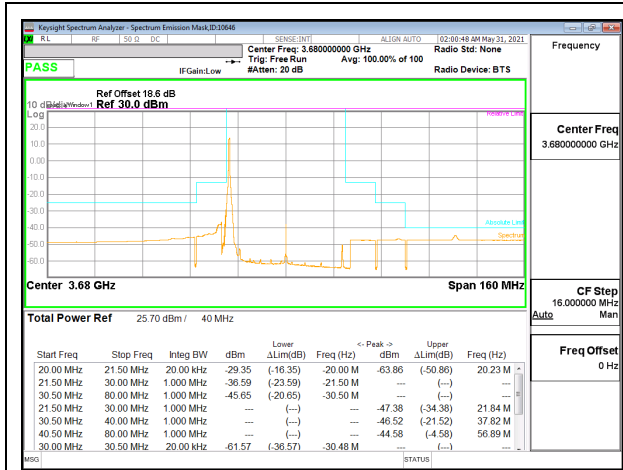
5G NR n48 40MHz BPSK Middle Channel RB1-105



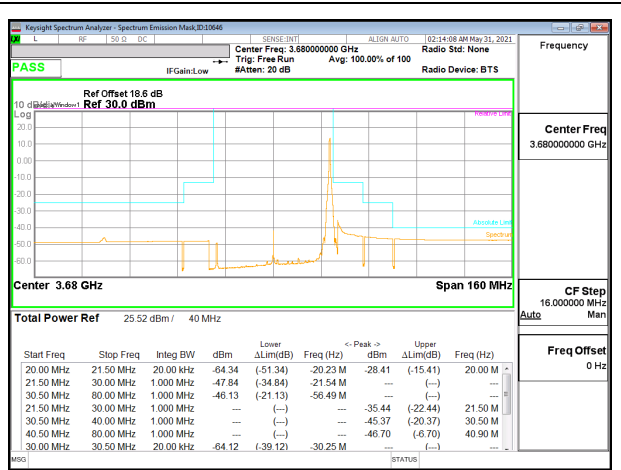
5G NR n48 40MHz BPSK Low Channel RB100-0



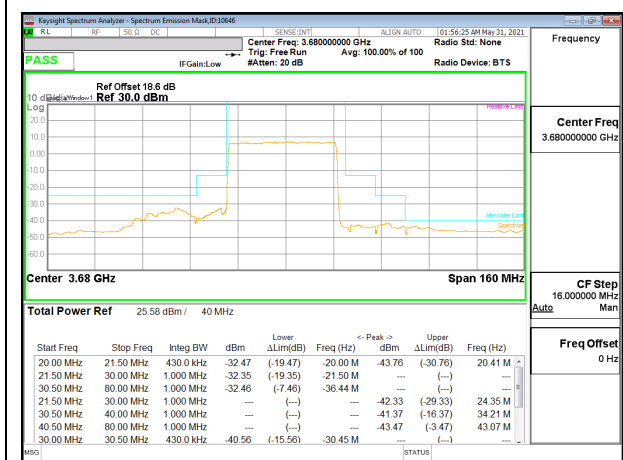
5G NR n48 40MHz BPSK Middle Channel RB100-0



5G NR n48 40MHz BPSK High Channel RB1-0



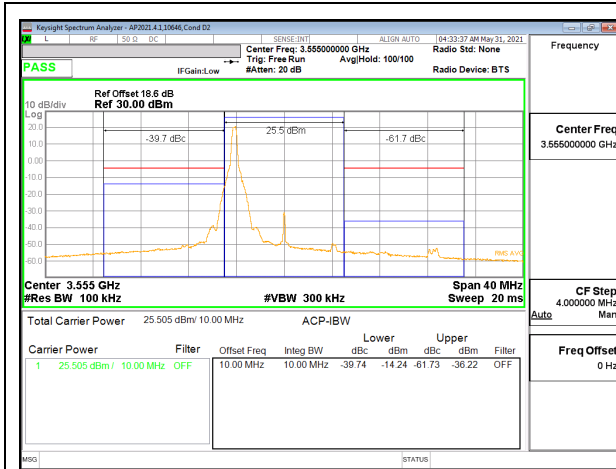
5G NR n48 40MHz BPSK High Channel RB1-105



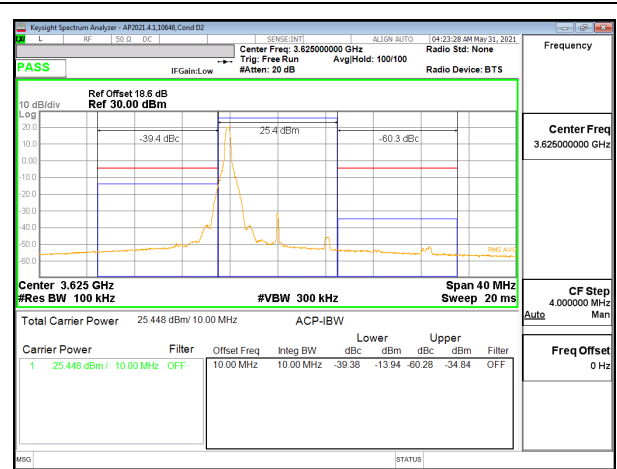
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Intentionally Blank

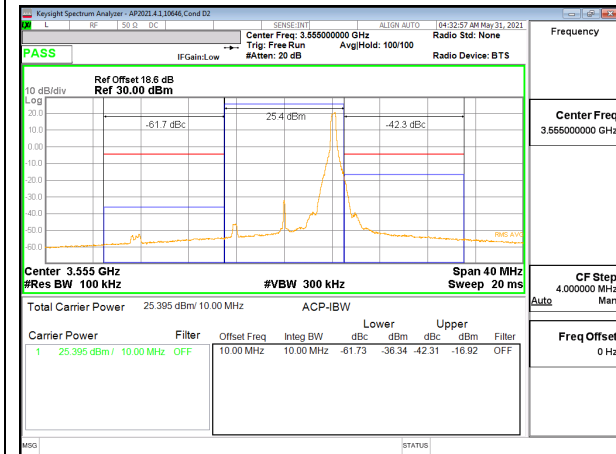
5G NR n48 ADJACENT CHANNEL POWER



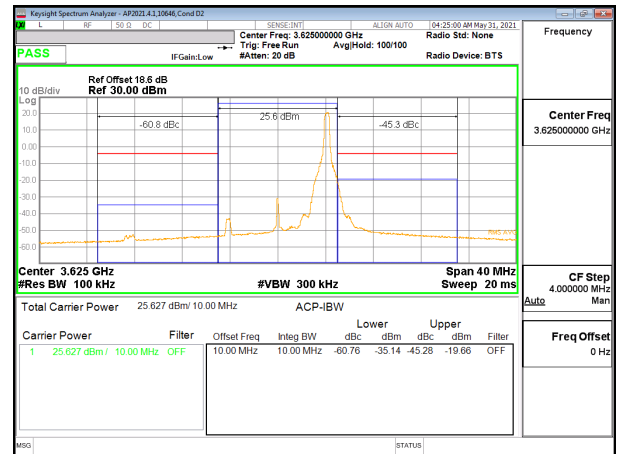
5G NR n48 10MHz BPSK Low Channel RB1-0



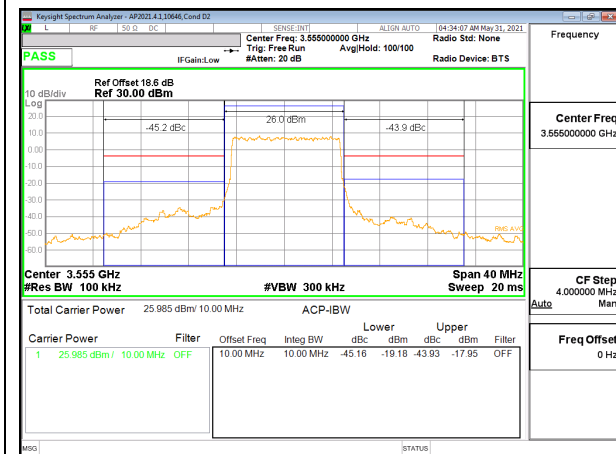
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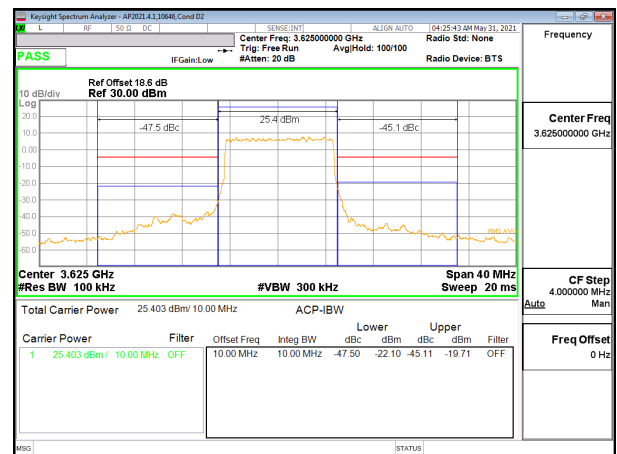
5G NR n48 10MHz BPSK Low Channel RB1-23



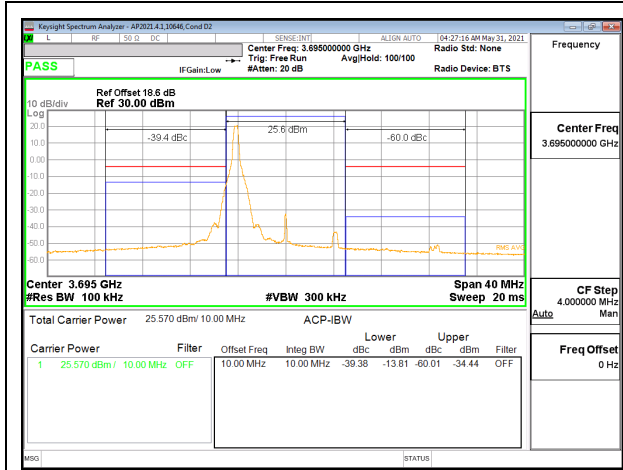
5G NR n48 10MHz BPSK Middle Channel RB1-23



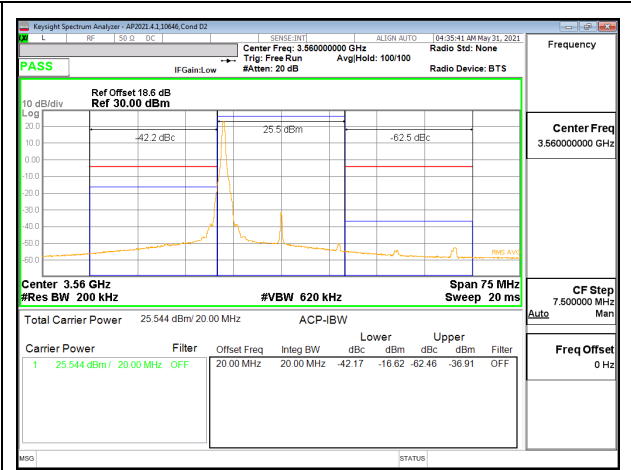
5G NR n48 10MHz BPSK Low Channel RB24-0



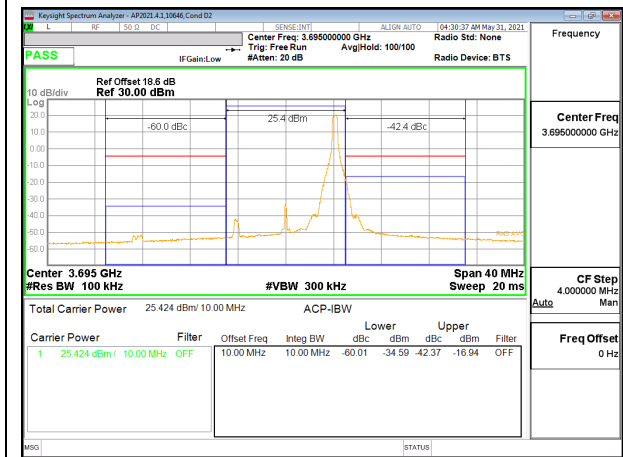
5G NR n48 10MHz BPSK Middle Channel RB24-0



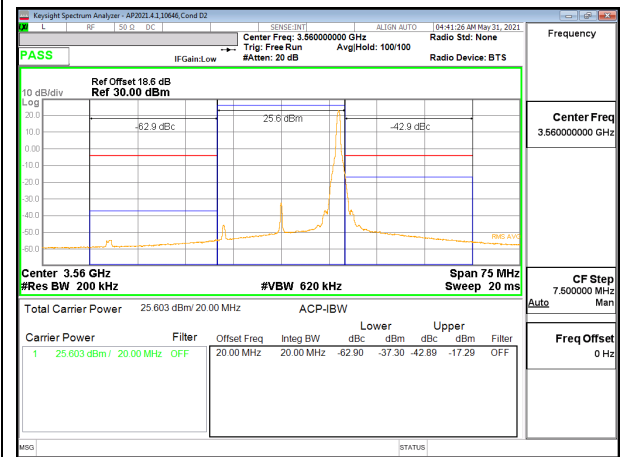
5G NR n48 10MHz BPSK High Channel RB1-0



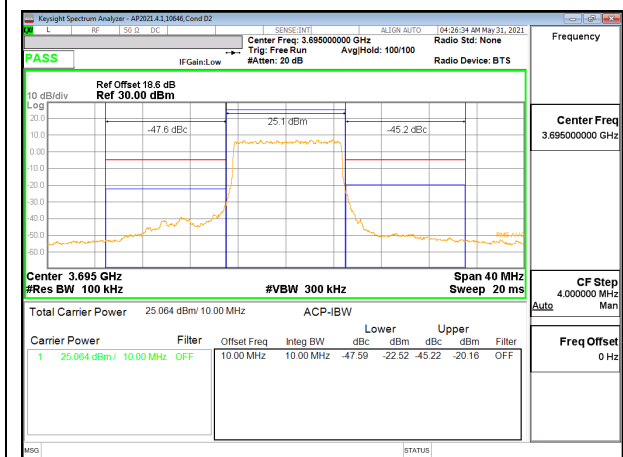
5G NR n48 20MHz BPSK Low Channel RB1-0



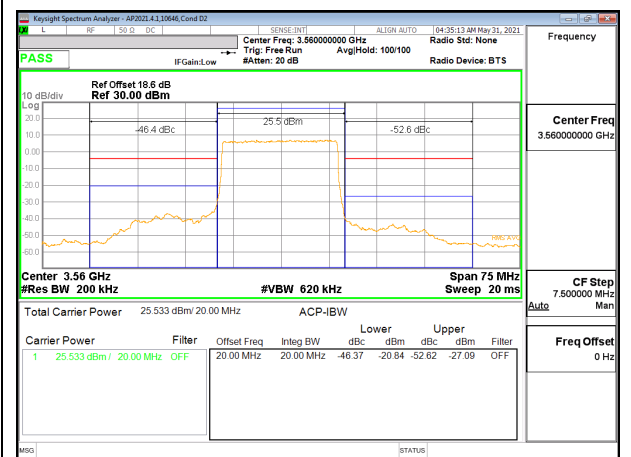
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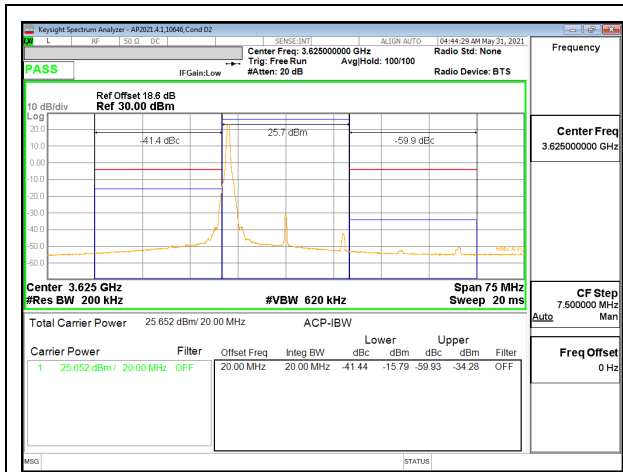
5G NR n48 20MHz BPSK Low Channel RB1-50



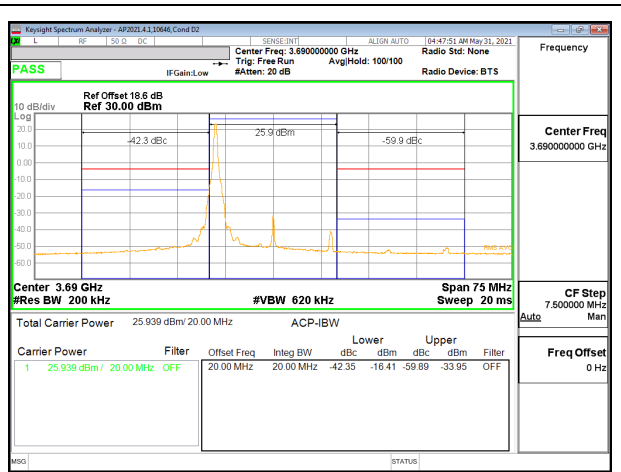
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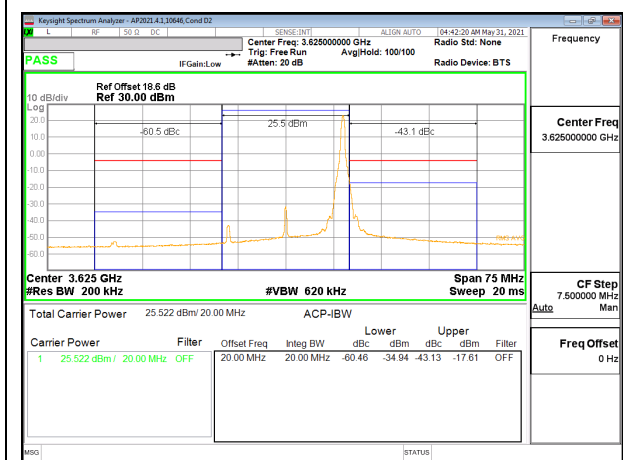
5G NR n48 20MHz BPSK Low Channel RB50-0



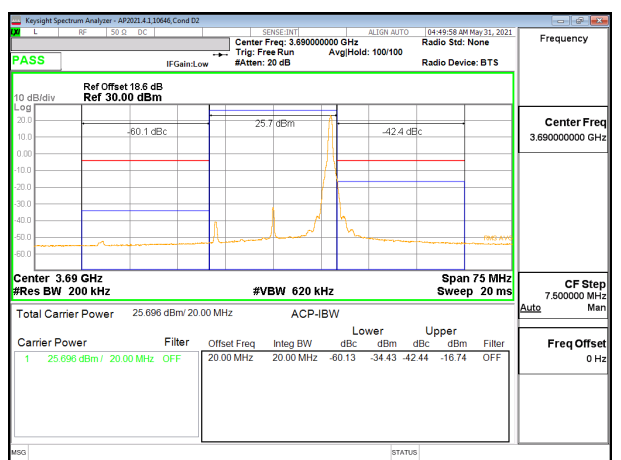
5G NR n48 20MHz BPSK Middle Channel RB1-0



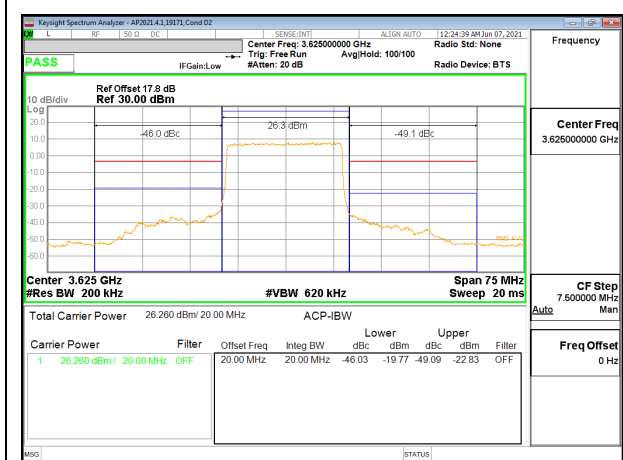
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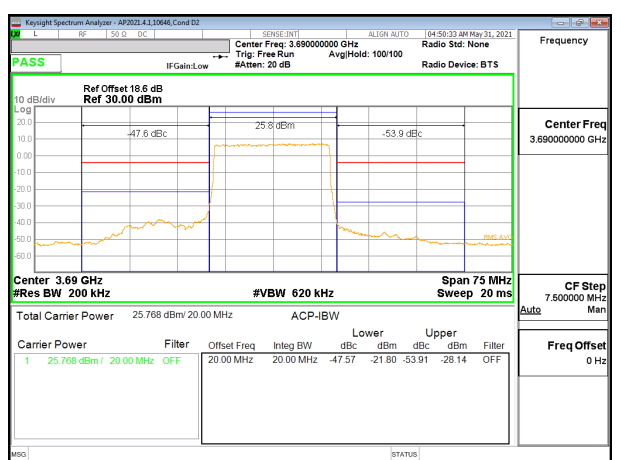
5G NR n48 20MHz BPSK Middle Channel RB1-50



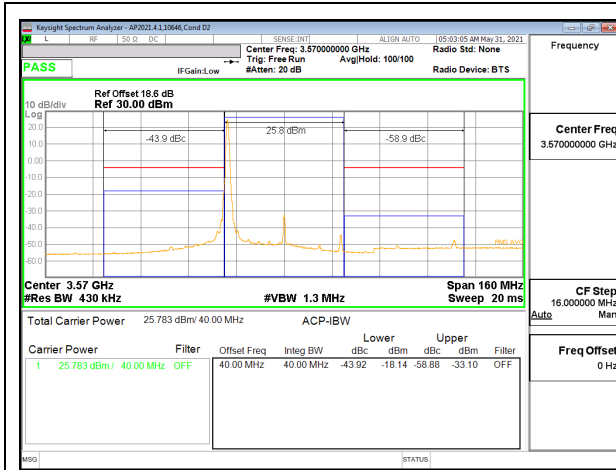
5G NR n48 20MHz BPSK High Channel RB1-50



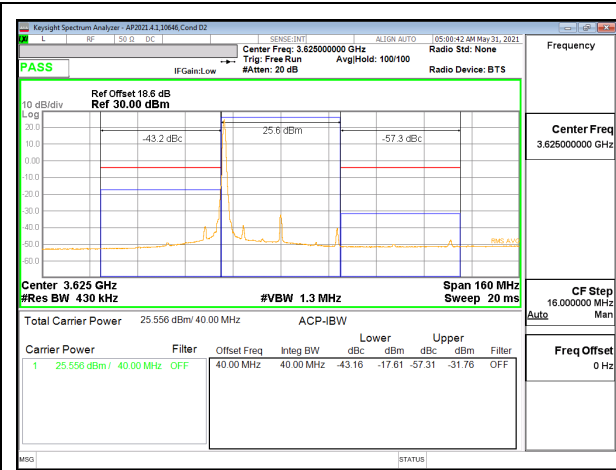
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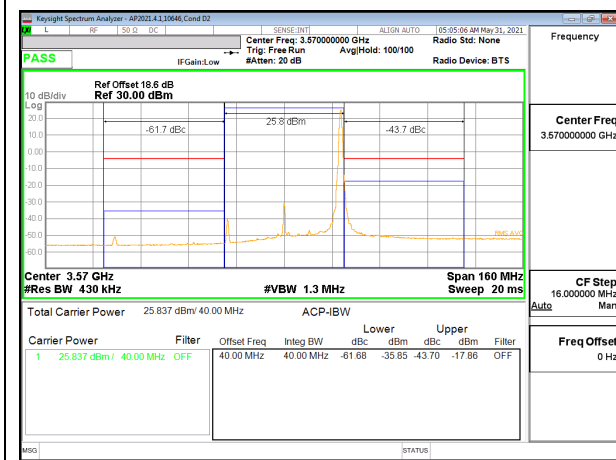
5G NR n48 20MHz BPSK High Channel RB50-0



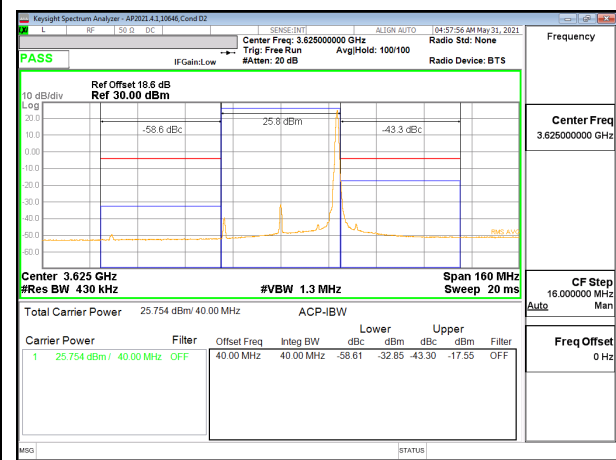
5G NR n48 40MHz BPSK Low Channel RB1-0



5G NR n48 40MHz BPSK Middle Channel RB1-0



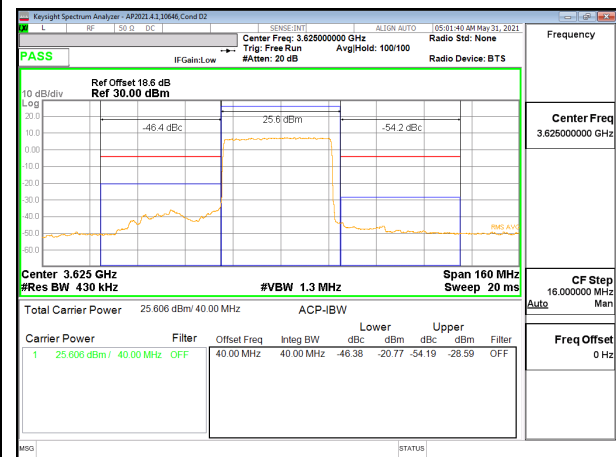
5G NR n48 40MHz BPSK Low Channel RB1-105



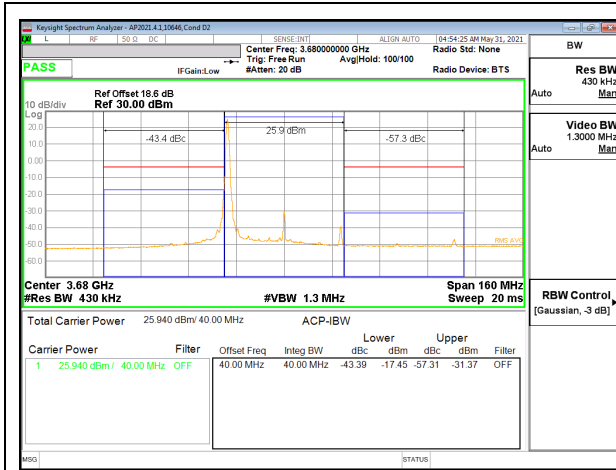
5G NR n48 40MHz BPSK Middle Channel RB1-105



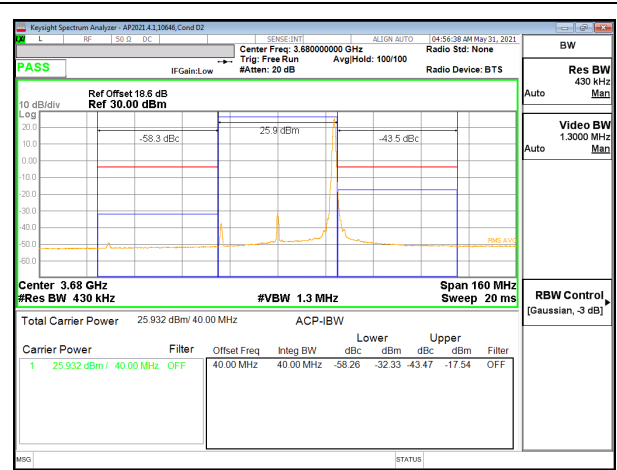
5G NR n48 40MHz BPSK Low Channel RB100-0



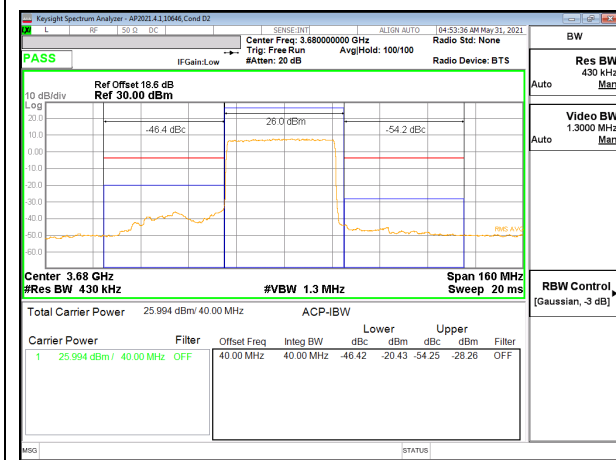
5G NR n48 40MHz BPSK Middle Channel RB100-0



5G NR n48 40MHz BPSK High Channel RB1-0



5G NR n48 40MHz BPSK High Channel RB1-105



5G NR n48 40MHz BPSK High Channel RB100-0

Intentionally Blank

9.3. OUT OF BAND EMISSIONS

TEST PROCEDURE

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-band Emissions, if any, up to 10th harmonic. Multiple sweeps were recorded in maximum hold mode using a peak detector to ensure that the worst-case emissions were caught.

For each out of band emissions measurement:

- Set display line at -40dBm according to the band Limit
- Set RBW & VBW to 100 kHz for the measurement below 1 GHz, and 1 MHz for the measurement above 1 GHz. (NOTE: Worst case set RBW/VBW to 1MHz/3MHz)

RESULTS

9.3.1. 5G NR n48

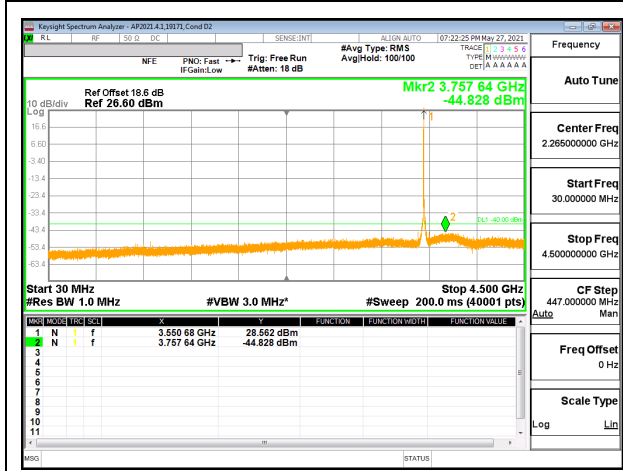
LIMITS

FCC: §96.41

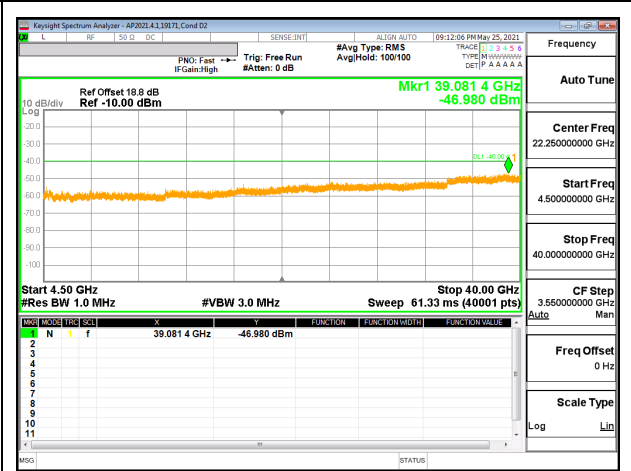
(e) 3.5 GHz Emissions and Interference Limits—

(2) Additional protection levels. Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed -25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed -40dBm/MHz.

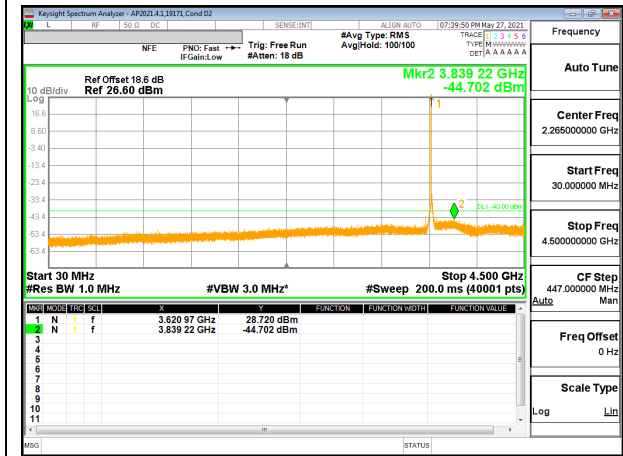
5G NR n48



5G NR n48 10MHz BPSK Low Channel RB1-0 (30M to 4.5G)



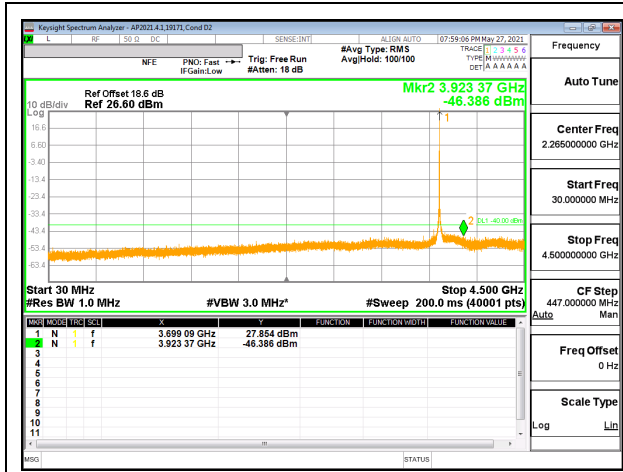
5G NR n48 10MHz BPSK Low Channel RB1-0 (4.5G to 40G)



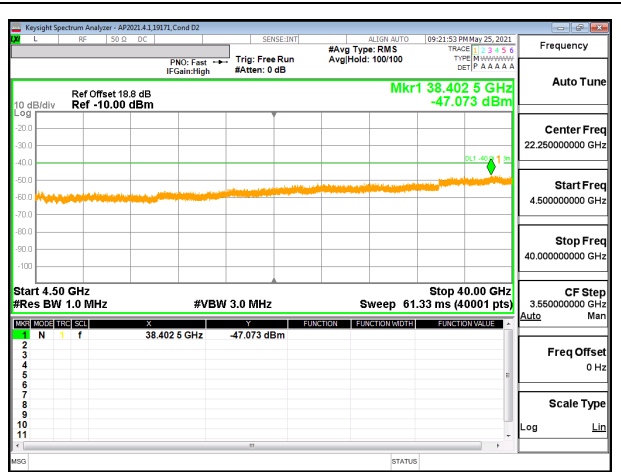
5G NR n48 10MHz BPSK Mid Channel RB1-1 (30M to 4.5G)



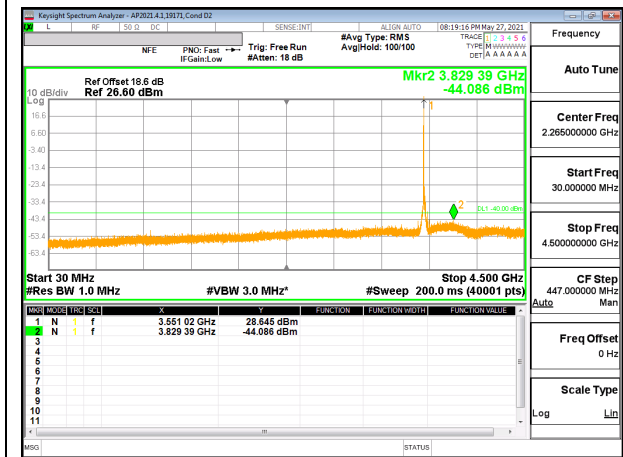
5G NR n48 10MHz BPSK Mid Channel RB1-1 (4.5GHz to 40G)



5G NR n48 10MHz BPSK High Channel RB1-23 (30M to 4.5G)



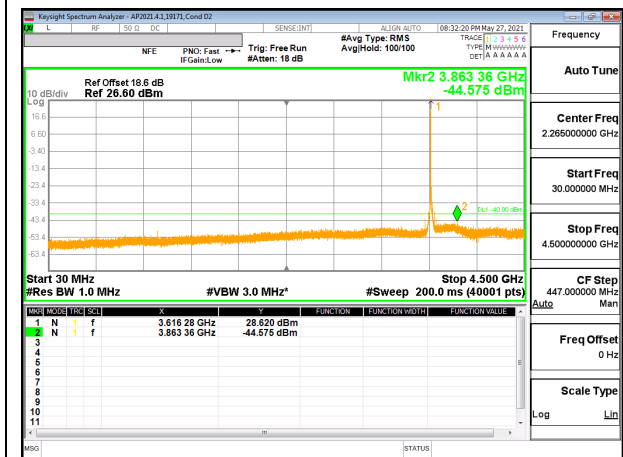
5G NR n48 10MHz BPSK High Channel RB1-23 (4.5G to 40G)



5G NR n48 20MHz BPSK Low Channel RB1-0 (30M to 4.5G)



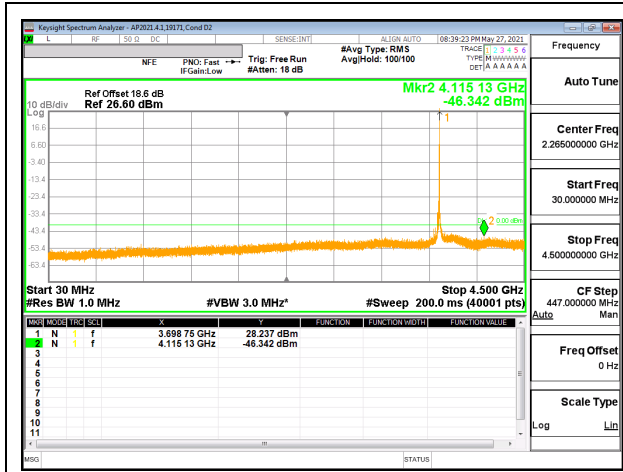
5G NR n48 20MHz BPSK Low Channel RB1-0 (4.5G to 40G)



5G NR n48 20MHz BPSK Mid Channel RB1-1 (30M to 4.5G)



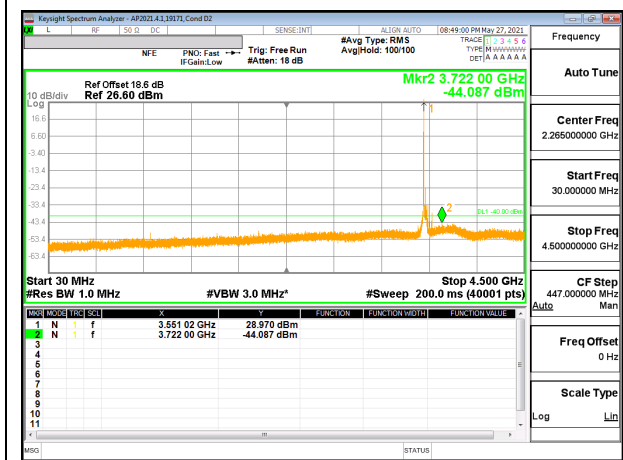
5G NR n48 20MHz BPSK Mid Channel RB1-1 (4.5G to 40G)



5G NR n48 20MHz BPSK High Channel RB1-50 (30M to 4.5G)



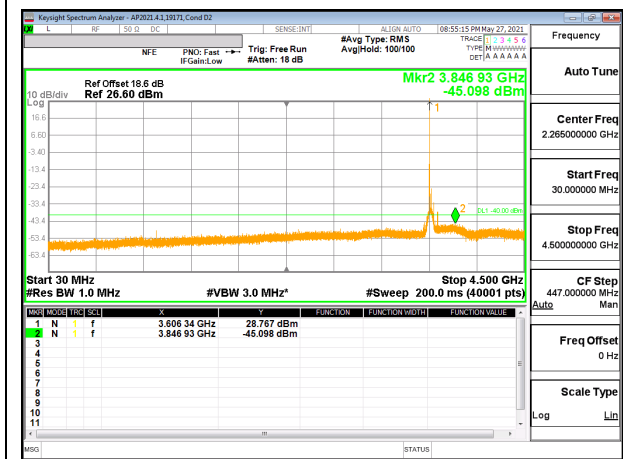
5G NR n48 20MHz BPSK High Channel RB1-50 (4.5G to 40G)



5G NR n48 40MHz BPSK Low Channel RB1-0 (30M to 4.5G)



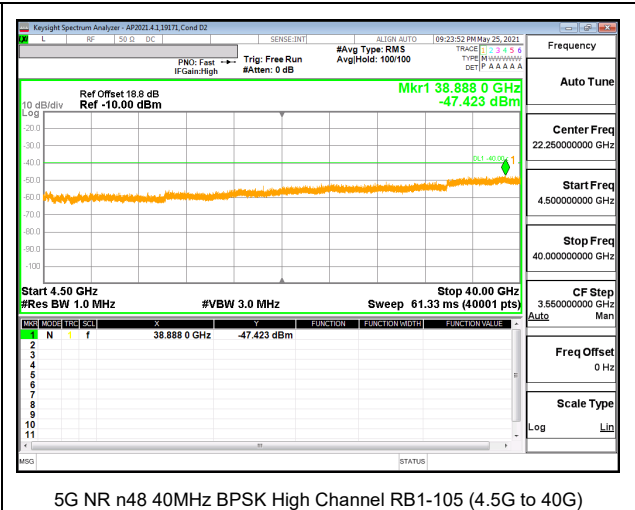
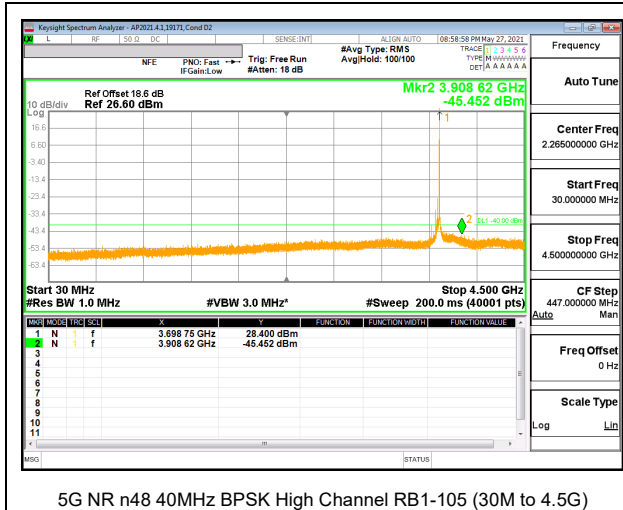
5G NR n48 40MHz BPSK Low Channel RB1-0 (4.5G to 40G)



5G NR n48 40MHz BPSK Mid Channel RB1-1 (30M to 4.5G)



5G NR n48 40MHz BPSK Mid Channel RB1-1 (4.5G to 40G)



9.4. FREQUENCY STABILITY

TEST PROCEDURE

Use CMW 500 with Frequency Error measurement capability.

- Temp. = -30°C to +50°C
- Voltage = (85% - 115%)
 Low voltage, 3.23VDC, Normal, 3.8VDC and High voltage, 4.37VDC.
 End Voltage, 3.2VDC.

Frequency Stability vs Temperature:

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

Frequency Stability vs Voltage:

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

RESULTS

9.4.1. 5G NR n48

Test Engineer ID:	10646	Test Date:	5/16/2021
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5G NR n48 QPSK (40MHz BANDWIDTH)

Limit		3550	3700	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	3551.0550	3696.7908		
Extreme (50C)		3551.0549	3696.7908	-22.2	-0.006
Extreme (40C)		3551.0549	3696.7908	-16.6	-0.005
Extreme (30C)		3551.0549	3696.7908	-30.5	-0.008
Extreme (10C)		3551.0549	3696.7908	-26.8	-0.007
Extreme (0C)		3551.0549	3696.7908	-27.7	-0.008
Extreme (-10C)		3551.0549	3696.7908	-32.6	-0.009
Extreme (-20C)		3551.0549	3696.7908	-22.4	-0.006
Extreme (-30C)		3551.0549	3696.7908	-30.3	-0.008
20C	15%	3551.0549	3696.7908	-22.9	-0.006
	-15%	3551.0549	3696.7908	-21.8	-0.006
	End Point	3551.0549	3696.7908	-25.7	-0.007

9.5. PEAK-TO-AVERAGE POWER RATIO

LIMIT

In addition, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

RESULT

Antenna 1 was used to measure as the worst case; full resource block (FRB) for each bandwidth was used to measure as the worst case. The results from all CCDF measurements are passed with 13dB peak-to-average power ratio criteria.

9.5.1. 5G NR n48

Test Engineer ID:	10646	Test Date:	3/16/2021
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Band	Bandwidth (MHz)	Frequency (MHz)	RB Allocation	RB OffSet	Modulation	Conducted Power (dBm)		Peak-to-Average Power Ratio (dB)
						Peak	Average	
LTE 5G NR n48	10MHz		24	0	BPSK	31.02	26.37	4.65
					16QAM	31.78	24.87	6.91
	20MHz		50	0	BPSK	30.92	26.34	4.58
					16QAM	31.83	24.82	7.01
	40MHz		100	0	BPSK	30.79	26.39	4.40
					16QAM	31.59	24.89	6.70
*Duty Cycle Correction Factor (dB) =			0.00					
Peak-to-Average Power Ratio= Peak Reading - Average Reading - Duty Cycle Correction Factor								

10. RADIATED TEST RESULTS

Radiated measurement using the Field Strength Method

Using the test configuration shown in Figure 6 below, We measure the radiated emissions directly from the EUT and convert the measured field strength or received power to ERP or EIRP, as required, for comparison to the applicable limits. As stated in 5.5.1 of ANSI C63.26-2015, the field strength measurement method using a test site validated to the requirements of ANSI C63.4 is an alternative to the substitution measurement method.

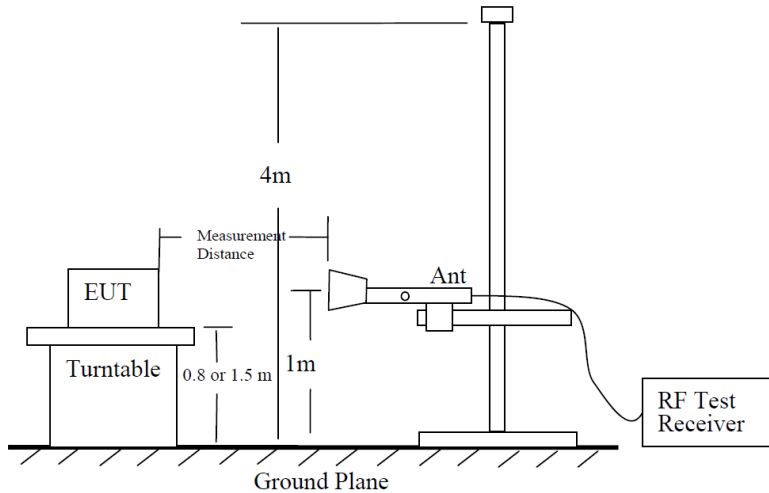


Figure 6—Test site-up for radiated ERP and/or EIRP measurements

Radiated Power Measurement Calculation According to ANSI C63.26-2015

- a) $E \text{ (dB}\mu\text{V/m)} = \text{Measured amplitude level (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$.
- b) $E \text{ (dB}\mu\text{V/m)} = \text{Measured amplitude level (dBm)} + 107 + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$.
- c) $E \text{ (dB}\mu\text{V/m)} = \text{EIRP (dBm)} - 20\log(D) + 104.8$; where D is the measurement distance (in the far field region) in m.
- d) $\text{EIRP (dBm)} = E \text{ (dB}\mu\text{V/m)} + 20\log(D) - 104.8$; where D is the measurement distance (in the far field region) in m.

So, from d)

The measuring distance is usually at 3m, then $20 \cdot \log(3) = 9.5424$

Then, $\text{EIRP (dBm)} = E \text{ (dB}\mu\text{V/m)} + 9.5424 - 104.8 = E \text{ (dB}\mu\text{V/m)} - 95.2576$

Note that: we do confidence check to our chambers every day to see if any degradation from expected/normal reading reference data. Also we do ambient check to all our chambers every month.

TEST PROCEDURE

KDB 971168 D01 v03r01/D02 v02/r01

All tests above 1GHz were done with a Resolution Bandwidth of 1MHz, and a Video Bandwidth of 3MHz.

LIMITS

FCC: §96.41

(e) 3.5 GHz Emissions and Interference Limits—

(2) Additional protection levels. Notwithstanding paragraph (d)(1) of this section, the conducted power of any emissions below 3530 MHz or above 3720 MHz shall not exceed -40dBm/MHz.

RESULTS

10.1. FIELD STRENGTH OF SPURIOUS RADIATION, ANT 4

BPSK 5G NR n48 (40.0MHZ BANDWIDTH)

Project #:	13571607
Date:	4/29/2021
Test Engineer:	30606
Configuration:	EUT only
Mode	n48 BPSK 40MHz
Chamber #:	Chamber A

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T348 (dB/m)	Amp/Cbl (dB)	T1792 3400-3800MHz BRF	EIRP CF	Corrected Reading (dBm)	Harmonics limit	Margin (dB)	Polarity
Low Channel, 3570MHz										
7.16878	28.59	RMS	36	-22.7	.5	-95.2	-52.81	-40	-12.81	H
7.17327	29.06	RMS	36	-22.8	.6	-95.2	-52.34	-40	-12.34	V
10.70878	26.05	RMS	37.8	-19.7	.5	-95.2	-50.55	-40	-10.55	V
10.73966	27.6	RMS	37.8	-19.6	.6	-95.2	-48.8	-40	-8.8	H
14.27855	26.34	RMS	39.4	-18.5	.7	-95.2	-47.26	-40	-7.26	H
14.28492	26.57	RMS	39.4	-18.5	.7	-95.2	-47.03	-40	-7.03	V
Mid Channel, 3625MHz										
7.22848	29.48	RMS	36	-23	.5	-95.2	-52.22	-40	-12.22	H
7.28376	28.69	RMS	36	-22.6	.5	-95.2	-52.61	-40	-12.61	V
10.86599	26.67	RMS	37.8	-19.3	.5	-95.2	-49.53	-40	-9.53	V
10.87298	26.08	RMS	37.7	-19.2	.5	-95.2	-50.12	-40	-10.12	H
14.44289	26.16	RMS	39.7	-18.1	.8	-95.2	-46.64	-40	-6.64	V
14.54335	27.59	RMS	39.9	-18.3	.8	-95.2	-45.21	-40	-5.21	H
High Channel, 3680MHz										
7.34869	28.69	RMS	36.1	-22.6	.6	-95.2	-52.41	-40	-12.41	H
7.40435	28.76	RMS	36.2	-22.9	.6	-95.2	-52.54	-40	-12.54	V
11.03762	26.23	RMS	37.8	-19	.6	-95.2	-49.57	-40	-9.57	H
11.04647	26.45	RMS	37.8	-18.8	.6	-95.2	-49.15	-40	-9.15	V
14.69603	26.65	RMS	40	-18.2	.9	-95.2	-45.85	-40	-5.85	H
14.73471	25.61	RMS	40	-18.1	.8	-95.2	-46.89	-40	-6.89	V

10.2. FIELD STRENGTH OF SPURIOUS RADIATION, ANT 7

BPSK 5G NR n48 (40.0MHZ BANDWIDTH)

Project #:	13571607
Date:	4/31/2021
Test Engineer:	50822
Configuration:	EUT only
Mode	n48 BPSK 40MHz
Chamber #:	Chamber B

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T348 (dB/m)	Amp/Cbl (dB)	T1792 3400-3800MHz BRF	EIRP CF	Corrected Reading (dBm)	Harmonics limit	Margin (dB)	Polarity
Low Channel, 3570MHz										
10.71443	19.01	RMS	37.8	-19.7	.5	-95.2	-57.59	-40	-17.59	H
14.28373	19.68	RMS	39.4	-18.5	.7	-95.2	-53.92	-40	-13.92	H
7.16024	21.47	RMS	36	-22.8	.5	-95.2	-60.03	-40	-20.03	V
10.70099	18.29	RMS	37.8	-19.7	.5	-95.2	-58.31	-40	-18.31	V
14.31373	19.33	RMS	39.4	-18.4	.7	-95.2	-54.17	-40	-14.17	V
7.1568	21.36	RMS	36.1	-22.8	.5	-95.2	-60.04	-40	-20.04	H
Mid Channel, 3625MHz										
7.22549	21.52	RMS	36	-22.9	.5	-95.2	-60.08	-40	-20.08	H
10.88944	18.43	RMS	37.8	-19.2	.6	-95.2	-57.57	-40	-17.57	H
14.55772	19.76	RMS	39.9	-18.3	.8	-95.2	-53.04	-40	-13.04	H
7.24314	20.56	RMS	36	-23.2	.5	-95.2	-61.34	-40	-21.34	V
10.8725	18.56	RMS	37.7	-19.2	.5	-95.2	-57.64	-40	-17.64	V
14.59393	19.38	RMS	40	-18.1	.9	-95.2	-53.02	-40	-13.02	V
High Channel, 3680MHz										
7.21539	28.95	RMS	37.2	-20.8	.6	-95.2	-49.25	-40	-9.25	H
7.29535	29.34	RMS	37.1	-20.7	.6	-95.2	-48.86	-40	-8.86	V
9.99507	26.37	RMS	38.3	-17.3	.7	-95.2	-47.13	-40	-7.13	V
10.1188	27.96	RMS	38.4	-17.6	.6	-95.2	-45.84	-40	-5.84	H
13.23675	27.43	RMS	40	-18.1	.6	-95.2	-45.27	-40	-5.27	H
13.40123	26.74	RMS	39.8	-18.8	.8	-95.2	-46.66	-40	-6.66	V

10.3. FIELD STRENGTH OF SPURIOUS RADIATION, ANT 8

BPSK 5G NR n48 (40.0MHZ BANDWIDTH)

Project #:	13571607
Date:	4/30/2021
Test Engineer:	30606
Configuration:	EUT only
Mode	n48 BPSK 40MHz
Chamber #:	Chamber A

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T348 (dB/m)	Amp/Cbl (dB)	T1792 3400-3800MHz BRF	EIRP CF	Corrected Reading (dBm)	Harmonics limit	Margin (dB)	Polarity
Low Channel, 3570MHz										
7.14329	21.48	RMS	36.1	-23	.5	-95.2	-60.12	-40	-20.12	H
10.76516	18.53	RMS	37.8	-19.2	.6	-95.2	-57.47	-40	-17.47	H
14.29594	19.2	RMS	39.3	-18.6	.7	-95.2	-54.6	-40	-14.6	H
7.15033	22	RMS	36	-22.9	.5	-95.2	-59.6	-40	-19.6	V
10.76263	18.75	RMS	37.8	-19.2	.6	-95.2	-57.25	-40	-17.25	V
14.33162	19.48	RMS	39.5	-18.4	.8	-95.2	-53.82	-40	-13.82	V
Mid Channel, 3625MHz										
7.32393	21.43	RMS	36.1	-22.5	.5	-95.2	-59.67	-40	-19.67	V
7.3293	21.94	RMS	36.1	-22.5	.5	-95.2	-59.16	-40	-19.16	H
9.84743	19.65	RMS	37.2	-20.7	.6	-95.2	-58.45	-40	-18.45	H
10.00266	19.36	RMS	37.3	-19.9	.7	-95.2	-57.74	-40	-17.74	V
13.64049	19.45	RMS	38.8	-19	.8	-95.2	-55.15	-40	-15.15	V
13.64261	19.19	RMS	38.8	-19	.8	-95.2	-55.41	-40	-15.41	H
High Channel, 3680MHz										
7.33553	21.48	RMS	36.1	-22.5	.5	-95.2	-59.62	-40	-19.62	V
7.33761	21.62	RMS	36.1	-22.5	.5	-95.2	-59.48	-40	-19.48	H
9.93137	19.56	RMS	37.3	-19.9	.6	-95.2	-57.64	-40	-17.64	V
9.96966	19.39	RMS	37.3	-20.1	.7	-95.2	-57.91	-40	-17.91	H
13.61482	19.31	RMS	38.7	-19	.7	-95.2	-55.49	-40	-15.49	H
13.62443	18.98	RMS	38.8	-18.9	.7	-95.2	-55.62	-40	-15.62	V

10.4. FIELD STRENGTH OF SPURIOUS RADIATION, ANT 9

BPSK 5G NR n48 (40.0MHZ BANDWIDTH)

Project #:	13571607
Date:	4/28/2021
Test Engineer:	30606
Configuration:	EUT only
Mode	n48 BPSK 40MHz
Chamber #:	Chamber A

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T348 (dB/m)	Amp/Cbl (dB)	T1792 3400-3800MHz BRF	EIRP CF	Corrected Reading (dBm)	Harmonics limit	Margin (dB)	Polarity
Low Channel, 3570MHz										
7.14519	21.63	RMS	36.1	-23	.5	-95.2	-59.97	-40	-19.97	H
7.14633	28.28	RMS	36	-23	.5	-95.2	-53.42	-40	-13.42	V
10.6507	26.55	RMS	37.8	-19.5	.6	-95.2	-49.75	-40	-9.75	V
10.75786	26.66	RMS	37.8	-19.2	.6	-95.2	-49.34	-40	-9.34	H
14.22309	26.21	RMS	39.1	-18.4	.8	-95.2	-47.49	-40	-7.49	V
14.24441	26.55	RMS	39.3	-18.6	.8	-95.2	-47.15	-40	-7.15	H
Mid Channel, 3625MHz										
7.24832	23.57	RMS	36.1	-23.1	.5	-95.2	-58.13	-40	-18.13	H
10.87402	25.09	RMS	37.7	-19.2	.5	-95.2	-51.11	-40	-11.11	H
14.6048	25.46	RMS	40	-17.8	.9	-95.2	-46.64	-40	-6.64	H
7.23776	28.87	RMS	36	-23.1	.5	-95.2	-52.93	-40	-12.93	V
10.89518	26.37	RMS	37.8	-19.2	.6	-95.2	-49.63	-40	-9.63	V
14.61007	26.31	RMS	40	-17.6	.9	-95.2	-45.59	-40	-5.59	V
High Channel, 3680MHz										
7.39408	23.36	RMS	36.1	-22.9	.7	-95.2	-57.94	-40	-17.94	V
7.3943	25.81	RMS	36.1	-22.9	.7	-95.2	-55.49	-40	-15.49	H
11.03009	18.59	RMS	37.7	-19.1	.6	-95.2	-57.41	-40	-17.41	V
11.06056	18.59	RMS	37.8	-18.8	.6	-95.2	-57.01	-40	-17.01	H
14.73242	26.36	RMS	40	-18	.8	-95.2	-46.04	-40	-6.04	V
14.77085	19.19	RMS	40	-18.1	.8	-95.2	-53.31	-40	-13.31	H

11. SETUP PHOTOS

Please refer to 14790372-EP4V1 FCC Setup Photo for setup photos

END OF REPORT