



MEASUREMENT REPORT LTE Band 8 (CAT-M1)

Client Name:
Council Rock Enterprises LLC
11 Centre Park
Rochester, NY 14614
United States


Date of Testing:
03/19 - 04/02/2021
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M2104020026-01.2AL52

FCC ID:	2AL52E1500N
Applicant:	Council Rock Enterprises LLC

Application Type:	Class II Permissive Change
Model:	CR00N
EUT Type:	Cellular Module
FCC Classification:	PCS Licensed Transmitter (PCB)
FCC Rule Part(s):	Part 27 Subpart P
Test Procedure(s):	ANSI C63.26-2015, KDB 971168 D01 v03r01
Class II Permissive Change:	Adding LTE Band 8 Frequency
Original Grant Date:	04/26/2021

This equipment has been evaluated against the requirements in the technical service rules presented in Part 27 Subpart P. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



Randy Ortanez
President






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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.


1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Council Rock Enterprises LLC LTE Cellular Module FCC ID: 2AL52E1500N**. This device operates using CAT-M1 LTE.

The test data contained in this report pertains only to the emissions due to the EUT's Cat-M1 LTE licensed transmitter for Band 8 (897.5 - 900.5MHz) operations only.

Test Device Serial No.: 82763

2.2 Device Capabilities

This device contains the following capabilities:

Cat-M1 LTE Band 2/25, 4, 5, 8, 12, 13

2.3 Test Configuration


The EUT was tested per the guidance of ANSI C63.26-2015 and KDB 971168 D01 v03r01. See Section 3.0 of this test report for a description of the radiated and antenna port conducted emissions tests.

2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

2.5 Software and Firmware

The test was conducted with software/firmware version L0.0.00.00.05.08 installed on the EUT.

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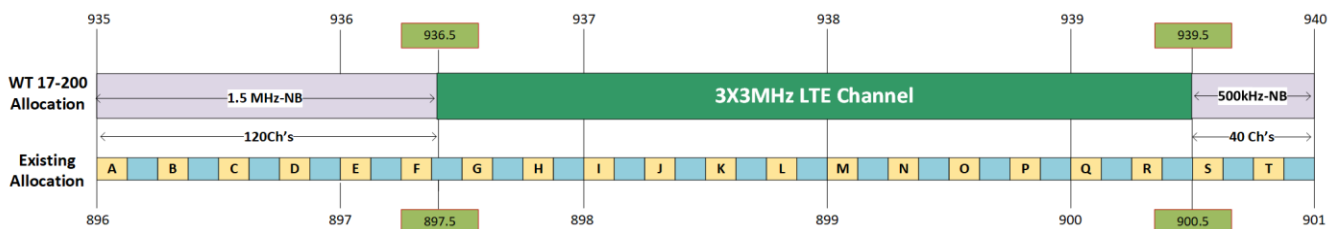
3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

This device was evaluated to the technical service rules presented in Part 27 Subpart P. The device operates using standard wideband LTE operation within the allocated 3MHz spectrum residing from 897.5MHz to 900.5MHz.

3.2 Broadband Frequency Assignment

The spectrum for this band is allocated as shown below.



3.3 Radiated Power and Radiated Spurious Emissions


The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. For measurements below 1GHz, the absorbers are removed. A raised turntable is used for radiated measurement. The turn table is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm tall test table made of Styrodur is placed on top of the turn table. A Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

The equipment under test was transmitting while connected to its integral antenna and is placed on a turntable 3 meters from the receive antenna. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer.

For radiated power measurements, substitution method is used per the guidance of ANSI C63.26-2015. A halfwave dipole is substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT. The power of the emission is calculated using the following formula:

$$P_d \text{ [dBm]} = P_g \text{ [dBm]} - \text{cable loss [dB]} + \text{antenna gain [dBd/dBi]};$$

where P_d is the dipole equivalent power, P_g is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to $P_g \text{ [dBm]} - \text{cable loss [dB]}$.

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For radiated spurious emissions measurements and calculations, conversion method is used per the formulas in KDB 971168 Section 5.8.4. Field Strength (EIRP) is calculated using the following formulas:



$$E_{[\text{dB}\mu\text{V}/\text{m}]} = \text{Measured amplitude level}_{[\text{dBm}]} + 107 + \text{Cable Loss}_{[\text{dB}]} + \text{Antenna Factor}_{[\text{dB}/\text{m}]}$$

And

$$\text{EIRP}_{[\text{dBm}]} = E_{[\text{dB}\mu\text{V}/\text{m}]} + 20\log D - 104.8; \text{ where } D \text{ is the measurement distance in meters.}$$

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.



Radiated power and radiated spurious emission levels are investigated with the receive antenna horizontally and vertically polarized per ANSI C63.26-2015.

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4.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (\pm dB)
Conducted Bench Top Measurements	1.13
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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5.0 TEST EQUIPMENT CALIBRATION DATA



Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	AP1	EMC Cable and Switch System	9/10/2020	Annual	9/10/2021	AP1
-	LTx2	Licensed Transmitter Cable Set	9/16/2020	Annual	9/16/2021	LTx2
Emco	3115	Horn Antenna (1-18GHz)	6/18/2020	Biennial	6/18/2022	9704-5182
Keysight Technologies	N9030B	PXA Signal Analyzer, Multi-touch	9/17/2020	Annual	9/17/2021	MY57141001
Anritsu	MT8821C	Radio Communication Analyzer	6/15/2020	Annual	6/15/2021	6201381794
Rohde & Schwarz	CMW500	Radion Communication Tester	11/5/2020	Annual	11/5/2021	112347
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/10/2020	Annual	8/10/2021	103200

Table 5-1. Summary of Test Results

Notes:

1. For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.
2. Equipment with a calibration date of "N/A" shown in this list was not used to make direct calibrated measurements.

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6.0 SAMPLE CALCULATIONS

Emission Designator

QPSK Modulation

Emission Designator = 8M62G7D

- LTE BW = 8.62 MHz
- G = Phase Modulation
- 7 = Quantized/Digital Info
- D = Data transmission, telemetry, telecommand

QAM Modulation


Emission Designator = 8M45W7D

- LTE BW = 8.45 MHz
- W = Amplitude/Angle Modulated
- 7 = Quantized/Digital Info
- D = Data transmission, telemetry, telecommand

Spurious Radiated Emission – LTE Band

Example: Middle Channel LTE Mode 2nd Harmonic (1564 MHz)

The average spectrum analyzer reading at 3 meters with the EUT on the turntable was -81.0 dBm. The gain of the substituted antenna is 8.1 dBi. The signal generator connected to the substituted antenna terminals is adjusted to produce a reading of -81.0 dBm on the spectrum analyzer. The loss of the cable between the signal generator and the terminals of the substituted antenna is 2.0 dB at 1564 MHz. So 6.1 dB is added to the signal generator reading of -30.9 dBm yielding -24.80 dBm. The fundamental EIRP was 25.501 dBm so this harmonic was 25.501 dBm $- (-24.80)$.

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7.0 TEST RESULTS

7.1 Summary



Company Name: Council Rock Enterprises LLC
 FCC ID: 2AL52E1500N
 Mode(s): LTE Band 8 CAT-M1

Test Condition	Test Description	FCC Part Section(s)	Test Limit	Test Result	Report Reference
CONDUCTED	Transmitter Conducted Output Power/ Effective Radiated Power	2.1046, 27.1507(a)(3)	10W ERP	PASS	Section 7.2
	Occupied Bandwidth	2.1049, 27.1506	N/A	PASS	Section 7.3
	Conducted Band Edge / Spurious Emissions	2.1051, 27.1509(a)	Attenuation > 43 + 10 log ₁₀ (P[Watts]) for all out-of-band emissions	PASS	Section 7.4, 7.5
	Peak-Average Ratio	2.1051, 27.1507(d)	< 13dB	PASS	Section 7.6
	Frequency Stability	2.1055	Fundamental emissions stay within authorized frequency block	PASS	Section 7.8
RADIATED	Radiated Spurious Emissions	2.1051, 27.1509(a)	Attenuation > 43 + 10 log ₁₀ (P[Watts]) for all out-of-band emissions	PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

- 1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots shown in Section 7.0 were taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
- 4) All conducted emissions measurements are performed with automated test software to capture the corresponding plots necessary to show compliance. The measurement software utilized is LTE Automation Version 5.3

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7.2 Transmitter Conducted Output Power/ Effective Radiated Power

Test Overview

The transmitter conducted output power is a measure of the total average power contained within 1.4MHz and 3MHz channels as defined in §27.1506. All modes of operation were investigated and the worst-case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 – Section 5.2.4.2

Test Settings

All conducted powers were measured using the R&S CMW500's Channel Measurement function.

Test Setup



The EUT and measurement equipment were set up as shown in the diagram below.



Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None

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LTE Band 8 3MHz Bandwidth			
Modulation	Number of RB	RB Offset	Mid Channel
			21640 (899.0 MHz)
			Conducted Power [dBm]
QPSK	1	0	24.78
	1	3	24.88
	1	5	24.22
	6	0	20.39
16 QAM	1	0	23.18
	1	3	22.99
	1	5	21.17
	6	0	19.75

Table 7-2. Transmitter Conducted Output Power Measurements (3 MHz)


LTE Band 8 1.4MHz Bandwidth					
Modulation	Number of RB	RB Offset	Low Channel	Mid Channel	High Channel
			21632 (898.2MHz)	21640 (899.0 MHz)	21648 (899.8MHz)
			Conducted Power [dBm]	Conducted Power [dBm]	Conducted Power [dBm]
QPSK	1	0	24.14	23.42	23.59
	1	3	22.14	22.28	22.85
	1	5	23.08	23.94	23.08
	6	0	20.37	20.81	20.04
16-QAM	1	0	22.20	21.90	21.86
	1	3	21.80	21.24	21.30
	1	5	21.53	22.43	21.14
	6	0	19.68	19.96	18.98

Table 7-3. Transmitter Conducted Output Power Measurements (1.4MHz)

Frequency Band [MHz]	Maximum Conducted Power [dBm]	Maximum ERP [dBm]	Maximum Antenna Gain [dBi]
899	25.00	40	17.15

Table 7-4. ERP Data (LTE Band 8)

Note: The 17.15dBi antenna gain shown in the table above is the maximum theoretical antenna gain that can be used by this device in order to reach the 10W ERP limit (42.15dBm EIRP) for operation in this band. An actual antenna was not used for testing to determine ERP compliance.

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7.3 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

ANSI C63.26-2015 – Section 5.4.4

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW $\geq 3 \times$ RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

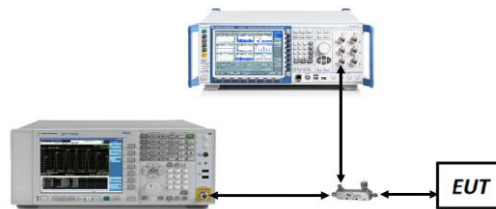




Figure 7-2. Test Instrument & Measurement Setup

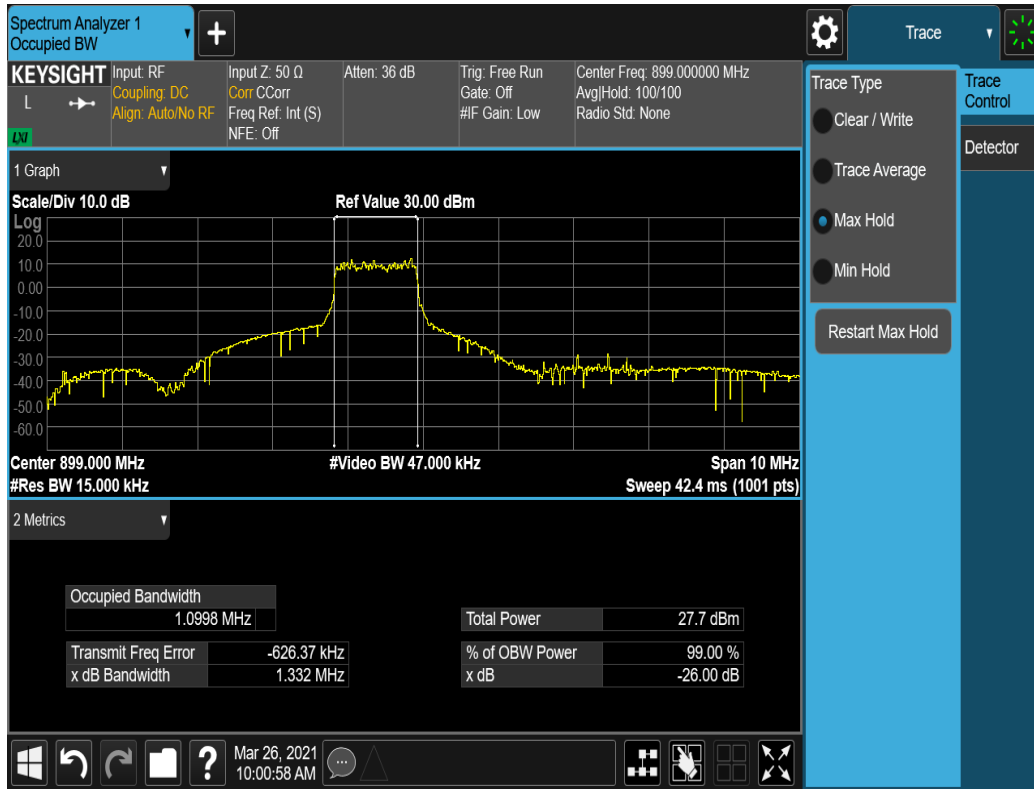
Test Notes

None


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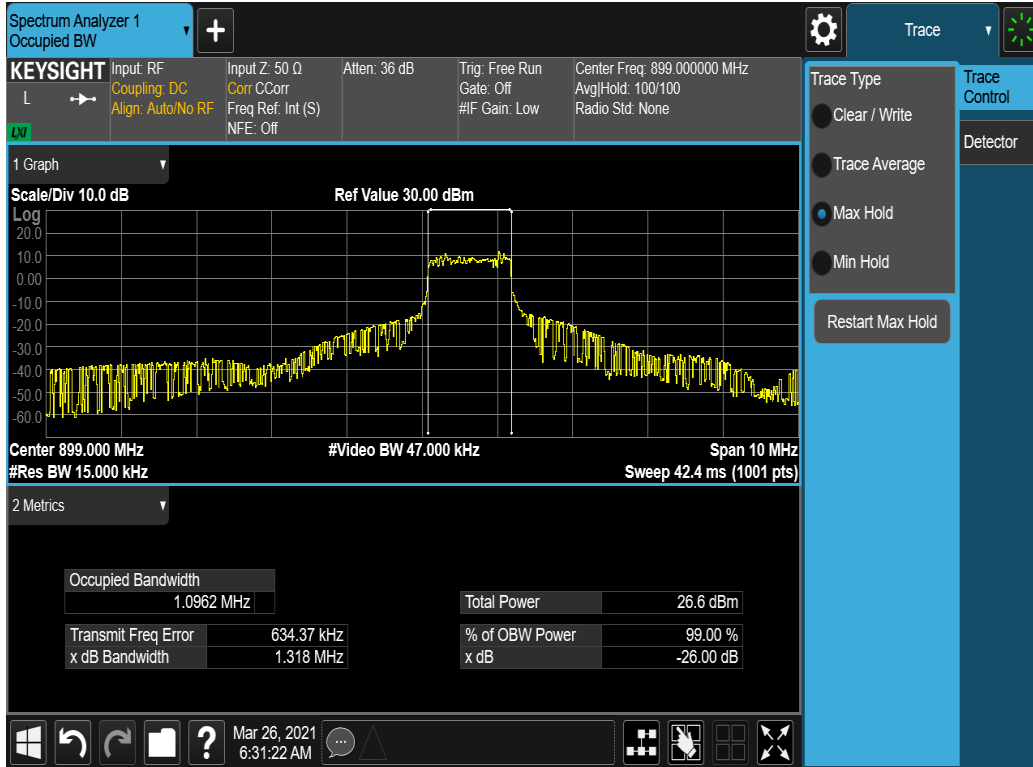
Mode	Channel Bandwidth (MHz)	Channel/ Frequency	Modulation	NB Value	Number of RB	RB Offset	Occupied BW (MHz)
LTE Band 8 (eMTC)	3	CH21640 - 899.0MHz	QPSK	0	6	0	1.0998
LTE Band 8 (eMTC)	3	CH21640 - 899.0MHz	QPSK	1	6	0	1.0962
LTE Band 8 (eMTC)	3	CH21640 - 899.0MHz	16 QAM	0	6	0	1.0911
LTE Band 8 (eMTC)	3	CH21640 - 899.0MHz	16 QAM	1	6	0	1.0837
LTE Band 8 (eMTC)	1.4	CH21640 - 899.0MHz	QPSK	0	6	0	1.0913
LTE Band 8 (eMTC)	1.4	CH21640 - 899.0MHz	16 QAM	0	6	0	1.0905

Table 7-4. Occupied Bandwidth Measurements



Plot 7-1. Occupied Bandwidth Plot (3MHz , QPSK, RB 6, RB Offset 0, NB=0)


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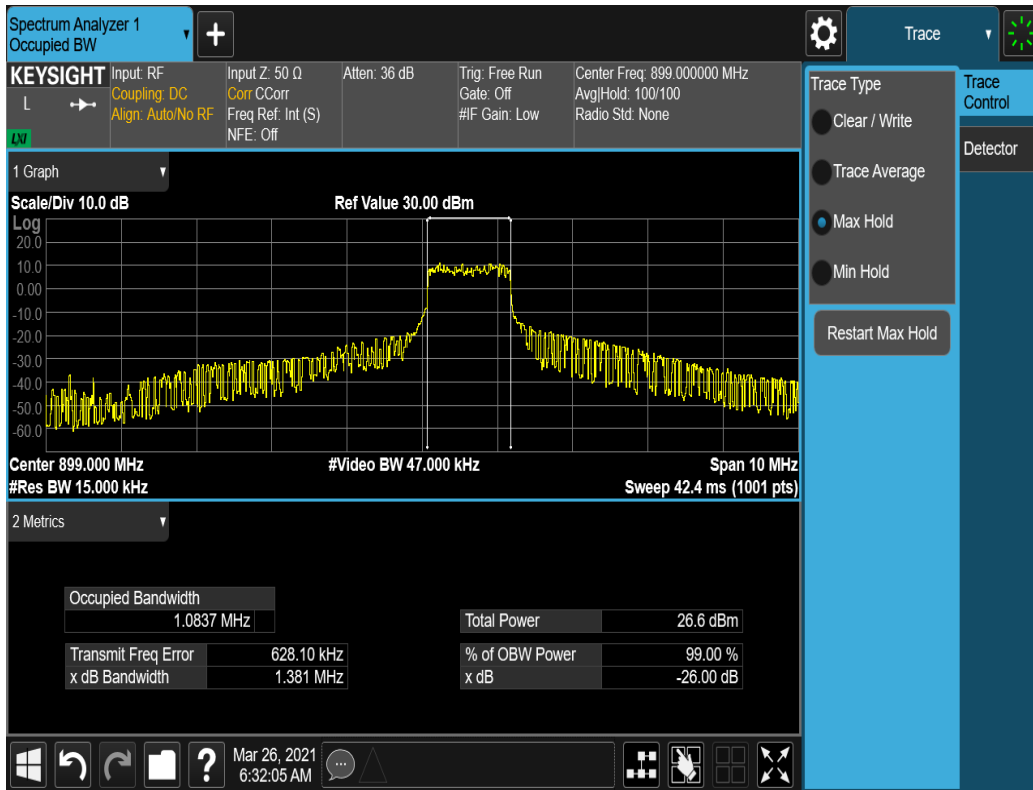


Plot 7-2. Occupied Bandwidth Plot (3MHz, QPSK, RB 6, RB Offset 0, NB=1)

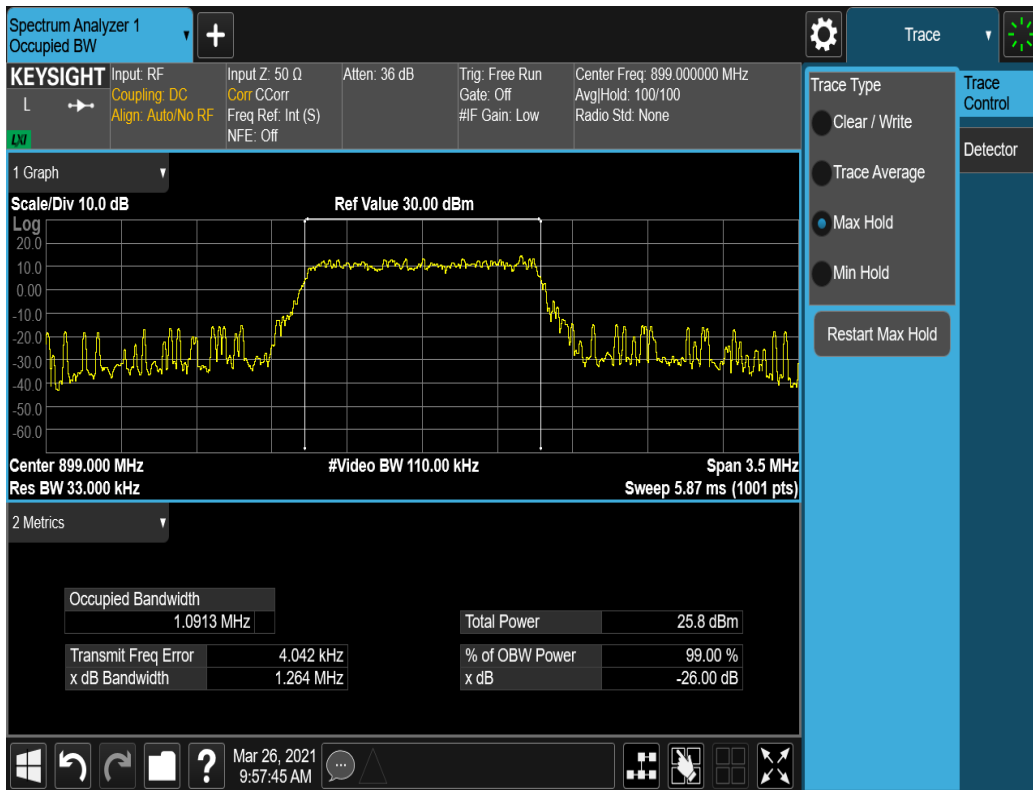



Plot 7-3. Occupied Bandwidth Plot (3MHz, 16QAM, RB 6, RB Offset 0, NB=0)

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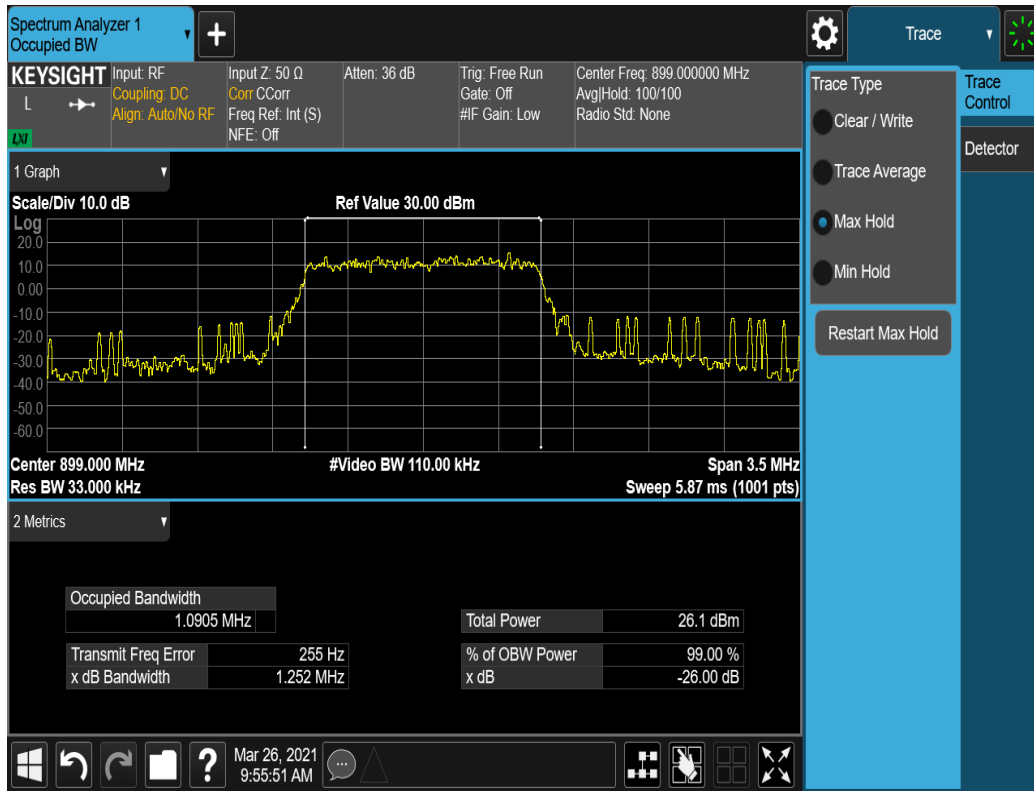


Plot 7-4. Occupied Bandwidth Plot (3MHz, 16QAM, RB 6, RB Offset 0, NB=1)




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Plot 7-5. Occupied Bandwidth Plot (1.4MHz, QPSK, RB 6, RB Offset 0, NB=0)



Plot 7-6. Occupied Bandwidth Plot (1.4MHz, 16QAM, RB 6, RB Offset 0, NB=0)

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7.4 Band Edge Emissions at Antenna Terminal

Test Overview

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. Several modes of operation were investigated and the worst case configuration results are reported in this section

The minimum permissible attenuation level of any spurious emission is $43 + 10 \log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.3

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. $RBW \geq 1\%$ of the emission bandwidth
4. $VBW \geq 3 \times RBW$
5. Detector = RMS
6. Number of sweep points $\geq 2 \times \text{Span}/RBW$
7. Trace mode = trace average for continuous emissions
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

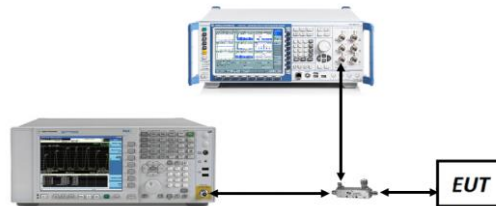



Figure 7-3. Test Instrument & Measurement Setup

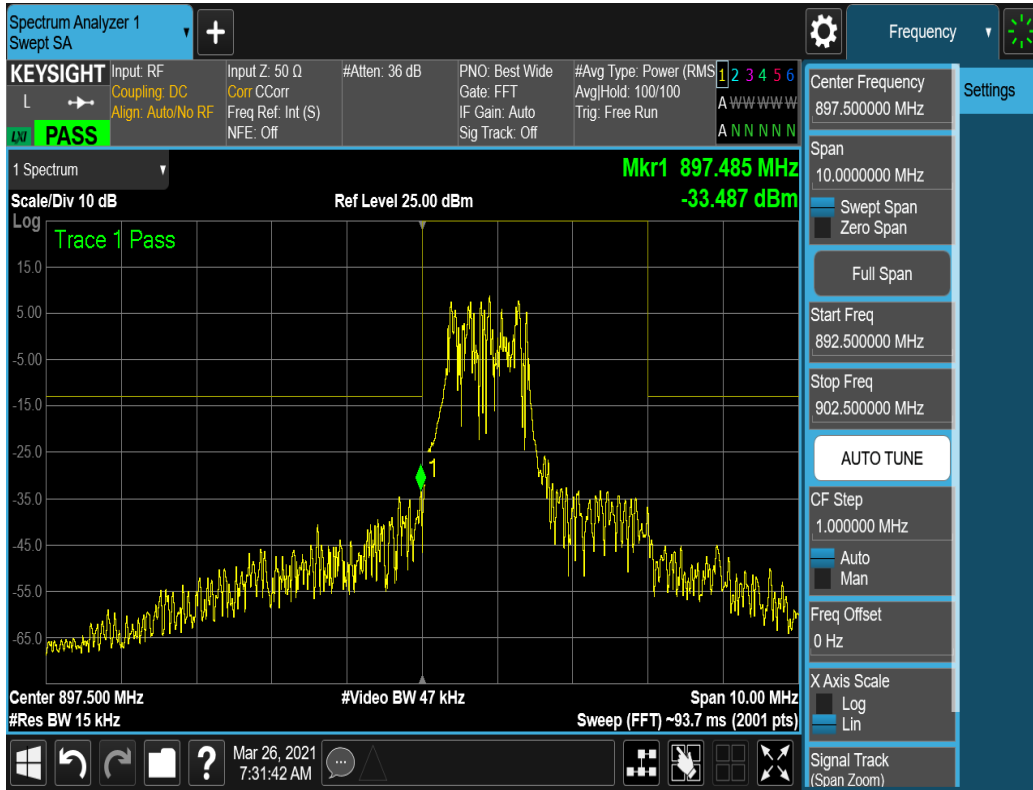
Test Notes

1. Per §27.1509(c), in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed to demonstrate compliance with the out-of-band emissions limit. 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 emission are attenuated at least 26 dB below the transmitter power.
2. This section shows non-compliant band edge emissions. The emissions were measured with the required 100kHz RBW and they were also investigated with a RBW greater than or equal to 1% of the channel emission bandwidth, as allowed by the rule


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Mode	Channel Bandwidth [MHz]	Modulation	NB Value	Number of RB	RB Offset	Band Edge Level [dBm]	Limit [dBm]	Margin [dB]
LTE Band 8 (CAT-M1)	3	QPSK	0	6	0	-33.487	-13	-20.487
LTE Band 8 (CAT-M1)	3	QPSK	1	6	0	-36.011	-13	-23.011
LTE Band 8 (CAT-M1)	1.4	QPSK	0	6	0	-31.829	-13	-18.829
LTE Band 8 (CAT-M1)	1.4	QPSK	0	6	0	-29.412	-13	-16.412

Table 7-5. Band Edge Measurements

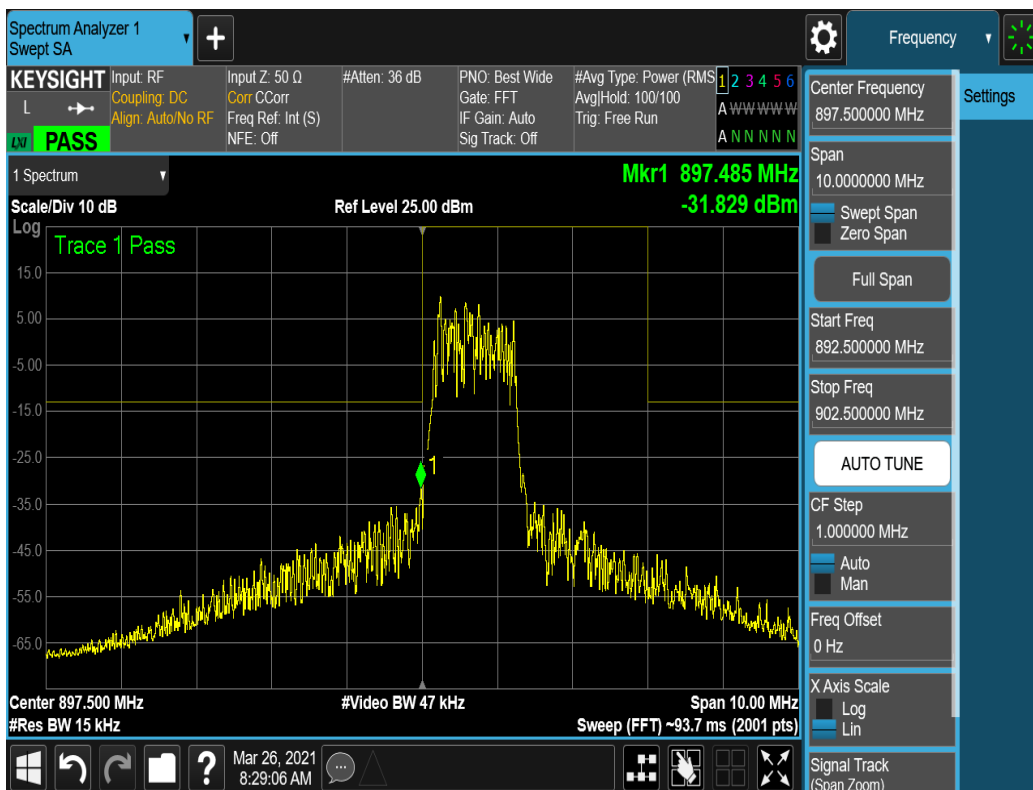


Plot 7-7. Lower Band Edge Plot (3MHz, QPSK, 6RB, RB Offset 0, NB=0)

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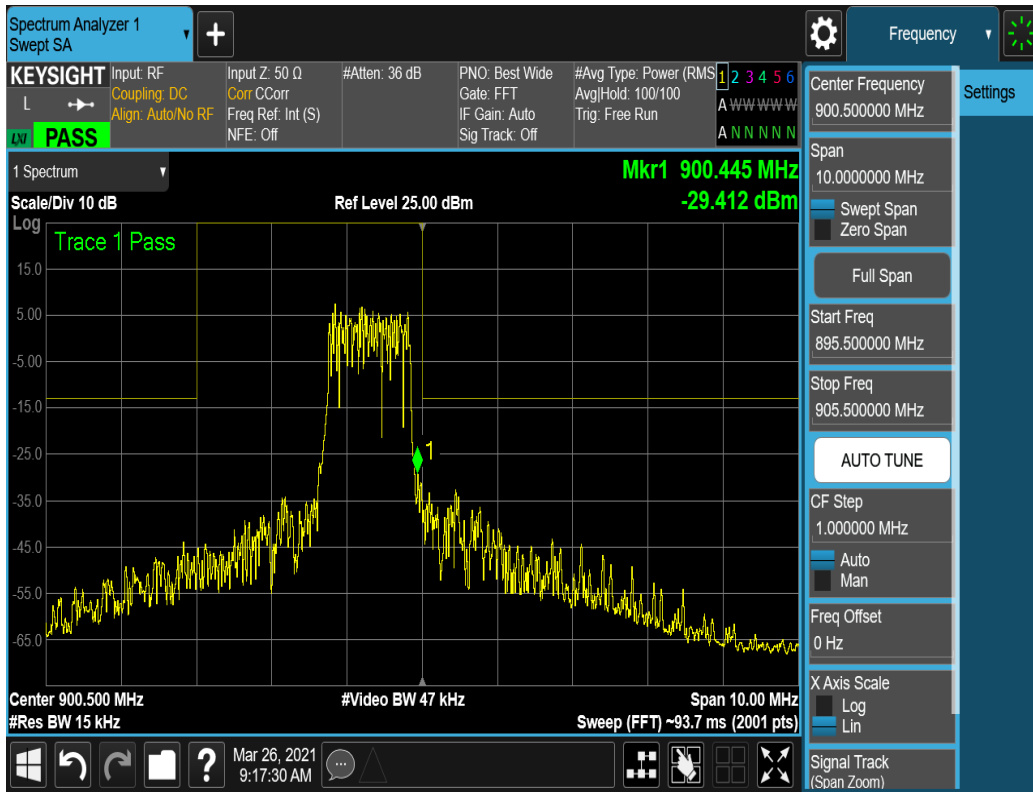


Plot 7-8. Upper Band Edge Plot (3MHz, QPSK, 6RB, RB Offset 0, NB=1)





Plot 7-9. Lower Band Edge Plot (1.4MHz, QPSK, 6RB, RB Offset 0, NB=0)

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Plot 7-10. Upper Band Edge Plot (1.4MHz, QPSK, 6RB, RB Offset 0, NB=0)

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7.5 Spurious and Harmonic Emissions at Antenna Terminal

Test Overview

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power, and at the appropriate frequencies. Several modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible attenuation level of any spurious emission is $43 + 10\log_{10}(P_{[Watts]})$, where P is the transmitter power in Watts.

Test Procedure Used

ANSI C63.26-2015 – Section 5.7.4

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 10GHz for Cell, 20GHz for AWS, 20GHz for PCS (separated into at least two plots per channel)
2. Detector = RMS
3. Trace mode = trace average for continuous emissions, max hold for pulse emissions
4. Sweep time = auto couple
5. The trace was allowed to stabilize
6. Please see test notes below for RBW and VBW settings

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

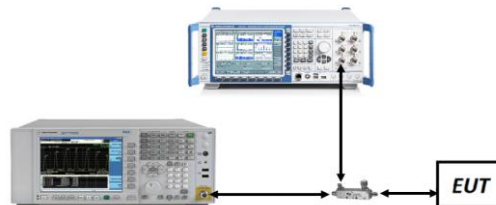




Figure 7-4. Test Instrument & Measurement Setup

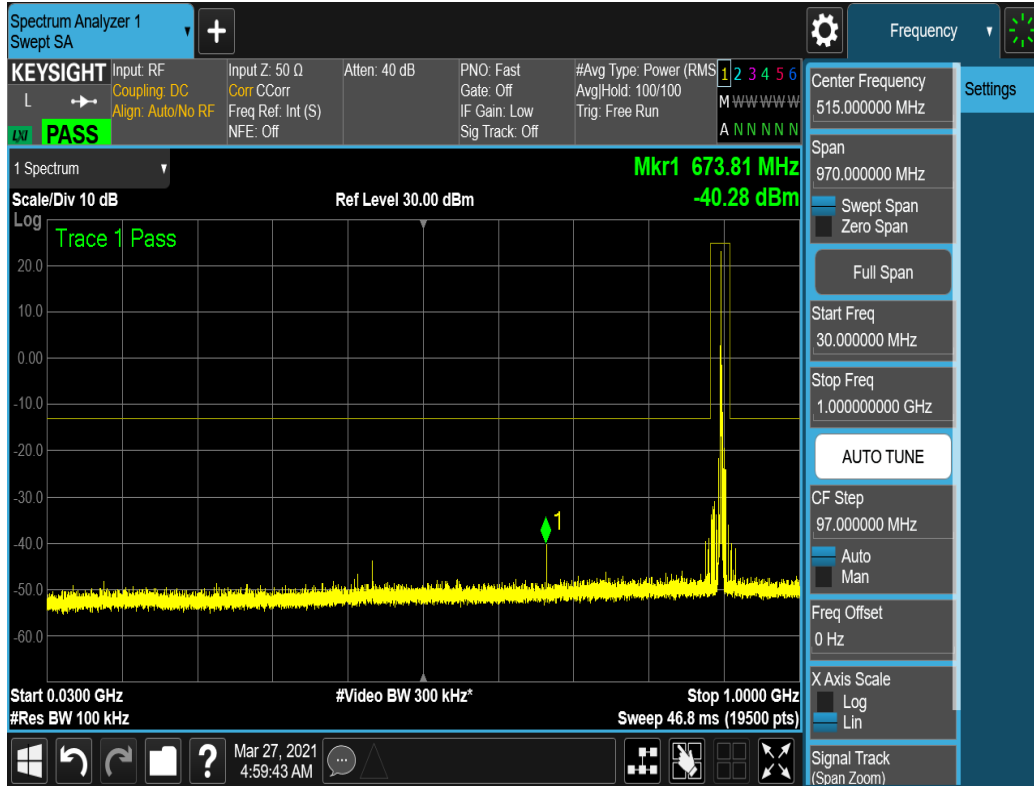
Test Notes

Per 27.1509(a), compliance with the applicable limits is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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 emission are attenuated at least 26 dB below the transmitter power.

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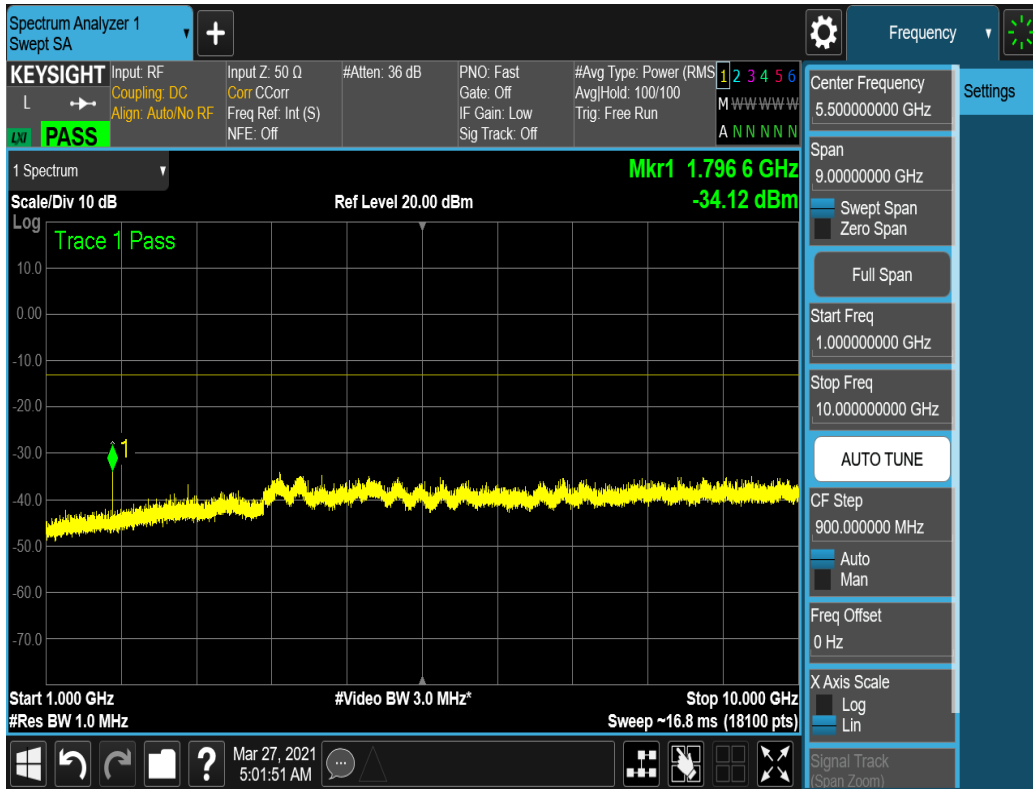
Mode	Channel Bandwidth [MHz]	Channel/Frequency	Modulation	Number of RB	RB Offset	Worst Case CSE [dBm]	Limit [dBm]	Margin [dB]
LTE Band 8 (CAT-M1)	3	H21640 - 899.0MHz	QPSK	1	3	-34.12	-13	-21.12
LTE Band 8 (CAT-M1)	1.4	H21640 - 899.0MHz	QPSK	1	5	-29.71	-13	-16.71
LTE Band 8 (CAT-M1)	1.4	H21632 - 898.2MHz	QPSK	1	0	-29.36	-13	-16.36
LTE Band 8 (CAT-M1)	1.4	H21648 - 899.8MHz	QPSK	1	0	-29.50	-13	-16.50

Table 7-6. Spurious Emission Measurements

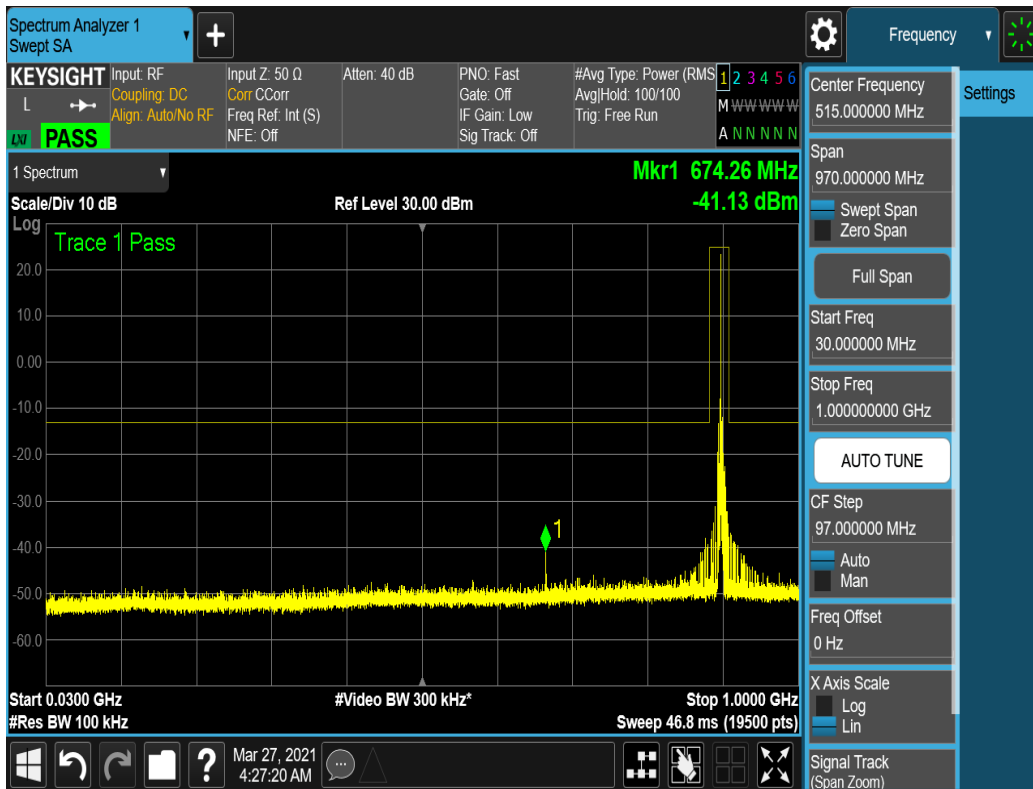


Plot 7-11. Conducted Spurious Plot – Mid Channel (3MHz, QPSK, 1RB, RB Offset 3)


FCC ID: 2AL52E1500N		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	Approved by: Technical Manager
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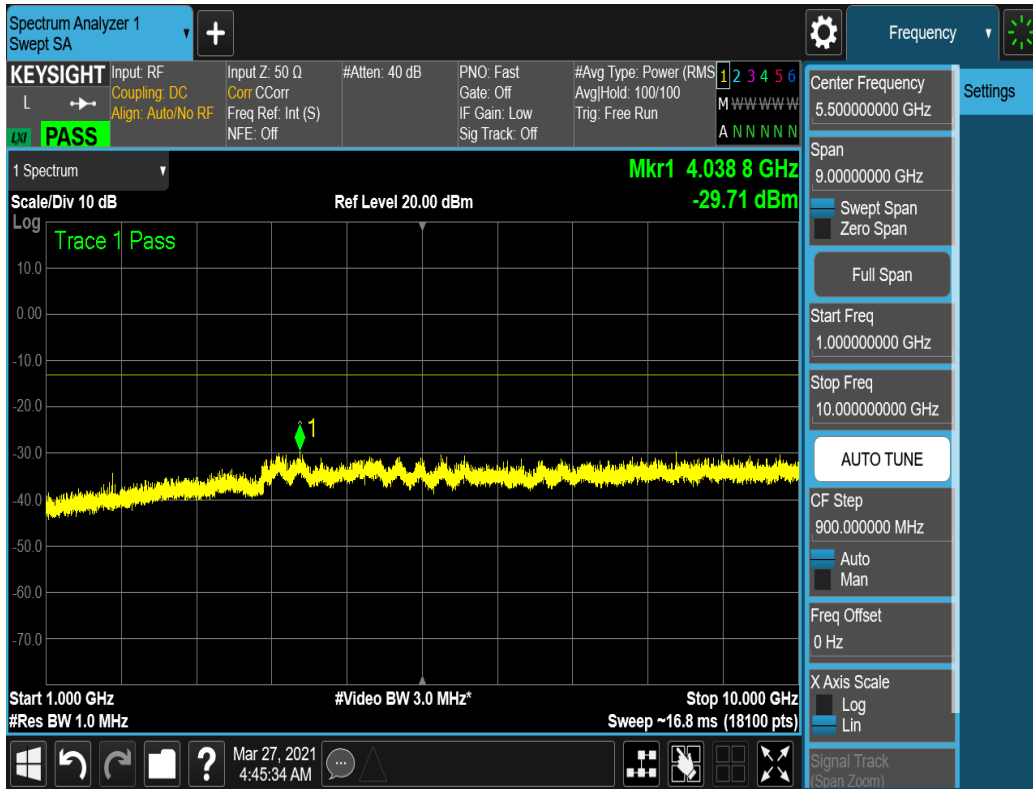


Plot 7-12. Conducted Spurious Plot – Mid Channel (3MHz, QPSK, 1RB, RB Offset 3)

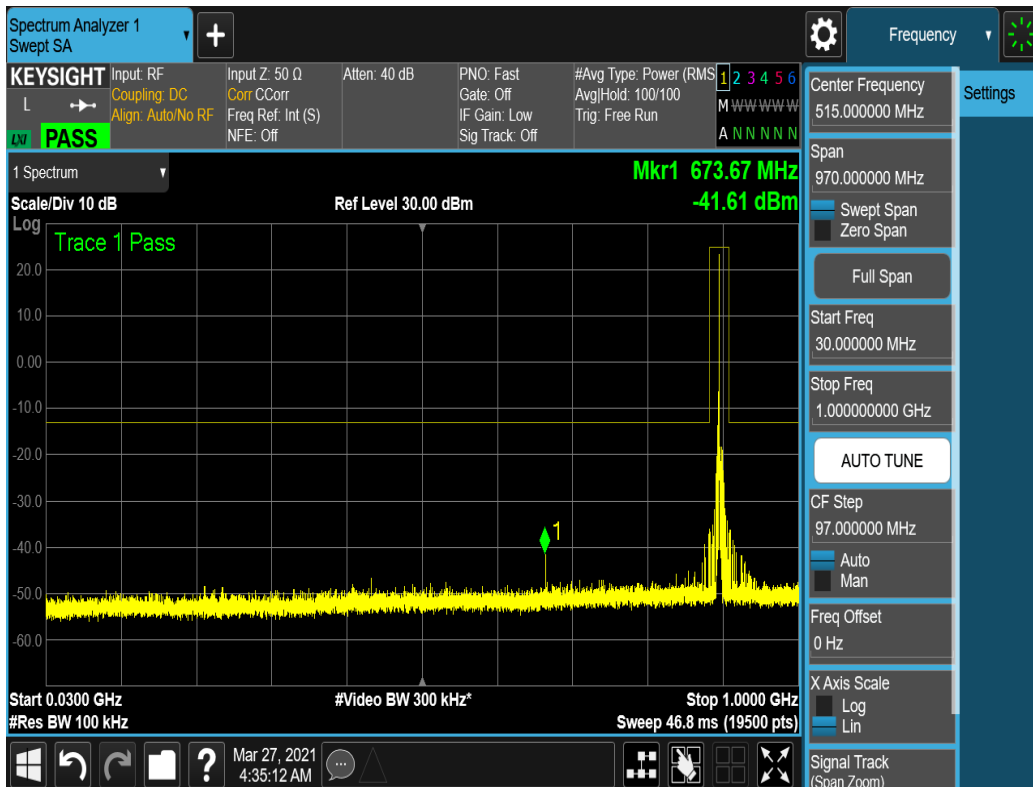


Plot 7-13. Conducted Spurious Plot – Mid Channel (1.4MHz, QPSK, 1RB, RB Offset 5)

FCC ID: 2AL52E1500N	 PCTEST Proud to be part of 	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	Approved by: Technical Manager
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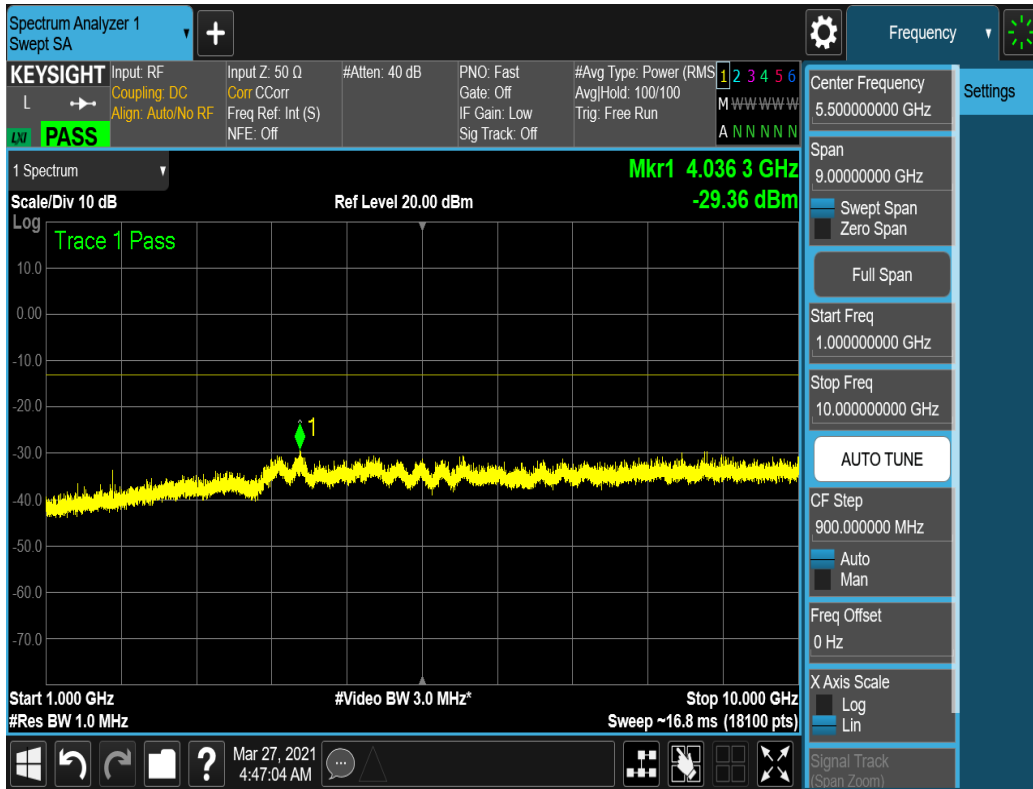


Plot 7-14. Conducted Spurious Plot – Mid Channel (1.4MHz, QPSK, 1RB, RB Offset 5)

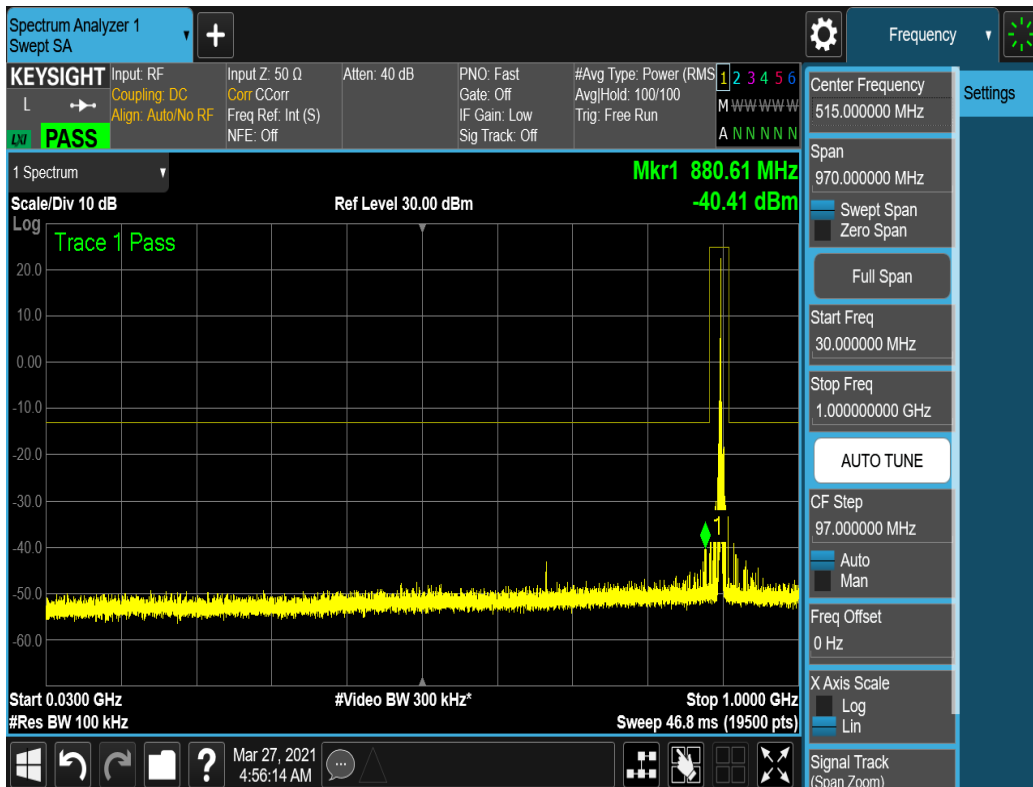


Plot 7-15. Conducted Spurious Plot – Low Channel (1.4MHz, QPSK, 1RB, RB Offset 0)

FCC ID: 2AL52E1500N	PCTEST Proud to be part of element	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	Approved by: Technical Manager
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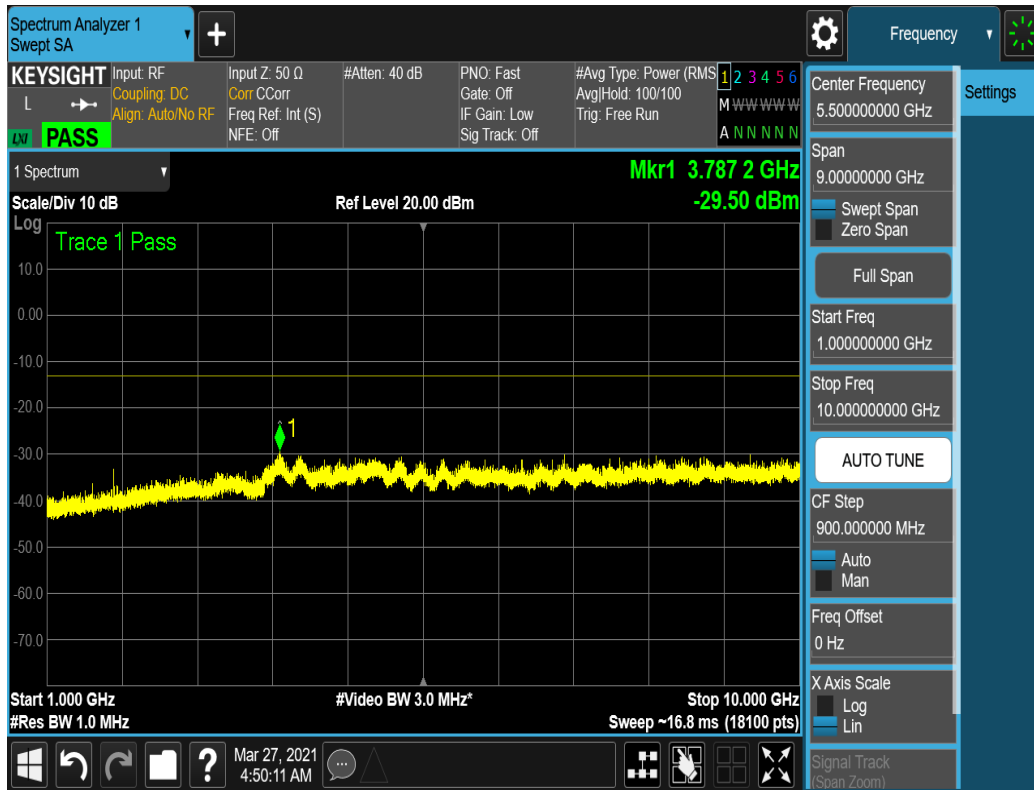


Plot 7-16. Conducted Spurious Plot – Low Channel (1.4MHz, QPSK, 1RB, RB Offset 0)





Plot 7-17. Conducted Spurious Plot – High Channel (1.4MHz, QPSK, 1RB, RB Offset 0)

FCC ID: 2AL52E1500N	PCTEST Proud to be part of element	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	Approved by: Technical Manager
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Plot 7-18. Conducted Spurious Plot – High Channel (1.4MHz, QPSK, 1RB, RB Offset 0)

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7.6 Peak-Average Ratio

Test Overview

A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level.

Test Procedure Used

KDB 971168 D01 v03r01 – Section 5.7.1

Test Settings

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW \geq OBW or specified reference bandwidth
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

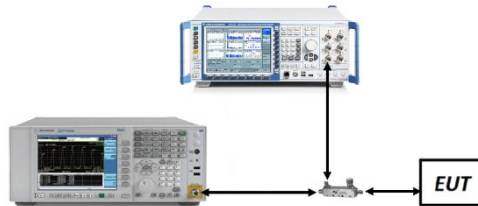




Figure 7-5. Test Instrument & Measurement Setup

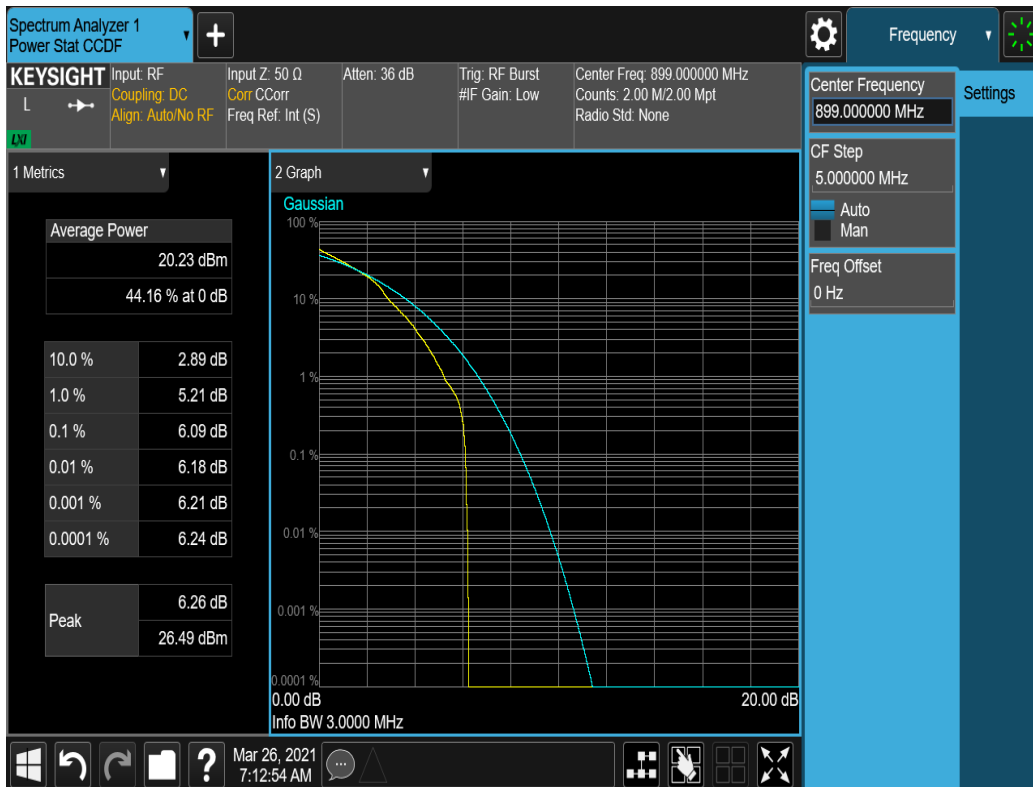
Test Notes

None.


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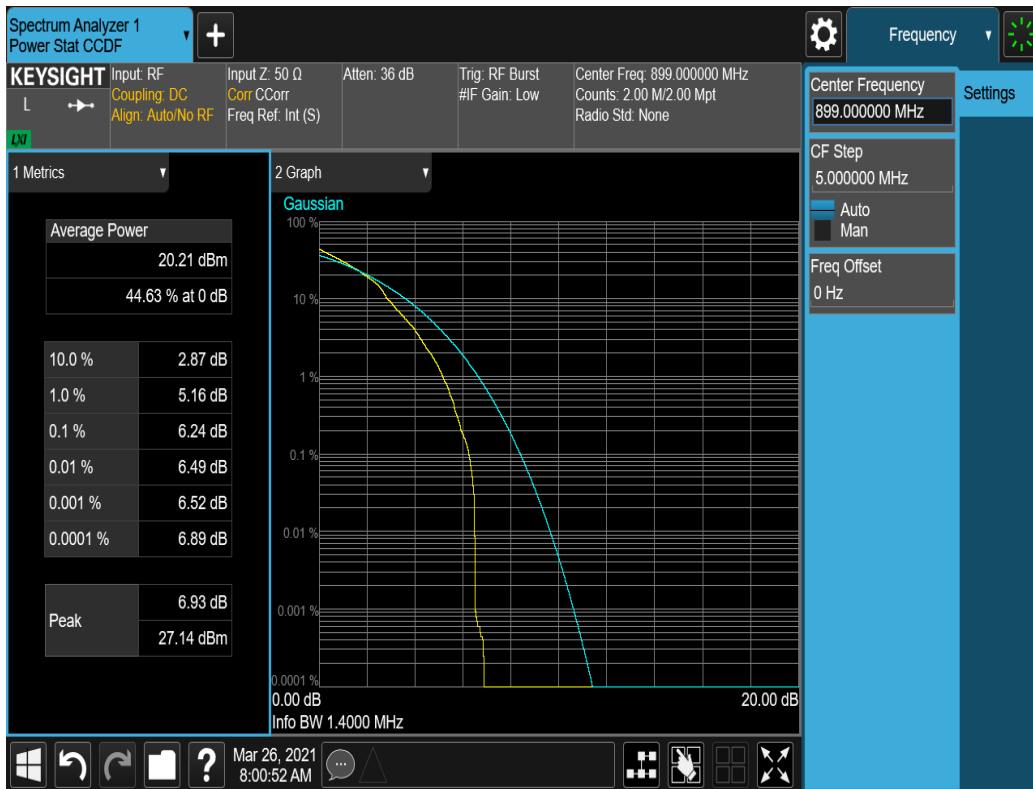
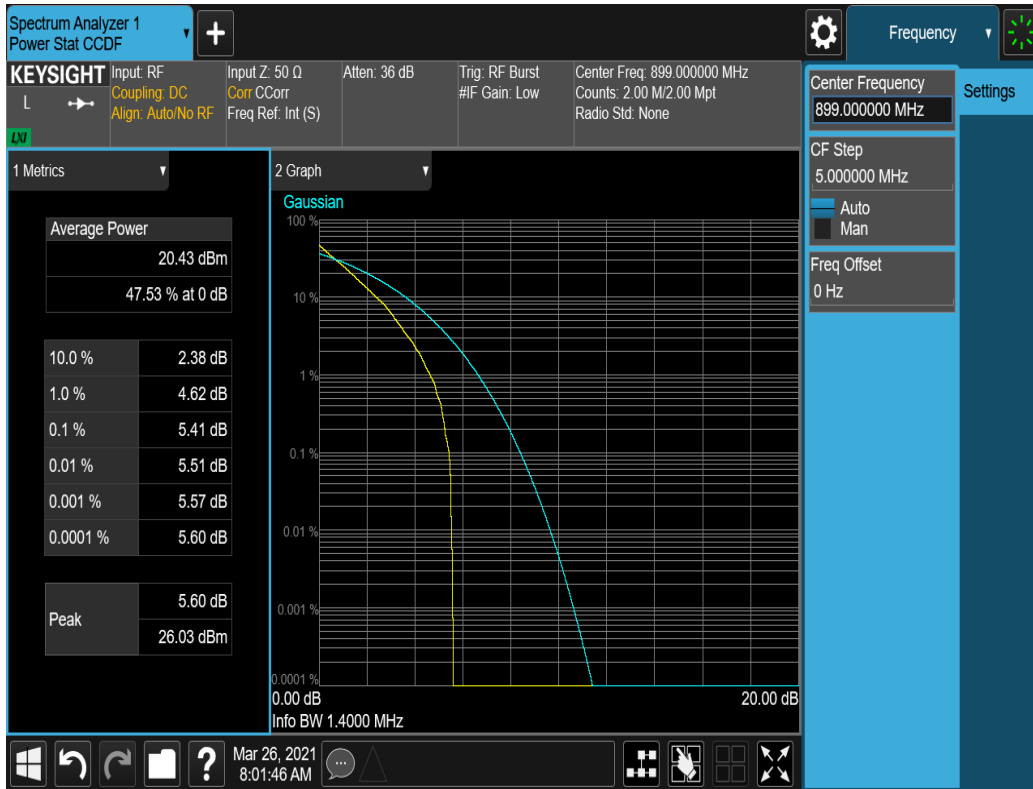



Plot 7-19. Peak to Average Ratio (3MHz, QPSK, RB 6, RB Offset 0, NB=0)



Plot 7-20. Peak to Average Ratio (3MHz, 16-QAM, RB 6, RB Offset 0, NB=0)

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7.7 Radiated Spurious Emissions Measurements

Test Overview

Radiated spurious emissions measurements are performed using the direct field strength conversion method described in ANSI C63.26-2015 with the EUT transmitting into a 50Ω termination. Measurements on signals operating below 1GHz are performed using horizontally and vertically polarized tuned dipole antennas. Measurements on signals operating above 1GHz are performed using vertically and horizontally polarized broadband horn antennas. All measurements are performed as peak measurements while the EUT is operating at maximum power, and at the appropriate frequencies.


Test Procedures Used

KDB 971168 D01 v03r01 – Section 7

ANSI C63.26-2015 – Section 5.5.4

Test Settings

1. RBW = 100kHz for emissions below 1GHz and 1MHz for emissions above 1GHz
2. VBW ≥ 3 x RBW
3. Span = 1.5 times the OBW
4. No. of sweep points ≥ 2 x span / RBW
5. Detector = RMS
6. Trace mode = Average (Max Hold for pulsed emissions)
7. The trace was allowed to stabilize

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Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

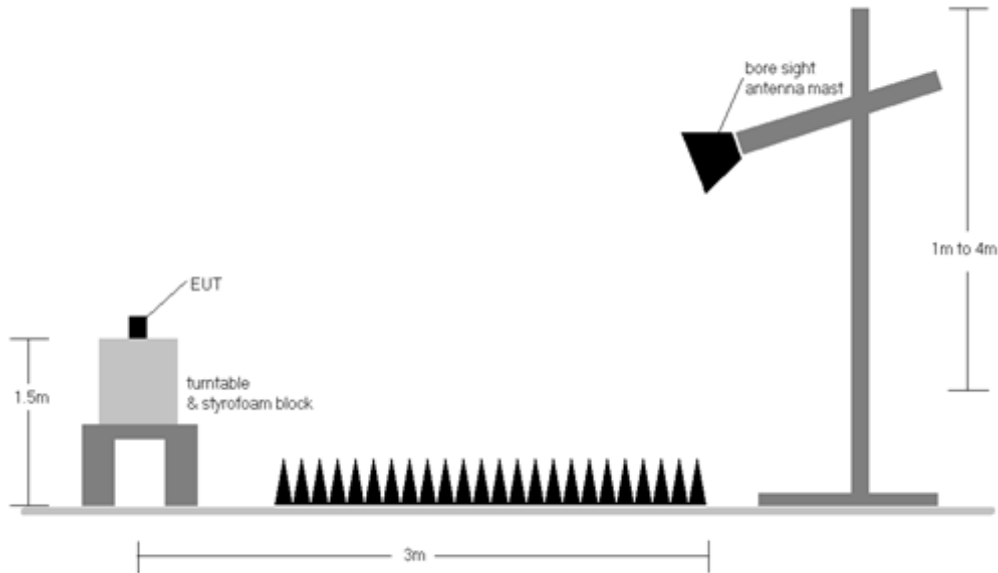


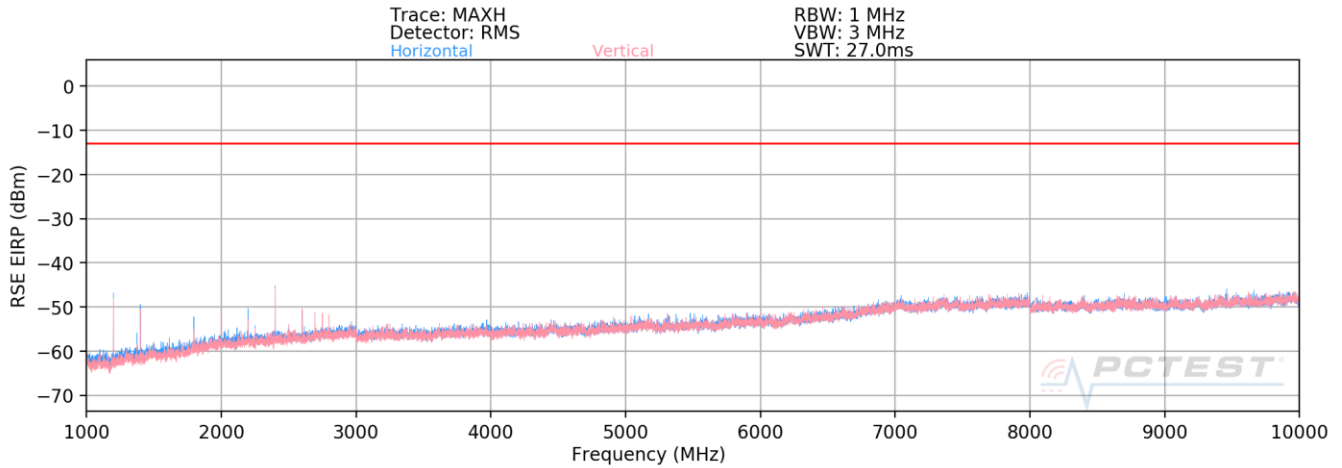


Figure 7-6. Test Instrument & Measurement Setup

Test Notes

- 1) Field strengths are calculated using the Measurement quantity conversions in KDB 971168 Section 5.8.4.
 - b) $E(\text{dB}\mu\text{V}/\text{m}) = \text{Measured amplitude level (dBm)} + 107 + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$
 - d) $\text{EIRP (dBm)} = E(\text{dB}\mu\text{V}/\text{m}) + 20\log D - 104.8$; where D is the measurement distance in meters.
- 2) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations shown in the tables below.
- 3) The EUT was tested in three orthogonal planes and in all possible test configurations and positioning. The worst case setup is reported in the tables below.
- 4) The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter. The worst-case emissions are reported.
- 5) Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
- 6) The "-" shown in the following RSE tables are used to denote a noise floor measurement.

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Plot 7-23. Radiated Spurious Plot (LTE Band 8- CAT-M1)

Bandwidth (MHz):	3
Frequency (MHz):	899.0
RB / Offset:	1 / 3
Detector / Trace Mode:	RMS /Max Hold
RBW / VBW:	1MHz / 3MHz

Frequency [MHz]	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBμV/m]	EIRP Spurious Emission Level [dBm]	Limit [dBm]	Margin [dB]
1199.5	H	249	163	-55.59	-2.65	48.76	-46.50	-13.00	-33.50
1374.5	H	312	162	-63.10	-1.57	42.33	-52.93	-13.00	-39.93
1399.5	H	170	168	-57.01	-1.64	48.35	-46.91	-13.00	-33.91
1798.0	H	156	213	-63.85	0.87	44.02	-51.24	-13.00	-38.24
2000.0	H	112	77	-64.21	2.48	45.27	-49.98	-13.00	-36.98
2199.5	H	101	159	-63.36	3.04	46.68	-48.57	-13.00	-35.57
2250.0	H	262	153	-65.00	2.30	44.30	-50.95	-13.00	-37.95
2399.5	H	191	159	-57.01	3.36	53.35	-41.91	-13.00	-28.91
2495.0	H	-	-	-69.13	3.40	41.27	-53.98	-13.00	-40.98
2697.0	H	224	161	-63.36	3.77	47.41	-47.85	-13.00	-34.85
2749.5	V	142	266	-65.28	4.43	46.15	-49.11	-13.00	-36.11
2799.5	V	155	290	-64.04	4.16	47.12	-48.14	-13.00	-35.14
2954.5	H	-	-	-69.36	4.22	41.86	-53.40	-13.00	-40.40
3596.0	H	-	-	-70.00	5.08	42.08	-53.17	-13.00	-40.17
4495.0	H	-	-	-71.28	6.36	42.08	-53.18	-13.00	-40.18
5394.0	H	-	-	-70.91	7.61	43.70	-51.56	-13.00	-38.56

Table 7-7. Radiated Spurious Data (LTE Band 8- CAT-M1)

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7.8 Frequency Stability / Temperature Variation

Test Overview and Limit

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.26-2015. The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from -30°C to +50°C in 10°C increments using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

Test Procedure Used

ANSI C63.26-2015 – Sections 5.6.4, 5.6.5

Test Settings



1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

Test Setup

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

Test Notes

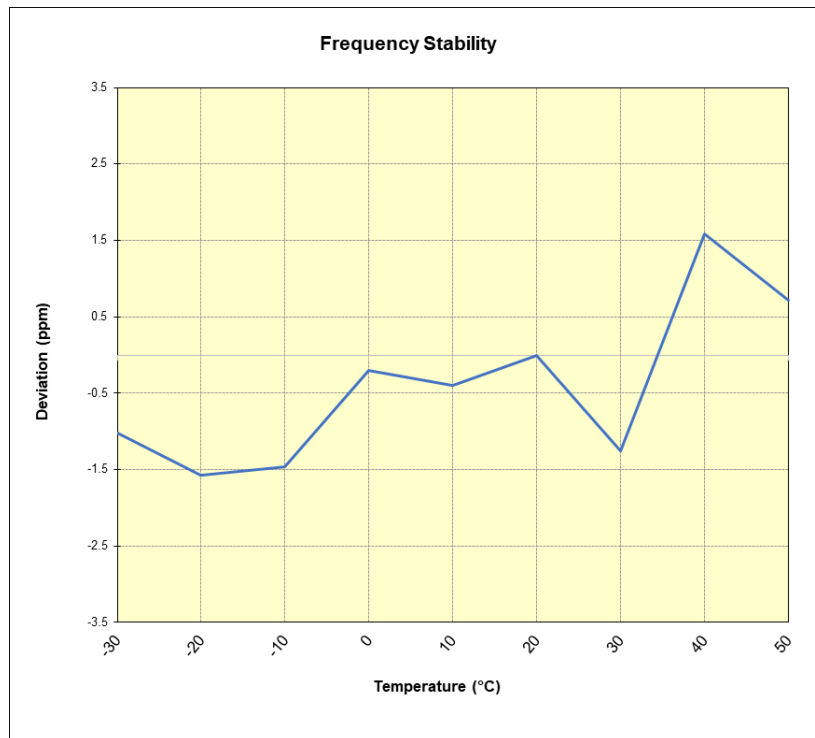
None

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Frequency Stability / Temperature Variation

LTE Band 8 (CAT-M1)					
		Operating Frequency (Hz):		899,000,000	
		Ref. Voltage (VDC):		24.00	
Voltage (%)	Power (VDC)	Temp (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	24.00	- 30	898,008,302	-913	-0.0001017
		- 20	898,007,807	-1,408	-0.0001568
		- 10	898,007,896	-1,319	-0.0001469
		0	898,009,037	-178	-0.0000198
		+ 10	898,008,860	-355	-0.0000395
		+ 20 (Ref)	898,009,215	0	0.0000000
		+ 30	898,008,087	-1,128	-0.0001256
		+ 40	898,010,640	1,425	0.0001587
		+ 50	898,009,853	638	0.0000710
115%	27.60	+ 20	898,009,746	531	0.0000591
85%	20.40	+ 20	898,008,893	-322	-0.0000359

Table 7-8. LTE Band 8 CAT-M1 Frequency Stability Data





Plot 7-23. LTE Band 8 CAT-M1 Frequency Stability Chart

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8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Council Rock Enterprises LLC LTE Cellular Module FCC ID: 2AL52E1500N** complies with all requirements specified in FCC Part 27 Subpart P of the FCC Rules for LTE CAT-M1 Operation.

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