CERTIFICATE #: 0214.19

Radio Test Report

Application for Grant of Equipment Authorization

FCC Part 24, and IC RSS-133
[1930MHz – 1995MHz]

FCC Part 27, IC RSS-139, and RSS-170
[2110MHz – 2200MHz]

FCC ID: VBNAHFIG-01
IC: 661W-AHFIG

Product Name: Airscale Base Transceiver Station Remote Radio Head
Model: AHFIG

Applicant: Nokia Solutions and Networks
6000 Connection Drive
Irving, TX 75039

Test Sites: Nokia Solutions and Networks
6000 Connection Drive
Irving, TX 75039

Test Dates: June 3 -7, 11, 13 & 24 – 27, 2019
Total Number of Pages: 265

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REVISION HISTORY

Rev#	Date	Comments	Modified By
0	06/28/2019	Initial Draft	BreAnna Cheatham
1	07/03/2019	Updated per customer redlines	BreAnna Cheatham
2	07/08/2019	Updated per customer redlines	BreAnna Cheatham

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SCOPE

Tests have been performed on Nokia Solutions and Networks product Airscale Base Station Remote Radio Head (RRH) Model AHFIG, pursuant to the relevant requirements of the following standard(s) to obtain device certification against the regulatory requirements of the Federal Communications Commission (FCC) and Innovation, Science and Economic Development Canada (ISED).

- Code of Federal Regulations (CFR) Title 47 Part 2
- (Radio Standards Specification) RSS-Gen Issue 5 Amendment 1, March 2019
- CFR Title 47 Part 24 Subpart E – Broadband PCS
- RSS-133 Issue 6, Amendment 1 - January 18, 2018 (2GHz Personal Communications Services)
- CFR Title 47 Part 27 Subpart C & L
- RSS-139 Issue 3- July 16, 2015

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards:

ANSI C63.26-2015
ANSI C63.4-2014
ANSI TIA-603-E
FCC KDB 971168 D01 v03r01
FCC KDB 971168 D03 v01
FCC KDB 662911D01 v02r01
TIA-102.CAAA-D

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC requirements.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of Nokia Solutions and Networks product Airscale Base Station Remote Radio Head (RRH) Model AHFIG and therefore apply only to the tested sample. The sample was selected and prepared by Hobert Smith and John Rattanavong of Nokia Solutions and Networks.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA and Canada, the device requires certification.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

Testing was performed only on Model AHFIG. No additional models were described or supplied for testing.

STATEMENT OF COMPLIANCE

The tested sample of Nokia Solutions and Networks product Airscale Base Transceiver Station Remote Radio Head (RRH) Model AHFIG complied with the requirements of the standards and frequency bands declared in the scope of this test report.

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

The following tables provide a summary of the test results:

FCC Part 24 and IC RSS-133 (Base Stations Operating in the 1930MHz to 1995MHz Band)

AHFIG operating in the PCS Band					
FCC	IC	Description	Measured	Limit	Results
Transmitter Modulation, output power and other characteristics					
24.229	RSS-133 Section 6.1	Frequency Ranges	LTE1.4: 1930.7 – 1989.3MHz LTE3: 1931.5 – 1988.5MHz LTE5: 1932.5 – 1992.5MHz LTE10: 1935.0 – 1990.0MHz LTE15: 1937.5 – 1987.5MHz LTE20: 1940.0 – 1985.0MHz WCDMA: 1932.4 – 1987.6MHz GSM/EDGE:1930.2 – 1989.8MHz	1930.0MHz to 1995.0MHz	Pass
2.1047	RSS-133 Section 6.2	Modulation Type	LTE1.4: QPSK, 16QAM, 64QAM, 256QAM LTE3: QPSK, 16QAM, 64QAM, 256QAM LTE5: QPSK, 16QAM, 64QAM, 256QAM LTE10: QPSK, 16QAM, 64QAM, 256QAM LTE15: QPSK, 16QAM, 64QAM, 256QAM LTE20: QPSK, 16QAM, 64QAM, 256QAM WCDMA: QPSK, 16QAM, 64QAM GSM/EDGE: GMSK, 8PSK	Digital	Pass
24.232	RSS-133 Section 6.4	Output Power	Highest Conducted Power Output RMS: 49.1dBm EIRP depends on antenna gain which is unknown	1640W/MHz EIRP/MHz	Pass
24.232	RSS-133 Section 6.4	Peak to Average Power Ratio	Highest Measured PAPR: 7.36dB	13dB	Pass
	RSS-133 Section 2.3	99% Emission Bandwidth	LTE1.4: 1.1129MHz LTE3: 2.7103MHz LTE5: 4.4981MHz LTE10: 8.9997MHz LTE15: 13.5085MHz LTE20: 17.9706MHz WCDMA: 3.9497MHz GMSK: 247kHz 8PSK: 244kHz	Remain in Block	Pass
24.238		26dB down Emission Bandwidth	LTE1.4: 1.241MHz LTE3: 2.928MHz LTE5: 4.841MHz LTE10: 9.670MHz LTE15: 14.538MHz LTE20: 19.358MHz WCDMA: 4.388MHz GMSK: 320kHz 8PSK: 312kHz	Remain in Block	Pass
Transmitter Spurious Emissions[1]					
24.238	RSS-133 Section 6.5.1	At the antenna terminals for GSM/EDGE	< -13dBm	-13dBm per Transmit Chain	Pass
		At the antenna terminals for WCDMA	< -16dBm	-16dBm per Transmit Chain	Pass
		At the antenna terminals for LTE	< -19dBm	-19dBm per Transmit Chain	Pass
		Field Strength	55.412dBuV/m at 1m Equivalent to -49.3dBm	-13dBm EIRP	Pass
Other Details					
24.235	RSS-133	Frequency Stability	Stays within authorized frequency block (0.0022ppm)	Stays within block	Pass
1.1310	RSS-102	RF Exposure	N/A		Pass[2]

Note 1: Based on 1MHz RBW. In the 1MHz immediately outside and adjacent to the frequency block a RBW of at least 1% of the emission bandwidth was used. The measurement bandwidth is 1MHz for measurements more than 1MHz from the band edge.
Note 2: Applicant's declaration on a separate exhibit based on hypothetical antenna gains.

LTE Emission Designators for the PCS Band								
Ch BW	LTE-QPSK		LTE-16QAM		LTE-64QAM		LTE-256QAM	
	FCC	IC	FCC	IC	FCC	IC	FCC	IC
1.4M	1M24F9W	1M11F9W	1M24F9W	1M11F9W	1M24F9W	1M11F9W	1M23F9W	1M11F9W
3M	2M92F9W	2M71F9W	2M92F9W	2M71F9W	2M93F9W	2M71F9W	2M93F9W	2M71F9W
5M	4M83F9W	4M49F9W	4M81F9W	4M48F9W	4M84F9W	4M49F9W	4M84F9W	4M50F9W
10M	9M66F9W	8M98F9W	9M67F9W	9M00F9W	9M64F9W	8M99F9W	9M65F9W	8M97F9W
15M	14M5F9W	13M5F9W	14M4F9W	13M5F9W	14M5F9W	13M4F9W	14M5F9W	13M5F9W
20M	19M4F9W	17M9F9W	19M3F9W	18M0F9W	19M3F9W	18M0F9W	19M3F9W	17M9F9W
Note: FCC based on 26dB emission bandwidth; IC based on 99% emission bandwidth.								

WCDMA Emission Designators for the PCS Band					
WCDMA-QPSK		WCDMA-16QAM		WCDMA-64QAM	
FCC	IC	FCC	IC	FCC	IC
4M36F9W	3M95F9W	4M39F9W	3M95F9W	4M36F9W	3M94F9W
Note: FCC based on 26dB emission bandwidth; IC based on 99% emission bandwidth.					

GSM/EDGE Emission Designators for the PCS Band			
GSM -GMSK		EDGE -8PSK	
FCC	IC	FCC	IC
320KGXW	247KGXW	312KG7W	244KG7W
Note: FCC based on 26dB emission bandwidth; IC based on 99% emission bandwidth.			

FCC Part 27 Subpart C&L/IC RSS-139 (Base Stations Operating in the 2110 - 2200MHz Band)

AHFIG operating in the AWS Band					
FCC	IC	Description	Measured	Limit	Results
Transmitter Modulation, output power and other characteristics					
27.5 (h)&(j)	RSS-139 Sec 6.1	Frequency Ranges	LTE1.4: 2110.7 – 2199.3MHz LTE3: 2111.5 - 2198.5MHz LTE5: 2112.5 - 2197.5MHz LTE10: 2115.0 - 2195.0MHz LTE15: 2117.5 - 2192.5MHz LTE20: 2120.0 - 2190.0MHz WCDMA: 2112.4 – 2167.6MHz	2110.0MHz to 2200.0MHz	Pass
2.1033 (c)(4)	RSS-139 Sec 6.2	Modulation Type	LTE1.4: QPSK, 16QAM, 64QAM, 256QAM LTE3: QPSK, 16QAM, 64QAM, 256QAM LTE5: QPSK, 16QAM, 64QAM, 256QAM LTE10: QPSK, 16QAM, 64QAM, 256QAM LTE15: QPSK, 16QAM, 64QAM, 256QAM LTE20: QPSK, 16QAM, 64QAM, 256QAM WCDMA: QPSK, 16QAM, 64QAM	Digital	Pass
27.50 (d)(2)	RSS-139 Sec 6.5	Output Power	Highest Conducted Power Output RMS: 46.2dBm EIRP depends on antenna gain which is unknown	1640W/MHz EIRP/MHz	Pass
27.50 (d)(5)	RSS-139 Sec 6.5	Peak to Average Power Ratio	Highest Measured PAPR: 7.37dB	13dB	Pass
	RSS-Gen Sec 6.6	99% Emission Bandwidth	LTE1.4: 1.1160MHz LTE3: 2.7197MHz LTE5: 4.4982MHz LTE10: 8.9854MHz LTE15: 13.4621MHz LTE20: 17.9712MHz WCDMA: 3.9494MHz	Remain in Block	Pass
27.53 (h)(3)		26dB down Emission Bandwidth	LTE1.4: 1.247MHz LTE3: 2.927MHz LTE5: 4.842MHz LTE10: 9.670MHz LTE15: 14.474MHz LTE20: 19.390MHz WCDMA: 4.365MHz	Remain in Block	Pass
Transmitter Spurious Emissions[1]					
27.53 (h)	RSS-139 Sec 6.6	At the antenna terminals for WCDMA	< -16dBm	-16dBm per Transmit Chain	Pass
		At the antenna terminals for LTE	< -19dBm	-19dBm per Transmit Chain	Pass
		Field strength	55.412dBuV/m at 1m Equivalent to -49.3dBm	-13 dBm EIRP	Pass
Other Details					
27.54	RSS-139 Sec 6.4	Frequency Stability	Stays within authorized frequency block (0.0021ppm)	Stays within block	Pass
1.1310	RSS102	RF Exposure	N/A		Pass[2]

Note 1: Based on 1MHz RBW. In the 1MHz immediately outside and adjacent to the frequency block a RBW of at least 1% of the emission bandwidth was used. The measurement bandwidth is 1MHz for measurements more than 1MHz from the band edge.
Note 2: Applicant's declaration on a separate exhibit based on hypothetical antenna gains.

LTE Emission Designators for the AWS Band								
Ch BW	LTE-QPSK		LTE-16QAM		LTE-64QAM		LTE-256QAM	
	FCC	IC	FCC	IC	FCC	IC	FCC	IC
1.4M	1M24F9W	1M11F9W	1M24F9W	1M11F9W	1M25F9W	1M12F9W	1M25F9W	1M12F9W
3M	2M92F9W	2M71F9W	2M93F9W	2M71F9W	2M92F9W	2M71F9W	2M93F9W	2M72F9W
5M	4M84F9W	4M49F9W	4M83F9W	4M48F9W	4M83F9W	4M50F9W	4M83F9W	4M50F9W
10M	9M65F9W	8M97F9W	9M63F9W	8M99F9W	9M67F9W	8M98F9W	9M63F9W	8M98F9W
15M	14M4F9W	13M5F9W	14M4F9W	13M5F9W	14M5F9W	13M5F9W	14M5F9W	13M5F9W
20M	19M4F9W	18M0F9W	19M2F9W	18M0F9W	19M4F9W	18M0F9W	19M3F9W	18M0F9W
Note: FCC based on 26dB emission bandwidth; IC based on 99% emission bandwidth.								

WCDMA Emission Designators for the AWS Band					
LTE-QPSK		LTE-16QAM		LTE-64QAM	
FCC	IC	FCC	IC	FCC	IC
4M36F9W	3M95F9W	4M36F9W	3M94F9W	4M37F9W	3M94F9W
Note: FCC based on 26dB emission bandwidth; IC based on 99% emission bandwidth.					

Extreme Conditions

Frequency stability is determined over extremes of temperature and voltage.

The extremes of voltage were 85 to 115 percent of the nominal value.

The extremes of temperature were -30°C to +50°C as specified in FCC §2.1055(a)(1).

Measurement Uncertainties

Measurement uncertainties of the test facility based on a 95% confidence level are as follows:

Test	Uncertainty
Radio frequency	± 0.2ppm
RF power conducted	±1.2 dB
RF power radiated	±3.3 dB
RF power density conducted	±1.2 dB
Spurious emissions conducted	±1.2 dB
Adjacent channel power	±0.4 dB
Spurious emissions radiated	±4 dB
Temperature	±1°C
Humidity	±1.6 %
Voltage (DC)	±0.2 %
Voltage (AC)	±0.3 %

EQUIPMENT UNDER TEST (EUT) DETAILS

General

The equipment under test (EUT) is a Nokia Solutions and Networks AirScale Base Transceiver Station (BTS) Remote Radio Head (RRH) module, model AHFIG. The AHFIG remote radio head is a multistandard multicarrier radio module designed to support GSM/EDGE, WCDMA, LTE, and narrow band IoT (internet of things) operations. The scope of testing in this effort is for GSM/EDGE, WCDMA and LTE operations.

The AHFIG RRH has four transmit/four receive antenna ports (4TX/4RX for Band 25 and 4TX/4RX for Band 66). Each antenna port supports 3GPP frequency band 25 (BTS Rx: 1850 to 1915 MHz/BTS TX: 1930 to 1995 MHz) and 3GPP frequency band 66 (BTS Rx: 1710 to 1780 MHz/BTS TX: 2110 to 2200 MHz). The maximum RF output power of the RRH is 480 Watts (80 watts per carrier and 80 per port for band 25 operations; 40 watts per carrier and 40 per port for band 66 operations). The TX and RX instantaneous bandwidth cover the full operational RRH bandwidth. Multi-carrier operation is supported.

The RRH can be operated as a 4x4 MIMO, 2x2 MIMO or as non-MIMO for LTE. The RRH supports 1.4, 3, 5, 10, 15, and 20MHz LTE bandwidths. The RRH supports four LTE downlink modulation types (QPSK, 16QAM, 64QAM and 256QAM). The RRH LTE downlink bands are supported over 3GPP frequency band 25 and band 66 frequency ranges (band 25 - BTS TX: 1930 to 1995 MHz & band 66 - BTS TX: 2110 to 2200 MHz).

The RRH can be operated as a 2x2 MIMO or as non-MIMO for WCDMA. The RRH supports three WCDMA downlink modulation types (QPSK, 16QAM, and 64QAM). The RRH WCDMA downlink bands are supported over 3GPP frequency band XXV and band X frequency ranges (band XXV - BTS TX: 1930 to 1995 MHz & band X - BTS TX: 2110 to 2170 MHz).

The RRH can be operated as non-MIMO for GSM/EDGE. The RRH supports two GSM/EDGE downlink modulation types (GMSK and 8PSK). The RRH GSM/EDGE downlink band is supported over 3GPP band PCS 1900 (BTS TX: 1930 to 1990 MHz).

The RRH has external interfaces including DC power (DC In), ground, transmit/receive (ANT), external alarm (EAC), optical CPRI (OPT) and remote electrical tilt (RET). The RRH with applicable installation kit may be pole or wall mounted.

The AHFIG downlink channel numbers and frequencies for LTE, WCDMA and GSM/EDGE operations are as follows:

The PCS Band LTE channel bandwidths are 1.4, 3, 5, 10, 15 and 20MHz. The channel spacing is 100 kHz between channel numbers. LTE1.4 and LTE3 bandwidths are limited to the 1930 to 1990MHz frequency range.

	Downlink EARFCN	Downlink Frequency (MHz)	LTE Channel Bandwidth					
			1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz
AHFIG PCS Band (Ant 1, 2, 3, 4)	8040	1930.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge
	.....							
	8047	1930.7	Bottom Ch					
	.....							
	8055	1931.5		Bottom Ch				
	.....							
	8065	1932.5			Bottom Ch			
	.....							
	8090	1935.0				Bottom Ch		
	.....							
	8115	1937.5					Bottom Ch	
	.....							
	8140	1940.0						Bottom Ch
	.....							
	8365	1962.5	Middle Ch	Middle Ch	Middle Ch	Middle Ch	Middle Ch	Middle Ch
	.....							
	8590	1985.0						Top Ch
	.....							
	8615	1987.5					Top Ch	
	.....							
	8625	1988.5		Top Ch				
	.....							
	8633	1989.3	Top Ch					
	.....							
	8640	1990.0	Band Edge	Band Edge		Top Ch		
	.....							
	8665	1992.5			Top Ch			
	.....							
	8690	1995.0			Band Edge	Band Edge	Band Edge	Band Edge

AHFIG Downlink Band Edge LTE PCS Band Frequency Channels

The AWS Band LTE channel bandwidths are 1.4, 3, 5, 10, 15 and 20MHz. The channel spacing is 100 kHz between channel numbers.

	Downlink EARFCN	Downlink Frequency (MHz)	LTE Channel Bandwidth					
			1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz
AHFIG AWS Band (Ant 1, 2, 3, 4)	66436	2110.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge
	……							
	66443	2110.7	Bottom Ch					
	……							
	66451	2111.5		Bottom Ch				
	……							
	66461	2112.5			Bottom Ch			
	……							
	66486	2115.0				Bottom Ch		
	……							
	66511	2117.5					Bottom Ch	
	……							
	66536	2120.0						Bottom Ch
	……							
	66886	2155.0	Middle Ch	Middle Ch	Middle Ch	Middle Ch	Middle Ch	Middle Ch
	……							
	67236	2190.0						Top Channel
	……							
	67261	2192.5					Top Channel	
	……							
	67286	2195.0				Top Channel		
	……							
	67311	2197.5			Top Channel			
	……							
	67321	2198.5		Top Channel				
	……							
	67329	2199.3	Top Channel					
	……							
	67336	2200.0	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge	Band Edge

AHFIG Downlink Band Edge LTE AWS Band Frequency Channels

LTE Multicarrier Test Cases

PCS Multicarrier Multiband Test Case

In the PCS band _Three LTE5 carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (EARFCN 8065: 1932.5 & EARFCN 8115: 1937.5MHz) and a third carrier with maximum spacing between the other two carrier frequencies (EARFCN 8665: 1992.5MHz) at the upper band edge. In the AWS band _ Single LTE1.4 carrier at the middle channel (EARFCN 66866: 2155MHz). The smallest channel bandwidth was selected to maximize carrier power spectral density. The LTE5 PCS carrier bandwidth was chosen because it was the smallest LTE bandwidth that covers the entire PCS frequency range.

AWS Multicarrier Multiband Test Case

In the AWS band: Three LTE1.4 carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (EARFCN 66443: 2110.7 & EARFCN 66457: 2112.1MHz) and a third carrier with maximum spacing between the other two carrier frequencies (EARFCN 67329: 2199.3MHz) at the upper band edge. In the PCS band: Single LTE1.4 carrier at the middle channel (EARFCN 8365: 1962.5MHz). The smallest channel bandwidth was selected to maximize carrier power spectral density.

Multicarrier Multiband Test Case

Three LTE1.4 carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the PCS band lower band edge (EARFCN 8047: 1930.7 & EARFCN 8061: 1932.1MHz) and a third carrier with maximum spacing between the other two carrier frequencies (EARFCN 67329: 2199.3MHz) at the AWS band upper band edge. The smallest channel bandwidth was selected to maximize carrier power spectral density.

The PCS and AWS Bands WCDMA channel bandwidth is 5MHz. The channel spacing is 200 kHz between channel numbers. The RRH software limits the PCS Band carrier operation to UTRA band II (upper band edge of 1990MHz).

	Downlink UARFCN UTRA Band II	Downlink Frequency (MHz)	WCDMA Channel
PCS Band_ AHFIG Antennas 1, 2, 3, 4	9660	1930.0	Band edge
	……		
	9662	1932.4	Bottom Channel
	9663	1932.6	Bottom Channel + 1
	……		
	9800	1960.0	Middle Channel
	……		
	9937	1987.4	Top Channel - 1
	9938	1987.6	Top Channel
	……		
	9940	1990.0	Band edge

AHFIG Downlink Band edge WCDMA PCS Band Frequency Channels

	Downlink UARFCN UTRA Band X	Downlink Frequency (MHz)	WCDMA Channel
AWS Band_ AHFIG Antennas 1, 2, 3, 4	3100	2110.0	Band edge
	……		
	3112	2112.4	Bottom Channel
	3113	2112.6	Bottom Channel + 1
	……		
	3250	2140.0	Middle Channel
	……		
	3387	2167.4	Top Channel - 1
	3388	2167.6	Top Channel
	……		
	3400	2170.0	Band edge

AHFIG Downlink Band edge WCDMA AWS Band Frequency Channels

WCDMA Multicarrier Test Cases

PCS Multicarrier Multiband Test Case

In the PCS band: Three carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (UARFCN 9662: 1932.4 & UARFCN 9687: 1937.4MHz) and a third carrier with maximum spacing between the other two carrier frequencies (UARFCN 9938: 1987.6MHz) at the upper band edge. In the AWS band: Single WCDMA carrier at the middle channel (UARFCN 3250: 2140MHz).

AWS Multicarrier Multiband Test Case

In the AWS band: Three WCDMA carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (UARFCN 3112: 2112.4 & UARFCN 3137: 2117.4MHz) and a third carrier with maximum spacing between the other two carrier frequencies (UARFCN 3388: 2167.6MHz) at the upper band edge. In the PCS band: Single WCDMA carrier at the middle channel (UARFCN 9800: 1960.0MHz).

Multicarrier Multiband Test Case

Three WCDMA carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the PCS band lower band edge (UARFCN 9662: 1932.4 & UARFCN 9687: 1937.4MHz) and a third carrier with maximum spacing between the other two carrier frequencies (UARFCN 3388: 2167.6MHz) at the AWS band upper band edge.

The PCS Band GSM/EDGE channel bandwidth is 200kHz. The minimum spacing between adjacent GSM/EDGE carriers is 400kHz. The maximum RF bandwidth is 37.5MHz (for rated power) for GSM carriers on the same antenna port. The spacing is 200 kHz between channel numbers.

	Downlink ARFCN PCS 1900	Downlink Frequency (MHz)	GSM/EDGE Channels
PCS Band_ AHFIG Antennas 1, 2, 3, 4	……	1930.0	Band Edge
	512	1930.2	Bottom Channel
	513	1930.4	Bottom Channel + 1
	……		
	624	1952.6	Max spacing from upper band edge: UBE-37.4MHz
	……		
	661	1960.0	Middle Channel
	……		
	698	1967.4	Max spacing from lower band edge: LBE+37.4MHz
	……		
	809	1989.6	Top Channel - 1
	810	1989.8	Top Channel
	……	1990.0	Band Edge

AHFIG Downlink Band Edge GSM/EDGE PCS Band Frequency Channels

Multicarrier Multiband Multi-RAT Test Case

(1) In the PCS band: Three GSM/EDGE carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (ARFCN 512: 1930.2 & ARFCN 514: 1930.6MHz) and a third carrier with maximum spacing between the other two GSM carrier frequencies (ARFCN 698: 1967.4MHz).
In the AWS band: Single LTE1.4 carrier with 256QAM at the middle channel (EARFCN 66886: 2155MHz). The smallest LTE channel bandwidth was selected to maximize carrier power spectral density.

(2) In the PCS band: Three GSM/EDGE carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at upper band edge (ARFCN 808: 1989.4 & ARFCN 810: 1989.8MHz) and a third carrier with maximum spacing between the other two carrier frequencies (ARFCN 624: 1952.6MHz).
In the AWS band: Single LTE1.4 carrier with 256QAM at the middle channel (EARFCN 66886: 2155MHz). The smallest LTE channel bandwidth was selected to maximize carrier power spectral density.

EUT Hardware

The EUT hardware used in testing on June 3 -7, 11, 13 & 24 - 27, 2019.

Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	AHFIG	AirScale BTS RRH	Part#: 475125A.101 Serial#: K9191322351	FCC ID: VBNAHFIG-01 IC ID: 661W-AHFIG

Enclosure

The EUT enclosure is made of heavy-duty aluminum.

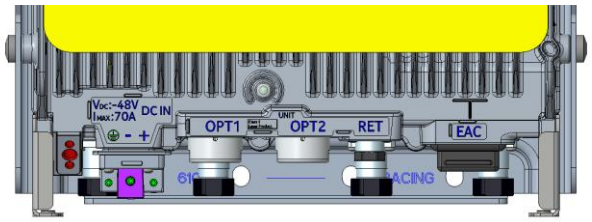
Support Equipment

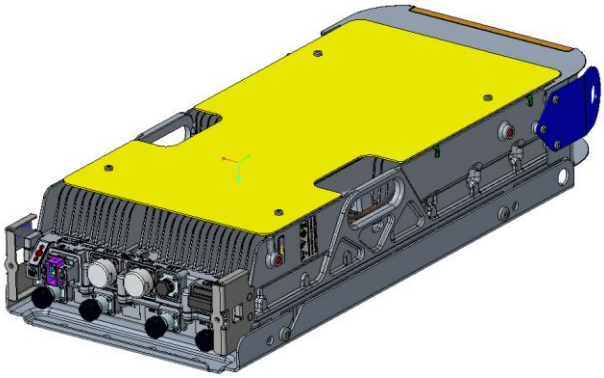
Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	AMIA	Airscale System Module	Part#: 473098A.102 Serial#: J8173107703	N/A
HP	Elite Book 6930p	Laptop PC	N/A	N/A
Dell	Studio XPS	Instrumentation PC	N/A	N/A

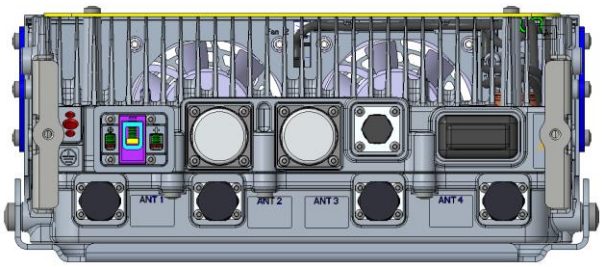
Auxillary Equipment

Company	Description	Part Number	Serial Number
Nokia	FOUC 10GHz SFP Module (Plugs into RRH Opt Ports)	473842A.101	KR16090020071 KR16180010036
RLC Electronics	2.4GHz High Pass Filter -2 Watt[1]	F-100-3000-5-R	0028
Microwave Circuits	1.4GHz Low Pass Filter -100 Watt[1]	L13502G1	2454-01
Weinschel	Attenuator 20dB -150 Watt[1]	66-20-33-LIM	BZ2075
Weinschel	Attenuator 40dB -250 Watt[1]	58-40-43-LIM	TC909
Weinschel	Attenuator 10dB -250 Watt[1]	58-10-43-LIM	TD446
Weinschel	Attenuator 3dB-100 Watt[1]	47-3-33	CG5493
Huber & Suhner	RF Cable – 1 meter[1]	Sucoflex 104	551123/4
Huber & Suhner	RF Cable -1 meter[1]	Sucoflex 106	297370
Note 1: Used only in antenna port RF conducted emission testing.			

AHFIG Connector Layout:







EUT External Interfaces

Name	Qty	Connector Type	Purpose (and Description)
DC In	1	Screw Terminal	2-pole Power Input Terminal
GND	1	Screw lug (2xM5/1xM8)	Ground
ANT	4	4.3-10	RF signal for Transmitter/Receiver (50 Ohm)
Unit	1	LED	Unit Status LED
EAC	1	MDR26	External Alarm Interface (4 alarms)
OPT	2	SFP+ cage	Optical CPRI Interface up to 10 Gps.
RET	1	8-pin circular connector conforming to IEC 60130-9 – Ed.3.0	AISG 2.0 to external devices
Fan	1	Molex Microfit	Power for RRH Fans. Located on the side of RRH.

EUT Interface Ports

The I/O cabling configuration during testing was as follows:

Cable	Type	Shield	Length	Used in Test	Quantity	Termination
Power Input	Power	No	~ 3 m	Yes	1	Power Supply
Earth	Earth	No	~ 1 m	Yes	1	Lab earth ground
Antenna	RF	Yes	~ 3 m	Yes	4	50Ω Loads
External Alarm	Signal	Yes	~ 3 m	Yes	1	Un-terminated
Remote Electrical Tilt	Signal	Yes	~ 3 m	Yes	1	Un-terminated
Multimode Optical	Optical	No	>6 m	Yes	2	System Module

EUT Operation

During testing, the EUT was transmitting continuously with 100% duty-cycle at full power on all chains.

EUT Software

The laptop PC connects to the System Module over the LMP (Ethernet) port. The system module controls the RRH via the optical interface. The laptop is used for changing configuration settings, monitoring tests and controlling the BTS. The following software versions are used for the testing:

(1) RRH Unit Software: FRM59.06.R10

(2) System Module Software: SBTS00_ENB_9999_190624_001520

Modifications

No modifications were made to the EUT during testing.

TESTING

General Information

Antenna port measurements were taken with NTS personnel (Alex Mathews) at Nokia premises located at 6000 Connection Drive; Irving, Texas 75309.

Radiated emissions and frequency accuracy/stability measurements were taken at NTS Plano branch located at 1701 E Plano Pkwy #150 Plano, TX 75074.

Radiated spurious emissions measurements were taken at the NTS Plano Anechoic Chamber listed below. The sites conform to the requirements of ANSI C63.4-2014: "*American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz" and CISPR 16-1-4:2010-04: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus* – Antennas and test sites for radiated disturbance measurements". They are on file with the FCC and Industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 1	A2LA Accredited Designation Number US1077	IC 4319A-2	1701 E Plano Pkwy #150 Plano, TX 75074.

Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements.

Measurement Procedures

The RMS average output power, peak power output, emission bandwidth, conducted spurious, and conducted band edge measurements were performed with a spectrum analyzer. The carrier frequency accuracy/stability and complementary cumulative distribution function (CCDF) measurements were performed with a signal analyzer. The EUT was operated at maximum RF output power for all tests (unless otherwise noted). While measuring one transmit chain, the other one was terminated with termination blocks. All measurements were corrected for the insertion loss of the RF network (attenuators, filters, and cables) inserted between the RF port of the EUT and the spectrum analyzer. Block diagrams and photographs of the test setups are provided below.

The 26dB emission bandwidth was measured in accordance with section 4 of FCC KDB 971168 D01v03r01 and ANSI C63.26 section 5.4. The 99% occupied bandwidth was measured in accordance with section 6.7 of RSS-Gen Issue 5. For both measurements, an occupied bandwidth built-in function in the spectrum analyzer was used and Keysight Benchvue Software was used to capture the spectrum analyzer screenshots. Spectrum analyzer settings are shown on their corresponding plots in test results section.

The emissions at the band edges were captured with Keysight Benchvue Software with settings described in the corresponding sections of the FCC and IC regulatory requirements. Spectrum analyzer settings are shown on their corresponding plots in test results section.

Average output power measurements were performed in accordance with sections 5.2/5.4 of FCC KDB 971168 D01v03r01 and ANSI C63.26 and the screenshots were captured using Keysight Benchvue Software. Peak power measurements were performed as described in section 5.1 of KDB 971168 D01v03r01 and ANSI C63.26-2015 section 5.2.3 and the screenshots were captured using Keysight Benchvue Software. The peak to average power ratio (PAPR) has been calculated as described in section 5.7 of KDB971168 D01v03r01 and ANSI C63.26-2015 section 5.2.6. Analyzer settings are shown on their corresponding plots in the test results section.

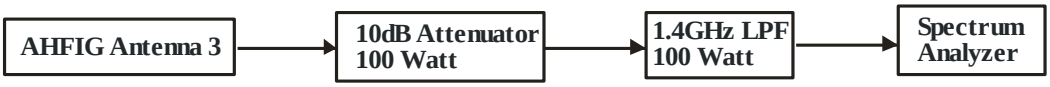
Conducted spurious emissions were captured with Keysight Benchvue Software across the 9kHz-22GHz frequency span. A low pass filter was used to reduce measurement instrumentation noise floor for the frequency ranges below 20MHz. A high pass filter was used to reduce measurement instrumentation noise floor for the frequency ranges above 6GHz. The total measurement RF path loss of the test setup (attenuators, filters and test cables) were accounted for by the spectrum analyzer reference level offset. Spectrum analyzer settings are described in the corresponding test result section.

For frequency stability/accuracy measurements, the EUT was placed inside a temperature chamber with all support and test equipment located outside of the chamber. Temperature was varied across the specified range in 10-degree increments and EUT was allowed enough time to stabilize at each temperature step (a minimum of 30 minutes per step). The input voltage was varied as required by FCC/IC regulatory requirements. A signal analyzer as detailed in the test equipment section was used for frequency stability/accuracy measurements.

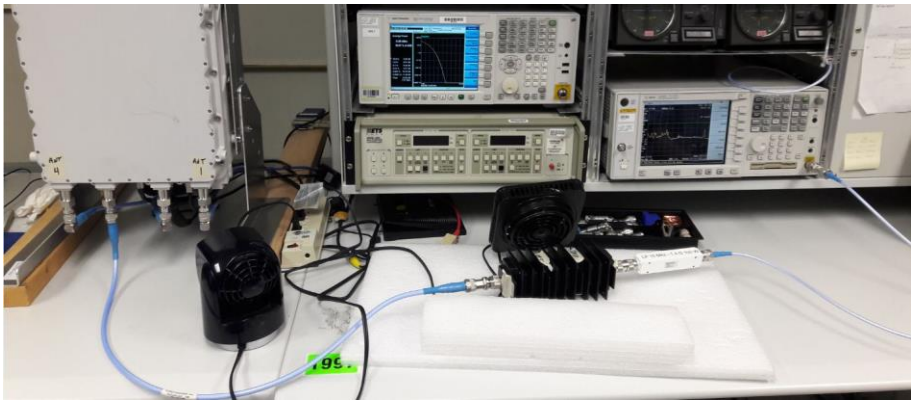
Transmitter radiated spurious emissions measurements were made in accordance with ANSI C63.4 by measuring the field strength of the emissions from the device at 3m test distance for emissions below 10 GHz and at 1m test distance for emissions above 10 GHz. The eirp limit as specified in the relevant rule part(s) is converted to a field strength at the test distance and the emissions from the EUT are then compared to that limit. Only emissions within 20dB of this limit are subjected to a substitution measurement in accordance with TIA-603. Both preliminary and final measurements were performed at the same FCC listed test chamber. Preliminary scans were performed with TILE6 software. This software corrected the measurements for antenna factors, cable losses and pre-amplifier gains. Both polarizations of the receiving antenna were scanned from 30MHz to 22GHz with a peak detector (RBW=1MHz, VBW=3MHz, with trace max hold over multiple sweeps). Based on the preliminary scan results, frequencies of interest have been maximized via rotating the EUT 360 degrees and varying the height of the test antenna (1m to 4m). Final measurements were also taken with the peak detector as described above. A biconilog antenna was used for 30MHz-1GHz range. A double ridged waveguide horn antenna was used for 1-18GHz range and a smaller horn antenna was used for 18-22GHz range. The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. The EUT was placed on a non-conductive RF transparent structure to provide 80cm height from the ground floor for frequencies $\leq$ 1GHz and 150cm height from the ground floor for frequencies > 1GHz in accordance with ANSI C63.26-2015. A motorized turntable allowed it to be rotated during testing to determine the angle with the highest level of emissions.

Antenna Port Conducted RF Measurement Test Setup Diagrams

The following setups were used in the AHFIG RF conducted emissions testing. The photographs of the test setups are also provided.

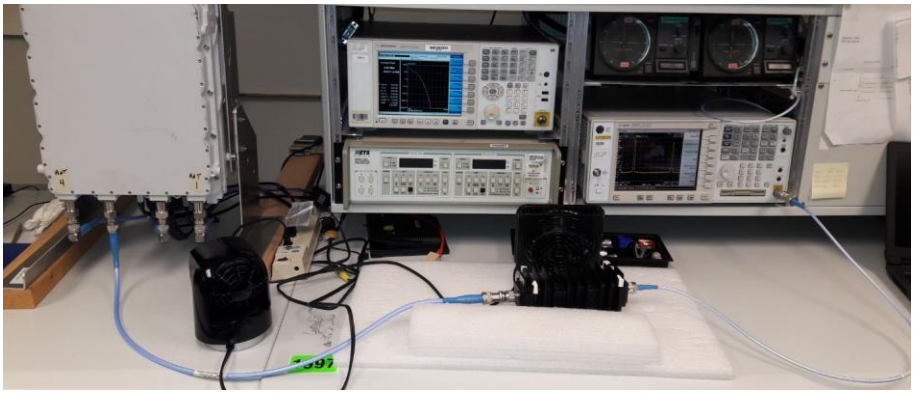


Setup for 9kHz to 150kHz and 150kHz to 20MHz Measurements

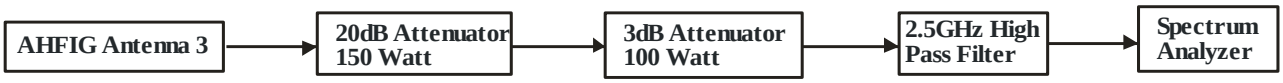


Photograph of 9kHz to 150kHz and 150kHz to 20MHz Test Setup

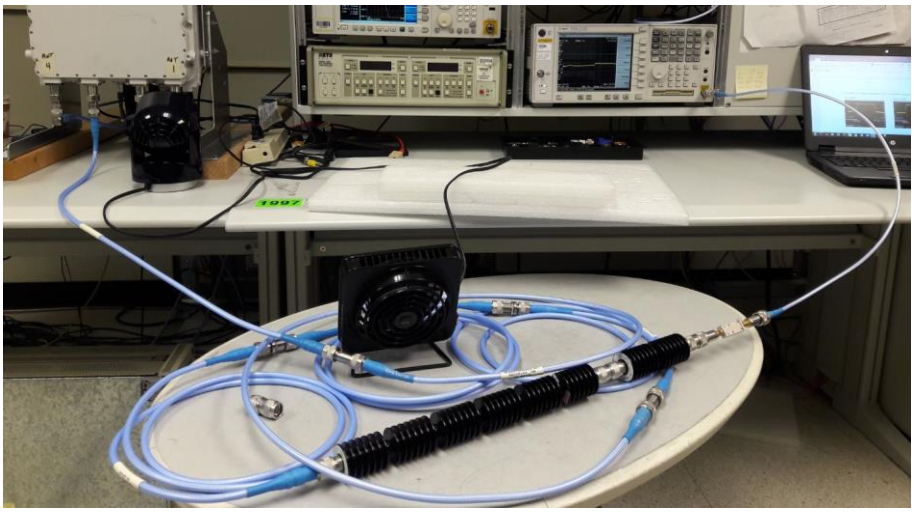
Setup for 20MHz to 3GHz and 3GHz to 6GHz Measurements



Photograph of 20MHz to 3GHz and 3GHz to 6GHz Test Setup



Setup for 6GHz to 22GHz Measurements



Photograph of for 6GHz to 18GHz Test Setup

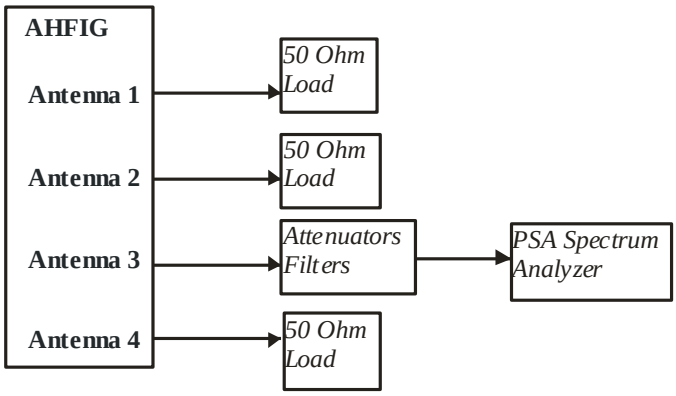
Test Measurement Equipment

Nokia Equipment #	Description	Manufacturer	Model	Calibration Duration	Calibration Due Date
120194[1]	PSA Spectrum Analyzer	Agilent	E4440A	12 Months	10/17/2019
NM04508[1]	MXA Signal Analyzer	Agilent	N9020A	24 Months	05/08/2021
NM06345[1]	ENA Network Analyzer	Keysight	E5063A	12 Months	12/15/2019
NM04509[1]	Network Analyzer	Rohde & Schwarz	ZVL 3	12 Months	2/12/2020
NM06374[1]	MXG Analog Signal Gen	Keysight	N5183B	36 Months	02/04/2021
Note 1: Customer equipment					

NTS ID#	Manufacturer/Model	Duration	Calibration Due
WC021613	Spectrum Analyzer Agilent E4440A	12 months	2/14/2020
WC066284	Spectrum Analyzer Agilent E4446A	12 months	6/14/2020
WC020916	ETS Bilog Antenna 3142C	12 months	1/2/2020
WC021208	EMCO 3116 Antenna 18-40GHz	12 months	1/16/2020
WC066299	MITEQ TTA1840-35HG Preamp 18-40GHz	12 months	1/16/2020
WC021206	EMCO Horn Antenna 3115	12 months	1/23/2020
WC021468	Miteq Pre-Amp AM1431-N-1179-SC	12 months	8/10/2019
WC038647	Com Power CGO-520 Comb Gen	NCR	NCR
WC021846	Com Power CGO-5100B Comb Gen	NCR	NCR
WC021377	Fluke 87 Multimeter	12 months	12/26/2019

APPENDIX A: ANTENNA PORT LTE TEST DATA FOR THE PCS BAND

All conducted RF measurements in this section were made at AHFIG antenna ports. All available LTE channel bandwidths (1.4, 3, 5, 10, 15, & 20MHz) with all available modulation types (QPSK, 16QAM, 64QAM & 256QAM) were measured. The LTE modulation types are setup according to 3GPP TS 36.141 E-UTRA Test Models (E-TM) as follows E-TM 1.1: QPSK, E-TM 3.1: 64QAM, E-TM3.1a: 256QAM and E-TM 3.2: 16QAM. The test setup used is provided below.



Test Setup Used for AHFIG Conducted RF Measurements

RF Output Power

RF output power has been measured in RMS Average terms for each PCS transmit chain at the middle channel (1962.5MHz) for 256QAM modulation and LTE5 bandwidth as described in section 5.2 of KDB 971168 D01v03r01 and ANSI C63.26-2015 section 5.2.4.4. The RRH was operated at maximum RF output power. The peak to average power ratio (PAPR) has been measured using the signal analyzer complementary cumulative distribution function (CCDF) for a probability of 0.1% as described in section 5.7.2 of KDB971168 D01v03r01 and ANSI C63.26-2015 section 5.2.3.4. All results are presented in tabular form below. The highest measured values are highlighted.

Antenna	LTE Bandwidth	LTE - 256QAM	
		PAPR (dB)	Average (dBm)
Port 1 Middle Channel	**5M**	**7.26**	48.69
Port 2 Middle Channel	**5M**	7.23	48.57
Port 3 Middle Channel	**5M**	7.23	**48.87**
Port 4 Middle Channel	**5M**	7.24	48.74

The variation in RMS output power levels between the antenna ports is 0.30 dB per data sample provided above. Pre-compliance testing (and testing of similar EUTs) shows that the output power variation between antenna ports is small (the output ports are essentially electrically identical). The highest power port was selected as the worst case.

Pre-compliance testing has shown that the output power variation between modulation types is small. Antenna port 3 power output measurements for the LTE5 bandwidth for all modulation types on the middle (center) channel are provided below.

	Modulation Type							
	QPSK		16QAM		64QAM		256QAM	
	PAPR (dB)	Ave (dBm)	PAPR (dB)	Ave (dBm)	PAPR (dB)	Ave (dBm)	PAPR (dB)	Ave (dBm)
Antenna Port 3 Middle Channel LTE5	7.25	48.79	7.25	48.85	7.26	48.80	7.23	48.87

The output power variation between modulation types is small in this measurement snapshot (and from past efforts on similar hardware as well). The variation of average power output versus modulation type is 0.08dB for the data snapshot provided. The variation of PAPR versus modulation type is 0.03dB for the data snapshot provided. All power measurements in this report (except the sample test noted above) were performed with the EUT operating with 256QAM modulation.

Based on the results above, Port 3 had the highest LTE RMS average power for the PCS band (represents the worst case) and therefore it was selected for all the remaining antenna port tests. Port 3 has the highest combined LTE RMS average power for the AWS + PCS bands.
Subsequently output power levels on bottom, middle, and top channels in all 6 LTE channel bandwidths and 256QAM modulation type were tested only at Port 3 and the results presented below. The highest measured values are highlighted.

Antenna LTE Channel	LTE Bandwidth	LTE - 256QAM	
		PAPR (dB)	Average (dBm)
Port 3 Bottom Channel	1.4M	7.27	48.63
	3M	7.24	48.65
	5M	7.26	48.79
	10M	7.32	48.86
	15M	7.34	**48.96**
	20M	**7.36**	**48.96**
Port 3 Middle Channel	1.4M	7.28	48.64
	3M	7.23	48.78
	5M	7.23	48.87
	10M	7.23	48.80
	15M	7.21	48.74
	20M	7.19	48.84
Port 3 Top Channel	1.4M	7.28	48.86
	3M	7.23	48.79
	5M	7.26	48.66
	10M	7.24	48.81
	15M	7.24	48.81
	20M	7.22	48.83

The data provided in the table shows (and testing of similar EUTs) that the output RMS power variation between channel bandwidths at the center frequency channel is small (0.23dB).

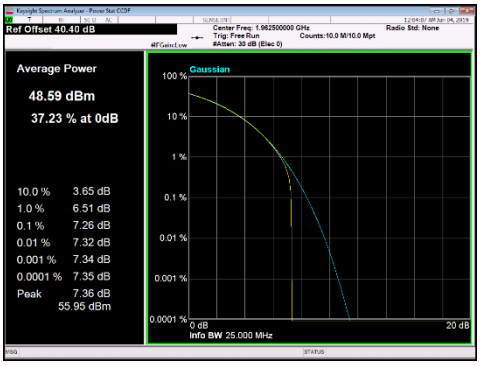
RF output power has been measured in RMS Average terms for each PCS multicarrier test configuration to verify/document the power levels. All results are presented in tabular form below.

Measured RMS Average Carrier Power Level for the Multicarrier Configurations at Antenna Port 3			
PCS Multicarrier LTE5		**Multiband Multicarrier LTE1.4**	
Bottom Carriers 1932.5 & 1937.5MHz	**Top Carrier 1992.5MHz**	**Bottom Carriers 1930.7 & 1932.1MHz**	**Top Carrier 2199.3MHz**
46.69 dBm (46.7 Watts)	44.45 dBm (27.9 Watts)	48.64 dBm (73.1 Watts)	45.69 dBm (37.1 Watts)
Total Carrier Power in PCS Band is 74.6 Watts or 48.73 dBm		Total Carrier Power in the PCS and AWS Band is 110.2 Watts or 50.4 dBm	

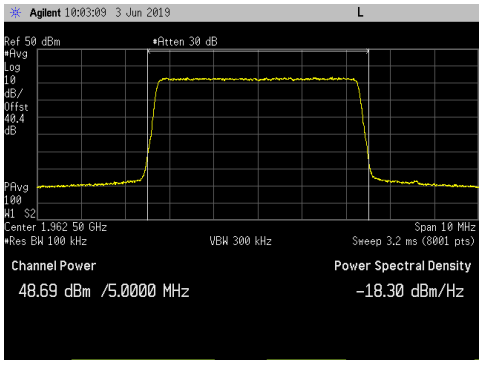
All measurement results are provided in the following pages. The total measurement RF path loss of the test setup (attenuator and test cables) was 40.4 dB and is accounted for by the spectrum analyzer reference level offset.

LTE5 Channel Power Plots at Middle Channel and 256QAM Modulation:

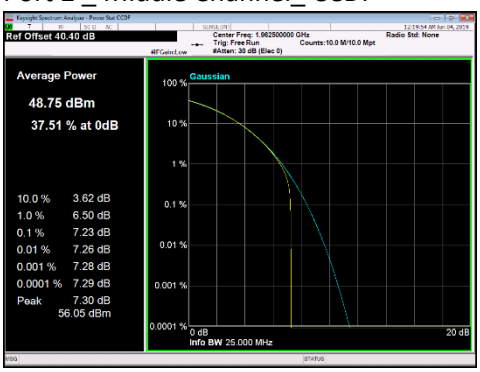
Port 1 _ Middle Channel_ CCDF



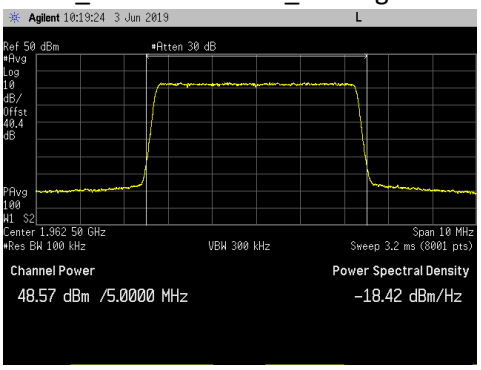
Port 1_ Middle Channel_ Average



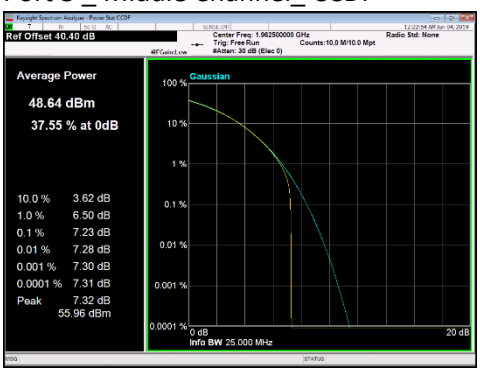
Port 2 _ Middle Channel_ CCDF



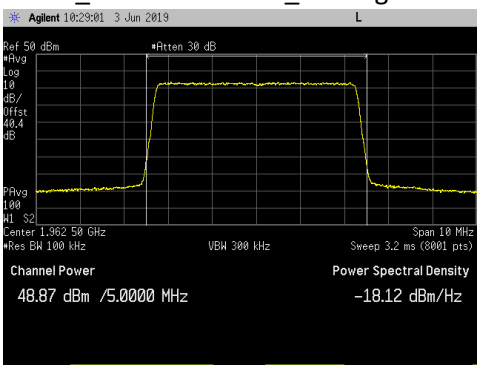
Port 2_ Middle Channel_ Average



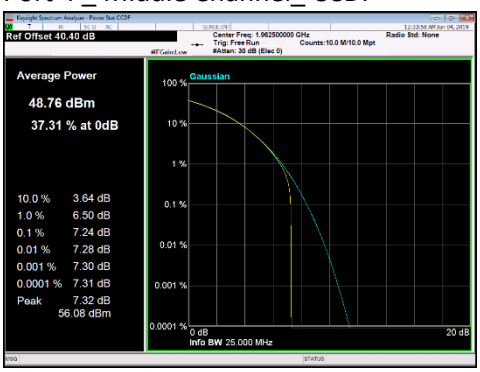
Port 3 _ Middle Channel_ CCDF



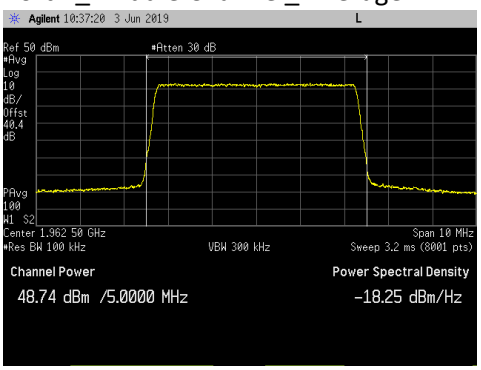
Port 3_ Middle Channel_ Average



Port 4 _ Middle Channel_ CCDF

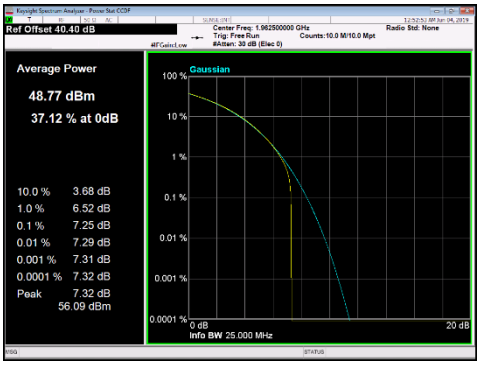


Port 4_ Middle Channel_ Average

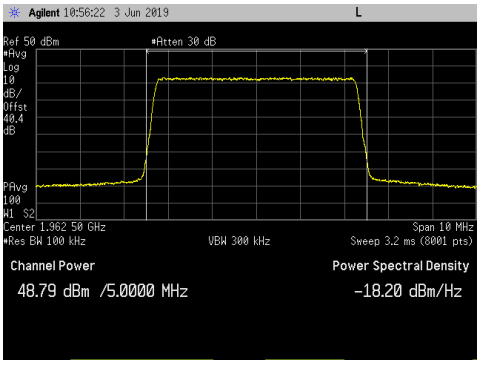


LTE5 Channel Power Plots for Antenna Port 3 at Middle Channel and all Modulation Types:

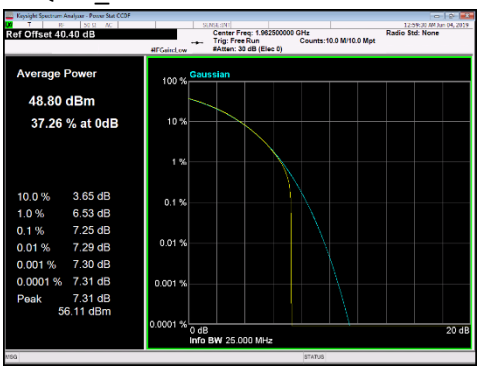
QPSK_ CCDF



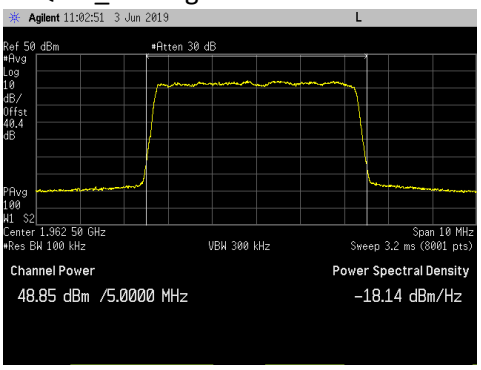
QPSK_ Average



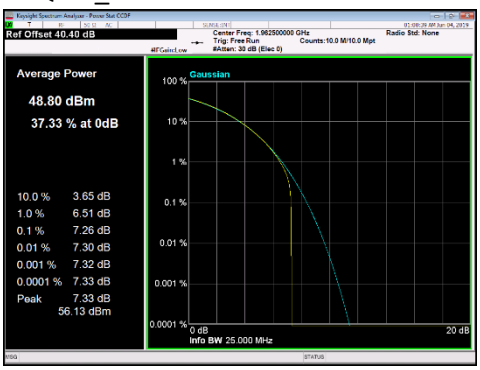
16QAM_ CCDF



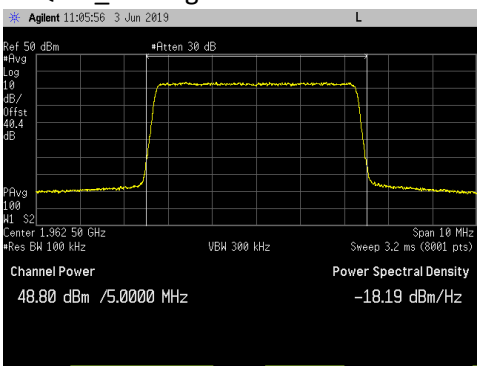
16QAM_ Average



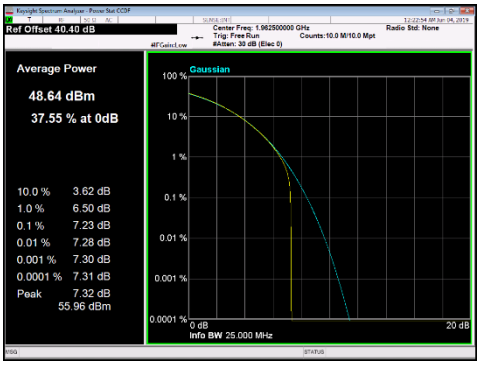
64QAM_ CCDF



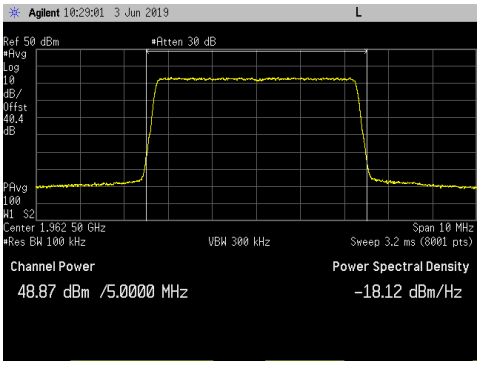
64QAM_ Average



256QAM_ CCDF

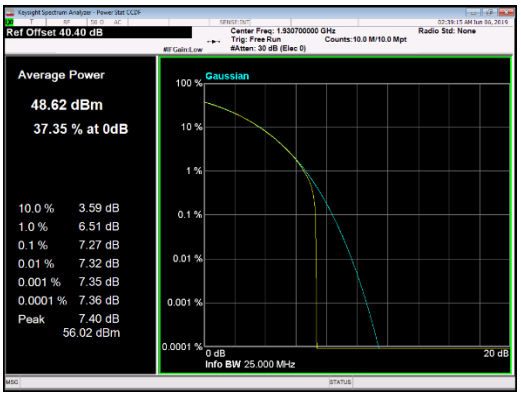


256QAM_ Average

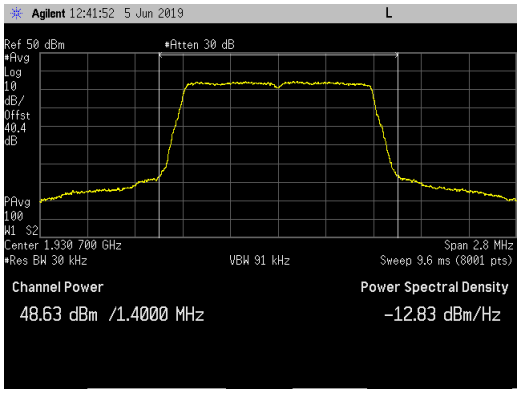


LTE1.4 Channel Power Plots for Antenna Port 3 and 256QAM Modulation:

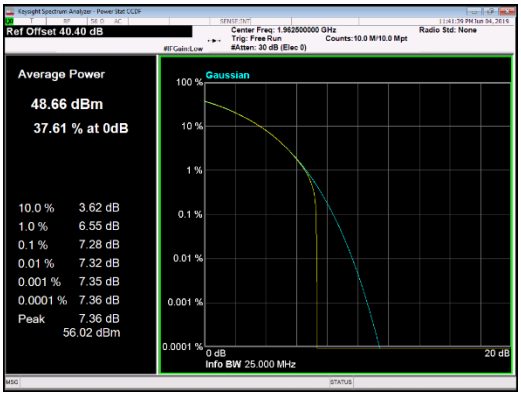
Bottom Channel_ CCDF



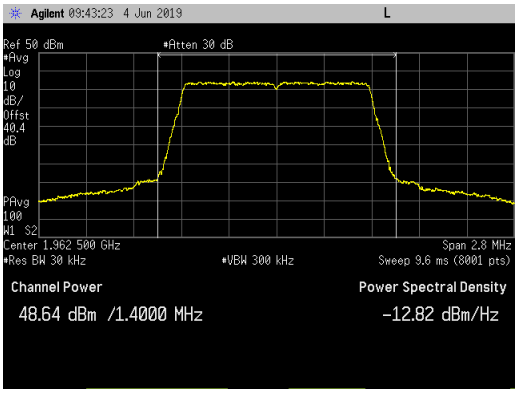
Bottom Channel_ Average



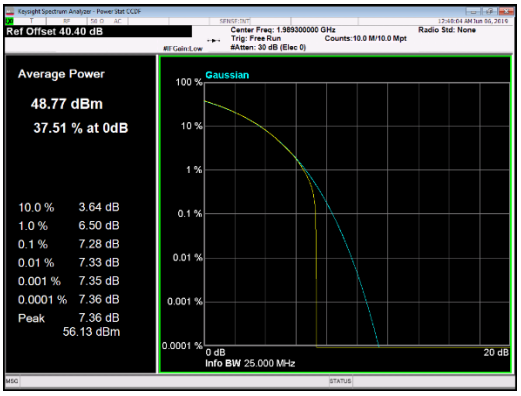
Middle Channel_ CCDF



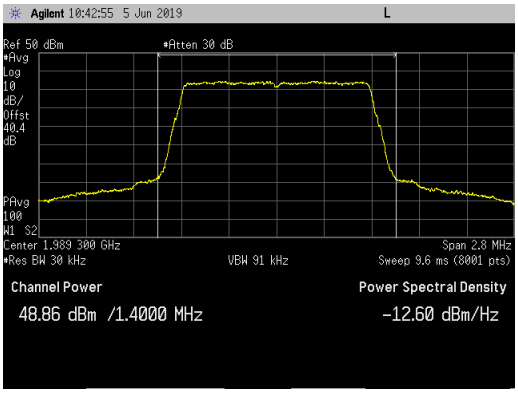
Middle Channel_ Average



Top Channel_ CCDF

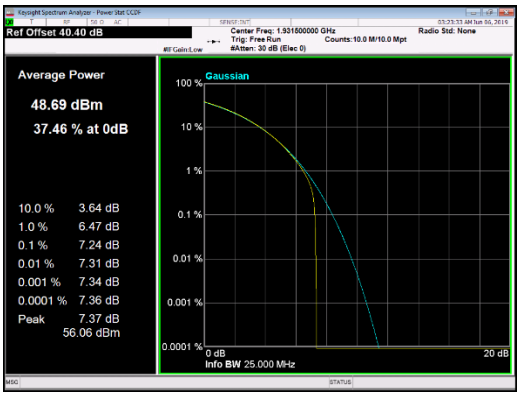


Top Channel_ Average

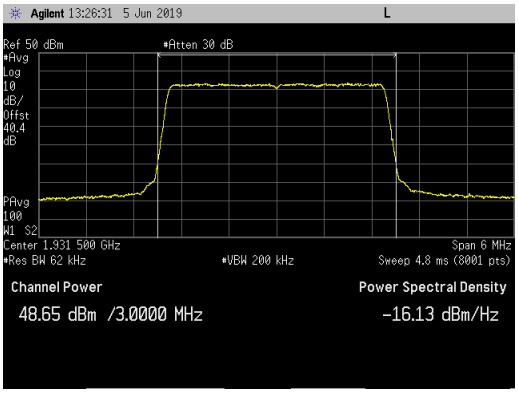


LTE3 Channel Power Plots for Antenna Port 3 and 256QAM Modulation:

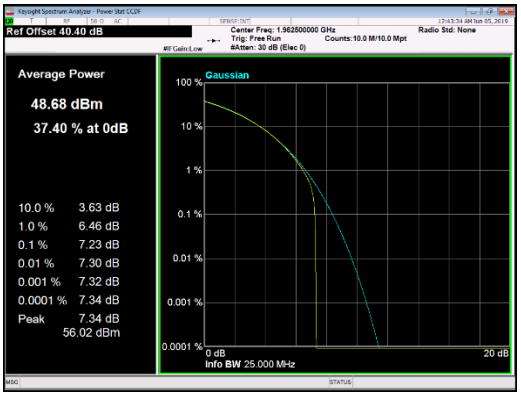
Bottom Channel_ CCDF



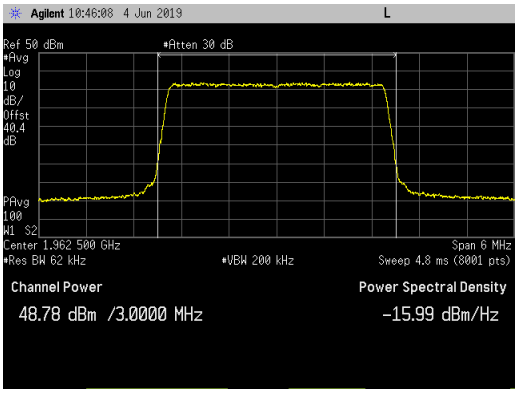
Bottom Channel_ Average



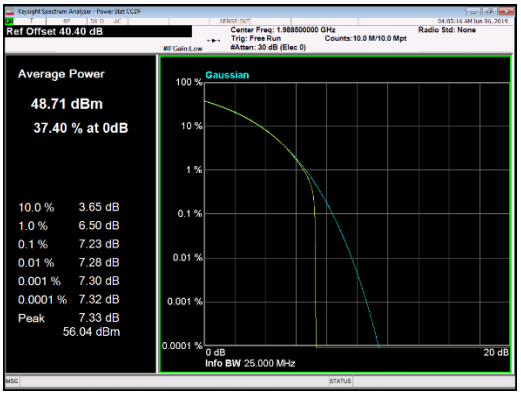
Middle Channel_ CCDF



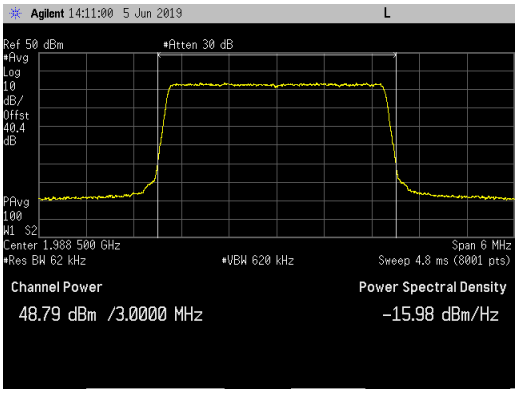
Middle Channel_ Average



Top Channel_ CCDF

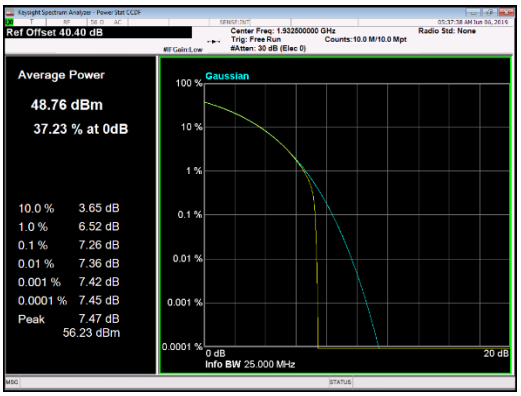


Top Channel_ Average

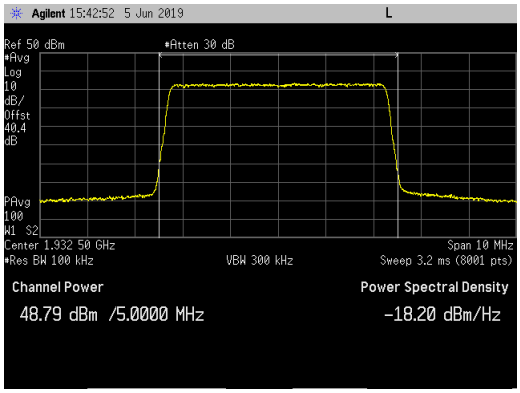


LTE5 Channel Power Plots for Antenna Port 3 and 256QAM Modulation:

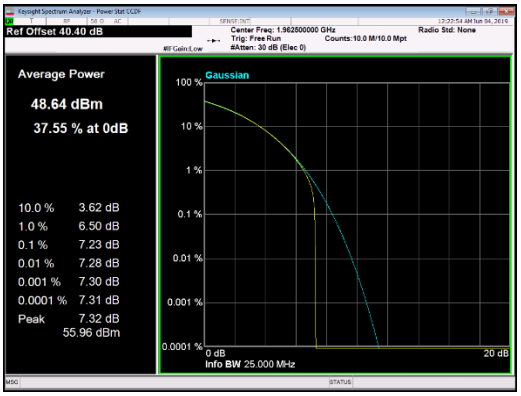
Bottom Channel_ CCDF



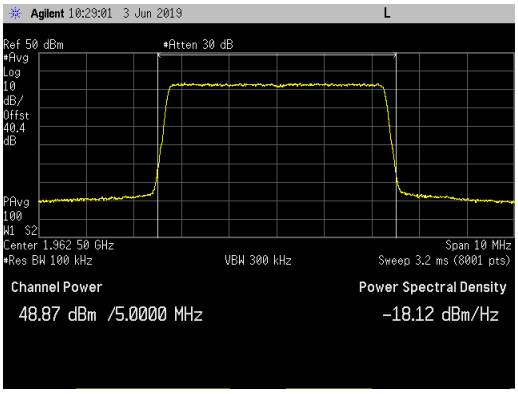
Bottom Channel_ Average



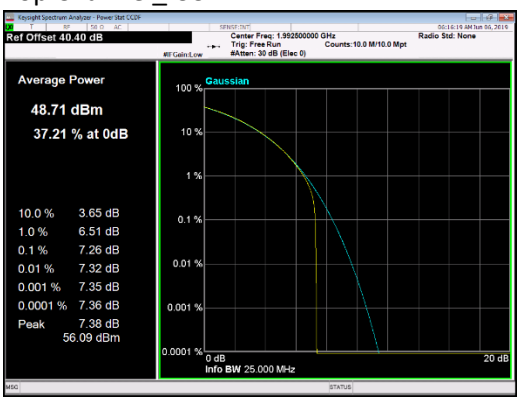
Middle Channel_ CCDF



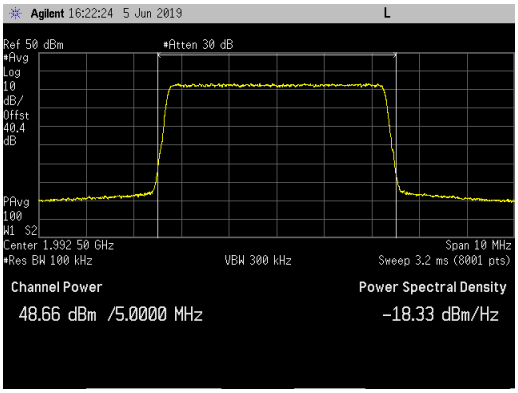
Middle Channel_ Average



Top Channel_ CCDF

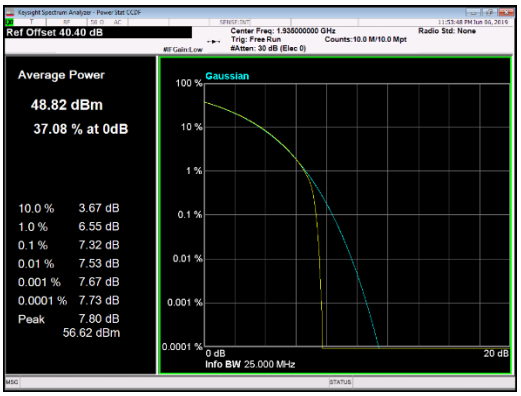


Top Channel_ Average

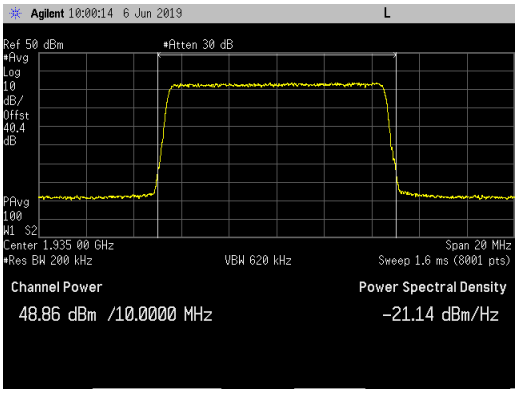


LTE10 Channel Power Plots for Antenna Port 3 and 256QAM Modulation:

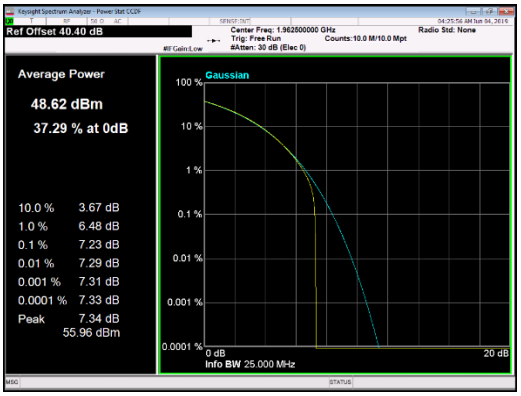
Bottom Channel_ CCDF



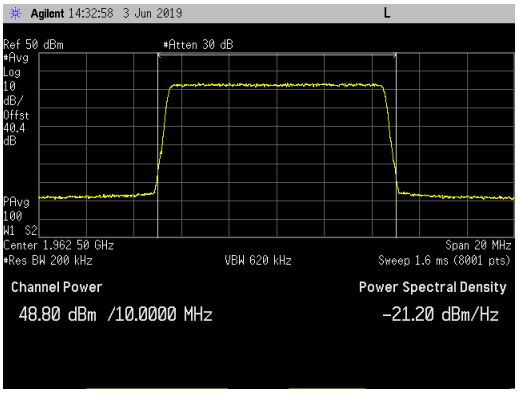
Bottom Channel_ Average



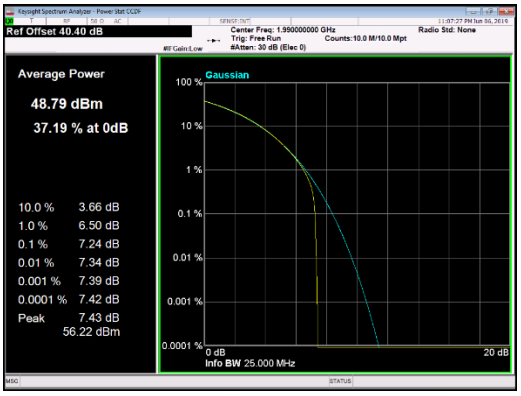
Middle Channel_ CCDF



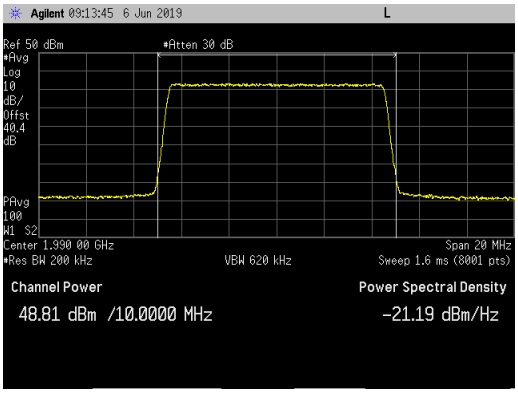
Middle Channel_ Average



Top Channel_ CCDF

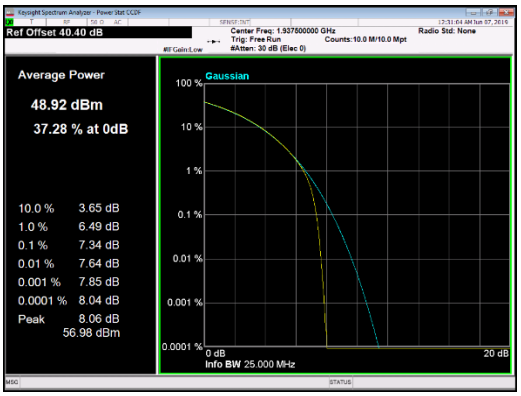


Top Channel_ Average

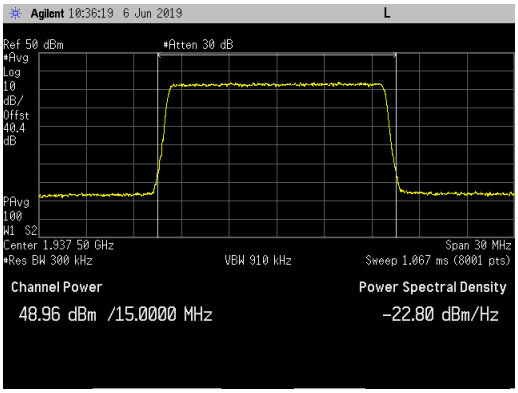


LTE15 Channel Power Plots for Antenna Port 3 and 256QAM Modulation:

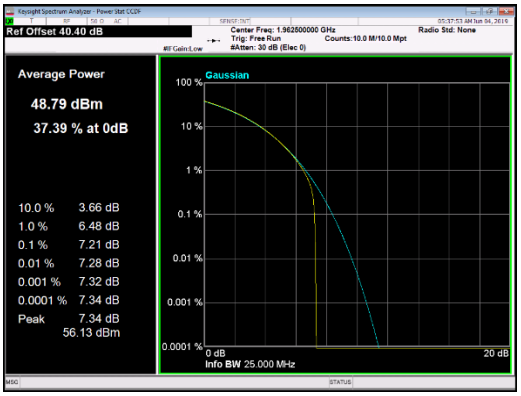
Bottom Channel_ CCDF



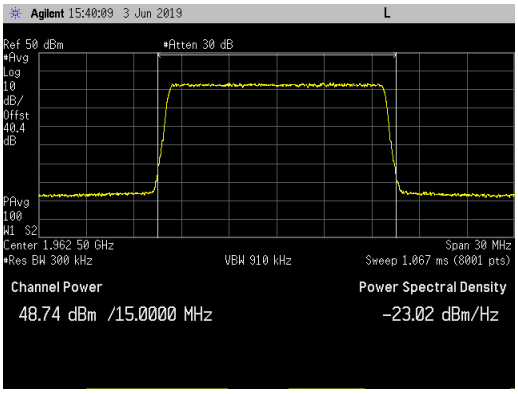
Bottom Channel_ Average



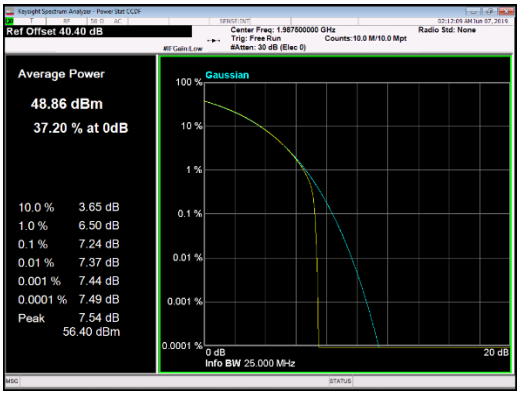
Middle Channel_ CCDF



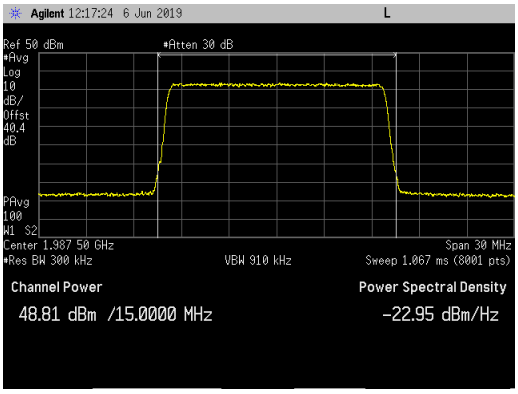
Middle Channel_ Average



Top Channel_ CCDF

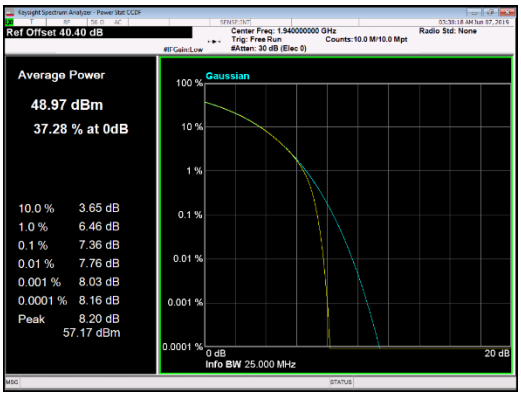


Top Channel_ Average

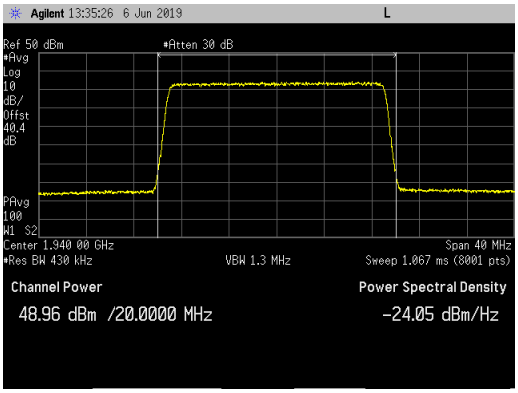


LTE20 Channel Power Plots for Antenna Port 3 and 256QAM Modulation:

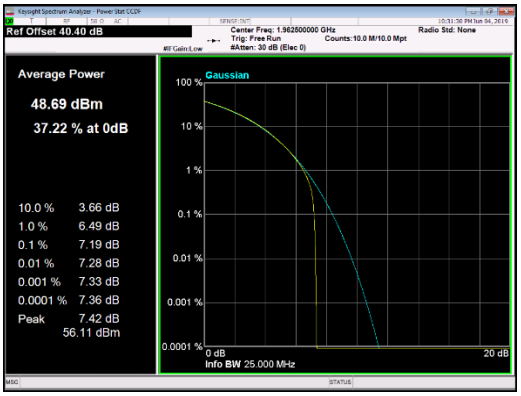
Bottom Channel_ CCDF



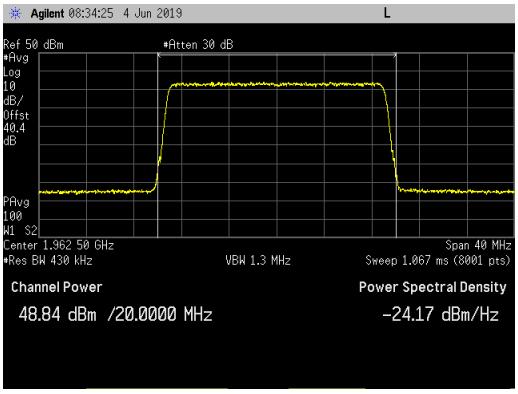
Bottom Channel_ Average



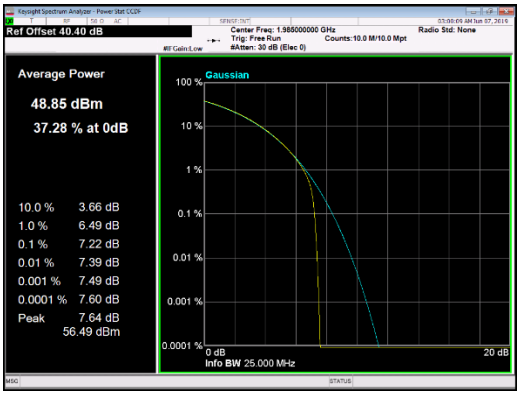
Middle Channel_ CCDF



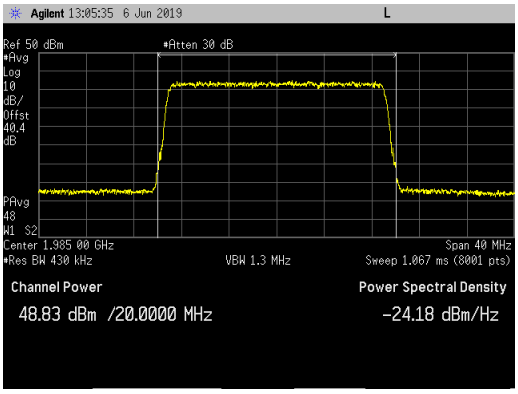
Middle Channel_ Average



Top Channel_ CCDF

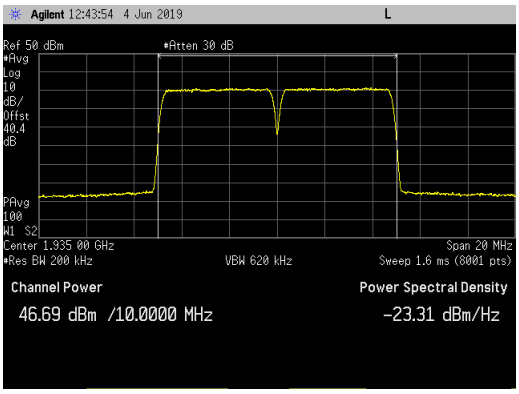


Top Channel_ Average

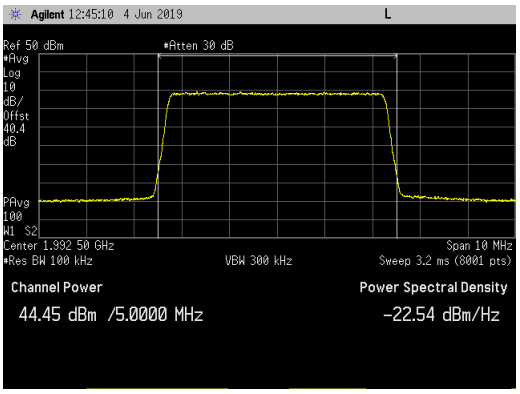


PCS Multicarrier LTE5 (Carriers at 1932.5, 1937.5 & 1992.5MHz) Channel Power Plots for Antenna Port 3:

256QAM_ 1932.5 & 1937.5MHz_ Average Power

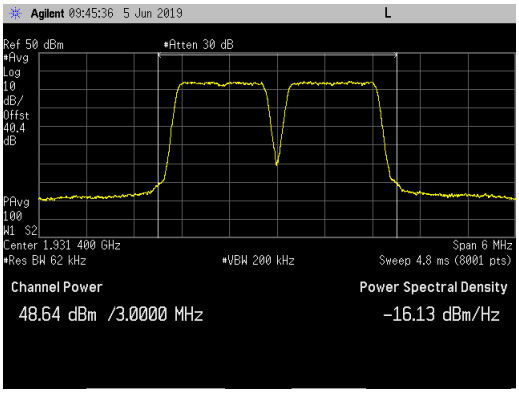


256QAM_ 1992.5MHz_ Average Power

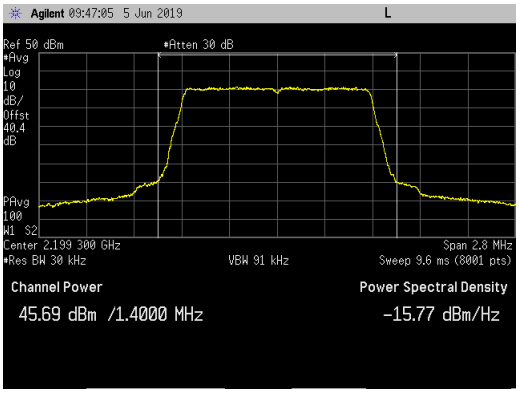


Multiband Multicarrier LTE1.4 (Carriers at 1930.7, 1932.1 & 2099.3MHz) Ch Power Plots for Antenna Port 3:

256QAM_ 1930.7 & 1932.1MHz_ Average Power



256QAM_ 2199.3MHz_ Average Power



Emission Bandwidth (26 dB down and 99%)

Emission bandwidth measurements were made at antenna port 3 on the middle channel with maximum RF output power. All available LTE modulations (QPSK, 16QAM, 64QAM and 256QAM) were used. All available LTE channel bandwidths (1.4 MHz, 3MHz, 5MHz, 10MHz, 15MHz, and 20MHz) were used.

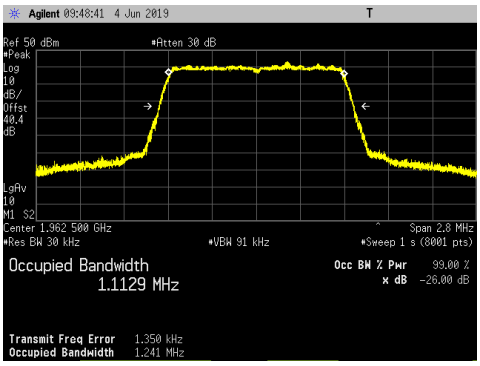
The 26dB emission bandwidth was measured in accordance with section 4 of FCC KDB 971168 D01v03r01 and ANSI C63.26 section 5.4. The 99% occupied bandwidth was measured in accordance with section 6.7 of RSS-Gen Issue 5. For both measurements, an occupied bandwidth built-in function in the spectrum analyzer was used. The results are provided in the following table. The largest emission bandwidths in each channel type are highlighted.

LTE Channel Bandwidth	Modulation Type							
	QPSK		16QAM		64QAM		256QAM	
	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)
1.4M	**1.241**	**1.1129**	1.236	1.1095	1.239	1.1058	1.230	1.1048
3M	2.920	2.7067	2.922	2.7056	**2.928**	**2.7103**	2.927	2.7051
5M	4.827	4.4882	4.811	4.4823	4.837	4.4932	**4.841**	**4.4981**
10M	9.658	8.9826	**9.670**	**8.9997**	9.635	8.9859	9.652	8.9743
15M	14.510	13.4765	14.431	13.4738	14.467	13.4421	**14.538**	**13.5085**
20M	**19.358**	17.9213	19.312	**17.9706**	19.327	17.9521	19.325	17.9423

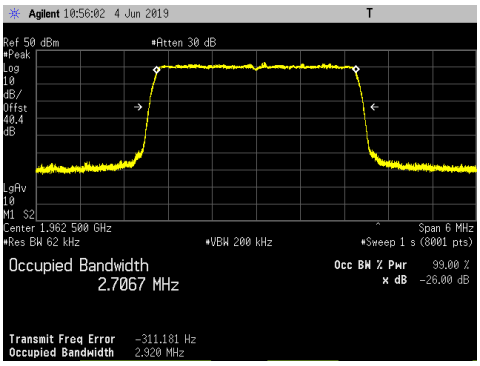
Emission bandwidth measurement data are provided in the following pages.

LTE1.4 and LTE3 Emission Bandwidth Plots on the Middle Channel for Antenna Port 3:

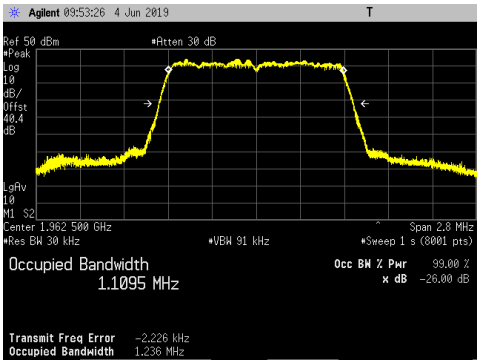
LTE1.4_ QPSK



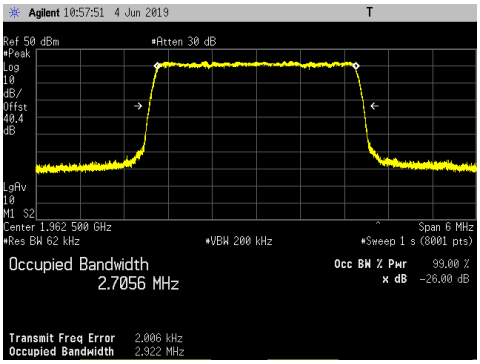
LTE3_ QPSK



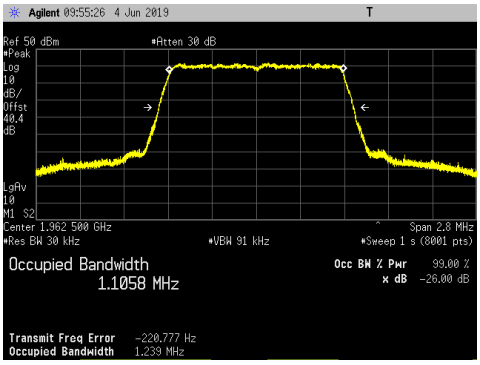
LTE1.4_ 16QAM



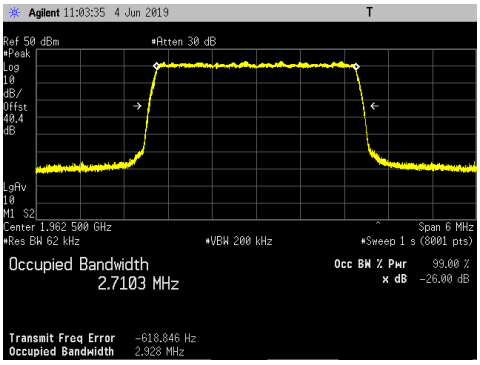
LTE3_ 16QAM



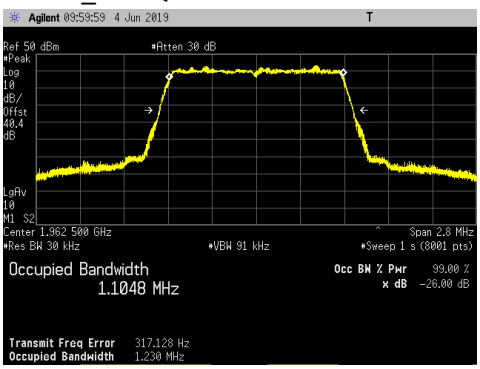
LTE1.4_ 64QAM



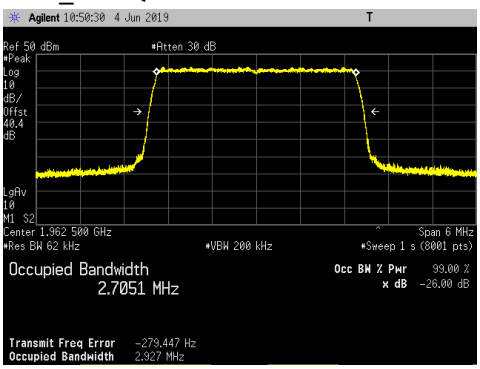
LTE3_ 64QAM



LTE1.4_ 256QAM

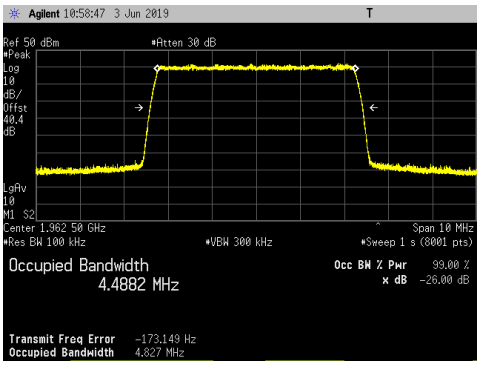


LTE3_ 256QAM

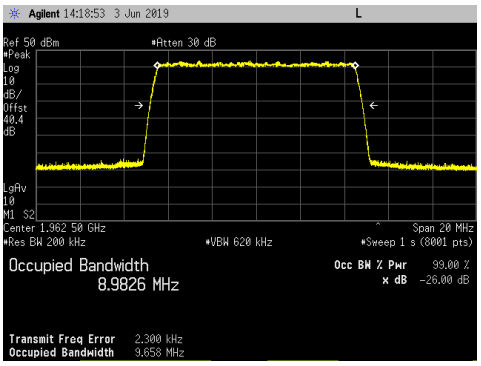


LTE5 and LTE10 Emission Bandwidth Plots on the Middle Channel for Antenna Port 3:

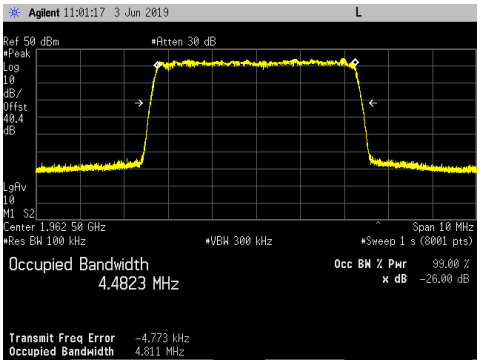
LTE5_ QPSK



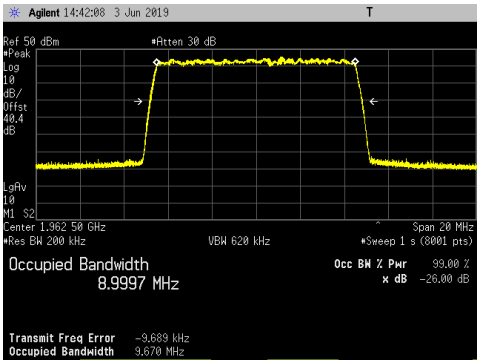
LTE10_ QPSK



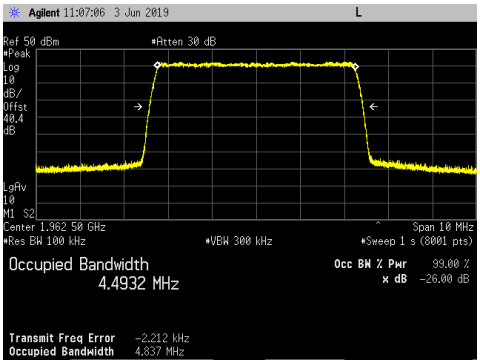
LTE5_ 16QAM



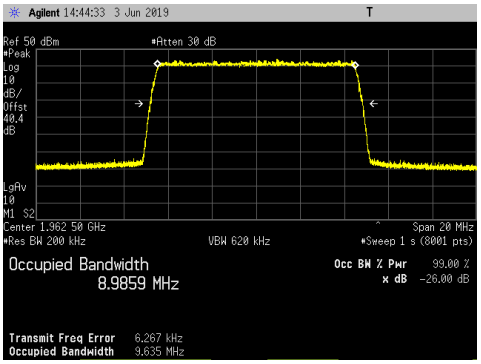
LTE10_ 16QAM



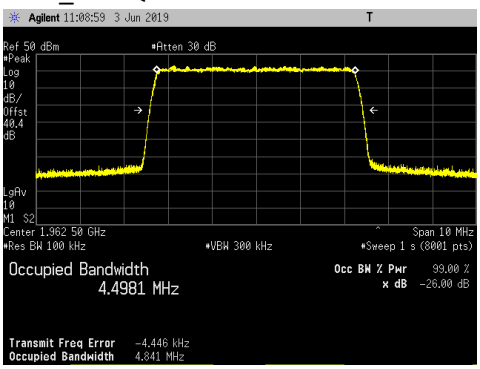
LTE5_ 64QAM



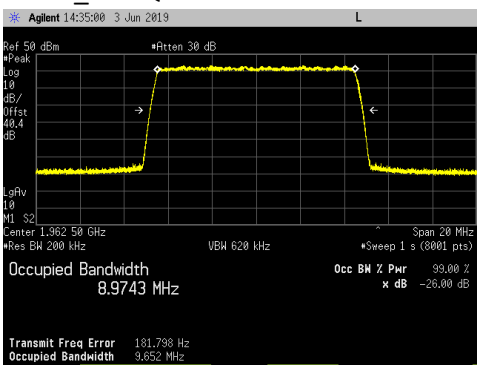
LTE10_ 64QAM



LTE5_ 256QAM

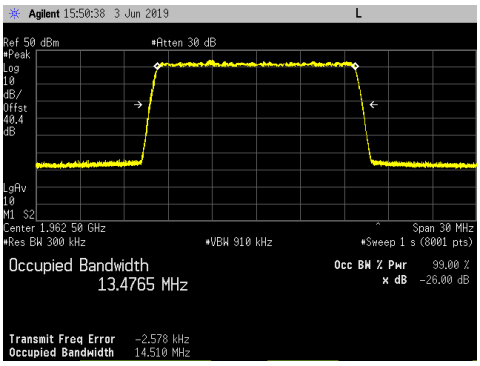


LTE10_ 256QAM

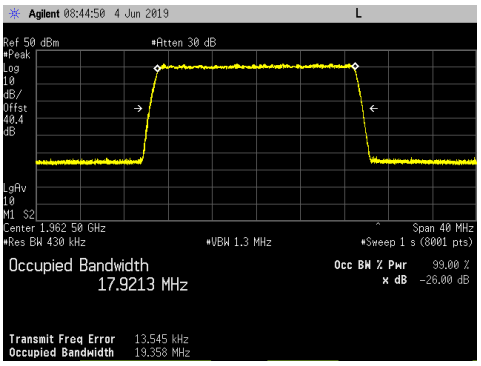


LTE15 and LTE20 Emission Bandwidth Plots on the Middle Channel for Antenna Port 3:

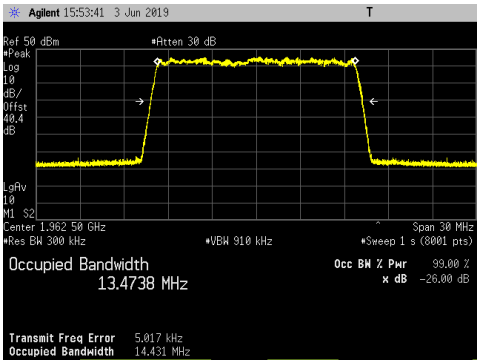
LTE15_ QPSK



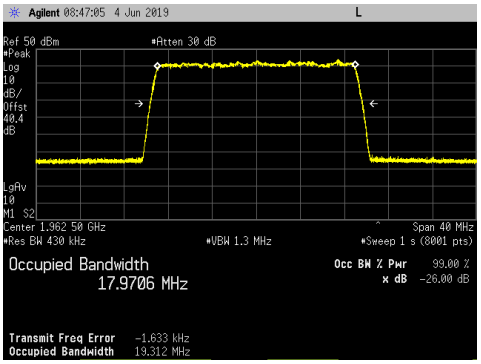
LTE20_ QPSK



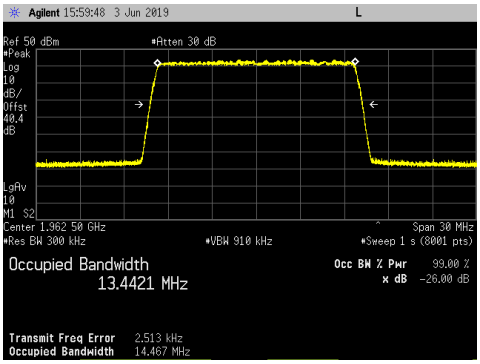
LTE15_ 16QAM



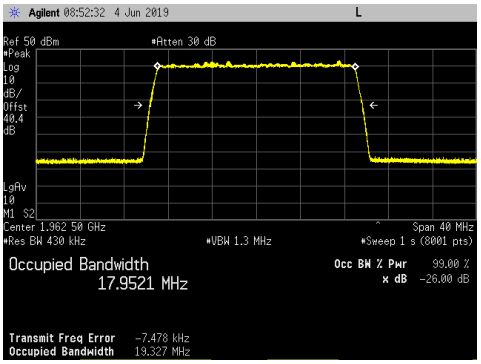
LTE20_ 16QAM



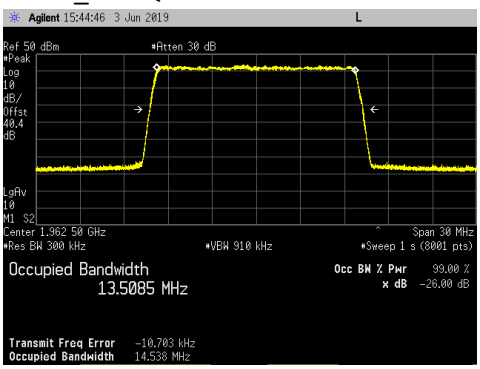
LTE15_ 64QAM



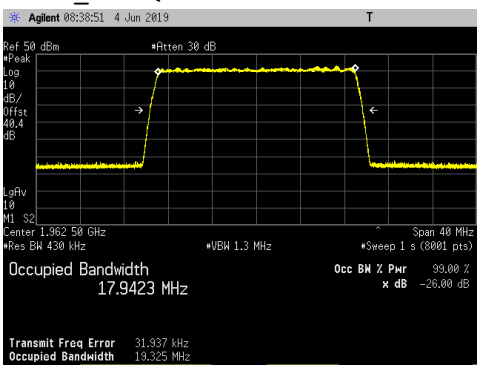
LTE20_ 64QAM



LTE15_ 256QAM



LTE20_ 256QAM



Antenna Port Conducted Band Edge

Conducted band edge measurements were made at RRH antenna port 3.

Single Carrier Test Cases

The RRH was operated at the PCS band edge frequencies with all modulation types (QPSK, 16QAM, 64QAM and 256QAM) for all LTE bandwidths (1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz and 20MHz) at maximum power (80 watts/port and 80 watts/carrier).

PCS Multicarrier Multiband Test Case

In the PCS band _Three LTE5 carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the lower band edge (EARFCN 8065: 1932.5 & EARFCN 8115: 1937.5MHz) and a third carrier with maximum spacing between the other two carrier frequencies (EARFCN 8665: 1992.5MHz) at the upper band edge. In the AWS band _ Single LTE1.4 carrier at the middle channel (EARFCN 66866: 2155MHz). The smallest channel bandwidth was selected to maximize carrier power spectral density. The LTE5 PCS carrier bandwidth was chosen because it was the smallest LTE bandwidth that covers the entire PCS frequency range. The carriers were operated at maximum power (~26W/PCS carrier and 40W/AWS carrier) with at total port power of 120 watts (80W for PCS band carriers + 40W for AWS band carrier). The same modulation type was used for both PCS and AWS carriers.

Multicarrier Multiband Test Case

Three LTE1.4 carriers (based upon KDB 971168 D03v01) using two carriers (with minimum spacing between carrier frequencies) at the PCS band lower band edge (EARFCN 8047: 1930.7 & EARFCN 8061: 1932.1MHz) and a third carrier with maximum spacing between the other two carrier frequencies (EARFCN 67329: 2199.3MHz) at the AWS band upper band edge. The smallest channel bandwidth was selected to maximize carrier power spectral density. The carriers were operated at maximum power (40W/PCS carrier and 40W/AWS carrier) with at total port power of 120 watts (80W for PCS band carriers + 40W for AWS band carrier). The same modulation type was used for both PCS and AWS carriers.

The limit of -19dBm was used in the certification testing. The limit is adjusted to -19dBm [-13dBm -10 log (4)] per FCC KDB 662911D01 v02r01 because the BTS may operate as a 4 port MIMO transmitter.

Measurements were performed with the spectrum analyzer in the RMS average mode over at least a 100 traces. In the 1MHz bands outside and adjacent to the frequency block, a resolution bandwidth of 1% of the emission bandwidth was used. In the 1 to 2MHz frequency range outside the band edge (i.e.: 1928 to 1929MHz and 1996 to 1997MHz bands) the RBW was again reduced to 1% of the emission bandwidth and the power integrated over 1MHz. In the 2 to 22MHz frequency range outside the band edge (i.e.: 1908 to 1928MHz and 1997 to 2017MHz bands) a 1MHz RBW and 3MHz VBW was used.

The results are summarized in the following table. The highest (worst case) emissions from the measurement data are provided.

Ch BW, Carrier Freq, Carrier Pwr		QPSK (dBm)		16QAM (dBm)		64QAM (dBm)		256QAM (dBm)	
PCS Band	**AWS Band**	**LBE**	**UBE**	**LBE**	**UBE**	**LBE**	**UBE**	**LBE**	**UBE**
LTE1.4, BC, 80W	Carrier Off	-20.107	N/A	-19.976	N/A	-19.451	N/A	-19.833	N/A
LTE3, BC, 80W	Carrier Off	-19.812	N/A	-20.027	N/A	-19.821	N/A	-19.443	N/A
LTE5, BC, 80W	Carrier Off	-20.086	N/A	-20.381	N/A	-20.112	N/A	-20.013	N/A
LTE10, BC, 80W	Carrier Off	-22.888	N/A	-22.183	N/A	-22.661	N/A	-23.279	N/A
LTE15, BC, 80W	Carrier Off	-23.034	N/A	-22.151	N/A	-23.766	N/A	-21.340	N/A
LTE20, BC, 80W	Carrier Off	-24.480	N/A	-24.163	N/A	-23.770	N/A	-24.501	N/A
LTE1.4, TC, 80W	Carrier Off	N/A	-20.572	N/A	-20.710	N/A	-20.339	N/A	-20.240
LTE3, TC, 80W (Note 1)	Carrier Off	N/A	-19.627	N/A	-19.547	N/A	-19.379	N/A	-19.553
LTE5, TC, 80W	Carrier Off	N/A	-20.709	N/A	-20.757	N/A	-20.748	N/A	-20.983
LTE10, TC, 80W	Carrier Off	N/A	-23.179	N/A	-22.829	N/A	-23.163	N/A	-23.286
LTE15, TC, 80W	Carrier Off	N/A	-22.256	N/A	-22.113	N/A	-23.332	N/A	-20.550
LTE20, TC, 80W	Carrier Off	N/A	-22.472	N/A	-23.139	N/A	-23.722	N/A	-22.854
PCS Multicarrier LTE5, BC, BC+1, & TC, 26W + 26W+26W	LTE1.4, MC, 40W	-20.951	-20.706	-20.685	-20.561	-21.042	-21.069	-20.328	-21.042
PCS Multicarrier LTE1.4, BC & BC+1, 40W + 40W	LTE1.4, TC, 40W	-19.653	-22.638	-19.588	-22.058	-19.70	-22.352	-19.722	-22.806

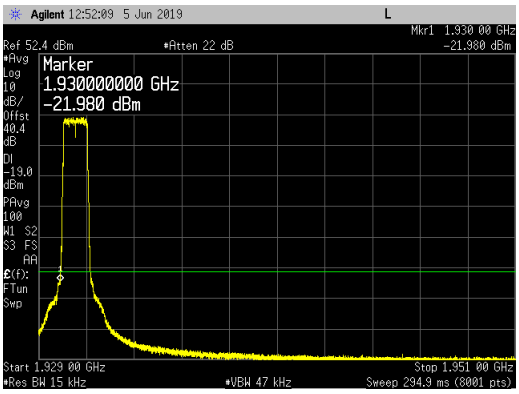
Note 1: Measurement was performed at RBW/2 (or 15kHz) off the upper band edge frequency (at 1990.015MHz) as allowed by ANSI C63.26-2015 paragraph 5.7.2.

The total measurement RF path loss of the test setup (attenuator and test cables) was 40.4 dB and is accounted for by the spectrum analyzer reference level offset. The display line on the plots reflects the required limit.

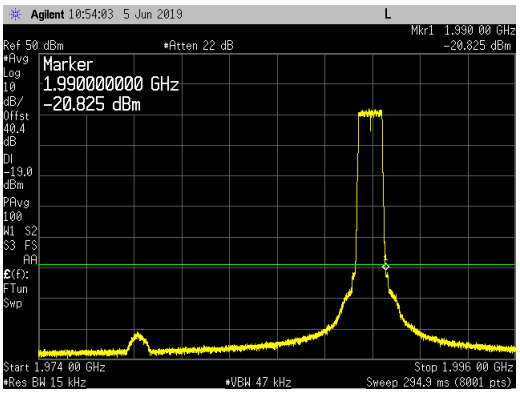
Conducted band edge measurements are provided in the following pages.

Single Carrier LTE1.4 Band Edge Plots for Antenna Port 3 and QPSK Modulation:

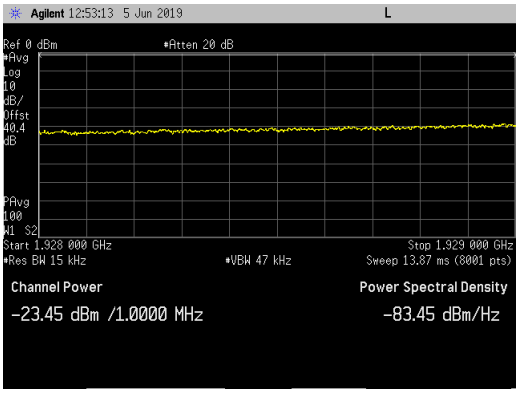
Bottom Channel_ LBE_ 1929 to 1951MHz



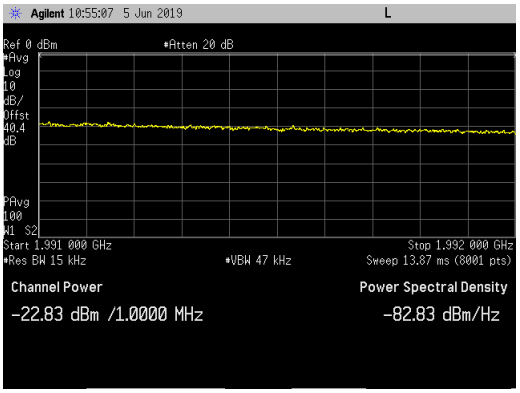
Top Channel_ UBE_ 1974 to 1996MHz



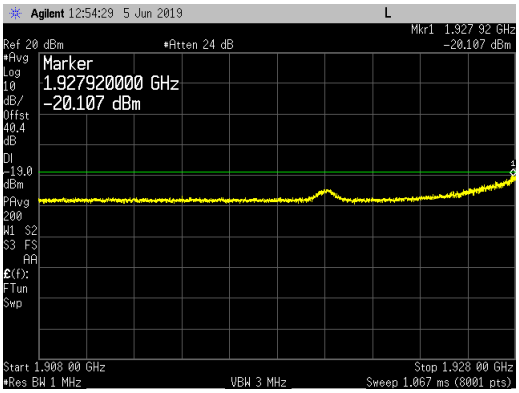
Bottom Channel_ LBE_ 1928 to 1929MHz



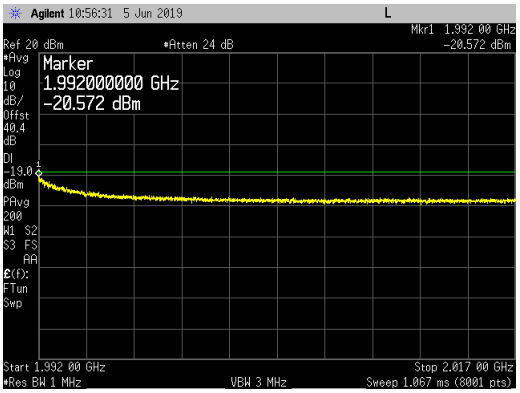
Top Channel_ UBE_ 1991 to 1992MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

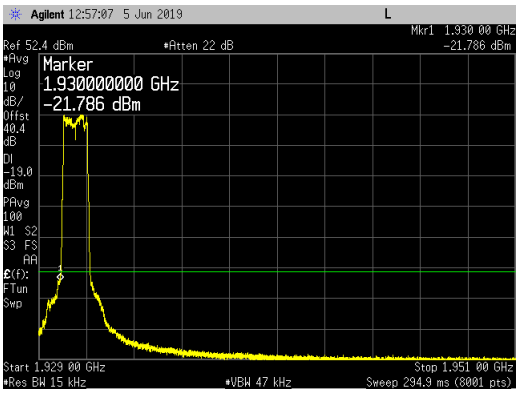


Top Channel_ UBE_ 1992 to 2017MHz

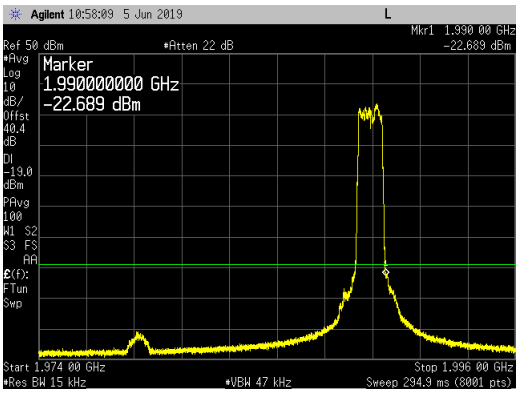


Single Carrier LTE1.4 Band Edge Plots for Antenna Port 3 and 16QAM Modulation:

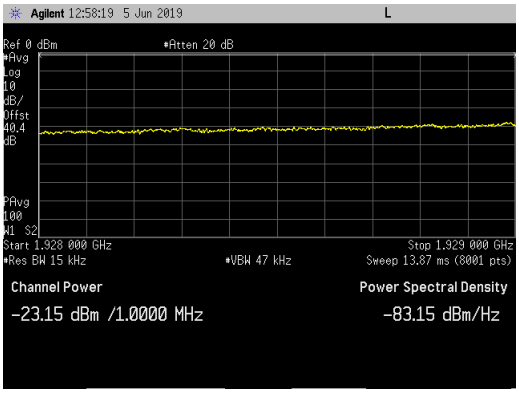
Bottom Channel_ LBE_ 1929 to 1951MHz



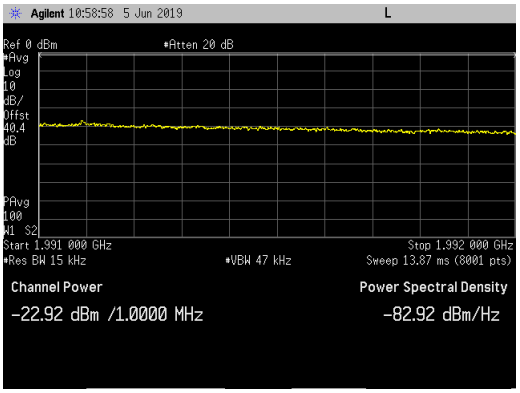
Top Channel_ UBE_ 1974 to 1996MHz



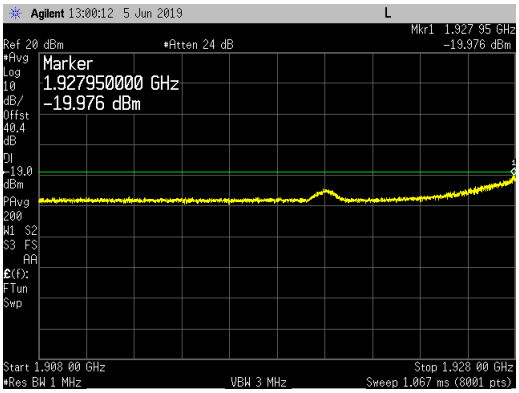
Bottom Channel_ LBE_ 1928 to 1929MHz



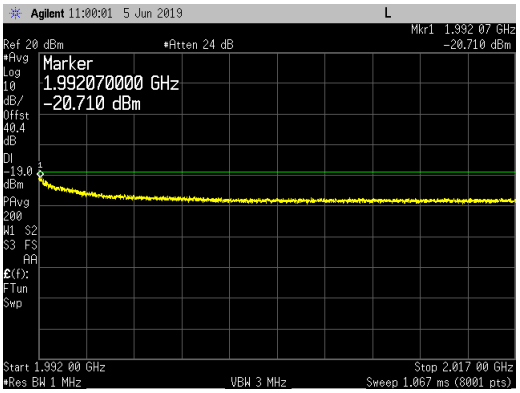
Top Channel_ UBE_ 1991 to 1992MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

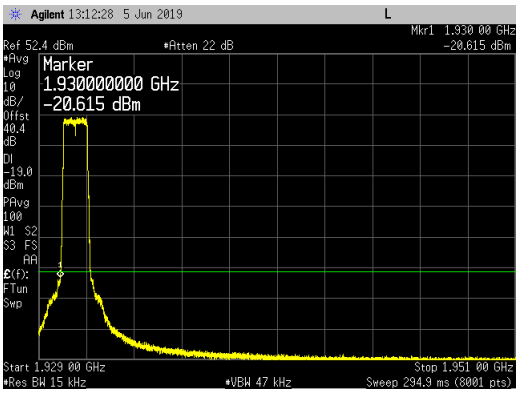


Top Channel_ UBE_ 1992 to 2017MHz

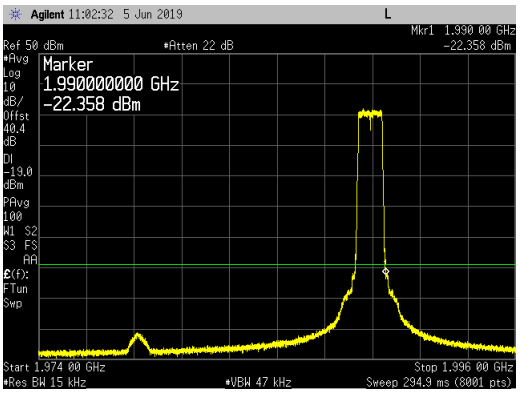


Single Carrier LTE1.4 Band Edge Plots for Antenna Port 3 and 64QAM Modulation:

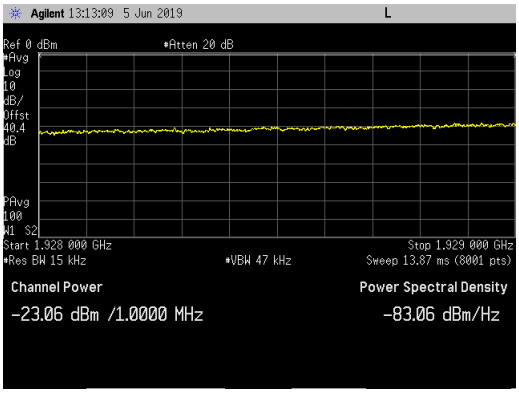
Bottom Channel_ LBE_ 1929 to 1951MHz



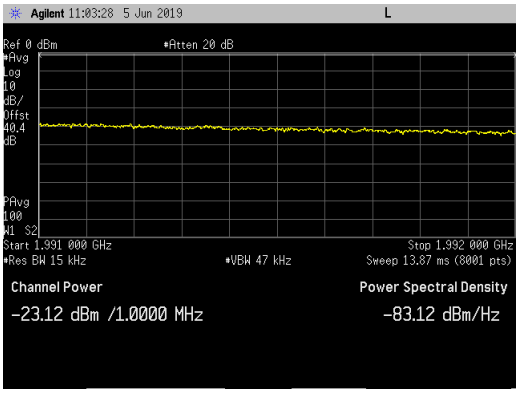
Top Channel_ UBE_ 1974 to 1996MHz



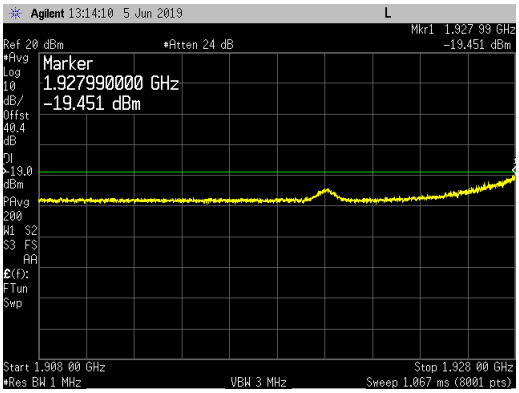
Bottom Channel_ LBE_ 1928 to 1929MHz



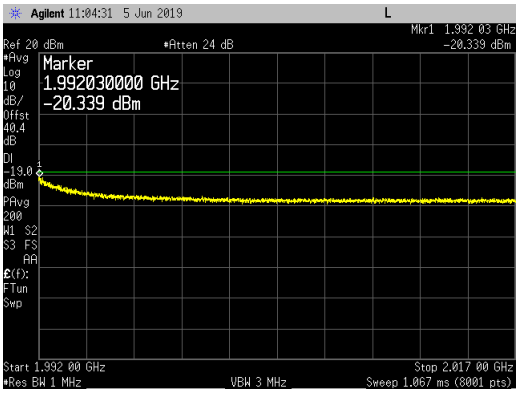
Top Channel_ UBE_ 1991 to 1992MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

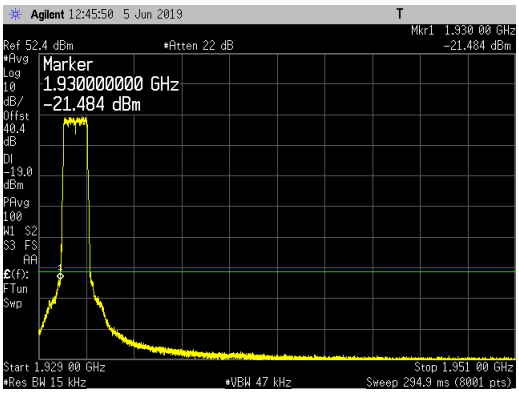


Top Channel_ UBE_ 1992 to 2017MHz

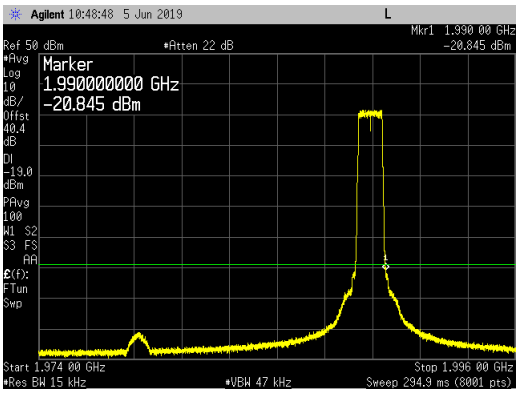


Single Carrier LTE1.4 Band Edge Plots for Antenna Port 3 and 256QAM Modulation:

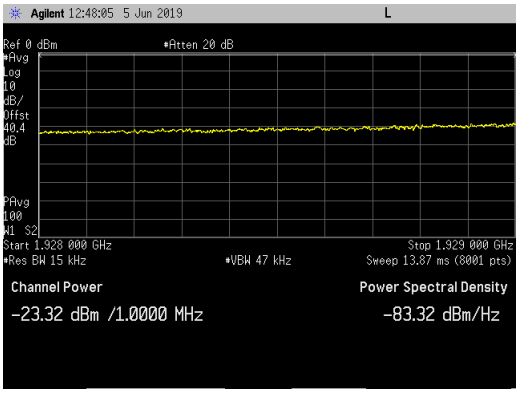
Bottom Channel_ LBE_ 1929 to 1951MHz



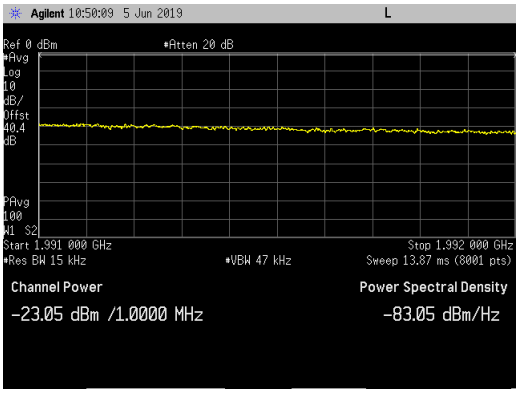
Top Channel_ UBE_ 1974 to 1996MHz



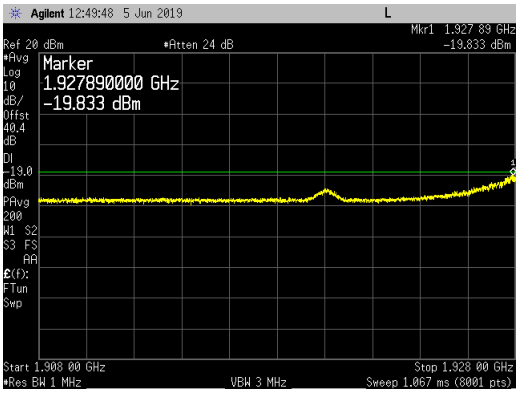
Bottom Channel_ LBE_ 1928 to 1929MHz



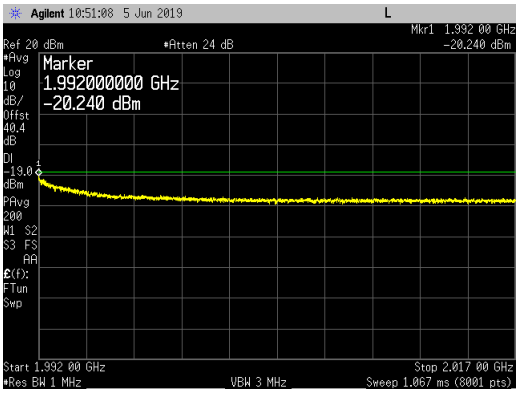
Top Channel_ UBE_ 1991 to 1992MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

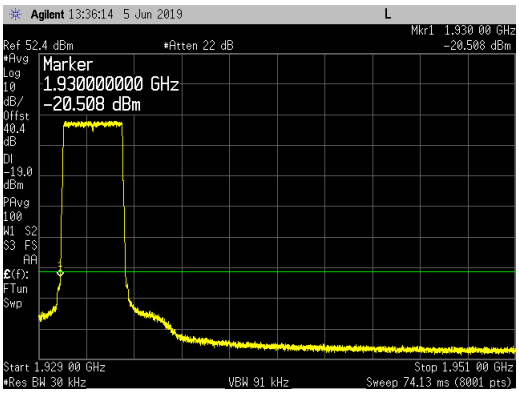


Top Channel_ UBE_ 1992 to 2017MHz

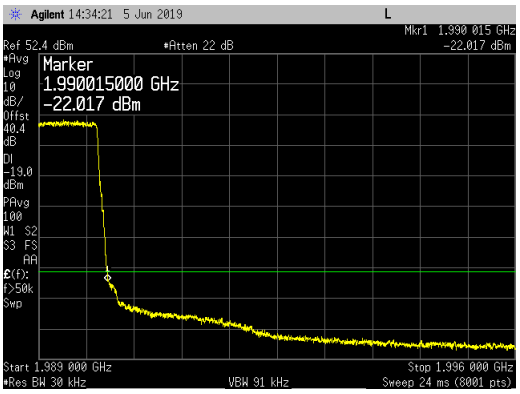


Single Carrier LTE3 Band Edge Plots for Antenna Port 3 and QPSK Modulation:

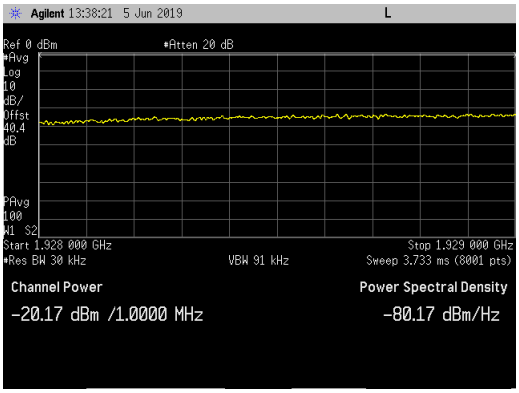
Bottom Channel_ LBE_ 1929 to 1951MHz



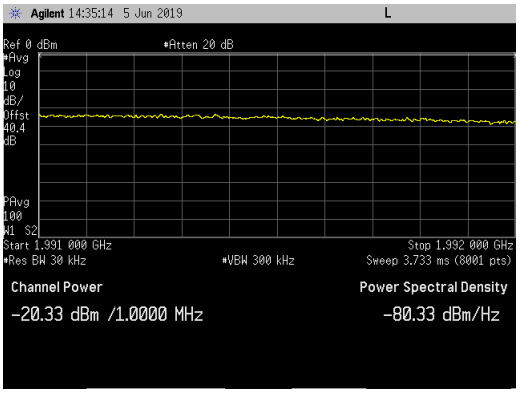
Top Channel_ UBE_ 1989 to 1996MHz



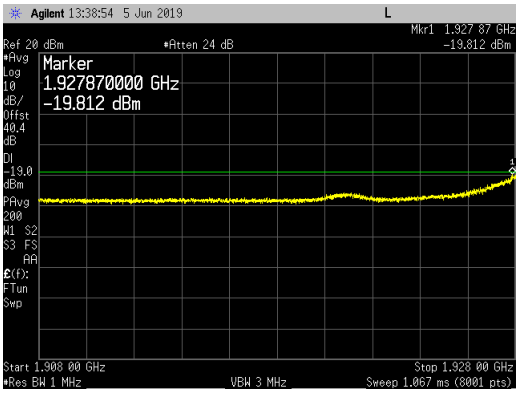
Bottom Channel_ LBE_ 1928 to 1929MHz



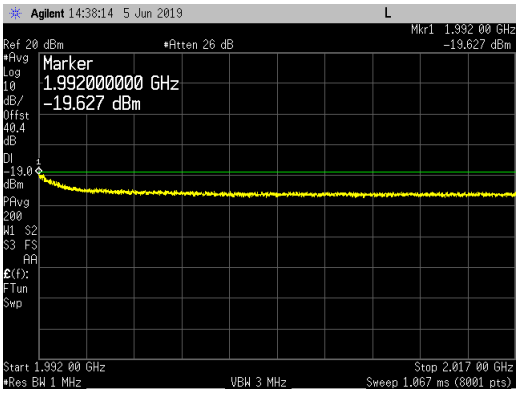
Top Channel_ UBE_ 1991 to 1992MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

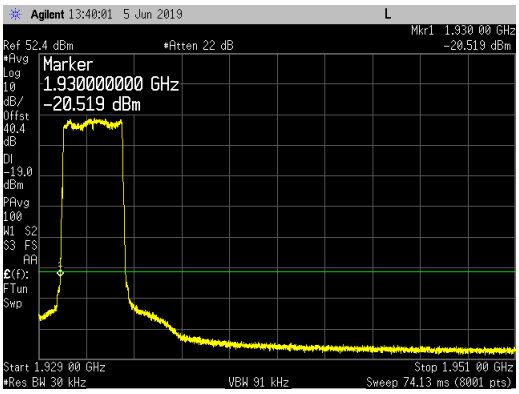


Top Channel_ UBE_ 1992 to 2017MHz

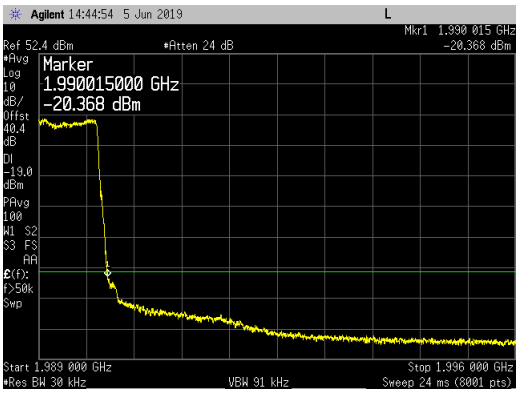


Single Carrier LTE3 Band Edge Plots for Antenna Port 3 and 16QAM Modulation:

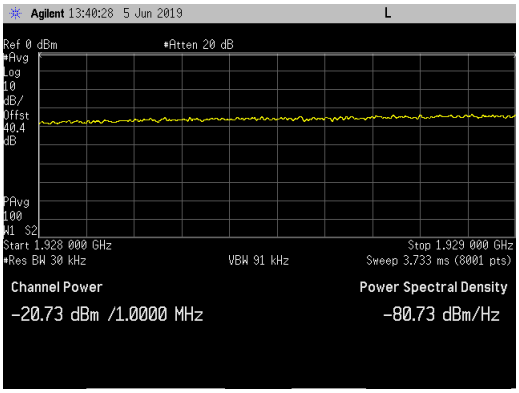
Bottom Channel_ LBE_ 1929 to 1951MHz



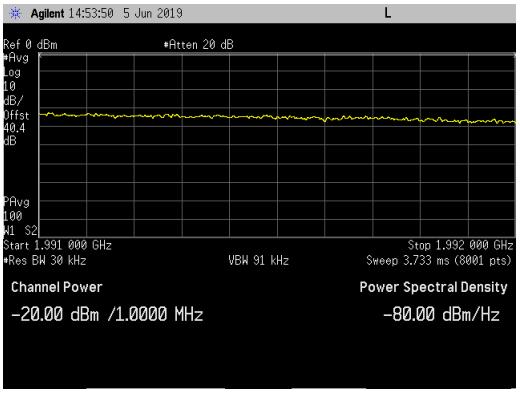
Top Channel_ UBE_ 1989 to 1996MHz



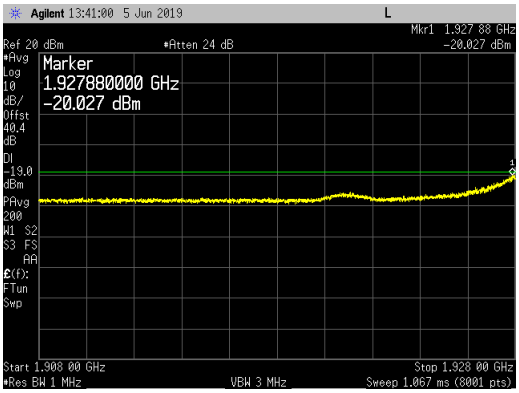
Bottom Channel_ LBE_ 1928 to 1929MHz



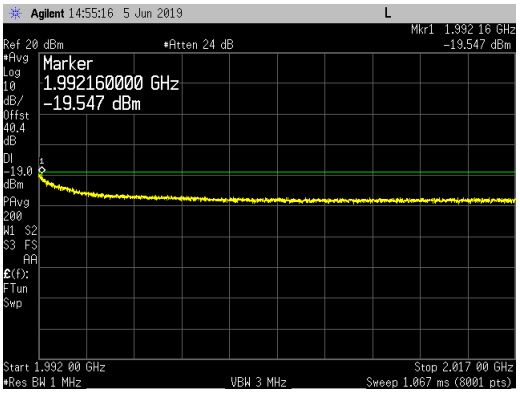
Top Channel_ UBE_ 1991 to 1992MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

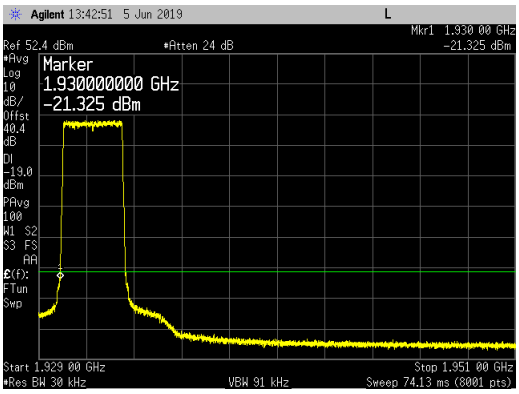


Top Channel_ UBE_ 1992 to 2017MHz

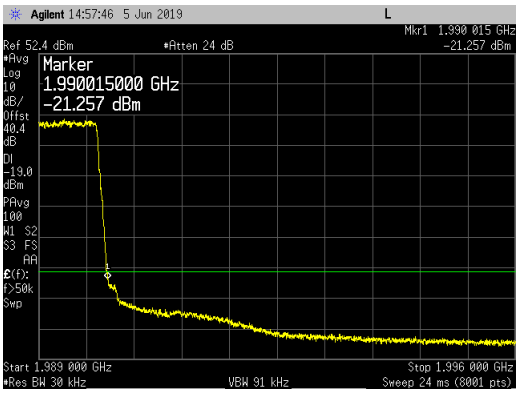


Single Carrier LTE3 Band Edge Plots for Antenna Port 3 and 64QAM Modulation:

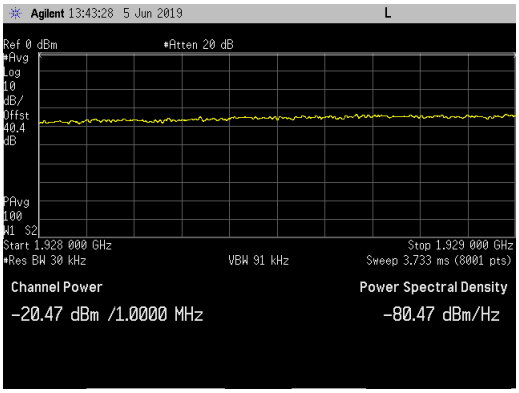
Bottom Channel_ LBE_ 1929 to 1951MHz



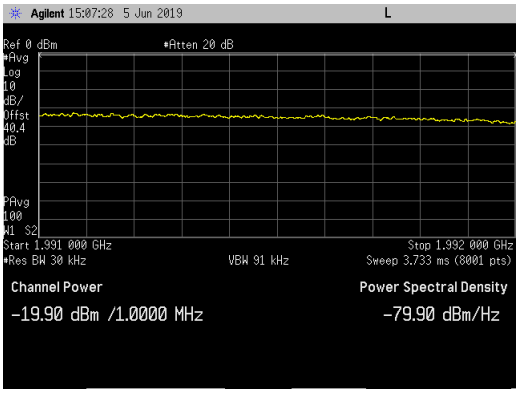
Top Channel_ UBE_ 1989 to 1996MHz



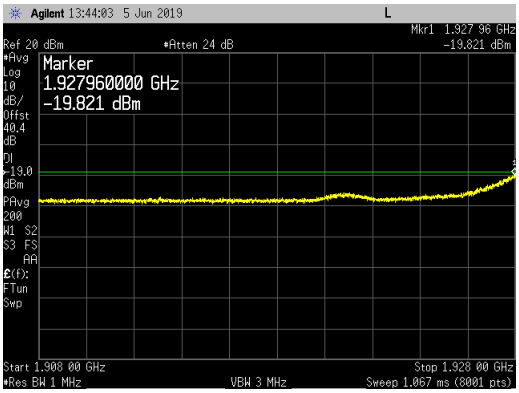
Bottom Channel_ LBE_ 1928 to 1929MHz



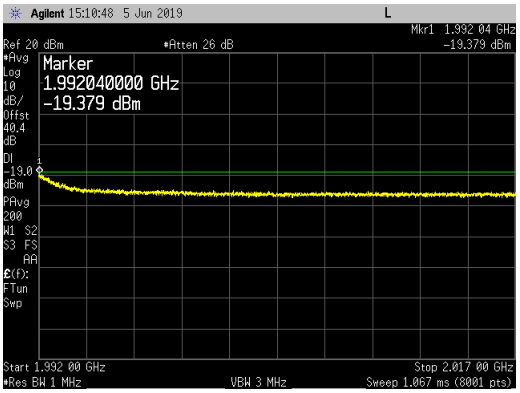
Top Channel_ UBE_ 1991 to 1992MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

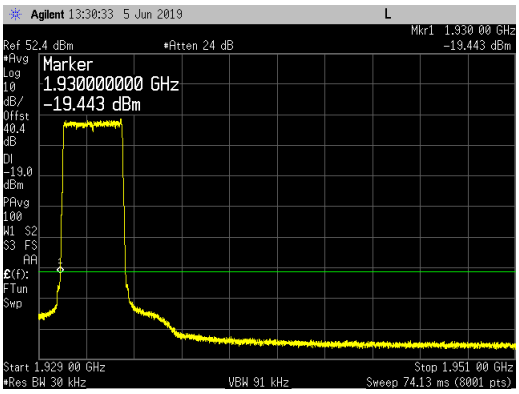


Top Channel_ UBE_ 1992 to 2017MHz

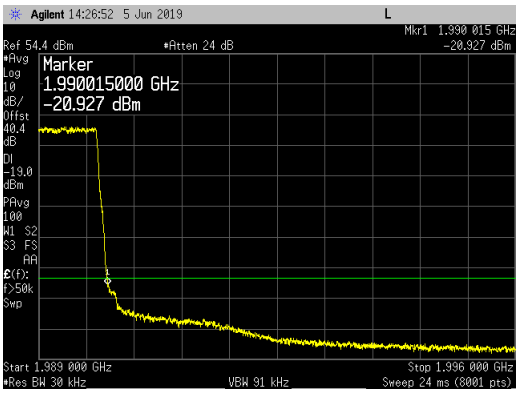


Single Carrier LTE3 Band Edge Plots for Antenna Port 3 and 256QAM Modulation:

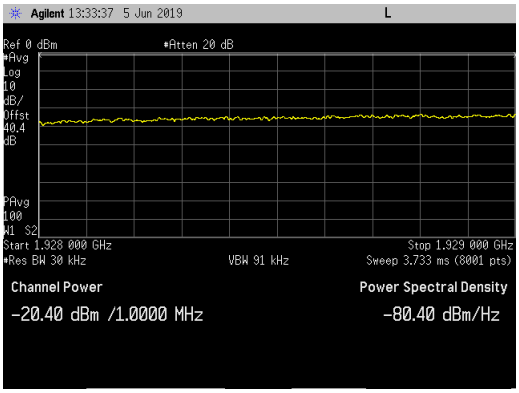
Bottom Channel_ LBE_ 1929 to 1951MHz



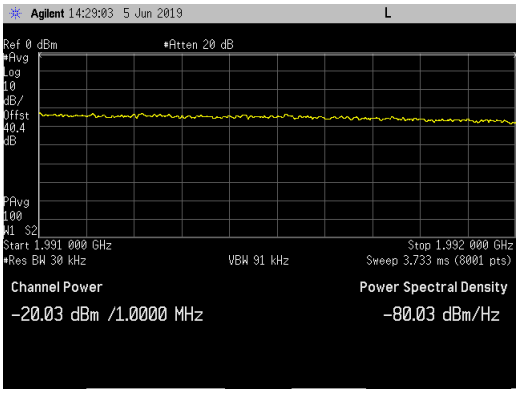
Top Channel_ UBE_ 1989 to 1996MHz



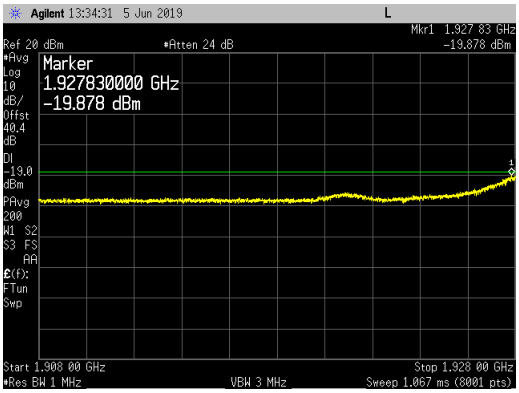
Bottom Channel_ LBE_ 1928 to 1929MHz



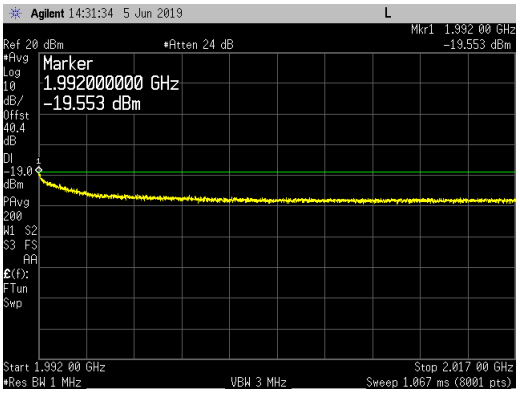
Top Channel_ UBE_ 1991 to 1992MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

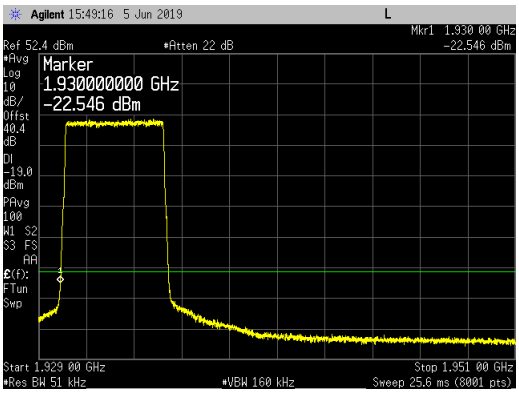


Top Channel_ UBE_ 1992 to 2017MHz

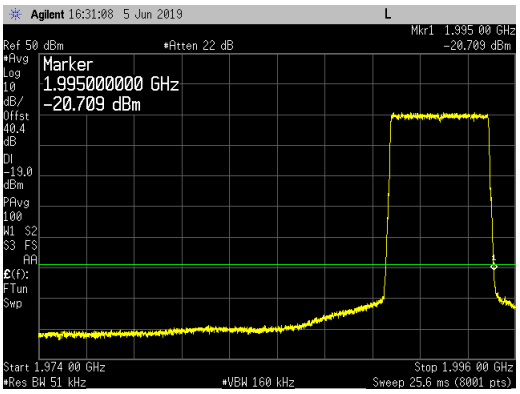


Single Carrier LTE5 Band Edge Plots for Antenna Port 3 and QPSK Modulation:

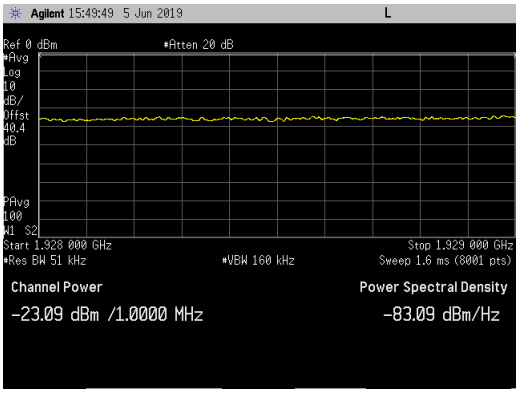
Bottom Channel_ LBE_ 1929 to 1951MHz



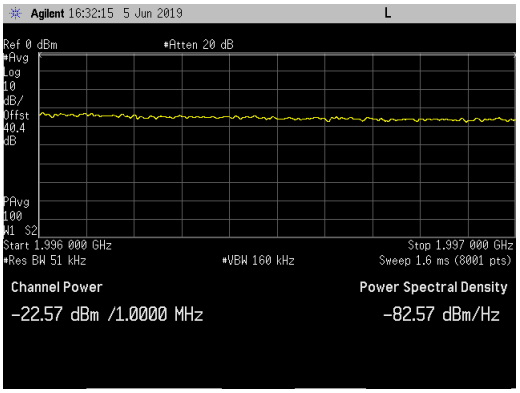
Top Channel_ UBE_ 1974 to 1996MHz



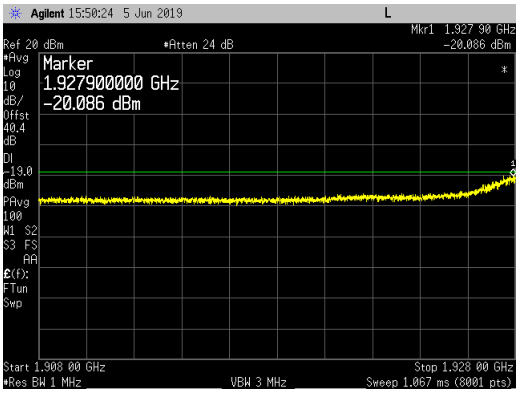
Bottom Channel_ LBE_ 1928 to 1929MHz



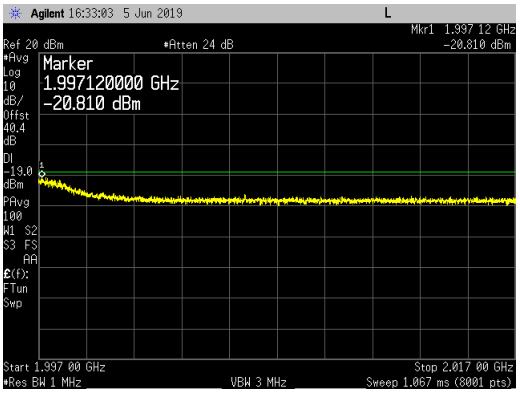
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

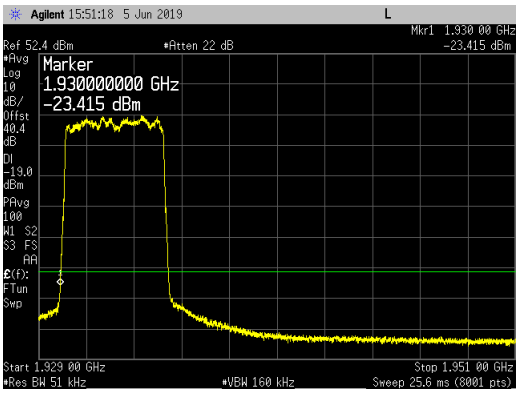


Top Channel_ UBE_ 1997 to 2017MHz

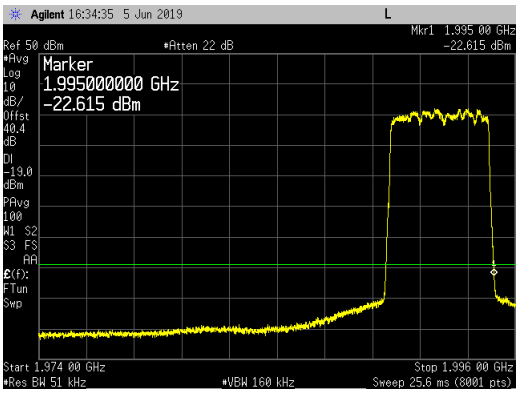


Single Carrier LTE5 Band Edge Plots for Antenna Port 3 and 16QAM Modulation:

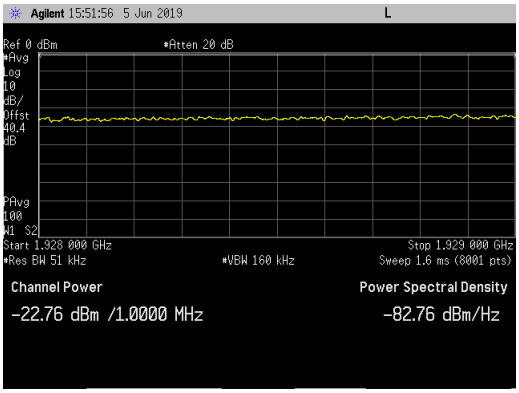
Bottom Channel_ LBE_ 1929 to 1951MHz



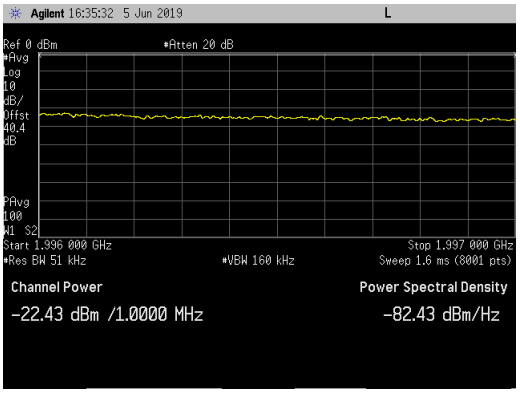
Top Channel_ UBE_ 1974 to 1996MHz



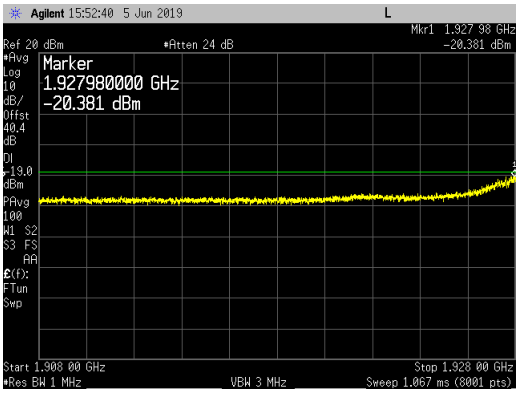
Bottom Channel_ LBE_ 1928 to 1929MHz



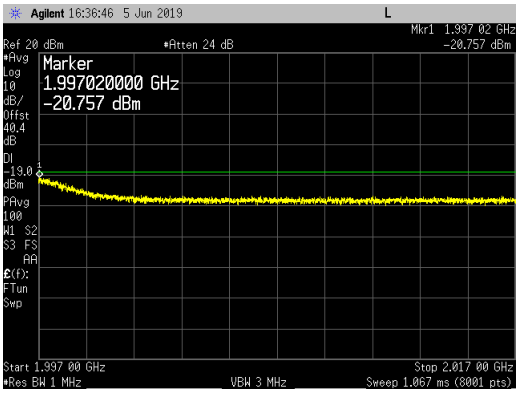
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

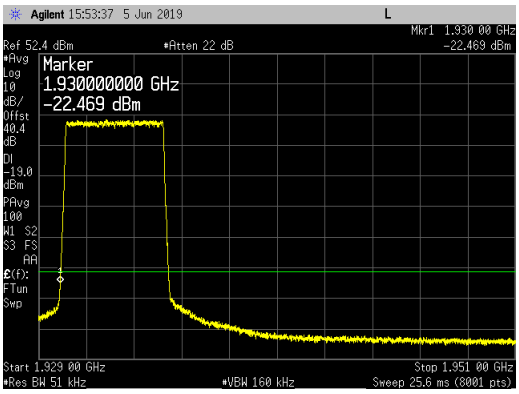


Top Channel_ UBE_ 1997 to 2017MHz

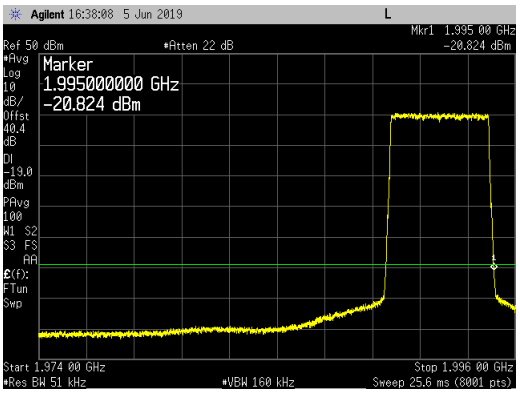


Single Carrier LTE5 Band Edge Plots for Antenna Port 3 and 64QAM Modulation:

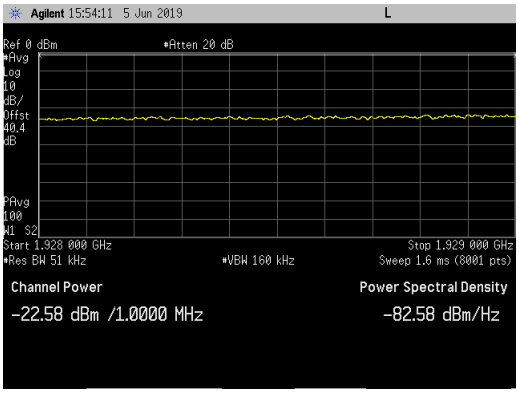
Bottom Channel_ LBE_ 1929 to 1951MHz



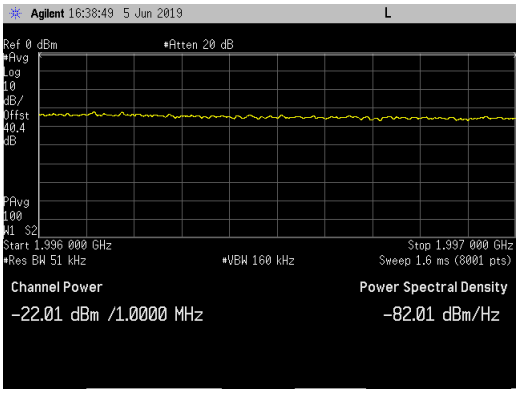
Top Channel_ UBE_ 1974 to 1996MHz



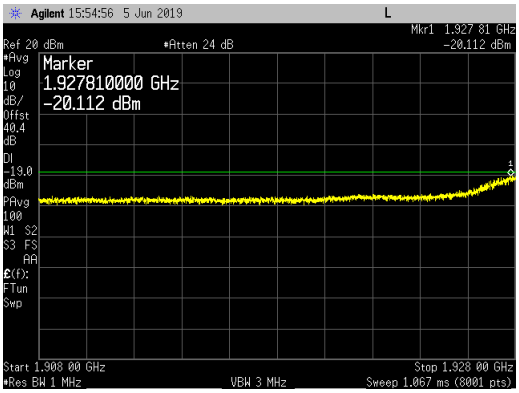
Bottom Channel_ LBE_ 1928 to 1929MHz



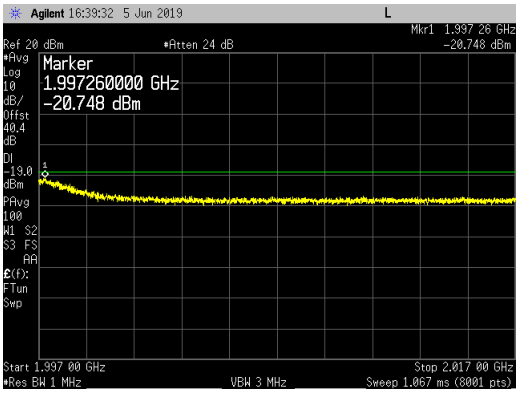
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

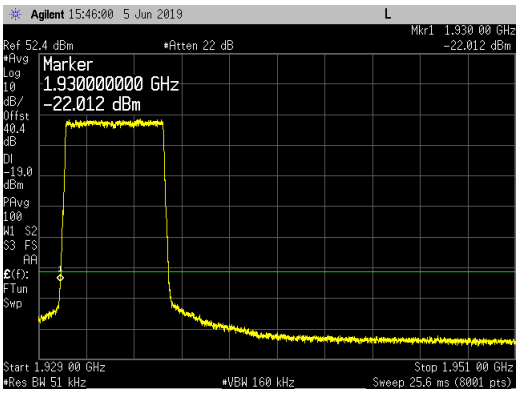


Top Channel_ UBE_ 1997 to 2017MHz

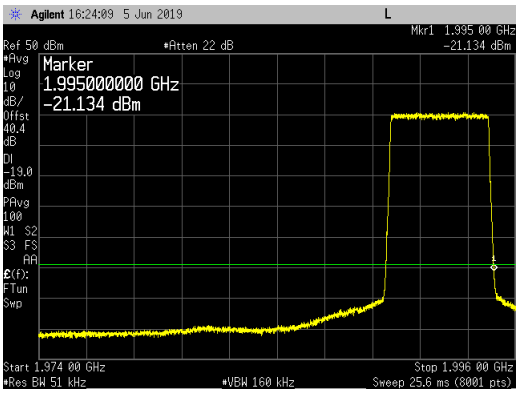


Single Carrier LTE5 Band Edge Plots for Antenna Port 3 and 256QAM Modulation:

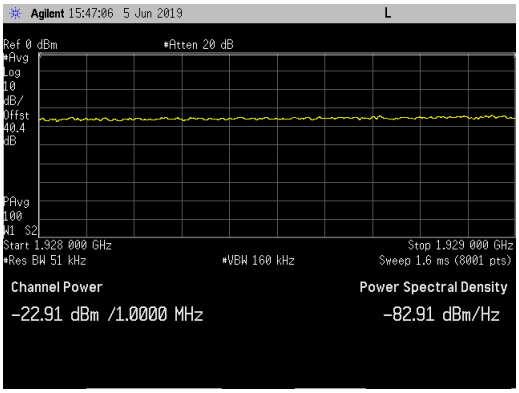
Bottom Channel_ LBE_ 1929 to 1951MHz



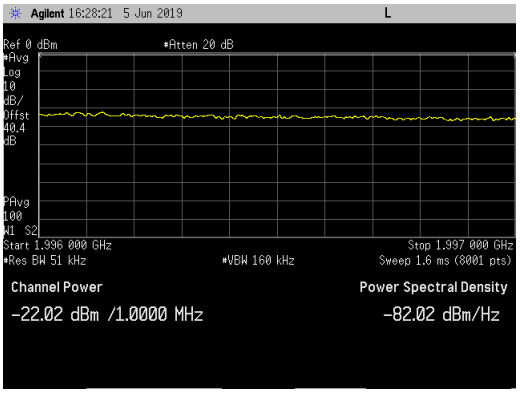
Top Channel_ UBE_ 1974 to 1996MHz



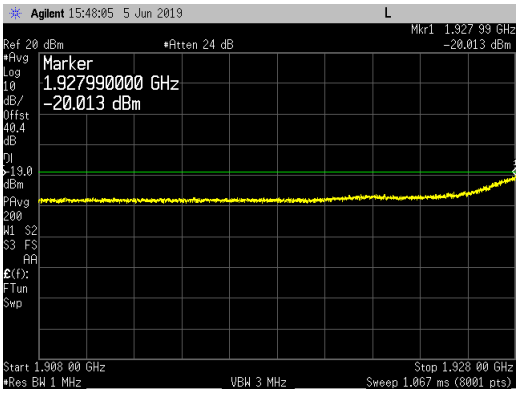
Bottom Channel_ LBE_ 1928 to 1929MHz



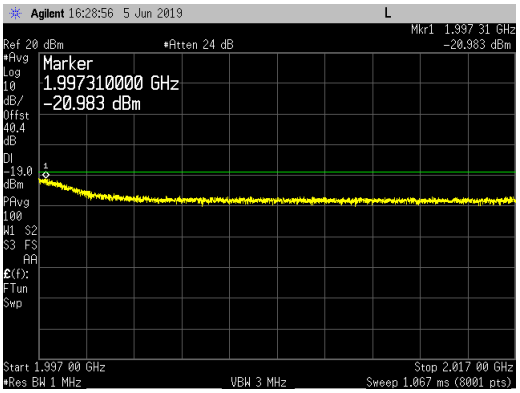
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

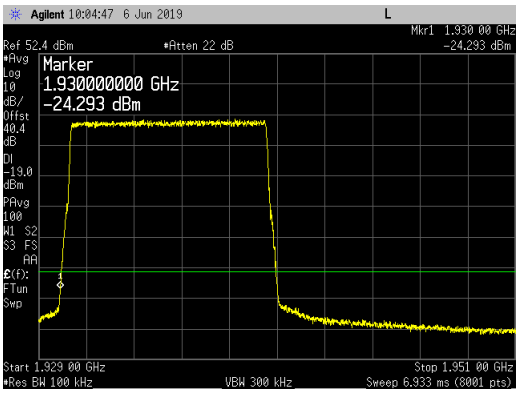


Top Channel_ UBE_ 1997 to 2017MHz

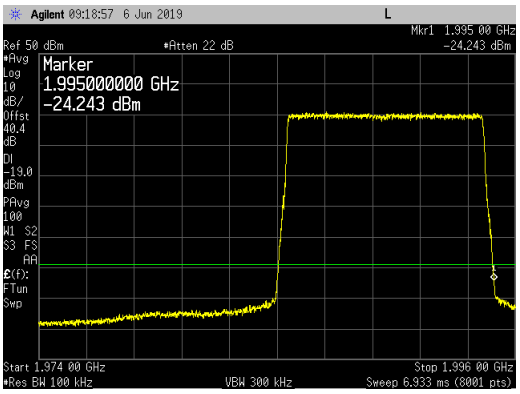


Single Carrier LTE10 Band Edge Plots for Antenna Port 3 and QPSK Modulation:

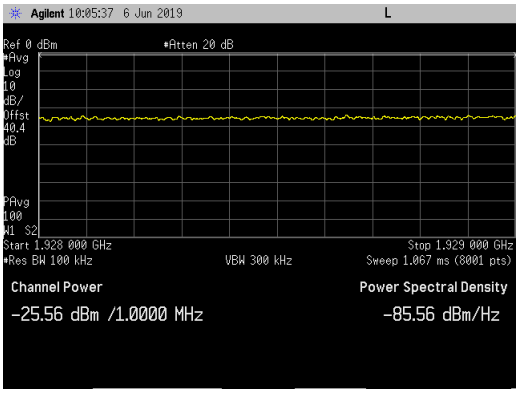
Bottom Channel_ LBE_ 1929 to 1951MHz



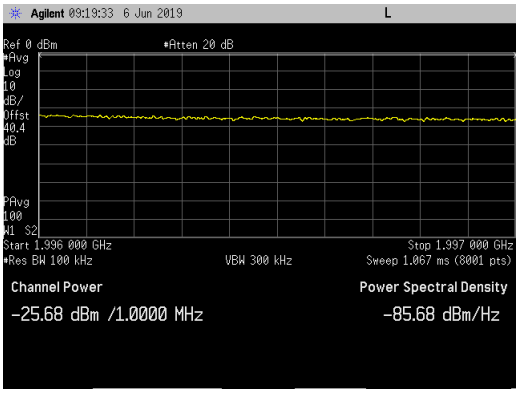
Top Channel_ UBE_ 1974 to 1996MHz



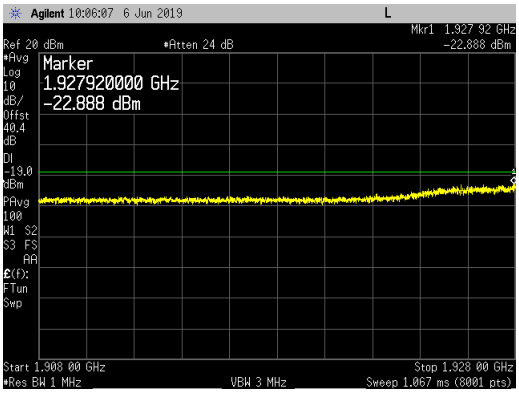
Bottom Channel_ LBE_ 1928 to 1929MHz



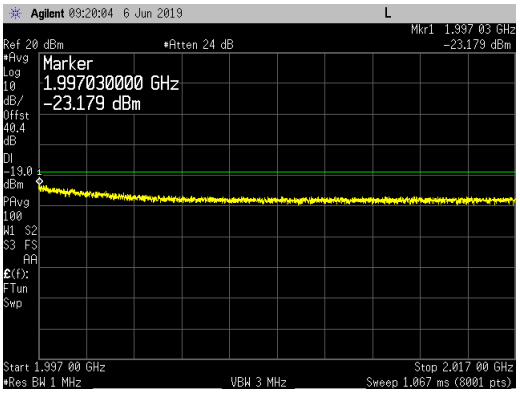
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

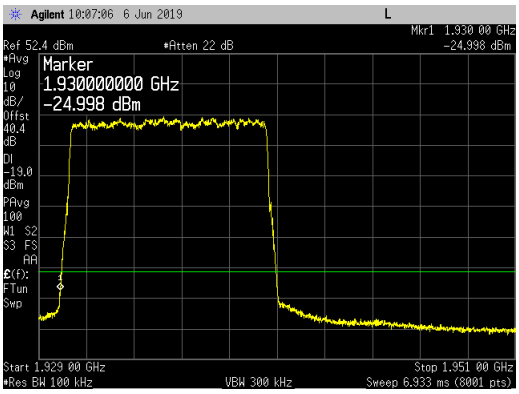


Top Channel_ UBE_ 1997 to 2017MHz

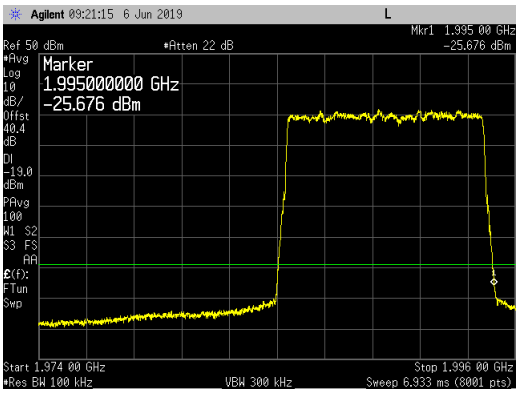


Single Carrier LTE10 Band Edge Plots for Antenna Port 3 and 16QAM Modulation:

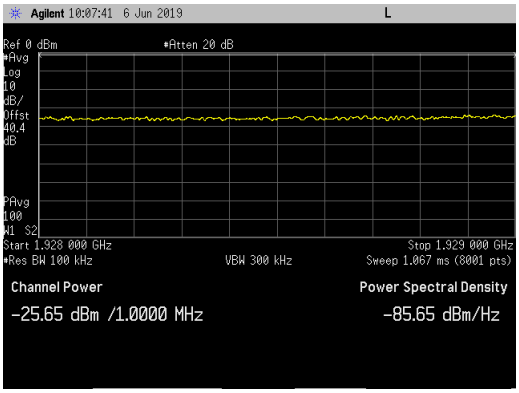
Bottom Channel_ LBE_ 1929 to 1951MHz



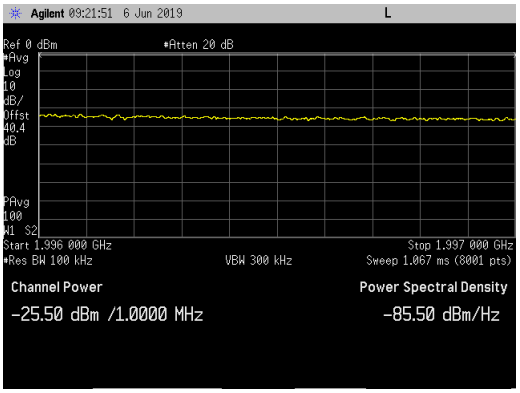
Top Channel_ UBE_ 1974 to 1996MHz



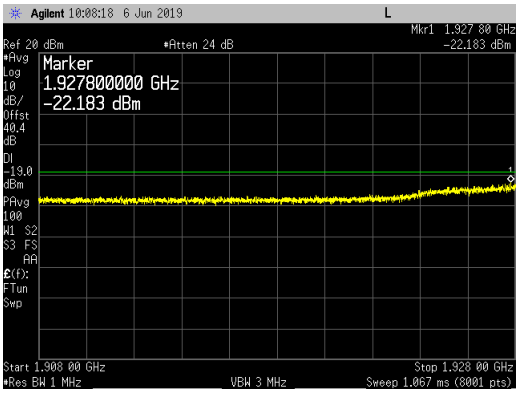
Bottom Channel_ LBE_ 1928 to 1929MHz



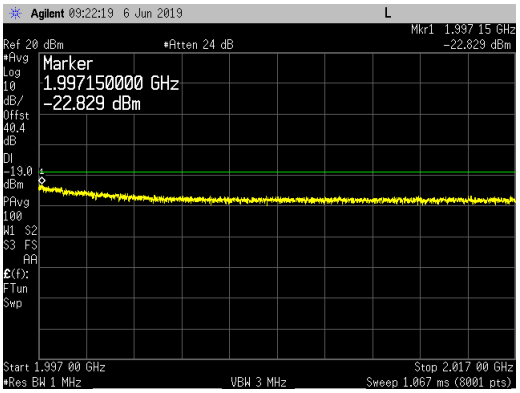
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

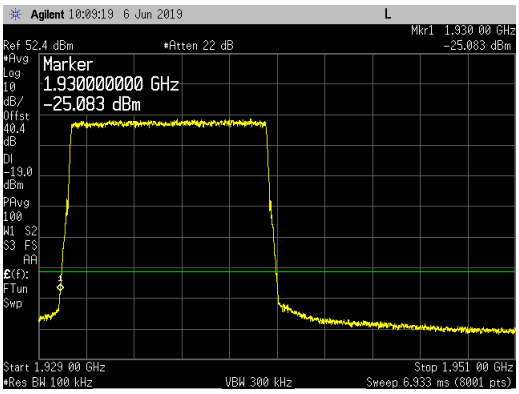


Top Channel_ UBE_ 1997 to 2017MHz

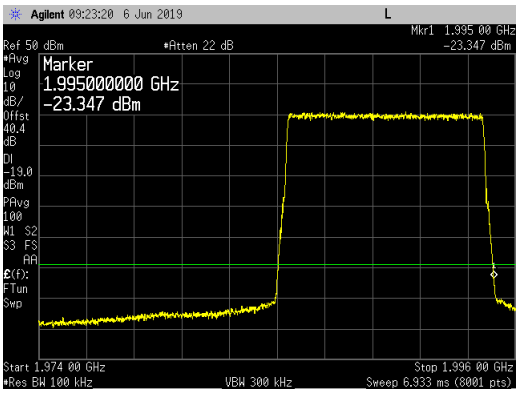


Single Carrier LTE10 Band Edge Plots for Antenna Port 3 and 64QAM Modulation:

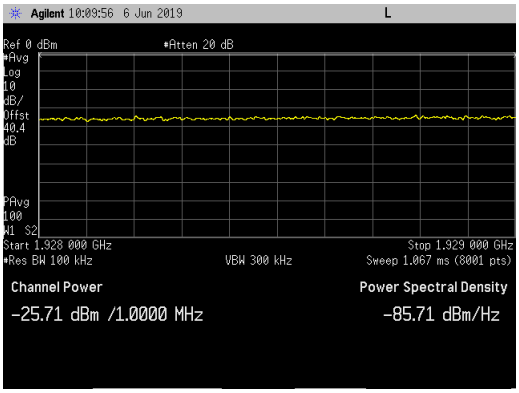
Bottom Channel_ LBE_ 1929 to 1951MHz



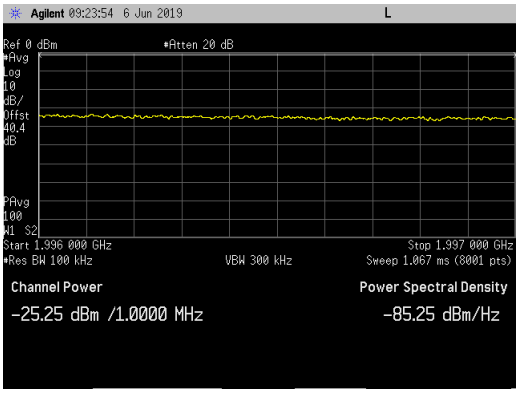
Top Channel_ UBE_ 1974 to 1996MHz



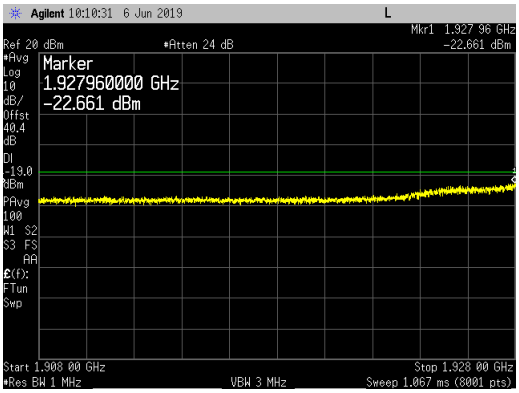
Bottom Channel_ LBE_ 1928 to 1929MHz



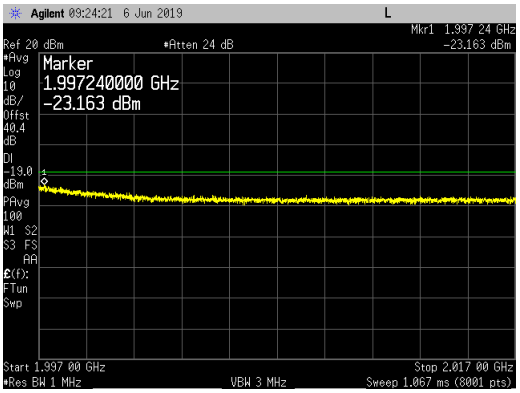
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

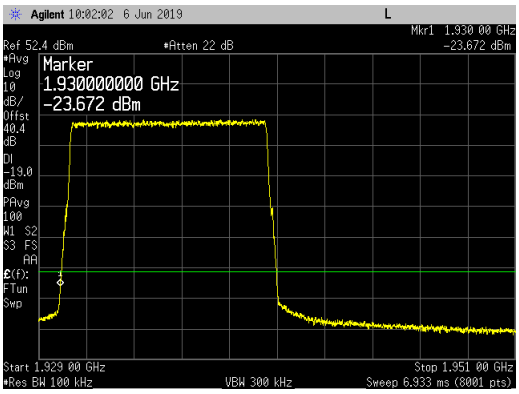


Top Channel_ UBE_ 1997 to 2017MHz

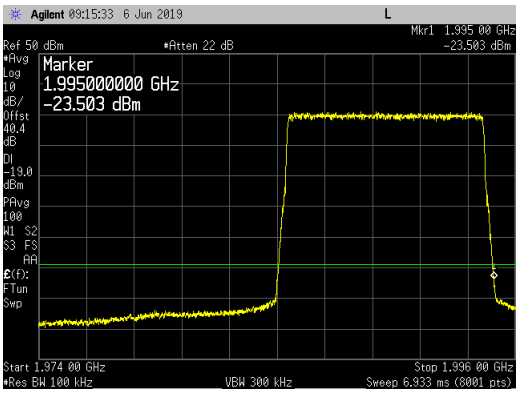


Single Carrier LTE10 Band Edge Plots for Antenna Port 3 and 256QAM Modulation:

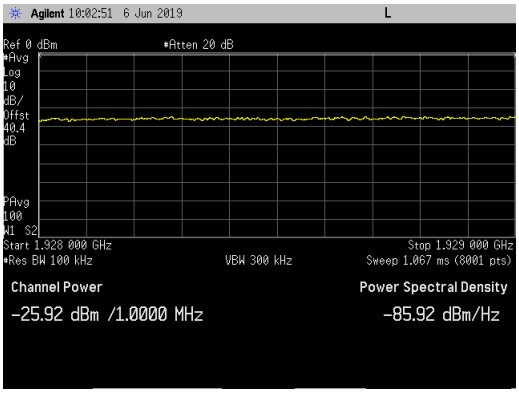
Bottom Channel_ LBE_ 1929 to 1951MHz



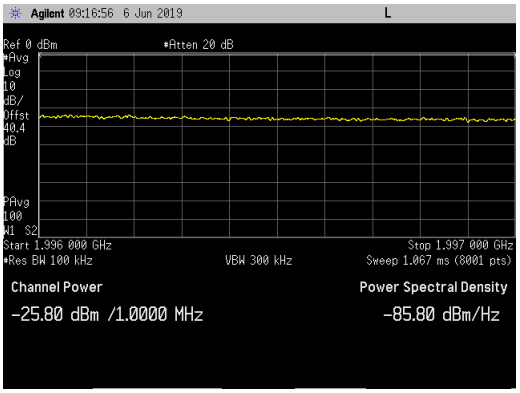
Top Channel_ UBE_ 1974 to 1996MHz



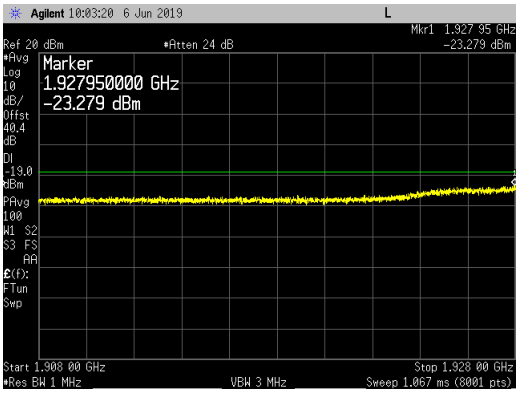
Bottom Channel_ LBE_ 1928 to 1929MHz



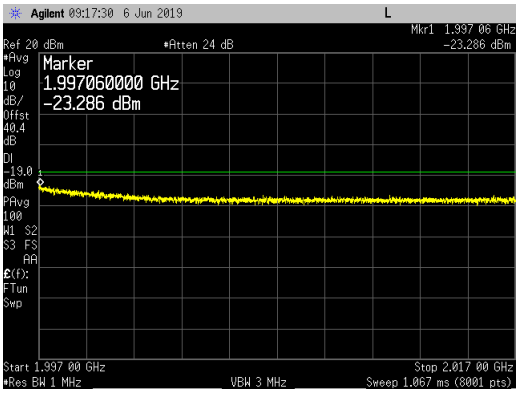
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

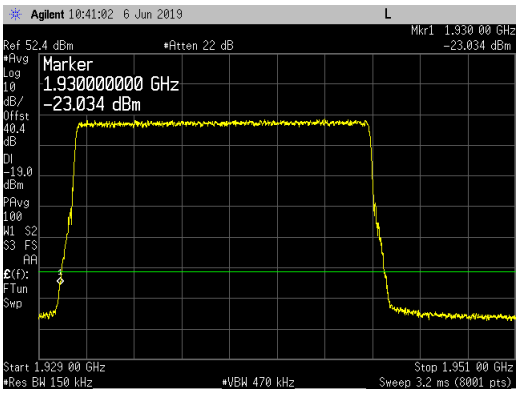


Top Channel_ UBE_ 1997 to 2017MHz

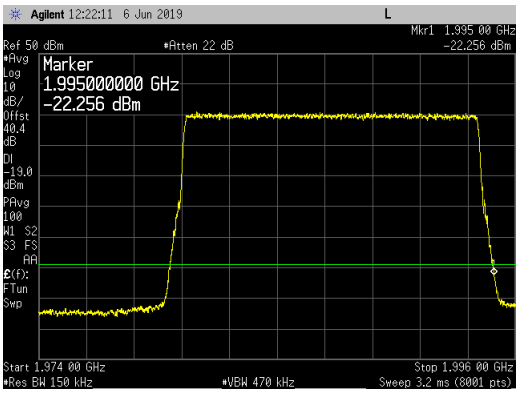


Single Carrier LTE15 Band Edge Plots for Antenna Port 3 and QPSK Modulation:

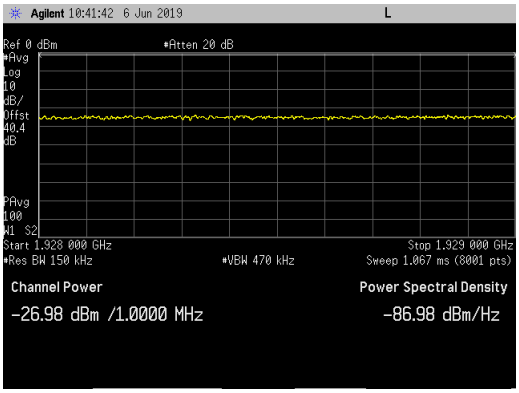
Bottom Channel_ LBE_ 1929 to 1951MHz



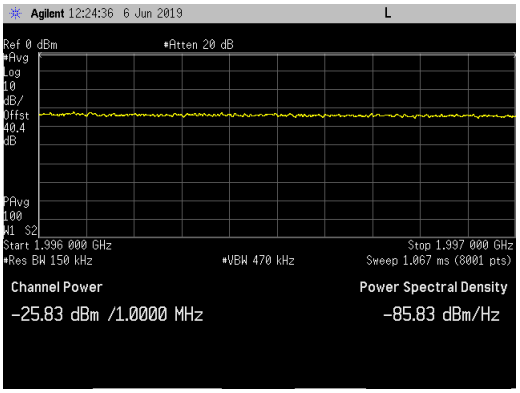
Top Channel_ UBE_ 1974 to 1996MHz



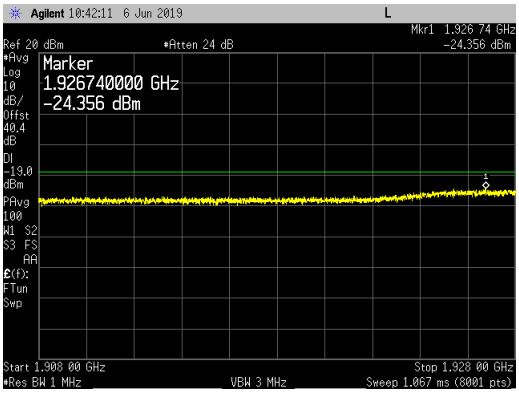
Bottom Channel_ LBE_ 1928 to 1929MHz



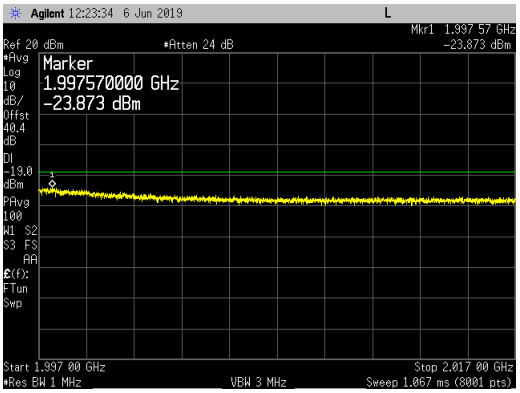
Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz

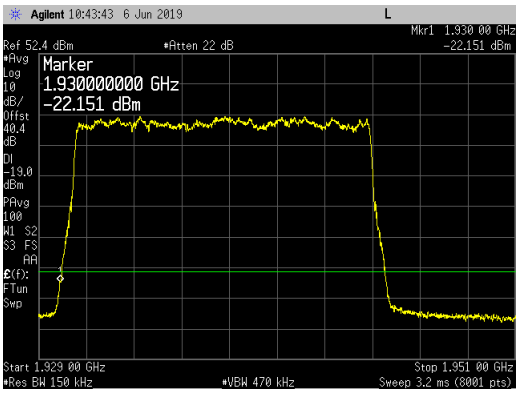


Top Channel_ UBE_ 1997 to 2017MHz

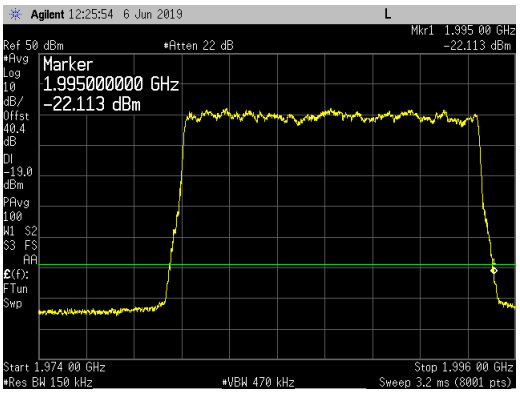


Single Carrier LTE15 Band Edge Plots for Antenna Port 3 and 16QAM Modulation:

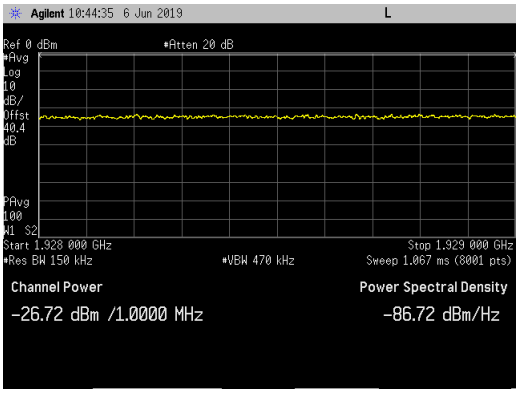
Bottom Channel_ LBE_ 1929 to 1951MHz



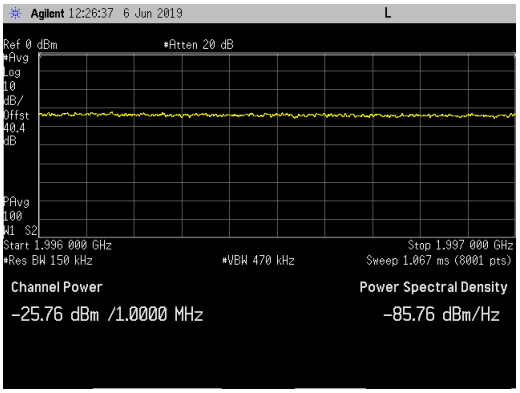
Top Channel_ UBE_ 1974 to 1996MHz



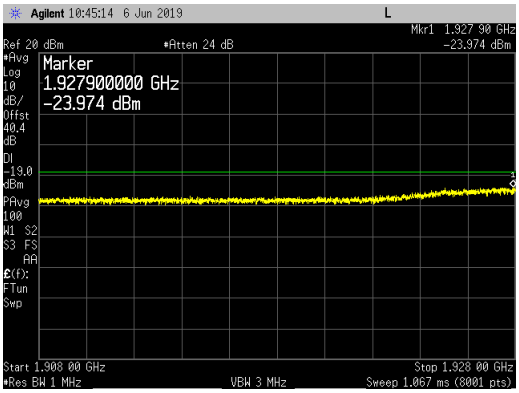
Bottom Channel_ LBE_ 1928 to 1929MHz



Top Channel_ UBE_ 1996 to 1997MHz



Bottom Channel_ LBE_ 1908 to 1928MHz



Top Channel_ UBE_ 1997 to 2017MHz