



Radio Test Report

Application for Grant of Equipment Authorization

CERTIFICATE #: 0214.19

FCC Part 27 Subpart C
617MHz – 652MHz
and
728MHz – 746MHz

FCC ID: VBNAHLOA-01

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

Applicant: Nokia Solutions and Networks
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Irving, TX 75039

Test Sites: Nokia Solutions and Networks
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REVISION HISTORY

Rev#	Date	Comments	Modified By
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SCOPE

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

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR Title 47 Part 27 Subpart C

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 C63.4-2014
ANSI TIA-603-D
FCC KDB 971168 D01 v02r02
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 AHLOA 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 AHLOA. 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 AHLOA 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 27 Subpart C (Base Stations Operating in the 617 to 652MHz Band)

AHLOA operating in 617MHz to 652MHz Frequency Band				
FCC	Description	Measured	Limit	Results
Transmitter Modulation, output power and other characteristics				
§27.5	Frequency Ranges	LTE5: 619.5 – 649.5MHz LTE10: 622.0 – 647.0MHz LTE15: 624.5 – 644.5MHz LTE20: 627.0 – 642.0MHz	617.0MHz to 652.0MHz	Pass
§2.1033(c)(4)	Modulation Type	QPSK, 16QAM, 64QAM and 256QAM for LTE5, LTE10, LTE15 & LTE20	Digital	Pass
§27.50	Output Power	Highest Conducted Power Output RMS: 48.20dBm ERP depends on antenna gain which is unknown	1000W ERP	Pass
Informational	Peak to Average Power Ratio	Highest Measured PAPR: 8.31dB	13dB	Pass
§2.1049	99% Emission Bandwidth	LTE5: 4.4980MHz LTE10: 9.0023MHz LTE15: 13.4804MHz LTE20: 17.9860MHz	Remain in Block	Pass
	26dB down Emission Bandwidth	LTE5: 4.849MHz LTE10: 9.687MHz LTE15: 14.510MHz LTE20: 19.379MHz	Remain in Block	Pass
Transmitter Spurious Emissions¹				
§27.53(g)	At the antenna terminals	< -19dBm	-19dBm per Transmit Chain	Pass ¹
	Field Strength	41.942dBuV/m at 3m Eq. to -53.231dBm EIRP	-13dBm EIRP	Pass
Other Details				
§27.54	Frequency Stability	Stays within authorized frequency block 0.0015ppm	Stays within block	Pass
§1.1310	RF Exposure	N/A		Pass ²
Note 1: Based on 100kHz RBW. In the 100kHz immediately outside and adjacent to the frequency block a RBW of 30kHz was used. The measurement bandwidth is 100kHz for measurements more than 100kHz from the band edge. See Section 27.53(g) for details.				
Note 2: Applicant's declaration on a separate exhibit based on hypothetical antenna gains.				

617MHz to 652MHz Band Emission Designators				
Channel Bandwidth	LTE-QPSK	LTE-16QAM	LTE-64QAM	LTE-256QAM
5M	4M85F9W	4M83F9W	4M83F9W	4M85F9W
10M	9M65F9W	9M67F9W	9M69F9W	9M65F9W
15M	14M46F9W	14M43F9W	14M51F9W	14M47F9W
20M	19M31F9W	19M25F9W	19M31F9W	19M38F9W

Note: FCC based on 26dB emission bandwidth

FCC Part 27 Subpart C (Base Stations Operating in the 728 to 746MHz Band)

AHLOA operating in 728MHz to 746MHz Frequency Band				
FCC	Description	Measured	Limit	Results
Transmitter Modulation, output power and other characteristics				
§27.5	Frequency Ranges	LTE1.4: 729.7 – 745.3MHz LTE3: 730.5 – 744.5MHz LTE5: 731.5 – 743.5MHz LTE10: 734.0 – 741.0MHz	728.0MHz to 746.0MHz	Pass
§2.1033(c)(4)	Modulation Type	QPSK, 16QAM, 64QAM and 256QAM for LTE1.4, LTE3, LTE5 & LTE10	Digital	Pass
§27.50	Output Power	Highest Conducted Power Output RMS: 47.92dBm ERP depends on antenna gain which is unknown	1000W ERP	Pass
Informational	Peak to Average Power Ratio	Highest Measured PAPR: 8.20dB	13dB	Pass
§2.1049	99% Emission Bandwidth	LTE1.4: 1.1167MHz LTE3: 2.7126MHz LTE5: 4.4970MHz LTE10: 9.0029MHz	Remain in Block	Pass
	26dB down Emission Bandwidth	LTE1.4: 1.259MHz LTE3: 2.929MHz LTE5: 4.843MHz LTE10: 9.682MHz	Remain in Block	Pass
Transmitter Spurious Emissions¹				
§27.53(g)	At the antenna terminals	< -19dBm	-19dBm per Transmit Chain	Pass ¹
	Field Strength	41.523dBuV/m at 3m Eq. to -53.677dBm EIRP	-13dBm EIRP	Pass
Other Details				
§27.54	Frequency Stability	Stays within authorized frequency block 0.0013ppm	Stays within block	Pass
§1.1310	RF Exposure	N/A		Pass ²
Note 1: Based on 100kHz RBW. In the 100kHz immediately outside and adjacent to the frequency block a RBW of 30kHz was used. The measurement bandwidth is 100kHz for measurements more than 100kHz from the band edge. See Section 27.53(g) for details.				
Note 2: Applicant's declaration on a separate exhibit based on hypothetical antenna gains.				

728MHz to 746MHz Band Emission Designators				
Channel Bandwidth	LTE-QPSK	LTE-16QAM	LTE-64QAM	LTE-256QAM
1.4M	1M26F9W	1M24F9W	1M24F9W	1M25F9W
3M	2M93F9W	2M92F9W	2M92F9W	2M93F9W
5M	4M84F9W	4M81F9W	4M84F9W	4M84F9W
10M	9M65F9W	9M67F9W	9M68F9W	9M65F9W

Note: FCC based on 26dB 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 AHLOA. The AHLOA remote radio head is a multistandard multicarrier radio module designed to support LTE, and narrow band IoT (internet of things) operations (in-band, guard band, standalone). The scope of testing in this effort is for LTE-FDD operations.

The AHLOA RRH has four transmit/four receive antenna ports (4TX/4RX for Band 71 and 4TX/4RX for Band 12). Each antenna port supports 3GPP frequency band 71 (BTS Rx: 663 to 698 MHz/BTS TX: 617 to 652 MHz) and 3GPP frequency band 12 (BTS Rx: 698 to 716 MHz/BTS TX: 728 to 746 MHz). The maximum RF output power of the RRH is 240 Watts (60 watts per antenna port and 60 watts per carrier). The RRH can be operated as a 4x4 MIMO, 2x2 MIMO or as non-MIMO. The TX and RX instantaneous bandwidth cover the full operational bandwidth. The RRH supports LTE bandwidths of 5, 10, 15 and 20MHz for 3GPP frequency band 71 operations. The RRH supports LTE bandwidths of 1.4, 3, 5 and 10MHz for 3GPP frequency band 12 operations. The RRH supports four LTE downlink modulation types (QPSK, 16QAM, 64QAM and 256QAM). Multi-carrier operation is supported.

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 RRH may be configured with optional cooling fan.

The AHLOA LTE channel numbers and frequencies are as follows:

	Downlink EARFCN	Downlink Frequency (MHz)	LTE Channel Bandwidth			
			5 MHz	10 MHz	15 MHz	20 MHz
Band 71 (Ant 1, 2, 3, 4)	68586	617.0	Band Edge	Band Edge	Band Edge	Band Edge
					
	68611	619.5	Bottom Ch			
					
	68636	622.0		Bottom Ch		
					
	68661	624.5			Bottom Ch	
					
	68686	627.0				Bottom Ch
					
	68761	634.5	Middle Ch	Middle Ch	Middle Ch	Middle Ch
					
	68836	642.0				Top Channel
					
	68861	644.5			Top Channel	
					
	68886	647.0		Top Channel		
					
	68911	649.5	Top Channel			
					
	68936	652.0	Band Edge	Band Edge	Band Edge	Band Edge

AHLOA Downlink Band Edge LTE Band 71 Frequency Channels

Notes:

- (1) Dual 5MHz Lower Band Edge at 619.5MHz (ARFCN 68611) and 724.5MHz (ARFCN 68661)
- (2) Dual 5MHz Upper Band Edge at 644.5MHz (ARFCN 68861) and 649.5MHz (ARFCN 68911)

	Downlink EARFCN	Downlink Frequency (MHz)	LTE Channel Bandwidth			
			1.4 MHz	3 MHz	5 MHz	10 MHz
Band 12 (Ant 1, 2, 3, 4)	5000	728.0	Band Edge	Band Edge	Band Edge	Band Edge
		1 MHz Offset			
	5010	729.0				
					
	5017	729.7	Bottom Ch			
					
	5025	730.5		Bottom Ch		
					
	5035	731.5			Bottom Ch	
					
	5060	734.0				Bottom Ch
					
	5090	737.0	Middle Ch	Middle Ch	Middle Ch	Middle Ch
					
	5130	741.0				Top Channel
					
	5155	743.5			Top Channel	
					
	5165	744.5		Top Channel		
					
	5173	745.3	Top Channel			
					
	5180	746.0	Band Edge	Band Edge	Band Edge	Band Edge

AHLOA Downlink Band Edge LTE Band 12 Frequency Channels

Notes:

- (1) Dual 1.4MHz Lower Band Edge at 729.7MHz (ARFCN 5017) and 731.1MHz (ARFCN 5031)
- (2) Dual 1.4MHz Upper Band Edge at 743.9MHz (ARFCN 5159) and 745.3MHz (ARFCN 5173)

EUT Hardware

The EUT hardware used in testing on April 2-11, 2018.

Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	AHLOA	AirScale BTS RRH	Part#: 474331A.101 Serial#: K9180540675	FCC ID: VBNAHLOA-01

Enclosure

The EUT enclosure is made of heavy duty aluminum.

Support Equipment

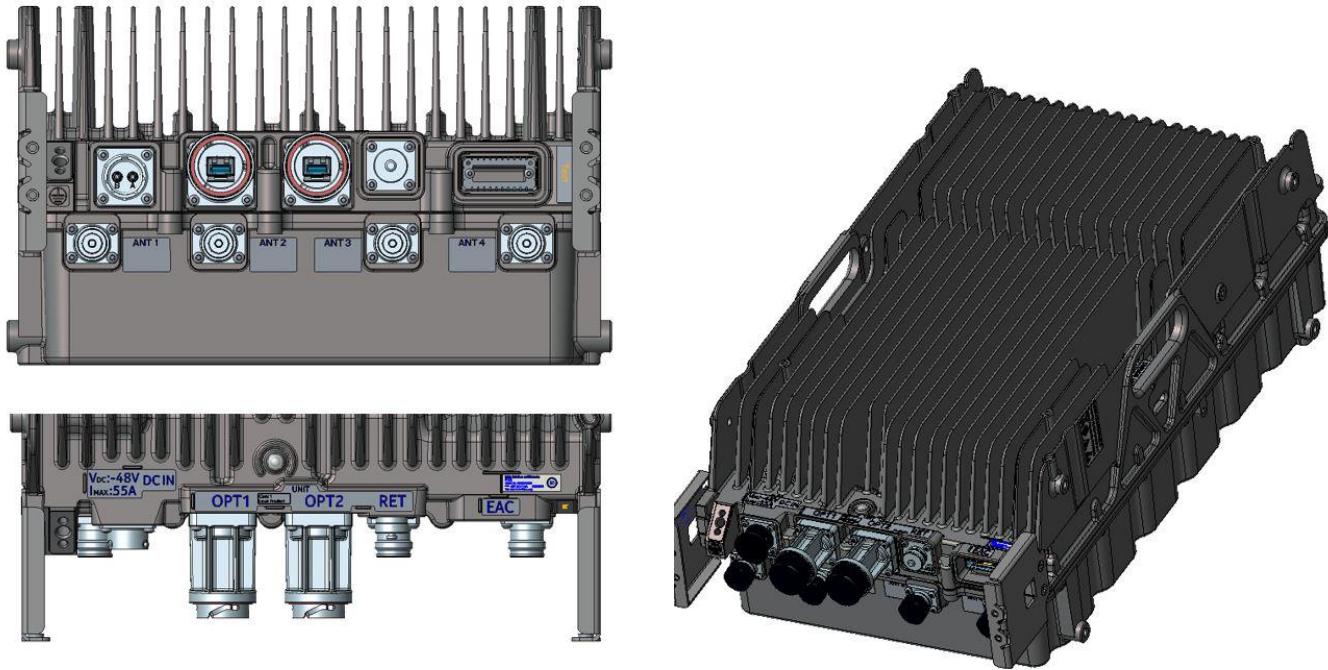
Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	AMIA	Airscale System Module	Part#: 473098A.101 Serial#: RK164201509	N/A
HP	Elite Book 6930p	Laptop PC	N/A	N/A
Dell	Studio XPS	Instrumentation PC	N/A	N/A

Auxillary Equipment

Company	Description	Part Number	Serial Number
Nokia	FOUC 10GHz SFP Module (Plugs into RRH Opt Ports)	473842A.101	KR16180010011
RLC Electronics	1.1GHz High Pass Filter ¹	F-14699	0050
Weinschel	Attenuator 40dB-250 Watt ¹	58-40-43-LIM	TC909
Weinschel	Attenuator 20dB-150 Watt ¹	66-20-33	BZ2075
Weinschel	Attenuator 10dB-100 Watt ¹		
Huber & Suhner	RF Cable – 0.5 meter ¹	Sucoflex 104	553624/4
Huber & Suhner	RF Cable - 1 meter ¹	Sucoflex 106	297370

Note 1: Used only in antenna port RF conducted emission testing.

AHLOA Connector Layout:



EUT External Interfaces

Name	Qty	Connector Type	Purpose (and Description)
DC In	1	Quick Disconnect	2-pole Power Circular Connector
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 Fan. 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	1	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 (CPRI) 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: FRM58.04.R01
- (2) System Module Software: FL18SP_FSM4_9999_180330_019798
- (3) BTS Site Manager: BTSSiteEM-FL00-0000_000440_000000

Modifications

No modifications were made to the EUT during testing.

TESTING

General Information

Antenna port measurements were taken with NTS personnel (Armando Del Angel and Jose Mendez) 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 output power, emission bandwidth, conducted spurious and conducted band edge measurements were performed with a spectrum analyzer. The carrier frequency accuracy/stability measurements were performed with a LTE signal analyzer. The EUT was operated at maximum RF output power for all tests. While measuring one transmit chain, the others were 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 4.1 of FCC KDB 971168 D01 v02r02. The 99% occupied bandwidth was measured in accordance with Section 6.6 of RSS-Gen Issue 4. 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.

Peak and average output power measurements were performed in accordance with FCC KDB 971168 D01 v02r02. Measurements were performed with the built-in power meter function found in the spectrum analyzer and the screenshots were captured using Keysight BenchVue Software. Peak to average power ratio (PAPR) was calculated in accordance with Section 5.7.2 of FCC KDB 971168 D01 v02r02. Spectrum analyzer settings are shown on their corresponding plots in test results section.

Conducted spurious emissions were captured with Keysight BenchVue Software across the 9kHz-8GHz frequency span. A high pass filter was used to reduce measurement instrumentation noise floor for the frequency ranges above 1.1GHz. The total measurement RF path loss of the test setup (attenuators, high pass filter 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. An LTE 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 C63.4-2014 by measuring the field strength of the emissions from the device at 3m test distance. 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 8GHz with a peak detector (RBW=100kHz, VBW=300kHz, 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 biconic log antenna was used for 30MHz-1GHz range. A double ridged waveguide horn antenna was used for 1-8GHz 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. EUT was placed on a non-conductive RF transparent structure to provide 80cm height from the ground floor. 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 RF conducted emissions testing. Photographs of the test setups are also provided.



Setup for 9kHz to 150kHz, 150kHz to 20MHz, 20MHz to 400MHz, 400 to 800MHz and 800MHz to 1.1GHz Measurements

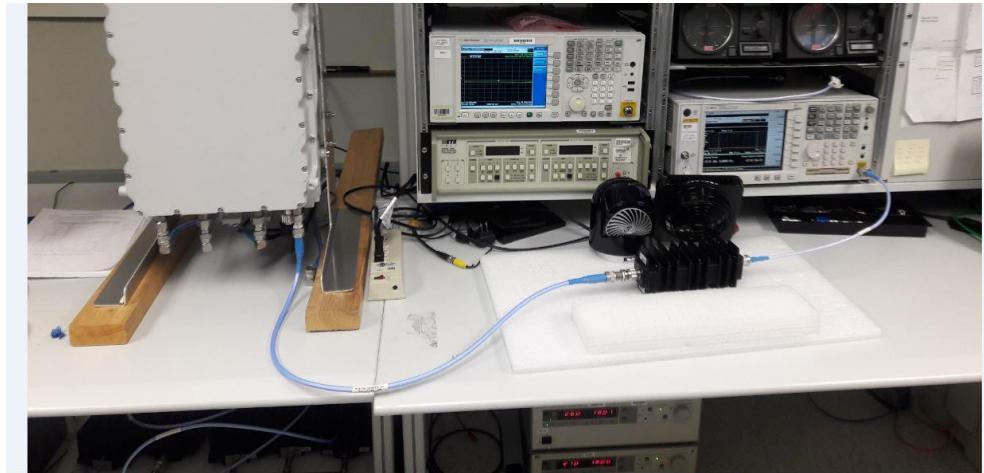
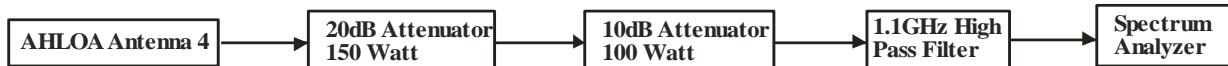
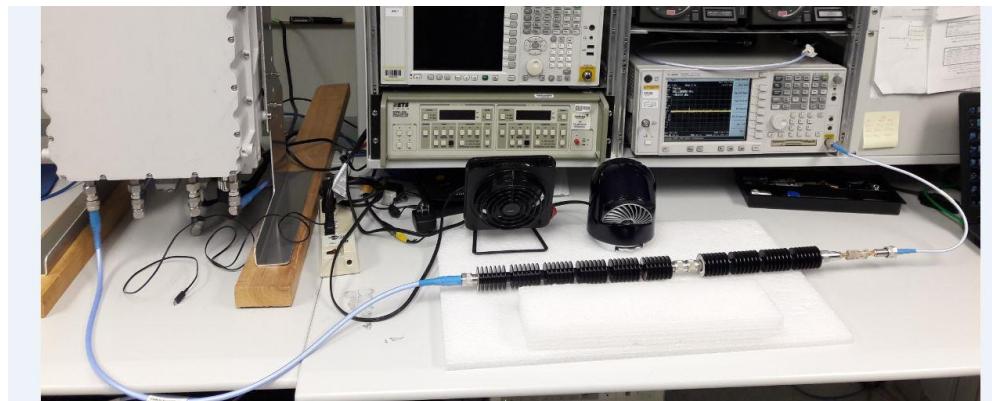


Photo of 9kHz to 150kHz, 150kHz to 20MHz, 20MHz to 400MHz, 400 to 800MHz and 800MHz to 1.1GHz Setup



Setup for 1.1GHz to 5GHz and 5GHz to 8GHz Measurements



Photograph of 1.1GHz to 5GHz and 5GHz to 8GHz Test Setup

Test Measurement Equipment

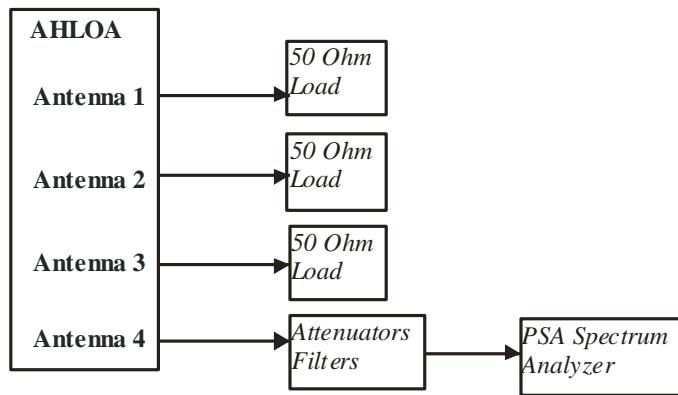
NTS Equipment #	Description	Manufacturer	Model	Calibration Duration	Calibration Due Date
ENV1195P	Climatic Chamber	Thermotron	SE-300-2-2	N/A	NCR
E1529P	PSA	Agilent	E4446A	12 Months	4/16/2018
E1260P	PreAmp (1GHz-18GHz)	MITEQ	AFS44-01001800-45-10P-44	12 Months	5/1/2018
E1365P	PreAmp (30MHz-1GHz)	MITEQ	AM-1431-N-1197SC	12 Months	5/14/2018
E1289P	Biconilog Antenna (30MHz-1GHz)	ETS Lindgren	3142C	12 Months	4/21/2018
E1019P	Horn Antenna (1GHz-18GHz)	EMCO	3115	12 Months	1/12/2019
E1068P	Horn Antenna (18GHz-40GHz)	EMCO	3116	12 Months	11/15/2018
E1447P	RMS Multimeter	Fluke	87V	12 Months	7/5/2018
ENV1035P	Thermometer	Fluke	52 II	12 Months	4/13/2018
120194 ¹	PSA Spectrum Analyzer	Agilent	E4440A	12 Months	10/25/2018
NM04509 ¹	Network Analyzer	Rohde & Schwarz	ZVL 3	12 Months	02/03/2019
NM06345 ¹	Network Analyzer	Keysight	E5063A	12 Months	11/20/2018
NM04508 ²	MXA Signal Analyzer	Agilent	N9020A	24 Months	05/02/2019

Note 1: Customer equipment used in antenna port RF conducted emission testing.

Note 2: Customer equipment used in LTE frequency accuracy/stability measurements.

APPENDIX A: ANTENNA PORT TEST DATA FOR BAND 71 (617-652MHz)

All conducted RF measurements in this section were made at AHLOA antenna ports. The test setup used is provided below.



Test Setup Used for Conducted RF Measurements on AHLOA

RF Output Power

RF output power has been measured in both Peak and RMS Average terms for each Band 5 (617 to 652MHz) transmit chain at the middle channel for 256QAM modulation and LTE5 bandwidth. Peak to average power ratio (PAPR) has been calculated as described in Section 5.7.2 of KDB971168 D01 v02r02 and all results are presented in tabular form below.

Antenna	LTE Bandwidth	LTE - 256QAM		
		Peak (dBm)	Average (dBm)	PAPR (dB)
Port 1 Middle Channel	5M	55.56	47.77	7.79
Port 2 Middle Channel	5M	55.51	47.68	7.83
Port 3 Middle Channel	5M	55.65	47.89	7.76
Port 4 Middle Channel	5M	55.84	47.93	7.91

The variation in RMS output power levels between the antenna ports is 0.25 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 4 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	
	Peak (dBm)	Ave (dBm)	Peak (dBm)	Ave (dBm)	Peak (dBm)	Ave (dBm)	Peak (dBm)	Ave (dBm)
Antenna Port 4 Middle Channel LTE5	55.91	47.92	55.84	47.95	55.92	47.96	55.84	47.93

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 0.04dB for the data snapshot provided. The variation of peak power output versus modulation type is 0.08dB 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 4 had the highest RMS average power for Band 71 (represents the worst case) and therefore it was selected for all the remaining antenna port tests. Port 4 has the highest combined RMS average power for Band 71 + Band 12.

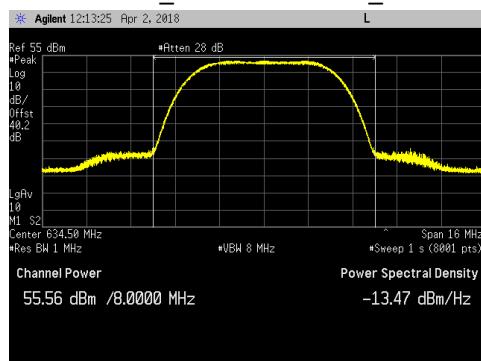
Subsequently output power levels on bottom, middle, and top channels in all 4 LTE channel bandwidths using 256QAM modulation type were tested only at Port 4 and the results presented below. The highest measured values are highlighted.

Antenna LTE Channel	LTE Bandwidth	LTE - 256QAM		
		Peak (dBm)	Ave (dBm)	PAPR (dB)
Port 4 Bottom Channel	5M	54.91	47.34	7.57
	10M	55.45	47.68	7.77
	15M	55.90	47.89	8.01
	20M	56.01	47.96	8.05
Port 4 Middle Channel	5M	55.84	47.93	7.91
	10M	56.08	48.07	8.01
	15M	55.72	47.72	8.00
	20M	55.83	48.01	7.82
Port 4 Top Channel	5M	54.91	47.32	7.59
	10M	55.78	47.72	8.06
	15M	55.80	47.84	7.96
	20M	56.51	48.20	8.31

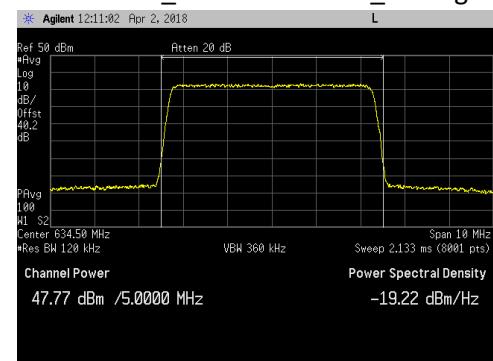
All measurement results are provided in the following pages. The total measurement RF path loss of the test setup (attenuator and test cables) was 40.2 dB and is accounted for by the spectrum analyzer reference level offset.

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

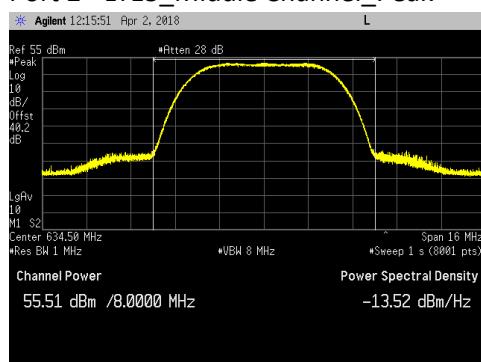
Port 1 - LTE5_Middle Channel_Peak



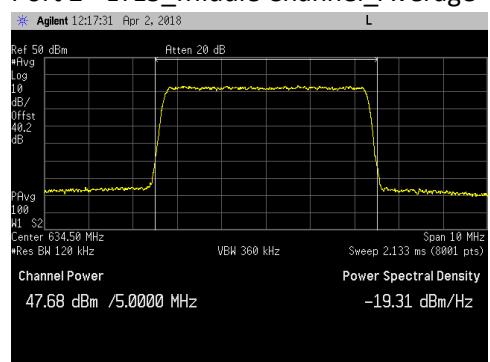
Port 1 - LTE5_Middle Channel_Average



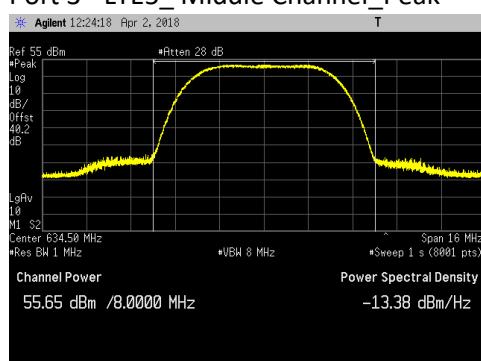
Port 2 - LTE5_Middle Channel_Peak



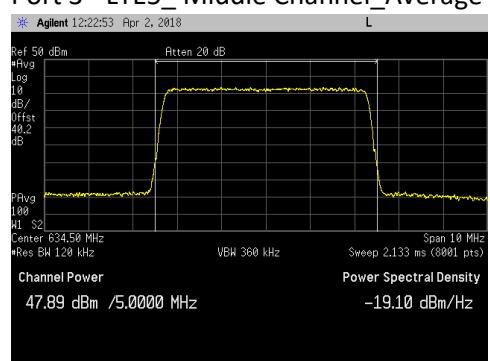
Port 2 - LTE5_Middle Channel_Average



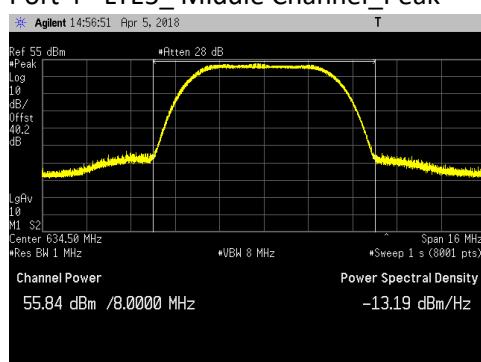
Port 3 - LTE5_Middle Channel_Peak



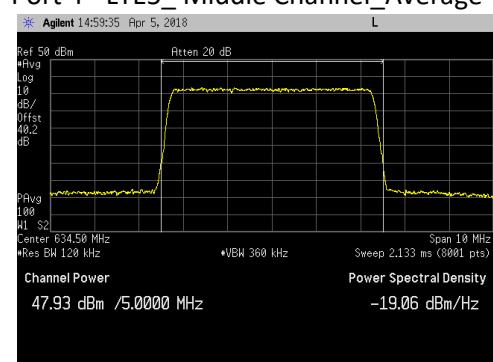
Port 3 - LTE5_Middle Channel_Average



Port 4 - LTE5_Middle Channel_Peak

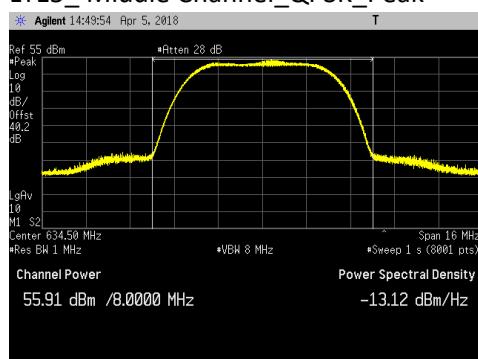


Port 4 - LTE5_Middle Channel_Average

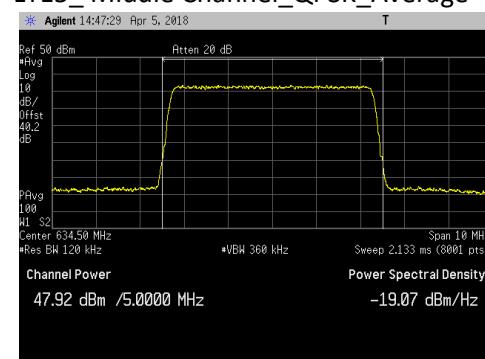


LTE5 Channel Power Plots for Antenna Port 4 at Middle Channel and all Modulation Types:

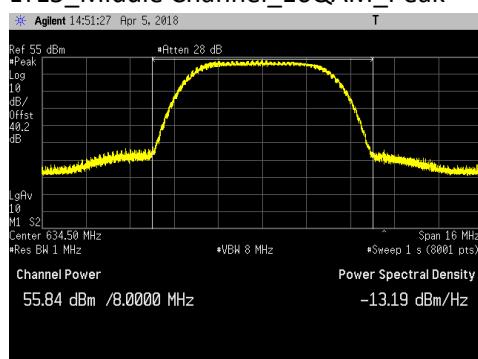
LTE5_Middle Channel_QPSK_Peak



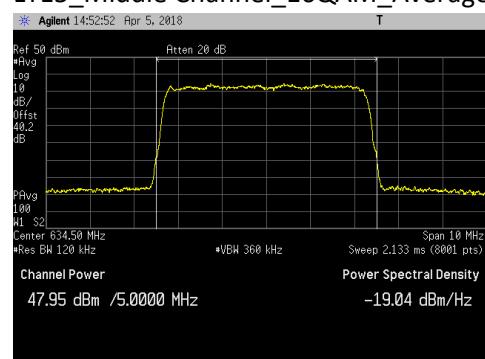
LTE5_Middle Channel_QPSK_Average



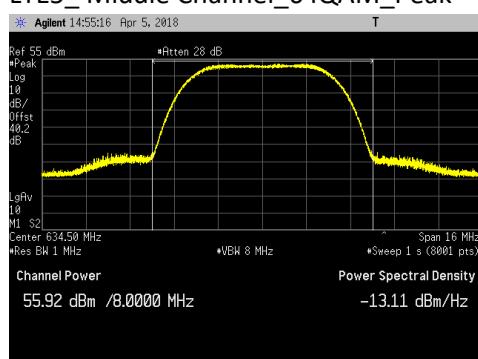
LTE5_Middle Channel_16QAM_Peak



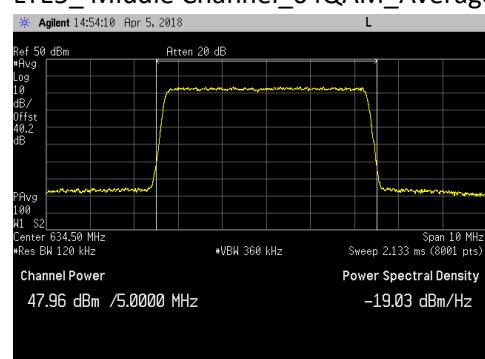
LTE5_Middle Channel_16QAM_Average



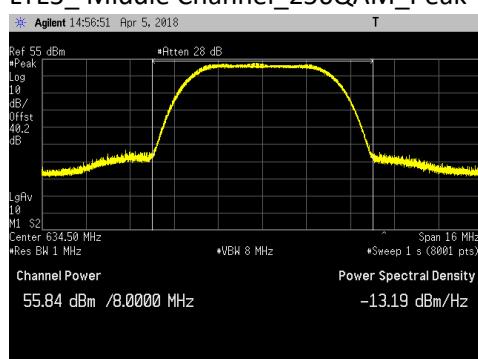
LTE5_Middle Channel_64QAM_Peak



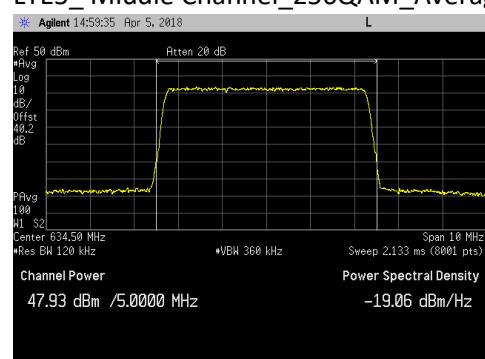
LTE5_Middle Channel_64QAM_Average



LTE5_Middle Channel_256QAM_Peak

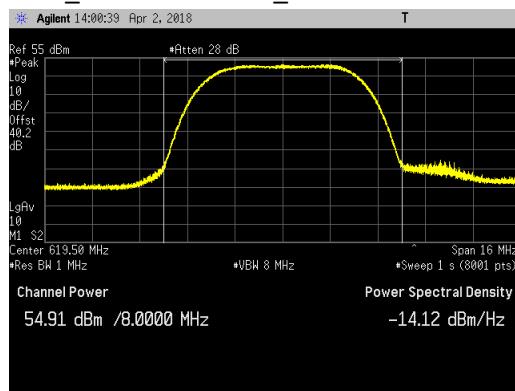


LTE5_Middle Channel_256QAM_Average

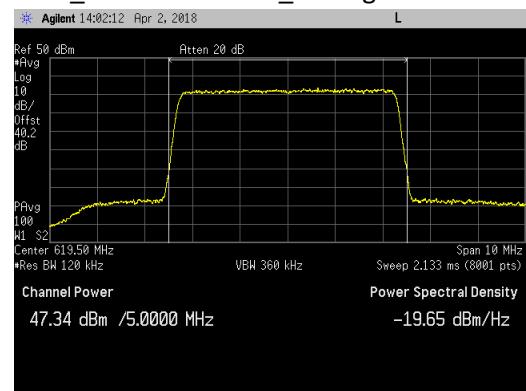


LTE5 Channel Power Plots for Antenna Port 4 and 256QAM Modulation:

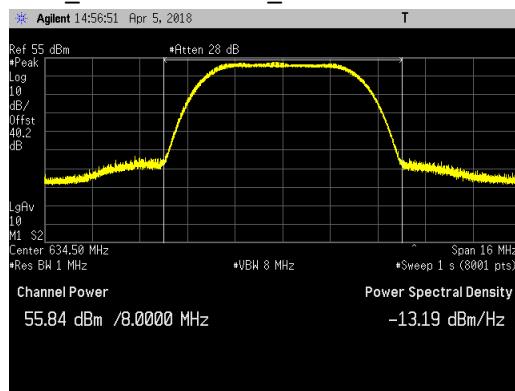
LTE5_Bottom Channel_Peak



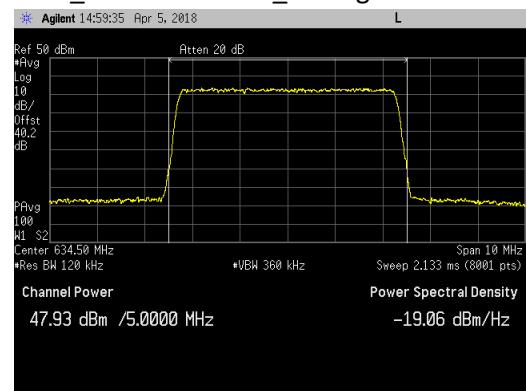
LTE5_Bottom Channel_Average



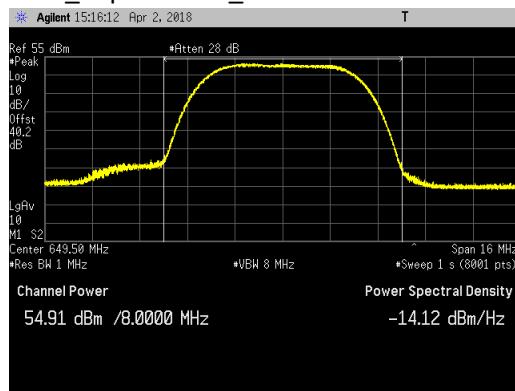
LTE5_Middle Channel_Peak



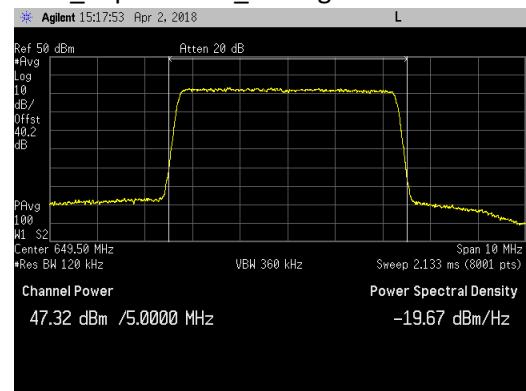
LTE5_Middle Channel_Average



LTE5_Top Channel_Peak

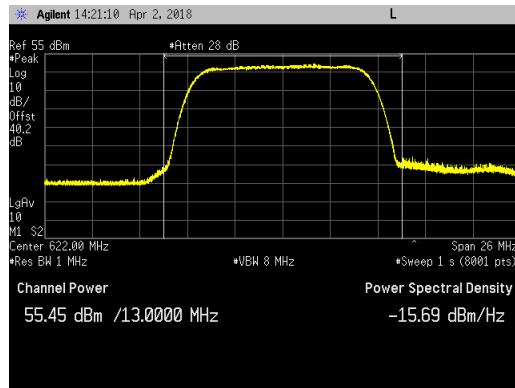


LTE5_Top Channel_Average

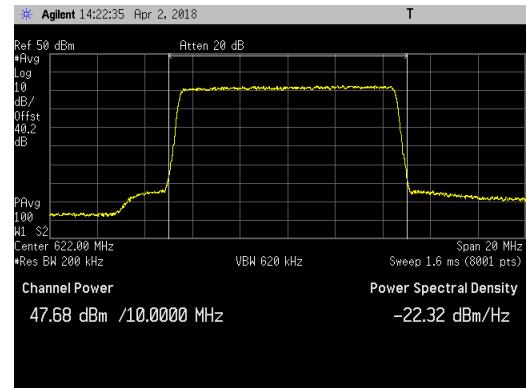


LTE10 Channel Power Plots for Antenna Port 4 and 256QAM Modulation:

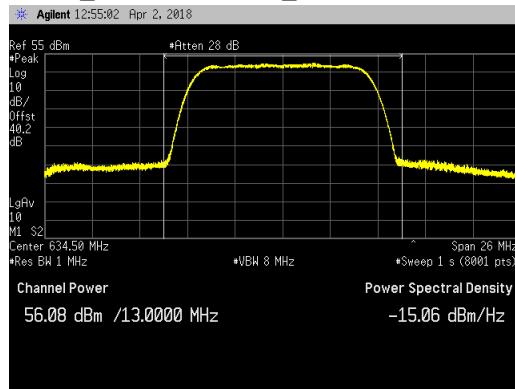
LTE10_Bottom Channel_Peak



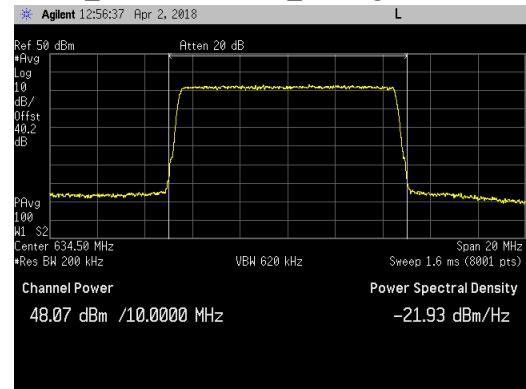
LTE10_Bottom Channel_Average



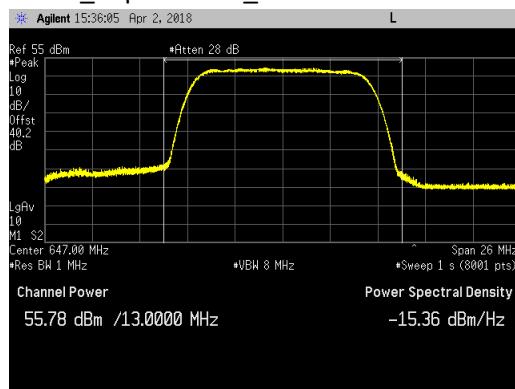
LTE10_Middle Channel_Peak



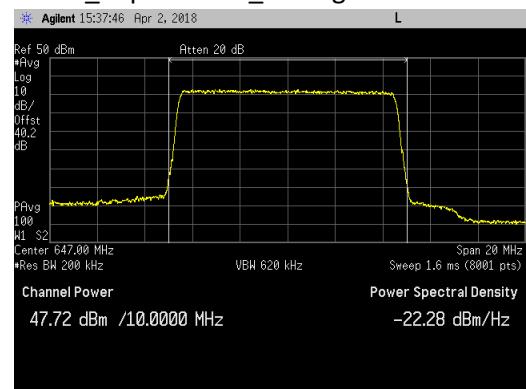
LTE10_Middle Channel_Average



LTE10_Top Channel_Peak

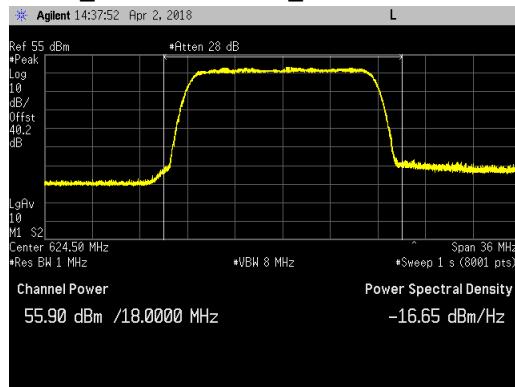


LTE10_Top Channel_Average

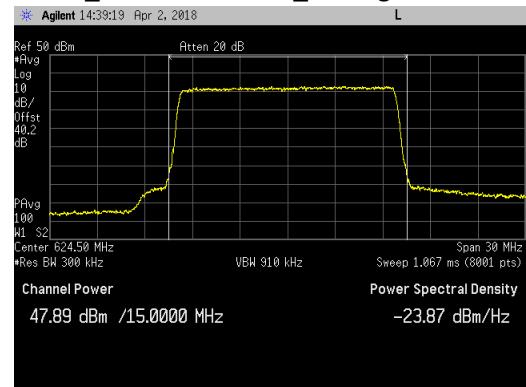


LTE15 Channel Power Plots for Antenna Port 4 and 256QAM Modulation:

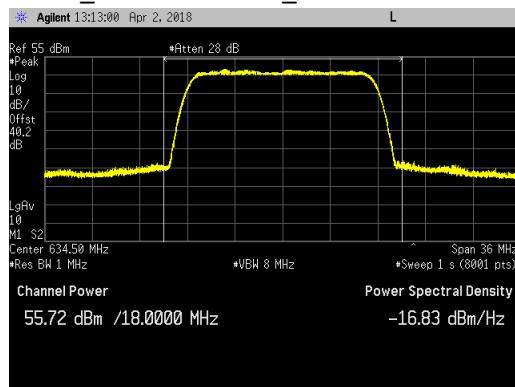
LTE15_Bottom Channel_Peak



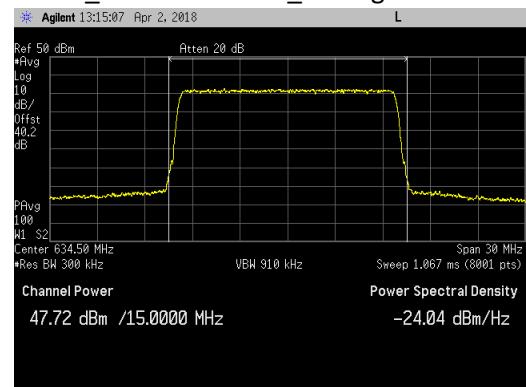
LTE15_Bottom Channel_Average



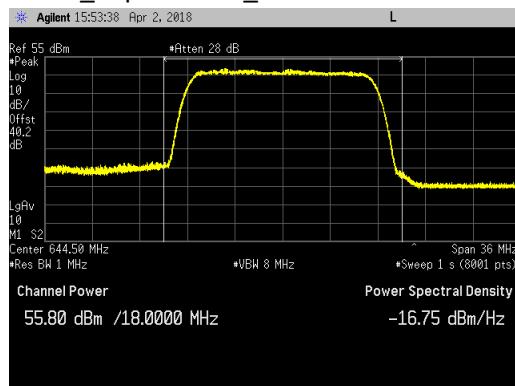
LTE15_Middle Channel_Peak



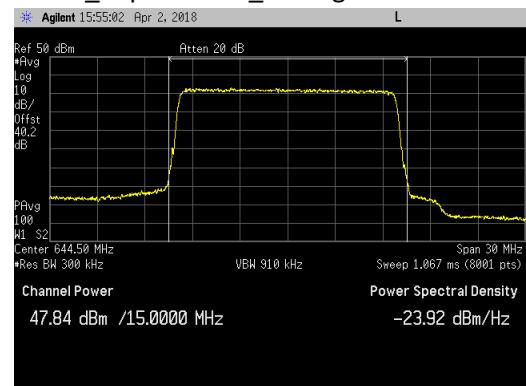
LTE15_Middle Channel_Average



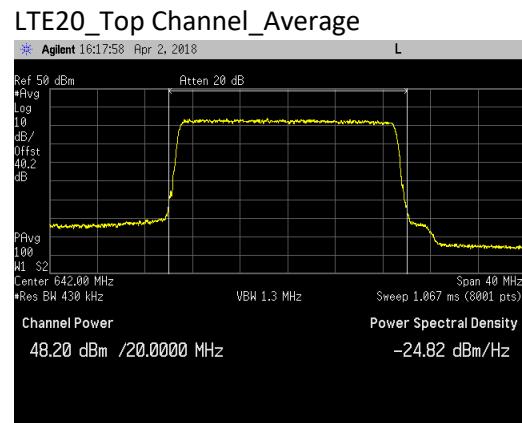
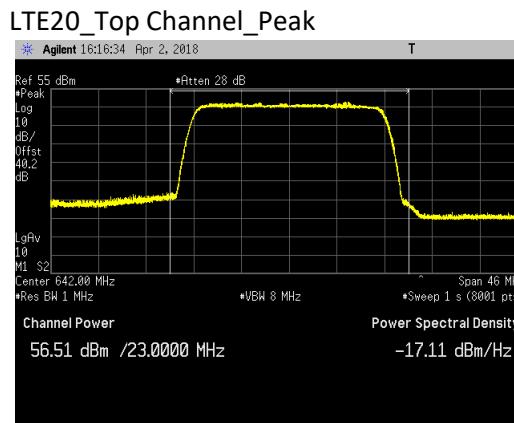
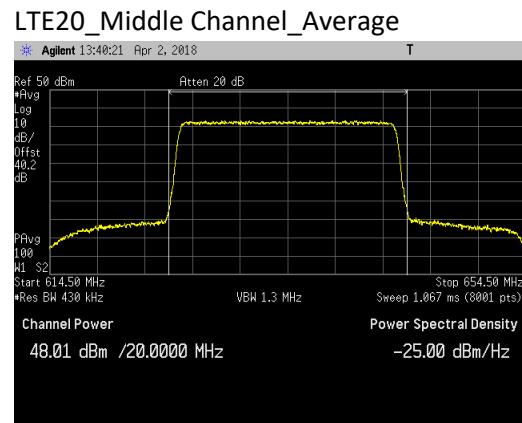
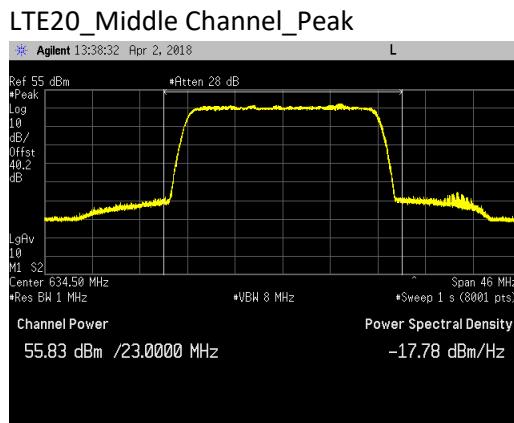
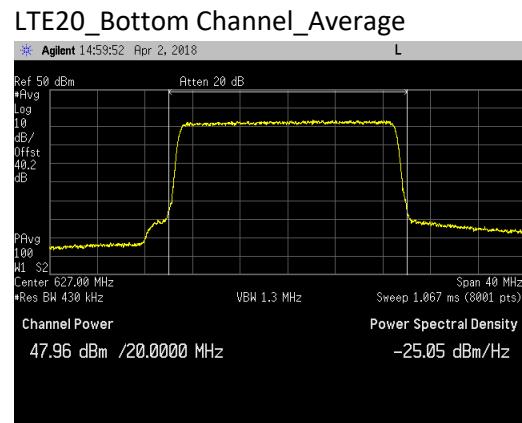
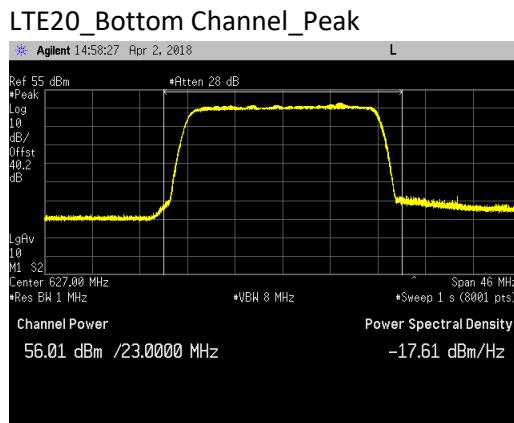
LTE15_Top Channel_Peak



LTE15_Top Channel_Average



LTE20 Channel Power Plots for Antenna Port 4 and 256QAM Modulation:



Emission Bandwidth (26 dB down and 99%)

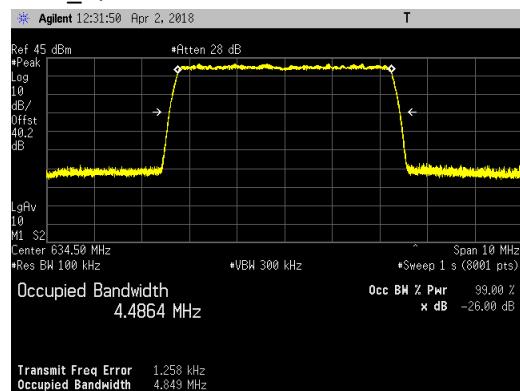
Emission bandwidth measurements were made at antenna port 4 on the middle channel with maximum RF output power. All available LTE modulations (QPSK, 16QAM, 64QAM, 256QAM) were used. All available LTE channel bandwidths (5MHz, 10MHz, 15MHz and 20MHz) were used. The results are provided in the following table. The largest emission bandwidths in each channel type are highlighted.

LTE Ch BW	Modulation Type							
	QPSK		16QAM		64QAM		256QAM	
	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)
5M	4.849	4.4864	4.825	4.4816	4.828	4.4937	4.845	4.4980
10M	9.651	8.9821	9.666	9.0023	9.687	8.9912	9.646	8.9731
15M	14.459	13.4706	14.429	13.4804	14.510	13.4667	14.471	13.4617
20M	19.313	17.9357	19.250	17.9860	19.310	17.9309	19.379	17.9527

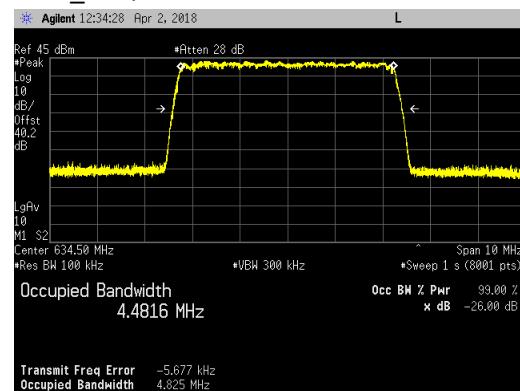
Emission bandwidth measurement data are provided in the following pages.

LTE5 Emission Bandwidth Plots on the Middle Channel for Antenna Port 4:

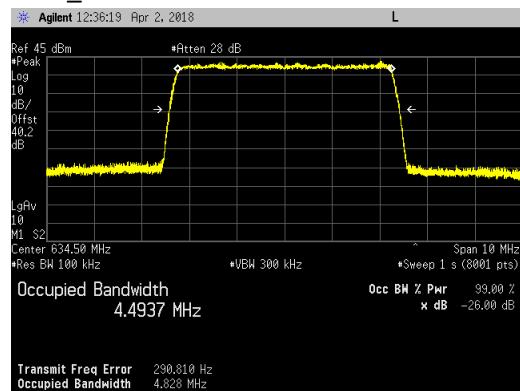
LTE5_QPSK



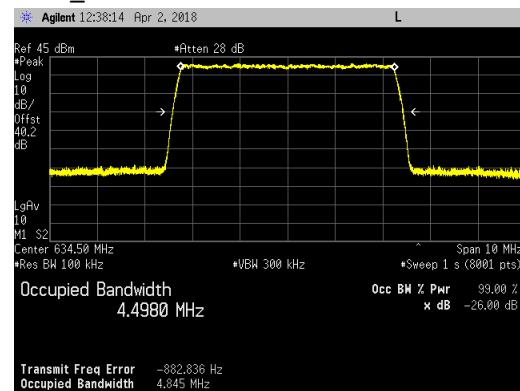
LTE5_16QAM



LTE5_64QAM

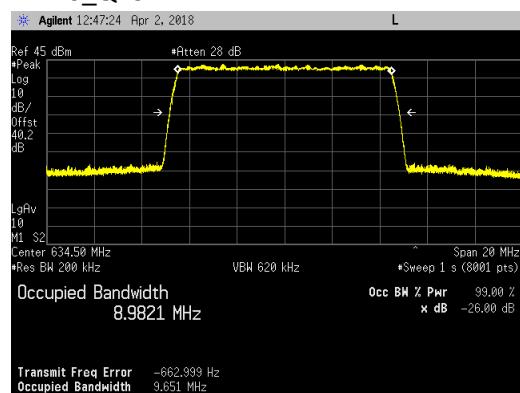


LTE5_256QAM

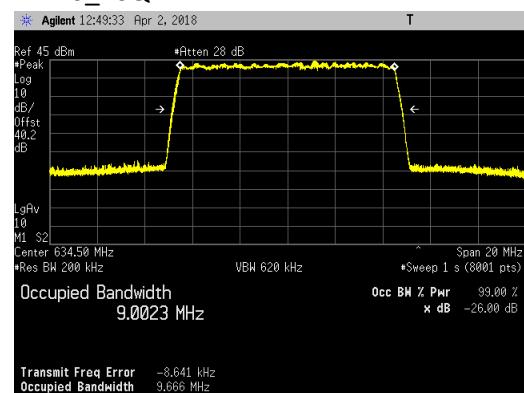


LTE10 Emission Bandwidth Plots on the Middle Channel for Antenna Port 4:

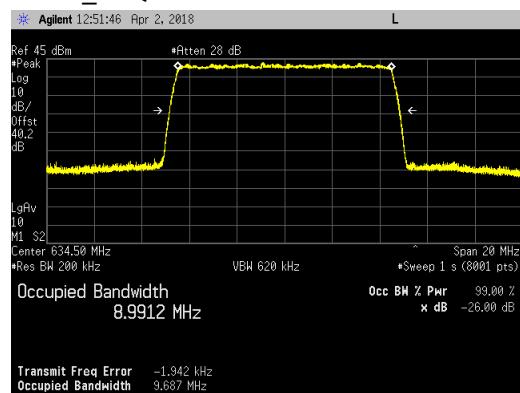
LTE10_QPSK



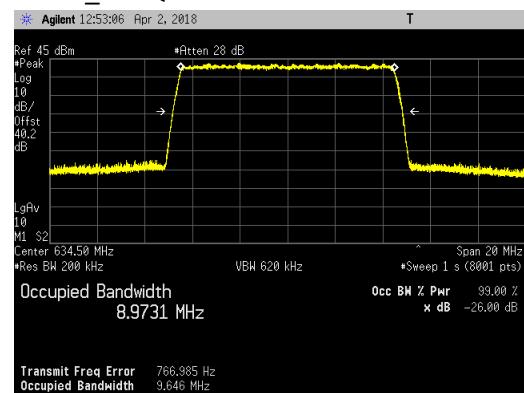
LTE10_16QAM



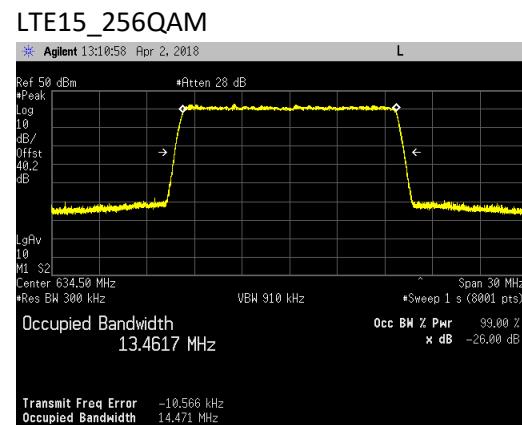
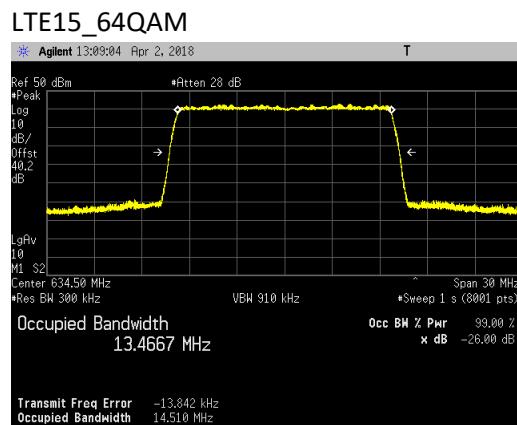
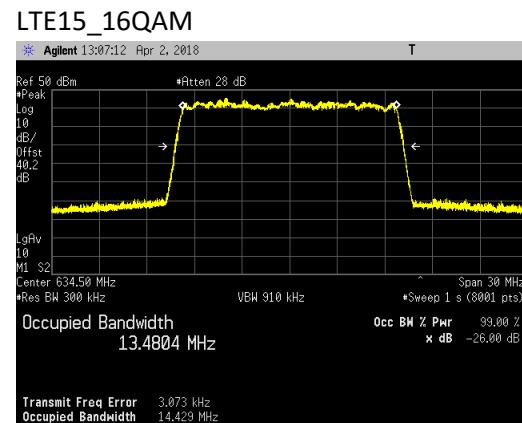
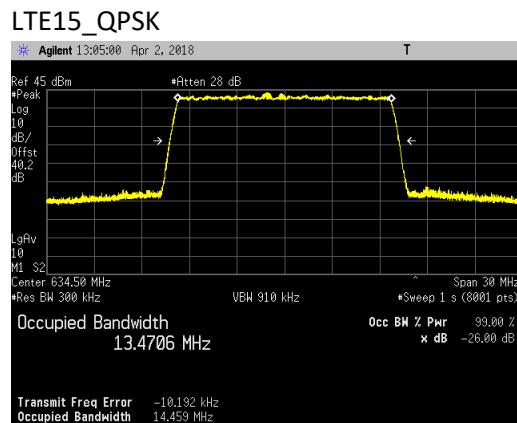
LTE10_64QAM



LTE10_256QAM

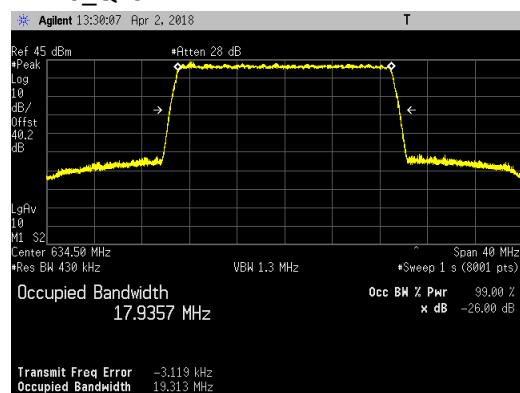


LTE15 Emission Bandwidth Plots on the Middle Channel for Antenna Port 4:

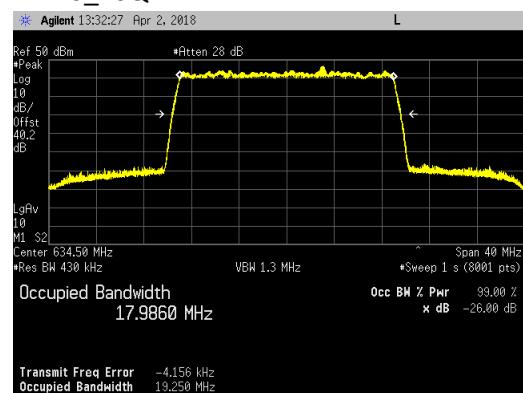


LTE20 Emission Bandwidth Plots on the Middle Channel for Antenna Port 4:

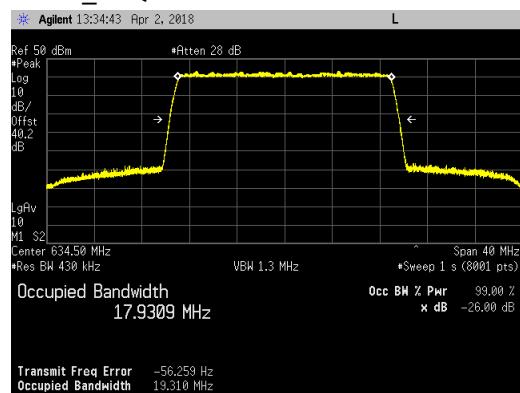
LTE20_QPSK



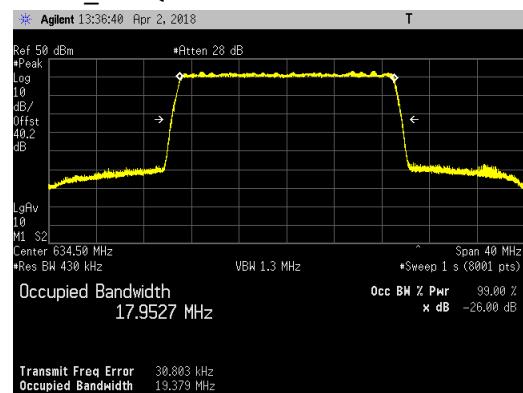
LTE20_16QAM



LTE20_64QAM



LTE20_256QAM



Antenna Port Conducted Band Edge

Conducted band edge measurements were made at RRH antenna port 4. The RRH was operated at the band edge frequencies with all modulation types (QPSK, 16QAM, 64QAM, 256QAM) for 5MHz, 10MHz, 15MHz and 20MHz LTE bandwidths.

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 100 traces. In the 100kHz bands outside and adjacent to the frequency block, a resolution bandwidth of 30kHz as allowed by FCC 27.53(g) was used. Outside the 100kHz band edge noted above, a 100kHz RBW and 300kHz VBW was used. Measurements were performed in the frequency range from the band edge to 20 MHz outside the band edge (i.e.: 597 to 617MHz and 652 to 672MHz bands).

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

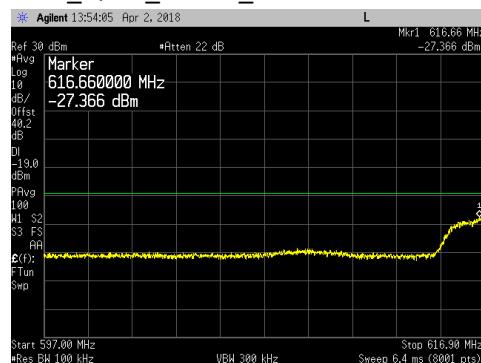
LTE BW	QPSK (dBm)		16QAM (dBm)		64QAM (dBm)		256QAM (dBm)	
	Bottom Channel	Top Channel	Bottom Channel	Top Channel	Bottom Channel	Top Channel	Bottom Channel	Top Channel
5M	-27.366	-27.728	-27.041	-26.940	-27.219	-27.273	-27.211	-26.790
10M	-27.024	-28.899	-27.147	-28.717	-26.819	-29.652	-27.139	-29.211
15M	-25.686	-26.401	-26.042	-28.081	-26.159	-27.283	-26.095	-27.654
20M	-26.695	-27.674	-27.005	-27.402	26.508	-27.732	-26.007	-28.031
Dual 5M	-23.159	-22.754	-24.128	-22.166	-23.315	-23.199	-22.845	-23.427

The total measurement RF path loss of the test setup (attenuator and test cables) was 40.2 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.

LTE5 Lower Band Edge Plots for Antenna Port 4:

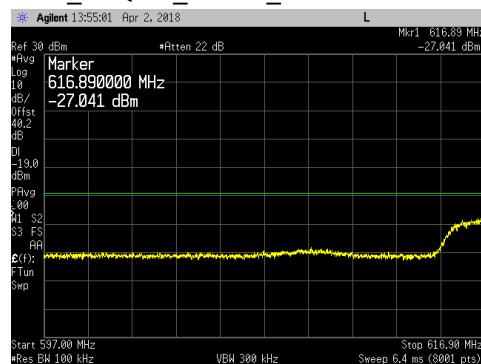
LTE5_QPSK_Bot Ch_597 to 616.9MHz



LTE5_QPSK_Bot Ch_616.9 to 617.1MHz



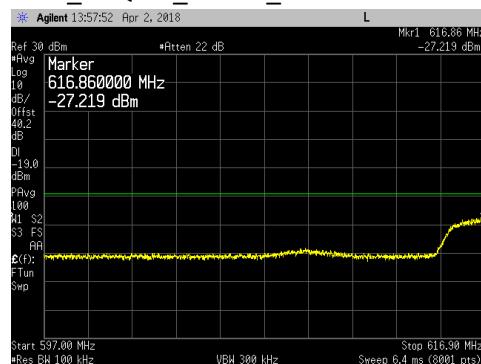
LTE5_16QAM_Bot Ch_597 to 616.9MHz



LTE5_16QAM_Bot Ch_616.9 to 617.1MHz



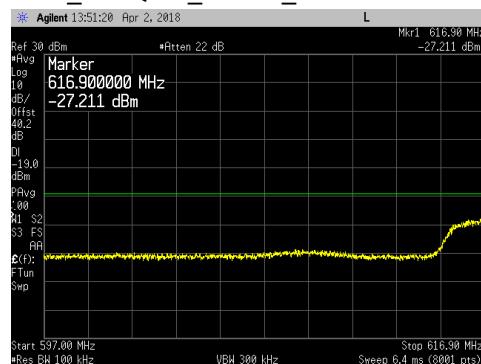
LTE5_64QAM_Bot Ch_597 to 616.9MHz



LTE5_64QAM_Bot Ch_616.9 to 617.1MHz



LTE5_256QAM_Bot Ch_597 to 616.9MHz

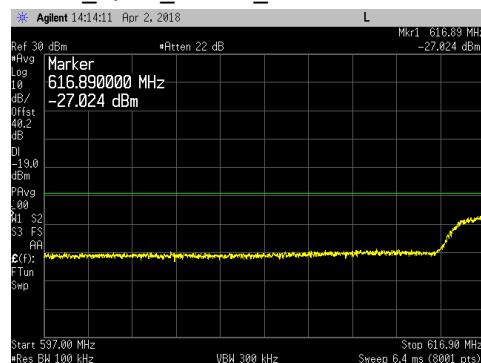


LTE5_256QAM_Bot Ch_616.9 to 617.1MHz



LTE10 Lower Band Edge Plots for Antenna Port 4:

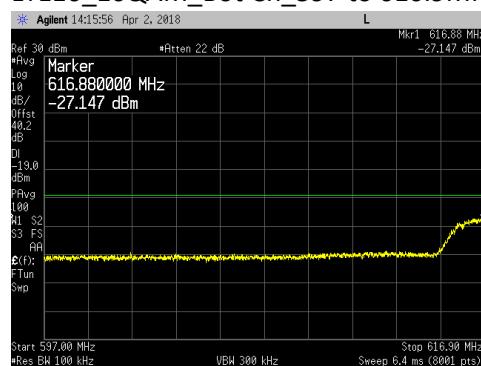
LTE10_QPSK_Bot Ch_597 to 616.9MHz



LTE10_QPSK_Bot Ch_616.9 to 617.1MHz



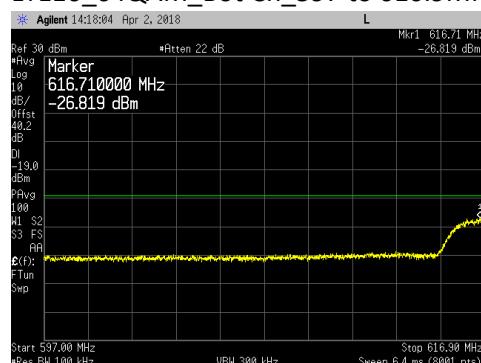
LTE10_16QAM_Bot Ch_597 to 616.9MHz



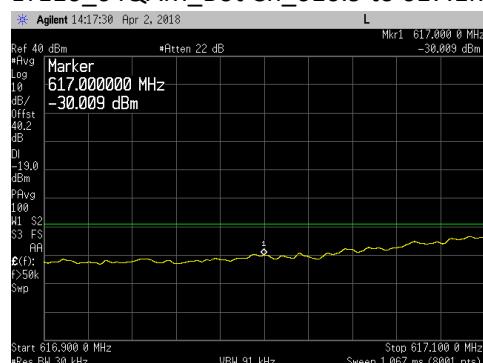
LTE10_16QAM_Bot Ch_616.9 to 617.1MHz



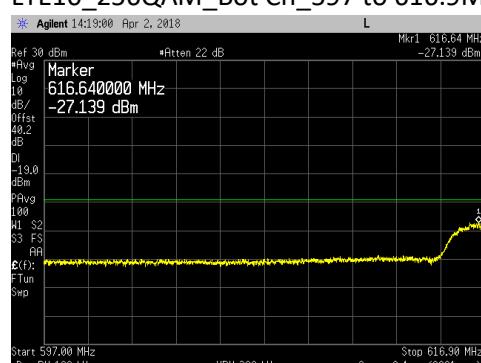
LTE10_64QAM_Bot Ch_597 to 616.9MHz



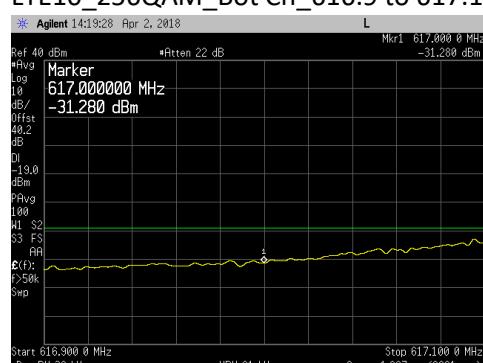
LTE10_64QAM_Bot Ch_616.9 to 617.1MHz



LTE10_256QAM_Bot Ch_597 to 616.9MHz

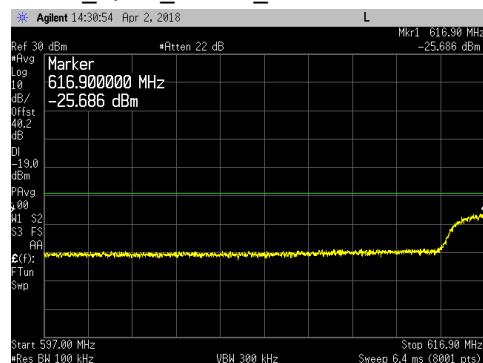


LTE10_256QAM_Bot Ch_616.9 to 617.1MHz

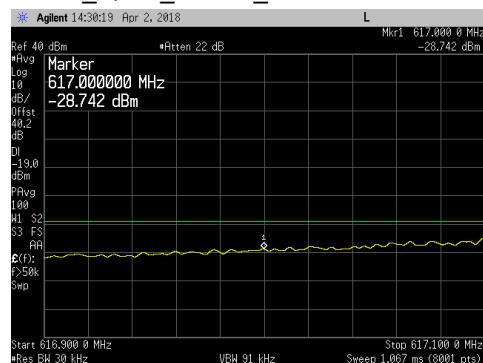


LTE15 Lower Band Edge Plots for Antenna Port 4:

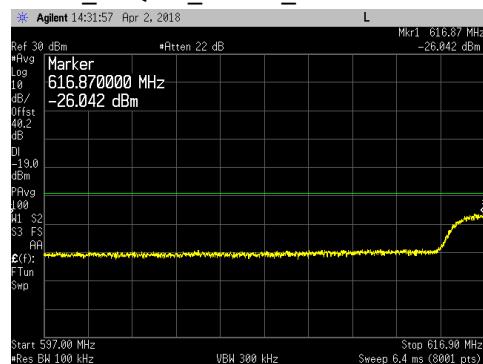
LTE15_QPSK_Bot Ch_597 to 616.9MHz



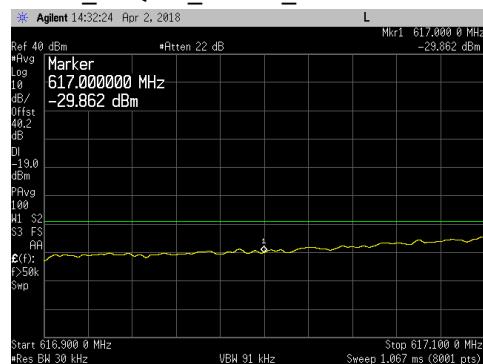
LTE15_QPSK_Bot Ch_616.9 to 617.1MHz



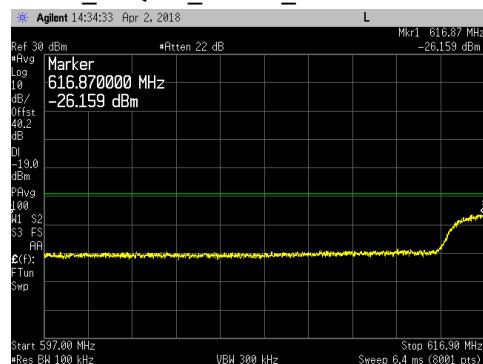
LTE15_16QAM_Bot Ch_597 to 616.9MHz



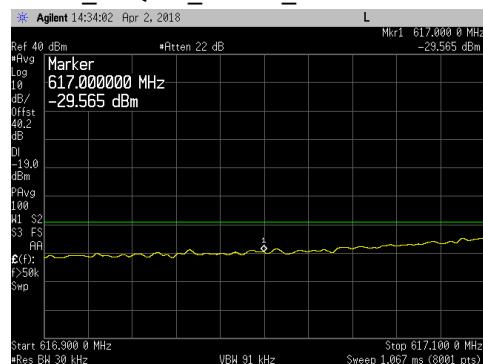
LTE15_16QAM_Bot Ch_616.9 to 617.1MHz



LTE15_64QAM_Bot Ch_597 to 616.9MHz



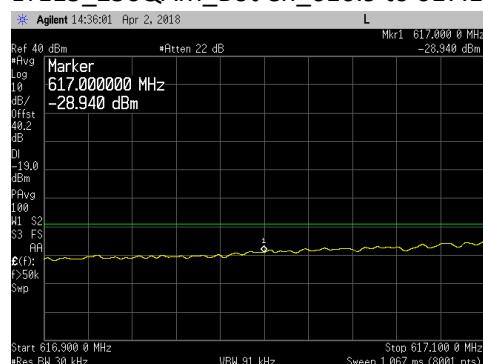
LTE15_64QAM_Bot Ch_616.9 to 617.1MHz



LTE15_256QAM_Bot Ch_597 to 616.9MHz

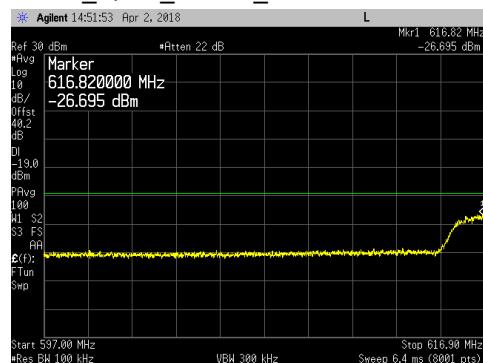


LTE15_256QAM_Bot Ch_616.9 to 617.1MHz



LTE20 Lower Band Edge Plots for Antenna Port 4:

LTE20_QPSK_Bot Ch_597 to 616.9MHz



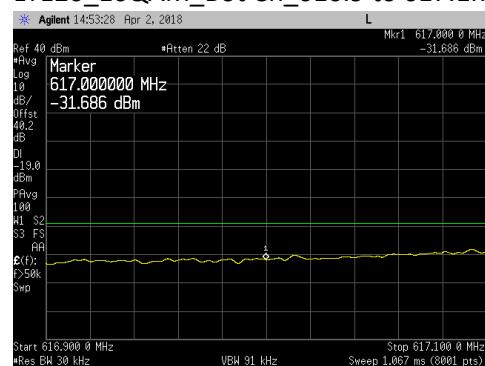
LTE20_QPSK_Bot Ch_616.9 to 617.1MHz



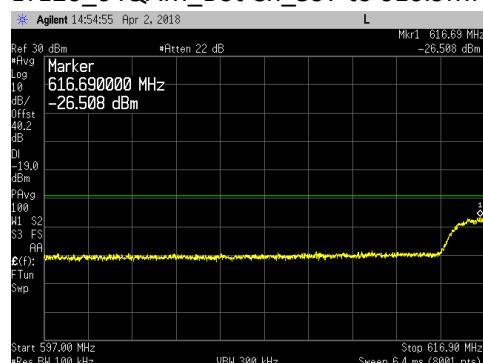
LTE20_16QAM_Bot Ch_597 to 616.9MHz



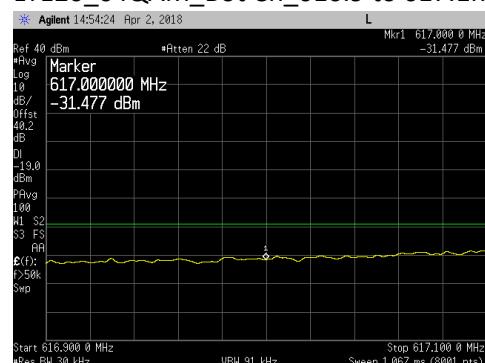
LTE20_16QAM_Bot Ch_616.9 to 617.1MHz



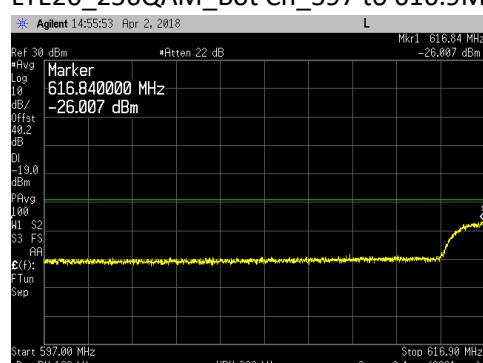
LTE20_64QAM_Bot Ch_597 to 616.9MHz



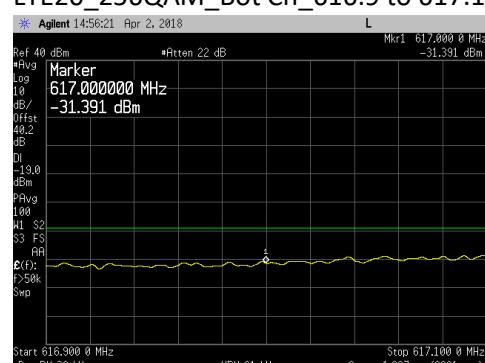
LTE20_64QAM_Bot Ch_616.9 to 617.1MHz



LTE20_256QAM_Bot Ch_597 to 616.9MHz



LTE20_256QAM_Bot Ch_616.9 to 617.1MHz



LTE5 Upper Band Edge Plots for Antenna Port 4:

LTE5_QPSK_Top Ch_651.9 to 652.1MHz



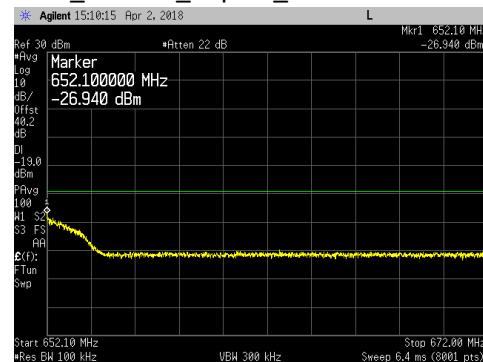
LTE5_QPSK_Top Ch_652.1 to 672MHz



LTE5_16QAM_Top Ch_651.9 to 652.1MHz



LTE5_16QAM_Top Ch_652.1 to 672MHz



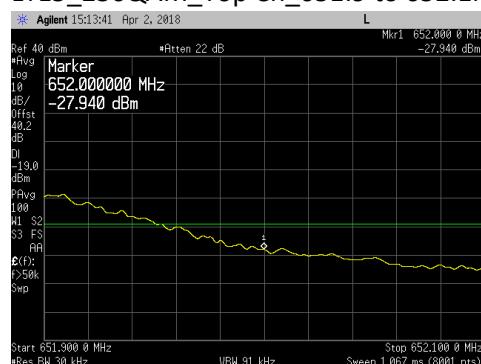
LTE5_64QAM_Top Ch_651.9 to 652.1MHz



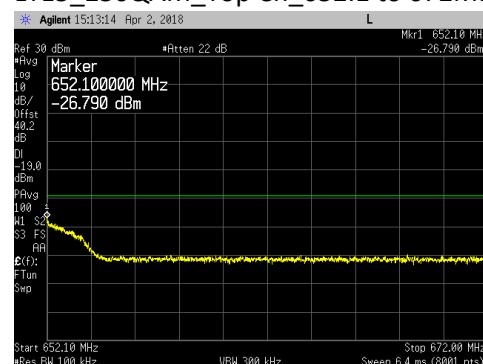
LTE5_64QAM_Top Ch_652.1 to 672MHz



LTE5_256QAM_Top Ch_651.9 to 652.1MHz

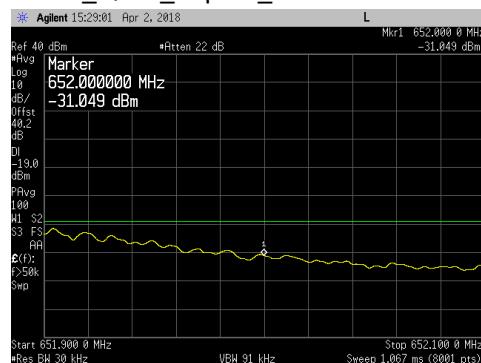


LTE5_256QAM_Top Ch_652.1 to 672MHz

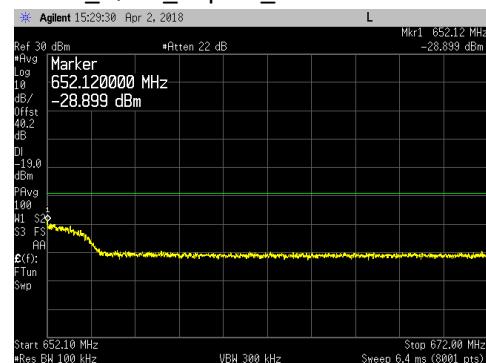


LTE10 Upper Band Edge Plots for Antenna Port 4:

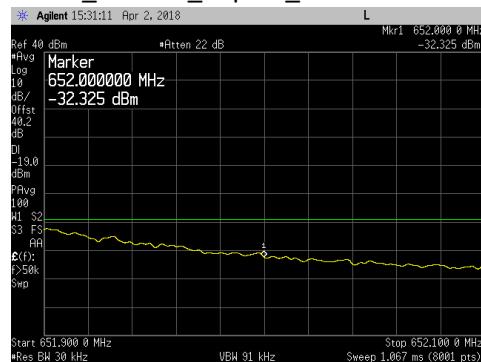
LTE10_QPSK_Top Ch_651.9 to 652.1MHz



LTE10_QPSK_Top Ch_652.1 to 672MHz



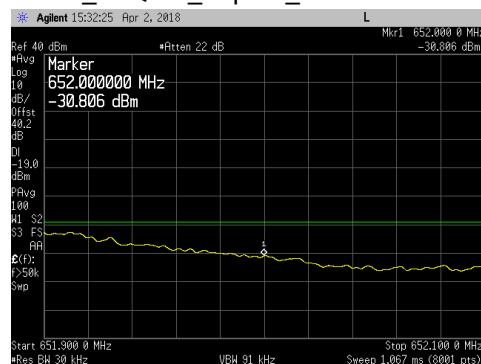
LTE10_16QAM_Top Ch_651.9 to 652.1MHz



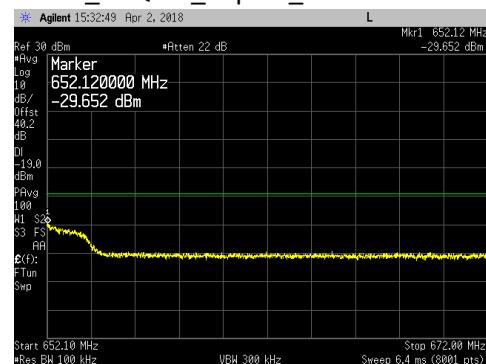
LTE10_16QAM_Top Ch_652.1 to 672MHz



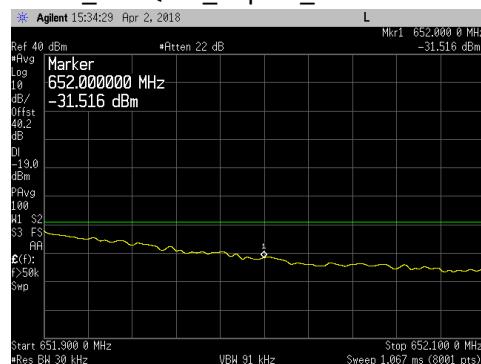
LTE10_64QAM_Top Ch_651.9 to 652.1MHz



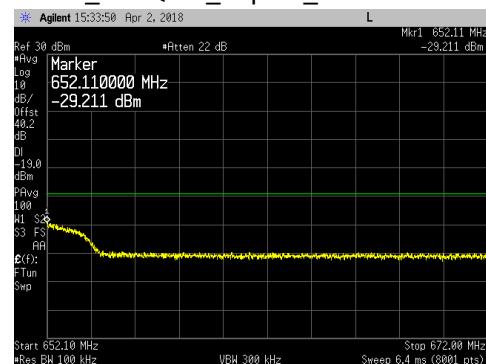
LTE10_64QAM_Top Ch_652.1 to 672MHz



LTE10_256QAM_Top Ch_651.9 to 652.1MHz

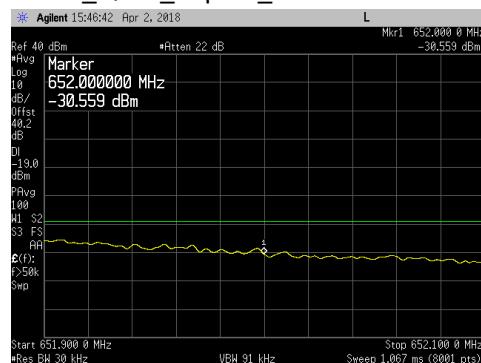


LTE10_256QAM_Top Ch_652.1 to 672MHz

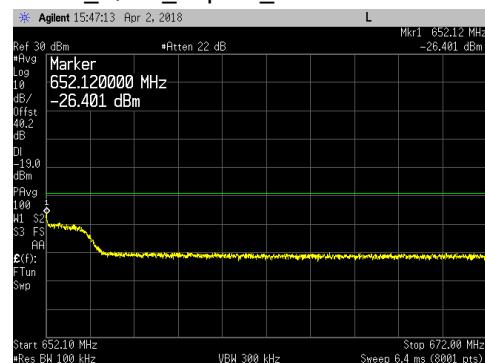


LTE15 Upper Band Edge Plots for Antenna Port 4:

LTE15_QPSK_Top Ch_651.9 to 652.1MHz



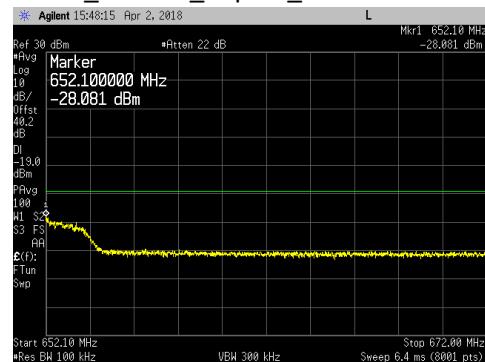
LTE15_QPSK_Top Ch_652.1 to 672MHz



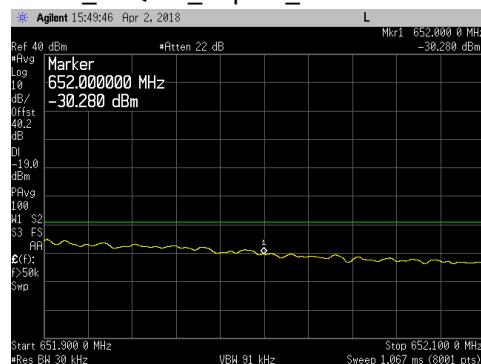
LTE15_16QAM_Top Ch_651.9 to 652.1MHz



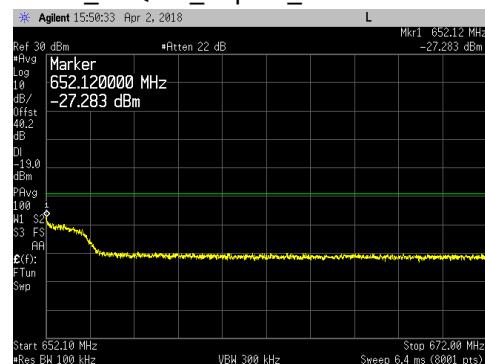
LTE15_16QAM_Top Ch_652.1 to 672MHz



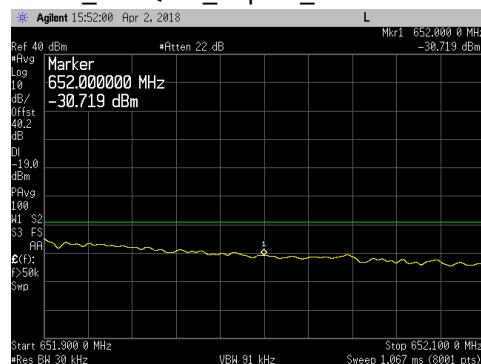
LTE15_64QAM_Top Ch_651.9 to 652.1MHz



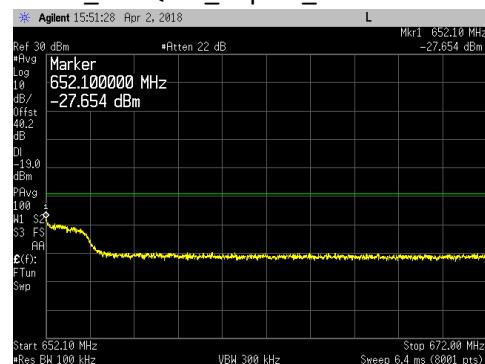
LTE15_64QAM_Top Ch_652.1 to 672MHz



LTE15_256QAM_Top Ch_651.9 to 652.1MHz

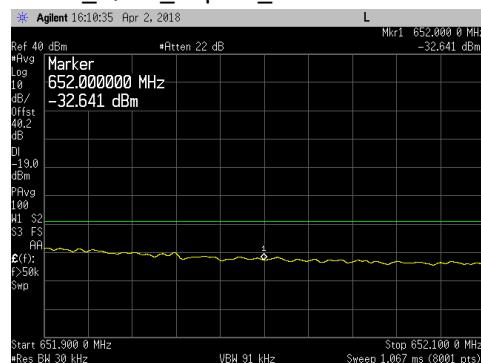


LTE15_256QAM_Top Ch_652.1 to 672MHz

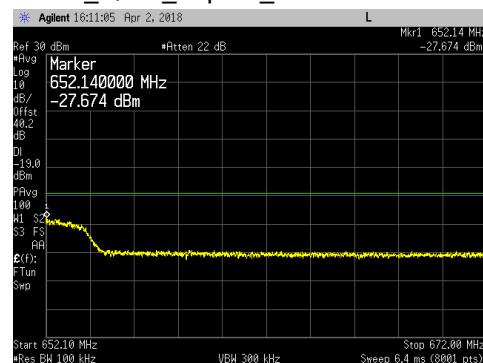


LTE20 Upper Band Edge Plots for Antenna Port 4:

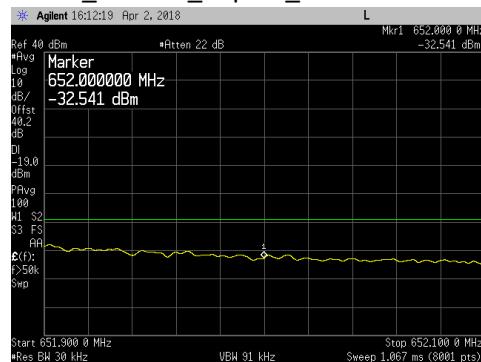
LTE20_QPSK_Top Ch_651.9 to 652.1MHz



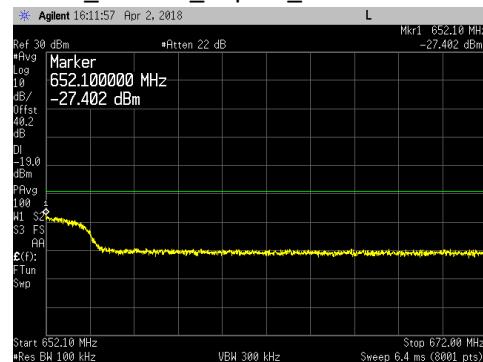
LTE20_QPSK_Top Ch_652.1 to 672MHz



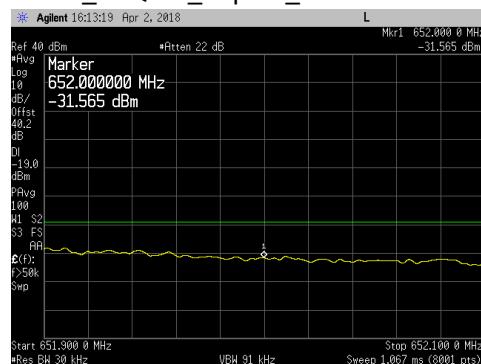
LTE20_16QAM_Top Ch_651.9 to 652.1MHz



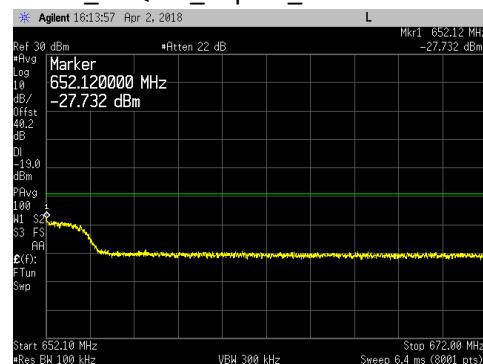
LTE20_16QAM_Top Ch_652.1 to 672MHz



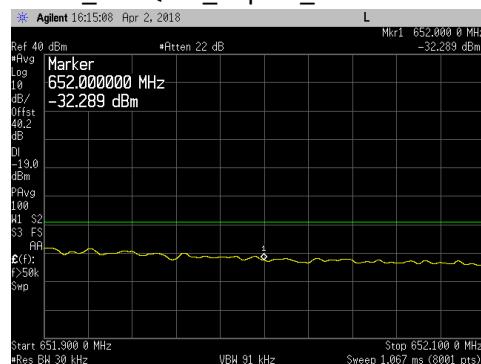
LTE20_64QAM_Top Ch_651.9 to 652.1MHz



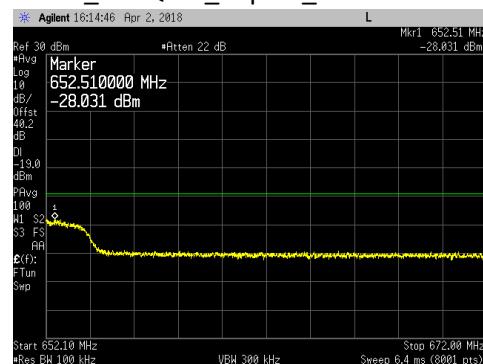
LTE20_64QAM_Top Ch_652.1 to 672MHz



LTE20_256QAM_Top Ch_651.9 to 652.1MHz

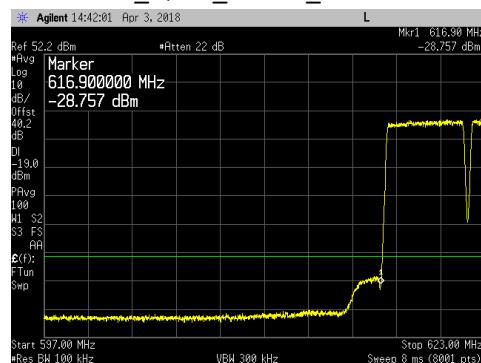


LTE20_256QAM_Top Ch_652.1 to 672MHz



Dual LTE5 Lower Band Edge Plots for Antenna Port 4:

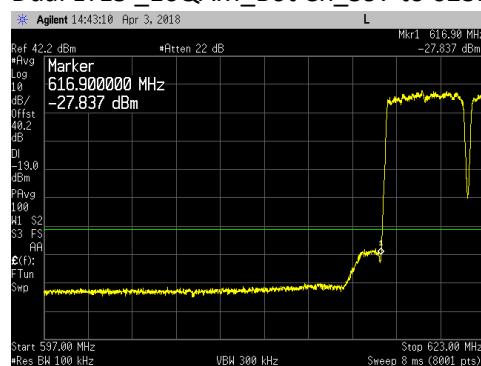
Dual LTE5 _QPSK_Bot Ch_597 to 623MHz



Dual LTE5 _QPSK_Bot Ch_616.9 to 617.1MHz



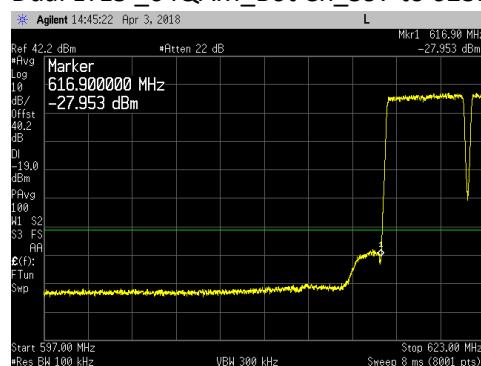
Dual LTE5 _16QAM_Bot Ch_597 to 623MHz



Dual LTE5 _16QAM_Bot Ch_616.9 to 617.1MHz



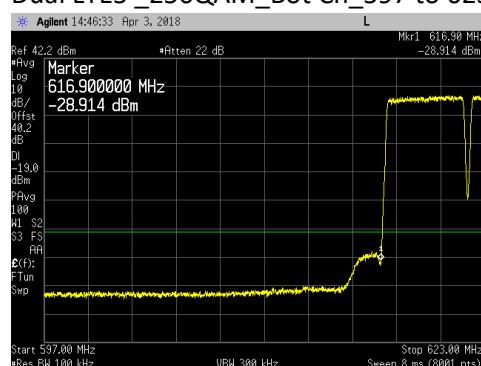
Dual LTE5 _64QAM_Bot Ch_597 to 623MHz



Dual LTE5 _64QAM_Bot Ch_616.9 to 617.1MHz



Dual LTE5 _256QAM_Bot Ch_597 to 623MHz



Dual LTE5 _256QAM_Bot Ch_616.9 to 617.1MHz

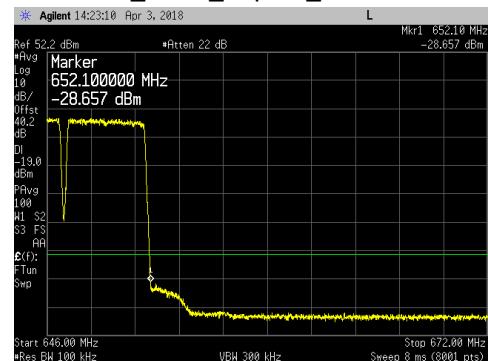


Dual LTE5 Upper Band Edge Plots for Antenna Port 4:

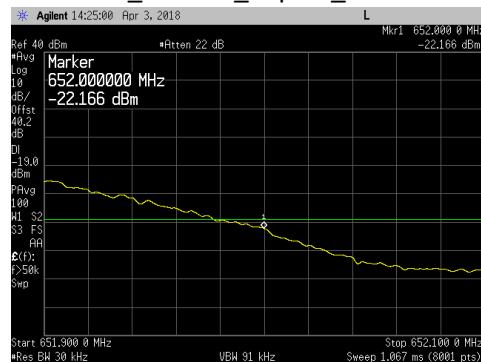
Dual LTE5_QPSK_Top Ch_651.9 to 652.1MHz



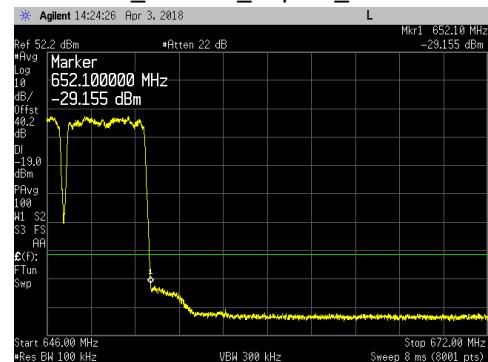
Dual LTE5_QPSK_Top Ch_646 to 672MHz



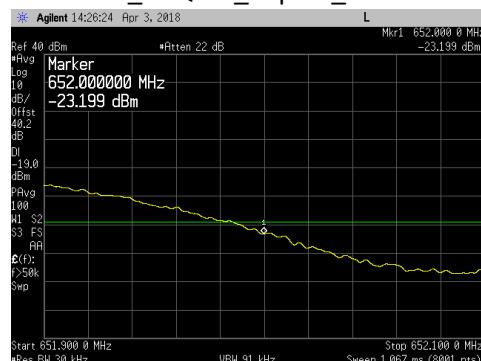
Dual LTE5_16QAM_Top Ch_651.9 to 652.1MHz



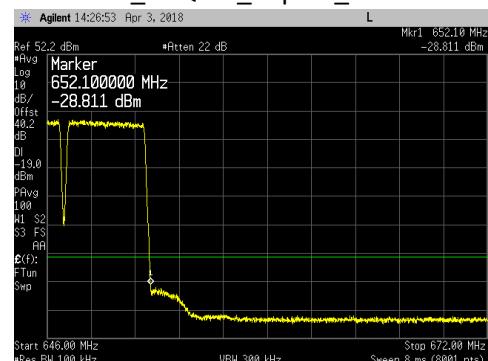
Dual LTE5_16QAM_Top Ch_646 to 672MHz



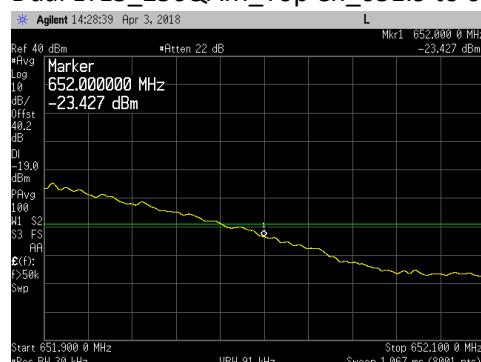
Dual LTE5_64QAM_Top Ch_651.9 to 652.1MHz



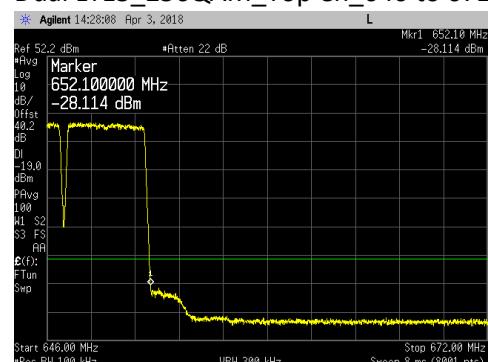
Dual LTE5_64QAM_Top Ch_646 to 672MHz



Dual LTE5_256QAM_Top Ch_651.9 to 652.1MHz



Dual LTE5_256QAM_Top Ch_646 to 672MHz



Transmitter Antenna Port Conducted Emissions

Transmitter conducted emission measurements were made at RRH antenna port 4. Measurements were performed over the 9kHz to 8GHz frequency range. Two test configurations are needed for conducted spurious emission measurements to prove compliance for the 3GPP Band 71 transmitters. The first test will be with the 3GPP Band 71 transmitters enabled at 60 watts per carrier (the 3GPP Band 12 transmitters will not be enabled). The second test will be with the 3GPP Band 71 and the 3GPP Band 12 transmitters enabled simultaneously at 30 watts per carrier (or 60 watts/antenna port).

The RRH was operated on the Band 71 middle channel (634.5MHz) and Band 12 middle channel (737.0MHz) simultaneously with all LTE modulation types (QPSK, 16QAM, 64QAM and 256QAM) for all available LTE bandwidths (Band 71: 5MHz, 10MHz, 15MHz and 20MHz; Band 12: 1.4MHz, 3MHz, 5MHz and 10MHz). The same LTE bandwidth was used for both frequency bands when available. If the same LTE bandwidth for both bands was not available then the smallest LTE bandwidth was used.

The parameters of the first test configuration are provided below:

3GPP Band 71 Transmission Parameters			3GPP Band 12 Transmission Parameters		
Carrier Frequency	Channel Bandwidth	Carrier Power	Carrier Frequency	Channel Bandwidth	Carrier Power
634.5MHz (Mid Ch)	LTE5	60 Watts	Carrier Idle/Off	N/A	0 Watts
634.5MHz (Mid Ch)	LTE10	60 Watts	Carrier Idle/Off	N/A	0 Watts
634.5MHz (Mid Ch)	LTE15	60 Watts	Carrier Idle/Off	N/A	0 Watts
634.5MHz (Mid Ch)	LTE20	60 Watts	Carrier Idle/Off	N/A	0 Watts

The parameters of the second test configuration are provided below:

3GPP Band 71 Transmission Parameters			3GPP Band 12 Transmission Parameters		
Carrier Frequency	Channel Bandwidth	Carrier Power	Carrier Frequency	Channel Bandwidth	Carrier Power
634.5MHz (Mid Ch)	LTE5	30 Watts	737.0MHz (Mid Ch)	LTE1.4	30 Watts
634.5MHz (Mid Ch)	LTE5	30 Watts	737.0MHz (Mid Ch)	LTE3	30 Watts
634.5MHz (Mid Ch)	LTE5	30 Watts	737.0MHz (Mid Ch)	LTE5	30 Watts
634.5MHz (Mid Ch)	LTE10	30 Watts	737.0MHz (Mid Ch)	LTE10	30 Watts
634.5MHz (Mid Ch)	LTE15	30 Watts	737.0MHz (Mid Ch)	LTE1.4	30 Watts
634.5MHz (Mid Ch)	LTE20	30 Watts	737.0MHz (Mid Ch)	LTE1.4	30 Watts

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. The required measurement parameters include a 100kHz bandwidth with power measured in average value (since transmitter power was measured in average value).

Measurements were performed with a spectrum analyzer using a peak detector with max hold over 50 sweeps (except for the 9kHz to 150kHz, 150kHz to 20MHz and 400MHz to 800MHz frequency ranges). Measurements for the 9kHz to 150kHz, 150kHz to 20MHz and 400MHz to 800MHz frequency ranges were performed with the spectrum analyzer in the RMS average mode over 100 traces.

The limit for the 9kHz to 150kHz frequency range was adjusted to -39dBm to correct for a spectrum analyzer RBW of 1kHz versus required RBW of 100kHz [i.e.: -39dBm = -19dBm -10log(100kHz/1kHz)]. The required limit of -19dBm with a RBW of \geq 100kHz was used for all other frequency ranges. The spectrum analyzer settings that were used for this test are summarized in the following table.

Frequency Range	RBW	VBW	Number of Data Points	Detector	Sweep Time	Max Hold over	Offset Note 1
9kHz to 150kHz	1kHz	3kHz	8001	Average	Auto	Note 2	40.1dB
150kHz to 20MHz	100kHz	300kHz	8001	Average	Auto	Note 2	39.9dB
20MHz to 400MHz	100kHz	300kHz	8001	Peak	Auto	50 Sweeps	40.1dB
400MHz to 800MHz	100kHz	300kHz	8001	Average	Auto	Note 2	40.2dB
800MHz to 1.1GHz	100kHz	300kHz	8001	Peak	Auto	50 Sweeps	40.2dB
1.1GHz to 5GHz	1MHz	3MHz	8001	Peak	Auto	50 Sweeps	32.0dB
5GHz to 8GHz	1MHz	3MHz	8001	Peak	Auto	50 Sweeps	30.1dB

Note 1: The total measurement RF path loss of the test setup (attenuators, filters and test cables) is accounted for by the spectrum analyzer reference level offset.

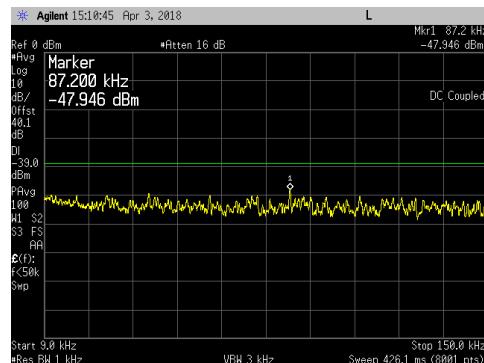
Note 2: Max Hold not used and instead measurements were performed with the spectrum analyzer in the RMS average mode over 100 traces.

A high pass filter was used to reduce measurement instrumentation noise floor for the frequency ranges above 1100MHz. The total measurement RF path loss of the test setup (attenuators, high pass filter and test cables) as shown in the table is accounted for by the spectrum analyzer reference level offset. The display line on the plots reflects the required limit.

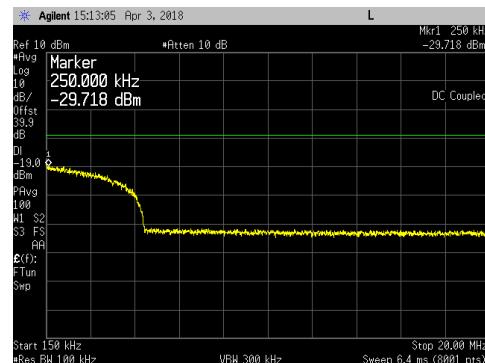
Conducted spurious emission plots/measurements are provided in the following pages.

LTE5 Ch BW _ QPSK _ Middle Channel (634.5MHz) at 60 watts/carrier:

9kHz to 150kHz



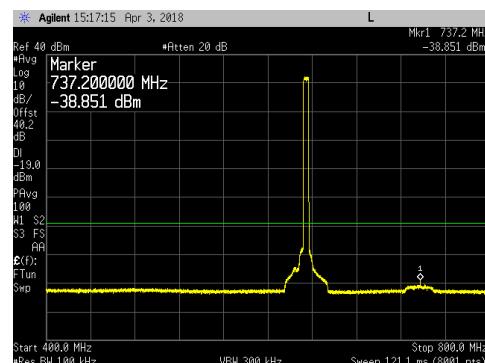
150kHz to 20MHz



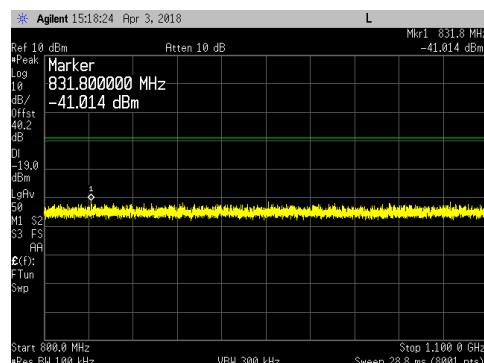
20MHz to 400MHz



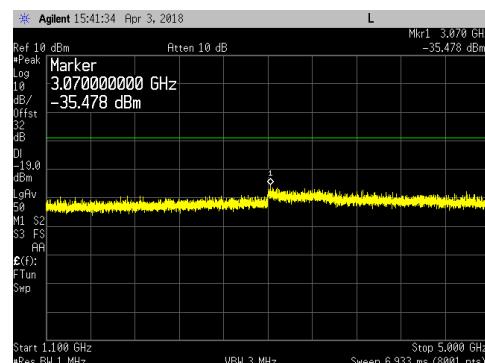
400MHz to 800MHz



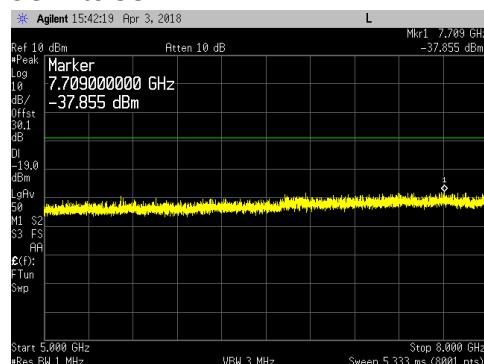
800MHz to 1.1GHz



1.1GHz to 5GHz

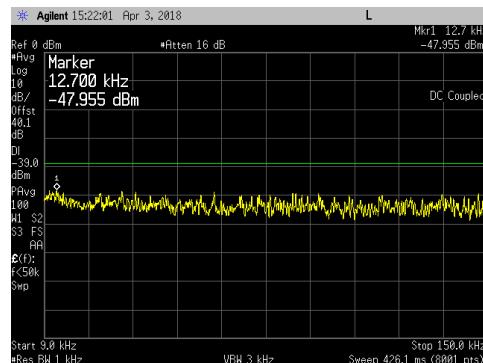


5GHz to 8GHz

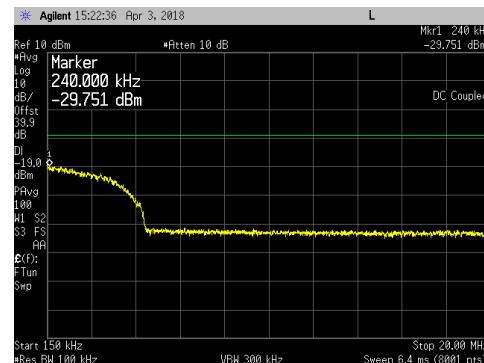


LTE5 Ch BW _ 16QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

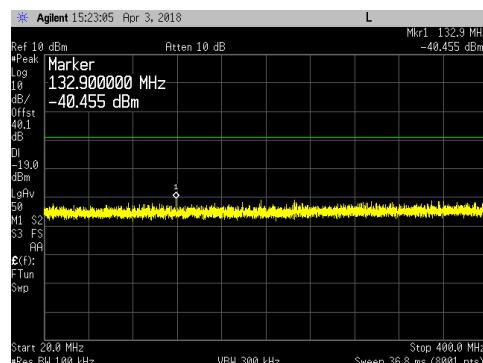
9kHz to 150kHz



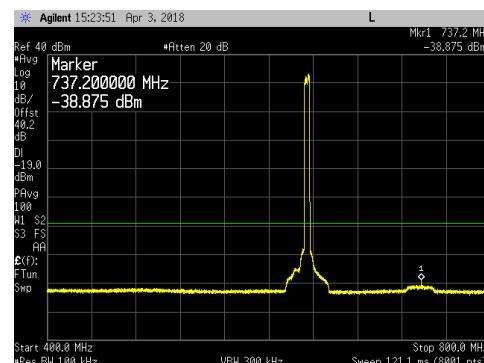
150kHz to 20MHz



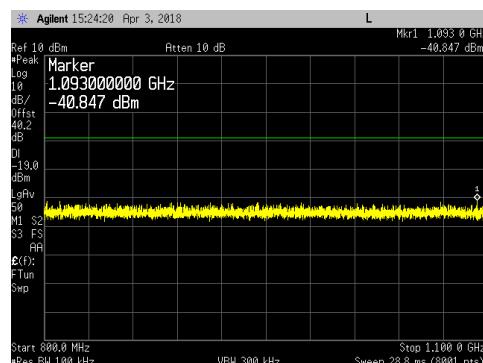
20MHz to 400MHz



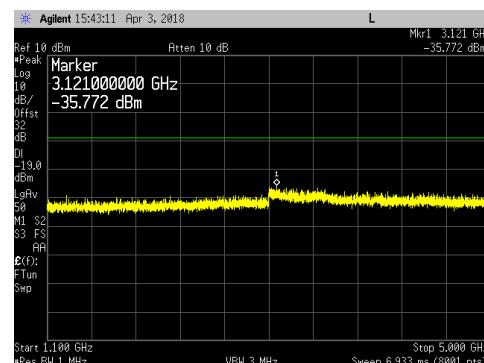
400MHz to 800MHz



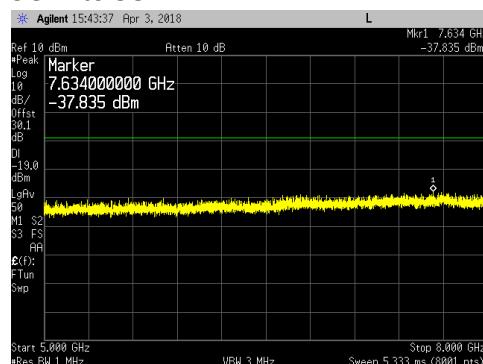
800MHz to 1.1GHz



1.1GHz to 5GHz

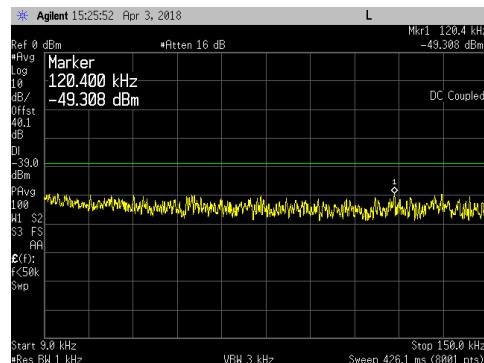


5GHz to 8GHz

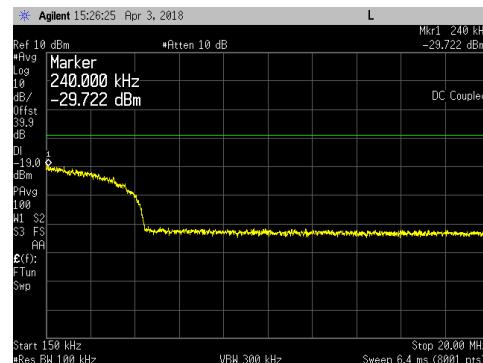


LTE5 Ch BW _ 64QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

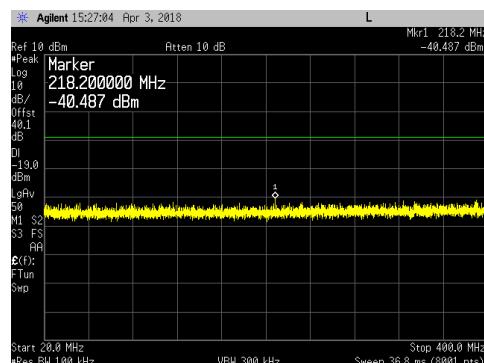
9kHz to 150kHz



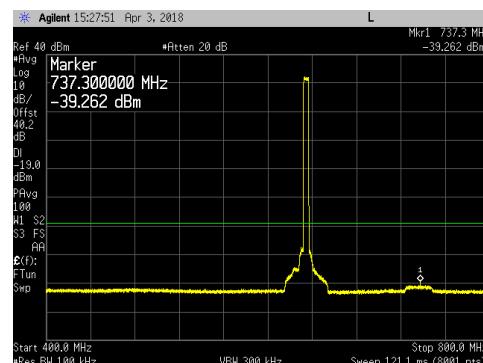
150kHz to 20MHz



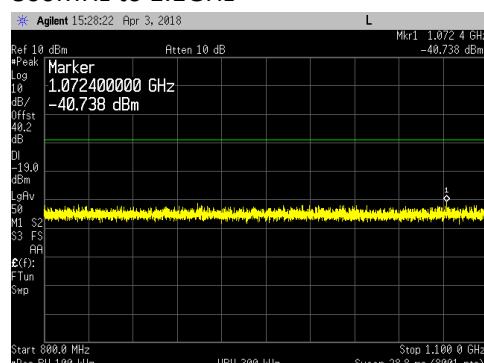
20MHz to 400MHz



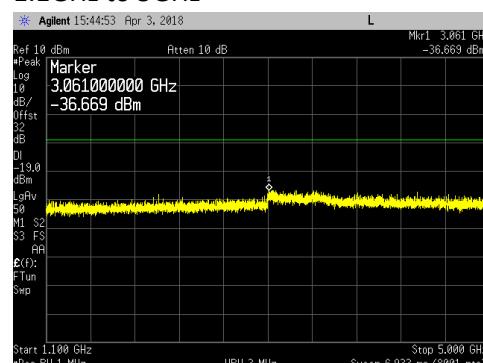
400MHz to 800MHz



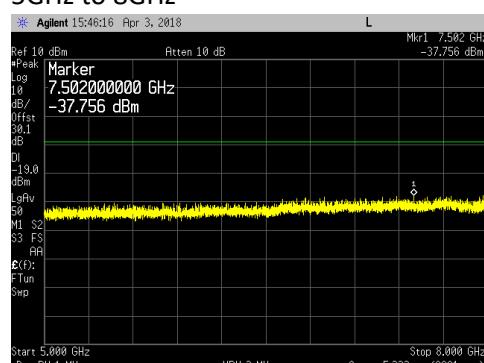
800MHz to 1.1GHz



1.1GHz to 5GHz

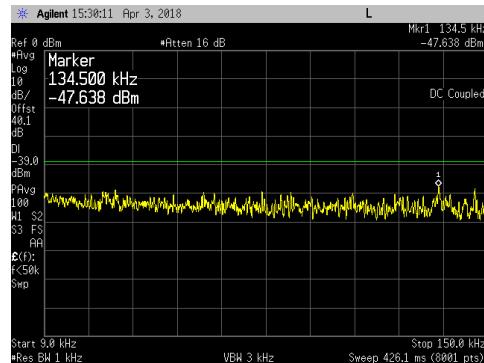


5GHz to 8GHz

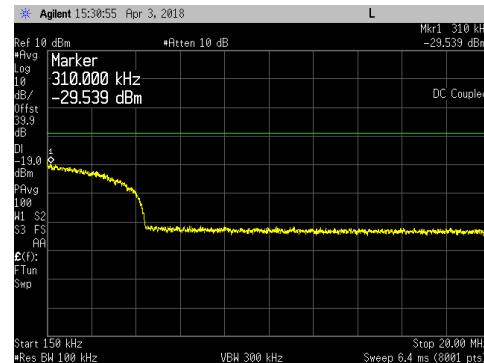


LTE5 Ch BW _ 256QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

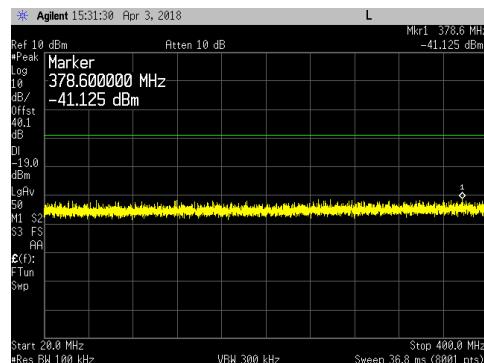
9kHz to 150kHz



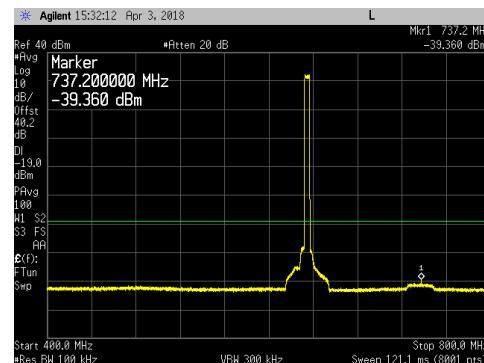
150kHz to 20MHz



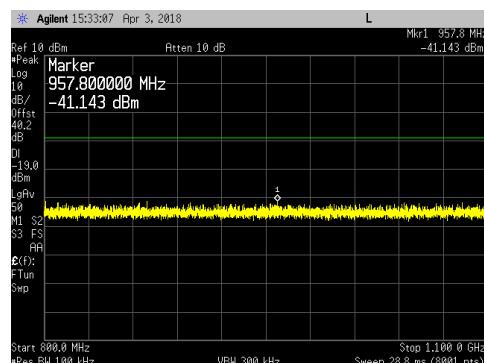
20MHz to 400MHz



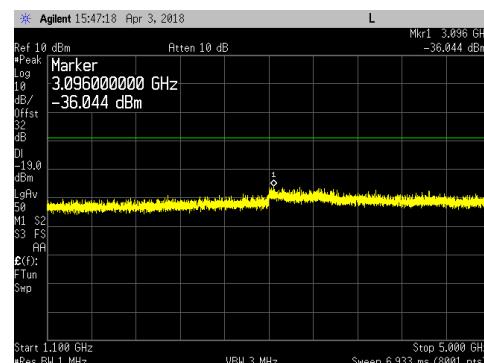
400MHz to 800MHz



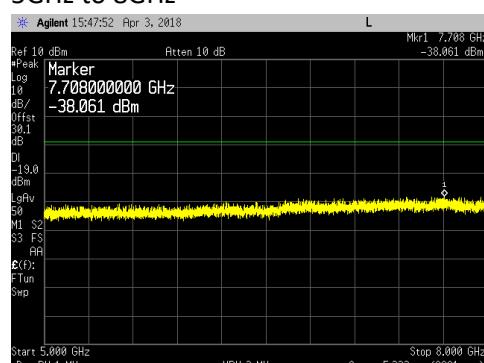
800MHz to 1.1GHz



1.1GHz to 5GHz

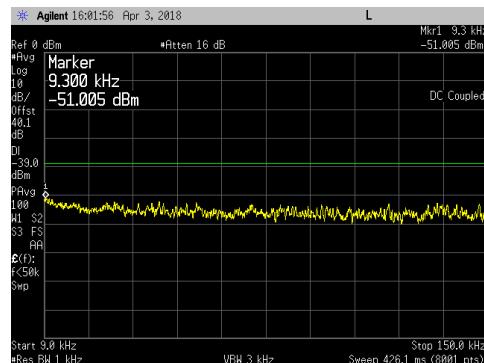


5GHz to 8GHz

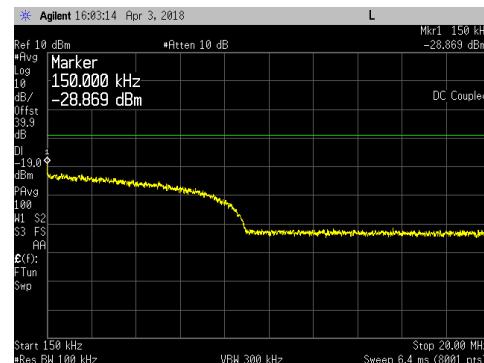


LTE10 Ch BW _ QPSK _ Middle Channel (634.5MHz) at 60 watts/carrier:

9kHz to 150kHz



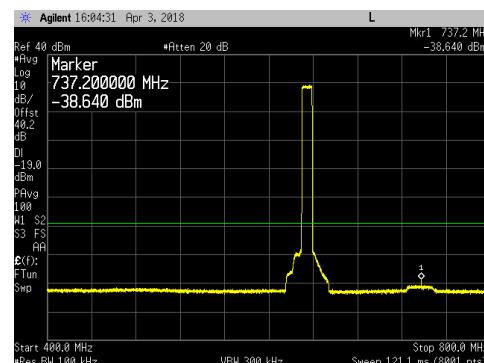
150kHz to 20MHz



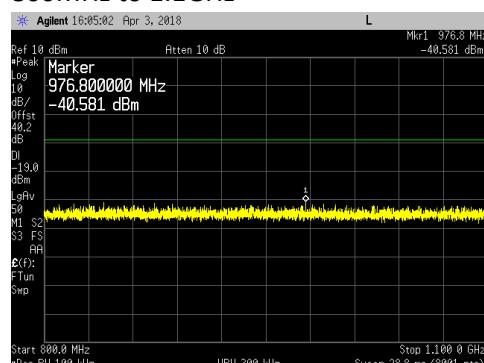
20MHz to 400MHz



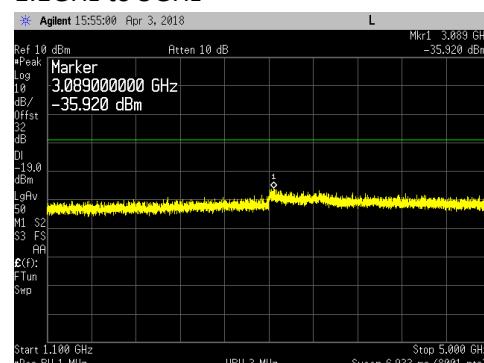
400MHz to 800MHz



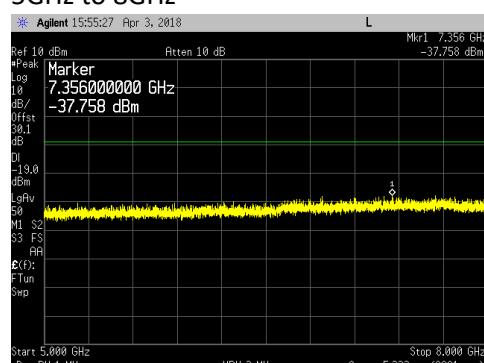
800MHz to 1.1GHz



1.1GHz to 5GHz

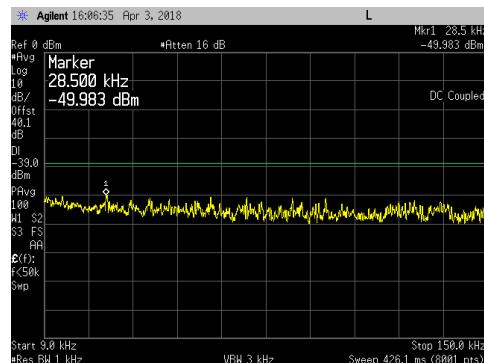


5GHz to 8GHz



LTE10 Ch BW _ 16QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

9kHz to 150kHz



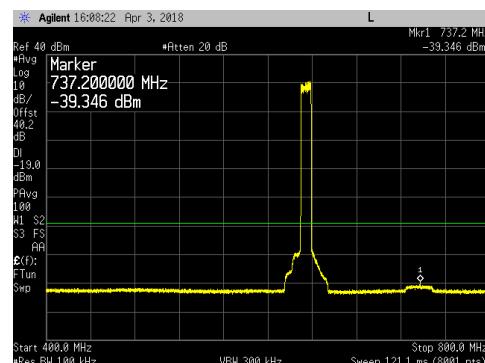
150kHz to 20MHz



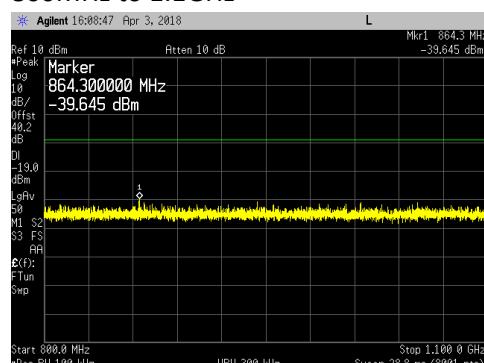
20MHz to 400MHz



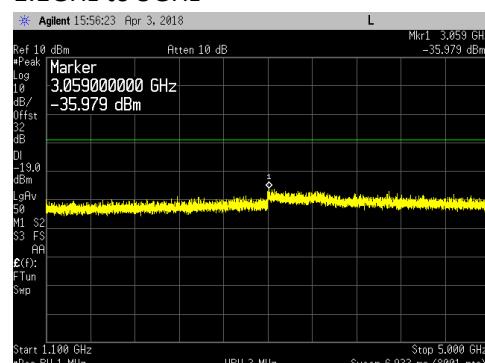
400MHz to 800MHz



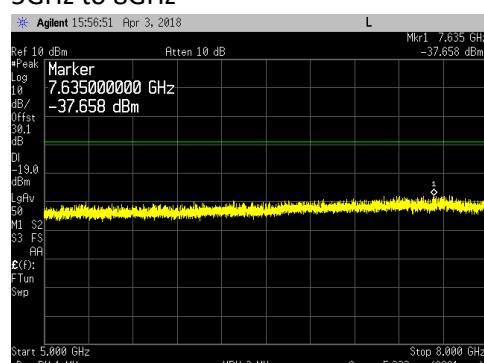
800MHz to 1.1GHz



1.1GHz to 5GHz

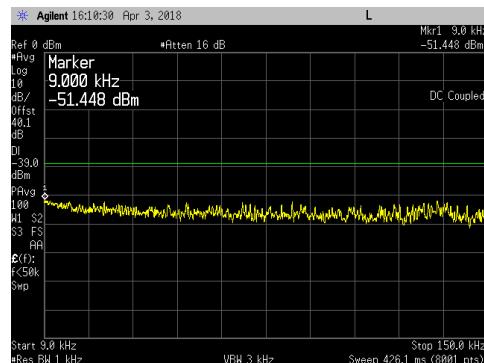


5GHz to 8GHz



LTE10 Ch BW _ 64QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

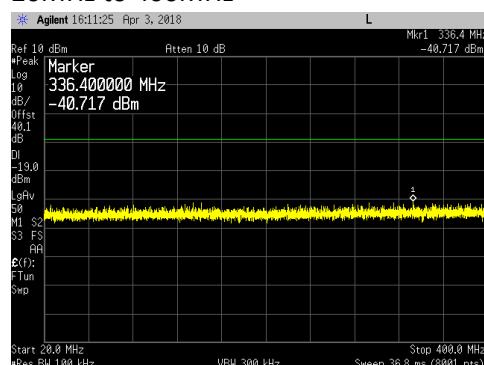
9kHz to 150kHz



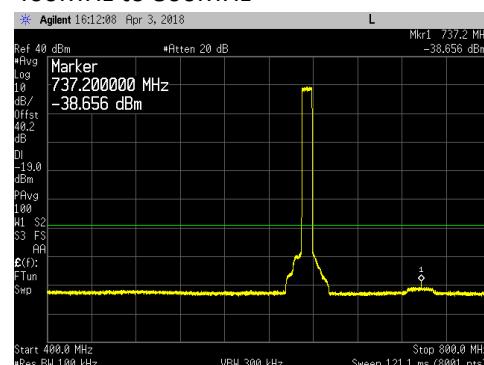
150kHz to 20MHz



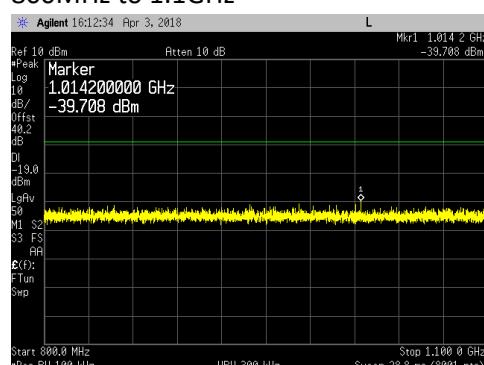
20MHz to 400MHz



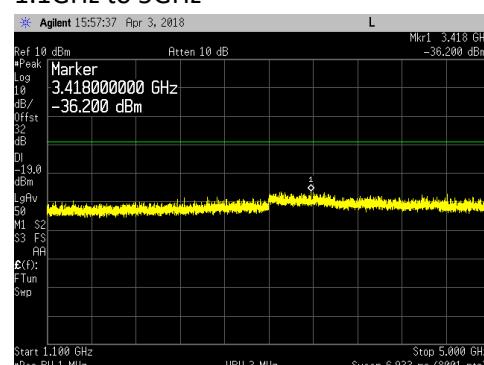
400MHz to 800MHz



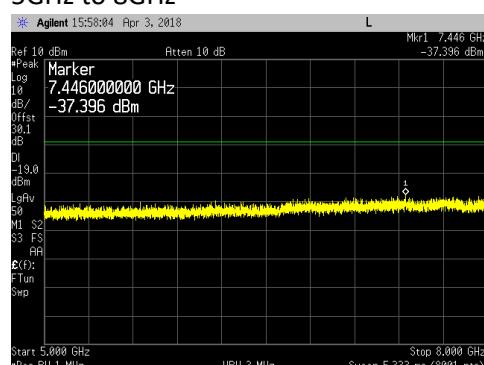
800MHz to 1.1GHz



1.1GHz to 5GHz

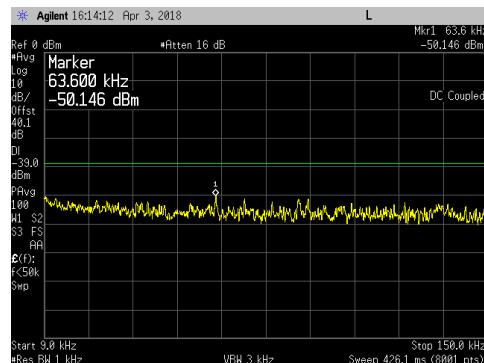


5GHz to 8GHz

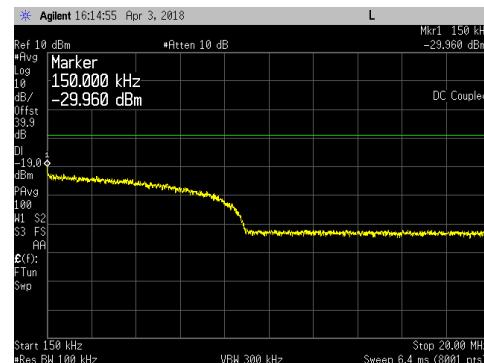


LTE10 Ch BW _ 256QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

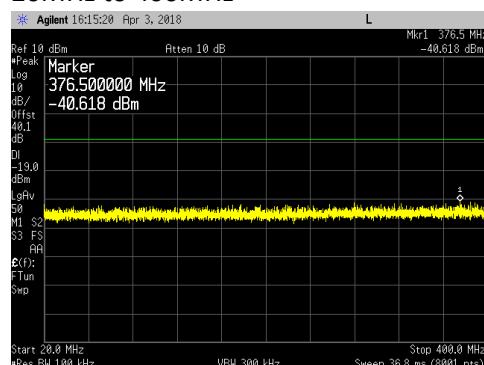
9kHz to 150kHz



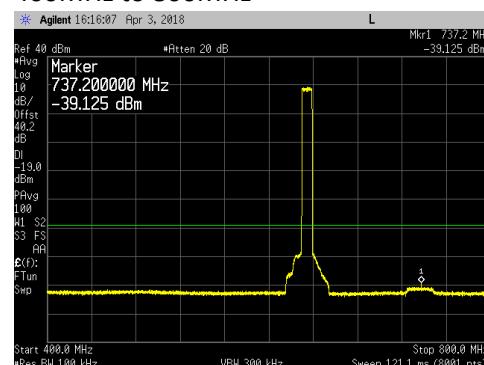
150kHz to 20MHz



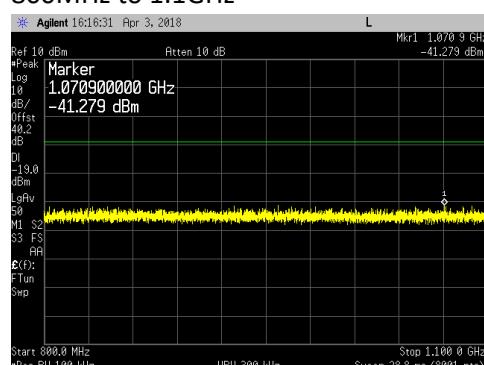
20MHz to 400MHz



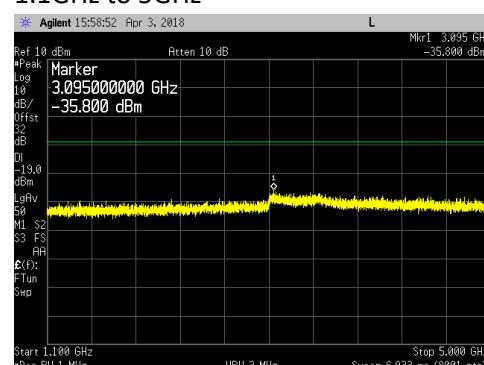
400MHz to 800MHz



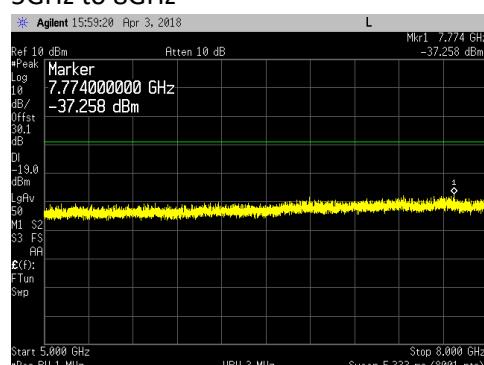
800MHz to 1.1GHz



1.1GHz to 5GHz

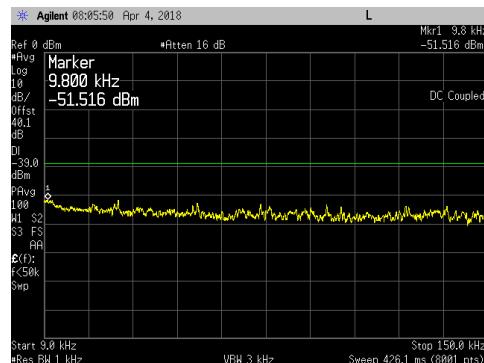


5GHz to 8GHz

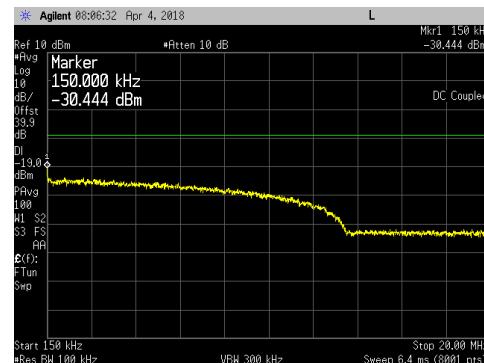


LTE15 Ch BW _ QPSK _ Middle Channel (634.5MHz) at 60 watts/carrier:

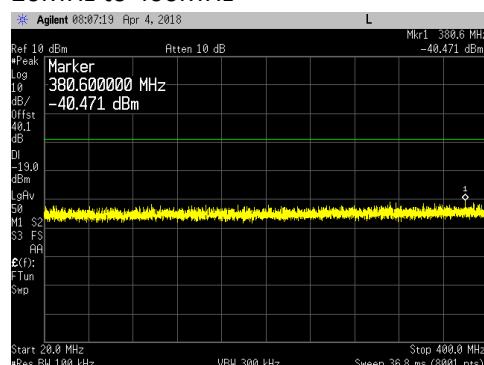
9kHz to 150kHz



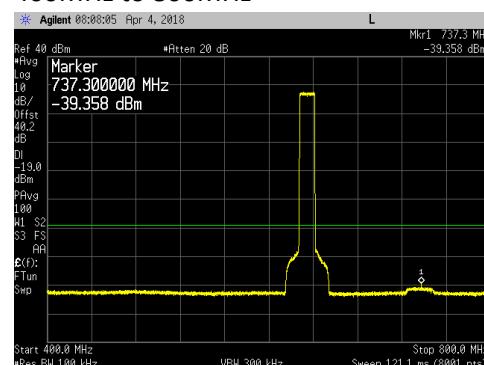
150kHz to 20MHz



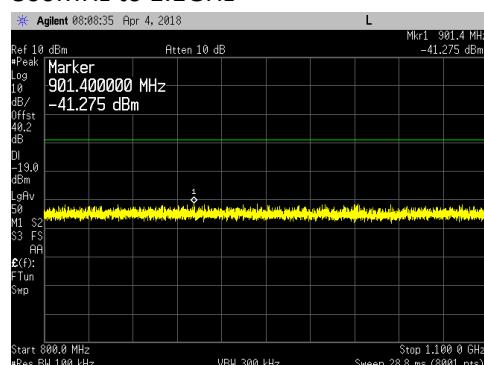
20MHz to 400MHz



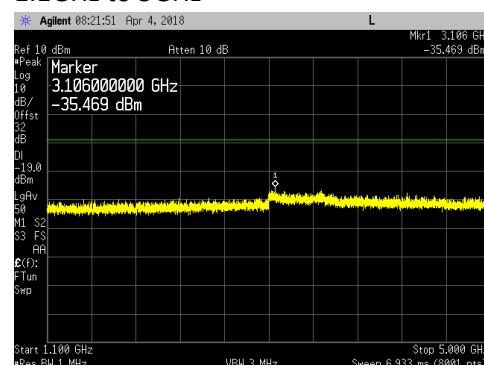
400MHz to 800MHz



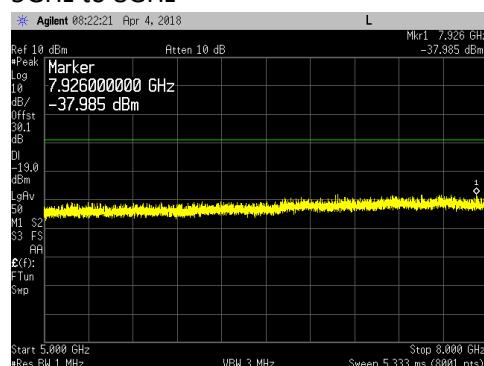
800MHz to 1.1GHz



1.1GHz to 5GHz

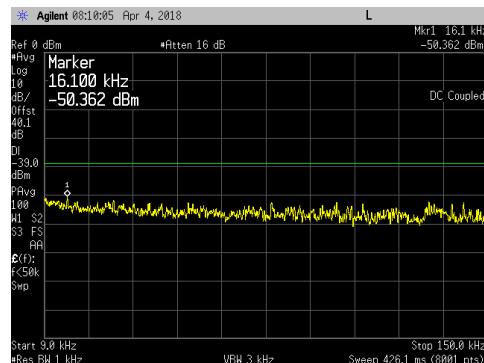


5GHz to 8GHz



LTE15 Ch BW _ 16QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

9kHz to 150kHz



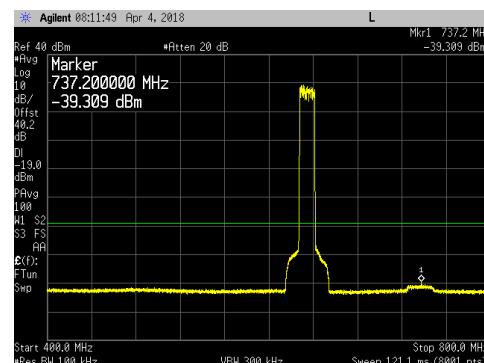
150kHz to 20MHz



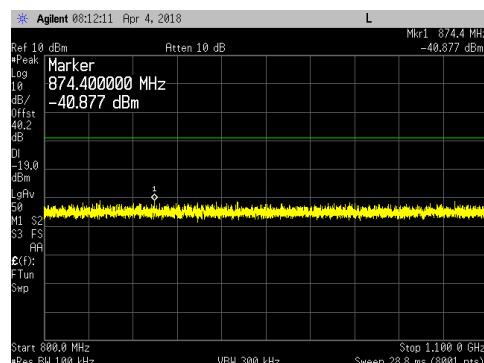
20MHz to 400MHz



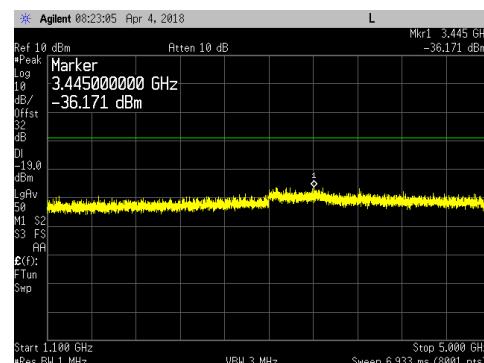
400MHz to 800MHz



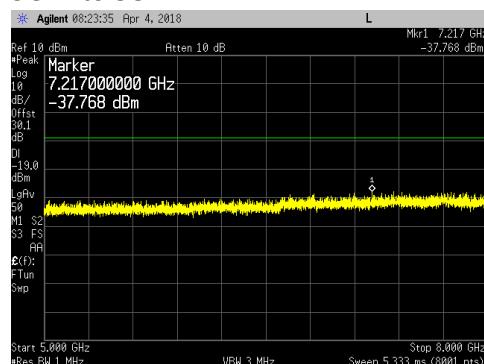
800MHz to 1.1GHz



1.1GHz to 5GHz

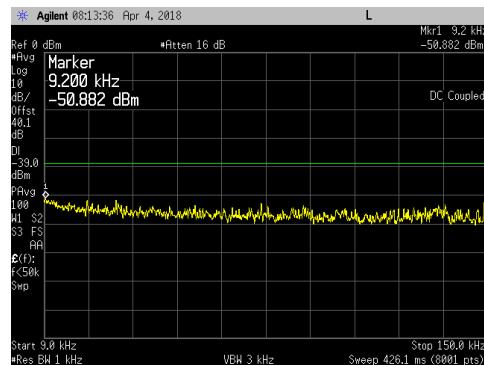


5GHz to 8GHz

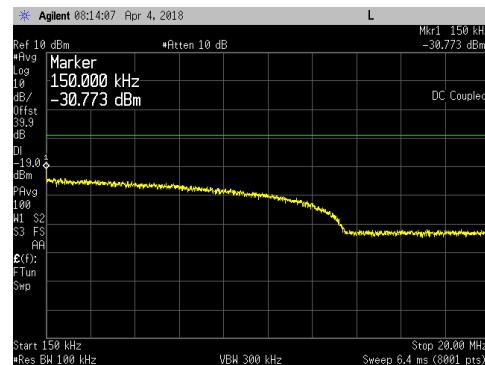


LTE15 Ch BW _ 64QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

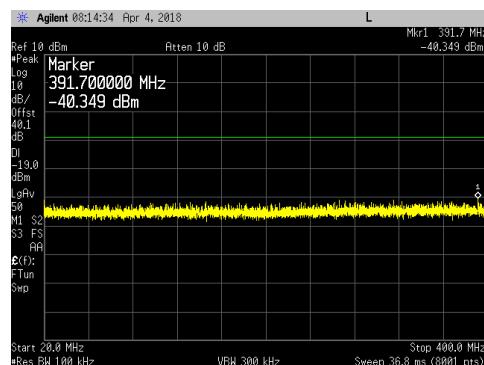
9kHz to 150kHz



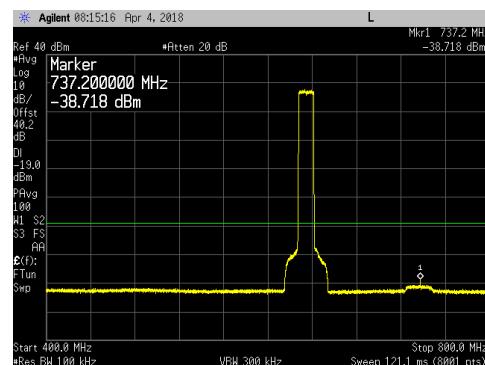
150kHz to 20MHz



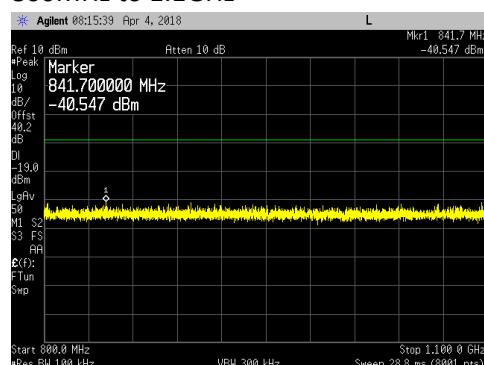
20MHz to 400MHz



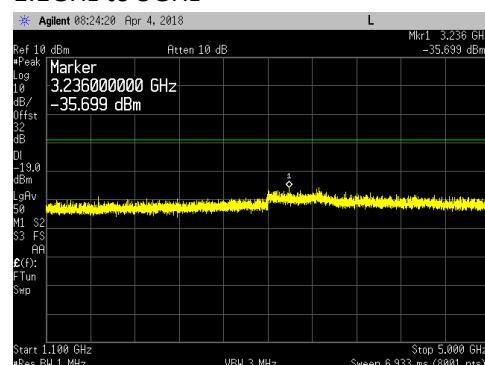
400MHz to 800MHz



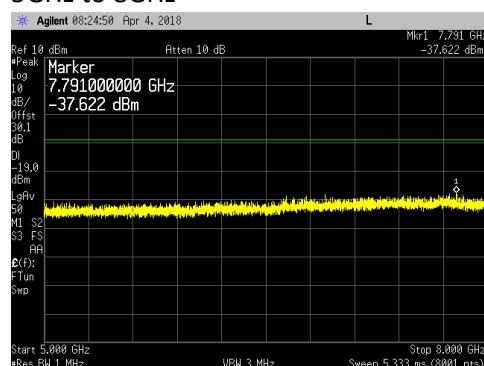
800MHz to 1.1GHz



1.1GHz to 5GHz

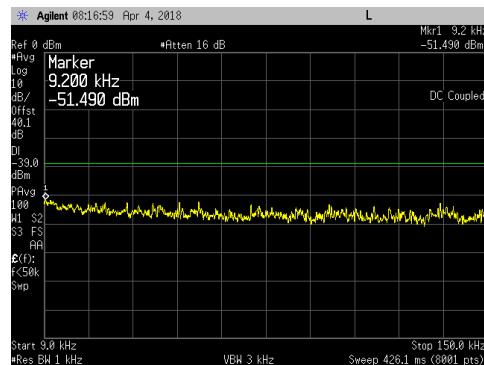


5GHz to 8GHz

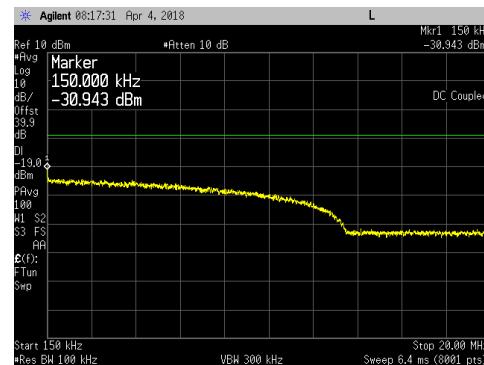


LTE15 Ch BW _ 256QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

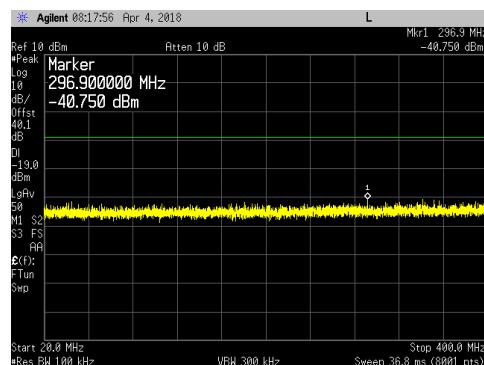
9kHz to 150kHz



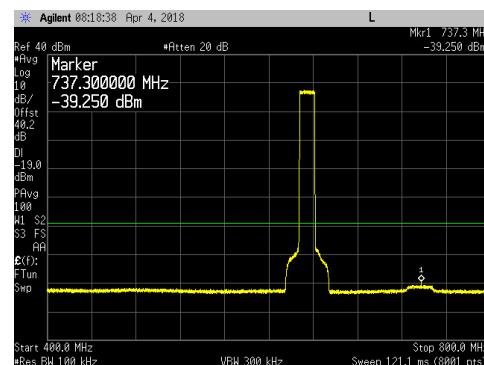
150kHz to 20MHz



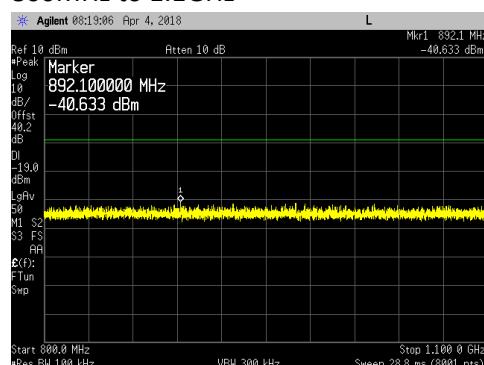
20MHz to 400MHz



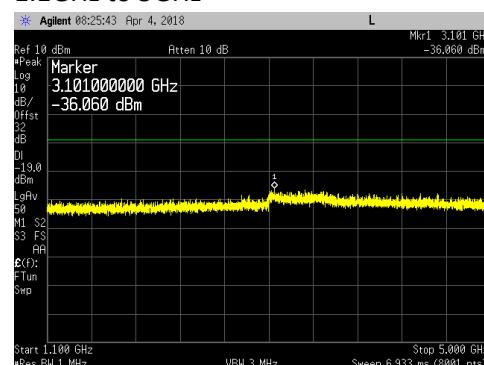
400MHz to 800MHz



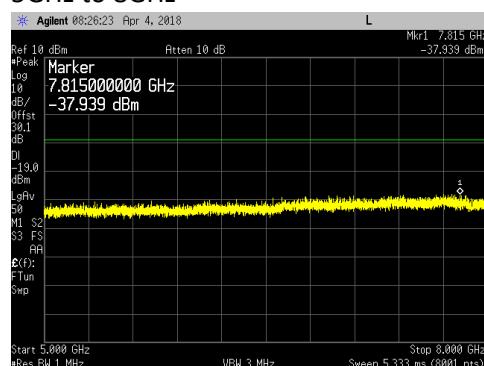
800MHz to 1.1GHz



1.1GHz to 5GHz

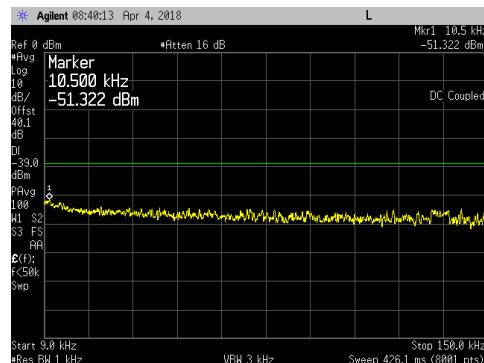


5GHz to 8GHz

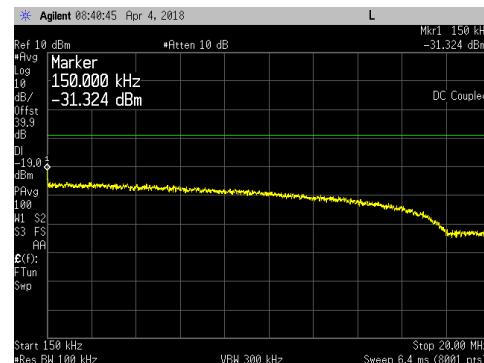


LTE20 Ch BW _ QPSK _ Middle Channel (634.5MHz) at 60 watts/carrier:

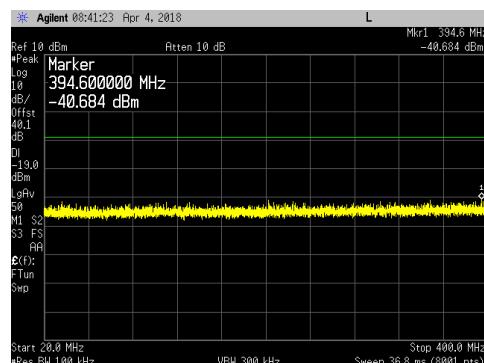
9kHz to 150kHz



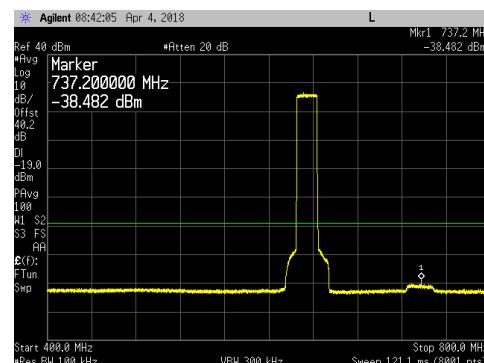
150kHz to 20MHz



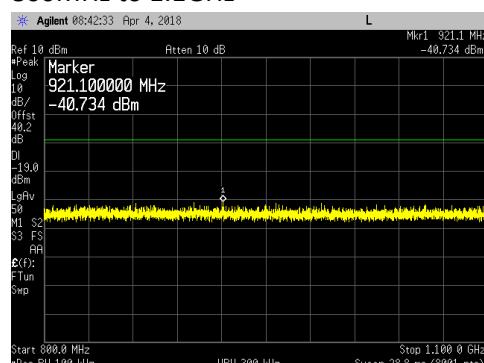
20MHz to 400MHz



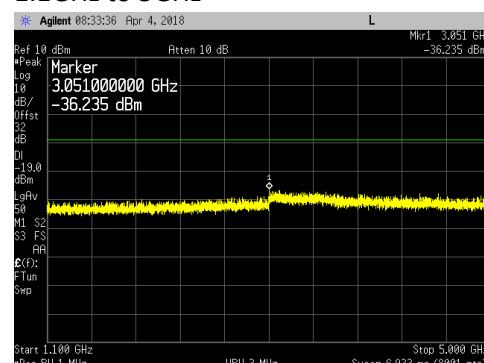
400MHz to 800MHz



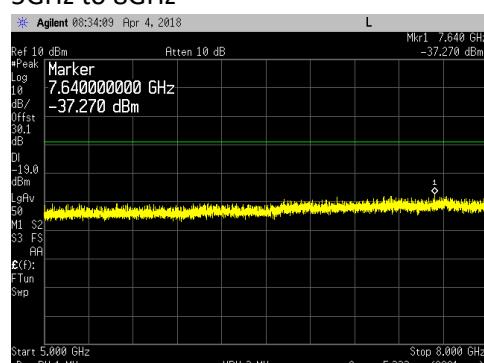
800MHz to 1.1GHz



1.1GHz to 5GHz

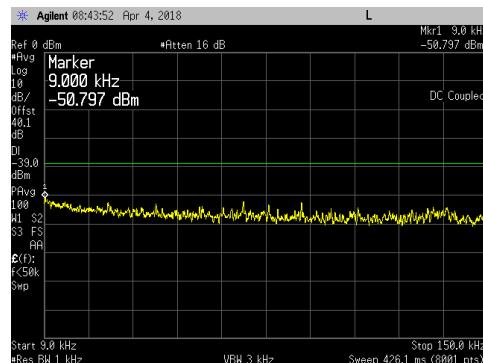


5GHz to 8GHz

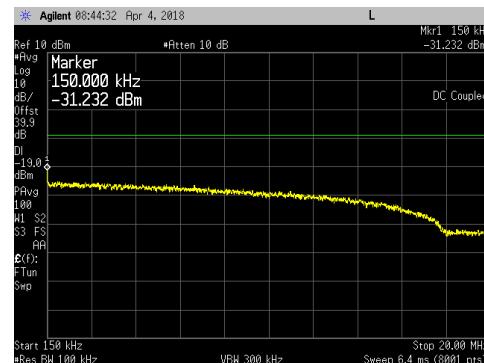


LTE20 Ch BW _ 16QAM _ Middle Channel (634.5MHz) at 60 watts/carrier:

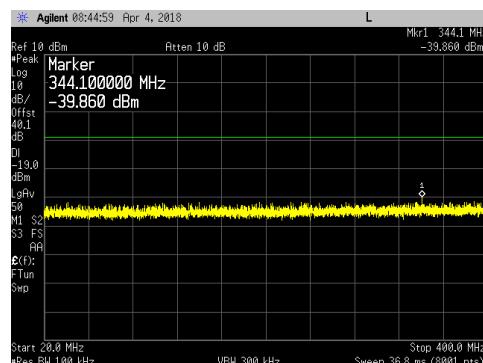
9kHz to 150kHz



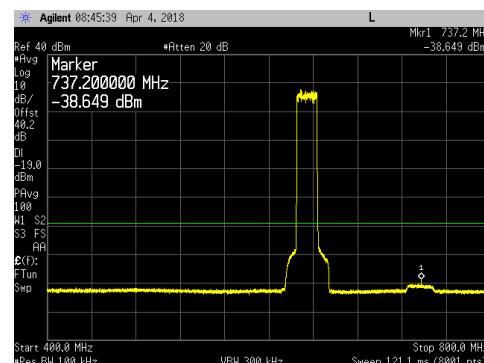
150kHz to 20MHz



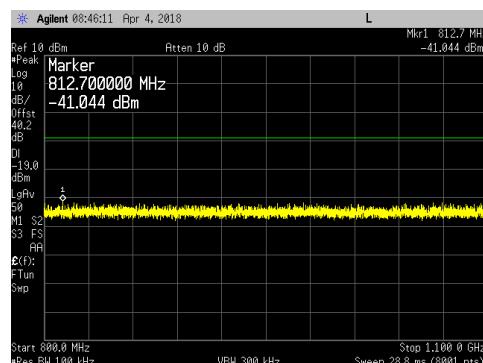
20MHz to 400MHz



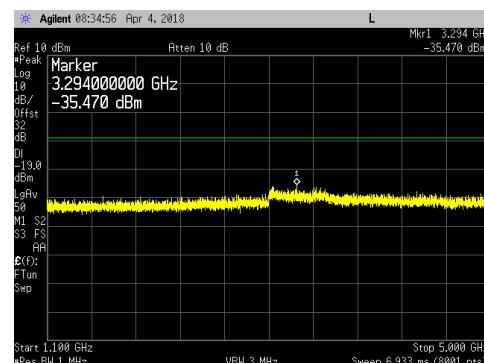
400MHz to 800MHz



800MHz to 1.1GHz



1.1GHz to 5GHz



5GHz to 8GHz

