TEST REPORT

Report number		RAPA15-O-041
Applicant	Name	Corning Optical Communications Wireless Inc.
	Logo	CORNING
	Address	13221 Woodland Park Rd, Suite 400 Herndon, Virginia 20171 USA
Manufacturer	Name	Corning Optical Communications Wireless Inc.
	Address	13221 Woodland Park Rd, Suite 400 Herndon, Virginia 20171 USA
Type of equipment		Optical Repeater
Basic model name		HX-2500-SISO
Multi model name		N/A
Serial number		N/A
FCC ID		OJFHX-2500-SISO
Test duration		October 27, 2015 to December 02, 2015
Date of issue		February 23, 2016
Total page		110 pages (including this page)

SUMMARY

The equipment complies with the regulation; FCC CFR 47 Part 27 Subpart C.

This test report only contains the result of a single test of the sample supplied for the examination.
It is not a general valid assessment of the features of the respective products of the mass-production.

February 23, 2016

Tested by Hyun Soo Lee
Manager

February 23, 2016

Reviewed by Sukil Park
Executive Managing Director

Test Report Version History

Version	Date	Revised by	Reason for revision
1.0	December 03, 2015	Hyun Soo Lee	Original Document
2.0	January 18, 2016	Hyun Soo Lee	Test procedure method insertion -935210 D05 v01
3.0	January 26, 2016	Hyun Soo Lee	Test results insertion -Out of band rejection -input versus output signal comparison
4.0	February 23, 2016	Hyun Soo Lee	Test result revision -LTE 20MHz Occupied Bandwidth

CONTENTS

1. General description of EUT

1.1 Applicant

- Company name : Corning Optical Communications Wireless Inc.
- Address : 13221 Woodland Park Rd, Suite 400 Herndon, Virginia 20171 USA
- Contact person : Habib Riazi / Product Manager
- Phone/Fax : 541-758-2880

1.2 Manufacturer

- Company name : Corning Optical Communications Wireless Inc.
- Address : 13221 Woodland Park Rd, Suite 400 Herndon, Virginia 20171 USA
- Phone/Fax : 541-758-2880

1.3 Basic description of EUT

- Product name : Optical Repeater
- Basic model name : HX-2500-SISO
- Alternative model name : N/A
- Output power : Downlink: +33 dBm(2 W)
- Frequency Range : 2 496 MHz ~ 2 690 MHz
- Emission Designators : LTE(G7D,W7D)
- Supported Bandwidth : 5 MHz ,10 MHz, 15 MHz, 20 MHz
- FCC Rule Part(s) : FCC CFR47 Part 2 and FCC CFR47 Part 27 Subpart C
- Place of test : Head office
  #101 & B104 Anyang Megavalley, 268, Hagui-ro, Dongan-gu, Anyang-si, Gyeonggi-do, 431-767, Korea

  Open area test site
  103, Anseok-gil, 138beon-gil, Hwaseong-si, Gyeonggi-Do, Korea

  (FCC Registration Number: 931589)
  (IC Company address code: 9355B)
  (RRA Designation Number: KR0027)

1.4 Alternative type(s)/model(s)

There is no alternative type(s) and/or model(s).

1.5 Electrical specification

1.System DL/UL common specifications			
NO	Item	Specification	Comment
General			
1.1	RF Output Port Impedance	50 ohm	
1.2	DL/UL Return loss	16 dB	Design goal 18 dB, all RF ports
1.3	DL to UL System Isolation	Requirement: >32 dB @ all bands (DC to 4 GHz) Conditions: 1. End to end System: includes BTSC, RIU enclosure, OCH, connected to HX2500. 2. Measured with DL & UL Max Gain (44/21 dB). 3. Measured separately for DL & UL operation mode 4. Test Case A: Test the Gain from OCH DL Input to RIU DL Output 5. Test Case B: Test the Gain from RIU UL Input to OCH UL Output 6. Tested with small signal input power (-50 dBm).	To eliminate system oscillation, Required 12 dB for 16 remotes and 20 dB margin, shall be complied even on the DL/UL transient with 16 remotes.
1.4	Delay absolute	Signal Delay <2.0 microseconds(Excluding the Optic link delay)	
1.5	Optical Connector Type	SC/APC	
1.6	Regulatory	FCC certificated, 3GPP 36.812, 3GPP 36.104, RoHS	See regulatory chapter
1.7	PIM at antenna	<-110 dBm for two tones, 33 dBm each. Condition: Insert two tone 33 dBm (WCS 2355 MHz AWS 2137 MHz) at external RF Input, and measured the antenna port equivalent IMD level on 2500 UL (2573 MHz).	Required by customer
1.8	RF Duplex type	TDD (LTE TDD)	
1.9	TDD DL & UL frame	As per 3GPP Standard Matrix	
1.10	MIMO support	2x2	

2. **Down Link Specifications (OCH to HX2500-TDD Antenna port on 2500 MHz band) over full operating ambient temperature**			
NO	**Item**	**Specification**	**Comment**
2.1	Frequency Range	2496 MHz – 2690 MHz	
2.2	Nominal System Output Power	33 dBm	Linear power
2.3	Gain nominal	53 dB	With OCH in RIU mode, With up to 2 km fiber (3 dBo)
2.4	Gain Max setting	55 dB	To enable 2 dB loss on OCH at 2500 band (margin for OCH loss and manufacturing tolerance compensation)
2.5	Gain variation over temperature	+/- 1 dB max	reference for gain variation is gain @ room temperature
2.6	Output power control Range	19 – 34 dBm min	For commissioning
2.7	Output power control step	1 dBi	
2.8	Pass Band Ripple over 70 MHz	3 dB peak to peak Max 2 dB p-p desired	Tested with OCH
2.9	DL Test Port coupling	-40 dB +/- 1.0 dB relative to DL output	
2.10	OIP3	Not specified (need to meet IMD3 requirement)	
2.11	IMD3	Not specified	
2.12	Spurious emission	Per 3GPP 36 104, 3GPP 36 812	
2.13	LTE spectrum emission mask	Per 3GPP 36 104	
2.14	LTE EVM	3 %, frequency error <±0.01 ppm	
2.15	Group delay variation	0.250 usec p-p max 0.200 usec p-p desired	
2.16	DL detector type	Two detector type shall be used: 1. Average 2. Peak	
2.17	DL Average detector	Shall use RMS detector and shall represent the average level (the same level measured by spectrum analyzer channel power)	The detector shall represent the average level for LTE signal for Max or Min resource block (equivalent to signal rise/fall time of 50 μsec)
2.18	DL Peak detector	Shall use post detection peak detector following the RMS detector, and shall represent the max level (for LTE signal, this is the level equivalent to using maximum resource block allocation).	
2.19	DL detector range	At least -1 to +37 dBm	For CW, For AVG reading, for LTE TDD equivalent to 19-37dBm.

NO	Item	Specification	Comment
2.20	DL detector step	1 dB	
2.21	DL detector calibration accuracy	1 dB With CW 1.5 dB modulated	
2.22		The Engineering GUI shall present levels of both detectors	
2.23		The limiter shall be based on either the Average or Peak detector. The detector to be used for the limiter, shall be selected on the engineering GUI. The default shall be Peak.	The detector implementation method shall be presented and agreed by COCW SE
2.24		The measured level of the selected detector shall be send to the management through the OCH.	
3. Up Link Specifications (HX2500-TDD to OCH on 2500 MHz band) over operating ambient temperature			
3.1	Frequency Range	2496 MHz – 2690 MHz	
3.2	Maximum Gain	41 dB	HX + fiber (1m) + OCH
3.3	Gain setting range	High Gain : 41 dB Normal Gain : 31 dB (default setting) Low Gain : 21 dB	HX + fiber (1m) + OCH
3.4	Gain setting accuracy	±1 dB	
3.5	Gain variation over temperature	+/- 1 dB max	reference for gain variation is gain @ room temperature
3.6	NF	10 dB max at Normal gain 6 dB max at High gain 5 dB max at High gain desired	Tested with OCH (with 1m & 2km fiber)
3.7	Pass Band Ripple	2.5 dB peak to peak Max 2 dB p-p desired	Tested with OCH, over any 70 MHz band
3.8	Limiter threshold	-50 dBm @ High Gain -40 dBm @ Normal Gain -30 dBm @ Low Gain	Above this level limiting starts, in order to prevent high level to BS and at OCH
3.9	High level notification	10 dB above limiter threshold	Notification message shall be sent to OCH
3.10	Max input Power for limiter operation	-5 dBm @ Nominal &Low Gain -15 dBm @ High Gain	@ Nominal &Low Gain
3.11	IIP3	>-10 dBm at nominal gain	For Normal gain and max input level, IMD3 should be below noise floor at BW 1.4 MHz (-103 dBm)
3.12	LTE EVM	3 %	At max UL signal level for each gain setting
3.13	Detector Sensitivity to external RF in signals	No change of detector accuracy for all external services (within 698-2360 MHz) occupied with 33 dBm per service (total power 40 dBm).	Requires high Isolation from external signals at 698 MHz-2360 MHz
3.14	UL EVM Sensitivity to external RF in signals	No change of EVM for all external services (within 698-2360 MHz) occupied with 33 dBm per service (total power 40 dBm).	Requires high Isolation from external signals at 698 MHz-2360 MHz
3.15	Detector range	at least: -5 dB below limiter threshold to -5 dBm	

4. Combiner External 1 RF In Specifications (Wideband)			
NO	**Item**	**Specification**	**Comment**
4.1	Frequency range	698 MHz – 2155 MHz	
4.2	Optional DL bands	728 MHz – 757 MHz 862 MHz – 894 MHz 1930 MHz – 1995 MHz 2110 MHz – 2155 MHz	
4.3	Optional UL bands	698 MHz – 716 MHz & 777 MHz – 787 MHz 817 MHz – 849 MHz 1850 MHz – 1915 MHz 1710 MHz – 1755 MHz	
4.4	Loss to antenna port	0.5 dB max 0.3 dB desired	From External RF In to Antenna port
4.5	Inband ripple	0.1 dB per band	
4.6	Group delay variation	10 nsec	On any band
4.7	Leakage of 2496 – 2690 MHz signal to External 1 & External 2 RF In	-7 dBm max	40 dB isolation from 2500 DL output to External RF In (towards HX4)
4.8	Noise leakage to External 1 RF In	-104 dBm/MHz max @ 698 – 2155 MHz	For any TDD channel in 2496 MHz – 2690 MHz
4.9	Isolation from External RF IN port to Internal UL port @ 2496 – 2690 MHz	>50 dB min	From External RF In (from HX4/HX2300) to 2500 UL input, To avoid PIM/IMD from HX4 to 2500 (WCS DL (2355), AWS DL (2137) => 2500 UL 2573)
5. Combiner External 2 RF In Specifications(WCS)			
5.1	Frequency range	2305 MHz – 2360 MHz	
5.2	Optional DL bands	2350 MHz – 2360 MHz	
5.3	Optional UL bands	2305 MHz – 2315 MHz	
5.4	Loss to antenna port	1.0 dB max 0.5 dB desired	From External RF In to Antenna port
5.5	Inband ripple	0.5 dB per band max	
5.6	Group delay variation	10 nsec	On any band
5.7	Leakage of 2350 – 2360 MHz signal to External 1 RF In	-7 dBm max	40 dB isolation from 2500 DL output to External RF In (towards HX4)
5.8	Noise leakage to External 2 RF In	-104 dBm/MHz max @ 698 – 2360 MHz	For any TDD channel in 2496 MHz – 2690 MHz
5.9	Isolation from External RF IN port to Internal UL port @ 2496 – 2690 MHz	>50 dB min	From External RF In (from HX4/HX2300) to 2500 UL input, To avoid PIM/IMD from HX4 to 2500 (WCS DL (2355), AWS DL (2137) => 2500 UL 2573)

6. DL Extension port specifications			
NO	**Item**	**Specification**	**Comment**
6.1	Connector type	SMA female 50 ohm	
6.2	Return loss	-14 dB max	
6.3	Frequency	300 to 2700 MHz (wide band signal received on the photo diode from the OCH)	
6.4	Gain from photo diode output to Ext. port output	20±1 dB	
6.5	NF of the gain block following the photo diode	3 dB max	In order not to degrade the DL system NF of the external unit
6.6	Ripple	3 dB p-p max from 550 to 2700 MHz 5 dB p-p max from 300 to 2700 MHz	
6.7	OIP3	TBD	
7. UL Extension port specifications			
7.1	Connector type	SMA female 50 ohm	
7.2	Return loss	-14 dB max	
7.3	Frequency	300 to 2700 MHz(wide band signal received on the photo diode from the OCH)	To enable combining of UL narrow band signal at any band
7.4	Gain from Ext. port input to Laser photo diode input	Switchable 15±1 / 20±1 dB	
7.5	NF of the gain block following the photo diode	3 dB max @ Gain 20 dB 5 dB max @ Gain 15 dB	In order not to degrade the UL system NF of the external unit
7.6	IIP3	TBD	
7.7	Ripple	3 dB p-p max from 550 to 2700 MHz 5 dB p-p max from 300 to 2700 MHz	

1.6 Mechanical specification

Item	Specifications	Note
Dimensions (L × W × H)	407 mm x 445 mm x 176.5 mm	19 inch(W), 4U(H)
Weight	<25 Kg	55lb
Operating power	34 Vdc ~48 Vdc	DC source 28 Vdc ~ 60 Vdc

1.7 Environmental specification

Item	Specifications	Note
Temperature	-30 °C ~ 50 °C	
Relative Humidity	10 % ~ 95 %	

2. General information of test

2.1 Test standards and results

Applied Standards : FCC CFR47 Part 27			
FCC part	**Section**	**Description of Test**	**Result**
Part 2.1049 Part 27.53	- (m)	Occupied Bandwidth	Pass
Part 2.1051 Part 27.53	- (m)(v)	Band Edge	Pass
Part 2.1051 Part 27.53	- (m)	Conducted Spurious Emission	Pass
Part 2.1046 Part 27.50	- (h)	Output Power	Pass
Part 2.1053 Part 27.53	- (m)	Radiated Spurious Emission	Pass
Part 2.1055 Part 27.54	(a)(1),(d) -	Frequency Stability / Temperature Variation	Pass

2.2 Description of EUT modification

During the test, there was no mechanical or circuitry modification to improve RF and spurious characteristic, and any RF and spurious suppression device(s) was not added against the device tested.

2.3 Test configuration

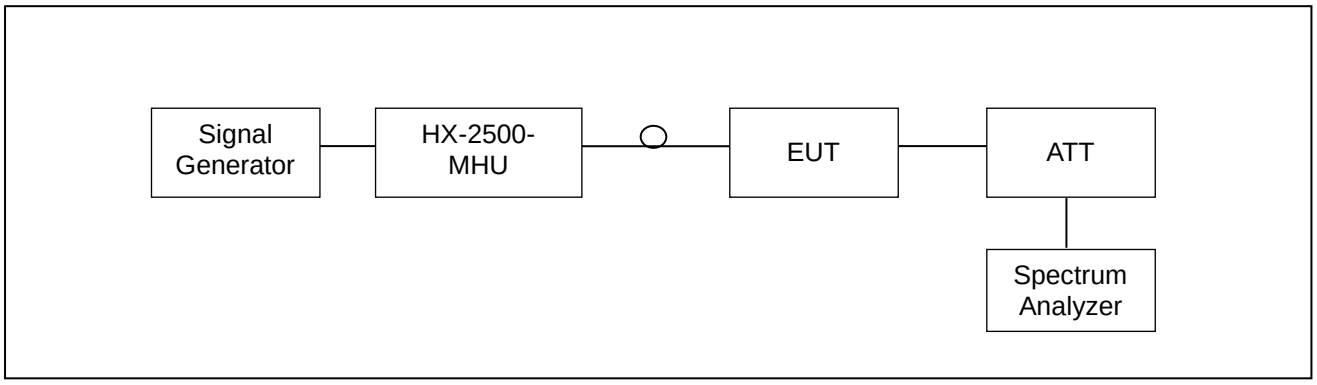
• Type of peripheral equipment used

Model	Manufacturer	Description	Connected to
HX-2500-SISO	Corning Optical Communications Wireless Inc.	EUT	HX-2500-MHU & Spectrum analyzer (thru ATTN)-
HX-2500-MHU	Corning Optical Communications Wireless Inc.	Master Hub Unit	EUT & Signal generator
N5182A	Agilent	Signal Generator	HX-2500-MHU
PE7019-20	Pasternack	Attenuator	EUT
N9020A	Agilent	Spectrum Analyzer	Attenuator

• Type of cable used

Device from	Device to	Type of Cable	Length (m)	Shielded
Signal Generator	HX-2500-MHU	SMA-Type	2.0	Y
HX-2500-MHU	EUT	Optical fiber	3.0	-
EUT	Attenuator	N-Type	0.0	Y
Attenuator	Spectrum analyzer	N-Type	3.0	Y

2.4 Test setup



2.5 Measurement Uncertainty

• Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)

0.15 ~ 30 MHz

Expanded Uncertainty (95% , K=2) : ± 3.08 dB

• Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)

For open site 30 ~ 1000 MHz

Expanded Uncertainty (95% , K=2) : ± 4.28 dB

3. Measurement data

3.1 Occupied Bandwidth / 26 dB Emission Bandwidth

3.1.1 Specification

- FCC Part 2.1049
- FCC Part 27.53

3.1.2 Test Description

The occupied bandwidth was measured using a spectrum analyzer's 26 dB bandwidth function.
The test was performed at three frequencies (low, middle and high channels) at each band using all applicable modulation.

Occupied Bandwidth and 26 dB Emission Bandwidth were measured on port 1 and port 2 under the three types of modulation mode which are QPSK, 16QAM and 64QAM, and resource block was 25~100.

UL/DL Allocation : Configuration 3
Dw/GP/UP length : Configuration 8

3.1.3 Test Procedure

The method used is as detailed in FCC KDB 935210 D05 v01.

The method used is as detailed in FCC KDB 971168 D01 v02r02.

The EUT was set up to the applicable test frequency with modulation. The EUT antenna terminal was conducted to the spectrum analyzer through an external attenuator (at the output test) and an appropriate coaxial cable.

For testing, the RBW was set to 1% to 3% of the 26 dB bandwidth and 99% Occupied Bandwidth. The VBW wast to 3 times the RBW and sweep time is coupled.

Occupied bandwidth measured was repeated for each modulation (QPSK, 16QAM and 64QAM)

3.1.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-2500-SISO	Corning Optical Communications Wireless, Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
Attenuator	PE7019-20	Pasternack
DC Power Supply	6674A	Agilent

3.1.5 Test condition

- Test place: Shield Room
- Test environment: 22.5 °C, 42.5 % R.H.

3.1.6 Test results

- **Port1**

Bandwidth	Modulation	Frequency [MHz]	Occupied Bandwidth [MHz]	26 dB Emission Bandwidth [MHz]
5 MHz	QPSK	2498.5	4.453	4.645
		2593.0	4.453	4.644
		2687.5	4.511	4.677
	16QAM	2498.5	4.540	4.694
		2593.0	4.540	4.693
		2687.5	4.539	4.694
	64QAM	2498.5	4.458	4.702
		2593.0	4.458	4.703
		2687.5	4.458	4.702
10 MHz	QPSK	2501.0	8.985	9.466
		2593.0	8.988	9.467
		2685.0	8.988	9.467
	16QAM	2501.0	8.695	9.425
		2593.0	8.966	9.426
		2685.0	8.962	9.428
	64QAM	2501.0	8.930	9.362
		2593.0	8.933	9.364
		2685.0	8.928	9.364
15 MHz	QPSK	2503.5	13.294	14.04
		2593.0	13.295	14.04
		2682.5	13.277	14.04
	16QAM	2503.5	13.406	14.16
		2593.0	13.413	14.15
		2682.5	13.408	14.15
	64QAM	2503.5	13.197	14.09
		2593.0	13.199	14.10
		2682.5	13.186	14.10
20 MHz	QPSK	2506.0	17.828	19.26
		2593.0	17.844	19.27
		2680.0	17.851	19.28
	16QAM	2506.0	17.864	18.79
		2593.0	17.871	18.80
		2680.0	17.872	18.78
	64QAM	2506.0	17.937	19.28
		2593.0	17.943	19.29
		2680.0	17.943	19.29

- **Port1 / Out of band rejection**

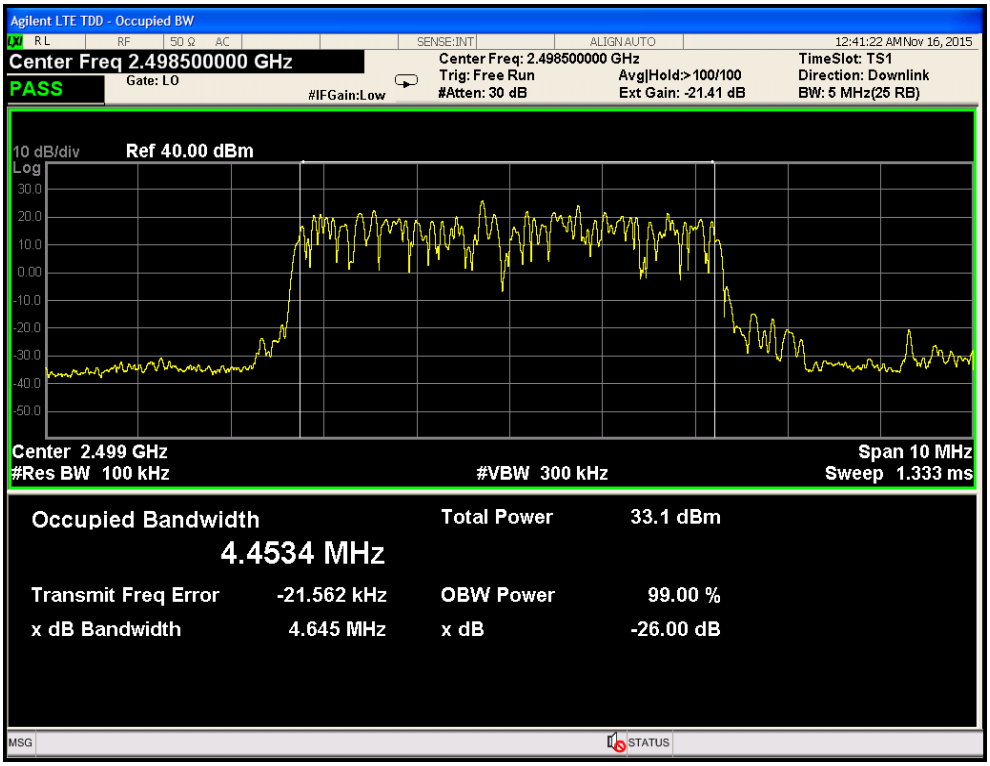
20 dB Frequency	Output power	Gain [dB]
2489.3 MHz ~ 2697.2 MHz	44.851	65.851

- **Input signal**

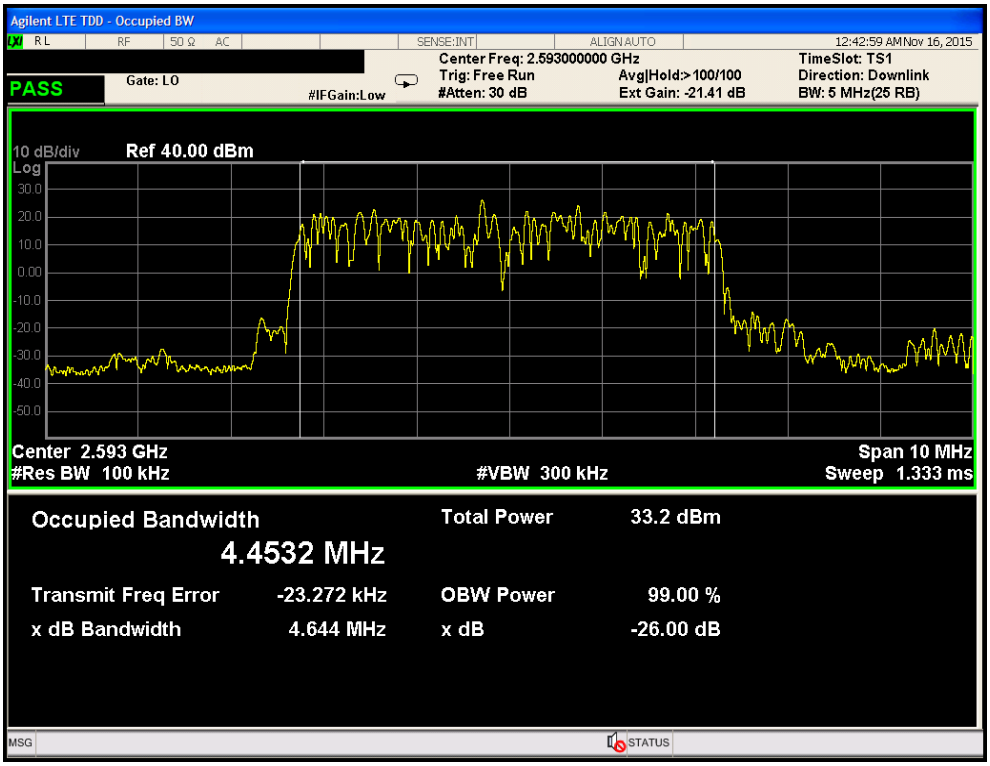
Bandwidth	Modulation	Frequency [MHz]	Occupied Bandwidth [MHz]
5 MHz	QPSK	2593.0	4.510
	16QAM	2593.0	4.512
	64QAM	2593.0	4.519
10 MHz	QPSK	2593.0	9.002
	16QAM	2593.0	9.030
	64QAM	2593.0	9.004
15 MHz	QPSK	2593.0	13.531
	16QAM	2593.0	13.566
	64QAM	2593.0	13.534
20 MHz	QPSK	2593.0	17.995
	16QAM	2593.0	18.024
	64QAM	2593.0	18.015

3.1.7 Test Plots

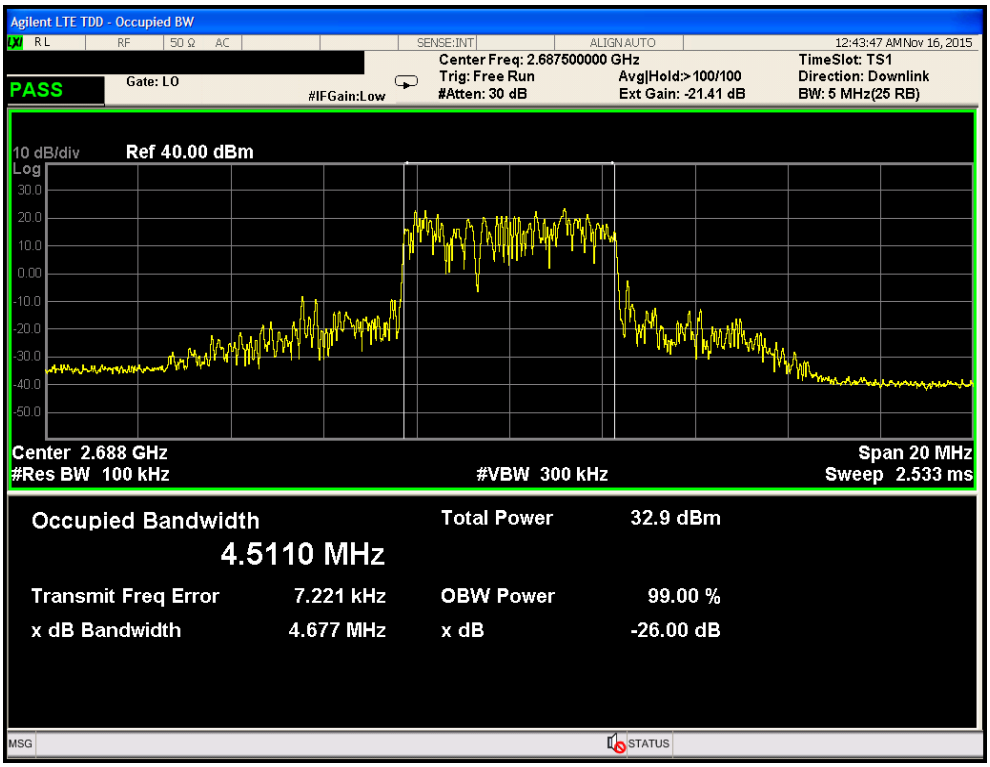
•Port1 / LTE 5M / 2498.5 MHz / QPSK



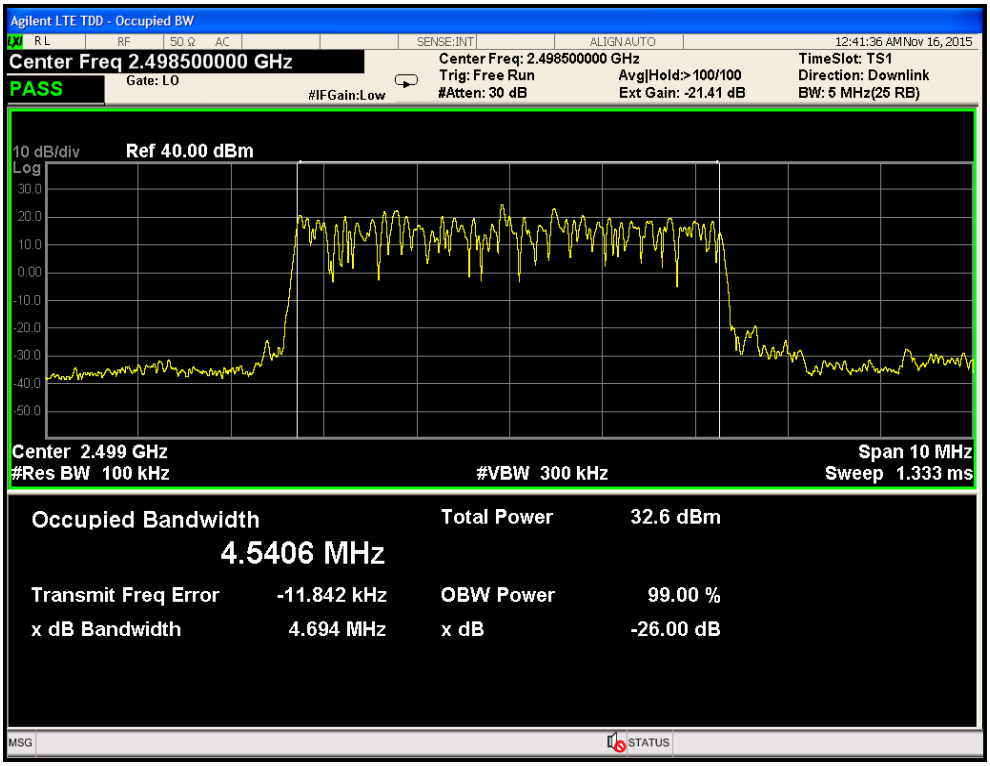
•Port1 / LTE 5M / 2593.0 MHz / QPSK



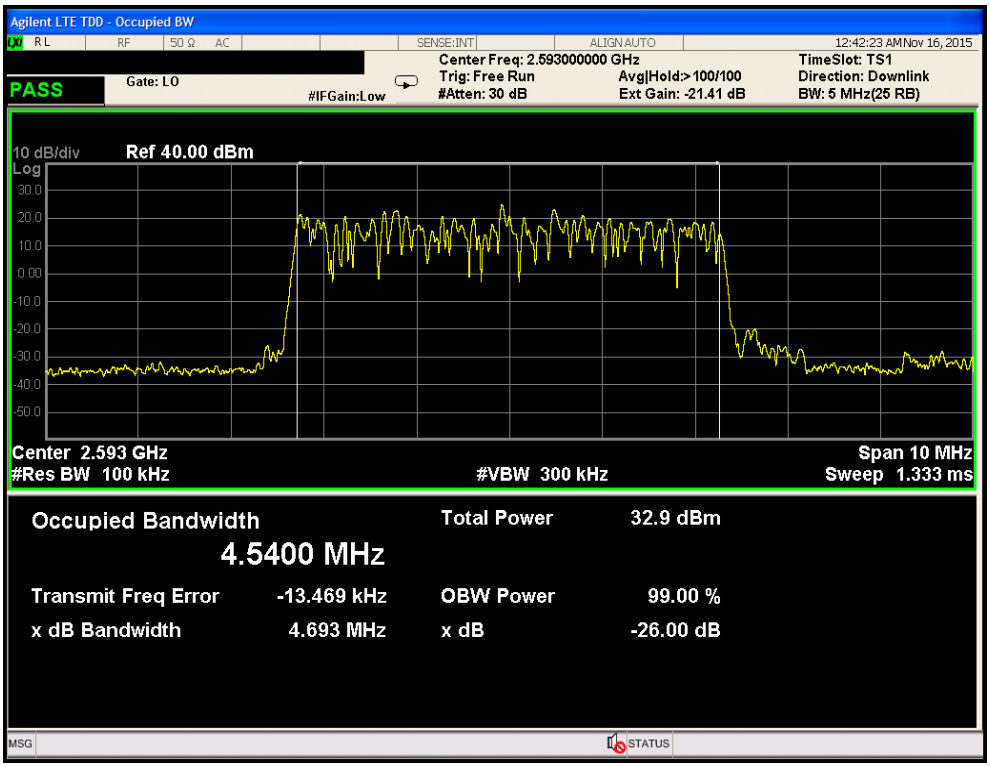
•Port1 / LTE 5M / 2687.5 MHz / QPSK



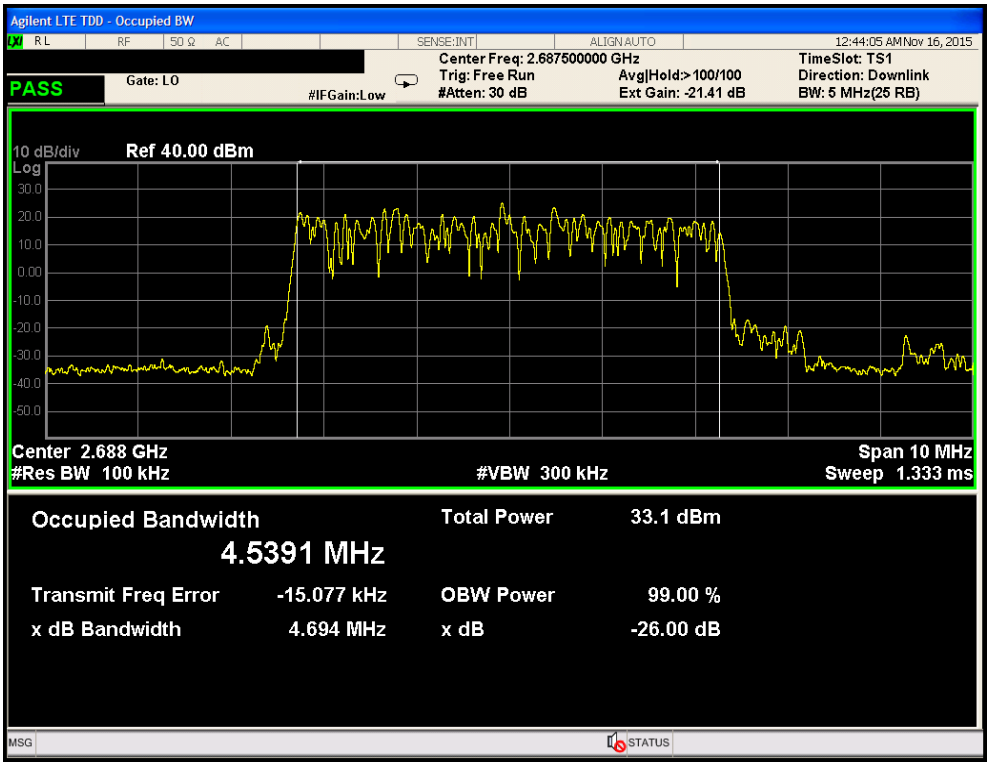
•Port1 / LTE 5M / 2498.5 MHz / 16QAM



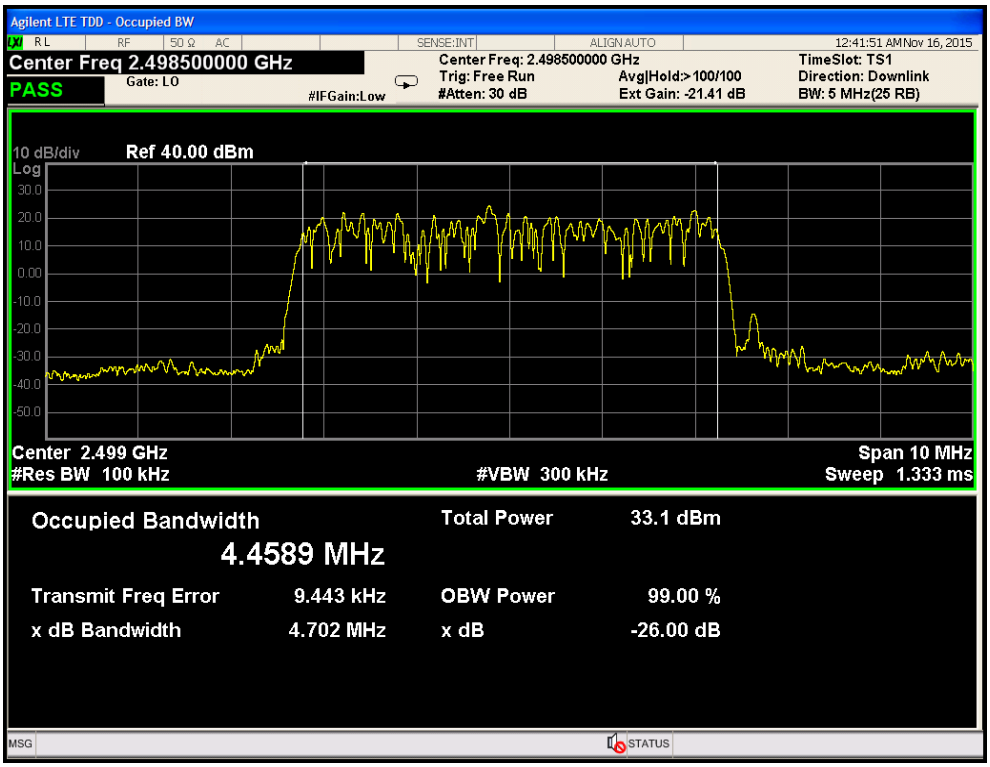
•Port1 / LTE 5M / 2593.0 MHz / 16QAM



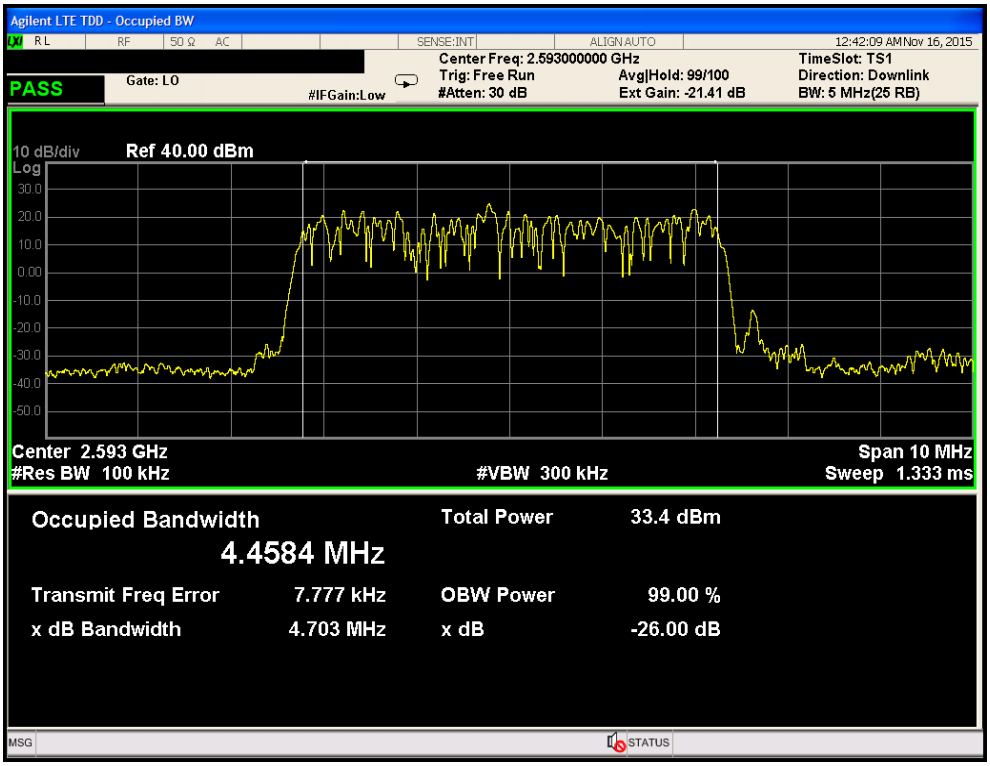
•Port1 / LTE 5M / 2687.5 MHz / 16QAM



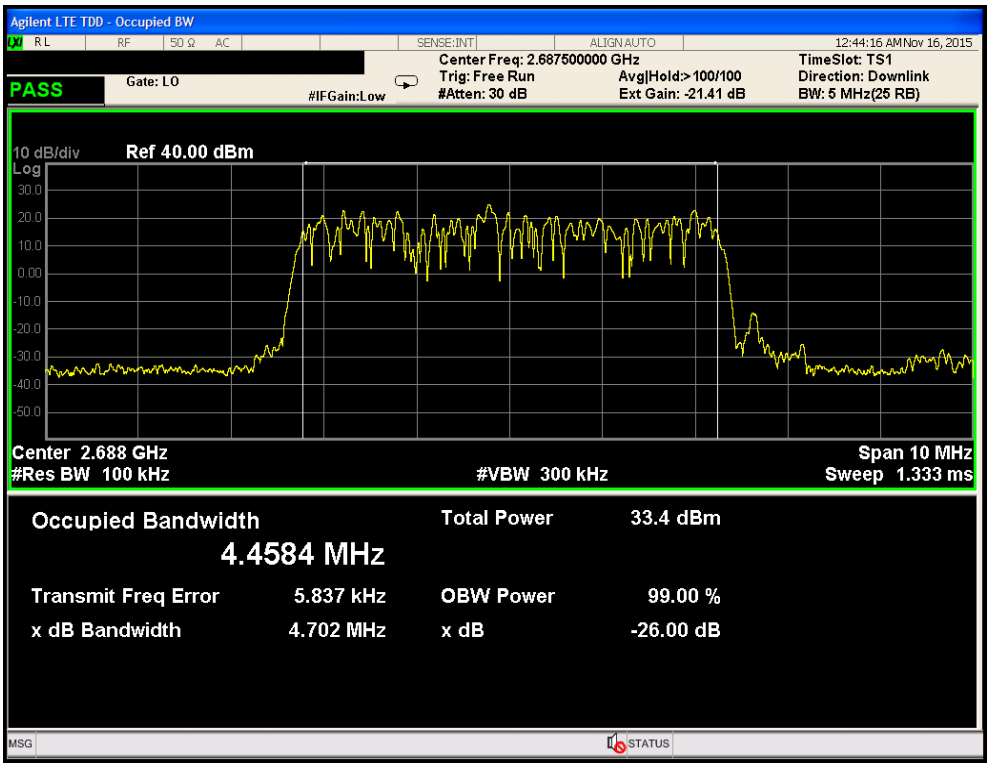
•Port1 / LTE 5M / 2498.5 MHz / 64QAM



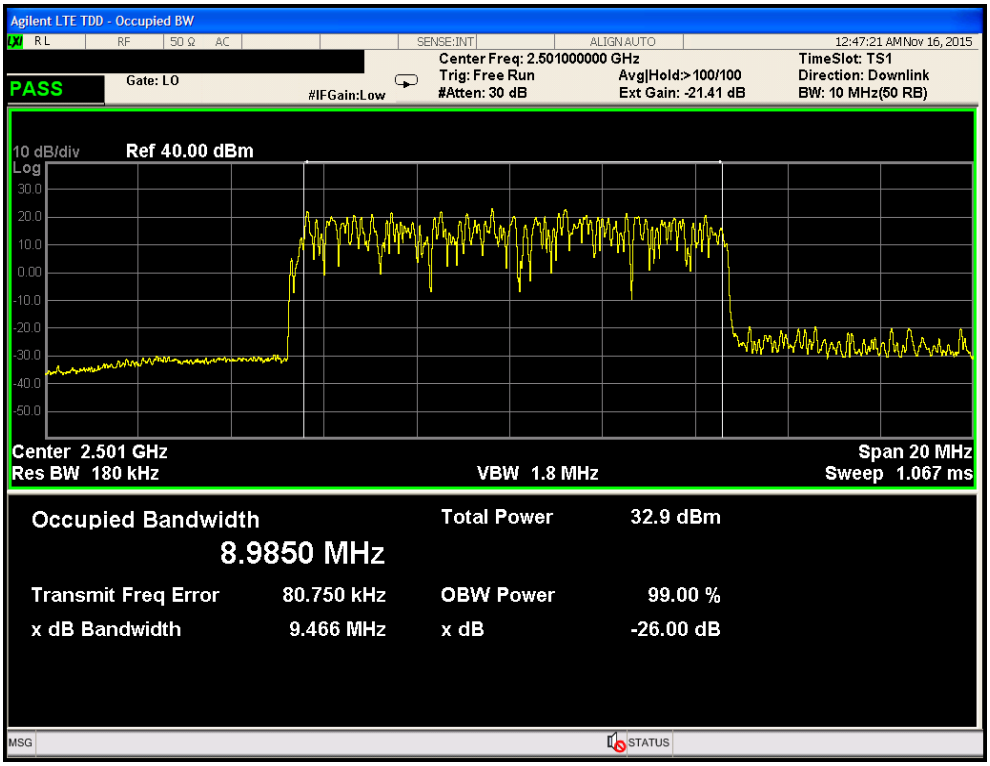
•Port1 / LTE 5M / 2593.0 MHz / 64QAM



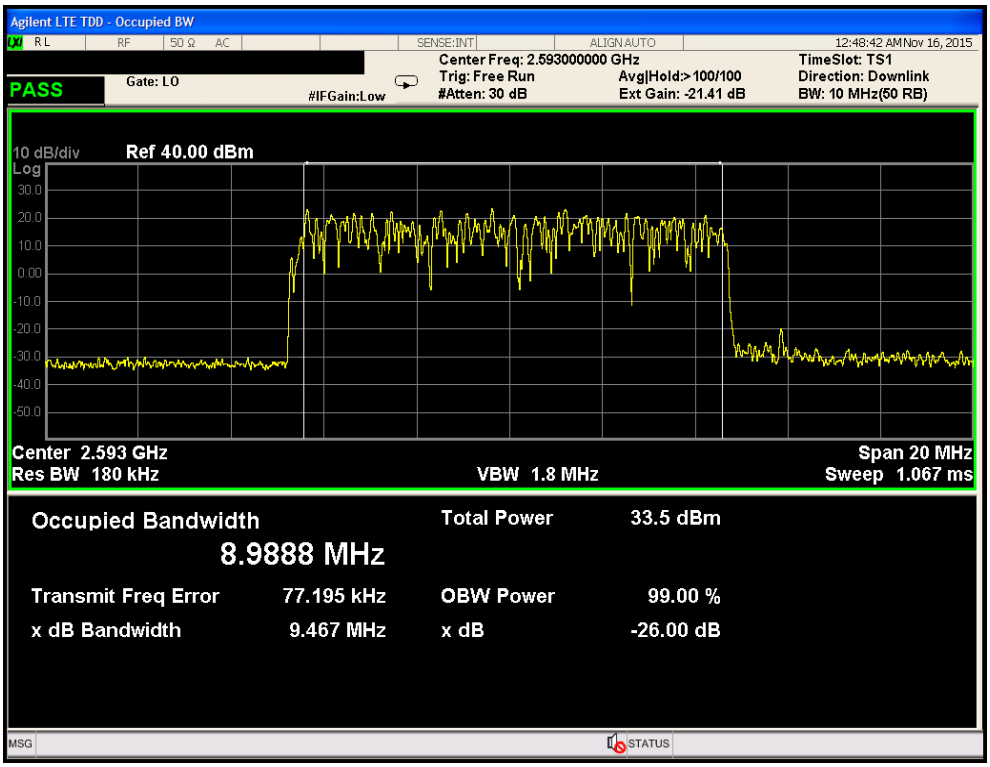
•Port1 / LTE 5M / 2687.5 MHz / 64QAM



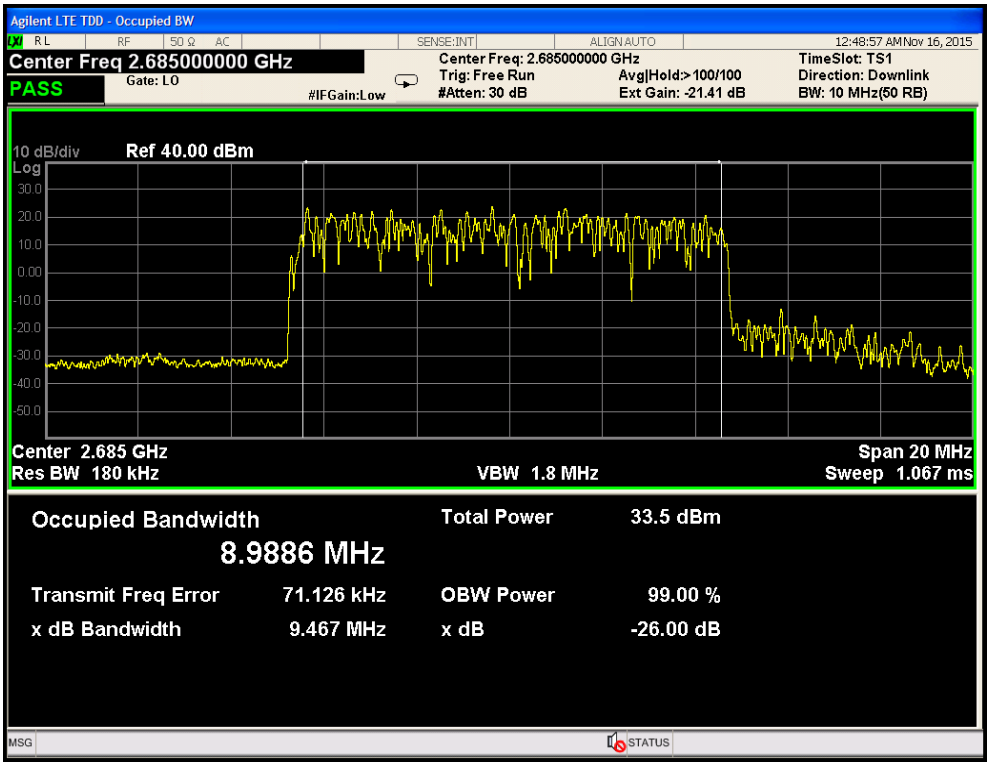
•Port1 / LTE 10M / 2501.0 MHz / QPSK



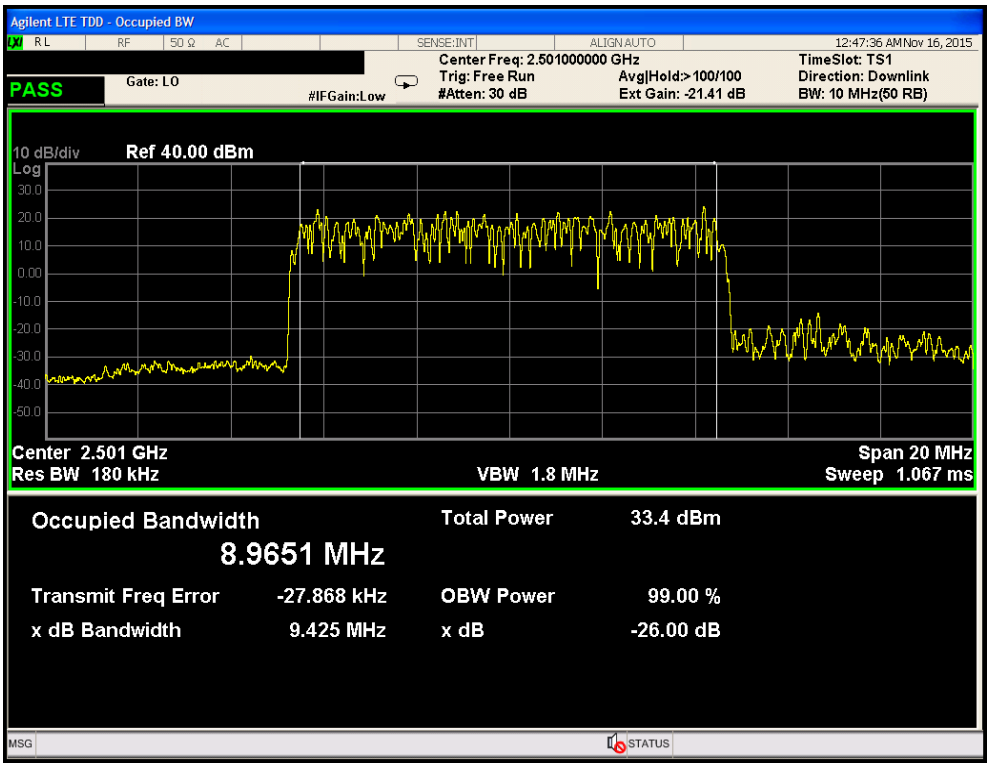
•Port1 / LTE 10M / 2593.0 MHz / QPSK



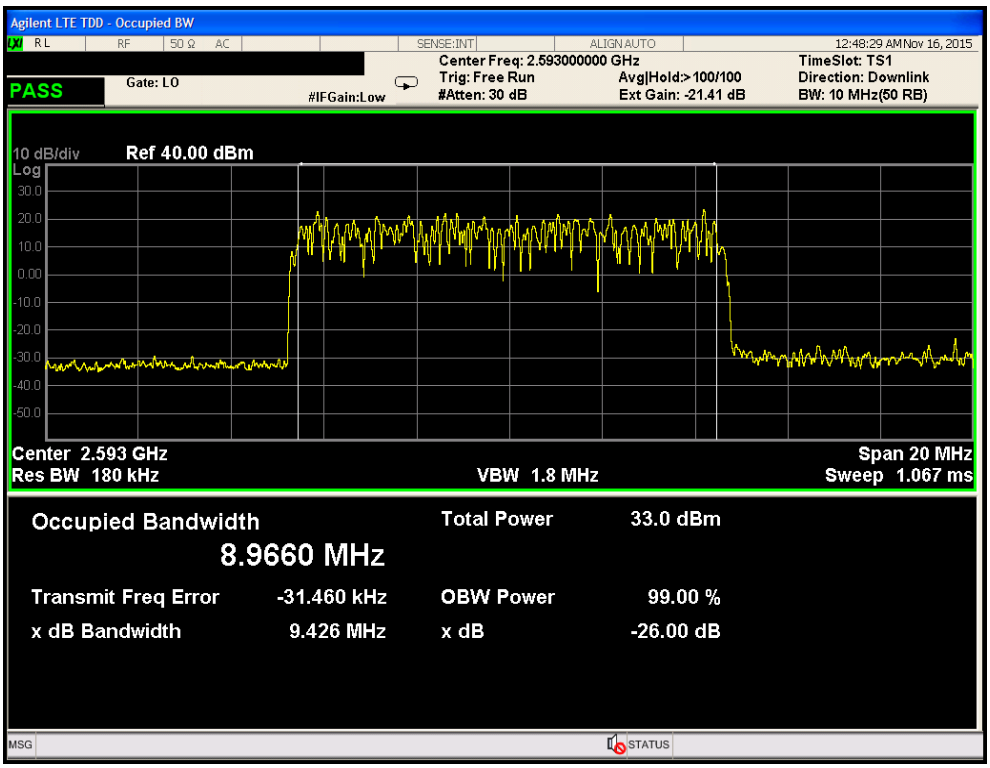
•Port1 / LTE 10M / 2685.0 MHz / QPSK



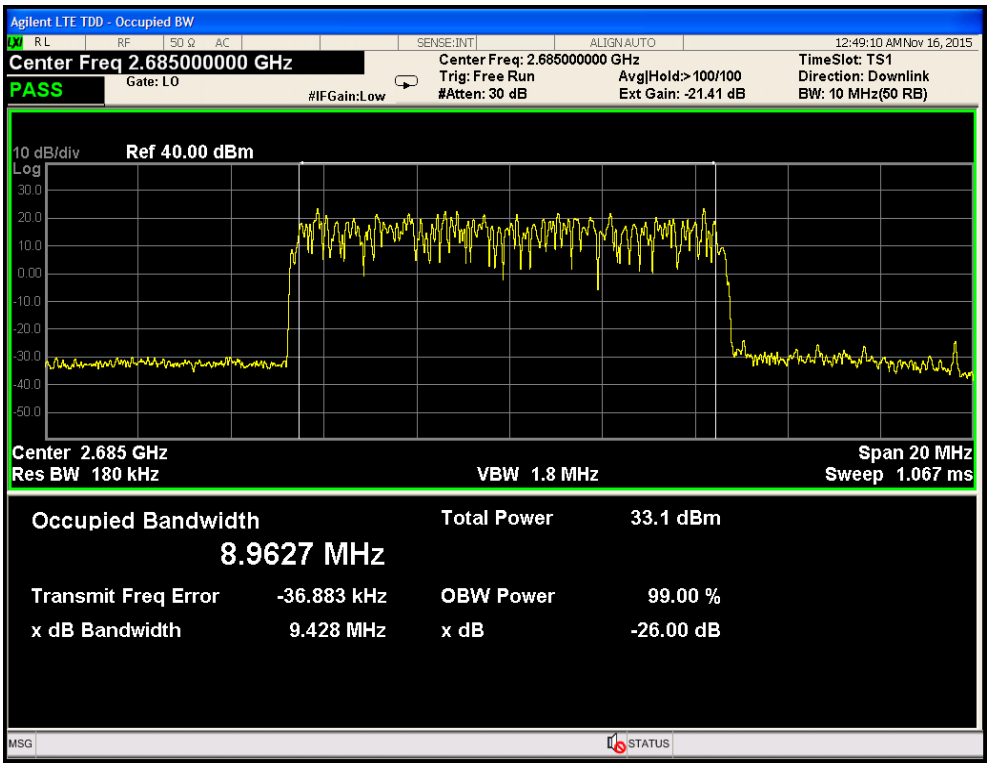
•Port1 / LTE 10M / 2501.0 MHz / 16QAM



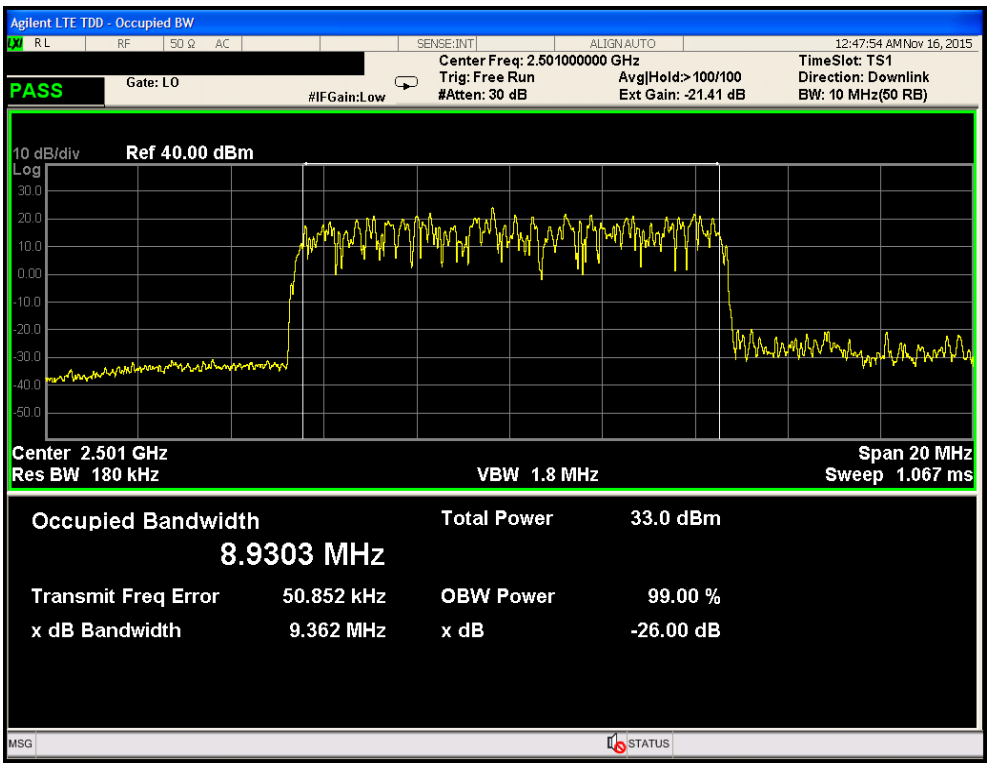
•Port1 / LTE 10M / 2593.0 MHz / 16QAM



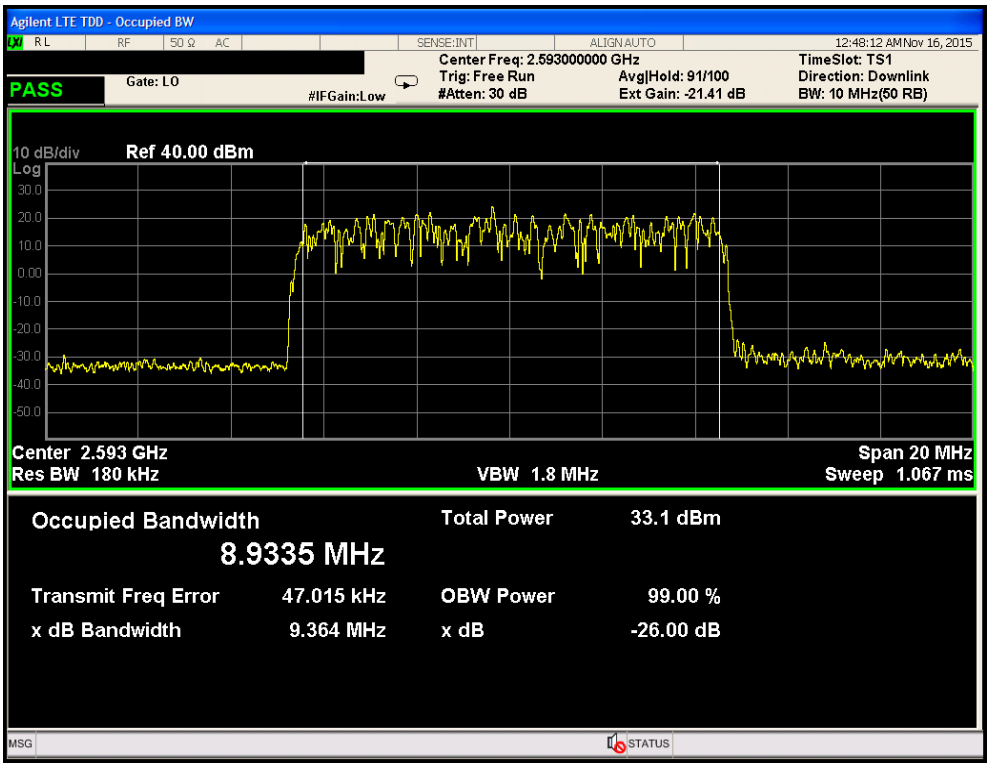
•Port1 / LTE 10M / 2685.0 MHz / 16QAM



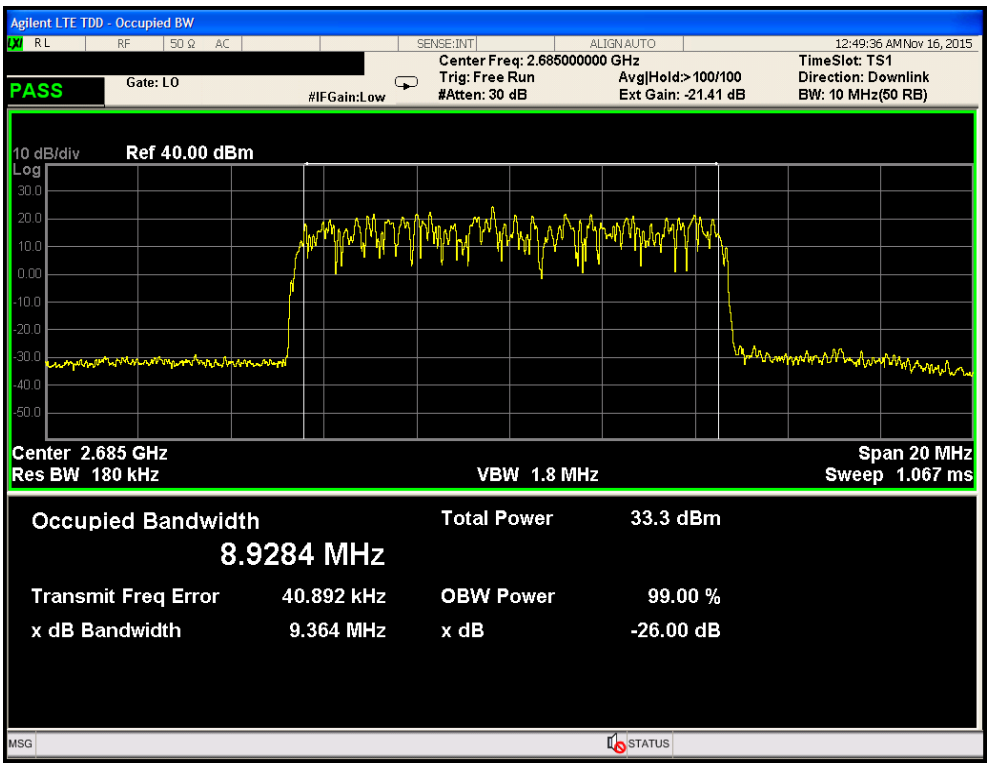
•Port1 / LTE 10M / 2501.0 MHz / 64QAM



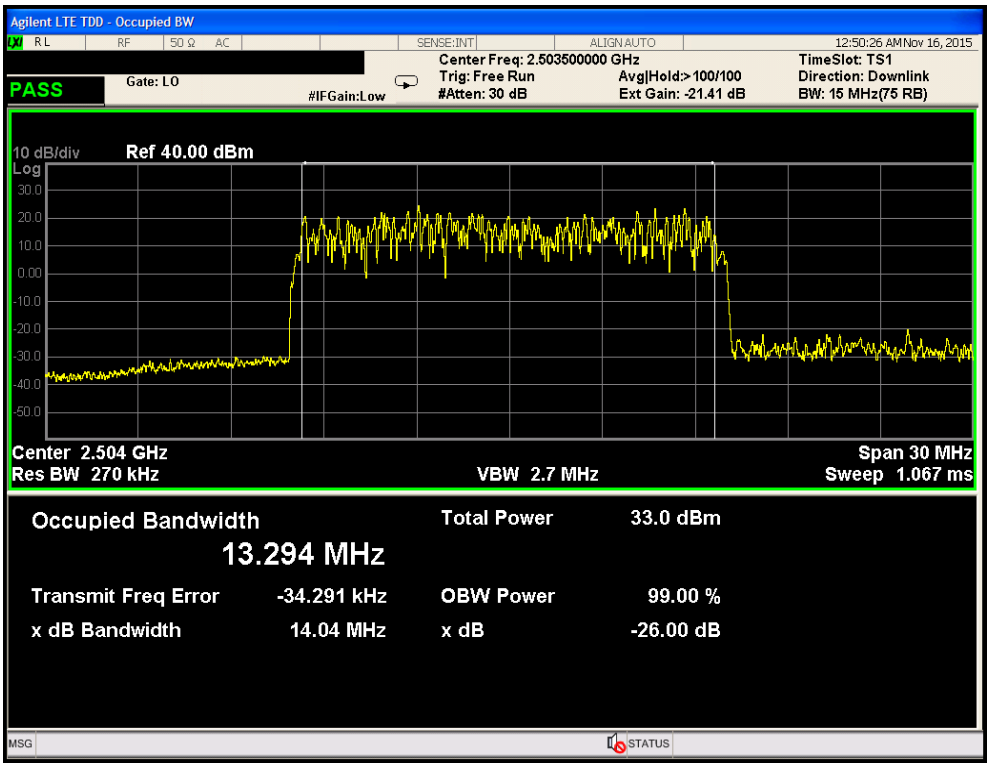
•Port1 / LTE 10M / 2593.0 MHz / 64QAM



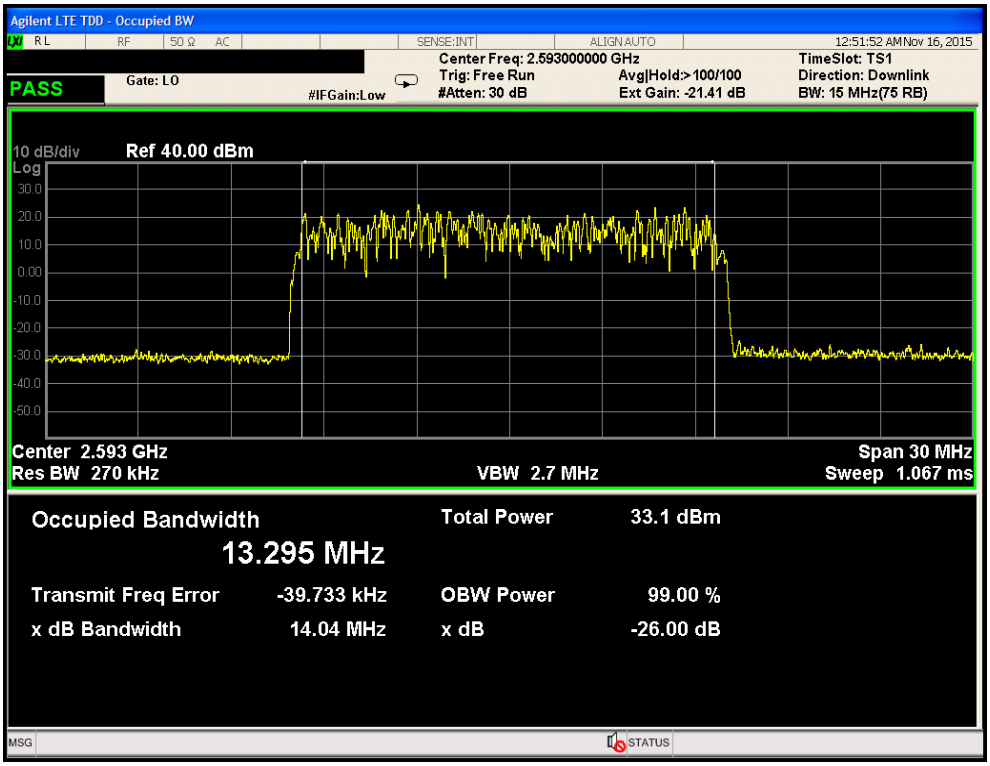
•Port1 / LTE 10M / 2685.0 MHz / 64QAM



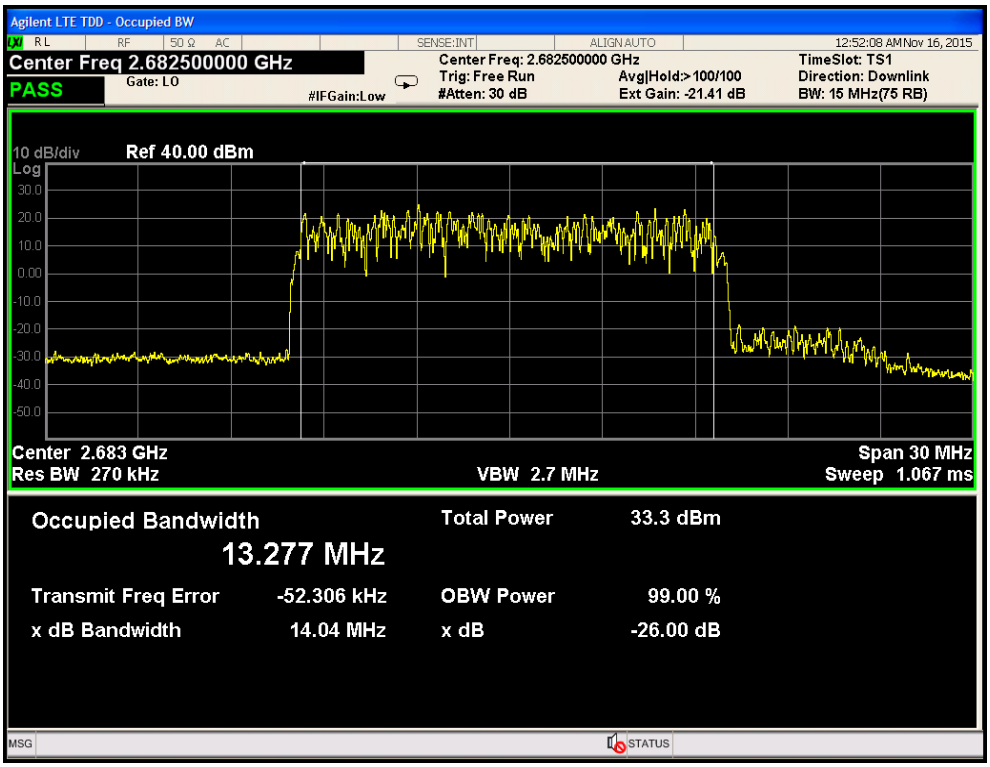
•Port1 / LTE 15M / 2503.5 MHz / QPSK



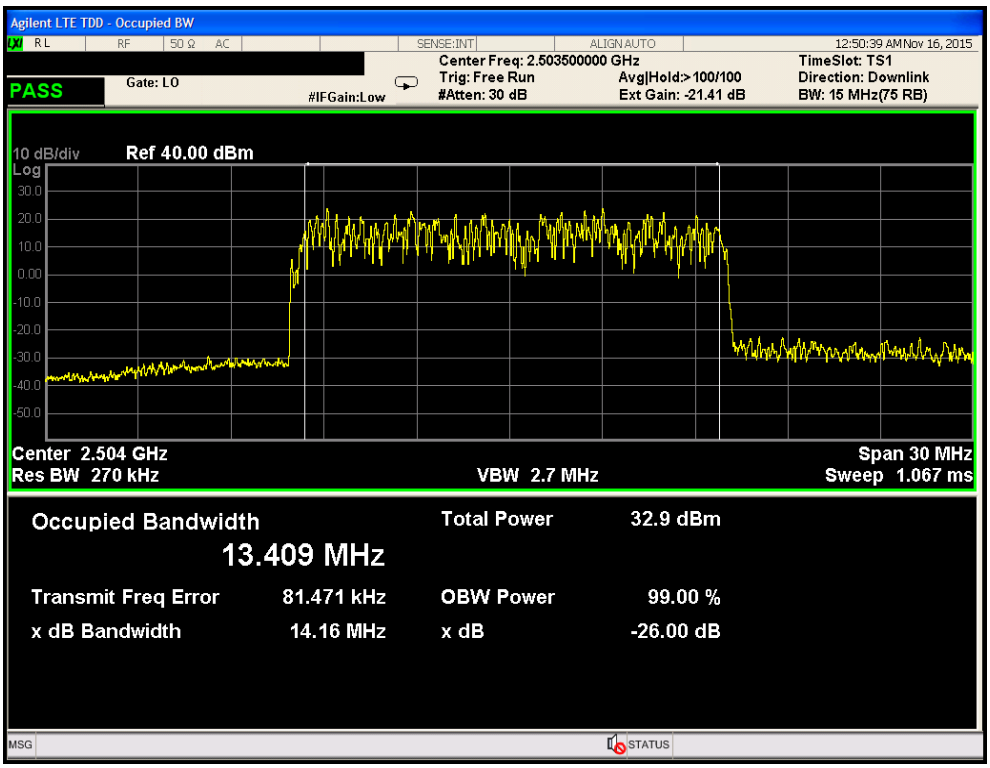
•Port1 / LTE 15M / 2593.0 MHz / QPSK



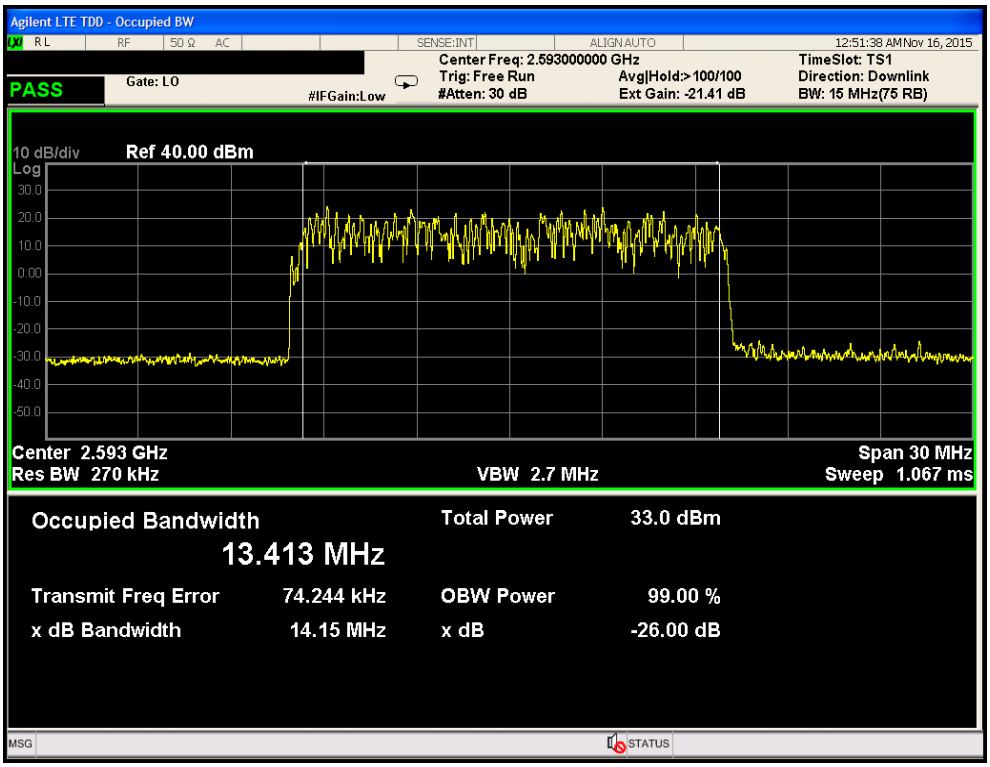
•Port1 / LTE 15M / 2682.5 MHz / QPSK



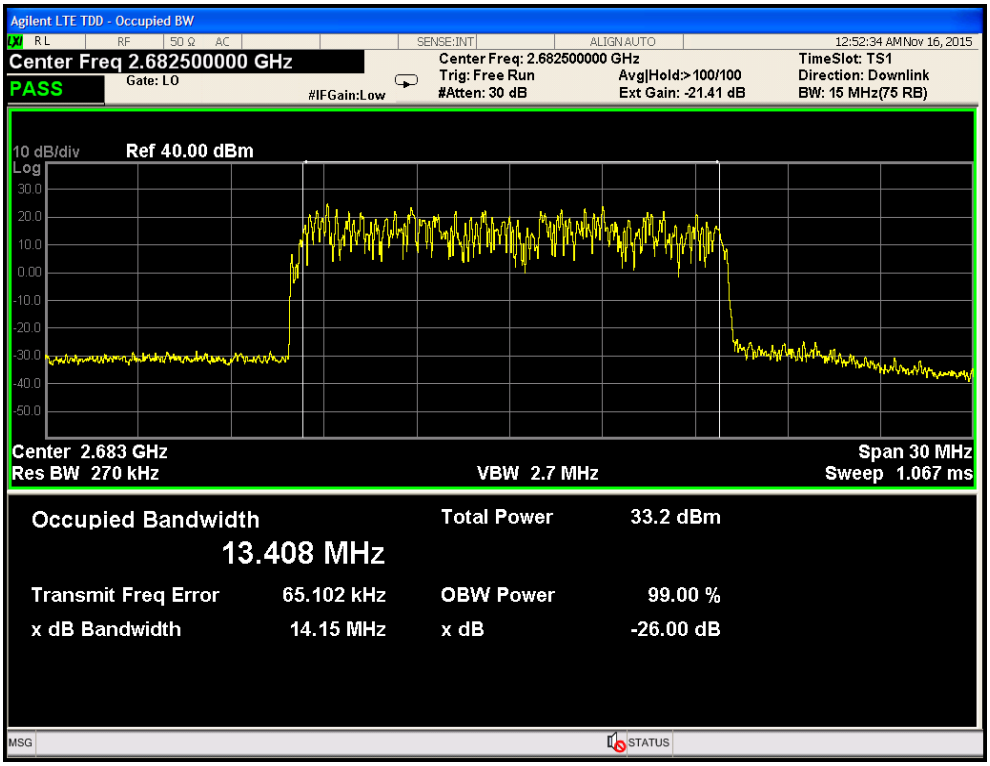
•Port1 / LTE 15M / 2503.5 MHz / 16QAM



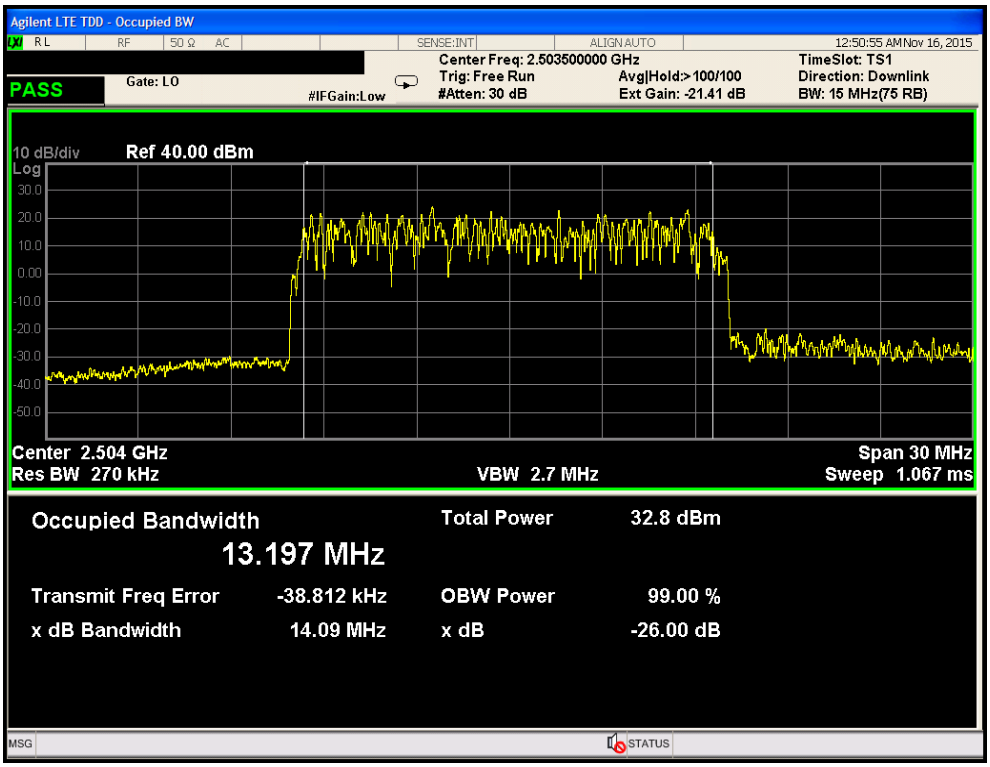
•Port1 / LTE 15M / 2593.0 MHz / 16QAM



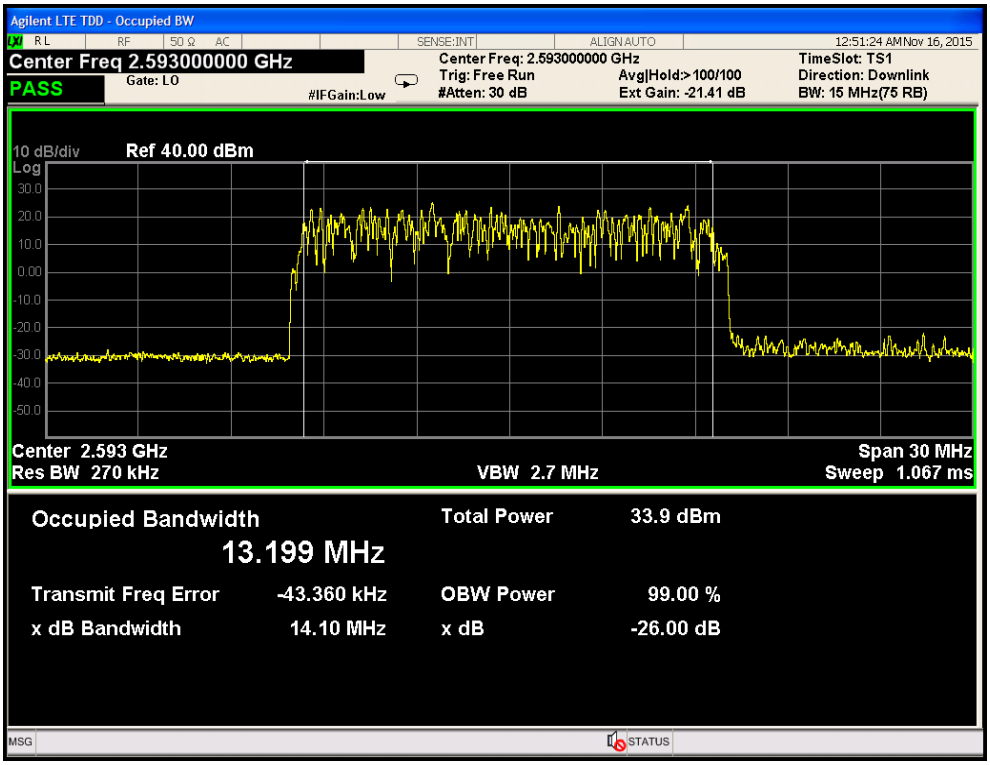
•Port1 / LTE 15M / 2682.5 MHz / 16QAM



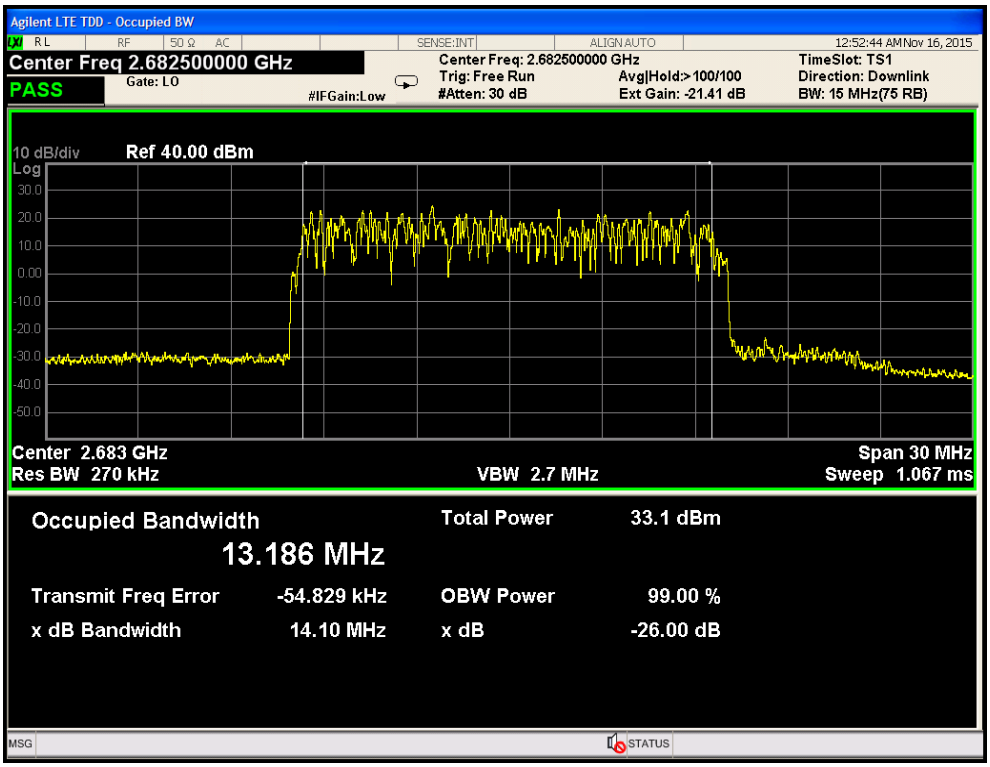
•Port1 / LTE 15M / 2503.5 MHz / 64QAM



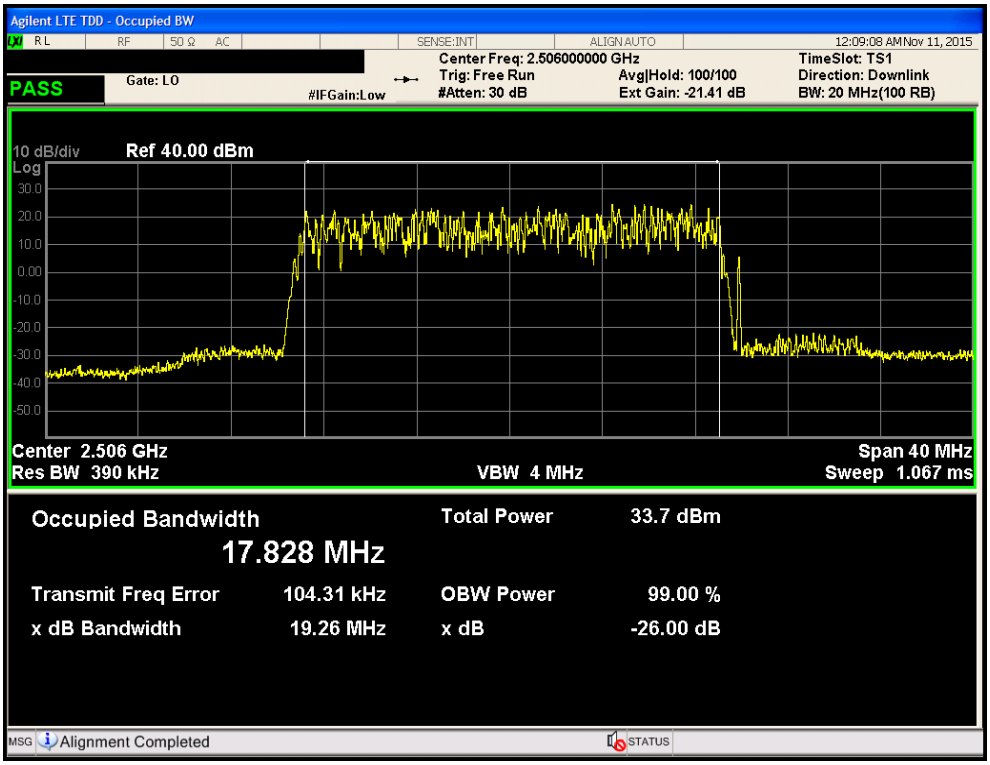
•Port1 / LTE 15M / 2593.0 MHz / 64QAM



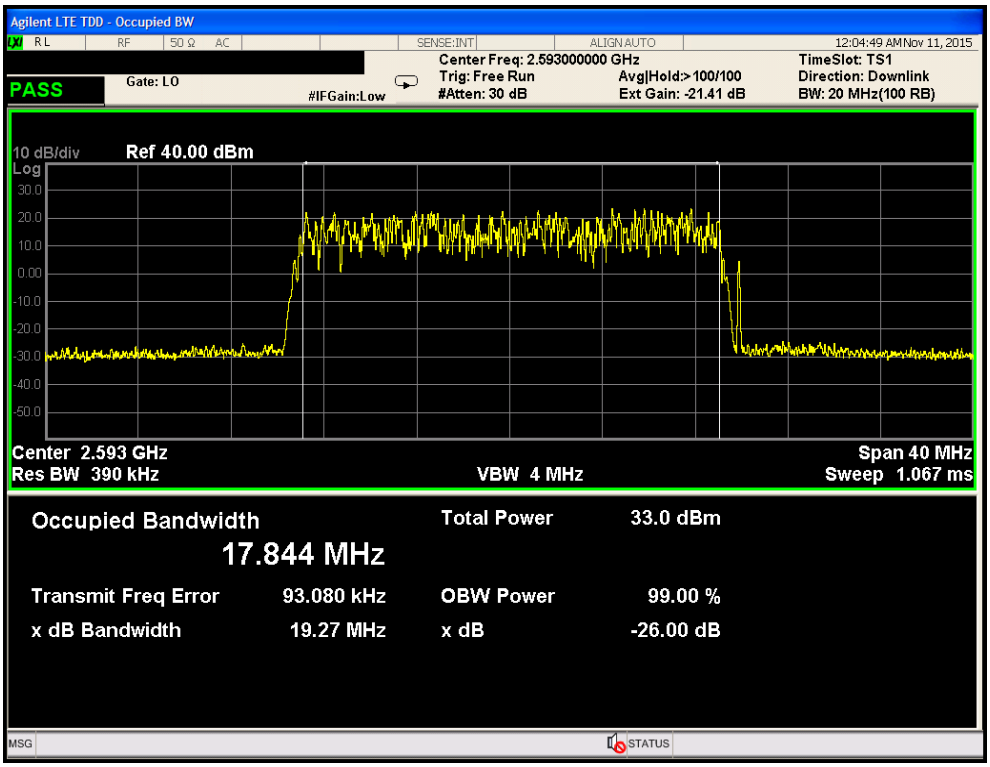
•Port1 / LTE 15M / 2682.5 MHz / 64QAM



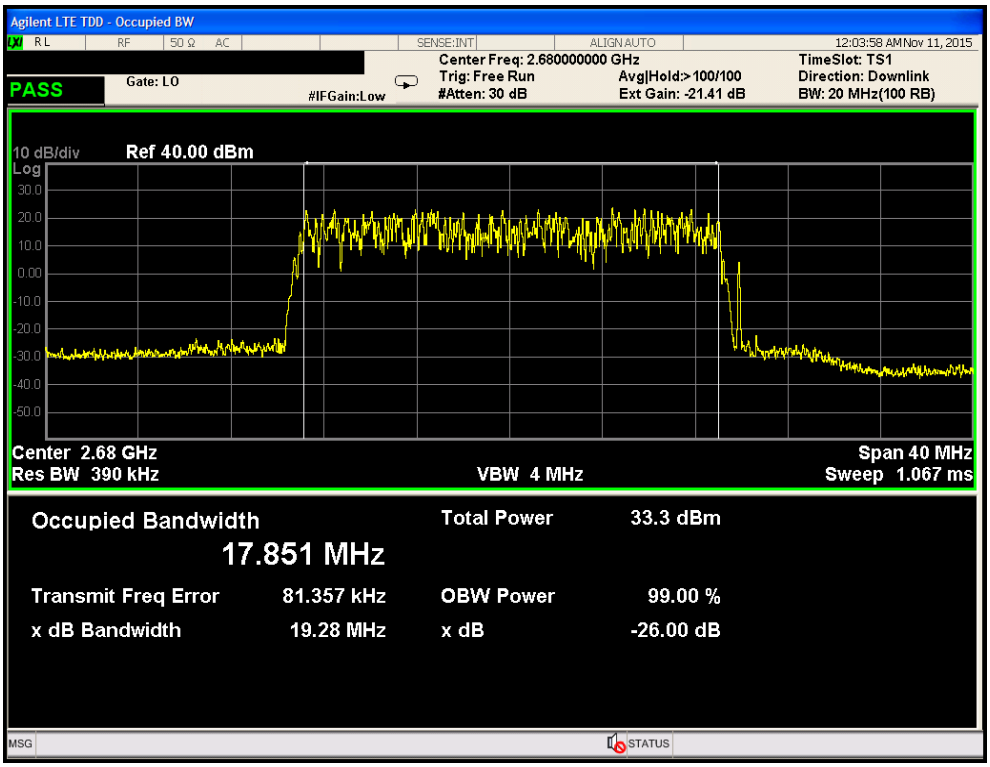
•Port1 / LTE 20M / 2506.0 MHz / QPSK



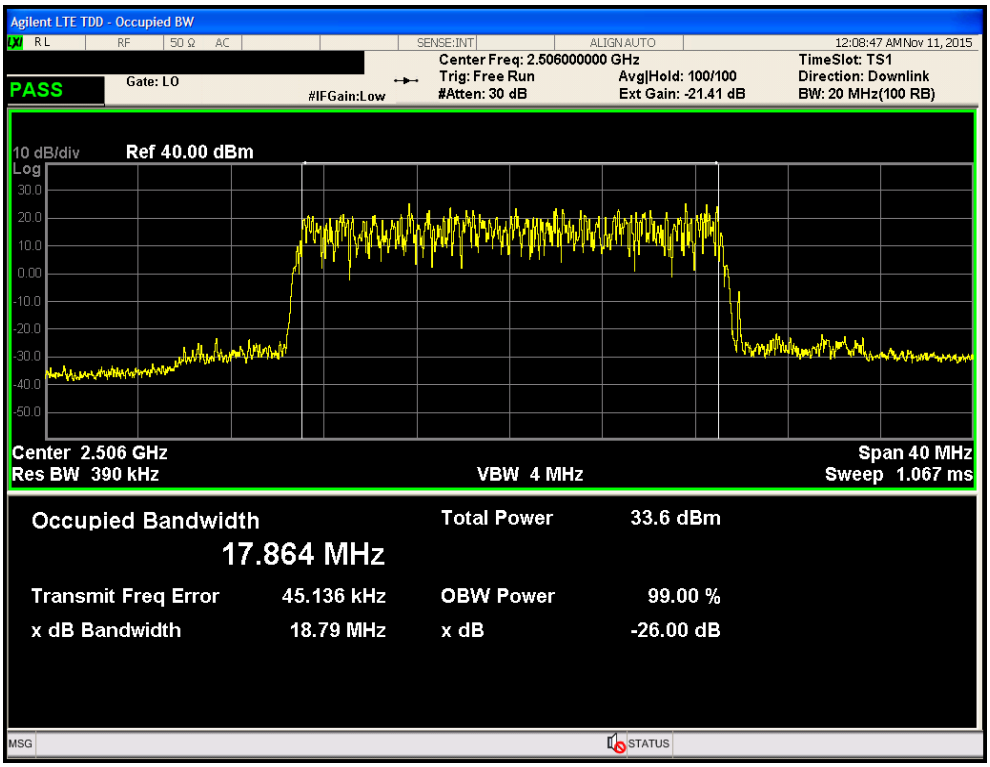
•Port1 / LTE 20M / 2593.0 MHz / QPSK



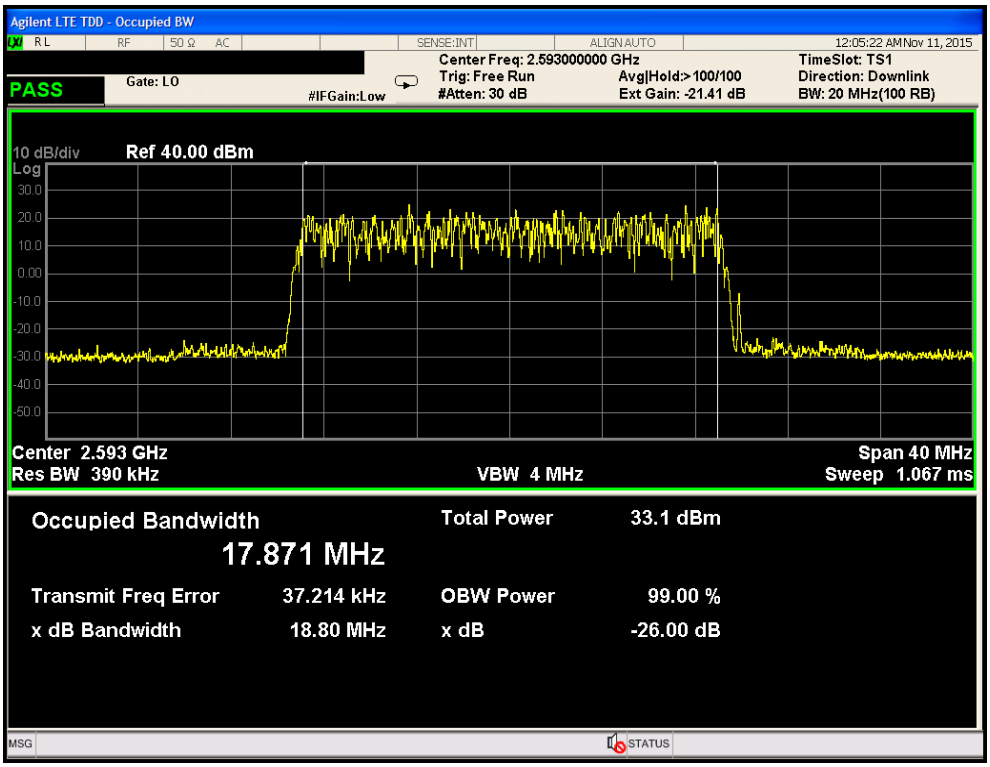
•Port1 / LTE 20M / 2680.0 MHz / QPSK



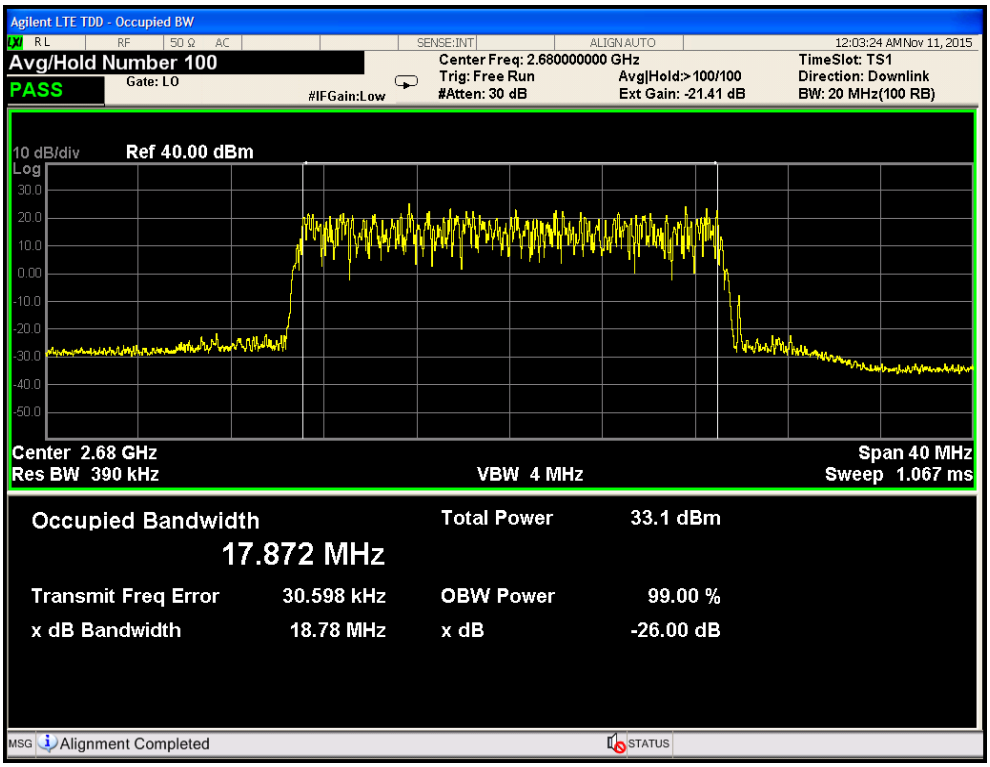
•Port1 / LTE 20M / 2506.0 MHz / 16QAM



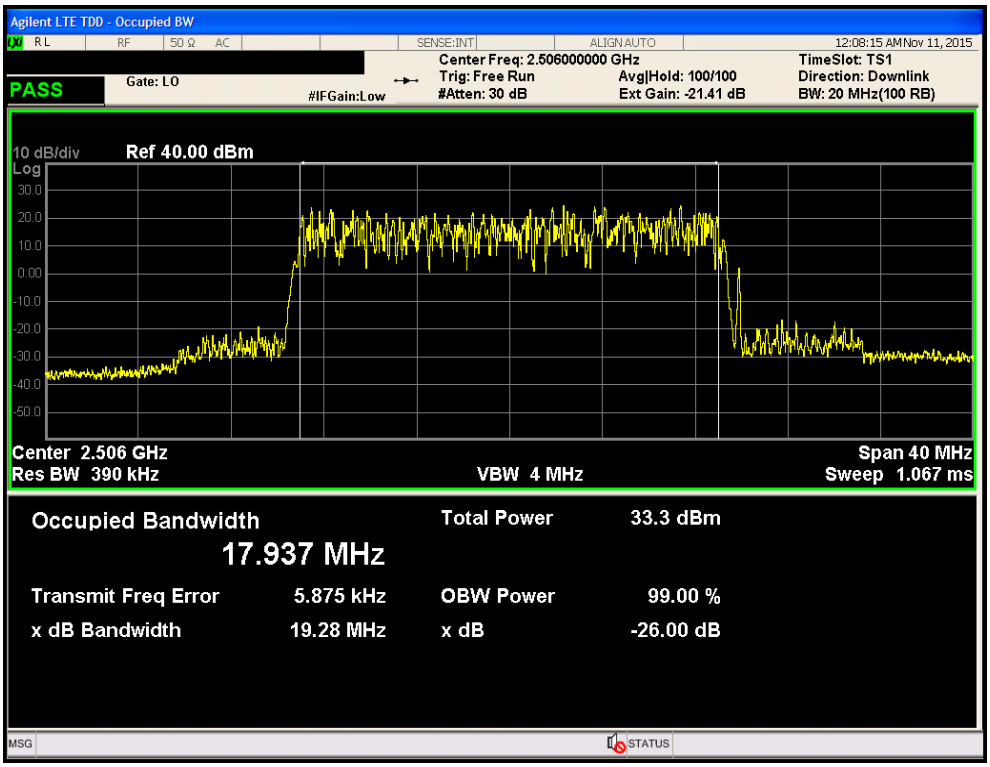
•Port1 / LTE 20M / 2593.0 MHz / 16QAM



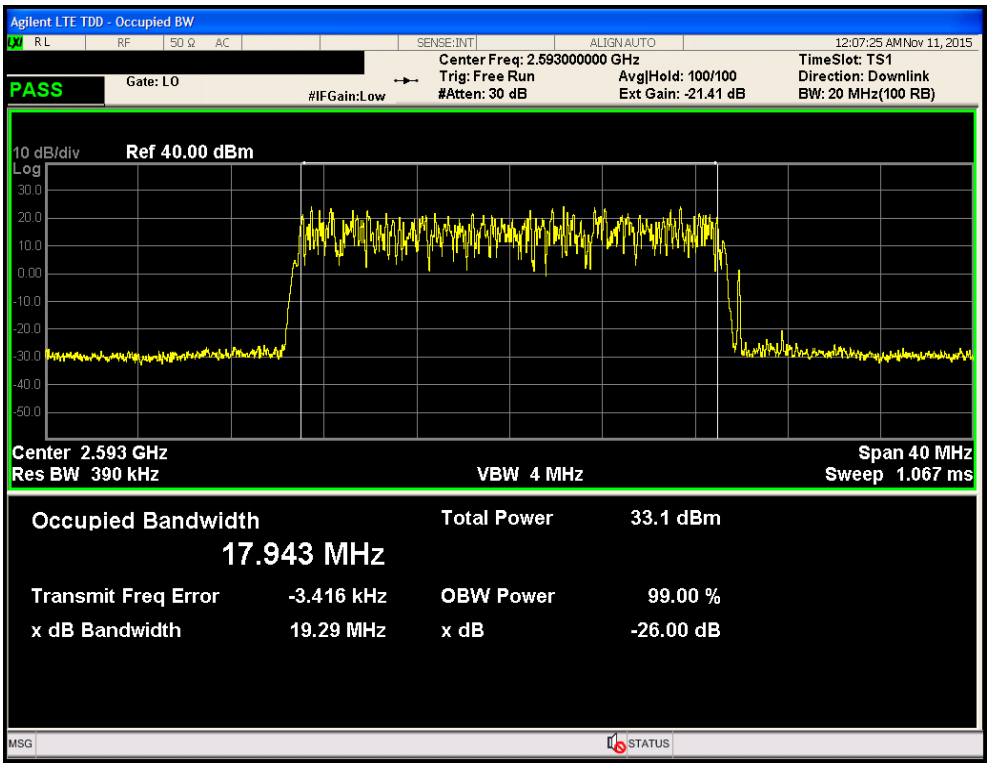
•Port1 / LTE 20M / 2680.0 MHz / 16QAM



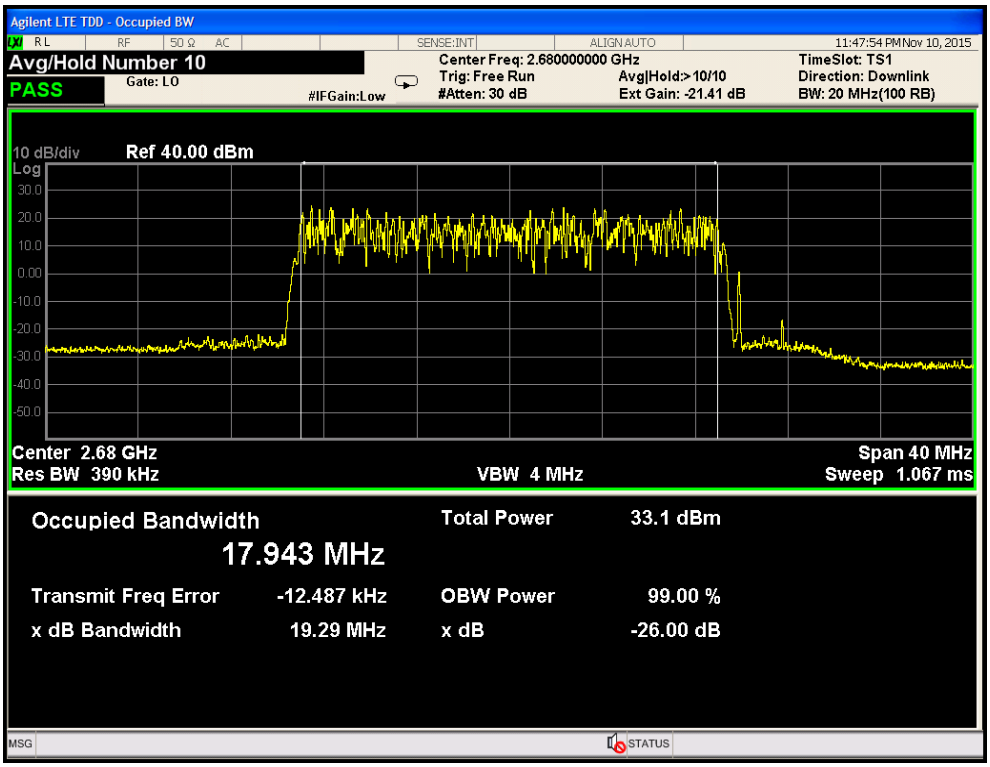
•Port1 / LTE 20M / 2506.0 MHz / 64QAM



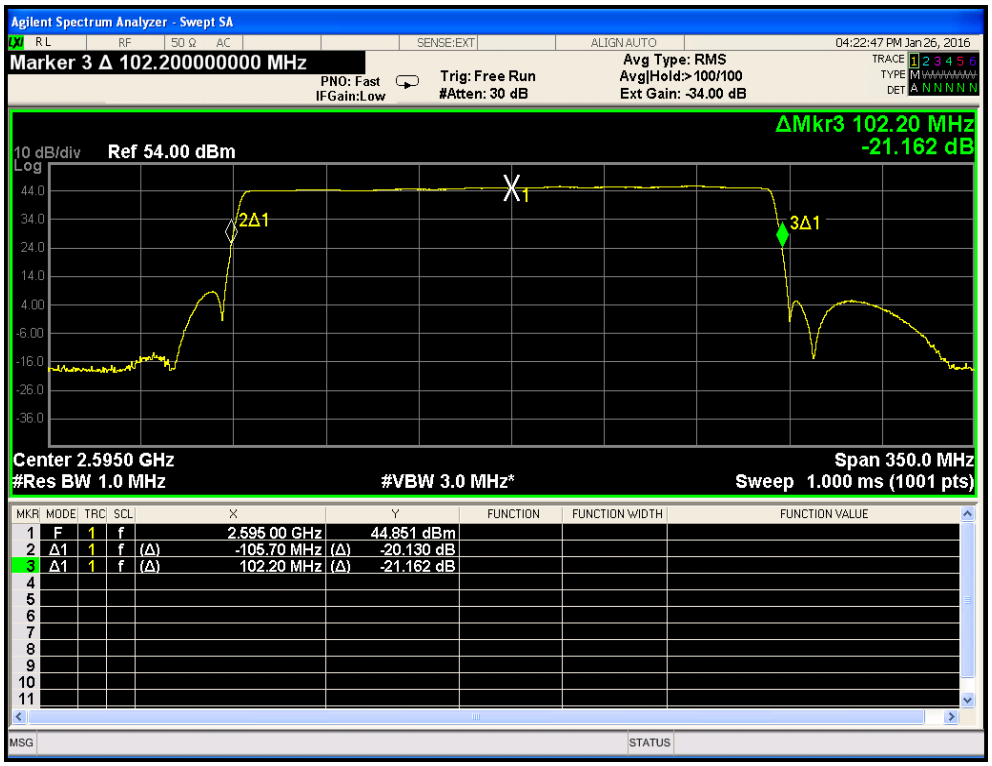
•Port1 / LTE 20M / 2593.0 MHz / 64QAM



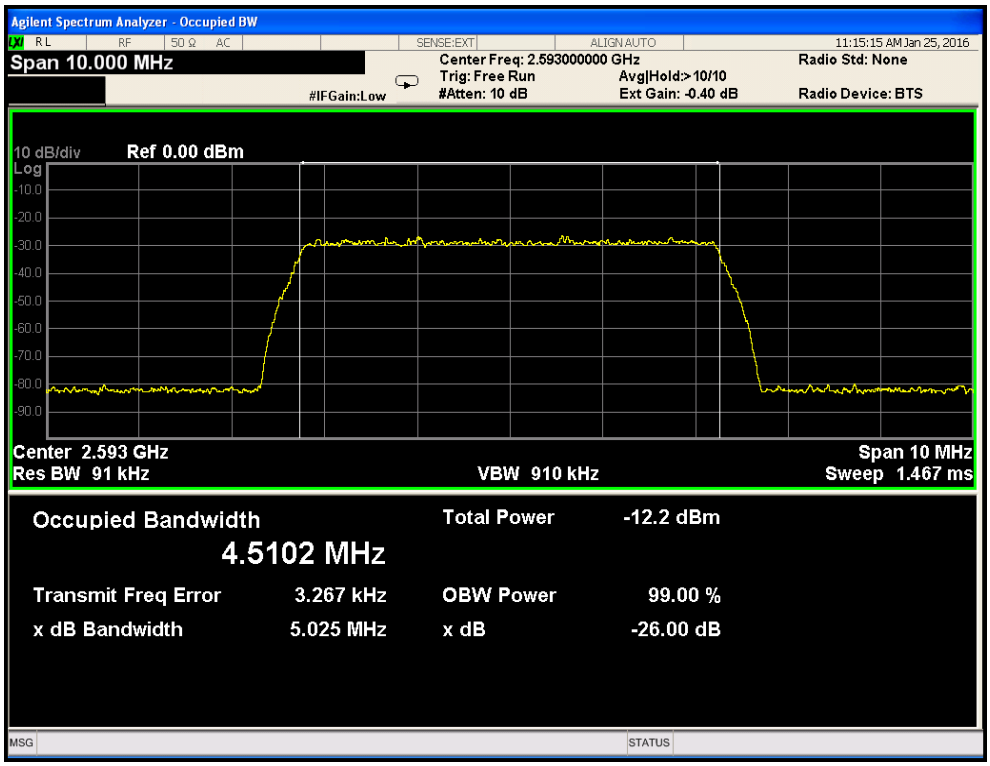
•Port1 / LTE 20M / 2680.0 MHz / 64QAM



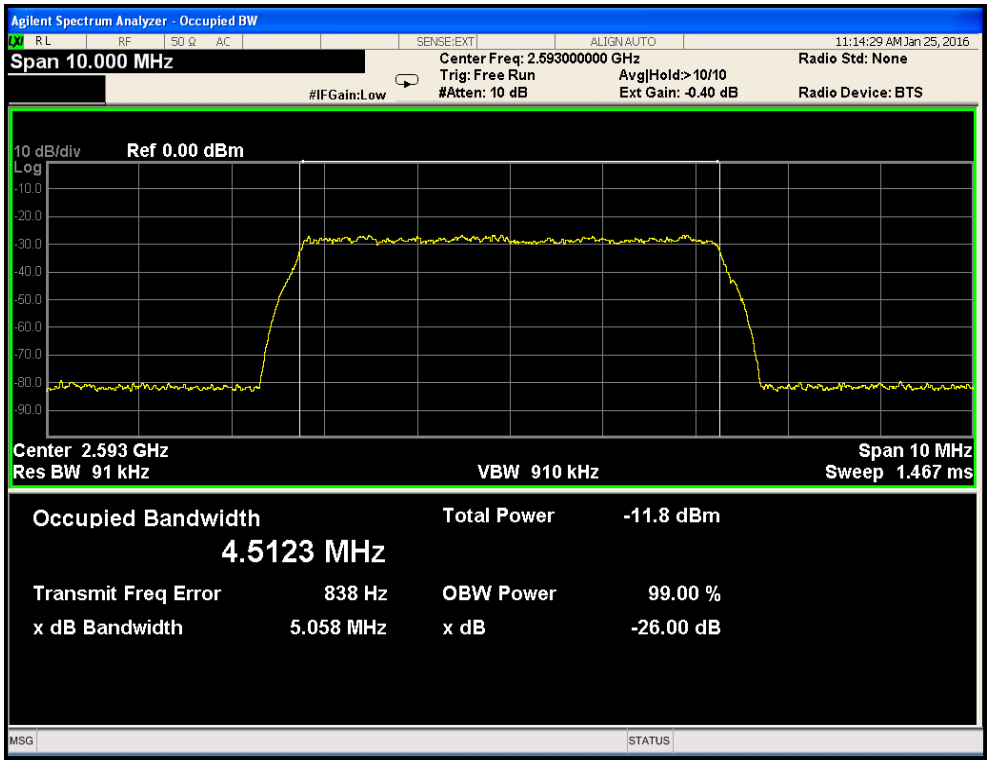
•Port1 / Out of band rejection



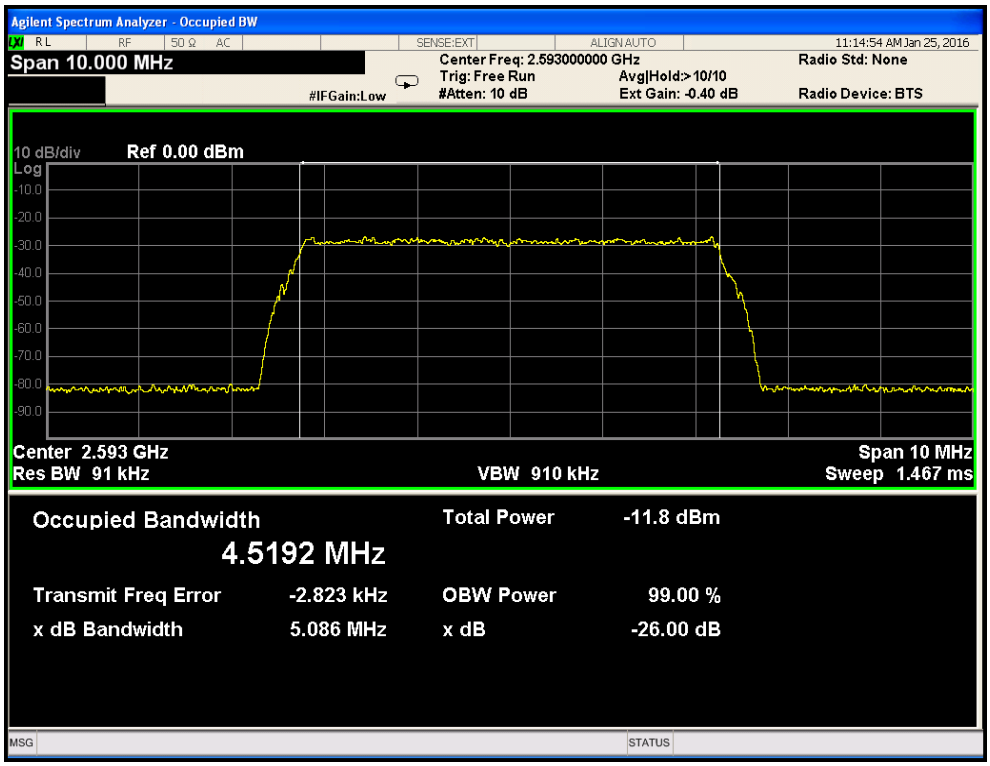
- **Input signal bandwidth / 5MHz / QPSK**



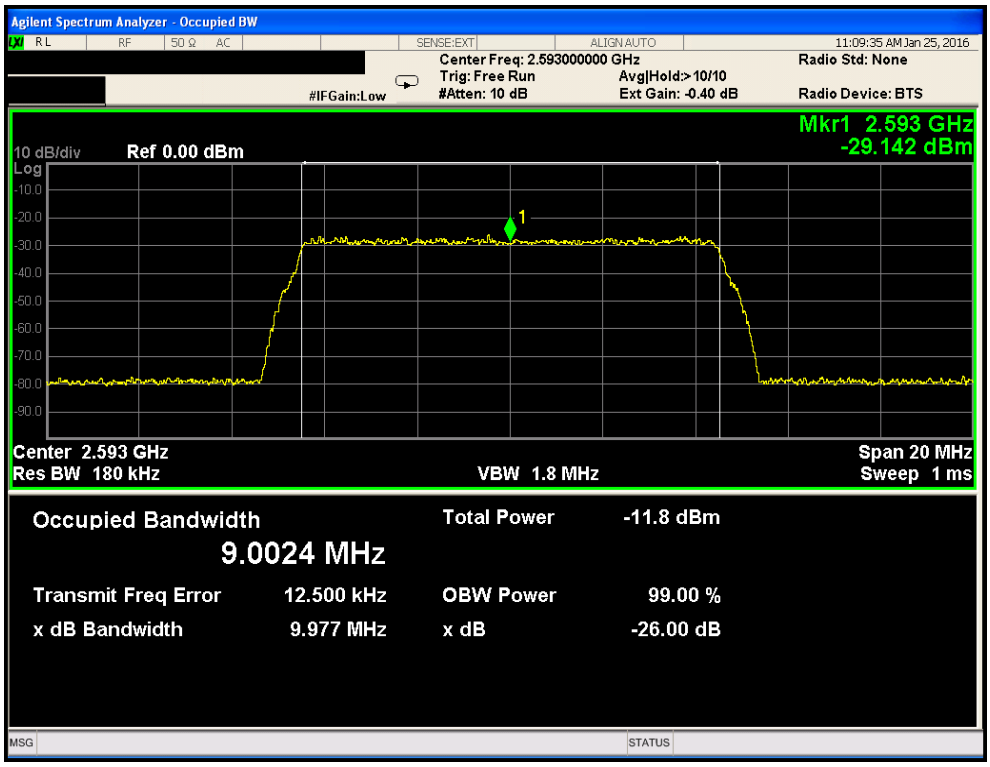
- **Input signal bandwidth / 5MHz / 16QAM**



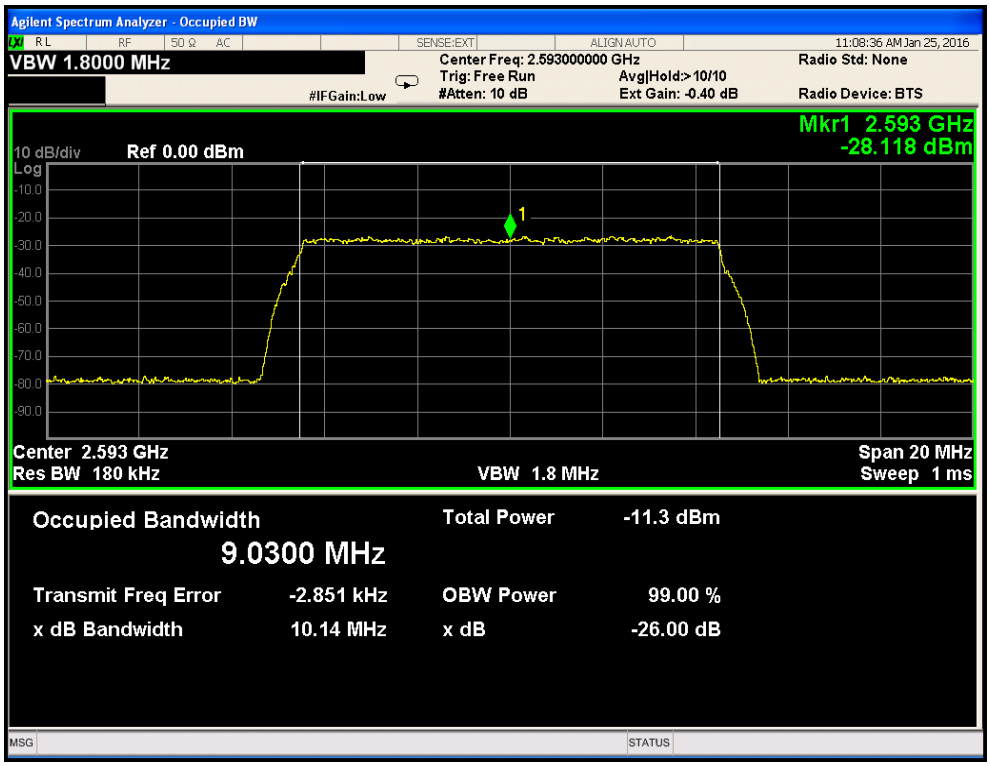
- **Input signal bandwidth / 5MHz / 64QAM**



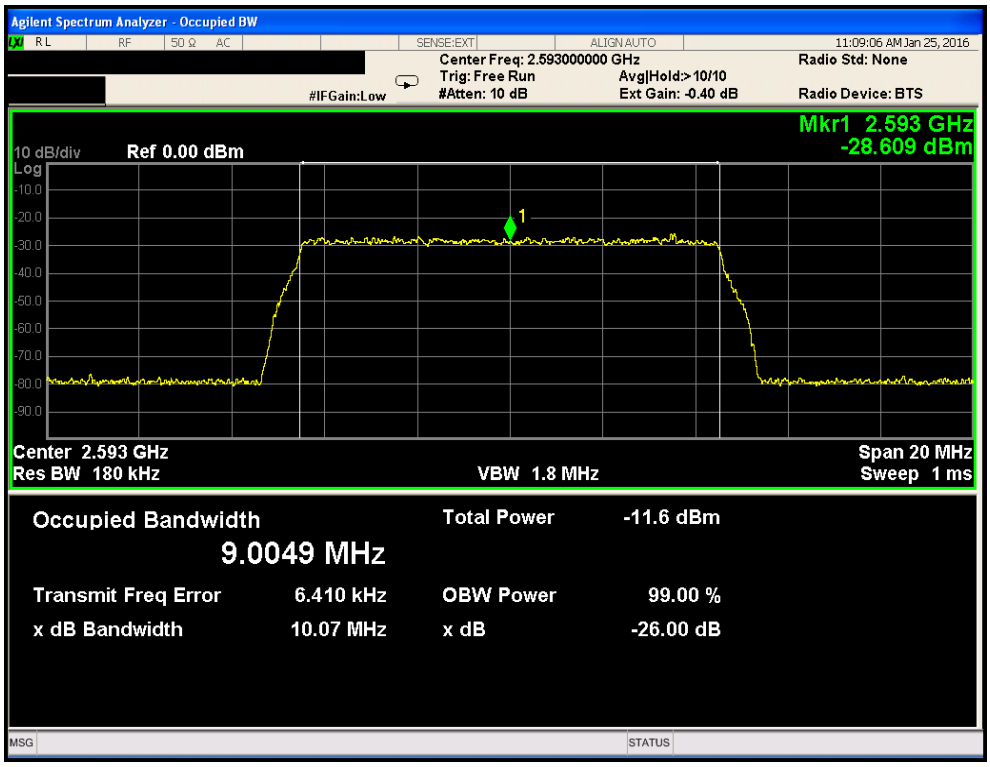
- **Input signal bandwidth / 10MHz / QPSK**



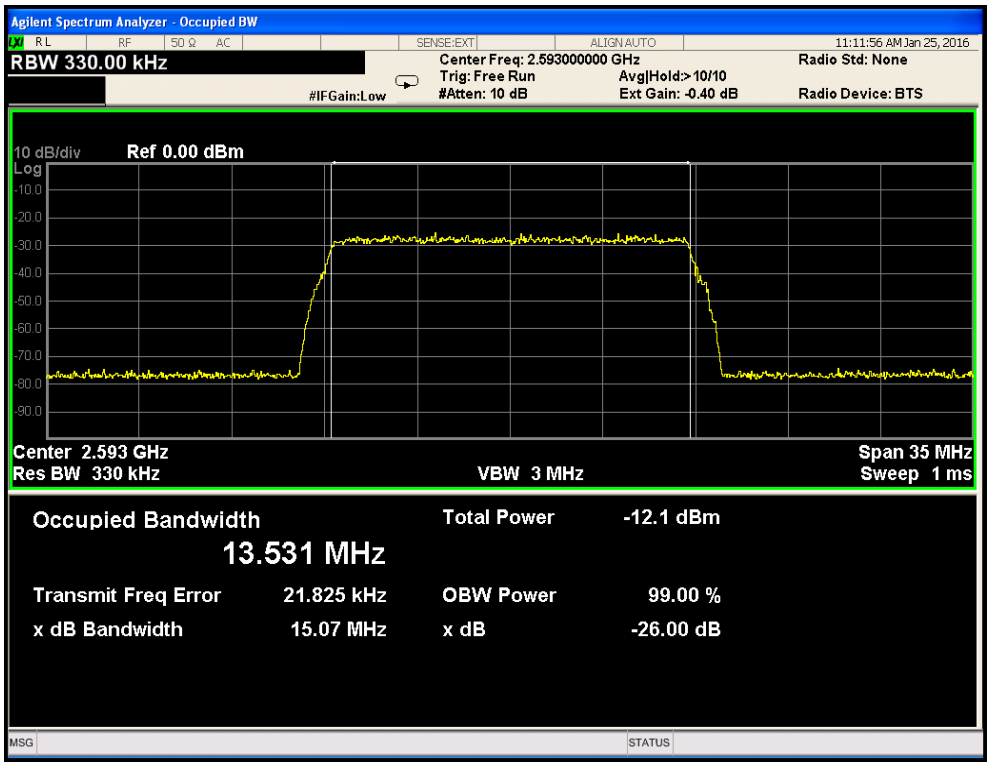
- **Input signal bandwidth / 10MHz / 16QAM**



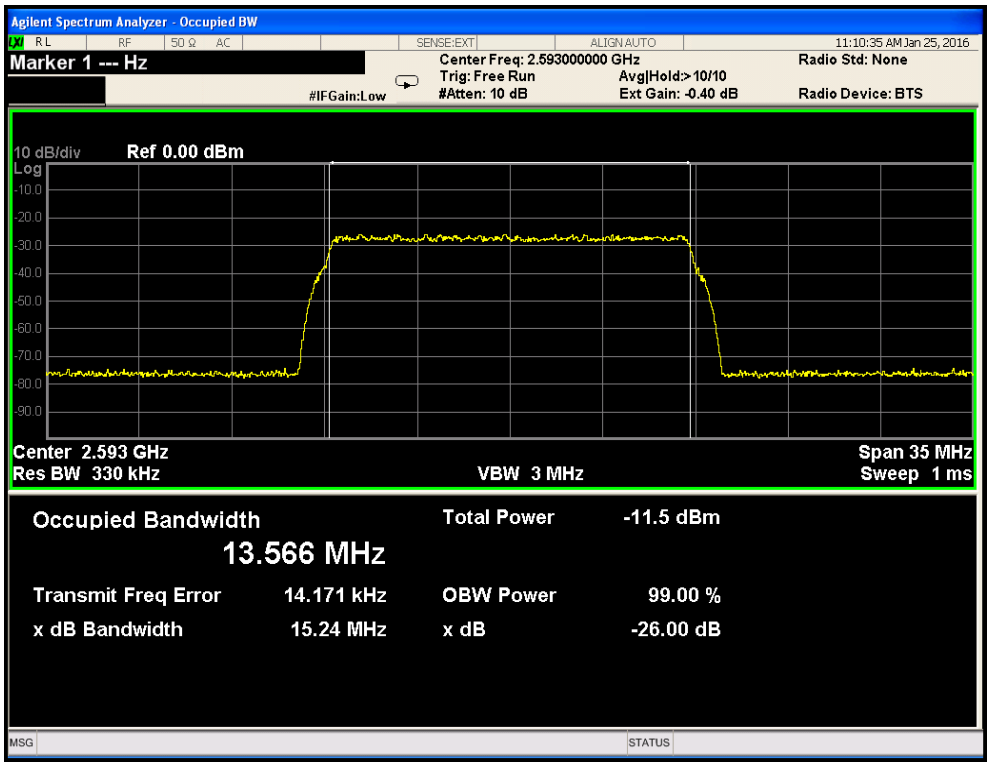
- **Input signal bandwidth / 10MHz / 64QAM**



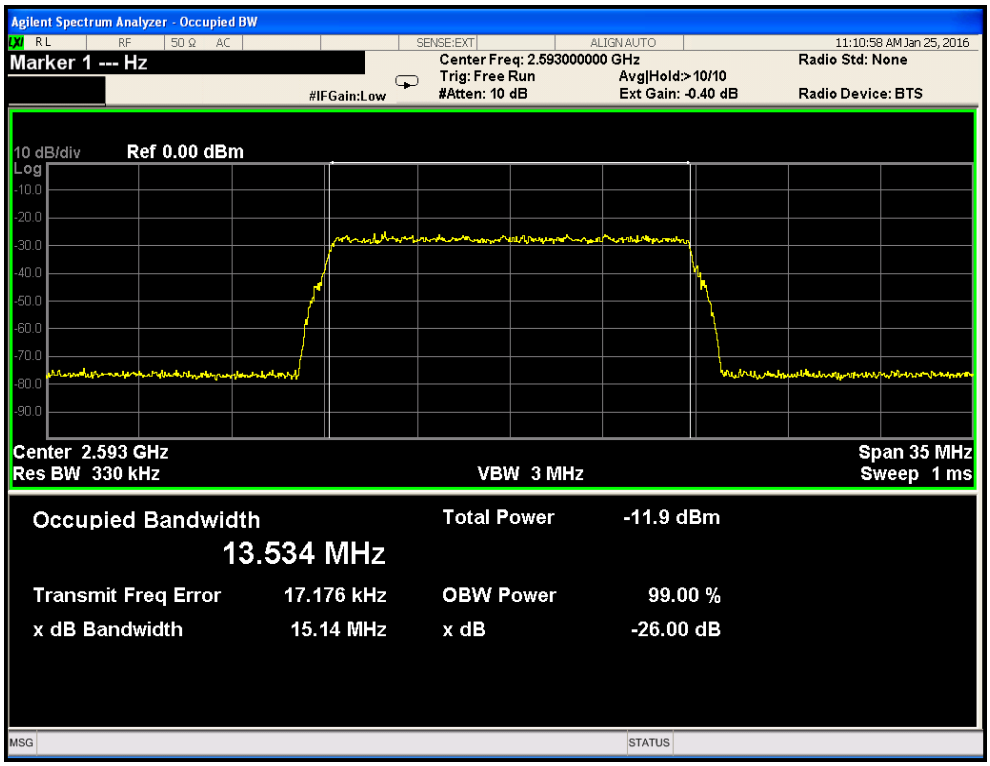
- **Input signal bandwidth / 15MHz / QPSK**



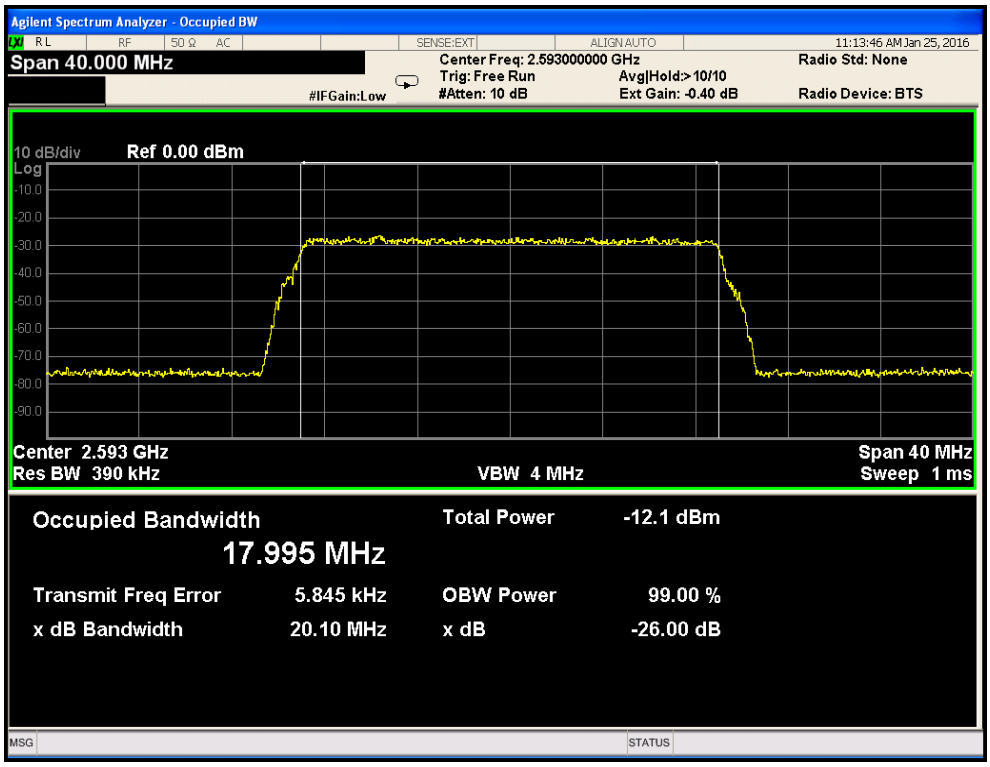
- **Input signal bandwidth / 15MHz / 16QAM**



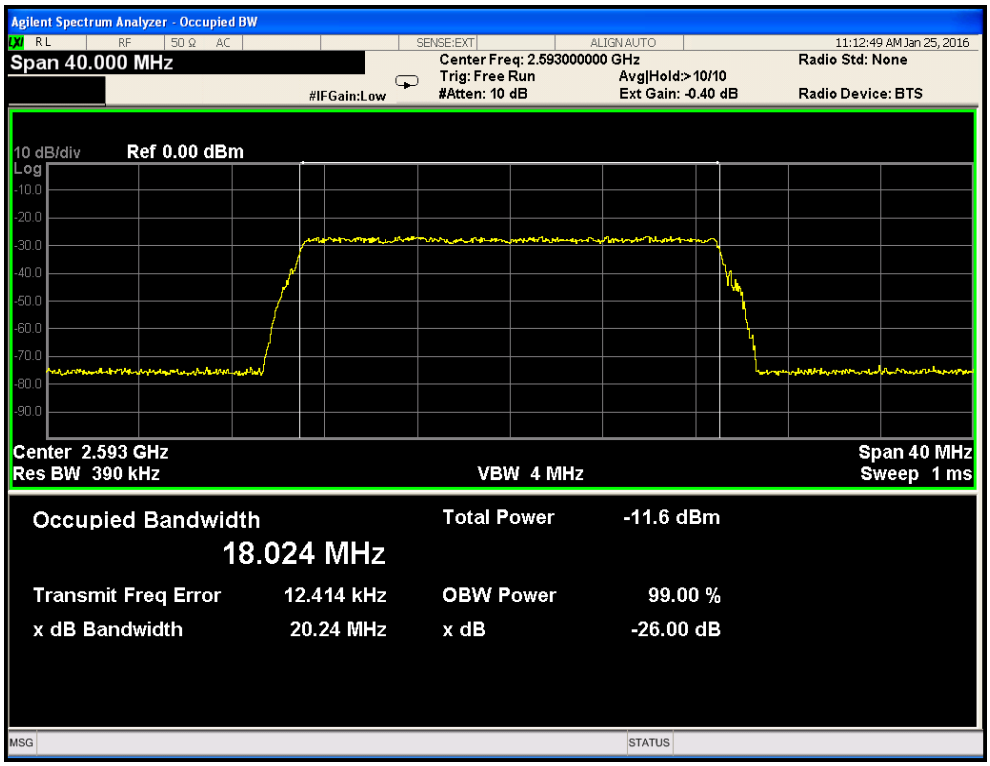
- **Input signal bandwidth / 15MHz / 64QAM**



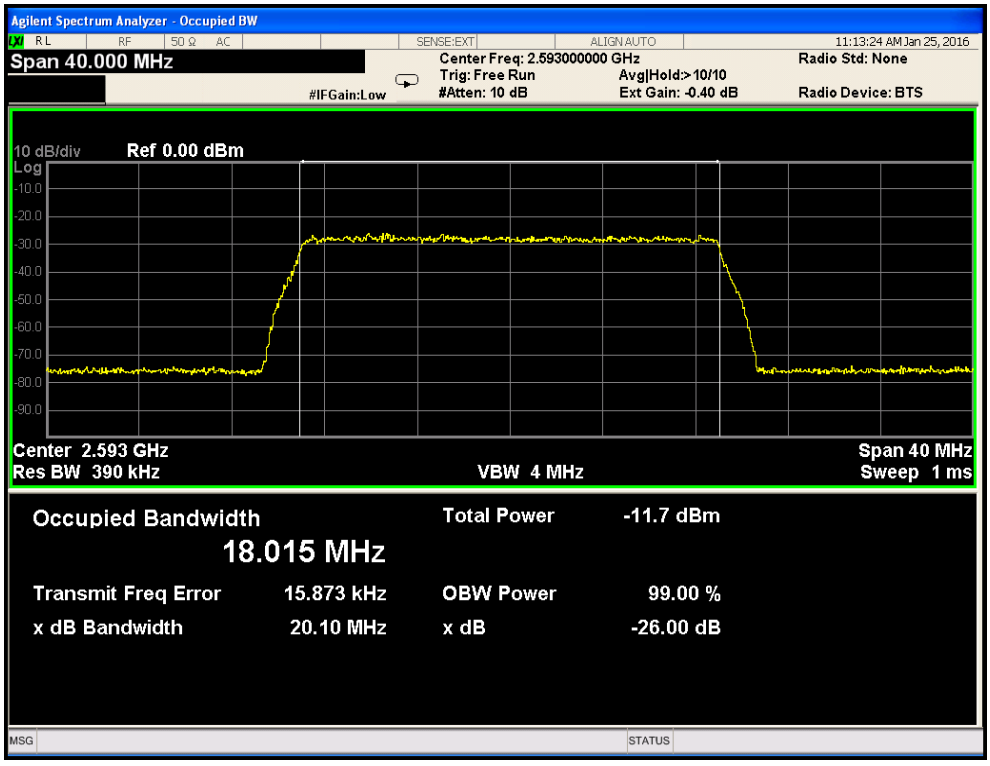
- **Input signal bandwidth / 20MHz / QPSK**



- **Input signal bandwidth / 20MHz / 16QAM**



- **Input signal bandwidth / 20MHz / 64QAM**



3.2 Band edge

3.2.1 Specification

- FCC Rules Part 2.1051
- FCC Rules Part 27.53 (m)(v)

3.2.2 Test description

The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in the available band. The channels closets to the band edges were selected. The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer.

For all fixed digital user stations, the attenuation factor shall be not less than 43 + 10 log (P) dB at the channel edge.

The spectrum was scanned blow the lower band edge and above the higher band edge. The resolution bandwidth was set to approximately 1% of the measured emissions bandwidth within the first 1 MHz block adjacent to the transmit band. An average RMS detector was used match the method used during Output power.

UL/DL Allocation : Configuration 3
Dw/GP/UP length : Configuration 8

3.2.3 Test Procedure

The method used is as detailed in FCC KDB 935210 D05 v01.

The method used is as detailed in FCC KDB 971168 D01 v02r02.

The test was performed at three frequencies (low, middle and high channels) at each band using all applicable modulation (QPSK, 16QAM and 64QAM)

The power of any emission in the 1MHz bands immediately outside and adjacent to the channel blocks was attenuated below the transmitting power (P) by a factor as specified in this section.

The EUT antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable

3.2.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-2500-SISO	Corning Optical Communications Wireless Inc.
MHU	HX-2500-MHU	Corning Optical Communications Wireless Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
Attenuator	PE7019-20	Pasternack
DC Power Supply	6674A	Agilent

3.2.5 Test condition

• Test place: Shield Room
• Test environment: 22.5 °C, 42.5 % R.H.

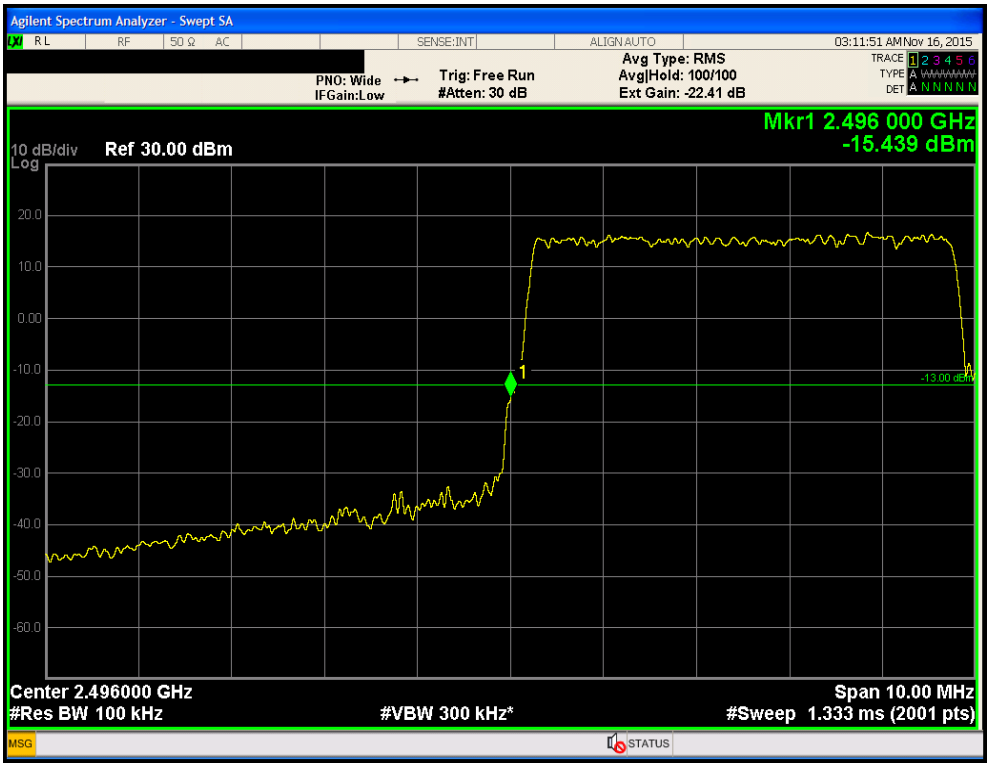
3.2.6 Test results

- **Port1**

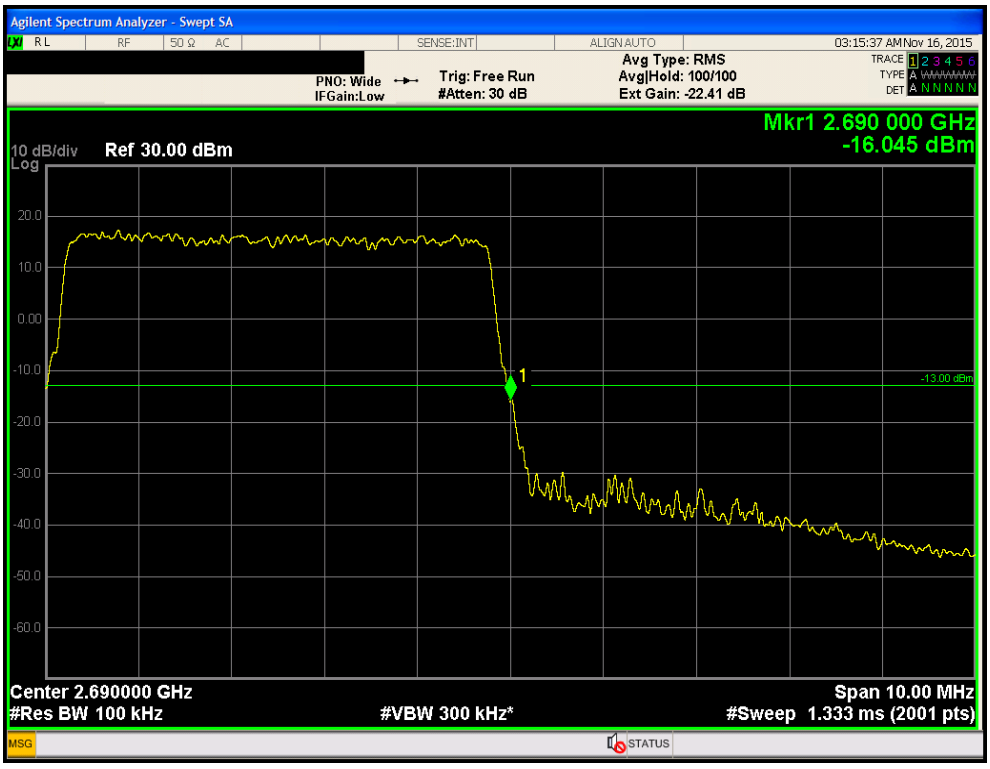
Bandwidth	Modulation	Frequency [MHz]	Band Edge	Emission Level [dBm]	Emission Limit [dBm]	Result
5 MHz	QPSK	2498.5	Lower	-15.43	-13.0	Pass
		2687.5	Upper	-16.04		
	16QAM	2498.5	Lower	-15.68		
		2687.5	Upper	-16.78		
	64QAM	2498.5	Lower	-16.13		
		2687.5	Upper	-14.57		
10 MHz	QPSK	2501.0	Lower	-20.03		
		2685.0	Upper	-18.20		
	16QAM	2501.0	Lower	-20.86		
		2685.0	Upper	-19.54		
	64QAM	2501.0	Lower	-20.55		
		2685.0	Upper	-22.63		
15 MHz	QPSK	2503.5	Lower	-25.18		
		2682.5	Upper	-25.07		
	16QAM	2503.5	Lower	-24.01		
		2682.5	Upper	-22.28		
	64QAM	2503.5	Lower	-26.18		
		2682.5	Upper	-22.81		
20 MHz	QPSK	2506.0	Lower	-25.33		
		2680.0	Upper	-24.65		
	16QAM	2506.0	Lower	-29.15		
		2680.0	Upper	-24.66		
	64QAM	2506.0	Lower	-27.86		
		2680.0	Upper	-27.46		

3.2.7 Test Plots

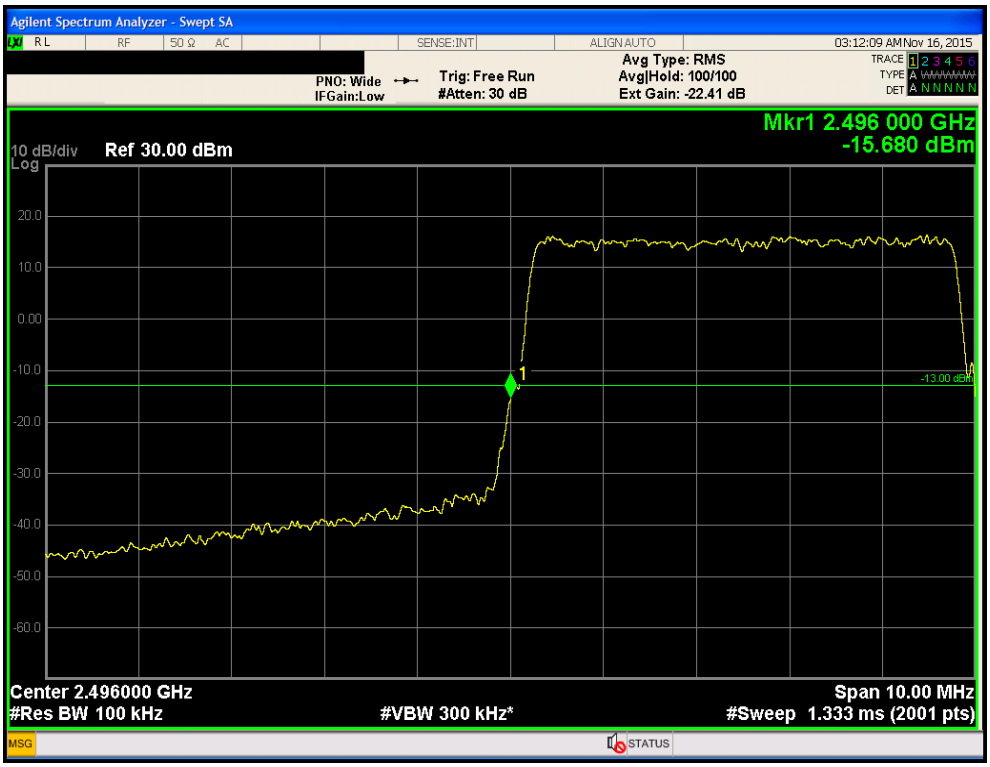
•Port1/ LTE 5M / 2498.5 MHz / QPSK



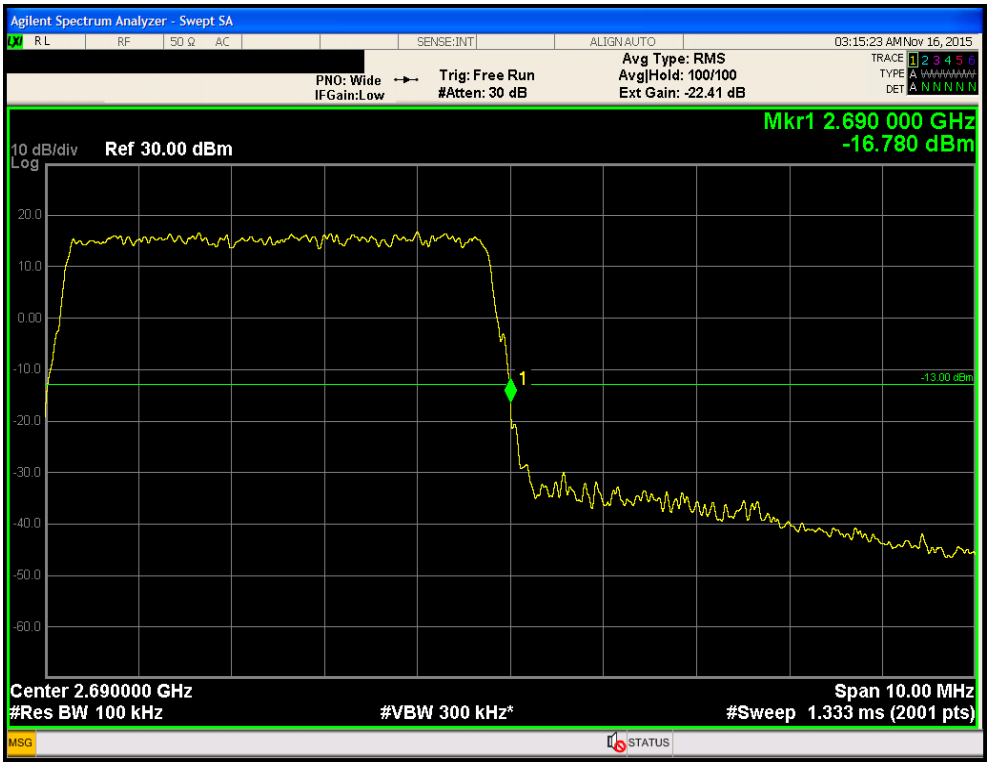
•Port1/ LTE 5M / 2687.5 MHz / QPSK



•Port1/ LTE 5M / 2498.5 MHz / 16QAM

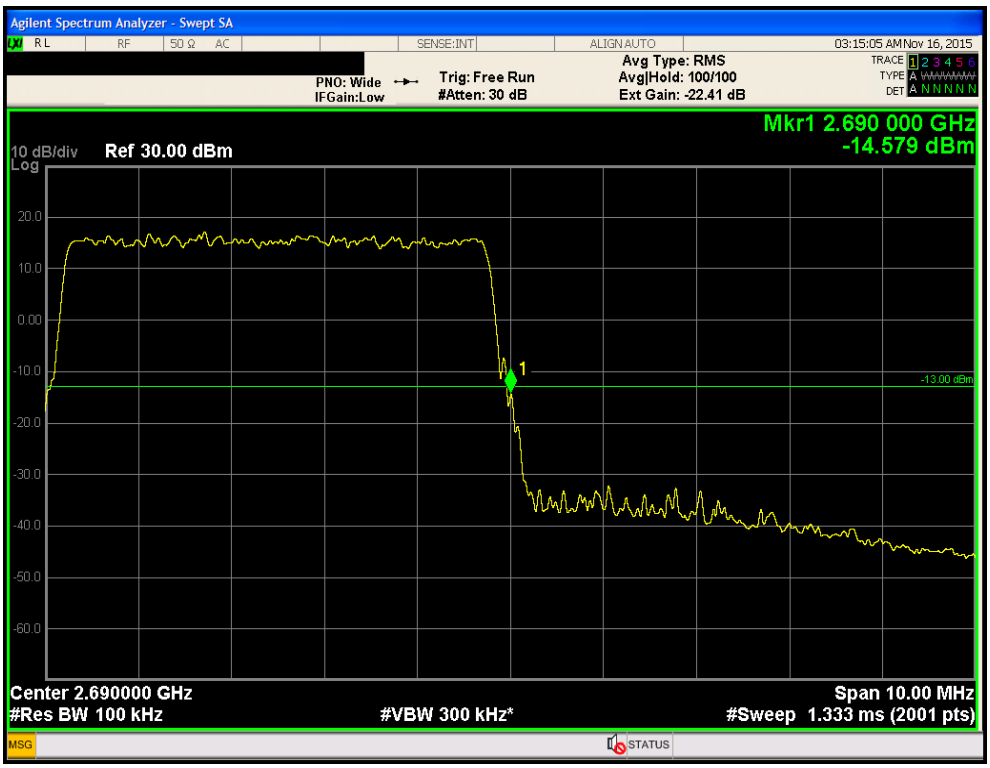


•Port1/ LTE 5M / 2687.5 MHz / 16QAM

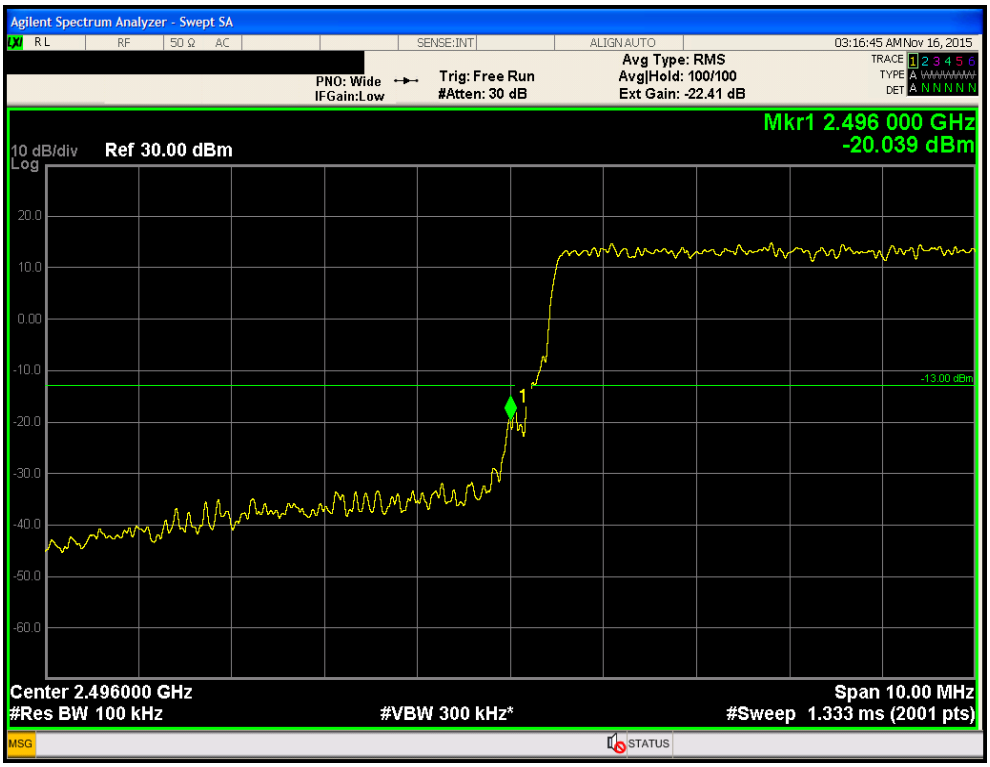


•Port1/ LTE 5M / 2498.5 MHz / 64QAM

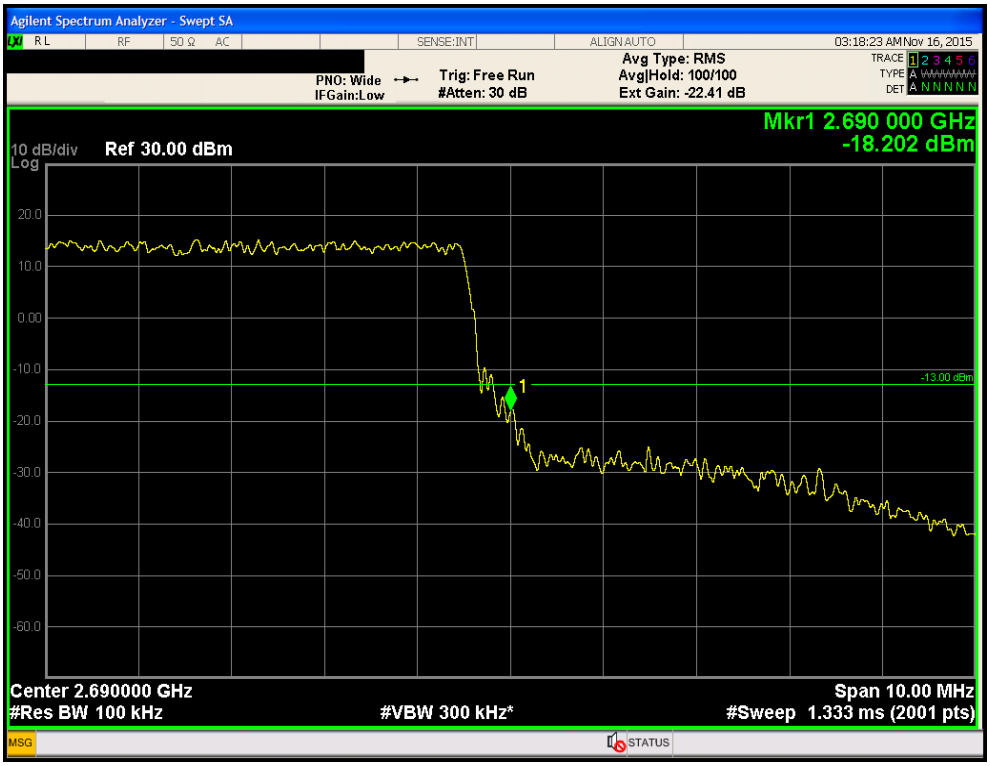
•Port1/ LTE 5M / 2687.5 MHz / 64QAM



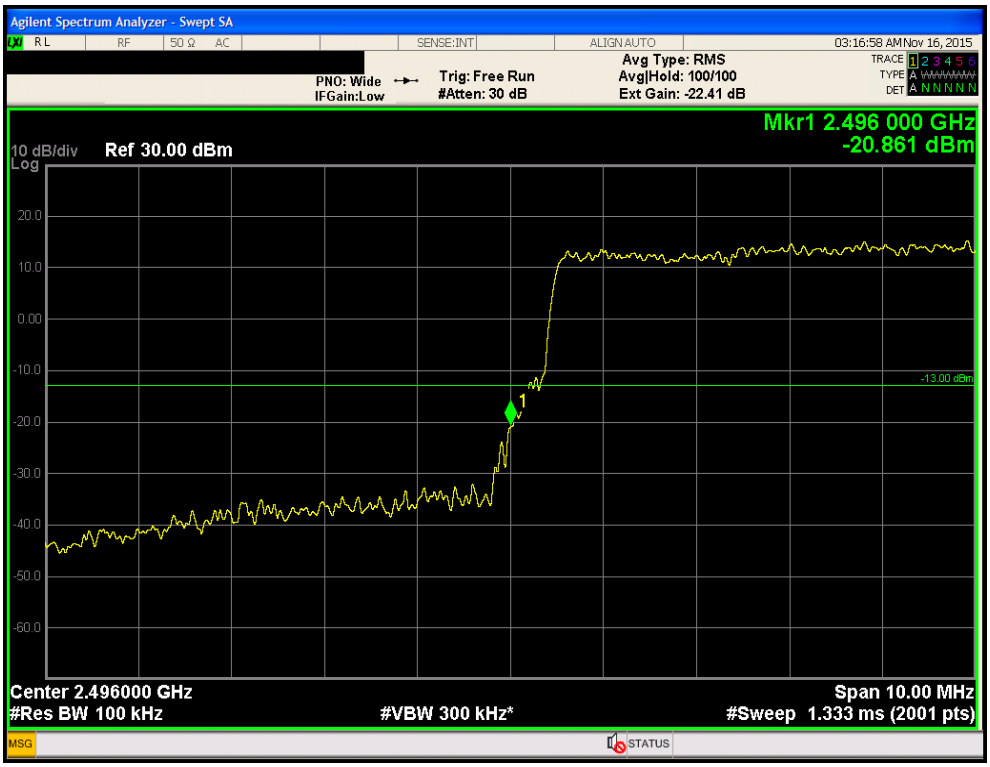
•Port1/ LTE 10M / 2501.0 MHz / QPSK



•Port1/ LTE 10M / 2685.0 MHz / QPSK



•Port1/ LTE 10M / 2501.0 MHz / 16QAM

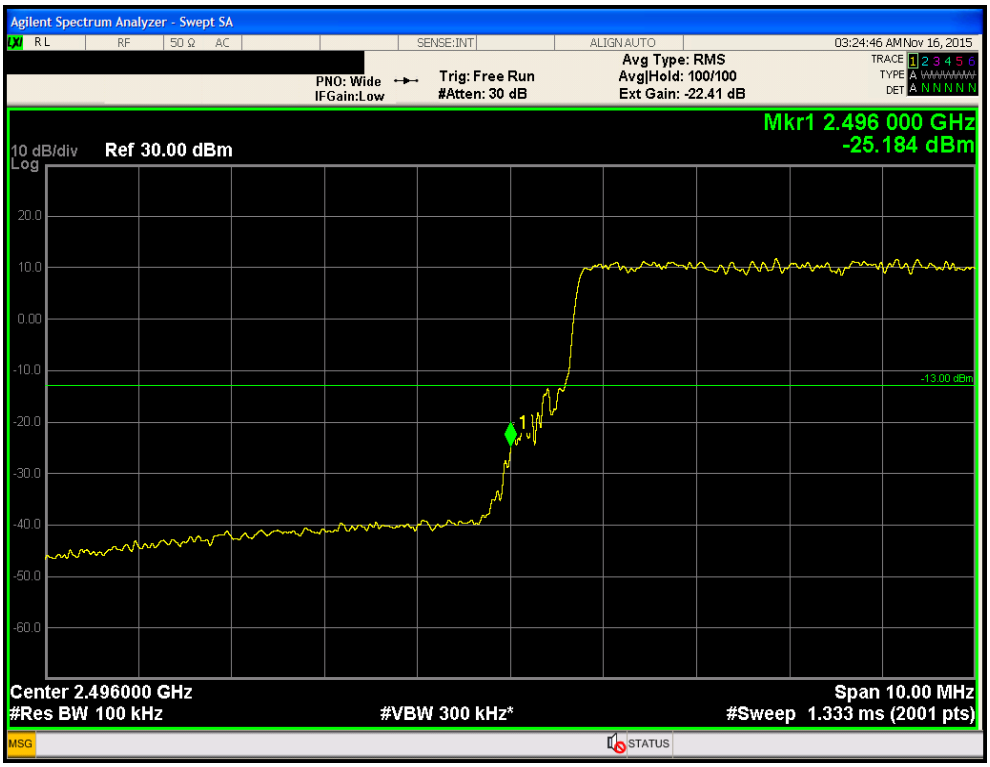


•Port1/ LTE 10M / 2685.0 MHz / 16QAM

•Port1/ LTE 10M / 2501.0 MHz / 64QAM

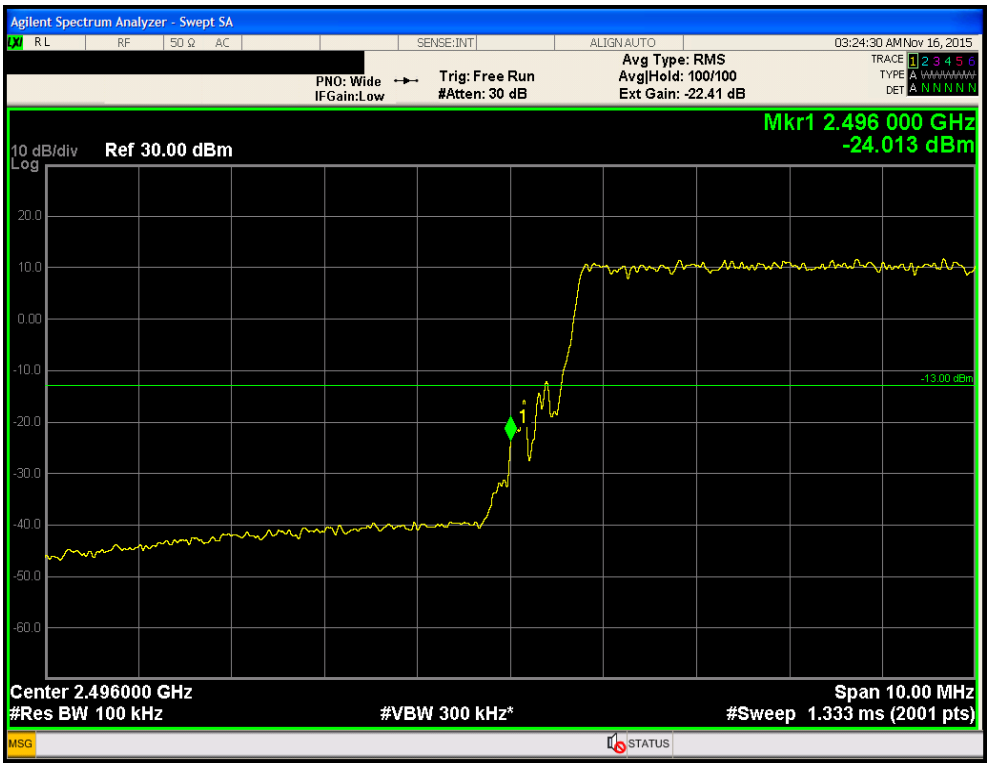
•Port1/ LTE 10M / 2685.0 MHz / 64QAM

•Port1/ LTE 15M / 2503.5 MHz / QPSK



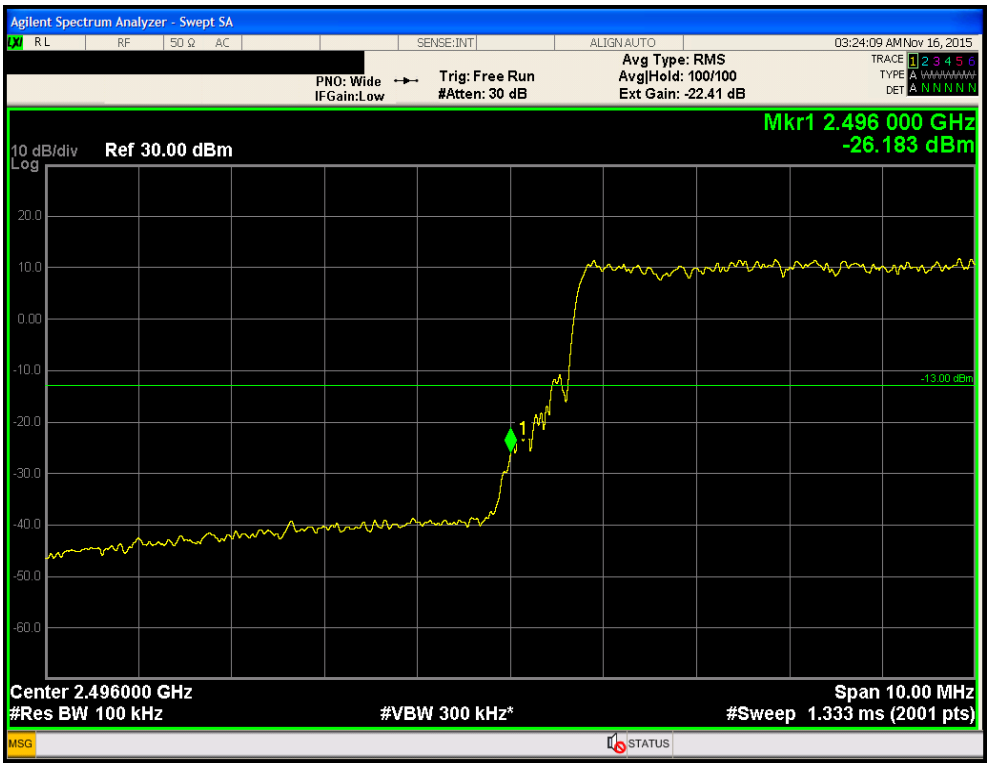
•Port1/ LTE 15M / 2682.5 MHz / QPSK

•Port1/ LTE 15M / 2503.5 MHz / 16QAM



•Port1/ LTE 15M / 2682.5 MHz / 16QAM

•Port1/ LTE 15M / 2503.5 MHz / 64QAM



•Port1/ LTE 15M / 2682.5 MHz / 64QAM

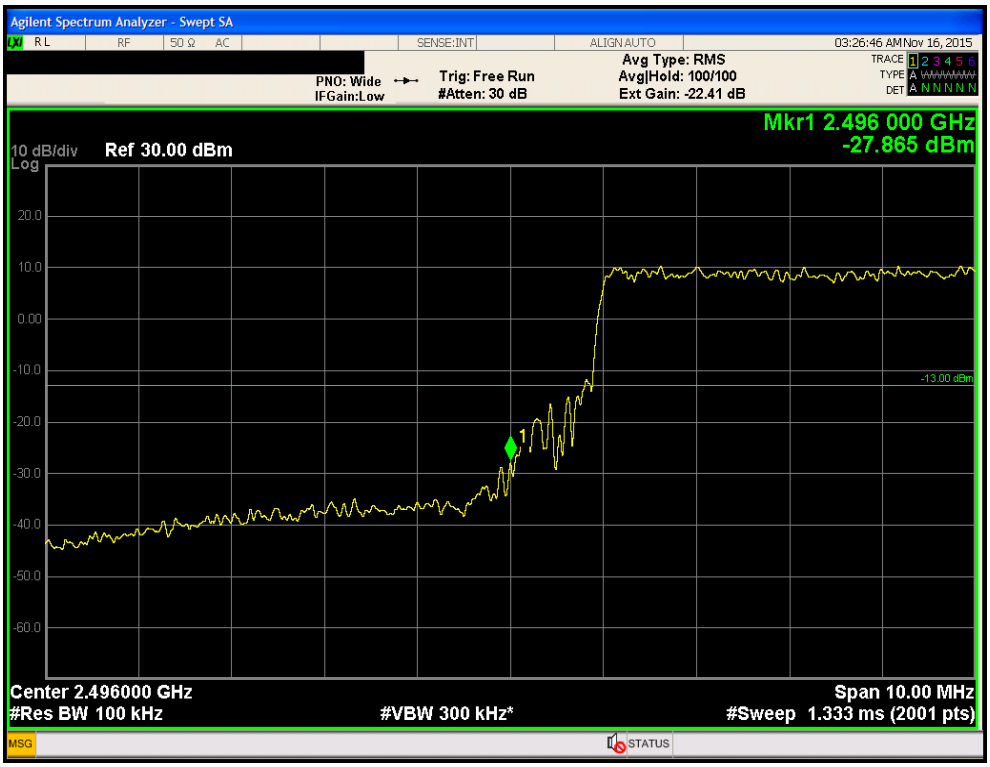
•Port1/ LTE 20M / 2506.0 MHz / QPSK

•Port1/ LTE 20M / 2680.0 MHz / QPSK

•Port1/ LTE 20M / 2506.0 MHz / 16QAM

•Port1/ LTE 20M / 2680.0 MHz / 16QAM

•Port1/ LTE 20M / 2506.0 MHz / 64QAM



•Port1/ LTE 20M / 2680.0 MHz / 64QAM

3.3 Conducted spurious emission

3.3.1 Specification

- FCC Rules Part 2.1051
- FCC Rules Part 27.53 (m)

3.3.2 Test Description

The antenna port spurious emissions were measured at the RF output terminal of the EUT with external attenuation on the RF input of the spectrum analyzer. Analyzer plots utilizing a 1MHz resolution bandwidth and no video filtering were made for each modulation type from 30 MHz to 26.5 GHz

The peak conducted power of spurious emissions, up to the 10^{th} harmonic of the transmit frequency, were investigated to ensure they were less than or equal to the limit. Emissions close to the limit were measured using an RMS detector.

The antenna port spurious emissions were measured on port 1 under the three types of modulation mode which are QPSK, 16QAM and 64QAM, and resource block was 25~100.

UL/DL Allocation : Configuration 3
Dw/GP/UP length : Configuration 8

3.3.3 Test Procedure

The method used is as detailed in FCC KDB 935210 D05 v01.

The power of any emission outside of the authorized operating frequency ranges (2496 ~ 2690 MHz) must be attenuated below the transmitting power (P) by a factor of at least as specified in this section.

The EUT antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable.

The evaluation was repeated for all modulations.

The evaluation was done in frequency band from 30MHz ~ 26.5GHz without band edges test.

3.3.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-2500-SISO	Corning Optical Communications Wireless, Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
Attenuator	PE7019-20	Pasternack
DC Power Supply	6674A	Agilent

3.3.5 Test condition

- Test place: Shield Room
- Test environment: 22.5 °C, 42.5 % R.H.

3.3.6 Test results

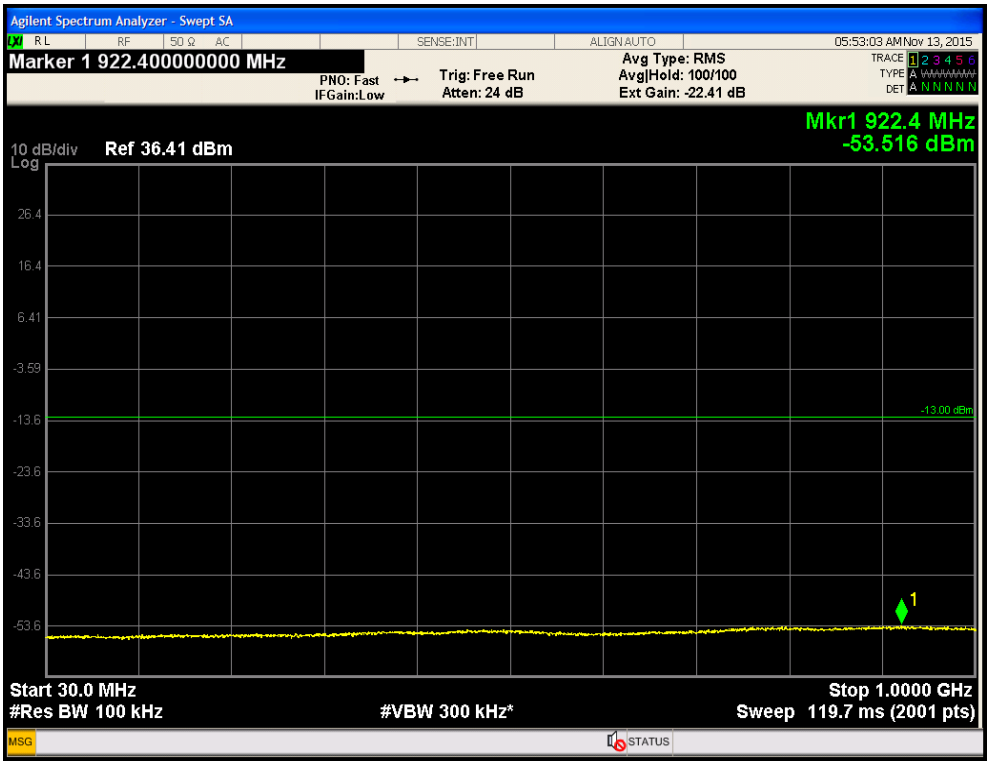
- **Port1 Spurious emissions (30 MHz ~ 26.5 GHz)**

Bandwidth	Modulation	Operation frequency [MHz]	Frequency range of spurious emission [MHz]	Level of spurious emission [dBm]	Limit [dBm]	Result
LTE 5 MHz	QPSK	2498.5	30 to 1 000	-53.51	-13.0	Pass
		2593.0		-53.62		
		2687.5		-53.52		
		2498.5	1 000 to 26 500	Not peak found		
		2593.0		Not peak found		
		2687.5		Not peak found		
	16QAM	2498.5	30 to 1 000	-53.16		
		2593.0		-53.60		
		2687.5		-53.56		
		2498.5	1 000 to 26 500	Not peak found		
		2593.0		Not peak found		
		2687.5		Not peak found		
	64QAM	2498.5	30 to 1 000	-53.66		
		2593.0		-53.50		
		2687.5		-53.37		
		2498.5	1 000 to 26 500	Not peak found		
		2593.0		Not peak found		
		2687.5		Not peak found		
LTE 20 MHz	QPSK	2506.0	30 to 1 000	-53.59		
		2593.0		-53.68		
		2680.0		-53.66		
		2506.0	1 000 to 26 500	Not peak found		
		2593.0		Not peak found		
		2680.0		Not peak found		
	16QAM	2506.0	30 to 1 000	-53.52		
		2593.0		-53.52		
		2680.0		-53.61		
		2506.0	1 000 to 26 500	Not peak found		
		2593.0		Not peak found		
		2680.0		Not peak found		
	64QAM	2506.0	30 to 1 000	-53.55		
		2593.0		-54.29		
		2680.0		-53.59		
		2506.0	1 000 to 26 500	Not peak found		
		2593.0		Not peak found		
		2680.0		Not peak found		

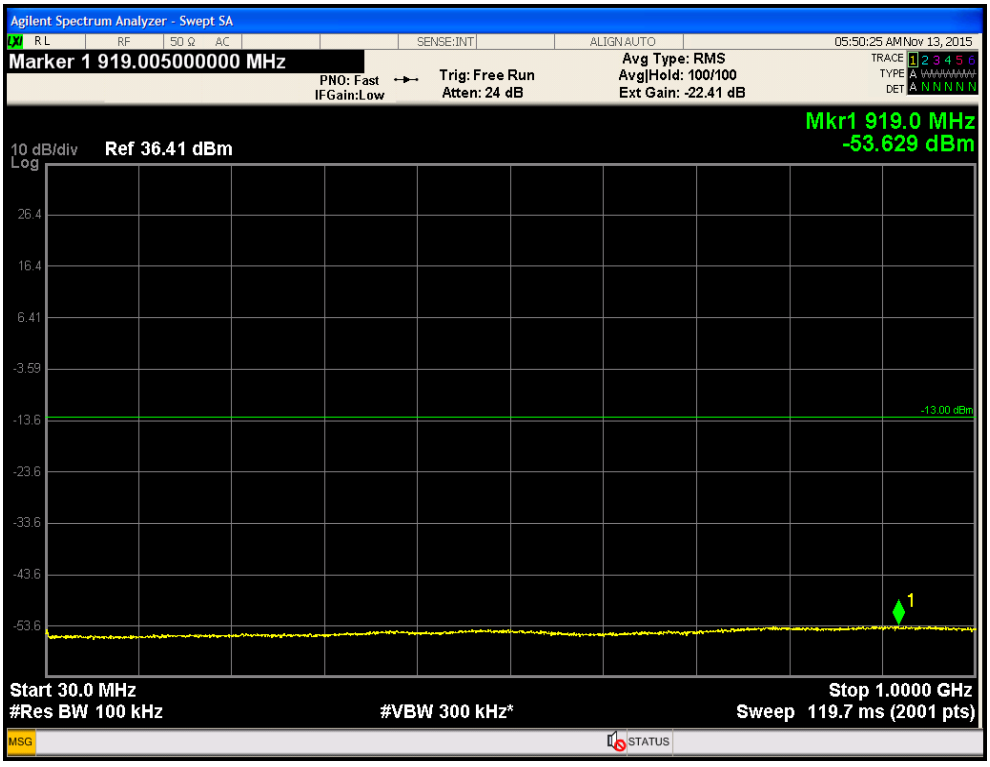
3.3.8 Plots of spurious emissions

3.3.8.1 30MHz ~ 1GHz Spurious emissions

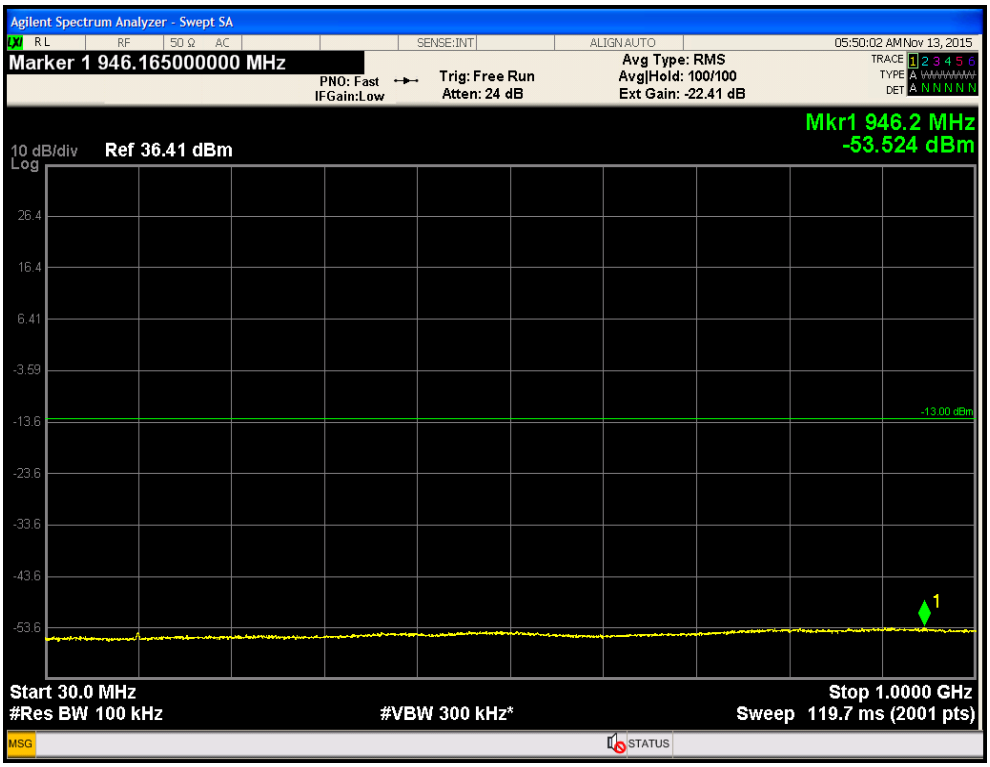
•Port1/ LTE 5M / 2498.5 MHz / QPSK



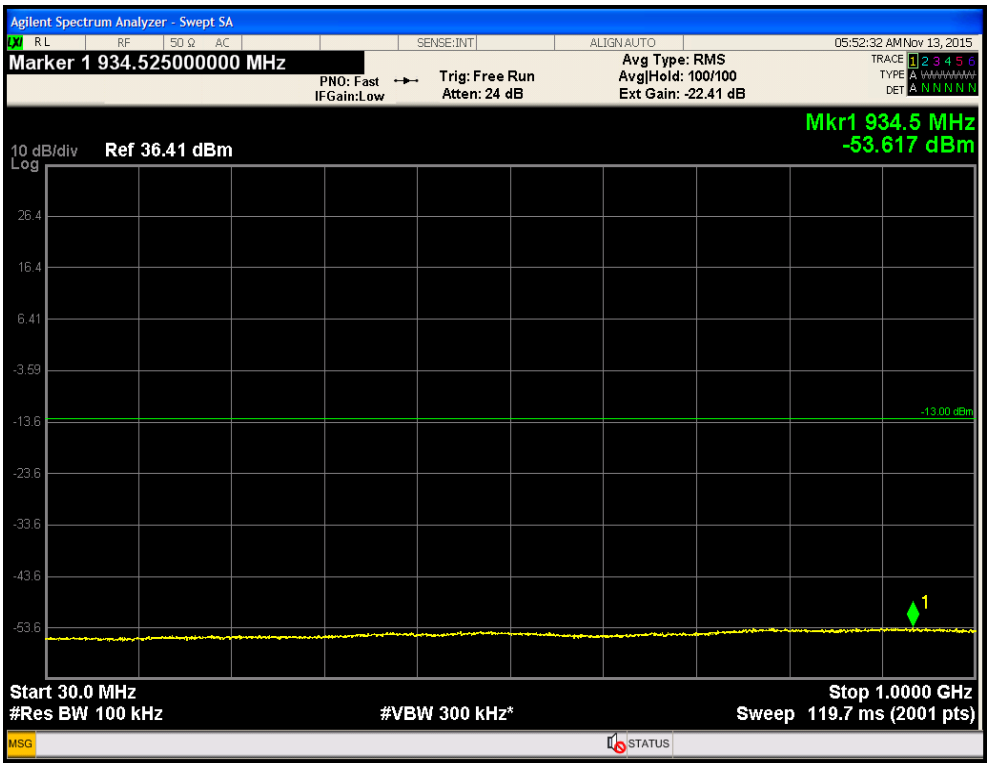
•Port1/ LTE 5M / 2593.0 MHz / QPSK



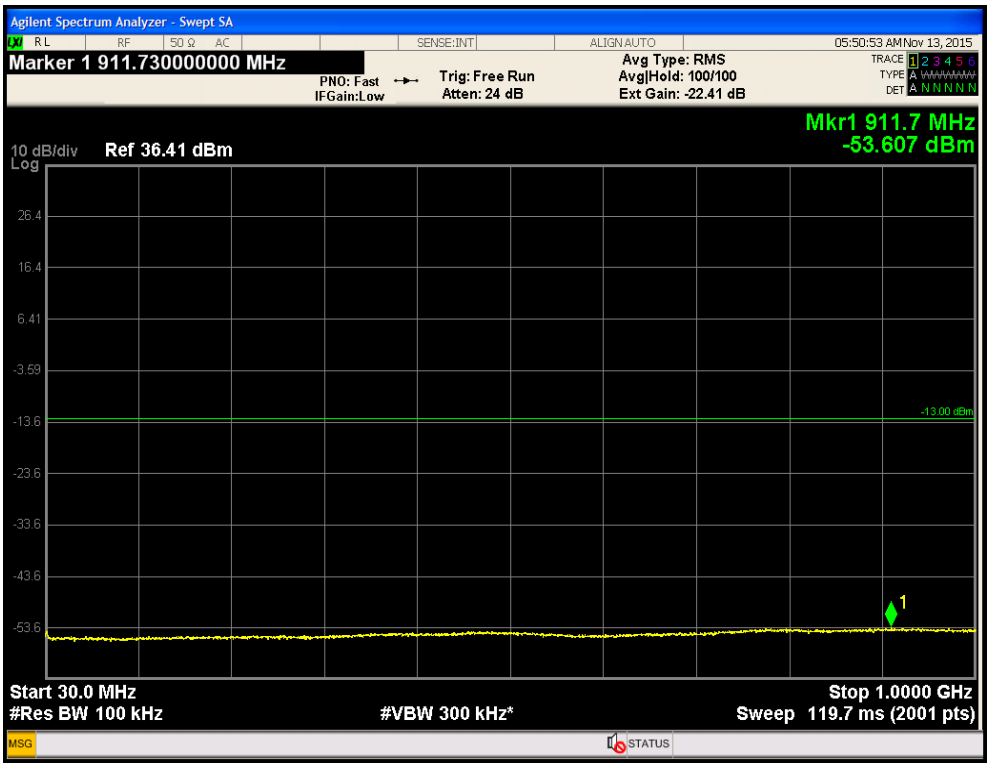
•Port1/ LTE 5M / 2687.5 MHz / QPSK



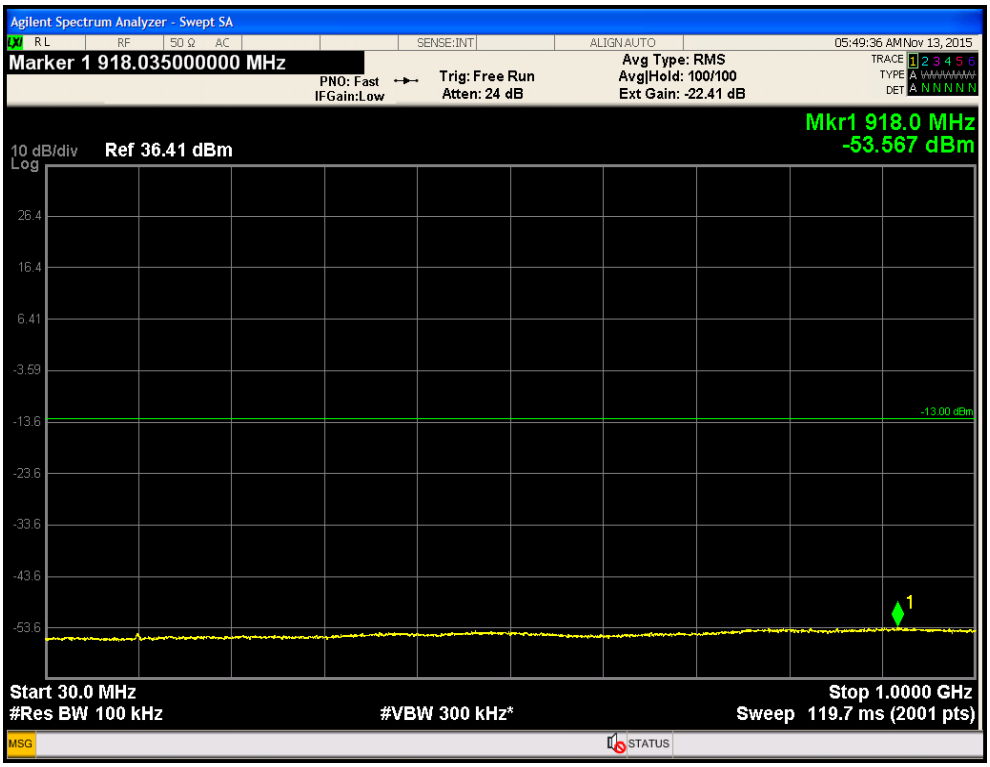
•Port1/ LTE 5M / 2498.5 MHz / 16QAM



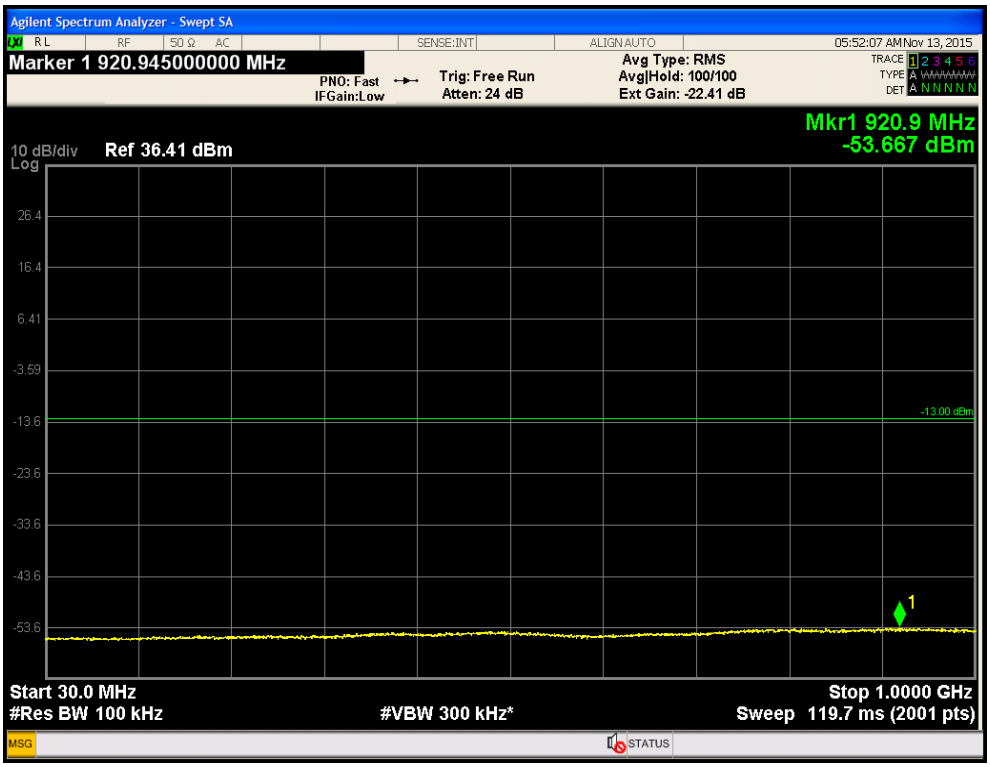
•Port1/ LTE 5M / 2593.0 MHz / 16QAM



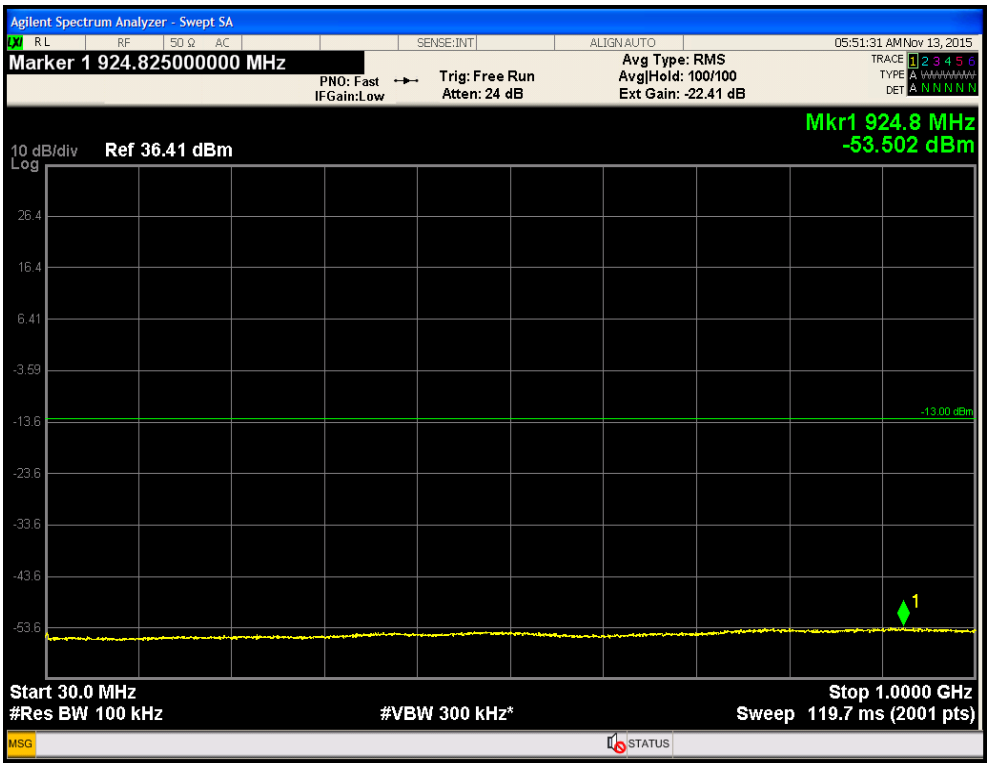
•Port1/ LTE 5M / 2687.5 MHz / 16QAM



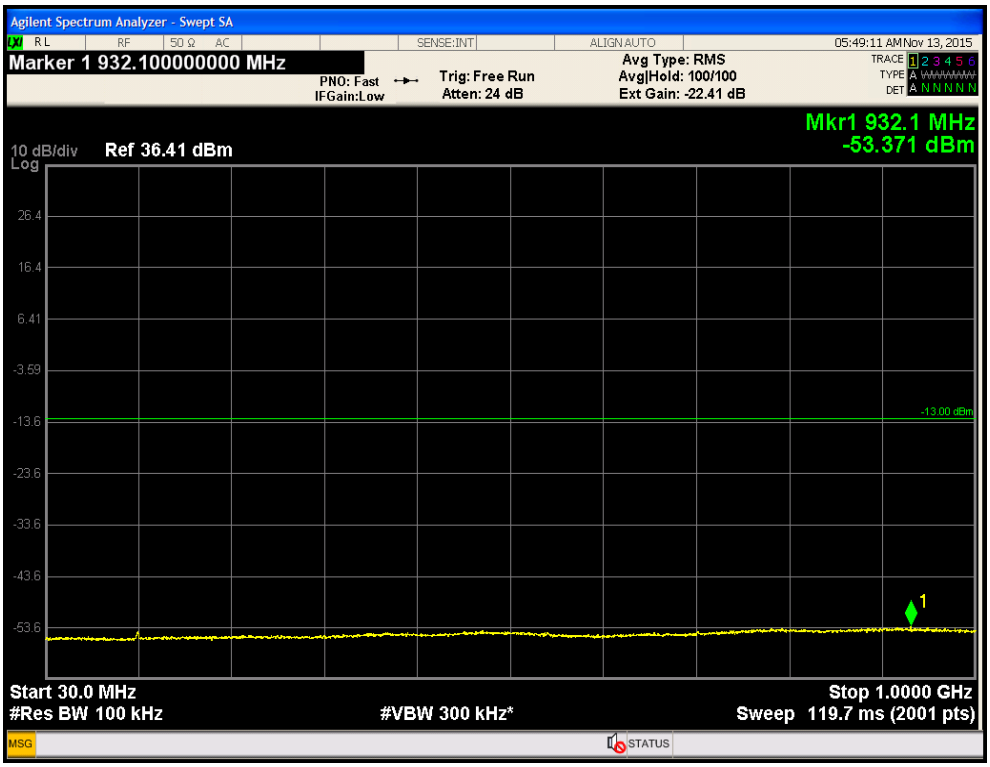
•Port1/ LTE 5M / 2498.5 MHz / 64QAM



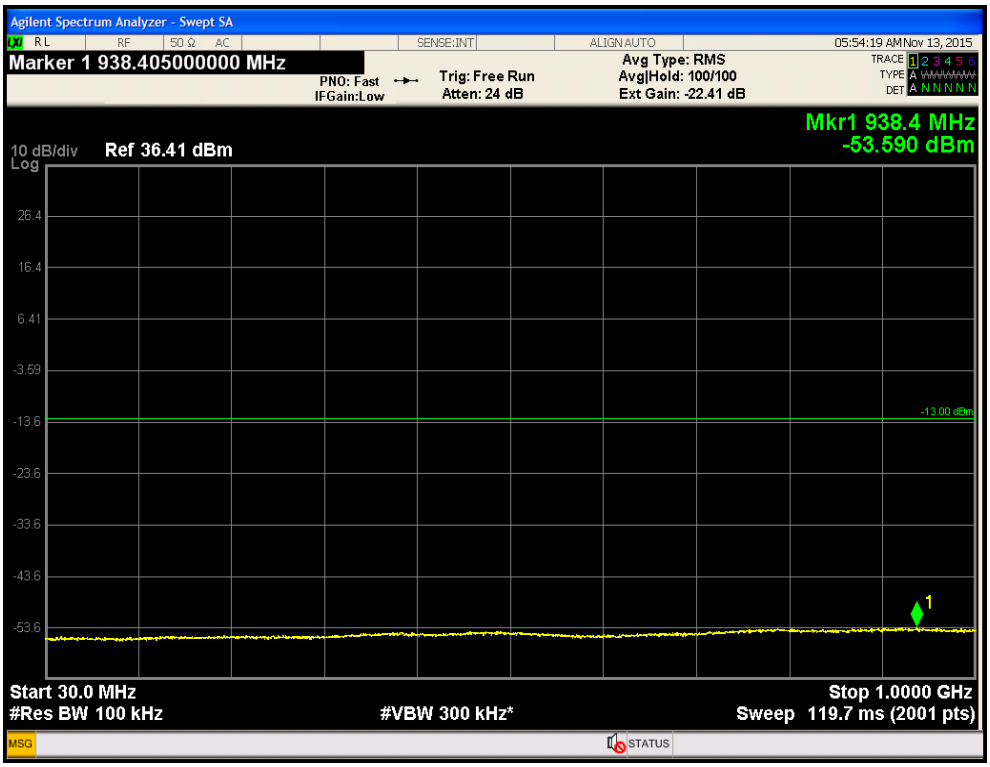
•Port1/ LTE 5M / 2593.0 MHz / 64QAM



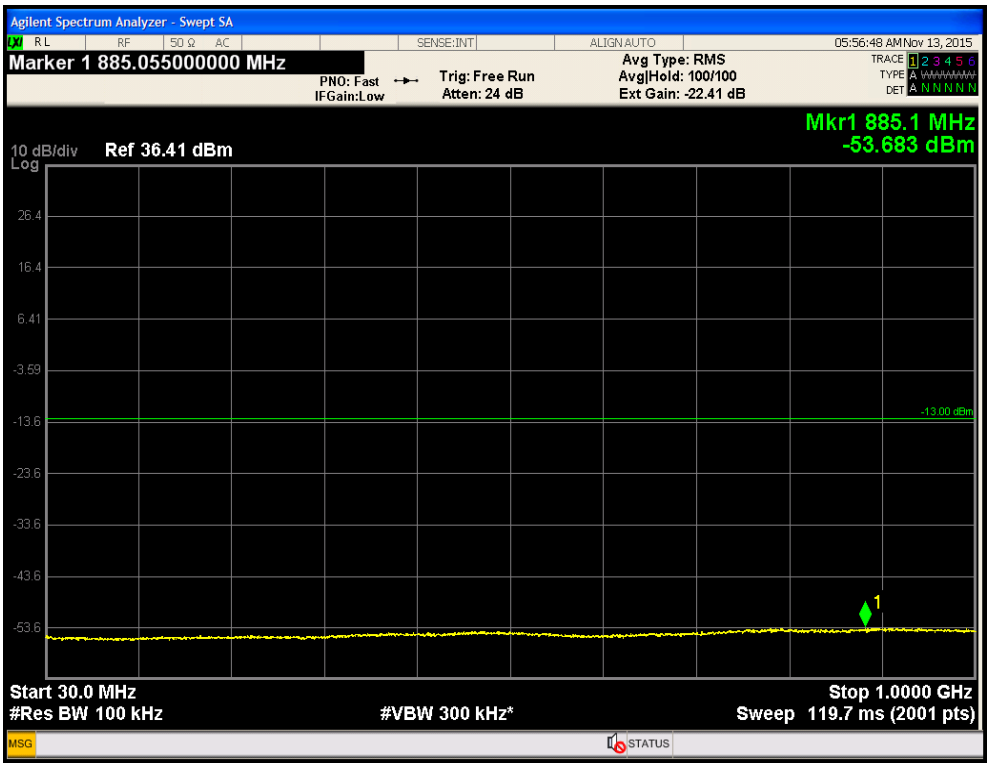
•Port1/ LTE 5M / 2687.5 MHz / 64QAM



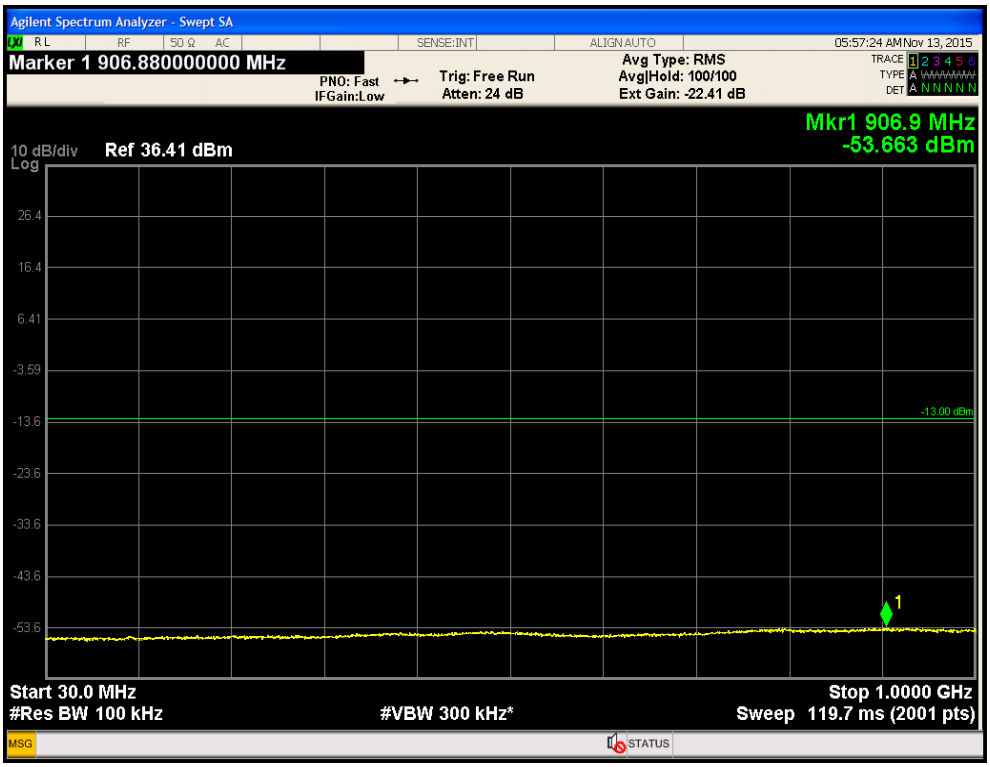
•Port1/ LTE 20M / 2506.0 MHz / QPSK



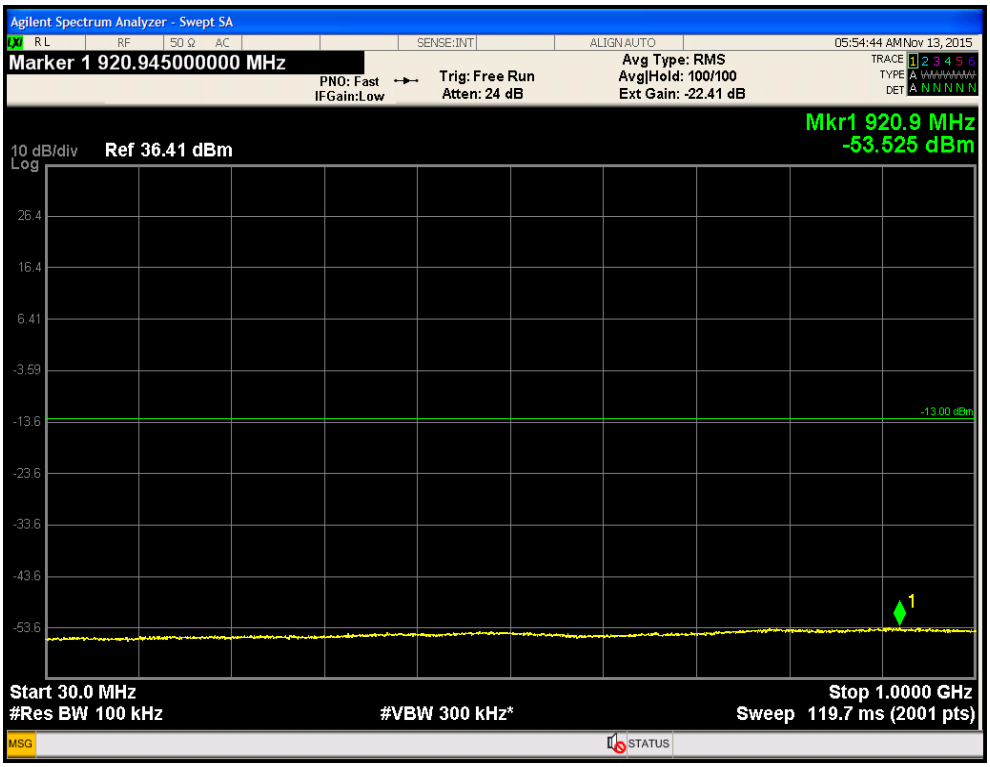
•Port1/ LTE 20M / 2593.0 MHz / QPSK



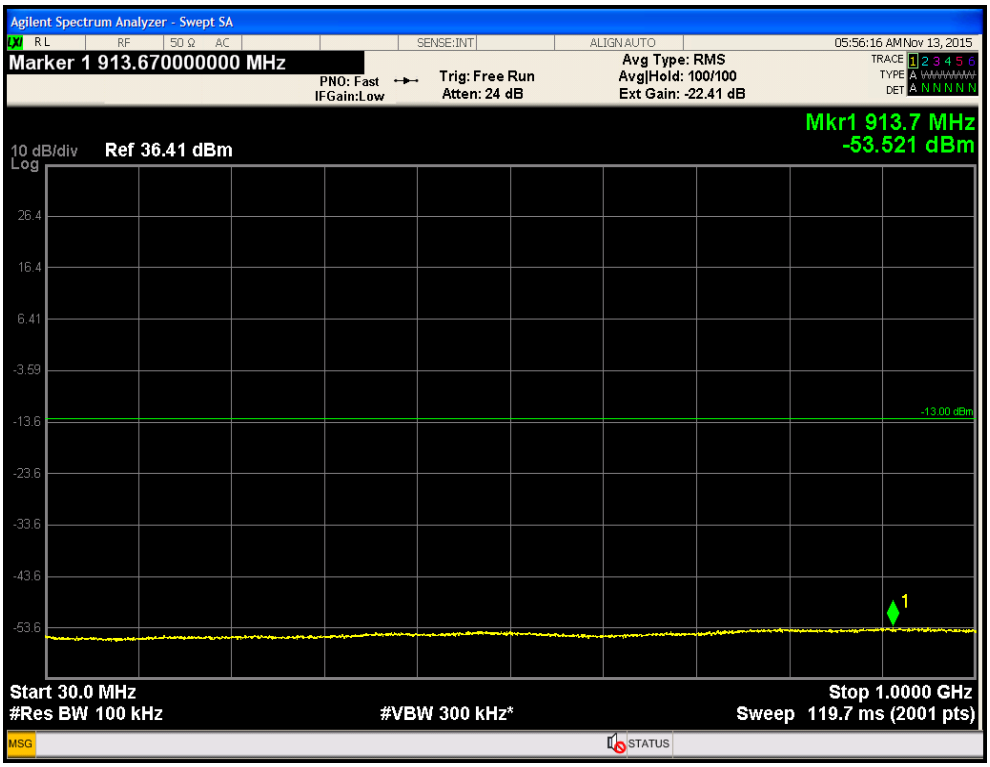
•Port1/ LTE 20M / 2680.0 MHz / QPSK



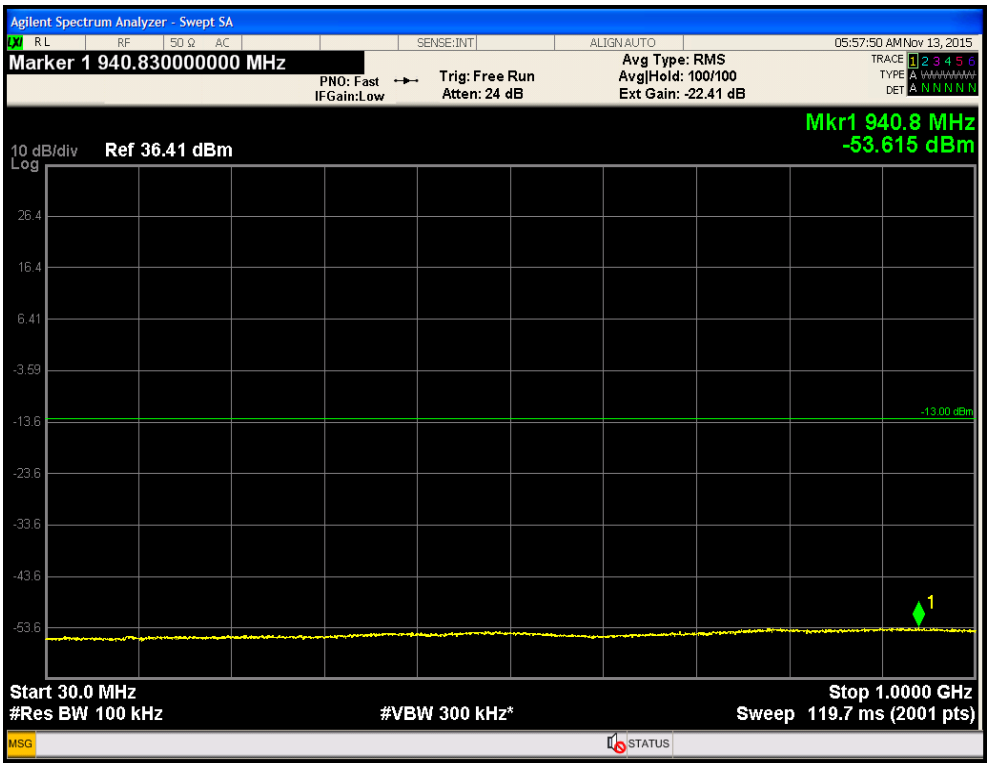
•Port1/ LTE 20M / 2506.0 MHz / 16QAM



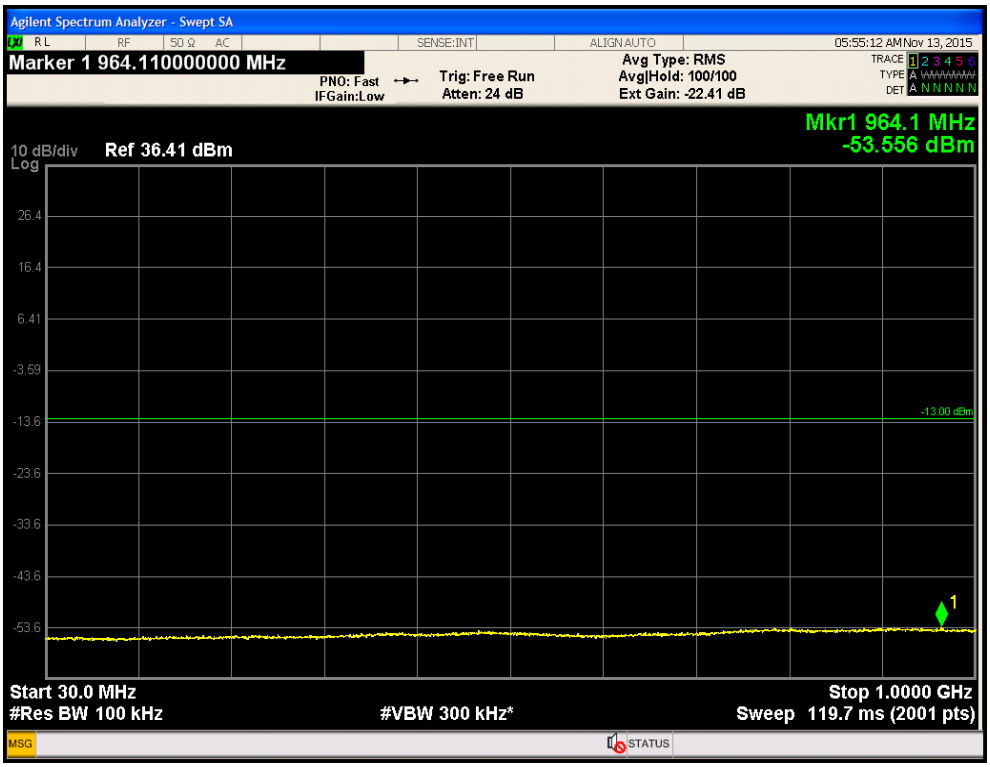
•Port1/ LTE 20M / 2593.0 MHz / 16QAM



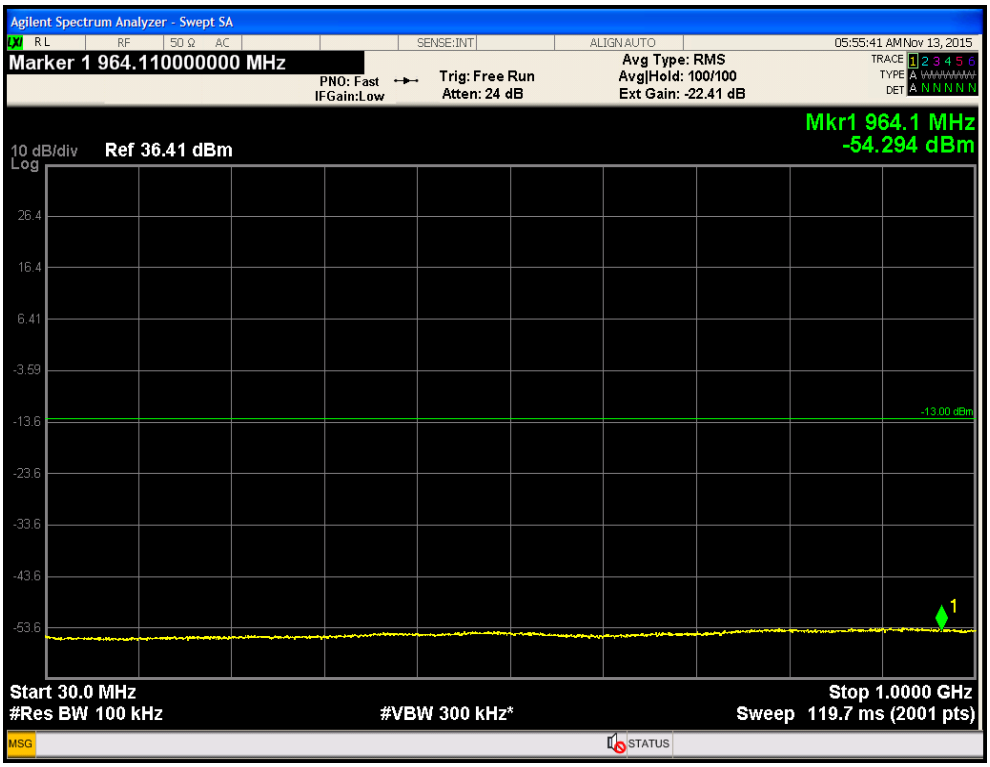
•Port1/ LTE 20M / 2680.0 MHz / 16QAM



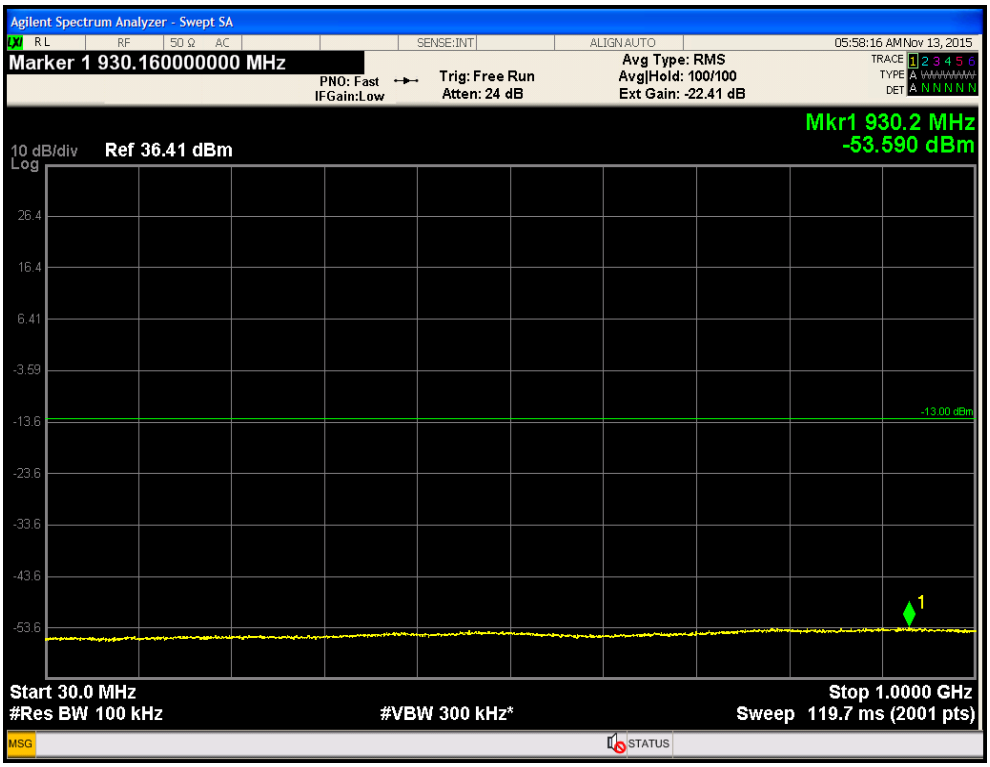
•Port1/ LTE 20M / 2506.0 MHz / 64QAM



•Port1/ LTE 20M / 2593.0 MHz / 64QAM

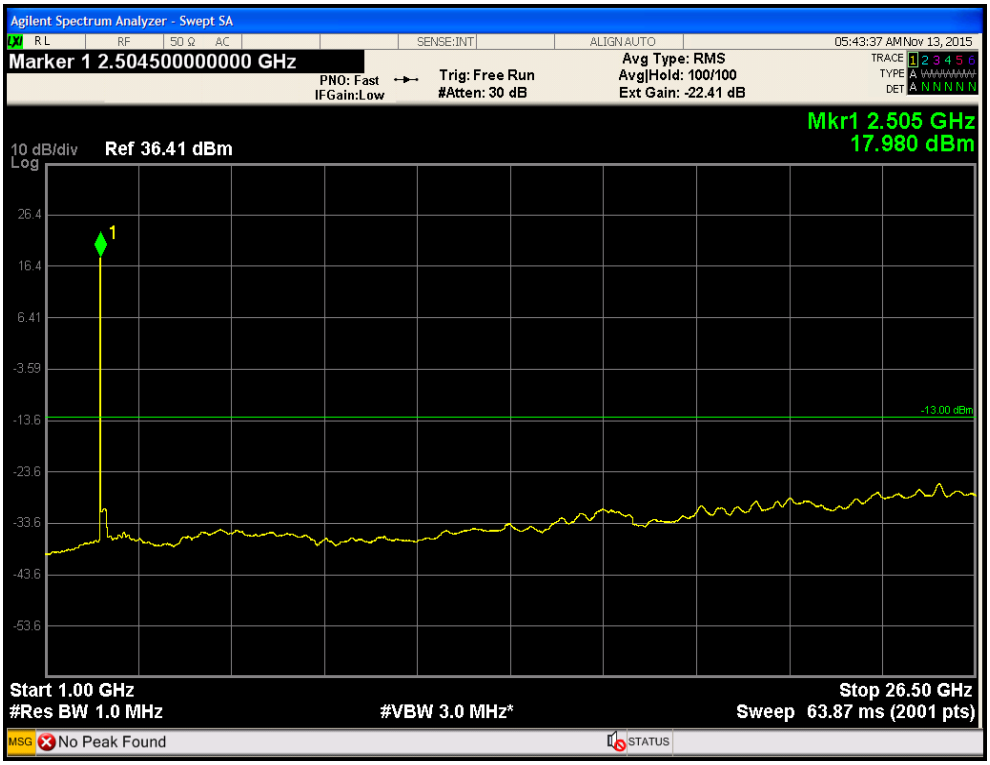


•Port1/ LTE 20M / 2680.0 MHz / 64QAM

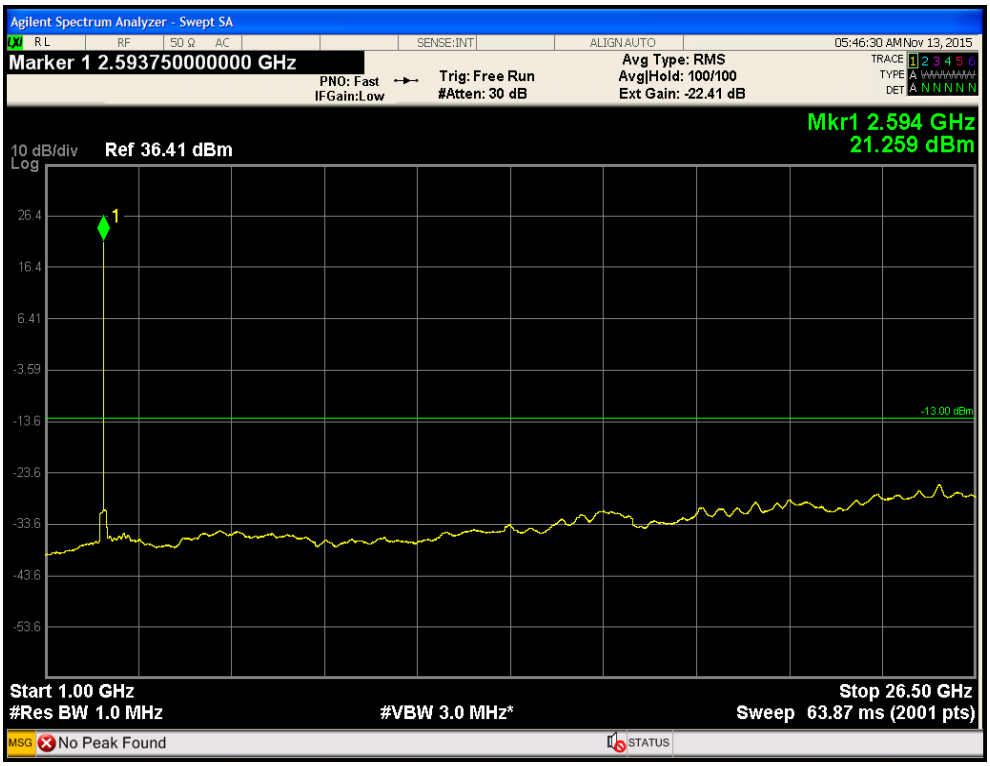


3.3.8.2 1GHz ~ 26.5GHz Spurious emissions

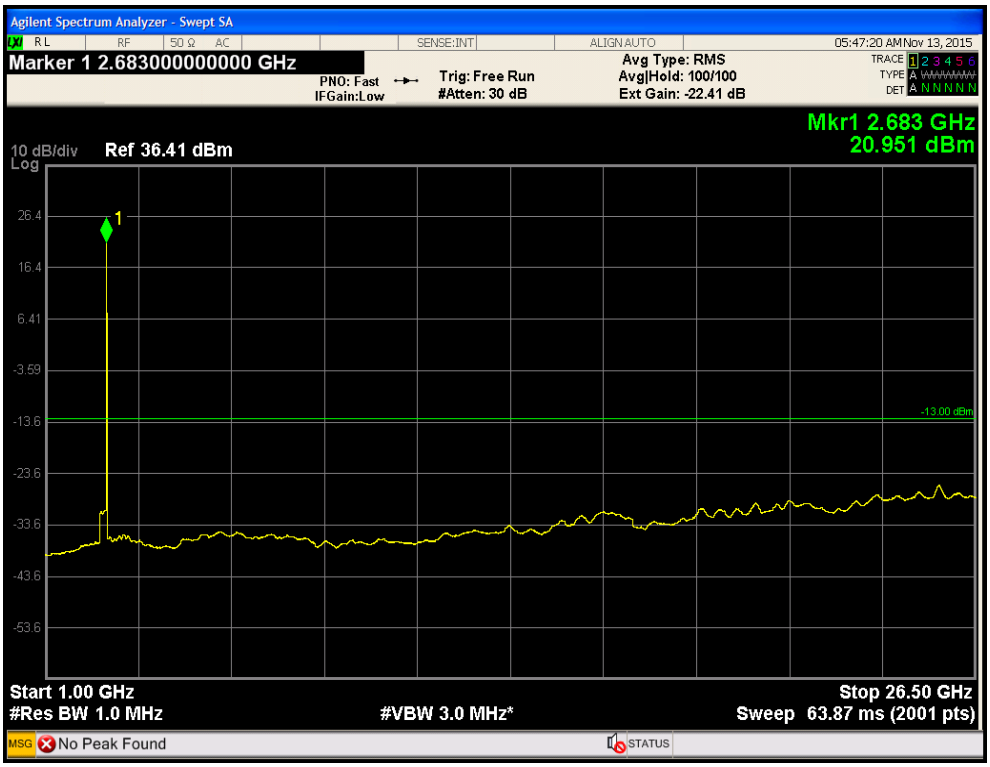
•Port1/ LTE 5M / 2498.5 MHz / QPSK



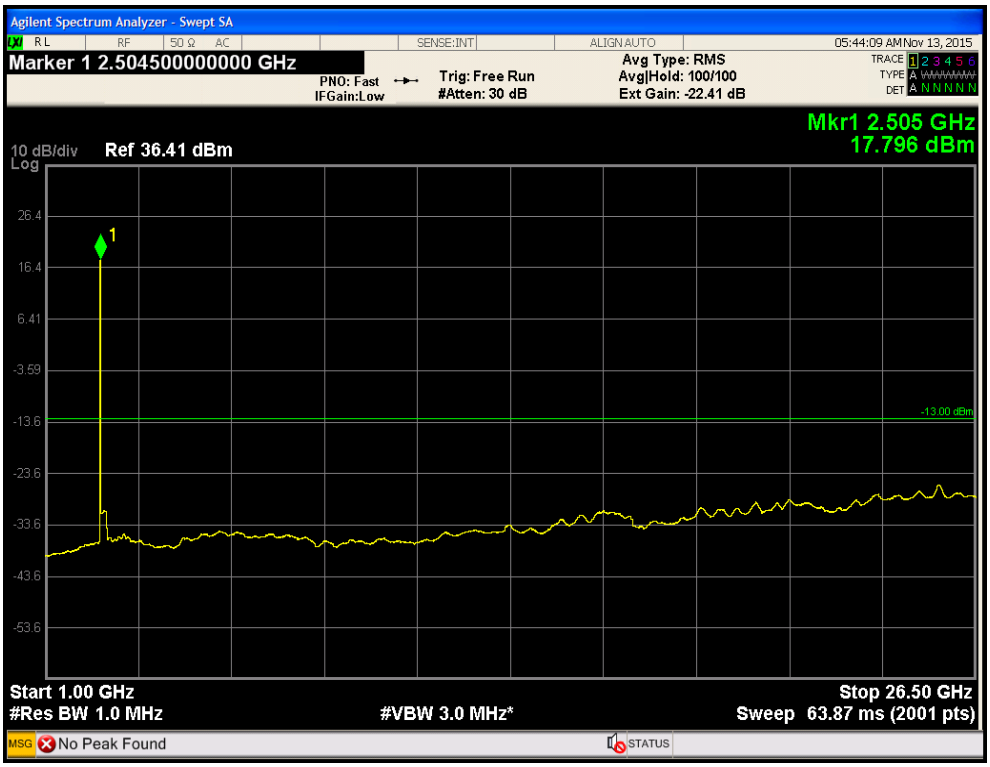
•Port1/ LTE 5M / 2593.0 MHz / QPSK



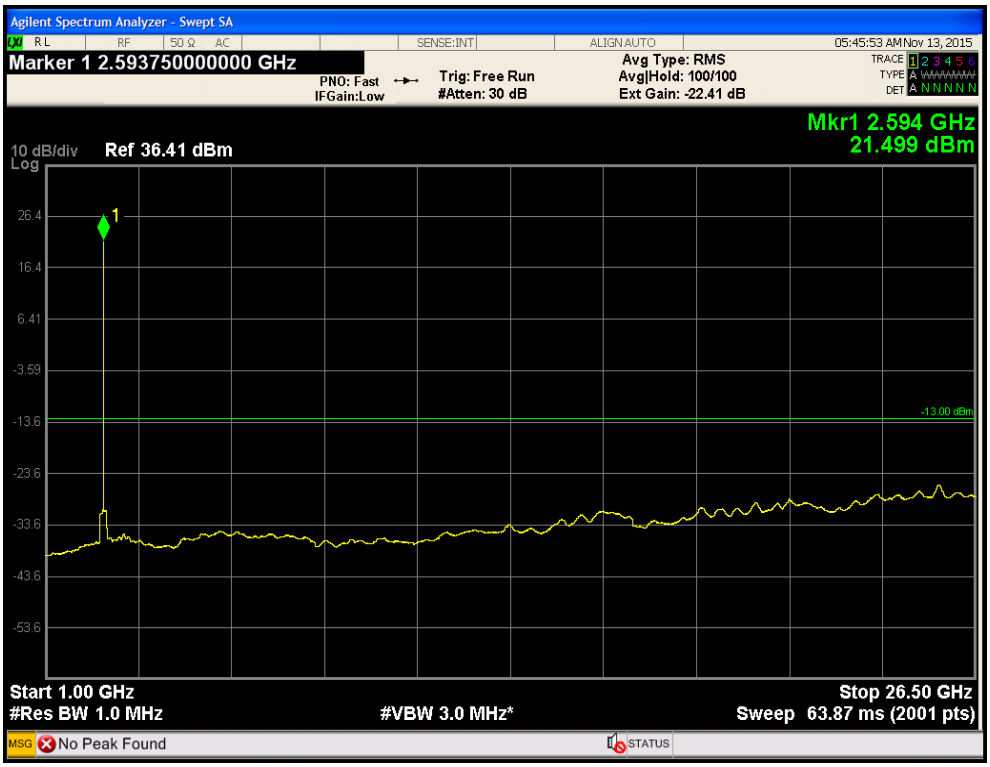
•Port1/ LTE 5M / 2687.5 MHz / QPSK



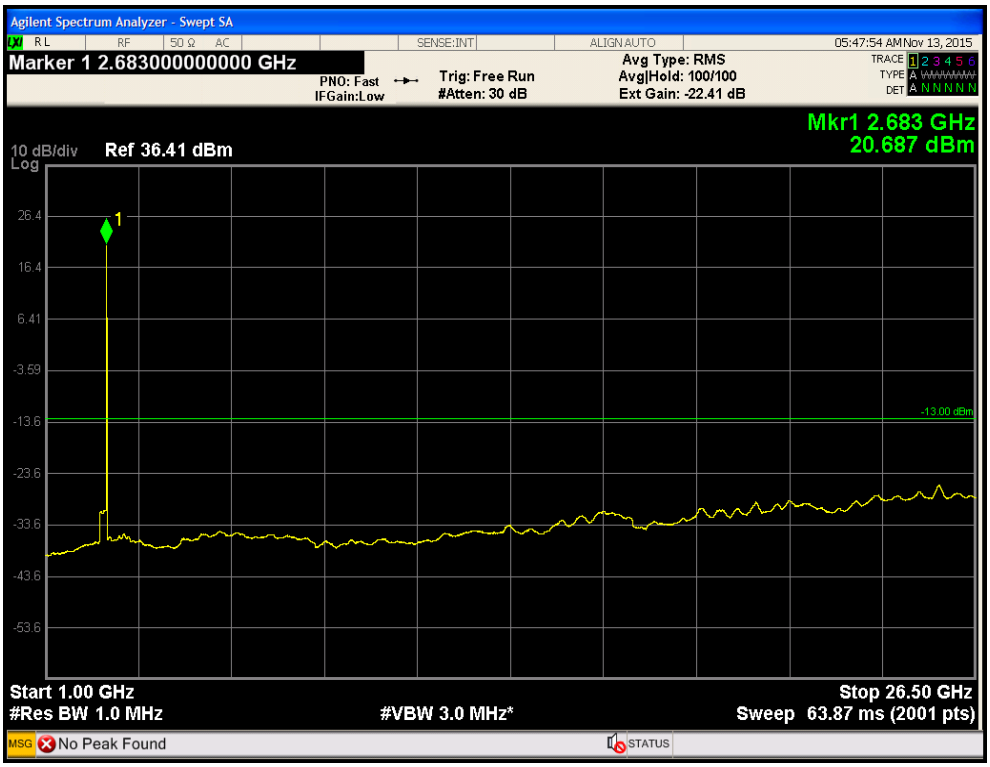
•Port1/ LTE 5M / 2498.5 MHz / 16QAM



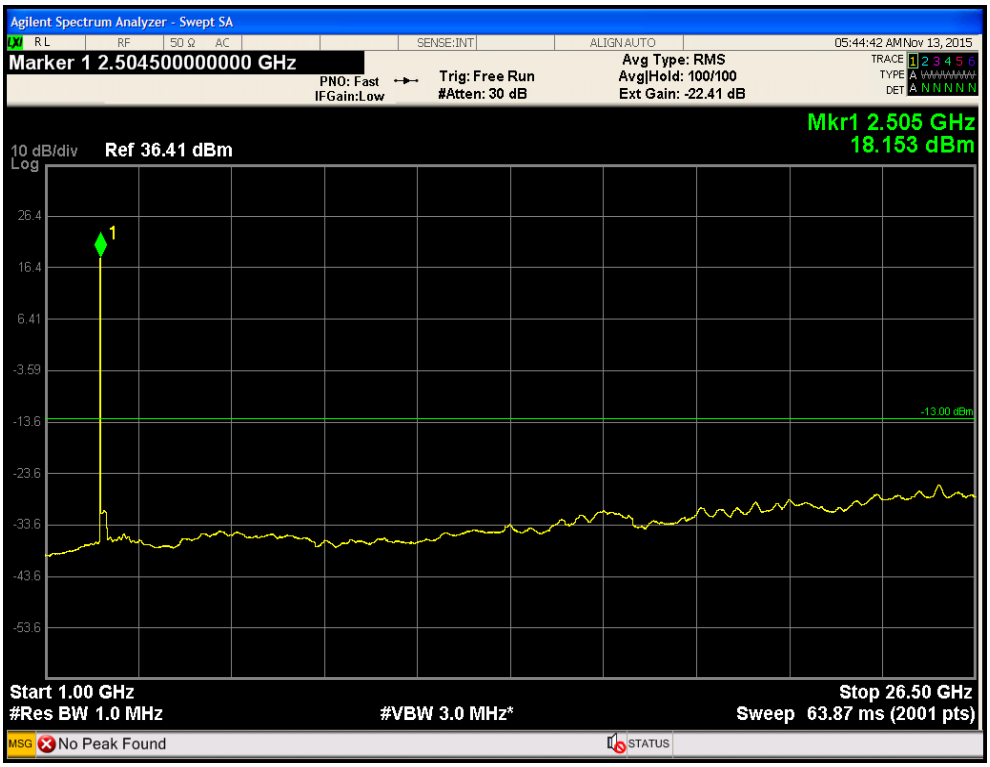
•Port1/ LTE 5M / 2593.0 MHz / 16QAM



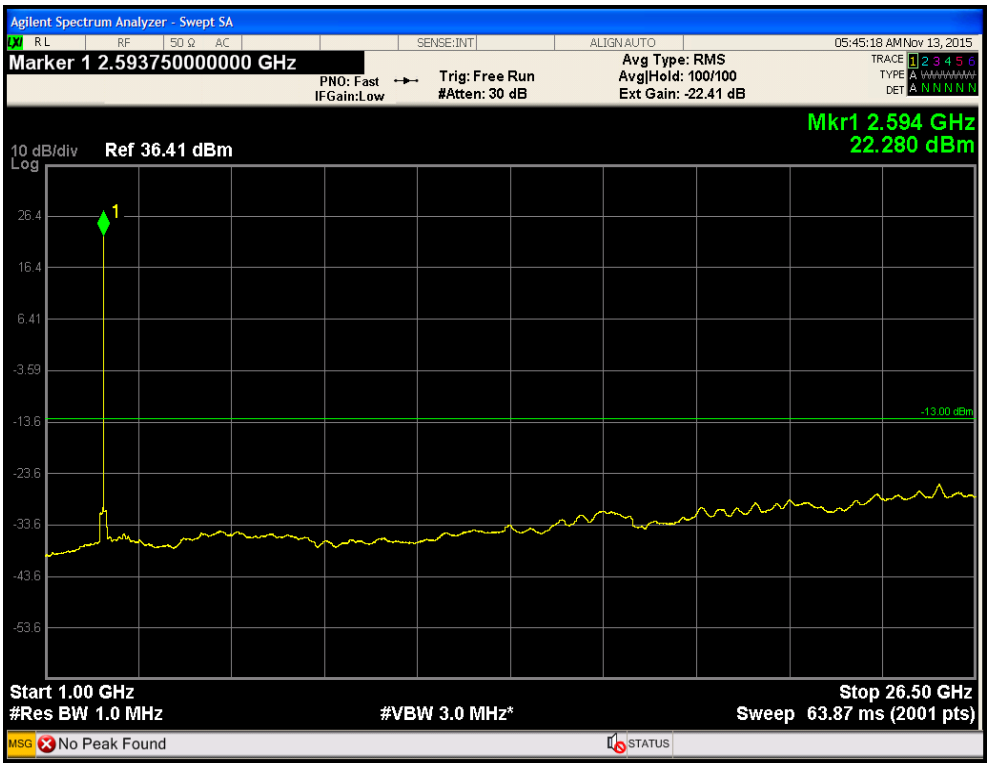
•Port1/ LTE 5M / 2687.5 MHz / 16QAM



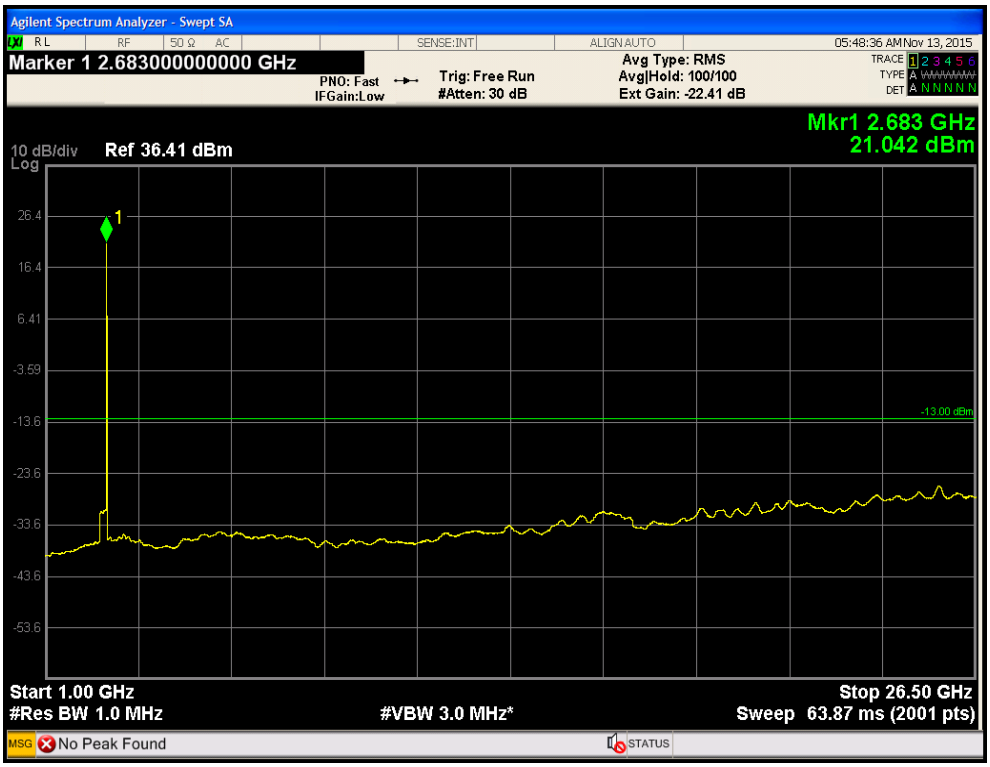
•Port1/ LTE 5M / 2498.5 MHz / 64QAM



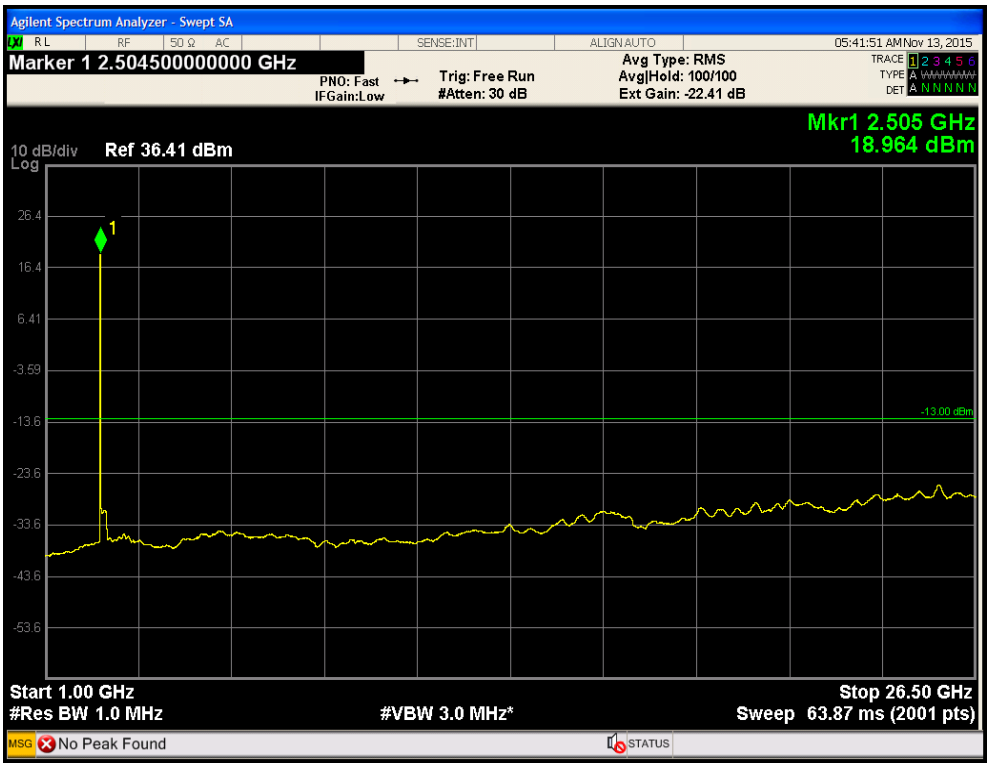
•Port1/ LTE 5M / 2593.0 MHz / 64QAM



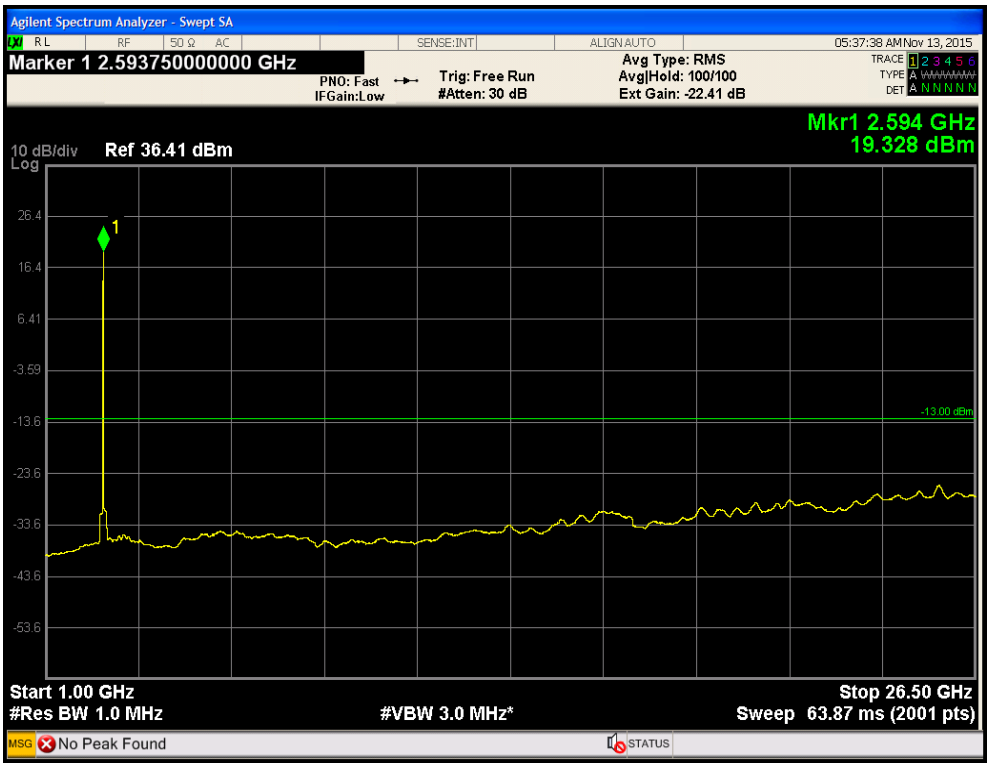
•Port1/ LTE 5M / 2687.5 MHz / 64QAM



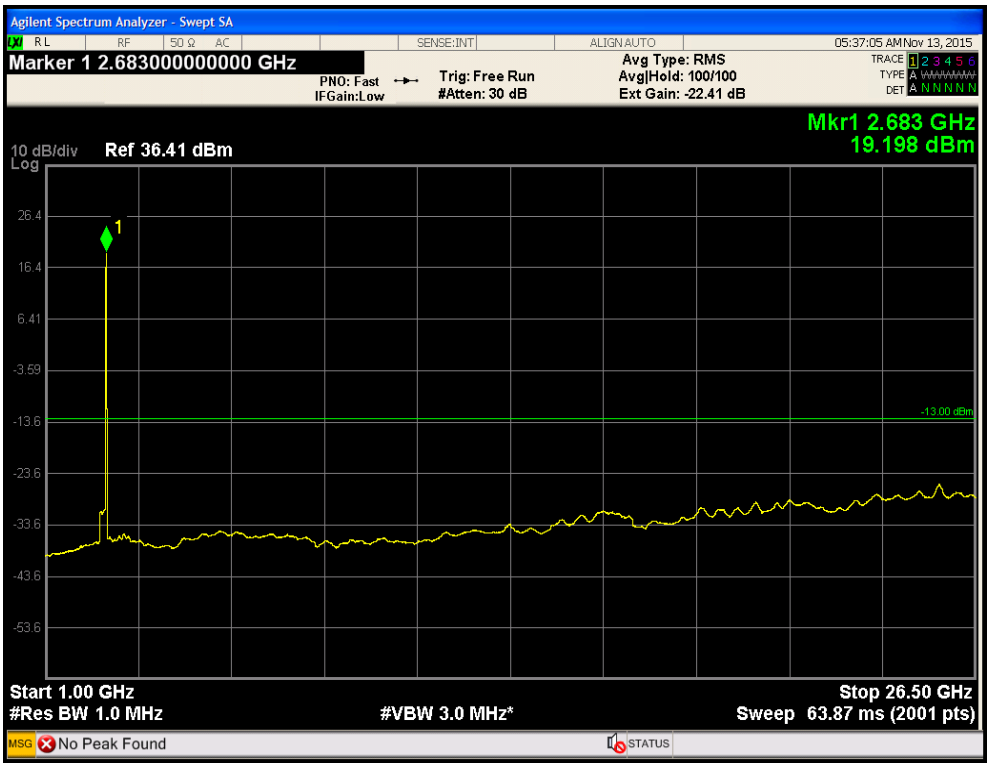
•Port1/ LTE 20M / 2506.0 MHz / QPSK



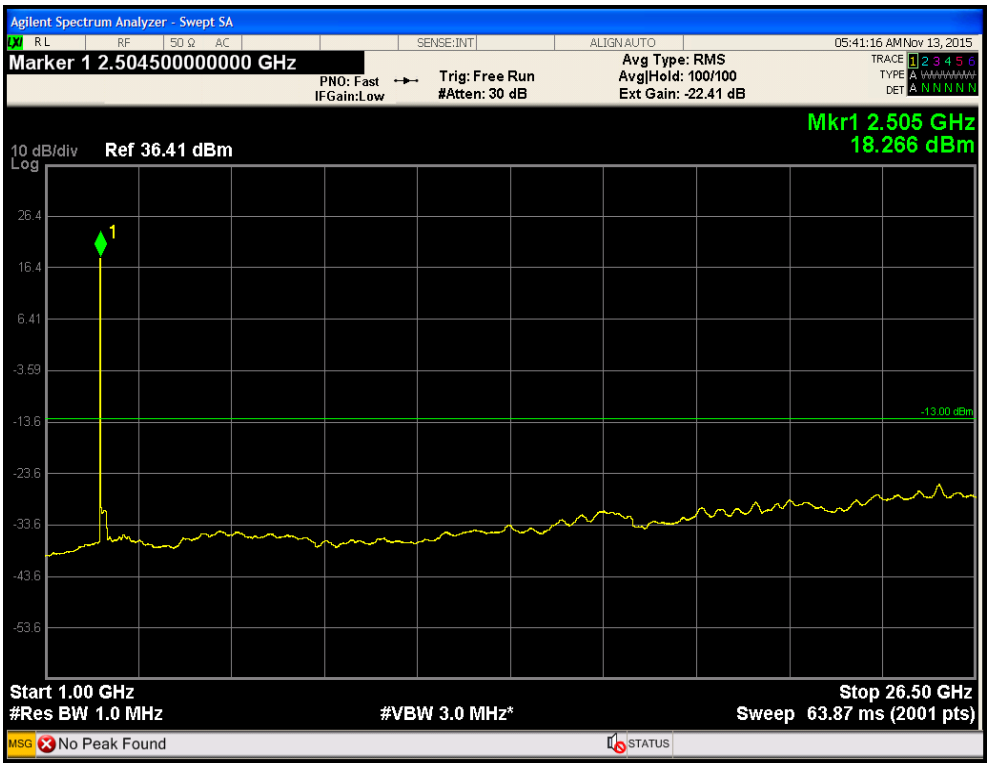
•Port1/ LTE 20M / 2593.0 MHz / QPSK



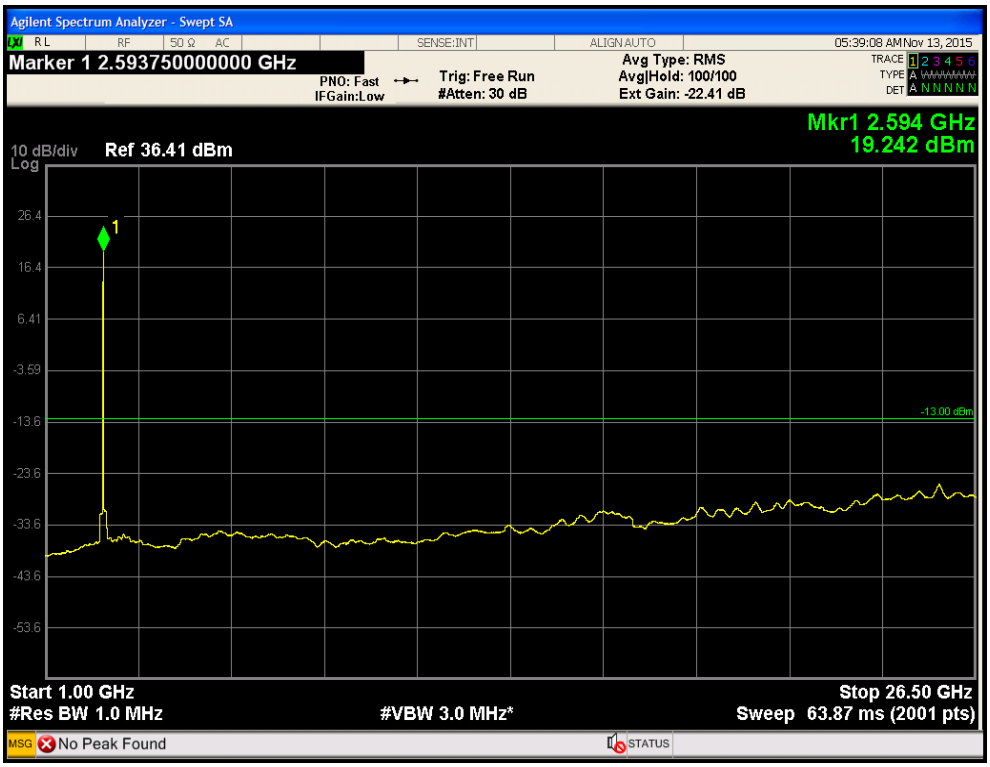
•Port1/ LTE 20M / 2680.0 MHz / QPSK



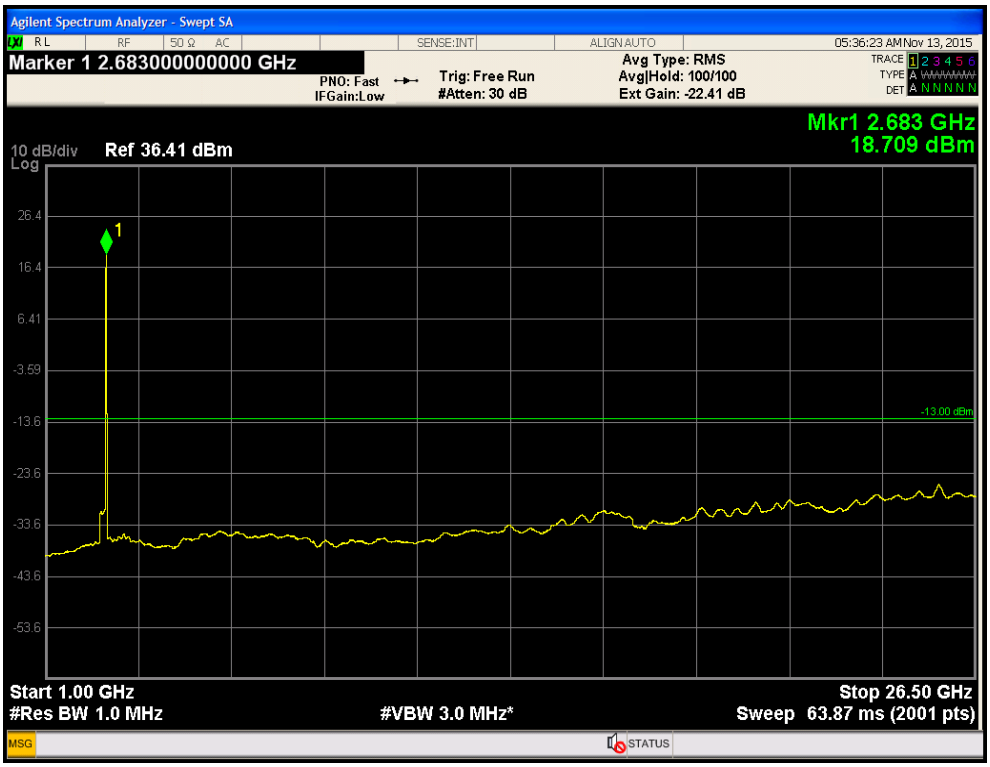
•Port1/ LTE 20M / 2506.0 MHz / 16QAM



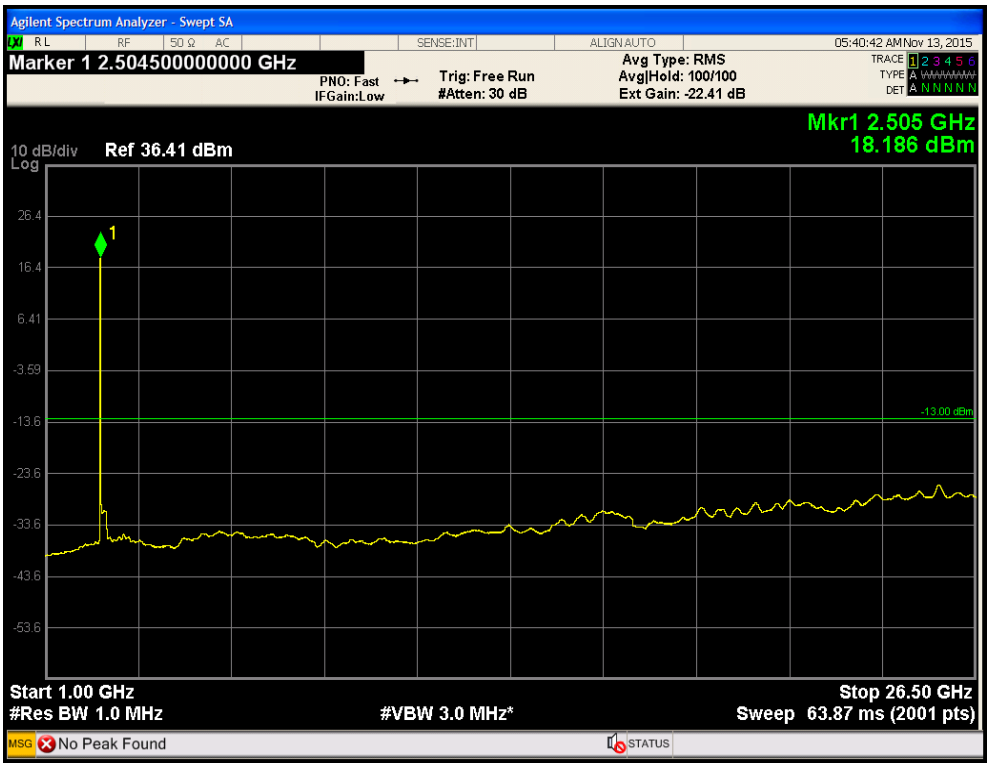
•Port1/ LTE 20M / 2593.0 MHz / 16QAM



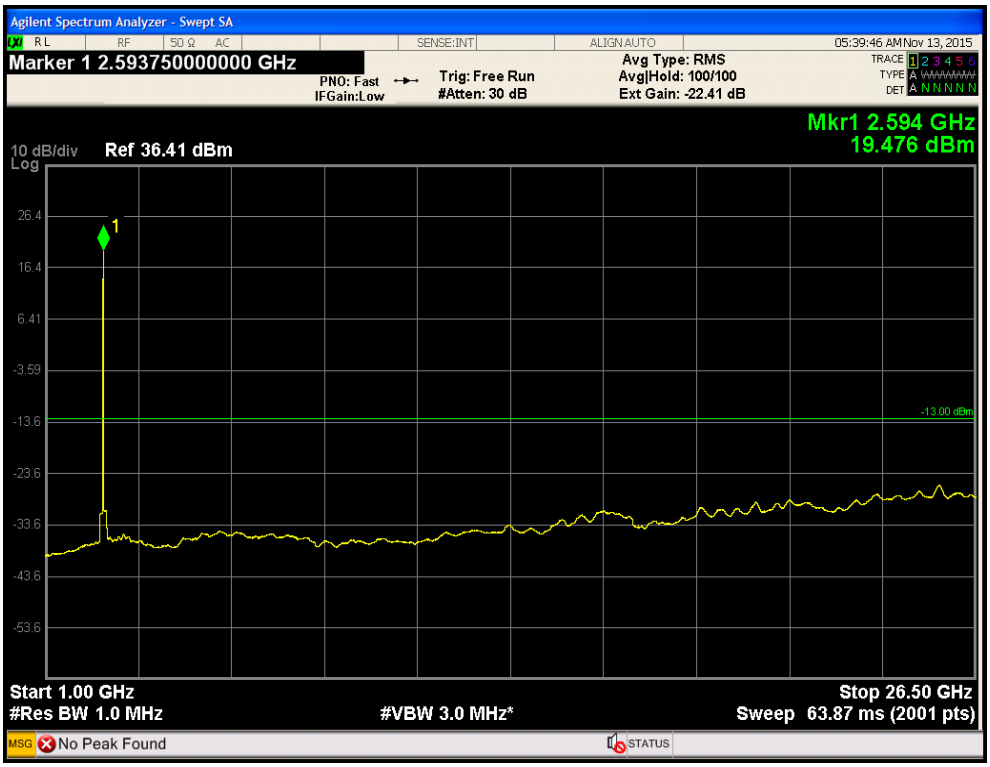
•Port1/ LTE 20M / 2680.0 MHz / 16QAM



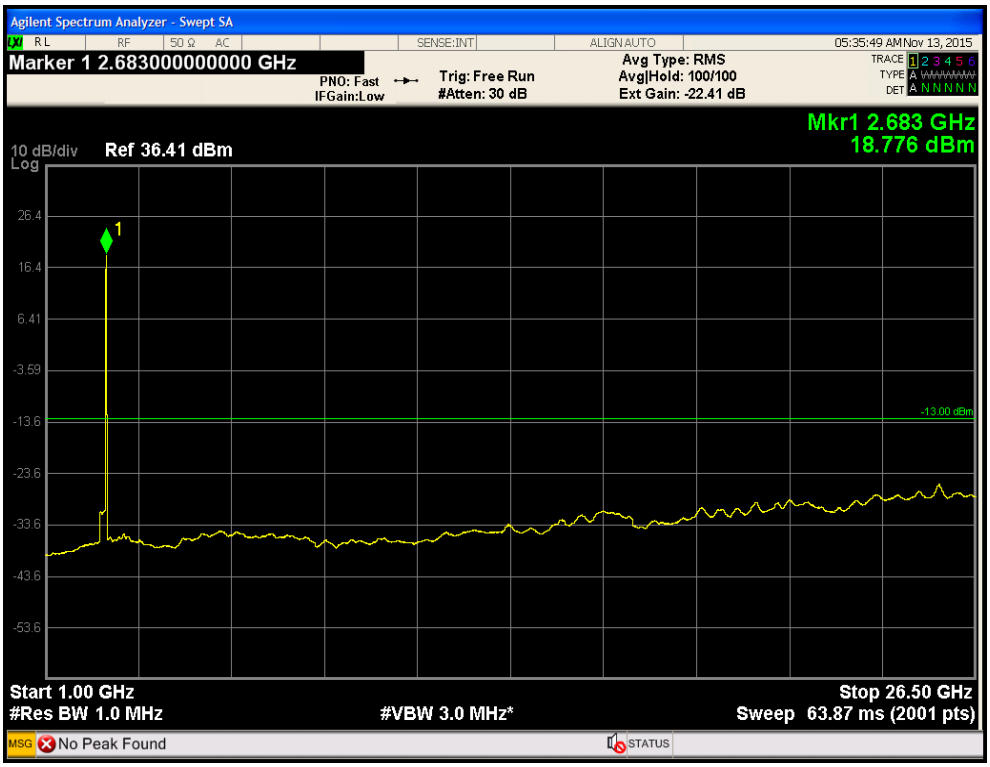
•Port1/ LTE 20M / 2506.0 MHz / 64QAM



•Port1/ LTE 20M / 2593.0 MHz / 64QAM



•Port1/ LTE 20M / 2680.0 MHz / 64QAM



3.4 Transmitter conducted output power

3.4.1 Specification

- FCC Part 2.1046
- FCC Part 27.50 (h)

3.4.2 Test Description

The measurement were performed in max output power transmitting mode at all channel of the 2496 MHz ~ 2690 MHz frequency ranges.

The EUT output power was connected to the spectrum analyzer through appropriate attenuator. The output power was measured using a spectrum analyzer Channel Power function.

Main, booster and base stations. (i) The maximum EIRP of a main, booster or base station shall not exceed 33 dBW + 10log(X/Y) dBW, where X is the actual channel width in MHz and Y is either 6 MHz if prior to transition or the station is in the MBS following transition or 5.5 MHz if the station is in the LBS and UBS following transition, except as provided in paragraph (h)(1)(ii) of this section.

Transmitter Conducted Output power was measured on port 1 under the three types of modulation mode which are QPSK, 16QAM and 64QAM and resource block was 25~100.

UL/DL Allocation : Configuration 3
Dw/GP/UP length : Configuration 8

3.4.3 Test Procedure

The test procedure used is as detailed in FCC KDB 935210

The test was performed at three frequencies (low, middle and high) at each band using all applicable modulation.

RF output power was measured by channel power measurement function of the spectrum analyzer with RMS mode.

3.4.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-2500-SISO	Corning Optical Communications Wireless Inc.
MHU	HX-2500-MHU	Corning Optical Communications Wireless Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
Attenuator	PE7019-20	Pasternack
DC Power Supply	6674A	Agilent

3.4.5 Test condition

- Test place: Shield Room
- Test environment: 22.5 °C, 42.5 % R.H.

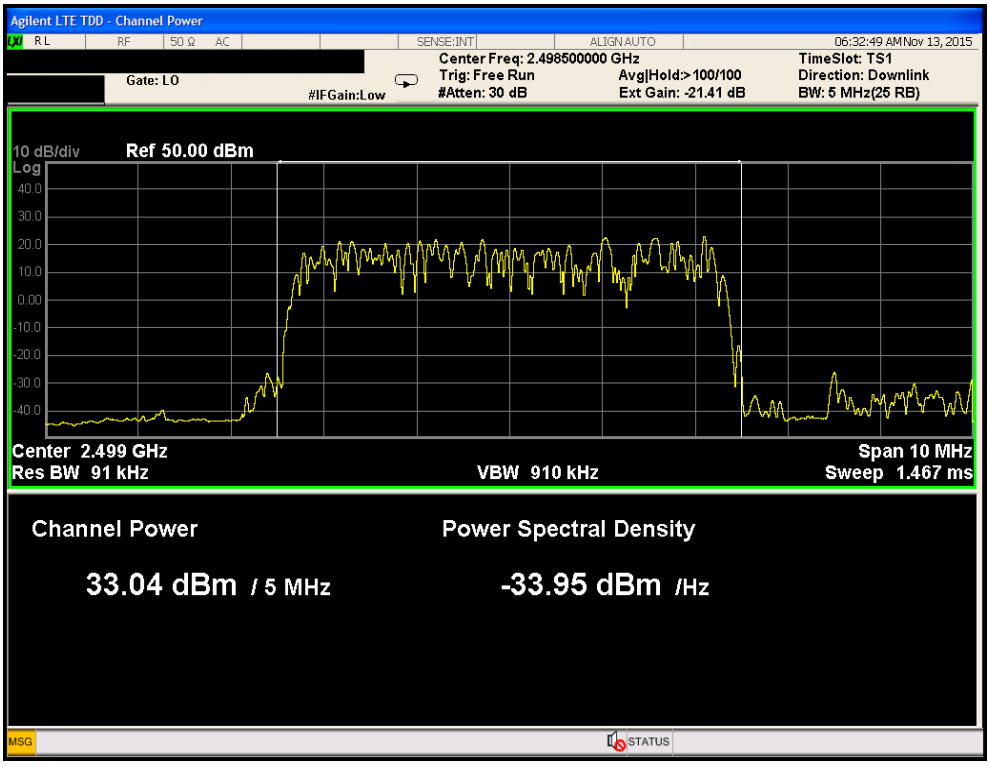
3.4.6 Test results

- **Port1**

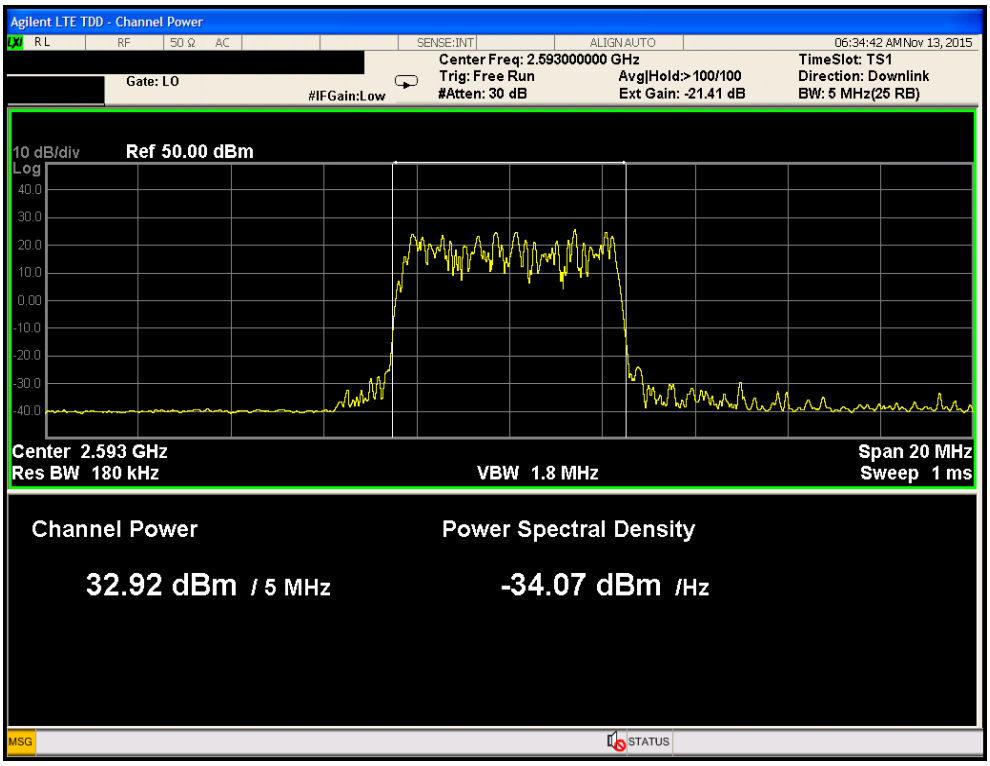
Bandwidth	Modulation	Frequency [MHz]	Output Level [dBm]	Antenna Gain [dBi]	EIRP [dBm]	EIRP [W]	Limit [W]
5 MHz	QPSK	2498.5	33.04	15.0	48.04	63.67	1811.34
		2593.0	32.92	15.0	47.92	61.94	
		2687.5	32.98	15.0	47.98	62.80	
	16QAM	2498.5	32.98	15.0	47.98	62.80	
		2593.0	33.00	15.0	48.00	63.09	
		2687.5	33.03	15.0	48.03	63.53	
	64QAM	2498.5	33.01	15.0	48.01	63.24	
		2593.0	32.98	15.0	47.98	62.80	
		2687.5	32.99	15.0	47.99	62.95	
10 MHz	QPSK	2501.0	32.99	15.0	47.99	62.95	3622.42
		2593.0	33.02	15.0	48.02	63.38	
		2685.0	32.96	15.0	47.96	62.51	
	16QAM	2501.0	32.77	15.0	47.77	59.84	
		2593.0	32.98	15.0	47.98	62.80	
		2685.0	32.98	15.0	47.98	62.80	
	64QAM	2501.0	33.02	15.0	48.02	63.38	
		2593.0	32.99	15.0	47.99	62.95	
		2685.0	33.00	15.0	48.00	63.09	
15 MHz	QPSK	2503.5	33.00	15.0	48.00	63.09	5432.50
		2593.0	32.99	15.0	47.99	62.95	
		2682.5	33.02	15.0	48.02	63.38	
	16QAM	2503.5	33.01	15.0	48.01	63.24	
		2593.0	32.98	15.0	47.98	62.80	
		2682.5	33.02	15.0	48.02	63.38	
	64QAM	2503.5	32.98	15.0	47.98	62.80	
		2593.0	33.02	15.0	48.02	63.38	
		2682.5	33.02	15.0	48.02	63.38	
20 MHz	QPSK	2506.0	33.00	15.0	48.00	63.09	7244.35
		2593.0	32.92	15.0	47.92	61.94	
		2680.0	32.99	15.0	47.99	62.95	
	16QAM	2506.0	33.04	15.0	48.04	63.67	
		2593.0	33.02	15.0	48.02	63.38	
		2680.0	32.97	15.0	47.97	62.66	
	64QAM	2506.0	33.00	15.0	48.00	63.09	
		2593.0	33.03	15.0	48.03	63.53	
		2680.0	32.96	15.0	47.96	62.51	

3.4.7 Test Plots

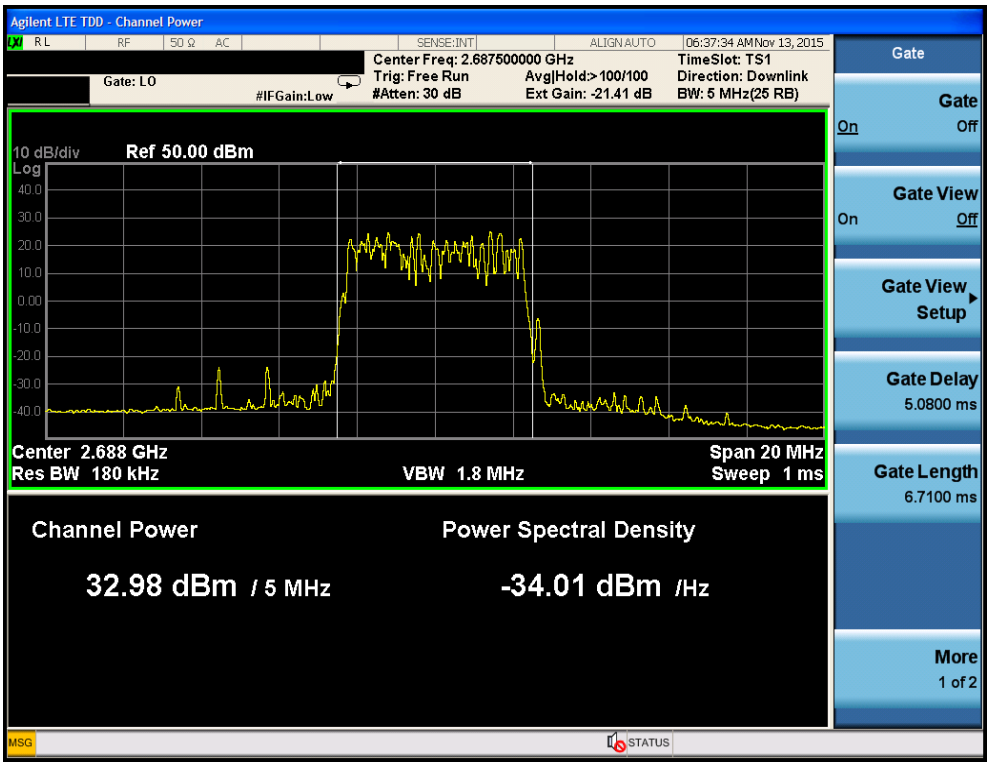
•Port1/ LTE 5M / 2498.5 MHz / QPSK



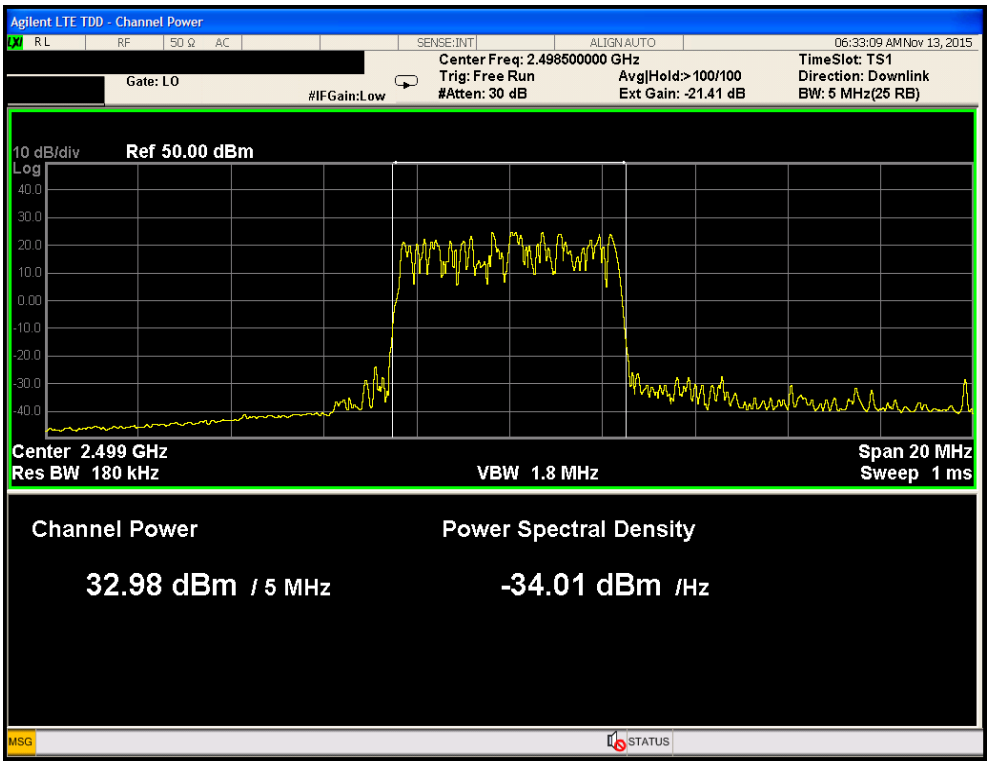
•Port1/ LTE 5M / 2593.0 MHz / QPSK



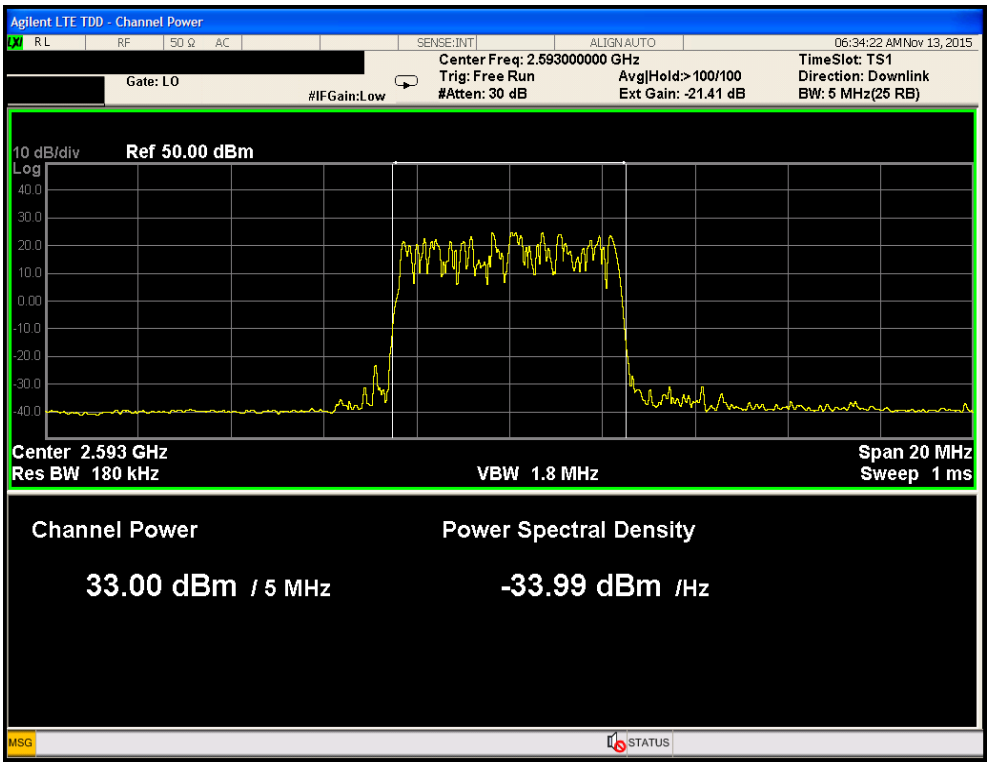
•Port1/ LTE 5M / 2687.5 MHz / QPSK



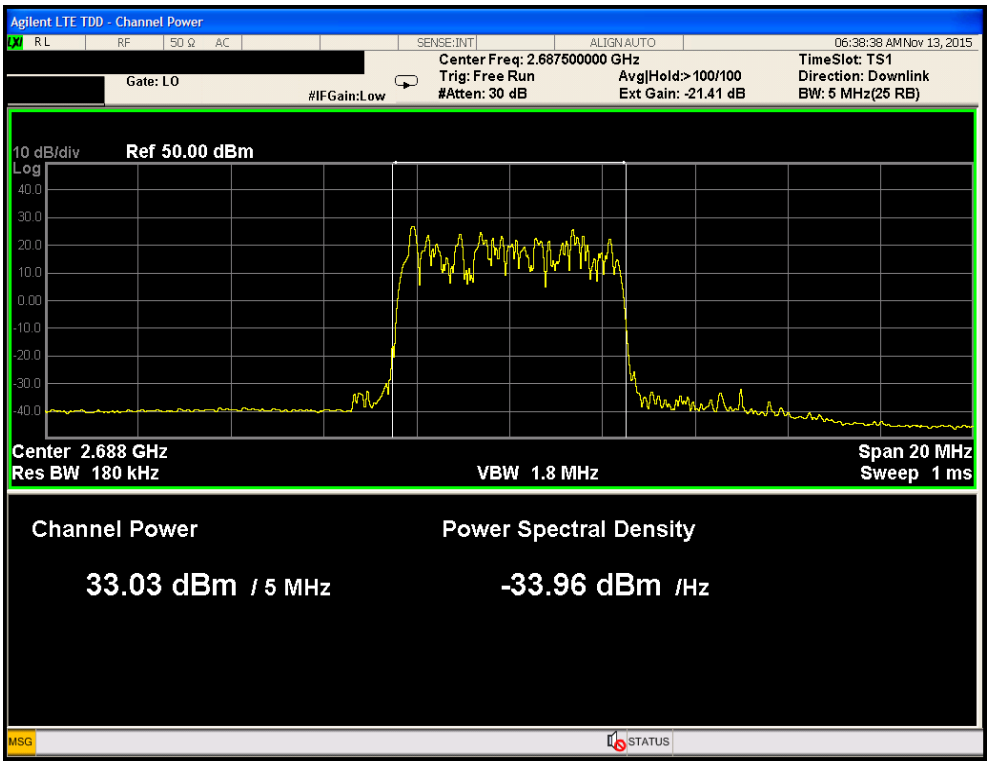
•Port1/ LTE 5M / 2498.5 MHz / 16QAM



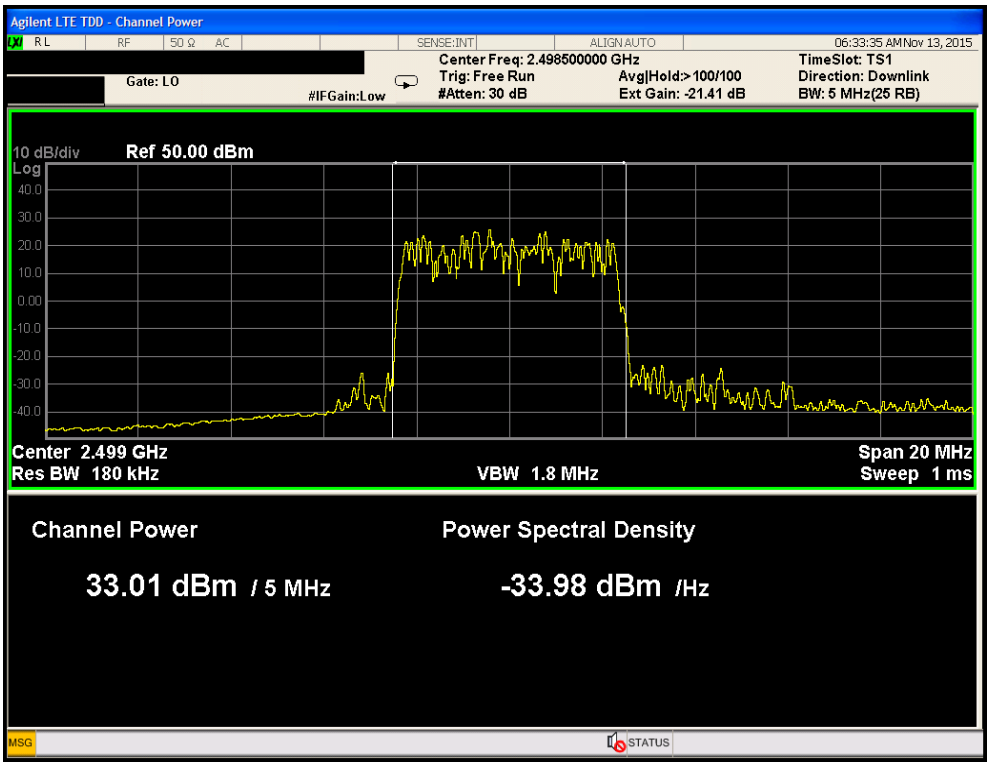
•Port1/ LTE 5M / 2593.0 MHz / 16QAM



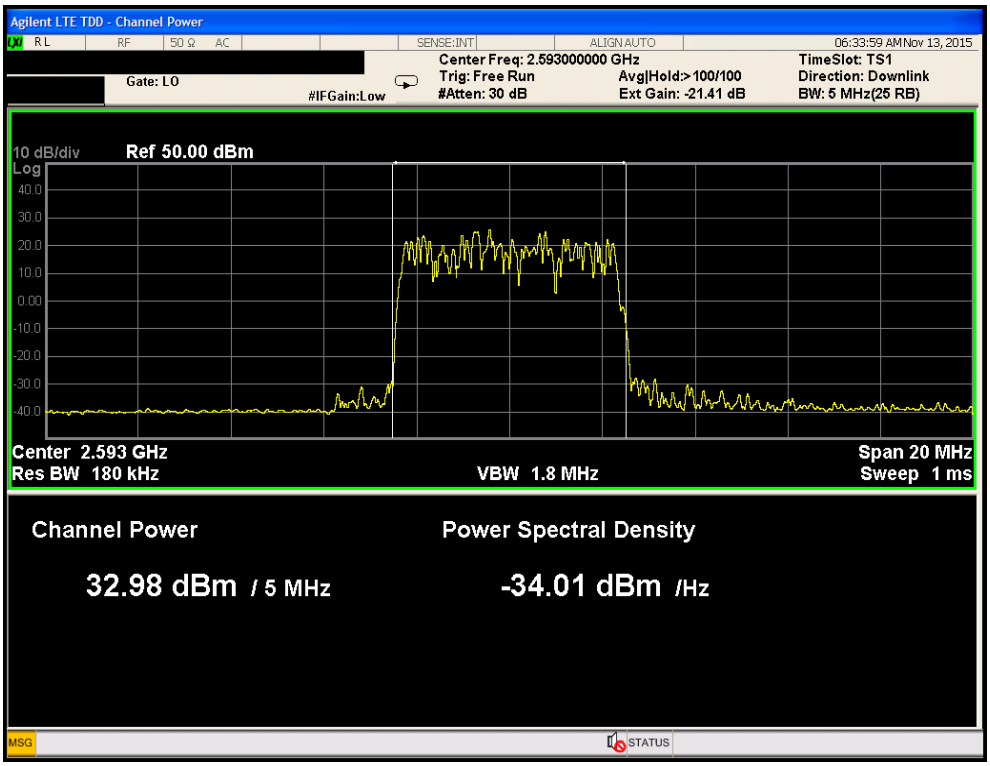
•Port1/ LTE 5M / 2687.5 MHz / 16QAM



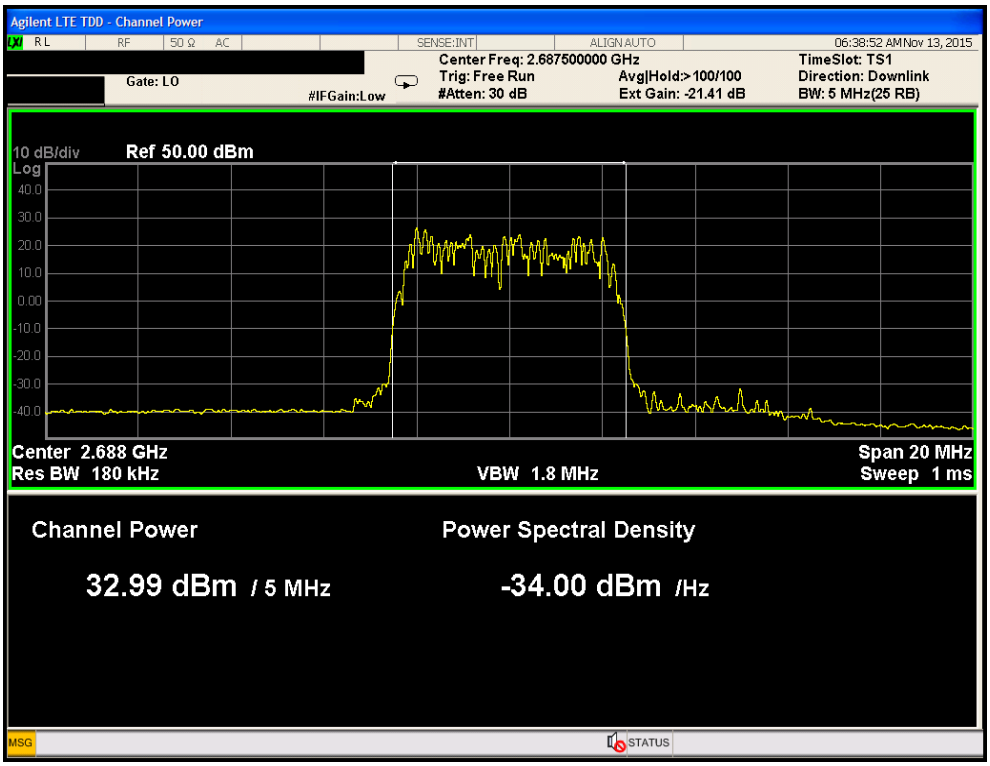
•Port1/ LTE 5M / 2498.5 MHz / 64QAM



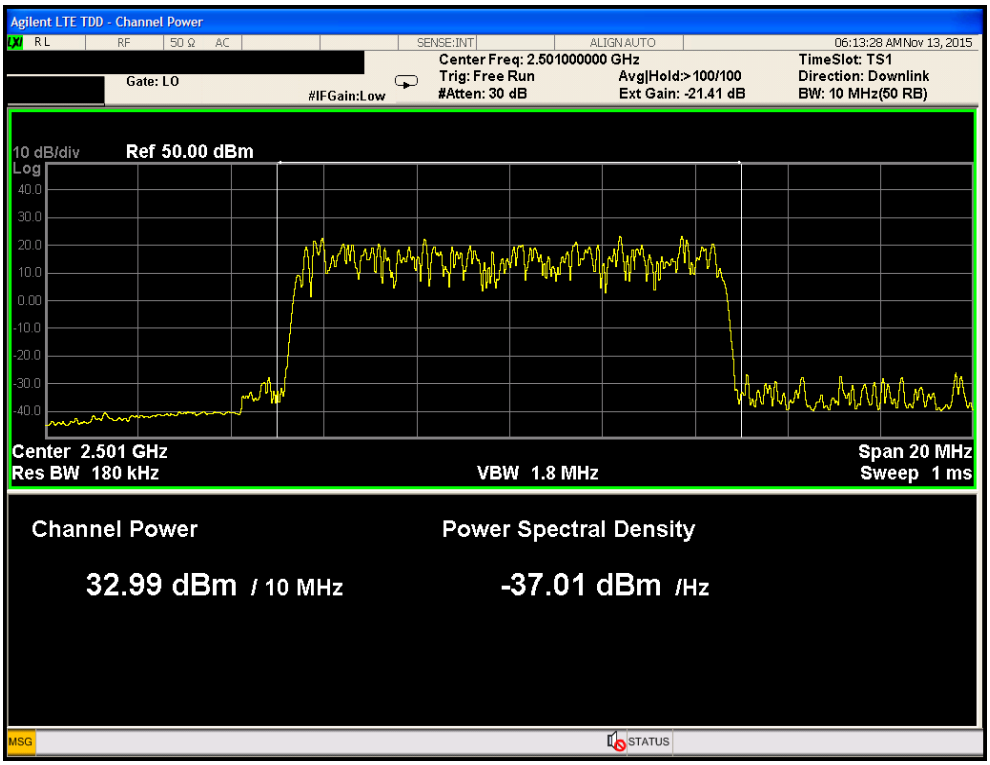
•Port1/ LTE 5M / 2593.0 MHz / 64QAM



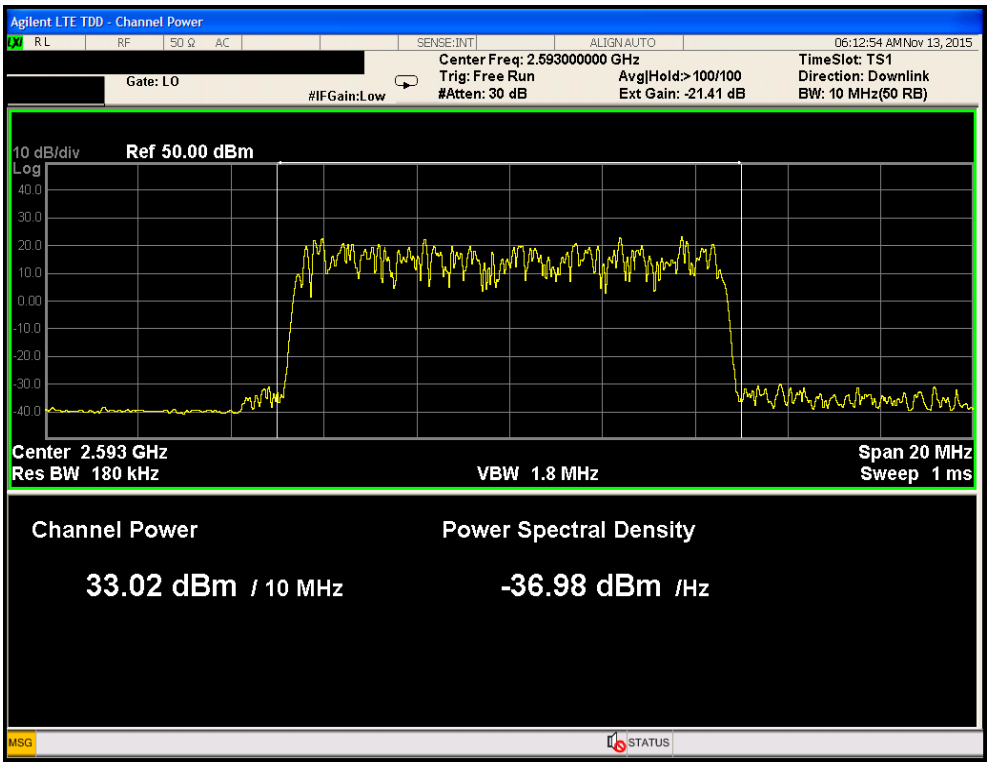
•Port1/ LTE 5M / 2687.5 MHz / 64QAM



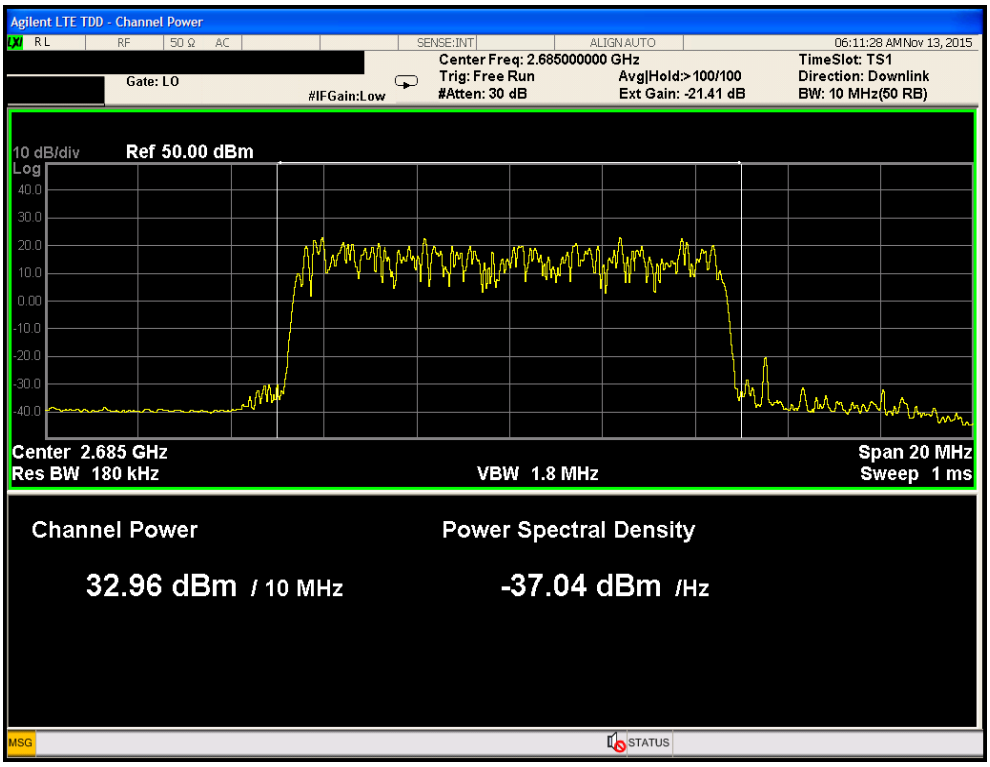
•Port1/ LTE 10M / 2501.0 MHz / QPSK



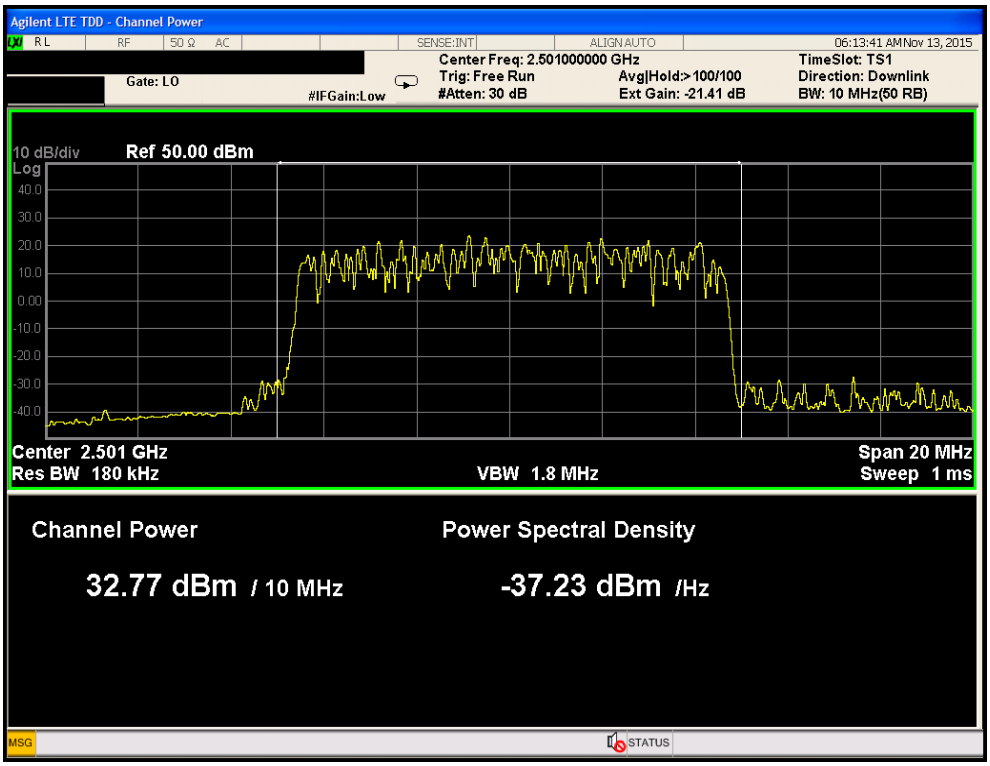
•Port1/ LTE 10M / 2593.0 MHz / QPSK



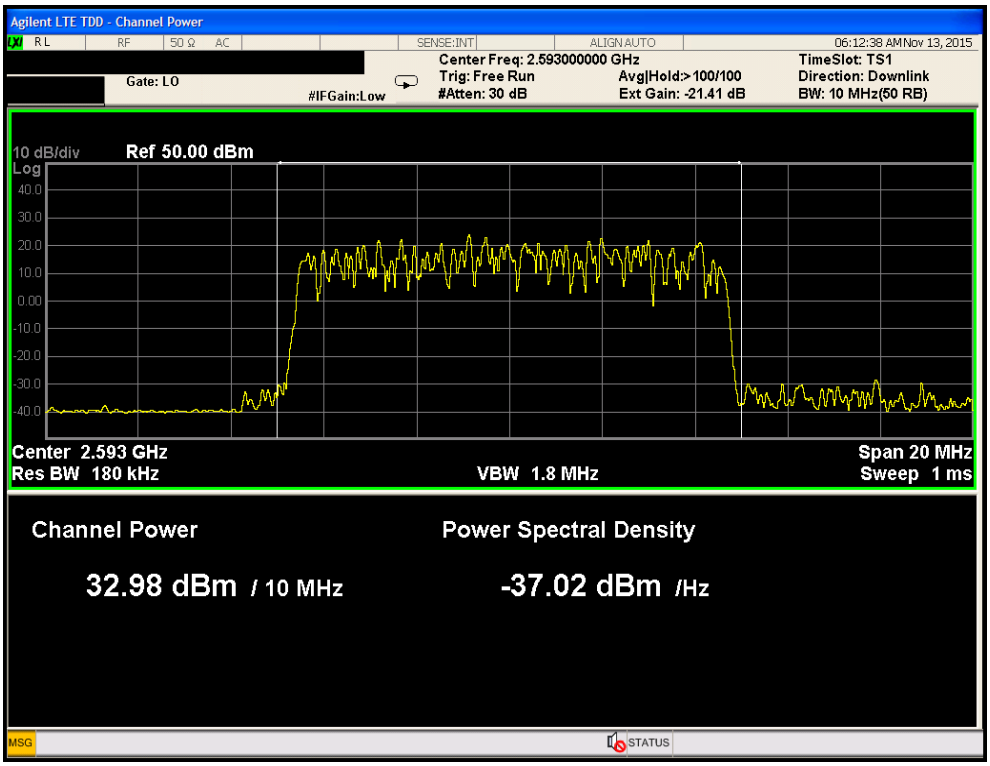
•Port1/ LTE 10M / 2685.0 MHz / QPSK



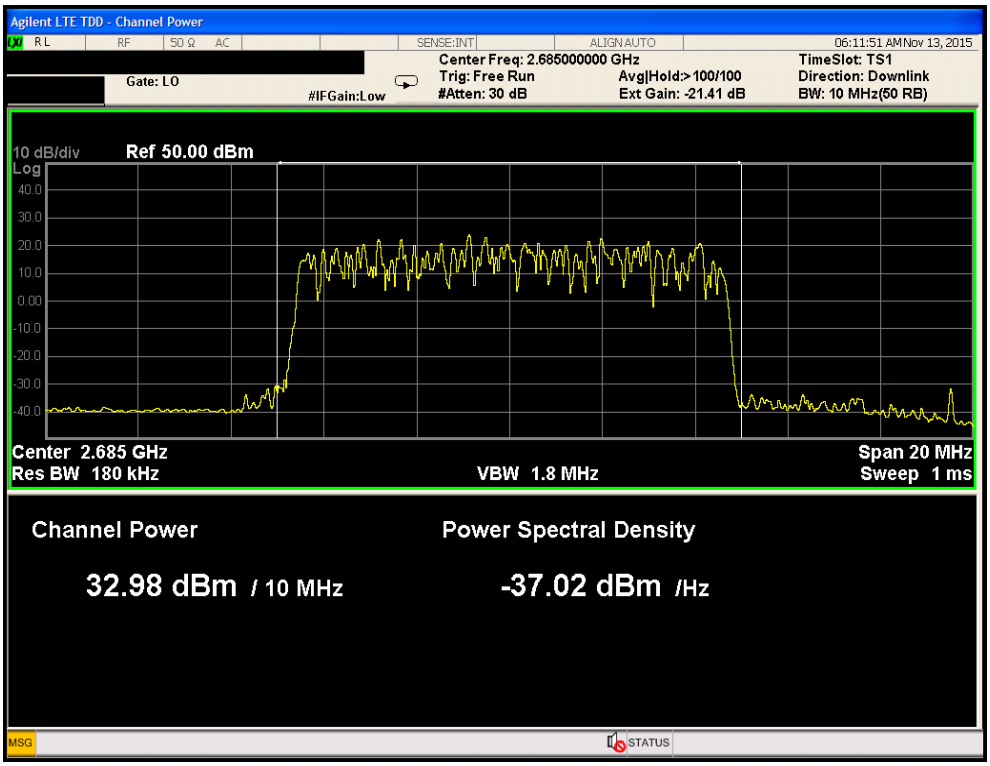
•Port1/ LTE 10M / 2501.0 MHz / 16QAM



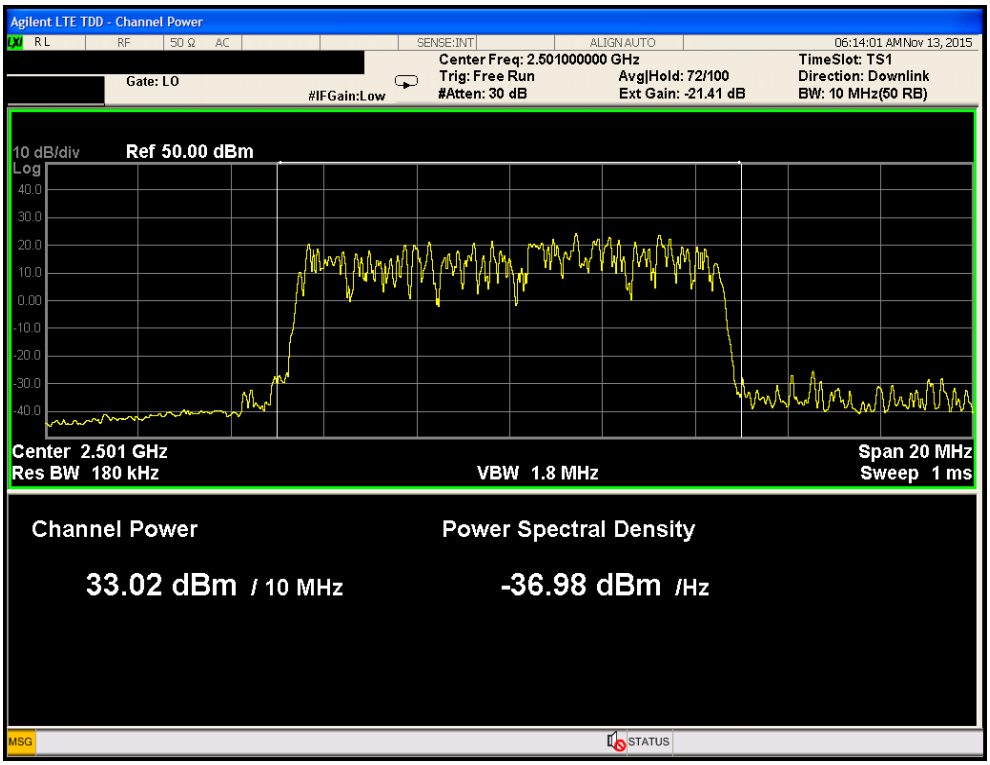
•Port1/ LTE 10M / 2593.0 MHz / 16QAM



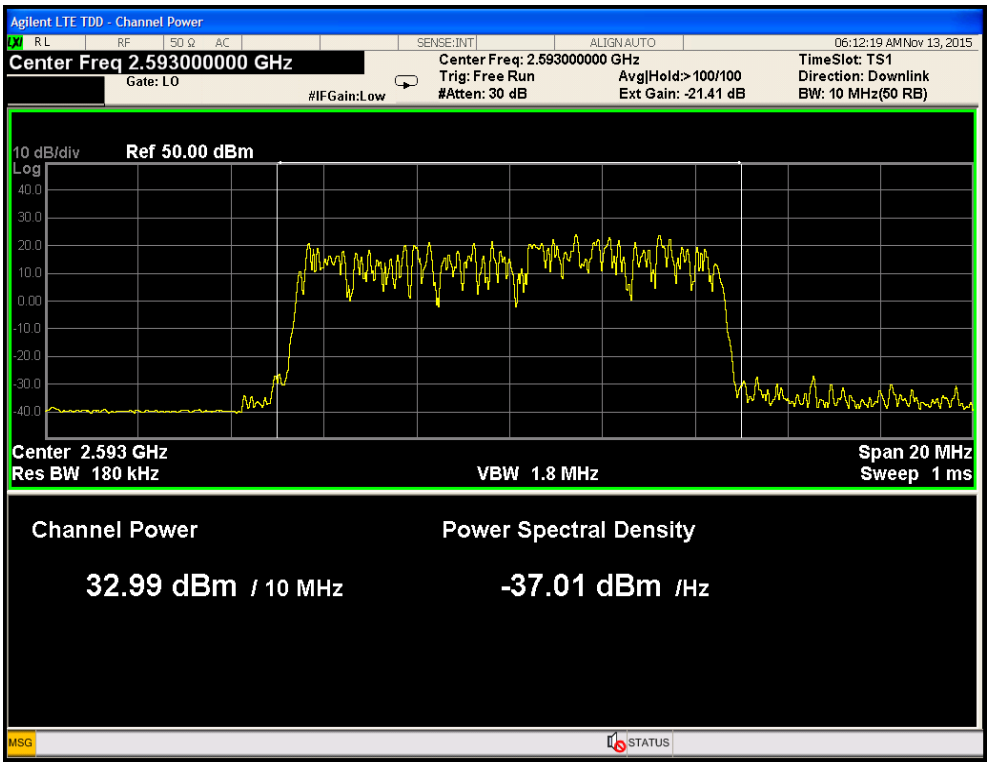
•Port1/ LTE 10M / 2685.0 MHz / 16QAM



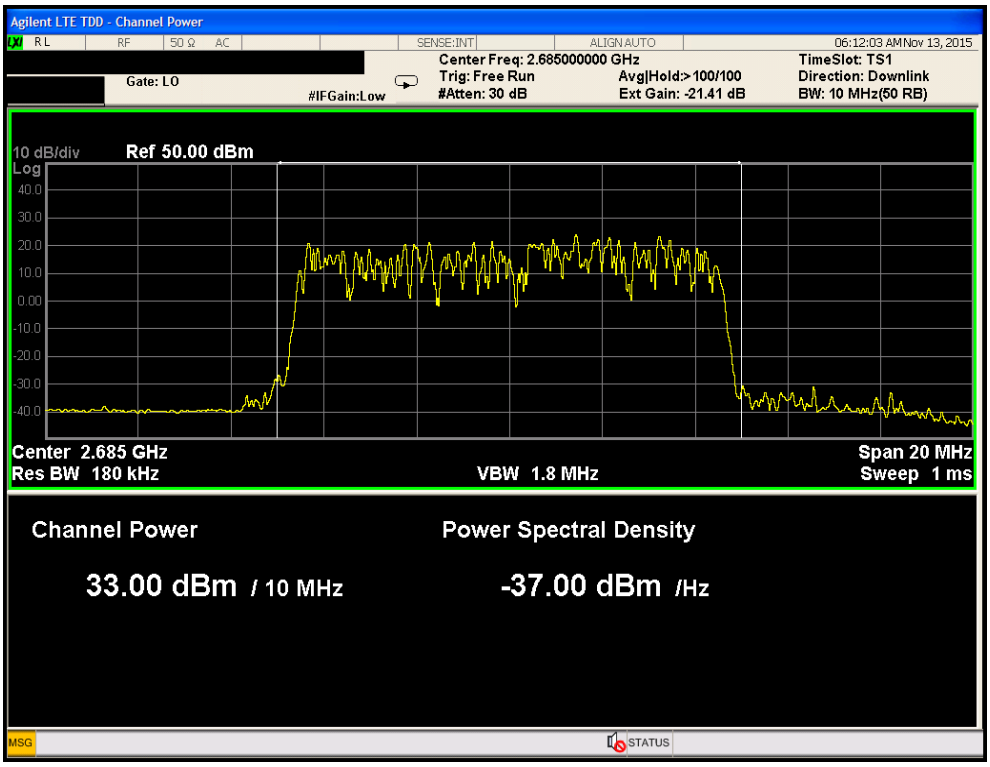
•Port1/ LTE 10M / 2501.0 MHz / 64QAM



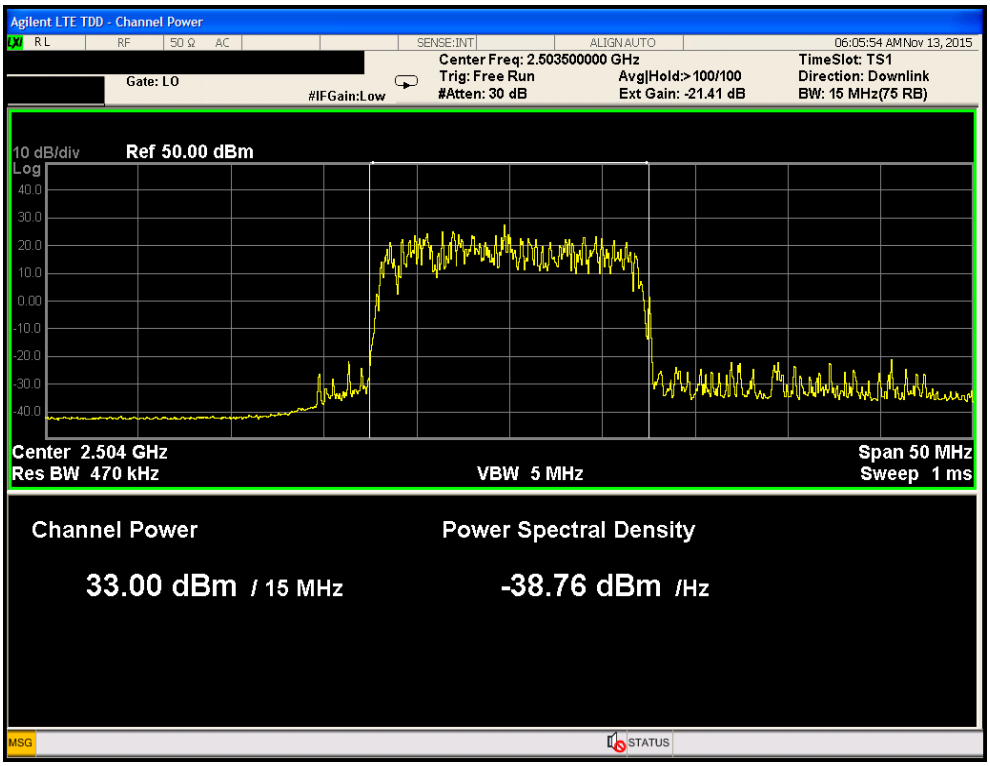
•Port1/ LTE 10M / 2593.0 MHz / 64QAM



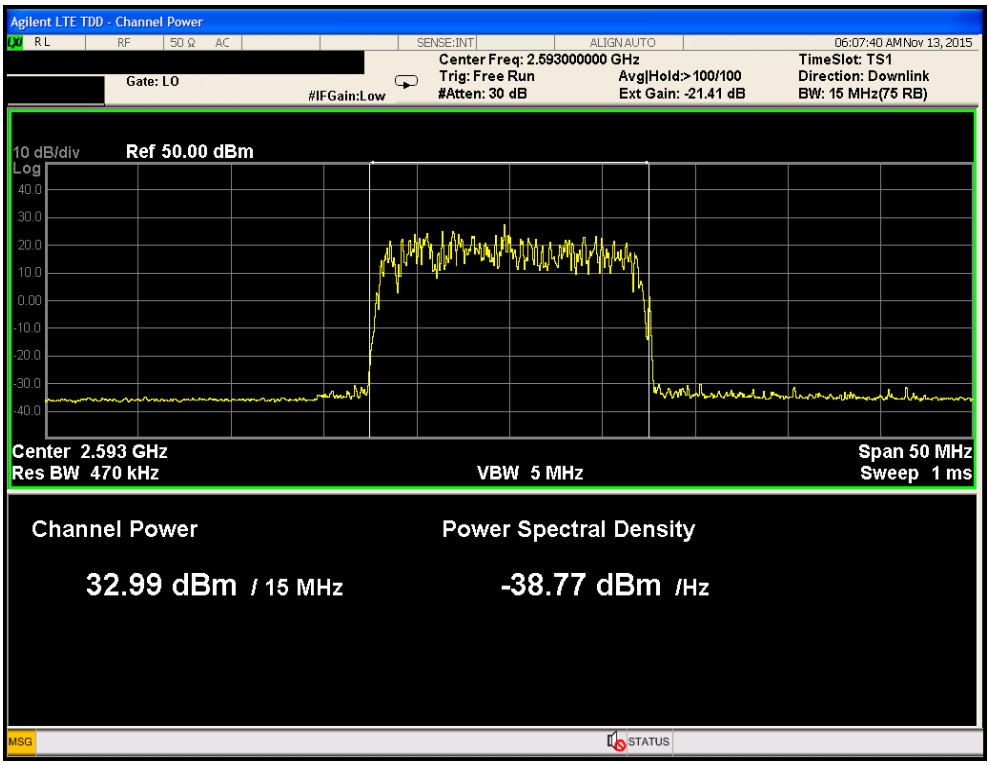
•Port1/ LTE 10M / 2685.0 MHz / 64QAM



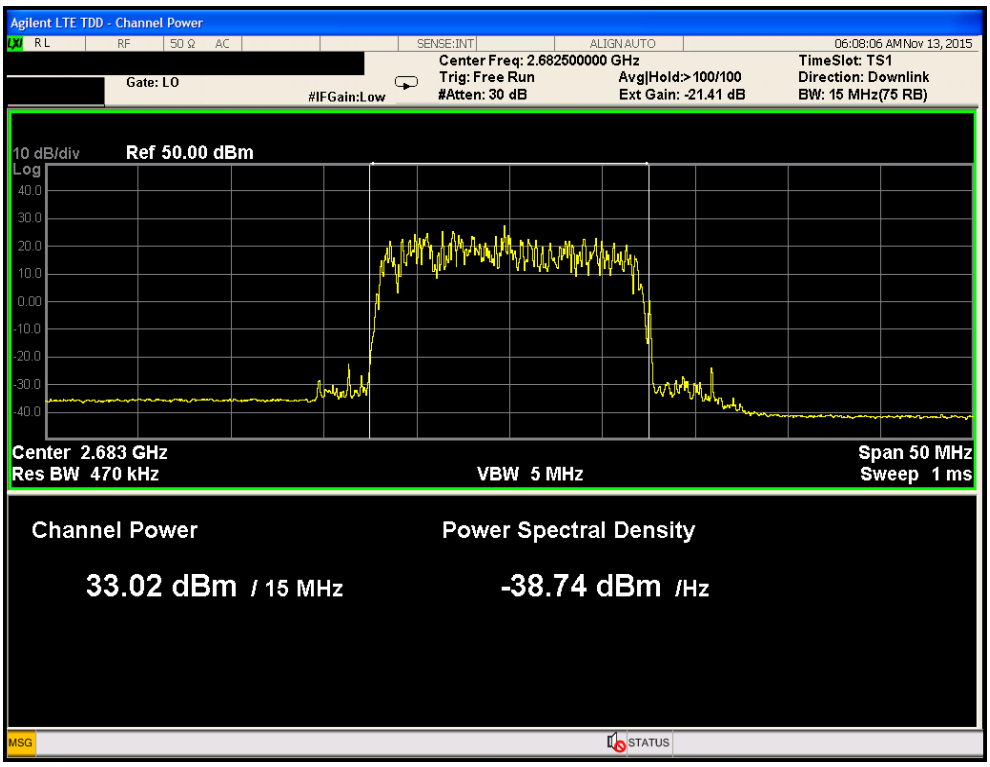
•Port1/ LTE 15M / 2503.5 MHz / QPSK



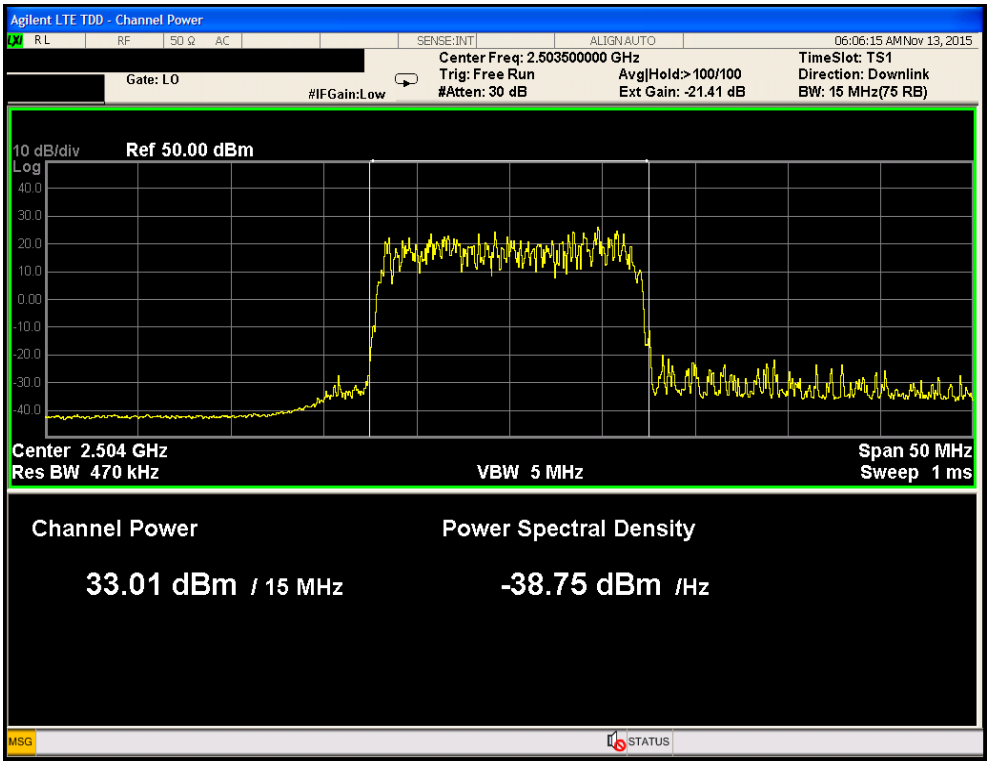
•Port1/ LTE 15M / 2593.0 MHz / QPSK



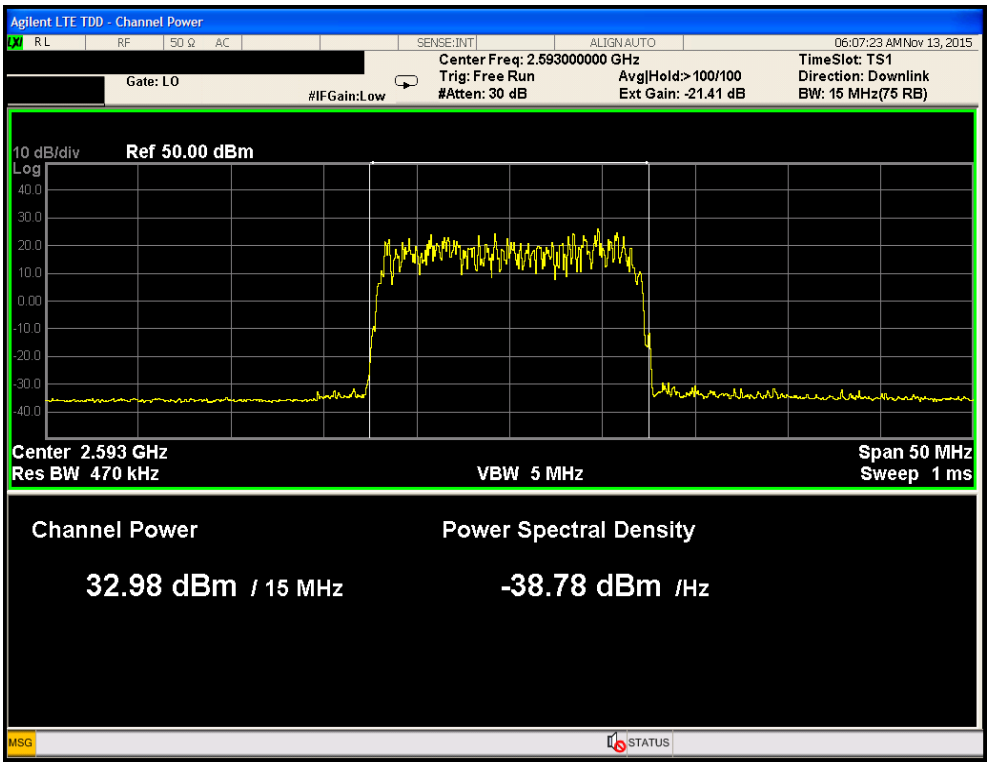
•Port1/ LTE 15M / 2682.5 MHz / QPSK



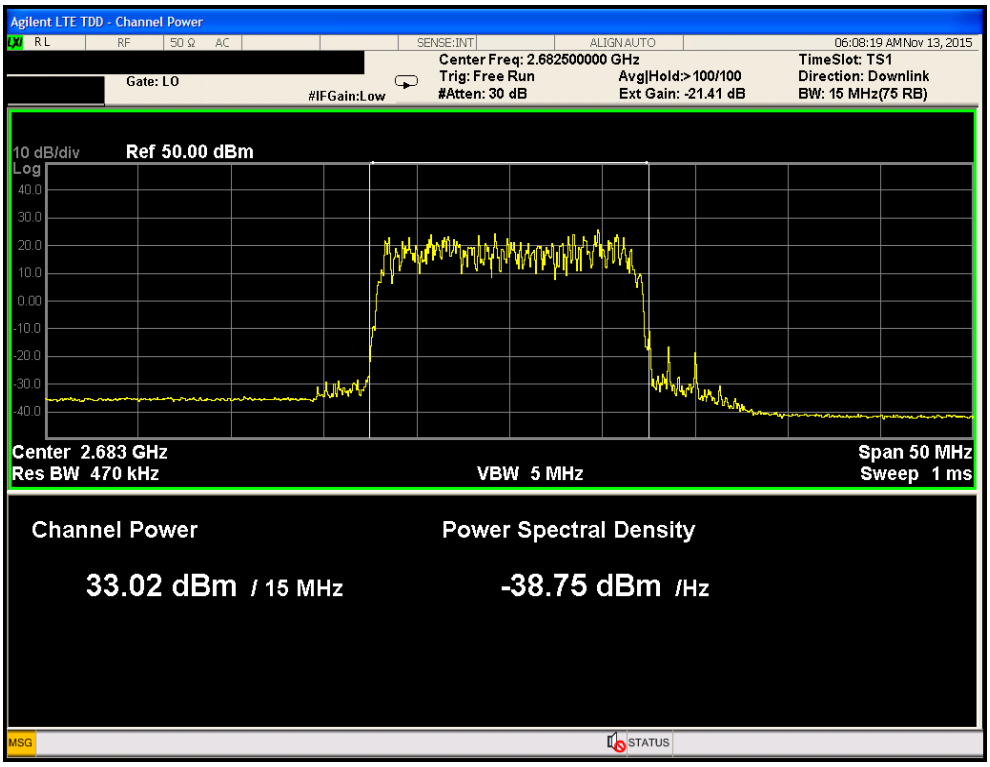
•Port1/ LTE 15M / 2503.5 MHz / 16QAM



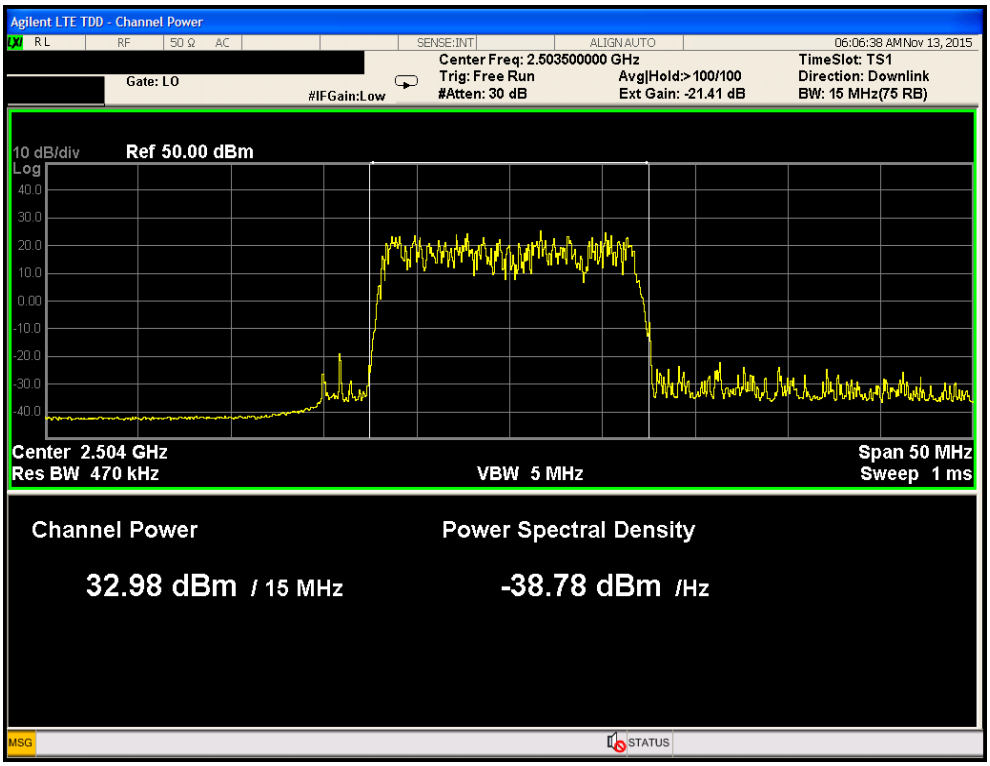
•Port1/ LTE 15M / 2593.0 MHz / 16QAM



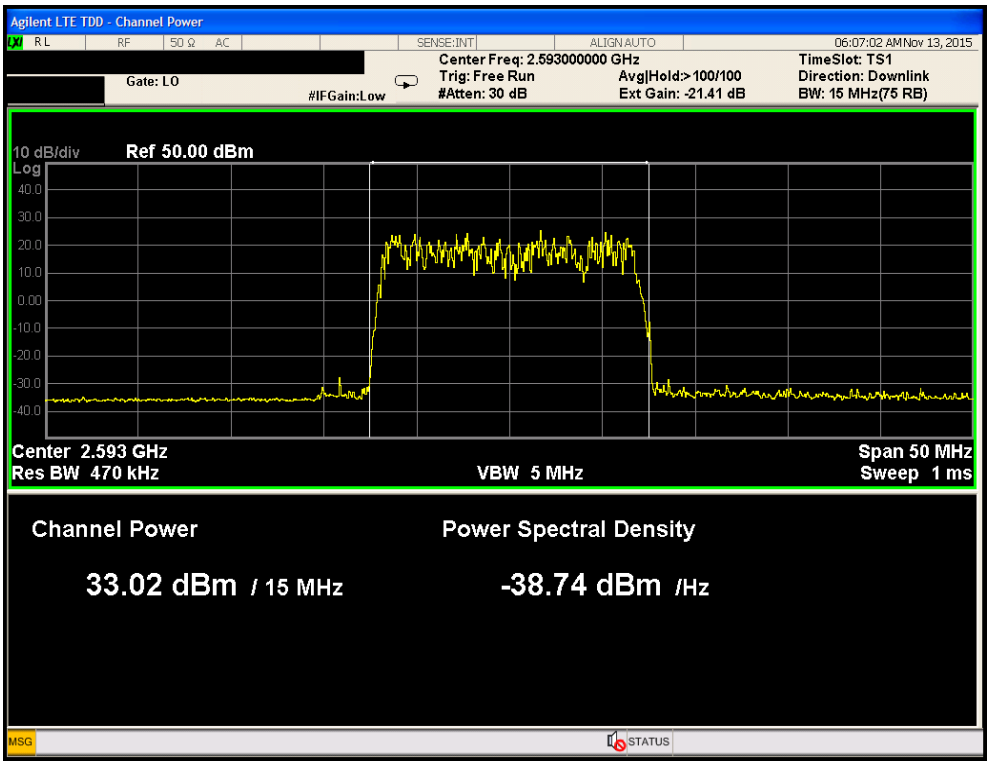
•Port1/ LTE 15M / 2682.5 MHz / 16QAM



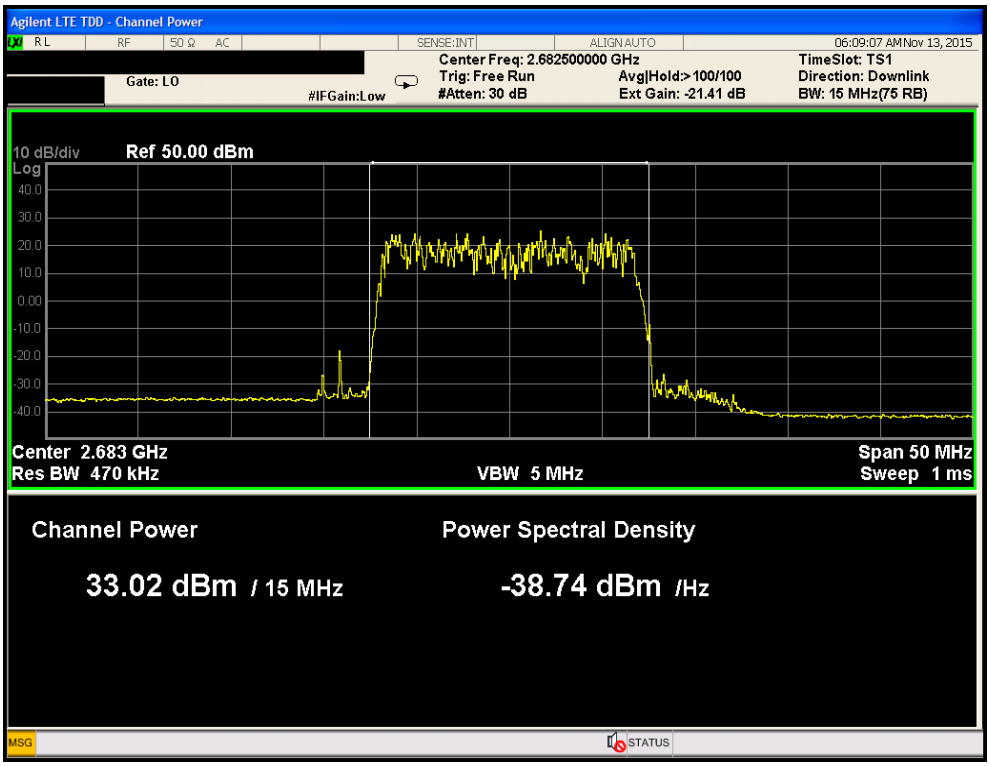
•Port1/ LTE 15M / 2503.5 MHz / 64QAM



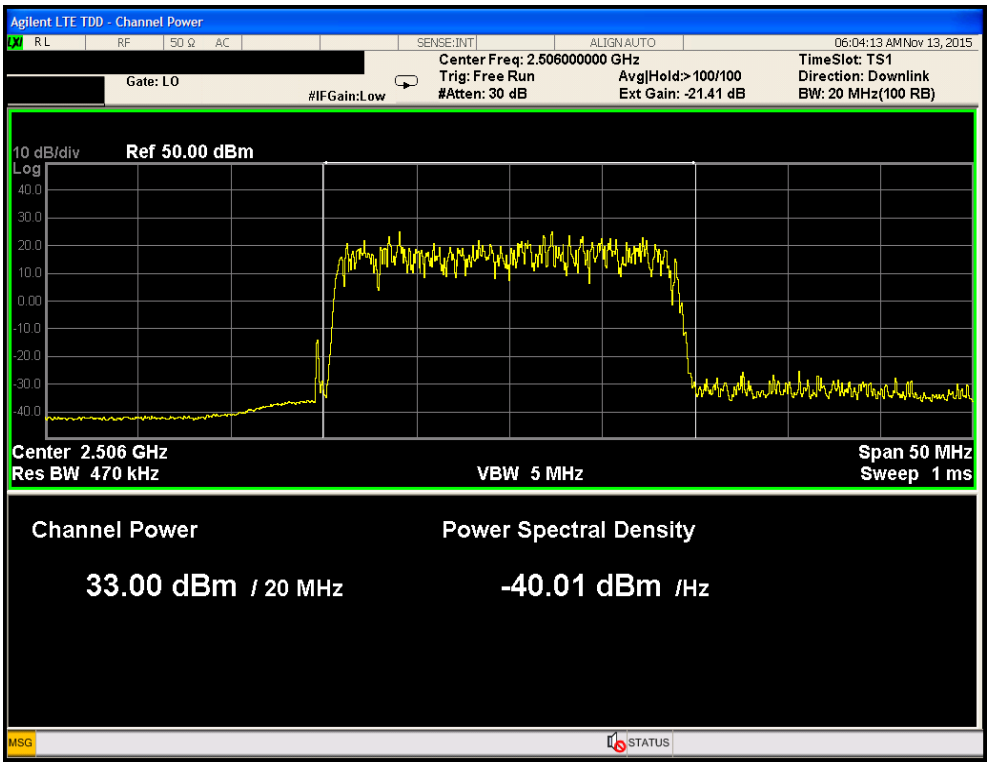
•Port1/ LTE 15M / 2593.0 MHz / 64QAM



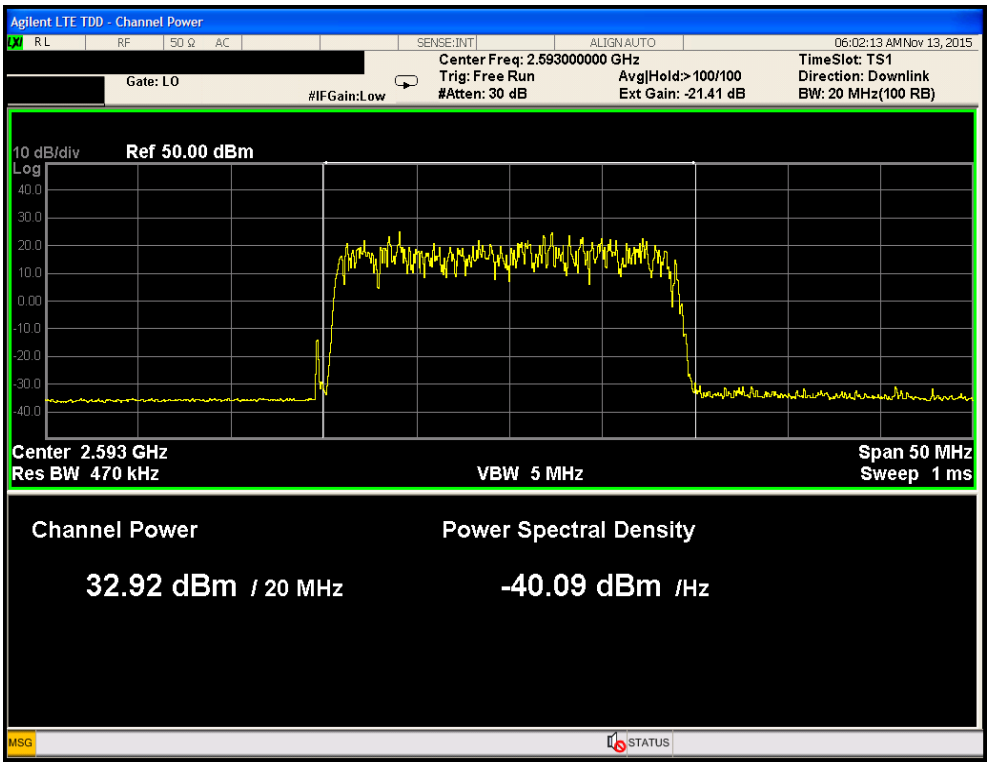
•Port1/ LTE 15M / 2682.5 MHz / 64QAM



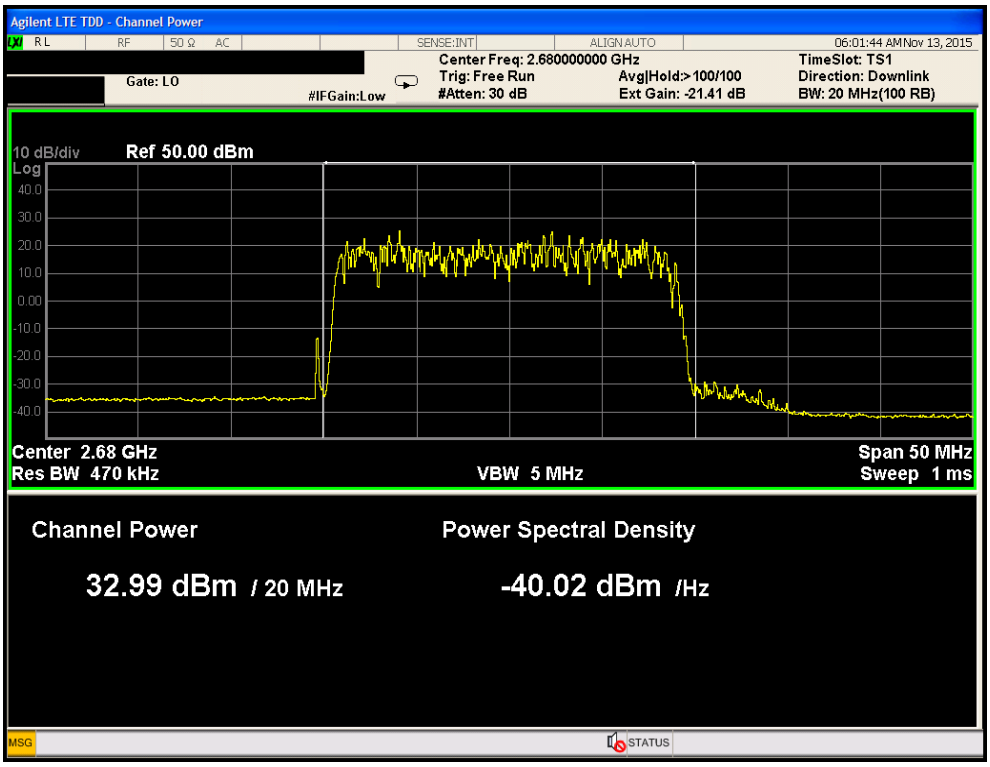
•Port1/ LTE 20M / 2506.0 MHz / QPSK



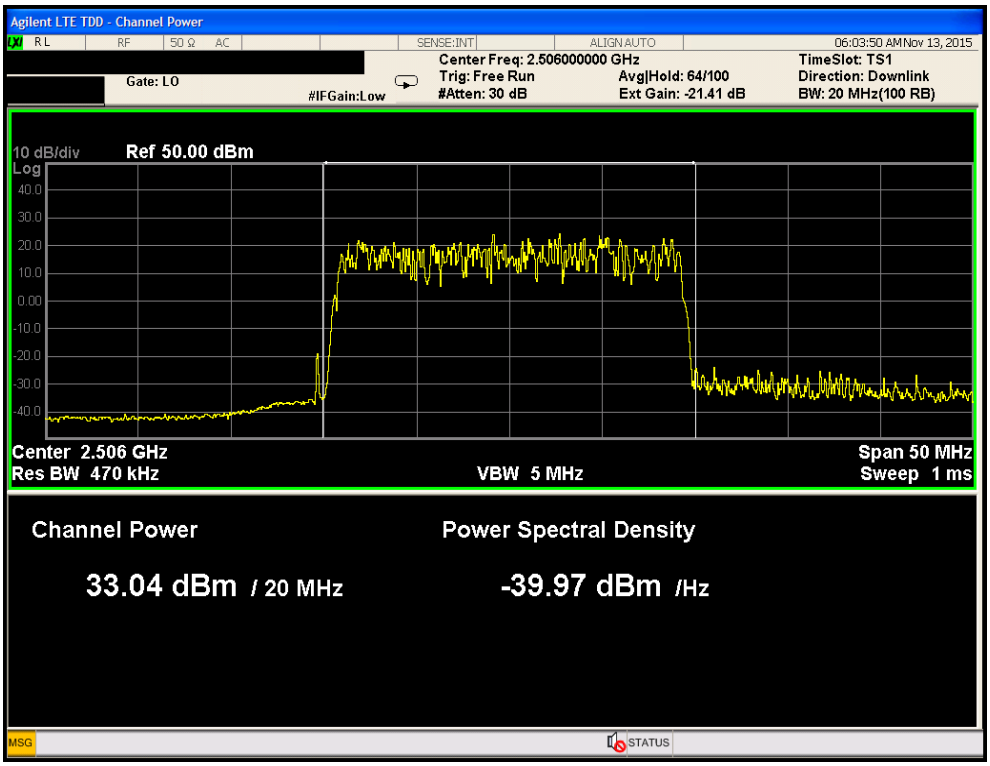
•Port1/ LTE 20M / 2593.0 MHz / QPSK



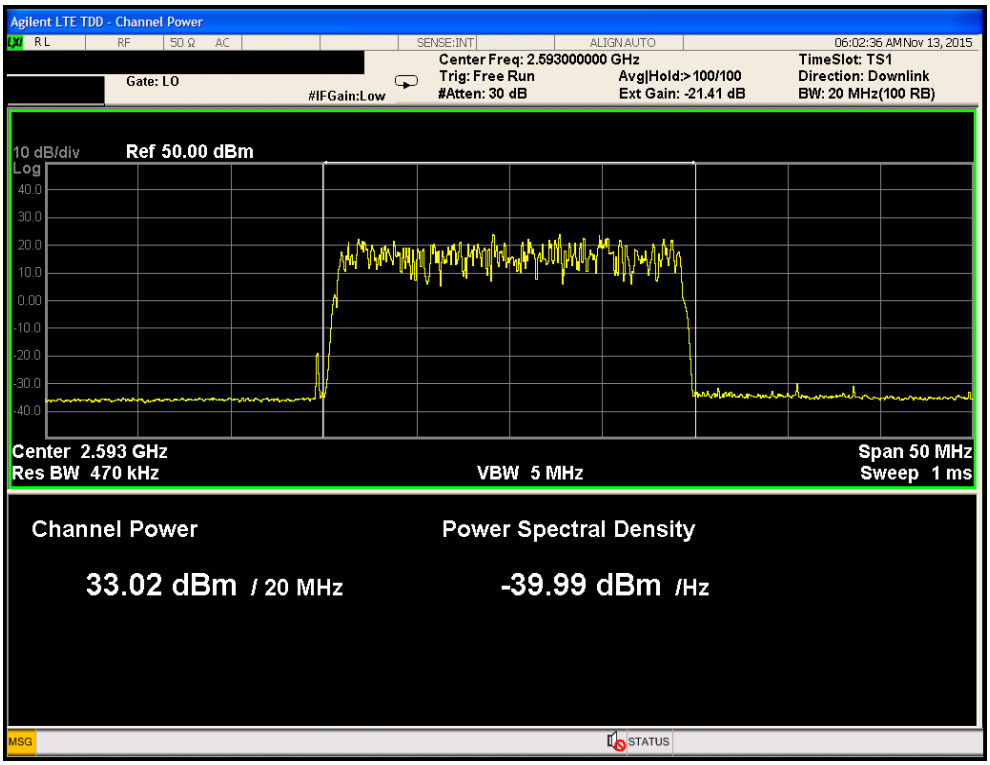
•Port1/ LTE 20M / 2680.0 MHz / QPSK



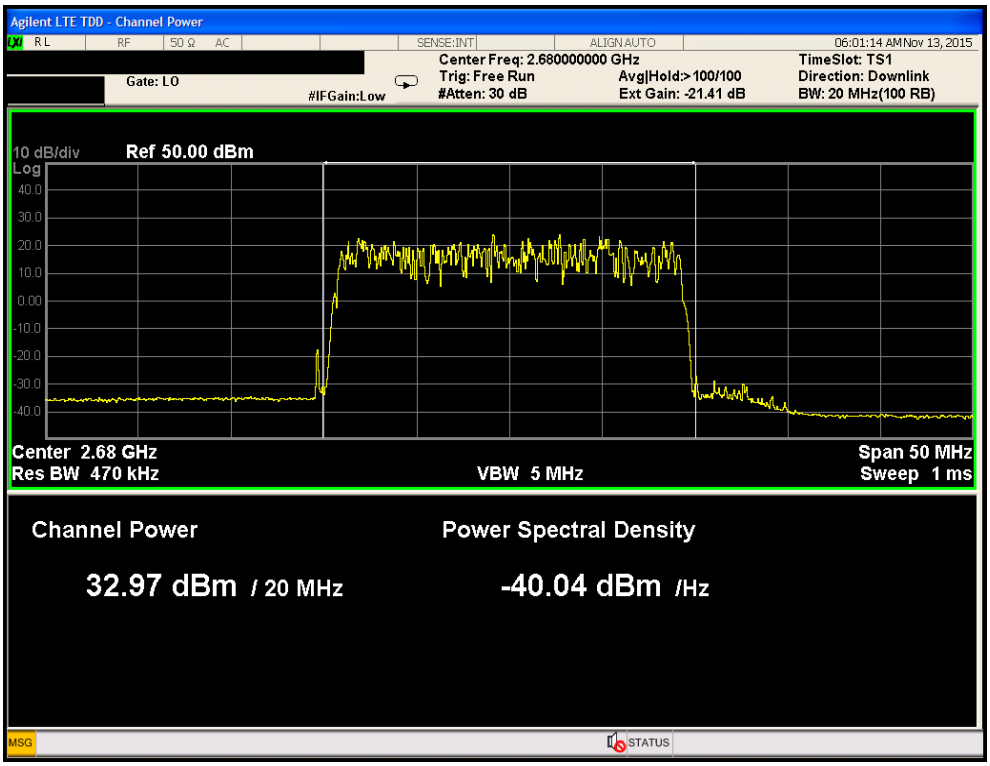
•Port1/ LTE 20M / 2506.0 MHz / 16QAM



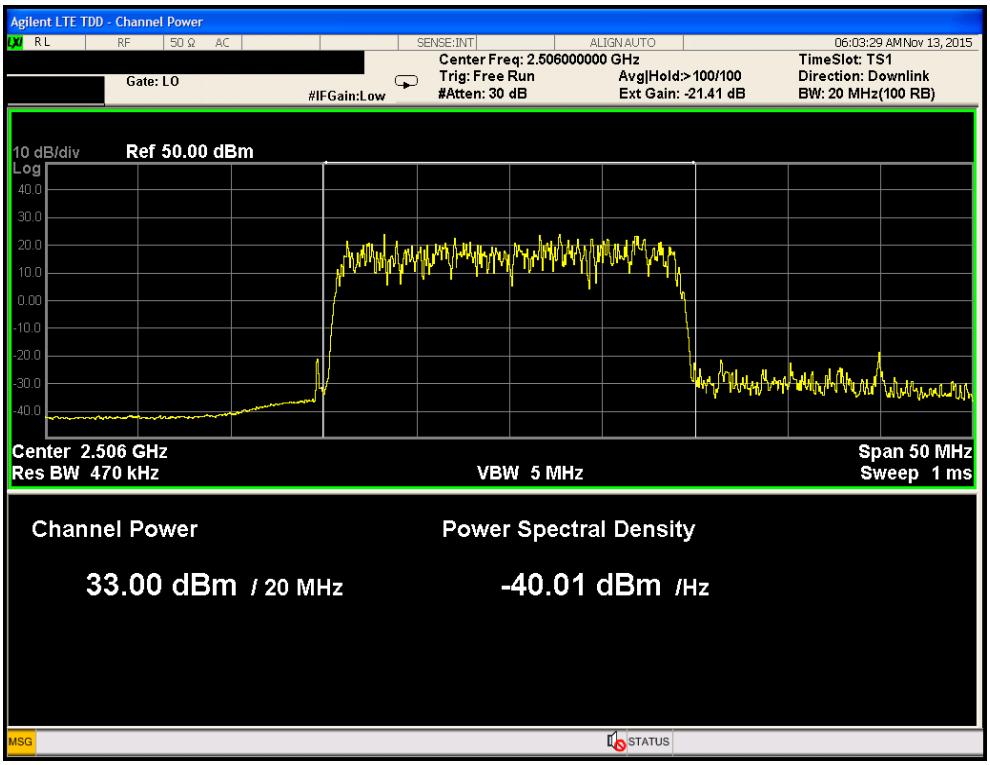
•Port1/ LTE 20M / 2593.0 MHz / 16QAM



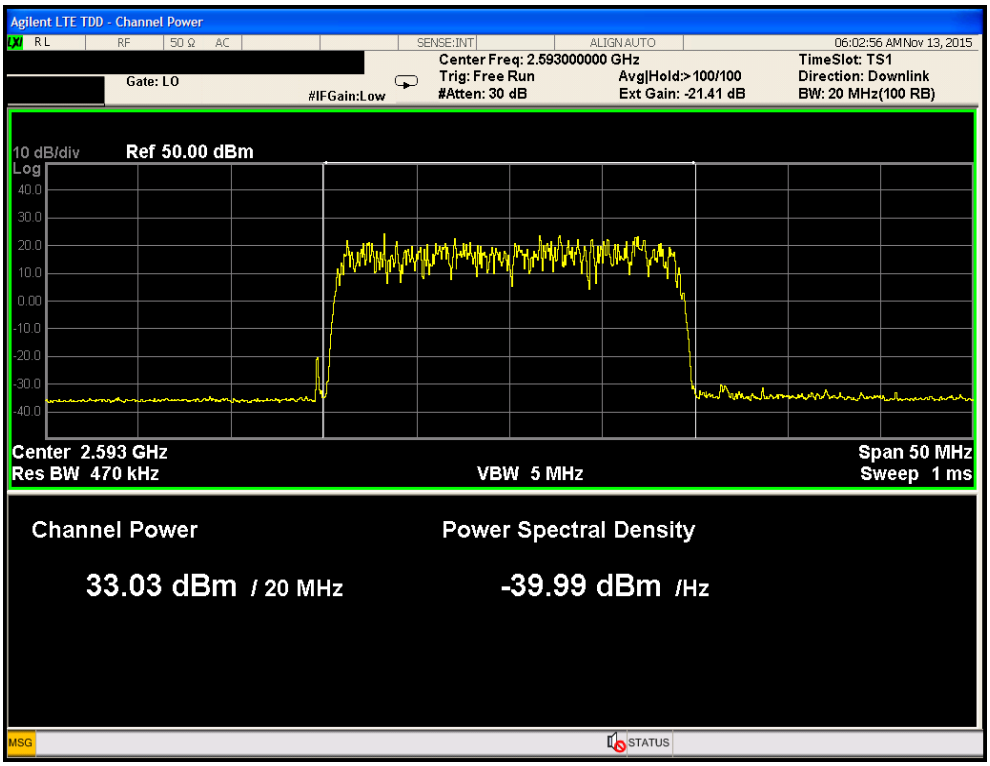
•Port1/ LTE 20M / 2680.0 MHz / 16QAM



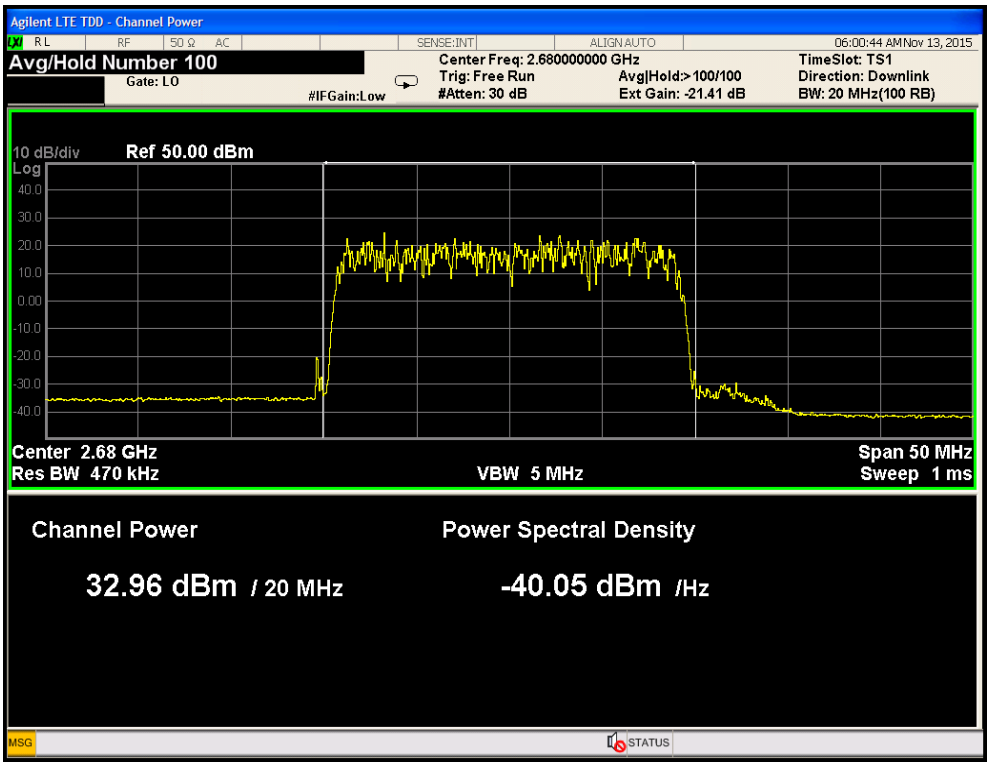
•Port1/ LTE 20M / 2506.0 MHz / 64QAM



•Port1/ LTE 20M / 2593.0 MHz / 64QAM



•Port1/ LTE 20M / 2680.0 MHz / 64QAM



3.5 Radiated spurious emission

3.5.1 Specification

- FCC Part 2.1053
- FCC Part 27.53

3.5.2 Test Description

The highest gain antenna to be used with the EUT was tested for final measurements. The EUT was configured for the lowest and the highest transmit frequency. For each configuration, the spectrum was scanned throughout the specified range. While scanning, emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis, and adjusting the measurement antenna height and polarization (per ANSI C63. 10:2009). A preamp and high pass filter were used for this test in order to provide sufficient measured sensitivity.

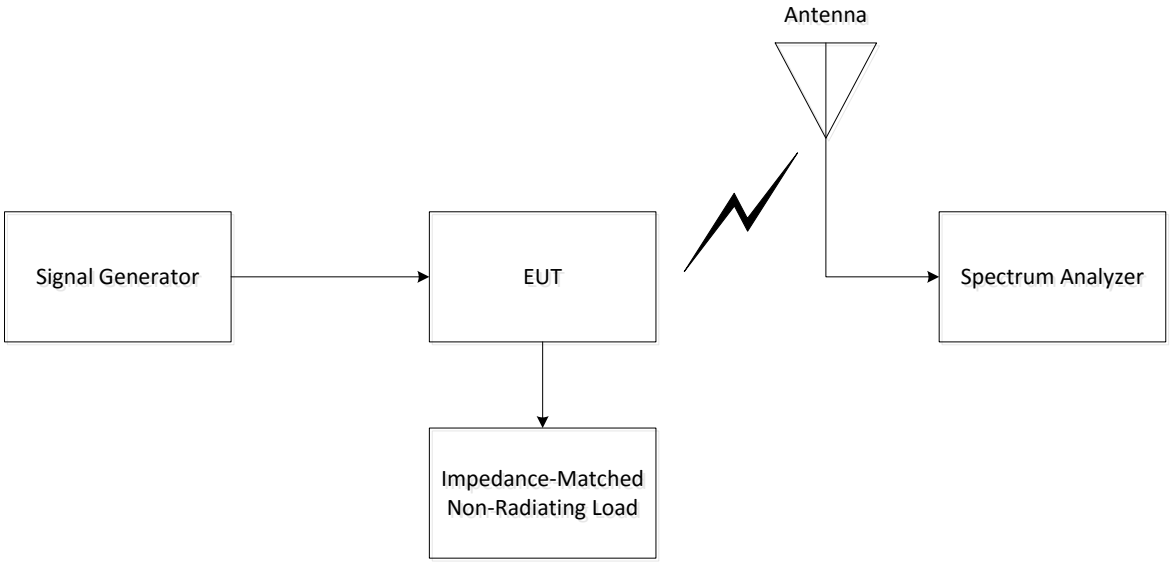
For licensed transmitters, the FCC reference TIA/EIA-603 as the measurement procedure standard. TIA/EIA-603 Section 2.2.12 describes a method for measuring radiated spurious emission that utilizes an antenna substitution method:

At an approved test site, the transmitter is place on a remotely controlled turntable, and the measurement antenna is place 3 meters from the transmitter.

The transmitter is place on a remotely controlled turntable, and the measurement antenna is placed 3 meters from the transmitter. The turntable azimuth is varied to maximize the level of spurious emissions. The height of the measurement antenna is also varied from 1 to 4 meters. The amplitude and frequency of the highest emission are noted. The transmitter is then replaced with a 1/2 wave dipole that is successively tuned to each of the highest spurious emission for emissions below 1 GHz, and a horn antenna for emission above 1 GHz.

A signal generator is connected to the dipole (horn antenna for frequency above 1GHz), and its output is adjusted to match the level previously noted for each frequency. The output of the signal generator is recorded, and by factoring in the cable loss to the antenna and its gain; the power(dBm) into an ideal 1/2 wave dipole antenna is determined for each radiated emission.

3.5.3 Set-Up



3.5.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-2500-SISO	Corning Optical Communications Wireless, Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
EMI Test Receiver	ESS	R&S
Bi-conical Antenna	VHA9103	R&S
Spectrum Analyzer	FSP	R&S
Log Periodic Antenna	VULP9118A	R&S
Turn table	DS 1500 S-1t-O	Innco GmbH
Antenna mast	MA4000-O	Innco GmbH
Controller	CO 2000	Innco GmbH

3.5.5 Test condition

• Test place: Shield Room
• Test environment: 22.5 °C, 42.5 % R.H.

3.5.6 Test results

• LTE 5 MHz / 2498.5 MHz / 64QAM

Frequency [MHz]	S/A [dBuV]	S/G [dBm]	Antenna gain [dBi]	Antenna polarity [H/V]	Cable loss [dB]	Total [dBm]	Limit [dBm]	Margin [dB]
60.05	18.30	-73.90	0.90	V	0.92	-72.92	-13.00	59.92
70.80	30.80	-59.10	1.34	V	0.97	-59.06	-13.00	46.06
91.89	26.55	-70.10	1.98	V	1.04	-68.37	-13.00	55.37
102.34	44.90	-45.10	1.39	V	1.07	-44.53	-13.00	31.53
112.53	28.15	-57.84	1.34	V	1.09	-57.59	-13.00	44.59
114.14	22.00	-52.85	0.97	V	1.26	-53.14	-13.00	40.14

• LTE 5 MHz / 2593.0 MHz / 64QAM

Frequency [MHz]	S/A [dBuV]	S/G [dBm]	Antenna gain [dBi]	Antenna polarity [H/V]	Cable loss [dB]	Total [dBm]	Limit [dBm]	Margin [dB]
60.03	17.15	-74.28	0.90	V	0.92	-74.30	-13.00	61.30
70.72	40.00	-59.11	1.34	V	0.97	-58.74	-13.00	45.74
91.86	27.11	-69.70	1.98	V	1.04	-68.76	-13.00	55.76
102.35	45.29	-45.12	1.39	V	1.07	-44.80	-13.00	31.80
112.44	28.50	-57.26	1.34	V	1.09	-57.01	-13.00	44.01
114.09	21.80	-52.32	0.97	V	1.26	-52.61	-13.00	39.61

• LTE 5 MHz / 2687.5 MHz / 64QAM

Frequency [MHz]	S/A [dBuV]	S/G [dBm]	Antenna gain [dBi]	Antenna polarity [H/V]	Cable loss [dB]	Total [dBm]	Limit [dBm]	Margin [dB]
60.09	17.18	-73.55	0.90	V	0.92	-73.57	-13.00	60.57
70.74	30.85	-58.89	1.34	V	0.97	-58.52	-13.00	45.52
91.84	27.10	-69.60	1.98	V	1.04	-68.66	-13.00	55.66
102.35	45.30	-44.68	1.39	V	1.07	-44.36	-13.00	31.36
112.43	28.44	-57.22	1.34	V	1.09	-56.97	-13.00	43.97
114.05	22.16	-52.28	0.97	V	1.26	-52.57	-13.00	39.57

Here, S/A is Spectrum Analyzer, S/G is Signal Generator, H is Horizontal and V is Vertical.

• LTE 20 MHz / 2506 MHz / 64QAM

Frequency [MHz]	S/A [dBuV]	S/G [dBm]	Antenna gain [dBi]	Antenna polarity [H/V]	Cable loss [dB]	Total [dBm]	Limit [dBm]	Margin [dB]
60.04	16.55	-72.15	0.90	V	0.92	-72.17	-13.00	59.17
70.79	30.95	-59.15	1.34	V	0.97	-58.78	-13.00	45.78
91.78	26.95	-69.49	1.99	V	1.04	-68.54	-13.00	55.54
102.35	45.29	-44.10	1.39	V	1.07	-43.78	-13.00	30.78
112.43	28.35	-57.07	1.34	V	1.09	-56.82	-13.00	43.82
174.06	24.95	-55.38	1.82	H	1.35	-54.91	-13.00	41.91

• LTE 20 MHz / 2593 MHz / 64QAM

Frequency [MHz]	S/A [dBuV]	S/G [dBm]	Antenna gain [dBi]	Antenna polarity [H/V]	Cable loss [dB]	Total [dBm]	Limit [dBm]	Margin [dB]
60.03	17.50	-73.00	0.90	V	0.92	-73.02	-13.00	60.02
70.78	31.25	-58.10	1.34	V	0.97	-57.03	-13.00	44.73
91.75	27.00	-69.11	1.99	V	1.04	-68.16	-13.00	55.16
102.35	45.00	-44.64	1.39	V	1.07	-44.32	-13.00	31.32
112.43	28.55	-56.87	1.34	V	1.09	-56.62	-13.00	43.62
174.05	24.75	-56.09	1.82	H	1.35	-55.62	-13.00	42.62

• LTE 20 MHz / 2680 MHz / 64QAM

Frequency [MHz]	S/A [dBuV]	S/G [dBm]	Antenna gain [dBi]	Antenna polarity [H/V]	Cable loss [dB]	Total [dBm]	Limit [dBm]	Margin [dB]
60.03	17.40	-72.75	0.90	V	0.92	-72.77	-13.00	59.77
70.75	31.22	-57.95	1.34	V	0.97	-57.58	-13.00	44.58
91.75	27.00	-69.41	1.99	V	1.04	-68.46	-13.00	55.46
102.34	45.41	-44.52	1.39	V	1.07	-44.20	-13.00	31.20
112.43	27.95	-57.01	1.34	V	1.09	-56.76	-13.00	43.76
174.04	25.60	-56.80	1.82	H	1.35	-56.33	-13.00	43.33

3.6 Frequency stability

3.6.1 Specification

- FCC Rules Part 2.1055
- FCC Rules Part 27.54

3.6.2 Test Description

A direct connect measurement was made between the EUT antenna cable and a spectrum analyzer. The spectrum analyzer is equipped with a precision frequency reference that exceeds the stability requirement of the EUT.

Measurements were made at the edges of the main transmit bands as called out on the data sheets. Testing was done with an absence of modulation in a CW mode of operation.

The primary supply voltage was varied from 85 % to 115 % of the nominal voltage using a temperature chamber, the transmit frequency was recorded at the extremes of the specified temperature (-30℃ to +50℃)

3.6.3 Test Procedure

The method used is as detailed in FCC KDB 935210 D05 v01.

The EUT was set up to the applicable test frequency with modulation. The EUT antenna terminal was conducted to the spectrum analyzer through an external attenuator (at the output test) and an appropriate coaxial cable.

The MAKER function was using for these evaluation.

3.6.4 Test equipment list

Equipment	Model Name	Manufacturer
EUT	HX-2500-SISO	Corning Optical Communications Wireless Inc.
MHU	HX-2500-MHU	Corning Optical Communications Wireless Inc.
Signal Generator	N5182A	Agilent
Spectrum Analyzer	N9020A	Agilent
Attenuator	PE7019-20	Pasternack
DC power supply	6674A	Agilent
Temp. / Humid. Chamber	SJ-1016-TH	Seo Jin

3.6.5 Test condition

- Test place: Temperature and Humidity Chamber
- Test environment: 22.5 °C, 42.5 % R.H.

3.6.6 Test result

• Port1 / 2 506 MHz

Voltage [%]	Supplied power [Vdc]	Temperature [ºC]	Frequency [MHz]	Deviation [ppm]	Limit [ppm]
85	40.8	-30	2 506	0.000199	1.50
		-20		-0.007999	
		-10		-0.006100	
		0		0.001100	
		+10		-0.003699	
		+20 (ref.)		-0.015999	
		+30		0.020100	
		+40		0.003600	
		+50		-0.002500	
100	48.0	-30		-0.004899	
		-20		0.004600	
		-10		0.003600	
		0		-0.006400	
		+10		0.010499	
		+20 (ref.)		0.001999	
		+30		0.010099	
		+40		0.006400	
		+50		0.008900	
115	55.2	-30		0.004399	
		-20		-0.003799	
		-10		-0.003200	
		0		0.018700	
		+10		0.005899	
		+20 (ref.)		-0.000100	
		+30		-0.002099	
		+40		-0.015600	
		+50		-0.004600	

• Port1 / 2 593 MHz

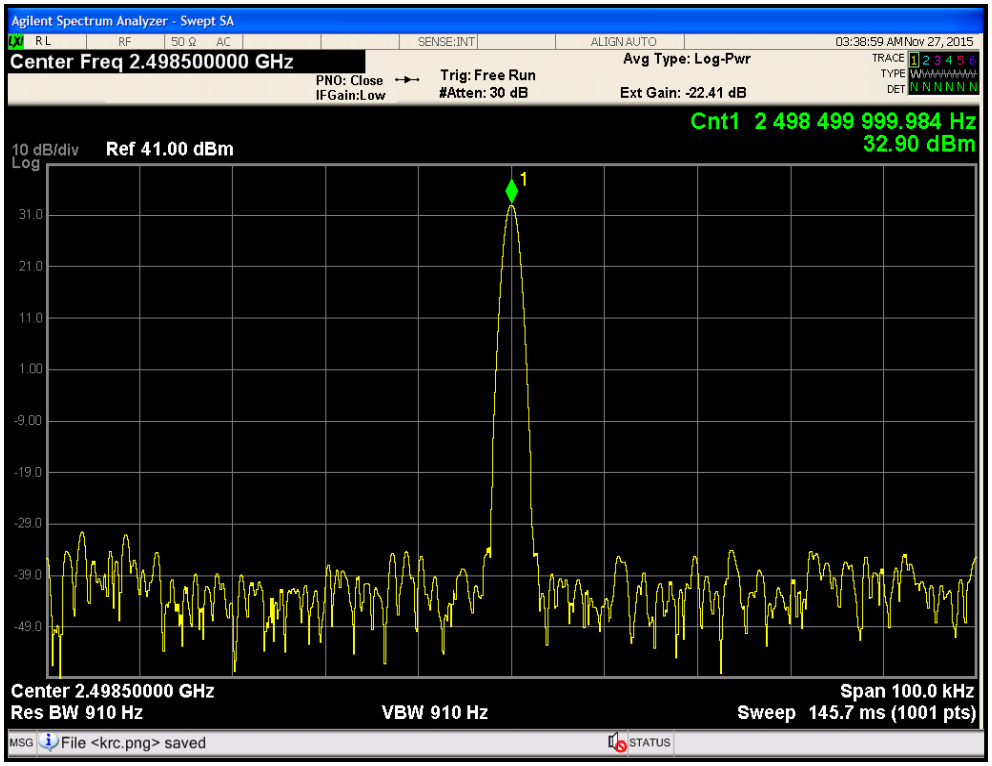
Voltage [%]	Supplied power [Vdc]	Temperature [°C]	Frequency [MHz]	Deviation [ppm]	Limit [ppm]
85	40.8	-30	2 593	-0.013299	1.50
		-20		-0.007199	
		-10		-0.021200	
		0		-0.002299	
		+10		0.009900	
		+20 (ref.)		0.014299	
		+30		0.001200	
		+40		0.008299	
		+50		-0.002600	
100	48.0	-30		-0.005499	
		-20		-0.022399	
		-10		0.000599	
		0		0.000000	
		+10		0.007900	
		+20 (ref.)		0.000000	
		+30		0.004899	
		+40		0.012300	
		+50		-0.007199	
115	55.2	-30		0.006800	
		-20		-0.014999	
		-10		0.008500	
		0		-0.002600	
		+10		-0.001999	
		+20 (ref.)		0.017600	
		+30		-0.001399	
		+40		-0.002799	
		+50		0.028800	

• Port1 / 2 680 MHz

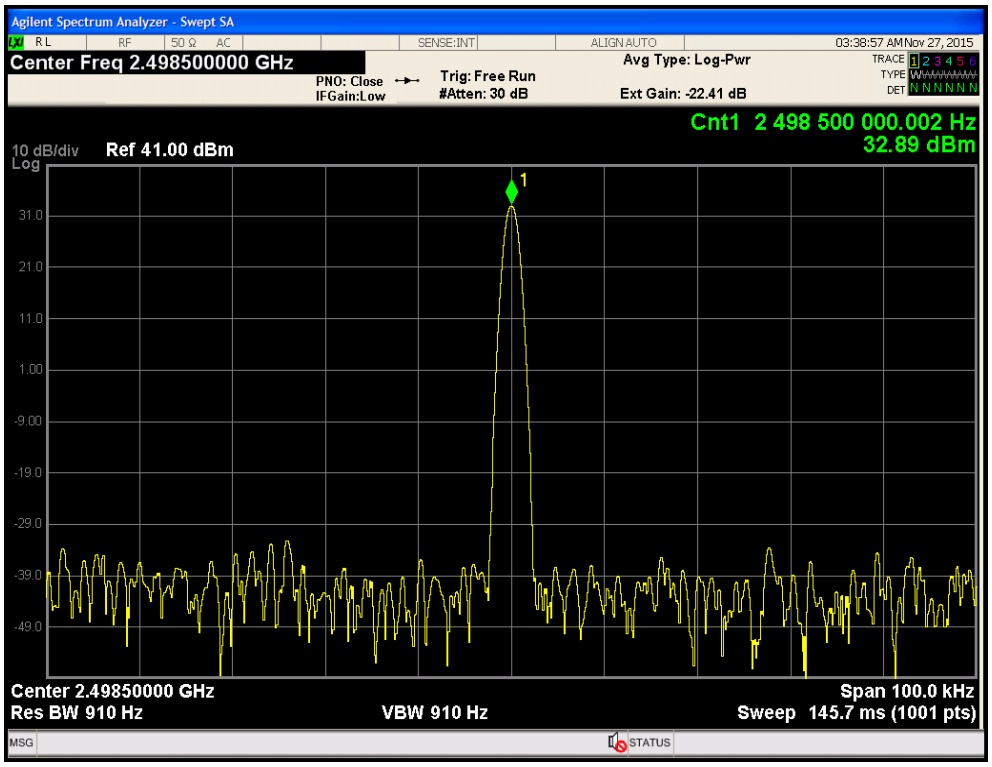
Voltage [%]	Supplied power [Vdc]	Temperature [°C]	Frequency [MHz]	Deviation [ppm]	Limit [ppm]
85	40.8	-30	2 680	0.015200	1.50
		-20		-0.007999	
		-10		0.008999	
		0		-0.006999	
		+10		0.007900	
		+20 (ref.)		0.000299	
		+30		0.004899	
		+40		0.003499	
		+50		-0.003099	
100	48.0	-30		-0.004899	
		-20		0.014500	
		-10		-0.001599	
		0		-0.001599	
		+10		0.008600	
		+20 (ref.)		0.008999	
		+30		0.014699	
		+40		-0.008200	
		+50		-0.011899	
115	55.2	-30		0.017899	
		-20		0.013000	
		-10		0.002299	
		0		-0.002299	
		+10		0.000400	
		+20 (ref.)		0.002799	
		+30		0.000599	
		+40		0.004499	
		+50		0.007199	

3.6.7 Test Plots

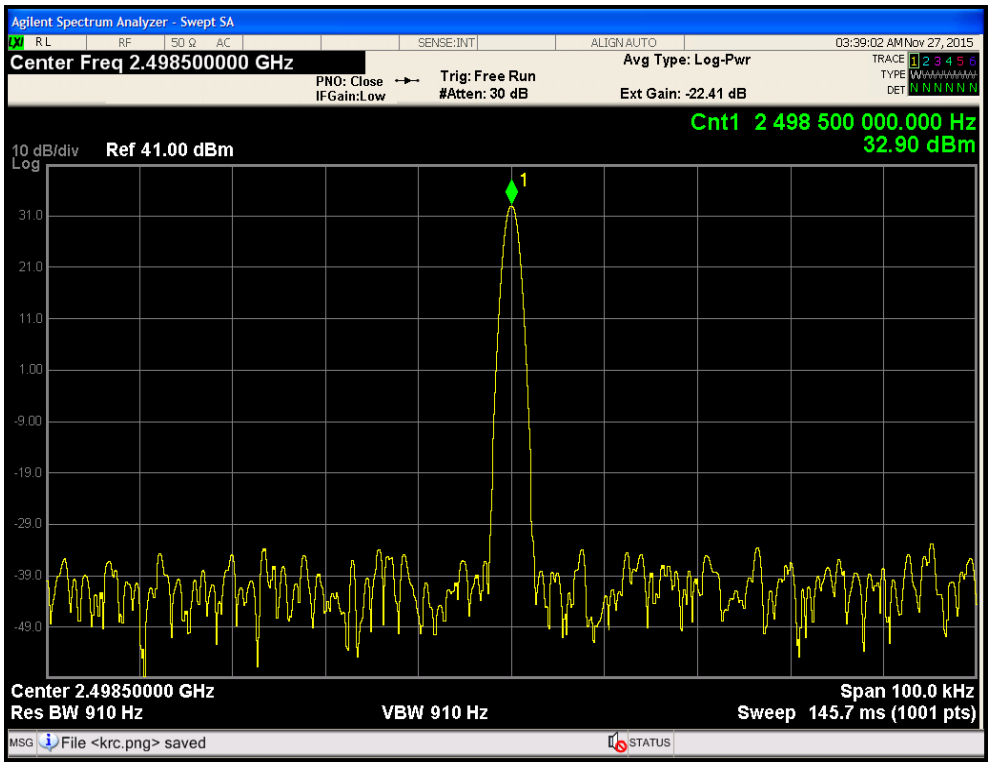
- **Port1 / 2 498.5 MHz / 85 %**



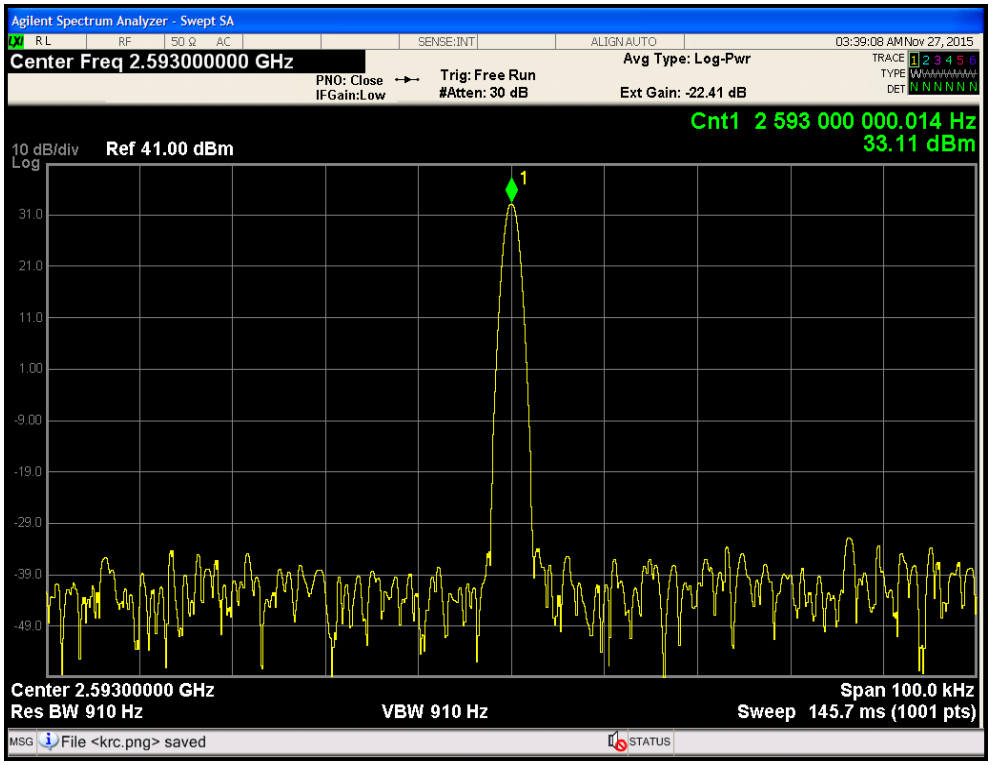
- **Port1 / 2 498.5 MHz / 100 %**



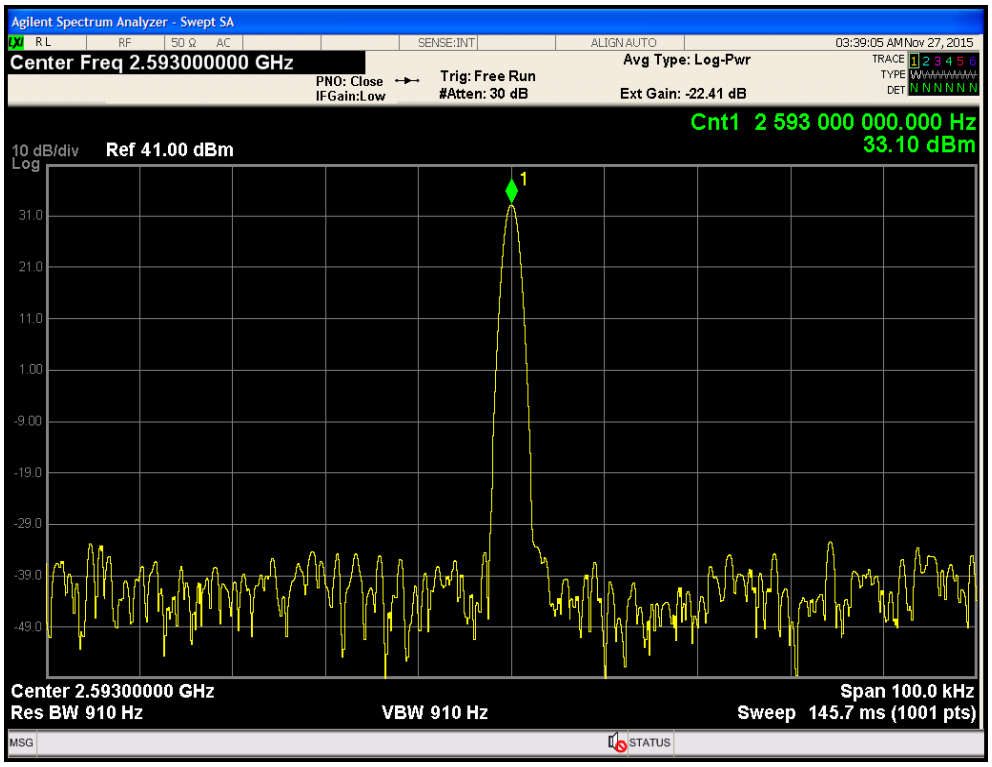
- **Port1 / 2 498.5 MHz / 115 %**



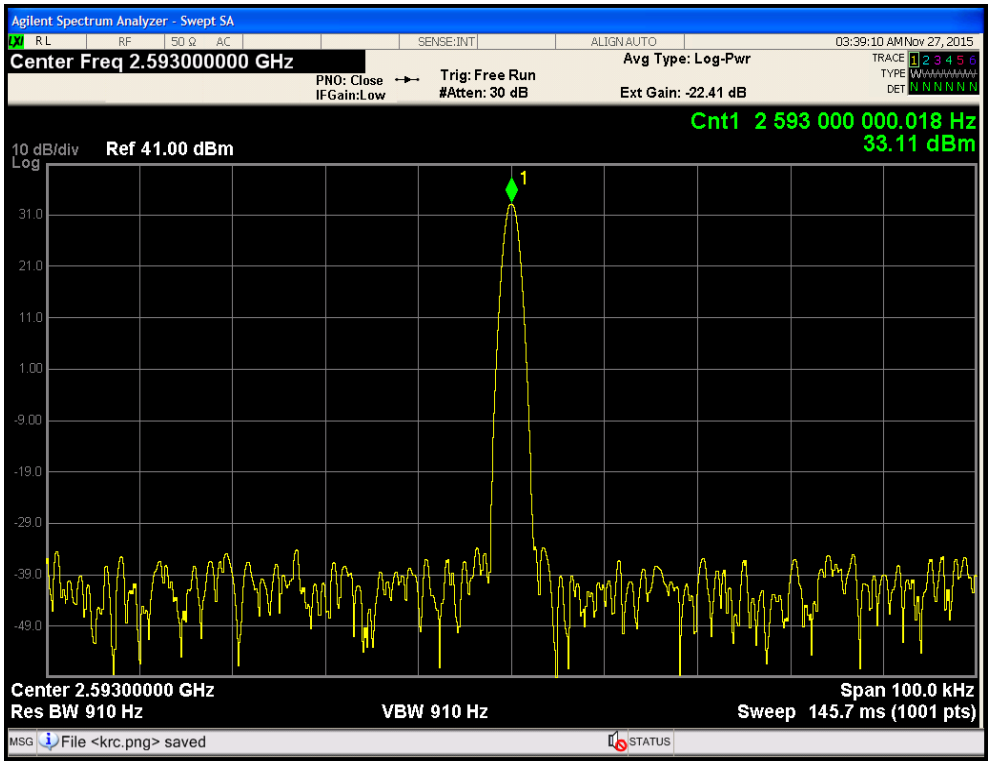
- **Port1 / 2 593 MHz / 85 %**



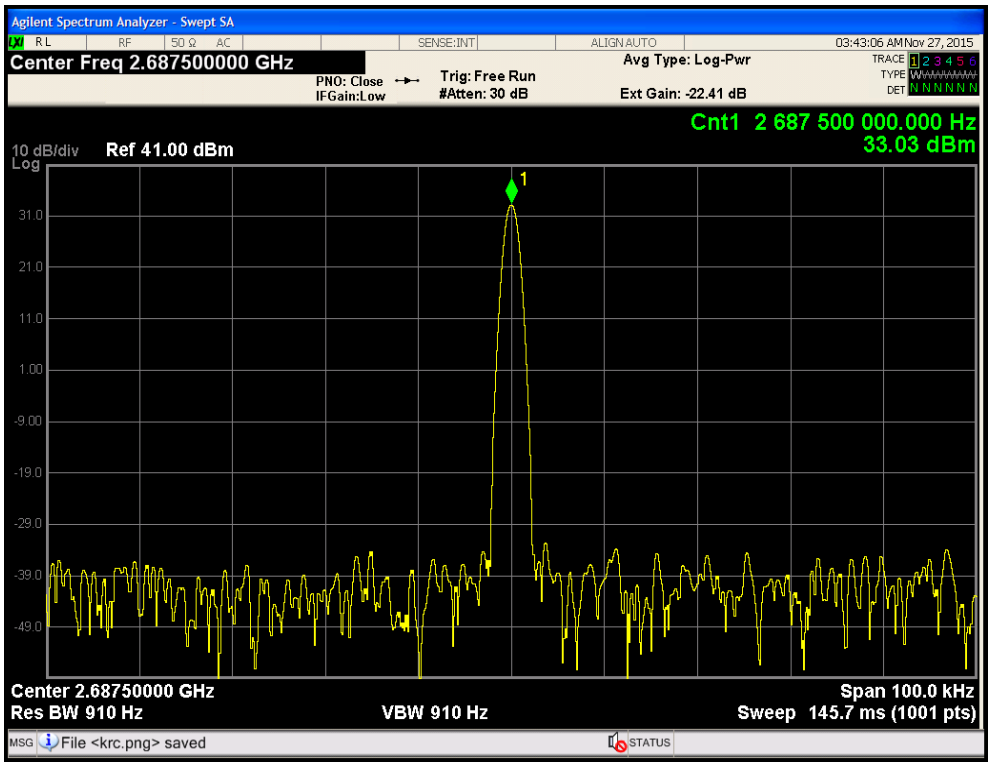
- **Port1 / 2 593 MHz / 100 %**



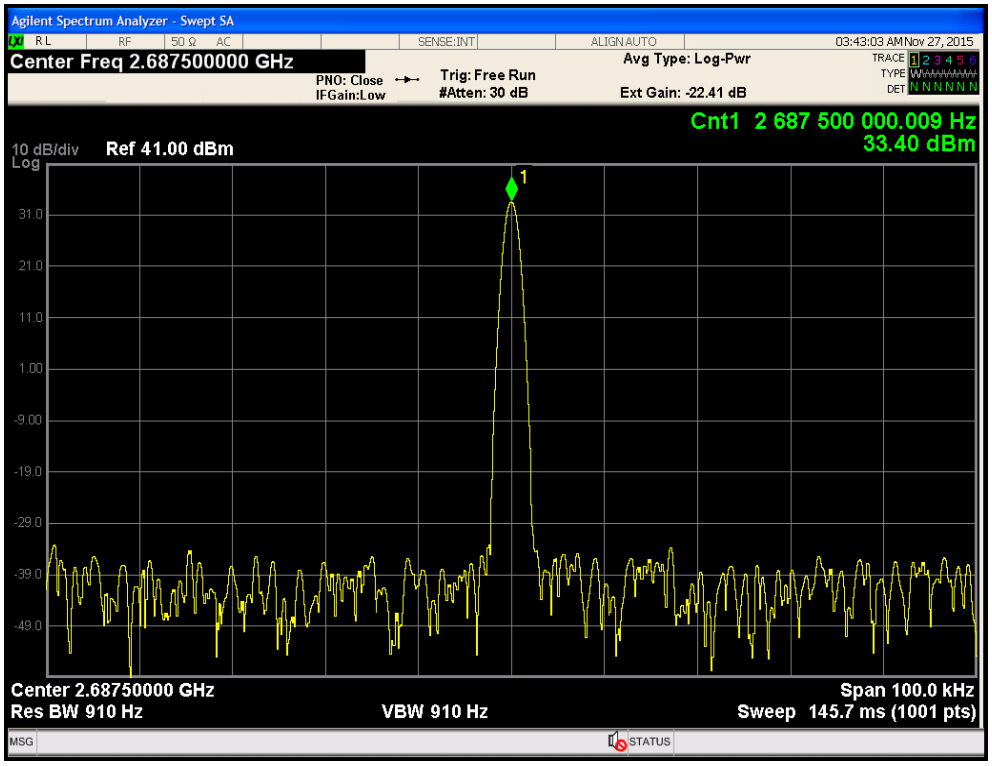
- **Port1 / 2 593 MHz / 115 %**



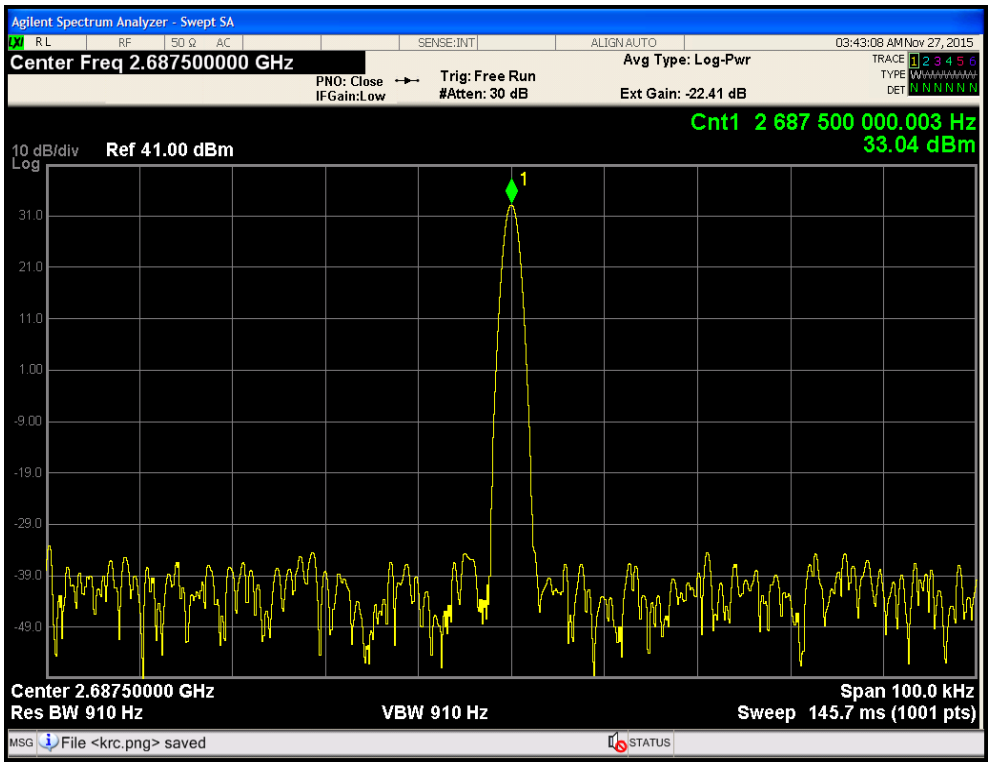
- **Port1 / 2 687.5 MHz / 85 %**



- **Port1 / 2 687.5 MHz / 100 %**



- **Port1 / 2 687.5 MHz / 115 %**



4. RF exposure statement

According to FCC Part1 Section 1.1307~1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Frequency Range [MHz]	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [mW/cm^2]	Averaging Time [minute]
Limits for General Population/Uncontrolled Exposure				
0.3 – 1.34	614	1.63	100	30
1.34 – 30	824/f	2.19/f	180/f^2	30
30 – 300	27.5	0.073	0.2	30
300 – 1500	-	-	f/1500	30
1500 – 100 000	-	-	1.0	30

Limits for General Population/Uncontrolled Exposure

Here, f = frequency in MHz

4.1 Friis transmission formula

$$P_d = (P_{out} \times G) / (4\pi r^2)$$

P_d = Power density
P_{out} = power input to antenna
G = power gain
r = distance to the center of radiation of the antenna

4.2 Information of Antenna

- **Service antenna model name: D5777i / Galtronics Corporation Ltd.**

Electrical Specification		
Frequency Range		2360 MHz ~ 2700 MHz
Polarization		Dual slant 45˚
Band Width		910 MHz
Gain		≥ 15 dBi
Beam width	Horizontal	27°
	Vertical	27°
VSWR		≤ 1.7:1
Impedance		50 Ω
IMD (3^{rd})		-150dBc (@ 2x43dBm)
Maximum input power		250 W

Mechanical Specification	
Operating Temperature	-40˚ ~ +70˚
Weight	~10 kg
Length	787 mm
Width	627 mm
Height	145 mm
RoHS	compliant
Ingress Protection	IP65(Outdoor)
Radome Color	White
Wind Survival Rating	241 km/h

4.3 Calculation of MPE at 100cm

• Port1

Bandwidth	Frequency [MHz]	Output power [dBm]	Antenna gain [dBi]	EIRP		Power density [mW/cm^2]	Limit [mW/cm^2]
				[dBm]	[W]		
LTE 5 MHz (64QAM)	2498.5	33.01	15.0	48.01	63.24	0.380727	1
	2593.0	32.98	15.0	47.98	62.80	0.378107	
	2687.5	32.99	15.0	47.99	62.95	0.378978	
LTE 10 MHz (64QAM)	2501.0	33.02	15.0	48.02	63.38	0.381605	
	2593.0	32.99	15.0	47.99	62.95	0.378978	
	2685.0	33.00	15.0	48.00	63.09	0.379852	
LTE 15 MHz (64QAM)	2503.5	32.98	15.0	47.98	62.80	0.378107	
	2593.0	33.02	15.0	48.02	63.38	0.381605	
	2682.5	33.02	15.0	48.02	63.38	0.381605	
LTE 20 MHz (64QAM)	2506.0	33.00	15.0	48.00	63.09	0.379852	
	2593	33.03	15.0	48.03	63.53	0.382485	
	2680.0	32.96	15.0	47.96	62.51	0.376639	

5. Test equipment list

The listing below denotes the test equipment for the test(s).

No.	Equipment	Model	Manufacturer	Serial Number	Calibration Due date
1	Spectrum analyzer	N9020A	Agilent	MY48010456	2016.01.20
2	Signal generator	N5182A	Agilent	MY49060695	2016.01.19
3	Attenuator	AF115A-09-34	Weinschel	18405	2016.01.20
4	Attenuator	PE7019-20	PASTERNACK	TEMP_1	2016.11.30
5	Biconical antenna	VHA9103	Schwarzbeck	2217	2017.11.04
6	Log-Periodic antenna	VULP9118A	Schwarzbeck	382	2017.11.04
7	Horn antenna	BBHA-9120D	Schwarzbeck	395	2017.06.05
8	Horn antenna	FR6517	Orbit Technology	0511106	2016.08.07
9	EMI Test Receiver	ESS	R&S	833776/011	2016.08.26
10	Preamp	8449B	Agilent	3008A02013	2016.04.16
11	RF Amplifier	SCU01	R&S	10020	2016.08.26
12	Turn table	DS 1500 S-1t-O	Innco GmbH	N/A	N/A
13	Turn table	ALL1.5TT	AIRLINK LAB	N/A	N/A
14	Antenna mast	MA4000-O	Innco GmbH	N/A	N/A
15	Antenna mast	ALL2.2MA	AIRLINK LAB	N/A	N/A
16	Controller	CO 2000	Innco GmbH	N/A	N/A
17	Controller	ALL-TC-V1.0	AIRLINK LAB	N/A	N/A