Radio Test Report

Application for Grant of Equipment Authorization

FCC Part 27 Subpart C
IC RSS-199 Issue 2
2496MHz – 2690MHz

FCC ID:	**2AD8UFZMFWHR01**
IC:	**109D-FZMFWHR01**
Model:	**FWHR**
Product Marketing Name:	**Flexi Zone Micro BTS**
APPLICANT:	**Nokia Solutions and Networks** **1455 W. Shure Dr.** **Arlington Heights, IL 60004**
TEST SITE(S):	**National Technical Systems - Plano** **1701 E Plano Pkwy #150** **Plano, TX 75074**
REPORT DATE:	**February 5th, 2016**
FINAL TEST DATES:	**January 27th – February 4th, 2016**
TOTAL NUMBER OF PAGES:	**90**

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REVISION HISTORY

Rev#	Date	Comments	Modified By
0	2/5/2016	(DRAFT) 1st release	Armando Del Angel
1	2/9/2016	Changes made per customer comments.	Armando Del Angel

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SCOPE

Tests have been performed on Nokia Solutions and Networks product FlexiZone Micro BTS Model FWHR, pursuant to the relevant requirements of the following standard(s) in order to obtain device certification against the regulatory requirements of the Federal Communications Commission.

- Code of Federal Regulations (CFR) Title 47 Part 2
- CFR Title 47 Part 27 Subpart C
- RSS-Gen Issue 4 November 2014
- RSS-199 Issue 2 October 2014

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 C63.4-2009
ANSI TIA-603-C
FCC KDB 971168 D01 v02r02

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 FlexiZone Micro BTS Model FWHR and therefore apply only to the tested samples. The samples were selected and prepared by Terrence Schwenk 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, 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 three Variations of Model FWHR. No additional models were described or supplied for testing. Of the three Variations listed below, only the Full band was fully tested in order to seek certification, the other two variations with sub band applications were partially tested in accordance to an abbreviated set of tests previously agreed with the TCB to demonstrate that such filters do not adversely affect the performance of the certified unit. Data included in Annex B of this report.

Sales Item Number	Description	Frequency Range
473531A	FWHR (full band)	2496-2690 MHz
473738A	FWHR (sub band high)	2593-2690 MHz
473737A	FWHR (sub band low)	2496-2593 MHz

STATEMENT OF COMPLIANCE

The tested samples of Nokia Solutions and Networks product FlexiZone Micro BTS Model FWHR 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

FCC Part 27 Subpart C and RSS-199 Issue 2 (Base Stations Operating in 2496MHz-2690MHz band)

FCC	IC	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§27.5(a)	N/A	Frequency range(s)	2501.0MHz – 2685.0MHz (10M LTE) 2503.5MHz – 2682.5MHz (15MHz LTE) 2506.0MHz – 2680.0MHz (20MHz)	2496.0MHz – 2690.0MHz	Pass
§2.1033(c)(4)	RSS-199 Section 4.1	Modulation Type	QPSK, 16QAM, 64QAM (10M, 15M, and 20M for each)	Digital	Pass
§27.50(a)	RSS-199 Section 4.4	Output Power	Conducted Output Power (Highest on Diversity Port) RMS: 45.3Bm EIRP will depend on antenna gain (unknown)	2000W EIRP	Pass
§27.50(a)	N/A	Peak to Average Ratio	9.33dB highest	13dB	Pass
§2.1049	RSS-199 Section 4.2	Emission Bandwidth (99%)	8.994MHz (10M LTE) 13.495MHz (15M LTE) 18.003MHz (20MHz LTE)	Remain in Block	Pass
N/A Informational	N/A Informational	Emission Bandwidth (26dB)	9.963MHz (10M LTE) 14.929MHz (15M LTE) 19.895MHz (20M LTE)	Remain in Block	Pass
Transmitter spurious emissions[1]					
§27.53(a)	RSS-199 Section 4.6	At the antenna terminals	< -16.03dBm	-16.03 dBm (per TX chain)	Pass
		Field strength	55.989dBuV/m at 1m Eq. to -48.782dBm EIRP	-13 dBm EIRP	Pass
Other details					
§27.54	RSS-199 Section 4.3	Frequency stability	Low = -16.16dBm High = -16.13dBm	Remain in Block (-16.03dBm)	Pass
§1.1310	RSS-102 Issue 5	RF Exposure	N/A		Pass[2]

Notes

Note 1 – Based on 1MHz RBW. In 1MHz bands immediately outside and adjacent to the frequency block an RBW of at least 1% of the emission bandwidth has been used.
Note 2 – Applicant's declaration on a separate exhibit based on hypothetical antenna gains.

	Emission Designators					
	LTE-QPSK		LTE-16QAM		LTE-64QAM	
	FCC	IC	FCC	IC	FCC	IC
10M	9M95F9W	8M98F9W	9M94F9W	8M99F9W	9M96F9W	8M98F9W
15M	14M86F9W	13M50F9W	14M81F9W	13M49F9W	14M93F9W	13M45F9W
20M	19M89F9W	18M00F9W	19M70F9W	17M99F9W	19M90F9W	17M97F9W

Note: FCC based on 26dB emission bandwidth, IC based on 99% emissions 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 FlexiZone Micro Base Transceiver Station (BTS), model FWHR which operates over 3GPP frequency band 41 (BTS Tx/RX: 2496 to 2690 MHz). The FWHR has two co-located transmitters with each transmit port supporting 20 watts maximum rated RF output power. The FWHR can be operated as MIMO or as non-MIMO. Multi-carrier operation is supported.

The FWHR supports three downlink modulation types for LTE (QPSK, 16QAM and 64QAM). The FWHR supports three LTE channel bandwidths (10 MHz, 15 MHz, and 20 MHz).

The FWHR has external interfaces including AC power, ground, TX/RX (Ant), Ethernet "B", Ethernet "C", USB port, GPS and Bluetooth. The FWHR with applicable installation kit may be pole or wall mounted. Bluetooth interface has modular FCC and IC approval.

The FWHR LTE channel numbers and frequencies are as follows:

	Downlink EARFCN	**Downlink Frequency (MHz)**	**LTE Channel Bandwidth**		
			10 MHz	**15 MHz**	**20 MHz**
Band 41 (Ant 1 & 2)	39650	2496.0	Bandedge	Bandedge	Bandedge
	39700	2501.0	Low Ch.		
	39725	2503.5		Low Ch.	
	39750	2506.0			Low Ch.
	40620	2593.0	Middle Ch.	Middle Ch.	Middle Ch.
	41490	*2680.0*			Top Ch.
	41515	2682.5		Top Ch.	
	41540	2685.0	Top Ch.		
	41589	2690.0	Bandedge	Bandedge	Bandedge

FWHR Downlink LTE Frequency Channels

The samples were received on January 26, 2016 and tested on January 27 – February 4, 2016. The only difference between the three serial numbers is the Band Filter used. Full Certification Testing was performed on Serial Number: RY154800521, Abbreviated testing was performed on Serial Number RY154800540 for the Upper Sub-Band and Serial Number: RY154800549 for the Lower Sub-Band. The EUT consisted of the following component(s):

Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	FWHR	FlexiZone Micro BS	Part#: 473548 Serial#: RY154800521	FCC ID: 2AD8UFZMFWHR01 IC:109D-FZMFWHR01
Nokia Solutions and Networks	FWHR	FlexiZone Micro BTS	Part#: 473548 Serial#: RY154800540	FCC ID: 2AD8UFZMFWHR01 IC: 109D-FZMFWHR01
Nokia Solutions and Networks	FWHR	FlexiZone Micro BTS	Part#: 473548 Serial#: RY154800549	FCC ID: 2AD8UFZMFWHR01 IC: 109D-FZMFWHR01

ENCLOSURE

The EUT enclosure is made of heavy duty aluminum and measures approximately 12(W) x 4(D) x 12(H) inches.

AUXILLARY EQUIPMENT

Company	Model	Description	Part/Serial Number	FCC ID/IC Number
N/A	N/A	N/A	N/A	N/A

SUPPORT EQUIPMENT

Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	086479A. X31	Nokia Argon HDMI	RY134602016	N/A
HP	Elite Book 8530w	Laptop PC	2CE918Bk1Q	N/A

EUT INTERFACE PORTS

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

Cable	Type	Shield	Length	Used in Test	Quantity	Termination
AC Power	Power	No	~ 3 m	Yes	1	Power Supply
Earth	Earth	No	~ 1 m	Yes	1	Lab earth ground
TX/RD D	RF	Yes	~ 1 m	Yes	1	50Ω Load
TX/RD M	RF	Yes	~ 1 m	Yes	1	50Ω Load
BH B	Signal	Yes	> 6 m	Yes	1	Laptop
BH C	Signal	Yes	> 6 m	Yes	1	Laptop

The connector layout for FWHR is provided below:

Figure 44 Flexi Zone Micro BTS (FWHR) interfaces - bottom view

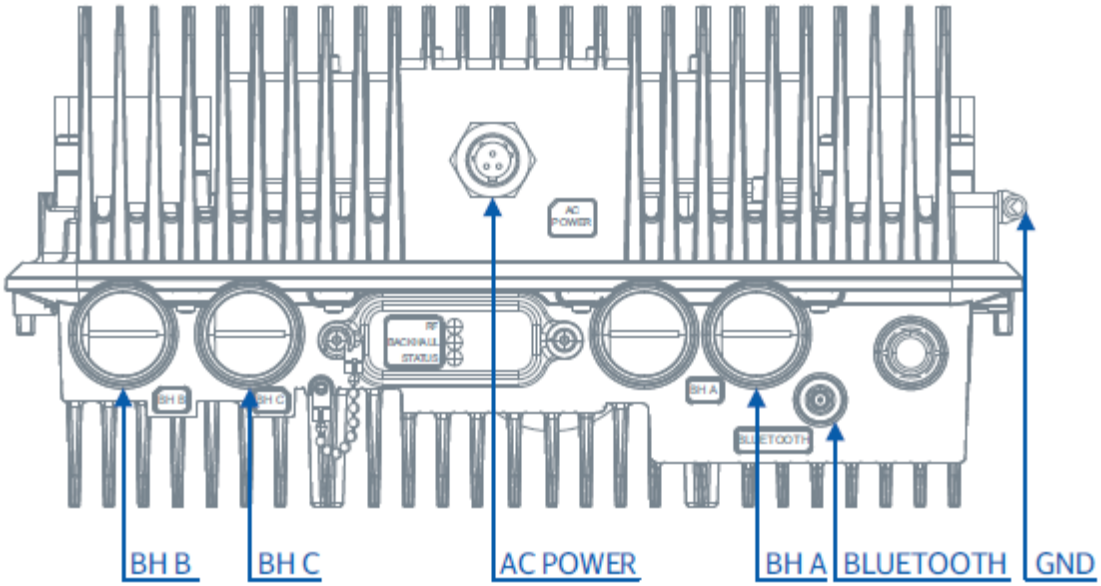
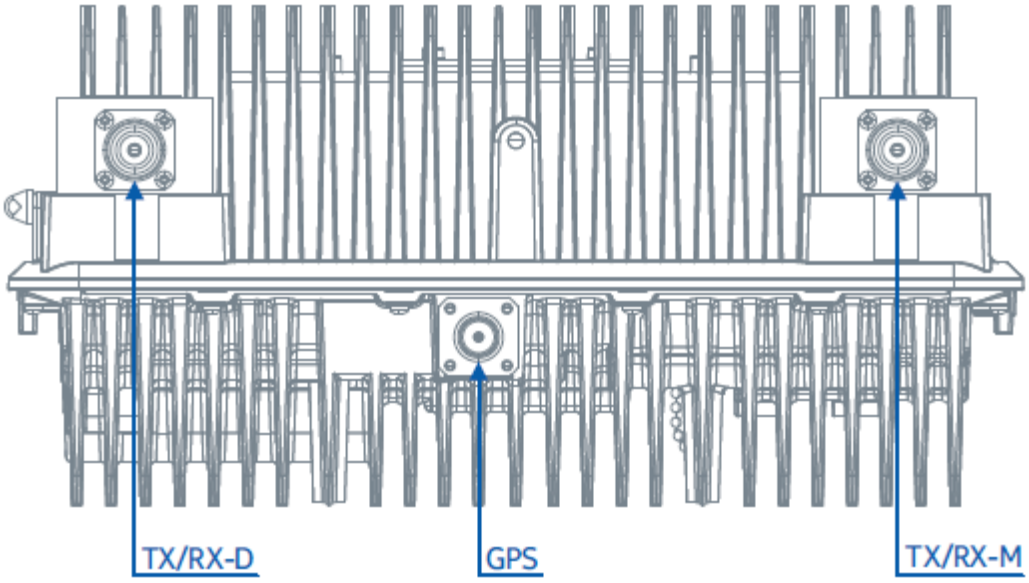


Figure 45 Flexi Zone Micro BTS (FWHR) interfaces - top view



FWHR External Interfaces:

Interface	Description
AC POWER	MIL-C-38999 standard size 9 shell power connector
BH A / D	Fiber-only backhaul interface
BH B	Copper-only backhaul interface with PoE (IEEE 802.3at-compliant)
BH C	Copper-only backhaul interface
BLUETOOTH	SMA Bluetooth antenna connector
GND	Grounding
GPS	Type N GPS antenna connector
TX/RX-D	4.1/9.5 Mini DIN antenna connector (diversity)
TX/RX-M	4.1/9.5 Mini DIN antenna connector (main)

EUT OPERATION

During testing, the EUT was transmitting continuously with 70% duty-cycle at full power on all chains.

EUT FIRMWARE/SOFTWARE

The laptop PC connects to the EUT over the Ethernet port. The laptop is used for changing configuration settings, monitoring tests and controlling the FWHR. The following software versions are used for the FWHR testing:

(1) LabVIEW Software: Version 2012

(2) EUT Firmware: FB_PS_REL_2014_05_374

MODIFICATIONS

No modifications were made to the EUT during testing.

TESTING

GENERAL INFORMATION

Antenna port measurements were taken at NTS Plano branch located at 1701 E Plano Pkwy #150 Plano, TX 75074.

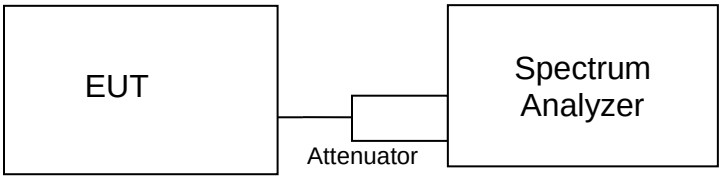
Radiated spurious emissions measurements were taken at the NTS Plano Anechoic Chamber listed below. The sites conform to the requirements of ANSI C63.4-2009 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz* and CISPR 16-1-4:2007 - *Specification for radio disturbance and immunity measuring apparatus and methods Part 1-4: Radio disturbance and immunity measuring apparatus Ancillary equipment Radiated disturbances*. 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	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

Output power, emission bandwidth, conducted spurious, conducted bandedge and carrier frequency stability measurements were all performed via a spectrum analyzer connected to the individual RF chains via a 40dB attenuator and an RF cable. The EUT was operating in 2x2 MIMO configuration at full power for all tests. While measuring one transmit chain, the other one was terminated with termination blocks. All measurements were corrected for the insertion loss of the attenuator and cable inserted between the RF port of the EUT and the spectrum analyzer. Simple test diagram is shown below.



Test Configuration for Antenna Port Measurements

26dB emission bandwidth was measured in accordance with Section 4.1 of FCC KDB 971168 D01 v02r02. 99% occupied bandwidth was measured in accordance with Section 6.6 of RSS-Gen Issue 4. For both measurements an NTS custom software tool was used. Spectrum analyzer settings are shown on their corresponding plots in test results section.

Emissions at the band-edges were also captured with an NTS custom software tool with settings described in the corresponding sections of the FCC and IC rules. 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. An NTS custom software tool was used for power integration to compensate for resolution bandwidth limitations of the spectrum analyzer and settings are shown on their corresponding plots in test results section.

Peak to average power ratio was calculated in accordance with Section 5.7.2 of FCC KDB 971168 D01 v02r02.

Conducted spurious emissions were captured with TILE6 software which corrected the readings for cable loss and attenuator loss across the 9kHz-27GHz frequency span. Settings of the spectrum analyzer are described in the corresponding test result section. The Internal attenuation for the Spectrum Analyzer was reduced from 20dB to 0dB to measure emissions in the 3-27GHz ranges to reduce measurement instrumentation noise floor.

For frequency stability, 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 spectrum analyzer as detailed in the test equipment section has been used to measure the Bandedges at the Low and High channels, making sure they remain inside the allocated frequency band.

Transmitter radiated spurious emissions measurements were made in accordance with ANSI C63.4-2009 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-C-2004. 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 27GHz with a peak detector (RBW=1MHz, VBW=3MHz, with trace max hold over multiple sweeps). Based on the preliminary scan results, frequencies of interest have been maximized via rotating the EUT 360 degrees and varying the height of the test antenna (1m to 4m). Final measurements were also taken with the peak detector as described above. A biconilog antenna was used for 30MHz-1GHz range. A double ridged waveguide horn antenna was used for 1-18GHz range and a smaller horn antenna was used for 18-27GHz 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.

Test Equipment

NTS Equipment #	Description	Manufacturer	Model	Calibration Duration	Calibration Due Date
E1529P	PSA	Agilent	E4446A	12 Months	3/3/2016
E1554P	PreAmp (1GHz-40GHz)	MITEQ	JS32-00104000-62-5P	12 Months	1/27/2017
E1364P	PreAmp (30MHz-1GHz)	MITEQ	AM-1431-N-1197SC	12 Months	3/27/2016
E1289P	Biconilog Antenna (30MHz-1GHz)	ETS Lindgren	3142C	12 Months	3/19/2016
E1019P	Horn Antenna (1GHz-18GHz)	EMCO	3115	12 Months	11/18/2016
E1068P	Horn Antenna (18GHz-40GHz)	EMCO	3116	12 Months	6/5/2016
E1447P	RMS Multimeter	Fluke	87V	12 Months	5/27/2016
ENV1035P	Thermometer	Fluke	52 II	12 Months	4/9/2016
ENV1195P	Climatic Chamber	Thermotron	SE-300-2-2	N/A	NCR

Appendix A Test Data

RF Output Power

RF output power has been measured in both Peak and RMS Average terms for each transmit chain at the center channel for all modulations and bandwidth modes. Peak to average ratio (PAR) has been calculated as described in Section 5.7.2 of KDB971168 D01 v02r02 and all results are presented in tabular form below.

		LTE - QPSK			LTE - 16QAM			LTE - 64QAM		
		Peak	Average	PAR	Peak	Average	PAR	Peak	Average	PAR
Port 1 Center Channel	10M	52.55	44.54	8.01	53.14	44.46	8.68	53.24	44.37	8.87
	15M	53.44	44.47	8.97	53.47	44.22	9.25	52.41	44.41	8
	20M	53.41	44.35	9.06	53.35	44.45	8.9	52.46	44.31	8.15
Port 2 Center Channel	10M	52.78	44.91	7.87	53.94	45.15	8.79	54	45.22	8.78
	15M	54.17	45.25	8.92	54.3	45.1	9.2	53.16	45.12	8.04
	20M	54.13	45.14	8.99	54.07	45.22	8.85	53.28	45.15	8.13
Combined Center Channel	10M	55.68	47.74	7.94	56.57	47.83	8.74	56.65	47.83	8.82
	15M	56.83	47.89	8.94	56.92	47.69	9.23	55.81	47.79	8.02
	20M	56.8	47.77	9.03	56.74	47.86	8.88	55.9	47.76	8.14

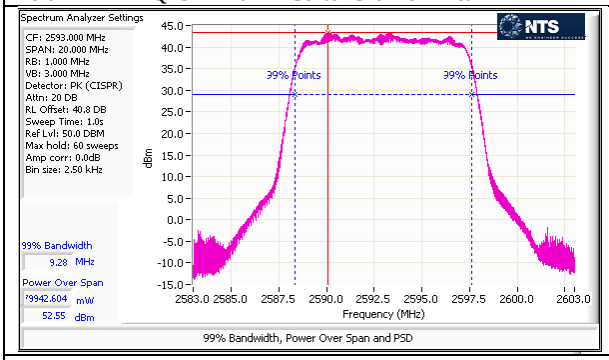
Based on the results above, Port 2 (Diversity Port) had the highest RMS average power and therefore it was selected for all the remaining antenna port tests on the product.

Subsequently output power levels on lowest and highest channels in all 4 channel bandwidths were tested only at Port 2 (Diversity Port) and results presented below.

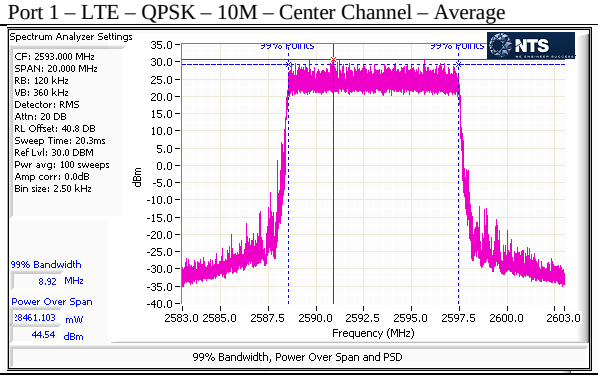
		LTE - QPSK			LTE - 16QAM			LTE - 64QAM		
		Peak (dBm)	Average (dBm)	PAR (dB)	Peak (dBm)	Average (dBm)	PAR (dB)	Peak (dBm)	Average (dBm)	PAR (dB)
Port 2 Low Channel	10M	52.27	43.5	8.77	52.2	43.6	8.6	51.48	43.51	7.97
	15M	52.56	43.67	8.89	52.61	43.3	9.31	51.51	43.54	7.97
	20M	52.53	43.57	8.96	52.48	43.61	8.87	51.76	43.64	8.12
Port 2 High Channel	10M	53.87	45.18	8.69	53.99	45.3	8.69	53.12	45.1	8.02
	15M	53.95	45.09	8.86	54.08	44.75	9.33	53.13	45.04	8.09
	20M	52.21	45.18	7.03	54.11	45.16	8.95	53.22	45.08	8.14

All corresponding plots included on the following pages. Total path loss of 40.8dB (Attenuator Loss: 40dB, RF cable loss: 0.8dB) accounted in via reference level offset to the spectrum analyzer.

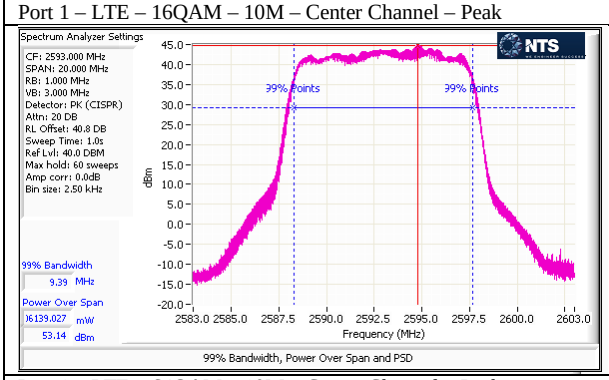
Port 1 – LTE – QPSK – 10M – Center Channel – Peak



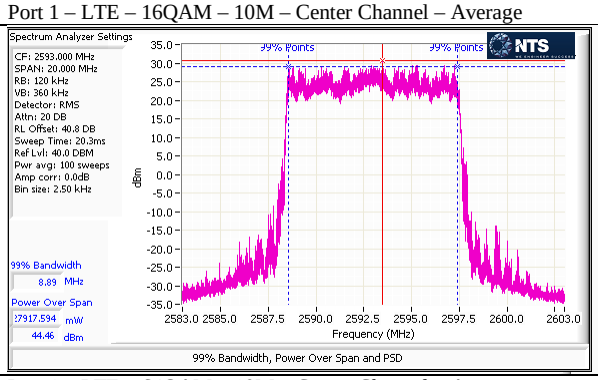
Port 1 – LTE – QPSK – 10M – Center Channel – Average



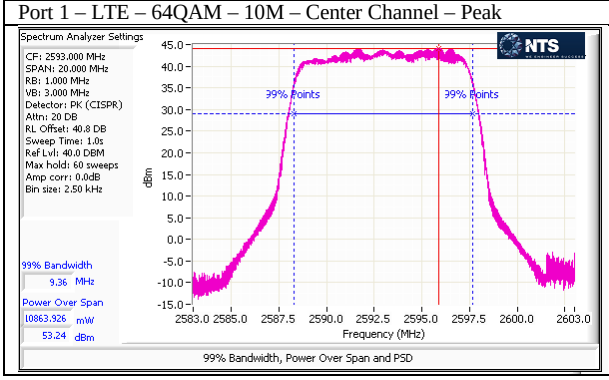
Port 1 – LTE – 16QAM – 10M – Center Channel – Peak



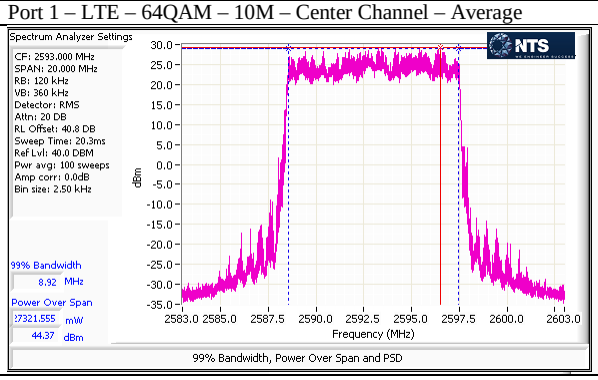
Port 1 – LTE – 16QAM – 10M – Center Channel – Average



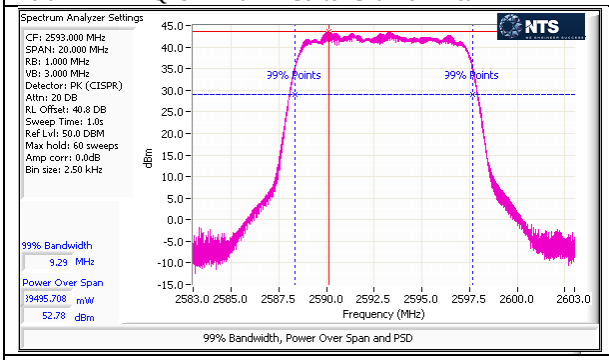
Port 1 – LTE – 64QAM – 10M – Center Channel – Peak



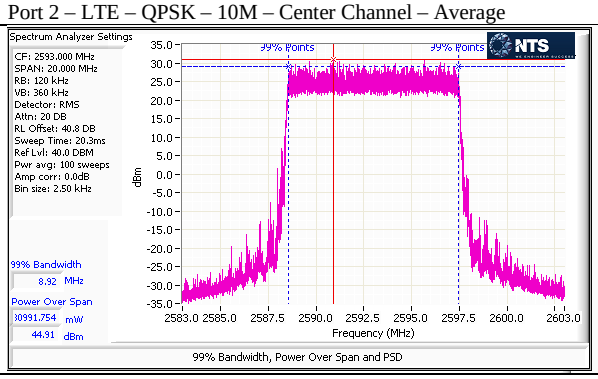
Port 1 – LTE – 64QAM – 10M – Center Channel – Average



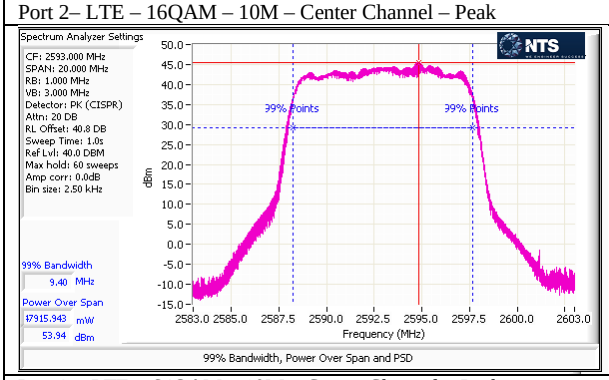
Port 2 – LTE – QPSK – 10M – Center Channel – Peak



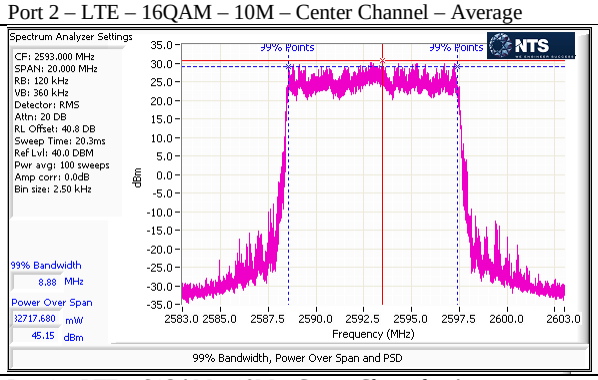
Port 2 – LTE – QPSK – 10M – Center Channel – Average



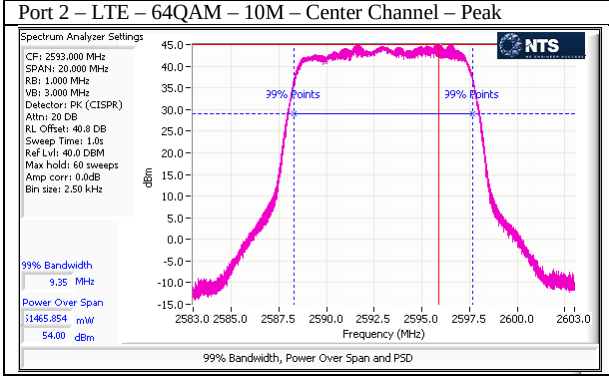
Port 2– LTE – 16QAM – 10M – Center Channel – Peak



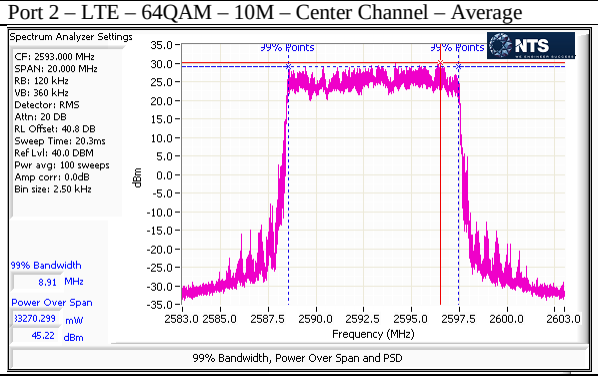
Port 2 – LTE – 16QAM – 10M – Center Channel – Average



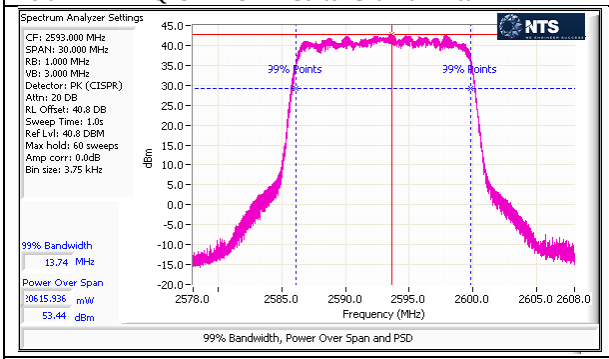
Port 2 – LTE – 64QAM – 10M – Center Channel – Peak



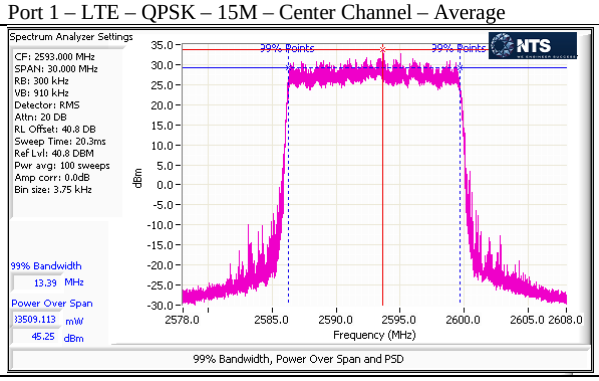
Port 2 – LTE – 64QAM – 10M – Center Channel – Average



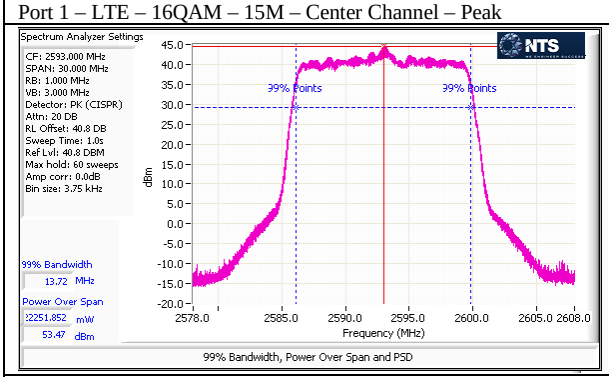
Port 1 – LTE – QPSK – 15M – Center Channel – Peak



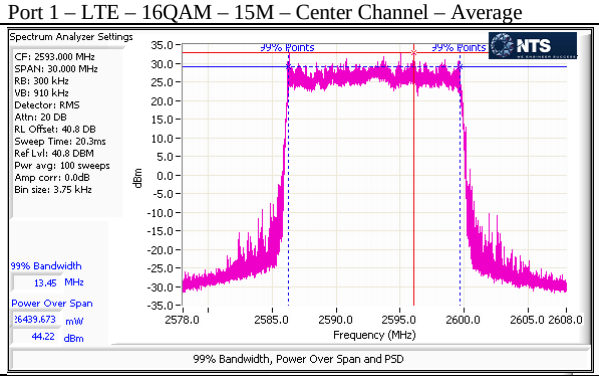
Port 1 – LTE – QPSK – 15M – Center Channel – Average



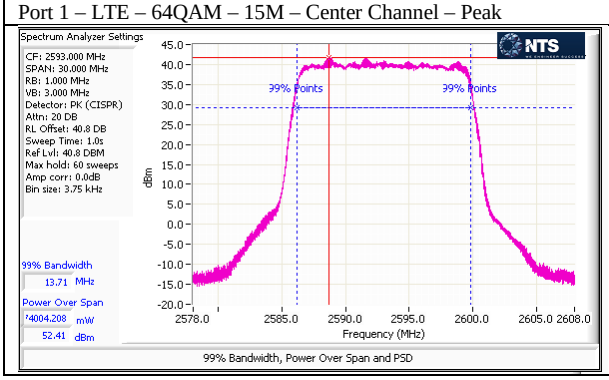
Port 1 – LTE – 16QAM – 15M – Center Channel – Peak



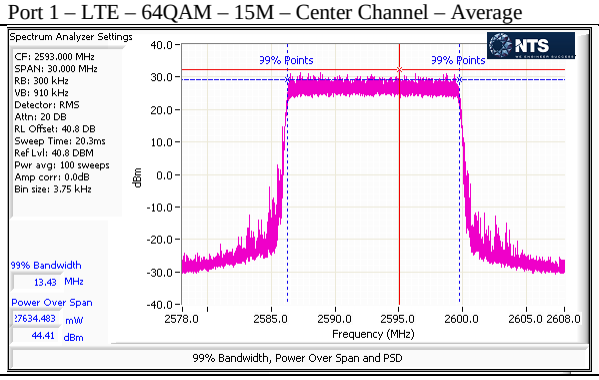
Port 1 – LTE – 16QAM – 15M – Center Channel – Average

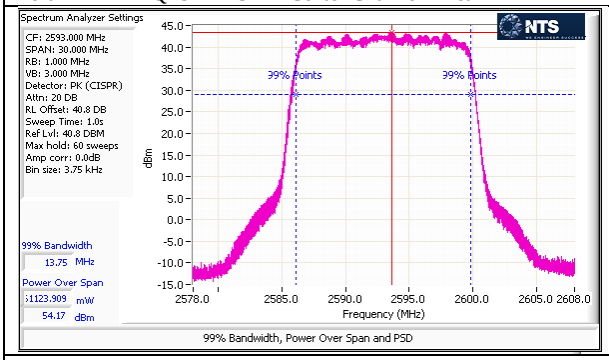
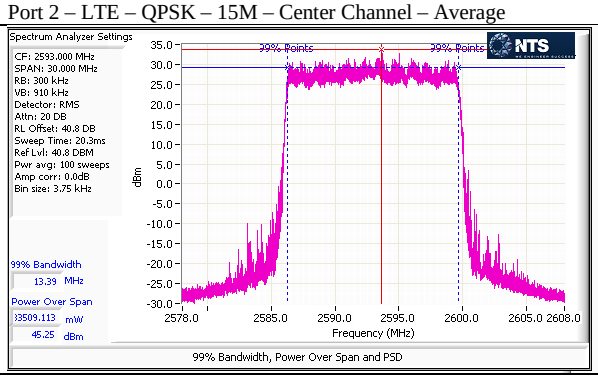
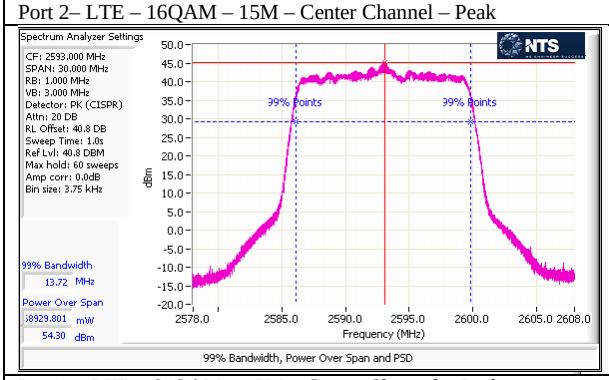
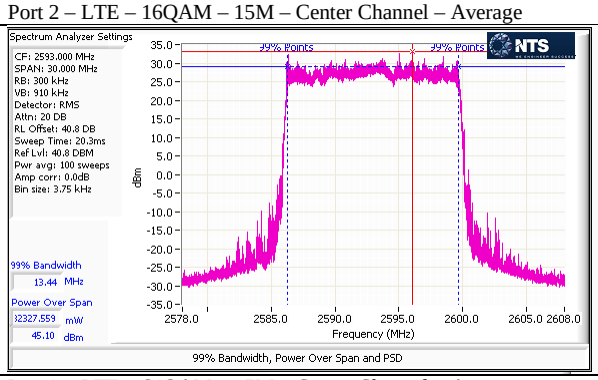
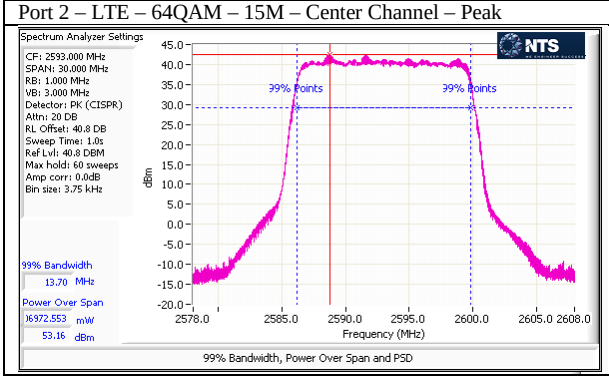
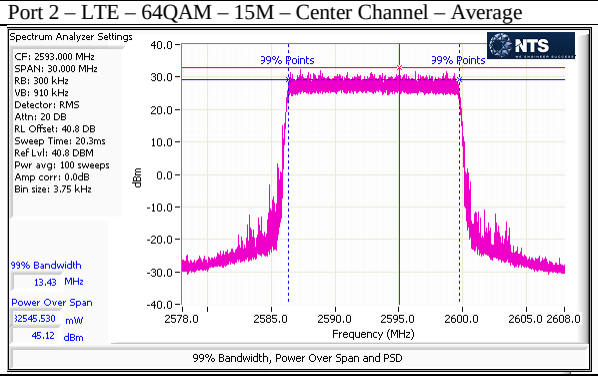


Port 1 – LTE – 64QAM – 15M – Center Channel – Peak

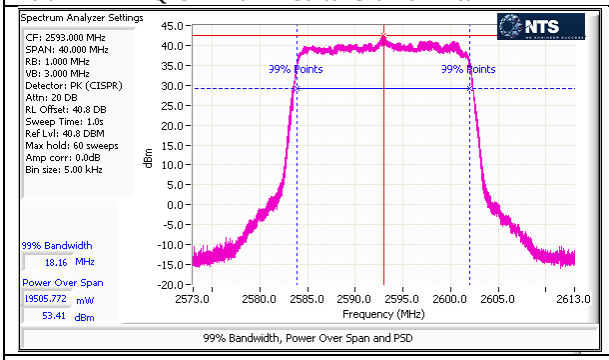


Port 1 – LTE – 64QAM – 15M – Center Channel – Average

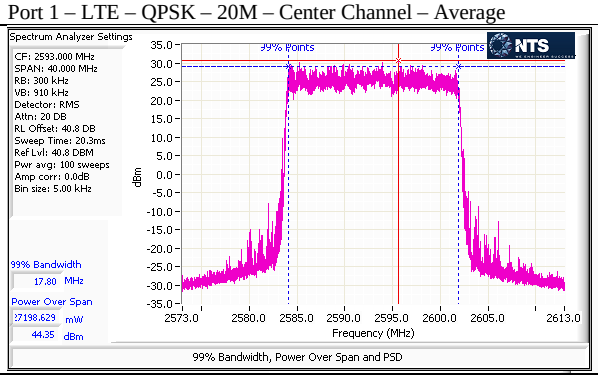


Port 2 – LTE – QPSK – 15M – Center Channel – Peak	Port 2 – LTE – QPSK – 15M – Center Channel – Average
	
Port 2– LTE – 16QAM – 15M – Center Channel – Peak	Port 2 – LTE – 16QAM – 15M – Center Channel – Average
	
Port 2 – LTE – 64QAM – 15M – Center Channel – Peak	Port 2 – LTE – 64QAM – 15M – Center Channel – Average
	

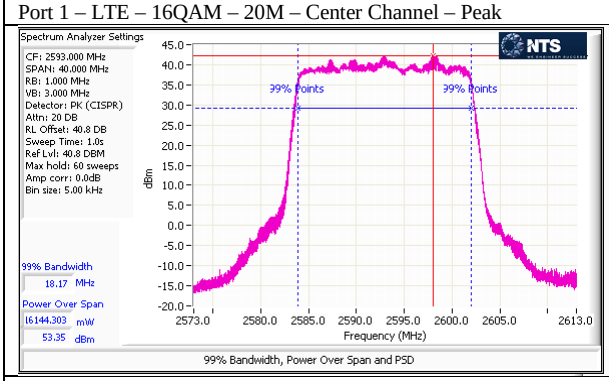
Port 1 – LTE – QPSK – 20M – Center Channel – Peak



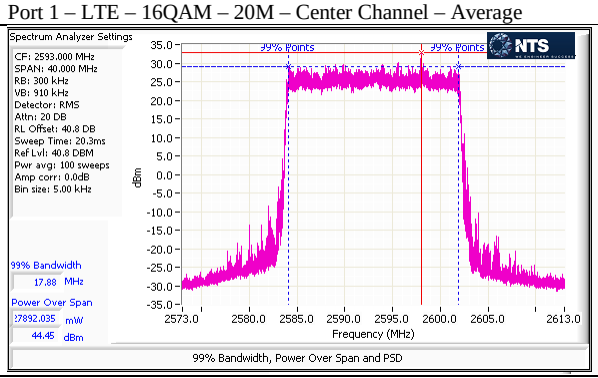
Port 1 – LTE – QPSK – 20M – Center Channel – Average



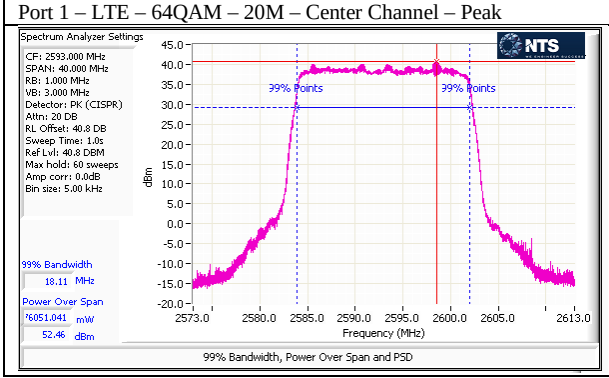
Port 1 – LTE – 16QAM – 20M – Center Channel – Peak



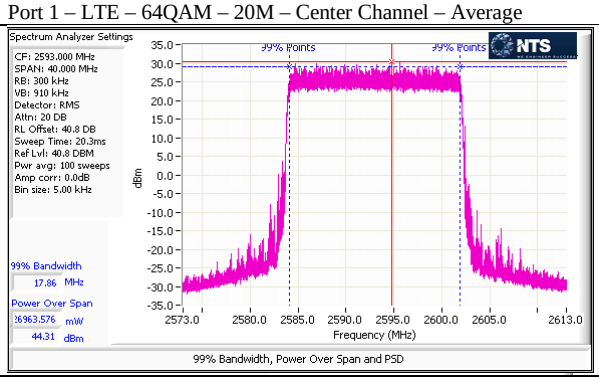
Port 1 – LTE – 16QAM – 20M – Center Channel – Average



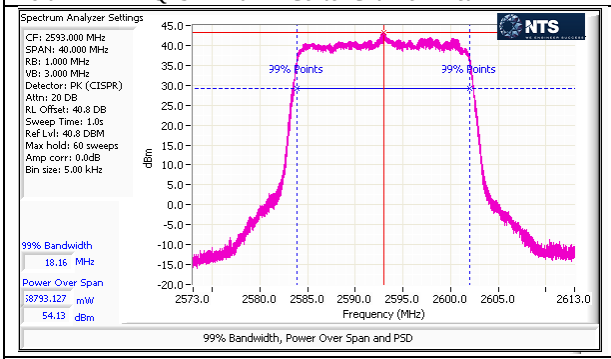
Port 1 – LTE – 64QAM – 20M – Center Channel – Peak



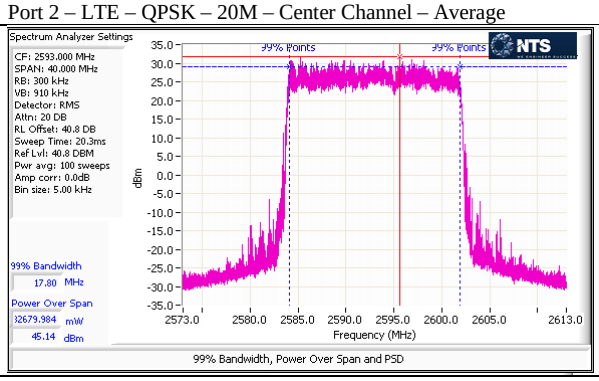
Port 1 – LTE – 64QAM – 20M – Center Channel – Average



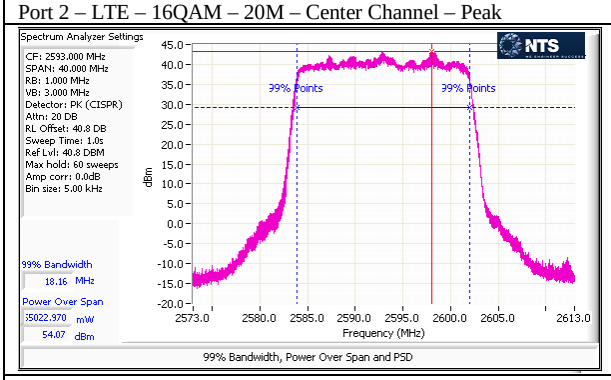
Port 2 – LTE – QPSK – 20M – Center Channel – Peak



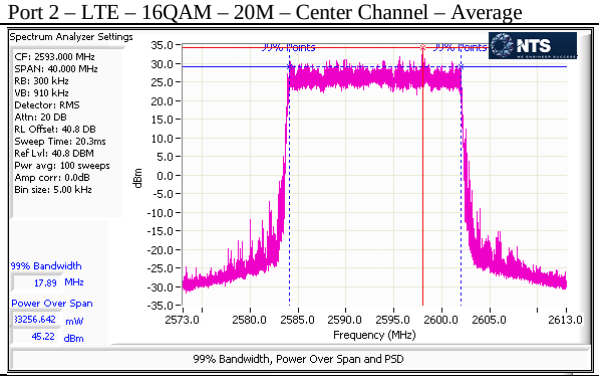
Port 2 – LTE – QPSK – 20M – Center Channel – Average



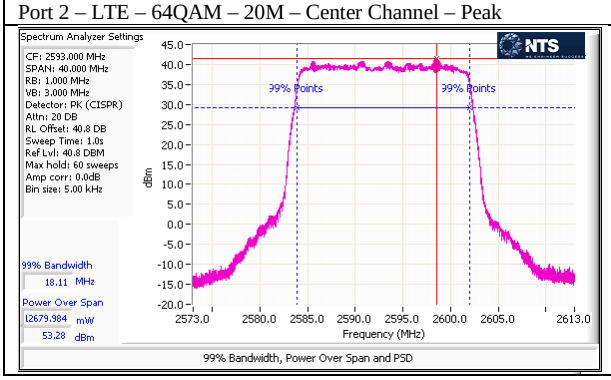
Port 2 – LTE – 16QAM – 20M – Center Channel – Peak



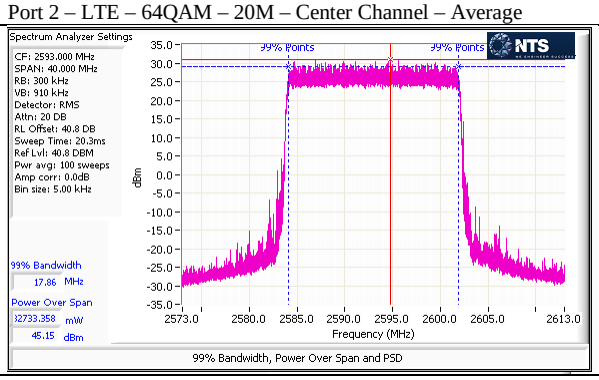
Port 2 – LTE – 16QAM – 20M – Center Channel – Average



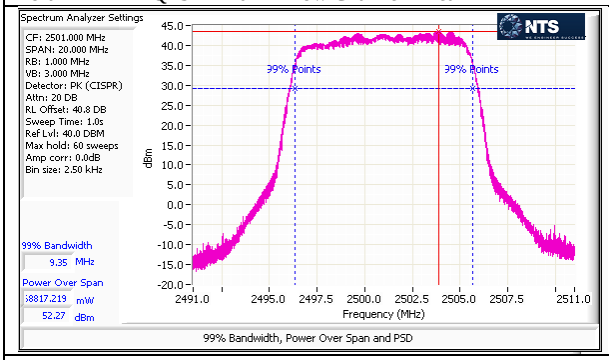
Port 2 – LTE – 64QAM – 20M – Center Channel – Peak



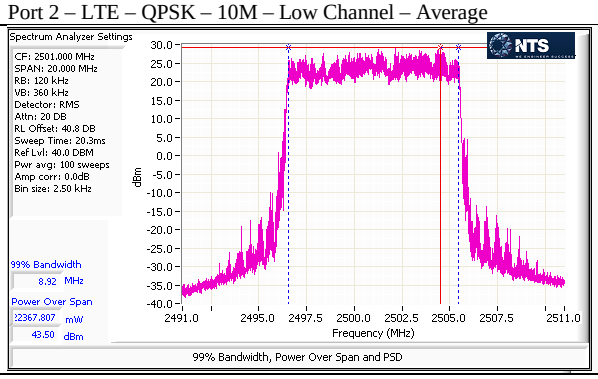
Port 2 – LTE – 64QAM – 20M – Center Channel – Average



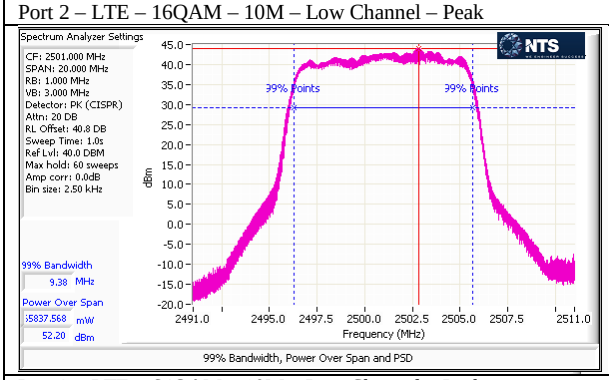
Port 2 – LTE – QPSK – 10M – Low Channel – Peak



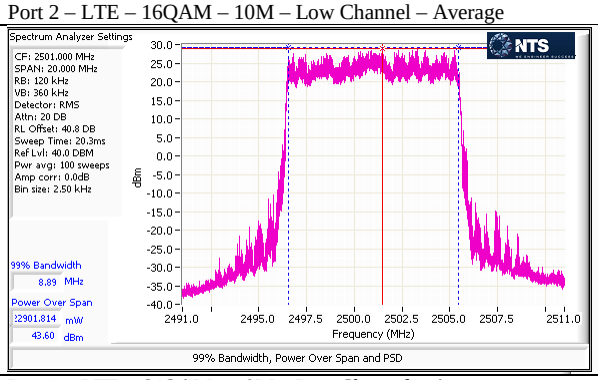
Port 2 – LTE – QPSK – 10M – Low Channel – Average



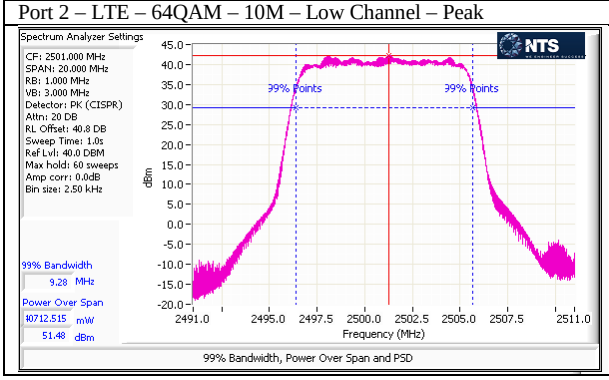
Port 2 – LTE – 16QAM – 10M – Low Channel – Peak



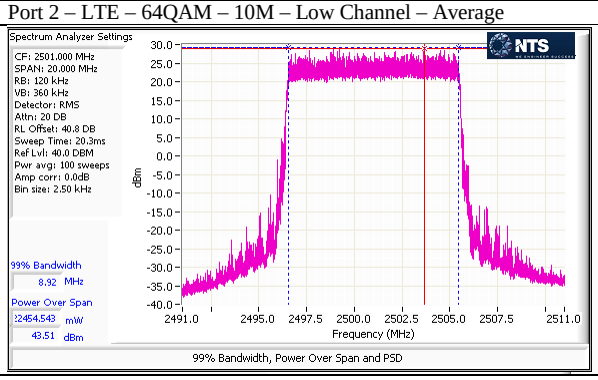
Port 2 – LTE – 16QAM – 10M – Low Channel – Average



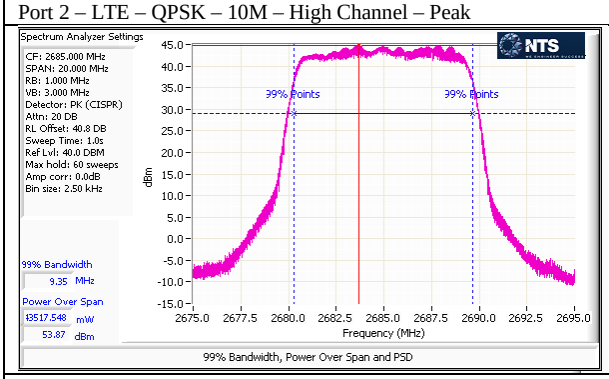
Port 2 – LTE – 64QAM – 10M – Low Channel – Peak



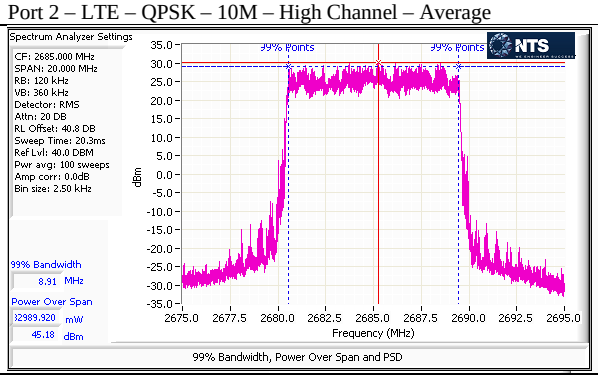
Port 2 – LTE – 64QAM – 10M – Low Channel – Average



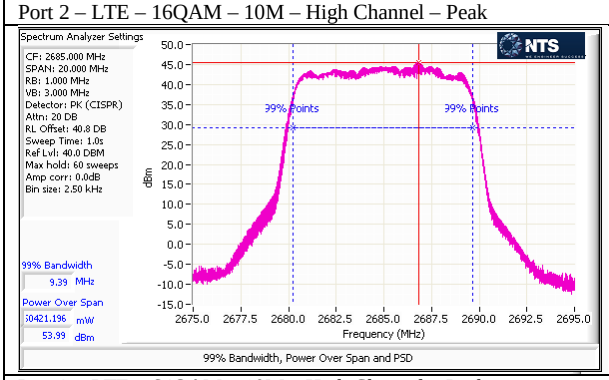
Port 2 – LTE – QPSK – 10M – High Channel – Peak



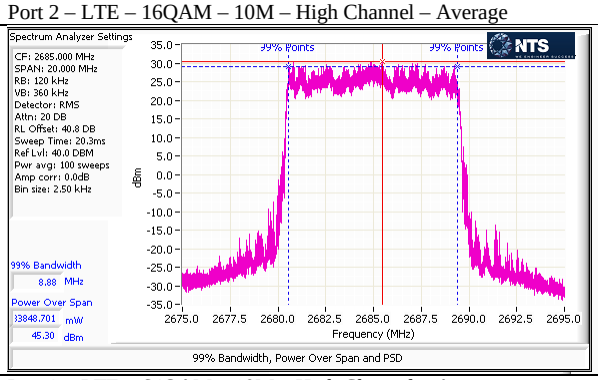
Port 2 – LTE – QPSK – 10M – High Channel – Average



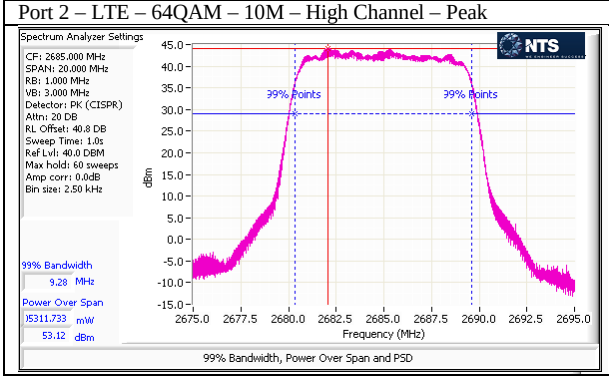
Port 2 – LTE – 16QAM – 10M – High Channel – Peak



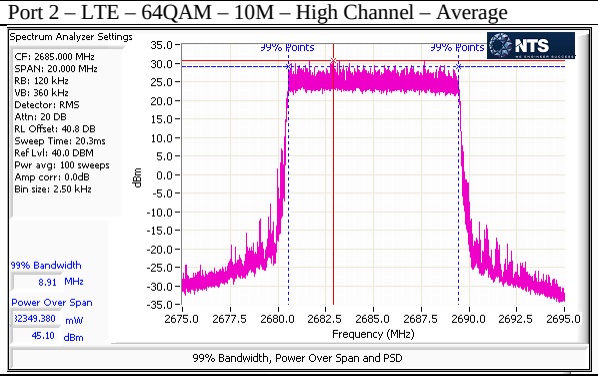
Port 2 – LTE – 16QAM – 10M – High Channel – Average



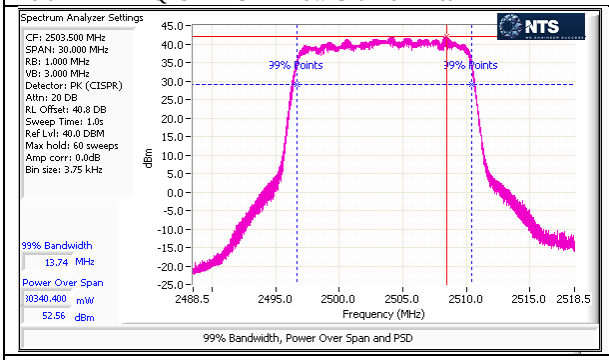
Port 2 – LTE – 64QAM – 10M – High Channel – Peak



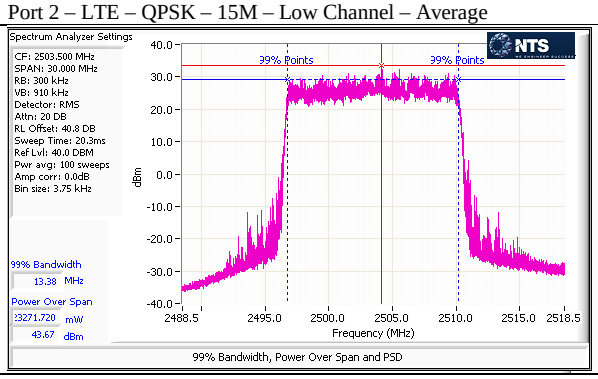
Port 2 – LTE – 64QAM – 10M – High Channel – Average



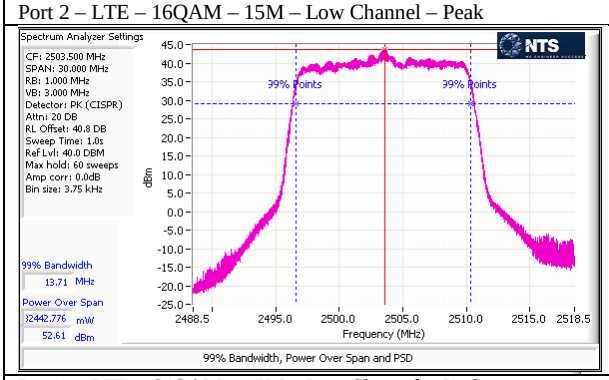
Port 2 – LTE – QPSK – 15M – Low Channel – Peak



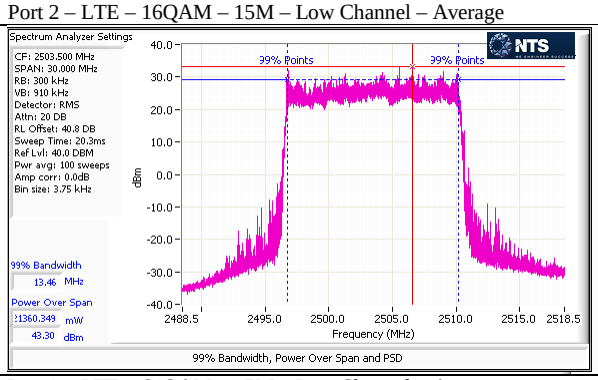
Port 2 – LTE – QPSK – 15M – Low Channel – Average



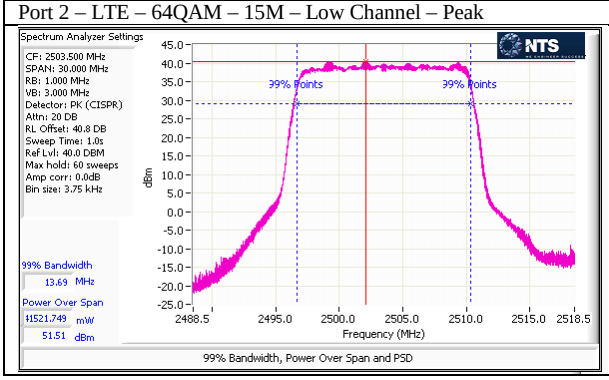
Port 2 – LTE – 16QAM – 15M – Low Channel – Peak



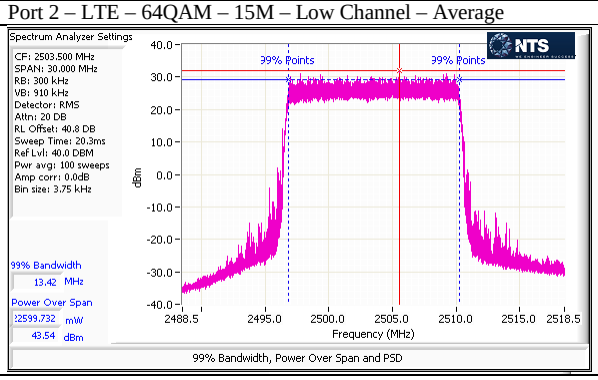
Port 2 – LTE – 16QAM – 15M – Low Channel – Average



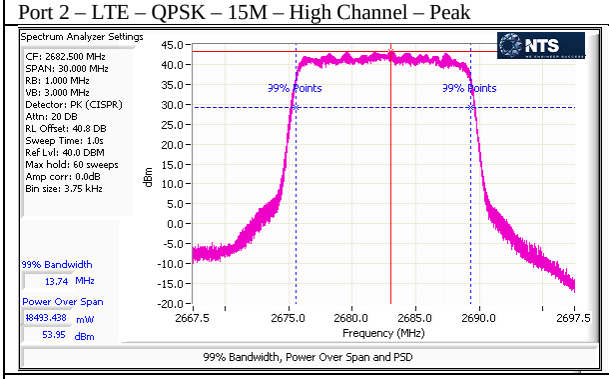
Port 2 – LTE – 64QAM – 15M – Low Channel – Peak



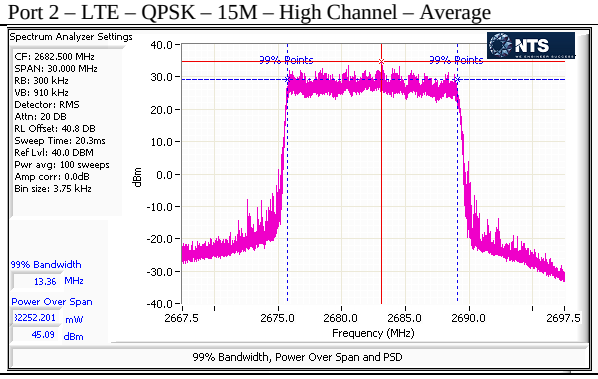
Port 2 – LTE – 64QAM – 15M – Low Channel – Average



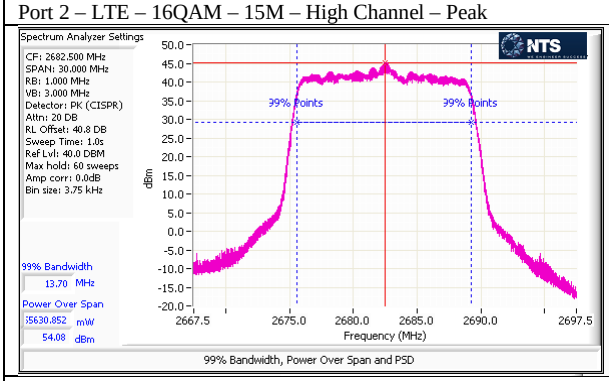
Port 2 – LTE – QPSK – 15M – High Channel – Peak



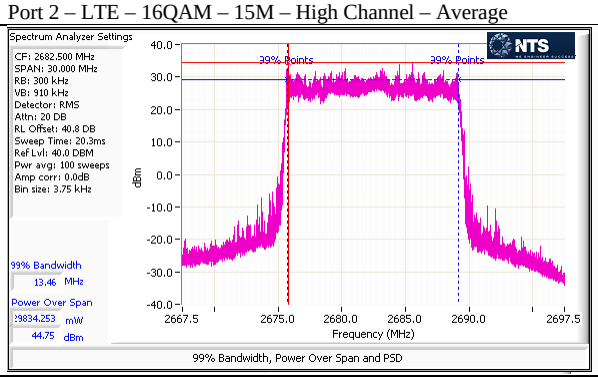
Port 2 – LTE – QPSK – 15M – High Channel – Average



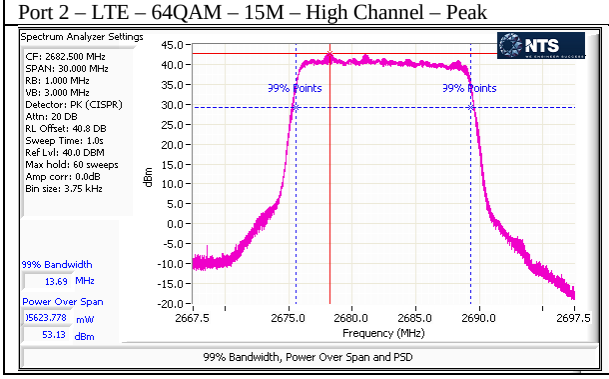
Port 2 – LTE – 16QAM – 15M – High Channel – Peak



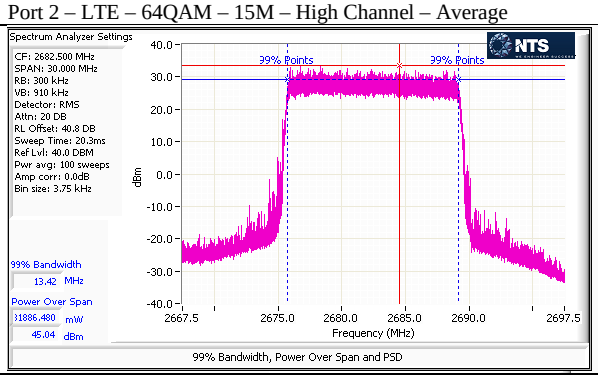
Port 2 – LTE – 16QAM – 15M – High Channel – Average



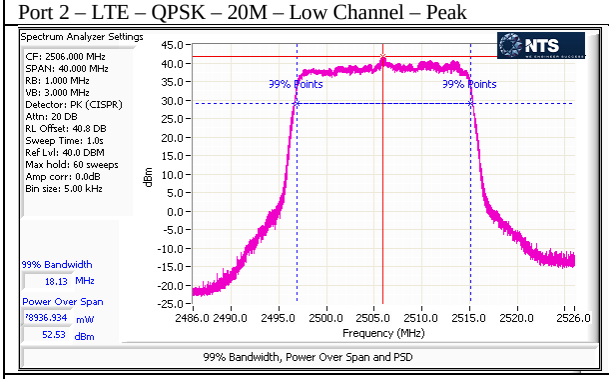
Port 2 – LTE – 64QAM – 15M – High Channel – Peak



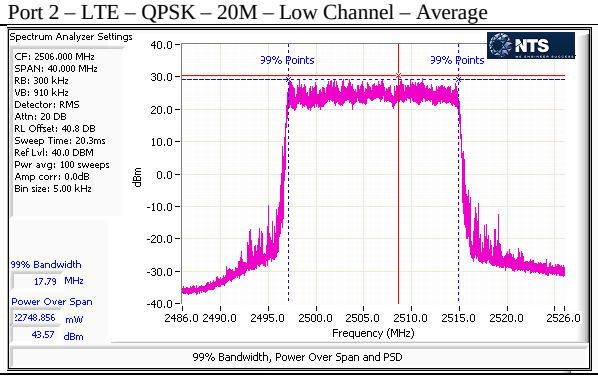
Port 2 – LTE – 64QAM – 15M – High Channel – Average



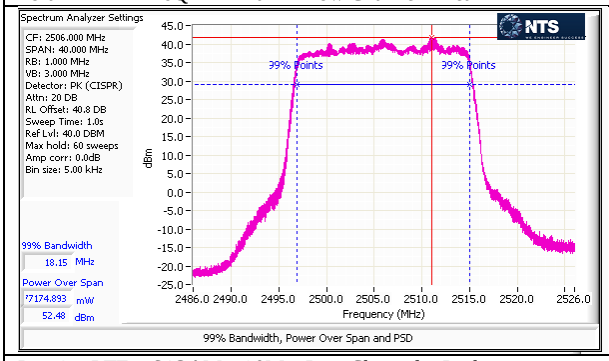
Port 2 – LTE – QPSK – 20M – Low Channel – Peak



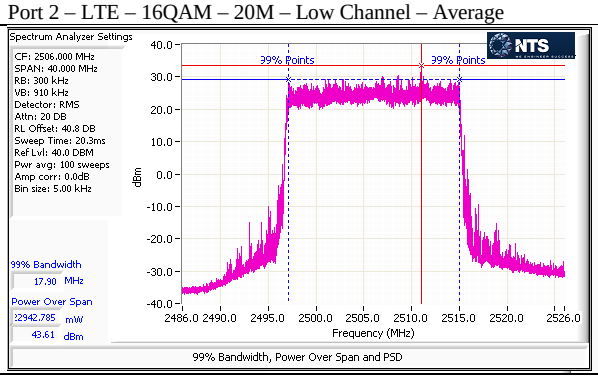
Port 2 – LTE – QPSK – 20M – Low Channel – Average



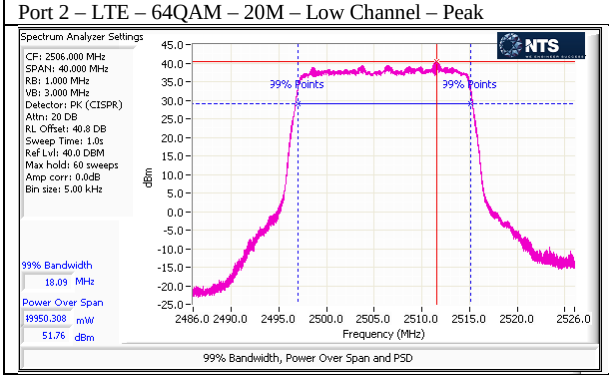
Port 2 – LTE – 16QAM – 20M – Low Channel – Peak



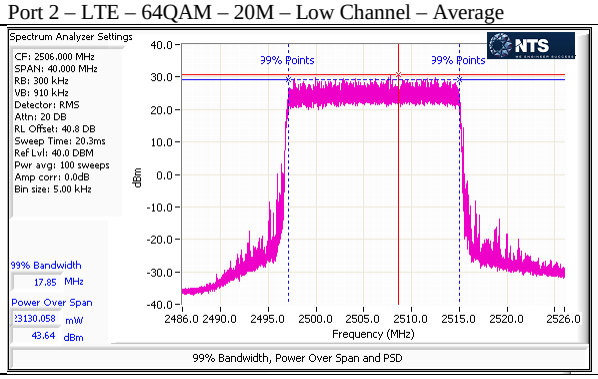
Port 2 – LTE – 16QAM – 20M – Low Channel – Average



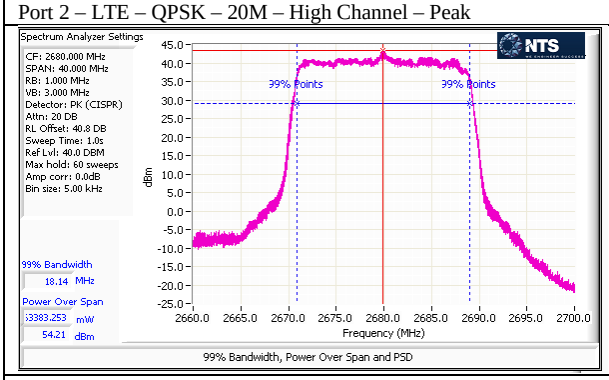
Port 2 – LTE – 64QAM – 20M – Low Channel – Peak



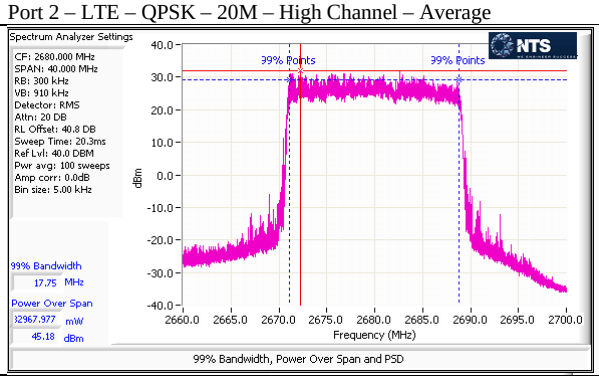
Port 2 – LTE – 64QAM – 20M – Low Channel – Average



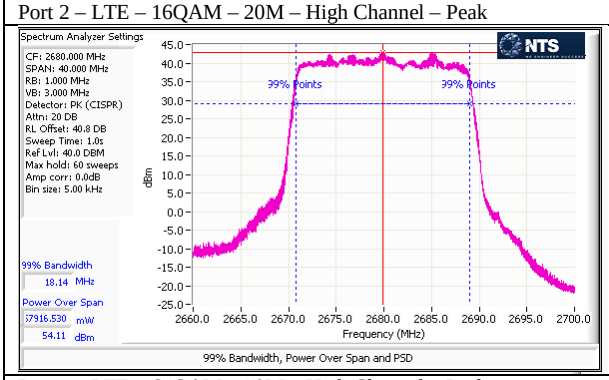
Port 2 – LTE – QPSK – 20M – High Channel – Peak



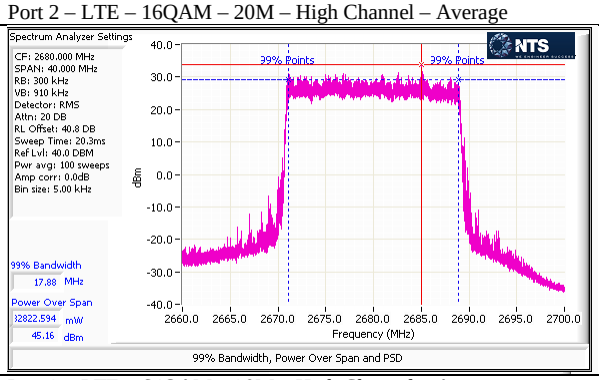
Port 2 – LTE – QPSK – 20M – High Channel – Average



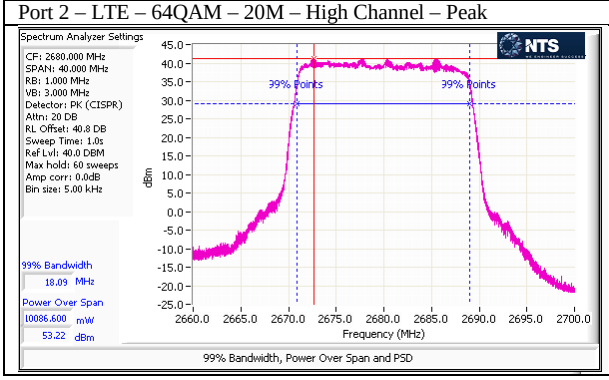
Port 2 – LTE – 16QAM – 20M – High Channel – Peak



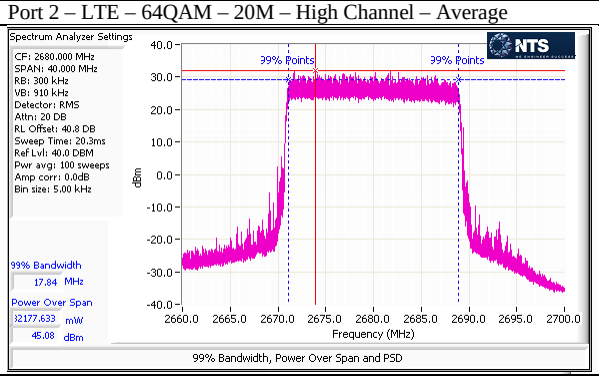
Port 2 – LTE – 16QAM – 20M – High Channel – Average



Port 2 – LTE – 64QAM – 20M – High Channel – Peak



Port 2 – LTE – 64QAM – 20M – High Channel – Average



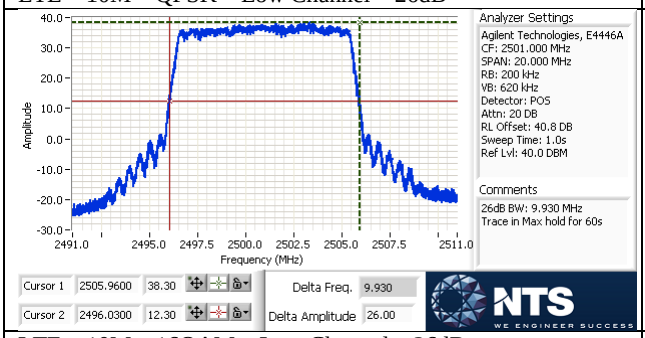
Emission Bandwidths (26dB and 99%)

Emissions bandwidths were measured at Port 2 on low, center, and high channels in 10MHz, 15MHz, and 20MHz channel bandwidths for all modulations and results presented below.

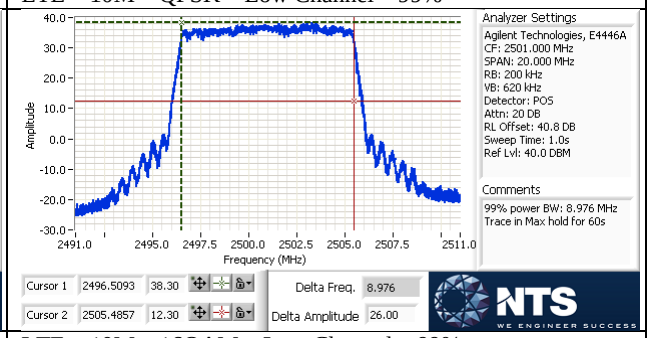
	LTE - QPSK						LTE - 16QAM						LTE - 64QAM					
	Low		Center		High		Low		Center		High		Low		Center		High	
	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)
10M	9.93	8.976	9.945	8.979	9.937	8.971	9.935	8.994	9.937	8.979	9.932	8.974	9.945	8.966	9.963	8.979	9.955	8.969
15M	14.854	13.487	14.857	13.495	14.812	13.476	14.726	13.453	14.805	13.487	14.764	13.453	14.903	13.446	14.899	13.45	14.929	13.438
20M	19.87	18.003	19.885	17.993	19.815	17.973	19.635	17.948	19.635	17.988	19.7	17.963	19.86	17.958	19.895	17.973	19.835	17.958

Corresponding plots included on the following pages.

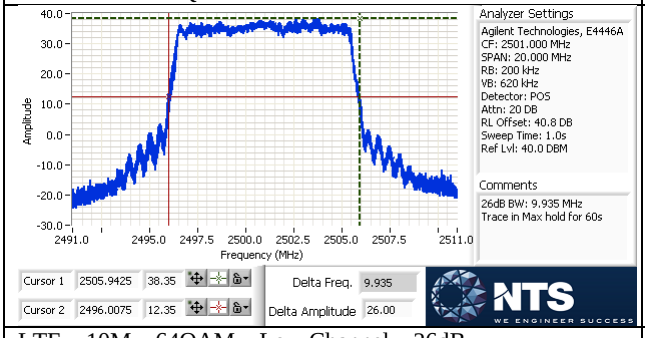
LTE – 10M – QPSK – Low Channel – 26dB



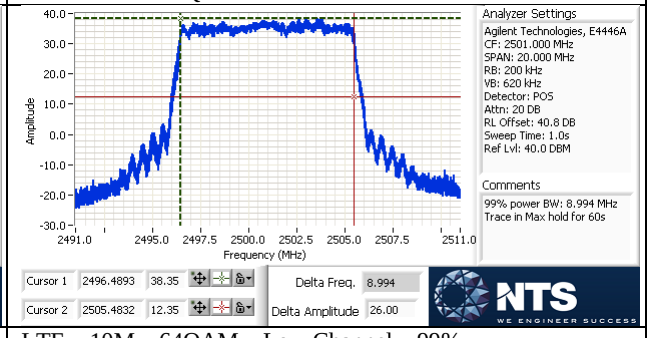
LTE – 10M – QPSK – Low Channel – 99%



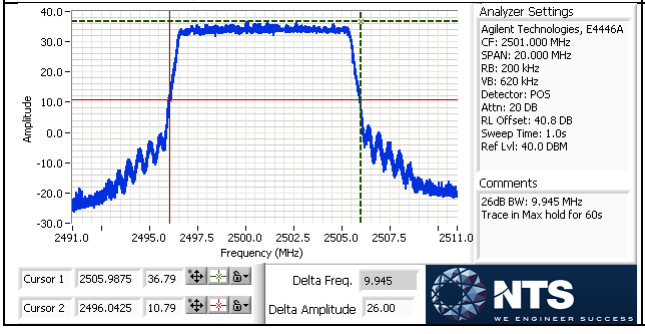
LTE – 10M – 16QAM – Low Channel – 26dB



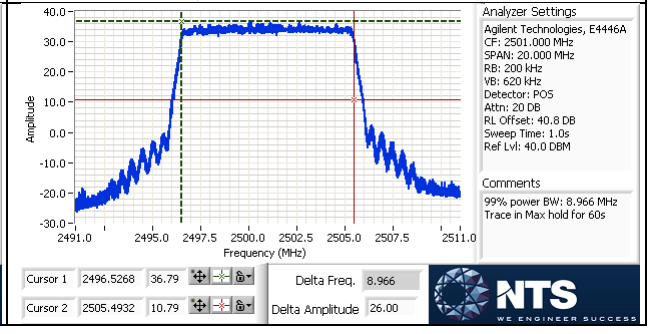
LTE – 10M – 16QAM – Low Channel – 99%



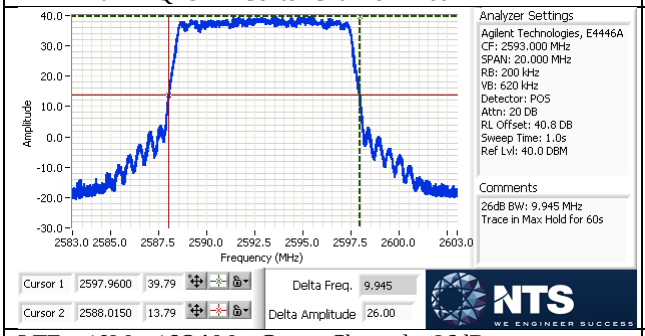
LTE – 10M – 64QAM – Low Channel – 26dB



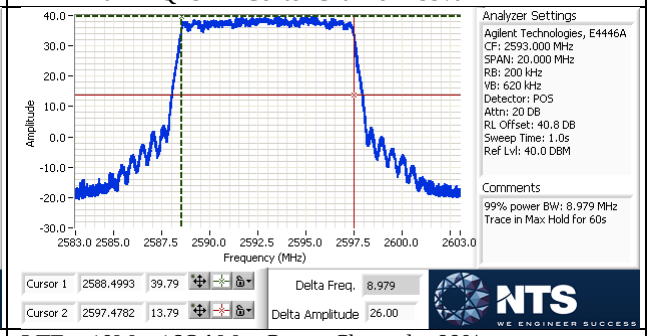
LTE – 10M – 64QAM – Low Channel – 99%



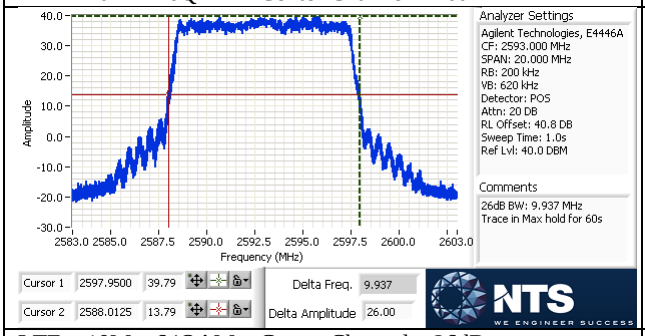
LTE – 10M – QPSK – Center Channel – 26dB



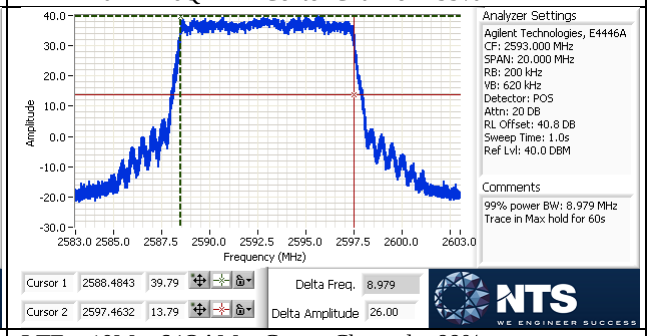
LTE – 10M – QPSK – Center Channel – 99%



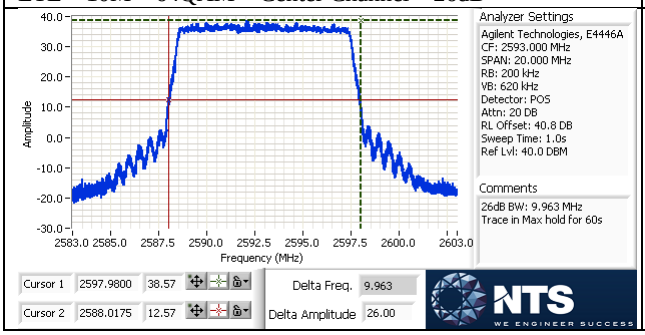
LTE – 10M – 16QAM – Center Channel – 26dB



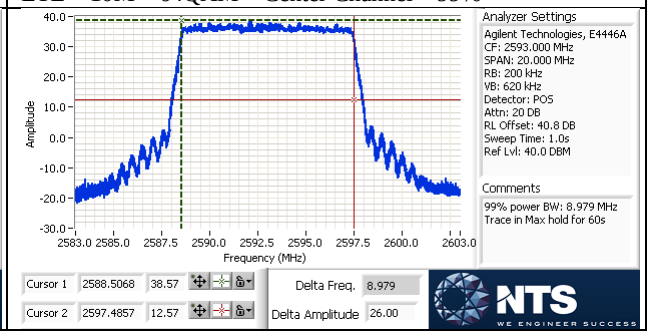
LTE – 10M – 16QAM – Center Channel – 99%



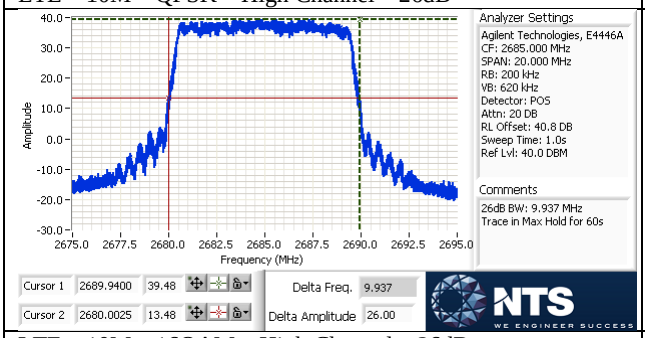
LTE – 10M – 64QAM – Center Channel – 26dB



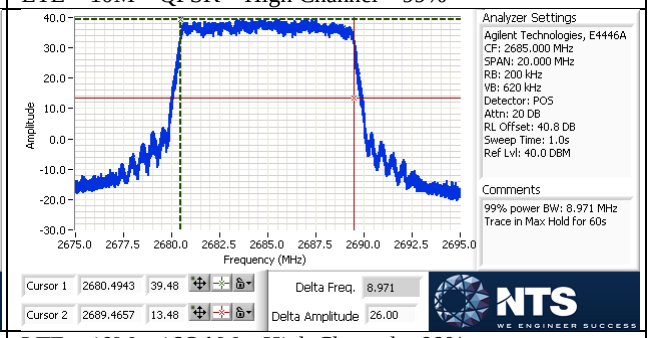
LTE – 10M – 64QAM – Center Channel – 99%



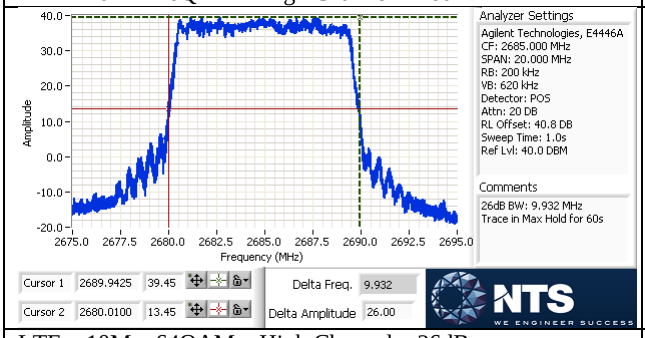
LTE – 10M – QPSK – High Channel – 26dB



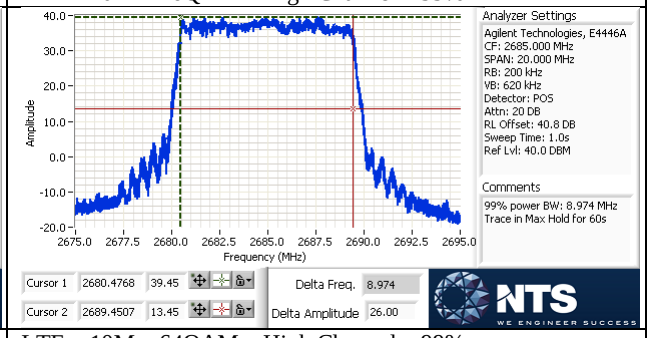
LTE – 10M – QPSK – High Channel – 99%



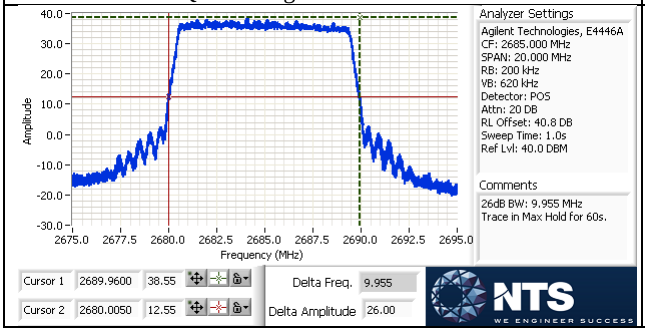
LTE – 10M – 16QAM – High Channel – 26dB



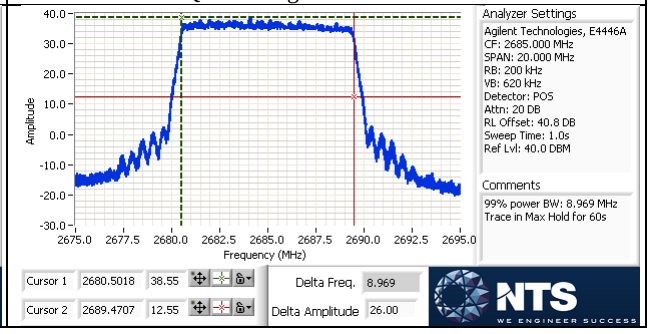
LTE – 10M – 16QAM – High Channel – 99%



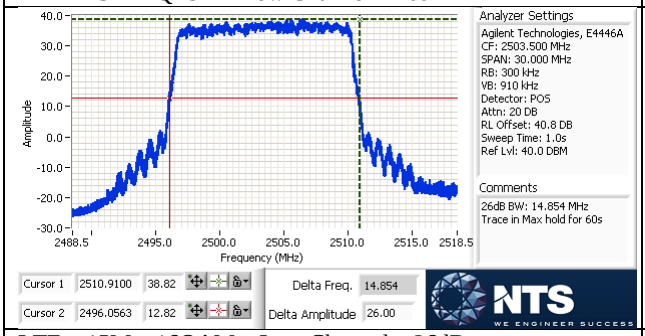
LTE – 10M – 64QAM – High Channel – 26dB



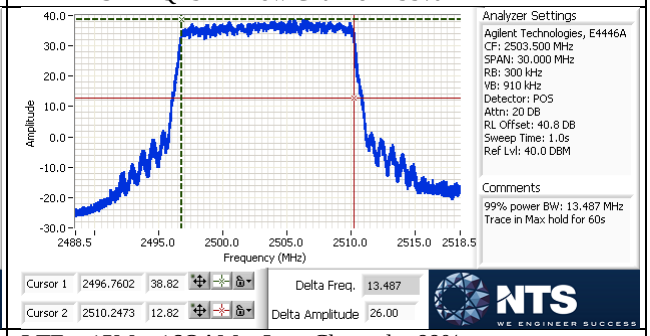
LTE – 10M – 64QAM – High Channel – 99%



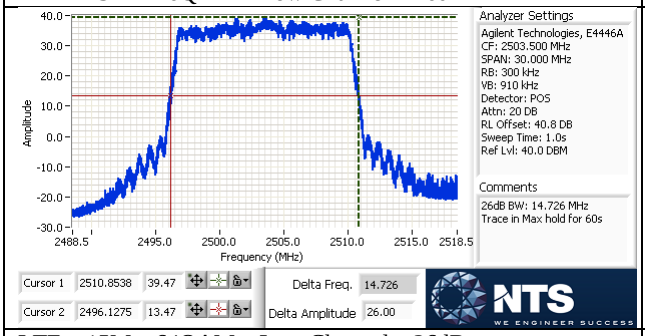
LTE – 15M – QPSK – Low Channel – 26dB



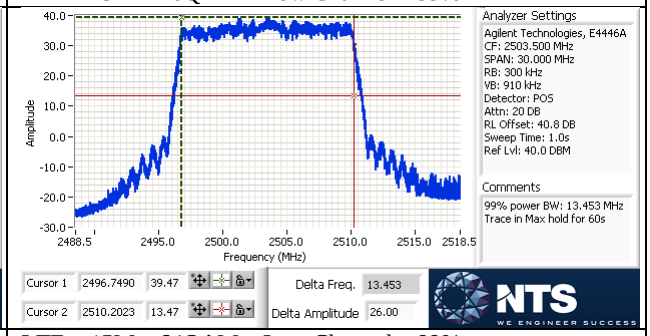
LTE – 15M – QPSK – Low Channel – 99%



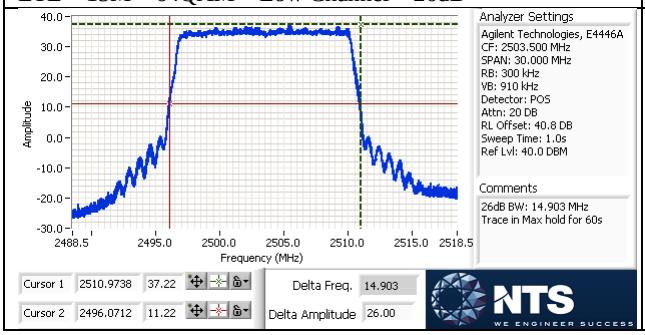
LTE – 15M – 16QAM – Low Channel – 26dB



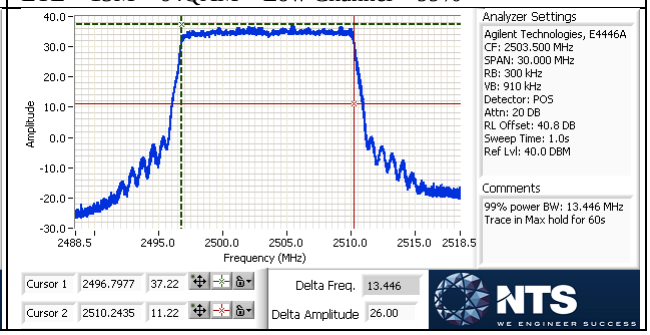
LTE – 15M – 16QAM – Low Channel – 99%



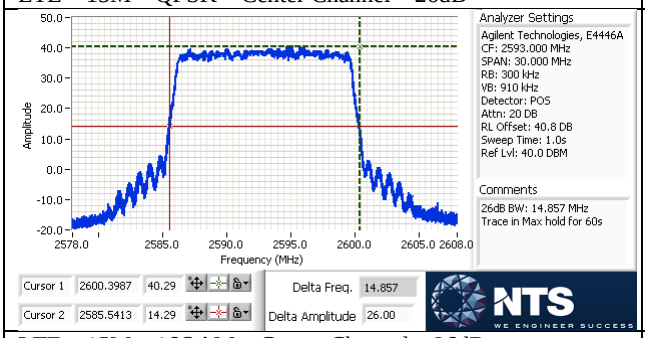
LTE – 15M – 64QAM – Low Channel – 26dB



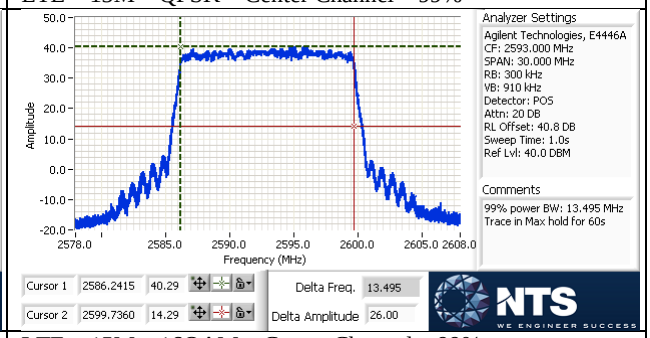
LTE – 15M – 64QAM – Low Channel – 99%



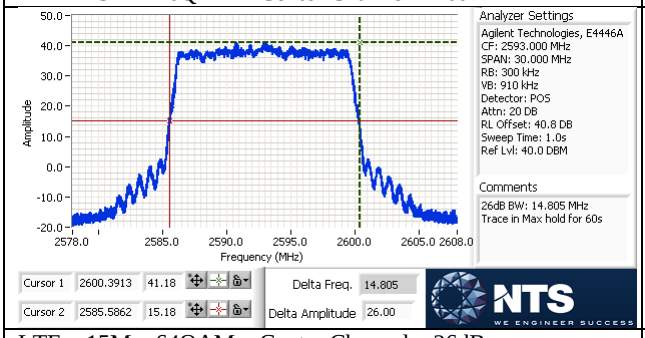
LTE – 15M – QPSK – Center Channel – 26dB



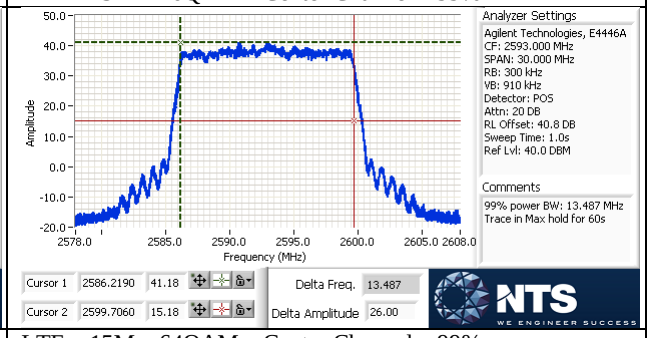
LTE – 15M – QPSK – Center Channel – 99%



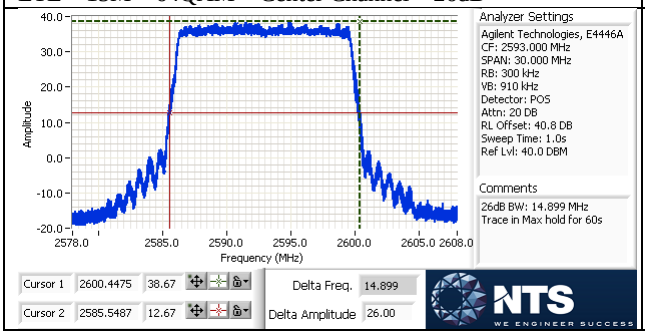
LTE – 15M – 16QAM – Center Channel – 26dB



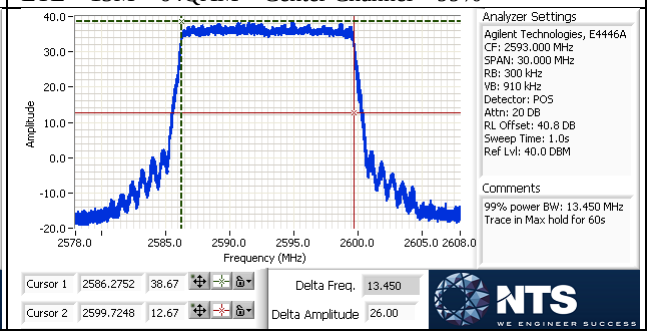
LTE – 15M – 16QAM – Center Channel – 99%



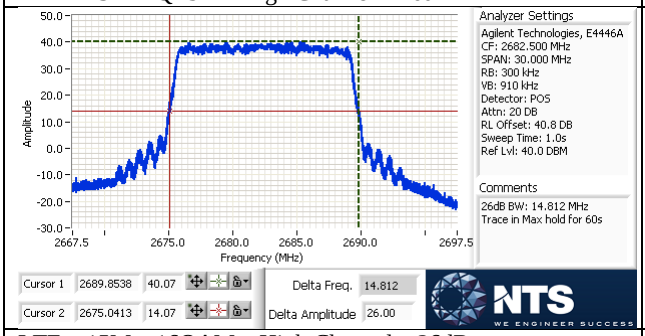
LTE – 15M – 64QAM – Center Channel – 26dB



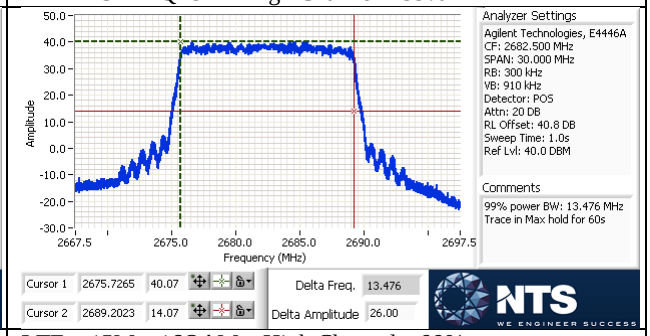
LTE – 15M – 64QAM – Center Channel – 99%



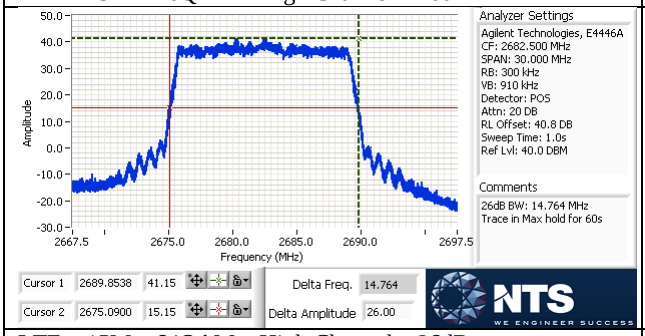
LTE – 15M – QPSK – High Channel – 26dB



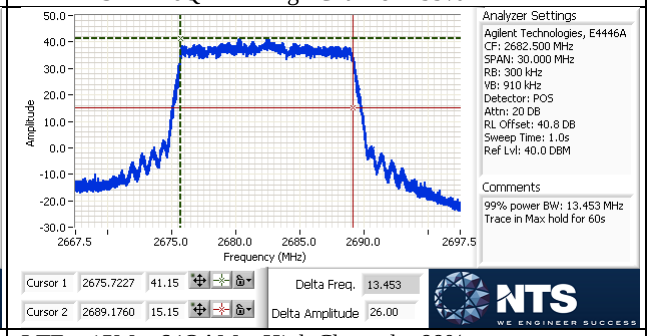
LTE – 15M – QPSK – High Channel – 99%



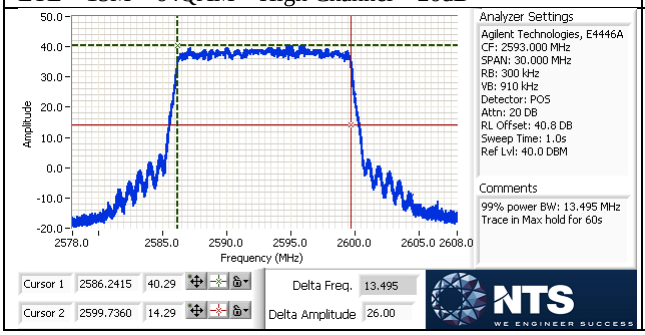
LTE – 15M – 16QAM – High Channel – 26dB



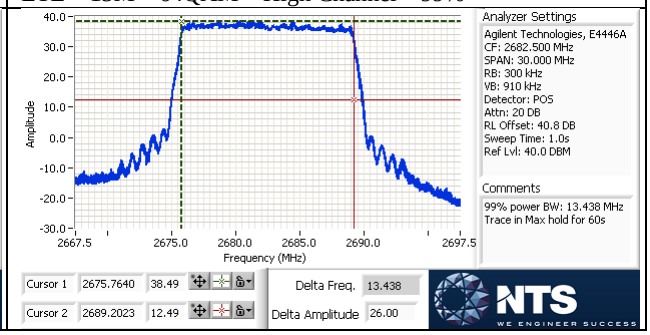
LTE – 15M – 16QAM – High Channel – 99%



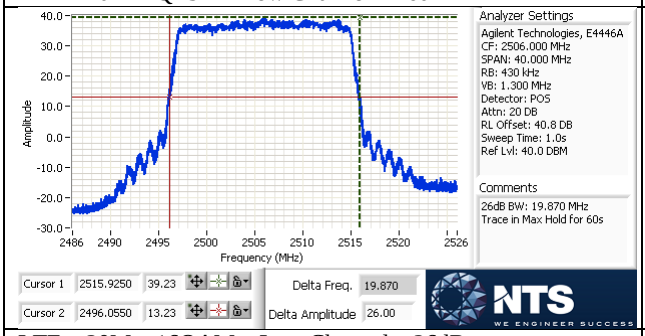
LTE – 15M – 64QAM – High Channel – 26dB



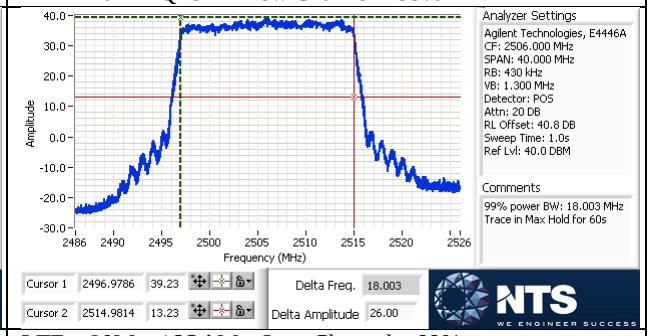
LTE – 15M – 64QAM – High Channel – 99%



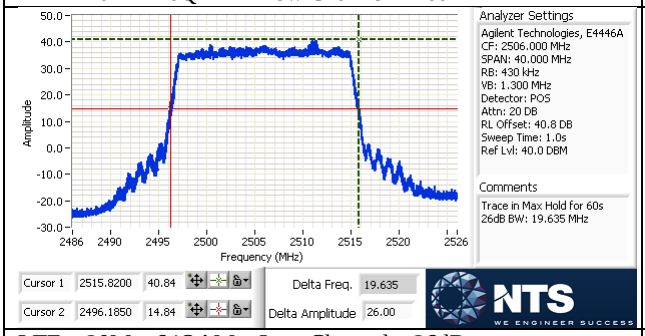
LTE – 20M – QPSK – Low Channel – 26dB



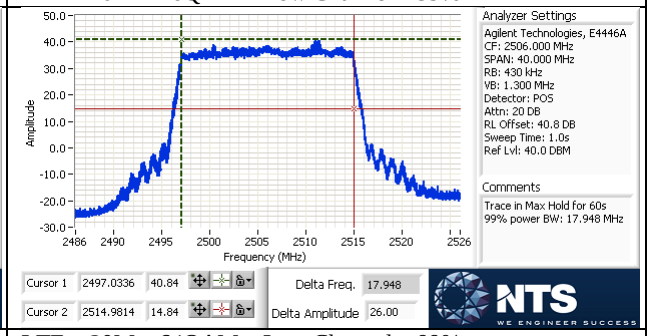
LTE – 20M – QPSK – Low Channel – 99%



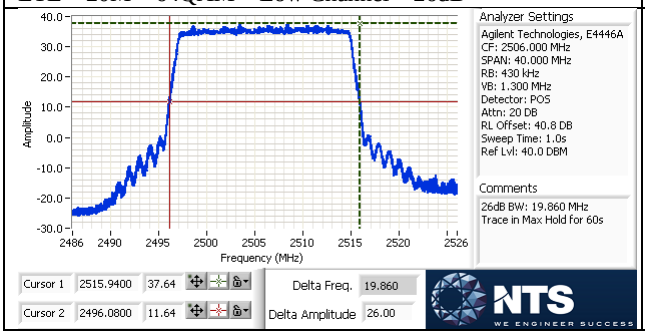
LTE – 20M – 16QAM – Low Channel – 26dB



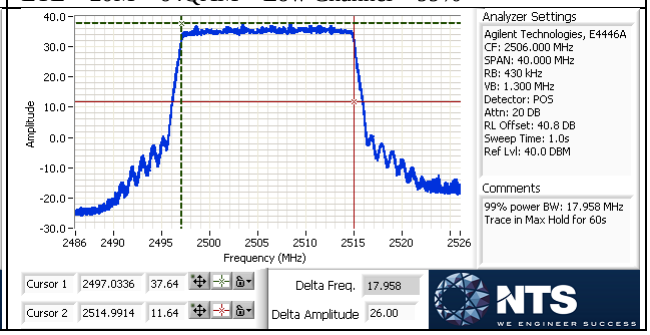
LTE – 20M – 16QAM – Low Channel – 99%



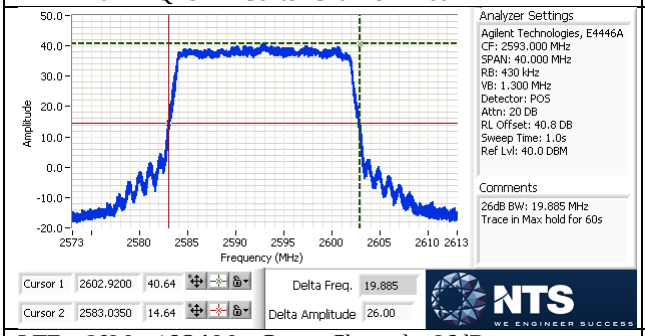
LTE – 20M – 64QAM – Low Channel – 26dB



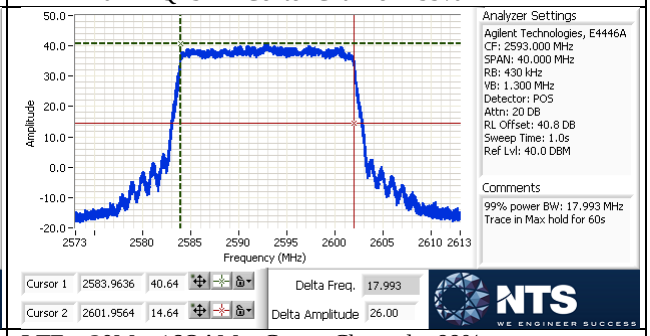
LTE – 20M – 64QAM – Low Channel – 99%



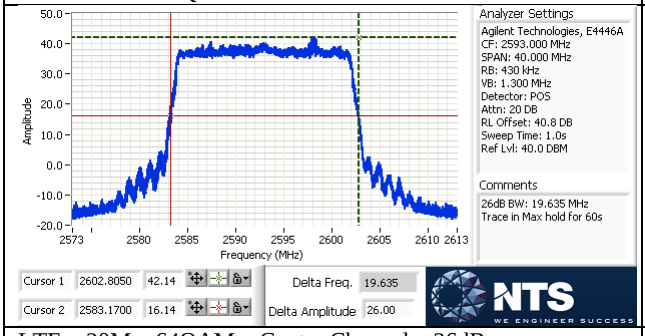
LTE – 20M – QPSK – Center Channel – 26dB



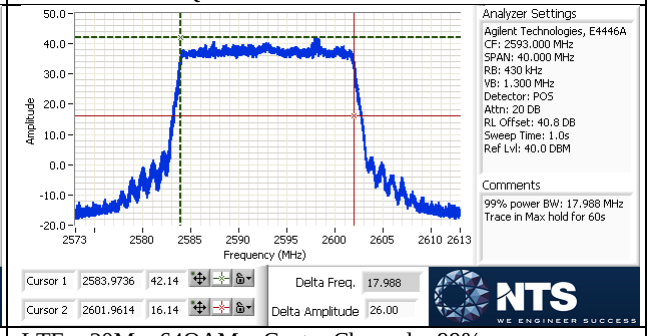
LTE – 20M – QPSK – Center Channel – 99%



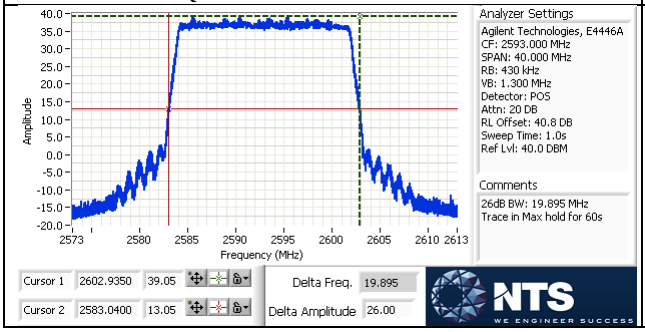
LTE – 20M – 16QAM – Center Channel – 26dB



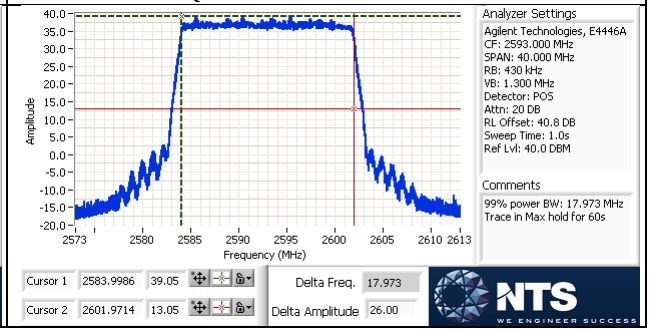
LTE – 20M – 16QAM – Center Channel – 99%



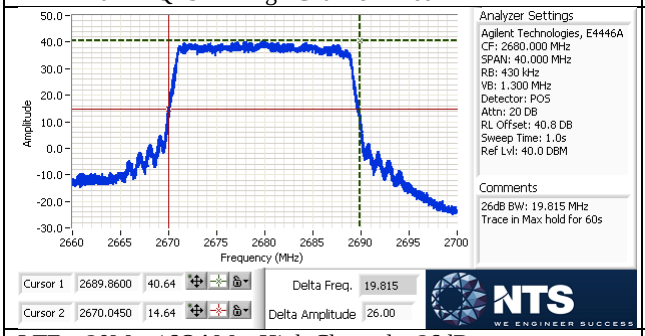
LTE – 20M – 64QAM – Center Channel – 26dB



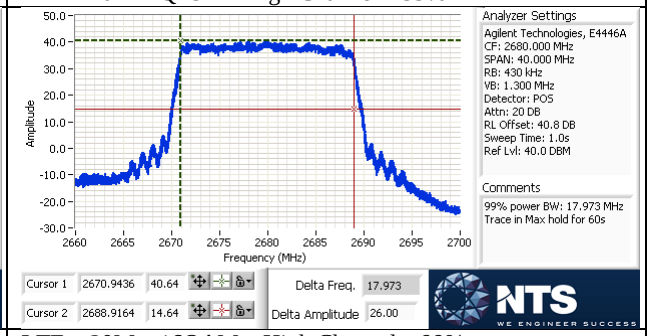
LTE – 20M – 64QAM – Center Channel – 99%



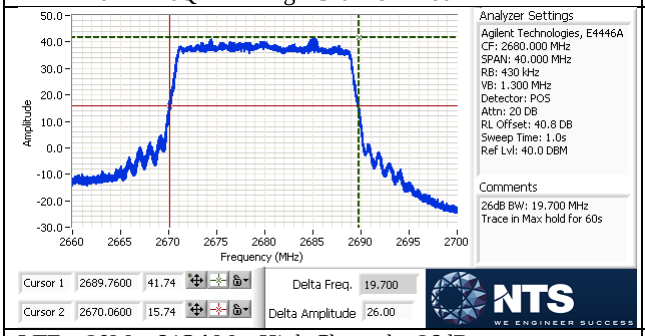
LTE – 20M – QPSK – High Channel – 26dB



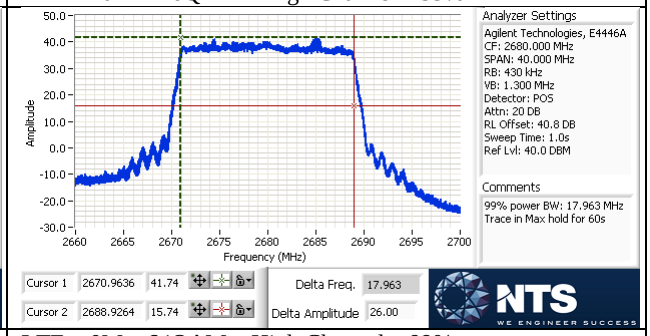
LTE – 20M – QPSK – High Channel – 99%



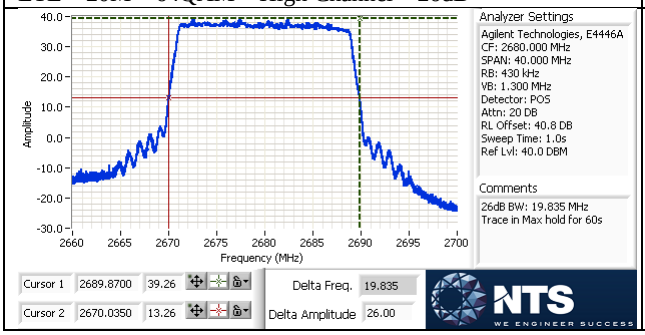
LTE – 20M – 16QAM – High Channel – 26dB



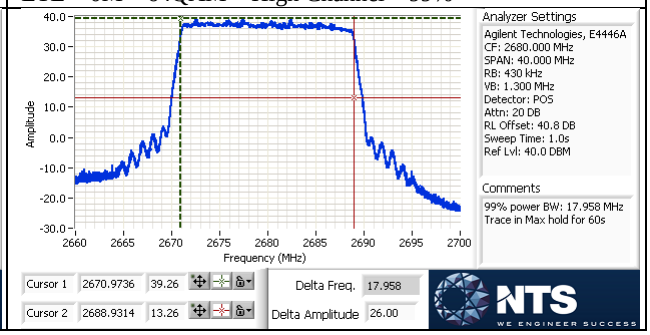
LTE – 20M – 16QAM – High Channel – 99%



LTE – 20M – 64QAM – High Channel – 26dB



LTE – 0M – 64QAM – High Channel – 99%



Antenna Port Conducted Bandedge Full Band

Limits below reflect reduction by 10*log(2) per FCC KDB 662911D01 v02r01 due to 2x2 MIMO operation.

Frequency (MHz)		Limit (dBm)
<2200		-16.0103
2200	2285	-43.0103
2288	2292	-40.0103
2292	2296	-34.0103
2296	2300	-28.0103
2300	2305	-16.0103
2305	2320	-16.0103
2320	2324	-28.0103
2324	2328	-34.0103
2328	2337	-40.0103
2337	2341	-34.0103
2341	2345	-28.0103
2345	2360	-16.0103
2360	2365	-16.0103
2365	2395	-43.0103
>2395		-16.0103

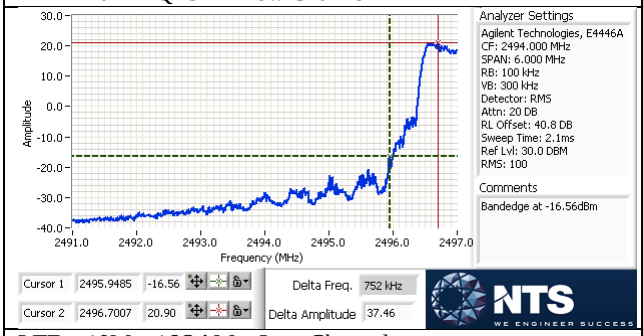
In 10MHz, 15MHz, and 20MHz channel bandwidth modes, low and high channels in dual and single carrier mode configurations were tested at the low and high channels.

Results summary:

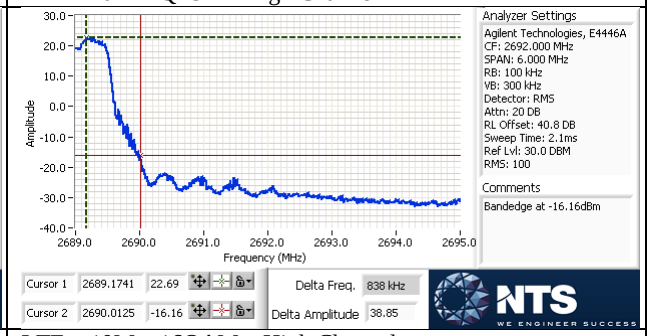
	LTE - QPSK		LTE - 16QAM		LTE - 64QAM	
	Low	High	Low	High	Low	High
10M	-16.56dBm	-16.16dBm	-16.83dBm	-16.17dBm	-16.36dBm	-16.09dBm
15M	-17.85dBm	-17.31dBm	-18.26dBm	-17.14dBm	-18.57dBm	-18.11dBm
20M	-18.14dBm	-17dBm	-18.43dBm	-17.7dBm	-19.06dBm	-18.03dBm
10M Dual	-21.54dBm	-17.75dBm	-20.96dBm	-17.44dBm	-19.8dBm	-18.45dBm
15M Dual	-20.7dBm	-19.59dBm	-20.46dBm	-18.24dBm	-20.44dBm	-18.73dBm
20M Dual	-20.88dBm	-21.18dBm	-22.13dBm	-20.36dBm	-20.99dBm	-20.89dBm

Measurements were performed at the Port 2 (Diversity Port) in RMS average mode over 100 traces. In 4MHz bands immediately outside and adjacent to the frequency blocks, RBW was reduced to 1% of the emission bandwidth. For all measurements insertion losses were factored in via reference level offset to the spectrum analyzer and settings are shown on corresponding plots on the following pages.

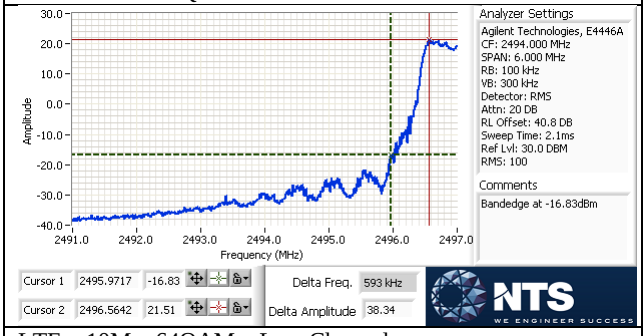
LTE – 10M – QPSK – Low Channel



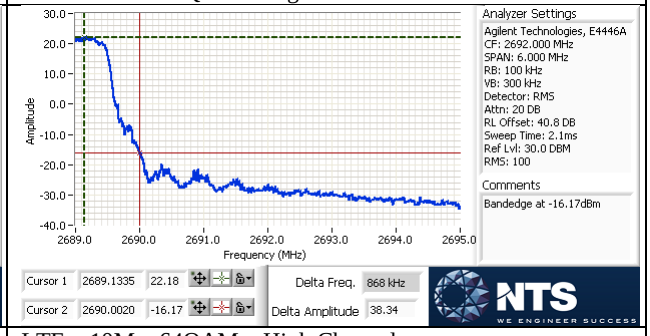
LTE – 10M – QPSK – High Channel



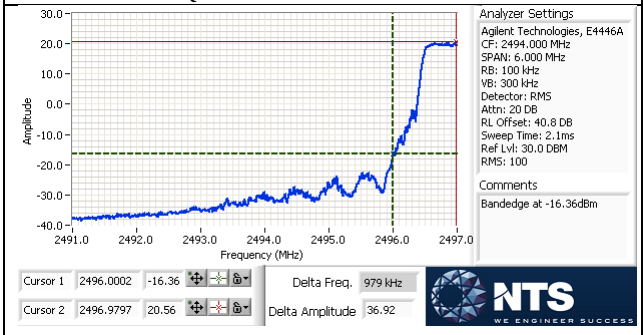
LTE – 10M – 16QAM – Low Channel



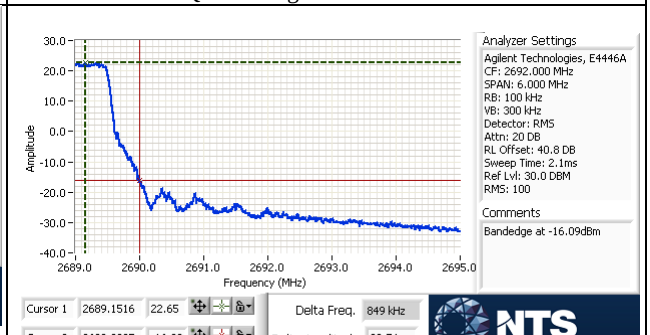
LTE – 10M – 16QAM – High Channel



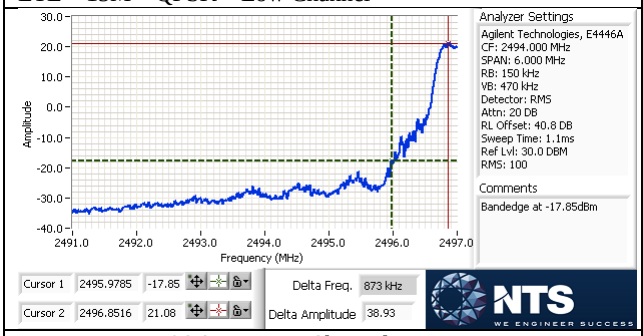
LTE – 10M – 64QAM – Low Channel



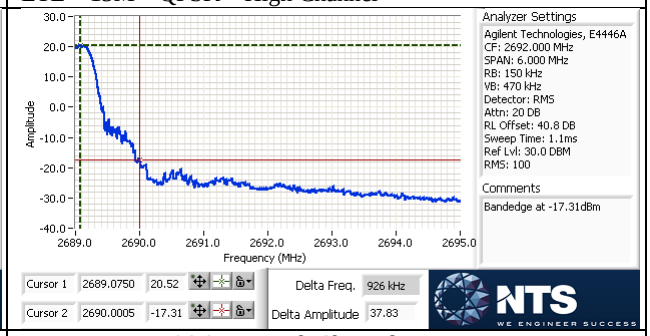
LTE – 10M – 64QAM – High Channel



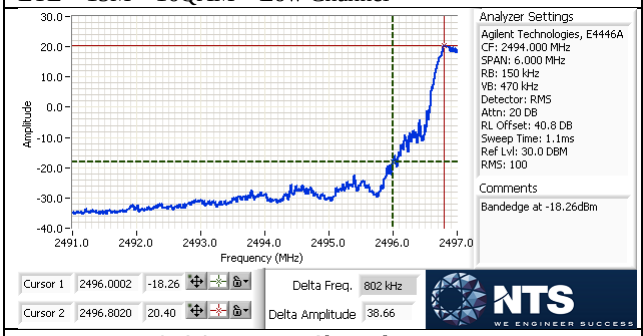
LTE – 15M – QPSK – Low Channel



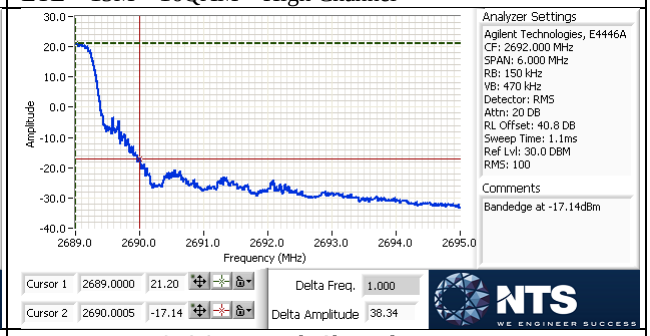
LTE – 15M – QPSK – High Channel



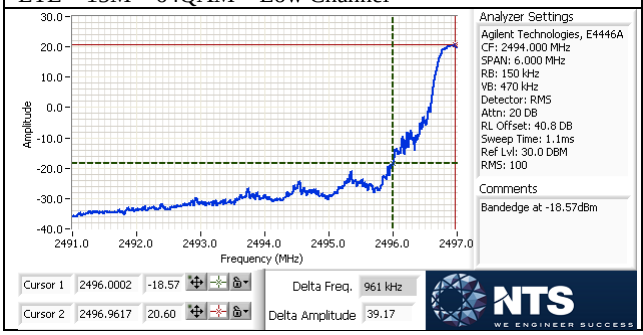
LTE – 15M – 16QAM – Low Channel



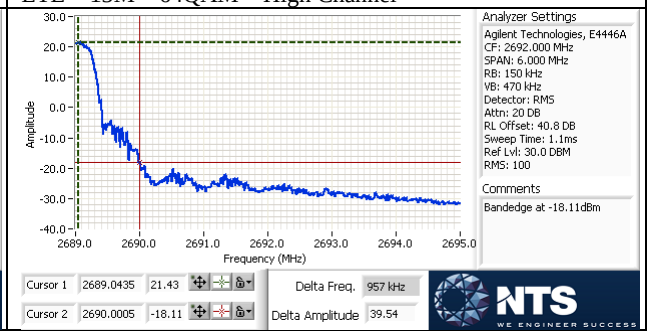
LTE – 15M – 16QAM – High Channel



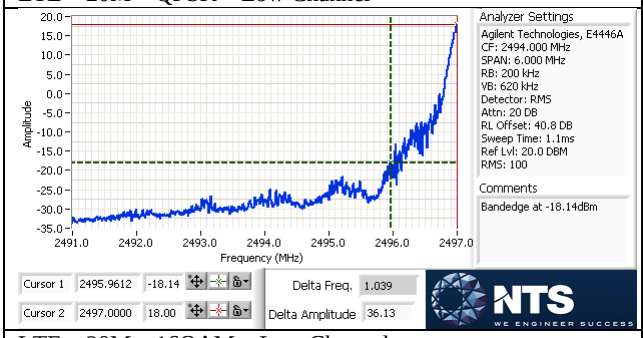
LTE – 15M – 64QAM – Low Channel



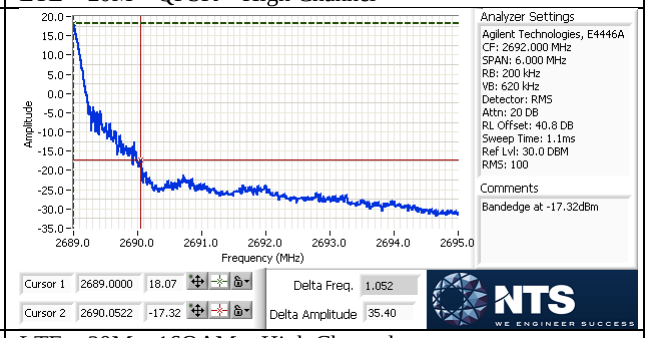
LTE – 15M – 64QAM – High Channel



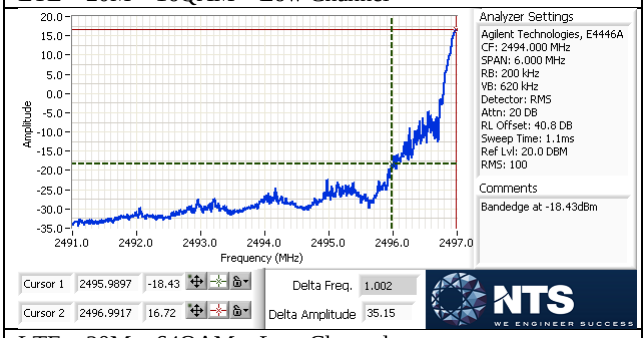
LTE – 20M – QPSK – Low Channel



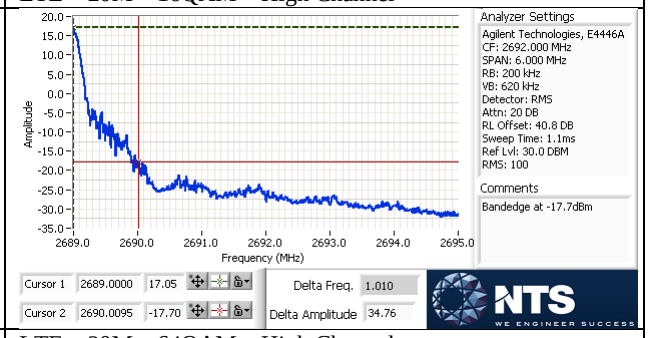
LTE – 20M – QPSK – High Channel



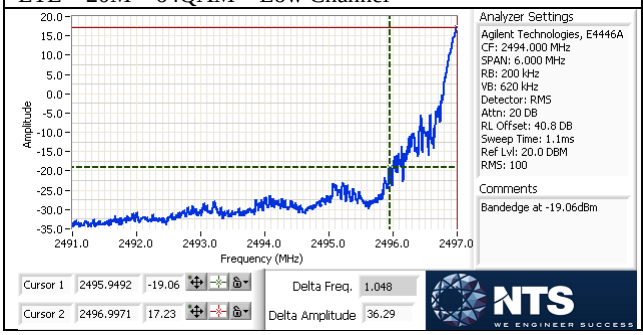
LTE – 20M – 16QAM – Low Channel



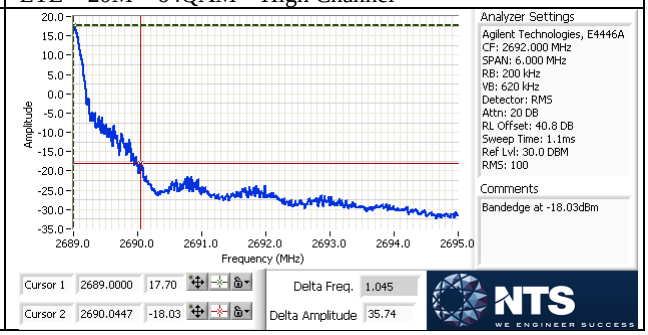
LTE – 20M – 16QAM – High Channel



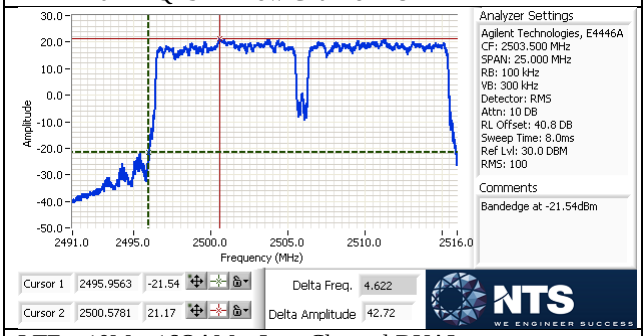
LTE – 20M – 64QAM – Low Channel



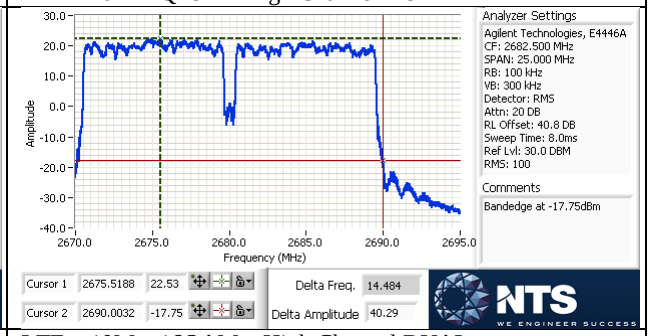
LTE – 20M – 64QAM – High Channel



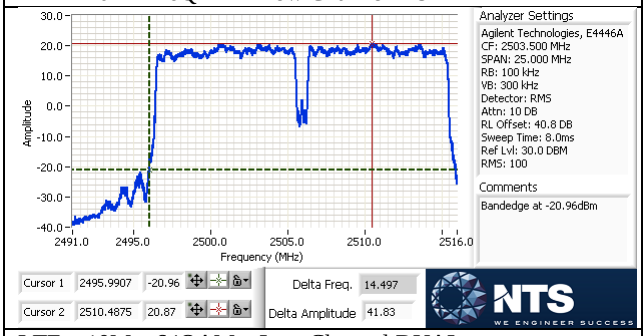
LTE – 10M – QPSK – Low Channel DUAL



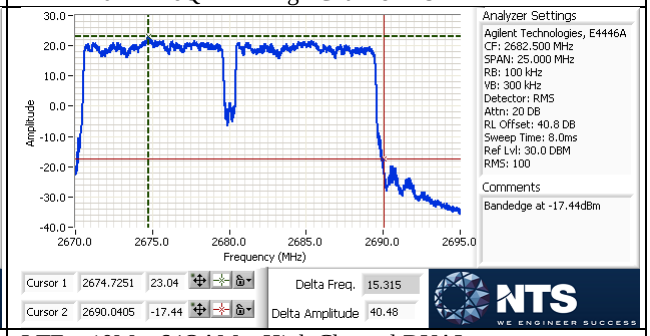
LTE – 10M – QPSK – High Channel DUAL



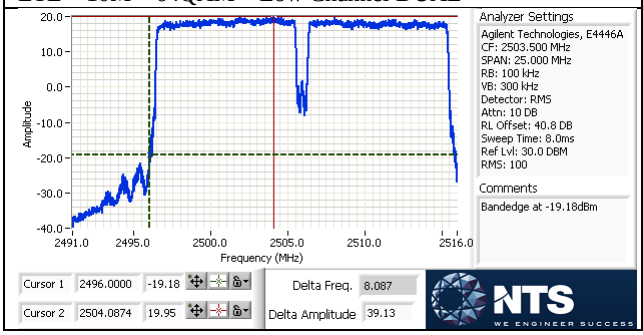
LTE – 10M – 16QAM – Low Channel DUAL



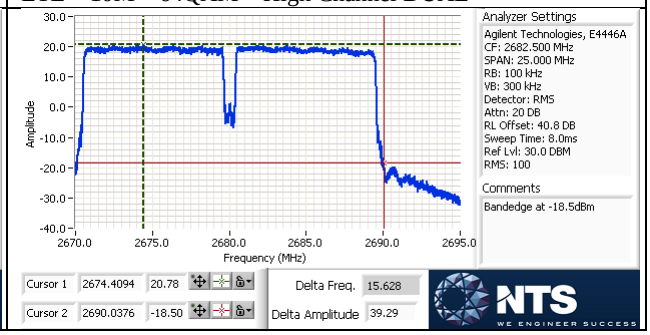
LTE – 10M – 16QAM – High Channel DUAL



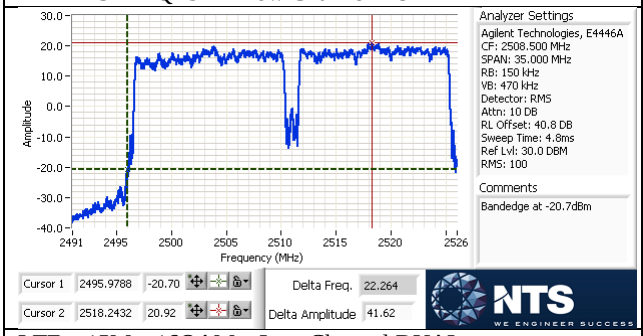
LTE – 10M – 64QAM – Low Channel DUAL



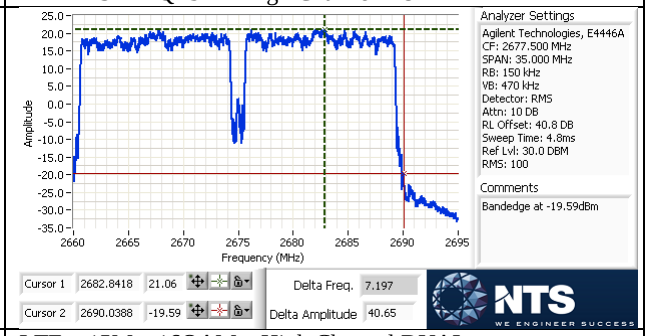
LTE – 10M – 64QAM – High Channel DUAL



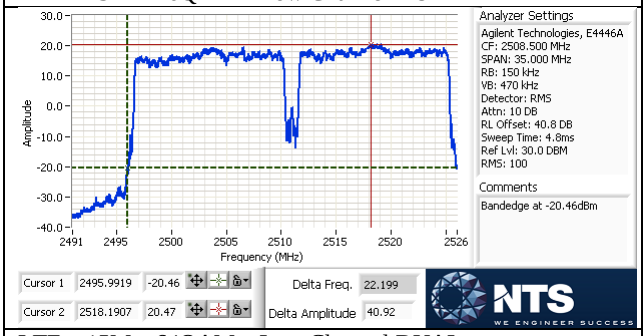
LTE – 15M – QPSK – Low Channel DUAL



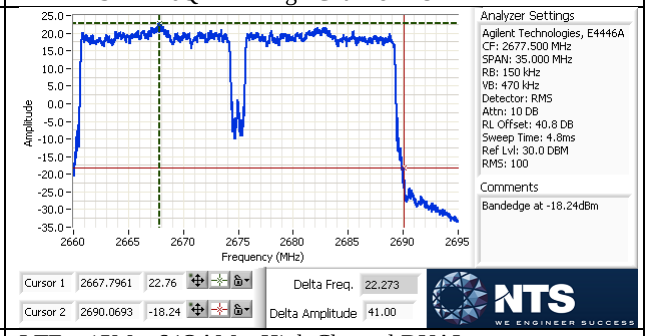
LTE – 15M – QPSK – High Channel DUAL



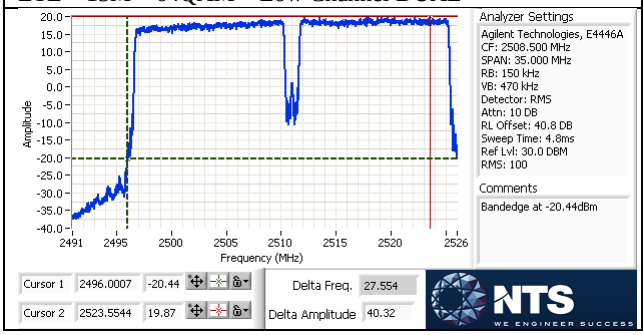
LTE – 15M – 16QAM – Low Channel DUAL



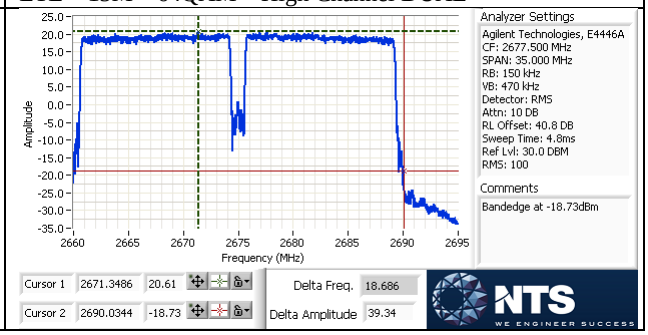
LTE – 15M – 16QAM – High Channel DUAL



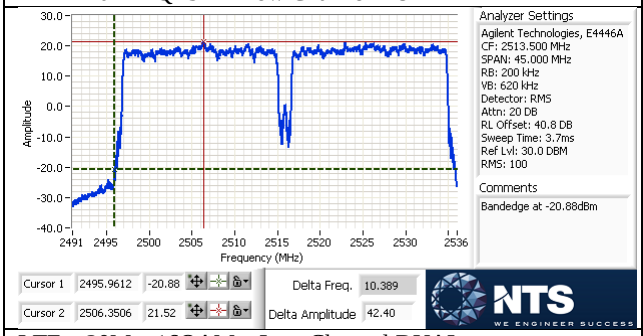
LTE – 15M – 64QAM – Low Channel DUAL



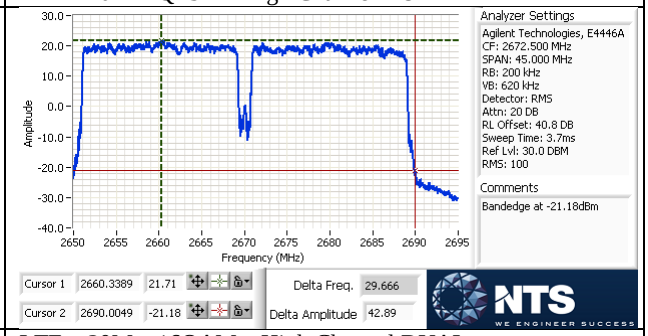
LTE – 15M – 64QAM – High Channel DUAL



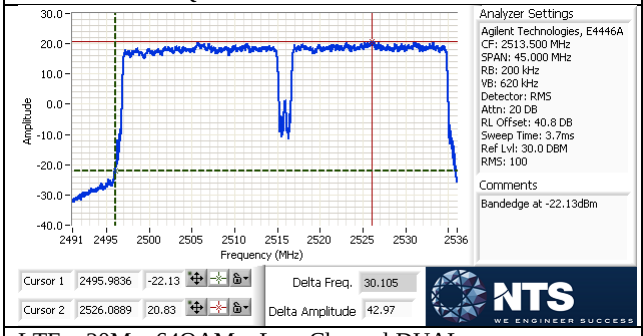
LTE – 20M – QPSK – Low Channel DUAL



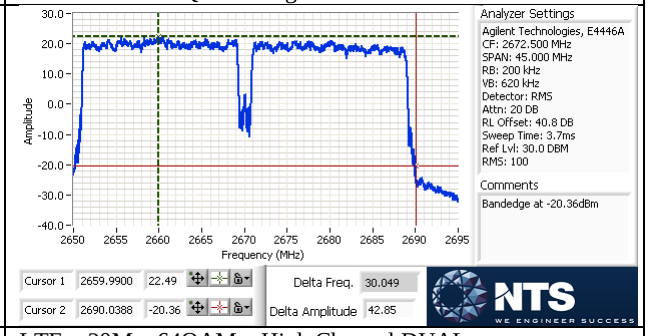
LTE – 20M – QPSK – High Channel DUAL



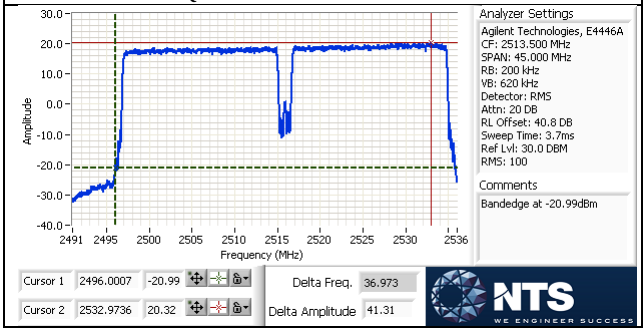
LTE – 20M – 16QAM – Low Channel DUAL



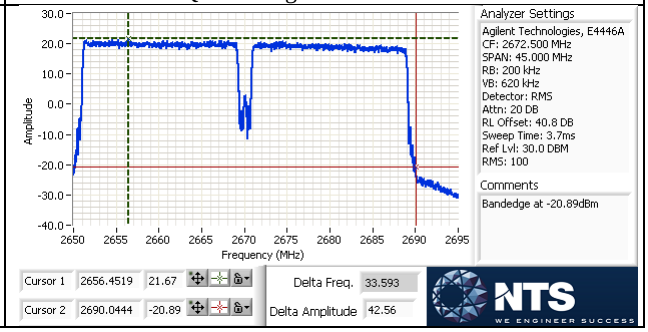
LTE – 20M – 16QAM – High Channel DUAL



LTE – 20M – 64QAM – Low Channel DUAL



LTE – 20M – 64QAM – High Channel DUAL



Transmitter Antenna Port Conducted Spurious Emissions

Tests performed at Port 2 on center channel for all modulations and bandwidth modes. Due to 2x2 MIMO operation, limit is -16.01dBm (-13dBm – 10*log(2)) per FCC KDB 662911D01 v02r01.

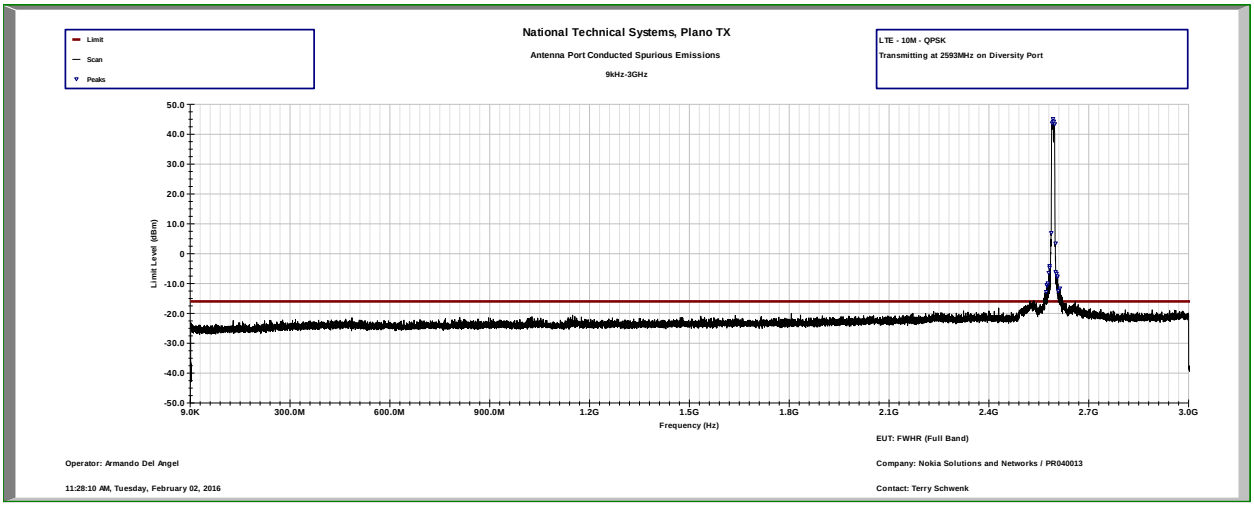
TILE6 measurement software was used during testing with the following settings:

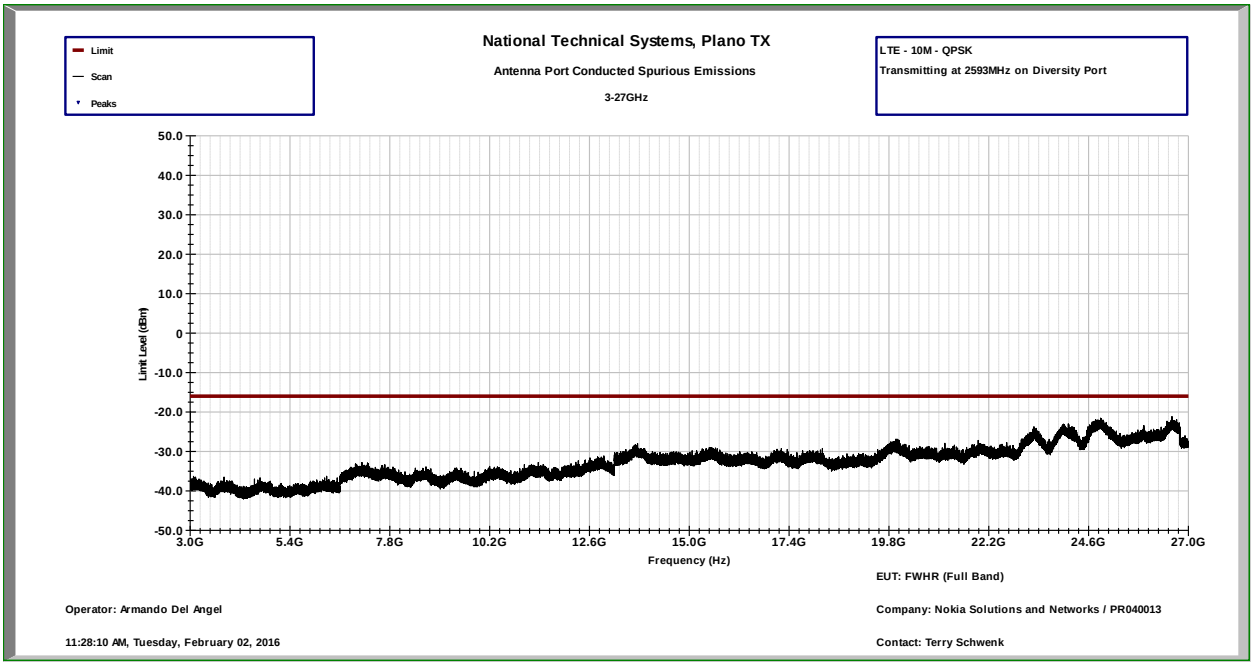
Frequency Range	**RBW**	**VBW**	**Number of data points**	**Divided into**	**Detector**	**Sweep Time**	**Max hold over**
9kHz-150kHz	1kHz	3kHz	8000	1 segment	Peak	Auto	50 sweeps
150kHz-1.5MHz	100kHz	300kHz	8000	1 segments	Peak	Auto	50 sweeps
1.5MHz-5GHz	1MHz	3MHz	8000	3 segments	Peak	Auto	50 sweeps
5GHz-7GHz	1MHz	3MHz	8000	10 segments	Peak	Auto	50 sweeps

Above 3GHz, in order to reduce the measurement instrumentation noise floor, the PSA's internal attenuation was reduced from 20dB to 0dB.

Corresponding plots are included on the following pages.

10M – LTE – QPSK – Center Channel Full Band (2593MHz)





10M – LTE – 16QAM – Center Channel Full Band (2593MHz)