Radio Test Report

Application for Grant of Equipment Authorization

FCC Part 90 Subpart S
862MHz – 869MHz

FCC ID:	**VBNFRCC-01**
Model:	**FRCC**
Product Name:	**Flexi Multiradio BTS**
APPLICANT:	**Nokia Solutions and Networks** **6000 Connection Drive** **Irving, TX 75039**
TEST SITE(S):	**National Technical Systems - Plano** **1701 E Plano Pkwy #150** **Plano, TX 75074**
REPORT DATE:	**May 26, 2015**
FINAL TEST DATES:	**Mar 12 – Mar 20, 2015**
TOTAL NUMBER OF PAGES:	**63**

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REVISION HISTORY

Rev#	Date	Comments	Modified By
0	Apr 13, 2015	1st release	Yunus Faziloglu
1	May 26, 2015	To address TCB comments	Yunus Faziloglu

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SCOPE

Tests have been performed on Nokia Solutions and Networks product Flexi Multiradio BTS RRH Model FRCC, 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 90 Subpart S

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 Flexi Multiradio BTS RRH Model FRCC and therefore apply only to the tested sample. The sample was selected and prepared by Hobert Smith 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 Model FRCC. No additional models were described or supplied for testing.

STATEMENT OF COMPLIANCE

The tested sample of Nokia Solutions and Networks product Flexi Multiradio BTS RRH Model FRCC 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 90 Subpart S (Base Stations Operating in 862MHz-869MHz band)

FCC	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics				
§90.617	Frequency range(s)	863.3MHz - 868.3MHz (1.4M LTE) 864.1MHz - 867.5MHz (3M LTE) 865.1MHz - 866.5MHz (5M LTE)	862MHz - 869MHz	Pass
§90.207	Modulation Type	QPSK, 16QAM, 64QAM (1.4M, 3M and 5M for each)	Digital	Pass
§90.635	Output Power	Conducted Output Power (Highest on Port 2) RMS: 46.39Bm ERP will depend on antenna gain (unknown)	FCC: 1000W ERP	Pass
N/A Informational	Peak to Average Ratio	10.81dB highest	--	--
§2.1049	Emission Bandwidth (99%)	1.117MHz (1.4M LTE) 2.707MHz (3M LTE) 4.501MHz (5M LTE)	Remain in Block	Pass
N/A Informational	Emission Bandwidth (26dB)	1.290MHz (1.4M LTE) 2.916MHz (3M LTE) 4.886MHz (5M LTE)	Remain in Block	Pass
Transmitter spurious emissions[1]				
§90.691	At the antenna terminals	< -16.02dBm	-16.02 dBm (per TX chain)	Pass
	Field strength	48.9dBuV/m at 3m Eq. to -46.3dBm EIRP	-13 dBm EIRP	Pass
Other details				
§90.213	Frequency stability	0.0005ppm	1.5ppm	Pass
§1.1310	RF Exposure	N/A		Pass[2]

Notes

Note 1 – Based on 100kHz RBW below 1GHz and 1MHz RBW above 1GHz, except in 100kHz bands immediately outside and adjacent to the frequency block smaller RBW settings have been used as detailed in the bandedge measurements section of the report.

Note 2 – Applicant's declaration on a separate exhibit based on hypothetical antenna gains.

	Emission Designators		
	LTE-QPSK	**LTE-16QAM**	**LTE-64QAM**
1.4M	1M29F9W	1M27F9W	1M26F9W
3M	2M92F9W	2M92F9W	2M91F9W
5M	4M88F9W	4M86F9W	4M89F9W

Note: Based on 26dB emission bandwidth for worst case representation.

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 Flexi Multiradio Base Transceiver Station (BTS) Remote Radio Head (RRH) module, model FRCC which operates over 3GPP frequency band 26A (862-869 MHz). The FRCC has two co-located transmitters with each transmit port supporting 40 watts maximum rated RF output power. The FRCC can be operated as MIMO or as non-MIMO. Multi-carrier operation is supported.

The FRCC is multi-standard capable (GSM/EDGE/WCDMA/LTE), but for this effort only the LTE mode is tested. The FRCC supports three downlink modulation types for LTE (QPSK, 16QAM and 64QAM). The FRCC supports three LTE channel bandwidths (1.4, 3.0 and 5 MHz).

The FRCC has external interfaces including DC power, ground, TX/RX (Ant), RX monitor (RXO), external alarm (EAC), optical OBSAI (OPT) and remote electrical tilt (RET). The RRH with applicable installation kit may be pole or wall mounted.

The FRCC LTE channel numbers and frequencies are as follows:

	Downlink EARFCN	Downlink Frequency (MHz)	LTE Channel Bandwidth		
			1.4 MHz	3.0MHz	5.0 MHz
Band 26A (Ant 1, 2)	8690 (8696)	862.0 (862.6)	Bandedge	Bandedge	Bandedge
	……				
	8703	863.3	Bottom Ch		
	……				
	8711	864.1		Bottom Ch	
	……				
	8721	865.1			Bottom Ch
	……				
	8725	865.5	Middle Ch	Middle Ch	Middle Ch
	……				
	8735	866.5			Top Channel
	……				
	8745	867.5		Top Channel	
	……				
	8753	868.3	Top Channel		
	……				
	8760	869.0	Bandedge	Bandedge	Bandedge

Note: The FRCC lower bandedge frequency is at 862.6 MHz.

FRCC Downlink LTE Frequency Channels

The sample was received on Mar 12, 2015 and tested on Mar 12 - Mar 20, 2015. The EUT consisted of the following component(s):

Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	FRCC	Flexi Multiradio BTS RRH	Part#: 473200A.x12 Serial#: YK144500022	FCC ID: VBNFRCC-01 IC: N/A

ENCLOSURE

The EUT enclosure is made of heavy duty aluminum and measures approximately 12(W) x 7(D) x 24(H) inches.

AUXILLARY EQUIPMENT

Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	FOSH	6GHz SFP Module (Plugs into RRH Opt Ports 1&2)	Part#: 472579A.101 (2 units per RRH) Serial#: CE30LCF0H and CE30LC48U	N/A

SUPPORT EQUIPMENT

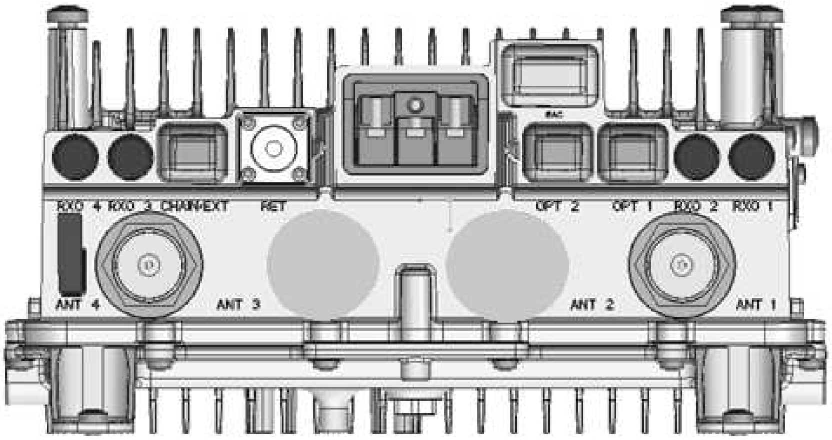
Company	Model	Description	Part/Serial Number	FCC ID/IC Number
Nokia Solutions and Networks	FSMF	Flexi System Module	Part#: 472181A.103	N/A
Nokia Solutions and Networks	FBBA	Baseband Extension Module	Part#: 472182A.101 (2 units per FSMF)	N/A
HP	Elite Book 6930p	Laptop PC	N/A	N/A

EUT INTERFACE PORTS

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

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

The connector layout for FRCC is provided below:



FRCC External Interfaces:

Name	Qty	Connector Type	Purpose (and Description)
DC In	1	Screw Terminal	3-port Power Input -48 VDC, up to AWG 4 cable
GND	1	Screw lug (2xM5/1xM8)	Ground
ANT	2	7/16	RF signal for Transmitter/Receiver (50 Ohm)
RXO	2	QMA	RX output for monitoring/location services
Unit	1	LED	Unit Status LED
LMP	1	Card edge	Local Management/Test Port (Ethernet 10Base-T/100Base-Tx and others, not field accessible)
EAC	1	MDR14	External Alarm Interface (4 alarms)
OPT	2	SFP+ cage	Optical OBSAI Interface up to 6 Gps.
RET	1	8-pin circular connector conforming to IEC 60130-9 – Ed.3.0	AISG 2.0 to external devices

EUT OPERATION

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

EUT FIRMWARE/SOFTWARE

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

(1) RRH Unit Software: FRM35.02.R03 updated with RFC 1 File (RFC1_02R03_NEW 1.4)
(2) System Module Software: FB_PS_REL_2013_09_016

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.

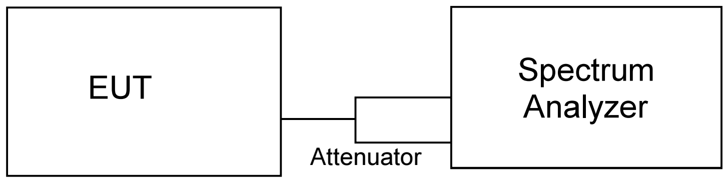
Radiated spurious emissions measurements were taken at the NTS Plano Anechoic Chamber listed below. The sites conform to the requirements of ANSI C63.4-2009 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range 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 was terminated with a termination block. 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-9GHz frequency span. Settings of the spectrum analyzer are described in the corresponding test result section.

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 signal analyzer as detailed in the test equipment section has been used for précised frequency error measurements.

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 9GHz with a peak detector (RBW=100kHz, VBW=300kHz below 1GHz and RBW=1MHz, VBW=3MHz above 1GHz, 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 1-9GHz 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
E1563P	PSA	Agilent	E4440A	12 Months	9/2/2015
E1554P	PreAmp (1GHz-40GHz)	MITEQ	JS32-00104000-62-5P	12 Months	5/14/2015
E1366P	PreAmp (30MHz-1GHz)	MITEQ	AM-1431-N-1197SC	12 Months	12/12/2015
E1289P	Biconilog Antenna (30MHz-1GHz)	ETS Lindgren	3142C	12 Months	3/19/2016
E1149P	Horn Antenna (1GHz-18GHz)	EMCO	3115	12 Months	12/10/2015
E1447P	RMS Multimeter	Fluke	87V	12 Months	5/20/2015
D1131P	Data Acquisition Switch Unit	Agilent	34970A	12 Months	7/2/2015
ENV1195P	Climatic Chamber	Thermotron	SE-300-2-2	N/A	NCR
* NM04508	MXA Signal Analyzer	Agilent	N9020A	24 Months	1/27/2017

* Test equipment supplied by the customer for LTE frequency error measurements

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.

Results on center channel:

		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 1 Center Channel	1.4M	54.42	45.9	8.52	54.57	45.91	8.66	54.32	45.87	8.45
	3M	55.24	45.87	9.37	55.36	45.9	9.46	55.36	45.94	9.42
	5M	55.61	45.58	10.03	56.22	45.6	10.62	55.44	45.54	9.9
Port 2 Center Channel	1.4M	54.73	46.23	8.5	54.88	**46.39**	8.49	54.61	46.12	8.49
	3M	55.57	46.12	9.45	55.63	46.13	9.5	55.66	46.06	9.6
	5M	55.85	45.8	10.05	**56.52**	45.71	**10.81**	55.7	45.76	9.94
Combined Center Channel	1.4M	57.59	49.08	8.51	57.74	49.17	8.57	57.48	49.01	8.47
	3M	58.42	49.01	9.41	58.51	49.03	9.48	58.52	49.01	9.51
	5M	58.74	48.7	10.04	59.38	48.67	10.71	58.58	48.66	9.92

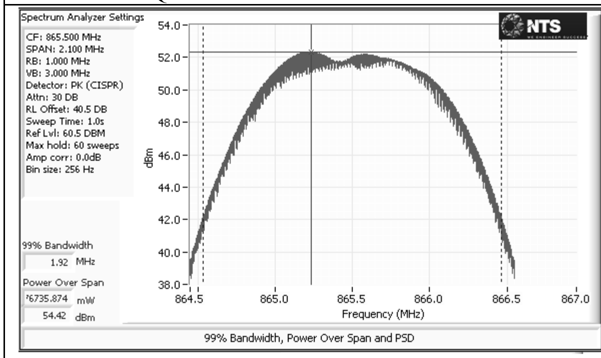
Based on the results above, Port 2 had the highest RMS average power and therefore it was selected for all the remaining antenna port tests on the product.

Subsequently output power levels on lowest and highest channels were tested only at Port 2 and results presented below.

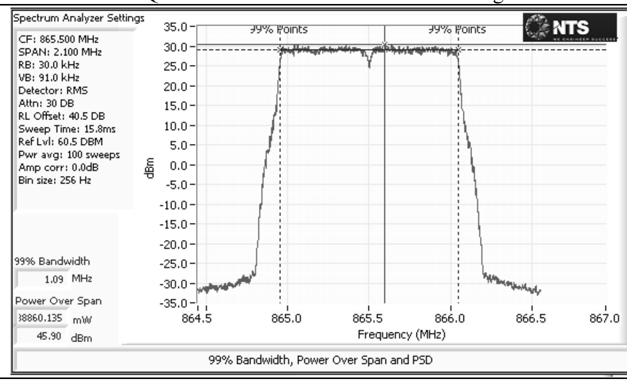
		LTE - QPSK			LTE - 16QAM			LTE - 64QAM		
		Peak (dBm)	Average (dBm)	PAR (dB)	Peak (dBm)	Average (dBm)	PAR (dB)	Peak (dBm)	Average (dBm)	PAR (dB)
Port 2 Low Channel	1.4M	54.42	45.93	8.49	54.74	**46.17**	8.57	54.43	45.89	8.54
	3M	55.55	46.12	9.43	55.52	46.14	9.38	55.69	46.13	9.56
	5M	55.94	45.85	10.09	**56.51**	45.73	**10.78**	55.88	45.95	9.93
Port 2 High Channel	1.4M	54.08	45.54	8.54	54.29	45.54	8.75	54.02	45.5	8.52
	3M	55.28	45.79	9.49	55.35	45.76	9.59	55.36	45.8	9.56
	5M	55.87	45.74	10.13	56.46	45.78	10.68	55.59	45.66	9.93

All corresponding plots included on the following pages. Total path loss of 40.4dB (Attenuator Loss: 40dB, RF cable loss: 0.4dB) accounted in via reference level offset to the spectrum analyzer.

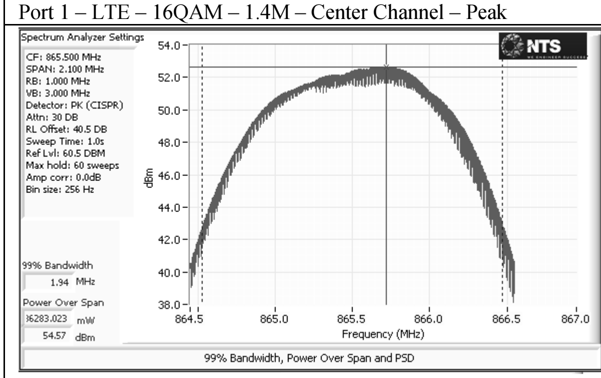
Port 1 – LTE – QPSK – 1.4M – Center Channel – Peak



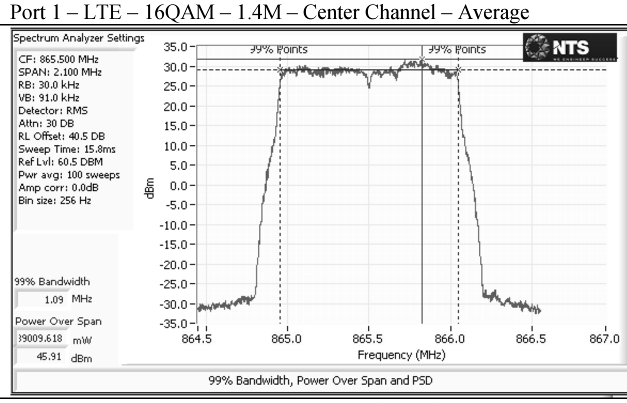
Port 1 – LTE – QPSK – 1.4M – Center Channel – Average



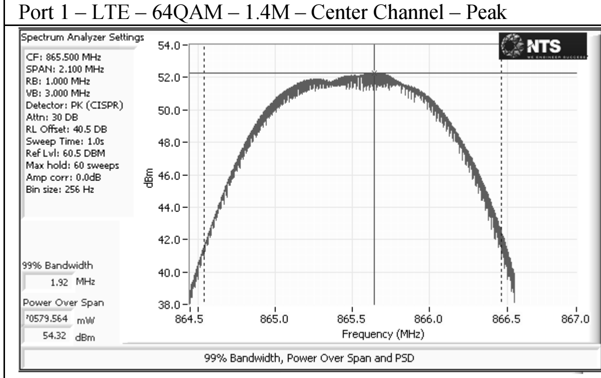
Port 1 – LTE – 16QAM – 1.4M – Center Channel – Peak



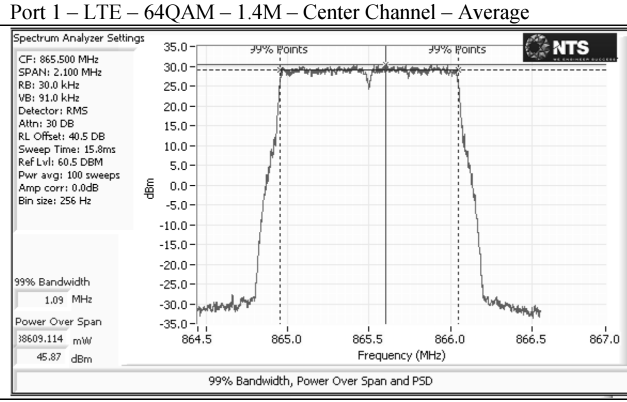
Port 1 – LTE – 16QAM – 1.4M – Center Channel – Average



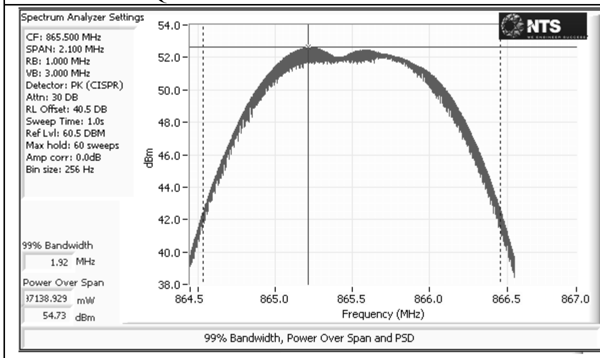
Port 1 – LTE – 64QAM – 1.4M – Center Channel – Peak



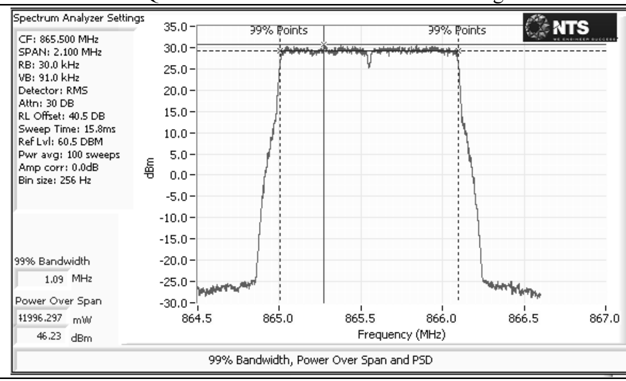
Port 1 – LTE – 64QAM – 1.4M – Center Channel – Average



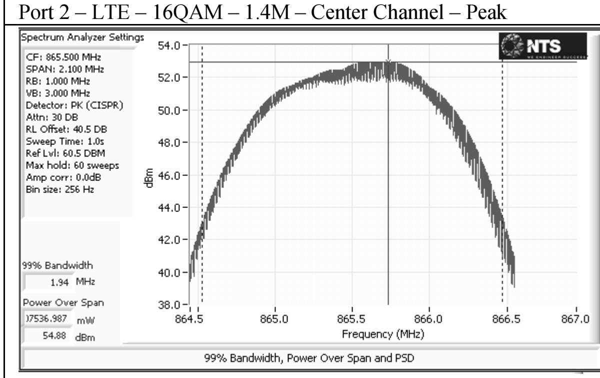
Port 2 – LTE – QPSK – 1.4M – Center Channel – Peak



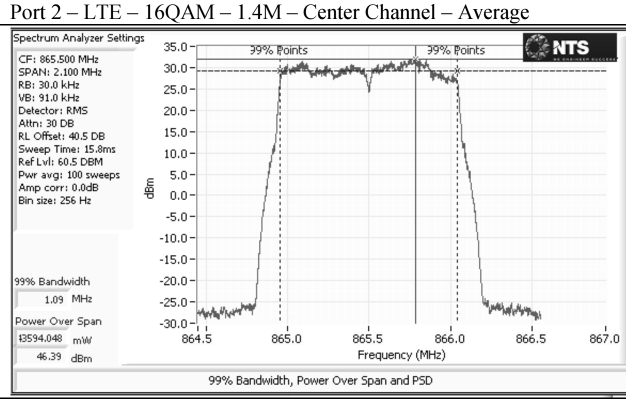
Port 2 – LTE – QPSK – 1.4M – Center Channel – Average



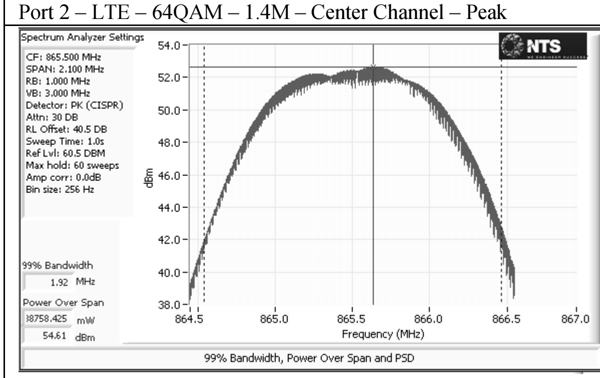
Port 2 – LTE – 16QAM – 1.4M – Center Channel – Peak



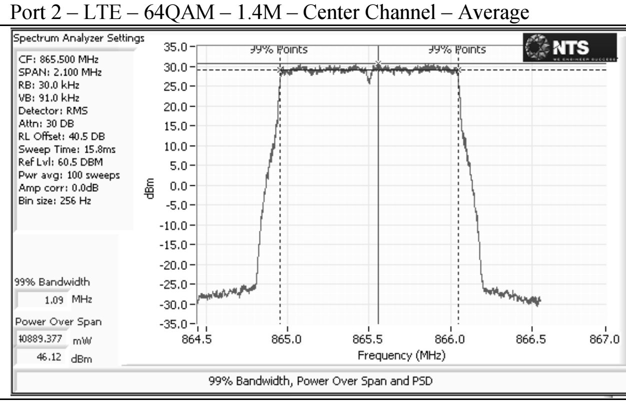
Port 2 – LTE – 16QAM – 1.4M – Center Channel – Average



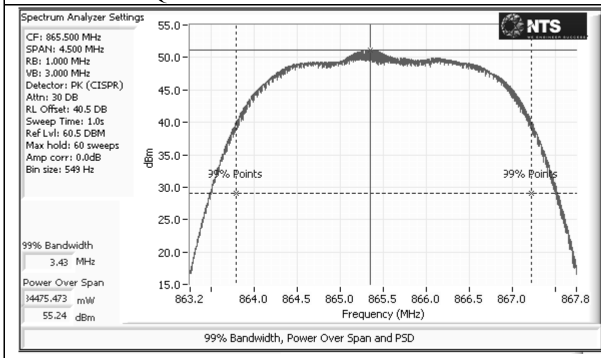
Port 2 – LTE – 64QAM – 1.4M – Center Channel – Peak



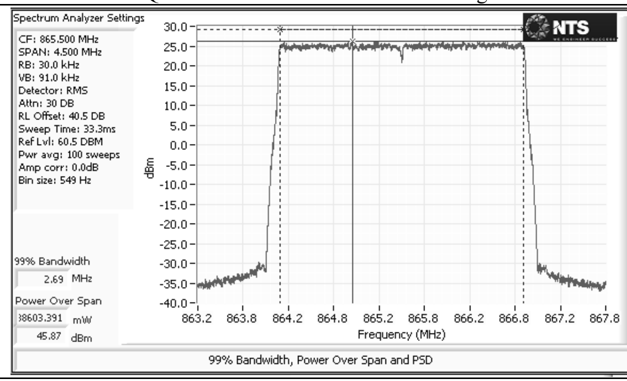
Port 2 – LTE – 64QAM – 1.4M – Center Channel – Average



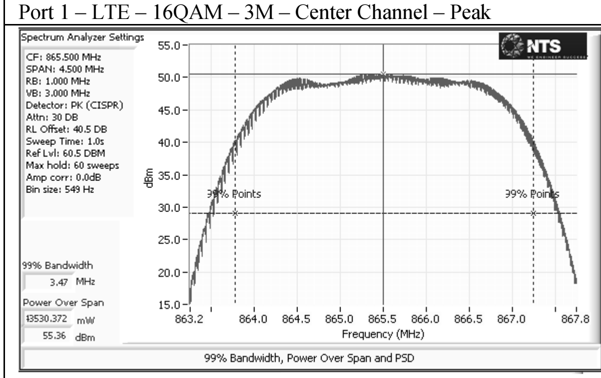
Port 1 – LTE – QPSK – 3M – Center Channel – Peak



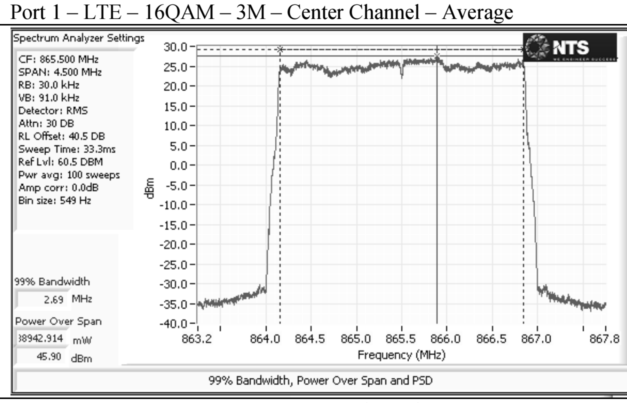
Port 1 – LTE – QPSK – 3M – Center Channel – Average



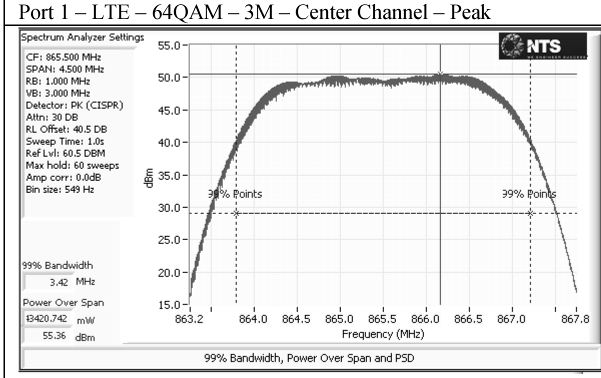
Port 1 – LTE – 16QAM – 3M – Center Channel – Peak



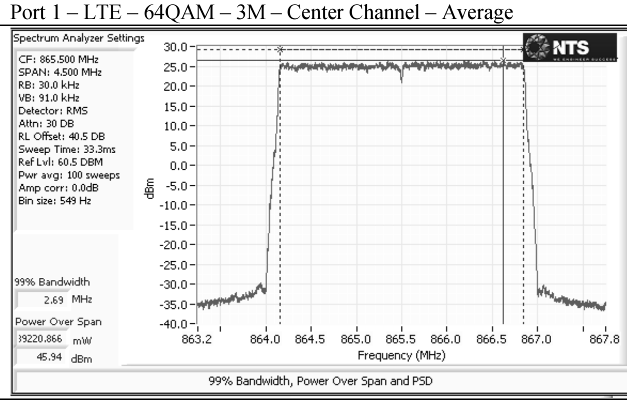
Port 1 – LTE – 16QAM – 3M – Center Channel – Average



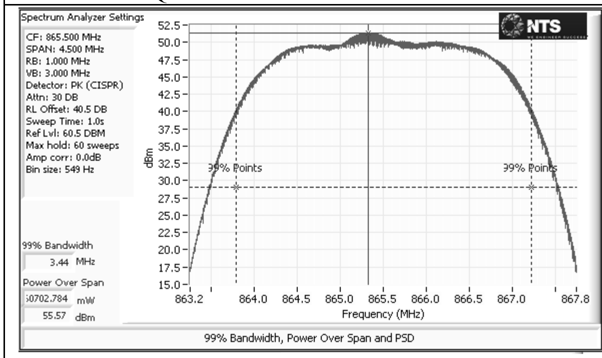
Port 1 – LTE – 64QAM – 3M – Center Channel – Peak



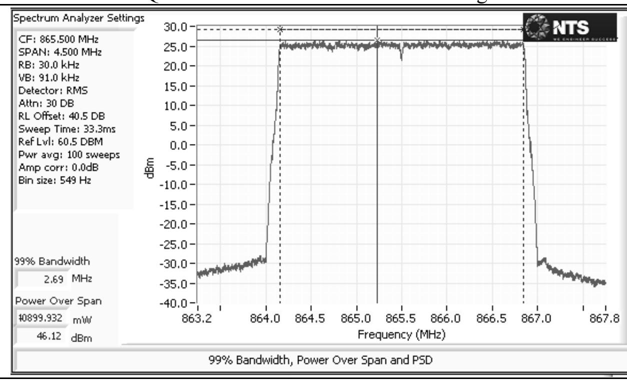
Port 1 – LTE – 64QAM – 3M – Center Channel – Average



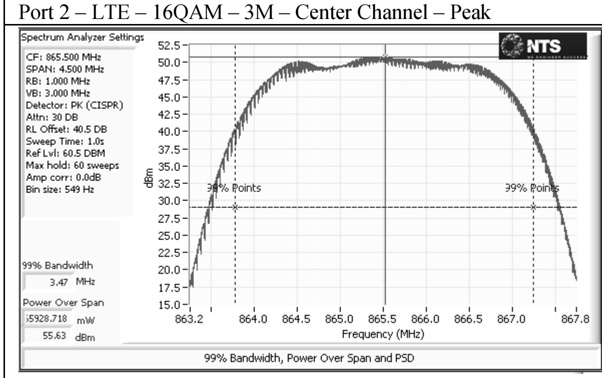
Port 2 – LTE – QPSK – 3M – Center Channel – Peak



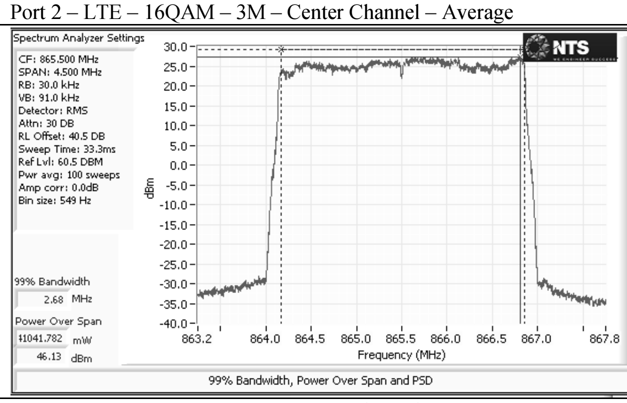
Port 2 – LTE – QPSK – 3M – Center Channel – Average



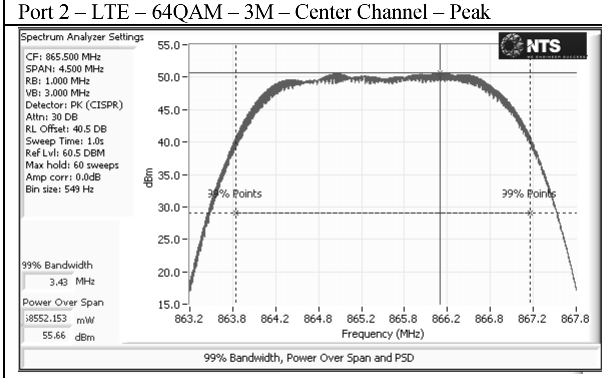
Port 2 – LTE – 16QAM – 3M – Center Channel – Peak



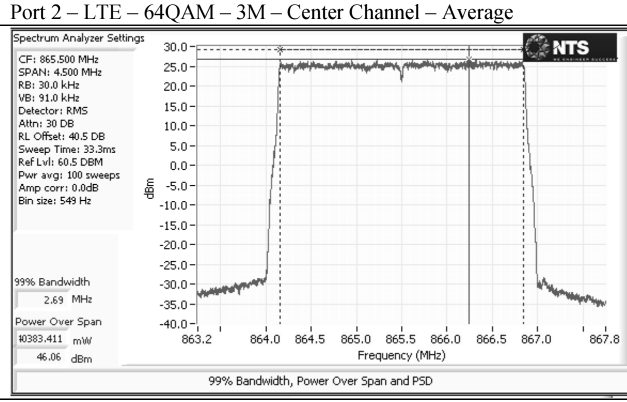
Port 2 – LTE – 16QAM – 3M – Center Channel – Average



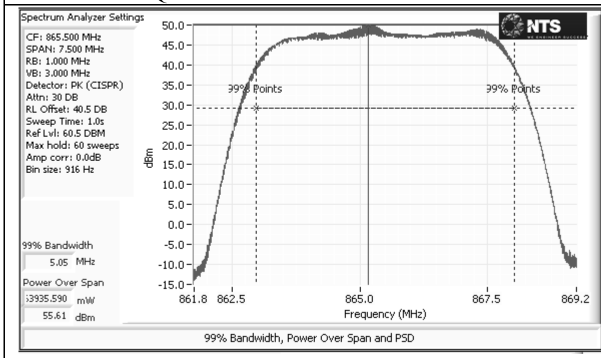
Port 2 – LTE – 64QAM – 3M – Center Channel – Peak



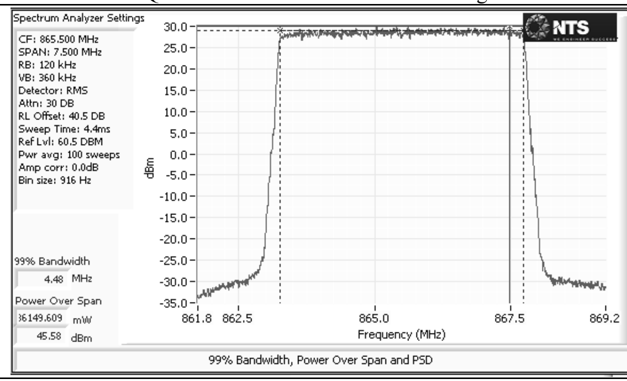
Port 2 – LTE – 64QAM – 3M – Center Channel – Average



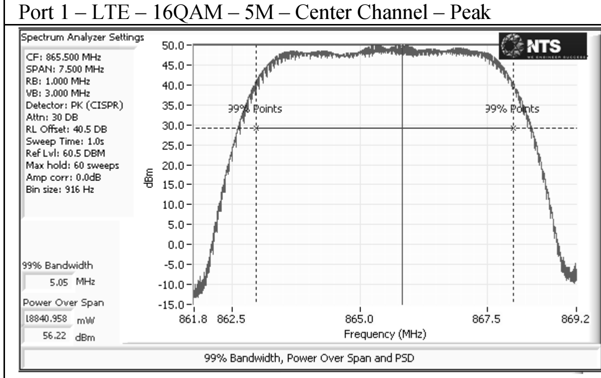
Port 1 – LTE – QPSK – 5M – Center Channel – Peak



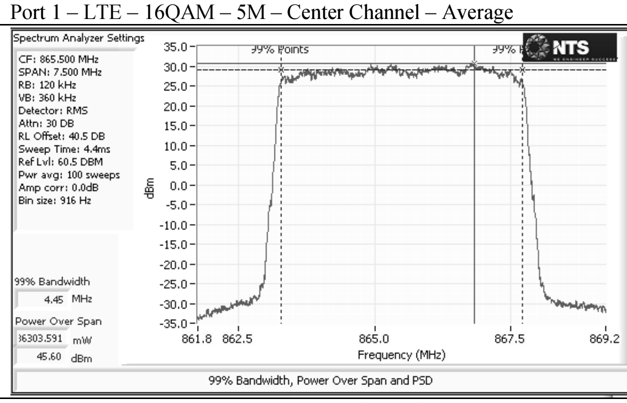
Port 1 – LTE – QPSK – 5M – Center Channel – Average



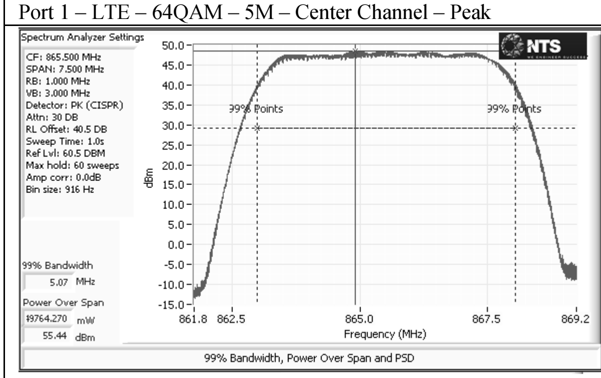
Port 1 – LTE – 16QAM – 5M – Center Channel – Peak



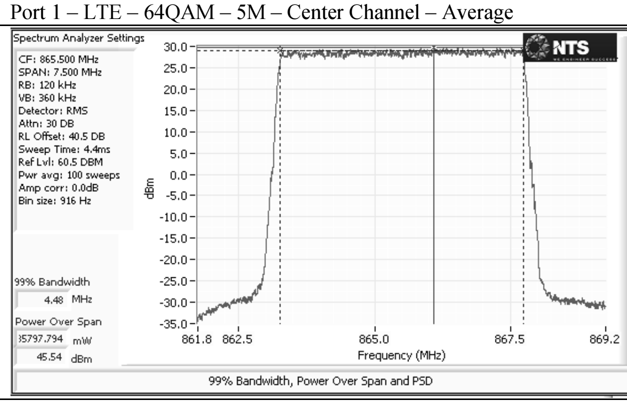
Port 1 – LTE – 16QAM – 5M – Center Channel – Average



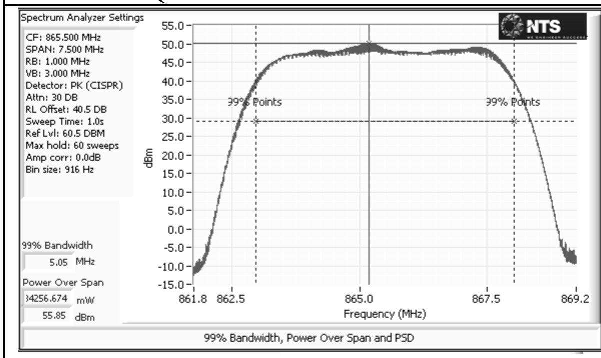
Port 1 – LTE – 64QAM – 5M – Center Channel – Peak



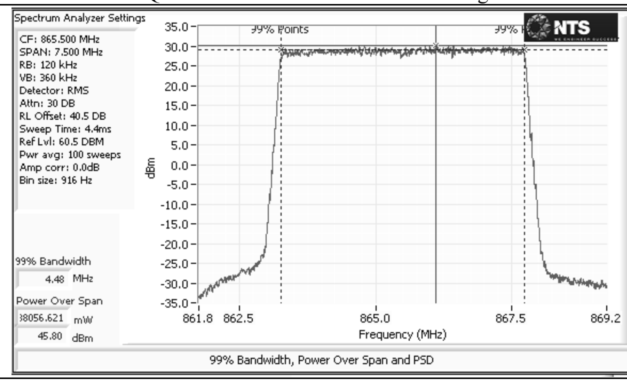
Port 1 – LTE – 64QAM – 5M – Center Channel – Average



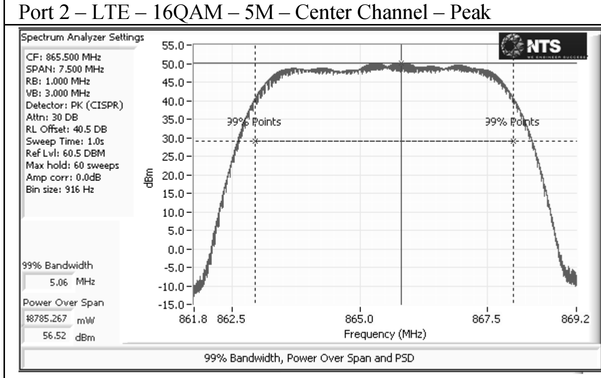
Port 2 – LTE – QPSK – 5M – Center Channel – Peak



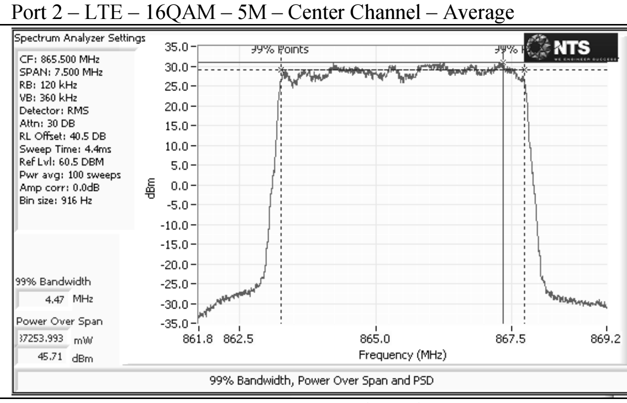
Port 2 – LTE – QPSK – 5M – Center Channel – Average



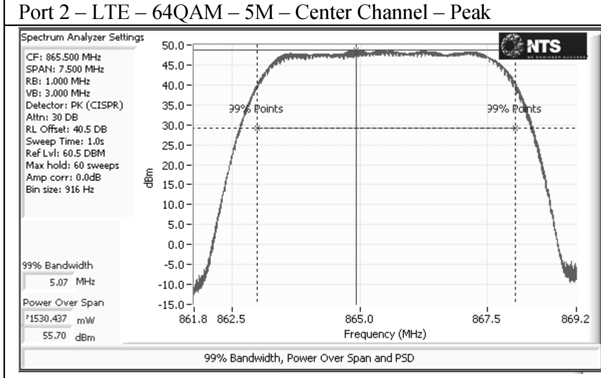
Port 2 – LTE – 16QAM – 5M – Center Channel – Peak



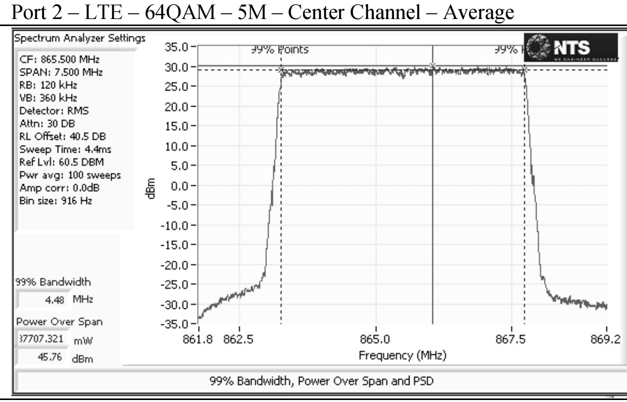
Port 2 – LTE – 16QAM – 5M – Center Channel – Average



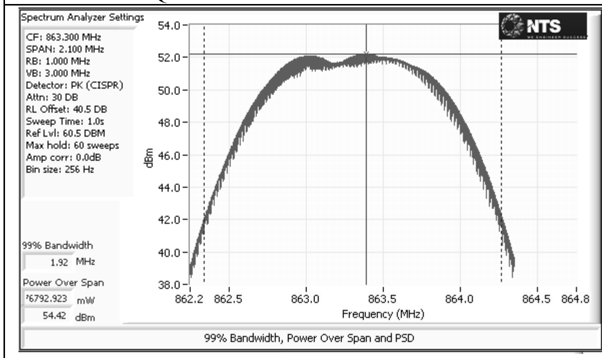
Port 2 – LTE – 64QAM – 5M – Center Channel – Peak



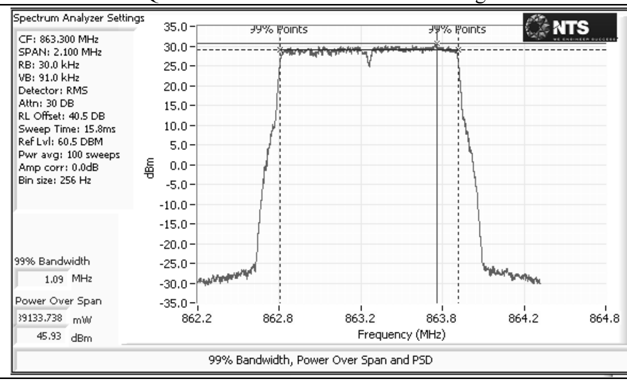
Port 2 – LTE – 64QAM – 5M – Center Channel – Average



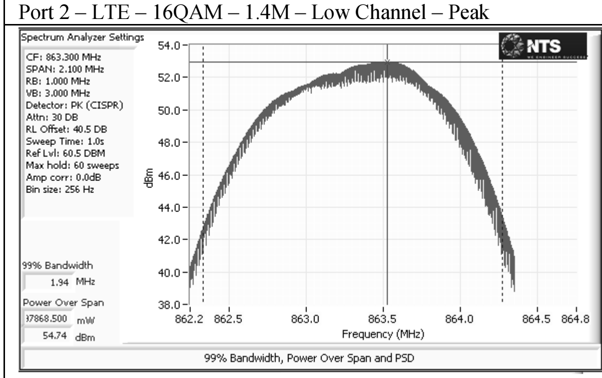
Port 2 – LTE – QPSK – 1.4M – Low Channel – Peak



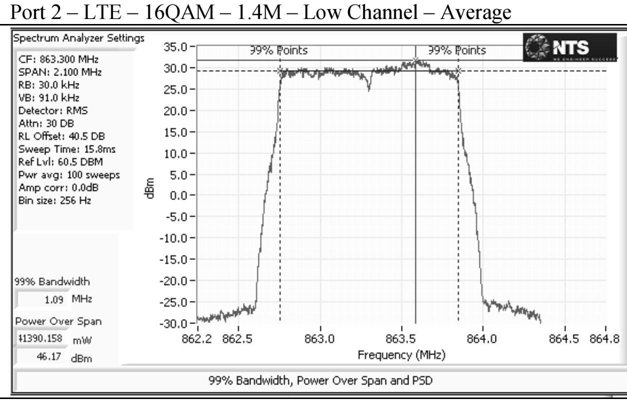
Port 2 – LTE – QPSK – 1.4M – Low Channel – Average



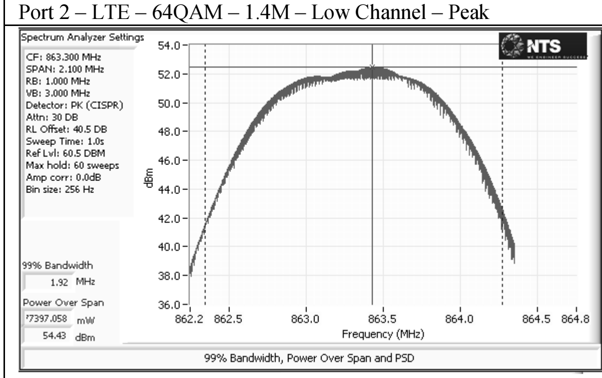
Port 2 – LTE – 16QAM – 1.4M – Low Channel – Peak



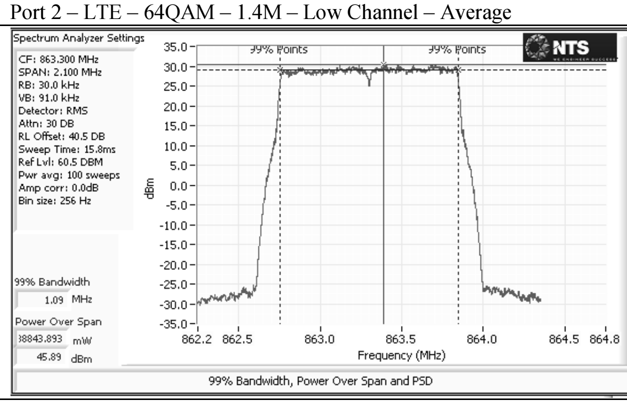
Port 2 – LTE – 16QAM – 1.4M – Low Channel – Average



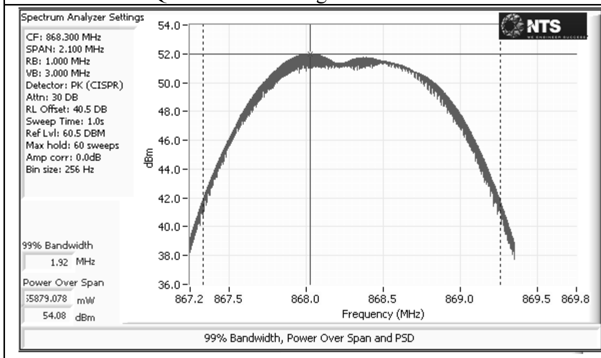
Port 2 – LTE – 64QAM – 1.4M – Low Channel – Peak



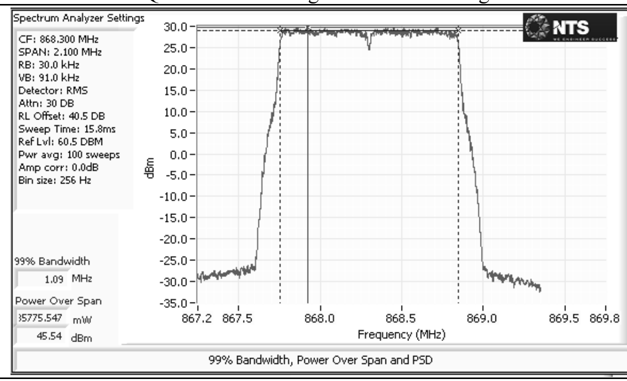
Port 2 – LTE – 64QAM – 1.4M – Low Channel – Average



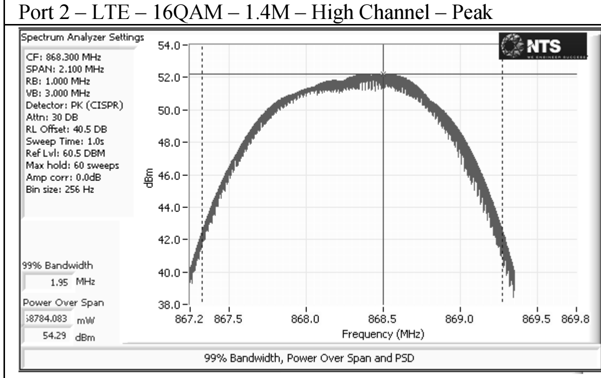
Port 2 – LTE – QPSK – 1.4M – High Channel – Peak



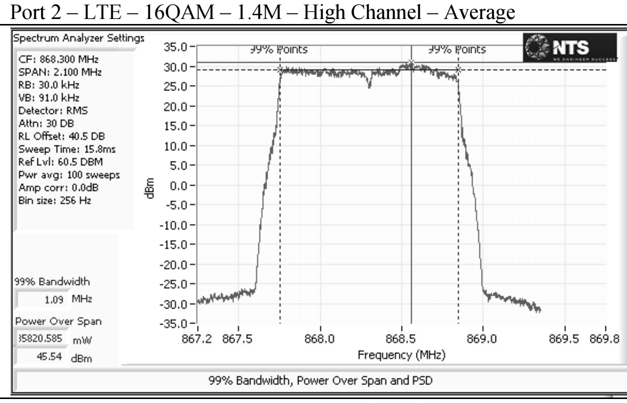
Port 2 – LTE – QPSK – 1.4M – High Channel – Average



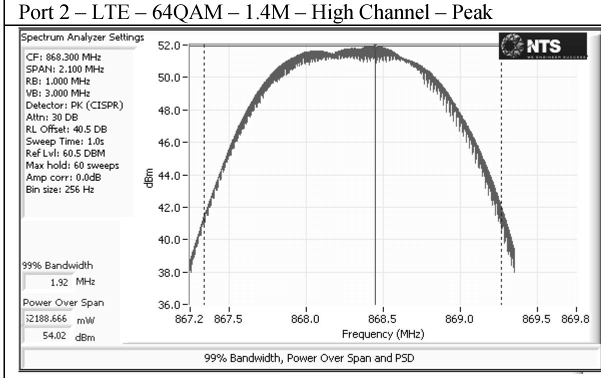
Port 2 – LTE – 16QAM – 1.4M – High Channel – Peak



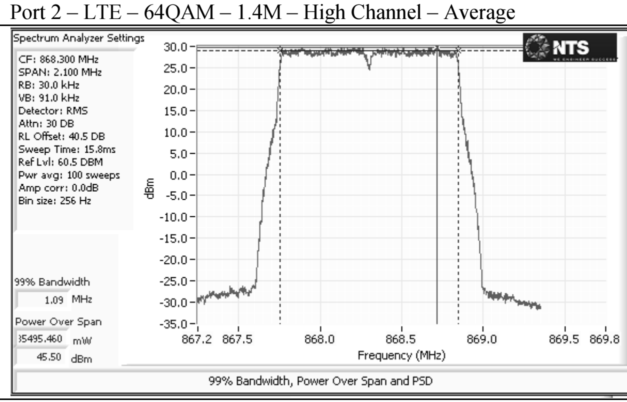
Port 2 – LTE – 16QAM – 1.4M – High Channel – Average



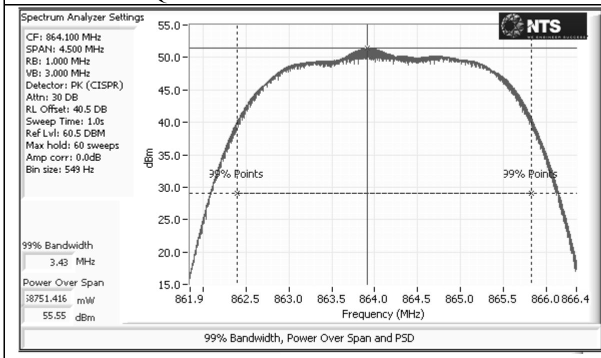
Port 2 – LTE – 64QAM – 1.4M – High Channel – Peak



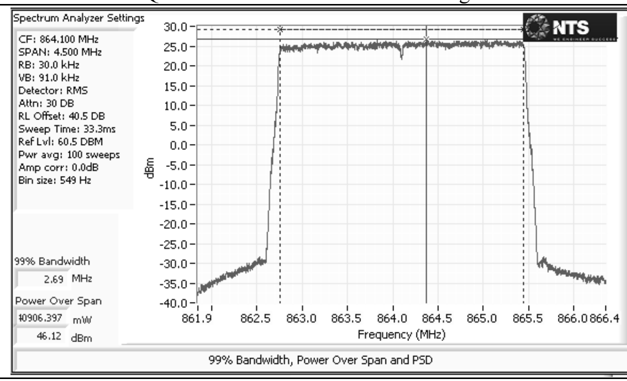
Port 2 – LTE – 64QAM – 1.4M – High Channel – Average



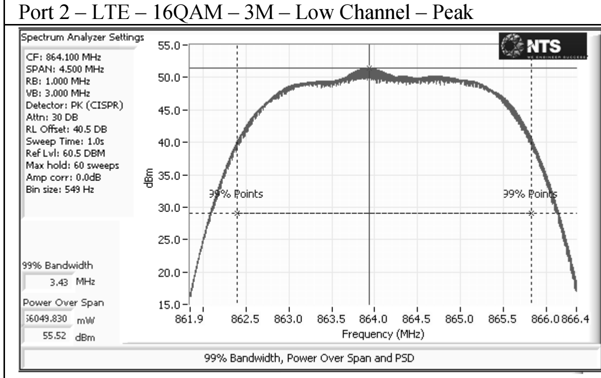
Port 2 – LTE – QPSK – 3M – Low Channel – Peak



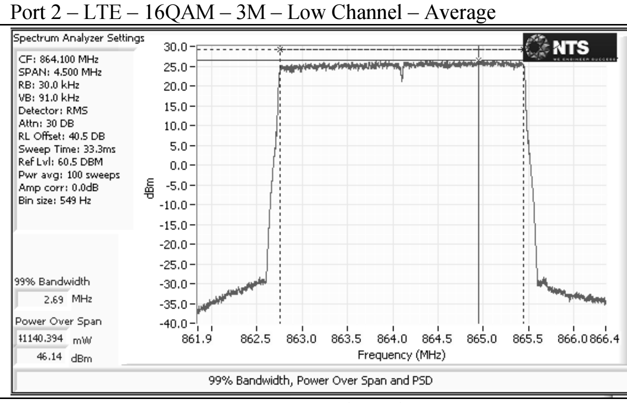
Port 2 – LTE – QPSK – 3M – Low Channel – Average



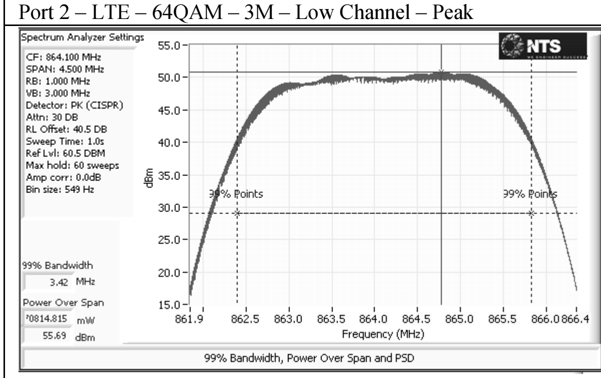
Port 2 – LTE – 16QAM – 3M – Low Channel – Peak



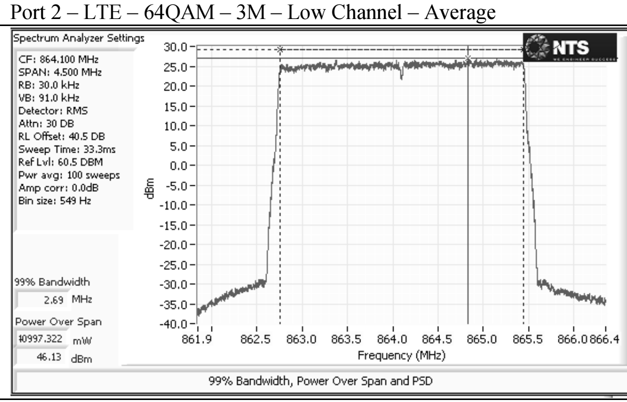
Port 2 – LTE – 16QAM – 3M – Low Channel – Average



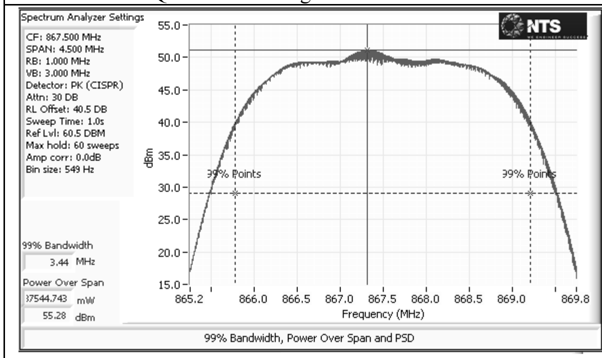
Port 2 – LTE – 64QAM – 3M – Low Channel – Peak



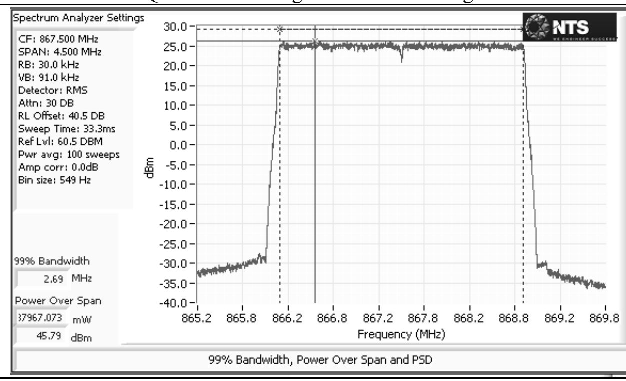
Port 2 – LTE – 64QAM – 3M – Low Channel – Average



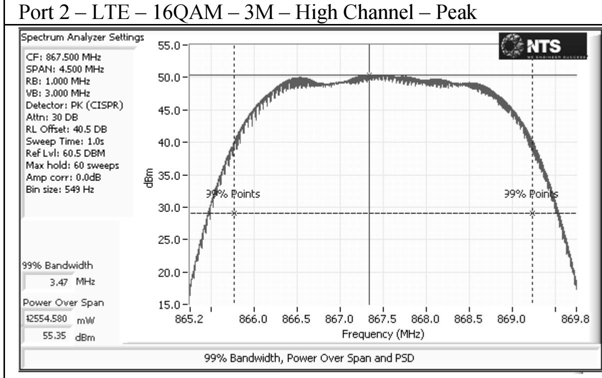
Port 2 – LTE – QPSK – 3M – High Channel – Peak



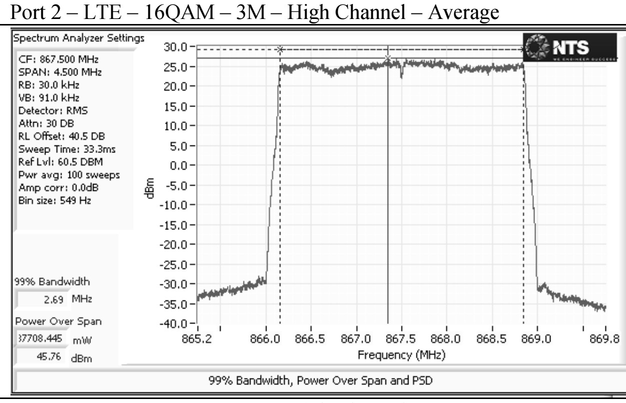
Port 2 – LTE – QPSK – 3M – High Channel – Average



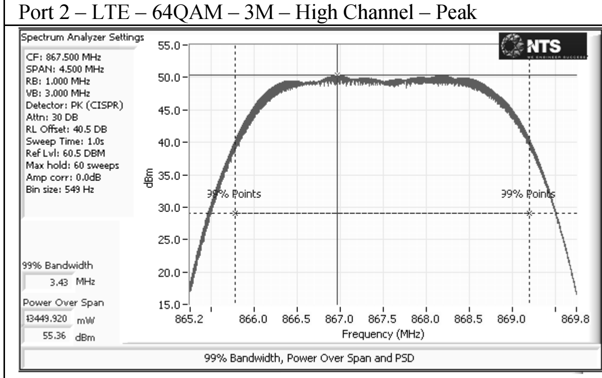
Port 2 – LTE – 16QAM – 3M – High Channel – Peak



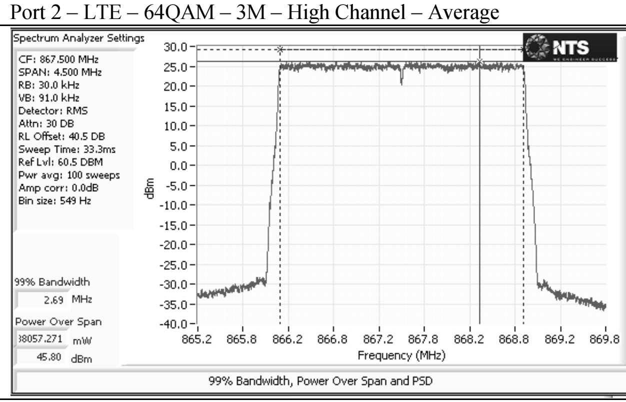
Port 2 – LTE – 16QAM – 3M – High Channel – Average



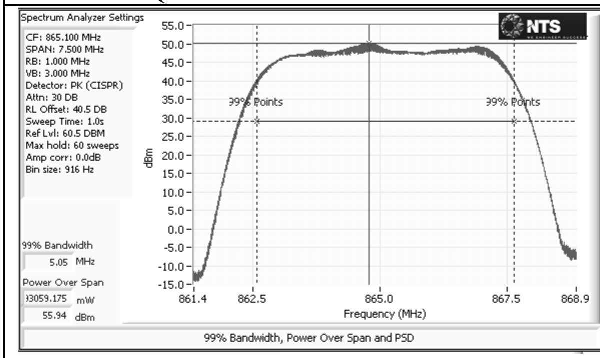
Port 2 – LTE – 64QAM – 3M – High Channel – Peak



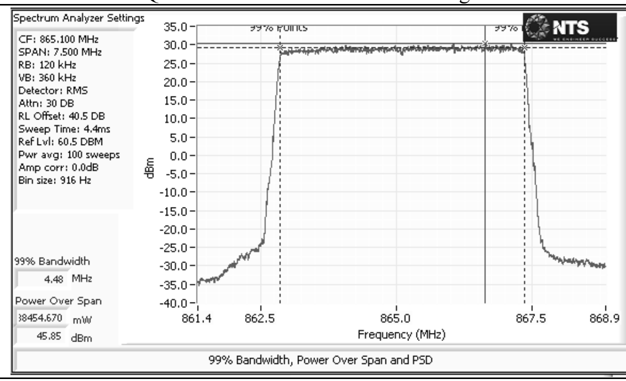
Port 2 – LTE – 64QAM – 3M – High Channel – Average



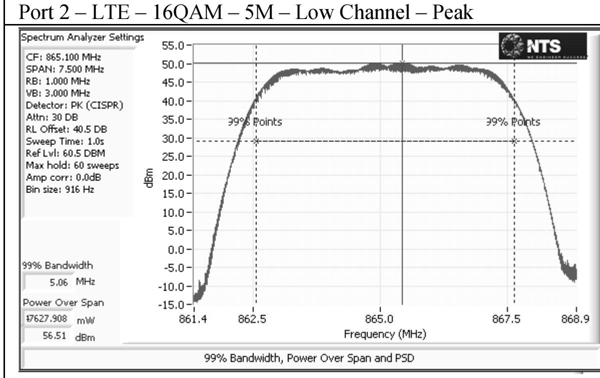
Port 2 – LTE – QPSK – 5M – Low Channel – Peak



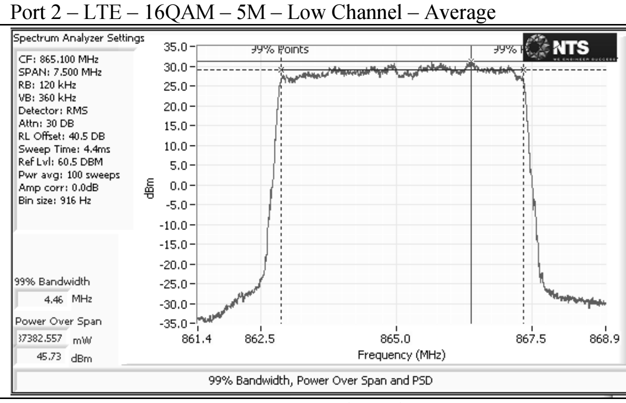
Port 2 – LTE – QPSK – 5M – Low Channel – Average



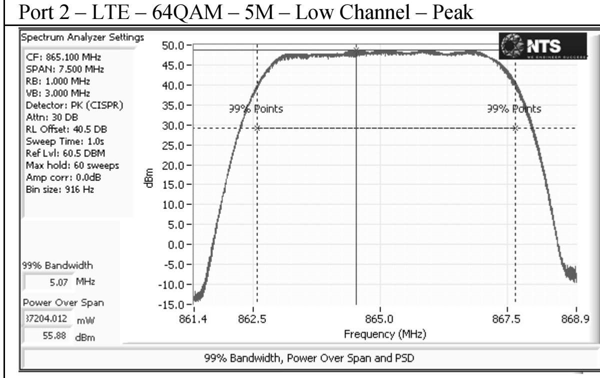
Port 2 – LTE – 16QAM – 5M – Low Channel – Peak



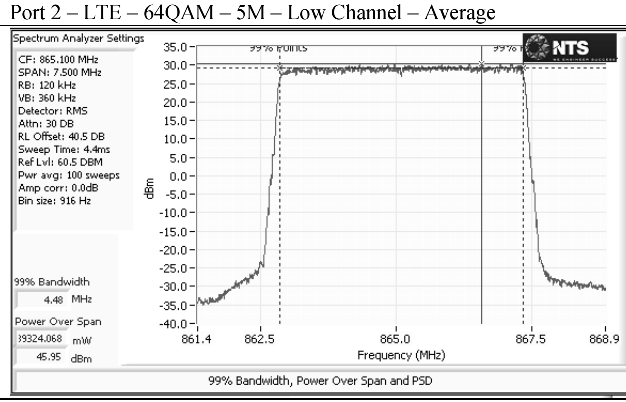
Port 2 – LTE – 16QAM – 5M – Low Channel – Average



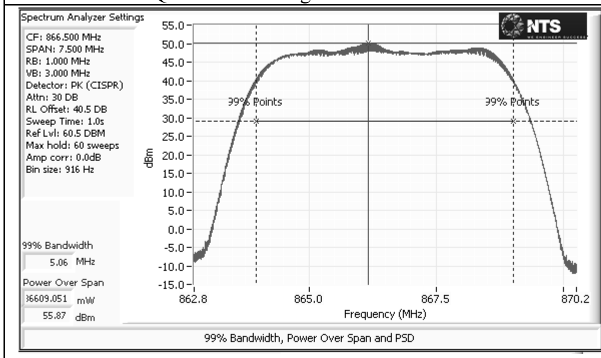
Port 2 – LTE – 64QAM – 5M – Low Channel – Peak



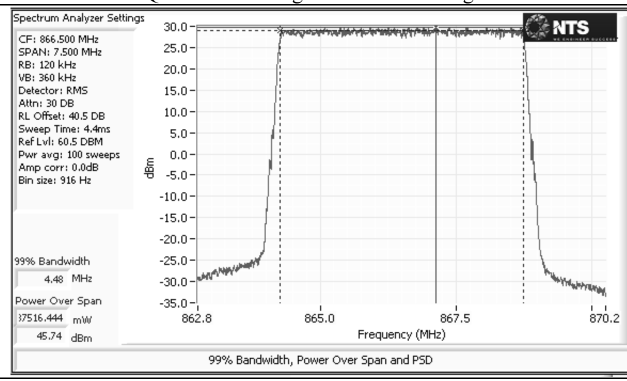
Port 2 – LTE – 64QAM – 5M – Low Channel – Average



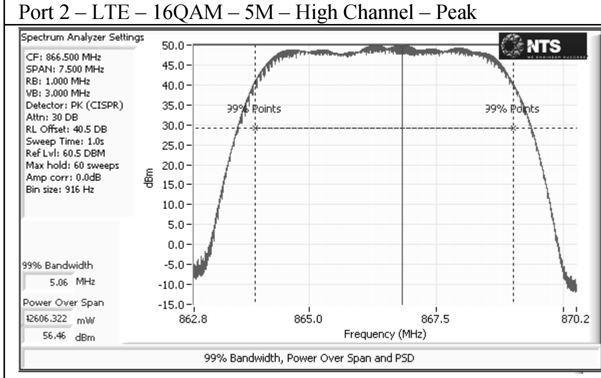
Port 2 – LTE – QPSK – 5M – High Channel – Peak



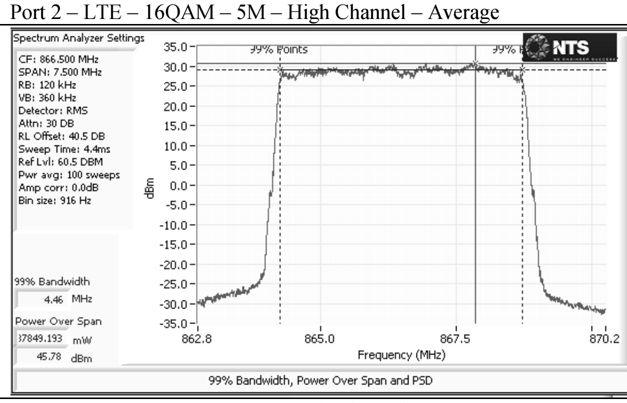
Port 2 – LTE – QPSK – 5M – High Channel – Average



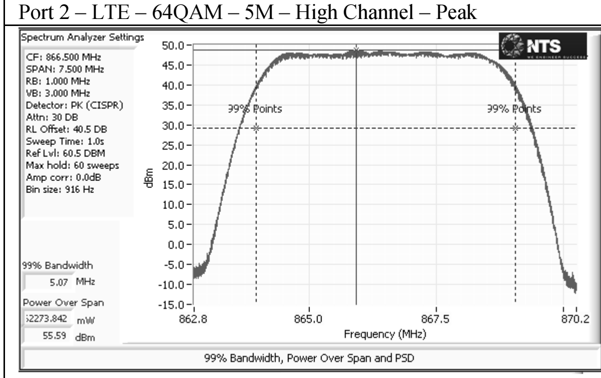
Port 2 – LTE – 16QAM – 5M – High Channel – Peak



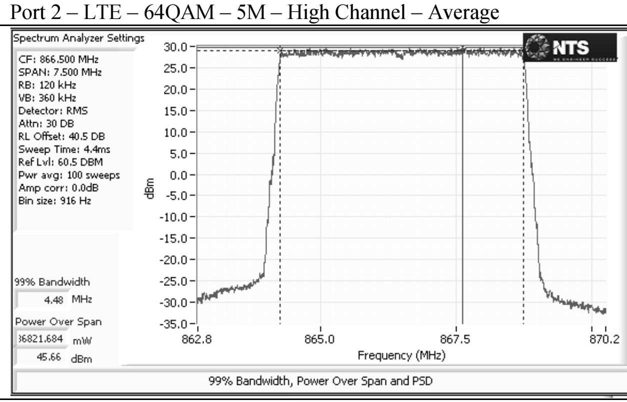
Port 2 – LTE – 16QAM – 5M – High Channel – Average



Port 2 – LTE – 64QAM – 5M – High Channel – Peak



Port 2 – LTE – 64QAM – 5M – High Channel – Average



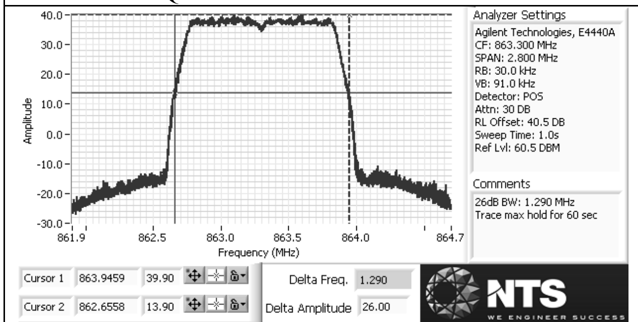
Emission Bandwidths (26dB and 99%)

Emissions bandwidths were measured at Port 2 on low and high channels for all modulations and channel bandwidth modes and results presented below.

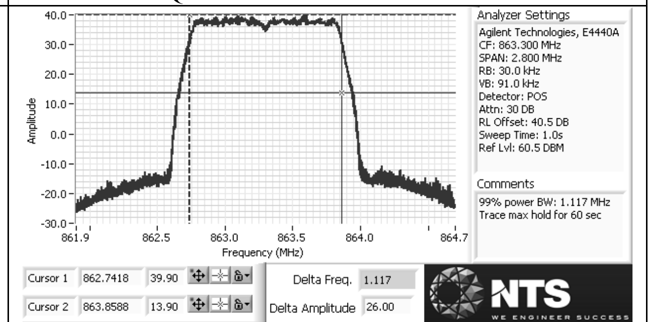
	LTE - QPSK				LTE - 16QAM				LTE - 64QAM			
	Low		High		Low		High		Low		High	
	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)
1.4M	**1.29**	**1.117**	1.29	1.116	1.264	1.109	1.269	1.11	1.26	1.109	1.262	1.109
3M	2.914	2.701	2.915	2.703	2.91	2.702	**2.916**	2.702	2.909	2.705	2.91	**2.707**
5M	4.87	4.484	4.881	4.489	4.852	4.478	4.855	4.479	4.881	4.496	**4.886**	**4.501**

Corresponding plots included on the following pages.

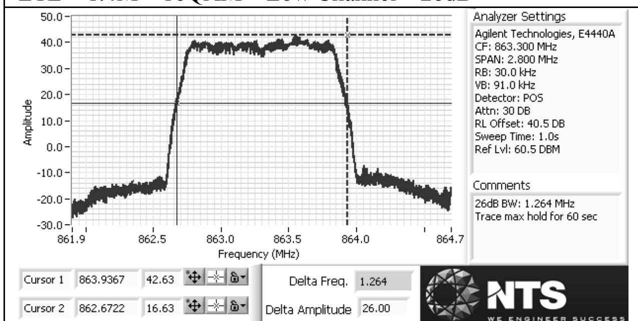
LTE – 1.4M – QPSK – Low Channel – 26dB



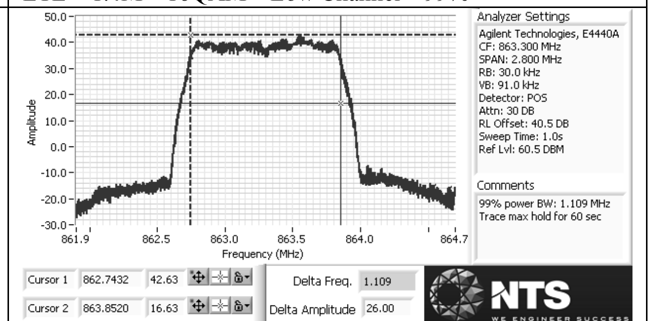
LTE – 1.4M – QPSK – Low Channel – 99%



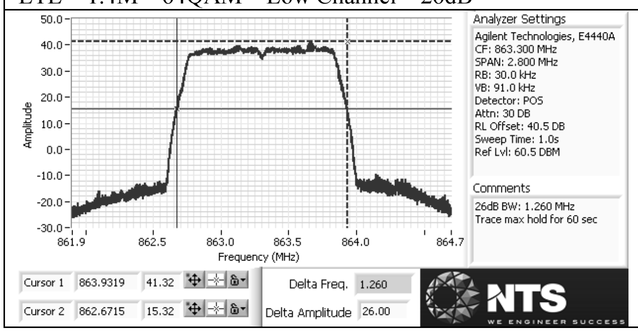
LTE – 1.4M – 16QAM – Low Channel – 26dB



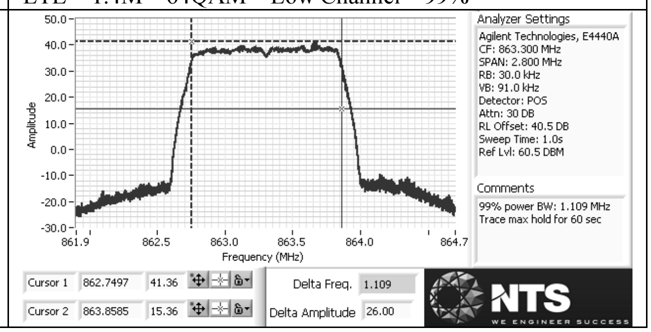
LTE – 1.4M – 16QAM – Low Channel – 99%



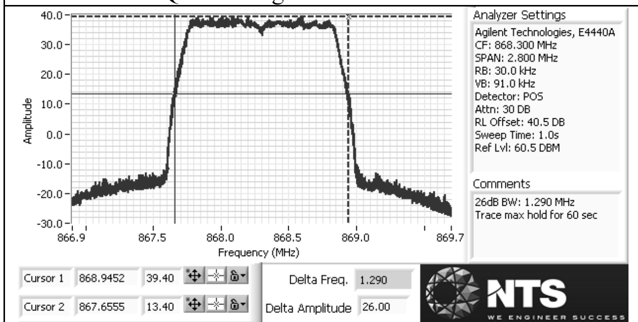
LTE – 1.4M – 64QAM – Low Channel – 26dB



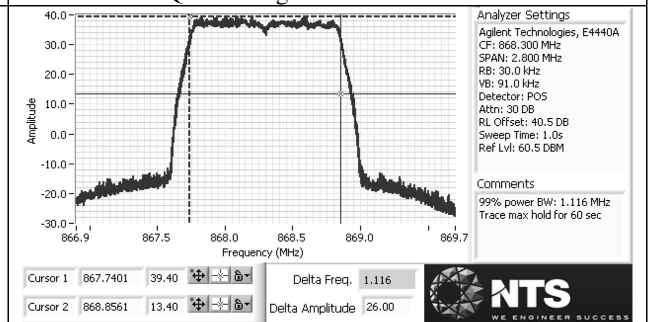
LTE – 1.4M – 64QAM – Low Channel – 99%



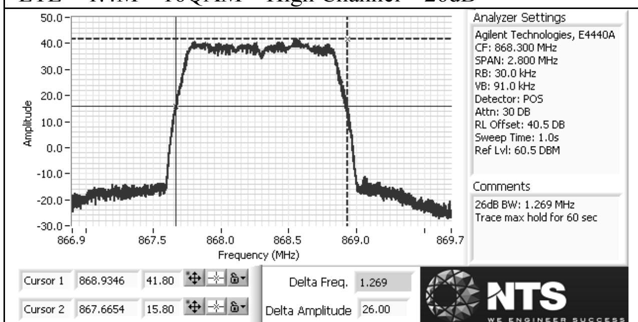
LTE – 1.4M – QPSK – High Channel – 26dB



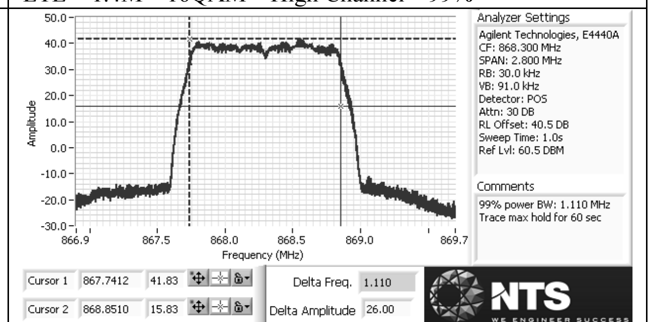
LTE – 1.4M – QPSK – High Channel – 99%



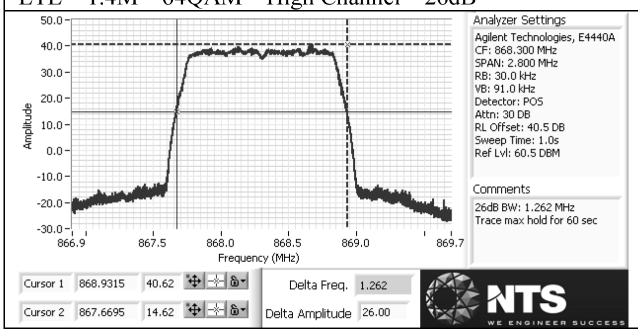
LTE – 1.4M – 16QAM – High Channel – 26dB



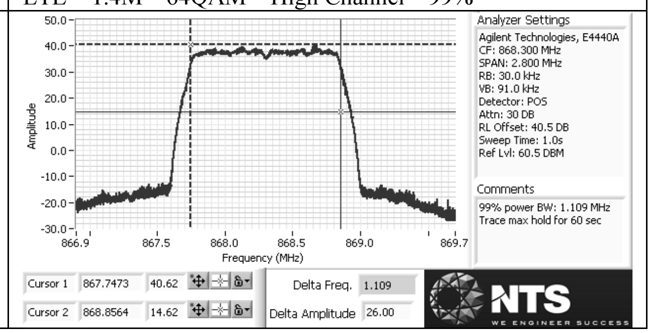
LTE – 1.4M – 16QAM – High Channel – 99%



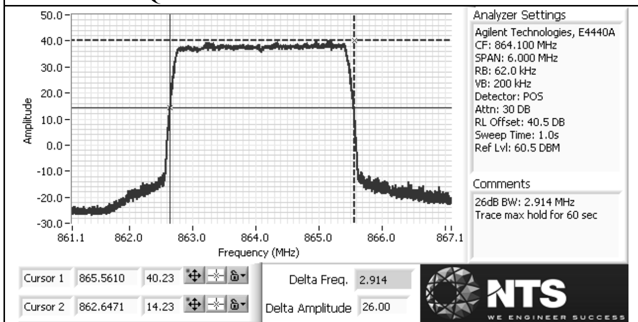
LTE – 1.4M – 64QAM – High Channel – 26dB



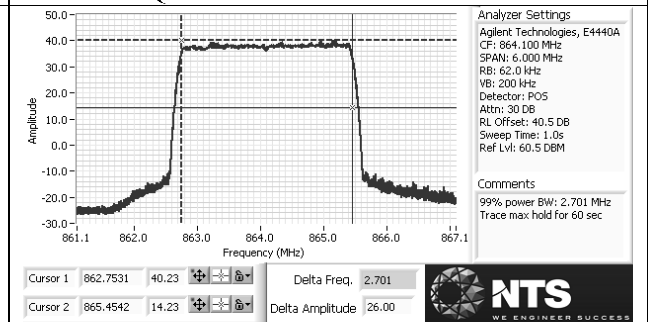
LTE – 1.4M – 64QAM – High Channel – 99%



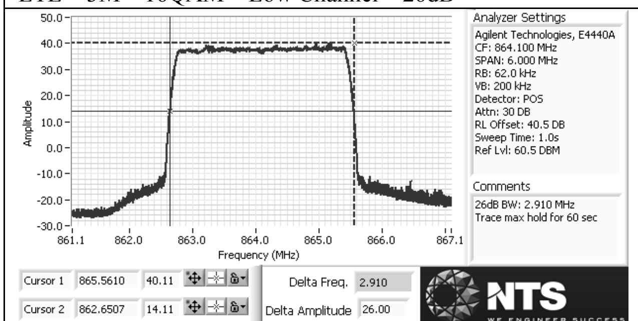
LTE – 3M – QPSK – Low Channel – 26dB



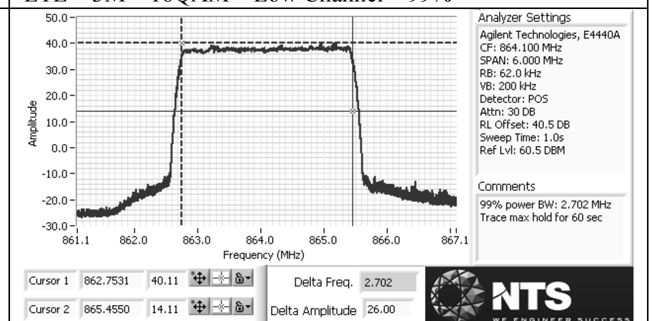
LTE – 3M – QPSK – Low Channel – 99%



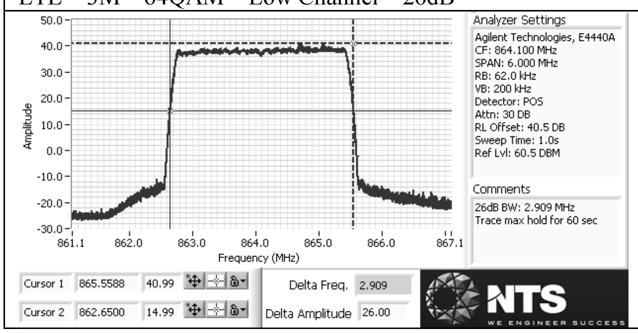
LTE – 3M – 16QAM – Low Channel – 26dB



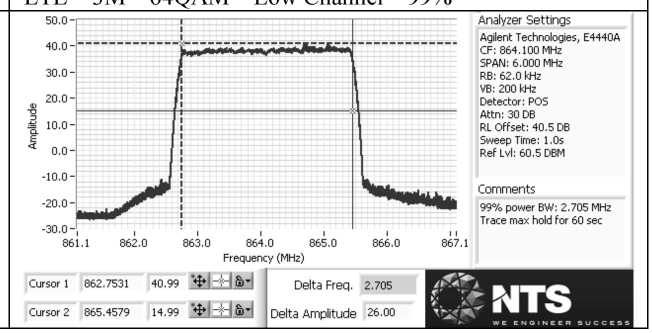
LTE – 3M – 16QAM – Low Channel – 99%



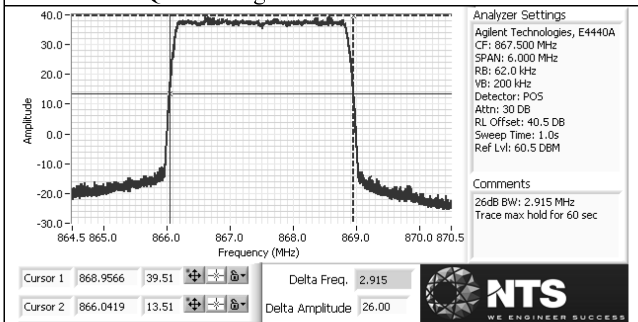
LTE – 3M – 64QAM – Low Channel – 26dB



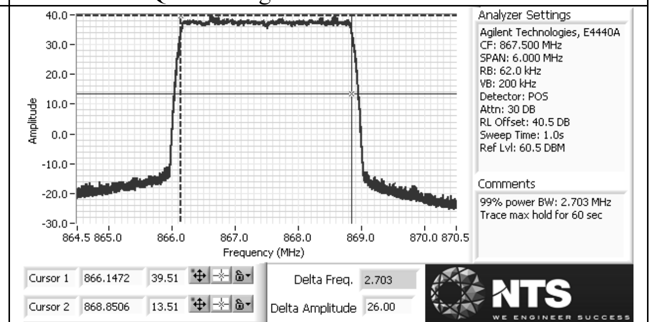
LTE – 3M – 64QAM – Low Channel – 99%



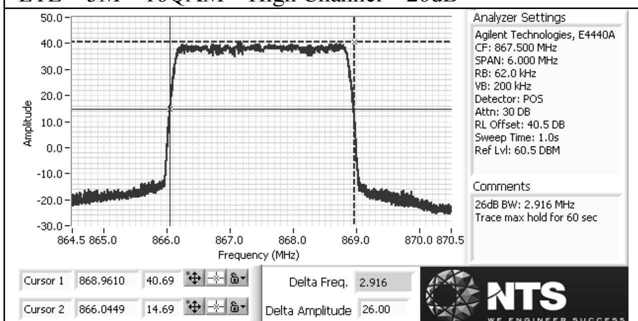
LTE – 3M – QPSK – High Channel – 26dB



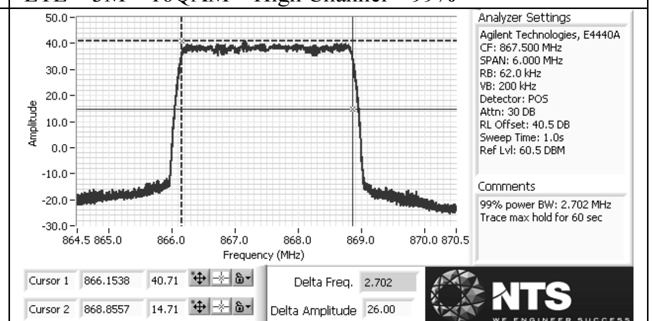
LTE – 3M – QPSK – High Channel – 99%



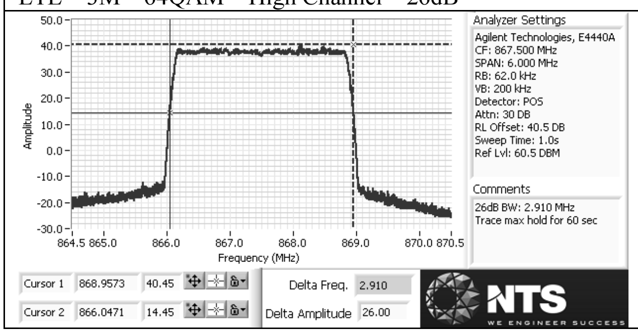
LTE – 3M – 16QAM – High Channel – 26dB



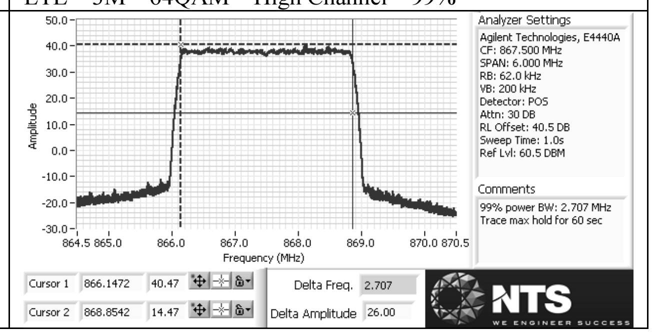
LTE – 3M – 16QAM – High Channel – 99%



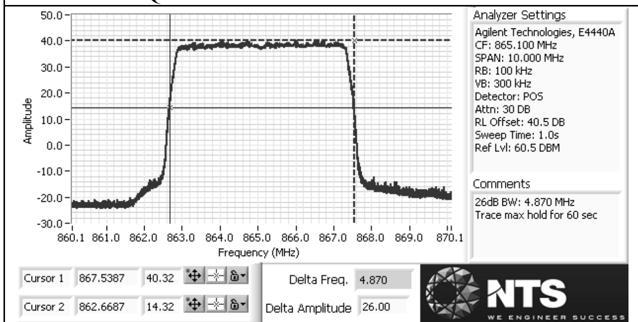
LTE – 3M – 64QAM – High Channel – 26dB



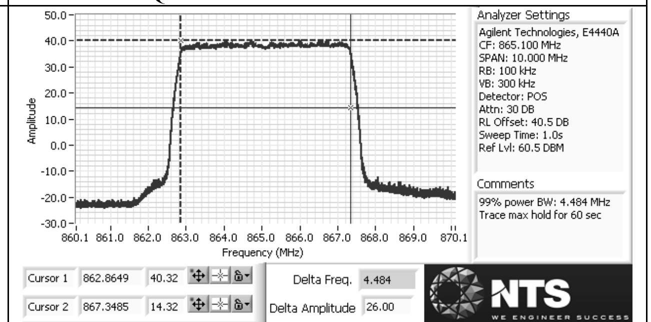
LTE – 3M – 64QAM – High Channel – 99%



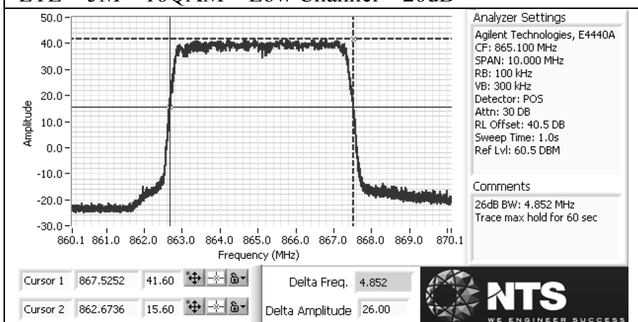
LTE – 5M – QPSK – Low Channel – 26dB



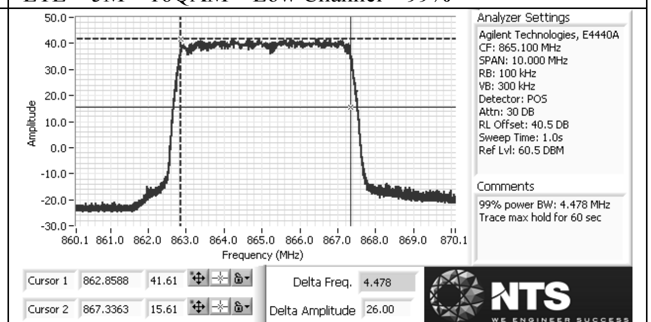
LTE – 5M – QPSK – Low Channel – 99%



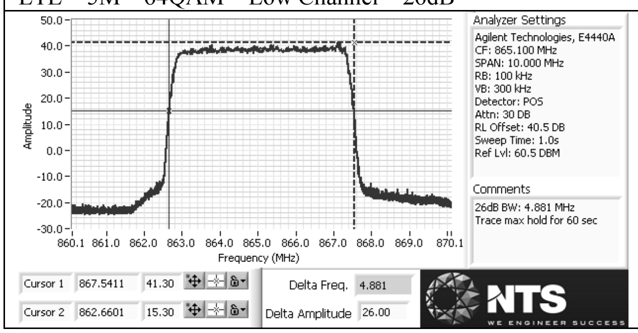
LTE – 5M – 16QAM – Low Channel – 26dB



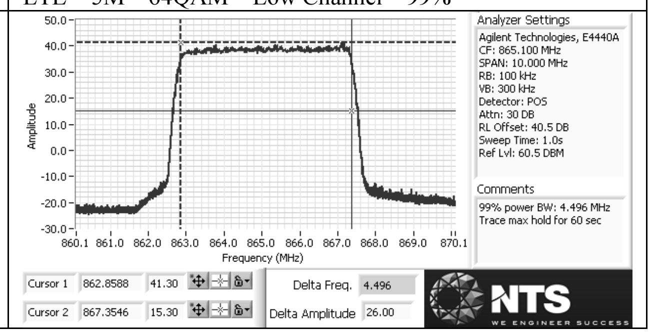
LTE – 5M – 16QAM – Low Channel – 99%



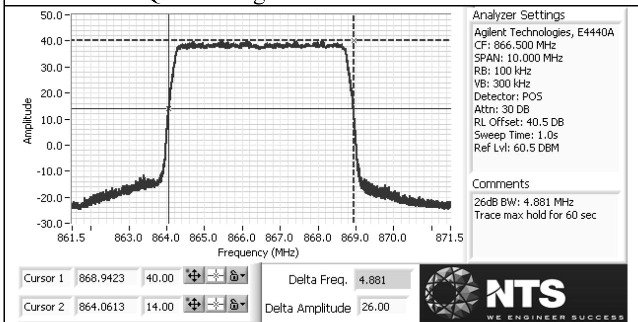
LTE – 5M – 64QAM – Low Channel – 26dB



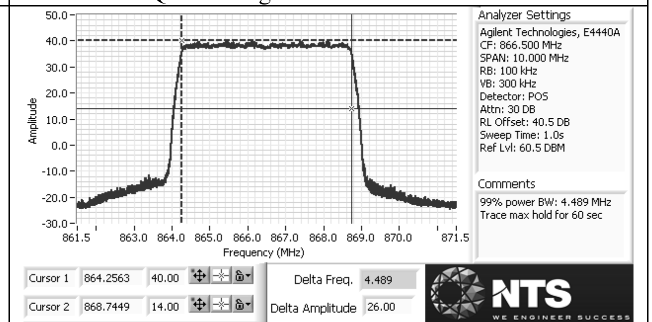
LTE – 5M – 64QAM – Low Channel – 99%



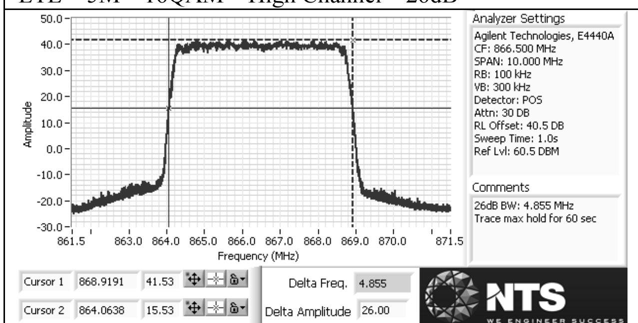
LTE – 5M – QPSK – High Channel – 26dB



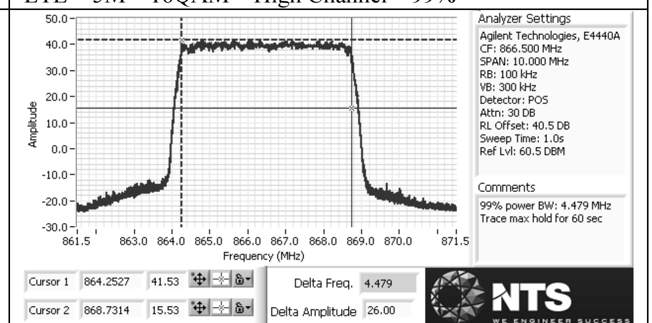
LTE – 5M – QPSK – High Channel – 99%



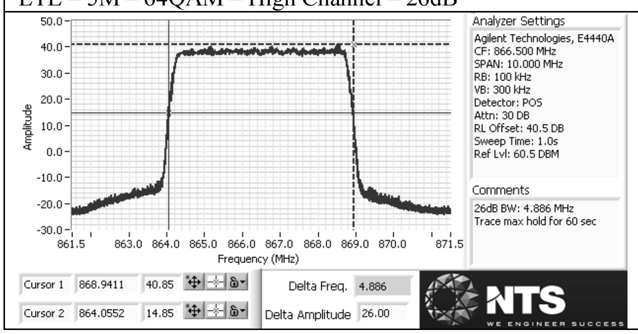
LTE – 5M – 16QAM – High Channel – 26dB



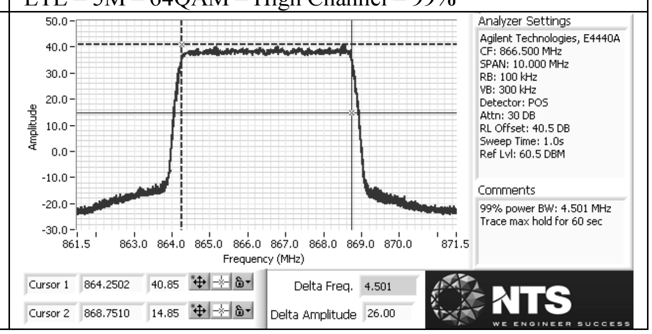
LTE – 5M – 16QAM – High Channel – 99%



LTE – 5M – 64QAM – High Channel – 26dB



LTE – 5M – 64QAM – High Channel – 99%



Antenna Port Conducted Bandedge

90.691 Limits (dBm)				
Frequency Range (MHz)		Limit (dBm)	RBW	Notes
<861.9		-16.02	100kHz	Note 1
861.9	861.9625	-16.02	100kHz	Notes 1,2
861.9625	861.9875	-23.02	100kHz	Notes 1,2
869.0125	869.0375	-23.02	27kHz	Note 1
869.0375	869.1	-16.02	30kHz	Note 1
>869.1		-16.02	100kHz	Note 1

Note 1: Limit is reduced by 10log(2) per FCC KDB 662911D01 v02r01 due to 2x2 MIMO operation
Note 2: Product met the bandedge limits with 100kHz RBW, therefore RBW reduction was not necessary.

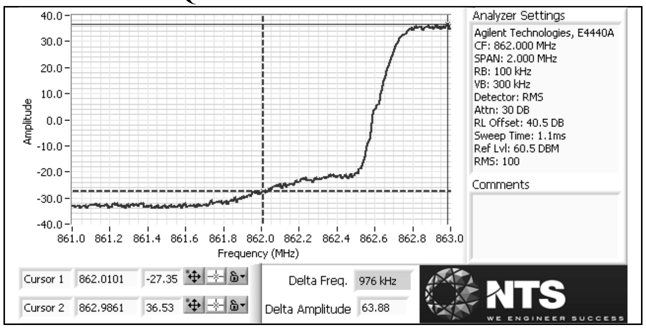
Results summary:

	LTE - QPSK		LTE - 16QAM		LTE - 64QAM	
	Low	High	Low	High	Low	High
1.4M	-27.35	-25.17	-26.57	-25.3	-27.86	-25.15
3M	-27.22	-28.47	-27.37	-28.95	-27.03	-27.05
5M	-27.57	-28.12	-28.3	-27.37	-28.39	-28.31
1.4M Dual	-27.68	-28.12	-27.67	-28.18	-27.63	-27.83

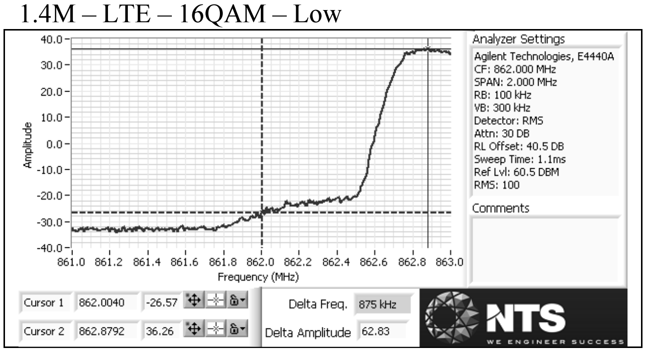
Note: 1.4M Dual Low = 863.3MHz + 864.7MHz
1.4M Dual High = 866.9MHz + 868.3MHz

All corresponding plots are included on the following pages. Measurements were performed at Port 2 in RMS average mode over 100 traces. Total path loss of 40.4dB accounted in via reference level offset to the spectrum analyzer.

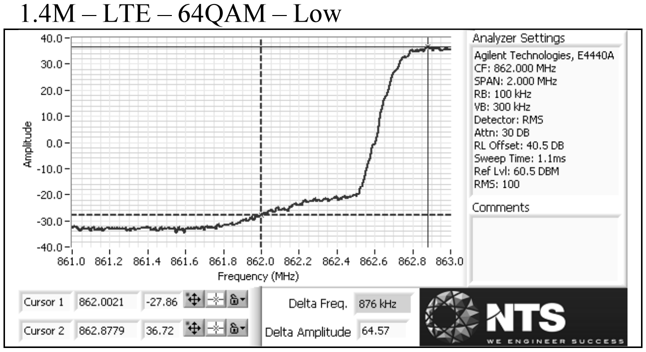
1.4M – LTE – QPSK – Low



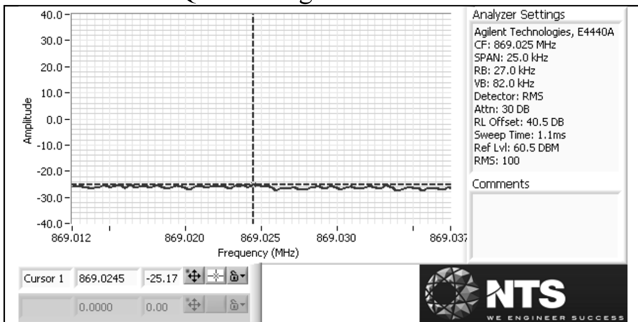
1.4M – LTE – 16QAM – Low

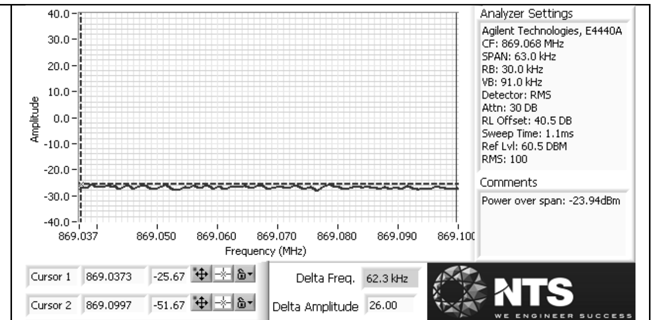


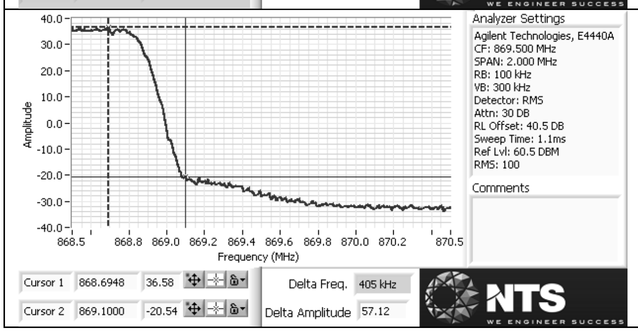
1.4M – LTE – 64QAM – Low



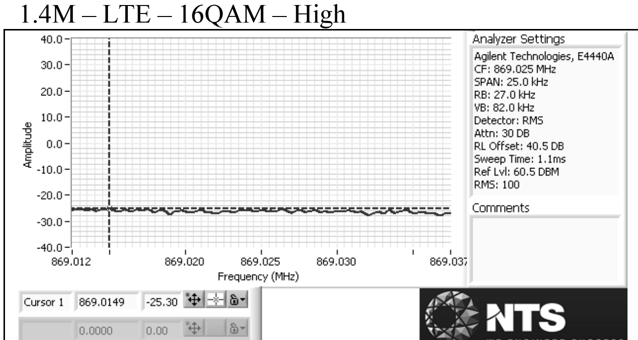
1.4M – LTE – QPSK – High

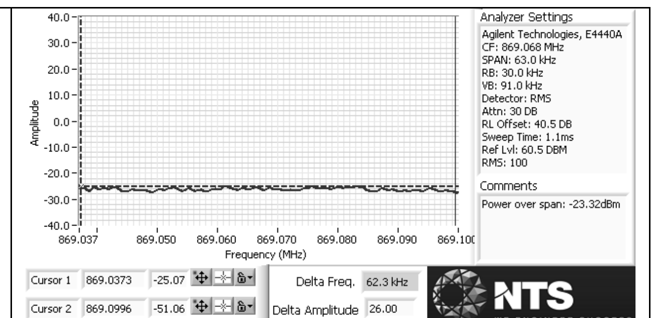


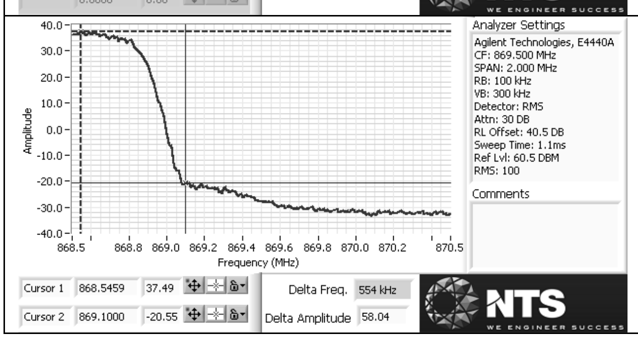




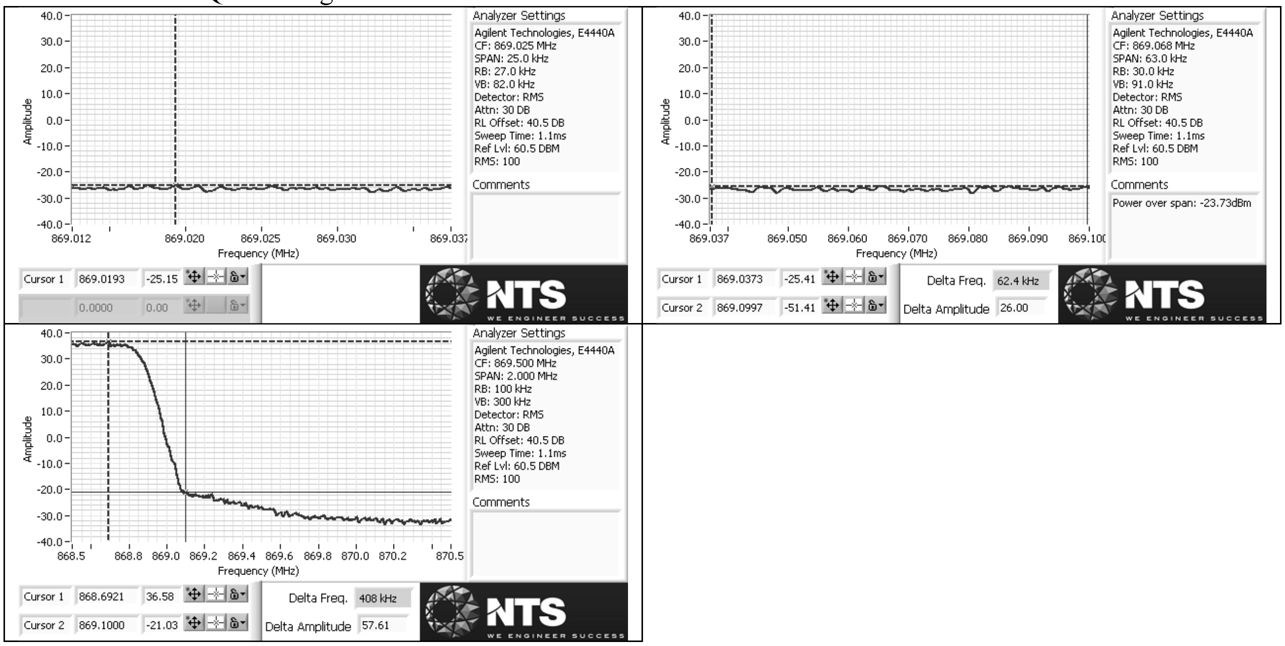
1.4M – LTE – 16QAM – High



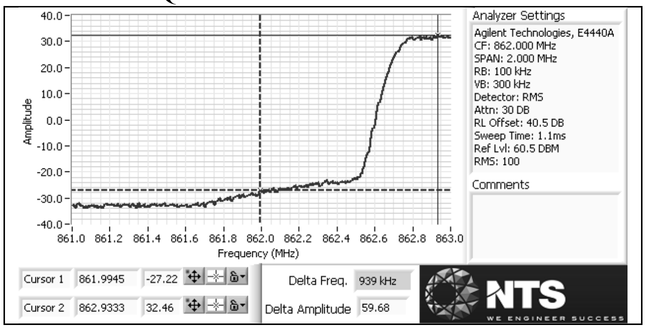




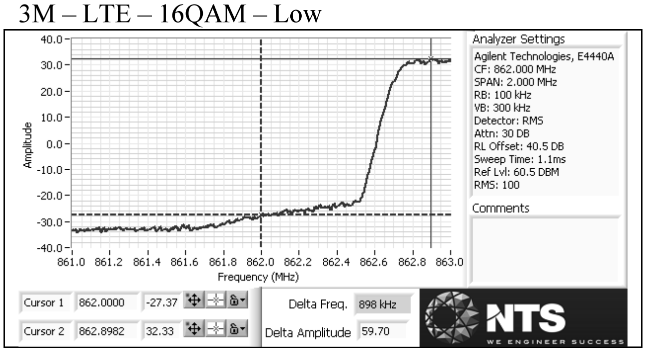
1.4M – LTE – 64QAM – High



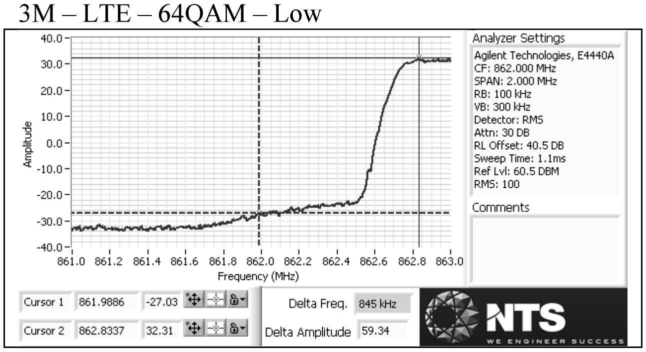
3M – LTE – QPSK – Low



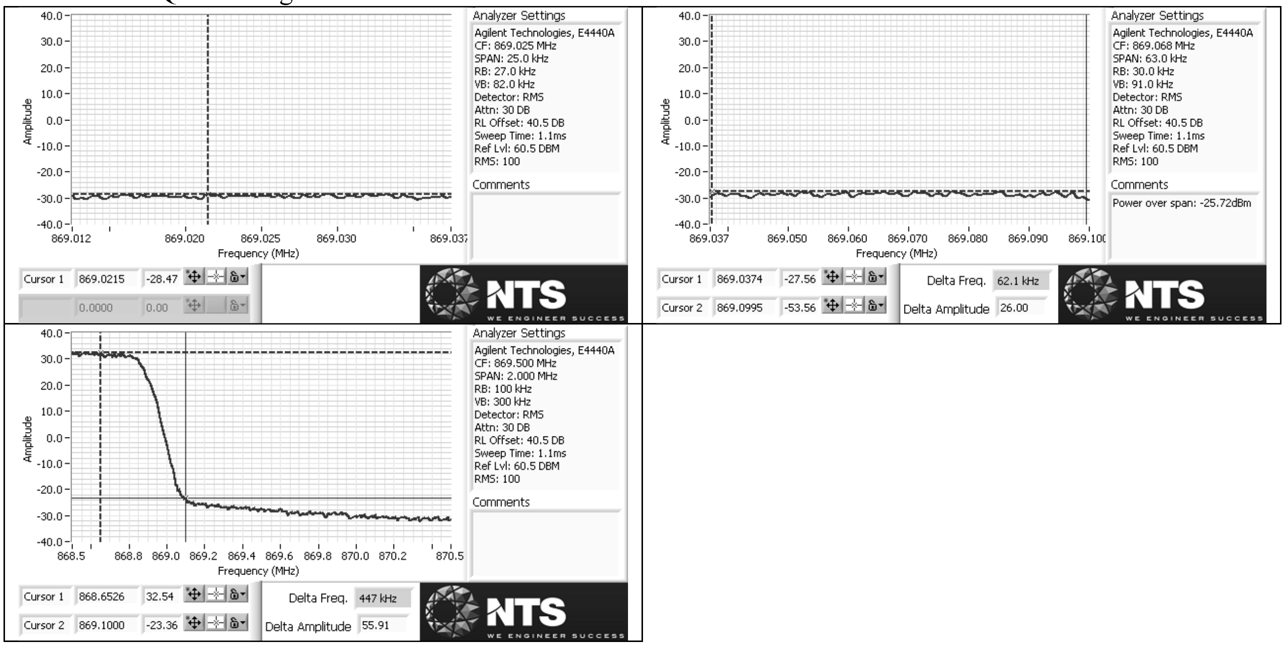
3M – LTE – 16QAM – Low



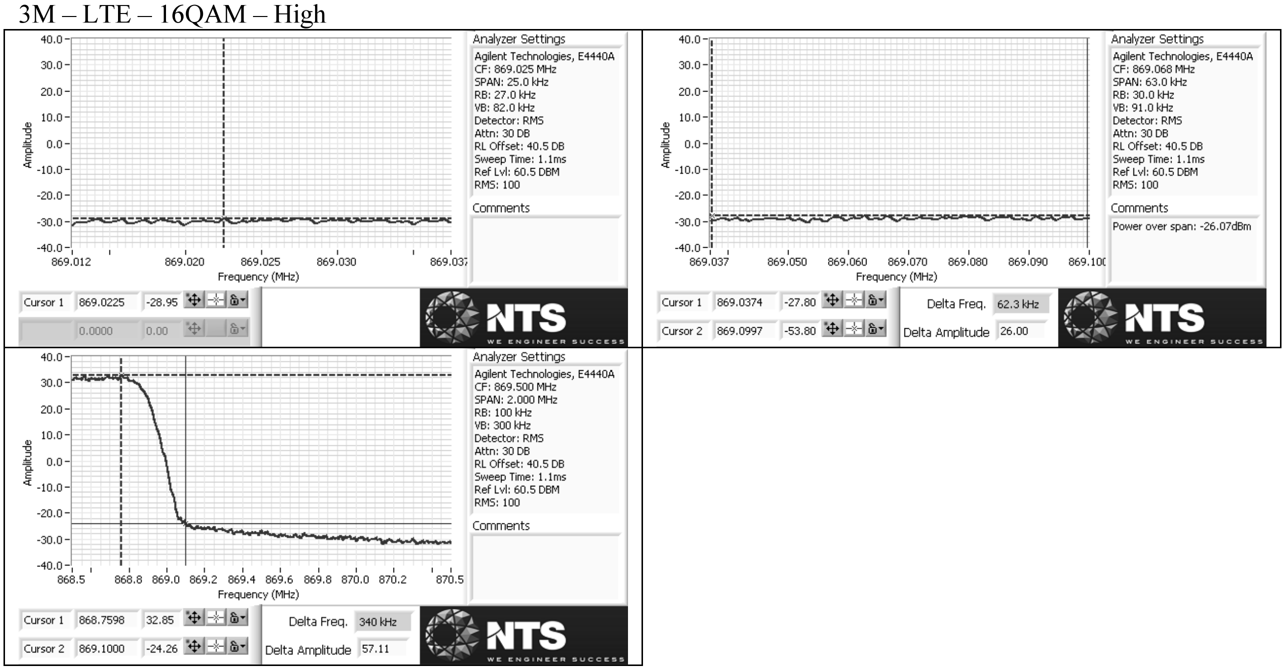
3M – LTE – 64QAM – Low



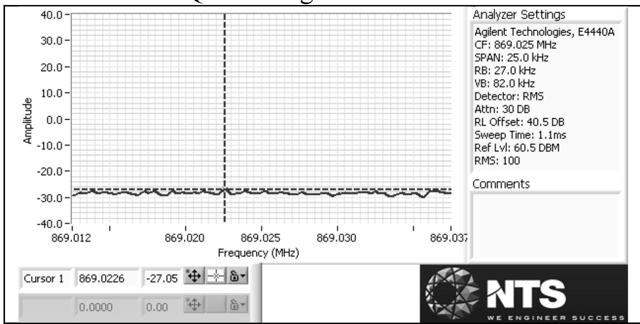
3M – LTE – QPSK – High

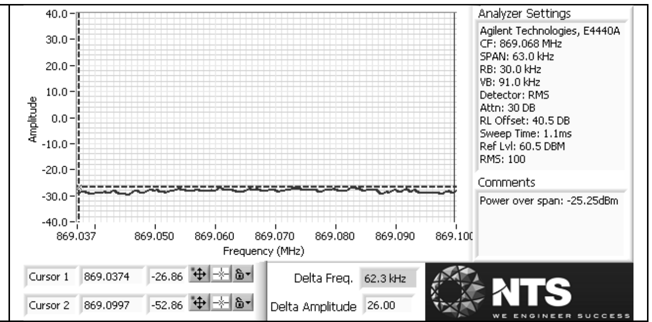


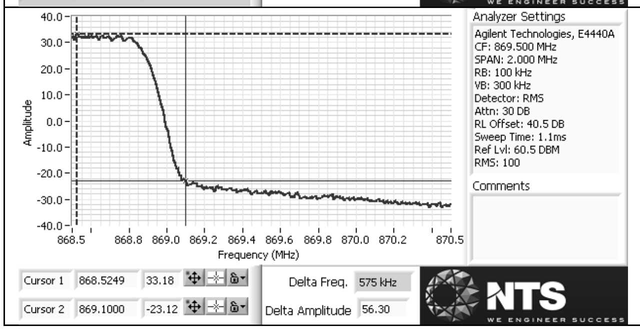
3M – LTE – 16QAM – High



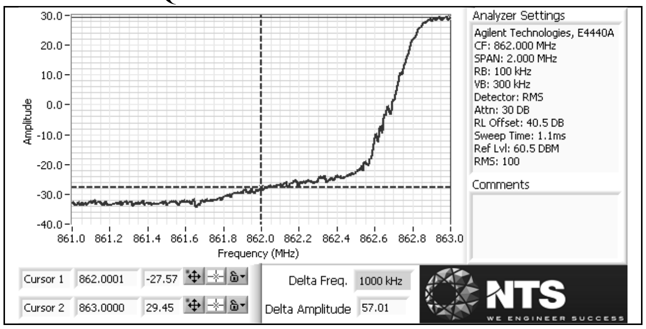
3M – LTE – 64QAM – High



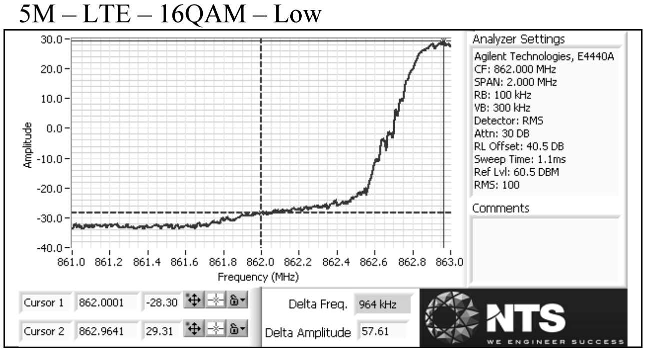




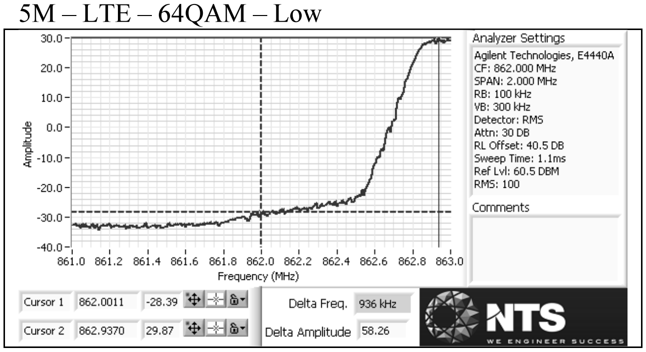
5M – LTE – QPSK – Low



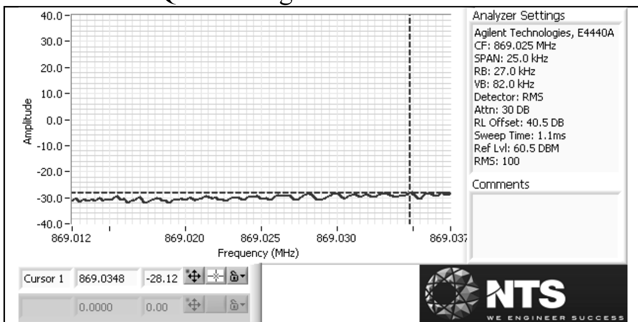
5M – LTE – 16QAM – Low

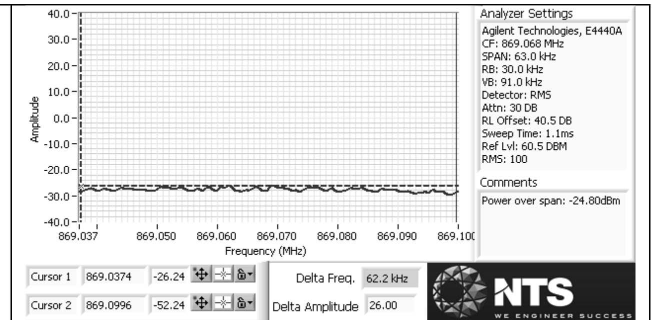


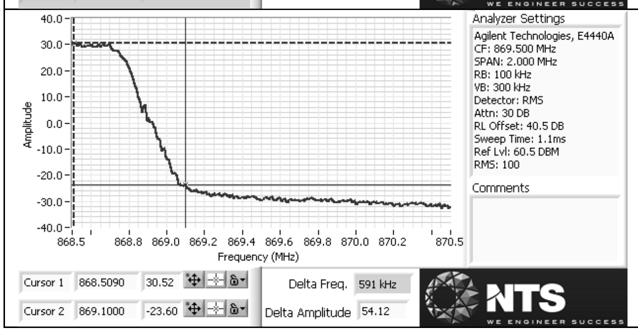
5M – LTE – 64QAM – Low



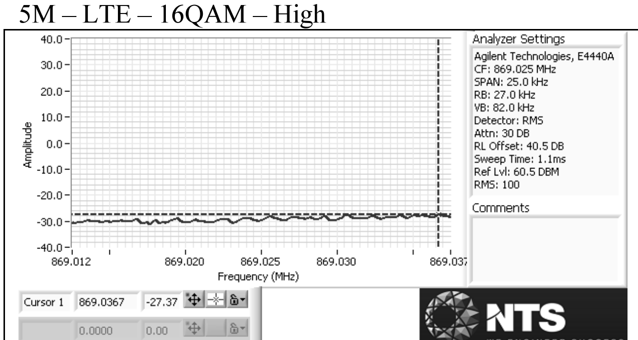
5M – LTE – QPSK – High

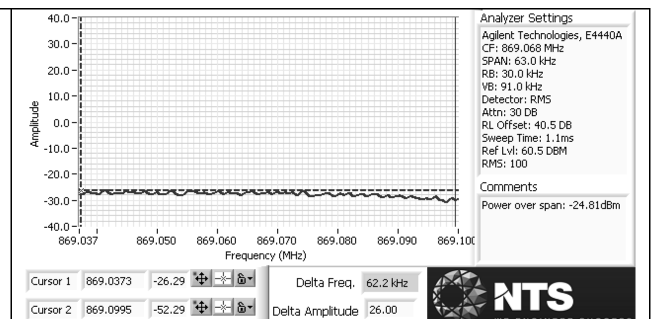


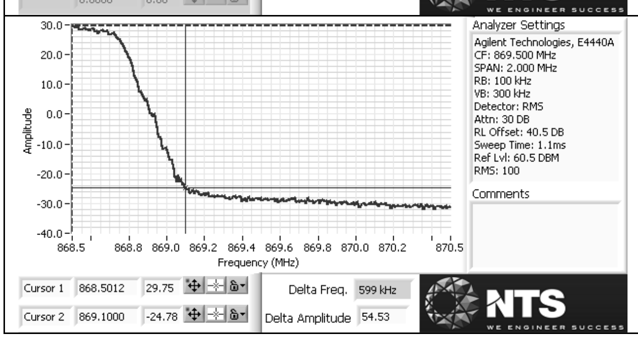




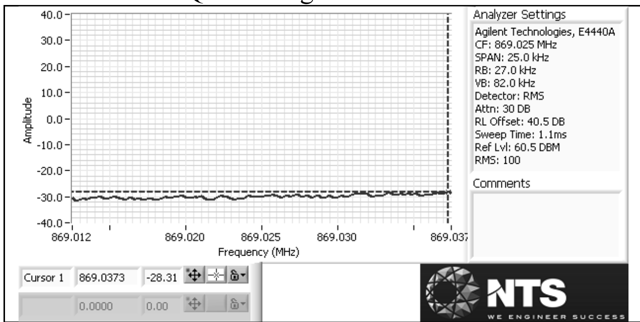
5M – LTE – 16QAM – High

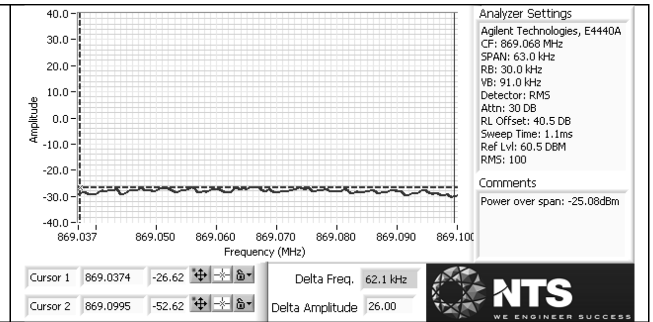


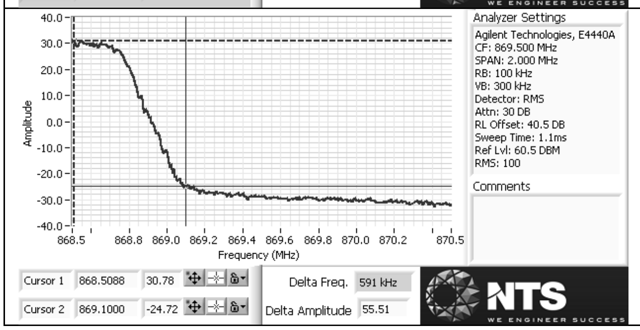




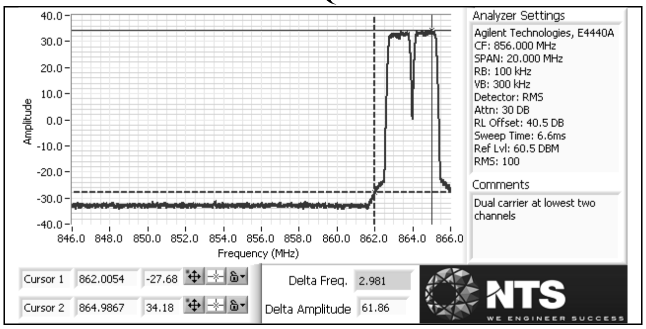
5M – LTE – 64QAM – High



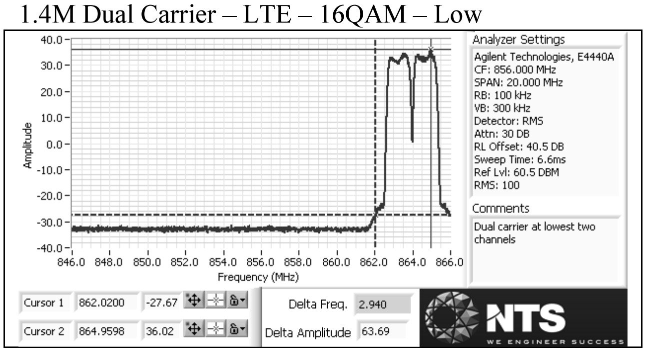




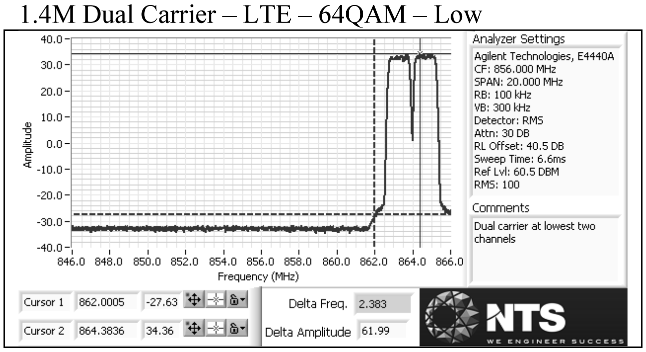
1.4M Dual Carrier – LTE – QPSK – Low



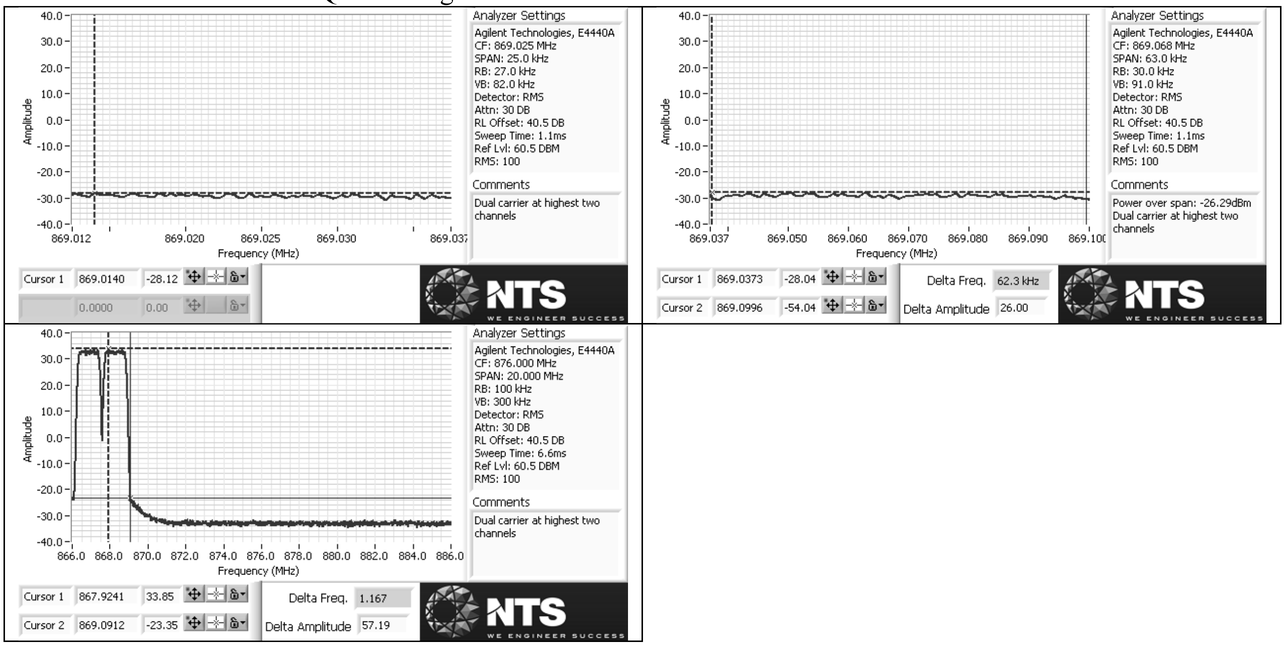
1.4M Dual Carrier – LTE – 16QAM – Low



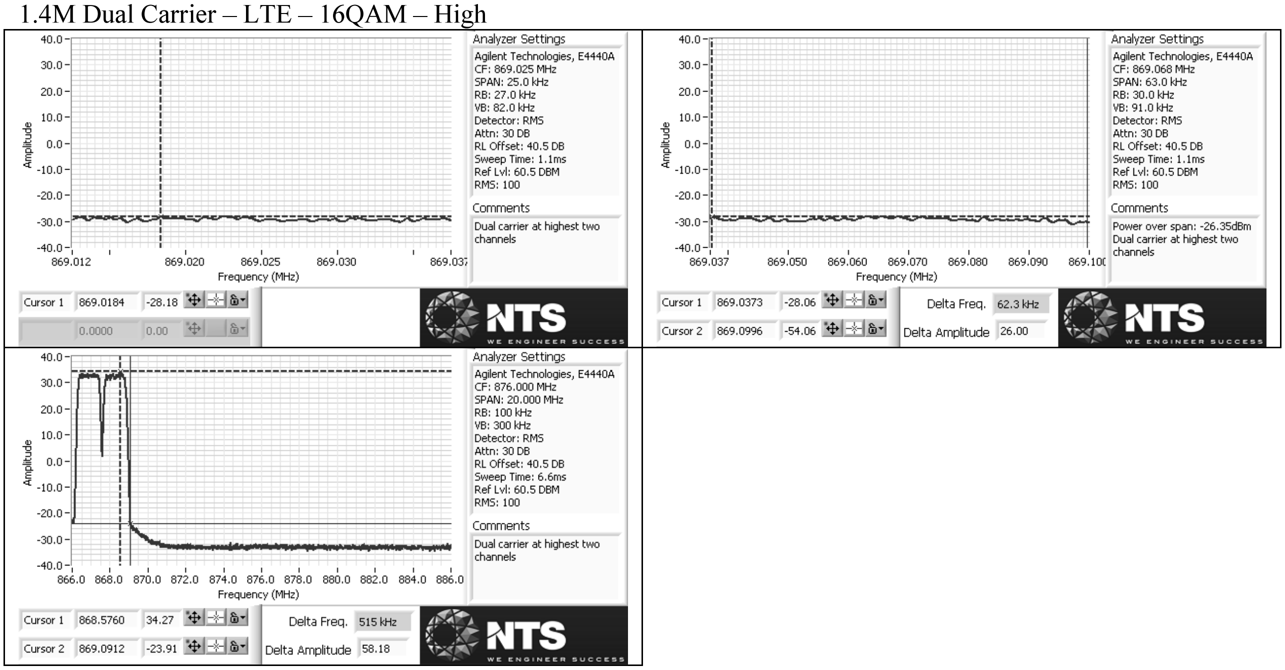
1.4M Dual Carrier – LTE – 64QAM – Low



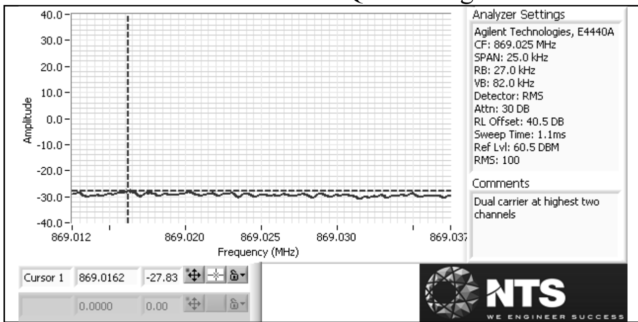
1.4M Dual Carrier – LTE – QPSK – High

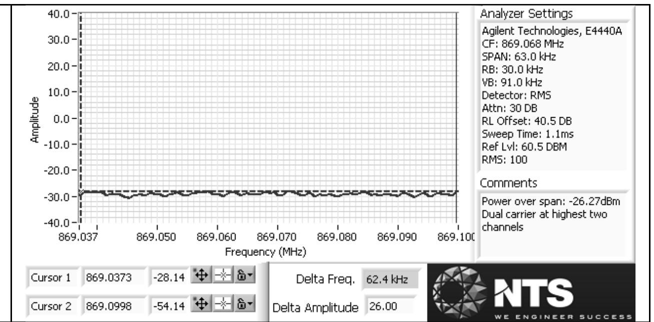


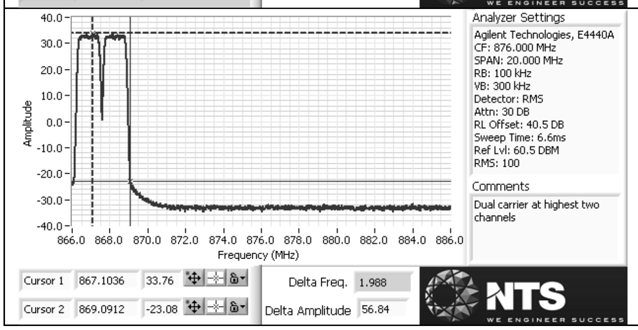
1.4M Dual Carrier – LTE – 16QAM – High



1.4M Dual Carrier – LTE – 64QAM – High







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 -16.02dBm (-13dBm – 10*log(2)) per FCC KDB 662911D01 v02r01.

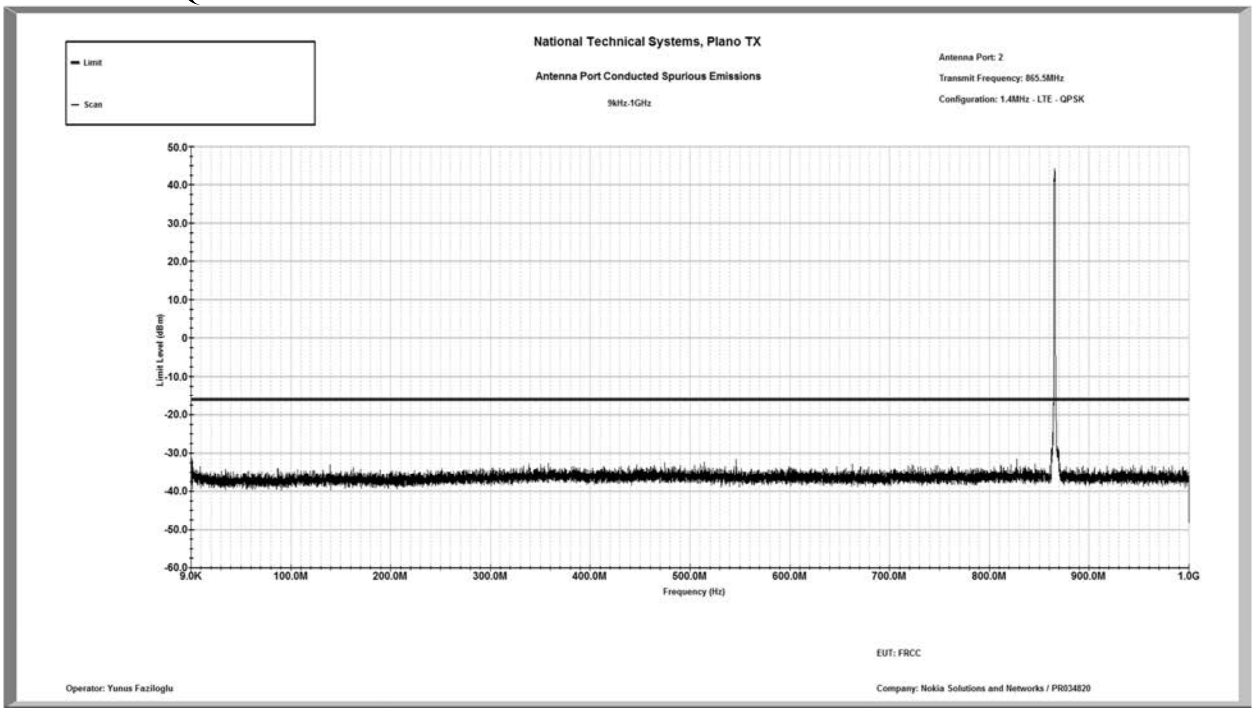
TILE6 measurement software was used during testing with the following settings:

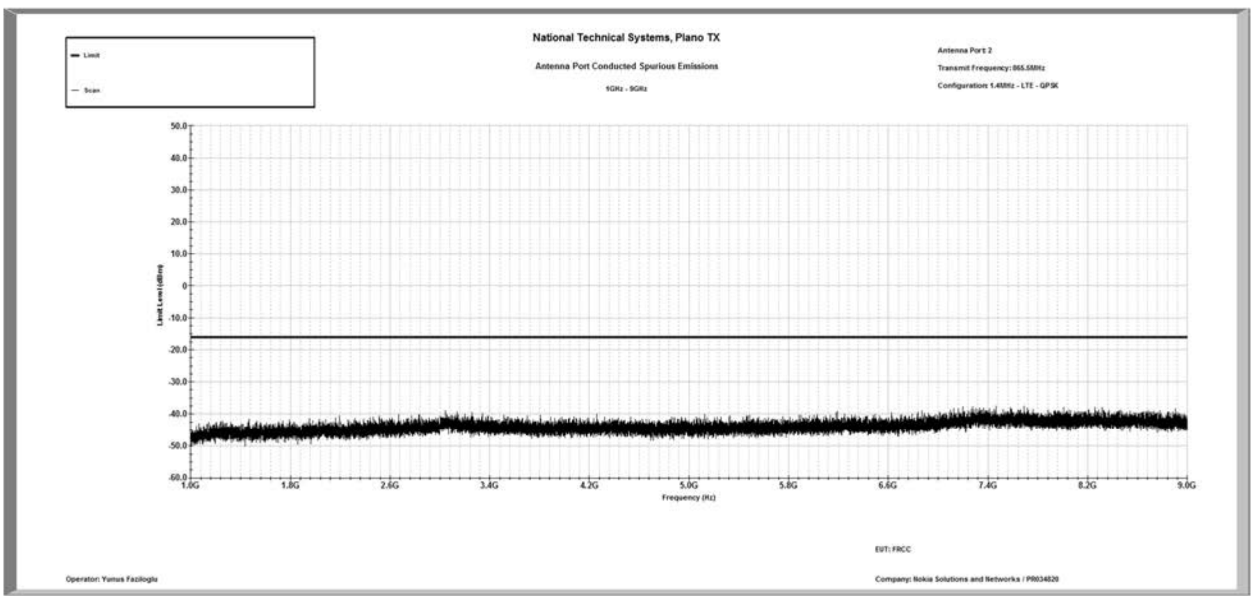
Frequency Range	RBW	VBW	Number of data points	Divided into	Detector	Sweep Time	Max hold over
9kHz-150kHz	1kHz	3kHz	8000	1 segment	Peak	Auto	50 sweeps
150kHz-1GHz	100kHz	300kHz	8000	3 segments	Peak	Auto	50 sweeps
1GHz-9GHz	1MHz	3MHz	8000	8 segments	Peak	Auto	50 sweeps

Above 1GHz, in order to reduce the measurement instrumentation noise floor a high pass filter has been used to block the fundamental.

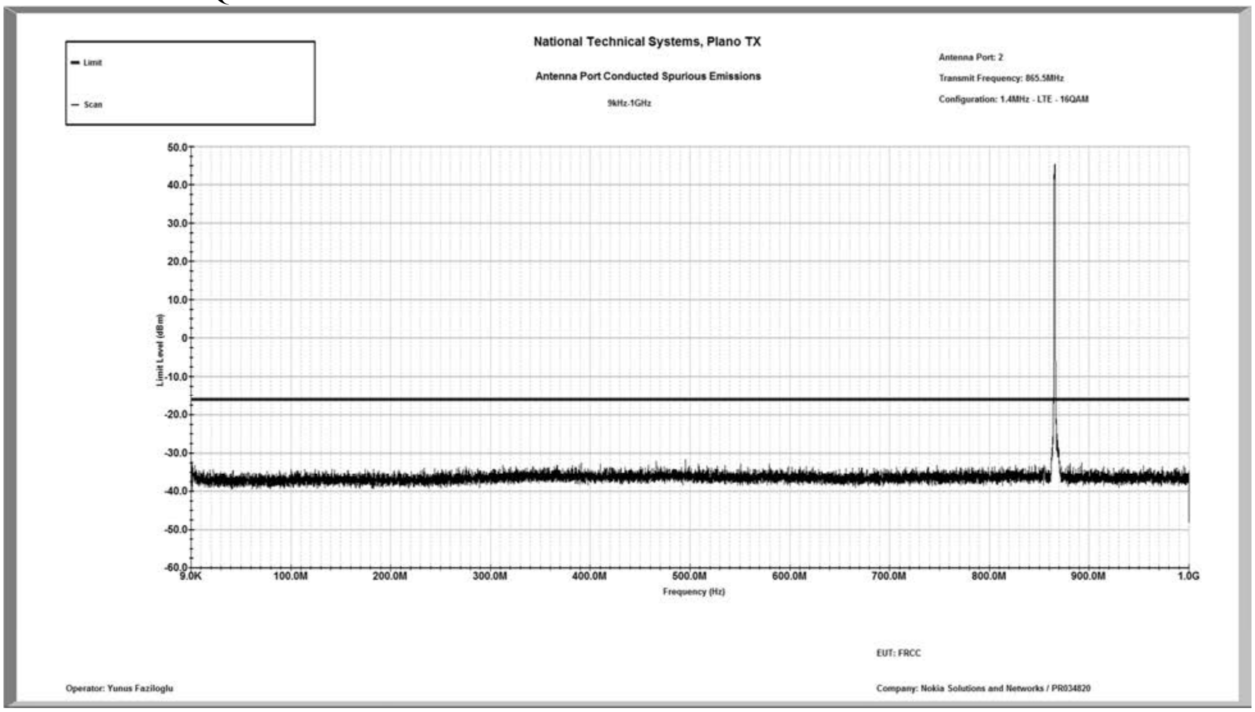
Corresponding plots are included on the following pages.

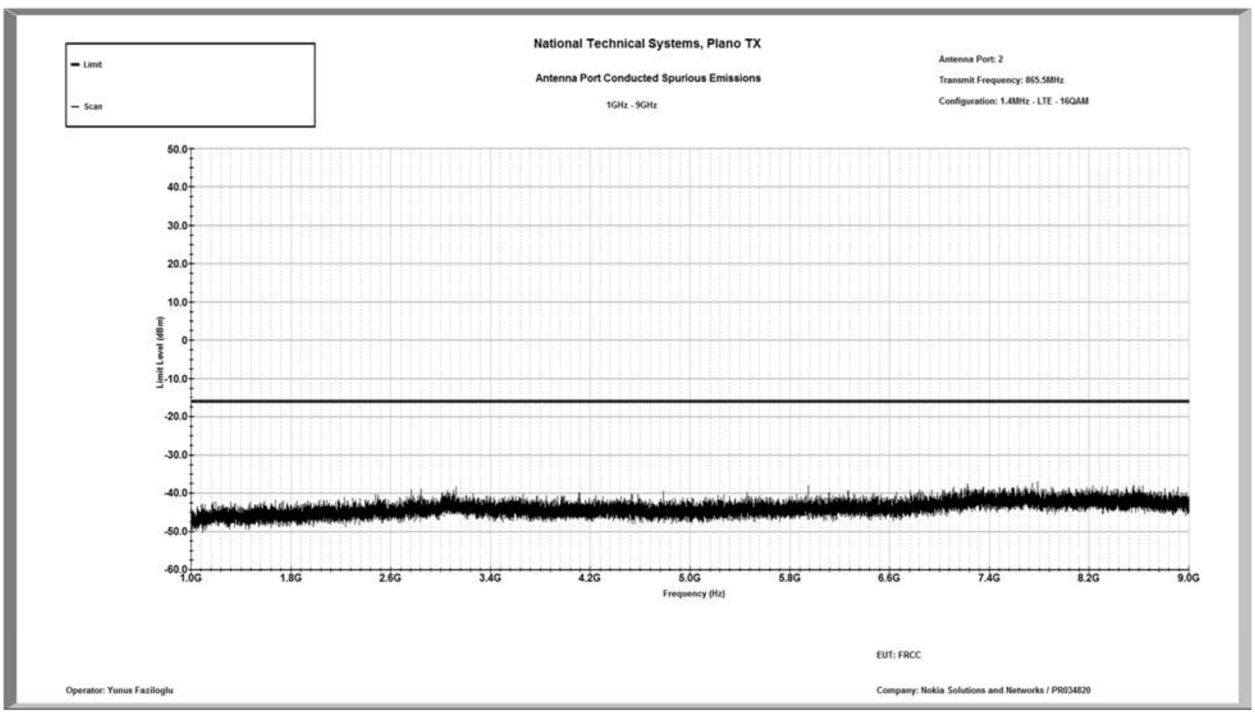
1.4M – LTE – QPSK


Limit
Scan
National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
9kHz-1GHz
Antenna Port: 2
Transmit Frequency: 865.5MHz
Configuration: 1.4MHz - LTE - QPSK
Limit Level (dBm)
Frequency (Hz)
EUT: FRCC
Operator: Yunus Faziloglu
Company: Nokia Solutions and Networks / PR034820

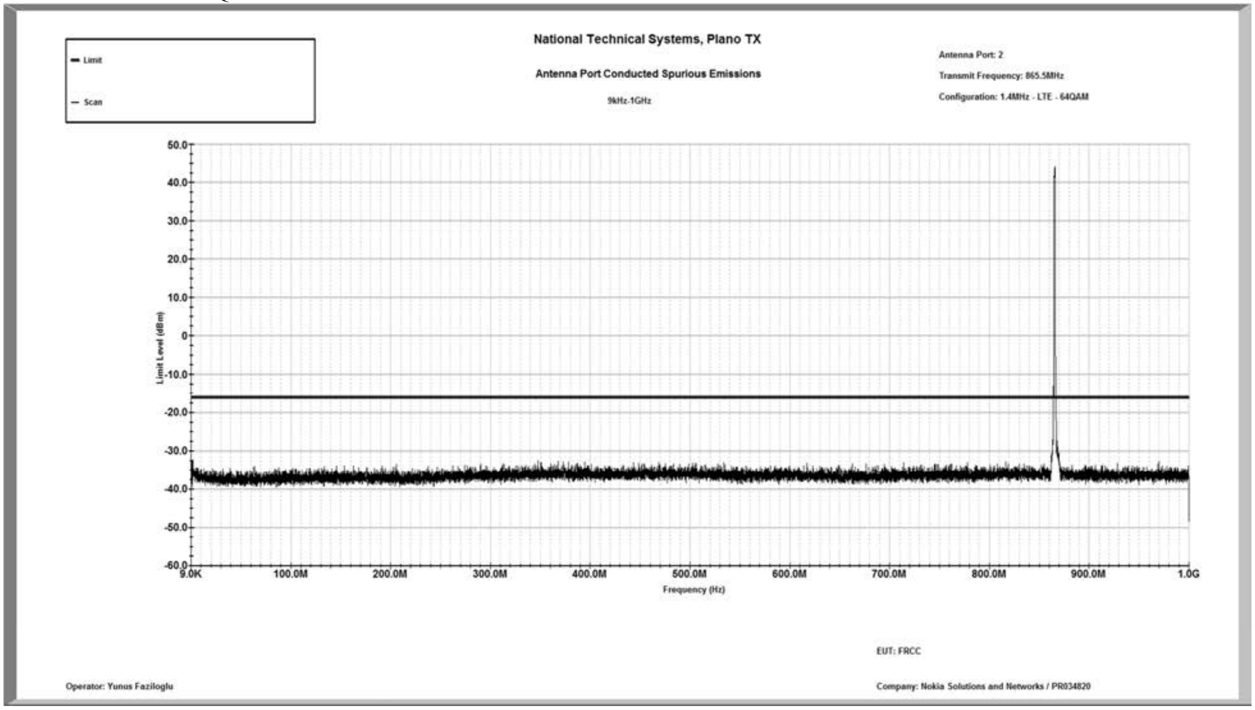

Limit
Scan
National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
1GHz - 9GHz
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 1.4MHz - LTE - QPSK
Limit Level (dBm)
Frequency (Hz)
EUT: FRCC
Operator: Yunus Faziloglu
Company: Nokia Solutions and Networks / PR034820

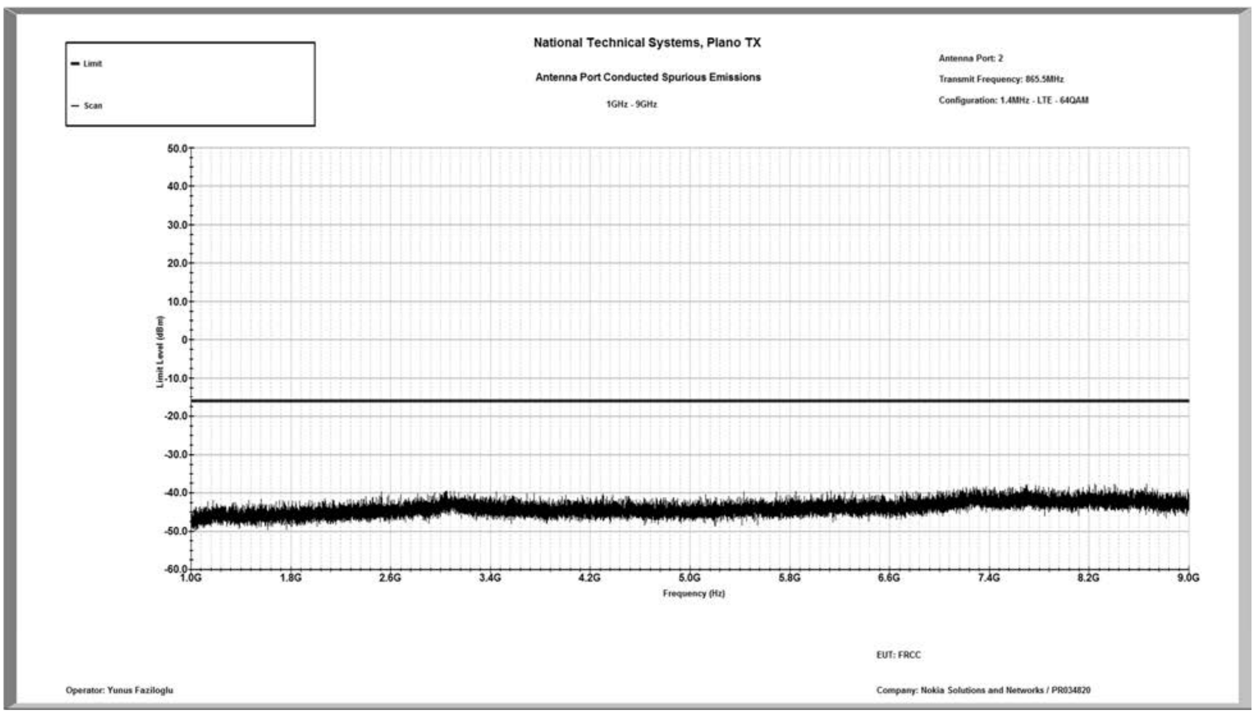
1.4M – LTE – 16QAM



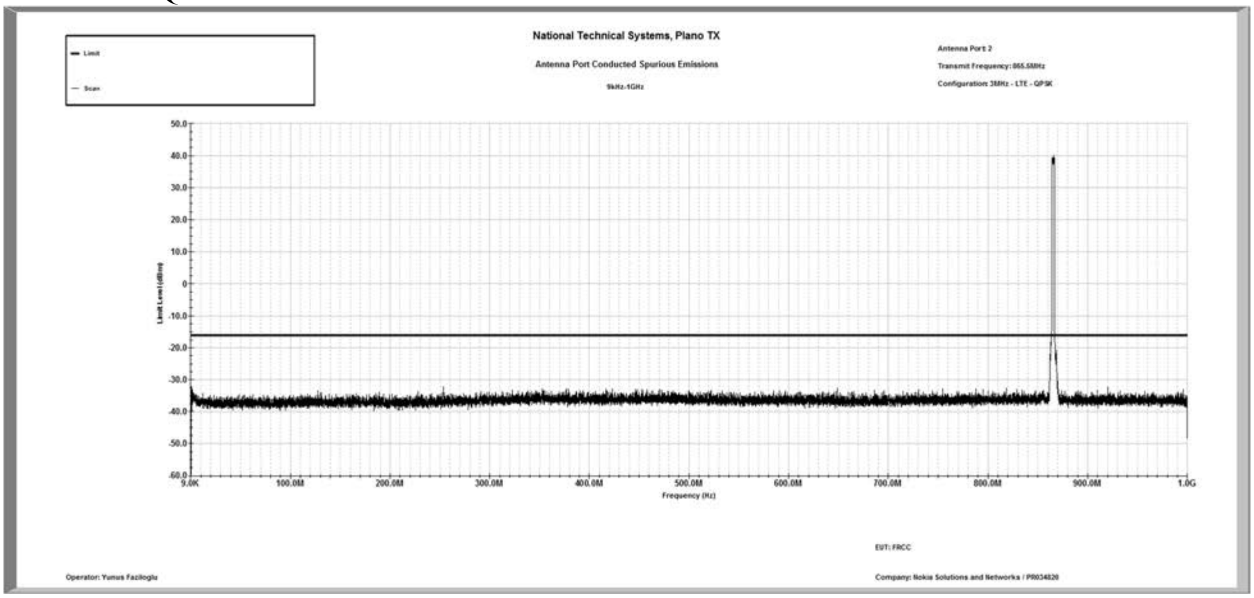


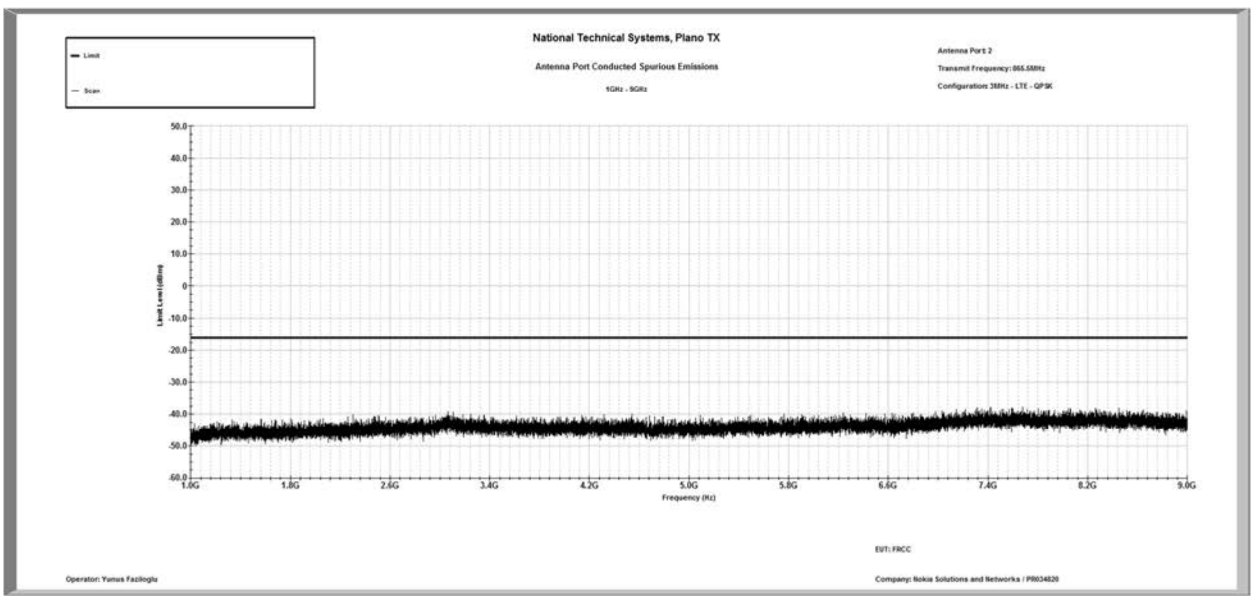
1.4M – LTE – 64QAM



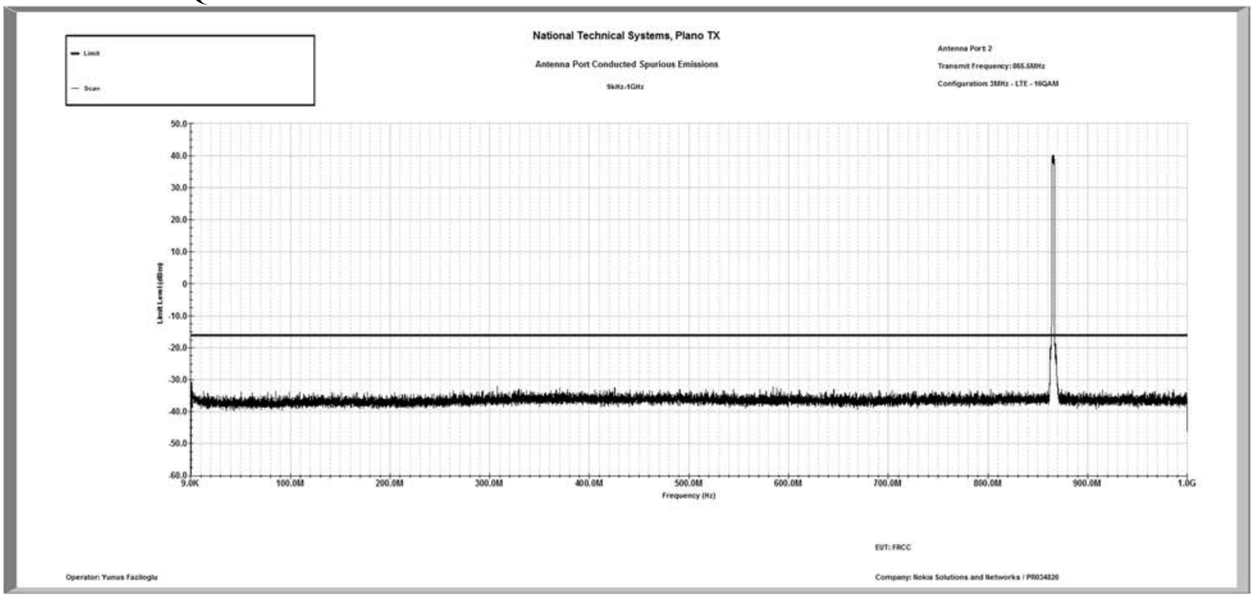


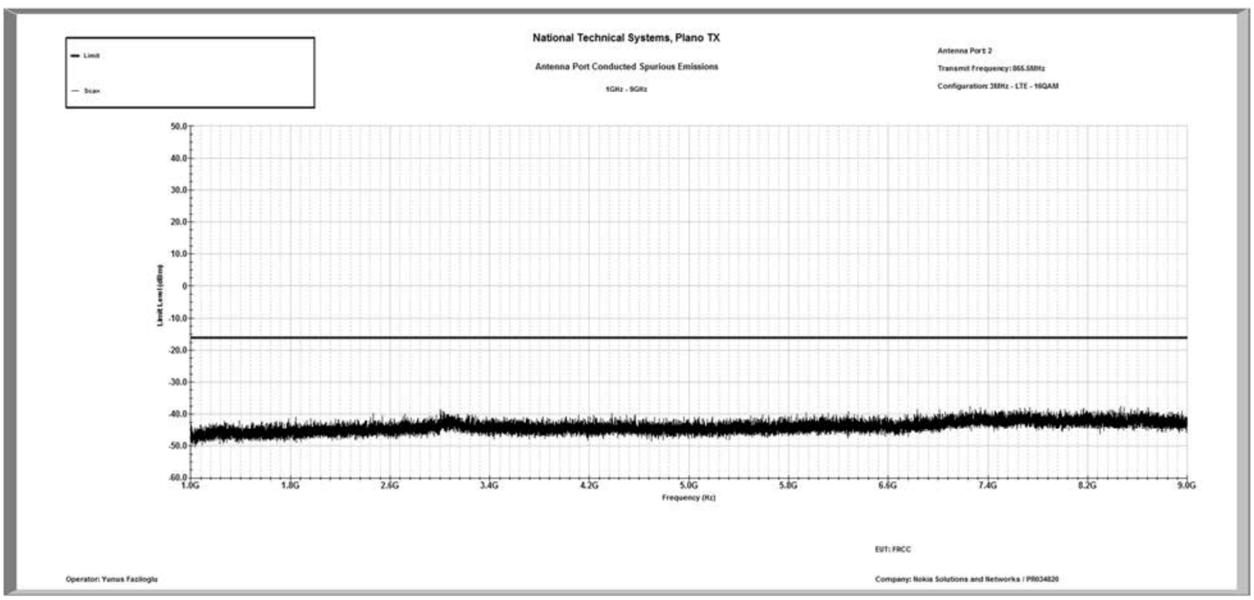
3M – LTE – QPSK


National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
9kHz-1GHz
Limit
Scan
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 3MHz - LTE - QPSK
Limit Level (dBm)
Frequency (Hz)
9.0K
100.0M
200.0M
300.0M
400.0M
500.0M
600.0M
700.0M
800.0M
900.0M
1.0G
EUT: FRCC
Operator: Yunus Fazlioglu
Company: Nokia Solutions and Networks / PR034820

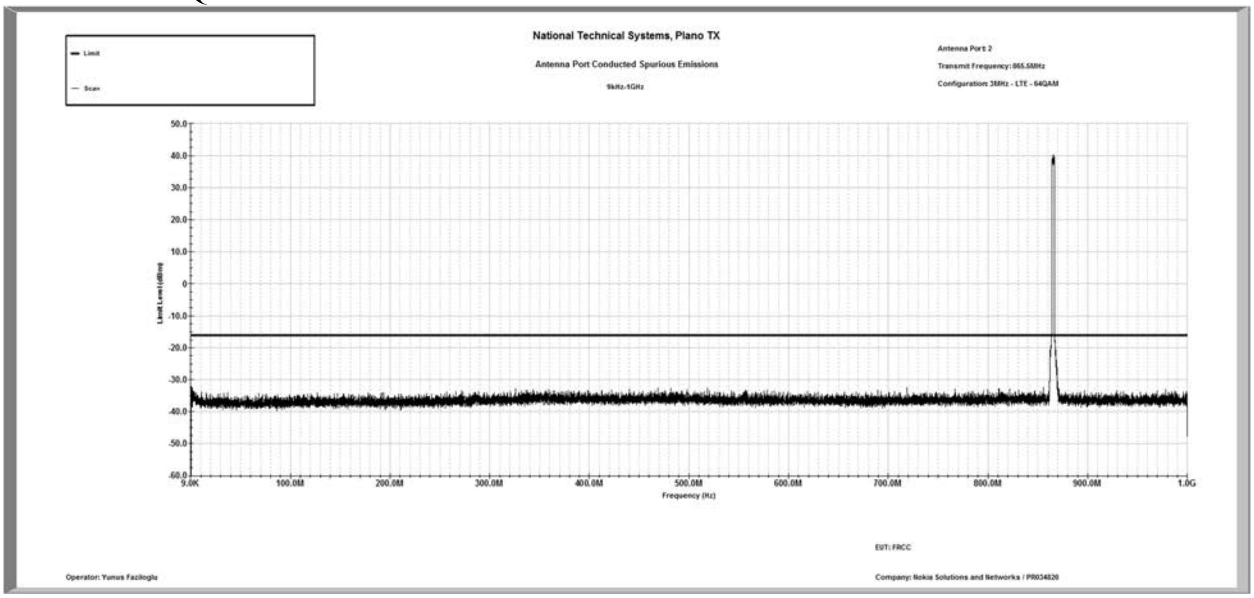

National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
1GHz - 9GHz
Limit
Scan
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 3MHz - LTE - QPSK
Limit Level (dBm)
Frequency (Hz)
1.0G
1.8G
2.6G
3.4G
4.2G
5.0G
5.8G
6.6G
7.4G
8.2G
9.0G
EUT: FRCC
Operator: Yunus Fazlioglu
Company: Nokia Solutions and Networks / PR034820

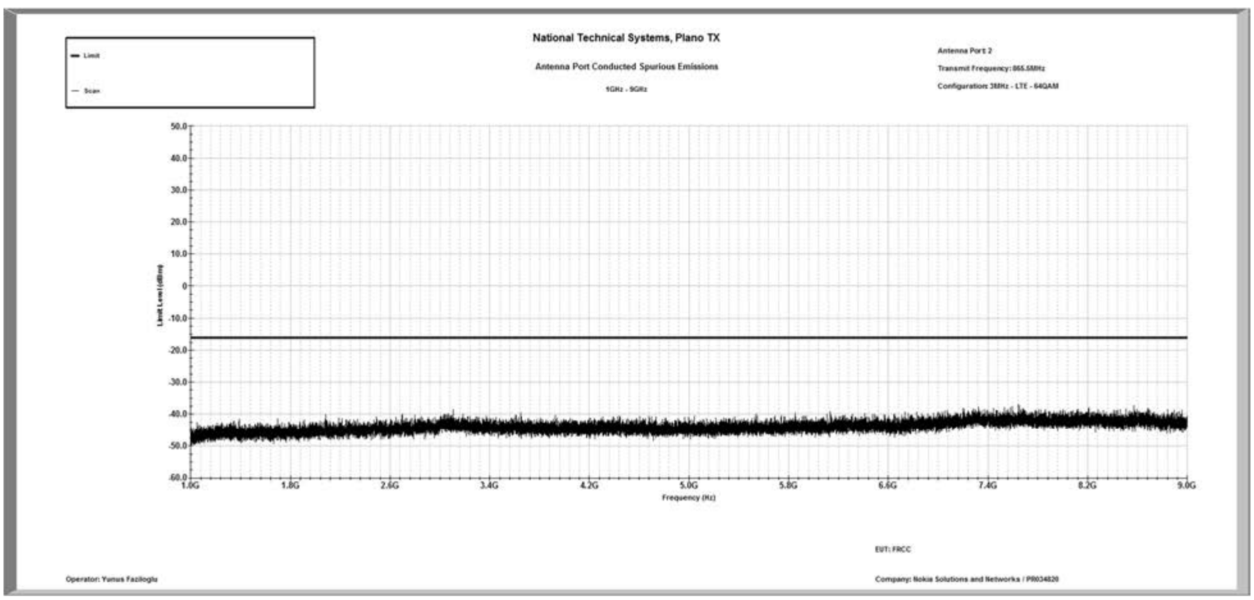
3M – LTE – 16QAM


National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
9kHz-1GHz
Limit
Scan
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 3MHz - LTE - 16QAM
Limit Level (dBm)
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
9.0K
100.0M
200.0M
300.0M
400.0M
500.0M
600.0M
700.0M
800.0M
900.0M
1.0G
Frequency (Hz)
EUT: FRCC
Operator: Yunus Faziloglu
Company: Nokia Solutions and Networks / PR034820

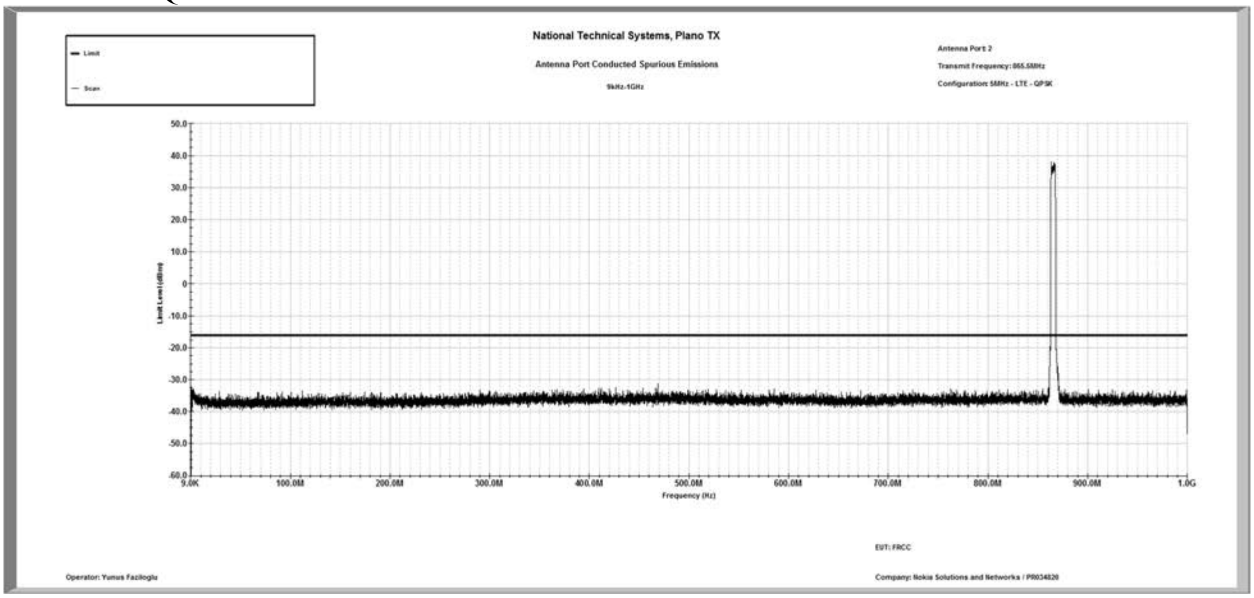

National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
1GHz - 9GHz
Limit
Scan
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 3MHz - LTE - 16QAM
Limit Level (dBm)
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
1.0G
1.8G
2.6G
3.4G
4.2G
5.0G
5.8G
6.6G
7.4G
8.2G
9.0G
Frequency (Hz)
EUT: FRCC
Operator: Yunus Faziloglu
Company: Nokia Solutions and Networks / PR034820

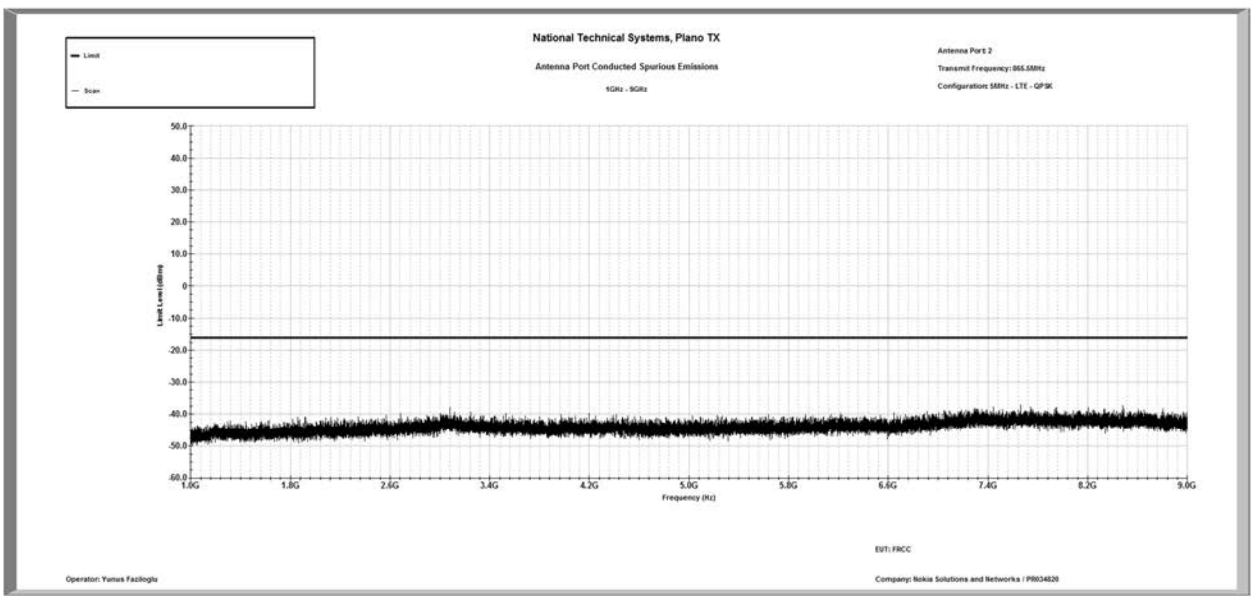
3M – LTE – 64QAM


National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
9kHz-1GHz
Limit
Scan
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 3MHz - LTE - 64QAM
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Limit Level (dBm)
9.0K
100.0M
200.0M
300.0M
400.0M
500.0M
600.0M
700.0M
800.0M
900.0M
1.0G
Frequency (Hz)
EUT: FRCC
Operator: Yunus Faziloglu
Company: Nokia Solutions and Networks / PR034820

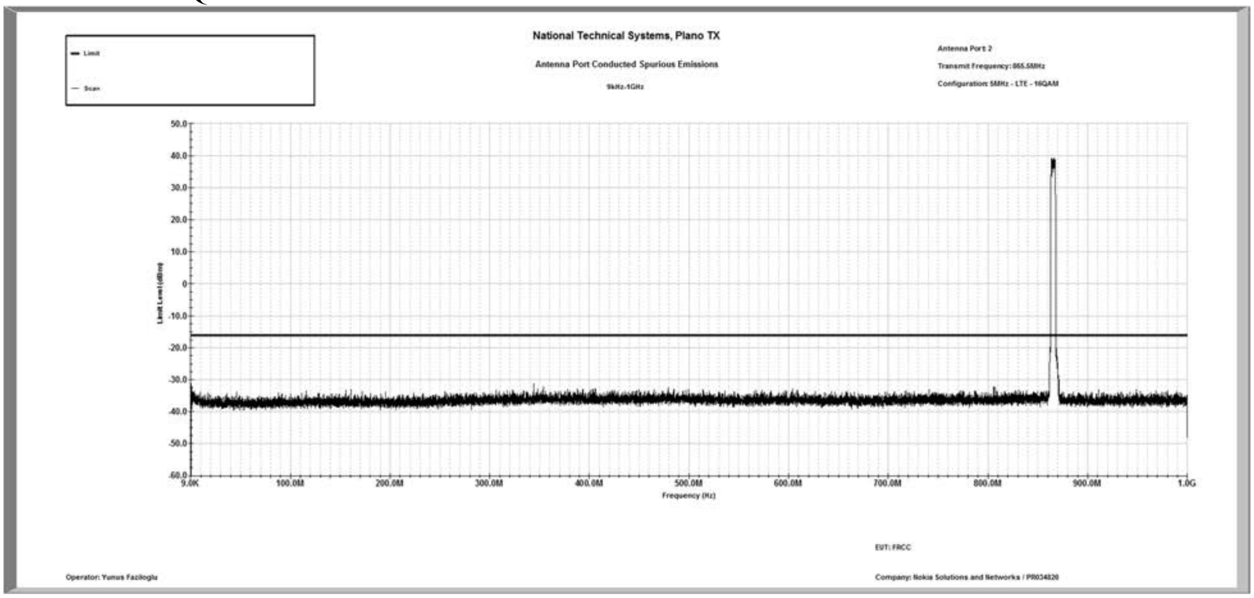

National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
1GHz - 9GHz
Limit
Scan
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 3MHz - LTE - 64QAM
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Limit Level (dBm)
1.0G
1.8G
2.6G
3.4G
4.2G
5.0G
5.8G
6.6G
7.4G
8.2G
9.0G
Frequency (Hz)
EUT: FRCC
Operator: Yunus Faziloglu
Company: Nokia Solutions and Networks / PR034820

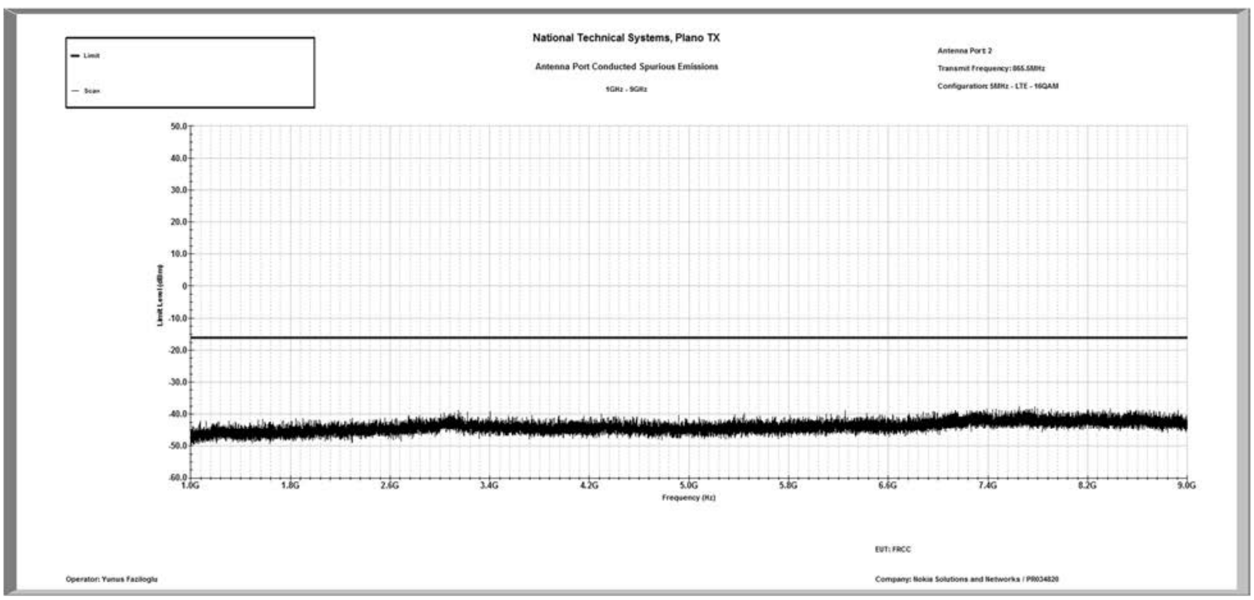
5M – LTE – QPSK


National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
9kHz-1GHz
Limit
Scan
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 5MHz - LTE - QPSK
Limit Level (dBm)
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
9.0K
100.0M
200.0M
300.0M
400.0M
500.0M
600.0M
700.0M
800.0M
900.0M
1.0G
Frequency (Hz)
EUT: FRCC
Operator: Yunus Faziloglu
Company: Nokia Solutions and Networks / PR034820

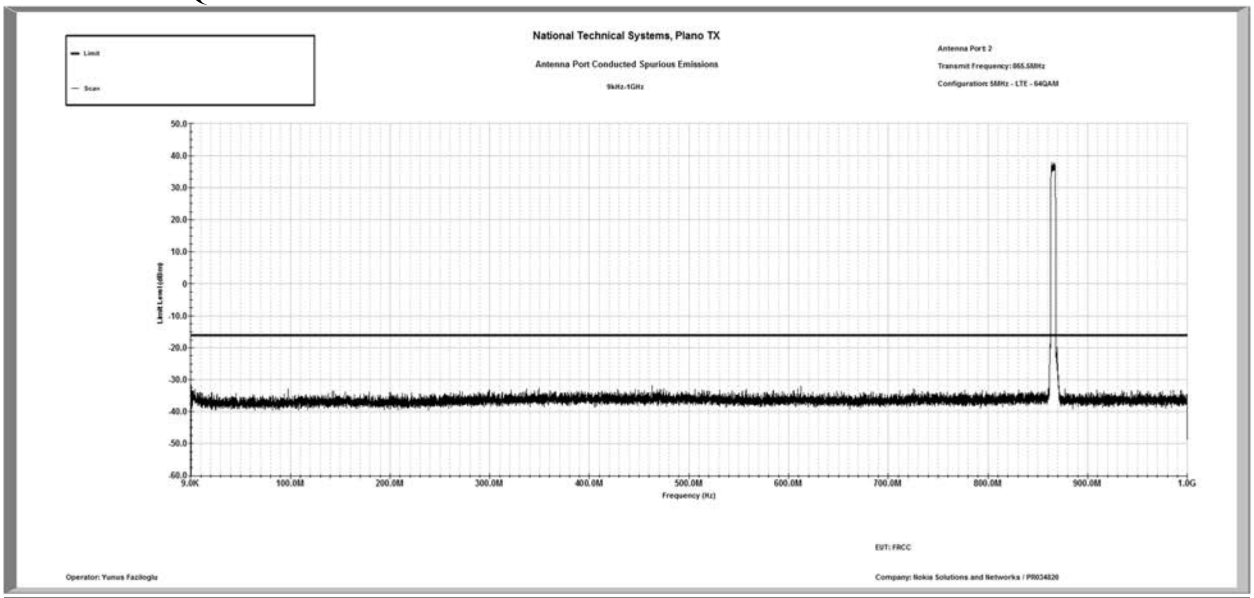

National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
1GHz - 9GHz
Limit
Scan
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 5MHz - LTE - QPSK
Limit Level (dBm)
50.0
40.0
30.0
20.0
10.0
0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
1.0G
1.8G
2.6G
3.4G
4.2G
5.0G
5.8G
6.6G
7.4G
8.2G
9.0G
Frequency (Hz)
EUT: FRCC
Operator: Yunus Faziloglu
Company: Nokia Solutions and Networks / PR034820

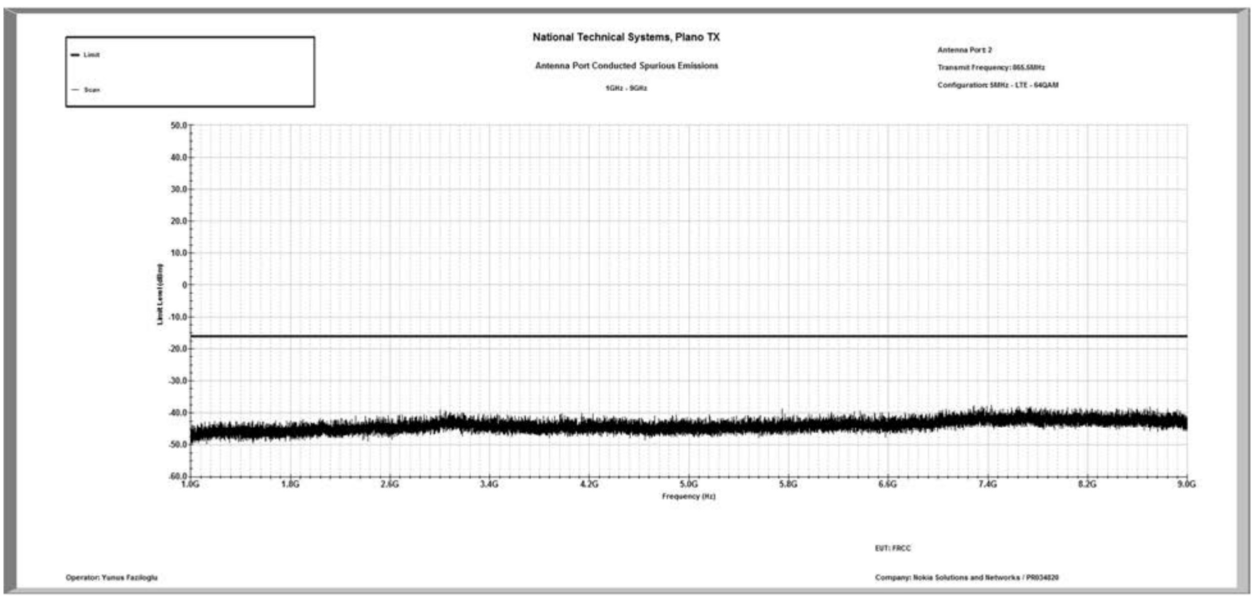
5M – LTE – 16QAM


National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
9kHz-1GHz
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 5MHz - LTE - 16QAM
Limit
Scan
Limit Level (dBm)
Frequency (Hz)
9.0K
100.0M
200.0M
300.0M
400.0M
500.0M
600.0M
700.0M
800.0M
900.0M
1.0G
EUT: FRCC
Operator: Yunus Fazlioglu
Company: Nokia Solutions and Networks / PR034820


National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
1GHz - 9GHz
Antenna Port 2
Transmit Frequency: 865.5MHz
Configuration: 5MHz - LTE - 16QAM
Limit
Scan
Limit Level (dBm)
Frequency (Hz)
1.0G
1.8G
2.6G
3.4G
4.2G
5.0G
5.8G
6.6G
7.4G
8.2G
9.0G
EUT: FRCC
Operator: Yunus Fazlioglu
Company: Nokia Solutions and Networks / PR034820

5M – LTE – 64QAM


National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
9kHz-1GHz
Limit
Scan
Antenna Port: 2
Transmit Frequency: 865.5MHz
Configuration: 5MHz - LTE - 64QAM
Limit Level (dBm)
Frequency (Hz)
EUT: FRCC
Operator: Yunus Fazlioglu
Company: Nokia Solutions and Networks / PR034820


National Technical Systems, Plano TX
Antenna Port Conducted Spurious Emissions
1GHz - 9GHz
Limit
Scan
Antenna Port: 2
Transmit Frequency: 865.5MHz
Configuration: 5MHz - LTE - 64QAM
Limit Level (dBm)
Frequency (Hz)
EUT: FRCC
Operator: Yunus Fazlioglu
Company: Nokia Solutions and Networks / PR034820

Transmitter Radiated Spurious Emissions

Antenna port conducted spurious emissions tests produced similar results for all modulations and channel bandwidth modes. Preliminary scans for radiated spurious emissions were performed in 30MHz – 9GHz frequency range in the following configuration:

Transmitting in 1.4MHz-16QAM-LTE mode at center channel (865.5MHz) on both ports.

Final maximized peak radiated emissions were measured in this mode. During testing both antenna ports of the base station were terminated with 50ohm termination blocks and unit was transmitting on both of its ports at full power as described above.

Frequency (MHz)	Polarity (H/V)	Raw Reading at 3m (dBuV)	Amplifier Gain (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Field Strength at 3m (dBuV/m)	Limit at 3m (dBuV/m)	Margin (dB)
614.4	V	50.1	-39.3	21	1.6	33.4	82.2	-48.8
614.4	H	52.2	-39.3	21	1.6	35.5	82.2	-46.7
921.6	V	50.6	-40.2	24.3	2.8	37.5	82.2	-44.7
921.6	H	47.9	-40.2	24.3	2.8	34.8	82.2	-47.4
1731	V	55.5	-49.1	26.2	2.6	35.2	82.2	-47
1731	H	57.6	-49.1	26.2	2.6	37.3	82.2	-44.9
2596.5	V	55.9	-47.9	28.9	3.2	40.1	82.2	-42.1
2596.5	H	54.8	-47.9	28.9	3.2	39	82.2	-43.2
3462	V	59.1	-47.3	31.2	4	47	82.2	-35.2
3462	H	59.2	-47.3	31.2	4	47.1	82.2	-35.1
8961 - NF	V	50.3	-45.2	37.7	6	48.8	82.2	-33.4
8961 - NF	H	50.4	-45.2	37.7	6	48.9	82.2	-33.3

Corrected Field Strength = Raw Reading + Amplifier Gain + Antenna Factor + Cable Loss

Negative margin indicates a passing result.

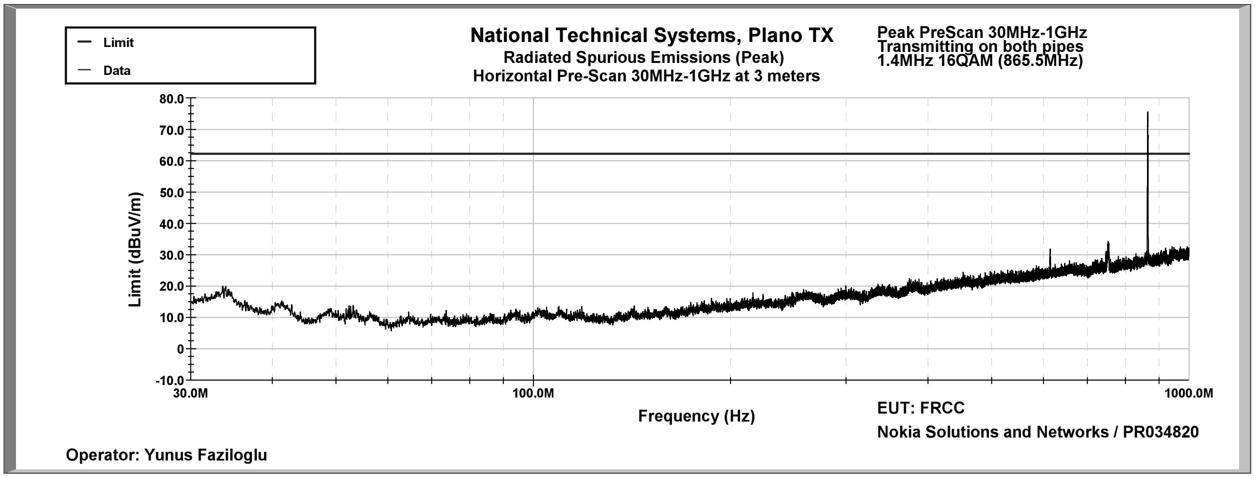
Detector: Peak, RBW=1MHz, VBW=3MHz, Max-hold
NF: Noise Floor

Highest noise floor of the measurement instrumentation was more than 20dB below the 82.2dBuV/m at 3m limit (equivalent to –13dBm EIRP).

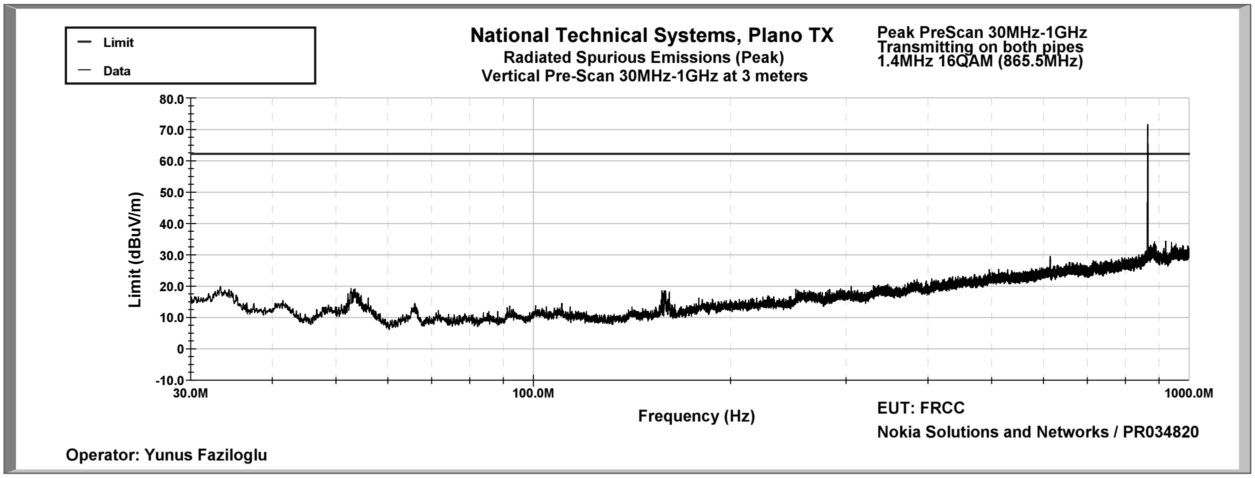
Since all maximized readings were more than 20dB below the 82.2dBuV/m at 3m limit (equivalent to -13dBm EIRP), substitution measurements were not performed.

TILE software was used for all prescans and plots included on the following pages. The limit shown on the plots is 20dB below the 82.2dBuV/m at 3m limit.

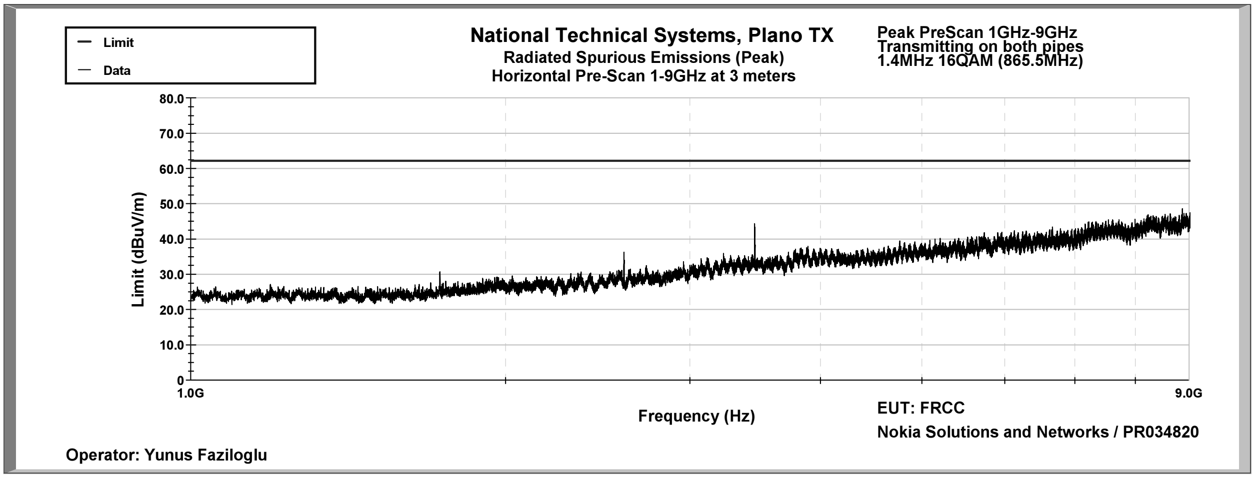
30MHz – 1GHz Peak Prescan at 3m – H



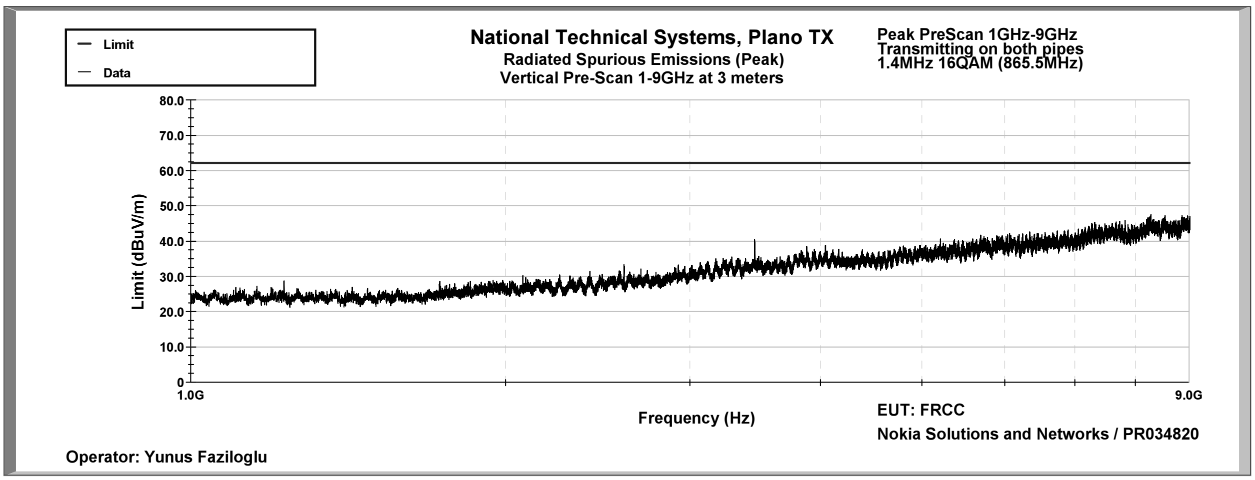
30MHz – 1GHz Peak Prescan at 3m – V



1GHz – 9GHz Peak Prescan at 3m – H



1GHz – 9GHz Peak Prescan at 3m – V



Frequency Stability

In order to demonstrate carrier frequency stability at extreme temperatures and voltages, frequency error was measured in the following configuration:

Transmitting in 5MHz-64QAM-LTE mode at center channel (865.5MHz) on port 2.

Nominal operating voltage of the product is declared as 48VDC.

Frequency error results are listed below for extreme voltages and temperatures.

Extreme Voltages

20C	Freq. Error (mHz)
40.8VDC	364
55.2VDC	270

Extreme Temperatures

48VDC	Freq. Error (mHz)
-30	188
-20	413
-10	210
0	300
10	361
20	55
30	274
40	289
50	315

Based on the results above, highest recorded frequency error is 0.0005ppm, which is below the 1.5ppm limit.

Results above are deemed sufficient to demonstrate carrier frequency stability for all other channel bandwidth modes and modulations since all carriers are controlled by the same frequency stabilization circuitry that was subjected to the extreme conditions under this test.

End of Report

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marks the last page of this test report.