Radio Test Report

Application for Grant of Equipment Authorization

FCC Part 24 & IC RSS-133
1930MHz – 1995MHz

FCC ID:	**VBNFWFA-01**
IC:	**661W-FWFA**
Product Name:	**Flexi Zone Micro BTS 1900**
Model(s):	**FWFA**
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:	**Feb 10, 2015**
FINAL TEST DATES:	**Dec 9-12, 2014**
TOTAL NUMBER OF PAGES:	**69**

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REVISION HISTORY

Rev#	Date	Comments	Modified By
0	Jan 7, 2015	1st release	Yunus Faziloglu
1	Feb 10, 2015	To address TCB comments	Yunus Faziloglu

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SCOPE

Tests have been performed on Nokia Solutions and Networks product Flexi Zone Micro BTS 1900 Model FWFA, 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 and Industry Canada.

- Code of Federal Regulations (CFR) Title 47 Part 2
- Industry Canada RSS-Gen Issue 4, November 2014
- CFR 47 Part 24 Subpart E – Broadband PCS
- RSS-133 Issue 6, January 2013 (2GHz Personal Communications Services)

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 and Industry Canada performance and procedural standards.

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 Zone Micro BTS 1900 Model FWFA 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. Prior to marketing in Canada, Class I transmitters, receivers and transceivers require 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 FWFA. No additional models were described or supplied for testing.

STATEMENT OF COMPLIANCE

The tested sample of Nokia Solutions and Networks product Flexi Zone Micro BTS 1900 Model FWFA 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 24 & IC RSS-133 (Base Stations Operating in 1930MHz-1995MHz band)

FCC	Canada	Description	Measured	Limit	Result
Transmitter Modulation, output power and other characteristics					
§24.229	RSS-133 Section 6.1	Frequency range(s)	1932.5 – 1992.5 (5M) 1935 – 1990 (10M) 1937.5 – 1987.5 (15M) 1940 – 1985 (20M)	1930-1995 MHz	Pass
§2.1047	RSS-133 Section 6.2	Modulation Type	QPSK, 16QAM, 64QAM (5M, 10M, 15M, 20M channels for each)	Digital	Pass
§24.232	RSS-133 Section 6.4	Output Power	Conducted Output Power (Highest on Port D) Peak: 46.96dBm RMS: 36.23Bm EIRP will depend on antenna gain (unknown)	FCC: 1640W EIRP IC: 100W Conducted	Pass
§24.232	RSS-133 Section 6.4	Peak to Average Ratio	10.90dB highest	<= 13 dB	Pass
§24.238	-	Emission Bandwidth (26dB)	4.990MHz (5M) 9.994MHz (10M) 14.929MHz (15M) 19.919MHz (20M)	Remain in Block	Pass
-	RSS-133 Section 2.3	Emission Bandwidth (99%)	4.514MHz (5M) 9.016MHz (10M) 13.506MHz (15M) 18.022MHz (20M)	Remain in Block	Pass
Transmitter spurious emissions[3]					
§24.238	RSS-133 Section 6.5.1	At the antenna terminals	< -16.02dBm	-16.02 dBm (per TX chain)	Pass
		Field strength	54.5dBuV/m at 3m Eq. to -40.7dBm EIRP	-13 dBm EIRP	Pass
Receiver spurious emissions[2]					
Other details					
§24.235	RSS-133 Section 6.3	Frequency stability	Stays within block	N/A[1]	Pass
§2.1093	RSS-102	RF Exposure	N/A		Pass[4]

Notes

Note 1 – The requirement for frequency stability is that the signal remains within the authorized frequency block.
Note 2 – As the frequency of operation is above 960 MHz there are no technical requirements for spurious emissions from the receiver.
Note 3 – The measurement at the channel edge is made with a resolution bandwidth of at least 1% of the emission bandwidth. For measurements more than 1MHz from the edge of the channel, the measurement bandwidth is 1MHz.
Note 4 – 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
5M	4M96F9W	4M49F9W	4M94F9W	4M49F9W	4M99F9W	4M51F9W
10M	9M94F9W	9M00F9W	9M95F9W	9M02F9W	9M99F9W	9M00F9W
15M	14M9F9W	13M5F9W	14M8F9W	13M5F9W	14M9F9W	13M5F9W
20M	19M9F9W	18M0F9W	19M8F9W	18M0F9W	19M9F9W	18M0F9W

Note: FCC based on 26dB emissions 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 is a Nokia Solutions and Networks Flexi Zone Micro BTS (base transceiver station) 1900. The FZM BTS 1900 is a single box LTE base station. The FWFA frequency variant being tested under this effort covers 3GPP frequency bands 2 and 25 (Downlink: 1930 to 1995 MHz). The FWFA has 2Tx and 2Rx antenna connections with each transmit port supporting 5 watts maximum rated RF output power. The FWFA BTS supports four channel bandwidths of 5, 10, 15 and 20 MHz. The FWFA BTS supports three downlink modulation types of QPSK, 16QAM and 64QAM. The FWFA supports 2x2 MIMO operations (2x2 MIMO was used for all testing). Multi carrier operation is not supported. The FWFA was configured with external interfaces including AC power, ground, LTE RF (TX/RX-M & TX/RX-D), wired Ethernet (RJ-45), optical Ethernet, GPS and Bluetooth. The BTS with applicable installation kits may be pole, wall or ceiling mounted. Bluetooth interface has modular FCC and IC approval.

Following table shows the channel numbers and frequencies for different channel bandwidth modes.

Downlink EARFCN Bands 2/25	Downlink Frequency (MHz)	Channel Bandwidth			
		5 MHz	10 MHz	15 MHz	20 MHz
600/8040	1930	Bandedge	Bandedge	Bandedge	Bandedge
.....					
625/8065	1932.5	Bottom Channel			
626/8066	1932.6	BC +1			
.....					
650/8090	1935		Bottom Channel		
651/8091	1935.1		BC + 1		
.....					
675/8115	1937.5			Bottom Channel	
676/8116	1937.6			BC +1	
.....					
700/8140	1940				Bottom Channel
701/8141	1940.1				BC + 1
.....					
925/8365	1962.5	Middle Channel	Middle Channel	Middle Channel	Middle Channel
.....					
1149/8589	1984.9				TC - 1
1150/8590	1985				Top Channel
.....					
1174/8614	1987.4			TC - 1	
1175/8615	1987.5			Top Channel	
.....					
1199/8639	1989.9		TC - 1		
NA (1200)/8640	1990		Top Channel		
.....					
NA (1224)/8664	1992.4	TC - 1			
NA (1225)/8665	1992.5	Top Channel			
.....					
NA (1250)/8690	1995	Bandedge	Bandedge	Bandedge	Bandedge

The sample was received on Dec 9, 2014 and tested on Dec 9-12, 2014. The EUT consisted of the following component(s):

Company	Model	Description	Serial/Part Number	FCC ID / IC#
Nokia Solutions and Networks	FWFA	Flexi Zone Micro BTS 1900	Part 473040A.101 Serial RY144604246	FCC ID: VBNFWFA-01 IC: 661W-FWFA

Unit does not support multiple RB modes for LTE. It was tested at the lowest and highest possible channels at highest power level for each modulation and channel bandwidth mode.

ENCLOSURE

The EUT enclosure is made of heavy duty aluminum and measures approximately 13(W) x 9.75(D) x 3(H) inches.

AUXILLARY EQUIPMENT

Company	Model	Description	Serial/Part Number	FCC ID
Finisar	FTLF5819P3BTL	Multimode SFP Optical Module (Plugs into FWFA BH A port)	Serial: PQK1XLE	N/A

SUPPORT EQUIPMENT

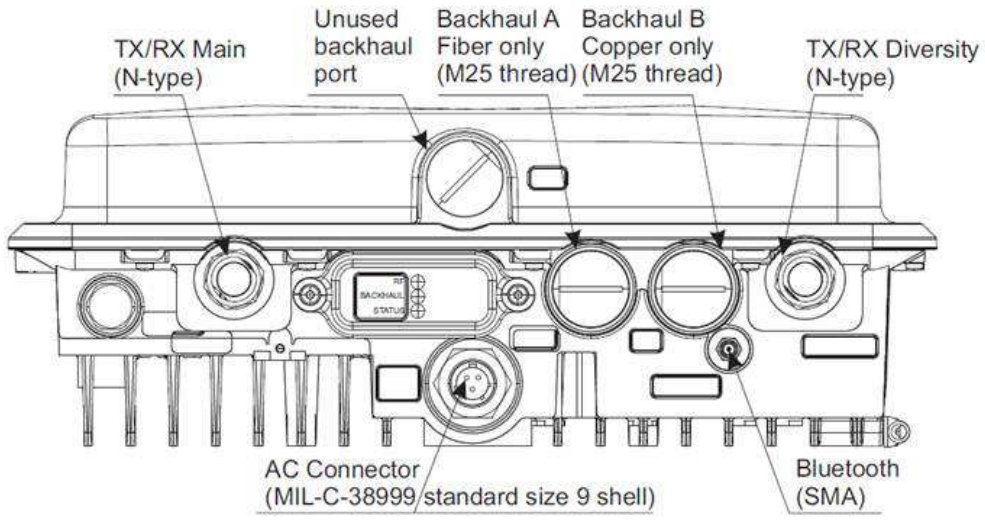
Company	Model	Description	Serial Number	FCC ID
HP	EliteBook 6930p	Laptop PC	2CE93960X5	N/A
TRENDnet	TFC-1000MGB	1000 Base-T to mini-GBIC Media Converter	C21412MG00194	N/A

EUT INTERFACE PORTS

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

Port	Connected To	Description	Cable(s)	
			Shielded or Unshielded	Length(m)
TX/RX-M	RF Load	LTE RF	Shielded	2
TX/RX-D	RF Load	LTE RF	Shielded	2
AC Power	Lab Power	Power Input	Shielded	2
BH A	PC	Fiber Optic Ethernet	Unshielded	>6
BH B	PC	Wired (RJ 45) Ethernet	Shielded	3
GPS	GPS Antenna	GPS Signal Input	Shielded	>6
Bluetooth	Antenna	Bluetooth Interface	None	N/A
Ground	Ground	Chassis Ground	Unshielded	2

The connector layout for FWFA is provided below:



EUT OPERATION

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

EUT FIRMWARE/SOFTWARE

The BTS software version used during all testing is "LNF5.0_ENB_1304_150_00". A PC running BTS Site Manager is used to control/operate the BTS during testing. The PC connects to the FZM BTS over the Backhaul (Ethernet) ports. The BTS Site Management interface is used for commissioning, changing configuration settings, monitoring status and to execute various tests on the FZM BTS.

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.

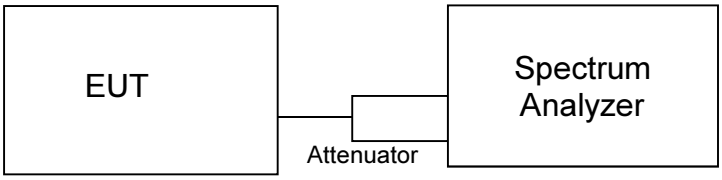
Radiated spurious emissions measurements were taken at the NTS Plano Anechoic Chamber listed below. The sites conform to the requirements of ANSI C63.4-2009 *American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range 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-20GHz 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. Bandedge measurements were performed at the lowest and highest channels to verify that the carrier stayed within the authorized frequency block.

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 ware scanned from 30MHz to 20GHz 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 double ridged waveguide horn antenna was used for 18-20GHz 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.

Receiver radiated spurious emissions testing was not applicable to the EUT since its receive frequency was outside the 30MHz-960MHz range for its LTE as well as its GPS function.

Test Equipment

NTS Equipment #	Description	Manufacturer	Model	Calibration Duration	Calibration Due Date
E1529P	PSA	Agilent	E4446A	12 Months	2/14/2015
E1554P	PreAmp (1GHz-40GHz)	MITEQ	JS32-00104000-62-5P	12 Months	5/14/2015
E1365P	PreAmp (30MHz-1GHz)	MITEQ	AM-1431-N-1197SC	12 Months	7/22/2015
E1524P	Biconilog Antenna (30MHz-1GHz)	ETS Lindgren	3142D	12 Months	3/10/2015
E1019P	Horn Antenna (1GHz-18GHz)	EMCO	3115	12 Months	10/23/2015
E1068P	Horn Antenna (18GHz-40GHz)	EMCO	3116	12 Months	5/12/2015
E1447P	RMS Multimeter	Fluke	87V	12 Months	5/20/2015
ENV1384P	Data Acquisition Switch Unit	Agilent	34970A	12 Months	2/24/2015
E1086P	Power Supply	Elgar	SW1750AE	N/A	No Calibration Required
ENV1195P	Climatic Chamber	Thermotron	SE-300-2-2	N/A	No Calibration Required

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 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. Highest PAR found (10.9 dB) is below the 13dB maximum limit.

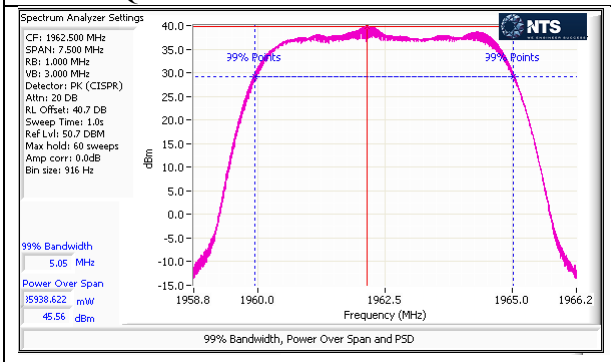
		LTE - QPSK			LTE - 16QAM			LTE - 64QAM		
		Peak (dBm)	Average (dBm)	PAR (dB)	Peak (dBm)	Average (dBm)	PAR (dB)	Peak (dBm)	Average (dBm)	PAR (dB)
Port M Center Channel	**5M**	45.56	35.64	9.92	46.3	35.63	10.67	45.49	35.64	9.85
	10M	45.81	35.77	10.04	46.43	35.59	10.84	45.72	35.69	10.03
	15M	45.86	35.85	10.01	46.69	35.88	10.81	45.78	35.84	9.94
	20M	45.82	35.96	9.86	46.57	35.89	10.68	45.82	35.88	9.94
Port D Center Channel	**5M**	45.73	35.85	9.88	46.4	35.87	10.53	45.63	35.82	9.81
	10M	46	35.85	10.15	46.62	35.72	**10.9**	45.89	35.83	10.06
	15M	46.01	**36.23**	9.78	46.91	36.09	10.82	46.03	36.15	9.88
	20M	46.09	35.97	10.12	46.75	35.93	10.82	45.96	35.98	9.98
Combined Center Channel	**5M**	48.66	38.76	9.9	49.36	38.76	10.6	48.57	38.74	9.83
	10M	48.92	38.82	10.1	49.54	38.67	10.87	48.82	38.77	10.05
	15M	48.95	39.05	9.9	49.81	39	10.81	48.92	39.01	9.91
	20M	48.97	38.98	9.99	49.67	38.92	10.75	48.9	38.94	9.96

Based on the results above, Port D had slightly higher power levels than Port M and therefore Port D was selected for all the remaining antenna port tests on the product. Subsequently output power levels on lowest and highest channels were tested only on Port D and results presented below.

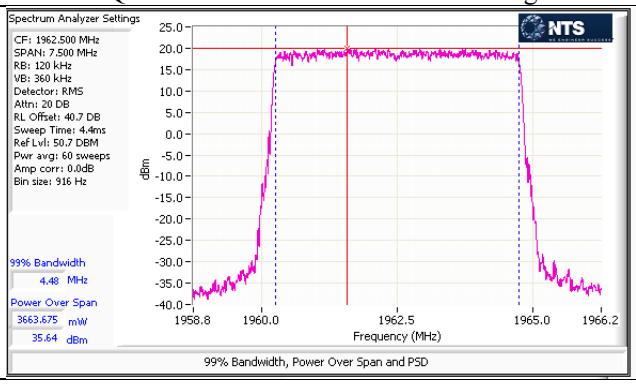
		LTE - QPSK			LTE - 16QAM			LTE - 64QAM		
		Peak (dBm)	Average (dBm)	PAR (dB)	Peak (dBm)	Average (dBm)	PAR (dB)	Peak (dBm)	Average (dBm)	PAR (dB)
Port D Bottom Channel	**5M**	45.5	35.63	9.87	46.04	35.41	10.63	45.25	35.44	9.81
	10M	45.92	35.78	10.14	46.51	35.69	10.82	45.8	35.73	10.07
	15M	45.97	36.13	9.84	46.91	36.12	10.79	46.02	36.11	9.91
	20M	46.19	36.16	10.03	**46.96**	36.22	10.74	46.14	36.16	9.98
Port D Top Channel	**5M**	45.73	35.95	9.78	46.44	35.72	10.72	45.55	35.71	9.84
	10M	46	35.8	10.2	46.55	35.86	10.69	45.81	35.77	10.04
	15M	45.87	35.97	9.9	46.79	35.95	10.84	45.89	35.96	9.93
	20M	46.17	36.18	9.99	46.87	36.08	10.79	46.11	36.07	10.04

Corresponding plots included on the following pages. Total path loss of 40.7dB (Attenuator Loss: 40dB, RF cable loss: 0.7dB) accounted in via reference level offset to the spectrum analyzer.

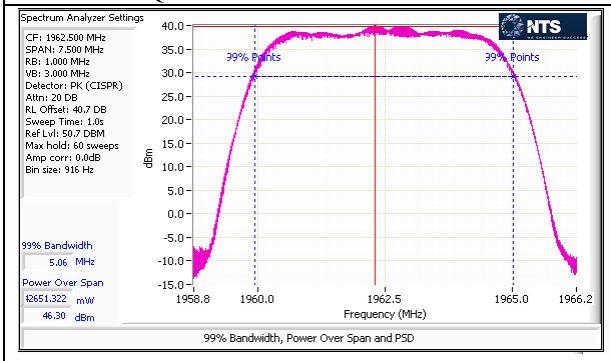
Port M – QPSK – 5M – Center Channel – Peak



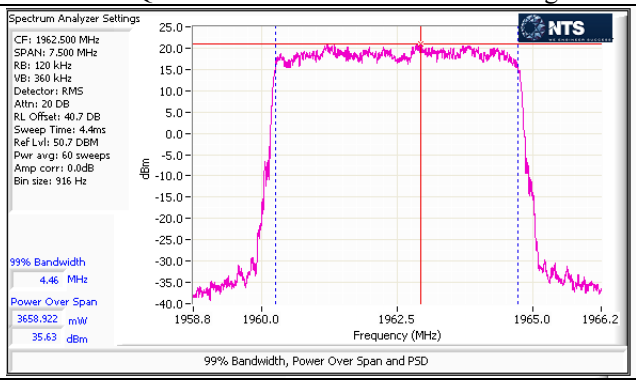
Port M – QPSK – 5M – Center Channel – Average



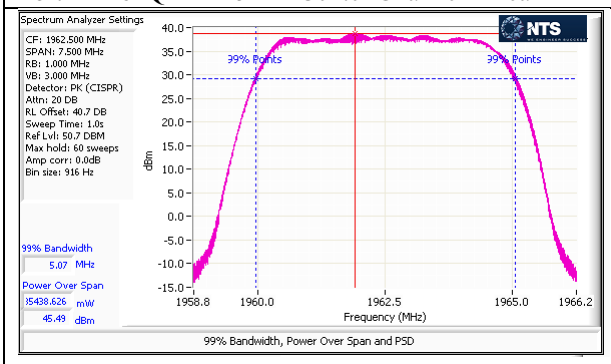
Port M – 16QAM – 5M – Center Channel – Peak



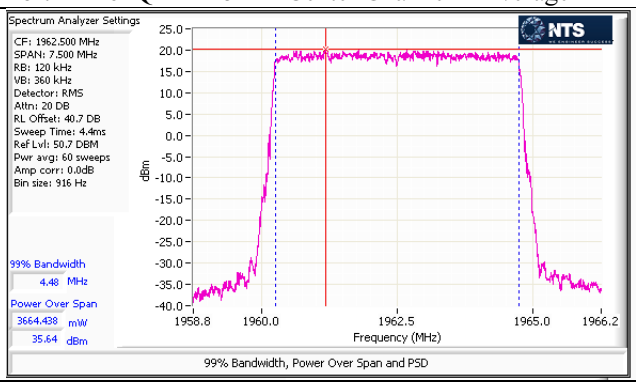
Port M – 16QAM – 5M – Center Channel – Average



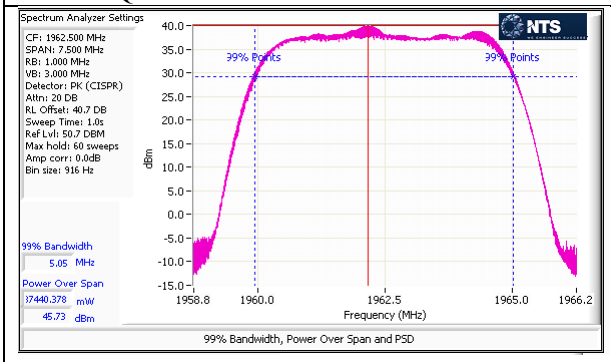
Port M – 64QAM – 5M – Center Channel – Peak



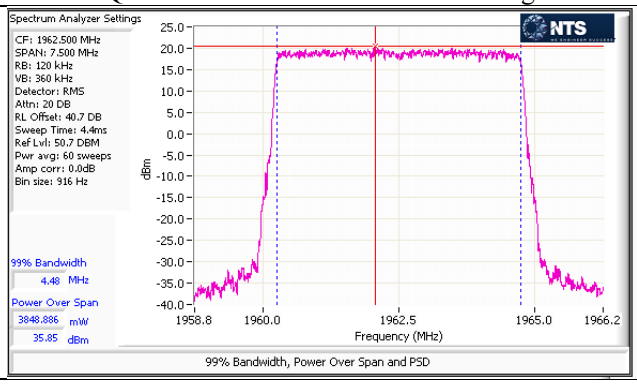
Port M – 64QAM – 5M – Center Channel – Average



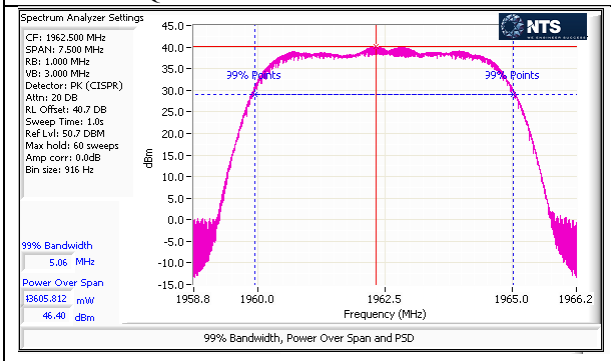
Port D – QPSK – 5M – Center Channel – Peak



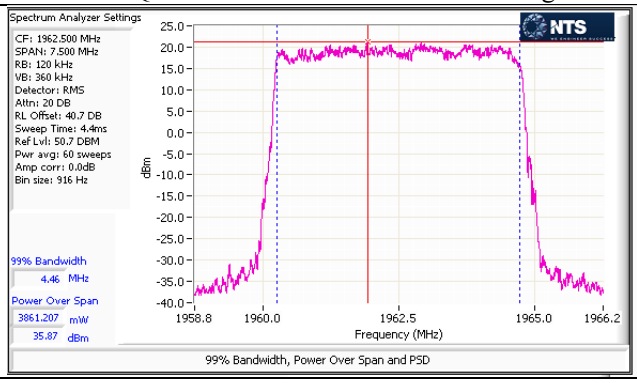
Port D – QPSK – 5M – Center Channel – Average



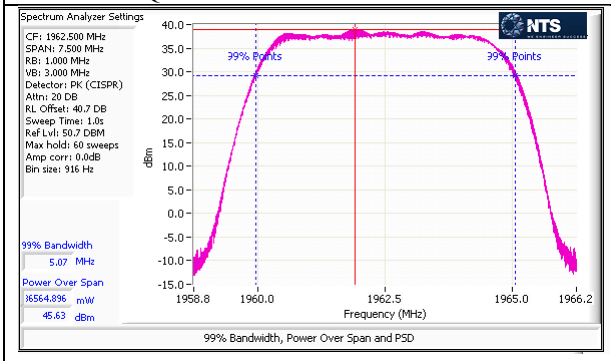
Port D – 16QAM – 5M – Center Channel – Peak



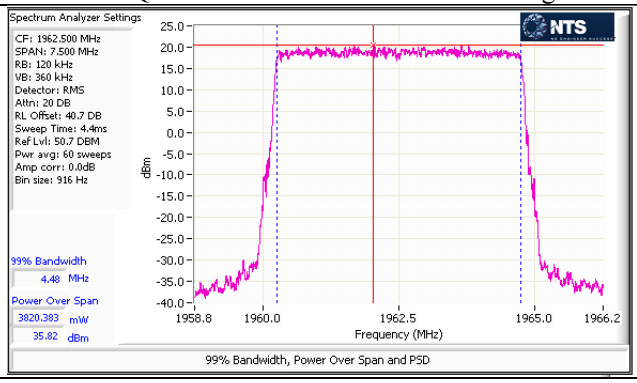
Port D – 16QAM – 5M – Center Channel – Average



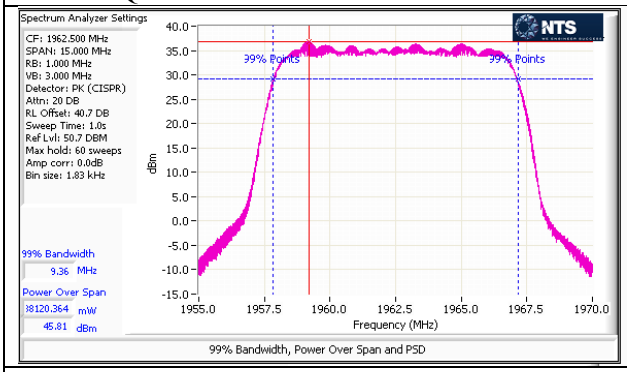
Port D – 64QAM – 5M – Center Channel – Peak



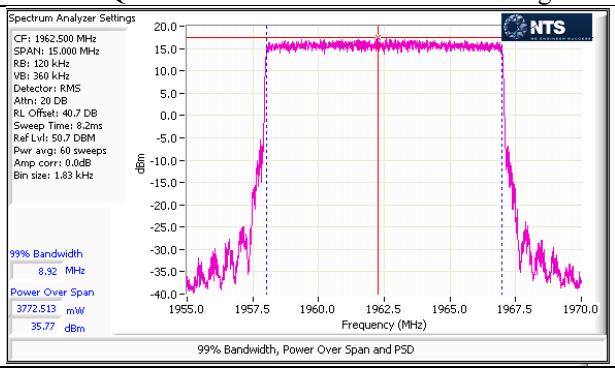
Port D – 64QAM – 5M – Center Channel – Average



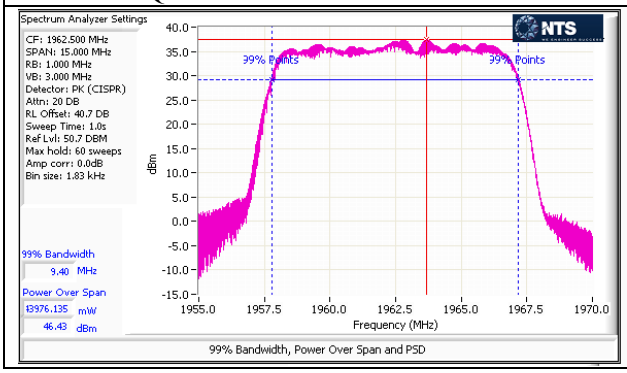
Port M – QPSK – 10M – Center Channel – Peak



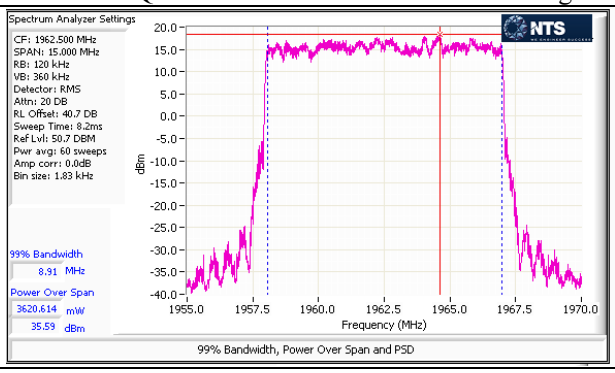
Port M – QPSK – 10M – Center Channel – Average



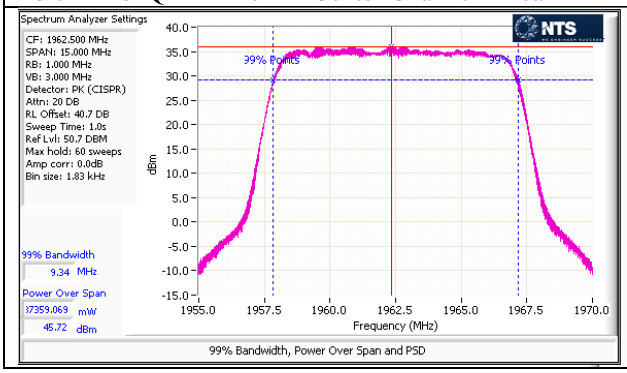
Port M – 16QAM – 10M – Center Channel – Peak



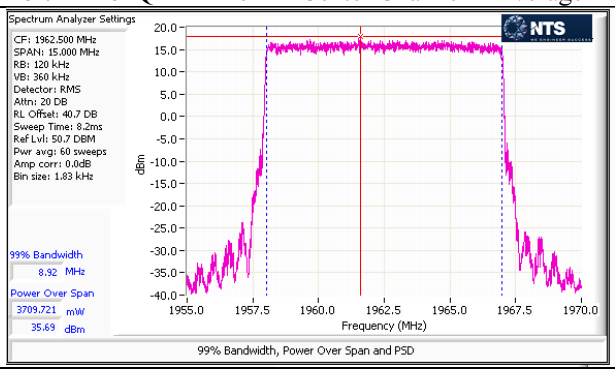
Port M – 16QAM – 10M – Center Channel – Average



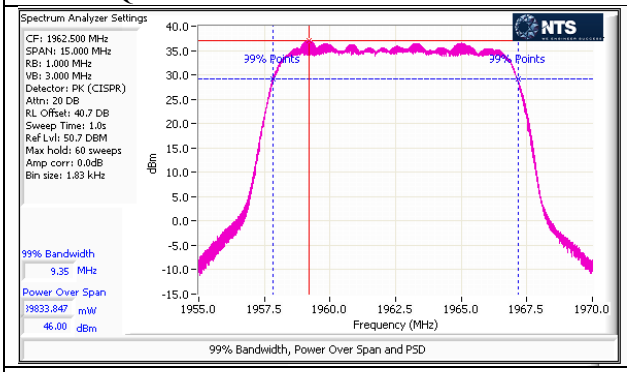
Port M – 64QAM – 10M – Center Channel – Peak



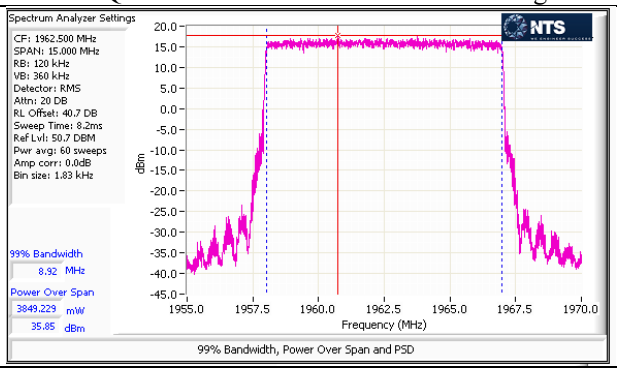
Port M – 64QAM – 10M – Center Channel – Average



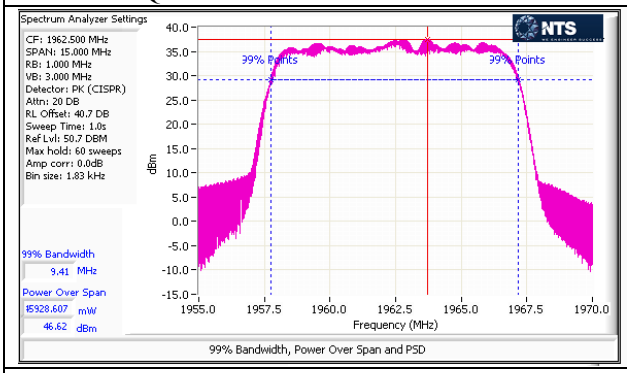
Port D – QPSK – 10M – Center Channel – Peak



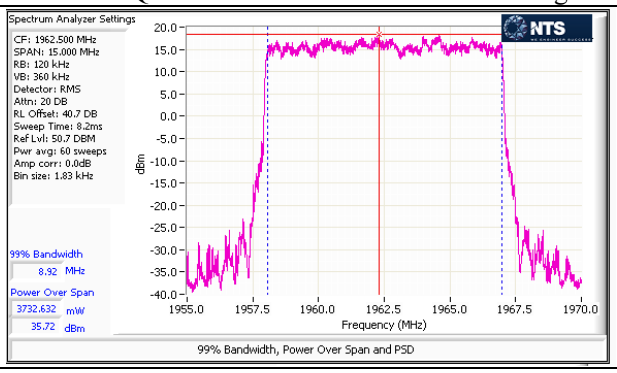
Port D – QPSK – 10M – Center Channel – Average



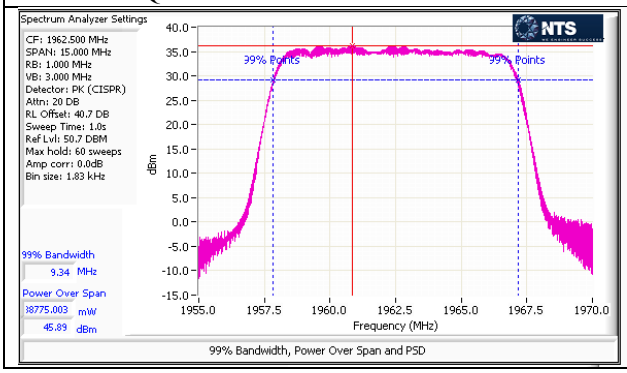
Port D – 16QAM – 10M – Center Channel – Peak



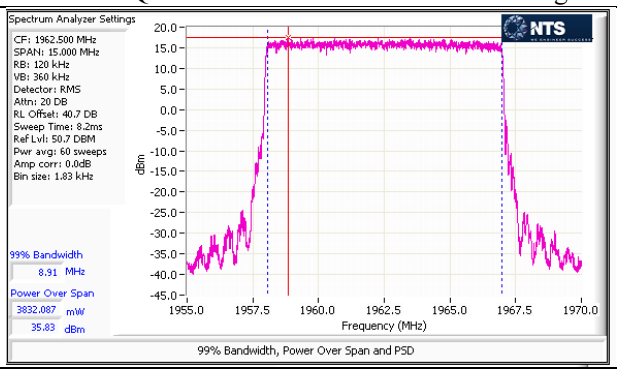
Port D – 16QAM – 10M – Center Channel – Average



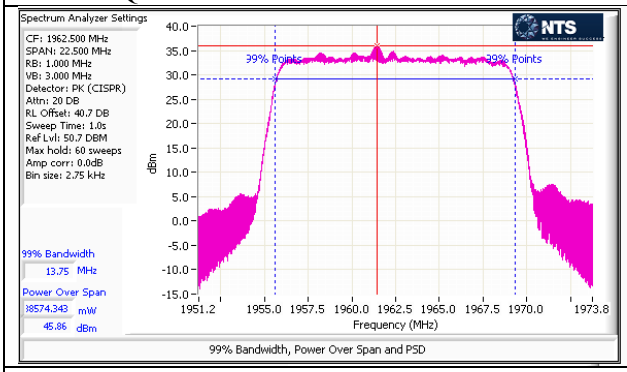
Port D – 64QAM – 10M – Center Channel – Peak



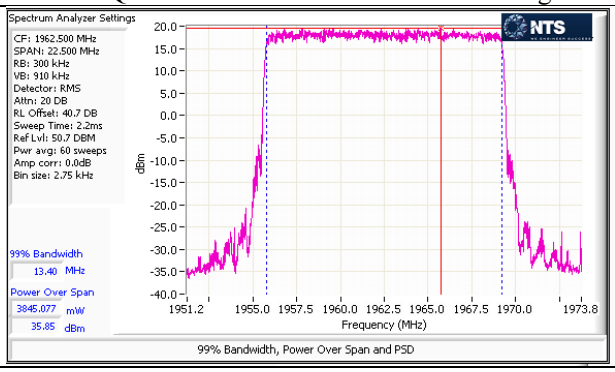
Port D – 64QAM – 10M – Center Channel – Average



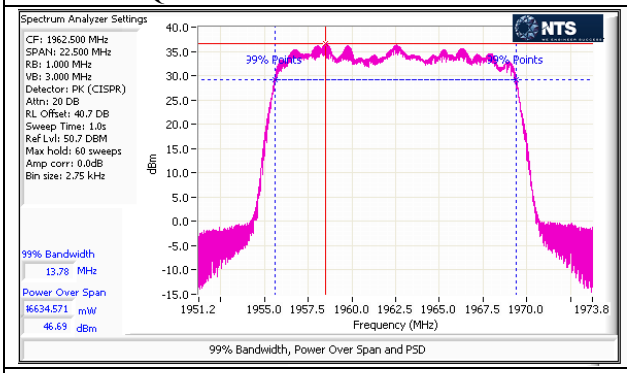
Port M – QPSK – 15M – Center Channel – Peak



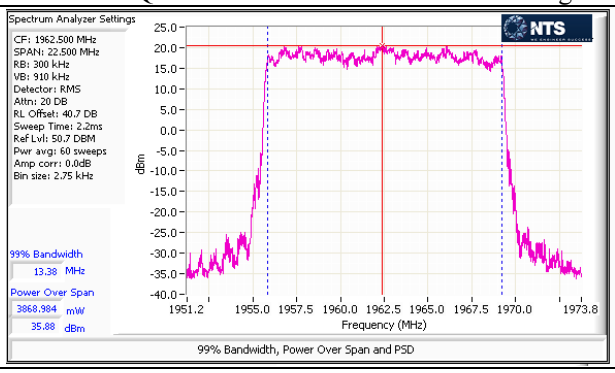
Port M – QPSK – 15M – Center Channel – Average



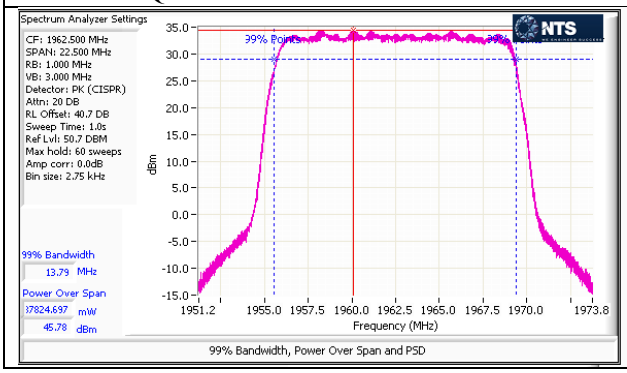
Port M – 16QAM – 15M – Center Channel – Peak



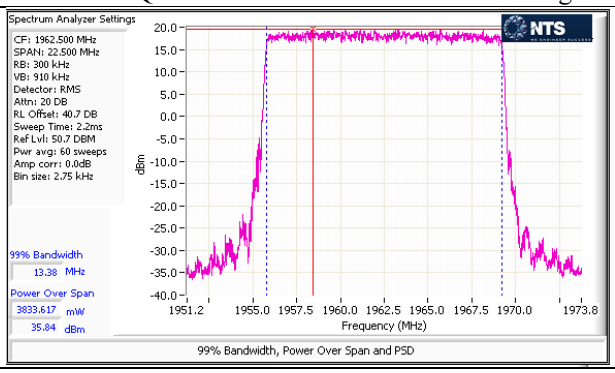
Port M – 16QAM – 15M – Center Channel – Average



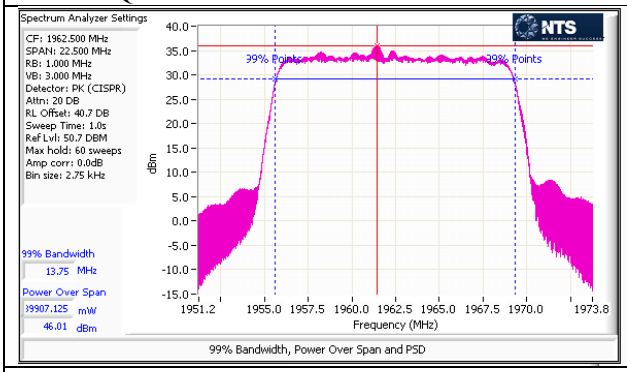
Port M – 64QAM – 15M – Center Channel – Peak



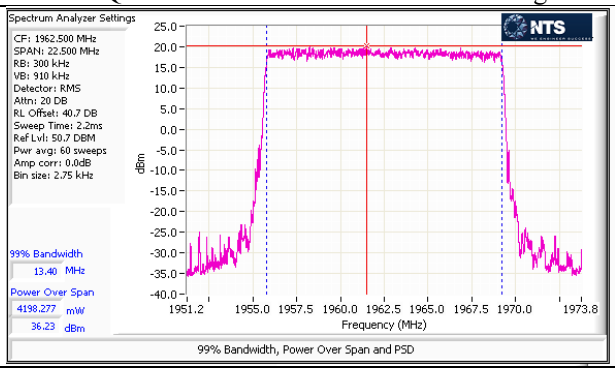
Port M – 64QAM – 15M – Center Channel – Average



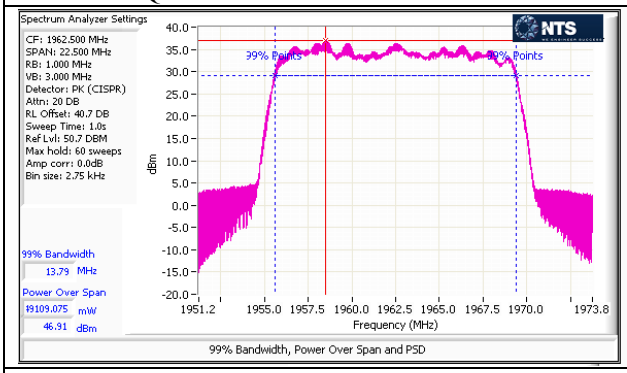
Port D – QPSK – 15M – Center Channel – Peak



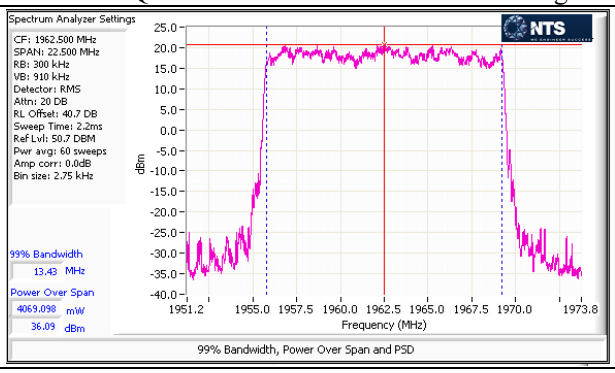
Port D – QPSK – 15M – Center Channel – Average



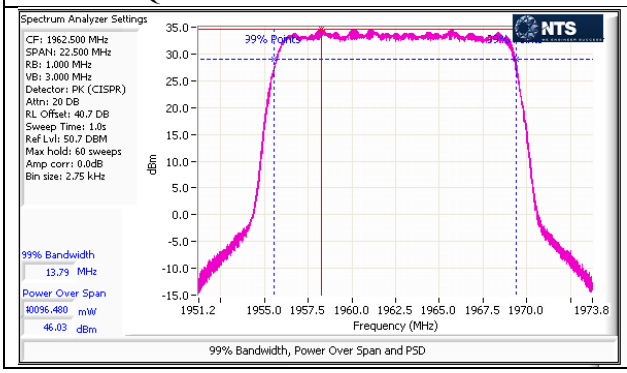
Port D – 16QAM – 15M – Center Channel – Peak



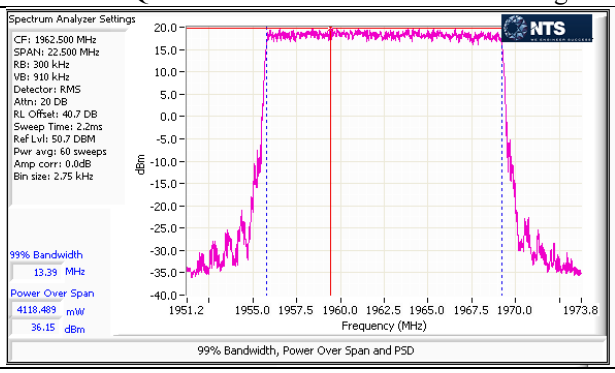
Port D – 16QAM – 15M – Center Channel – Average

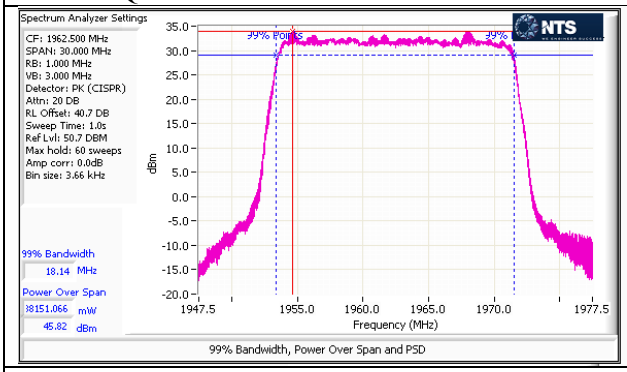
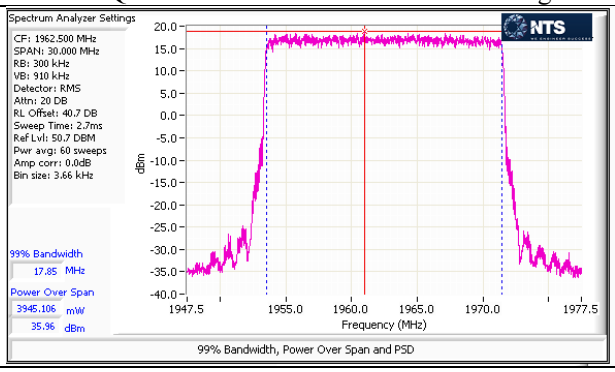
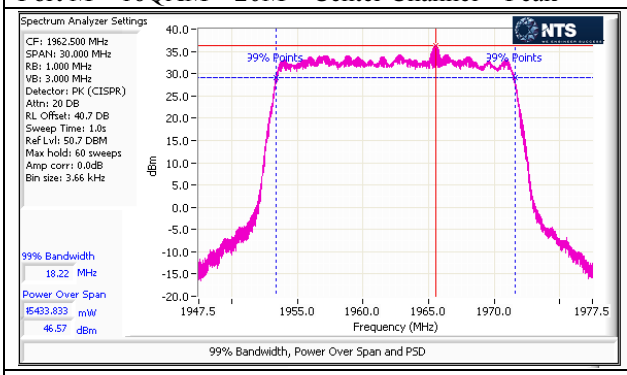
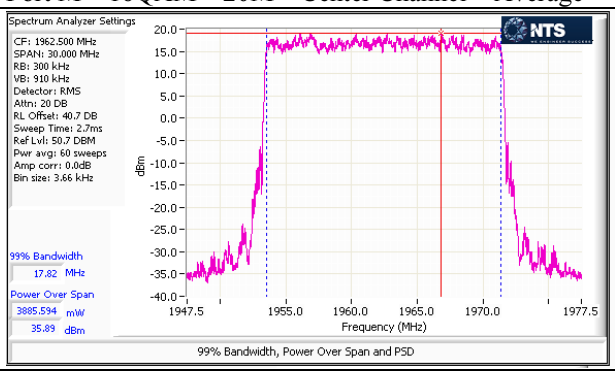
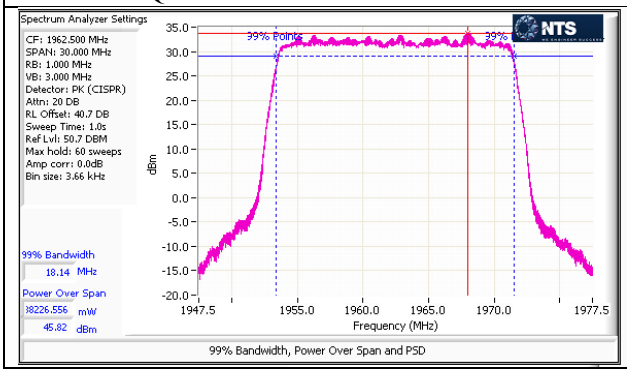
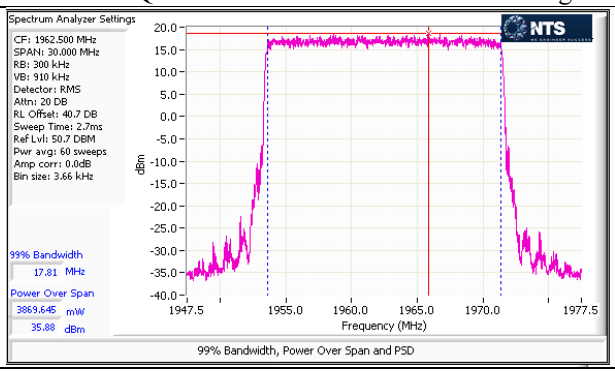


Port D – 64QAM – 15M – Center Channel – Peak

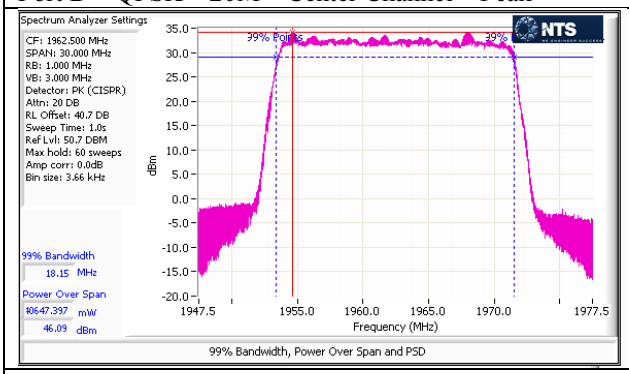


Port D – 64QAM – 15M – Center Channel – Average

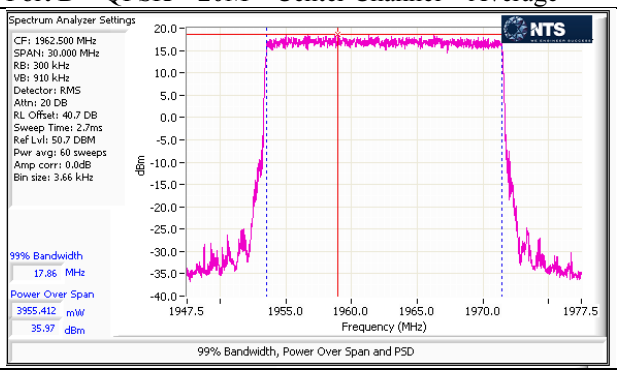


Port M – QPSK – 20M – Center Channel – Peak	Port M – QPSK – 20M – Center Channel – Average
	
Port M – 16QAM – 20M – Center Channel – Peak	Port M – 16QAM – 20M – Center Channel – Average
	
Port M – 64QAM – 20M – Center Channel – Peak	Port M – 64QAM – 20M – Center Channel – Average
	

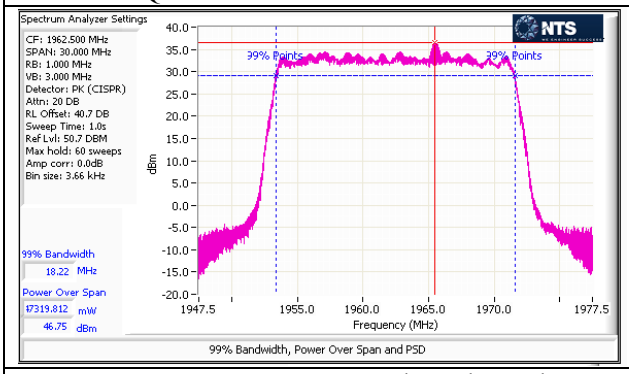
Port D – QPSK – 20M – Center Channel – Peak



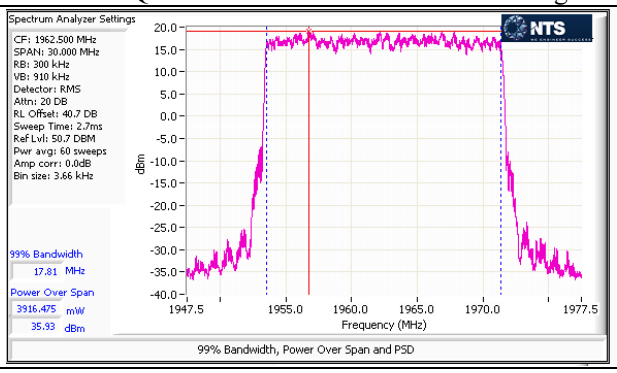
Port D – QPSK – 20M – Center Channel – Average



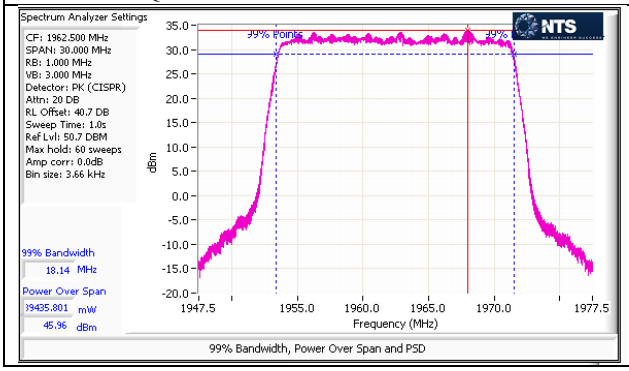
Port D – 16QAM – 20M – Center Channel – Peak



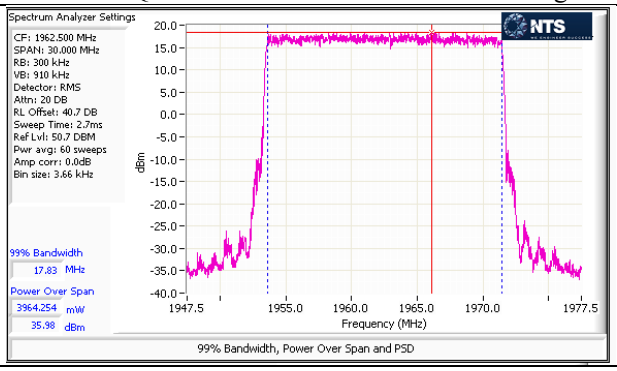
Port D – 16QAM – 20M – Center Channel – Average

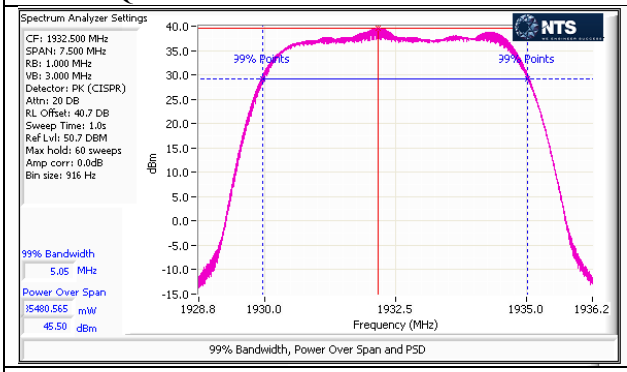
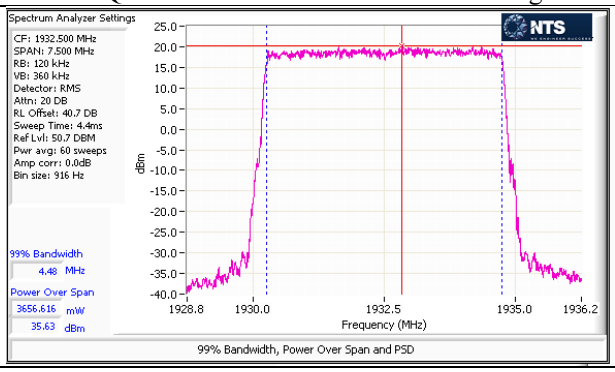
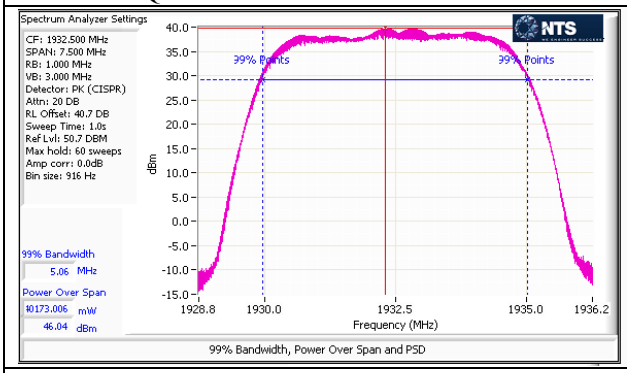
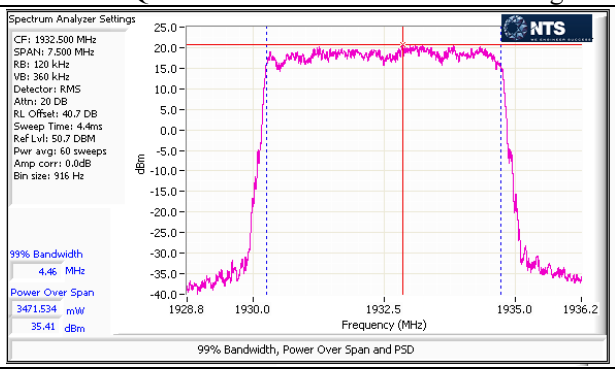
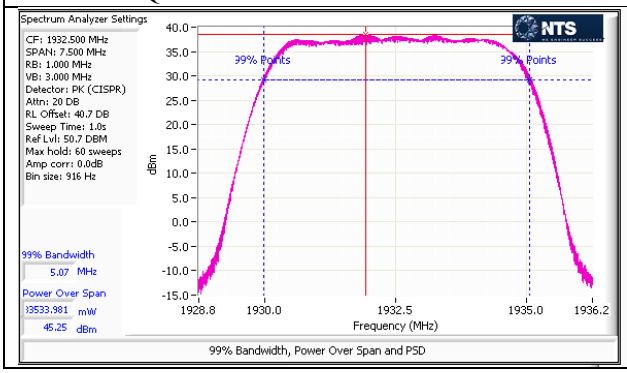
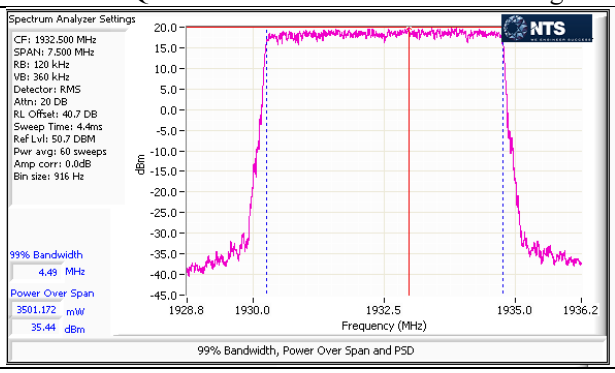


Port D – 64QAM – 20M – Center Channel – Peak

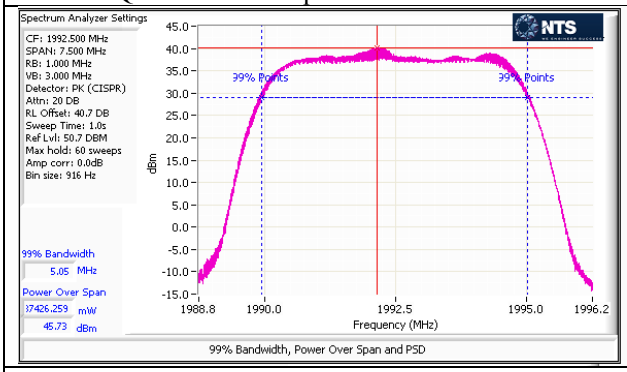


Port D – 64QAM – 20M – Center Channel – Average

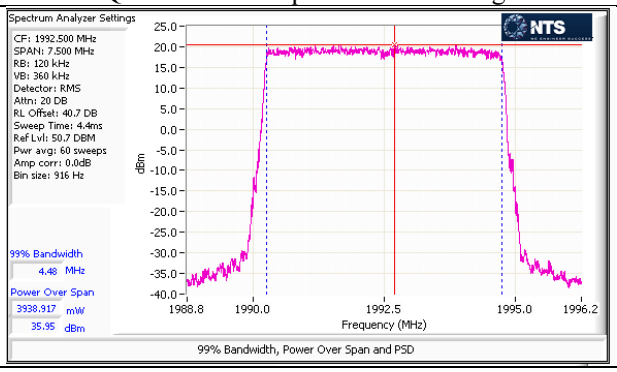


Port D – QPSK – 5M – Bottom Channel – Peak	Port D – QPSK – 5M – Bottom Channel – Average
	
Port D – 16QAM – 5M – Bottom Channel – Peak	Port D – 16QAM – 5M – Bottom Channel – Average
	
Port D – 64QAM – 5M – Bottom Channel – Peak	Port D – 64QAM – 5M – Bottom Channel – Average
	

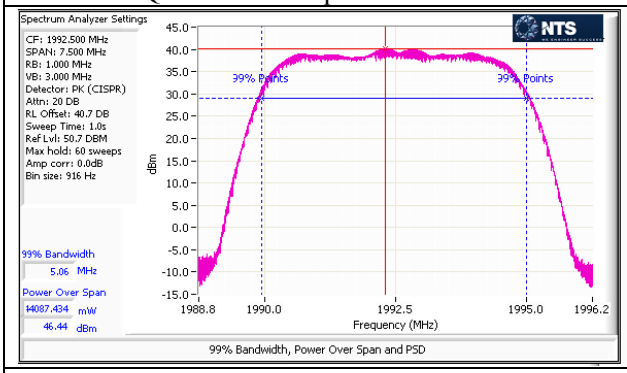
Port D – QPSK – 5M – Top Channel – Peak



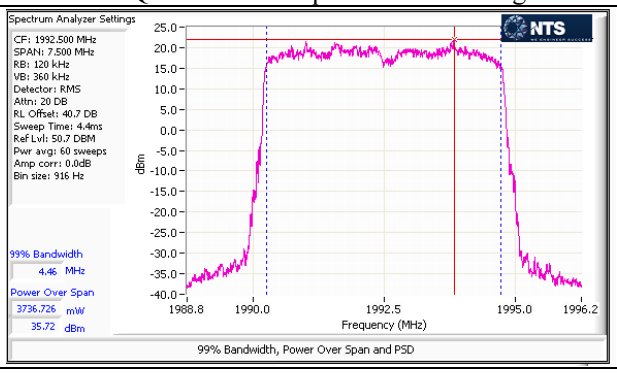
Port D – QPSK – 5M – Top Channel – Average



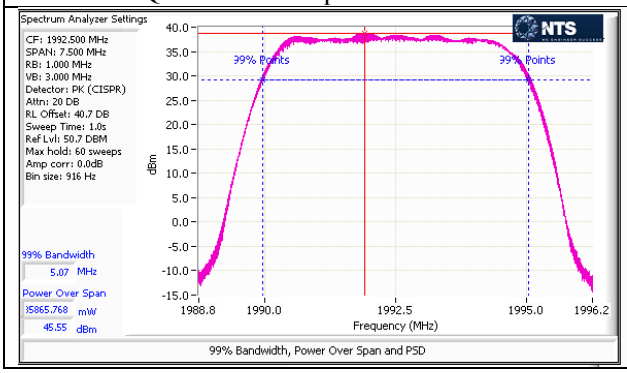
Port D – 16QAM – 5M – Top Channel – Peak



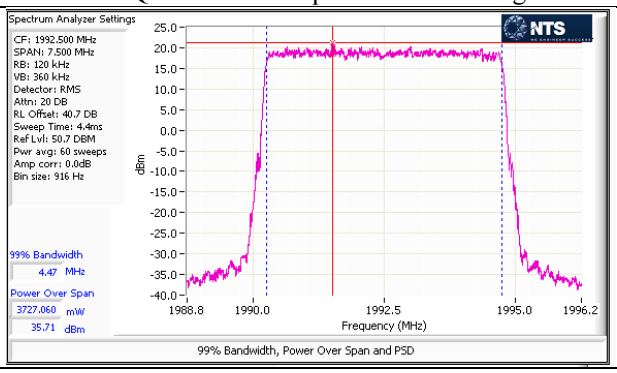
Port D – 16QAM – 5M – Top Channel – Average

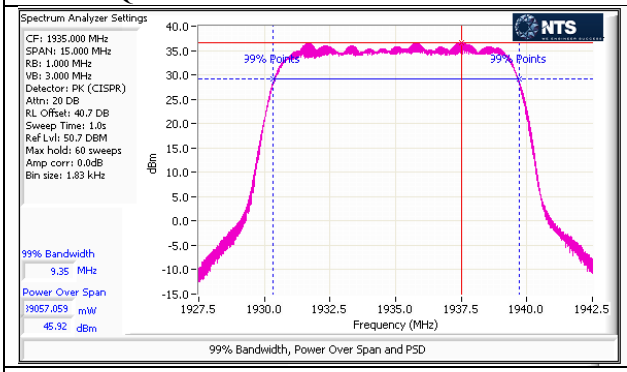
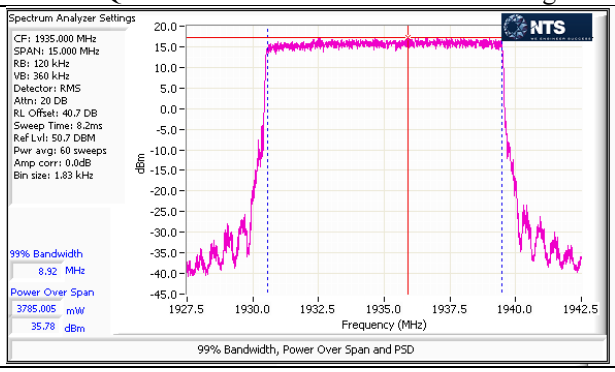
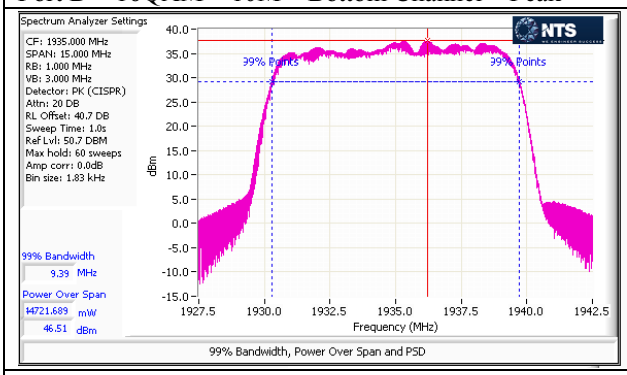
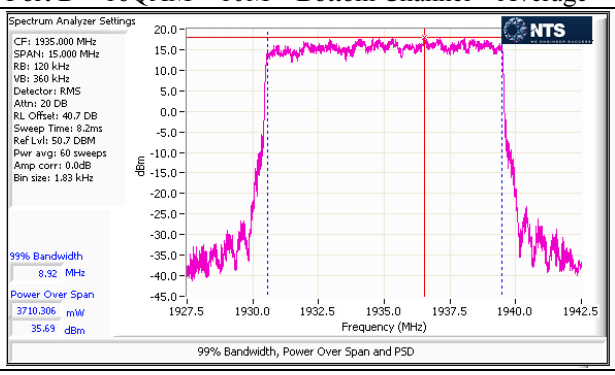
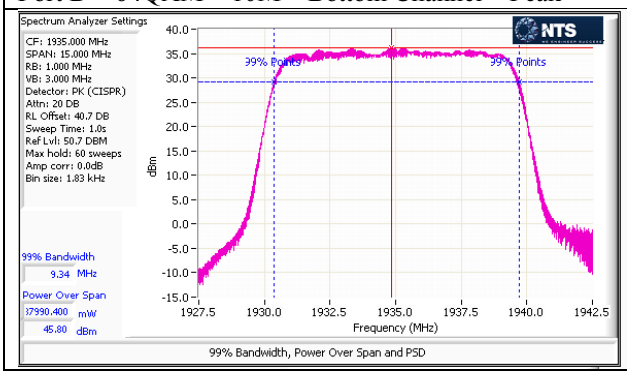
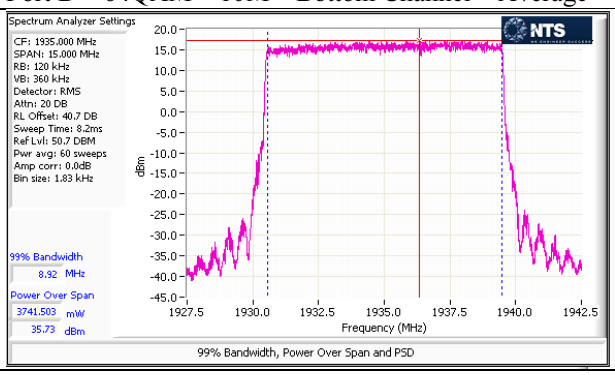


Port D – 64QAM – 5M – Top Channel – Peak

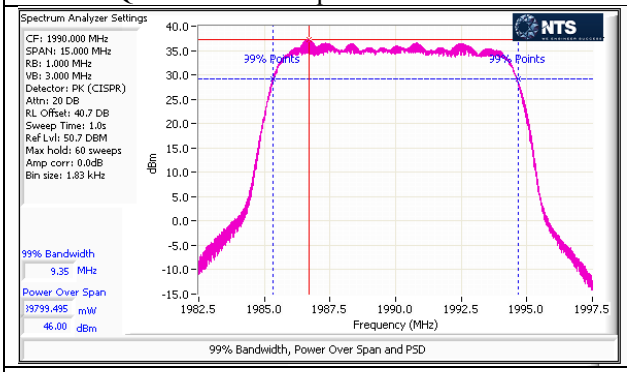


Port D – 64QAM – 5M – Top Channel – Average

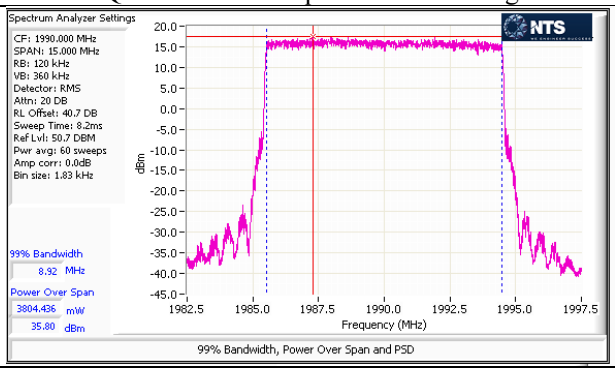


Port D – QPSK – 10M – Bottom Channel – Peak	Port D – QPSK – 10M – Bottom Channel – Average
	
Port D – 16QAM – 10M – Bottom Channel – Peak	Port D – 16QAM – 10M – Bottom Channel – Average
	
Port D – 64QAM – 10M – Bottom Channel – Peak	Port D – 64QAM – 10M – Bottom Channel – Average
	

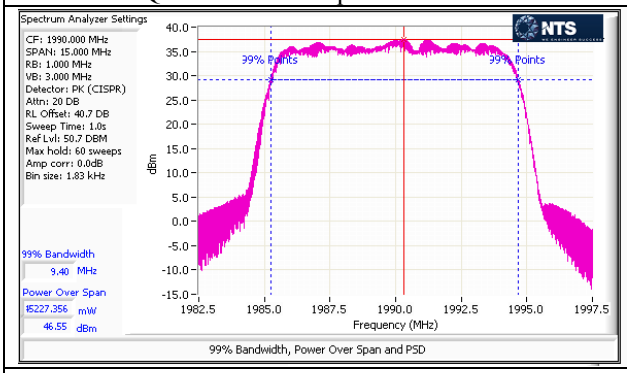
Port D – QPSK – 10M – Top Channel – Peak



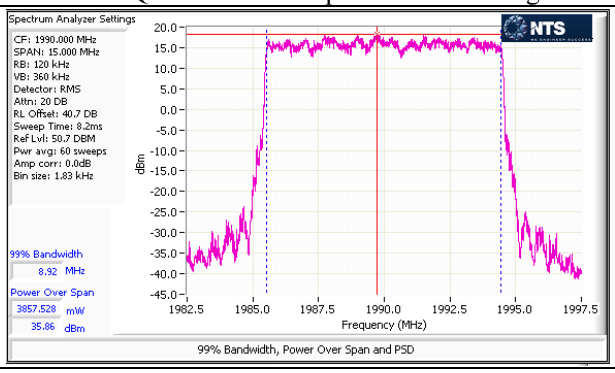
Port D – QPSK – 10M – Top Channel – Average



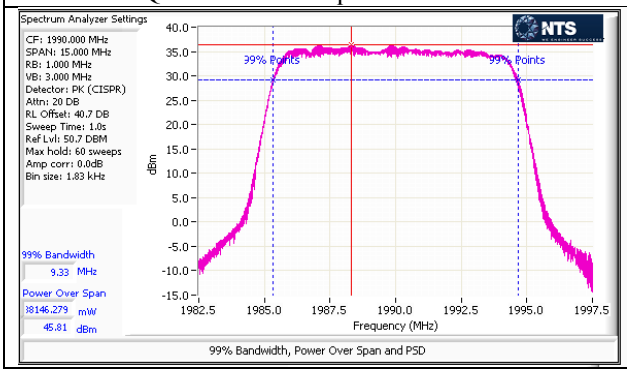
Port D – 16QAM – 10M – Top Channel – Peak



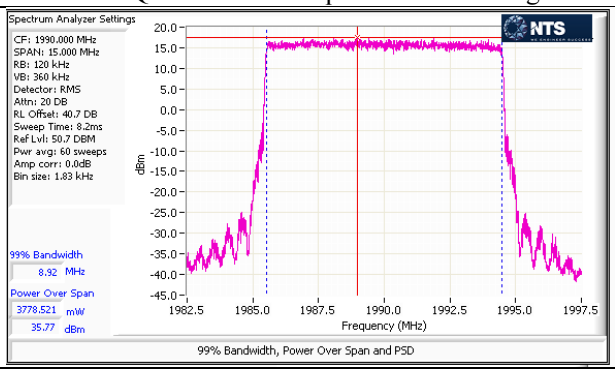
Port D – 16QAM – 10M – Top Channel – Average

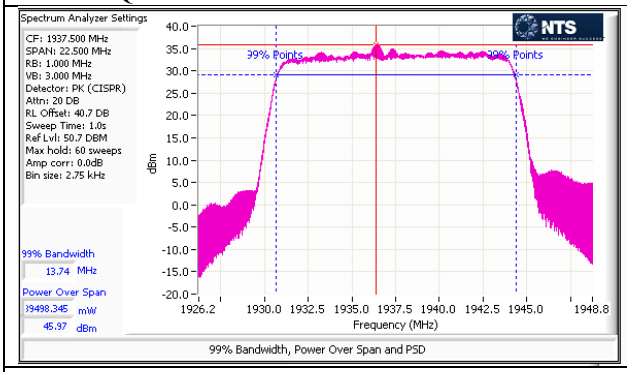
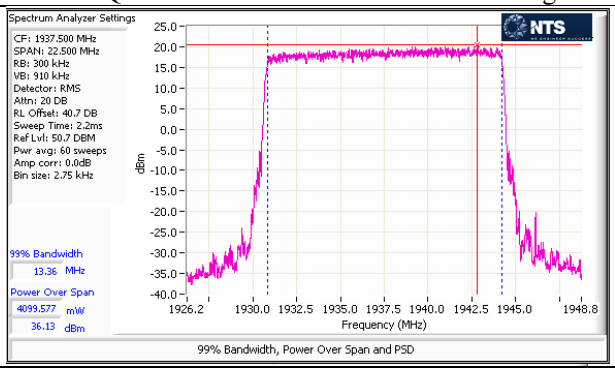
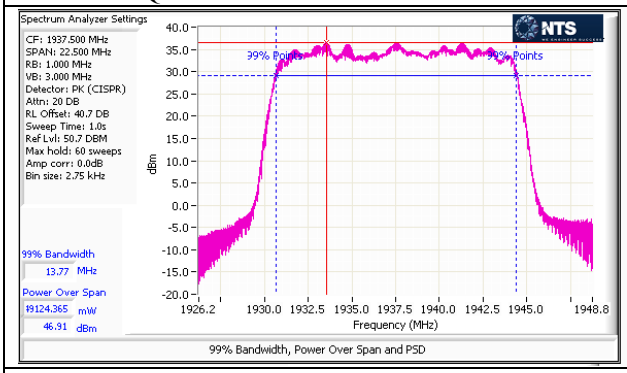
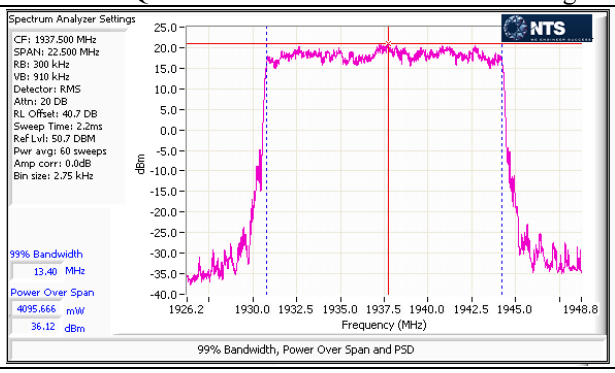
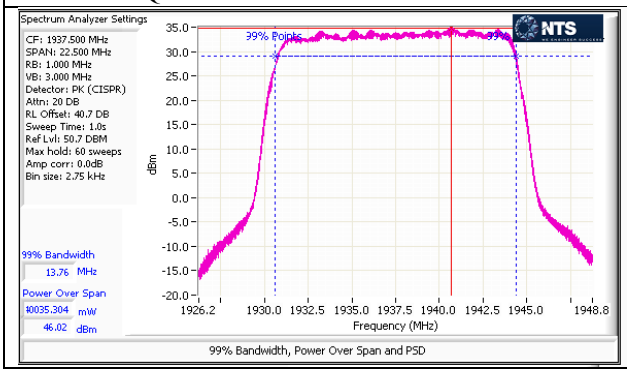
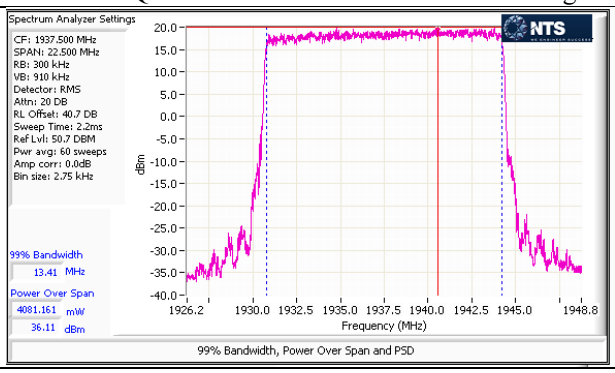


Port D – 64QAM – 10M – Top Channel – Peak

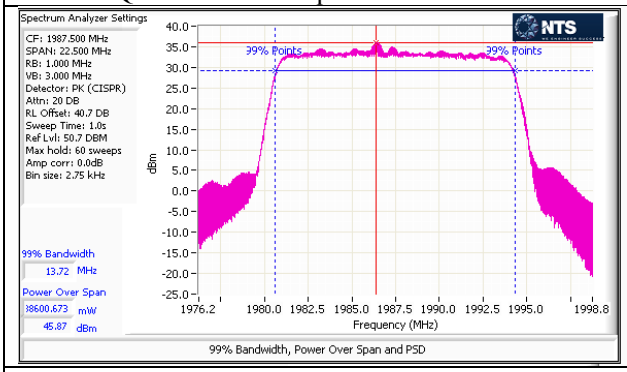


Port D – 64QAM – 10M – Top Channel – Average

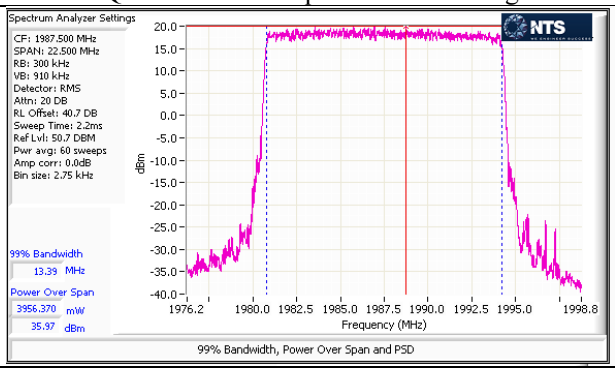


Port D – QPSK – 15M – Bottom Channel – Peak	Port D – QPSK – 15M – Bottom Channel – Average
	
Port D – 16QAM – 15M – Bottom Channel – Peak	Port D – 16QAM – 15M – Bottom Channel – Average
	
Port D – 64QAM – 15M – Bottom Channel – Peak	Port D – 64QAM – 15M – Bottom Channel – Average
	

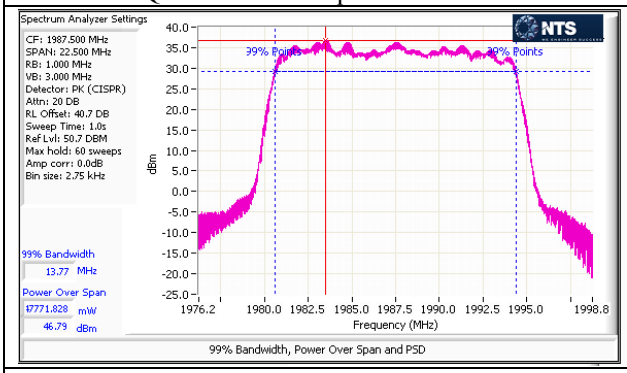
Port D – QPSK – 15M – Top Channel – Peak



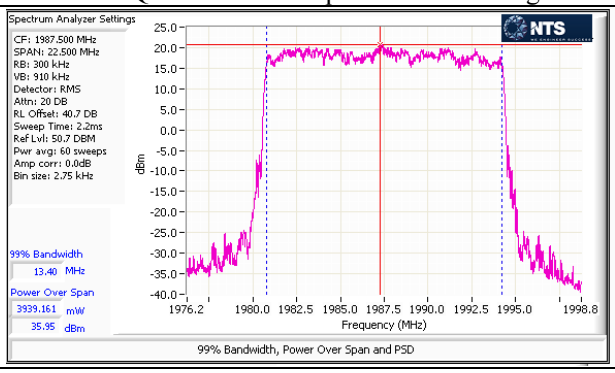
Port D – QPSK – 15M – Top Channel – Average



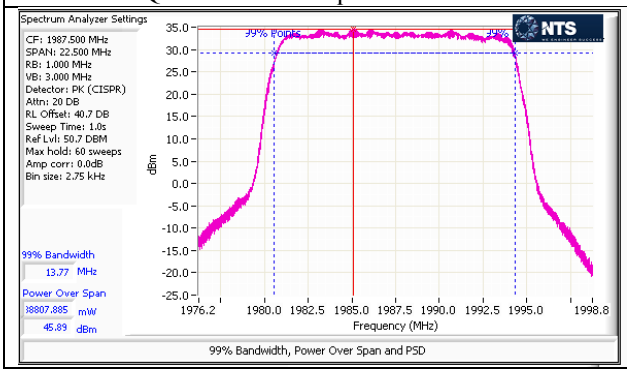
Port D – 16QAM – 15M – Top Channel – Peak



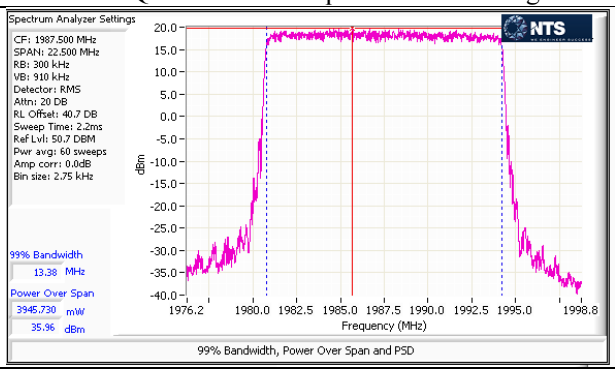
Port D – 16QAM – 15M – Top Channel – Average



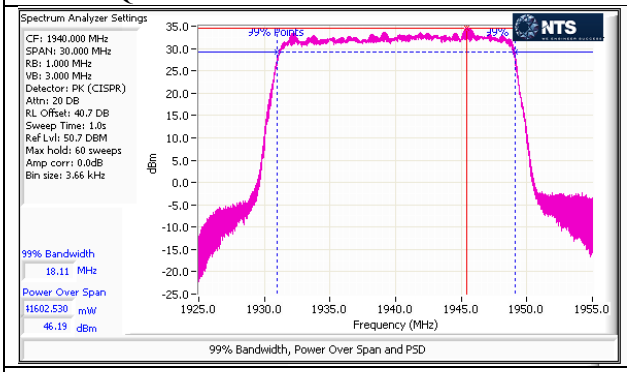
Port D – 64QAM – 15M – Top Channel – Peak



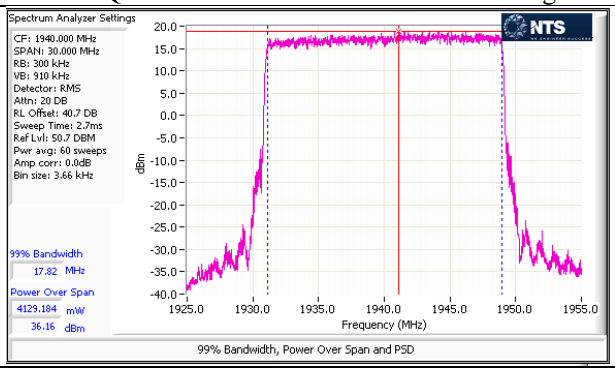
Port D – 64QAM – 15M – Top Channel – Average



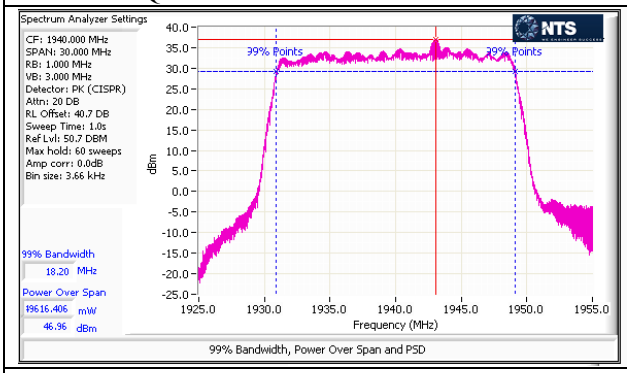
Port D – QPSK – 20M – Bottom Channel – Peak



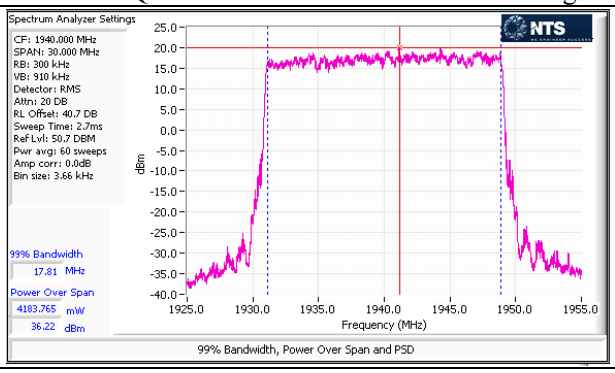
Port D – QPSK – 20M – Bottom Channel – Average



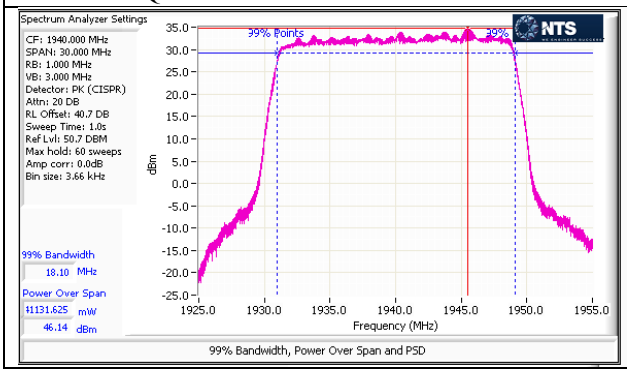
Port D – 16QAM – 20M – Bottom Channel – Peak



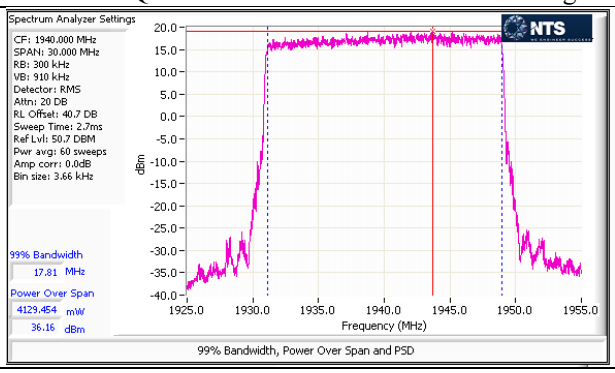
Port D – 16QAM – 20M – Bottom Channel – Average



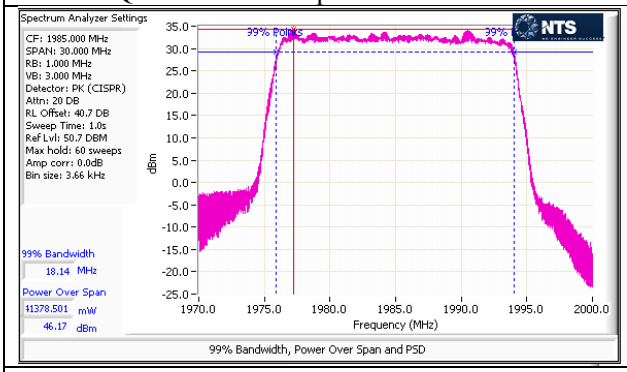
Port D – 64QAM – 20M – Bottom Channel – Peak



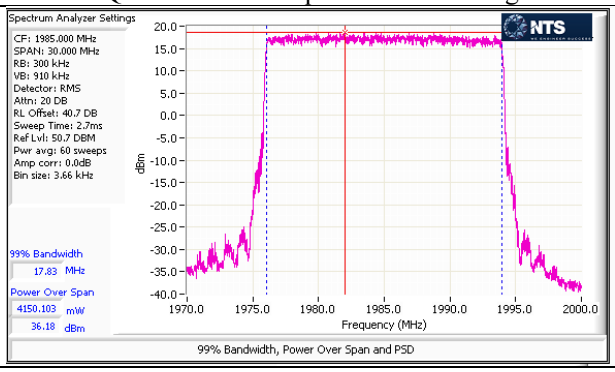
Port D – 64QAM – 20M – Bottom Channel – Average



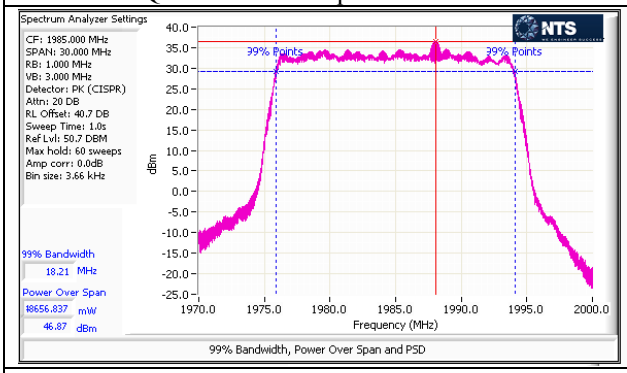
Port D – QPSK – 20M – Top Channel – Peak



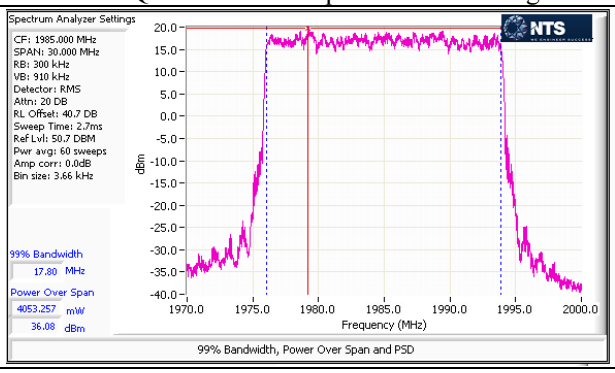
Port D – QPSK – 20M – Top Channel – Average



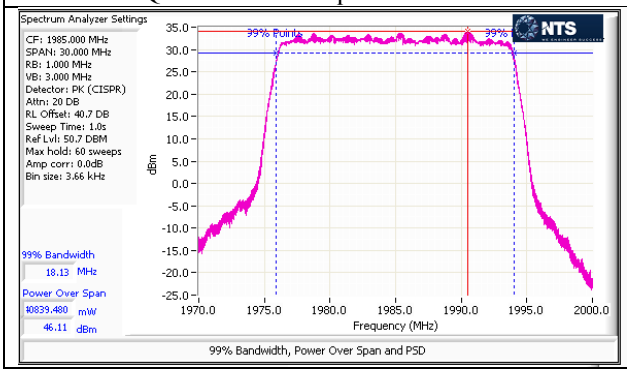
Port D – 16QAM – 20M – Top Channel – Peak



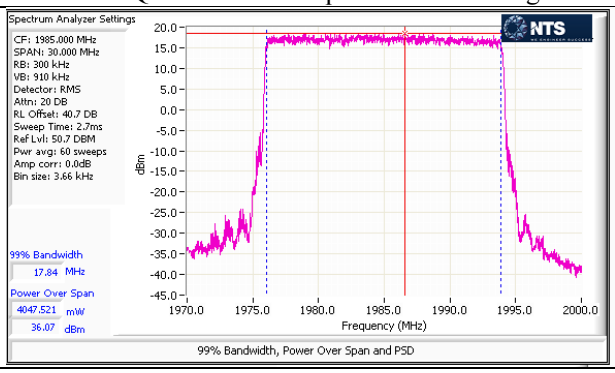
Port D – 16QAM – 20M – Top Channel – Average



Port D – 64QAM – 20M – Top Channel – Peak



Port D – 64QAM – 20M – Top Channel – Average



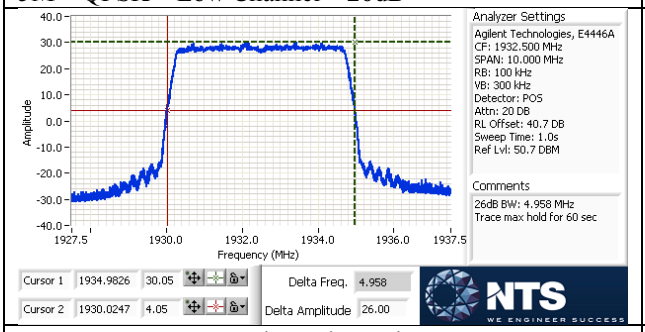
Emission Bandwidths (26dB and 99%)

Emissions bandwidths were measured on bottom and top channels for all modulations and bandwidth modes on Port D and results presented below. Highest emission bandwidths for each channel bandwidth mode are marked in bold.

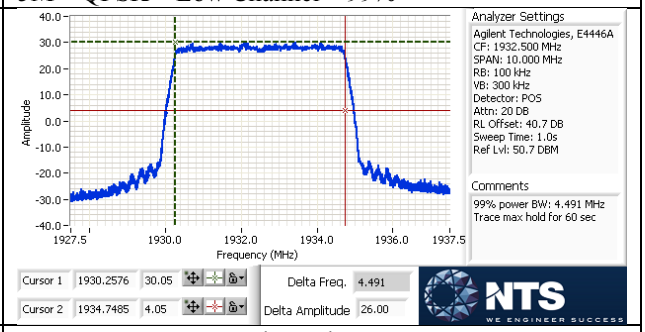
	LTE - QPSK				LTE - 16QAM				LTE - 64QAM			
	Low		High		Low		High		Low		High	
	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)	26dB (MHz)	99% (MHz)
5M	4.958	4.491	4.96	4.492	4.936	4.486	4.926	4.482	**4.99**	4.508	4.987	**4.514**
10M	9.938	8.994	9.933	9.001	9.913	9.014	9.948	**9.016**	9.979	9.001	**9.994**	9.004
15M	14.896	13.491	14.866	13.491	14.778	13.506	14.753	13.499	14.877	13.499	**14.929**	**13.506**
20M	**19.919**	17.969	19.875	17.974	19.7	18.013	19.788	**18.022**	19.875	17.949	19.9	17.979

Corresponding plots included on the following pages.

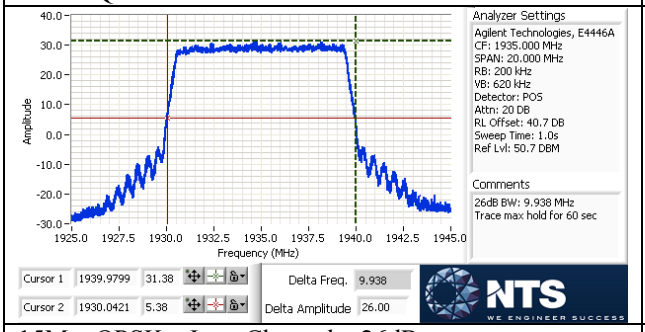
5M – QPSK – Low Channel – 26dB



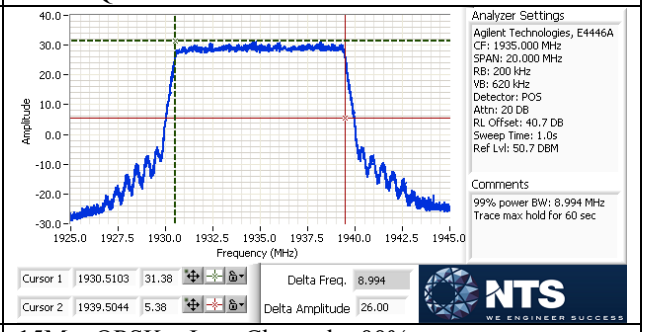
5M – QPSK – Low Channel – 99%



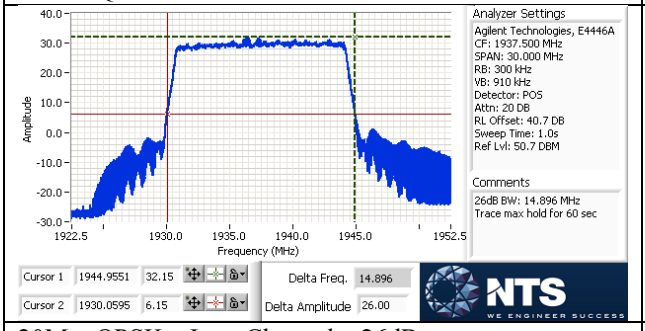
10M – QPSK – Low Channel – 26dB



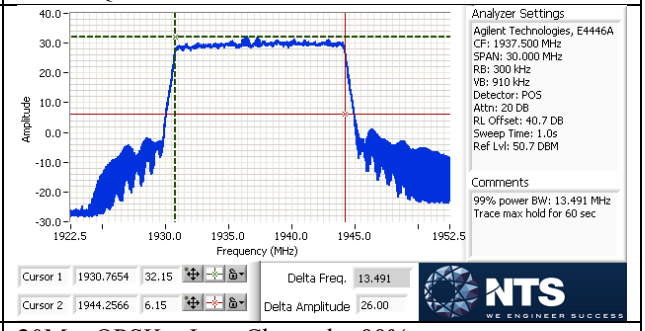
10M – QPSK – Low Channel – 99%



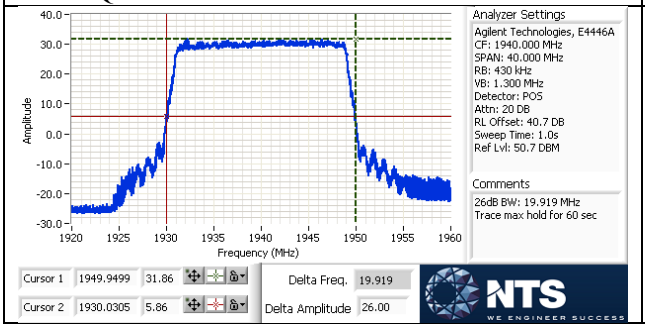
15M – QPSK – Low Channel – 26dB



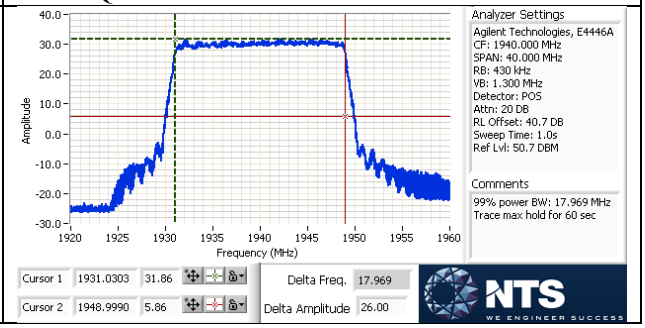
15M – QPSK – Low Channel – 99%



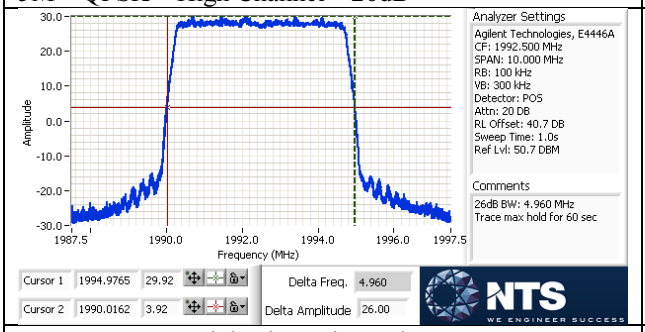
20M – QPSK – Low Channel – 26dB



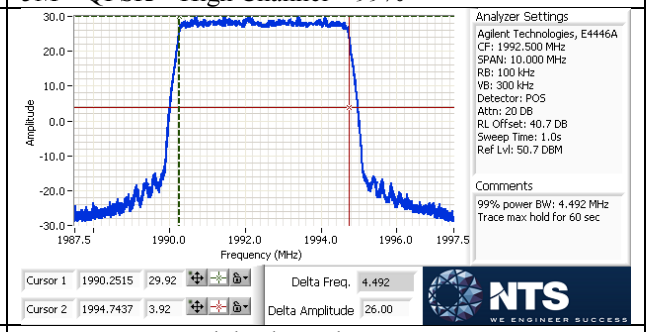
20M – QPSK – Low Channel – 99%



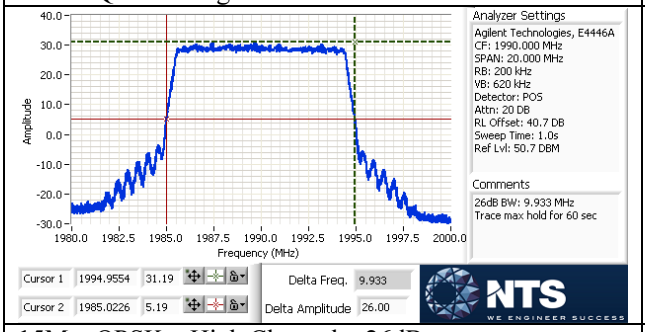
5M – QPSK – High Channel – 26dB



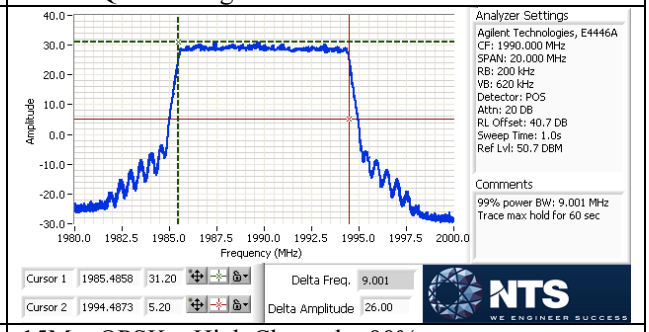
5M – QPSK – High Channel – 99%



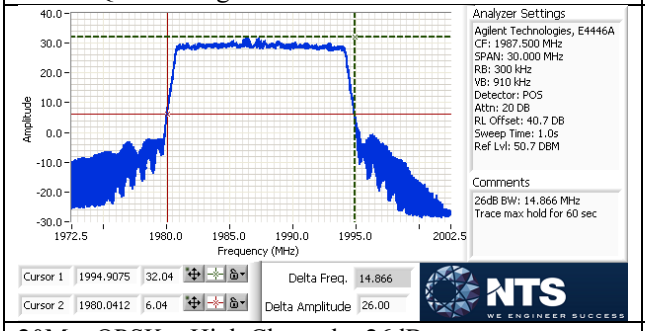
10M – QPSK – High Channel – 26dB



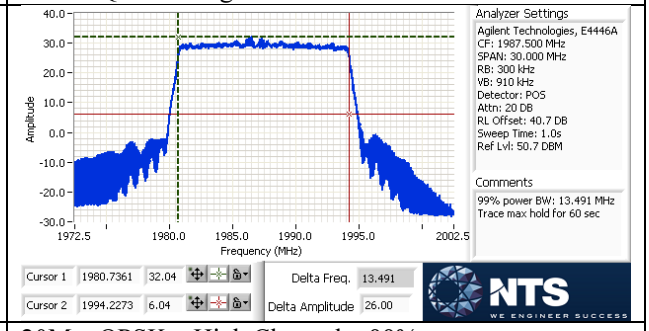
10M – QPSK – High Channel – 99%



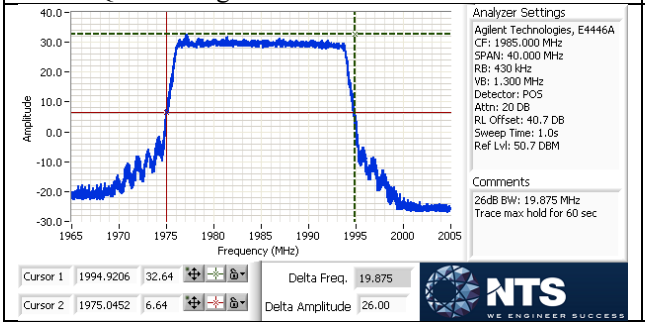
15M – QPSK – High Channel – 26dB



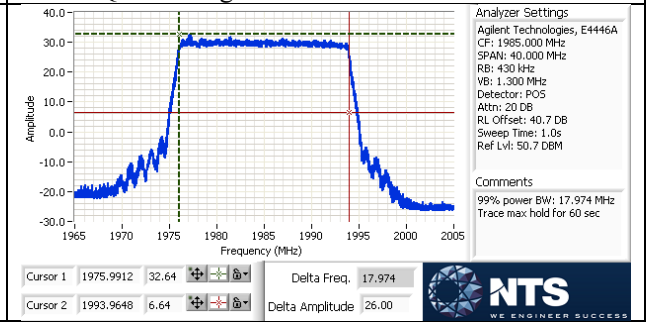
15M – QPSK – High Channel – 99%



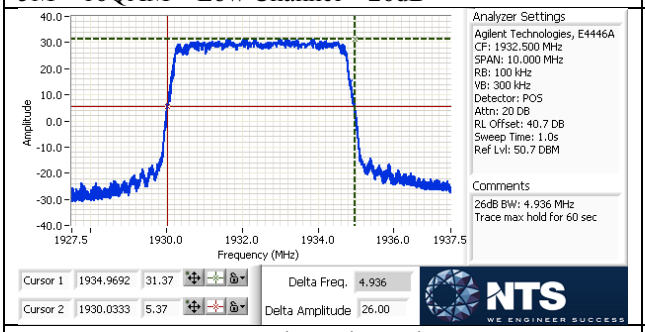
20M – QPSK – High Channel – 26dB



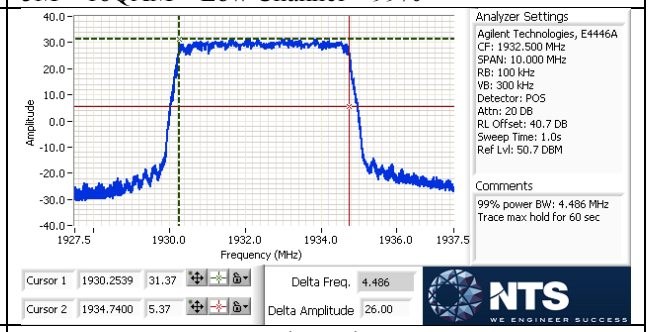
20M – QPSK – High Channel – 99%



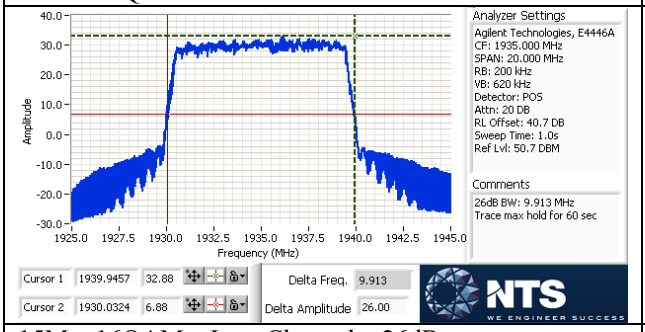
5M – 16QAM – Low Channel – 26dB



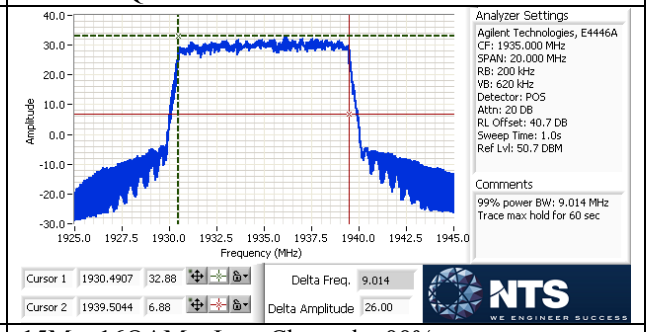
5M – 16QAM – Low Channel – 99%



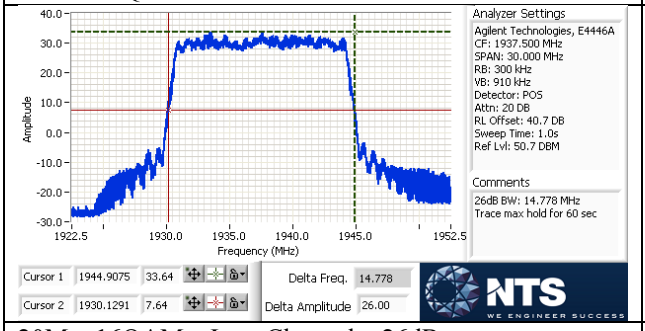
10M – 16QAM – Low Channel – 26dB



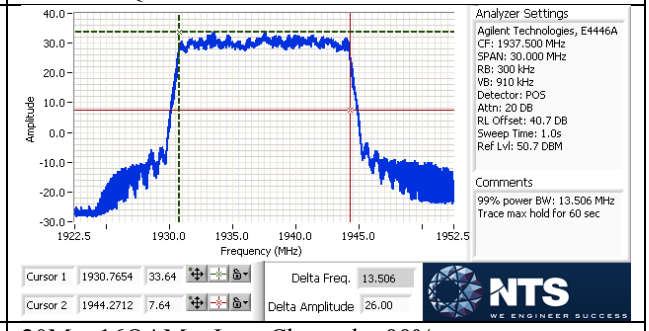
10M – 16QAM – Low Channel – 99%



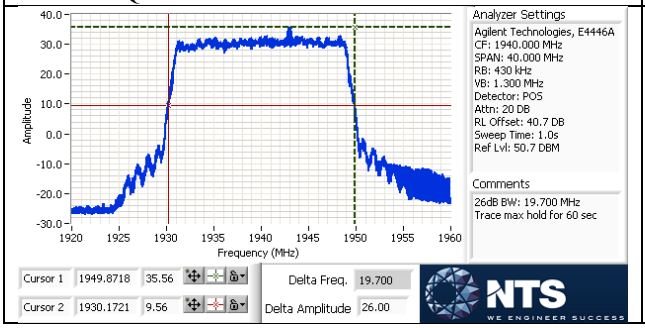
15M – 16QAM – Low Channel – 26dB



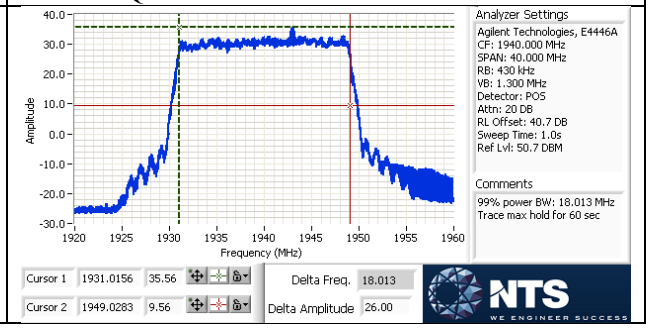
15M – 16QAM – Low Channel – 99%



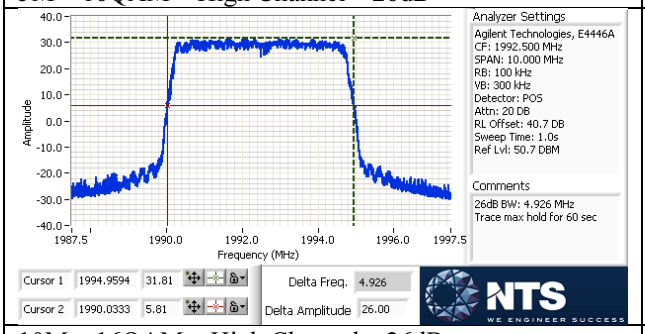
20M – 16QAM – Low Channel – 26dB



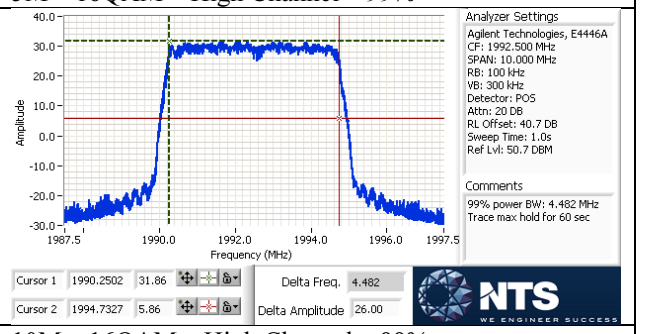
20M – 16QAM – Low Channel – 99%



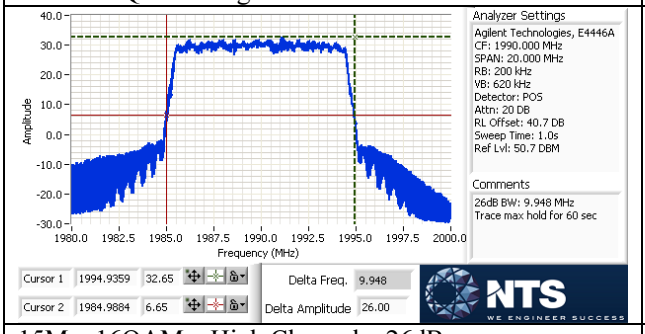
5M – 16QAM – High Channel – 26dB



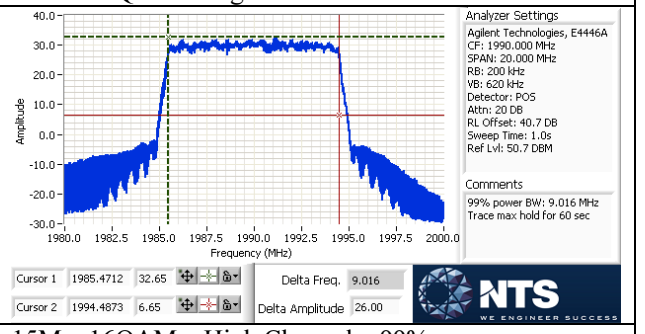
5M – 16QAM – High Channel – 99%



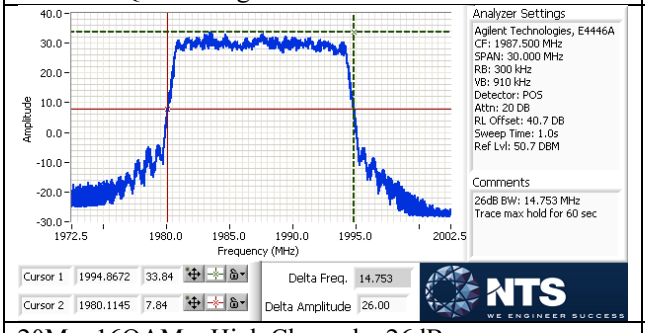
10M – 16QAM – High Channel – 26dB



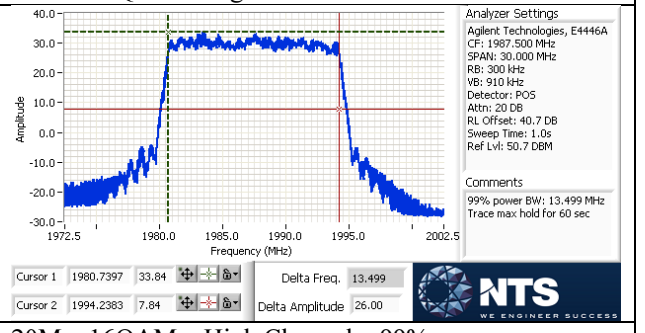
10M – 16QAM – High Channel – 99%



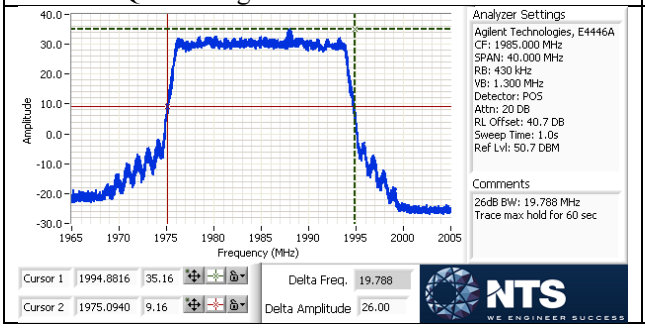
15M – 16QAM – High Channel – 26dB



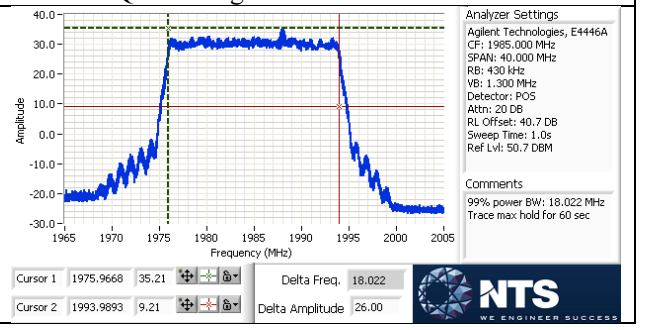
15M – 16QAM – High Channel – 99%



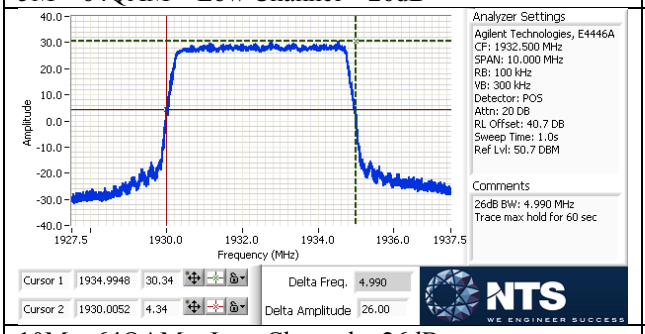
20M – 16QAM – High Channel – 26dB



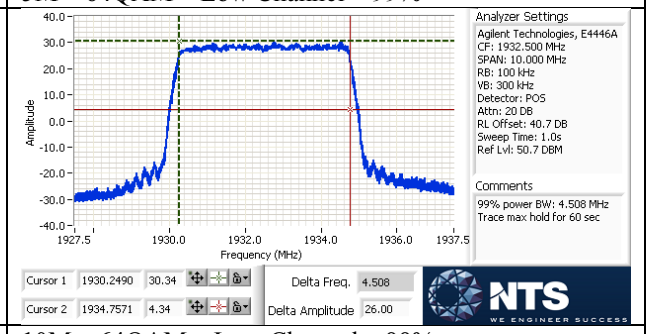
20M – 16QAM – High Channel – 99%



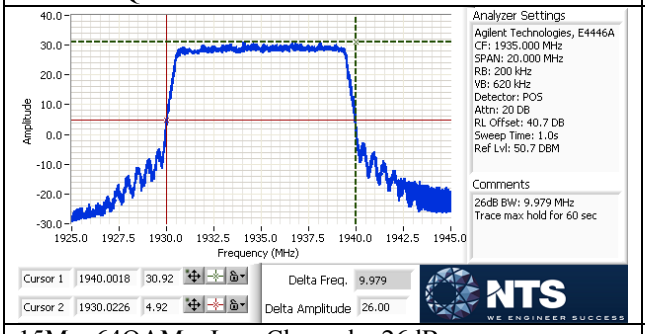
5M – 64QAM – Low Channel – 26dB



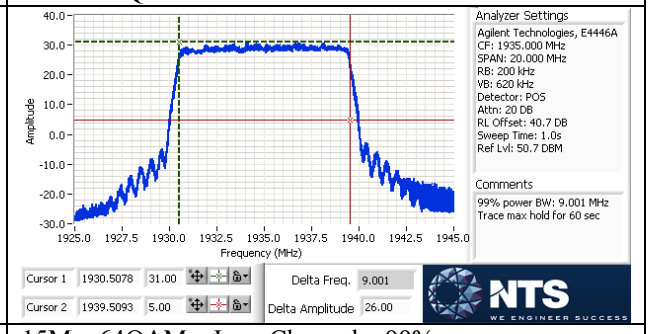
5M – 64QAM – Low Channel – 99%



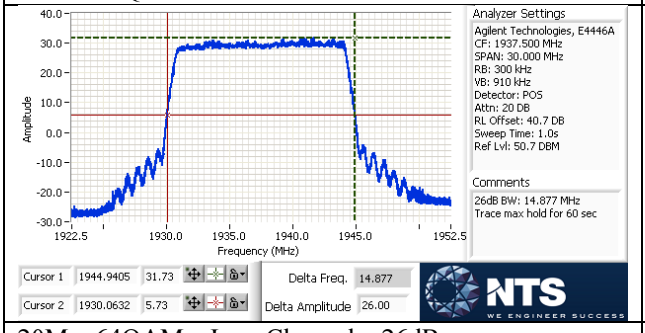
10M – 64QAM – Low Channel – 26dB



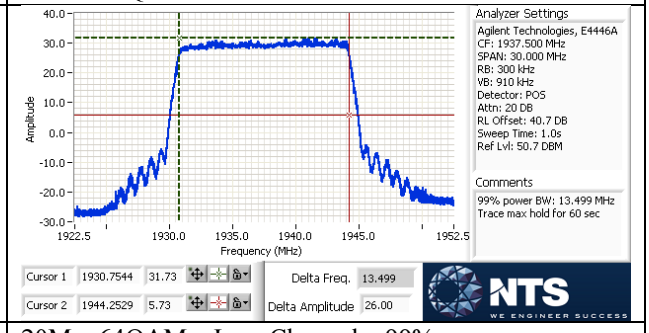
10M – 64QAM – Low Channel – 99%



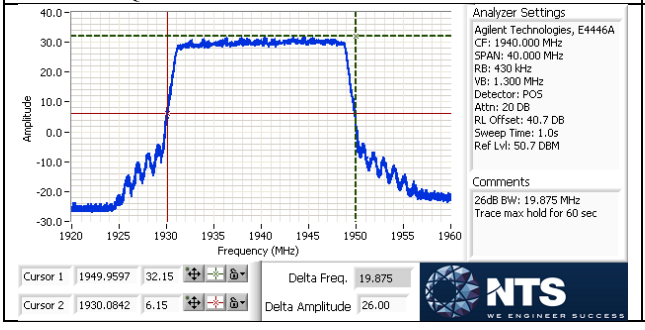
15M – 64QAM – Low Channel – 26dB



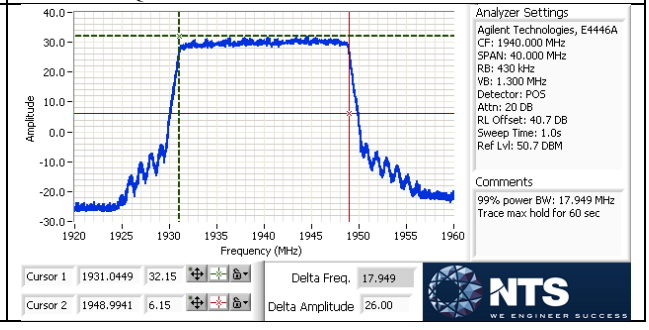
15M – 64QAM – Low Channel – 99%



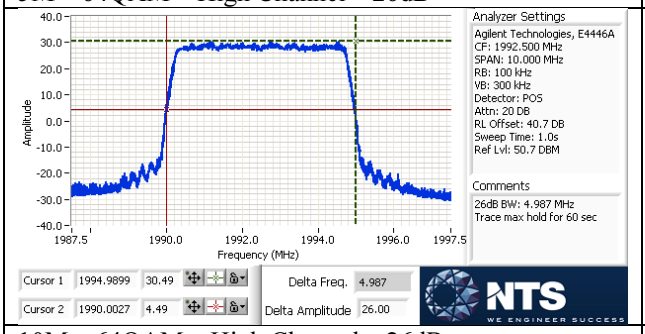
20M – 64QAM – Low Channel – 26dB



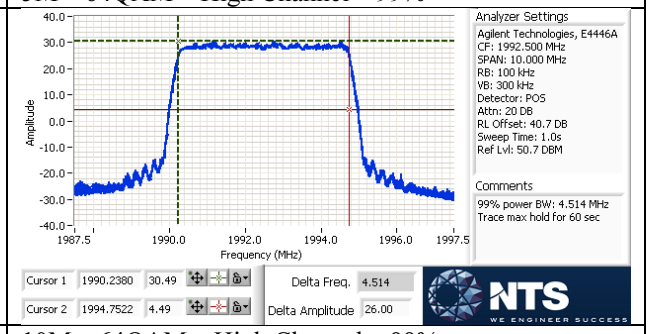
20M – 64QAM – Low Channel – 99%



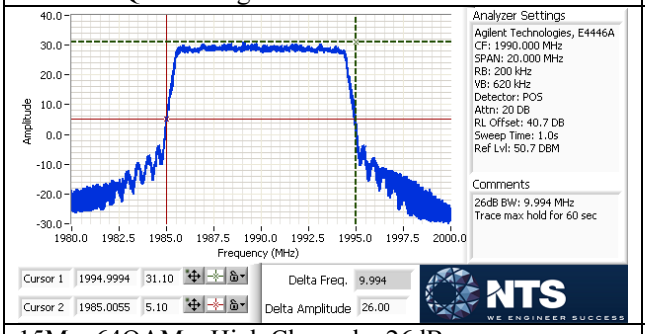
5M – 64QAM – High Channel – 26dB



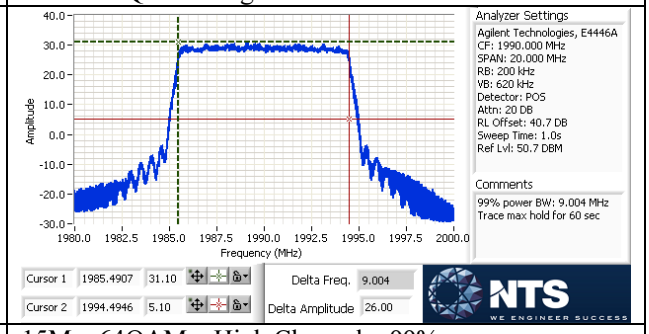
5M – 64QAM – High Channel – 99%



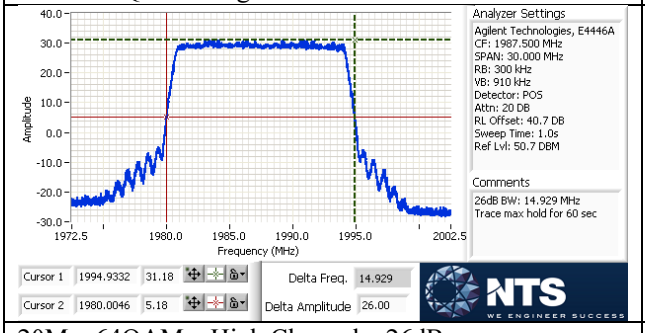
10M – 64QAM – High Channel – 26dB



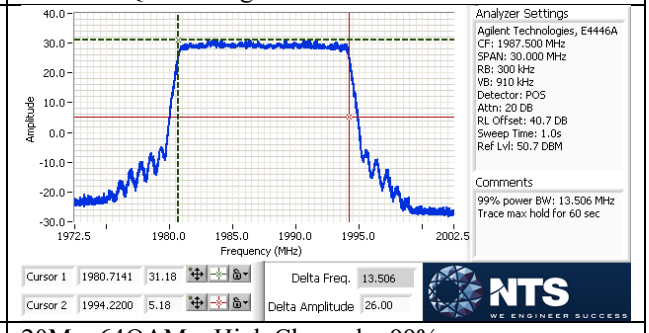
10M – 64QAM – High Channel – 99%



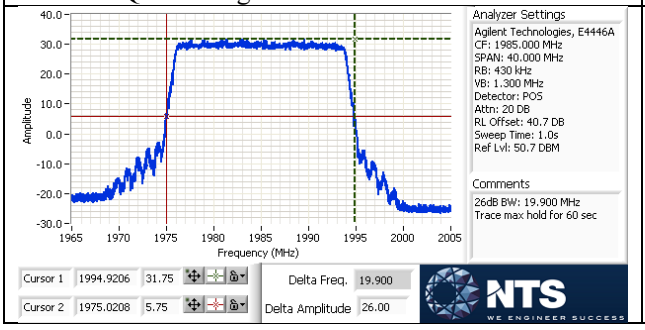
15M – 64QAM – High Channel – 26dB



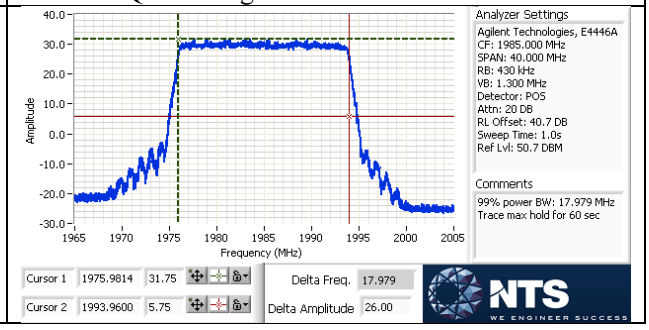
15M – 64QAM – High Channel – 99%



20M – 64QAM – High Channel – 26dB



20M – 64QAM – High Channel – 99%



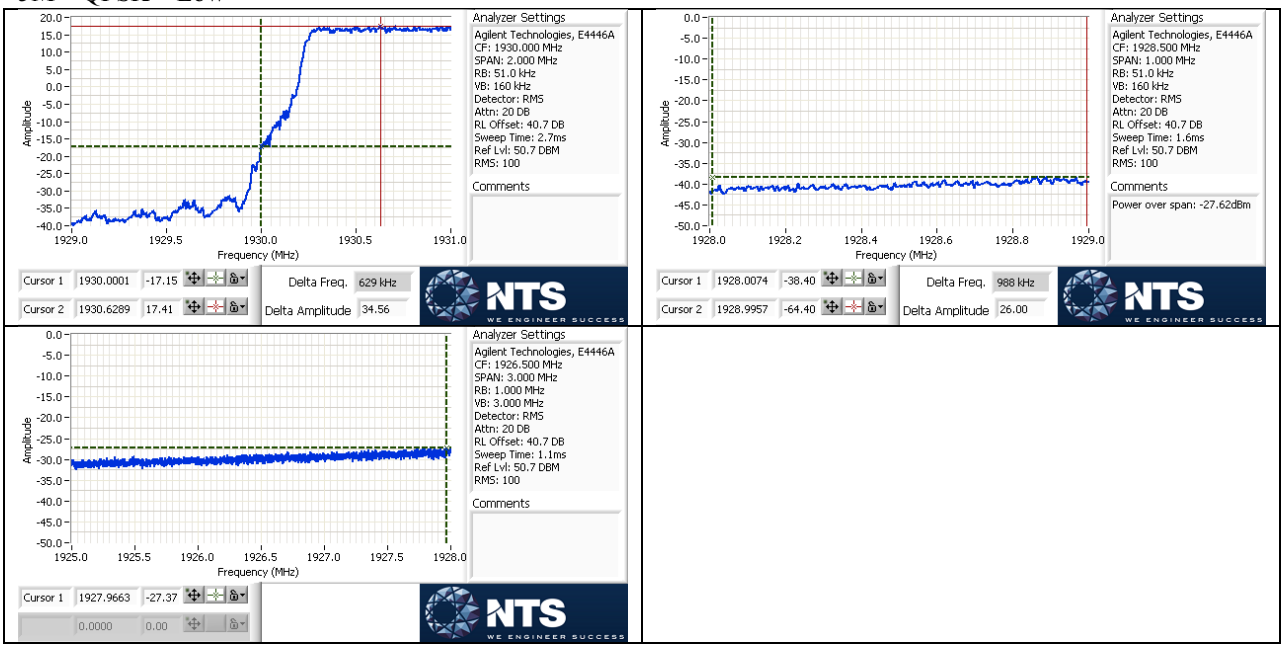
Antenna Port Conducted Bandedge

Tests performed at Port D on lowest and highest channels for all modulations and channel bandwidth modes. Due to 2x2 MIMO operation, limit is -16.02dBm (-13dBm – 10*log(2)) per FCC KDB 662911D01 v02r01. Total path loss 40.7dB accounted in via reference level offset to the spectrum analyzer.

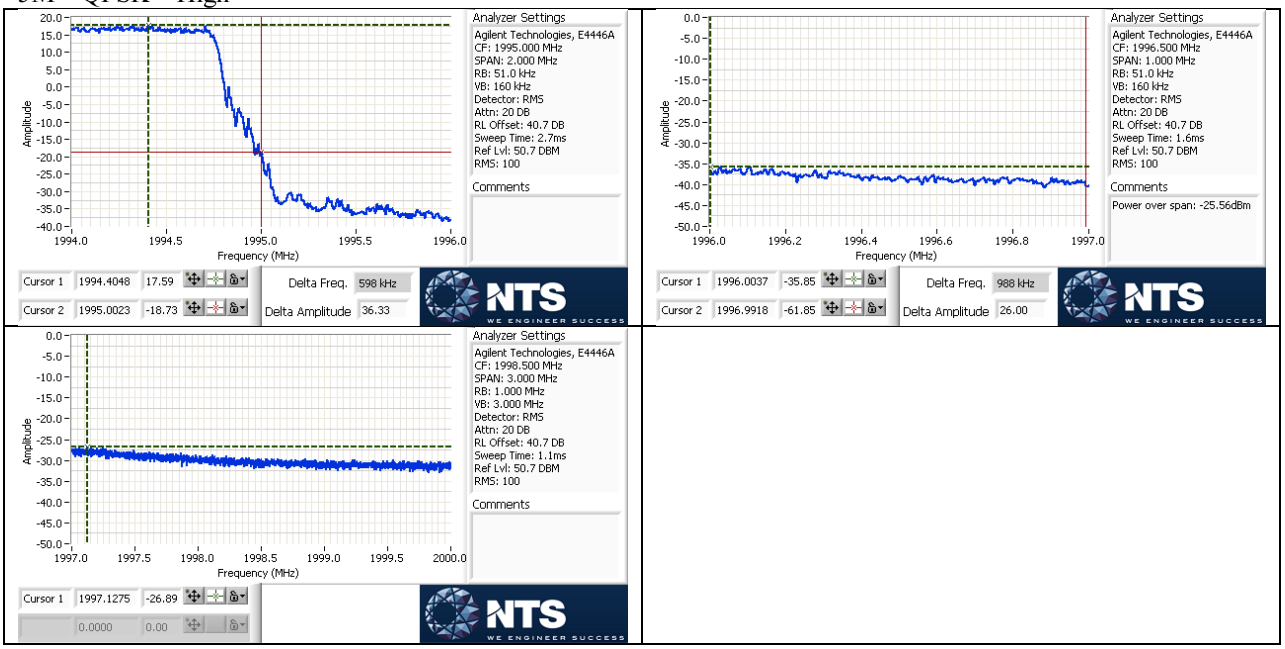
	QPSK		16QAM		64QAM	
	Low (dBm)	High (dBm)	Low (dBm)	High (dBm)	Low (dBm)	High (dBm)
5M	-17.15	-18.73	-19.65	-17.67	-18.52	-17.07
10M	-18.38	-17.04	-19.45	-18.52	-18.32	-17.9
15M	-17.87	-20.04	-19.58	-18.88	-19.49	-20.15
20M	-19.81	-19.51	-18.6	-19.23	-19.36	-19.83

All corresponding plots are included on the following pages.

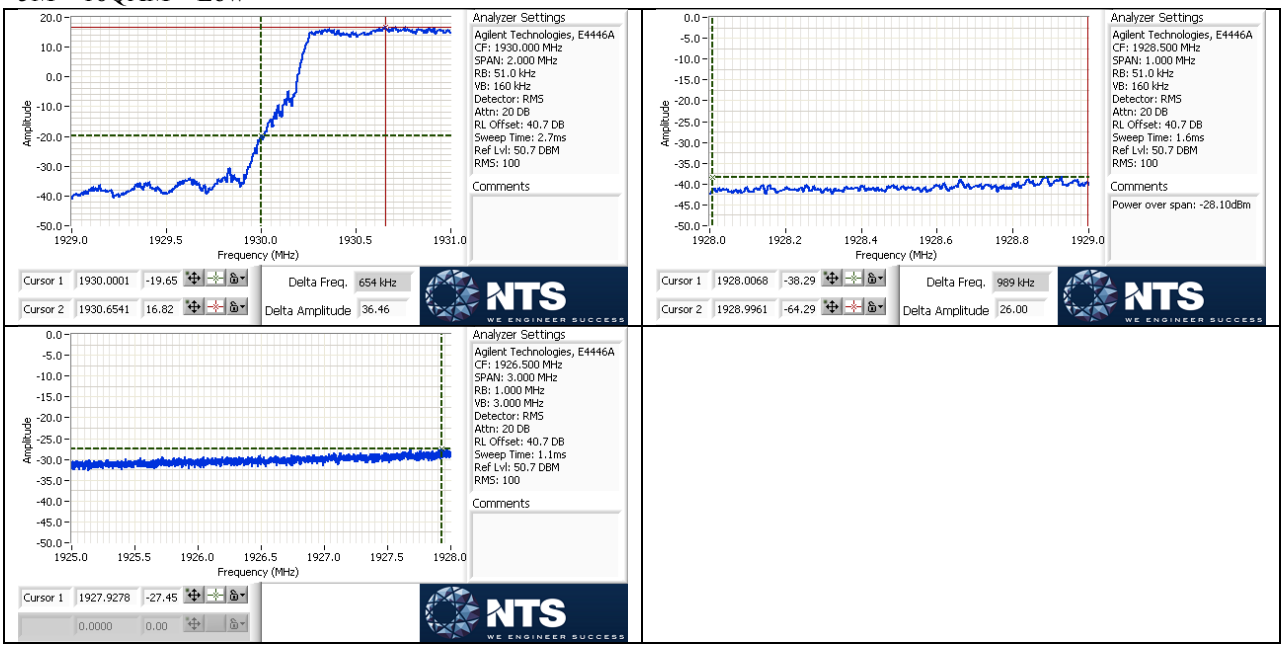
5M – QPSK – Low



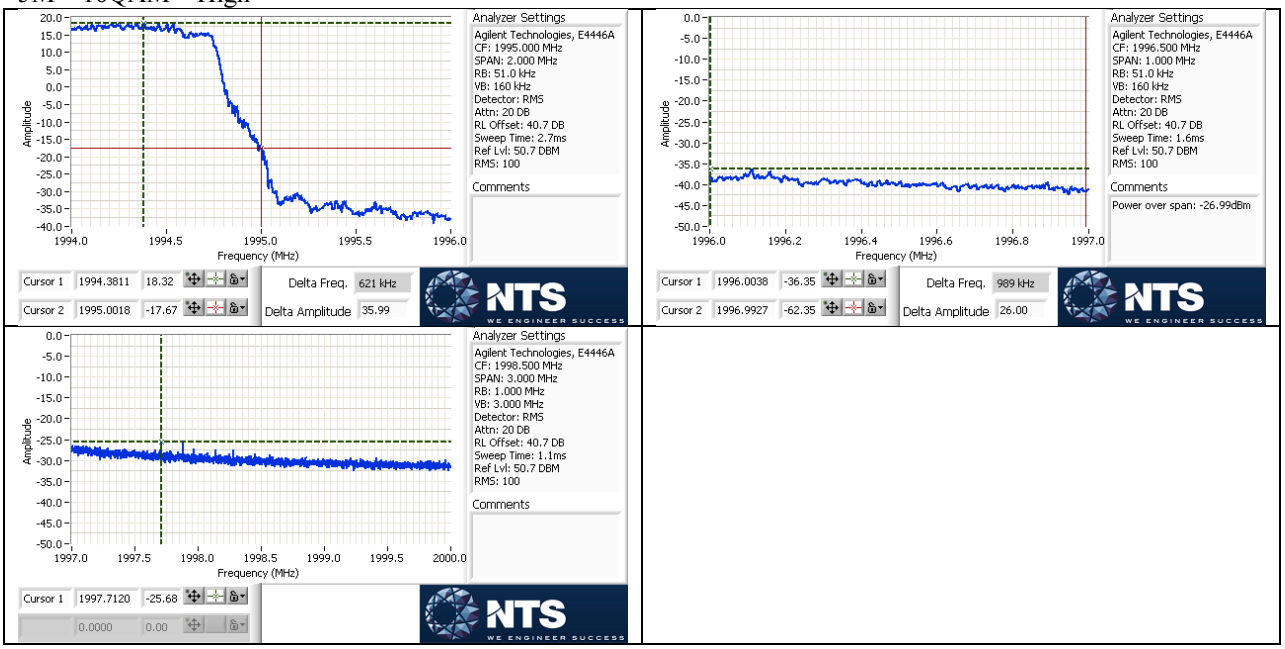
5M – QPSK – High



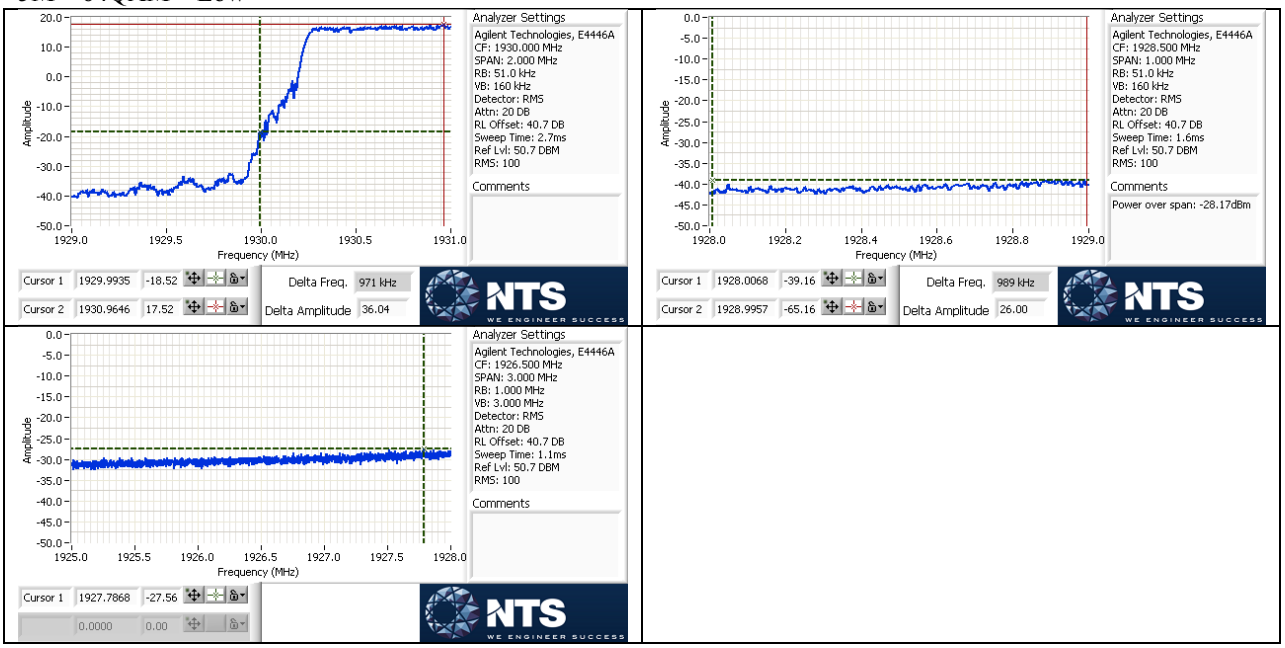
5M – 16QAM – Low



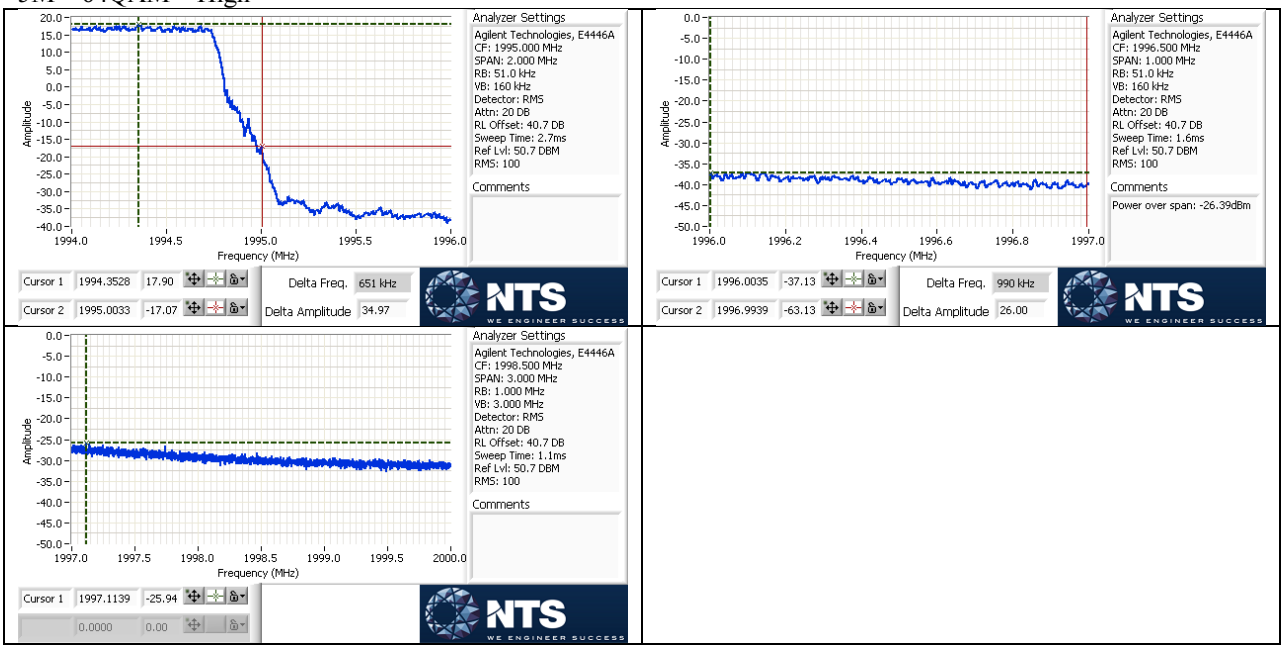
5M – 16QAM – High



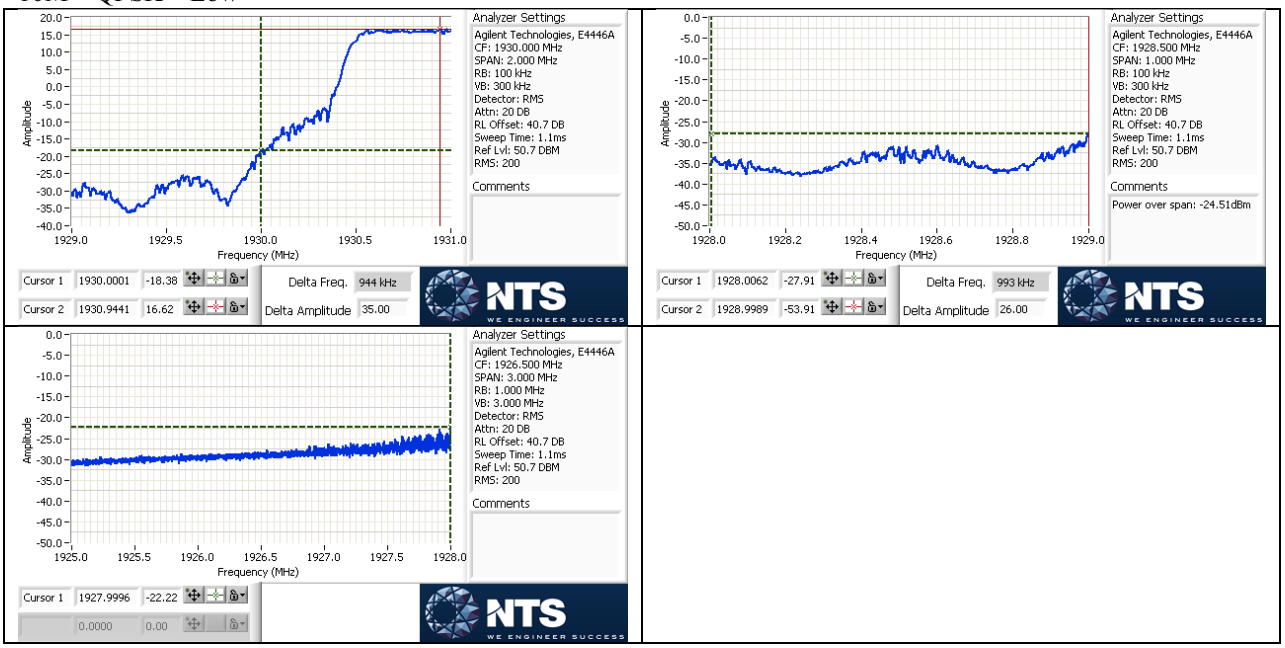
5M – 64QAM – Low



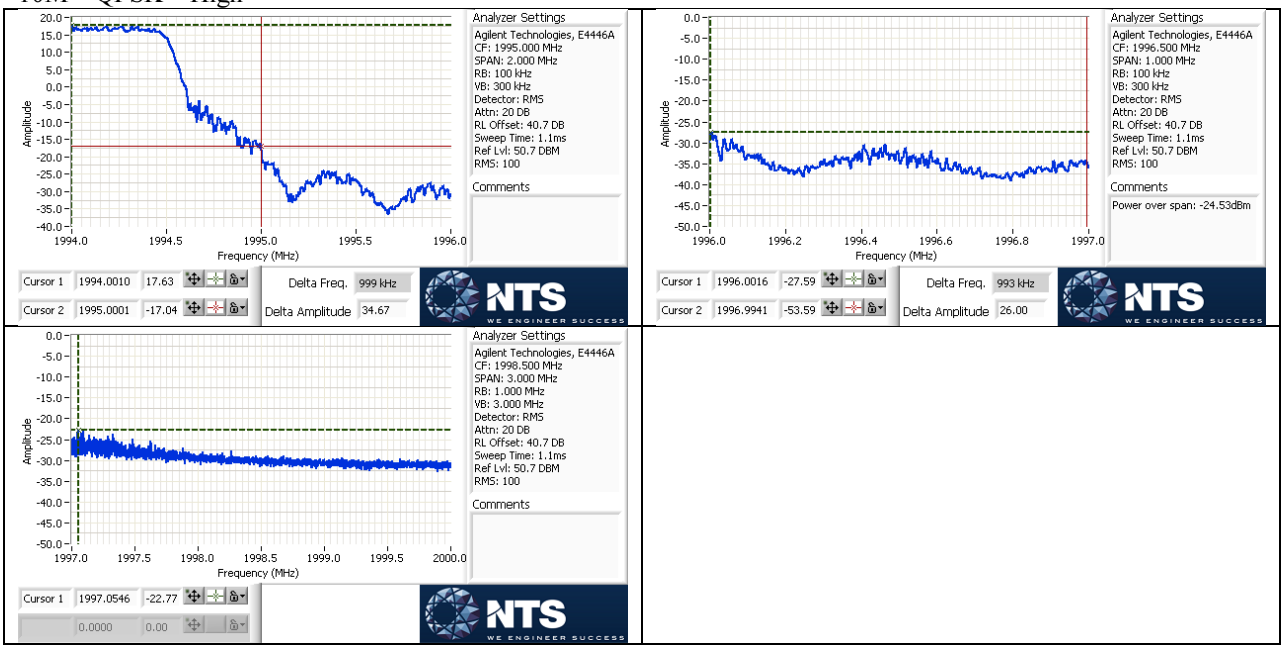
5M – 64QAM – High



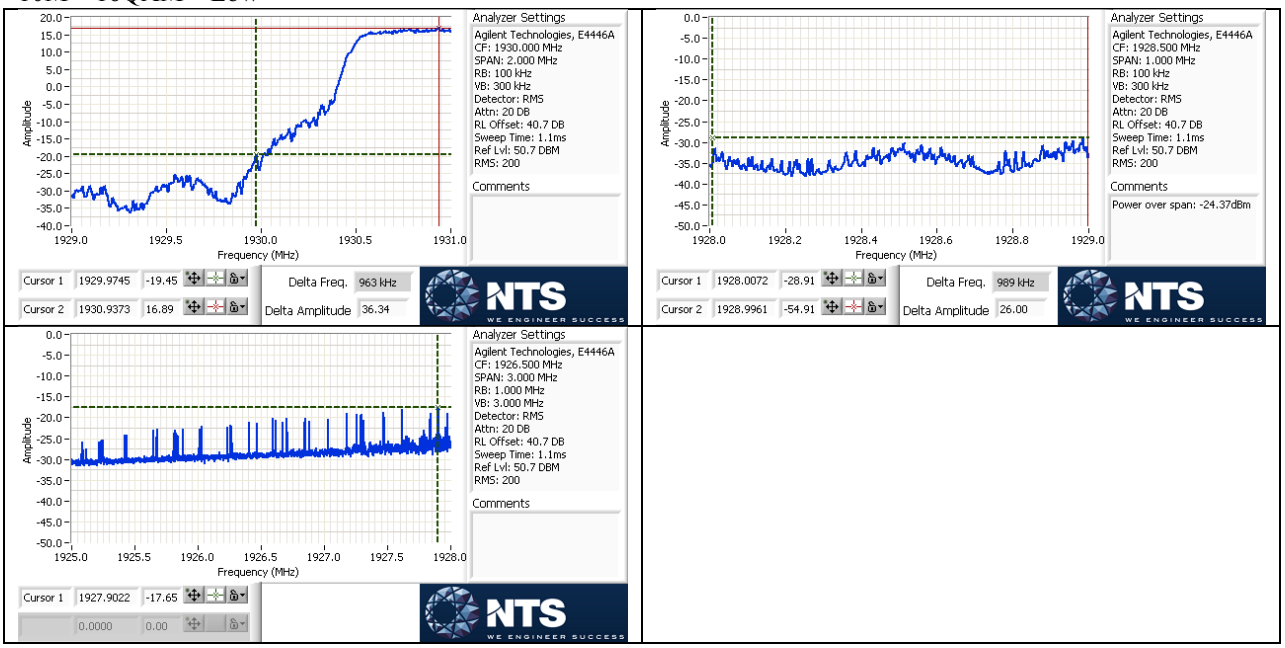
10M – QPSK – Low



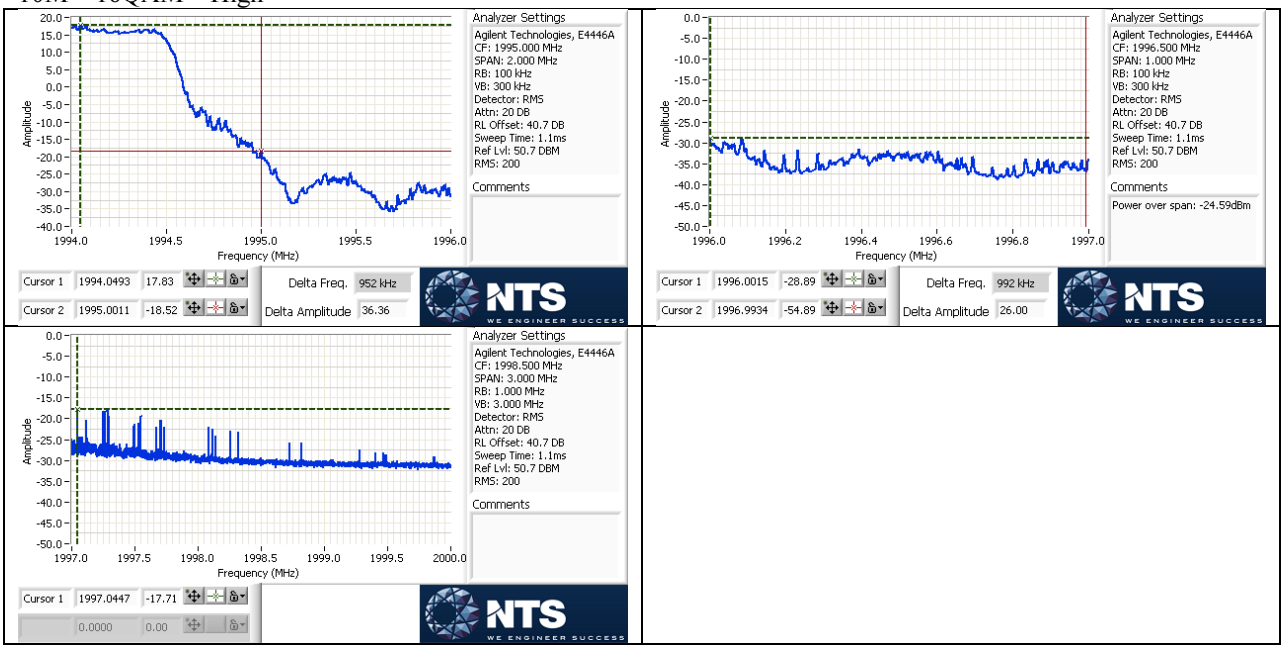
10M – QPSK – High



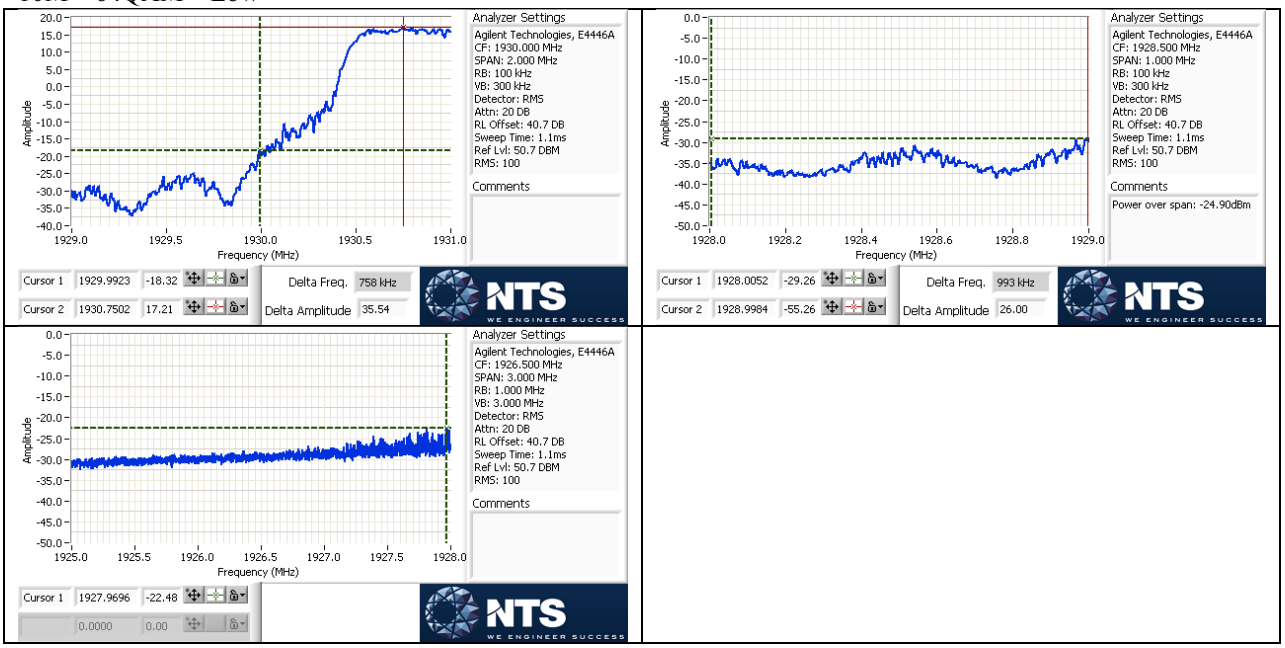
10M – 16QAM – Low



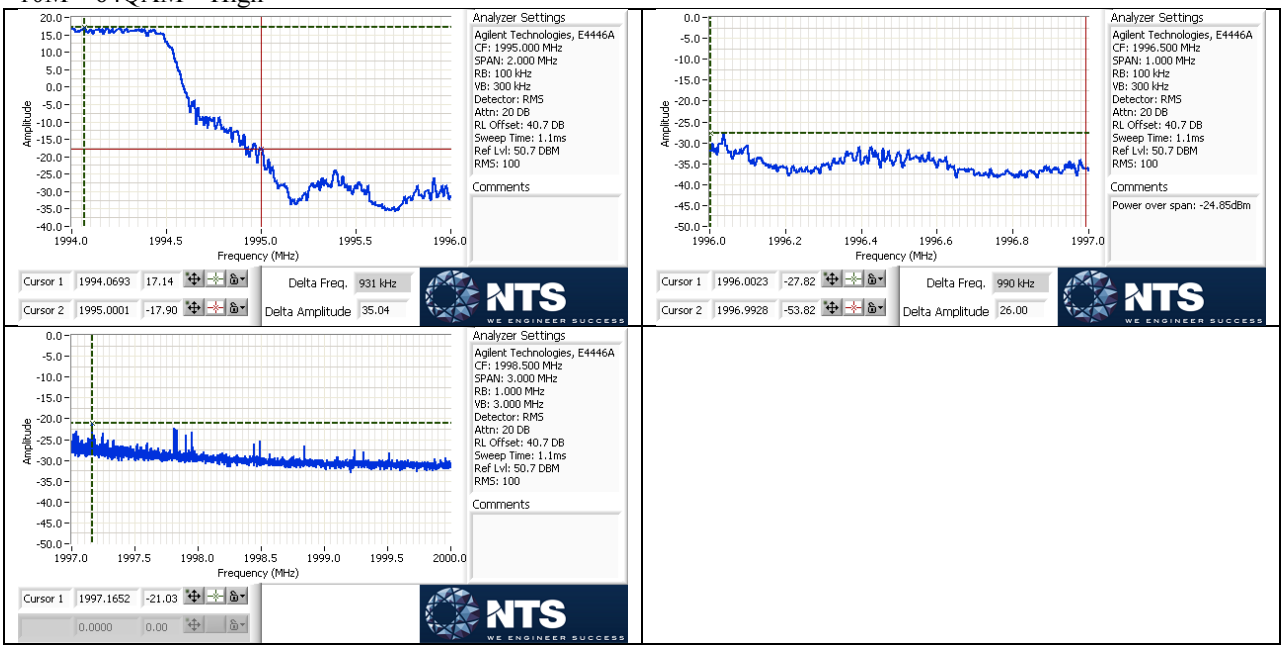
10M – 16QAM – High



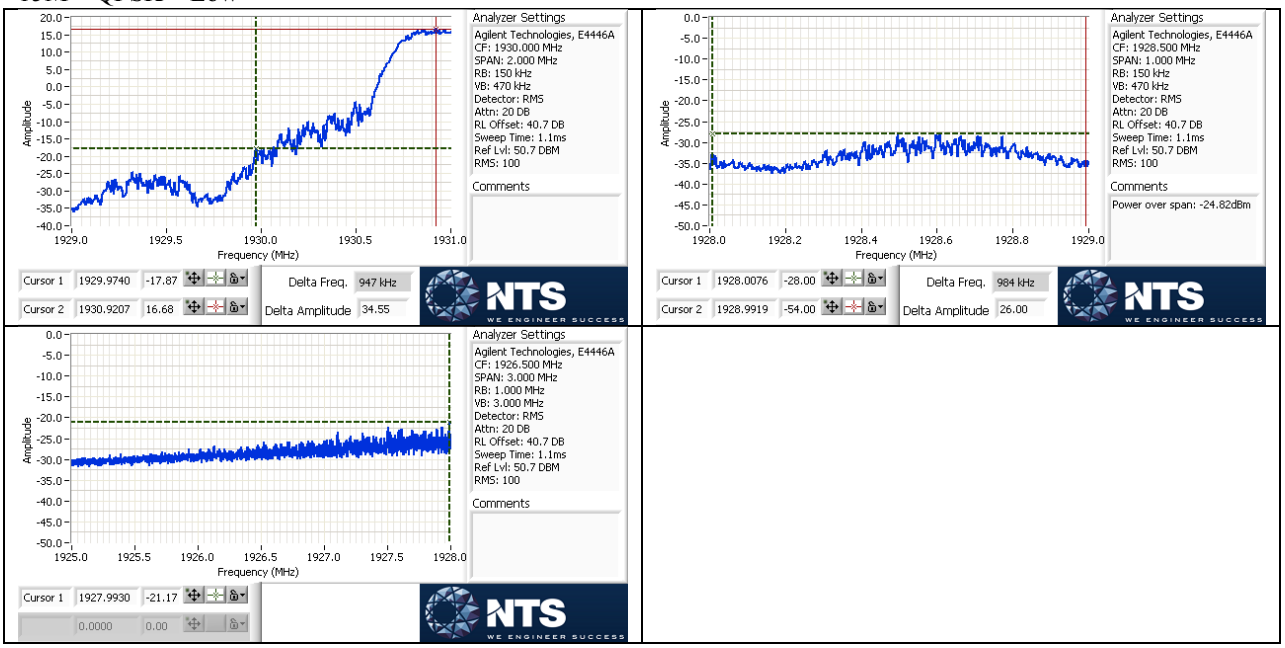
10M – 64QAM – Low



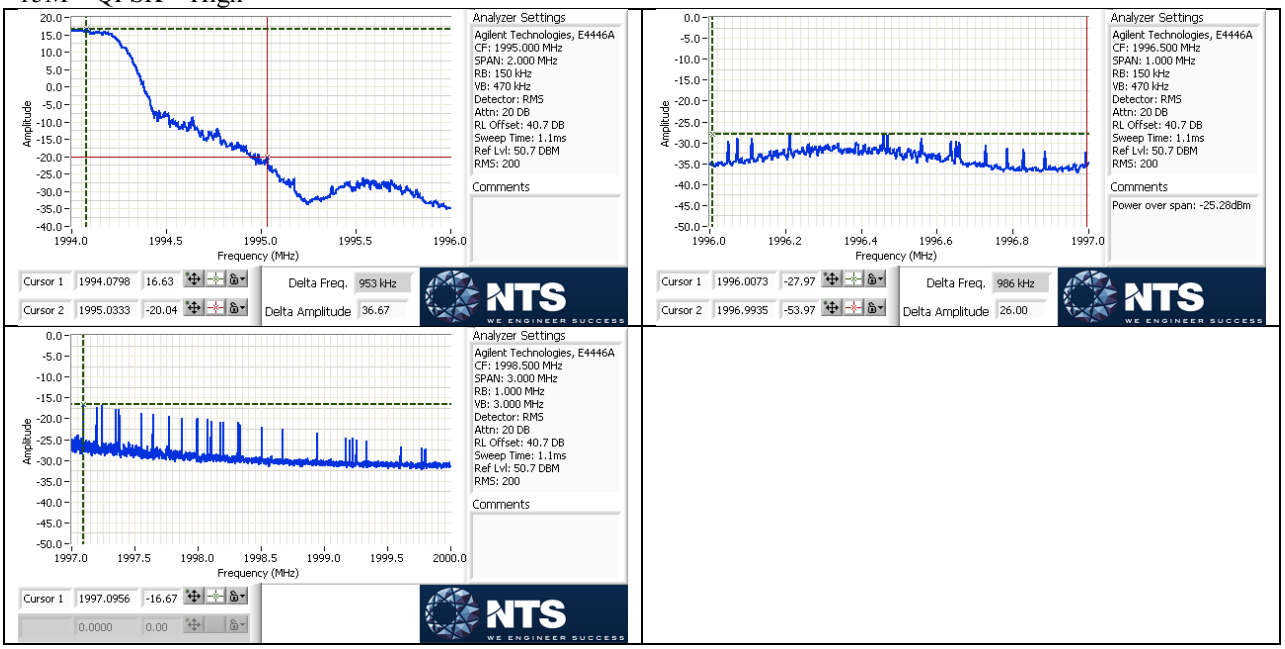
10M – 64QAM – High



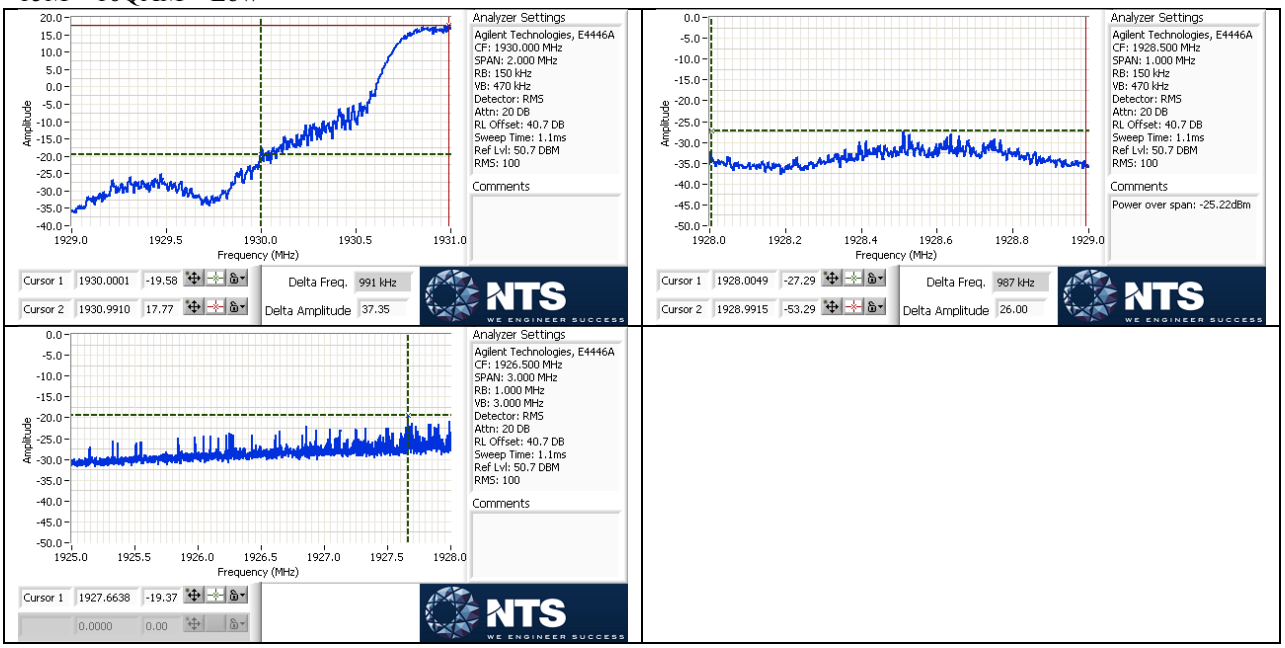
15M – QPSK – Low



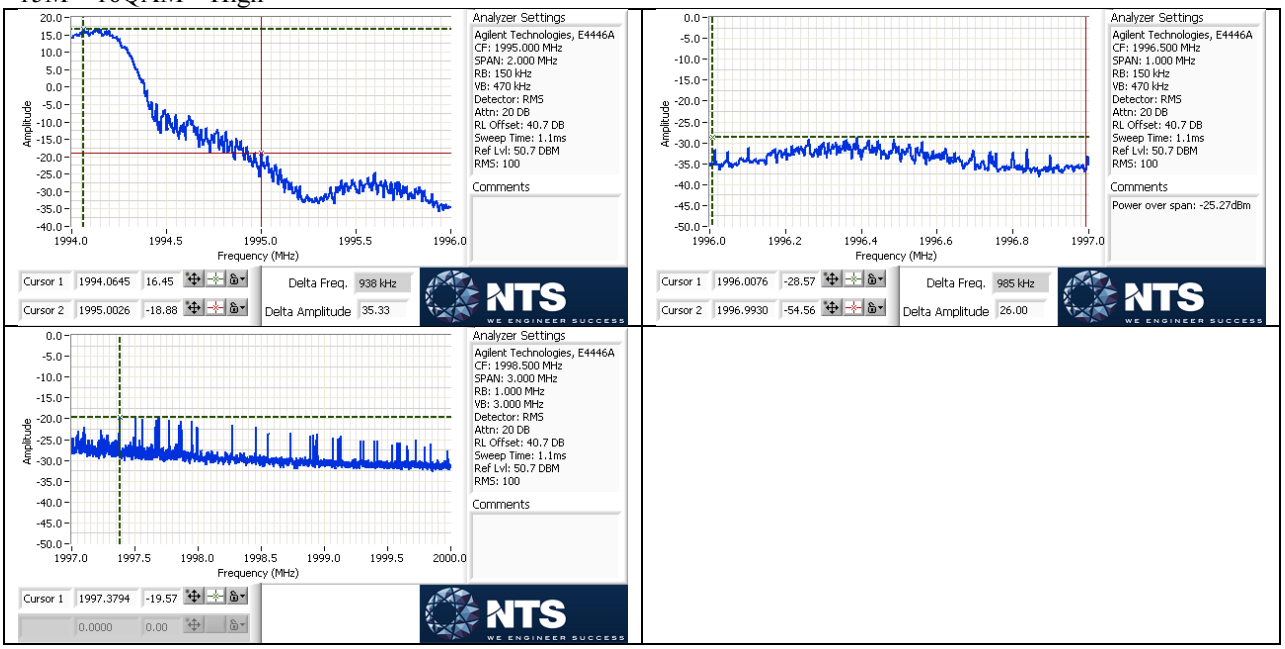
15M – QPSK – High



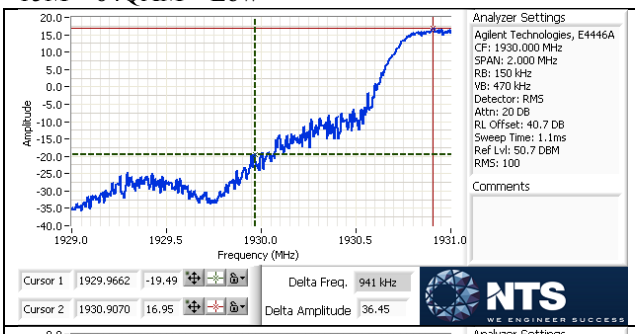
15M – 16QAM – Low

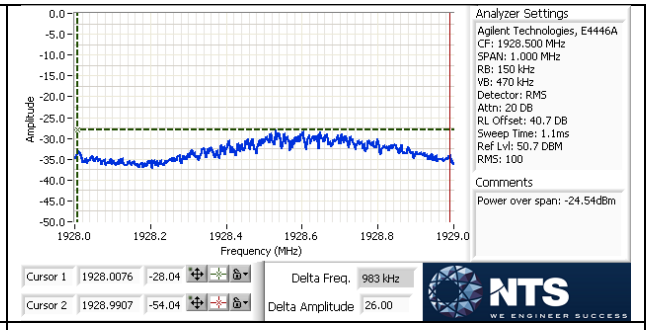


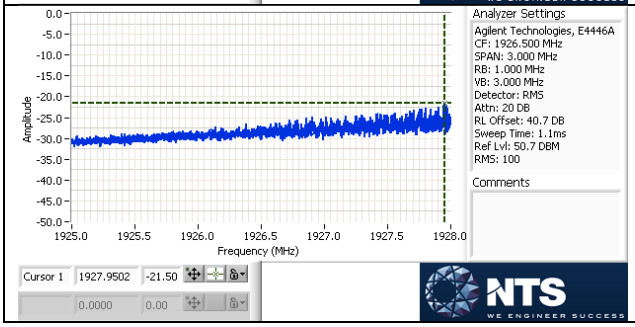
15M – 16QAM – High



15M – 64QAM – Low







15M – 64QAM – High