URM 700 – Universal Radio Module
Radio Compliance
FCC Test Report

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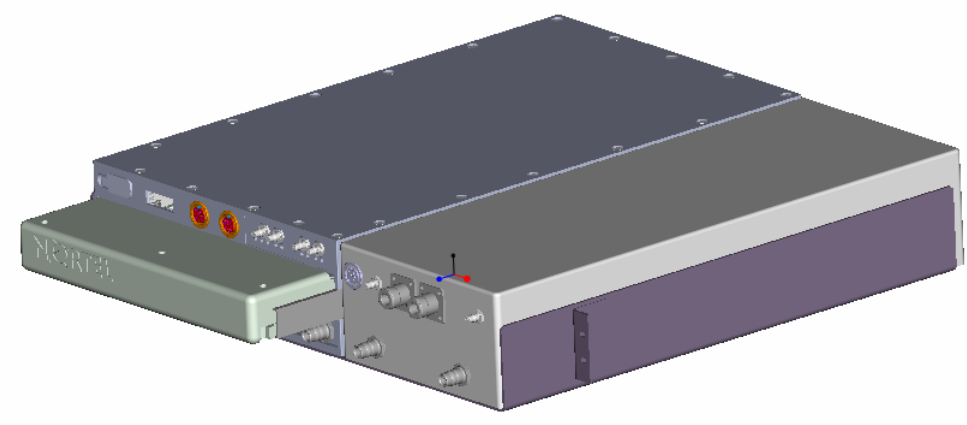

Approvals and Key Reviewers

Name	Function	Role	Status
David Bolzon	Regulatory Prime	Author / Ratifier	Approved
Radu Trandafir	SPIR TL	Reviewer	

Revision History

Issue	Description of change	Changed by	Date
0.1	Draft	David Bolzon	27 July 2009
1.0	Approved	David Bolzon	24 August 2009

Reference Documents

1. FCC 47 CFR Part 27 “Wireless Communications Services”
2. FCC 47 CFR Part 15 “Unintentional Radiators”
3. ICES-003 “Digital Apparatus” EMC
4. 3GPP TS 36.104 V9.0.0 (2009-05) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception (Release 9)
5. EN 50385:2002—Product Standard to Demonstrate the Compliance of Radio Base Stations and Fixed Terminal Stations for Wireless Telecommunication Systems with the Basic Restrictions or the Reference Levels Related to Human Exposure to Radio-Frequency Electromagnetic Fields (110 MHz–40 GHz)—General Public
6. 3GPP TS 36.113 V9.0.0(2009-05) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) and repeater Electro Magnetic Compatibility (EMC) (Release 9)
7. EN 55022, Limits and methods of measurement of radio disturbance characteristics of information technology equipment (CISPR22: 1997), 1998, European Committee for Electro-technical Standardization
8. 3GPP TS 36.141 V9.0.0 (2009-05): 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) ; Base Station (BS) conformance testing (Release 9).
9. SM.328: "Spectra and bandwidth of emissions".
10. CISPR 22: "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".
11. CISPR 16-1-1: "Specification for radio disturbance and immunity measuring apparatus and methods - Measuring apparatus".
12. ETSI TS 136 141 V8.2.0 (2009-04) LTE; Evolved Universal Radio Access (E-UTRA); Base Station (BS) conformance testing (3GPP TS 36.141 version 8.2.0 Release 8)
13. ETSI TS 136 104 V8.5.0 (2009-04) LTE; Evolved Universal Terrestrial Radio Access (E-UTRA);Base Station (BS) radio transmission and reception (3GPP TS 36.104 version 8.5.0 Release 8)
14. ETSI TS 136 113 V8.1.0 (2009-01) LTE; Evolved Universal Terrestrial Radio Access (E-UTRA);Base Station (BS) and repeater Electro Magnetic Compatibility (EMC) (3GPP TS 36.113 version 8.1.0 Release 8)
15. 3GPP TS 36.211 V8.7.0 (2009-05) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 8)
16. 3GPP TS 36.212 V8.7.0 (2009-05) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding (Release 8)
17. 3GPP TS 36.213 V8.7.0 (2009-05) 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 8)
18. 700MHz LTE Universal Radio Module, Feature Requirements Specification, Rack Based Unit (URM2-4) V0.71, 17 Nov. 2008
19. Nemko EMC Report: 124408-1TRFEMC, Nortel Universal Radio Module

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Acronyms

URM	Universal Radio Module
UDM	Universal Digital Module
DDM	Dual Duplexer Module
BTS	Base Station Transceiver
EUT	Equipment Under Test
LTE	Long Term Evolution
ACP	Adjacent Channel Power
CPRI	Common Public Radio Interface
NIST	National Institute of Standards and Technology
NRTL	National Recognized Testing Laboratory
NVLAP	National Voluntary Laboratory Accreditation Program
LAP	Laboratory Accreditation Programs
IC	Industry Canada
FCC	Federal Communication Commission
CFR	Code of Federal Regulations (US)
CAB	Conformity assessment body
EMC	Electromagnetic Compatibility
EMI	Electromagnetic interference
RTTE	Radio and Telecommunications Terminal Equipment
TTE	Telecommunications equipment
TCB	Telecom Certification Body
CCB	Canadian Certification Body
IECEE	International Electro-technical Committee for Conformity Testing to Standards for Electrical Equipment
NCB	National Certification Bodies
CBTL	CB Test Laboratory
ITL	Independent Test Laboratory
ITE	Information Technology Equipment

1 Results Summary

Applicant:	Nortel Networks 3500 Carling Ave Nepean, Ontario K2H 8E9
Apparatus:	700MHz URM NT2410AA
Application:	Fixed Wireless Base Station Transceiver
FCC ID:	VZTNT2410AA
In Accordance With:	FCC CFR 47 Part 27 Miscellaneous Wireless Communications Services

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 27. Conducted measurements were performed in accordance with ANSI TIA-603-B-2002. Radiated tests were conducted is accordance with ANSI C63.4-2003. Radiated emissions were made in a 3 meter Semi-Anechoic chamber at Nemko Canada. A description of the test facility is on file with the FCC. Conducted Emissions were evaluated at Nortel Networks Carling facilities.

The assessment summary is as follows:

Apparatus Assessed:	700MHz URM (Universal Radio Module NT2410AAE5)
Specification:	FCC CFR 47 Part 27 Miscellaneous Wireless Communications Services
Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None
Report Release History:	Original Release

2 Introduction

This document supports the FCC filing capturing the Radio Regulatory Compliance Requirements and Results for the Nortel URM 700MHz in accordance to Nemko Canada FCC Approved "Permit but Ask" test plan in compliance to:

- FCC CFR 47 Part 27 Subpart C, Miscellaneous Wireless Communications Services.
- FCC CFR 47, Subpart 2, Subpart J, Equipment Authorization Procedures – Equipment Authorization.

The initial URM deployment will support a 10MHz BW for Fixed Wireless Base Station (BTS) applications with a rated output of 40W (46dBm) in a 2 x 2 MIMO configuration. Initial frequency band will address the US Upper C Block.

Hardware

The BTS equipment is comprised of the following:

1) NT2410AAE5: Universal Radio Module [URM] **EUT**
   NT1901AAE6: Dual Duplexer Module [DDM]
2) NT1B10AAE5 Universal Digital Module [UDM]

URM Details

Frequency: FCC 700MHz Band

Transmit / Downlink: 746 – 757MHz – Upper Block C: 751MHz

- Modulation: OFDMA, QPSK, 16QAM, 64QAM
- BW: 10 MHz
- MIMO, 2 x 2 (Spatial Multiplexing)
- Diversity, 2 Way Transmit
- Throughput: Up to 60 Mbps
- Power: 46dBm (40W)
- PAPR: 7dB

Duplex: FDD (30MHz)

Frequency Stability: +/-0.05ppm

Channel Raster: 100 kHz

Receive / Uplink: 776 - 787MHz – Upper Block C: 781MHz

- Modulation: SC-FDMA, QPSK, 16QAM
- BW: 10 MHz
- MIMO, 2 x 2, Multi-User
- Throughput: Up to 20Mbps
- Diversity, 2 and (4 Branch Receive)

URM/DPM Physical Details:

PWR: -48V (typical) DC 540W (max), Size: 17.5" x 20" x 3.5", Weight: 52lbs

3 Equipment Under Test

3.1 Product Identification

The Equipment Under Test is identified for Fixed Base Station operation as follows: Nortel NT2410AA, 700MHz URM.

3.2 Technical Specifications of the EUT

Manufacturer:	Nortel Networks
Operating Frequency:	TX: 751MHz RX: 781MHz
Emission Designator:	W7D
Modulation:	LTE OFDMA, MIMO Technology (Two transmitters, 2 receivers per sector)
Antenna Data:	Andrew LNX-6513DS-T4M 12.7dBd, 14.8dBi (max) Beamwidth – Horizontal 65°

3.3 Technical Description

The URM operates in the North American 700MHz Upper C Block, as a single sector Transceiver (2 transmitter, 2 receivers per radio / sector) operating in FDD mode.

The URM design is a 2 transmit / 2 receive (expandable to 4 receive) single sector FDD radio which will be introduced as part of Nortel's next generation BTS product line. The initial URM product offering addresses the LTE air interface, while the URM radio architecture will be 4G agnostic to support OFDM based air interfaces including the long term evolution of GSM/UMTS (LTE), 802.16e OFDMA standards with Multiple Inputs Multiple Outputs (MIMO) operation.

The Nortel LTE URM is intended for indoor installation but is designed with features to enable and comply with future configurations for both indoor and outdoor installations. The URM is housed and interconnected with an active duplexer for enhanced up link performance and antenna interface. All compliance and performance testing will include a band / spectrum dependent DDM (duplexer) installed with the URM product offering.

The URM operates at a transmit center frequency of 751MHz at 10MHz BW in the down link employing OFDMA QPSK, 16QAM and 64QAM Modulation at a rated output of 40W. The recommended customer furnished antenna detail is as follows:

MFG: Andrew Antenna
Model: LNX-6513DS-T4M
Gain: 12.7dBd (14.8dBi)
Beam width: Horizontal 65°

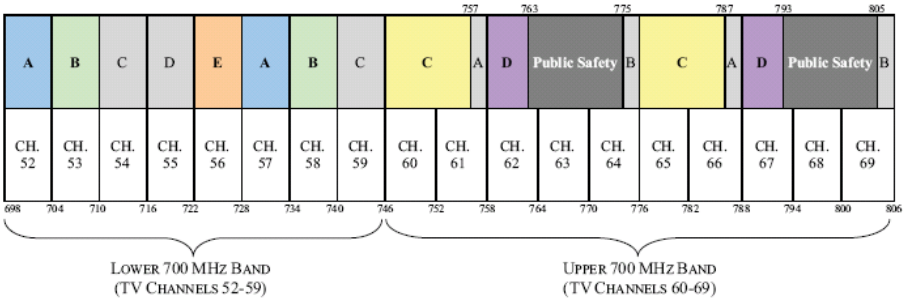
The Nortel URM design consists of logical sections comprised of Digital, RF, Power Amplifiers and a Power Supply housed in two interconnected modules. A Fan Module, external to the two section assembly provides air movement over the external cooling fins for temperature control.

The digital section provides processing resources to the URM CPRI based optical link to the Nortel UDM (Universal Digital Module) and Soft Radio Core. This single sector Tower Bottom Radio is targeted to support up to 20MHz baseband data bandwidth. (Initial deployment will be limited to 10MHz) The digital section of the transceiver card provides the processing solution for the 4G Universal Radio. The unit operates over an ambient temperature of -40°C to +50°C and is forced air / convection cooled.

The PSU provides primary power conversion from a nominal input of -48VDC (540W) for the internal PCB circuit requirements. The PA board produces the RF output power for BTS transmission at a rated power up to 40W.

The URM consists of a shelf based Radio/Duplexer combination for FCC compliance. All compliance measurements and ratings are referenced at the antenna ports which are via the duplexer interface. A Mounting Tray (N0205581) is provided to facilitate module integration and assembly for rack mount applications. The URM and band dependant DDM are mounted in the Tray/Shelf secured for structural integrity and interconnected providing the Top Level assembly (NT2410AAE5) for product deliverables.

Revised 700 MHz Band Plan for Commercial Services



Block	Frequencies (MHz)	Bandwidth	Pairing	Area Type	Licenses
A	698-704, 728-734	12 MHz	2 x 6 MHz	EA	176
B	704-710, 734-740	12 MHz	2 x 6 MHz	CMA	734
C	710-716, 740-746	12 MHz	2 x 6 MHz	CMA	734
D	716-722	6 MHz	unpaired	EAG	6
E	722-728	6 MHz	unpaired	EA	176
C	746-757, 776-787	22 MHz	2 x 11 MHz	REAG	12
A	757-758, 787-788	2 MHz	2 x 1 MHz	MEA	52
D	758-763, 788-793	10 MHz	2 x 5 MHz	Nationwide	1 *
B	775-776, 805-806	2 MHz	2 x 1 MHz	MEA	52

* Subject to conditions respecting a public/private partnership.

The blocks shaded above in gray (Lower 700 MHz Band C and D Blocks and Upper 700 MHz Band A and B Blocks) were auctioned prior to Auction 73.

Figure 3-1: FCC Revised 700MHz Frequency Band

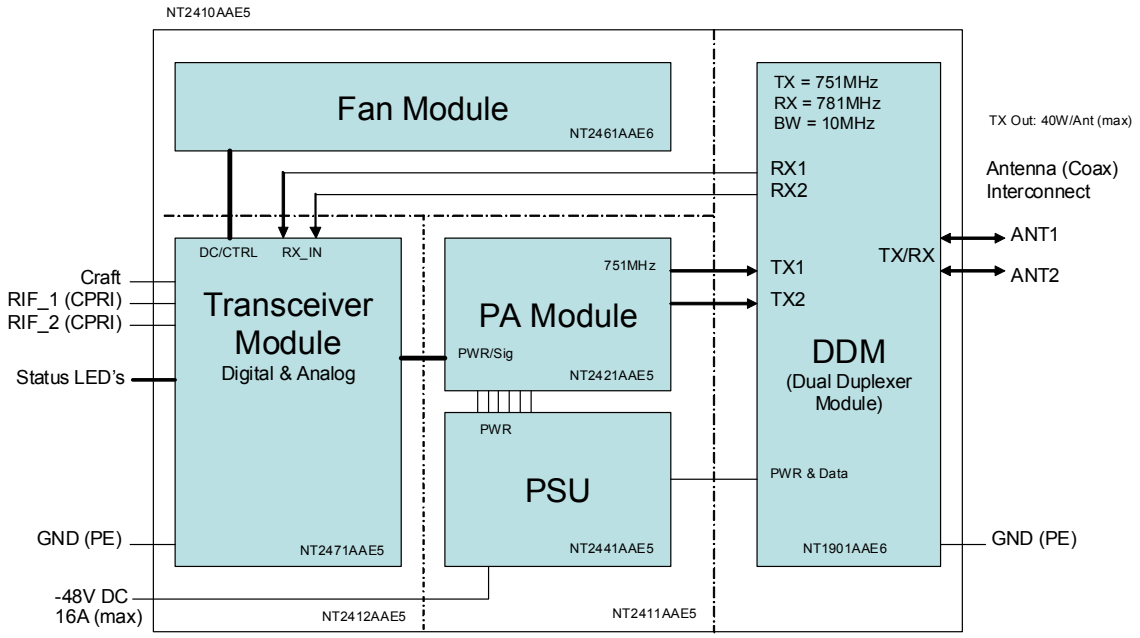
Radio Standard is LTE [12], OFDMA TX, (SC-FDMA RX) configured for a 2x2 MIMO operating mode with an output rated power of 40W (46dBm) at the antenna port. Transmit outputs 1 and 2 are non-correlated connected to two isolated customer furnished antenna.

The TX Modulation schemes of QPSK, 16QAM, and 64QAM will be supported along with a Bandwidth of 10MHz for initial product release in the Upper C Block spectrum. QPSK, 16QAM, and 64 QAM will employ 3/4 CTC data rate coding.

The URM NT2410AAE5 employs a CPRI (Common Public Radio Interface) for interoperability and standardization of the radio protocol interface.

Test Units

Part 27: UUT URM700MHz, NT2410AAE5, S/N NNTM740000LG
UDM – NT1B10AAE5, S/N NNTM40122875
Part 15: UUT URM700MHz, NT2410AAE5, S/N NNTM740000LG
UUT URM700MHz, NT2410AAE5, S/N NNTM740000LL
UUT URM700MHz, NT2410AAE5, S/N NNTM740000L6
UDM – NT1B10AAE5, S/N NNTM40123363



UUT: URM 700MHz NT2410AAE5

4 Test Conditions

4.1 Specifications

The apparatus will be assessed against the following specifications:
FCC CFR 47 Part 27 Miscellaneous Wireless Communications Services

4.2 Test Environment

All tests would be performed under the following environmental conditions:

Temperature range	:	15 – 30 ^{o}C
Humidity range	:	20 - 75 %
Pressure range	:	86 - 106 kPa
Power supply range	:	+/- 5% of rated voltages

4.3 Test Equipment

Table 4-1: Conducted Emissions - List of Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Cal Due
Signal Analyzer	Agilent	MXA N9020A	US46470369	02/06/11
Power Meter	HP	E4410B	MY45102221	26 Nov. 09
Power Sensor	HP	8481A	US37294387	5 Dec. 09
Attenuator 30dB (Qty=2)	Narda	769-30		----
Attenuator 20dB (Qty=2)	Meca	650-20-1F4		----
Climatic Chamber	Burnsco	600	L054493	----
Thermal Probe	Omega	HH23	T-85092	April 06/10

Table 4-2 Radiated Emissions - List of Test Equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next Cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	May 06/09
Bilog	Sunol	JB3	FA002108	Jan. 27/10
Horn Antenna #2	EMCO	3115	FA000825	Jan. 21/10
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Dec. 16/09
50 Coax cable	HUBER + SUHNER	None	FA002022	July 07/09
50 Coax cable	HUBER + SUHNER	None	FA002074	July 07/09
Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use				

5 Applicable Tests

This section contains the following:

FCC Part 27: Test Requirements

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N No: not applicable / not relevant.

Y Yes: Mandatory i.e. the apparatus shall conform to these tests.

N/T Not Tested, mandatory but not assessed. (See section 3.4 Test deleted)

The results contained in this report are representative of the operation of the apparatus as originally submitted.

5.1 FCC Part 27: Test Parameters

Table 5-1: Applicable Tests

Clause	Test Method	Test Description	Required	Result
27.50	2.1046	Effective radiated power	Y	
-----	2.1049	Occupied bandwidth	Y	
27.53(c)	2.1051	Spurious emissions at the antenna terminal	Y	
27.53(c)	2.1053	Field strength of spurious radiation	Y	
27.54	2.1055	Frequency stability	Y	

6 Test Plan / Results

6.1 Effective Radiated Power and Antenna Height

Clause 27.50

(b) The following power and antenna height limits apply to transmitters operating in the 746–763 MHz, 775–793 MHz and 805–806 MHz bands:

(4) Fixed and base stations transmitting a signal in the 746–757 MHz, 758–763 MHz, 776–787 MHz, and 788–793 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 1000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 1000 watts/MHz ERP accordance with Table 3 of this section.

(5) Fixed and base stations located in a county with population density of 100 or fewer persons per square mile, based upon the most recently available population statistics from the Bureau of the Census, and transmitting a signal in the 746–757 MHz, 758–763 MHz, 776–787 MHz, and 788–793 MHz bands with an emission bandwidth greater than 1 MHz must not exceed an ERP of 2000 watts/MHz and an antenna height of 305 m HAAT, except that antenna heights greater than 305 m HAAT are permitted if power levels are reduced below 2000 watts/MHz ERP in accordance with Table 4 of this section.

(9) Control stations and mobile stations transmitting in the 746–757 MHz, 758–763 MHz, 776–793 MHz, and 805–806 MHz bands and fixed stations transmitting in the 787–788 MHz and 805–806 MHz bands are limited to 30 watts ERP.

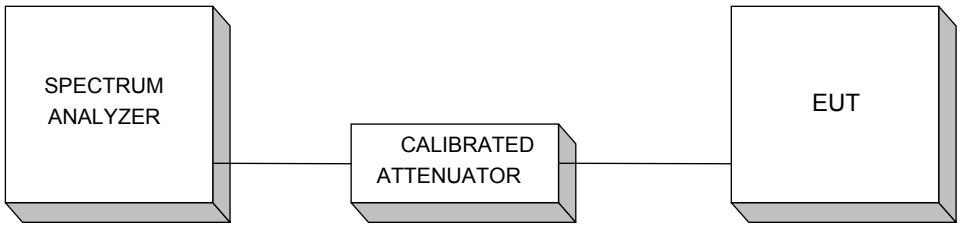
Table 3 to §27.50.—Permissible Power and Antenna Heights for Base and Fixed Stations in the 698–757 MHz, 758–763 MHz, 776–787 MHz and 788–793 MHz Bands Transmitting a Signal With an Emission Bandwidth Greater than 1 MHz

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) per MHz (watts/MHz)
Above 1372 (4500)	65
Above 1220 (4000) To 1372 (4500)	70
Above 1067 (3500) To 1220 (4000)	75
Above 915 (3000) To 1067 (3500)	100
Above 763 (2500) To 915 (3000)	140
Above 610 (2000) To 763 (2500)	200
Above 458 (1500) To 610 (2000)	350
Above 305 (1000) To 458 (1500)	600
Up to 305 (1000)	1000

Table 4 to §27.50.—Permissible Power and Antenna Heights for Base and Fixed Stations in the 698–757 MHz, 758–763 MHz, 776–787 MHz and 788–793 MHz Bands Transmitting a Signal With an Emission Bandwidth Greater than 1 MHz

Antenna height (AAT) in meters (feet)	Effective radiated power (ERP) per MHz (watts/MHz)
Above 1372 (4500)	130
Above 1220 (4000) To 1372 (4500)	140
Above 1067 (3500) To 1220 (4000)	150
Above 915 (3000) To 1067 (3500)	200
Above 763 (2500) To 915 (3000)	280
Above 610 (2000) To 763 (2500)	400
Above 458 (1500) To 610 (2000)	700
Above 305 (1000) To 458 (1500)	1200
Up to 305 (1000)	2000

Test Setup



Test conditions:

All modulations (QPSK, 16QAM, and 64QAM) modes and different data rates are evaluated using representative waveforms of all modulation schemes. The test results cover 10MHz bandwidth configuration.

Physical Channels

A downlink physical channel corresponds to a set of resource elements carrying information originating from higher layers and is the interface defined between 36.212 and 36.211 [15]. The following downlink physical channels are defined:

- Physical Downlink Shared Channel, PDSCH – QPSK, 16QAM, 64QAM
- Physical Broadcast Channel, PBCH - QPSK
- Physical Downlink Control Channel, PDCCH - QPSK
- Physical Control Format Indicator Channel, PCFICH - QPSK
- Physical Hybrid ARQ Indicator Channel, PHICH - BPSK

LTE standard defines BPSK as an ARQ Indicator Channel, thus being embedded into the LTE signal and does not contain traffic data. As BPSK is embedded in each modulation scheme, waveforms tested represent the worst case conditions.

Table 6-1: Setting Remarks / Measurement Results – Channel Power

Setting		10MHz Channel Power Output (dBm) (Note: BPSK embedded in each modulation scheme)					
		QPSK		16 QAM		64 QAM	
		TX1	TX2	TX1	TX2	TX1	TX2
Frequency	751MHz	46.09	45.81	46.04	45.72	46.06	45.78
RBW	1MHz						
VBW	3MHz						
CH BW	10MHz						
Span	50MHz						
Sweep	1ms						
Reference Level Offset	51.0dB						
Detector	RMS	ERP = Power Out + 12.7dBd Antenna Gain (W/MHz)					
Attenuation	10dB	75.68	70.96	74.82	69.50	75.16	70.47

Antenna Height Limit: (see FCC Clause 27.50 tables 3 and 4 for antenna compliance reference heights)

Note: Antenna are customer furnished … G = 12.7dBd (max)
ERP (Watts/MHz) = 10^((46 + 12.7)/10)/1000/10 = 75 (W/MHz)
Aggregate Power: TX1 + TX2 + Antenna Gain

PWR PdBm/MHz = $10\log(10^{\wedge}(P_1\text{dBm}/10) + 10^{\wedge}(P_2\text{dBm}/10))$ = 49dBm (10MHz) = 39dBm/MHz
39 + 12.7 = 51.7dBm/MHz (147.91W/MHz)

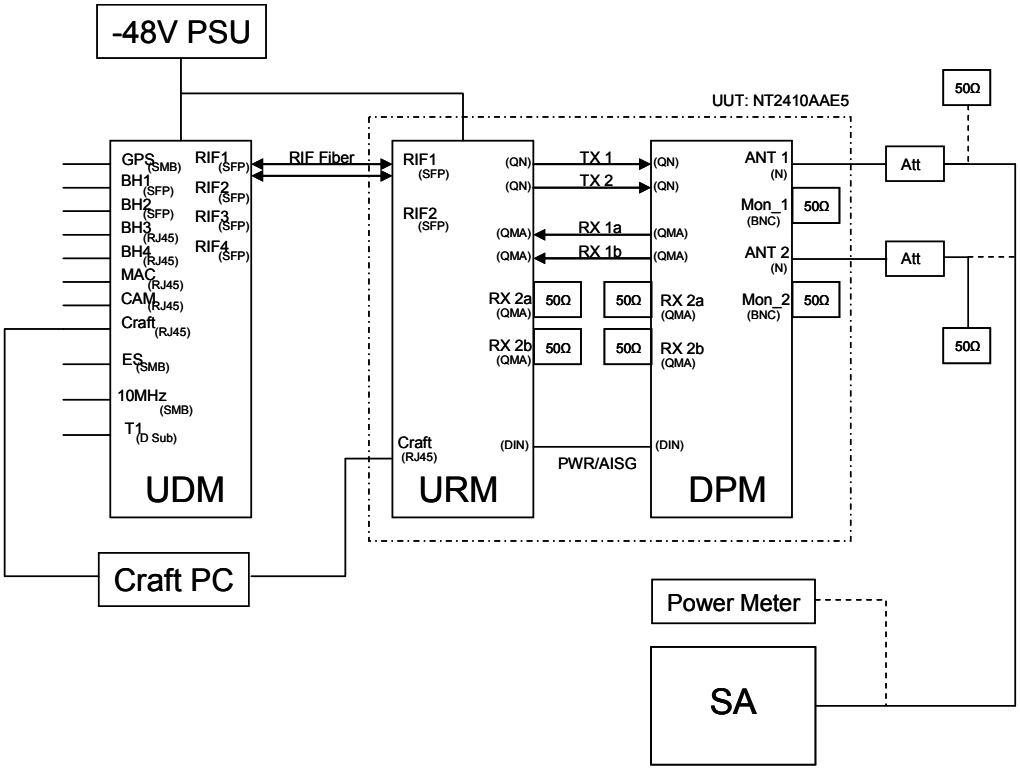


Figure 6-1 URM Radio Compliance Set Up / Configuration

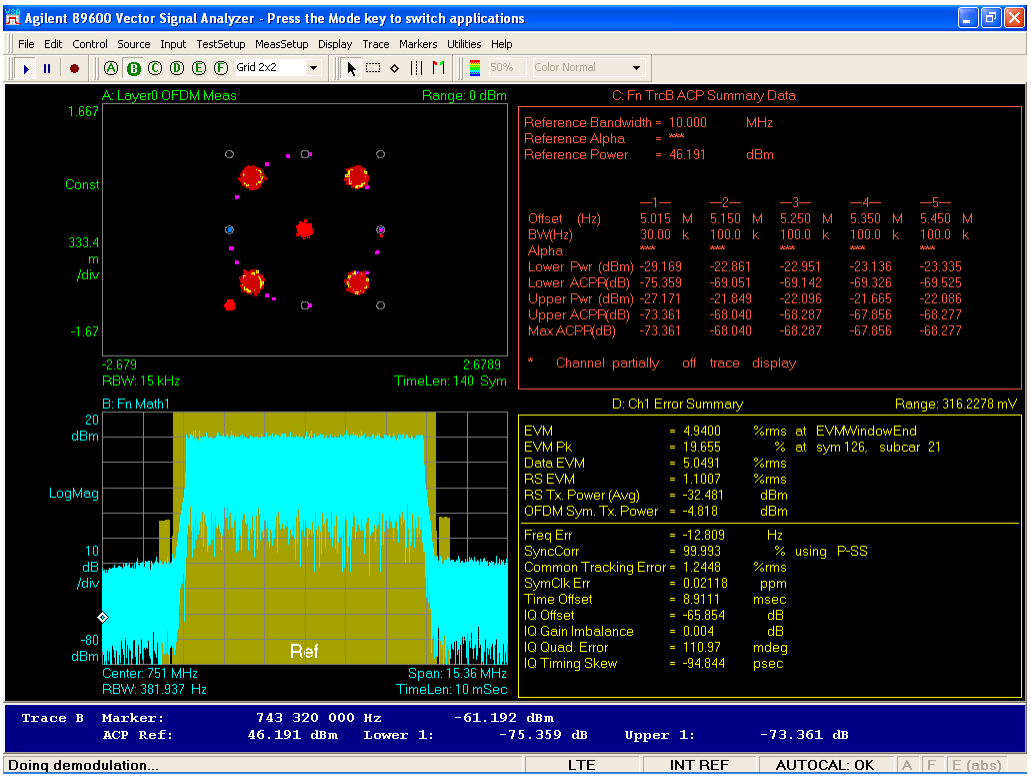


Figure 6-2: Modulation: TX1_QPSK

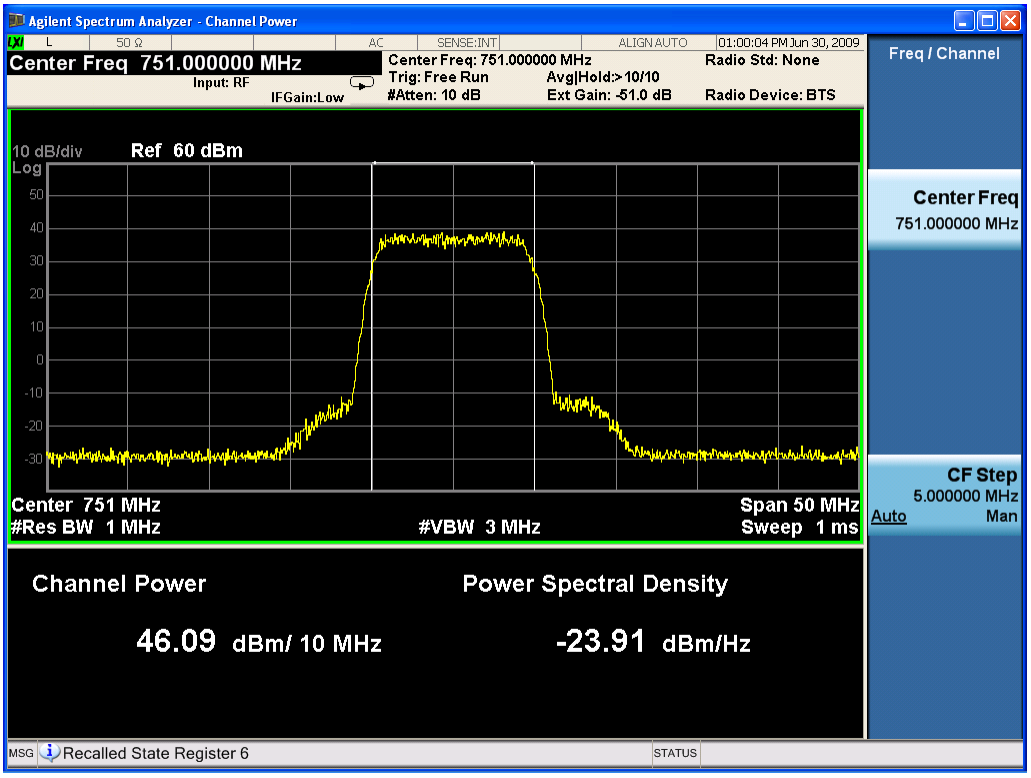


Figure 6-3: Channel Power TX1_QPSK

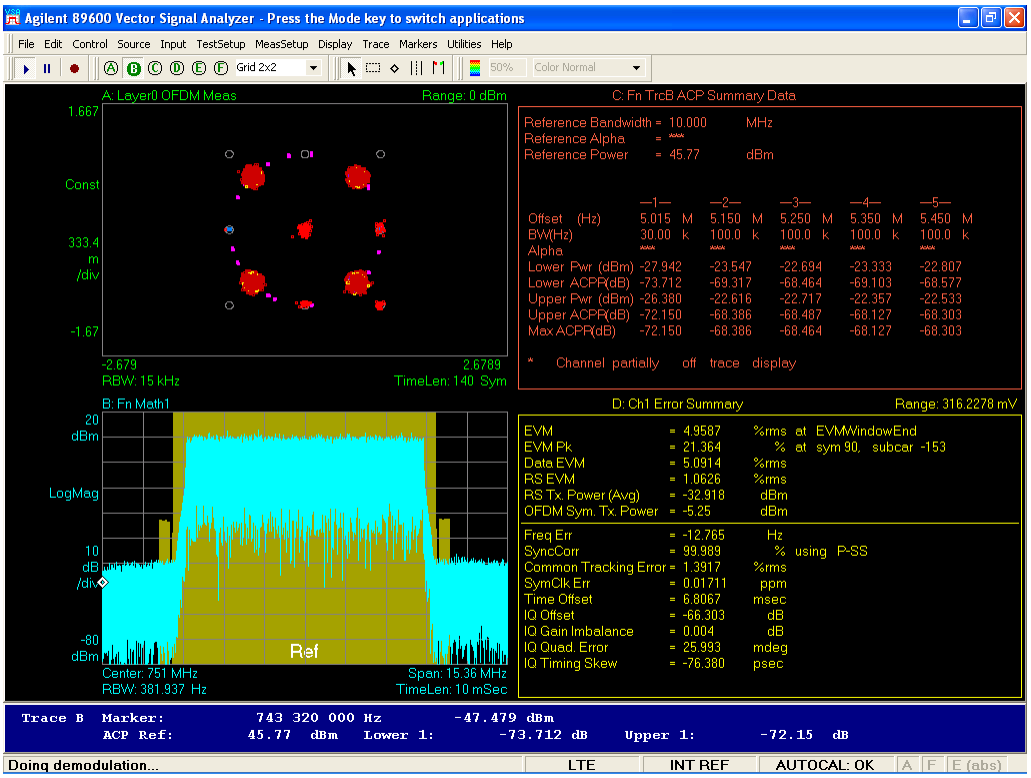


Figure 6-4: Modulation: TX2_QPSK

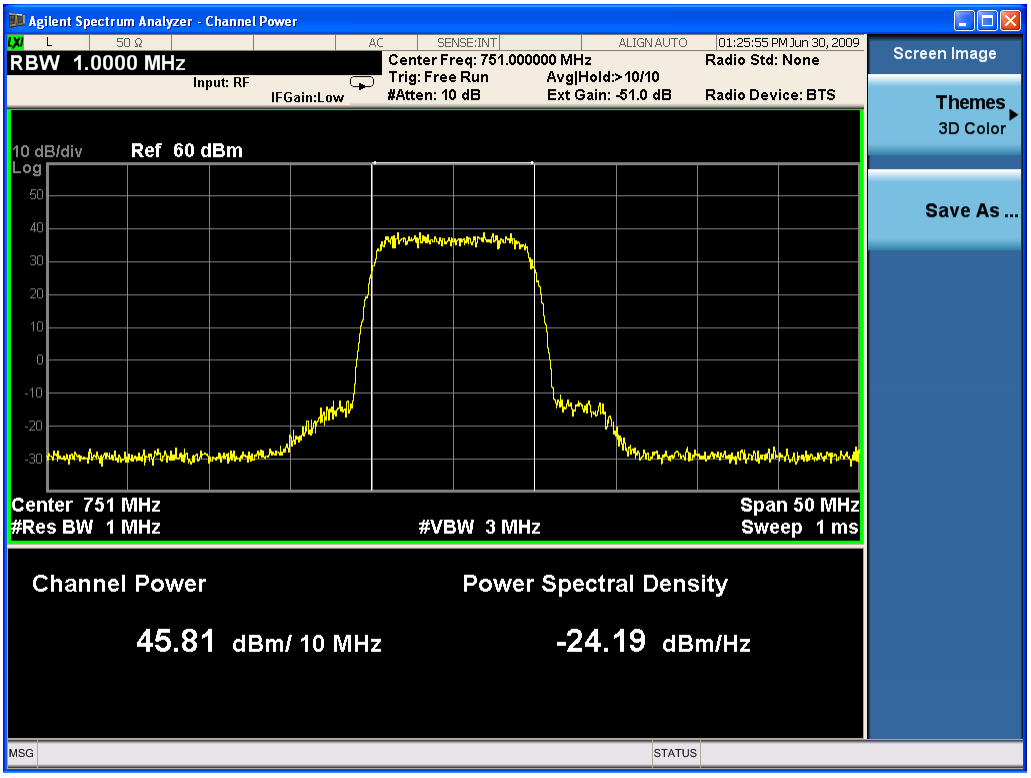


Figure 6-5: Channel Power TX2_QPSK

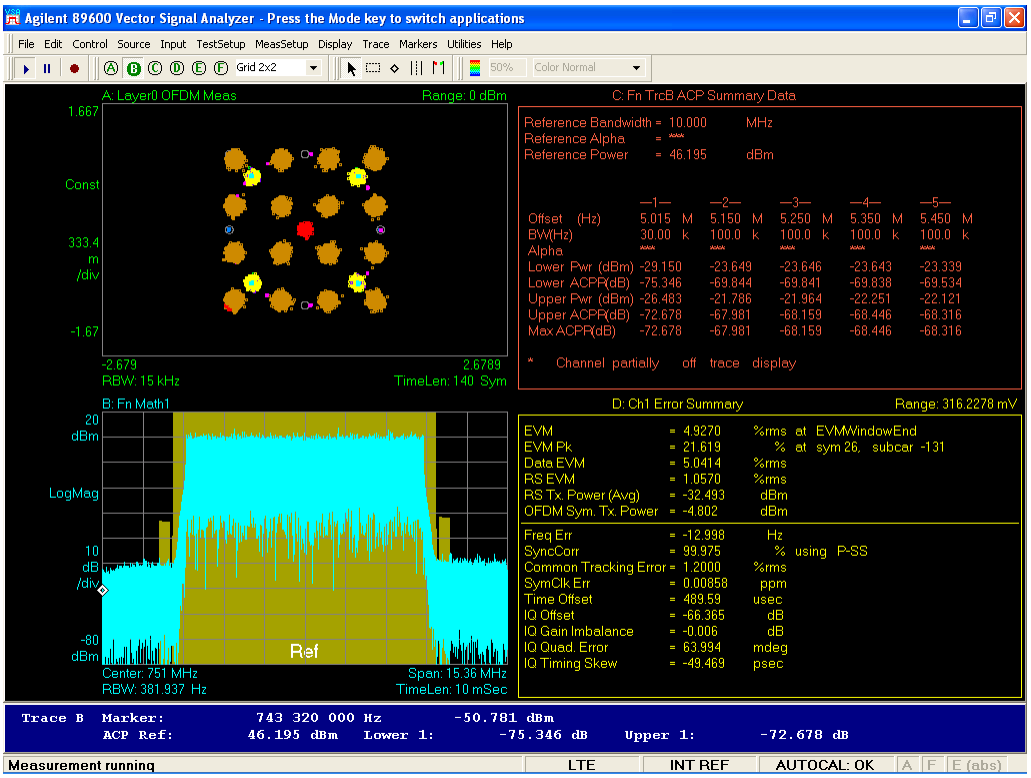


Figure 6-6: Modulation: TX1_16 QAM

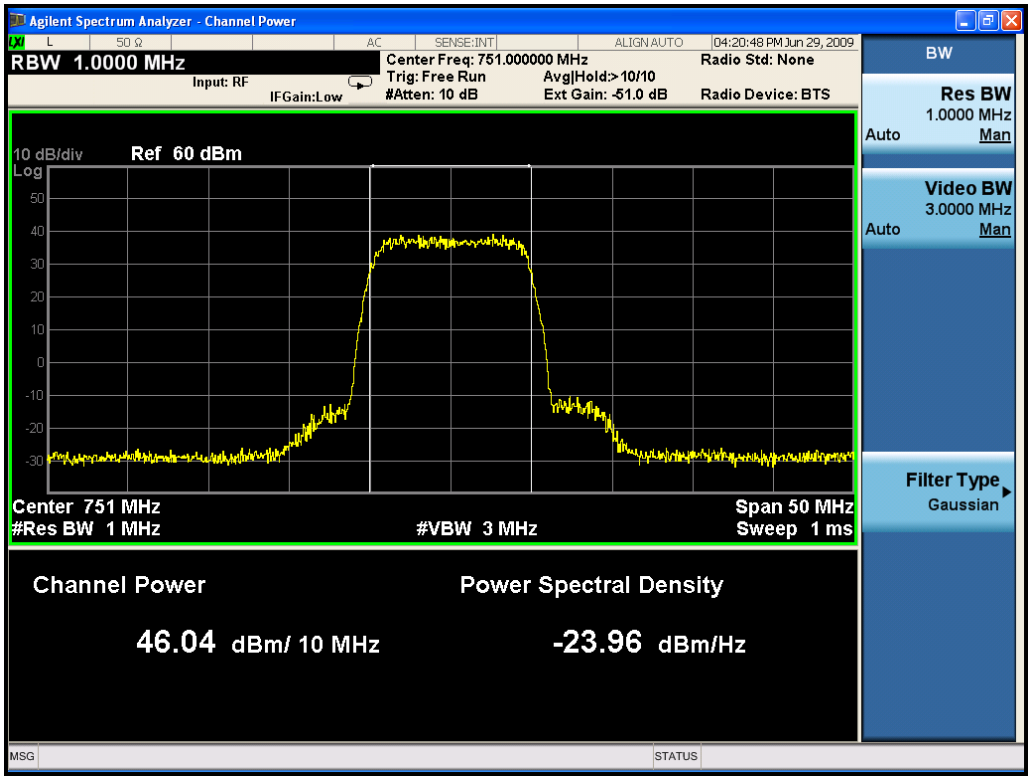


Figure 6-7: Channel Power TX1_16 QAM

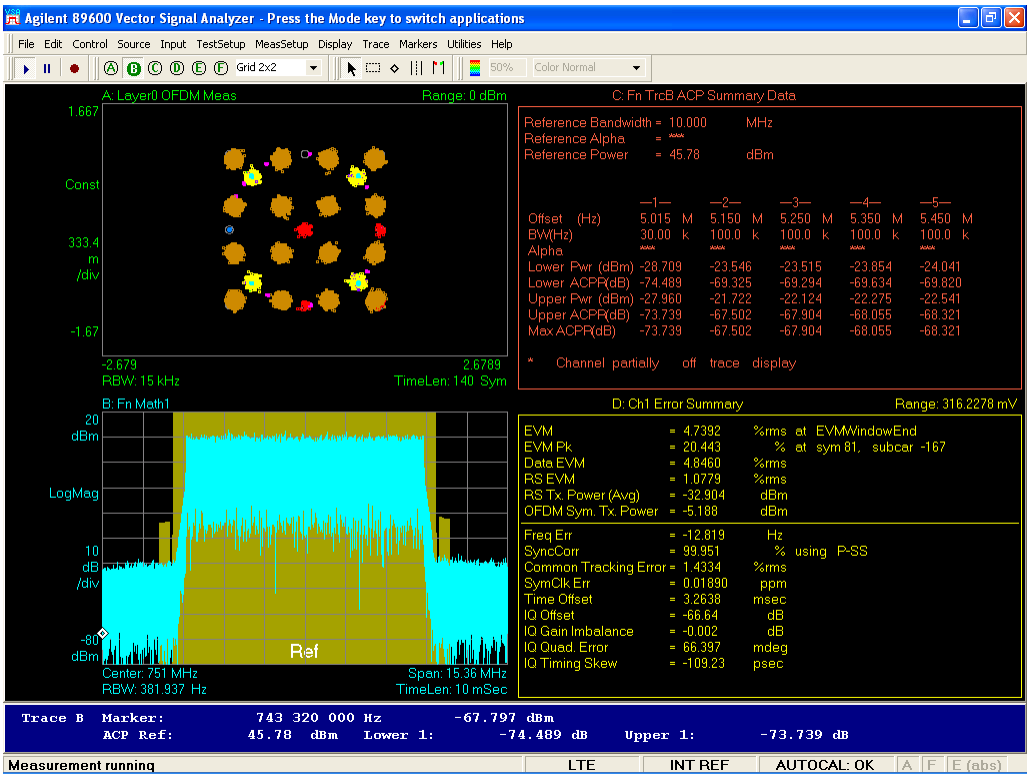


Figure 6-8: Modulation: TX2_16 QAM

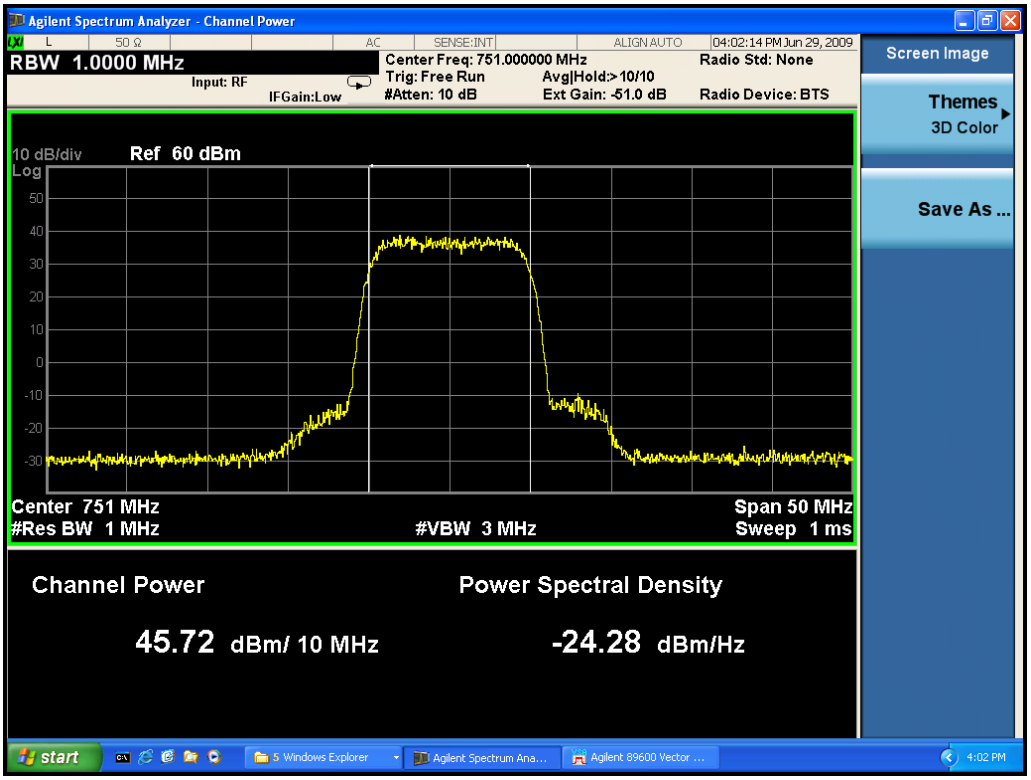


Figure 6-9: Channel Power TX2_16 QAM

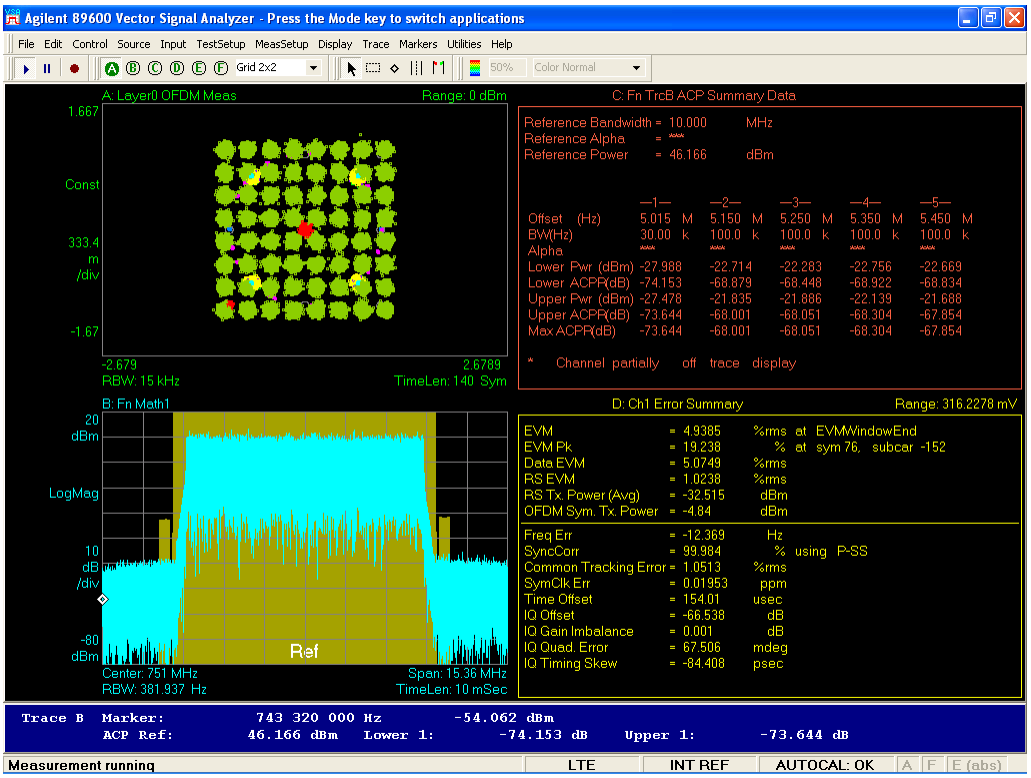


Figure 6-10: Modulation: TX1_64 QAM

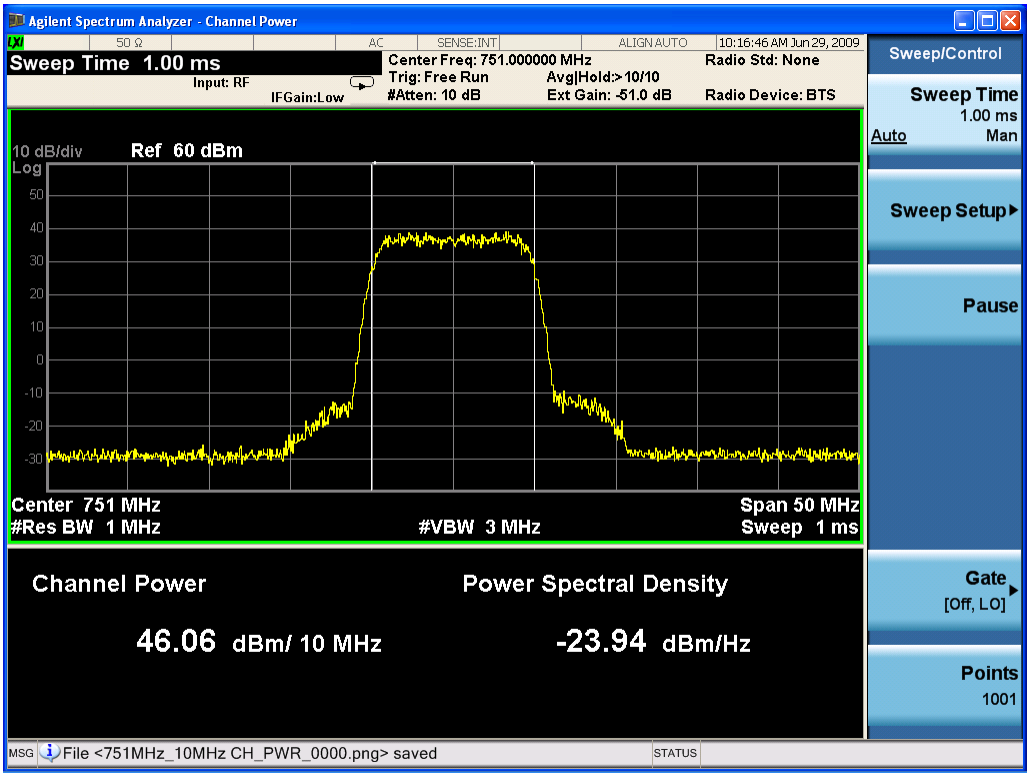


Figure 6-11: Channel Power TX1_64 QAM

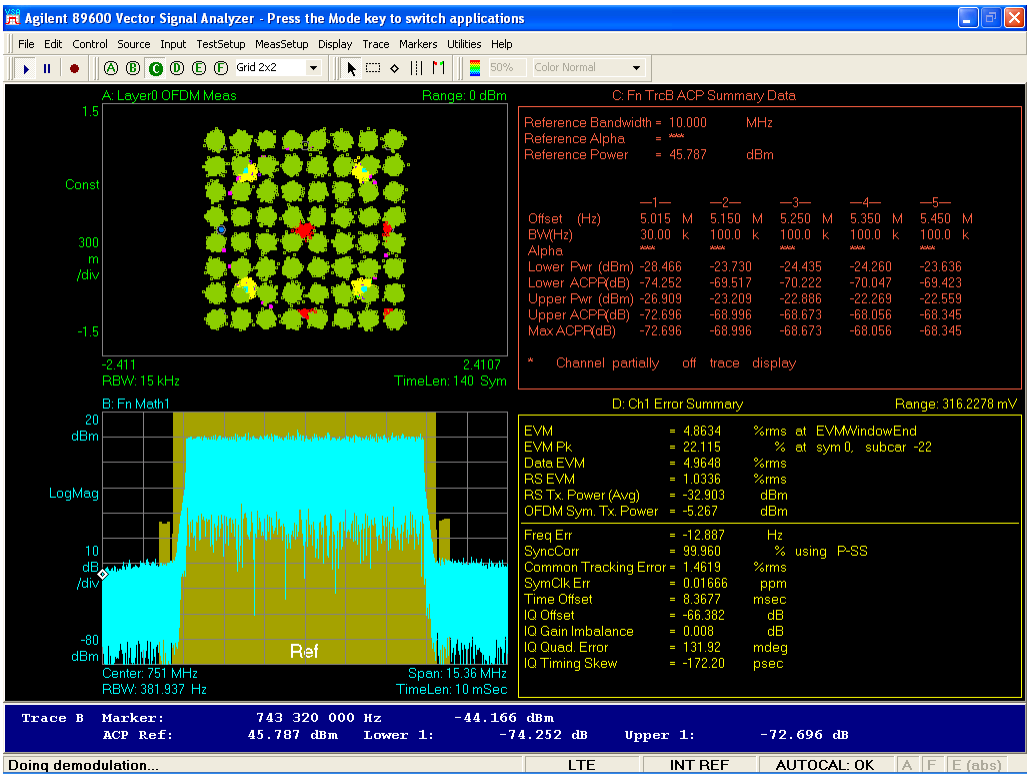


Figure 6-12: Modulation: TX2_64 QAM

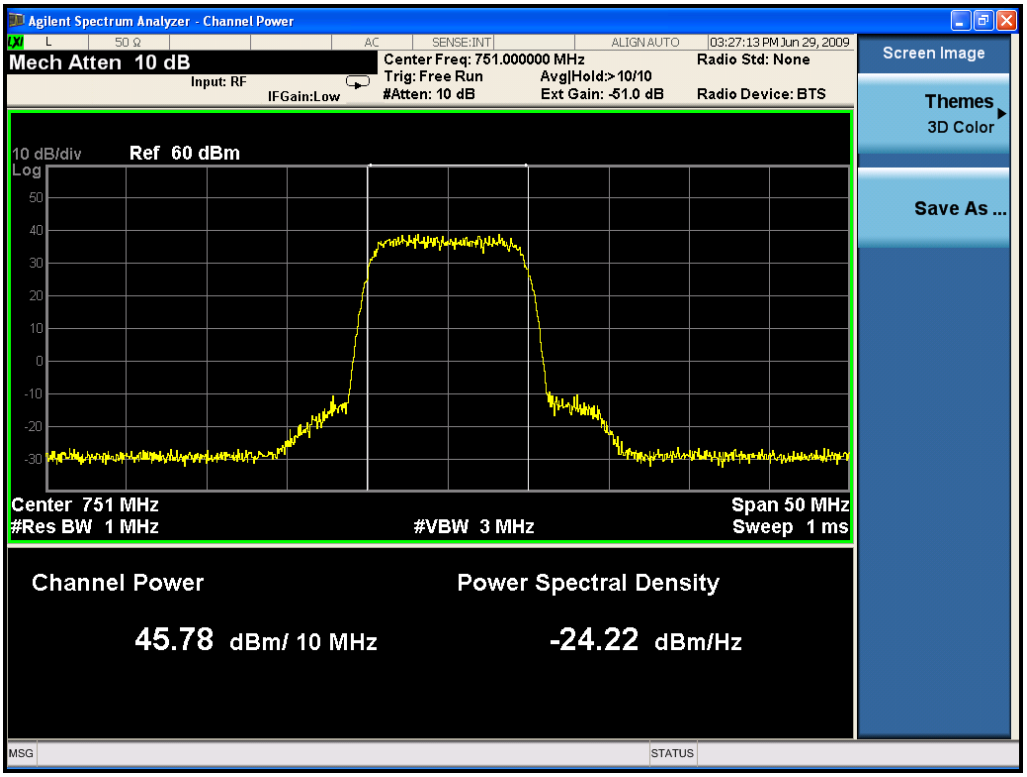


Figure 6-13: Channel Power TX2_64 QAM

6.2 RF Safety

Licensees and manufacturers are subject to the radio frequency radiation exposure requirements specified in sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

RF Safety: Based on the rated output power and 14.8dB antenna gain, a minimum distance of 4.5 meters to the operating antenna must be maintained.

Prediction of MPE limit at a given distance

Reference_1: Equation from page 51 of EN 50385: Basic standard for the calculation and measurement of electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunication systems (110 MHz - 40 GHz)

Reference 2: Equation from page 18 of OET Bulletin 65, Edition 97-01: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

URM 700: NT2410AAE5, 700MHz

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	46.00	(dBm)
Maximum peak output power at antenna input terminal:	39810.71706	(mW)
Antenna gain(typical):	14.8	(dBi)
Maximum antenna gain:	30.1995172	(numeric)
Prediction distance:	450	(cm)
Prediction frequency:	751	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.5	(mW/cm^2)
Power density at prediction frequency:	0.472460	(mW/cm^2)
Maximum allowable antenna gain:	15.04604896	(dBi)
Margin of Compliance:	0.246048959	

6.3 Occupied Bandwidth

Clause 2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

Test Setup

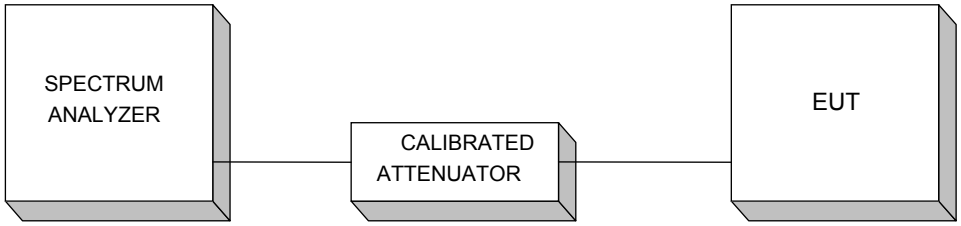


Table 6-2: Setting Remarks / Measurement Results – Occupied Bandwidth

Setting		Occupied Bandwidth (MHz) (Note: BPSK embedded in each modulation scheme)					
		QPSK		16 QAM		64 QAM	
		TX1	TX2	TX1	TX2	TX1	TX2
Frequency	751MHz	8.97	8.96	8.94	8.95	8.98	8.96
RBW	180kHz						
VBW	1.8MHz						
CH BW	10MHz						
Span	20MHz						
Sweep	1ms						
Reference Level Offset	51.0dB						
Detector	Peak						
Attenuation	10dB						

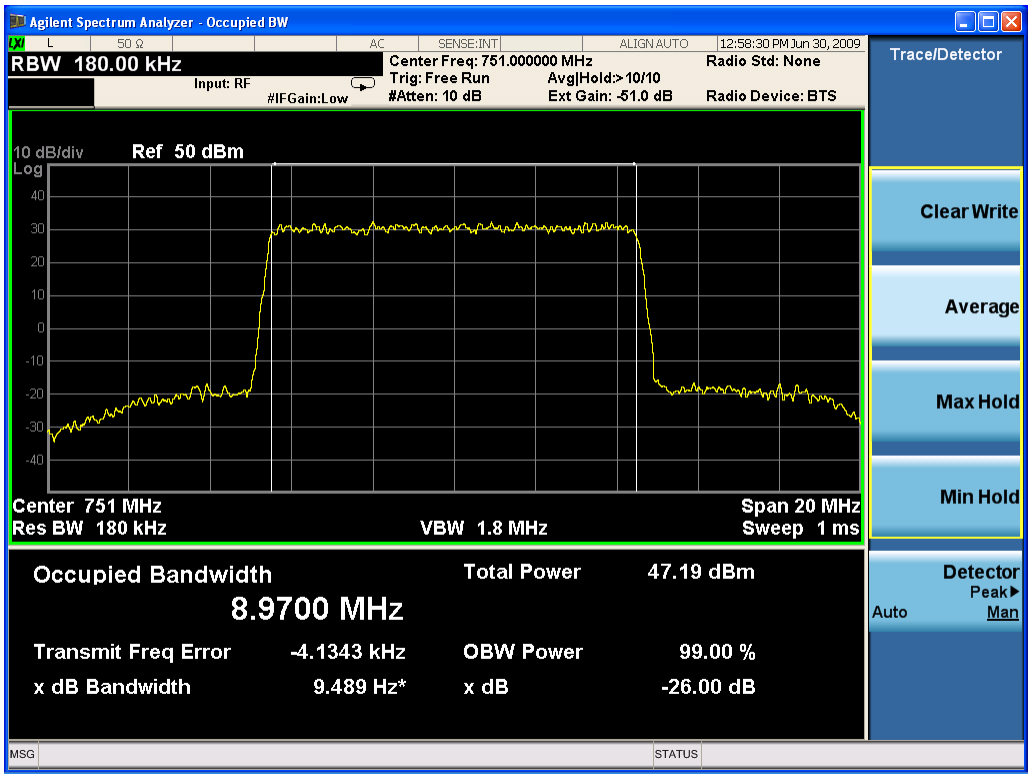


Figure 6-14: TX1_QPSK – Occupied Bandwidth

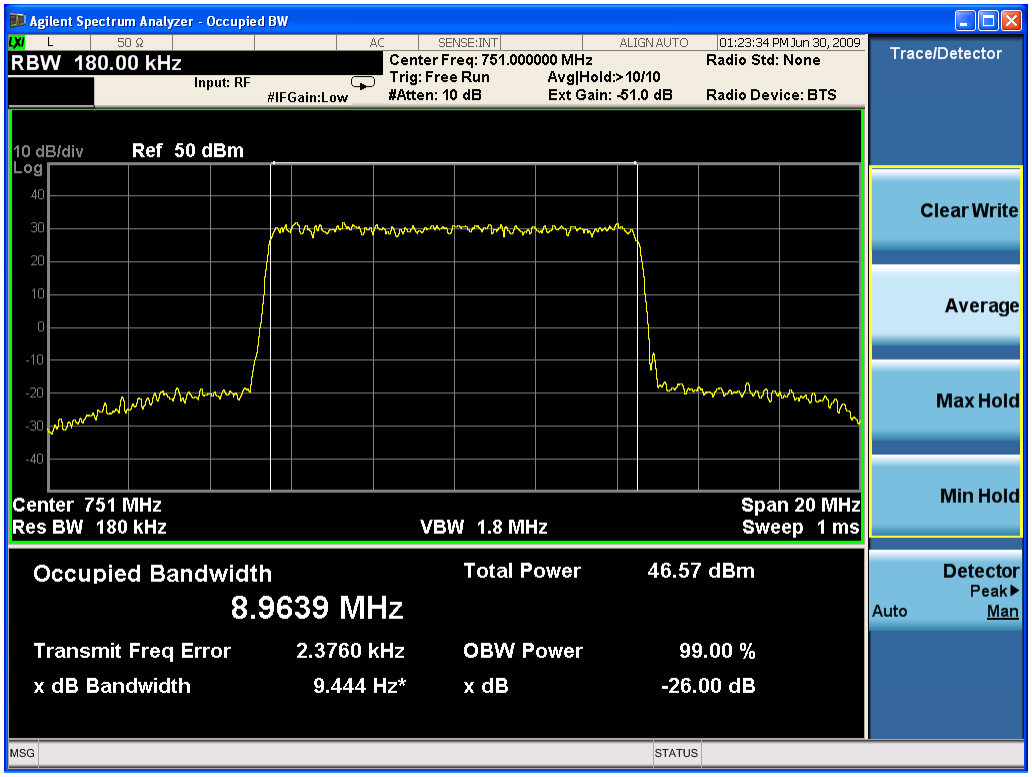


Figure 6-15: TX2_QPSK – Occupied Bandwidth

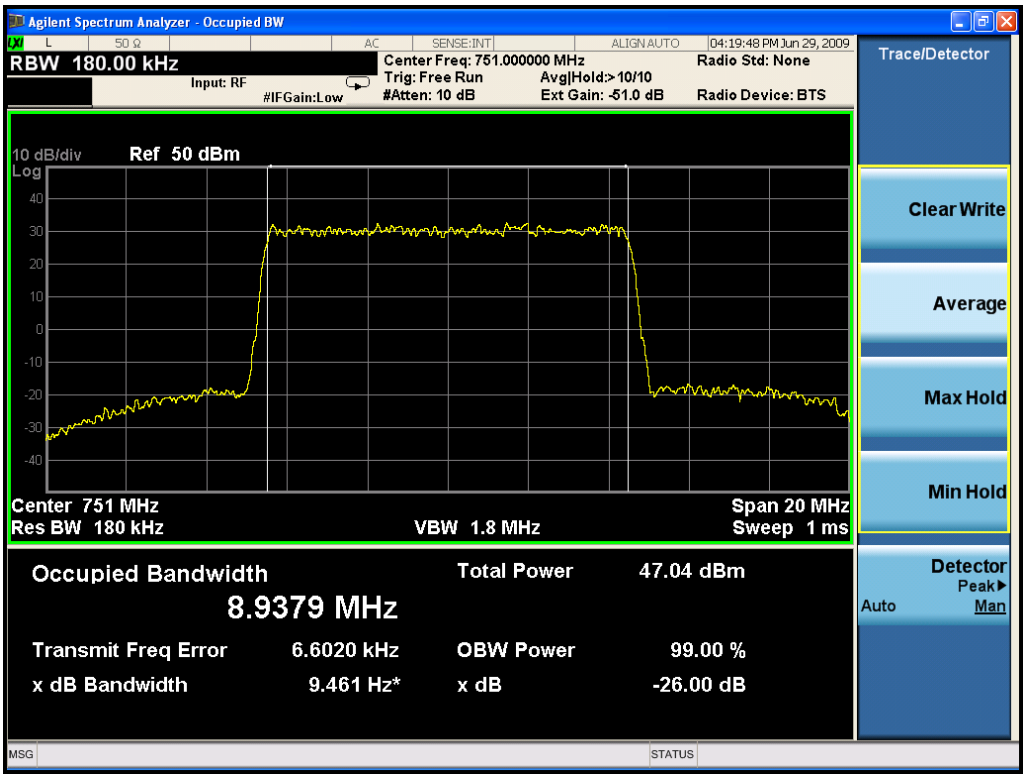


Figure 6-16: TX1_16 QAM – Occupied Bandwidth

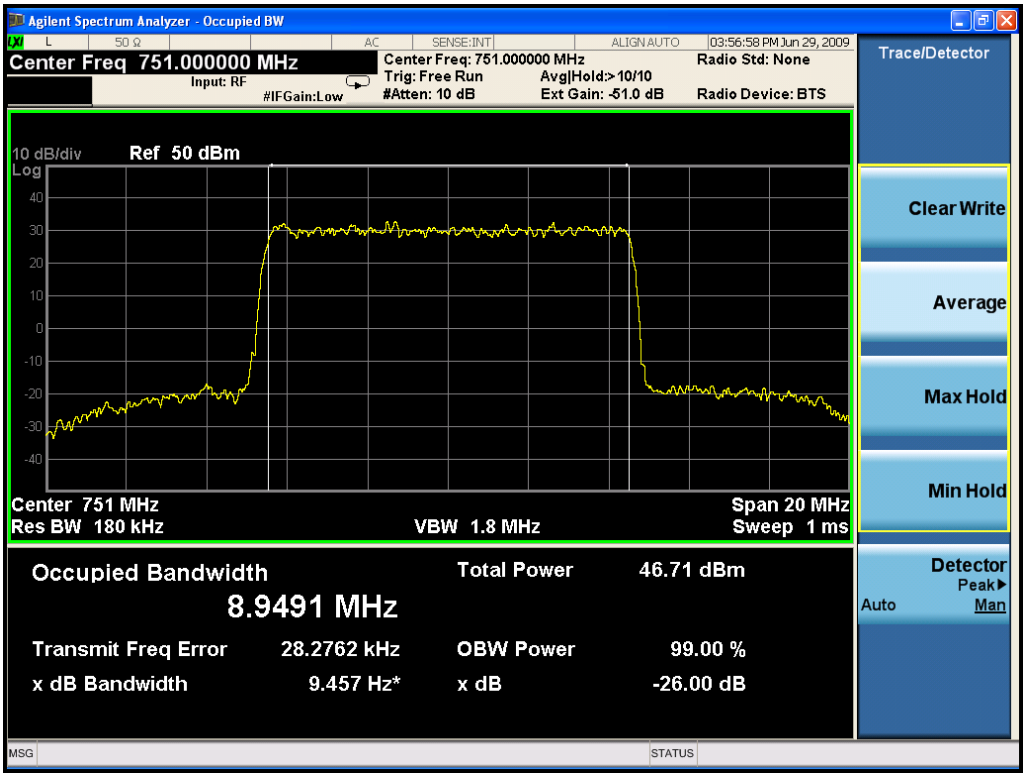


Figure 6-17: TX2_16 QAM – Occupied Bandwidth

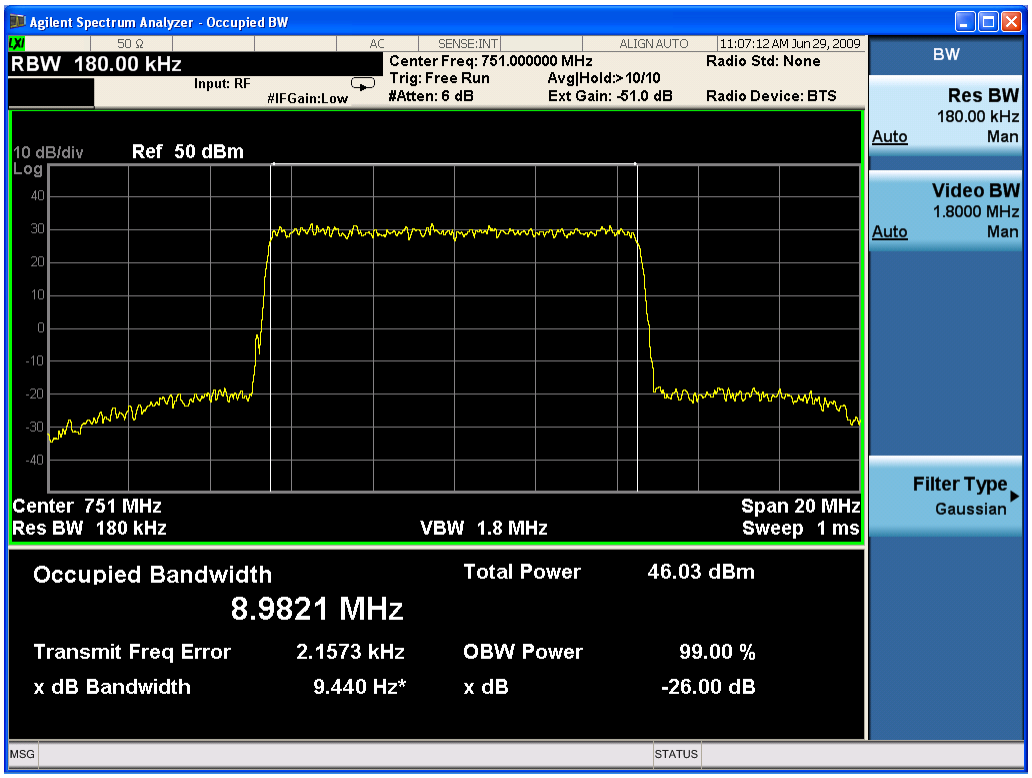


Figure 6-18: TX1_64 QAM – Occupied Bandwidth

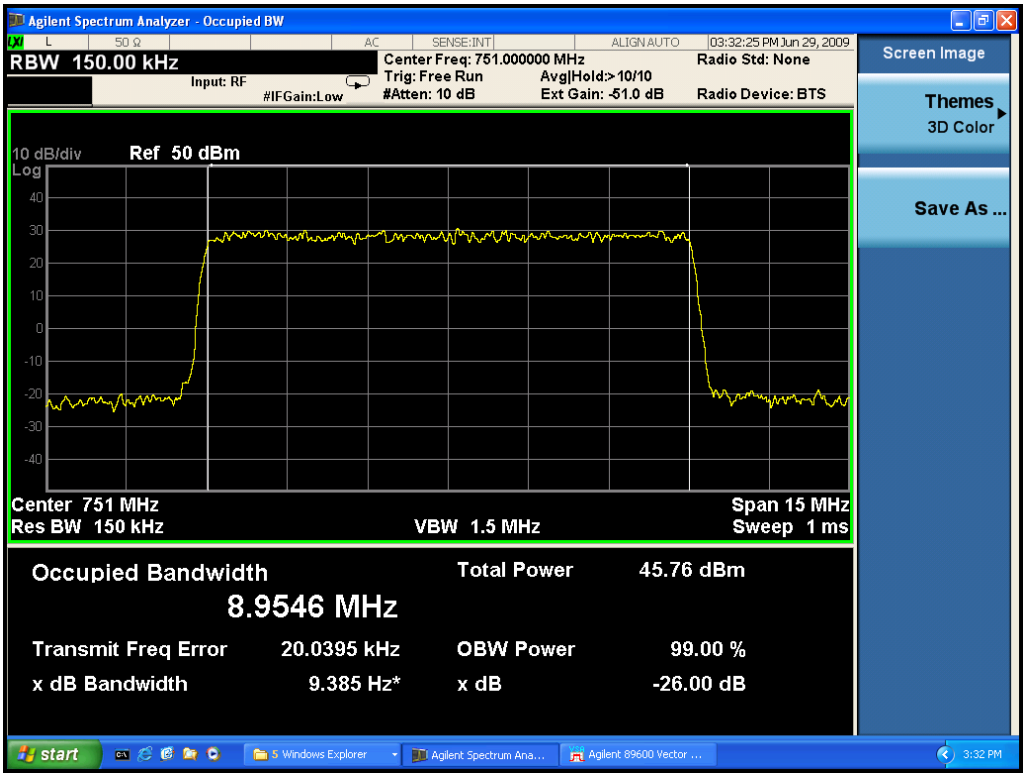


Figure 6-19: TX2_64 QAM – Occupied Bandwidth

6.4 Spurious emissions at the antenna terminal

Clause 27.53(c)

(c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

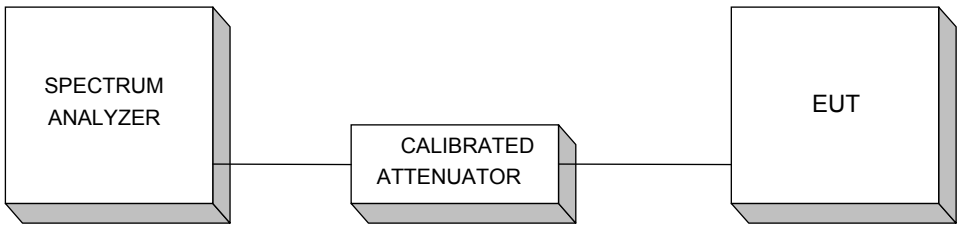
(3) On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(f) For operations in the 746–763 MHz, 775–793 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Test Setup:



FCC Section 27.53(c) (1), (5):

On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed

FCC Limit = $PWR_{(dBm)} - [\ 43 + 10\log(PWR_{(W)})\ ] = 46 - 43 + 10\log(40) = -13dBm$

Table 6-3: Setting Remarks / Measurement Results – Spurious Emissions Band Edge

Setting		**Spurious Emissions (dBm) FCC Limit -13dBm** (Note: BPSK embedded in each modulation scheme)					
		QPSK		**16 QAM**		**64 QAM**	
Measurement ACP		**TX1**	**TX2**	**TX1**	**TX2**	**TX1**	**TX2**
Frequency	751MHz	**Lower Edge Emission (746MHz)**					
RBW	30kHz	-28.15	-29.26	-28.43	-28.27	-29.52	-28.26
VBW	30kHz	**Upper Edge Emission (757MHz)**					
CH BW	10MHz	-27.00	-28.33	-27.34	-29.00	-27.30	-26.32
Reference Level Offset	51.0dB	**Margin to FCC Limit (dB)**					
Detector	RMS	15.15	16.26	15.43	15.27	16.52	15.26
Attenuation	6dB	14.00	15.33	14.34	16.00	14.30	13.32

Setting		**Spurious Emissions (dBm) FCC Limit -13dBm** (Note: BPSK embedded in each modulation scheme)		
		QPSK	**16 QAM**	**64 QAM**
Measurement ACP		**TX1 & TX2**	**TX1 & TX2**	**TX1 & TX2**
Frequency	751MHz	**Lower Edge Emission (746MHz)**		
RBW	30kHz	-25.15	-26.39	-25.70
VBW	30kHz	**Upper Edge Emission (757MHz)**		
CH BW	10MHz	-23.09	-23.69	-24.19
Reference Level Offset	51.0dB	**Margin to FCC Limit (dB)**		
Detector	RMS	12.15	13.39	12.70
Attenuation	6dB	10.09	10.69	11.19

Table 6-4: Setting Remarks / Measurement Results – Spurious Emissions < 2MHz

Setting Measurement ACP < 2MHz		Spurious Emissions (dBm) FCC Limit -13dBm (Note: BPSK embedded in each modulation scheme)					
		QPSK		16 QAM		64 QAM	
		TX1	TX2	TX1	TX2	TX1	TX2
Frequency	751MHz	-22.05	-22.45	-21.88	-22.40	-22.10	-22.66
RBW	30kHz						
VBW	30kHz						
CH BW	10MHz						
Reference Level Offset	51.0dB						
Detector	RMS	Margin to FCC Limit (dB)					
Attenuation	6dB	9.05	9.45	8.88	9.40	9.10	9.66

Table 6-5: Setting Remarks / Measurement Results – Spurious Emissions <1GHz

Setting Measurement < 1GHz		Spurious Emissions (dBm) FCC Limit -13dBm (Note: BPSK embedded in each modulation scheme)					
		QPSK		16 QAM		64 QAM	
		TX1	TX2	TX1	TX2	TX1	TX2
Frequency	751MHz	-39.25	-41.25	-43.54	-40.31	-39.51	-41.46
RBW	100kHz						
VBW	300kHz						
CH BW	10MHz						
Reference Level Offset	51.0dB						
Detector	RMS	Margin to FCC Limit (dB)					
Attenuation	6dB	26.25	28.25	30.54	27.31	26.51	28.46

Table 6-6: Setting Remarks / Measurement Results – Spurious Emissions > 1GHz

Setting Measurement > 1GHz		Spurious Emissions (dBm) FCC Limit -13dBm (Note: BPSK embedded in each modulation scheme)					
		QPSK		16 QAM		64 QAM	
		TX1	TX2	TX1	TX2	TX1	TX2
Frequency	751MHz	-26.08	-31.03	-26.85	-26.64	-29.62	-28.86
RBW	1MHz						
VBW	3MHz						
CH BW	10MHz						
Reference Level Offset	51.0dB						
Detector	RMS	Margin to FCC Limit (dB)					
Attenuation	6dB	13.08	18.03	13.85	13.64	16.62	15.86

Table 6-7: Setting Remarks / Measurement Results – Spurious Emissions 763 – 775MHz

Setting **Measurement 763-775MHz**		**Spurious Emissions (dBm) FCC Limit -46dBm/6.25kHz (-49.19dBm/3kHz)** (Note: BPSK embedded in each modulation scheme)					
		QPSK		**16 QAM**		**64 QAM**	
		TX1	**TX2**	**TX1**	**TX2**	**TX1**	**TX2**
Frequency	751MHz	-57.03	-54.96	-58.31	-57.07	-57.61	-54.71
RBW	3kHz						
VBW	10kHz						
CH BW	10MHz						
Reference Level Offset	67.0dB						
Detector	RMS	**Margin to FCC Limit (dB)**					
Attenuation	0dB	7.84	5.77	9.12	7.88	8.42	5.52

Setting **Measurement 763-775MHz**		**Spurious Emissions (dBm) FCC Limit -46dBm/6.25kHz (-49.19dBm/3kHz)** (Note: BPSK embedded in each modulation scheme)		
		QPSK	**16 QAM**	**64 QAM**
		Tx1 & Tx2	**Tx1 & Tx2**	**Tx1 & Tx2**
Frequency	751MHz	-54.20	-52.80	-56.44
RBW	3kHz			
VBW	10kHz			
CH BW	10MHz			
Reference Level Offset	67.0dB			
Detector	RMS	**Margin to FCC Limit (dB)**		
Attenuation	6dB	5.01	3.61	7.25

Table 6-8: Setting Remarks / Measurement Results – Spurious Emissions 793 – 805MHz

Setting Measurement 793 - 805MHz		Spurious Emissions (dBm) FCC Limit -46dBm/6.25kHz (-49.19dBm/3kHz) (Note: BPSK embedded in each modulation scheme)					
		QPSK		16 QAM		64 QAM	
		TX1	TX2	TX1	TX2	TX1	TX2
Frequency	751MHz	-59.39	-59.52	-56.94	-55.42	-58.37	-56.84
RBW	3kHz						
VBW	10kHz						
CH BW	10MHz						
Reference Level Offset	63.0dB						
Detector	RMS	Margin to FCC Limit (dB)					
Attenuation	0dB	10.20	10.33	7.75	6.23	9.18	7.65

Setting Measurement 793-805MHz		Spurious Emissions (dBm) FCC Limit -46dBm/6.25kHz (-49.19dBm/3kHz) (Note: BPSK embedded in each modulation scheme)		
		QPSK	16 QAM	64 QAM
		Tx1 & Tx2	Tx1 & Tx2	Tx1 & Tx2
Frequency	751MHz	-58.51	-55.73	-56.36
RBW	3kHz			
VBW	10kHz			
CH BW	10MHz			
Reference Level Offset	67.0dB			
Detector	RMS	Margin to FCC Limit (dB)		
Attenuation	0dB	9.32	6.54	7.17

FCC Section 27.53(c)(3):

Based on a measurement resolution bandwidth of 6.25 kHz, all frequencies between 763 to 775 MHz and 793 to 805 MHz shall be attenuated at least 76 + 10log (P) dB

= -46 dBm/6.25 kHz = -49.19dBm/3kHz.

Measurement BW = 3kHz (3kHz RBW Limit = -46 – 10log(6.25/3) = -49.19dBm)

Table 6-9: Setting Remarks / Measurement Results: Spurious Emissions 1559 – 1610MHz

Setting **Measurement 1559 – 1610MHz**		**Spurious Emissions (dBm) FCC Limit -80dBW EIRP** (Note: BPSK embedded in each modulation scheme)					
		QPSK		**16 QAM**		**64 QAM**	
		TX1	**TX2**	**TX1**	**TX2**	**TX1**	**TX2**
Frequency	751MHz	-85.52	-84.85	-91.97	-92.05	-92.00	-92.31
RBW	1MHz						
VBW	3MHz						
CH BW	10MHz						
Reference Level Offset	0dB						
Detector	RMS	**Margin to FCC Limit (dB)**					
Attenuation	0dB	20.72	20.05	27.17	27.25	27.20	27.51

Setting **Measurement 1559 – 1610MHz**		**Spurious Emissions (dBm) FCC Limit -80dBW EIRP** (Note: BPSK embedded in each modulation scheme)		
		QPSK	**16 QAM**	**64 QAM**
		Tx1 & Tx2	**Tx1 & Tx2**	**Tx1 & Tx2**
Frequency	751MHz	-91.06	-91.13	-85.23
RBW	3kHz			
VBW	10kHz			
CH BW	10MHz			
Reference Level Offset	67.0dB			
Detector	RMS	**Margin to FCC Limit (dB)**		
Attenuation	0dB	26.26	26.33	20.43

Note: Emissions were below the SA noise floor which is shown in the table.

FCC Section 27.53(c) (6):

Emissions in the band 1559 - 1610 MHz shall be limited to -80dBW EIRP for discrete emissions of less than 700Hz BW.

Antenna Gain = 14.8dBi

Limit = -80dBW + Antenna Gain = -64.8dBm

Margin = Limit – Measurement

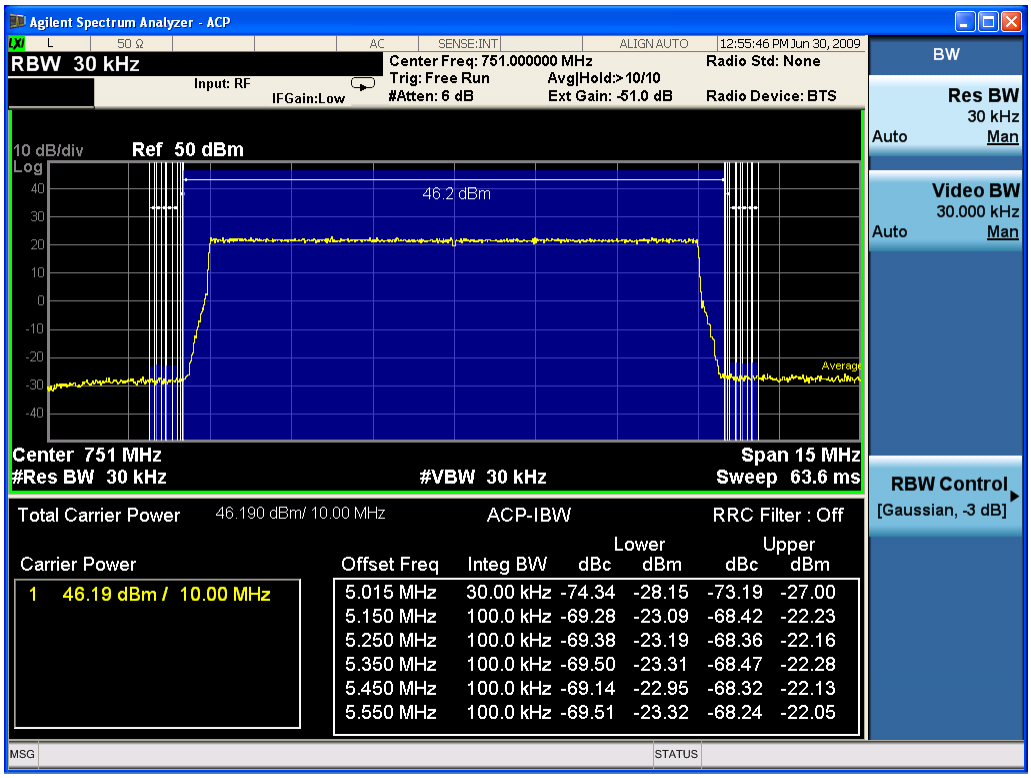


Figure 6-20: Spurious Emissions TX1_QPSK Band Edge (ACP 15kHz – 550kHz)

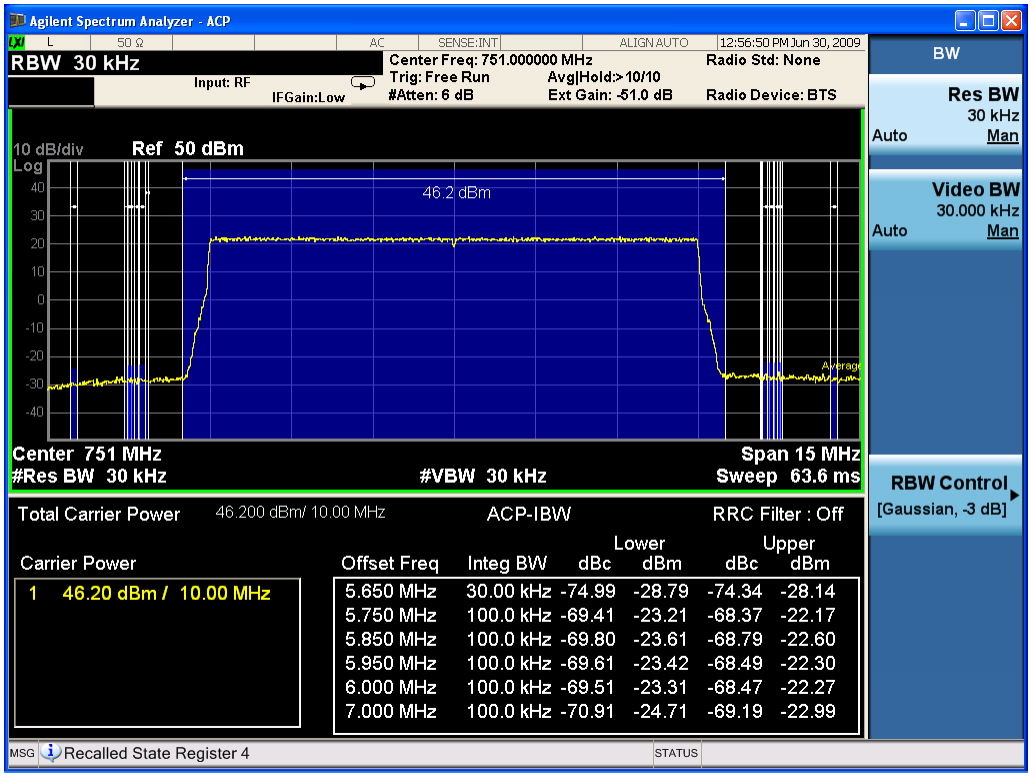


Figure 6-21: Spurious Emissions TX1_QPSK Band Edge (ACP 650kHz – 2MHz)

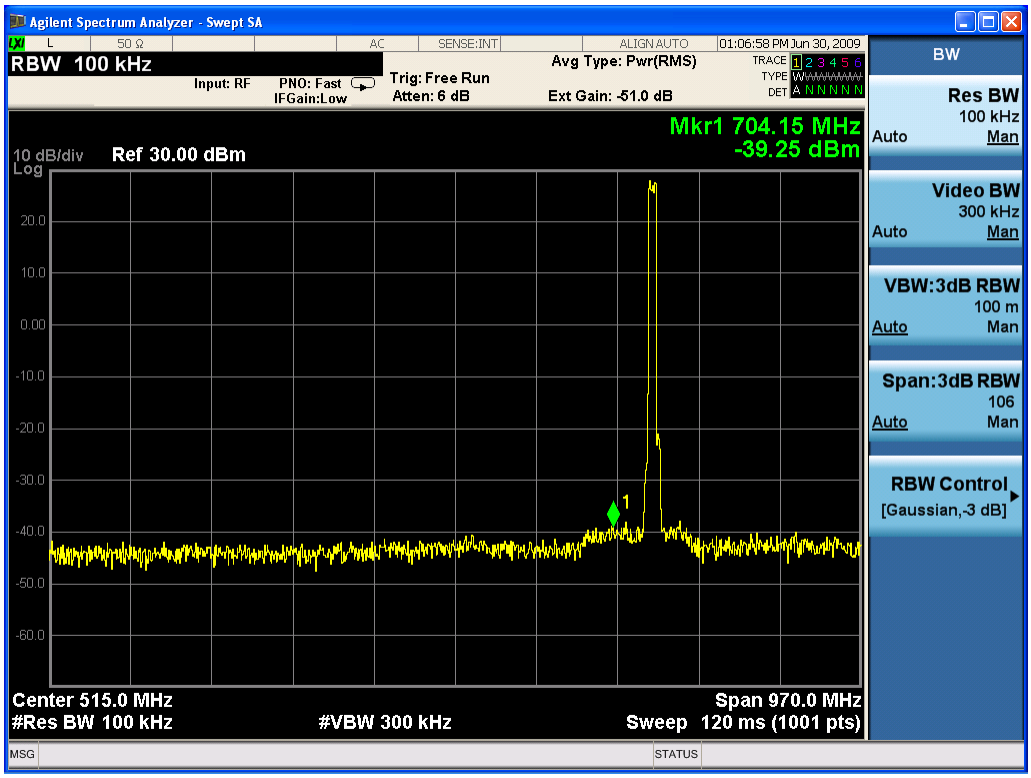


Figure 6-22: Spurious Emissions TX1_QPSK (30MHz – 1GHz)

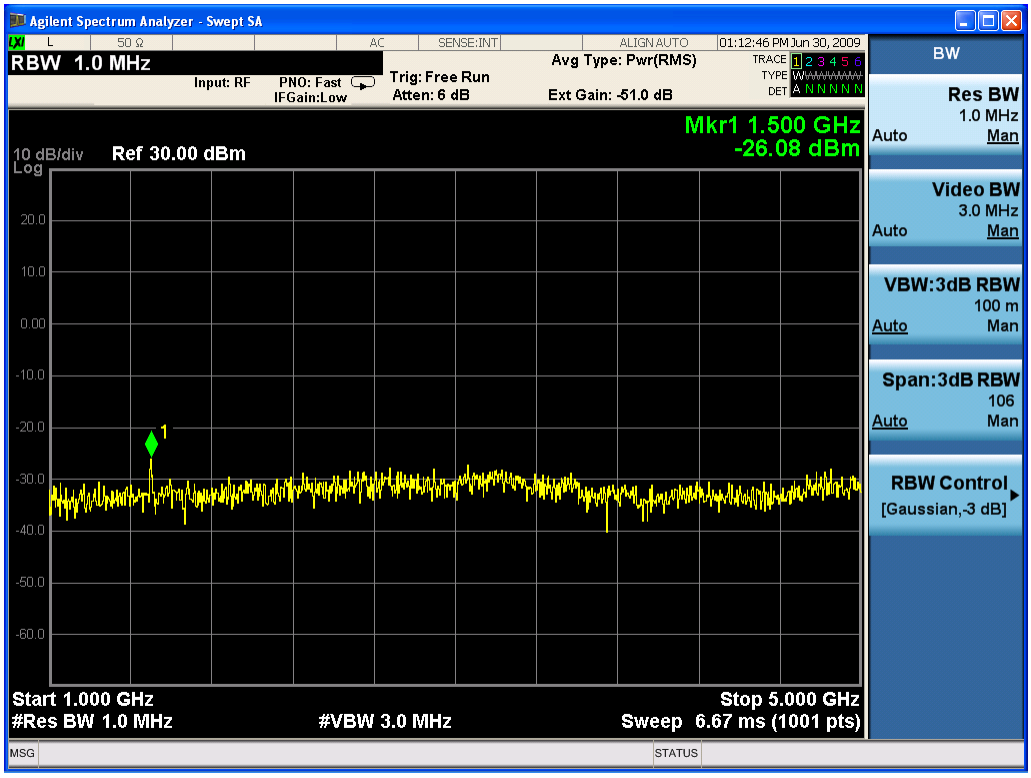


Figure 6-23: Spurious Emissions TX1_QPSK (1GHz-5GHz)

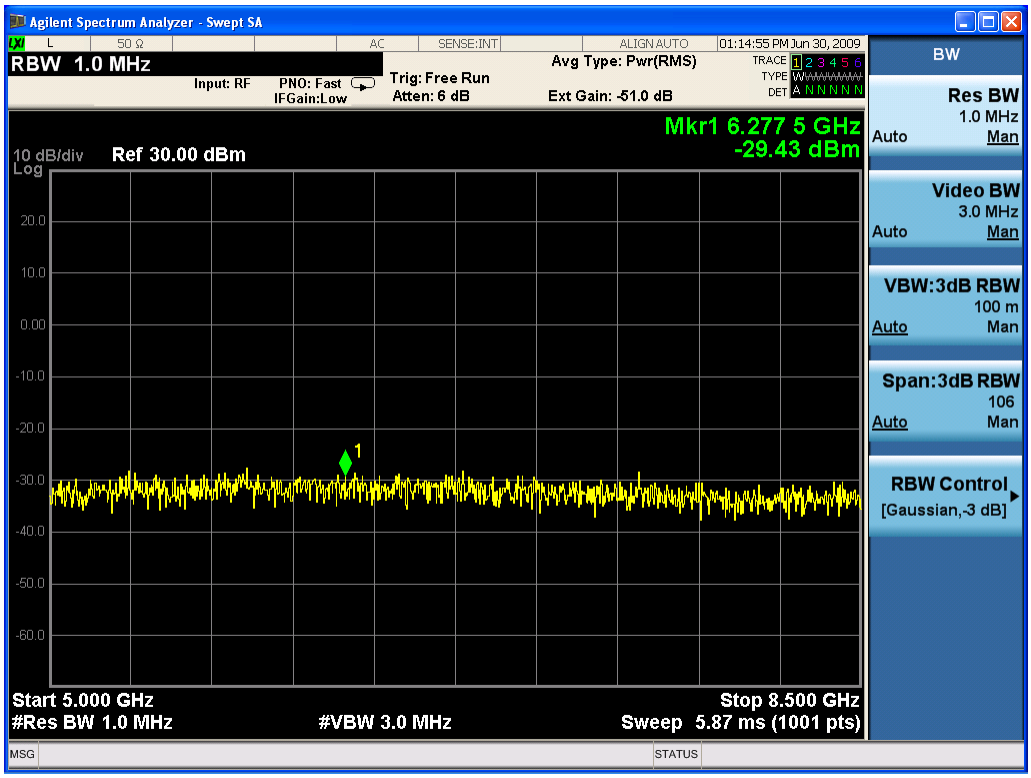


Figure 6-24: Spurious Emissions TX1_QPSK (5GHz-8.5GHz)

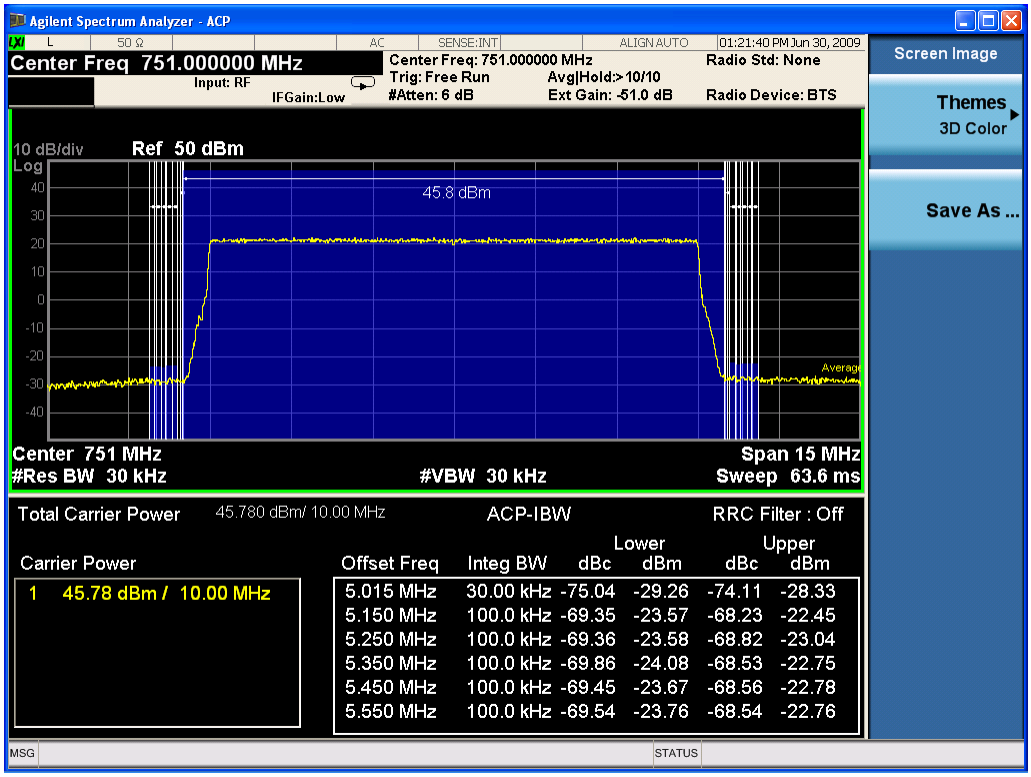


Figure 6-25: Spurious Emissions TX2_QPSK Band Edge (ACP 15kHz – 550kHz)

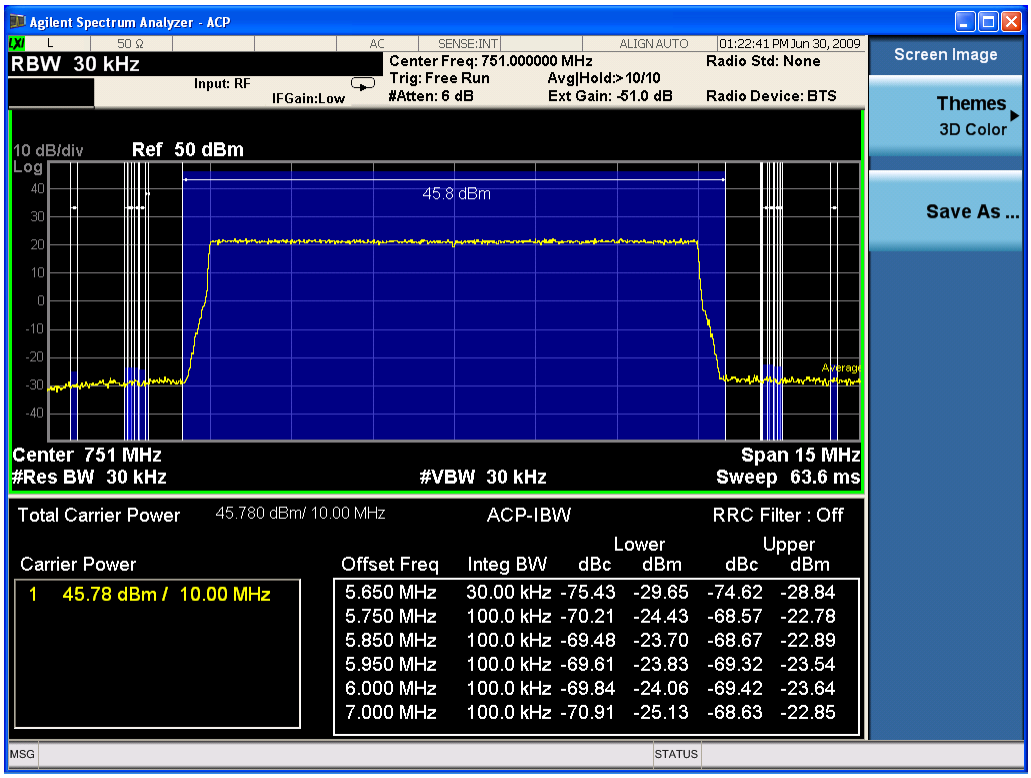


Figure 6-26: Spurious Emissions TX2_QPSK Band Edge (ACP 650kHz – 2MHz)

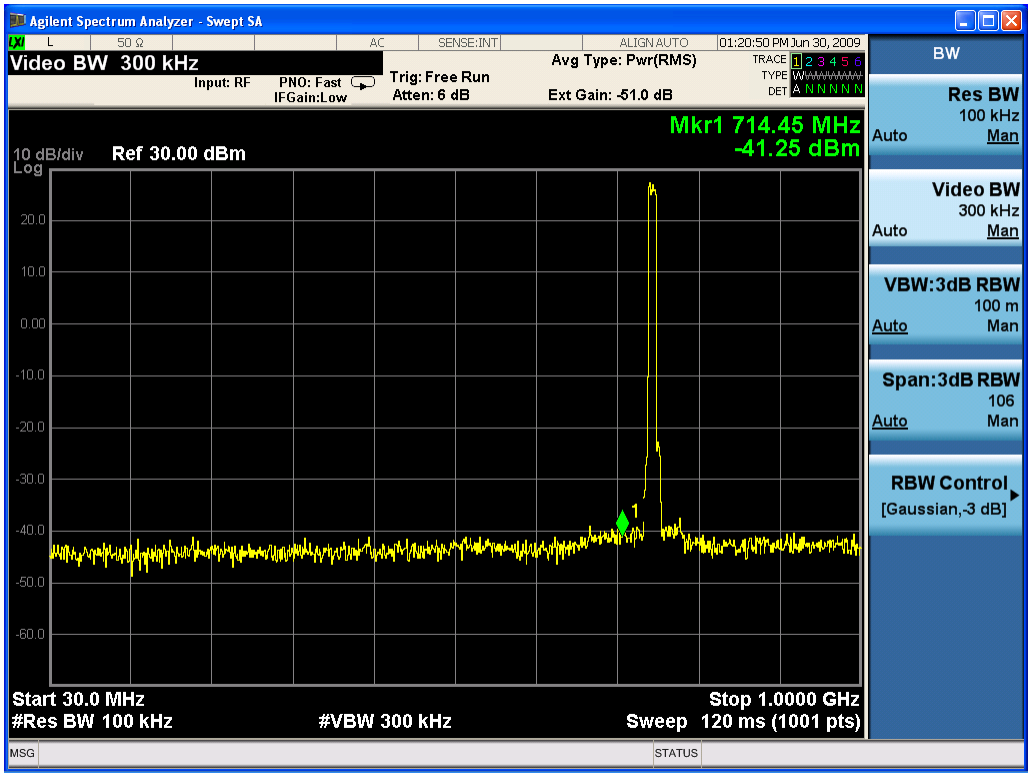


Figure 6-27: Spurious Emissions TX2_QPSK (30MHz – 1GHz)

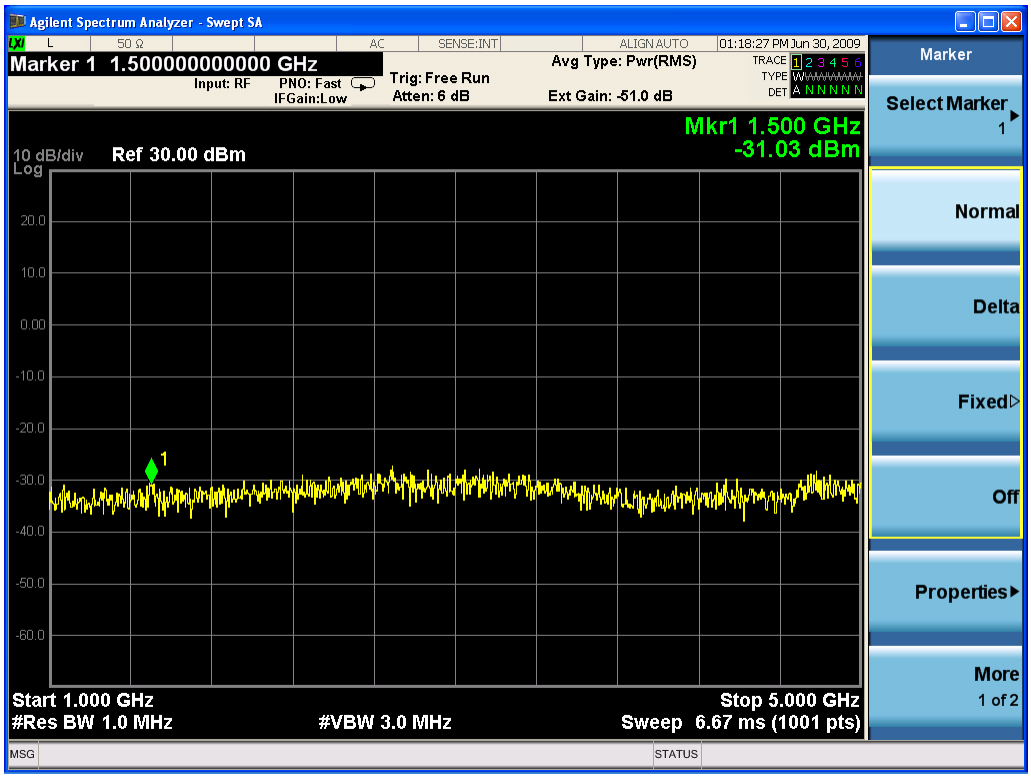


Figure 6-28: Spurious Emissions TX2_QPSK (1GHz-5GHz)

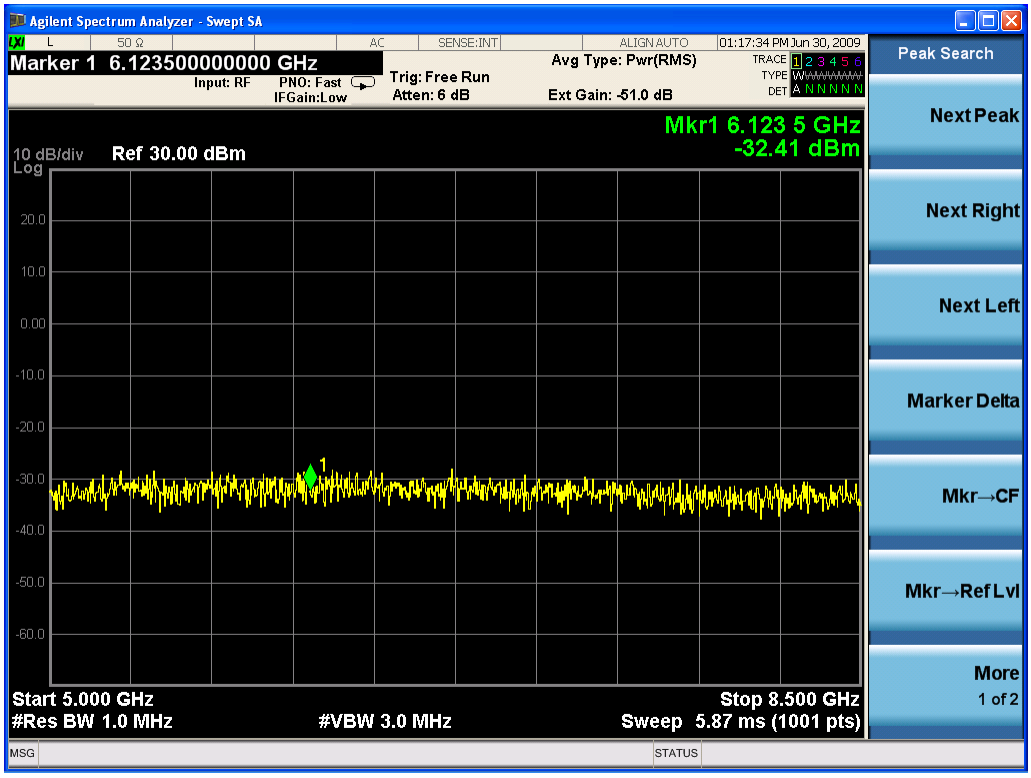


Figure 6-29: Spurious Emissions TX2_QPSK (5GHz-8.5GHz)

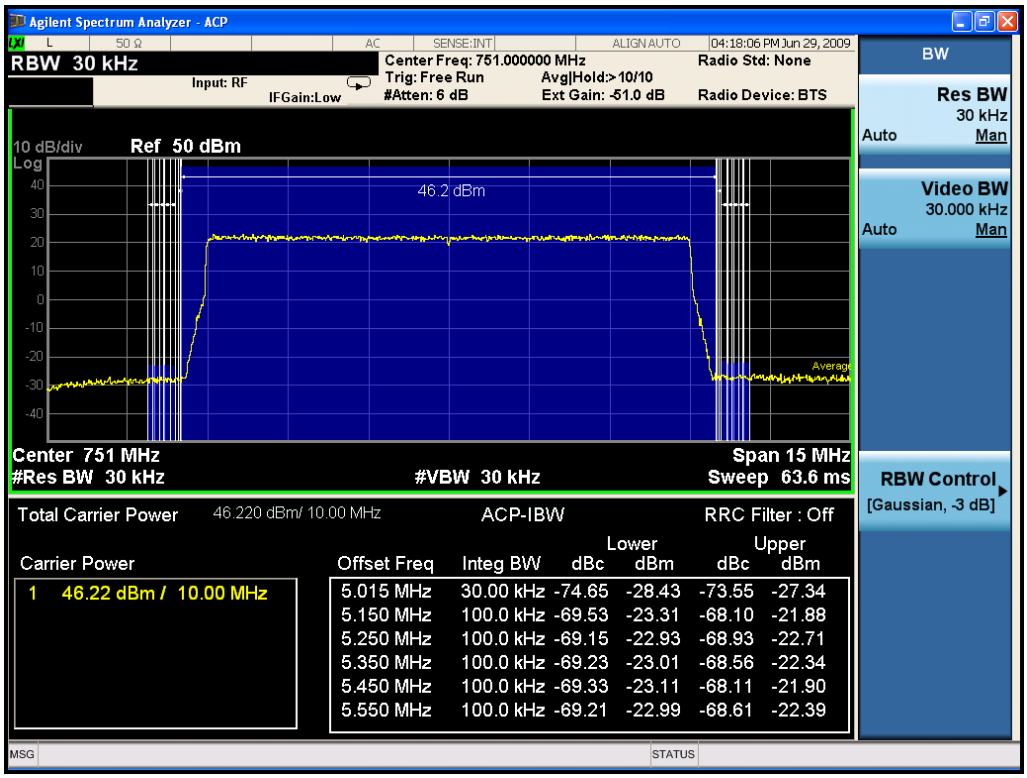


Figure 6-30: Spurious Emissions TX1_16 QAM Band Edge (ACP 15kHz – 550kHz)

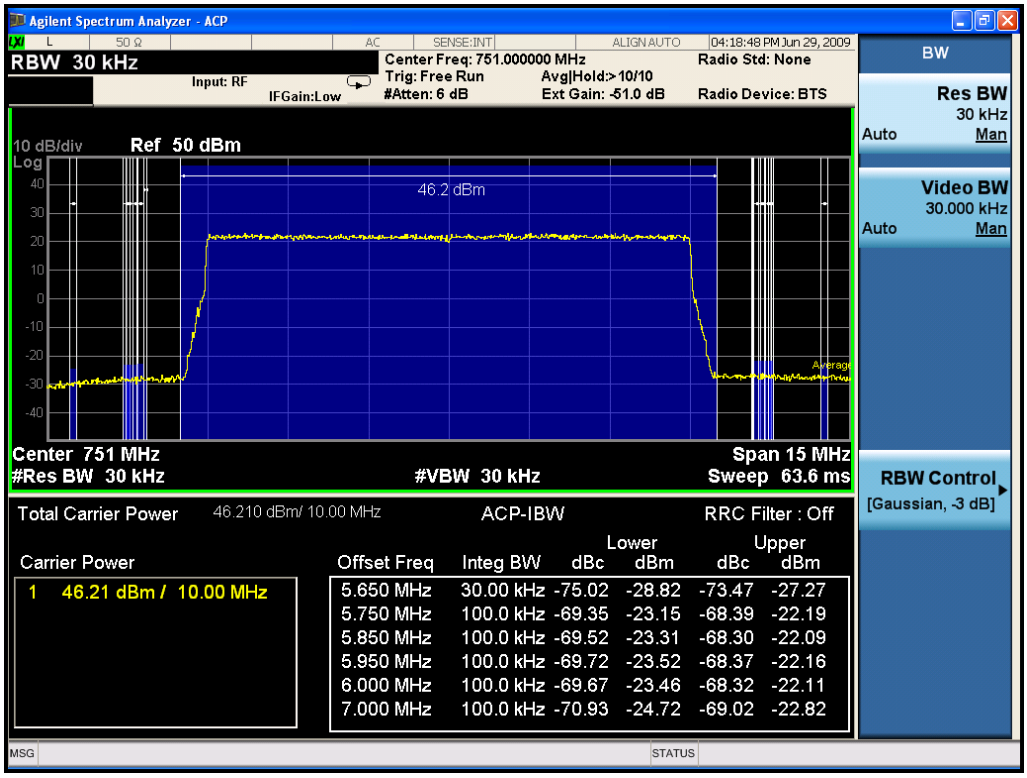


Figure 6-31: Spurious Emissions TX1_16 QAM Band Edge (ACP 650kHz – 2MHz)

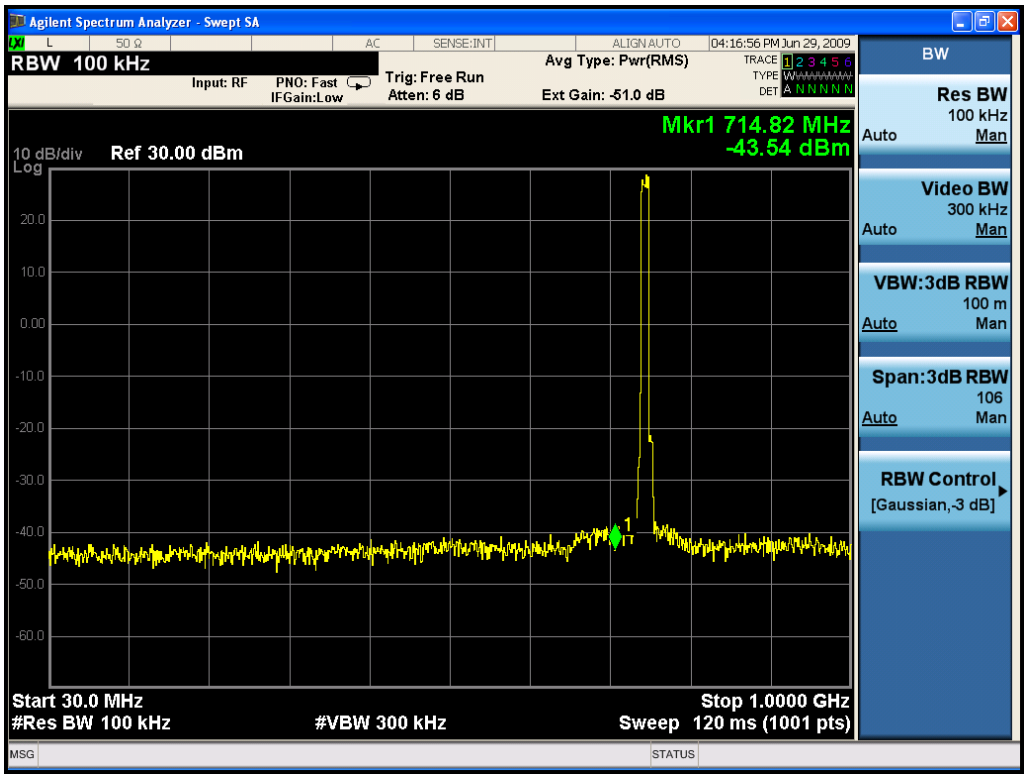


Figure 6-32: Spurious Emissions TX1_16 QAM (30MHz – 1GHz)

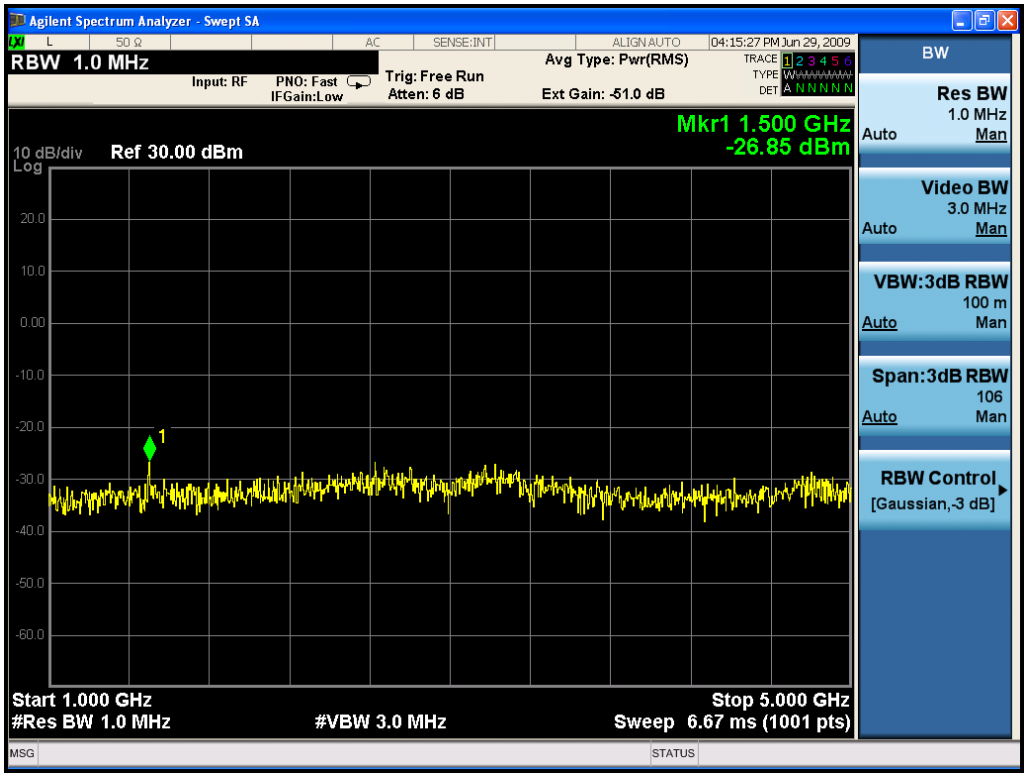


Figure 6-33: Spurious Emissions TX1_16 QAM (1GHz-5GHz)

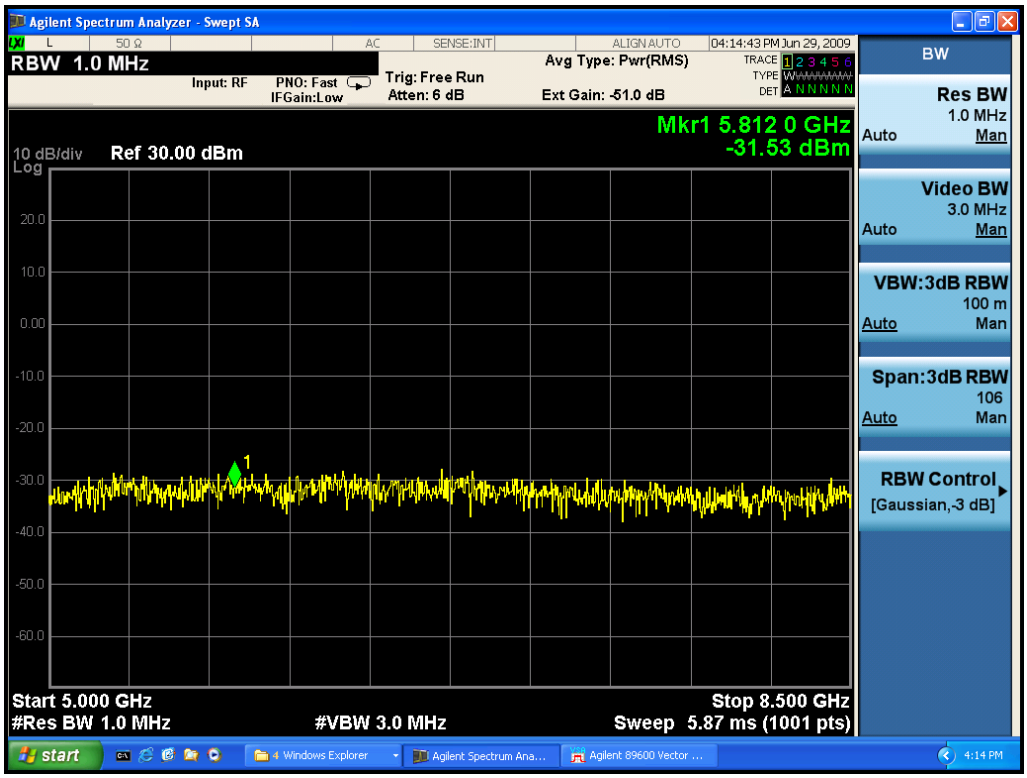


Figure 6-34: Spurious Emissions TX1_16 QAM (5GHz-8.5GHz)

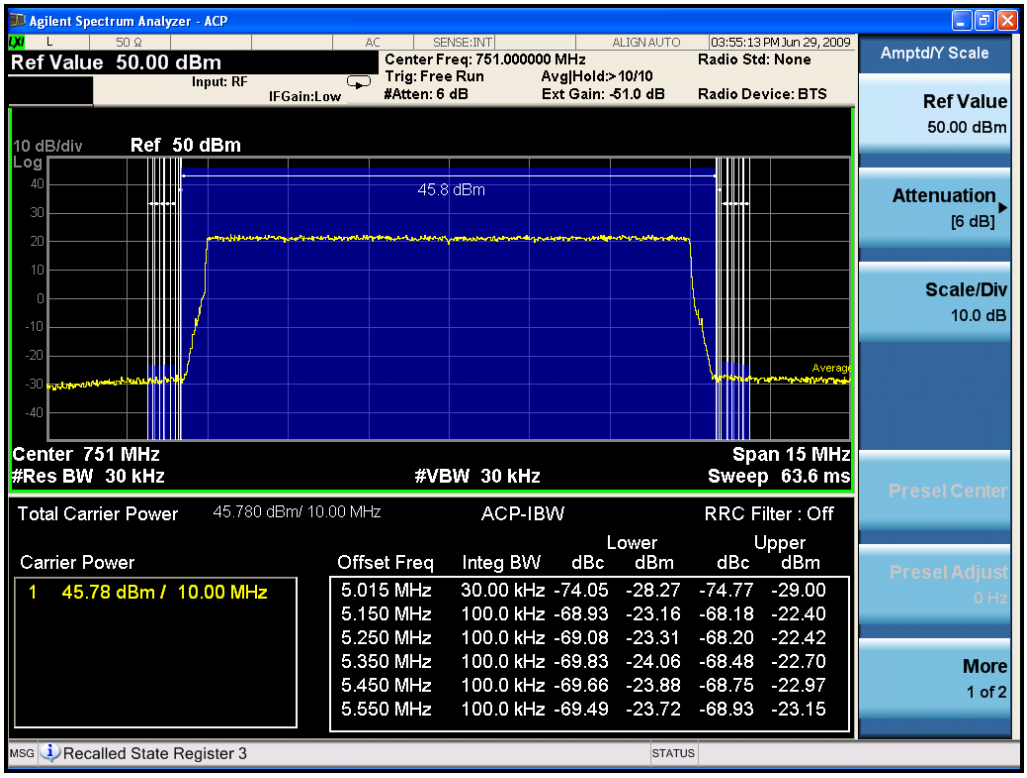


Figure 6-35: Spurious Emissions TX2_16 QAM Band Edge (ACP 15kHz – 550kHz)

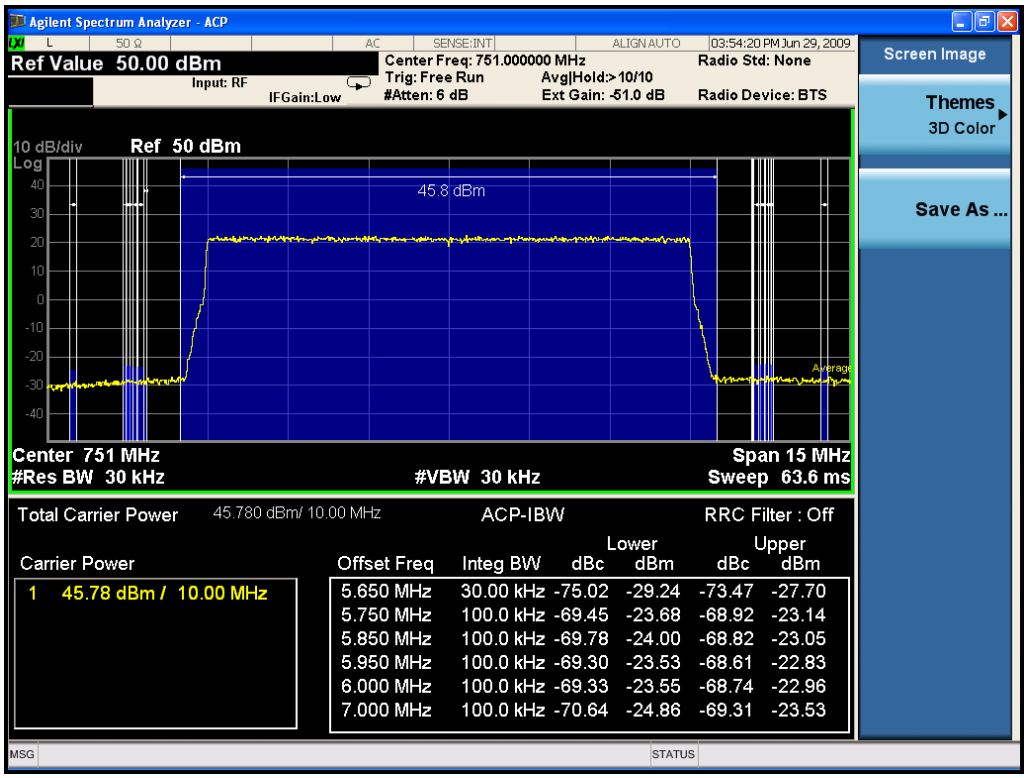


Figure 6-36: Spurious Emissions TX2_16 QAM Band Edge (ACP 650kHz – 2MHz)

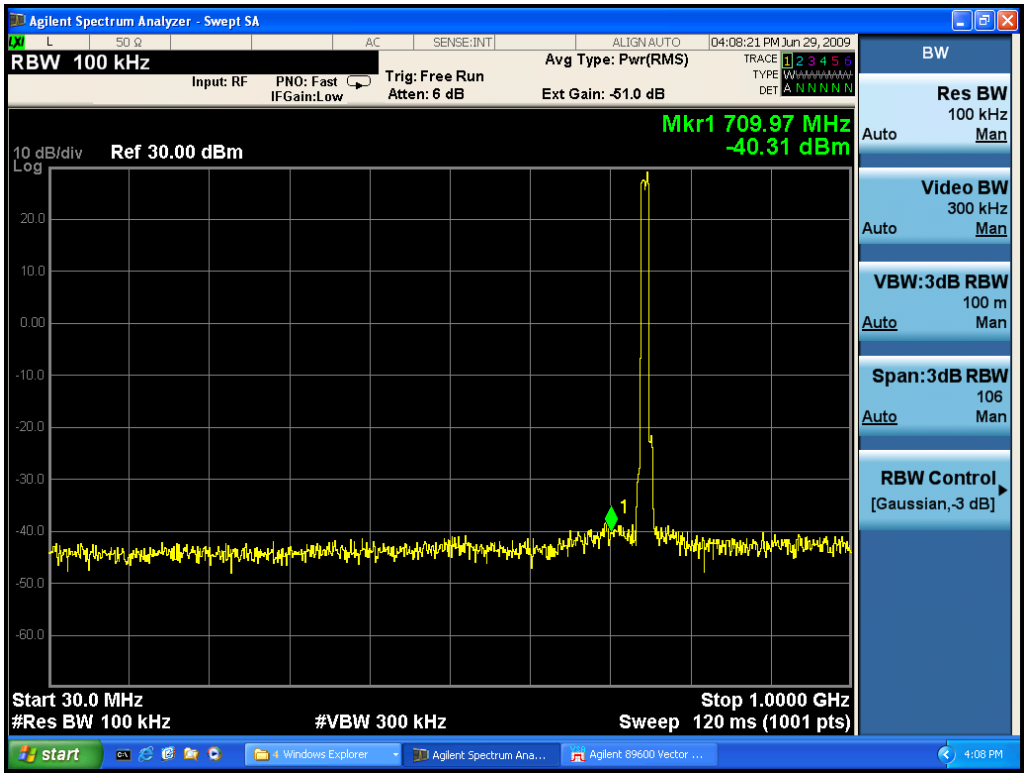


Figure 6-37: Spurious Emissions TX2_16 QAM (30MHz – 1GHz)

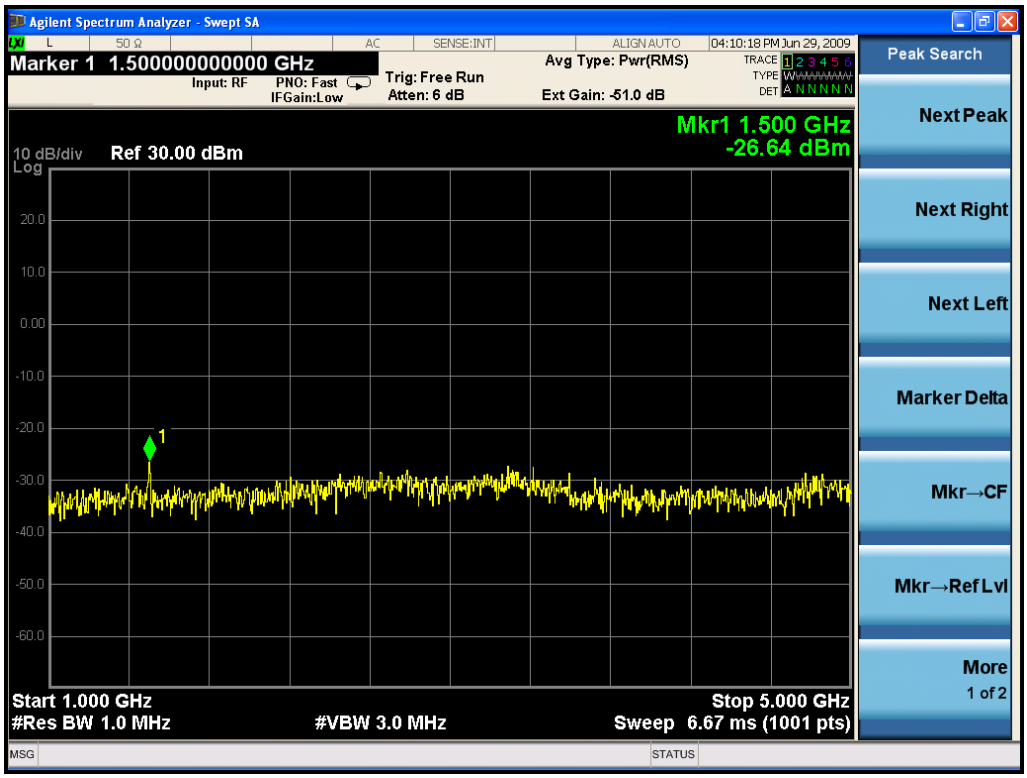


Figure 6-38: Spurious Emissions TX2_16 QAM (1GHz – 5GHz)

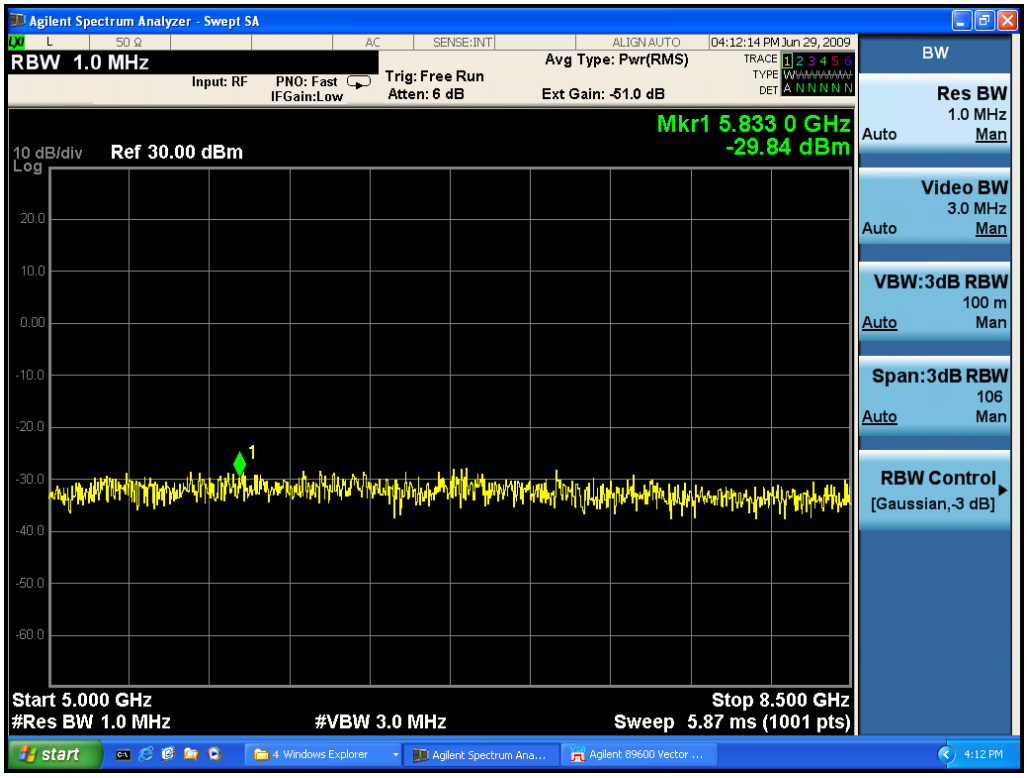


Figure 6-39: Spurious Emissions TX2_16 QAM (5GHz – 8.5GHz)

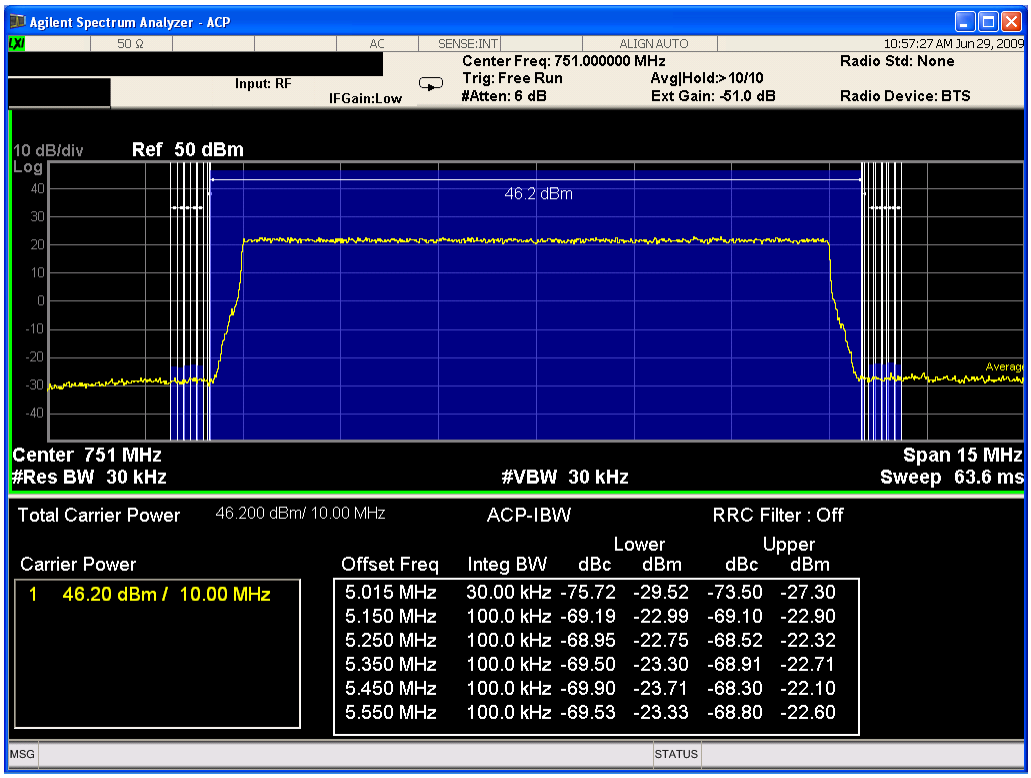


Figure 6-40: Spurious Emissions TX1_64 QAM Band Edge (ACP 15kHz – 550kHz)

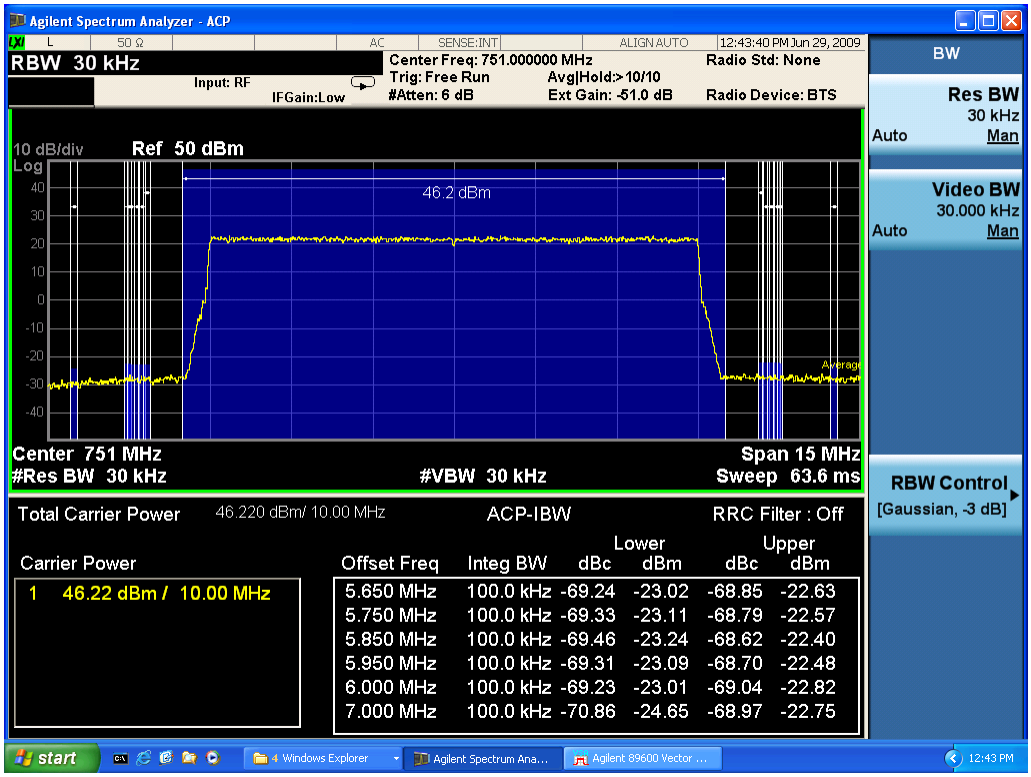


Figure 6-41: Spurious Emissions TX1_64 QAM Band Edge (ACP 650kHz – 2MHz)

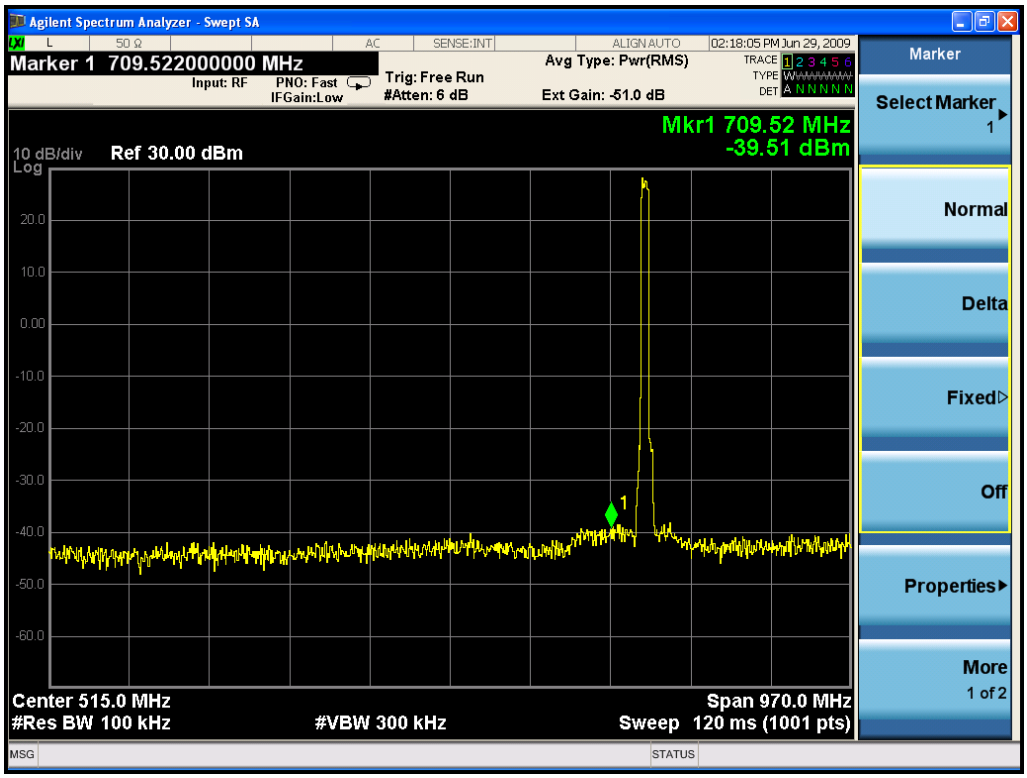


Figure 6-42: Spurious Emissions TX1_64 QAM (30MHz – 1GHz)

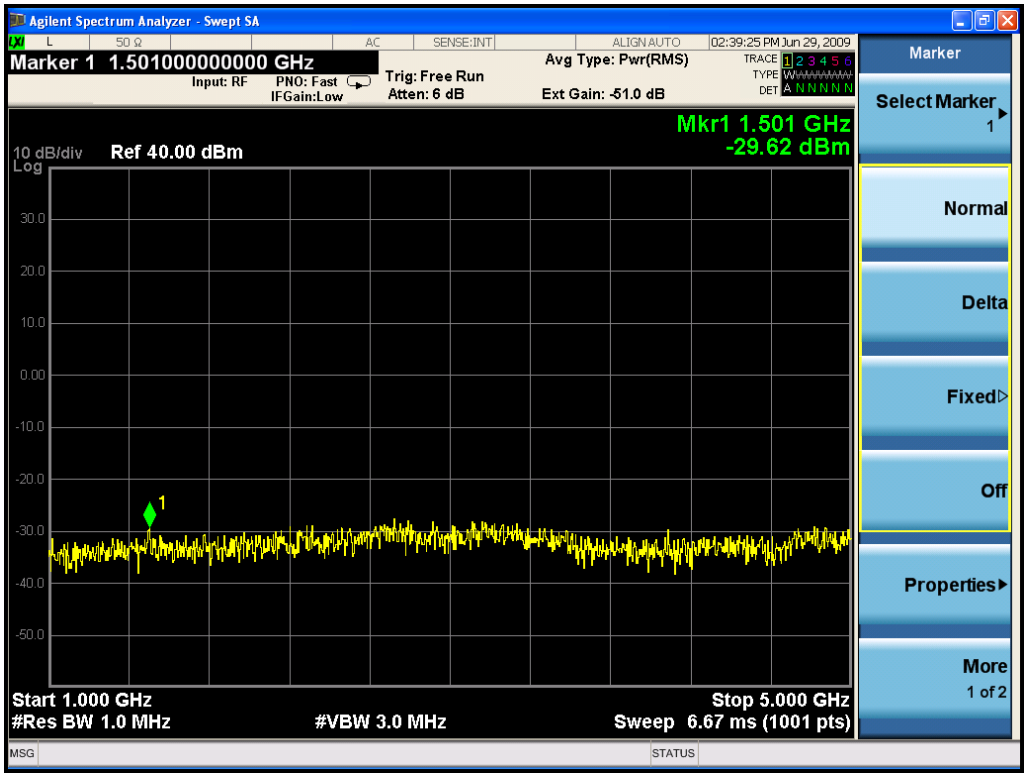


Figure 6-43: Spurious Emissions TX1_64 QAM (1GHz – 5GHz)

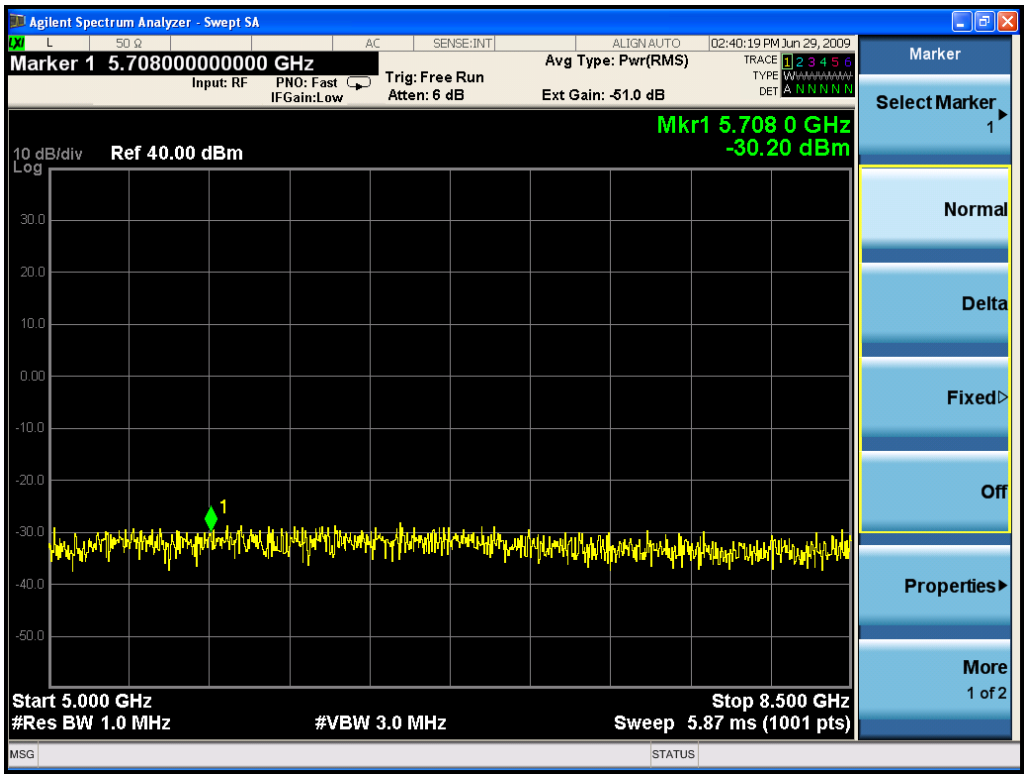


Figure 6-44: Spurious Emissions TX1_64 QAM (5GHz – 8.5GHz)

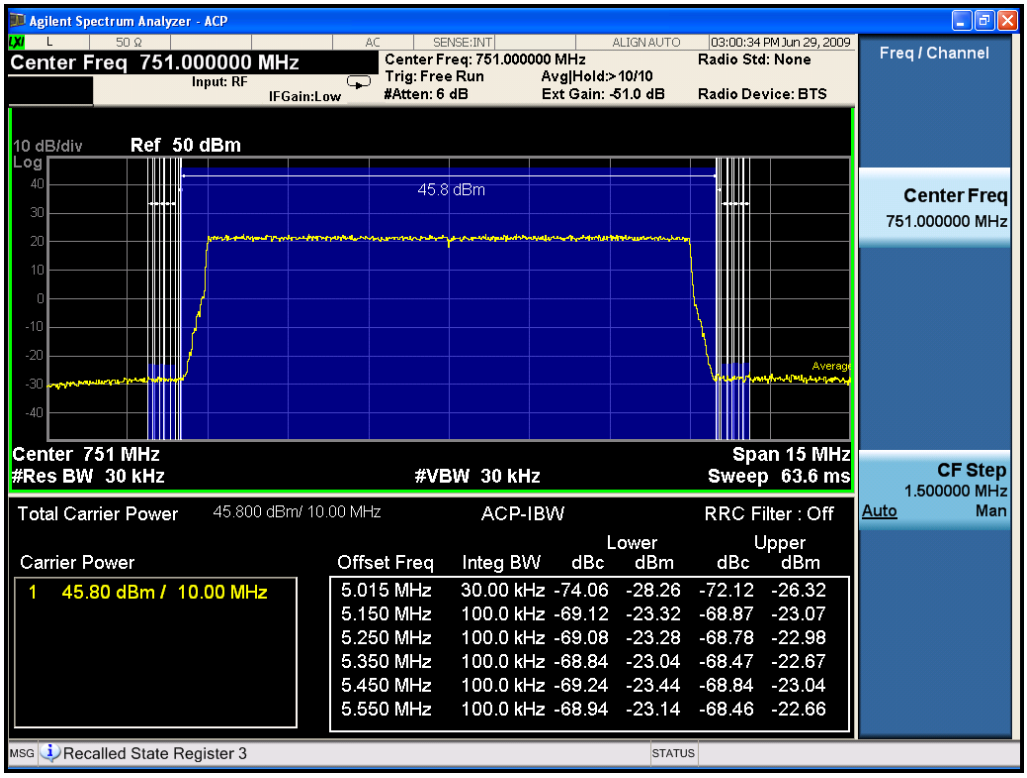


Figure 6-45: Spurious Emissions TX2_64 QAM Band Edge (ACP 15kHz – 550kHz)

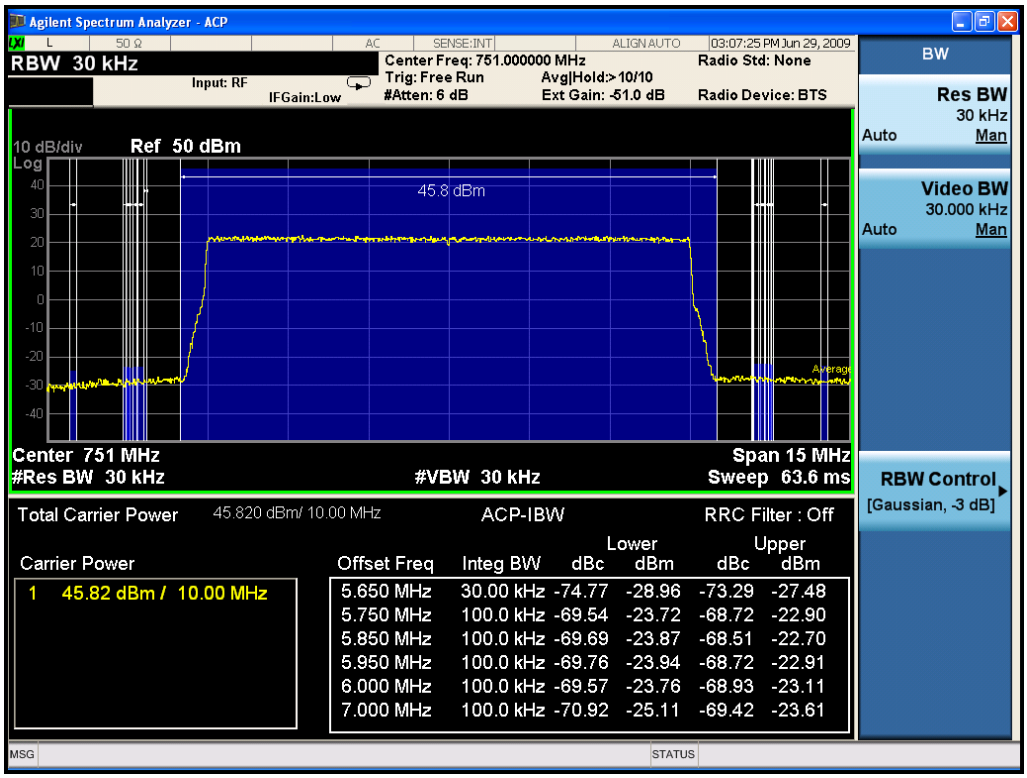


Figure 6-46: Spurious Emissions TX2_64 QAM Band Edge (ACP 650kHz – 2MHz)

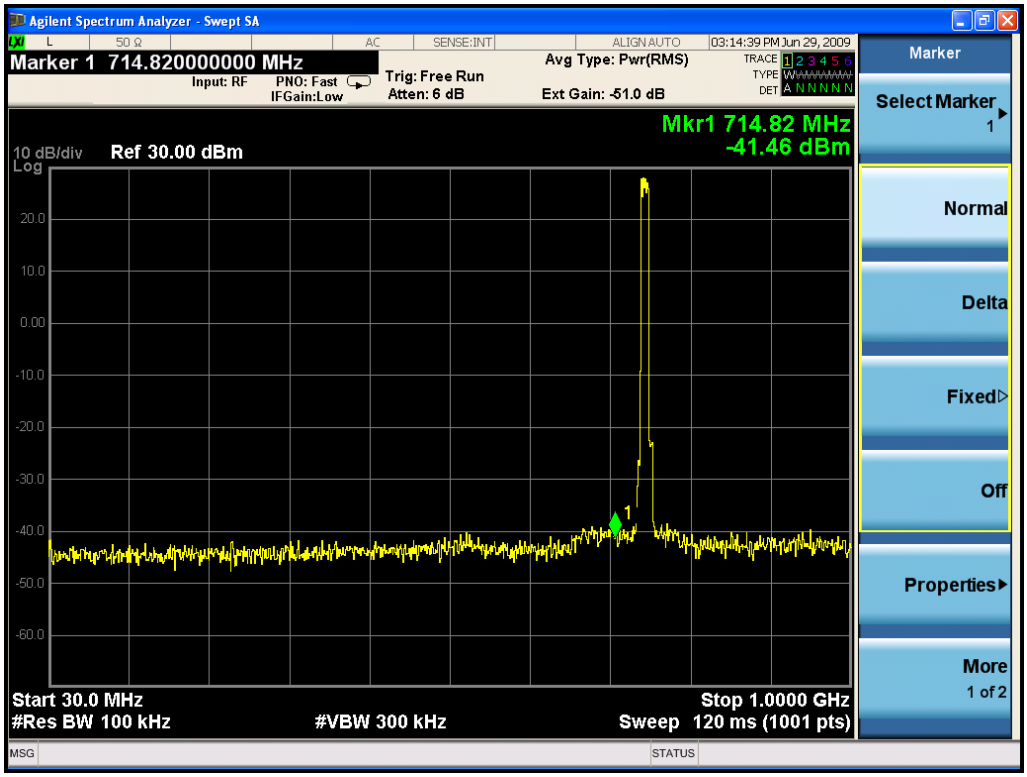


Figure 6-47: Spurious Emissions TX2_64 QAM (30MHz – 1GHz)

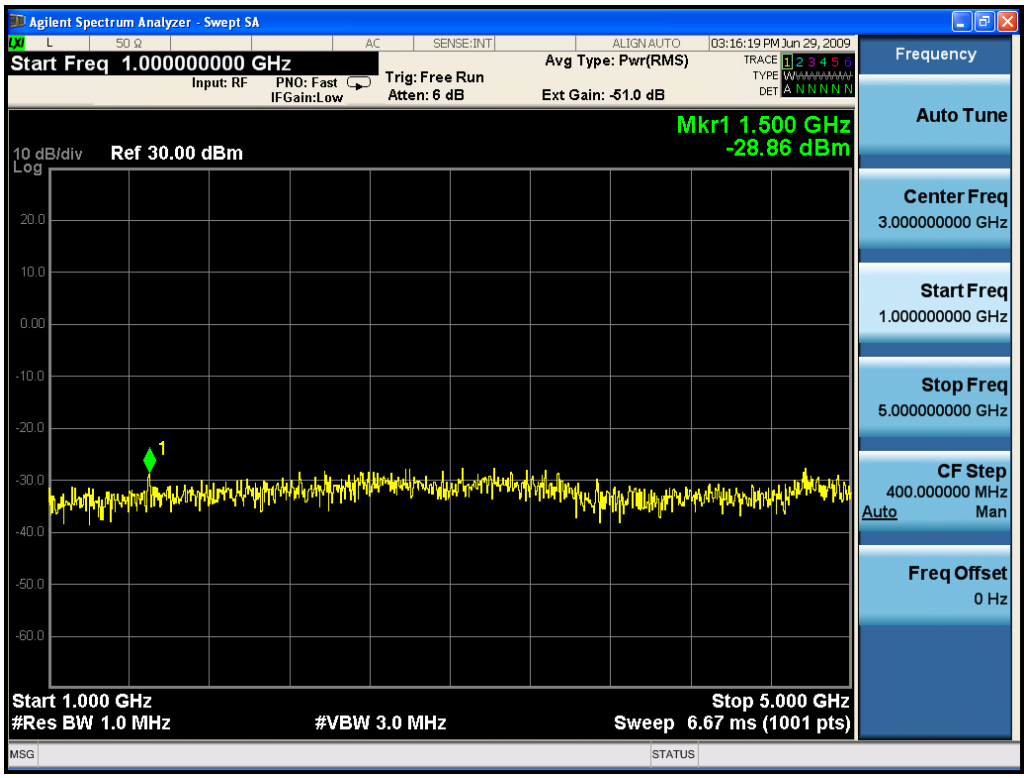


Figure 6-48: Spurious Emissions TX1_64 QAM (1GHz – 5GHz)

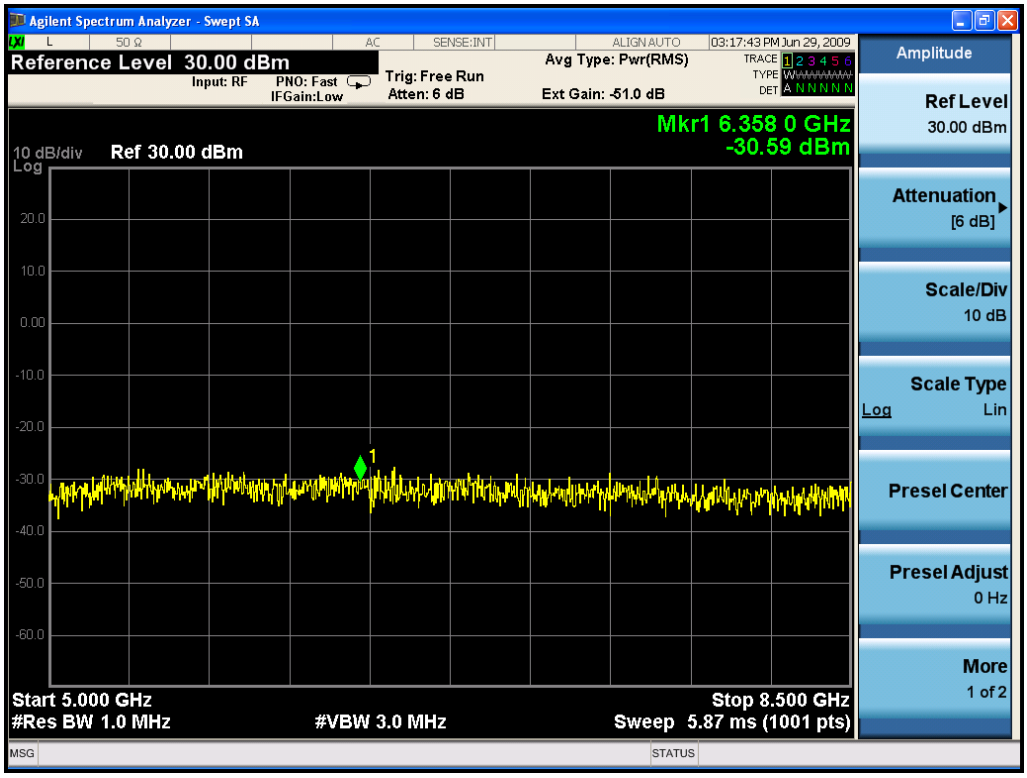


Figure 6-49: Spurious Emissions TX1_64 QAM (5GHz – 8.5GHz)

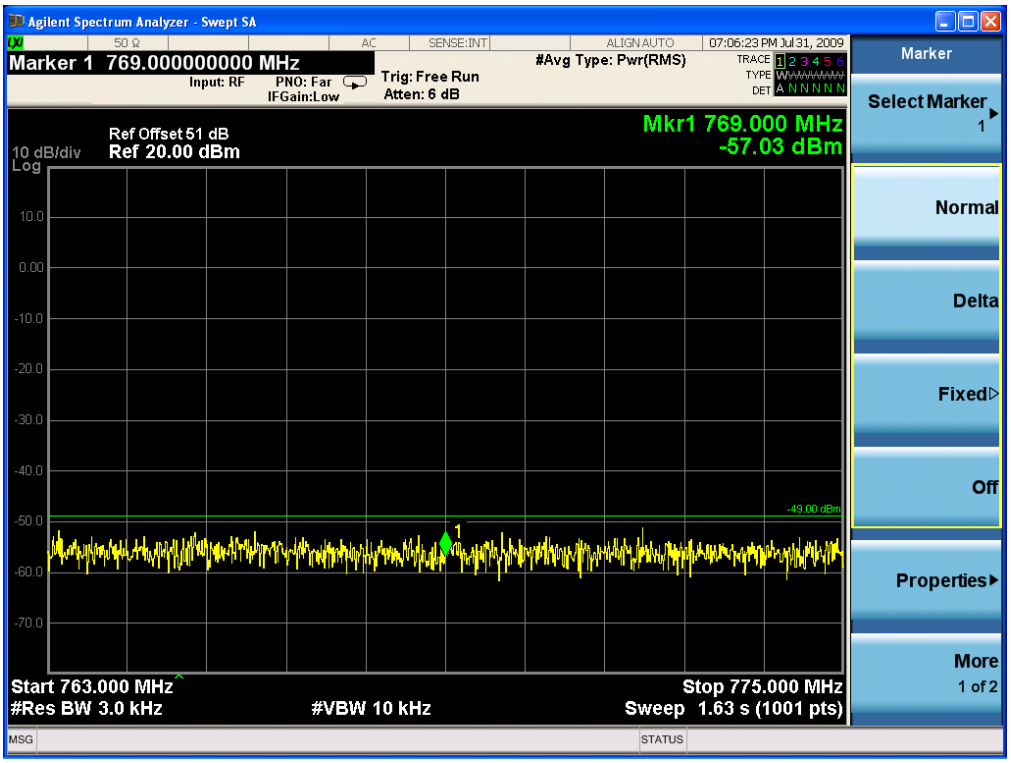


Figure 6-50: Spurious Emissions TX1_QPSK (763 – 775MHz)

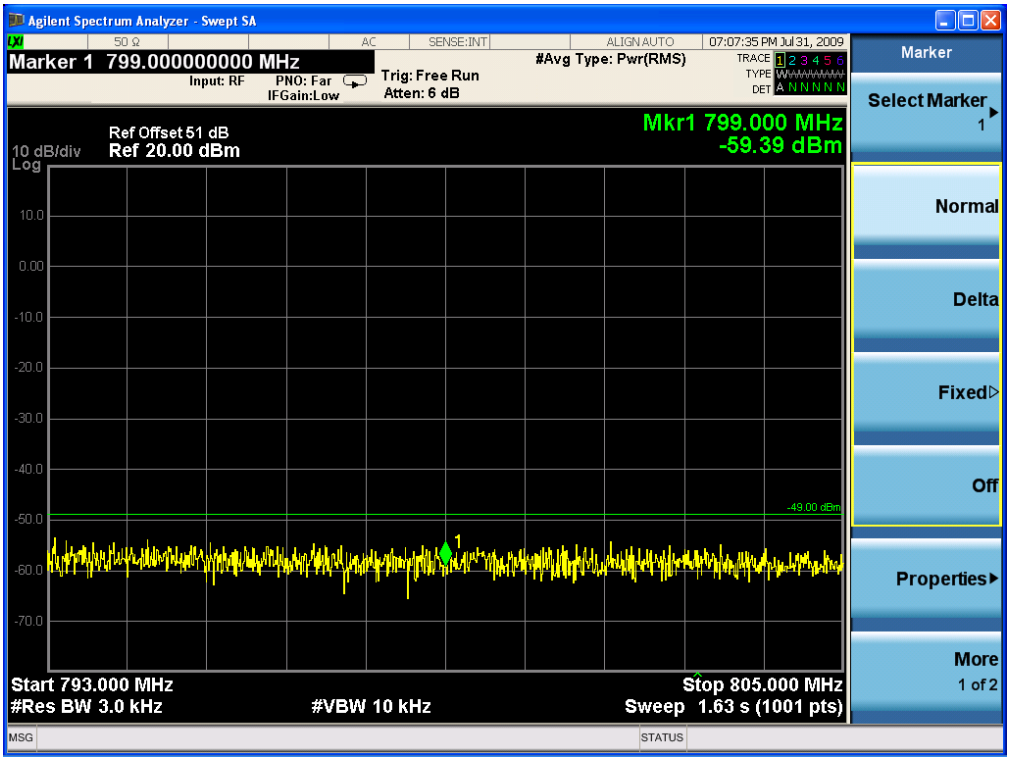


Figure 6-51: Spurious Emissions TX1_QPSK (793 – 805MHz)

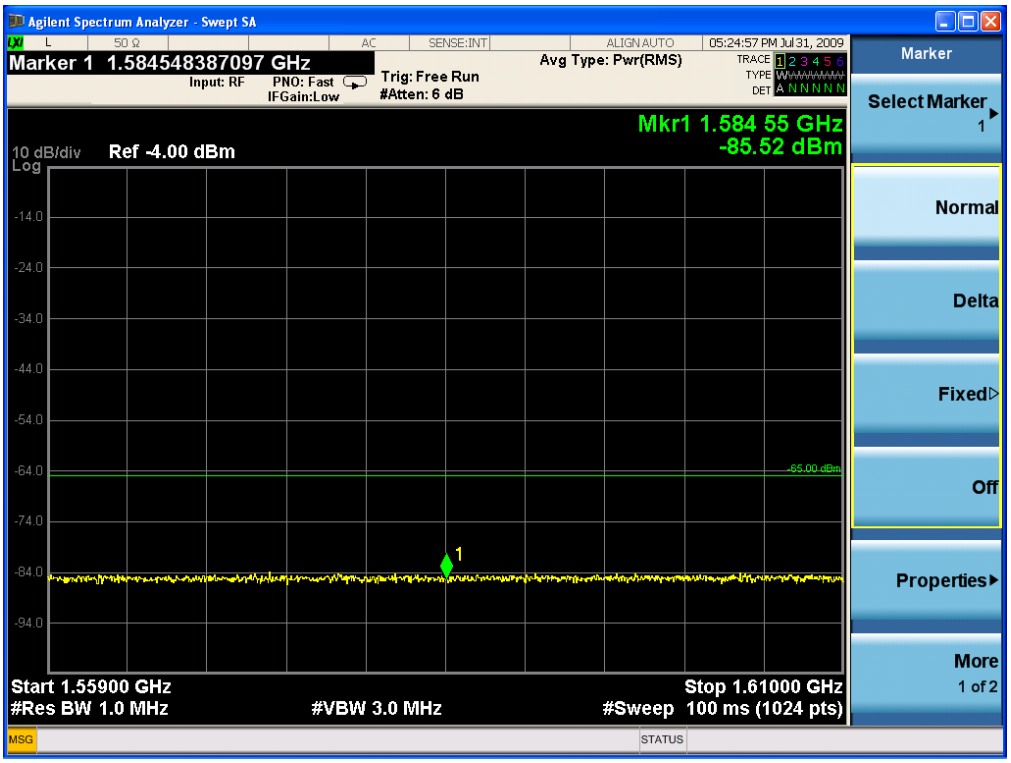


Figure 6-52: Spurious Emissions TX1_QPSK (1559 – 1610MHz)

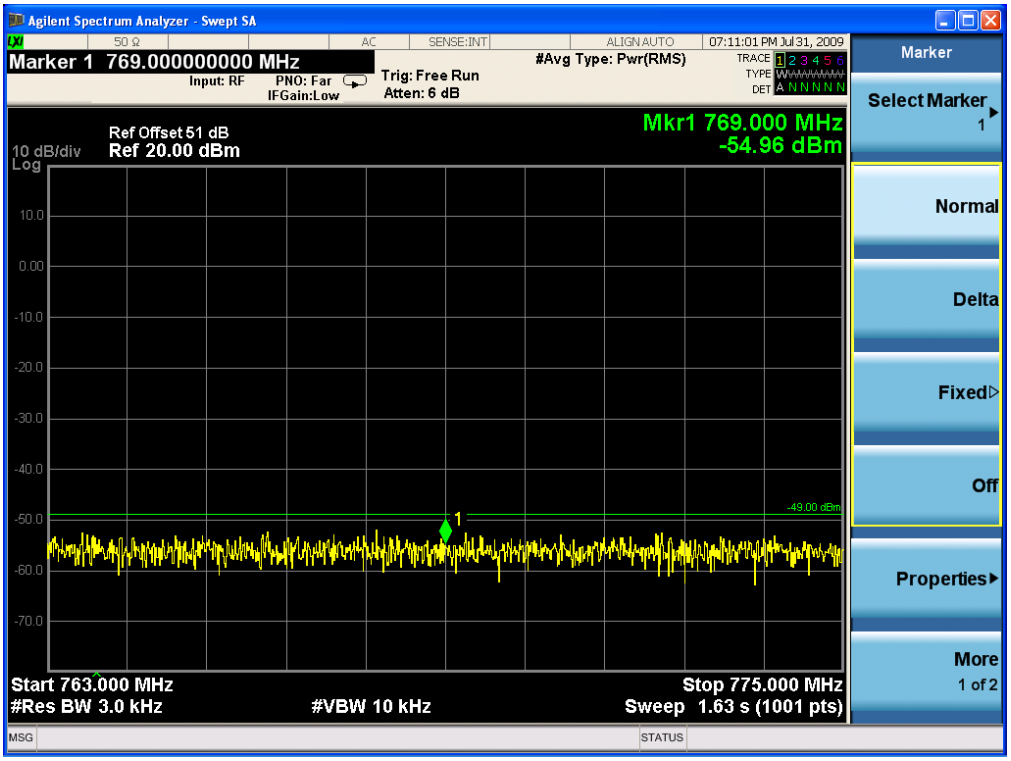


Figure 6-53: Spurious Emissions TX2_QPSK (763 – 775MHz)

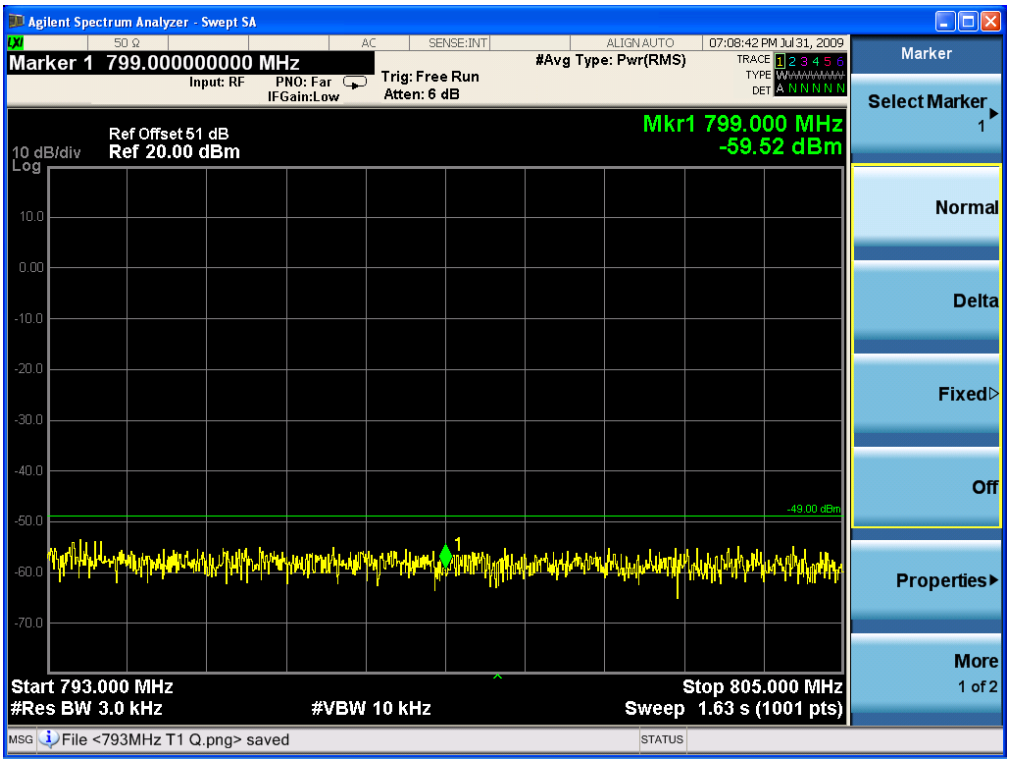


Figure 6-54: Spurious Emissions TX2_QPSK (793 – 805MHz)

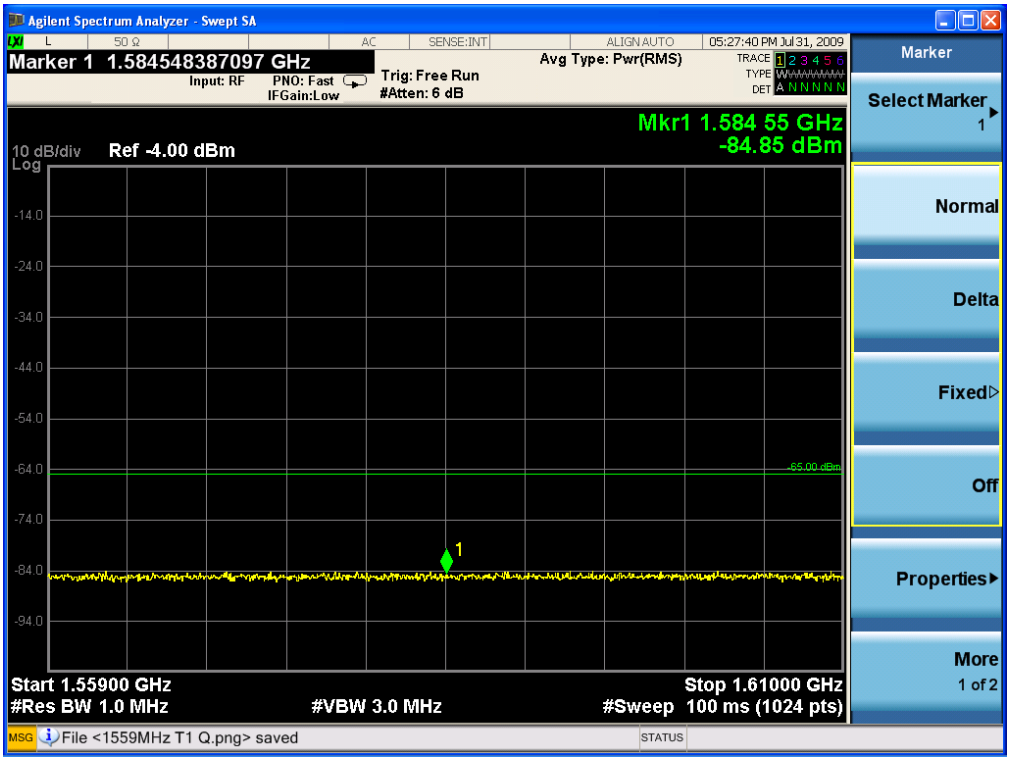


Figure 6-55: Spurious Emissions TX2_QPSK (1559 – 1610MHz)

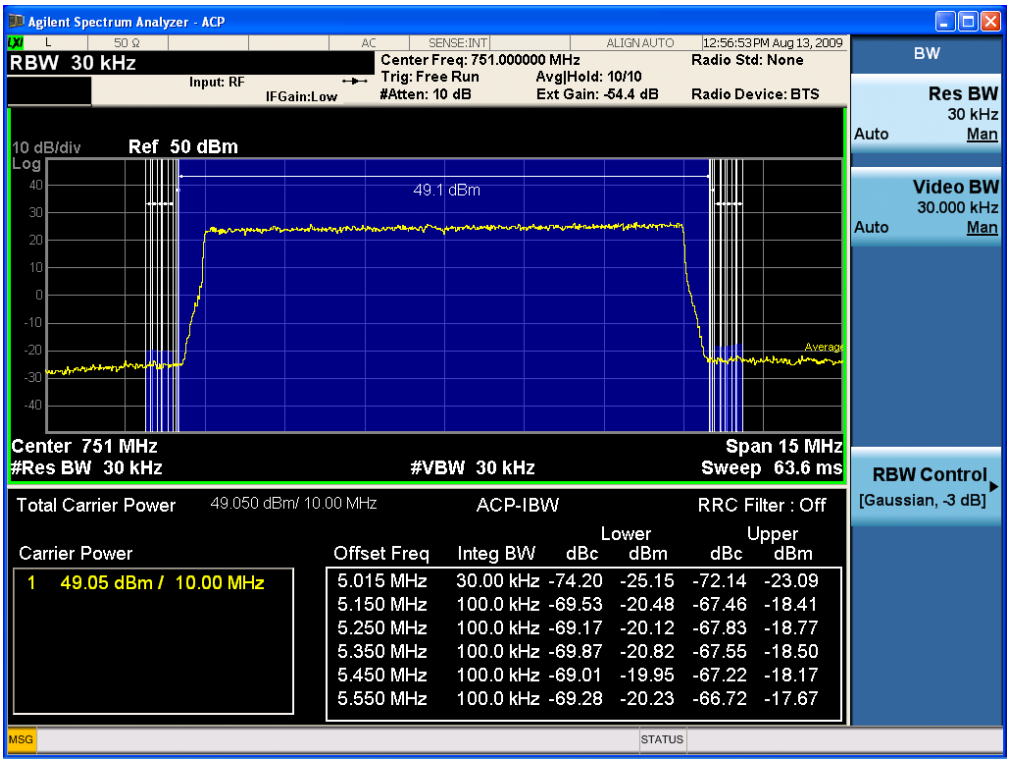


Figure 6-56: Spurious Emissions TX1 & TX2 QPSK Band Edge (ACP 15kHz – 550kHz)

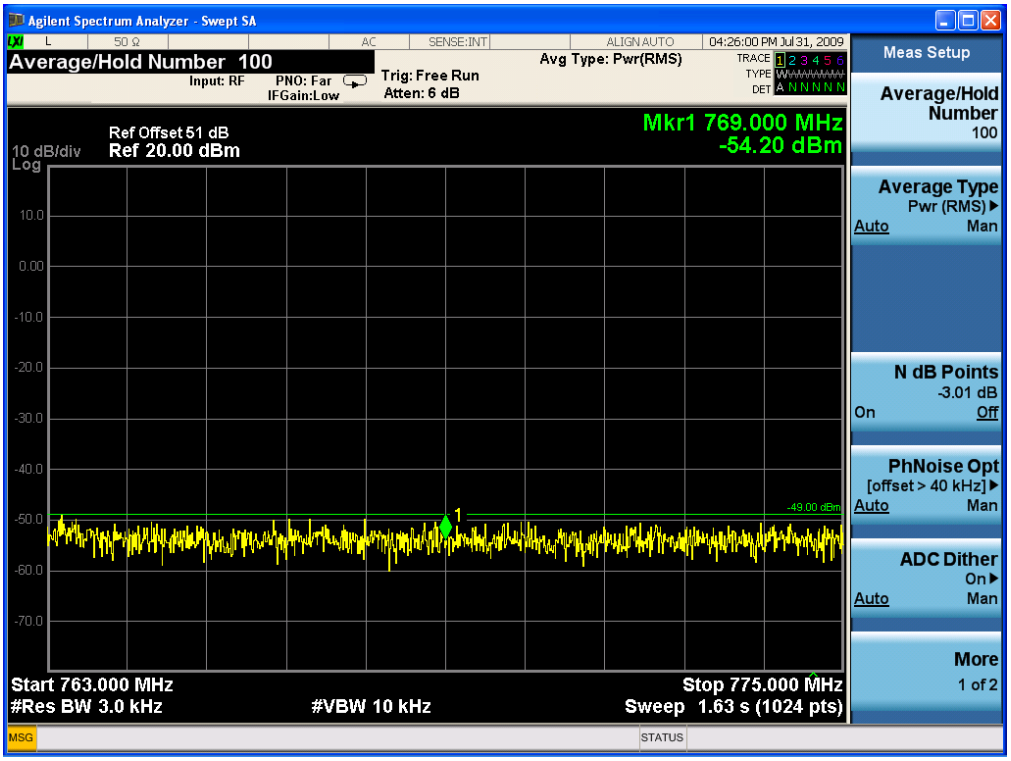


Figure 6-57: Spurious Emissions TX1 & TX2 QPSK (763 – 775MHz)

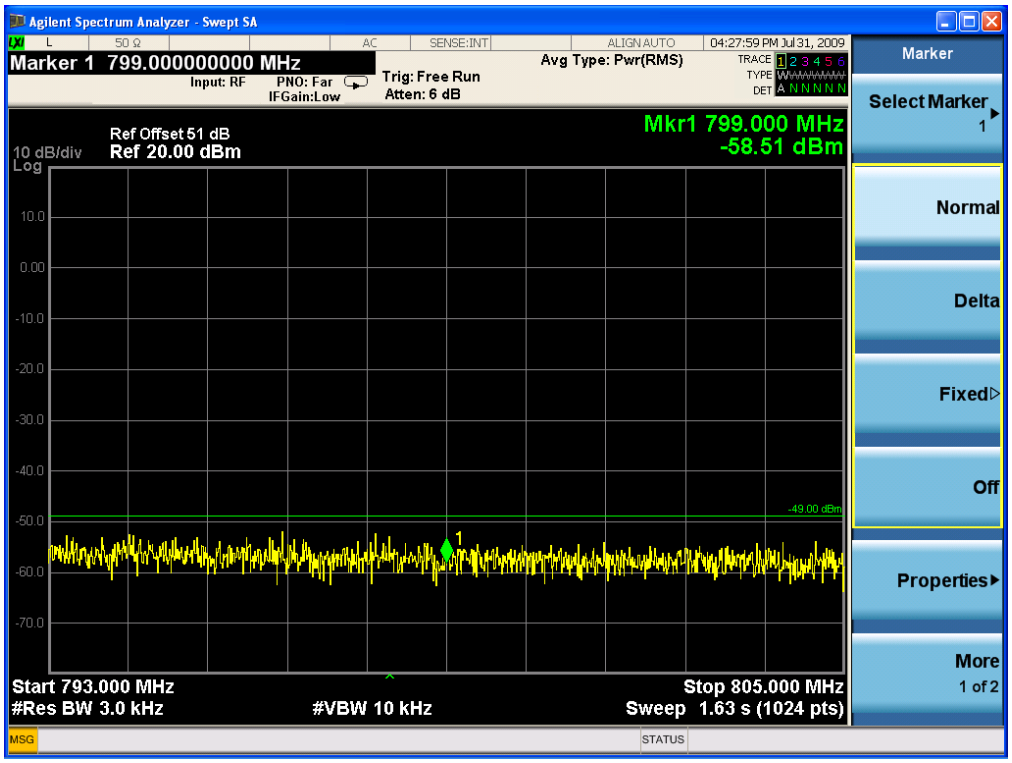


Figure 6-58: Spurious Emissions TX1 & TX2 QPSK (793 – 805MHz)

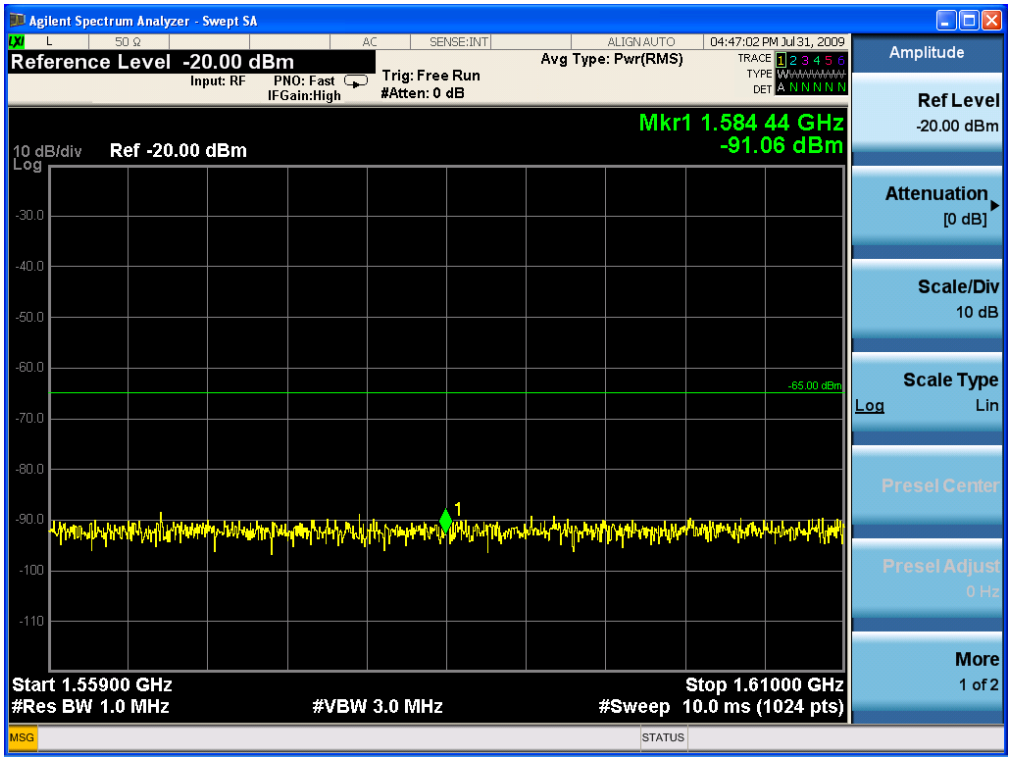


Figure 6-59: Spurious Emissions TX1 & TX2 QPSK (1559 – 1610MHz)

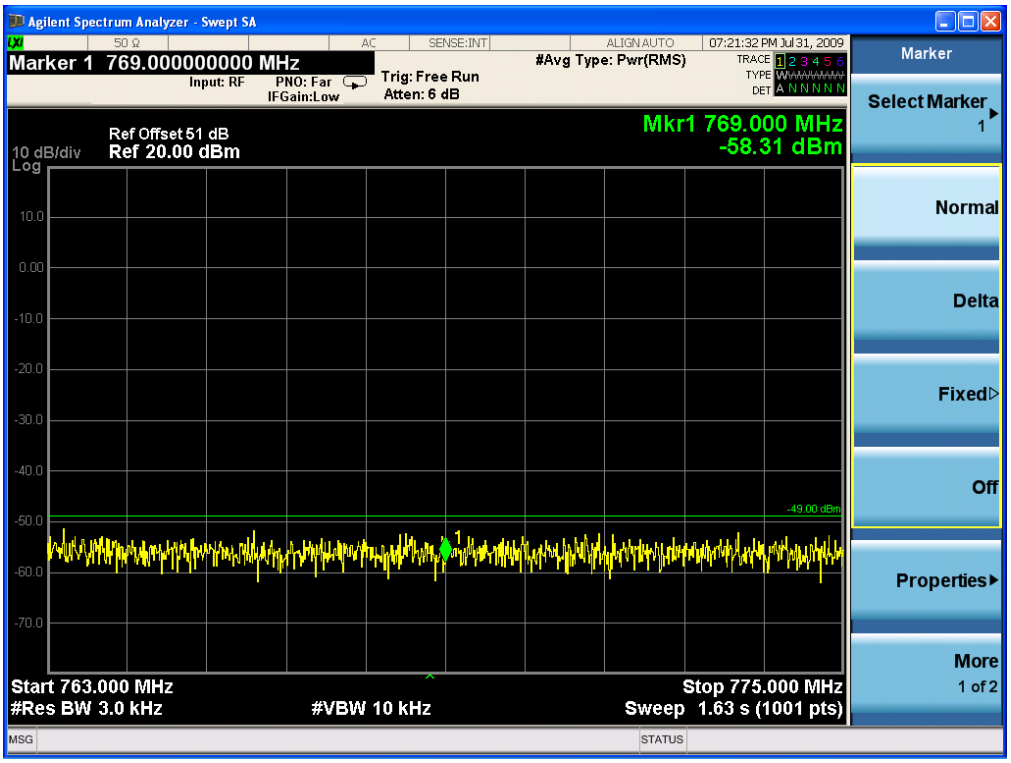


Figure 6-60: Spurious Emissions TX1_16 QAM (763 – 775MHz)

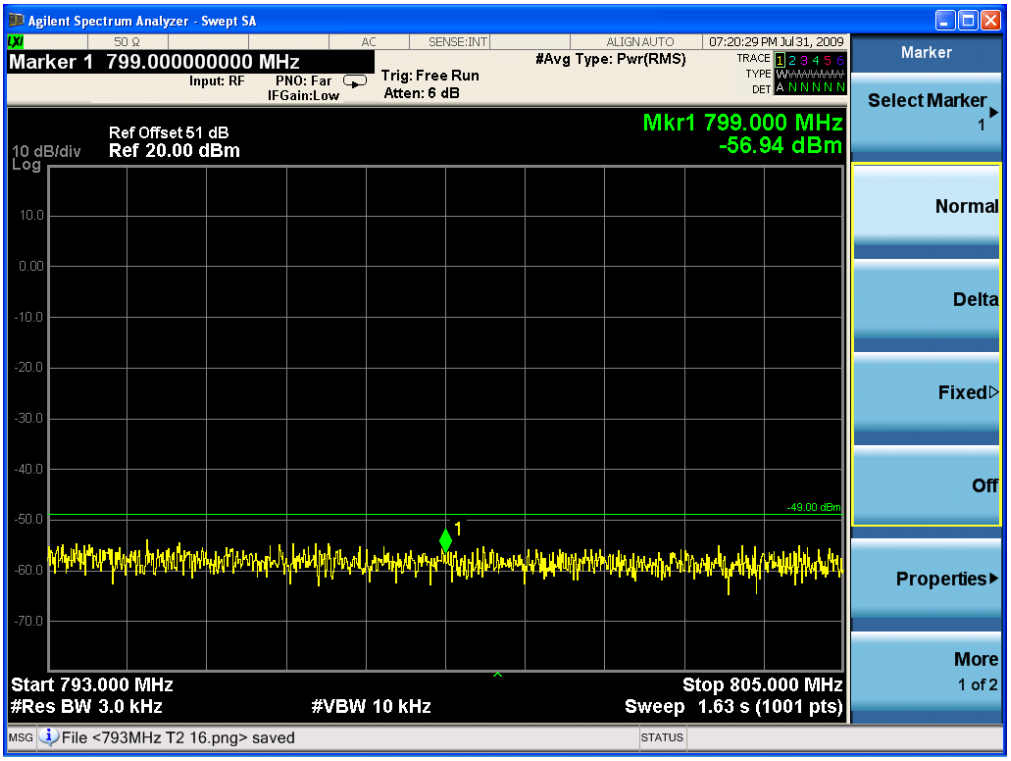


Figure 6-61: Spurious Emissions TX1_16 QAM (793 – 805MHz)

Figure 6-62: Spurious Emissions TX1_16 QAM (1559 – 1610MHz)

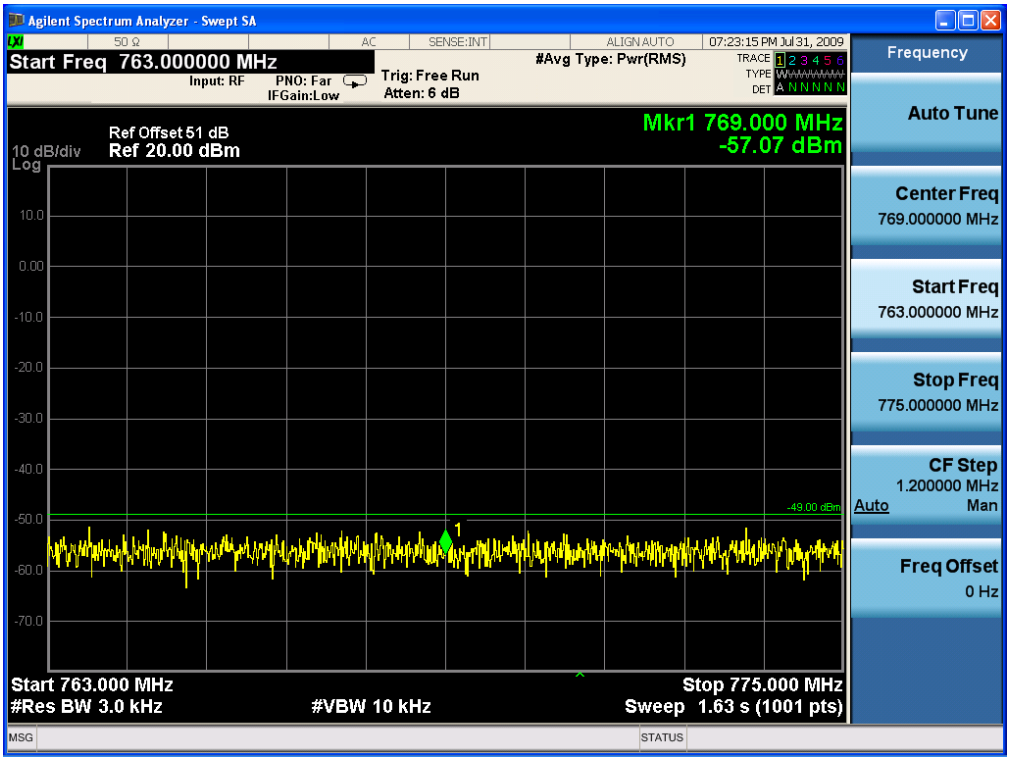


Figure 6-63: Spurious Emissions TX2_16 QAM (763 – 775MHz)

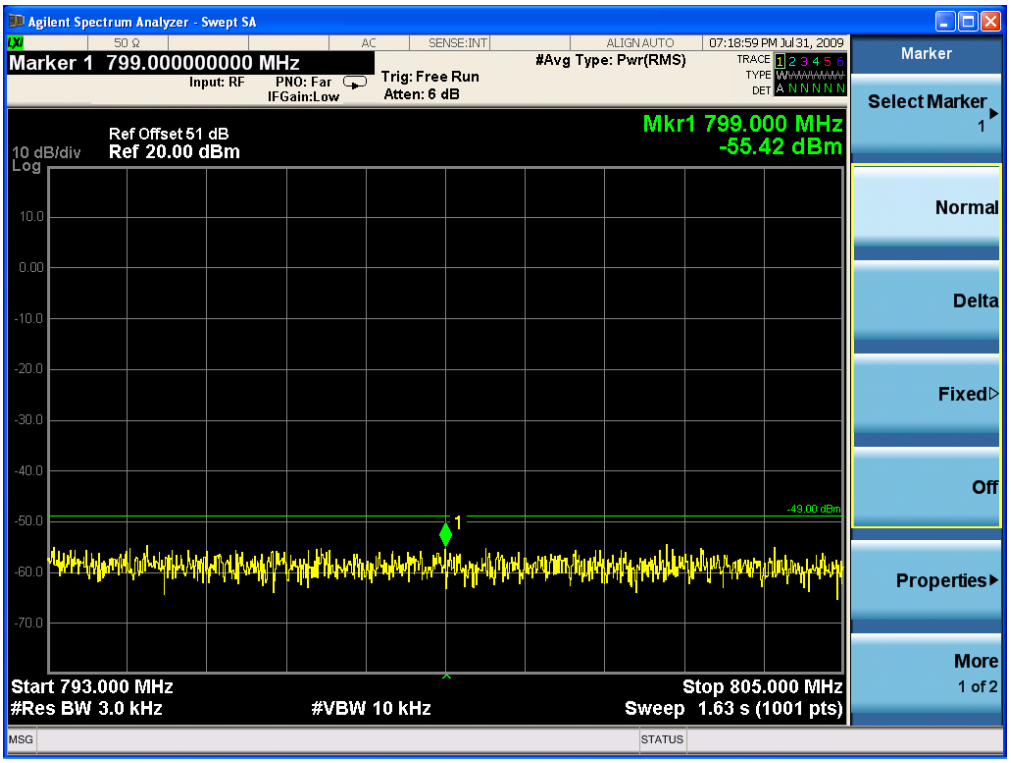


Figure 6-64: Spurious Emissions TX2_16 QAM (793 – 805MHz)

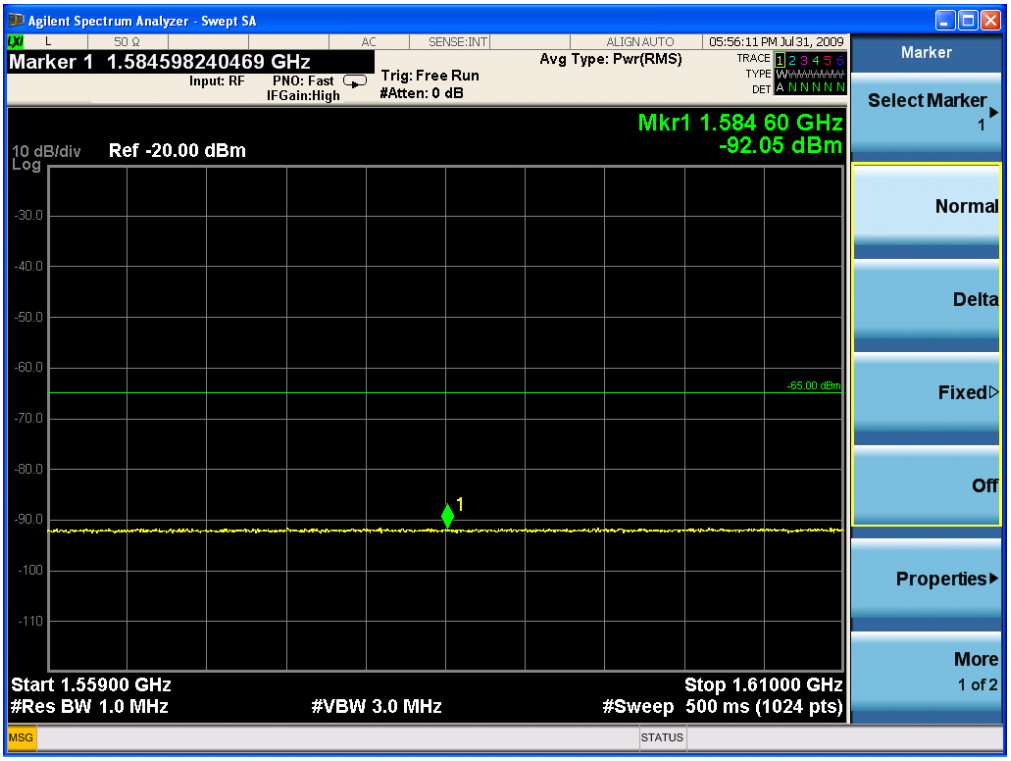


Figure 6-65: Spurious Emissions TX2_16 QAM (1559 – 1610MHz)

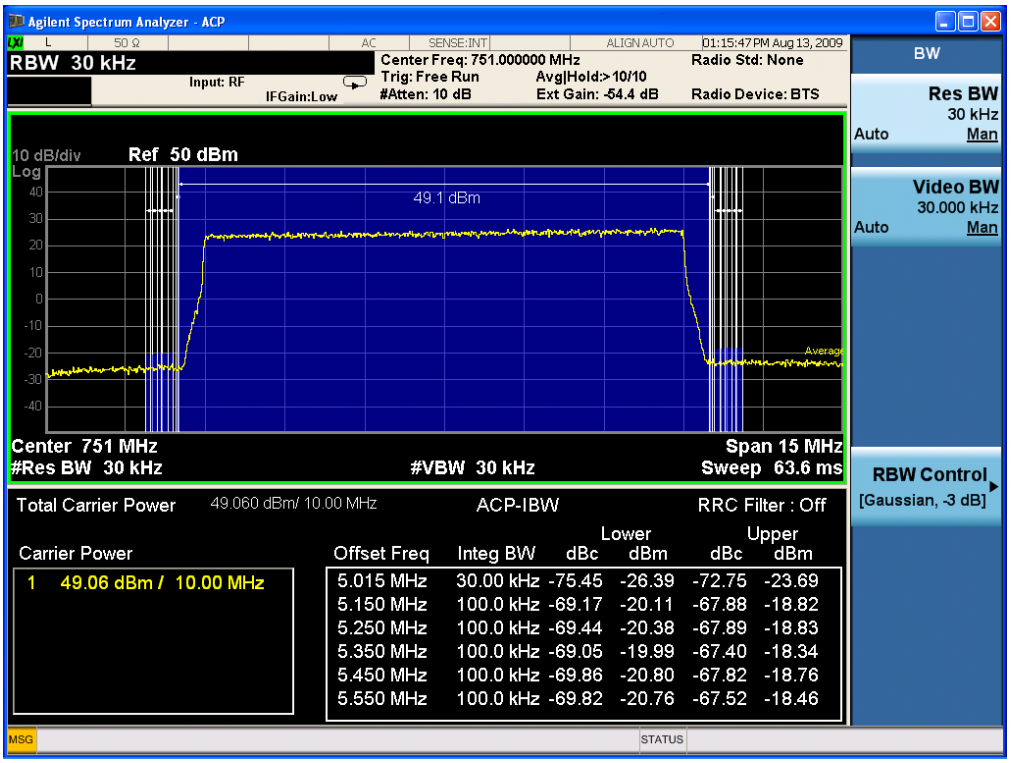


Figure 6-66: Spurious Emissions TX1 & TX2 16 QAM Band Edge (ACP 15kHz – 550kHz)

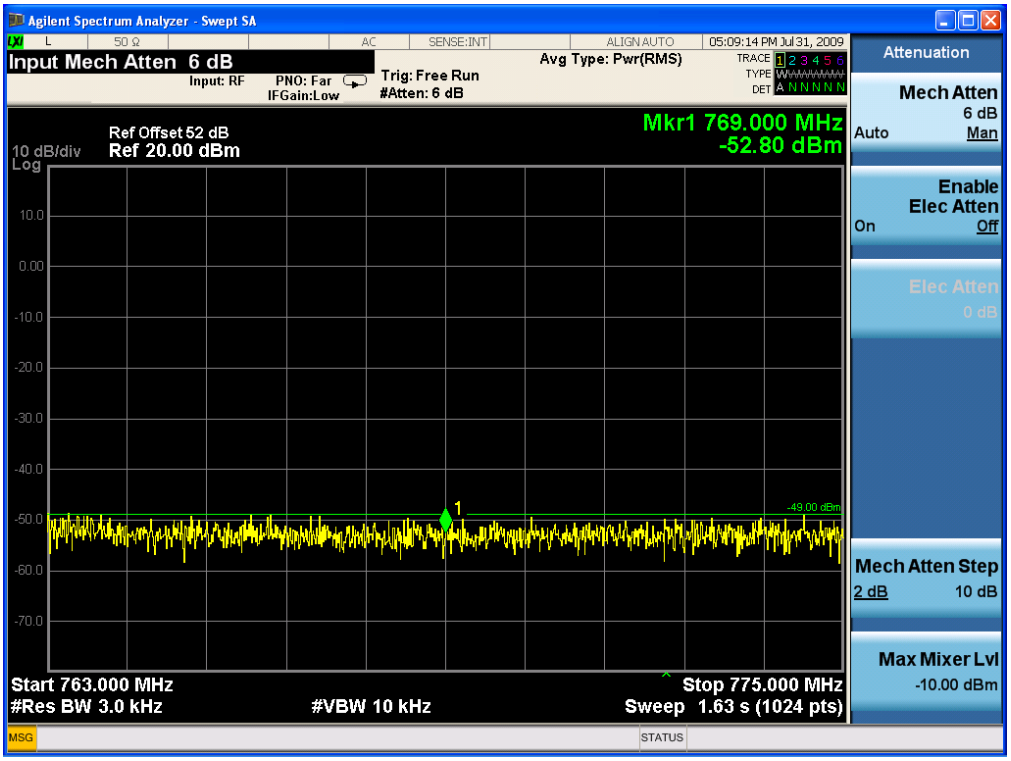


Figure 6-67: Spurious Emissions TX1 & TX2 16 QAM (763 – 775MHz)

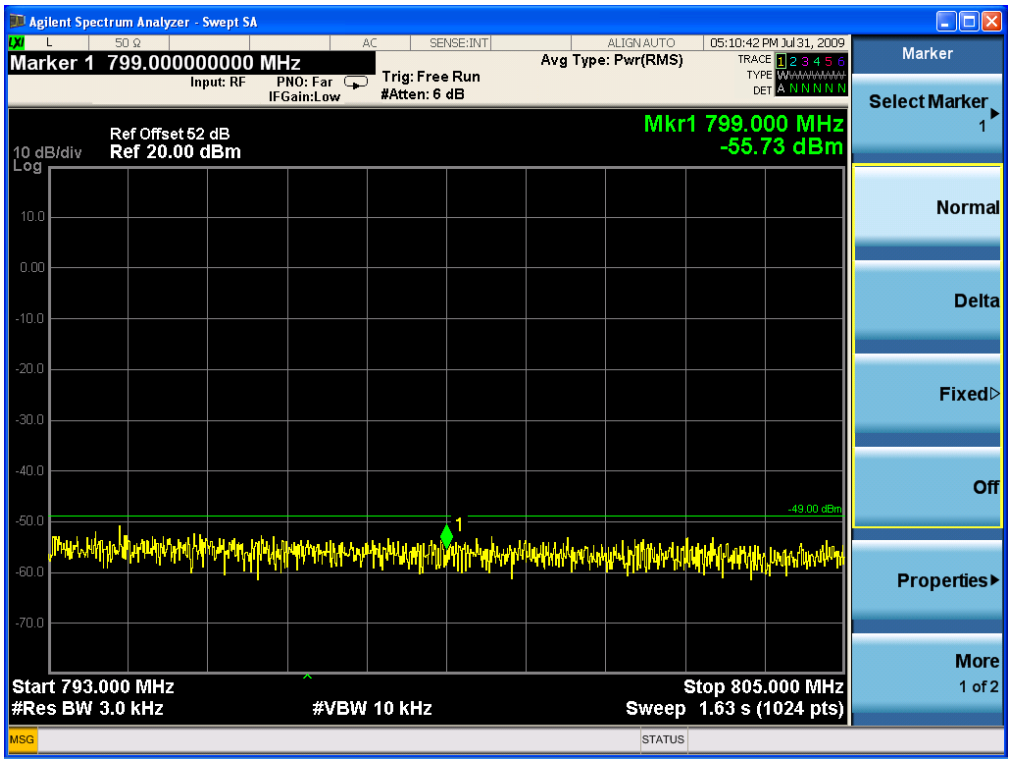


Figure 6-68: Spurious Emissions TX1 & TX2 16 QAM (793 – 805MHz)

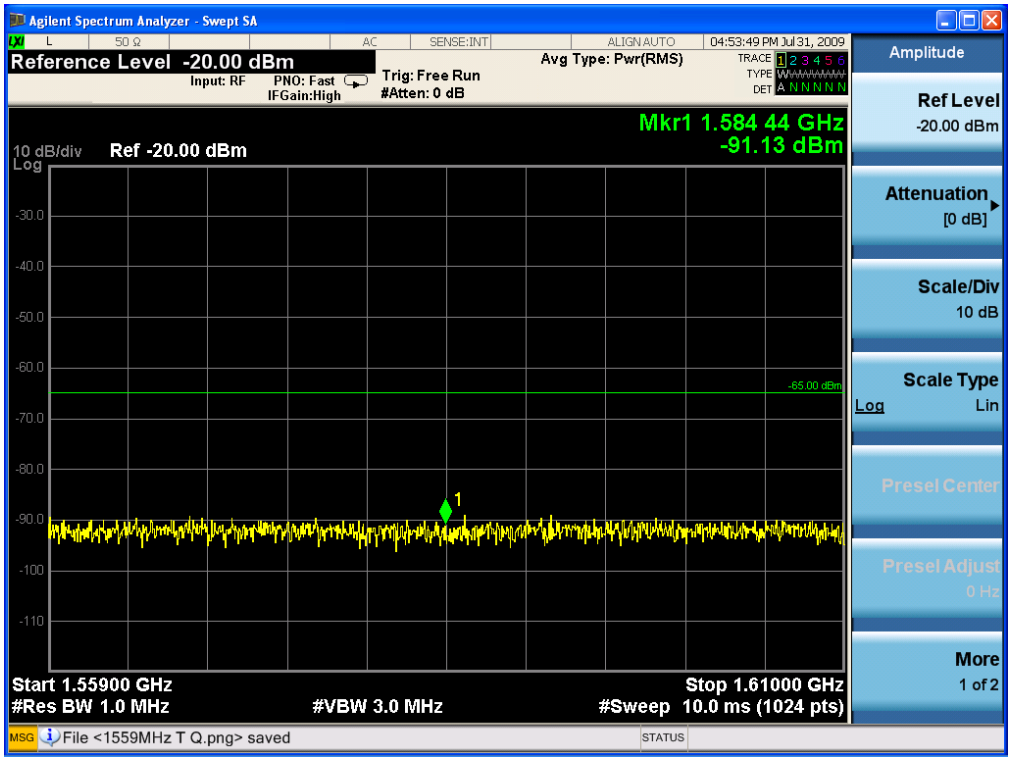


Figure 6-69: Spurious Emissions TX1 & TX2 16 QAM (1559 – 1610MHz)

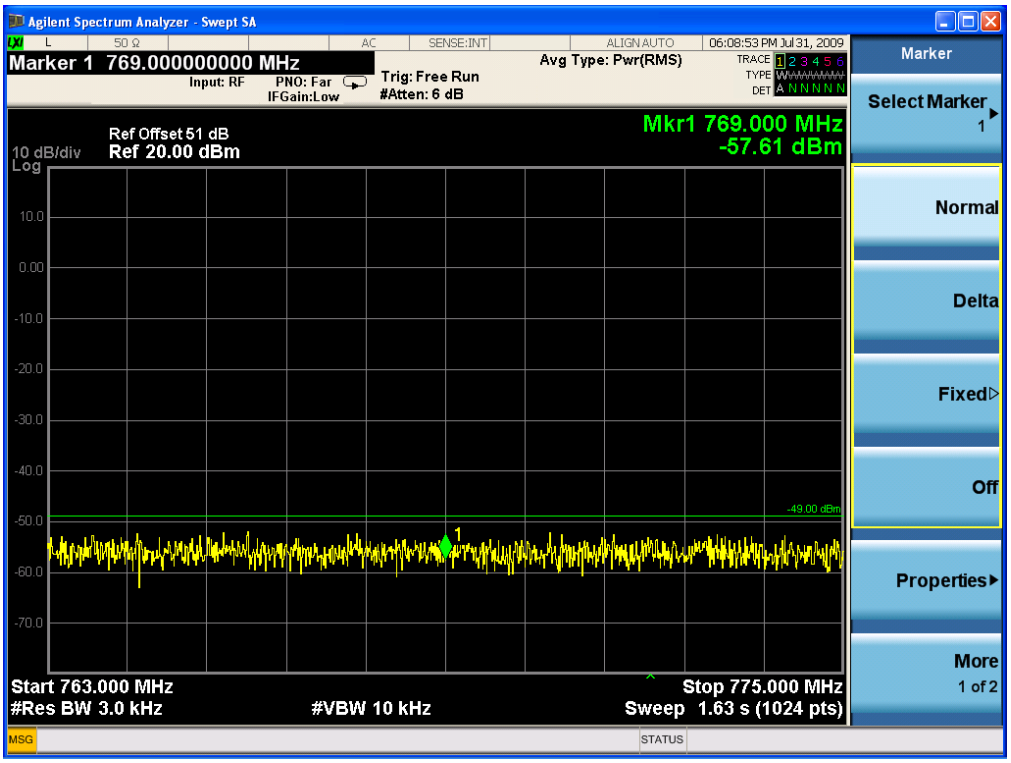


Figure 6-70: Spurious Emissions TX1_64 QAM (763 – 775MHz)

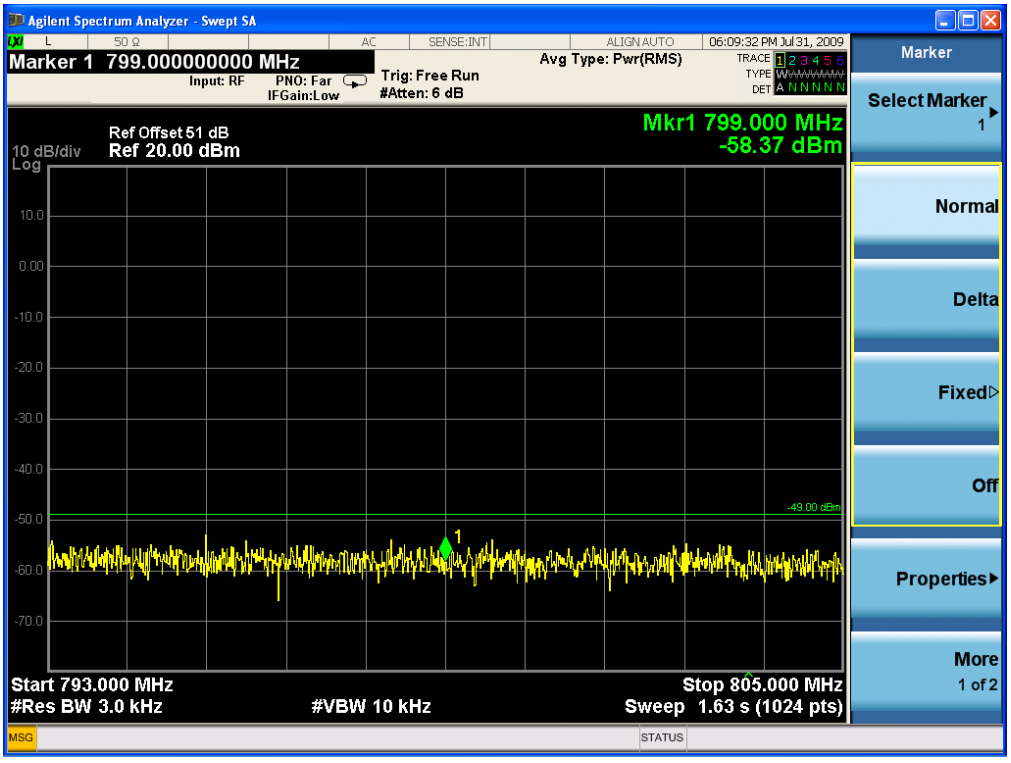


Figure 6-71: Spurious Emissions TX1_64 QAM (793 – 805MHz)

Figure 6-72: Spurious Emissions TX1_64 QAM (1559 – 1610MHz)

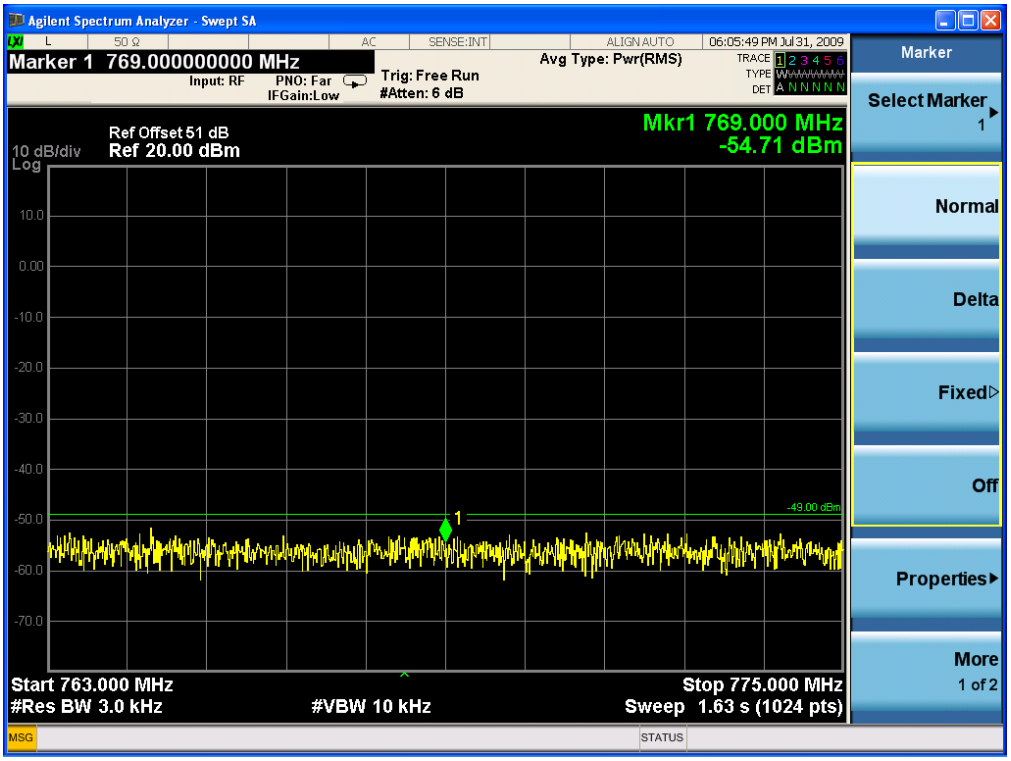


Figure 6-73: Spurious Emissions TX2_64 QAM (763 – 775MHz)

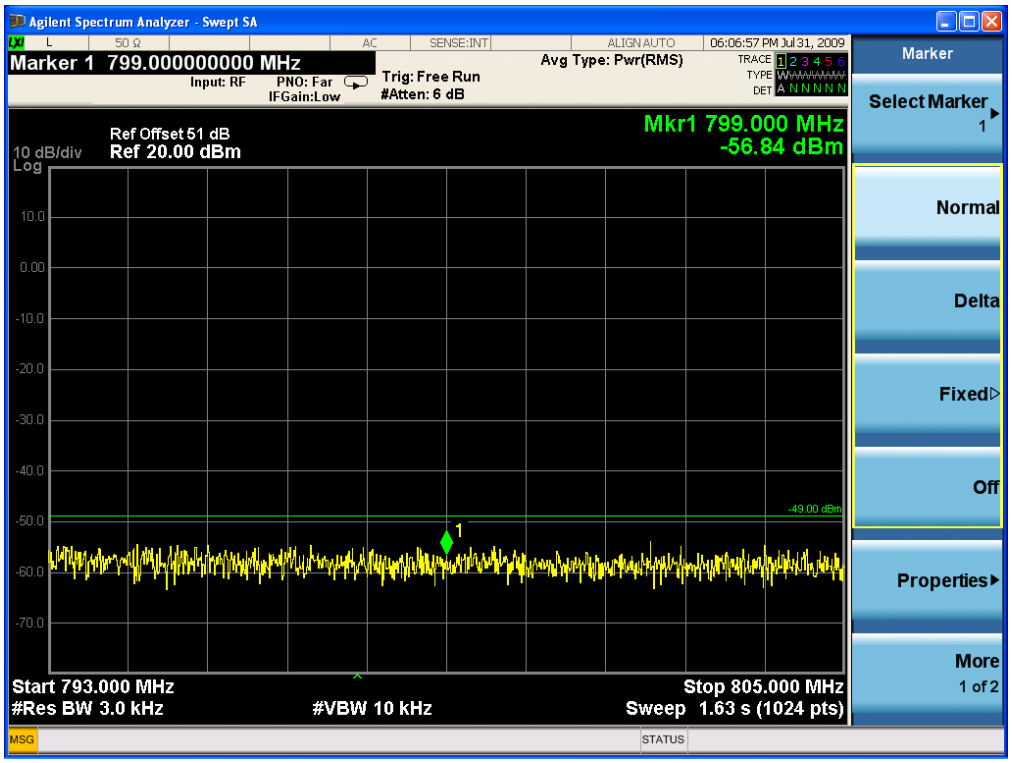


Figure 6-74: Spurious Emissions TX2_64 QAM (793 – 805MHz)

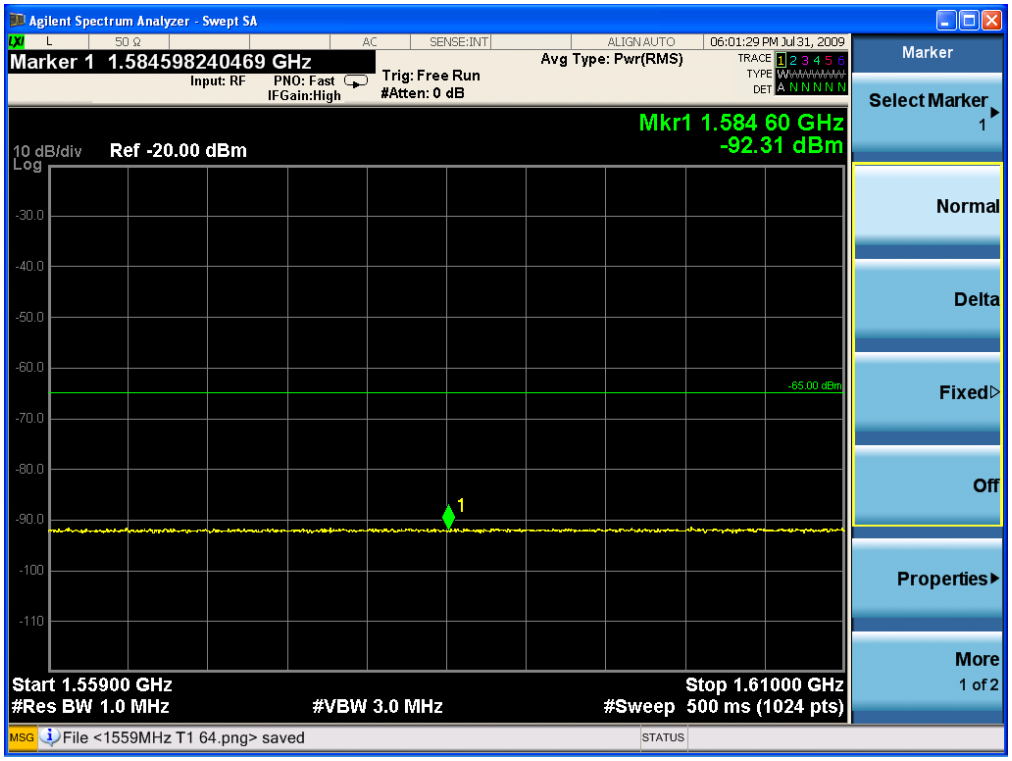


Figure 6-75: Spurious Emissions TX2_64 QAM (1559 – 1610MHz)

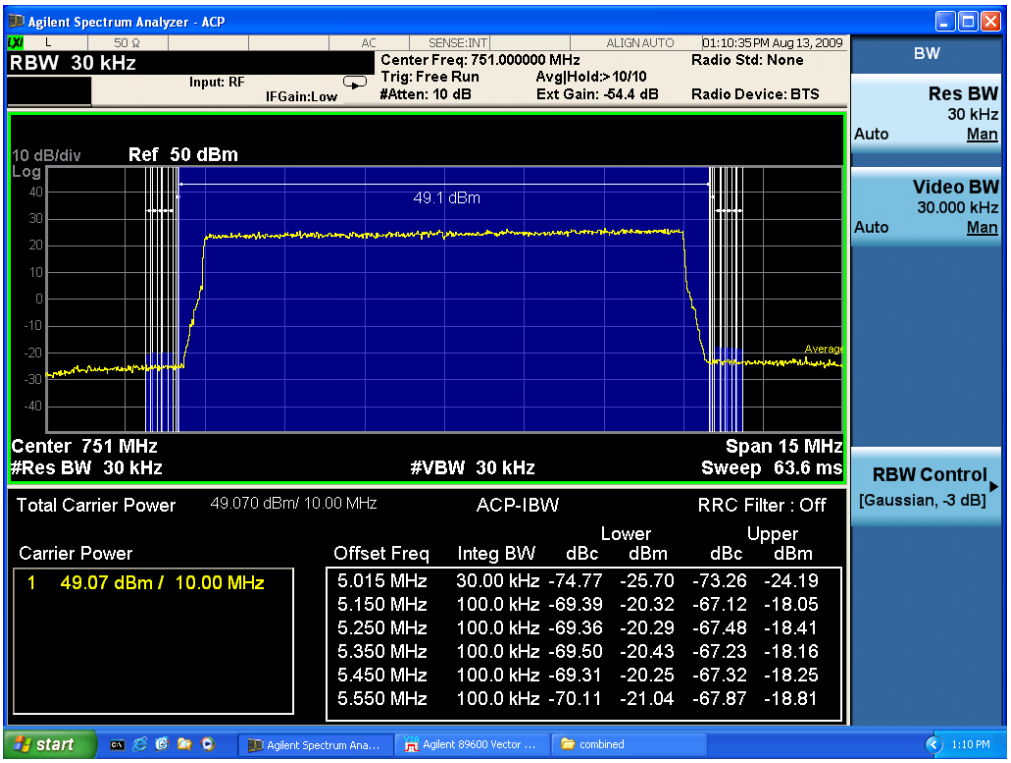


Figure 6-76: Spurious Emissions TX1 & TX2 64 QAM Band Edge (ACP 15kHz – 550kHz)

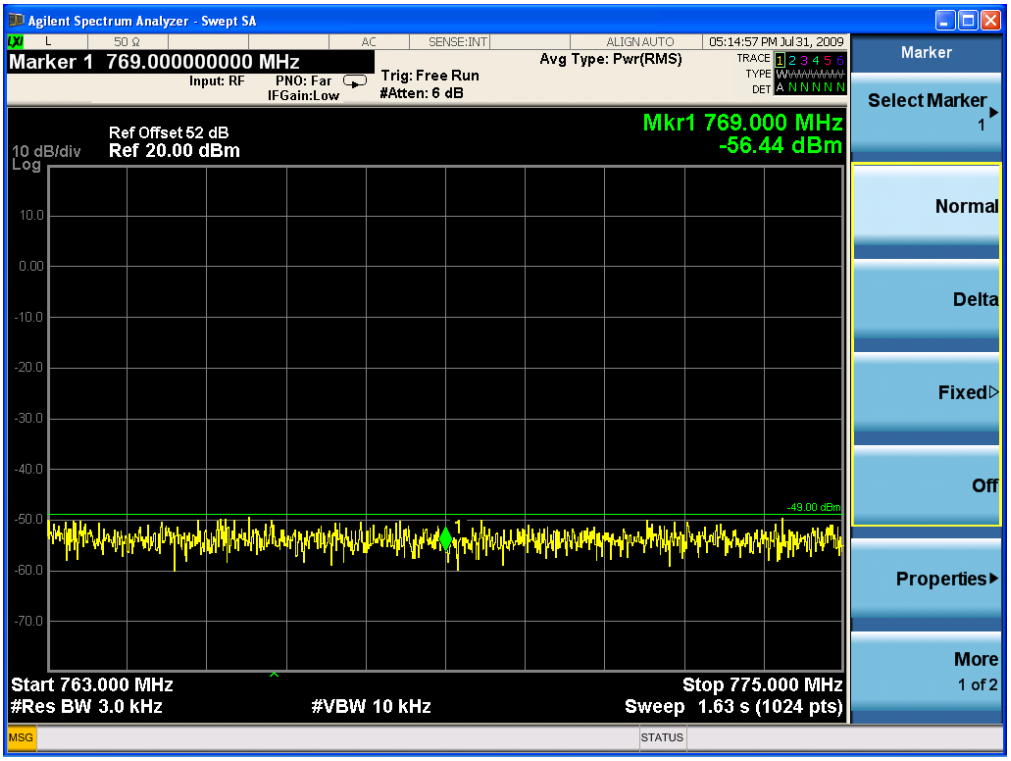


Figure 6-77: Spurious Emissions TX1 & TX2 64 QAM (763 – 805MHz)

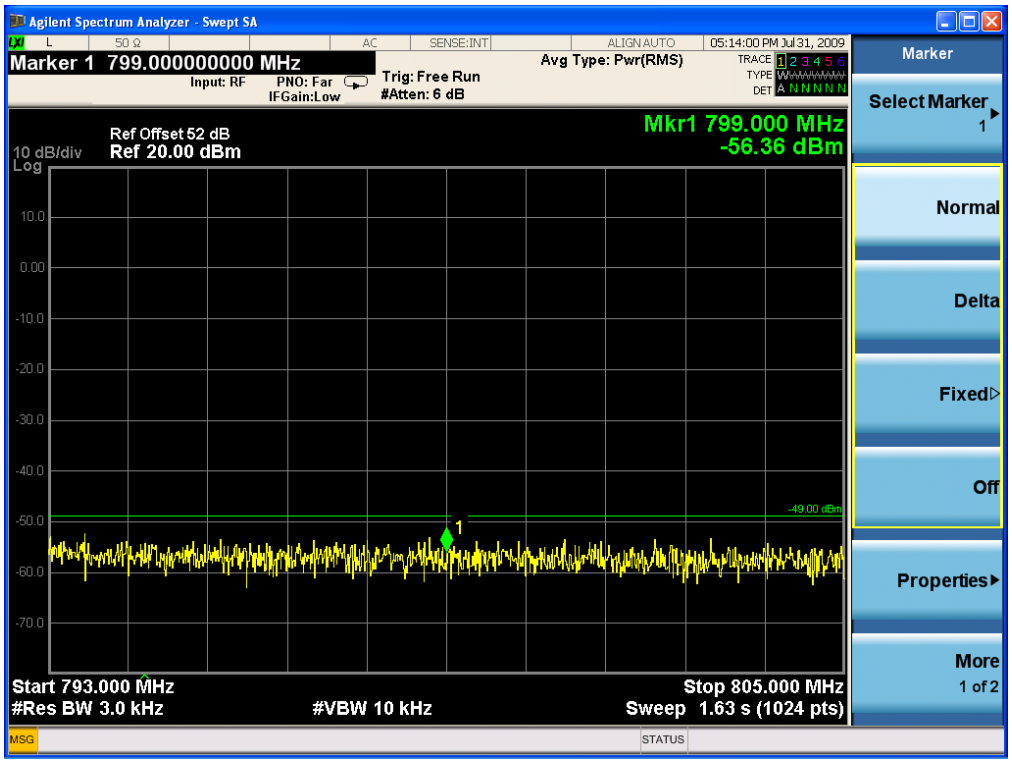


Figure 6-78: Spurious Emissions TX1 & TX2 64 QAM (793 – 805MHz)

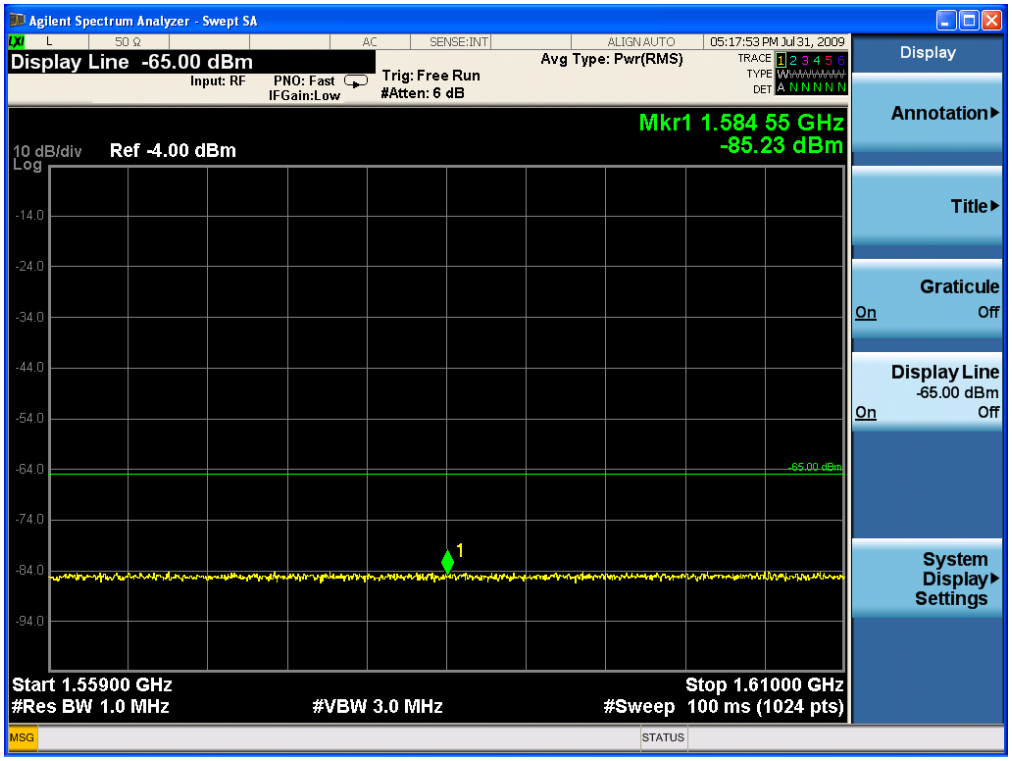


Figure 6-79: Spurious Emissions TX1 & TX2 64 QAM (1559 – 1610MHz)

6.5 Field Strength of Spurious Radiation

Clause 27.53(c)

(c) For operations in the 746–758 MHz band and the 776–788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746–758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

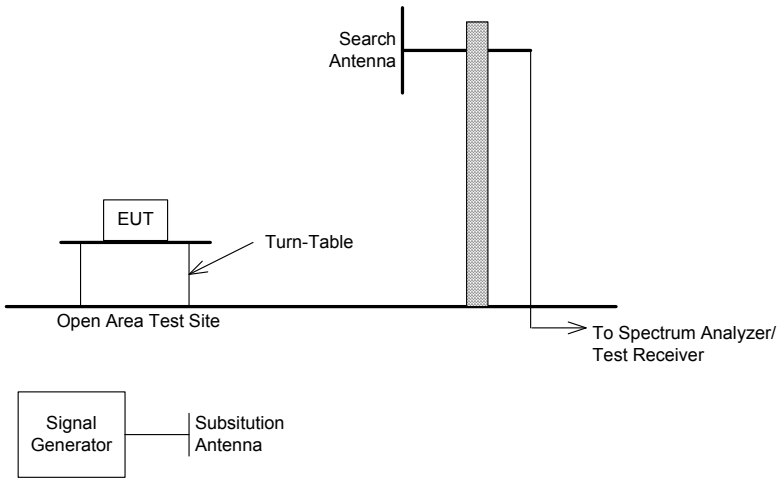
(3) On all frequencies between 763–775 MHz and 793–805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(f) For operations in the 746–763 MHz, 775–793 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to −70 dBW/MHz equivalent isotropic radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

Test Setup:



Settings Remarks:

1. The test was conducted at 3 meter Semi-Anechoic chamber with signal substitution method.
2. The low, medium and high operation frequencies would be evaluated.
3. The frequency range would be start from 30MHz to 10th Harmonics.
4. The measurement would be performed using a peak detector with 100kHz RBW/VBW below 1GHz and 1MHz RBW/VBW above 1GHz at a distance of 3 meters.
5. Radiated emission band edge check in the 100 kHz bands immediately outside and adjacent to the frequency block would be conducted with the EUT operated the nearest channel to the band edge with the RBW/VBW as 30kHz/100kHz and RMS detector would be applied.
6. Radiated emission test for the band of 763–775 MHz and 793–805 MHz would be based on the RMS detector and RBW/VBW setting as 3kHz/10kHz, the correction factor 10*log(6.25/3)=3.19dB would be applied.
7. Radiated emission test for the band 1559–1610Mhz would be base on the RMS detector and RBW/VBW setting as 1MHz/3MHz.
8. All modulations (QPSK, 16QAM, and 64QAM) modes and different data rates would be evaluated using representative waveforms of all 4-modulation schemes. The test would cover 10MHz bandwidth configuration.

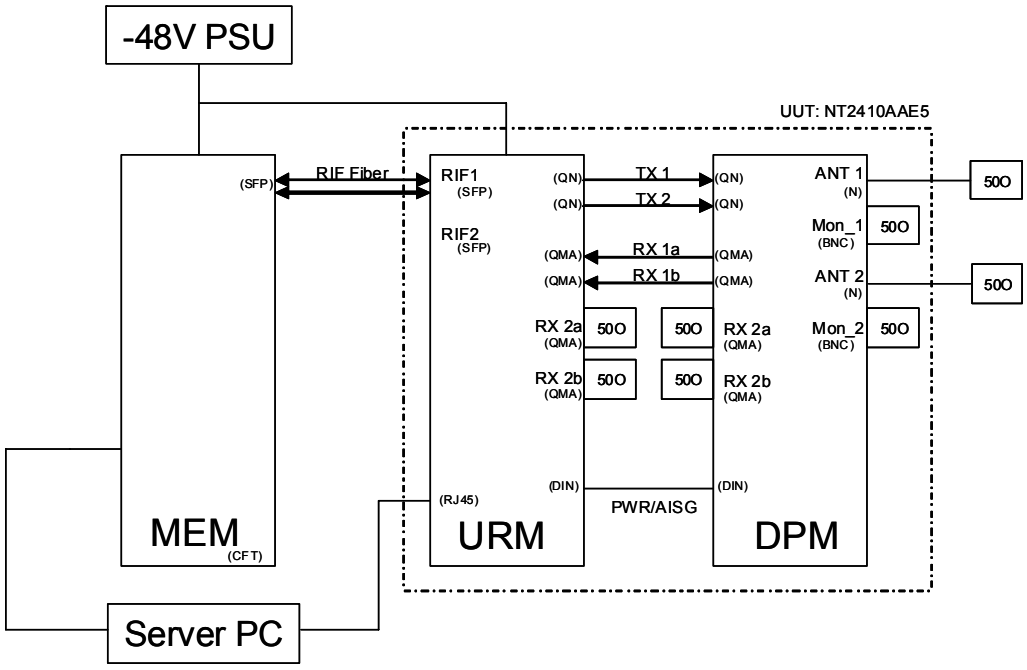


Figure 6-80 URM EMC Set Up / Configuration

The following table was derived from measurements made in the Nemko 3 meter anechoic chamber.

Nemko EMC Report: 124408-1TRFEMC.

Table 6-10 Radiated Emissions

Frequency	Field strength	Subst fact	Corr	ERP	Limit	Margin
MHz	dBuV/m	dB	dB	dBm	dBm	dB
1503.40	51.84	-70.42	-17.70	-36.28	-13.00	23.28
2256.70	63.75	-66.89	-13.60	-16.74	-13.00	3.74
3001.00	51.50	-63.59	-10.71	-22.80	-13.00	9.80
3754.90	52.88	-61.17	-8.54	-16.83	-13.00	3.83
4504.80	51.14	-60.35	-6.91	-16.12	-13.00	3.12

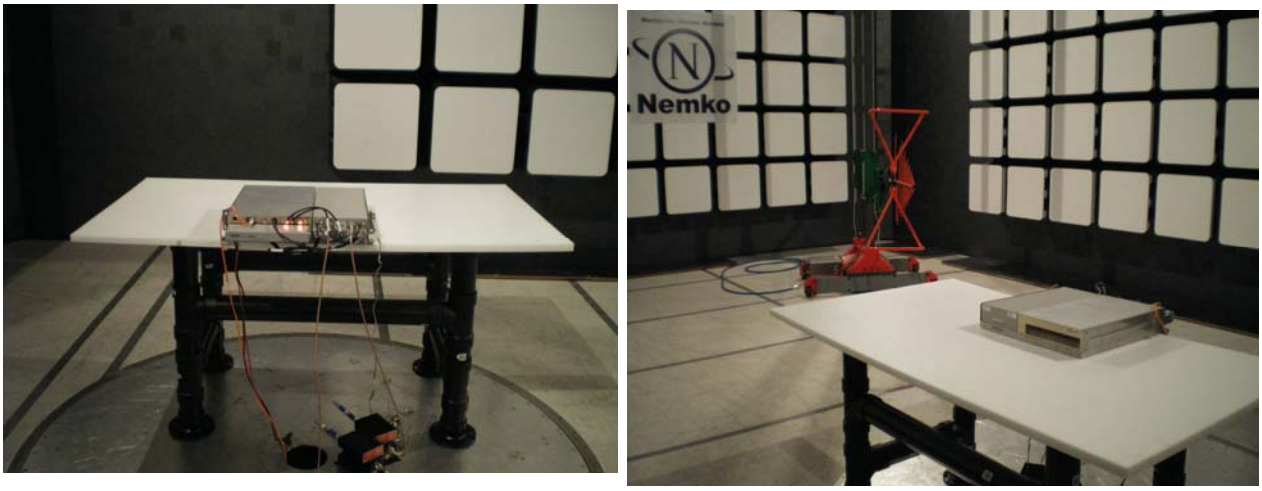


Figure 6-81 Radiated Emissions Set Up Photo's

6.6 Frequency Stability

Clause 27.54

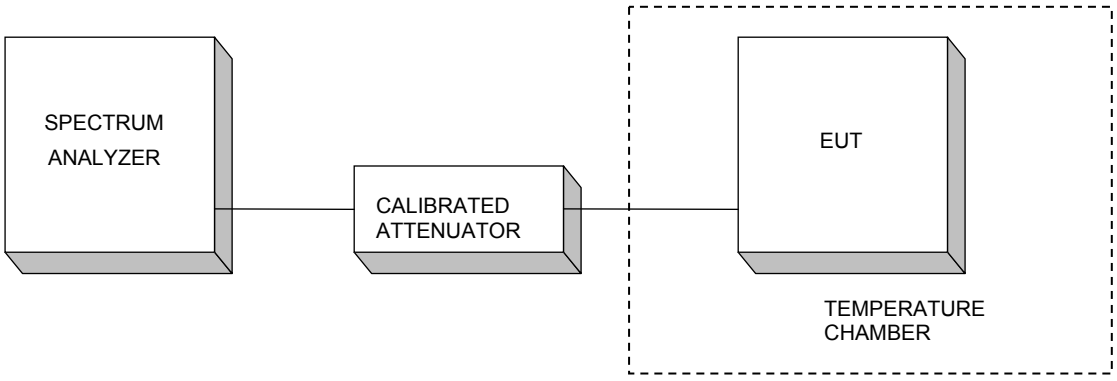
§27.54 Frequency stability. - The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

FCC Clause 2.1055 Frequency Stability

§2.1055 Measurements required: Frequency stability.
(a) The frequency stability shall be measured with variation of ambient temperature as follows:
(1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a)(2) and (3) of this section
(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

Test Setup



Test Conditions:

Extreme Temperature Condition: –30°C to 50°C
Extreme Voltage Conditions: ±15% of standard voltage condition.

Settings Remarks

1. The EUT would be operated and frequency offset / error monitored over the variables.
2. The EUT would be connected to a spectrum analyzer. The frequency stability would be determined by the frequency counter function of the spectrum analyzer.
3. Test would be conducted at the temperature range from –30°C to 50°C degree with 10°C intervals. Measurement would also be conducted with varying the primary supply voltage from 85% to 115% of the nominal value.

Table 6-11: Frequency Stability vs. Temperature / Voltage Variation

Temp (°C)	DC (V)	f_error (Hz)	Time	Date		Mean (Hz)	-12.551
-30	40	-12.238	10:00	2-Jul-09		Deviation (Hz)	-0.313
-30	48	-12.877	10:00	2-Jul-09			0.326
-30	55	-12.214	10:00	2-Jul-09			-0.337
-20	40	-12.472	10:30	2-Jul-09			-0.079
-20	48	-12.624	10:30	2-Jul-09			0.073
-20	55	-12.488	10:30	2-Jul-09			-0.063
-10	40	-12.867	11:00	2-Jul-09			0.316
-10	48	-12.607	11:00	2-Jul-09			0.056
-10	55	-12.410	11:00	2-Jul-09			-0.141
0	40	-12.759	11:30	2-Jul-09			0.208
0	48	-12.817	11:30	2-Jul-09			0.266
0	55	-12.431	11:30	2-Jul-09			-0.120
10	40	-12.709	12:00	2-Jul-09			0.158
10	48	-12.598	12:00	2-Jul-09			0.047
10	55	-12.670	12:00	2-Jul-09			0.119
20	40	-12.649	13:00	2-Jul-09			0.098
20	48	-12.452	13:00	2-Jul-09			-0.099
20	55	-12.575	13:00	2-Jul-09			0.024
30	40	-12.729	13:30	2-Jul-09			0.178
30	48	-12.409	13:30	2-Jul-09			-0.142
30	55	-12.226	13:30	2-Jul-09			-0.325
40	40	-12.463	14:00	2-Jul-09			-0.088
40	48	-12.797	14:00	2-Jul-09			0.246
40	55	-12.122	14:00	2-Jul-09			-0.429
50	40	-12.552	14:30	2-Jul-09			0.001
50	48	-12.775	14:30	2-Jul-09			0.224
50	55	-12.343	14:30	2-Jul-09			-0.208

The mean offset frequency deviation was measured at -12.5Hz (absolute). Variation (stability) over voltage and temperature was measured <0.5Hz.

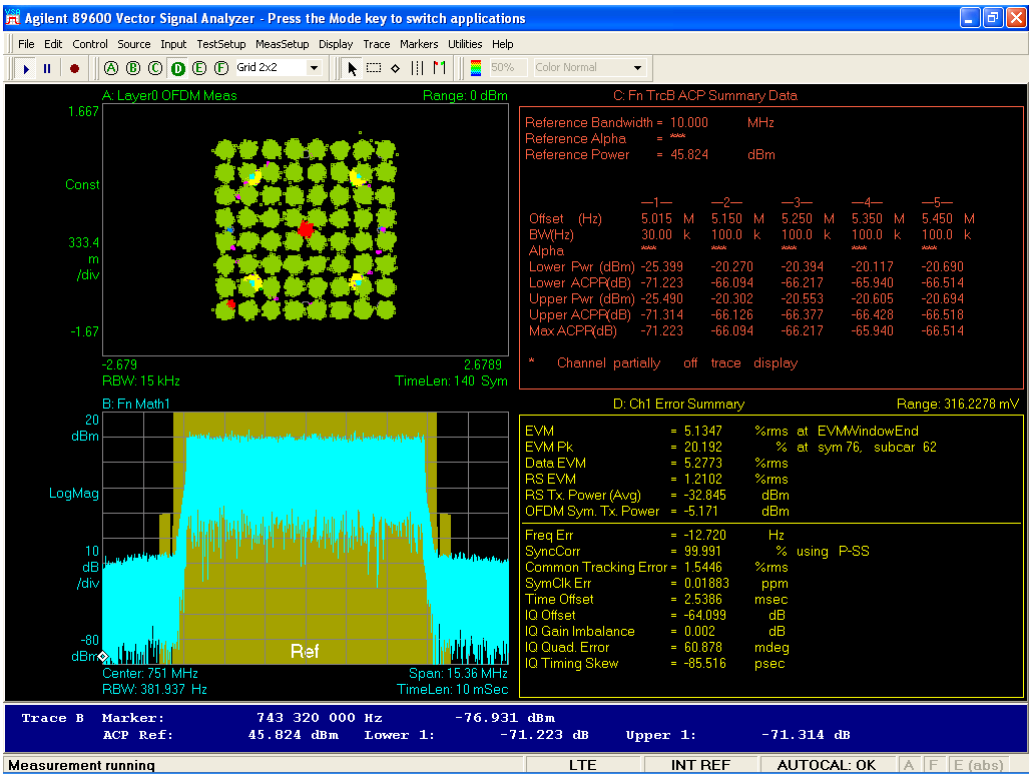


Figure 6-82: Stability -30°C

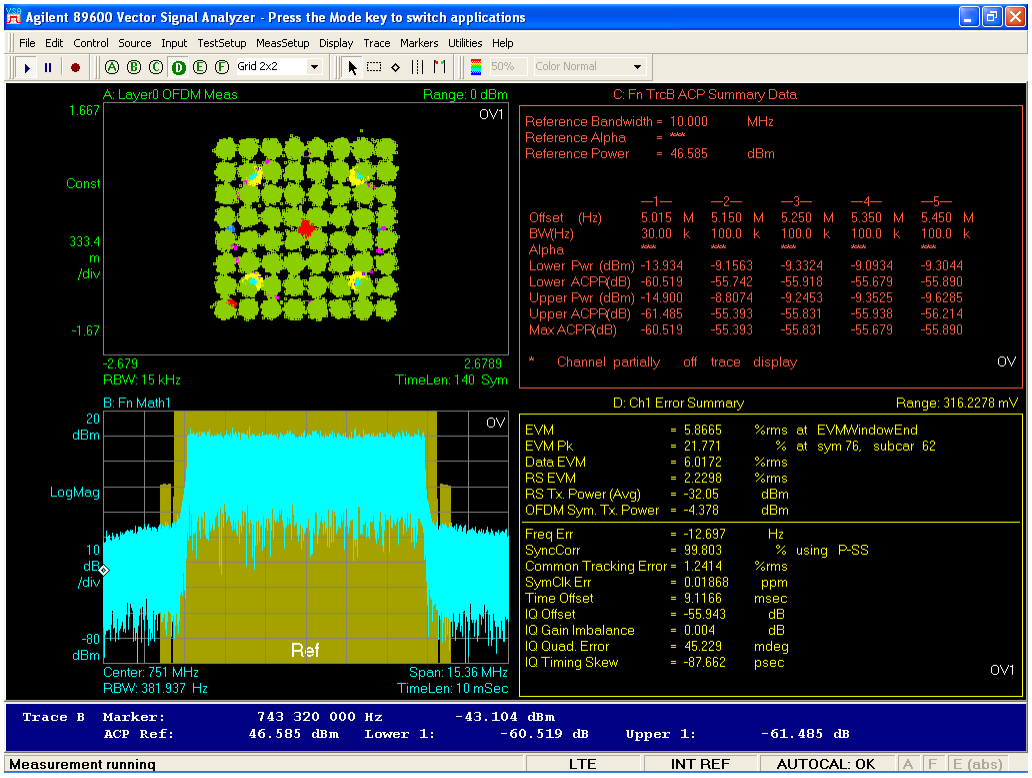


Figure 6-83: Stability -20°C

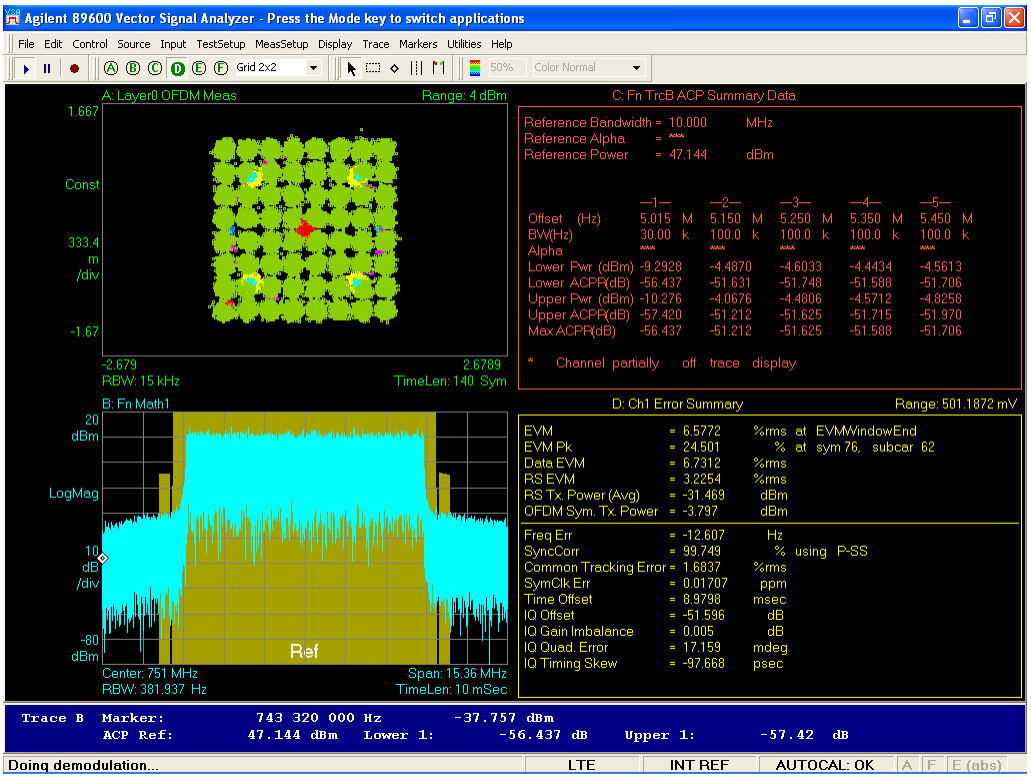


Figure 6-84: Stability -10°C

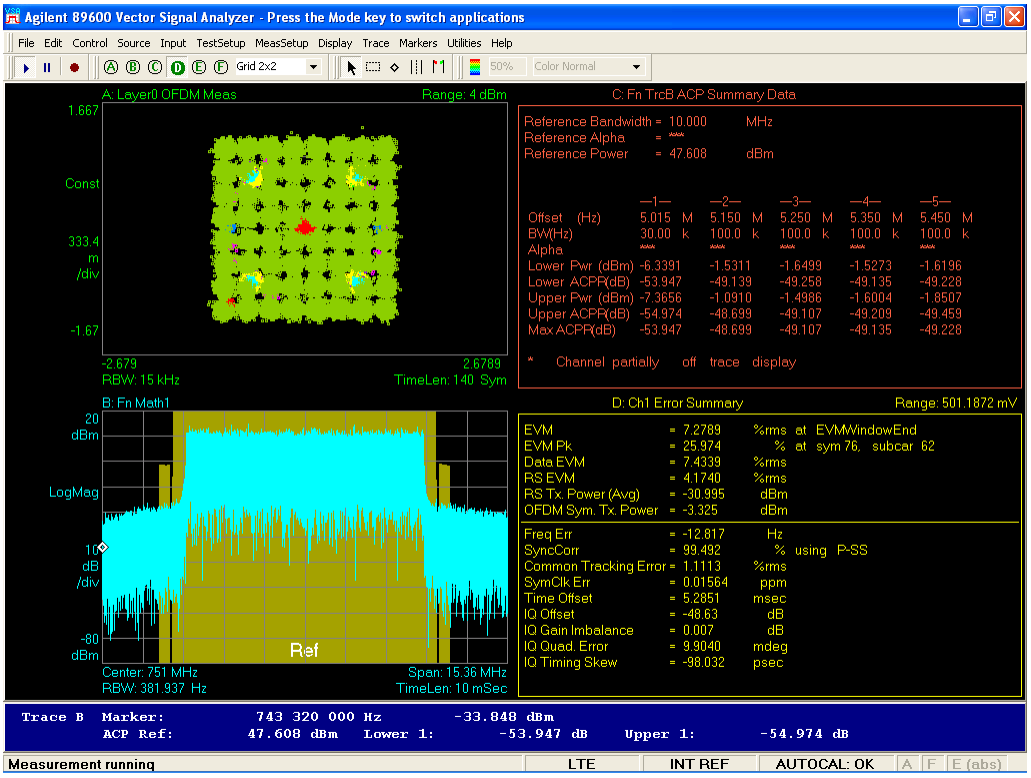


Figure 6-85: Stability 0°C

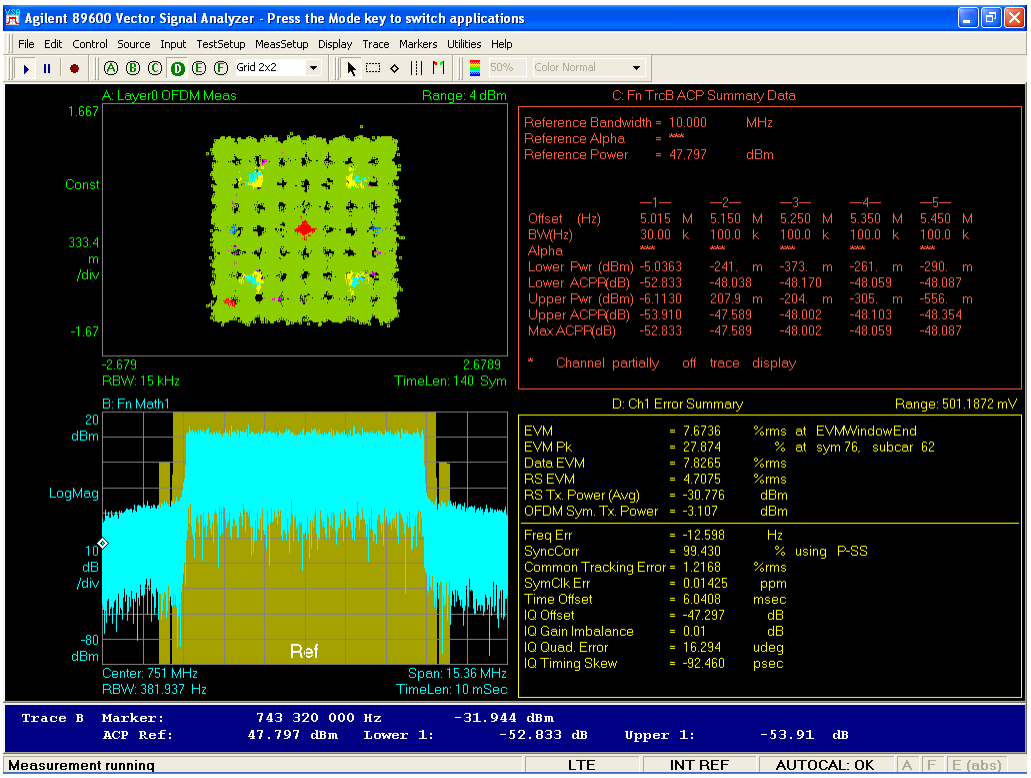


Figure 6-86: Stability 10°C

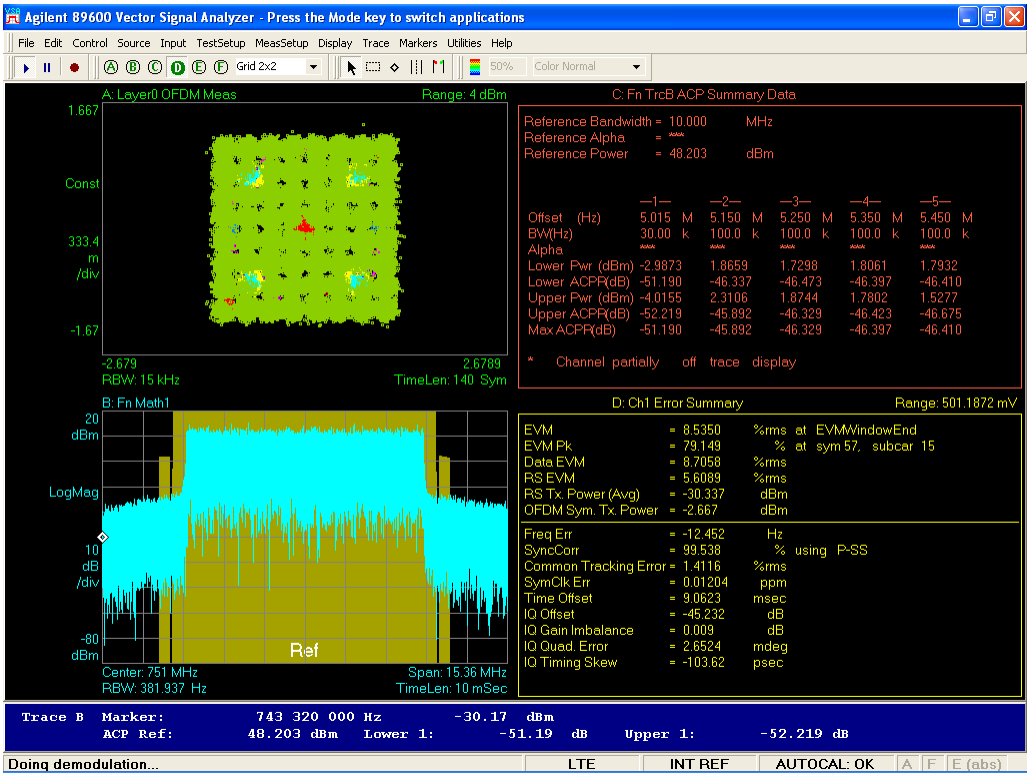


Figure 6-87: Stability 20°C

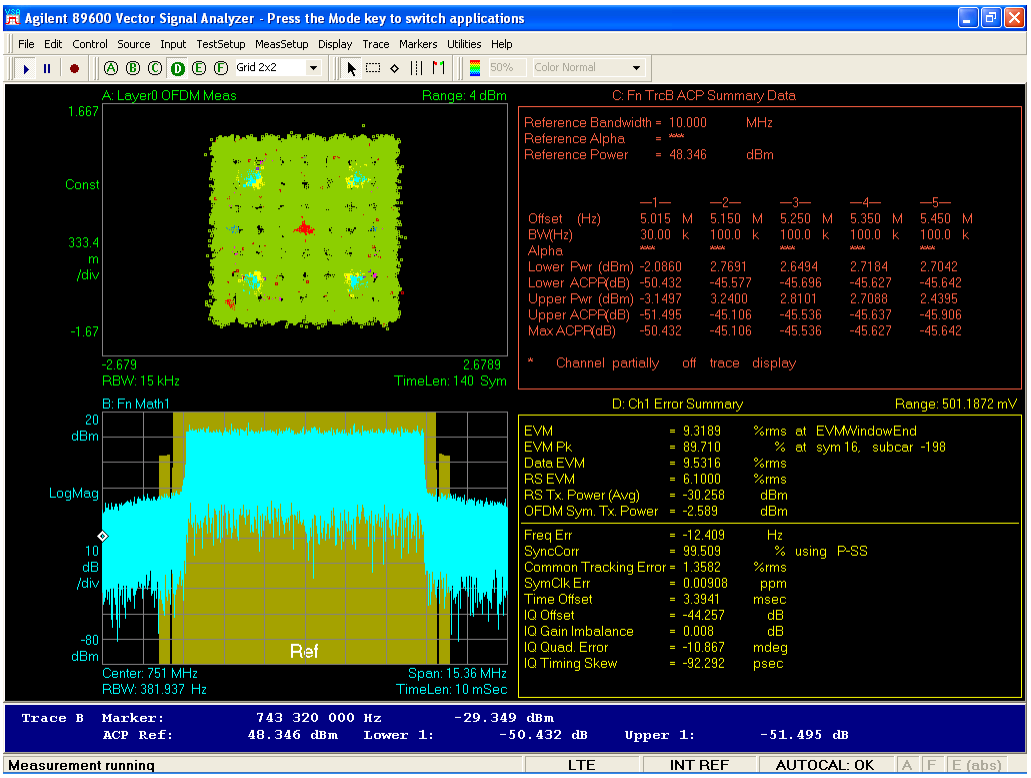


Figure 6-88: Stability 30°C

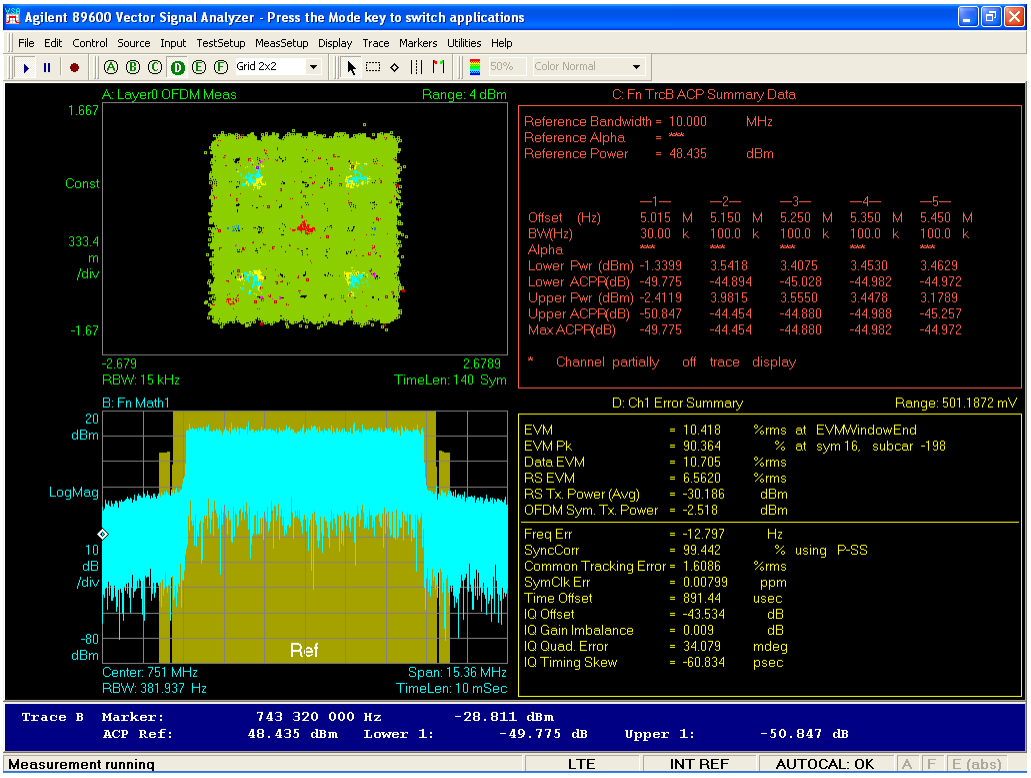


Figure 6-89: Stability 40°C

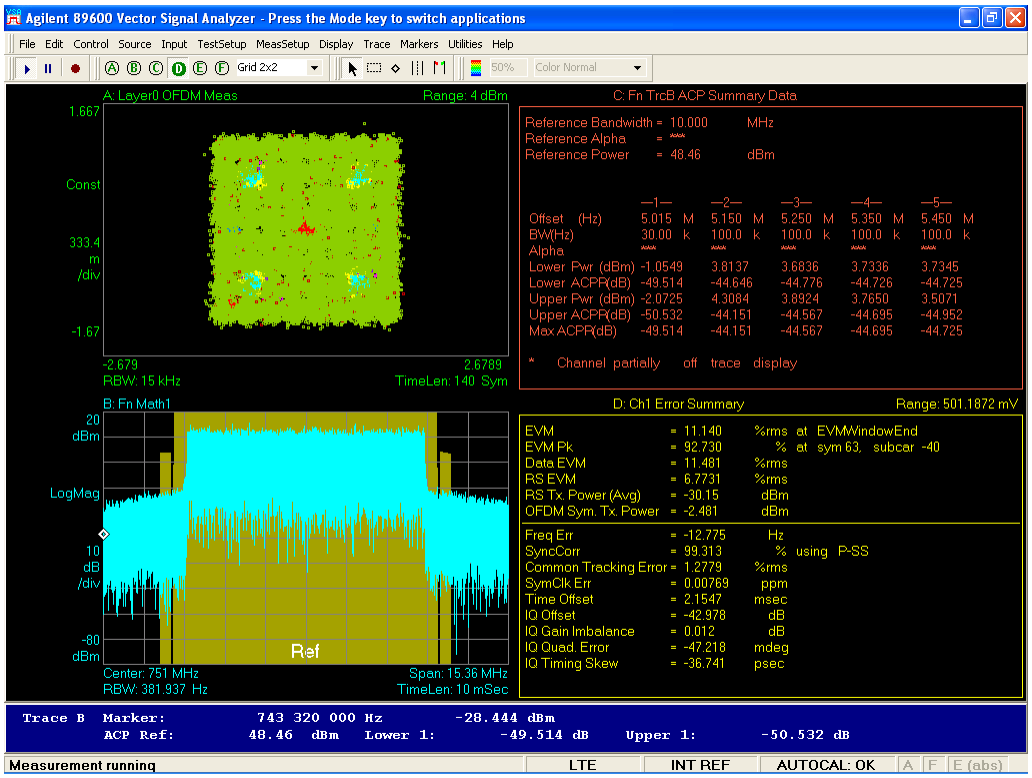


Figure 6-90: Stability 50°C