**MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313
33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372
3162 BELICK STREET • SANTA CLARA, CA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372
13501 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

November 13, 2018

Andrew Wireless Systems
Industriering 10,
Buchdorf, 86675 Germany

Dear Kent Morrett,

Enclosed is the EMC Wireless test report for compliance testing of the Andrew Wireless Systems, CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002 as tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 27 Subpart L for Broadband Radio Service (BRS) Devices.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please contact me.

Sincerely yours,
MET LABORATORIES, INC.

Joel Huna
Documentation Department

Reference: (\Andrew Wireless Systems\EMC100040-FCC27 Rev. 1)

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# Electromagnetic Compatibility Criteria
# Test Report

for the

**Andrew Wireless Systems**
**Model CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002**

**Tested under**
**FCC Certification Rules**
**Title 47 of the CFR, Part 27 Subpart L**

**MET Report: EMC100040-FCC27 Rev. 1**

November 13, 2018

**Prepared For:**

**Andrew Wireless Systems**
**Industriering 10,**
**Buchdorf, 86675 Germany**

**Prepared By:**
**MET Laboratories, Inc.**
914 West Patapsco Avenue,
Baltimore, MD 21230

# Electromagnetic Compatibility Criteria
# Test Report

for the

## Andrew Wireless Systems
## Model CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002

**Tested Under**

**FCC Certification Rules**
**Title 47 of the CFR, Part 27 Subpart L**

Deepak Giri, Project Engineer
Electromagnetic Compatibility Lab

Joel Huna
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 27 L of the FCC Rules under normal use and maintenance.

John Mason,
Director, Electromagnetic Compatibility Lab

# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| ∅ | November 6, 2018 | Initial Issue. |
| 1 | November 13, 2018 | TCB Review. |

# Table of Contents



# List of Tables



# List of Plots



# List of Terms and Abbreviations

| | |
|---|---|
| **AC** | **A**lternating **C**urrent |
| **ACF** | **A**ntenna **C**orrection **F**actor |
| **Cal** | **Cal**ibration |
| ***d*** | **M**easurement **D**istance |
| **dB** | **D**eci**b**els |
| **dBµA** | **D**eci**b**els above one **micro**amp |
| **dBµV** | **D**eci**b**els above one **micro**volt |
| **dBµA/m** | **D**eci**b**els above one **micro**amp **per m**eter |
| **dBµV/m** | **D**eci**b**els above one **micro**volt **per m**eter |
| **DC** | **D**irect **C**urrent |
| **E** | **E**lectric Field |
| **DSL** | **D**igital **S**ubscriber **L**ine |
| **ESD** | **E**lectro**s**tatic **D**ischarge |
| **EUT** | **E**quipment **U**nder **T**est |
| ***f*** | **F**requency |
| **FCC** | **F**ederal **C**ommunications **C**ommission |
| **GRP** | **G**round **R**eference **P**lane |
| **H** | Magnetic Field |
| **HCP** | **H**orizontal **C**oupling **P**lane |
| **Hz** | **H**ert**z** |
| **IEC** | **I**nternational **E**lectrotechnical **C**ommission |
| **kHz** | **k**ilo**h**ert**z** |
| **kPa** | **k**ilo**pa**scal |
| **kV** | **k**ilo**v**olt |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **MHz** | **M**ega**h**ertz |
| **µH** | **microh**enry |
| **µ** | **microf**arad |
| **µs** | **micros**econds |
| **NEBS** | **N**etwork **E**quipment-**B**uilding **S**ystem |
| **PRF** | **P**ulse **R**epetition **F**requency |
| **RF** | **R**adio **F**requency |
| **RMS** | **R**oot-**M**ean-**S**quare |
| **TWT** | **T**raveling **W**ave **T**ube |
| **V/m** | **V**olts **per m**eter |
| **VCP** | **V**ertical **C**oupling **P**lane |

# I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Andrew Wireless Systems CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002, with the requirements of Part 27. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002. Andrew Wireless Systems should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 27, in accordance with Andrew Wireless Systems, purchase order number 8002549647.

| Reference | Description | Compliance |
|---|---|---|
| §2.1046; §27.50(a)(1)and 27.50(h) (1) | RF Power Output | Compliant |
| §2.1047 | Modulation Characteristics | Not Applicable |
| §2.1049 | Occupied Bandwidth | Compliant |
| §2.1051; §27.53( m) | Spurious Emissions at Antenna Terminals | Compliant |
| §2.1051 | Emissions in GPS Bands | Not Applicable |
| §2.1053 | Radiated Spurious Emissions | Compliant |
| §2.1055 | Frequency Stability | Not Applicable |
| Section 3.62 FCC KDB 93510 and section 7.2.2.5.2 ANSI C63.26 | Intermodulation Products | Compliant |
| Section 3.3 FCC KDB 93510 and section 7.2.2.2 ANSI C63.26 | Filter Response | Compliant |
| 2.1091 | RF Exposure | Not Applicable |

**Table 1. Executive Summary of EMC ComplianceTesting**

Note: Only downlink frequencies of the relevant bands have been tested as the uplink side travels directly through a Fiber-optic cable, and is never transmitted over the air.

# II. Equipment Configuration

# A. Overview

MET Laboratories, Inc. was contracted by Andrew Wireless Systems to perform testing on the CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002, under Andrew Wireless Systems's purchase order number 8002549647.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Andrew Wireless Systems, CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002.

The results obtained relate only to the item(s) tested.

| | | |
|---|---|---|
| **Model(s) Tested** | CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002 | |
| **Model(s) Covered:** | CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002 | |
| **EUT Specifications:** | FCC ID: XS5-CAPM23232525 | |
| | Primary Power: 36-60 VDC (Nominal 48VDC) for 7820689-0002 & 85VAC to 264 VAC (Nominal 110VAC) for 7820689-0001 | |
| | Equipment Code: | B2I |
| | RF Output Power: Watts | 36.64 dBm |
| | EUT Frequency Range: | 2350-2360 MHz & 2496-2690 MHz |
| **Analysis:** | The results obtained relate only to the item(s) tested. | |
| **Environmental Test Conditions:** | Temperature: 15-35º C | |
| | Relative Humidity: 30-60% | |
| | Barometric Pressure: 860-1060 mbar | |
| **Evaluated by:** | Deepak Giri | |
| **Date(s):** | November 13, 2018 | |

**Table 2. EUT Summary Table**

## B. References

| | |
|---|---|
| **CFR 47, Part 27** | Federal Communication Commission, Code of Federal Regulations, Title 47, Part 27: Rules and Regulations for Advanced Wireless Services |
| **ANSI C63.4:2014** | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz |
| **ISO/IEC 17025:2005** | General Requirements for the Competence of Testing and Calibration Laboratories |
| **EIA/TIA-603-A-2001** | Land Mobile FM or PM Communication Equipment Measurement and Performance Standards |
| **ANSI C63.26: 2015** | American National Standard for Compliance Testing of Transmitters Used in the Licensed Radio Services |
| **KDB 935210 D02 v04r01** | Signal Boosters Basic Certification Requirements |
| **KDB 935210 D05 v01r02** | Measurements Guidance for Industrial and Non-Consumer Signal Booster, Repeater, and Amplifier Devices |

**Table 3. Standard References**

## C. Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site).

## D. Measurement Uncertainty

| Test Method | Typical Expanded Uncertainty | K | Confidence Level |
|---|---|---|---|
| **RF Frequencies** | ±4.52 Hz | 2 | 95% |
| **RF Power Conducted Emissions** | ±2.32 dB | 2 | 95% |
| **RF Power Conducted Spurious Emissions** | ±2.25 dB | 2 | 95% |
| **RF Power Radiated Emissions** | ±3.01 dB | 2 | 95% |

**Table 4. Uncertainty Calculations Summary**

## E. Description of Test Sample

The Andrew Wireless Systems CAPM – 23/23/25/25TDD/ Models 7820689-0001 and 7820689-0002, Equipment Under Test (EUT), is DAS (Distributed Antenna System) Remote. It does not operate in a stand-alone mode.

## F. Equipment Configuration

| Ref. ID | Slot # | Name / Description | Model Number | Part Number | Serial Number | Rev. # |
|---|---|---|---|---|---|---|
| | | CAP M 23/23/25/25-F-AC | 7820689-0001 | | | 0001 |
| | | CAP M 23/23/25/25-F-DC | 7820689-0002 | | | 0002 |
| | | ION-E WCS-2 Subrack | 7635443-00 | | | 00 |
| | | PSU shelf, AC | 7693531-00 | | | 00 |
| | | ION-E RFD, RF Donor | 7633229-01 | | | 01 |
| | | ION-E OPT, Optical Transport | 7642123-00 | | | 00 |
| | | ION-E SUI, System Interface | 7642125-00 | | | 00 |
| | | JUMPER, RISR, LS, 1.6MM, DPLX, LC/LC, AQ, MT010 | FEXLCLC42 -MXM010 | | | 00 |
| | | SFP+, 10GBase-SR, (MM) | 7660511 | | | 00 |

**Table 5. Equipment Configuration**

## G. Support Equipment

| Ref. ID | Name / Description | Manufacturer | Model Number | *Customer Supplied Calibration Data |
|---|---|---|---|---|
| | Laptop | | | N/A |
| | Qty 4 - Cat 5 Cable | | | N/A |
| | Qty 2 - Signal Generators (2496-2690 MHZ) | | | Not Available |
| | Qty 2 - Signal Generators (2350-2360 MHZ) | | | Not Available |
| | 48VDC Power Supply | | | N/A |

The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.

**Table 6. Support Equipment**

## H. Ports and Cabling Information

| Ref. ID | Port name on EUT | Cable Description or reason for no cable | Qty | Length as tested (m) | Max Length (m) | Shielded? (Y/N) | Termination Box ID & Port Name |
|---|---|---|---|---|---|---|---|
| 1 | Fiber Input Cable | Customer supplied Fiber Cable | 1 | 15 | | Yes | EUT Input |
| 2 | 48VDC Input | DC power Cable | 1 | 2 | | No | EUT Power Supply |
| 3 | ANT 1 & 2 | Test Equipment | 1 | 2 | | No | Antenna Port |

**Table 7. Ports and Cabling Information**

## I. Mode of Operation

The EUT will operate in a continuous emission mode. The unit will be tested to address FCC Part 15 B (Class B) – Unintentional Radiator Conducted and Radiated Emissions.

The EUT will also be operated in a continuous emission mode addressing FCC Part 27 & RSS-131, RSS-139 Intentional Radiator mode for Frequency Band 2350-2360 MHz (Band 30) (Bandwidths 5, 10 MHz) and Frequency Band (2496-2690 MHz (Band 41) ( Bandwidths 5, 10, 15, 20 MHz).

## J. Method of Monitoring EUT Operation

The LED on the unit will be solid green if the unit is powered on and operational. If the unit is powered on and the LED on the unit is a solid red, the unit is not operational. It will be identified as a major hardware issue and an alarm will be raised on the GUI.

## K. Modifications

**a) Modifications to EUT**

No modifications were made to the EUT.

**b) Modifications to Test Standard**

No modifications were made to the test standard.

## L. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Andrew Wireless Systems upon completion of testing.

# III. Electromagnetic Compatibility Criteria for Intentional Radiators

## Electromagnetic Compatibility Criteria for Intentional Radiators

## § 2.1046 RF Power Output

**Test Requirement(s):** §27.50(a)(1)and 27.50(h) (1) --- Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

**Test Procedures:** The EUT was tested according to the average power integration procedures of ANSI C63.26 7.2.2.4.1. The power measurement function of spectrum analyzer was used and configured in the following manner.

(a) Frequency = channel cf
(b) Span = 2-3 x the OBW
(c) RBW = 1-5 % of the OBW
(d) VBW 1-3 x the RBW
(e) Sweep Time = Auto
(f) Detector = Average

The AGC threshold is to be determined as follows.
In the case of fiber-optic distribution systems, the RF input port of the equipment under test (EUT) refers to the RF input of the supporting equipment RF to optical convertor; see also descriptions and diagrams for typical DAS booster systems in KDB Publication 935210 D02 [R7].
Devices intended to be directly connected to an RF source (donor port) only need to be evaluated for any over-the-air transmit paths.

a) A signal generator was connected to the input of the EUT.

b) A spectrum analyzer or power meter was connected to the output of the EUT using appropriate attenuation as necessary.

c) The signal generator was initially configured to produce either of the required test signals (i.e., broadband or narrowband).

d) The signal generator frequency was set to the center frequency of the EUT operating band.

e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 or 3.5.4, the input level was increased until a 1 dB increase in the input signal power no longer caused a 1 dB increase in the output signal power.

f) This level was recorded as the AGC threshold level.

g) The procedure was repeated with the remaining test signal.

**Test Results:** The EUT was found compliant with the requirements of this section.

**Test Engineer(s):** Bradley Jones

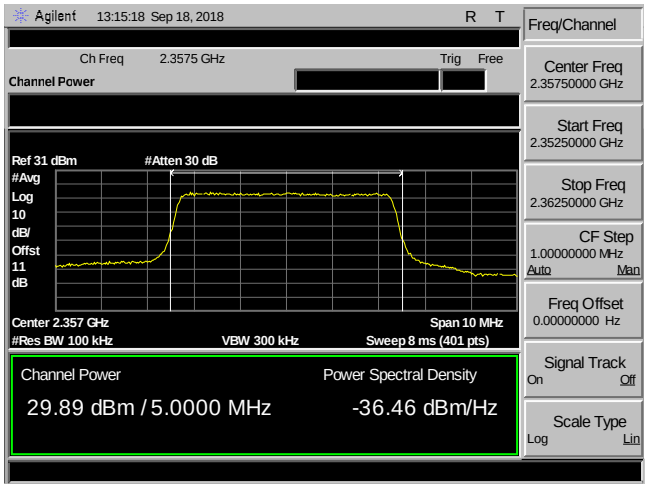
**Test Date(s):** September 18, 2018

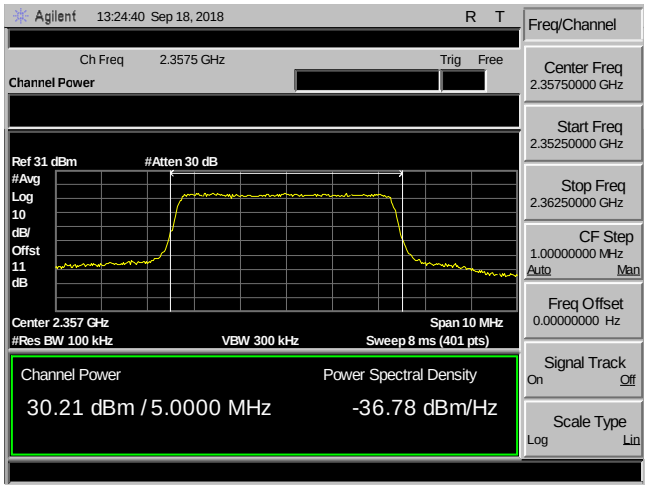
| Band 30 | | frequency | Input Power | Output Port 1 | Output Port 2 | Output Sum | Gain |
|---|---|---|---|---|---|---|---|
| 5 MHz | Low | 2352.5 | -5.19 | 30.89 | 31.1 | 34.006569 | 39.19657 |
| | Middle | 2355 | -4.86 | 29.92 | 30.53 | 33.246001 | 38.106 |
| | High | 2357.5 | -4.78 | 29.89 | 30.21 | 33.063247 | 37.84325 |
| 10 MHz | Middle | 2355 | -5.07 | 29.19 | 29.73 | 32.478687 | 37.54869 |
| | | | | | | | |
| **Band 41** | | **frequency** | **Input Power** | **Output Port 1** | **Output Port 2** | **Output Sum** | **Gain** |
| 5 MHz | Low | 2498.5 | 10.11 | 33.1 | 33.18 | 36.150484 | 26.04048 |
| | Middle | 2593 | 10.6 | 33.49 | 33.21 | 36.362556 | 25.76256 |
| | High | 2687.5 | 10.61 | 33.53 | 33.11 | 36.335375 | 25.72538 |
| 10 MHz | Low | 2501 | 10.11 | 33.18 | 33.39 | 36.296569 | 26.18657 |
| | Middle | 2593 | 9.95 | 33.25 | 32.57 | 35.933595 | 25.9836 |
| | High | 2685 | 10.06 | 33.29 | 33.24 | 36.275372 | 26.21537 |
| 15 MHz | Low | 2503.5 | 10.35 | 33.3 | 33.26 | 36.290346 | 25.94035 |
| | Middle | 2593 | 10.16 | 33.6 | 33.66 | 36.640404 | 26.4804 |
| | High | 2682.5 | 10.14 | 33.21 | 33.09 | 36.160714 | 26.02071 |
| 20 MHz | Low | 2506 | 10.13 | 32.45 | 32.52 | 35.495441 | 25.36544 |
| | Middle | 2593 | 10.05 | 33.07 | 33.3 | 36.196822 | 26.14682 |
| | High | 2680 | 9.97 | 32.78 | 32.76 | 35.780311 | 25.81031 |

**Table 8. RF Output Power, Part 27, Test Results**

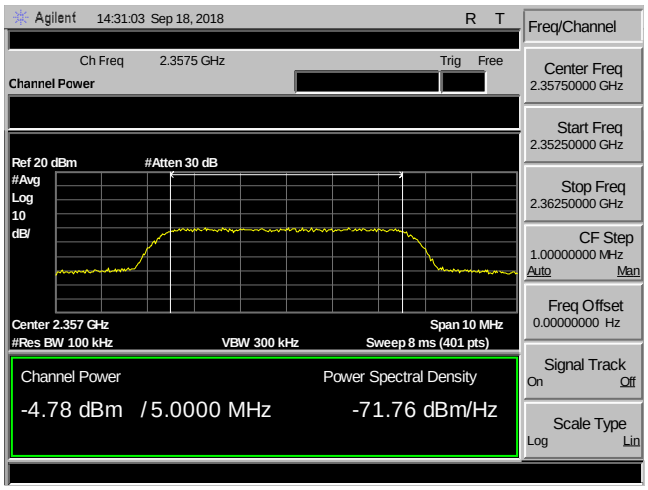
# RF Output Power, Band 30



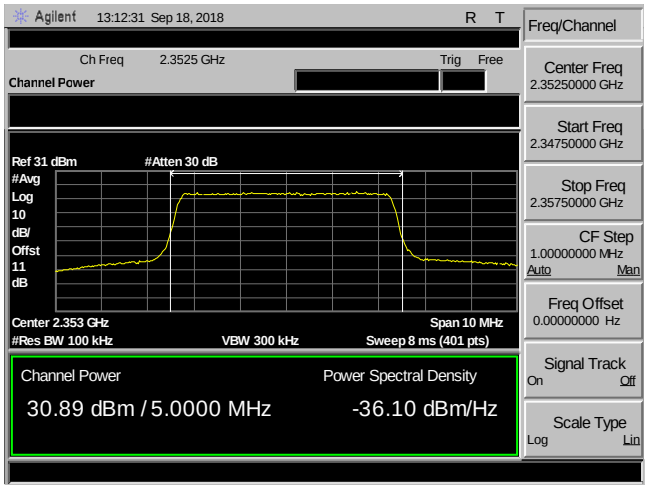

**Plot 1. RF Power Output, WCS2300, 5 MHz, High, Port 1**



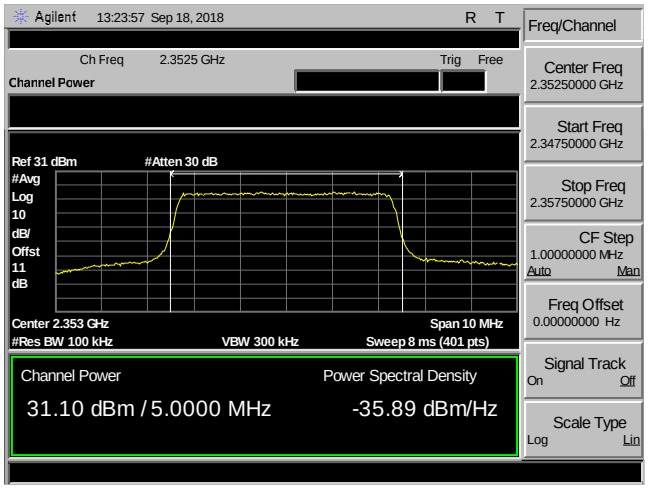

**Plot 2. RF Power Output, WCS2300, 5 MHz, High, Port 2**



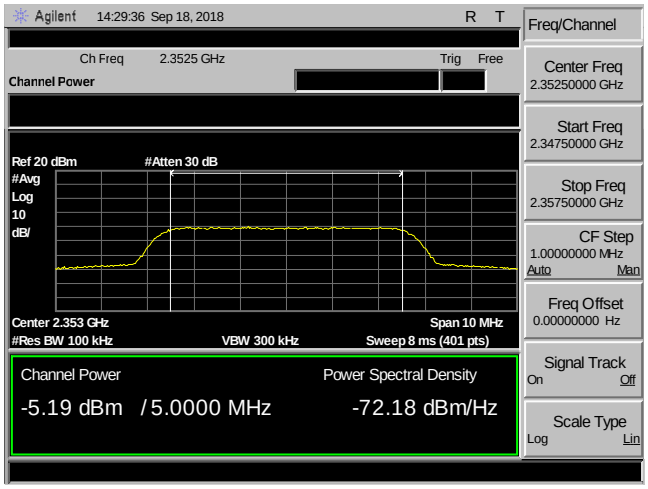

**Plot 3. RF Power Output, WCS2300, 5 MHz, High, SG**



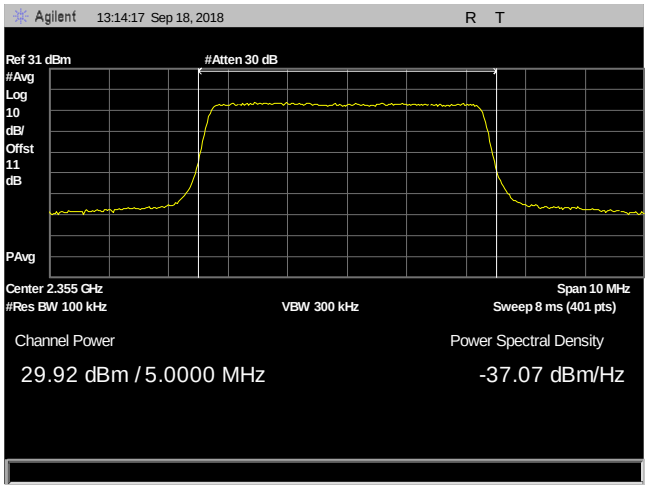

**Plot 4. RF Power Output, WCS2300, 5 MHz, Low, Port 1**



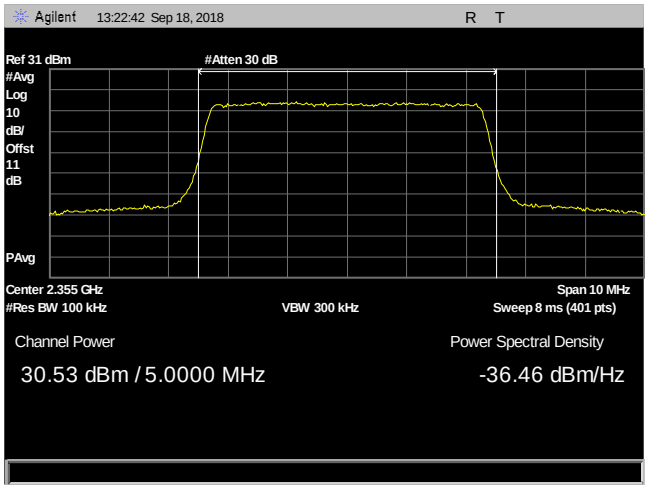

**Plot 5. RF Power Output, WCS2300, 5 MHz, Low, Port 2**



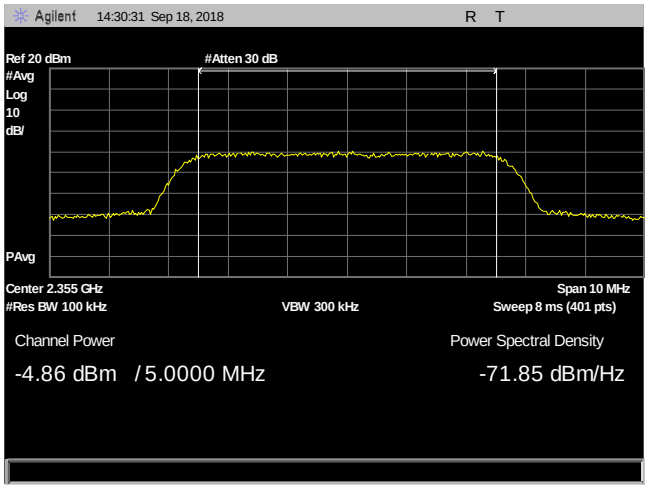

**Plot 6. RF Power Output, WCS2300, 5 MHz, Low, SG**



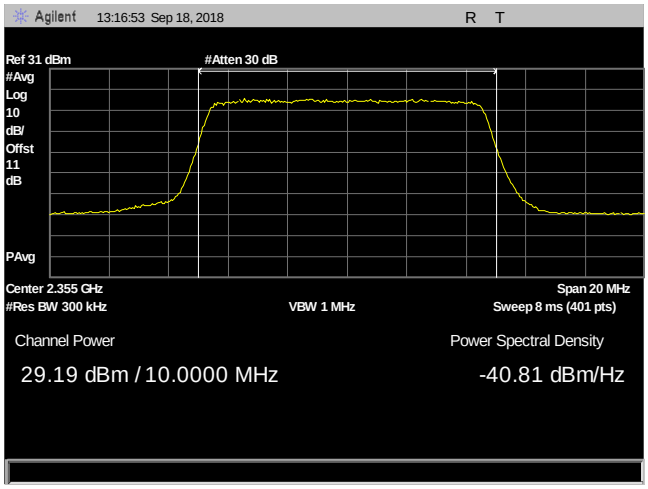

**Plot 7. RF Power Output, WCS2300, 5 MHz, Mid, Port 1**



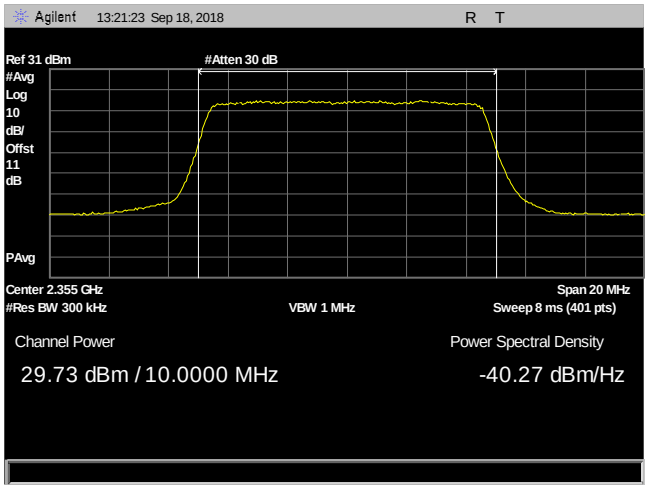

**Plot 8. RF Power Output, WCS2300, 5 MHz, Mid, Port 2**



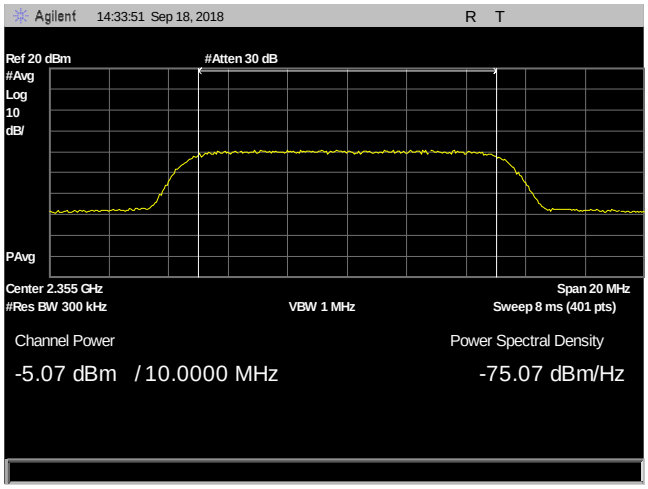

**Plot 9. RF Power Output, WCS2300, 5 MHz, Mid, SG**




**Plot 10. RF Power Output, WCS2300, 10 MHz, Mid, Port 1**

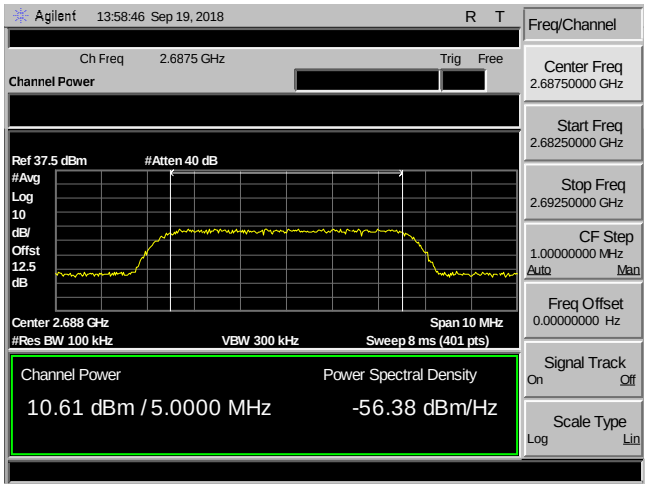



**Plot 11. RF Power Output, WCS2300, 10 MHz, Mid, Port 2**

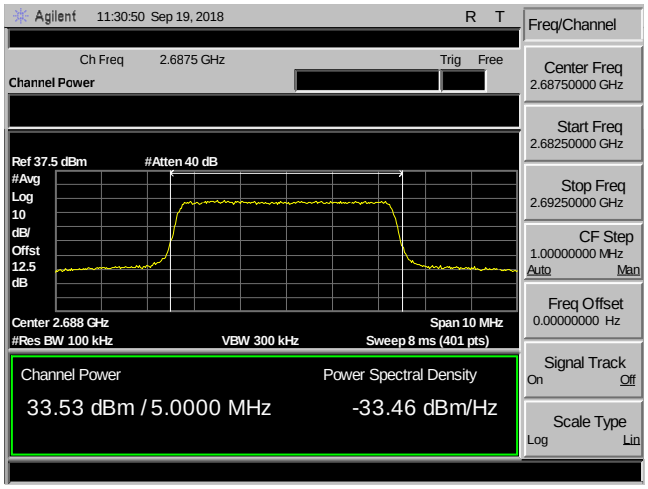



**Plot 12. RF Power Output, WCS2300, 10 MHz, Mid, SG**

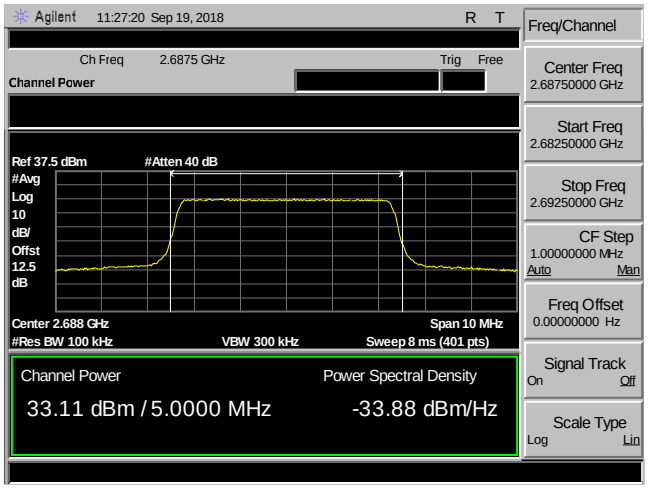
## RF Output Power, Band 41




**Plot 13. RF Power Output, Band 41, 5 MHz, High, AGC**

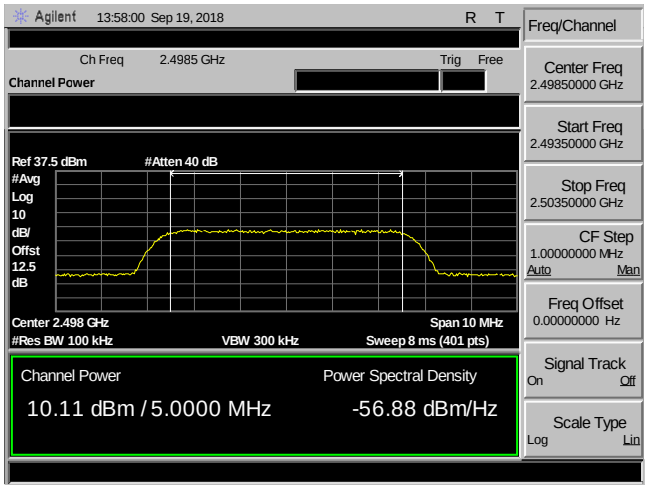



**Plot 14. RF Power Output, Band 41, 5 MHz, MHz, High, Port 1**

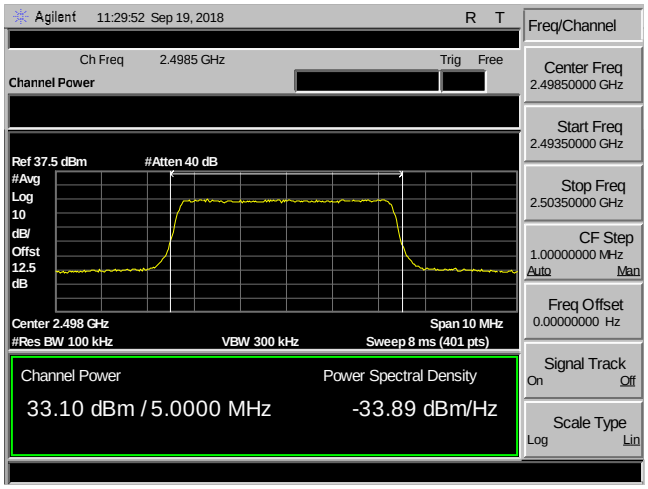



**Plot 15. RF Power Output, Band 41, 5 MHz, High, Port 2**

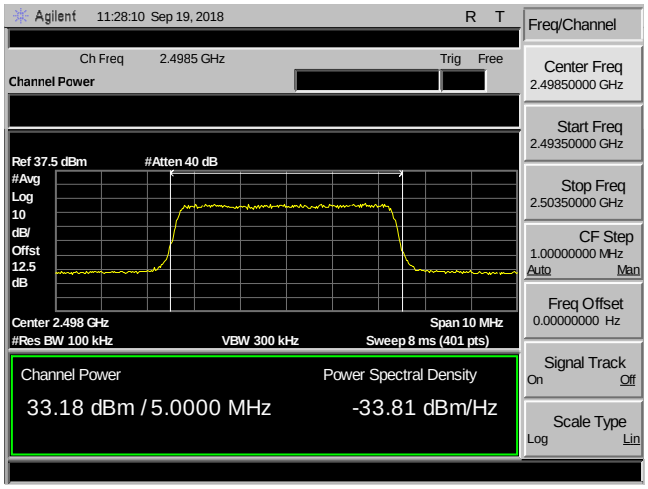
  




**Plot 16. RF Power Output, Band 41, 5 MHz, MHz, Low, AGC**

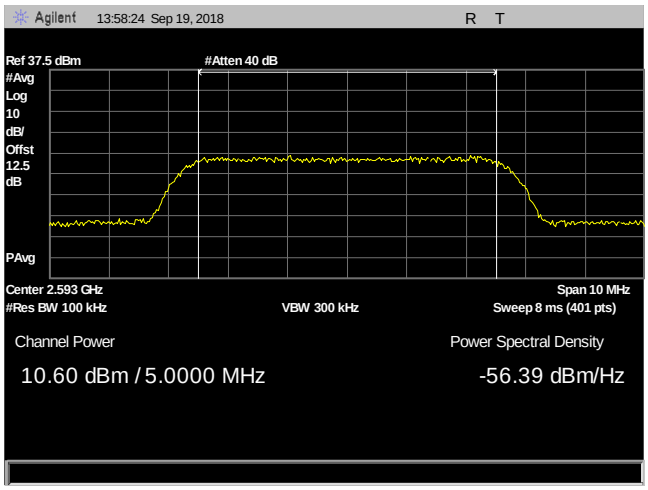



**Plot 17. RF Power Output, Band 41, 5 MHz, Low, Port 1**

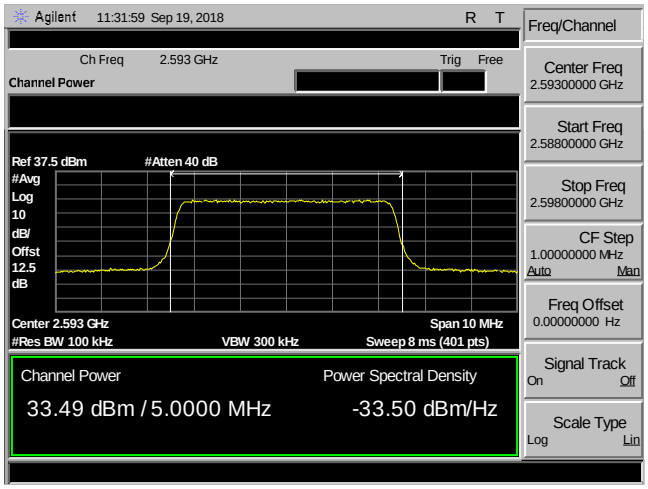



**Plot 18. RF Power Output, Band 41, 5 MHz, Low, Port 2**

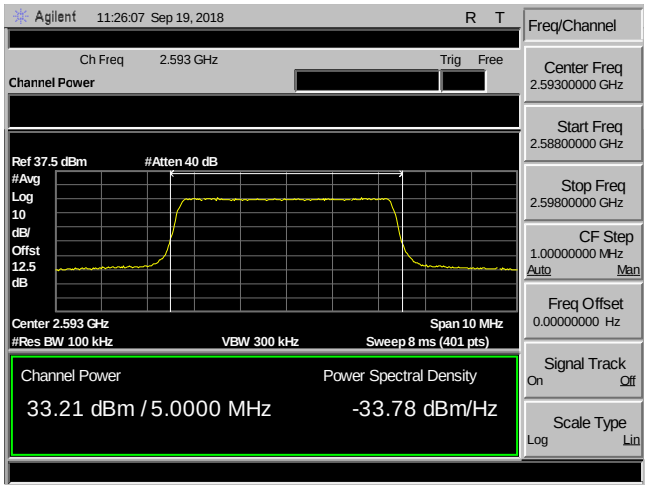
  




**Plot 19. RF Power Output, Band 41, 5 MHz, Mid, AGC**

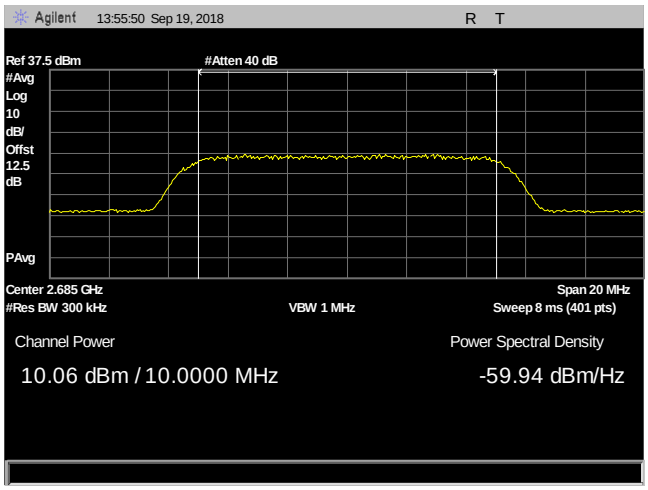



**Plot 20. RF Power Output, Band 41, 5 MHz, Mid, Port 1**

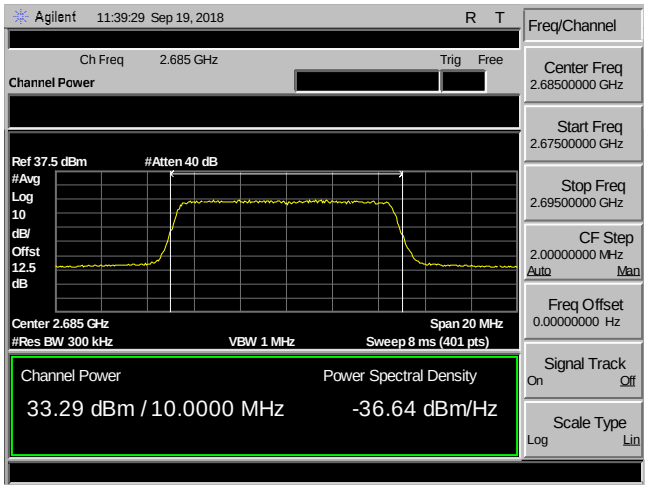



**Plot 21. RF Power Output, Band 41, 5 MHz, Mid, Port 2**

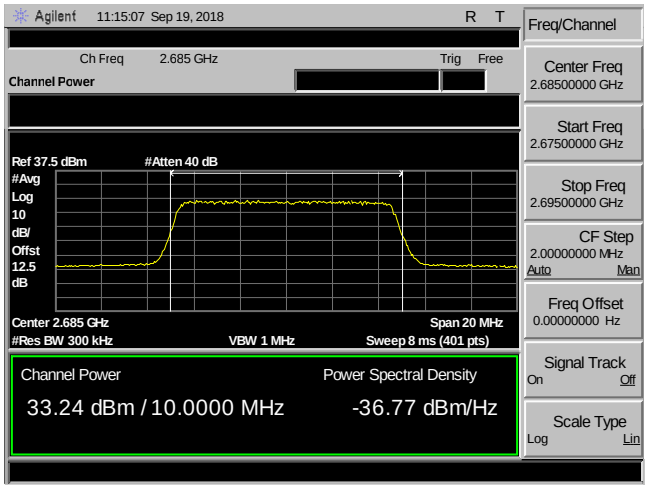
  




**Plot 22. RF Power Output, Band 41, 10 MHz, High, AGC**

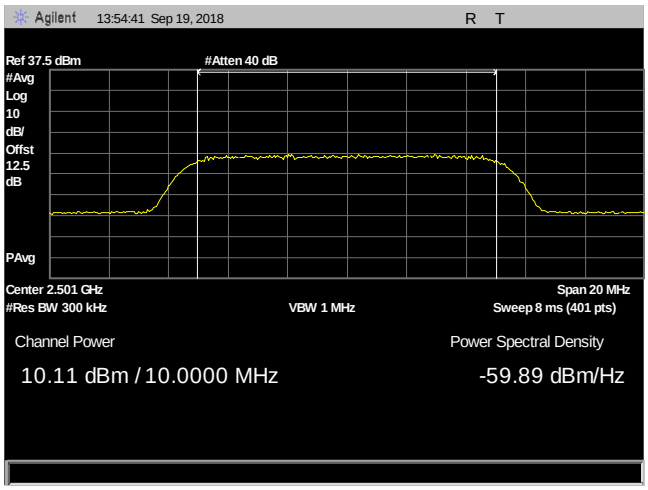



**Plot 23. RF Power Output, Band 41, 10 MHz, High, Port 1**

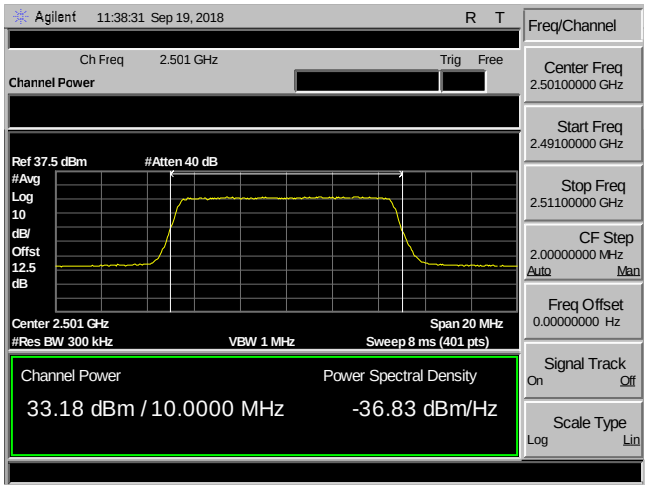



**Plot 24. RF Power Output, Band 41, 10 MHz, High, Port 2**

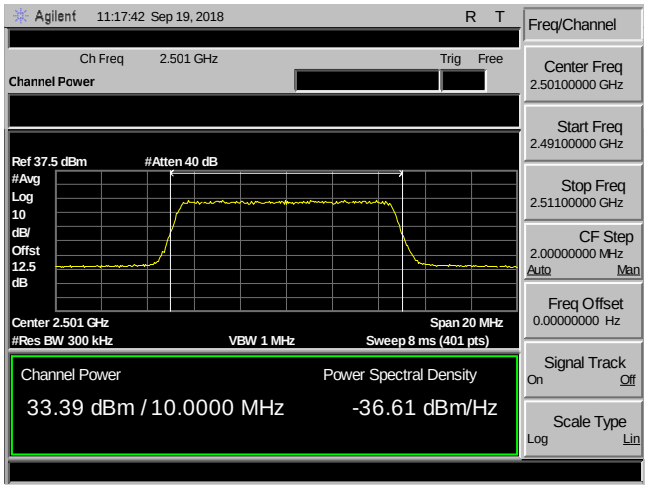
  




**Plot 25. RF Output Power, Band 41, 10 MHz, Low, AGC**

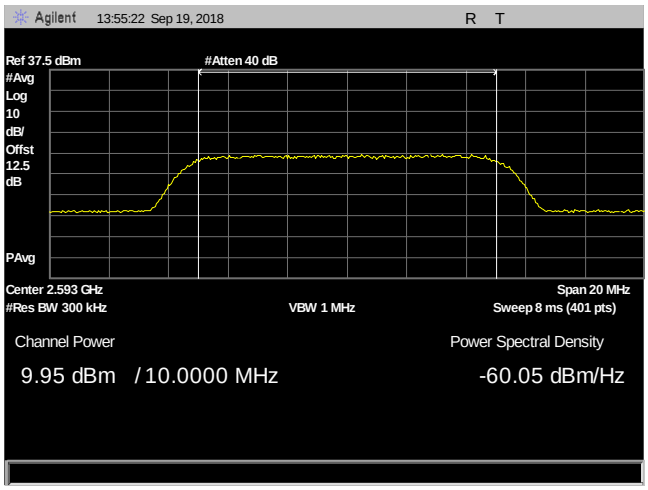



**Plot 26. RF Power Output, Band 41, 10 MHz, Low, Port 1**

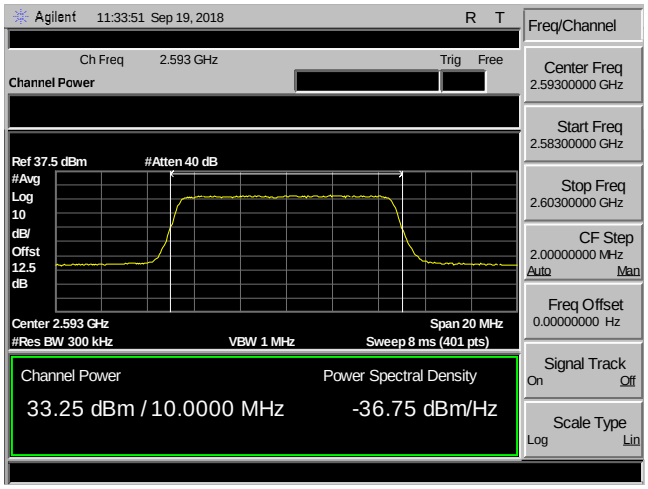



**Plot 27. RF Power Output, Band 41, 10 MHz, Low, Port 2**

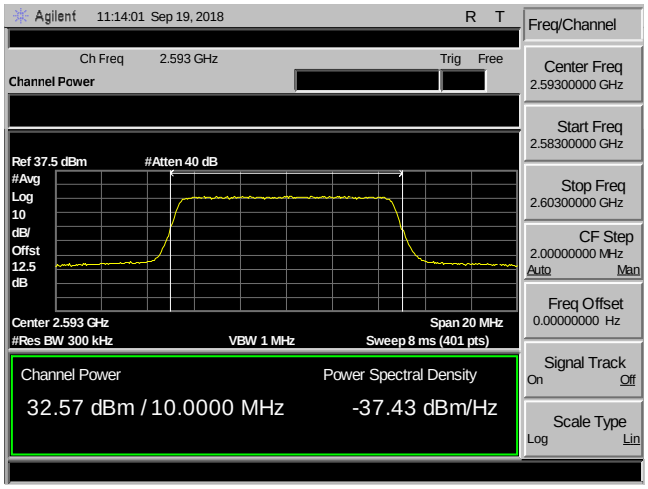
  




**Plot 28. RF Power Output, Band 41, 10 MHz, Mid, AGC**

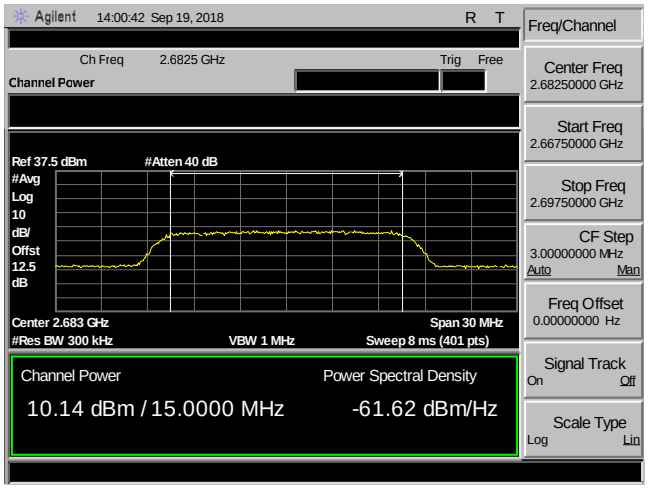



**Plot 29. RF Power Output, Band 41, 10 MHz, Mid, Port 1**

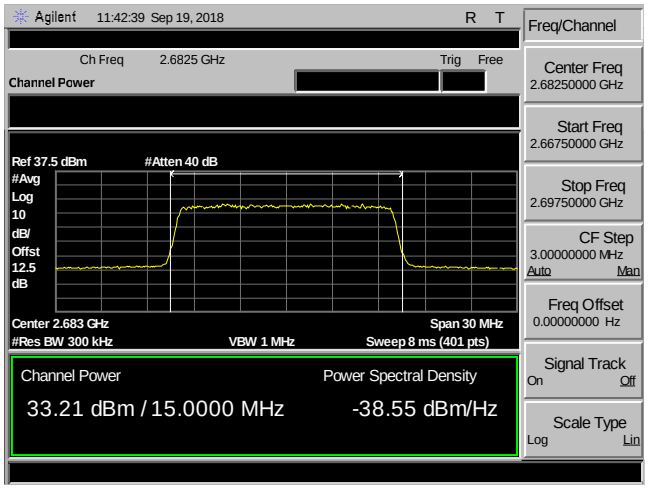



**Plot 30. RF Power Output, Band 41, 10 MHz, Mid, Port 2**

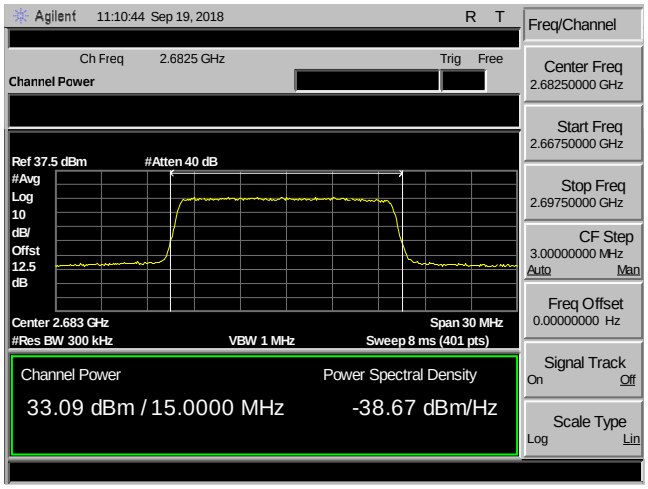
  




**Plot 31. RF Power Output, Band 41, 15 MHz, High, AGC**

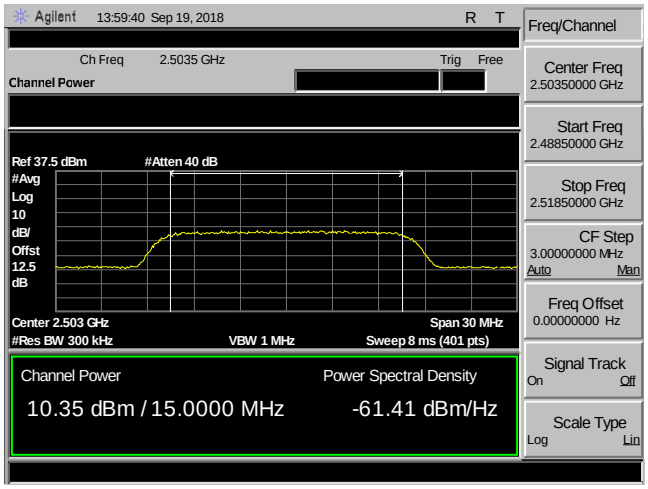



**Plot 32. RF Power Output, Band 41, 15 MHz, High, Port 1**

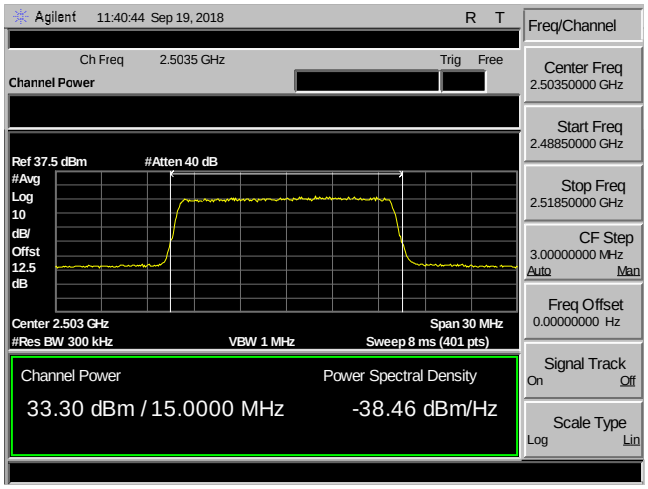



**Plot 33. RF Power Output, Band 41, 15 MHz, High, Port 2**

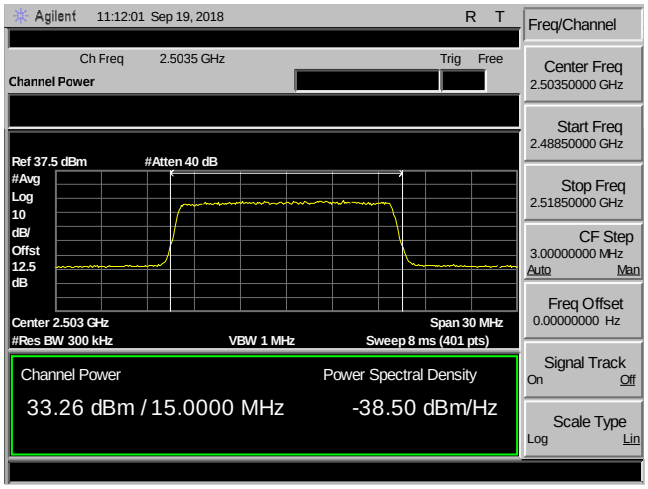
  




**Plot 34. RF Power Output, Band 41, 15 MHz, Low, AGC**

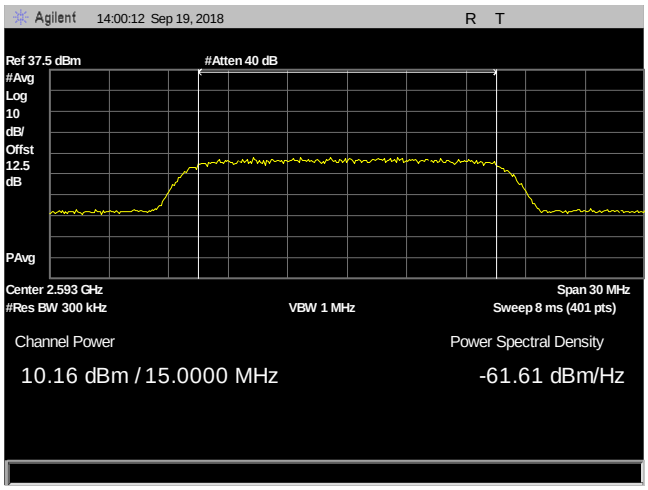



**Plot 35. RF Power Output, Band 41, 15 MHz, Low, Port 1**

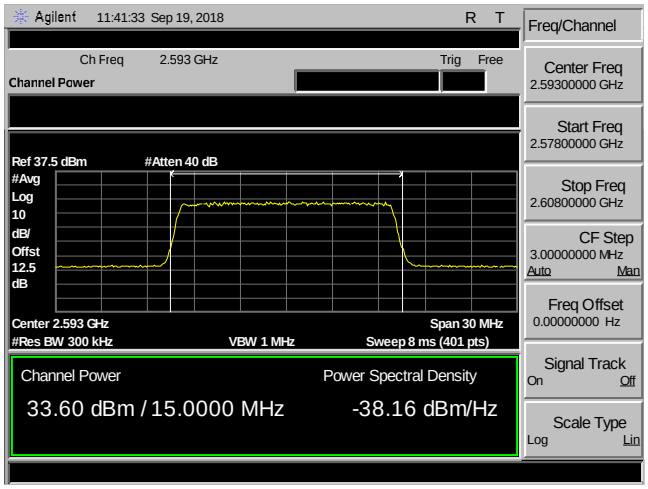



**Plot 36. RF Power Output, Band 41, 15 MHz, Low, Port 2**

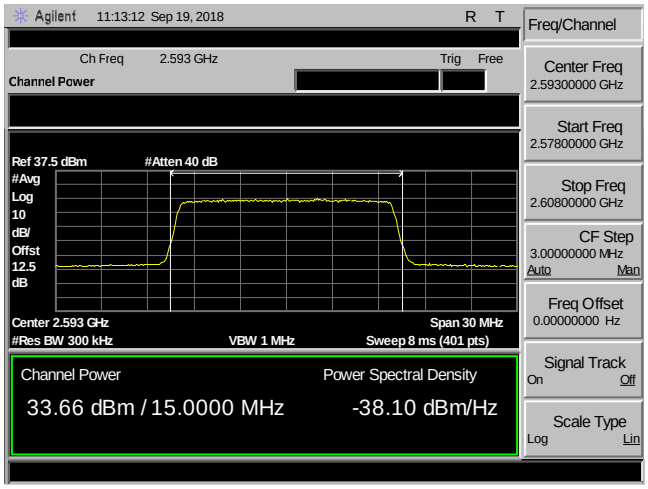
  




**Plot 37. RF Power Output, Band 41, 15 MHz, Mid, AGC**

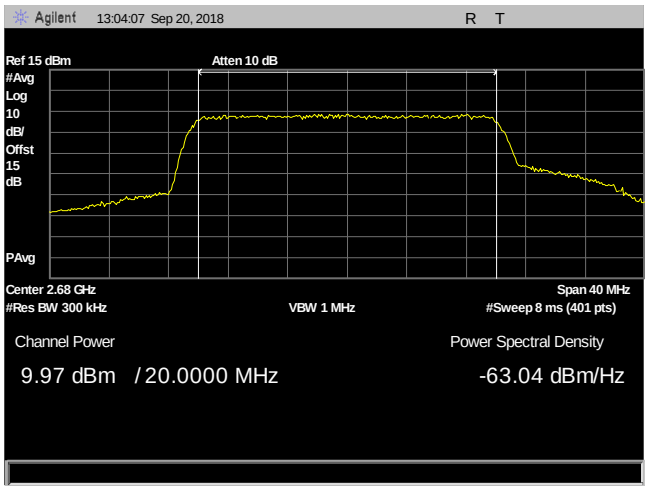



**Plot 38. RF Power Output, Band 41, 15 MHz, Mid, Port 1**

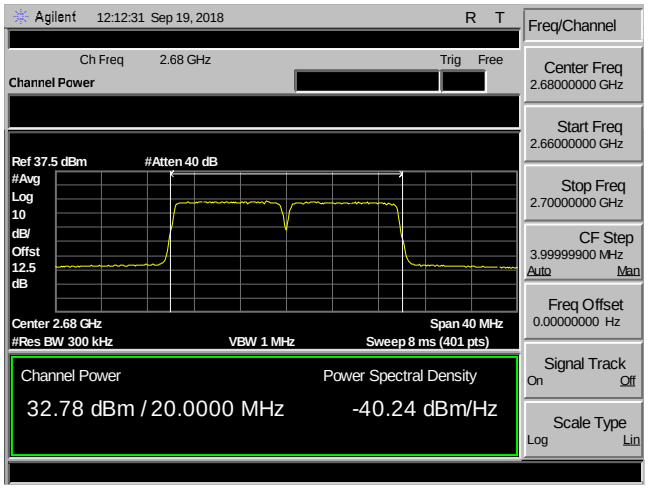



**Plot 39. RF Power Output, Band 41, 15 MHz, Mid, Port 2**

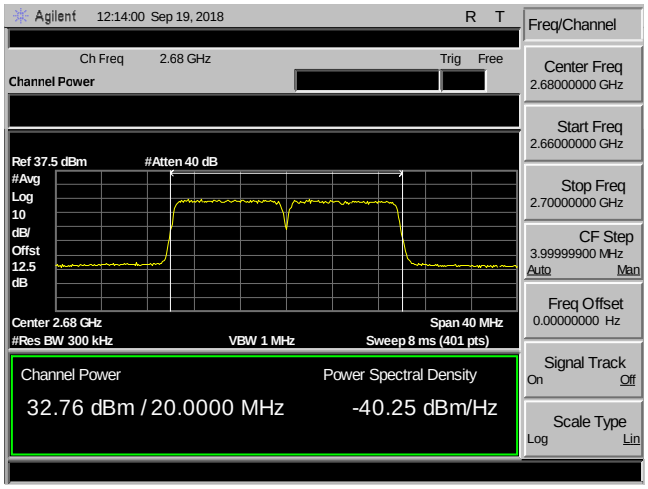
  




**Plot 40. RF Power Output, Band 41, 20 MHz, High, AGC**

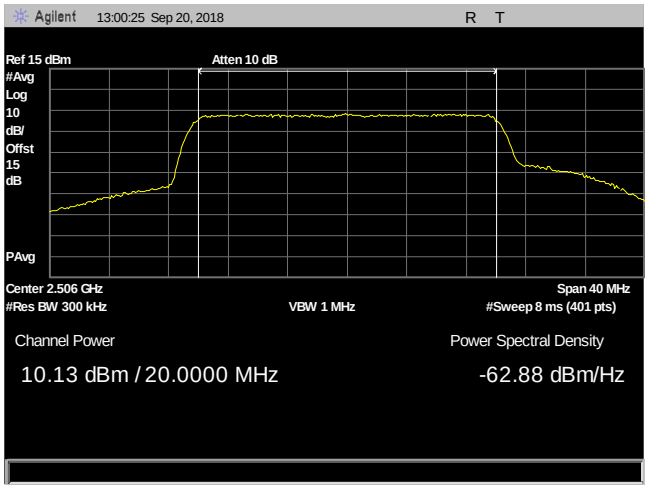



**Plot 41. RF Power Output, Band 41, 20 MHz, High, Port 1**

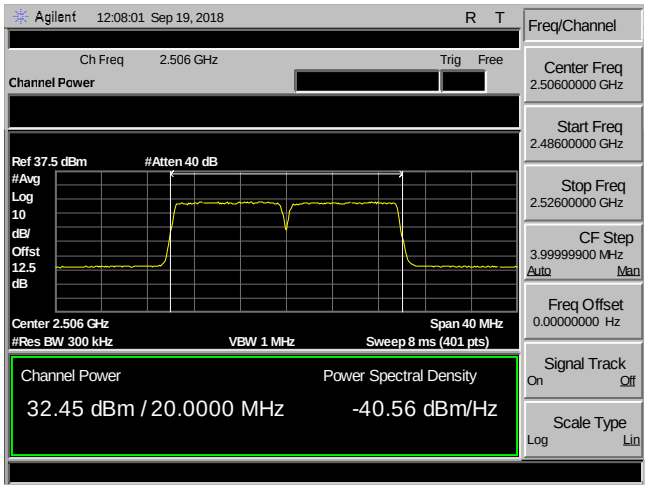



**Plot 42. RF Power Output, Band 41, 20 MHz, High, Port 2**

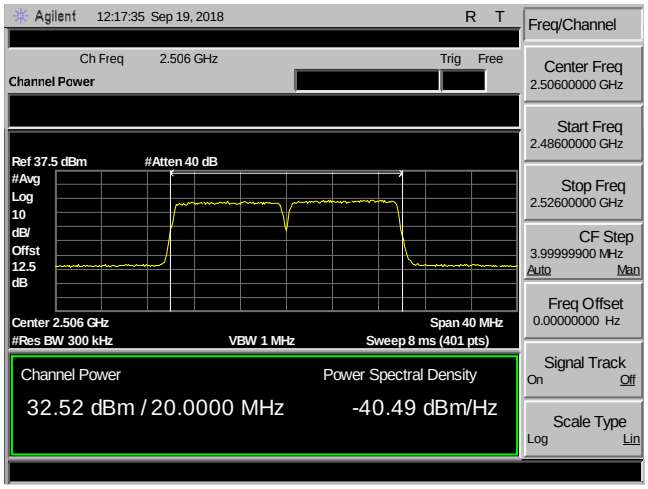
  




**Plot 43. RF Power Output, Band 41, 20 MHz, Low, AGC**

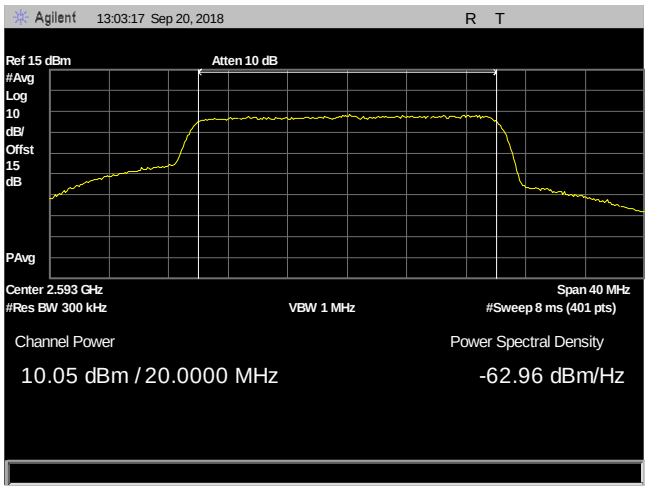



**Plot 44. RF Power Output, Band 41, 20 MHz, Low, Port 1**

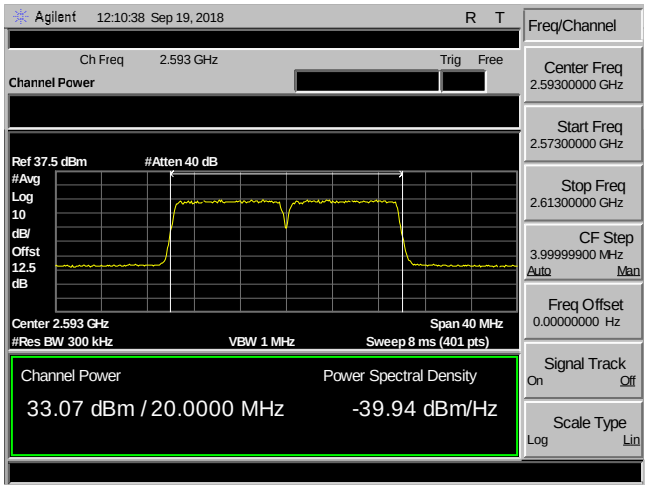



**Plot 45. RF Power Output, Band 41, 20 MHz, Low, Port 2**

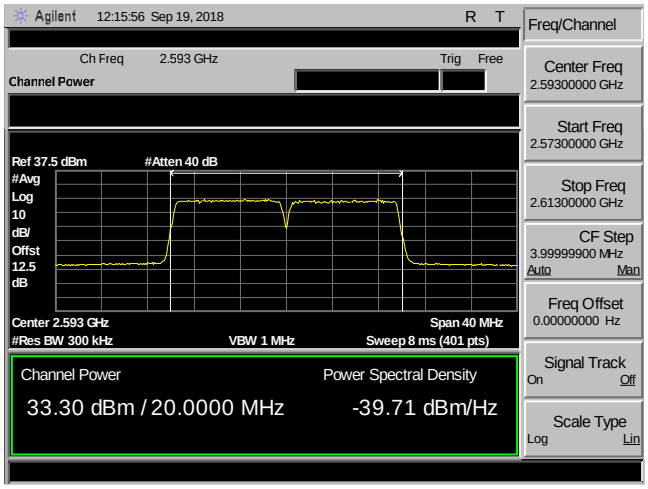
  




**Plot 46. RF Power Output, Band 41, 20 MHz, Mid, AGC**




**Plot 47. RF Power Output, Band 41, 20 MHz, Mid, Port 1**




**Plot 48. RF Power Output, Band 41, 20 MHz, Mid, Port 2**

## § 2.1049 Occupied Bandwidth

**Test Requirement(s):** **§ 2.1049 Measurements required: Occupied bandwidth:** 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 specified conditions of § 2.1049 (a) through (i) as applicable.

**Test Procedures:** The EUT was tested according to relative measurement procedure of KDB935210 D05 section 3.4 or C63.26-2015 section 7.2.2.3. The OBW measurement function of the spectrum analyzer was used and configured in the following manner.

(a) Frequency = channel cf
(b) Span = 2-5 x the OBW
(c) RBW = 1-5 % of the OBW
(d) VBW 1-3 x the RBW
(e) Sweep Time = Auto
(f) Detector = peak
(g) –X dB = 26

a) A signal generator was connected to the input of the EUT.
b) The signal generator was configured to transmit the AWGN signal.
c) The signal amplitude was configured to be just below the AGC threshold level (see 3.2), but not more than 0.5 dB below.
d) A spectrum analyzer was connected to the output of the EUT using appropriate attenuation.
e) The spectrum analyzer center frequency was set to the center frequency of the operational band under test. The span range of the spectrum analyzer was between 2 times to 5 times the emission bandwidth (EBW) or alternatively, the OBW.
f) The nominal RBW was in the range of 1 % to 5 % of the anticipated OBW, and the VBW was ≥ 3 × RBW.
g) The reference level of the instrument was set as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation. In general, the peak of the spectral envelope must be more than [10 log (OBW / RBW)] below the reference level.
Steps f) and g) may require iteration to enable adjustments within the specified tolerances.
h) The noise floor of the spectrum analyzer at the selected RBW were at least 36 dB below the reference level.
i) Spectrum analyzer detection function was set to positive peak.
j) The trace mode was set to max hold.
k) The reference value was determined: the trace to stabilize was allowed. The spectrum analyzer marker was set to the highest amplitude level of the displayed trace (this is the reference value) and the associated frequency was recorded as $f_0$.
l) Two markers were placed, one at the lowest and the other at the highest frequency of the envelope of the spectral display, such that each marker was at or slightly below the −26 dB down amplitude. The 26 dB EBW (alternatively OBW) is the positive frequency difference between the two markers. If the spectral envelope crossed the −26 dB down amplitude at multiple points, the lowest or highest frequency were selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the −26 dB down amplitude point.

m) Steps e) to l) were repeated with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
n) The spectral plot of the input signal (determined from step m) was compared to the output signal (determined from step l) to affirm that they are similar (in passband and rolloff characteristic features and relative spectral locations), and plot(s) and descriptions were included in test report.
o) The procedure was repeated [steps e) to n)] with the input signal amplitude set to 3 dB above the AGC threshold.
p) Steps e) to o) were repeated with the signal generator set to the narrowband signal.
q) Steps e) to p) were repeated for all frequency bands authorized for use by the EUT.

**Test Results:** Equipment was found compliant with Section 2.1049. The following pages show measurements of 99% and -26 dB Occupied Bandwidth plots.

**Test Engineer(s):** Bradley Jones

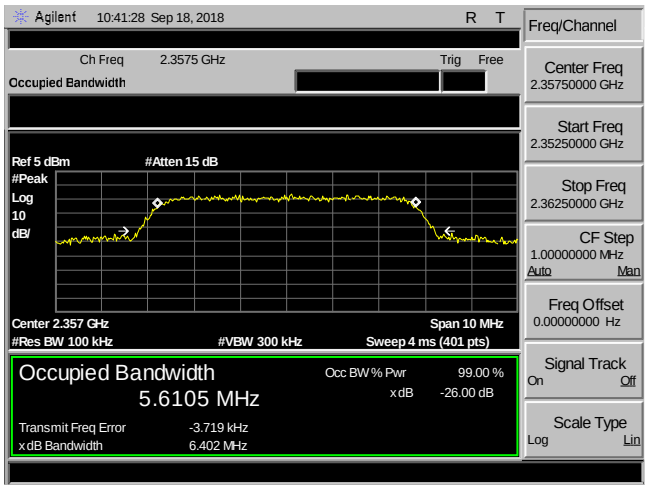
**Test Date(s):** September 20, 2018

| Band 30 | | frequency | OBW Input | OBW Output | % diff |
|---|---|---|---|---|---|
| 5 MHz | Low | 2352.5 | 6.447 | 4.937 | -23.4217 |
| | Middle | 2355 | 6.435 | 4.934 | -23.3256 |
| | High | 2357.5 | 6.402 | 4.924 | -23.0865 |
| 10 MHz | Middle | 2355 | 12.812 | 10.178 | -20.5589 |
| | | | | | |
| **Band 41** | | **frequency** | **OBW Input** | **OBW Output** | **% diff** |
| 5 MHz | Low | 2498.5 | 6.37 | 4.919 | -22.7786 |
| | Middle | 2593 | 6.43 | 4.899 | -23.8103 |
| | High | 2687.5 | 6.335 | 4.928 | -22.2099 |
| 10 MHz | Low | 2501 | 12.637 | 10.07 | -20.3134 |
| | Middle | 2593 | 12.766 | 10.113 | -20.7818 |
| | High | 2685 | 12.705 | 10.102 | -20.488 |
| 15 MHz | Low | 2503.5 | 18.903 | 14.662 | -22.4356 |
| | Middle | 2593 | 18.982 | 14.426 | -24.0017 |
| | High | 2682.5 | 18.825 | 14.657 | -22.1408 |
| 20 MHz | Low | 2506 | 25.082 | 20.123 | -19.7712 |
| | Middle | 2593 | 27.372 | 20.073 | -26.6659 |
| | High | 2680 | 24.873 | 20.081 | -19.2659 |

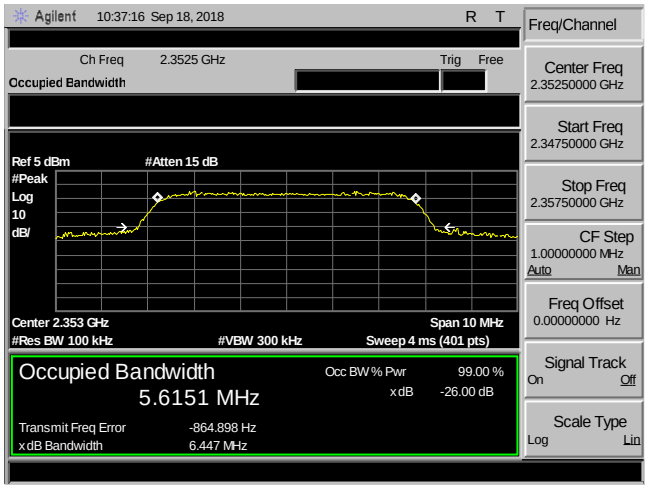
**Table 9. Occupied Bandwidth, Test Results**

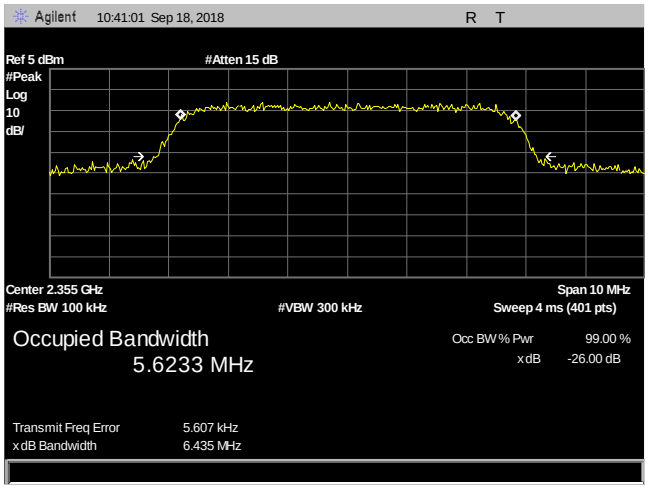
## Occupied Bandwidth, Band 30



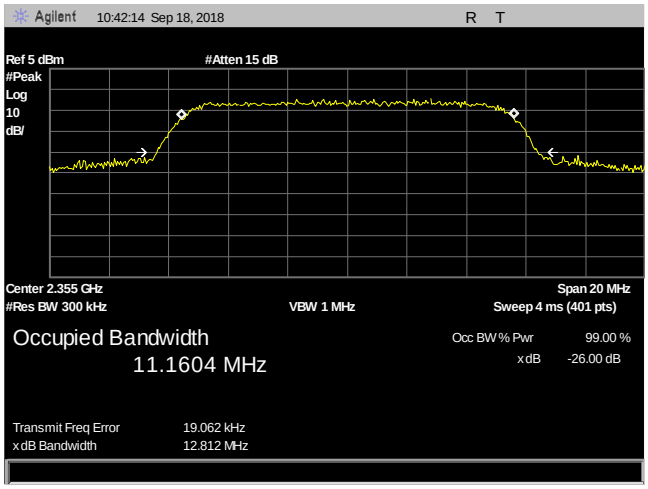

**Plot 49. Occupied Bandwidth, SG, WCS2300, 5 MHz, High**



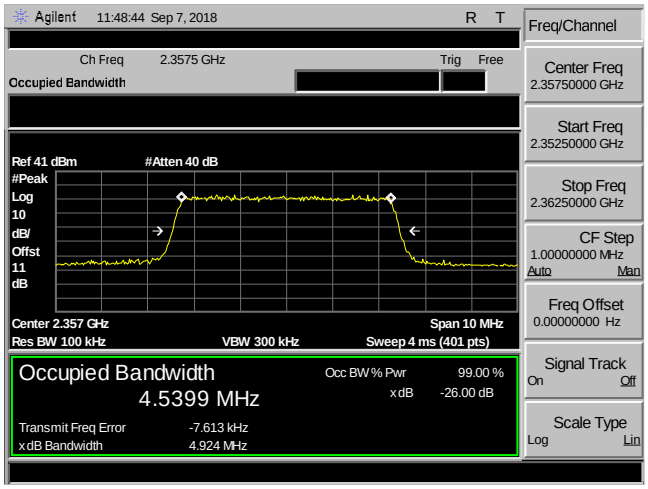

**Plot 50. Occupied Bandwidth, SG, WCS2300, 5 MHz, Low**



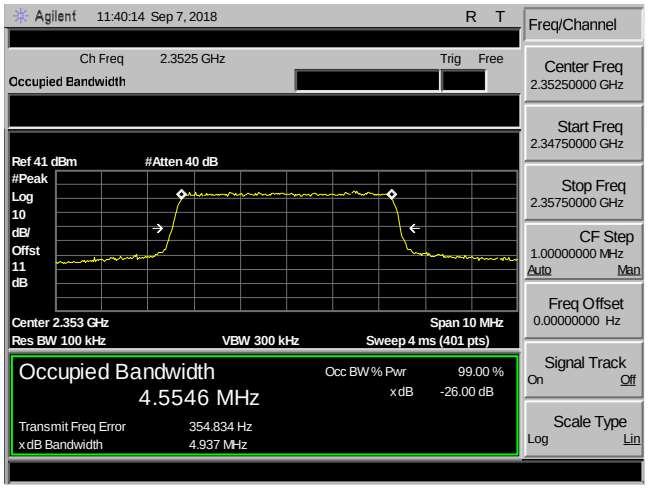

**Plot 51. Occupied Bandwidth, SG, WCS2300, 5 MHz, Mid**



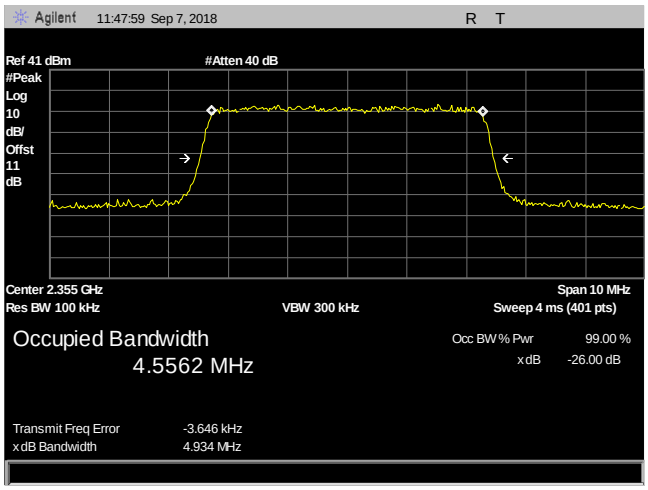

**Plot 52. Occupied Bandwidth, SG, WCS2300, 10 MHz, Mid**



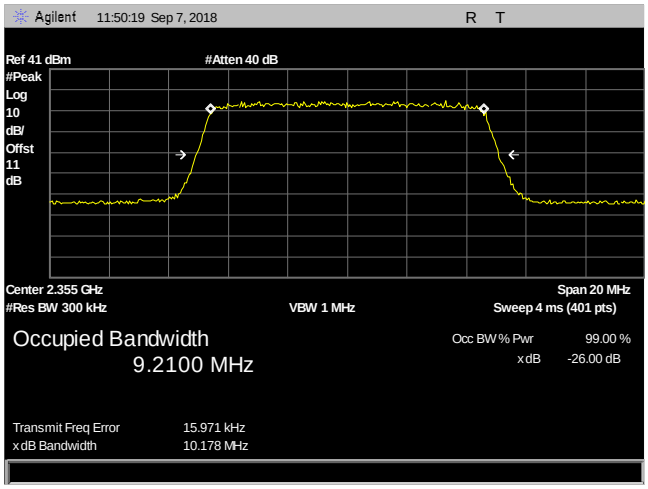

**Plot 53. Occupied Bandwidth, WCS2300, 5 MHz, High**




**Plot 54. Occupied Bandwidth, WCS2300, 5 MHz, Low**

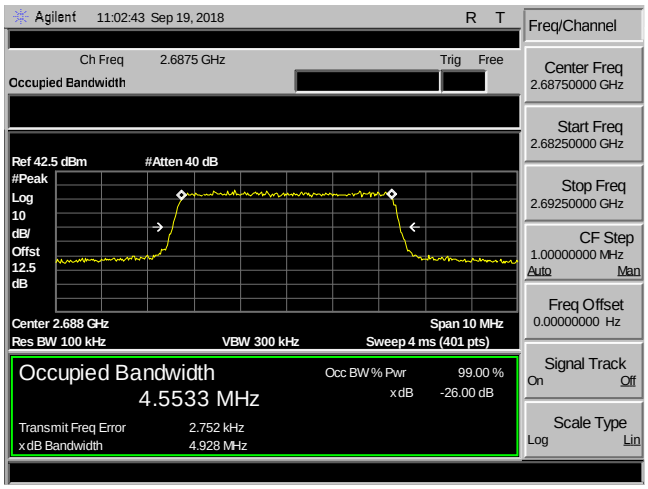



**Plot 55. Occupied Bandwidth, WCS2300, 5 MHz, Mid**

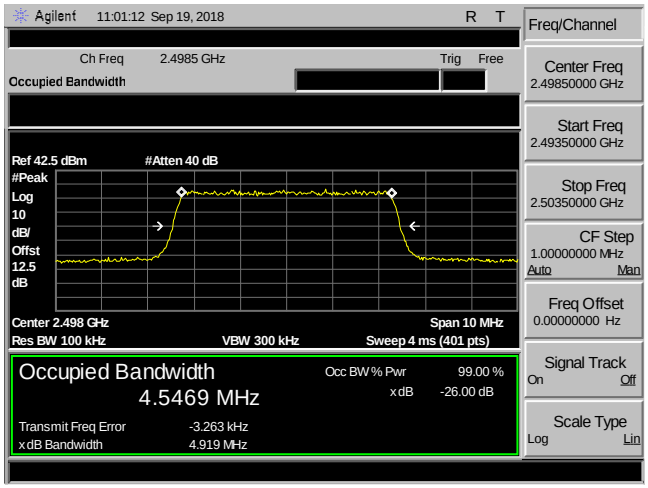



**Plot 56. Occupied Bandwidth, WCS2300, 10 MHz, Mid**

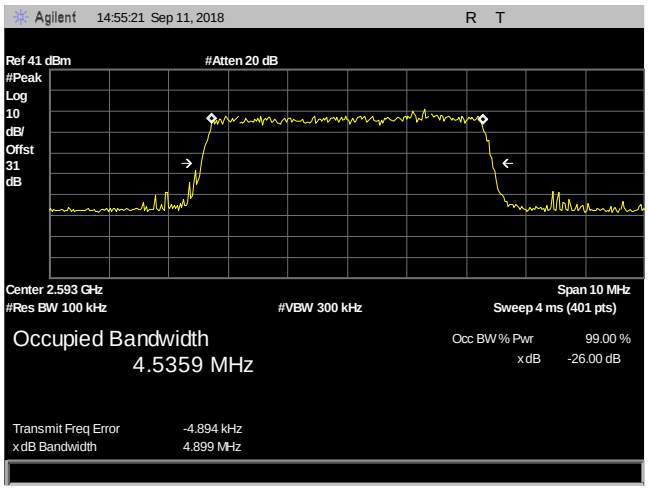
## Occupied Bandwidth, Band 41



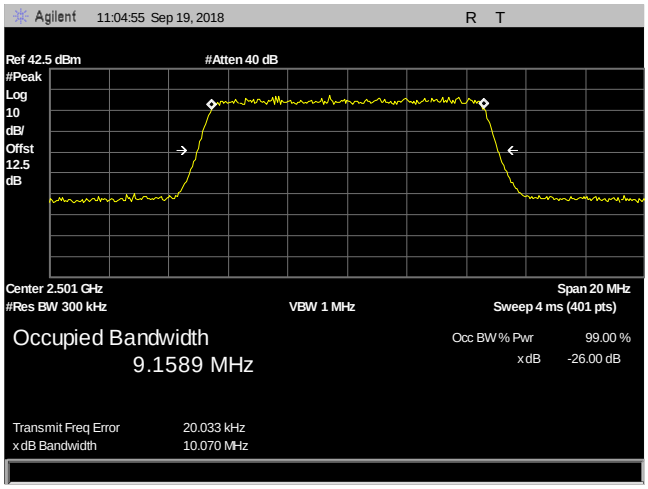

**Plot 57. Occupied Bandwidth, Band 41, 5 MHz, 2496 – 2690 MHz, High, Port 2**



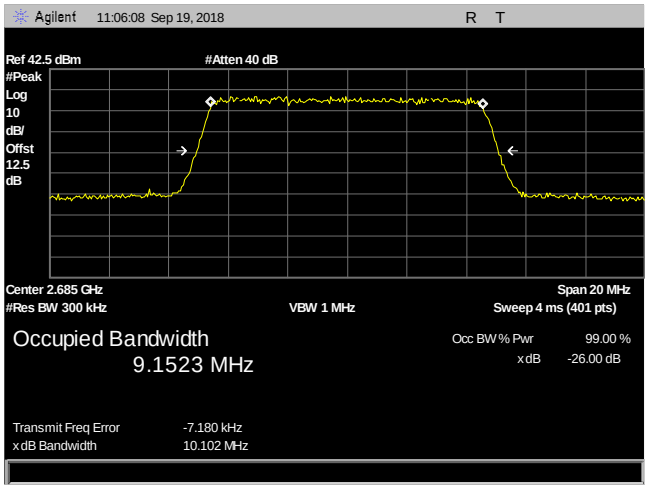

**Plot 58. Occupied Bandwidth, Band 41, 5 MHz, 2496 – 2690 MHz, Low, Port 2**



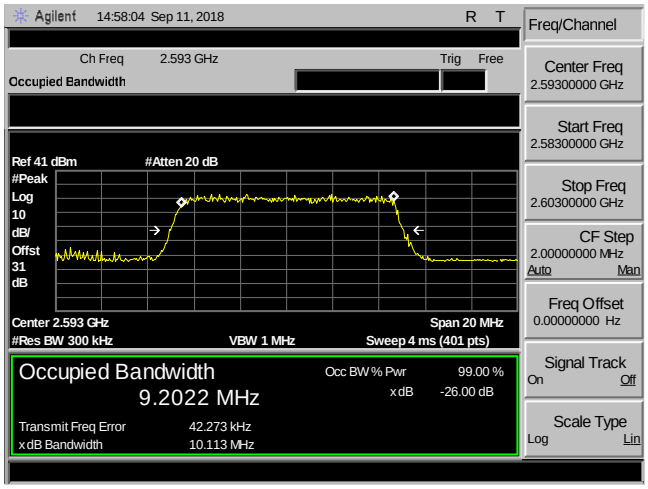

**Plot 59. Occupied Bandwidth, Band 41, 5 MHz, Mid, Port 2**




**Plot 60. Occupied Bandwidth, Band 41, 10 MHz, 2496 – 2690 MHz, Low, Port 2**

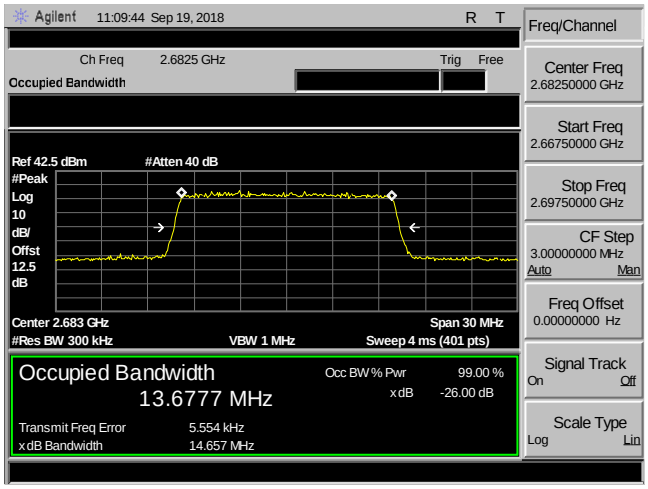



**Plot 61. Occupied Bandwidth, Band 41, 10 MHz, High, Port 2**

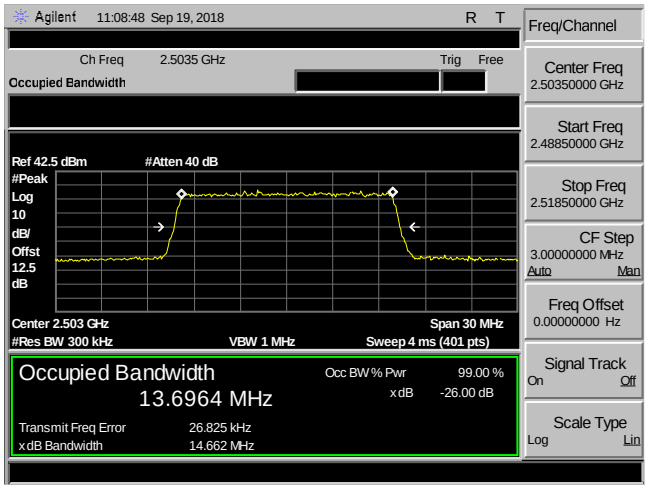



**Plot 62. Occupied Bandwidth, Band 41, 10 MHz, Mid, Port 2**

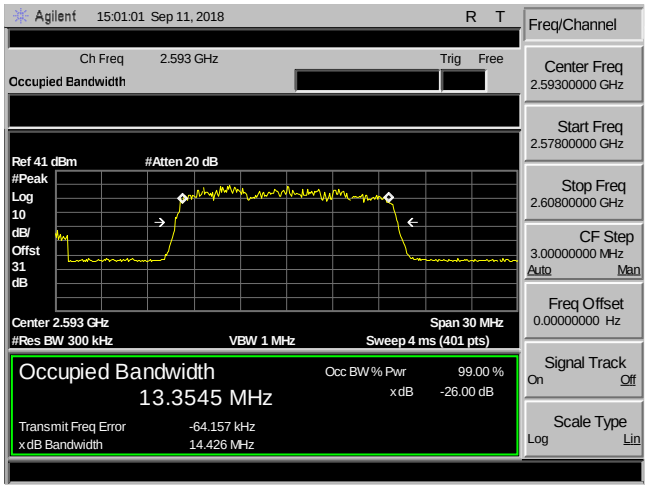
  




**Plot 63. Occupied Bandwidth, Band 41, 15 MHz, High, Port 2**

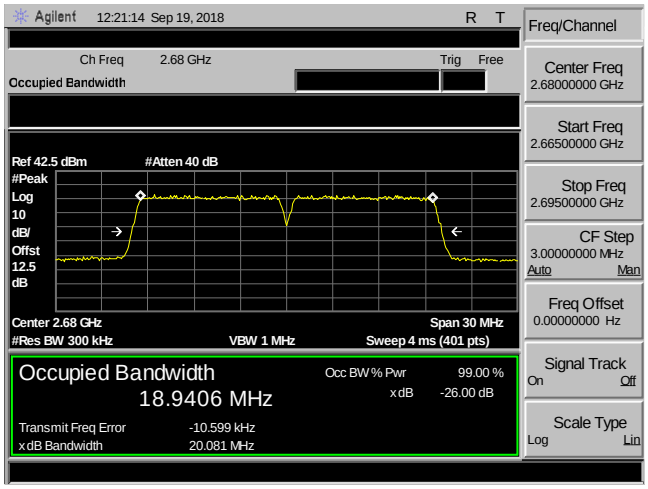



**Plot 64. Occupied Bandwidth, Band 41, 15 MHz, Low, Port 2**

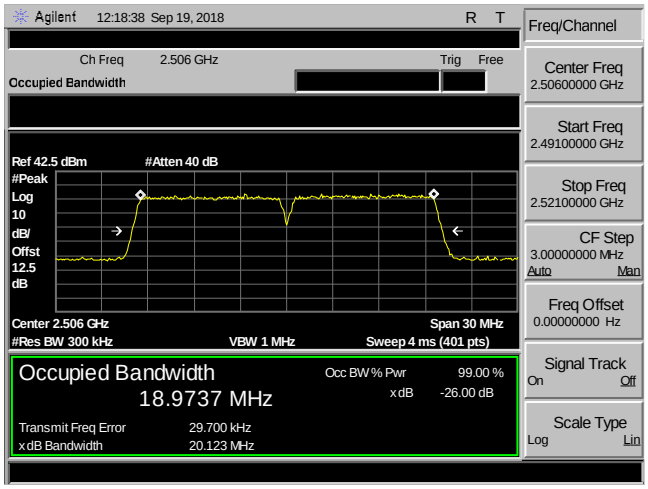



**Plot 65. Occupied Bandwidth, Band 41, 15 MHz, Mid, Port 2**

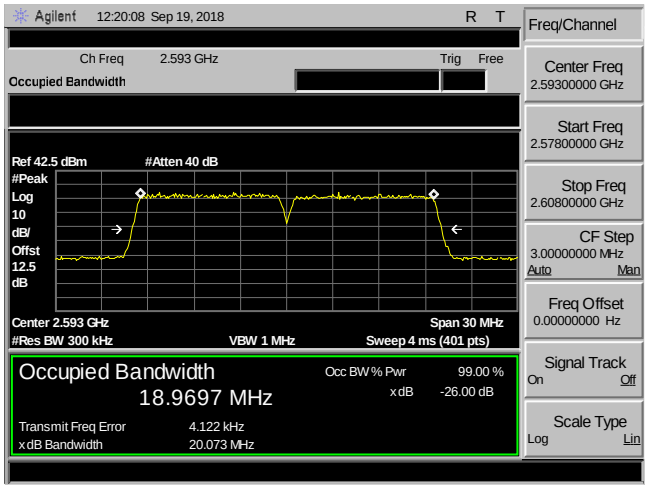
  




**Plot 66. Occupied Bandwidth, Band 41, 20 MHz, High, Port 2**

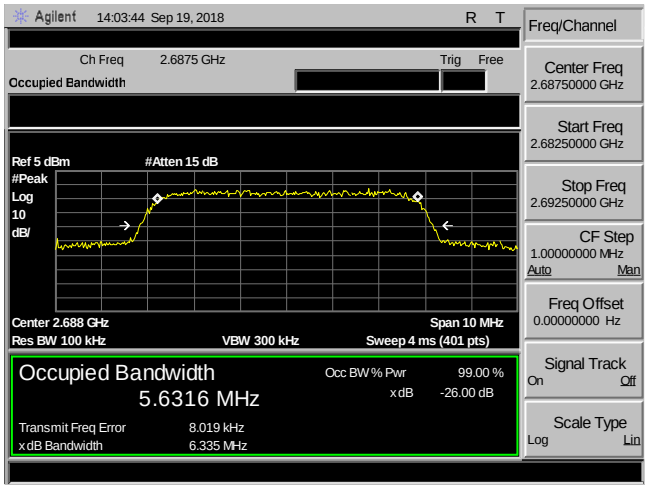



**Plot 67. Occupied Bandwidth, Band 41, 20 MHz, Low, Port 2**

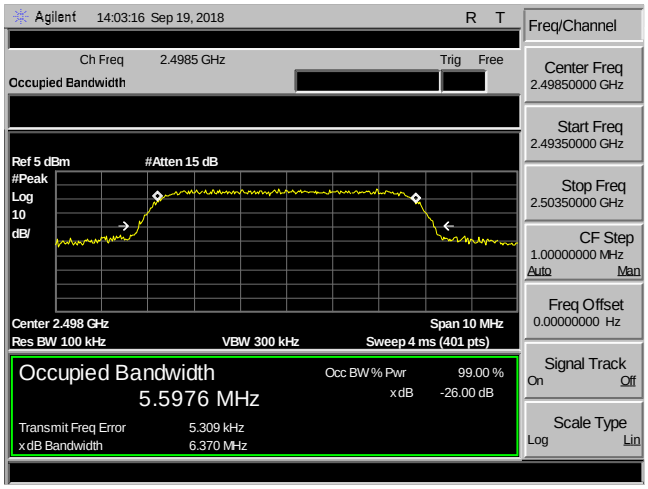



**Plot 68. Occupied Bandwidth, Band 41, 20 MHz, Mid, Port 2**

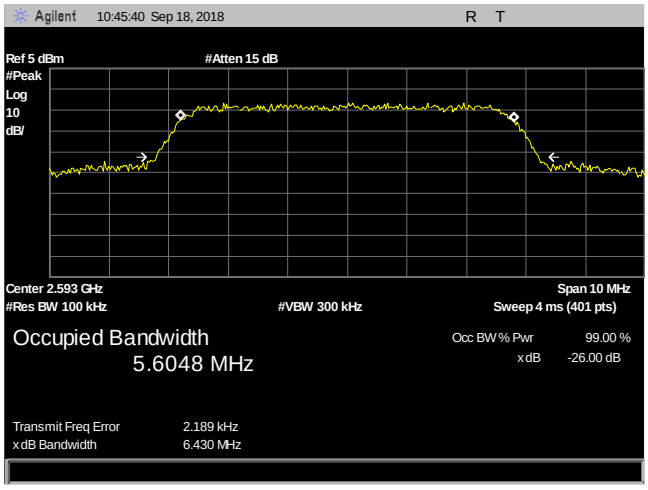
  




**Plot 69. Occupied Bandwidth, Band 41, SG, 5 MHz, High**

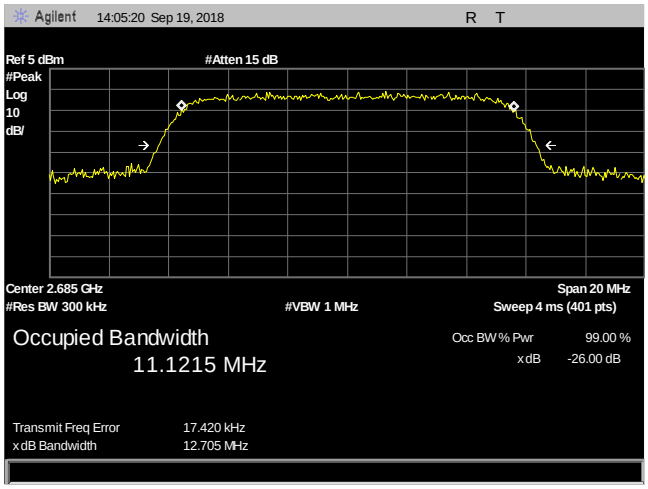



**Plot 70. Occupied Bandwidth, Band 41, SG, 5 MHz, Low**

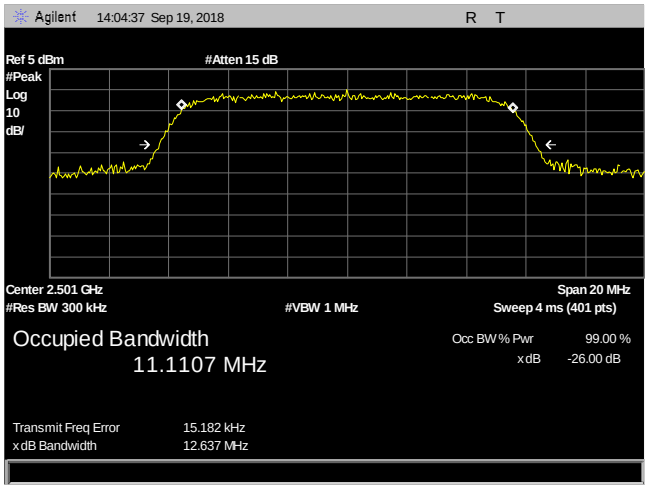



**Plot 71. Occupied Bandwidth, Band 41, SG, 5 MHz, Mid**

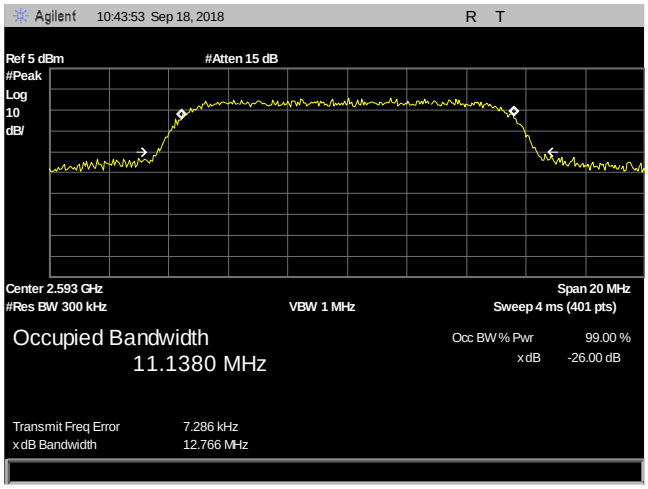
  




**Plot 72. Occupied Bandwidth, Band 41, SG, 10 MHz, High**

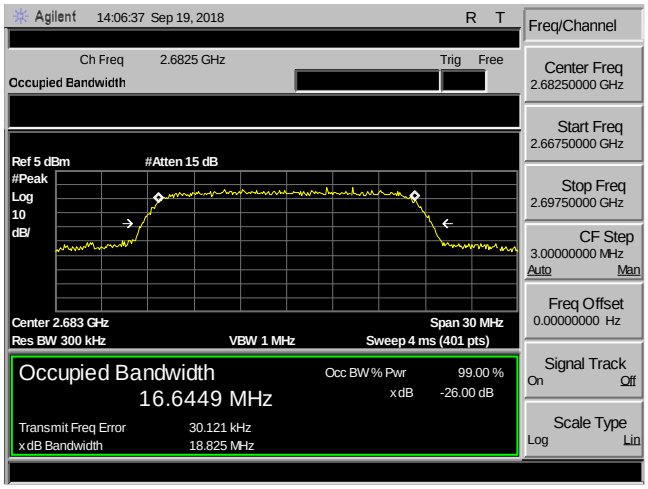



**Plot 73. Occupied Bandwidth, Band 41, SG, 10 MHz, Low**

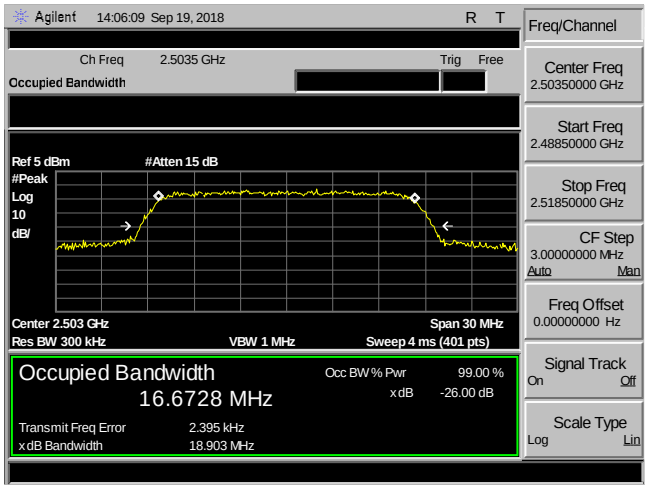



**Plot 74. Occupied Bandwidth, Band 41, SG, 10 MHz, Mid**

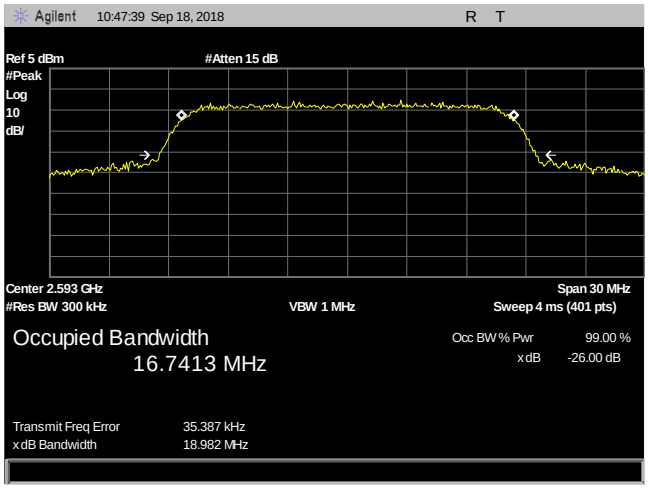
  




**Plot 75. Occupied Bandwidth, Band 41, SG, 15 MHz, High**

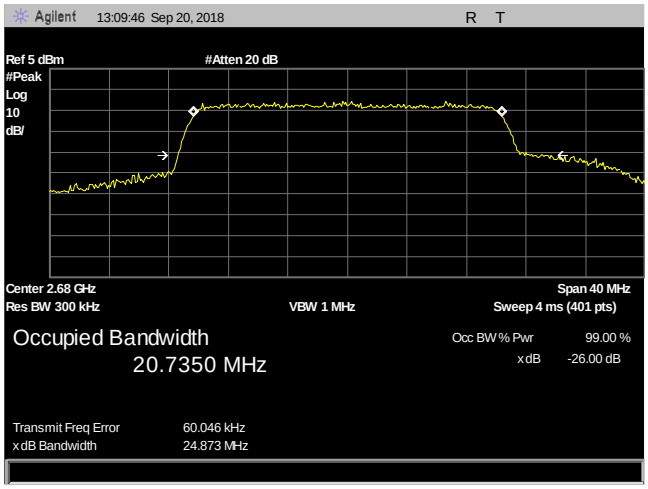



**Plot 76. Occupied Bandwidth, Band 41, SG, 15 MHz, Low**

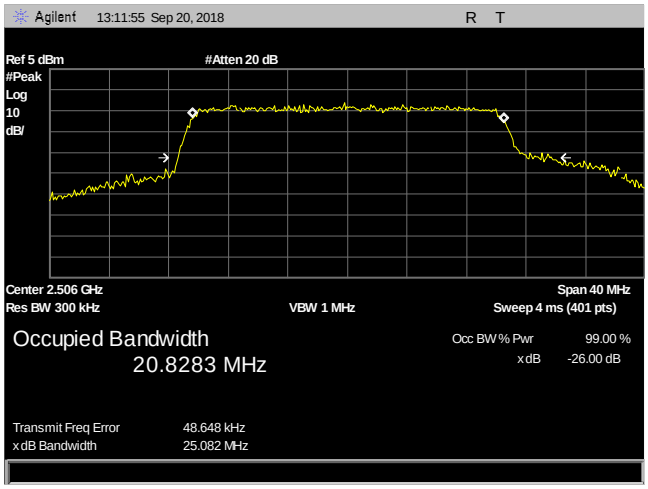



**Plot 77. Occupied Bandwidth, Band 41, SG, 15 MHz, Mid**

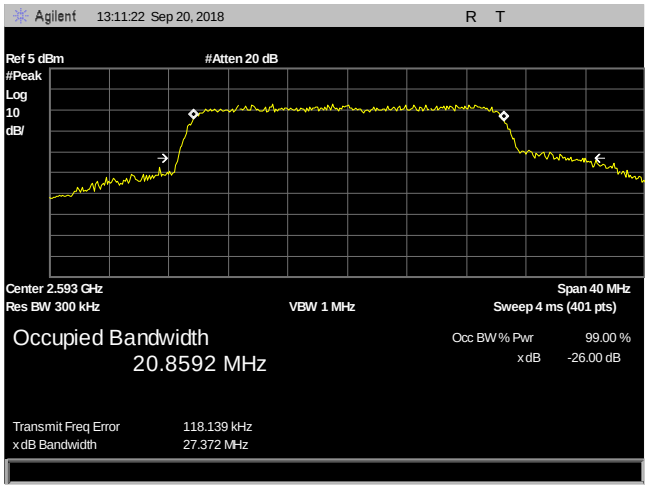
  




**Plot 78. Occupied Bandwidth, Band 41, SG, 20 MHz, High**




**Plot 79. Occupied Bandwidth, Band 41, SG, 20 MHz, Low**




**Plot 80. Occupied Bandwidth, Band 41, SG, 20 MHz, Mid**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 2.1053 Radiated Spurious Emissions

**Test Requirement(s):** **§ 2.1053 Measurements required: Field strength of spurious radiation.**

**§ 2.1053 (a)** Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

**§ 2.1053 (b):** The measurements specified in paragraph (a) of this section shall be made for the following equipment:

**(1)** Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

**(2)** All equipment operating on frequencies higher than 25 MHz.

**(3)** All equipment where the antenna is an integral part of, and attached directly to the transmitter.

**(4)** Other types of equipment as required, when deemed necessary by the Commission.

**Test Procedures:** The EUT was tested according to field strength method of ANSI C63.26 5.5.4. The spectrum analyzer was used and configured in the following manner:

(a) Frequency Range = Lowest Generated – $10^{th}$ Harmonic
(b) RBW = 1MHz
(c) VBW 1-3 x the RBW
(d) Detector = Average

Radiated emission measurements were performed inside a 3 meter chamber that satisfies the site requirements of ANSI C63.4-2014. The EUT was place on an rf transparent 80 cm table for measurements below 1GHz and an rf transparent 1.5 meter table for measurements above 1GHz. The EUT's RF ports were terminated to 50ohm load. The EUT was tested using all modulations and at the low, mid, and high channels. The EUT was rotated about $360^0$ and the receiving antenna scanned from 1-4m in order to capture the maximum emission. The plots are corrected for cable loss, antenna correction factor, and distance correction. The field strength was mathematically corrected to an E.I.R.P.

Emissions below 30MHz and above 18GHz were more than 20dB below the limit. The worse-case configurations are reported.

**Test Results:** The EUT was found compliant with the requirements of this section.

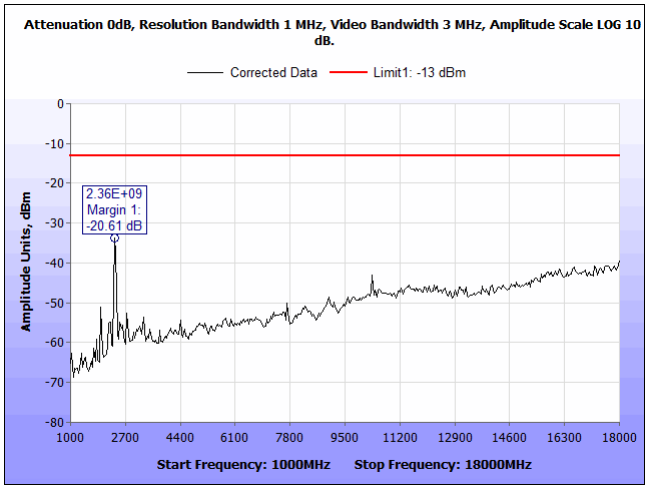
Measurements were made in each configuration. Data is presented for the worse case configuration.

**Test Engineer:** Bradley Jones

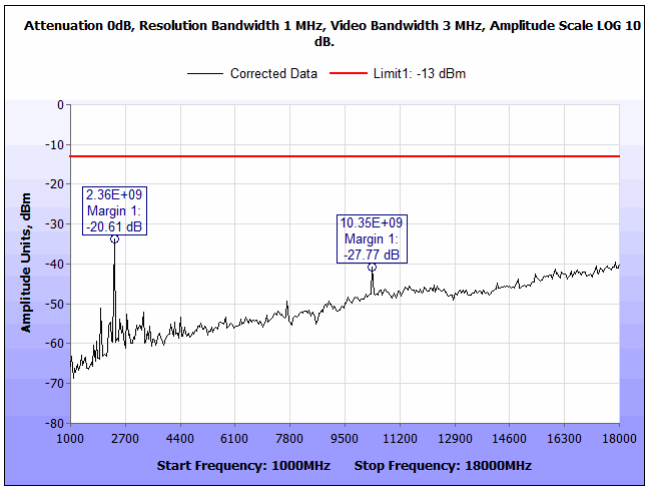
**Test Date(s):** September 26, 2018

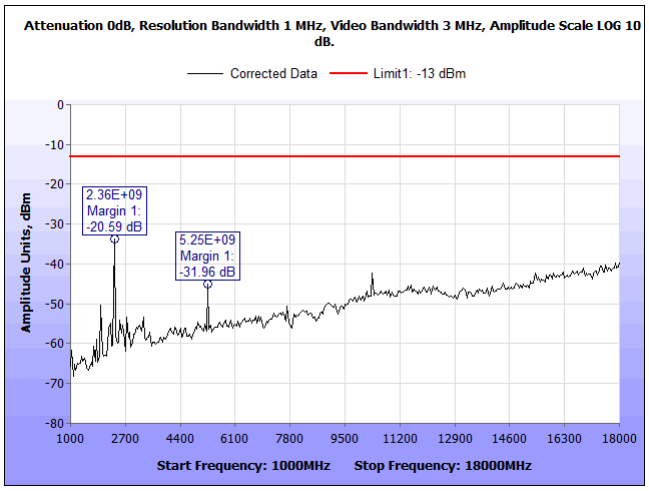
## Radiated Spurious Emissions



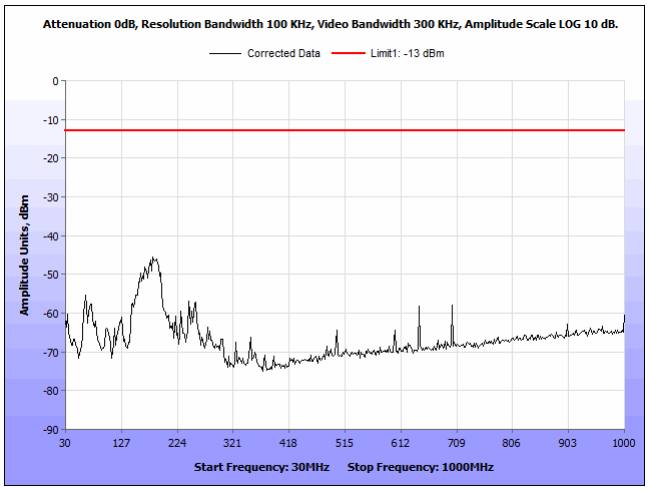

**Plot 81. Radiated Spurious Emissions, Band 30, 5 MHz, 1 – 18 GHz, High**



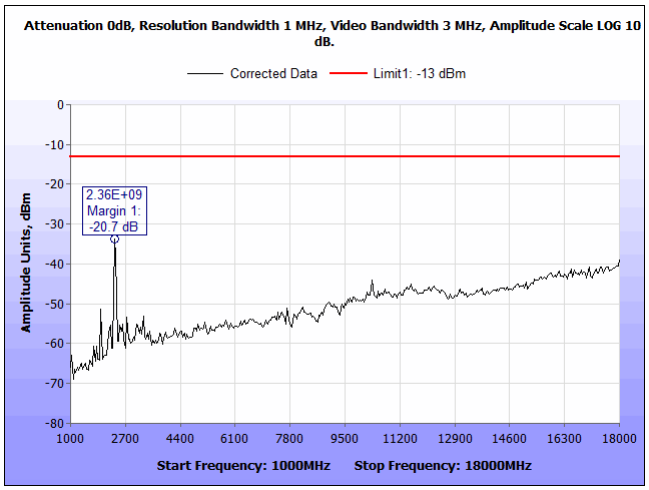

**Plot 82. Radiated Spurious Emissions, Band 30, 5 MHz, 1 – 18 GHz, Low**



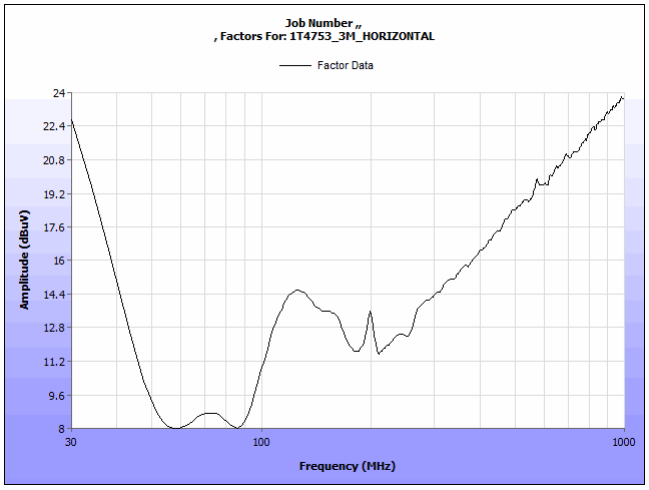

**Plot 83. Radiated Spurious Emissions, Band 30, 5 MHz, 1 – 18 GHz, Mid**




**Plot 84. Radiated Spurious Emissions, Band 30, 5 MHz, 30 MHz – 1 GHz**

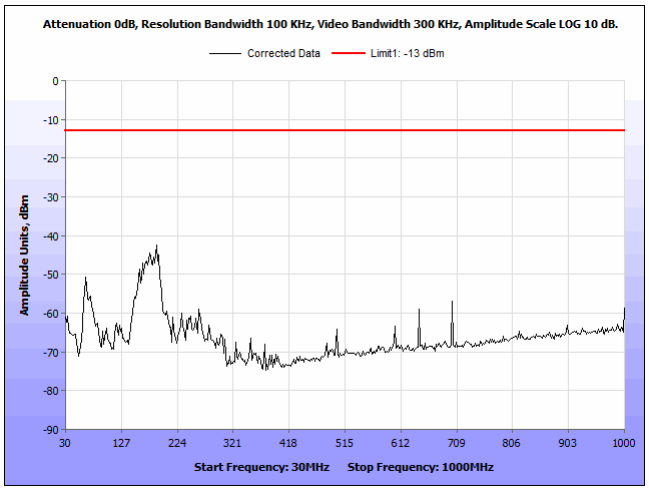



**Plot 85. Radiated Spurious Emissions, Band 30, 10 MHz, 1 – 18 GHz, Mid**

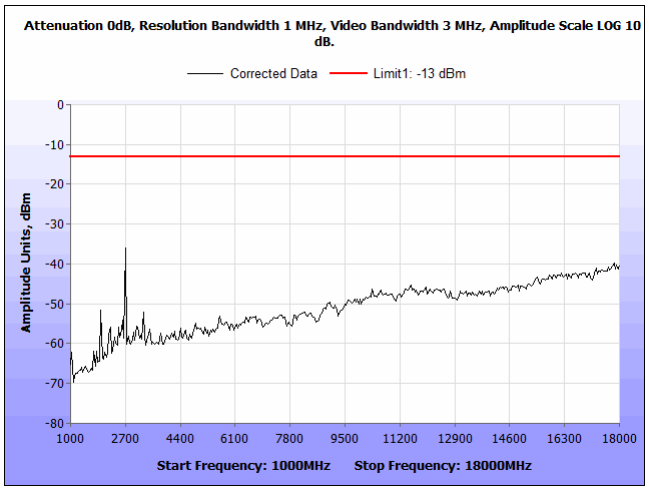



**Plot 86. Radiated Spurious Emissions, Band 30, 10 MHz, 30 MHz – 1 GHz, factors**

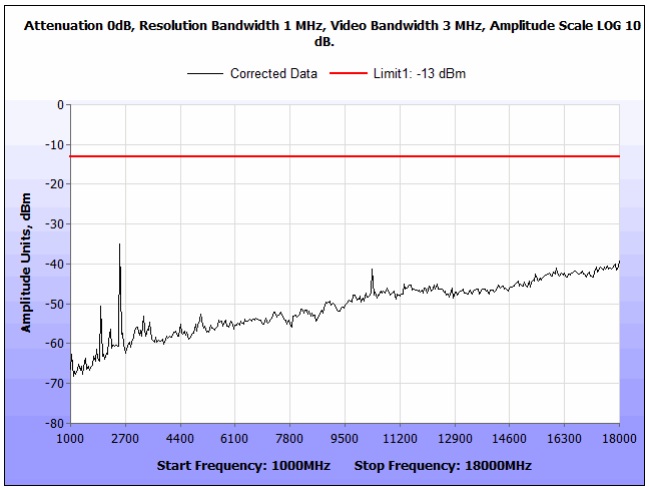
  



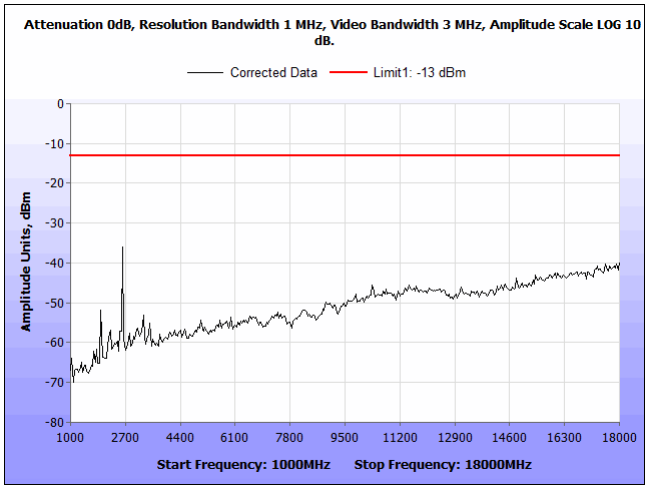

**Plot 87. Radiated Spurious Emissions, Band 30, 10 MHz, 30 MHz – 1 GHz**



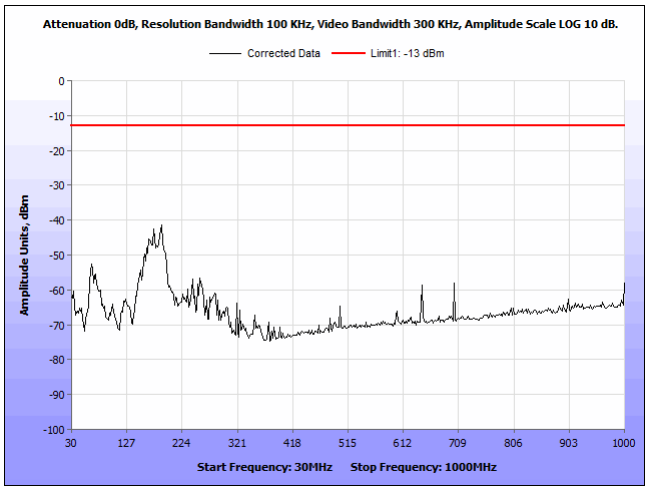

**Plot 88. Radiated Spurious Emissions, Band 41, 5 MHz, 1 – 18 GHz, High**



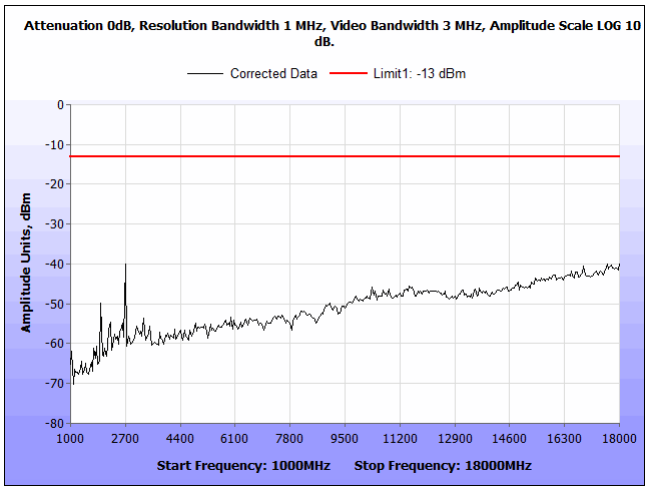

**Plot 89. Radiated Spurious Emissions, Band 41, 5 MHz, 1 – 18 GHz, Low**



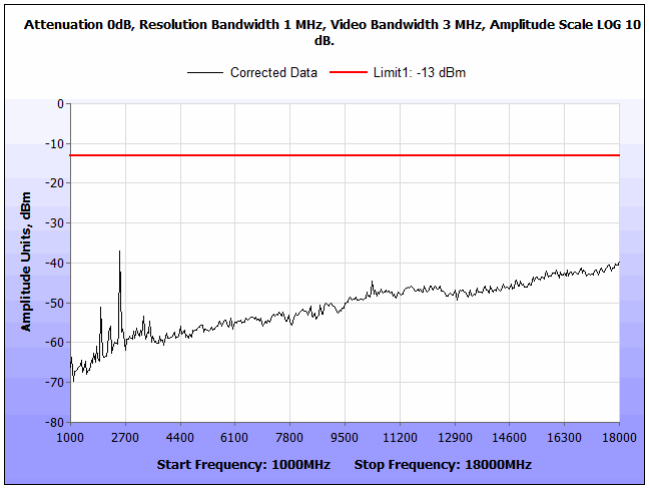

**Plot 90. Radiated Spurious Emissions, Band 41, 5 MHz, 1 – 18 GHz, Mid**




**Plot 91. Radiated Spurious Emissions, Band 41, 5 MHz, 30 MHz – 1 GHz**

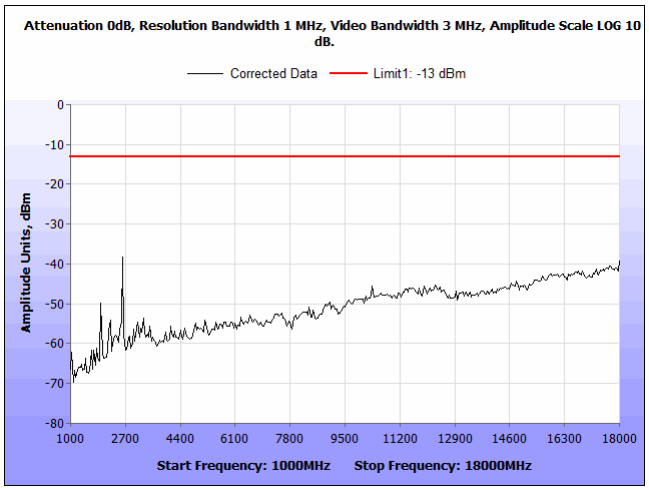



**Plot 92. Radiated Spurious Emissions, Band 41, 10 MHz, 1 – 18 GHz, High**

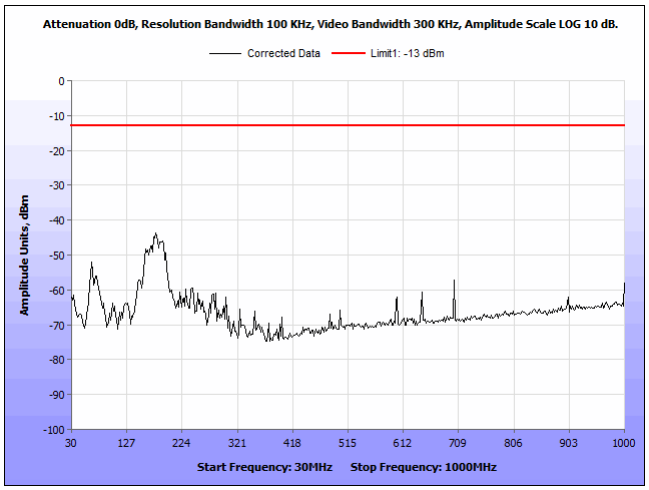



**Plot 93. Radiated Spurious Emissions, Band 41, 10 MHz, 1 – 18 GHz, Low**

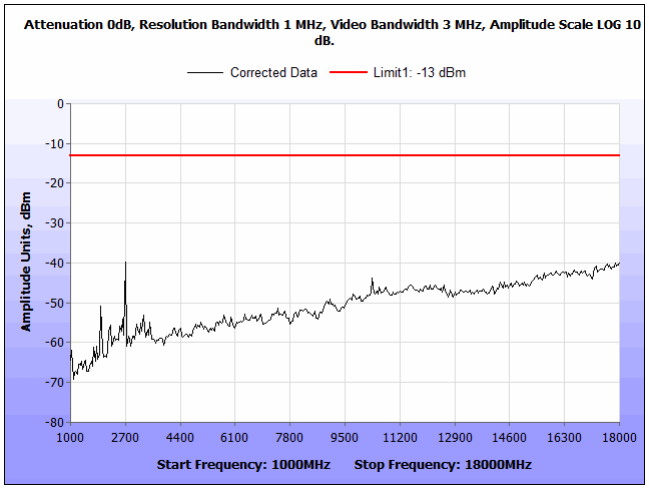
  



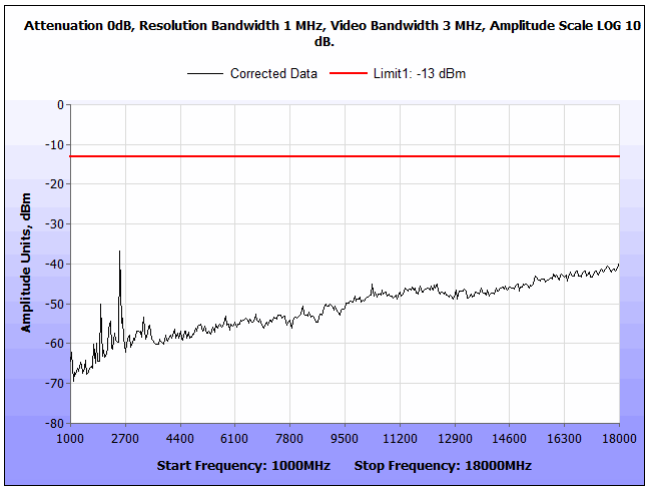

**Plot 94. Radiated Spurious Emissions, Band 41, 10 MHz, 1 – 18 GHz, Mid**



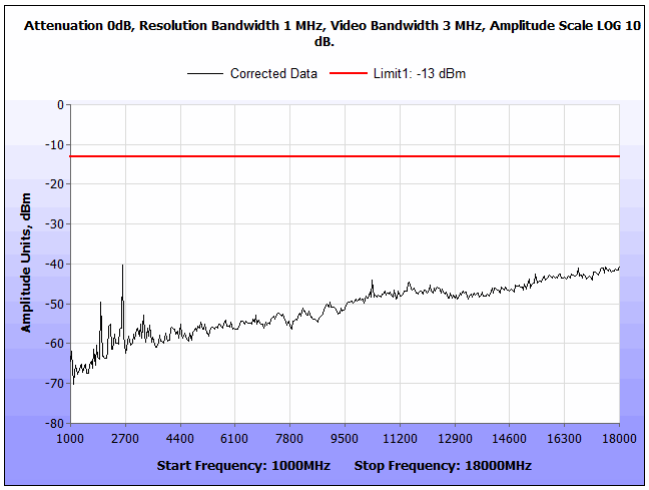

**Plot 95. Radiated Spurious Emissions, Band 41, 10 MHz, 30 MHz – 1 GHz**



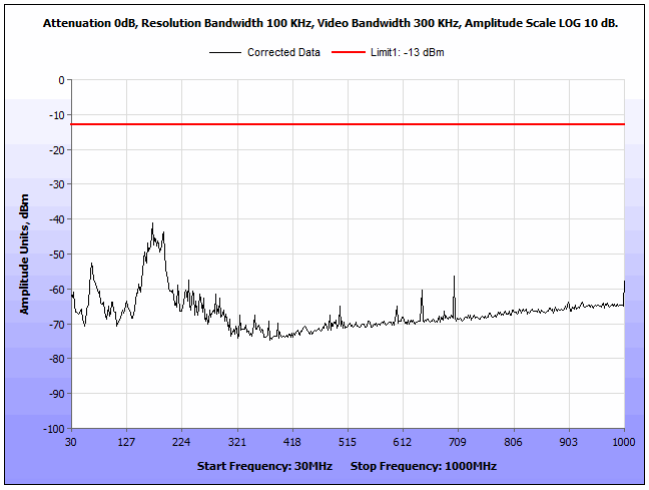

**Plot 96. Radiated Spurious Emissions, Band 41, 15 MHz, 1 – 18 GHz, High**



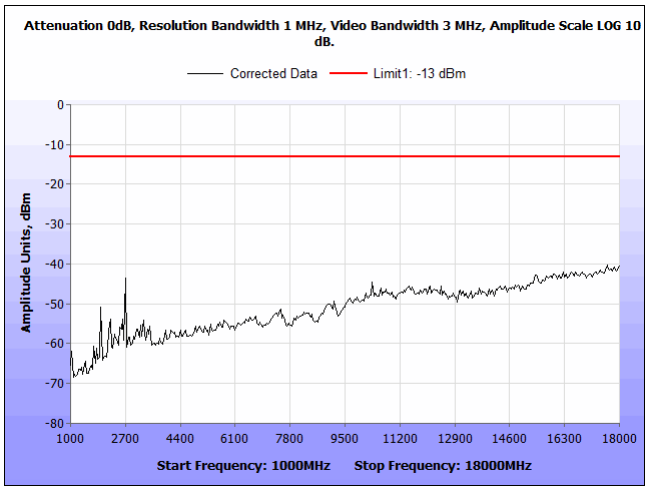

**Plot 97. Radiated Spurious Emissions, Band 41, 15 MHz, 1 – 18 GHz, Low**



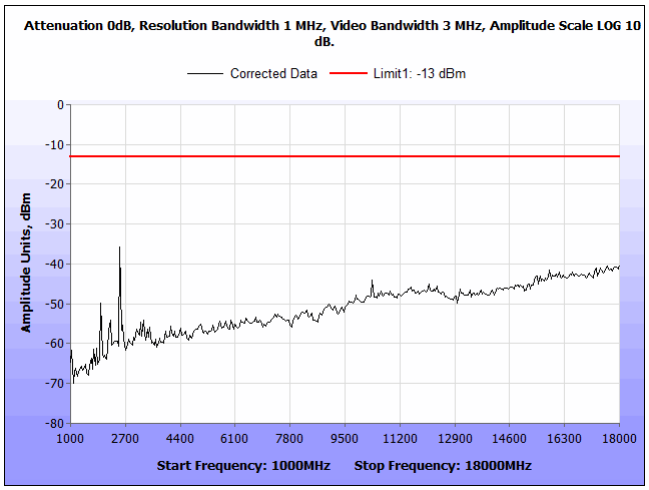

**Plot 98. Radiated Spurious Emissions, Band 41, 15 MHz, 1 – 18 GHz, Mid**



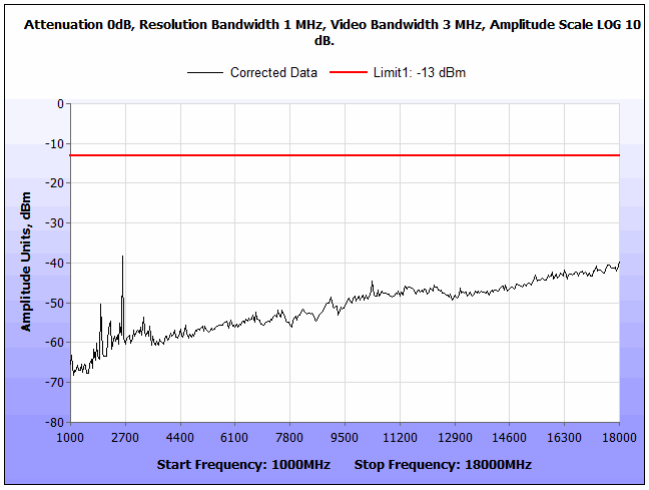

**Plot 99. Radiated Spurious Emissions, Band 41, 15 MHz, 30 MHz – 1 GHz**



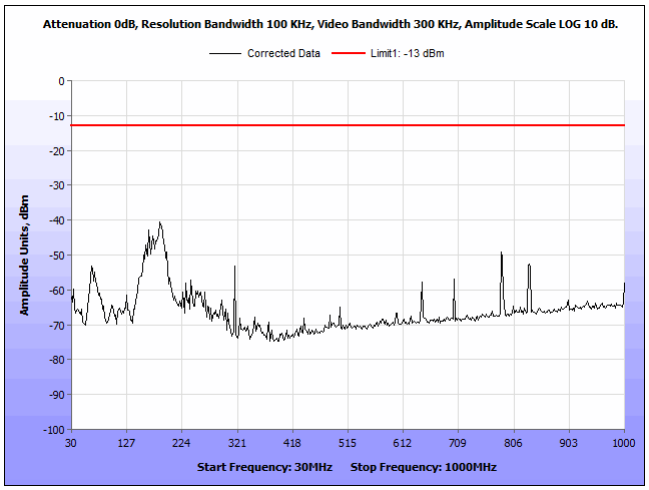

**Plot 100. Radiated Spurious Emissions, Band 41, 20 MHz, 1 – 18 GHz, High**




**Plot 101. Radiated Spurious Emissions, Band 41, 20 MHz, 1 – 18 GHz, Low**

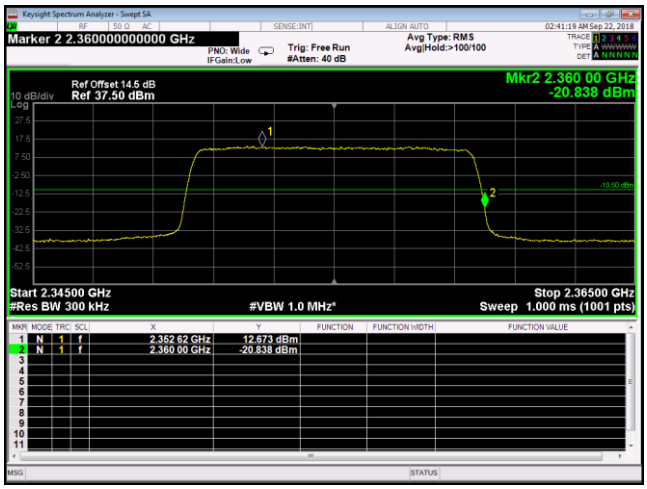



**Plot 102. Radiated Spurious Emissions, Band 41, 20 MHz, 1 – 18 GHz, Mid**

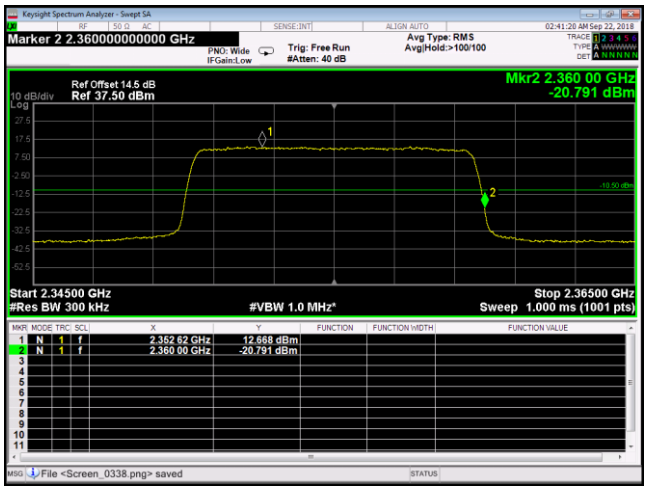



**Plot 103. Radiated Spurious Emissions, Band 41, 20 MHz, 30 MHz – 1 GHz**

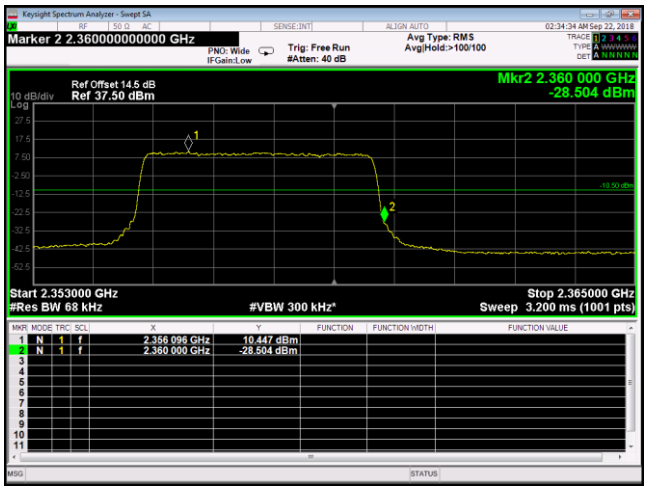
## Radiated Band Edge, Band 30




**Plot 104. Radiated Band Edge, WCS 2300, high channel, port 1, 10 MHz**

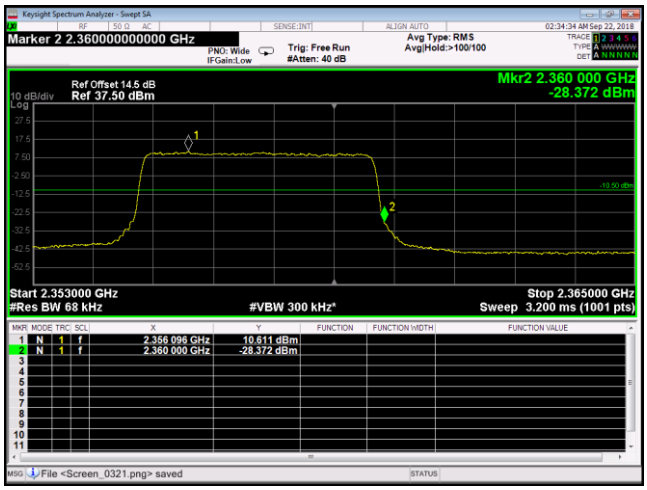



**Plot 105. Radiated Band Edge, WCS 2300, high channel, port 2, 10 MHz**

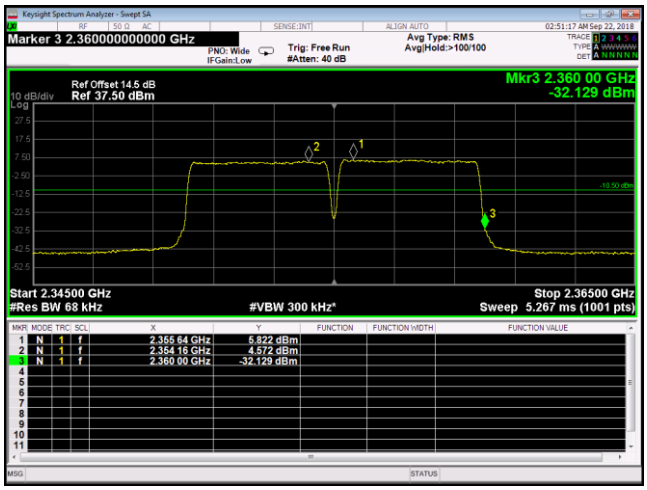



**Plot 106. Radiated Band Edge, WCS 2300, high channel, one signal, port 1, 5 MHz**

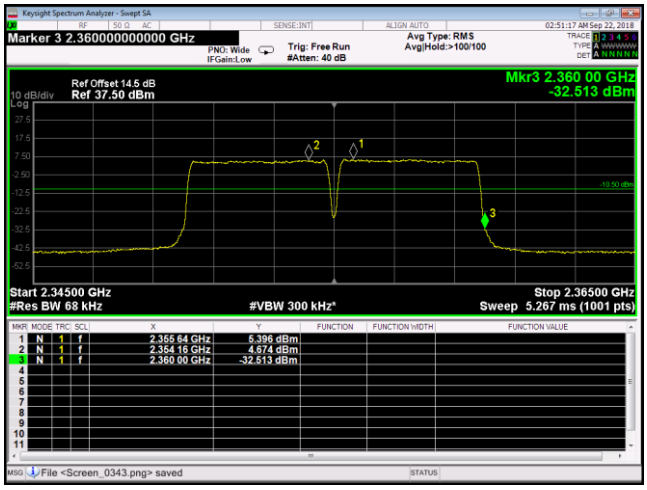
  




**Plot 107. Radiated Band Edge, WCS 2300, high channel, one signal, port 2, 5 MHz**

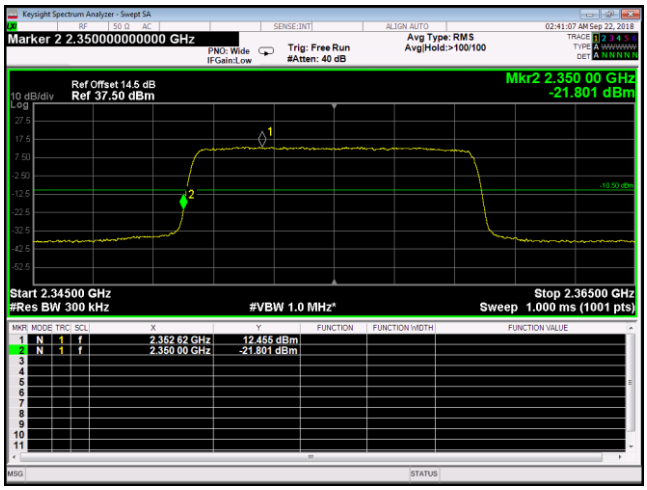



**Plot 108. Radiated Band Edge, WCS 2300, high channel, two signal, port 1, 5 MHz**

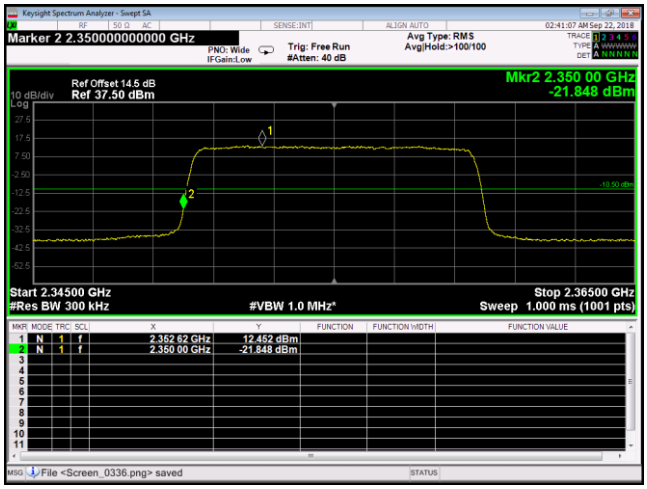



**Plot 109. Radiated Band Edge, WCS 2300, high channel, two signal, port 2, 5 MHz**

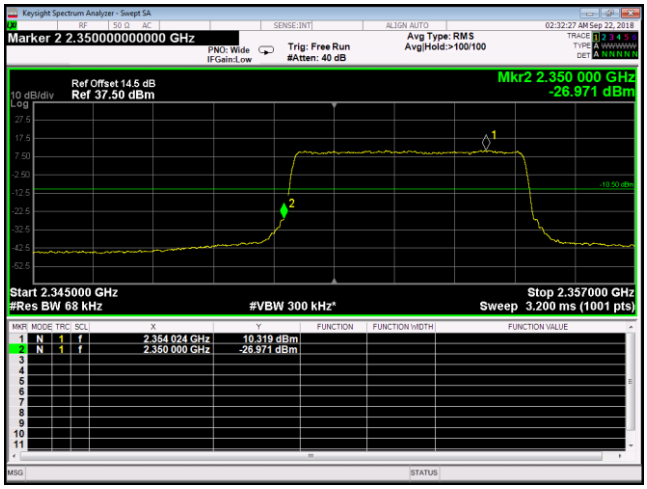
  




**Plot 110. Radiated Band Edge, WCS 2300, low channel, port 1, 10 MHz**

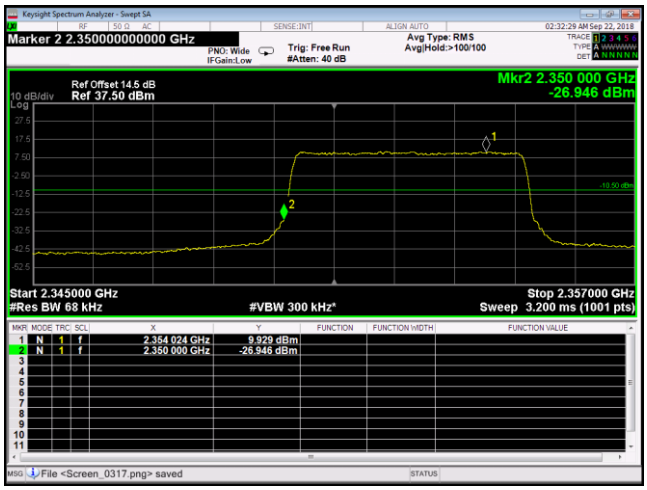



**Plot 111. Radiated Band Edge, WCS 2300, low channel, port 2, 10 MHz**

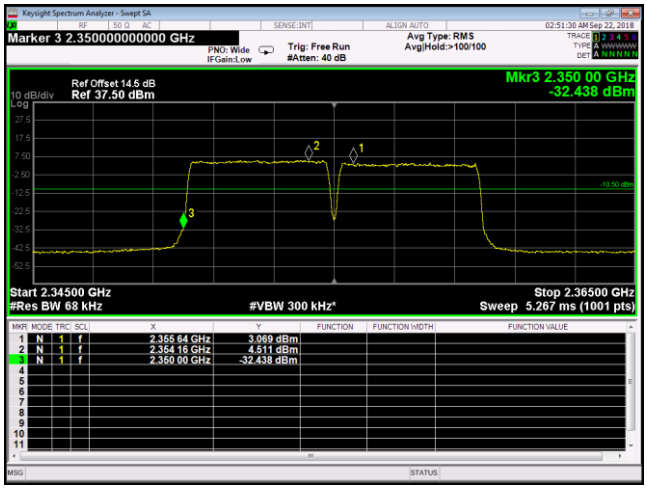



**Plot 112. Radiated Band Edge, WCS 2300, low channel, one signal, port 1, 5 MHz**

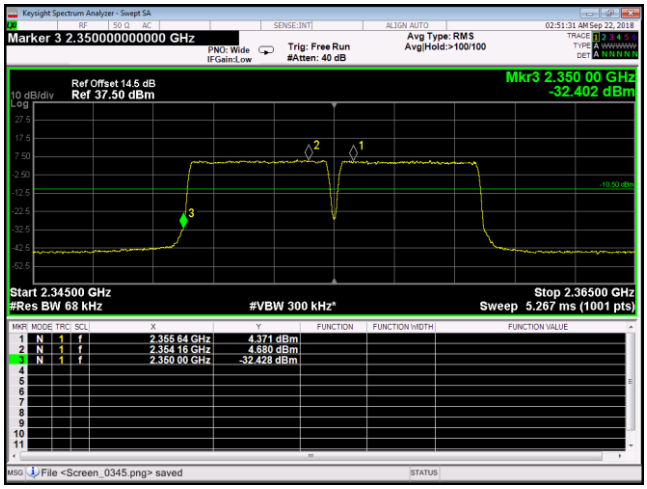
  




**Plot 113. Radiated Band Edge, WCS 2300, low channel, one signal, port 2, 5 MHz**

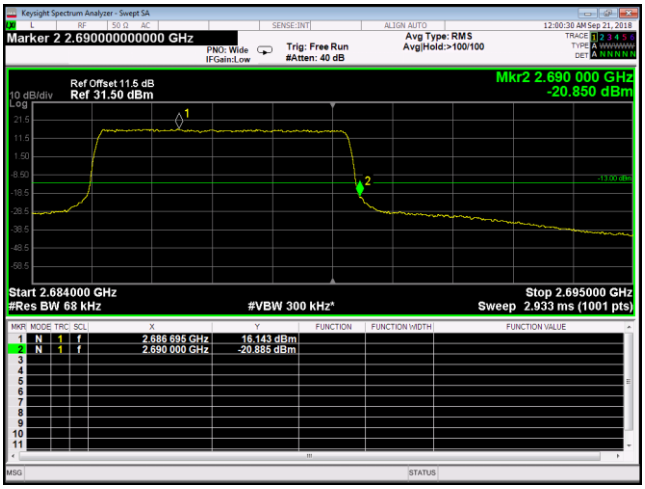



**Plot 114. Radiated Band Edge, WCS 2300, low channel, two signal, port 1, 5 MHz**

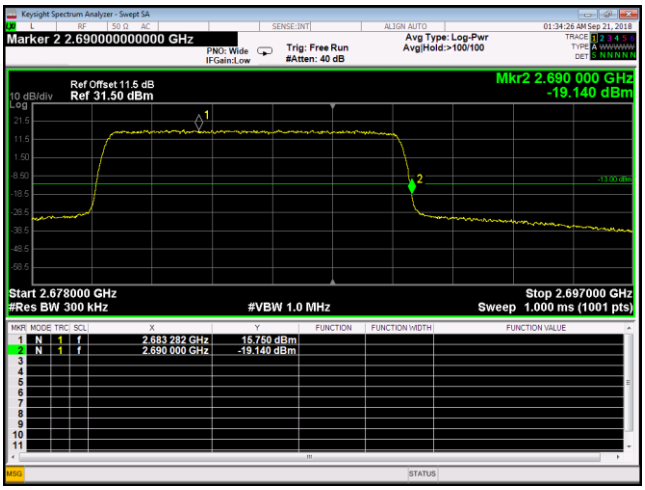



**Plot 115. Radiated Band Edge, WCS 2300, low channel, two signal, port 2, 5 MHz**

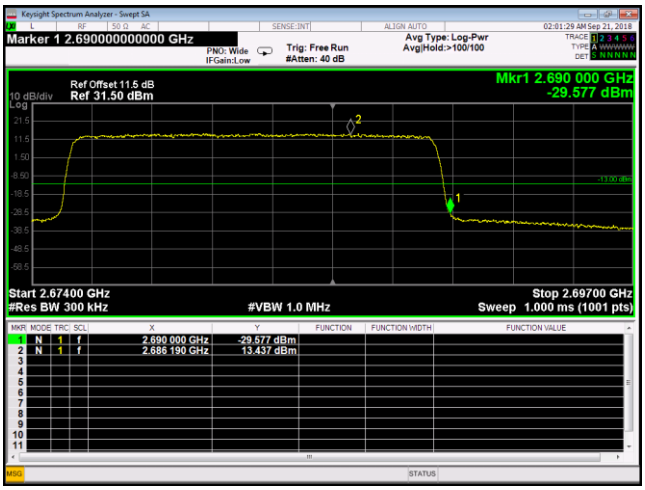
## Radiated Band Edge, Band 41



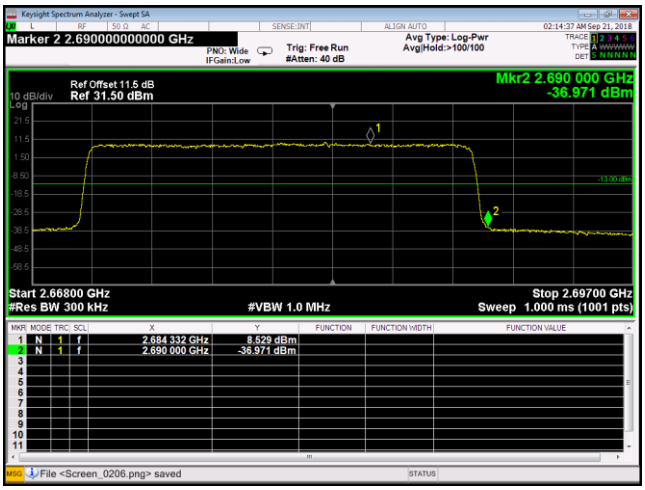

**Plot 116. Radiated Band Edge, BRS 2500, high channel, one signal, port 1, 5 MHz**



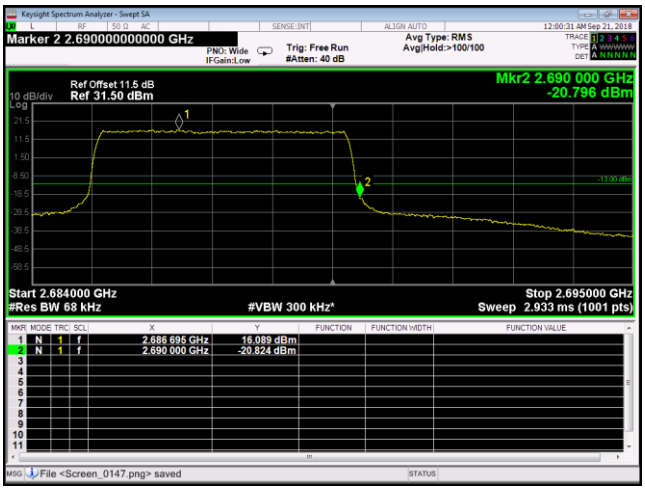

**Plot 117. Radiated Band Edge, BRS 2500, high channel, one signal, port 1, 10 MHz**



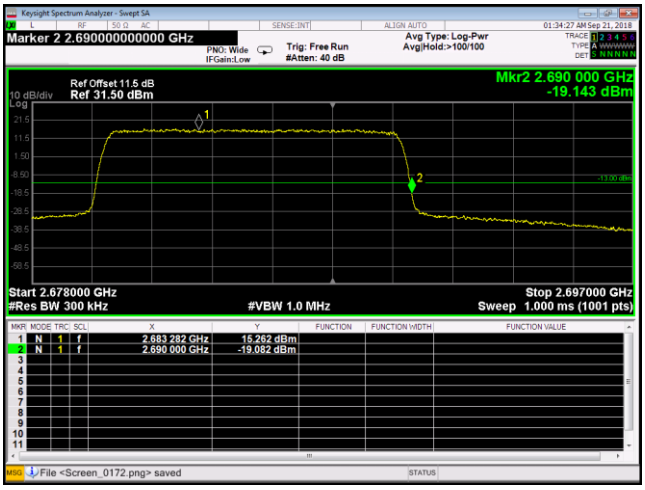

**Plot 118. Radiated Band Edge, BRS 2500, high channel, one signal, port 1, 15 MHz**




**Plot 119. Radiated Band Edge, BRS 2500, high channel, one signal, port 1, 20 MHz**

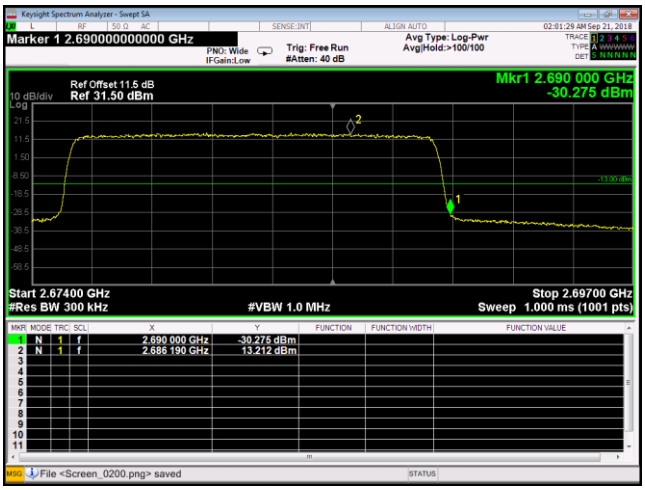



**Plot 120. Radiated Band Edge, BRS 2500, high channel, one signal, port 2, 5 MHz**

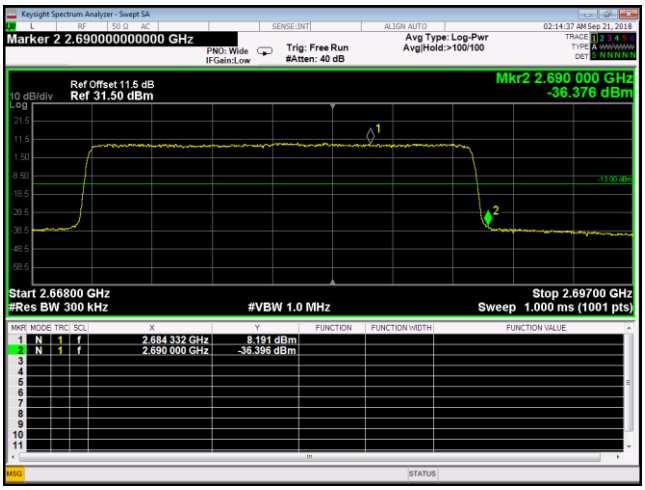



**Plot 121. Radiated Band Edge, BRS 2500, high channel, one signal, port 2, 10 MHz**

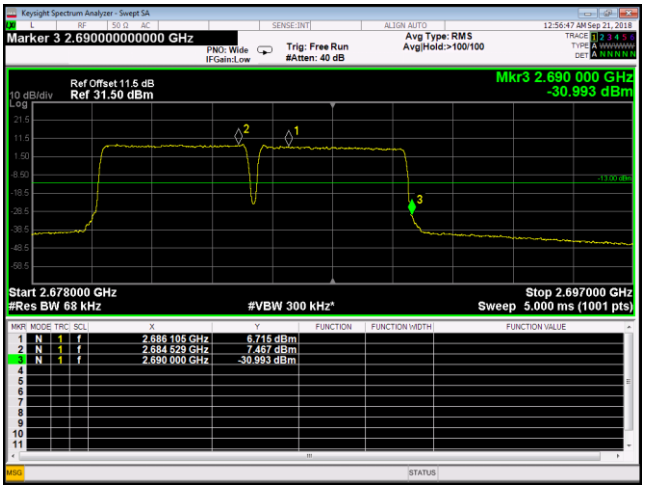
  




**Plot 122. Radiated Band Edge, BRS 2500, high channel, one signal, port 3, 15 MHz**

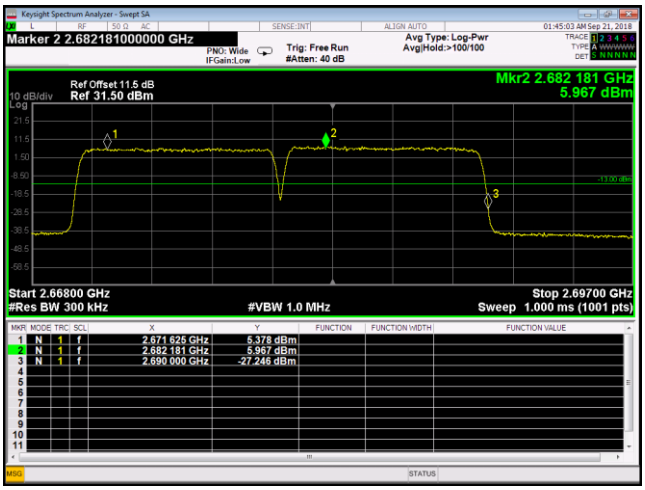



**Plot 123. Radiated Band Edge, BRS 2500, high channel, one signal, port 2, 20 MHz**

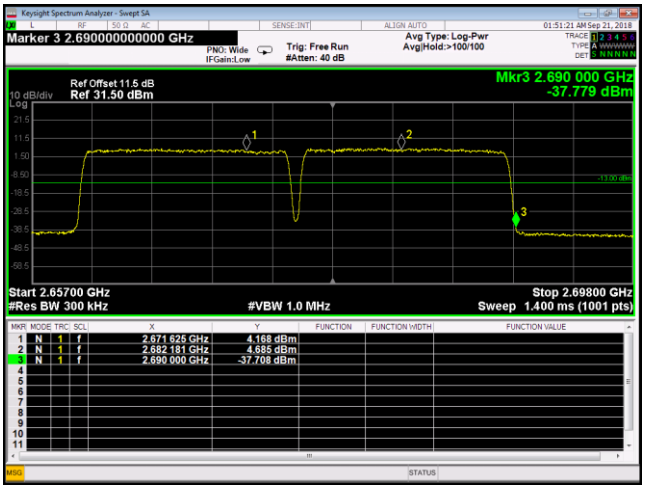



**Plot 124. Radiated Band Edge, BRS 2500, high channel, two signal, port 1, 5 MHz**

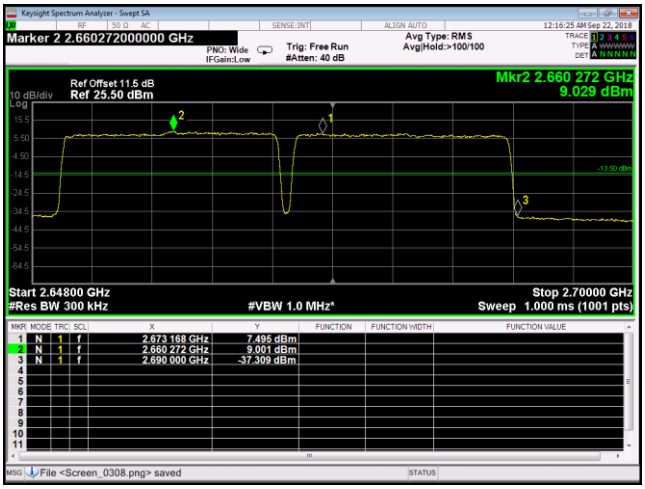
  




**Plot 125. Radiated Band Edge, BRS 2500, high channel, two signal, port 1, 10 MHz**

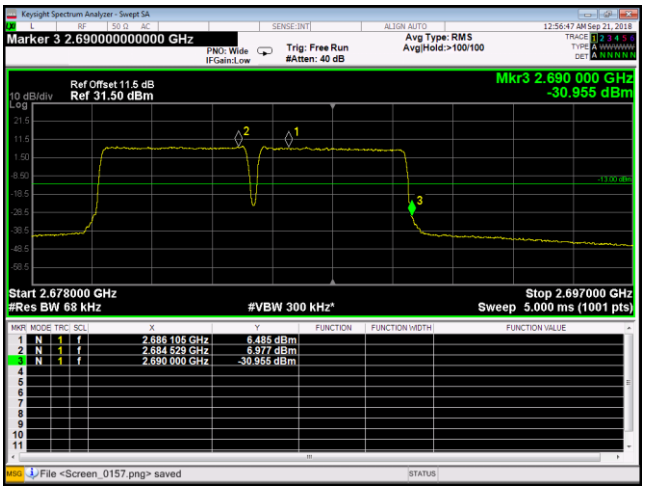



**Plot 126. Radiated Band Edge, BRS 2500, high channel, two signal, port 1, 15 MHz**

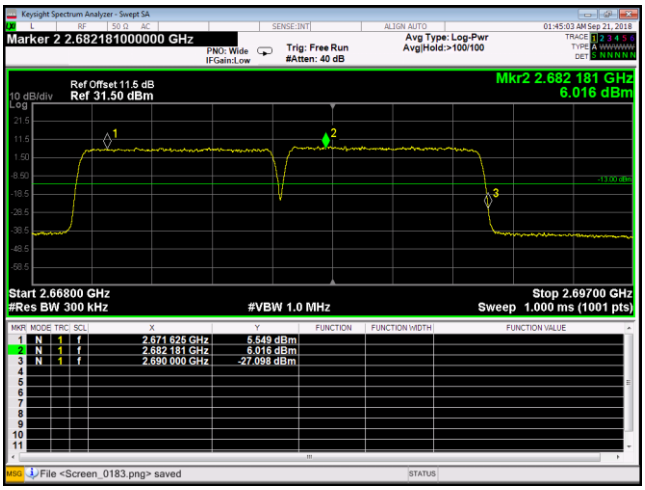



**Plot 127. Radiated Band Edge, BRS 2500, high channel, two signal, port 1, 20 MHz**

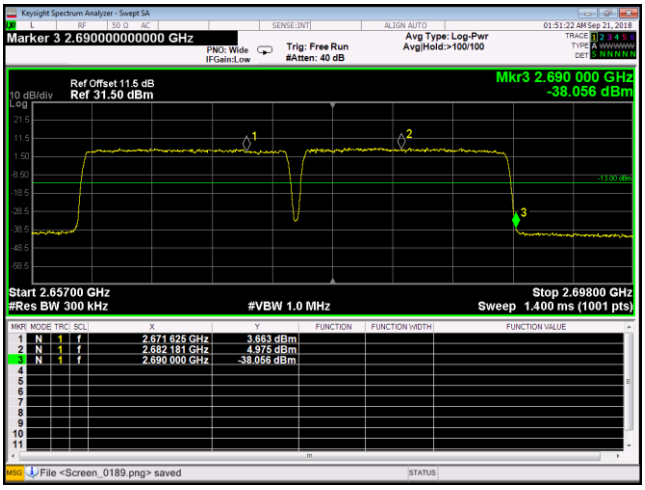
  




**Plot 128. Radiated Band Edge, BRS 2500, high channel, two signal, port 2, 5 MHz**

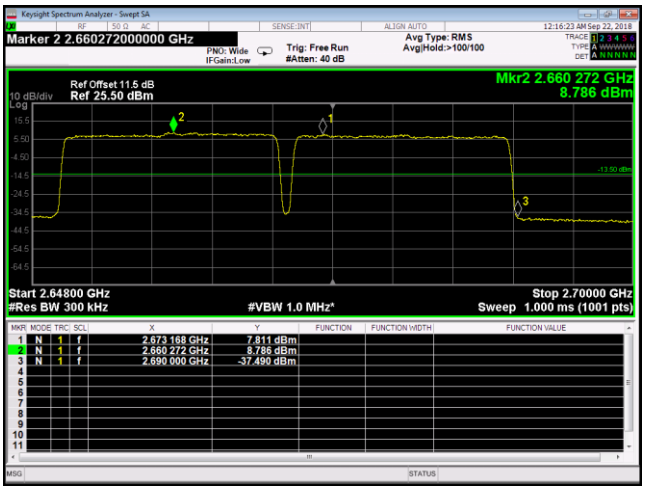



**Plot 129. Radiated Band Edge, BRS 2500, high channel, two signal, port 2, 10 MHz**

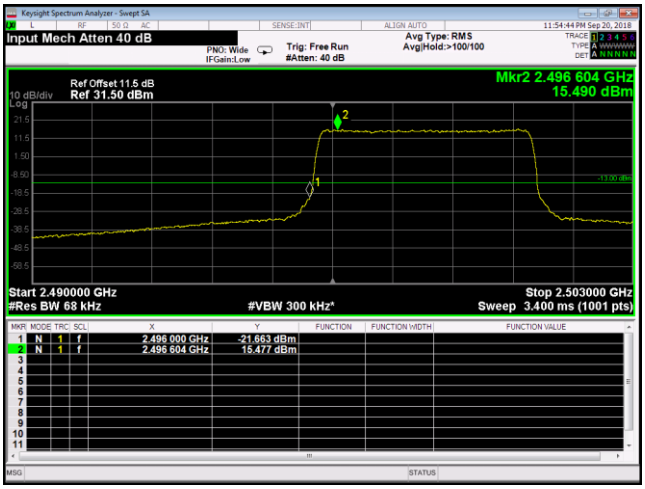



**Plot 130. Radiated Band Edge, BRS 2500, high channel, two signal, port 2, 15 MHz**

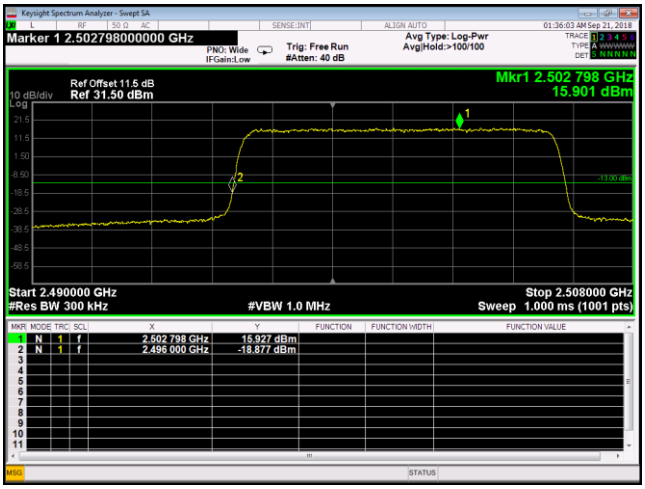
  




**Plot 131. Radiated Band Edge, BRS 2500, high channel, two signal, port 2, 20 MHz**

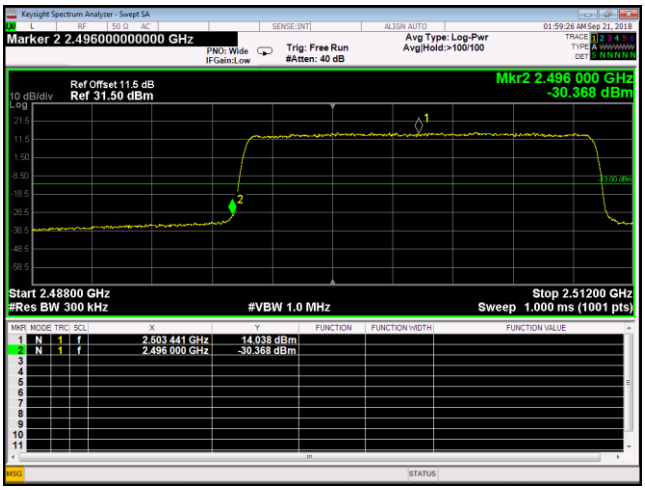



**Plot 132. Radiated Band Edge, BRS 2500, low channel, one signal, port 1, 5 MHz**

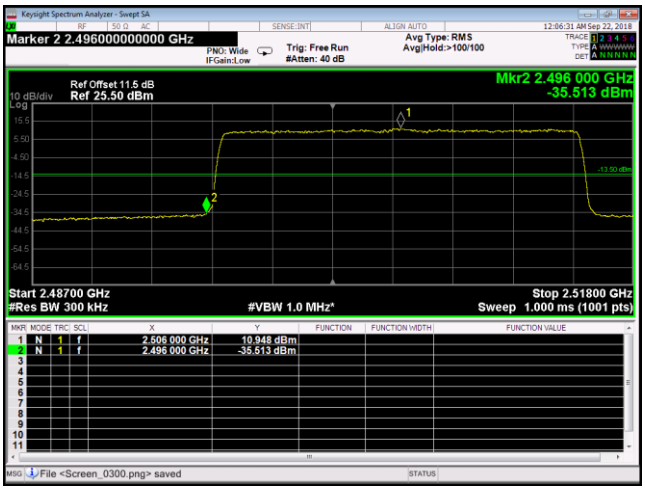



**Plot 133. Radiated Band Edge, BRS 2500, low channel, one signal, port 1, 10 MHz**

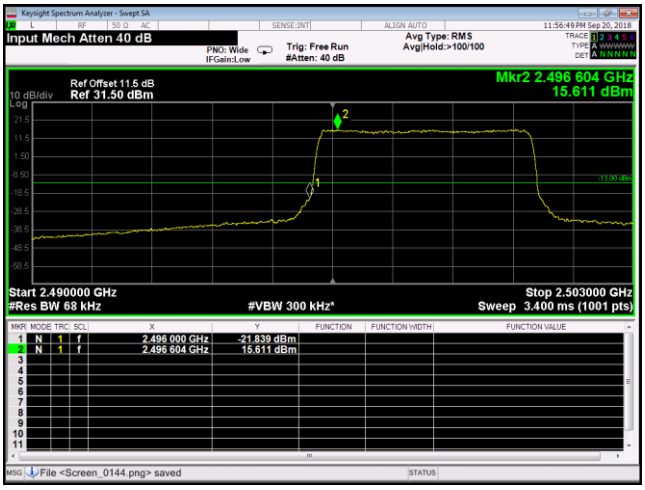
  




**Plot 134. Radiated Band Edge, BRS 2500, low channel, one signal, port 1, 15 MHz**

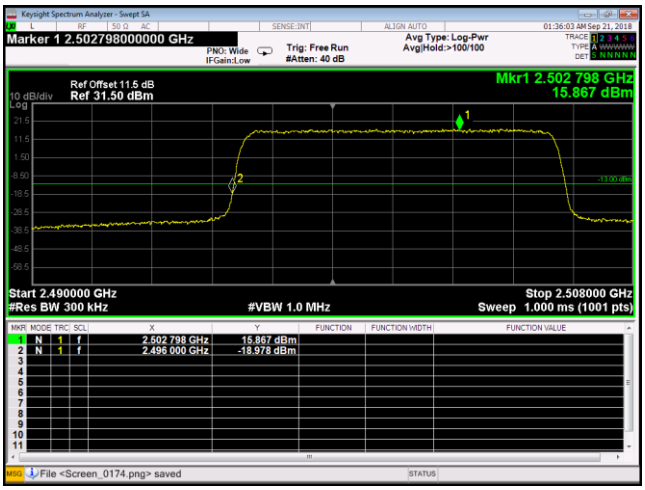



**Plot 135. Radiated Band Edge, BRS 2500, low channel, one signal, port 1, 20 MHz**

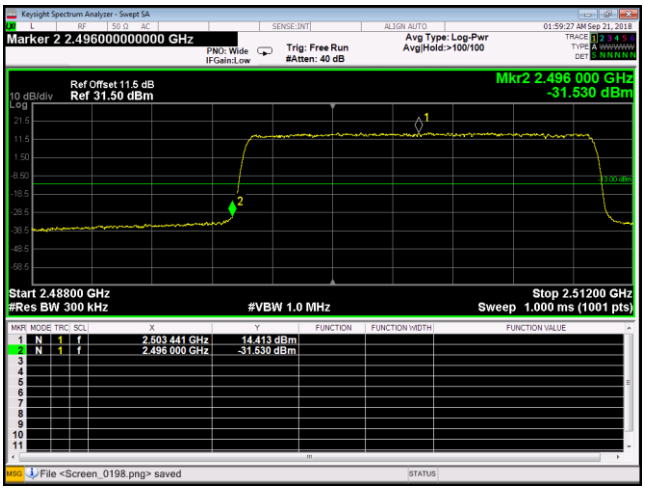



**Plot 136. Radiated Band Edge, BRS 2500, low channel, one signal, port 2, 5 MHz**

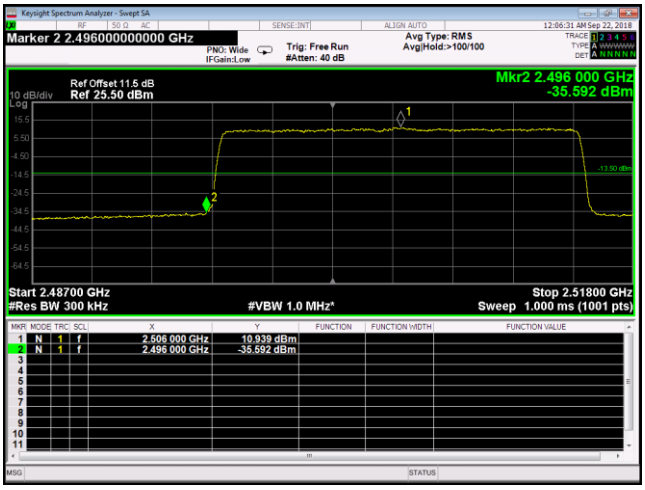
  




**Plot 137. Radiated Band Edge, BRS 2500, low channel, one signal, port 2, 10 MHz**

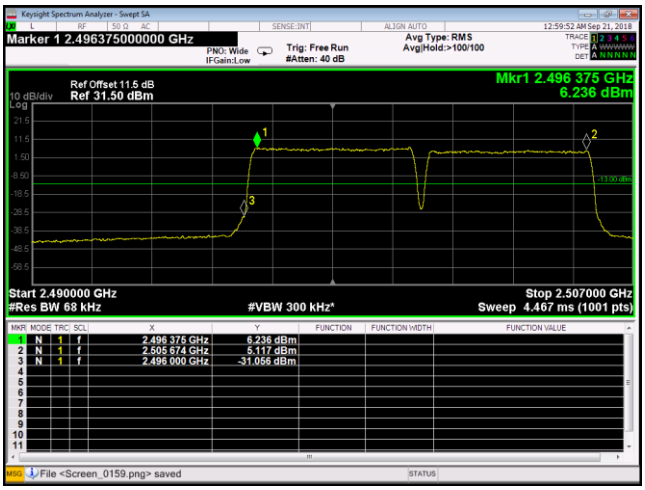



**Plot 138. Radiated Band Edge, BRS 2500, low channel, one signal, port 2, 15 MHz**

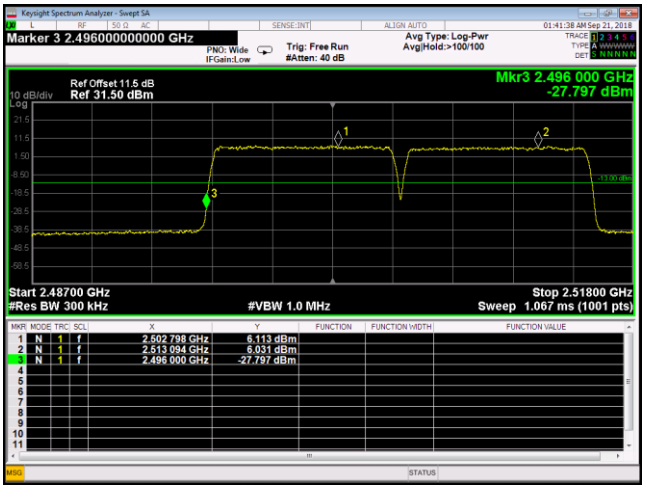



**Plot 139. Radiated Band Edge, BRS 2500, low channel, one signal, port2, 20 MHz**

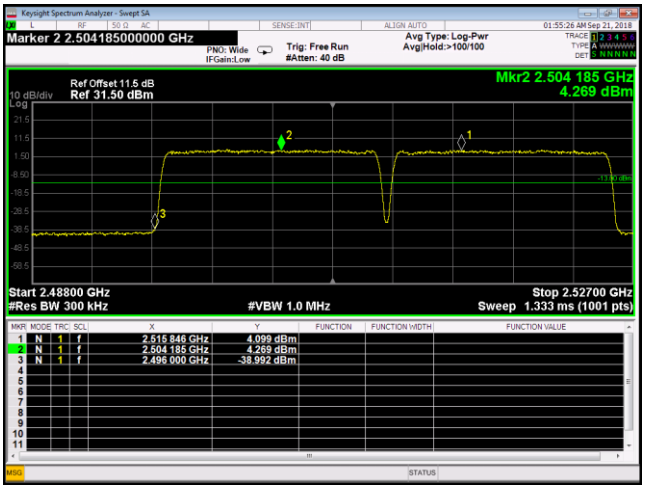
  




**Plot 140. Radiated Band Edge, BRS 2500, low channel, two signal, port 1, 5 MHz**

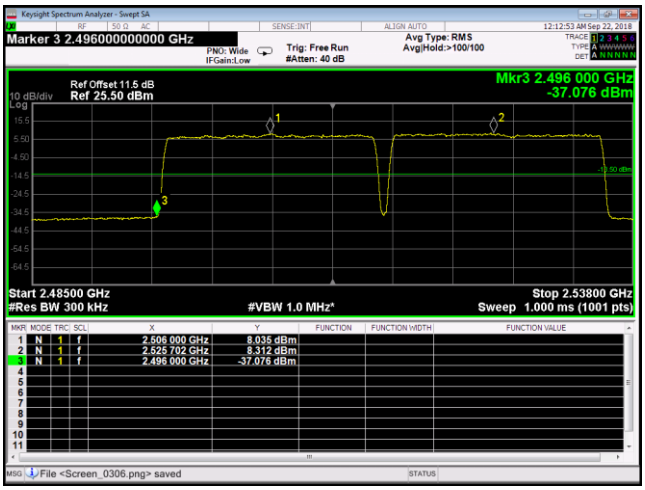



**Plot 141. Radiated Band Edge, BRS 2500, low channel, two signal, port 1, 10 MHz**

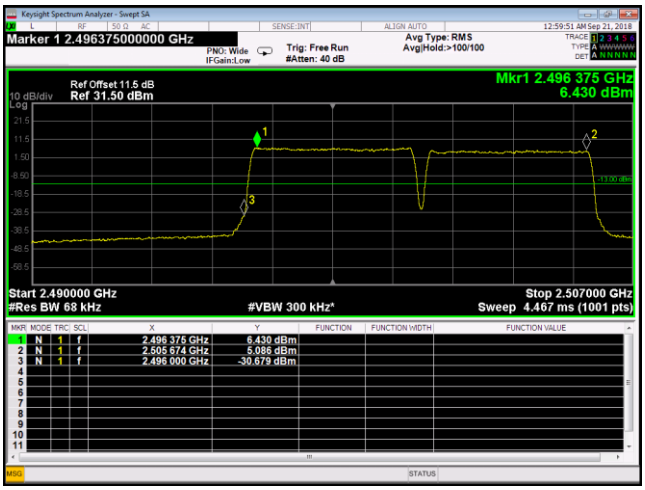



**Plot 142. Radiated Band Edge, BRS 2500, low channel, two signal, port 1, 15 MHz**

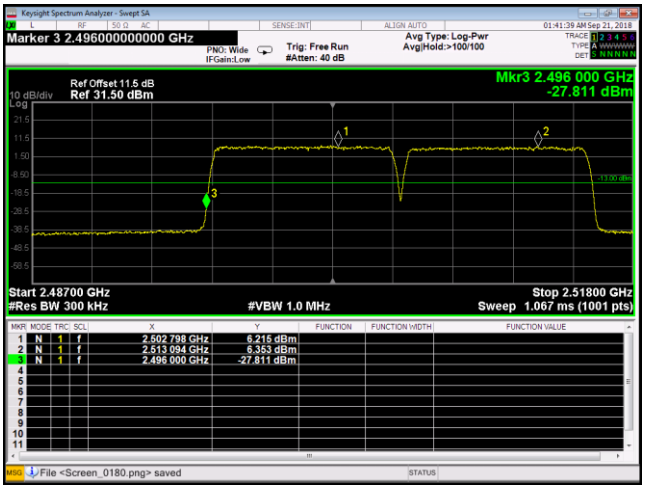
  




**Plot 143. Radiated Band Edge, BRS 2500, low channel, two signal, port 1, 20 MHz**

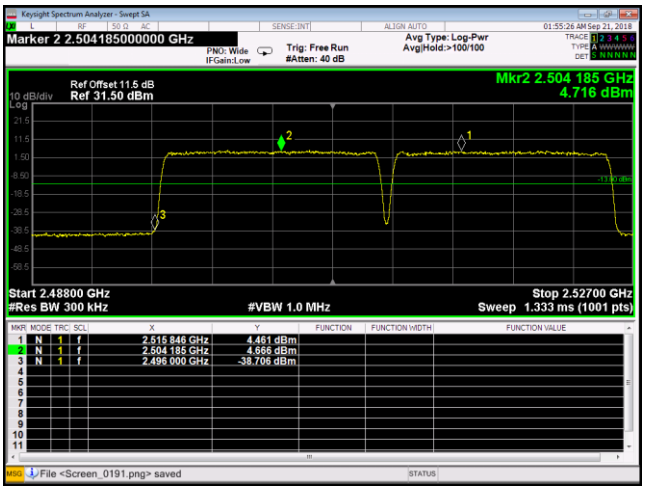



**Plot 144. Radiated Band Edge, BRS 2500, low channel, two signal, port 2, 5 MHz**

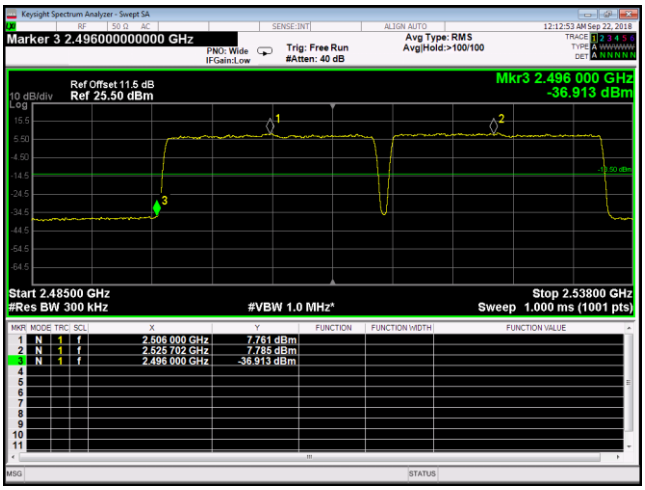



**Plot 145. Radiated Band Edge, BRS 2500, low channel, two signal, port 2, 10 MHz**




**Plot 146. Radiated Band Edge, BRS 2500, low channel, two signal, port 2, 15 MHz**




**Plot 147. Radiated Band Edge, BRS 2500, low channel, two signal, port 2, 20 MHz**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 2.1051 Spurious Emissions at Antenna Terminals

**Test Requirement(s):** **§ 2.1051 and 27.53(m) Measurements required: Spurious emissions at antenna terminals:** The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate.

**Test Procedures:** The EUT was tested according to the unwanted emissions procedures of ANSI C63.26 5.7.3.The spectrum analyzer was used and configured in the following manner:

(a) Frequency Range = 30MHz – 10$^{th}$ Harmonic
(b) RBW = 1% of the OBW, or greater
(c) VBW 1-3 x the RBW
(d) Detector = Peak
(e) Sweet Time = Auto

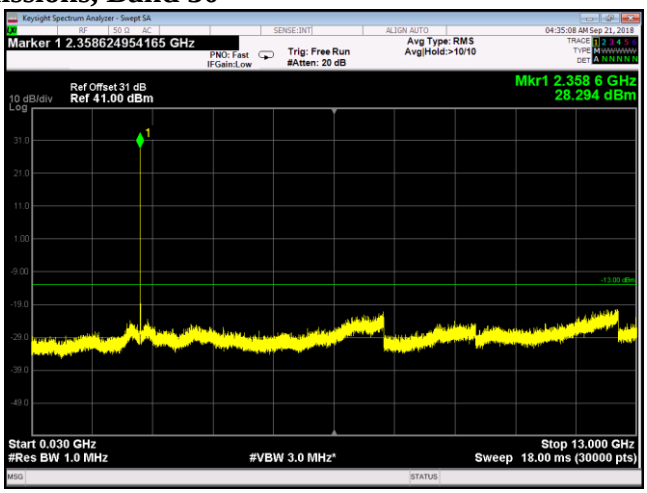
**Test Results:** The equipment was found compliant with the requirements of this section.

**Test Engineer(s):** Deepak Giri and Bradley Jones

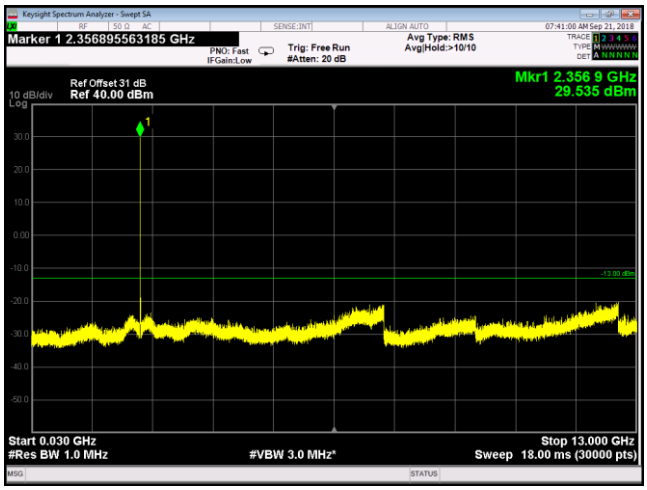
**Test Date(s):** September 20, 2018

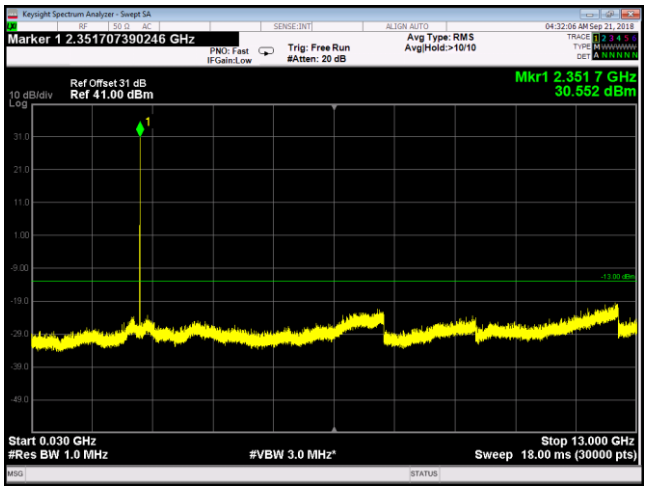
## Conducted Spurious Emissions, Band 30



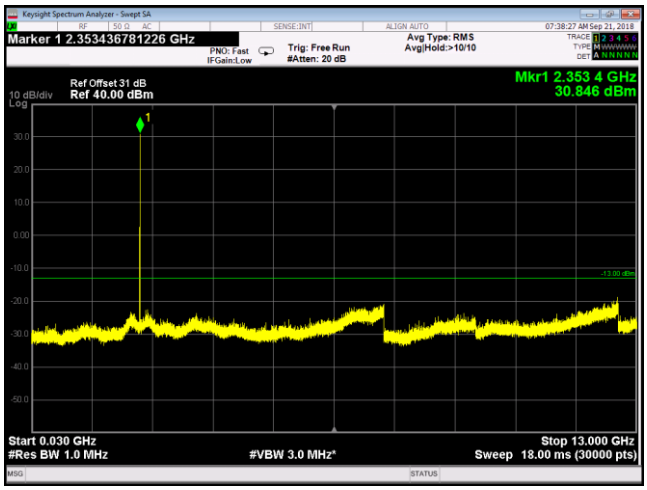

**Plot 148. Spurious Emissions at Antenna Terminals, Band 30, 5 MHz, .03 – 13 GHz, High, Port 1**



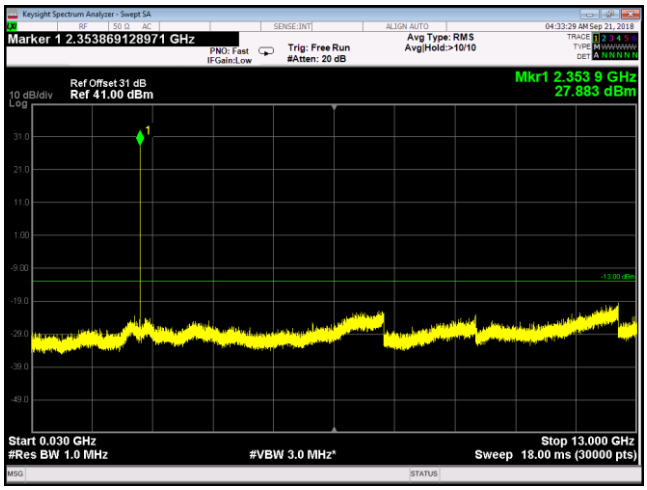

**Plot 149. Spurious Emissions at Antenna Terminals, Band 30, 5 MHz, .03 – 13 GHz, High, Port 2**



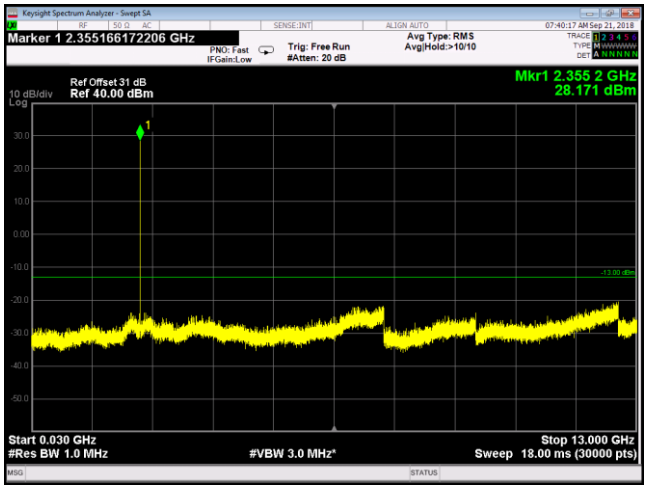

**Plot 150. Spurious Emissions at Antenna Terminals, Band 30, 5 MHz, .03 – 13 GHz, Low, Port 1**




**Plot 151. Spurious Emissions at Antenna Terminals, Band 30, 5 MHz, .03 – 13 GHz, Low, Port 2**




**Plot 152. Spurious Emissions at Antenna Terminals, Band 30, 5 MHz, .03 – 13 GHz, Mid, Port 1**




**Plot 153. Spurious Emissions at Antenna Terminals, Band 30, .5 MHz, 3 – 13 GHz, Mid, Port 2**