# Cellphone-Mate, Inc.

**TEST REPORT FOR**

## Wideband Consumer Booster
## Model: Fusion 5S V2.0

**Tested To The Following Standard:**

**FCC Part 2 / 27**

**Report No.: 98021-15**

**Date of issue: January 27, 2016**

ACCREDITED
Testing Certificates:
803.01, 803.02, 803.05, 803.06

**This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of EMC testing for CKC Laboratories, Inc.**

**We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.**

This report contains a total of 58 pages and may be reproduced in full only. Partial reproduction may only be done with the written consent of CKC Laboratories, Inc.

Testing the Future
CKC LABORATORIES, INC.

## TABLE OF CONTENTS


Administrative Information ..... 3

Test Report Information ..... 3

Report Authorization ..... 3

Test Facility Information ..... 4

Software Versions ..... 4

Site Registration & Accreditation Information ..... 4

Summary of Results ..... 5

Modifications During Testing ..... 6

Conditions During Testing ..... 6

Equipment Under Test ..... 7

FCC Part(s) 2 / 27 ..... 8

2.1049 Occupied Bandwidth ..... 8

Summary of Results ..... 9

2.1051 Spurious Emissions at Antenna Terminals ..... 34

Summary of Results ..... 35

2.1053 Field Strength of Spurious Radiation ..... 52

Summary of Results ..... 54

Supplemental Information ..... 57

Measurement Uncertainty ..... 57

Emissions Test Details ..... 57

# ADMINISTRATIVE INFORMATION

## Test Report Information

**REPORT PREPARED FOR:**

Cellphone-Mate, Inc.
48346 Milmont Drive
Fremont CA 94538

Representative: Dennis Findley
Customer Reference Number: CKC20160121

**REPORT PREPARED BY:**

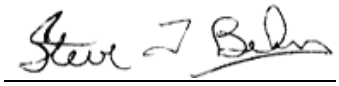
Dianne Dudley
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 98021

**DATE OF EQUIPMENT RECEIPT:** January 5, 2016
**DATE(S) OF TESTING:** January 5-20, 2016

## Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



***Steve Behm***
***Director of Quality Assurance & Engineering Services***
***CKC Laboratories, Inc.***

# Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
1120 Fulton Place
Fremont, CA 94539

# Software Versions

| CKC Laboratories Proprietary Software | Version |
|---|---|
| EMITest Emissions | 5.03.00 |
| EMITest Immunity | 5.03.00 |

# Site Registration & Accreditation Information

| Location | CB # | TAIWAN | CANADA | FCC | JAPAN |
|---|---|---|---|---|---|
| Fremont | US0082 | SL2-IN-E-1148R | 3082B-1 | 958979 | A-0149 |

# SUMMARY OF RESULTS

## Standard / Specification: FCC Part 2/27

| KDB 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v03, June 5, 2015 | | FCC Part Section Correlation | | Mods | Results |
|---|---|---|---|---|---|
| **Guidance Sec #** | **Guidance Description** | **FCC Sec #** | **FCC Rule Description** | | |
| | | | | | |
| 7.1 a) - k) | Authorized Frequency Band Verification Test | 20.21(e)(3) | Frequency Bands | NA | NA[1] |
| | | | | | |
| 7.2.2 a) - k) | Maximum Power Measurement Procedure | 2.1046/20.21(e)(8)(i)(D) | Power Limit | NA | NA[1] |
| | | | | | |
| 7.3 a) - d) | Maximum Booster Gain Computation | 20.21(e)(8)(i)(B) | Bidirectional Capabilities | NA | NA[1] |
| | | | | | |
| 7.4 a) - n) | Intermodulation Product | 20.21(e)(8)(i)(F) | Intermodulation Limit | NA | NA[1] |
| | | | | | |
| 7.5 a) - n) | Out of Band Emissions | 20.21(e)(8)(i)(E) | Out of Band Emission | NA | NA[1] |
| | | | | | |
| 7.6 a) - e) | Conducted Spurious Emission | 2.1051/22/24/27 | Spurious emission | NA | PASS |
| | | | | | |
| 7.7.1 a) - g)<br>7.7.1 h) - n)<br>7.7.2 a) - g) | Noise Limit Procedure<br>Variable Noise<br>Variable Noise Timing | 20.21(e)(8)(i)(A)(2)(i)<br>20.21(e)(8)(i)(A)(1)<br>20.21(e)(8)(i)(H) | Noise Limits<br><br>Transmit Power Off Mode | NA | NA[1] |
| | | | | | |
| 7.8 a) - l) | Uplink inactivity | 20.21(e)(8)(i)(I) | Uplink Inactivity | NA | NA[1] |

NA = Not Applicable

NA[1] = A different standard applies; see applicable test report.

## Standard / Specification: FCC Part 2/27 - continued

| KDB 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v03, June 5, 2015 | | FCC Part Section Correlation | | Mods | Results |
|---|---|---|---|---|---|
| **Guidance Sec #** | **Guidance Description** | **FCC Sec #** | **FCC Rule Description** | | |
| | | | | | |
| 7.9.1 a) - l)<br><br>7.9.2 a) - f) | Variable Booster Gain<br><br>Variable Uplink Gain Timing | 20.21(e)(8)(i)(C) (1), (2)(i)<br>20.21(e)(8)(i)(H) | Booster Gain<br><br>Transmit Power Off Mode | NA | NA[1] |
| | | | | | |
| 7.10.a) - j) | Occupied Band Width | 2.1049/22/24/27 | Occupied Band Width | NA | PASS |
| | | | | | |
| 7.11.2 a) - r)<br>7.11.3 a) - h)<br>7.11.4 a) - h)<br>(alternate to 7.11.3) | Anti-Oscillation | 20.21(e)(8)(ii)(A) | Anti-Oscillation | NA | NA[1] |
| | | | | | |
| 7.12a) - f) | Radiated Spurious Emission | 2.1053/ 22/24/27 | Spurious Emission | NA | PASS |
| | | | | | |
| 7.13 a) - c) | Spectrum Block Filter[2] | NA[1] | NA[1] | NA | NA[1] |
| | | | | | |

NA = Not Applicable
NA[1] = A different standard applies; see applicable test report.

## Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

| Summary of Conditions |
|---|
| No modifications were made during testing. |
| |

**Modifications listed above must be incorporated into all production units.**

## Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

| Summary of Conditions |
|---|
| None |
| |

# EQUIPMENT UNDER TEST (EUT)

During testing numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

## Configuration 1

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Wideband Consumer Booster | Cellphone-Mate, Inc. | Fusion 5S V2.0 | 01 |
| Switching Power Adapter | SureCall | GFP451DA-1238-1 | 1404-0000642 |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Signal Generator | Agilent | E4433B | US40052164 |
| Signal Generator | Agilent | E4438C | MY42082260 |

## Configuration 2

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Wideband Consumer Booster | Cellphone-Mate, Inc. | Fusion 5S V2.0 | 01 |
| Switching Power Adapter | SureCall | GFP451DA-1238-1 | 1404-0000642 |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Signal Generator | Agilent | E4438C | MY42082260 |

# FCC PART(S) 2 / 27

## 2.1049 Occupied Bandwidth

### Test Conditions / Setup

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170 | | |
| Customer: | Cellphone-Mate, Inc. | | |
| Specification: | **7.10 Occupied Band Width** | | |
| Work Order #: | **98021** | Date: | 01/12/2016 |
| Test Type: | **Conducted Emissions** | Time: | 14:15:51 |
| Tested By: | Daniel Bertran | Sequence#: | 1 |
| Software: | EMITest 5.03.00 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

The equipment under test (EUT) is a Fixed Wideband Consumer Booster.
The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.

Part 27
UL: 1710-1755MHz, 698-716MHz, 776-787MHz
DL: 2110-2155MHz, 728-746MHz, 746-757MHz

Test environment conditions:
Temperature: 20°C
Relative Humidity: 40%
Atmospheric Pressure: 102kPa

The test was performed in accordance with section 7.10 of the FCC document: 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v03 Dated June 5, 2015.

Firmware: V3.0

***Test Equipment:***

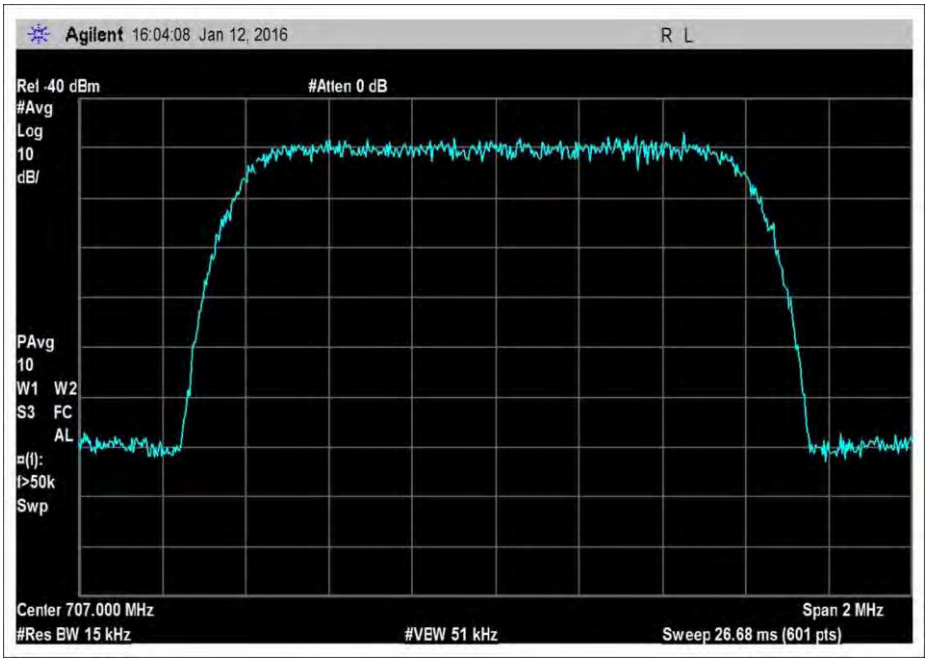
| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| | ANP06709 | Cable | 32026-29094K-29094K-72TC | 9/18/2014 | 9/18/2016 |
| | ANP06710 | Cable | 32026-29094K-29094K-72TC | 9/18/2014 | 9/18/2016 |
| | AN02660 | Spectrum Analyzer | E4446A | 7/9/2015 | 7/9/2017 |
| | ANP06467 | Attenuator | PE7014-10 | 5/13/2015 | 5/13/2017 |
| | ANP06239 | Attenuator | 54A-10 | 7/9/2014 | 7/9/2016 |

## Summary of Results

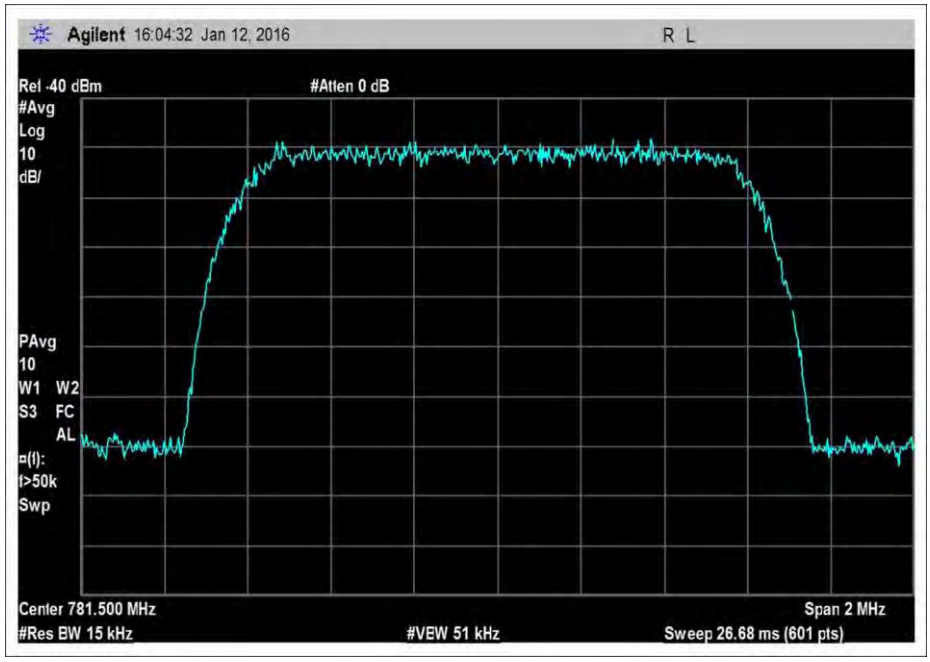
Pass: As summarized in plots below, the uniformity of the output signal relative to the input signal are practically identical. Therefore, the comparison is within limits.

## Plots

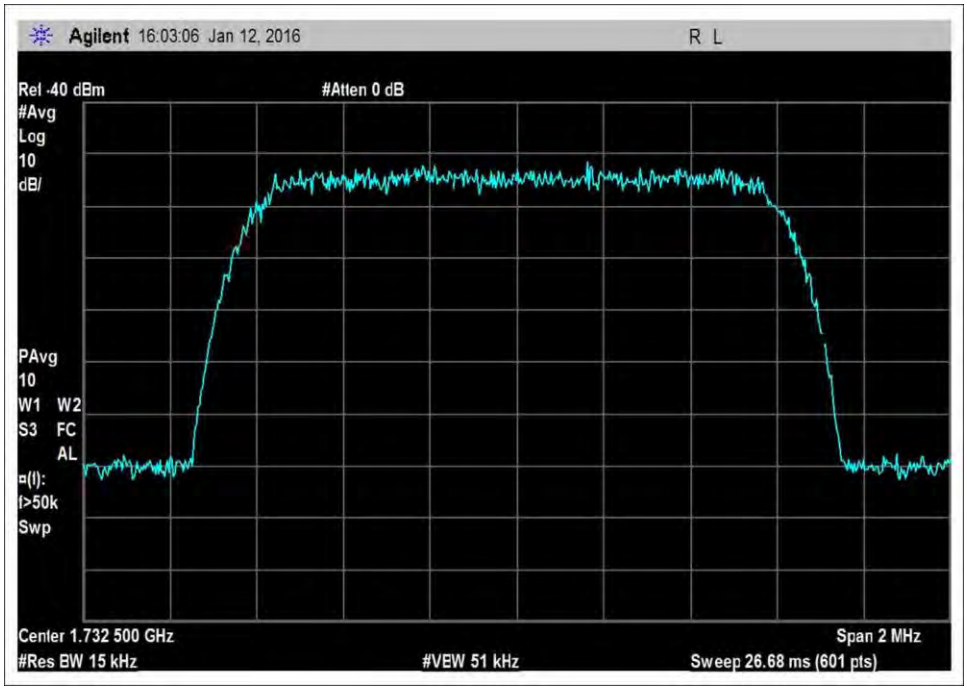
**Input – CDMA**



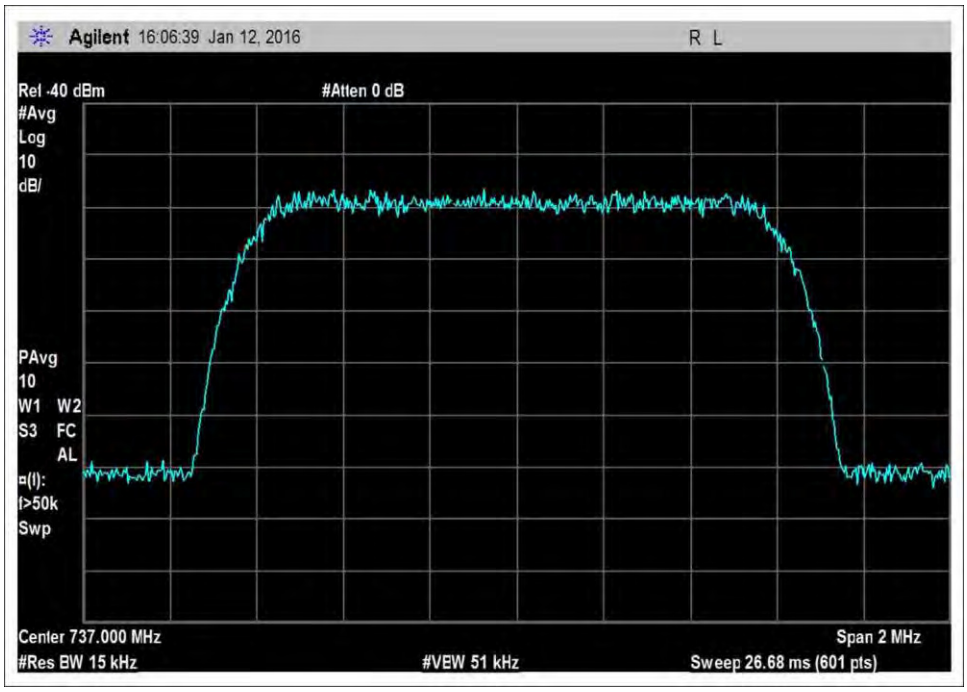

7.10_OBW_UL_698-716MHz_CDMA



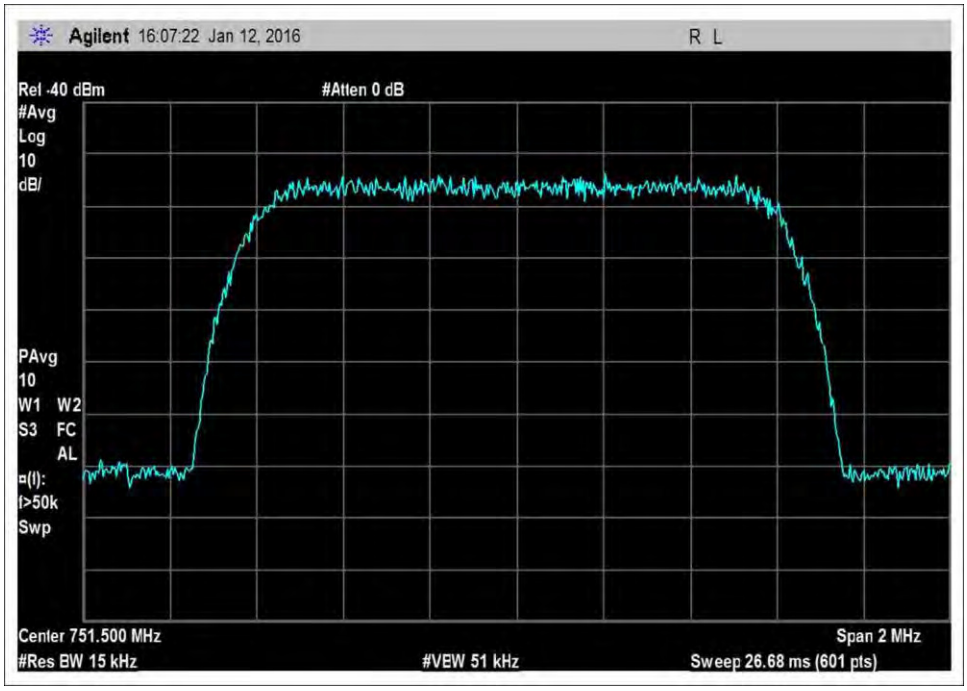

7.10_OBW_UL_776-787MHz_CDMA



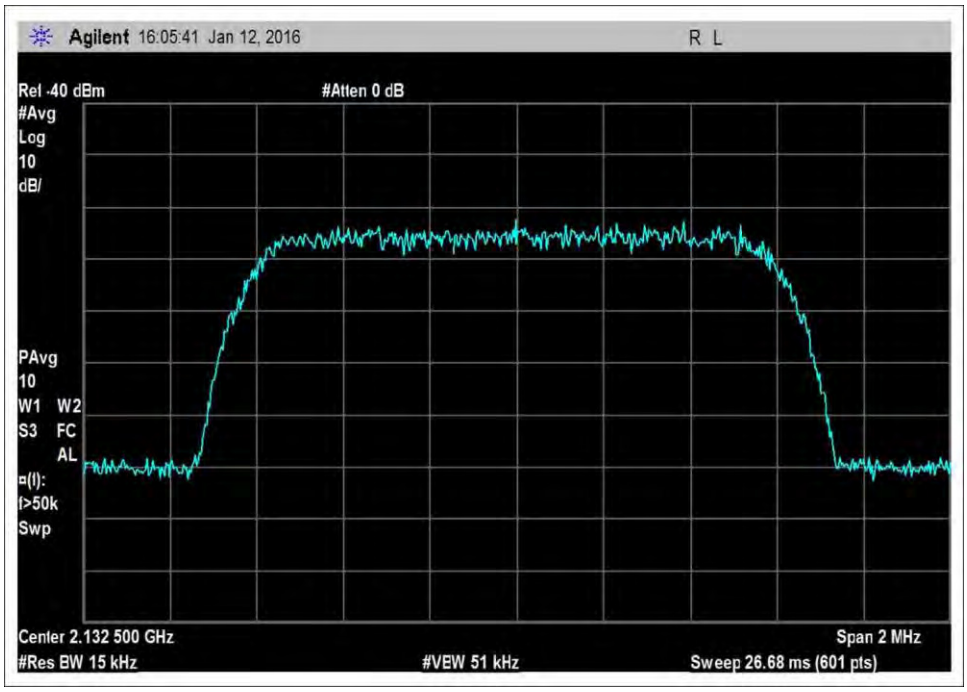

7.10_OBW_UL_1710-1755MHz_CDMA




7.10_OBW_DL_728-746MHz_CDMA

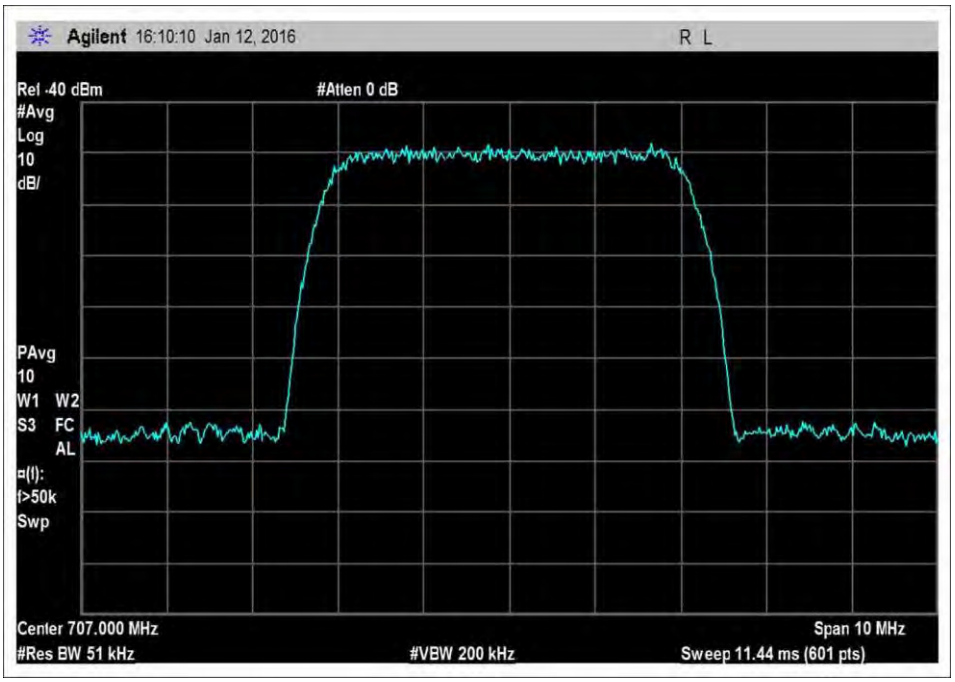



7.10_OBW_DL_746-757MHz_CDMA

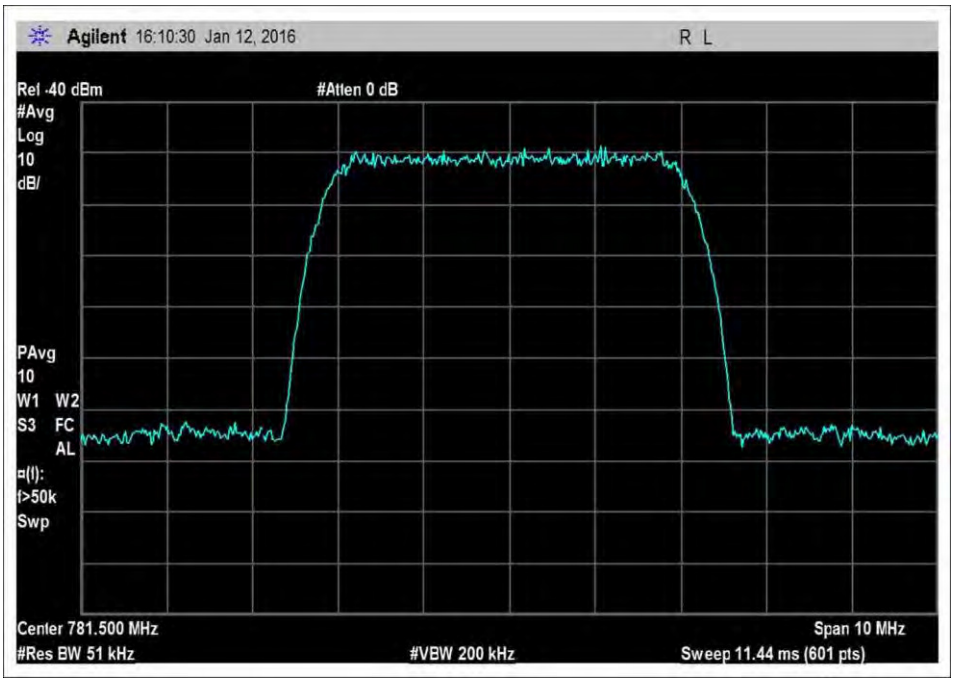



7.10_OBW_DL_2110-2155MHz_CDMA

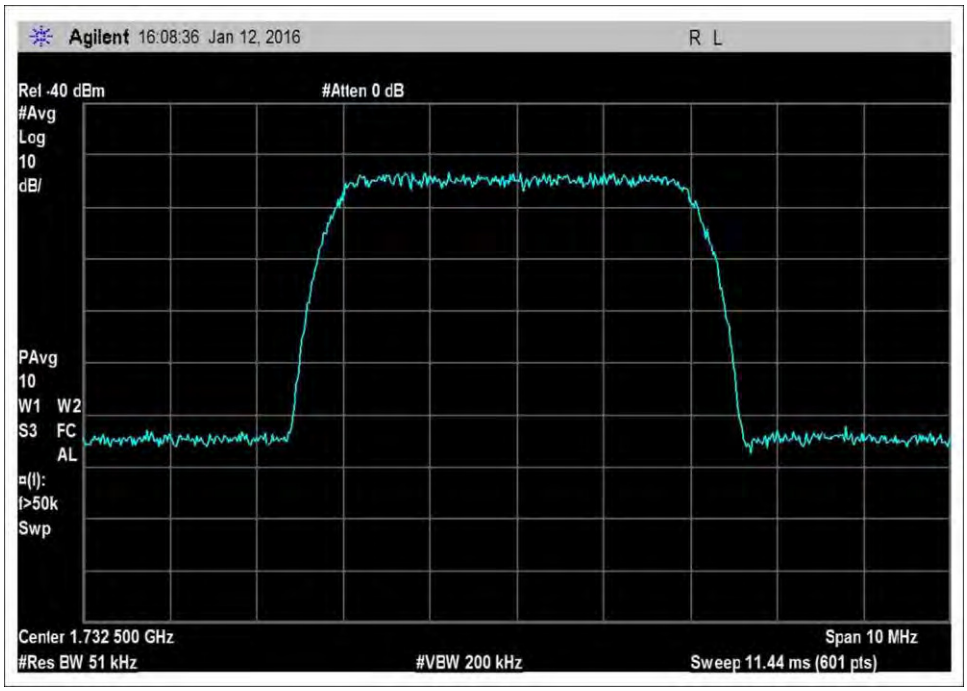
## Input – WCDMA



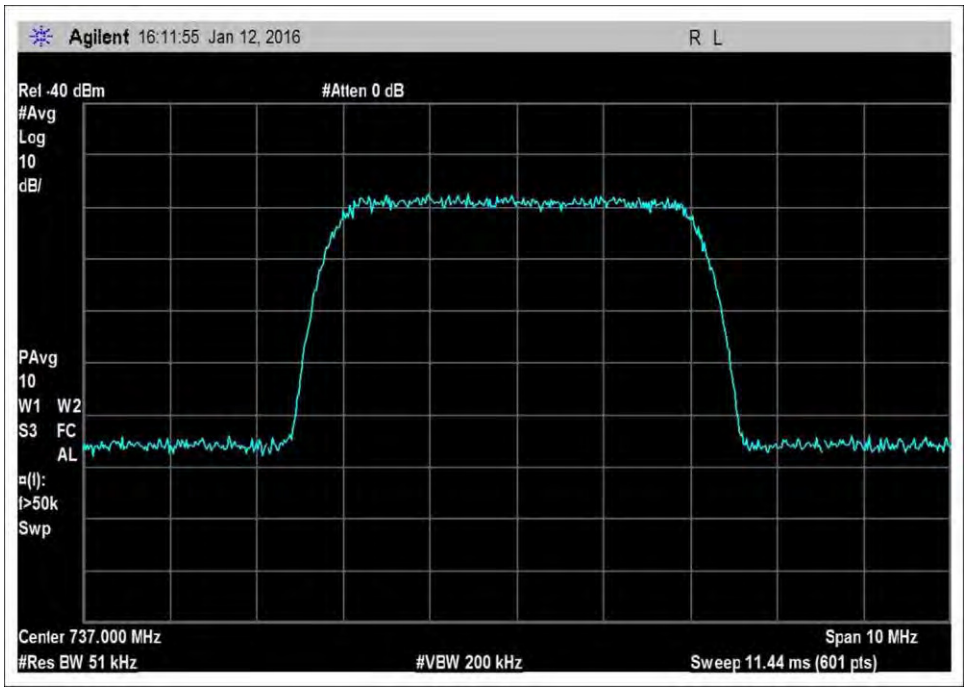

7.10_OBW_UL_698-716MHz_WCDMA



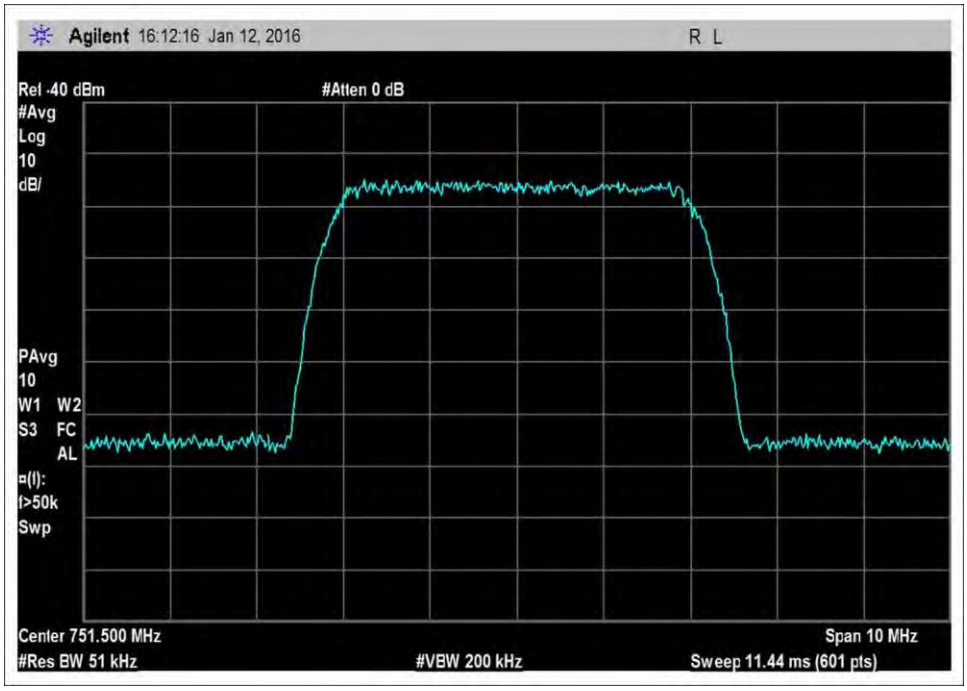

7.10_OBW_UL_776-787MHz_WCDMA



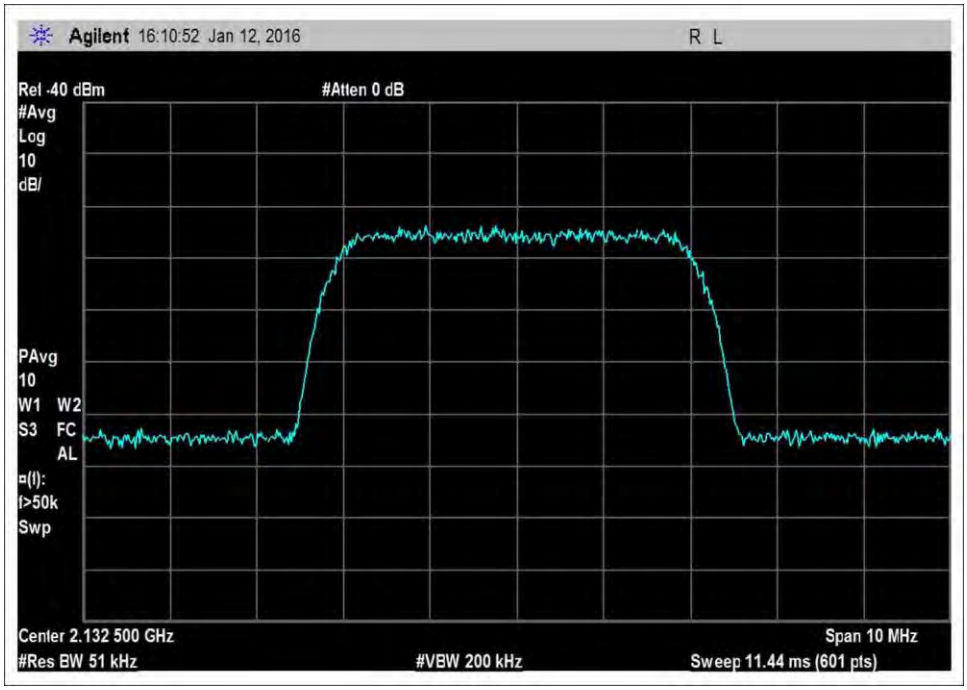

7.10_OBW_UL_1710-1755MHz_WCDMA




7.10_OBW_DL_728-746MHz_WCDMA

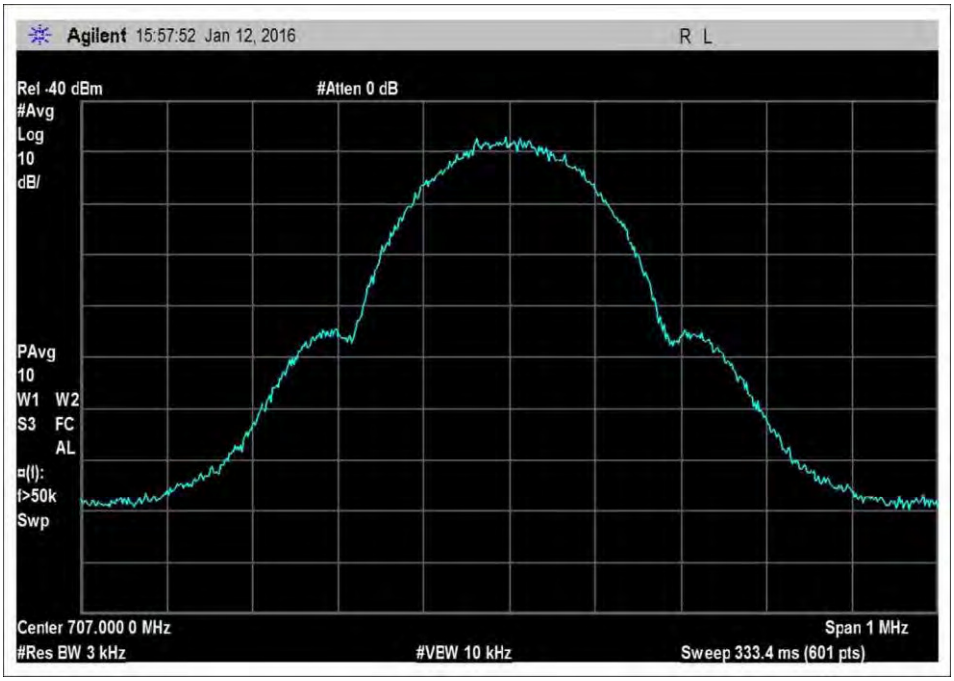



7.10_OBW_DL_746-757MHz_WCDMA

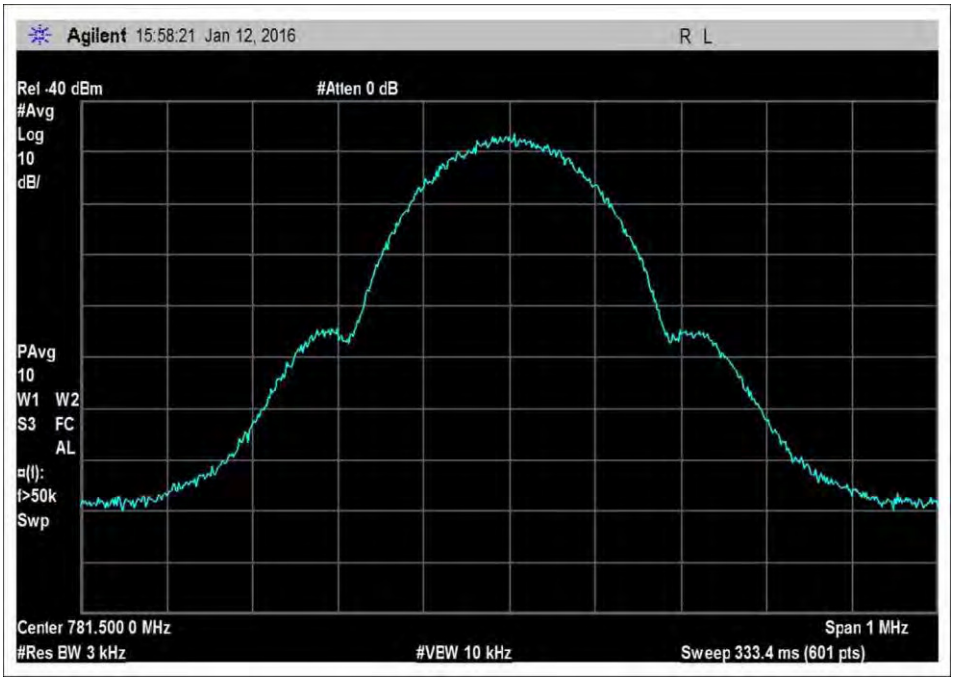



7.10_OBW_DL_2110-2155MHz_WCDMA

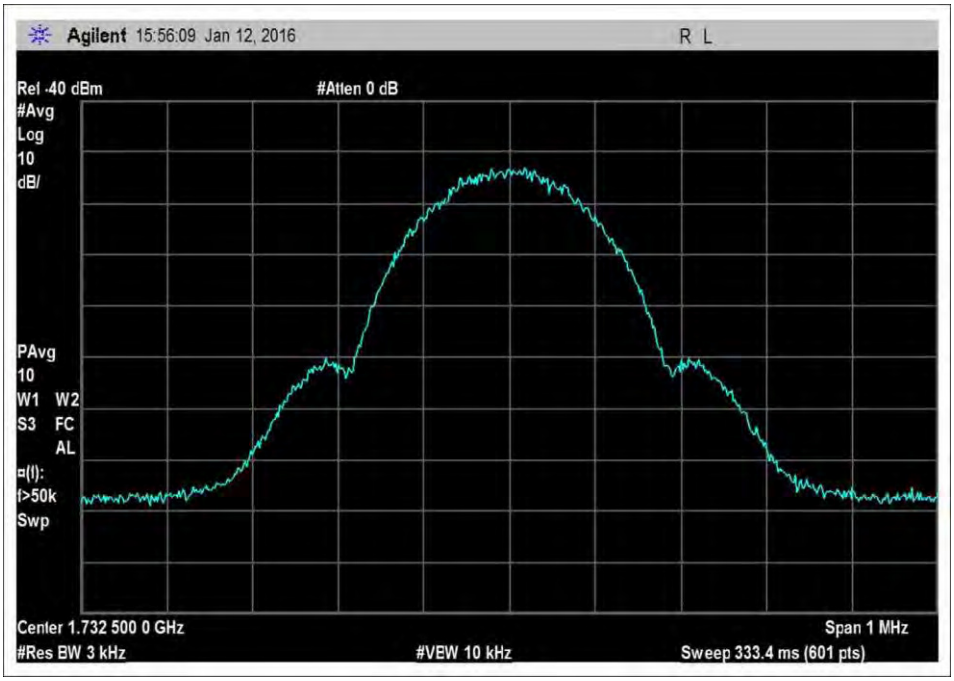
## Input – GSM



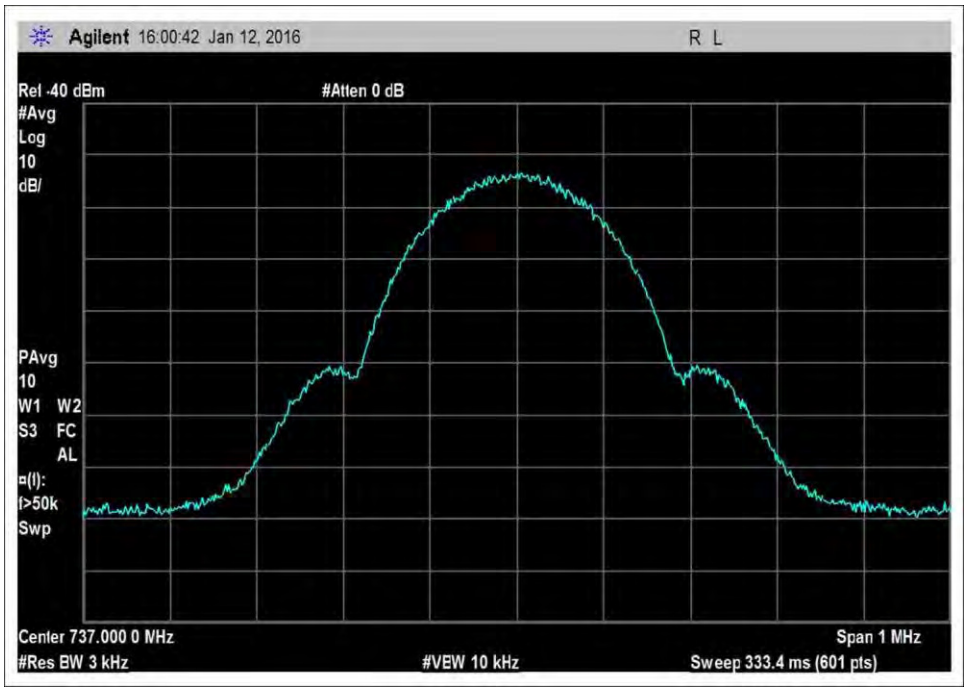

7.10_OBW_UL_698-716MHz_GSM



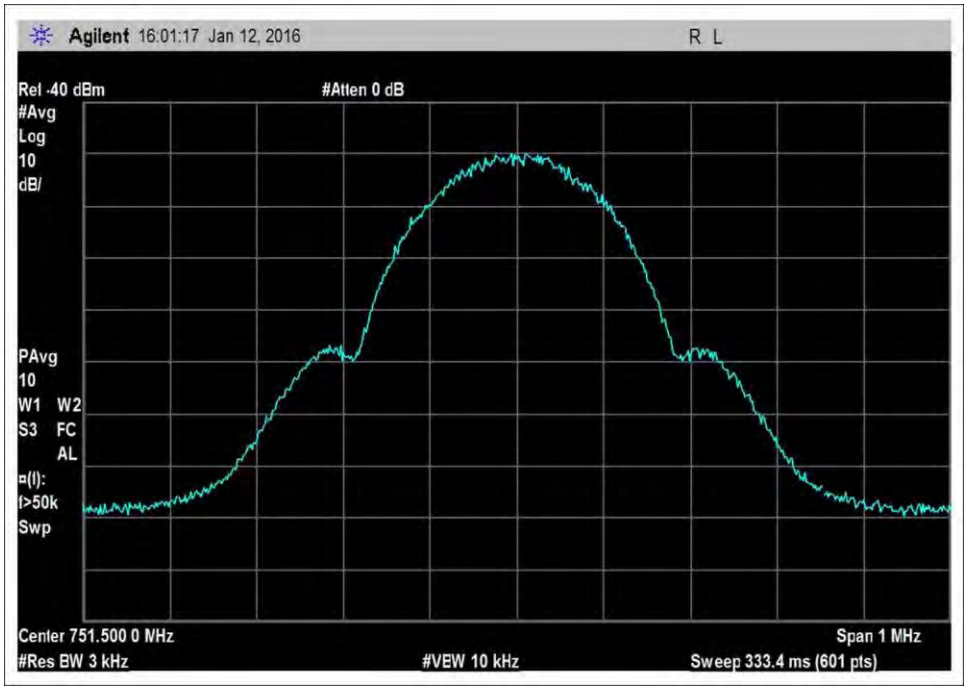

7.10_OBW_UL_776-787MHz_GSM



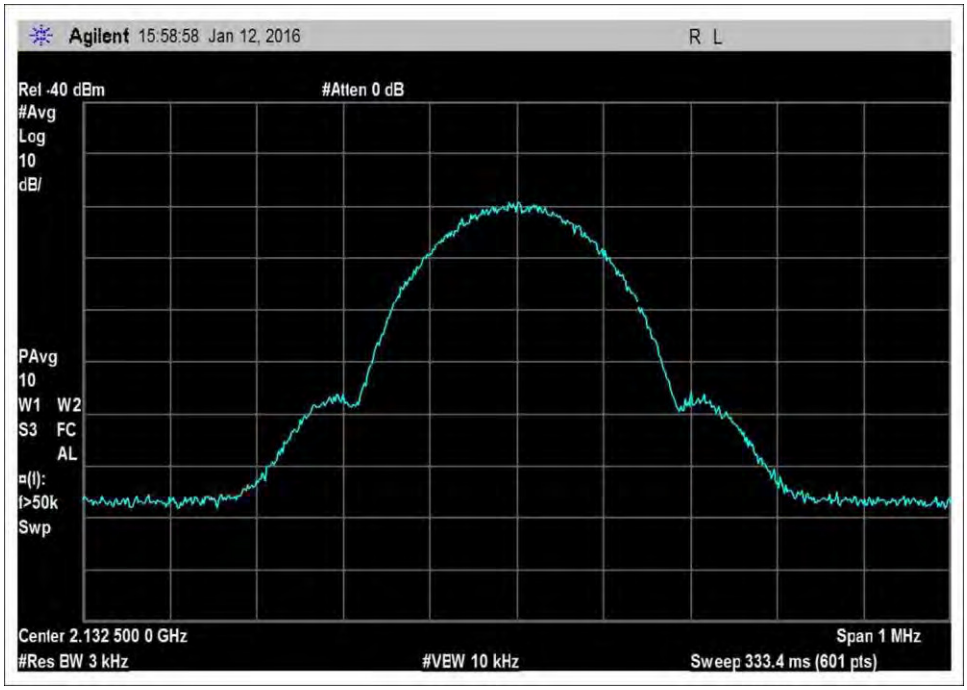

7.10_OBW_UL_1710-1755MHz_GSM




7.10_OBW_DL_728-746MHz_GSM

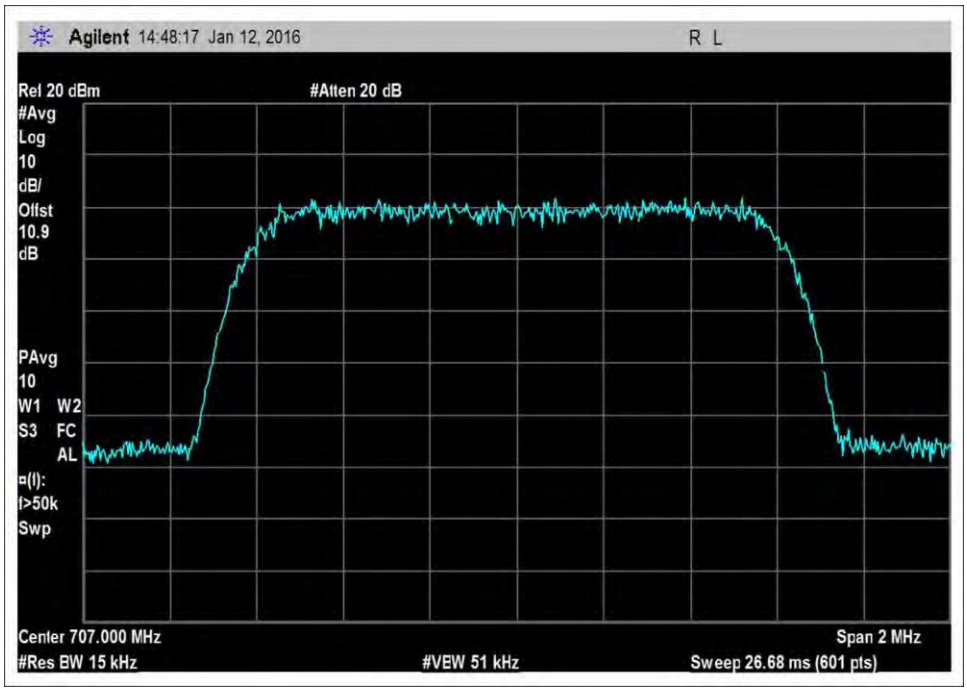



7.10_OBW_DL_746-757MHz_GSM

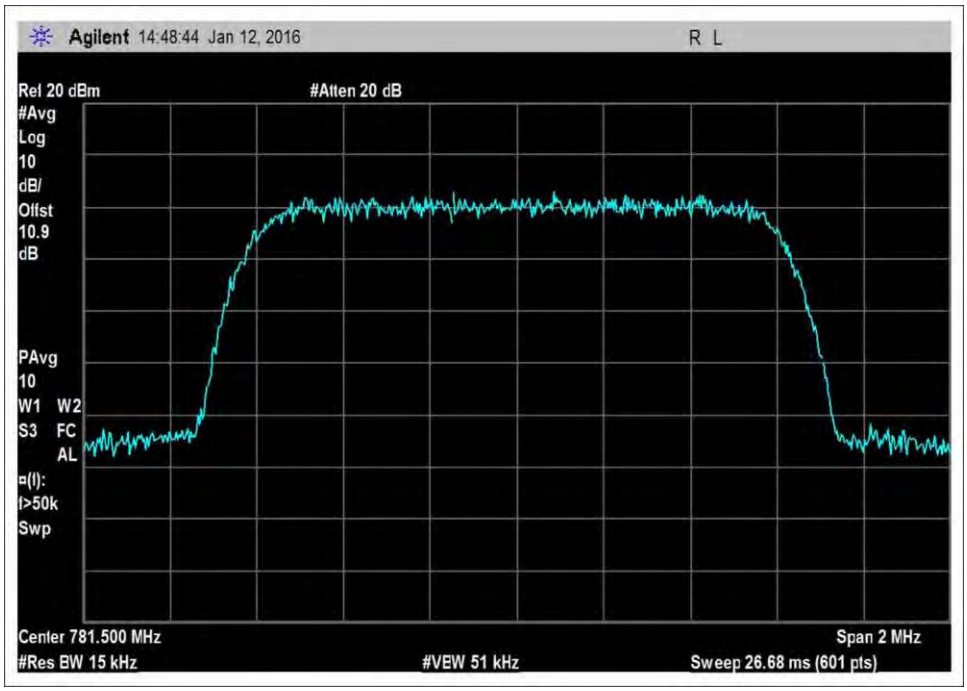



7.10_OBW_DL_2110-2155MHz_GSM

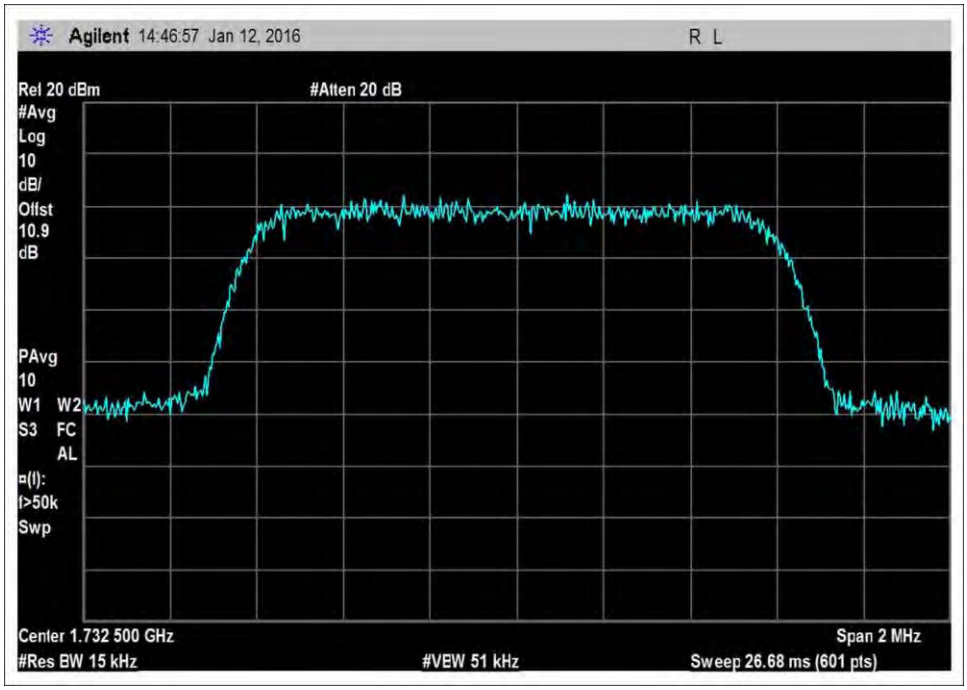
## Output– CDMA



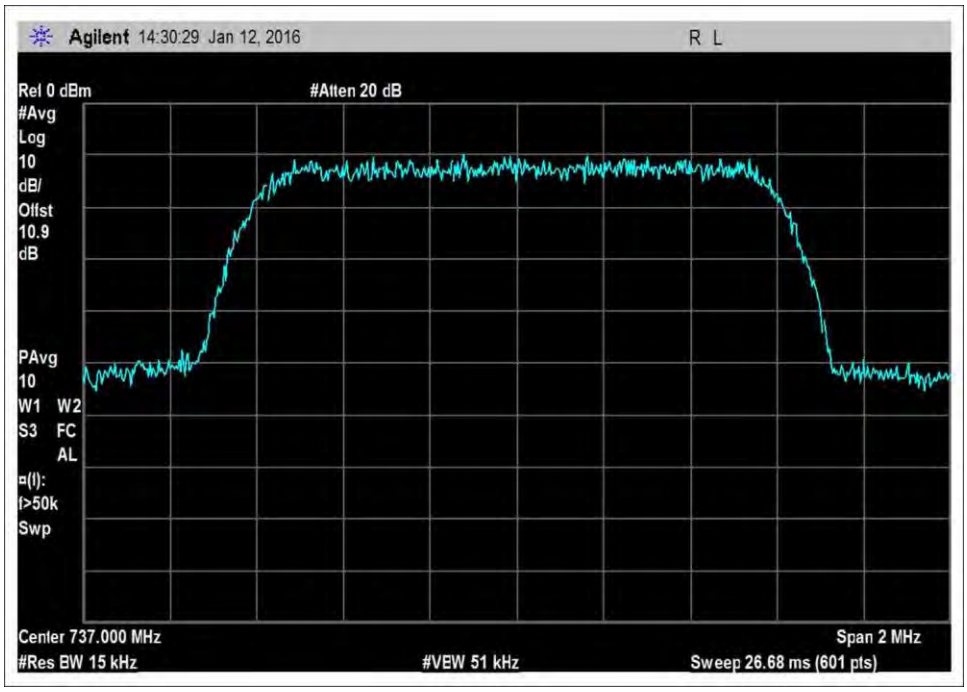

7.10_OBW_UL_698-716MHz_CDMA



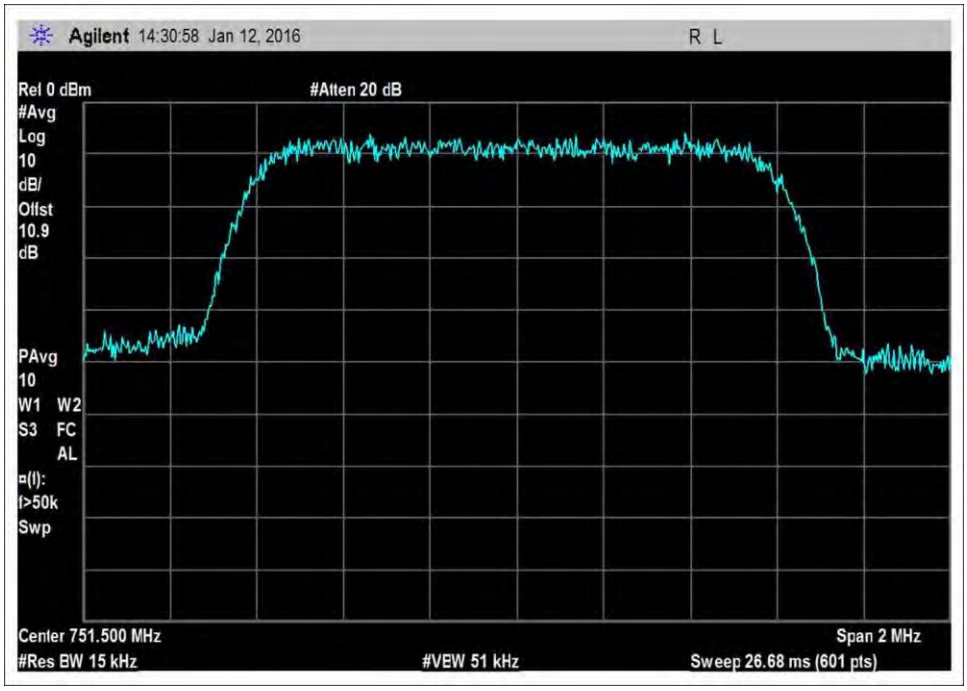

7.10_OBW_UL_776-787MHz_CDMA



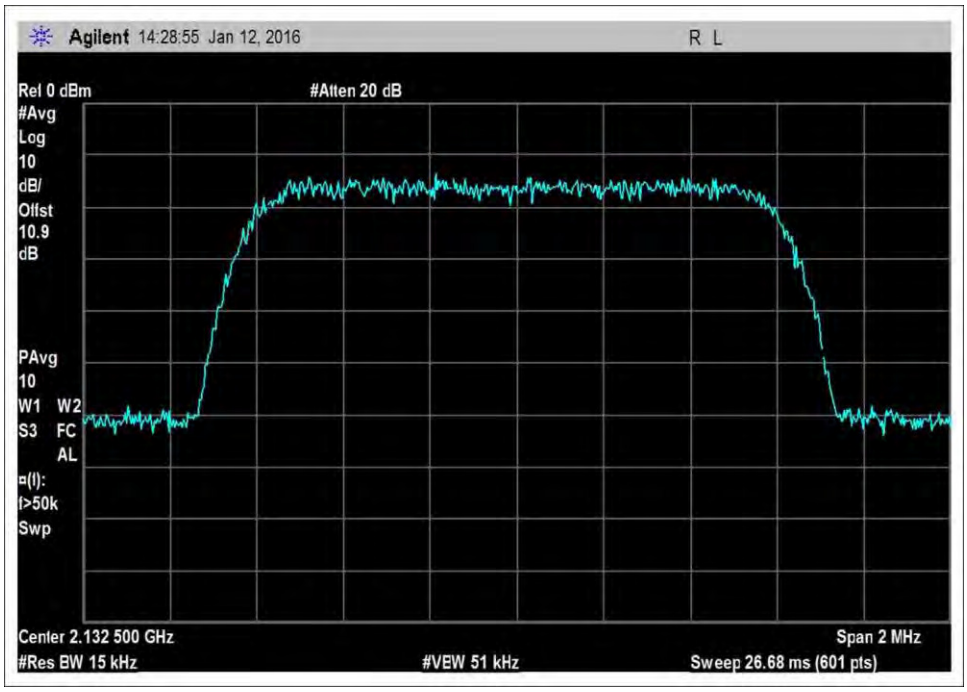

7.10_OBW_UL_1710-1755MHz_CDMA




7.10_OBW_DL_728-746MHz_CDMA

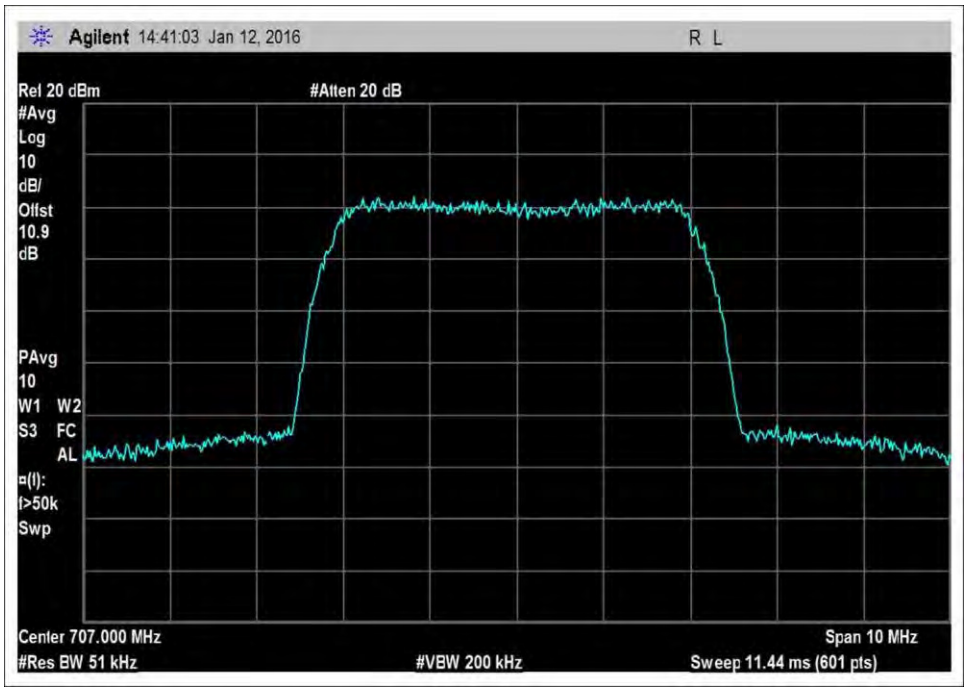



7.10_OBW_DL_746-757MHz_CDMA

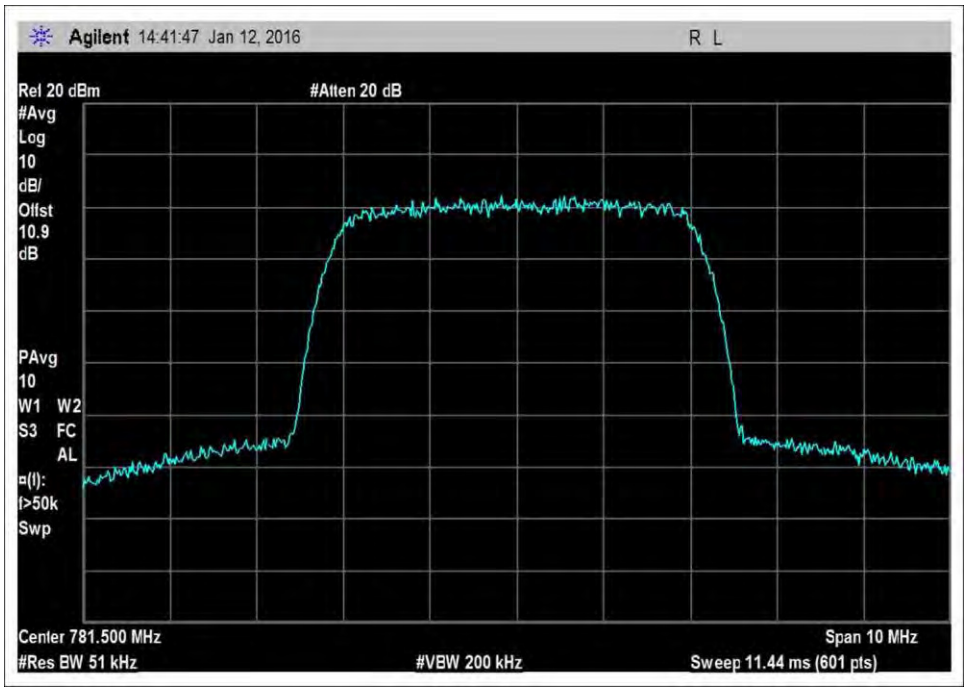



7.10_OBW_DL_2110-2155MHz_CDMA

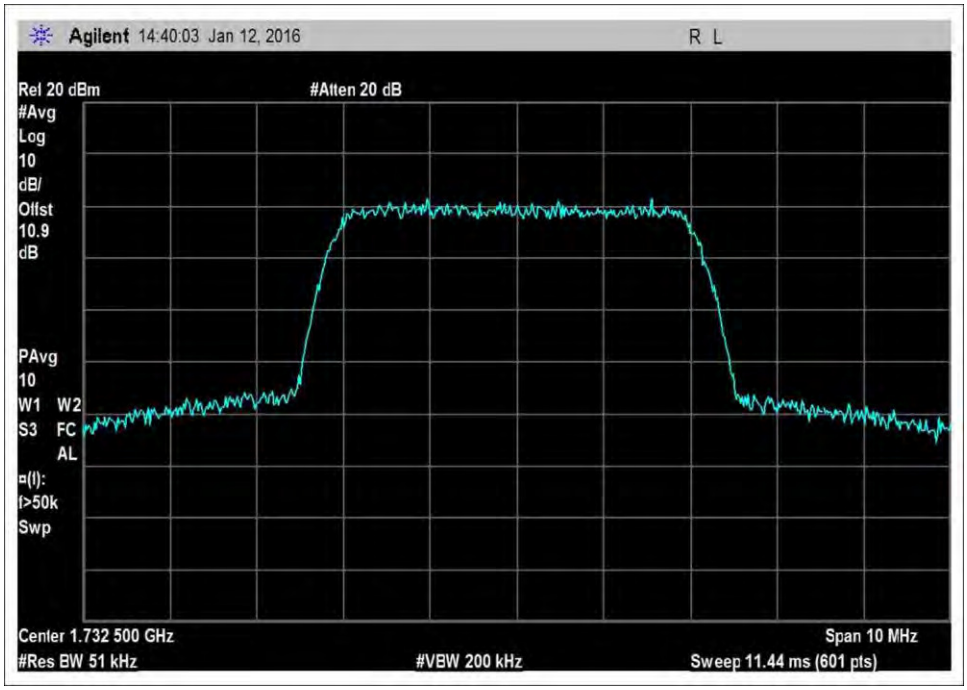
## Output– WCDMA



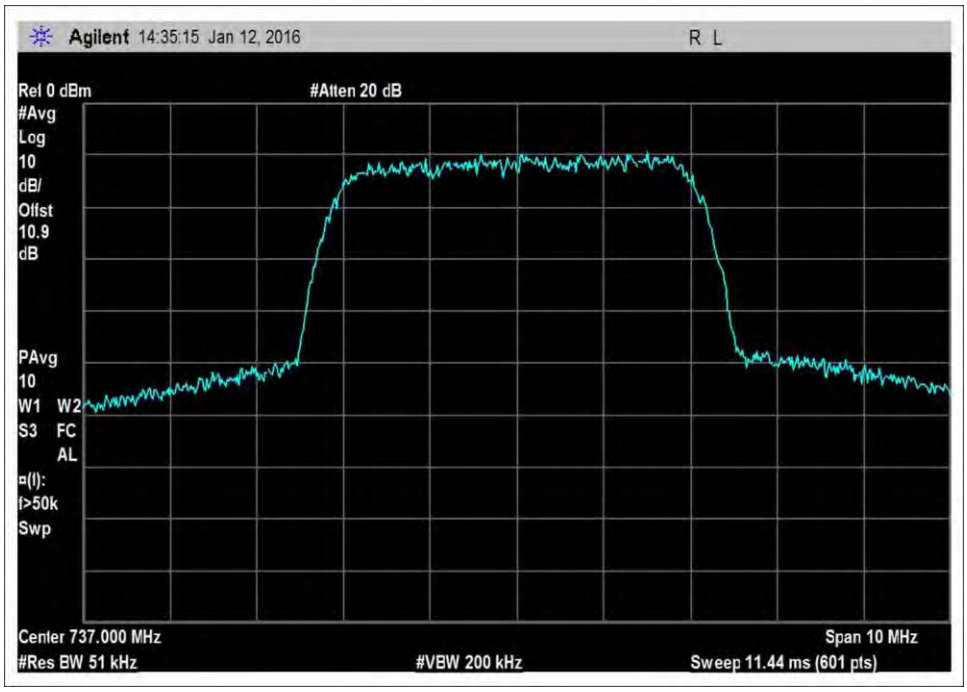

7.10_OBW_UL_698-716MHz_WCDMA



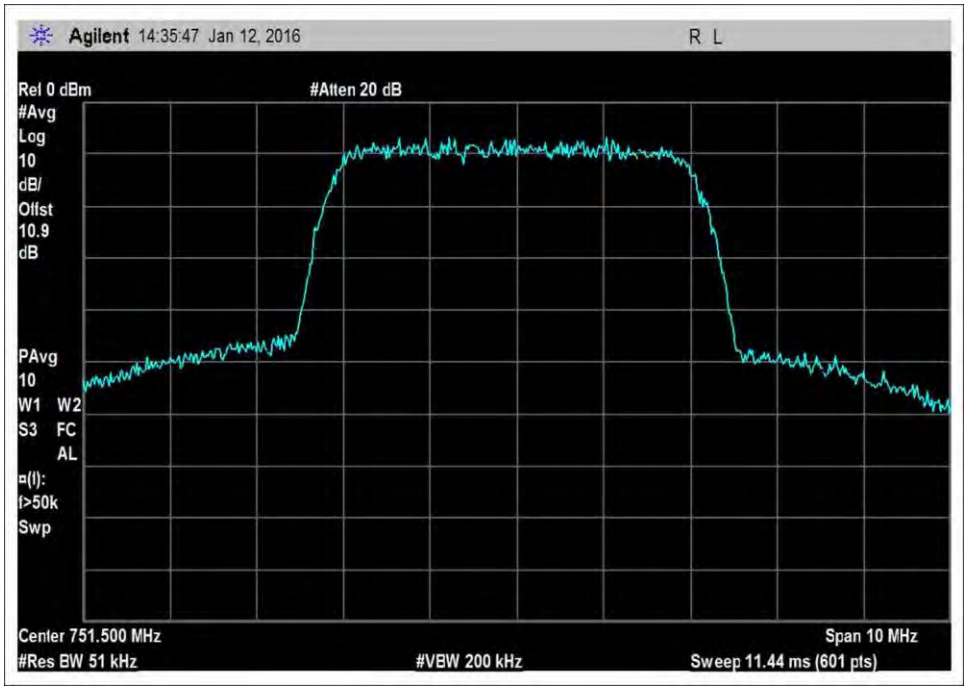

7.10_OBW_UL_776-787MHz_WCDMA



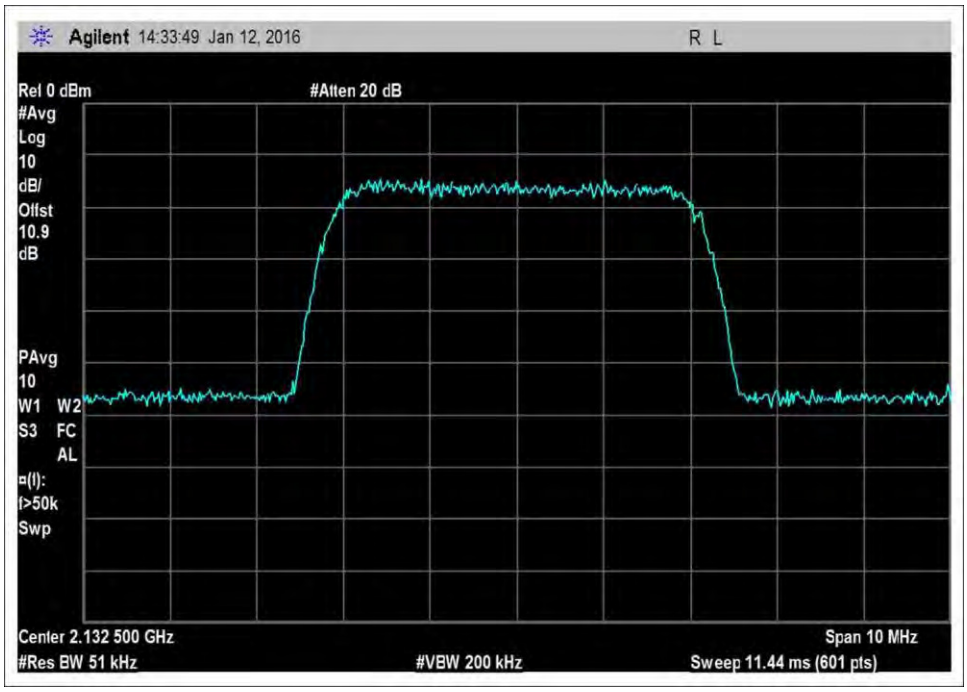

7.10_OBW_UL_1710-1755MHz_WCDMA




7.10_OBW_DL_728-746MHz_WCDMA

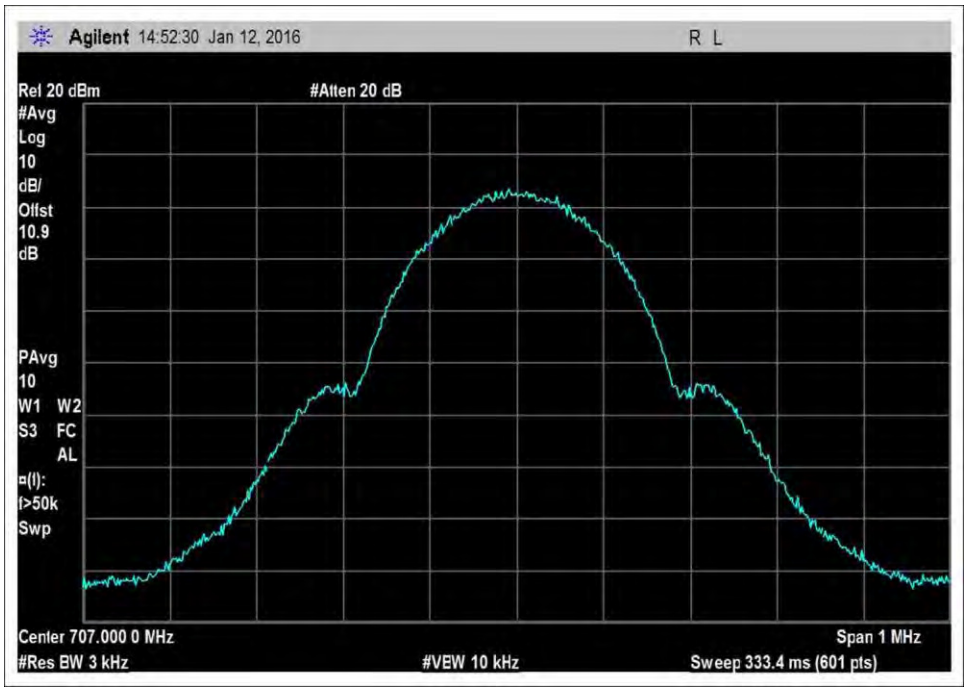



7.10_OBW_DL_746-757MHz_WCDMA

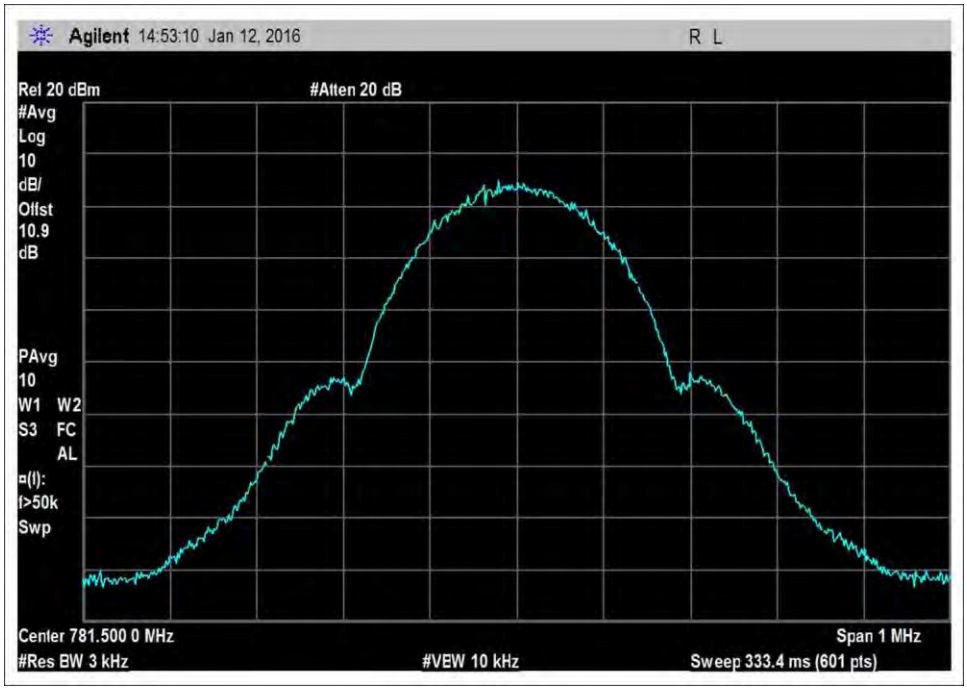



7.10_OBW_DL_2110-2155MHz_WCDMA

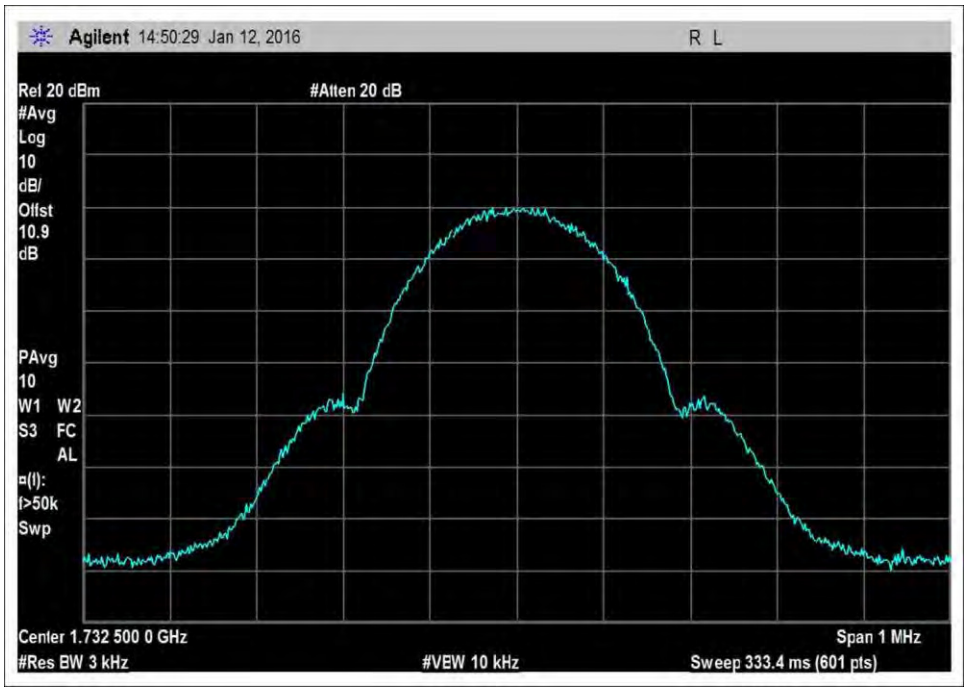
## Output– GSM



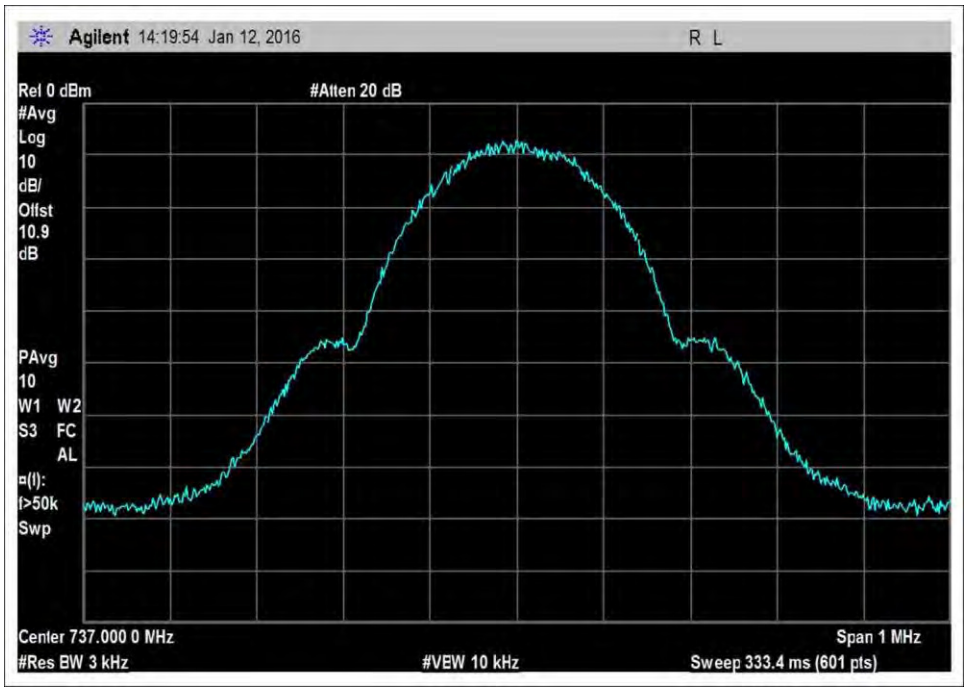

7.10_OBW_UL_698-716MHz_GSM



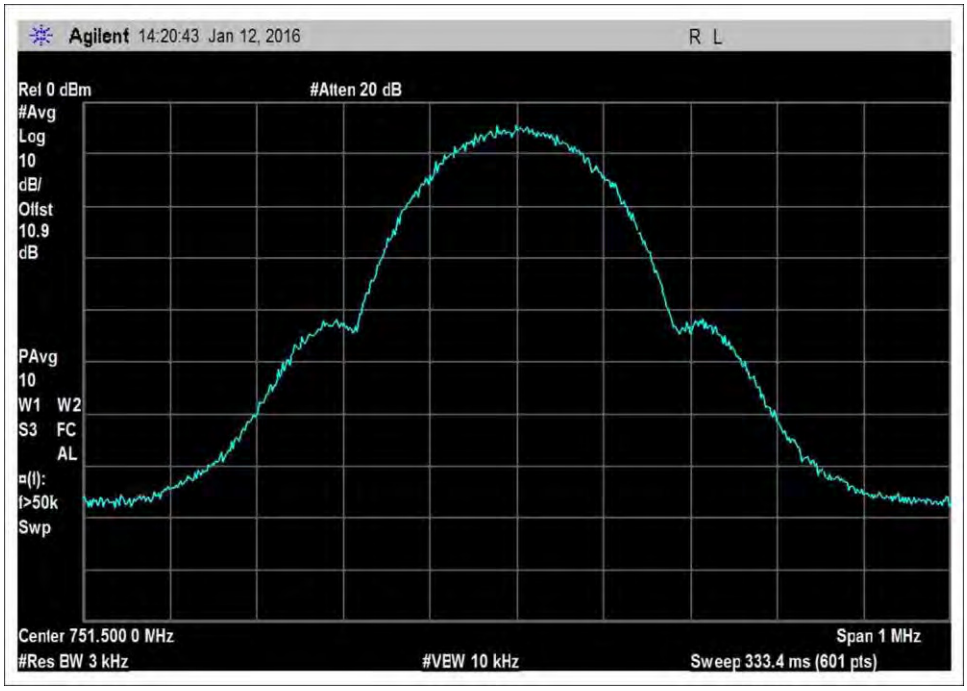

7.10_OBW_UL_776-787MHz_GSM



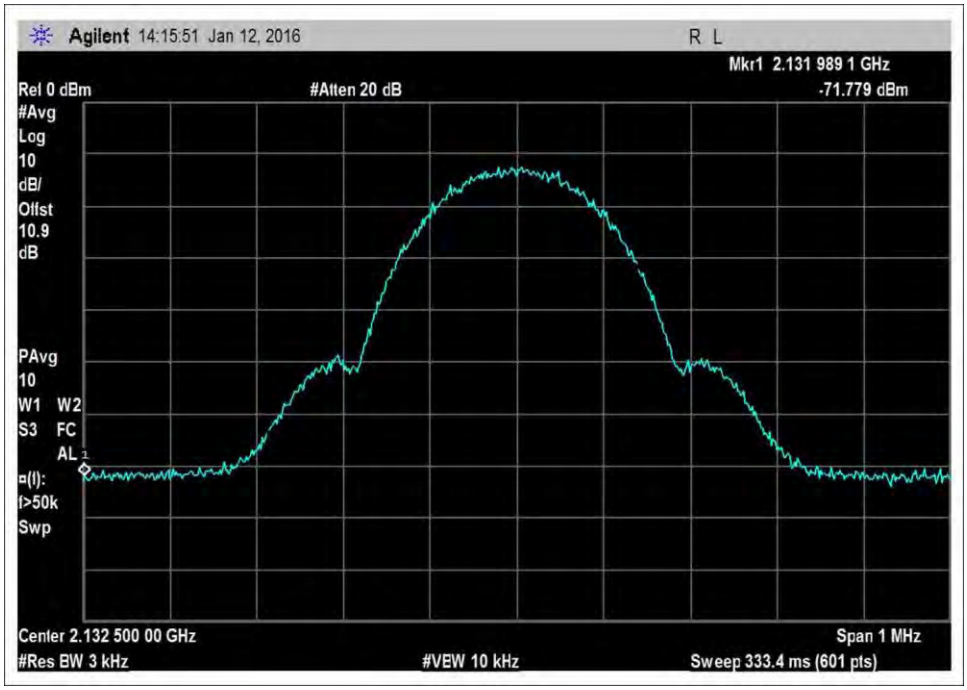

7.10_OBW_UL_1710-1755MHz_GSM




7.10_OBW_DL_728-746MHz_GSM

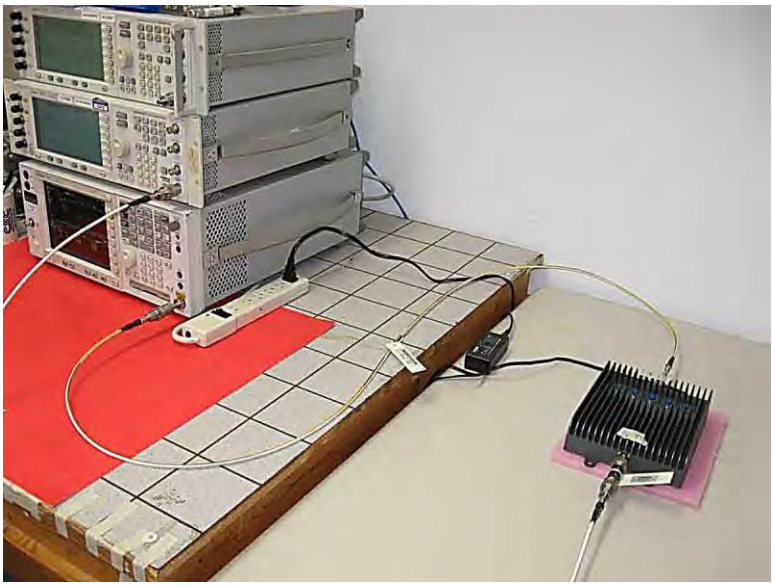



7.10_OBW_DL_746-757MHz_GSM




7.10_OBW_DL_2110-2155MHz_GSM

## Test Setup Photo



# 2.1051 Spurious Emissions at Antenna Terminals

## Test Conditions / Setup

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170 | | |
| Customer: | Cellphone-Mate, Inc. | | |
| Specification: | **7.6 Conducted Spurious Emissions / 47 CFR §2.1051 Spurious Emissions at Antenna Terminals** | | |
| Work Order #: | **98021** | Date: | 01/12/2016 |
| Test Type: | **Conducted Emissions** | Time: | 10:47:38 |
| Tested By: | Daniel Bertran | Sequence#: | 1 |
| Software: | EMITest 5.03.00 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 1 | | | |

***Test Conditions / Notes:***

The equipment under test (EUT) is a Fixed Wideband Consumer Booster. The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port.

Part 27
UL: 1710-1755MHz, 698-716MHz, 776-787MHz
DL: 2110-2155MHz, 728-746MHz, 746-757MHz

Frequency range of measurement = 9 kHz- 22 GHz.

| | | | |
|---|---|---|---|
| 9 kHz | - | 150 kHz -> | RBW= 200Hz VBW= 200Hz |
| 150 kHz | - | 30 MHz -> | RBW= 9kHz VBW= 9kHz |
| 30 MHz | - | 1000MHz -> | RBW*= 1MHz VBW= 3MHz |
| 1000 MHz | - | 22000MHz -> | RBW= 1MHz VBW= 3MHz |

*Note: As specified on 7.6 Conducted spurious emissions test procedure of 935210 D03 Signal Booster Measurements v03, for frequencies below 1 GHz, an RBW of 1 MHz may be used in a preliminary measurement. If non-compliant emissions are detected, a final measurement shall be made with a 100 kHz RBW. Additionally, a peak detector may also be used for the preliminary measurement. If non-compliant emissions are detected then a final measurement of these emissions shall be made with the power averaging (RMS) detector.

Test environment conditions: Temperature: 20.3°C, 42% Relative Humidity, Pressure:102 kPa

The test was performed in accordance with section 7.6 of the FCC document: 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v03 Dated June 5, 2015.

Firmware: V3.0
Note: 27.53 (f) For operations in the 746-758 MHz, 775-788 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 Equipment:***

| ID | Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| | ANP06709 | Cable | 32026-29094K-29094K-72TC | 9/18/2014 | 9/18/2016 |
| | ANP06710 | Cable | 32026-29094K-29094K-72TC | 9/18/2014 | 9/18/2016 |
| | AN02660 | Spectrum Analyzer | E4446A | 7/9/2015 | 7/9/2017 |
| | ANP06467 | Attenuator | PE7014-10 | 5/13/2015 | 5/13/2017 |
| | ANP06239 | Attenuator | 54A-10 | 7/9/2014 | 7/9/2016 |

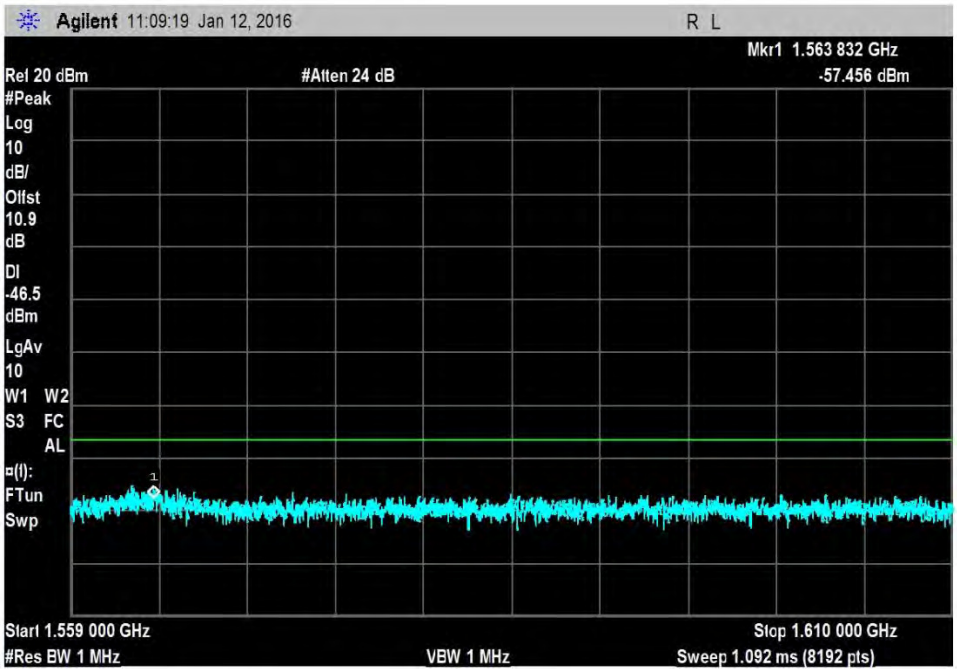
## Summary of Results

Pass: As summarized in plots below, the conducted spurious emissions are within limits.

**9 KHz-30 MHz**

No Conducted Spurious Emissions were found within 20dB of the limit.

Per section 27.53 (f), the 1559-1610 band was also investigated and found emission within limits using applied correction (see calculation below).




Calculation:

| | |
|---|---|
| UL776-787MHz=> | Antenna Gain (10dB) / Cable Loss (3.52dB) |
| Limit line EIRP on this band 1559-1610MHz => | −70 dBW/MHz =>-40dBm |
| Limit line EIRP corrected => | -40dBm-10dBi+3.52dB=> -46.48dBm |

## LIMIT LINE FOR SPURIOUS CONDUCTED EMISSION

**REQUIRED ATTENUATION = 43+10 LOG P DB**

Limit line (dBuV) = $V_{dBuv}$ - Attenuation

$$V_{dBuV} = 20 \text{ Log } \frac{V}{1 \text{ x } 10^{-6}}$$

$$= 20\left(\text{Log } V - \text{Log } 1 \text{ x } 10^{-6}\right)$$

$$= 20 \text{ Log } V - 20 \text{ Log} 1 \text{ x } 10^{-6}$$

$$= 20 \text{ Log } V - 20(-6)$$

$$= 20 \text{ Log } V + 120$$

$$\text{Attenuation} = 43 + 10 \text{ Log } P$$

$$= 43 + 10 \text{ Log } \frac{V^2}{R}$$

$$= 43 + 10\left(\text{Log } V^2 - \text{Log } R\right)$$

$$= 43 + 10\left(2 \text{ Log } V - \text{Log } R\right)$$

$$= 43 + 20 \text{ Log } V - 10 \text{ Log } R$$

Limit line = $V_{dBuv}$ - Attenuation

= 20 Log V + 120 – (43 + 20 Log V – 10Log R)

= 20 Log V + 120 – 43 – 20 Log V + 10Log R

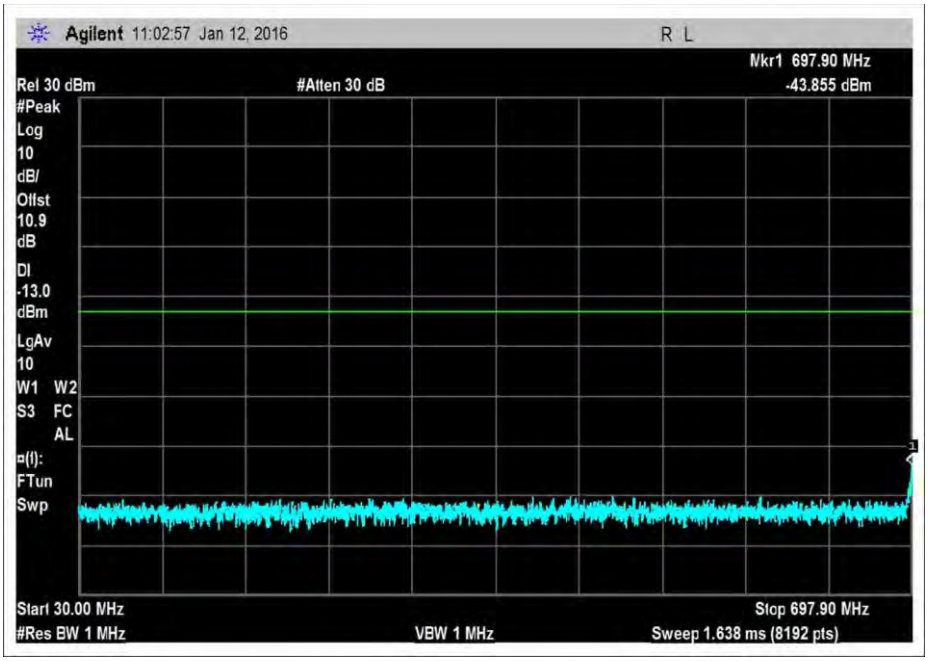
= 20 Log V + 120 – 43 – 20 Log V + 10Log R

= 120 – 43 + 10 Log 50 Note : R = 50 Ω

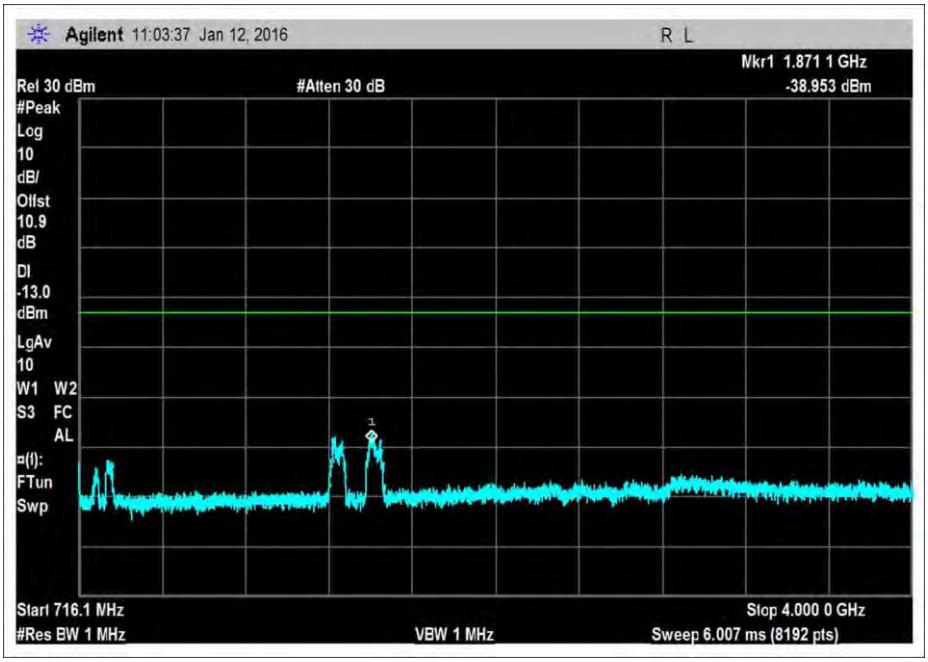
= 120 –43 + 16.897

= 94 dBuV at any power level

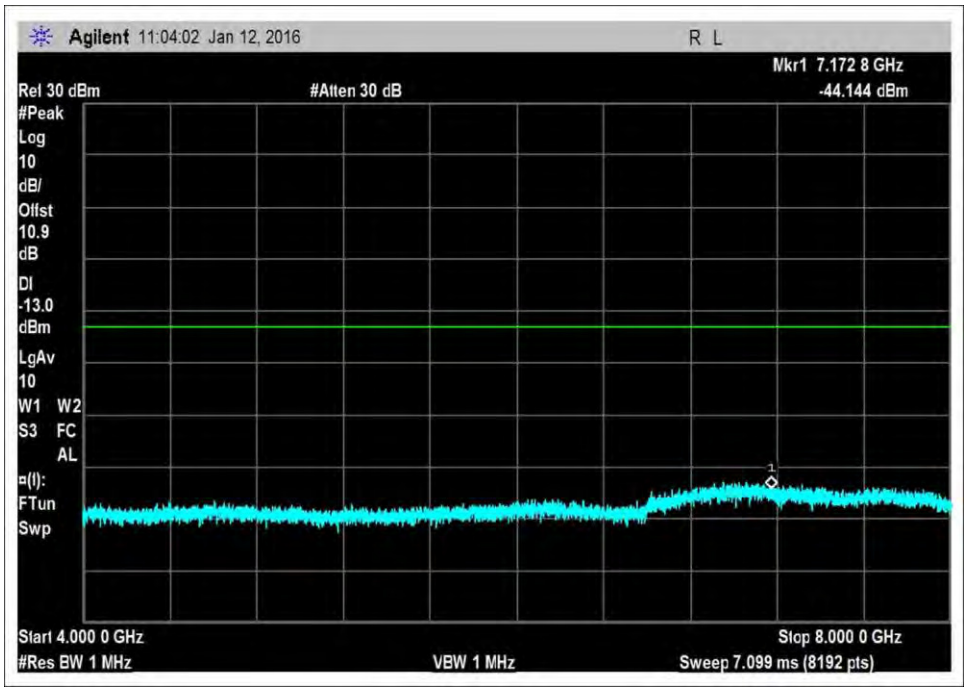
# Plots



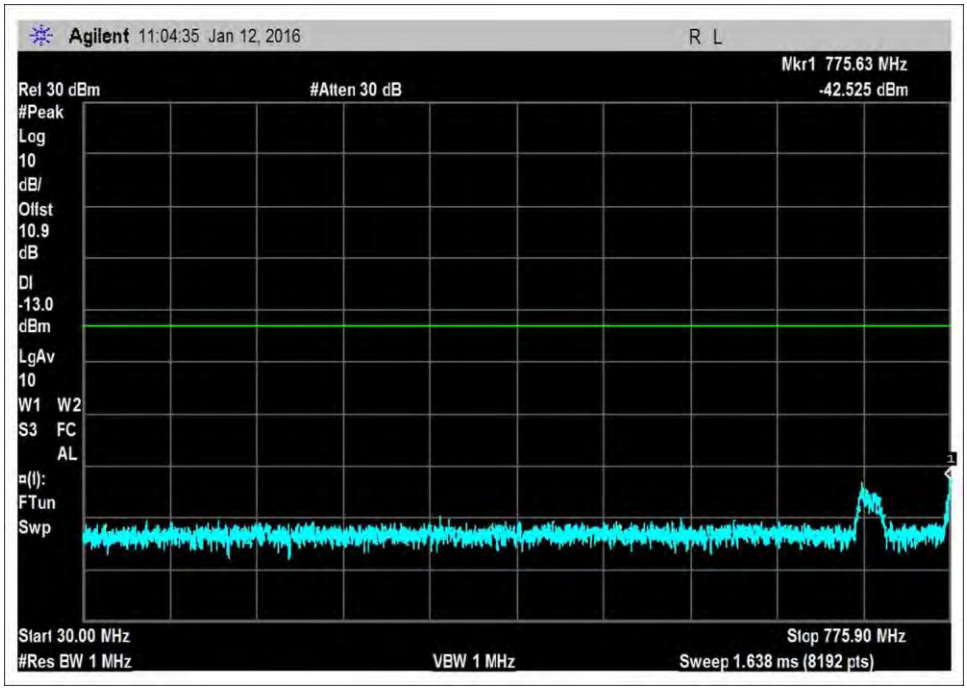

UL_698-716L



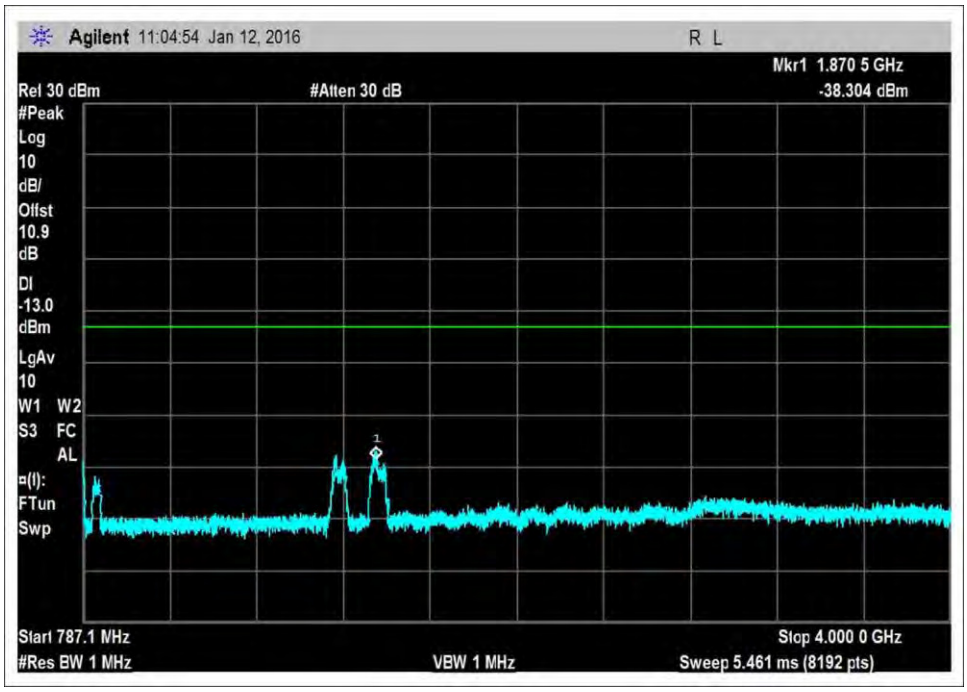

UL_698-716R1



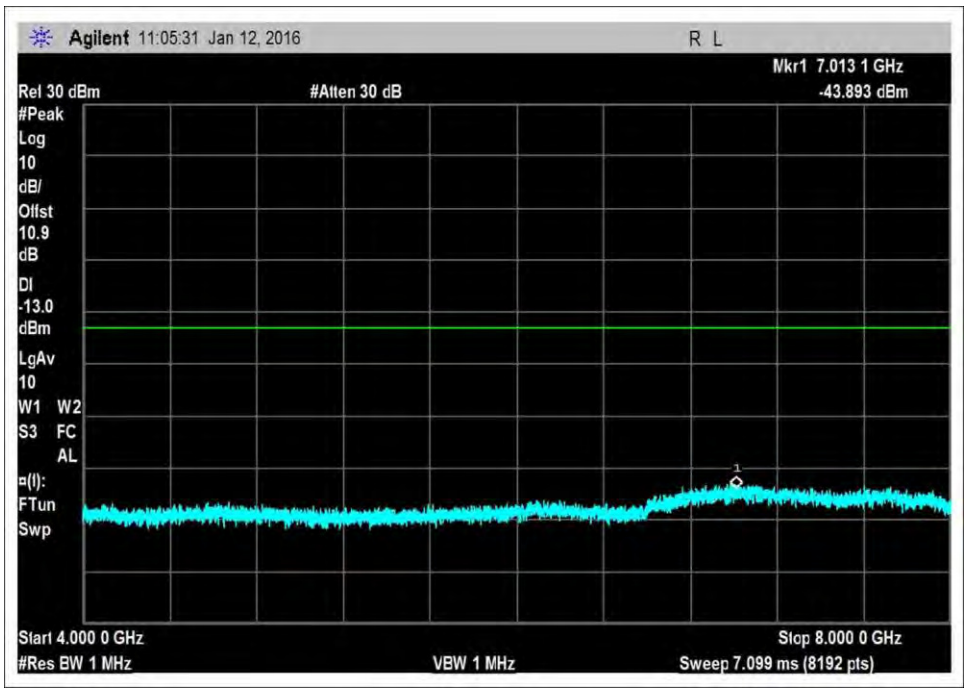

UL_698-716R2



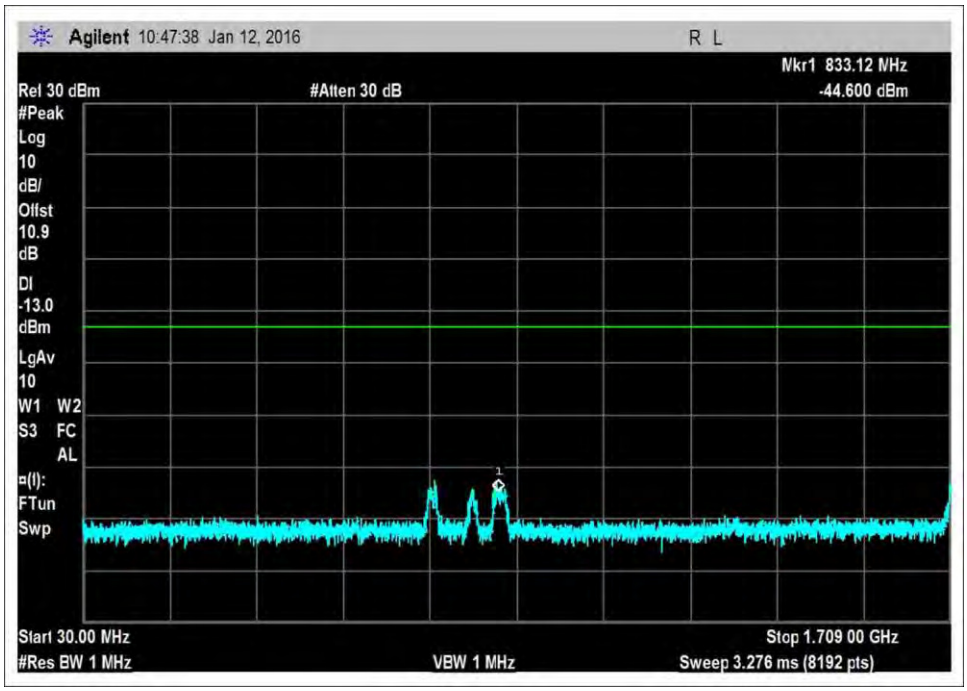

UL_776-787L



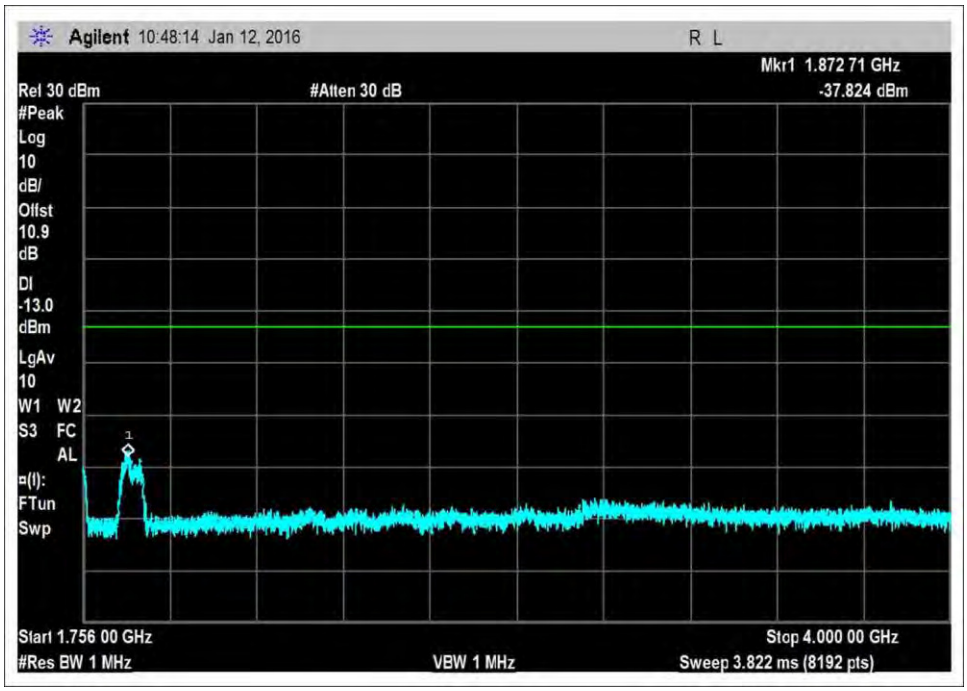

UL_776-787R1



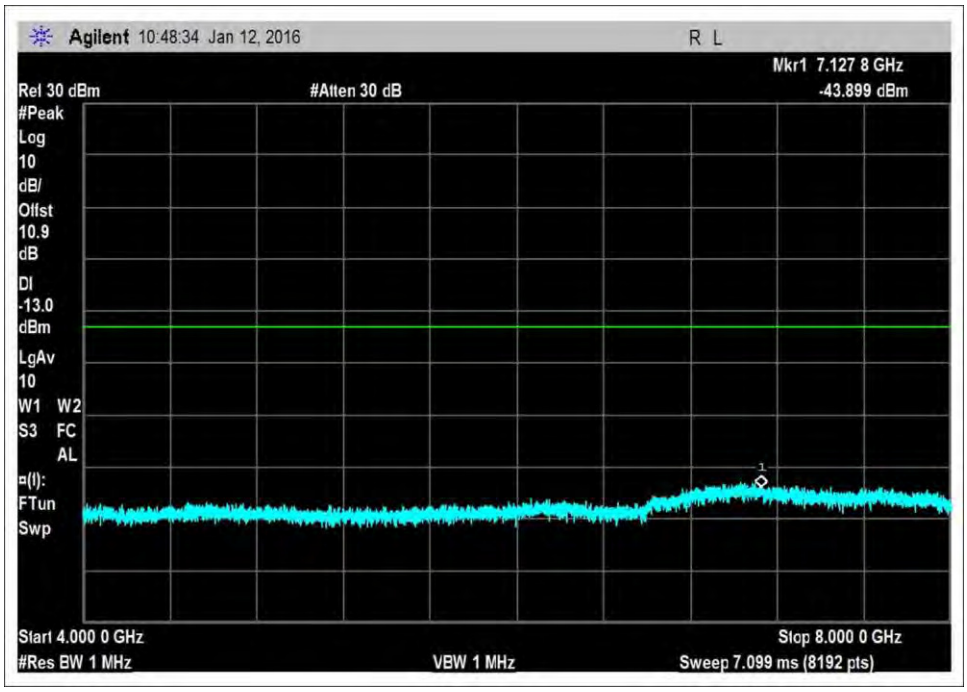

UL_776-787R2



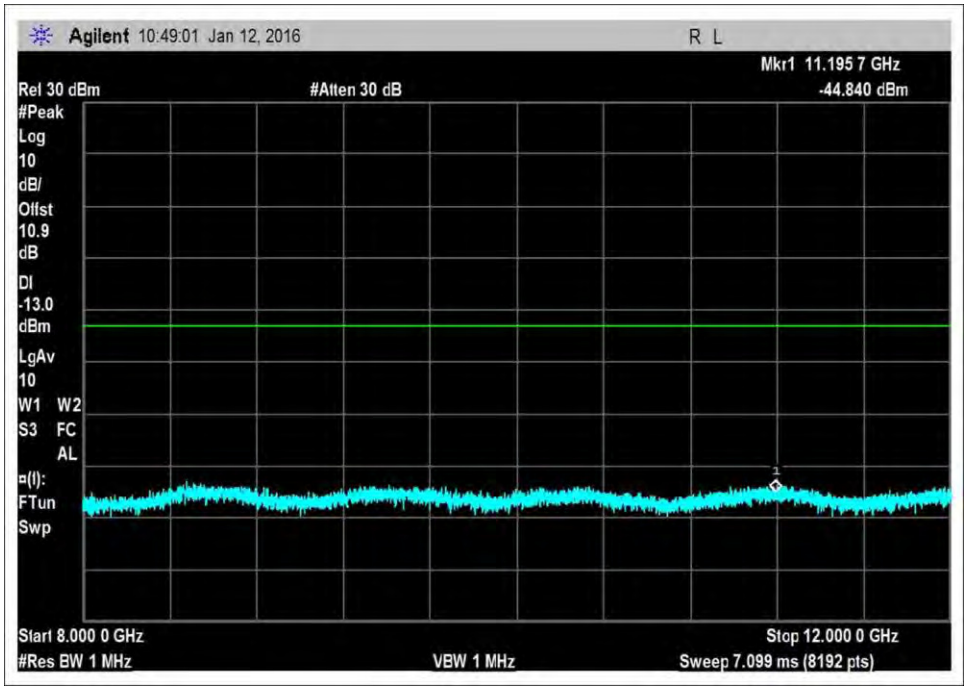

UL_1710-1755L



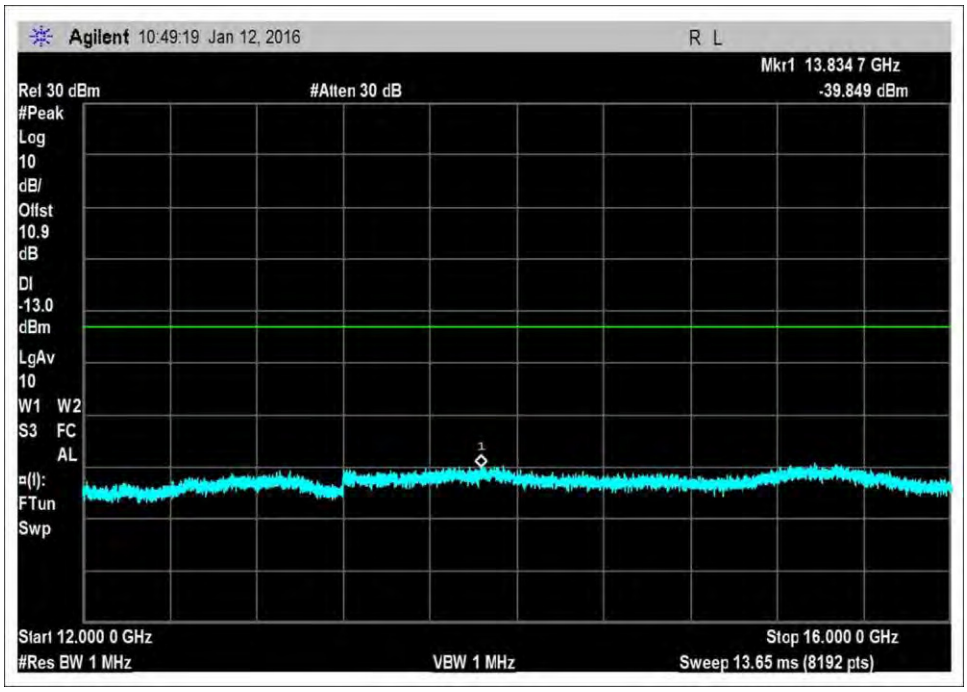

UL_1710-1755R1



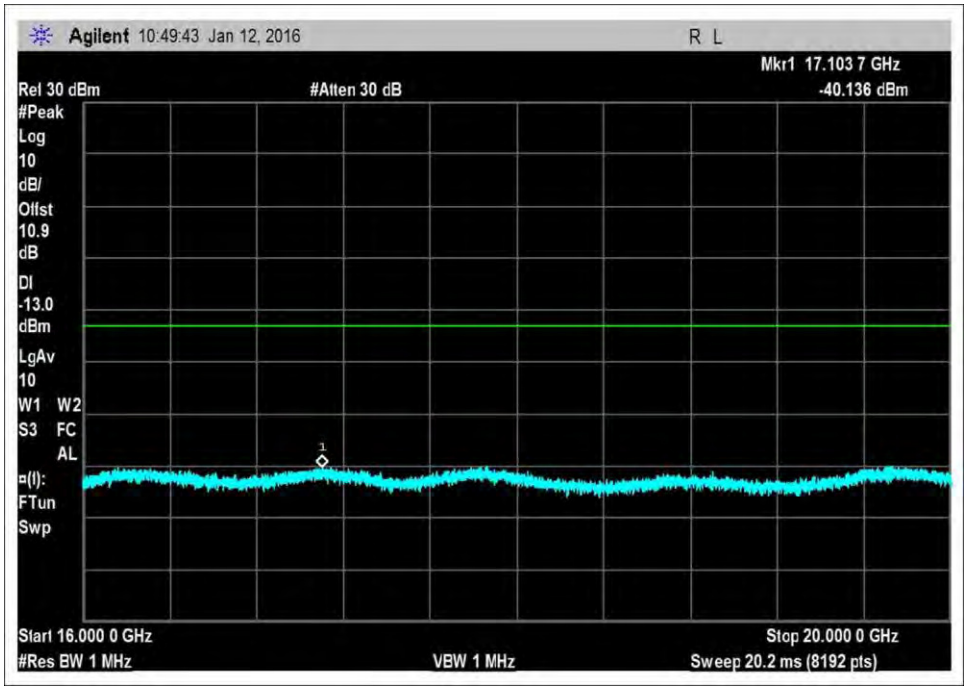

UL_1710-1755R2



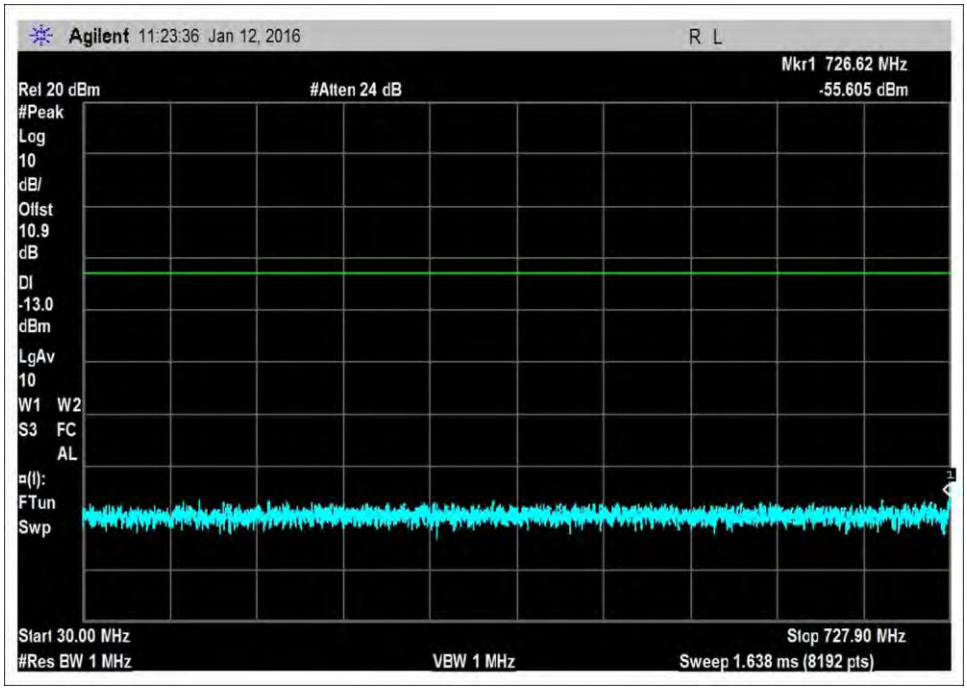

UL_1710-1755R3



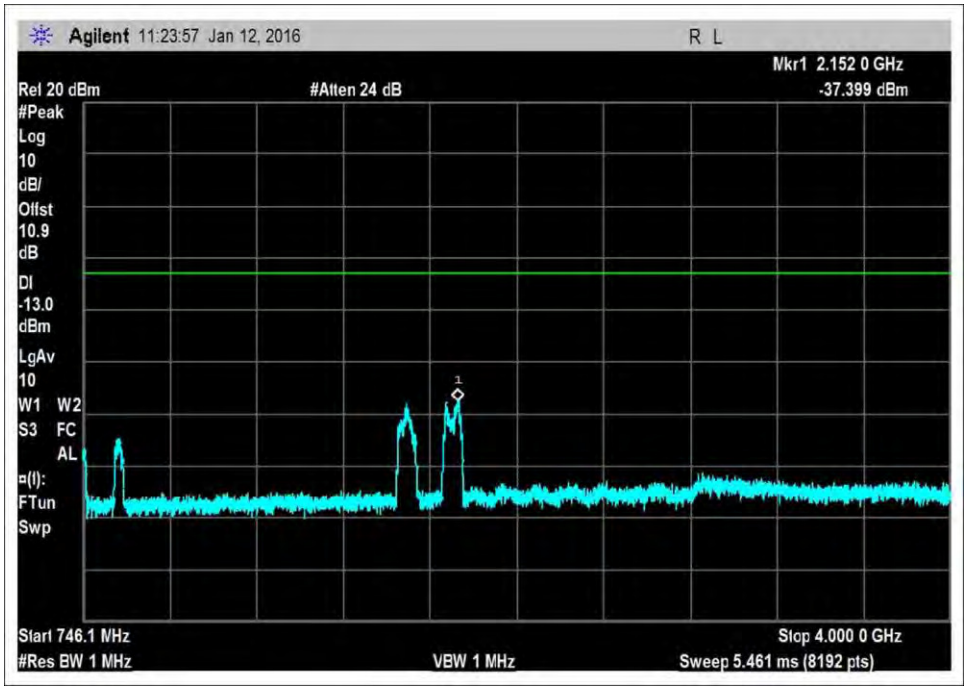

UL_1710-1755R4



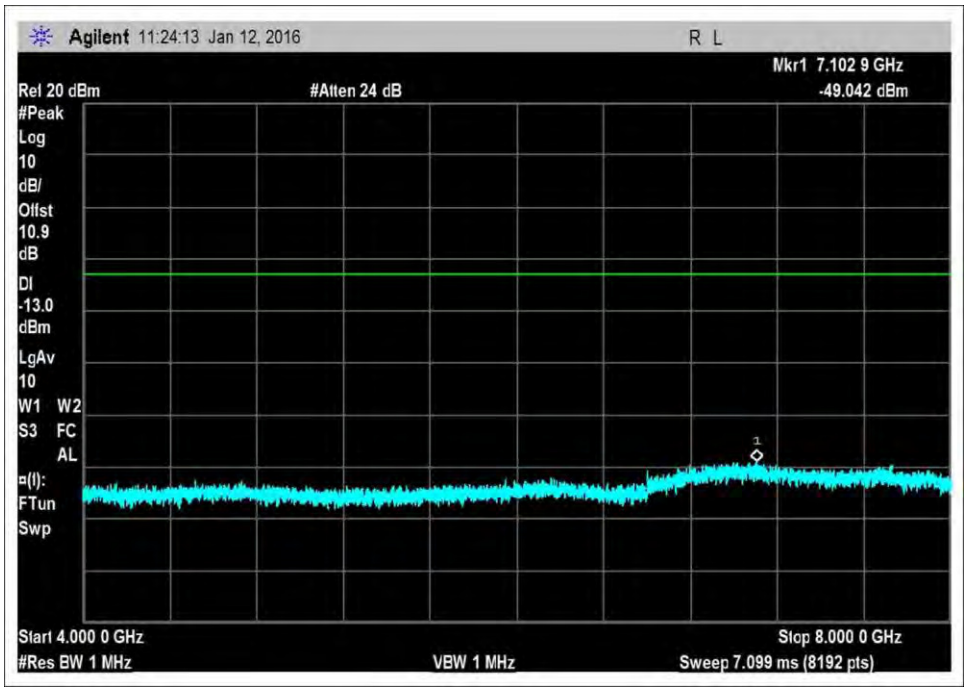

UL_1710-1755R5



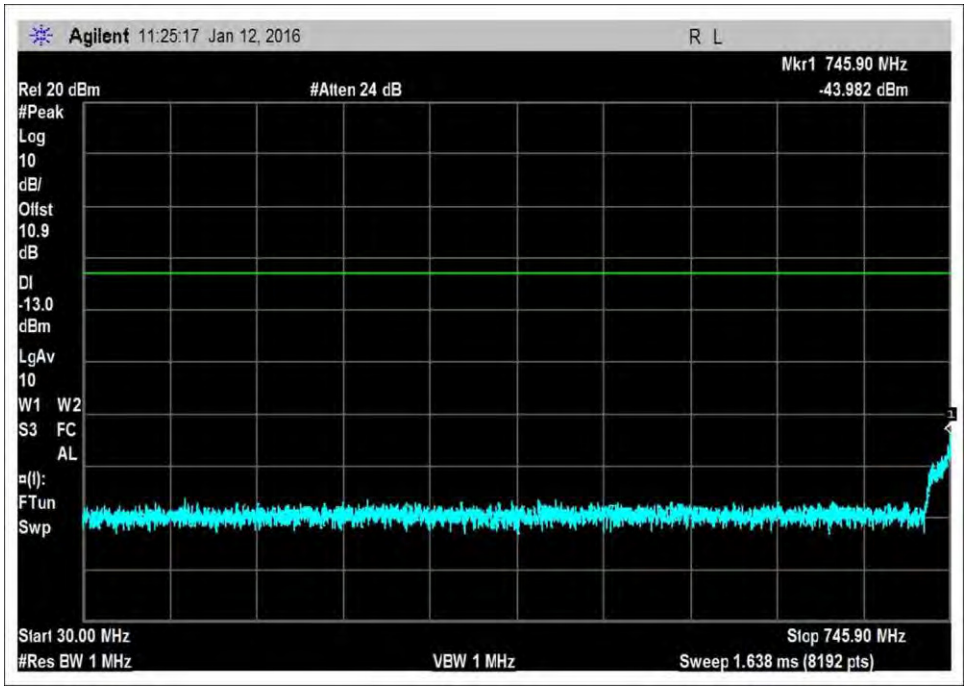

DL_728-746L



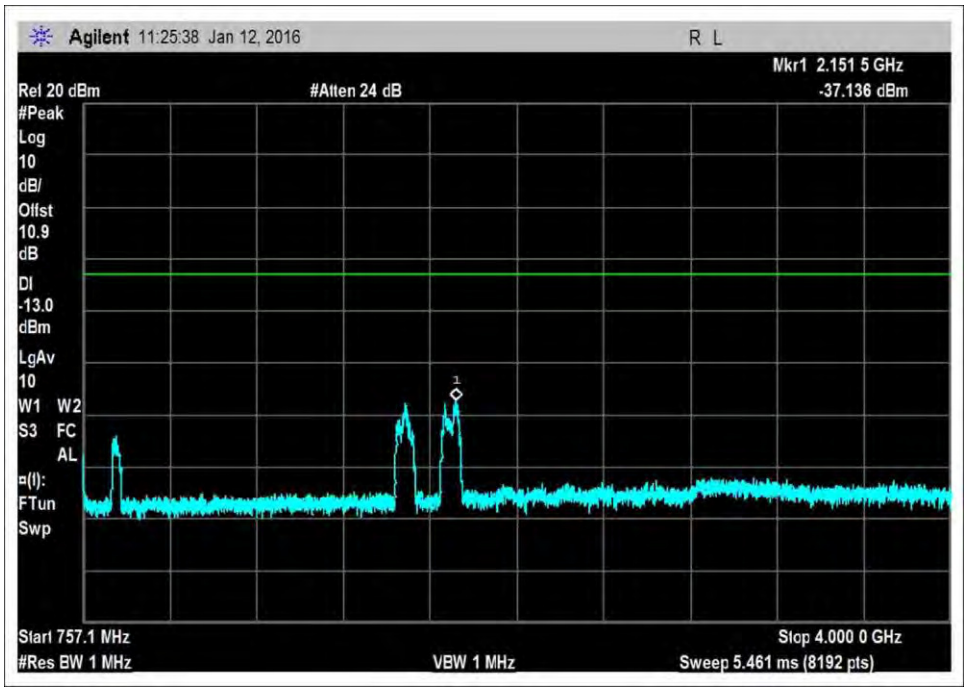

DL_728-746R1



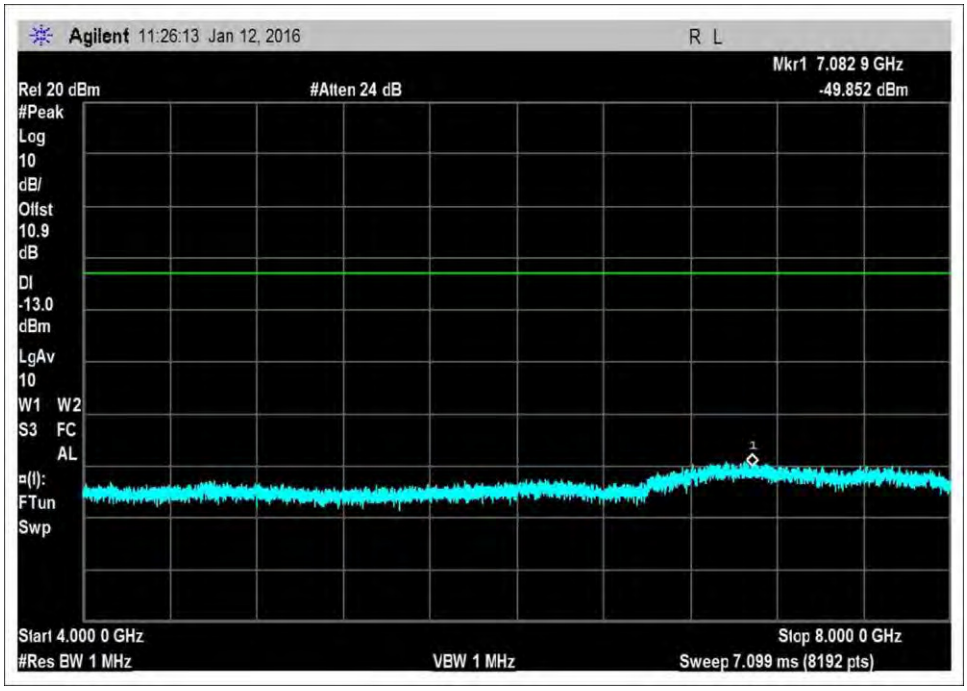

DL_728-746R2



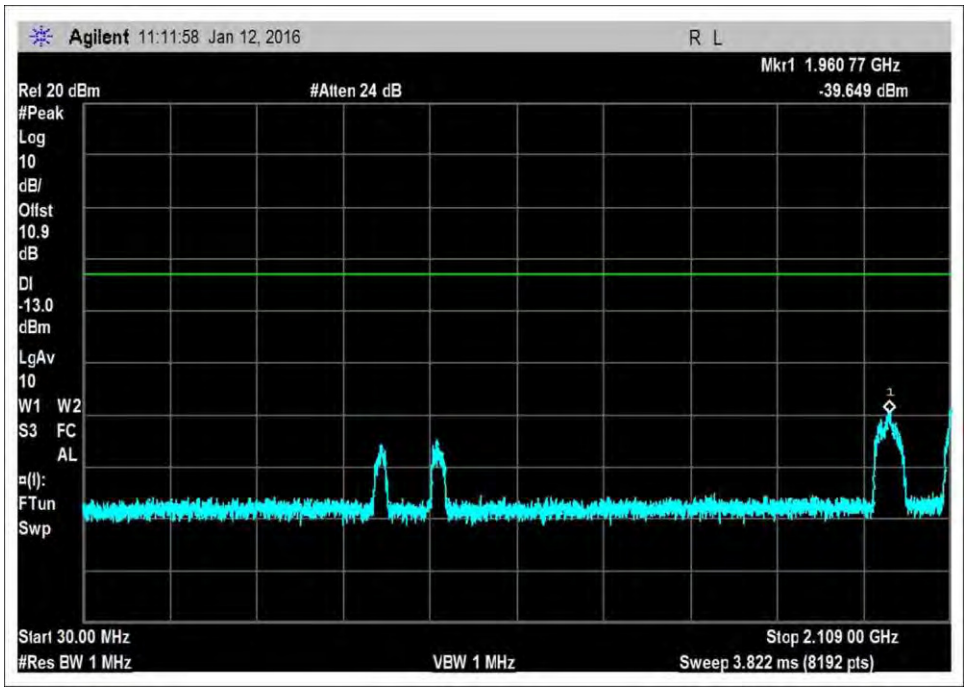

DL_746-757L



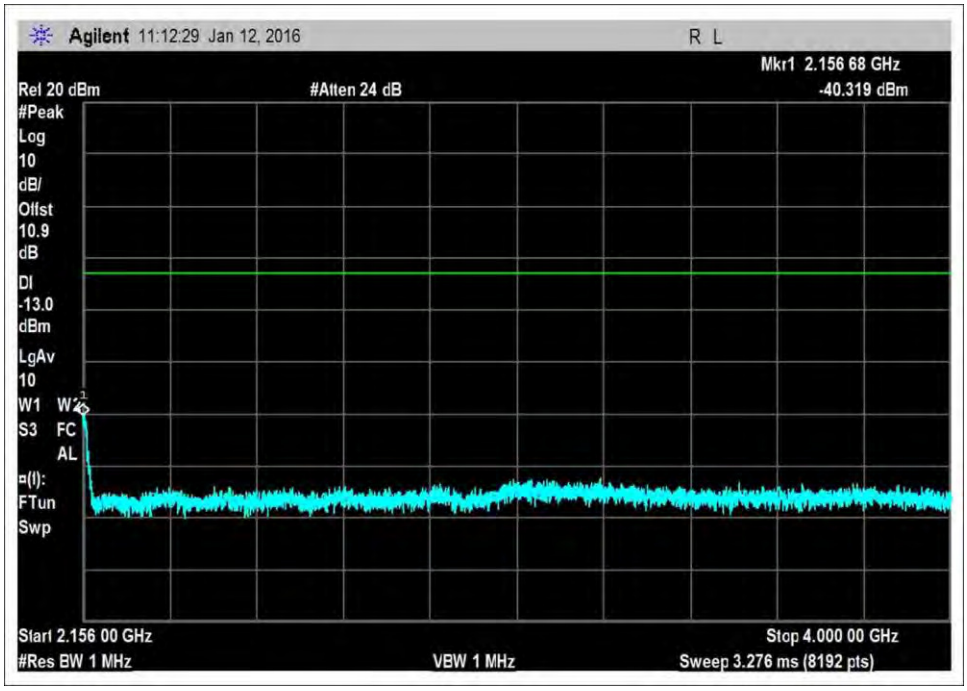

DL_746-757R1



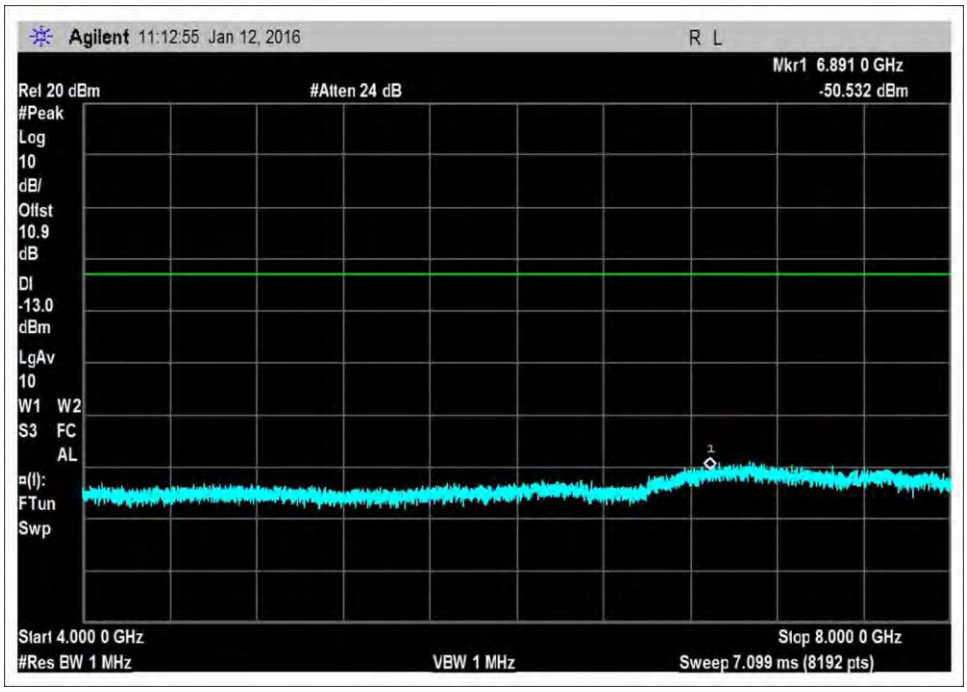

DL_746-757R2



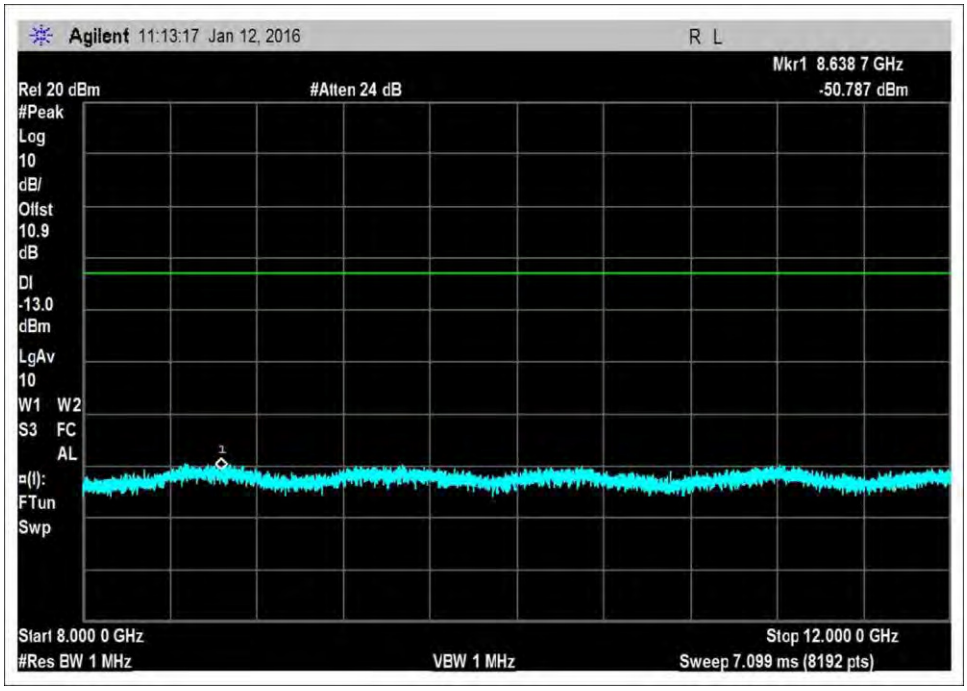

DL_2110-2155L



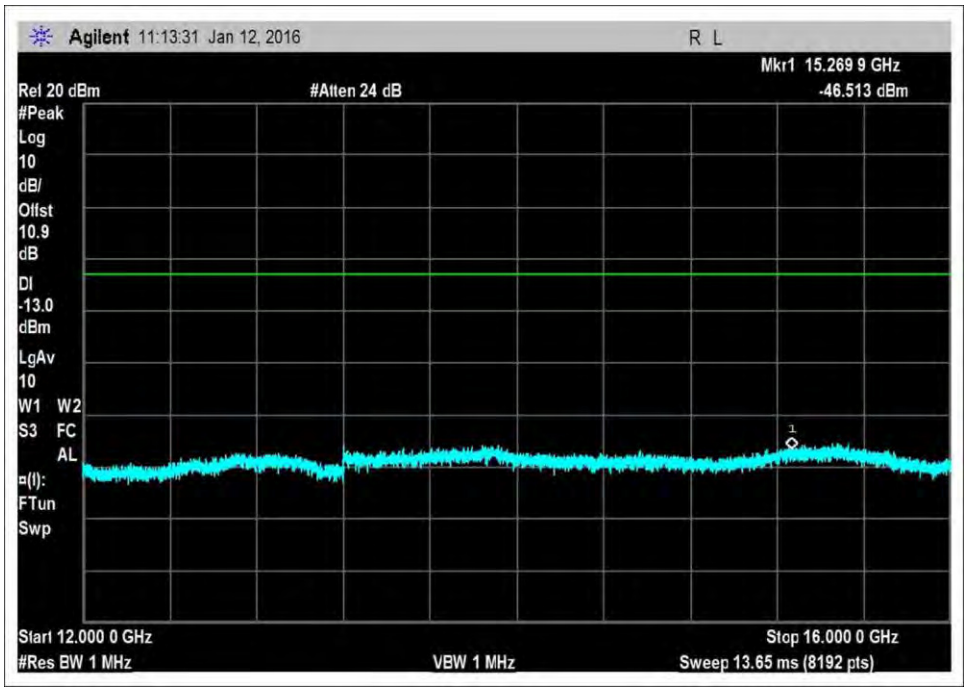

DL_2110-2155R1



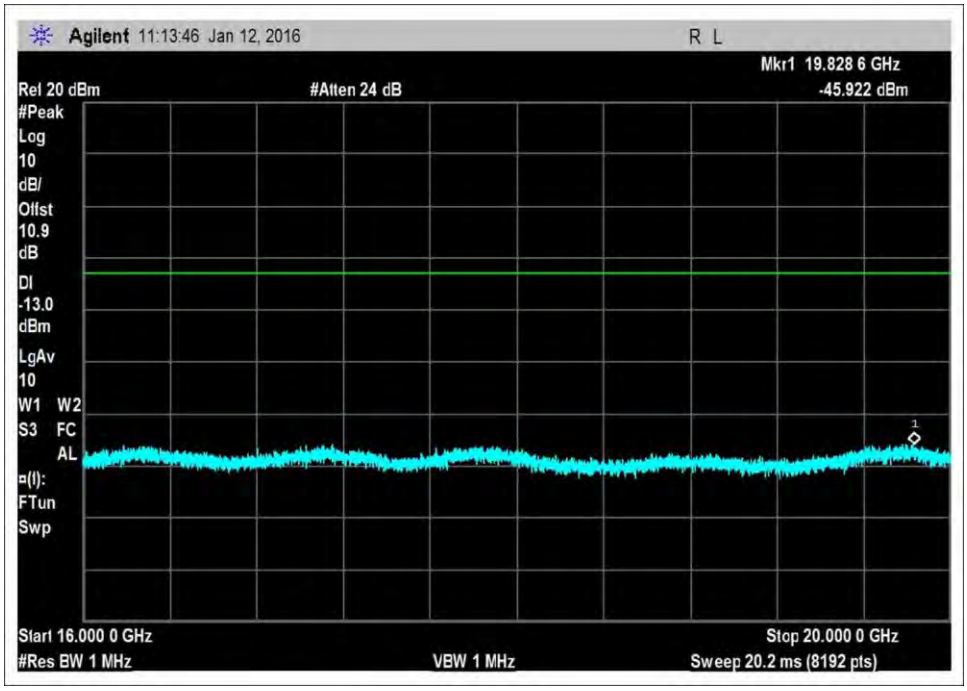

DL_2110-2155R2



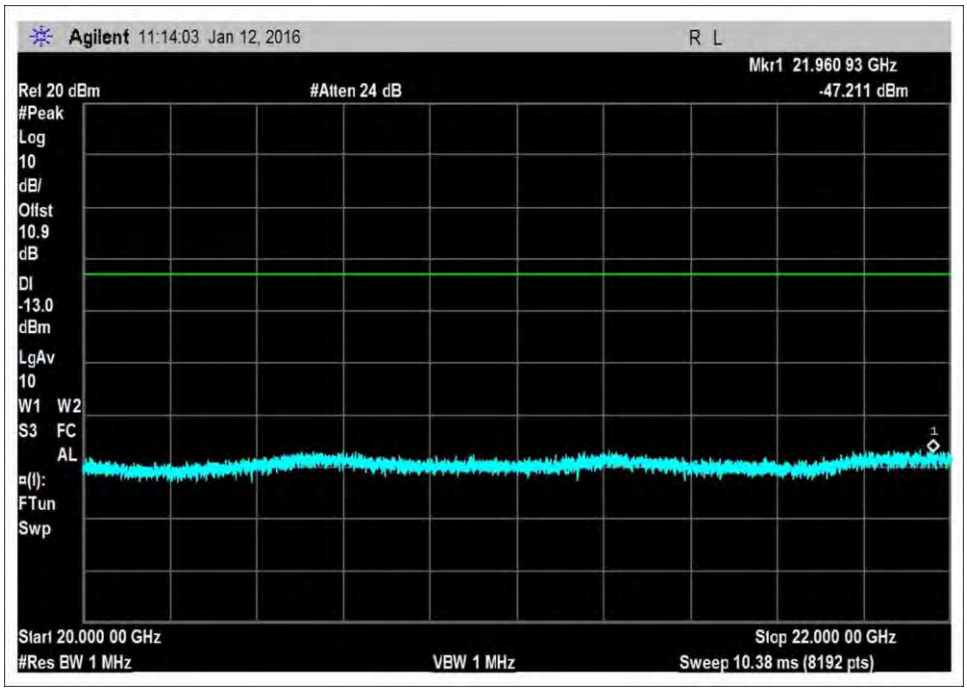

DL_2110-2155R3




DL_2110-2155R4

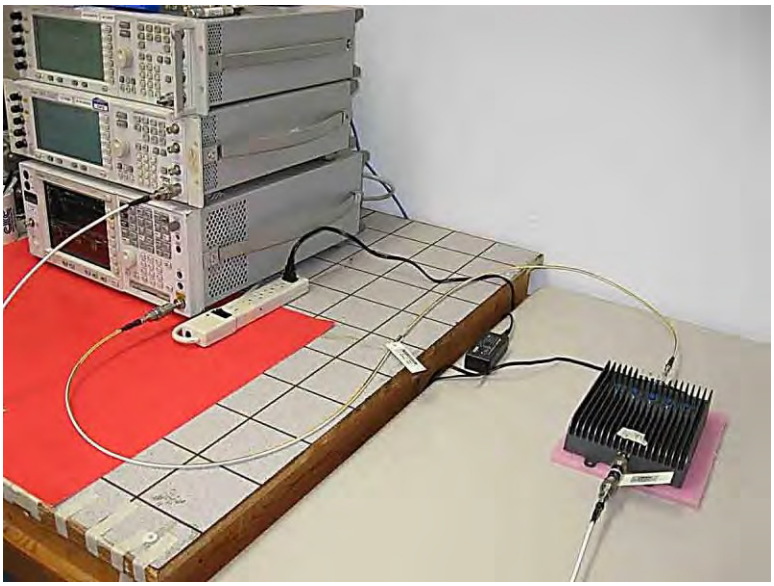



DL_2110-2155R5




DL_2110-2155R6

# Test Setup Photo



# 2.1053 Field Strength of Spurious Radiation

## Test Conditions / Setup

| | | | |
|---|---|---|---|
| Test Location: | CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170 | | |
| Customer: | Cellphone-Mate, Inc. | | |
| Specification: | **47 CFR §27.53(c), (f), (g) and (h) Spurious Emissions** | | |
| Work Order #: | **98021** | Date: | 01/20/2016 |
| Test Type: | **Conducted Emissions** | Time: | 08:23:39 |
| Tested By: | Daniel Bertran | Sequence#: | 1 |
| Software: | EMITest 5.03.00 | | |

***Equipment Tested:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 2 | | | |

***Support Equipment:***

| Device | Manufacturer | Model # | S/N |
|---|---|---|---|
| Configuration 2 | | | |

***Test Conditions / Notes:***

The equipment under test (EUT) is a Fixed CMRS Wideband Consumer Booster.
During testing, the (EUT) is placed on the Styrofoam table top.
Five different CW signals (one per each band) are injected sequentially to the input port of EUT using a signal generator. The signal generator is set to produce a CW signal with the frequency set to the center of each operational band under test and the power level is set at Pin (obtained for report 98021-25) as determined from 7.2 section of the test procedure indicated further below..
Evaluation of DL path was performed with signals fed into the Outside antenna port while Inside antenna port was terminated with 50 Ohm Pasternack load (MN: PE6187 / SN: 1443).
Evaluation of UL path was performed with signal fed into the Inside antenna port while Outside antenna port was terminated with the same above 50 Ohm load.
Part 27
UL: 1710-1755MHz, 698-716MHz, 776-787MHz
DL: 2110-2155MHz, 728-746MHz, 746-757MHz

TX Freq = > Center frequency of above listed bands.
Modulation=> CW
Frequency range of measurement = 9 kHz- 22 GHz.
9 kHz - 150 kHz -RBW=200 Hz VBW=200 Hz
150 kHz - 30 MHz - RBW=9 kHz VBW=9 kHz
30 MHz - 1000MHz -RBW=120 kHz VBW=120 kHz
1000 MHz-22000MHz -RBW=1 MHz VBW=1 MHz

Test environment conditions: Temperature: 20°C, 45% Relative Humidity, Pressure: 101.1 kPa
The test was performed in accordance with section 7.12 of the FCC document: 935210 D03 Wideband Consumer Signal Booster Measurement Guidance v03 Dated June 5, 2015.
Firmware: V3.0
Note: **No spurious emissions were found within 20dB of the limit line.**
Emissions in the band 1559-1610 MHz were investigated and these were not found within 20dB of the limit line.
27.53(f) For operations in the 746-758 MHz, 775-788 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.

***Test Equipment:***

| ID | Asset | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|---|
| | AN00852 | Biconilog Antenna | CBL 6111C | 11/24/2014 | 11/24/2016 |
| | ANP00880 | Cable | RG214U | 6/13/2014 | 6/13/2016 |
| | ANP06691 | Cable | PE3062-180 | 8/8/2014 | 8/8/2016 |
| | AN00567 | Preamp | 8447D | 1/2/2015 | 1/2/2017 |
| | ANP01187 | Cable | CNT-195 | 12/30/2014 | 12/30/2016 |
| | AN03471 | RF Characteristics Analyzer | E4440A | 1/4/2016 | 1/4/2018 |
| | AN02113 | Horn Antenna | 3115 | 2/3/2015 | 2/3/2017 |
| | ANP06900 | Cable | 32022-29094K-29094K-36TC | 12/30/2015 | 12/30/2017 |
| | AN03303 | Preamp | AMF-7D-00101800-30-10P | 1/4/2016 | 1/4/2018 |
| | ANP01210 | Cable | FSJ1P-50A-4A | 1/15/2015 | 1/15/2017 |
| | AN03302 | Cable | 32026-29094K-29094K-72TC | 3/24/2014 | 3/24/2016 |
| | AN02693 | Active Horn Antenna-ANSI C63.5 3m | AMFW-5F-12001800-20-10P | 5/6/2015 | 5/6/2017 |
| | ANP06126 | Cable | 32022-29094K-29094K-168TC | 3/18/2015 | 3/18/2017 |
| | ANP00928 | Cable | various | 1/23/2014 | 1/23/2016 |
| | ANP06901 | Cable | 32022-29094K-29094K-36TC | 12/30/2015 | 12/30/2017 |
| | AN02694 | Horn Antenna-ANSI C63.5 3m | AMFW-5F-18002650-20-10P | 5/7/2015 | 5/7/2017 |
| | ANP00929 | Cable | various | 1/23/2014 | 1/23/2016 |
| | AN00432 | Loop Antenna | 6502 | 5/8/2015 | 5/8/2017 |
| | ANP06710 | Cable | 32026-29094K-29094K-72TC | 9/18/2014 | 9/18/2016 |
| | ANP06467 | Attenuator | PE7014-10 | 5/13/2015 | 5/13/2017 |

## Summary of Results

Pass: No data provided since all emissions were found more than 20dB below the limit.

## LIMIT LINE FOR SPURIOUS RADIATED EMISSION

**REQUIRED ATTENUATION = 43+10 LOG P (DB)**

For radiated spurious emission measured at 3 meter test distance,

Required attenuation = 43+10 Log $P_{t\ at\ 3\ meter}$ dB
Limit line (dBuV) = $E_{dBuv}$ - Attenuation

$E_{dBuv}$ = Measured field strength at 3 meter in dBuV/m

**Power Density (Isotropic)**

$$P_D = \frac{P_t}{4\pi r^2}$$

$P_D$ = Power Density in Watts /$m^2$
Pt = Average Transmit Power
r = Test distance

**Field Intensity E (V/m)**

$$E = \sqrt{P_D \times 377}$$

$$E = \frac{\sqrt{P_t \times 377}}{4\pi r^2}$$

$$E = \sqrt{\frac{P_t \times 30}{r^2}}$$

$$P_t = \left(\frac{E^2 \times r^2}{30}\right)$$

10 Log $P_t$ = 10 Log $E^2$ (V/m)+ 10 Log $r^2$ – 10 Log 30

10 Log $P_t$ = 20 Log E (V/m) + 20 Log r – 10 Log 30

At 3 meter, r = 3 m

10 Log $P_t$ = 20 Log E (V/m) + 20 Log 3 – 10 Log 30

10 Log $P_t$ = 20 Log E (V/m) + 9.54 – 14.77

10 Log $P_t$ = 20 Log E (V/m) - 5.23

***Since 20 Log E (V/m) = 20 Log E (uV/m) –120***

10 Log $P_t$ = 20 Log E (uV/m) - 120 - 5.23

10 Log $P_t$ = 20 Log E (uV/m) –125.23

Limit line (dBuV) at 3 meter = $E_{dBuv}$ – Attenuation

= $E_{dBuv}$ - ( 43+10 Log $P_{t\ at\ 3\ meter}$ )

= $E_{dBuv}$ - 43 - 10 Log $P_{t\ at\ 3\ meter}$

= $E_{dBuv}$ - 43 – (20 Log E (uV/m) –125.23)

= $E_{dBuv}$ - 43 - 20 Log E (uV/m) + 125.23

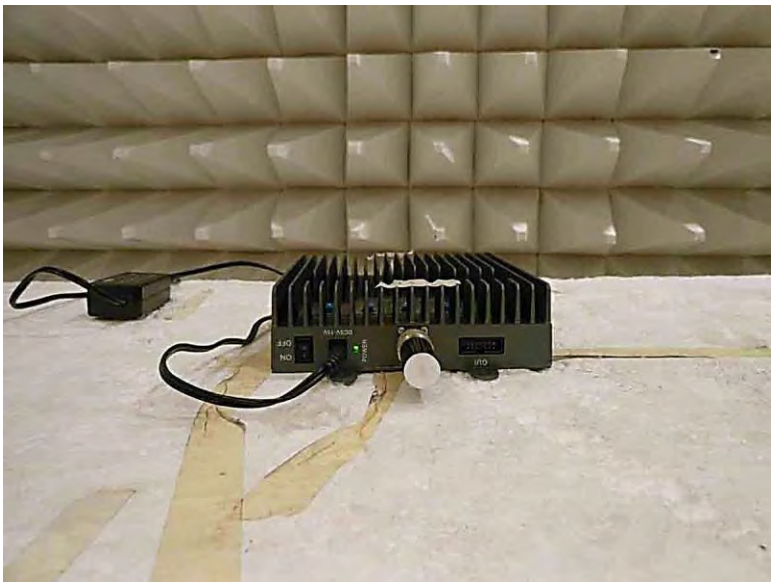
= $E_{dBuv}$ - 20 Log E (uV/m) + 82.23

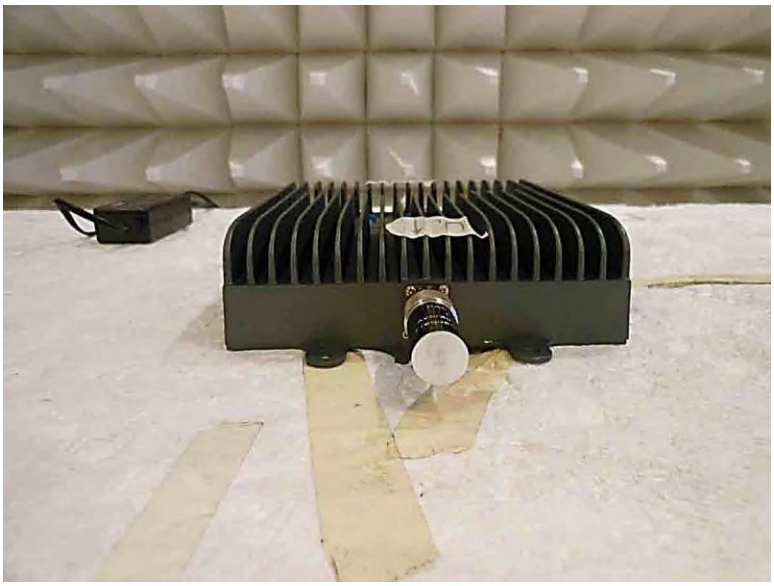
Since 20 Log E (uV/m) = E in dBuV/m

= ~~$E_{dBuv}$~~ - ~~$E_{dBuv}$~~ + 82.23

Radiated Emission limit 3 meter = 82.23 dBuV at any power level measured in dBuV

## Test Setup Photos





# SUPPLEMENTAL INFORMATION

## Measurement Uncertainty

| Uncertainty Value | Parameter |
|---|---|
| 4.73 dB | Radiated Emissions |
| 3.34 dB | Mains Conducted Emissions |
| 3.30 dB | Disturbance Power |

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2.

## Emissions Test Details

**TESTING PARAMETERS**

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

**CORRECTION FACTORS**

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on the limit value subtracting the corrected measured value; a negative margin represents a measurement exceeding the limit while a positive margin represents a measurement less than the limit.

| SAMPLE CALCULATIONS | | |
|---|---|---|
| | Meter reading | (dBµV) |
| + | Antenna Factor | (dB/m) |
| + | Cable Loss | (dB) |
| - | Distance Correction | (dB) |
| - | Preamplifier Gain | (dB) |
| = | Corrected Reading | (dBµV/m) |

**TEST INSTRUMENTATION AND ANALYZER SETTINGS**

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

| MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE | | | |
|---|---|---|---|
| TEST | BEGINNING FREQUENCY | ENDING FREQUENCY | BANDWIDTH SETTING |
| CONDUCTED EMISSIONS | 150 kHz | 30 MHz | 9 kHz |
| RADIATED EMISSIONS | 9 kHz | 150 kHz | 200 Hz |
| RADIATED EMISSIONS | 150 kHz | 30 MHz | 9 kHz |
| RADIATED EMISSIONS | 30 MHz | 1000 MHz | 120 kHz |
| RADIATED EMISSIONS | 1000 MHz | >1 GHz | 1 MHz |

**SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS**

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or carrot ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

**Peak**

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

**Quasi-Peak**

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

**Average**

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.