PCTEST ENGINEERING LABORATORY, INC.
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctestlab.com

# MEASUREMENT REPORT
## FCC Part 15.225 NFC

**Applicant Name:**
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

**Date of Testing:**
11/3 - 11/21/2016
**Test Site/Location:**
PCTEST Lab, Columbia, MD, USA
**Test Report Serial No.:**
0Y1612051882.A3L

| | |
|---|---|
| **FCC ID:** | **A3LSMA720X** |
| **APPLICANT:** | **Samsung Electronics Co., Ltd.** |

| | |
|---|---|
| **Application Type:** | Certification |
| **Model(s):** | SM-A720X |
| **EUT Type:** | Portable Handset |
| **Frequency:** | 13.56MHz |
| **FCC Classification:** | Low Power Communications Device Transmitter (DXX) |
| **FCC Rule Part(s):** | FCC Part 15 Subpart C (15.225) |
| **Test Procedure(s):** | ANSI C63.10-2013 |

The device bearing the FCC Identifier specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and has been tested in accordance with the measurement procedures specified in ANSI C63.10-2013 (See Test Report). These measurements were performed with no deviation from the standards. Test results reported herein relate only to the item(s) tested.

I authorize and attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

*NVLAP accreditation does not constitute any product endorsement by NVLAP or any agency of the United States Government. This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.*

Randy Ortanez
President

Lab Code 100431-0


© 2016 PCTEST Engineering Laboratory, Inc.

# TABLE OF CONTENTS


FCC Part 15.225 MEASUREMENT REPORT ..... 3

1.0 INTRODUCTION ..... 4

1.1 Scope ..... 4

1.2 PCTEST Test Location ..... 4

2.0 PRODUCT INFORMATION ..... 5

2.1 Equipment Description ..... 5

2.2 Device Capabilities ..... 5

2.3 Test Configuration ..... 5

2.4 EMI Suppression Device(s)/Modifications ..... 5

3.0 DESCRIPTION OF TEST ..... 6

3.1 Evaluation Procedure ..... 6

3.2 AC Line Conducted Emissions ..... 6

3.3 Radiated Emissions ..... 7

3.4 Environmental Conditions ..... 7

4.0 ANTENNA REQUIREMENTS ..... 8

5.0 MEASUREMENT UNCERTAINTY ..... 9

6.0 TEST EQUIPMENT CALIBRATION DATA ..... 10

7.0 SAMPLE CALCULATIONS ..... 11

7.1 Conducted Emission Measurement Sample Calculation ..... 11

7.2 Radiated Emission Measurement Sample Calculation ..... 11

8.0 TEST DATA ..... 12

8.1 Summary ..... 12

8.2 20dB Bandwidth Measurement ..... 13

8.3 Frequency Stability Test Data ..... 15

8.4 In-Band Radiated Spurious Emission Measurements ..... 18

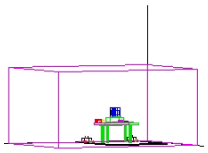
8.5 Radiated Spurious Emission Measurements, Out-of-Band ..... 21

8.6 Line Conducted Measurement Data ..... 25

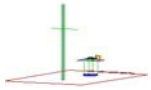
9.0 CONCLUSION ..... 31




© 2016 PCTEST Engineering Laboratory, Inc.



# MEASUREMENT REPORT
## FCC Part 15.225



## § 2.1033 General Information

| | |
|---|---|
| **APPLICANT:** | Samsung Electronics Co., Ltd. |
| **APPLICANT ADDRESS:** | 129, Samsung-ro,<br>Yeongtong-gu, Suwon-si<br>Gyeonggi-do, 16677, Korea |
| **TEST SITE:** | PCTEST ENGINEERING LABORATORY, INC. |
| **TEST SITE ADDRESS:** | 7185 Oakland Mills Road, Columbia, MD 21046 USA |
| **FCC RULE PART(S):** | Part 15 Subpart C (15.225) |
| **BASE MODEL:** | SM-A720X |
| **FCC ID:** | A3LSMA720X |
| **FCC CLASSIFICATION:** | Low Power Communications Device Transmitter (DXX) |
| **Test Device Serial No.:** | 54702, 9S4EF, 54744, JD1VJ, JD1XH ☐ Production ☒ Pre-Production ☐ Engineering |
| **DATE(S) OF TEST:** | 11/3 - 11/21/2016 |
| **TEST REPORT S/N:** | 0Y1612051882.A3L |

## Test Facility / Accreditations

**Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.**

- PCTEST facility is an FCC registered (PCTEST Reg. No. 159966) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (2451B-1).
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing Aid Compatibility (HAC) testing, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (2451B-1) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS, CDMA, and EvDO wireless devices and for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO, and CDMA 1xRTT.



© 2016 PCTEST Engineering Laboratory, Inc.

# 1.0 INTRODUCTION

## 1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

## 1.2 PCTEST Test Location

The map below shows the location of the PCTEST LABORATORY, its proximity to the FCC Laboratory, the Columbia vicinity, the Baltimore-Washington Internt'l (BWI) airport, the city of Baltimore and the Washington, DC area. (*See Figure 1-1*).

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The site coordinates are 39º 10'23" N latitude and 76º 49'50" W longitude. The facility is 0.4 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2014 on January 22, 2015.

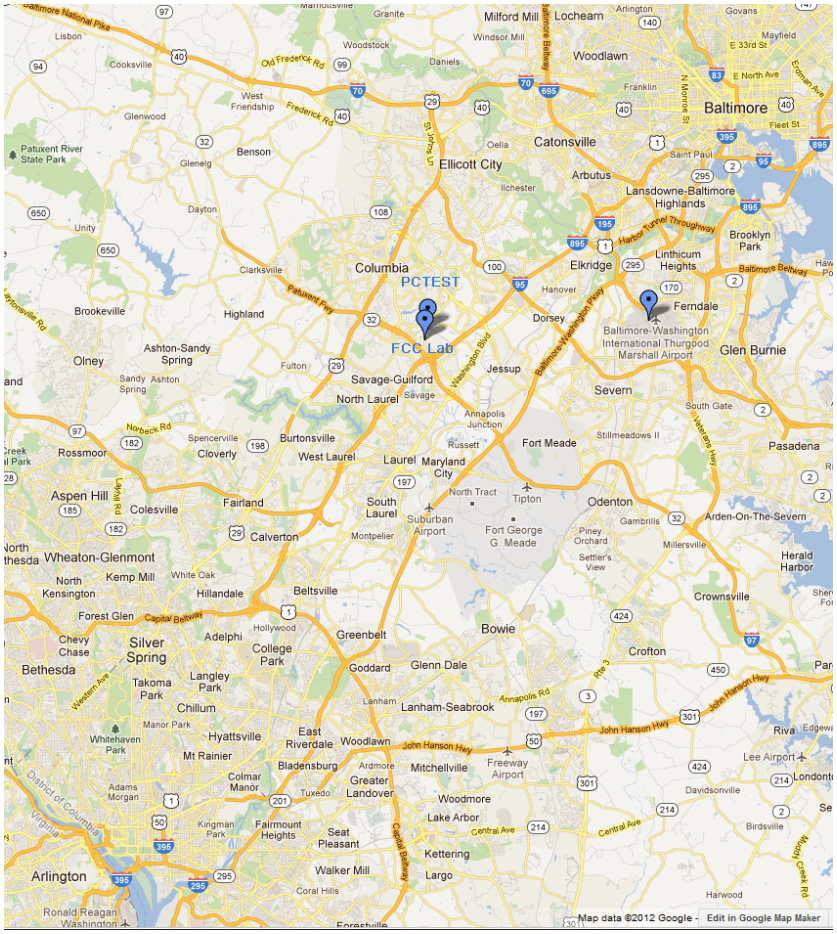



**Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area**


© 2016 PCTEST Engineering Laboratory, Inc.

# 2.0 PRODUCT INFORMATION

## 2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMA720X**. The test data contained in this report pertains only to the emissions due to the NFC transmitter of the EUT.

## 2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n WLAN, 802.11a/n/ac UNII, Bluetooth (1x, EDR, LE), NFC, ANT+

## 2.3 Test Configuration

The EUT was set to continuously transmit at 13.56MHz. This was performed using manufacturer software loaded on the phone and a passive RFID tag to allow for continuous transmission. This device was tested in accordance with the guidance of ANSI C63.10-2013. See Sections 3.2 and 3.3 of this test report for a description of the AC line conducted emissions and radiated emissions test setups, respectively.

## 2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.


© 2016 PCTEST Engineering Laboratory, Inc.

# 3.0 DESCRIPTION OF TEST

## 3.1 Evaluation Procedure

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the EUT.

**Deviation from measurement procedure…….....None**

## 3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 8.6. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.


© 2016 PCTEST Engineering Laboratory, Inc.

## 3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 in Clause 5 of ANSI C63.4-2014. A raised turntable is used for radiated measurement. It is a continuously rotatable, remote-controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. A 72.4cm high PVC support structure is placed on top of the turntable. A 3" (~7.6cm) sheet of high density polystyrene is used as the table top and is placed on top of the PVC supports to bring the total height of the table to 80cm. For measurements above 1GHz, a high density expanded polystyrene block is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

## 3.4 Environmental Conditions

The temperature is controlled within range of 15ºC to 35ºC. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).


© 2016 PCTEST Engineering Laboratory, Inc.

# 4.0 ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna of the EUT are **permanently attached.**
- This unit was tested with its standard battery.

**Conclusion:**

The EUT complies with the requirement of §15.203.


© 2016 PCTEST Engineering Laboratory, Inc.

# 5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement data shown herein meets or exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

| Contribution | Expanded Uncertainty (±dB) |
|---|---|
| Line Conducted Disturbance | 3.09 |
| Radiated Disturbance (<1GHz) | 4.98 |


© 2016 PCTEST Engineering Laboratory, Inc.

# 6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2006.

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| - | RE1 | Radiated Emissions Cable Set (UHF/EHF) | 7/11/2016 | Annual | 7/11/2017 | RE1 |
| Agilent | N9038A | MXE EMI Receiver | 4/21/2016 | Annual | 4/21/2017 | MY51210133 |
| Com-Power | AL-130 | 9kHz - 30MHz Loop Antenna | 7/30/2015 | Biennial | 7/30/2017 | 121034 |
| Com-Power | PAM-103 | Pre-Amplifier (1-1000MHz) | 2/26/2016 | Annual | 2/26/2017 | 441119 |
| PCTEST | - | EMC Switch System | 7/11/2016 | Annual | 7/11/2017 | NM1 |
| PCTEST | - | EMC Switch System | 7/6/2016 | Annual | 7/6/2017 | NM2 |
| Rohde & Schwarz | ESU40 | EMI Test Receiver (40GHz) | 7/15/2016 | Annual | 7/15/2017 | 100348 |
| Seekonk | NC-100 | Torque Wrench 5/16", 8" lbs | 3/2/2016 | Biennial | 3/2/2018 | N/A |
| Solar Electronics | 8012-50-R-24-BNC | Line Impedance Stabilization Network | 7/30/2015 | Biennial | 7/30/2017 | 310233 |
| Sunol | JB5 | Bi-Log Antenna (30M - 5GHz) | 3/14/2016 | Biennial | 3/14/2018 | A051107 |

**Table 6-1. Annual Test Equipment Calibration Schedule**

**Note:**

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.


© 2016 PCTEST Engineering Laboratory, Inc.

# 7.0 SAMPLE CALCULATIONS

## 7.1 Conducted Emission Measurement Sample Calculation

**@ 20.3 MHz**

| | |
|---|---|
| **Class B limit** | **= 60.0 dBμV (Quasi-peak limit)** |
| Reading | = - 57.8 dBm (calibrated quasi-peak level) |
| Convert to dbμV | = - 57.8 + 107 = 49.2 dBμV |
| Margin | = 49.2 - 60.0 = - 10.8 dB |
| | **= 10.8 dB below limit** |

## 7.2 Radiated Emission Measurement Sample Calculation

**@ 66.7 MHz**

| | |
|---|---|
| **Class B limit** | **= 100 μV/m = 40.0 dBμV/m** |
| Reading | = - 76.0 dBm (calibrated level) |
| Convert to dbμV | = - 76.0 + 107 = 31.0 dBμV |
| Antenna Factor + Cable Loss | = 5.8 dB/m |
| Total | = 36.8 dBμV/m |
| Margin | = 36.8 - 40.0 = - 3.2 dB |
| | **= 3.2 dB below limit** |

**Note:**

Level [dBμV] = 20 log $_{10}$ (Level [μV/m])

Level [dBμV] = Level [dBm] + 107


© 2016 PCTEST Engineering Laboratory, Inc.

# 8.0 TEST DATA

## 8.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMA720X

FCC Classification: Low Power Communications Device Transmitter (DXX)

Frequencies Examined: 13.56MHz

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| **TRANSMITTER MODE (Tx)** | | | | | |
| 2.1049 | 20 dB Bandwidth | N/A | RADIATED | PASS | Section 8.2 |
| 15.225 (a)(b)(c) | In-Band Emissions | 15,848µV/m @ 30m<br>13.553 – 13.567 MHz<br><br>334µV/m @ 30m<br>13.410 – 13.553 MHz<br>13.567 – 13.710 MHz<br><br>106µV/m @ 30m<br>13.110 – 13.410 MHz<br>13.710 – 14.010 MHz | | PASS | Section 8.4 |
| 15.225 (d)<br>15.209 | Out-of-Band Emissions | Emissions outside of the specified band (13.110 – 14.010 MHz) must meet the radiated limits detailed in 15.209 | | PASS | Section 8.5 |
| 15.225 (e) | Frequency Stability Tolerance | ± 0.01% of Operating Frequency | Temperature Chamber | PASS | Section 8.3 |
| 15.207 | AC Conducted Emissions 150kHz – 30MHz | < FCC 15.207 limits | LINE CONDUCTED | PASS | Section 8.6 |

**Table 8-1. Summary of Test Results**

**Note:**

This unit was tested with its standard battery.


© 2016 PCTEST Engineering Laboratory, Inc.

## 8.2 20dB Bandwidth Measurement

**§2.1049**

**Test Overview and Limit**

The bandwidth at 20dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequency.

**Test Procedure Used**

ANSI C63.10-2013 – Section 6.9.2

**Test Settings**

1. Spectrum analyzer frequency is set to the nominal EUT channel center frequency.
2. RBW = 1 – 5% OBW
3. VBW ≥ 3 x RBW
4. Reference level set to keep signal from exceeding maximum input mixer level for linear operation.
5. Detector = Peak
6. Trace mode = max hold
7. Sweep = auto couple
8. The trace was allowed to stabilize
9. Using the marker-delta function, determine the "-20dB down amplitude" using [(highest in band spectral density) – 20dB].
10. Set a marker at the lowest frequency of the envelope of the spectral density, such that the marker is at or slightly below the "-20dB down amplitude" determined in Step 9.
11. Reset marker-delta function and move the marker to other side of the emission until the delta marker amplitude is the same level as reference level amplitude. The marker delta frequency reading at this point is the specified emission bandwidth.

**Test Notes**

None.


© 2016 PCTEST Engineering Laboratory, Inc.

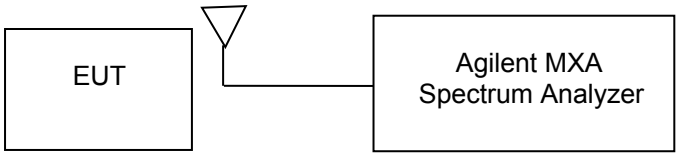



**Figure 8-1. Test Instrument & Measurement Setup**

| Frequency | 20dB Bandwidth |
|---|---|
| 13.56MHz | 220.40 kHz |

**Table 8-2. 20dB Bandwidth Measurement**

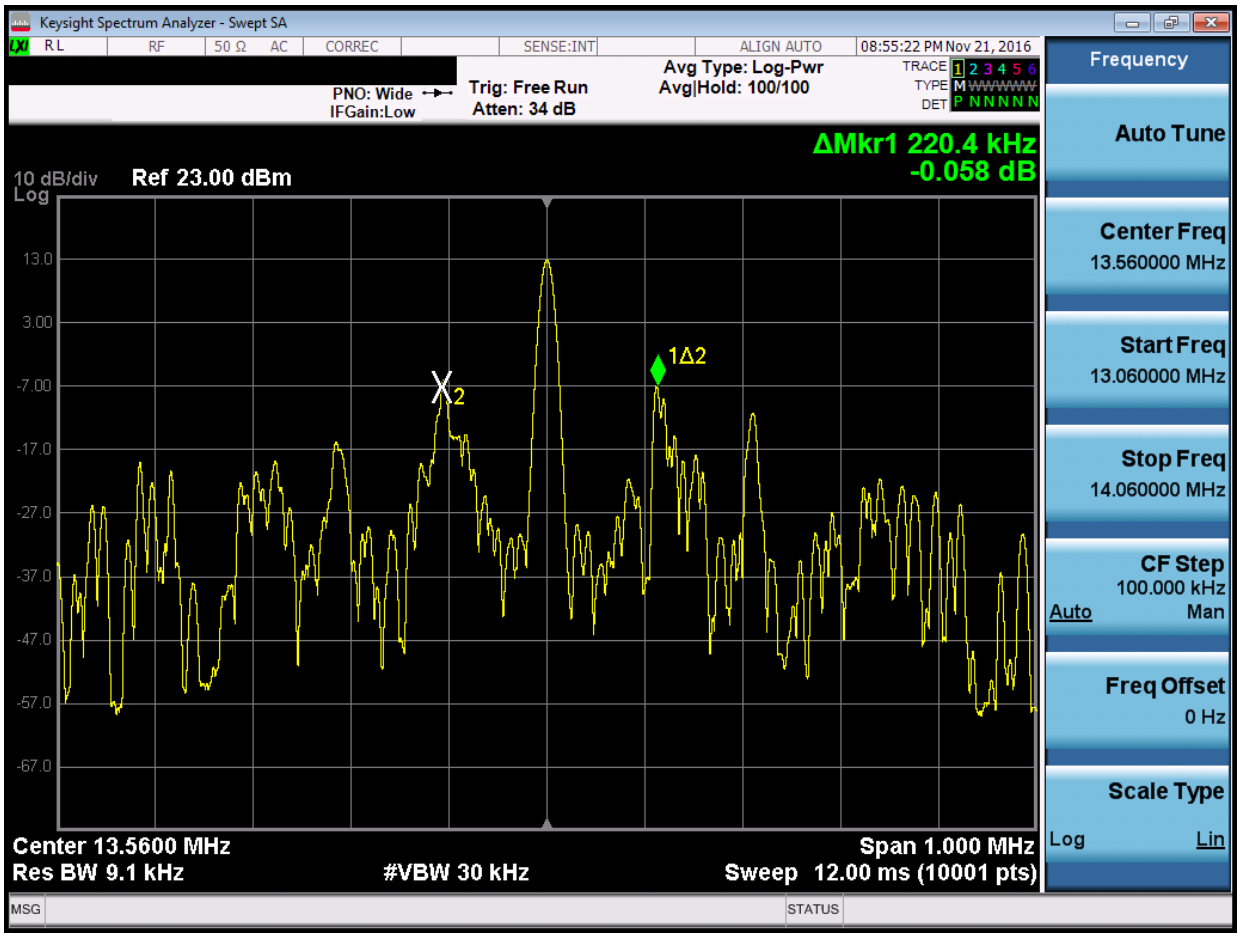



**Figure 8-2. 20dB Bandwidth Plot**


© 2016 PCTEST Engineering Laboratory, Inc.

## 8.3 Frequency Stability Test Data

**§15.225**

**Test Overview and Limit**

Frequency stability testing is performed in accordance with the guidelines of ANSI C63.10-2013. The frequency stability of the transmitter is measured by:

a.) **Temperature:** The temperature is varied from -20°C to +50°C in 10°C increments using an environmental chamber.

b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

***For Part 15.225, the frequency stability of the transmitter shall be maintained within ±0.01% of the center frequency.***

**Test Procedure Used**

ANSI C63.10-2013 – Section 6.8

**Test Settings**

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a "standby" condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -20°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

**Test Setup**

The EUT was connected via an RF cable to a spectrum analyzer with the EUT placed inside an environmental chamber.

**Test Notes**

None.


© 2016 PCTEST Engineering Laboratory, Inc.

## Frequency Stability Test Data
§15.225

OPERATING FREQUENCY: 13,560,000 Hz

REFERENCE VOLTAGE: 3.85 VDC

DEVIATION LIMIT: ± 0.01 % = 1356Hz

| VOLTAGE (%) | POWER (VDC) | TEMP (°C) | FREQUENCY (Hz) | Freq. Dev. (Hz) | Deviation (%) |
|---|---|---|---|---|---|
| 100 % | 3.85 | + 20 (Ref) | 13,559,883 | -117 | -0.0008622 |
| 100 % | | - 30 | 13,559,879 | -121 | -0.0008899 |
| 100 % | | - 20 | 13,559,919 | -81 | -0.0005960 |
| 100 % | | - 10 | 13,559,880 | -120 | -0.0008837 |
| 100 % | | 0 | 13,559,848 | -152 | -0.0011193 |
| 100 % | | + 10 | 13,559,877 | -123 | -0.0009087 |
| 100 % | | + 20 | 13,559,856 | -144 | -0.0010644 |
| 100 % | | + 30 | 13,559,870 | -130 | -0.0009551 |
| 100 % | | + 40 | 13,559,956 | -44 | -0.0003271 |
| 100 % | | + 50 | 13,559,892 | -108 | -0.0007943 |
| BATT. ENDPOINT | 3.45 | + 20 | 13,559,912 | -88 | -0.0006477 |

**Table 8-3. Frequency Stability Test Data**


© 2016 PCTEST Engineering Laboratory, Inc.

# Frequency Stability Test Data
**§15.225**

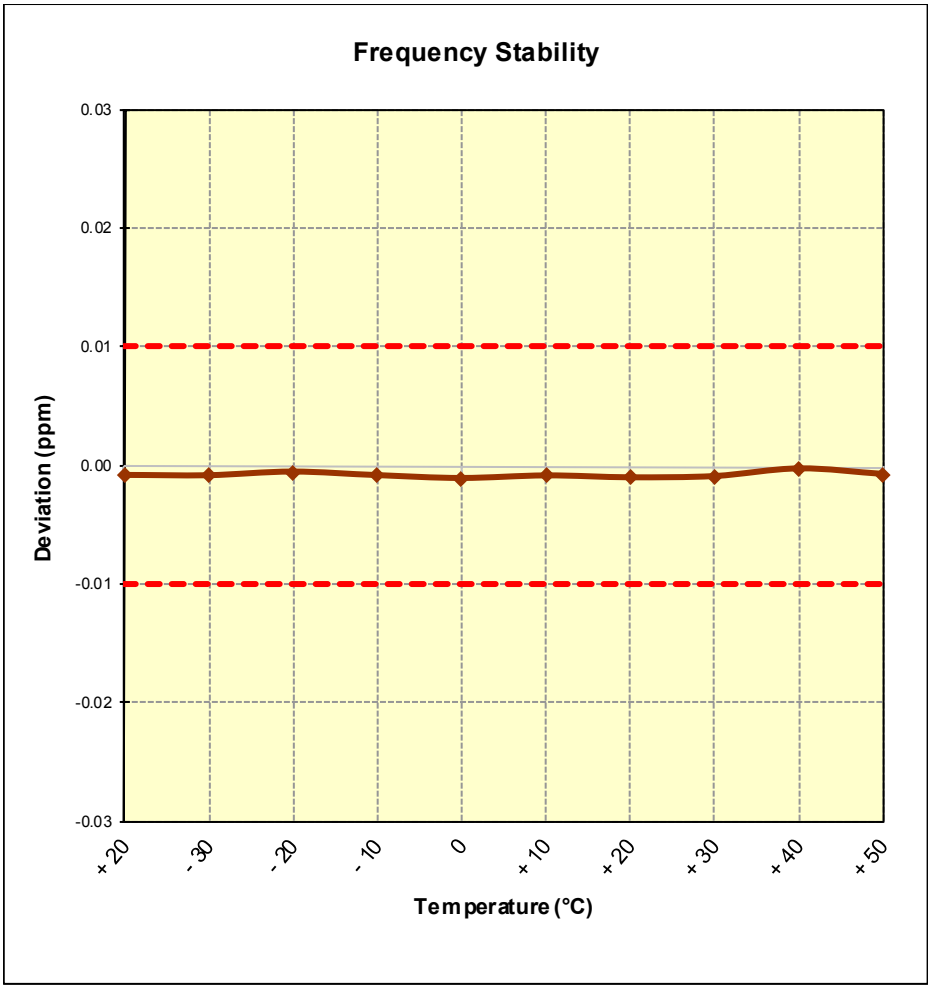



**Figure 8-3. Frequency Stability Plot**


© 2016 PCTEST Engineering Laboratory, Inc.

## 8.4 In-Band Radiated Spurious Emission Measurements

**§15.225(a)(b)(c)**

**Test Overview and Limit**

The EUT was tested from 13.110 – 14.010 MHz. All in-band radiated spurious emissions are measured with a spectrum analyzer connected to a loop antenna while the EUT is operating at appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

***All in-band emissions appearing in a restricted band as specified in Section 15.225 of the Title 47 CFR must not exceed the limits shown in Table 8-4.***

| Frequency [MHz] | Field Strength [μV/m] | Measured Distance [Meters] |
|---|---|---|
| 13.553-13.567 MHz | 15,848 | 30 |
| 13.410-13.553 MHz and 13.567-13.710 MHz | 334 | 30 |
| 13.110-13.410 MHz | 106 | 30 |

**Table 8-4. Radiated Limits**

**Test Procedures Used**

ANSI C63.10-2013 – Section 6.4.7

**Test Settings**

1. RBW = 9kHz
2. VBW ≥ 3 x RBW
3. Detector = peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize


© 2016 PCTEST Engineering Laboratory, Inc.

## Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

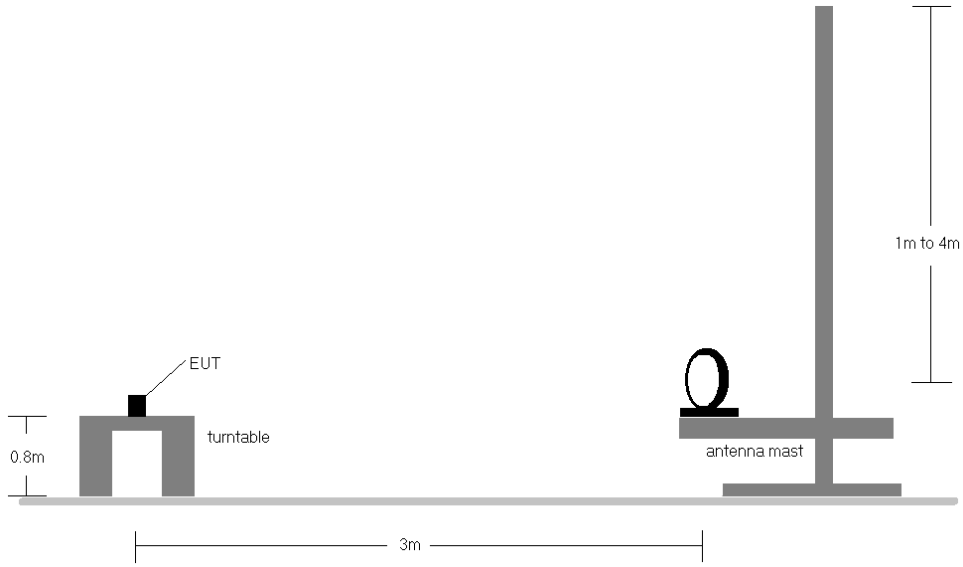



**Figure 8-4. Radiated Test Setup**

## Test Notes:

1. All emissions lying in restricted bands specified in §15.225 are below the limit shown in Table 8-4.
2. All measurements were performed using a loop antenna. The antenna was positioned in three orthogonal positions (X front, Y side, Z top) and the position with the highest emission level was recorded.
3. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
4. Measurements were performed at 3m and the data was extrapolated to the specified measurement distance of 30m using the square of an inverse linear distance extrapolation factor (40 dB/decade) as specified in §15.31(f)(2). Extrapolation Factor = $20 \log_{10}(30/3)^2$ = 40dB.
5. The spectrum was investigated from 9kHz up to 30MHz using the loop antenna. Only the emissions shown in the table below were found to be significant.
6. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector.
7. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

## Sample Calculation

- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$


© 2016 PCTEST Engineering Laboratory, Inc.

## In-Band Radiated Spurious Emission Measurements

**§15.225(a)(b)(c)**

Frequency: 13.56MHz

Measurement Distance: 3 Meters

| Frequency [MHz] | Antenna Position | Antenna Height [cm] | Turntable Azimuth [degree] | Level [dBm] | AFCL [dB/m] | 3m Field Strength [dBµV/m] | 30m Field Strength [dBµV/m] | Limit [µV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| 13.450 | X | 113 | 200 | 0.00 | 10.80 | 29.35 | -10.65 | 334.00 | 50.47 | -61.12 |
| 13.544 | X | 113 | 200 | 0.00 | 14.58 | 30.43 | -9.57 | 334.00 | 50.47 | -60.04 |
| 13.548 | X | 113 | 200 | 0.00 | 14.58 | 37.21 | -2.79 | 334.00 | 50.47 | -53.26 |
| 13.560 | X | 113 | 200 | 0.00 | 14.57 | 46.53 | 6.53 | 15848.00 | 84.00 | -77.47 |
| 13.570 | X | 113 | 200 | 0.00 | 14.57 | 36.12 | -3.88 | 334.00 | 50.47 | -54.35 |
| 13.670 | X | 113 | 200 | 0.00 | 14.57 | 31.00 | -9.00 | 334.00 | 50.47 | -59.48 |
| 13.690 | X | 113 | 200 | 0.00 | 14.57 | 28.34 | -11.66 | 334.00 | 50.47 | -62.14 |

**Table 8-5. In-Band Radiated Measurements**



© 2016 PCTEST Engineering Laboratory, Inc.

## 8.5 Radiated Spurious Emission Measurements, Out-of-Band

**§15.209 §15.225(d)**

**Test Overview and Limit**

The EUT was tested from 9kHz up to the 1GHz excluding the band 13.110 – 14.010 MHz. All measurements up to 960MHz were recorded with a spectrum analyzer employing a quasi-peak detector.

***All out-of-band emissions appearing in a restricted band as specified in Section 15.225 of the Title 47 CFR must not exceed the limits shown in Table 8-6 per Section 15.209.***

| Frequency | Field Strength [μV/m] | Measured Distance [Meters] |
|---|---|---|
| 0.009 – 0.490 MHz | 2400/F (kHz) | 300 |
| 0.490 – 1.705 MHz | 24000/F (kHz) | 30 |
| 1.705 – 30.00 MHz | 30 | 30 |
| 30.00 – 88.00 MHz | 100 | 3 |
| 88.00 – 216.0 MHz | 150 | 3 |
| 216.0 – 960.0 MHz | 200 | 3 |
| Above 960.0 MHz | 500 | 3 |

**Table 8-6. Radiated Limits – Out of band**

**Test Procedures Used**

ANSI C63.10-2013 – Section 6.5.4

**Test Settings**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 9kHz for emissions below 30MHz and 100kHz for emissions between 30MHz and 1GHz
3. VBW ≥ 3 x RBW
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize


© 2016 PCTEST Engineering Laboratory, Inc.

## Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

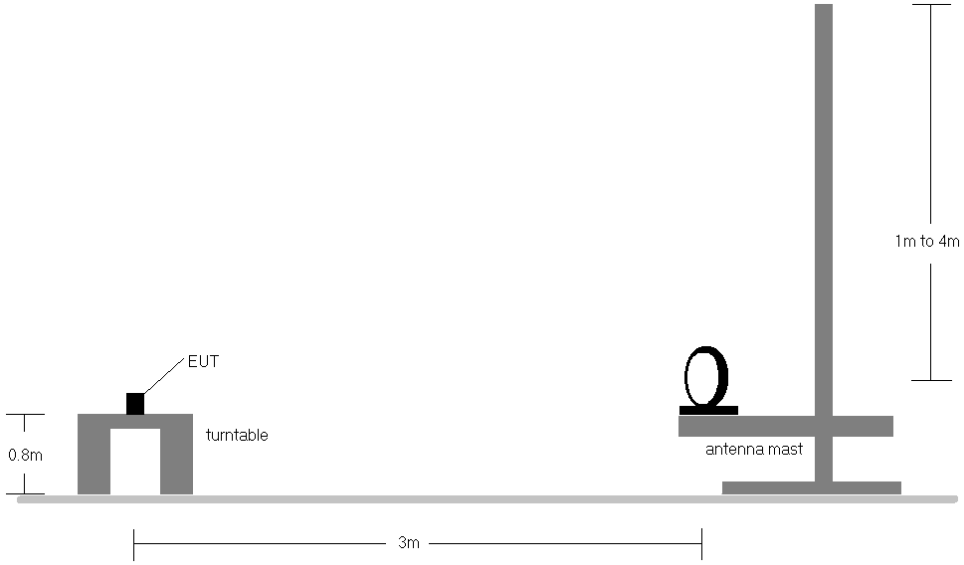



**Figure 8-5. Radiated Test Setup < 30MHz**

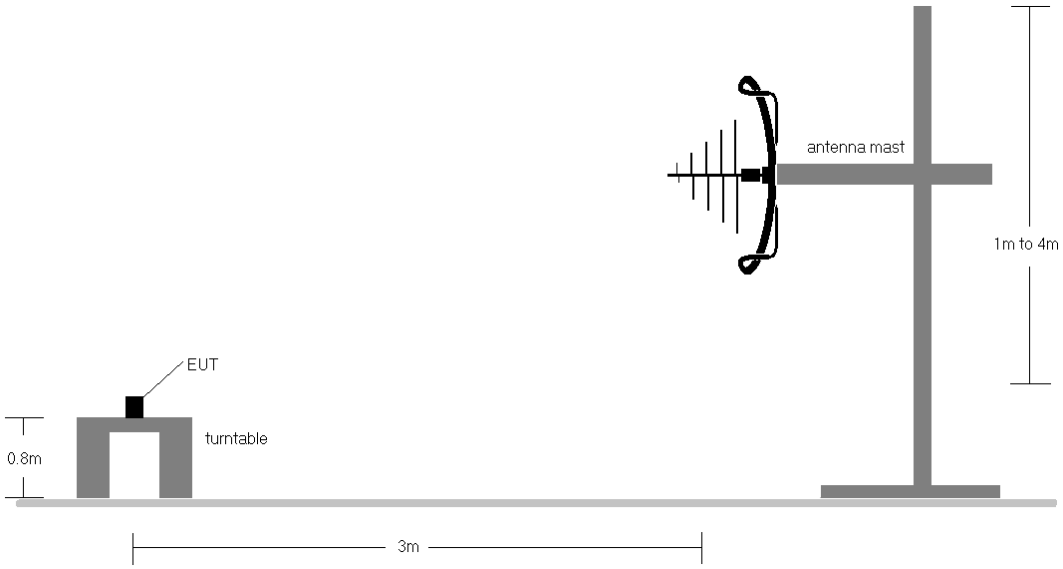



**Figure 8-6. Radiated Test Setup > 30MHz**



© 2016 PCTEST Engineering Laboratory, Inc.

**Test Notes:**

1. All measurements were recorded using a spectrum analyzer employing a quasi-peak detector for emissions below 960MHz.
2. A loop antenna was used to investigate emissions below 30MHz.
3. Both Vertical and Horizontal polarities of the receive antenna were evaluated with the worst case emissions being reported. Below 30MHz the loop antenna was positioned in 3 orthogonal planes (X front, Y side, Z top) to determine the orientation resulting in the worst case emissions.
4. The EUT was positioned in three orthogonal planes to determine the orientation resulting in the worst case emissions.
5. The spectrum is measured from 9kHz to the $10^{th}$ harmonic and the worst-case emissions are reported.
6. No spurious emissions levels were found to be greater than the level of the fundamental.
7. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

**Sample Calculation**

- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$


© 2016 PCTEST Engineering Laboratory, Inc.

## Radiated Spurious Emission Measurements, Out-of-Band
**§15.209 §15.225(d)**

Tx Frequency 13.56MHz

Measurement Distance: 3 Meters

| Frequency [MHz] | Ant. Pol. [H/V] | Antenna Height [cm] | Turntable Azimuth [degree] | Level [dBm] | AFCL [dB/m] | 3m Field Strength [dBµV/m] | Limit [dBµV/m] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|
| 27.12 | X | - | - | -94.01 | 13.35 | 26.34 | 69.54 | -43.20 |
| 40.68 | V | - | - | -81.03 | -15.23 | 10.74 | 40.00 | -29.26 |
| 54.24 | V | - | - | -82.26 | -21.07 | 3.67 | 40.00 | -36.33 |

**Table 8-7. Radiated Measurements**


© 2016 PCTEST Engineering Laboratory, Inc.

## 8.6 Line Conducted Measurement Data

**§15.207**

**Test Overview and Limit**

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

***All conducted emissions must not exceed the limits shown in the table below, per 15.207.***

| Frequency of emission (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 – 0.5 | 66 to 56* | 56 to 46* |
| 0.5 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |

**Table 8-8. Conducted Limits**

*Decreases with the logarithm of the frequency.

**Test Procedures Used**

ANSI C63.10-2013, Section 6.2

**Test Settings**

**Quasi-Peak Field Strength Measurements**

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

**Average Field Strength Measurements**

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize


© 2016 PCTEST Engineering Laboratory, Inc.

## Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

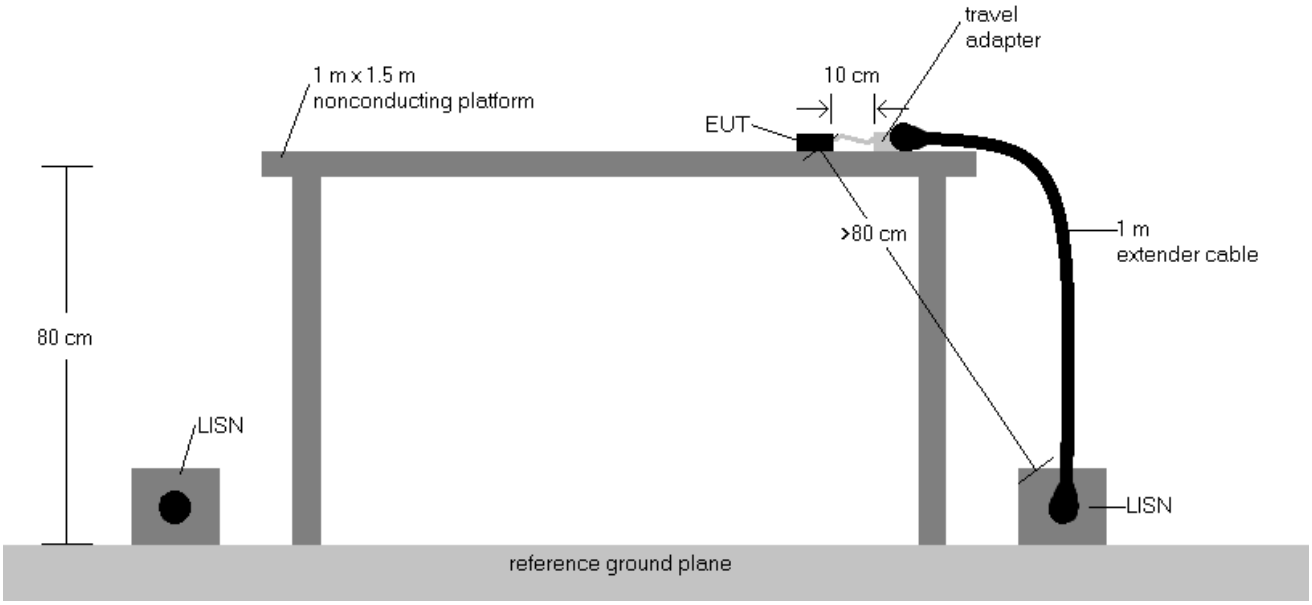



**Figure 8-7. Test Instrument & Measurement Setup**

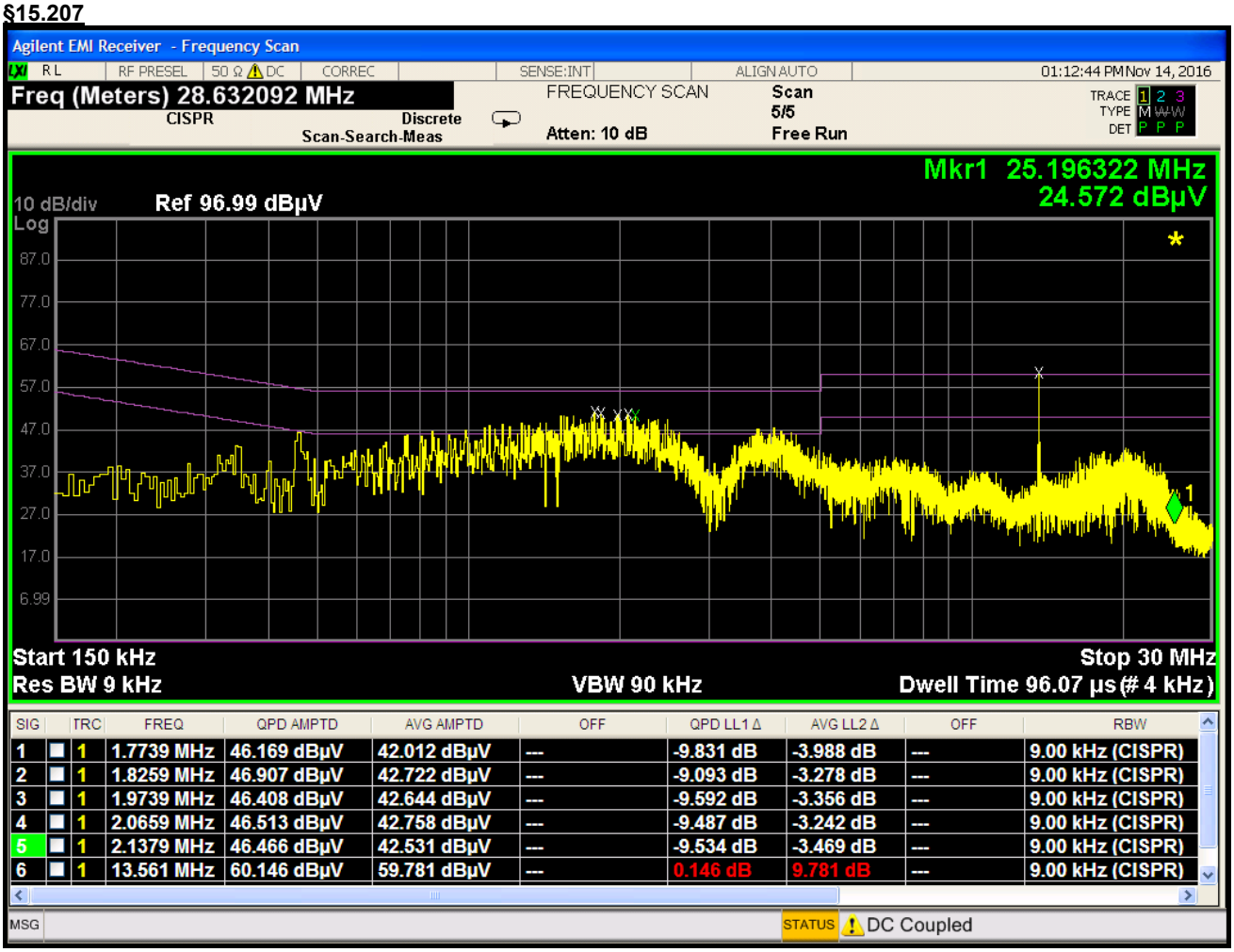
## Test Notes

1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in RSS-Gen (8.8).
3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBμV) = QP/AV Analyzer/Receiver Level (dBμV) + Corr. (dB)
5. Margin (dB) = QP/AV Limit (dBμV) - QP/AV Level (dBμV)
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.


© 2016 PCTEST Engineering Laboratory, Inc.

# Line-Conducted Test Data

§15.207




| SIG | | TRC | FREQ | QPD AMPTD | AVG AMPTD | OFF | QPD LL1 Δ | AVG LL2 Δ | OFF | RBW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ■ | 1 | 1.7739 MHz | 46.169 dBµV | 42.012 dBµV | --- | -9.831 dB | -3.988 dB | --- | 9.00 kHz (CISPR) |
| 2 | ■ | 1 | 1.8259 MHz | 46.907 dBµV | 42.722 dBµV | --- | -9.093 dB | -3.278 dB | --- | 9.00 kHz (CISPR) |
| 3 | ■ | 1 | 1.9739 MHz | 46.408 dBµV | 42.644 dBµV | --- | -9.592 dB | -3.356 dB | --- | 9.00 kHz (CISPR) |
| 4 | ■ | 1 | 2.0659 MHz | 46.513 dBµV | 42.758 dBµV | --- | -9.487 dB | -3.242 dB | --- | 9.00 kHz (CISPR) |
| 5 | ■ | 1 | 2.1379 MHz | 46.466 dBµV | 42.531 dBµV | --- | -9.534 dB | -3.469 dB | --- | 9.00 kHz (CISPR) |
| 6 | ■ | 1 | 13.561 MHz | 60.146 dBµV | 59.781 dBµV | --- | 0.146 dB | 9.781 dB | --- | 9.00 kHz (CISPR) |

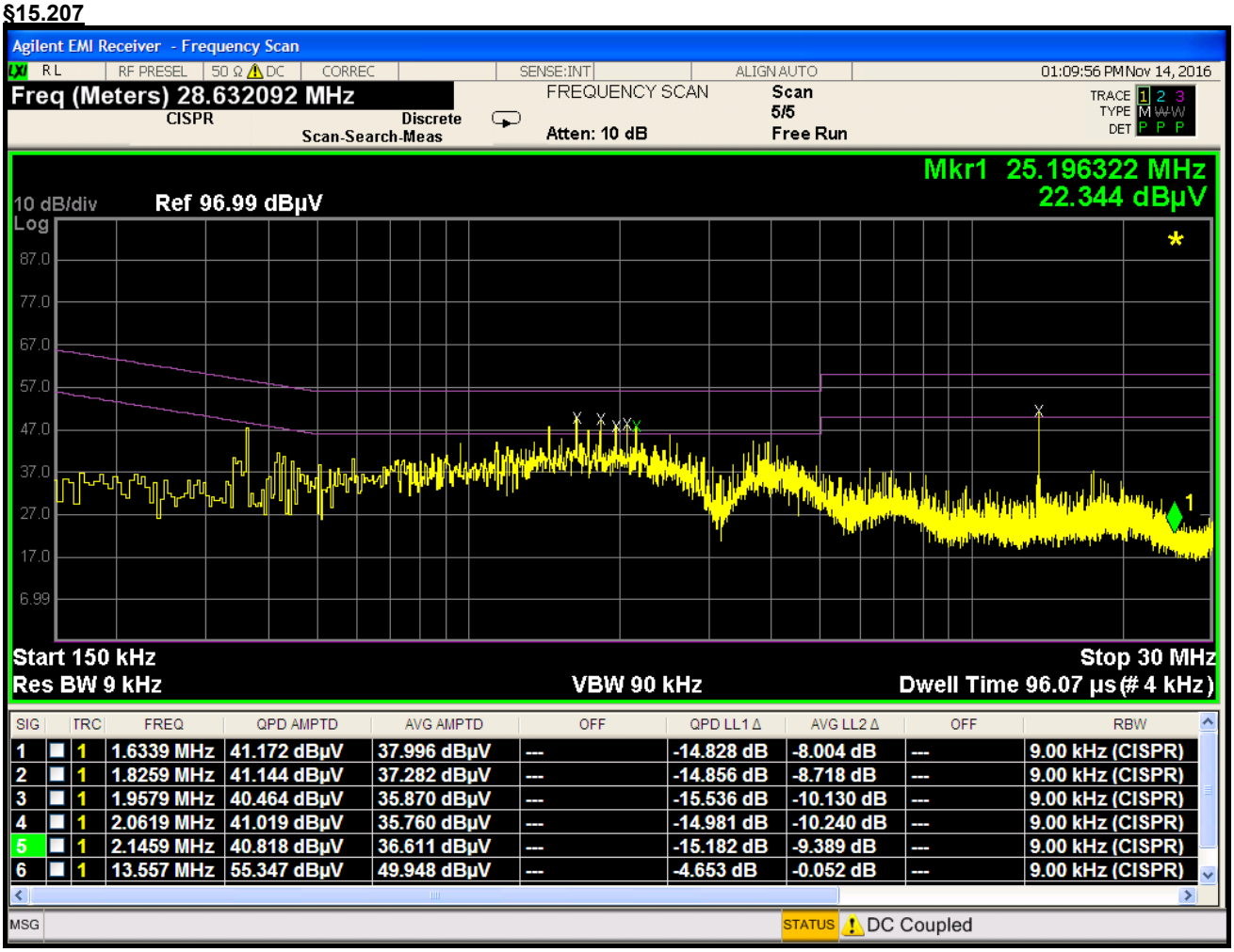
**Plot 8-1. Line-Conducted Test Plot (L1)**



© 2016 PCTEST Engineering Laboratory, Inc.

# Line Conducted Measurement Data

§15.207




| SIG | | TRC | FREQ | QPD AMPTD | AVG AMPTD | OFF | QPD LL1 Δ | AVG LL2 Δ | OFF | RBW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ■ | 1 | 1.6339 MHz | 41.172 dBµV | 37.996 dBµV | --- | -14.828 dB | -8.004 dB | --- | 9.00 kHz (CISPR) |
| 2 | ■ | 1 | 1.8259 MHz | 41.144 dBµV | 37.282 dBµV | --- | -14.856 dB | -8.718 dB | --- | 9.00 kHz (CISPR) |
| 3 | ■ | 1 | 1.9579 MHz | 40.464 dBµV | 35.870 dBµV | --- | -15.536 dB | -10.130 dB | --- | 9.00 kHz (CISPR) |
| 4 | ■ | 1 | 2.0619 MHz | 41.019 dBµV | 35.760 dBµV | --- | -14.981 dB | -10.240 dB | --- | 9.00 kHz (CISPR) |
| 5 | ■ | 1 | 2.1459 MHz | 40.818 dBµV | 36.611 dBµV | --- | -15.182 dB | -9.389 dB | --- | 9.00 kHz (CISPR) |
| 6 | ■ | 1 | 13.557 MHz | 55.347 dBµV | 49.948 dBµV | --- | -4.653 dB | -0.052 dB | --- | 9.00 kHz (CISPR) |

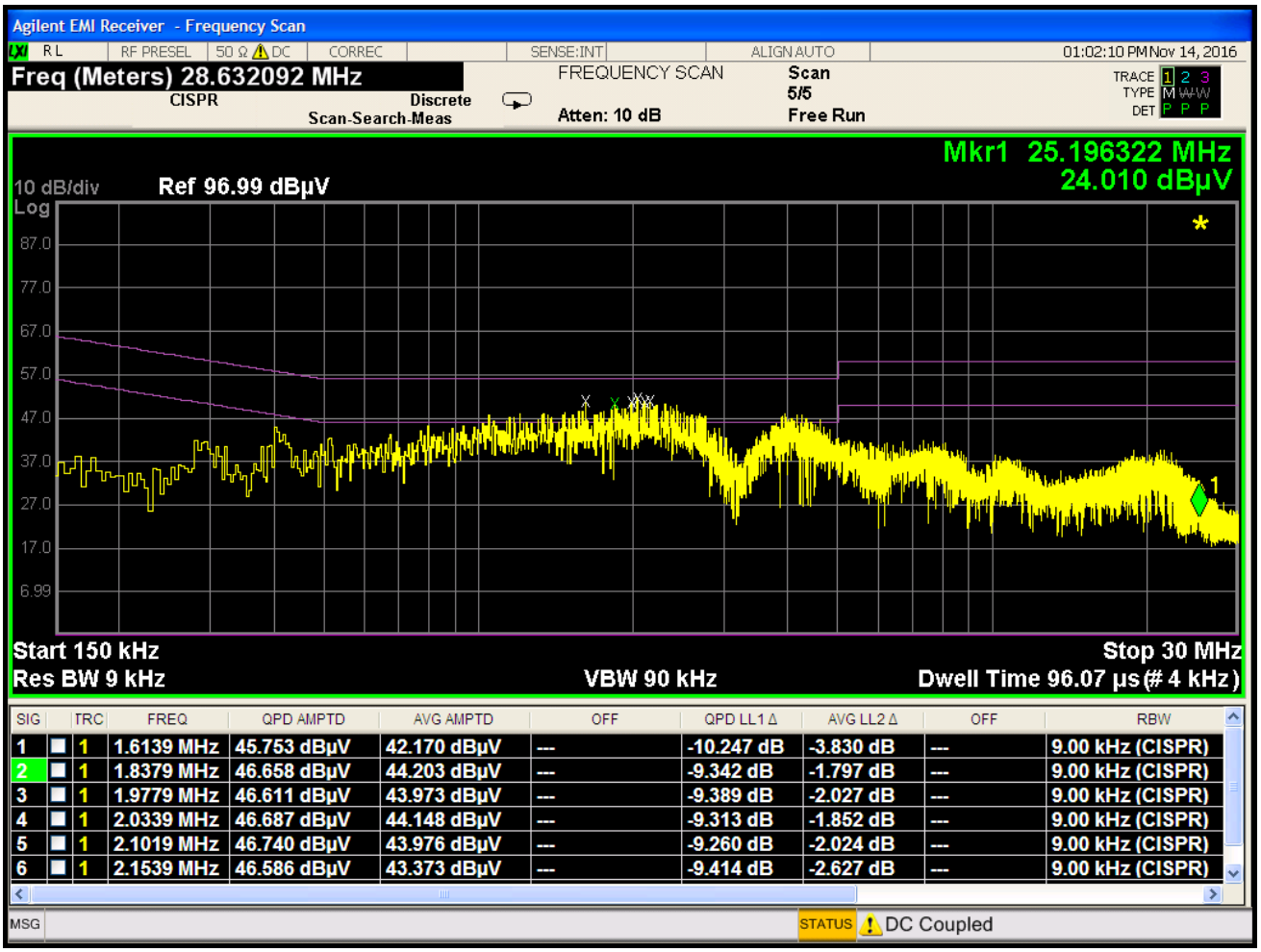
**Plot 8-2. Line-Conducted Test Plot (N)**



© 2016 PCTEST Engineering Laboratory, Inc.

# Line-Conducted Test Data (RFID Antenna Terminated in 50Ω)

**§15.207**




| SIG | | TRC | FREQ | QPD AMPTD | AVG AMPTD | OFF | QPD LL1 Δ | AVG LL2 Δ | OFF | RBW |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ■ | 1 | 1.6139 MHz | 45.753 dBµV | 42.170 dBµV | --- | -10.247 dB | -3.830 dB | --- | 9.00 kHz (CISPR) |
| 2 | ■ | 1 | 1.8379 MHz | 46.658 dBµV | 44.203 dBµV | --- | -9.342 dB | -1.797 dB | --- | 9.00 kHz (CISPR) |
| 3 | ■ | 1 | 1.9779 MHz | 46.611 dBµV | 43.973 dBµV | --- | -9.389 dB | -2.027 dB | --- | 9.00 kHz (CISPR) |
| 4 | ■ | 1 | 2.0339 MHz | 46.687 dBµV | 44.148 dBµV | --- | -9.313 dB | -1.852 dB | --- | 9.00 kHz (CISPR) |
| 5 | ■ | 1 | 2.1019 MHz | 46.740 dBµV | 43.976 dBµV | --- | -9.260 dB | -2.024 dB | --- | 9.00 kHz (CISPR) |
| 6 | ■ | 1 | 2.1539 MHz | 46.586 dBµV | 43.373 dBµV | --- | -9.414 dB | -2.627 dB | --- | 9.00 kHz (CISPR) |

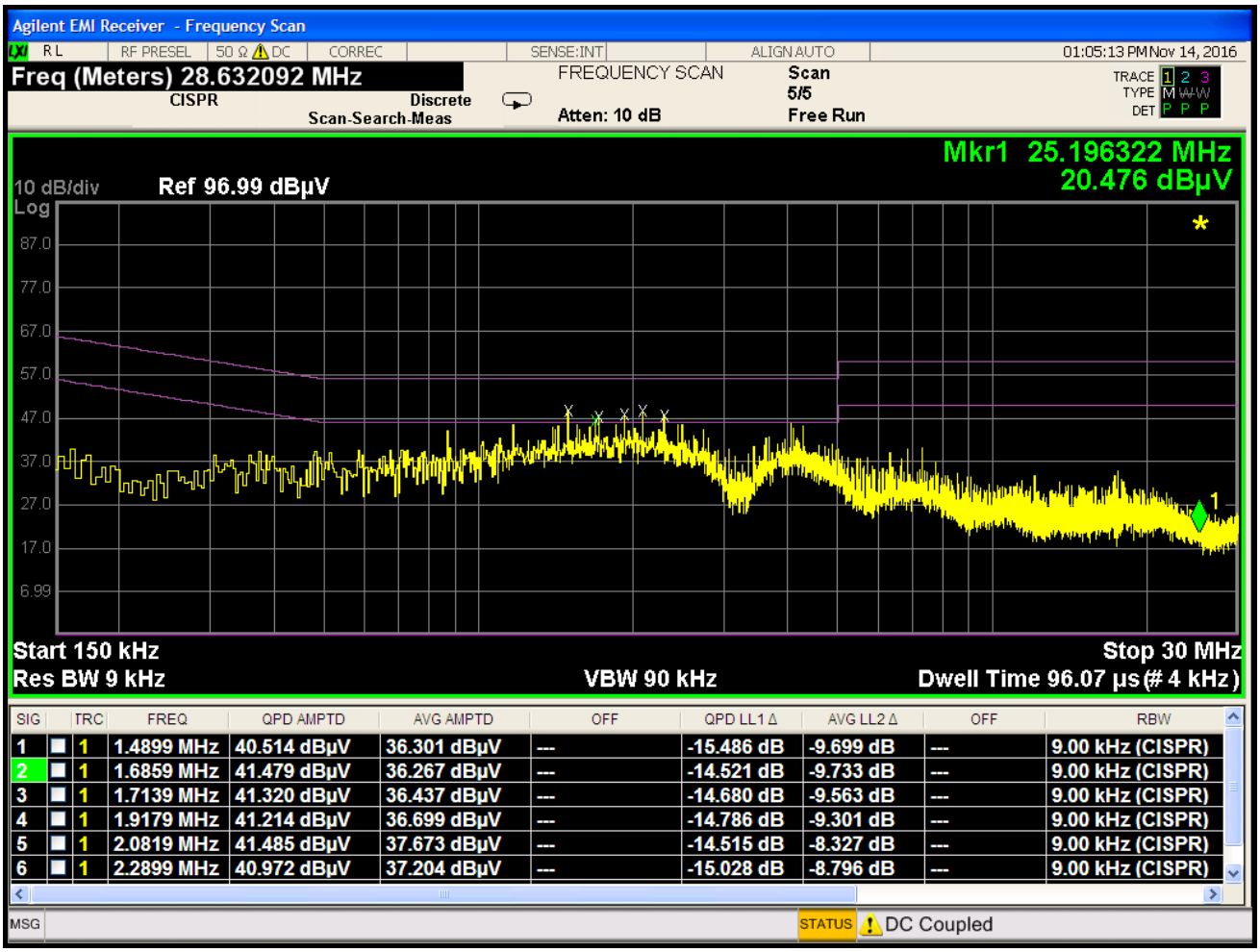
**Plot 8-3. Line-Conducted Test Plot (L1)**



© 2016 PCTEST Engineering Laboratory, Inc.

# Line-Conducted Test Data (RFID Antenna Terminated in 50Ω)

**§15.207**




| SIG | TRC | FREQ | QPD AMPTD | AVG AMPTD | OFF | QPD LL1 Δ | AVG LL2 Δ | OFF | RBW |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1.4899 MHz | 40.514 dBµV | 36.301 dBµV | --- | -15.486 dB | -9.699 dB | --- | 9.00 kHz (CISPR) |
| 2 | 1 | 1.6859 MHz | 41.479 dBµV | 36.267 dBµV | --- | -14.521 dB | -9.733 dB | --- | 9.00 kHz (CISPR) |
| 3 | 1 | 1.7139 MHz | 41.320 dBµV | 36.437 dBµV | --- | -14.680 dB | -9.563 dB | --- | 9.00 kHz (CISPR) |
| 4 | 1 | 1.9179 MHz | 41.214 dBµV | 36.699 dBµV | --- | -14.786 dB | -9.301 dB | --- | 9.00 kHz (CISPR) |
| 5 | 1 | 2.0819 MHz | 41.485 dBµV | 37.673 dBµV | --- | -14.515 dB | -8.327 dB | --- | 9.00 kHz (CISPR) |
| 6 | 1 | 2.2899 MHz | 40.972 dBµV | 37.204 dBµV | --- | -15.028 dB | -8.796 dB | --- | 9.00 kHz (CISPR) |

**Plot 8-4. Line-Conducted Test Plot (N)**



© 2016 PCTEST Engineering Laboratory, Inc.

# 9.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMA720X** has been tested to show compliance with the requirements specified in §15.225 of the FCC Rules.


© 2016 PCTEST Engineering Laboratory, Inc.