Report: TR 15-1002

ELECTROMAGNETIC EMISSIONS CHARACTERIZATION OF SAMPLES USED AT TLPS DEMONSTRATION

May 7, 2015

Prepared by:

Federal Communications Commission
Office of Engineering and Technology
Table of Contents

1. Introduction ................................................................................................................. 8
   1.1 Executive Summary ................................................................................................. 8
   1.2 Test Results Summary ........................................................................................... 8
2. Device Description ........................................................................................................ 8
   2.1 Sample Devices ..................................................................................................... 8
   2.1 Location of Testing ............................................................................................... 9
   2.2 EUT Setup ............................................................................................................ 9
3. Emissions Tests and Results ......................................................................................... 12
   3.1 Conducted Emissions .............................................................................................. 12
       3.1.1 Test Description .............................................................................................. 12
       3.1.2 Test Equipment Used ................................................................................... 13
       3.1.3 Test Setup .................................................................................................... 13
       3.1.4 Conducted Occupied Bandwidth (OBW) Test .................................................. 13
       3.1.5 Conducted Occupied Bandwidth (OBW) Results ............................................. 14
       3.1.6 Conducted Total Channel Power (TCP) Test .................................................... 16
       3.1.7 Conducted Total Channel Power (TCP) Results ............................................. 16
       3.1.8 Antenna Port Conducted Emissions Test and Test Results ............................... 18
       3.1.9 Conducted “Out-of-Band” Spurious (OOBS) Emissions Test ............................ 18
       3.1.10 Conducted “Out-of-Band” Spurious OOBS Emissions Test Results .................. 19
       3.1.11 Conducted Emissions Test Plots ..................................................................... 20
   3.2 Radiated Emissions ................................................................................................. 21
       3.2.1 Test Description ............................................................................................... 21
       3.2.2 Test Equipment Used ...................................................................................... 22
       3.2.3 Test Setup ..................................................................................................... 22
       3.2.4 Radiated Occupied Bandwidth (OBW) Test ...................................................... 22
       3.2.5 Radiated Occupied Bandwidth (OBW) Test Results ....................................... 22
       3.2.6 Radiated Total Channel Power (TCP) Test ....................................................... 23
       3.2.7 Radiated Total Channel Power (TCP) Test Results ....................................... 24
       3.2.8 Radiated Emissions Tests and Test Results ...................................................... 25
       3.2.9 Radiated Emissions Plots ................................................................................ 25
   ANNEX A – CONDUCTED EMISSIONS TEST DATA ......................................................... 26
   ANNEX B – RADIATED EMISSIONS TEST DATA ............................................................... 96
List of Figures

Figure 1 – Conducted Emissions Test Setup with Sample Device ............................................................. 10
Figure 2 – Conducted Emissions Sample Device, s/n 141403003812 ........................................................... 10
Figure 3 – Radiated Emissions Test Setup with Sample Device ................................................................. 11
Figure 4 – Radiated Emissions Sample Device, s/n 47147360229 .............................................................. 11
Figure 5 – Conducted CH14 A0 OFDM 64-QAM, P0, OBW/TCP Plot ...................................................... 26
Figure 6 – Conducted CH14 A0 OFDM 64-QAM, P1, OBW/TCP Plot ...................................................... 27
Figure 7 – Conducted CH14 A0 OFDM 64-QAM, P2, OBW/TCP Plot ...................................................... 27
Figure 8 – Conducted CH14 A0 OFDM 16-QAM, P0, OBW/TCP Plot ...................................................... 28
Figure 9 – Conducted CH14 A0 OFDM 16-QAM, P1, OBW/TCP Plot ...................................................... 28
Figure 10 – Conducted CH14 A0 OFDM 16-QAM, P2, OBW/TCP Plot ..................................................... 29
Figure 11 – Conducted CH14 A0 OFDM BPSK, P0, OBW/TCP Plot ........................................................... 29
Figure 12 – Conducted CH14 A0 OFDM BPSK, P1, OBW/TCP Plot ........................................................... 30
Figure 13 – Conducted CH14 A0 OFDM BPSK, P2, OBW/TCP Plot ........................................................... 30
Figure 14 – Conducted CH14 A1 OFDM 64-QAM, P0, OBW/TCP Plot ...................................................... 31
Figure 15 – Conducted CH14 A1 OFDM 64-QAM, P1, OBW/TCP Plot ...................................................... 32
Figure 16 – Conducted CH14 A1 OFDM 64-QAM, P2, OBW/TCP Plot ...................................................... 32
Figure 17 – Conducted CH14 A1 OFDM 64-QAM, P0, OBW/TCP Plot ...................................................... 33
Figure 18 – Conducted CH14 A1 OFDM 64-QAM, P1, OBW/TCP Plot ...................................................... 33
Figure 19 – Conducted CH14 A1 OFDM 64-QAM, P2, OBW/TCP Plot ...................................................... 34
Figure 20 – Conducted CH14 A1 OFDM BPSK, P0, OBW/TCP Plot ........................................................... 34
Figure 21 – Conducted CH14 A1 OFDM BPSK, P1, OBW/TCP Plot ........................................................... 35
Figure 22 – Conducted CH14 A1 OFDM BPSK, P2, OBW/TCP Plot ........................................................... 35
Figure 23 – Conducted CH14 A2 OFDM 64-QAM, P0, OBW/TCP Plot ...................................................... 36
Figure 24 – Conducted CH14 A2 OFDM 64-QAM, P1, OBW/TCP Plot ...................................................... 37
Figure 25 – Conducted CH14 A2 OFDM 64-QAM, P2, OBW/TCP Plot ...................................................... 37
Figure 26 – Conducted CH14 A2 OFDM 16-QAM, P0, OBW/TCP Plot ...................................................... 38
Figure 27 – Conducted CH14 A2 OFDM 16-QAM, P1, OBW/TCP Plot ...................................................... 38
Figure 28 – Conducted CH14 A2 OFDM 16-QAM, P2, OBW/TCP Plot ...................................................... 39
Figure 29 – Conducted CH14 A2 OFDM BPSK, P0, OBW/TCP Plot ........................................................... 39
Figure 30 – Conducted CH14 A2 OFDM BPSK, P1, OBW/TCP Plot ........................................................... 40
Figure 31 – Conducted CH14 A2 OFDM BPSK, P2, OBW/TCP Plot ........................................................... 40
Figure 32 – Conducted CH14 A0 OFDM 64-QAM, P0, Emissions Plot ........................................................ 41
Figure 33 – Conducted CH14 A0 OFDM 64-QAM, P1, Emissions Plot ........................................................ 42
Figure 34 – Conducted CH14 A0 OFDM 64-QAM, P2, Emissions Plot ........................................................ 42
Figure 35 – Conducted CH14 A0 OFDM 16-QAM, P0, Emissions Plot ........................................................ 43
Figure 36 – Conducted CH14 A0 OFDM 16-QAM, P1, Emissions Plot ........................................................ 43
Figure 37 – Conducted CH14 A0 OFDM 16-QAM, P2, Emissions Plot ........................................................ 44
Figure 38 – Conducted CH14 A0 OFDM BPSK, P0, Emissions Plot ........................................................... 44
Figure 39 – Conducted CH14 A0 OFDM BPSK, P1, Emissions Plot ........................................................... 45
Figure 40 – Conducted CH14 A0 OFDM BPSK, P2, Emissions Plot ........................................................... 45
Figure 41 – Conducted CH14 A1 OFDM 64-QAM, P0, Emissions Plot ........................................................ 46
Figure 42 – Conducted CH14 A1 OFDM 64-QAM, P1, Emissions Plot ........................................................ 47
List of Tables

Table 1 – Sample Device List (EUT)............................................................................................................ 9
Table 2 – Conducted Emissions Test Equipment ....................................................................................... 13
Table 3 – Conducted OBW, Channel 14 OFDM 64-QAM results ............................................................. 14
Table 4 – Conducted OBW, Channel 14 OFDM 16-QAM results ............................................................. 14
Table 5 – Conducted OBW, Channel 14 OFDM BPSK results ............................................................... 15
Table 6 – Conducted OBW, Channel 6 OFDM 64-QAM results ............................................................... 15
Table 7 – Conducted OBW, Channel 6 OFDM 16-QAM results ............................................................... 15
Table 8 – Conducted OBW, Channel 6 OFDM BPSK results ............................................................... 15
Table 9 – Conducted TCP, Channel 14 OFDM 64-QAM results ............................................................... 16
Table 10 – Conducted TCP, Channel 14 OFDM 16-QAM results ............................................................. 17
Table 11 – Conducted TCP, Channel 14 OFDM BPSK results ............................................................... 17
Table 12 – Conducted TCP, Channel 6 OFDM 64-QAM results ............................................................... 17
Table 13 – Conducted TCP, Channel 6 OFDM 16-QAM results ............................................................... 17
Table 14 – Conducted TCP, Channel 6 OFDM BPSK results ............................................................... 18
Table 15 – Conducted CH14 OFDM 64-QAM, P0, OOBs results ............................................................ 19
Table 16 – Conducted CH14 OFDM 64-QAM, P2, OOBs results ............................................................ 20
Table 17 – Conducted CH14 OFDM 64-QAM, P0, OOBs results ............................................................ 20
Table 18 – Radiated Emissions Test Equipment......................................................................................... 22
Table 19 – Radiated OBW, Channel 14 results .......................................................................................... 23
Table 20 – Radiated OBW, Channel 6 results ............................................................................................ 23
Table 21 – Radiated TCP, Channel 14 results ............................................................................................ 24
Table 22 – Radiated TCP, Channel 6 results .............................................................................................. 24
1. Introduction

1.1 Executive Summary

The primary purpose of this testing was to characterize the electromagnetic emissions profile of sample devices that Globalstar, Inc. (Globalstar) used in a recent demonstration of its proposed terrestrial low power service (TLPS) at the FCC Technology Experience Center. The sample devices provided for these tests were manufactured by Ruckus Wireless and contained modular transmitters approved under Sections 15.247 and 15.407 of the Commission’s rules. The objective of this testing was to characterize the transmission profile of the devices; there was no intent or effort to perform comprehensive compliance testing.

Two sample devices that were used in the demonstration were provided for this testing. One sample device was provided unmodified and was used for radiated emissions testing in the Commission’s Semi-anechoic Test Chamber. The second sample device was modified to permit access to the antenna port for conducted emissions testing. Since the device has three antenna ports, for MIMO (Multiple Input Multiple Output) operation, tests were performed on each antenna port.

In order to compare the characteristics of the sample devices with the configuration of the equipment used as part of the demonstration, various combinations of power levels, channel settings, and transmission modes were tested. In general, the following options were tested:

- Channels tested: Channel 14 (centered at 2484 MHz) and Channel 6 (centered at 2437 MHz);
- Power level settings: Maximum Power (+23 dBm), Max-3 dBm (+20 dBm), and Max -8 dBm (+15 dBm), referred to as P0, P1 and P2 respectively;
- Modulation types: OFDM 64 ½ rate QAM, OFDM 16 ½ rate QAM and OFDM BPSK ¾ rate

The conducted and radiated test data for each of these combinations is provided in this report.

1.2 Test Results Summary

This report summarizes the emissions characterization tests performed on the sample devices. Section 2 briefly describes the devices provided for the tests and the general test procedures used. Section 3 includes the summary results for each test and the plots for each of the measurements. Annex A includes the conducted emissions test plots and Annex B includes the radiated emissions test plots. Since these measurements were not performed as compliance tests, in some cases only a limited number of measurements were performed to characterize the emissions.

2. Device Description

2.1 Sample Devices

The Equipment Under Test (EUT) was a Wi-Fi Access Point (AP) manufactured by Ruckus Wireless. It is a host device containing modules operating in the 2.4 GHz and 5 GHz bands in accordance with the protocols in IEEE 802.11. For this testing, two sample devices were made available to the FCC’s

---

1 March 6, 9-10, 2015.
3 This refers to the power levels set through the control software for the devices.
Table 1 provides a list of the sample devices covered by this test report.

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Manufacturer</th>
<th>Model</th>
<th>FCC ID</th>
<th>Serial Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducted</td>
<td>Ruckus Wireless</td>
<td>ZoneFlex 7982 AP</td>
<td>S9G-MPE2N33A, S9G-MPE5N33A</td>
<td>141403003812</td>
</tr>
<tr>
<td>Radiated</td>
<td>Ruckus Wireless</td>
<td>ZoneFlex 7982 AP</td>
<td>S9G-MPE2N33A, S9G-MPE5N33A</td>
<td>471473600229</td>
</tr>
</tbody>
</table>

Table 1 – Sample Device List (EUT)

The sample device with serial number (S/N): 471473600229 was used for the radiated emissions measurements and the sample device with serial number S/N: 141403003812 was used for the conducted emissions measurements. The sample devices were configured as MIMO devices with 3 transmitter outputs and 3 receiver inputs (3Tx3R). The antennas were integrated on a separate printed circuit board connected to the module using coaxial cables, with maximum gain of 3 dBi for each antenna. The tests were only performed on the 2.4 GHz transmitter portion of the devices (FCC ID S9G-MPE2N33A).

In order to perform conducted emissions measurements, access was provided to the internal antenna ports of the device. Test software was provided to allow for controlled tests. This test software permitted the sample device to be configured for the power level, channel operation, and modulation type.

### 2.1 Location of Testing

All radiated emissions testing was performed in the 3-meter Semi-Anechoic Test Chamber and the conducted emissions testing was performed on a workbench outside of the Semi-Anechoic Test Chamber at the FCC Laboratory facility located in Columbia, Maryland.

### 2.2 EUT Setup

For all testing, the manufacturer’s unique test-mode software was utilized to enable the sample device to be set at target power levels and to be operated with continuous transmission with operational commands to select the transmit channel, bandwidth (20/40 MHz for 802.11n) and modulation modes predetermined prior to testing (i.e., OFDM BPSK ¾ rate, OFDM 16 ½ rate QAM, and OFDM 64 5/6 rate QAM).

For conducted antenna port emissions testing, the sample device was connected to the test equipment through a reverse SMB coaxial pigtail, and positioned on a generic test workbench (Figure 1). Antenna terminal ports not being tested were terminated into 50 ohm resistive loads. The antenna port for the conducted emissions sample device, showing the product label, is illustrated in Figure 2. The three antenna ports that were available for conducted tests are referred to as A0, A1 and A2 in the report.
For the radiated emissions test setup, the device was positioned atop an 80 cm high non-conductive test table. Electrical power to the device was provided through a Power over Ethernet (PoE) adapter. The ancillary laptop computer was powered by filtered 115 volts AC through the Semi-Anechoic Test Chamber’s turntable’s AC power slip-ring for radiated emissions testing (Figure 3). The radiated emissions sample device, showing the product label, is illustrated in Figure 4.
Figure 3 – Radiated Emissions Test Setup with Sample Device

Figure 4 – Radiated Emissions Sample Device, s/n 471473600229
3. Emissions Tests and Results

3.1 Conducted Emissions

3.1.1 Test Description

The conducted antenna port(s) emissions test results were collected using procedures described in ANSI C63.10 and KDB Publication 558074 for performing measurements on MIMO devices. Based on this test guidance the following measurements were made to characterize the antenna port conducted emissions:

- Channel Power
- Occupied Bandwidth
- Antenna Port Conducted Emissions
- Spurious Emissions (reduced scan)

These measurements were performed for the following operational combinations:

- Channels tested: Channel 14 (centered at 2484 MHz) and Channel 6 (centered at 2437 MHz)
- Power level settings: Maximum Power (+23 dBm); Max-3 dBm (+20 dBm); Max -8 dBm (+15 dBm), referred to as P0, P1 and P2, respectively;
- Modulation types: OFDM 64 5/6 rate QAM, OFDM 16 ½ rate QAM & OFDM BPSK ¾ rate

The measurements were made on each of the sample device’s internal antenna port terminals (i.e., A0, A1, A2), atop a test laboratory test bench. An RF Spectrum Analyzer was connected to each of the sample device’s antenna port terminals through a 50 ohm coaxial cable. An ancillary laptop computer, loaded with the manufacturer’s unique test-mode software, was used to enable the sample device to operate at different power level settings for continuous transmit operation, channel frequency, bandwidth and modulation modes preselected for testing.

An RF Spectrum Analyzer was used to collect raw conducted spectrum data ($P_{SA}$, in dBm). Once the raw conducted test data was obtained, cable loss factors ($C_L$, in dB) were applied to the correct data to account for all losses (or gains) within the measurement path. The cable loss function ($C_L$, in dB) was algebraically summed to the raw conducted data ($P_{SA}$, in dBm) to calculate the corrected conducted emissions result, which then could be plotted as final measurement results. Since the measurement system had adequate dynamic range, a pre-amplifier was not used. All amplitude values reported on the data plots represent corrected values.

The following equation was used to convert the Spectrum Analyzer’s uncorrected (raw) spectrum sweep into the corrected antenna port emissions result:

---

4 Since the sample devices transmit across multiple bands, this measurement was performed to determine the channel emissions roll-off.
Corrected (dBm) = PSA (dBm) + CL (dB)

Where

PSA: Spectrum Analyzer’s raw conducted spectrum data (frequency, dBm)
CL: Cable Loss Factor (frequency, dB)

During conducted antenna port emissions testing, the Spectrum Analyzer utilized the following settings:

- 1000 MHz – 5500 MHz: 100 kHz RBW\(^5\)
- 300 kHz VBW\(^6\)
- AUTO sweep
- 1001 points

All cable loss factors were internally loaded into the Spectrum Analyzer. The calibration information for the test equipment used is electronically stored at the FCC Laboratory.

### 3.1.2 Test Equipment Used

<table>
<thead>
<tr>
<th>Asset No.</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Description</th>
<th>Cal. Due</th>
</tr>
</thead>
</table>

Table 2 – Conducted Emissions Test Equipment

### 3.1.3 Test Setup

See Section 2.2 EUT Setup for a description of the test setup. Test setup photographs and sample device photos are shown in Figure 3 and Figure 4.

### 3.1.4 Conducted Occupied Bandwidth (OBW) Test

The conducted antenna port(s) OBW were examined for two channels (Channels 6 and 14), under three output power level settings P0, P1 and P2, using three modulations modes (OFDM 64 5/6 rate QAM, OFDM 16 ½ rate QAM, and OFDM BPSK ¾ rate), respectively.

An RF Spectrum Analyzer was used to measure the OBW, -6 dB (each side of center) from the highest amplitude signal observed at the fundamental frequency, or located at the first order modulation products, on each of the modulated sample device’s three internal antenna ports.

During the conducted antenna port OBW measurement, the Spectrum Analyzer settings were:

- RBW ≥ 100 kHz
- VBW ≥ 3x RBW
- SPAN ≥ 3x RBW
- SWEEP AUTO
- DETECTOR = RMS AVE
- TRACE = Trace AVE

---

\(^5\) RBW – Resolution Bandwidth setting for the Spectrum Analyzer.

\(^6\) VBW – Video Bandwidth setting for the Spectrum Analyzer.
MEAS = internal OBW measurement personality

The tabular results are summarized in Section 3.1.5 Conducted Occupied Bandwidth (OBW) Results, Table 3 through Table 8, and are illustrated in Section 3.1.11, Figure 5 through Figure 31 (Ch14) and Figure 59 through Figure 85 (CH6).

### 3.1.5 Conducted Occupied Bandwidth (OBW) Results

Table 3 through Table 8 summarizes the results for each measurement and indicates the location of the corresponding OBW plot (i.e., Figure No.) for each conducted antenna terminal measurement under the corresponding modulation mode.

<table>
<thead>
<tr>
<th>Chanel 14 Port (OFDM 64-QAM)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>18.100 MHz</td>
<td>17.652 MHz</td>
<td>17.632 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 5</td>
<td>Figure 6</td>
<td>Figure 7</td>
</tr>
<tr>
<td>A1</td>
<td>17.904 MHz</td>
<td>17.644 MHz</td>
<td>17.615 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 14</td>
<td>Figure 15</td>
<td>Figure 16</td>
</tr>
<tr>
<td>A2</td>
<td>17.918 MHz</td>
<td>17.674 MHz</td>
<td>17.614 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 23</td>
<td>Figure 24</td>
<td>Figure 25</td>
</tr>
</tbody>
</table>

**Table 3 – Conducted OBW, Channel 14 OFDM 64-QAM results**

<table>
<thead>
<tr>
<th>Chanel 14 Port (OFDM 16-QAM)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>18.280 MHz</td>
<td>17.677 MHz</td>
<td>17.632 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 8</td>
<td>Figure 9</td>
<td>Figure 10</td>
</tr>
<tr>
<td>A1</td>
<td>17.907 MHz</td>
<td>17.663 MHz</td>
<td>17.635 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 17</td>
<td>Figure 18</td>
<td>Figure 19</td>
</tr>
<tr>
<td>A2</td>
<td>17.935 MHz</td>
<td>17.672 MHz</td>
<td>17.630 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 26</td>
<td>Figure 27</td>
<td>Figure 28</td>
</tr>
</tbody>
</table>

**Table 4 – Conducted OBW, Channel 14 OFDM 16-QAM results**
<table>
<thead>
<tr>
<th>Chanel 14 Port (OFDM BPSK)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>18.714 MHz</td>
<td>17.701 MHz</td>
<td>17.647 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 11</td>
<td>Figure 12</td>
<td>Figure 13</td>
</tr>
<tr>
<td>A1</td>
<td>18.055 MHz</td>
<td>17.692 MHz</td>
<td>17.672 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 20</td>
<td>Figure 21</td>
<td>Figure 22</td>
</tr>
<tr>
<td>A2</td>
<td>18.158 MHz</td>
<td>17.713 MHz</td>
<td>17.652 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 29</td>
<td>Figure 30</td>
<td>Figure 31</td>
</tr>
</tbody>
</table>

Table 5 – Conducted OBW, Channel 14 OFDM BPSK results

<table>
<thead>
<tr>
<th>Chanel 6 Port (OFDM 64-QAM)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>17.744 MHz</td>
<td>17.636 MHz</td>
<td>17.613 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 59</td>
<td>Figure 60</td>
<td>Figure 61</td>
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<tr>
<td>A1</td>
<td>17.692 MHz</td>
<td>17.622 MHz</td>
<td>17.621 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 68</td>
<td>Figure 69</td>
<td>Figure 70</td>
</tr>
<tr>
<td>A2</td>
<td>17.772 MHz</td>
<td>17.632 MHz</td>
<td>17.618 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 77</td>
<td>Figure 78</td>
<td>Figure 79</td>
</tr>
</tbody>
</table>

Table 6 – Conducted OBW, Channel 6 OFDM 64-QAM results

<table>
<thead>
<tr>
<th>Chanel 6 Port (OFDM 16-QAM)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>17.800 MHz</td>
<td>17.657 MHz</td>
<td>17.626 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 62</td>
<td>Figure 63</td>
<td>Figure 64</td>
</tr>
<tr>
<td>A1</td>
<td>17.722 MHz</td>
<td>17.645 MHz</td>
<td>17.629 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 71</td>
<td>Figure 72</td>
<td>Figure 73</td>
</tr>
<tr>
<td>A2</td>
<td>17.802 MHz</td>
<td>17.654 MHz</td>
<td>17.632 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 80</td>
<td>Figure 81</td>
<td>Figure 82</td>
</tr>
</tbody>
</table>

Table 7 – Conducted OBW, Channel 6 OFDM 16-QAM results

<table>
<thead>
<tr>
<th>Chanel 6 Port (OFDM BPSK)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>17.851 MHz</td>
<td>17.694 MHz</td>
<td>17.657 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 65</td>
<td>Figure 66</td>
<td>Figure 67</td>
</tr>
<tr>
<td>A1</td>
<td>17.735 MHz</td>
<td>17.663 MHz</td>
<td>17.651 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 74</td>
<td>Figure 75</td>
<td>Figure 76</td>
</tr>
<tr>
<td>A2</td>
<td>17.829 MHz</td>
<td>17.675 MHz</td>
<td>17.652 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 83</td>
<td>Figure 84</td>
<td>Figure 85</td>
</tr>
</tbody>
</table>

Table 8 – Conducted OBW, Channel 6 OFDM BPSK results
3.1.6 Conducted Total Channel Power (TCP) Test

From an RF Spectrum Analyzer, the TCP was measured from the highest amplitude signal observed at the fundamental frequency or located at the first order modulation products, on each of the modulated sample device’s three internal antenna ports.

During the TCP measurement, the Spectrum Analyzer settings were:

- RBW $\geq 100$ kHz
- VBW $\geq 3x$ RBW
- SPAN $\geq 3x$ RBW
- SWEEP AUTO
- DETECTOR = RMS AVE
- TRACE = Trace AVE
- MEAS = internal Channel Power measurement personality

The tabular results are summarized in Section 3.1.7 Conducted TCP Results, Table 9 through Table 14, and are illustrated in Section 3.1.11, Figure 5 through Figure 31 (CH14) and Figure 59 through Figure 85 (CH6).

3.1.7 Conducted Total Channel Power (TCP) Results

Table 9 through Table 14 summarizes the results for each measurement and indicates the location of the corresponding TCP plot (i.e., Figure No.) for each conducted antenna terminal measurement under the corresponding TCP/modulation condition.

<table>
<thead>
<tr>
<th>Channel 14 Port (OFDM 64-QAM)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>22.2 dBm</td>
<td>19.8 dBm</td>
<td>15.7 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 5</td>
<td>Figure 6</td>
<td>Figure 7</td>
</tr>
<tr>
<td>A1</td>
<td>21.8 dBm</td>
<td>19.5 dBm</td>
<td>15.2 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 14</td>
<td>Figure 15</td>
<td>Figure 16</td>
</tr>
<tr>
<td>A2</td>
<td>21.7 dBm</td>
<td>20.0 dBm</td>
<td>14.8 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 23</td>
<td>Figure 24</td>
<td>Figure 25</td>
</tr>
</tbody>
</table>

Table 9 – Conducted TCP, Channel 14 OFDM 64-QAM results
### Table 10 – Conducted TCP, Channel 14 OFDM 16-QAM results

<table>
<thead>
<tr>
<th>Channel 14 Port (OFDM 16-QAM)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>22.6 dBm</td>
<td>20.2 dBm</td>
<td>15.7 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 8</td>
<td>Figure 9</td>
<td>Figure 10</td>
</tr>
<tr>
<td>A1</td>
<td>22.1 dBm</td>
<td>18.3 dBm</td>
<td>15.5 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 17</td>
<td>Figure 18</td>
<td>Figure 19</td>
</tr>
<tr>
<td>A2</td>
<td>21.9 dBm</td>
<td>19.9 dBm</td>
<td>15.3 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 26</td>
<td>Figure 27</td>
<td>Figure 28</td>
</tr>
</tbody>
</table>

### Table 11 – Conducted TCP, Channel 14 OFDM BPSK results

<table>
<thead>
<tr>
<th>Channel 14 Port (OFDM BPSK)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>23.2 dBm</td>
<td>20.8 dBm</td>
<td>16.2 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 11</td>
<td>Figure 12</td>
<td>Figure 13</td>
</tr>
<tr>
<td>A1</td>
<td>22.7 dBm</td>
<td>20.2 dBm</td>
<td>16.5 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 20</td>
<td>Figure 21</td>
<td>Figure 22</td>
</tr>
<tr>
<td>A2</td>
<td>22.4 dBm</td>
<td>20.6 dBm</td>
<td>15.8 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 29</td>
<td>Figure 30</td>
<td>Figure 31</td>
</tr>
</tbody>
</table>

### Table 12 – Conducted TCP, Channel 6 OFDM 64-QAM results

<table>
<thead>
<tr>
<th>Channel 6 Port (OFDM 64-QAM)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>21.1 dBm</td>
<td>18.9 dBm</td>
<td>13.8 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 59</td>
<td>Figure 60</td>
<td>Figure 61</td>
</tr>
<tr>
<td>A1</td>
<td>20.9 dBm</td>
<td>18.3 dBm</td>
<td>13.8 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 68</td>
<td>Figure 69</td>
<td>Figure 70</td>
</tr>
<tr>
<td>A2</td>
<td>21.5 dBm</td>
<td>18.9 dBm</td>
<td>14.1 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 77</td>
<td>Figure 78</td>
<td>Figure 79</td>
</tr>
</tbody>
</table>

### Table 13 – Conducted TCP, Channel 6 OFDM 16-QAM results

<table>
<thead>
<tr>
<th>Channel 6 Port (OFDM 16-QAM)</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>21.4 dBm</td>
<td>19.3 dBm</td>
<td>14.3 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 62</td>
<td>Figure 63</td>
<td>Figure 64</td>
</tr>
<tr>
<td>A1</td>
<td>21.3 dBm</td>
<td>18.6 dBm</td>
<td>14.2 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 71</td>
<td>Figure 72</td>
<td>Figure 73</td>
</tr>
<tr>
<td>A2</td>
<td>21.8 dBm</td>
<td>19.2 dBm</td>
<td>14.4 dBm</td>
</tr>
<tr>
<td></td>
<td>Figure 80</td>
<td>Figure 81</td>
<td>Figure 82</td>
</tr>
</tbody>
</table>
### 3.1.8 Antenna Port Conducted Emissions Test and Test Results

Using an RF Spectrum Analyzer, the conducted emissions from the antenna terminal were measured over a 50 MHz span and with a 100 kHz RBW, on each of the modulated sample device’s three internal antenna ports. The markers on the plots were set to show the measured results over the frequency span.

During the conducted emissions measurement, the Spectrum Analyzer settings were:

- RBW ≥ 100 kHz
- VBW ≥ 300 kHz
- SPAN ≥ 50 MHz
- SWEEP AUTO
- DETECTOR = RMS AVE
- TRACE = Trace AVE
- MEAS = Markers set at various point on the plot

The results are illustrated in Section 3.1.11, Figure 32 through Figure 58 (CH14) and Figure 86-Figure 112 (CH6).

### 3.1.9 Conducted “Out-of-Band” Spurious (OOBS) Emissions Test

Using an RF Spectrum Analyzer, each of the device’s conducted antenna terminals OOBS, from 1000 MHz to 5500 MHz, were examined. In particular, OOBS scans were recorded from 2400 to 2500 MHz, 2460 to 2560 MHz, and from 1000 to 5500 MHz.

OOBS is specified in Section 15.209 of the Commission’s rules as maximum radiated field strength of 500 μV/m at a measurement distance of 3 meters. In addition, Section 15.35(b) specifies that this limit is based on the average detector function, using a minimum Resolution Bandwidth (RBW) of 1 MHz. Thus, a corresponding EIRP limit (dBm/MHz) can be derived from the specified radiated field strength limit by converting the conducted antenna terminal recorded OOBS level and adding the associated device’s transmit antenna array gain (in dBi).

---

7 47 C.F.R. § 15.209.
8 47 C.F.R. § 15.35(b).
In the interest of detecting lower level OOBS in the noise-floor of the measurement system, the Spectrum Analyzer’s RBW was reduced from 1 MHz to 100 kHz to further resolve any buried spurious emissions within the noise floor of the Spectrum Analyzer. For the 1 GHz to 5.5 GHz OOBS scan, a 1 MHz RBW was used.

For the OOBS measurement, the Spectrum Analyzer settings were:

- FREQUENCY 2400-2500 MHz, 2460-2560 MHz, 1000-5500 MHz
- RBW ≥ 1 MHz
- VBW ≥ 3 MHz
- SPAN ≥ 100, 4500 MHz
- SWEEP AUTO
- DETECTOR = RMS AVE
- TRACE = Trace AVE
- MEAS = observe OOBS emissions above Spectrum Analyzers noise floor

The tabular results are summarized in Section 3.1.11 Conducted OOBS Results, Table 15 through Table 17, and are illustrated in Section 3.1.11, Figure 113 through Figure 127.9

### 3.1.10 Conducted “Out-of-Band” Spurious OOBS Emissions Test Results

Table 15 through Table 17 summarizes the results for each measurement and indicates the location of the corresponding OOBS plot (i.e., Figure No.) for each tuned OOBS emissions frequency scan.

<table>
<thead>
<tr>
<th>Frequency Range (MHz)</th>
<th>P0 (A0)</th>
<th>P0 (A1)</th>
<th>P0 (A2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400-2500 MHz (“Left plot”)</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
</tr>
<tr>
<td></td>
<td>Figure 113</td>
<td>Figure 114</td>
<td>Figure 115</td>
</tr>
<tr>
<td>2460-2560 MHz (“Right plot”)</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
</tr>
<tr>
<td></td>
<td>Figure 116</td>
<td>Figure 117</td>
<td>Figure 118</td>
</tr>
</tbody>
</table>

Table 15 – Conducted CH14 OFDM 64-QAM, P0, OOBS results

---

9 Only measured power levels are presented. The field strength was not derived for these measurements.
<table>
<thead>
<tr>
<th>Frequency Range (MHz)</th>
<th>P2 (A0)</th>
<th>P2 (A1)</th>
<th>P2 (A2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400-2500 MHz</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
</tr>
<tr>
<td>(“Left Plot”)</td>
<td>Figure 119</td>
<td>Figure 120</td>
<td>Figure 121</td>
</tr>
<tr>
<td>2460-2560 MHz</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
</tr>
<tr>
<td>(“Right Plot”)</td>
<td>Figure 122</td>
<td>Figure 123</td>
<td>Figure 124</td>
</tr>
</tbody>
</table>

Table 16 – Conducted CH14 OFDM 64-QAM, P2, OOBS results

<table>
<thead>
<tr>
<th>Frequency Range (MHz)</th>
<th>P0 (A0)</th>
<th>P0 (A1)</th>
<th>P0 (A2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000-5500 MHz</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
<td>Minimal OOBS detected</td>
</tr>
<tr>
<td></td>
<td>Figure 125</td>
<td>Figure 126</td>
<td>Figure 127</td>
</tr>
</tbody>
</table>

Table 17 – Conducted CH14 OFDM 64-QAM, P0, OOBS results

3.1.11 Conducted Emissions Test Plots

See Annex A for the conducted emissions test plots.
3.2 Radiated Emissions

3.2.1 Test Description

Radiated EIRP test results were collected using the procedures described in ANSI C63.10 and KDB Publications 558074, 412172, and 662911. The following measurements were performed:

- Channel Power
- Occupied Bandwidth
- Radiated Emissions

These measurements were made for the following operational combinations:

- Channels tested: Channel 14 (centered at 2484 MHz) and Channel 6 (centered at 2437 MHz)
- Power level settings: Maximum Power (+23 dBm); Max-3 dBm (+20 dBm); Max -8 dBm (+15 dBm), referred to as P0, P1 and P2 respectively;
- Modulation types: OFDM 64 \( \frac{5}{6} \) rate QAM, OFDM 16 \( \frac{1}{2} \) rate QAM & OFDM BPSK \( \frac{3}{4} \) rate

The radiated EIRP measurements were made at a distance of 3 meters inside a Semi-Anechoic Test Chamber. The radiated emissions were maximized by rotating the device 360 degrees. In addition, the receive test antenna height was varied from 1 to 4 meters in height, and vertical/horizontal test antenna polarizations were examined. An RF Spectrum Analyzer, located in the adjoining screen room, was connected to the test antenna (Double Ridge Guided Horn) 50 ohm output port via a coaxial cable. An ancillary laptop computer, loaded with the manufacturer’s unique test-mode software, was used to set the emissions power levels, and to enable the device for continuous transmit, channel, bandwidth, and modulation modes preselected for testing.

An RF Spectrum Analyzer was used to collect raw radiated spectrum data \((P_{SA}, \text{in} \ dBm)\). Once the raw radiated data was obtained, receive antenna gain factors \((G_{R}, \text{in} \ dB)\), Path Loss \((P_{L}, \text{in} \ dB)\) and Cable Loss factors \((C_{L}, \text{in} \ dB)\) were applied to the raw radiated data to account for all losses (or gains) within the measurement path. The receive antenna gain function \((G_{R}, \text{dB})\), the Path Loss \((P_{L}, \text{in} \ dB)\), and the Cable Loss function \((C_{L}, \text{in} \ dB)\) were algebraically summed to the raw radiated data \((P_{SA}, \text{in} \ dBm)\) to calculate the corrected radiated EIRP, which then could be plotted. Since the measurement system had adequate dynamic range, a pre-amplifier was not used. All amplitude values reported on the data plots represent corrected values.

The following equation was used to convert the Spectrum Analyzer’s uncorrected (raw) spectrum sweep into the corrected radiated EIRP result:

\[
EIRP \ (dBm) = P_{SA} \ (dBm) - G_{R} \ (dB) + P_{L} \ (dB) + C_{L} \ (dB)
\]

Where

- \(P_{SA}\): Spectrum Analyzer’s raw radiated spectrum data (frequency, dBm)
- \(P_{L}\): Path Loss (frequency, dB)
  \[
  = 20*\log (f \ [MHz]) + 20*\log (d[m])-27.5
  \]
- \(C_{L}\): Cable Loss Factor (frequency, dB)
- \(G_{R}\): Receive Antenna Gain (frequency, dBi)

During radiated emissions testing, the Spectrum Analyzer was set as follows:

(For DRG Horn antenna range)
1000 MHz – 5500 MHz: 100 kHz RBW
300 kHz VBW
AUTO sweep
1001 points

All Antenna Gain and Cable Loss factors were internally loaded on the Spectrum Analyzer. The calibration information for the test equipment used is electronically stored at the FCC Laboratory.

### 3.2.2 Test Equipment Used

<table>
<thead>
<tr>
<th>Asset No.</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Description</th>
<th>Cal. Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEMO-30</td>
<td>ETS Lindgren</td>
<td>3m semi anechoic</td>
<td>Test Chamber</td>
<td>*CNR</td>
</tr>
<tr>
<td>1052646</td>
<td>ETS Lindgren</td>
<td>3117</td>
<td>DRG Horn Antenna</td>
<td>20 Mar 2016</td>
</tr>
</tbody>
</table>

*Table 18 – Radiated Emissions Test Equipment

*CNR - Calibration Not Required

### 3.2.3 Test Setup

See Section 2.3 for description of the test setup. Test setup photographs and sample device photos are contained in Figure 3 and Figure 4.

### 3.2.4 Radiated Occupied Bandwidth (OBW) Test

Using an RF Spectrum Analyzer, the OBW was measured -6 dB (each side of center) from the highest amplitude signal observed at the fundamental frequency, or located at the first order modulation products, of the modulated sample device.

During the OBW measurement, the Spectrum Analyzer settings were:

- RBW ≥ 100 kHz
- VBW ≥ 3x RBW
- SPAN ≥ 3x RBW
- SWEEP AUTO
- DETECTOR = RMS AVE
- TRACE = Trace AVE
- MEAS = internal OBW measurement personality

The tabular results are summarized in Section 3.2.5, Table 19 and Table 20, and are illustrated in Section 3.2.9, Figure 128 through Figure 136 (CH14) and Figure 146 through Figure 154 (CH6).

### 3.2.5 Radiated Occupied Bandwidth (OBW) Test Results

Table 19 and Table 20 summarize the results for each measurement and indicate the location of the
corresponding plot (i.e., Figure No.) for each OBW under the corresponding TCP/modulation mode. For each test condition, the Test Table azimuth was recorded where maximum channel power was indicated on the spectrum analyzer. See KDB Publication 662911 for MIMO and Spatial Multiplexing explanation and the reason for “maximizing” the sample device’s rotation.

<table>
<thead>
<tr>
<th>Channel 14</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>64-QAM</td>
<td>17.479 MHz</td>
<td>17.428 MHz</td>
<td>17.277 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 128</td>
<td>Figure 129</td>
<td>Figure 130</td>
</tr>
<tr>
<td></td>
<td>Turntable 44.4°</td>
<td>Turntable 26.6°</td>
<td>Turntable 25.8°</td>
</tr>
<tr>
<td>16-QAM</td>
<td>17.799 MHz</td>
<td>17.428 MHz</td>
<td>17.430 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 131</td>
<td>Figure 132</td>
<td>Figure 133</td>
</tr>
<tr>
<td></td>
<td>Turntable 44.4°</td>
<td>Turntable 26.6°</td>
<td>Turntable 25.8°</td>
</tr>
<tr>
<td>BPSK</td>
<td>17.780 MHz</td>
<td>17.049 MHz</td>
<td>17.345 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 134</td>
<td>Figure 135</td>
<td>Figure 136</td>
</tr>
<tr>
<td></td>
<td>Turntable 44.4°</td>
<td>Turntable 44.4°</td>
<td>Turntable 25.8°</td>
</tr>
</tbody>
</table>

Table 19 – Radiated OBW, Channel 14 results

<table>
<thead>
<tr>
<th>Channel 6</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>64-QAM</td>
<td>17.671 MHz</td>
<td>17.644 MHz</td>
<td>17.658 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 146</td>
<td>Figure 147</td>
<td>Figure 148</td>
</tr>
<tr>
<td></td>
<td>Turntable 147.6°</td>
<td>Turntable 129.8°</td>
<td>Turntable 128.4°</td>
</tr>
<tr>
<td>16-QAM</td>
<td>17.711 MHz</td>
<td>17.665 MHz</td>
<td>17.665 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 149</td>
<td>Figure 150</td>
<td>Figure 151</td>
</tr>
<tr>
<td></td>
<td>Turntable 147.6°</td>
<td>Turntable 129.8°</td>
<td>Turntable 128.4°</td>
</tr>
<tr>
<td>BPSK</td>
<td>17.745 MHz</td>
<td>17.541 MHz</td>
<td>17.617 MHz</td>
</tr>
<tr>
<td></td>
<td>Figure 152</td>
<td>Figure 153</td>
<td>Figure 154</td>
</tr>
<tr>
<td></td>
<td>Turntable 147.6°</td>
<td>Turntable 144.1°</td>
<td>Turntable 128.4°</td>
</tr>
</tbody>
</table>

Table 20 – Radiated OBW, Channel 6 results

3.2.6 Radiated Total Channel Power (TCP) Test

Using an RF Spectrum Analyzer, the TCP was measured from the highest amplitude signal observed at the fundamental frequency or located at the first order modulation products of the modulated device.

During the TCP measurement, the Spectrum Analyzer settings were:

- RBW ≥ 100 kHz
- VBW ≥ 3x RBW
- SPAN ≥ 3x RBW
- SWEEP AUTO
- DETECTOR = RMS AVE
- TRACE = Trace AVE
MEAS = internal Channel Power measurement personality

The tabular results are summarized in Section 3.2.7 Radiated TCP Results, Table 21 and Table 22, and are illustrated in Section 3.2.9, Figure 128 through Figure 136 (CH14) and Figure 146 through Figure 154 (CH6).

3.2.7 Radiated Total Channel Power (TCP) Test Results

Table 21 and Table 22 summarize the results for each measurement and indicate the location of the corresponding plot (i.e., Figure No.) for each Total Channel Power plot under the corresponding modulation mode. For each test condition, the Test Table azimuth was recorded where maximum channel power was indicated on the spectrum analyzer.10

<table>
<thead>
<tr>
<th>Channel 14</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>64-QAM</td>
<td>19.6 dBm Figure 128 Turntable 44.4°</td>
<td>18.1 dBm Figure 129 Turntable 26.6°</td>
<td>13.5 dBm Figure 130 Turntable 25.8°</td>
</tr>
<tr>
<td>16-QAM</td>
<td>20.0 dBm Figure 131 Turntable 44.4°</td>
<td>18.5 dBm Figure 132 Turntable 26.6°</td>
<td>14.0 dBm Figure 133 Turntable 25.8°</td>
</tr>
<tr>
<td>BPSK</td>
<td>20.7 dBm Figure 134 Turntable 44.4°</td>
<td>18.7 dBm Figure 135 Turntable 44.4°</td>
<td>14.6 dBm Figure 136 Turntable 25.8°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Channel 6</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>64-QAM</td>
<td>19.6 dBm Figure 146 Turntable 147.6°</td>
<td>18.2 dBm Figure 147 Turntable 129.8°</td>
<td>12.9 dBm Figure 148 Turntable 128.4°</td>
</tr>
<tr>
<td>16-QAM</td>
<td>19.5 dBm Figure 149 Turntable 147.6°</td>
<td>18.4 dBm Figure 150 Turntable 129.8°</td>
<td>13.6 dBm Figure 151 Turntable 128.4°</td>
</tr>
<tr>
<td>BPSK</td>
<td>19.8 dBm Figure 152 Turntable 147.6°</td>
<td>18.8 dBm Figure 153 Turntable 144.1°</td>
<td>14.2 dBm Figure 154 Turntable 128.4°</td>
</tr>
</tbody>
</table>

10 See Publication KDB 662911 for MIMO and Spatial Multiplexing explanation and the reason for “maximizing” the sample device’s rotation.
3.2.8 Radiated Emissions Tests and Test Results

Using an RF Spectrum Analyzer, the radiated emissions from the antenna terminal were measured over a 50 MHz span and with a 100 kHz RBW, on each of the modulated sample device’s three internal antenna ports to the frequency 100 kHz from channel center. The markers on the plots were set to show the measured results over the frequency span.

During the radiated emissions measurement, the Spectrum Analyzer settings were:

- RBW ≥ 100 kHz
- VBW ≥ 300 kHz
- SPAN ≥ 50 MHz
- SWEEP AUTO
- DETECTOR = RMS AVE
- TRACE = Trace AVE
- MEAS = markers were set at various frequency points on the emission plots

The results are illustrated in Section 3.2.9, Figure 137 through Figure 145 (CH14) and Figure 155 through Figure 163 (CH6).

3.2.9 Radiated Emissions Plots

See Annex B for the radiated emissions test plots.
ANNEX A – CONDUCTED EMISSIONS TEST DATA

Channel 14 A0: OBW/TCP Plots

The following plots present Occupied Bandwidth / Total Channel Power measurement emissions for Channel 14 on Chain A0.

![Conducted CH14 A0 OFDM 64-QAM, P0, OBW/TCP Plot](image)

- Occupied Bandwidth: 18.100 MHz
- Total Power: 22.2 dBm
- Transmit Freq Error: 89.485 kHz
- OBW Power: 99.00%
- x dB Bandwidth: 17.69 MHz
- OBW Power: -6.00 dB

Figure 5 – Conducted CH14 A0 OFDM 64-QAM, P0, OBW/TCP Plot
Figure 6 – Conducted CH14 A0 OFDM 64-QAM, P1, OBW/TCP Plot

Figure 7 – Conducted CH14 A0 OFDM 64-QAM, P2, OBW/TCP Plot
Figure 8 – Conducted CH14 A0 OFDM 16-QAM, P0, OBW/TCP Plot

Figure 9 – Conducted CH14 A0 OFDM 16-QAM, P1, OBW/TCP Plot
Figure 10 – Conducted CH14 A0 OFDM 16-QAM, P2, OBW/TCP Plot

Figure 11 – Conducted CH14 A0 OFDM BPSK, P0, OBW/TCP Plot
Figure 12 – Conducted CH14 A0 OFDM BPSK, P1, OBW/TCP Plot

Figure 13 – Conducted CH14 A0 OFDM BPSK, P2, OBW/TCP Plot
Channel 14 A1: OBW/TCP Plots

The following plots present Occupied Bandwidth / Total Channel Power measurement emissions for Channel 14 on Chain A1.

![Figure 14 – Conducted CH14 A1 OFDM 64-QAM, P0, OBW/TCP Plot](image)

- Occupied Bandwidth: 17.904 MHz
- Total Power: 21.8 dBm
- Transmit Freq Error: 22.684 kHz
- OBW Power: 99.00%
- x dB Bandwidth: 17.68 MHz
- x dB: -6.00 dB
Figure 15 – Conducted CH14 A1 OFDM 64-QAM, P1, OBW/TCP Plot

Figure 16 – Conducted CH14 A1 OFDM 64-QAM, P2, OBW/TCP Plot
Figure 17 – Conducted CH14 A1 OFDM 16-QAM, P0, OBW/TCP Plot

Figure 18 – Conducted CH14 A1 OFDM 16-QAM, P1, OBW/TCP Plot
Figure 19 – Conducted CH14 A1 OFDM 16-QAM, P2, OBW/TCP Plot

Figure 20 – Conducted CH14 A1 OFDM BPSK, P0, OBW/TCP Plot
Figure 21 – Conducted CH14 A1 OFDM BPSK, P1, OBW/TCP Plot

Figure 22 – Conducted CH14 A1 OFDM BPSK, P2, OBW/TCP Plot
Channel 14 A2: OBW/TCP Plots

The following plots present Occupied Bandwidth / Total Channel Power measurement emissions for Channel 14 on Chain A1.

Figure 23 – Conducted CH14 A2 OFDM 64-QAM, P0, OBW/TCP Plot
Figure 24 – Conducted CH14 A2 OFDM 64-QAM, P1, OBW/TCP Plot

Figure 25 – Conducted CH14 A2 OFDM 64-QAM, P2, OBW/TCP Plot
Figure 26 – Conducted CH14 A2 OFDM 16-QAM, P0, OBW/TCP Plot

Figure 27 – Conducted CH14 A2 OFDM 16-QAM, P1, OBW/TCP Plot
Figure 28 – Conducted CH14 A2 OFDM 16-QAM, P2, OBW/TCP Plot

Figure 29 – Conducted CH14 A2 OFDM BPSK, P0, OBW/TCP Plot
Figure 30 – Conducted CH14 A2 OFDM BPSK, P1, OBW/TCP Plot

Figure 31 – Conducted CH14 A2 OFDM BPSK, P2, OBW/TCP Plot
Channel 14 A0: Antenna Port Conducted Emissions Measurements

The following plots present the antenna port conducted emissions for Channel 14 on Chain A0.

Figure 32 – Conducted CH14 A0 OFDM 64-QAM, P0, Emissions Plot
Figure 33 – Conducted CH14 A0 OFDM 64-QAM, P1, Emissions Plot

Figure 34 – Conducted CH14 A0 OFDM 64-QAM, P2, Emissions Plot
Figure 35 – Conducted CH14 A0 OFDM 16-QAM, P0, Emissions Plot

Figure 36 – Conducted CH14 A0 OFDM 16-QAM, P1, Emissions Plot
Figure 37 – Conducted CH14 A0 OFDM 16-QAM, P2, Emissions Plot

Figure 38 – Conducted CH14 A0 OFDM BPSK, P0, Emissions Plot
Figure 39 – Conducted CH14 A0 OFDM BPSK, P1, Emissions Plot

Figure 40 – Conducted CH14 A0 OFDM BPSK, P2, Emissions Plot
Channel 14 A1: Antenna Port Conducted Emissions Measurements

The following plots present the antenna port conducted emissions for Channel 14 on Chain A1.

Figure 41 – Conducted CH14 A1 OFDM 64-QAM, P0, Emissions Plot
Figure 42 – Conducted CH14 A1 OFDM 64-QAM, P1, Emissions Plot

Figure 43 – Conducted CH14 A1 OFDM 64-QAM, P2, Emissions Plot
Figure 44 – Conducted CH14 A1 OFDM 16-QAM, P0, Emissions Plot

Figure 45 – Conducted CH14 A1 OFDM 16-QAM, P1, Emissions Plot
Figure 46 – Conducted CH14 A1 OFDM 16-QAM, P2, Emissions Plot

Figure 47 – Conducted CH14 A1 OFDM BPSK, P0, Emissions Plot
Figure 48 – Conducted CH14 A1 OFDM BPSK, P1, Emissions Plot

Figure 49 – Conducted CH14 A1 OFDM BPSK, P2, Emissions Plot
Channel 14 A2: Antenna Port Conducted Emissions Measurements

The following plots present the antenna port conducted emissions for Channel 14 on Chain A2.

Figure 50 – Conducted CH14 A2 OFDM 64-QAM, P0, Emissions Plot
Figure 51 – Conducted CH14 A2 OFDM 64-QAM, P1, Emissions Plot

Figure 52 – Conducted CH14 A2 OFDM 64-QAM, P2, Emissions Plot
Figure 53 – Conducted CH14 A2 OFDM 16-QAM, P0, Emissions Plot

Figure 54 – Conducted CH14 A2 OFDM 16-QAM, P1, Emissions Plot
Figure 55 – Conducted CH14 A2 OFDM 16-QAM, P2, Emissions Plot

Figure 56 – Conducted CH14 A2 OFDM BPSK, P0, Emissions Plot
Figure 57 – Conducted CH14 A2 OFDM BPSK, P1, Emissions Plot

Figure 58 – Conducted CH14 A2 OFDM BPSK, P2, Emissions Plot
Channel 6 A0 Occupied Bandwidth and Total Power Measurements

The following plots present Occupied Bandwidth and Total Power measurements for Channel 6 on Chain A0.

Figure 59 – Conducted CH6 A0 OFDM 64-QAM, P0, OBW/TCP Plot
Figure 60 – Conducted CH6 A0 OFDM 64-QAM, P1, OBW/TCP Plot

Figure 61 – Conducted CH6 A0 OFDM 64-QAM, P2, OBW/TCP Plot
Figure 62 – Conducted CH6 A0 OFDM 16-QAM, P0, OBW/TCP Plot

Figure 63 – Conducted CH6 A0 OFDM 16-QAM, P1, OBW/TCP Plot
Figure 64 – Conducted CH6 A0 OFDM 16-QAM, P2, OBW/TCP Plot

Figure 65 – Conducted CH6 A0 OFDM BPSK, P0, OBW/TCP Plot
Figure 66 – Conducted CH6 A0 OFDM BPSK, P1, OBW/TCP Plot

Figure 67 – Conducted CH6 A0 OFDM BPSK, P2, OBW/TCP Plot
Channel 6 A1 Occupied Bandwidth and Total Power Measurements

The following plots present Occupied Bandwidth and Total Power measurements for Channel 6 on Chain A1.

Figure 68 – Conducted CH6 A1 OFDM 64-QAM, P0, OBW/TCP Plot
Figure 69 – Conducted CH6 A1 OFDM 64-QAM, P1, OBW/TCP Plot

Figure 70 – Conducted CH6 A1 OFDM 64-QAM, P2, OBW/TCP Plot
Figure 71 – Conducted CH6 A1 OFDM 16-QAM, P0, OBW/TCP Plot

Figure 72 – Conducted CH6 A1 OFDM 16-QAM, P1, OBW/TCP Plot
Figure 73 – Conducted CH6 A1 OFDM 16-QAM, P2, OBW/TCP Plot

Figure 74 – Conducted CH6 A1 OFDM BPSK, P0, OBW/TCP Plot
Figure 75 – Conducted CH6 A1 OFDM BPSK, P1, OBW/TCP Plot

Figure 76 – Conducted CH6 A1 OFDM BPSK, P2, OBW/TCP Plot
**Channel 6 A2 Occupied Bandwidth and Total Power Measurements**

The following plots present Occupied Bandwidth and Total Power measurements for Channel 6 on Chain A2.

![Plot of Occupied Bandwidth and Total Power Measurements](image)

**Occupied Bandwidth**

- 17.772 MHz
- Transmit Freq Error: -10.162 kHz
- x dB Bandwidth: 17.70 MHz

**Total Power**

- 21.5 dBm
- OBW Power: 99.00 %
- x dB: -6.00 dB

*Figure 77 – Conducted CH6 A2 OFDM 64-QAM, P0, OBW/TCP Plot*
Figure 78 – Conducted CH6 A2 OFDM 64-QAM, P1, OBW/TCP Plot

Figure 79 – Conducted CH6 A2 OFDM 64-QAM, P2, OBW/TCP Plot
Figure 80 – Conducted CH6 A2 OFDM 16-QAM, P0, OBW/TCP Plot

Figure 81 – Conducted CH6 A2 OFDM 16-QAM, P1, OBW/TCP Plot
Figure 82 – Conducted CH6 A2 OFDM 16-QAM, P2, OBW/TCP Plot

Figure 83 – Conducted CH6 A2 OFDM BPSK, P0, OBW/TCP Plot
Figure 84 – Conducted CH6 A2 OFDM BPSK, P1, OBW/TCP Plot

Figure 85 – Conducted CH6 A2 OFDM BPSK, P2, OBW/TCP Plot
Channel 6 A0 Antenna Port Conducted Emissions Measurements

The following plots present the antenna port conducted emissions for Channel 6 on Chain A0.

Figure 86 – Conducted CH6 A0 OFDM 64-QAM, P0, Emissions Plot
### Figure 87 – Conducted CH6 A0 OFDM 64-QAM, P1, Emissions Plot

![Graph showing emissions plot with key data points and analysis](image)

### Figure 88 – Conducted CH6 A0 OFDM 64-QAM, P2, Emissions Plot

![Graph showing emissions plot with key data points and analysis](image)
Figure 89 – Conducted CH6 A0 OFDM 16-QAM, P0, Emissions Plot

Figure 90 – Conducted CH6 A0 OFDM 16-QAM, P1, Emissions Plot
Figure 91 – Conducted CH6 A0 OFDM 16-QAM, P2, Emissions Plot

Figure 92 – Conducted CH6 A0 OFDM BPSK, P0, Emissions Plot
Figure 93 – Conducted CH6 A0 OFDM BPSK, P1, Emissions Plot

Figure 94 – Conducted CH6 A0 OFDM BPSK, P2, Emissions Plot
Channel 6 A1 Antenna Port Conducted Emissions Measurements

The following plots present the antenna port conducted emissions for Channel 6 on Chain A1.

Figure 95 – Conducted CH6 A1 OFDM 64-QAM, P0, Emissions Plot
Figure 96 – Conducted CH6 A1 OFDM 64-QAM, P1, Emissions Plot

Figure 97 – Conducted CH6 A1 OFDM 64-QAM, P2, Emissions Plot
Figure 98 – Conducted CH6 A1 OFDM 16-QAM, P0, Emissions Plot

Figure 99 – Conducted CH6 A1 OFDM 16-QAM, P1, Emissions Plot
Figure 100 – Conducted CH6 A1 OFDM 16-QAM, P2, Emissions Plot

Figure 101 – Conducted CH6 A1 OFDM BPSK, P0, Emissions Plot
Figure 102 – Conducted CH6 A1 OFDM BPSK, P1, Emissions Plot

Figure 103 – Conducted CH6 A1 OFDM BPSK, P2, Emissions Plot
Channel 6 A2 Antenna Port Conducted Emissions Measurements

The following plots present the antenna port conducted emissions for Channel 6 on Chain A2.

Figure 104 – Conducted CH6 A2 OFDM 64-QAM, P0, Emissions Plot
Figure 105 – Conducted CH6 A2 OFDM 64-QAM, P1, Emissions Plot

Figure 106 – Conducted CH6 A2 OFDM 64-QAM, P2, Emissions Plot
Figure 107 – Conducted CH6 A2 OFDM 16-QAM, P0, Emissions Plot

Figure 108 – Conducted CH6 A2 OFDM 16-QAM, P1, Emissions Plot
Figure 109 – Conducted CH6 A2 OFDM 16-QAM, P2, Emissions Plot

Figure 110 – Conducted CH6 A2 OFDM BPSK, P0, Emissions Plot
Figure 111 – Conducted CH6 A2 OFDM BPSK, P1, Emissions Plot

Figure 112 – Conducted CH6 A2 OFDM BPSK, P2, Emissions Plot
Channel 14 Spurious Measurement

The following plots present Spurious Measurements for Channel 14 at maximum power setting (2400 – 2500 MHz).

Figure 113 – Conducted CH14 A0 OFDM 64-QAM, P0, Spurious Left Plot
Figure 114 – Conducted CH14 A1 OFDM 64-QAM, P0, Spurious Left Plot

Figure 115 – Conducted CH14 A2 OFDM 64-QAM, P0, Spurious Left Plot
Channel 14 Spurious Measurement

The following plots present Spurious Measurements for Channel 14 at maximum power setting (2460 – 2560 MHz).

Figure 116 – Conducted CH14 A0 OFDM 64-QAM, P0, Spurious Right Plot
Figure 117 – Conducted CH14 A1 OFDM 64-QAM, P0, Spurious Right Plot

Figure 118 – Conducted CH14 A2 OFDM 64-QAM, P0, Spurious Right Plot
Channel 14 Spurious Measurement

The following plots present Spurious Measurements for Channel 14 at maximum power reduced by 8 dB setting (2400 - 2500 MHz).

Figure 119 – Conducted CH14 A0 OFDM 64-QAM, P2, Spurious Left Plot
Figure 120 – Conducted CH14 A1 OFDM 64-QAM, P2, Spurious Left Plot

Figure 121 – Conducted CH14 A2 OFDM 64-QAM, P2, Spurious Left Plot
Channel 14 Spurious Measurement

The following plots present Spurious Measurements for Channel 14 at maximum power reduced by 8 dB setting (2460 - 2560 MHz).

Figure 122 – Conducted CH14 A0 OFDM 64-QAM, P2, Spurious Right Plot
Figure 123 – Conducted CH14 A1 OFDM 64-QAM, P2, Spurious Right Plot

Figure 124 – Conducted CH14 A2 OFDM 64-QAM, P2, Spurious Right Plot
Channel 14 Spurious Measurement

The following plots present Spurious Measurements for Channel 14 at maximum power setting (1000 - 5500 MHz).

Figure 125 – Conducted CH14 A0 OFDM 64-QAM, P0, Spurious Plot
Figure 126 – Conducted CH14 A1 OFDM 64-QAM, P0, Spurious Plot

Figure 127 – Conducted CH14 A2 OFDM 64-QAM, P0, Spurious Plot
ANNEX B – RADIATED EMISSIONS TEST DATA

Channel 14: OBW/TCP Plots

![OBW/TCP Plot](image)

Figure 128 – Radiated Channel 14 OFDM 64-QAM, P0, OBW/TCP Plot
Figure 129 – Radiated Channel 14 OFDM 64-QAM, P1, OBW/TCP Plot

Figure 130 – Radiated Channel 14 OFDM 64-QAM, P2, OBW/TCP Plot
Figure 131 – Radiated Channel 14 OFDM 16-QAM, P0, OBW/TCP Plot

Figure 132 – Radiated Channel 14 OFDM 16-QAM, P1, OBW/TCP Plot
Figure 133 – Radiated Channel 14 OFDM 16-QAM, P2, OBW/TCP Plot

Figure 134 – Radiated Channel 14 OFDM BPSK, P0, OBW/TCP Plot
Figure 135 – Radiated Channel 14 OFDM BPSK, P1, OBW/TCP Plot

Figure 136 – Radiated Channel 14 OFDM BPSK, P2, OBW/TCP Plot
Channel 14: Radiated Emissions Plots

Figure 137 – Radiated Channel 14 OFDM 64-QAM, P0, Emissions Plot

Figure 138 – Radiated Channel 14 OFDM 64-QAM, P1, Emissions Plot
### Figure 139 – Radiated Channel 14 OFDM 64-QAM, P2, Emissions Plot

![Radiated Channel 14 OFDM 64-QAM, P2, Emissions Plot](image1)

### Figure 140 – Radiated Channel 14 OFDM 16-QAM, P0, Emissions Plot

![Radiated Channel 14 OFDM 16-QAM, P0, Emissions Plot](image2)
Figure 141 – Radiated Channel 14 OFDM 16-QAM, P1, Emissions Plot

Figure 142 – Radiated Channel 14 OFDM 16-QAM, P2, Emissions Plot
Figure 143 – Radiated Channel 14 OFDM BPSK, P0, Emissions Plot

Figure 144 – Radiated Channel 14 OFDM BPSK, P1, Emissions Plot
Figure 145 – Radiated Channel 14 OFDM BPSK, P2, Emissions Plot
Channel 6: OBW/TCP Plots

Figure 146 – Radiated Channel 6 OFDM 64-QAM, P0, OBW/TCP Plot

Figure 147 – Radiated Channel 6 OFDM 64-QAM, P1, OBW/TCP Plot
Figure 148 – Radiated Channel 6 OFDM 64-QAM, P2, OBW/TCP Plot

Figure 149 – Radiated Channel 6 OFDM 16-QAM, P0, OBW/TCP Plot
Figure 150 – Radiated Channel 6 OFDM 16-QAM, P1, OBW/TCP Plot

Figure 151 – Radiated Channel 6 OFDM 16-QAM, P2, OBW/TCP Plot
Figure 152 – Radiated Channel 6 OFDM BPSK, P0, OBW/TCP Plot

Figure 153 – Radiated Channel 6 OFDM BPSK, P1, OBW/TCP Plot
Figure 154 – Radiated Channel 6 OFDM BPSK, P2, OBW/TCP Plot

Occupied Bandwidth 17.617 MHz
Transmit Freq Error 5.963 kHz
× dB Bandwidth 17.75 MHz
Total Power 14.2 dBm
OBW Power 99.00 %
OBW Power -6.00 dB
Channel 6: Emissions Plots

Figure 155 – Radiated Channel 6 OFDM 64-QAM, P0, Emissions Plot

Figure 156 – Radiated Channel 6 OFDM 64-QAM, P1, Emissions Plot
Figure 157 – Radiated Channel 6 OFDM 64-QAM, P2, Emissions Plot

Figure 158 – Radiated Channel 6 OFDM 16-QAM, P0, Emissions Plot
Figure 159 – Radiated Channel 6 OFDM 16-QAM, P1, Emissions Plot

Figure 160 – Radiated Channel 6 OFDM 16-QAM, P2, Emissions Plot
Figure 161 – Radiated Channel 6 OFDM BPSK, P0, Emissions Plot

Figure 162 – Radiated Channel 6 OFDM BPSK, P1, Emissions Plot
Figure 163 – Radiated Channel 6 OFDM BPSK, P2, Emissions Plot