HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

Hermon Laboratories Ltd.
Harakevet Industrial Zone, Binyamina 30500,
Israel
Tel. +972-4-6288001
Fax. +972-4-6288277
E-mail: mail@hermonlabs.com

# TEST REPORT

**ACCORDING TO: FCC 47CFR part 27**

**FOR:**

## Runcom Technologies Ltd.
## Base station operating in 700 MHz band
## Model: Pico Base Station RNU4000BS
## P/N: PICO-O-700-M-4X1W
## FCC ID:XYMPICO4A701WDC

# Table of contents

# 1 Applicant information

| | |
|---|---|
| **Client name:** | Runcom Technologies Ltd. |
| **Address:** | 11 Moshe Levi street, UMI Building, 12th floor, Rishon Lezion 75658, Israel |
| **Telephone:** | +972 3942 8866 |
| **Fax:** | +972 3952 8805 |
| **E-mail:** | yonatan.zvi@runcom.co.il |
| **Contact name:** | Mr. Yonatan Zvi |

# 2 Equipment under test attributes

| | |
|---|---|
| **Product name:** | Base station operating in 700 MHz band |
| **Product type:** | Transceiver |
| **Model(s):** | Pico Base Station RNU4000BS |
| **Part number:** | PICO-O-700-M-4X1W |
| **Serial number:** | 0406D2207F009B1 |
| **Hardware version:** | Rev2.2 |
| **Software release:** | 03.30.53.01 |
| **Receipt date** | 2/12/2013 |

# 3 Manufacturer information

| | |
|---|---|
| **Manufacturer name:** | Runcom Technologies Ltd. |
| **Address:** | 11 Moshe Levi street, UMI Building, 12th floor, Rishon Lezion 75658, Israel |
| **Telephone:** | +972 3942 8866 |
| **Fax:** | +972 3952 8805 |
| **E-Mail:** | yonatan.zvi@runcom.co.il |
| **Contact name:** | Mr. Yonatan Zvi |

# 4 Test details

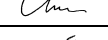
| | |
|---|---|
| **Project ID:** | 24208 |
| **Location:** | Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel |
| **Test started:** | 2/12/2013 |
| **Test completed:** | 2/24/2013 |
| **Test specification(s):** | FCC 47CFR part 27 |

# 5 Tests summary

| Test | Status |
|---|---|
| **Transmitter characteristics** | |
| Section 27.50(c)(3), Peak output power at RF antenna connector | Pass |
| Section 27.52, RF safety | Pass, exhibit provided in Application for Certification |
| Section 27.53(g), Spurious emissions at RF antenna connector | Pass |
| Section 27.53(g), Band edge emissions (emission mask) at RF antenna connector | Pass |
| Section 27.53(g), Radiated spurious emissions | Pass |
| Section 27.54, Frequency stability | Pass |
| Section 2.1049, Occupied bandwidth | Pass |

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

This test report supersedes the previously issued test report identified by Doc ID:RUNRAD_FCC.24208.

| | Name and Title | Date | Signature |
|---|---|---|---|
| **Tested by:** | Mr. S. Samokha, test engineer | February 24, 2013 |  |
| **Reviewed by:** | Mrs. M. Cherniavsky, certification engineer | March 7, 2013 |  |
| **Approved by:** | Mr. M. Nikishin, EMC and Radio group manager | March 7, 2013 |  |

# 6 EUT description

## 6.1 General information

The EUT is a base station of WiMAX system operating in 700 MHz band.

## 6.2 Ports and lines

| Port type | Port description | Connected from | Connected to | Qty. | Cable type | Cable length, m |
|---|---|---|---|---|---|---|
| Power | 48 VDC | DC power supply | EUT | 1 | Unshielded | 10 |
| RF | N-Type | EUT | Antenna | 4 | Coaxial | 1 |
| Signal | 10Base-T | Ethernet switch | Ethernet switch | 1 | Cat 5 | 10 |
| Control* | UART | EUT | PC USB-Com | 1 | Shielded | 10 |
| RF | GPS | EUT | 50 Ohm termination | 1 | NA | NA |
| RF | PPS input | EUT | 50 Ohm termination | 1 | NA | NA |
| RF | PPS output | EUT | 50 Ohm termination | 1 | NA | NA |

* - for service only

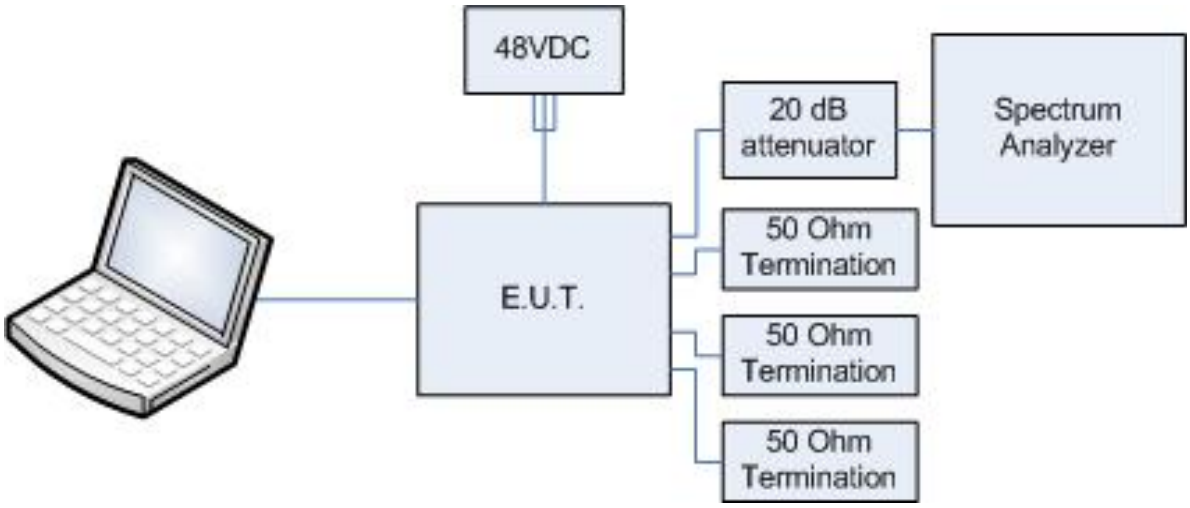
## 6.3 Support and test equipment

| Description | Manufacturer | Model number | Serial number |
|---|---|---|---|
| DC power supply | MW (Mean Well) | ESP-240-48 | NA |
| Laptop | IBM | ThinkPad R60 | L3-A7675 |
| 50 Ohm termination | RELM | LT-50 | 3835 |
| 50 Ohm termination | RELM | LT-50 | 3836 |
| AC/DC adapter | Lenovo | 42T4432 | Z1ZF3J9BA2RD |
| DC power supply | Horizon Electronics | DHR3655D | 767469 |

## 6.4 Changes made in EUT

No changes were implemented in the EUT.

## 6.5 Test configuration



## 6.6 Transmitter characteristics

| Type of equipment | | |
|---|---|---|
| V | Stand-alone (Equipment with or without its own control provisions) | |
| | Combined equipment (Equipment where the radio part is fully integrated within another type of equipment) | |
| | Plug-in card (Equipment intended for a variety of host systems) | |

| Intended use | | Condition of use |
|---|---|---|
| V | fixed | Always at a distance more than 2 m from all people |
| | mobile | Always at a distance more than 20 cm from all people |
| | portable | May operate at a distance closer than 20 cm to human body |

| | |
|---|---|
| **Assigned frequency range** | 705.0 – 745.0 MHz |
| **Operating frequency range** | 707.5 – 742.5 MHz for 5 MHz OBW<br>710.0 –740.0 MHz for 10 MHz OBW |
| **RF channel spacing** | 5, 10 MHz |
| **Maximum rated output power** | At transmitter 50 Ω RF output connector (aggregate power of four RF chains): 21.57 dBm – 5 MHz OBW; 22.51 dBm – 10 MHz OBW |

| | | | | | |
|---|---|---|---|---|---|
| **Is transmitter output power variable?** | | No | | | |
| | **V** | Yes | | continuous variable | |
| | | | V | stepped variable with step size | 1.0 dB |
| | | | minimum RF power | | 0 dBm |
| | | | maximum RF power | | dBm |

| Antenna connection | | | | |
|---|---|---|---|---|
| unique coupling | **V** | standard connector | Integral | with temporary RF connector |
| | | | | without temporary RF connector |

| Antenna/s technical characteristics | | | |
|---|---|---|---|
| Type | Manufacturer | Model number | Gain |
| Dual polarized 90° sector antenna | Alpha Wireless | AW3054 | 12.5 dBi |
| Dual polarized 65° sector antenna | Alpha Wireless | AW3052 | 13.5 dBi |

| Transmitter aggregate data rate/s, Mbps | | | |
|---|---|---|---|
| Transmitter 99% power bandwidth | Type of modulation | | |
| | QPSK | 16QAM | 64QAM |
| 5 MHz | 2.5-3.8 Mbps | 5.0-7.6 Mbps | 5.6-9.3 Mbps |
| 10 MHz | 5.1-7.6 Mbps | 10.2-15.2 Mbps | 11.2-18.7 Mbps |

| | |
|---|---|
| **Type of modulation** | QPSK1/2, QPSK3/4, 16QAM1/2, 16QAM3/4, 64QAM1/2, 64QAM2/3, 64QAM3/4, 64QAM5/6 |
| Type of multiplexing | OFDMA/TDD |
| Modulating test signal (baseband) | PRBS |
| Maximum transmitter duty cycle in normal use | 67 % |
| Beamforming MIMO/SISO | Yes |

| Transmitter power source | | | |
|---|---|---|---|
| V | DC | Nominal rated voltage | 48 VDC |
| | AC | Nominal rated voltage | |

| Common power source for transmitter and receiver | V | yes | no |
|---|---|---|---|

| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

# 7 Transmitter tests according to 47CFR part 27

## 7.1 Output power test

### 7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1.

**Table 7.1.1 Output power limits**

| Transmitter type | Assigned frequency range, MHz | Maximum output power, ERP | |
|---|---|---|---|
| | | W | dBm |
| Fixed and base stations | 698 – 746 | 1000/1 MHz | 60.0/1 MHz |

* The maximum output power limit shall be calculated by subtracting of antenna gain in dBd from maximum allowed ERP

### 7.1.2 Test procedure

**7.1.2.1** The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

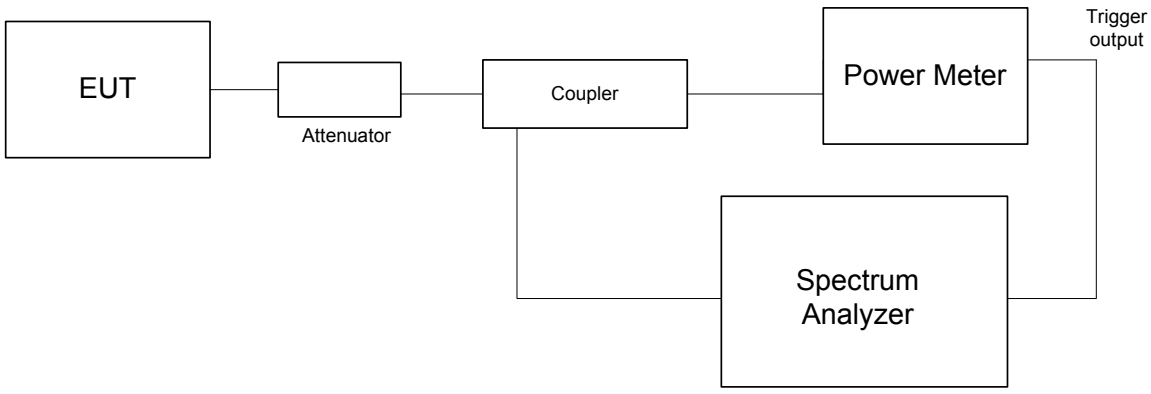
**7.1.2.2** The EUT was adjusted to produce maximum available to the end user RF output power.

**7.1.2.3** The resolution bandwidth of spectrum analyzer was set to 1 MHz and the average power was integrated over EBW as provided in Table 7.1.2, Table 7.1.4.

**7.1.2.4** The peak output power was measured with power meter as provided in Table 7.1.3, Table 7.1.5.

**7.1.2.5** The test results are provided in the tables below and the associated plots.

**Figure 7.1.1 Peak output power test setup**



| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

**Table 7.1.2 ERP test results**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
RESOLUTION BANDWIDTH: 1000 kHz
VIDEO BANDWIDTH: 3000 kHz
MODULATING SIGNAL: PRBS
MAXIMUM ANTENNA GAIN: 13.5 dBi (11.35 dBd)

BEAM FORMING GAIN: Enable (6 dB)
CHANNEL BANDWIDTH: 5 MHz

| Carrier frequency, MHz | Spectrum analyzer reading RF#1 dBm/MHz | Spectrum analyzer reading RF#2 dBm/MHz | Spectrum analyzer reading RF#3 dBm/MHz | Spectrum analyzer reading RF#4 dBm/MHz | Antenna gain, dBd | Beamforming gain, dB | Total ERP density, dBm/MHz* | Limit, dBm/MHz | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **QPSK** | | | | | | | | | | |
| 707.5 | 5.86 | 7.02 | 4.57 | 4.62 | 11.35 | 6.00 | 29.01 | 60.0 | -30.99 | Pass |
| 725.0 | 6.27 | 7.59 | 5.35 | 5.41 | 11.35 | 6.00 | 29.62 | 60.0 | -30.38 | Pass |
| 742.5 | 6.55 | 6.79 | 5.11 | 5.28 | 11.35 | 6.00 | 29.37 | 60.0 | -30.63 | Pass |
| **64QAM** | | | | | | | | | | |
| 707.5 | 5.91 | 7.07 | 4.62 | 4.65 | 11.35 | 6.00 | 29.05 | 60.0 | -30.95 | Pass |
| 725.0 | 6.42 | 7.71 | 5.46 | 5.49 | 11.35 | 6.00 | 29.74 | 60.0 | -30.26 | Pass |
| 742.5 | 6.59 | 6.87 | 5.22 | 5.39 | 11.35 | 6.00 | 29.45 | 60.0 | -30.55 | Pass |

BEAM FORMING GAIN: Enable (6 dB)
CHANNEL BANDWIDTH: 10 MHz

| Carrier frequency, MHz | Spectrum analyzer reading RF#1 dBm/MHz | Spectrum analyzer reading RF#2 dBm/MHz | Spectrum analyzer reading RF#3 dBm/MHz | Spectrum analyzer reading RF#4 dBm/MHz | Antenna gain, dBd | Beamforming gain, dB | Total ERP density, dBm/MHz* | Limit, dBm/MHz | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **QPSK** | | | | | | | | | | |
| 710.0 | 4.20 | 5.31 | 2.97 | 2.92 | 11.35 | 6.00 | 27.34 | 60.0 | -32.66 | Pass |
| 725.0 | 4.44 | 5.81 | 3.65 | 3.57 | 11.35 | 6.00 | 27.84 | 60.0 | -32.16 | Pass |
| 740.0 | 4.78 | 5.05 | 3.39 | 3.54 | 11.35 | 6.00 | 27.62 | 60.0 | -32.38 | Pass |
| **64QAM** | | | | | | | | | | |
| 710.0 | 3.80 | 5.09 | 2.80 | 2.86 | 11.35 | 6.00 | 27.11 | 60.0 | -32.89 | Pass |
| 725.0 | 4.57 | 5.78 | 3.78 | 3.68 | 11.35 | 6.00 | 27.91 | 60.0 | -32.09 | Pass |
| 740.0 | 4.82 | 5.14 | 3.54 | 3.68 | 11.35 | 6.00 | 27.72 | 60.0 | -32.28 | Pass |

* - Total ERP density, dBm/MHz = Pmeas**, dBm/MHz + Antenna Gain, dBd + Beamforming Gain,dB
** - Pmeas , dBm/MHz = 10 log{10^[P(dBm/MHz,RF#1)/10]+ 10^([P(dBm/MHz, RF#2)/10]+10^[P(dBm/MHz,RF#3)/10]+ 10^([P(dBm/MHz, RF#4)/10]}
*** Margin (dB) = Total ERP density (dBm/MHz) – Limit (dBm/MHz)

| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

**Table 7.1.3 Total output power test results**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
RESOLUTION BANDWIDTH: 1000 kHz
VIDEO BANDWIDTH: 3000 kHz
MODULATING SIGNAL: PRBS
MAXIMUM ANTENNA GAIN: 13.5 dbi (11.35 dBd)

BEAM FORMING GAIN: Enable (6 dB)
CHANNEL BANDWIDTH: 5 MHz

| Carrier frequency, MHz | Power Meter reading RF#1 dBm | Power Meter reading RF#2, dBm | Power Meter reading RF#3 dBm | Power Meter reading RF#4, dBm | Antenna gain, dBd | Beamforming gain, dB | Total ERP*, dBm | Limit, dBm | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **QPSK** | | | | | | | | | | |
| 707.5 | 15.22 | 16.39 | 13.88 | 13.89 | 11.35 | 6.00 | 38.34 | 60.0 | -21.66 | Pass |
| 725.0 | 15.56 | 16.92 | 14.62 | 14.58 | 11.35 | 6.00 | 38.90 | 60.0 | -21.10 | Pass |
| 742.5 | 15.82 | 16.12 | 14.39 | 14.57 | 11.35 | 6.00 | 38.66 | 60.0 | -21.34 | Pass |
| **64QAM** | | | | | | | | | | |
| 707.5 | 15.18 | 16.37 | 13.91 | 13.95 | 11.35 | 6.00 | 38.34 | 60.0 | -21.66 | Pass |
| 725.0 | 15.61 | 16.94 | 14.63 | 14.60 | 11.35 | 6.00 | 38.92 | 60.0 | -21.08 | Pass |
| 742.5 | 15.79 | 16.14 | 14.43 | 14.58 | 11.35 | 6.00 | 38.67 | 60.0 | -21.33 | Pass |

BEAM FORMING GAIN: Enable (6 dB)
CHANNEL BANDWIDTH: 10 MHz

| Carrier frequency, MHz | Power Meter reading RF#1 dBm | Power Meter reading RF#2, dBm | Power Meter reading RF#3 dBm | Power Meter reading RF#4, dBm | Antenna gain, dBd | Beamforming gain, dB | Total ERP*, dBm | Limit, dBm | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **QPSK** | | | | | | | | | | |
| 710.0 | 16.04 | 17.33 | 14.86 | 14.73 | 11.35 | 6.00 | 39.24 | 60.0 | -20.76 | Pass |
| 725.0 | 15.93 | 17.46 | 15.03 | 15.32 | 11.35 | 6.00 | 39.41 | 60.0 | -20.59 | Pass |
| 740.0 | 16.92 | 17.27 | 15.39 | 15.62 | 11.35 | 6.00 | 39.75 | 60.0 | -20.25 | Pass |
| **64QAM** | | | | | | | | | | |
| 710.0 | 15.68 | 17.01 | 14.61 | 14.62 | 11.35 | 6.00 | 38.97 | 60.0 | -21.03 | Pass |
| 725.0 | 16.21 | 17.51 | 15.49 | 15.38 | 11.35 | 6.00 | 39.60 | 60.0 | -20.40 | Pass |
| 740.0 | 16.94 | 17.30 | 15.67 | 15.83 | 11.35 | 6.00 | 39.86 | 60.0 | -20.14 | Pass |

* - Total ERP, dBm = Pmeas**, dBm + Antenna Gain, dBd + Beamforming Gain,dB
** - Pmeas , dBm = 10 log{10^[P(dBm,RF#1)/10]+ 10^([P(dBm, RF#2)/10]+10^[P(dBm,RF#3)/10]+ 10^([P(dBm, RF#4)/10]}
*** - Margin (dB) = Total ERP (dBm)– Limit (dBm)

| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

**Table 7.1.4 ERP test results**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
RESOLUTION BANDWIDTH: 1000 kHz
VIDEO BANDWIDTH: 3000 kHz
MODULATING SIGNAL: PRBS
MAXIMUM ANTENNA GAIN: 13.5 dbi (11.35 dBd)

BEAM FORMING GAIN: Enable (3 dB)
CHANNEL BANDWIDTH: 5 MHz

| Carrier frequency, MHz | Spectrum analyzer reading RF#1 dBm/MHz | Spectrum analyzer reading RF#2 dBm/MHz | Spectrum analyzer reading RF#3 dBm/MHz | Spectrum analyzer reading RF#4 dBm/MHz | Antenna gain, dBd | Beamforming gain, dB | Total ERP density, dBm/MHz* | Limit, dBm/MHz | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **QPSK** | | | | | | | | | | |
| 707.5 | 5.57 | 6.68 | 4.36 | 4.27 | 11.35 | 3.0 | 25.71 | 60.0 | -34.29 | Pass |
| 725.0 | 6.14 | 7.33 | 5.22 | 5.18 | 11.35 | 3.0 | 26.43 | 60.0 | -33.57 | Pass |
| 742.5 | 6.25 | 6.39 | 4.86 | 5.15 | 11.35 | 3.0 | 26.08 | 60.0 | -33.92 | Pass |
| **64QAM** | | | | | | | | | | |
| 707.5 | 5.67 | 6.81 | 4.44 | 4.37 | 11.35 | 3.0 | 25.81 | 60.0 | -34.19 | Pass |
| 725.0 | 6.33 | 7.53 | 5.43 | 5.38 | 11.35 | 3.0 | 26.63 | 60.0 | -33.37 | Pass |
| 742.5 | 6.46 | 6.58 | 5.07 | 5.33 | 11.35 | 3.0 | 26.28 | 60.0 | -33.72 | Pass |

BEAM FORMING GAIN: Enable (3 dB)
CHANNEL BANDWIDTH: 10 MHz

| Carrier frequency, MHz | Spectrum analyzer reading RF#1 dBm/MHz | Spectrum analyzer reading RF#2 dBm/MHz | Spectrum analyzer reading RF#3 dBm/MHz | Spectrum analyzer reading RF#4 dBm/MHz | Antenna gain, dBd | Beamforming gain, dB | Total ERP density, dBm/MHz* | Limit, dBm/MHz | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **QPSK** | | | | | | | | | | |
| 710.0 | 3.96 | 5.00 | 2.76 | 2.69 | 11.35 | 3.0 | 24.08 | 60.0 | -35.92 | Pass |
| 725.0 | 4.26 | 5.51 | 3.44 | 3.45 | 11.35 | 3.0 | 24.62 | 60.0 | -35.38 | Pass |
| 740.0 | 4.46 | 4.80 | 3.20 | 3.35 | 11.35 | 3.0 | 24.38 | 60.0 | -35.62 | Pass |
| **64QAM** | | | | | | | | | | |
| 710.0 | 4.02 | 5.05 | 2.79 | 2.69 | 11.35 | 3.0 | 24.12 | 60.0 | -35.88 | Pass |
| 725.0 | 4.20 | 5.45 | 3.36 | 3.37 | 11.35 | 3.0 | 24.55 | 60.0 | -35.45 | Pass |
| 740.0 | 4.56 | 4.88 | 3.26 | 3.37 | 11.35 | 3.0 | 24.45 | 60.0 | -35.55 | Pass |

* - Total ERP density, dBm/MHz = Pmeas**, dBm/MHz + Antenna Gain, dBd + Beamforming Gain,dB
** - Pmeas , dBm/MHz = 10 log{10^[P(dBm/MHz,RF#1)/10]+ 10^([P(dBm/MHz, RF#2)/10]+10^[P(dBm/MHz,RF#3)/10]+ 10^([P(dBm/MHz, RF#4)/10]}
*** Margin (dB) = Total ERP density (dBm/MHz) – Limit (dBm/MHz)

| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

**Table 7.1.5 Total output power test results**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
RESOLUTION BANDWIDTH: 1000 kHz
VIDEO BANDWIDTH: 3000 kHz
MODULATING SIGNAL: PRBS
MAXIMUM ANTENNA GAIN: 13.5 dbi (11.35 dBd)

BEAM FORMING GAIN: Enable (3 dB)
CHANNEL BANDWIDTH: 5 MHz

| Carrier frequency, MHz | Power Meter reading RF#1 dBm | Power Meter reading RF#2, dBm | Power Meter reading RF#3 dBm | Power Meter reading RF#4, dBm | Antenna gain, dBd | Beamforming gain, dB | Total ERP*, dBm | Limit, dBm | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **QPSK** | | | | | | | | | | |
| 707.5 | 14.85 | 16.01 | 13.67 | 13.54 | 11.35 | 3.0 | 35.01 | 60.0 | -24.99 | Pass |
| 725.0 | 15.44 | 16.63 | 14.54 | 14.44 | 11.35 | 3.0 | 35.73 | 60.0 | -24.27 | Pass |
| 742.5 | 15.54 | 15.72 | 14.18 | 14.39 | 11.35 | 3.0 | 35.38 | 60.0 | -24.62 | Pass |
| **64QAM** | | | | | | | | | | |
| 707.5 | 14.89 | 15.97 | 13.63 | 13.53 | 11.35 | 3.0 | 34.99 | 60.0 | -25.01 | Pass |
| 725.0 | 15.43 | 16.64 | 14.55 | 14.46 | 11.35 | 3.0 | 35.73 | 60.0 | -24.27 | Pass |
| 742.5 | 15.61 | 15.77 | 14.17 | 14.47 | 11.35 | 3.0 | 35.43 | 60.0 | -24.57 | Pass |

BEAM FORMING GAIN: Enable (3 dB)
CHANNEL BANDWIDTH: 10 MHz

| Carrier frequency, MHz | Power Meter reading RF#1 dBm | Power Meter reading RF#2, dBm | Power Meter reading RF#3 dBm | Power Meter reading RF#4, dBm | Antenna gain, dBd | Beamforming gain, dB | Total ERP*, dBm | Limit, dBm | Margin, dB*** | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **QPSK** | | | | | | | | | | |
| 710.0 | 16.22 | 17.29 | 14.96 | 14.86 | 11.35 | 3.0 | 36.32 | 60.0 | -23.68 | Pass |
| 725.0 | 16.16 | 17.41 | 15.36 | 15.38 | 11.35 | 3.0 | 36.53 | 60.0 | -23.47 | Pass |
| 740.0 | 16.63 | 16.99 | 15.39 | 15.52 | 11.35 | 3.0 | 36.56 | 60.0 | -23.44 | Pass |
| **64QAM** | | | | | | | | | | |
| 710.0 | 16.24 | 17.32 | 14.97 | 14.88 | 11.35 | 3.0 | 36.34 | 60.0 | -23.66 | Pass |
| 725.0 | 16.15 | 17.43 | 15.36 | 15.39 | 11.35 | 3.0 | 36.54 | 60.0 | -23.46 | Pass |
| 740.0 | 16.67 | 17.02 | 15.42 | 15.53 | 11.35 | 3.0 | 36.59 | 60.0 | -23.41 | Pass |

* - Total ERP, dBm = Pmeas**, dBm + Antenna Gain, dBd + Beamforming Gain,dB
** - Pmeas , dBm = 10 log{10^[P(dBm,RF#1)/10]+ 10^([P(dBm, RF#2)/10]+10^[P(dBm,RF#3)/10]+ 10^([P(dBm, RF#4)/10]}
*** - Margin (dB) = Total ERP (dBm)– Limit (dBm)

**Reference numbers of test equipment used**

| HL 2952 | HL 3301 | HL 3302 | HL 3472 | HL 3473 | HL 3474 | HL 3781 | HL 3818 |
|---|---|---|---|---|---|---|---|
| HL 3901 | HL 4425 | | | | | | |

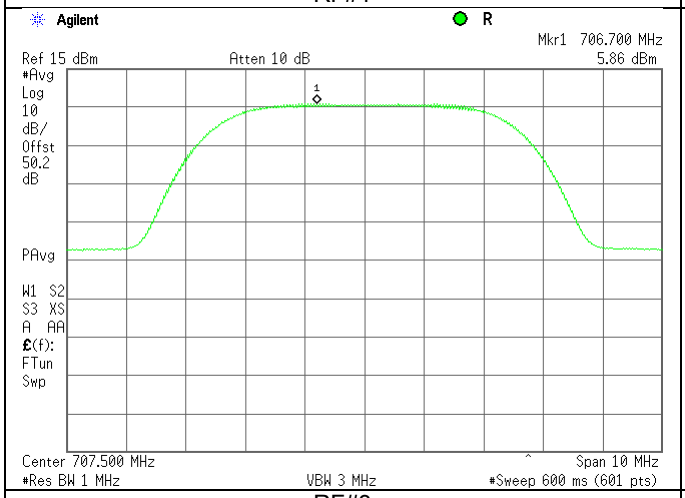
Full description is given in Appendix A.

| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

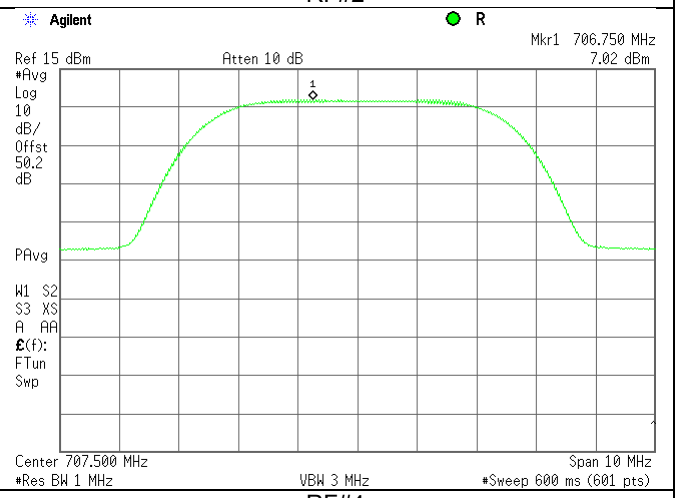
**Plot 7.1.1 Output power test results at low frequency, QPSK modulation, 5 MHz CBW**

| BEAMFORMING GAIN: | 6 dB |
|---|---|

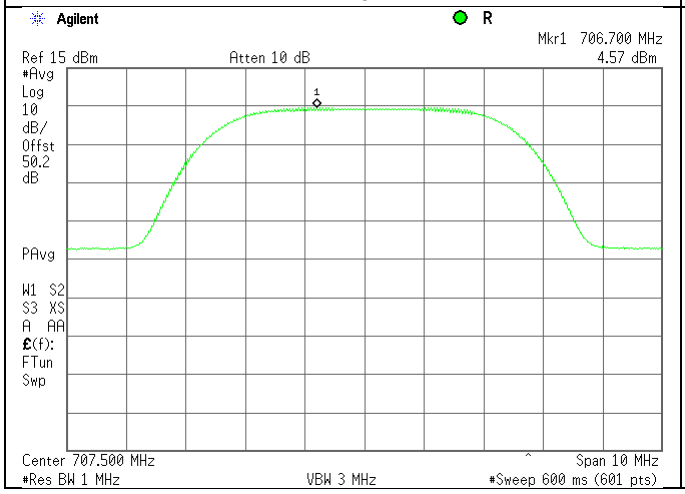
RF#1



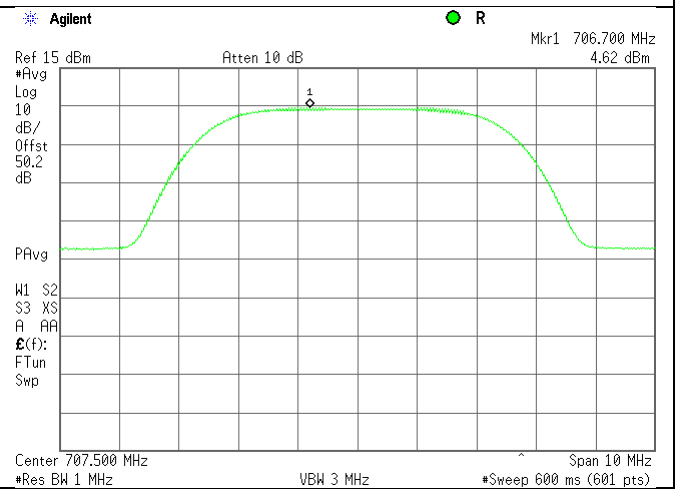

RF#2




RF#3




RF#4

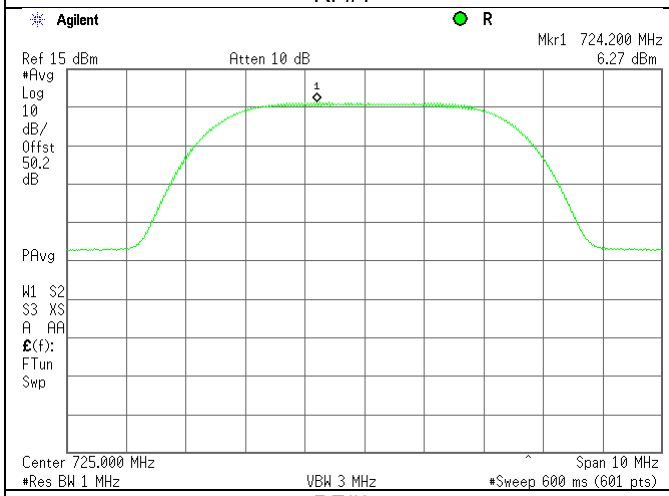


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

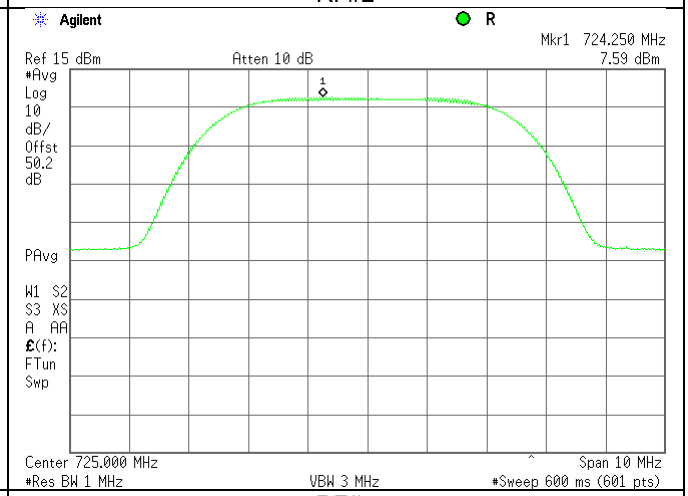
**Plot 7.1.2 Output power test results at mid frequency, QPSK modulation, 5 MHz CBW**

BEAMFORMING GAIN: 6 dB

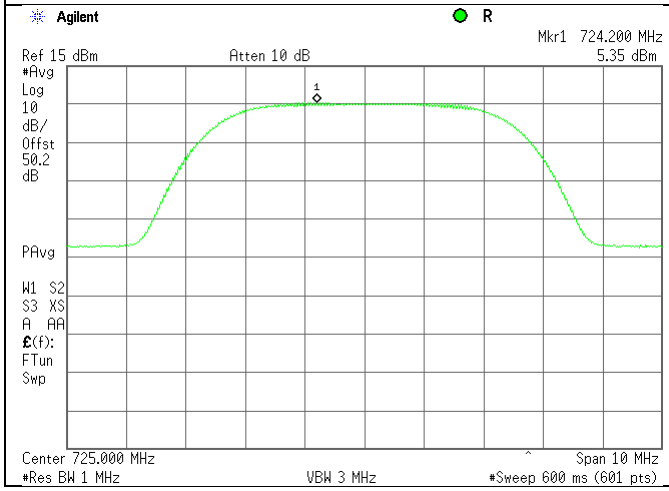
RF#1



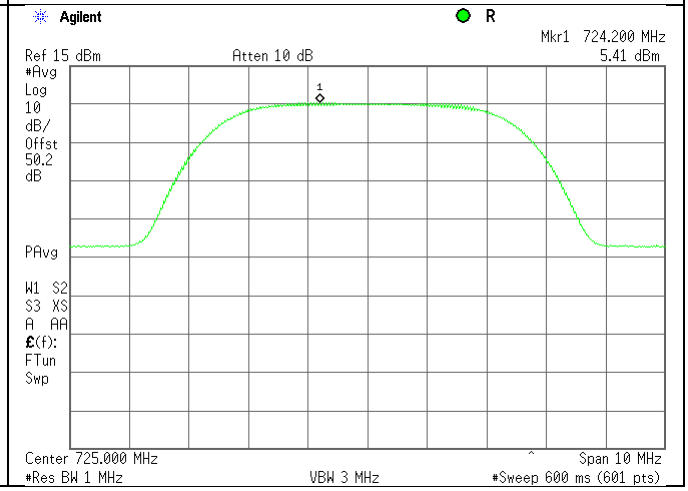

RF#2




RF#3




RF#4

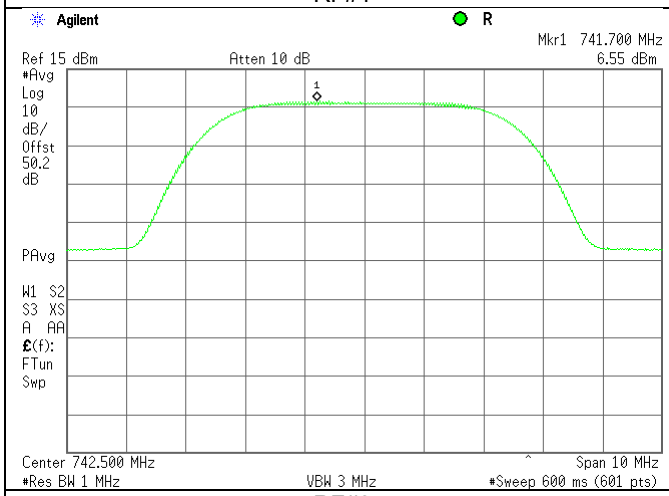


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

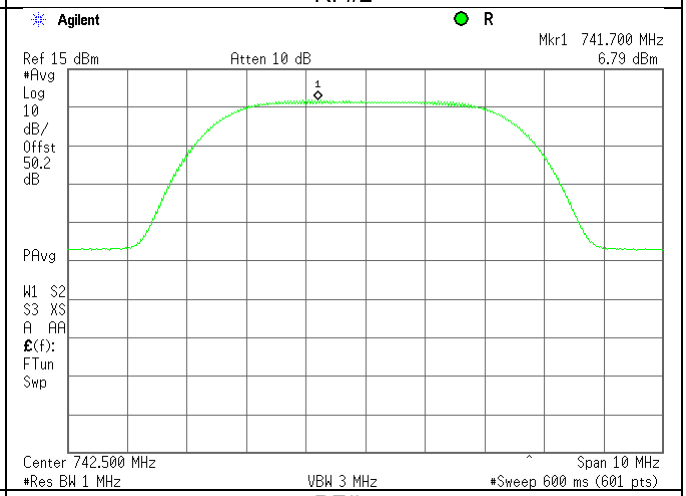
**Plot 7.1.3 Output power test results at high frequency, QPSK modulation, 5 MHz CBW**

BEAMFORMING GAIN: 6 dB

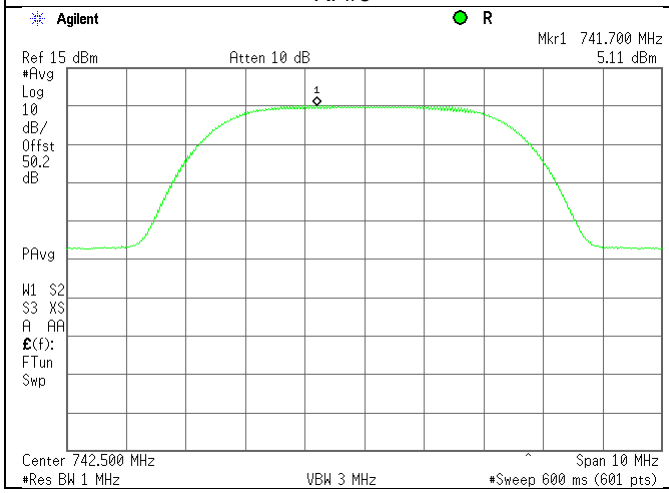
RF#1



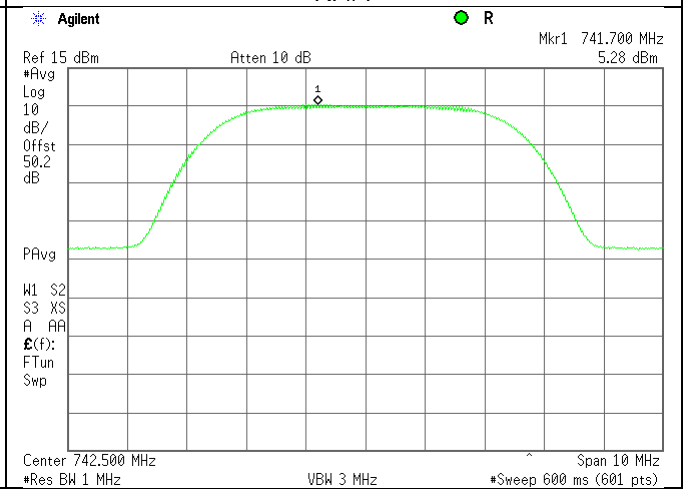

RF#2




RF#3




RF#4

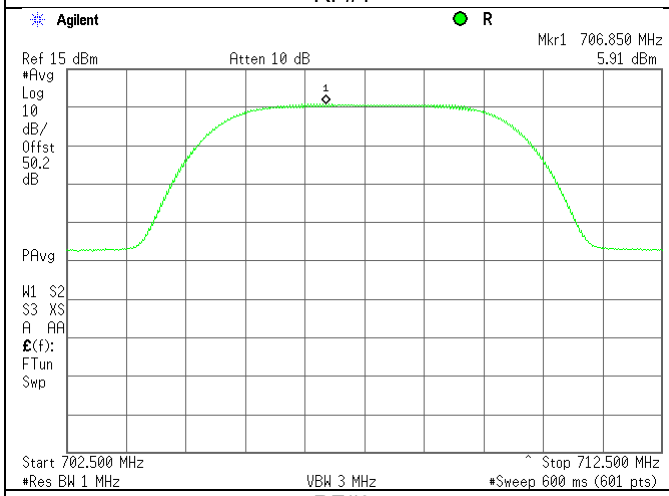


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 °C | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

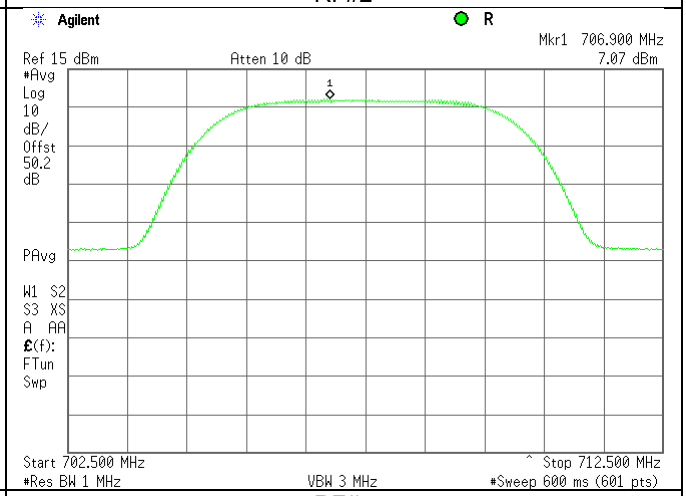
**Plot 7.1.4 Output power test results at low frequency, 64QAM modulation, 5 MHz CBW**

| BEAMFORMING GAIN: | 6 dB |
|---|---|

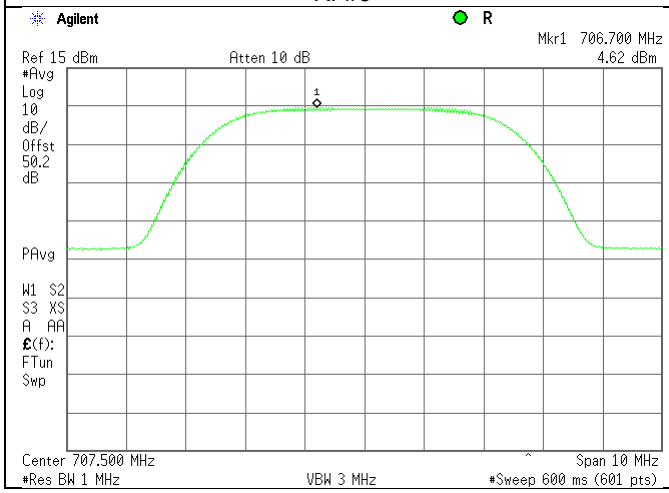
RF#1



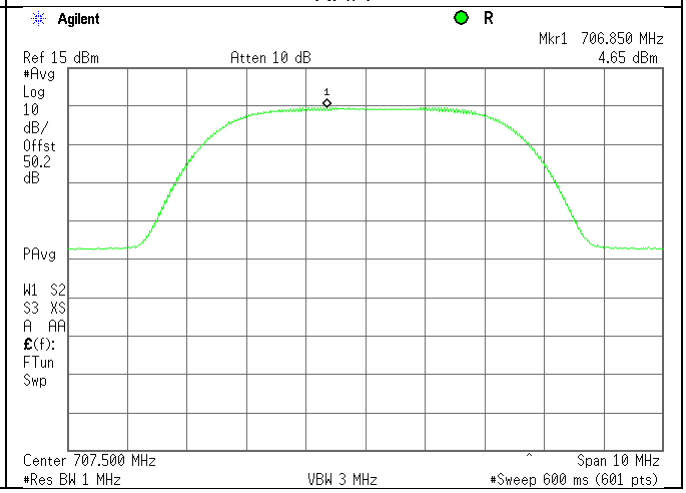

RF#2




RF#3




RF#4

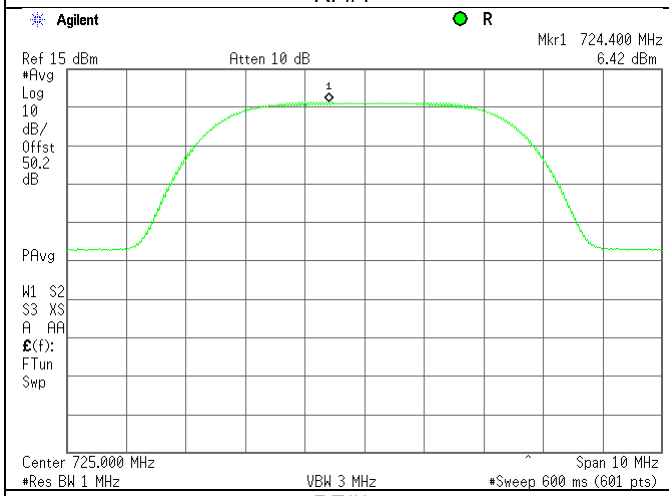


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

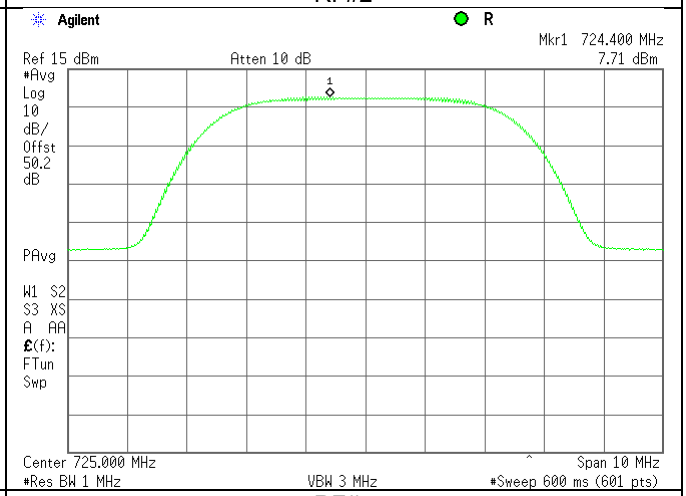
**Plot 7.1.5 Output power test results at mid frequency, 64QAM modulation, 5 MHz CBW**

BEAMFORMING GAIN: 6 dB

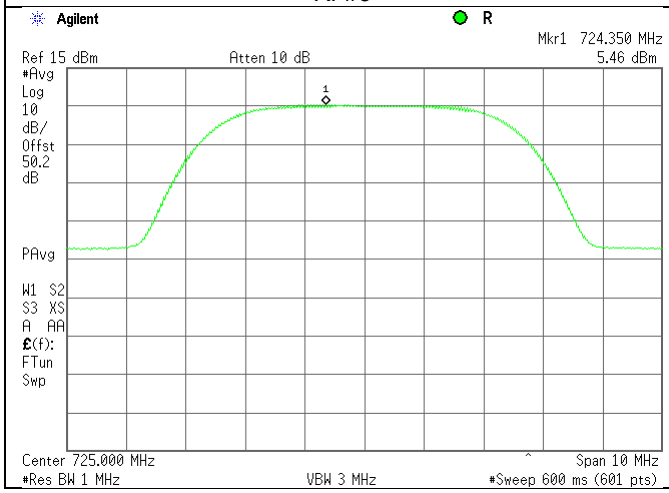
RF#1



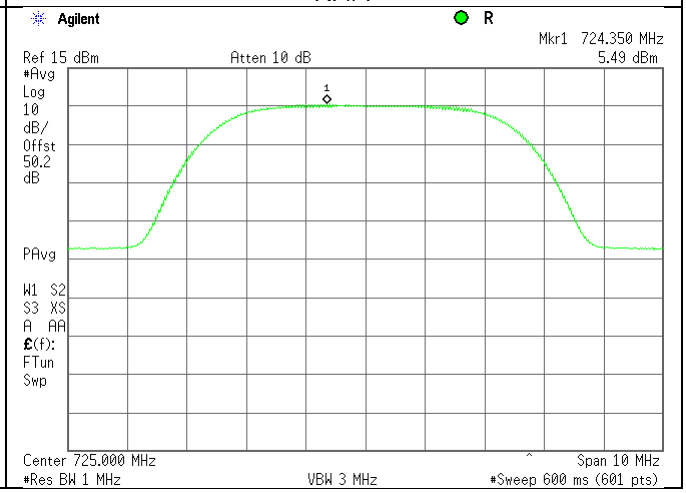

RF#2




RF#3




RF#4

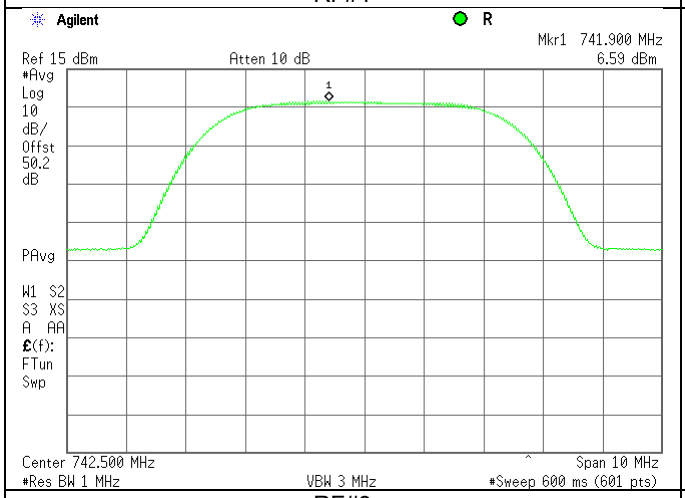


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

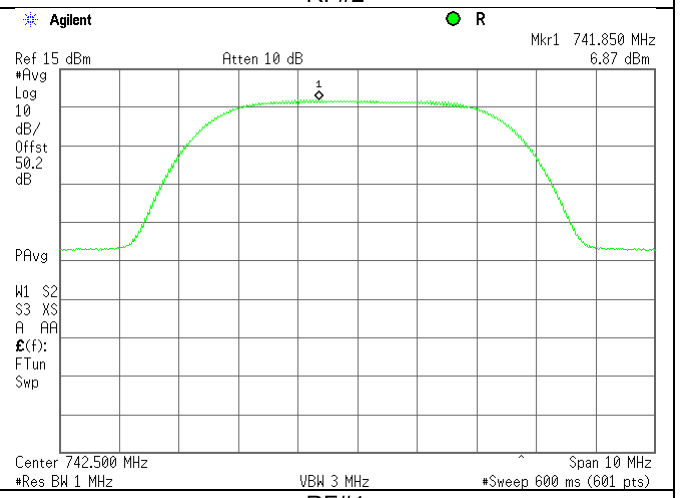
**Plot 7.1.6 Output power test results at high frequency, 64QAM modulation, 5 MHz CBW**

| BEAMFORMING GAIN: | 6 dB |
|---|---|

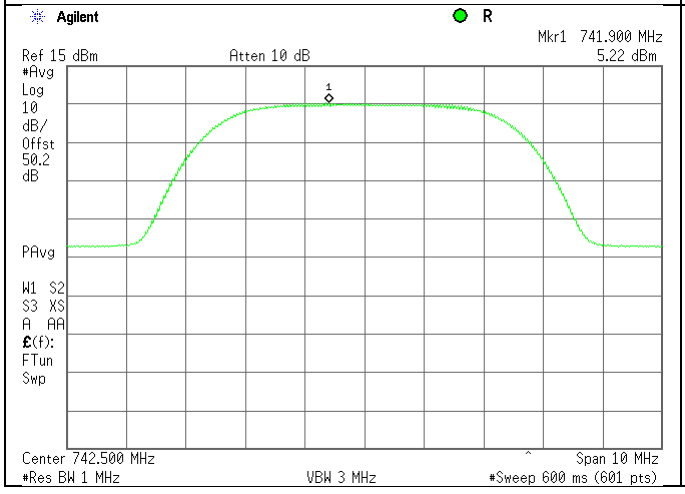
RF#1



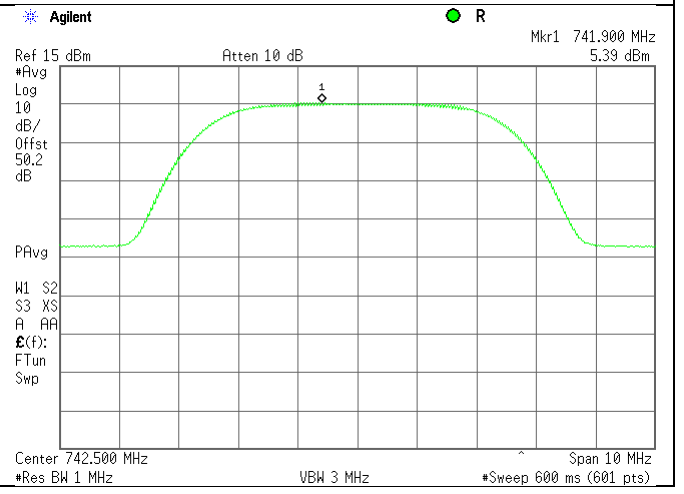

RF#2




RF#3




RF#4

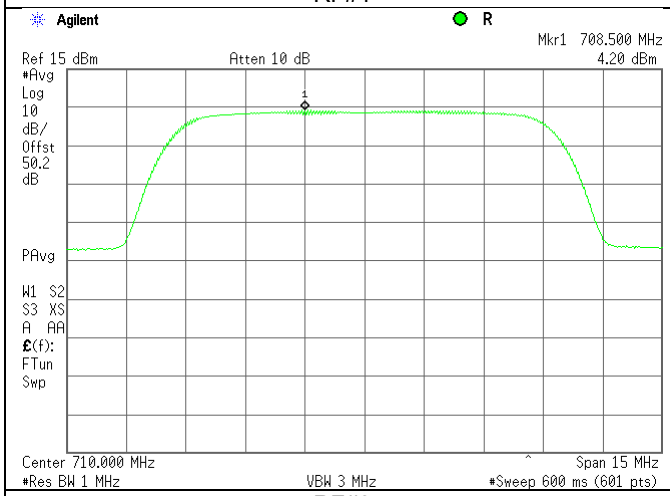


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

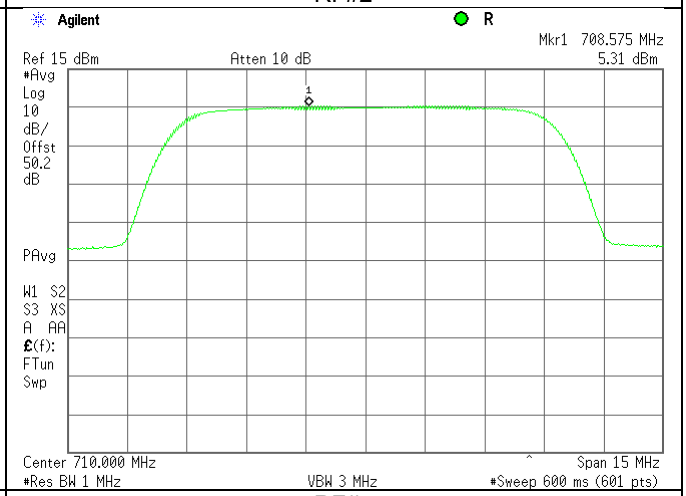
**Plot 7.1.7 Output power test results at low frequency, QPSK modulation, 10 MHz CBW**

BEAMFORMING GAIN: 6 dB

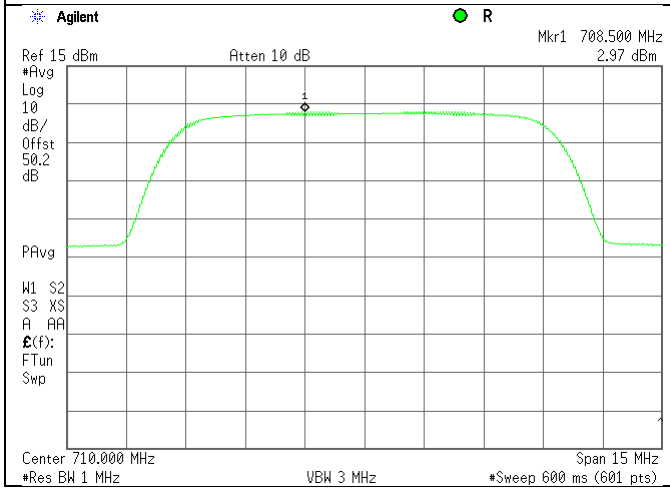
RF#1



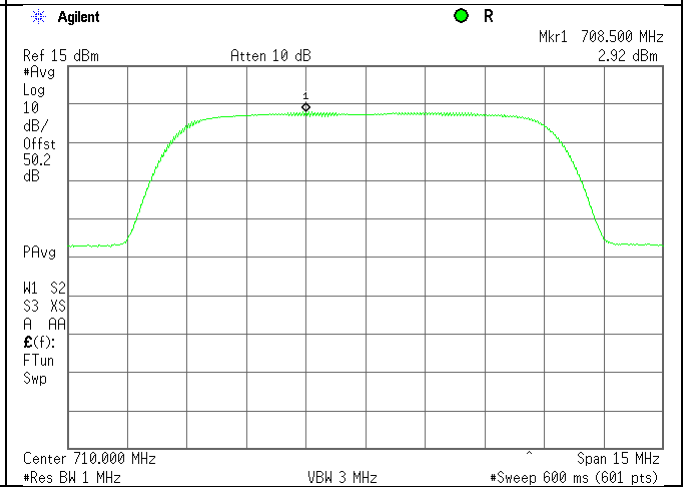

RF#2




RF#3




RF#4

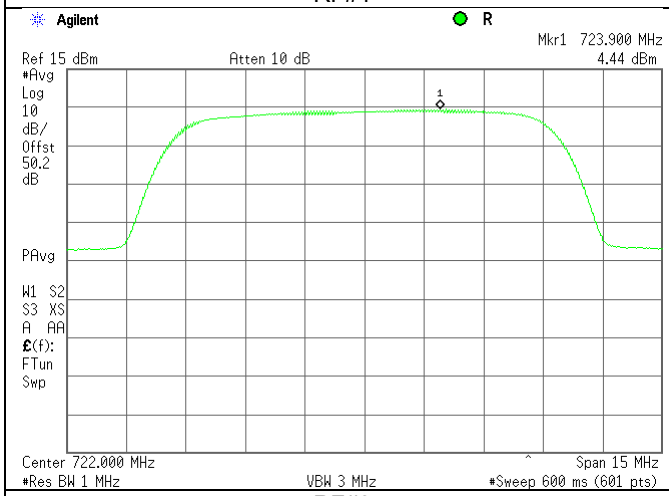


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 °C | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

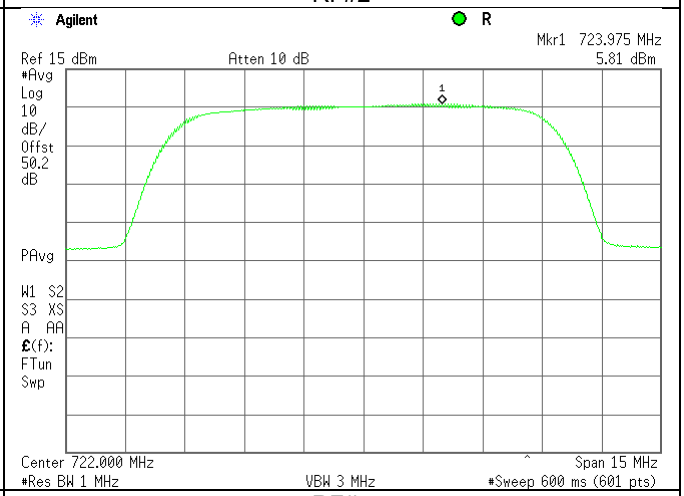
**Plot 7.1.8 Output power test results at mid frequency, QPSK modulation, 10 MHz CBW**

BEAMFORMING GAIN: 6 dB

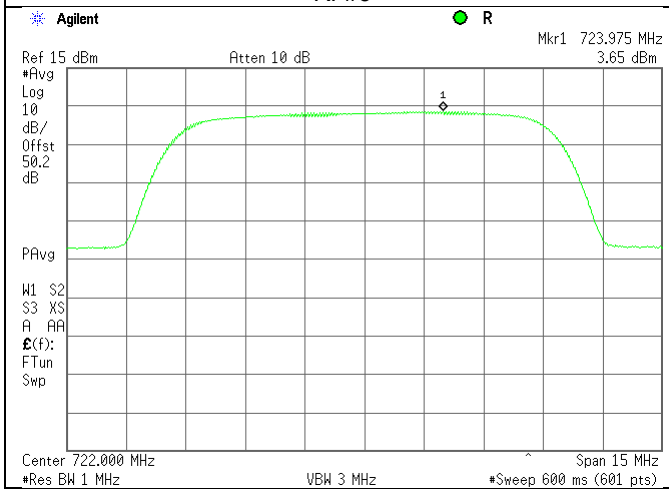
RF#1



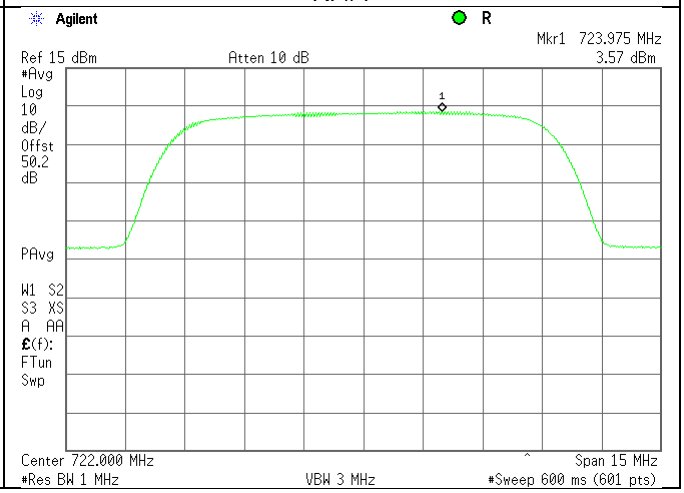

RF#2




RF#3




RF#4

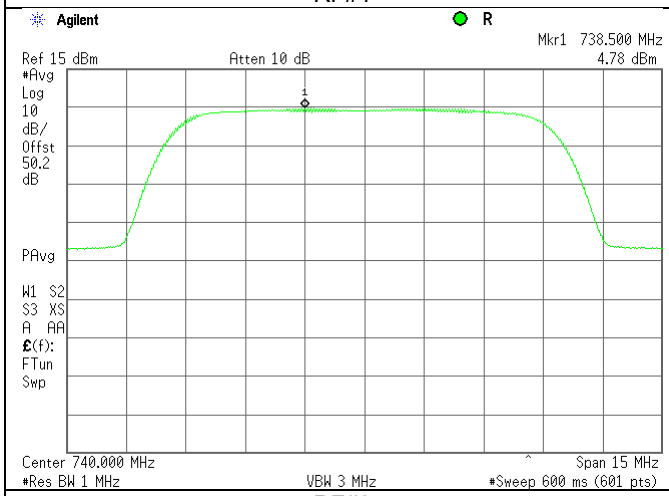


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

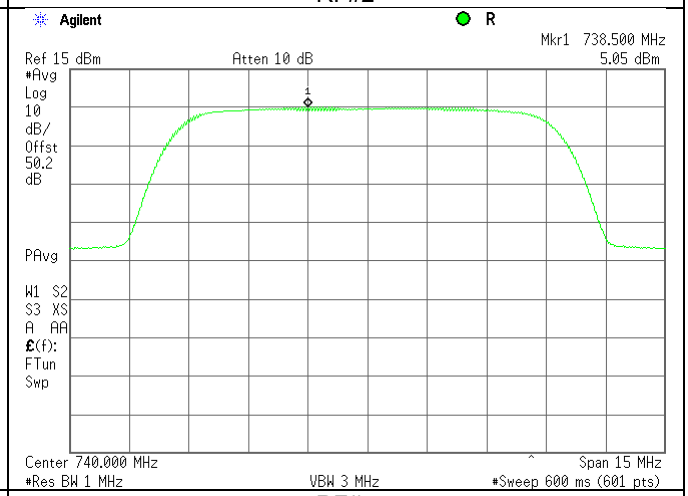
**Plot 7.1.9 Output power test results at high frequency, QPSK modulation, 10 MHz CBW**

| BEAMFORMING GAIN: | 6 dB |
|---|---|

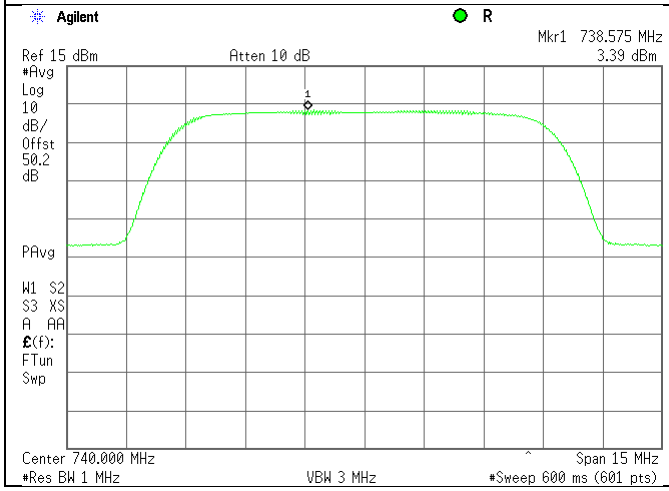
RF#1



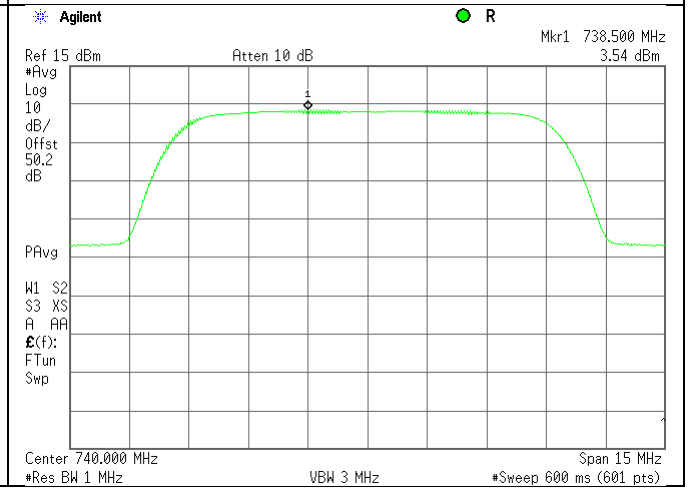

RF#2




RF#3




RF#4

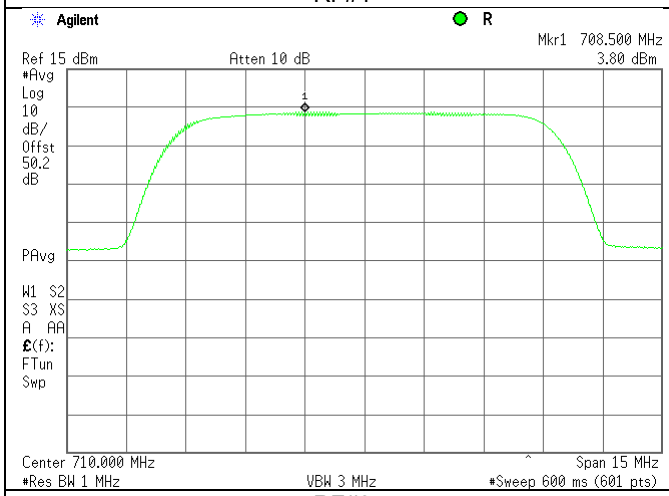


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

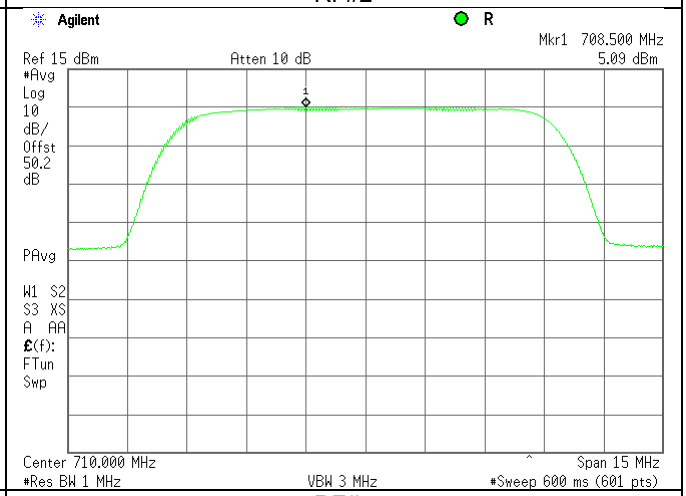
**Plot 7.1.10 Output power test results at low frequency, 64QAM modulation, 10 MHz CBW**

BEAMFORMING GAIN: 6 dB

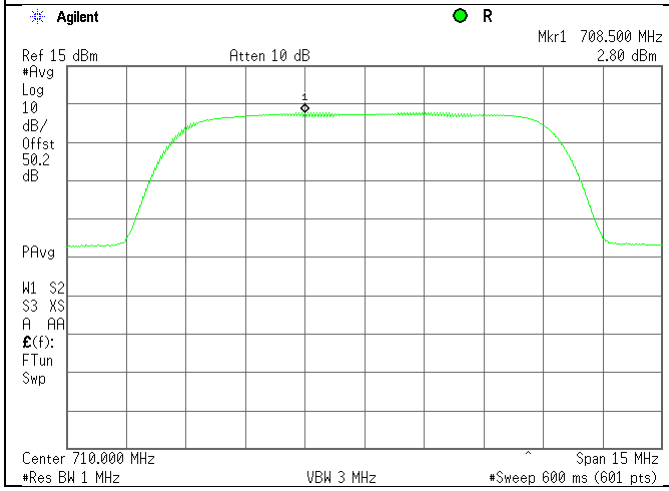
RF#1



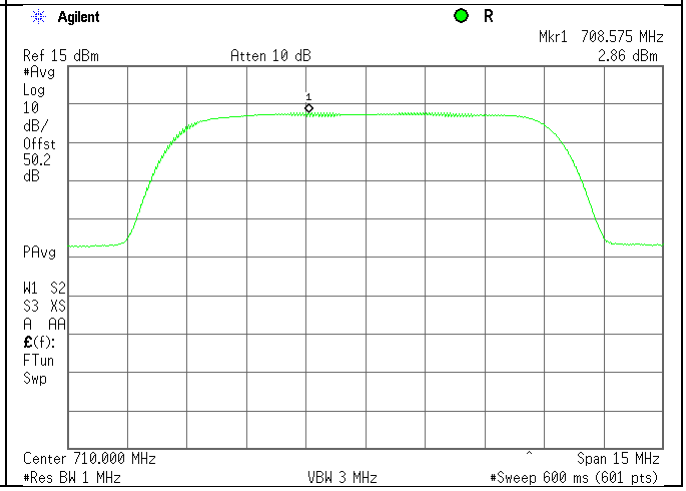

RF#2




RF#3




RF#4

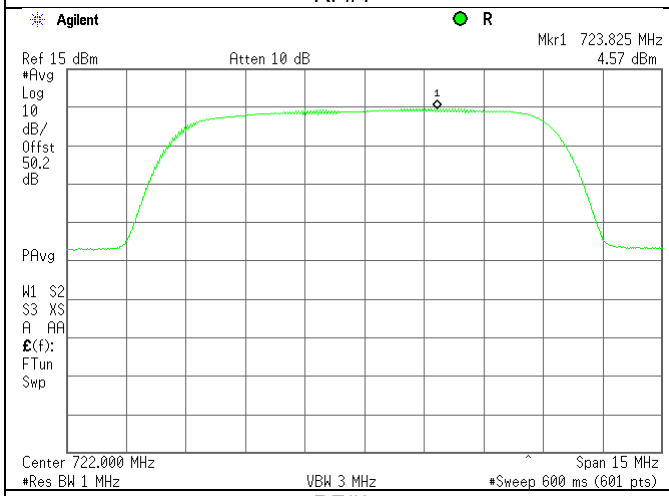


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

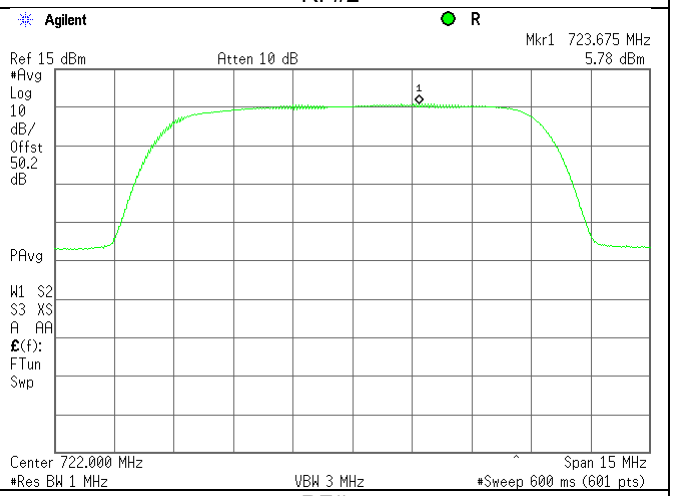
**Plot 7.1.11 Output power test results at mid frequency, 64QAM modulation, 10 MHz CBW**

BEAMFORMING GAIN: 6 dB

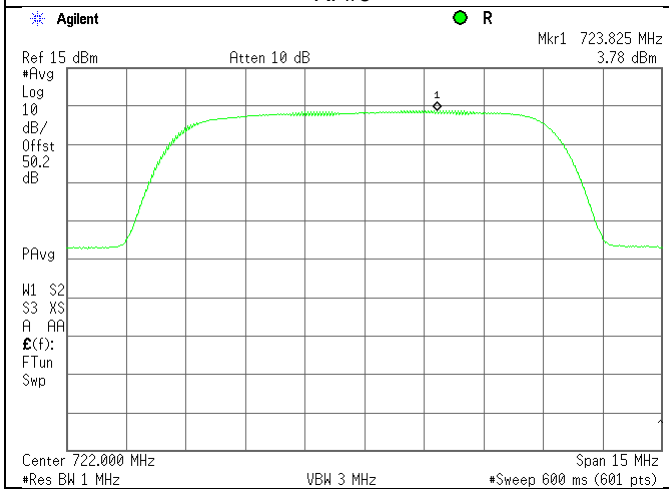
RF#1



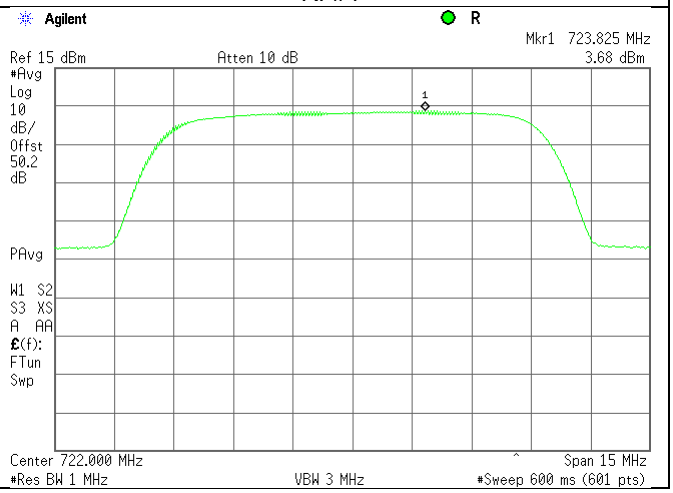

RF#2




RF#3




RF#4

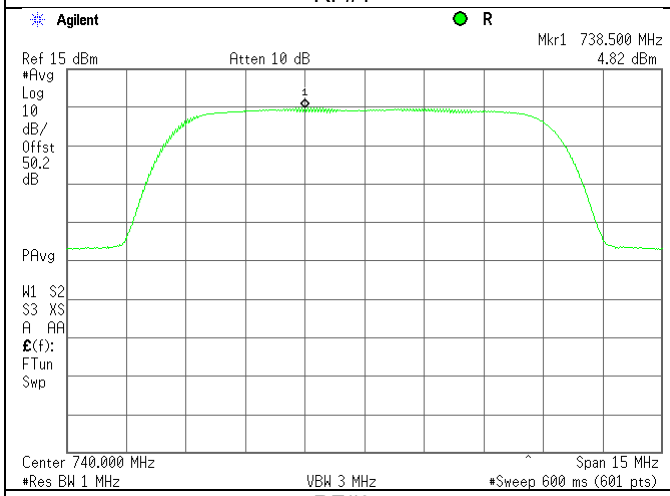


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

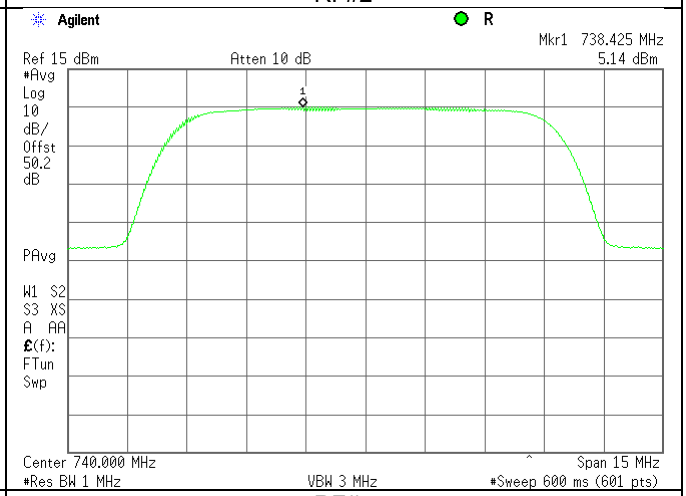
**Plot 7.1.12 Output power test results at high frequency, 64QAM modulation, 10 MHz CBW**

BEAMFORMING GAIN: 6 dB

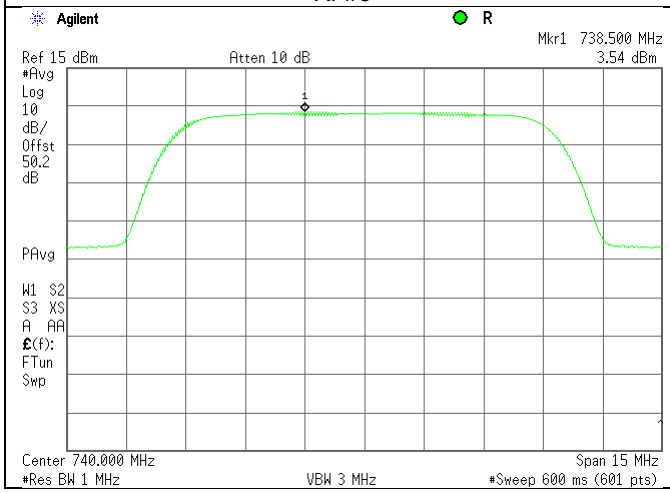
RF#1



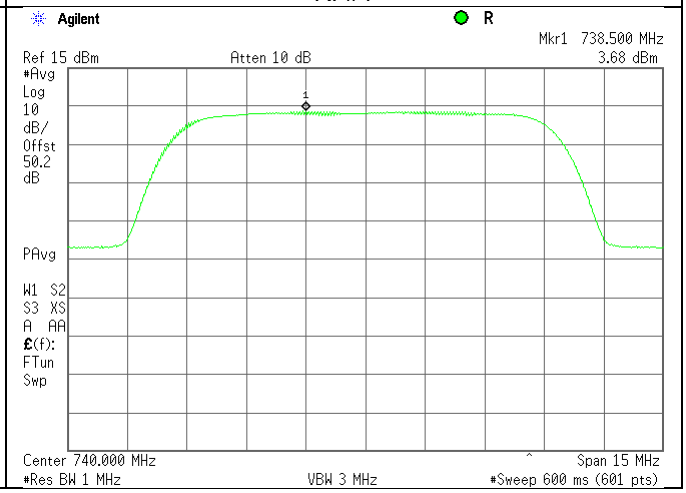

RF#2




RF#3




RF#4

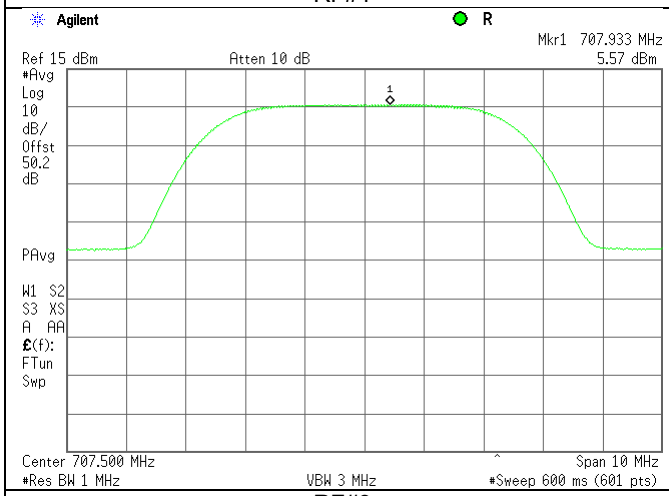


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

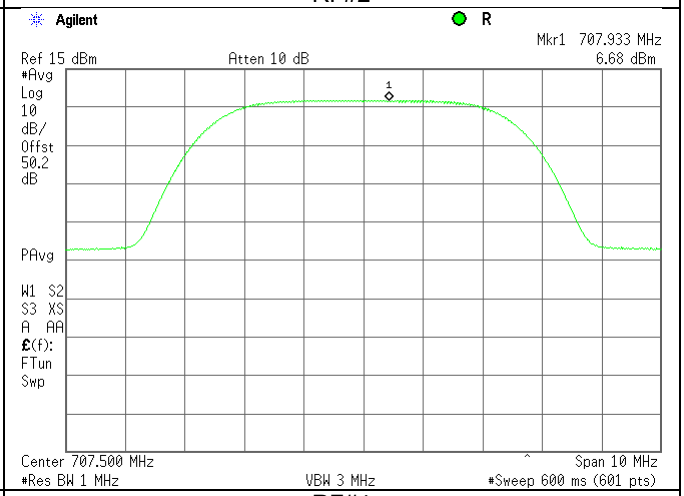
**Plot 7.1.13 Output power test results at low frequency, QPSK modulation, 5 MHz CBW**

BEAMFORMING GAIN: 3 dB

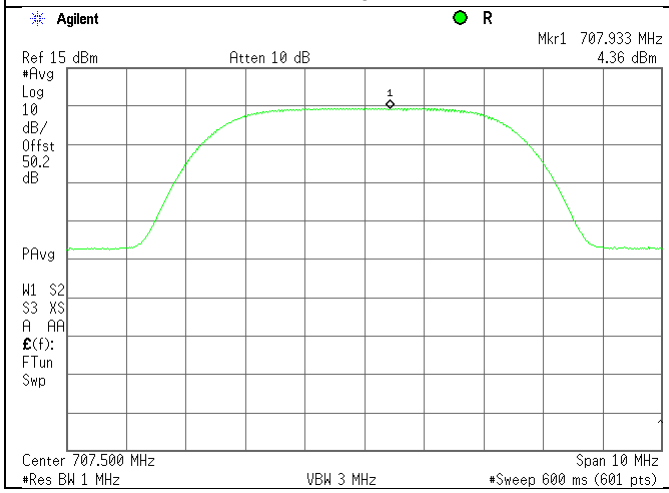
RF#1



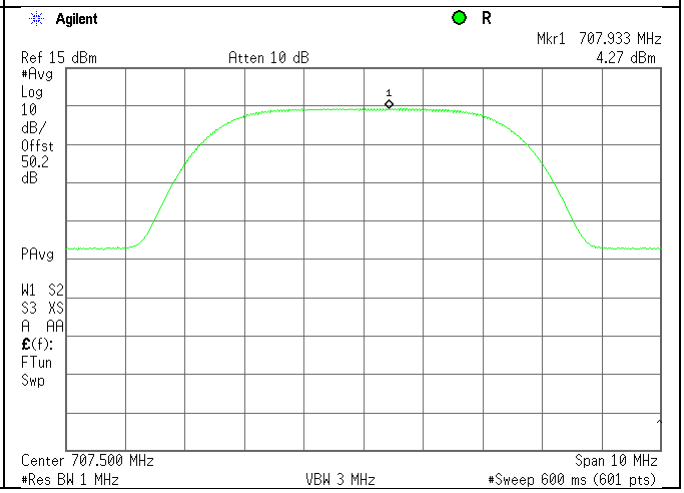

RF#2




RF#3




RF#4

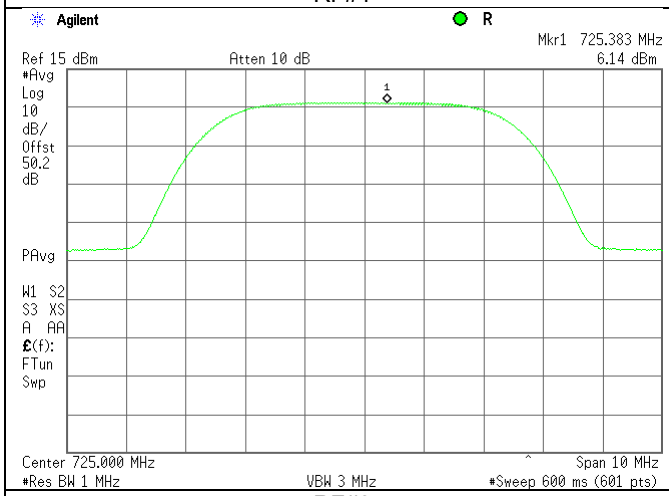


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

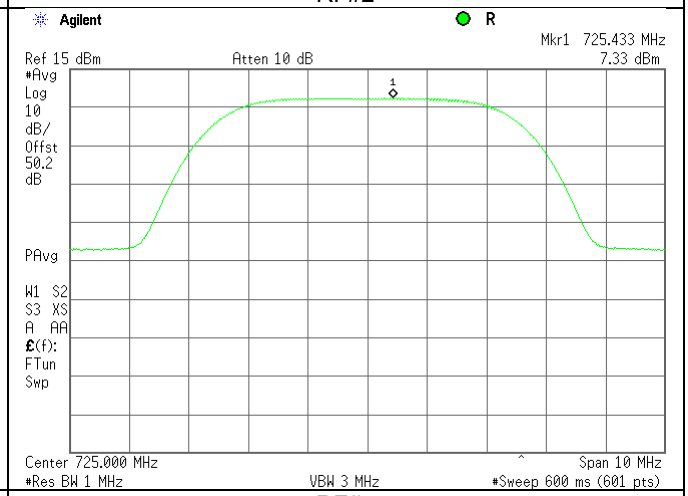
**Plot 7.1.14 Output power test results at mid frequency, QPSK modulation, 5 MHz CBW**

BEAMFORMING GAIN: 3 dB

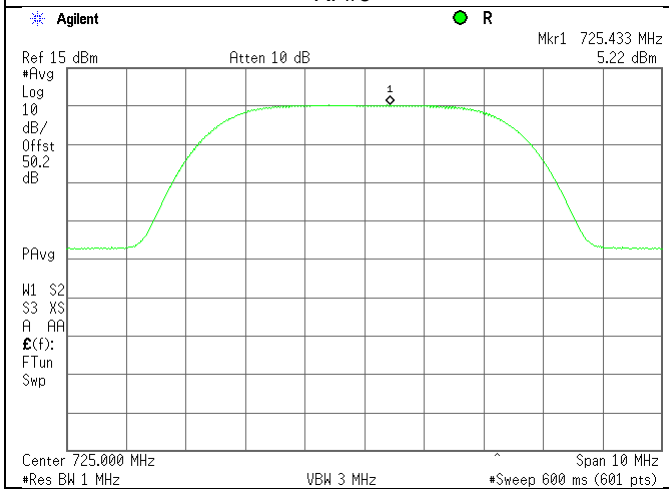
RF#1



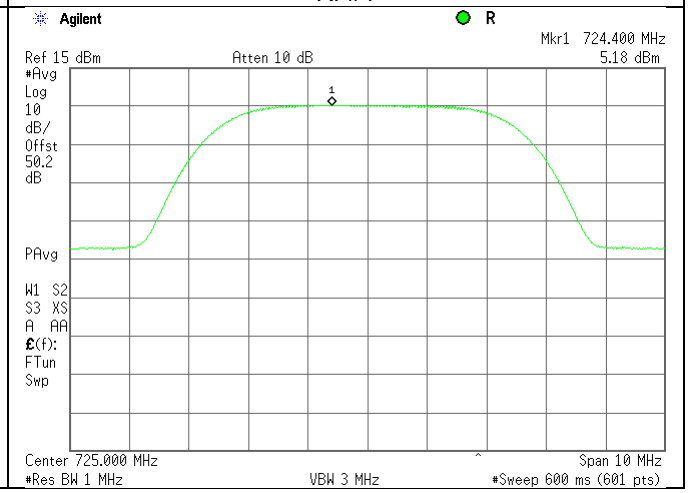

RF#2




RF#3




RF#4

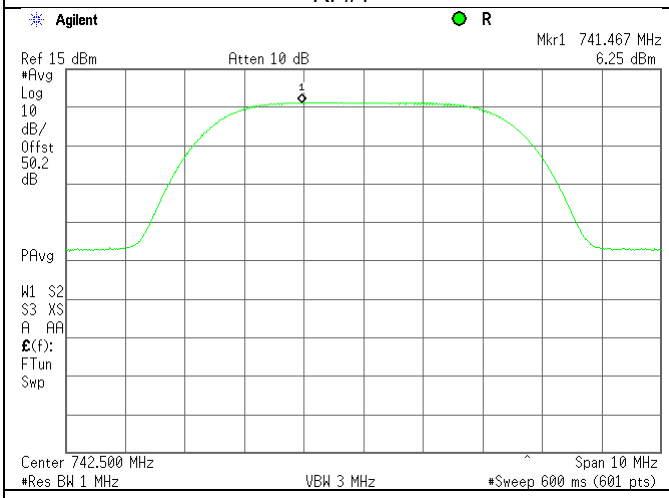


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

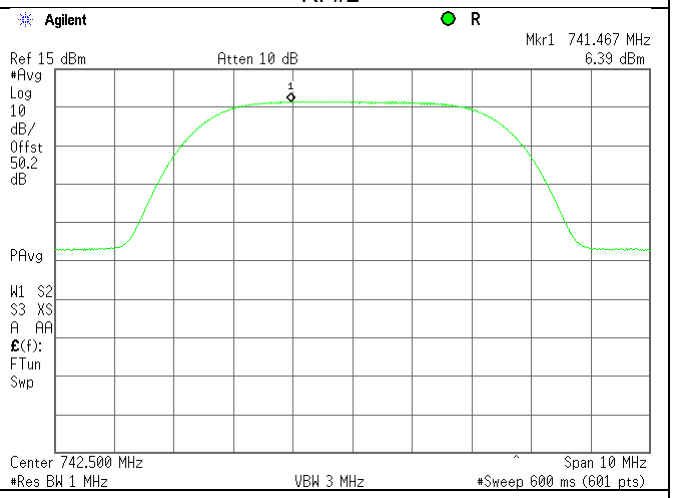
**Plot 7.1.15 Output power test results at high frequency, QPSK modulation, 5 MHz CBW**

BEAMFORMING GAIN: 3 dB

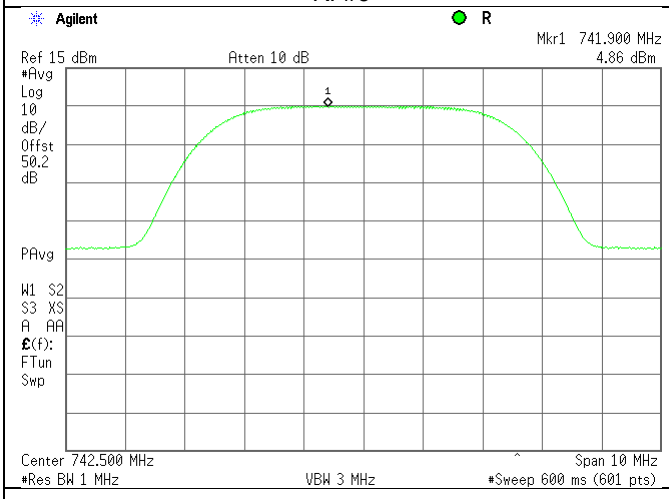
RF#1



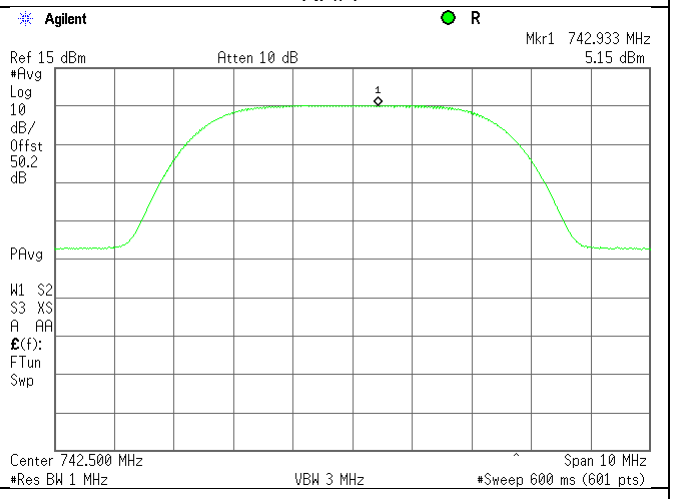

RF#2




RF#3




RF#4

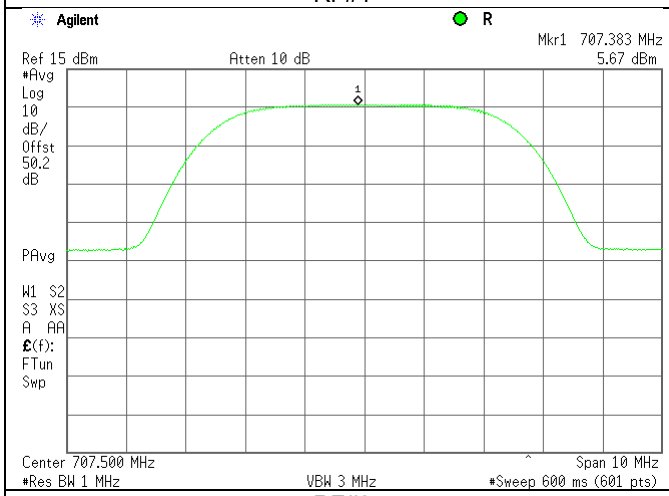


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

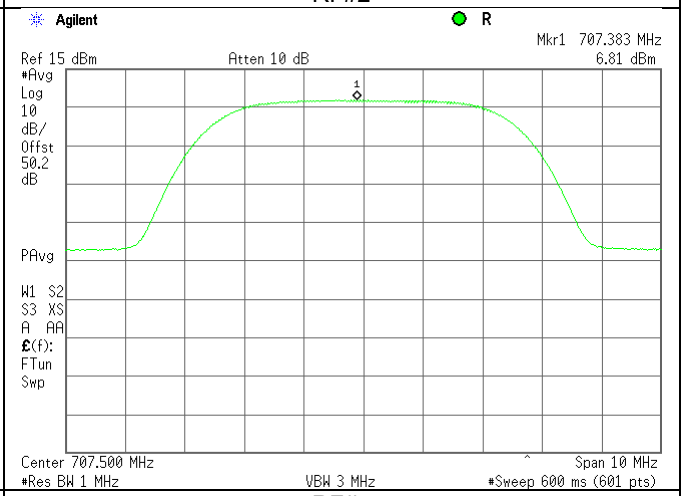
**Plot 7.1.16 Output power test results at low frequency, 64QAM modulation, 5 MHz CBW**

BEAMFORMING GAIN: 3 dB

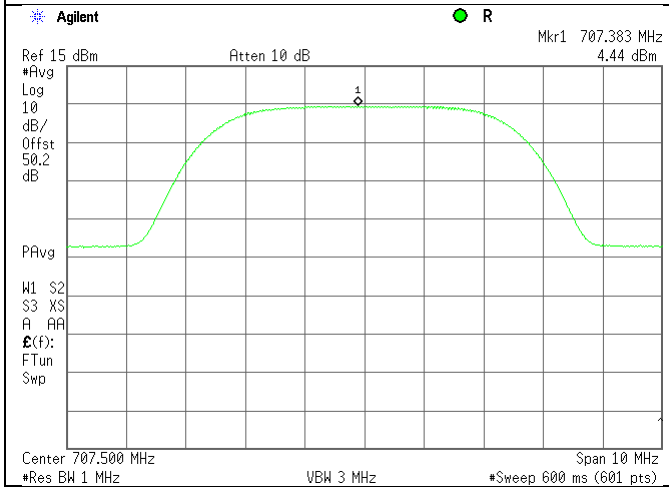
RF#1



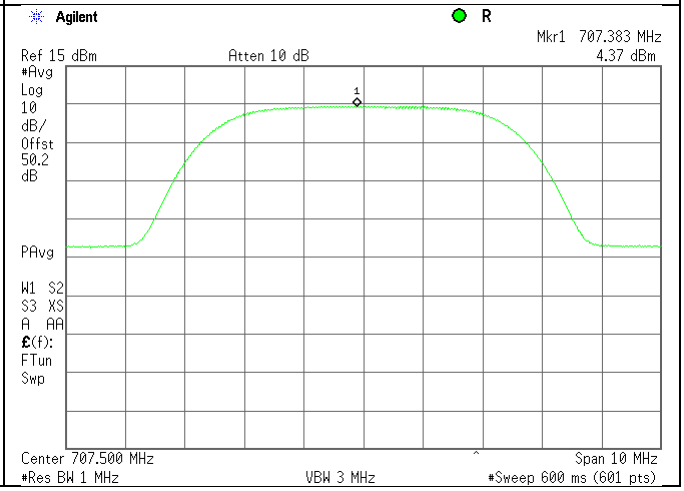

RF#2




RF#3




RF#4

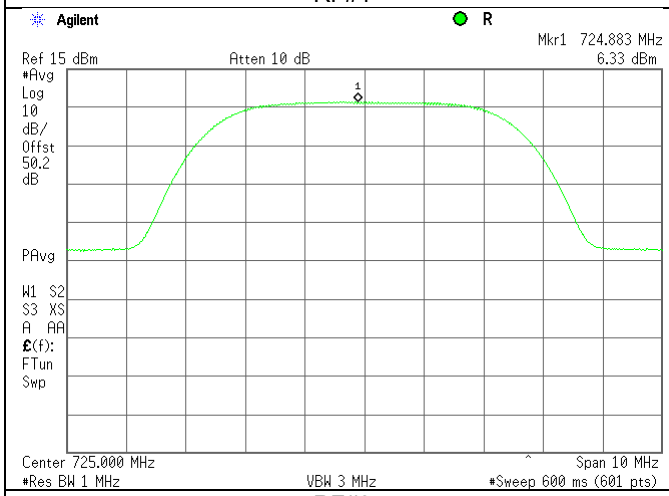


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 °C | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

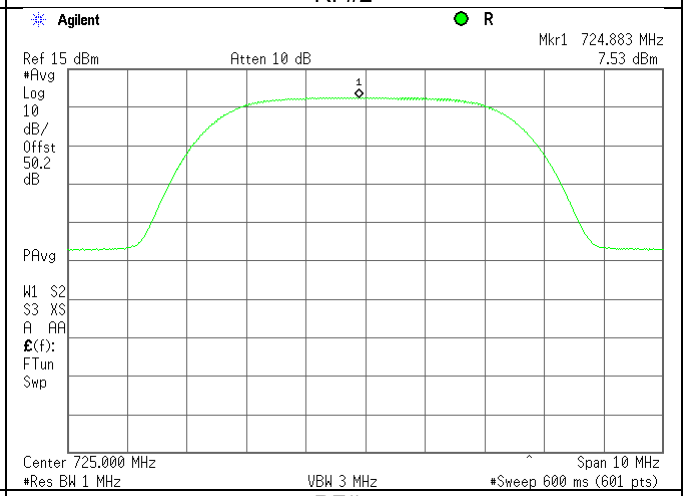
**Plot 7.1.17 Output power test results at mid frequency, 64QAM modulation, 5 MHz CBW**

BEAMFORMING GAIN: 3 dB

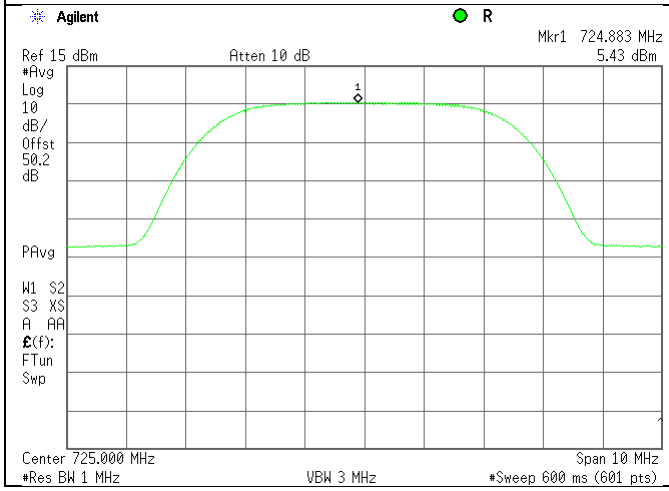
RF#1



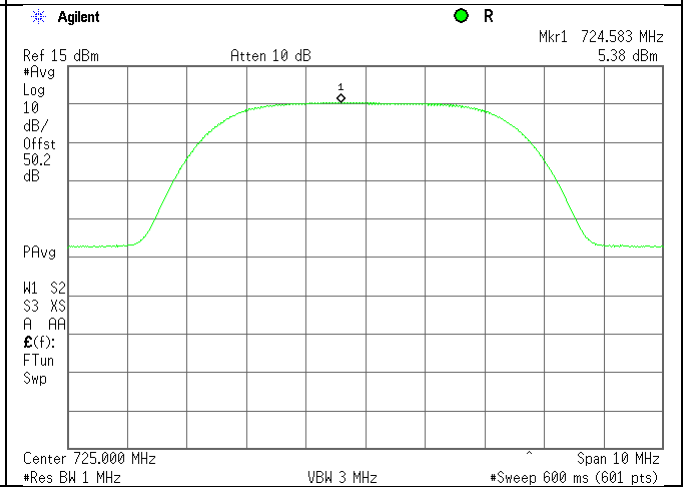

RF#2




RF#3




RF#4

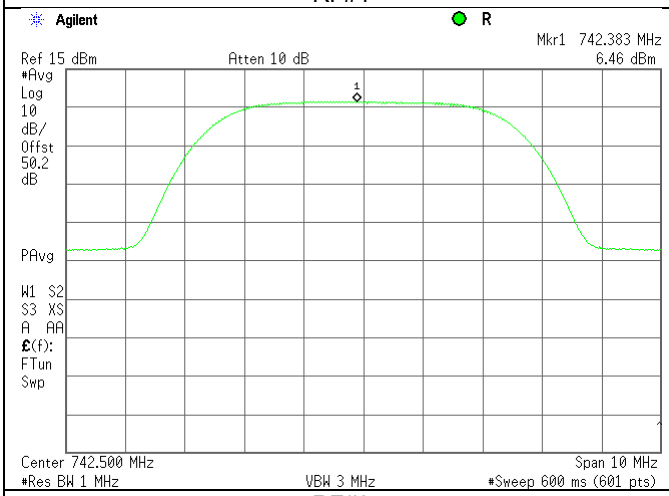


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

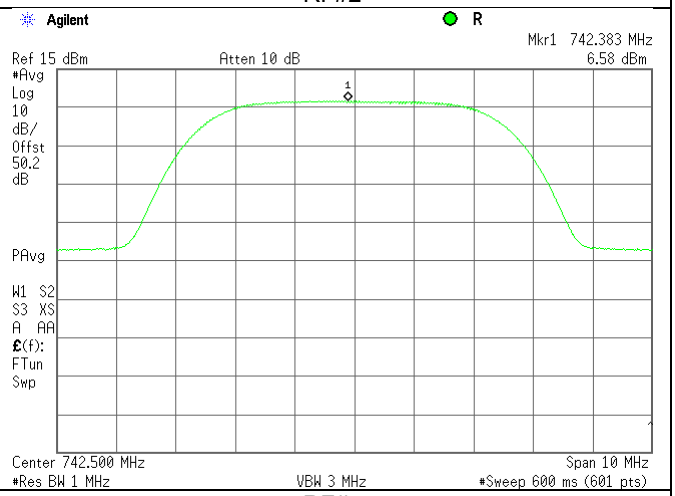
**Plot 7.1.18 Output power test results at high frequency, 64QAM modulation, 5 MHz CBW**

BEAMFORMING GAIN: 3 dB

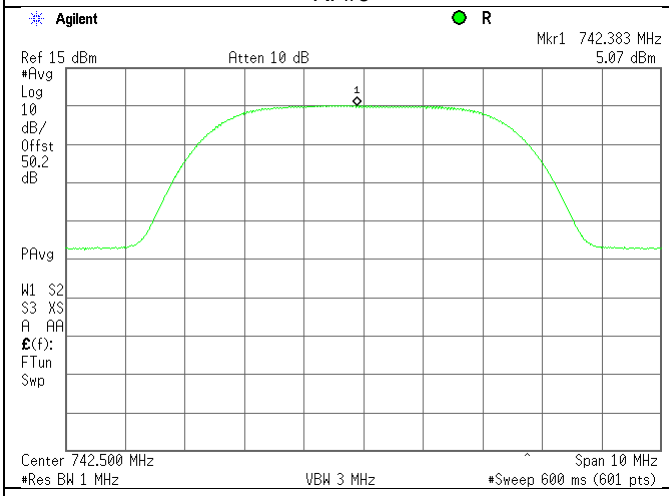
RF#1



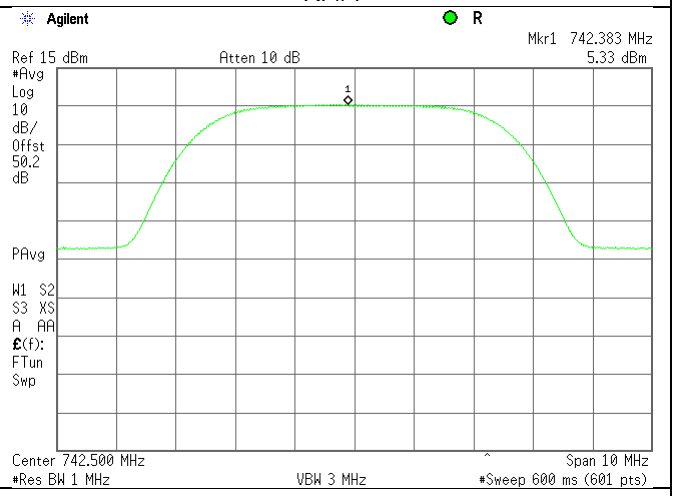

RF#2




RF#3




RF#4

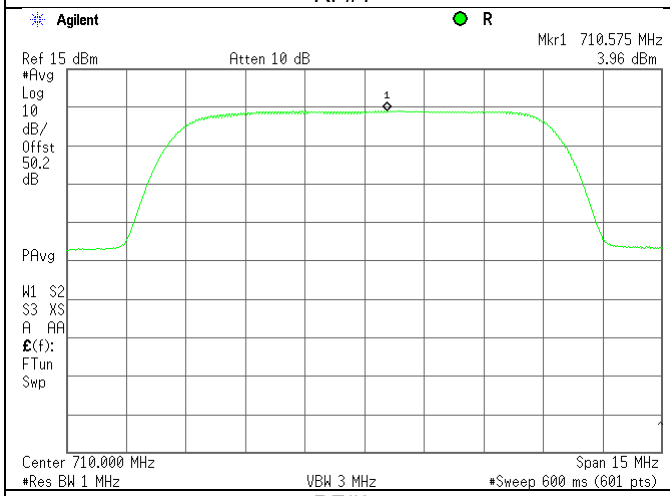


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

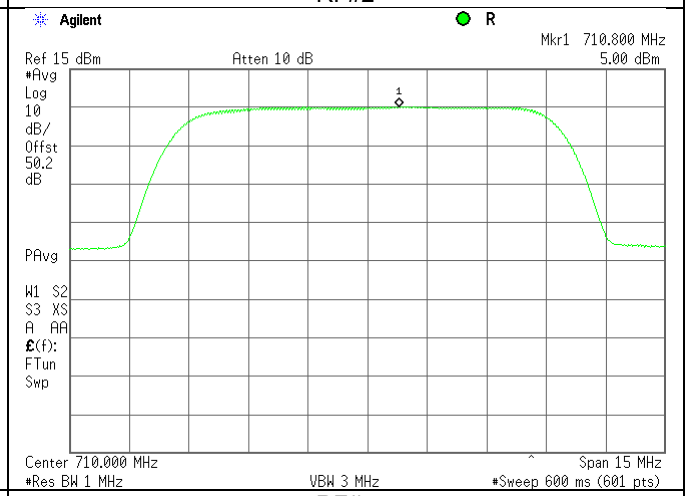
**Plot 7.1.19 Output power test results at low frequency, QPSK modulation, 10 MHz CBW**

BEAMFORMING GAIN: 3 dB

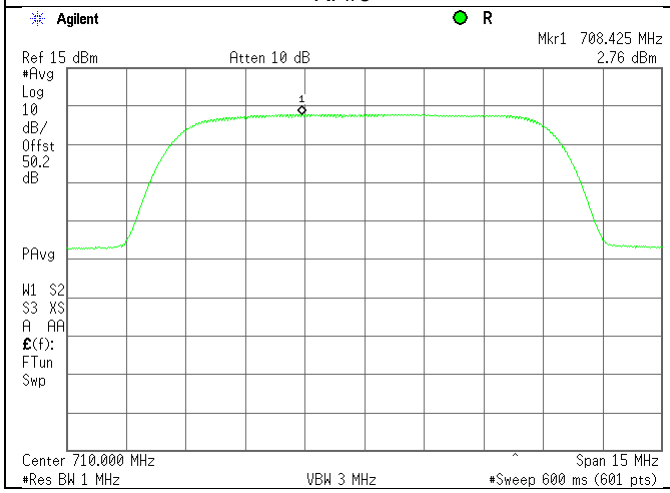
RF#1



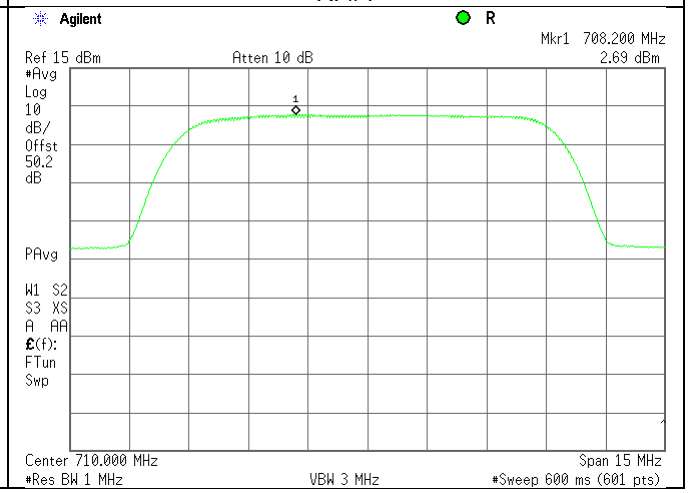

RF#2




RF#3




RF#4

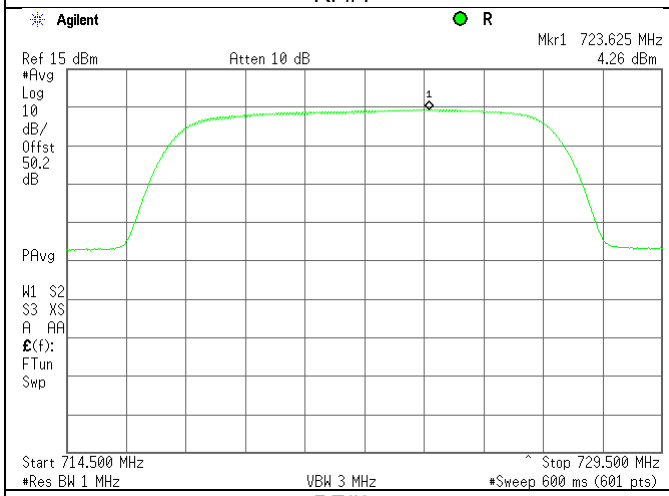


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

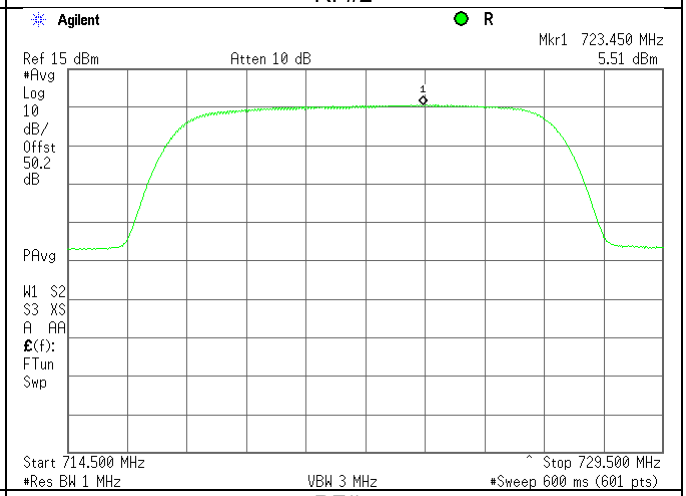
**Plot 7.1.20 Output power test results at mid frequency, QPSK modulation, 10 MHz CBW**

BEAMFORMING GAIN: 3 dB

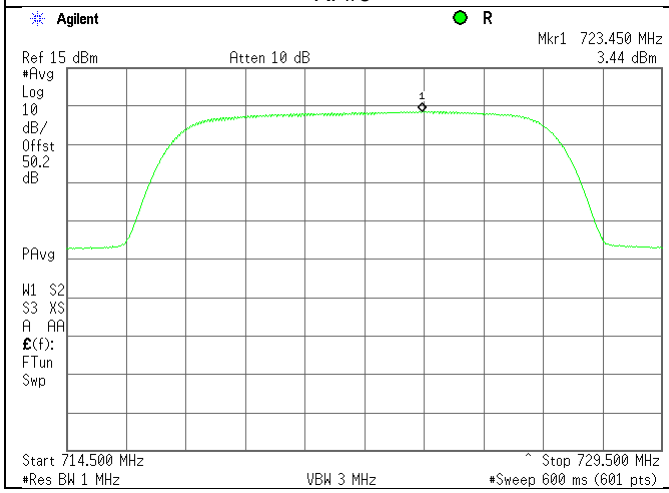
RF#1



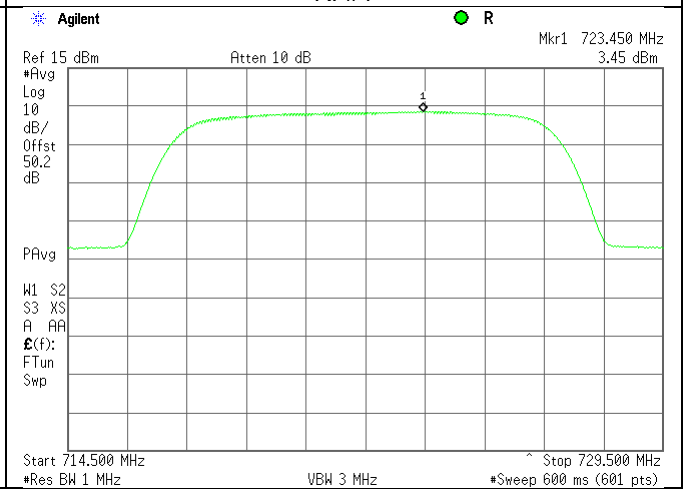

RF#2




RF#3




RF#4

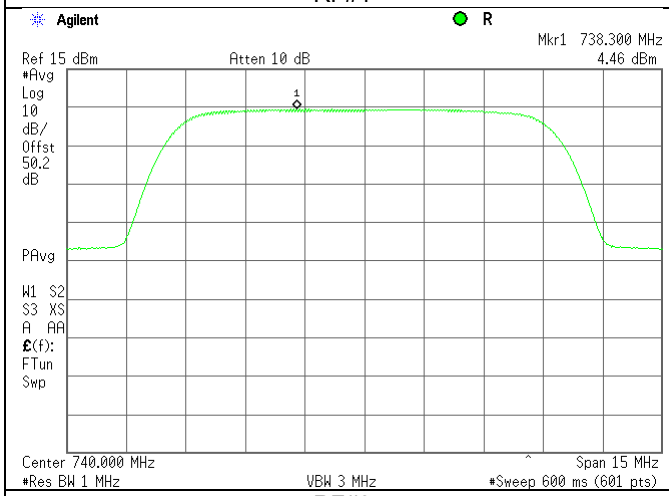


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

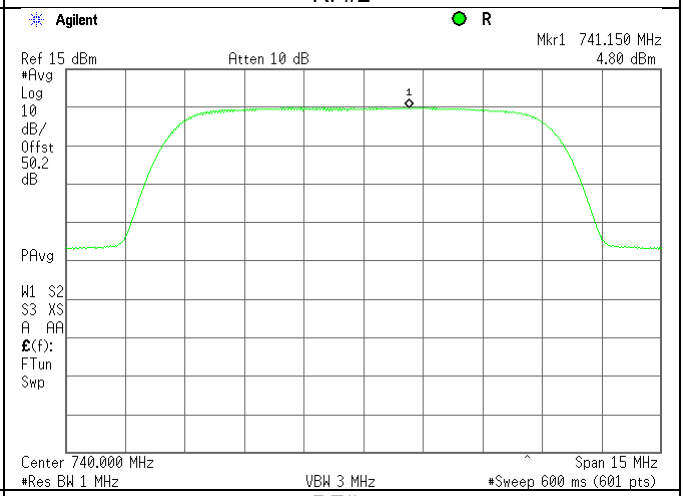
**Plot 7.1.21 Output power test results at high frequency, QPSK modulation, 10 MHz CBW**

| BEAMFORMING GAIN: | 3 dB |
|---|---|

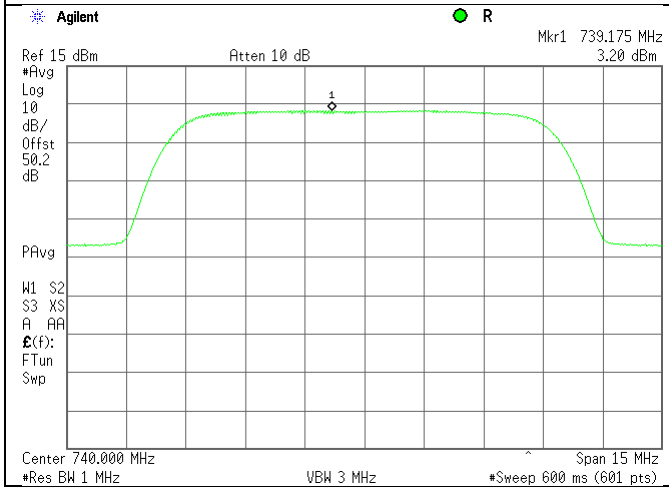
RF#1



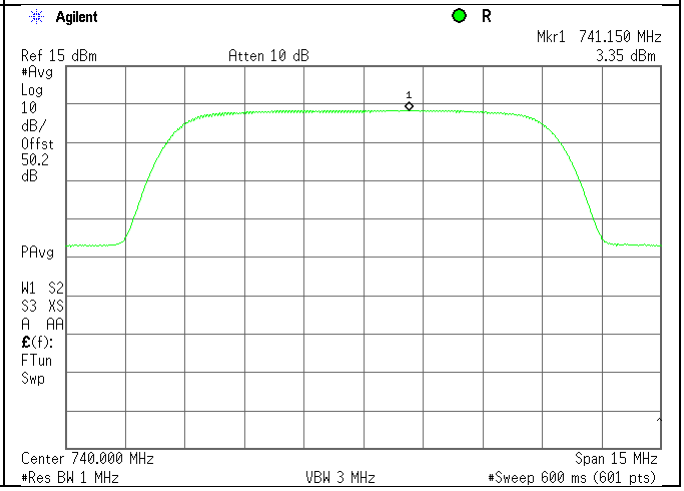

RF#2




RF#3




RF#4

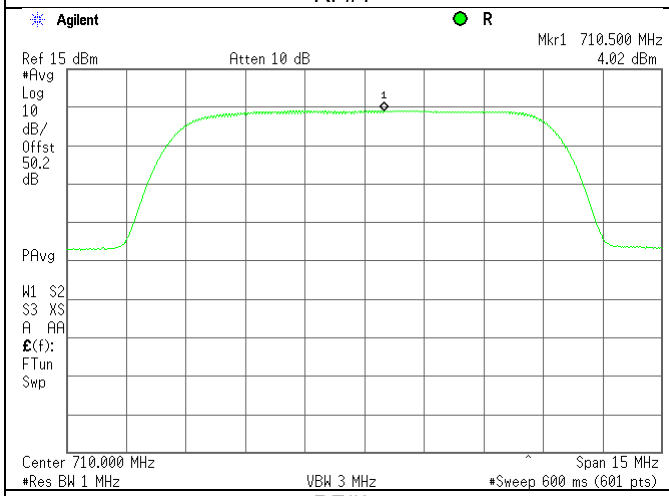


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

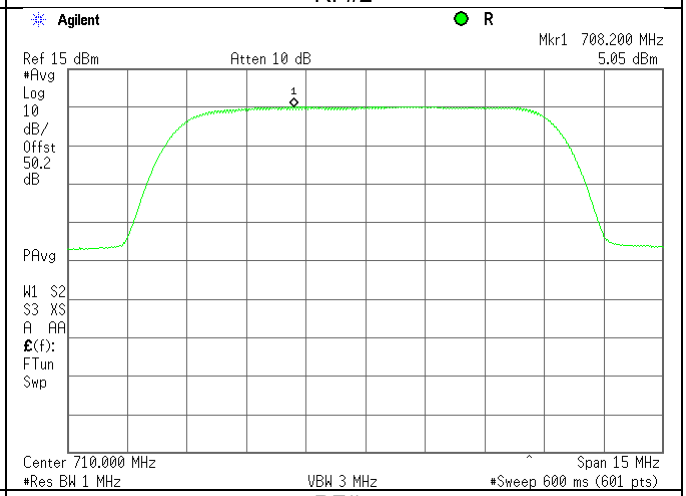
**Plot 7.1.22 Output power test results at low frequency, 64QAM modulation, 10 MHz CBW**

BEAMFORMING GAIN: 3 dB

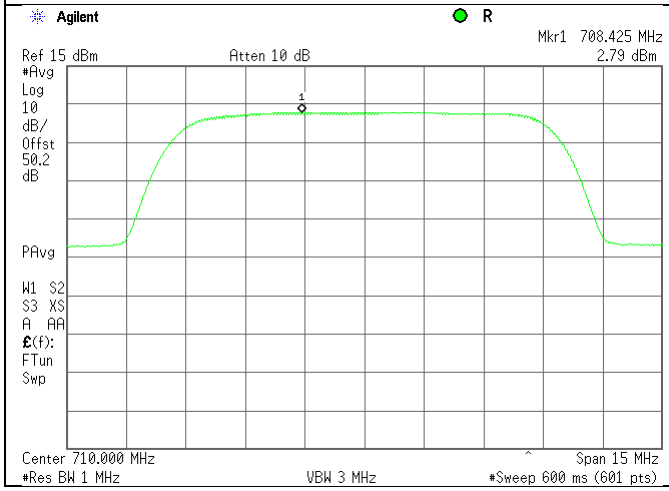
RF#1



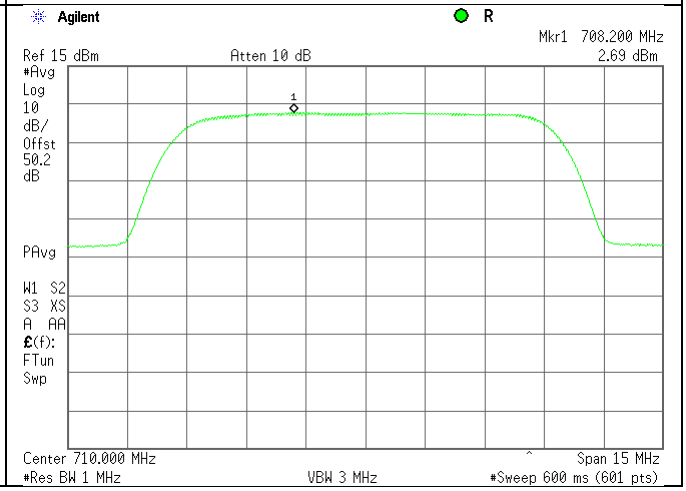

RF#2




RF#3




RF#4

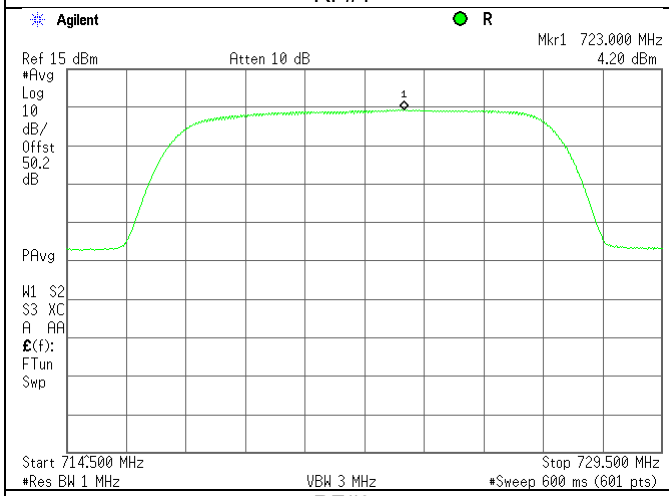


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

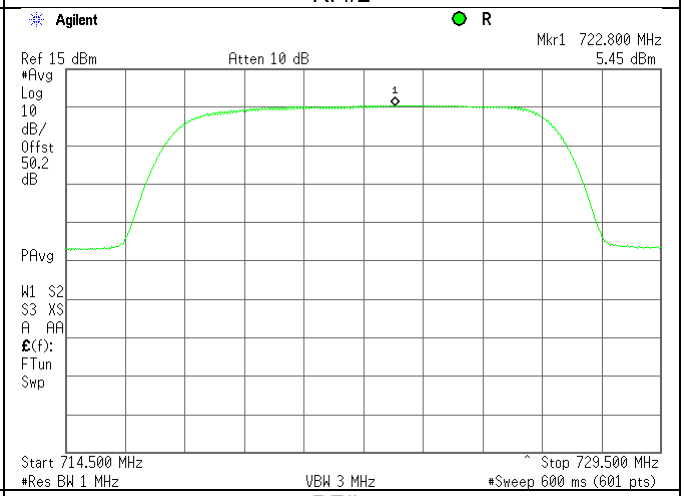
**Plot 7.1.23 Output power test results at mid frequency, 64QAM modulation, 10 MHz CBW**

BEAMFORMING GAIN: 3 dB

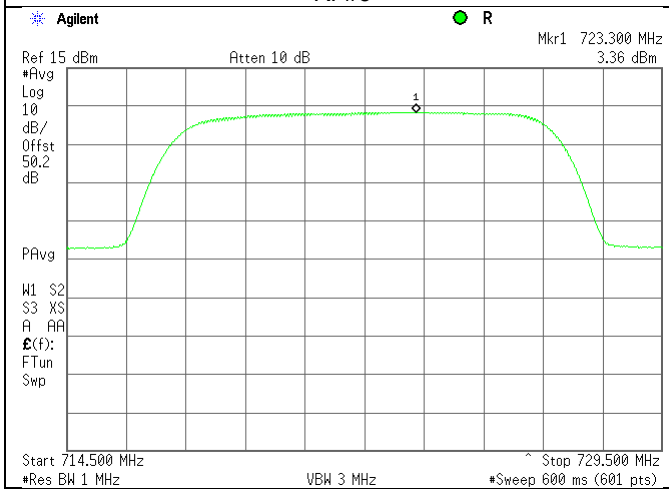
RF#1



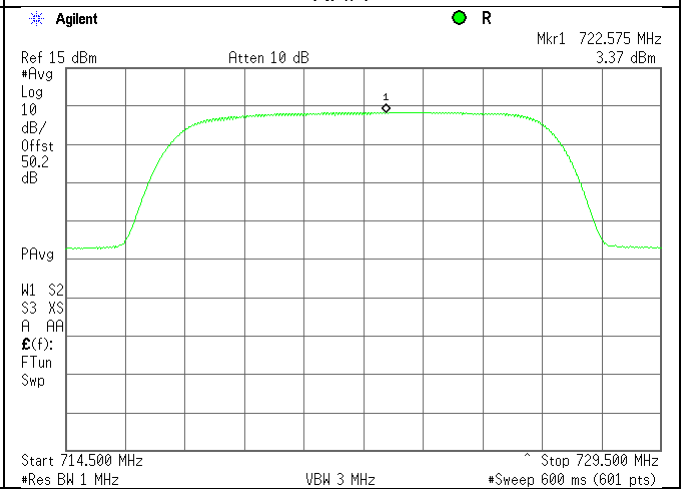

RF#2




RF#3




RF#4

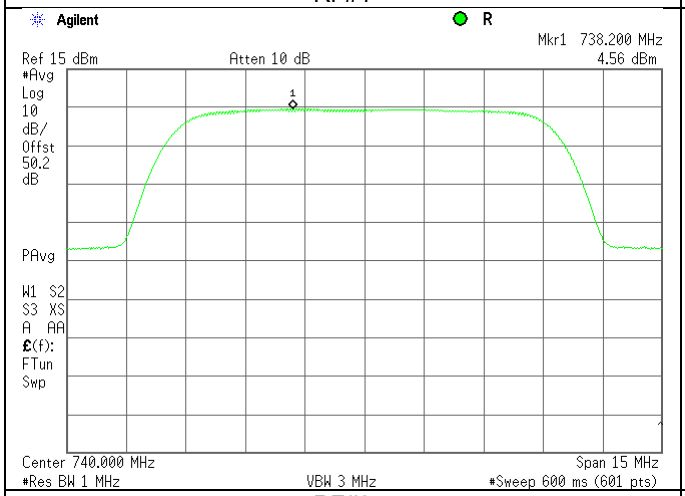


| Test specification: | Section 27.50(c)(3), Output power at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

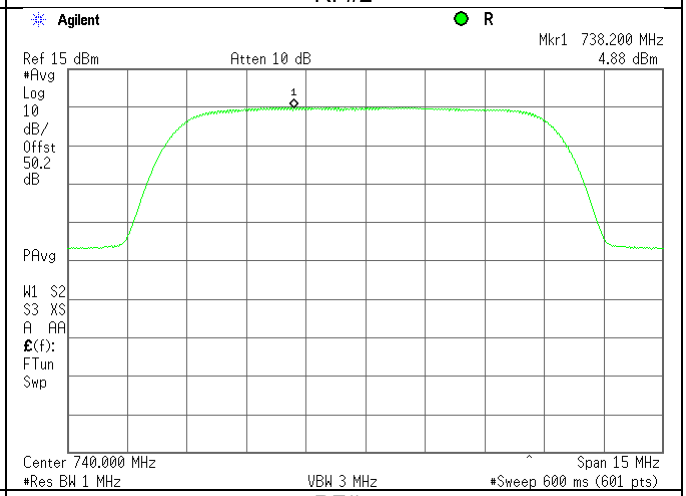
**Plot 7.1.24 Output power test results at high frequency, 64QAM modulation, 10 MHz CBW**

BEAMFORMING GAIN: 3 dB

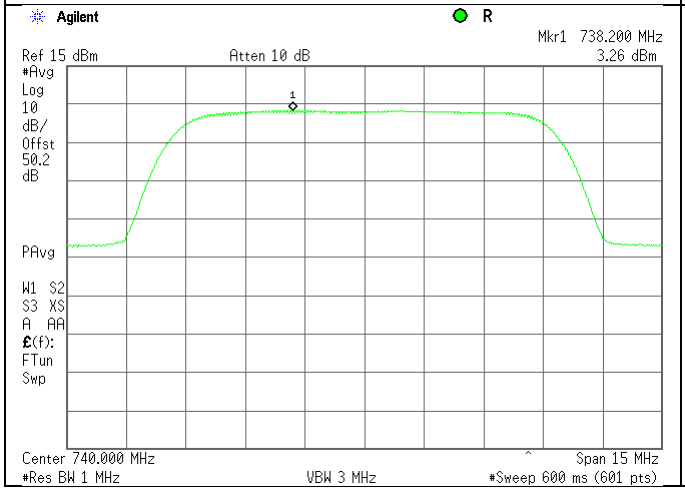
RF#1



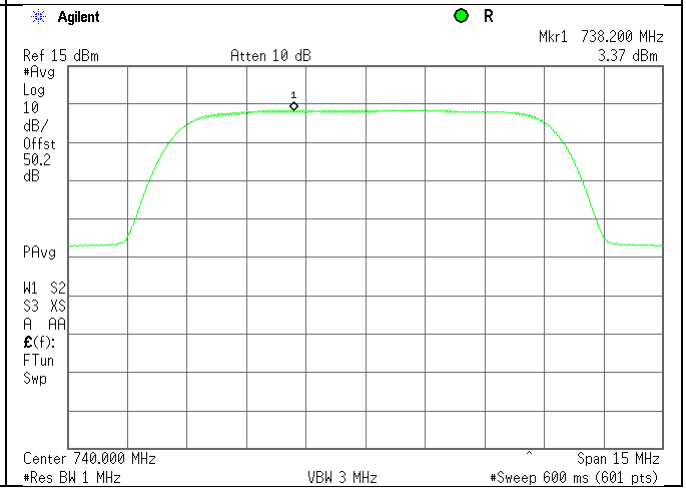

RF#2




RF#3




RF#4



| Test specification: | Section 2.1049, Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1049 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 ºC | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

## 7.2 Occupied bandwidth test

### 7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1.

**Table 7.2.1 Occupied bandwidth limits**

| Assigned frequency, MHz | Maximum allowed bandwidth, kHz |
|---|---|
| 698.0 – 746.0 | NA |

* - Modulation envelope reference points are provided in terms of attenuation below the unmodulated carrier.

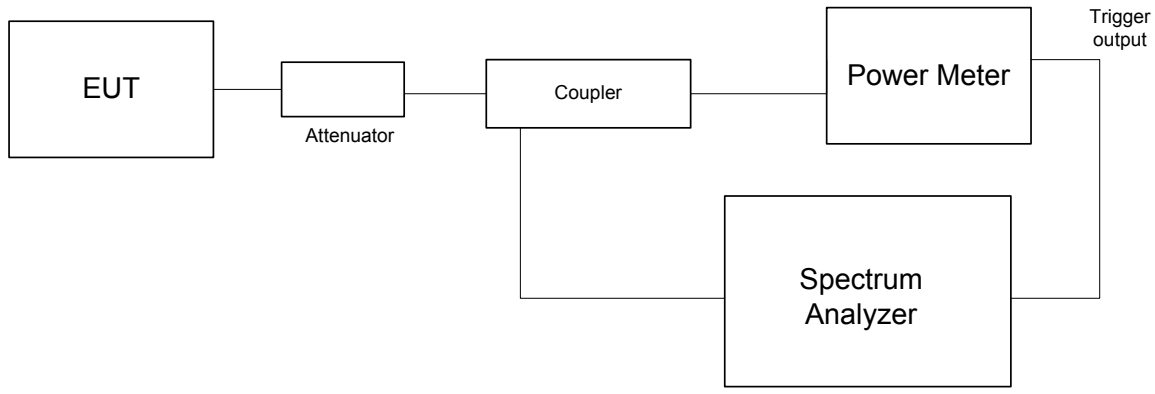
### 7.2.2 Test procedure

**7.2.2.1** The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

**7.2.2.2** The EUT was set to transmit the normally modulated carrier.

**7.2.2.3** The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.2.2 and the associated plots.

**Figure 7.2.1 Occupied bandwidth test setup**



| **Test specification:** | **Section 2.1049, Occupied bandwidth** | | |
|---|---|---|---|
| **Test procedure:** | 47 CFR, Section 2.1049 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 2/14/2013 | | |
| **Temperature:** 22.3 ºC | **Air Pressure:** 1012 hPa | **Relative Humidity:** 41 % | **Power Supply:** 48VDC |
| **Remarks:** | | | |

**Table 7.2.2 Occupied bandwidth test results**

DETECTOR USED: Average
RESOLUTION BANDWIDTH: 0.5 – 2 % of OBW
VIDEO BANDWIDTH: 10 times RBW
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc and 99% power
MODULATION: OFDM (QPSK – 64QAM)
MODULATING SIGNAL: PRBS

| Channel Bandwidth, MHz | Modulation | Carrier frequency, MHz | Occupied bandwidth 99%, kHz | Occupied bandwidth 26 dBc, kHz |
|---|---|---|---|---|
| 5.0 | QPSK | 707.5 | 4562.9 | 5176.0 |
| 5.0 | QPSK | 725.0 | 4563.1 | 5174.0 |
| 5.0 | QPSK | 742.5 | 4563.0 | 5175.0 |
| 5.0 | 64QAM | 707.5 | 4525.2 | 4859.0 |
| 5.0 | 64QAM | 725.0 | 4524.5 | 4866.0 |
| 5.0 | 64QAM | 742.5 | 4525.1 | 4859.0 |
| 10.0 | QPSK | 710.0 | 9086.3 | 9601.0 |
| 10.0 | QPSK | 725.0 | 9077.7 | 9601.0 |
| 10.0 | QPSK | 740.0 | 9083.2 | 9602.0 |
| 10.0 | 64QAM | 710.0 | 9079.8 | 9681.0 |
| 10.0 | 64QAM | 725.0 | 9079.8 | 9679.0 |
| 10.0 | 64QAM | 740.0 | 9071.8 | 9743.0 |

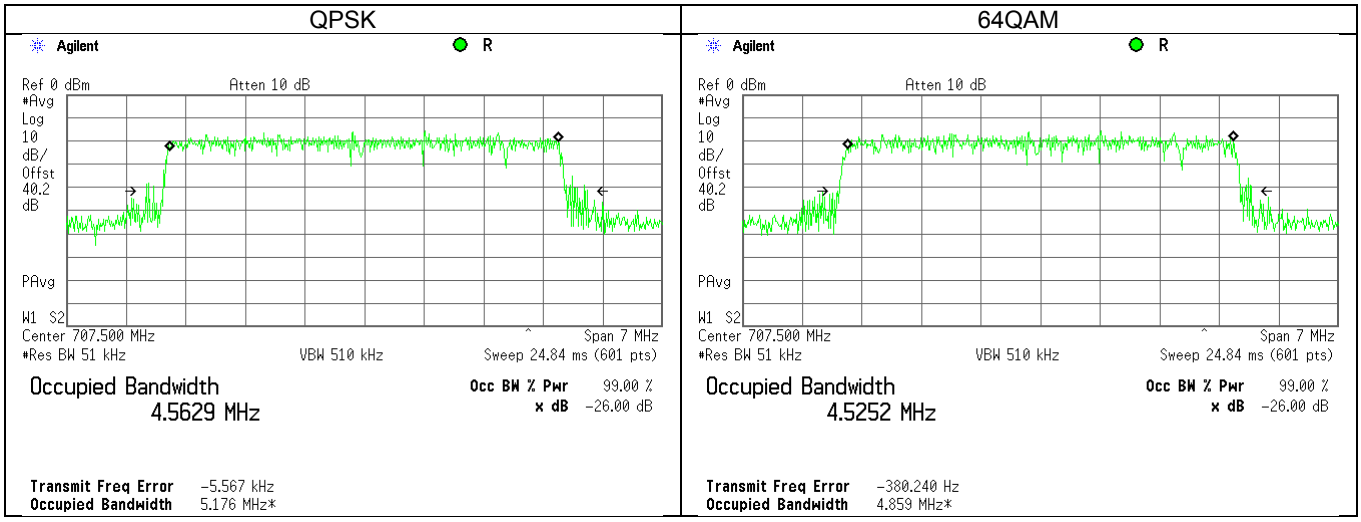
**Reference numbers of test equipment used**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 3472 | HL 3818 | HL 3901 | HL 4425 | | | | |

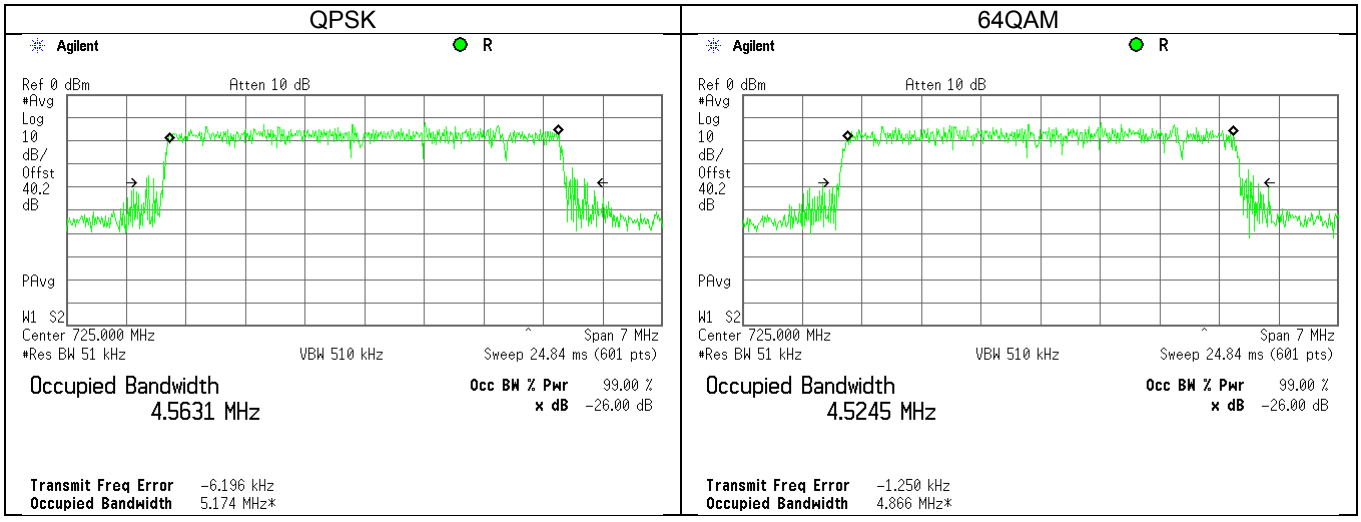
Full description is given in Appendix A.

| Test specification: | Section 2.1049, Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1049 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 °C | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.2.1 Occupied bandwidth test result at low frequency, 5 MHz CBW**



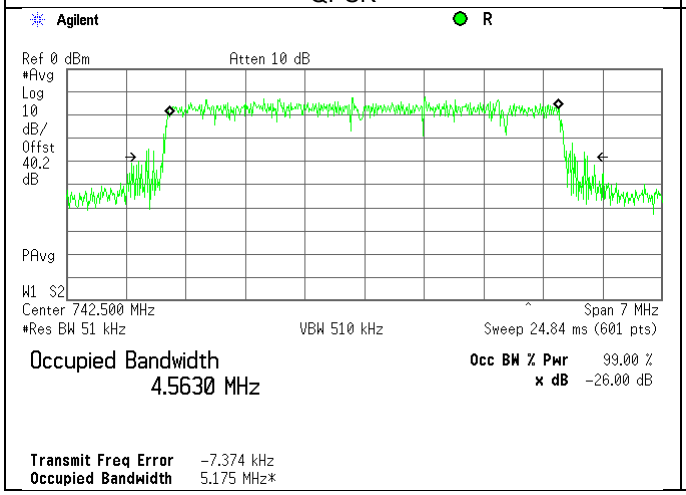

**Plot 7.2.2 Occupied bandwidth test result at mid frequency, 5 MHz CBW**



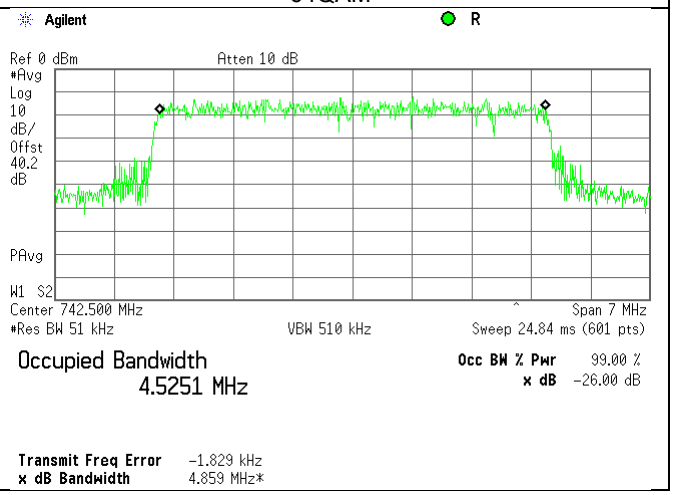
| Test specification: | Section 2.1049, Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1049 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 °C | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.2.3 Occupied bandwidth test result at high frequency, 5 MHz CBW**

QPSK

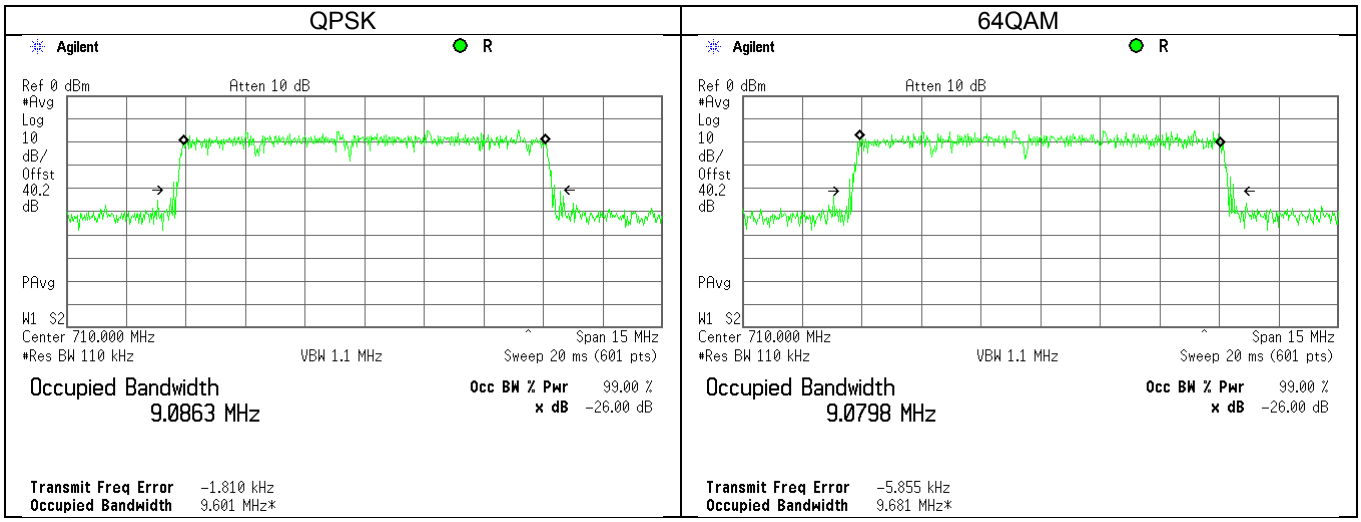



64QAM

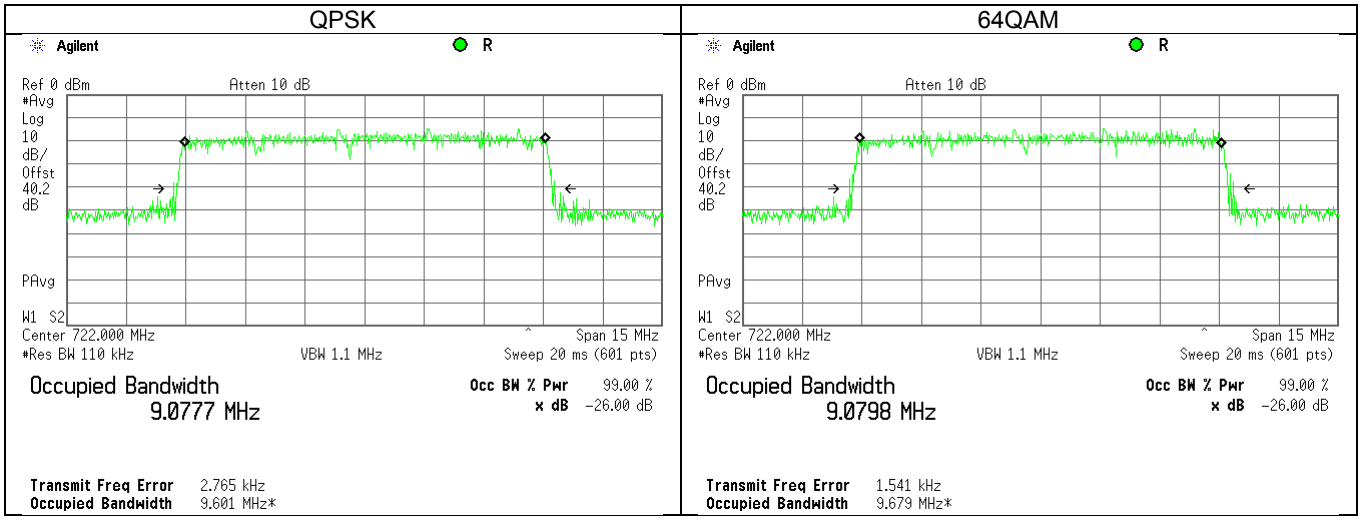


| Test specification: | Section 2.1049, Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1049 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 °C | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.2.4 Occupied bandwidth test result at low frequency, 10 MHz CBW**



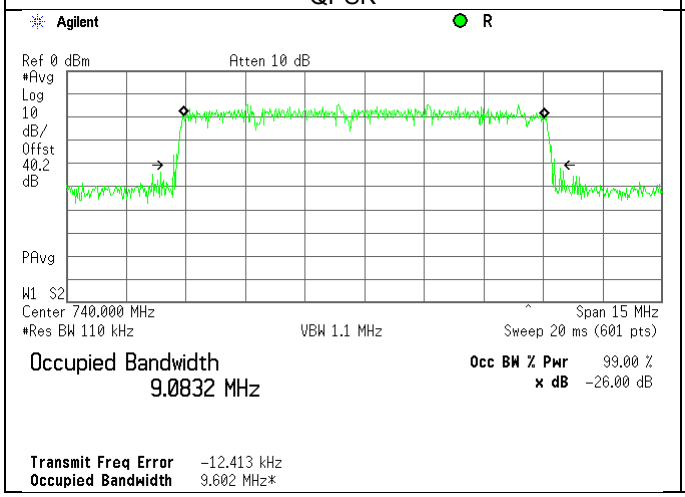

**Plot 7.2.5 Occupied bandwidth test result at mid frequency, 10 MHz CBW**



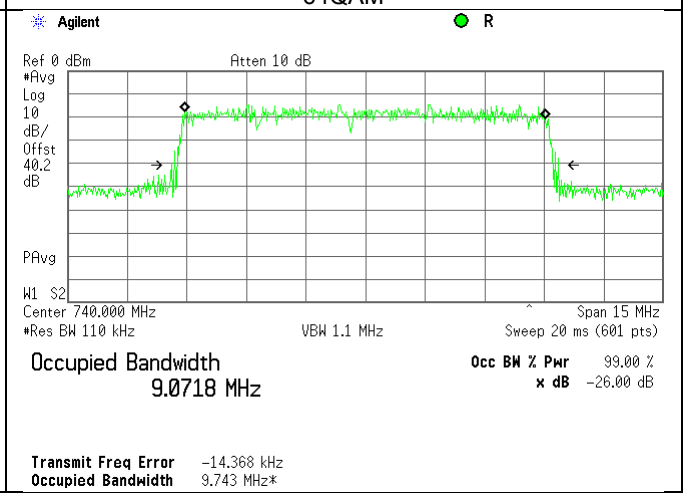
| Test specification: | Section 2.1049, Occupied bandwidth | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1049 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/14/2013 | | |
| Temperature: 22.3 °C | Air Pressure: 1012 hPa | Relative Humidity: 41 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.2.6 Occupied bandwidth test result at high frequency, 10 MHz CBW**

QPSK




64QAM



| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

## 7.3 Emission mask (band edge emissions) test

### 7.3.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.3.1.

**Table 7.3.1 Emission mask limits**

| Investigated band, MHz | Attenuation below carrier, dBc | ERP of spurious, dBm | RBW, kHz |
|---|---|---|---|
| 0.009 - 7500 | 43+10logP(W) | -13.0 | 100 |
| 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block | 43+10logP(W) | -13.0 | 30 |

| OBW (MHz) | Investigated Band Edge | Attenuation below carrier, dBc |
|---|---|---|
| **704.0 - 710.0 MHz Channel (Block B low)** | | |
| 5 | 703.9 – 704.0 MHz<br>710.0 – 710.1 MHz | 43+10logP(W)<br>(RBW = 30 kHz) |
| **704.0 - 716.0 MHz Channel (Block B + Block C low)** | | |
| 10 | 703.9 – 704.0 MHz<br>716.0 – 716.1 MHz | 43+10logP(W)<br>(RBW = 30 kHz) |
| **722.0 - 728.0 MHz Channel (Block D + Block E)** | | |
| 5 | 721.9 – 722.0 MHz<br>728.0 – 728.1 MHz | 43+10logP(W)<br>(RBW = 30 kHz) |
| **716.0 - 728.0 MHz Channel (Block D + Block E)** | | |
| 10 | 715.9 – 716.0 MHz<br>728.0 – 728.1 MHz | 43+10logP(W)<br>(RBW = 30 kHz) |
| **740.0 - 746.0 MHz Channel (Block C high)** | | |
| 5 | 739.9 – 740.0 MHz<br>746.0 – 746.1 MHz | 43+10logP(W)<br>(RBW = 30 kHz) |
| **734.0 - 746.0 MHz Channel (Block B + Block C high)** | | |
| 10 | 733.9 – 734.0 MHz<br>746.0 – 746.1 MHz | 43+10logP(W)<br>(RBW = 30 kHz) |

### 7.3.2 Test procedure

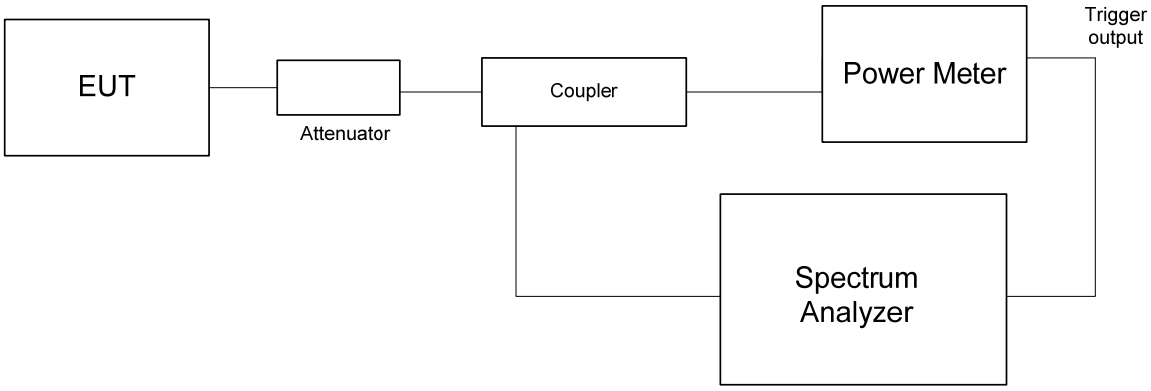
**7.3.2.1** The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

**7.3.2.2** The emission mask was measured with spectrum analyzer as provided in the associated plots.

**7.3.2.3** The spurious emission was measured with spectrum analyzer as provided in Table 7.3.2, Table 7.3.3 and the associated plots.

| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Figure 7.3.1 Emission mask test setup**



| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Table 7.3.2 Spurious emission at band edges test results (4 outputs)**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 7500 MHz
DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
NUMBER OF RF CHAINS: N =4 (worst case)
BEAMFORMING GAIN: 6 dB

| Frequency, MHz | SA reading, dBm | Attenuator, dB | Cable loss, dB | RBW, kHz | Spurious emission, dBm | Calculated limit, dBm** | Margin, dB* | Verdict |
|---|---|---|---|---|---|---|---|---|
| **QPSK 5.0 MHz CBW 707.5 MHz** | | | | | | | | |
| 704.0 | -49.34 | Included | Included | 100 | -49.34 | -25.0 | -24.34 | Pass |
| 710.0 | -31.97 | Included | Included | 100 | -31.97 | -25.0 | -6.97 | Pass |
| **QPSK 5.0 MHz CBW 725.0 MHz** | | | | | | | | |
| 722.0 | -44.34 | Included | Included | 100 | -44.34 | -25.0 | -19.34 | Pass |
| 728.0 | -45.22 | Included | Included | 100 | -45.22 | -25.0 | -20.22 | Pass |
| **QPSK 5.0 MHz CBW 742.50 MHz** | | | | | | | | |
| 740.0 | -29.03 | Included | Included | 100 | -29.03 | -25.0 | -4.03 | Pass |
| 746.0 | -49.79 | Included | Included | 100 | -49.79 | -25.0 | -24.79 | Pass |
| **64QAM 5.0 MHz CBW 707.5 MHz** | | | | | | | | |
| 704.0 | -48.93 | Included | Included | 100 | -48.93 | -25.0 | -23.93 | Pass |
| 710.0 | -30.34 | Included | Included | 100 | -30.34 | -25.0 | -5.34 | Pass |
| **64QAM 5.0 MHz CBW 725.0 MHz** | | | | | | | | |
| 722.0 | -49.63 | Included | Included | 100 | -49.63 | -25.0 | -24.63 | Pass |
| 728.0 | -48.08 | Included | Included | 100 | -48.08 | -25.0 | -23.08 | Pass |
| **64QAM 5.0 MHz CBW 742.5 MHz** | | | | | | | | |
| 740.0 | -33.03 | Included | Included | 100 | -33.03 | -25.0 | -8.03 | Pass |
| 746.0 | -52.57 | Included | Included | 100 | -52.57 | -25.0 | -27.57 | Pass |
| **QPSK 10.0 MHz CBW 710.0 MHz** | | | | | | | | |
| 704.0 | -48.14 | Included | Included | 100 | -48.14 | -25.0 | -23.14 | Pass |
| 716.0 | -47.08 | Included | Included | 100 | -47.08 | -25.0 | -22.08 | Pass |
| **QPSK 10.0 MHz CBW 722.0 MHz** | | | | | | | | |
| 716.0 | -49.13 | Included | Included | 100 | -49.13 | -25.0 | -24.13 | Pass |
| 728.0 | -48.81 | Included | Included | 100 | -48.81 | -25.0 | -23.81 | Pass |
| **QPSK 10.0 MHz CBW 740.0 MHz** | | | | | | | | |
| 734.0 | -44.30 | Included | Included | 100 | -44.30 | -25.0 | -19.30 | Pass |
| 746.0 | -42.97 | Included | Included | 100 | -42.97 | -25.0 | -17.97 | Pass |
| **64QAM 10.0 MHz CBW 710.0 MHz** | | | | | | | | |
| 704.0 | -51.04 | Included | Included | 100 | -51.04 | -25.0 | -26.04 | Pass |
| 716.0 | -46.69 | Included | Included | 100 | -46.69 | -25.0 | -21.69 | Pass |
| **64QAM 10.0 MHz CBW 722.0 MHz** | | | | | | | | |
| 716.0 | -52.70 | Included | Included | 100 | -52.70 | -25.0 | -27.70 | Pass |
| 728.0 | -47.32 | Included | Included | 100 | -47.32 | -25.0 | -22.32 | Pass |
| **64QAM 10.0 MHz CBW 740.0 MHz** | | | | | | | | |
| 734.0 | -50.98 | Included | Included | 100 | -50.98 | -25.0 | -25.98 | Pass |
| 746.0 | -48.01 | Included | Included | 100 | -48.01 | -25.0 | -23.01 | Pass |

* - Margin, dB = Spurious Emission – Specification limit
** - Calculated limit, dBm = Specification limit – 10log(N) – Beamforming gain = -13 dBm- 6 dB-6 dB=-25 dBm

| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Table 7.3.3 Spurious emission at band edges test results (single output)**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 7500 MHz
DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
NUMBER OF RF CHAINS: N = 1
BEAMFORMING GAIN: 0 dB

| Frequency, MHz | SA reading, dBm | Attenuator, dB | Cable loss, dB | RBW, kHz | Spurious emission, dBm | Limit, dBm | Margin, dB* | Verdict |
|---|---|---|---|---|---|---|---|---|
| **QPSK 5.0 MHz CBW 707.5 MHz** | | | | | | | | |
| 704.0 | -49.34 | Included | Included | 100 | -49.34 | -13.0 | -36.34 | Pass |
| 710.0 | -31.97 | Included | Included | 100 | -31.97 | -13.0 | -18.97 | Pass |
| **QPSK 5.0 MHz CBW 725.0 MHz** | | | | | | | | |
| 722.0 | -44.34 | Included | Included | 100 | -44.34 | -13.0 | -31.34 | Pass |
| 728.0 | -45.22 | Included | Included | 100 | -45.22 | -13.0 | -32.22 | Pass |
| **QPSK 5.0 MHz CBW 742.50 MHz** | | | | | | | | |
| 740.0 | -29.03 | Included | Included | 100 | -29.03 | -13.0 | -16.03 | Pass |
| 746.0 | -49.79 | Included | Included | 100 | -49.79 | -13.0 | -36.79 | Pass |
| **64QAM 5.0 MHz CBW 707.5 MHz** | | | | | | | | |
| 704.0 | -48.93 | Included | Included | 100 | -48.93 | -13.0 | -35.93 | Pass |
| 710.0 | -30.34 | Included | Included | 100 | -30.34 | -13.0 | -17.34 | Pass |
| **64QAM 5.0 MHz CBW 725.0 MHz** | | | | | | | | |
| 722.0 | -49.63 | Included | Included | 100 | -49.63 | -13.0 | -36.63 | Pass |
| 728.0 | -48.08 | Included | Included | 100 | -48.08 | -13.0 | -35.08 | Pass |
| **64QAM 5.0 MHz CBW 742.5 MHz** | | | | | | | | |
| 740.0 | -33.03 | Included | Included | 100 | -33.03 | -13.0 | -20.03 | Pass |
| 746.0 | -53.41 | Included | Included | 100 | -53.41 | -13.0 | -40.41 | Pass |
| **QPSK 10.0 MHz CBW 710.0 MHz** | | | | | | | | |
| 704.0 | -48.14 | Included | Included | 100 | -48.14 | -13.0 | -35.14 | Pass |
| 716.0 | -47.08 | Included | Included | 100 | -47.08 | -13.0 | -34.08 | Pass |
| **QPSK 10.0 MHz CBW 722.0 MHz** | | | | | | | | |
| 716.0 | -49.13 | Included | Included | 100 | -49.13 | -13.0 | -36.13 | Pass |
| 728.0 | -48.81 | Included | Included | 100 | -48.81 | -13.0 | -35.81 | Pass |
| **QPSK 10.0 MHz CBW 740.0 MHz** | | | | | | | | |
| 734.0 | -44.30 | Included | Included | 100 | -44.30 | -13.0 | -31.30 | Pass |
| 746.0 | -42.97 | Included | Included | 100 | -42.97 | -13.0 | -29.97 | Pass |
| **64QAM 10.0 MHz CBW 710.0 MHz** | | | | | | | | |
| 704.0 | -51.04 | Included | Included | 100 | -51.04 | -13.0 | -38.04 | Pass |
| 716.0 | -46.69 | Included | Included | 100 | -46.69 | -13.0 | -33.69 | Pass |
| **64QAM 10.0 MHz CBW 722.0 MHz** | | | | | | | | |
| 716.0 | -52.70 | Included | Included | 100 | -52.70 | -13.0 | -39.70 | Pass |
| 728.0 | -47.32 | Included | Included | 100 | -47.32 | -13.0 | -34.32 | Pass |
| **64QAM 10.0 MHz CBW 740.0 MHz** | | | | | | | | |
| 734.0 | -50.98 | Included | Included | 100 | -50.98 | -13.0 | -37.98 | Pass |
| 746.0 | -48.01 | Included | Included | 100 | -48.01 | -13.0 | -35.01 | Pass |

*****- Margin, dB = Spurious emission – specification limit.

**Reference numbers of test equipment used**

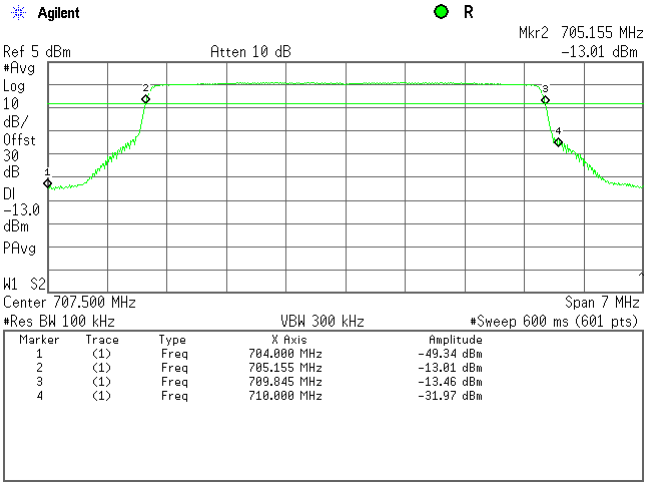
| HL 2952 | HL 3301 | HL 3302 | HL 3472 | HL 3473 | HL 3474 | HL 3781 | HL 3818 |
|---|---|---|---|---|---|---|---|
| HL 3901 | HL 4425 | | | | | | |

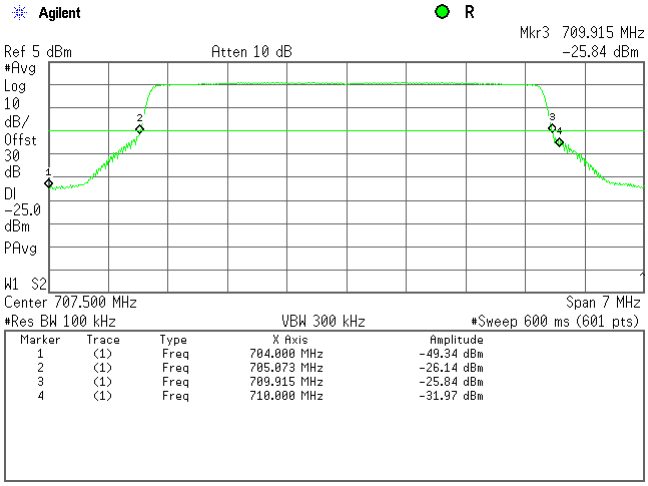
Full description is given in Appendix A.

| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 °C | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.3.1 Emission mask test results at low carrier frequency, 5 MHz CBW**

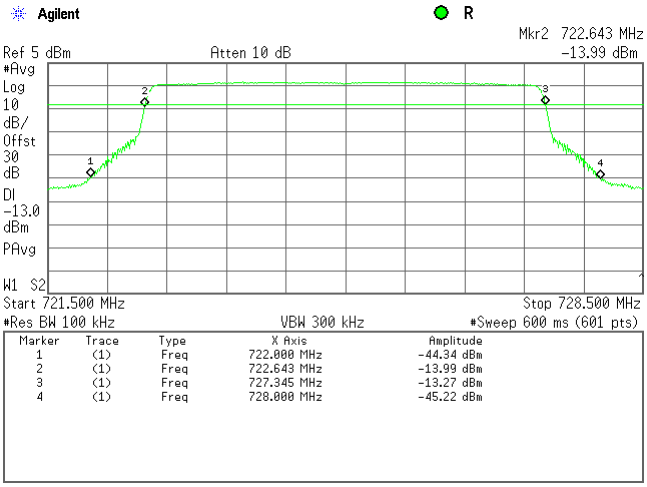
ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: QPSK
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

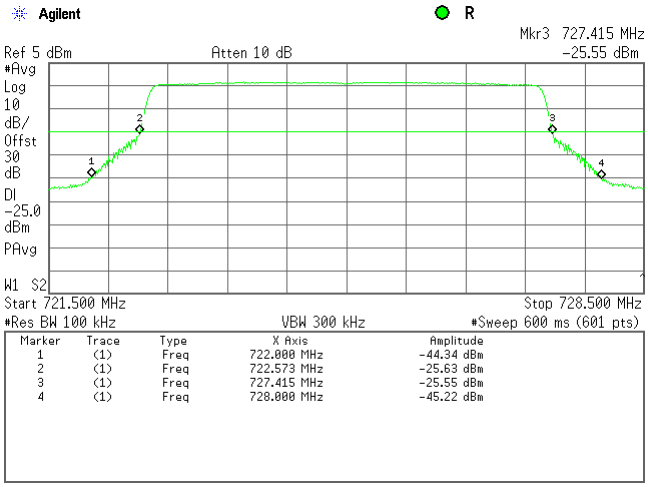



**Plot 7.3.2 Emission mask test results at mid carrier frequency, 5 MHz CBW**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: QPSK
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

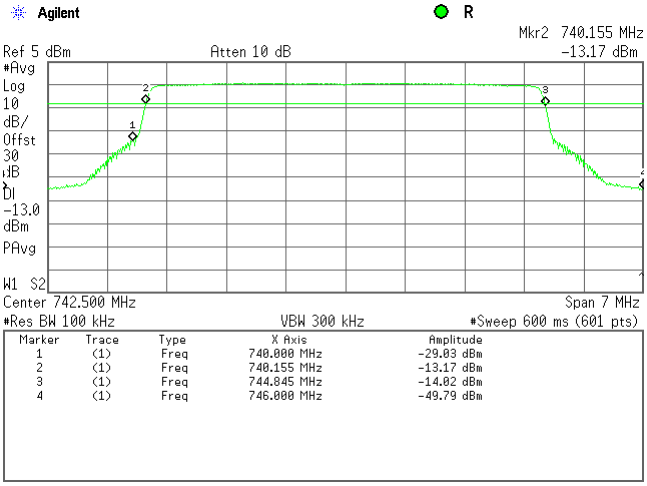


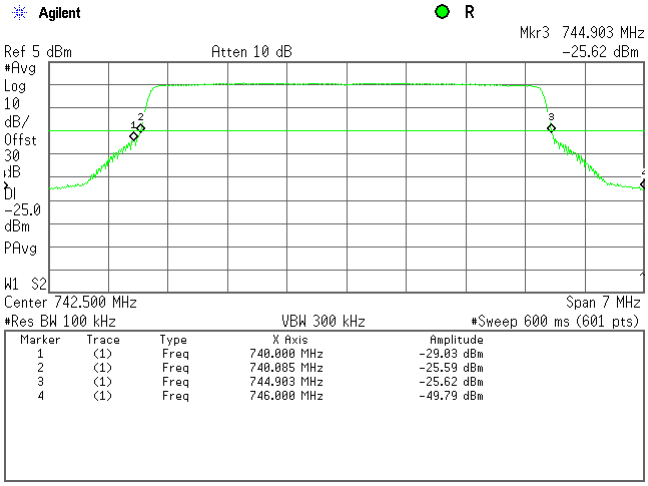



| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 °C | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.3.3 Emission mask test results at high carrier frequency, 5 MHz CBW**

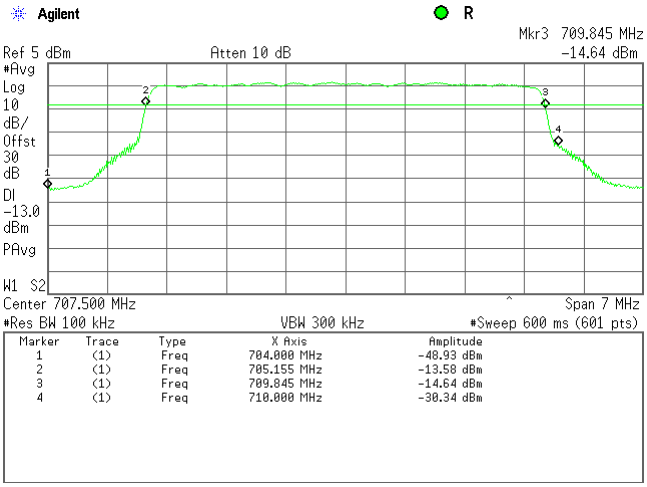
ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: QPSK
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

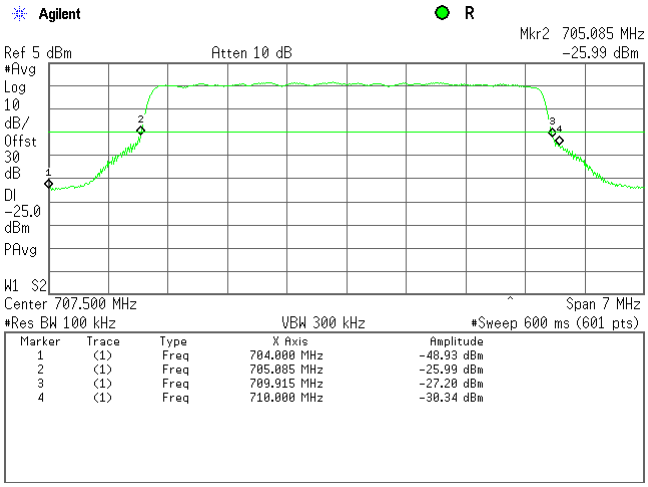



**Plot 7.3.4 Emission mask test results at low carrier frequency, 5 MHz CBW**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

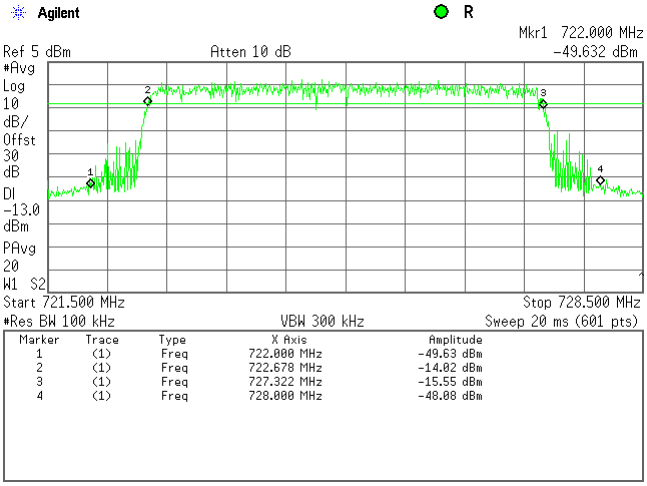


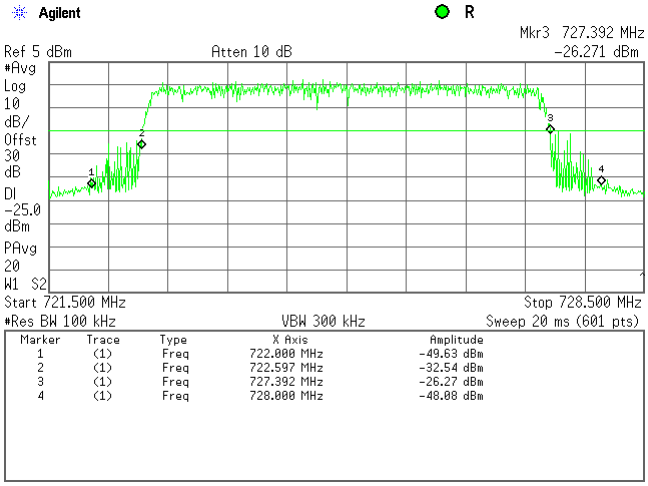



| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 °C | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.3.5 Emission mask test results at mid carrier frequency, 5 MHz CBW**

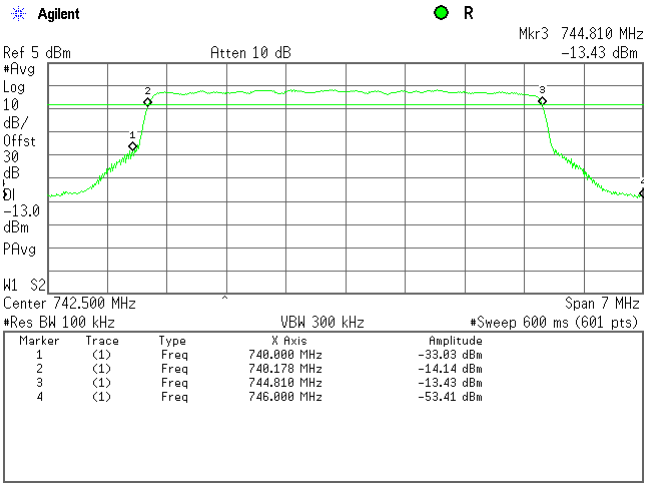
ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

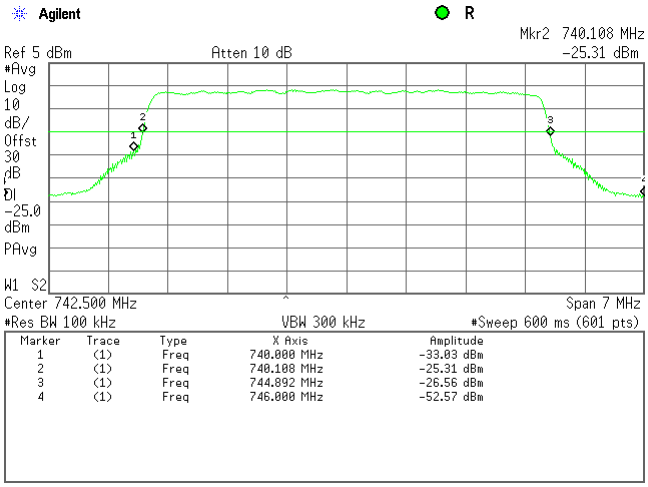



**Plot 7.3.6 Emission mask test results at high carrier frequency, 5 MHz CBW**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

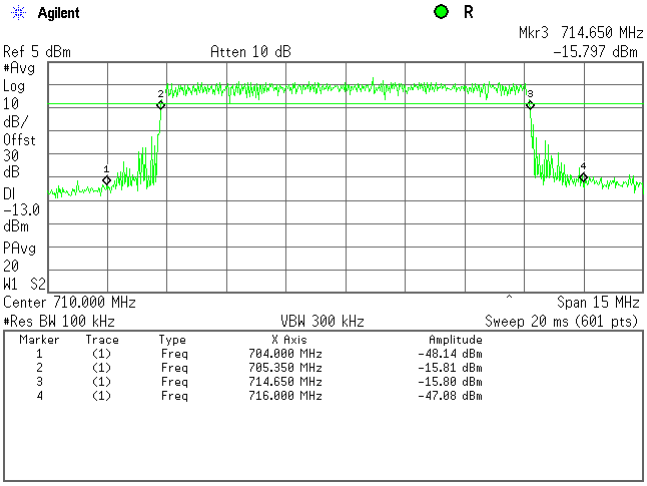


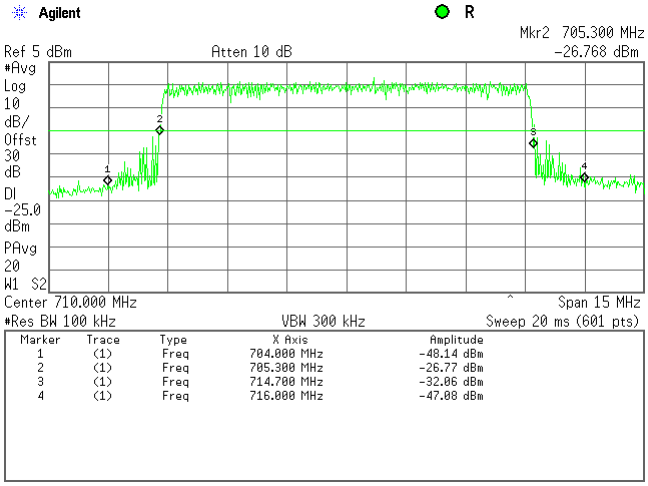



| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 °C | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.3.7 Emission mask test results at low carrier frequency, 10 MHz CBW**

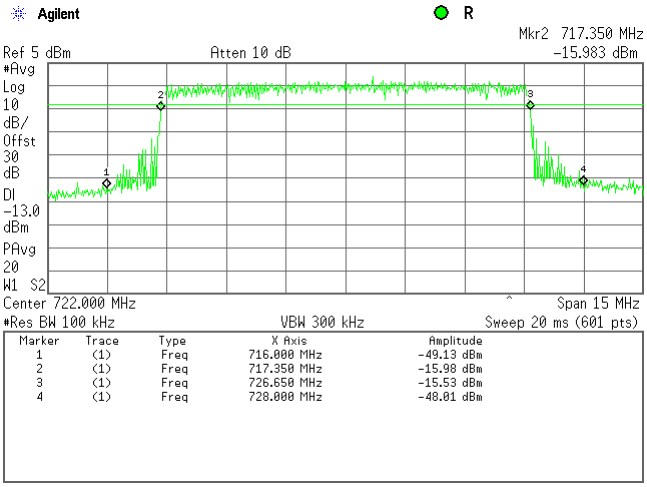
ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: QPSK
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

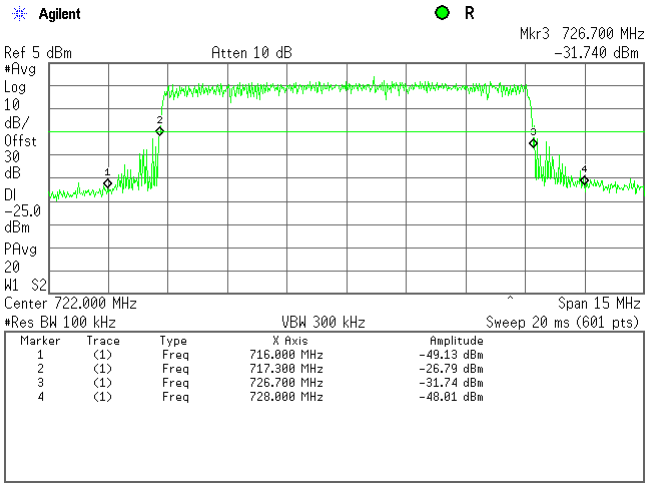



**Plot 7.3.8 Emission mask test results at mid carrier frequency, 10 MHz CBW**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: QPSK
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

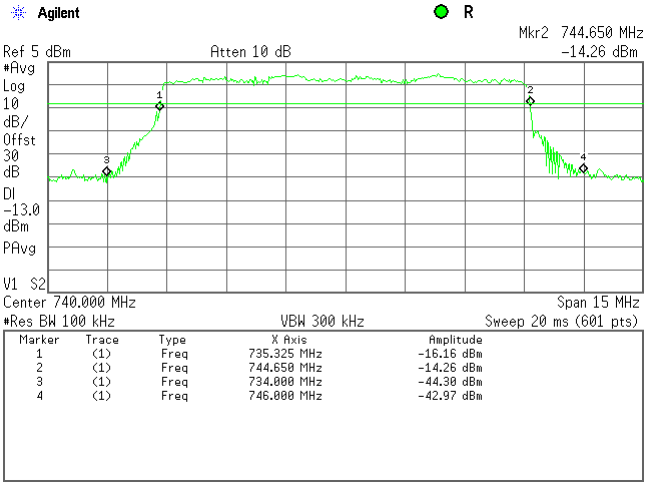


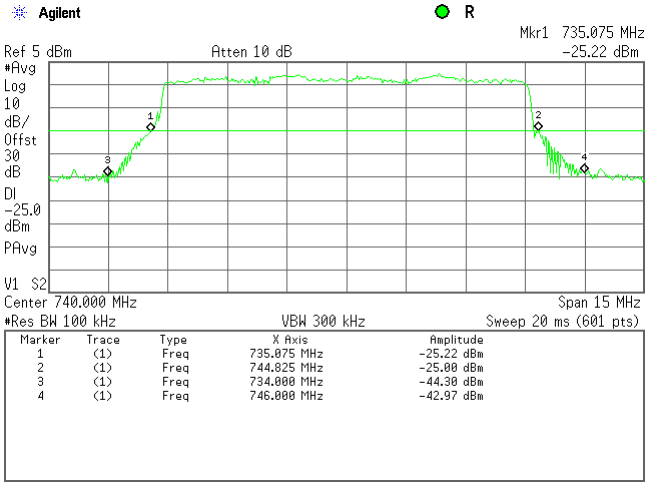



| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 °C | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.3.9 Emission mask test results at high carrier frequency, 10 MHz CBW**

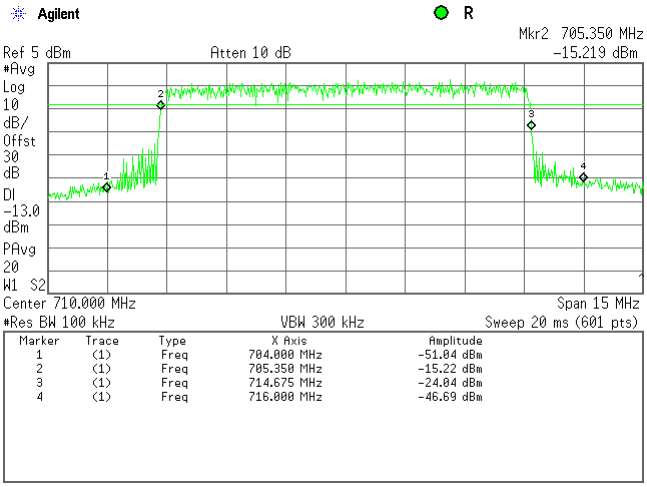
ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: QPSK
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

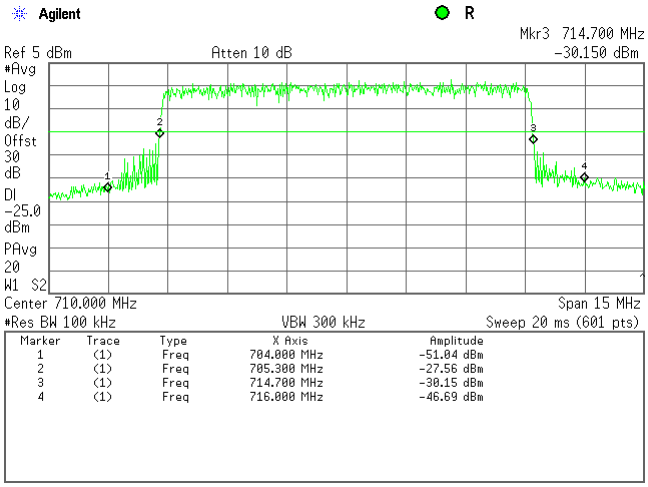



**Plot 7.3.10 Emission mask test results at low carrier frequency, 10 MHz CBW**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

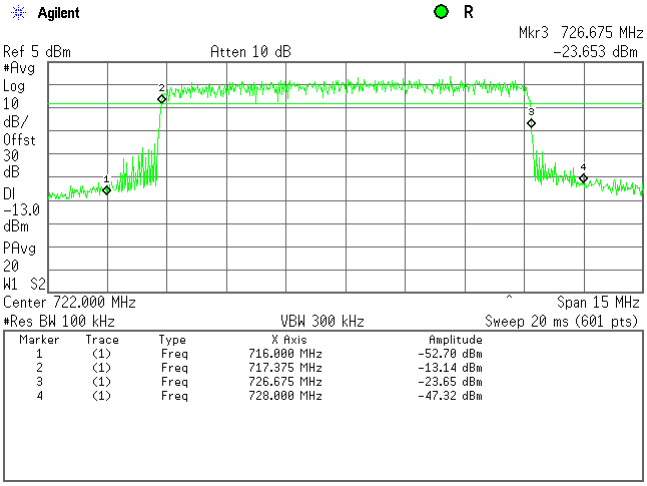


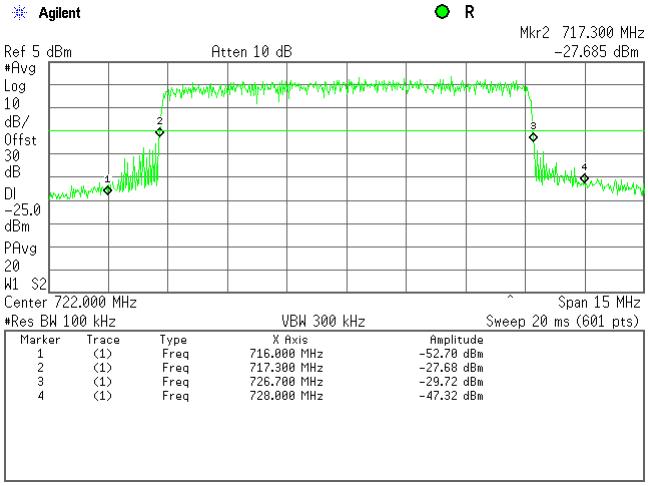



| Test specification: | Section 27.53(g), Band edge emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1047 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/17/2013 | | |
| Temperature: 22.2 °C | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.3.11 Emission mask test results at mid carrier frequency, 10 MHz CBW**

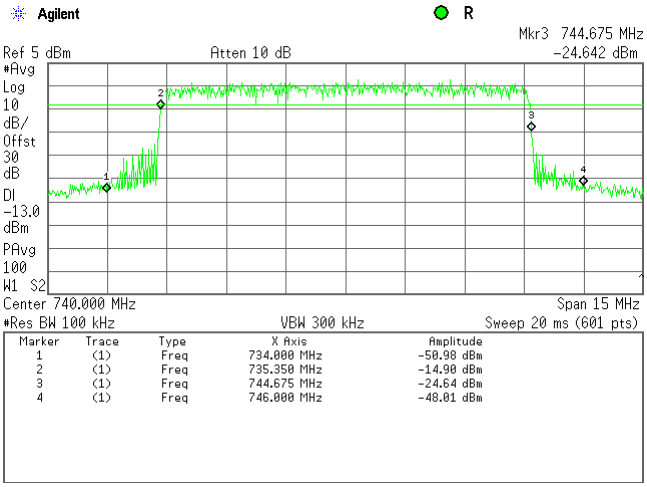
ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO

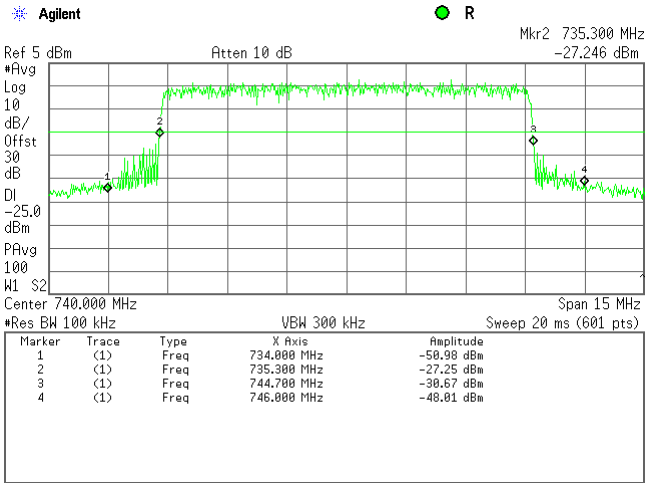



**Plot 7.3.12 Emission mask test results at high carrier frequency, 10 MHz CBW**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
CONFIGURATION: MIMO



| Test specification: | Section 27.53(g), Spurious emissions at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1051 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 22.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

## 7.4 Spurious emissions at RF antenna connector test

### 7.4.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.4.1.

**Table 7.4.1 Spurious emission limits**

| Investigated band, MHz | Attenuation below carrier, dBc | Spurious emissions, dBm | RBW, kHz |
|---|---|---|---|
| 0.009 - 10th harmonic* | 43+10logP(W)** | -13.0 | 100 |
| 100 kHz bands immediately outside and adjacent to a licensee's frequency block | 43+10logP(W)** | -13.0 | 30 |

* - spurious emission limits do not apply to the in band emission investigated in course of emission mask testing
** - P is transmitter output power in watts

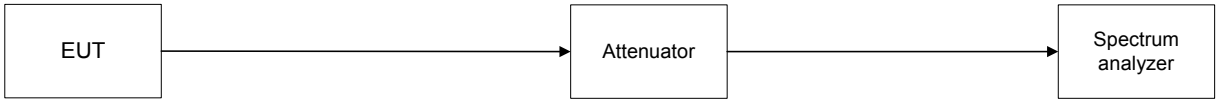
### 7.4.2 Test procedure

**7.4.2.1** The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.

**7.4.2.2** The EUT was adjusted to produce maximum available for end user RF output power.

**7.4.2.3** The spurious emission was measured with spectrum analyzer as provided in Table 7.4.2 and associated plots.

**Figure 7.4.1 Spurious emission test setup, single output**



| **Test specification:** | **Section 27.53(g), Spurious emissions at RF antenna connector** | | |
|---|---|---|---|
| **Test procedure:** | 47 CFR, Sections 2.1051 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 2/18/2013 - 2/19/2013 | | |
| **Temperature:** 22.1 ºC | **Air Pressure:** 1016 hPa | **Relative Humidity:** 43 % | **Power Supply:** 48VDC |
| **Remarks:** | | | |

**Table 7.4.2 Spurious emission test results**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 7500 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATION: 64QAM / QPSK
MODULATING SIGNAL: PRBS
BIT RATE: 7 Mbps
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
NUMBER OF RF CHAINS: N = 1
BEAMFORMING GAIN: 0 dB

| Frequency, MHz | SA reading, dBm | Attenuation, dB | Cable loss, dB | RBW, kHz | Spurious emission, dBm | Limit, dBm | Margin, dB* | Verdict |
|---|---|---|---|---|---|---|---|---|
| **Low carrier frequency** | | | | | | | | |
| All emissions were more than 20 dB below the limit | | | | | | | | Pass |
| **Mid carrier frequency** | | | | | | | | |
| All emissions were more than 20 dB below the limit | | | | | | | | Pass |
| **High carrier frequency** | | | | | | | | |
| All emissions were more than 20 dB below the limit | | | | | | | | Pass |

NUMBER OF RF CHAINS: N =4 (Worst case)
BEAMFORMING GAIN: 6 dB

| Frequency, MHz | SA reading, dBm | Attenuation, dB | Cable loss, dB | RBW, kHz | Spurious emission, dBm | Calculated limit, dBm** | Margin, dB* | Verdict |
|---|---|---|---|---|---|---|---|---|
| **Low carrier frequency** | | | | | | | | |
| 739.7 | -44.62 | Included | Included | 100 | -44.62 | -25.0 | -19.62 | Pass |
| **Mid carrier frequency** | | | | | | | | |
| 700.9 | -42.73 | Included | Included | 100 | -42.73 | -25.0 | -17.73 | Pass |
| **High carrier frequency** | | | | | | | | |
| 700.9 | -42.65 | Included | Included | 100 | -42.65 | -25.0 | -17.65 | Pass |

*****- Margin = Spurious emission – specification limit.
** - Calculated limit, dBm = Specification limit – 10log(N) – Beamforming gain = -13 dBm- 6 dB-6 dB=-25 dBm

**Reference numbers of test equipment used**

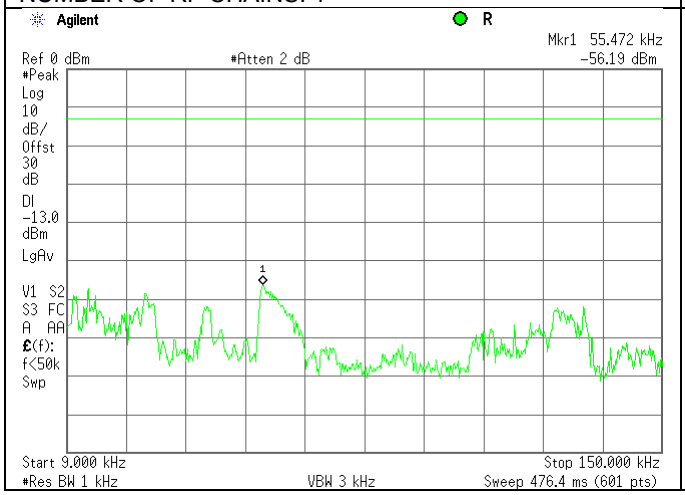
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 3776 | HL 3787 | HL 3818 | HL 3903 | | | | |

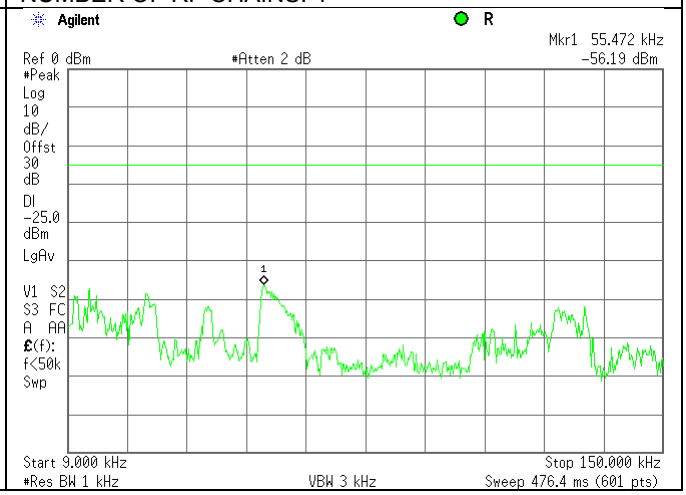
Full description is given in Appendix A.

| Test specification: | Section 27.53(g), Spurious emissions at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1051 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 22.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.4.1 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency**

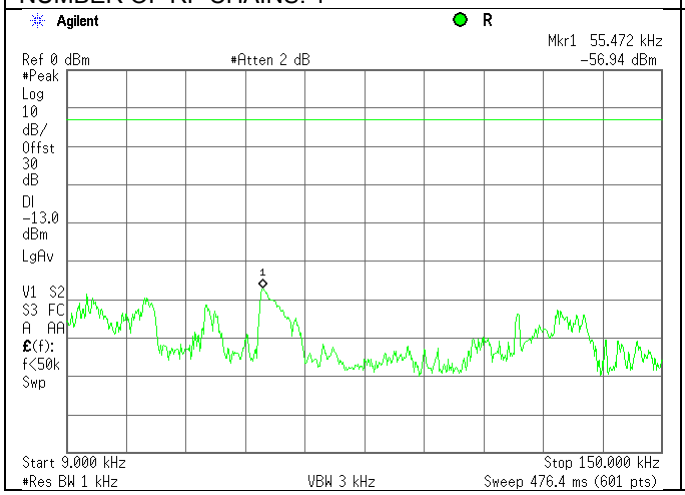
| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |

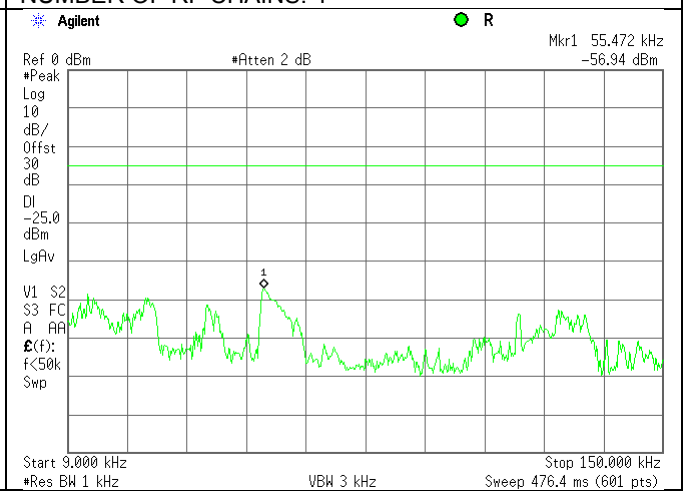



**Plot 7.4.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency**

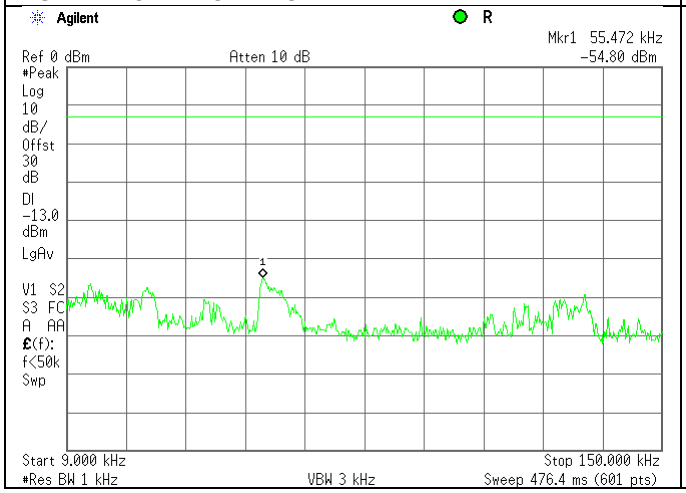
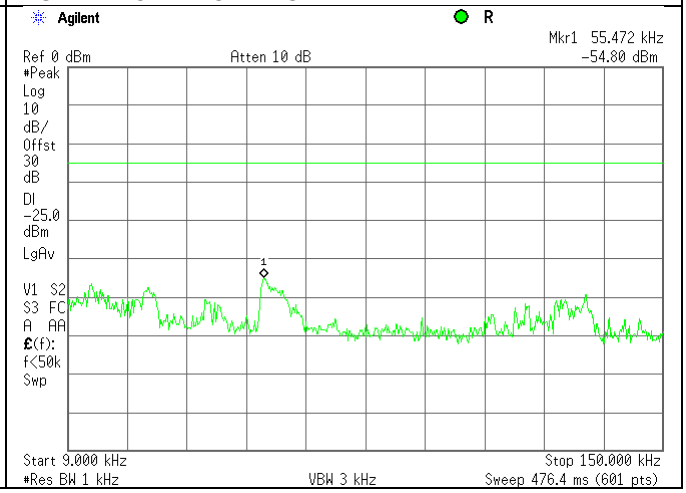
| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |



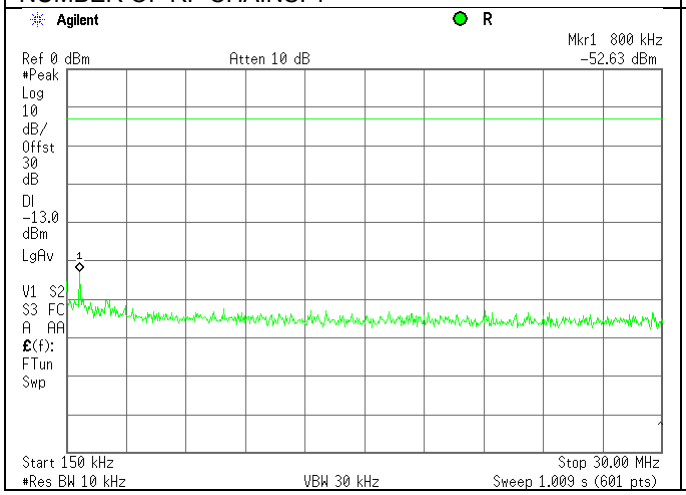
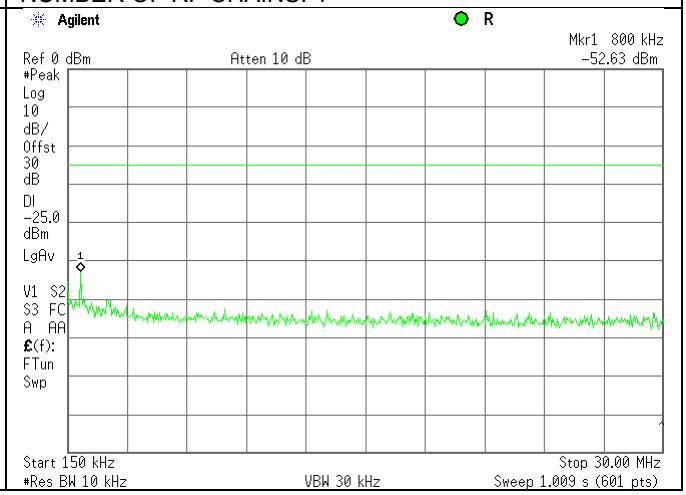
| Test specification: | Section 27.53(g), Spurious emissions at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1051 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 22.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.4.3 Spurious emission measurements in 9 - 150 kHz range at high carrier frequency**

| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |
|  |  |

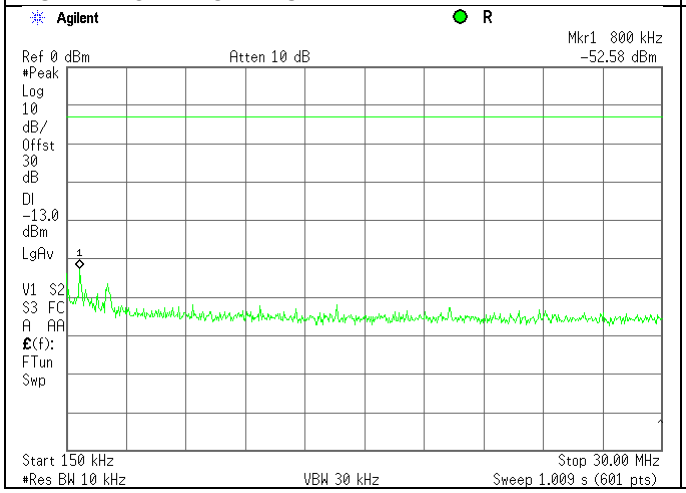
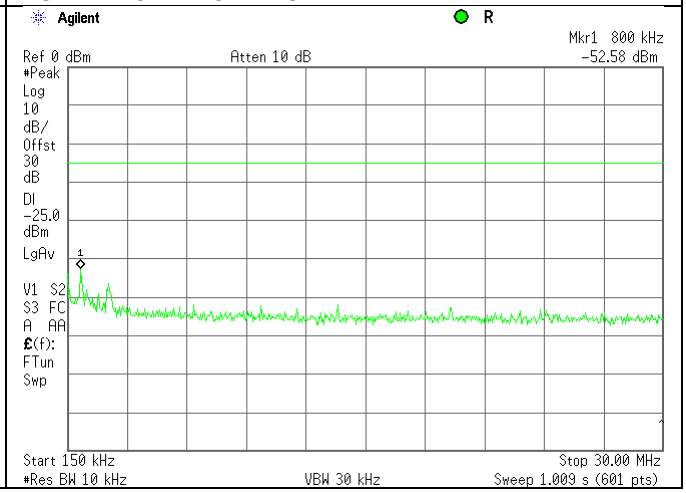


**Plot 7.4.4 Spurious emission measurements in 0.15 - 30.0 MHz range at low carrier frequency**

| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |
|  |  |

| Test specification: | Section 27.53(g), Spurious emissions at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1051 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 22.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

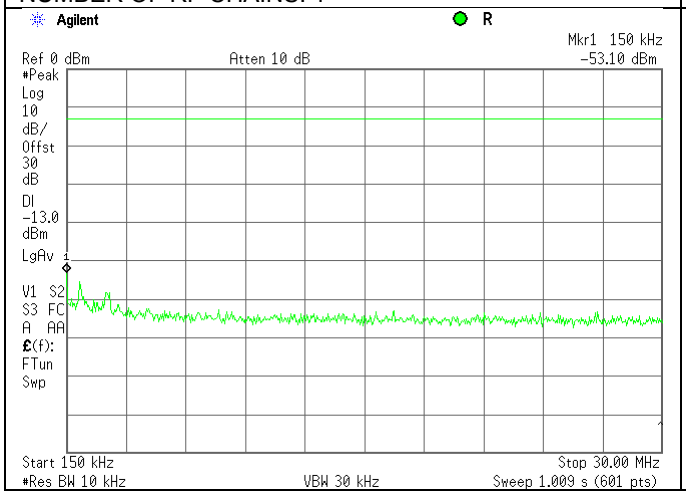
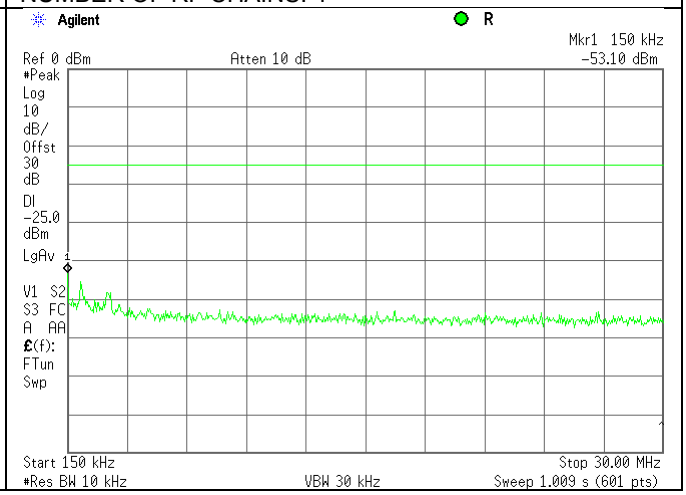
**Plot 7.4.5 Spurious emission measurements in 0.15 - 30.0 MHz range at mid carrier frequency**

| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |
|  |  |



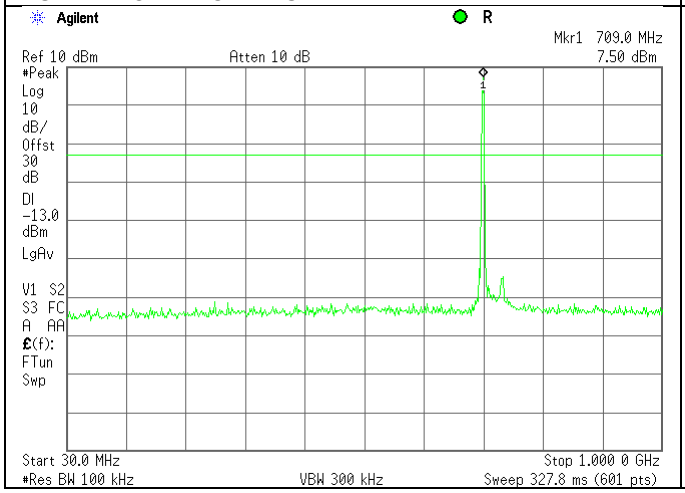
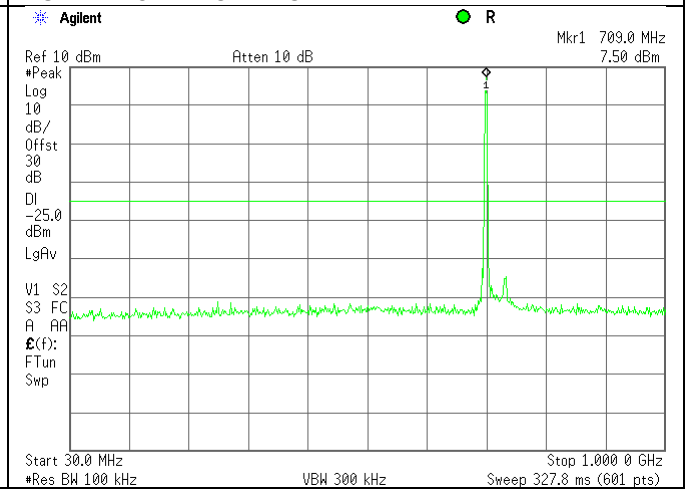


**Plot 7.4.6 Spurious emission measurements in 0.15 - 30.0 MHz range at high carrier frequency**

| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |
|  |  |

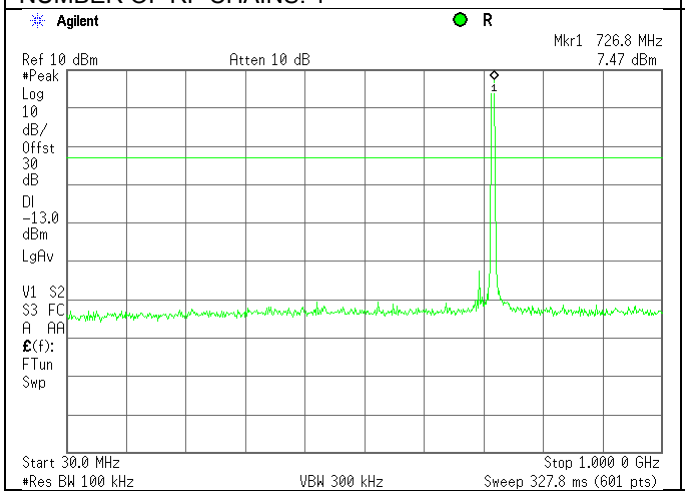
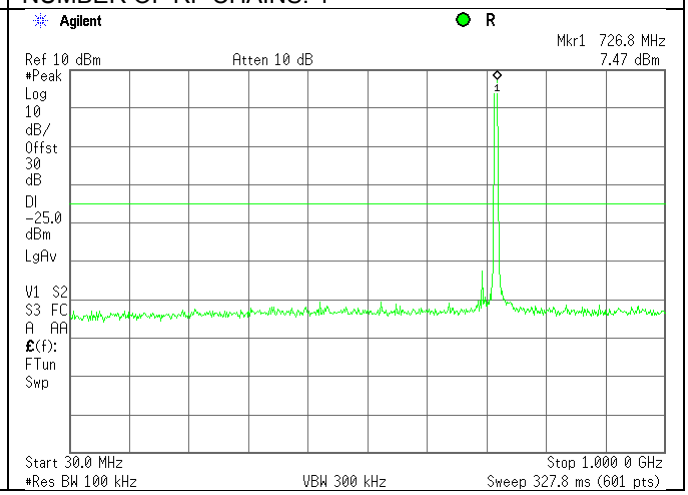
| Test specification: | Section 27.53(g), Spurious emissions at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1051 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 22.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.4.7 Spurious emission measurements in 30 - 1000 MHz range at low carrier frequency**

| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |
|  |  |

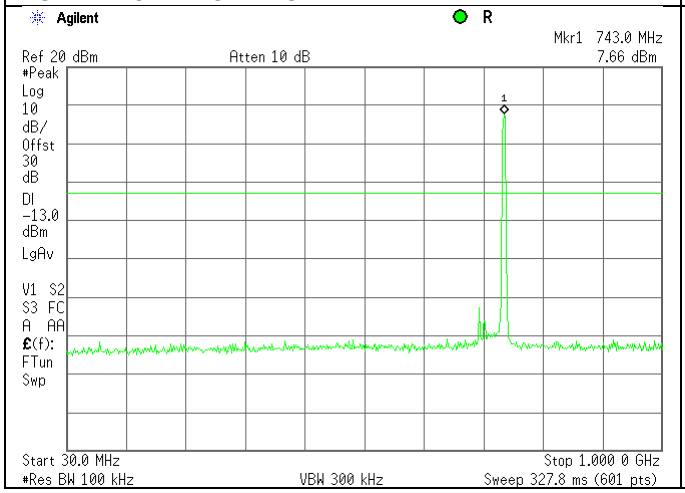
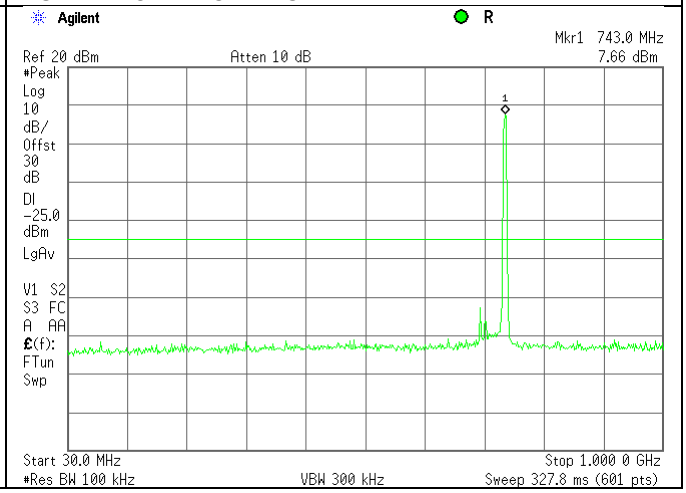


**Plot 7.4.8 Spurious emission measurements in 30 - 1000 MHz range at mid carrier frequency**

| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |
|  |  |

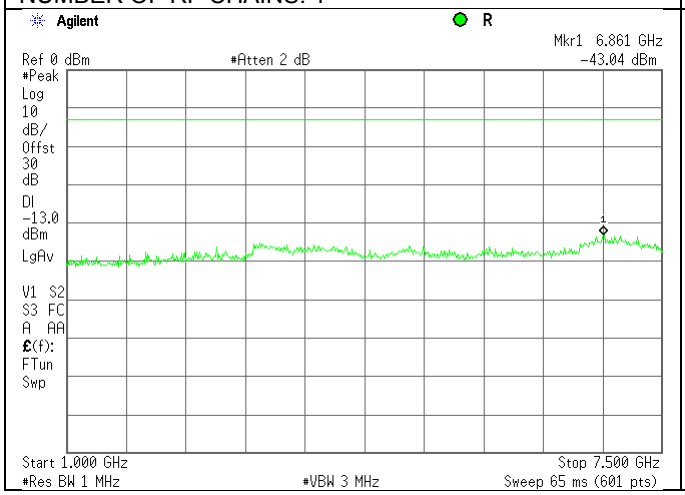
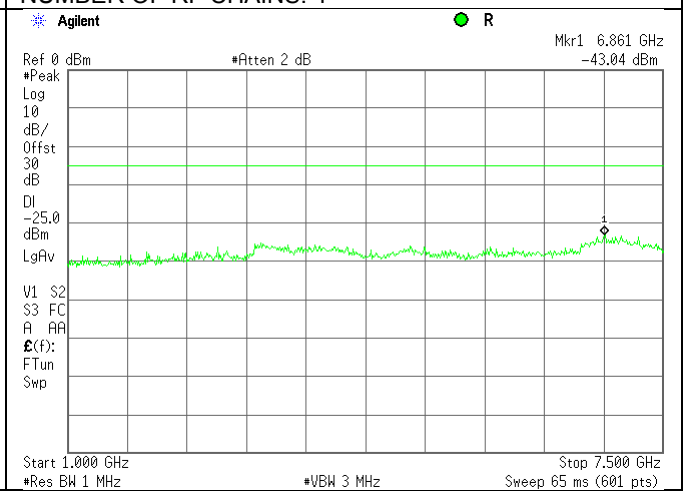
| Test specification: | Section 27.53(g), Spurious emissions at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1051 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 22.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

**Plot 7.4.9 Spurious emission measurements in 30 - 1000 MHz range at high carrier frequency**

| BEAMFORMING GAIN: 0 dB<br>NUMBER OF RF CHAINS: 1 | BEAMFORMING GAIN: 6 dB<br>NUMBER OF RF CHAINS: 4 |
|---|---|
|  |  |



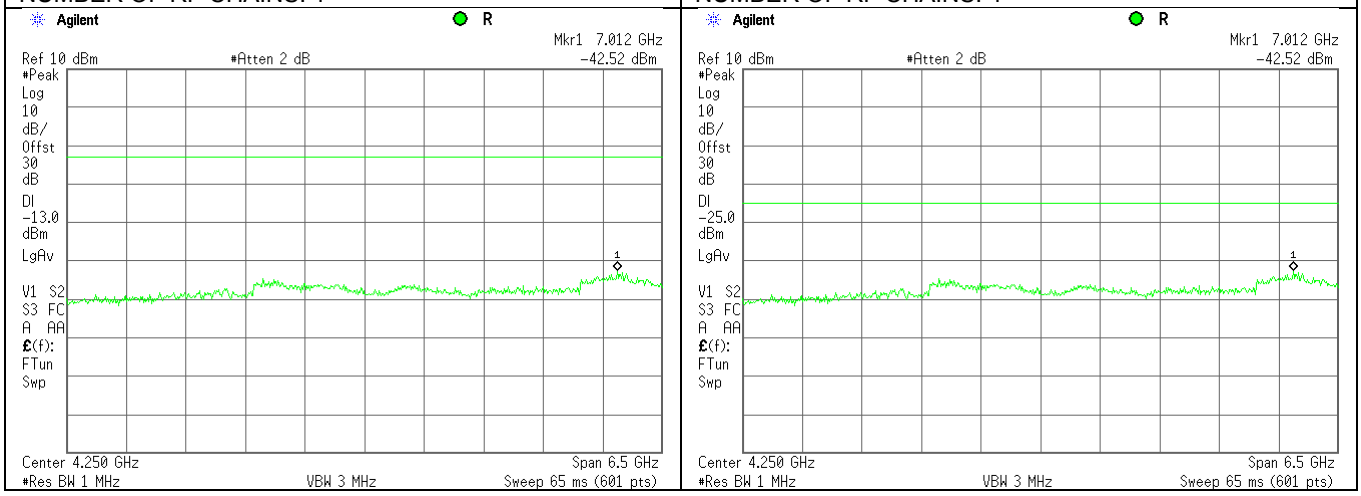
**Plot 7.4.10 Spurious emission measurements in 1000 - 7500 MHz range at low carrier frequency**

| BEAMFORMING GAIN: 0 dB<br>NUMBER OF RF CHAINS: 1 | BEAMFORMING GAIN: 6 dB<br>NUMBER OF RF CHAINS: 4 |
|---|---|
|  |  |

| Test specification: | Section 27.53(g), Spurious emissions at RF antenna connector | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1051 and 27.53(g); TIA/EIA-603-C, Section 2.2.13 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 22.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 43 % | Power Supply: 48VDC |
| Remarks: | | | |

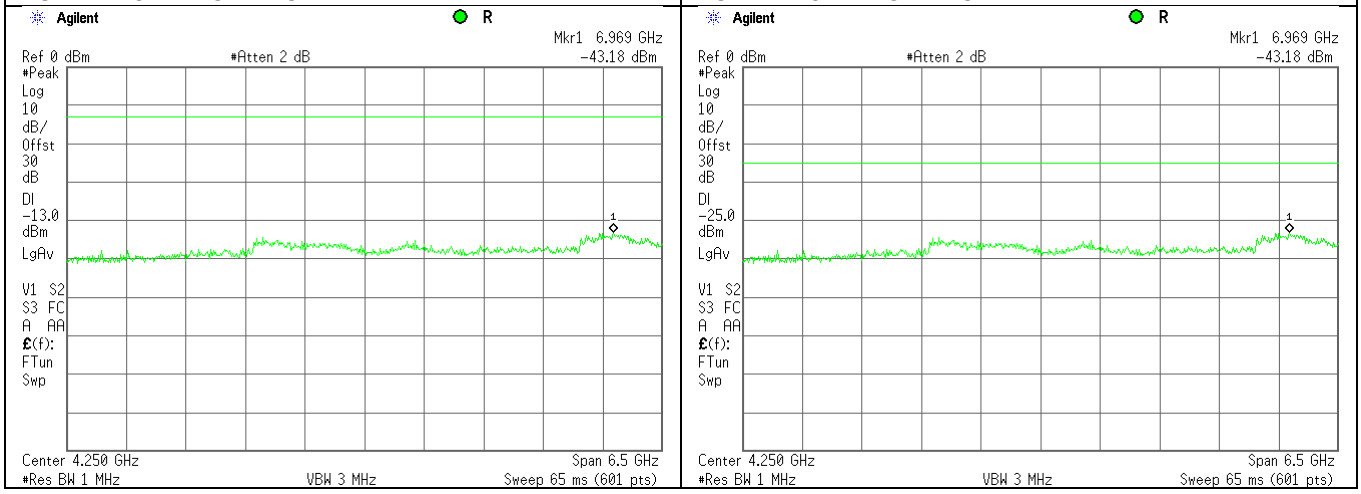
**Plot 7.4.11 Spurious emission measurements in 1000 - 7500 MHz at mid carrier frequency**

| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |




**Plot 7.4.12 Spurious emission measurements in 1000 - 7500 MHz at high carrier frequency**

| BEAMFORMING GAIN: 0 dB | BEAMFORMING GAIN: 6 dB |
|---|---|
| NUMBER OF RF CHAINS: 1 | NUMBER OF RF CHAINS: 4 |



| Test specification: | Section 27.53(g), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 23.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 46 % | Power Supply: 48VDC |
| Remarks: | | | |

## 7.5 Radiated spurious emission measurements

### 7.5.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.5.1.

**Table 7.5.1 Radiated spurious emission test limits**

| Frequency, MHz | Attenuation below carrier, dBc | ERP of spurious, dBm | Equivalent field strength limit @ 3m, dB(µV/m)*** |
|---|---|---|---|
| 0.009 – 10th harmonic* | 43+10logP** | -13 | 84.4 |

* - Excluding the band emission
** - P is transmitter output power in Watts
*** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: E=sqrt(30×P×1.64)/r, where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

### 7.5.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

**7.5.2.1** The EUT was set up as shown in Figure 7.5.1, energized and the performance check was conducted.

**7.5.2.2** The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated $360^0$ and the measuring antenna was rotated around its vertical axis.

**7.5.2.3** The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

### 7.5.3 Test procedure for spurious emission field strength measurements above 30 MHz

**7.5.3.1** The EUT was set up as shown in Figure 7.5.2, energized and the performance check was conducted.

**7.5.3.2** The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated $360^0$ and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

**7.5.3.3** The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.

### 7.5.4 Test procedure for substitution ERP measurements of spurious

**7.5.4.1** The test equipment was set up as shown in Figure 7.5.3 and energized.

**7.5.4.2** RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

**7.5.4.3** The test antenna height was swept from 1 to 4 m to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

**7.5.4.4** The above procedure was performed in both, horizontal and vertical, polarizations of the test and substitution antennas.

**7.5.4.5** The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

**7.5.4.6** The above procedure was repeated at the rest of investigated frequencies.

**7.5.4.7** The worst test results (the lowest margins) were recorded in Table 7.5.3 and shown in the associated plots.

| Test specification: | Section 27.53(g), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 23.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 46 % | Power Supply: 48VDC |
| Remarks: | | | |

**Figure 7.5.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band**

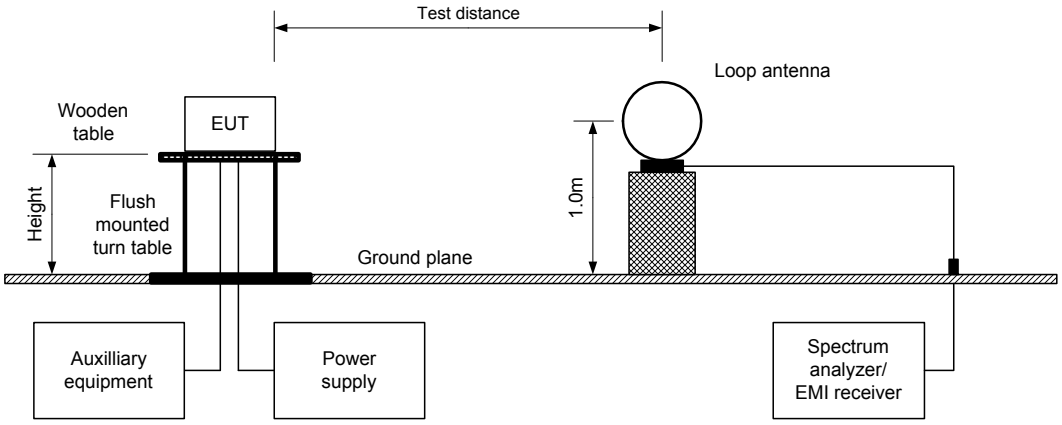
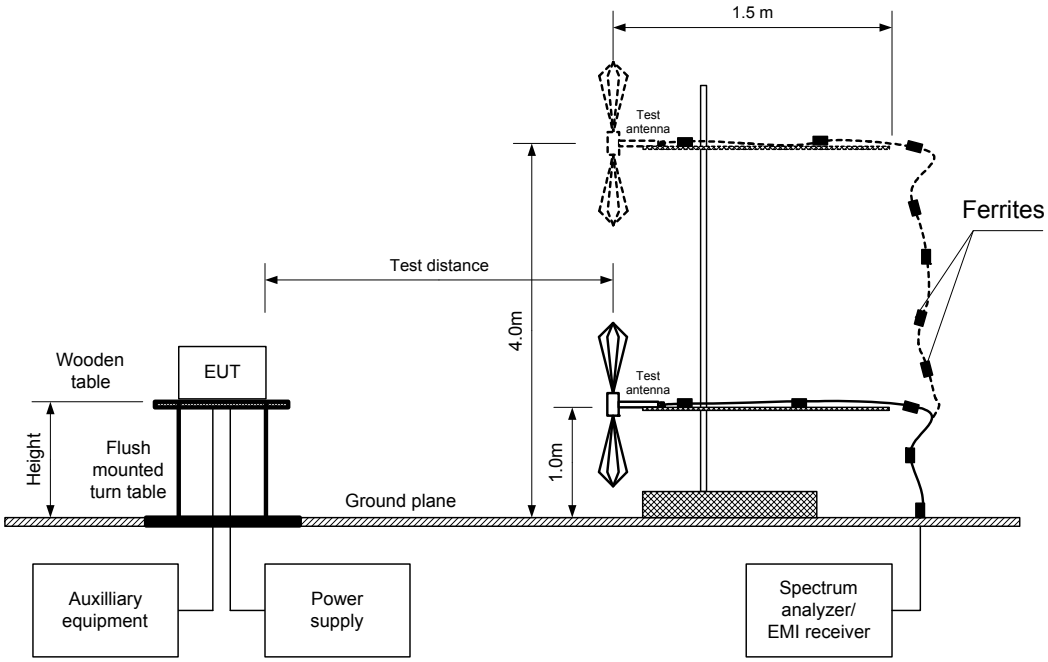
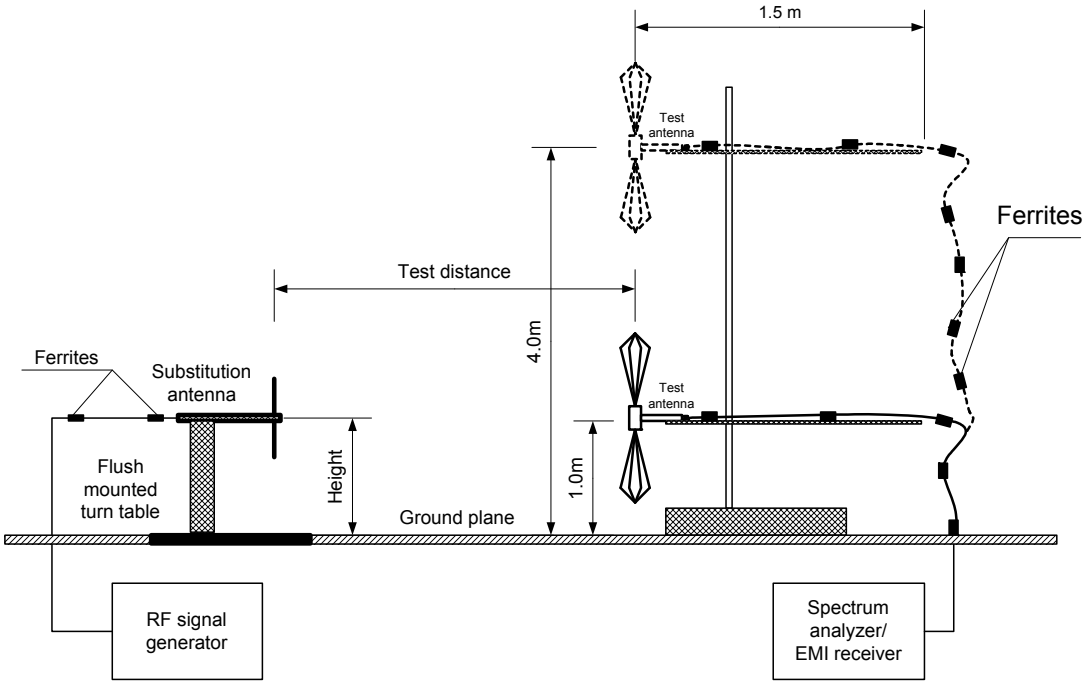



**Figure 7.5.2 Setup for spurious emission field strength measurements above 30 MHz**



| Test specification: | Section 27.53(g), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 23.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 46 % | Power Supply: 48VDC |
| Remarks: | | | |

**Figure 7.5.3 Setup for substitution ERP measurements of spurious**



| **Test specification:** | **Section 27.53(g), Radiated spurious emissions** | | |
|---|---|---|---|
| **Test procedure:** | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 2/18/2013 - 2/19/2013 | | |
| **Temperature:** 23.1 ºC | **Air Pressure:** 1016 hPa | **Relative Humidity:** 46 % | **Power Supply:** 48VDC |
| **Remarks:** | | | |

**Table 7.5.2 Spurious emission field strength test results**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
TEST DISTANCE: 3 m
TEST SITE: Semi anechoic chamber
EUT HEIGHT: 0.8 m
INVESTIGATED FREQUENCY RANGE: 0.009 – 7500 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: > Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
MODULATION: QPSK
MODULATING SIGNAL: PRBS
BIT RATE: 7 Mbps
CHANNEL BANDWIDTH: 5 MHz (worst case power density)
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

| Frequency, MHz | Field strength, dB(µV/m) | Limit, dB(µV/m) | Margin, dB* | RBW, kHz | Antenna polarization | Antenna height, m | Turn-table position**, degrees |
|---|---|---|---|---|---|---|---|
| **Low carrier frequency MHz** | | | | | | | |
| 3239.900 | 62.52 | 84.4 | -21.88 | 1000 | Hor | 1.0 | 133 |
| 6480.017 | 63.05 | 84.4 | -21.35 | 1000 | Hor | 1.0 | 289 |
| **Mid carrier frequency MHz** | | | | | | | |
| 3239.900 | 61.17 | 84.4 | -23.23 | 1000 | Hor | 1.0 | 133 |
| 6479.917 | 64.52 | 84.4 | -19.88 | 1000 | Vert | 1.4 | 15 |
| **High carrier frequency MHz** | | | | | | | |
| 3239.933 | 61.88 | 84.4 | -22.52 | 1000 | Vert | 1.4 | 178 |
| 6479.967 | 63.38 | 84.4 | -21.02 | 1000 | Hor | 1.5 | 339 |

*****- Margin = Field strength of spurious – calculated field strength limit.
******- EUT front panel refers to 0 degrees position of turntable.

| **Test specification:** | **Section 27.53(g), Radiated spurious emissions** | | |
|---|---|---|---|
| **Test procedure:** | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 2/18/2013 - 2/19/2013 | | |
| **Temperature:** 23.1 ºC | **Air Pressure:** 1016 hPa | **Relative Humidity:** 46 % | **Power Supply:** 48VDC |
| **Remarks:** | | | |

**Table 7.5.3 Substitution ERP of spurious test results**

ASSIGNED FREQUENCY RANGE: 698.0 – 746.0 MHz
TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
SUBSTITUTION ANTENNA HEIGHT: 0.8 m
DETECTOR USED: Peak
VIDEO BANDWIDTH: > Resolution bandwidth
SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)

| Frequency, MHz | Field strength, dB(µV/m) | RBW, kHz | Antenna polarization | RF generator output, dBm | Ant gain, dBd | Cable loss, dB | ERP, dBm | Limit, dBc | Margin, dB* | Verdict |
|---|---|---|---|---|---|---|---|---|---|---|
| **Low carrier frequency** | | | | | | | | | | |
| 3239.900 | 62.52 | 1000 | Hor | -40.16 | 6.69 | 1.73 | -35.20 | -13.00 | -22.20 | Pass |
| 6480.017 | 63.05 | 1000 | Hor | -40.28 | 9.08 | 2.51 | -33.71 | -13.00 | -20.71 | Pass |
| **Mid carrier frequency** | | | | | | | | | | |
| 3239.900 | 61.17 | 1000 | Hor | -41.51 | 6.69 | 1.73 | -36.55 | -13.00 | -23.55 | Pass |
| 6479.917 | 64.52 | 1000 | Vert | -38.81 | 9.08 | 2.51 | -32.24 | -13.00 | -19.24 | Pass |
| **High carrier frequency** | | | | | | | | | | |
| 3239.933 | 61.88 | 1000 | Vert | -40.80 | 6.69 | 1.73 | -35.84 | -13.00 | -22.84 | Pass |
| 6479.967 | 63.38 | 1000 | Hor | -39.95 | 9.08 | 2.51 | -33.38 | -13.00 | -20.38 | Pass |

*****- Margin = Spurious emission – specification limit.

**Reference numbers of test equipment used**

| HL 0446 | HL 0604 | HL 0661 | HL 1984 | HL 2871 | HL 3818 | HL 4114 | HL 4352 |
|---|---|---|---|---|---|---|---|
| HL 4353 | | | | | | | |

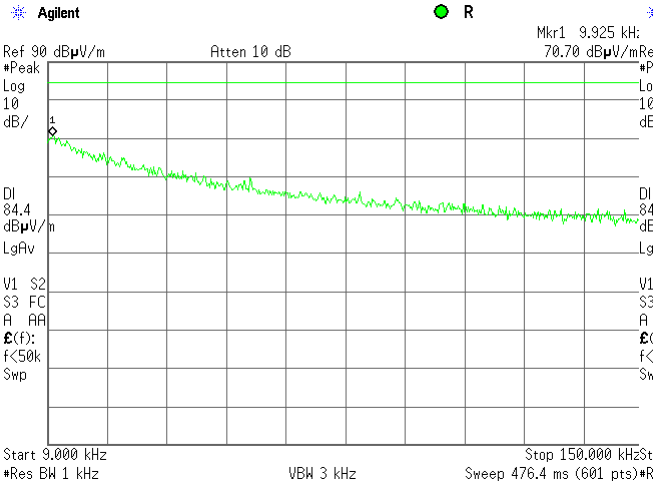
Full description is given in Appendix A.

| Test specification: | Section 27.53(g), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 23.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 46 % | Power Supply: 48VDC |
| Remarks: | | | |

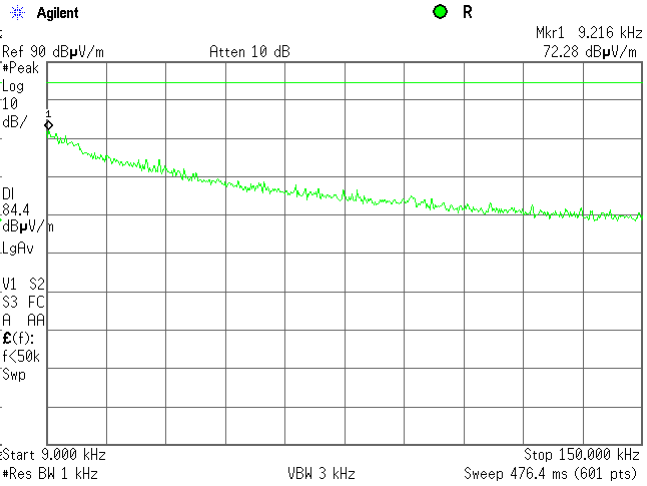
**Plot 7.5.1 Radiated emission measurements in 9 - 150 kHz range**

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m

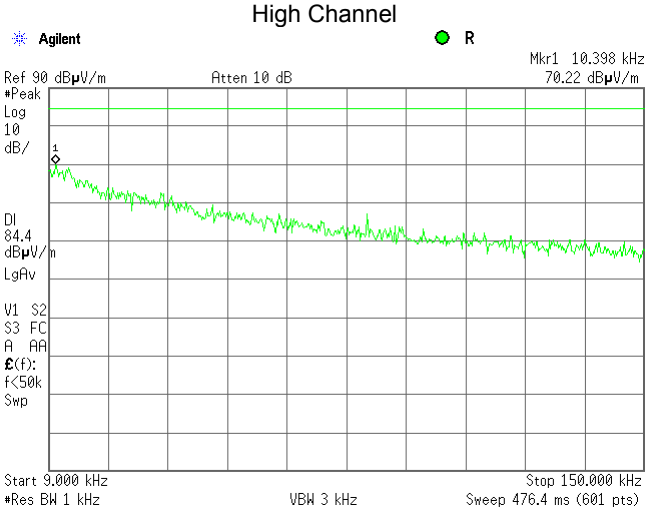
Low channel




Mid Channel



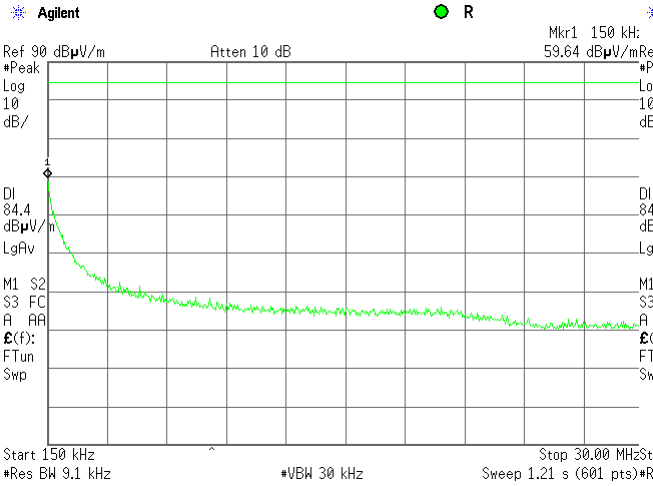

High Channel



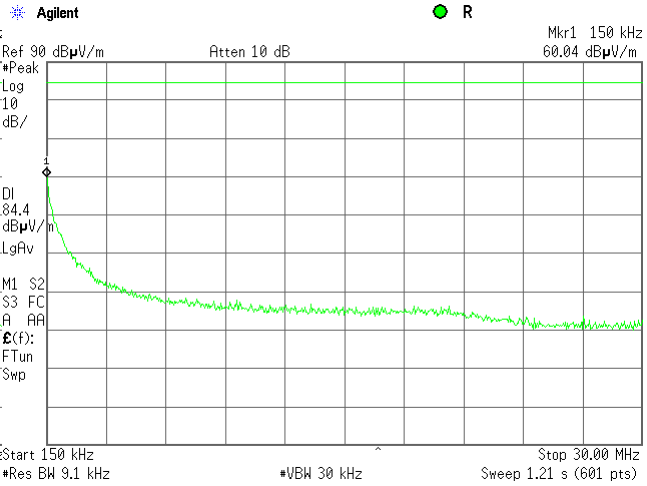
| **Test specification:** | **Section 27.53(g), Radiated spurious emissions** | | |
|---|---|---|---|
| **Test procedure:** | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 2/18/2013 - 2/19/2013 | | |
| **Temperature:** 23.1 ºC | **Air Pressure:** 1016 hPa | **Relative Humidity:** 46 % | **Power Supply:** 48VDC |
| **Remarks:** | | | |

**Plot 7.5.2 Radiated emission measurements in 0.15 - 30 MHz range**

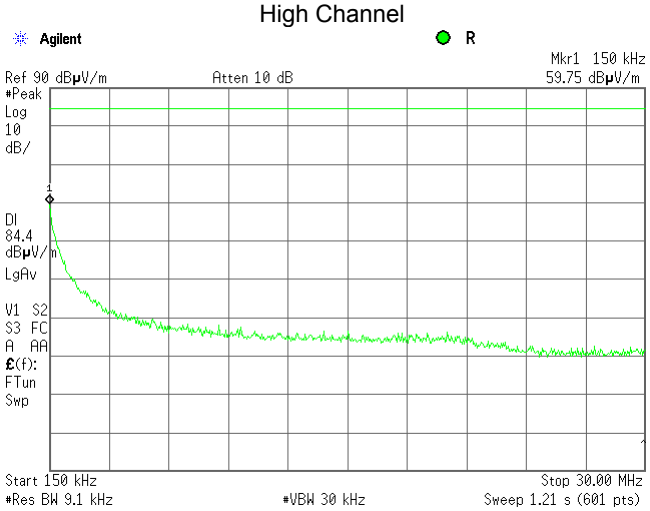
TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m
Low channel




Mid Channel




High Channel

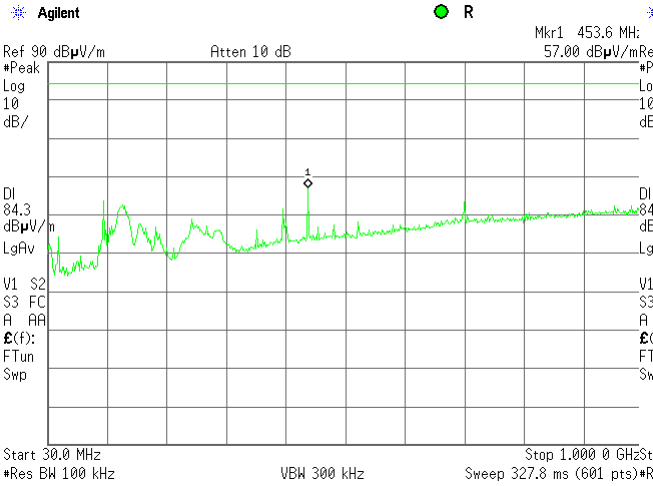


| Test specification: | Section 27.53(g), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 23.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 46 % | Power Supply: 48VDC |
| Remarks: | | | |

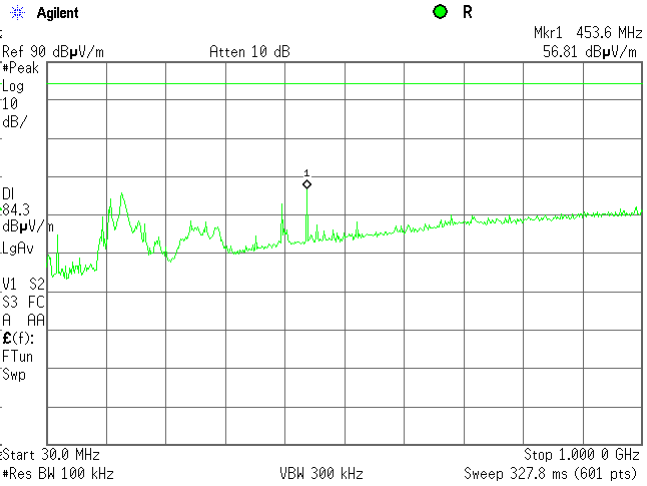
**Plot 7.5.3 Radiated emission measurements in 30 - 1000 MHz range**

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m

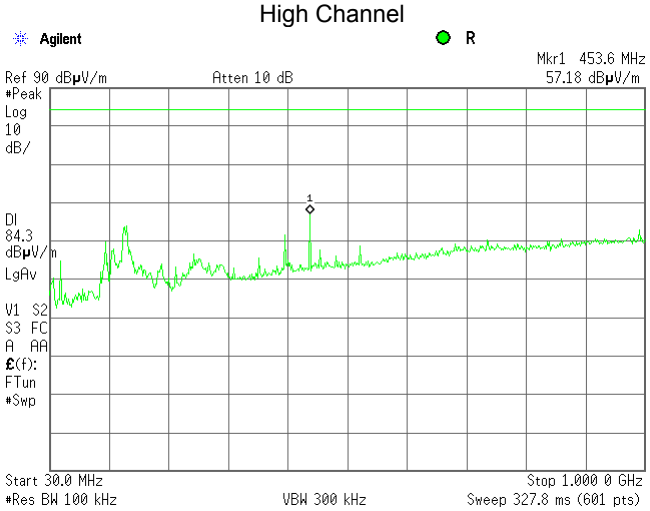
Low channel




Mid Channel




High Channel

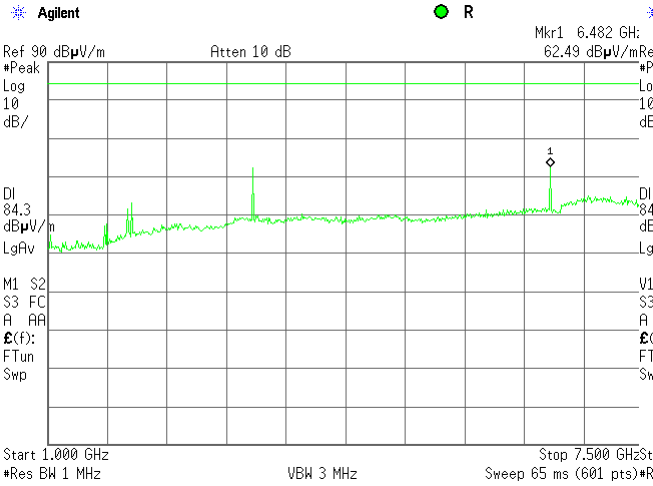


| Test specification: | Section 27.53(g), Radiated spurious emissions | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Sections 2.1053 and 27.53(g); TIA/EIA-603-C, Section 2.2.12 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/18/2013 - 2/19/2013 | | |
| Temperature: 23.1 ºC | Air Pressure: 1016 hPa | Relative Humidity: 46 % | Power Supply: 48VDC |
| Remarks: | | | |

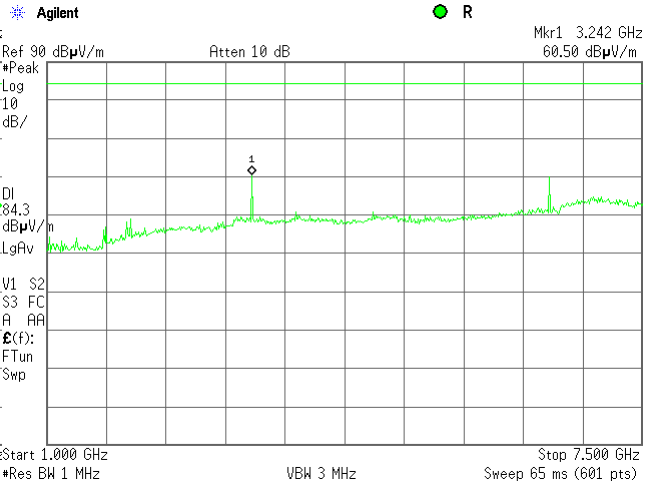
**Plot 7.5.4 Radiated emission measurements in 1000 – 8000 MHz range**

TEST SITE: Semi anechoic chamber
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m

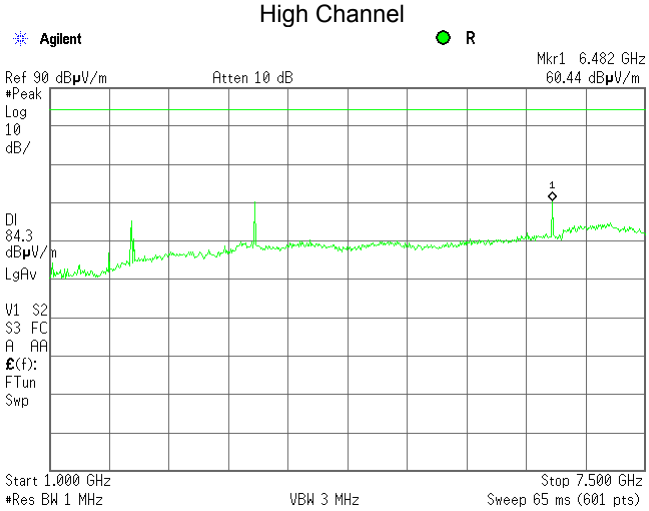
Low channel




Mid Channel




High Channel



| Test specification: | Section 27.54, Frequency stability | | |
|---|---|---|---|
| Test procedure: | 47 CFR, Section 2.1055; TIA/EIA-603-C Section 2.2.2 | | |
| Test mode: | Compliance | Verdict: | PASS |
| Date(s): | 2/19/2013 - 2/20/2013 | | |
| Temperature: 23.1 ºC | Air Pressure: 1018 hPa | Relative Humidity: 40 % | Power Supply: 48VDC |
| Remarks: | | | |

## 7.6 Frequency stability test

### 7.6.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.6.1.

**Table 7.6.1 Frequency stability limits**

| Assigned frequency, MHz | Maximum allowed frequency displacement |
|---|---|
| 705.0 – 745.0 | The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation. |

### 7.6.2 Test procedure

**7.6.2.1** The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

**7.6.2.2** The EUT power was turned off. Temperature within test chamber was set to +30˚C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

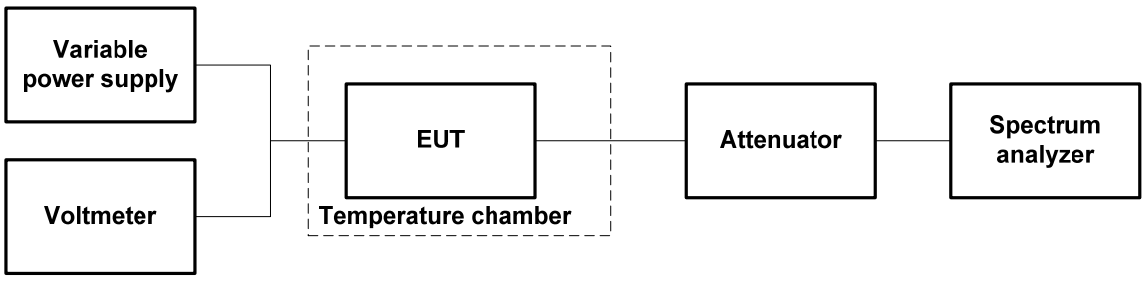
**7.6.2.3** The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

**7.6.2.4** The above procedure was repeated at 0˚C and at the lowest test temperature.

**7.6.2.5** The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.

**7.6.2.6** Frequency displacement was calculated and provided in Table 7.6.2.

**Figure 7.6.1 Frequency stability test setup**



| **Test specification:** | **Section 27.54, Frequency stability** | | |
|---|---|---|---|
| **Test procedure:** | 47 CFR, Section 2.1055; TIA/EIA-603-C Section 2.2.2 | | |
| **Test mode:** | Compliance | **Verdict:** | PASS |
| **Date(s):** | 2/19/2013 - 2/20/2013 | | |
| **Temperature:** 23.1 ºC | **Air Pressure:** 1018 hPa | **Relative Humidity:** 40 % | **Power Supply:** 48VDC |
| **Remarks:** | | | |

**Table 7.6.2 Frequency stability test results**

OPERATING FREQUENCY: 705.0 – 745.0 MHz
NOMINAL POWER VOLTAGE: 48 V
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 1 kHz
VIDEO BANDWIDTH: 3 kHz
MODULATION: Unmodulated

| T, ºC | Voltage, V | Frequency, MHz | | | | | | | Max frequency drift, Hz | | Max frequency drift,ppm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start up | 1st min | 2nd min | 3rd min | 4th min | 5th min | 10th min | Positive | Negative | Positive | Negative |
| **Low channel: 700.0 MHz** | | | | | | | | | | | | |
| -30 | nominal | 707.499371 | 707.499136 | 707.498968 | 707.498793 | 707.498712 | 707.498614 | 707.498269 | 2721 | 0 | 3.85 | 0.00 |
| -20 | nominal | 707.497084 | NA | NA | NA | NA | NA | 707.497032 | 434 | 0 | 0.61 | 0.00 |
| -10 | nominal | 707.496911 | NA | NA | NA | NA | NA | 707.496609 | 261 | -41 | 0.37 | -0.06 |
| 0 | nominal | 707.496485 | 707.496494 | 707.496501 | 707.496506 | 707.496509 | 707.496512 | 707.496523 | 0 | -165 | 0.00 | -0.23 |
| 10 | nominal | 707.496504 | NA | NA | NA | NA | NA | 707.496754 | 104 | -146 | 0.15 | -0.21 |
| 20 | 55.2 | 707.496634 | NA | NA | NA | NA | NA | 707.496643 | 0 | -16 | 0.00 | -0.02 |
| 20 | 48.0 | 707.496636 | 707.496635 | 707.496628 | 707.496618 | 707.496628 | 707.496633 | 707.496650* | 0 | -32 | 0.00 | -0.05 |
| 20 | 40.8 | 707.496631 | NA | NA | NA | NA | NA | 707.496660 | 10 | -19 | 0.01 | -0.03 |
| 30 | nominal | 707.496624 | 707.496626 | 707.496612 | 707.496644 | 707.496639 | 707.496637 | 707.496632 | 0 | -38 | 0.00 | -0.05 |
| 40 | nominal | 707.496626 | NA | NA | NA | NA | NA | 707.496632 | 0 | -24 | 0.00 | -0.03 |
| 50 | nominal | 707.496684 | 707.496688 | 707.496688 | 707.496693 | 707.496697 | 707.496703 | 707.496705 | 55 | 0 | 0.08 | 0.00 |
| **Mid channel: 719.0 MHz** | | | | | | | | | | | | |
| -30 | nominal | 724.998199 | 724.998153 | 724.998118 | 724.998084 | 724.998056 | 724.998031 | 724.997934 | 1465 | 0 | 2.02 | 0.00 |
| -20 | nominal | 724.997127 | NA | NA | NA | NA | NA | 724.996999 | 393 | 0 | 0.54 | 0.00 |
| -10 | nominal | 724.996505 | NA | NA | NA | NA | NA | 724.996456 | 0 | -278 | 0.00 | -0.38 |
| 0 | nominal | 724.996349 | 724.996359 | 724.996370 | 724.996378 | 724.996385 | 724.996392 | 724.996414 | 0 | -385 | 0.00 | -0.53 |
| 10 | nominal | 724.996687 | NA | NA | NA | NA | NA | 724.996771 | 37 | 0 | 0.05 | 0.00 |
| 20 | 55.2 | 724.996632 | NA | NA | NA | NA | NA | 724.996731 | 0 | -102 | 0.00 | -0.14 |
| 20 | 48.0 | 724.996624 | NA | NA | NA | NA | NA | 724.996734 | 0 | -110 | 0.00 | -0.15 |
| 20 | 40.8 | 724.996619 | NA | NA | NA | NA | NA | 724.996737 | 3 | -115 | 0.00 | -0.16 |
| 30 | nominal | 724.996566 | 724.996576 | 724.996567 | 724.996563 | 724.996559 | 724.996557 | 724.996556 | 0 | -178 | 0.00 | -0.25 |
| 40 | nominal | 724.996544 | NA | NA | NA | NA | NA | 724.996555 | 0 | -190 | 0.00 | -0.26 |
| 50 | nominal | 724.996617 | 724.996611 | 724.996613 | 724.996616 | 724.996618 | 724.996621 | 724.996634 | 0 | -123 | 0.00 | -0.17 |
| **High channel: 744.0 MHz** | | | | | | | | | | | | |
| -30 | nominal | 742.497898 | 742.497891 | 742.497882 | 742.497869 | 742.497856 | 742.497846 | 742.497808 | 1242 | 0 | 1.67 | 0.00 |
| -20 | nominal | 742.497633 | NA | NA | NA | NA | NA | 742.497073 | 977 | 0 | 1.32 | 0.00 |
| -10 | nominal | 742.496323 | NA | NA | NA | NA | NA | 742.496352 | 0 | -333 | 0.00 | -0.45 |
| 0 | nominal | 742.496241 | 742.496247 | 742.496247 | 742.496251 | 742.496255 | 742.496260 | 742.496289 | 0 | -415 | 0.00 | -0.56 |
| 10 | nominal | 742.496707 | NA | NA | NA | NA | NA | 742.496754 | 98 | 0 | 0.13 | 0.00 |
| 20 | 55.2 | 742.496917 | NA | NA | NA | NA | NA | 742.496648 | 261 | -8 | 0.35 | -0.01 |
| 20 | 48.0 | 742.497020 | NA | NA | NA | NA | NA | 742.496656 | 364 | 0 | 0.49 | 0.00 |
| 20 | 40.8 | 742.496917 | NA | NA | NA | NA | NA | 742.496642 | 261 | -14 | 0.35 | -0.02 |
| 30 | nominal | 742.496736 | 742.496683 | 742.496651 | 742.496607 | 742.496584 | 742.496565 | 742.496495 | 80 | -161 | 0.11 | -0.22 |
| 40 | nominal | 742.496467 | NA | NA | NA | NA | NA | 742.496473 | 0 | -189 | 0.00 | -0.25 |
| 50 | nominal | 742.496452 | 742.496469 | 742.496483 | 742.496487 | 742.496493 | 742.496503 | 742.496516 | 0 | -204 | 0.00 | -0.27 |

NOTE: Frequency stability test results are sufficient enough to ensure that the fundamental emissions stay within the authorized bands of operation

* - Reference frequency

**Reference numbers of test equipment used**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| HL 1464 | HL 3437 | HL 3768 | HL 3818 | HL 3903 | | | |

Full description is given in Appendix A.

# 8 APPENDIX A Test equipment and ancillaries used for tests

| HL No | Description | Manufacturer | Model | Ser. No. | Last Cal./ Check | Due Cal./ Check |
|---|---|---|---|---|---|---|
| 0446 | Antenna, Loop, Active, 10 kHz - 30 MHz | EMCO | 6502 | 2857 | 03-Jul-12 | 03-Jul-13 |
| 0604 | Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz | EMCO | 3141 | 9611-1011 | 20-May-12 | 20-May-14 |
| 0661 | Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm | Hewlett Packard | 83640B | 3614A00266 | 16-Jan-13 | 16-Jan-14 |
| 1464 | Cable, 0.5 m, N-Type/N-Type | Harbour Industries | MIL 17/60-RG142 | 1464 | 2-Sept-12 | 2-Sept-13 |
| 1984 | Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W | EMC Test Systems | 3115 | 9911-5964 | 07-Dec-12 | 07-Dec-13 |
| 2871 | Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA | Huber-Suhner | 198-8155-00 | 2871 | 04-Dec-12 | 04-Dec-13 |
| 2952 | Cable, RF, 18 GHz, 1.2 m, SMA-SMA | Gore | 10020014 | NA | 10-Oct-12 | 10-Oct-13 |
| 3301 | Power Meter, P-series, 50 MHz to 40 GHz | Agilent Technologies | N1911A | MY45101057 | 19-Dec-12 | 19-Dec-13 |
| 3302 | Power sensor, P-Series, 50 MHz to 40 GHz, -35/30 to 20 dBm | Agilent Technologies | N1922A | MY45240586 | 19-Dec-12 | 19-Dec-13 |
| 3437 | Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz | Mini-Circuits | BW-S10W5+ | NA | 07-Mar-12 | 07-Mar-13 |
| 3472 | Cable, Coax, Microwave, DC-18 GHz, SMA-SMA, 1.0 m | Gore | GORE 65474 | 1003478 | 09-May-12 | 09-May-13 |
| 3473 | Cable, Coax, Microwave, DC-18 GHz, SMA-SMA, 0.6 m | Gore | GORE 65474 | 1003478 | 09-May-12 | 09-May-13 |
| 3474 | Cable, Coax, Microwave, DC-18 GHz, SMA-SMA, 0.6 m | Gore | GORE 65475 | 1640102 | 09-May-12 | 09-May-13 |
| 3768 | Attenuator, N-type, 20 dB, DC to 18 GHz, 5 W | Mini-Circuits | BW-N20W5+ | NA | 22-Aug-12 | 22-Aug-13 |
| 3776 | Attenuator, N-type, 10 dB, DC to 18 GHz, 5 W | Mini-Circuits | BW-N10W5+ | NA | 22-Aug-12 | 22-Aug-13 |
| 3781 | Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz | Mini-Circuits | BW-S10W5+ | NA | 04-Dec-12 | 04-Dec-13 |
| 3787 | Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz | Mini-Circuits | BW-S10W5+ | NA | 04-Dec-12 | 04-Dec-13 |
| 3818 | PSA Series Spectrum Analyzer, 3 Hz- 44 GHz | Agilent Technologies | E4446A | MY48250288 | 16-Feb-12 | 16-Feb-13 |
| 3901 | Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA | Huber-Suhner | SUCOFLEX 102A | 1225/2A | 06-Feb-13 | 06-Feb-14 |
| 3903 | Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA | Huber-Suhner | SUCOFLEX 102A | 1226/2A | 06-Feb-13 | 06-Feb-14 |
| 4114 | Antenna, Double-Ridged Waveguide Horn, 1-18 GHz | ETS Lindgren | 3117 | 00123515 | 07-Dec-12 | 07-Dec-13 |
| 4352 | Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M | MegaPhase | NC29-N1N1-244 | 12025101002 | 06-Jun-12 | 06-Mar-13 |
| 4353 | Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M | MegaPhase | NC29-N1N1-244 | 12025101003 | 06-Jun-12 | 06-Mar-13 |
| 4425 | Switch Matrices, DC up to 18 GHz | Mini-Circuits | USB-4SPDT-A18 | 11206140027 | 15-Jul-12 | 15-Jul-13 |

# 9 APPENDIX B Measurement uncertainties

**Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements**

| Test description | Expanded uncertainty |
|---|---|
| **Transmitter tests** | |
| Carrier power conducted at antenna connector | ± 1.7 dB |
| Carrier power radiated (substitution method) | ± 4.5 dB |
| Occupied bandwidth | ±8% |
| Conducted emissions at RF antenna connector | 9 kHz to 2.9 GHz: ± 2.6 dB<br>2.9 GHz to 6.46 GHz: ± 3.5 dB<br>6.46 GHz to 13.2 GHz: ± 4.3 dB<br>13.2 GHz to 22.0 GHz: ± 5.0 dB<br>22.0 GHz to 26.8 GHz: ± 5.5 dB<br>26.8 GHz to 40.0 GHz: ± 4.8 dB |
| Spurious emissions radiated 30 MHz – 40 GHz (substitution method) | ± 4.5 dB |
| Frequency error | 30 – 300 MHz: ± 50.5 Hz (1.68 ppm)<br>300 – 1000 MHz: ± 168 Hz (0.56 ppm) |
| Duty cycle, timing (Tx ON / OFF) and average factor measurements | ± 1.0 % |

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

# 10 APPENDIX C Test facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.
Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file numbers IC 2186A-1 for OATS, IC 2186A-2 for anechoic chamber, IC 2186A-3 for full-anechoic chamber for RE measurements above 1 GHz), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01). The FCC Designation Number is US1003.

Address: P.O. Box 23, Binyamina 30500, Israel.
Telephone: +972 4628 8001
Fax: +972 4628 8277
e-mail: mail@hermonlabs.com
website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

# 11 APPENDIX D Specification references

| | |
|---|---|
| 47CFR part 27: 2012 | Private land mobile radio services |
| 47CFR part 1: 2012 | Practice and procedure |
| 47CFR part 2: 2012 | Frequency allocations and radio treaty matters; general rules and regulations |
| ANSI C63.2: 1996 | American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications. |
| ANSI C63.4: 2003 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |
| ANSI/TIA/EIA-603-C:2004 | Land Mobile FM or PM Communications Equipment Measurement and Performance Standards |

# 12 APPENDIX E Test equipment correction factors

**Antenna factor**
**Active loop antenna**
**Model 6502, S/N 2857, HL 0446**

| Frequency, MHz | Magnetic antenna factor, dB | Electric antenna factor, dB |
|---|---|---|
| 0.009 | -32.8 | 18.7 |
| 0.010 | -33.8 | 17.7 |
| 0.020 | -38.3 | 13.2 |
| 0.050 | -41.1 | 10.4 |
| 0.075 | -41.3 | 10.2 |
| 0.100 | -41.6 | 9.9 |
| 0.150 | -41.7 | 9.8 |
| 0.250 | -41.6 | 9.9 |
| 0.500 | -41.8 | 9.8 |
| 0.750 | -41.9 | 9.7 |
| 1.000 | -41.4 | 10.1 |
| 2.000 | -41.5 | 10.0 |
| 3.000 | -41.4 | 10.2 |
| 4.000 | -41.4 | 10.1 |
| 5.000 | -41.5 | 10.1 |
| 10.000 | -41.9 | 9.6 |
| 15.000 | -41.9 | 9.6 |
| 20.000 | -42.2 | 9.3 |
| 25.000 | -42.8 | 8.7 |
| 30.000 | -44.0 | 7.5 |

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field strength in dB(μV/m).

**Antenna factor**
**Biconilog antenna EMCO Model 3141**
**Ser.No.1011, HL 0604**

| Frequency, MHz | Antenna factor, dB(1/m) | Frequency, MHz | Antenna factor, dB(1/m) | Frequency, MHz | Antenna factor, dB(1/m) |
|---|---|---|---|---|---|
| 26 | 7.8 | 580 | 20.6 | 1320 | 27.8 |
| 28 | 7.8 | 600 | 21.3 | 1340 | 28.3 |
| 30 | 7.8 | 620 | 21.5 | 1360 | 28.2 |
| 40 | 7.2 | 640 | 21.2 | 1380 | 27.9 |
| 60 | 7.1 | 660 | 21.4 | 1400 | 27.9 |
| 70 | 8.5 | 680 | 21.9 | 1420 | 27.9 |
| 80 | 9.4 | 700 | 22.2 | 1440 | 27.8 |
| 90 | 9.8 | 720 | 22.2 | 1460 | 27.8 |
| 100 | 9.7 | 740 | 22.1 | 1480 | 28.0 |
| 110 | 9.3 | 760 | 22.3 | 1500 | 28.5 |
| 120 | 8.8 | 780 | 22.6 | 1520 | 28.9 |
| 130 | 8.7 | 800 | 22.7 | 1540 | 29.6 |
| 140 | 9.2 | 820 | 22.9 | 1560 | 29.8 |
| 150 | 9.8 | 840 | 23.1 | 1580 | 29.6 |
| 160 | 10.2 | 860 | 23.4 | 1600 | 29.5 |
| 170 | 10.4 | 880 | 23.8 | 1620 | 29.3 |
| 180 | 10.4 | 900 | 24.1 | 1640 | 29.2 |
| 190 | 10.3 | 920 | 24.1 | 1660 | 29.4 |
| 200 | 10.6 | 940 | 24.0 | 1680 | 29.6 |
| 220 | 11.6 | 960 | 24.1 | 1700 | 29.8 |
| 240 | 12.4 | 980 | 24.5 | 1720 | 30.3 |
| 260 | 12.8 | 1000 | 24.9 | 1740 | 30.8 |
| 280 | 13.7 | 1020 | 25.0 | 1760 | 31.1 |
| 300 | 14.7 | 1040 | 25.2 | 1780 | 31.0 |
| 320 | 15.2 | 1060 | 25.4 | 1800 | 30.9 |
| 340 | 15.4 | 1080 | 25.6 | 1820 | 30.7 |
| 360 | 16.1 | 1100 | 25.7 | 1840 | 30.6 |
| 380 | 16.4 | 1120 | 26.0 | 1860 | 30.6 |
| 400 | 16.6 | 1140 | 26.4 | 1880 | 30.6 |
| 420 | 16.7 | 1160 | 27.0 | 1900 | 30.6 |
| 440 | 17.0 | 1180 | 27.0 | 1920 | 30.7 |
| 460 | 17.7 | 1200 | 26.7 | 1940 | 30.9 |
| 480 | 18.1 | 1220 | 26.5 | 1960 | 31.2 |
| 500 | 18.5 | 1240 | 26.5 | 1980 | 31.6 |
| 520 | 19.1 | 1260 | 26.5 | 2000 | 32.0 |
| 540 | 19.5 | 1280 | 26.6 | | |
| 560 | 19.8 | 1300 | 27.0 | | |

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB($\mu$V) to convert it into field strength in dB($\mu$V/m).

**Antenna factor**
**Double-ridged wave guide horn antenna**
**Model 3115, S/N 9911-5964, HL1984**

| Frequency, MHz | Antenna factor, dB(1/m) |
|---|---|
| 1000.0 | 24.7 |
| 1500.0 | 25.7 |
| 2000.0 | 27.6 |
| 2500.0 | 28.9 |
| 3000.0 | 31.2 |
| 3500.0 | 32.0 |
| 4000.0 | 32.5 |
| 4500.0 | 32.7 |
| 5000.0 | 33.6 |
| 5500.0 | 35.1 |
| 6000.0 | 35.4 |
| 6500.0 | 34.9 |
| 7000.0 | 36.1 |
| 7500.0 | 37.8 |
| 8000.0 | 38.0 |
| 8500.0 | 38.1 |
| 9000.0 | 39.1 |
| 9500.0 | 38.3 |
| 10000.0 | 38.6 |
| 10500.0 | 38.2 |
| 11000.0 | 38.7 |
| 11500.0 | 39.5 |
| 12000.0 | 40.0 |
| 12500.0 | 40.4 |
| 13000.0 | 40.5 |
| 13500.0 | 41.1 |
| 14000.0 | 41.6 |
| 14500.0 | 41.7 |
| 15000.0 | 38.7 |
| 15500.0 | 38.2 |
| 16000.0 | 38.8 |
| 16500.0 | 40.5 |
| 17000.0 | 42.5 |
| 17500.0 | 45.9 |
| 18000.0 | 49.4 |

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field strength in dB(μV/m).

**Antenna factor**
**Double-ridged waveguide horn antenna**
**ETS Lindgren, Model 3117, serial number: 00123515, HL 4114**

| Frequency, MHz | Antenna factor, dB/m | | |
|---|---|---|---|
| | Measured | Manufacturer | Deviation |
| 1000 | 28.0 | 28.4 | -0.4 |
| 1500 | 28.0 | 27.4 | 0.6 |
| 2000 | 31.2 | 30.9 | 0.3 |
| 2500 | 32.5 | 33.4 | -0.9 |
| 3000 | 32.9 | 32.6 | 0.3 |
| 3500 | 32.7 | 32.8 | -0.1 |
| 4000 | 33.1 | 33.4 | -0.3 |
| 4500 | 33.8 | 33.9 | -0.1 |
| 5000 | 33.8 | 34.1 | -0.3 |
| 5500 | 34.4 | 34.5 | -0.1 |
| 6000 | 35.0 | 35.2 | -0.2 |
| 6500 | 35.4 | 35.5 | -0.1 |
| 7000 | 35.7 | 35.7 | 0.0 |
| 7500 | 35.9 | 35.7 | 0.2 |
| 8000 | 35.8 | 35.8 | 0.0 |
| 8500 | 35.9 | 35.8 | 0.1 |
| 9000 | 36.3 | 36.2 | 0.1 |
| 9500 | 36.6 | 36.6 | 0.0 |
| 10000 | 37.1 | 37.1 | 0.0 |
| 10500 | 37.6 | 37.5 | 0.1 |
| 11000 | 37.9 | 37.7 | 0.2 |
| 11500 | 38.5 | 38.1 | 0.4 |
| 12000 | 39.2 | 38.7 | 0.5 |
| 12500 | 39.0 | 38.9 | 0.1 |
| 13000 | 39.1 | 39.1 | 0.0 |
| 13500 | 38.9 | 38.8 | 0.1 |
| 14000 | 39.0 | 38.8 | 0.2 |
| 14500 | 39.6 | 39.9 | -0.3 |
| 15000 | 39.9 | 39.7 | 0.2 |
| 15500 | 39.9 | 40.1 | -0.2 |
| 16000 | 40.7 | 40.8 | -0.1 |
| 16500 | 41.3 | 41.8 | -0.5 |
| 17000 | 42.5 | 42.1 | 0.4 |
| 17500 | 41.3 | 41.2 | 0.1 |
| 18000 | 41.4 | 40.9 | 0.5 |

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field strength in dB(μV/meter)

**Cable loss**
**Cable coaxial, Huber-Suhner, 18 GHz, 6.4 m, SMA - SMA, model 198-8155-00, HL 2871**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|
| 10 | 0.12 | 5750 | 2.34 | 12000 | 3.55 |
| 30 | 0.14 | 6000 | 2.39 | 12250 | 3.61 |
| 100 | 0.27 | 6250 | 2.46 | 12500 | 3.67 |
| 250 | 0.45 | 6500 | 2.52 | 12750 | 3.74 |
| 500 | 0.63 | 6750 | 2.58 | 13000 | 3.79 |
| 750 | 0.76 | 7000 | 2.64 | 13250 | 3.82 |
| 1000 | 0.89 | 7250 | 2.68 | 13500 | 3.83 |
| 1250 | 1.01 | 7500 | 2.73 | 13750 | 3.83 |
| 1500 | 1.12 | 7750 | 2.78 | 14000 | 3.88 |
| 1750 | 1.23 | 8000 | 2.83 | 14250 | 3.93 |
| 2000 | 1.32 | 8250 | 2.88 | 14500 | 3.96 |
| 2250 | 1.41 | 8500 | 2.94 | 14750 | 4.01 |
| 2500 | 1.49 | 8750 | 2.97 | 15000 | 4.00 |
| 2750 | 1.58 | 9000 | 3.02 | 15250 | 4.01 |
| 3000 | 1.66 | 9250 | 3.07 | 15500 | 4.00 |
| 3250 | 1.73 | 9500 | 3.13 | 15750 | 4.13 |
| 3500 | 1.80 | 9750 | 3.18 | 16000 | 4.22 |
| 3750 | 1.87 | 10000 | 3.21 | 16250 | 4.29 |
| 4000 | 1.93 | 10250 | 3.26 | 16500 | 4.29 |
| 4250 | 2.01 | 10500 | 3.30 | 16750 | 4.32 |
| 4500 | 2.06 | 10750 | 3.36 | 17000 | 4.37 |
| 4750 | 2.12 | 11000 | 3.39 | 17250 | 4.45 |
| 5000 | 2.17 | 11250 | 3.44 | 17500 | 4.49 |
| 5250 | 2.24 | 11500 | 3.48 | 17750 | 4.53 |
| 5500 | 2.29 | 11750 | 3.52 | 18000 | 4.55 |

**Cable loss**
**Cable coaxial, Gore, 18 GHz, 1.2 m, SMA-SMA, S/N 10020014**
**HL 2952**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|
| 10 | 0.03 | 5750 | 0.97 | 12000 | 1.50 |
| 30 | 0.05 | 6000 | 1.01 | 12250 | 1.45 |
| 100 | 0.11 | 6250 | 1.03 | 12500 | 1.48 |
| 250 | 0.19 | 6500 | 1.06 | 12750 | 1.57 |
| 500 | 0.26 | 6750 | 1.08 | 13000 | 1.51 |
| 750 | 0.32 | 7000 | 1.10 | 13250 | 1.64 |
| 1000 | 0.38 | 7250 | 1.13 | 13500 | 1.60 |
| 1250 | 0.43 | 7500 | 1.13 | 13750 | 1.63 |
| 1500 | 0.47 | 7750 | 1.21 | 14000 | 1.59 |
| 1750 | 0.53 | 8000 | 1.20 | 14250 | 1.66 |
| 2000 | 0.55 | 8250 | 1.24 | 14500 | 1.60 |
| 2250 | 0.59 | 8500 | 1.29 | 14750 | 1.65 |
| 2500 | 0.63 | 8750 | 1.23 | 15000 | 1.72 |
| 2750 | 0.66 | 9000 | 1.27 | 15250 | 1.68 |
| 3000 | 0.69 | 9250 | 1.27 | 15500 | 1.73 |
| 3250 | 0.72 | 9500 | 1.29 | 15750 | 1.70 |
| 3500 | 0.75 | 9750 | 1.30 | 16000 | 1.82 |
| 3750 | 0.78 | 10000 | 1.38 | 16250 | 1.79 |
| 4000 | 0.82 | 10250 | 1.44 | 16500 | 1.81 |
| 4250 | 0.84 | 10500 | 1.47 | 16750 | 1.91 |
| 4500 | 0.86 | 10750 | 1.45 | 17000 | 1.92 |
| 4750 | 0.90 | 11000 | 1.50 | 17250 | 1.98 |
| 5000 | 0.91 | 11250 | 1.46 | 17500 | 2.05 |
| 5250 | 0.94 | 11500 | 1.47 | 17750 | 2.04 |
| 5500 | 0.96 | 11750 | 1.44 | 18000 | 2.05 |

**Cable loss**
**Cable coaxial, Microwave, SMA-SMA, 18 GHz, 1.0 m**
**Gore, HL 3472**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|---|---|
| 10 | 0.01 | 5000 | 0.47 | 10200 | 0.72 | 15500 | 0.75 |
| 30 | 0.03 | 5100 | 0.47 | 10300 | 0.67 | 15600 | 0.89 |
| 50 | 0.04 | 5200 | 0.47 | 10400 | 0.77 | 15700 | 0.82 |
| 100 | 0.04 | 5300 | 0.47 | 10500 | 0.67 | 15800 | 0.89 |
| 200 | 0.08 | 5400 | 0.49 | 10600 | 0.74 | 15900 | 0.89 |
| 300 | 0.11 | 5500 | 0.48 | 10700 | 0.81 | 16000 | 0.93 |
| 400 | 0.11 | 5600 | 0.49 | 10800 | 0.77 | 16100 | 0.90 |
| 500 | 0.12 | 5700 | 0.49 | 10900 | 0.82 | 16200 | 0.92 |
| 600 | 0.14 | 5800 | 0.51 | 11000 | 0.86 | 16300 | 0.90 |
| 700 | 0.15 | 5900 | 0.50 | 11100 | 0.78 | 16400 | 0.94 |
| 800 | 0.16 | 6000 | 0.51 | 11200 | 0.82 | 16500 | 0.93 |
| 900 | 0.18 | 6100 | 0.53 | 11300 | 0.77 | 16600 | 0.95 |
| 1000 | 0.17 | 6200 | 0.52 | 11400 | 0.84 | 16700 | 0.98 |
| 1100 | 0.19 | 6300 | 0.53 | 11500 | 0.74 | 16800 | 1.00 |
| 1200 | 0.22 | 6400 | 0.54 | 11600 | 0.81 | 16900 | 0.94 |
| 1300 | 0.21 | 6500 | 0.55 | 11700 | 0.73 | 17000 | 1.00 |
| 1400 | 0.22 | 6600 | 0.54 | 11800 | 0.75 | 17100 | 0.93 |
| 1500 | 0.23 | 6700 | 0.57 | 11900 | 0.73 | 17200 | 1.00 |
| 1600 | 0.24 | 6800 | 0.54 | 12000 | 0.75 | 17300 | 0.93 |
| 1700 | 0.24 | 6900 | 0.58 | 12100 | 0.66 | 17400 | 0.93 |
| 1800 | 0.25 | 7000 | 0.58 | 12200 | 0.66 | 17500 | 0.96 |
| 1900 | 0.26 | 7100 | 0.58 | 12300 | 0.72 | 17600 | 0.94 |
| 2000 | 0.28 | 7200 | 0.61 | 12400 | 0.64 | 17700 | 0.99 |
| 2100 | 0.27 | 7300 | 0.59 | 12500 | 0.75 | 17800 | 0.97 |
| 2200 | 0.29 | 7400 | 0.55 | 12600 | 0.67 | 17900 | 0.90 |
| 2300 | 0.29 | 7500 | 0.63 | 12700 | 0.75 | 18000 | 0.78 |
| 2400 | 0.30 | 7600 | 0.60 | 12800 | 0.66 | | |
| 2500 | 0.30 | 7700 | 0.61 | 12900 | 0.81 | | |
| 2600 | 0.32 | 7800 | 0.64 | 13000 | 0.75 | | |
| 2700 | 0.32 | 7900 | 0.60 | 13100 | 0.80 | | |
| 2800 | 0.33 | 8000 | 0.58 | 13200 | 0.80 | | |
| 2900 | 0.34 | 8100 | 0.61 | 13300 | 0.81 | | |
| 3000 | 0.34 | 8200 | 0.62 | 13400 | 0.88 | | |
| 3100 | 0.35 | 8300 | 0.62 | 13500 | 0.82 | | |
| 3200 | 0.35 | 8400 | 0.68 | 13600 | 1.00 | | |
| 3300 | 0.36 | 8500 | 0.63 | 13700 | 0.93 | | |
| 3400 | 0.37 | 8600 | 0.61 | 13800 | 0.86 | | |
| 3500 | 0.38 | 8700 | 0.63 | 13900 | 0.84 | | |
| 3600 | 0.38 | 8800 | 0.62 | 14000 | 1.00 | | |
| 3700 | 0.40 | 8900 | 0.64 | 14100 | 0.86 | | |
| 3800 | 0.40 | 9000 | 0.62 | 14200 | 0.98 | | |
| 3900 | 0.40 | 9100 | 0.64 | 14300 | 0.99 | | |
| 4000 | 0.40 | 9200 | 0.62 | 14400 | 0.82 | | |
| 4100 | 0.43 | 9300 | 0.62 | 14600 | 0.89 | | |
| 4200 | 0.43 | 9400 | 0.62 | 14700 | 0.84 | | |
| 4300 | 0.43 | 9500 | 0.63 | 14800 | 0.90 | | |
| 4400 | 0.44 | 9600 | 0.64 | 14900 | 0.89 | | |
| 4500 | 0.45 | 9700 | 0.60 | 15000 | 0.89 | | |
| 4600 | 0.45 | 9800 | 0.65 | 15100 | 0.86 | | |
| 4700 | 0.46 | 9900 | 0.60 | 15200 | 0.87 | | |
| 4800 | 0.46 | 10000 | 0.67 | 15300 | 0.86 | | |
| 4900 | 0.46 | 10100 | 0.69 | 15400 | 0.87 | | |

**Cable loss**
**Cable coaxial, Microwave, SMA-SMA, 18 GHz, 0.6 m**
**Gore, HL 3473**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|---|---|
| 10 | 0.01 | 5000 | 0.48 | 10200 | 0.72 | 15500 | 0.85 |
| 30 | 0.03 | 5100 | 0.48 | 10300 | 0.70 | 15600 | 0.93 |
| 50 | 0.04 | 5200 | 0.48 | 10400 | 0.75 | 15700 | 0.87 |
| 100 | 0.04 | 5300 | 0.48 | 10500 | 0.68 | 15800 | 0.88 |
| 200 | 0.08 | 5400 | 0.50 | 10600 | 0.77 | 15900 | 0.94 |
| 300 | 0.11 | 5500 | 0.48 | 10700 | 0.80 | 16000 | 0.94 |
| 400 | 0.12 | 5600 | 0.50 | 10800 | 0.77 | 16100 | 0.99 |
| 500 | 0.13 | 5700 | 0.50 | 10900 | 0.85 | 16200 | 0.96 |
| 600 | 0.15 | 5800 | 0.52 | 11000 | 0.83 | 16300 | 0.96 |
| 700 | 0.15 | 5900 | 0.51 | 11100 | 0.79 | 16400 | 0.94 |
| 800 | 0.17 | 6000 | 0.52 | 11200 | 0.82 | 16500 | 0.94 |
| 900 | 0.19 | 6100 | 0.54 | 11300 | 0.79 | 16600 | 1.03 |
| 1000 | 0.18 | 6200 | 0.53 | 11400 | 0.81 | 16700 | 1.04 |
| 1100 | 0.20 | 6300 | 0.54 | 11500 | 0.76 | 16800 | 1.07 |
| 1200 | 0.22 | 6400 | 0.55 | 11600 | 0.78 | 16900 | 0.94 |
| 1300 | 0.22 | 6500 | 0.56 | 11700 | 0.74 | 17000 | 1.05 |
| 1400 | 0.23 | 6600 | 0.56 | 11800 | 0.76 | 17100 | 0.96 |
| 1500 | 0.24 | 6700 | 0.60 | 11900 | 0.79 | 17200 | 1.07 |
| 1600 | 0.25 | 6800 | 0.55 | 12000 | 0.74 | 17300 | 0.98 |
| 1700 | 0.25 | 6900 | 0.60 | 12100 | 0.69 | 17400 | 1.16 |
| 1800 | 0.26 | 7000 | 0.59 | 12200 | 0.69 | 17500 | 1.05 |
| 1900 | 0.27 | 7100 | 0.60 | 12300 | 0.75 | 17600 | 1.13 |
| 2000 | 0.29 | 7200 | 0.61 | 12400 | 0.66 | 17700 | 1.05 |
| 2100 | 0.28 | 7300 | 0.60 | 12500 | 0.76 | 17800 | 1.22 |
| 2200 | 0.30 | 7400 | 0.57 | 12600 | 0.70 | 17900 | 1.02 |
| 2300 | 0.30 | 7500 | 0.63 | 12700 | 0.77 | 18000 | 1.04 |
| 2400 | 0.31 | 7600 | 0.60 | 12800 | 0.69 | | |
| 2500 | 0.31 | 7700 | 0.63 | 12900 | 0.79 | | |
| 2600 | 0.33 | 7800 | 0.66 | 13000 | 0.81 | | |
| 2700 | 0.33 | 7900 | 0.61 | 13100 | 0.83 | | |
| 2800 | 0.35 | 8000 | 0.58 | 13200 | 0.80 | | |
| 2900 | 0.35 | 8100 | 0.62 | 13300 | 0.82 | | |
| 3000 | 0.35 | 8200 | 0.62 | 13400 | 0.90 | | |
| 3100 | 0.35 | 8300 | 0.63 | 13500 | 0.85 | | |
| 3200 | 0.36 | 8400 | 0.67 | 13600 | 1.04 | | |
| 3300 | 0.38 | 8500 | 0.63 | 13700 | 0.93 | | |
| 3400 | 0.38 | 8600 | 0.61 | 13800 | 0.91 | | |
| 3500 | 0.40 | 8700 | 0.64 | 13900 | 0.89 | | |
| 3600 | 0.40 | 8800 | 0.62 | 14000 | 0.96 | | |
| 3700 | 0.40 | 8900 | 0.64 | 14100 | 0.88 | | |
| 3800 | 0.41 | 9000 | 0.64 | 14200 | 1.01 | | |
| 3900 | 0.41 | 9100 | 0.64 | 14300 | 0.99 | | |
| 4000 | 0.41 | 9200 | 0.63 | 14400 | 0.83 | | |
| 4100 | 0.45 | 9300 | 0.63 | 14600 | 0.88 | | |
| 4200 | 0.43 | 9400 | 0.63 | 14700 | 0.91 | | |
| 4300 | 0.46 | 9500 | 0.64 | 14800 | 0.91 | | |
| 4400 | 0.44 | 9600 | 0.65 | 14900 | 0.88 | | |
| 4500 | 0.47 | 9700 | 0.62 | 15000 | 0.89 | | |
| 4600 | 0.46 | 9800 | 0.66 | 15100 | 0.91 | | |
| 4700 | 0.47 | 9900 | 0.61 | 15200 | 0.88 | | |
| 4800 | 0.47 | 10000 | 0.70 | 15300 | 0.94 | | |
| 4900 | 0.48 | 10100 | 0.70 | 15400 | 0.91 | | |

**Cable loss**
**Cable coaxial, Microwave, SMA-SMA, 18 GHz, 0.6 m**
**Gore, HL 3474**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|---|---|
| 10 | 0.00 | 5000 | 0.44 | 10200 | 0.72 | 15500 | 0.84 |
| 30 | 0.02 | 5100 | 0.44 | 10300 | 0.68 | 15600 | 0.95 |
| 50 | 0.03 | 5200 | 0.44 | 10400 | 0.75 | 15700 | 0.82 |
| 100 | 0.03 | 5300 | 0.44 | 10500 | 0.64 | 15800 | 0.94 |
| 200 | 0.07 | 5400 | 0.46 | 10600 | 0.75 | 15900 | 0.91 |
| 300 | 0.10 | 5500 | 0.45 | 10700 | 0.80 | 16000 | 0.91 |
| 400 | 0.11 | 5600 | 0.46 | 10800 | 0.77 | 16100 | 0.86 |
| 500 | 0.12 | 5700 | 0.47 | 10900 | 0.80 | 16200 | 0.86 |
| 600 | 0.14 | 5800 | 0.48 | 11000 | 0.79 | 16300 | 0.86 |
| 700 | 0.14 | 5900 | 0.48 | 11100 | 0.70 | 16400 | 0.84 |
| 800 | 0.15 | 6000 | 0.49 | 11200 | 0.76 | 16500 | 0.83 |
| 900 | 0.18 | 6100 | 0.51 | 11300 | 0.70 | 16600 | 0.87 |
| 1000 | 0.17 | 6200 | 0.50 | 11400 | 0.73 | 16700 | 0.90 |
| 1100 | 0.18 | 6300 | 0.50 | 11500 | 0.67 | 16800 | 0.91 |
| 1200 | 0.21 | 6400 | 0.51 | 11600 | 0.74 | 16900 | 0.90 |
| 1300 | 0.20 | 6500 | 0.51 | 11700 | 0.64 | 17000 | 0.97 |
| 1400 | 0.21 | 6600 | 0.52 | 11800 | 0.68 | 17100 | 0.94 |
| 1500 | 0.22 | 6700 | 0.54 | 11900 | 0.67 | 17200 | 1.01 |
| 1600 | 0.23 | 6800 | 0.51 | 12000 | 0.71 | 17300 | 0.97 |
| 1700 | 0.23 | 6900 | 0.55 | 12100 | 0.64 | 17400 | 1.02 |
| 1800 | 0.24 | 7000 | 0.54 | 12200 | 0.64 | 17500 | 1.06 |
| 1900 | 0.25 | 7100 | 0.55 | 12300 | 0.71 | 17600 | 1.01 |
| 2000 | 0.27 | 7200 | 0.55 | 12400 | 0.62 | 17700 | 1.10 |
| 2100 | 0.26 | 7300 | 0.54 | 12500 | 0.80 | 17800 | 1.16 |
| 2200 | 0.28 | 7400 | 0.52 | 12600 | 0.69 | 17900 | 1.12 |
| 2300 | 0.28 | 7500 | 0.58 | 12700 | 0.85 | 18000 | 1.00 |
| 2400 | 0.28 | 7600 | 0.56 | 12800 | 0.67 | | |
| 2500 | 0.29 | 7700 | 0.57 | 12900 | 0.84 | | |
| 2600 | 0.30 | 7800 | 0.62 | 13000 | 0.76 | | |
| 2700 | 0.31 | 7900 | 0.57 | 13100 | 0.85 | | |
| 2800 | 0.32 | 8000 | 0.55 | 13200 | 0.77 | | |
| 2900 | 0.32 | 8100 | 0.59 | 13300 | 0.82 | | |
| 3000 | 0.32 | 8200 | 0.59 | 13400 | 0.79 | | |
| 3100 | 0.33 | 8300 | 0.60 | 13500 | 0.82 | | |
| 3200 | 0.33 | 8400 | 0.66 | 13600 | 0.91 | | |
| 3300 | 0.35 | 8500 | 0.60 | 13700 | 0.81 | | |
| 3400 | 0.35 | 8600 | 0.59 | 13800 | 0.76 | | |
| 3500 | 0.36 | 8700 | 0.59 | 13900 | 0.75 | | |
| 3600 | 0.36 | 8800 | 0.58 | 14000 | 0.81 | | |
| 3700 | 0.37 | 8900 | 0.60 | 14100 | 0.77 | | |
| 3800 | 0.38 | 9000 | 0.60 | 14200 | 0.89 | | |
| 3900 | 0.38 | 9100 | 0.60 | 14300 | 0.92 | | |
| 4000 | 0.38 | 9200 | 0.57 | 14400 | 0.78 | | |
| 4100 | 0.41 | 9300 | 0.57 | 14600 | 0.85 | | |
| 4200 | 0.40 | 9400 | 0.58 | 14700 | 0.83 | | |
| 4300 | 0.41 | 9500 | 0.60 | 14800 | 0.95 | | |
| 4400 | 0.42 | 9600 | 0.62 | 14900 | 0.89 | | |
| 4500 | 0.43 | 9700 | 0.58 | 15000 | 0.96 | | |
| 4600 | 0.42 | 9800 | 0.63 | 15100 | 0.90 | | |
| 4700 | 0.44 | 9900 | 0.58 | 15200 | 0.96 | | |
| 4800 | 0.43 | 10000 | 0.67 | 15300 | 0.90 | | |
| 4900 | 0.44 | 10100 | 0.69 | 15400 | 0.95 | | |

**Cable loss**
**Microwave Cable Assembly, Huber-Suhner, 40 GHz, 3.5 m, SMA-SMA, S/N 1225/2A**
**HL 3901**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|
| 10 | 0.09 | 9500 | 4.29 | 21000 | 6.67 |
| 100 | 0.41 | 10000 | 4.40 | 22000 | 6.92 |
| 500 | 0.93 | 10500 | 4.52 | 23000 | 7.00 |
| 1000 | 1.33 | 11000 | 4.64 | 24000 | 7.18 |
| 1500 | 1.63 | 11500 | 4.76 | 25000 | 7.29 |
| 2000 | 1.90 | 12000 | 4.87 | 26000 | 7.55 |
| 2500 | 2.12 | 12500 | 4.99 | 27000 | 7.70 |
| 3000 | 2.33 | 13000 | 5.11 | 28000 | 7.88 |
| 3500 | 2.50 | 13500 | 5.20 | 29000 | 8.02 |
| 4000 | 2.67 | 14000 | 5.31 | 30000 | 8.15 |
| 4500 | 2.82 | 14500 | 5.42 | 31000 | 8.35 |
| 5000 | 2.99 | 15000 | 5.51 | 32000 | 8.40 |
| 5500 | 3.16 | 15500 | 5.58 | 33000 | 8.62 |
| 6000 | 3.32 | 16000 | 5.68 | 34000 | 8.73 |
| 6500 | 3.51 | 16500 | 5.78 | 35000 | 8.78 |
| 7000 | 3.65 | 17000 | 5.91 | 36000 | 8.94 |
| 7500 | 3.79 | 17500 | 5.99 | 37000 | 9.21 |
| 8000 | 3.92 | 18000 | 6.07 | 38000 | 9.37 |
| 8500 | 4.04 | 19000 | 6.36 | 39000 | 9.45 |
| 9000 | 4.18 | 20000 | 6.49 | 40000 | 9.52 |

**Cable loss**
**Microwave Cable Assembly, Huber-Suhner, 40 GHz, 1.5 m, SMA-SMA, S/N 1226/2A**
**HL 3903**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|---|---|
| 10 | -0.02 | 9500 | 1.84 | 21000 | 2.98 |
| 100 | 0.15 | 10000 | 1.86 | 22000 | 3.07 |
| 500 | 0.38 | 10500 | 1.93 | 23000 | 3.13 |
| 1000 | 0.56 | 11000 | 1.99 | 24000 | 3.21 |
| 1500 | 0.69 | 11500 | 2.04 | 25000 | 3.26 |
| 2000 | 0.82 | 12000 | 2.10 | 26000 | 3.48 |
| 2500 | 0.90 | 12500 | 2.15 | 27000 | 3.44 |
| 3000 | 0.98 | 13000 | 2.21 | 28000 | 3.53 |
| 3500 | 1.06 | 13500 | 2.25 | 29000 | 3.59 |
| 4000 | 1.11 | 14000 | 2.29 | 30000 | 3.66 |
| 4500 | 1.17 | 14500 | 2.34 | 31000 | 3.70 |
| 5000 | 1.24 | 15000 | 2.36 | 32000 | 3.79 |
| 5500 | 1.32 | 15500 | 2.40 | 33000 | 3.88 |
| 6000 | 1.40 | 16000 | 2.45 | 34000 | 3.94 |
| 6500 | 1.50 | 16500 | 2.48 | 35000 | 3.91 |
| 7000 | 1.56 | 17000 | 2.56 | 36000 | 4.05 |
| 7500 | 1.62 | 17500 | 2.58 | 37000 | 4.22 |
| 8000 | 1.68 | 18000 | 2.60 | 38000 | 4.25 |
| 8500 | 1.74 | 19000 | 2.84 | 39000 | 4.27 |
| 9000 | 1.78 | 20000 | 2.88 | 40000 | 4.33 |

**Cable loss**
**Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,**
**NC29-N1N1-244S/N 12025101 002,**
**HL 4352**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|
| 50 | 0.20 | 9000 | 2.81 |
| 100 | 0.28 | 9500 | 2.89 |
| 300 | 0.49 | 10000 | 3.00 |
| 500 | 0.63 | 10500 | 3.07 |
| 1000 | 0.90 | 11000 | 3.15 |
| 1500 | 1.10 | 11500 | 3.23 |
| 2000 | 1.28 | 12000 | 3.30 |
| 2500 | 1.44 | 12500 | 3.38 |
| 3000 | 1.57 | 13000 | 3.47 |
| 3500 | 1.71 | 13500 | 3.55 |
| 4000 | 1.85 | 14000 | 3.61 |
| 4500 | 1.95 | 14500 | 3.68 |
| 5000 | 2.05 | 15000 | 3.76 |
| 5500 | 2.14 | 15500 | 3.86 |
| 6000 | 2.27 | 16000 | 3.92 |
| 6500 | 2.38 | 16500 | 3.97 |
| 7000 | 2.47 | 17000 | 4.03 |
| 7500 | 2.58 | 17500 | 4.10 |
| 8000 | 2.65 | 18000 | 4.18 |
| 8500 | 2.74 | | |

**Cable loss**
**Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,**
**NC29-N1N1-244S/N 12025101 003,**
**HL 4353**

| Frequency, MHz | Cable loss, dB | Frequency, MHz | Cable loss, dB |
|---|---|---|---|
| 50 | 0.20 | 9000 | 2.71 |
| 100 | 0.27 | 9500 | 2.81 |
| 300 | 0.47 | 10000 | 2.90 |
| 500 | 0.61 | 10500 | 2.97 |
| 1000 | 0.87 | 11000 | 3.06 |
| 1500 | 1.07 | 11500 | 3.13 |
| 2000 | 1.24 | 12000 | 3.20 |
| 2500 | 1.39 | 12500 | 3.26 |
| 3000 | 1.53 | 13000 | 3.34 |
| 3500 | 1.65 | 13500 | 3.39 |
| 4000 | 1.77 | 14000 | 3.47 |
| 4500 | 1.89 | 14500 | 3.54 |
| 5000 | 1.99 | 15000 | 3.62 |
| 5500 | 2.07 | 15500 | 3.69 |
| 6000 | 2.20 | 16000 | 3.76 |
| 6500 | 2.30 | 16500 | 3.83 |
| 7000 | 2.39 | 17000 | 3.86 |
| 7500 | 2.51 | 17500 | 3.94 |
| 8000 | 2.58 | 18000 | 4.02 |
| 8500 | 2.65 | | |

# 13 APPENDIX F Abbreviations and acronyms

| | |
|---|---|
| A | ampere |
| AC | alternating current |
| AM | amplitude modulation |
| AVRG | average (detector) |
| BB | broad band |
| cm | centimeter |
| dB | decibel |
| dBm | decibel referred to one milliwatt |
| dB(μV) | decibel referred to one microvolt |
| dB(μV/m) | decibel referred to one microvolt per meter |
| dB(μA) | decibel referred to one microampere |
| DC | direct current |
| EIRP | equivalent isotropically radiated power |
| ERP | effective radiated power |
| EUT | equipment under test |
| F | frequency |
| GHz | gigahertz |
| GND | ground |
| H | height |
| HL | Hermon laboratories |
| Hz | hertz |
| k | kilo |
| kHz | kilohertz |
| LO | local oscillator |
| m | meter |
| MHz | megahertz |
| min | minute |
| mm | millimeter |
| ms | millisecond |
| μs | microsecond |
| NA | not applicable |
| NB | narrow band |
| OATS | open area test site |
| Ω | Ohm |
| QP | quasi-peak |
| RE | radiated emission |
| RF | radio frequency |
| rms | root mean square |
| Rx | receive |
| s | second |
| T | temperature |
| Tx | transmit |
| V | volt |

END OF DOCUMENT