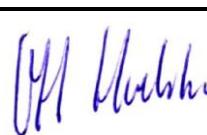


| | | |
|---|--|---|
| Test Report No.: 11030302 | | Page 1 of 36 |
| Client: Plugwise B.V. Wattstraat 56, 2171TR Sassenheim | | |
| Test Item: Energy Management System, ZigBee device | | |
| Identification: | Stick | Serial No.: ---- |
| Project No.: | 11030302 | Date of Receipt: 2011-06-01 |
| Testing Location: TÜV Rheinland EPS B.V. Smidshornerweg 18 9822 TL Niekerk | | |
| Test Specification: FCC 47 CFR Part 15, Subpart C, Section 15.247 (October 1, 2010) ANSI C63.4-2009 KDB Publication No. 558074: Measurement of Digital Transmission Systems Operating under Section 15.247 (March 23, 2005) | | |
| Test Result: <i>The test item passed the test specification(s).</i> | | |
| Testing Laboratory: TÜV Rheinland EPS B.V. Smidshornerweg 18 9822 TL Niekerk | | |
| Tested by:  | Reviewed by:  | |
| 2011-07-18 | R. van der Meer / Inspector | 2011-07-18 O. Hoekstra / Reviewer |
| Date | Name/Position | Signature |
| Other Aspects: N/A | | |
| Abbreviations: P(ass) = passed Fail) = failed N/A = not applicable N/T = not tested | | |
| This report shall not be reproduced, except in full, without the written permission of TÜV Rheinland EPS B.V. The test results relate only to the item(s) tested. | | |

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TEST SUMMARY

5.1.1 VOLTAGE REQUIREMENTS

RESULT: PASS

5.1.2 ANTENNA REQUIREMENTS

RESULT: PASS

5.1.3 RESTRICTED BANDS OF OPERATION

RESULT: PASS

5.2.1 CONDUCTED OUTPUT POWER

RESULT: PASS

5.2.2 6dB BANDWIDTH

RESULT: PASS

5.2.3 CONDUCTED SPURIOUS EMISSION

RESULT: PASS

5.2.4 PEAK POWER SPECTRAL DENSITY

RESULT: PASS

5.2.5 BAND EDGE CONDUCTED EMISSIONS

RESULT: Pass

5.2.6 RADIATED SPURIOUS EMISSIONS OF TRANSMITTER

RESULT: PASS

5.3.1 AC POWER LINE CONDUCTED EMISSION OF TRANSMITTER

RESULT: PASS

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1. General Remarks

1.1 Complementary Materials

There is no attachment to this test report.

2. Test Sites

2.1 Test Facilities

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland EPS B.V., located in Niekerk, 9822 TL Smidshornerweg 18, The Netherlands, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948, per October 23, 2000.

The description of the test facilities has been filed at the Office of the Federal Communications Commission under registration number 90828. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The description of the test facilities has been filed to Industry Canada under registration number 2932G-1. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

Normal test conditions:

| | |
|----------------------|------------------|
| Temperature (*) | : +15°C to +35°C |
| Relative humidity(*) | : 20 % to 75 % |
| Supply voltage | : USB power |
| Air pressure | : 950 – 1050 hPa |

When it was impracticable to carry out the tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests are stated separately.

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2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

| Kind of Equipment | Manufacturer | Model Name | Inventory number | Calibration date (mm/yyyy) | Calibration due date (mm/yyyy) |
|---|-----------------|----------------------|------------------|----------------------------|--------------------------------|
| For Antenna Port Conducted Emission | | | | | |
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | 99538 | 05/2011 | 05/2012 |
| Temperature-Humiditymeter | Europe supplies | WS-7082 | 99613 | 10/2010 | 10/2011 |
| | | | | | |
| For AC Power Line Conducted Emission | | | | | |
| LISN | EMCO | 3625/2 | 12512 | 01/2010 | 01/2012 |
| Measurement Receiver | Rohde & Schwarz | ESCI | 99699 | 02/2011 | 02/2012 |
| Temperature-Humiditymeter | Europe supplies | WS-7082 | 99548 | 10/2010 | 10/2011 |
| Variac | RFT | LTS006 | 99161 | N/A | N/A |
| For Radiated Emission | | | | | |
| Measurement Receiver | Rohde & Schwarz | ESCI | 99699 | 02/2011 | 02/2012 |
| Coax 5m RG213 OATS | NMi Certin B.V. | KABEL 5M OATS | 99069 | 10/2010 | 10/2011 |
| Coax 15m RG213 OATS | NMi Certin B.V. | KABEL 15M OATS | 99070 | 10/2010 | 10/2011 |
| Coax OATS ground | NMi Certin B.V. | KABEL GROND OATS | 99071 | 10/2010 | 10/2011 |
| Controller OATS | Heinrich Deisel | 4630-100 | 99107 | N/A | N/A |
| OATS | Comtest | FCC listed: 90828 | 99580 | 08/2008 | 08/2011 |
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | 99538 | 05/2011 | 05/2012 |
| Controller (OATS) | EMCS | DOC202 | 99608 | N/A | N/A |
| Antenna mast | EMCS | AP-4702C | 99609 | N/A | N/A |
| Temperature-Humiditymeter | Europe supplies | WS-7082 | 99547 | 10/2010 | 10/2011 |
| Guidehorn 1-18 GHz | EMCO | 3115 | 12484 | 04/2011 | 04/2012 |
| Guidehorn 18-26.5 GHz | EMCO | RA42-K-F-4B-C | 12488 | 09/2010 | 09/2011 |
| Biconilog Testantenna | Chase | CBL 6111B | 15633 | 02/2011 | 02/2012 |
| 2.4 GHz bandreject filter | BSC | XN-1783 | 14450 | N/A | N/A |
| Bandpass filter 4-10 GHz | Reactel | 7AS-7G-6G-511 | 99076 | N/A | N/A |
| Bandpass filter 10-26 GHz | Reactel | 9HS-10G/26.5G-S11 | 99136 | N/A | N/A |
| Preamplifier 0.5 - 18 GHz | Miteq | AMF-5D-005180-28-13p | 99596 | N/A | N/A |

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| Kind of Equipment | Manufacturer | Model Name | Inventory number | Calibration date (mm/yyyy) | Calibration due date (mm/yyyy) |
|-------------------|--------------|------------|------------------|----------------------------|--------------------------------|
| ----- | | | | | |
| -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- |
| -- | -- | -- | -- | -- | -- |

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.

2.3 Measurement Uncertainty

Table 2: Emission Measurement Uncertainty

| Measurement Type | Frequency | Uncertainty |
|----------------------------------|----------------|-------------|
| AC Power Line Conducted Emission | 150kHz - 30MHz | ±3.5dB |
| Antenna Port Conducted Emission | < 1GHz | ±0.5dB |
| | > 1GHz | ±0.7dB |
| Radiated Emission | 150kHz - 30MHz | ±5.0dB |
| | 30MHz - 1GHz | ±5.0dB |
| | > 1GHz | ±5.5dB |

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3. General Product Information

3.1 Product Function and Intended Use

The brand Plugwise model Stick, hereafter referred to as EUT, is a digitally modulated transmitter intended to be used in an energy management system using a wireless ZigBee-mesh network. It operates in the 2400 – 2483.5 frequency band (it actually uses the frequency range of 2405 – 2480 MHz).

The content of this report and measurement results have not been changed other than the way of presenting the data.

3.2 System Details

Details and an overview of the system and all of its components, as it has been tested, may be found below.

| | | |
|-----------------------|---|---|
| EUT | : | Energy Management System, ZigBee device |
| Manufacturer | : | Applied Micro Electronics "AME" BV |
| Brand | : | Plugwise |
| Model | : | Stick |
| Serial number | : | -- |
| MAC | : | 000D6F0000C3CEE2 |
| Voltage input rating | : | 4.4 – 5.25 Vdc (USB-powered) |
| Voltage output rating | : | -- |
| Current input rating | : | -- |
| Antenna | : | Integral, integrated on the PCB |
| Operating frequency | : | 2405 – 2480 MHz |
| Modulation | : | O-QPSK |
| Remarks | : | n.a. |

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Table 3: Interfaces present on the EUT

| No. | Interface | Cable Length for Testing, Shielding | Interface Classification |
|-----|---------------|--|--------------------------|
| 1. | USB Connector | 3m | DC input power port |

3.3 Clock Frequencies

The highest clock frequency generated by the EUT is 24.000 MHz.

3.4 Countermeasures to achieve EMC Compliance

No additional measures were employed to achieve compliance.

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4. Test Set-up and Operation Modes

4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209, 15.247 and KDB Publication No. 558074: Measurement of Digital Transmission Systems Operating under Section 15.247.

The test methods, which have been used, are based on ANSI C63.4-2009.

For details, see under each test item.

4.2 Operation Modes

Testing was performed at the lowest operating frequency (2405MHz), at the operating frequency in the middle of the specified frequency band (2440MHz) and at the highest operating frequency (2480MHz).

The basic operation modes used for testing are:

- A. EUT transmits (TX mode), with full power, at lowest channel, Channel 11 (2405MHz), a continuous modulated signal streaming called "Burst Mode".
- B. EUT transmits (TX mode), with full power, at middle channel, Channel 18 (2440MHz), a continuous modulated signal streaming called "Burst Mode".
- C. EUT transmits (TX mode), with full power, at highest channel, Channel 26 (2480MHz), a continuous modulated signal streaming called "Burst Mode".

4.3 Physical Configuration for Testing

The EUT was tested on a stand-alone basis (only attached to the test jig) and the test system was configured in a typical fashion (as a customer would normally use it).

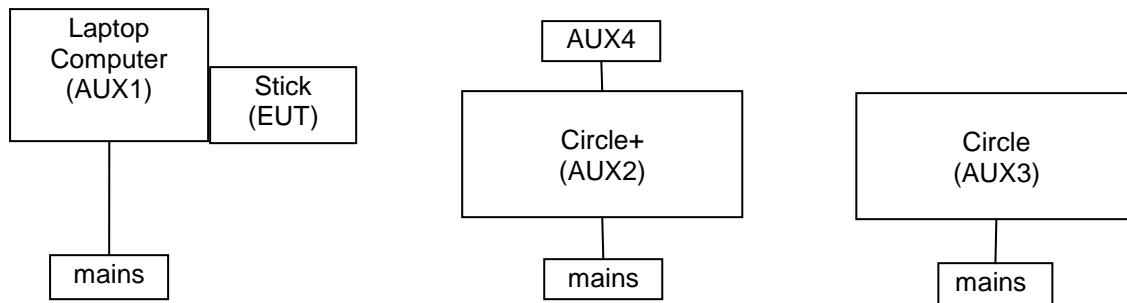
The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.4:2009.

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Figure 1: Test Setup Diagram



Notes:

For antenna conducted measurements, the antenna was replaced by a 50Ω antenna connector and a short RF cable.

For more details, refer to the document: Test Set-Up Photographs document.

4.4 Test Software

The EUT was provided by the manufacturer with suitable software to allow operation in all the required modes.

Software used for testing: Plugwise Easy Tool Build date: 5/27/2011.

This software was running on a laptop computer (AUX1). It was used to enable the test operation modes listed in section 4.2 as appropriate.

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4.5 Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

1. AUX1

Product: Laptop Computer
Manufacturer: Lenovo
Model: 9456-HTG
Serial Number: L3-BF847 07/02
Remark: property TR-EPS, host for testsoftware and AUX2

2. AUX2

Product: ZigBee module
Manufacturer: Plugwise
Model: Circle+
Rated Voltage: 100 – 240 Vac
Antenna: Internal, integrated on the PCB
Remarks: N/A

3. AUX3

Product: ZigBee module
Manufacturer: Plugwise
Model: Circle
Rated Voltage: 100 – 240 Vac
Antenna: Internal, integrated on the PCB
Remarks: N/A

4. AUX4

Product: Test jig
Manufacturer: N/A
Model: N/A
Remarks: Used for Conducted tests between PCB and Spectrum analyzer

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5. Test Results RADIO

5.1 Technical Requirements

5.1.1 Voltage Requirements

RESULT: PASS

Requirements:

FCC 15.31(e)

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

Verdict:

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the power supply requirements.

5.1.2 Antenna Requirements

RESULT: PASS

Requirements:

FCC 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Verdict:

The EUT has an internal antenna which is not user accessible. Hence it complies with the requirements.

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5.1.3 Restricted Bands of Operation

RESULT: PASS

Requirements:

FCC 15.205

Only spurious emissions are permitted in any of the restricted frequency bands, unless otherwise specified.

Verdict:

The EUT operation frequency range is 2405 MHz - 2480 MHz. Therefore only spurious emissions may be found in the restricted bands of operation and the EUT complies with the restricted frequency band requirement.

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5.2 Conducted Measurements at Antenna Port

5.2.1 Conducted Output Power

RESULT: PASS

Date of testing: 2011-07-11

Requirements:

FCC 15.247(b)(3)

For systems using digital modulation in the 2400-2483.5MHz band, the maximum peak output power is 1W (+30dBm).

Test procedure:

ANSI C63.4-2009 and KDB Publication No. 558074: Measurement of Digital Transmission Systems Operating under Section 15.247.

The maximum peak output power (conducted) was measured at the antenna connector with a spectrum analyzer. The final measurement takes into account the loss generated by all the involved cables.

Table 4: Conducted Output Power

| Frequency [MHz] | Reading [dBm] | Correction Factor [dB] | Output Power [dBm] | Output Power [mW] | Limit [dBm] | Limit [mW] | Margin [dB] |
|-----------------|---------------|------------------------|--------------------|-------------------|-------------|------------|-------------|
| 2405 | -4.39 | 1.0 | -3.39 | 0.458 | +30 | 1000 | 33.39 |
| 2440 | -5.62 | 1.0 | -4.62 | 0.345 | +30 | 1000 | 34.62 |
| 2480 | -7.26 | 1.0 | -6.26 | 0.237 | +30 | 1000 | 36.26 |

Notes: Output power = Reading + Correction factor

Correction factor = Total cable loss

mW = $10^{(dBm/10)}$

dBm = $10 \log(mW)$

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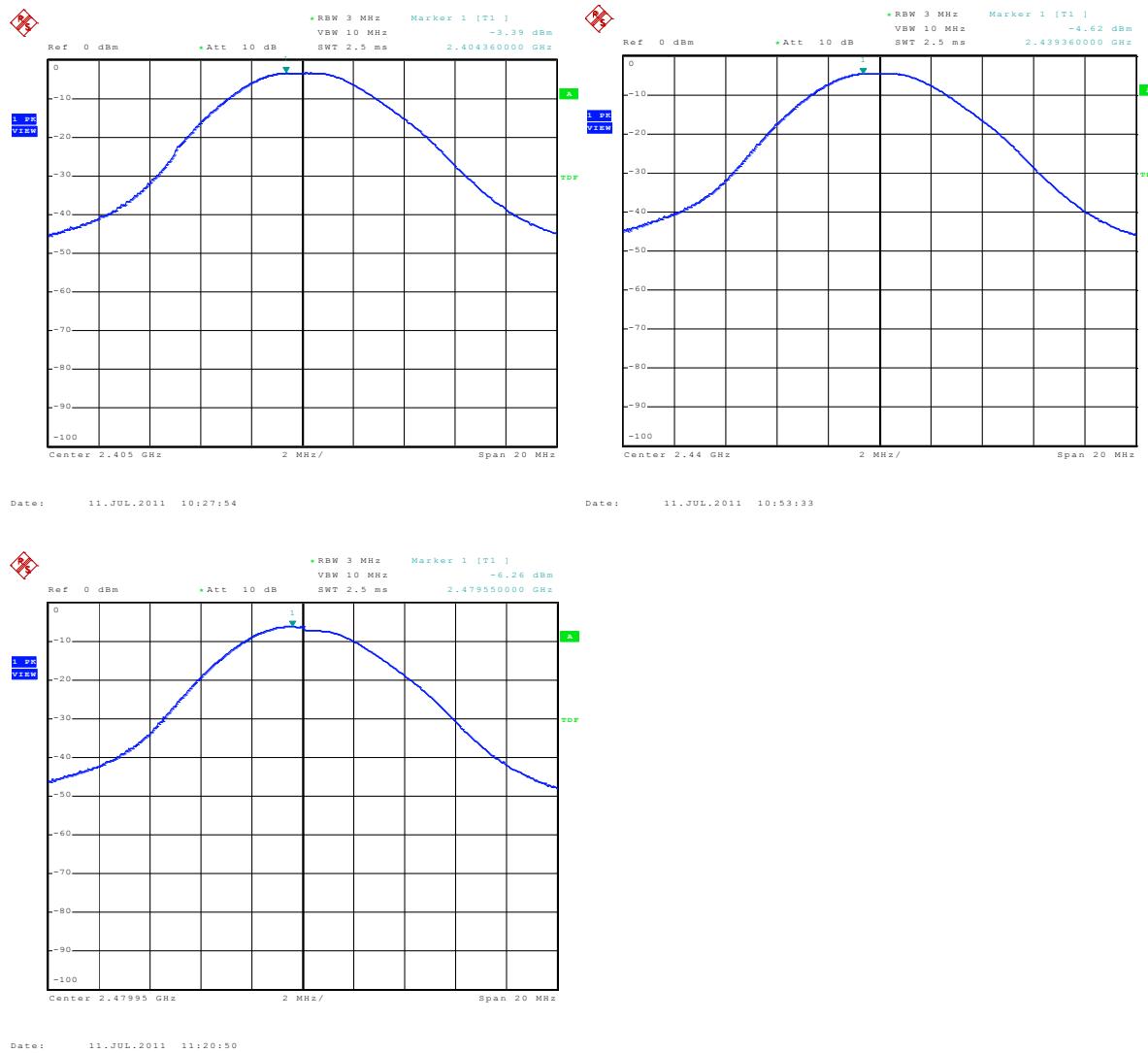


Figure 2: Peak power plots,

Figures 2a, 2b and 2c showing plots of the Peak Power outputs, correction factors included in the reading.

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5.2.2 6dB Bandwidth

RESULT: PASS

Date of testing: 2011-07-11

Requirements:

FCC 15.247(a)(2)

For systems using digital modulation in the 2400-2483.5MHz band, the 6dB bandwidth shall be at least 500kHz.

Test procedure:

ANSI C63.4-2009 and KDB Publication No. 558074: Measurement of Digital Transmission Systems Operating under Section 15.247.

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 100kHz and the span to 5 MHz.

Test Report No.:

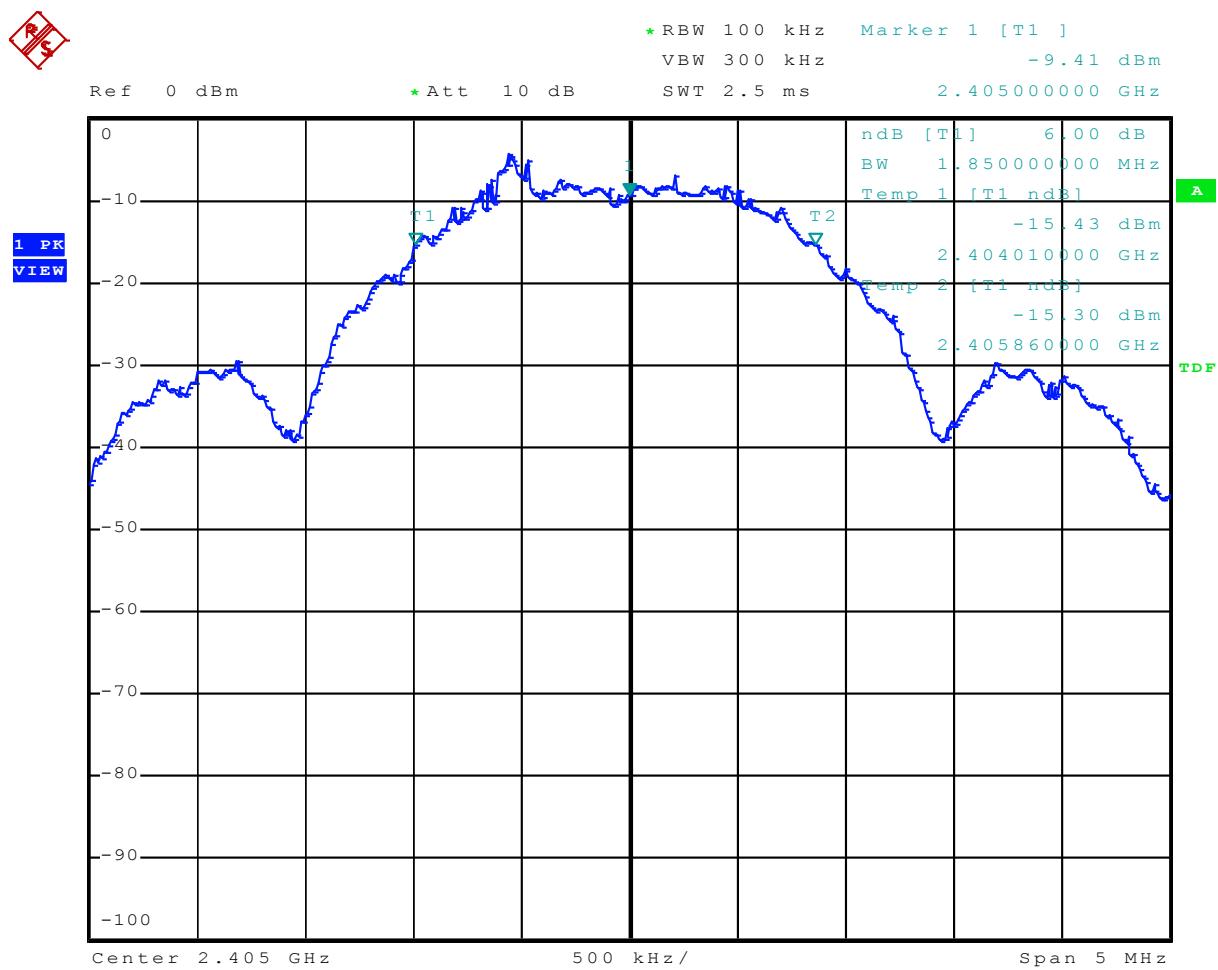
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Table 5: 6dB Bandwidth

| Operating Frequency [MHz] | 6dB Bandwidth [kHz] | Limit [kHz] |
|---------------------------|---------------------|-------------|
| 2405 | 1850 | 500 |
| 2440 | 1610 | 500 |
| 2480 | 1780 | 500 |

Figure 3: 6dB Bandwidth, Mode A (2405MHz)



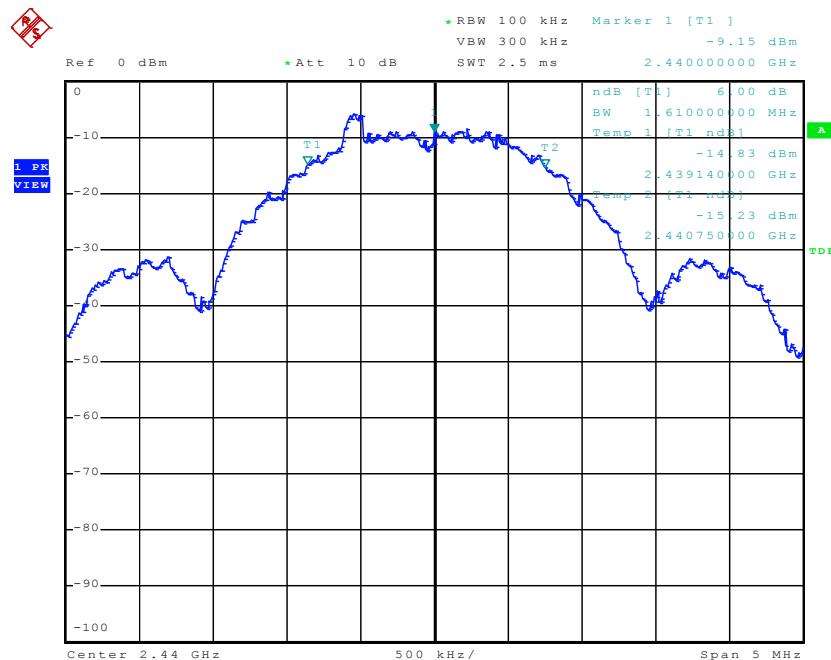
Date: 11.JUL.2011 10:24:56

Test Report No.:

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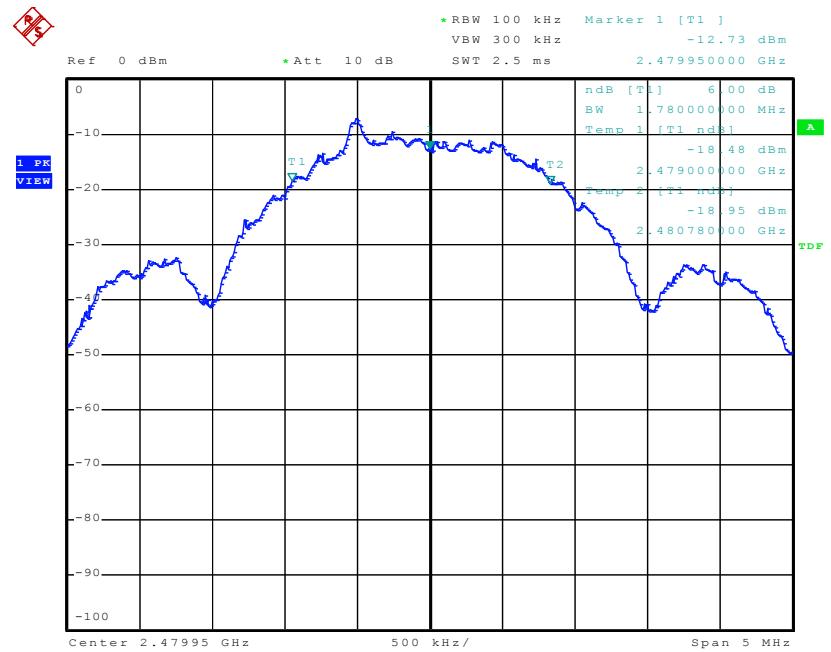
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Figure 4: 6dB Bandwidth, Mode B (2440MHz)



Date: 11.JUL.2011 10:50:39

Figure 5: 6dB Bandwidth, Mode C (2480MHz)



Date: 11.JUL.2011 11:15:43

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5.2.3 Conducted Spurious Emission

RESULT: PASS

Date of testing: 2011-07-11

Requirements:

FCC 15.247(d)

In any 100kHz bandwidth outside the frequency band, the RF power shall be at least 20dB below that of the maximum in-band 100kHz emission.

Test procedure:

ANSI C63.4-2009 and KDB Publication No. 558074: Measurement of Digital Transmission Systems Operating under Section 15.247.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 100kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30MHz to 25GHz (10th harmonics).

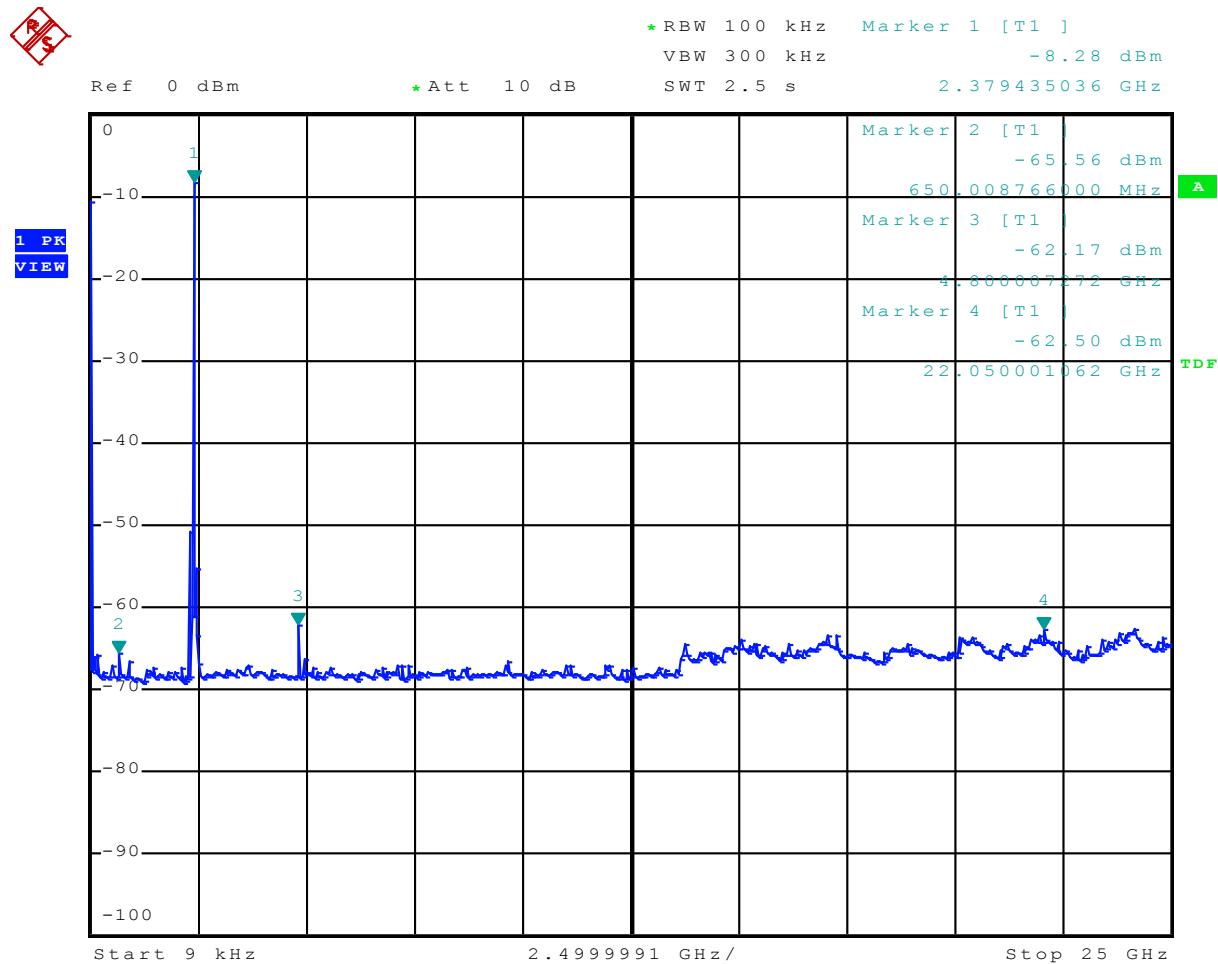
The final measurement takes into account the loss generated by all the involved cables.

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Figure 6: Conducted Spurious Emission, 30MHz - 25GHz, Mode A (2405MHz)



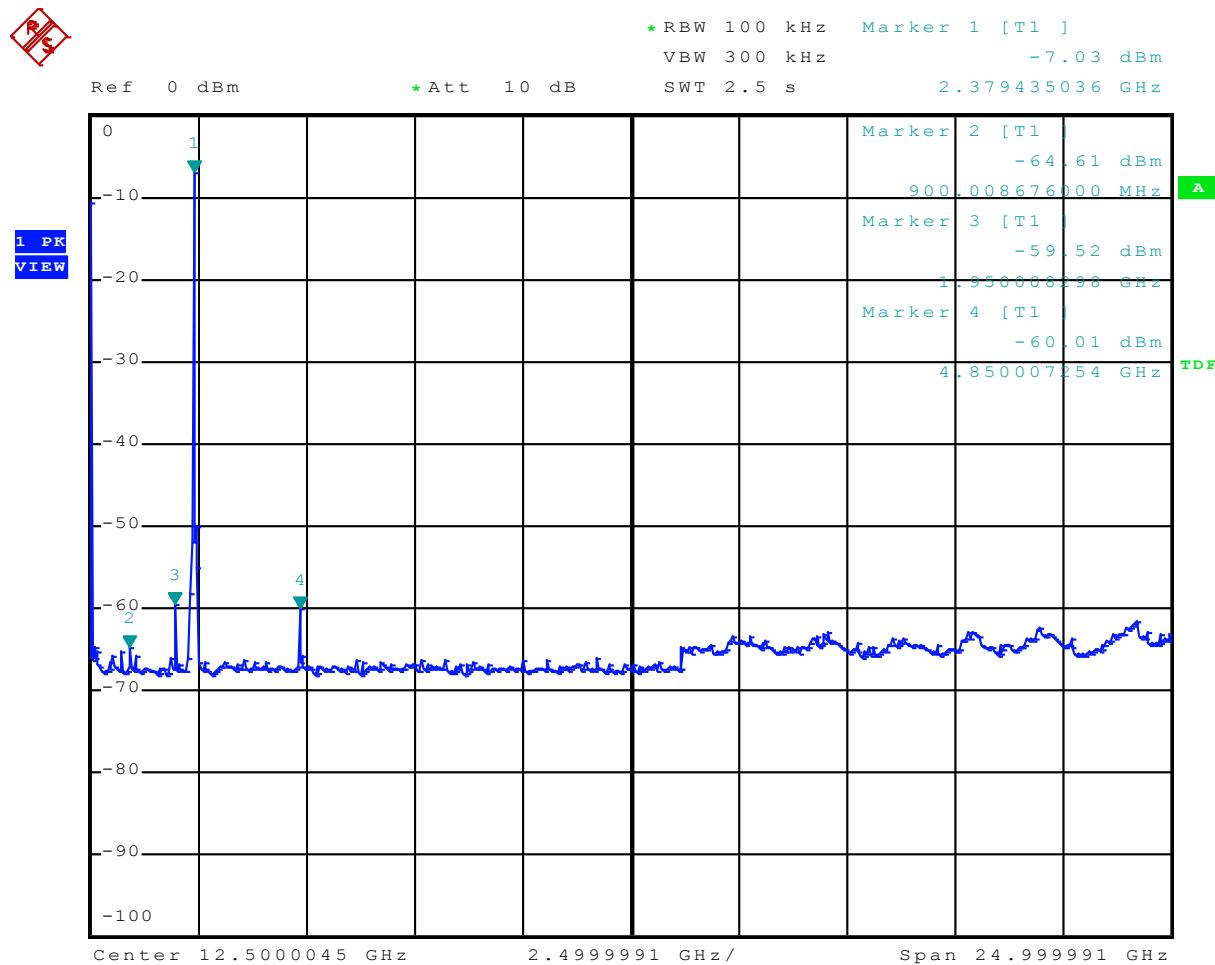
Date: 11.JUL.2011 12:58:12

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Figure 7: Conducted Spurious Emission, 30MHz - 25GHz, Mode B (2440MHz)



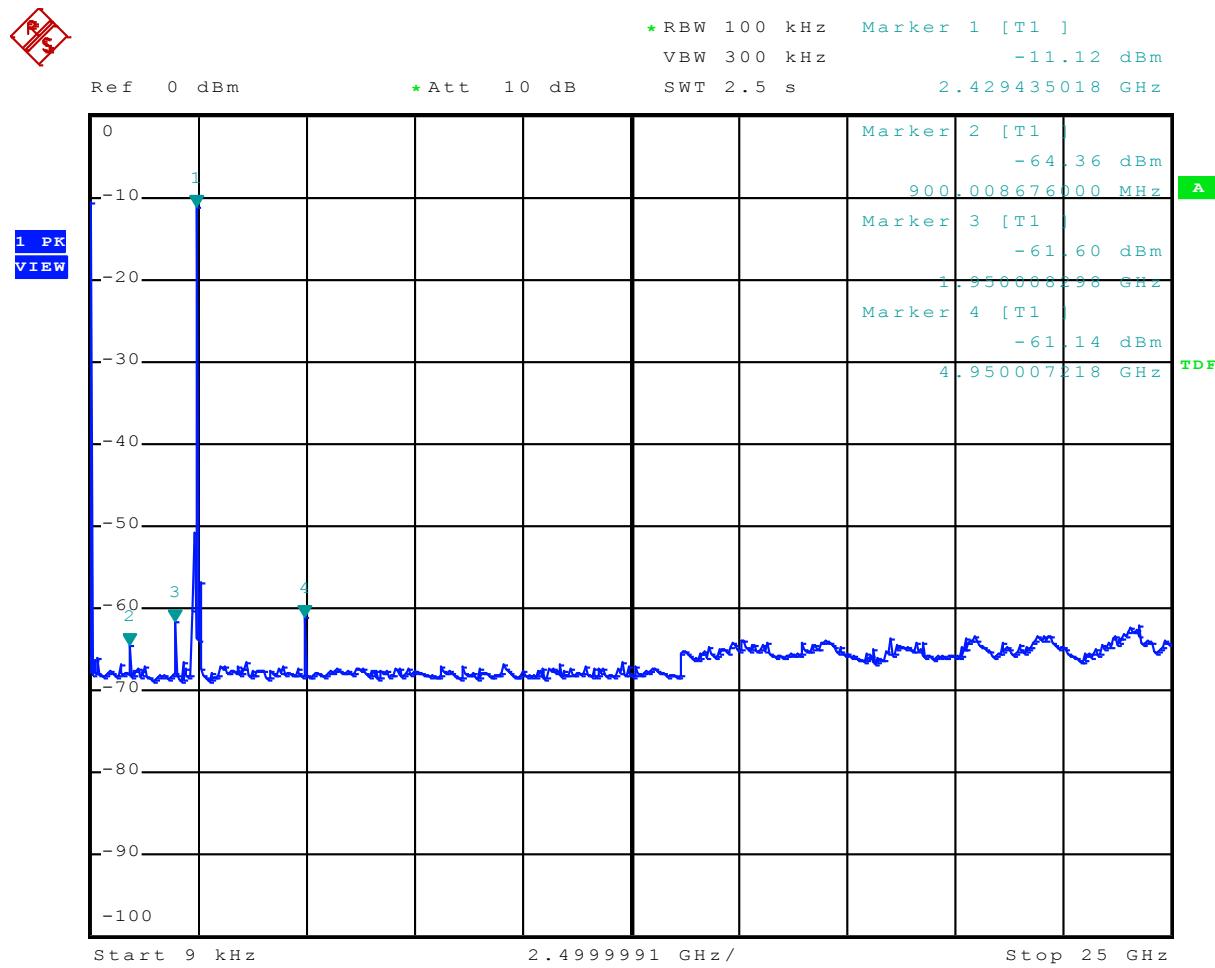
Date: 11.JUL.2011 12:51:20

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Figure 8: Conducted Spurious Emission, 30MHz - 25GHz, Mode C (2480MHz)



Date: 11.JUL.2011 11:55:39

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5.2.4 Peak Power Spectral Density

RESULT: PASS

Date of testing: 2011-07-11

Requirements:

FCC 15.247(e)

For digitally modulated systems, the power spectral density (PSD) conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

Test procedure:

ANSI C63.4-2009 and KDB Publication No. 558074: Measurement of Digital Transmission Systems Operating under Section 15.247.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 3kHz and the video bandwidth was set to 10kHz. The sweep time was set to 500s.

The final measurement takes into account the loss generated by all the involved cables.

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Table 6: Peak Power Spectral Density

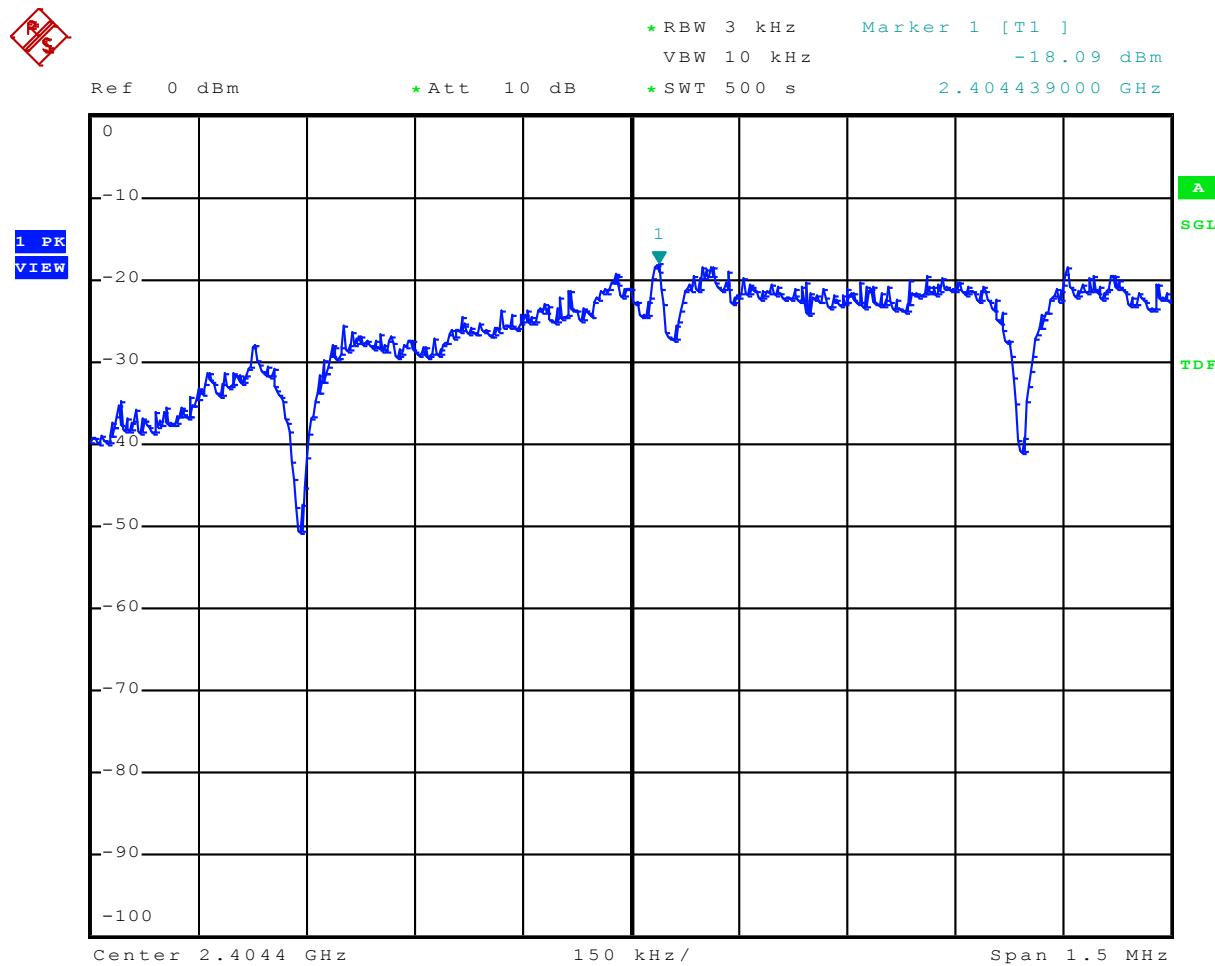
| Operating Frequency [MHz] | Max PSD Frequency [MHz] | Reading [dBm] | Correction Factor [dB] | Max PSD [dBm] | Limit [dBm] | Margin [dB] |
|---------------------------|-------------------------|---------------|------------------------|---------------|-------------|-------------|
| 2405 | 2404.439 | -19.09 | 1.0 | -18.09 | 8 | 26.09 |
| 2440 | 2440.198 | -20.24 | 1.0 | -19.24 | 8 | 27.24 |
| 2480 | 2479.435 | -21.97 | 1.0 | -20.97 | 8 | 28.97 |

Notes: Power density = Reading + Correction factor

Correction factor = Total cable loss

Figures 9, 10 and 11 includes the correction factor

Figure 9: Power Spectral Density, Mode A (2405MHz)

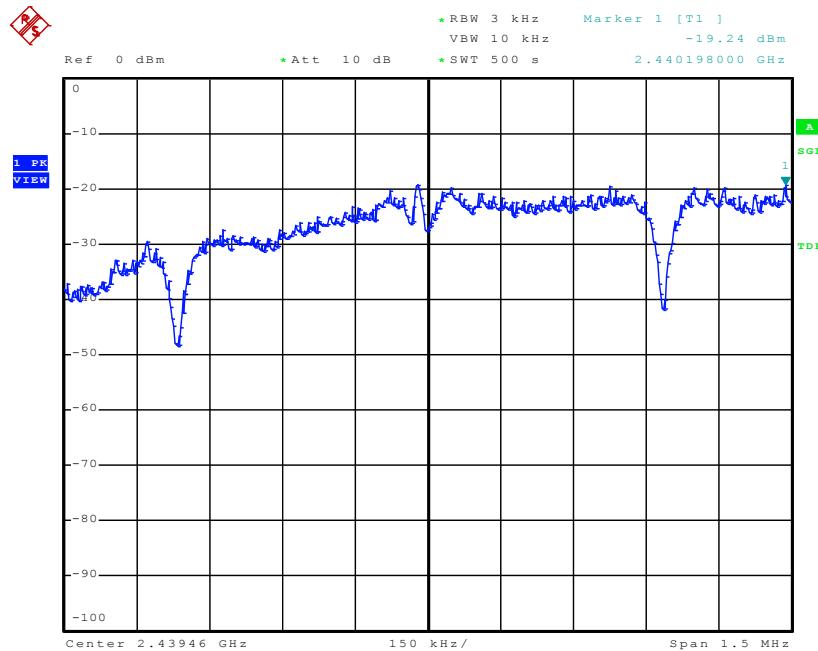


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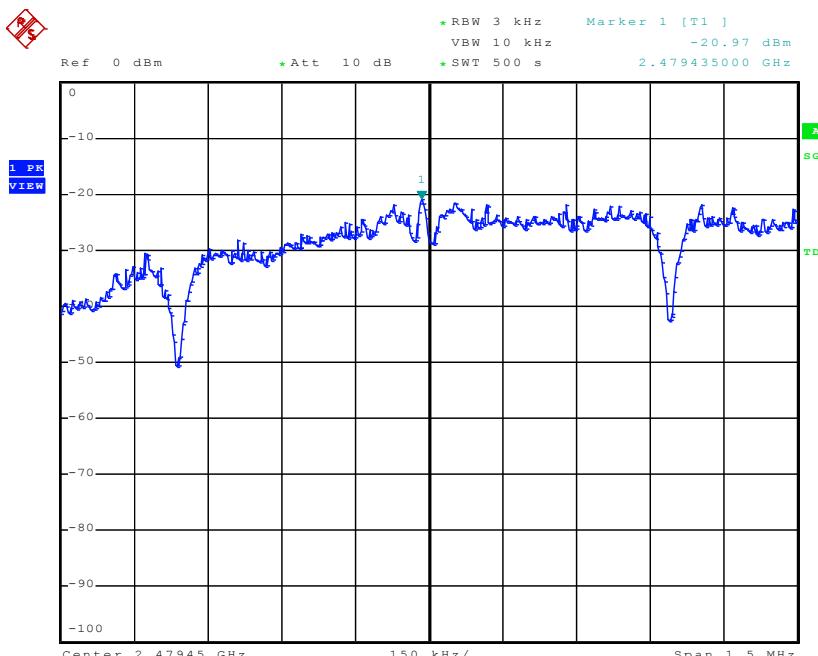
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Figure 10: Power Spectral Density, Mode B (2440MHz)



Date: 11.JUL.2011 11:11:04

Figure 11: Power Spectral Density, Mode C (2480MHz)



Date: 11.JUL.2011 11:44:37

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5.2.5 Band Edge Conducted Emissions

RESULT: Pass

Date of testing: 2011-07-11

Requirements:

FCC 15.205, FCC 15.209 and FCC 15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test procedure:

ANSI C63.4-2009 and KDB Publication No. 558074: Measurement of Digital Transmission Systems Operating under Section 15.247.

Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings:
RBW = 100kHz, VBW = 300kHz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

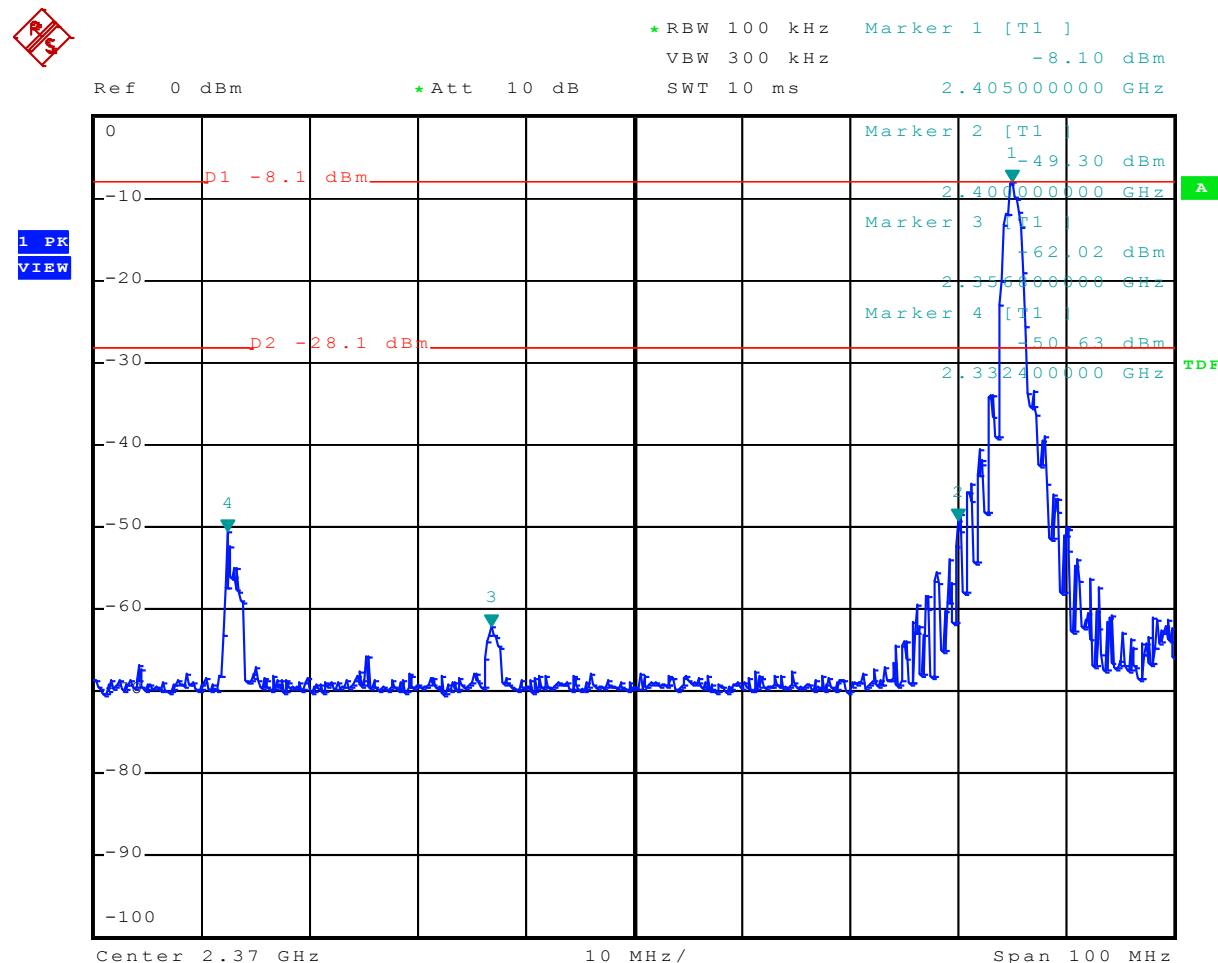
Results: All out of band spurious emissions are more than 20 dB below the fundamental. See Figures 12 and 13 on the following pages.

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Figure 12: Band Edge Conducted Emission, Spectral Diagram, Mode A (2405MHz)



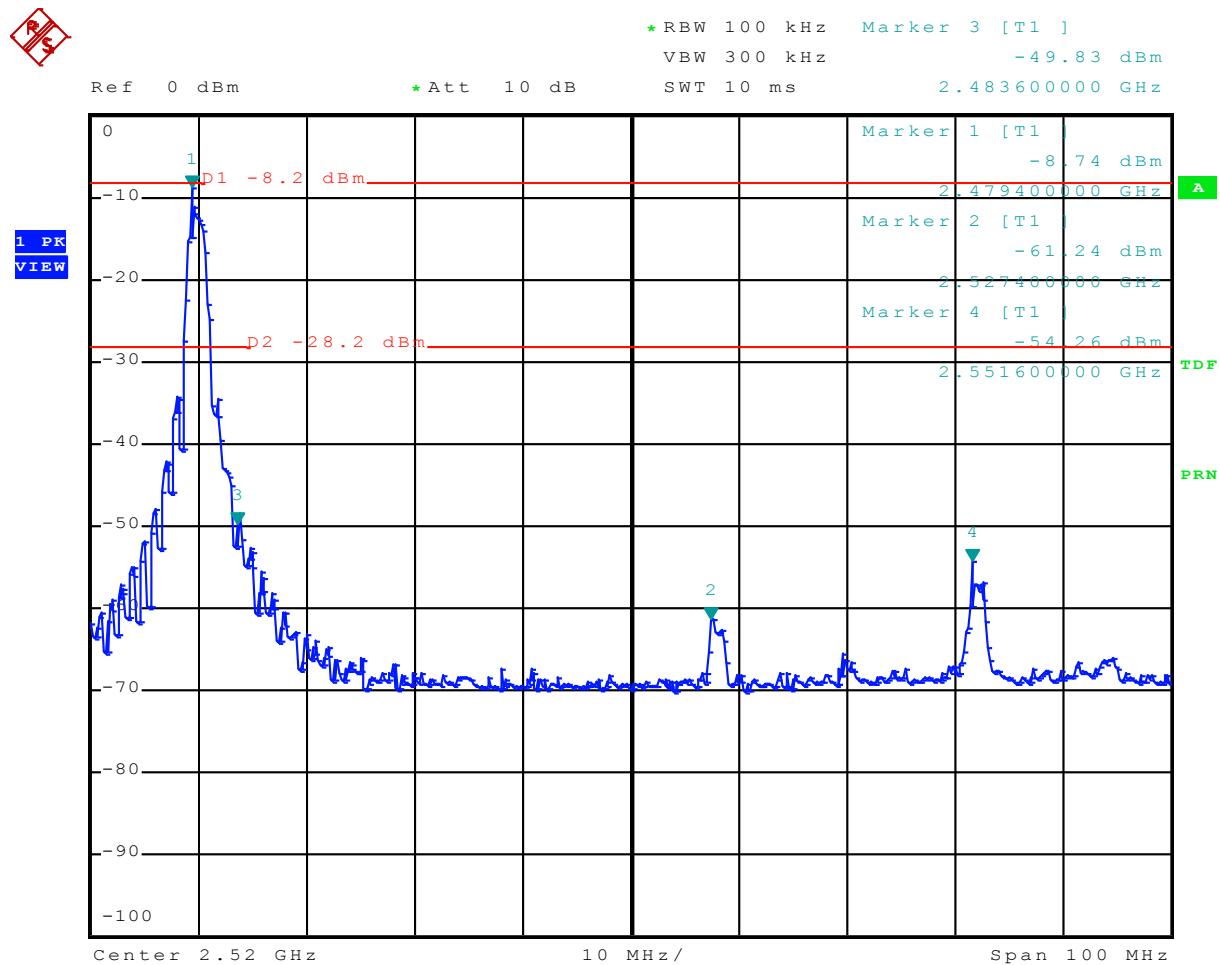
Date: 11.JUL.2011 10:17:48

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Figure 13: Band Edge Conducted Emission, Spectral Diagram, Mode C (2480MHz)



Date: 8.JUL.2011 14:39:30

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5.2.6 Radiated Spurious Emissions of Transmitter

RESULT: PASS

Date of testing: 2011-06-17

Frequency range: 30MHz - 25GHz

Requirements:

FCC 15.205, FCC 15.209 and FCC 15.247(d)

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a), must comply with the radiated emission limits specified in FCC 15.209(a).

Radiated emissions which fall outside the operation frequency band and outside restricted bands shall either meet the limit specified in FCC 15.209(a) or be attenuated at least 20dB below the power level in the 100kHz bandwidth within the band that contains the highest level of the desired power (the less severe limit applies).

Test procedure:

ANSI C63.4-2009 and KDB Publication No. 558074: Measurement of Digital Transmission Systems Operating under Section 15.247.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to the 10th harmonic of the highest fundamental transmitter frequency (25GHz). Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit.

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Table 7: Radiated Emission, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations

| Freq. [MHz] | Antenna Orientation | Reading QP [dB μ V] | Factor [dB(1/m)] | Level QP [dB μ V/m] | Limit [dB μ V/m] | Margin QP [dB] |
|-------------|---------------------|-------------------------|------------------|-------------------------|----------------------|----------------|
| 48.000 | Vertical | 9.4 | 9.9 | 19.3 | 40.0 | 20.7 |
| 48.925 | Vertical | 7.4 | 9.9 | 17.3 | 40.0 | 22.7 |
| 52.525 | Vertical | 8.1 | 8.6 | 16.7 | 40.0 | 23.3 |
| 65.175 | Vertical | 14.5 | 7.1 | 21.6 | 40.0 | 18.4 |
| 72.350 | Vertical | 10.0 | 7.8 | 17.8 | 40.0 | 22.2 |
| 149.50 | Vertical | 8.7 | 13.7 | 22.4 | 43.5 | 21.1 |
| 152.25 | Vertical | 9.0 | 13.6 | 22.6 | 43.5 | 20.9 |
| 259.50 | Vertical | 8.9 | 16.7 | 25.6 | 46.0 | 20.4 |

Note:

- Level QP = Reading QP + Factor
- Tested in Mode A (2405MHz), Mode B (2440MHz) and Mode C (2480MHz), highest values noted.
- Quasi Peak detector used with a bandwidth of 120 kHz

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Table 8: Radiated Emission, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (2405MHz)

| Freq. [MHz] | Antenna Orientation | Reading AV [dB μ V] | Factor [dB(1/m)] | Level AV [dB μ V/m] | Limit [dB μ V/m] | Margin AV [dB] |
|-------------|---------------------|-------------------------|------------------|-------------------------|----------------------|----------------|
| 4810 | Horizontal | 2.5 | 35.0 | 37.5 | 54 | 16.5 |
| 7215 | Horizontal | -8.4 | 38.0 | 29.6 | 54 | 24.4 |
| 9620 | Horizontal | -8.6 | 38.4 | 29.8 | 54 | 24.2 |
| 12025 | Vertical | -5.0 | 39.4 | 34.4 | 54 | 19.6 |
| 14430 | Horizontal | -2.6 | 41.3 | 38.7 | 54 | 15.3 |
| 16835 | Vertical | 3.6 | 39.8 | 43.4 | 54 | 10.6 |

Note: - Level AV = Reading AV + Factor
- Average detector used with a bandwidth of 1 MHz.

Table 9: Radiated Emission, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (2405MHz)

| Freq. [MHz] | Antenna Orientation | Reading PK [dB μ V] | Factor [dB(1/m)] | Level PK [dB μ V/m] | Limit [dB μ V/m] | Margin PK [dB] |
|-------------|---------------------|-------------------------|------------------|-------------------------|----------------------|----------------|
| 4810 | Horizontal | 22.3 | 35.0 | 57.3 | 74 | 16.7 |
| 7215 | Horizontal | 3.6 | 38.0 | 41.6 | 74 | 32.4 |
| 9620 | Horizontal | 2.1 | 38.4 | 40.5 | 74 | 33.5 |
| 12025 | Horizontal | 6.3 | 39.4 | 45.7 | 74 | 28.3 |
| 14430 | Vertical | 7.8 | 41.3 | 49.1 | 74 | 24.9 |
| 16835 | Vertical | 14.0 | 39.8 | 53.8 | 74 | 20.2 |

Note: - Level PK = Reading PK + Factor
- Peak detector used with a bandwidth of 1 MHz

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Table 10: Radiated Emission, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode B (2440MHz)

| Freq. [MHz] | Antenna Orientation | Reading AV [dB μ V] | Factor [dB(1/m)] | Level AV [dB μ V/m] | Limit [dB μ V/m] | Margin AV [dB] |
|-------------|---------------------|-------------------------|------------------|-------------------------|----------------------|----------------|
| 4880 | Vertical | -5.7 | 36.2 | 30.5 | 54 | 23.5 |
| 7320 | Vertical | -8.0 | 39.3 | 31.3 | 54 | 22.7 |
| 9760 | Vertical | -9.8 | 40.0 | 30.2 | 54 | 23.8 |
| 12200 | Vertical | -6.9 | 39.4 | 32.5 | 54 | 21.5 |
| 14640 | Vertical | -6.1 | 41.3 | 35.2 | 54 | 18.8 |
| 17080 | Horizontal | 2.8 | 41.7 | 44.5 | 54 | 9.5 |

Note: - Level AV = Reading AV + Factor
- Average detector used with a bandwidth of 1 MHz

Table 11: Radiated Emission, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode B (2440MHz)

| Freq. [MHz] | Antenna Orientation | Reading PK [dB μ V] | Factor [dB(1/m)] | Level PK [dB μ V/m] | Limit [dB μ V/m] | Margin PK [dB] |
|-------------|---------------------|-------------------------|------------------|-------------------------|----------------------|----------------|
| 4880 | Horizontal | 7.8 | 36.2 | 44.0 | 74 | 30.0 |
| 7320 | Horizontal | -2.2 | 39.3 | 37.1 | 74 | 36.9 |
| 9760 | Vertical | -8.4 | 40.0 | 31.6 | 74 | 42.4 |
| 12200 | Vertical | -6.0 | 39.4 | 33.4 | 74 | 40.6 |
| 14640 | Vertical | -1.3 | 41.3 | 40.0 | 74 | 34.0 |
| 17080 | Horizontal | 4.1 | 41.7 | 45.8 | 74 | 28.2 |

Note: - Level PK = Reading PK + Factor
- Peak detector used with a bandwidth of 1 MHz

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Table 12: Radiated Emission, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)

| Freq. [MHz] | Antenna Orientation | Reading AV [dB μ V] | Factor [dB(1/m)] | Level AV [dB μ V/m] | Limit [dB μ V/m] | Margin AV [dB] |
|-------------|---------------------|-------------------------|------------------|-------------------------|----------------------|----------------|
| 4960 | Horizontal | -3.3 | 36.2 | 32.9 | 54 | 21.1 |
| 7440 | Vertical | -7.7 | 37.8 | 30.1 | 54 | 23.9 |
| 9920 | Horizontal | -7.4 | 38.5 | 31.1 | 54 | 22.9 |
| 12400 | Vertical | -6.3 | 39.0 | 32.7 | 54 | 21.3 |
| 14880 | Vertical | 0.1 | 39.9 | 40.0 | 54 | 14.0 |
| 17360 | Vertical | -0.8 | 44.6 | 43.8 | 54 | 10.2 |

Note: - Level AV = Reading AV + Factor
- Average detector used with a bandwidth of 1 MHz

Table 13: Radiated Emission, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)

| Freq. [MHz] | Antenna Orientation | Reading PK [dB μ V] | Factor [dB(1/m)] | Level PK [dB μ V/m] | Limit [dB μ V/m] | Margin PK [dB] |
|-------------|---------------------|-------------------------|------------------|-------------------------|----------------------|----------------|
| 4960 | Horizontal | 9.7 | 36.2 | 45.9 | 74 | 28.1 |
| 7440 | Horizontal | -2.3 | 37.8 | 35.5 | 74 | 38.5 |
| 9920 | Horizontal | -6.3 | 38.5 | 32.2 | 74 | 41.8 |
| 12400 | Vertical | -5.1 | 39.0 | 33.9 | 74 | 40.1 |
| 14880 | Vertical | 1.1 | 39.9 | 41.0 | 74 | 33.0 |
| 17360 | Vertical | 0.3 | 44.6 | 44.9 | 74 | 29.1 |

Note: - Level PK = Reading PK + Factor
- Peak detector used with a bandwidth of 1 MHz

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5.3 AC Power Line Conducted Measurements

5.3.1 AC Power Line Conducted Emission of Transmitter

RESULT: PASS

Date of testing: 2011-06-07

Frequency range: 0.15 - 30MHz
Kind of test site: Shielded Room

Requirements:

FCC 15.207

The AC power line conducted emission on any frequency within the band 150kHz to 30MHz shall not exceed the limits specified in FCC 15.207.

Test procedure:

ANSI C63.4-2009

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The EUT was connected to a Line Impedance Stabilization Network (LISN).

The EUT was tested while directly connected to a laptop's USB port. First the laptop was tested without the EUT, so emissions from the EUT can easily be distinguished from the laptop's emissions.

The physical arrangement of the test system and associated cabling was varied to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed with the measuring receiver operating in the CISPR quasi-peak and average detection modes. The analyzer's 6dB bandwidth was set to 9kHz.

Conducted emissions at frequencies not listed in the table are more than 20 dB below the applicable limit.

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Table 14: AC Power Line Conducted Emission, Quasi Peak and Average Data, 0.15 - 30MHz, Phase N (L2) and L (L1)

| Freq. [MHz] | Reading L1 QP [dB μ V] | Reading L1 AV [dB μ V] | Level N(L2) QP [dB μ V] | Level N(L2) AV [dB μ V] | Limit QP [dB μ V] | Limit AV [dB μ V] | Margin QP [dB] | Margin AV [dB] |
|-------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------|-----------------------|----------------|----------------|
| 0.210 | 49.2 | 38.6 | 46.9 | 37.4 | 63.2 | 53.2 | 16.3 | 14.6 |
| 0.274 | 30.6 | 8.5 | 39.0 | 31.1 | 61.1 | 51.1 | 22.1 | 20.0 |
| 0.418 | 29.0 | 2.7 | 30.3 | 23.3 | 57.4 | 47.4 | 27.1 | 24.1 |
| 0.554 | 34.7 | 27.1 | 31.4 | 26.3 | 56.0 | 46.0 | 21.3 | 18.9 |
| 3.322 | 22.7 | 15.3 | 26.8 | 24.2 | 56.0 | 46.0 | 29.2 | 21.8 |
| 5.122 | 24.3 | 24.3 | 13.6 | 26.9 | 60.0 | 50.0 | 35.7 | 23.1 |
| 5.398 | 25.2 | 17.6 | 28.6 | 18.3 | 60.0 | 50.0 | 31.4 | 31.7 |
| 20.414 | 25.7 | 18.4 | 13.9 | 18.3 | 60.0 | 50.0 | 34.3 | 31.6 |

Note:

- Level QP = Reading QP + Factor, Level AV = Reading AV + Factor
- Tested in Mode A (2405MHz), Mode B (2440MHz) and Mode C (2480MHz), worst case values noted.
- Margin is given in the worst case situation (L compared to N).

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