# Electro Magnetic Compatibility Test Report

## Regarding the CE Mark Compliance of the Unintentional Emissions and Immunity of the

## Analog Devices – PicoZed SDR (Software Defined Radio)

## Model number: Z7035/AD9361

## In Accordance with the Information Technology Standards

## EN 55022:2010 for Emissions

## And

## EN 55024:2010 for Immunity

### Report Revision History

| Revision | Date | Summary |
|---|---|---|
| 1.0 | 12 April 2016 | Initial release |

## Description of Equipment Under Test (EUT)

| | | |
|---|---|---|
| Test Item | : | PicoZed SDR – Software Defined Radio |
| Models | : | Z7035 and AD9361 |
| Manufacturer | : | Analog Devices |

## Manufacturer's information

| | | |
|---|---|---|
| Manufacturers Representative | : | Robin Getz – Robin.Getz@Analog.com |
| Company | : | Analog Devices |
| Address | : | One Technology Way<br>Norwood, MA 02062-9106<br>U.S.A. |
| Website | : | Analog Devices |

## Tests Performed at

| | | |
|---|---|---|
| Address | : | EMI Test Lab LLC<br>1822 Skyway Drive Unit J<br>Longmont, Colorado 80504<br>U.S.A |
| Website | : | http://www.emitestlab.com/ |

| | | |
|---|---|---|
| **Test Specifications** | : | EN 55022:2010 and EN 55024:2010 |
| Tests completed | : | 4 April 2016 |
| **Result of Testing** | : | **The EUT is in Compliance with EN 55022:2010 and EN 55024:2010** |
| Senior EMC Engineer | : | Dennis King |
| Report written by | : | Dennis King – EMI Test Lab |
| Test Plan | : | Neil Wilson and Dennis King for Analog Devices |
| Report date | : | 12 April 2016 |

**These test results relate only to the specific unit and configuration, as tested.**
**A periodic production audit to verify continued compliance is recommended.**

## Table of Contents

1. General Test Information……..page 4
   1.1. Applied Standards
   1.2. Detailed description of test configuration, input and output ports
      1.2.1. Description of test configuration and power supply
      1.2.2. Description of input and output ports
      1.2.3. Operating mode(s)

2. Emissions……page 8
   2.1. AC Mains conducted emissions
   2.2. Enclosure radiated emissions
      2.2.1. 30-1,000 MHz
      2.2.2. 1-6 GHz
   2.3. Harmonic current emissions
   2.4. Voltage fluctuations and flicker

3. Immunity……page 27
   3.1. Performance criteria
   3.2. Enclosure tests
      3.2.1. Radio-frequency electromagnetic fields
      3.2.2. Electrostatic discharge
      3.2.3. RF common mode on signal and telecom ports
      3.2.4. Fast transients on signal and telecom ports
   3.3. AC power port tests
      3.3.1. Radio-frequency immunity, common mode
      3.3.2. Surges
      3.3.3. Fast Transients, common mode
      3.3.4. Voltage Dips and Interruptions

4. Modifications During Testing ……page 40

5. Test equipment and Environmental Conditions……page 41

6. Measurement Uncertainty……page 43

7. Test Plan……page 45

8. Conclusion……page 55

# 1 General

## 1.1 Applied Standards

The Analog Devices PicoZed SDR (Software Defined Radio) was evaluated for unintentional emissions using EN 55022:2010 and for immunity using EN 55024:2010.

Since the RF Development Card can be used from 70 MHz to 6 GHz – and is not intended to be an end use product - it's not practical to test the card for all the ETSI Standards to cover the RF portion. Recommendations will be made to the Development Professional to provide adequate measures to insure that the product does not interfere with local emergency radio services such as using the device in a low power mode or using the device in a shielded room.

The device should be tested in the end use application for all applicable RF standards.

EN 55022:2010 is the European Union's version of the international CISPR standard CISPR 22:2008.

EN 55024:2010 is the European Union's version of the international CISPR standard CISPR 24:2010.

## 1.2 Detailed description of the test configuration, input and output ports

The PicoZed SDR Z7035/AD9361 SOM (AES-Z7P7-SDR2-G) was mounted on the PicoZed SDR FMC Carrier Card (AES-PZSDRCC-FMC-G) and was operated in a mode where the software that is supplied with the unit is communicating to the board but the RF transmitter was off.

This RF Development board is intended for use by Engineers as a development tool in an Engineering lab environment and is not intended as an end use product.

If the product is used as an end use product the user must test for all applicable RF standards and laws since this report only covers the unintentional portion of the CE mark testing.

**Product Details**

Avnet's PicoZed™ Software Defined Radio (SDR) – the PicoZed™ SDR Z7035/AD9361 – combines the Analog Devices AD9361 integrated RF Agile Transceiver™ with the Xilinx Z7035 Zynq®-7000 All Programmable SoC. In a handheld form-factor PicoZed SDR provides frequency-agile wideband 2x2 receive and transmit paths in the 70 MHz to 6.0 GHz range, making it ideal for a broad range of fixed and mobile SDR applications. Integrating the critical RF signal path and high-speed programmable logic in a fully-verified system-on-module (SOM), PicoZed SDR forms the RF-to-baseband signal processing core of a wireless communications system, allowing you to focus on the differentiating features of your product. With available carrier cards for fast prototype and supported by robust simulation and code generation tools that integrate seamlessly with Xilinx Vivado® Design Suite, PicoZed SDR enables dramatic reduction in design cycles of your software-defined radio products

**Test Configuration Definition:**

The RF development board was mounted to the FMC carrier card. The EUT was connected to a notebook computer, through an Ethernet cable and a usb cable, that had preloaded test software. The radio was off during emissions testing for reasons described in section 1.1 of this report. The radio was on during immunity and conducted emissions testing.

See the test plan section for details.

**Test Software:**

Test software was pre-loaded on the supplied notebook computer, from Analog Devices. See the test plan section for details.

The RF circuit board was functional but the TX portion was turned off for emissions and left on during immunity testing.

### 1.2.1 Description of test configuration and power supply

| | | |
|---|---|---|
| **EUT** | : | PicoZed SRD |
| Manufacturer | : | Analog Devices |
| Model | : | AES-PZSDR-Z7035-AD9361-G |
| Serial Number | : | SIG 1420760 RFSOM Rev B |
| **Carrier Card** | | |
| Model | : | SOM Breakout 039931 Rev A |
| Serial Number | : | 20 |
| Test Voltage | : | 230 VAC 50 Hz |
| **Power Supply** | : | Super Power Supply |
| Model | : | SPS-WA01-050200 |
| Input | : | 100-240 VAC 50/60 Hz |
| Out | : | 5 VDC 2A |
| Conductors | : | 2, Line and Neutral |

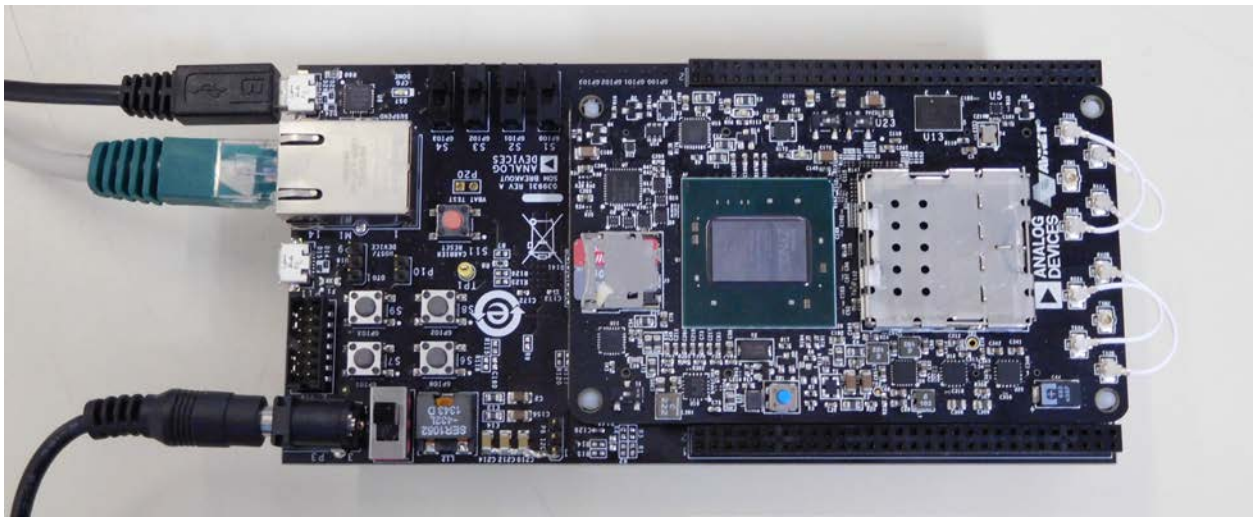
### 1.2.2 Description of tested input and output ports

| Number of cable type | Type of Cable | From | To | Shielded? | Remarks - length |
|---|---|---|---|---|---|
| 1 | USB | EUT | Acer Notebook | Yes | 3 ft. ferrite at EUT end |
| 1 | Ethernet | EUT | Acer Notebook | No | 6 ft. |

### 1.2.3 Operation mode

For radiated emissions the EUT was tested in a power up mode and the RF transmitting portions were disabled for reasons explained in section 1.1 of this report.

For immunity testing the RF portions were left on, referred to as “active mode” in the test plan, and were monitored to see that the software and the TX and RX portions of the device were continuing to function properly.



**The PicoZed SDR mounted to the Carrier Card**

## 2 Emissions

The EUT has been tested to determine conformity with the relevant emissions parts of the EN 55022:2010 standard.

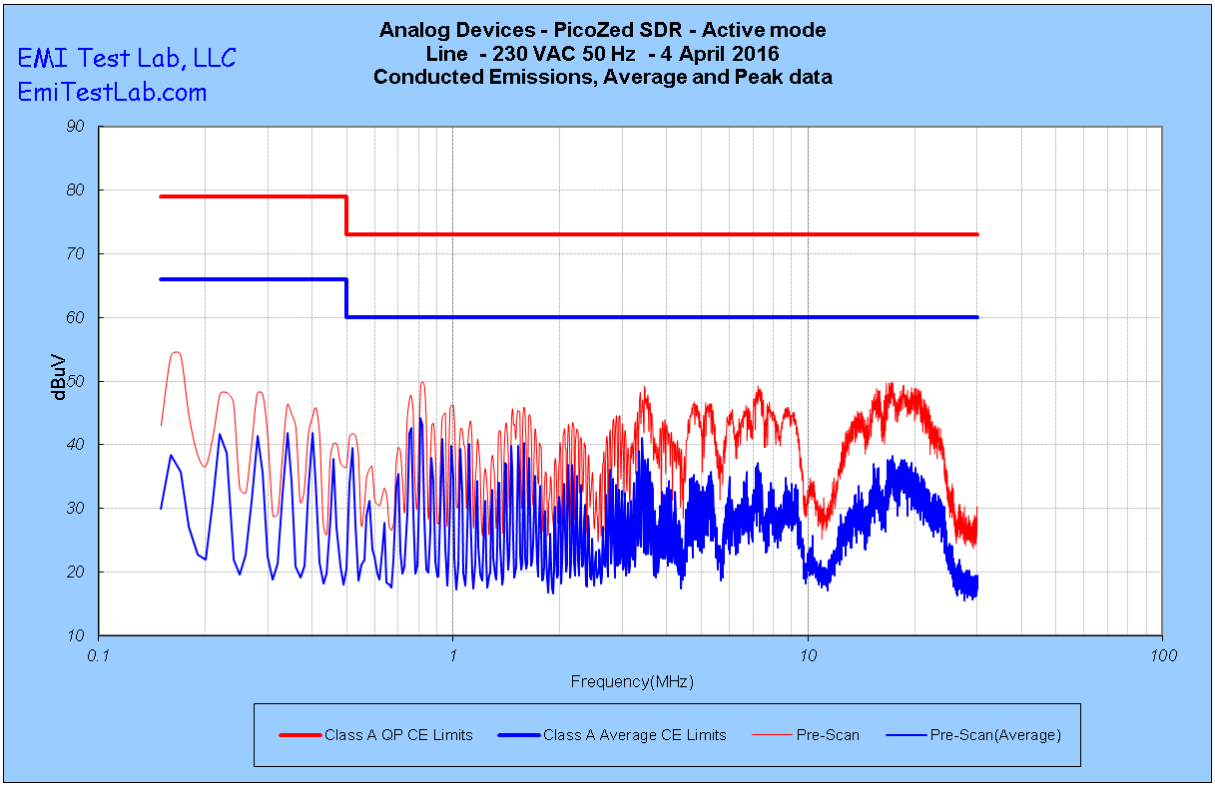
AC Power line conducted and radiated field strength measurements concerning the emission of radiated and conducted electromagnetic disturbances were made.

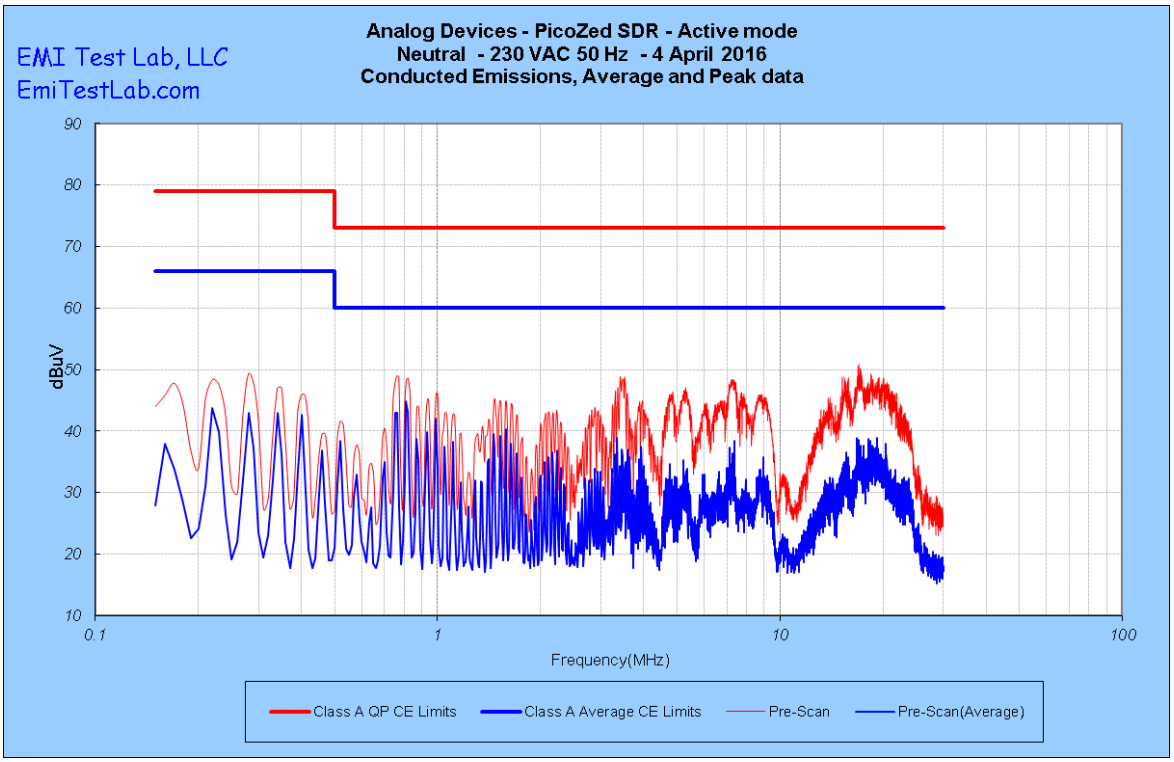
## 2.1 AC Mains Power Input Ports

The disturbance voltage emissions levels at the AC mains power port of the EUT were measured in conformity with and according to the criteria as stated below.

| | | |
|---|---|---|
| Basic standard | : | CISPR 22:2008 |
| Test setup | : | EN 55022:2010 |
| Frequency range 1 | : | 0.15 – 0.5 MHz |
| Limit | : | 79.0 dBuV quasi peak, 66 dBuV average |
| Frequency range 2 | : | 0.5 – 30 MHz |
| Limit | : | 73 dBuV quasi peak, 60 dBuV average |

| | |
|---|---|
| Results of the measurements concerning the emissions of voltage levels at the AC mains input port of the EUT. | **PASS Class A** |
| Name of Test Engineer: | Dennis King |
| Signature: | |
| Date: | 4 April 2016 |
| Remarks: test voltage / frequency - 230VAC 50Hz.<br>The EUT was in Active mode during conducted emissions. Worst case power draw for conducted emissions. | |


EMI Test Lab, LLC
EmiTestLab.com
Analog Devices - PicoZed SDR - Active mode
Line - 230 VAC 50 Hz - 4 April 2016
Conducted Emissions, Average and Peak data
dBuV
90
80
70
60
50
40
30
20
10
0.1
1
10
100
Frequency(MHz)
Class A QP CE Limits
Class A Average CE Limits
Pre-Scan
Pre-Scan(Average)


EMI Test Lab, LLC
EmiTestLab.com
Analog Devices - PicoZed SDR - Active mode
Neutral - 230 VAC 50 Hz - 4 April 2016
Conducted Emissions, Average and Peak data
dBuV
90
80
70
60
50
40
30
20
10
0.1
1
10
100
Frequency(MHz)
Class A QP CE Limits
Class A Average CE Limits
Pre-Scan
Pre-Scan(Average)

**Conducted emissions test setup**

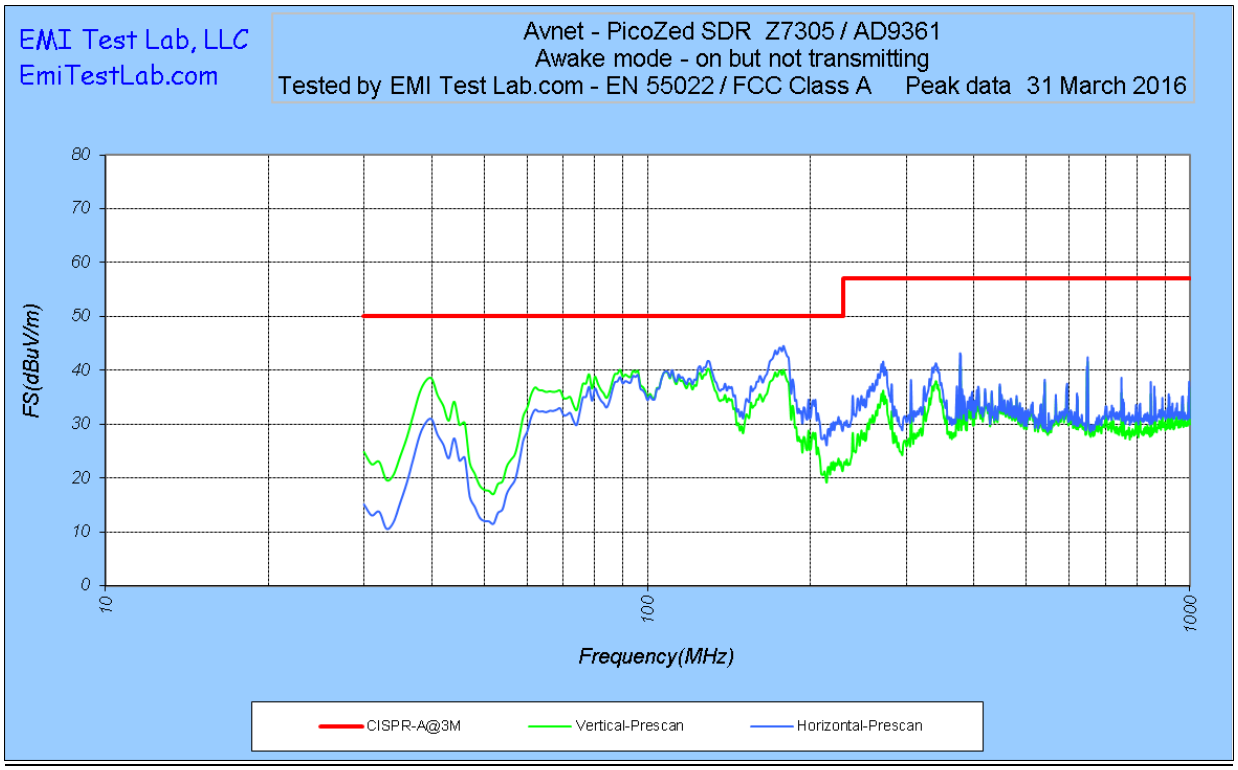
## 2.2 Enclosure

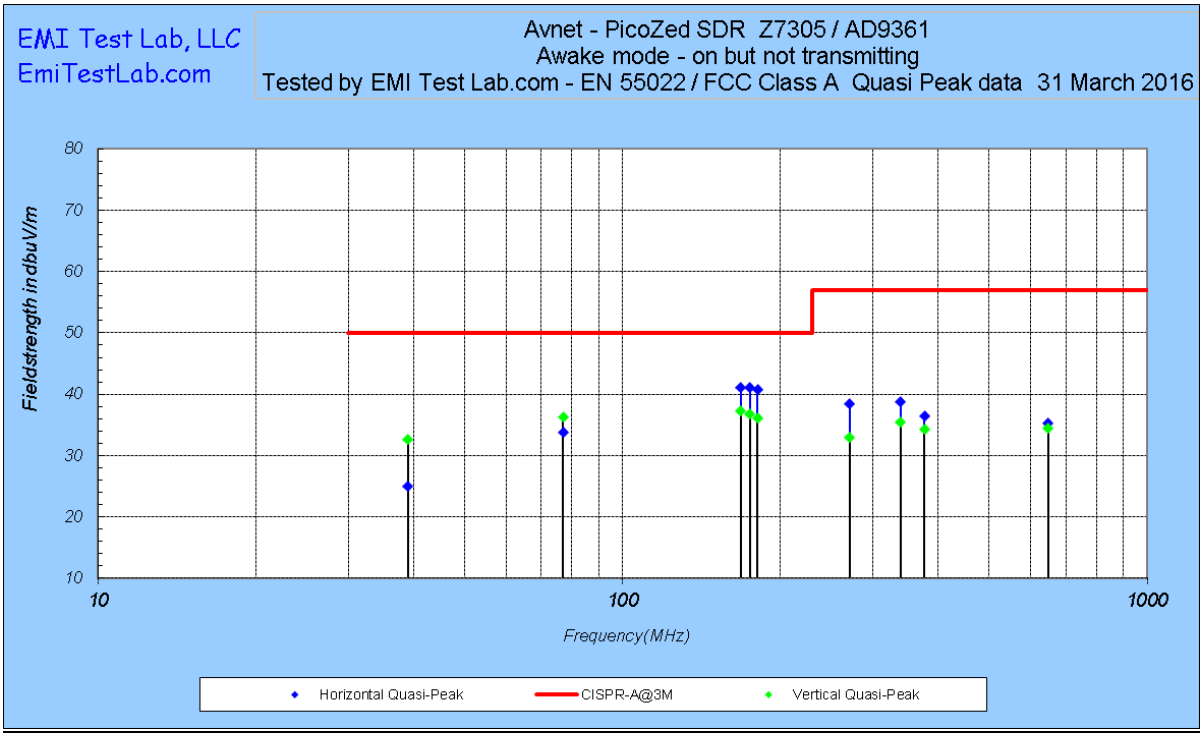
### 2.2.1 30-1,000 MHz

The radiated field strength levels (electric component) have been measured in conformity with and according to the criteria as stated below.

| | | |
|---|---|---|
| Basic standard | : | CISPR 22:2008 |
| Test setup | : | EN 55022:2010 |
| Limit distance | : | 3 meters |
| Frequency range 1 | : | 30 -230 MHz |
| Limits | : | 50 dBuV/m |
| Frequency range 2 | : | 230 – 1,000 MHz |
| Limits | : | 57 dBuV/m |

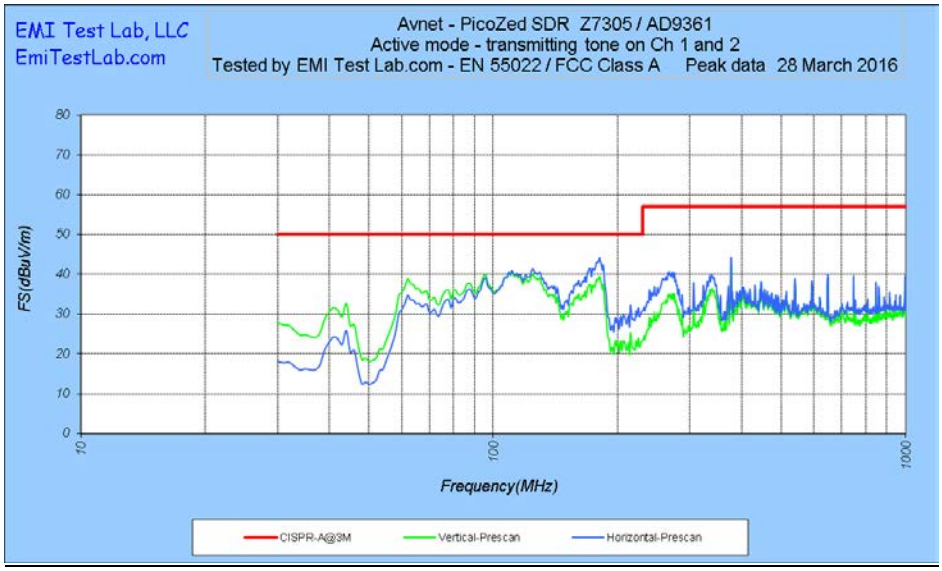
| | |
|---|---|
| Results of the measurements concerning radiated electromagnetic fields (electric component) emitted by the EUT, enclosure, as a tested system | **PASS Class A** |
| Name of Test Engineer:<br>Signature:<br>Date: | Dennis King<br> <br>31 March 2016 |
| Remarks:<br>Running “awake mode” software. The radio portion is on but the TX portion of the EUT was turned off, see section 1.1. | |


EMI Test Lab, LLC
EmiTestLab.com
Avnet - PicoZed SDR Z7305 / AD9361
Awake mode - on but not transmitting
Tested by EMI Test Lab.com - EN 55022 / FCC Class A Peak data 31 March 2016
FS(dBuV/m)
80
70
60
50
40
30
20
10
0
10
100
1000
Frequency(MHz)
CISPR-A@3M
Vertical-Prescan
Horizontal-Prescan

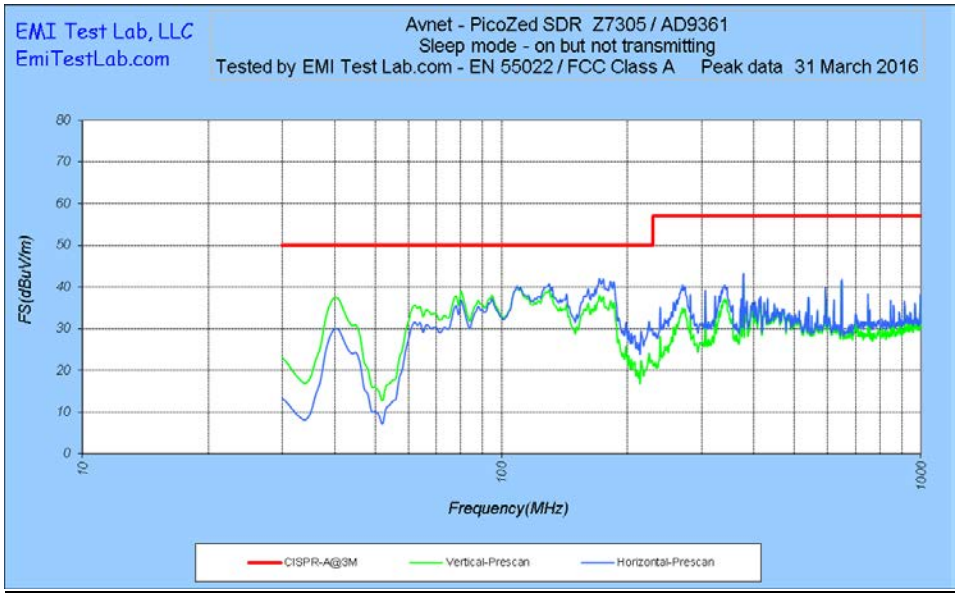



| Frequency(MHz) | Horizontal Quasi-Peak dBuV/m | Vertical Quasi-Peak dBuV/m | Delta from the Limit Horiz | Delta from Limit Vertical |
|---|---|---|---|---|
| 39.99 | 24.93 | 32.68 | **-25.07** | **-17.32** |
| 77.95 | 33.80 | 36.25 | **-16.20** | **-13.75** |
| 168.86 | 41.05 | 37.24 | **-8.95** | **-12.76** |
| 175.85 | 41.05 | 36.81 | **-8.95** | **-13.19** |
| 181.84 | 40.84 | 36.21 | **-9.16** | **-13.79** |
| 271.75 | 38.47 | 33.04 | **-18.53** | **-23.96** |
| 339.68 | 38.87 | 35.52 | **-18.13** | **-21.48** |
| 376.64 | 36.50 | 34.28 | **-20.50** | **-22.72** |
| 647.36 | 35.28 | 34.39 | **-21.72** | **-22.61** |

**Active mode – for information only**




**Sleep mode – for information only**

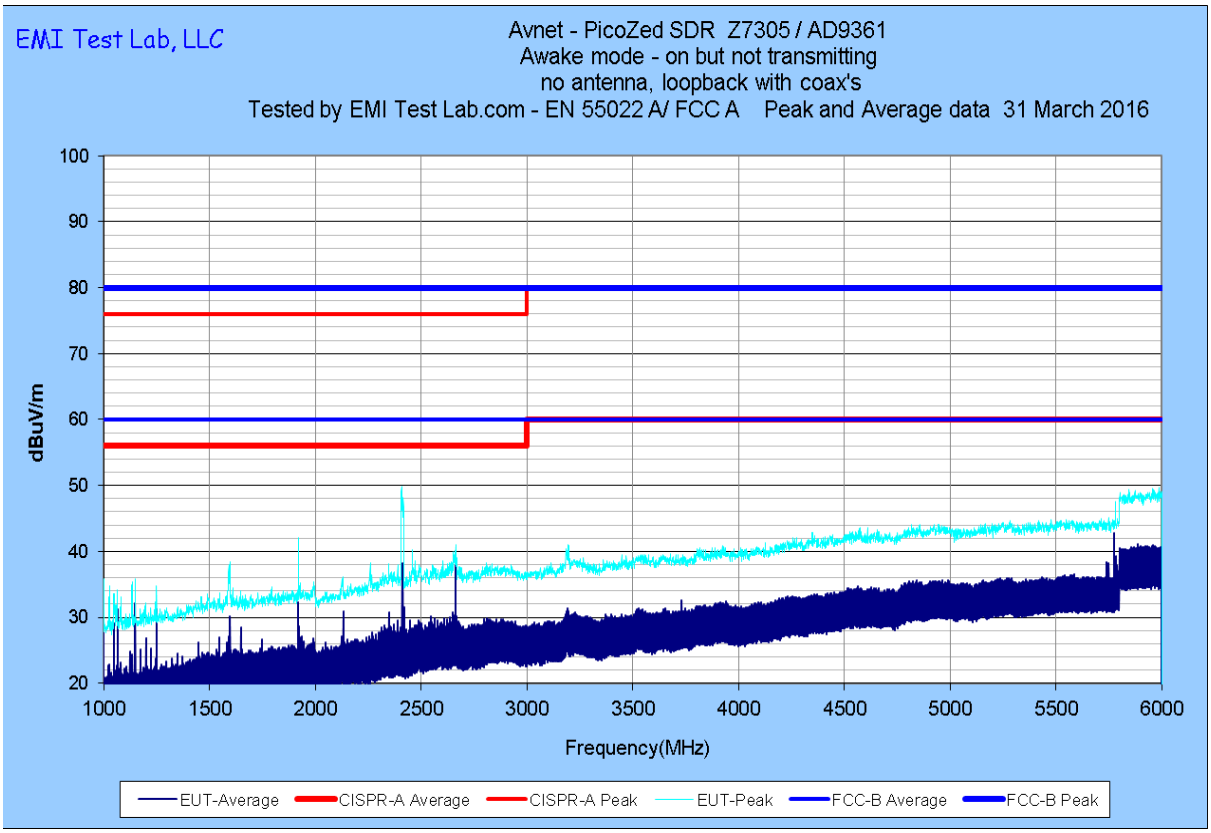


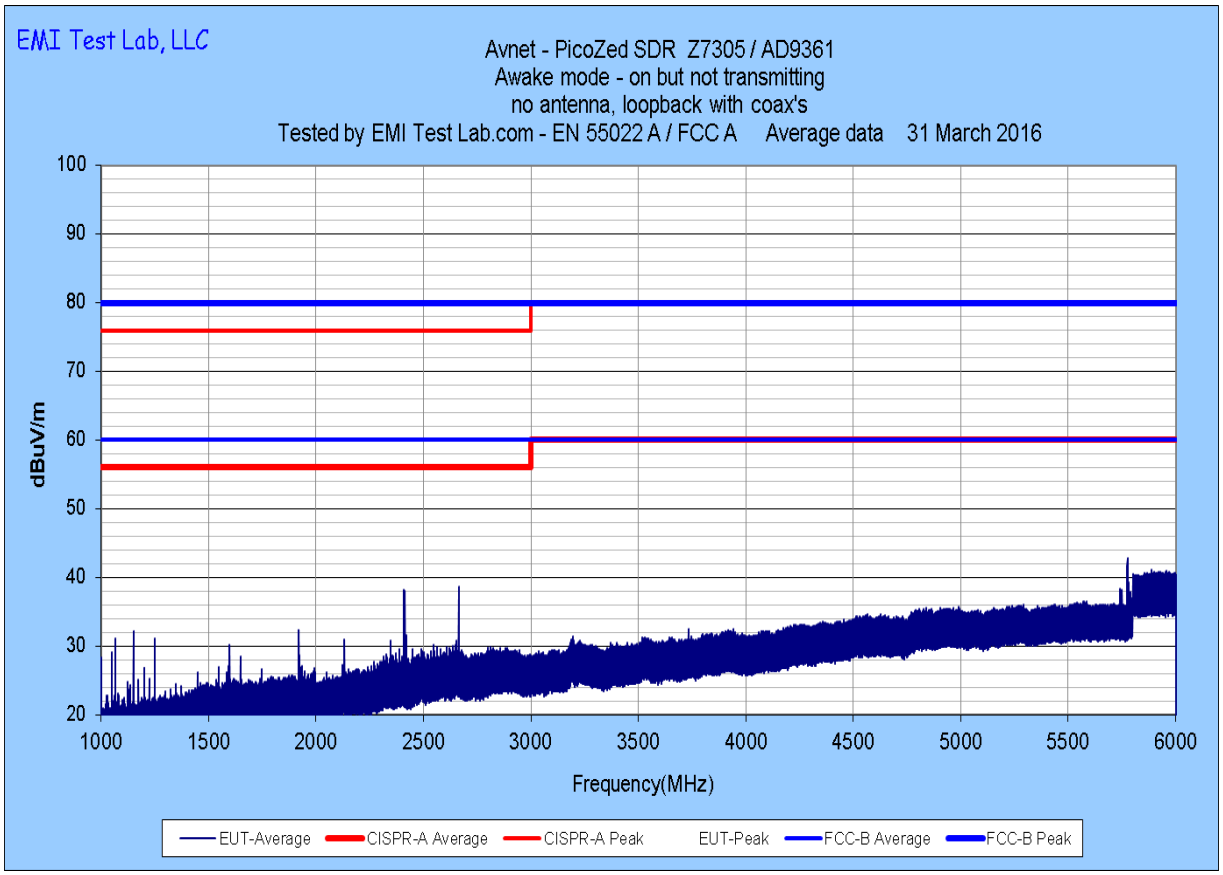
### 2.2.2 1-6 GHz

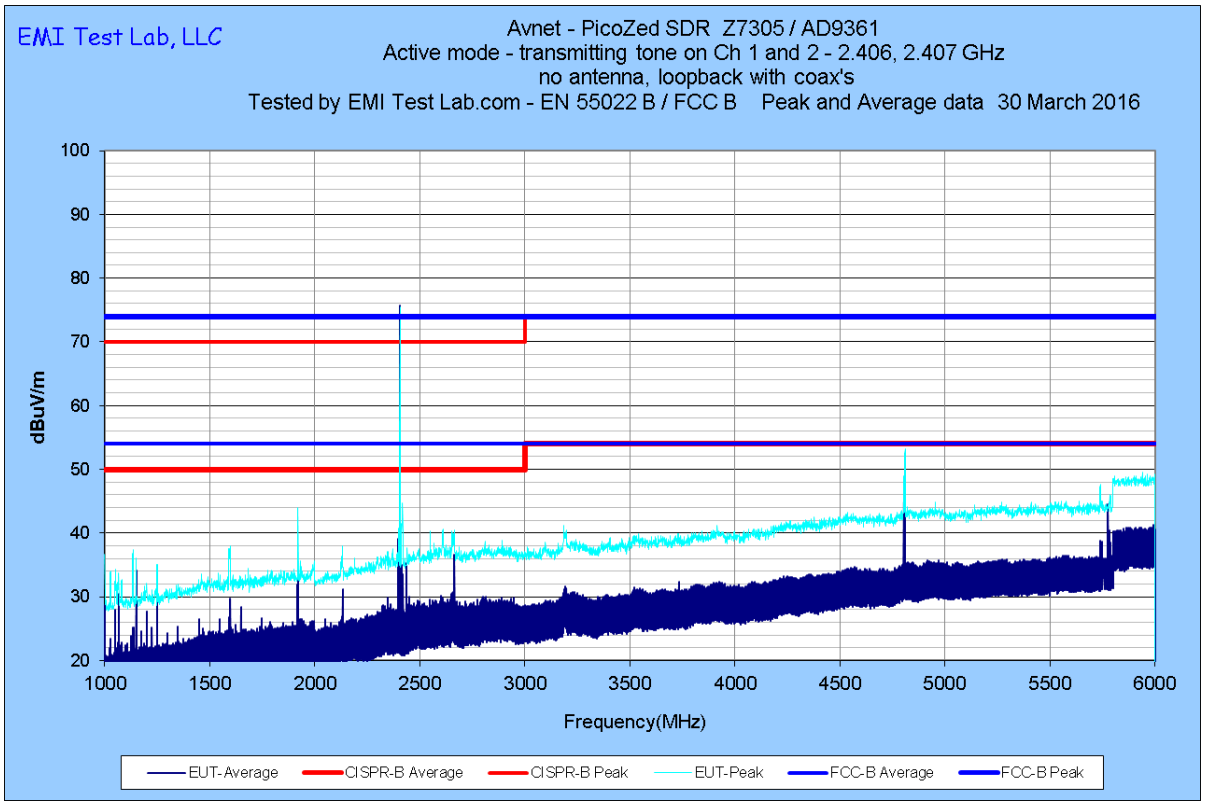
The radiated field strength levels (electric component) have been measured in conformity with and according to the criteria as stated below.

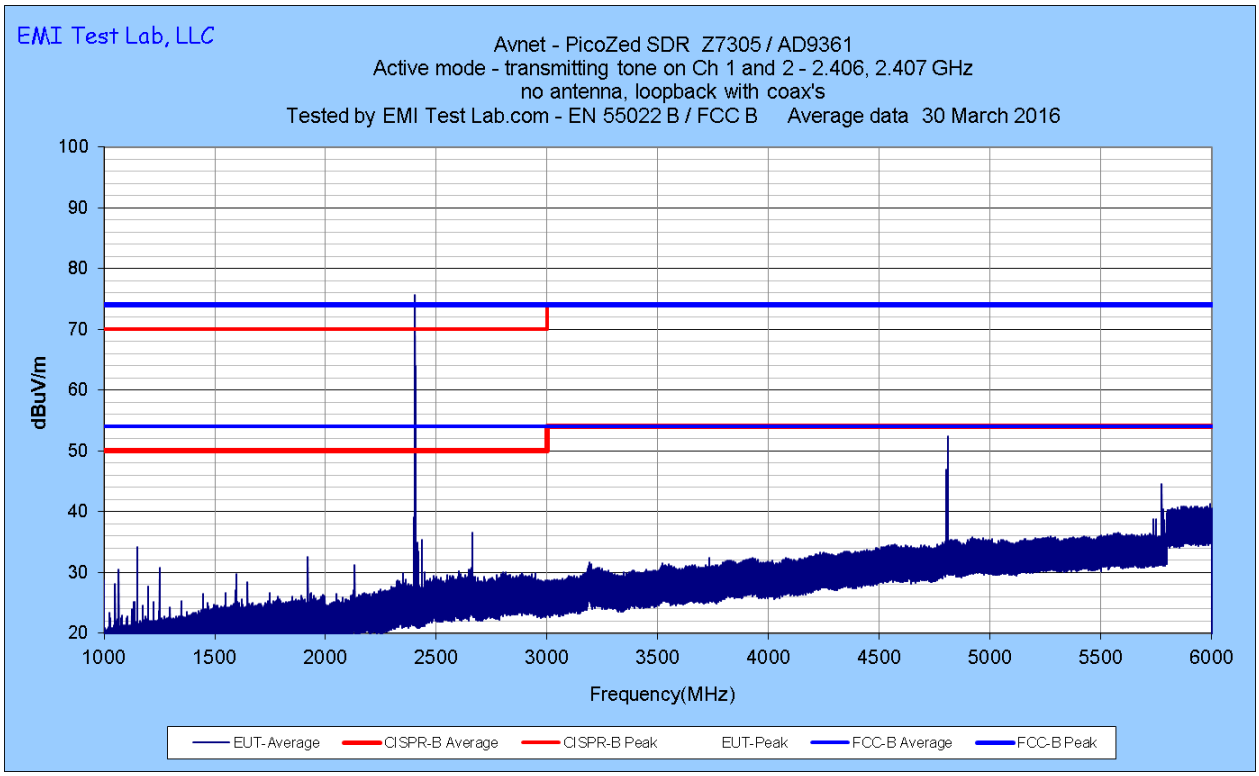
| | | |
|---|---|---|
| Basic standard | : | CISPR 22:2008 |
| Test setup | : | EN 55022:2010 |
| Limit distance | : | 3 meters |
| Frequency range 1 | : | 1-3 GHz |
| Limits | : | Average 56 dBuV/m, Peak 76 dBuV/m |
| Frequency range 2 | : | 3-6 GHz |
| Limits | : | Average 60 dBuV/m, Peak 80 dBuV/m |

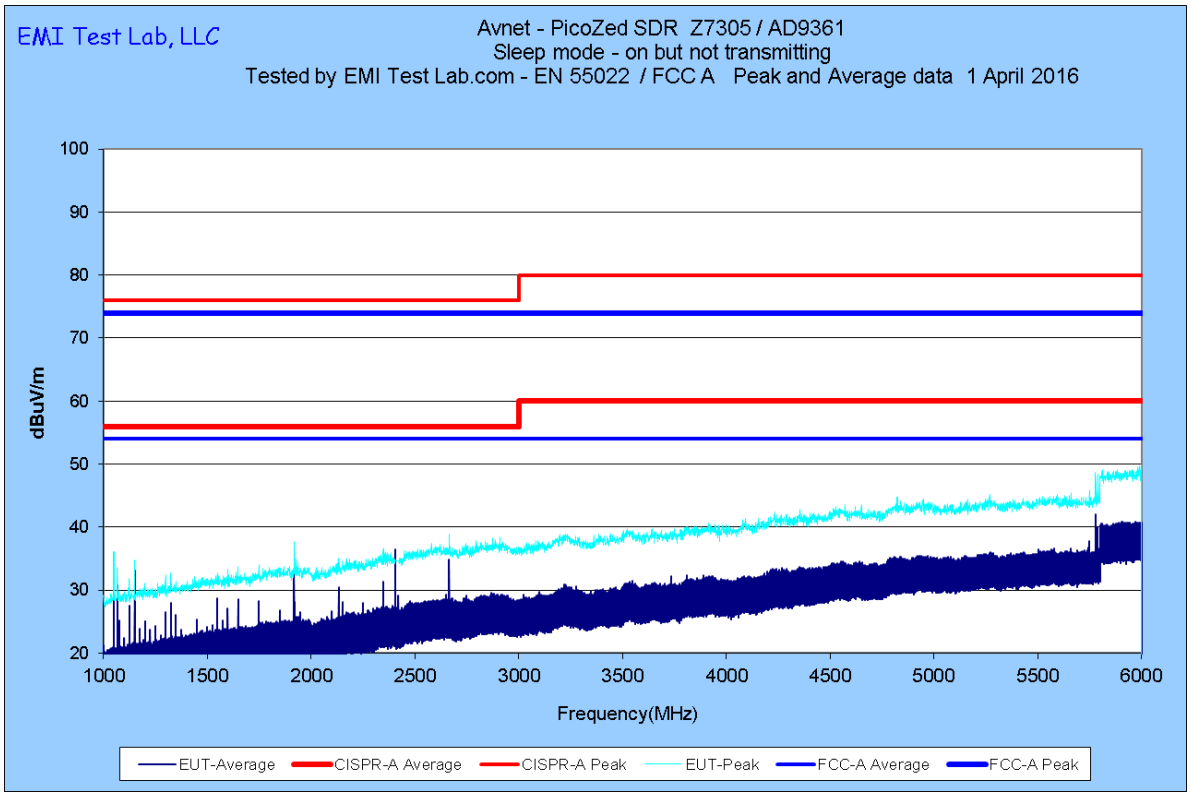
| | |
|---|---|
| Results of the measurements concerning radiated electromagnetic fields (electric component) emitted by the EUT, enclosure, as a tested system | **PASS Class A** |
| Name of Test Engineer:<br>Signature:<br>Date: | Dennis King<br> <br>26 August 2012 |
| Remarks: The unit is tested in “Awake “ mode. The RF portion is on but the TX portion of the EUT was turned off, see section 1.1. The Active and Sleep mode data is inserted for information only. | |

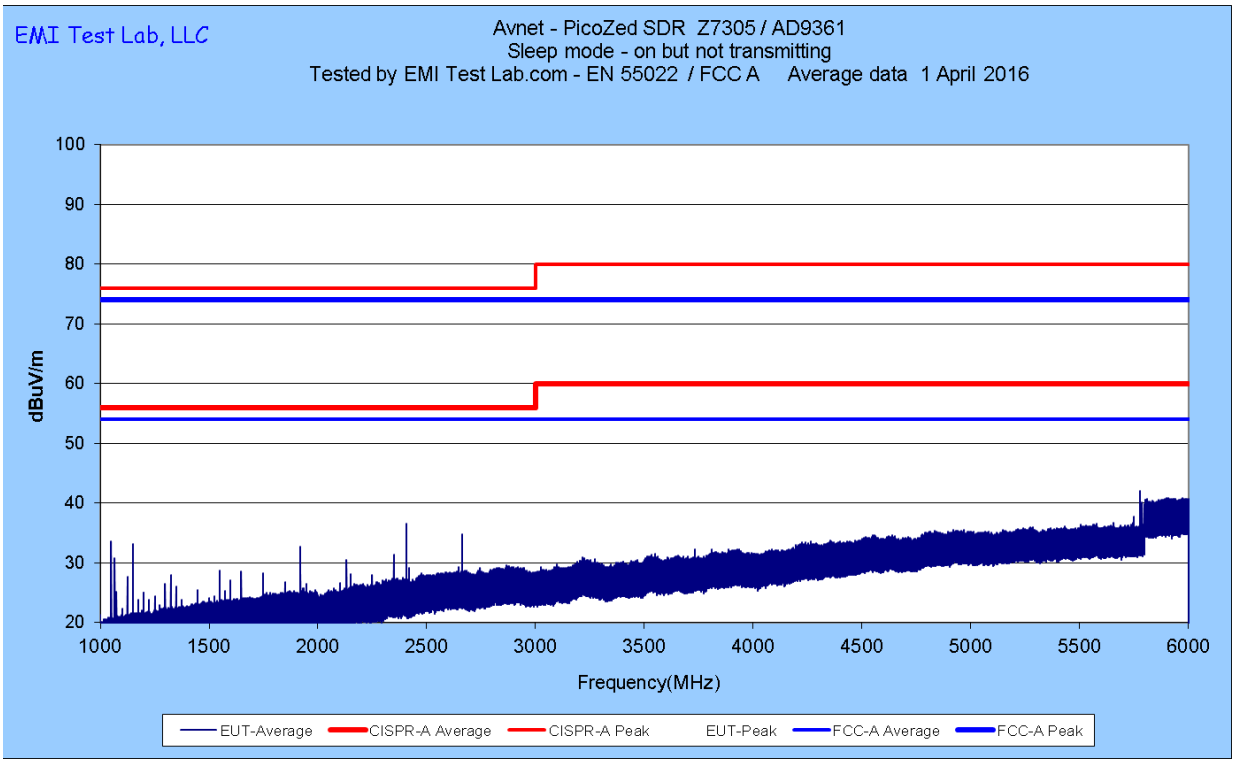

EMI Test Lab, LLC
Avnet - PicoZed SDR Z7305 / AD9361
Awake mode - on but not transmitting
no antenna, loopback with coax's
Tested by EMI Test Lab.com - EN 55022 A/ FCC A Peak and Average data 31 March 2016
dBuV/m
100
90
80
70
60
50
40
30
20
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency(MHz)
EUT-Average
CISPR-A Average
CISPR-A Peak
EUT-Peak
FCC-B Average
FCC-B Peak


EMI Test Lab, LLC
Avnet - PicoZed SDR Z7305 / AD9361
Awake mode - on but not transmitting
no antenna, loopback with coax's
Tested by EMI Test Lab.com - EN 55022 A / FCC A Average data 31 March 2016
dBuV/m
100
90
80
70
60
50
40
30
20
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency(MHz)
EUT-Average
CISPR-A Average
CISPR-A Peak
EUT-Peak
FCC-B Average
FCC-B Peak


EMI Test Lab, LLC
Avnet - PicoZed SDR Z7305 / AD9361
Active mode - transmitting tone on Ch 1 and 2 - 2.406, 2.407 GHz
no antenna, loopback with coax's
Tested by EMI Test Lab.com - EN 55022 B / FCC B Peak and Average data 30 March 2016
dBuV/m
100
90
80
70
60
50
40
30
20
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency(MHz)
EUT-Average
CISPR-B Average
CISPR-B Peak
EUT-Peak
FCC-B Average
FCC-B Peak


EMI Test Lab, LLC
Avnet - PicoZed SDR Z7305 / AD9361
Active mode - transmitting tone on Ch 1 and 2 - 2.406, 2.407 GHz
no antenna, loopback with coax's
Tested by EMI Test Lab.com - EN 55022 B / FCC B Average data 30 March 2016
dBuV/m
100
90
80
70
60
50
40
30
20
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency(MHz)
EUT-Average
CISPR-B Average
CISPR-B Peak
EUT-Peak
FCC-B Average
FCC-B Peak


EMI Test Lab, LLC
Avnet - PicoZed SDR Z7305 / AD9361
Sleep mode - on but not transmitting
Tested by EMI Test Lab.com - EN 55022 / FCC A Peak and Average data 1 April 2016
dBuV/m
100
90
80
70
60
50
40
30
20
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency(MHz)
EUT-Average
CISPR-A Average
CISPR-A Peak
EUT-Peak
FCC-A Average
FCC-A Peak


EMI Test Lab, LLC
Avnet - PicoZed SDR Z7305 / AD9361
Sleep mode - on but not transmitting
Tested by EMI Test Lab.com - EN 55022 / FCC A Average data 1 April 2016
dBuV/m
100
90
80
70
60
50
40
30
20
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency(MHz)
EUT-Average
CISPR-A Average
CISPR-A Peak
EUT-Peak
FCC-A Average
FCC-A Peak

## Radiated Emissions test setup

## 2.3 Harmonic current emissions

The emissions of harmonic currents at the AC mains connection terminals of the EUT were measured in conformance with and according to the criteria as stated below.

Basic standard : EN 61000-3-2
Test setup : EN 61000-3-2
Frequency range : 100 Hz – 2000 Hz

| | |
|---|---|
| Results of the measurements concerning the emission of harmonic currents at the AC mains connection terminals of the EUT | **Not applicable** |
| Name of Test Engineer: | Dennis King |
| Signature: | |
| Date: | 4 April 2016 |
| Remarks:<br>No requirements below 75 watts. | |

### 2.4 Voltage fluctuations and flicker

Voltage fluctuations and flicker at the AC mains connection terminals of the EUT were measured in conformance with and according to the criteria as stated below.

Basic standard : EN 61000-3-3
Test setup : EN 61000-3-3

| | |
|---|---|
| Results of the measurements concerning voltage fluctuations and flicker at the AC mains connection terminals of the EUT | **PASS per Super Power Supply testing** |
| Name of Test Engineer:<br>Signature:<br>Date: | Dennis King<br> <br>4 April 2016 |
| Remarks:<br>The power supply manufacturer has completed and passed this testing per their CE mark Declaration of Conformity. | |

## 3 Immunity

The EUT has been tested in conformity with parts of the standard EN 55024:2010 (immunity) concerning susceptibility and transient, conducted and radiated disturbances including electrostatic discharges.

### 3.1 Performance criteria

The general principles (performance criteria) for the evaluation of the immunity test results are given below. The details are in EN 55024:2010

**Performance Criterion A**: The apparatus shall continue to operate as intended during the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of performance) specified by the manufacturer, when the apparatus is used as intended.

**Performance Criterion B:** The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level (or permissible loss of function) specified by the manufacturer, when the apparatus is used as intended. During the test, degradation of performance is allowed, however, no change of actual operating state or stored data is allowed.

**Performance Criterion C:** Temporary loss of function is allowed, provided the function is self-recoverable or can be restored by the operation of the controls, or by any operation specified in the instructions for use.

## 3.2 Enclosure Port

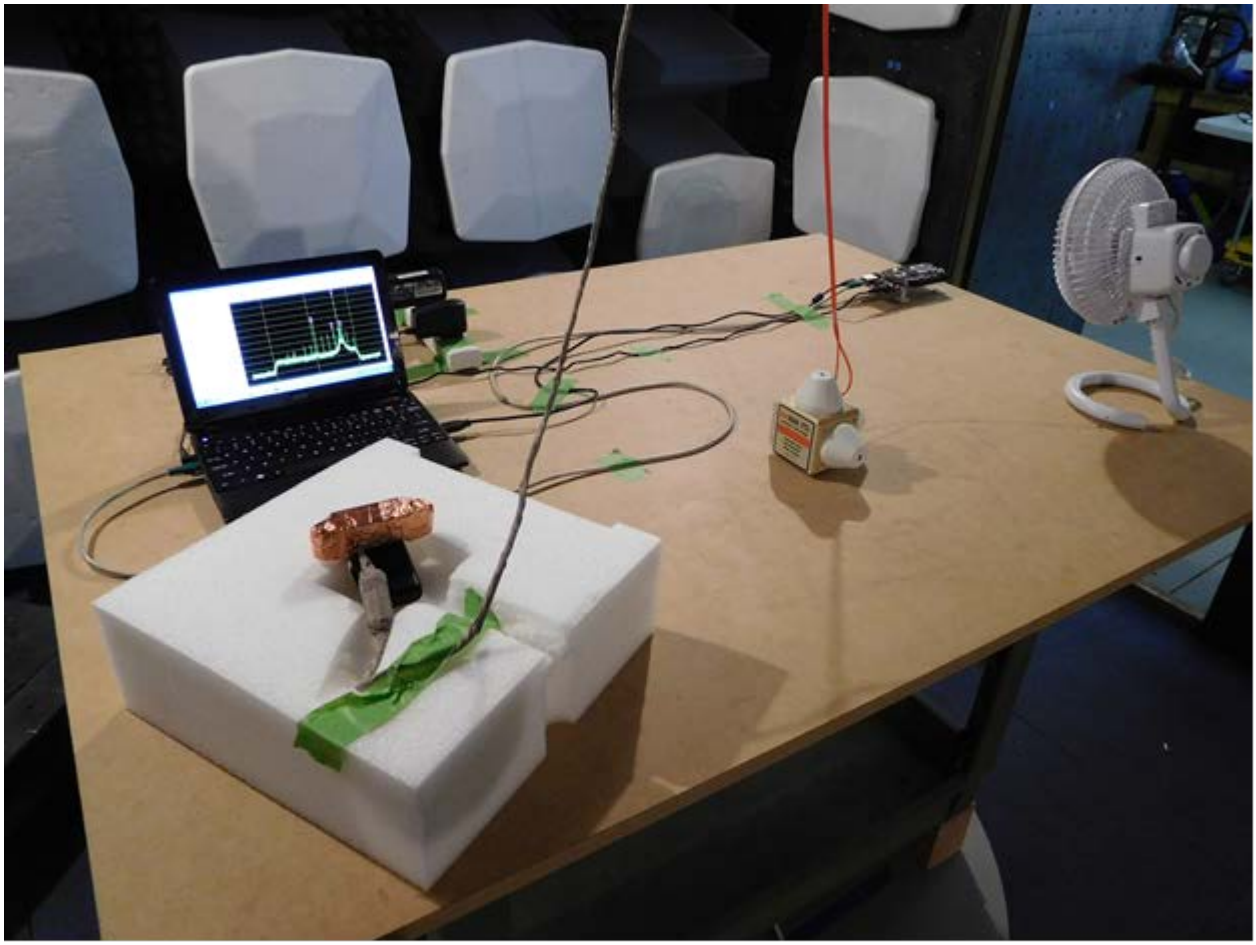
### 3.2.1 Radio-frequency electromagnetic field. Amplitude modulated.

The susceptibility of the EUT to radio-frequency electromagnetic fields has been tested in conformity with and according to the criteria as stated below.

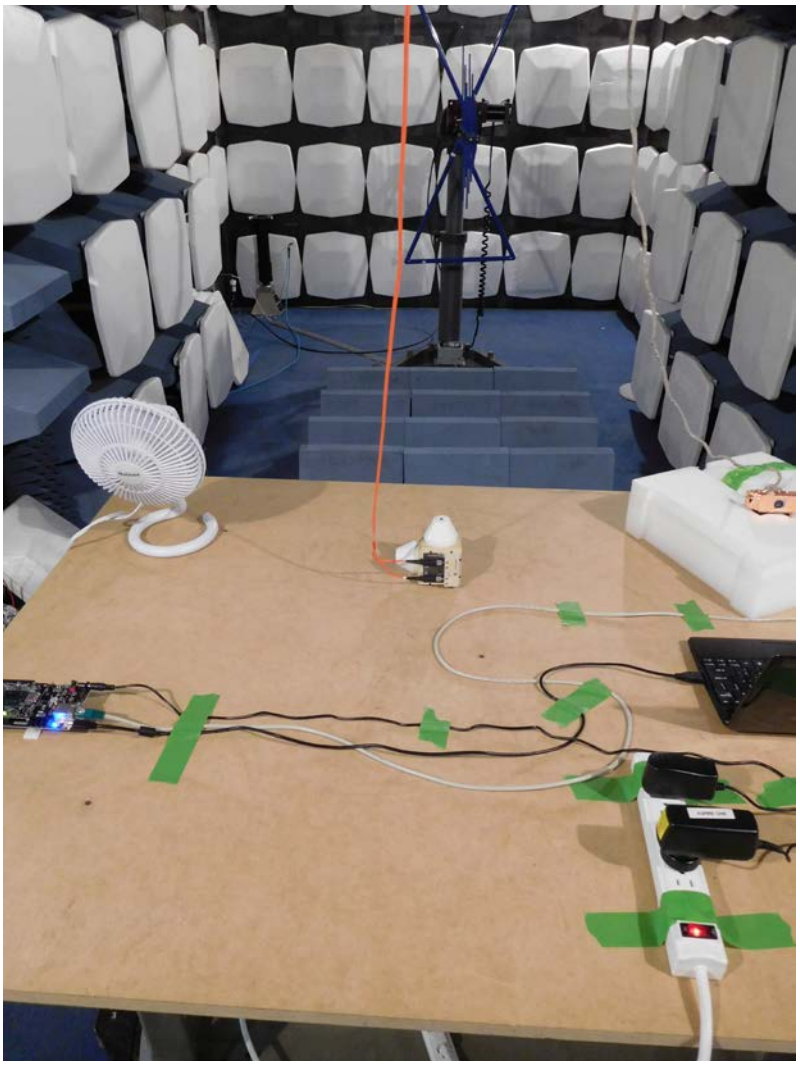
| | | |
|---|---|---|
| Basic standard | : | EN55024:2010 |
| Test setup | : | EN61000-4-3 |
| Frequency range | : | 80 MHz to 1000 MHz |
| Field strength level | : | 3 V/m (selected w/o modulation, applied w/mod.) |
| Modulation | : | 1 kHz AM modulation, 80% depth |
| Performance criteria | : | Criteria A |

.

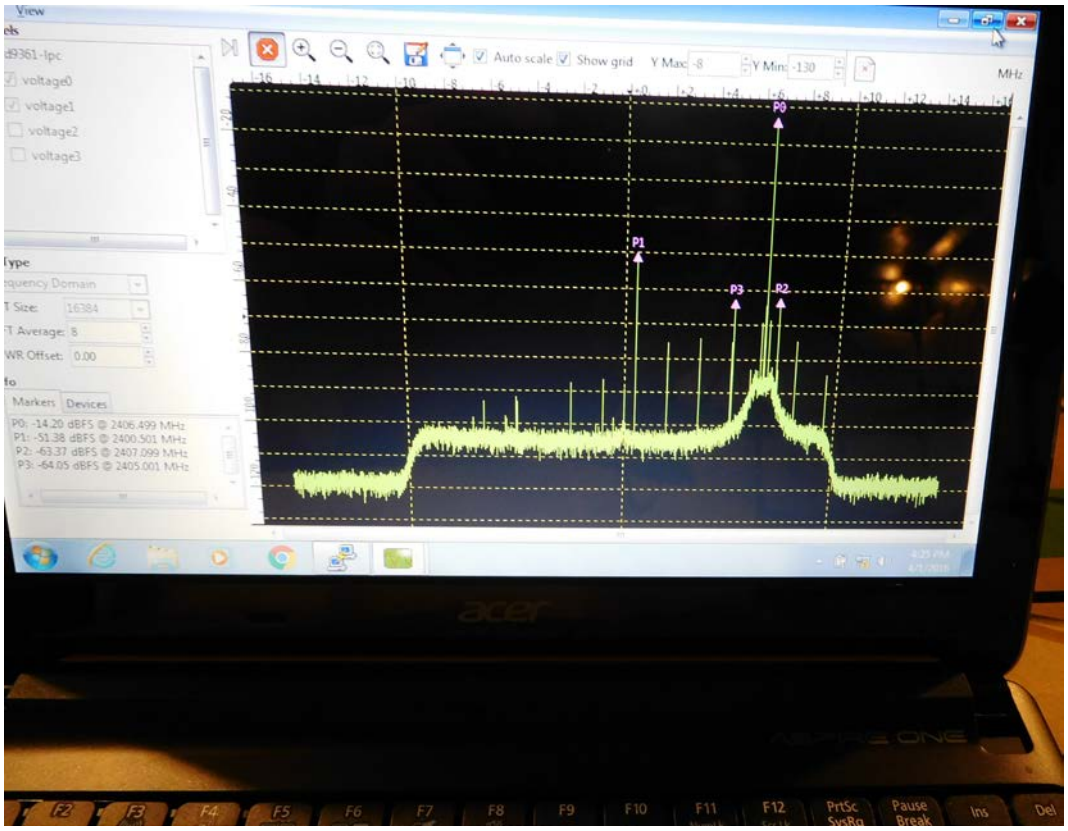
| | |
|---|---|
| Results of the measurements concerning the susceptibility of the EUT to radio-frequency electromagnetic fields | **PASS Criteria A** |
| Name of Test Engineer:<br>Signature:<br>Date: | Dennis King<br> <br>1 April 2016 |
| Remarks: The unit continued to operate as intended during the testing, passing criteria A. | |



**Radiated immunity test setup – 80-1,000 MHz**
**All four sides, Horizontal and Vertical polarizations were checked**
**The unit passes 3V/m**



**Radiated immunity test setup – 80-1,000 MHz**
**All four sides, Horizontal and Vertical polarizations were checked**
**The unit passes 3V/m**




**Screen shot showing the software used during the immunity testing**

### 3.2.2 Electrostatic discharge

The susceptibility of the EUT to electrostatic discharge was not tested. See notes below.

| | | |
|---|---|---|
| Basic standard | : | EN 55024:2010 |
| Test setup | : | EN 61000-4-2 |
| Test levels | : | +- 4kV and +- 8 kV air discharge |
| | | +- 2kV and +- 4 kV contact discharge |
| Performance criteria | : | B |

| | |
|---|---|
| Results of the test concerning the susceptibility of the EUT to electrostatic discharges (enclosure port) | **Not Applicable** |
| Name of Test Engineer: | Dennis King |
| Signature: | |
| Date: | 11 April 2016 |
| Remarks:<br>Due to the open nature of the circuit board, ESD is a potentially destructive test. Notes are included in the User's Manual to take ESD precautions when handling the Circuit Board. | |

## Signal ports including telecommunication ports

### 3.2.3 Radio-frequency (common mode). Amplitude modulated

The susceptibility of the EUT to radio-frequency (common mode, amplitude modulated) signals to be tested in conformity with and according to the criteria as stated below

| | | |
|---|---|---|
| Basic Standard | : | EN 55024:2010 |
| Test setup | : | EN 61000-4-6 |
| Frequency range | : | 0.15 – 80 MHz |
| Test level | : | 3 Vrms |
| Modulation | : | 1 kHz AM to a depth of 80% |
| Source impedance | : | 150 Ohms |
| Performance criteria | : | Criteria A |

***Note: Conducted only on ports interfacing with cables whose total length, according to the manufacturer's functional specification, may exceed 3 meters.***

| | |
|---|---|
| Results of the test concerning the susceptibility of the EUT to radio-frequency signals (common mode, AM modulated applied to signal and telecom ports) | **Not Applicable** |
| Name of Test Engineer:<br>Signature:<br>Date: | Dennis King<br> <br>11 April 2016 |
| Remarks:<br>There are no interconnecting cables on the unit that exceed 3 meters. See the test plan. | |

### 3.2.4 Fast Transients

The susceptibility of the EUT to fast transients has been tested in conformity with and according to the criteria as stated below.

| | | |
|---|---|---|
| Basic standard | : | EN 55024:2010 |
| Test setup | : | EN 61000-4-4 |
| Test level | : | +- 1 KV |
| Tr/Th | : | 5/50 nSec |
| Repetition frequency | : | 5 kHz |
| Performance criteria | : | Criteria B |

***Note: Conducted only on ports interfacing with cables whose total length, according to the manufacturer's functional specification, may exceed 3 meters.***

| | |
|---|---|
| Results of the test concerning the susceptibility of the EUT to fast transients | **Not Applicable** |
| Name of Test Engineer:<br>Signature:<br>Date: | Dennis King<br> <br>11 April 2016 |
| Remarks:<br>There are no interconnecting cables on the unit that exceed 3 meters. See the test plan. | |

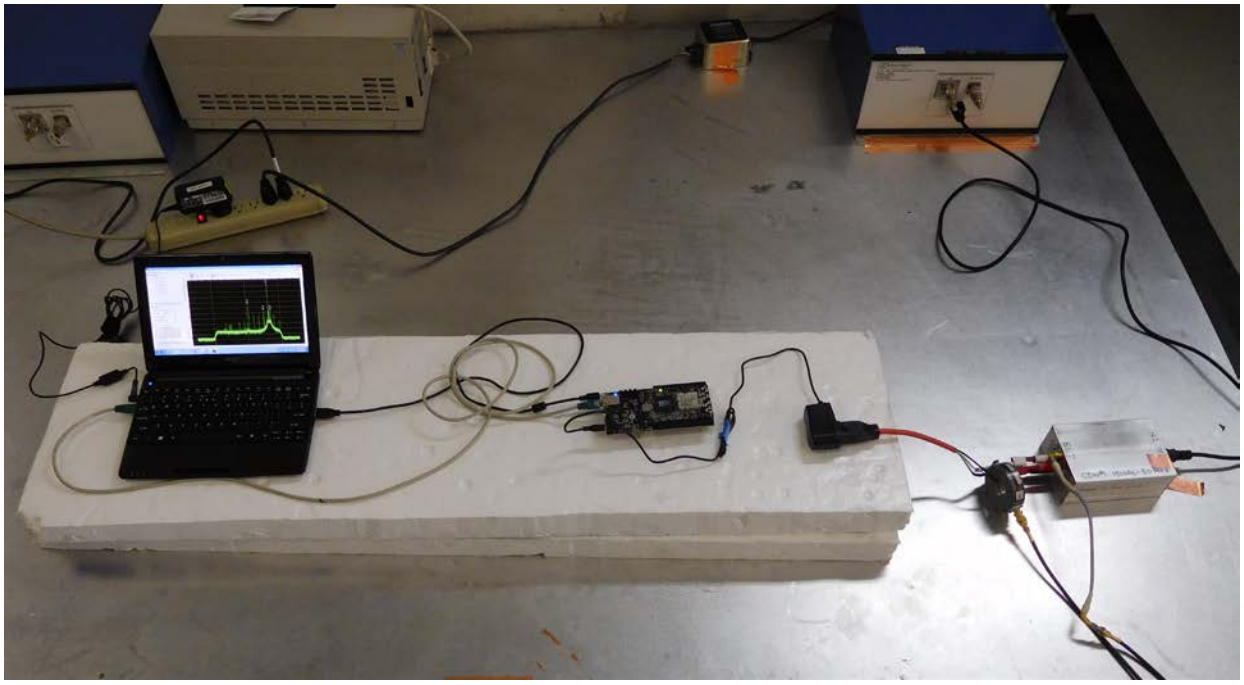
### 3.3 AC input and AC output power ports

### 3.3.1 Radio-frequency (common mode, amplitude modulated)

The susceptibility of the EUT to radio-frequency signals (common mode, amplitude modulated, has been tested in conformity with and according to the criteria as stated below.

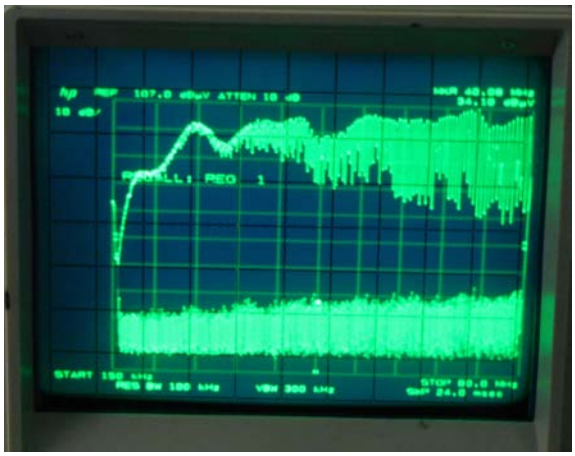
| | | |
|---|---|---|
| Basic standard | : | EN 55024:2010 |
| Test setup | : | EN61000-4-6 |
| Frequency range | : | 0.15 – 80 MHz |
| Test level | : | 3 Vrms |
| Source impedance | : | 150 Ohms |
| Performance criteria | : | Criteria A |

| | |
|---|---|
| Results of the test concerning the susceptibility of the EUT to radio-frequency signals (common mode, amplitude modulated) – AC input and AC output power ports | **Pass Criteria A** |
| Name of Test Engineer:<br>Signature:<br>Date: | Dennis King<br> <br>1 April 2016 |
| Remarks:<br><br>The EUT continued to operate as intended during all testing, passing Criteria A. | |



**AC power line conducted immunity setup per EN 61000-4-6**

**The current probe is used to monitor the applied voltage on a spectrum analyzer**



### 3.3.2 Surges

The susceptibility of the EUT to surges has been tested in conformity with and according to the criteria as stated below

| | | |
|---|---|---|
| Basic Standard | : | EN 55024:2010 |
| Test setup | : | EN 61000-4-5 |
| Test level 1 | : | +-0.5 kV, +- 1.0 kV |
| Test level 2 | : | +- 2 kV |
| Tr/Th | : | 1.2/50(8/20) micro Seconds |
| Number of pulses | | |
| Per phase angle/voltage | : | 5 |
| Performance criteria | : | Criteria B |
| Note | : | ***Applicable only to input AC ports*** |

| | |
|---|---|
| Results of the test concerning the susceptibility of the EUT to surges (AC input and AC output power ports | **Pass per Power Supply Manufacturer** |
| Name of Test Engineer: | Dennis King |
| Signature: | |
| Date: | 12 April 2016 |
| Remarks:<br>The power supply passes per the Super Power Supply documentation. | |

### 3.3.3 Fast Transients

The susceptibility of the EUT to fast transients (common mode) has been tested in conformity with and according to the criteria as stated below.

| | | |
|---|---|---|
| Basic standard | : | IEC/EN 60601-1-2:2007 |
| Test setup | : | EN 61000-4-4 |
| Test level | : | +- 2 KV |
| Tr/Th | : | 5/50 nSec |
| Repetition frequency | : | 5 kHz |
| Performance criteria | : | Criteria B |
| Note | : | ***Conducted on the AC input.*** |

| | |
|---|---|
| Results of the test concerning the susceptibility of the EUT to fast transients (common mode, AC input and AC output ports) | **Pass per Power Supply Manufacturer** |
| Name of Test Engineer: | Dennis King |
| Signature: | |
| Date: | 12 April 2016 |
| Remarks:<br>The power supply passes per the Super Power Supply documentation. | |

### 3.3.4 Voltage Dips and Interruptions

The susceptibility of the EUT to voltage dips and interruptions has been tested in conformity with and according to the criteria as stated below.

| | | |
|---|---|---|
| Basic Standard | : | EN 55024:2010 |
| Test setup | : | EN61000-4-11 |
| Test level (a) | : | Line at 0% of nominal for 0 .5 cycles |
| Test level (b) | : | Line at 40% of nominal for 5 cycles |
| Test level (c) | : | Line at 70% of nominal for 25 cycles |
| Test level (d) | : | Line at 0% of nominal for 250 cycles |

| | |
|---|---|
| Results of the test concerning the susceptibility of the EUT to voltage dips and interruptions – AC input and AC output ports | **Pass per Power Supply Manufacturer** |
| Name of Test Engineer:<br>Signature:<br>Date: | Dennis King<br> <br>12 April 2016 |
| Remarks:<br>The power supply passes per the Super Power Supply documentation. | |

# 4 Modifications during testing

No modifications were made to the unit during testing.

# 5 Test equipment and Environmental Conditions

All tests were conducted within parameters specified for each test, for example >30% humidity for ESD. The lab temperature during all testing was between 70-72 degrees F. Barometric pressure has no effect on any of the EMC tests contained in this report so it is not recorded. All equipment used for testing has been calibrated or verified for cal using NIST traceable standards. Each piece of test equipment has a cal verification procedure that is conducted before and after each test.

## Table of Test Equipment

| Equipment | Description and Test | Model number | Serial number | Next cal due |
|---|---|---|---|---|
| HP Spectrum Analyzer | Used for Radiated and Conducted Emissions | 8566B | 2607A02760 | 3 June 2016 |
| HP Quasi-Peak Adapter | Used for Radiated and Conducted Emissions | 85650A | 8574A00233 | 3 June 2016 |
| Advantest Spectrum Analyzer | Used for Radiated and Conducted Emissions | R3361A | 01730556 | 20 October 2016 |
| Com-Power transient Limiter | Conducted Emissions | HZ560 | 001 | 3 June 2016 |
| RF Bay Pre-Amp | Radiated emissions – 100kHz to 10 GHz | LPA-10-20 | 0643 | 2 Dec 2016 |
| GTEM | Radiated Emissions and Radiated Immunity | 5317 | 9703-1209 | 25 April 2016 – Field Uniformity Cal per IEC 61000-4-20 |
| 3 Meter FAR – Fully Anechoic Room | Radiated Immunity and Emissions | N/A | FAR #1 | 15 October 2016 Field Uniformity per IEC/EN 61000-4-3 and Correlation data to GTEM |
| ComPower Horn Antenna | 1-18 GHz – Radiated Immunity and Emissions | AH 118 | 071040 | 20 March 2017 |
| Chase BiLog Antenna | Radiated Emissions and Immunity | CBL6111 | 1121 | 20 March 2017 |
| Marconi Instruments – Signal Generator 10kHz – 2.7 GHz | Radiated Immunity | 2031 | 1196061031 | 20 October 2016 |
| HP Signal Generator | Radiated Immunity | 8657A | STD0578 | 3 May 2016 |

| | | | | |
|---|---|---|---|---|
| HP Synthesized Sweep Generator .01-20 GHz | Radiated Immunity<br><br>1 GHz to 2.7 GHz | 83752B | 34462 | 3 May 2016 |
| Amplifier Research .800 – 4.2 GHz Amp | Radiated Immunity – 1 GHz to 2.7 GHz | 10S1G4 | 34516 | 4 May 2016 |
| Antenna Research Associates – 100 Watt amplifier w/controller | Radiated Immunity – 80-1000 MHz in the FAR | ARAPS/PC757LC<br>ARA757LC-CE | 587V7<br>587V7 | 20 October 2016 |
| Kalmus Power Amplifier | Radiated Immunity 150kHz – 1 GHz – in the GTEM | 747LC-CE | 7894-1 | 12 May 2016 |
| Amplifier Research E- Field Probe | Radiated Immunity | FP 2000 | 12845 | 12 May 2016 |
| Com-Power LISN | Conducted emissions | LI-115 | 241010 | 17 May 2016 |
| Com-Power LISN | Conducted emissions | LI-115 | 241011 | 17 May 2016 |
| California Instruments 1000 VA Power Source | Emissions and Immunity - used as a 100/120/230/240-VAC 50/60 Hz AC source | 1001WP | L04788 | 4 June 2016 |
| EMI Labs CDN | Conducted Immunity | EMICDN | 001 | 9 Dec 2016 |
| Schaffner ESD Gun | Electro Static Discharge | NSG435 | 54711 | 11 Dec 2016 |
| KeyTek ECAT | Fast transients / Burst | E412 | 32612 | 5 June 2016 |
| FCC Inc. RF Current Probe | Monitor Conducted Immunity signal | F-33-1 | 423 | 9 Dec 2016 |
| A.H. Systems Injection Current Probe | Inject RF signal on I/O cables for Conducted Immunity | ICP-521 | 206 | 14 Mar 2017 |
| EMI Labs EFT Clamp | EFT/Burst for I/O cables | EFTClamp013 | 003 | 16 Mar 2017 |
| EMI Labs Mag Loop | Magnetic Loop Antenna | Mag100 | 80162 | 12 Dec 2016 |
| Thermo Keytek CE Master | Surge/ AC Dips and Interrupts | CE Master | 0405277 | 15 Dec 2016 |

## 6 Measurement Uncertainty - Radiated Emissions example;

| Table of Uncertainty Calculation | | | | | |
|---|---|---|---|---|---|
| √ | Contribution | Designation | Probability Distribution | k | Uncertainty (dB) |
| | Equipment Under Test Uncertainties | $U_{EUT}$ | | | Note 1 |
| √ | Measuring Receiver Amplitude Accuracy | $U_{RXaccuracy}$ | rectangular | $\sqrt{3}$ | ± 0.9 |
| √ | GTEM Uniformity | $U_{Uniformity}$ | rectangular | $\sqrt{3}$ | ± 4.0 |
| √ | Secondary Field Components | $U_{Secondary}$ | | | Excluded by Test Method |
| √ | Mismatch Uncertainty-GTEM to Pre-Amplifier | $U_{Mismatch}$ | U-shaped | $\sqrt{2}$ | +0.63 and -0.65 |
| √ | Mismatch Uncertainty-Pre-Amplifier to Spectrum Analyzer | $U_{Mismatch}$ | U-shaped | $\sqrt{2}$ | +0.92 and -1.03 |
| √ | System Sensitivity Error | $U_{Sensitivity}$ | rectangular | $\sqrt{3}$ | 0.28 |
| √ | GTEM Electric-Field Frequency Response | $U_{E-Field}$ | rectangular | $\sqrt{3}$ | ± 1.6 |
| | Ambient Signal Uncertainty | $U_{Abient}$ | | | Not Significant |
| √ | GTEM to OATS Correlation | $U_{Corr}$ | rectangular | $\sqrt{3}$ | ±1.2 |
| √ | Septum Height Variation | $U_{Septum}$ | normal | 2 | +0.72 and -0.82 |
| | Coaxial Cable Temperature Variations | $U_{CableTemperature}$ | | | Not Significant |
| √ | Coaxial Cable Calibration | $U_{CableCalibration}$ | rectangular | $\sqrt{3}$ | ±0.05 |
| √ | Pre-amplifier Calibration Uncertainty | $U_{Pre-Amp}$ | rectangular | $\sqrt{3}$ | ±0.05 |
| | Combined Uncertainty(dB) Positive Terms | | | | 2.77 |
| | Combined Uncertainty(dB) Negative Terms | | | | -2.75 |
| | Expanded Uncertainty Positive Terms | | Normal | 2 | 5.54 |
| | Expanded Uncertainty Negative Terms | | Normal | 2 | -5.50 |

## Typical Measurement Uncertainty for the following Tests:

| |
|---|
| The estimated combined standard uncertainty for ESD testing, EN 61000-4-2 is ± 4% |
| The estimated combined standard uncertainty for Radiated Immunity, EN 61000-4-3 is ± 2.7dB |
| The estimated combined standard uncertainty for EFT/Burst, EN 61000-4-4 is ± 5.8% |
| The estimated combined standard uncertainty for Surge, EN 61000-4-5 is ± 8% |
| The estimated combined standard uncertainty for Conducted Immunity, EN 61000-4-6 is ± 1.5 dB |
| The estimated combined standard uncertainty for Magnetic Fields, EN 61000-4-8 is ± 0.6% |
| The estimated combined standard uncertainty for Voltage Dips and Interrupts, EN 61000-4-11 is ± 4.3% |
| The estimated combined standard uncertainty for Conducted Emissions, CISPR 11 is ± 1.2dB |
| The estimated combined standard uncertainty for Harmonic current and flicker is ± 11.6% |

# 7 Test Plan

# CE Mark Test Plan

The evaluation kit is intended for use by engineers as a development tool in an engineering lab environment.

Note: all cables included in the development kit are less than 3 meters in length

Objective:

The RF Development Board is to be tested for CE Mark Compliance and shall pass Class A Radiated and Conducted Emissions with at least a 3 dB margin. The unit shall also pass Radiated and Conducted Immunity, Criteria A – the unit shall continue to operate as intended per the manufacturers specifications.

Reliance upon CE mark testing conducted by Super Power Supply for the CE Test Report of the AC to DC power adapter – model number SPS-WA01-050200 - used with the development kit, shall be utilized for the power supply tests required for the CE Mark.

## *1.1 CE Class A Emissions Tests:*

- **Radiated Emissions - Frequency Range <30MHz-1GHz > 3 meter test distance**
  - Class A Spec: *EN 55022: 2010*
  - Test Method: *CISPR 22:2008*
  - With EUT running and rotating on table while capturing radiated spectrum
- **Radiated Emissions - Frequency Range <1GHz-6GHz> 3 meter test distance**
  - Class A Spec: *EN 55022: 2010*
  - Test Method: *CISPR 22:2008*
  - With EUT running and rotating on table while capturing radiated spectrum
- **Conducted Emissions - Frequency Range <150KHz-30MHz> Hot line & Neutral line, Peak and Quasi-Peak measurements**
  - Class A Spec: *EN 55022: 2010*
  - Test Method: *CISPR 22:2008*
  - With EUT running and on stationary table while capturing noise spectrum on AC line

- ***CE Immunity Tests:***
- **Radiated Immunity –at 3V/m**
  4 Sides vertical and 4 sides horizontal polarization (directional antenna orientation)
  Frequency Range <80MHz-1GHz w/1KHz 80% AM modulation>
  - Spec: *EN 55024:2010*
  - Test Method: *CISPR 24:2010*
  - With EUT running while monitoring RF Software preloaded on SD Card
- **Conducted Immunity –at 3Vrms**
  Injected on the primary side of the power supply
  Frequency Range <150kHz-80 MHz w/1KHz AM modulation>
  - Spec: *EN 55024:2010*
  - Test Method: *CISPR 24:2010*
  - With EUT running while monitoring RF Software

### *1.2 AC to DC Power Supply Immunity Tests:*

One non-destructive power supply test shall be used as part of the CE mark self certification to augment test data from the power supply tests.

EN 61000-4-6 (Conducted RF Immunity Testing) with 3 second dwell time

### *1.3 Software:*

Software for all testing will be provided by Analog Devices and pre-loaded on an SD card and host netbook computer.

### *1.4 Test Configuration Definition:*

*Standalone* is defined as an RF Development board attached to the carrier card, in free space on a table top, not in a PC chassis.

This configuration uses DC power to the equipment under test (EUT) provided by the SOM breakout card connected to European AC power input of 230VAC/50Hz from an AC power supply. There are no I/O cables longer than 3 meters in length.

### 1.4.1 Standalone Test Configuration:

The card is to be set up for testing as directed by Neil Wilson's instructions.

***Standalone Configuration*** **:**

**Test Configuration Definition:**

See the following hardware and software test instructions provided by Analog Devices.

**Test Software:**

**See the following software test instructions provided by Analog Devices.**

## *1.5 Test Facility:*

CE Mark Class A testing is performed at the following location:

EMI Test Lab LLC
GTEM and Fully Anechoic 3 Meter Test Chamber and Lab Facilities
1822 Skyway Drive, Unit J
Longmont, CO 80504

Testing performed by: Dennis Michael King, Senior EMC Engineer, Phone 303-684-6650

## *1.6 Tests Not Planned as Part of CE Mark Self Certification:*

- EN 61000-4-2 (ESD): will not be tested on the standalone configuration as this would be a destructive test since there is no shielding around the circuit boards that are being tested. ESD warnings and proper handling recommendations of the development kit will be included in the kit User Manual.
- EN 61000-4-8 (Magnetic Field Susceptibility Testing): will not be performed on the development kit as there are not any components on the printed circuit assembly susceptible to magnetic fields.

Analog Devices will leverage the Super Power Supply CE Mark EMC test data for the following power line tests.

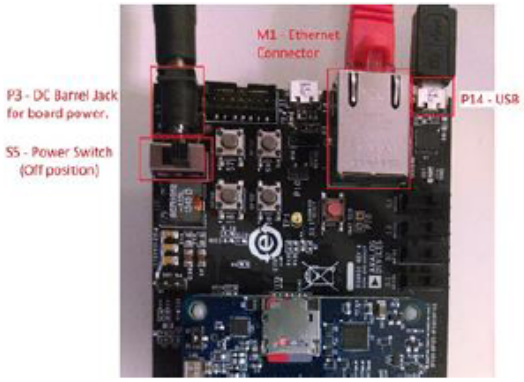
- EN 61000-4-4 (Electrical Fast Transients)
- EN 61000-4-5 (Surge Testing on Power Lines
- EN 61000-4-11 (AC Dips, Voltage Sag and Interruptions)

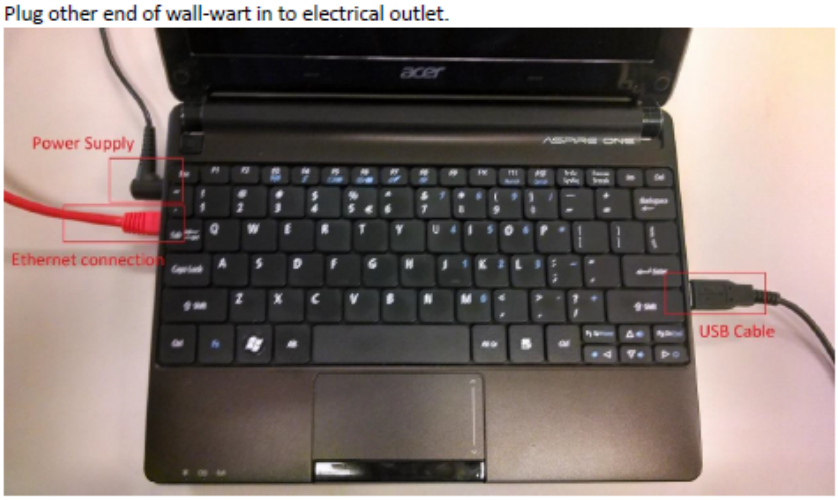
Immunity Testing Notes:

For all immunity testing, each test will be monitored to verify the EUT is still operating normally without interruption or error.

The unit shall continue to function as intended, note any interference detected.

## Hardware Setup

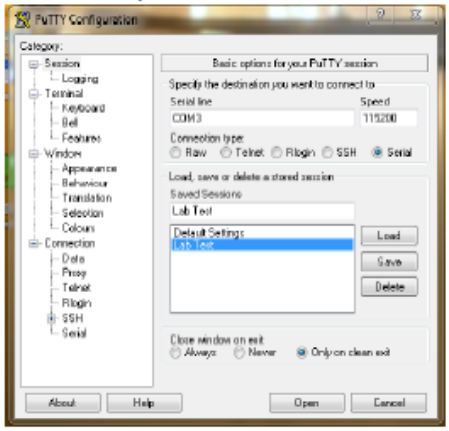
1. Plug PicoZed module into breakout board.
2. Set the PicoZed module power switch (S5) to the off position (knob of switch towards middle of PCB).
3. Plug USB cable in to connector P14 of the breakout board.
4. Plug Ethernet crossover cable in to connector M1 of the breakout board.
5. Plug Wallwart in to connector P3 of the break out board.
6. Plug other end of wall-wart in to electrical outlet.
7. 

8. Plug USB cable into netbook (front port).
9. Plug Ethernet cable in to netbook.
10. Plug second wall-wart in to netbook.
11. Plug other end of wall-wart in to electrical outlet.
12. 

13. Turn netbook on.
14. When the operating system has loaded, turn PicoZed SDR module on by flipping switch S5.

## Software Setup

1. Double click the desktop executable 'PuTTY'.

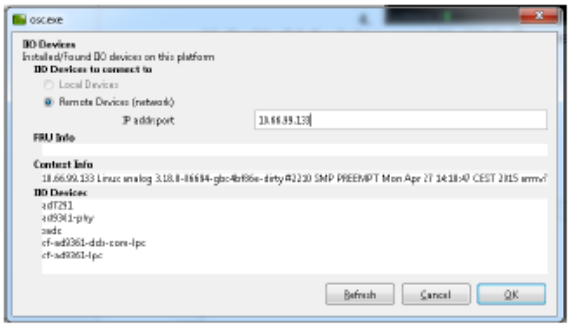


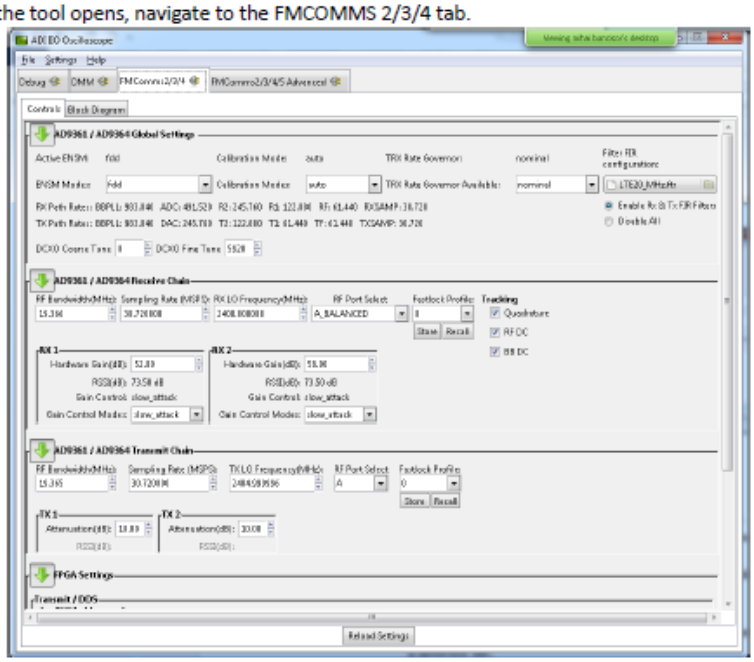

a.

a. Click 'ADI TEST'.
b. Press 'Load'.
c. Press 'Open'.
    i. The 'PuTTY Configuration' window will minimize automatically.
d. Press 'Enter'.
    i. This prompt allows you to enter some basic commands only when necessary.
        1. 'ifconfig' – displays device address and HW address.
        2. 'reboot' – This reboots hardware without manually switching off the power.
        3. 'halt' – This halts the system. All halts must be followed by manually toggling the power switch (S3).

4.

15. Double click the desktop executable 'IIO Oscilloscope'.
    a. Click 'Settings'.
    b. Click 'Connect'.

c. Type '192.168.0.102' in the text field 'IP addr:port'.
   i. Type 'ifconfig' in the command prompt of the putty window to determine the appropriate address. I think the last 3 digits of the ip changed to '.101' or '.103'
d. Click 'Refresh'.
   i. The address in the image below is different, ignore it and use the address detailed above.
   ii. 

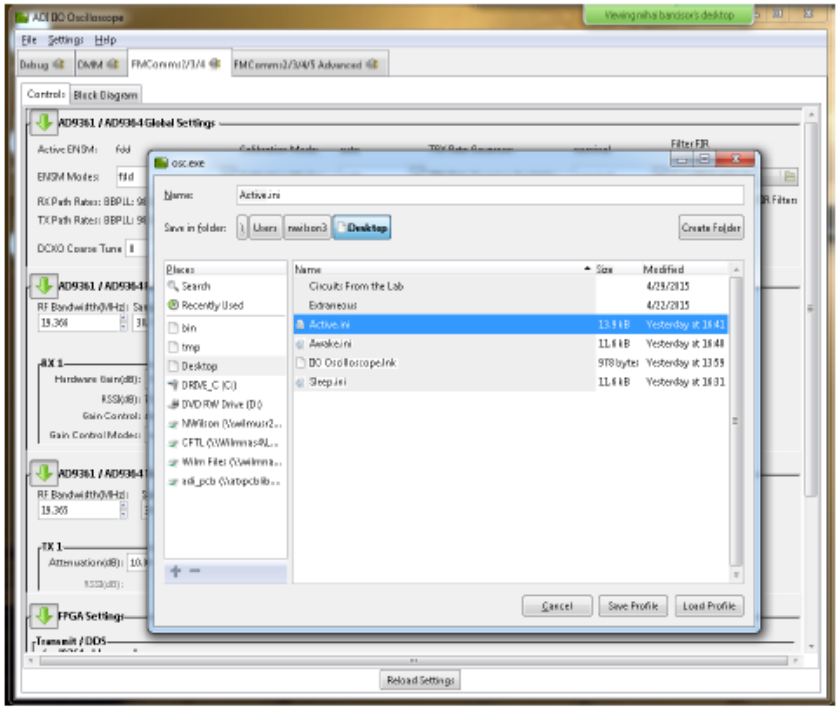
e. Click 'Ok'.
f. When the tool opens, navigate to the FMCOMMS 2/3/4 tab.
   i. 

g. Click File -> 'Load/Save Profile'
   i. Three profiles have been saved to the desktop.
      1. The first profile puts the AD9361 in a sleep mode.

2. The second profile puts the AD9361 in an awake mode, but has the transmit channels disabled.
3. The third profile 'active' puts the AD9361 in a mode where it is actively transmitting tones on channel 1 and channel 2.

h. Select a profile and click 'Load Profile' in the bottom right corner.

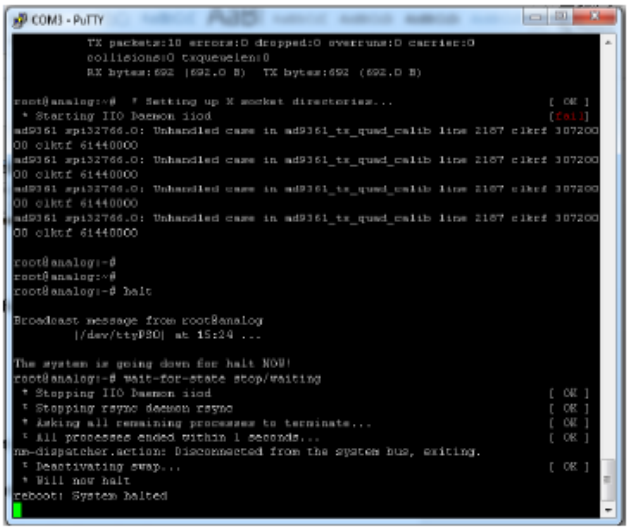
i. A new profile can be loaded by performing the same sequence of steps and loading a different file.

ii. 


## Restarting the setup

1. If the IIO Scope tool crashes, you can restart the tool from the icon on the desktop and follow the steps described previously.
2. On occasion, a full system reset can be helpful.
   a. Start by closing IIO_Oscilloscope.
   b. Bring forward the PuTTY window.
   c. Type 'halt' and press enter.
      i. This will bring the system down. Wait several seconds and the window will display the message 'System Halted'.

ii.




d. Toggle the power switch on the breakout board 'S3'.

3. Wait thirty seconds for the system to boot.
4. Double click the IIO_Oscilloscope tool and continue as described previously.
5. Please, always perform a 'halt' sequence before power cycling the hardware!!!

# Power Supply Information

**The Super Power Supply used during all testing**

# 8 Conclusion

**The Analog Devices PicoZed SDR (Software Defined Radio)**

**- complies with the emissions standard EN 55022:2010**

**- and the immunity standard EN 55024:2010**

**in the configuration and operating modes as stated in this test report.**

**The RF Portion of the Development Board was not tested. Guidance will be given to the Development Professional using this board to either use the board in an RF Shielded enclosure or use the device in a low power mode to avoid the possibility of jamming local emergency frequencies and other radio frequencies.**

**End of Report**