# FCC /IC Test Report

**FOR**

# Intel Corporation

**Model Name: EP110**

**Product Description: Smartphone with GSM/GPRS/EDGE, UMTS/HSPA+/LTE, Wi-Fi, BT and GPS Radios**

**FCC ID: O2Z-EP110**
**IC ID: 1000W – EP110**

**FCC Part 15B**
**ICES-003, issue 5**

**TEST REPORT #: EMC_INTEL-054-14001_15B_rev2**
**DATE: 2014-12-23**



**FCC:**
**A2LA Accredited**

**IC recognized #**
**3462E-1**

***CETECOM* Inc.**
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*CETECOM* Inc. is a Delaware Corporation with Corporation number: 2113686

# TABLE OF CONTENTS

# 1 Assessment

**The following device was evaluated against the applicable criteria specified in FCC rules Part 15B of the Code of Federal Regulations and ICES-003 Issue 5. No deviations were ascertained during the course of the tests performed.**

| Company | Description | Model # |
|---|---|---|
| Intel Corporation | Smartphone with GSM/GPRS/EDGE, UMTS/HSPA+/LTE, Wi-Fi, BT and GPS Radios | EP110 |

**Responsible for Testing Laboratory:**

| Date | Section | Name | Signature |
|---|---|---|---|
| 2014-12-23 | Compliance | Milton Ponce Deleon (Manager Compliance) | Milton Ponce de Leon<br>Digitally signed by Milton Ponce de Leon<br>DN: cn=Milton Ponce de Leon, c=US, o=Cetecom Inc., ou=OTA, email=milton.deleon@cetecom.com<br>Date: 2015.01.08 12:59:09 -08'00' |

**Responsible for the Report:**

| Date | Section | Name | Signature |
|---|---|---|---|
| 2014-12-23 | Compliance | Muhammad Umair Anees (EMC Engineer) | Muhammad Umair Anees<br>Digitally signed by Muhammad Umair Anees<br>DN: cn=Muhammad Umair Anees, c=US, o=EMC, ou=Compliance, email=Muhammad.Anees@cetecom.com<br>Date: 2015.01.08 12:43:02 -08'00' |

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

# 2 Administrative Data

## 2.1 Identification of the Testing Laboratory Issuing the Test Report

| | |
|---|---|
| **Company Name:** | CETECOM Inc. |
| **Department:** | Compliance |
| **Address:** | 6370 Nancy Ridge Drive #101<br>San Diego, CA 92121<br>U.S.A. |
| **Telephone:** | +1 (858) 362-2400 |
| **Fax:** | +1 (858) 587-4809 |
| **Test Lab Manager:** | Milton Deleon |
| **Responsible Project Leader:** | Muhammad Umair Anees |

## 2.2 Identification of the Client

| | |
|---|---|
| **Applicant's Name:** | Intel Corporation |
| **Street Address:** | 2200 Mission College |
| **City/Zip Code** | Santa Clara, CA 94054 |
| **Country** | USA |
| **Contact Person:** | Christine Ryan |
| **Phone No.** | +1 (408) 300-2167 |
| **e-mail:** | Christine.m.ryan@intel.com |

## 2.3 Identification of the Manufacturer

| | |
|---|---|
| **Manufacturer's Name:** | Same as client. |
| **Manufacturers Address:** | |
| **City/Zip Code** | |
| **Country** | |

# 3 Equipment under Test (EUT)

## 3.1 Specification of the Equipment under Test

| | |
|---|---|
| **Marketing Name / Model No:** | Intel 4.7-inch Smartphone / EP110 |
| **HW Revision :** | PR2 |
| **FCC-ID / IC-ID:** | O2Z-EP110 / 1000W-EP110 |
| **Product Description:** | Smartphone with GSM/GPRS/EDGE, UMTS/HSPA+/LTE, Wi-Fi, BT and GPS Radios |
| **Power supply** | Rechargeable lithium-ion battery<br>Voltage Range 3.6V-4.2V DC<br>Nominal Voltage 3.8V DC |
| **Antenna / highest declared gain:** | Main cellular antenna internal monopole / 3.2dBi<br>Secondary cellular antenna internal monopole / 0dBi<br>Wi-Fi/BT internal monopole / -1.8dBi<br>GPS internal monopole /-2dBi |
| **Operating temperature range** | -10ºC to 55ºC |
| **Prototype / Production unit** | Prototype |
| **Radios included in the device:** | Intel XMM 7160 Radio Module<br>- GSM 850/900/1800/1900MHz<br>- GPRS / EDGE Multi-slot class 33 operation<br>- WCDMA / HSPA+ 850/900/1700/1900/2100 MHz<br>- LTE 700/800/850/900/1700/1800/1900/2100/2600<br>Wi-Fi, BT BDR, BT EDR, BT LE (BCM4339) 2.4 GHz band of operation and 5GHz band of operation<br>GPS 1575.42 MHz (BCM4752) |
| **Measurement Frequency Range** | - 150kHz ~ 30MHz (Conducted Power Measurement)<br>- 30MHz ~ 30GHz* (Radiated Power Measurement)<br><br>*FCC 15.33b specifies the highest frequency to be measured as up to 5th Harmonic of the highest frequency which in this device is the WIFI signal at 5.825GHz. Thus 30GHz is selected. |

### 3.2 Identification of the Equipment Under Test (EUT)

| EUT # | Serial Number | HW Revision | SW Version | Notes/Comments |
|---|---|---|---|---|
| **1** | INV141400226 | PR2 | 4.4.4 KTU84P main engineering 53181-dev-keys | Radiated/Conducted |
| **2** | INV141400717 | PR2 | 4.4.4 KTU84P main engineering 53181-dev-keys | Radiated/Conducted |
| **3** | INV141401015 | PR2 | 4.4.4 KTU84P main engineering 53181-dev-keys | BT/WIFI/GPS Radiated/Conducted |

### 3.3 Identification of Accessory equipment

| STE # | Type | Manufacturer | Model | Serial Number |
|---|---|---|---|---|
| **1** | AC Adapter | Salcomp | SC1402 | 1309500144736 |
| **2** | Laptop computer | Dell | Latitude | N/A |

### 3.4 Environmental Conditions during test:

The following environmental conditions were maintained during the course of testing:

Ambient Temperature: 20-25°C
Relative Humidity: 40-60%

### 3.5 Dates of testing:

08/06/2014 – 09/18/2014

## 4 Subject of Investigation

Testing was performed on the EP110 model to evaluate compliance with the applicable criteria specified in FCC CFR 47 Part 15 Subpart B and Industry Canada Standard ICES-003, issue 5

Radiated Emission tests are carried out to show that the EUT complies with FCC15.109 (a) radiated emissions limit for Class B device.

Conducted Emission tests are carried out to show that the EUT complies with FCC15.107 (a) conducted emissions limit for Class B device.

The EUT has been tested with its USB port connected to a laptop and while running an app (application) built into the phone by the manufacturer. Running this app exercises the phone's CPU, Memory, Drives(read/write), audio and video, to create a worst case EMC condition for emissions. All radios (cellular/WIFI) have been turned off during this testing.

## 5 Summary of Measurement Results

| Test Limits | Test Case | Temperature and Voltage Conditions | Mode | Pass | Fail | NA | NP | Result |
|---|---|---|---|---|---|---|---|---|
| **§15.109 ICES-003 §7.1** | RX Spurious Emissions Radiated | Nominal | Digital Device | ■ | ☐ | ☐ | ☐ | Complies |
| **§15.107(a) ICES-003 §7.1** | Conducted Emissions <30MHz | Nominal | Digital Device | ■ | ☐ | ☐ | ☐ | Complies |

**Note**: NA= Not Applicable; NP= Not Performed.

# 6 Radiated Emissions

## 6.1 Reference:

FCC §15.109
ICES-003, issue 5 sections 6.2:

Radiated emission limits- Unintentional Radiators quasi-peak power limits (or average-peak power limits) for a class B (residential) device:

| Frequency of emission (MHz) | Field strength (µV/m) / (dB µV/m) |
|---|---|
| 30–88 | 100 / 40 |
| 88–216 | 150 / 43.5 |
| 216–960 | 200 / 46 |
| Above 960 | 500 / 54 |

For measurements below 1000MHz, the limits are based on using the quasi-peak or peak detector function in the measurement instrumentation. Above 1000MHz, the limits are based on using the average detector function.

## 6.2 Radiated Emissions Measurement Procedure

The radiated measurement is performed according to:
ANSI C63.4 (2009)
ANSI C63.10 (2009)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 16 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9kHz to 30MHz, a Biconlog antenna is used from 30MHz to 1GHz, two different horn antennas are used to cover frequencies up to 40GHz.

**Radiated Emissions Measurement Uncertainty: ±3dB**

## 6.3 Sample Calculations for Radiated Measurements

6.3.1.1 Field Strength Measurements:

Measurements from the Spectrum Analyzer/ Receiver are used to calculate the Field Strength, taking into account the following parameters:

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

FS (dBµV/m) = Measured Value on SA (dBµV)+ Cable Loss (dB)+ Antenna Factor (dB/m)

Eg:

| Frequency (MHz) | Measured SA (dBµV) | Cable Loss (dB) | Antenna Factor Correction (dB) | Field Strength Result (dBµV/m) |
|---|---|---|---|---|
| 1000 | 80.5 | 3.5 | 14 | 98.0 |

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

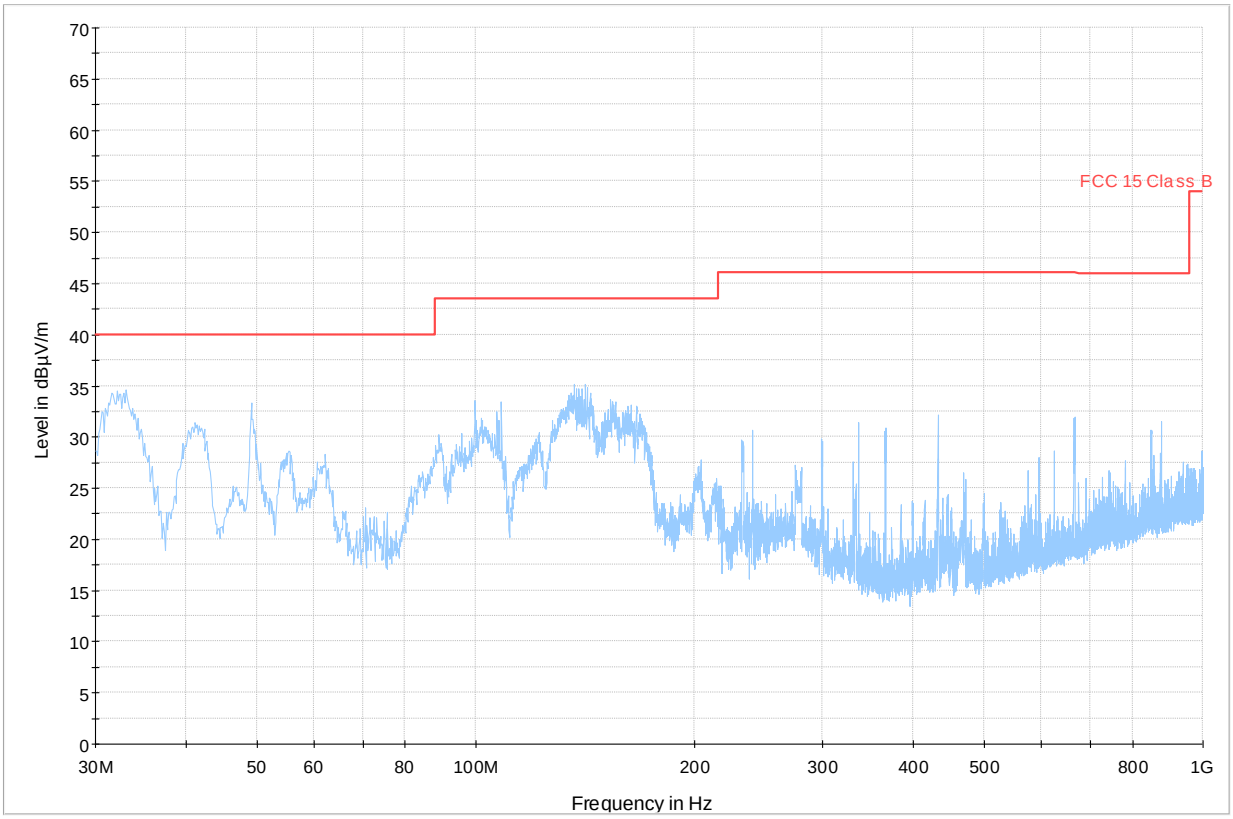
## 6.4 Testing Notes:

The relevant procedures of ANSI C63.4: 2009 have been followed.

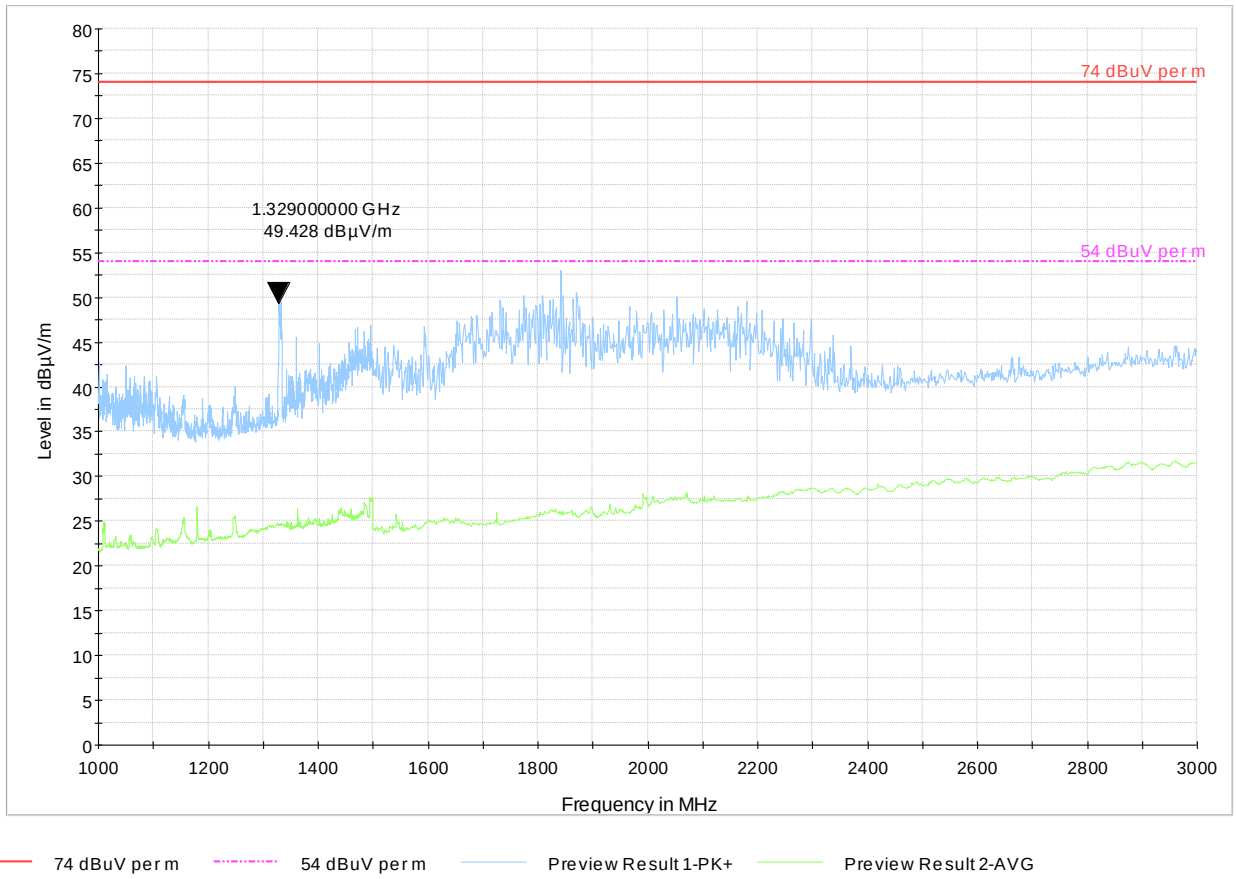
All radiated test data in this report shows the worst case emissions for H/V measurement antenna polarizations and for all three orthogonal orientations of the EUT.

## 6.5 Results

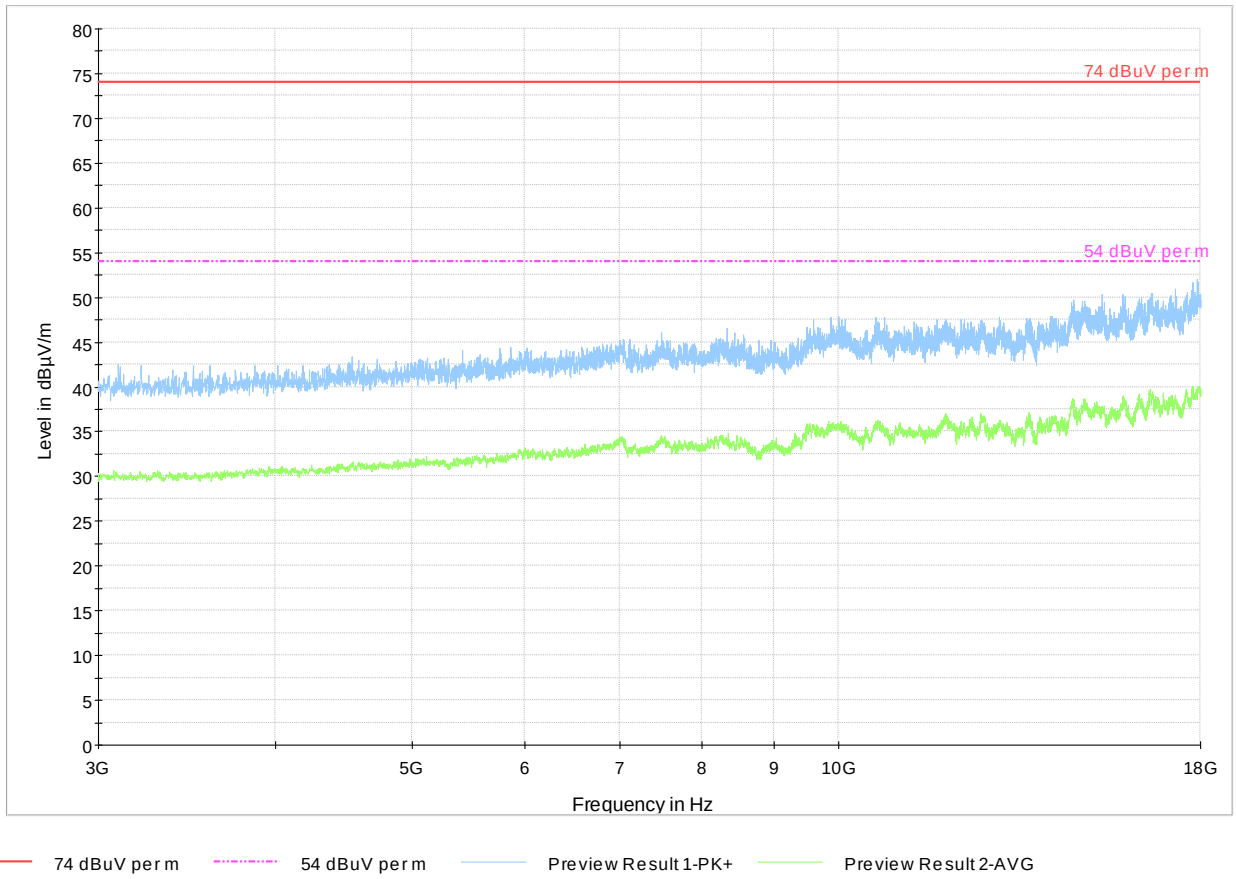
### Radiated Emissions: 30M- 1GHz



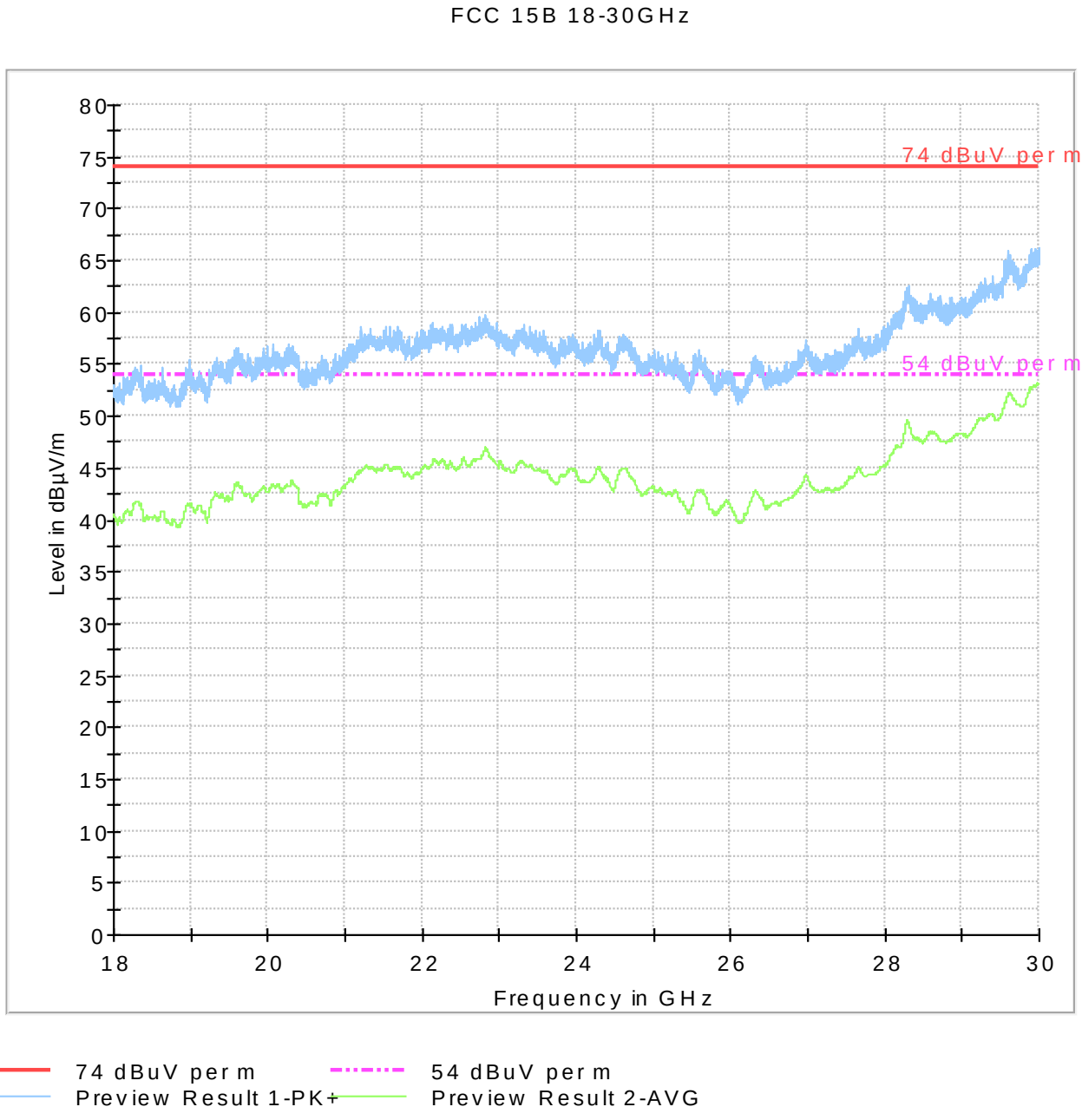
## Radiated Emissions: 1 GHz- 3 GHz



## Radiated Emissions: 3 GHz- 18 GHz



## Radiated Emissions: 18 GHz- 30 GHz



# 7 AC Power Line Conducted Emissions

## 7.1 Conducted limits- Unintentional Radiators

**§ 15.107** (a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

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

*Decreases with the logarithm of the frequency.

(b) For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15–0.5 | 79 | 66 |
| 0.5–5 | 73 | 60 |

**Note:**
IC limits are specified in the standard ICES-003 issue 5, section 7.1 that are identical to FCC limits given above.

## 7.2 Measurement Procedure:

**ANSI C63.4 (2009) Section 7.3.1: Measurements at a test site**

Tabletop devices shall be placed on a nonconducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane, when used, or wall of a screened room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground plane or on insulating material. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs. AC power-line adapters that are used with EUTs, such as notebook computers, should be placed as typically used (i.e., on the tabletop) if the adapter-to-EUT cord is too short to allow the power adapter to reach the floor. Each current-carrying conductor of the EUT power cord(s), except the ground (safety) conductor(s), shall be individually connected through a LISN to the input power source. All 50 Ω ports of the LISN shall be resistively terminated into 50 Ω loads when not connected to the measuring instrument. When the test configuration consists of multiple units (EUT and associated/peripheral equipment, or EUT consisting of multiple equipment) that have their own power cords, ac power-line conducted emissions measurements shall be performed with the ac power-line cord of the particular unit under test connected to one LISN that is connected to the measuring instrument. Those power cords for the units in the remainder of the configuration not under measurement shall be connected to a separate LISN or LISNs. This connection may be made using a multiple-receptacle device. Emissions from each current-carrying conductor of the EUT shall be individually measured. Where multiple portions of the EUT receive ac power from a common power strip, which is furnished by the manufacturer as part of the EUT, measurements need only be made on the current-carrying conductors of the common power strip. Adapters or extension cords connected between the EUT power cord plug and the LISN power receptacle shall be included in the LISN setup, such that the calibration of the combined adapter or extension cord with an adapter and the LISN meets the requirements of 5.2.3.
If the EUT consists of a number of devices that have their own separate ac power connections, e.g., a floorstanding frame with independent power cords for each shelf, that are able to connect directly to the ac power network, each current-carrying conductor of one device is measured while the other devices are connected to a second (or more) LISN(s). All devices shall be separately measured. If the manufacturer provides a power strip to supply power to all of the devices making up the EUT, only the conductors in the common power cord to the power strip shall be measured.

If the EUT is normally operated with a ground (safety) connection, the EUT shall be connected to the ground at the LISN through a conductor provided in the lead from the ac power to the LISN.
The excess length of the power cord between the EUT and the LISN receptacle (or ac power receptacle where a LISN cannot be used), or an adapter or extension cord connected to and measured with the LISN, shall be folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length. If the EUT does not have a flexible power lead, the EUT shall be placed at a distance of 80 cm from the LISN (or power receptacle where a LISN cannot be used) and connected thereto by a power lead or appropriate connection no more than 1 m long. The measurement shall be made at the LISN end of this power lead or connection.

The LISN housing, measuring instrument case, reference ground plane, vertical conducting plane, if used, shall be bonded together.

**ANSI C63.4 (2009) Section 7.3.3: Exploratory ac power-line conducted emission measurements**

Exploratory measurements shall be used to identify the frequency of the emission that has the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation and for each ac power current-carrying conductor, cable manipulation may be performed within the range of likely configurations. For this measurement or series of measurements, the frequency spectrum of interest shall be monitored looking for the emission that has the highest amplitude relative to the limit. Once that emission is found for each current-carrying conductor of each power cord associated with the EUT (but not the cords associated with non-EUT equipment in the overall system), the one configuration and arrangement and mode of operation that produces the emission closest to the limit across all the measured conductors is recorded.

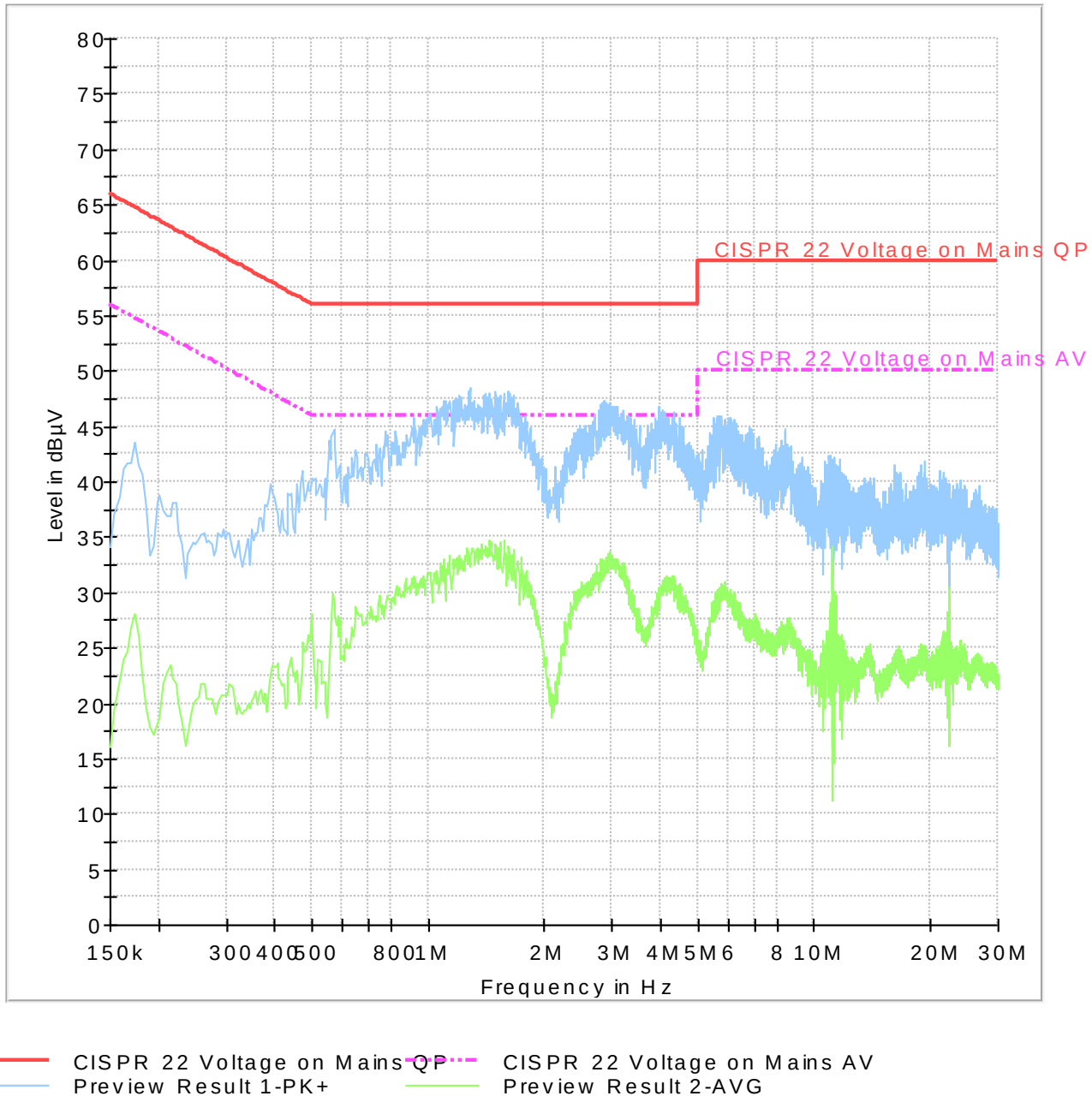
**ANSI C63.4 (2009) Section 7.3.4: Final ac power-line conducted emission measurements**

Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without additional variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT consists of equipment units that have their own separate ac power connections (e.g., a floor-standing frame with independent power cords for each shelf that are able to connect directly to the ac power network), then each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be measured separately. If the manufacturer provides a power strip to supply all the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

## Conducted Emissions Measurement Uncertainty: ±3dB

## 7.3 Results:

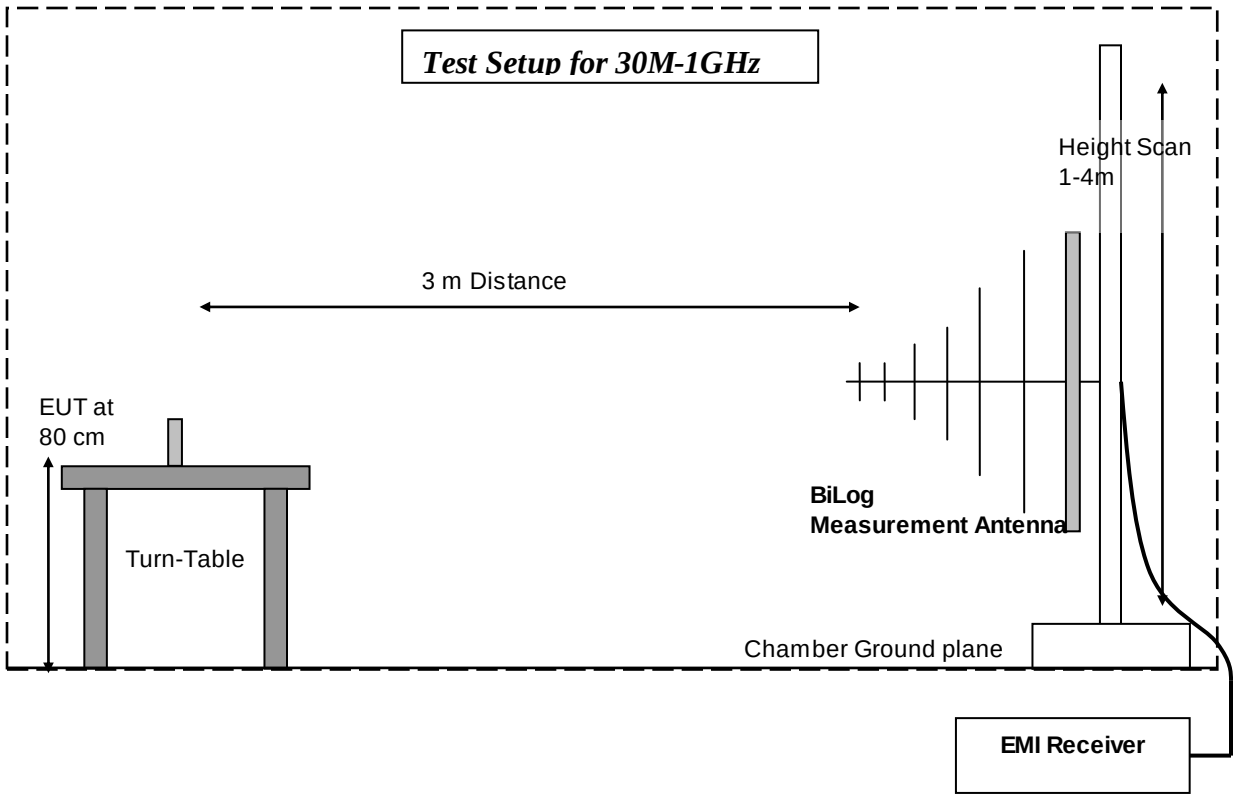
**Plots below show the worst case representation of emissions into LINE and NEUTRAL.**

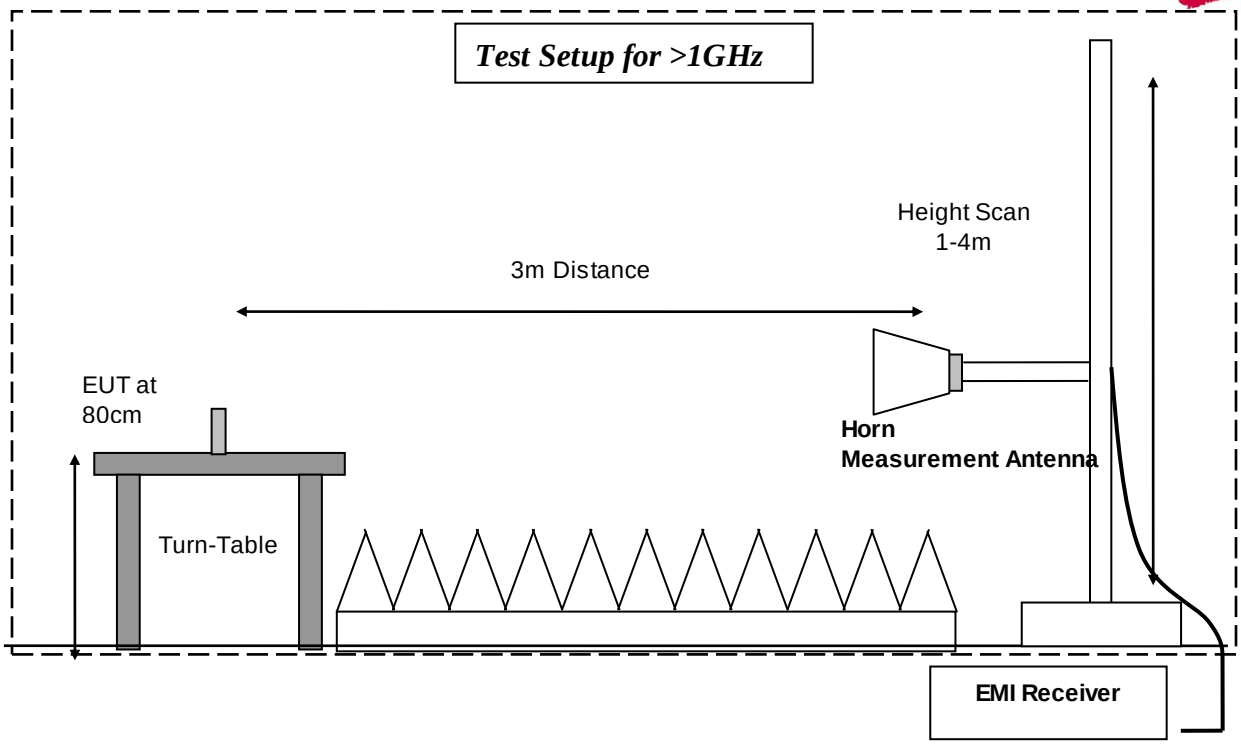


## 8 Test Equipment and ancillaries used for tests

| Equipment Name | Manufacturer | Type/Model | Serial No. | Cal Date | Cal Interval | Next cal date |
|---|---|---|---|---|---|---|
| **3m Semi- Anechoic Chamber:** | | | | | | |
| Spectrum Analyzer | Rohde und Schwarz | FSU 26 | 200302 | 6/2013 | 2 years | 6/2015 |
| Spectrum Analyzer | Rohde und Schwarz | FSV 40 | 0547 | 7/2014 | 2 years | 7/2016 |
| Receiver | Rohde und Schwarz | ESR3 | 101663 | 2/2013 | 2 years | 2/2015 |
| LISN | Rohde und Schwarz | ESV 216 | 101129 | 1/2013 | 2 years | 1/2015 |
| Radio Communications Tester | Rohde and Schwarz | CMU 200 | 121672 | 7/2013 | 2 years | 7/2015 |
| Log Periodic Antenna | Rohde and Schwarz | HL 050 | 100515 | 4/2013 | 3 year | 4/2016 |
| Ultralog Antenna | Rohde and Schwarz | HL 562 | 100495 | 2/2012 | 3 year | 2/2015 |
| Double-ridge Horn Antenna (1G-18G) | ETS-Lindgren | 3117-PA | 00167061 | 7/2014 | 3 year | 7/2017 |
| Double-ridge Horn Antenna (18G-40G) | ETS-Lindgren | 3116C-PA | 00166821 | 7/2014 | 3 year | 7/2017 |
| Loop Antenna | ETS-Lindgren | 6512 | 00164698 | 7/2014 | 3 year | 7/2017 |
| Open Switch Control Unit | Rohde and Schwarz | OPS 130 | 10085 | n/a | | |
| Extention Unit Open Switch Control Unit | Rohde and Schwarz | OSP 150 | 10086 | n/a | | |
| Turn Table TT | Maturo | 1.5 SI | TT 1.5SI/204/6070910 | n/a | | |
| Compact antenna Mast | Maturo | CAM 4.0-P | CAM4.0-P/067/6000910 | n/a | | |
| Multiple Control Unit | Maturo | MCU | 2140910 | n/a | | |
| Pre-Amplifier | Rohde and Schwarz | TS-PR 18 | 100072 | Part of the system calibration | | |
| High Pass Filter | Mini-Circuits | SHP-1200+ | RUU11201224 | | | |
| High Pass Filter | Wainwright Instr. | WHKX 3.0/18 | 109 | | | |

## 9 Test Setup Diagrams




Test Setup for >1GHz
Height Scan
1-4m
3m Distance
EUT at
80cm
Horn
Measurement Antenna
Turn-Table
EMI Receiver

## 10 Revision History

| Date | Report Name | Changes to report | Report prepared by |
|---|---|---|---|
| 2014-10-01 | EMC_INTEL-054-14001_15B | First Version | Huey Lin |
| 2014-10-27 | EMC_INTEL-054-14001_15B_rev1 | Formatting, and modified table | M.Anees |
| 2014-12-22 | EMC_INTEL-054-14001_15B_rev2 | Retested with USB port connected to the laptop | M.Anees |