# FCC and ISED Canada Testing of the

# Unikey Technologies, Inc.
# SR3-UK

## In accordance with FCC 47 CFR part 15.209 and ISED Canada's Radio Standards Specifications RSS-210

America

Add value.
Inspire trust.

Prepared for: Unikey Technologies, Inc.
111 W Jefferson St. STE 100
Orlando, FL 32801

FCC ID: 2ANJI-SR3
IC: 10727A-SR3

## COMMERCIAL-IN-CONFIDENCE

Document Number: TP72151666.200 | Version Number: 01

| RESPONSIBLE FOR | NAME | DATE | SIGNATURE |
|---|---|---|---|
| **Authorized Signatory** | Peter Walsh | 2019 -September-18 |  |
| **Testing** | Thierry Jean-Charles | 2019-September-18 |  |

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

| FCC Accreditation | Innovation, Science, and Economic Development Canada Accreditation |
|---|---|
| Designation Number US1063 Tampa, FL Test Laboratory | Site Number 2087A-2 Tampa, FL Test Laboratory |

EXECUTIVE SUMMARY
Samples of this product were tested and found to be in compliance with 15.209. and ISED Canada's RSS-210.

A2LA Cert. No. 2955.15



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# Contents

# 1 Report Summary

## 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

| Issue | Description of Change | Date of Issue |
|---|---|---|
| 1 | First Issue | 2019-September-18 |

## 1.2 Introduction

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations Section 15.209 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-210 for the tests documented herein.

| | |
|---|---|
| Applicant | Unikey Technologies, Inc. |
| Manufacturer | Unikey Technologies, Inc. |
| Applicant's Email Address | allen@unikey.com |
| Model Number(s) | SR3-UK |
| Serial Number(s) | 4 |
| FCC ID | 2ANJI-SR3 |
| ISED Certification Number | 10727A-SR3 |
| Hardware Version(s) | SR3-UK-BOM-0001r4 |
| Software Version(s) | 1.8.31 |
| Number of Samples Tested | 1 |
| Test Specification/Issue/Date | US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2018<br>Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-210 — Licence-Exempt Radio Apparatus: Category I Equipment, Issue 9, August 2016 |
| Test Plan/Issue/Date | 2019-April-23 |
| Order Number | 72151666 |
| Date | 2019-July-23 |
| Date of Receipt of EUT | 2019-July-29 |
| Start of Test | 2019-July-29 |
| Finish of Test | 2019-August-24 |
| Name of Engineer(s) | Thierry Jean-Charles |
| Related Document(s) | ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices<br>US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2018.<br>Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN - General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1, March 2019. |

## 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15.209 and ISED Canada's RSS-210 is shown below.

**Table 1.3-1: Test Result Summary**

| Test Parameter | Test Plan (Yes/No) | Test Result | FCC 47 CFR Rule Part | ISED Canada's RSS | Test Report Page No |
|---|---|---|---|---|---|
| Antenna Requirement | Yes | Pass | 15.203, 15.204 | ------- | 9 |
| 20 dB Bandwidth | Yes | Pass | 15.215(c) | ------- | 10 |
| 99% Bandwidth | Yes | Pass | ------- | RSS-GEN 6.6 | 12 |
| Radiated Field Strength of Fundamental and Spurious Emissions | Yes | Pass | 15.209 | RSS-210 2.5 | 14 |
| Power Line Conducted Emissions | Yes | Pass | 15.207 | RSS-GEN 8.8 | 20 |

## 1.4 Product Information

### 1.4.1 Technical Description

The EUT is a Mobile enabled PACS Access control reader. The device includes a 2.4 GHz Bluetooth Low Energy (BLE) transceiver as well as 125 kHz RFID. The test report covers the compliance of the 125 kHz RFID radio.

Technical Details
Mode of Operation: 125 kHz RFID
Frequency Range: 125 kHz
Number of Channels: 1
Channel Separation: N/A
Data Rate: N/A
Modulations: Not Modulated
Antenna Type/Gain: Coil Antenna
Input Power: 12 VDC

A full description and detailed product specification details are available from the manufacturer.

**Table 1.4.1-1 – Cable Descriptions**

| Cable/Port | Description |
|---|---|
| Data Cable | 6 leads, 10 m, Not Shielded, EUT to Access Controller |
| Power Leads | 0.7 m, Not Shielded, Power Supply to Access Controller |

**Table 1.4.1-2 – Support Equipment Descriptions**

| Make/Model | Description |
|---|---|
| Linear/Emerge e3 Series | Remote Access Controller, SN: 620-100954B2184900031 |
| Linear/PIP12VDC60W | 12 VDC Power Supply |

## Declaration of Build Status

| EQUIPMENT DESCRIPTION | |
|---|---|
| Model Name/Number | SR3-UK |
| Part Number | SR3-UK-0001-R1 |
| Hardware Version | SR3-UK-BOM-0001r4 |
| Software Version | 1.8.31 |
| FCC ID (if applicable) | 2ANJI-SR3 |
| ISED ID (if applicable) | 10727A- SR3 |
| Technical Description (Please provide a brief description of the intended use of the equipment) | Mobile enabled PACS Access control reader. |

| UN-INTENTIONAL RADIATOR | |
|---|---|
| Highest frequency generated or used in the device or on which the device operates or tunes | 2.480 GHz |
| Lowest frequency generated or used in the device or on which the device operates or tunes | 2.402GHz (low ch BLE). 125kHz prox card |
| Class A Digital Device (Use in commercial, industrial or business environment) ☐<br>Class B Digital Device (Use in residential environment only) ☒ | |

| Power Source | | | |
|---|---|---|---|
| AC | Single Phase | Three Phase | Nominal Voltage |
| | ☒ | ☐ | N/A |
| External DC | Nominal Voltage | | Maximum Current |
| | 12v | | 300mA |
| Battery | Nominal Voltage | | Battery Operating End Point Voltage |
| | N/A | | N/A |
| | | | |

| EXTREME CONDITIONS | | | | | |
|---|---|---|---|---|---|
| Maximum temperature | +50 | °C | Minimum temperature | -40 | °C |

| Ancillaries |
|---|
| Please list all ancillaries which will be used with the device. |
| PACS access controller |

I hereby declare that the information supplied is correct and complete.

Name: Anders Johansson

Position held: Hardware Lead Date: Aug 19, 2019

### 1.4.2 Modes of Operation

Both the BLE and 125 kHz transmitters were active during the evaluation.

### 1.4.3 Monitoring of Performance

The radiated emissions evaluation was performed on the EUT connected to an access controller which was set outside of the testing environment. The EUT was tested in the orientation of typical installation.

The power line conducted emissions measurements were performed on the power supply of the remote access controller through which the EUT was powered.

### 1.4.4 Performance Criteria

The report documents the compliance of the 125 kHz RFID radio to the FCC Section 15.207 and 15.209 as well as ISED Canada's RSS-210. The BLE transmitter was active during the evaluation. No intermodulation product from the co-located radios transmitting at the same time could be observed during the evaluation. A summary of the parameters that were evaluated is provided below.

**Table 1.4.4 -1: Performance Criteria**

| Parameter | Requirement |
|---|---|
| Antenna Requirement | FCC: Section 15.203. 15.204 |
| 20 dB Bandwidth | FCC: Section 15.215(c) |
| 99% Bandwidth | ISED Canada: RSS-GEN 6.7 |
| Radiated Field Strength of Fundamental and Spurious Emissions | FCC: Section 15.209; ISED Canada: RSS-210 2.5 |
| Power Line Conducted Emissions | FCC: Section 15.207; ISED Canada: RSS-GEN 8.8 |

## 1.5 Deviations from the Standard

The EUT was evaluated without any deviation from the test standard.

## 1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme. The modifications incorporated during each test are recorded on the appropriate test pages.

| Modification State | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|---|---|---|---|
| LC filter values | C19, C21 = 3.9 nH<br>C46, C97 = 1.5 PF | Unikey | 8/8/2019 |
| DC Blocking | C19 = 47 pF | Unikey | 8/8/2019 |

The equipment was tested with the modifications listed above to meet the test requirements.

The DC blocking was implemented to resolve an anomaly at the RF switch when the EUT RF port was connected to a spectrum analyzer for the RF conducted measurements on the BLE radio.

## 1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Tampa FL Test Laboratory.

| Test Name | Name of Engineer(s) | Accreditation |
|---|---|---|
| AC Powered Operating | | |
| Antenna Requirement | | A2LA |
| 20 dB Bandwidth | Thierry Jean-Charles | A2LA |
| 99% Bandwidth | Thierry Jean-Charles | A2LA |
| Radiated Field Strength of Fundamental and Spurious Emissions | Thierry Jean-Charles | A2LA |
| Power Line Conducted Emissions | Thierry Jean-Charles | A2LA |

Office Address:

TÜV SÜD America, Inc.
5610 W. Sligh Ave, Suite 100
Tampa, FL 33634
USA

# 2 Test Details

## 2.1 Antenna Requirements

### 2.1.1 Specification Reference

FCC: Section 15.203, 15.204

### 2.1.2 Equipment Under Test and Modification State

SN: 4

### 2.1.3 Date of Test

N/A

### 2.1.4 Test Method

N/A

### 2.1.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | N/A |
| Relative Humidity | N/A |
| Atmospheric Pressure | N/A |

### 2.1.6 Test Results

Limit Clause FCC Sections: 15.203, 15,204

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.

The EUT uses a coil antenna that is directly soldered to the PCB. The antenna is not removeable and therefore meets the requirements of FCC Section 15.203.

### 2.1.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

As this is a visual inspection, no test equipment was used.

## 2.2 20 dB Bandwidth

### 2.2.1 Specification Reference

FCC: Section 15.215

### 2.2.2 Equipment Under Test and Modification State

SN: 4

### 2.2.3 Date of Test

7/29/2019

### 2.2.4 Test Method

The 20 dB bandwidth was measured in accordance with ANSI C63.10 Subclause 6.9.2. The RBW of the spectrum analyzer was set to 1% to 5% of the occupied bandwidth. Span was set large enough to capture the emissions and >> RBW. A peak detector was used for the measurements.

### 2.2.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 23.8°C |
| Relative Humidity | 46.4 % |
| Atmospheric Pressure | 1017 mbar |

### 2.2.6 Test Results

AC Powered Operating

Limit Clause FCC Part 15.215

The intentional radiator must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

**Table 2.2.6-1: 20 dB Bandwidth Test Results**

| Frequency (kHz) | 20 dB Bandwidth (Hz) |
|---|---|
| 125.0 | 2.0 |

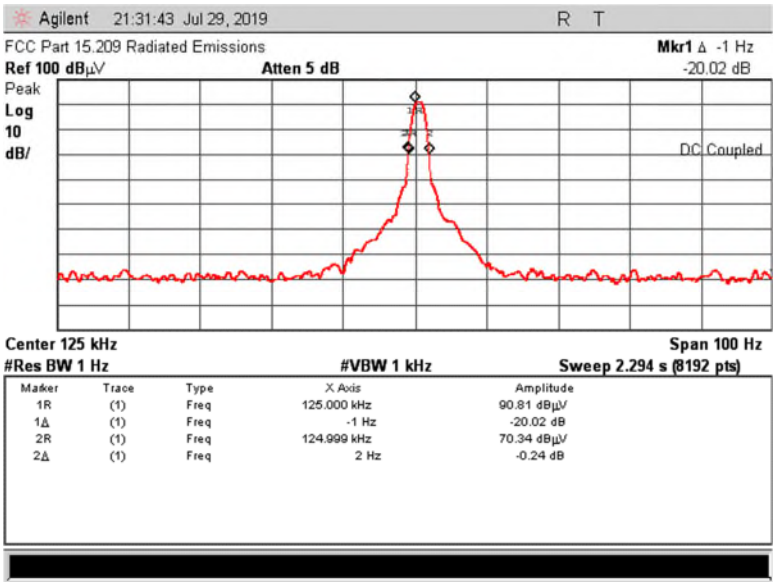


**Figure 2.2.6-1: 20 dB Bandwidth Test Results**

## 2.2.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|---|
| 9kHz-26.5GHz EMC analyzer/HYZ | Agilent | E7405A | BEMC00523 | A.14.06 | 24 | 27-Nov-20 |
| Tile Automation Software | ETS Lindgren | TILE4! - Version 4.2.A | BEMC02095 | 4.2A | N/A | NCR |
| Loop Antenna | Com Power | AL-130 | TEMC00025 | N/A | 24 | 07-Nov-19 |
| EMC Chamber | Panashield | N/A | TEMC00031 | N/A | 24 | 28-Jan-20 |
| Radiated Cable Set 9 kHz - 30 MHz | TUV SUD Tampa | Cable 2 | TEMC00186 | N/A | 12 | 08-May-20 |

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable

## 2.3 99% Bandwidth

### 2.3.1 Specification Reference

ISED Canada: RSS-GEN 6.7

### 2.3.2 Equipment Under Test and Modification State

SN: 4

### 2.3.3 Date of Test

7/29/2019

### 2.3.4 Test Method

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set to 1% to 5% of the approximated bandwidth. The occupied 99% bandwidth was measured by using the delta marker function of the spectrum analyzer across the 99% of the total transmitted power of the fundamental transmitted emission.

### 2.3.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 24°C |
| Relative Humidity | 45.8 % |
| Atmospheric Pressure | 1017.1 mbar |

### 2.3.6 Test Results

AC Powered Operating

Limit Clause ISED RSS-GEN 6.7

The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs

**Table 2.3.6-1: Occupied Bandwidth Test Results**

| Frequency (kHz) | 99% Bandwidth (Hz) |
|---|---|
| 125.0 | 2.0 |

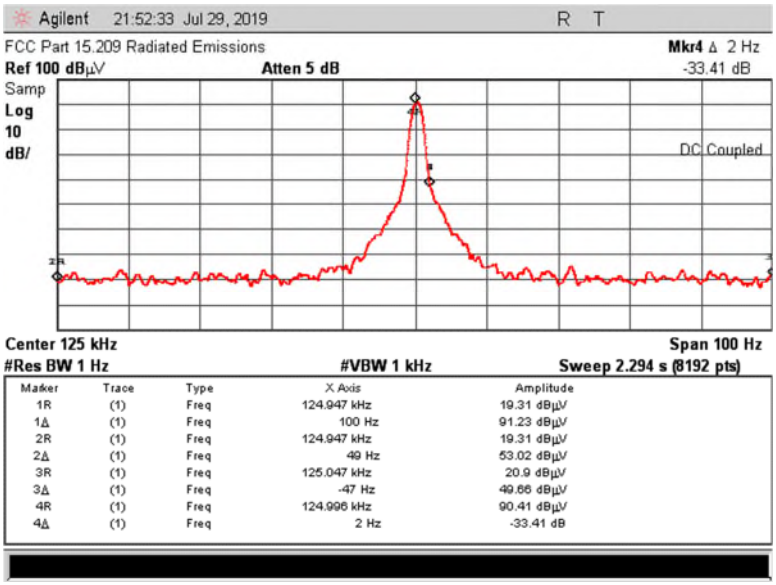


**Figure 2.3.6-1: Occupied Bandwidth Test Results**

Note: The transmitted signal is not modulated. The minimum spectrum analyzer RBW was used for the measurements.

### 2.3.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|---|
| 9kHz-26.5GHz EMC analyzer/HYZ | Agilent | E7405A | BEMC00523 | A.14.06 | 24 | 27-Nov-20 |
| Tile Automation Software | ETS Lindgren | TILE4! - Version 4.2.A | BEMC02095 | 4.2A | N/A | NCR |
| Loop Antenna | Com Power | AL-130 | TEMC00025 | N/A | 24 | 07-Nov-19 |
| EMC Chamber | Panashield | N/A | TEMC00031 | N/A | 24 | 28-Jan-20 |
| Radiated Cable Set 9 kHz - 30 MHz | TUV SUD Tampa | Cable 2 | TEMC00186 | N/A | 12 | 08-May-20 |

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable

## 2.4 Radiated Field Strength and Spurious Emissions

### 2.4.1 Specification Reference

FCC Sections: 15.209;
ISED Canada: RSS-210 2.5

### 2.4.2 Equipment Under Test and Modification State

SN: 4

### 2.4.3 Date of Test

7/29/2019

### 2.4.4 Test Method

Radiated emissions tests were made over the frequency range of 9 kHz to 1 GHz, 10 times the highest fundamental frequency. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in Section 15.209.

For measurements below 30 MHz, the receive antenna height was set to 1 m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements are made with RBW of 1 MHz and VBW of 3 MHz. Average measurements are performed in the linear scale using VBW of 30 Hz.

### 2.4.5 Distance Correction for Measurements below 30 MHz – FCC: Section 15.31

Radiated measurements were performed at a distance closer than 300 meters and 30m as required, according to Part 15.209. Therefore, a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor is shown below for limits expressed at a 300m measurement distance and a 30m measurement distance.

Distance correction factor (300m Specified Test Distance) = 40*Log (Test Distance/300)
= 40*Log (3/300)
= - 80 dB

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (3/30)
= - 40 dB

### 2.4.6 Duty Cycle Correction

The EUT was configured to transmit at 100% duty cycle during the evaluation. No duty cycle correction factor was used for the average measurements.

### 2.4.7 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 24.6 °C |
| Relative Humidity | 41.9 % |
| Atmospheric Pressure | 1014.6 mbar |

### 2.4.8 Test Results

AC Powered Operating

Limit Clause FCC Sections 15.209, ISED Canada: RSS-210 2.5

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.4090-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100** | 3 |
| 88-216 | 150** | 3 |
| 216-960 | 200** | 3 |
| Above 960 | 500 | 3 |

**Table 2.4.8-1: TX Radiated Spurious Emissions**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity (H/V) | Correction Factors (dB) | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pk | Qpk/Avg | | | Pk | Qpk/Avg | Pk | Qpk/Avg | Pk | Qpk/Avg |
| **Fundamental Frequency** | | | | | | | | | | |
| **0.125** | 76.63 | 76.42 | V | 14.64 | 91.27 | 91.06 | 125.7 | 105.7 | 34.4 | 14.6 |
| **Spurious Emissions** | | | | | | | | | | |
| **0.375** | 43.71 | 39.19 | V | 14.62 | 58.33 | 53.81 | 116.1 | 96.1 | 57.8 | 42.3 |
| **0.625** | --------- | 33.22 | V | 14.84 | --------- | 48.06 | -------- | 71.7 | --------- | 23.6 |
| **0.875** | --------- | 28.52 | V | 14.95 | --------- | 43.47 | -------- | 68.8 | --------- | 25.3 |
| **1.125** | --------- | 24.95 | V | 15.24 | --------- | 40.19 | -------- | 66.6 | --------- | 26.4 |
| **1.375** | --------- | 22.37 | V | 15.27 | --------- | 37.64 | -------- | 64.8 | --------- | 27.2 |
| **15.4555** | --------- | 15.67 | V | 14.82 | --------- | 30.49 | -------- | 69.5 | --------- | 39.0 |
| **Emissions from 30 MHz - 1 GHz** | | | | | | | | | | |
| **39.12** | --------- | 11.96 | V | 20.20 | --------- | 32.16 | --------- | 40 | --------- | 7.8 |
| **43.4** | --------- | 6.29 | V | 17.80 | --------- | 24.09 | --------- | 40 | --------- | 15.9 |
| **44.6** | --------- | 4.49 | V | 17.20 | --------- | 21.69 | --------- | 40 | --------- | 18.3 |
| **69.6** | --------- | 12.86 | V | 13.40 | --------- | 26.26 | --------- | 40 | --------- | 13.7 |
| **70.84** | --------- | 9.38 | V | 13.40 | --------- | 22.78 | --------- | 40 | --------- | 17.2 |
| **107.28** | --------- | 1.41 | V | 19.10 | --------- | 20.51 | --------- | 43.5 | --------- | 23.0 |
| **121.72** | --------- | 3.00 | H | 19.80 | --------- | 22.80 | --------- | 43.5 | --------- | 20.7 |
| **494** | --------- | -1.28 | V | 26.50 | --------- | 25.22 | --------- | 46 | --------- | 20.8 |
| **612.08** | --------- | -0.53 | H | 28.30 | --------- | 27.77 | --------- | 46 | --------- | 18.2 |
| **686** | --------- | -0.68 | H | 28.80 | --------- | 28.12 | --------- | 46 | --------- | 17.9 |
| **941.92** | --------- | 0.17 | H | 31.50 | --------- | 31.67 | --------- | 46 | --------- | 14.3 |

Notes:

- The emissions at 125 kHz and 375 kHz were measured with a peak and average detector. All the remaining measurements were performed using a quasi-peak detector.
- The emissions were performed at a test distance of 3 m.

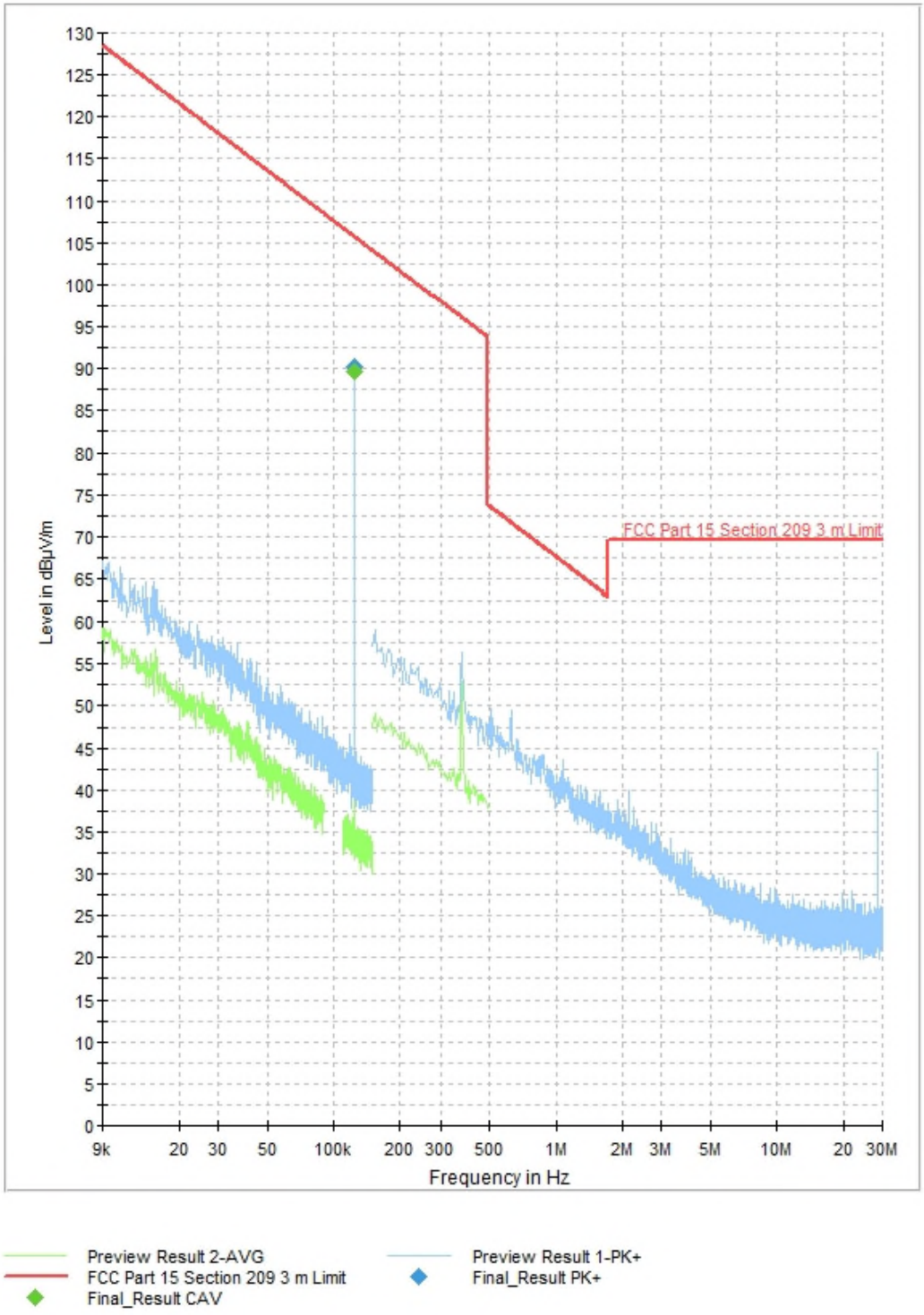


**Figure 2.4.8-1 – Radiated Emissions Plot 9 kHz – 30 MHz**

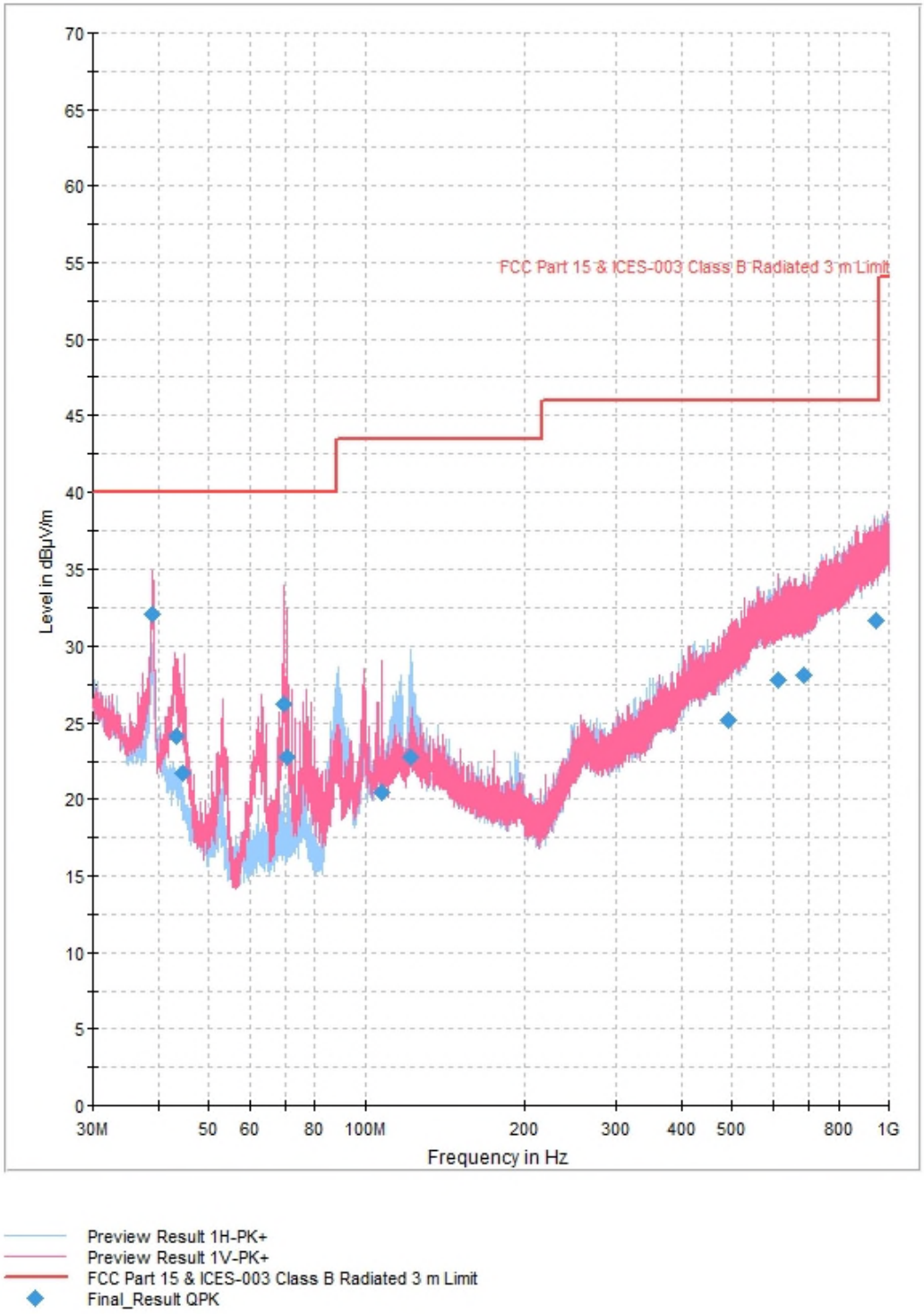


**Figure 2.4.8-2 – Radiated Emissions Plot 30 MHz - 1000 MHz**

### 2.4.9 Sample Calculations

$R_C = R_U + CF_T$

Where:

| | | |
|---|---|---|
| $CF_T$ | = | Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only) |
| $R_U$ | = | Uncorrected Reading |
| $R_C$ | = | Corrected Level |
| AF | = | Antenna Factor |
| CA | = | Cable Attenuation |
| AG | = | Amplifier Gain |
| DC | = | Duty Cycle Correction Factor |

**Example Calculation: Peak**
Corrected Level: 43.71 + 14.62 = 58.33 dBµV/m
Margin: 116.1 dBµV/m – 58.33 dBµV/m = 57.77 dB

**Example Calculation: Average**
Corrected Level: 39.19 + 14.62 - 0 = 53.81 dBµV/m
Margin: 96.1 dBµV/m – 53.81 dBµV/m = 42.29 dB

### 2.4.10 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|---|
| 9kHz-26.5GHz EMC analyzer/HYZ | Agilent | E7405A | BEMC00523 | A.14.06 | 24 | 27-Nov-20 |
| Tile Automation Software | ETS Lindgren | TILE4! - Version 4.2.A | BEMC02095 | 4.2A | N/A | NCR |
| BI LOG PERIODIC, ANTENNA | Schaffner | CBL6112B | TEMC00005 | N/A | 24 | 19-Dec-19 |
| Loop Antenna | Com Power | AL-130 | TEMC00025 | N/A | 24 | 07-Nov-19 |
| EMC Chamber | Panashield | N/A | TEMC00031 | N/A | 24 | 28-Jan-20 |
| EMI Test Receiver | Rohde & Schwarz | ESIB 40 | TEMC00128 | N/A | 24 | 16-Nov-19 |
| Radiated Cable Set 30 MHz - 1 GHz | TUV SUD Tampa | Cable 2 | TEMC00179 | N/A | 12 | 07-May-20 |
| Test Software | Rohde & Schwarz | EMC32 | TEMC00184 | N/A | N/A | NCR |
| Radiated Cable Set 9 kHz - 30 MHz | TUV SUD Tampa | Cable 2 | TEMC00186 | N/A | 12 | 08-May-20 |

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable

## 2.5 Power Line Conducted Emissions

### 2.5.1 Specification Reference

FCC: Section 15.207
ISED Canada; RSS-GEN 8.8

### 2.5.2 Equipment Under Test and Modification State

SN: 4

### 2.5.3 Date of Test

8/14/2019

### 2.5.4 Test Method

ANSI C63.10 section 6.2 was the guiding document for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**
**Margin = Applicable Limit - Corrected Reading**

### 2.5.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 24.3 °C |
| Relative Humidity | 44.3 % |
| Atmospheric Pressure | 1013.3 mbar |

### 2.5.6 Test Results

| 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.

**Table 2.5.6-1: Power Line Conducted Emissions – Quasi-Peak Detector Results**

| Frequency (MHz) | Quasi-peak (dBµV) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|
| 0.159000 | 51.61 | L1 | 10.0 | 13.91 | 65.52 |
| 0.213000 | 43.22 | L1 | 10.0 | 19.87 | 63.09 |
| 0.528000 | 42.32 | L1 | 10.0 | 13.68 | 56.00 |
| 0.892500 | 32.78 | N | 10.1 | 23.22 | 56.00 |
| 1.279500 | 31.66 | N | 10.2 | 24.34 | 56.00 |
| 4.893000 | 29.10 | N | 10.5 | 26.90 | 56.00 |
| 10.374000 | 37.65 | L1 | 11.0 | 22.35 | 60.00 |
| 10.626000 | 46.85 | L1 | 11.0 | 13.15 | 60.00 |
| 10.873500 | 38.14 | L1 | 11.0 | 21.86 | 60.00 |
| 29.373000 | 38.36 | L1 | 12.3 | 21.64 | 60.00 |

**Table 2.5.6-2: Power Line Conducted Emissions – Average Detector Results**

| Frequency (MHz) | Average (dBµV) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|
| 0.159000 | 46.04 | L1 | 10.0 | 9.48 | 55.52 |
| 0.249000 | 32.88 | L1 | 10.0 | 18.91 | 51.79 |
| 0.541500 | 38.14 | L1 | 10.0 | 7.86 | 46.00 |
| 0.609000 | 34.31 | L1 | 10.0 | 11.69 | 46.00 |
| 0.892500 | 29.47 | N | 10.1 | 16.53 | 46.00 |
| 1.279500 | 28.15 | N | 10.2 | 17.85 | 46.00 |
| 5.577000 | 24.75 | N | 10.6 | 25.25 | 50.00 |
| 10.374000 | 33.91 | L1 | 11.0 | 16.09 | 50.00 |
| 10.626000 | 46.69 | N | 11.0 | 3.31 | 50.00 |
| 29.625000 | 37.93 | L1 | 12.3 | 12.07 | 50.00 |

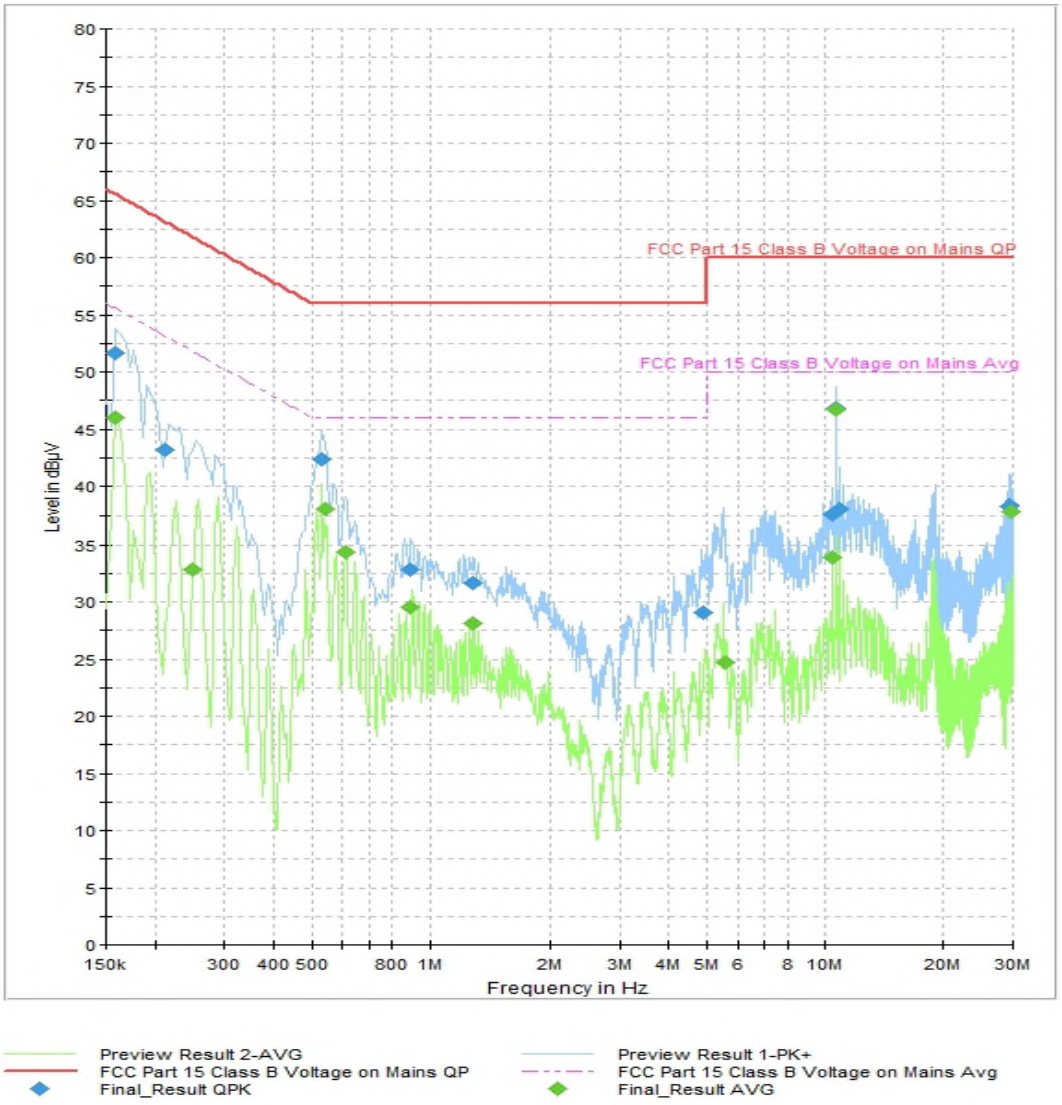


**Figure 2.5.6-1: Graphical Results – AC Mains Composite Line and Neutral Plot**

### 2.5.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|---|
| LISN | Rohde & Schwarz | ESH3-Z5 | TEMC00002 | N/A | 12 | 27-Sep-19 |
| EMI Test Receiver | Rohde & Schwarz | ESCS30 | TEMC00011 | N/A | 24 | 17-Nov-19 |
| RFI/EMI Shielded Enclosure | UNIVERSAL SHIELDING CORP. | N/A | TEMC00100 | N/A | N/A | NCR |
| Test Software | Rohde & Schwarz | EMC32 | TEMC00184 | N/A | N/A | NCR |

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable

# 3 Test Equipment Information

## 3.1 General Test Equipment Used

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|---|---|---|---|---|---|---|
| 9kHz-26.5GHz EMC analyzer/HYZ | Agilent | E7405A | BEMC00523 | A.14.06 | 24 | 27-Nov-20 |
| Tile Automation Software | ETS Lindgren | TILE4! - Version 4.2.A | BEMC02095 | 4.2A | N/A | NCR |
| LISN | Rohde & Schwarz | ESH3-Z5 | TEMC00002 | N/A | 12 | 27-Sep-19 |
| BI LOG PERIODIC, ANTENNA | Schaffner | CBL6112B | TEMC00005 | N/A | 24 | 19-Dec-19 |
| EMI Test Receiver | Rohde & Schwarz | ESCS30 | TEMC00011 | N/A | 24 | 17-Nov-19 |
| Loop Antenna | Com Power | AL-130 | TEMC00025 | N/A | 24 | 7-Nov-19 |
| EMC Chamber | Panasheild | N/A | TEMC00031 | N/A | 24 | 28-Jan-20 |
| RFI/EMI Shielded Enclosure | UNIVERSAL SHIELDING CORP. | N/A | TEMC00100 | N/A | N/A | NCR |
| EMI Test Receiver | Rohde & Schwarz | ESIB 40 | TEMC00128 | N/A | 24 | 16-Nov-19 |
| Radiated Cable Set 30 MHz - 1 GHz | TUV SUD Tampa | Cable 2 | TEMC00179 | N/A | 12 | 7-May-20 |
| Test Software | Rohde & Schwarz | EMC32 | TEMC00184 | N/A | N/A | NCR |
| Radiated Cable Set 9 kHz - 30 MHz | TUV SUD Tampa | Cable 2 | TEMC00186 | N/A | 12 | 8-May-20 |

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable

# 4 Diagram of Test Set-ups

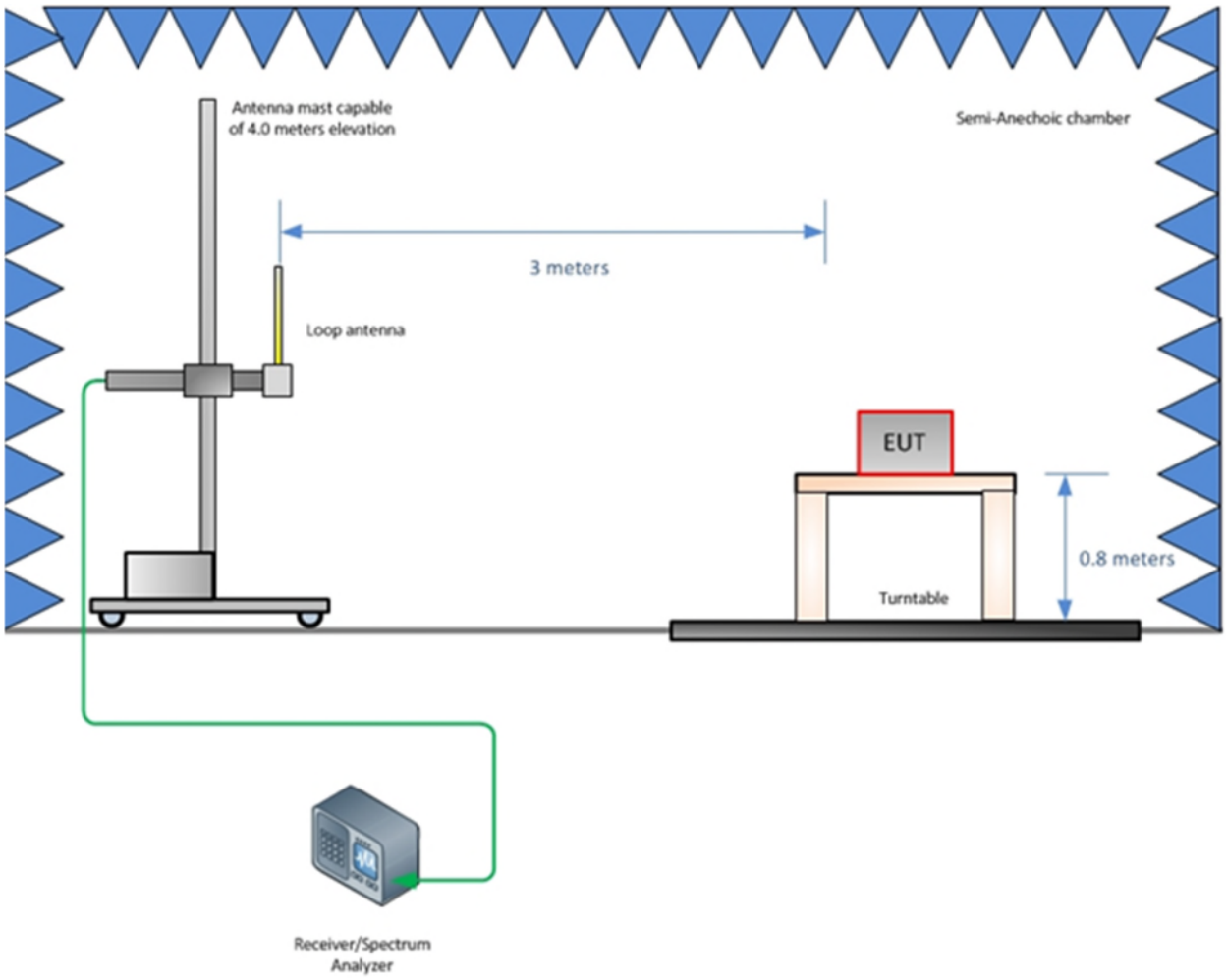


**Figure 4-1 - Radiated Emission Test Setup Below 30 MHz**

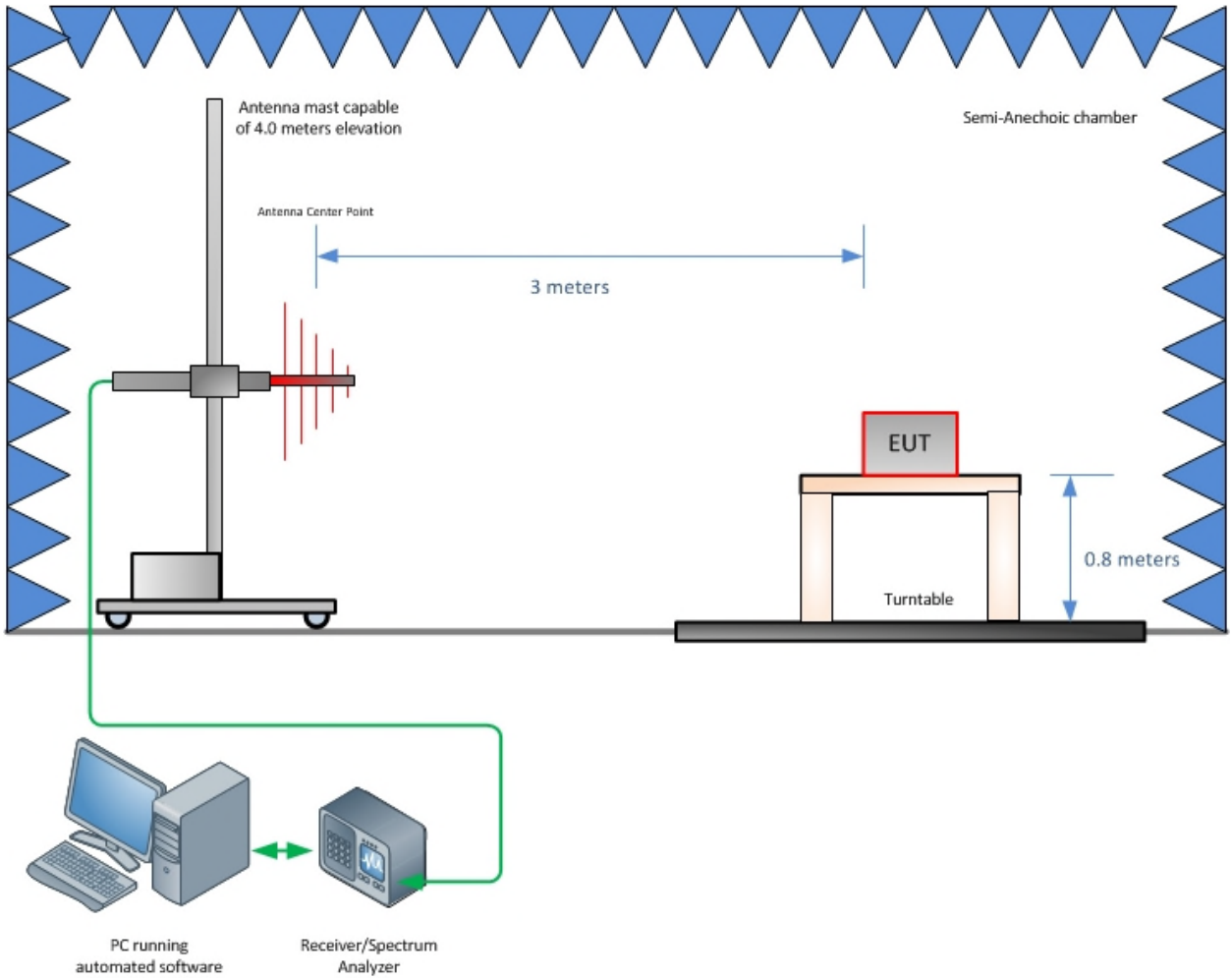


**Figure 4-2 - Radiated Emissions Test Setup up to 1 GHz**

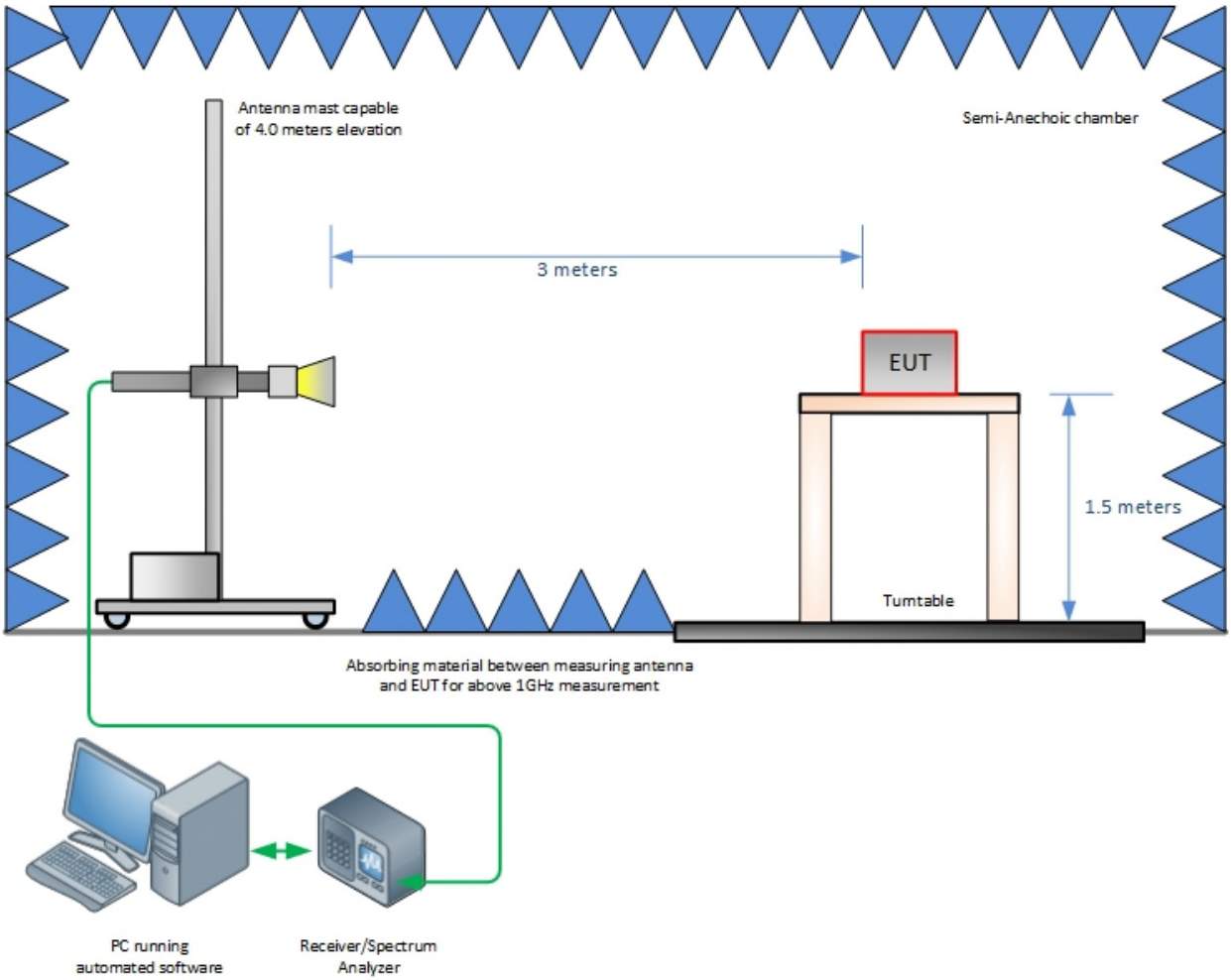


**Figure 4-3 - Radiated Emissions Test Setup above 1 GHz**

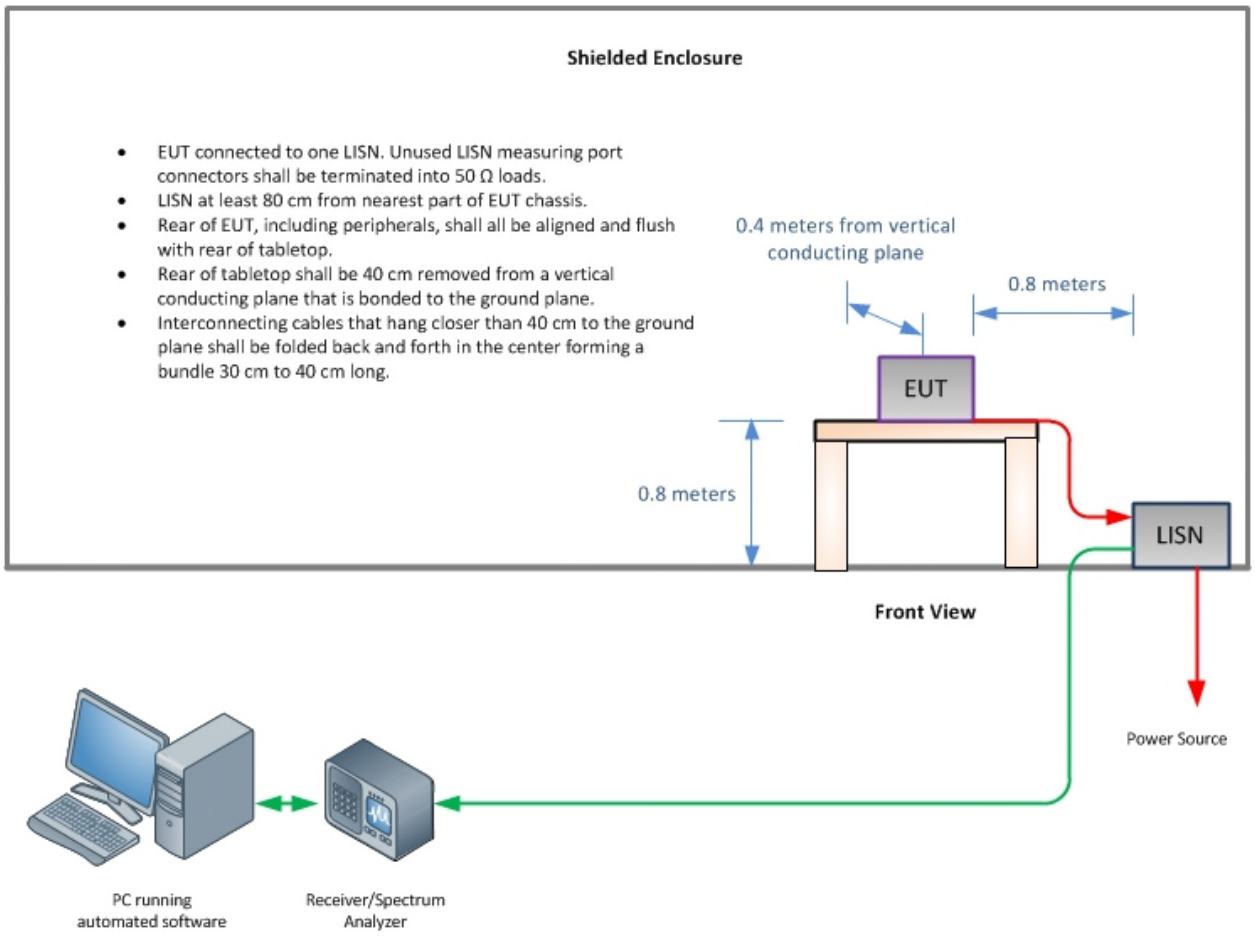


**Figure 4-4 – Conducted Emissions Test Setup**

# 5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

**Table 5-1 - Values of $U_{cispr}$ and $U_{Lab}$**

| Measurement | $U_{cispr}$ | $U_{Lab}$ |
|---|---|---|
| Conducted disturbance (mains port)<br>(9 kHz – 150 kHz)<br>(150 kHz – 30 MHz) | <br>3.8 dB<br>3.4 dB | <br>3.71 dB<br>3.31 dB |
| Conducted disturbance (telecom port)<br>(150 kHz – 30 MHz 55 dB LCL)<br>(150 kHz – 30 MHz 65 dB LCL)<br>(150 kHz – 30 MHz 75 dB LCL) | <br>5.0 dB<br>5.0 dB<br>5.0 dB | <br>4.11 dB<br>4.50 dB<br>4.94 dB |
| Radiated disturbance (electric field strength on an open area test site or alternative test site)<br>(30 MHz – 1 000 MHz)<br>(1 – 6 GHz)<br>(6-18 GHz) | <br>6.3 dB<br>5.2 dB<br>5.5 dB | <br>5.85 dB<br>4.48 dB<br>4.48 dB |

**Notes:**

***U*cispr** resembles a value of measurement uncertainty for a specific test, which was determined by considering uncertainties associated with the quantities listed in CISPR 16-4-2:2011.

Compliance or non-compliance with a disturbance limit shall be determined in the following manner.

If $U_{Lab}$ is less than or equal to $U_{cispr}$ in Table 5.0-1, then:
- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If $U_{Lab}$ is greater than $U_{cispr}$, then:
- compliance is deemed to occur if no measured disturbance, increased by ($U_{Lab}$ – $U_{cispr}$), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by ($U_{Lab}$ – $U_{cispr}$), exceeds the disturbance limit.

The TÜV SÜD AMERICA, Inc. calculated MU is less than the internationally accepted MU, therefore an adjustment to the measured result as mentioned above is not necessary.

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