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# Report On

Radio Testing of the  
KABA GmbH  
KABA 91 25 Remote Reader

FCC Part 15 Subpart C §15.225

Report No. SD72119117-0816G

October 2016



|                           |                                                                                                                                                                                     |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>REPORT ON</b>          | Radio Testing of the<br>KABA GmbH<br>Remote Reader                                                                                                                                  |
| <b>TEST REPORT NUMBER</b> | SD72119117-0816G                                                                                                                                                                    |
| <b>REPORT DATE</b>        | October 2016                                                                                                                                                                        |
| <b>PREPARED FOR</b>       | Mr. Markus Jäckle                                                                                                                                                                   |
| <b>PREPARED BY</b>        | <br>_____<br>Juan Manuel Gonzalez<br><b>Name</b><br>Title: EMC Service Line Manager Western region |
| <b>APPROVED BY</b>        | <br>_____<br>Chip R. Fleury<br><b>Name</b><br>Authorized Signatory<br>Title: Regional EMC manager  |
| <b>DATED</b>              | _____<br>October 05, 2016                                                                                                                                                           |



## Revision History

| SD72119117-0816G<br>KABA GmbH<br>KABA 91 25<br>Remote Reader |                 |              |        |                   |             |
|--------------------------------------------------------------|-----------------|--------------|--------|-------------------|-------------|
| DATE                                                         | OLD REVISION    | NEW REVISION | REASON | PAGES<br>AFFECTED | APPROVED BY |
| 10/05/2016                                                   | Initial Release |              |        |                   | Chip Fleury |
|                                                              |                 |              |        |                   |             |
|                                                              |                 |              |        |                   |             |
|                                                              |                 |              |        |                   |             |
|                                                              |                 |              |        |                   |             |

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## **SECTION 1**

### **REPORT SUMMARY**

Radio Testing of the  
KABA 91 25  
KABA GmbH  
Remote Reader



## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the KABA GmbH Remote Reader to the requirements of FCC Part 15 Subpart C §15.225.

|                               |                                                                                                                                                       |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective                     | To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out. |
| Manufacturer                  | KABA GmbH                                                                                                                                             |
| Model Number(s)               | KABA 91 25                                                                                                                                            |
| FCC ID Number                 | NVI-KRR9125-K5                                                                                                                                        |
| IC Number                     | 11038A-KRR9125K5                                                                                                                                      |
| Serial Number(s)              | Engineering Sample                                                                                                                                    |
| Number of Samples Tested      | 1                                                                                                                                                     |
| Test Specification/Issue/Date | <ul style="list-style-type: none"><li>FCC Part 15 Subpart C §15.225 (October 1, 2015).</li></ul>                                                      |
| Start of Test                 | July 16, 2016                                                                                                                                         |
| Finish of Test                | October 05, 2016                                                                                                                                      |
| Name of Engineer(s)           | Juan Manuel Gonzalez<br>Kathy Mackenzie                                                                                                               |
| Related Document(s)           | None. Supporting documents for EUT certification are separate exhibits.                                                                               |

## 1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.225.

| Section | FCC Part 15     | §15.225 Spec Clause | Test Description            | Result    | Comments/Base Standard |
|---------|-----------------|---------------------|-----------------------------|-----------|------------------------|
|         | §15.31(e)       |                     | Voltage Requirement         | Compliant | §15.225(e)             |
|         | §15.203 and 204 |                     | Antenna Requirements        | Compliant | See Test Note          |
| 2.1     |                 | §15.225(e)          | Frequency Tolerance         | Compliant |                        |
| 2.2     | §15.215(c)      |                     | 20dB Bandwidth              | Compliant |                        |
| 2.3     |                 | §15.225(a)(b)(c)    | Emission Mask               | Compliant |                        |
| 2.4     | §15.209         | §15.225(d)          | Spurious Radiated Emissions | Compliant |                        |
| 2.5     |                 | §15.207(a)          | Conducted Emissions         | Compliant |                        |

Test Note: This requirement does not apply to intentional radiators that are professionally installed.

### 1.3 PRODUCT INFORMATION

#### 1.3.1 Technical Description

The Equipment Under Test (EUT) was a KABA GmbH Remote Reader KABA 91 25 as shown in the photograph below. The EUT has 2 antenna ports (for diversity communication) and at the time of the test 4 different antennas were evaluated:

- Kaba registration unit 90 00
- Kone registration unit 90 00
- Kone registration unit 90 01
- Kone registration unit 90 02



#### Equipment Under Test

Antenna: Kaba registration unit 90 00



Antenna: KONE registration unit 90 00



Antenna: Kaba registration unit 90 01 / KONE registration unit



Antenna: Kaba registration unit 90 02 / KONE registration unit



#### Antennas

### 1.3.2 EUT General Description

|                                 |                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| EUT Description                 | Remote Reader                                                                                                            |
| Model Number(s)                 | KABA 91 25                                                                                                               |
| Rated Voltage                   | 10-34 VDC ( Nominal Voltage 24VDC)                                                                                       |
| EUT RFID Field Strength         | <b>69.65</b> dB $\mu$ V/m @ 3 meters                                                                                     |
| Frequency Range                 | 13.56 MHz in the 13.110 to 14.0101 MHz band                                                                              |
| Number of Operating Frequencies | 1                                                                                                                        |
| Modulation Used                 | ASK                                                                                                                      |
| Antenna(s) Dimension            | Kaba 90 00: 4,0 cm x 4,0 cm<br>Kone 90 00: 4,2 cm x 3,5 cm<br>Kone 90 01: 7,5 cm x 7,5 cm<br>Kaba 90 02: 7,5 cm x 7,5 cm |

## 1.4 EUT TEST CONFIGURATION

### 1.4.1 Test Configuration Description

| Test Configuration | Description                                                                              |
|--------------------|------------------------------------------------------------------------------------------|
| A                  | Antennas Kaba registration unit 90 00 and Kone registration unit 90 01 connected to EUT. |
| B                  | Antennas Kone registration unit 90 00 and Kone registration unit 90 02 connected to EUT. |
| C                  | Antenna ports terminated with 50 Ohms loads for Conducted emissions test.                |

### 1.4.2 EUT Exercise Software

None. No special software was used during evaluation. The EUT was transmitting continuously after start-up.

### 1.4.3 Support Equipment and I/O cables

| Manufacturer | Equipment/Cable | Description |
|--------------|-----------------|-------------|
| N/A          | N/A             | -           |

### 1.4.4 Simplified Test Configuration Diagrams





## 1.5 DEVIATIONS FROM THE STANDARD

All deviations made during testing from the applicable test standards or test plan are detailed under Section 1.2 of this test report.

## 1.6 MODIFICATION RECORD

| Description of Modification       | Modification Fitted By | Date Modification Fitted |
|-----------------------------------|------------------------|--------------------------|
| Serial Number: Engineering Sample |                        |                          |
| N/A                               |                        |                          |

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

## 1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

## 1.8 TEST FACILITY LOCATION

### 1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

### 1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678 1400 FAX: 858-546 0364

## 1.9 TEST FACILITY REGISTRATION

### 1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.498 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.



**1.9.2 Industry Canada (IC) Registration No.: 3067A**

The Semi-anechoic chamber of TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.

**1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)**

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

**1.9.4 VCCI – Registration No. A-0132**

TUV SUD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.



## **SECTION 2**

### **TEST DETAILS**

Radio Testing of the  
KABA 91 25  
KABA GmbH  
Remote Reader



## **2.1 FREQUENCY STABILITY**

### **2.1.1 Specification Reference**

Part 15 Subpart C §15.225(e)

### **2.1.2 Standard Applicable**

(e) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

### **2.1.3 Equipment Under Test and Modification State**

Serial No: Engineering Sample / Test was performed at Model KABA 9200 transmitting with antenna Kone registration unit 90 01. Report # SD72119117-0816C (Data representative for this model)

### **2.1.4 Date of Test/Initial of test personnel who performed the test**

August 4, 2016 /JMG

### **2.1.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.1.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Mira Mesa Laboratory

|                     |          |
|---------------------|----------|
| Ambient Temperature | 24.2°C   |
| Relative Humidity   | 45.9%    |
| ATM Pressure        | 99.1 kPa |

### **2.1.7 Additional Observations**

- The temperature was varied from  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  in 10 degree increments with a nominal voltage of 24VDC, then the voltage was changed from 10VDC to 34VDC (Max. and Min. rated voltage) maintaining a temperature of  $20^{\circ}\text{C}$ .

## 2.1.8 Test Results

| RFID @ 13.56MHz |             |           |                     |                     |               |
|-----------------|-------------|-----------|---------------------|---------------------|---------------|
| Voltage (%)     | Power (VDC) | Temp (°C) | Frequency (Hz)      | Frequency Deviation | Deviation (%) |
| 100             | 24.0        | -20       | 13.559879808        | 0.000120192         | 0.000886372   |
| 100             |             | -10       | 13.559639423        | 0.000360577         | 0.002659122   |
| 100             |             | 0         | 13.559879808        | 0.000120192         | 0.000886372   |
| 100             |             | +10       | 13.559639923        | 0.000360077         | 0.002655435   |
| 100             |             | +20       | 13.559879808        | 0.000120192         | 0.000886372   |
| 100             |             | +30       | 13.559879808        | 0.000120192         | 0.000886372   |
| 100             |             | +40       | 13.559569802        | 0.000430198         | 0.003172552   |
| 100             |             | +50       | <b>13.559278846</b> | <b>0.000721154</b>  | 0.005318245   |
| 41.66           | 10.0        | +20       | 13.559879808        | 0.000120192         | 0.000886372   |
| 62.5            | 15.0        | +20       | 13.559399038        | 0.000600962         | 0.004431873   |
| 83.33           | 20.0        | +20       | 13.559879808        | 0.000120192         | 0.000886372   |
| 100             | 24.0        | +20       | 13.559879808        | 0.000120192         | 0.000886372   |
| 116.66          | 28.0        | +20       | 13.559879808        | 0.000120192         | 0.000886372   |
| 133.33          | 32.0        | +20       | 13.559879808        | 0.000120192         | 0.000886372   |
| 141.66          | 34.0        | +20       | 13.559879808        | 0.000120192         | 0.000886372   |

**Maximum Deviation Allowed** = 0.001356MHz < 0.01% (13.558644MHz to 13.561356MHz)

**Maximum Deviation Recorded** = 0.000721154 (Complies)

## 2.1.9 Test Set Up Pictures





## **2.2 20 dB BANDWIDTH**

### **2.2.1 Specification Reference**

Part 15 Subpart C §15.215(c)

### **2.2.2 Standard Applicable**

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

### **2.2.3 Equipment Under Test and Modification State**

Serial No: Engineering Sample / Test Configuration A and B

### **2.2.4 Date of Test/Initial of test personnel who performed the test**

July 16, 2016 /JMG

### **2.2.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.2.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Mira Mesa laboratory

|                     |          |
|---------------------|----------|
| Ambient Temperature | 24.0°C   |
| Relative Humidity   | 46.0%    |
| ATM Pressure        | 98.4 kPa |

### **2.2.7 Additional Observations**

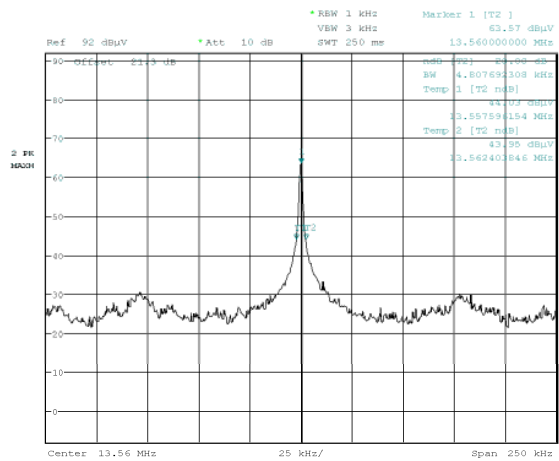
- This is a conducted test.
- A transducer factor (TDF) was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is set to 1 kHz.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.

- The “n” dB down marker function of the spectrum analyzer was used for this test.

## 2.2.8 Test Results

| Frequency | 20dB bandwidth |
|-----------|----------------|
| 13.56 MHz | 5.21 kHz       |

KABA 90 00

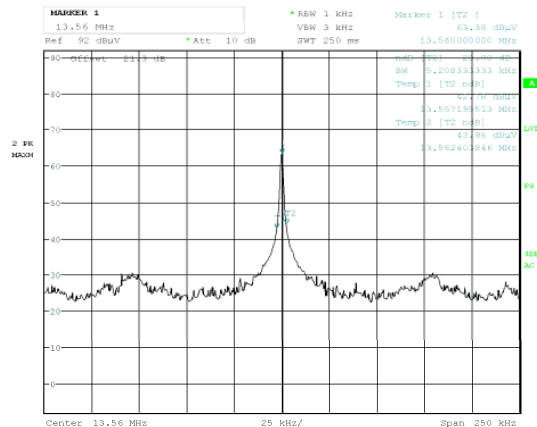


Date: 16.JUL.2016 09:27:38

Measured 20dB Bandwidth: 4.8 kHz  
 Frequency Band: 13.110 to 14.010 MHz

$13.56 \text{ MHz} - (20\text{dB BW}/2) = 13.5576\text{MHz}$  (within the frequency band - **Compliant**)  
 $13.56 \text{ MHz} + (20\text{dB BW}/2) = 13.5624\text{MHz}$  (within the frequency band - **Compliant**)

# KONE 90 00

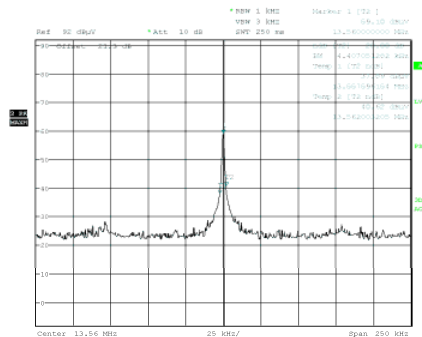


Date: 16.JUL.2016 09:23:45

Measured 20dB Bandwidth: 5.21 kHz  
 Frequency Band: 13.110 to 14.010 MHz

13.56 MHz – (20dB BW/2) = 13.557395MHz (within the frequency band - **Compliant**)  
 13.56 MHz + (20dB BW/2) = 13.562605MHz (within the frequency band - **Compliant**)

# KONE 90 01

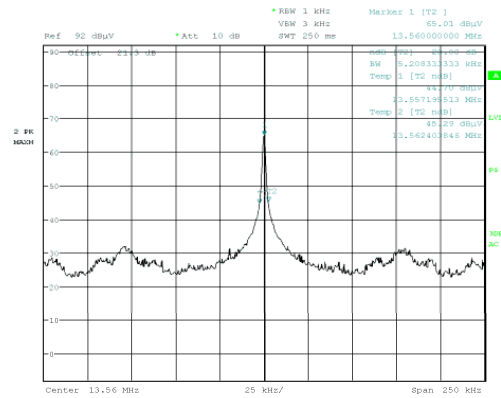


Date: 16.JUL.2016 09:30:36

Measured 20dB Bandwidth: 4.4 kHz  
 Frequency Band: 13.110 to 14.010 MHz

13.56 MHz – (20dB BW/2) = 13.5578 MHz (within the frequency band - **Compliant**)  
 13.56 MHz + (20dB BW/2) = 13.5622MHz (within the frequency band - **Compliant**)

# KONE 90 02



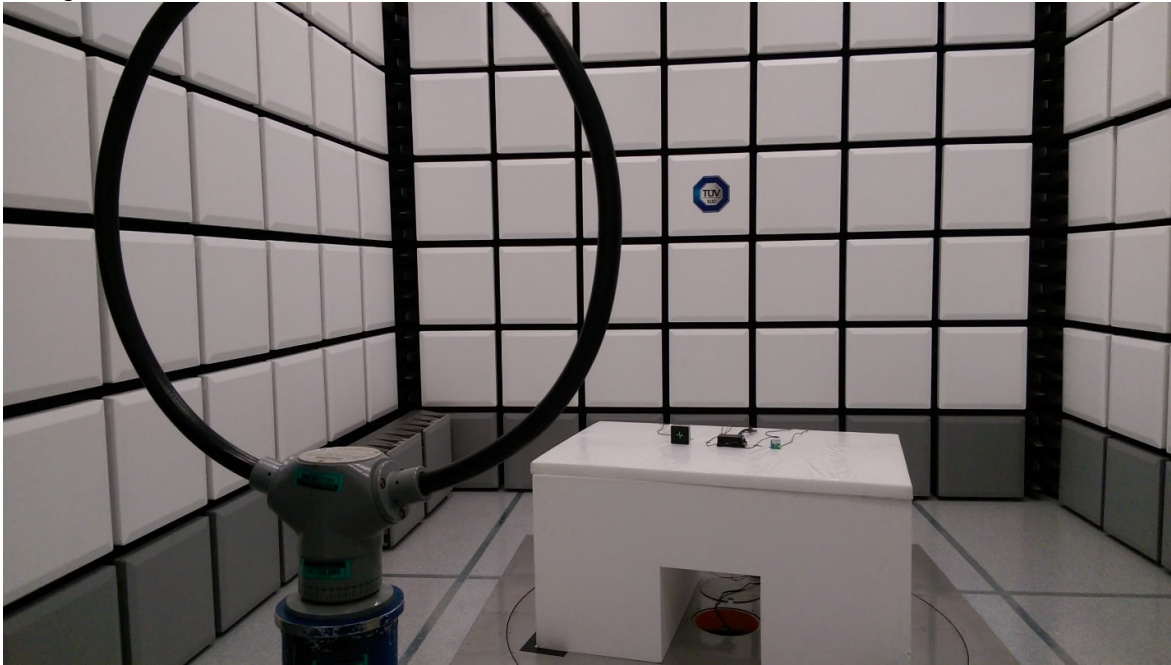
Date: 16.JUL.2016 09:19:43

Measured 20dB Bandwidth: 5.21 kHz  
 Frequency Band: 13.110 to 14.010 MHz

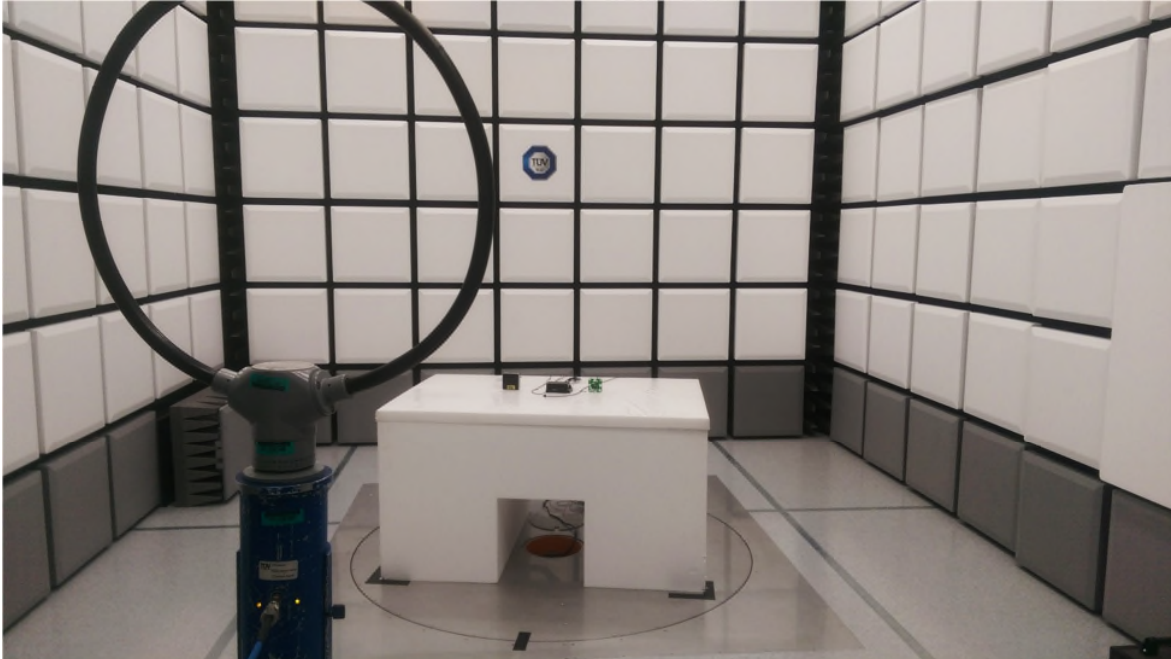
13.56 MHz – (20dB BW/2) = 13.557395MHz (within the frequency band - **Compliant**)  
 13.56 MHz + (20dB BW/2) = 13.562605MHz (within the frequency band - **Compliant**)

## 2.2.9 Test Set up Pictures

Configuration A



Configuration B





## **2.3 EMISSION MASK**

### **2.3.1 Specification Reference**

Part 15 Subpart C §15.225(a)(b)(c)

### **2.3.2 Standard Applicable**

- (a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

### **2.3.3 Equipment Under Test and Modification State**

Serial No: Engineering Sample / Test Configuration A & B

### **2.3.4 Date of Test/Initial of test personnel who performed the test**

August 03, 2016 /JMG

### **2.3.5 Test Equipment Used**

The major items of test equipment used for the above tests are identified in Section 3.1.

### **2.3.6 Environmental Conditions/ Test Location**

Test performed at TÜV SÜD America Inc. Mira Messa Laboratory

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.0°C   |
| Relative Humidity   | 46.6%    |
| ATM Pressure        | 99.0 kPa |

### **2.3.7 Additional Observations**

- This is a radiated test. The spectrum was searched from 9kHz to 30MHz. Only 13.110 MHz to 14.010 MHz presented. There are no significant emissions observed other than the fundamental frequency (13.56 MHz) measured at 3 meters.
- Limits were converted from 30 meters to 3 meters using worst case 20 dB/decade extrapolation rules. Measurement was focused on the RFID system and not the host.
- Measurement was done using EMC32 V9.26.0 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.3.1 for sample computation.

### 2.3.1 Sample Computation (Radiated Emission)

|                                                             |                        |      |      |
|-------------------------------------------------------------|------------------------|------|------|
| Measuring equipment raw measurement (db $\mu$ V) @ 13.56MHz |                        |      | 15.0 |
| Correction Factor (dB)                                      | Asset# 1026 (cable)    | 0.6  | 21.5 |
|                                                             | Asset# 1057 3m (cable) | 0.7  |      |
|                                                             | Asset# 6628 (antenna)  | 19.9 |      |
|                                                             | Asset# 1187(cable)     | 0.3  |      |
| Reported QuasiPeak Final Measurement (db $\mu$ V/m) @ 30MHz |                        |      | 36.5 |

### 2.3.2 Sample Computation (Limits)

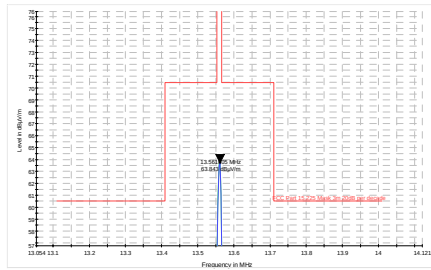
|                                       |                               |
|---------------------------------------|-------------------------------|
| Limit @ 13.553–13.567 MHz:            | = 15,848 $\mu$ V/m @30 meters |
|                                       | = 20 log(15,848 $\mu$ V/m)    |
|                                       | = 84 dB $\mu$ V/m @30 meters  |
| Using 20dB/decade extrapolation rule: | = 20 log (30m/3m)             |
| Measuring distance correction factor: | = 20 dB                       |
| Calculated limit @ 3 meters:          | = 84 dB $\mu$ V/m + 20 dB     |
|                                       | = 104 dB $\mu$ V/m            |

### 2.3.3 Test Results

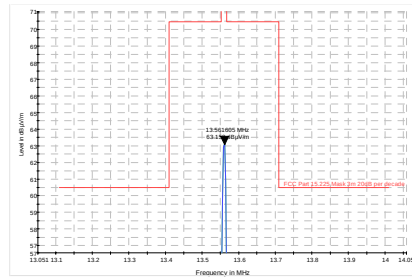
See attached plots.

## 2.3.4 Test Results Pre Scans Individual antennas

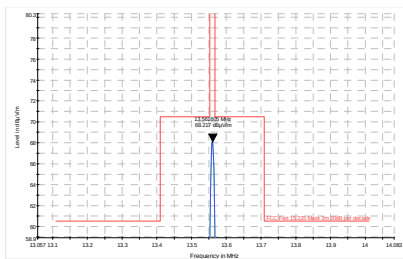
KABA 9000 13-14MHz



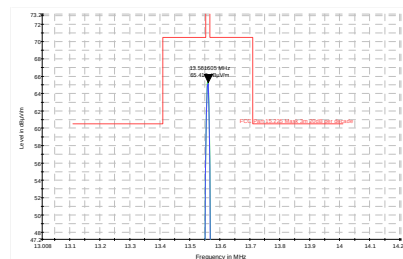
KONE 9000 13-14MHz



KONE 9001 13-14MHz

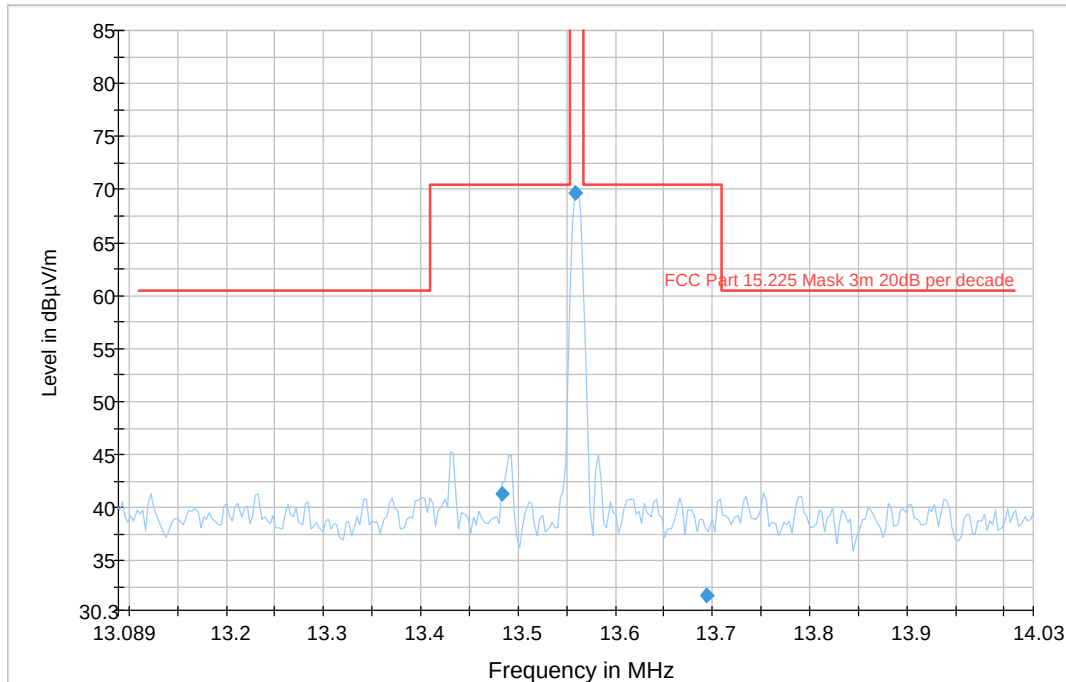


KONE 9002 13-14MHz



### 2.3.5 Test Results TEST MODE A (Worst Case presented only)

Full Spectrum



## Final Result

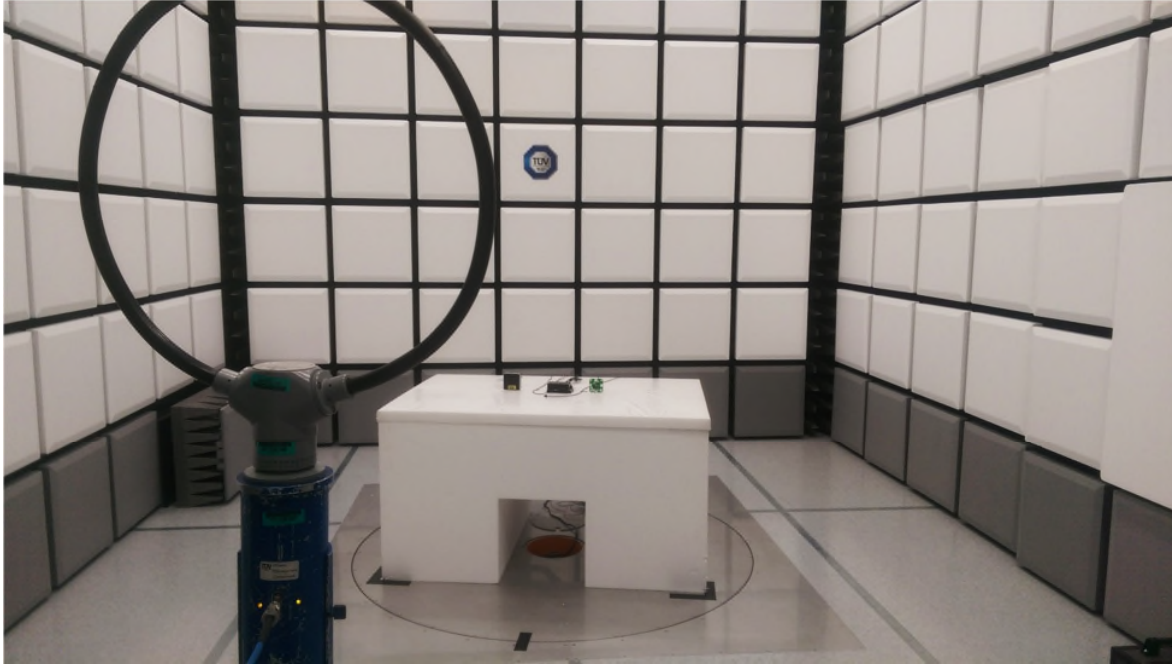
| Frequency (MHz) | QP (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Pol | Azimuth (deg) | Corr. (dB) | Comment     |
|-----------------|-------------------|----------------------|-------------|-----------------|-----------------|-----|---------------|------------|-------------|
| 13.483265       | 41.38             | 70.47                | 29.09       | 1000.0          | 9.000           | H   | 300.0         | 21.2       |             |
| 13.558605       | 69.65             | 104.00               | 34.35       | 1000.0          | 9.000           | H   | 322.0         | 21.3       | FUNDAMENTAL |
| 13.693645       | 31.77             | 70.47                | 38.70       | 1000.0          | 9.000           | H   | 39.0          | 21.3       |             |

### 2.3.6 Test Set Up Pictures

Configuration A



Configuration B





## 2.4 SPURIOUS RADIATED EMISSIONS

### 2.4.1 Specification Reference

Part 15 Subpart C §15.225(d)

### 2.4.2 Standard Applicable

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

### 2.4.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Test Configuration A

### 2.4.4 Date of Test/Initial of test personnel who performed the test

August 03, 2016 /JMG

### 2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Mira Mesa Laboratory

|                     |          |
|---------------------|----------|
| Ambient Temperature | 25.0°C   |
| Relative Humidity   | 46.6%    |
| ATM Pressure        | 99.0 kPa |

### 2.4.7 Additional Observations

- This is a radiated test. The spectrum was searched from 9KHz to 1GHz.
- Measurement was done using EMC32 V9.26.0 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.4.8 for sample computation.

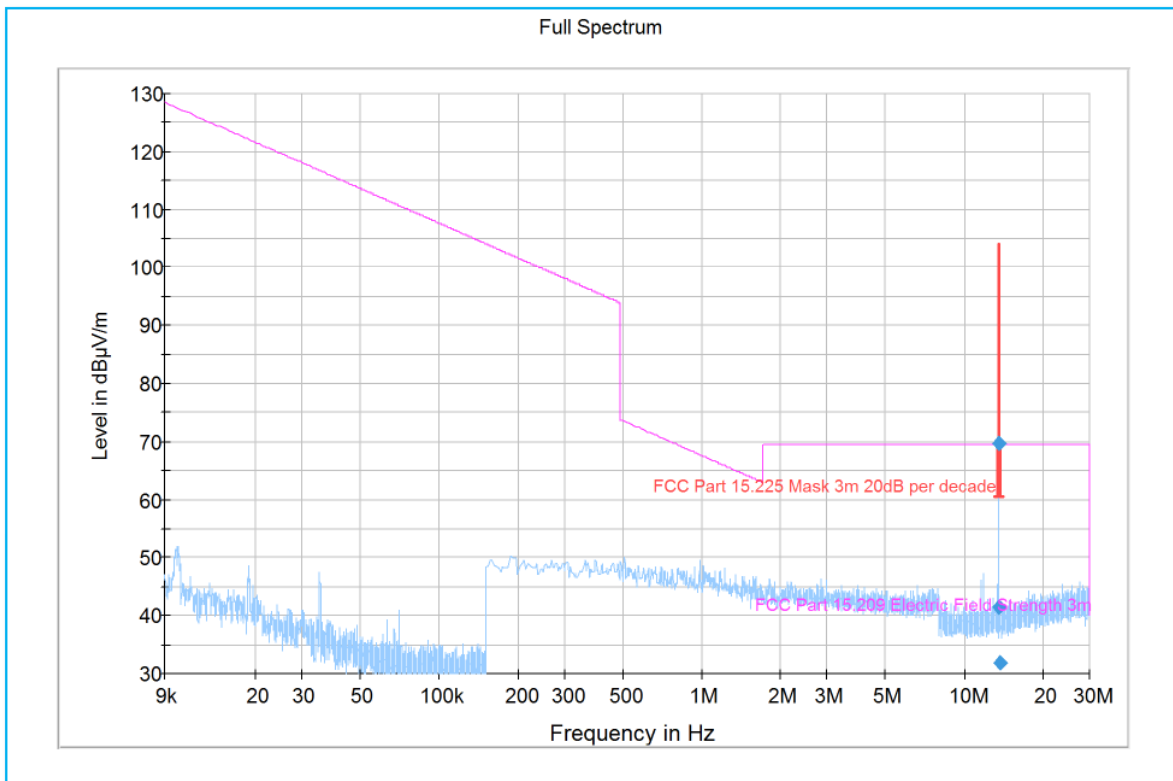
### 2.4.8 Sample Computation (Radiated Emission)

|                                                       |                            |       |       |
|-------------------------------------------------------|----------------------------|-------|-------|
| Measuring equipment raw measurement (dbμV) @ 30 MHz   |                            |       | 24.4  |
| Correction Factor (dB)                                | Asset# 1066 (cable)        | 0.3   | -12.6 |
|                                                       | Asset# 1172 (cable)        | 0.3   |       |
|                                                       | Asset# 1016 (preamplifier) | -30.7 |       |
|                                                       | Asset# 1175(cable)         | 0.3   |       |
|                                                       | Asset# 1002 (antenna)      | 17.2  |       |
| Reported QuasiPeak Final Measurement (dbμV/m) @ 30MHz |                            |       | 11.8  |

### 2.4.9 Test Results

See attached plots.

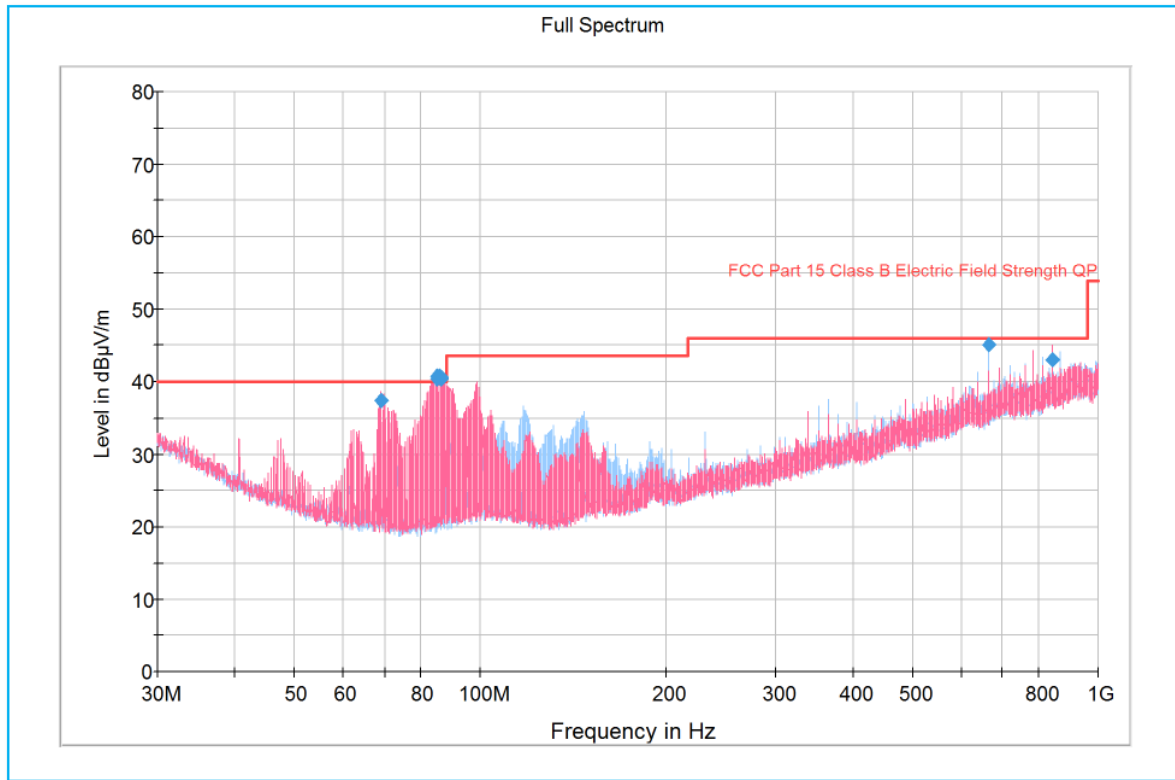
#### 2.4.10 Test Results 9KHz-30 MHz Test mode A (Worst case)



### Final Result

| Frequency (MHz) | Quasi Peak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Pol | Azimuth (deg) | Corr. (dB) | Comment |
|-----------------|---------------------|----------------|-------------|-----------------|-----------------|-----|---------------|------------|---------|
| 13.483265       | 41.38               | 70.47          | 29.09       | 1000.0          | 9.000           | H   | 300.0         | 21.2       |         |
| 13.558605       | 69.65               | 104.00         | 34.35       | 1000.0          | 9.000           | H   | 322.0         | 21.3       |         |
| 13.693645       | 31.77               | 70.47          | 38.70       | 1000.0          | 9.000           | H   | 39.0          | 21.3       |         |

#### 2.4.11 Test Results 30MHz-1GHz Test mode A (Worst case)

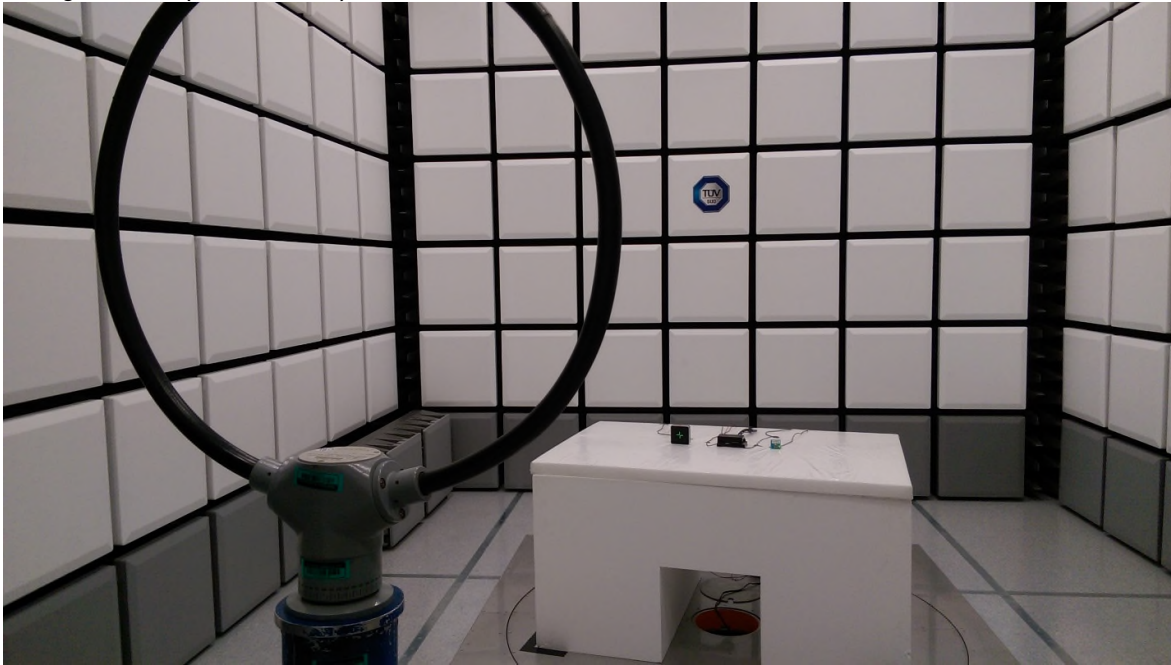


### Final\_Result

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) | Comment |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|------------|---------|
| 69.091000       | 37.31              | 40.00          | 2.69        | 1000.0          | 120.000         | 207.5       | V   | 120.0         | 13.8       |         |
| 85.138667       | 39.50              | 40.00          | 0.50        | 1000.0          | 120.000         | 103.5       | V   | 189.0         | 14.3       |         |
| 85.149000       | 39.50              | 40.00          | 0.50        | 1000.0          | 120.000         | 102.8       | V   | 177.0         | 14.3       |         |
| 85.678000       | 39.42              | 40.00          | 0.58        | 1000.0          | 120.000         | 97.7        | V   | 198.0         | 14.3       |         |
| 85.687000       | 39.40              | 40.00          | 0.60        | 1000.0          | 120.000         | 104.2       | V   | 203.0         | 14.3       |         |
| 85.688333       | 39.31              | 40.00          | 0.69        | 1000.0          | 120.000         | 105.2       | V   | 188.0         | 14.3       |         |
| 86.227667       | 39.80              | 40.00          | 0.20        | 1000.0          | 120.000         | 107.1       | V   | 209.0         | 14.4       |         |
| 86.257333       | 39.91              | 40.00          | 0.09        | 1000.0          | 120.000         | 102.7       | V   | 222.0         | 14.4       |         |
| 664.444667      | 45.01              | 46.00          | 0.99        | 1000.0          | 120.000         | 117.8       | H   | 161.0         | 29.7       |         |
| 840.718333      | 43.06              | 46.00          | 2.94        | 1000.0          | 120.000         | 102.8       | V   | 197.0         | 32.1       |         |

#### 2.4.12 Test Set Up Pictures

Configuration A (9KHz-30MHz)



Configuration A (30MHz-1GHz)



## 2.5 CONDUCTED EMISSIONS

### 2.5.1 Specification Reference

Part 15 Subpart C §15.207(a)

### 2.5.2 Standard Applicable

An intentional radiator 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  $\mu$ H/50 ohms line impedance stabilization network (LISN).

| Frequency of emission (MHz) | Conducted limit (dB $\mu$ V) |           |
|-----------------------------|------------------------------|-----------|
|                             | 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.*

### 2.5.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Test Configuration C

### 2.5.4 Date of Test/Initial of test personnel who performed the test

October 05, 2016 /KM

### 2.5.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

### 2.5.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

|                     |          |
|---------------------|----------|
| Ambient Temperature | 24.0°C   |
| Relative Humidity   | 44.2%    |
| ATM Pressure        | 99.1 kPa |

### 2.5.7 Additional Observations

- The RFID module was configured as per specification.



- The antenna was replaced by a 50Ω load for this test.
- The EUT was powered by a DC Protek 35010M Power Supply and measured through the AC lines of the power supply as per test plan.
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.5.8 for sample computation.

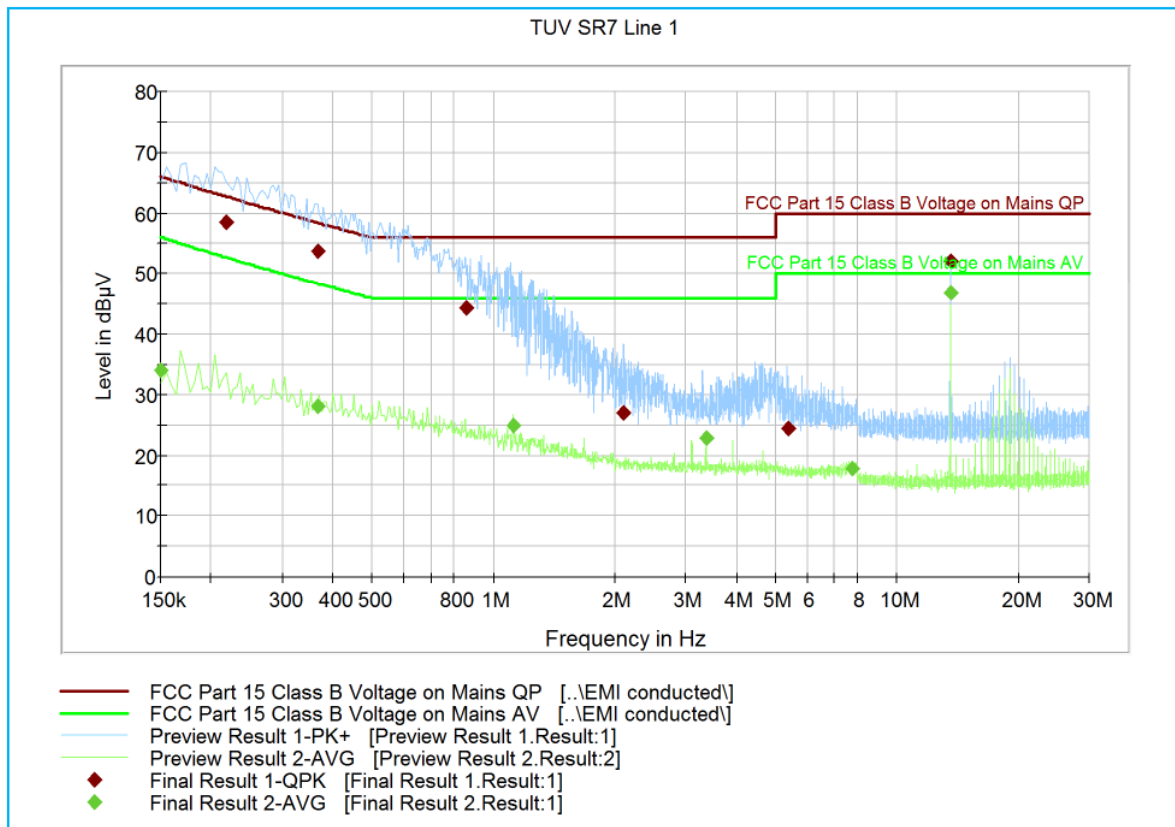
#### 2.5.8 Sample Computation (Conducted Emission – Quasi Peak)

|                                                      |                                |      |      |
|------------------------------------------------------|--------------------------------|------|------|
| Measuring equipment raw measurement (dBμV) @ 150kHz  |                                |      | 5.5  |
| Correction Factor (dB)                               | Asset# 8607 (20 dB attenuator) | 19.9 | 20.7 |
|                                                      | Asset# 1177 (cable)            | 0.15 |      |
|                                                      | Asset# 1176 (cable)            | 0.35 |      |
|                                                      | Asset# 7568 (LISN)             | 0.30 |      |
| Reported QuasiPeak Final Measurement (dBμV) @ 150kHz |                                |      | 26.2 |

#### 2.5.9 Test Results

Compliant. See attached plots and tables.

## 2.5.10 Line 1 (With Antenna port Terminated)



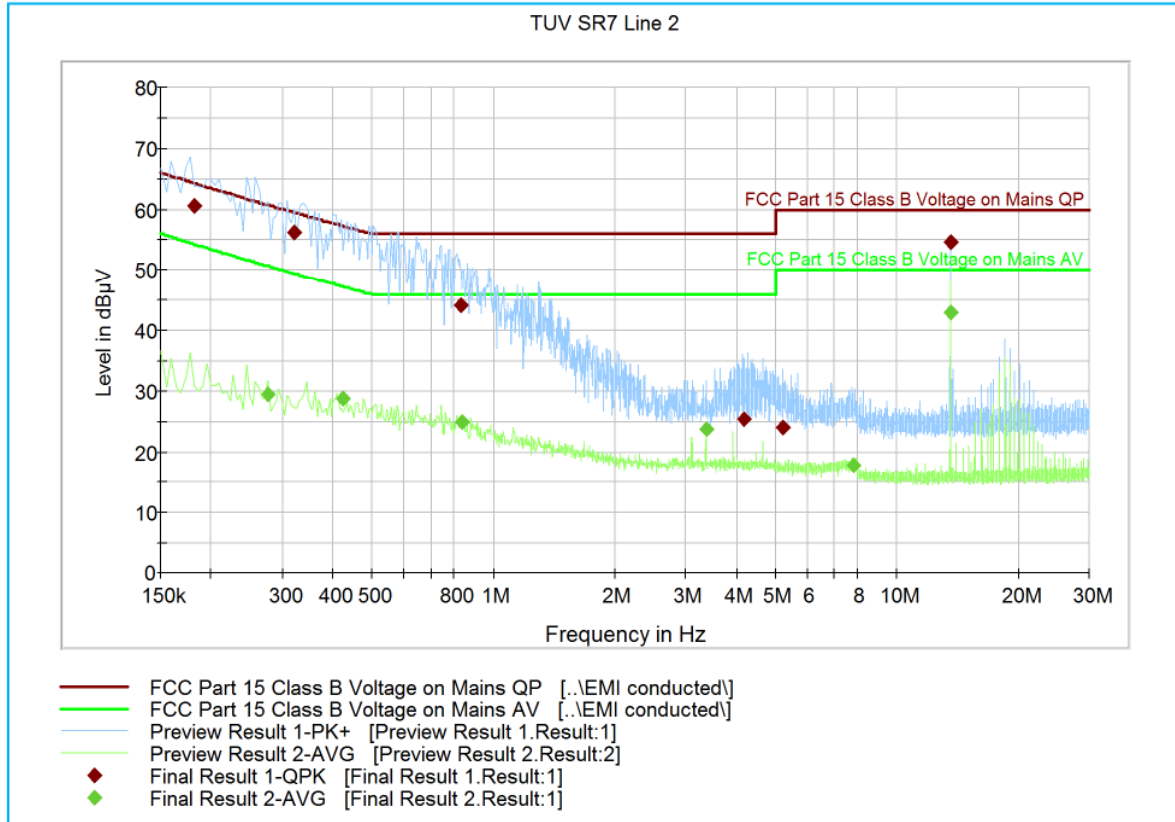
## Final Result 1

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|---------|
| 0.217500        | 58.6             | 1000.0          | 9.000           | Off    | L1   | 20.1       | 4.2         | 62.7         |         |
| 0.366000        | 53.8             | 1000.0          | 9.000           | Off    | L1   | 20.0       | 4.6         | 58.4         |         |
| 0.856500        | 44.4             | 1000.0          | 9.000           | Off    | L1   | 20.0       | 11.6        | 56.0         |         |
| 2.098500        | 27.0             | 1000.0          | 9.000           | Off    | L1   | 20.0       | 29.0        | 56.0         |         |
| 5.365500        | 24.4             | 1000.0          | 9.000           | Off    | L1   | 20.1       | 35.6        | 60.0         |         |
| 13.560000       | 52.1             | 1000.0          | 9.000           | Off    | L1   | 20.2       | 7.9         | 60.0         |         |

## Final Result 2

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|---------|
| 0.150000        | 34.1           | 1000.0          | 9.000           | Off    | L1   | 20.2       | 21.9        | 56.0         |         |
| 0.366000        | 28.2           | 1000.0          | 9.000           | Off    | L1   | 20.0       | 20.2        | 48.4         |         |
| 1.117500        | 25.0           | 1000.0          | 9.000           | Off    | L1   | 20.0       | 21.0        | 46.0         |         |
| 3.358500        | 23.0           | 1000.0          | 9.000           | Off    | L1   | 20.1       | 23.0        | 46.0         |         |
| 7.714500        | 17.8           | 1000.0          | 9.000           | Off    | L1   | 20.1       | 32.2        | 50.0         |         |
| 13.560000       | 46.9           | 1000.0          | 9.000           | Off    | L1   | 20.2       | 3.1         | 50.0         |         |

## 2.5.11 Line 2 (With Antenna port Terminated)



## Final Result 1

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|---------|
| 0.181500        | 60.5             | 1000.0          | 9.000           | Off    | N    | 20.1       | 3.8         | 64.3         |         |
| 0.321000        | 56.2             | 1000.0          | 9.000           | Off    | N    | 20.0       | 3.2         | 59.5         |         |
| 0.829500        | 44.0             | 1000.0          | 9.000           | Off    | N    | 20.0       | 12.0        | 56.0         |         |
| 4.186500        | 25.4             | 1000.0          | 9.000           | Off    | N    | 20.1       | 30.6        | 56.0         |         |
| 5.221500        | 24.0             | 1000.0          | 9.000           | Off    | N    | 20.1       | 36.0        | 60.0         |         |
| 13.560000       | 54.6             | 1000.0          | 9.000           | Off    | N    | 20.2       | 5.4         | 60.0         |         |

## Final Result 2

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|-----------------|----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|---------|
| 0.276000        | 29.5           | 1000.0          | 9.000           | Off    | N    | 20.0       | 21.2        | 50.7         |         |
| 0.424500        | 28.8           | 1000.0          | 9.000           | Off    | N    | 20.0       | 18.4        | 47.2         |         |
| 0.834000        | 24.9           | 1000.0          | 9.000           | Off    | N    | 20.0       | 21.1        | 46.0         |         |
| 3.358500        | 23.8           | 1000.0          | 9.000           | Off    | N    | 20.1       | 22.2        | 46.0         |         |
| 7.822500        | 17.9           | 1000.0          | 9.000           | Off    | N    | 20.1       | 32.1        | 50.0         |         |
| 13.555500       | 43.0           | 1000.0          | 9.000           | Off    | N    | 20.2       | 7.0         | 50.0         |         |

#### 2.5.12 Test Set up Pictures (Antenna ports terminated with 50 Ohm Loads)





### **SECTION 3**

#### **TEST EQUIPMENT USED**



### 3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

| ID Number<br>(SDGE/SDRB) | Test Equipment      | Type                | Serial Number | Manufacturer         | Cal Date | Cal Due Date |
|--------------------------|---------------------|---------------------|---------------|----------------------|----------|--------------|
| Radiated Test Setup      |                     |                     |               |                      |          |              |
| 1002                     | Bilog Antenna       | 3142C               | 00058717      | ETS-Lindgren         | 11/06/15 | 11/06/17     |
| 7620                     | EMI Test Receiver   | ESU                 | 100399        | Rhode & Schwarz      | 08/24/15 | 08/24/16     |
| 6628                     | Loop Antenna        | HFH2-Z2             | 880.458/25    | Rhode & Schwarz      | 10/28/15 | 10/28/16     |
| Frequency Stability      |                     |                     |               |                      |          |              |
| 6610                     | Temperature chamber | SH-27C              | 9963481-S1074 | Rhode & Schwarz      | 01/20/16 | 01/20/17     |
| Conducted Test Setup     |                     |                     |               |                      |          |              |
| 7620                     | EMI Test Receiver   | ESU40               | 100399        | Rhode & Schwarz      | 09/09/16 | 09/09/17     |
| 8822                     | 20dB Attenuator     | 34-20-34            | N/A           | MCE / Weinschel      | 02/29/16 | 02/28/17     |
| 8824                     | 20dB Attenuator     | 34-20-34            | N/A           | MCE / Weinschel      | 02/29/16 | 02/28/17     |
| 7568                     | LISN                | FCC-LISN-50-25-2-10 | 120305        | Fischer Custom Comm. | 10/28/15 | 10/28/16     |
| Miscellaneous            |                     |                     |               |                      |          |              |
| -                        | Test Software       | EMC32               | V9.26.0       | Rhode & Schwarz      | N/A      |              |
| -                        | Test Software       | EMC32               | V8.5.3        | Rhode & Schwarz      | N/A      |              |
| 6455                     | DC Power Supply     | E3611A              | 2529          | HP                   | N/A      |              |
| 09075                    | DC Power Supply     | 35010M              | 10226075      | Protek               | N/A      |              |

### 3.2 MEASUREMENT UNCERTAINTY

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

#### 3.2.1 Conducted Emissions (AC) Measurements

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.36                           | 0.21                          | 0.04         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | LISN                       | Rectangular                   | 0.66                           | 0.38                          | 0.15         |
| 4                               | Attenuator                 | Rectangular                   | 0.30                           | 0.17                          | 0.03         |
| 5                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 0.80         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 1.59         |

#### 3.2.2 Radiated Emission Measurements (Below 1GHz)

| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.45                           | 0.26                          | 0.07         |
| 2                               | Cables                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 3                               | Preamp                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 4                               | Antenna                    | Rectangular                   | 0.75                           | 0.43                          | 0.19         |
| 5                               | Site                       | Rectangular                   | 3.55                           | 2.05                          | 4.20         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 2.23         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 4.45         |

#### 3.2.3 Radiated Emission Measurements (Above 1GHz)

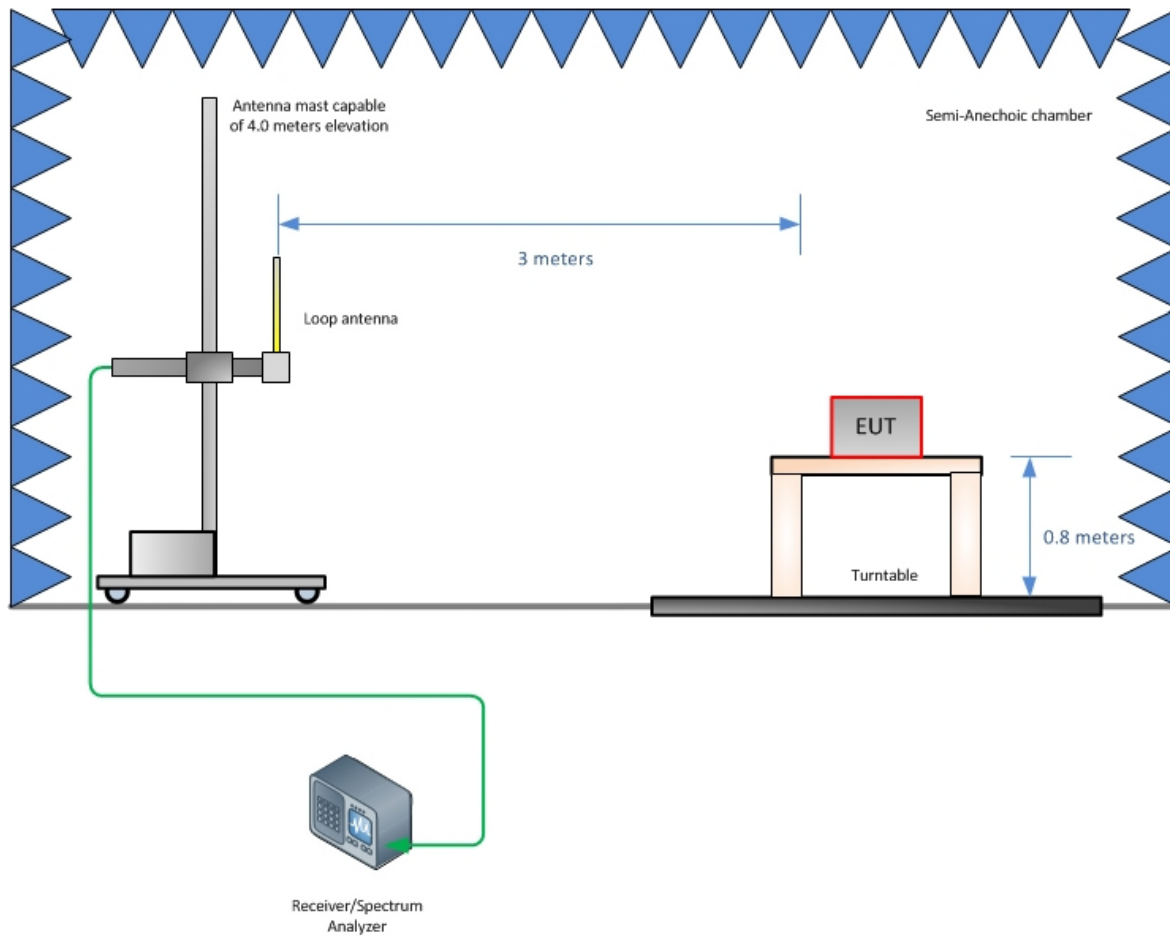
| Contribution                    |                            | Probability Distribution Type | Probability Distribution $x_i$ | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|
| 1                               | Receiver/Spectrum Analyzer | Rectangular                   | 0.57                           | 0.33                          | 0.11         |
| 2                               | Cables                     | Rectangular                   | 0.70                           | 0.40                          | 0.16         |
| 3                               | Preamp                     | Rectangular                   | 0.50                           | 0.29                          | 0.08         |
| 4                               | Antenna                    | Rectangular                   | 0.37                           | 0.21                          | 0.05         |
| 5                               | Site                       | Rectangular                   | 3.55                           | 2.05                          | 4.20         |
| 6                               | EUT Setup                  | Rectangular                   | 1.00                           | 0.58                          | 0.33         |
| Combined Uncertainty ( $u_c$ ): |                            |                               |                                |                               | 2.22         |
| Coverage Factor (k):            |                            |                               |                                |                               | 2            |
| Expanded Uncertainty:           |                            |                               |                                |                               | 4.44         |



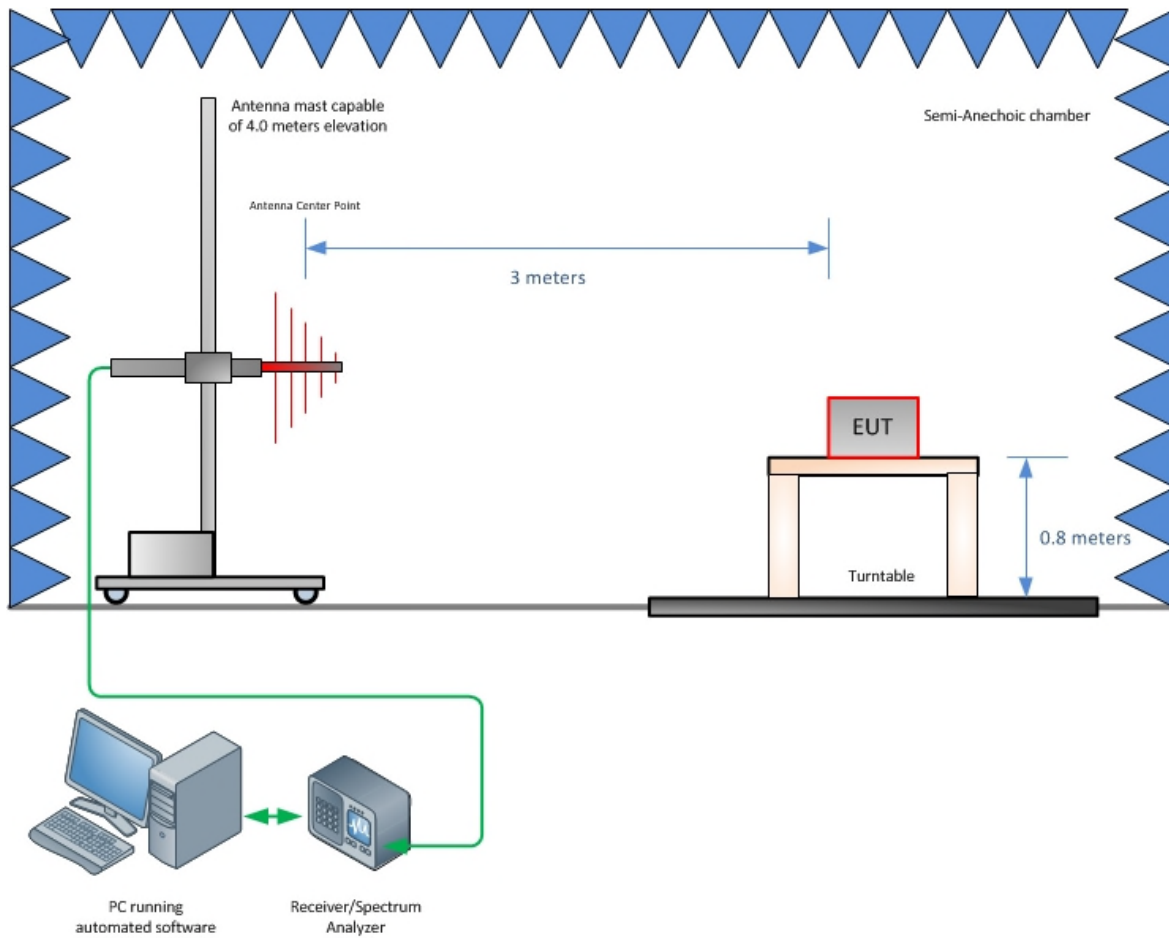
## **SECTION 4**

### **DIAGRAM OF TEST SETUP**

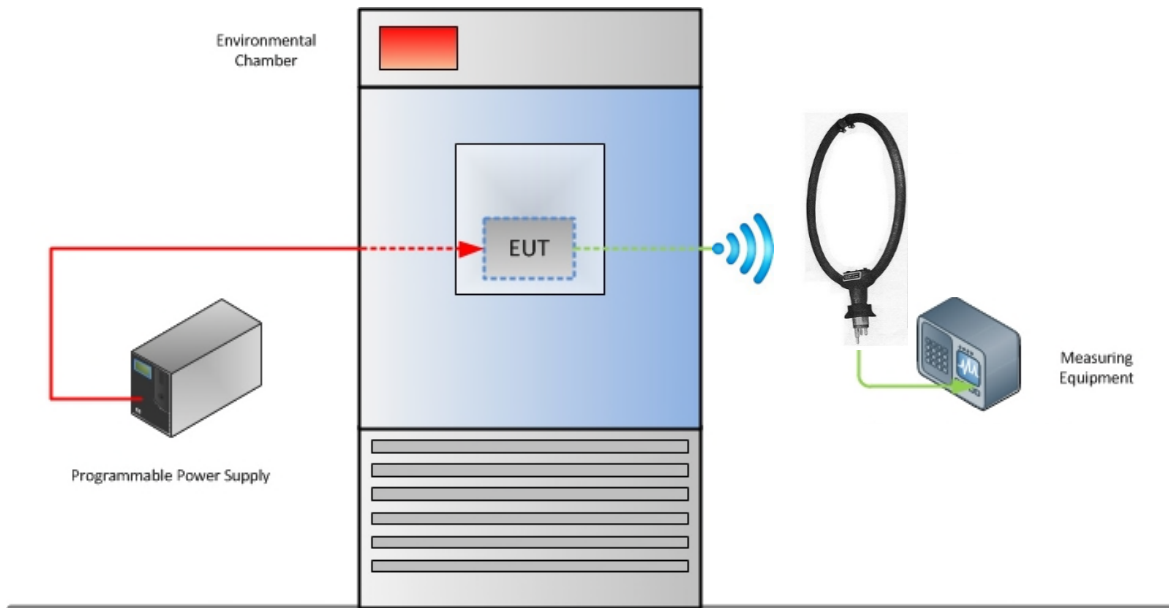
#### 4.1 TEST SETUP DIAGRAM (EMISSION MASK)



#### 4.2 TEST SETUP DIAGRAM (RADIATED EMISSIONS 30 TO 1000MHZ)

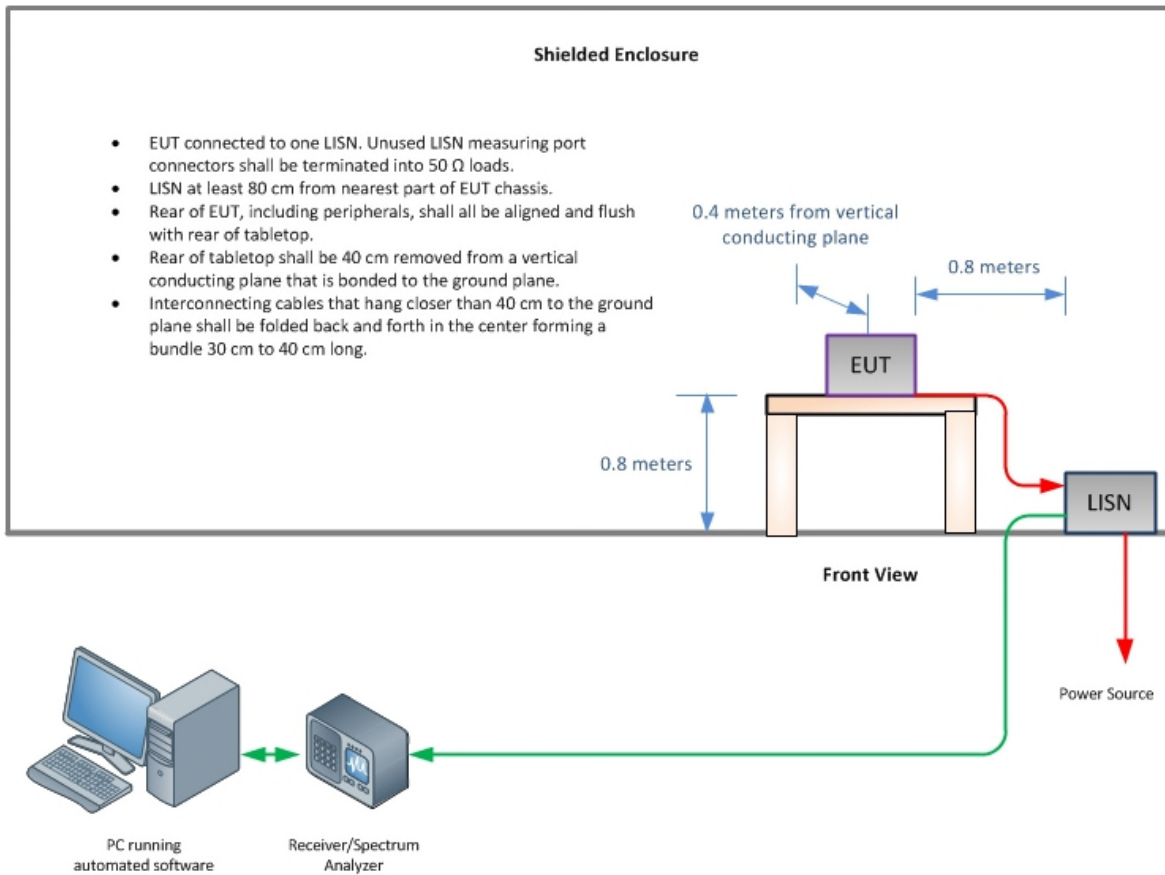


#### 4.3 TEST SETUP DIAGRAM (FREQUENCY STABILITY)



Frequency Stability Test Configuration

#### 4.4 TEST SETUP DIAGRAM (CONDUCTED EMISSIONS)





## **SECTION 5**

### **ACCREDITATION, DISCLAIMERS AND COPYRIGHT**



## 5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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