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|-----------------------------------|---|
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| <b>Quotation</b>                  | Q20-1410-1  |
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| <b>Test Report By</b>             | Michael Kirby   |
| <b>FCC Test Firm Registration</b> | 409640  |
| <b>IC Site Registration</b>       | IE0001  |
| <b>Date</b>                       | 15 <sup>th</sup> Mar 2021   |
| <b>EUT Description</b>            | HUBA  |
| <b>FCC ID</b>                     | 2ATIMHUBA   |
| <b>IC ID</b>                      | 25094-HUBA  |
| <b>Authorised by</b>              | <b>Paul Reilly</b>  |
| <b>Authorised Signature:</b>      |  |

## TEST SUMMARY

The equipment complies with the requirements according to the following standards.

| FCC Section | RSS Section | TEST PARAMETERS             | Test Result |
|-------------|-------------|-----------------------------|-------------|
| 15.209      | RSS Gen 7.3 | Radiated Spurious Emissions | Pass        |

RSS Gen Issue5 Amd 2 (Feb 2021)

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF COMPLIANCE ENGINEERING IRELAND LTD

**Exhibit A – Technical Report**

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## 1.0 EUT Description

|                                      |  |
|--------------------------------------|--|
| <b>Model:</b>                        | HUBA   |
| <b>Type:</b>                         | Wireless Gateway   |
| <b>Type of radio:</b>                | Stand-alone  |
| <b>Transmitter Type:</b>             | 802.15.4 (Thread), 802.11G 802.11N Wifi                                  |
| <b>Operating Frequency Range(s):</b> | 2.405 GHz - 2.480GHz Thread<br>2.412-2.462GHz Wifi<br>433.92MHz receiver |
| <b>Number of Channels:</b>           | 16 Thread<br>11 Wifi   |
| <b>Antenna:</b>                      | Integral   |
| <b>Power configuration:</b>          | 12 v Battery.  |
| <b>Ports:</b>                        | None   |
| <b>Classification:</b>               | DTS, CYY   |
| <b>HVIN:</b>                         | HUBA   |
| <b>PMN:</b>                          | HUBA   |
| <b>Test Standards:</b>               | 15.209, RSS Gen  |
| <b>Test Methodology:</b>             | Measurements performed according to the procedures in ANSI C63.4-2014    |

The EUT was a Gateway for use in the vehicles. Its purpose was to relay packets received on the 433MHz band using a transmitter in the 2.4GHz band.

The EUT contained transmitters using Wifi and Thread technology and also a 433MHz receiver.

For Wifi it was possible to switch between 2 internal antennas, one an internal module antenna and the other one a printed pcb antenna.

The Thread radio had its own dedicated pcb antenna.

This report relates to test carried out on the 433.92MHz receiver with the Thread and Wifi transmitters off.

## 1.1 EUT Operation

### Operating Conditions during Test:

The EUT was placed into receive mode (433.92MHz) with the Wifi and Thread transmitters off.

The EUT was powered from a bench PSU set to 12Vdc. for all tests

There was active communication on all the wired communication lines (PLC, CAN ,RS485)

### Environmental conditions

|                          | Temperature | Relative Humidity |
|--------------------------|-------------|-------------------|
| <b>Test</b>              | °C          | %                 |
| Radiated Emissions <1GHz | 19          | 49                |
| Radiated Emissions >1GHz | 22          | 42                |

## 1.2 Modifications

No modifications were required in order to pass the test specifications.

## 1.3 Date of Test

The tests were carried out on 6<sup>th</sup> -15<sup>th</sup> Jan 2021.

## 1.4. Measurement Uncertainty

The measurement uncertainty (with a 95% confidence level) for the conducted emissions test was  $\pm 3.5$  dB.

The measurement uncertainty (with a 95% confidence level) for the radiated emissions test was  $\pm 5.3$  dB (from 30 to 100 MHz),  $\pm 4.7$  dB (from 100 to 300 MHz),  $\pm 3.9$  dB (from 300 to 1000 MHz) and  $\pm 3.8$  dB (from 1 GHz to 40 GHz).

The test data can be compared directly to the specification limit to determine compliance, as the calculated measurement uncertainty meets the requirements of the applicable specification.

## 1.5 Special Test Software

Tests were performed manually and no special test software was used

## **2 Emissions Measurements**

### **2.2 Radiated Emissions Measurements**

Emissions below 1GHz were measured in a semi anechoic chamber using a test antenna positioned at a distance of 3 metres from the EUT (as measured from the closest point of the EUT). The radiated emissions were maximised by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 metres. In this case the resolution bandwidth was 100kHz.

Emissions in the 1GHz-12.75GHz range were measured using a horn antenna located at 3 metres distance from the EUT in a fully anechoic chamber. The radiated emissions were maximised by configuring the EUT and by rotating the EUT, and by raising and lowering the test antenna from 1 to 4 metres.

The test table height was 0.8m for all tests.

A pre-scan was performed to determine the worst case EUT orientation for the radiated measurements.

All tests were performed with the EUT in orientation O1 for Horizontal polarization measurements and with the EUT in orientation O2 for Vertical polarisation measurements.

Ref Appendix B for orientations.

### 3. Radiated Emissions Measurements

| Frequency MHz | Quasi Peak Level dBuV/m | Antenna Polarity | Antenna Factor dB | Cable loss dB | Final Field Strength Quasi Peak dBuV/m | Quasi Peak Limit dBuV/m | Margin dB |
|---------------|-------------------------|------------------|-------------------|---------------|--|-------------------------|-----------|
| 35.1          | 14.8                    | Vertical         | 11.9              | 0.9           | 27.6                                   | 40.0                    | 12.4      |
| 65.175        | 22.6                    | Vertical         | 9.7               | 1             | 33.3                                   | 40.0                    | 6.7       |
| 91.1          | 20.4                    | Vertical         | 9.2               | 1.1           | 30.7                                   | 43.5                    | 12.8      |
| 153.85        | 20.1                    | Vertical         | 11.9              | 1.2           | 33.2                                   | 43.5                    | 10.3      |
| 240           | 17                      | Vertical         | 15.7              | 1.4           | 34.1                                   | 46.0                    | 11.9      |
| 272           | 9                       | Vertical         | 17.2              | 1.4           | 27.6                                   | 46.0                    | 18.4      |
| 368           | 14.1                    | Vertical         | 15.3              | 1.6           | 31                                     | 46.0                    | 15.0      |
| 37.7          | 13.6                    | Vertical         | 11.3              | 0.9           | 25.8                                   | 40.0                    | 14.2      |
| 400           | 13.9                    | Vertical         | 16.3              | 1.6           | 31.8                                   | 46.0                    | 14.2      |
| 512           | 8.2                     | Vertical         | 18.4              | 1.8           | 28.4                                   | 46.0                    | 17.6      |
| 815.975       | 4.2                     | Vertical         | 22.1              | 2.1           | 28.4                                   | 46.0                    | 17.6      |
| 153.325       | 20.6                    | Horizontal       | 11.8              | 1.2           | 33.6                                   | 43.5                    | 9.9       |
| 208           | 15.8                    | Horizontal       | 14.6              | 1.4           | 31.8                                   | 43.5                    | 11.7      |
| 272           | 16.8                    | Horizontal       | 17.2              | 1.4           | 35.4                                   | 46.0                    | 10.6      |
| 320           | 11.7                    | Horizontal       | 15.2              | 1.5           | 28.4                                   | 46.0                    | 17.6      |
| 336           | 13.1                    | Horizontal       | 15.5              | 1.5           | 30.1                                   | 46.0                    | 15.9      |
| 384           | 17.3                    | Horizontal       | 15.7              | 1.7           | 34.7                                   | 46.0                    | 11.3      |
| 744.025       | 3                       | Horizontal       | 21.6              | 2.1           | 26.7                                   | 46.0                    | 19.3      |
| 840.025       | 9.3                     | Horizontal       | 22.7              | 2.2           | 34.2                                   | 46.0                    | 11.8      |

Ref Appendix A for Scans

Test Result: - Pass

#### 4 List of Test Equipment

| Instrument                            | Manufacturer    | Model         | Serial Num            | CEI Ref | Cal Due Date | Cal Interval Months |
|---------------------------------------|-----------------|---------------|-----------------------|---------|--------------|---------------------|
| Spectrum Analyser 30Hz-40GHz          | Rohde & Schwarz | FSP40         | 100053                | 850     | 11-Dec-21    | 36                  |
| Test Receiver 3.6GHz                  | Rohde & Schwarz | ESR           | 1316.3003k03-101625-s | 869     | 28-May-23    | 36                  |
| Antenna Biconical                     | Schwarzbeck     | VHBB 9124     | 9124 667              | 871     | 03-Sep-21    | 36                  |
| Antenna Horn                          | EMCO            | 3115          | 9905-5809             | 655     | 14-Mar-21    | 24                  |
| Anechoic Chamber                      | CEI             | SAR 10M       | 845                   | 845     | 16-May-22    | 36                  |
| Antenna Log Periodic                  | Chase           | UPA6108       | 1072                  | 609     | 03-Sep-21    | 36                  |
| Fully Anechoic Chamber                | CEI             | FAR 3M        | 906                   | 906     | 22-Mar-21    | 36                  |
| Microwave Preamplifier                | Hewlett Packard | 83017A        | 3123A00175            | 805     | 30-Sep-21    | 12                  |
| Antenna Horn Standard Gain 18-26.5GHz | A-Info          | LB-42-25-C-KF | J2021091103028        | 877     | 05-Oct-21    | 12                  |



## Appendix A

### Radiated Spurious Emissions

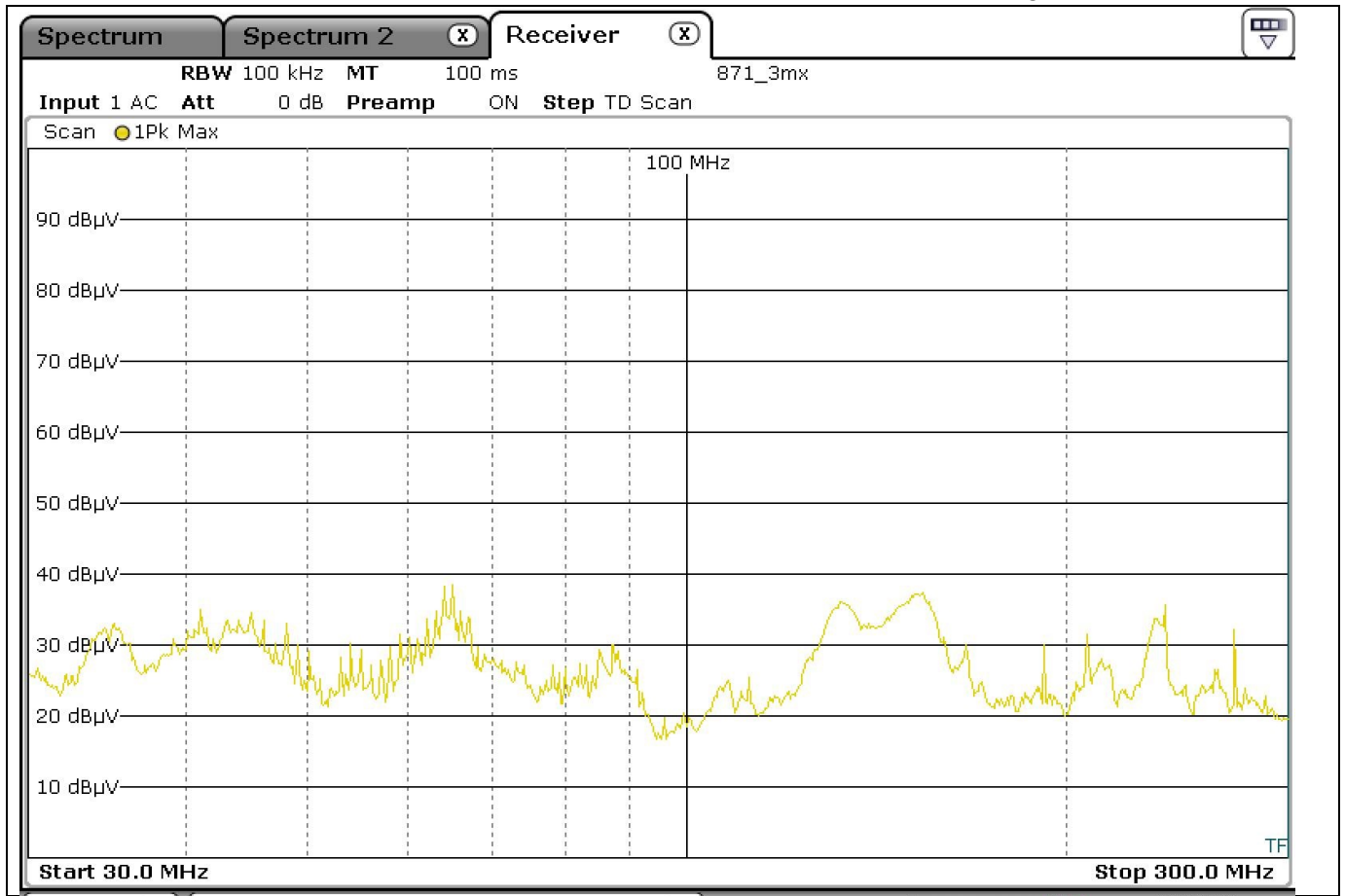


Fig A1 Radiated Emissions 30MHz -300MHz Vertical 3metres

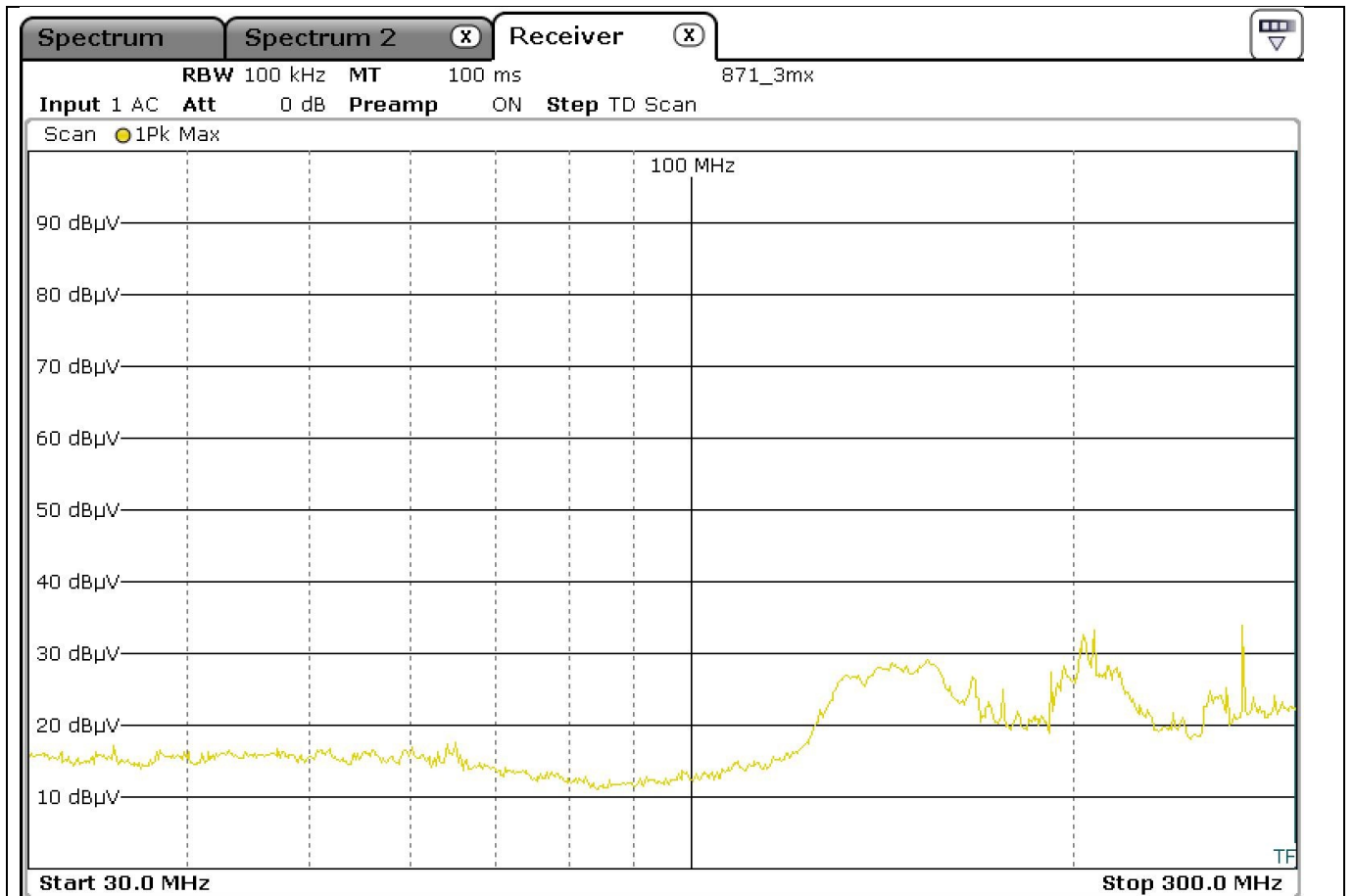


Fig A2 Radiated Emissions 30MHz -300MHz Horizontal 3metres

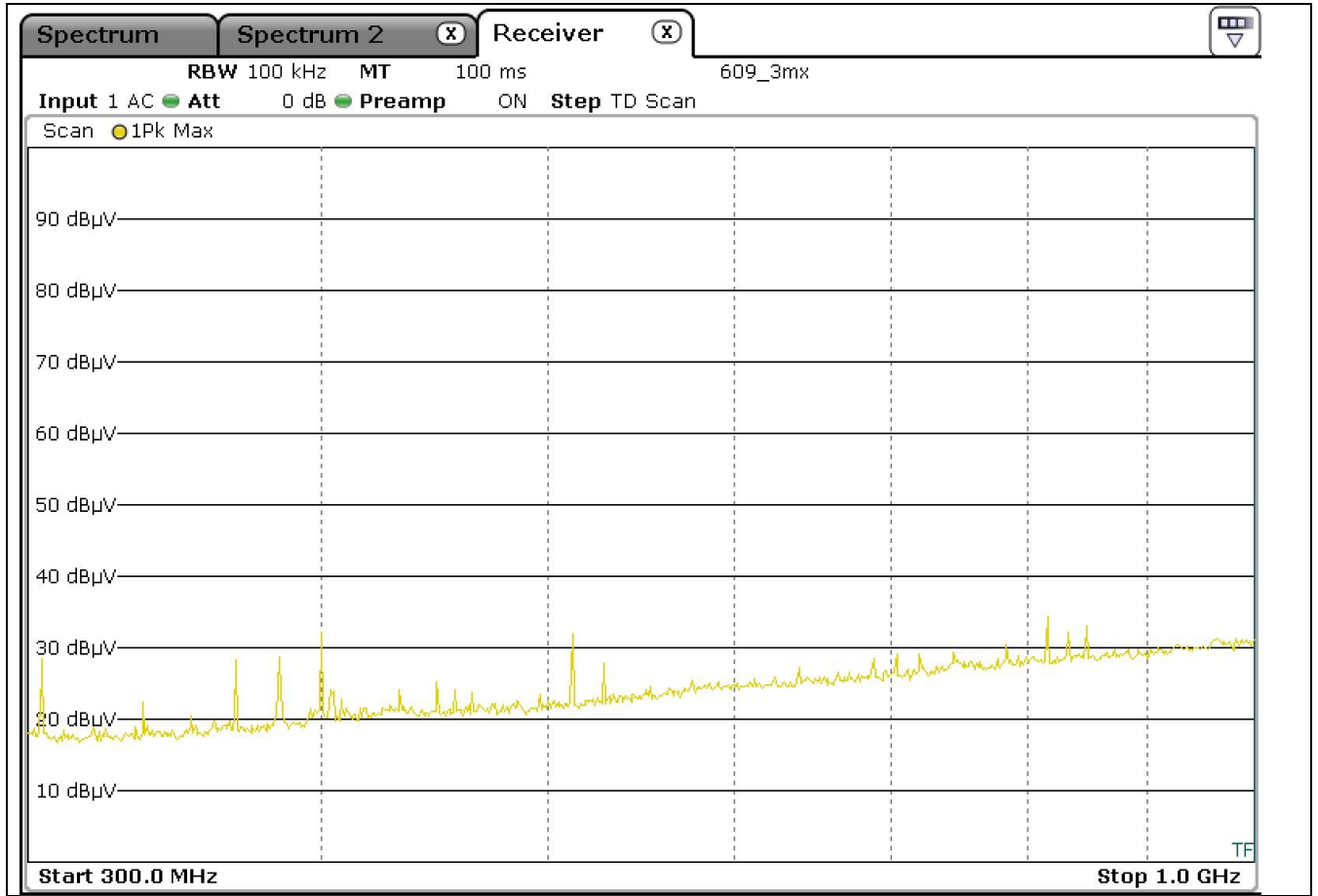


Fig A3 Radiated Emissions 300MHz -1GHz Vertical 3metres

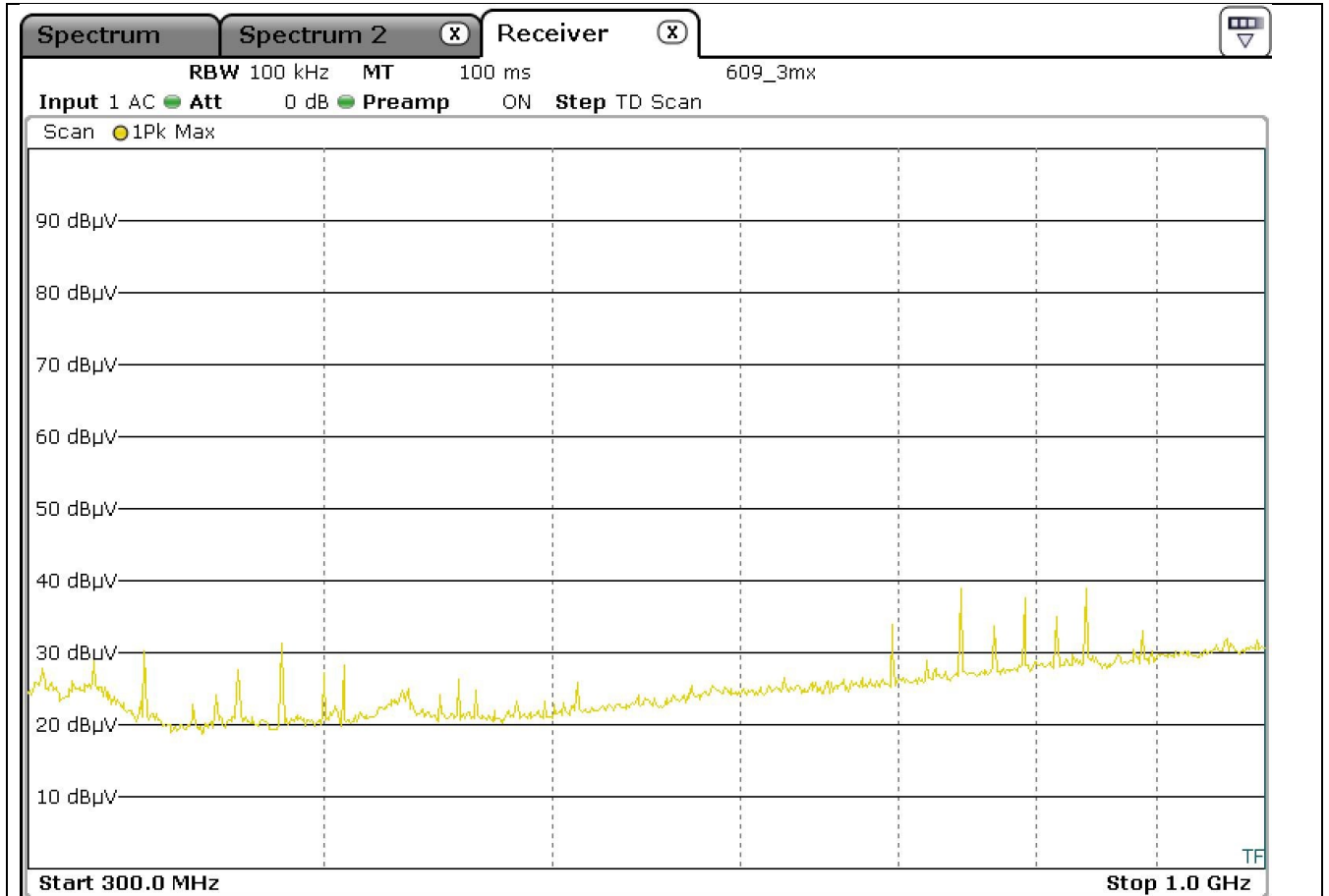


Fig A4 Radiated Emissions 300MHz -1GHz Horizontal 3metres

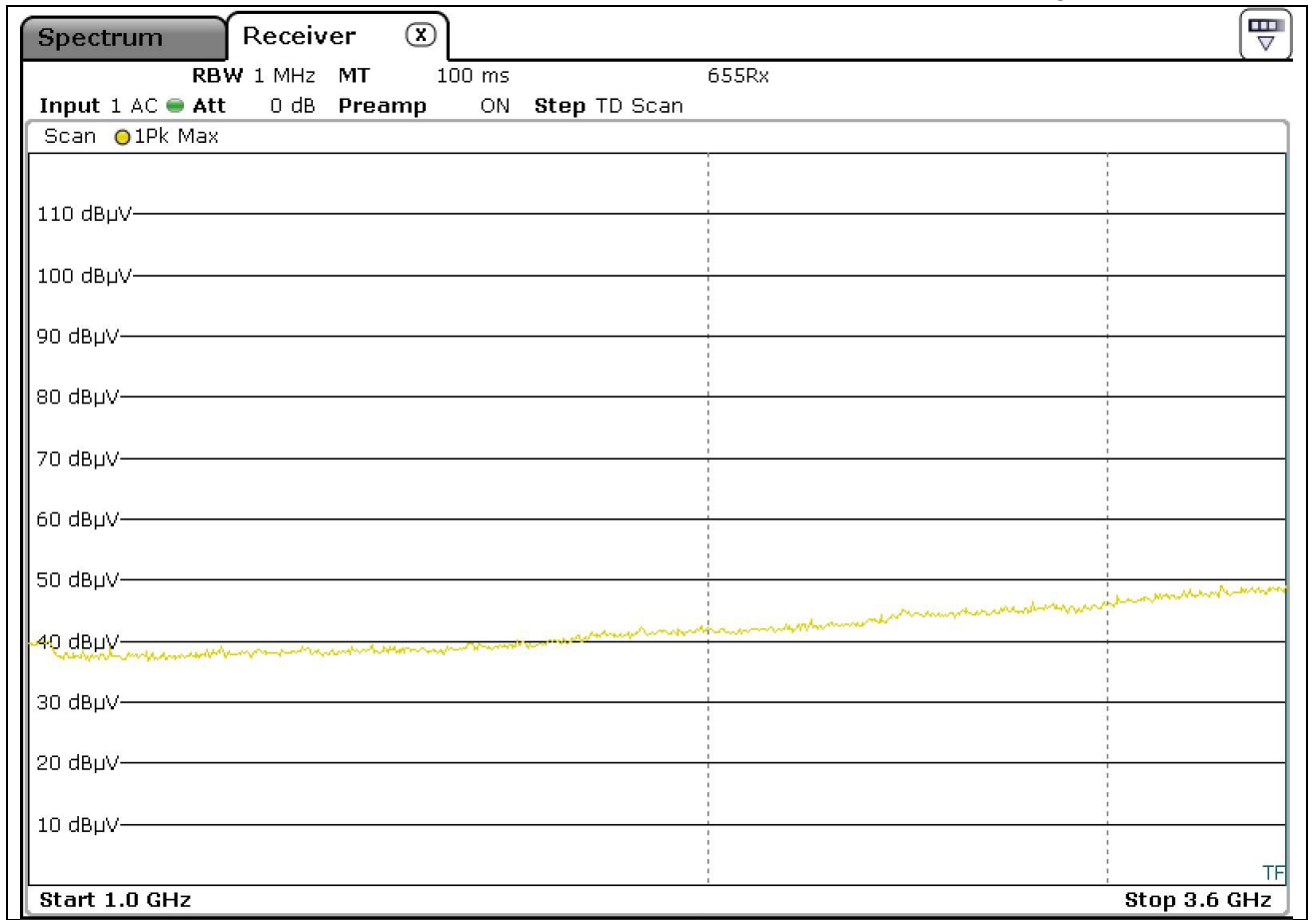


Fig A5 Radiated Emissions 1GHz -3.6GHz Vertical 3metres

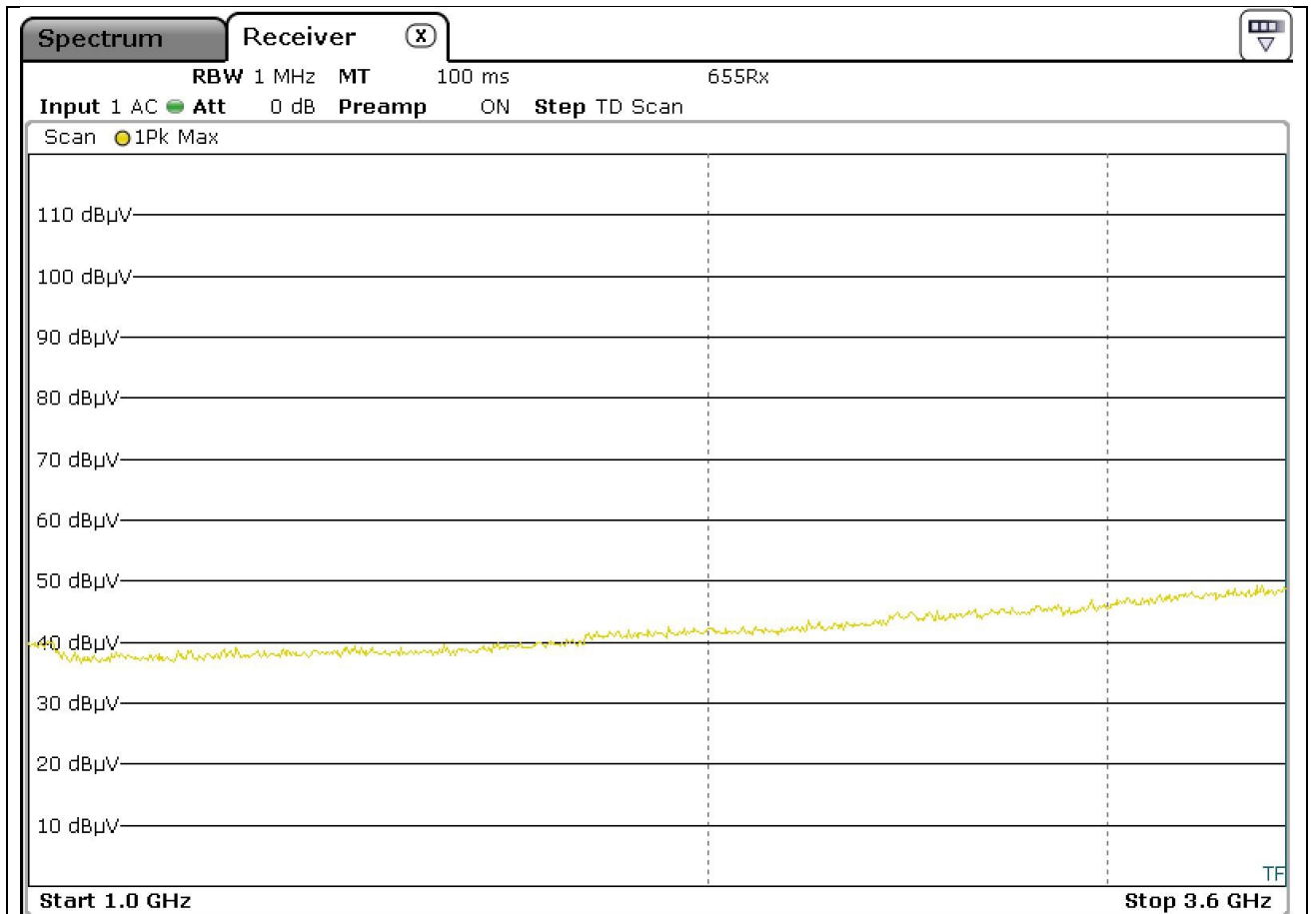


Fig A6 Radiated Emissions 1GHz -3.6GHz Horizontal 3metres

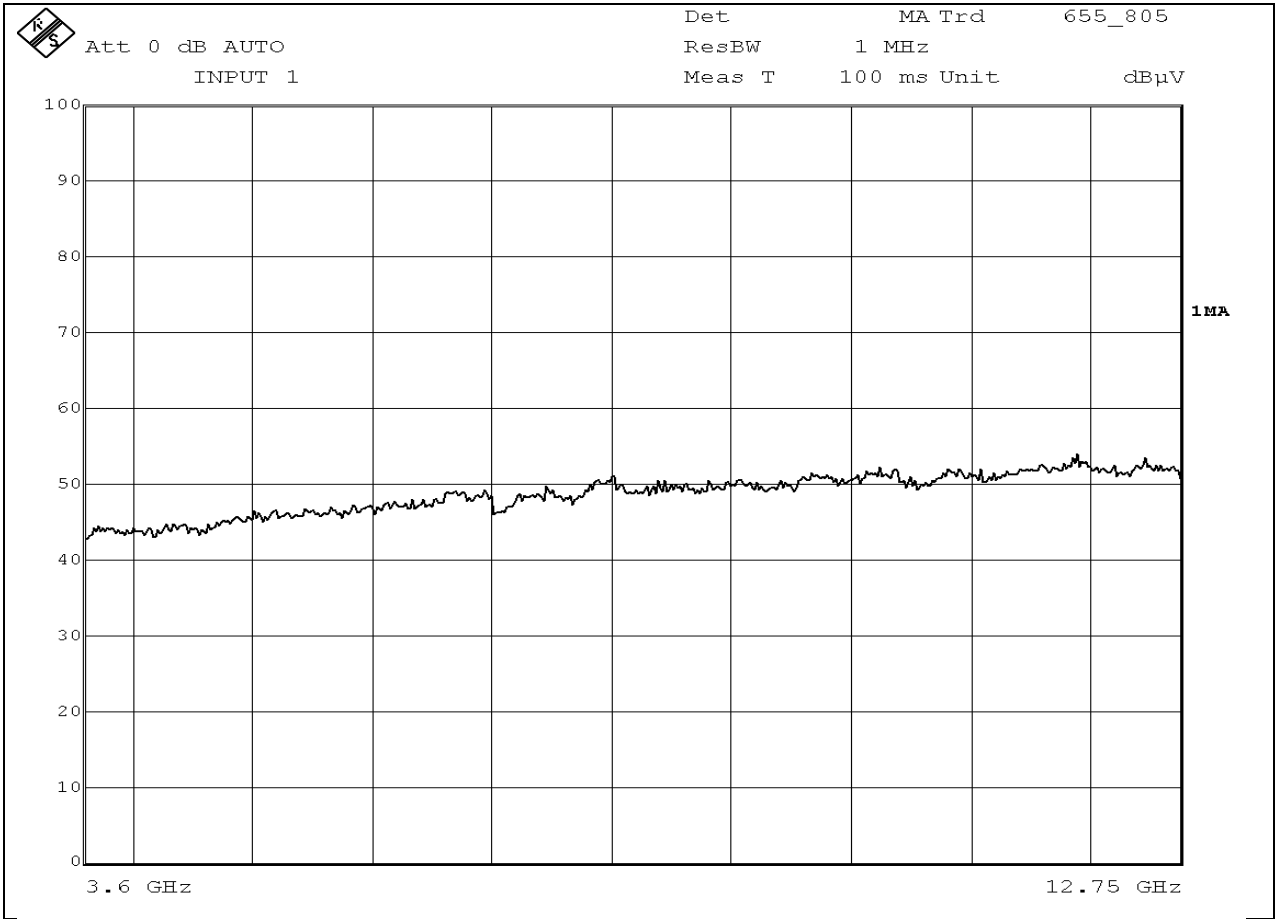


Fig A7 Radiated Emissions 3.6GHz -12.75GHz Vertical 3metres

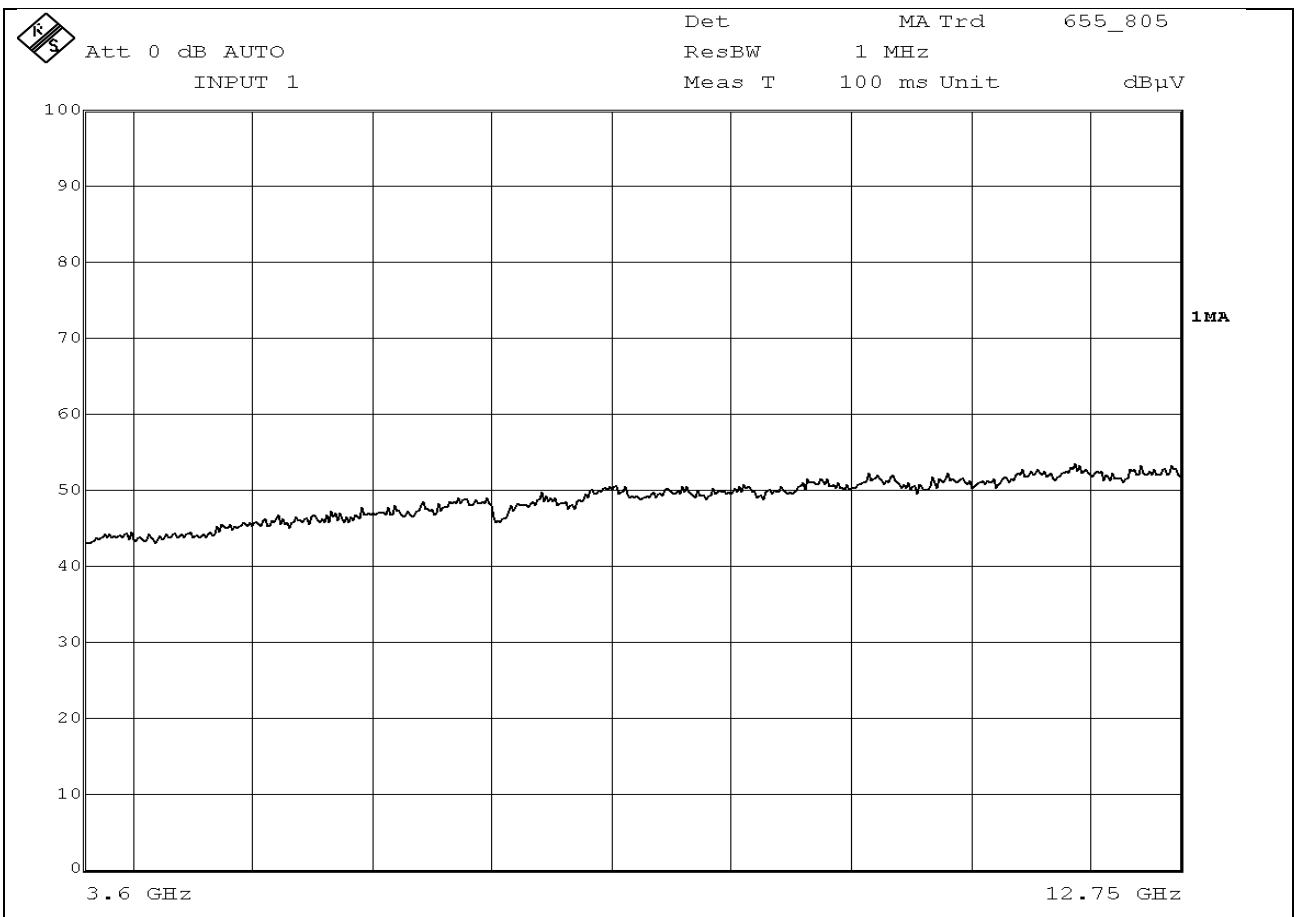


Fig A8 Radiated Emissions 3.6GHz -12.75GHz Horizontal 3metres

**Appendix B**

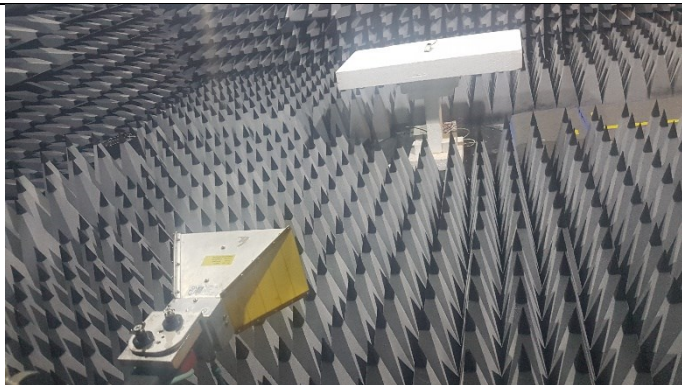
**Test Configurations:**



**Fig B1 Spurious Emissions 30MHz-300MHz 3 metres**



**Fig B2 Radiated Emissions 300MHz-1GHz 3metres**



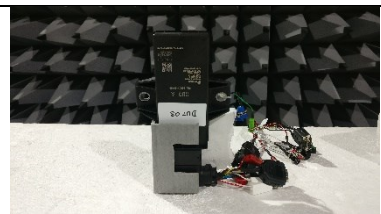
**Fig B3 Radiated Emissions 1GHz-12.75GHz 3metres**



**Fig B4 Radiated Emissions EUT close up**



**Fig B5 EUT orientation "O1"**



**Fig B6 EUT orientation "O2"**

Orientations for Radiated Emissions

**End of Report**