FCC Test Report

LB Foster Railway Technologies
Flood Master Node, Model: FLD-A-021-001

In accordance with FCC 47 CFR Part 15C (LoRa)

Prepared for: LB Foster Railway Technologies
The Midway
Lenton
Nottingham, Nottinghamshire
NG7 2TS, UNITED KINGDOM

FCC ID: 2BDI4FLDA021

COMMERCIAL-IN-CONFIDENCE

Document 75959548-04 Issue 01

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Steve Marshall	Senior Engineer	Authorised Signatory	07 December 2023

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

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance FCC 47 CFR Part 15C. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Aakash Rawal	07 December 2023	

FCC Accreditation	ISED Accreditation
90987 Octagon House, Fareham Test Laboratory	12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C: 2021 for the tests detailed in section 1.3.

TÜV SÜD
is a trading name of TUV SUD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuvsud.com/en

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire
PO15 5RL
United Kingdom

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
01	First Issue	07-December-2023

Table 1

1.2 Introduction

Applicant	LB Foster Railway Technologies
Manufacturer	LB Foster Railway Technologies
Model Number(s)	FLD-A-021-001
Serial Number(s)	LBF019028
Hardware Version(s)	A
Software Version(s)	4.1.0
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2021
Order Number	P15072CND - QAF
Date	09-October-2023
Date of Receipt of EUT	26-October-2023
Start of Test	30-October-2023
Finish of Test	03-November-2023
Name of Engineer(s)	Aakash Rawal
Related Document(s)	ANSI C63.10 (2013) KDB 996369 D04 Module Integration Guide v02 ANSI C63.4 (2014)

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C is shown below.

Section	Specification Clause Part 15C	Test Description	Result	Comments/Base Standard
Configuration and Mode: 915MHz Master Node - Spurious Emissions				
2.1	15.209 and 15.247 (d)	Spurious Radiated Emissions	Pass	KDB 996369 D04 Module Integration Guide v02 ANSI C63.10 (2013) ANSI C63.4 (2014)

Table 2

1.4 Customer Supplied Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment including the technologies the product supports)*	Master node unit which provides connectivity & live camera footage for the inline flood monitoring system in remote locations powered by battery with solar back up.		
Manufacturer:	LB Foster		
Model:	North America		
Part Number:	FLD-A-021-001		
Hardware Version:	A		
Software Version:	4.1.0		
FCC ID of the product under test – see guidance here		HopeRF RFM95CW-915S2R FCC id: 2ASEORFM95C Teltonika RUT955 - FCC id: 2AET4RUT955AF	
IC ID of the product under test – see guidance here			
Device Category	Mobile ☐	Portable ☐	Fixed ☒
Equipment is fitted with an Audio Low Pass Filter		Yes ☐	No ☒

Table 3

Intentional Radiators

Technology	LoRa	RUT956 Cellular	RUT956 LTE Bands
Frequency Range (MHz to MHz)	137-1020		Band 2 – 1850 – 1910 (UL), 1930-1990 (DL) Band 4 – 1710 – 1755 (UL), 2110-2155 (DL) Band 5 – 824 849 (UL), 869 – 894 (DL) Band 13 – 777 – 787 (UL), 746 – 756 (DL) Band 71 – 663 – 698 (UL), 617 – 652 (DL)
Conducted Declared Output Power (dBm)	20	Wi-Fi: 17.88 GSM900: 33 GSM1800: 30 WCDMA: 24 LTE: 23	23
Antenna Gain (dBi)	1.5	2	2
Supported Bandwidth(s) (MHz) (e.g. 1 MHz, 20 MHz, 40 MHz)	500kHz		Band 2 – 60 Band 4 – 45 Band 5 – 25 Band 13 – 10 Band 71 – 35
Modulation Scheme(s) (e.g. GFSK, QPSK etc)	LoRa/(G)FSK		Band 2 – FDD Band 4 – FDD Band 5 – FDD Band 13 – FDD Band 71 – FDD

ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)			
Bottom Frequency (MHz)	137		Band 2 – 1850 Band 4 – 1710 Band 5 – 824 Band 13 – 777 Band 71 – 663
Middle Frequency (MHz)	578.5		Band 2 – 1900 Band 4 – 1700 Band 5 – 850 Band 13 – 700 Band 71 – 600
Top Frequency (MHz)	1020		Band 2 – 1990 Band 4 – 2155 Band 5 – 894 Band 13 – 756 Band 71 – 652

Table 4

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	48MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	DC
Class A Digital Device (Use in commercial, industrial or business environment) ☒ Class B Digital Device (Use in residential environment only) ☐	

Table 5

AC Power Source

AC supply frequency:		Hz
Voltage		V
Max current:		A
Single Phase ☐ Three Phase ☐		

Table 6

DC Power Source

Nominal voltage:		
Extreme upper voltage:		
Extreme lower voltage:		
Max current:		

Table 7

Battery Power Source

Voltage:	12	V
End-point voltage:	11.1	V *(Point at which the battery will terminate)*
Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☒ **(Vehicle regulated)*		
Other ☐ Please detail:		

Table 8

Charging

Can the EUT transmit whilst being charged	Yes ☒ No ☐

Table 9

Temperature

Minimum temperature:	-20	°C
Maximum temperature:	60	°C

Table 10

Cable Loss

Adapter Cable Loss (Conducted sample)		dB

Table 11

Antenna Characteristics

Antenna connector ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☐	Type:		Gain		dBi
External antenna ☒	Type:	FWTR35292-SM-KR	Gain	1.5	dBi
External antenna ☒	Type:	2111520.80	Gain	2	dBi
For external antenna only: Standard Antenna Jack ☐ If yes, describe how user is prohibited from changing antenna (if not professional installed): Equipment is only ever professionally installed ☒ Non-standard Antenna Jack ☐ All part 15 applications will need to show how the antenna gain was derived either from a manufacturer data sheet or a measurement. Where the gain of the antenna is inherently accounted for as a result of the measurement, such as field strength measurements on a part 15.249 or 15.231 device, so the gain does not necessarily need to be verified. However, enough information regarding the construction of the antenna shall be provided. Such information maybe photographs, length of wire antenna etc.					

Table 12

Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

Table 13

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

Name: Michael Cane
Position held: Senior Electronics Systems Engineer
Date: 25/10/2023

1.5 Product Information

1.5.1 Technical Description

The Master node unit provides connectivity & live camera footage for the inline flood monitoring system in remote locations powered by battery with solar back up.

1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.7 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
Model: FLD-A-021-001, Serial Number: LBF019028			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 14

1.8 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 915MHz Master Node - Spurious Emissions		
Spurious Radiated Emissions	Aakash Rawal	UKAS

Table 15

Office Address:

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire,
PO15 5RL
United Kingdom

2 Test Details

2.1 Spurious Radiated Emissions

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.209 and 15.247 (d)

2.1.2 Equipment Under Test and Modification State

Model Number FLD-A-021-001, S/N: LBF019028 - Modification State 0

2.1.3 Date of Test

30-October-2023 to 03-November-2023

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.6.

Measurements were only performed over the frequency range specified in FCC Part 15.35(b) as required by KDB 996369 D04, clause 3.4.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10, clause 11.12.2.5.2.

The plots shown are the characterisation of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dBµV/m to µV/m:

10^(Field Strength in dBµV/m/20).

2.1.5 Example Test Setup Diagram

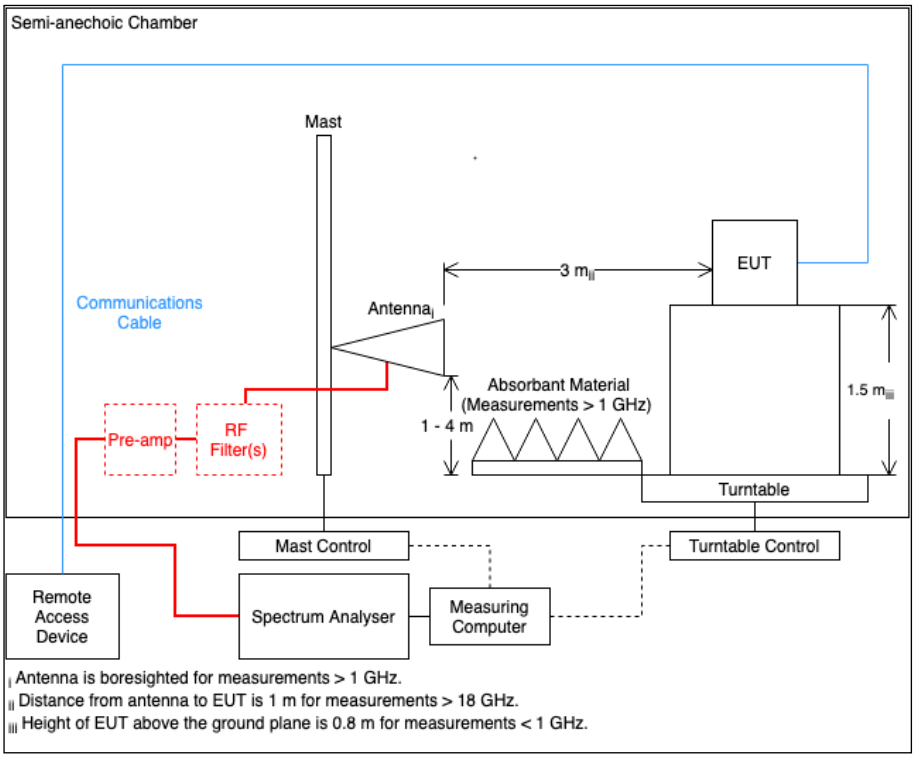

Figure 1

2.1.6 Environmental Conditions

Ambient Temperature	21.5 °C
Relative Humidity	50.4 %

2.1.7 Test Results

915MHz Master Node - Spurious Emissions

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
74.388	38.39	40.00	-1.61	Q-Peak	207	277	Horizontal
74.803	37.04	40.00	-2.96	Q-Peak	192	283	Horizontal
169.101	34.22	43.50	-9.28	Q-Peak	182	100	Horizontal
2747.995	51.34	54.00	-2.66	RMS	306	145	Vertical
2748.150	50.30	54.00	-3.70	CISPR Avg	348	162	Horizontal
3663.990	50.29	54.00	-3.71	RMS	36	157	Horizontal
3664.020	52.65	54.00	-1.35	RMS	16	183	Vertical
4579.960	50.78	54.00	-3.22	RMS	304	145	Horizontal
4579.995	51.67	54.00	-2.33	RMS	307	107	Vertical

Table 16 - 915 MHz, 30 MHz to 5 GHz

No other emissions found within 10 dB of the limit.

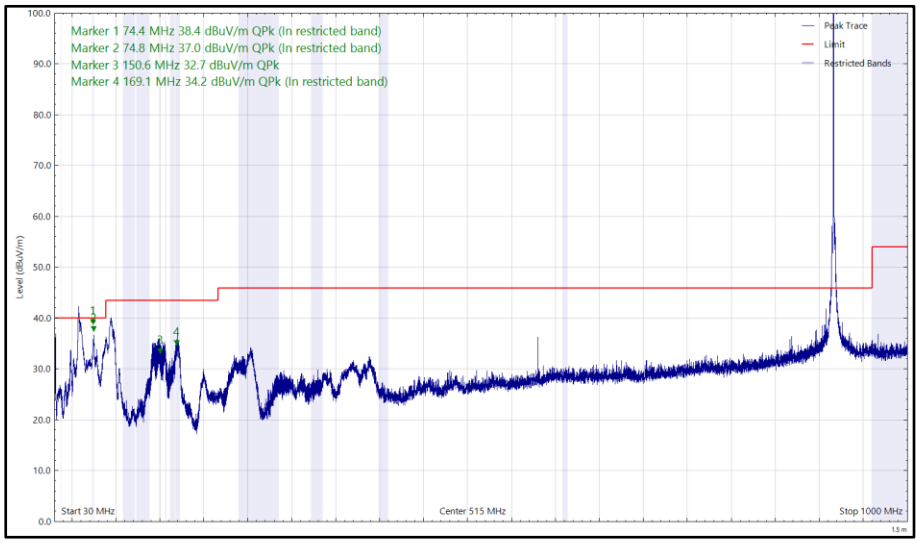

Figure 2 - 915 MHz, 30 MHz to 1 GHz, Horizontal (Peak)

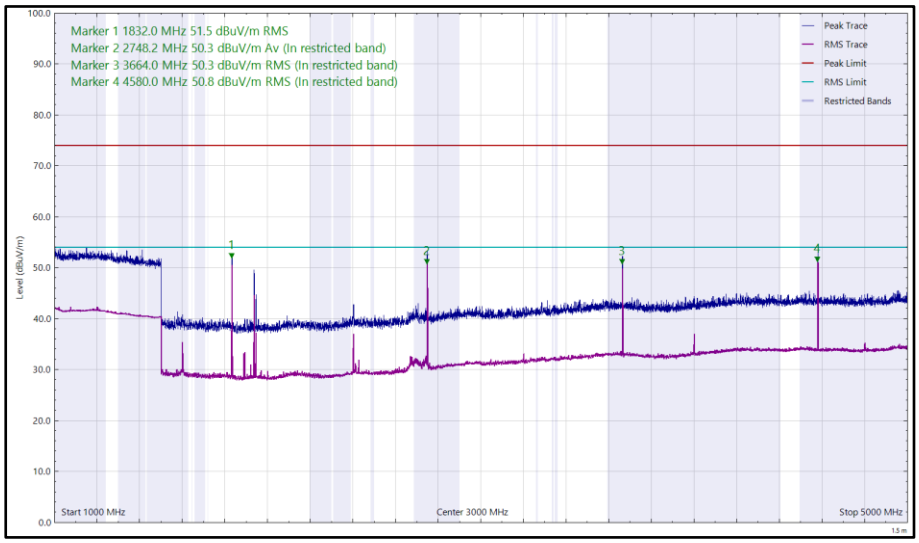

Figure 3 - 915 MHz, 1 GHz to 5 GHz, Horizontal

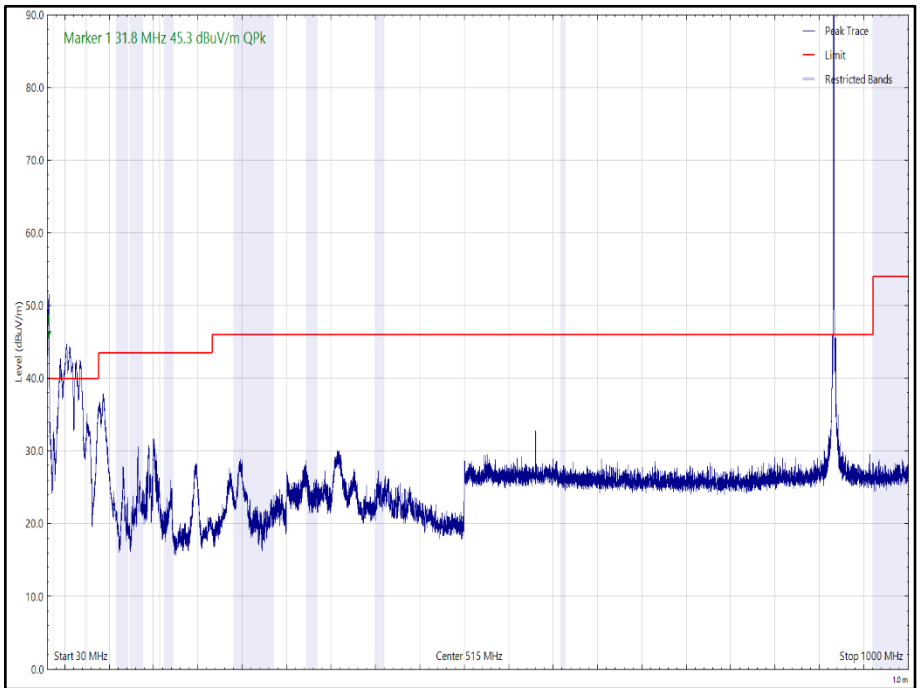

Figure 4 - 915 MHz, 30 MHz to 1 GHz, Vertical (Peak)

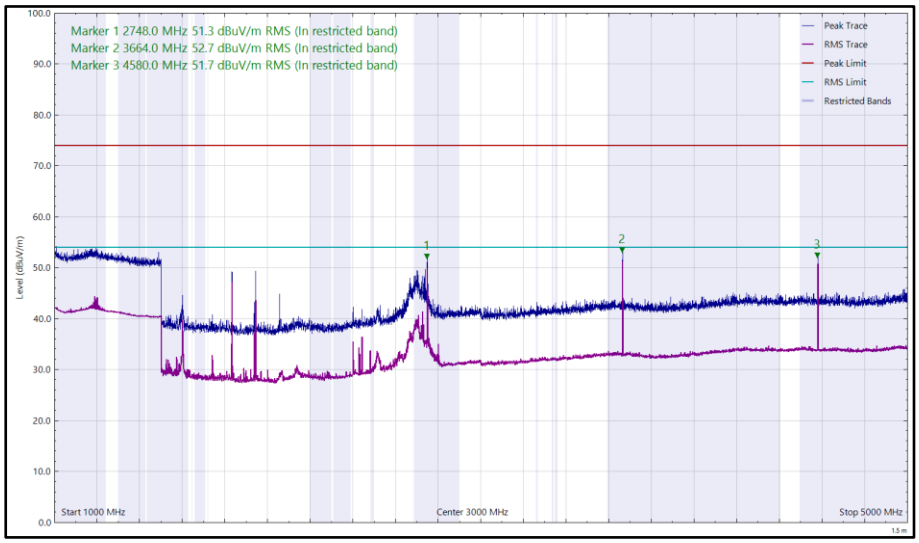

Figure 5 - 915 MHz, 1 GHz to 5 GHz, Vertical

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

2.1.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Screened Room (5)	Rainford	Rainford	1545	36	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Power Supply Unit	Farnell	LT30-2	2659	-	TU
Hygropalm Temperature and Humidity Meter	Rotronic	HP21	4410	12	08-Sep-2024
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
4 dB Attenuator	Pasternack	PE7047-4	4935	12	20-Jul-2024
High Pass Filter	Wainwright	WHKX12-12901500-18000-80SS	4962	12	14-Jun-2024
Emission Software	TUV SUD	EmX V3.1.12	5125	-	TU
Pre-amplifier (30 dB, 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	14-Apr-2024
Cable (SMA to SMA, 2m)	Junkosha	MWX221-02000AMSAMS/A	5517	12	21-May-2024
Cable (N- Type to N-Type, 8m)	Junkosha	MWX221-08000NMSNMS/B	5521	12	05-Jun-2024
Antenna (DRG, 1 GHz to 10.5 GHz)	Schwarzbeck	BBH9120B	5611	12	15-Oct-2024
Cable (K- Type to K Type, 2m)	Junkosha	MWX241-02000KMSKMS/B	5934	12	18-Jun-2024
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9168	6635	24	13-Jun-2025

Table 17

TU - Traceability Unscheduled

3 Photographs

3.1 Test Setup Photographs

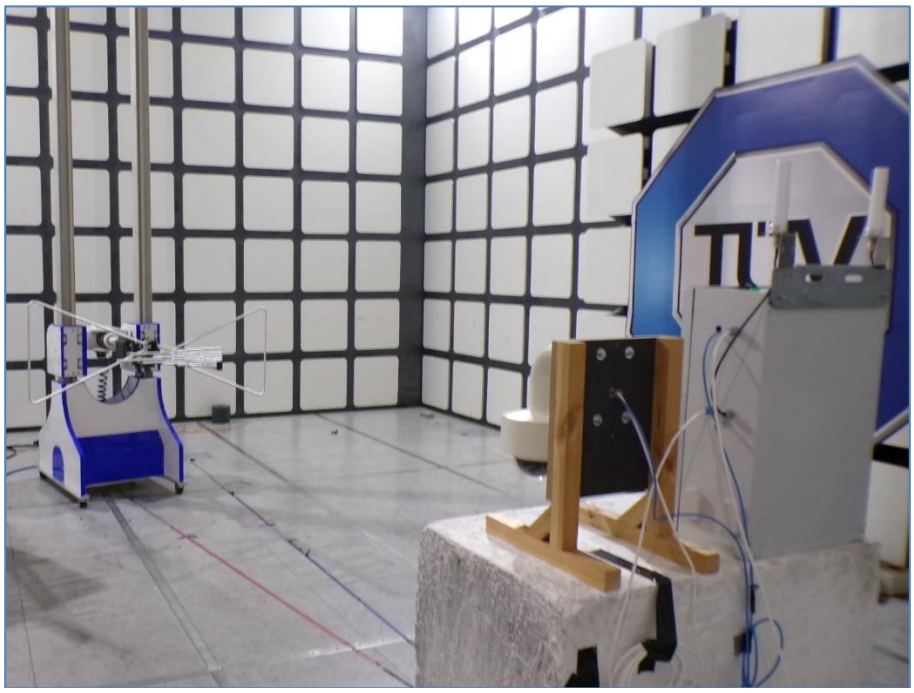

Figure 6 – 30 MHz to 1 GHz

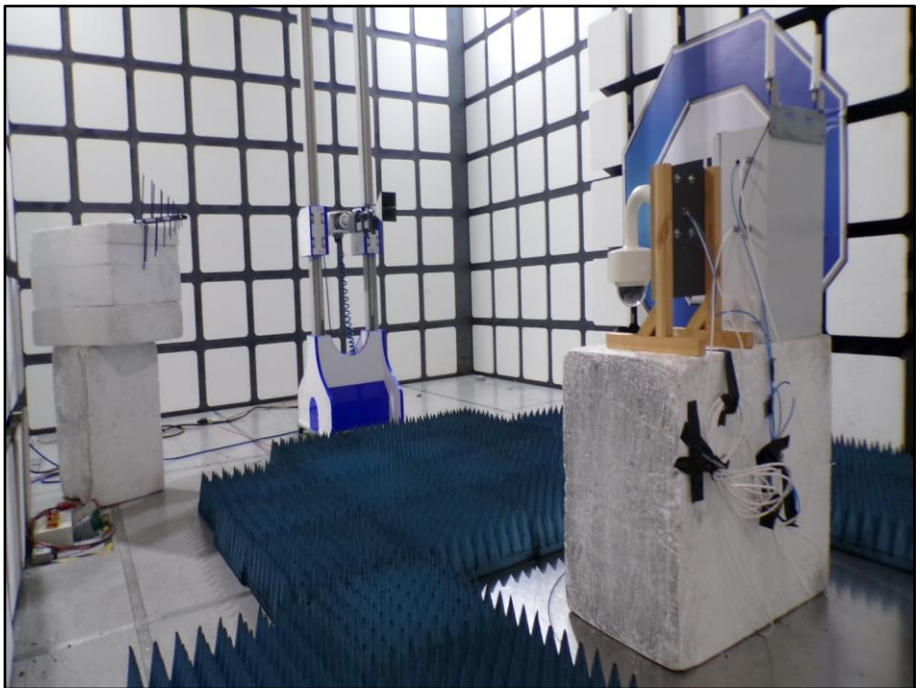

Figure 7 – 1 GHz to 5 GHz

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 18

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.