

FCC Test Report

MiX Telematics International (Pty) Ltd
Telematics Unit, Model: MiX 6AMB-4G-B

In accordance with FCC 47 CFR Part 15C
(2.4 GHz Bluetooth Low Energy)

Prepared for: MiX Telematics International (Pty) Ltd
Blaauwklip Office Park 2
Cnr Strand & Webersvalley Roads
Stellenbosch
South Africa



FCC ID: 2AFMS-6AMB4G

COMMERCIAL-IN-CONFIDENCE

Document 75949089-15 Issue 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	17 February 2021

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 with 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	Graeme Lawler	17 February 2021	

FCC Accreditation
90987 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: 2019 for the tests detailed in section 1.3.



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ACCREDITATION

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Contents

1	Report Summary	2
1.1	Report Modification Record.....	2
1.2	Introduction.....	2
1.3	Brief Summary of Results	3
1.4	Manufacturer Declared Variant(s)	4
1.5	Application Form	5
1.6	Product Information	10
1.7	Deviations from the Standard.....	10
1.8	EUT Modification Record	10
1.9	Test Location	10
2	Test Details	11
2.1	Restricted Band Edges.....	11
2.2	Authorised Band Edges	15
3	Measurement Uncertainty	19



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	17 February 2021

Table 1

1.2 Introduction

Applicant	MiX Telematics International (Pty) Ltd
Manufacturer	MiX Telematics International (Pty) Ltd
Model Number(s)	MiX 6AMB-4G-B
Manufacturer Declared Variant(s)	MiX 6AMB-4G
Serial Number(s)	66000181
Hardware Version(s)	1
Software Version(s)	V2.04
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2019
Order Number	P0093632
Date	20-May-2020
Date of Receipt of EUT	19-January-2021
Start of Test	27-January-2021
Finish of Test	27-January-2021
Name of Engineer(s)	Graeme Lawler
Related Document(s)	ANSI C63.10 (2013)



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	Test Description	Result	Comments/Base Standard
Configuration and Mode: 2.4 GHz Bluetooth Low Energy				
2.1	15.205	Restricted Band Edges	Pass	ANSI C63.10 (2013)
2.2	15.247 (d)	Authorised Band Edges	Pass	ANSI C63.10 (2013)

Table 2

1.4 Manufacturer Declared Variant(s)



Stellenbosch 28 Jan 2021

To: Whom it may concern

From: MiX Telematics International (Pty) Ltd
Blaauwklip Office Park 2, CNR Strand & Webbers Valley
Stellenbosch – South Africa

Subject: Declaration of Similarity

MiX Telematics International (Pty) Ltd, hereby also declare that the battery and non-battery variants, present the same electrical, physical and electro mechanics characteristics, the same PCB (AWZ0006A-1D), layout and components. The only difference between them is that the “-B” models have an internal backup battery plugged in, allowing the device to work after the disconnection of the vehicle’s battery.

The following product variants (with part numbers) are available:

Part Number	Official Product Name	Description	Series
U0042MT	MiX 6AMB-4G	MiX 6000 MK2 6AMB-4G Electronic Unit	MiX 6000 MK2
U0044MT	MiX 6AMB-4G-B	MiX 6000 MK2 6AMB-4G-B Electronic Unit with Backup Battery	MiX 6000 MK2

Tabel 1: Variants in the MiX 6AMB-4G/-B Series of Products

We remain at your disposal for any clarifications that may become necessary.

Sincerely,



Certification Manager: TC Bothma

Blaauwklip Office Park 2, CNR Strand & Webbers Valley – Stellenbosch – South Africa



1.5 Application Form

Equipment Description

Technical Description: (Please provide a brief description of the intended use of the equipment including the technologies the product supports)	The MiX 6AMB-4G is a high-end Fleet product that incorporates the latest market trends. It supports LTE CAT 4 with 2G/3G fall-back, 3-Axis Accelerometer, WiFi, Bluetooth, 433 or 915 MHz Short Range Device and GNSS. The MiX 6AMB-4G-B is the same design, but it also includes a backup battery. The kit consists of: Main Harness MP10, External LTE Antenna PA8, PUCK Antenna and Code Plug Socket Harness CP4	
Manufacturer:	MiX Telematics (Pty) Ltd.	
Model:	MiX 6AMB-4G-B	
Part Number:	U0044MT	
Hardware Version:	1	
Software Version:	2.0.4	
FCC ID of the product under test – see guidance here	2AFMS-6AMB4G	
IC ID of the product under test	Not Applicable	

Intentional Radiators

Technology	GSM850	GSM1900	WCDMA BAND II	WCDMA BAND IV	WCDMA BAND V
Frequency Range (MHz to MHz)	824.2-848.8	1850.2-1909.8	1852.4-1907.6	1712.4-1752.6	826.4-846.6
Conducted Declared Output Power (dBm)	33 27	30 26	24	24	24
Antenna Gain (dBi)	2.29	1.59	1.59	2	2.29
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	296Kbps (DL) 236.8Kbps (UL)	296Kbps (DL) 236.8Kbps (UL)	60	45	25
Modulation Scheme(s) (e.g GFSK, QPSK etc)	GMSK, 8PSK	GMSK, 8PSK	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM	QPSK, 16QAM, 64QAM
ITU Emission Designator (see guidance here)	247KGXW 245KG7W	249KGXW 249KG7W	4M15F9W	4M14F9W	4M13F9W
Bottom Frequency (MHz)	824.2	1850.2	1850	1710	824
Middle Frequency (MHz)	837	1880	1880	1732.5	836.5
Top Frequency (MHz)	848.8	1909.8	1910	1755	849



Technology	SRD 915	SRD2400 BT/BLE	SRD2400 WiFi
Frequency Range (MHz to MHz)	902-928	2402-2480	2412-2467
Conducted Declared Output Power (dBm)	20	6	15.6
Antenna Gain (dBi)	0	3	3
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	0.025	1	20 40
Modulation Scheme(s) (e.g GFSK, QPSK etc)	2FSK	GFSK 8-DPSK	GFSK (BDR) (1 Mbit/s); $\pi/4$ -DQPSK (EDR) (2 Mbit/s); 8-PSK (EDR) (3 Mbits/s)
ITU Emission Designator (see guidance here)	38K2F7D	1M10F1D	16M7D1D
Bottom Frequency (MHz)	902	2402	2412
Middle Frequency (MHz)	915	2440	2439.5
Top Frequency (MHz)	928	2480	2467

Technology	LTE Band 2	LTE Band 4	LTE Band 5	LTE Band 7	LTE Band 12
Frequency Range (MHz to MHz)	1850-1910	1710-1755	824-849	2500-2570	699-716
Conducted Declared Output Power (dBm)	23±2	23±2	23±2	23±2	23±2
Antenna Gain (dBi)	1.59	4.2	2.29	3	3.26
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	1.4, 3, 5,10,15, 20	1.4, 3, 5,10,15, 20	1.4, 3, 5,10,15	5,10,15, 20	1.4, 3, 5,10
Modulation Scheme(s) (e.g GFSK, QPSK etc)	QPSK, 16QAM	QPSK, 16QAM	QPSK, 16QAM	QPSK, 16QAM	QPSK, 16QAM
ITU Emission Designator (see guidance here)	17M9G7D 17M9W7D 1M09W7D	17M9G7D 17M9W7D 1M09W7D	8M93G7D 8M93W7D2M 70G7D 1M09W7D	17M9G7D 17M9W7D 4M49W7D	8M93G7D 8M93W7D 1M09W7D
Bottom Frequency (MHz)	1850	1710	824	2500	699
Middle Frequency (MHz)	1880	1732.5	836.5	2535	707.5
Top Frequency (MHz)	1910	1755	849	2570	716



Technology	LTE Band 13	LTE Band 25	LTE Band 26	LTE Band 38	LTE Band 41
Frequency Range (MHz to MHz)	777-787	1850-1915	814-849	2570-2620	2496-2690
Conducted Declared Output Power (dBm)	23±2	23±2	23±2	23±2	23±2
Antenna Gain (dBi)	4.45	1.59	2.53	2.06	3
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	5,10	1.4, 3, 5,10,15, 20	1.4, 3, 5,10	5,10,15, 20	5,10,15, 20
Modulation Scheme(s) (e.g GFSK, QPSK etc)	QPSK, 16QAM	QPSK, 16QAM	QPSK, 16QAM	QPSK, 16QAM	QPSK, 16QAM
ITU Emission Designator (see guidance here)	8M91G7D 8M91W7D 4M48G7D 4M49W7D	17M9G7D 17M9W7D 8M91G7D 1M09W7D	8M91G7D 8M91W7D 1M09G7D 1M09W7D 13M5G7D 13M4W7D 4M49W7D	17M8G7D 17M8W7D 8M91G7D	17M9G7D 17M9W7D 8M91G7D 4M50W7D
Bottom Frequency (MHz)	777	1850	814	2570	2496
Middle Frequency (MHz)	782	1882.5	831.5	2595	2593
Top Frequency (MHz)	787	1915	849	2620	2690

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	2690 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	699 MHz
Class A Digital Device (Use in commercial, industrial or business environment) ☐	
Class B Digital Device (Use in residential environment only) ☒	



AC Power Source

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

DC Power Source

Nominal voltage:	13.8/27.6	V
Extreme upper voltage:	32	V
Extreme lower voltage:	10.5	V
Max current:	7.5A absolute max (7.5A Fused) 3.5A typical	A

Battery Power Source

Voltage:	3.2	V
End-point voltage:	2.5	V (Point at which the battery will terminate)
Alkaline ☐ Leclanche ☐ Lithium ☒ Nickel Cadmium ☐ Lead Acid* ☒ *(Vehicle regulated)		
Other ☐	Please detail:	

Charging

Can the EUT transmit whilst being charged	Yes ☒ No ☐
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Temperature

Minimum temperature:	-20	°C
Maximum temperature:	+60 (limited by backup battery) Else +80	°C



Antenna Characteristics

Antenna connector ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:	SRD915	Gain	0	dBi
External antenna ☒	Type:	LTE Primary LTE Diversity Bluetooth/WiFi GNSS	Gain	2.84 (3G); 2.44 (4G) 2 3 RX	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 ☒					

Ancillaries (if applicable)

Manufacturer:	CHM	Part Number:	440FT0033
Model:	Main Harness MP10	Country of Origin:	South Africa
Manufacturer:	Jinchang Electron Global Service	Part Number:	A0050MT
Model:	PUCK Antenna, LTE, WiFi/Bluetooth and GNSS Combination Antenna (JCE305)	Country of Origin:	China
Manufacturer:	RF Design	Part Number:	A0049MT
Model:	External LTE antenna PA8 Fakra connector	Country of Origin:	South Africa
Manufacturer:	CHM	Part Number:	440FT0032
Model:	Code Plug Harness with socket CP4	Country of Origin:	South Africa
Manufacturer:	CHM	Part Number:	A0041MT
Model:	Auxiliary Harness AX5 (optional)	Country of Origin:	South Africa
Manufacturer:	CHM	Part Number:	440FT0931
Model:	Serial Harness SR1 (optional)	Country of Origin:	South Africa

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

Name: Christo Bothma
Position held: Certification Manager
Date: 26 Nov 2020



1.6 Product Information

1.6.1 Technical Description

The MiX 6AMB-4G is a high-end Fleet product that incorporates the latest market trends. It supports LTE CAT 4 with 2G/3G fallback, 3-Axis Accelerometer, WiFi, Bluetooth, 433 or 915 MHz Short Range Device and GNSS. The MiX 6AMB-4G-B is the same design, but it also includes a backup battery.

1.7 Deviations from the Standard

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

1.8 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: MiX 6AMB-4G-B, Serial Number: 66000181			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.9 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz Bluetooth Low Energy		
Restricted Band Edges	Graeme Lawler	UKAS
Authorised Band Edges	Graeme Lawler	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom



2 Test Details

2.1 Restricted Band Edges

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205

2.1.2 Equipment Under Test and Modification State

MiX 6AMB-4G-B, S/N: 66000181 - Modification State 0

2.1.3 Date of Test

27-January-2021

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5 and 11.12.1.

Plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.5. These are shown for information purposes and were used to determine the worst case measurement point. Final average measurements were then taken in accordance with ANSI C63.10, clause 11.12.2.5.2. to obtain the measurement result recorded in the test results tables.

The following conversion can be applied to convert from dB μ V/m to μ V/m:

$10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$.

2.1.5 Environmental Conditions

Ambient Temperature	23.7 °C
Relative Humidity	38.2 %

2.1.6 Test Results

2.4 GHz Bluetooth Low Energy

Modulation	Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK	2402.0	2390.0	55.90	44.91
GFSK	2480.0	2483.5	58.07	50.02

Table 5 - Restricted Band Edge Results

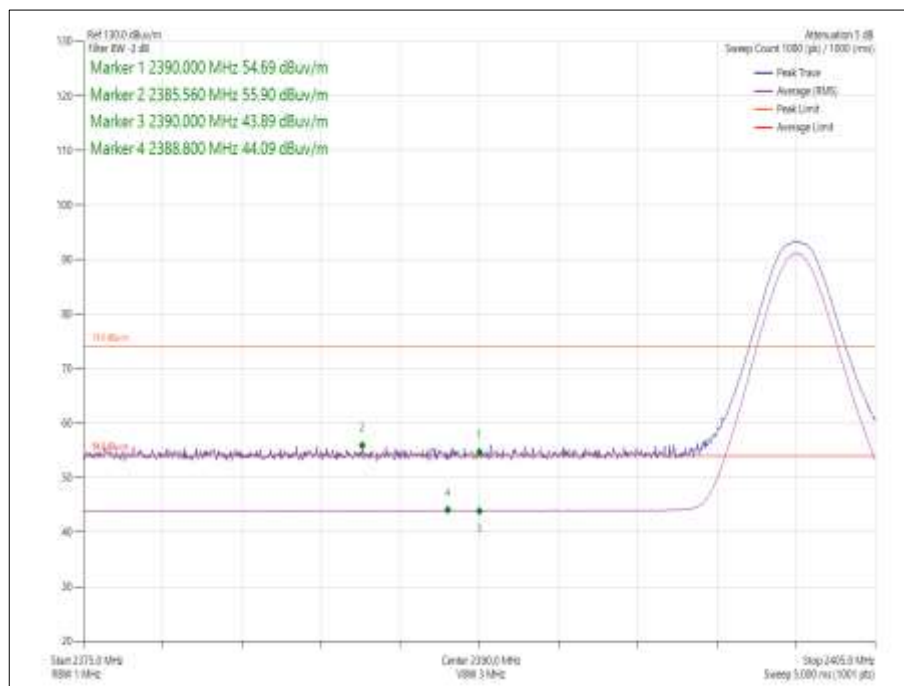


Figure 1 - GFSK – 2402.0 MHz - Band Edge Frequency 2390.0 MHz

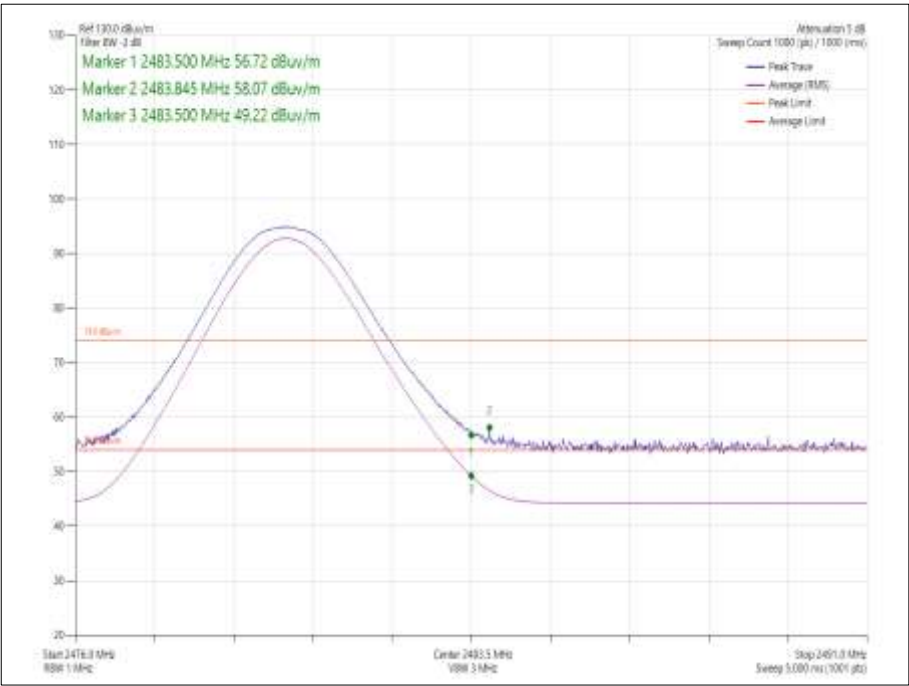


Figure 2 - GFSK – 2480.0 MHz - Band Edge Frequency 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (µV/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 6



2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
DC Power Supply	Hewlett Packard	6269B	326	-	O/P Mon
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	14-Jan-2022
Multimeter	Fluke	175	4427	12	16-Mar-2021
EmX Emissions Software	TUV SUD	V2.1.1 V.V2.1.1	5125	-	N/A - Software
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	18-Mar-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5519	12	24-Mar-2021
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023

Table 7

TU – Traceability Unscheduled

O/P Mon – Output Monitored Using Calibrated Test Equipment.



2.2 Authorised Band Edges

2.2.1 Specification Reference

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

2.2.2 Equipment Under Test and Modification State

MiX 6AMB-4G-B, S/N: 66000181 - Modification State 0

2.2.3 Date of Test

27-January-2021

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

2.2.5 Environmental Conditions

Ambient Temperature	23.7 °C
Relative Humidity	38.2 %

2.2.6 Test Results

2.4 GHz Bluetooth Low Energy

Modulation	Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	2402.0	2400.0	-44.83
GFSK	2480.0	2483.5	-48.27

Table 8 - Authorised Band Edge Results

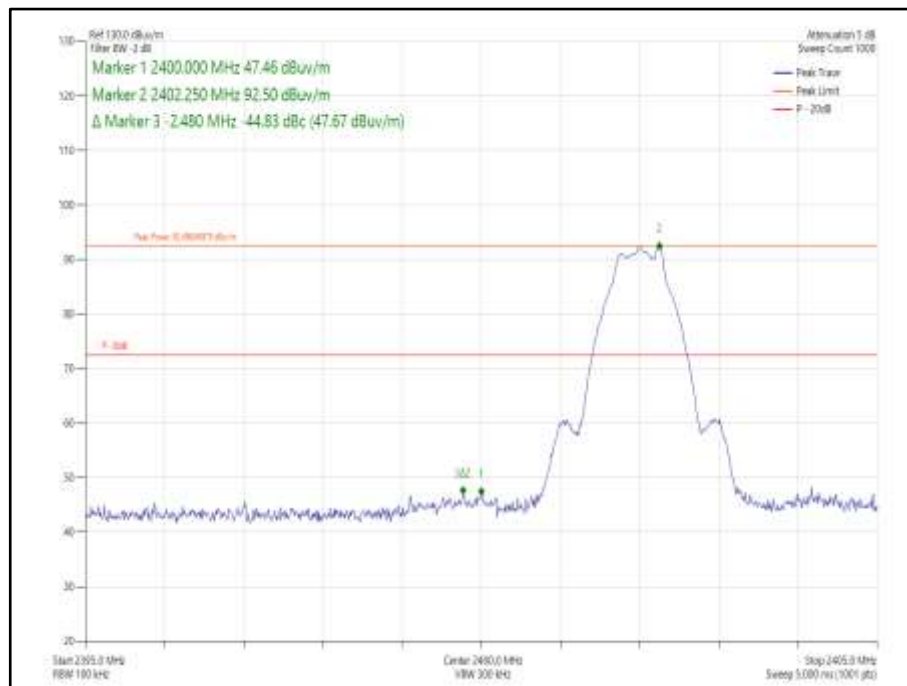


Figure 3 - GFSK – 2402.0 MHz – Band Edge Frequency 2400.0 MHz

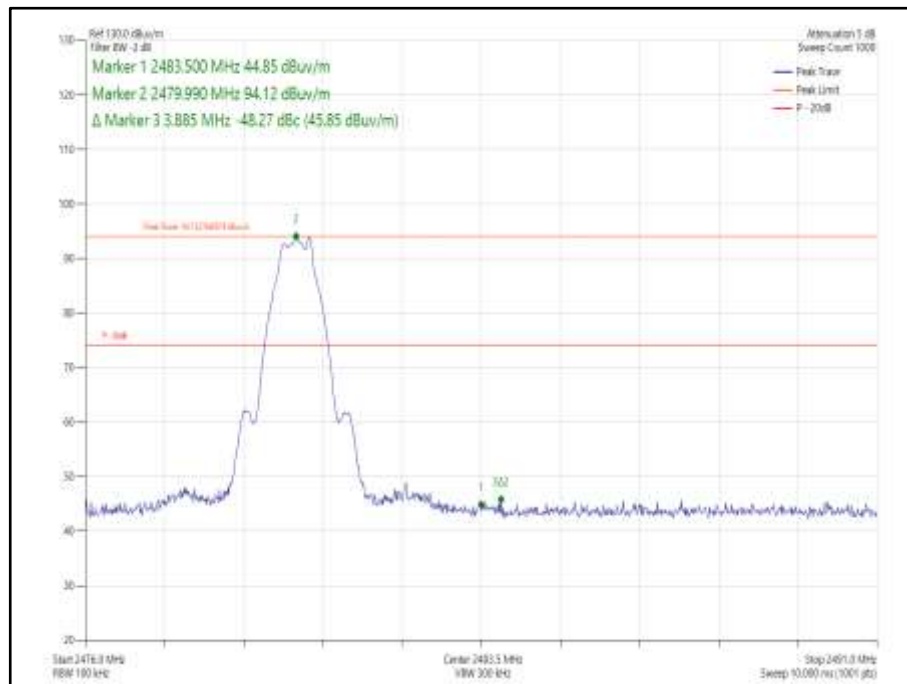


Figure 4 - GFSK – 2480.0 MHz – Band Edge Frequency 2483.5 MHz

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

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.



2.2.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
DC Power Supply	Hewlett Packard	6269B	326	-	O/P Mon
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	14-Jan-2022
Multimeter	Fluke	175	4427	12	16-Mar-2021
EmX Emissions Software	TUV SUD	V2.1.1 V.V2.1.1	5125	-	N/A - Software
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	18-Mar-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5519	12	24-Mar-2021
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023

Table 9

TU – Traceability Unscheduled

O/P Mon – Output Monitored Using Calibrated Test Equipment.



3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 10

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.