FCC Test Report

Axnes Aviation AS
Mobile Base Station, Model: BST35

In accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2

Prepared for: Axnes Aviation AS
Terje Lovasvei 1
Grimstad
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NORWAY

FCC ID: 2AOHPBST3XA

COMMERCIAL-IN-CONFIDENCE

Document 75948989-02 Issue 02

SIGNATURE			
Ryan Henley			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Ryan Henley	Sales Manager (RF & Telecoms)	Authorised Signatory	17 July 2020

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 90 and FCC 47 CFR Part 2. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Neil Rousell	17 July 2020	
Testing	Graeme Lawler	17 July 2020	

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 90: 2019 and FCC 47 CFR Part 2: 2019 for the tests detailed in section 1.3.

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Contents

1 Report Summary

1.1 Report Modification Record

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

Issue	Description of Change	Date of Issue
1	First Issue	25 June 2020
2	Update to section 1.7 to specify a deviation from the standard.	17 July 2020

Table 1

1.2 Introduction

Applicant	Axnes Aviation AS
Manufacturer	Axnes Aviation AS
Model Number(s)	BST35
Manufacturer Declared Variant(s)	BST30
Serial Number(s)	AXS-SW-0711
Hardware Version(s)	R4
Software Version(s)	AXS-SW-0711
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 90: 2019 FCC 47 CFR Part 2: 2019
Order Number Date	AX-PNG-OTH-2138 06-May-2020
Date of Receipt of EUT	07-May-2020
Start of Test	24-May-2020
Finish of Test	01-June-2020
Name of Engineer(s)	Neil Rousell and Graeme Lawler
Related Document(s)	ANSI C63.26: 2015

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 90 and FCC 47 CFR Part 2 is shown below.

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	Part 90	Part 2			
Configuration and Mode: Battery Powered - Transmit 16QAM					
2.1	90.213	2.1055	Frequency Stability	Pass	ANSI C36.26: 2015
2.2	90.210	2.1053	Radiated Spurious Emissions	Pass	ANSI C36.26: 2015
2.3	90.210	2.1051	Spurious Emissions at Antenna Terminals	Pass	ANSI C36.26: 2015

Table 2

1.4 Manufacturer Declared Variant(s)

Axnes Aviation AS

Declaration of similarity BST30 and BST35

The BST30 and BST35 are two variants of base station in the PNG family of products supplied by Axnes AS, Norway. Both base stations are portable, allowing carry on/temporary installs to various aircrafts and vehicles.

It is hereby declared that the PNG base station BST30 and the PNG base station BST35 are identical, with the exception of BST35 are equipped with six (internal) battery cells, giving the option to operate from external power or to operate from the internal batteries, without external power.

On the BST30 the battery cells are not installed, and external power are required.

The units are otherwise identical.

.....
Petter Johnsen (Chief Technical Officer)
on behalf of Axnes AS

Document number:	AX-PNG-OTH-2170
Revision:	Issue A
Date:	15 Jun 2020

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1.5 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment)*	PNG system is a wireless intercom extension, for use in demanding high noise environments as tracked vehicles, around helicopters and aircrafts and similar high noise and demanding operating environments. The base station (BST35) is connected either a standalone unit or connected to the vehicle/aircraft intercom. The crew is using either and MP30 handset or a MP50 handset, connected to their helmet coms/ or headset. BST35 communicates with the MP30/50 in the UHF band (406-470 MHz band). Actual frequency is programmed according to each customer's licensed band.
Manufacturer:	Axnes AS
Model:	BST35
Part Number:	AXS-BS-D0350-N
Hardware Version:	R4
Software Version:	AXS-SW-0711
FCC ID (if applicable)	2AOHPBST3XA
IC ID (if applicable)	Not Applicable

Intentional Radiators

Technology	The BST35 is the vehicle/aircraft/boat mounted radio communicating with the crew handheld radio MP50 or MP30 in the PNG system. The PNG system is designed for wireless intercom use. The use area are demanding noise environments as tracked vehicles, around helicopters and aircrafts, on boats and similar demanding environments. The system communicates in the 406.1-430 and 450-470 MHz band between the different PNG components for intercom use. In intercom mode the radio operates in digital transmission supporting 16QAM, 25 KHz channel separation, Time Division Multiplexing. One channel will carry 5 voice channels and data, occupying 20KHz band. Alternative robust modulation is available, supporting 8PSK, 25 KHz channel separation, Time Division Multiplexing. One channel will carry 3 voice channels and additional data, occupying 20KHz band. Output power is 400mW.
Frequency Band (MHz)	406-470
Conducted Declared Output Power (dBm)	26
Antenna Gain (dBi)	Typical Gain 5.1
Supported Bandwidth(s) (MHz)	20 kHz OBW and 25 kHz channel separation
Modulation Scheme(s)	8PSK/16QAM
ITU Emission Designator	20K0D7W
Bottom Frequency (MHz)	406.1125
Middle Frequency (MHz)	438.0500
Top Frequency (MHz)	469.9875

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	469.9875
Lowest frequency generated or used in the device or on which the device operates or tunes	406.1125
Class A Digital Device (Use in commercial, industrial or business environment) ☒ Class B Digital Device (Use in residential environment only) ☐	

DC Power Source

Nominal voltage:	28	V
Extreme upper voltage:	30	V
Extreme lower voltage:	24	V
Max current:	2	A

Battery Power Source

Voltage:	10.8	V
End-point voltage:	9.6	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 ☐

Temperature

Minimum temperature:	-20	°C
Maximum temperature:	50	°C

Antenna Characteristics

Antenna connector ☒			State impedance	50	Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☐	Type:		Gain		dBi
External antenna ☒	Type:	Typical monopol	Gain	5.1	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:		Part Number:	
Model:		Country of Origin:	

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

Name: Petter Johnsen
Position held: Logistics manager
Date: 15 June 2020

1.6 Product Information

1.6.1 Technical Description

The (EUT) Equipment Under Test is an AXNES Aviation AS, Model: BST35.

PNG system is a wireless intercom extension, for use in demanding high noise environments as tracked vehicles, around helicopters and aircrafts and similar high noise and demanding operating environments. The base station (BST35) is connected either a standalone unit or connected to the vehicle/aircraft intercom.

The crew is using either and MP30 handset or a MP50 handset, connected to their helmet coms/ or headset.

BST35 communicates with the MP30/50 in the UHF band (406-470 MHz band). Actual frequency is programmed according to each customer's licensed band.

1.6.2 Test Setup Diagram(s)

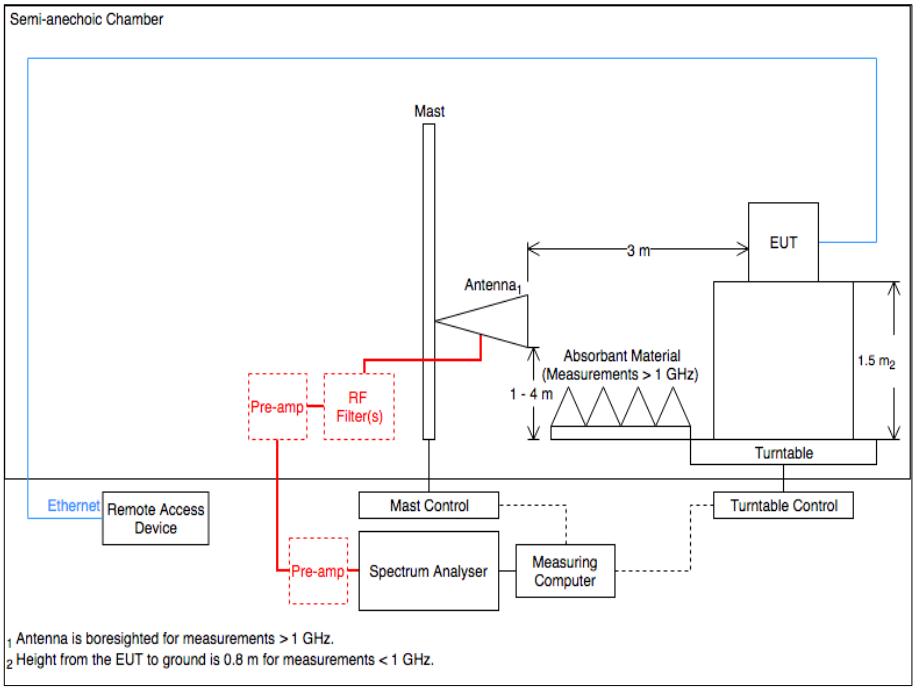

Figure 1 - Radiated Emissions

1.6.3 EUT Configuration and Rationale for Radiated Spurious Emissions

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. The EUT could reasonably be used in multiple planes, therefore, pre-scans were performed with the EUT orientated in X, Y and Z planes with reference to the ground plane.

1.7 Deviations from the Standard

The device under test is capable of operation between 405 MHz and 470 MHz and as such it straddles several frequency ranges which are covered under 47 CFR Part 90.

The channels used for testing were limited to bottom, middle and top for the entire frequency range supported by the device as opposed to bottom, middle and top for each individual band stated in Part 90. The performance of the radio over the entire frequency range was linear and therefore this was considered sufficient to demonstrate that the device under test is compliant for each channel supported.

Channels that are not allowed under Part 90, will not be accessible within the final device.

No other 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: BST35, Serial Number: AXS-SW-0711			
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: Battery Powered - Transmit 16QAM		
Frequency Stability	Neil Rousell	UKAS
Radiated Spurious Emissions	Graeme Lawler	UKAS
Spurious Emissions at Antenna Terminals	Neil Rousell	UKAS

Table 4

Office Address:

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

2 Test Details

2.1 Frequency Stability

2.1.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.213
FCC 47 CFR Part 2, Clause 2.1055

2.1.2 Equipment Under Test and Modification State

BST35, S/N: AXS-SW-0711 - Modification State 0

2.1.3 Date of Test

29-May-2020 to 01-June-2020

2.1.4 Test Method

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 90, Clause 90.213 and FCC CFR 47 Part 2, Clause 2.1055 (a) (1), (d) (2).

The EUT was connected to the spectrum analyser via a cable and attenuator was set to transmit a modulated signal at maximum power. The external frequency reference of the spectrum analyser was locked to a 10 MHz rubidium frequency reference. The marker function of the spectrum analyser was used to find the peak and the relative +- 20 dBc values (f1, f2). The carrier frequency error was the difference between the stated frequency and the measured / calculated frequency using the formula Fc = (f1+f2)/2. In accordance with 2.1055, the temperature was varied from -30°C to +50° in 10° steps at nominal voltage. The frequency measurement was repeated at +20° with the battery at its end point voltage.

As suggested by the manufacturer, the following method for testing the EUT at battery endpoint was used.

The EUT was left transmitting until it automatically switched itself off due to full battery discharge. The EUT was then attached to its battery charger for 10 min. The EUT carrier frequency was then measured.

2.1.5 Environmental Conditions

Ambient Temperature	21.3 - 23.3 °C
Relative Humidity	39.4 - 41.5 %

2.1.6 Test Results

Battery Powered - Transmit 16QAM

Voltage	Frequency Error (ppm)		
	406.1125 MHz	438.0500 MHz	469.9875 MHz
Battery low	0.3804	0.5045	0.3287
Battery nominal	0.4814	0.5593	0.4011

Table 5 - Frequency Stability Under Voltage Variations

Temperature	Frequency Error (ppm)		
	406.1125 MHz	438.0500 MHz	469.9875 MHz
+50.0 °C	0.1588	0.3573	0.7564
+40.0 °C	0.2807	0.3356	0.3319
+30.0 °C	0.2081	0.2796	0.3277
+20.0 °C	0.4814	0.5593	0.4011
+10.0 °C	0.7461	0.5445	0.6809
0 °C	0.2352	0.5673	0.3266
-10.0 °C	0.7055	0.6187	0.4468
-20.0 °C	0.5417	0.6129	0.6724
-30.0 °C	0.1108	0.3390	0.3000

Table 6 - Frequency Stability Under Voltage Variations

FCC 47 CFR Part 90, Limit Clause 90.213

5.0 ppm

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	08-Nov-2020
Stop Clock	R.S Components	RS328 061	2674	12	24-Jul-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	21-Oct-2020
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5480	12	18-Mar-2021

Table 7

O/P Mon – Output Monitored using calibrated equipment

2.2 Radiated Spurious Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.210
FCC 47 CFR Part 2, Clause 2.1053

2.2.2 Equipment Under Test and Modification State

BST35, S/N: AXS-SW-0711 - Modification State 0

2.2.3 Date of Test

24-May-2020

2.2.4 Test Method

A preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber.

Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Testing was performed in accordance with ANSI C63.26, clause 5.5.

Prescans and final measurements were performed using the direct field strength method.
The Regulatory limit of -13dBm / MHz has been converted to a field strength limit in accordance with ANSI C63.26 clause 5.2.7 equation c)

This is the limit line shown on the plots.

Example calculation
E (dBuV/m) = EIRP (dBm) - 20log(d) + 104.8 where (d) is the measurement distance.
E (dBuV/m) = -13 - 20log(3) + 104.8
E (dBuV/m) = 82.26

2.2.5 Environmental Conditions

Ambient Temperature	18.8 °C
Relative Humidity	48.2 %

2.2.6 Test Results

Battery Powered - Transmit 16QAM

Frequency (MHz)	Level (dBm)
*	

Table 8 - 406.1125 MHz – 30 MHz to 5 GHz

*No emissions were detected within 10 dB of the limit.

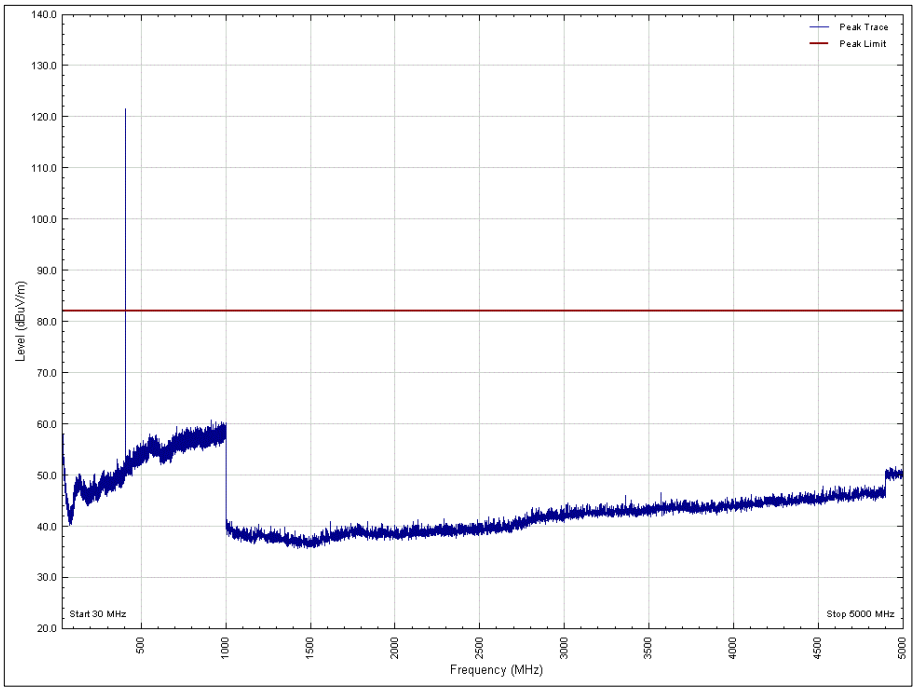

Figure 2 - 406.1125 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation X

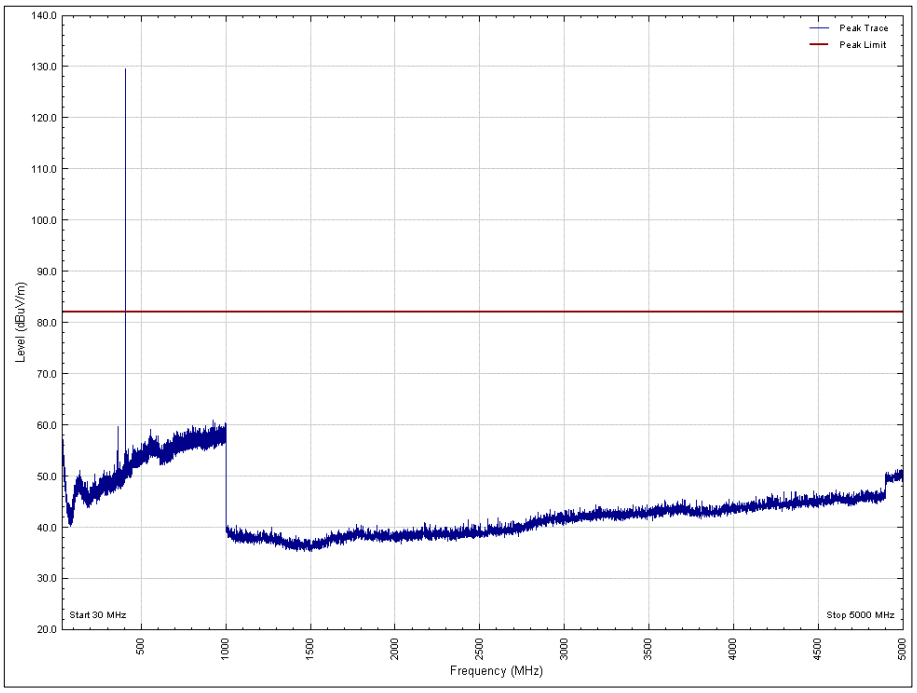

Figure 3 - 406.1125 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation X

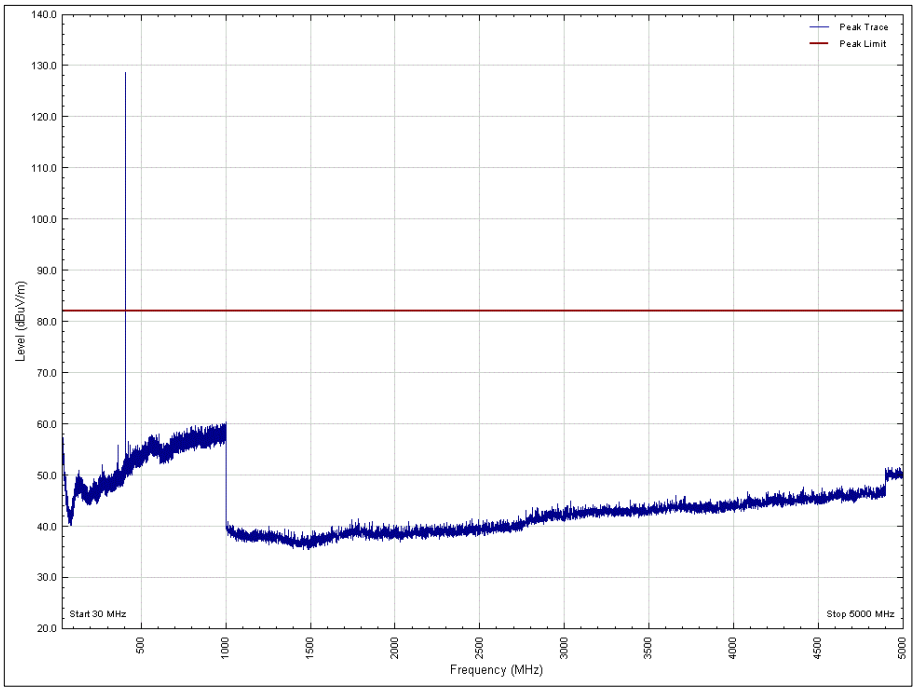

Figure 4 - 406.1125 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation Y

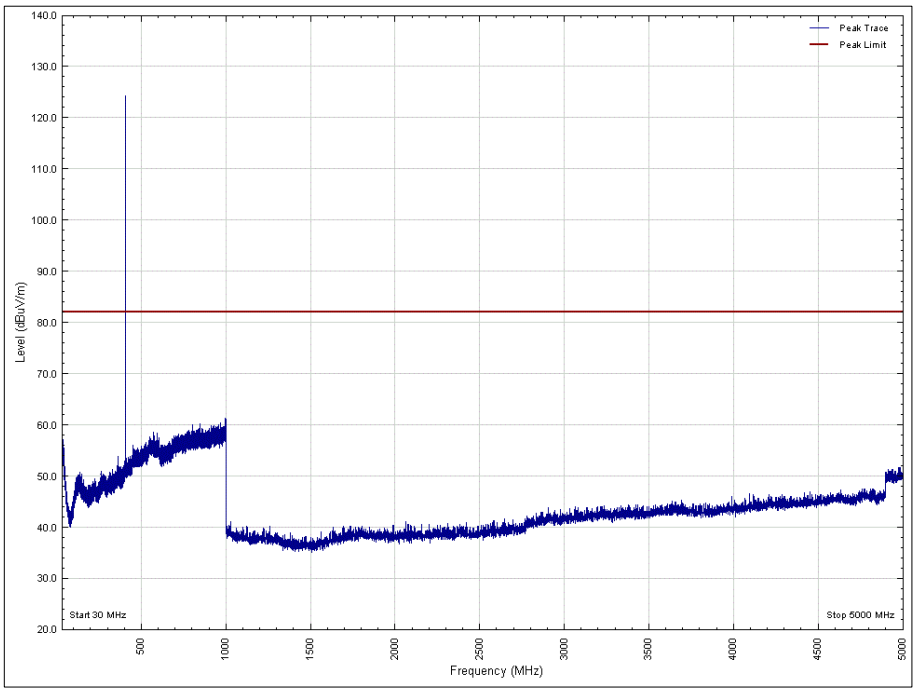

Figure 5 - 406.1125 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation Y

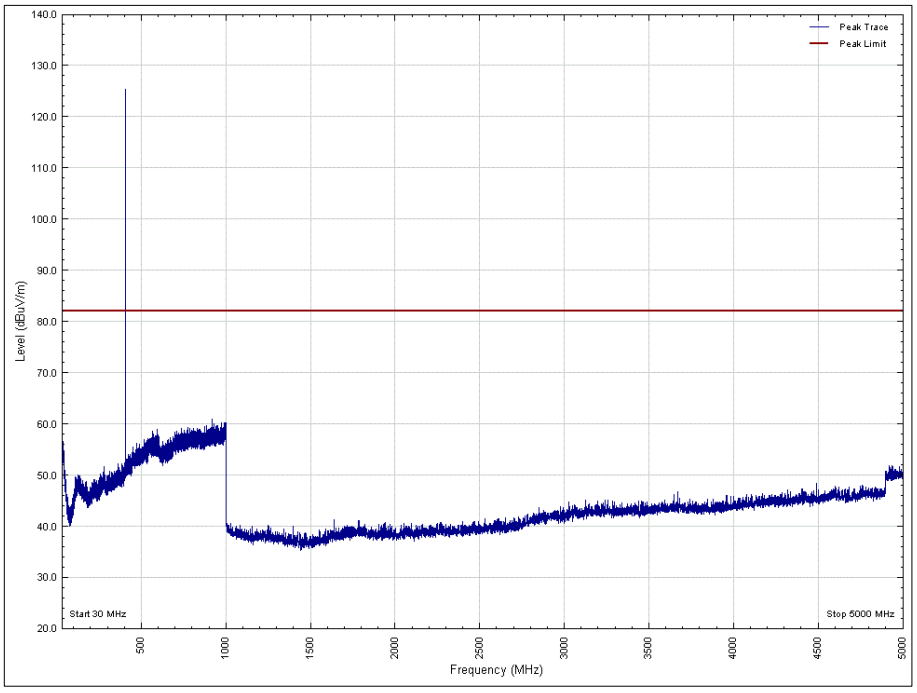

Figure 6 - 406.1125 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation Z

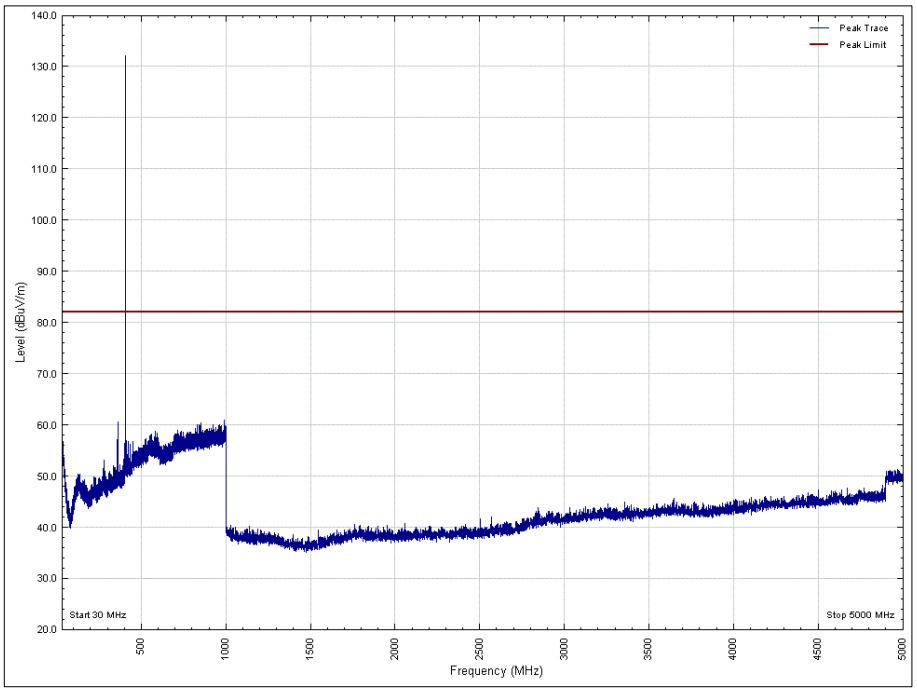

Figure 7 - 406.1125 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation Z

Frequency (MHz)	Level (dBm)
*	

Table 9 - 438.0500 MHz – 30 MHz to 5 GHz

*No emissions were detected within 10 dB of the limit.

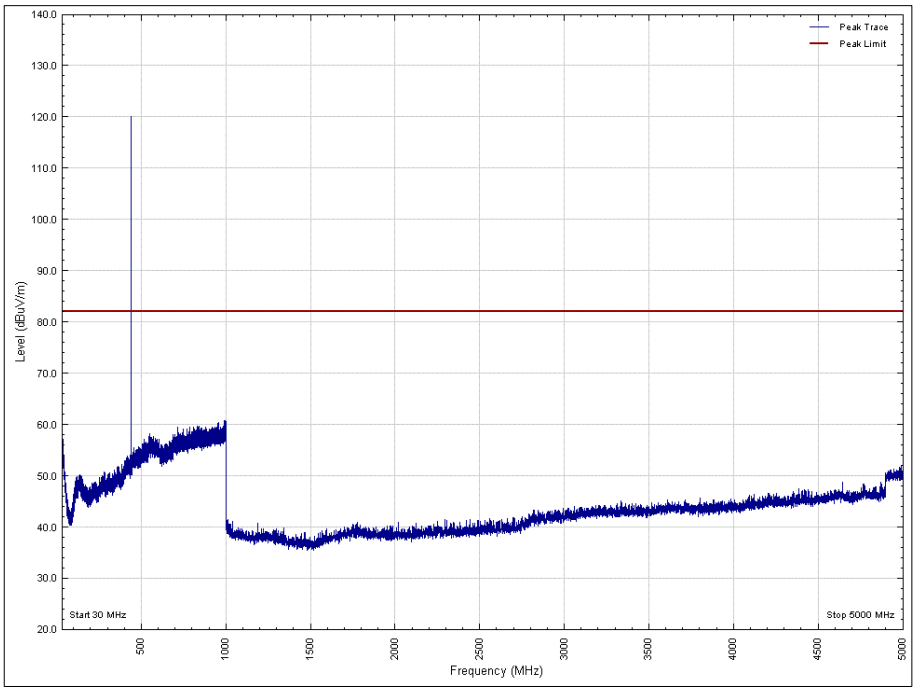

Figure 8 - 438.0500 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation X

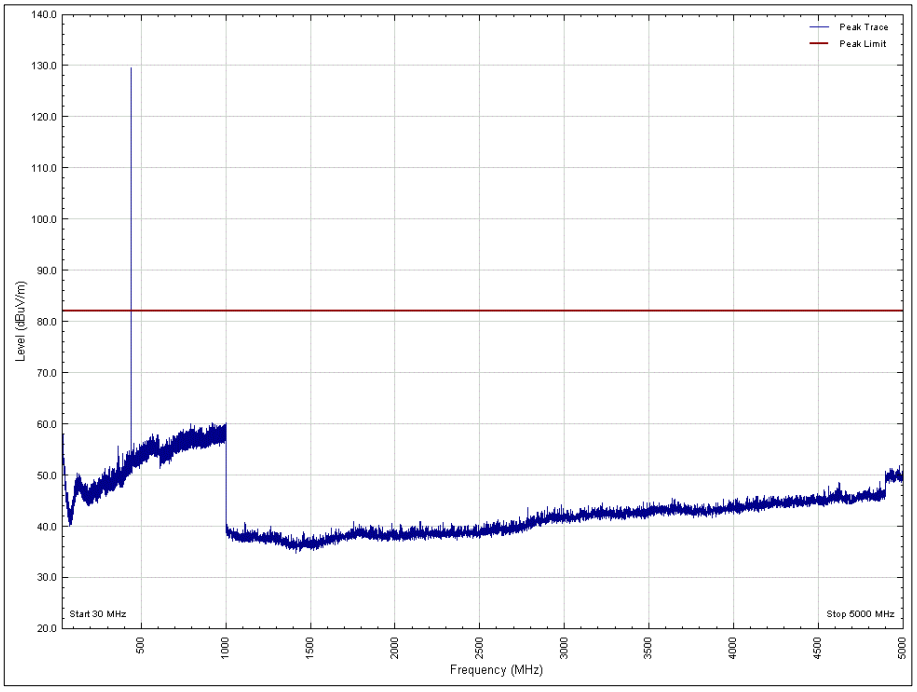

Figure 9 - 438.0500 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation X

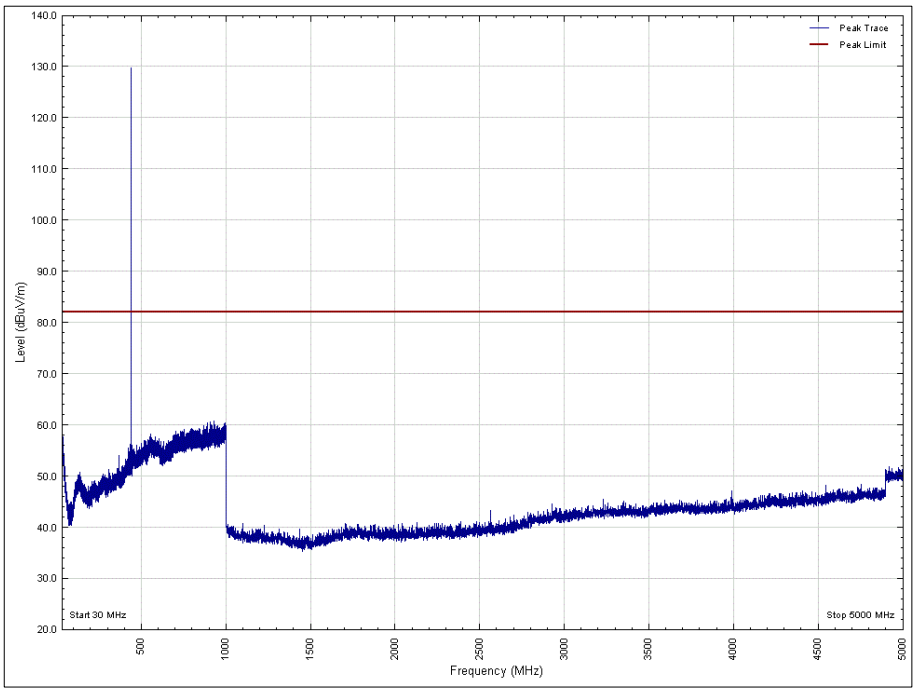

Figure 10 - 438.0500 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation Y

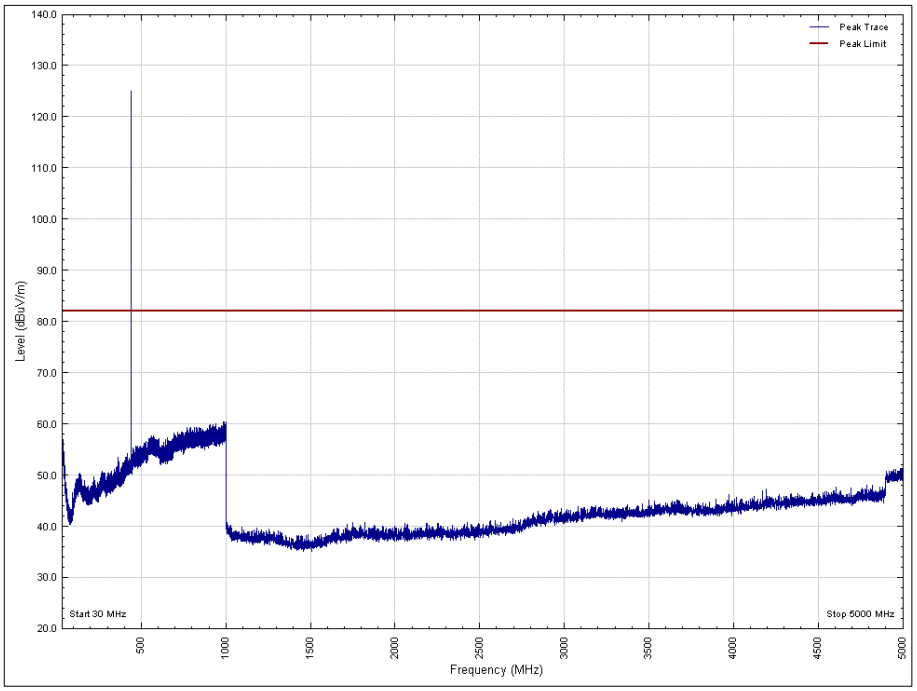

Figure 11 - 438.0500 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation Y

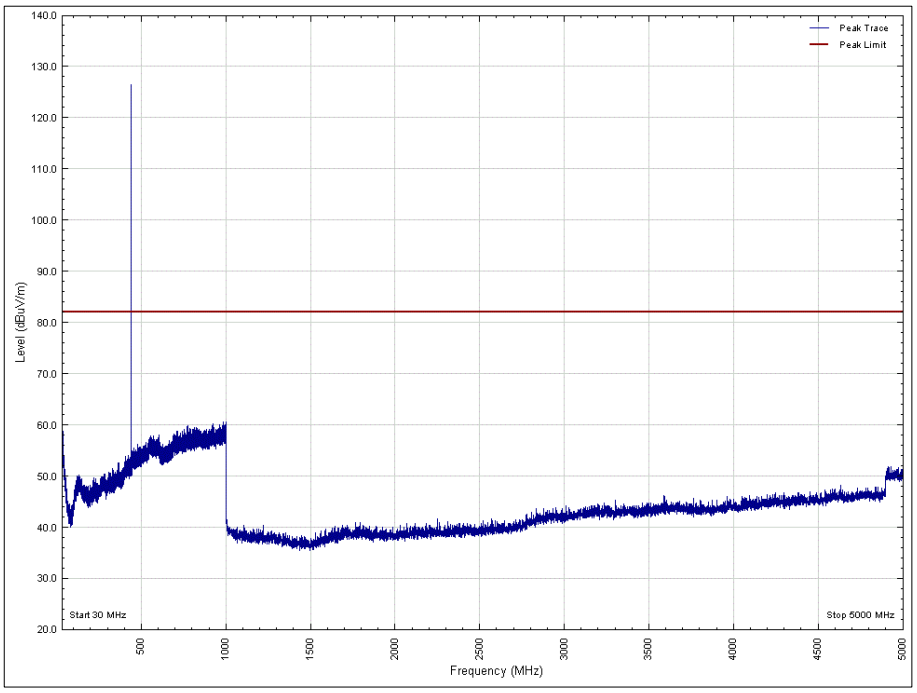

Figure 12 - 438.0500 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation Z

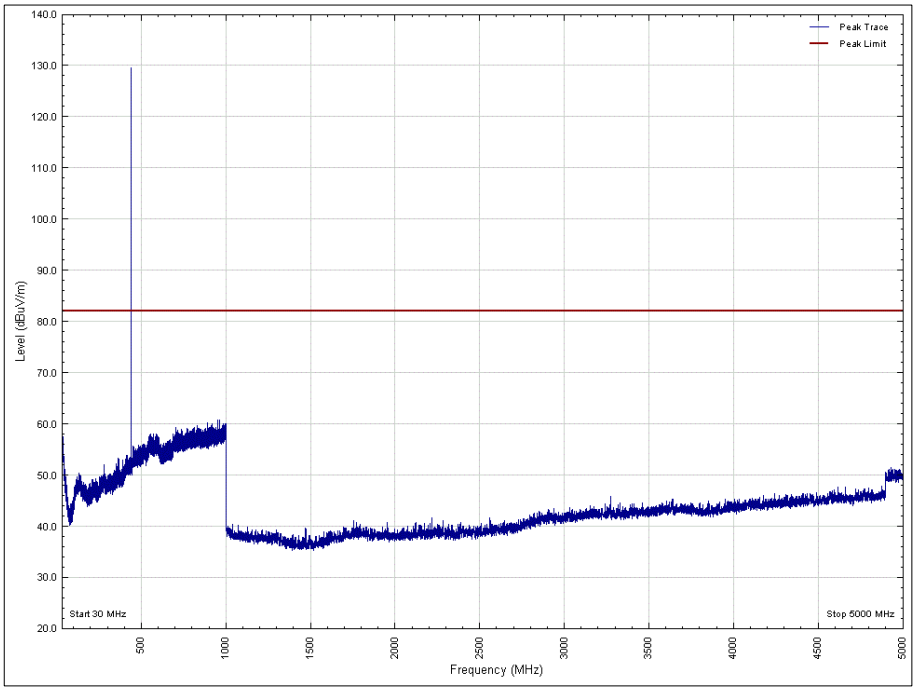

Figure 13 - 438.0500 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation Z

Frequency (MHz)	Level (dBm)
*	

Table 10 - 438.0500 MHz – 30 MHz to 5 GHz

*No emissions were detected within 10 dB of the limit.

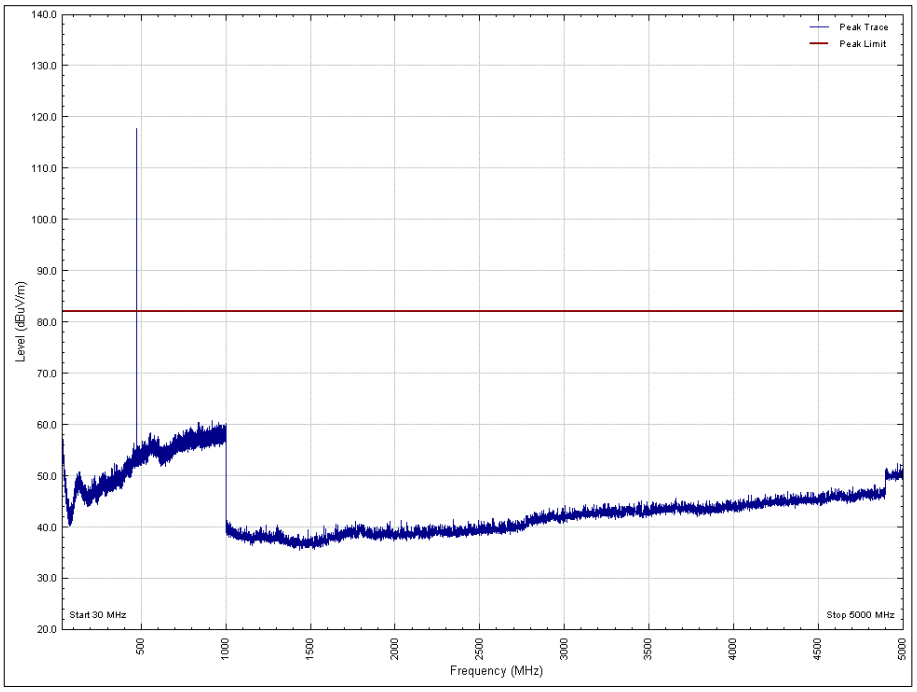

Figure 14 - 469.9875 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation X

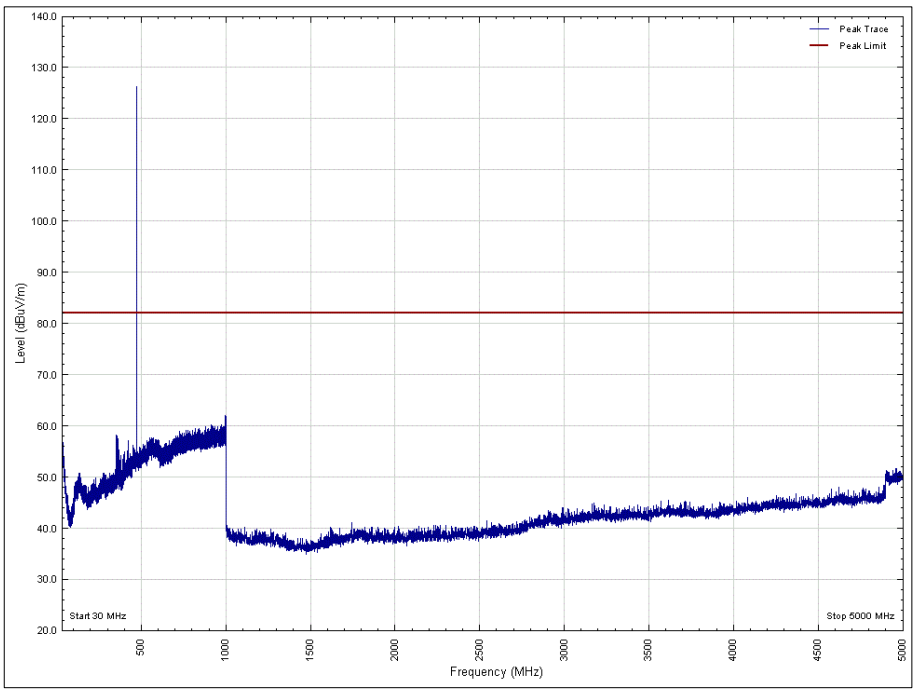

Figure 15 - 469.9875 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation X

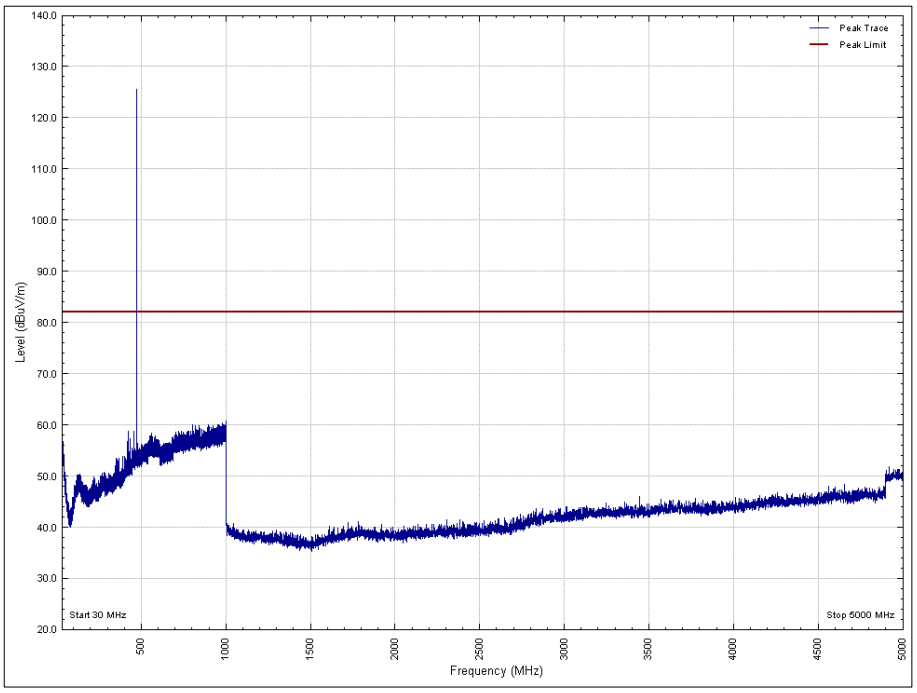

Figure 16 - 469.9875 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation Y

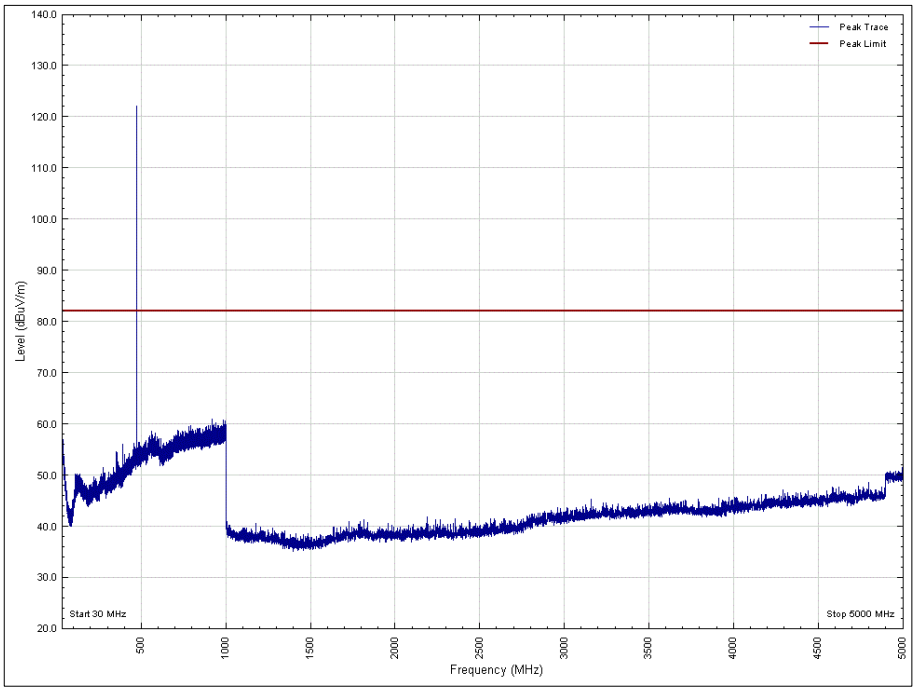

Figure 17 - 469.9875 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation Y

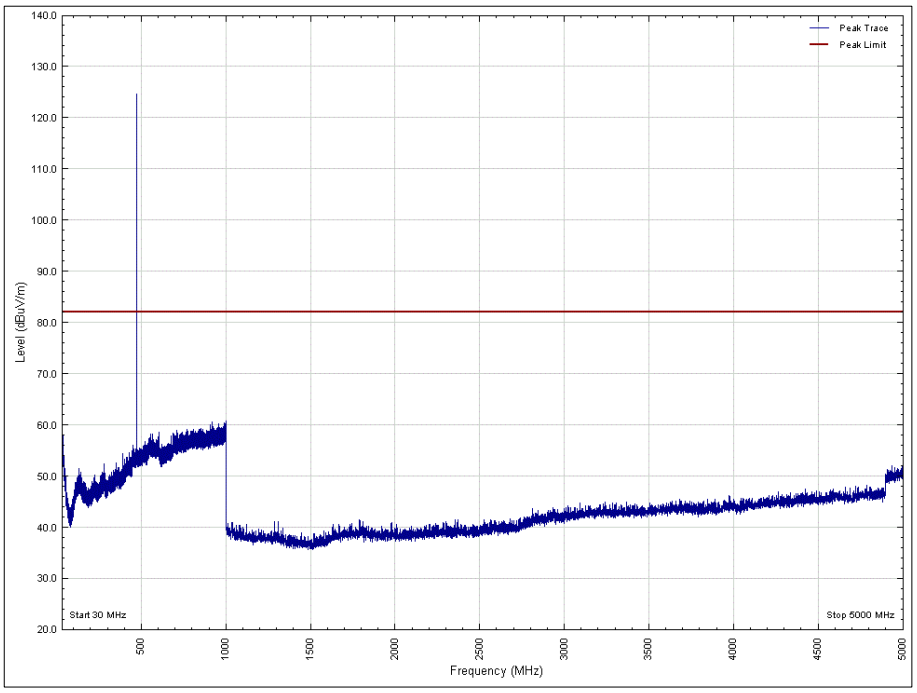

Figure 18 - 469.9875 MHz - 30 MHz to 5 GHz Vertical, EUT Orientation Z

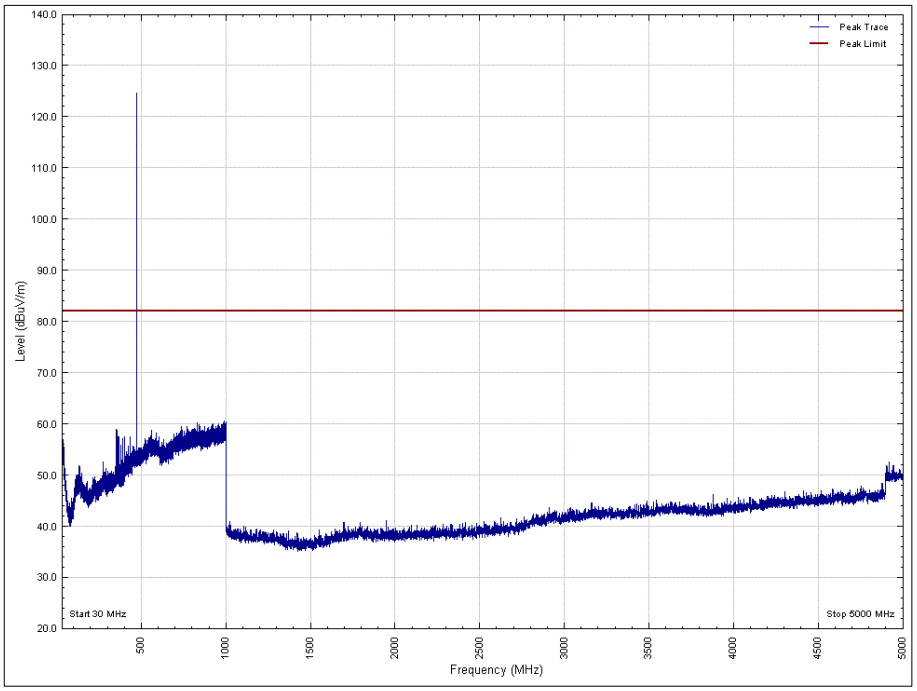

Figure 19 - 469.9875 MHz - 30 MHz to 5 GHz Horizontal, EUT Orientation Z

FCC 47 CFR Part 90, Limit Clause 90.210

The EUT shall comply with emission mask B as per FCC 47 CFR Part 90.210.

2.2.7 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 Due
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
Comb Generator	Schaffner	RSG1000	3034	-	TU
Cable (Yellow, Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4527	6	09-Jun-2020
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	10-Mar-2021
4dB Attenuator	Pasternack	PE7047-4	4935	24	30-Sep-2021
1.5m 40GHz RF Cable	Scott Cables	KPS-1501-2000-KPS	5127	6	24-Sep-2020
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Thermo-Hygro-Barometer	PCE Instruments	OCE-THB-40	5470	12	16-Mar-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	06-Feb-2021

Table 11

TU - Traceability Unscheduled

2.3 Spurious Emissions at Antenna Terminals

2.3.1 Specification Reference

FCC 47 CFR Part 90, Clause 90.210
FCC 47 CFR Part 2, Clause 2.1051

2.3.2 Equipment Under Test and Modification State

BST35, S/N: AXS-SW-0711 - Modification State 0

2.3.3 Date of Test

29-May-2020

2.3.4 Test Method

Emissions where the frequency is removed less than 250 % of the authorized bandwidth measurements were performed conducted as follows:

The EUT was connected to a spectrum analyser via a cable and attenuator. The path loss between the EUT and analyser was calibrated using a network analyser and entered into the spectrum analyser as a reference level offset. The reference level for the mask was established with an RBW approximately 2 or 3 times the emission bandwidth. The RBW was then reduced to at least 1% of the emission bandwidth, with a VBW of 3 times RBW. The mask as per FCC CFR 47 Part 80.210 (b) was applied. The authorised bandwidth used for calculation of the mask was determined from 90.221 (a) ACP limits.

2.3.5 Environmental Conditions

Ambient Temperature	23.3 °C
Relative Humidity	39.4 %

2.3.6 Test Results

Battery Powered - Transmit 16QAM

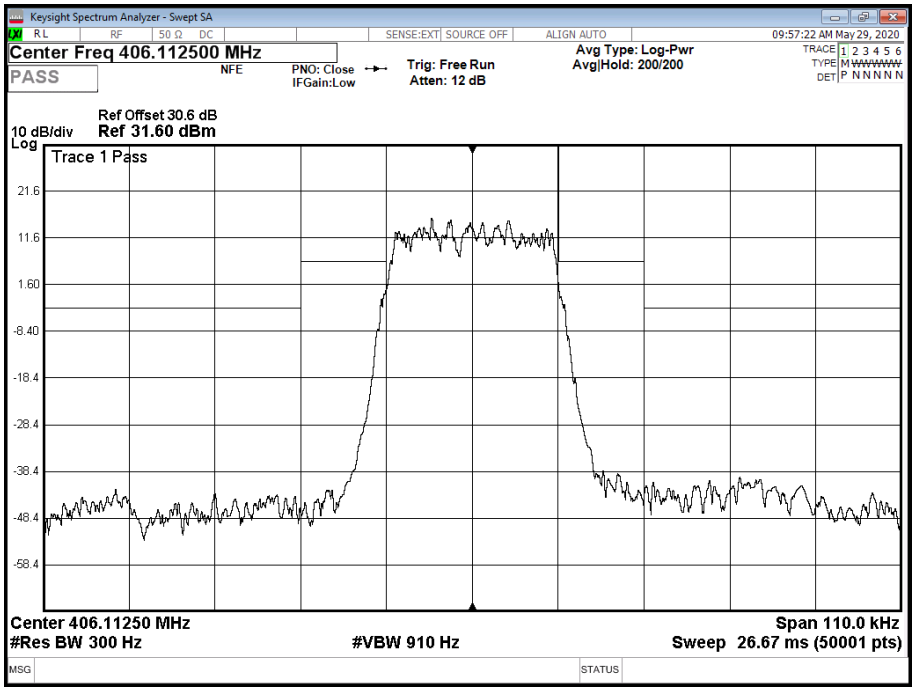

Figure 20 - 406.1125 MHz - Transmitter Spectrum Mask

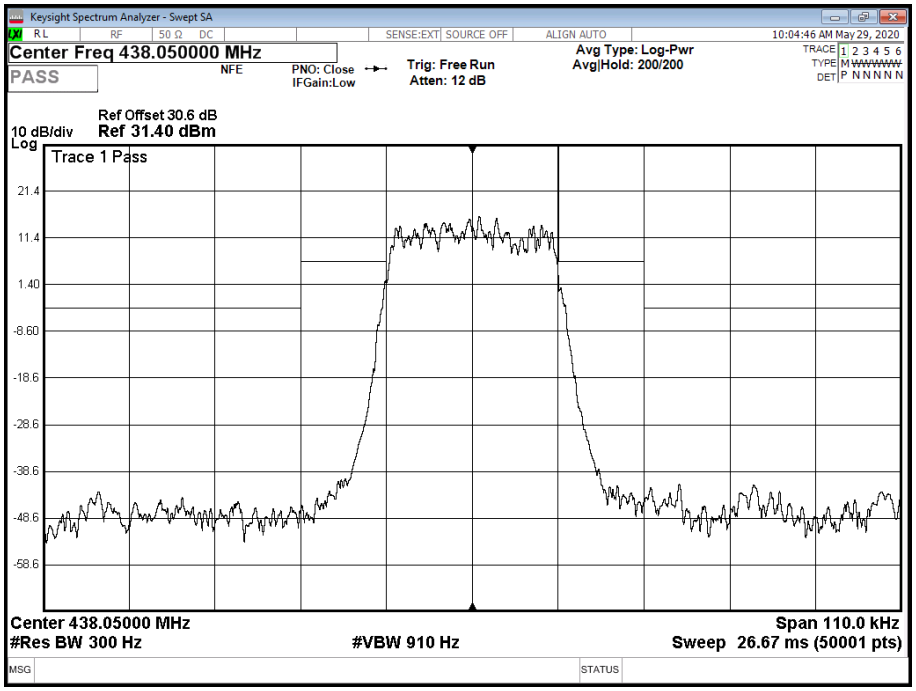

Figure 21 - 438.0500 MHz - Transmitter Spectrum Mask

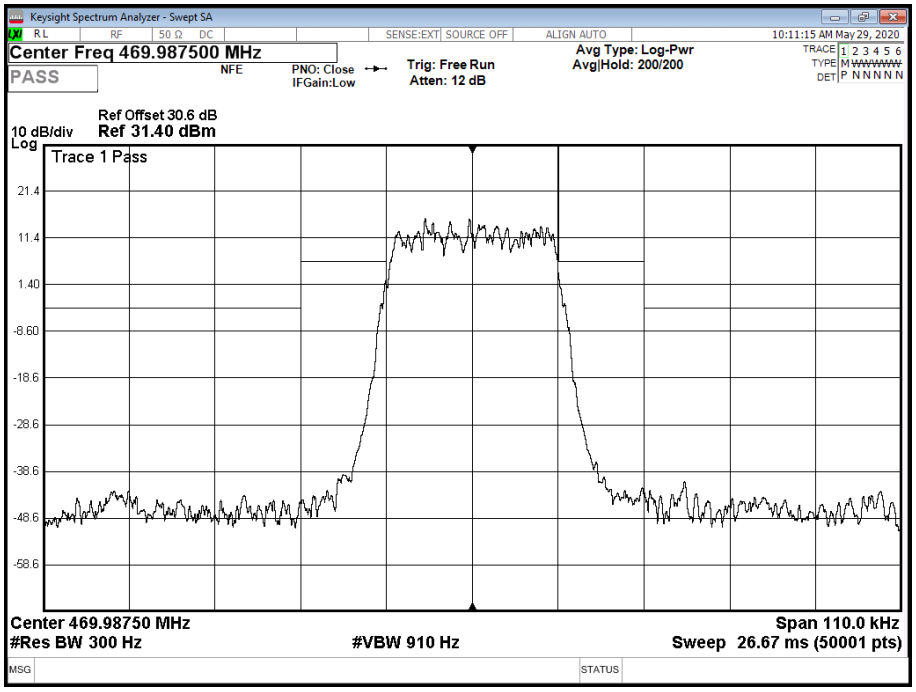

Figure 22 - 469.9875 MHz - Transmitter Spectrum Mask

FCC 47 CFR Part 90, Limit Clause 90.210

The EUT shall comply with emission mask B as per FCC 47 CFR Part 90.210.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	08-Nov-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	21-Oct-2020
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5480	12	18-Mar-2021

Table 12

3 Photographs

3.1 Test Setup Photographs

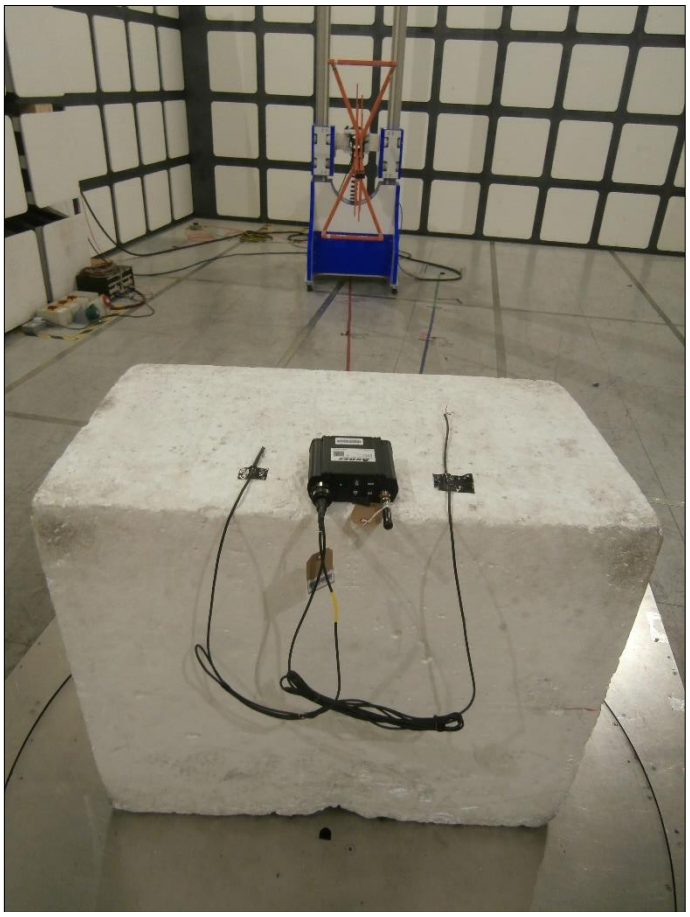

Figure 23 - Test Setup - 30 MHz to 1 GHz, X Orientation

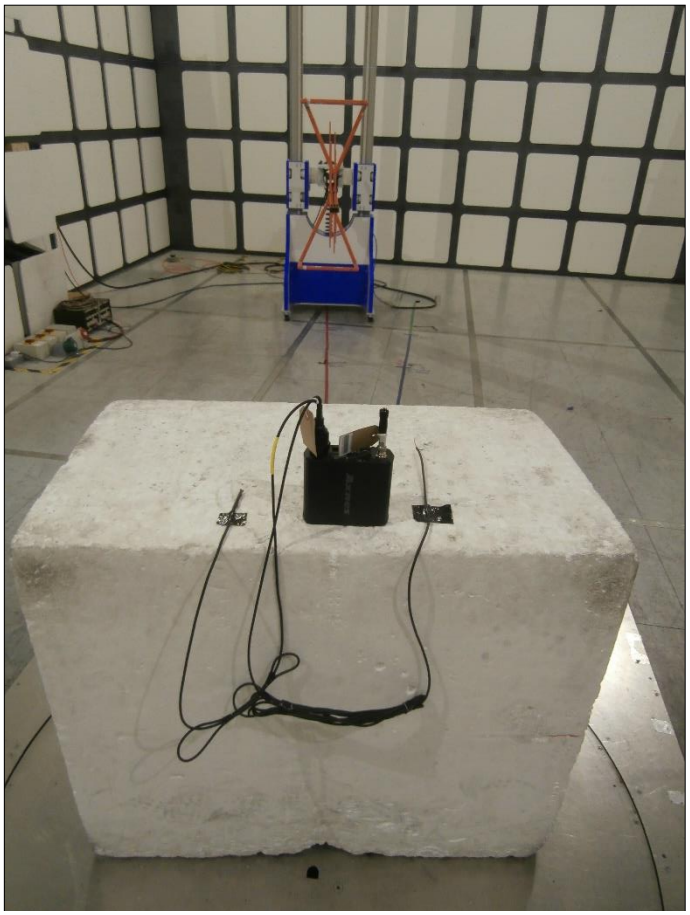

Figure 24 - Test Setup - 30 MHz to 1 GHz, Y Orientation

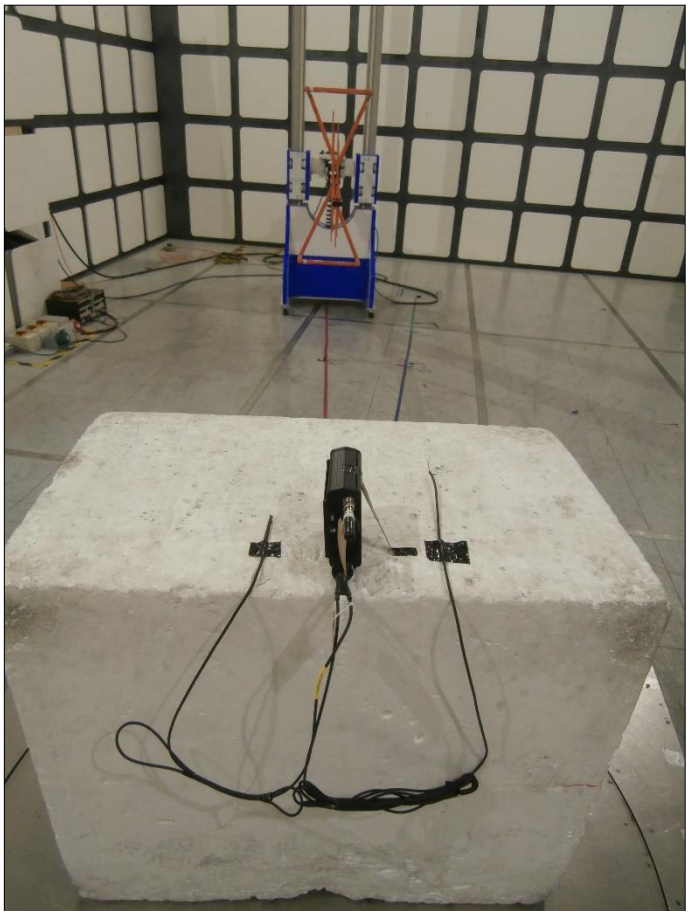

Figure 25 - Test Setup - 30 MHz to 1 GHz, Z Orientation

Figure 26 - Test Setup - 1 GHz to 5 GHz, X Orientation

Figure 27 - Test Setup - 1 GHz to 5 GHz, Y Orientation

Figure 28 - Test Setup - 1 GHz to 5 GHz, Z Orientation

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Frequency Stability	± 11 Hz
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 18 GHz: ± 6.3 dB
Spurious Emissions at Antenna Terminals	± 3.45 dB

Table 13

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.