Report on the FCC Testing of:

MiX Telematics International (Pty) Ltd
Vehicle Tracking Fleet Management Device, Model: MiX 45MC-4G-B

In accordance with FCC 47 CFR Part 15C

Prepared for: MiX Telematics Euro Ltd
Cherry Orchard North, Kembrey Park,
Swindon, SN2 8UH, United Kingdom

FCC ID: 2AFMS-45MC4G

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COMMERCIAL-IN-CONFIDENCE

Document Number: 75942815-02 | Issue: 03

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Simon Bennett	Chief Engineer	Authorised Signatory	20 November 2019

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

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Daniel Bishop	Test Engineer	Testing	20 November 2019
Graeme Lawler	Test Engineer	Testing	20 November 2019

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: 2017.

TÜV SÜD
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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	05 November 2018
2	To include a hyphen in the FCC ID	19 November 2018
3	To include declared variants	20 November 2019

Table 1

1.2 Introduction

Applicant	MiX Telematics Euro Ltd
Manufacturer	MiX Telematics International (Pty) Ltd
Model Number(s)	MiX 45MC-4G-B
Declared Variant(s)	MiX 45MC-4G (440FT0187) MiX 45MC-4G-B (440FT0191) MiX 44MC-3G-B (U0034MT) MiX 424C-2G MiX 424C-2G-B MiX 494C-2G MiX 494C-2G-B
Serial Number(s)	45000209 / IMEI 357812090498665 45000203 / IMEI 357812090506921
Hardware Version(s)	1
Software Version(s)	1.80
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2017
Order Number Date	P0089659 21-May-2018
Date of Receipt of EUT	01-October-2018 and 03-October-2018
Start of Test	01-October-2018
Finish of Test	10-October-2018
Name of Engineer(s)	Daniel Bishop and 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: Transmit - 915 MHz SRD				
2.1	15.247 (a)(1)	Frequency Hopping Systems - Number of Hopping Channels	Pass	ANSI C63.10 (2013)
2.2	15.247 (a)(1)	Frequency Hopping Systems - 20 dB Bandwidth	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(1)	Frequency Hopping Systems - Channel Separation	Pass	ANSI C63.10 (2013)
2.4	15.247 (a)(1)	Frequency Hopping Systems - Average Time of Occupancy	Pass	ANSI C63.10 (2013)
2.5	15.247 (b)	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.6	15.247 (d) and 15.205	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.7	15.247 (d)	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.8	15.205	Restricted Band Edges	Pass	ANSI C63.10 (2013)

Table 2

1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	MiX 45MC-4G; MiX 45MC-4G-B
Part Number	440FT0187; 440FT0191
Hardware Version	1
Software Version	1.8.0
FCC ID (if applicable)	2AFMS-45MC4G
Industry Canada ID (if applicable)	
Technical Description (Please provide a brief description of the intended use of the equipment)	The MiX 4000 LTE is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, a LTE CAT M1 modem, a GNSS, an accelerometer, Low Energy Bluetooth, I/O, 2 x CAN, 2 x RS232, 4 x positive drives and 434 / 915 MHz short range transceiver.

INTENTIONAL RADIATORS									
Technology	Frequency Band (MHz)	Conducted Declared Output Power (dBm)	Antenna Gain (dBi)	Supported Bandwidth (s) (MHz)	Modulation Scheme(s)	ITU Emission Designator	Test Channels (MHz)		
							Bottom	Middle	Top
LTE BAND12 LTE BAND13	700A 700C	23 23	0.76 1.39	CAT M1	FDMA/OFDMA.16QAM	LTE M1/ X7D	699 777	707.5 782	716 787
LTE BAND5	850	23	0.21	CAT M1	FDMA/OFDMA.16QAM	LTE M1/ X7D	824	836.5.	849
LTE BAND4	1700	23	1.46	CAT M1	FDMA/OFDMA.16QAM	X7LTE M1/ X7D	1710	1747.5	1785
LTE BAND 2	1900	23	2.07	CAT M1	FDMA/OFDMA.16QAM	LTE M1/ X7D	1850	1880	1910
SRD915 SRD2400	902-928 2400-2480	20 7	0 1.40	25kHz BLE	2FSK GFSK	F1D F1D	902 2402	915 2440	928 2480

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	2480MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	699MHz
Class A Digital Device (Use in commercial, industrial or business environment) ☐ Class B Digital Device (Use in residential environment only) ☒	

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	N/A	N/A	N/A
External DC	Nominal Voltage	Maximum Current	
	12/24 V	2A typical_max 4.5A absolute max (7.5A Fused)	
Battery	Nominal Voltage	Battery Operating End Point Voltage	
	3.2 V	3.2V	
Can EUT transmit whilst being charged?		Yes ☒ No ☐	

EXTREME CONDITIONS					
Maximum temperature	+85	°C (with no backup battery)	Minimum temperature	-25	°C

Ancillaries
Please list all ancillaries which will be used with the device.
Code Plug, Immobilizing Relay and RS232 data link Active GPS antenna

ANTENNA CHARACTERISTICS						
☒	Antenna connector			State impedance	50	Ohm
☒	Temporary antenna connector			State impedance	50	Ohm
☒	Integral antenna	Type	LTE/BLE/SRD915/ GPS			
☒	External antenna	Type	GPS			

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

Name: B.van der Merwe

Position held: RF Engineer Date: 12/10/2018

1.5 Customer Declared Variants

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

Part ID	Official Name	Modem	Description
440FT0187	MiX 45MC-4G	SARA-R410M (LTE Cat M1)	MiX 4000 LTE (Model 45MC-4G) Electronic Unit with SRD 434MHz and 915MHz support
440FT0191	MiX 45MC-4G-B	SARA-R410M (LTE Cat M1)	MiX 4000 LTE (Model 45MC-4G-B) Electronic Unit with Battery plugged in and SRD 434MHz and 915MHz support.
U0032MT	MiX 44MC-3G	SARA-U201 (3G)	MiX 44MC-3G (SARA-U201) with SRD (433MHz and 915MHz)
U0034MT	MiX 44MC-3G-B	SARA-U201 (3G)	MiX 44MC-3G (SARA-U201) with Backup Battery Electronic Unit 3G (Global) and SRD (433MHz and 915MHz) support
440FT0082	MiX 494C-2G	SARA-G450 (2G)	MiX 4000 2G (SARA-G450) (Model 494C-2G) Electronic Unit with SRD 434MHz support
440FT0088	MiX 494C-2G-B	SARA-G450 (2G)	MiX 4000 2G (SARA-G450) Electronic Unit with backup battery plugged in and with SRD 434MHz support
U0022MT	MiX 424C-2G	SARA-G350 (2G)	MiX 4000 2G (SARA-G350) with SRD (433MHz) support

All variants listed above contain the same PCB 440AWZ124 but contains different modems. The modems are all of the same manufacturer (uBlox) and have the same PCB footprint.

The LTE and 3G variants have a dual SRD (434 and 915 MHz), while the 2G variants only have SRD support the 434 MHz frequency.

1.6 Product Information

1.6.1 Technical Description

The MiX 4000 LTE is a fleet product that incorporates the latest market trends. It consists mainly of an on-board computer, a LTE CAT M1 modem, a GNSS, an accelerometer, Low Energy Bluetooth, I/O, 2 x CAN, 2 x RS232, 4 x positive drives and 434 / 915 MHz short range transceiver.

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
Serial Number: 45000209 / IMEI 357812090498665			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: 45000203 / IMEI 357812090506921			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.9 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Transmit - 915 MHz SRD		
Frequency Hopping Systems - Number of Hopping Channels	Daniel Bishop	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	Daniel Bishop	UKAS
Frequency Hopping Systems - Channel Separation	Daniel Bishop	UKAS
Frequency Hopping Systems - Average Time of Occupancy	Daniel Bishop	UKAS
Maximum Conducted Output Power	Daniel Bishop	UKAS
Spurious Radiated Emissions	Graeme Lawler	UKAS
Authorised Band Edges	Graeme Lawler	UKAS
Restricted 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 Frequency Hopping Systems - Number of Hopping Channels

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)

2.1.2 Equipment Under Test and Modification State

MiX 45MC-4G-B, S/N: 45000209 / IMEI 357812090498665 - Modification State 0

2.1.3 Date of Test

05-October-2018

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.3.

2.1.5 Environmental Conditions

Ambient Temperature	21.0 °C
Relative Humidity	47.1 %

2.1.6 Test Results

Transmit - 915 MHz SRD

Number of Hopping Channels: 64

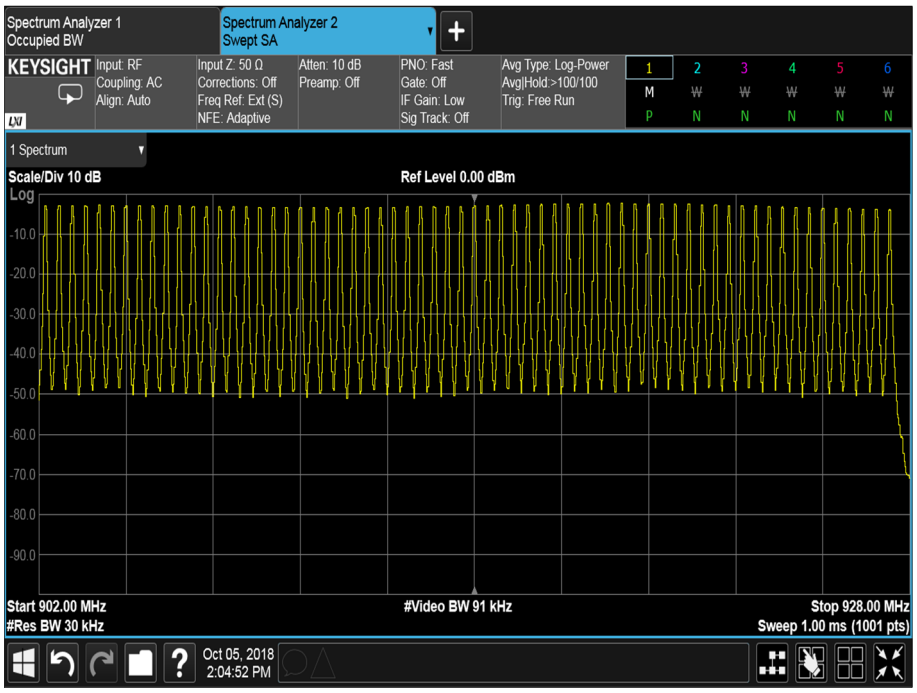

Figure 1 - Measurement Frequency Range: 902 MHz to 928 MHz

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i)

20 dB Bandwidth	Minimum Number of Hopping Frequencies
< 250 kHz	50
≥ 250 kHz	25

Table 5

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMG	42	12	06-Feb-2019
Multimeter	Fluke	75 Mk3	455	12	14-Sep-2019
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 6

O/P Mon – Output monitored using calibrated test equipment.

2.2 Frequency Hopping Systems - 20 dB Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)

2.2.2 Equipment Under Test and Modification State

MiX 45MC-4G-B, S/N: 45000209 / IMEI 357812090498665 - Modification State 0

2.2.3 Date of Test

05-October-2018

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.1.

2.2.5 Environmental Conditions

Ambient Temperature	21.4 °C
Relative Humidity	47.3 %

2.2.6 Test Results

Transmit - 915 MHz SRD

20 dB Bandwidth (kHz)		
902.2 MHz	915 MHz	927.4 MHz
42.21	42.34	41.84

Table 7

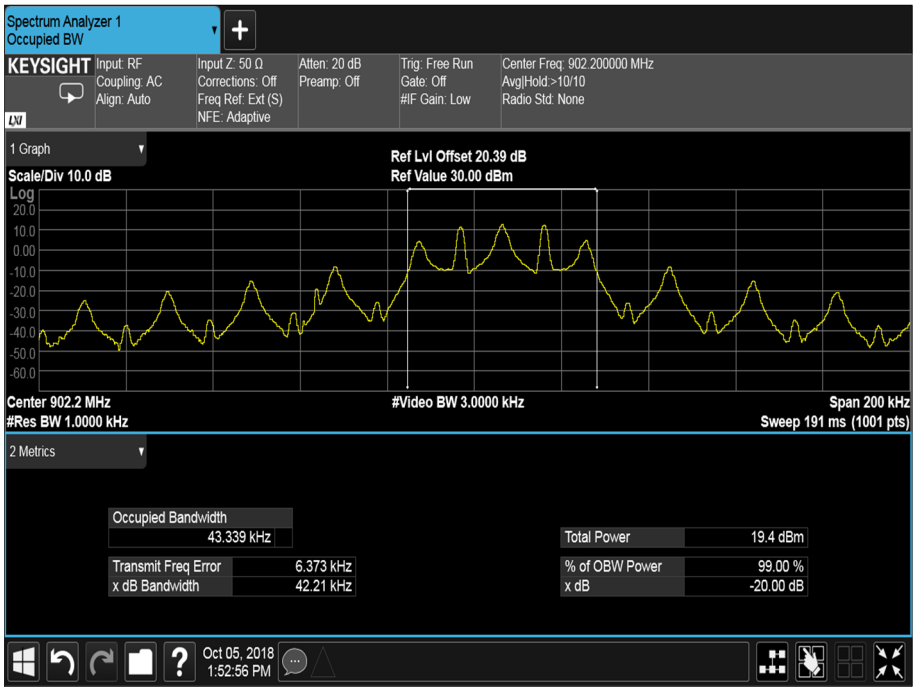

Figure 2 - 902.2 MHz

Figure 3 - 915 MHz

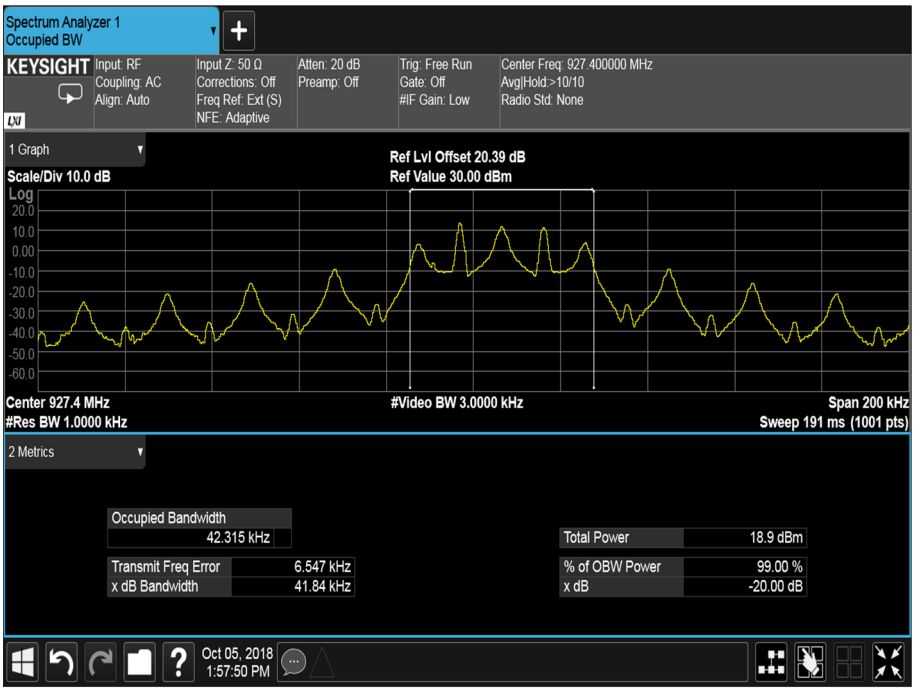

Figure 4 - 927.4 MHz

FCC 47 CFR Part 15, Limit Clause 15.247(a)(1)(i)

≤ 500 kHz

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMG	42	12	06-Feb-2019
Multimeter	Fluke	75 Mk3	455	12	14-Sep-2019
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 8

O/P – Output monitored using calibrated test equipment.

2.3 Frequency Hopping Systems - Channel Separation

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)

2.3.2 Equipment Under Test and Modification State

MiX 45MC-4G-B, S/N: 45000209 / IMEI 357812090498665 - Modification State 0

2.3.3 Date of Test

05-October-2018

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.2.

2.3.5 Environmental Conditions

Ambient Temperature	20.3 °C
Relative Humidity	49.8 %

2.3.6 Test Results

Transmit - 915 MHz SRD

Modulation	Channel Separation (MHz)
GFSK	0.4004

Table 9

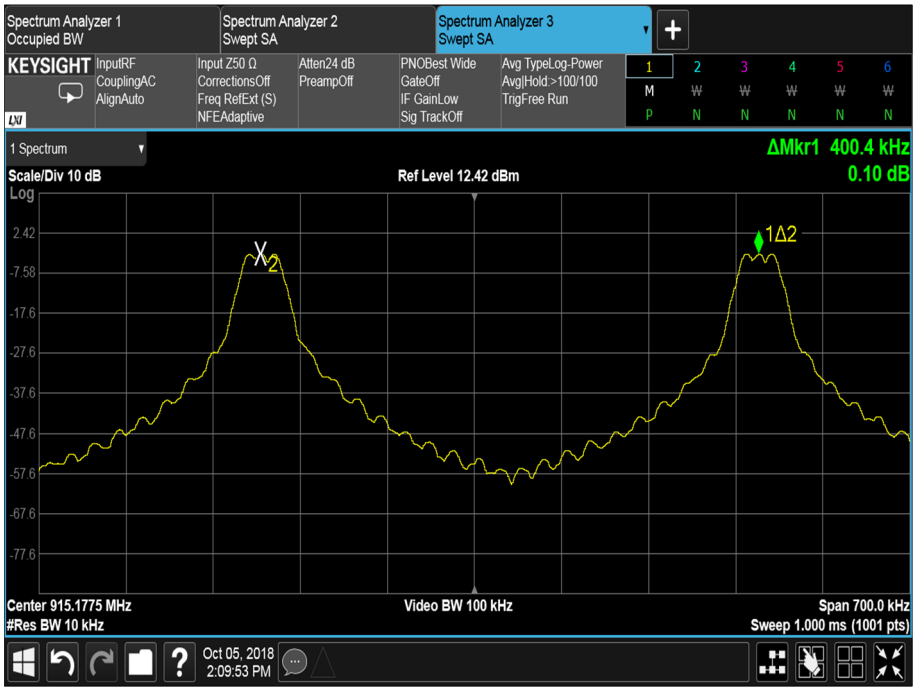

Figure 5 - GFSK

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMG	42	12	06-Feb-2019
Multimeter	Fluke	75 Mk3	455	12	14-Sep-2019
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 10

O/P Mon – Output monitored using calibrated test equipment.

2.4 Frequency Hopping Systems - Average Time of Occupancy

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)

2.4.2 Equipment Under Test and Modification State

MiX 45MC-4G-B, S/N: 45000209 / IMEI 357812090498665 - Modification State 0

2.4.3 Date of Test

05-October-2018

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.4.

2.4.5 Environmental Conditions

Ambient Temperature	20.8 °C
Relative Humidity	47.8 %

2.4.6 Test Results

Transmit - 915 MHz SRD

Packet Type	Dwell Time (ms)	Number of Transmissions	Average Occupancy Time (ms)
915 SRD frequency-hop packet	11.86	23	272.78

Table 11

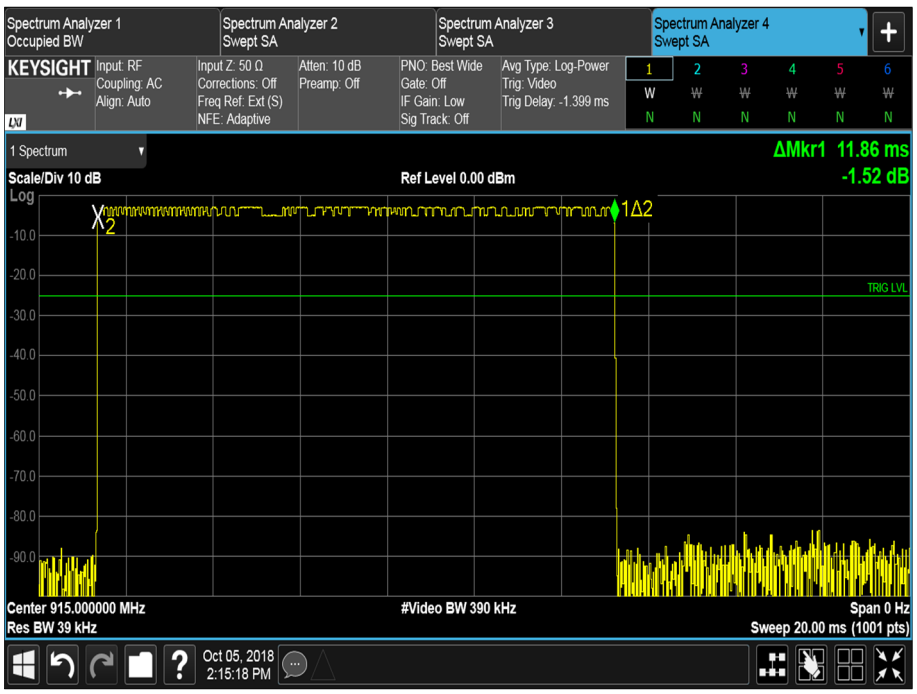

Figure 6 - 915 SRD frequency-hop packet, Dwell Time

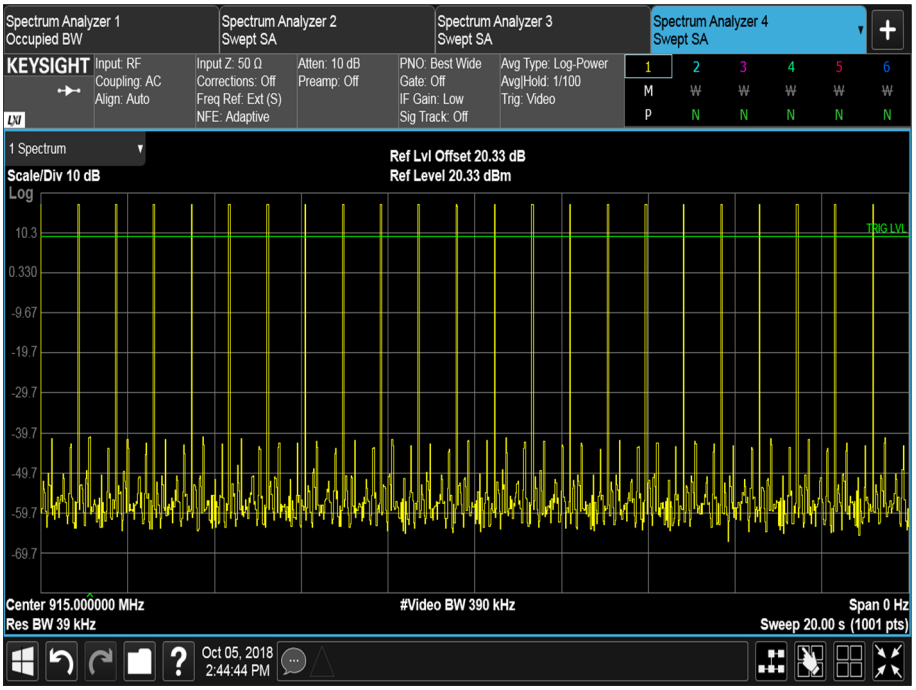

Figure 7 - 915 SRD frequency-hop packet, Total Average Time of Occupancy

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i)

For frequency hopping systems operating in the 902–928 MHz band:

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

2.4.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMG	42	12	06-Feb-2019
Multimeter	Fluke	75 Mk3	455	12	14-Sep-2019
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 12

O/P Mon – Output monitored using calibrated equipment.

2.5 Maximum Conducted Output Power

2.5.1 Specification Reference

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

2.5.2 Equipment Under Test and Modification State

MiX45MC-4G-B, S/N: 45000209 / 440FT0191 / IMEI 357812090498665 - Modification State 0

2.5.3 Date of Test

05-October-2018

2.5.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.5.

2.5.5 Environmental Conditions

Ambient Temperature	21.0 °C
Relative Humidity	47.0 %

2.5.6 Test Results

Transmit - 915 MHz SRD

Frequency (MHz)	Output Power	
	dBm	mW
902.2	17.49	56.11
915.0	17.40	54.95
927.4	16.63	46.03

Table 13

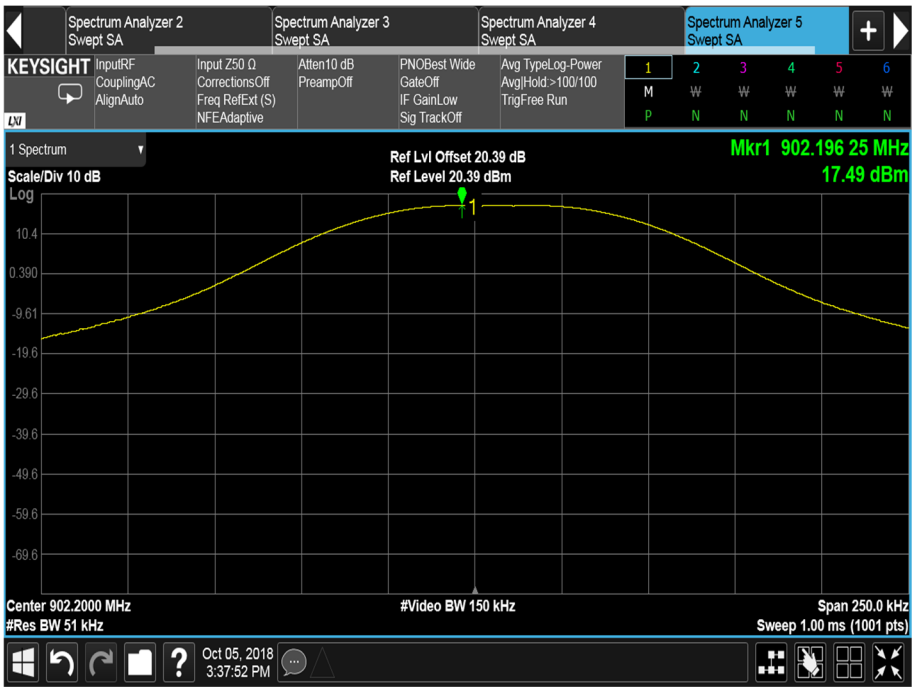

Figure 8 – 902.2 MHz, Conducted Output Power

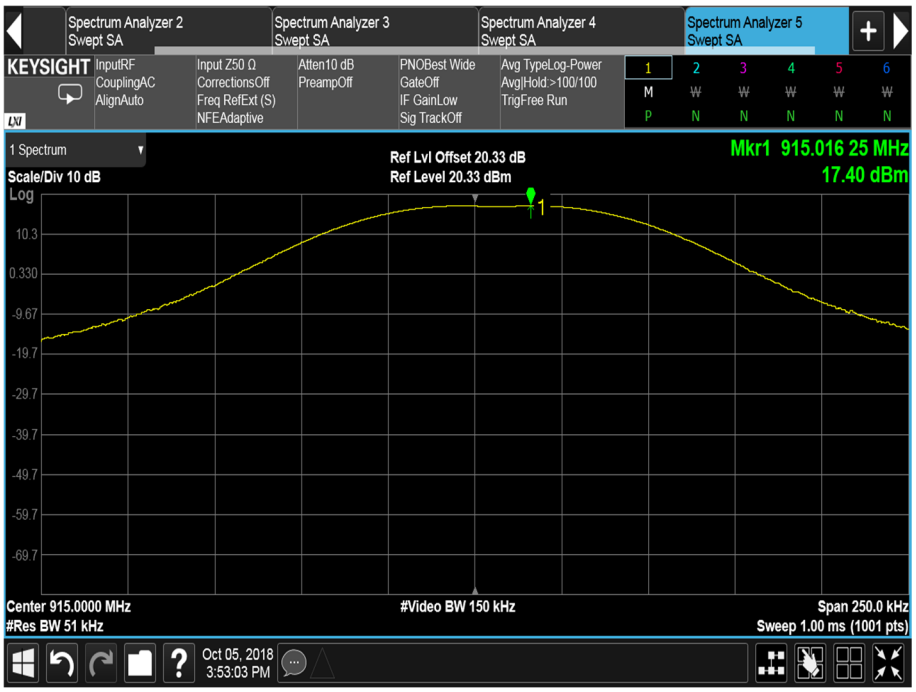

Figure 9 – 915.0 MHz, Conducted Output Power

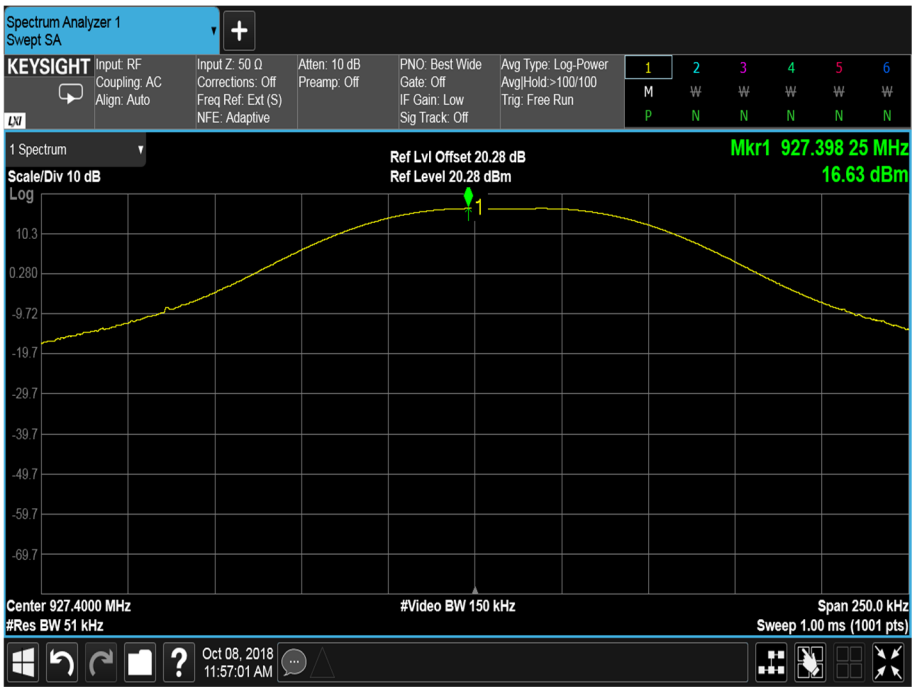

Figure 10 – 927.4 MHz, Conducted Output Power

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

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMG	42	12	06-Feb-2019
Multimeter	Fluke	75 Mk3	455	12	14-Sep-2019
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Hygrometer	Rotronic	A1	1388	12	20-Jun-2019
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3160	12	02-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 14

O/P Mon – Output monitored using calibrated test equipment.

2.6 Spurious Radiated Emissions

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205

2.6.2 Equipment Under Test and Modification State

MiX 45MC-4G-B, S/N: 45000203 / IMEI 357812090506921 - Modification State 0

2.6.3 Date of Test

01-October-2018 to 02-October-2018

2.6.4 Test Method

This test was performed in accordance with ANSI C63.10-2013 clause 6.3, 6.5 and 6.6.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.3 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.2.

The plots shown are the characterization 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).

2.6.5 Environmental Conditions

Ambient Temperature	22.9 °C
Relative Humidity	47.2 %

2.6.6 Test Results

Transmit - 915 MHz SRD

Frequency (MHz)	QPeak Level (dBuV/m)	QPeak Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
37.50	24.05	-15.95	0	360	Vertical

Table 15 – 902.2 MHz - 30 MHz to 1 GHz Emissions Results

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

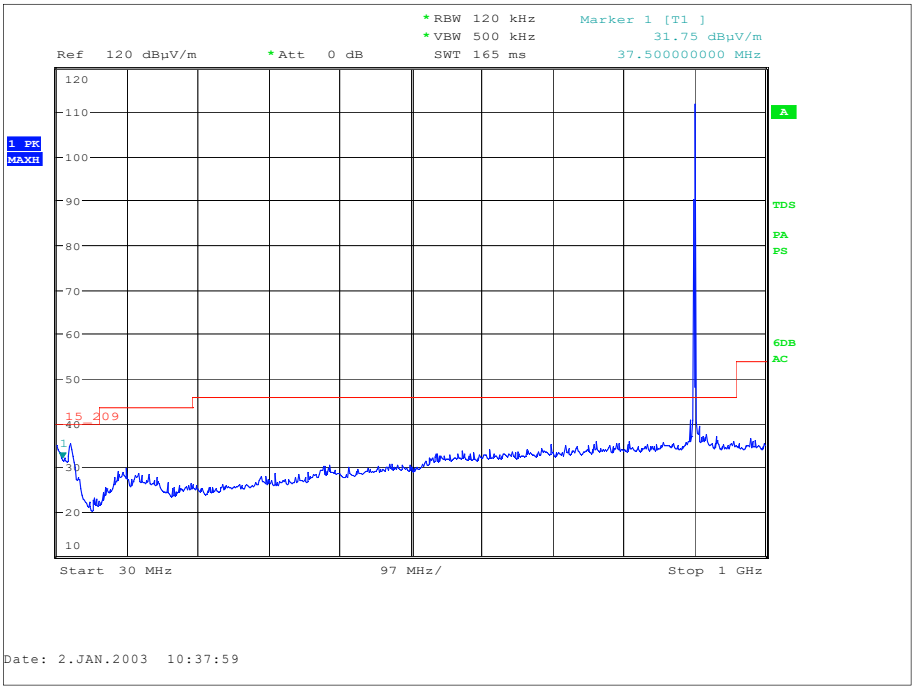

Figure 11 - 902.2 MHz - 30 MHz to 1 GHz - X Orientation - Horizontal and Vertical

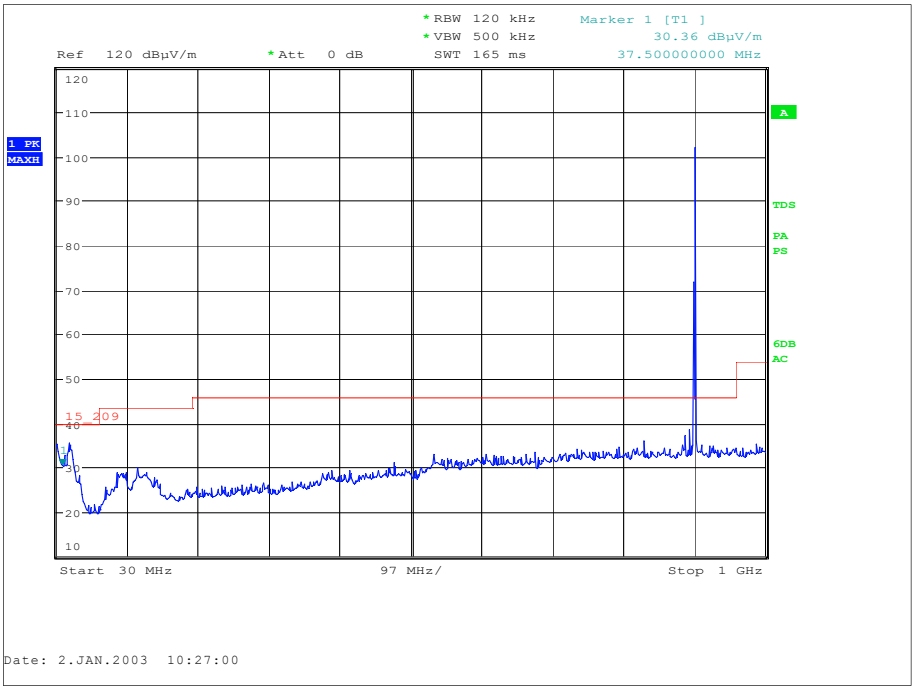

Figure 12 - 902.2 MHz - 30 MHz to 1 GHz - Y Orientation - Horizontal and Vertical

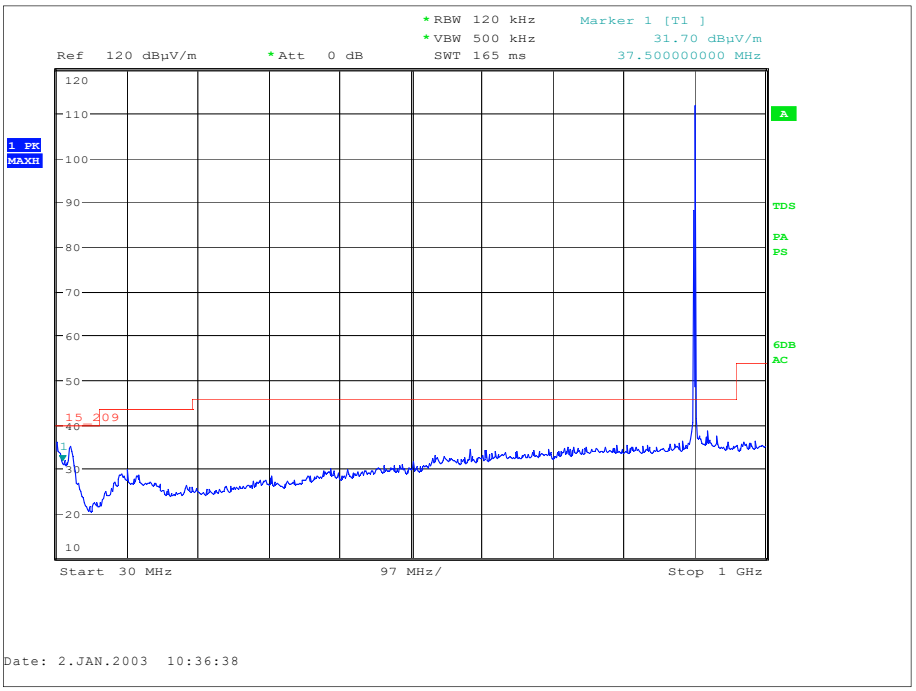

Figure 13 - 902.2 MHz - 30 MHz to 1 GHz - Z Orientation - Horizontal and Vertical

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)	
	Peak	Average	Peak	Average	Peak	Average
3.608814	50.96	49.51	73.98	53.98	23.02	4.47
5.413285	50.82	49.11	73.98	53.98	23.16	4.87

Table 16 - 902.2 MHz - 1 GHz to 10 GHz Emissions Results

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

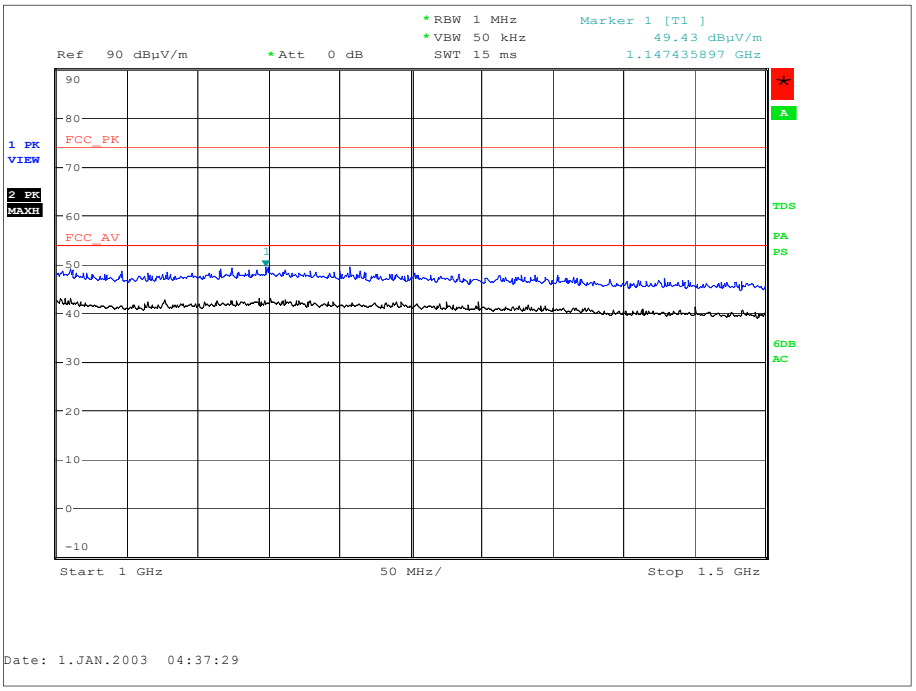

Figure 14 - 902.2 MHz - 1 GHz to 1.5 GHz - X Orientation - Horizontal and Vertical

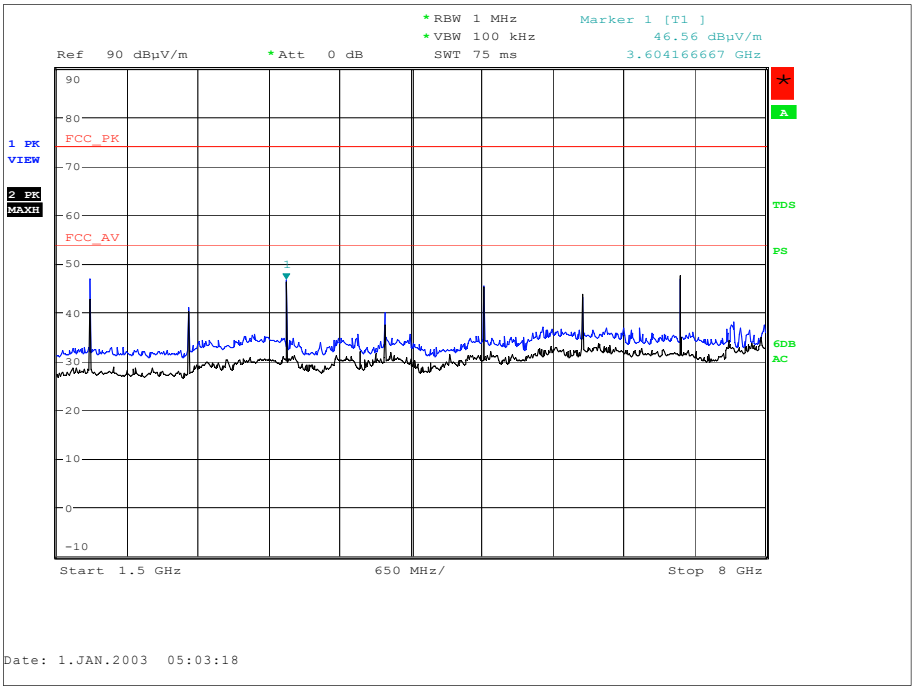

Figure 15 - 902.2 MHz - 1.5 GHz to 8 GHz - X Orientation - Horizontal and Vertical

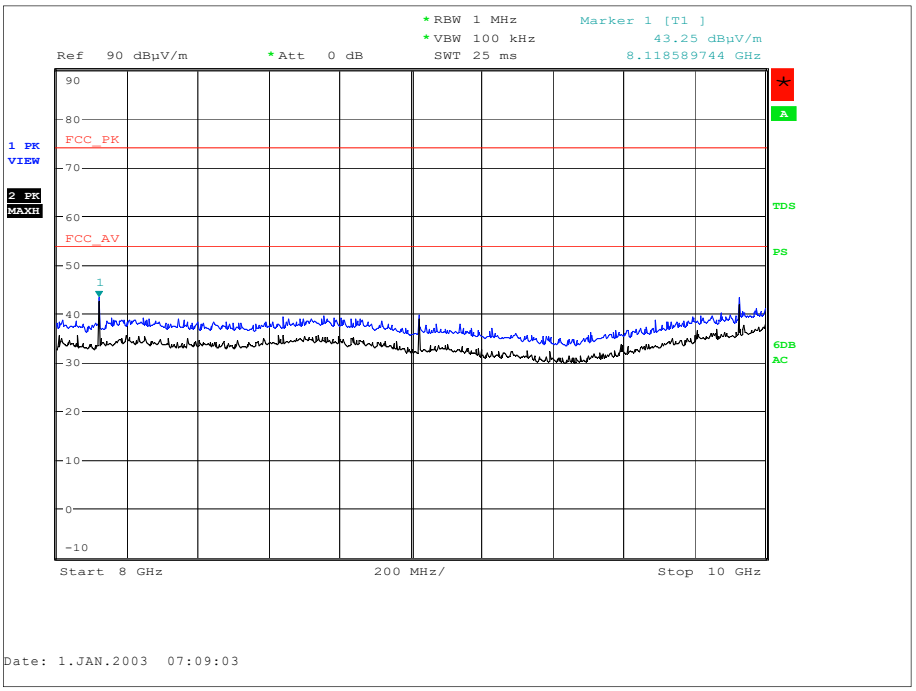

Figure 16 - 902.2 MHz - 8 GHz to 10 GHz - X Orientation - Horizontal and Vertical

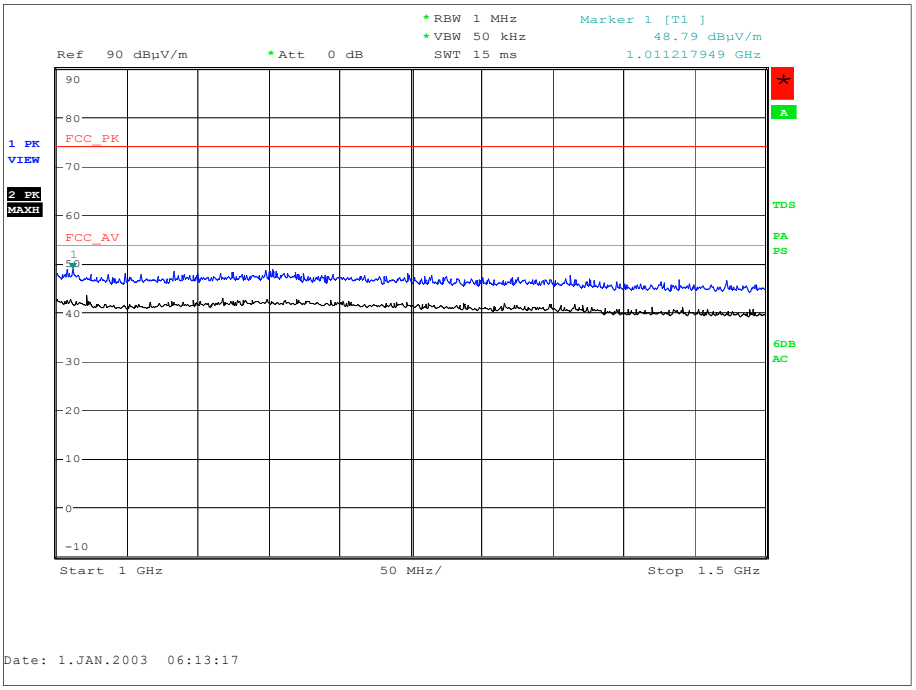

Figure 17 - 902.2 MHz - 1 GHz to 1.5 GHz - Y Orientation - Horizontal and Vertical

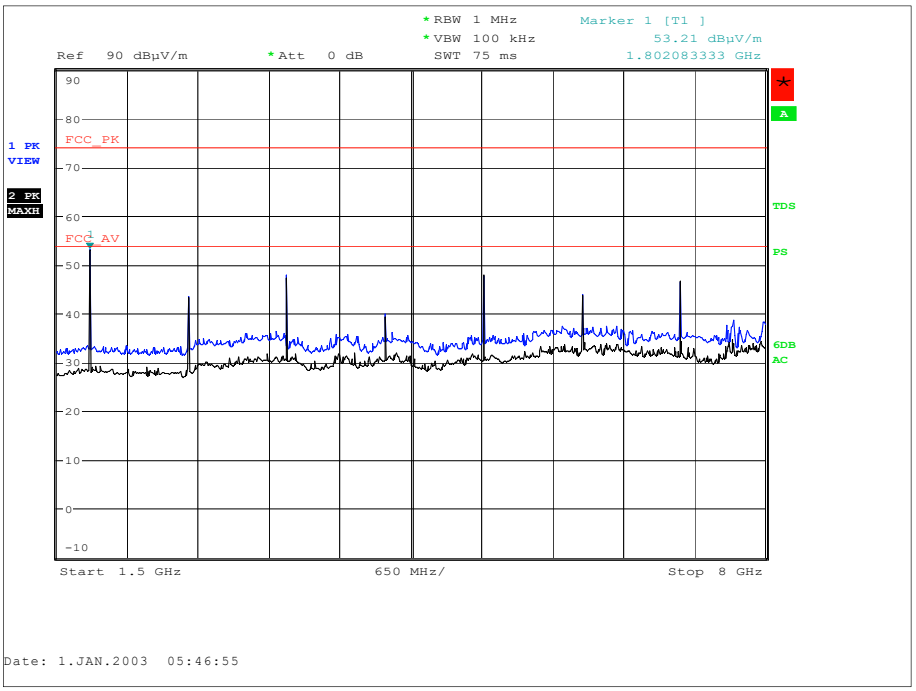

Figure 18 - 902.2 MHz - 1.5 GHz to 8 GHz - Y Orientation - Horizontal and Vertical

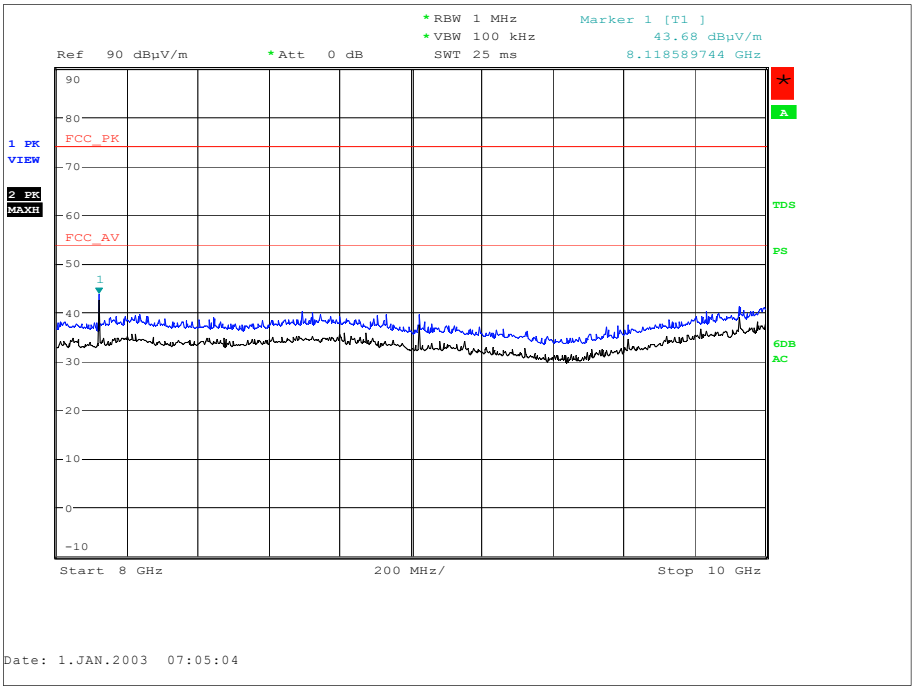

Figure 19 - 902.2 MHz - 8 GHz to 10 GHz - Y Orientation - Horizontal and Vertical

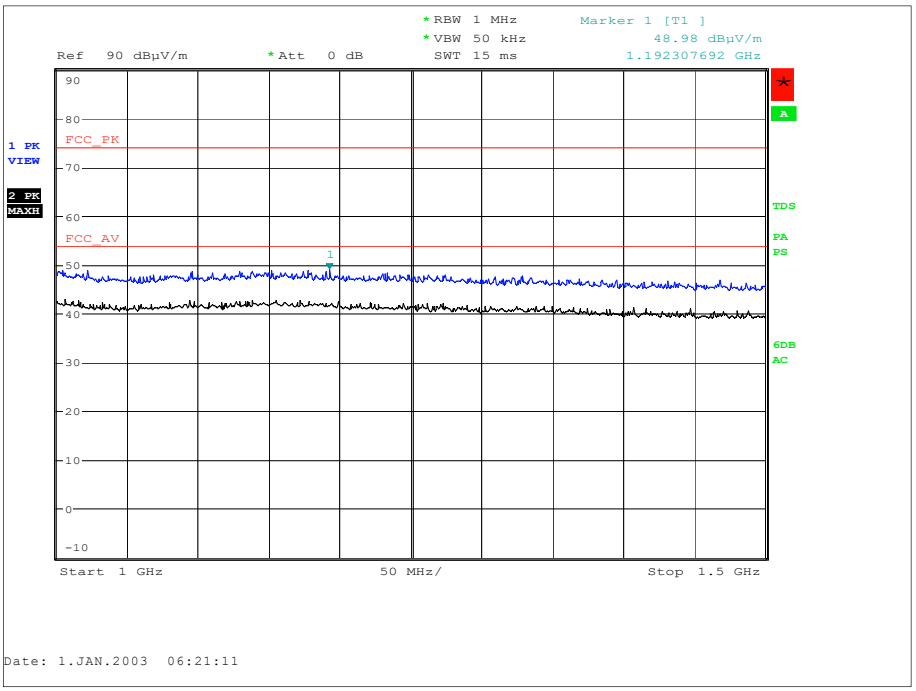

Figure 20 - 902.2 MHz - 1 GHz to 1.5 GHz - Z Orientation - Horizontal and Vertical

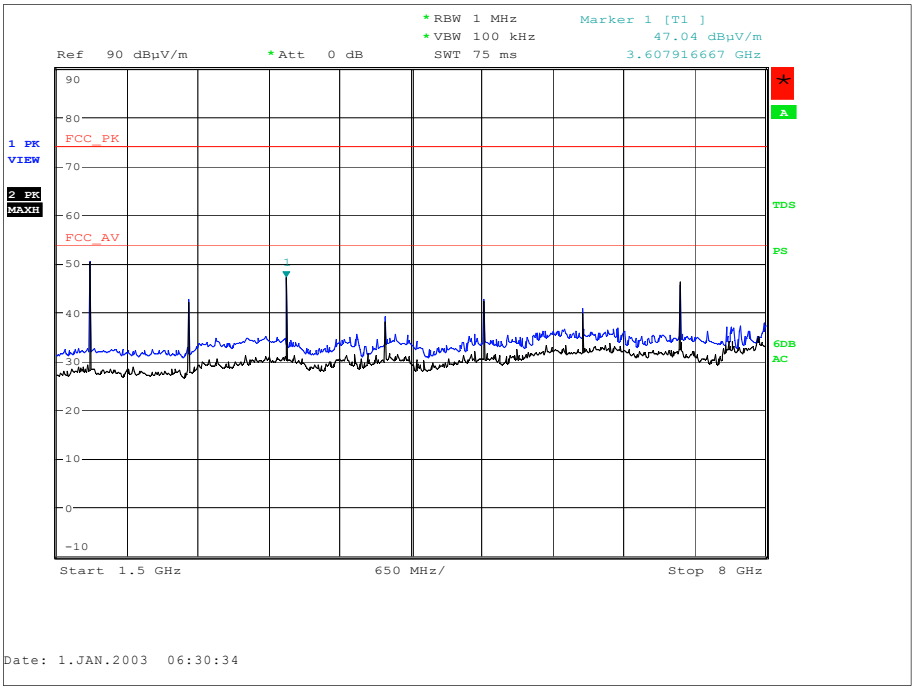

Figure 21 - 902.2 MHz - 1.5 GHz to 8 GHz - Z Orientation - Horizontal and Vertical

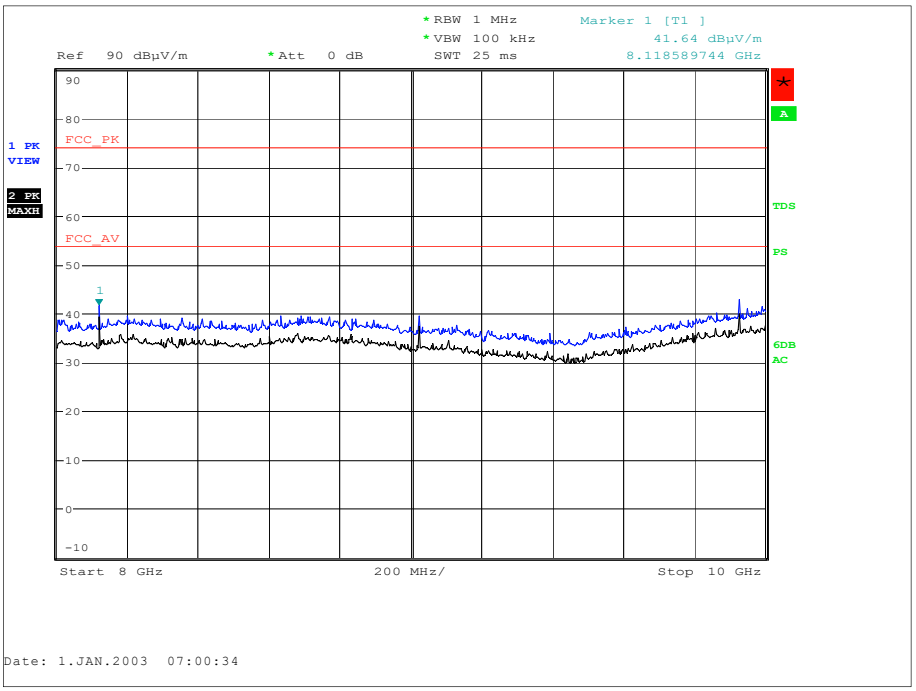

Figure 22 - 902.2 MHz - 8 GHz to 10 GHz - Z Orientation - Horizontal and Vertical

Frequency (MHz)	QPeak Level (dBuV/m)	QPeak Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
37.50	23.05	-16.95	0	360	Vertical

Table 17 – 915 MHz - 30 MHz to 1 GHz Emissions Results

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

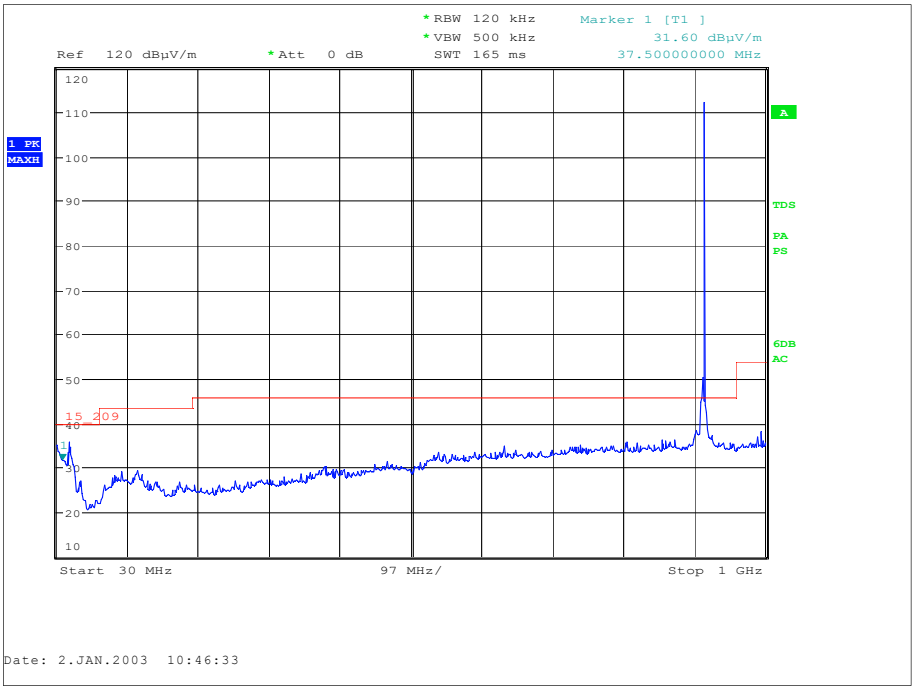

Figure 23 - 915 MHz - 30 MHz to 1 GHz - X Orientation - Horizontal and Vertical

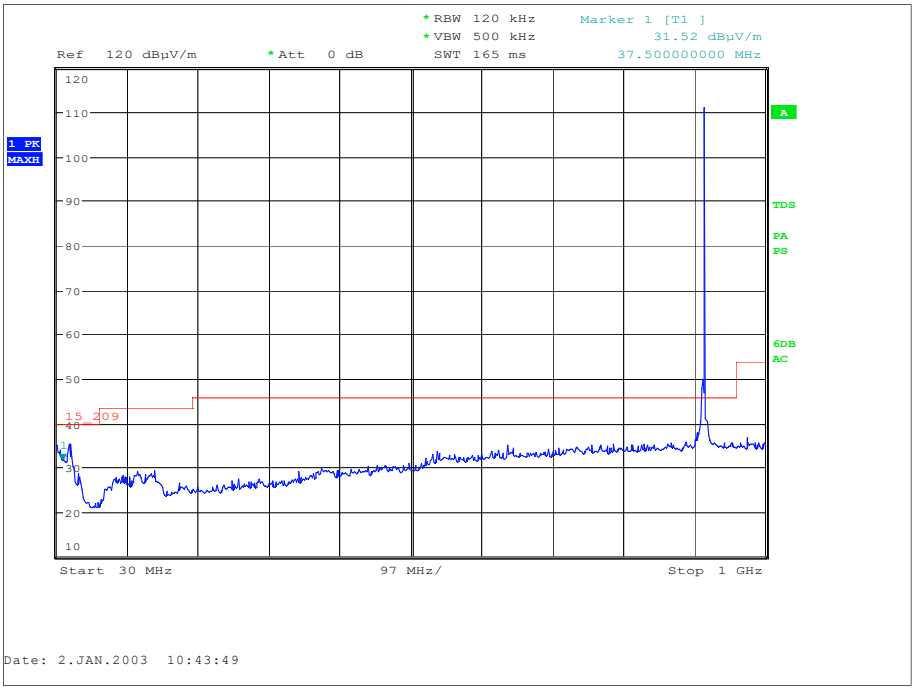

Figure 24 - 915 MHz - 30 MHz to 1 GHz - Y Orientation - Horizontal and Vertical

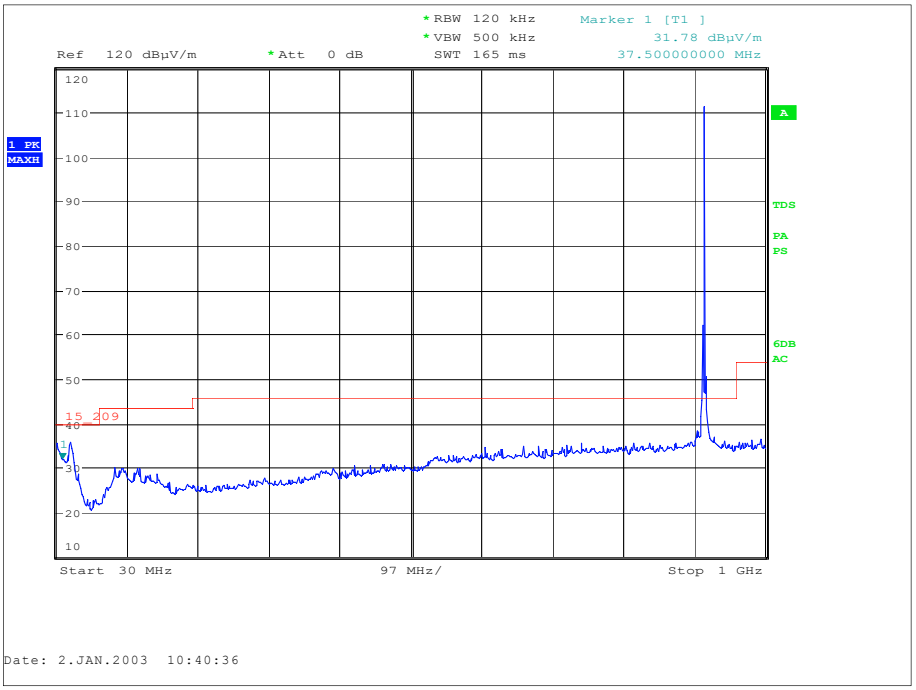

Figure 25 - 915 MHz - 30 MHz to 1 GHz - Z Orientation - Horizontal and Vertical

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)	
	Peak	Average	Peak	Average	Peak	Average
3.660024	51.09	49.44	73.98	53.98	22.89	4.54
7.320051	52.30	51.00	73.98	53.98	21.59	2.98

Table 18 - 915 MHz - 1 GHz to 10 GHz Emissions Results

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

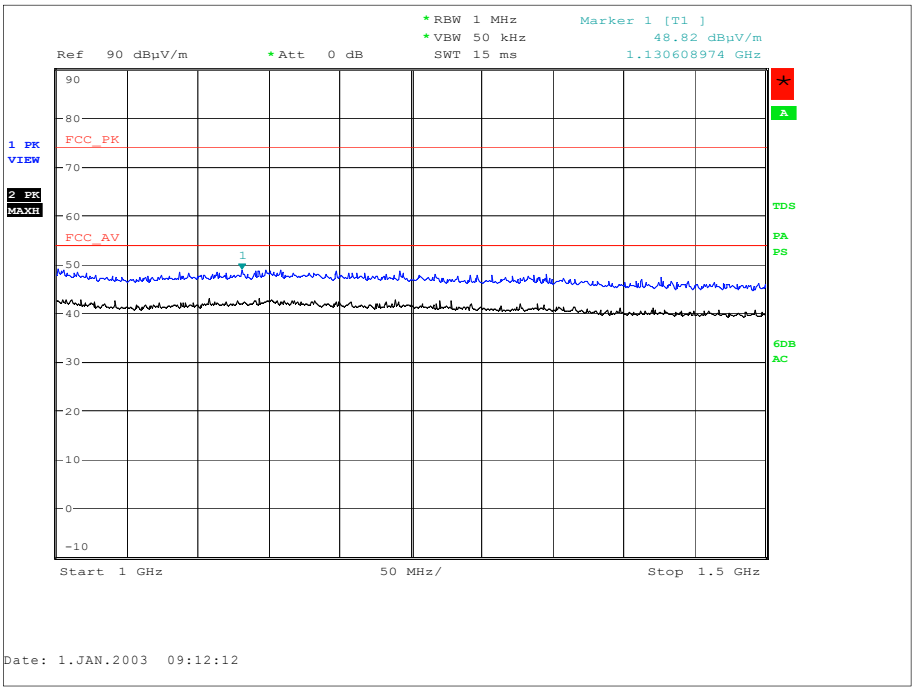

Figure 26 - 915 MHz - 1 GHz to 1.5 GHz - X Orientation - Horizontal and Vertical

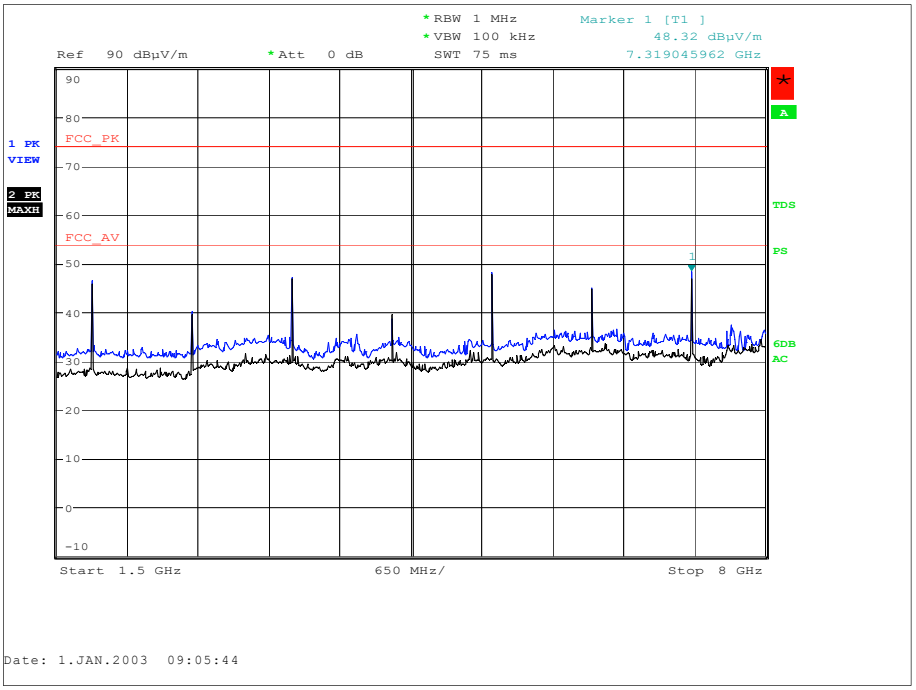

Figure 27 - 915 MHz - 1.5 GHz to 8 GHz - X Orientation - Horizontal and Vertical

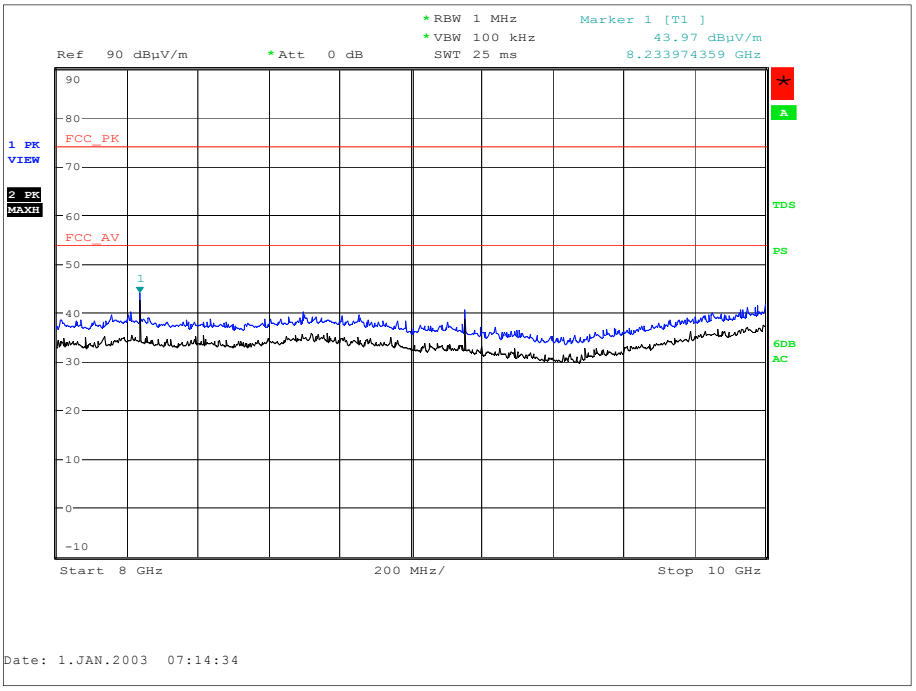

Figure 28 - 915 MHz - 8 GHz to 10 GHz - X Orientation - Horizontal and Vertical

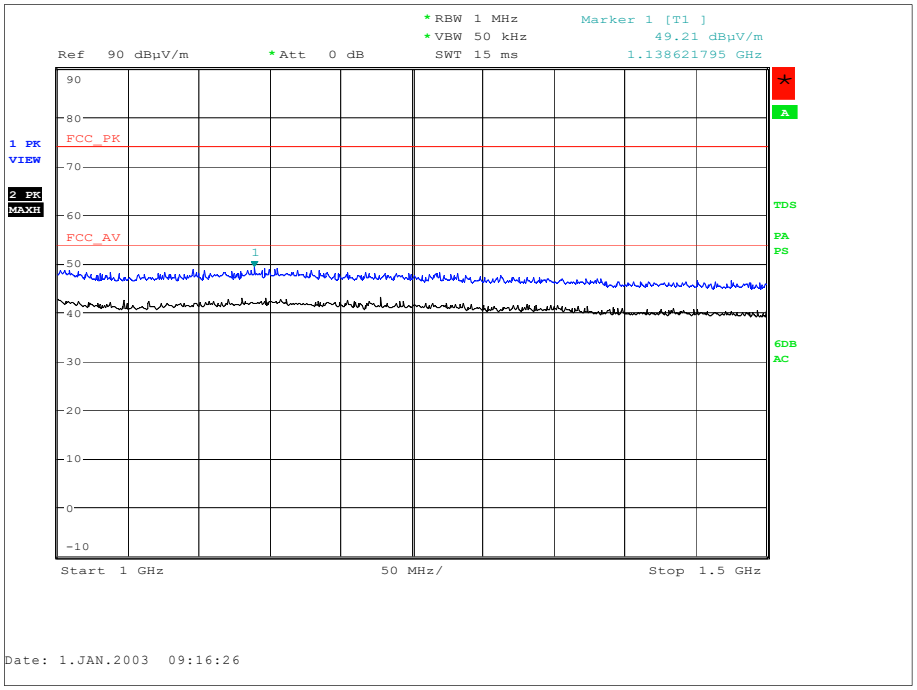

Figure 29 - 915 MHz - 1 GHz to 1.5 GHz - Y Orientation - Horizontal and Vertical

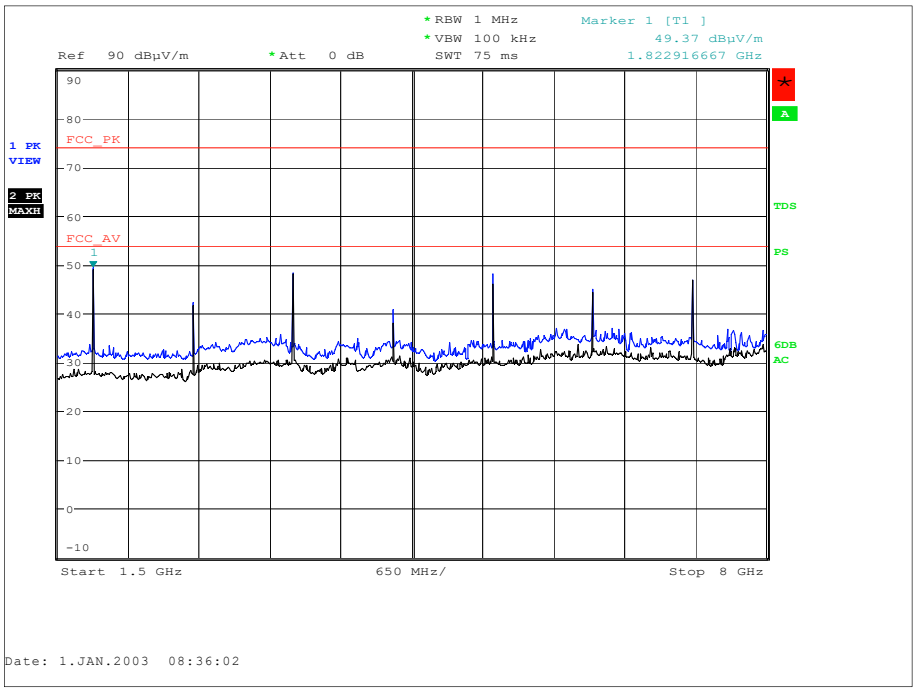

Figure 30 - 915 MHz - 1.5 GHz to 8 GHz - Y Orientation - Horizontal and Vertical

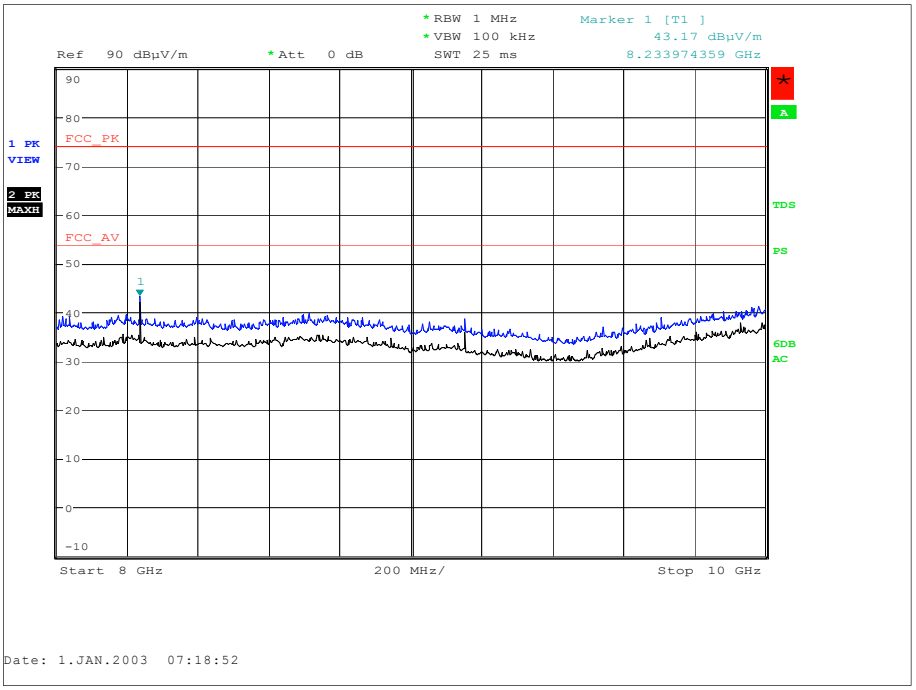

Figure 31 - 915 MHz - 8 GHz to 10 GHz - Y Orientation - Horizontal and Vertical

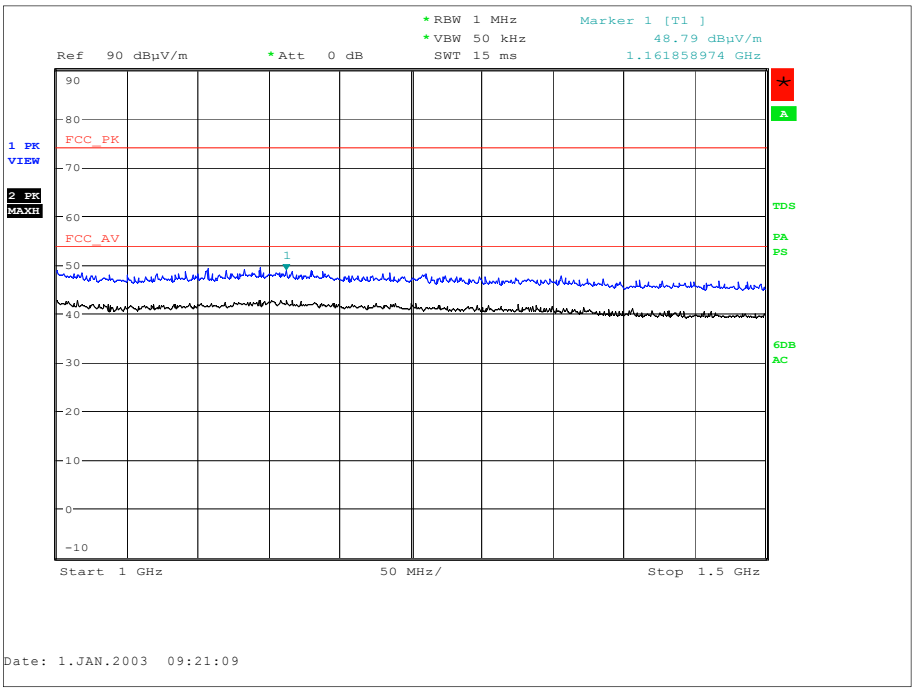

Figure 32 - 915 MHz - 1 GHz to 1.5 GHz - Z Orientation - Horizontal and Vertical

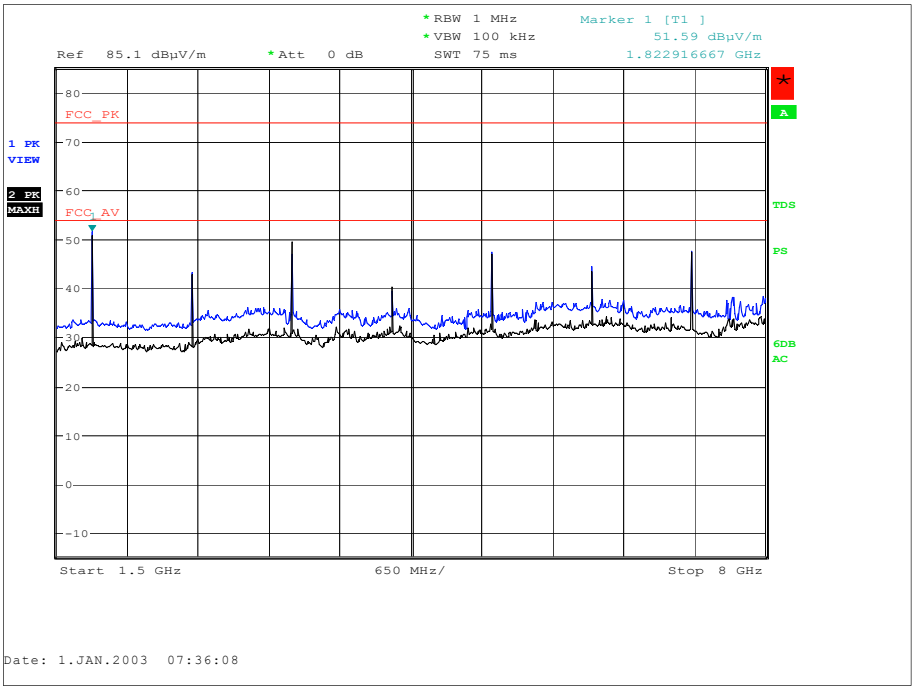

Figure 33 - 915 MHz - 1.5 GHz to 8 GHz - Z Orientation - Horizontal and Vertical

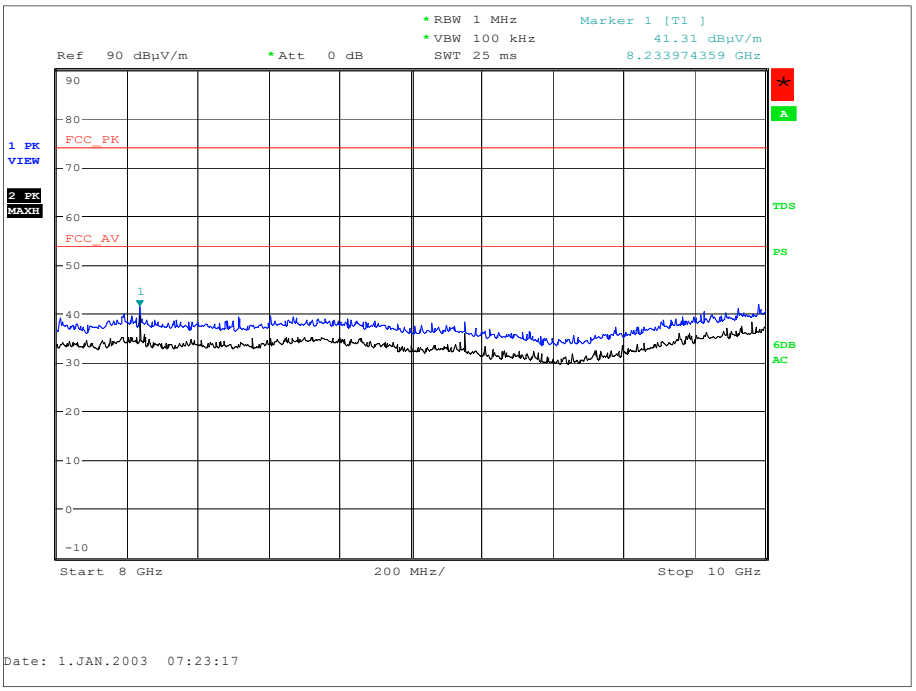

Figure 34 - 915 MHz - 8 GHz to 10 GHz - Z Orientation - Horizontal and Vertical

Frequency (MHz)	QPeak Level (dBuV/m)	QPeak Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
37.50	24.65	-15.35	0	1000	Vertical

Table 19 – 927.4 MHz - 30 MHz to 1 GHz Emissions Results

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

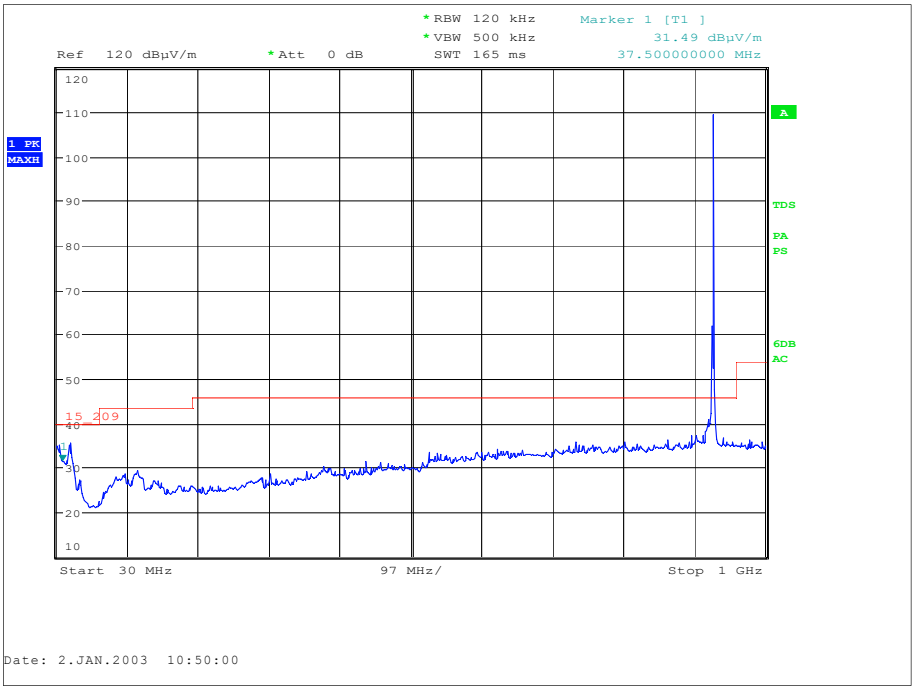

Figure 35 - 927.4 MHz - 30 MHz to 1 GHz - X Orientation - Horizontal and Vertical

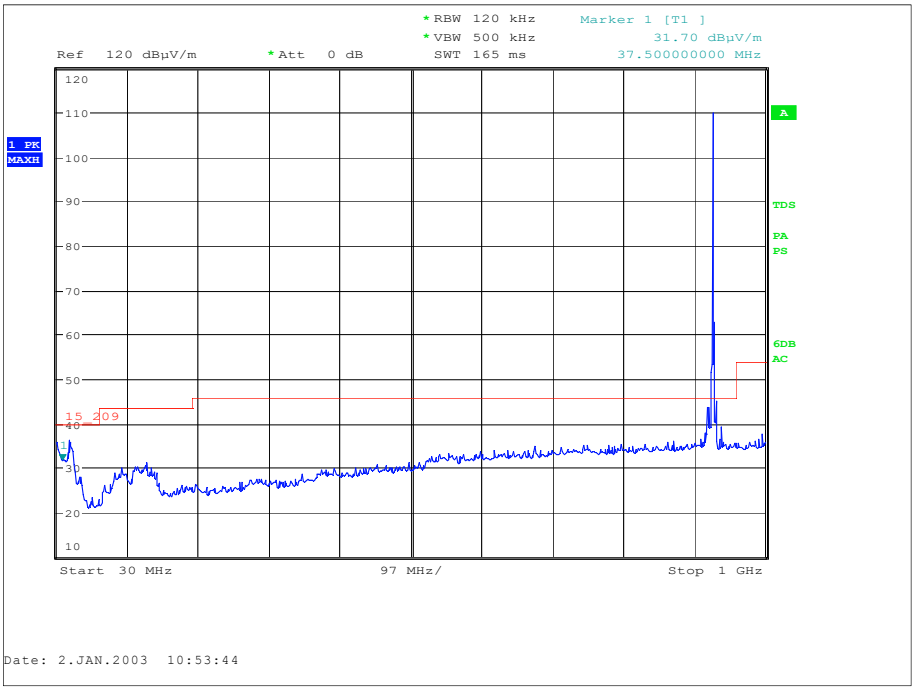

Figure 36 - 927.4 MHz - 30 MHz to 1 GHz - Y Orientation - Horizontal and Vertical

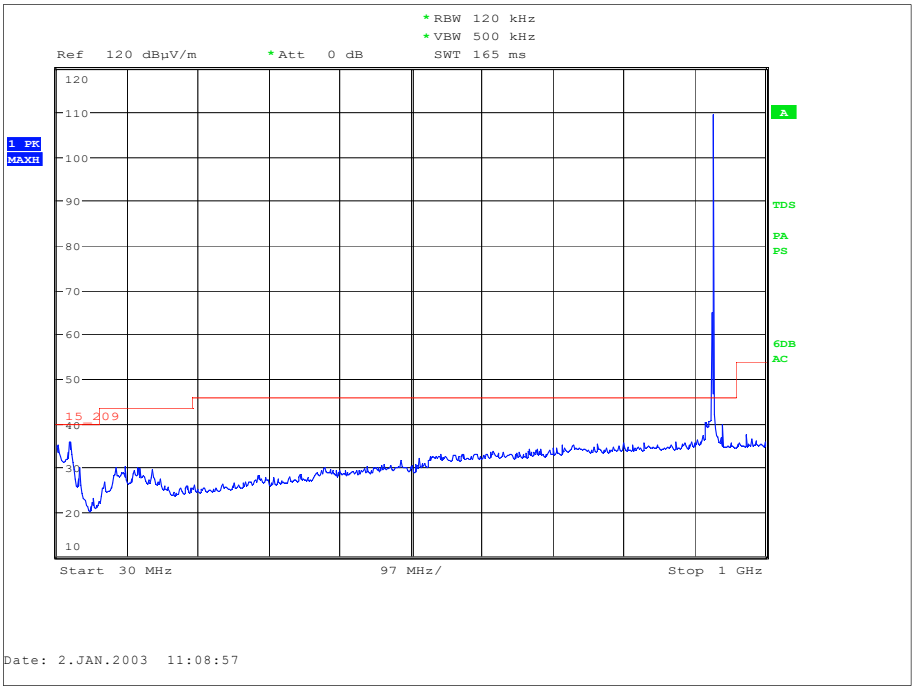

Figure 37 - 927.4 MHz - 30 MHz to 1 GHz - Z Orientation - Horizontal and Vertical

Frequency (GHz)	Result (dBµV/m)		Limit (dBµV/m)		Margin (dBµV/m)	
	Peak	Average	Peak	Average	Peak	Average
3.709519	52.22	50.85	73.98	53.98	21.76	3.13
7.419240	50.61	48.64	73.98	53.98	23.37	5.34

Table 20 - 927.4 MHz - 1 GHz to 10 GHz Emissions Results

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

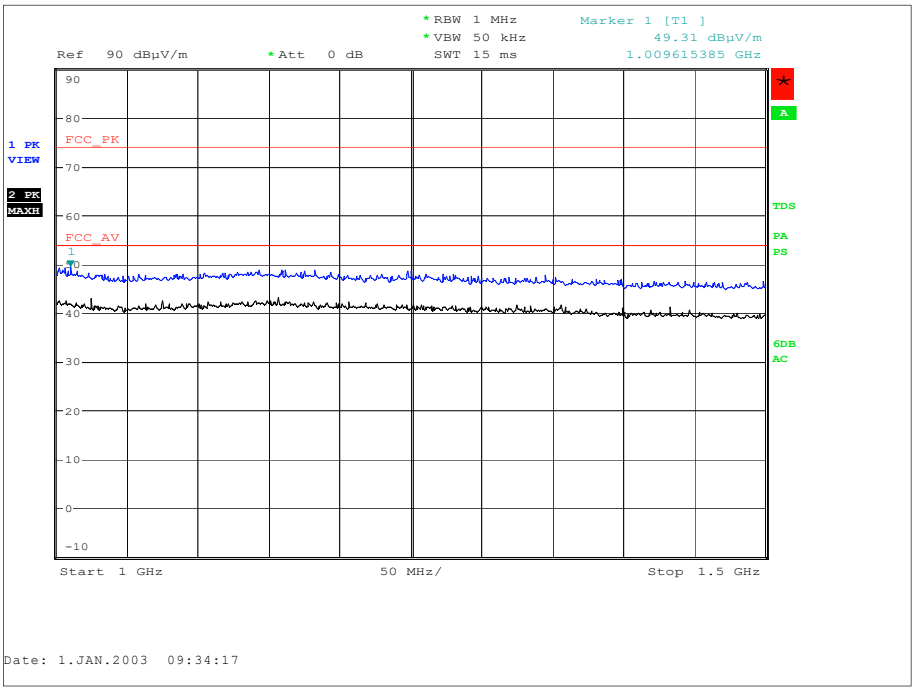

Figure 38 - 927.4 MHz - 1 GHz to 1.5 GHz - X Orientation - Horizontal and Vertical

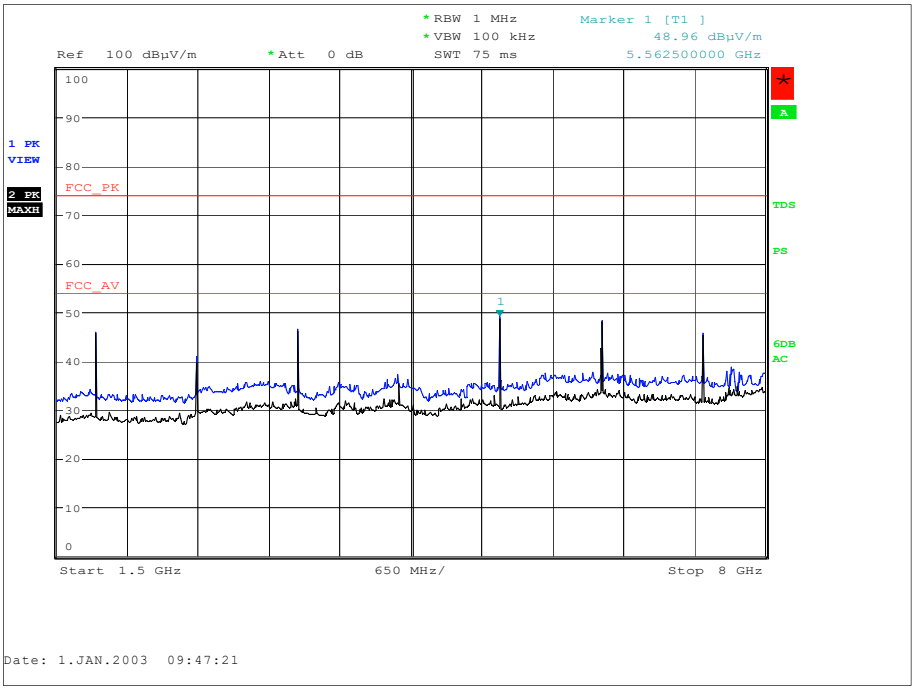

Figure 39 - 927.4 MHz - 1.5 GHz to 8 GHz - X Orientation - Horizontal and Vertical

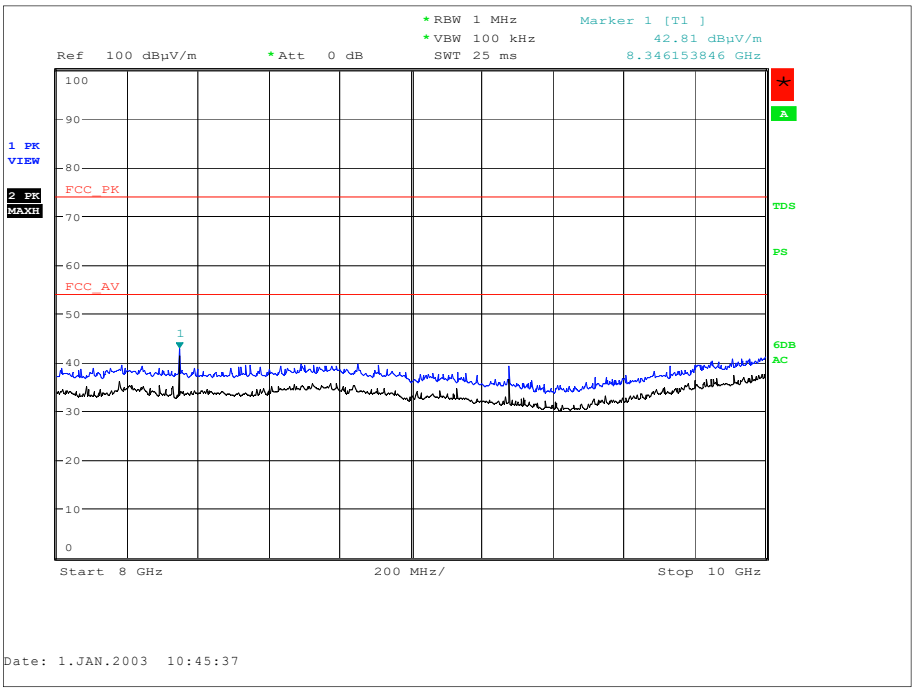

Figure 40 - 927.4 MHz - 8 GHz to 10 GHz - X Orientation - Horizontal and Vertical

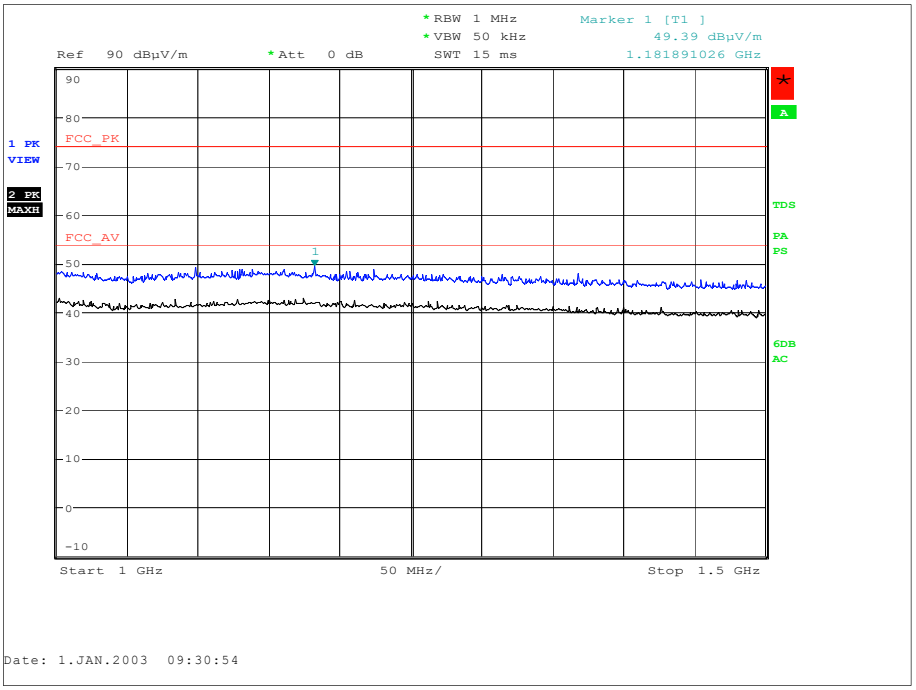

Figure 41 - 927.4 MHz - 1 GHz to 1.5 GHz - Y Orientation - Horizontal and Vertical

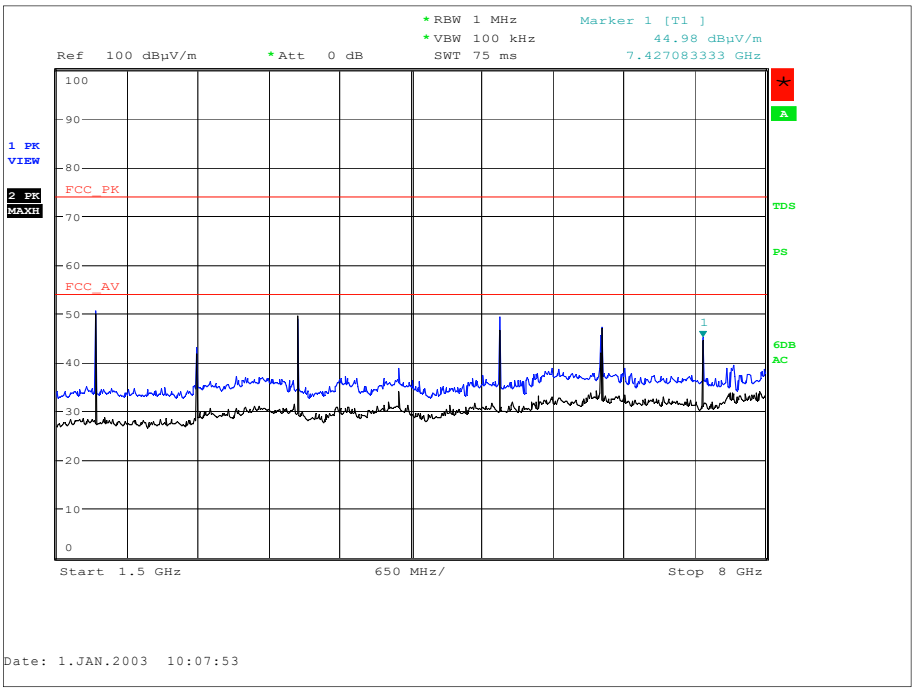

Figure 42 - 927.4 MHz - 1.5 GHz to 8 GHz - Y Orientation - Horizontal and Vertical

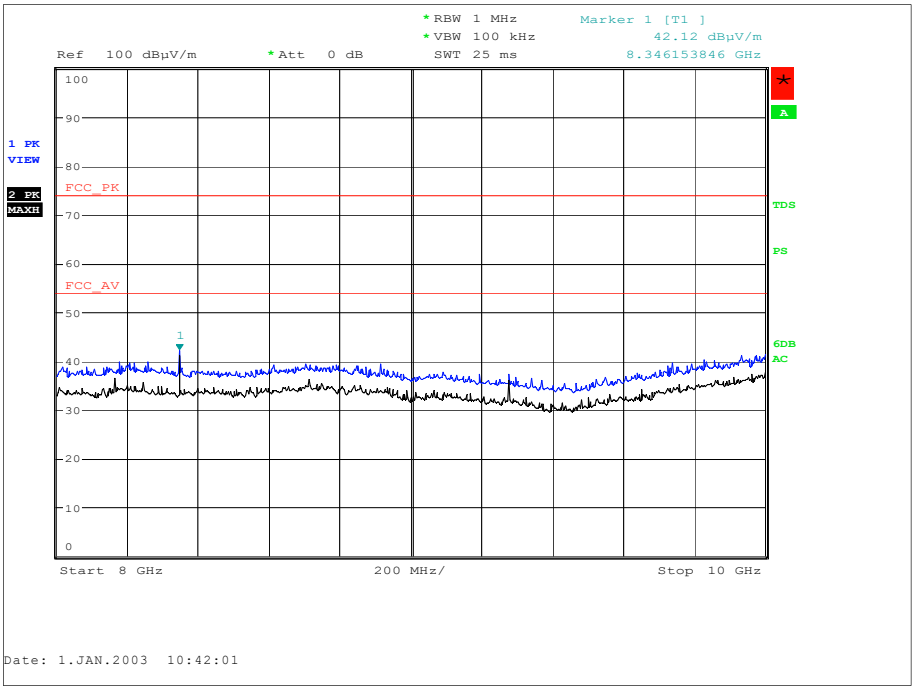

Figure 43 - 927.4 MHz - 8 GHz to 10 GHz - Y Orientation - Horizontal and Vertical

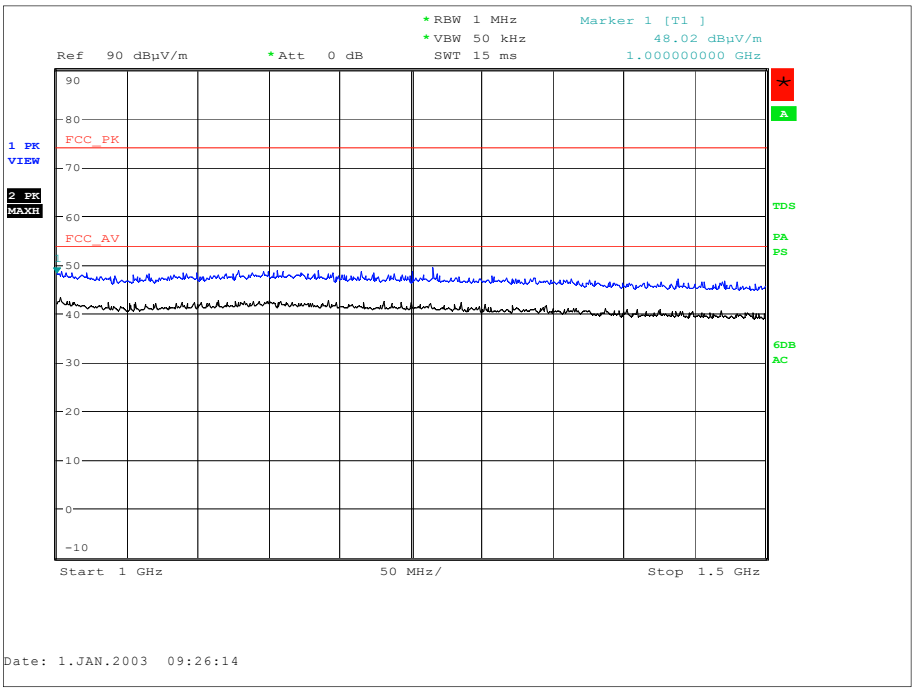

Figure 44 - 927.4 MHz - 1 GHz to 1.5 GHz - Z Orientation - Horizontal and Vertical

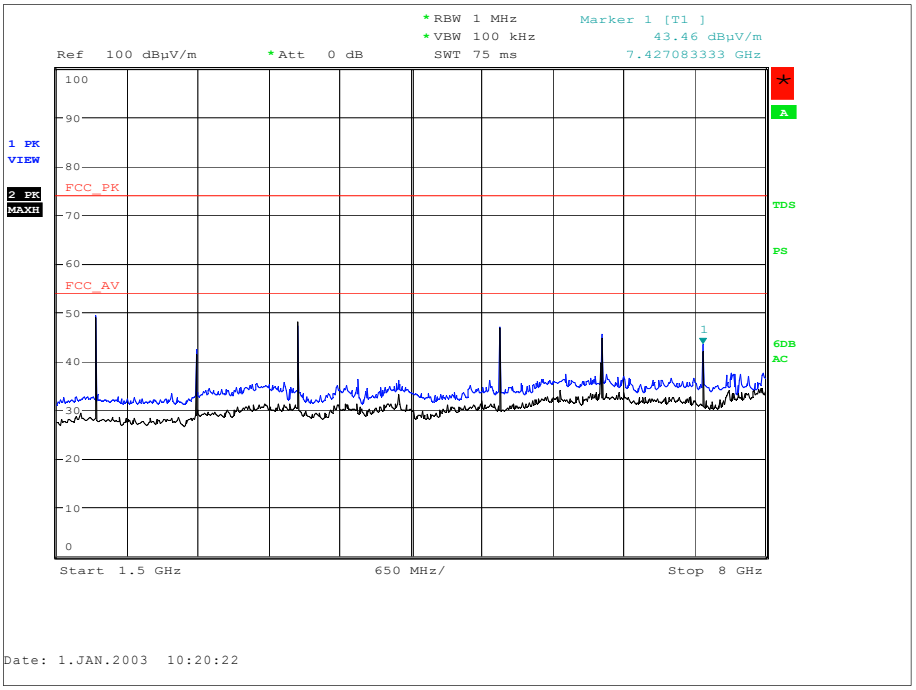

Figure 45 - 927.4 MHz - 1.5 GHz to 8 GHz - Z Orientation - Horizontal and Vertical

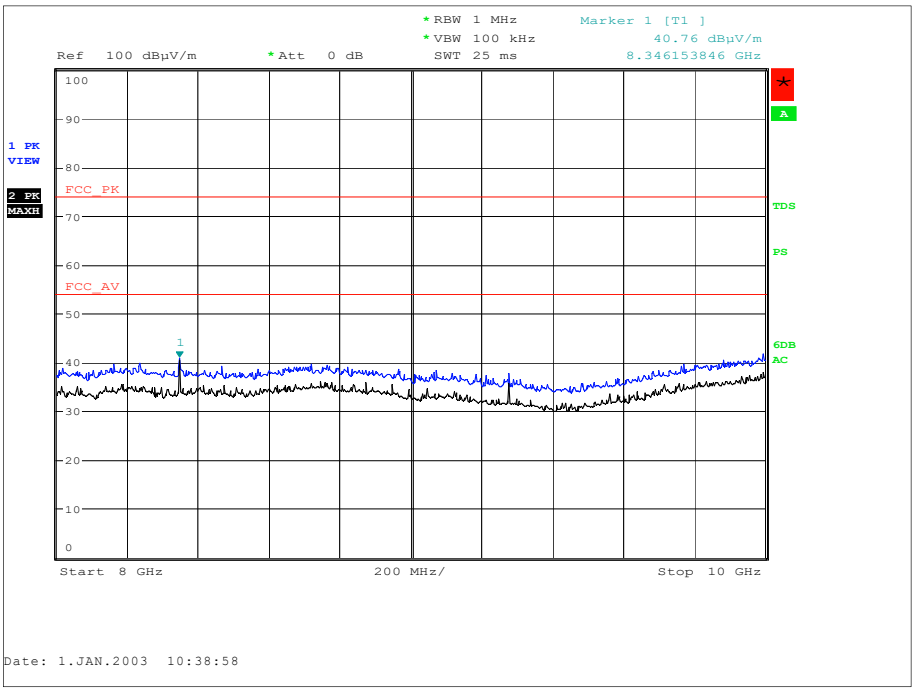

Figure 46 - 927.4 MHz - 8 GHz to 10 GHz - Z Orientation - Horizontal and Vertical

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).

2.6.7 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
Pre-Amplifier	Phase One	PS04-0086	1533	12	12-Jan-2019
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Power Supply	Hewlett Packard	6104A	1948	-	TU
Multimeter	Iso-tech	IDM101	2419	12	23-Nov-2018
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	18-Oct-2018
1 metre SMA Cable	Florida Labs	SMS-235SP-39.4-SMS	4512	-	O/P Mon
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
9m N type RF cable	Rosenberger	2303-0 9.0m PNm PNm	4827	6	04-Jan-2019
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	12-Feb-2019
4dB Attenuator	Pasternack	PE7047-4	4935	12	28-Nov-2018
High Pass filter	Wainwright	WHKX12-1290-1500-18000-80SS	4962	-	O/P Mon
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
Cable (26.5GHz	Rosenberger	LU7-133-5000	5019	-	O/P Mon
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021

Table 21

TU – Traceability unscheduled
O/P Mon – Output monitored using calibrated test equipment.

2.7 Authorised Band Edges

2.7.1 Specification Reference

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

2.7.2 Equipment Under Test and Modification State

MiX 45MC-4G-B, S/N: 45000203 / IMEI 357812090506921 - Modification State 0

2.7.3 Date of Test

02-October-2018 to 10-October-2018

2.7.4 Test Method

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

2.7.5 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	58.9 %

2.7.6 Test Results

Transmit - 915 MHz SRD

Mode	Frequency (MHz)	Measured Frequency (MHz)	Level (dBc)
Static	927.4	928.0	-62.78
Hopping	927.4	928.0	-68.67
Static	902.2	902.0	-41.83
Hopping	902.2	902.0	-37.80

Table 22

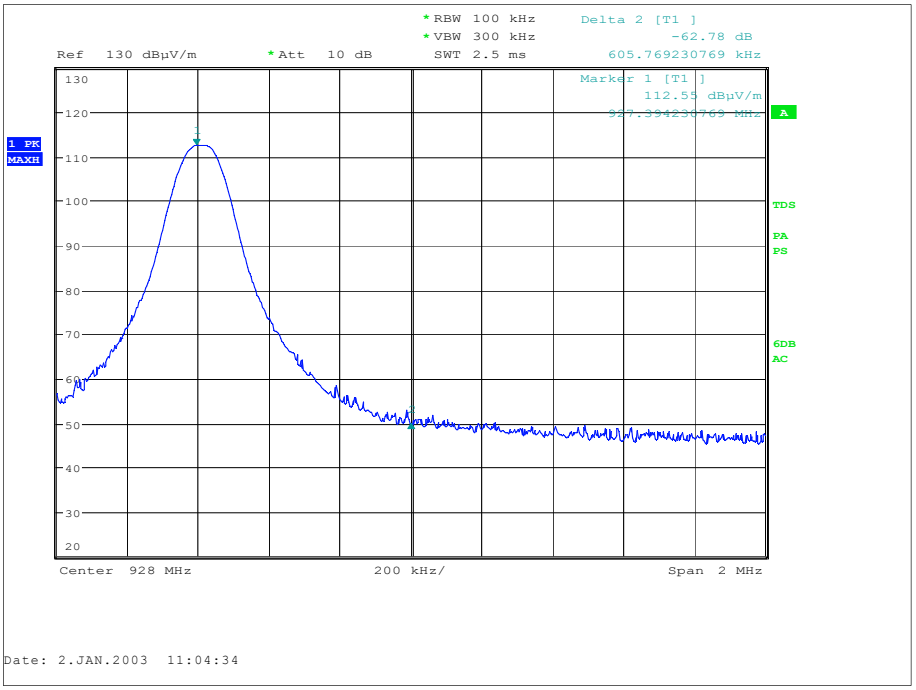

Figure 47 - Static - 927.4 MHz - Measured Frequency 928.0 MHz

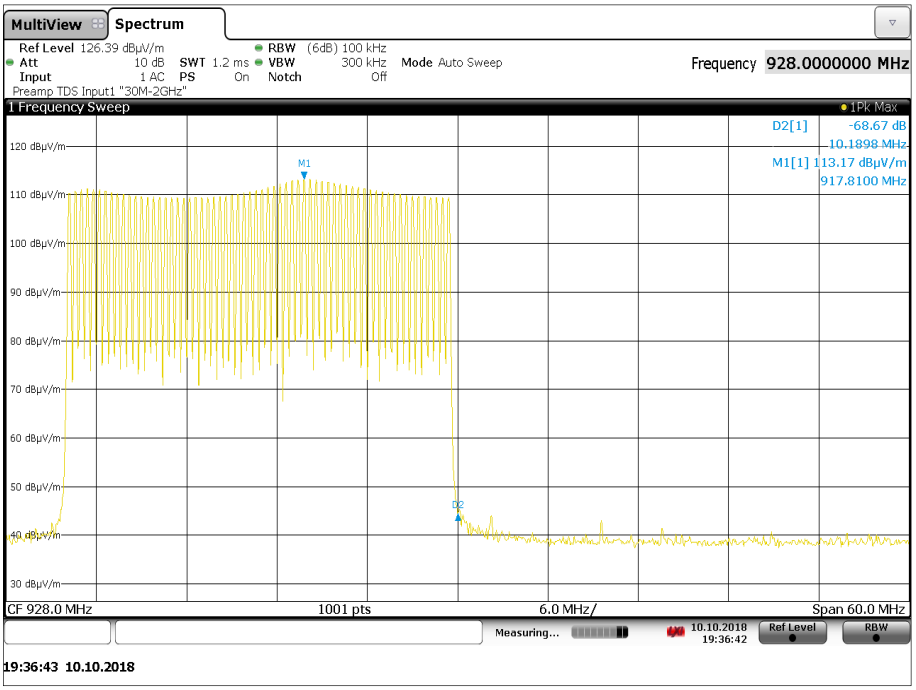

Figure 48 - Hopping - 927.4 MHz - Measured Frequency 928.0 MHz

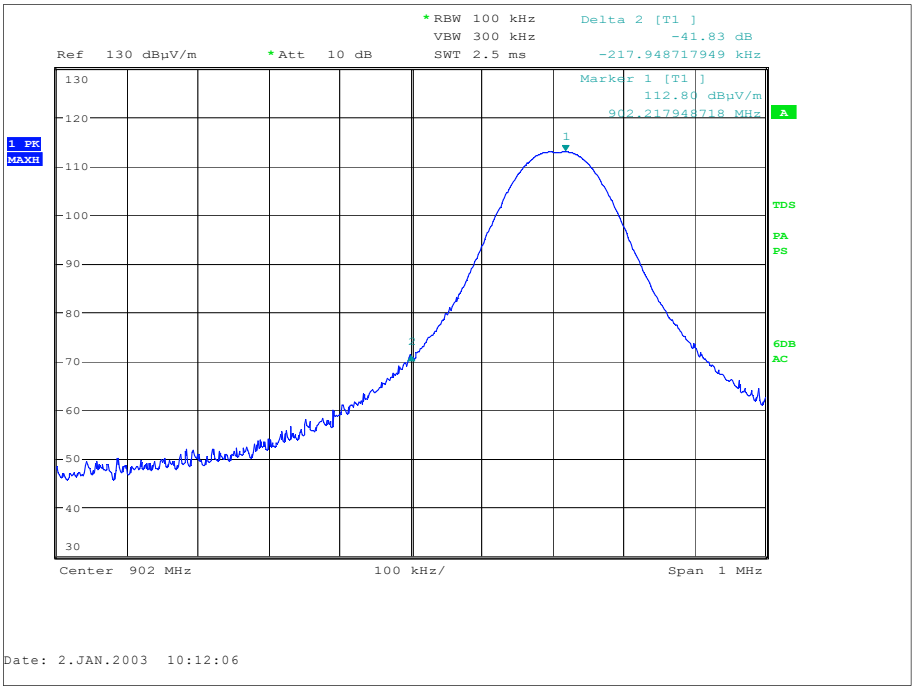

Figure 49 - Static - 902.2 MHz - Measured Frequency 902.0 MHz

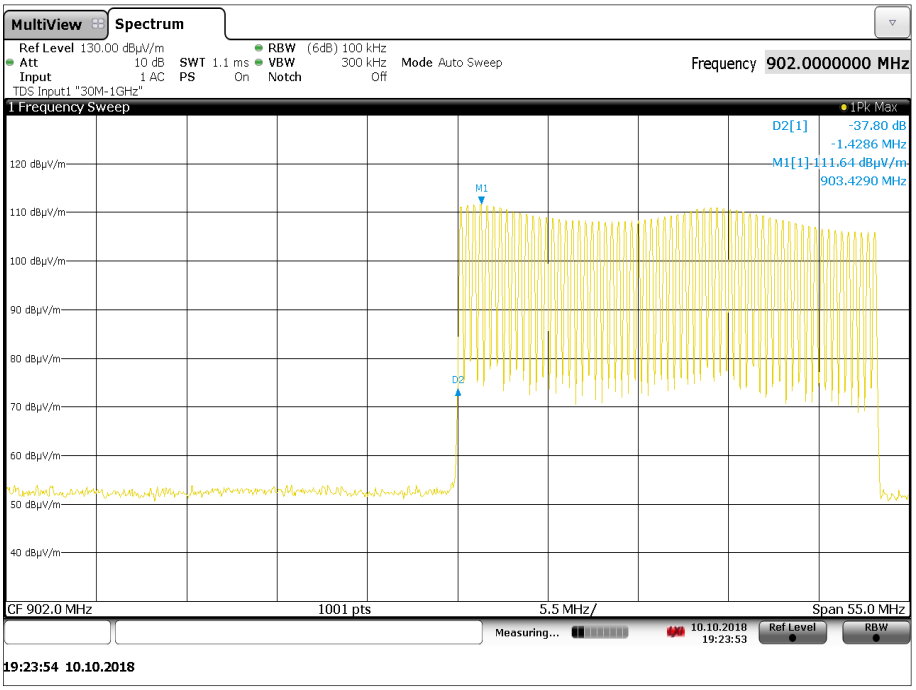

Figure 50 - Hopping - 902.2 MHz - Measured Frequency 902.0 MHz

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.

2.7.7 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
Multimeter	Iso-tech	IDM101	2419	12	23-Nov-2018
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
9m N type RF cable	Rosenberger	2303-0 9.0m PNm PNm	4827	6	04-Jan-2019
4dB Attenuator	Pasternack	PE7047-4	4935	12	28-Nov-2018
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
Cable (40GHz)	Rosenberger	LU1-001-2000	5020	-	O/P Mon
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	12-Sep-2019

Table 23

TU – Traceability unscheduled
O/P Mon – Output monitored using calibrated test equipment

2.8 Restricted Band Edges

2.8.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205

2.8.2 Equipment Under Test and Modification State

MiX 45MC-4G-B, S/N: 45000203 / IMEI 357812090506921 - Modification State 0

2.8.3 Date of Test

02-October-2018 to 10-October-2018

2.8.4 Test Method

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

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

A peak detector has been used in lieu of a Quasi-Peak detector for band-edge measurements, however this is considered to be worst case and there is >10 dB margin on all results.

2.8.5 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	58.9 %

2.8.6 Test Results

Transmit - 915 MHz SRD

Mode	Frequency (MHz)	Measured Frequency (MHz)	Peak Level (dBµV/m)
Static	927.4	960.0	38.08
Hopping	927.4	960.0	39.17
Static	902.2	614.0	37.16
Hopping	902.2	614.0	35.87

Table 24 - Restricted Band Edge Results

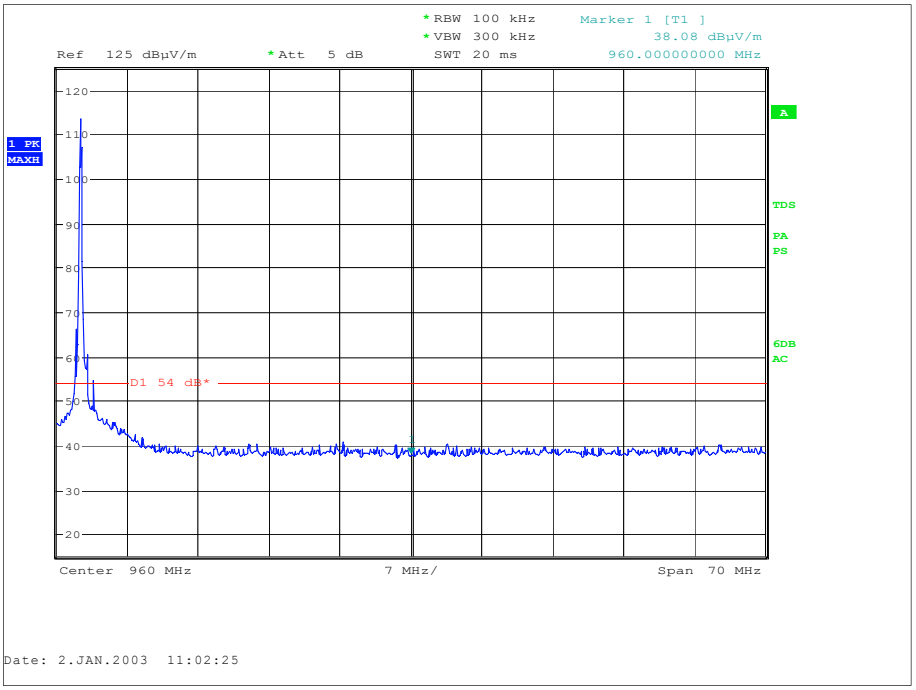

Figure 51 - Static- 927.4 MHz - Measured Frequency 960.0 MHz - Peak

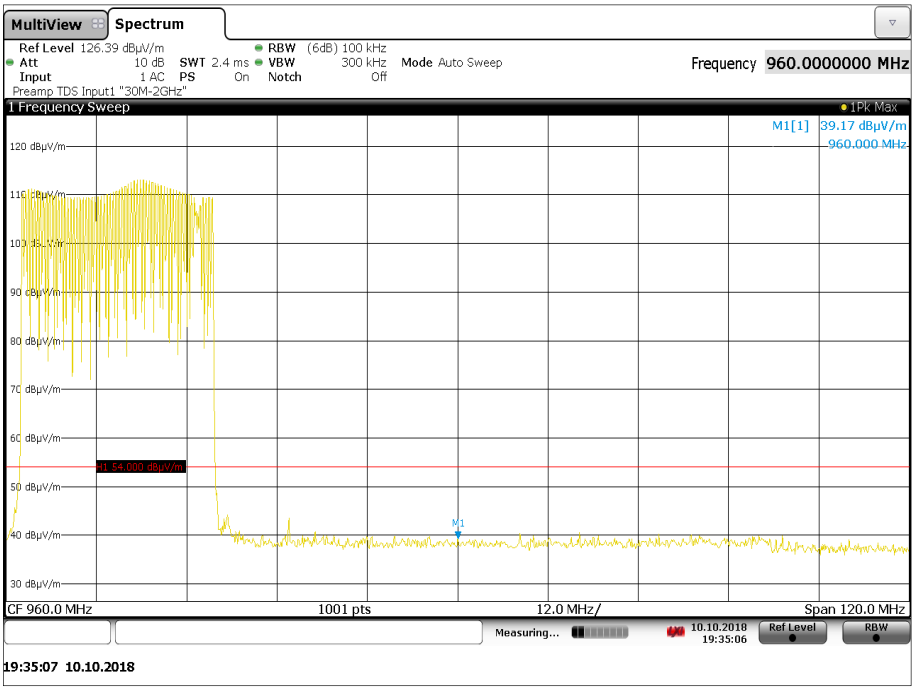

Figure 52 - Hopping- 927.4 MHz - Measured Frequency 960.0 MHz - Peak

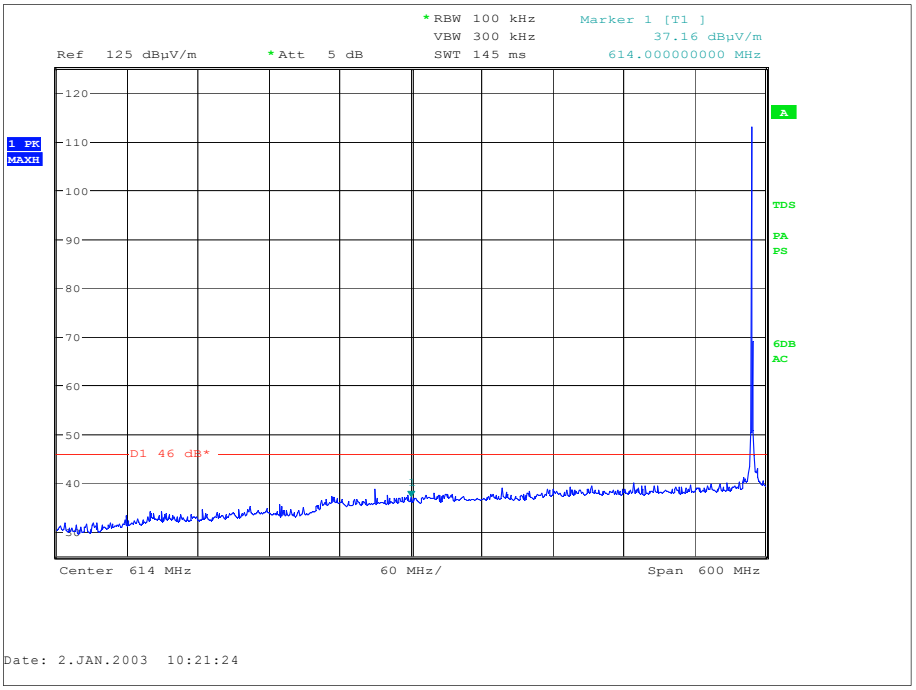

Figure 53 - Static- 902.2 MHz - Measured Frequency 614.0 MHz - Peak

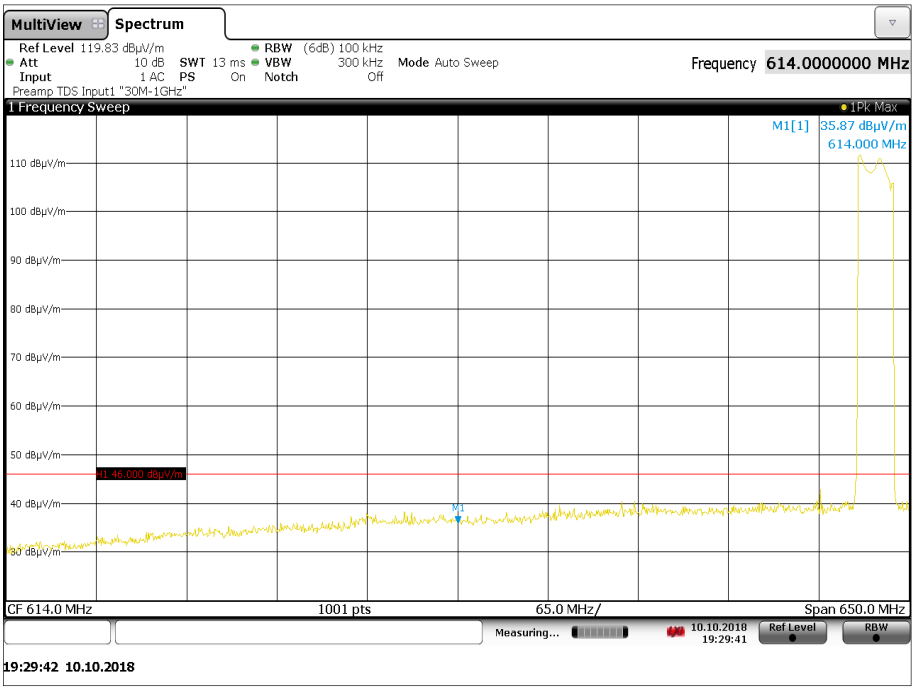

Figure 54 - Hopping- 902.2 MHz - Measured Frequency 614.0 MHz - Peak

FCC 47 CFR Part 15, Limit Clause 15.205

	Peak (dBµV/m)	Average (dBµV/m)
Restricted Bands of Operation	74	54

Table 25

2.8.7 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
Multimeter	Iso-tech	IDM101	2419	12	23-Nov-2018
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	08-Aug-2019
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	22-Nov-2018
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
9m N type RF cable	Rosenberger	2303-0 9.0m PNm PNm	4827	6	04-Jan-2019
4dB Attenuator	Pasternack	PE7047-4	4935	12	28-Nov-2018
Hygrometer	Rotronic	HP21	4989	12	26-Apr-2019
Cable (40GHz)	Rosenberger	LU1-001-2000	5020	-	O/P Mon
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	12-Sep-2019

Table 26

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	Conducted: ± 3.08 dB Radiated: 30 MHz to 1 GHz: ± 5.2 dB Radiated: 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Maximum Conducted Output Power	± 3.2 dB
Frequency Hopping Systems - Average Time of Occupancy	-
Frequency Hopping Systems - Channel Separation	± 1.827 kHz
Frequency Hopping Systems - 20 dB Bandwidth	± 1.827 kHz
Frequency Hopping Systems - Number of Hopping Channels	-

Table 27