FCC Test Report

Fluid Conservation Systems (FCS) Radio Transceiver, Model: Patroller 4

In accordance with FCC 47 CFR Part 15C

Prepared for: HWM Water Ltd
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FCC ID: RUZ-154

COMMERCIAL-IN-CONFIDENCE

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SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Simon Bennett	Innovations Manager	Authorised Signatory	19 November 2019

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	19 November 2019	
Testing	Francis Kane	19 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: 2018 for the tests detailed in section 1.3.

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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	19 November 2019

Table 1

1.2 Introduction

Applicant	HWM Water Ltd
Manufacturer	Fluid Conservation Systems (FCS)
Model Number(s)	Patroller 4
Serial Number(s)	Unit 2.4
Hardware Version(s)	B
Software Version(s)	1.09
Number of Samples Tested	1
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2018
Order Number Date	83195 14-August-2019
Date of Receipt of EUT	04-October-2019
Start of Test	01-October-2019
Finish of Test	05-November-2019
Name of Engineer(s)	Graeme Lawler and Francis Kane
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: 914.5 MHz SRD				
-	15.203	Antenna Requirement	Pass	The equipment under test was fitted with a detachable antenna, however, the equipment will only ever be installed in a professional installation.
2.1	15.249 (a)	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.2	15.249 (a)	Field Strength of Fundamental	Pass	ANSI C63.10 (2013)
2.3	15.249 (a)(d)	Field Strength of Emissions	Pass	ANSI C63.10 (2013)
2.4	15.249 (b)(2)	Frequency Tolerance Under Temperature Variations	Pass	ANSI C63.10 (2013)
2.5	15.215(c)	20 dB Bandwidth	Pass	-

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment)*	The device is a wireless configuration and data download tool for HWM data loggers
Manufacturer:	HWM-Water Ltd – Branded Fluid Conservation Systems Inc. (FCS)
Model:	Patroller 4
Part Number:	PAT4/F/914/1
Hardware Version:	B
Software Version:	1.09
FCC ID (if applicable)	RUZ-154

Intentional Radiators

Technology	RF Narrowband Transceiver
Frequency Band (MHz)	914.5
Conducted Declared Output Power (dBm)	-7.5dBm
Antenna Gain (dBi)	2
Supported Bandwidth(s) (MHz)	164-192, 410-480, 820-960
Modulation Scheme(s)	2-FSK
ITU Emission Designator	125KF1D
Bottom Frequency (MHz)	914.5
Middle Frequency (MHz)	914.5
Top Frequency (MHz)	914.5

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	7.3728 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	32.768 kHz
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:	5	V
Extreme upper voltage:	5.25	V
Extreme lower voltage:	4.75	V
Max current:	50m	A

Battery Power Source

Voltage:	3.7	V
End-point voltage:	3.21	V *(Point at which the battery will terminate)*
Alkaline ☐ Leclanche ☐ Lithium ☐ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)*		
Other ☒ Please detail:	Lithium Ion	

Charging

Can the EUT transmit whilst being charged	Yes ☒ No ☐

Temperature

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

Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☐	Type:		State impedance		dBI
External antenna ☒	Type:	SMA 50Ohm	State impedance	2	dBI

Ancillaries (if applicable)

Manufacturer:		Part Number:	
Model:		Country of Origin:	

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

Name: Andy Earp
Position held: Design Assurance
Date: 13/09/2019

1.5 Product Information

1.5.1 Technical Description

Patroller 4 is a radio communications device used for the configuration and downloading of data from data loggers. It provides a Bluetooth or USB to UHF radio radio bridge.

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: Patroller 4: Serial Number: Unit 2.4			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 914.5 MHz SRD		
Authorised Band Edges	Graeme Lawler	UKAS
Field Strength of Fundamental	Graeme Lawler	UKAS
Field Strength of Emissions	Graeme Lawler	UKAS
Frequency Tolerance Under Temperature Variations	Francis Kane	UKAS
20 dB Bandwidth	Francis Kane	UKAS

Table 4

Office Address:

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

2 Test Details

2.1 Authorised Band Edges

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.249 (a)

2.1.2 Equipment Under Test and Modification State

Patroller 4, S/N: Unit 2.4 - Modification State 0

2.1.3 Date of Test

06-October-2019

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.10.4.

2.1.5 Environmental Conditions

Ambient Temperature 20.2 °C
Relative Humidity 65.1 %

2.1.6 Test Results

914.5 MHz SRD

Frequency	Measured Frequency (MHz)	Peak Level (dBµV/m)
914.5 MHz	902	37.63
914.5 MHz	928	38.35

Table 5 - Authorised Band Edge Results

Note: The appropriate limit is 200 µV/meter at 3 m (46 dBµV/m at 3m) as this is less stringent than 50 dBc.

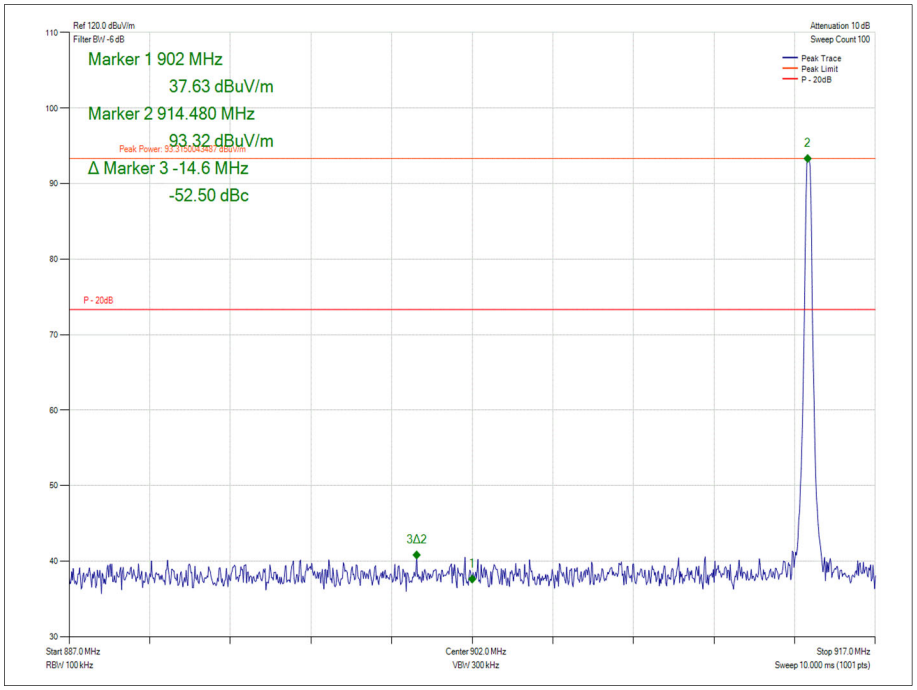

Figure 1 – 914.5 MHz, Measured Frequency 902 MHz

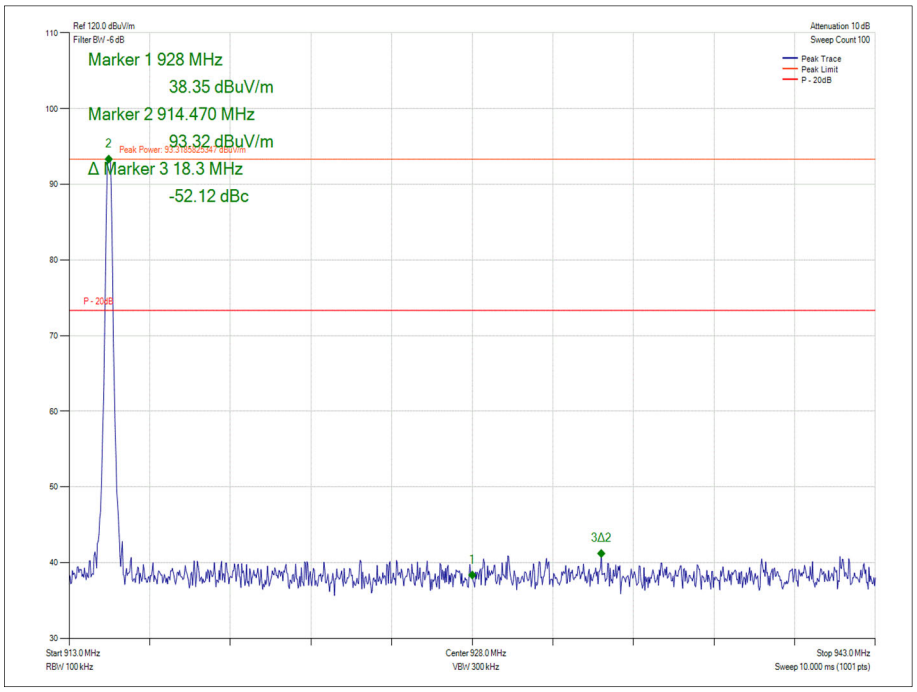

Figure 2 – 914.5 MHz, Measured Frequency 928 MHz

FCC 47 CFR Part 15, Limit Clause 15.249 (d)

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

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 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygromer	Rotronic	A1	2677	12	20-Feb-2020
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
4dB Attenuator	Pasternack	PE7047-4	4935	24	28-Nov-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX	5125	-	Software
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020

Table 7

TU - Traceability Unscheduled

2.2 Field Strength of Fundamental

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.249 (a)

2.2.2 Equipment Under Test and Modification State

Patroller 4, S/N: Unit 2.4 - Modification State 0

2.2.3 Date of Test

06-October-2019

2.2.4 Test Method

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

2.2.5 Environmental Conditions

Ambient Temperature 20.2 °C
Relative Humidity 65.1 %

2.2.6 Test Results

914.5 MHz SRD

Frequency MHz	Field Strength (dBµV/m)
	Quasi-Peak
914.5 MHz	93.23

Table 8

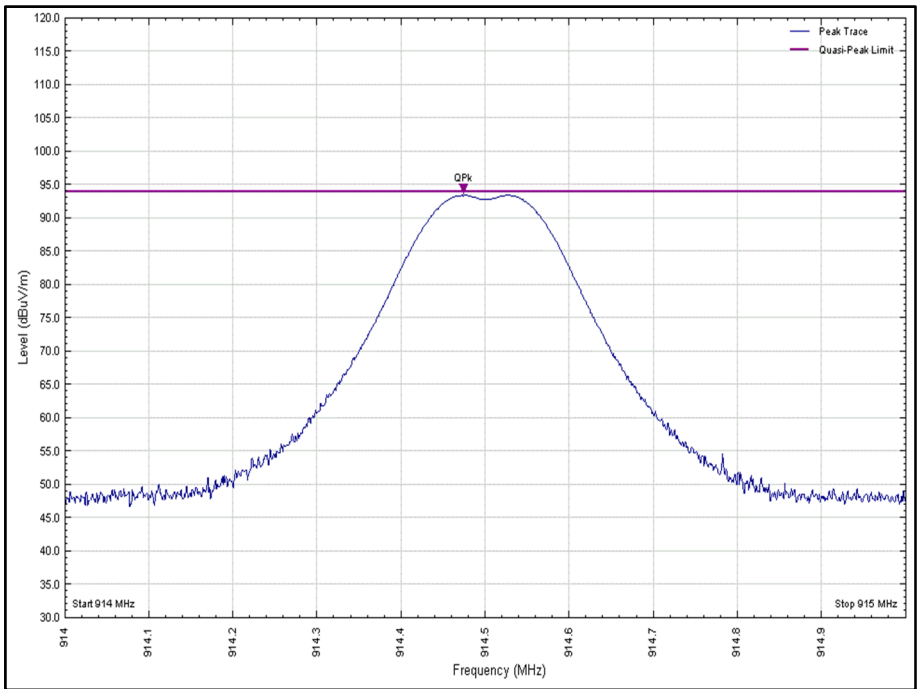

Figure 3 – 914.5 MHz, Quasi-Peak

FCC 47 CFR Part 15, Limit Clause 15.249 (a)

Fundamental Frequency (MHz)	Field Strength of Fundamental (mV/m)
902 to 928	50
2400 to 2483.5	50
5725 to 5875	50
24000 to 24250	250

Table 9

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
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygromer	Rotronic	A1	2677	12	20-Feb-2020
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	17-Dec-2019
Cable (Rx, Km-Km 2m)	Scott Cables	KPS-1501-2000-KPS	4526	6	11-Dec-2019
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
4dB Attenuator	Pasternack	PE7047-4	4935	24	28-Nov-2019
8m N-Type RF Cable	Teledyne	PR90-088-8MTR	5093	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX	5125	-	Software
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020

Table 10

TU - Traceability Unscheduled

2.3 Field Strength of Emissions

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.249 (a)(d)

2.3.2 Equipment Under Test and Modification State

Patroller 4, S/N: Unit 2.4 - Modification State 0

2.3.3 Date of Test

01-October-2019 to 07-October-2019

2.3.4 Test Method

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

The plots show the characterization of the EUT. 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.

For frequencies greater than 1 GHz, plots for average measurements were taken with an RMS detector and a max hold trace 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.

If emissions were found to be pulsed, final measurements were taken in accordance with ANSI C63.10, clause 7.5. A peak measurement is performed. A duty cycle correction factor is then determined by the expression duty (dB) = 20log(On Time/(On Time + Off Time)). This factor is then added to the peak value to determine the average value.

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

2.3.5 Environmental Conditions

Ambient Temperature	19.6 °C
Relative Humidity	63.0 %

2.3.6 Test Results

914.5 MHz SRD

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
43.235	37.7	40.0	-2.3	Q-Peak	309	100	Vertical
56.901	36.2	40.0	-3.8	Q-Peak	319	100	Vertical
67.252	36.7	40.0	-3.4	Q-Peak	166	107	Vertical
103.198	39.3	43.5	-4.2	Q-Peak	189	110	Vertical

Table 11 - 914.5 MHz - 30 MHz to 1 GHz - X Orientation

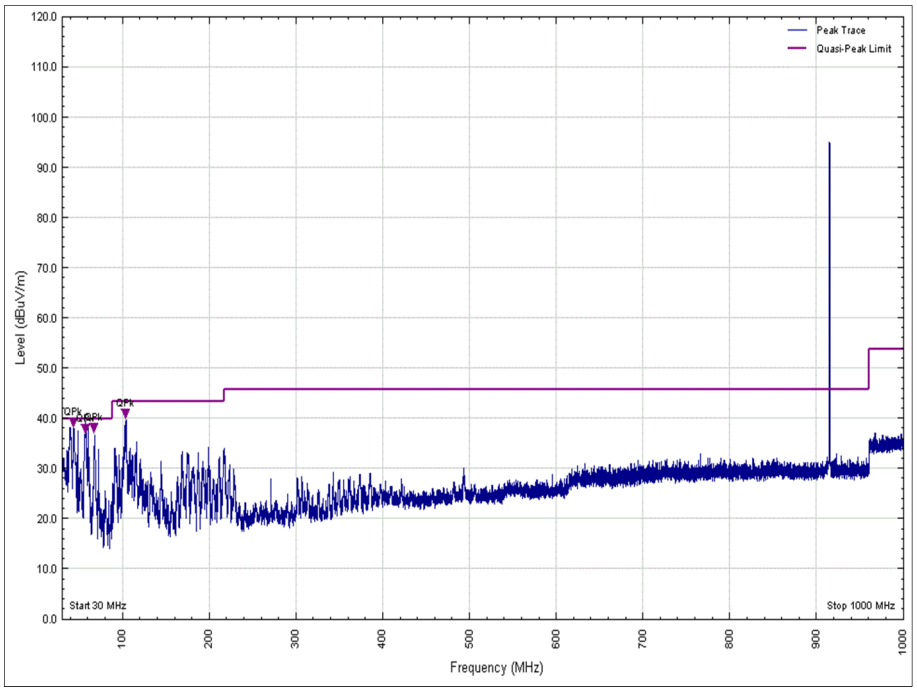

Figure 4 - 914.5 MHz - 30 MHz to 1 GHz - X Orientation - Vertical

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
402.531	38.0	46.0	-8.0	Q-Peak	309	100	Vertical

Table 12 - 914.5 MHz - 30 MHz to 1 GHz - X Orientation

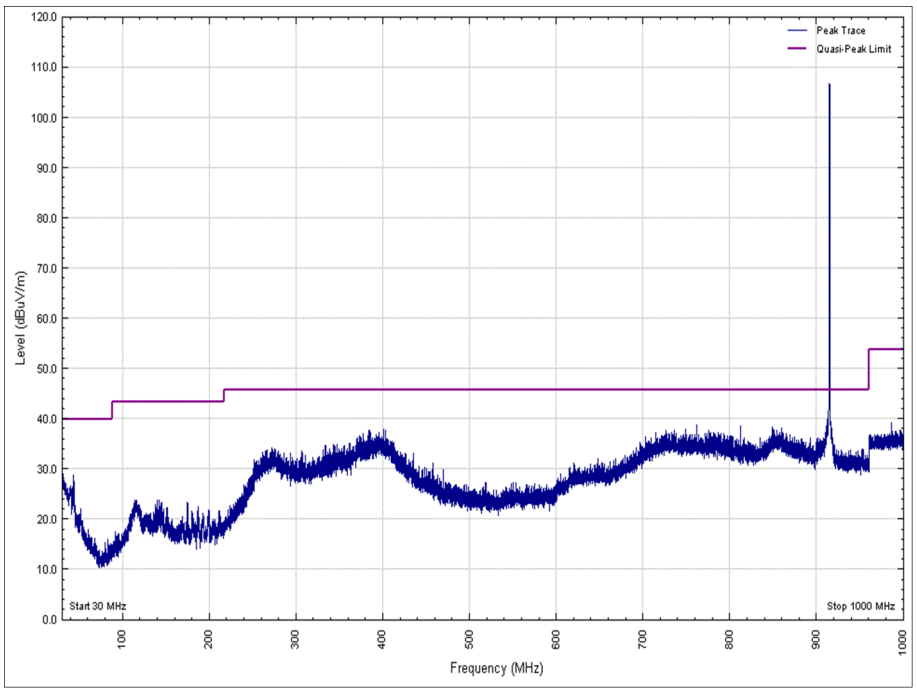

Figure 5 - 914.5 MHz - 30 MHz to 1 GHz - X Orientation - Horizontal

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
38.247	31.3	40.0	-8.7	Q-Peak	346	1.29	Vertical
43.264	38.3	40.0	-1.8	Q-Peak	315	100	Vertical
59.997	34.3	40.0	-5.7	Q-Peak	72	100	Vertical
67.456	31.6	40.0	-8.4	Q-Peak	55	113	Vertical
103.447	35.0	43.5	-8.5	Q-Peak	46	120	Vertical
402.489	38.6	46.0	-7.4	Q-Peak	9	113	Vertical

Table 13 - 914.5 MHz - 30 MHz to 1 GHz - Y Orientation

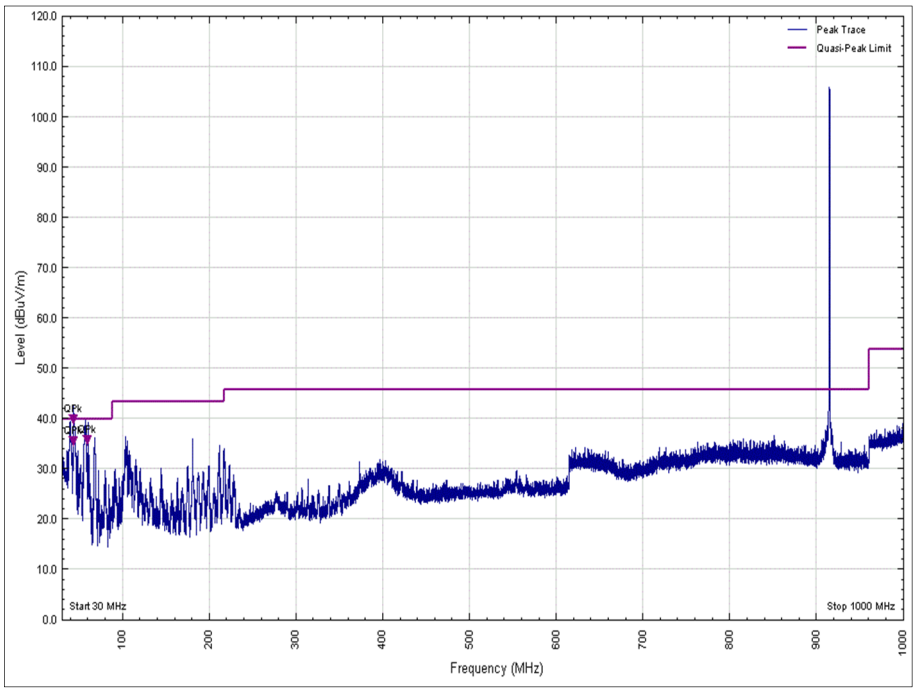

Figure 6 - 914.5 MHz - 30 MHz to 1 GHz - Y Orientation - Vertical

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
*							

Table 14 - 914.5 MHz - 30 MHz to 1 GHz - Y Orientation

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

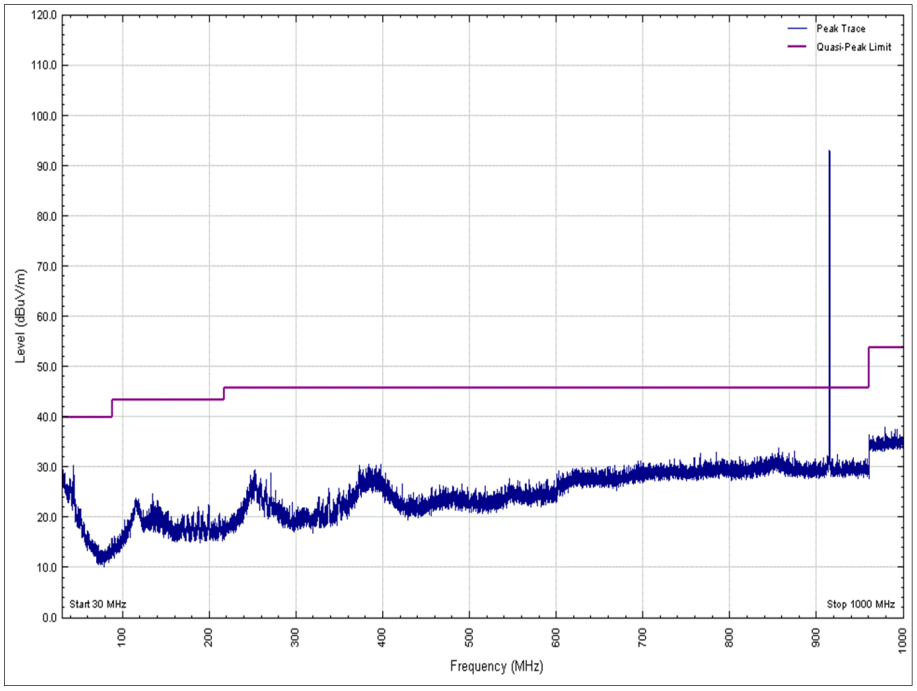

Figure 7 - 914.5 MHz - 30 MHz to 1 GHz - Y Orientation - Horizontal

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
38.911	36.0	40.0	-4.0	Q-Peak	236	100	Vertical
43.226	36.9	40.0	-3.1	Q-Peak	187	100	Vertical
60.004	34.8	40.0	-5.2	Q-Peak	122	100	Vertical
103.260	37.1	43.5	-6.4	Q-Peak	3	102	Vertical

Table 15 - 914.5 MHz - 30 MHz to 1 GHz - Z Orientation

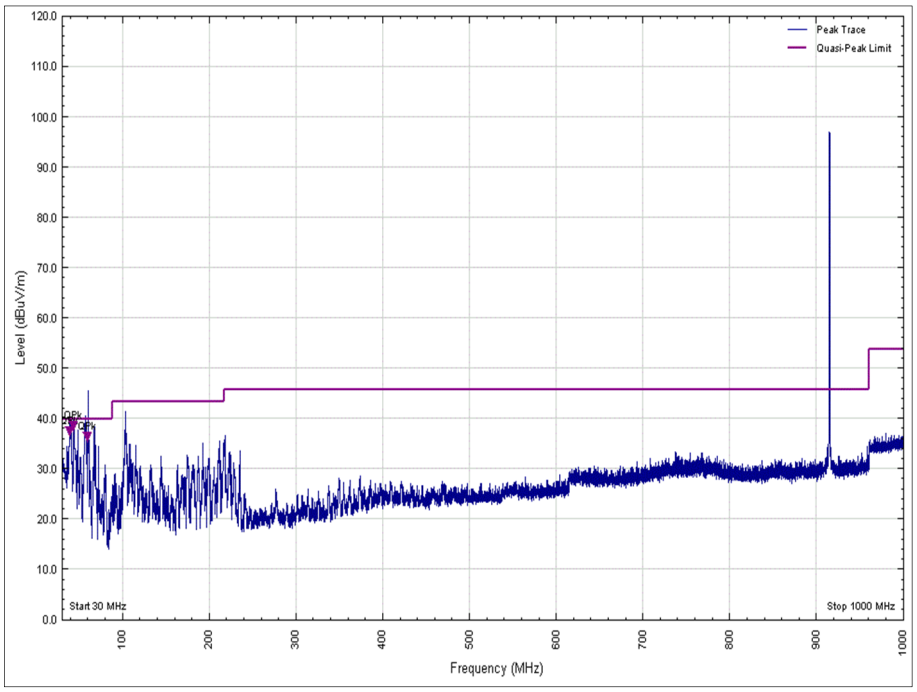

Figure 8 - 914.5 MHz - 30 MHz to 1 GHz - Z Orientation - Vertical

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
402.443	36.13	46.0	-9.9	Q-Peak	263	100	Horizontal

Table 16 - 914.5 MHz - 30 MHz to 1 GHz - Z Orientation

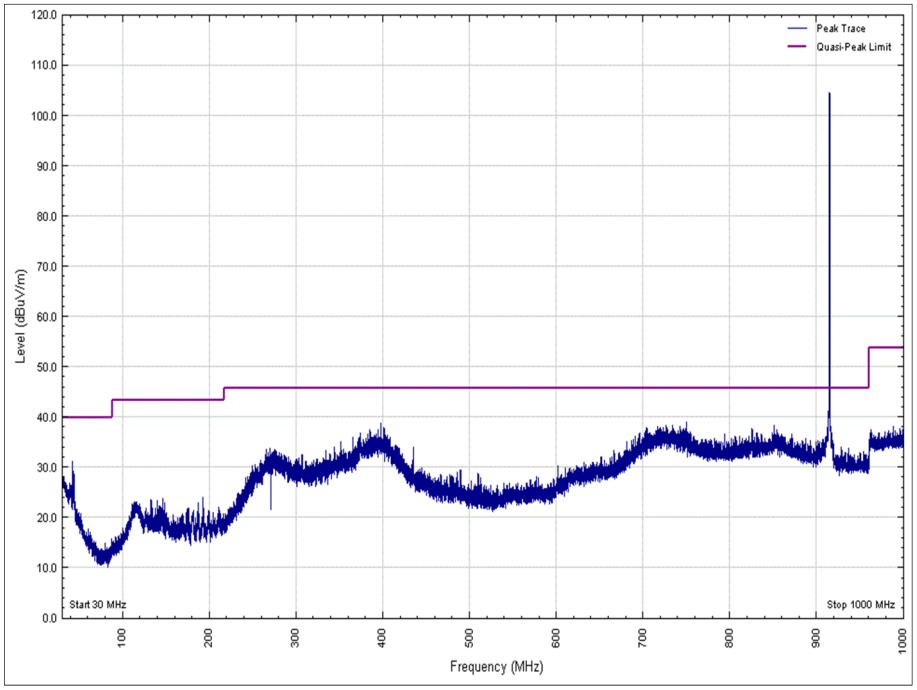

Figure 9 - 914.5 MHz - 30 MHz to 1 GHz - Z Orientation - Horizontal

Frequency (MHz)	Final Peak (dBµV/m)	Final Average (dBµV/m)	Final Peak (µV/m)	Final Average (µV/m)	Angle (°)	Height (m)	Polarisation
3658.140	N/A	50.14	N/A	321.37	282	1.01	Horizontal

Table 17 - 1 GHz to 10 GHz

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

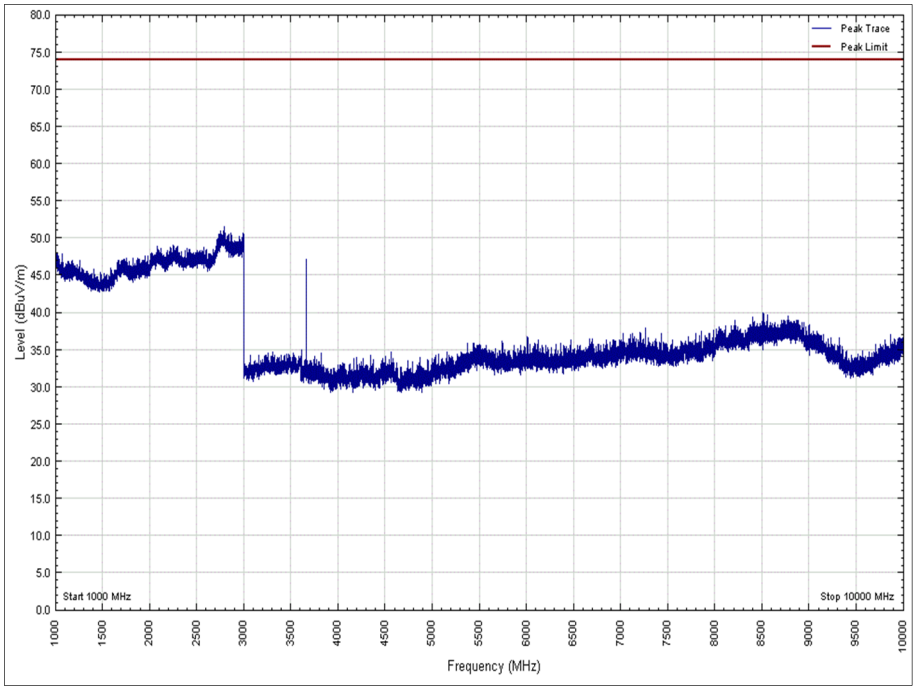

Figure 10 - 914.5 - 1 GHz to 10 GHz - X Orientation – Vertical - Peak

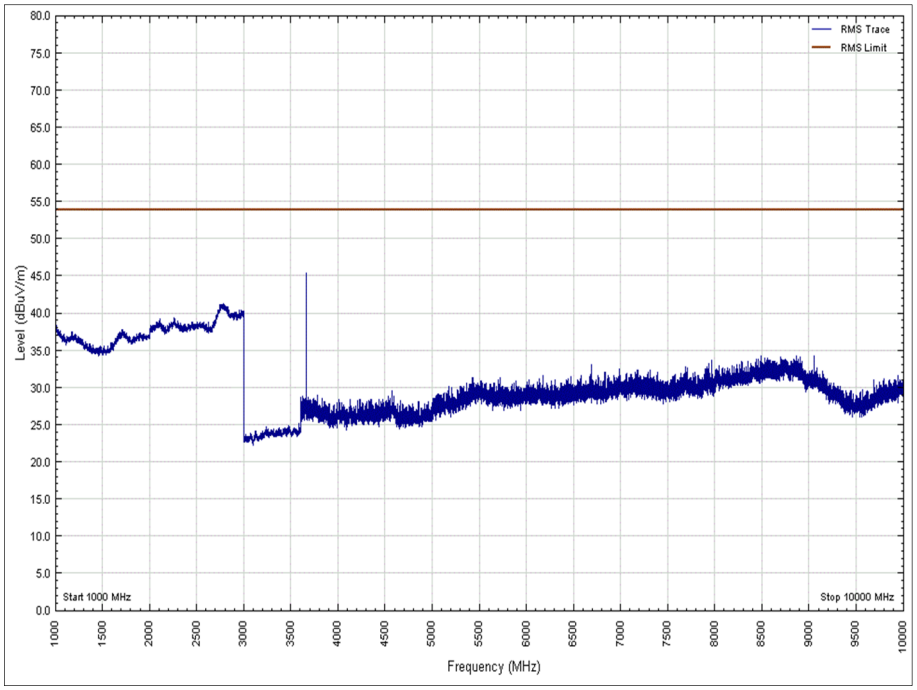

Figure 11 - 914.5 - 1 GHz to 10 GHz - X Orientation – Vertical – Average

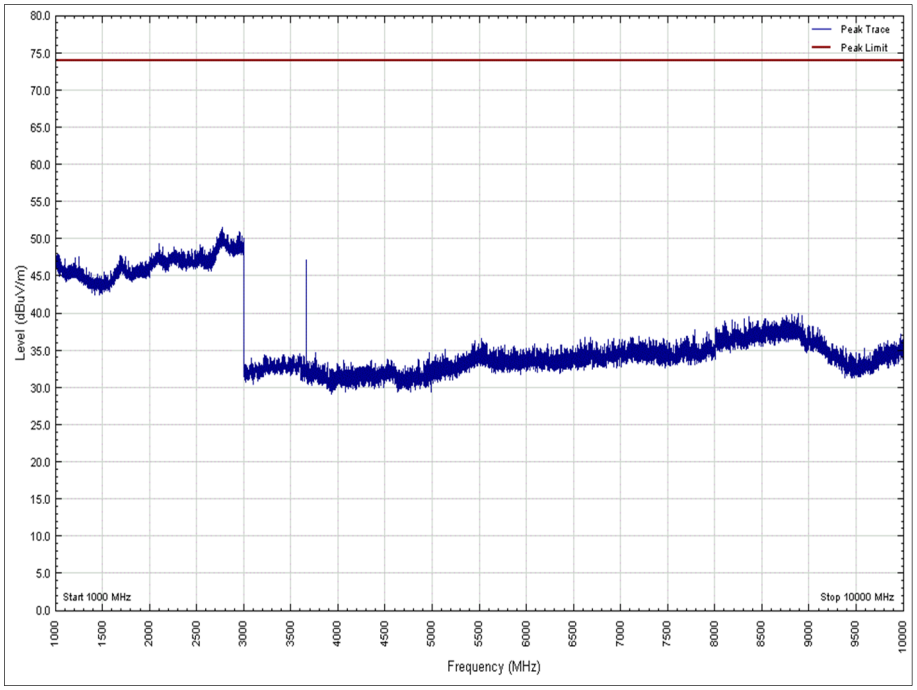

Figure 12 - 914.5 - 1 GHz to 10 GHz - X Orientation – Horizontal - Peak

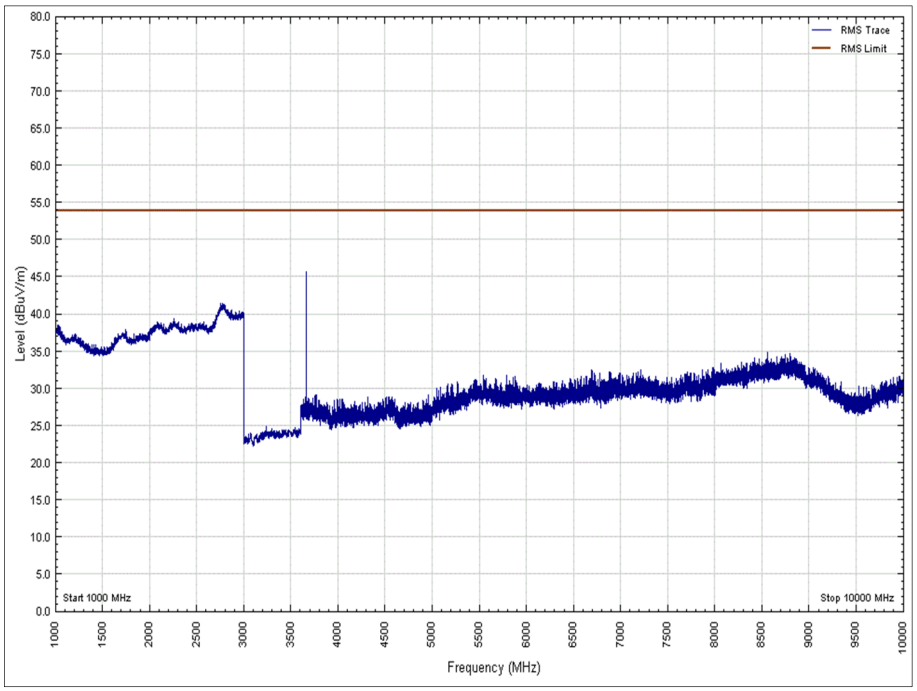

Figure 13 - 914.5 - 1 GHz to 10 GHz - X Orientation – Horizontal - Average

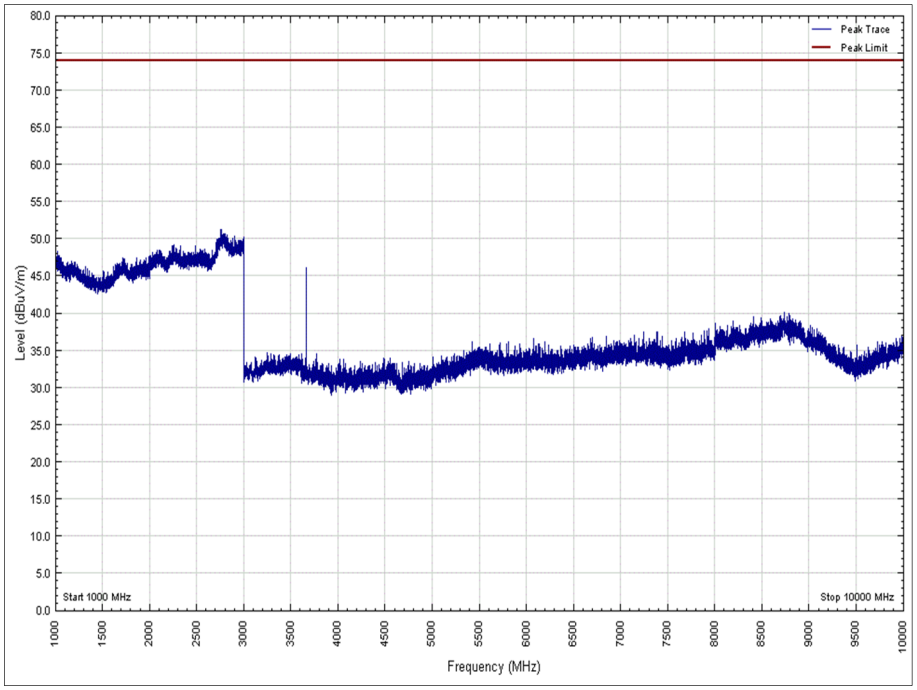

Figure 14 - 914.5 - 1 GHz to 10 GHz - Y Orientation – Vertical - Peak

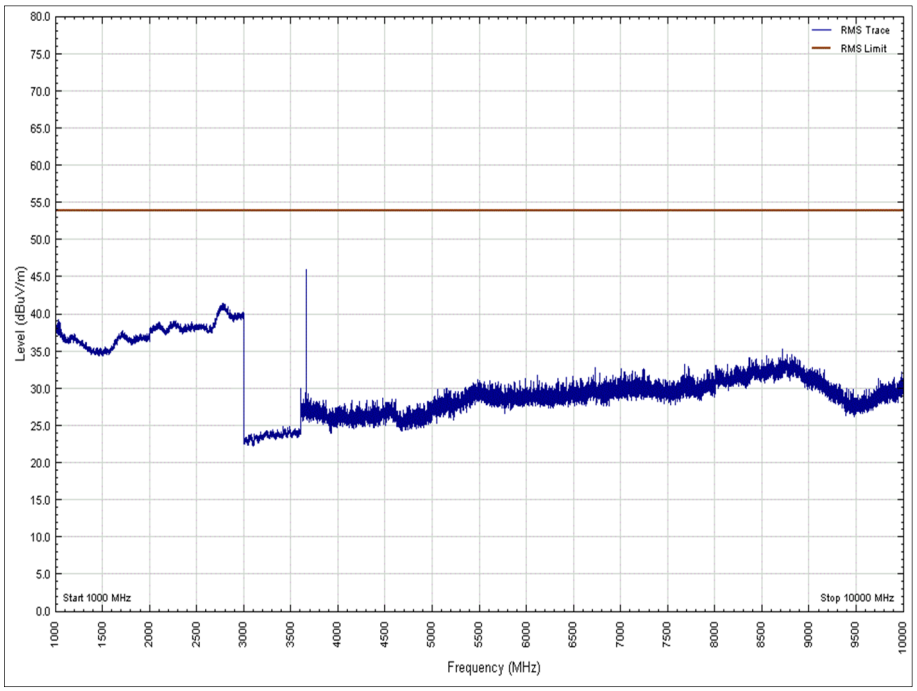

Figure 15 - 914.5 - 1 GHz to 10 GHz - Y Orientation – Vertical – Average

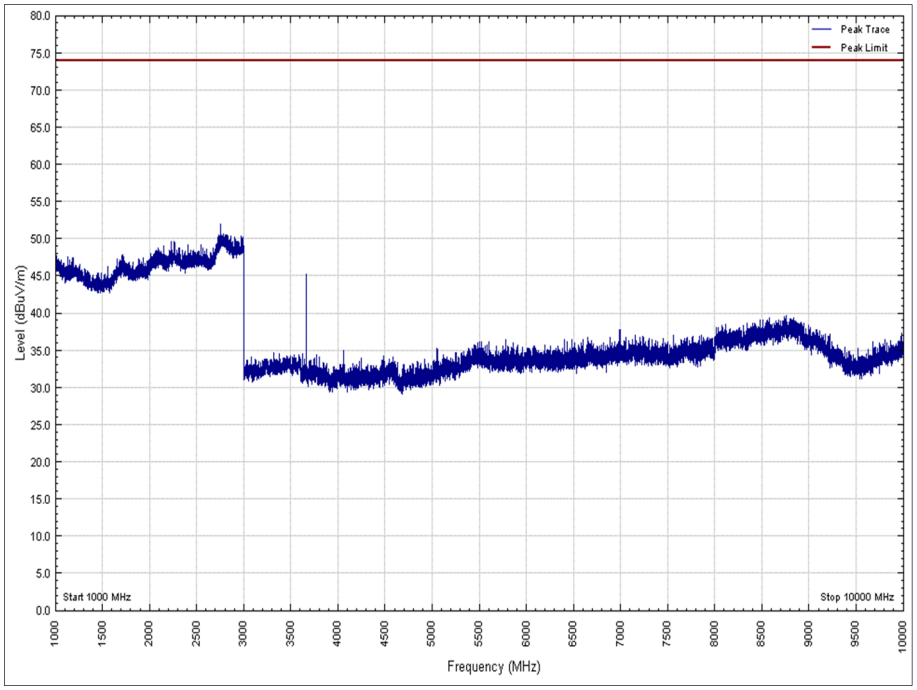

Figure 16 - 914.5 - 1 GHz to 10 GHz - Y Orientation – Horizontal - Peak

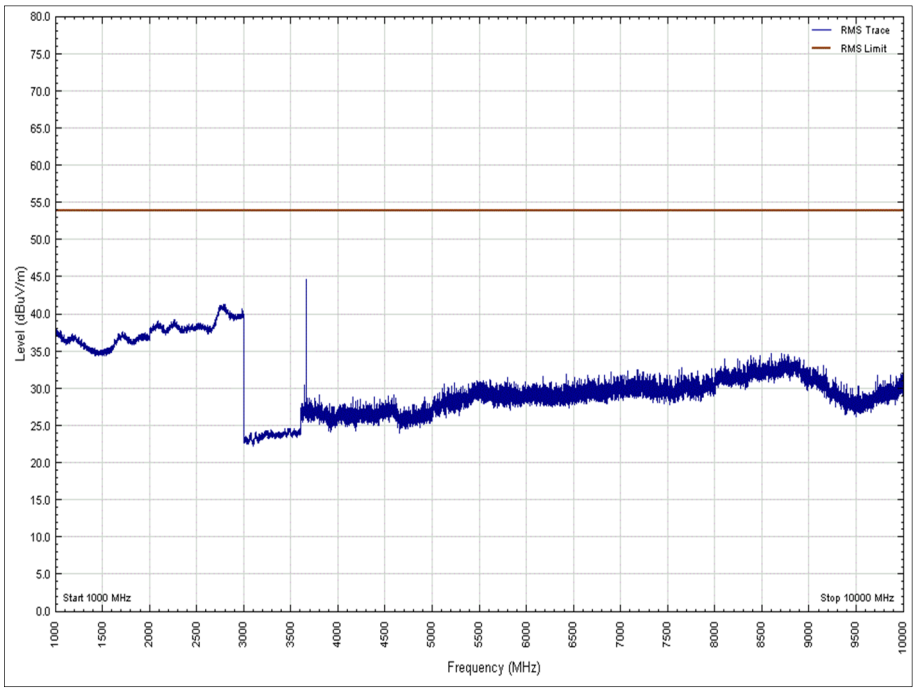

Figure 17 - 914.5 - 1 GHz to 10 GHz - Y Orientation – Horizontal - Average