Engineering and Testing for EMC and Safety Compliance

FCC Part 15 Certification Report

VEGA Grieshaber KG
Am Hohenstein 113
77761 Schiltach
Germany

MODELS: VEGAPULS 65
VEGAPULS 66

FCC ID: O6QPS60XC1

Frequency Range	Output Power (W) Conducted	Frequency Tolerance (ppm)	Emission Designator
6.3 GHz	0.01	N/A	N/A

Report Prepared By: Desmond A. Fraser

Document Number: 2009282-6566

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15 and ANSI C63.4.

Signature: ____________ Date: October 6, 2010

Typed/Printed Name: Desmond A. Fraser Position: President

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANSI-ASQ National Accreditation Board/ACLASS. Refer to certificate and scope of accreditation AT-1445.

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1 General Information

The following measurement report is prepared on behalf of VEGA Grieshaber KG in accordance with the Federal Communications Commission Rules and Regulations. The Equipment Under Test (EUT) were Models VEGAPULS 65 and VEGAPULS 66, FCC ID: O6QPS60XC1, Level Probing Radars (LPR) with 10dBm conducted output power for closed tank applications. The configured tanks were metal, concrete and reinforced fiberglass tanks. The EUT also has three housings, aluminum, steel, and plastic. The plastic housing represents the worst-case condition. Hence all data in this FCC report is from the EUT configured using the plastic housing. The test results reported in this document relate only to the items tested.

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47, including guidance from the FCC Millimeter Wave Procedure.

The EUT was tested on RTL's open area test site with the LPR device configured pointing downwards inside the tanks. The tanks were placed on the OATS ground plane with all other test equipment arranged in accordance with C63.4, 2009. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, pre-amplifier, and cables. This report contains compliant FCC Part 15.209 data for the VEGAPULS 65/66 installed in metal, concrete and reinforced fiberglass tanks.

1.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report submitted to and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 2009).

1.2 Referenced Standards

Standards Referenced for this Report	
Part 2: 2009	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Part 15: 2009	Radio frequency devices - §15.209: Radiated Emissions Limits
ANSI C63.4-2009	Standard Format Measurement/Technical Report Personal Computer and Peripherals
Agilent Spectrum Analyzer Application Note	HP Application Note 150-2

2 EUT Configuration, Exercise and Measurement

The EUT was installed pointing downward inside the closed tanks and configured in constant measurement mode. The VEGAPULS 65/66 is a 2-wire sensor that is supplied with a 4 to 20mA current loop. To conserve power, it incorporates a power management system that limits transmission time to about 200 ms (360,000 pulses), with power being switched off for 3 to 5 seconds. The EUT was configured to continuously transmit and receive echoes within the timeframe described above inside closed metal, concrete and fiberglass tanks. The normal operating measurement mode of the EUT is a 1.2ns radar pulse width with 3.56MHz (280ns) pulse repetition frequency.

As a result, all measurements were made with the spectrum analyzer in peak max-hold mode. Since the main lobe of the carrier of the EUT was enclosed in the tanks, FCC measurements requiring 1 MHz RBW's were deemed impractical due to the fact that no radiated emissions were escaping from the closed tanks; the EUT was investigated and measured using 1 kHz, 3 kHz, 10 kHz, and 1 MHz RBWs. No reportable emissions were found; all emissions were at or below the noise floor of the instrumentation, hence the EUT complies with the FCC's limit.

2.1 Test Equipment Consideration

Measurement system dynamic range is typically not sufficient at millimeter frequencies because of high instrument noise floor. As a result, the EUT was investigated by holding the test antenna in and around the closed tanks at different RBWs, namely, 1 MHz, 100 kHz, 10 kHz, 3 kHz, and 1 kHz, in order to find worst-case emissions. When no radiated emissions were detected, the noise floor levels were recorded and reported.

1. A high gain, low noise figure Miteq-Wireless pre-amplifier was installed directly at the test antenna input port to compensate cable loss, add gain and increase sensitivity.

2. A low loss, high frequency cable (5.5dB total loss at 6.3 GHz) was used to connect the pre-amplifier to the spectrum analyzer/receiver.

3. Water was poured in the tanks in order to increase the carrier's reflected signal.

4. Tank dimensions are as follows: Metal tank: height 1.2m, diameter 44cm; Concrete tank: height 90cm, diameter 60cm; Reinforced fiber glass tank: height 1.4m, length and width 1m.

5. The antenna mast seen behind the tank in the radiated test configuration pictures supports the EUT when configured as a downward-pointing-radar in open-air configurations. The main lobe is re-radiated from the angle of repose sand mound during measurement. This antenna mast does not affect testing when the EUT is set-up as an in-tank configuration.

6. Explanation of the large sand mound seen in the radiated test photographs. This test configuration was determined to be the most appropriate configuration for testing downward pointing radar, for either open-air or in-tank applications. The test set is designed to support open air testing as well as closed tank testing. The open air configuration uses the angle of repose sand mound configuration for testing. When configured for in-tank measurements, the EUT (in-tank) is placed in front of the sand mound. The mound is within the ellipse as part of the test configuration but does not affect the measurement of emissions from the carrier in the in-tank configuration. The dielectric constant of sand is such that it would require the main lobe to reflect any energy. The mound does not affect testing of the radar even though it is within the ellipse. The FCC is aware of this test configuration at RTL and has reviewed many measurement reports from RTL over the past three years; this set has been used in support of numerous other on-going measurement work with the Commission. It would be impractical to remove and replace 3 tons of sand when making in-tank and open-air measurements.

3 Pulse De-sensitizing Factor and Duty Cycle

The Pulse width and Pulse period data values provided by the manufacturer are used to calculate the Pulse Desensitizing Factor (PDF) and the duty cycle. The EUT Pulse width (τ_{eff}) = 1.2 nanosecond; the EUT Pulse period (T) = 280 nanoseconds. The PDF is used to calculate the FCC's peak limit, which is 20 dB above the average limit, when emissions from the carrier can be measured. Since there were no emissions found, the PDF was not used.

3.1 Calculation of Pulse Desensitization Factor

As described in the Agilent Application Note 150-2, "Spectrum Analysis...Pulsed RF", there are two possible Pulse Desensitization Factors (PDF) depending on whether the EUT is configured in line or in spectrum mode.

3.1.1 Line Spectrum Mode

The PDF can be calculated using

$$RBW < 0.3 * PRF \qquad \text{(equ.1)}$$

$$PDF = 20 * \log\left(\frac{\tau_{eff}}{T}\right) = 20 * \log(\tau_{eff} * PRF) \qquad \text{(equ.2)}$$

Where $\tau_{eff:}$ Effective Pulse Length

PRF: Pulse Repetition Frequency

3.1.2 Pulse Spectrum Mode

For the PDF value in Pulse Spectrum Mode, the resolution bandwidth (RBW) of the analyzer shall be:

$$RBW > 1.7 * PRF \qquad \text{(equ.3) and}$$

$$RBW < \frac{0.1}{\tau_{eff}} \qquad \text{(equ.4)}$$

In this instance, the PDF can be calculated as:

$$PDF = 20 * \log(\tau_{eff} * K * RBW) \qquad \text{(equ.5)}$$

Where, K correction factor for the IF amplifier of the spectrum analyzer (in case of an Agilent PSA-model K) = 1.5

3.1.3 Duty Cycle Factor

The Duty Cycle Factor is used to calculate the final FCC average limit by subtracting the Duty Cycle Factor (DCF) from the Peak result.

Where $DCF = 20 * \log\left(\frac{\tau_{eff}}{T}\right) = 20 * \log(\tau_{eff} * PRF)$ (equ.6)

Where: $\tau_{eff:}$ [Pulse width], T [Pulse Repetition Period], PRF [Pulse Repetition Frequency]

DCF = 20Log 1.2nS/280nS = 47.4dB

3.2 Field Strength Calculation

The final peak and average field strength was calculated using the following:

$$\text{Peak result} = \text{Spectrum Analyzer Level (dB}\mu\text{V/m)} + \text{SCF (dB/m)}$$

$$\text{Average result} = \text{Spectrum Analyzer Level (dB}\mu\text{V)} + \text{SCF (dB/m)} - \text{DC (dB)}$$

Pulse De-sensitizing Factor (PDF) = Pulse width/Pulse period = 20Log 1.2nS/280nS = 47.4dB

$$SCF = AF + CL - \text{AG} + PDF$$

Where:
AF [Antenna factor] = 28.3dB
CL [Cable loss] = 5.5dB
AG [Amplifier gain] = 33.0dB
PDF [Pulsed Desensitizing Factor for line spectrum] = 47.4dB

$$\text{SCF} = 48.2\text{dB}$$

3.3 EUT Antenna Data

Table 3-1: EUT Antenna Data

Antenna Type	Gain (dBi)	3dB BW (°) E-Plane	Diameter (mm)	Length (mm)	Antenna Tested
Rod, length 50mm	16.6	25.0	40	352	X
Rod, length 100mm	15.6	29.5	40	415	Note 1
Rod, length 250mm	15.6	28.5	40	565	X
Horn 4"/DN100	15.1	32.0	96	113	X
Horn 6"/DN150	18.1	19.5	146	205	Note 2
Horn 8"/DN200	20.1	13.5	196	296	Note 2
Horn 10"/DN250	21.6	12.0	242	380	X

Note 1: This antenna (100mm Rod) was not tested; it belongs to the same family of antennas as the 50mm and 250mm Rod antennas. The FCC allows the highest and the lowest gain antennas within the same antenna family, namely the 50mm and 250mm rod antennas, to represent the antenna family when tested.

Note 2: These two antennas (6”, and 8” Horns) were not tested; they belong to the same family of antennas as the 4” and 10” horn antennas. The FCC allows the highest and the lowest gain antennas within the same antenna family, namely the 4” and 10” horn antennas, to represent the antenna family when tested.

3.4 Test Distance

The final radiated emissions tests were performed at a 3 meter horizontal distance from the edge of each tank to the test antenna. The EUT was also investigated at closer test distances in order to discern any emissions.

3.5 Test Set-up

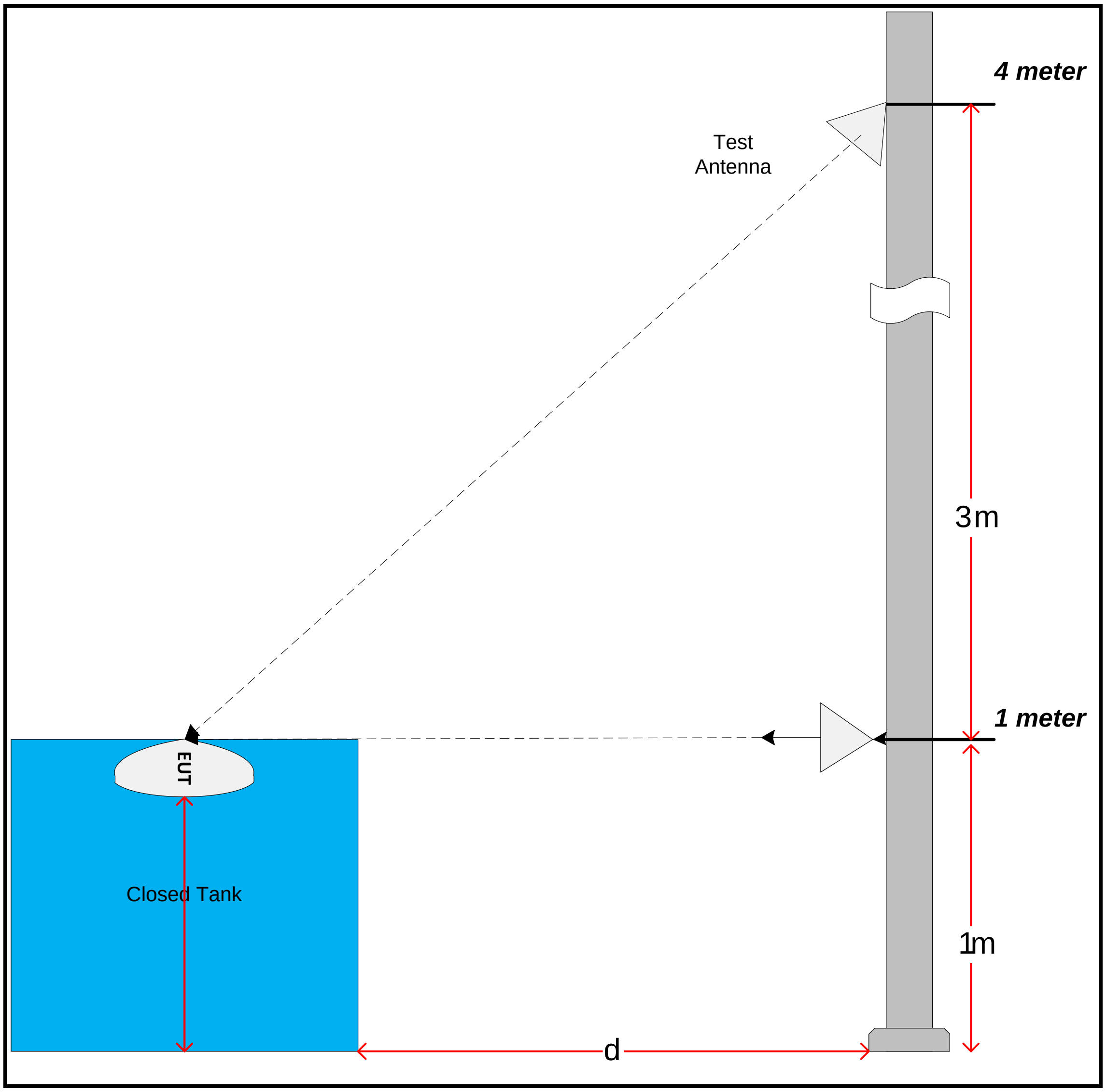


Figure 3-1: Radiated Emissions Test Set-up

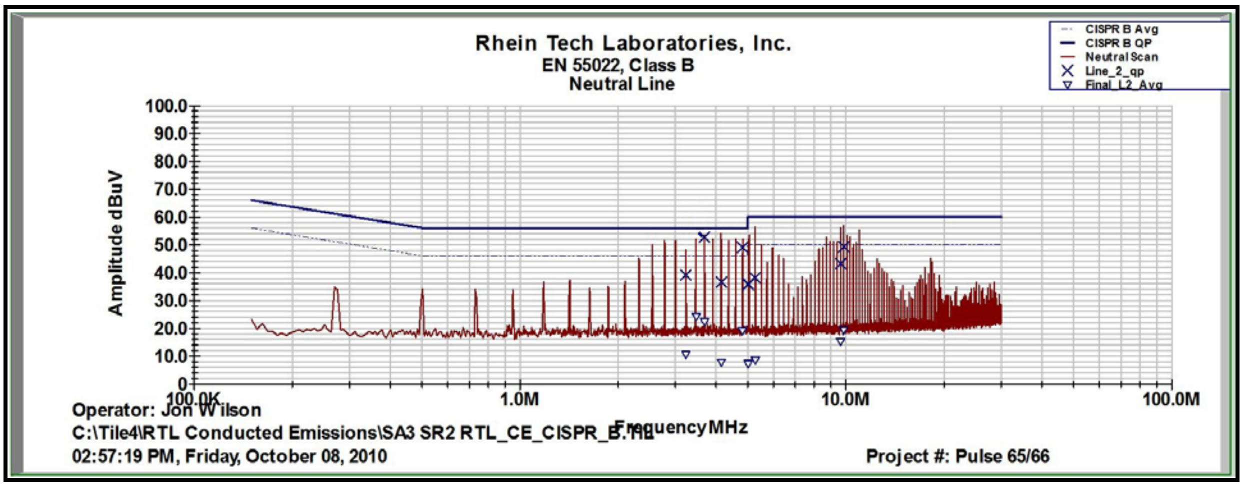
4 Conducted Emissions - §15.207

4.1 Conducted Limits - §15.207 Test Procedure

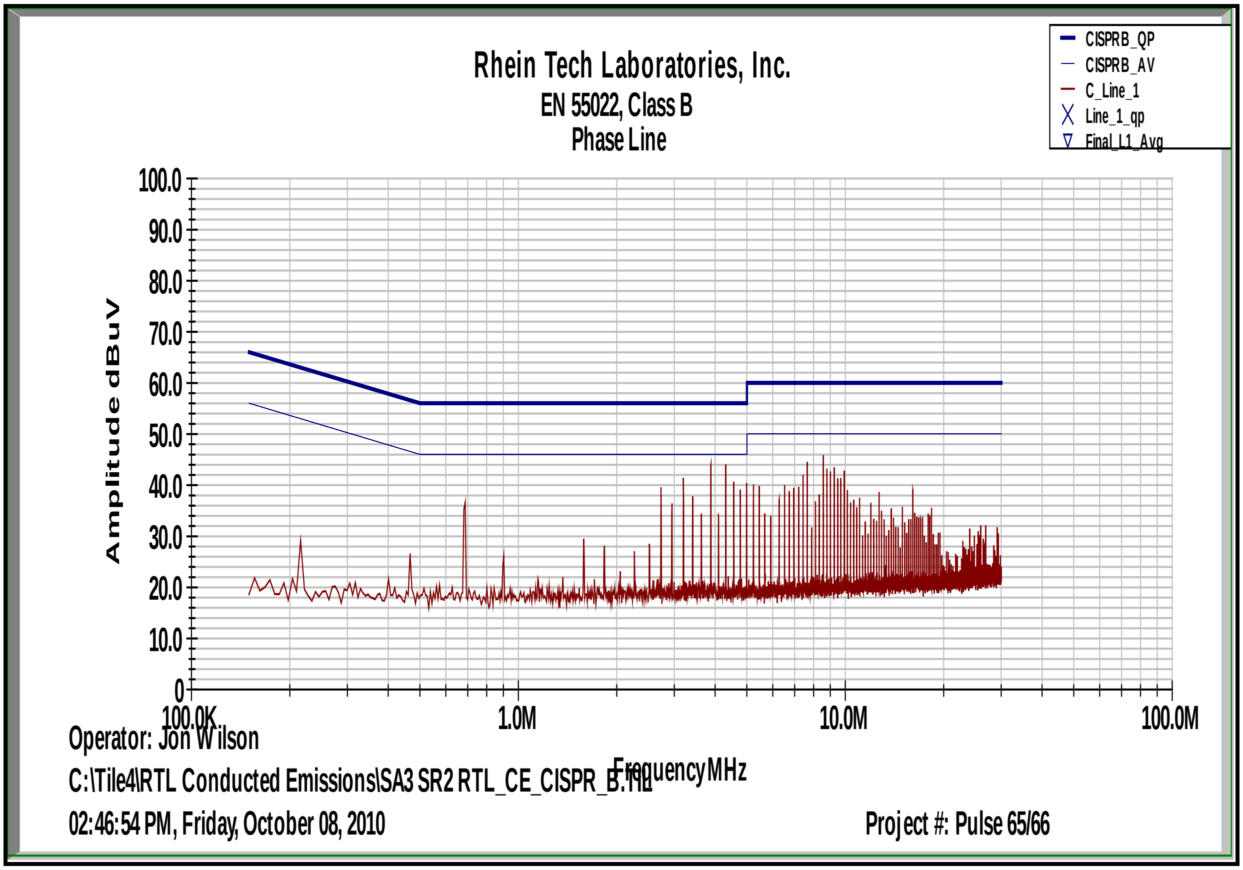
Conducted emissions were performed on the EUT using an off-the-shelf 24 volt power supply. The general conducted limit under Part 15.207 was applied. The EUT was investigated and tested with three housings - plastic, aluminum, and steel; there was no difference in the conducted emissions data for the three housings. The data below is the worst-case conducted emissions measured using the EUT with plastic housing and the highest gain antenna, the 21.6dBi 10-Inch Horn antenna.

4.2 Conducted Emission Test Data Plot

Plot 4-1: Conducted Emissions Plot with Limits – Neutral Side (Line 1)



Plot 4-2: **Conducted Emissions Plot with Limits – Hot Side (Line 2)**



Test Personnel:

Desmond A. Fraser	[signature]	10/08/2010
EMC Test Engineer	Signature	Date of Test

5 Radiated Emissions - §15.209

5.1 Radiated Emission Limits - §15.209 – Test Procedure

Radiated spurious emissions of harmonics and spurious emissions that fall in the restricted and non-restricted bands were investigated from 0.009 kHz to 30 GHz; the restricted bands are listed in Part 15.205. Sections of FCC Millimeter Wave Procedure and ANSI 63.4, 2009 were used to configure and test the EUT.

The maximum permitted average field strength for the restricted band is listed in Part 15.209. The EUT was configured pointing downward in a metal tank, a concrete tank, and a fiberglass tank. Each tank was positioned 3 meters away in line with the test antenna on the OATS ground plane.

The EUT was rotated along its vertical axis while installed in the tank so that emissions could be maximized; the test antenna height was varied between 1 to 4 meters and polarized horizontally and vertically during testing to measure worst case emissions. Additionally, the test antenna bore-sight position for each test was also varied in order to measure worst-case reflected emissions.

When the carrier could not be measured during tank measurements, the horizontal test antenna distance was reduced to 1 meter and the test was repeated. Also, handheld measurements were made in and around the tanks to detect and determine the carrier for worst-case emissions as well as repeatability. The data in this report represents the worst-case configurations.

The EUT was investigated and tested with three housings - plastic, aluminum, and steel; there was no difference in the radiated emissions data for the three housings. The data below is the worst-case radiated emissions measured using the EUT with plastic housing and the antennas listed in the radiated emissions data Tables 5-1, 5-2, and 5-3.

5.2 Radiated Emissions Limits Test Data

The calculated PDF value was not added to the analyzer level with the EUT operating since there were no discernable emissions in the metal, concrete or fiberglass tank configurations. Furthermore, the noise floor levels were the same whether the EUT was operating or was off.

No other emissions above the system noise floor were detected for the EUT with different antennas in the metal, concrete or reinforced fiberglass tank configurations. The following plots are the measured analyzer noise floor level of the EUT operating in metal, concrete and reinforced fiberglass tanks. As stated in Section 2.2, the EUT was investigated by holding the test antenna in and around the closed tanks using different RBWs to find and detect any radiated emissions. No emissions were found in the three tank configurations using the antennas listed.

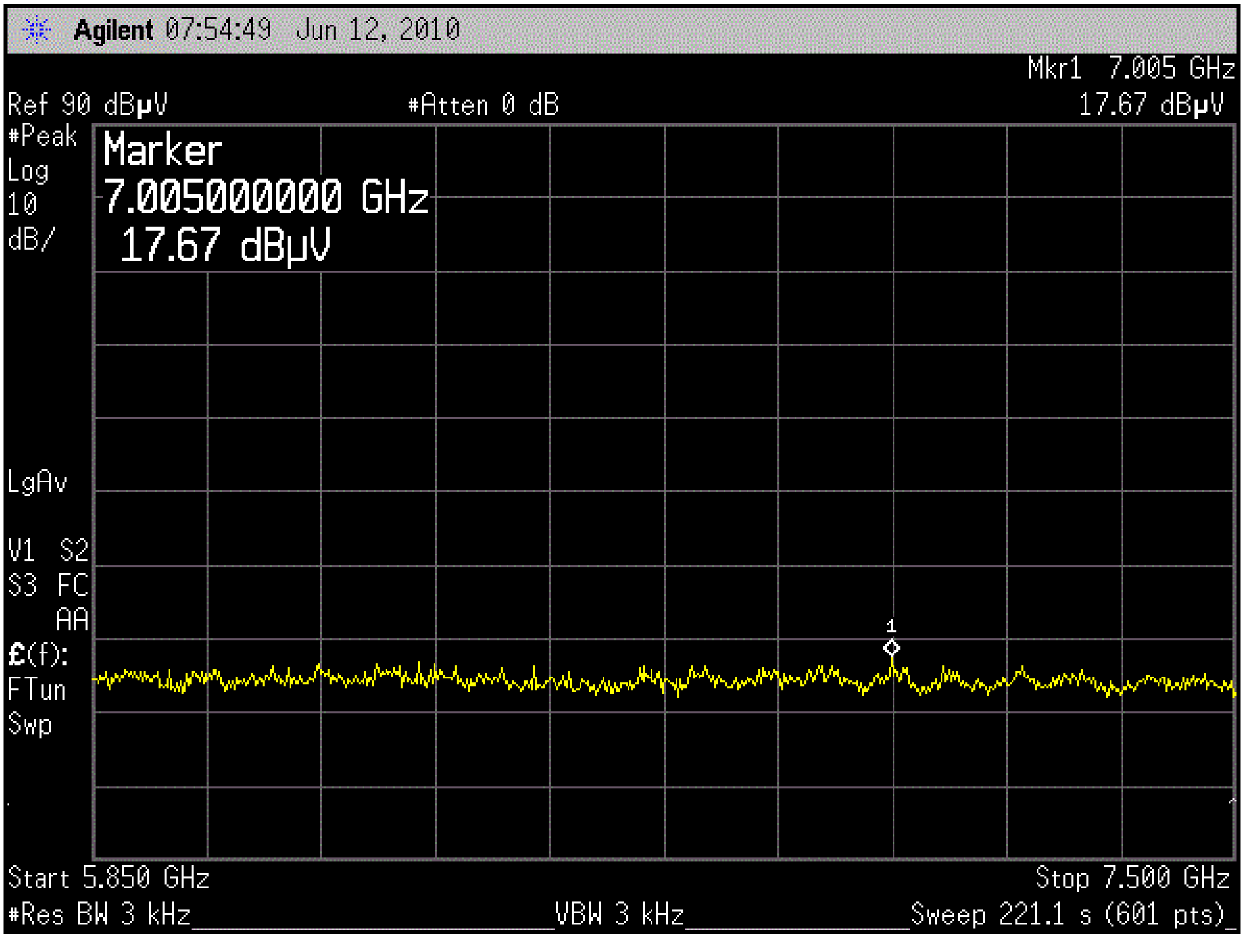
5.2.1 Metal Tank Test Data

Table 5-1: Field Strength of Carrier in Metal Tank

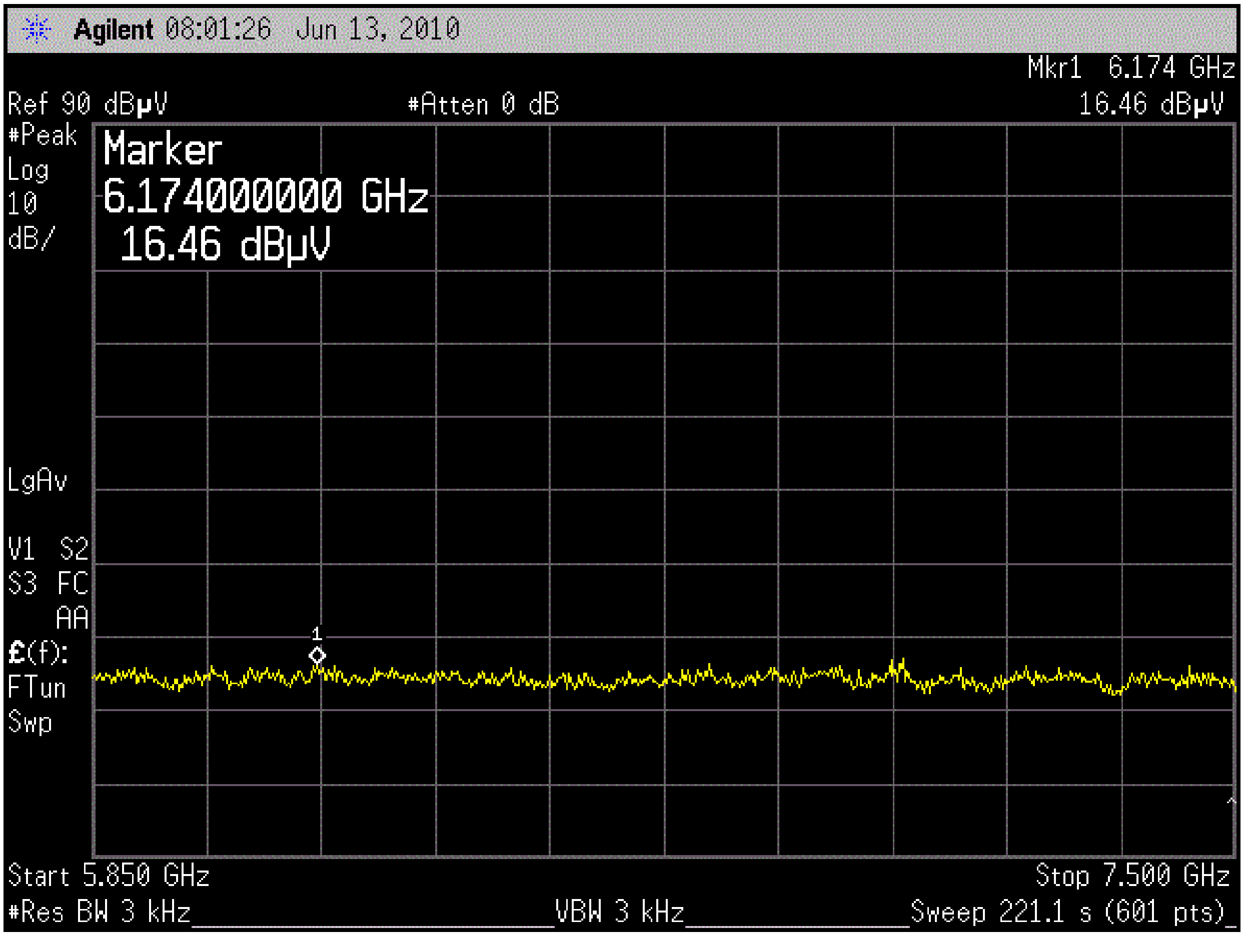
Antenna Type	Frequency (GHz)	Detector	Antenna Pol. (H/V)	Spectrum Analyzer Level (dBμV)	Site Correction Factor (dBμV/m)	Spectrum Analyzer Level Corrected (dBμV/m)	Duty Cycle (dB)	Spectrum Analyzer Level Final (dBμV/m)	FCC Limit (dBμV)	Margin (dB)	Note 1 [See Plot]
4" Horn	7.005	Peak	V	17.67	48.2	65.9	0	65.9	74	-8.1	Plot 5-1
4" Horn	7.005	Average	V	17.67	48.2	65.9	47.7	18.2	54	-35.8	Plot 5-1
10" Horn	6.174	Peak	V	16.46	48.2	64.7	0	64.7	74	-9.3	Plot 5-2
10" Horn	6.174	Average	V	16.46	48.2	64.7	47.4	17.3	54	-36.7	Plot 5-2
50mm Rod	6.367	Peak	V	19.96	48.2	68.2	0	68.2	74	-5.8	Plot 5-3
50mm Rod	6.367	Average	V	19.96	48.2	68.2	47.4	20.8	54	-33.2	Plot 5-3
250mm Rod	6.832	Peak	V	17.02	48.2	65.2	0	65.2	74	-8.8	Plot 5-4
250mm Rod	6.832	Average	V	17.02	48.2	65.2	47.4	17.8	54	-36.2	Plot 5-4

Note 1: Though it is typical to demonstrate compliance using at least six data points, noise floor Plots 5-1 to 5-4 are used to demonstrate compliance. There are no fundamental carrier emissions or any other spurious emissions from the in-tank measurements that could be measured; they are attenuated by the enclosed tanks. The data plots with resolved Resolution Bandwidth down to 3 kHz demonstrate that only the instrumentation noise floor could be measured. This is after complete up-close hand measurements investigating the carrier and all other spurious emissions in order to determine compliance.

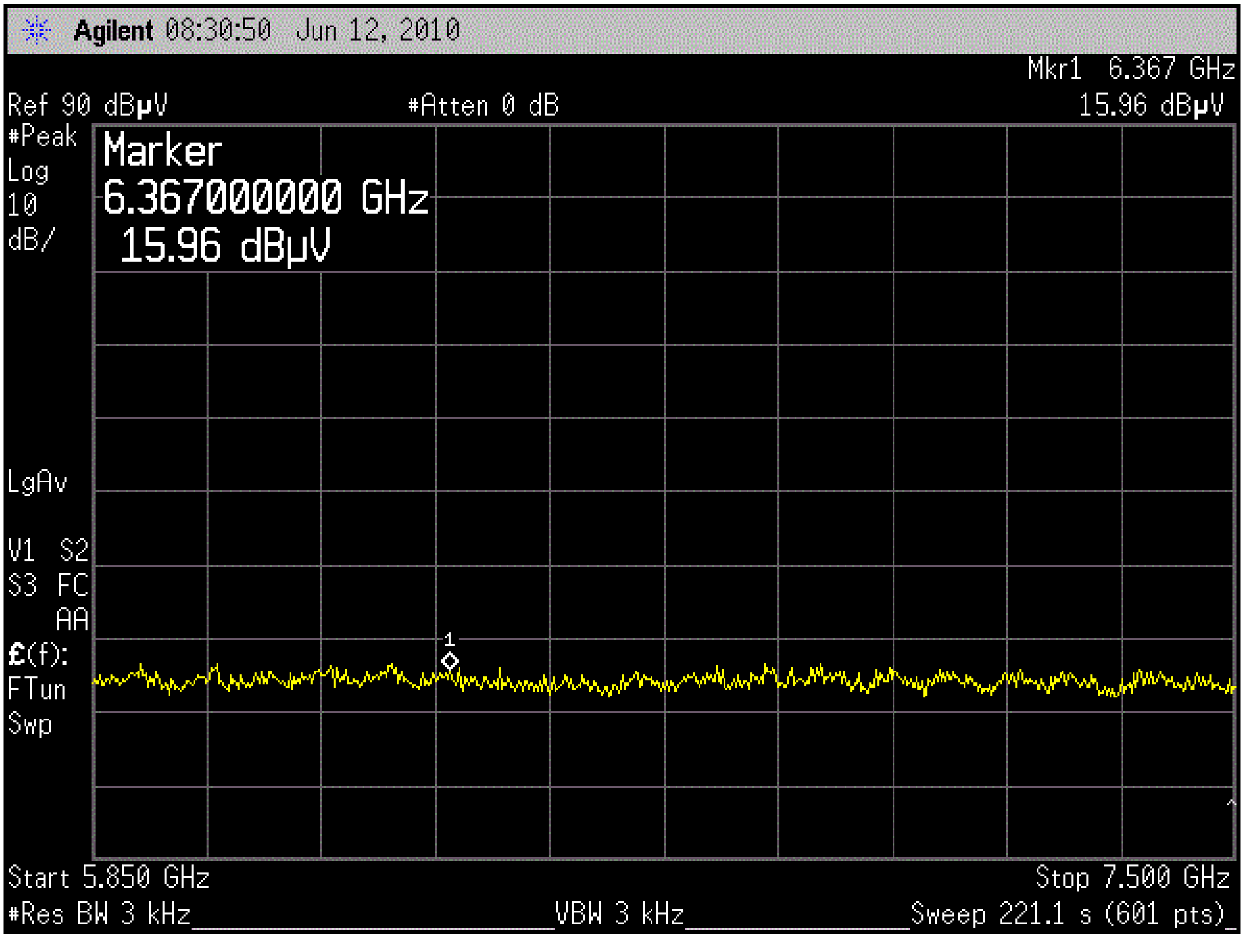
Plot 5-1: **Analyzer Noise Floor Level - EUT [4” Horn Antenna] in Metal Tank**



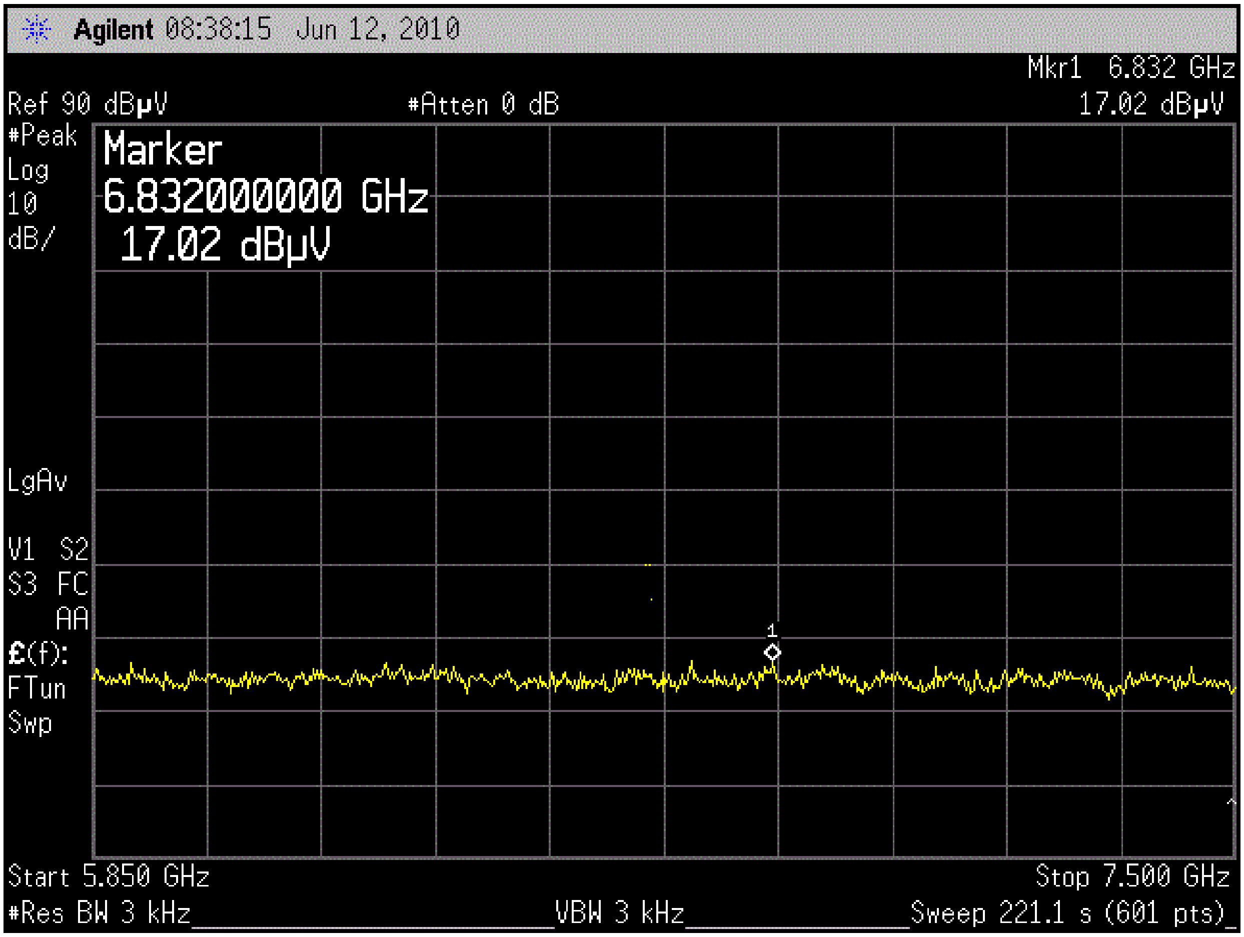
Plot 5-2: Analyzer Noise Floor Level - EUT [10" Horn Antenna] in Metal Tank



Plot 5-3: **Analyzer Noise Floor Level - EUT [50mm Rod Antenna] in Metal Tank**



Plot 5-4: **Analyzer Noise Floor Level - EUT [250mm Rod Antenna] in Metal Tank**



Test Personnel:

Desmond A. Fraser		June 12 &13, 2010
EMC Test Engineer	Signature	Dates of Test

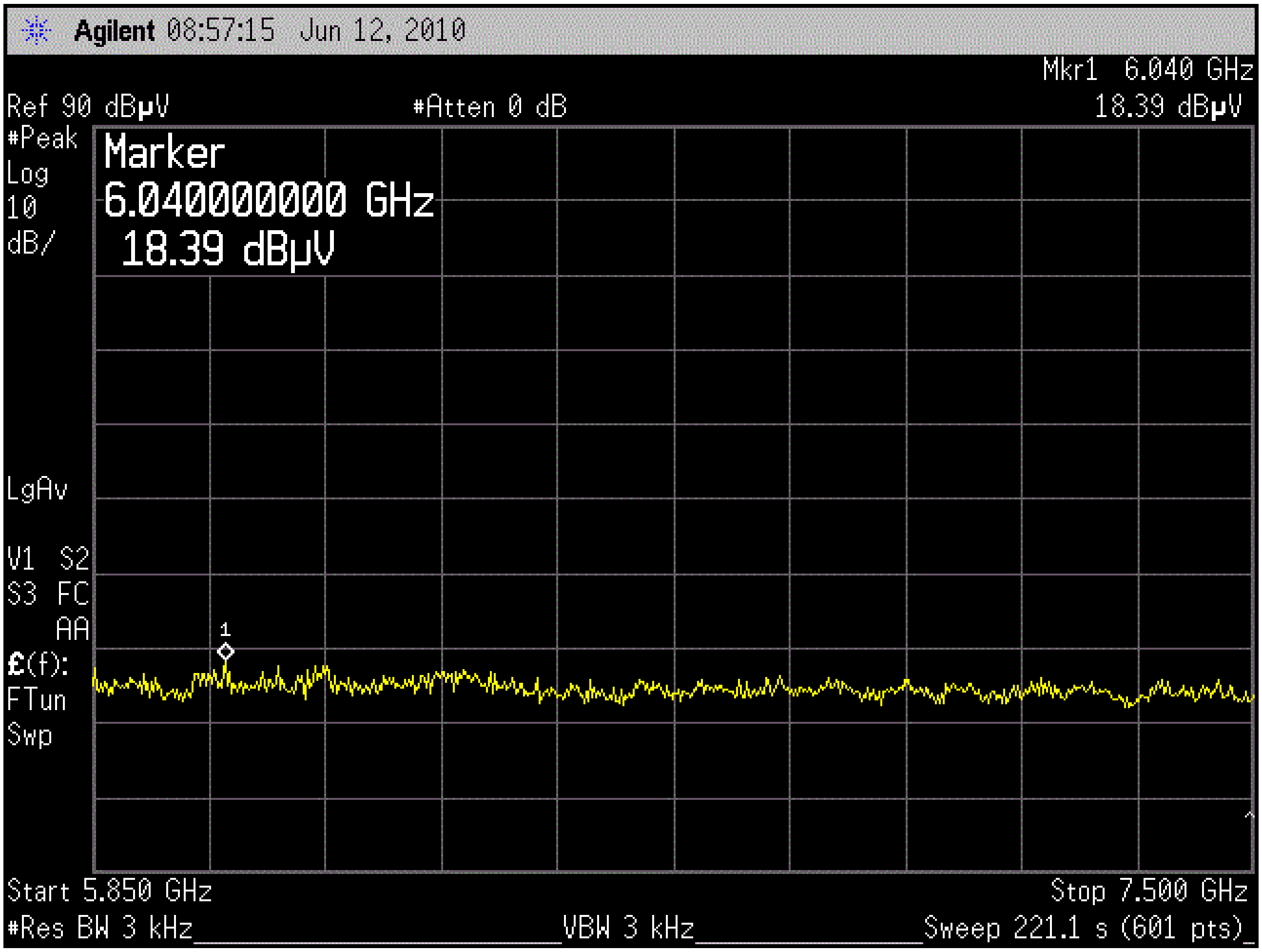
5.2.2 Concrete Tank Test Data

Table 5-2: Field Strength of Carrier with Concrete Tanks

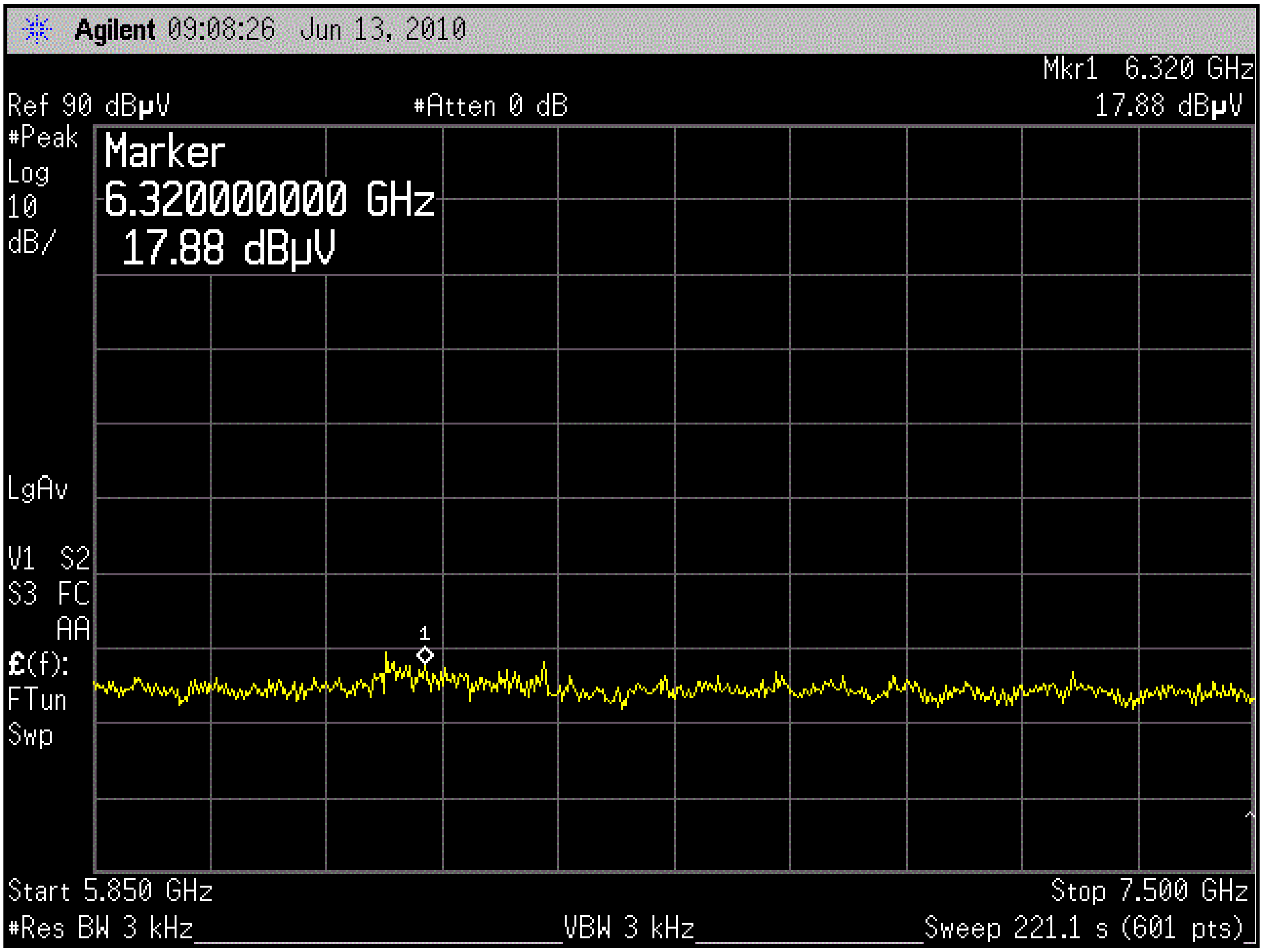
Antenna Type	Frequency (GHz)	Detector	Antenna Pol. (H/V)	Spectrum Analyzer Level (dBµV)	Site Correction Factor (dB/m)	Spectrum Analyzer Level Corrected (dBµV/m)	Duty Cycle (dB)	Spectrum Analyzer Level Final (dBµV/m)	FCC Limit (dBµV)	Margin (dB)	Note 1 [See Plot]
4” Horn	6.040	Peak	V	18.39	48.2	66.6	0	66.6	74	-7.4	Plot 5-5
4” Horn	6.040	Average	V	18.39	48.2	66.6	47.4	19.2	54	-34.8	Plot 5-5
10” Horn	6.332	Peak	V	17.88	48.2	66.1	0	66.1	74	-7.9	Plot 5-6
10” Horn	6.332	Average	V	17.88	48.2	66.1	47.4	18.7	54	-35.3	Plot 5-6
50mm Rod	6.303	Peak	V	17.44	48.2	65.6	0	65.6	74	-8.4	Plot 5-7
50mm Rod	6.303	Average	V	17.44	48.2	65.6	47.4	18.2	54	-35.8	Plot 5-7
250mm Rod	6.370	Peak	V	17.59	48.2	65.8	0	65.8	74	-8.2	Plot 5-8
250mm Rod	6.370	Average	V	17.59	48.2	65.8	47.4	18.4	54	-35.6	Plot 5-8

Note 1: Though it is typical to demonstrate compliance using at least six data points, noise floor Plots 5-5 to 5-8 are used to demonstrate compliance. There are no fundamental carrier emissions or any other spurious emissions from the in-tank measurements that could be measured; they are attenuated by the enclosed tanks. The data plots with resolved Resolution Bandwidth down to 3 kHz demonstrate that only the instrumentation noise floor could be measured. This is after complete up-close hand measurements investigating the carrier and all other spurious emissions in order to determine compliance.

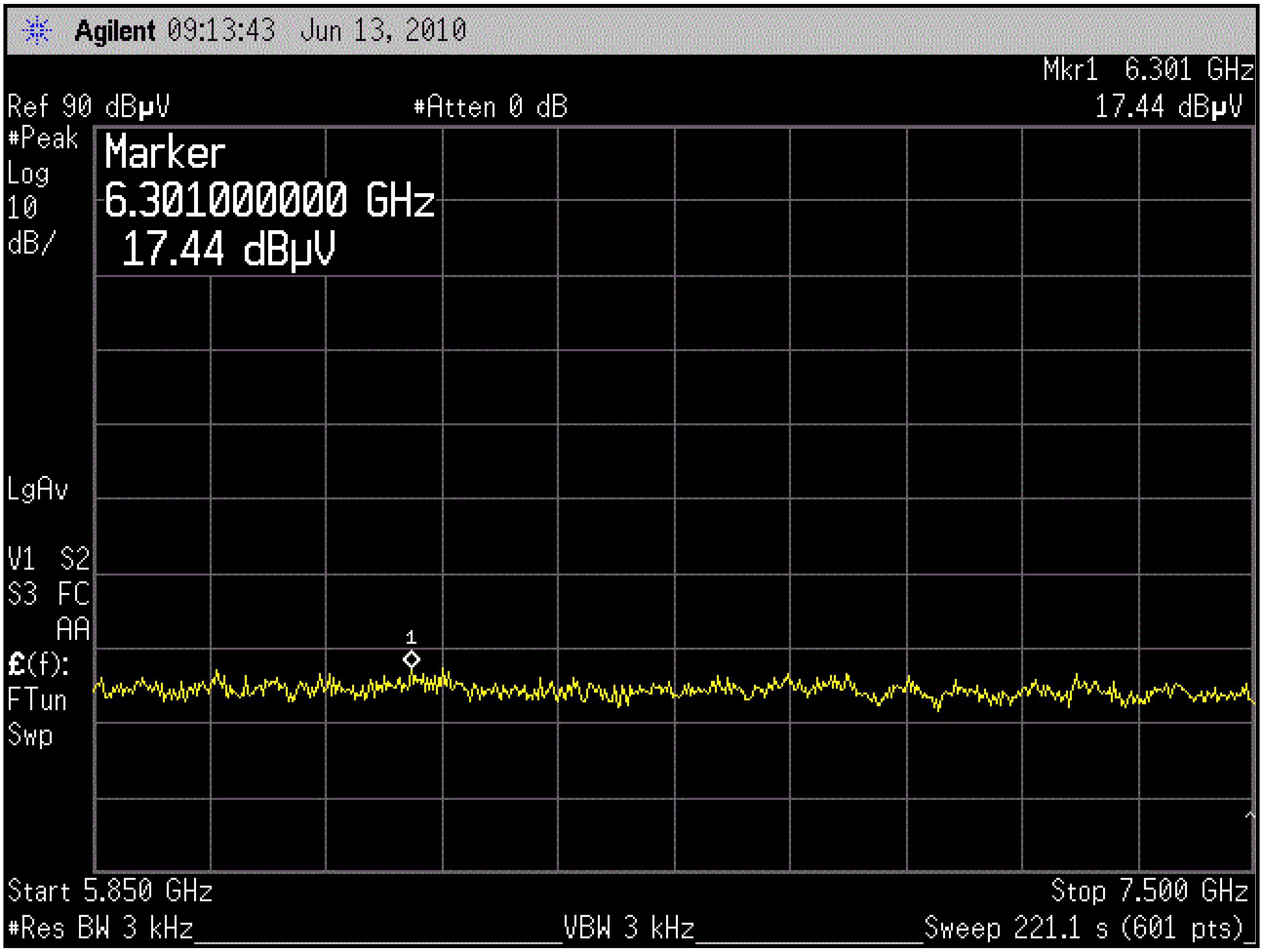
Plot 5-5: Analyzer Noise Floor Level - EUT [4" Horn Antenna] in Concrete Tank



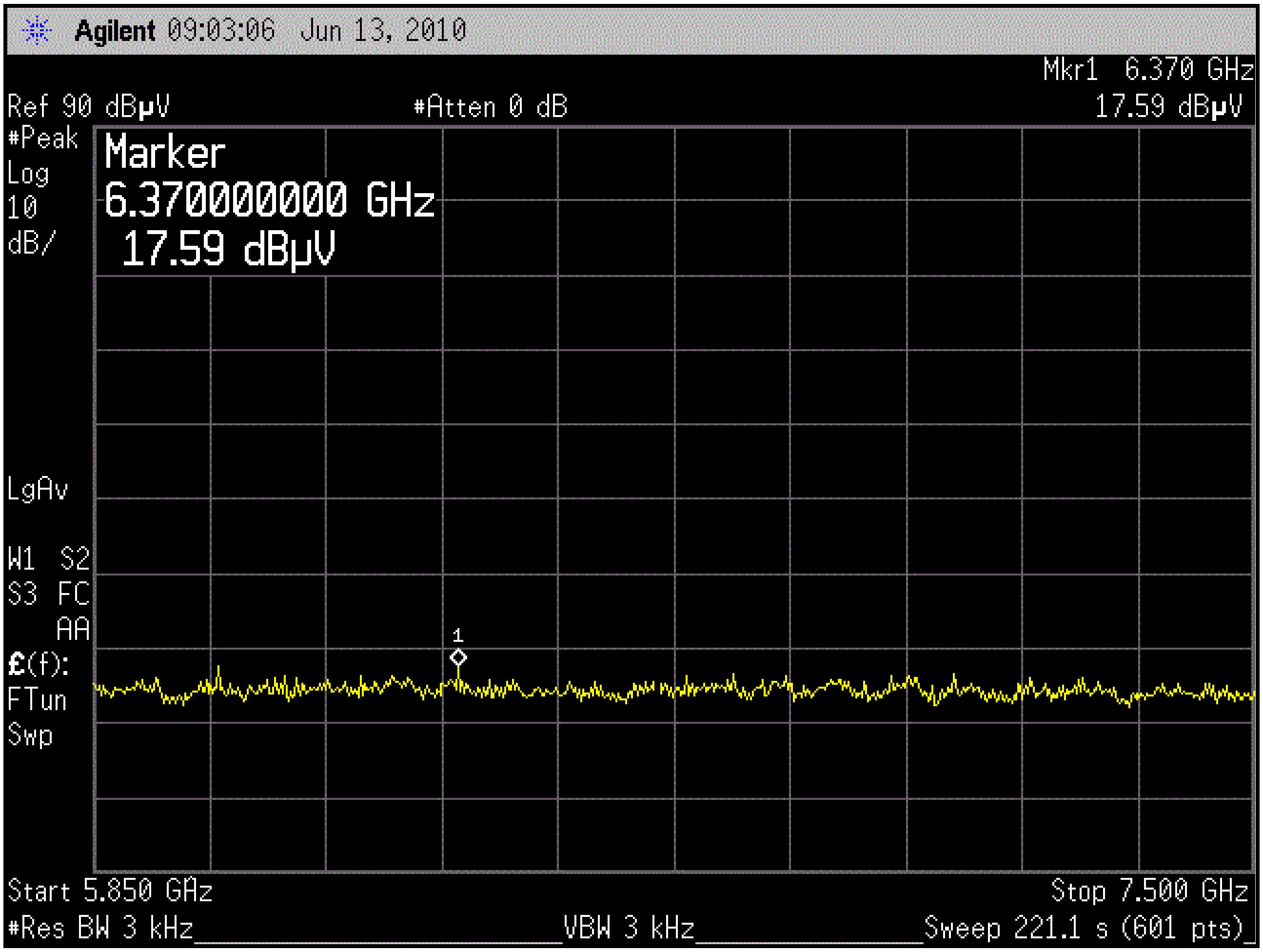
Plot 5-6: **Analyzer Noise Floor Level – EUT [10" Horn Antenna] in Concrete Tank**



Plot 5-7: **Analyzer Noise Floor Level - EUT [50mm Rod Antenna] in Concrete Tank**



Plot 5-8: Analyzer Noise Floor Level - EUT [250mm Rod Antenna] in Concrete Tank



Test Personnel:

Desmond A. Fraser		June 12 & 13, 2010
EMC Test Engineer	Signature	Dates of Test

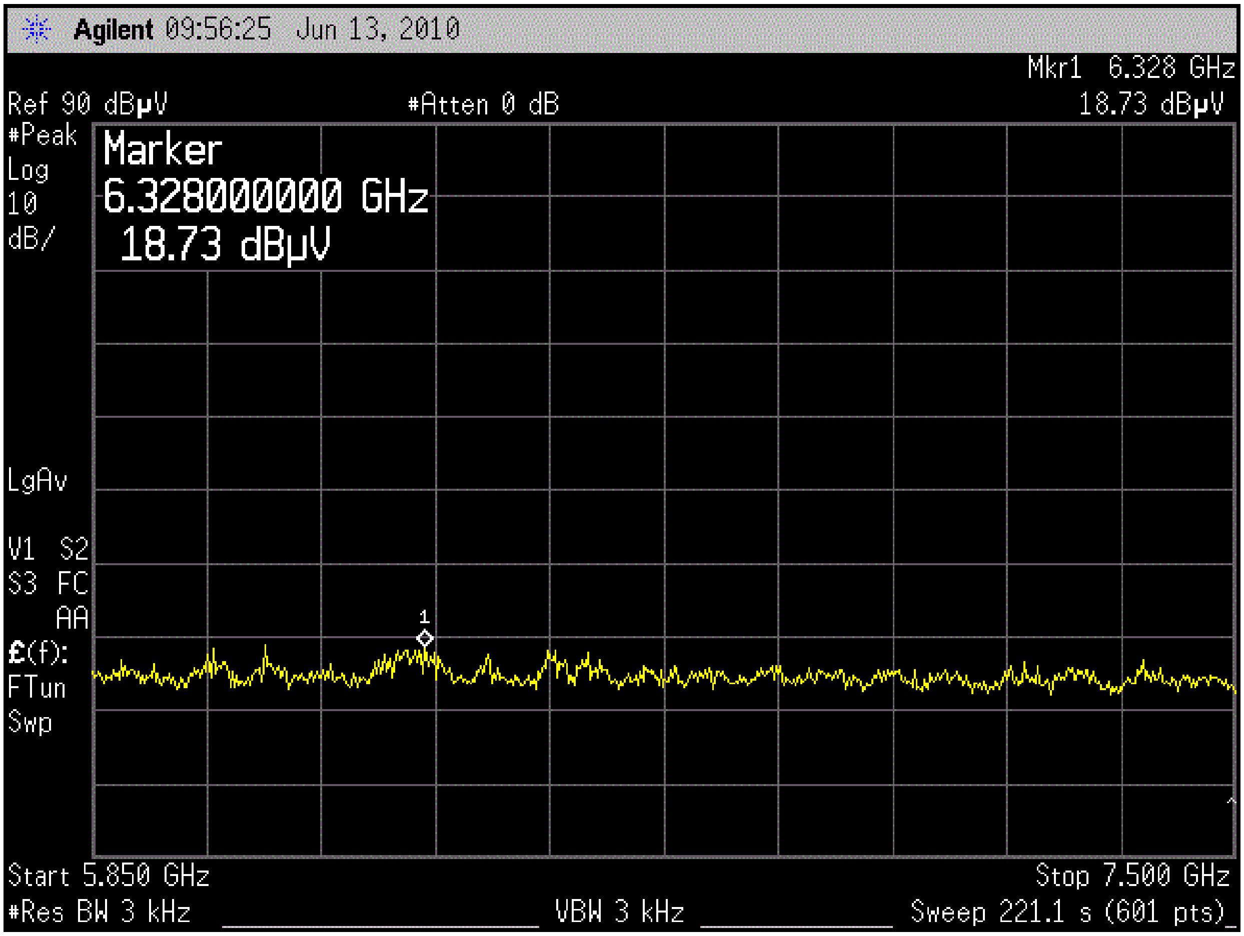
5.2.3 Fiberglass Tank Test Data

Table 5-3: Field Strength of Carrier with Fiberglass Tank

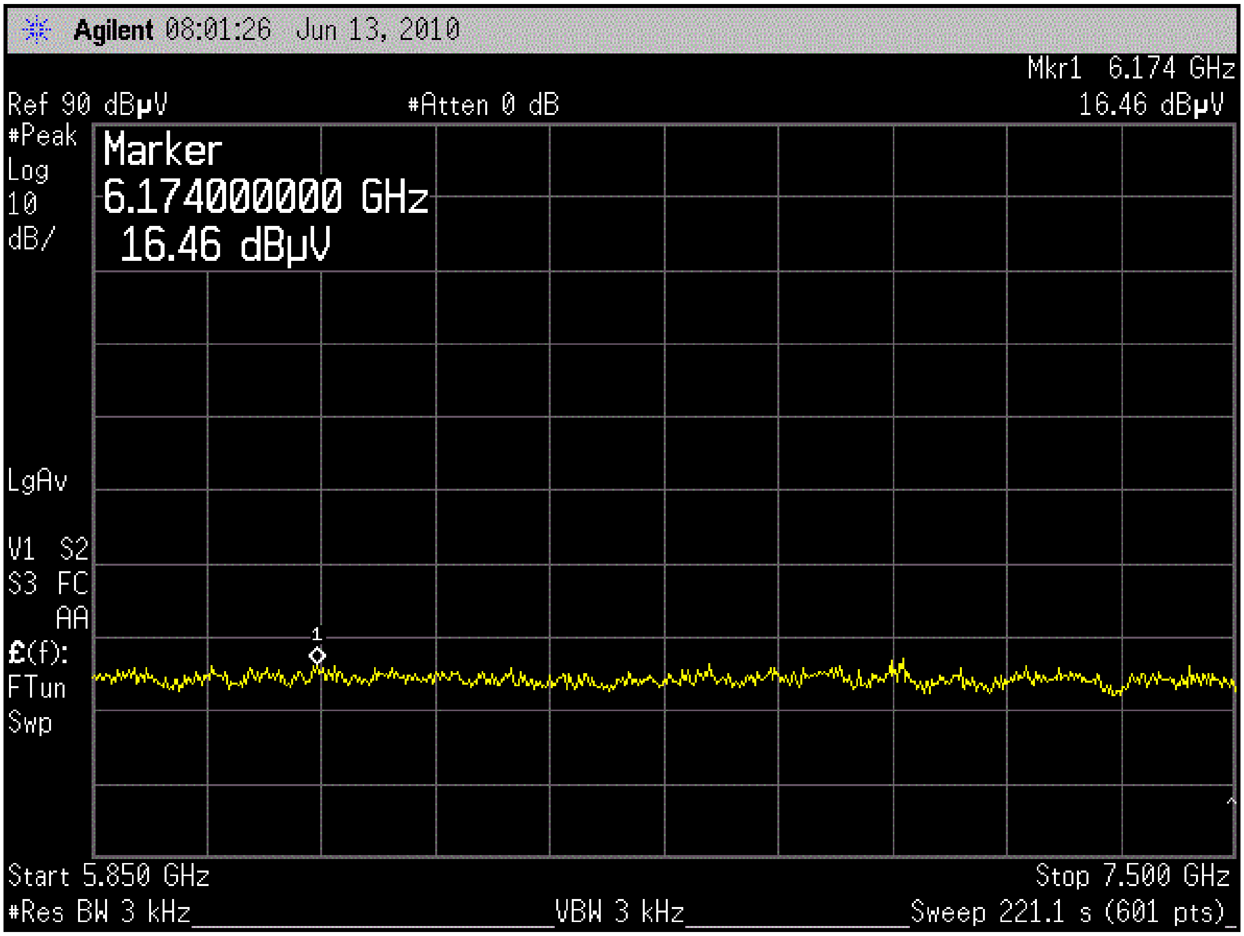
Antenna Type	Frequency (GHz)	Detector	Antenna Pol. (H/V)	Spectrum Analyzer Level (dBµV)	Site Correction Factor (dB/m)	Spectrum Analyzer Level Corrected (dBµV/m)	Duty Cycle (dB)	Spectrum Analyzer Level Final (dBµV/m)	FCC Limit (dBµV)	Margin (dB)	Note 1 [See Plot]
4" Horn	6.328	Peak	V	18.73	48.2	66.9	0	66.9	74	-7.1	Plot 5-9
4" Horn	6.328	Average	V	18.73	48.2	66.9	47.4	19.5	54	-34.5	Plot 5-9
10" Horn	6.174	Peak	V	16.46	48.2	64.7	0	64.7	74	-9.3	Plot 5-10
10" Horn	6.174	Average	V	16.46	48.2	64.7	47.4	17.3	54	-36.7	Plot 5-10
50mm Rod	6.466	Peak	V	16.20	48.2	64.4	0	64.4	74	-9.6	Plot 5-11
50mm Rod	6.466	Average	V	16.20	48.2	64.4	47.4	17.0	54	-37.0	Plot 5-11
250mm Rod	6.111	Peak	V	19.48	48.2	67.7	0	67.7	74	-6.3	Plot 5-12
250mm Rod	6.111	Average	V	19.48	48.2	67.7	47.4	20.3	54	-33.7	Plot 5-12

Note 1: Though it is typical to demonstrate compliance using at least six data points, noise floor Plots 5-9 to 5-12 are used to demonstrate compliance. There are no fundamental carrier emissions or any other spurious emissions from the in-tank measurements that could be measured; they are attenuated by the enclosed tanks. The data plots with resolved Resolution Bandwidth down to 3 kHz demonstrate that only the instrumentation noise floor could be measured. This is after complete up-close hand measurements investigating the carrier and all other spurious emissions in order to determine compliance.

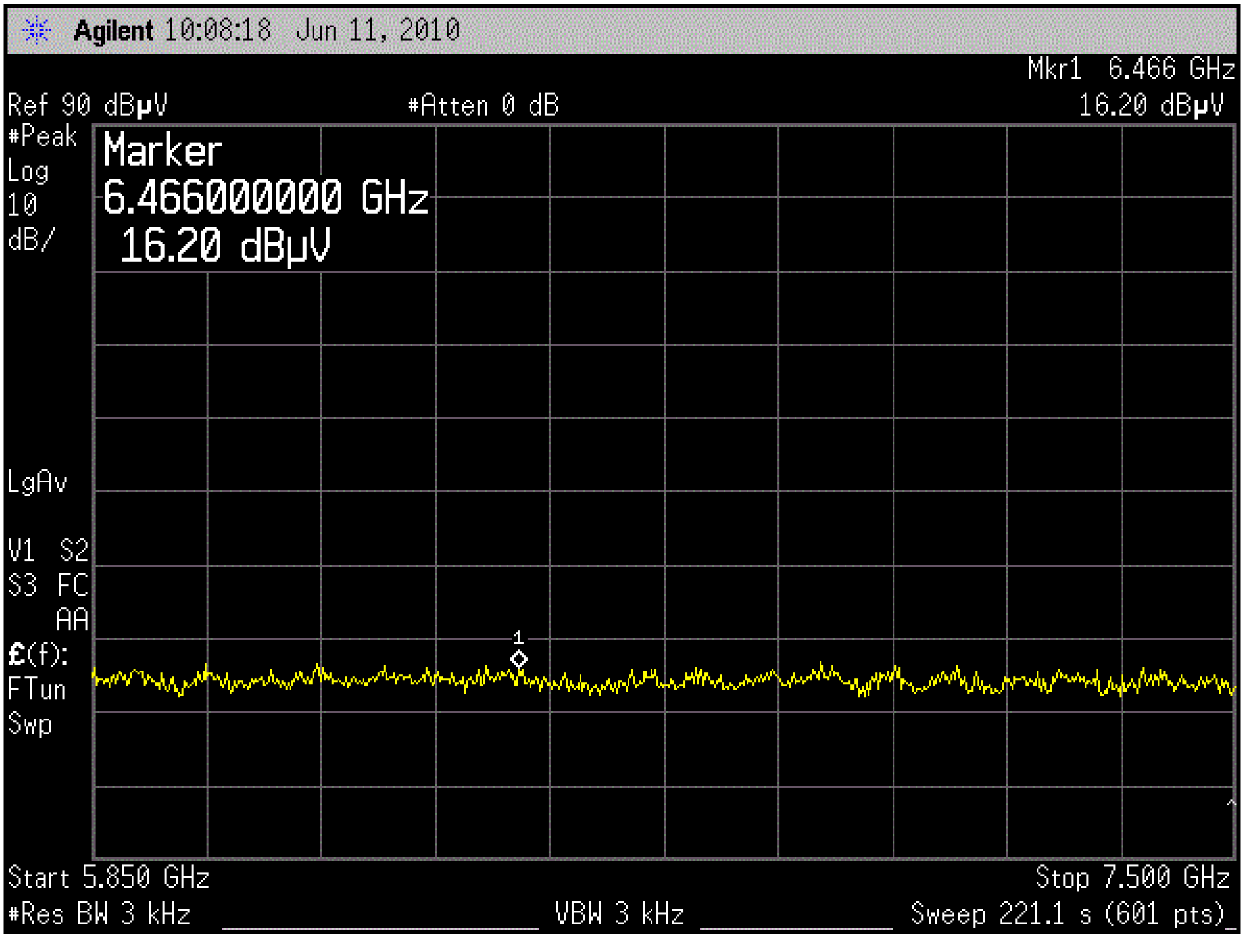
Plot 5-9: Analyzer Noise Floor Level - EUT [4" Horn Antenna] in Fiberglass Tank



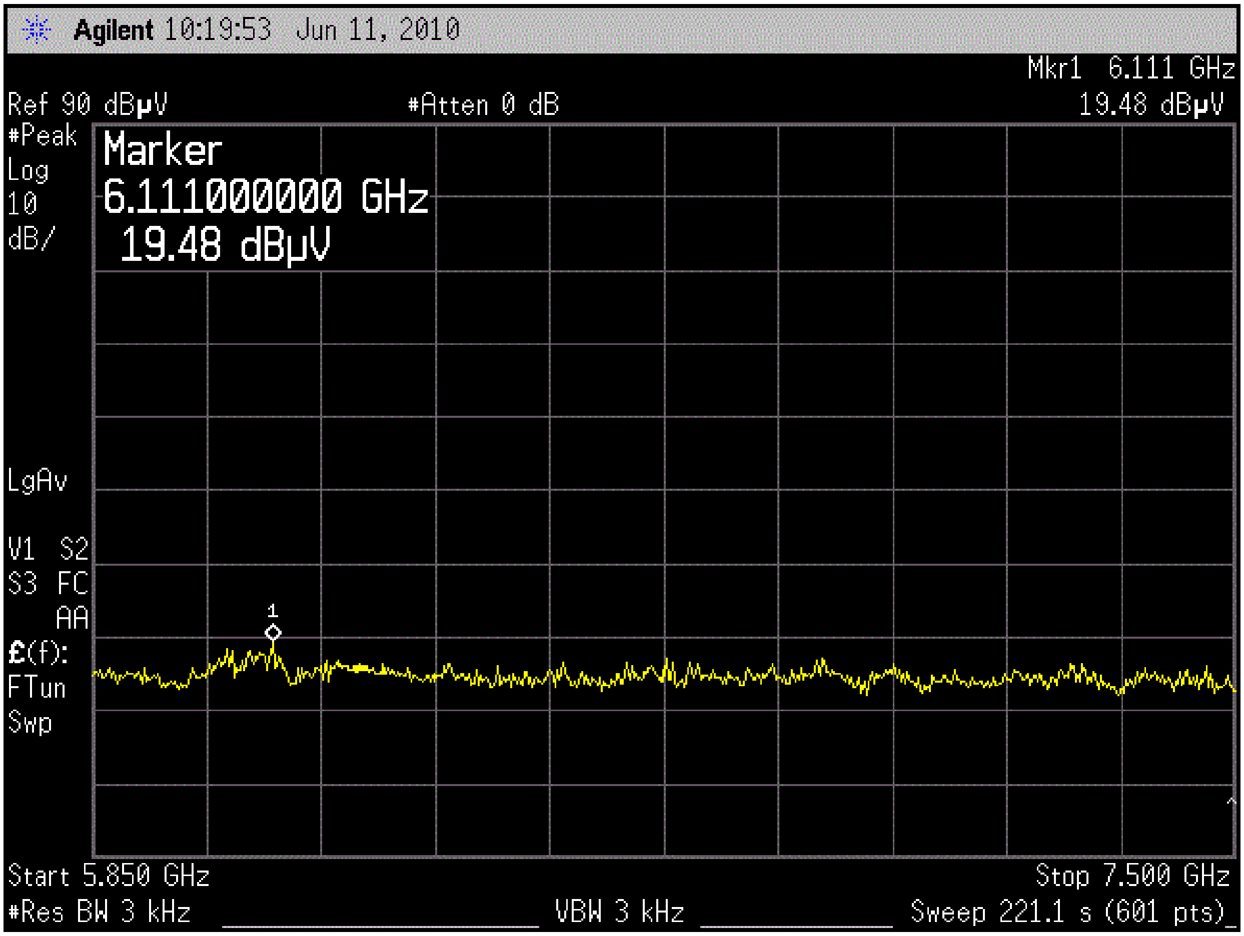
Plot 5-10: Analyzer Noise Floor Level - EUT [10" Horn Antenna] in Fiberglass Tank



Plot 5-11: **Analyzer Noise Floor Level - EUT [50mm Rod Antenna] in Fiberglass Tank**



Plot 5-12: Analyzer Noise Floor Level - EUT [250mm Rod Antenna] in Fiberglass Tank



Test Personnel:

Desmond A. Fraser		June 11 & 13, 2010
EMC Test Engineer	Signature	Dates of Test

6 Restricted Bands - §15.205

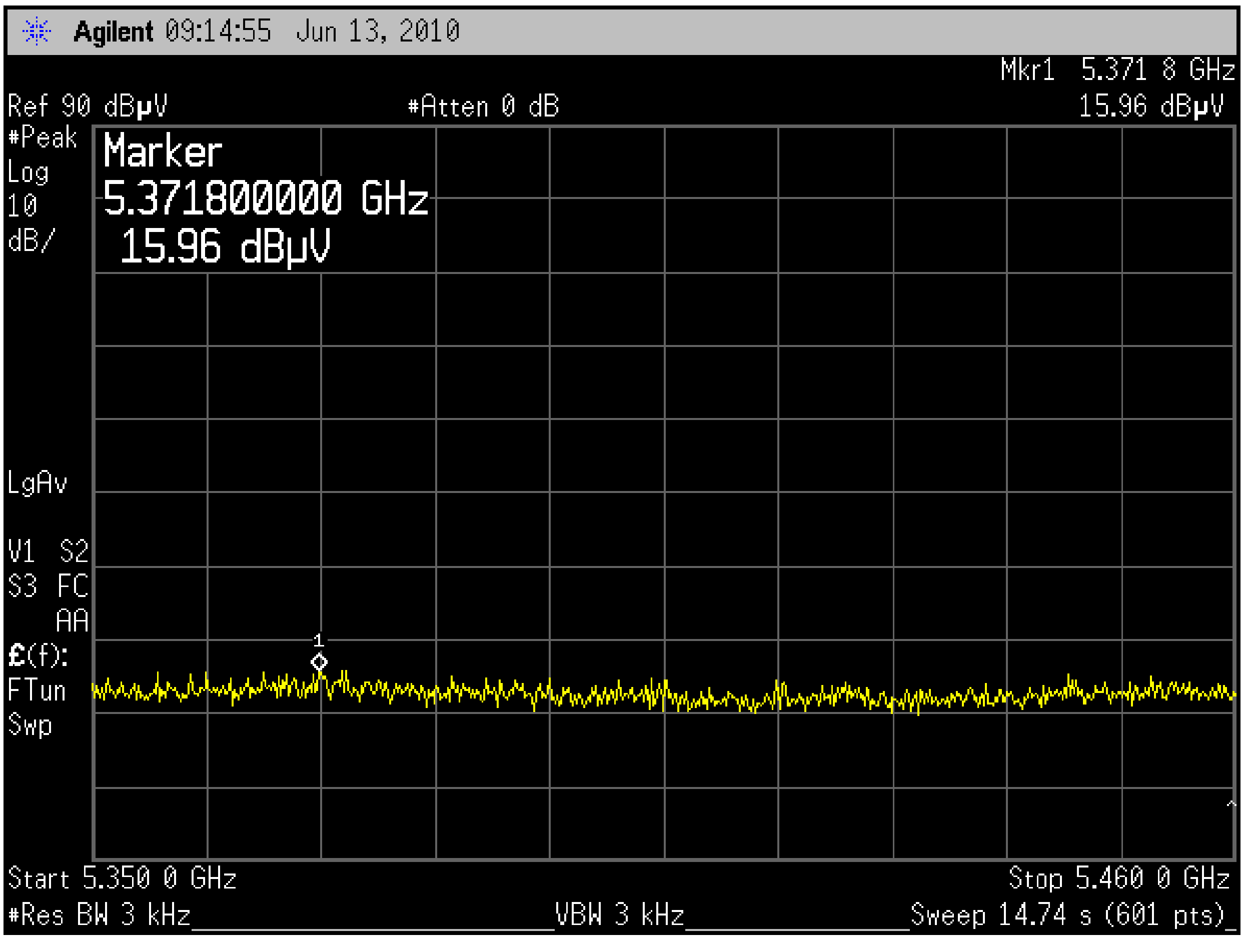
6.1 Restricted Band Limits - §15.205 – Test Procedure

6.1.1 Compliance with 5.35–5.46 and 7.25–7.75 GHz Adjacent Band

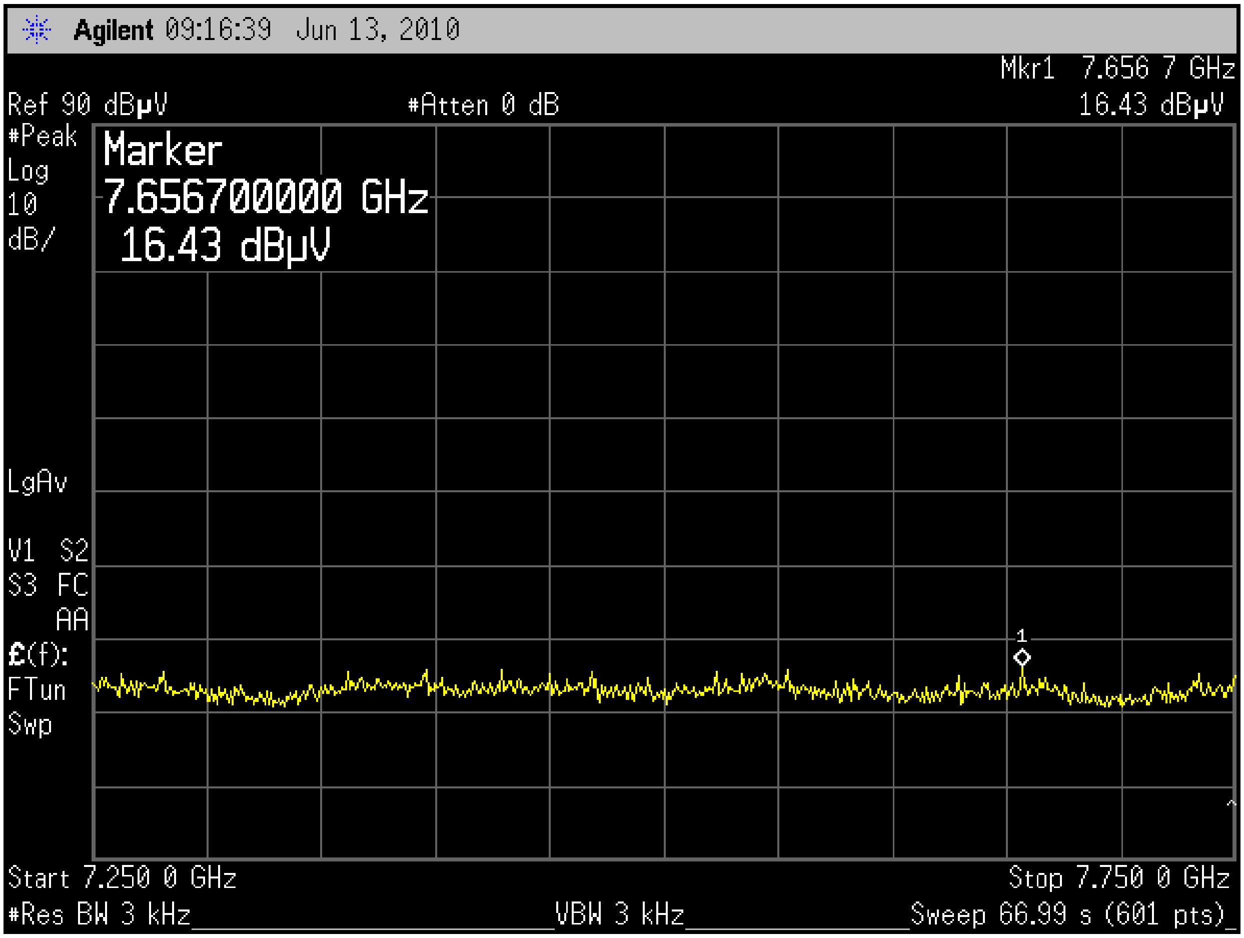
The EUT shall ensure that any emissions within restricted frequency bands in accordance with authority are spurious emissions only. Unless otherwise specifically authorized, the spurious emissions shall meet the prescribed limits in accordance with 47 CFR §15.209.

For compliance with the adjacent band at 5.35–5.46 and 7.25–7.GHz, the test configuration set-up in Figure 1 was used, including the same analyzer settings used for measuring the carrier, specifically RBW, VBW, Peak Detector function, and Attenuator setting. The Sweep Time on the analyzer was set to auto. The trace was allowed to stabilize during the measurement. The restricted band average limit is 54dBµV per 47 CFR §15.205.

Plot 6-1: 5.35–5.46 GHz Restricted Band



Plot 6-2: **7.25–7.75 GHz Restricted Band**



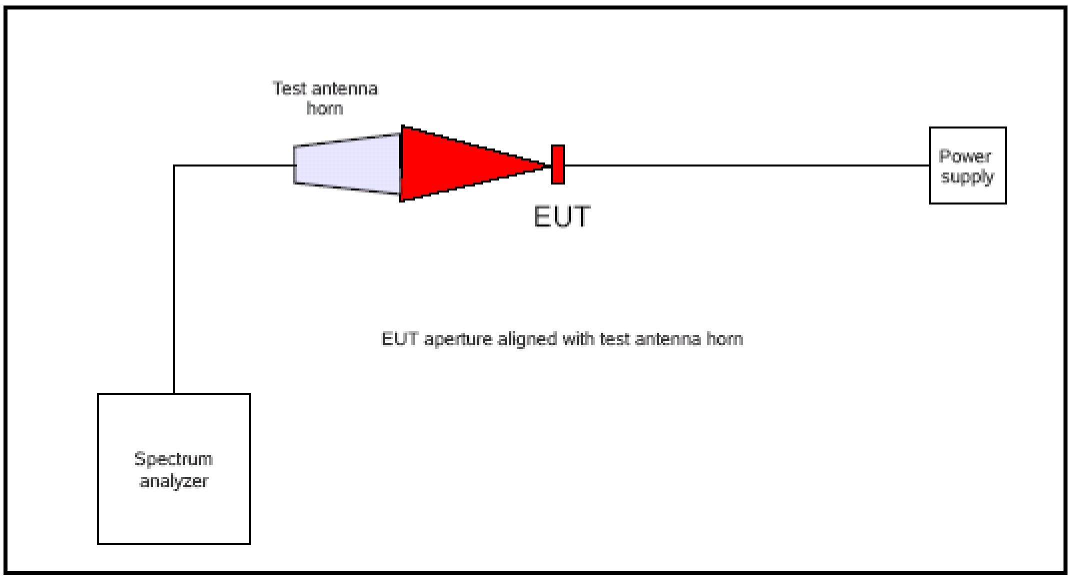
7 Bandwidth Measurement - §15.403(c)

7.1 26 dB Emission Bandwidth Procedure

The Emission Band-Width (EBW) is defined as the width of the signal between two points, one below the carrier center frequency, and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the maximum level of the modulated carrier (from 47 C.F.R. Section 15.403(c)).

The EBW was measured using the spectrum analyzer with the EUT configuration test set-up as shown in Figure 7-1 below.

Figure 7-1: Test Set-Up for Bandwidth Measurement



The following spectrum analyzer settings were used:

Span = 5 GHz

RBW = VBW = 100 kHz

Sweep = auto

Detector function = peak

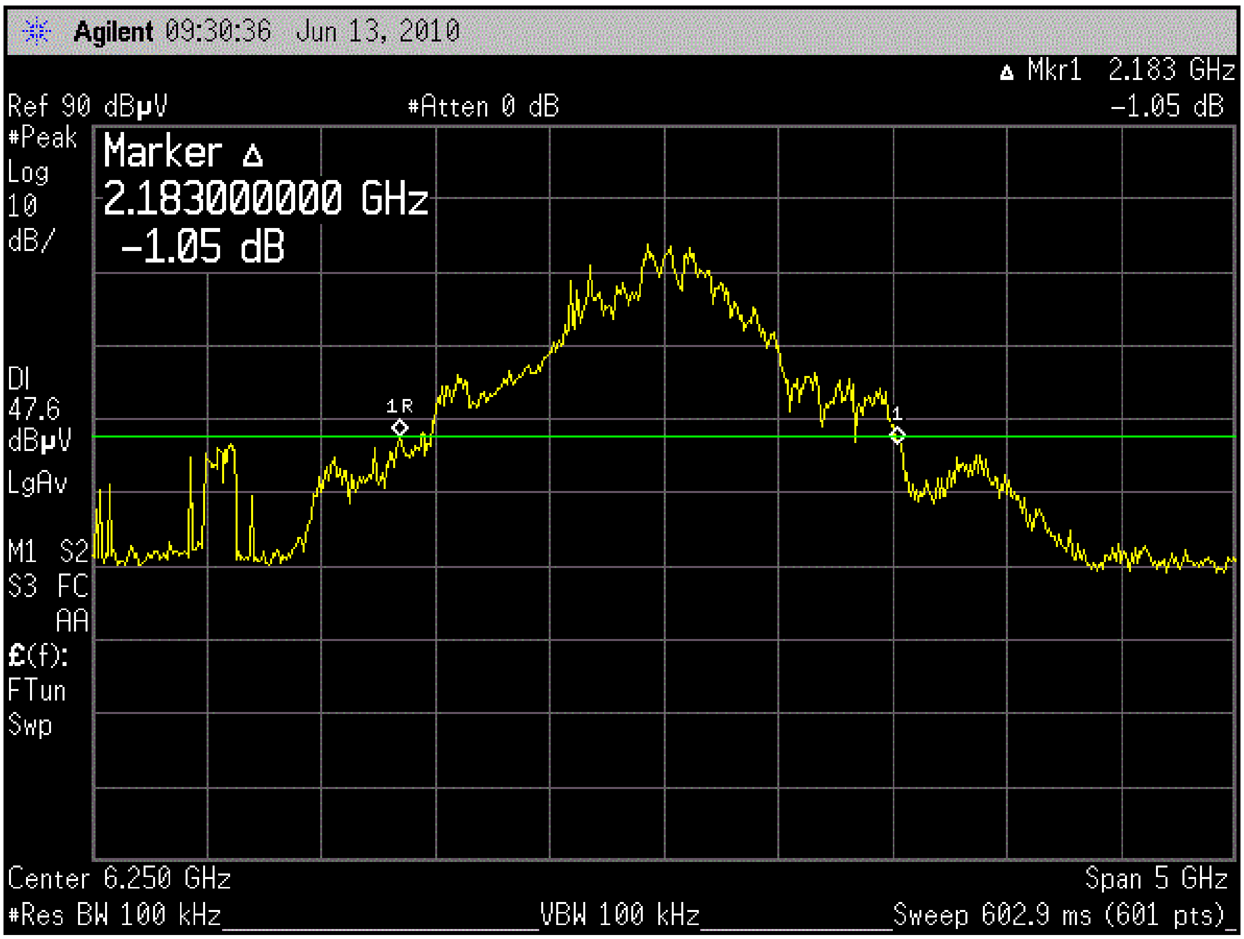
Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize.

Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 26 dB down one side of the emission.

Reset the marker-delta function, and move the marker to the other side of the emission, until it is as close as possible to being even with the reference marker level. The marker-delta reading at this point is the 26dB-bandwidth of the emission. The 26dB-bandwidth is 2.183 GHz.

Plot 7-1: 26 dB Bandwidth



7.2 2/ (τ_{eff}) Bandwidth Calculation

The main lobe bandwidth is calculated by using 2/(τ_{eff}), where τ_{eff} is the Pulse width for Pulse radar devices.

With τ_{eff} = 1.2 ns, the main lobe bandwidth = 2/(τ_{eff}) = 2/(1.2x10^{-9}s) = 1.67 GHz

8 Test Equipment

Table 8-1: Radiated Spurious Emissions Test Equipment

VEGA/RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901218	EMCO	3160-09	Horn Antenna (18 – 26 GHz)	960281-003	5/9/11
900392	Hewlett Packard	E4448	Spectrum Analyzer	3525A00159	7/9/11
N/A	Rhode & Schwarz	FSV 40	Spectrum Analyzer	N/A	4/6/12
900388	Ciao Wireless	CA1826-302	Pre-Amplifier	N/A	7/9/11
900669	Flann	20240-20 UBR220	Horn Antenna (18 – 26 GHz)	805 1905-1	7/9/11
900888	Huber + Suhner	Sucoflex 104	2m Coaxial Cable	171100/4	7/9/11
900889	Huber + Suhner	Sucoflex 104	2m Coaxial Cable	97045/4	7/9/11
900717	Hewlett Packard	11970U	Harmonic Mixer (40 - 60 GHz)	2332A01110	8/19/11
901218	EMCO	3160-09	Horn Antenna (18 - 26 GHz)	960281-003	6/14/11
900715	Hewlett Packard	11970V	Harmonic Mixer (50 - 75 GHz)	2521A00512	7/19/11
900716	Hewlett Packard	11970W	Harmonic Mixer (75 - 110 GHz)	2521A00710	6/08/11
900126	Hewlett Packard	11970A	Harmonic Mixer (26 - 40 GHz)	2332A01199	6/08/11
900056	ATM	19-443-6	Horn Antenna (40 – 60 GHz)	8041704-01	6/08/11
900826	ATM	08-443-6	Horn Antenna (90 – 140 GHz)	8041904-01	6/08/11
900719	ATM	05-443-6	Horn Antenna (140 – 220 GHz)	50685	6/08/11
900661	ATM	10-443-6	Horn Antenna (75 – 110 GHz)	805 1905-1	6/08/11
901262	EMCO	3160-9	Horn Antenna (1 – 18 GHz)	6748	9/09/11
900723	Hewlett Packard	8447	Amplifier (1 GHz – 26 GHz)	NA	6/08/11
900444	Miteq	1037	Amplifier (30 – 1000 MHz)	PR1040	6/08/11
900791	Schaffner - Chase	CBL6112	Antenna (25 MHz - 2 GHz)	2099	7/07/11
900151	Rohde & Schwarz	HFH2-Z2	Loop Antenna (9 kHz - 30 MHz)	827525	8/09/11
900772	EMCO	3161-02	Horn Antenna (2 – 4 GHz)	9804-1044	7/08/11
900321	EMCO	3161-03	Horn Antenna (4 - 8.2 GHz)	9508-1020	7/08/11
900323	EMCO	3161-07	Horn Antenna (8.2 - 12 GHz)	9508-1054	7/08/11

9 Conclusion

The data in this report demonstrates that the VEGA Grieshaber KG, Models VEGAPULS 65 and VEGAPULS 66 configured pointing downwards in closed metal, concrete and reinforced fiberglass tanks when tested on an OATS site complies with the emissions requirements of Parts 2 and 15 of the FCC Rules and Regulations.