Emissions
Test Report

EUT Name: MiSeq System

Model No.: MiSeq System

CFR 47 Part 15.225:2010 and RSS 210:2010

Prepared for:

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Statement of Compliance

Manufacturer:	Illumina, Inc 25861 Industrial Blvd. Hayward, CA 94545 (510) 670-9319
Requester / Applicant:	Carol Rogers Escano
Name of Equipment:	MiSeq System
Model No.	MiSeq System
Type of Equipment:	Industrial, Scientific, or Medical (ISM)
Application of Regulations:	CFR 47 Part 15.225:2010 and RSS 210:2010
Test Dates:	15 August 2011 to 18 August 2011

Guidance Documents:

Emissions: ANSI C63.10: 2009

Test Methods:

Emissions: ANSI C63.10: 2009

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This report contains data that are not covered by NVLAP accreditation. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Jeremy Luong	18 August 2011	Conan Boyle	18 August 2011
Test Engineer	Date	NVLAP Signatory	Date

Industry Canada

500011-0	**US5254**	**2932M**

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1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.225:2010 and RSS 210:2010 based on the results of testing performed on 15 August 2011 through 18 August 2011 on the MiSeq System Model MiSeq System manufactured by Illumina, Inc. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4	Test Parameters (from Standard)	Result
Receiver Spurious Emissions	CFR47 15.109, RSS-GEN Sect.6	Class B	**Complied**
Transmitter Spurious Emissions	CFR47 15.209, RSS-GEN Sect.7.2.5	Class B	**Complied**
Restricted Bands of Operation	CFR47 15.205, RSS 210 Sect.2.6	Class B	**Complied**
AC Power Conducted Emissions	CFR47 15.207, RSS-GEN Sect.7.2.2	Na	**Complied**
Occupied Bandwidth	CFR47 15.215 (c), RSS GEN Sect.4.4.1	Na	**Complied**
Carrier Field Strength	CFR47 15.225 (a), RSS 210 Sect. A 2.6 (a)	124 dBuV/m at 3 meter	**Complied**
Out of Band Emissions	CFR47 15.225 (b), (c) RSS 210 Sect. A 2.6 (b) (c)	Per Standards.	**Complied**
Frequency Stability	CFR47 15.225 (e), RSS 210 Sect. A 2.6 (d)	100ppm / +0.01%	**Complied**
Voltage Variation	CFR47 15.31 (e),	100ppm / +0.01%	**Complied**
RF Exposure	CFR47 Part 1.1310	General Population	**Complied**

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

Description of Change	Additional Engineering Details	Root Cause of Change
Add ferrite to Assembly PN 15026097 RFID PCBA lead for Flowcell RFID PCBA	Ferrite Bead MPN 28A0392-0A0 added to assembly PN 15026097	Harmonics over the limit for CFR 47 Part 15 and EN 330 300
Add ferrite to cable PN 15028032 for Chiller RFID PCB	Ferrite Bead MPN 28A0392-0A0 added to cable PN 15028032	Harmonics over the limit for CFR 47 Part 15 and EN 330 300
Add ferrite to cable PN 15022743 for PR2 RFID PCB	Ferrite Bead MPN 28A0392-0A0 added to cable PN 15022743	Harmonics over the limit for CFR 47 Part 15 and EN 330 300
Modify Assembly PN 15020850 to add 1/2" shield braid. Extend the braid through the rear of the Chiller and ground to the E-box.	Assembly PN 15020850 will be revised.	Harmonics over the limit for CFR 47 Part 15 and EN 330 300
Modify Cable PN 15022743 to extend the cable shield. Ground the cable shield to the LCD/PR2 console.	Cable PN 15022743 will be revised.	Harmonic at 94.92 MHz over the limit for EN 330 300.

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America at 1279 Quarry Lane, Ste. A., Pleasanton, CA 94566, is accredited by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (FRN # US5254). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP

TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:2005 and ISO 9002 (Lab Code 500011-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada

Industry Canada

TUV Rheinland of North America at the 1279 Quarry Ln, Pleasanton, CA 94566 address is accredited by Industry Canada for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by Industry Canada (File Number 2932M). This reference number is the indication to the Industry Canada Certification Officers that the site meets the requirements of RSS 212, Issue 1 (Provisional). The accreditation is updated every 3 years.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America at 1279 Quarry Lane, Pleasanton, CA 94566 has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration Nos. R-3269, C-3637, C-3638, T-1752, T-1753).

2.1.5 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Lane, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / NVLAP accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Ste. A, Pleasanton, California 94566, USA. The 2305 Mission College, Santa Clara, 95054, USA location is considered a Pleasanton annex.

2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2003, at test distances of 3 and 5 meters. The site is listed with the FCC and accredited by NVLAP (Lab Code 500011-0). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2003, at test distances of 3 meters and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 4.8 m x 3.175 mm thick aluminum floor connected to PE ground.

For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors.

For EFT, Surge, PQF, the HCP and VCP are removed.

RF Field Immunity testing is performed in a 7.3m x 4.3m x 4.1m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.8m x 3.7m x 3.175mm thick aluminum ground plane.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.3.2 Measurement Uncertainties

Table 2: Summary of Uncertainties

	U_{lab}	U_{cispr}
Radiated Disturbance		
30 MHz – 25,000 MHz	3.2 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	2.4 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.5 dB

Note: U_{lab} is the calculated Combined Standard Uncertainty
U_{cispr} is the measurement uncertainty requirement per CISPR 16.

Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is ± 4.1%.
The estimated combined standard uncertainty for radiated immunity measurements is ± 2.7dB.
The estimated combined standard uncertainty for conducted immunity measurements is ± 1.4dB.
The estimated combined standard uncertainty for damped oscillatory wave immunity measurements is ± 8.8%.
The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 0.45%.

Measurement Uncertainty – Radio Testing

The estimated combined standard uncertainty for frequency error measurements is ± 3.88 Hz
The estimated combined standard uncertainty for carrier power measurements is ± 1.59 dB.
The estimated combined standard uncertainty for adjacent channel power measurements is ± 1.47 dB.
The estimated combined standard uncertainty for modulation frequency response measurements is ± 0.46 dB.
The estimated combined standard uncertainty for transmitter conducted emission measurements is ± 4.01 dB

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Guide 17025:2005.

3 Product Information

3.1 Product Description

The Illumina MiSeq System is a Genetic Sequencer Analyzer with three RFIDs

- RFID #1 is at the Flow Cell. It has detachable antenna.
- RFID #2 is at the Chiller. It has integrated antenna.
- RFID #3 is at PR2. It has integrated antenna.

3.2 Equipment Configuration

A description of the equipment configuration is given in Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in Test Plan Section. In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.4 *Unique Antenna Connector*

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

The MiSeq System uses the permanently attached antenna for each RF Identification.
There are two antenna setups:

- PCB antenna integrated in RFID Reader PCB
- PCB antenna connected to RFID Reader PCB through custom harness

Both antenna setup use rectangular multi□turn loop antenna.

- Antenna Size: 37mm x 18mm

Connector for detached antenna:

- Mfr: Hirose
- Mfr PN: DF13□2P□1.25DSA
- Description: Rectangular header, 2 position, 1.25mm
- Antenna Cable: Illumina PN: 15023646
- Length: 3.5”

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.225:2010 and RSS 210 Annex 2:2010. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in ANSI C63.10: 2009 were used.

4.1 Carrier Field Strength Requirements

The RF fundamental field strength requirement is the power radiated in the direction of the maximum level under specified conditions of measurements in the presence of modulation.

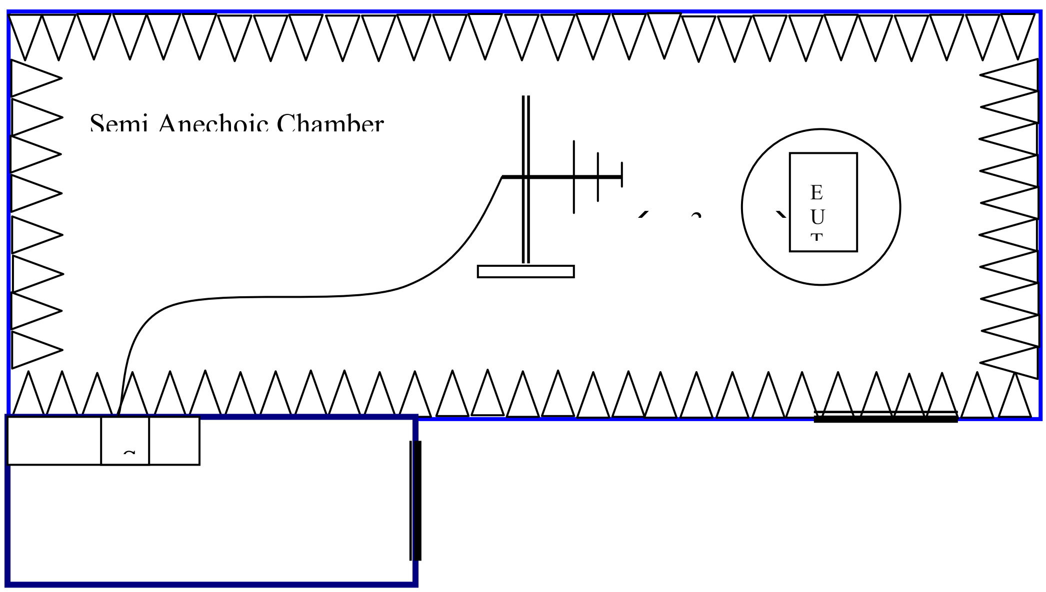
The RF fundamental field strengths shall not exceed CFR47 Part 15.225 (a):2010 and RSS 210 A2.6 (a):2010.

The field strength of any emission in the band of 13.553 and 13.567MHz shall be less than 84 dBuV/m at 30 meter distance; or 124 dBuV/m at 3 meter.

4.1.1 Test Method

The radiated method was used to measure the field strength of the fundamental signal according to ANSI C63.10:2009 Section 6.3. The measurement was performed with modulation. This test was conducted on all three RFID boards installed in the MiSeq System, S/N: M101. The worst result indicated below.

Test Setup:



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4.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 3: RF Fundamental Field Strength – Test Results

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only						
Antenna Type: Attached / Integrated				**Power Setting:** 100mW Chipset Output		
Signal State: Modulated				**Duty Cycle:** 52.8 %		
Ambient Temp.: 22 °C				**Relative Humidity:**35 %		
Operating Frequency:	**Test Results**					
13.56 MHz	**Measured Level [dBuV/m]**	**Loop Position**	**Table [degree]**	**Antenna [cm]**	**Limit [dBuV/m]**	**Margin [dB]**
RFID #1	69.61	0	91	100	124.00	-55.26
RFID #1	73.32	90	186	100	124.00	-52.04
RFID #2	57.33	0	126	100	124.00	-67.03
RFID #2	55.84	90	375	100	124.00	-68.83
RFID #3	42.21	0	86	100	124.00	-82.79
RFID #3	43.20	90	178	100	124.00	-81.75
Note: 1. The above data is tested in X-Axis since all RFID would fix inside the MiSeq System. 2. Measurements were taken at 3 meter distance, and the limit was extrapolated accordingly.						

4.2 Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

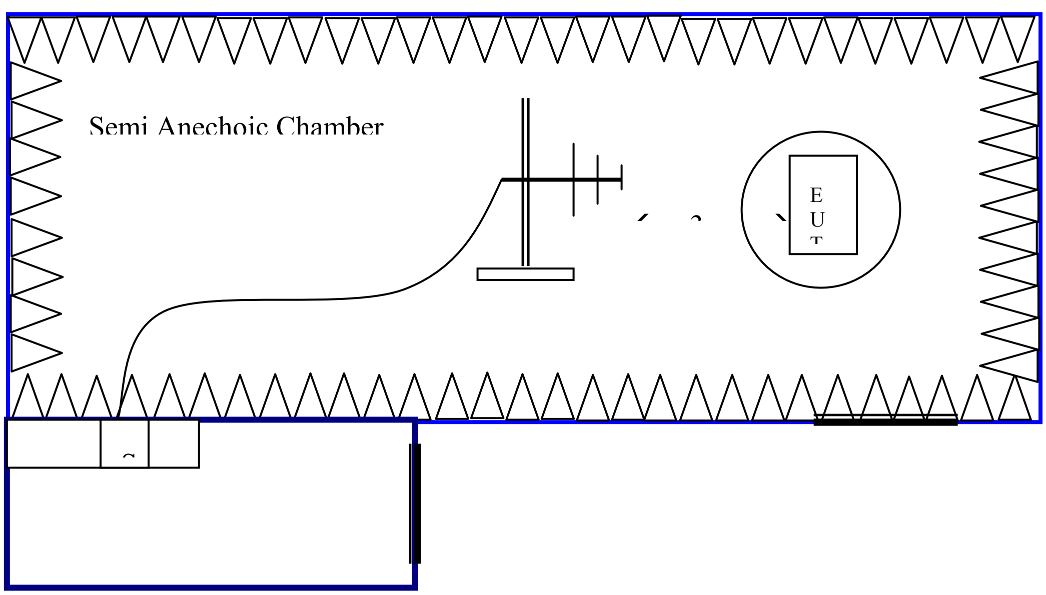
The 20dB bandwidth is defined the bandwidth of 20 dBr from highest transmitted level of the fundamental frequency.

The bandwidth shall be documented per Section CFR47 15.215(c) 2010 and RSS Gen Sect. 4.6: 2010. Intentional radiators operating under the alternative provisions to the general emission limits, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If the frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4.2.1 Test Method

The radiated method was used to measure the occupied bandwidth according to ANSI C63.10:2009. The measurement was performed with modulation. This test was performed on all three RFIDs installed inside MiSeq System; SN M101. The worst sample result indicated below.

Test Setup:



4.2.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Occupied Bandwidth – Test Results

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only				
Antenna Type: Integrated			**Power Setting:** 100mW Chipset Output	
Signal State: Modulated			**Duty Cycle:** 52.8 %	
Ambient Temp.: 22 °C			**Relative Humidity:**36%	
Occupied Bandwidth for 13.56 MHz RFID				
Sample	**Limit (kHz)**	**99% BW (kHz)**	**20 dB BW (kHz)**	**Results**
RFID #1	Na	3.3966	4.350	Pass
RFID #2	Na	3.3839	3.450	Pass
RFID #3	Na	3.9890	3.450	Pass
Note: All lower and upper markers of 99% Bandwidth and 20 dB Bandwidth are within the allowable band; 13.553 MHz to 13.567MHz				

Table 5: 20 dB Bandwidth Frequency – Test Results

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only				
Antenna Type: Integrated			**Power Setting:** 100mW Chipset Output	
Signal State: Modulated			**Duty Cycle:** 52.8 %	
Ambient Temp.: 22 °C			**Relative Humidity:**36%	
20 dB Bandwidth Frequencies for 13.56 MHz RFID				
Sample	**Occupied Band Limit (MHz)**	**Lower Freq. (MHz)**	**Upper Freq. (MHz)**	**Results**
RFID #1	13.553 < X < 13.567	13.557900	13.562250	Pass
RFID #2	13.553 < X < 13.567	13.558200	13.561650	Pass
RFID #3	13.553 < X < 13.567	13.558250	13.561700	Pass
Note: All lower and upper markers of 20 dB Bandwidth are within the allowable band; 13.553 MHz to 13.567MHz; where X is the lower frequency and upper frequency.				

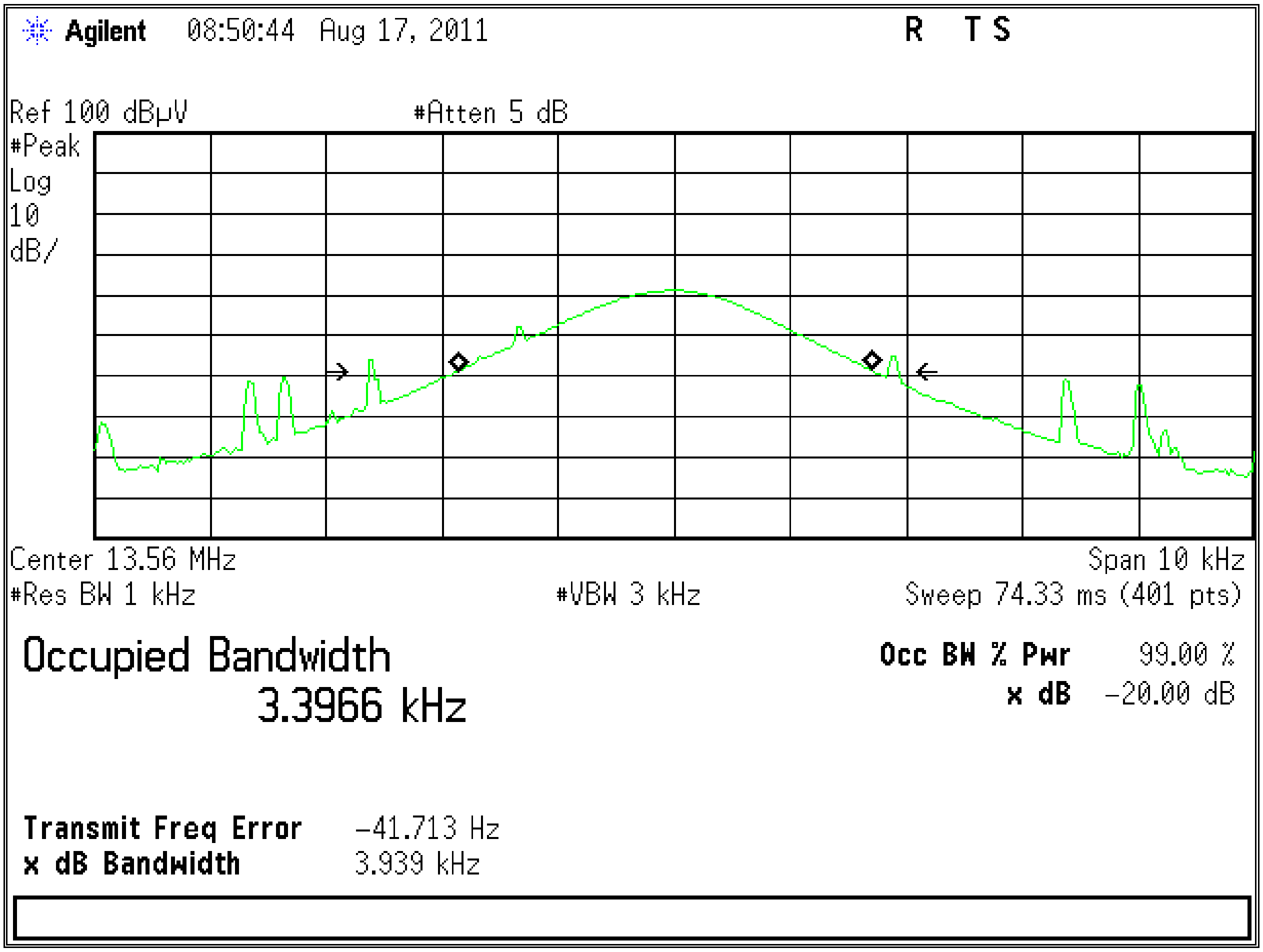


Figure 1: 99% Bandwidth of RFID #1

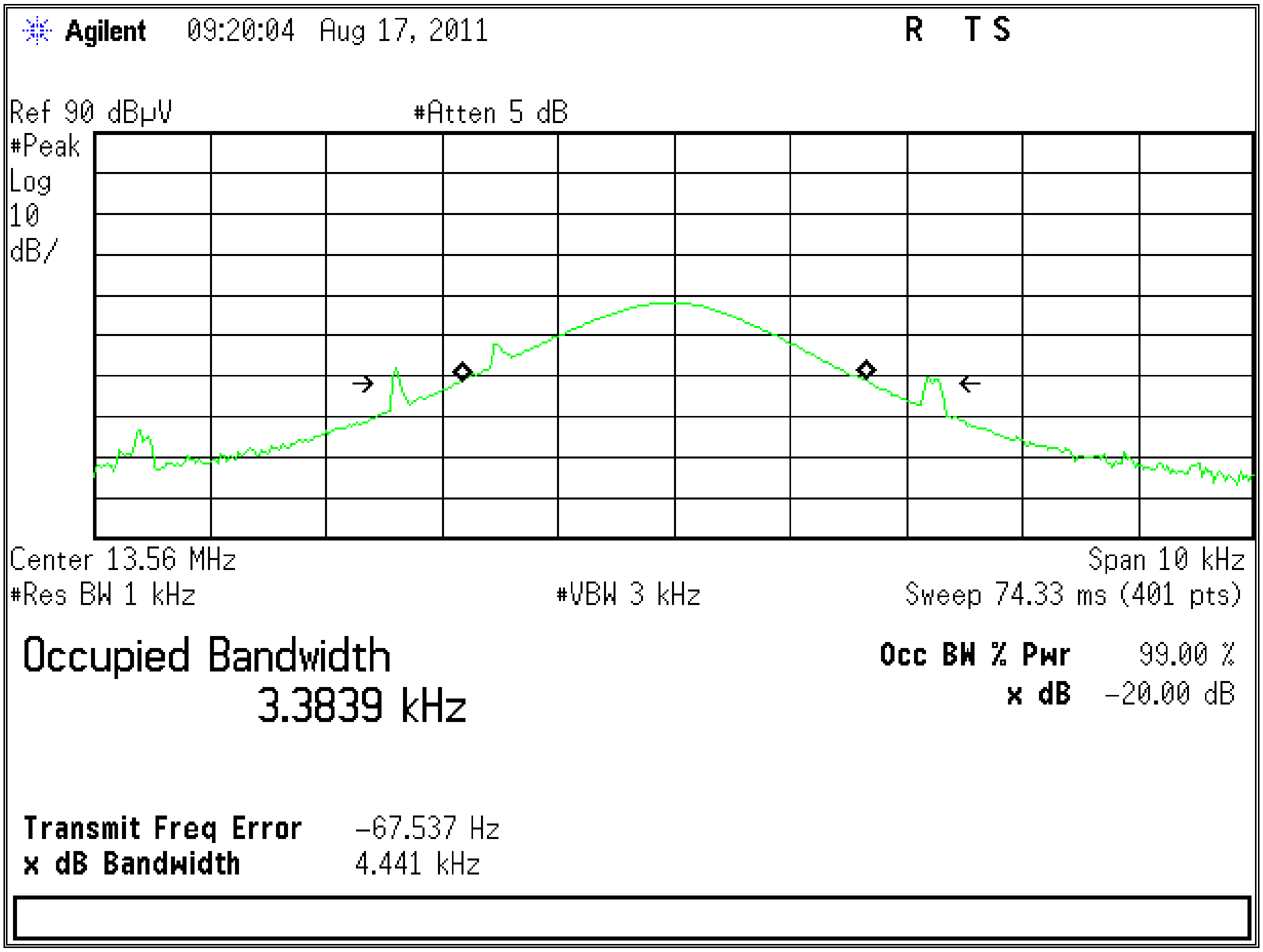


Figure 2: 99% Bandwidth of RFID #2

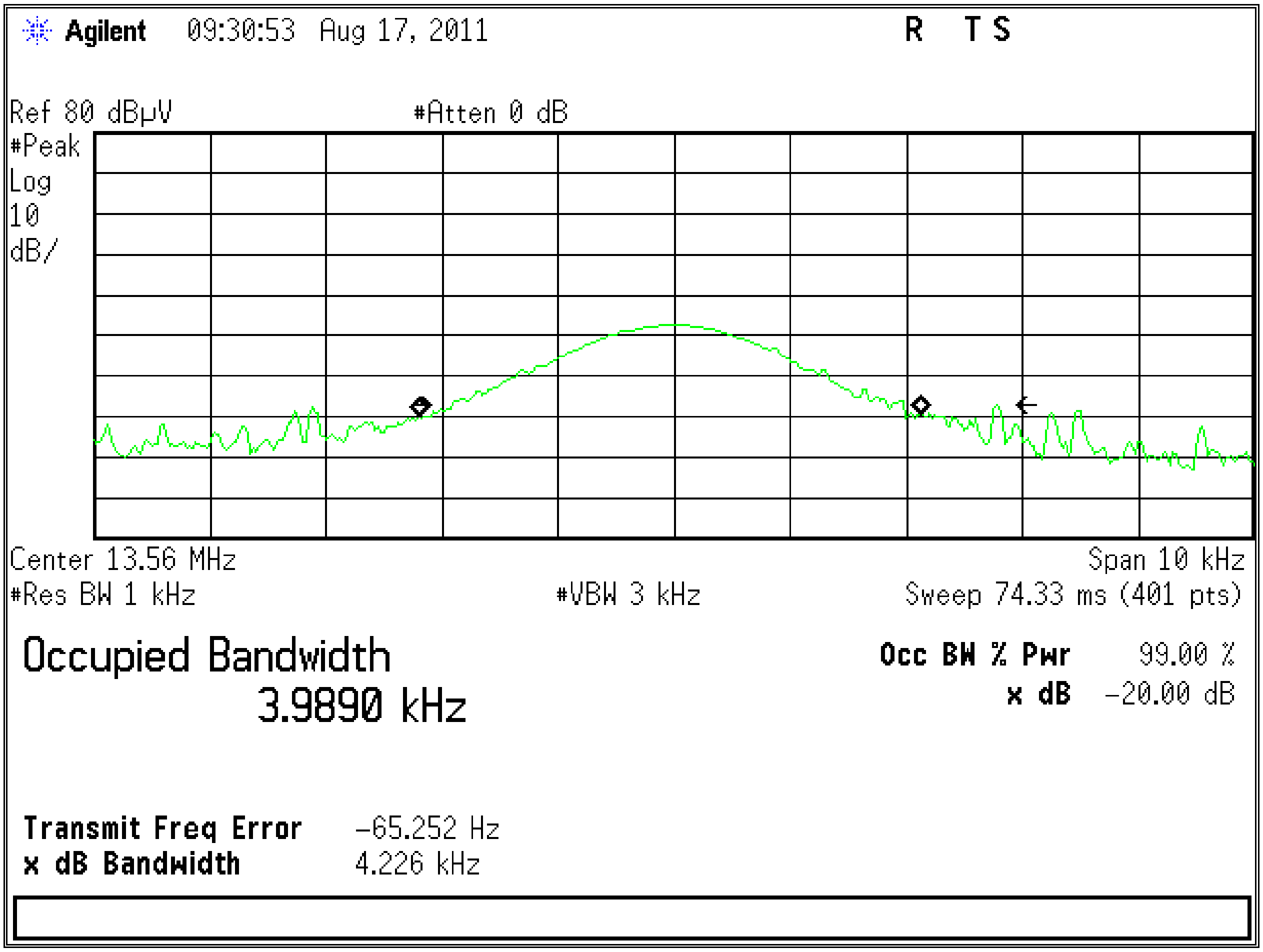


Figure 3: 99% Bandwidth of RFID #3

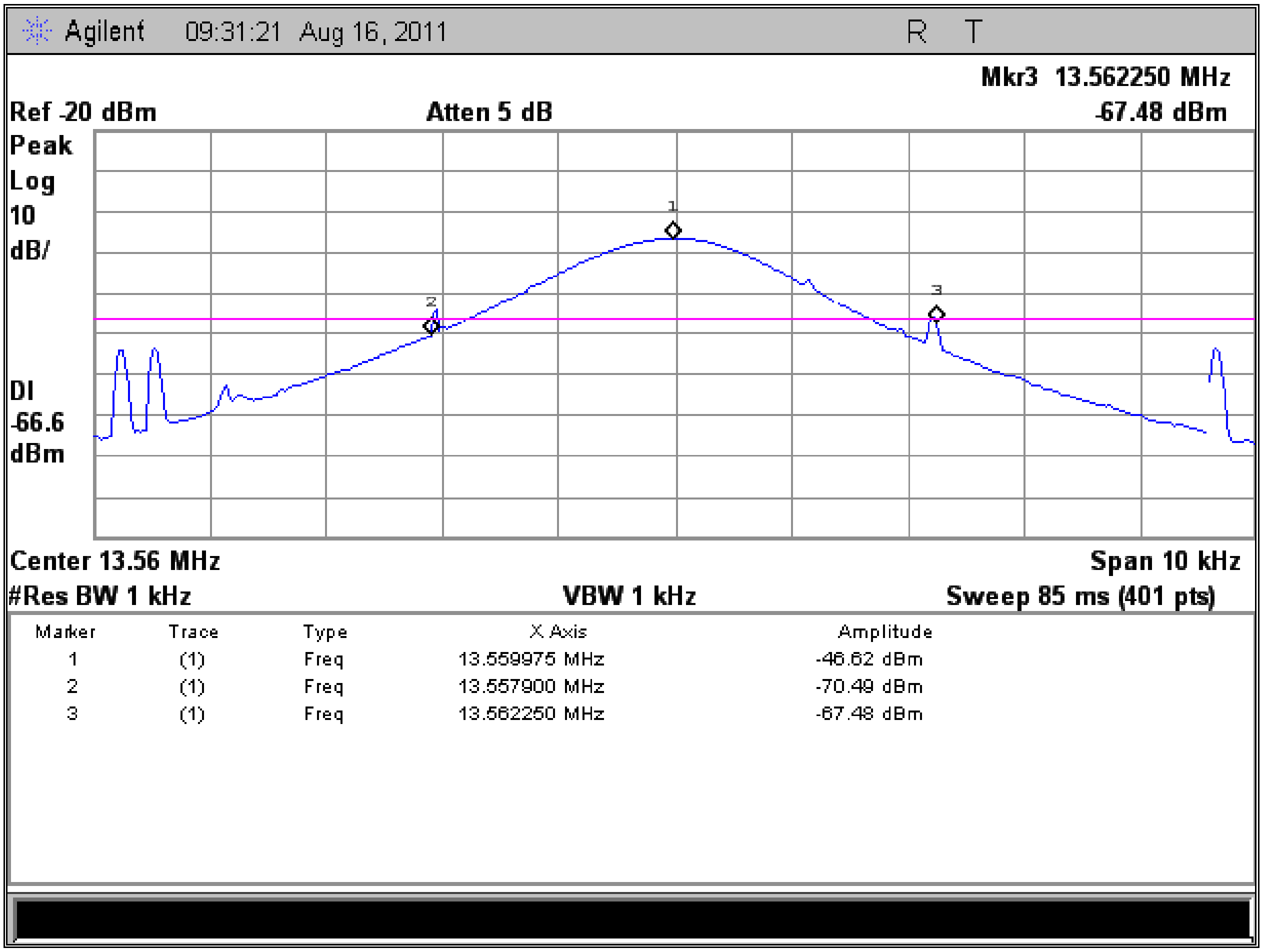


Figure 4: 20 dB Bandwidth of RFID #1

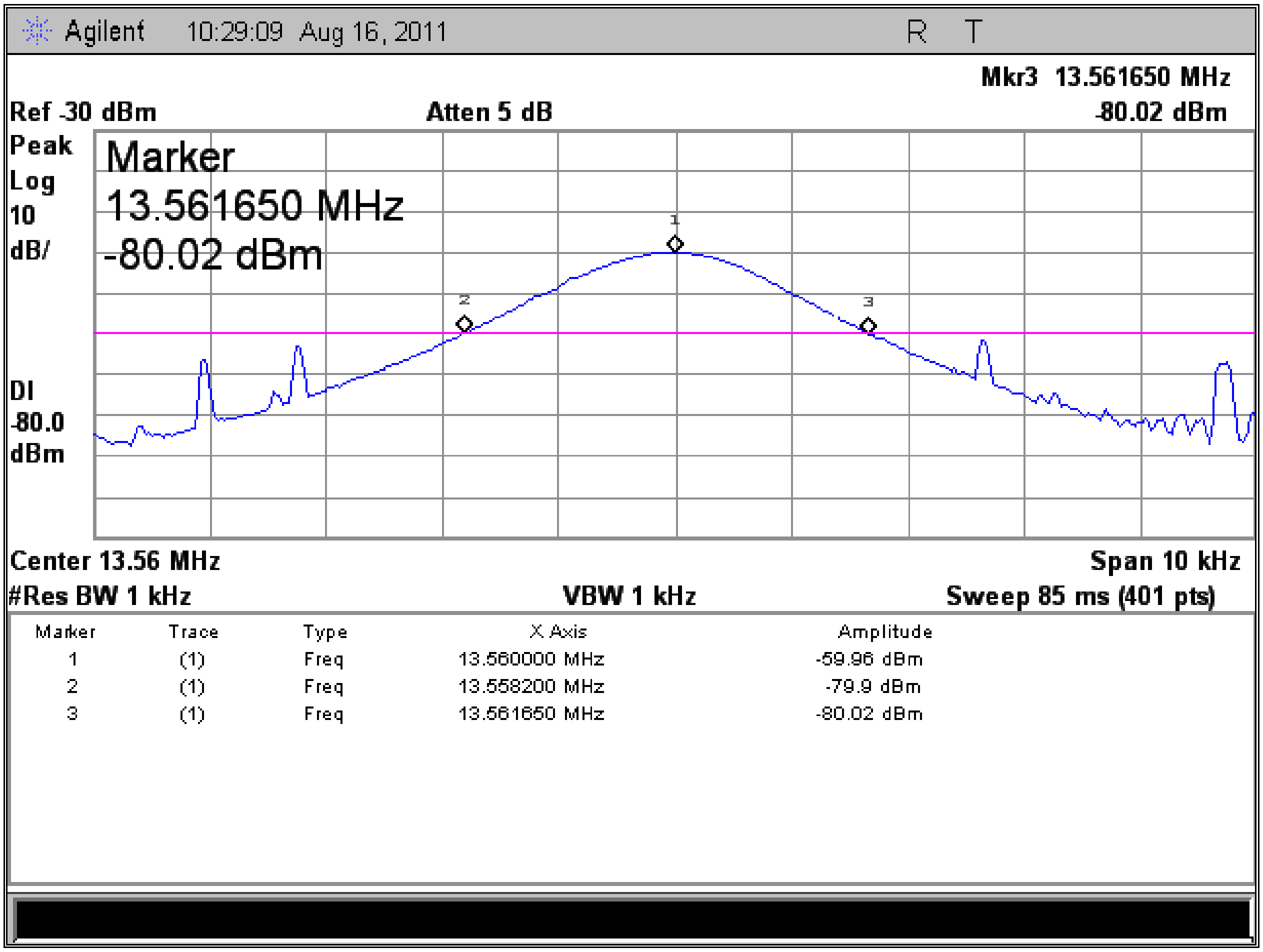


Figure 5: 20 dB Bandwidth of RFID #2

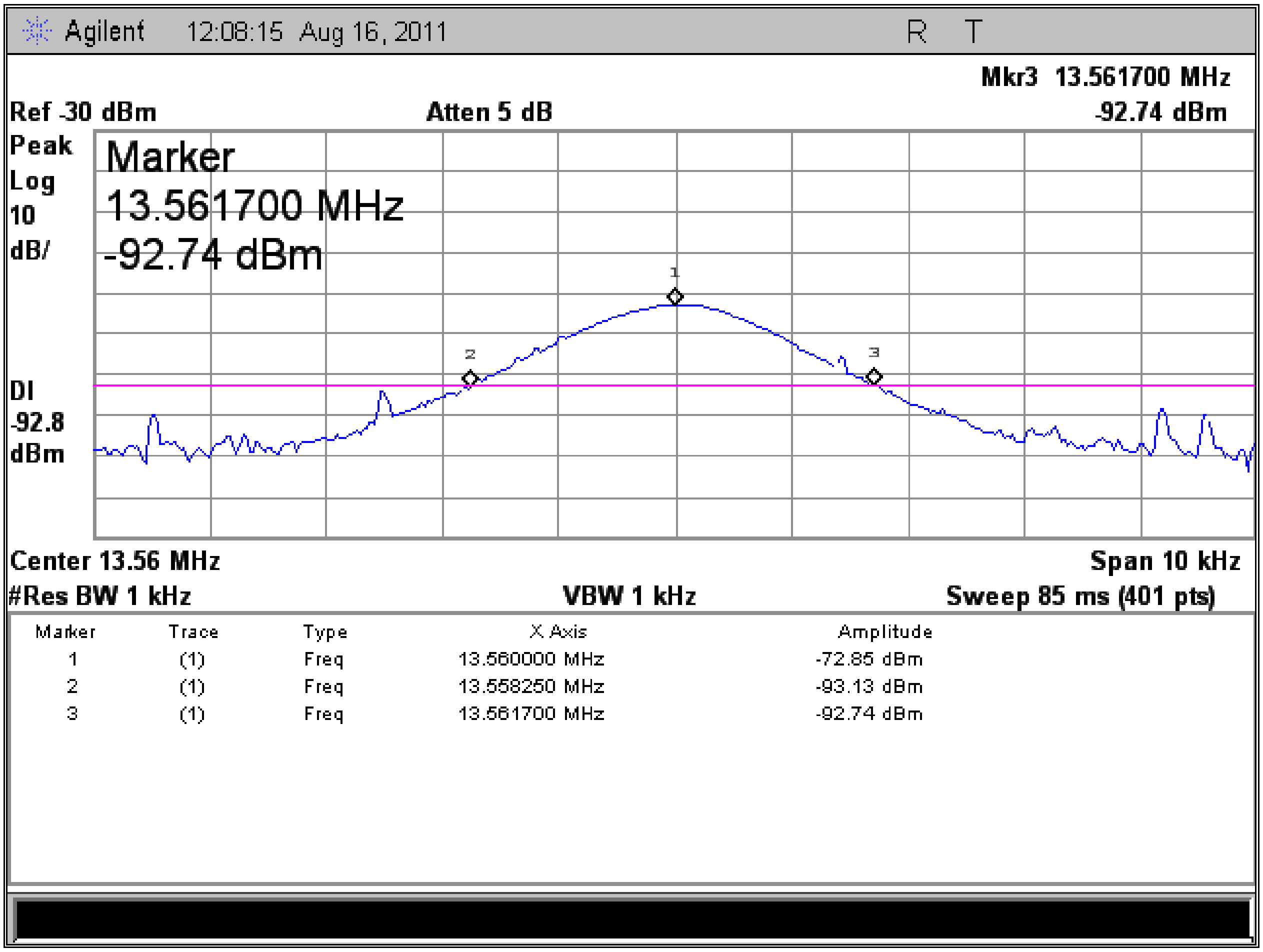


Figure 6: 20 dB Bandwidth of RFID #3

4.3 Out-of-Band Emissions

The out of band emission is leakage measurement of the main carrier outside the allocated operating frequency band; 13.553 MHz to 13.567 MHz.
According to CFR47 Part 15.225: 2010 and RSS210 A2.6: 2010, the out of band emission shall;
-Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter (84 dBuV/m) at 30 meters,
-Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter (40.5 dBuV/m) at 30 meters.

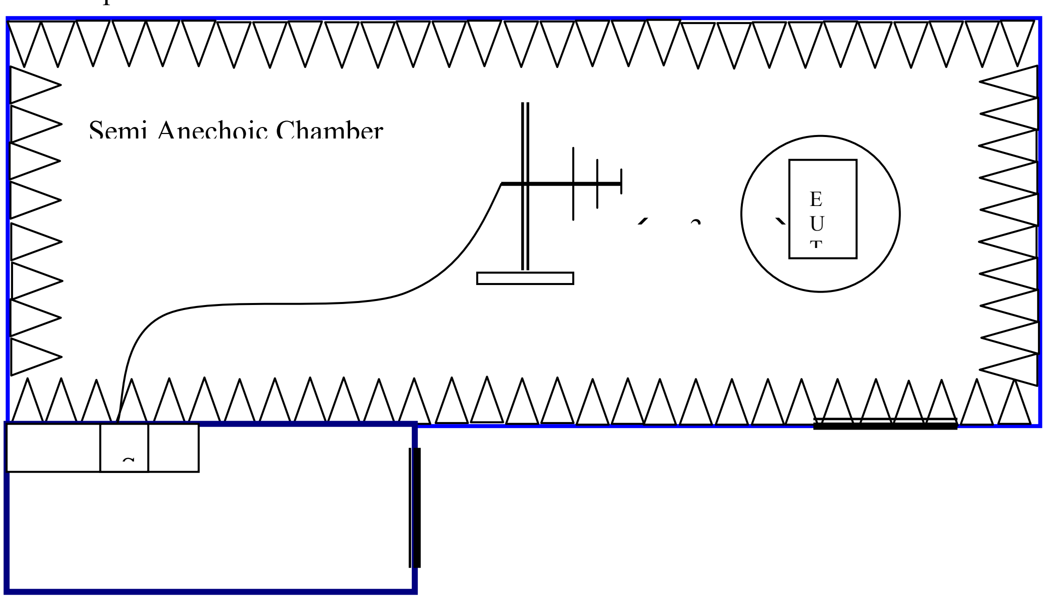
Table 6: Out of Band Emissions Limit

Frequency (MHz)	*Limit at 30m (dBuV/m)*	*Limit at 3m (dBuV/m)*	*Comment*
<13.110	*29.5*	*69.5*	*CFR47 15.225 (d), RSS210 A2.6 (d). Out of Band*
13.110-13.410	*40.5*	*80.5*	*CFR47 15.225 (c), RSS210 A2.6 (c). Out of Band*
13.410-13.533	*50.5*	*90.5*	*CFR47 15.225 (b), RSS210 A2.6 (b). Out of Band*
13.553-13.567	*84.0*	*124.0*	*CFR47 15.225 (a), RSS210 A2.6 (a), Inband (Carrier)*
13.567-13.710	*50.5*	*90.5*	*CFR47 15.225 (b), RSS210 A2.6 (b), Out of Band*
13.710-14.010	*40.5*	*80.5*	*CFR47 15.225 (c), RSS210 A2.6 (c), Out of Band*
>14.010	*29.5*	*69.5*	*CFR47 15.225 (d), RSS210 A2.6 (d), Out of Band*
Note: The limit was extrapolated 40dB/decade per CFR47 Part 15.31 (f)(3).			

4.3.1 Test Method

The radiated method was used to measure the out-of-band emission requirement. The measurement was performed with modulation per CFR47 15.225 (b) (c) 2010 and *RSS 210 A2.6.* (b) (c)*: 2010*. This test was performed on all 3 RFIDs installed inside MiSeq System SN: M101. The worst result indicated below.

Test Setup:



4.3.2 Test Result

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 7: Out of Band Emissions – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only				
Antenna Type: Detachable / Integrated		**Power Setting:** 100mW Chipset Output		
Signal State: Modulated		**Duty Cycle:** 52.8 %		
Ambient Temp.: 21 °C		**Relative Humidity:**34%		
Sample	**Limit**	**Loop Antenna Position**	**Spectrum Mask (13.410 to 14.010MHz)**	**Result**
RFID #1 (Flow Cell)	See Table 6	0	Plot #7	Pass
		90	Plot #8	Pass
RFID #2 (Chiller)		0	Plot #9	Pass
		90	Plot #10	Pass
RFID #3 (PR2)		0	Plot #11	Pass
		90	Plot #12	Pass
Note: All maximized emissions within 10 MHz to 15 MHz are below the spectrum mask limit per Table 6..				

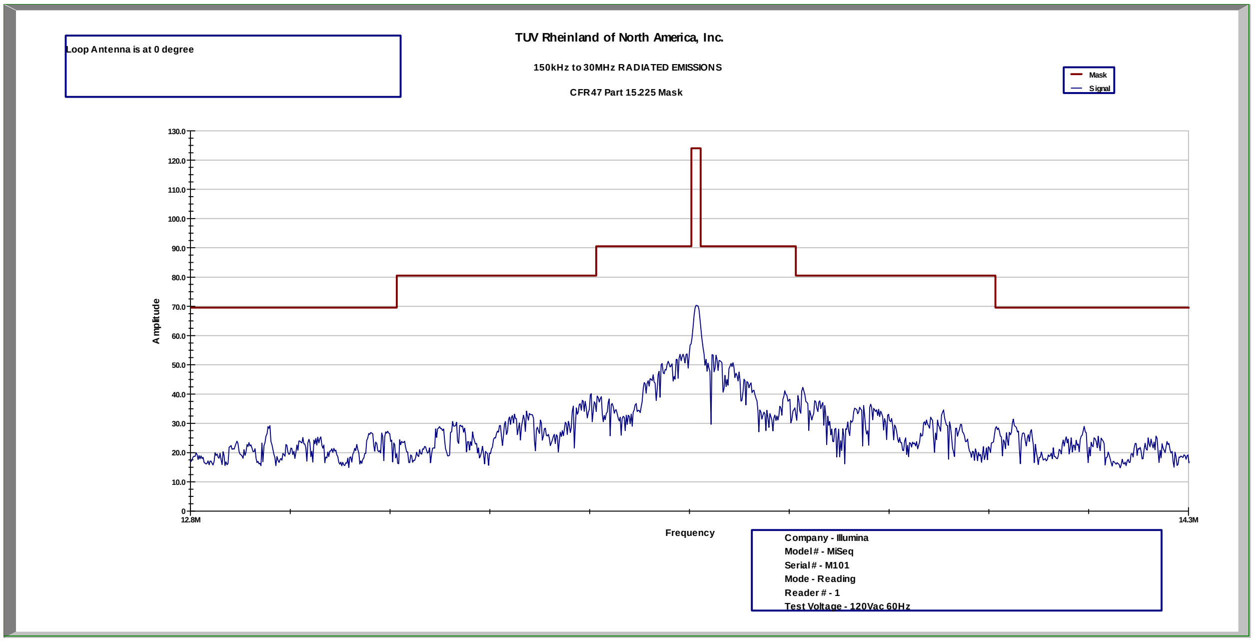


Figure 7: Out of Band Spectrum Mask for RFID #1 – 0 Degree Loop Antenna

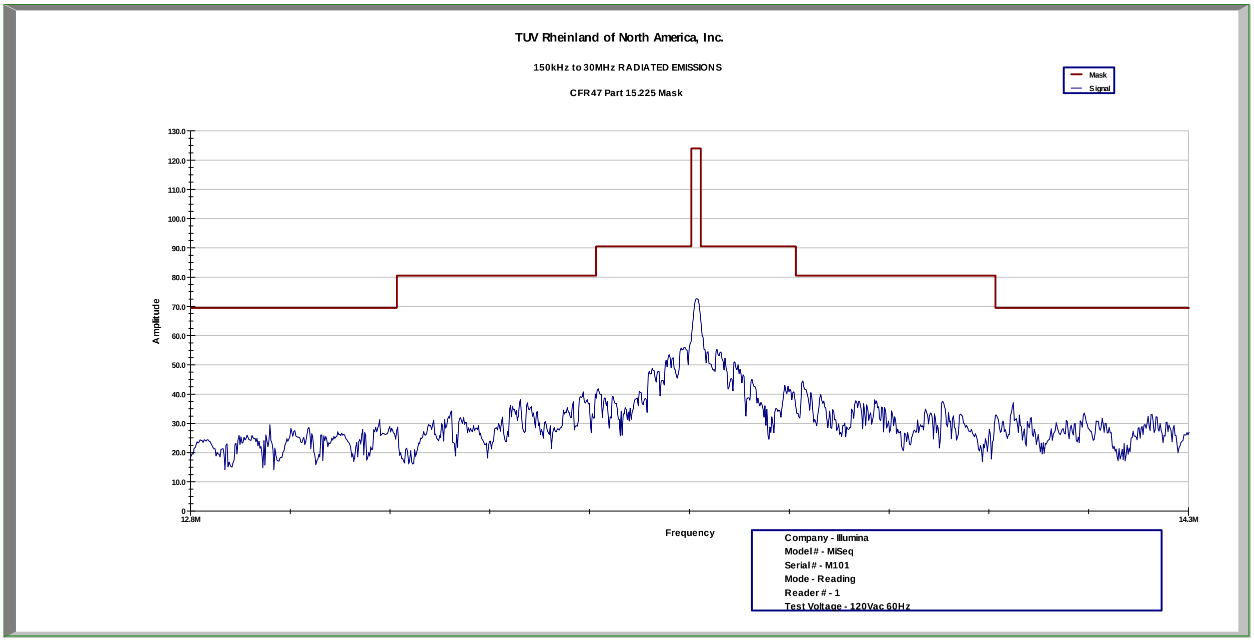


Figure 8: Out of Band Spectrum Mask for RFID #1 – 90 Degree Loop Antenna

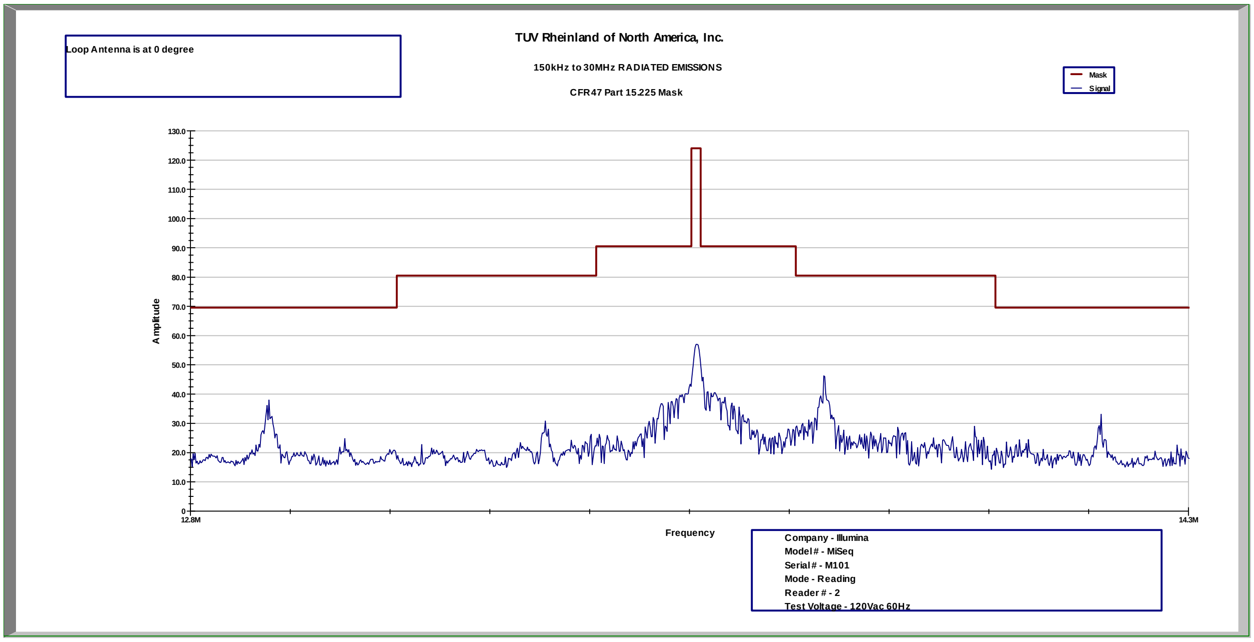


Figure 9: Out of Band Spectrum Mask for RFID #2 – 0 Degree Loop Antenna

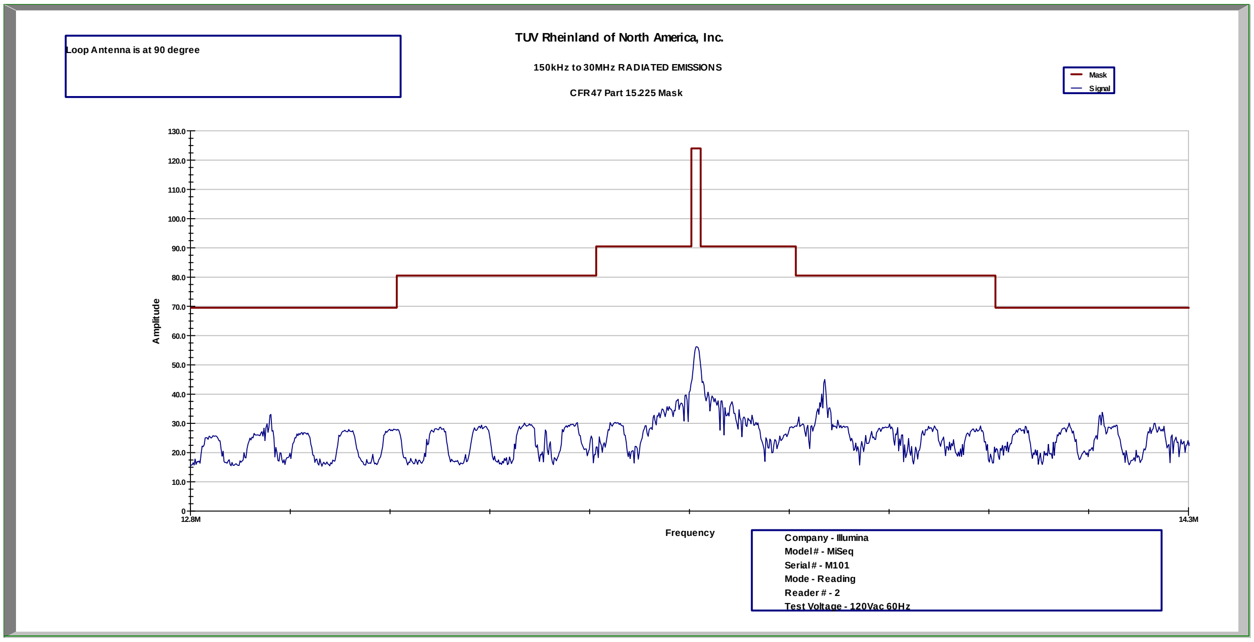


Figure 10: Out of Band Spectrum Mask for RFID #2 – 90 Degree Loop Antenna

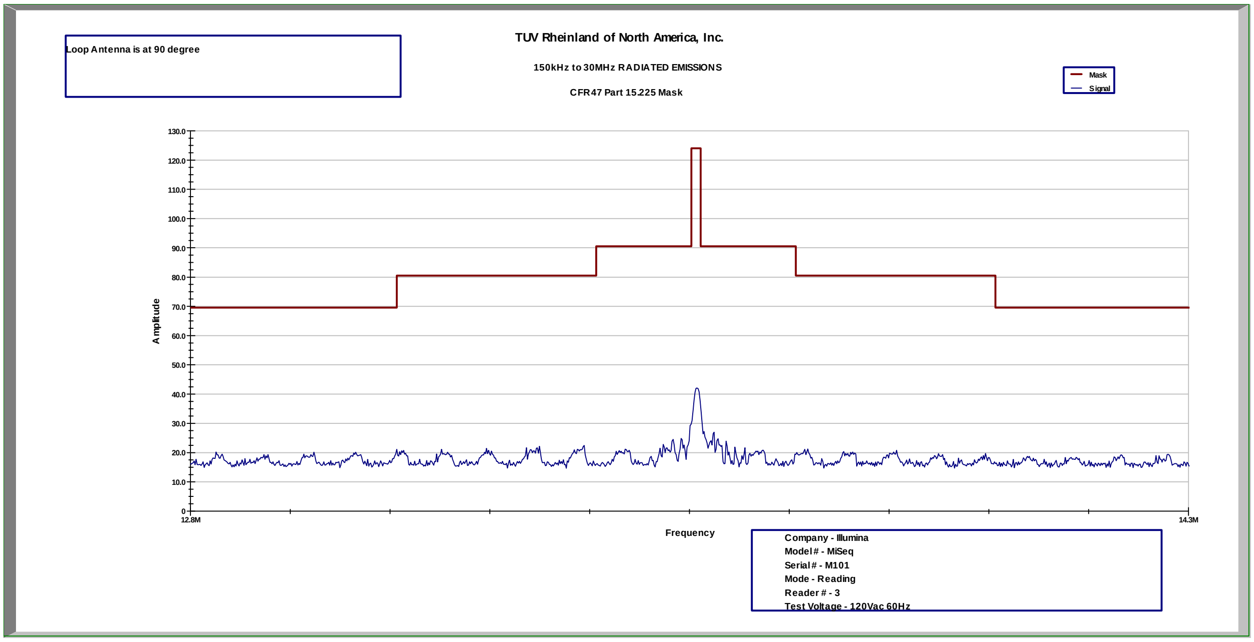


Figure 11: Out of Band Spectrum Mask for RFID #3 – 0 Degree Loop Antenna

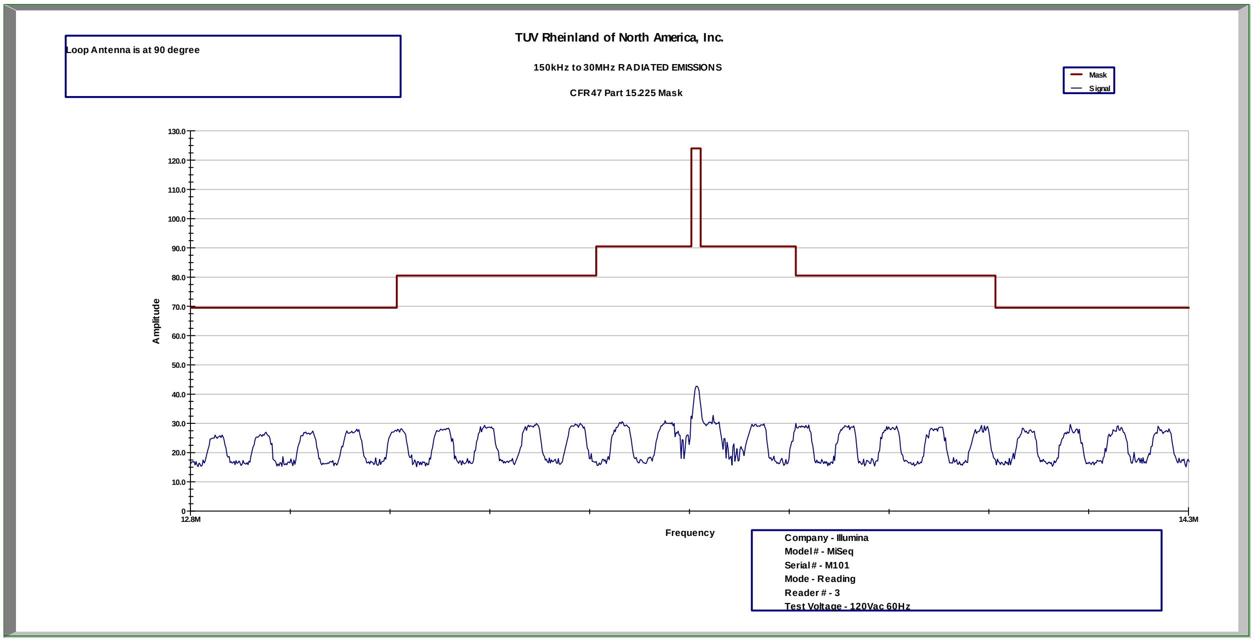


Figure 12: Out of Band Spectrum Mask for RFID #3 – 90 Degree Loop Antenna

4.4 Maximum Permissible Exposure

4.4.1 Test Methodology

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for the basic restrictions to human exposure specified in FCC 1.1310 Table 1 is followed. The average emitting power of the apparatus is determined through the RFIDs' field strength and product's normal loading condition.

4.4.2 RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1	30

F = Frequency in MHz

4.4.3 EUT Operating Condition

The software provided by Manufacturer enabled the EUT to transmit at the regulated power for all 3 RFIDs; The chipset output power was 100 mW using 9.1.6 FPGA firmware.

4.4.4 Classification

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in user's manual. So, this device is classified as a **Mobile Device**.

4.4.5 Test Results

4.4.5.1 Antenna Gain

The transmitting antenna was integrated or attached. Carrier field strength of each RFID was measured.

4.4.5.2 Duty Cycle

All RFIDs duty cycles were recorded. The minimum duty cycle was observed at 52.8% or 0.528 (numeric).

Duty Cycle Factor is calculated and applied for averaging over time.

Duty Cycle Factor = 10*Log(0.528) = -2.77 dB

4.4.5.3 Distance Correction Factor

Distance Correction Factor was used to extrapolate the measured field strength to 20cm. Per CFR47 Part 15.31, 40 dB/decade was used.

Distance Correction Factor = 40*Log(3/0.2) = 47.04 dB.

4.4.5.4 MPE Limit

General population limit is used for worse case.

Limit: 1.34 MHz to 30MHz = 824/13.56 (MHz) = 60.77 V/m = 155.67 dBuV/m.

4.4.5.5 Maximum Permissible Exposure Calculation

As calculated, the EUT was found to be compliant to the requirements of the test standard(s).

Radio	Freq. (MHz)	Field Strength (dBuV/m)	Dist. Factor (dB)	Duty Cycle (dB)	Ave. Field Strength (dBuV/m)	Limit (dBuV/m)	Margin (dB)
RFID #1	13.56	73.32	47.04	-2.77	123.13	155.67	-32.54
RFID #2	13.56	57.33	47.04	-2.77	107.14	155.67	-48.53
RFID #3	13.56	43.20	47.04	-2.77	93.01	155.67	-62.66
Comment: All 3 RFID main carriers are met per FCC 1.1310 Table 1 to the general population							

4.5 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.225(d), RSS GEN Sect. 6

4.5.1 Test Methodology

4.5.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.5.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

The final spurious emission scans performed on the X-Axis for three RFIDs.

4.5.1.3 Deviations

None.

4.5.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2010 and RSS GEN 6.1: 2010.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490......................	2400/F(kHz)	300
0.490-1.705......................	24000/F(kHz)	30
1.705-30.0.......................	30	30
30-88............................	100 **	3
88-216...........................	150 **	3
216-960..........................	200 **	3
Above 960........................	500	3

4.5.3 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

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EUT Name	MiSeq System	**Date**	August 15, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#1	**Line AC / Freq**	120 Vac / 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / 6511 & JB3	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) Pk (dBuV/m)	FIM QP/Ave (dBuV/m)	Total CF dBuV	E-Field QP/Ave (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
9 kHz to 30MHz										
14.58	90	100	128	33.84	25.05	8.60	33.65	69.50	-35.85	Spurious
15.40	90	100	178	30.99	24.27	8.62	32.89	69.50	-36.61	Spurious
16.25	90	100	180	29.37	20.11	8.64	28.75	69.50	-40.75	Spurious
13.56	90	100	186	64.66	63.30	8.66	71.96	124.00	-52.04	Carrier
0.07	0	100	238	47.22	43.93	11.57	55.50	111.02	-55.52	Spurious
13.56	0	100	91	61.04	60.17	8.57	68.74	124.00	-55.26	Carrier
17.09	0	100	175	26.65	11.24	8.66	19.90	69.50	-49.60	Spurious
20.41	0	100	165	22.77	13.63	8.75	22.38	69.50	-47.12	Spurious
30MHz to 1000MHz										
67.79	H	204	14	52.92	48.27	-16.39	31.88	40.00	-8.12	Spurious
67.92	H	227	8	58.35	53.65	-16.39	37.26	40.00	-2.74	Spurious
79.99	H	252	346	52.62	48.02	-16.15	31.87	40.00	-8.13	Spurious
122.04	H	252	4	45.30	39.13	-9.59	29.54	43.52	-13.98	Spurious
128.75	H	236	358	48.11	44.01	-9.59	34.42	43.52	-9.10	Spurious
140.00	H	228	241	49.34	45.41	-10.33	35.08	43.52	-8.44	Spurious
67.08	V	224	93	57.53	52.27	-16.60	35.67	40.00	-4.33	Spurious
67.80	V	169	150	48.85	46.43	-16.67	29.76	40.00	-10.24	Spurious
130.42	V	234	269	43.95	38.52	-9.63	28.89	43.52	-14.63	Spurious
142.51	V	232	114	41.31	37.50	-10.45	27.05	43.52	-16.47	Spurious

Spec Margin = E-Field QP – Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Note: 1. MiSeq System configured with Cool Master PS, Ferrite bead, Rev. B., 9.1.6 FPGA
2. RBW/VBW Setting:
9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz
30 MHz to 1000 MHz; RBW = 120kHz, VBW = 300kHz

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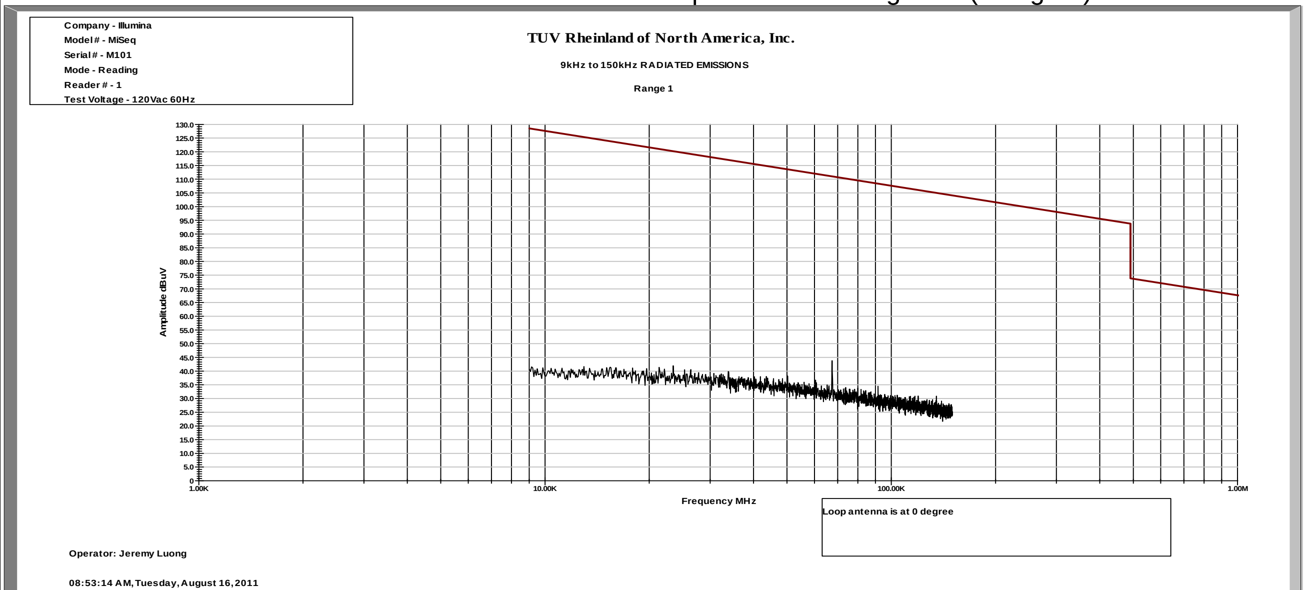
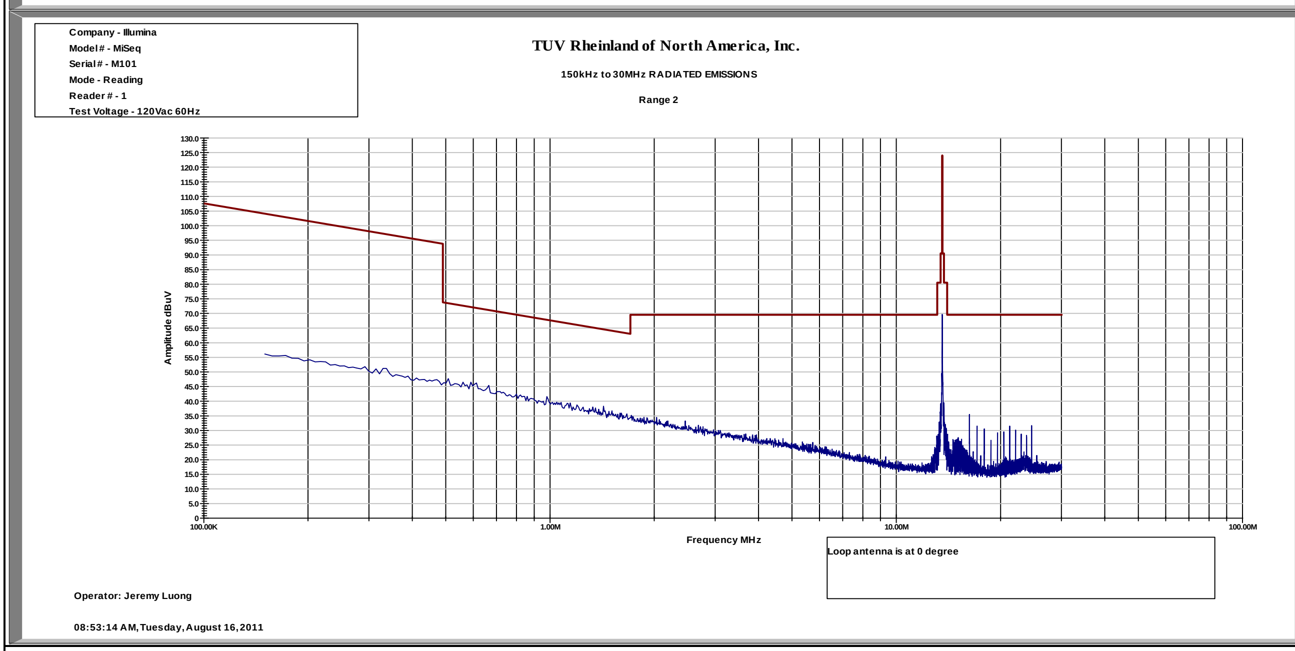
EUT Name	MiSeq System	**Date**	August 16, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#1	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	See below
Dist/Ant Used	3m / 6511	**Performed by**	Jeremy Luong

9 kHz to 30 MHz Plot for RFID #1 at Loop Antenna Facing EUT (0 degree)





Notes: 9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz

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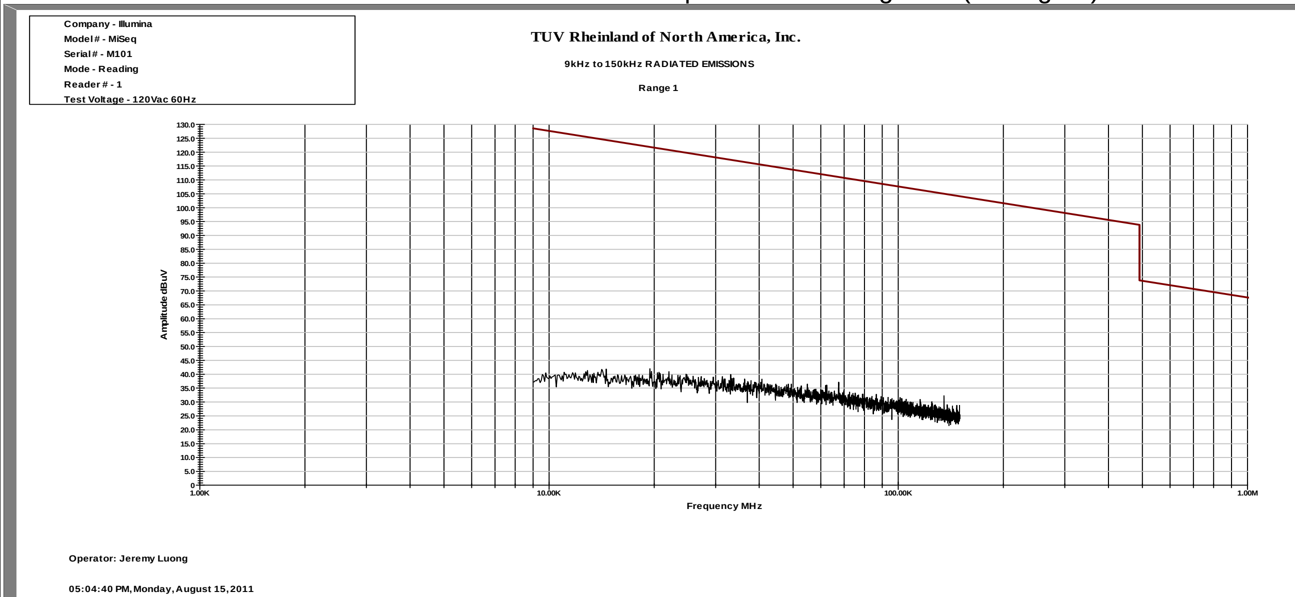
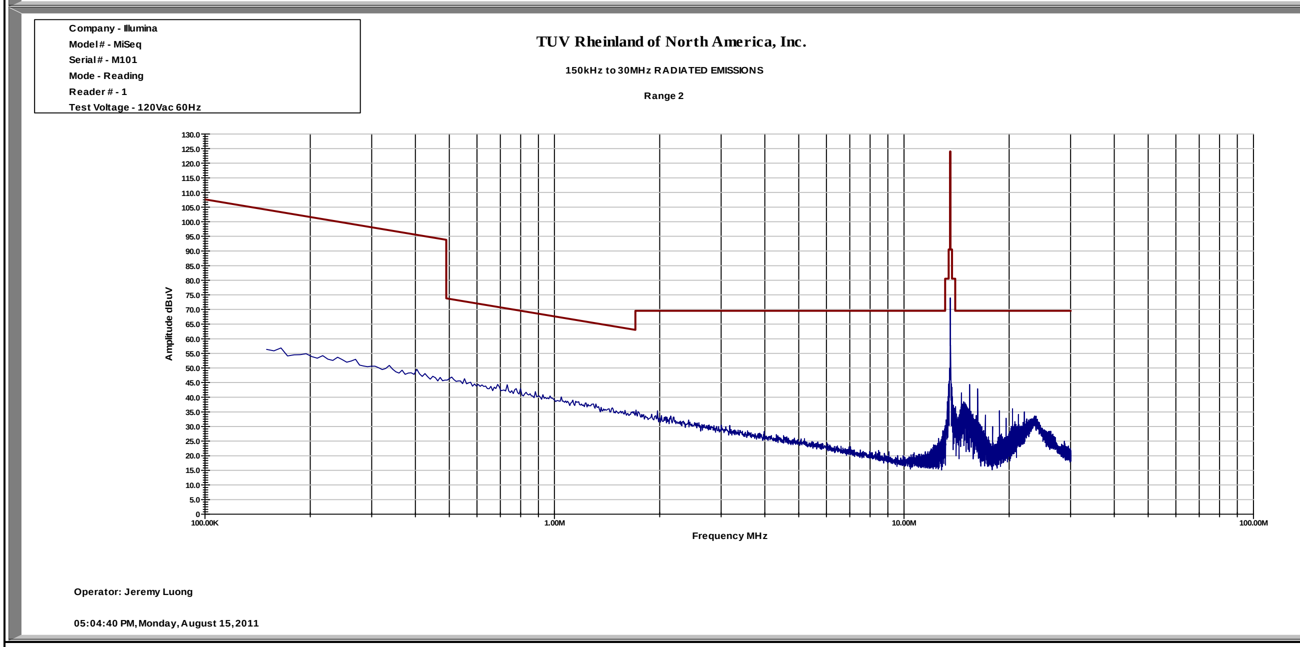
EUT Name	MiSeq System	**Date**	August 15, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#1	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	See below
Dist/Ant Used	3m / 6511	**Performed by**	Jeremy Luong

9 kHz to 30 MHz Plot for RFID #1 at Loop Antenna Facing EUT (90 degree)





Notes: 9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz

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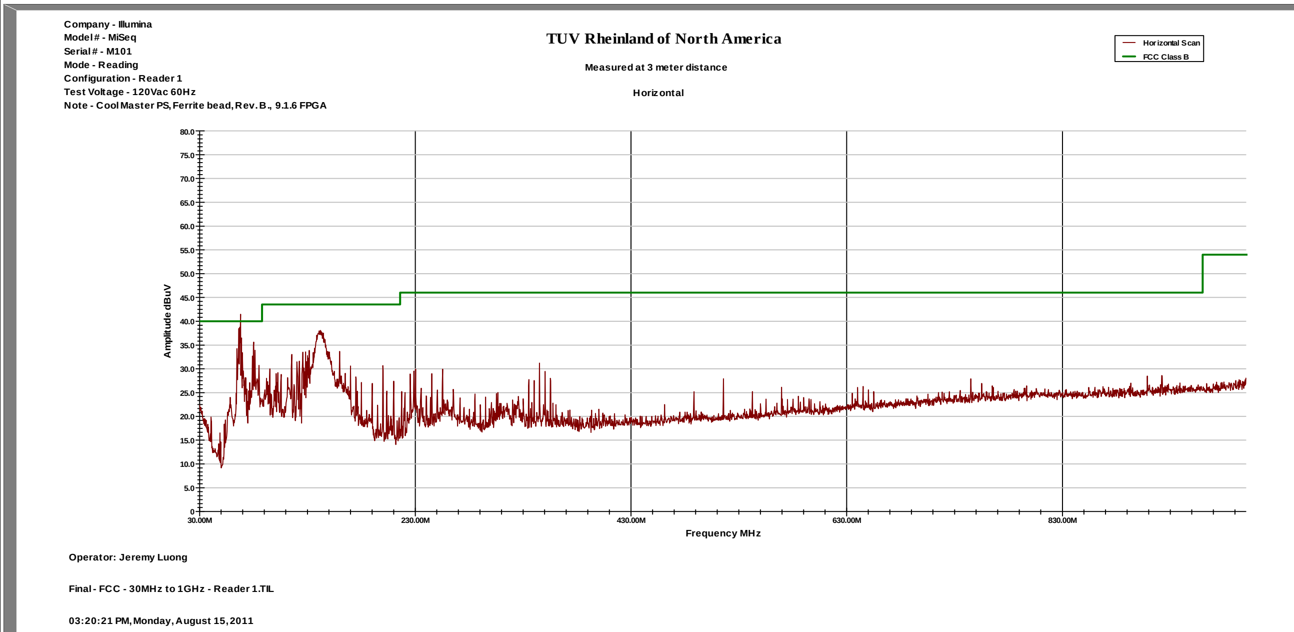
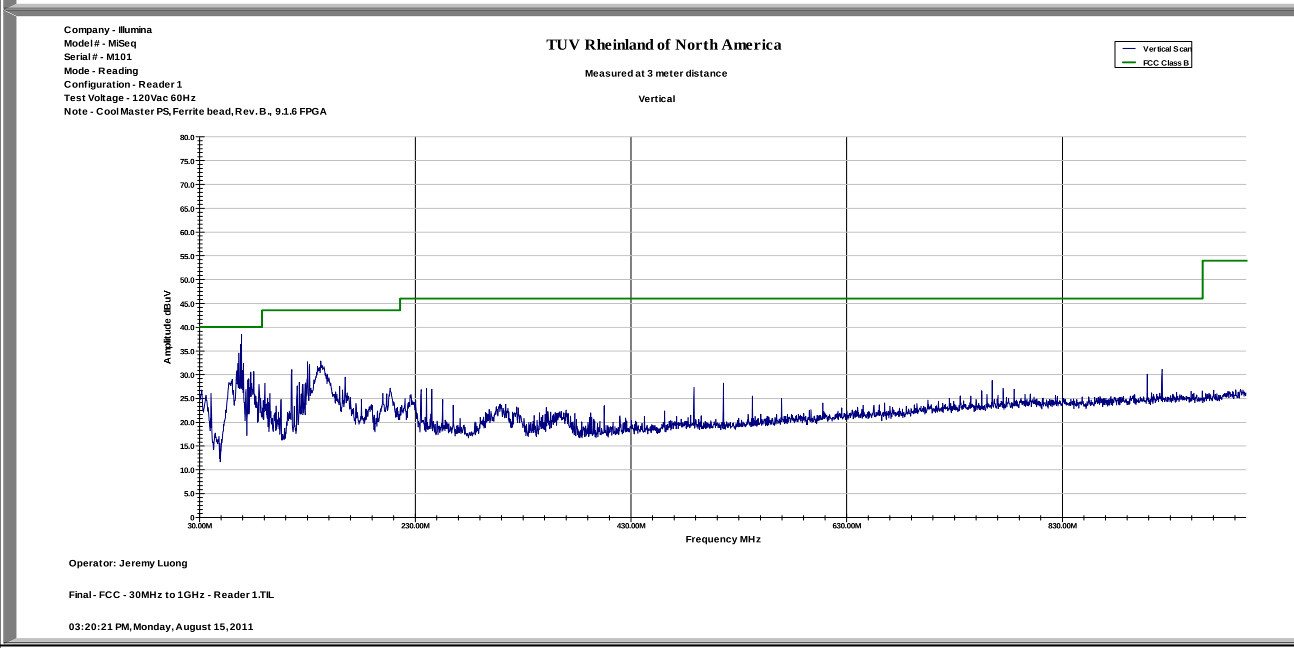
EUT Name	MiSeq System	**Date**	August 15, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#1	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

30MHz to 1000MHz Plot for RFID #1





Notes: The scan was in the peak detector. Final measurement using QP is on Page 34.

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EUT Name	MiSeq System	**Date**	August 15, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#2	**Line AC / Freq**	120 Vac / 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / 6511 & JB3	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) Pk (dBuV/m)	FIM QP/Ave (dBuV/m)	Total CF dBuV	E-Field QP/Ave (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
9 kHz to 30MHz										
0.07	0	100	232	48.00	43.35	11.57	54.92	111.02	-56.10	Spurious
12.92	0	100	127	29.52	19.66	8.55	28.21	69.50	-41.29	Spurious
13.56	0	100	126	48.76	48.40	8.57	56.97	124.00	-67.03	Carrier
16.25	0	100	180	32.46	21.84	8.64	30.48	69.50	-39.02	Spurious
13.56	90	100	375	47.27	46.60	8.57	55.17	124.00	-68.83	Carrier
14.58	90	100	187	42.23	32.52	8.60	41.12	69.50	-28.38	Spurious
17.08	90	100	135	34.18	22.72	8.66	31.38	69.50	-38.12	Spurious
30MHz to 1000MHz										
92.07	H	298	39	53.16	46.51	-15.97	30.54	43.52	-12.98	Spurious
94.92	H	328	84	47.12	45.02	-15.35	29.67	43.52	-13.85	Spurious
128.75	H	215	169	50.85	45.22	-9.59	35.63	43.52	-7.89	Spurious
160.00	H	203	210	45.23	42.99	-10.92	32.07	43.52	-11.45	Spurious
92.91	V	214	298	49.26	43.07	-15.00	28.07	43.52	-15.45	Spurious
95.00	V	226	280	42.53	39.91	-14.64	25.27	43.52	-18.25	Spurious
122.08	V	217	225	43.91	35.73	-9.78	25.95	43.52	-17.57	Spurious
131.24	V	237	4	44.60	36.14	-9.67	26.47	43.52	-17.05	Spurious

Spec Margin = E-Field QP – Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Note: 1. MiSeq System configured with Cool Master PS, Ferrite bead, Rev. B., 9.1.6 FPGA
2. RBW/VBW Setting:
9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz
30 MHz to 1000 MHz; RBW = 120kHz, VBW = 300kHz

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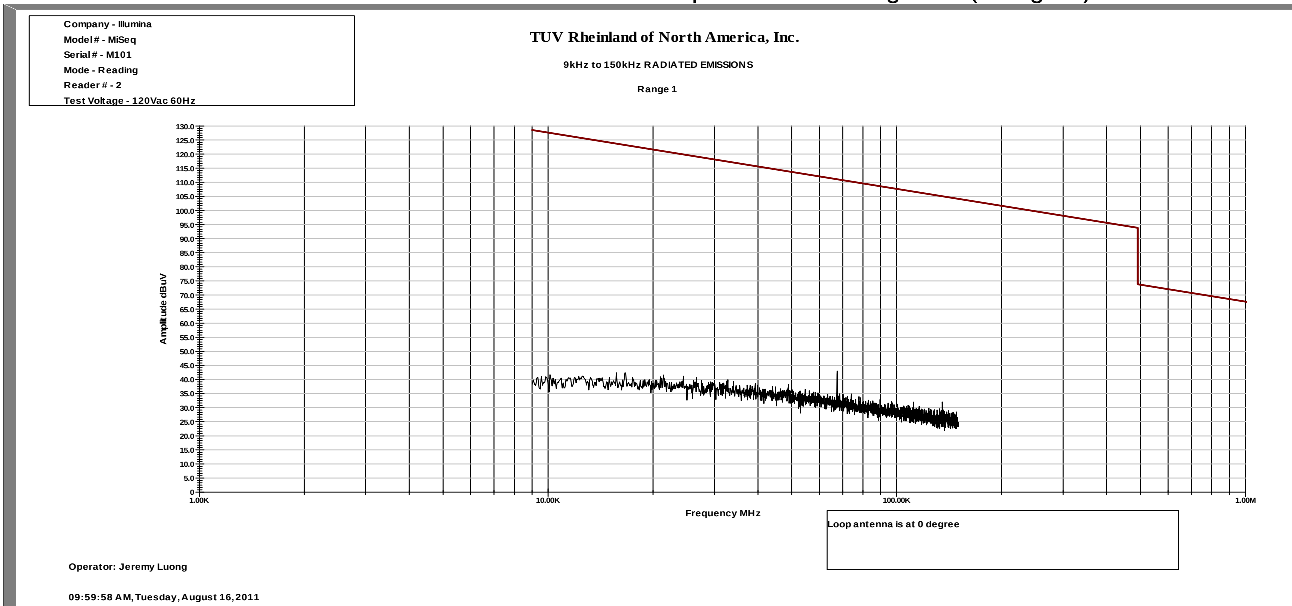
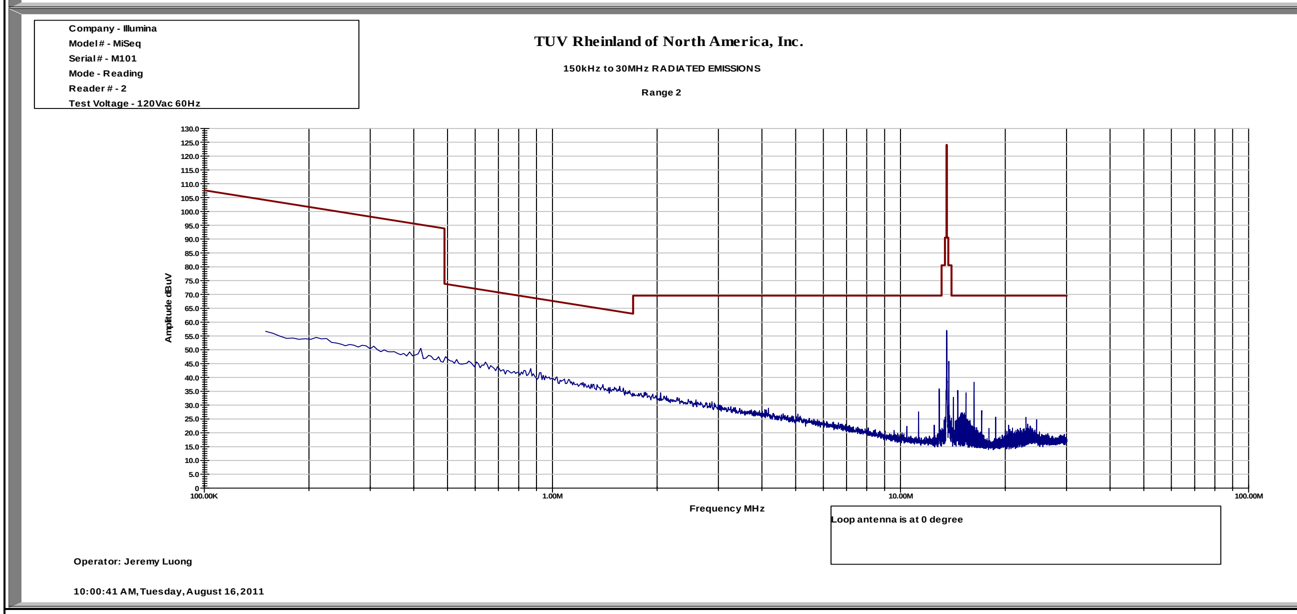
EUT Name	MiSeq System	**Date**	August 16, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#2	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	See below
Dist/Ant Used	3m / 6511	**Performed by**	Jeremy Luong

9 kHz to 30 MHz Plot for RFID #2 at Loop Antenna Facing EUT (0 degree)





Notes: 9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz

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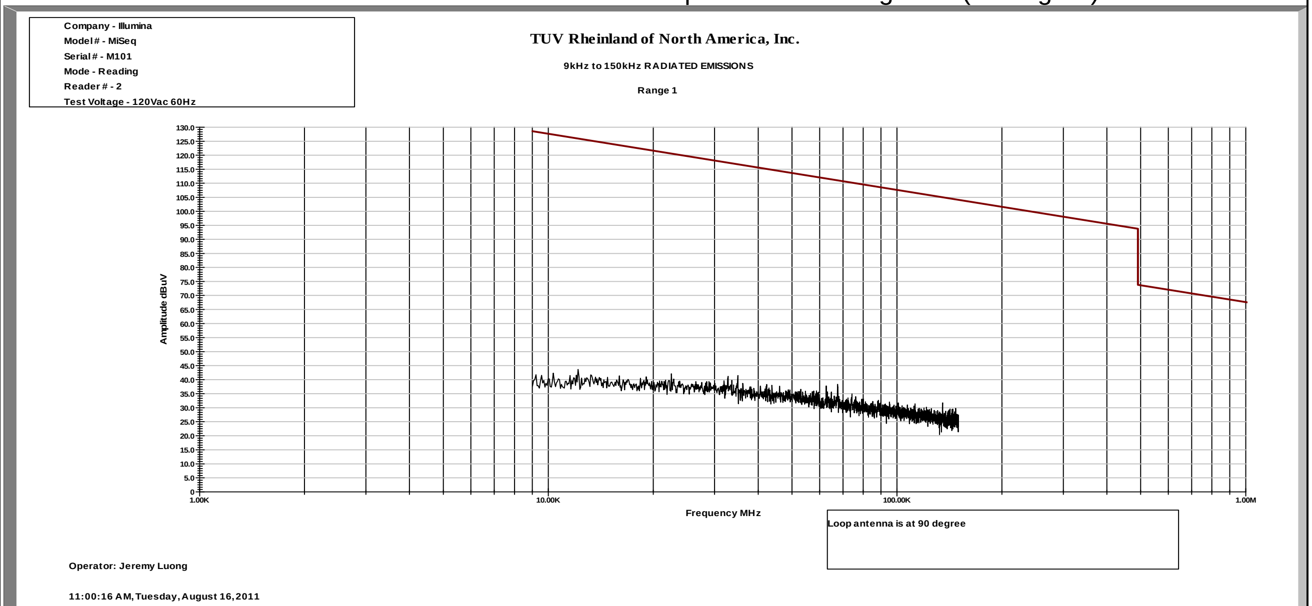
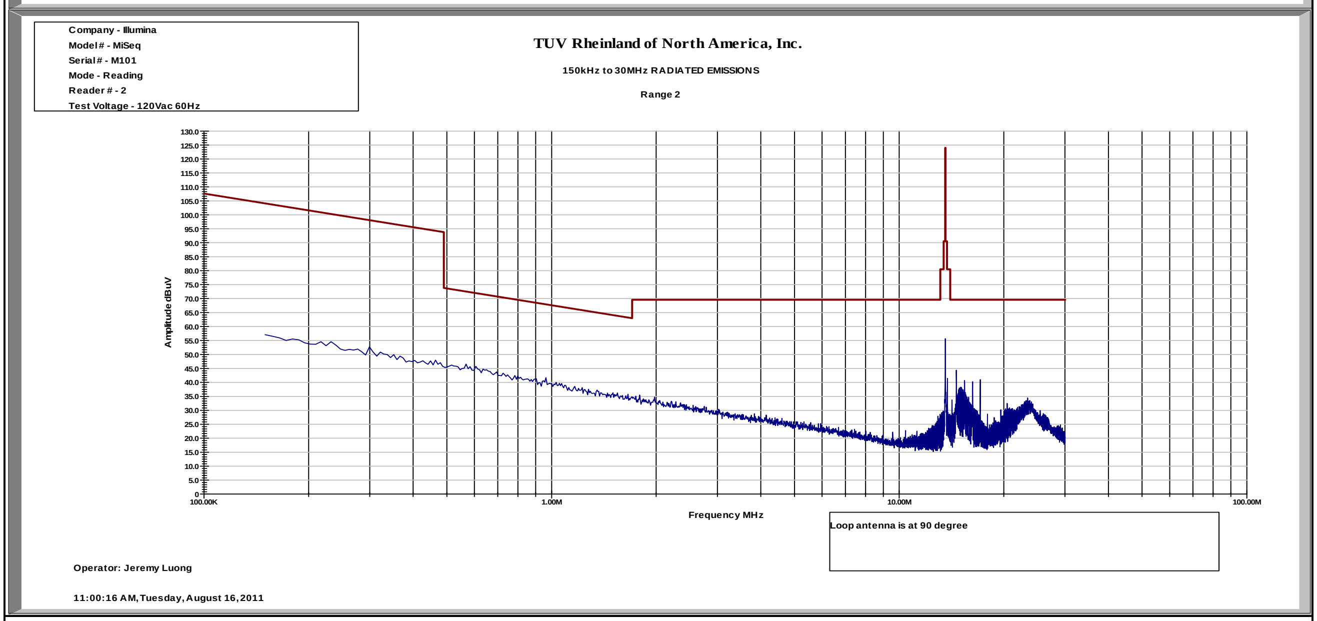
EUT Name	MiSeq System	**Date**	August 15, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#2	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	See below
Dist/Ant Used	3m / 6511	**Performed by**	Jeremy Luong

9 kHz to 30 MHz Plot for RFID #2 at Loop Antenna Facing EUT (90 degree)





Notes: 9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz

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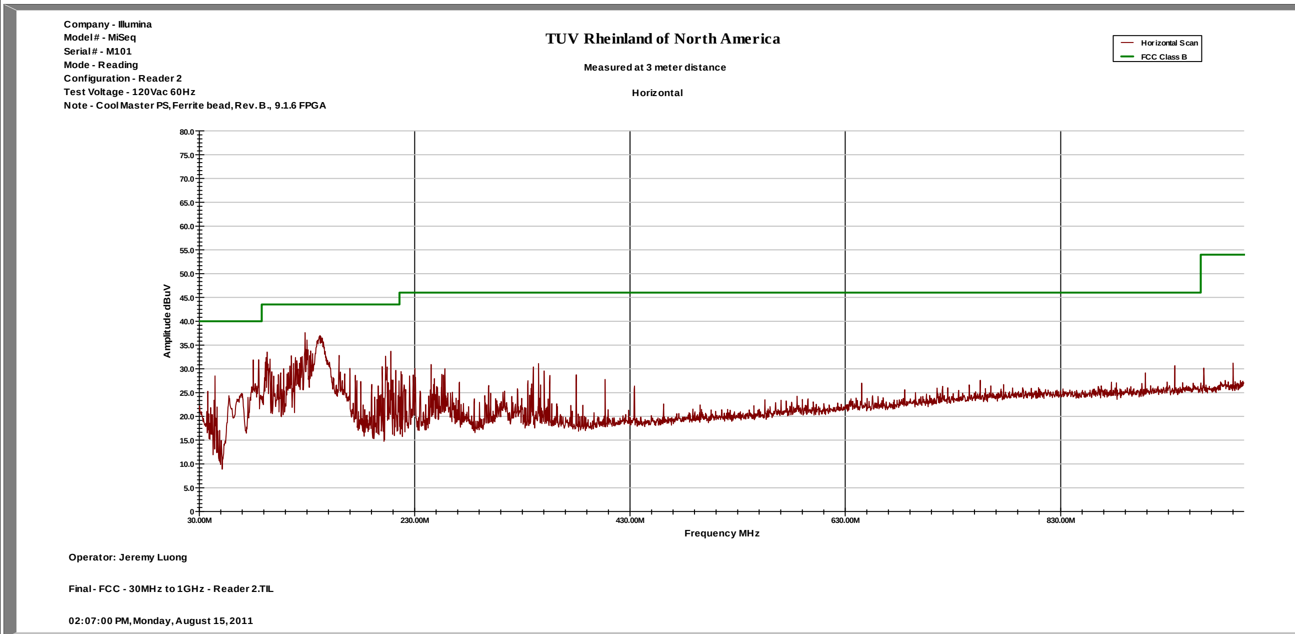
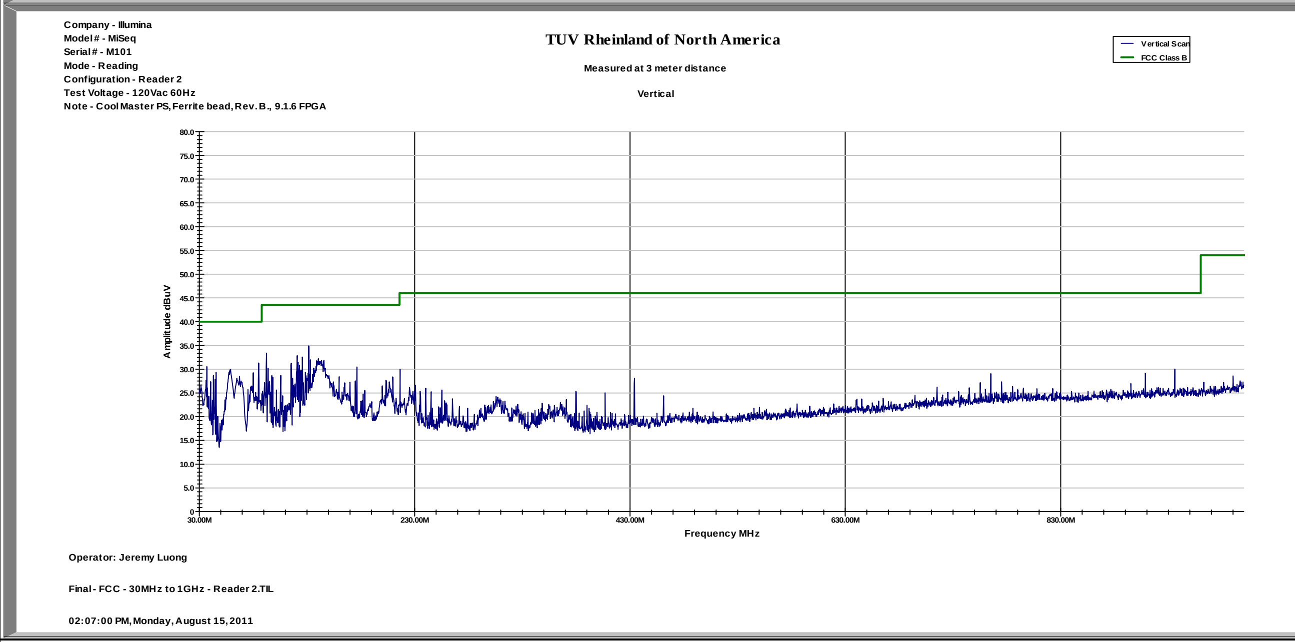
EUT Name	MiSeq System	**Date**	August 15, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#2	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

30MHz to 1000MHz Plot for RFID #2





Notes: None.

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EUT Name	MiSeq System	**Date**	August 15, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#3	**Line AC / Freq**	120 Vac / 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / 6511 & JB3	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) Pk (dBuV/m)	FIM QP (dBuV/m)	Total CF dBuV	E-Field QP (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
9 kHz to 30MHz										
13.56	90	100	178	34.63	33.68	8.57	42.25	124.00	-81.75	Carrier
15.20	90	100	126	29.50	26.92	8.61	35.53	69.50	-33.97	Spurious
23.52	90	100	235	25.05	19.68	8.82	28.50	69.50	-41.00	Spurious
13.56	0	100	86	33.64	32.64	8.57	41.21	124.00	-82.79	Carrier
15.01	0	100	148	18.00	15.62	8.61	24.23	69.50	-45.27	Spurious
25.42	0	100	92	20.54	10.01	8.87	18.88	69.50	-50.62	Spurious
30MHz to 1000MHz										
94.92	H	272	55	48.91	47.24	-15.35	31.89	43.52	-11.63	Spurious
122.03	H	188	116	46.93	46.60	-9.59	37.01	43.52	-6.51	Spurious
141.28	H	219	75	49.17	44.19	-10.44	33.75	43.52	-9.77	Spurious
94.92	V	107	164	46.15	44.82	-14.66	30.16	43.52	-13.36	Spurious
122.04	V	103	289	44.38	43.96	-9.78	34.18	43.52	-9.34	Spurious
135.59	V	100	234	44.15	41.85	-9.87	31.98	43.52	-11.54	Spurious
298.32	V	133	173	42.16	40.79	-8.85	31.94	46.02	-14.08	Spurious

Spec Margin = E-Field QP – Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Note: 1. MiSeq System configured with Cool Master PS, Ferrite bead, Rev. B., 9.1.6 FPGA
2. RBW/VBW Setting:
9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz
30 MHz to 1000 MHz; RBW = 120kHz, VBW = 300kHz

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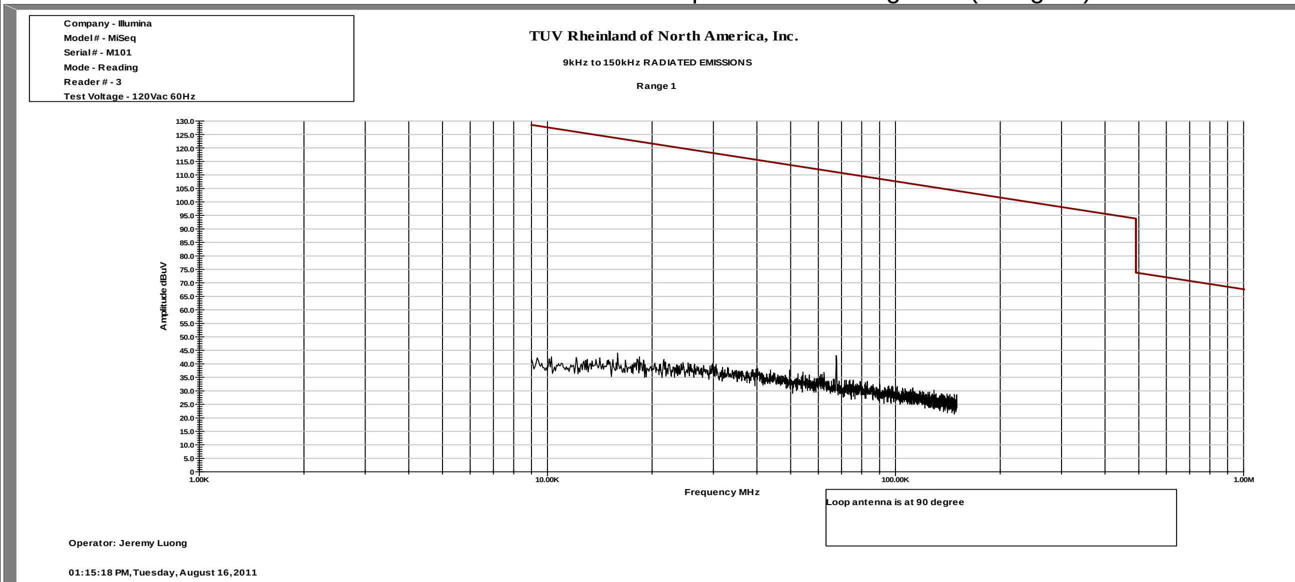
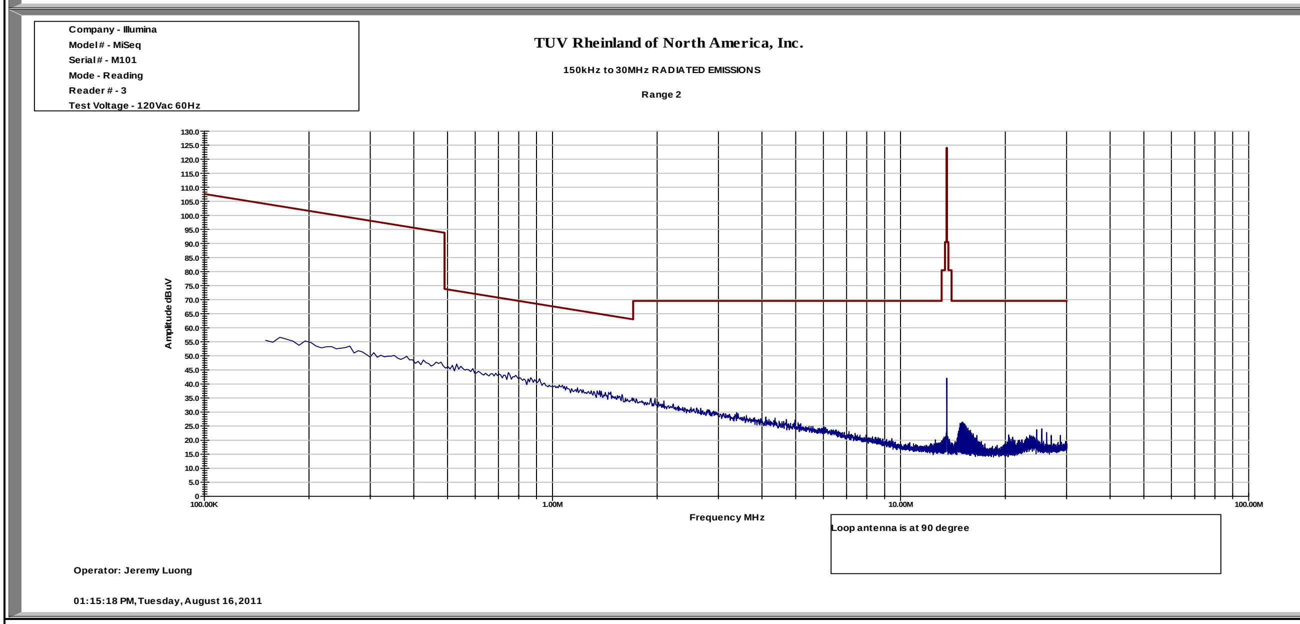
EUT Name	MiSeq System	**Date**	August 16, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#3	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	See below
Dist/Ant Used	3m / 6511	**Performed by**	Jeremy Luong

9 kHz to 30 MHz Plot for RFID #3 at Loop Antenna Facing EUT (0 degree)





Notes: 9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz

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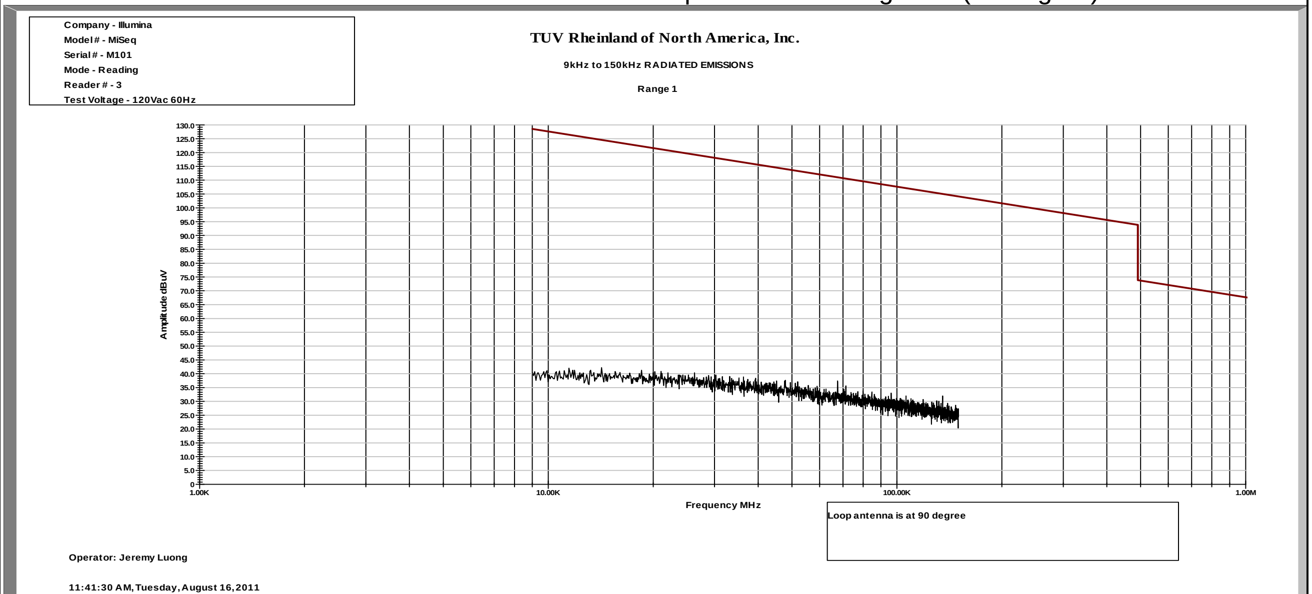
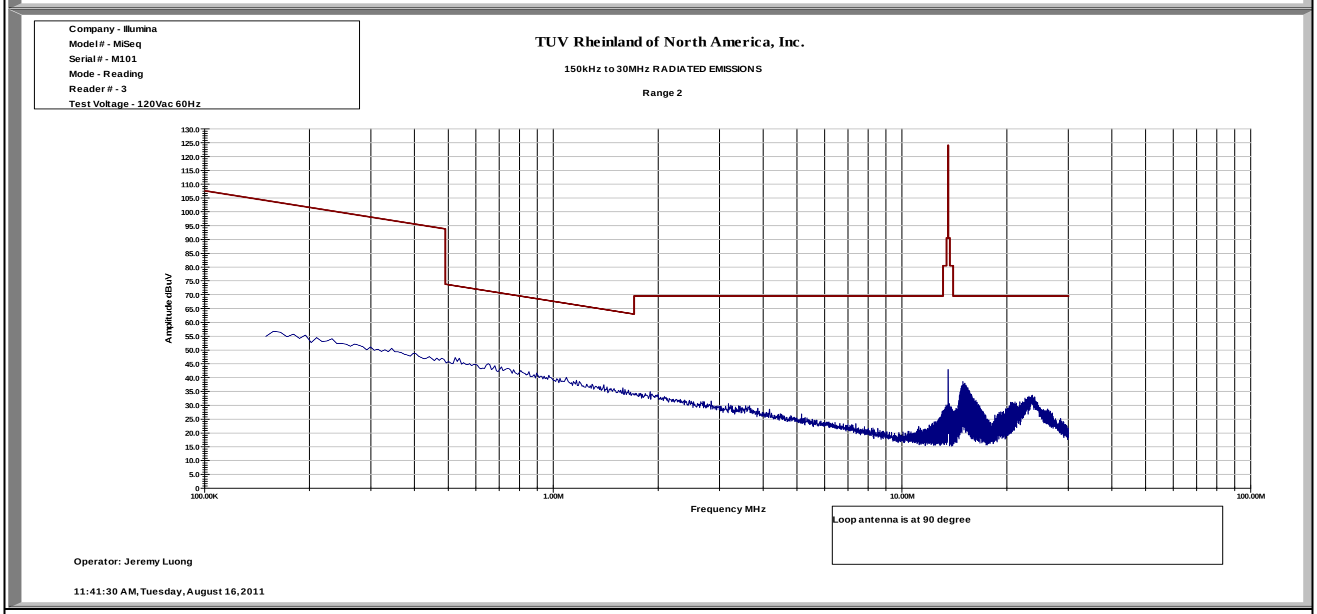
EUT Name	MiSeq System	**Date**	August 16, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#3	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	See below
Dist/Ant Used	3m / 6511	**Performed by**	Jeremy Luong

9 kHz to 30 MHz Plot for RFID #3 at Loop Antenna Facing EUT (90 degree)





Notes: 9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz

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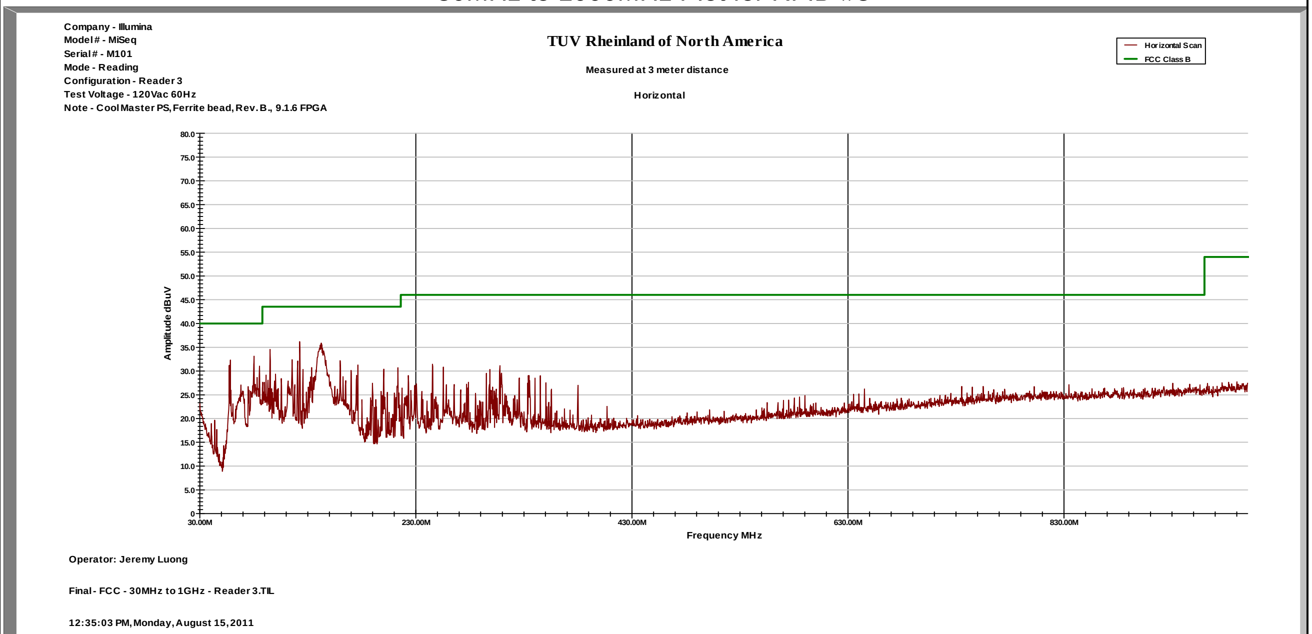
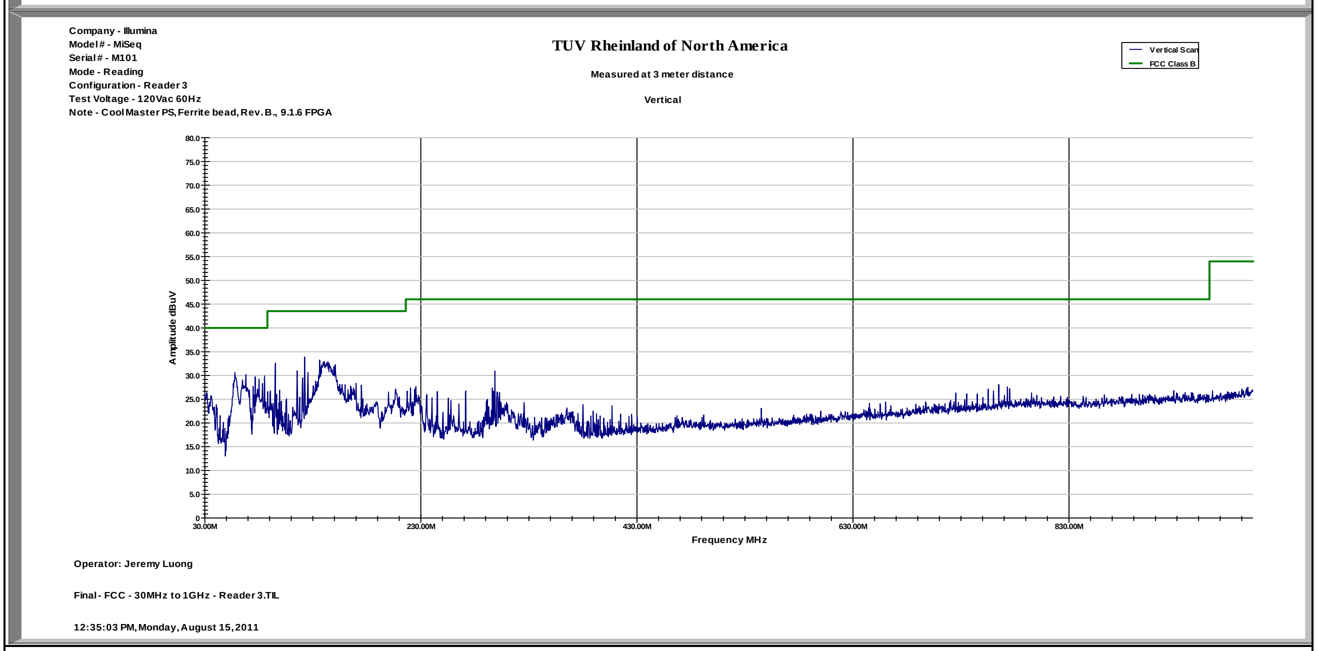
EUT Name	MiSeq System	**Date**	August 15, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID#3	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

30MHz to 1000MHz Plot for RFID #3





Notes: None.

4.5.4 Sample Calculation

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = FIM - AMP + CBL + ACF

Where: FIM = Field Intensity Meter (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

4.6 Receiver Spurious Emissions

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

The spurious emissions of the receiver shall not exceed the values in CFR47 Part 15.109 and RSS 210 Sect 2.7.

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.6.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

The final scans performed on all RFID in received mode with MiSeq System position in X-Axis.

4.6.1.3 Deviations

None.

4.6.2 Receiver Spurious Emission Limit

The spurious emissions of the receiver shall not exceed the values in CFR47 Part 15.109: 2010 and RSS-GEN Sect. 6: 2010.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490......................	2400/F(kHz)	300
0.490-1.705......................	24000/F(kHz)	30
1.705-30.0.......................	30	30
30-88............................	100 **	3
88-216...........................	150 **	3
216-960..........................	200 **	3
Above 960........................	500	3

According to CFR47 Part 15.31, measurements would be extrapolated to 40 dB/decade for frequency below 30MHz and 20 dB/decade for frequency above 30 MHz.

4.6.3 Test Results

The final measurement data indicates the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

4.6.3.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and without any modifications or special accessories implemented as the manufacturer intends.

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EUT Name	MiSeq System	**Date**	August 16, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	All 3 RFIDs in RX Mode	**Line AC / Freq**	120V/60Hz
Standard	CFR47 Part 15 Subpart B	**RBW / VBW**	See notes below
Dist/Ant Used	3m / 6511 & JB3	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) Pk (dBuV/m)	FIM QP (dBuV/m)	Total CF dBuV	E-Field QP (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
9 kHz to 30 MHz with All RFIDs in Receive Mode										
0.0676	0	100	236	46.00	42.43	11.57	54.00	111.02	-57.02	Spurious
15.0025	0	100	237	17.79	14.55	8.61	23.16	69.50	-46.34	Spurious
15.0725	0	100	241	17.08	14.41	8.61	23.02	69.50	-46.48	Spurious
14.9975	90	100	184	29.09	26.77	8.61	35.38	69.50	-34.12	Spurious
15.0725	90	100	167	30.31	27.89	8.61	36.50	69.50	-33.00	Spurious
23.4000	90	100	115	25.21	19.45	8.82	28.27	69.50	-41.23	Spurious
30 MHz to 1000 MHz with All RFIDs in Receive Mode										
79.97	H	231	16	51.40	47.81	-16.15	31.66	40.00	-8.34	Spurious
115.00	H	189	232	42.94	41.28	-10.40	30.88	43.52	-12.64	Spurious
138.83	H	220	221	51.68	47.93	-10.23	37.70	43.52	-5.82	Spurious
141.00	H	184	226	54.47	48.58	-10.41	38.17	43.52	-5.35	Spurious
57.50	V	123	197	46.04	43.40	-16.57	26.83	40.00	-13.17	Spurious
135.00	V	99	224	46.27	43.40	-9.83	33.57	43.52	-9.95	Spurious
145.03	V	94	322	47.99	44.28	-10.60	33.68	43.52	-9.84	Spurious
298.32	V	133	173	42.16	40.79	-8.85	31.94	46.02	-14.08	Spurious

Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor

Combined Standard Uncertainty $u_c(y)$ = ± 3.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Note: 1. MiSeq System configured with Cool Master PS, Ferrite bead, Rev. B., 9.1.6 FPGA
2. RBW/VBW Setting:
9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz
30 MHz to 1000 MHz; RBW = 120kHz, VBW = 300kHz

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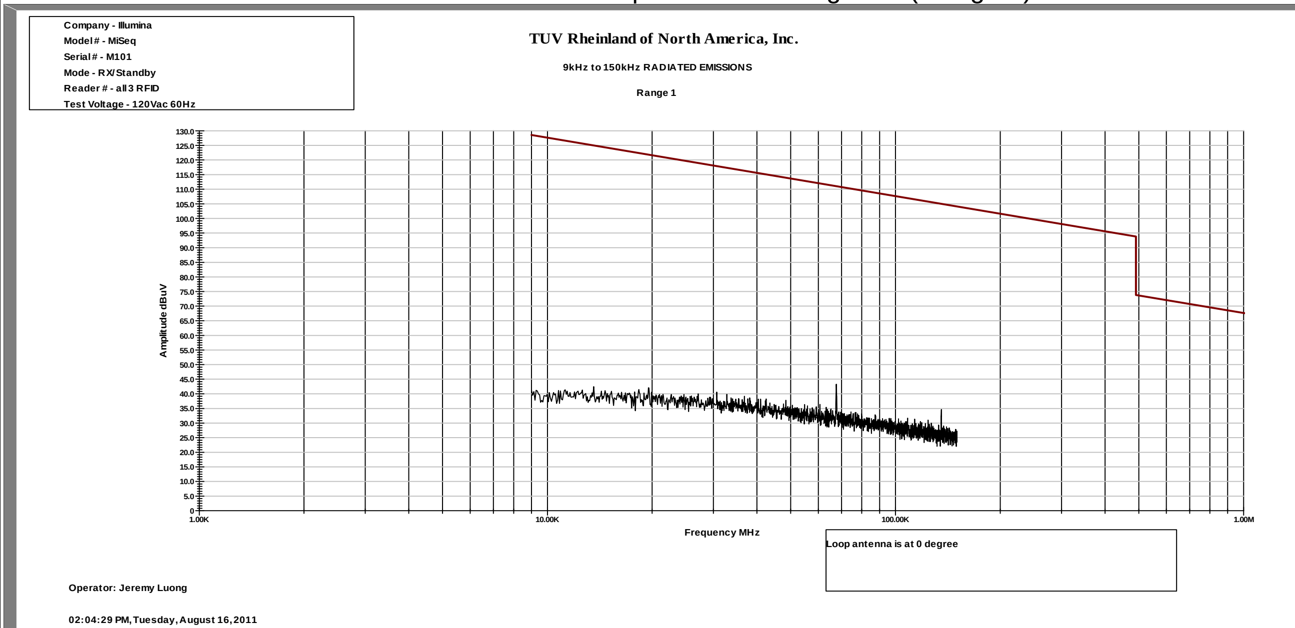
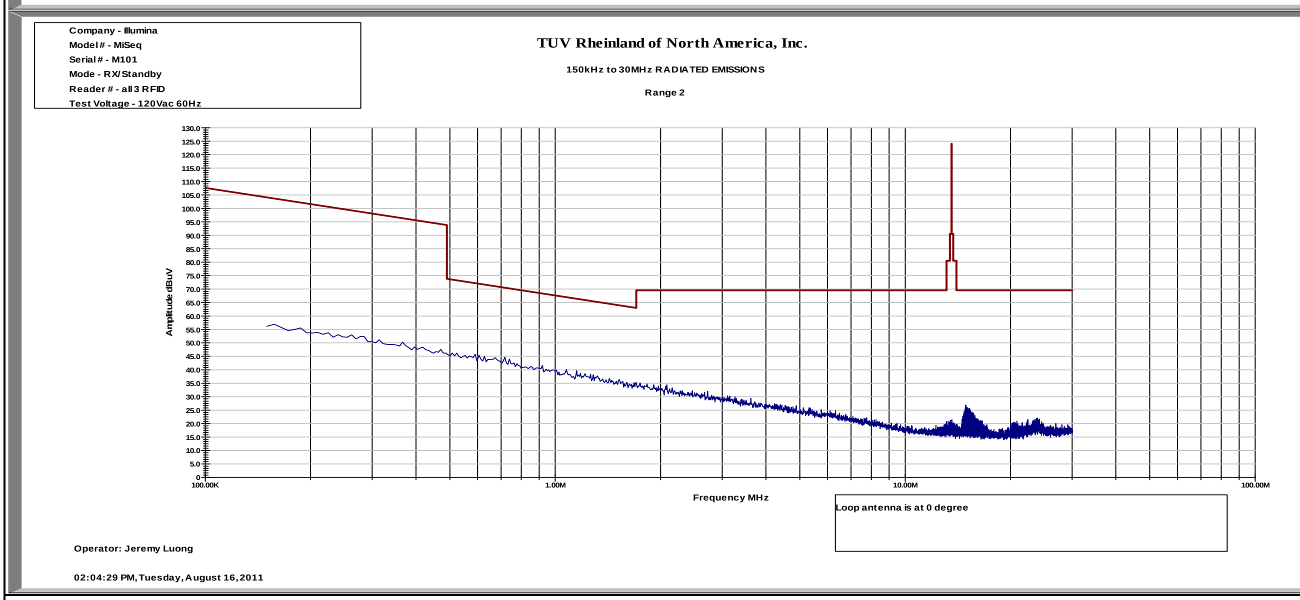
EUT Name	MiSeq System	**Date**	August 16, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	All 3 RFIDs in RX Mode	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart B	**RBW / VBW**	See below
Dist/Ant Used	3m / 6511	**Performed by**	Jeremy Luong

9 kHz to 30 MHz Plot with Loop Antenna Facing EUT (0 degree)





Notes: 9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz

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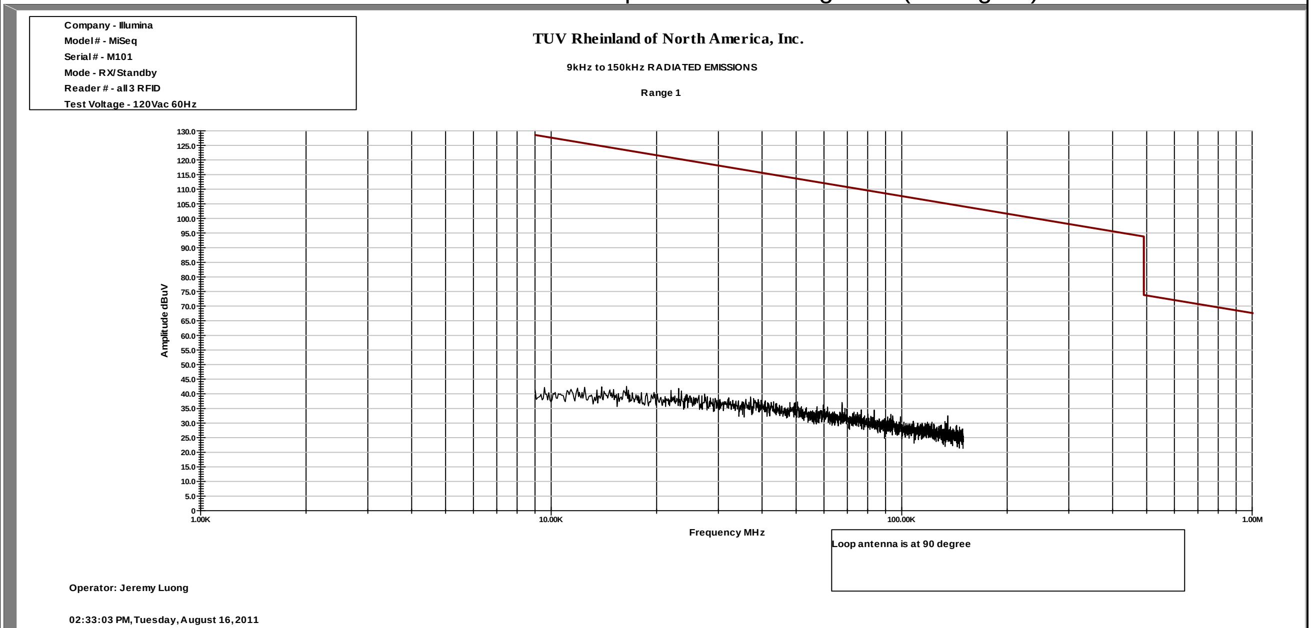
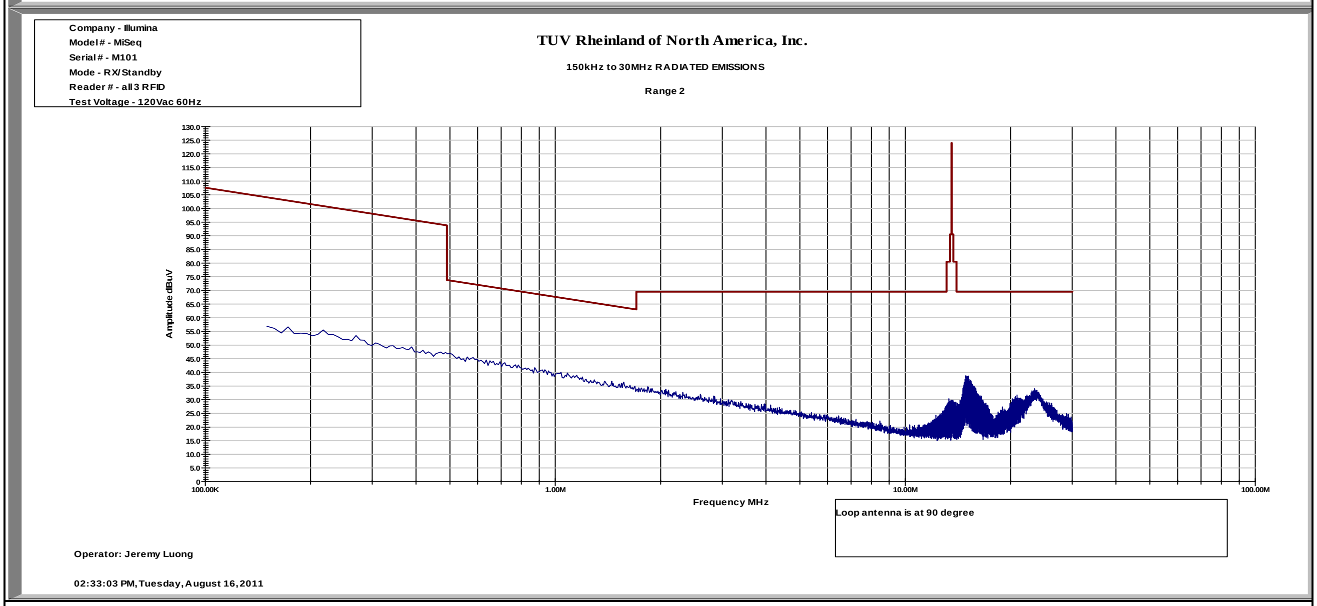
EUT Name	MiSeq System	**Date**	August 16, 2011
EUT Model	MiSeq System	**Temp / Hum in**	22°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	All 3 RFIDs in RX Mode	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart B	**RBW / VBW**	See below
Dist/Ant Used	3m / 6511	**Performed by**	Jeremy Luong

9 kHz to 30 MHz Plot with Loop Antenna Facing EUT (90 degree)





Notes: 9 kHz to 150 kHz; RBW = 200Hz, VBW = 1kHz
150 kHz to 30 MHz; RBW = 9kHz, VBW = 30kHz

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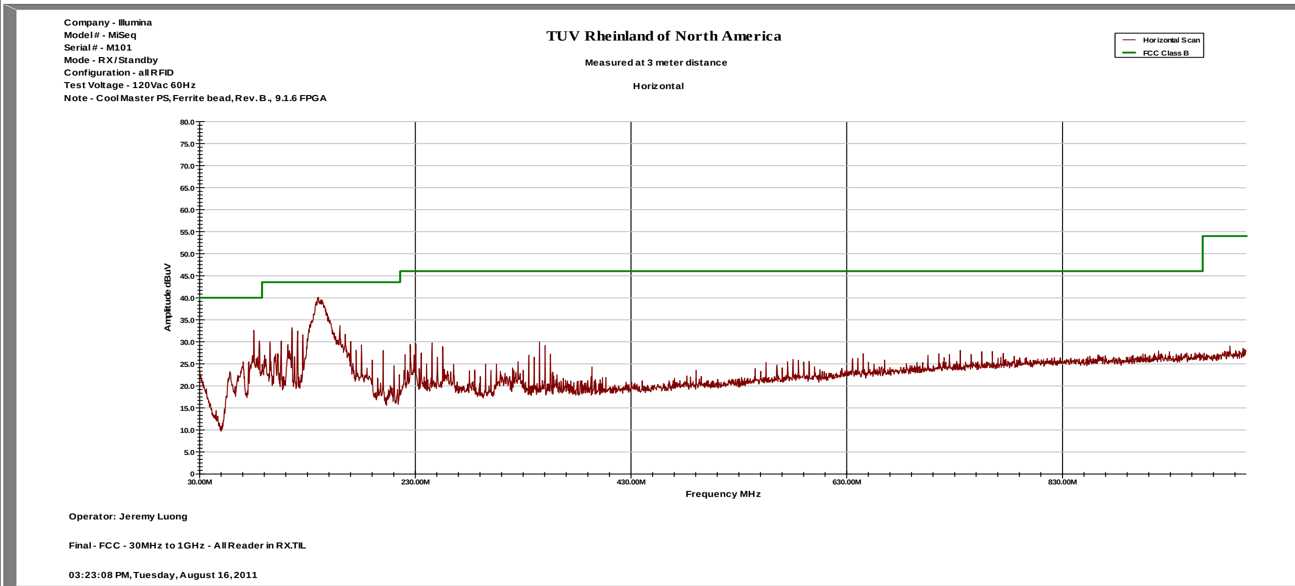
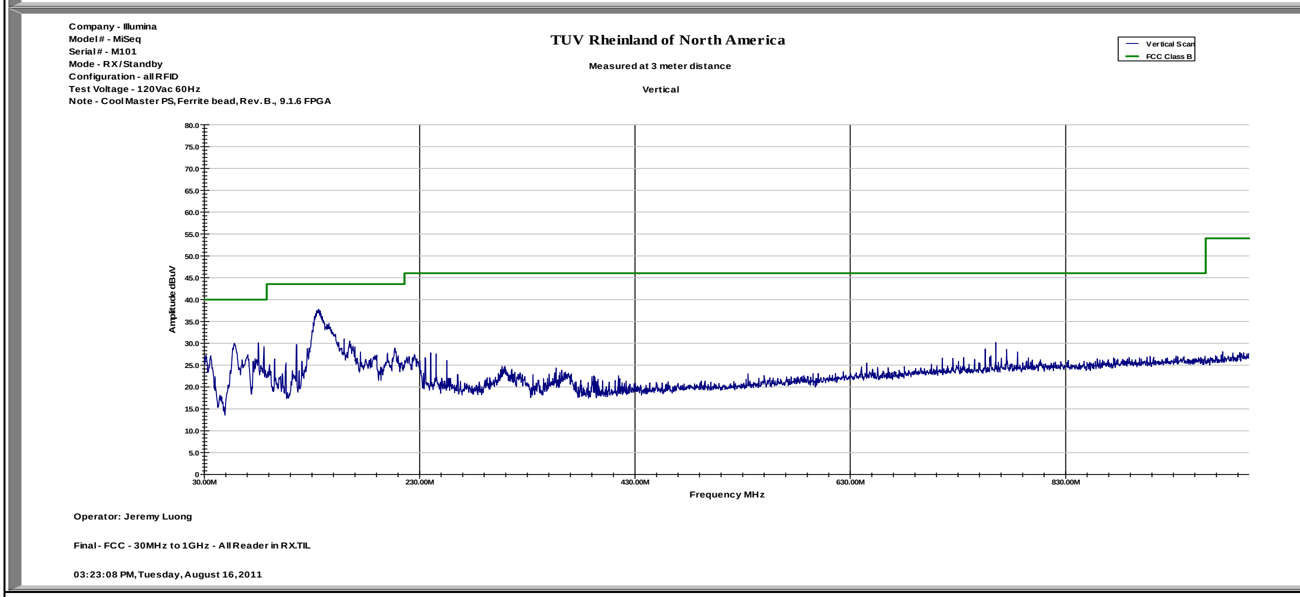
EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23°C / 37%rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	All 3 RFIDs in RX Mode	**Line AC**	120V/60Hz
Standard	CFR47 Part 15 Subpart B	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

30MHz to 1000MHz Plots





Notes: None.

4.7 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4: 2003. These test methods are listed under the laboratory's NVLAP Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2010 and RSS 210: 2010.

4.7.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50µH / 50Ω LISNs.

Testing is either performed in 5m Chamber. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.7.1.1 Deviations

There were no deviations from this test methodology.

4.7.2 Test Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 8: AC Conducted Emissions – Test Results

Test Conditions: Conducted Measurement at Normal Conditions only		
Antenna Type: Detached / Attached	**Power Level:** Fix (9.1.6 FPGA)	
AC Power: 120 Vac/60 Hz	**Configuration:** Tabletop	
Ambient Temperature: 22° C	**Relative Humidity:** 37% RH	
Configuration	**Frequency Range**	**Test Result**
Line 1 (Hot)	0.15 to 30 MHz	Pass
Line 2 (Neutral)	0.15 to 30 MHz	Pass

SOP 2 Conducted Emissions

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EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #1 with Attached Antenna	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber /ComPower, Line 1	**Performed by**	Jeremy Luong

Frequency	**Quasi-Peak**	**Average**	**QP Limit**	**Ave Limit**	**QP Margin**	**Ave Margin**
MHz	**dBuV**	**dBuV**	**dBuV**	**dBuV**	**dB**	**dBuV**
0.198	39.78	8.47	64.64	54.64	-24.86	-46.18
0.198	39.69	29.52	64.64	54.64	-24.95	-25.12
0.270	38.83	30.52	62.57	52.57	-23.74	-22.06
1.621	31.63	30.63	56.00	46.00	-24.37	-15.37
7.760	38.87	36.63	60.00	50.00	-21.13	-13.38
13.560	53.87	46.63	60.00	50.00	-6.13	-3.37
13.629	45.60	40.32	60.00	50.00	-14.40	-9.68
15.382	42.73	37.70	60.00	50.00	-17.27	-12.30
16.667	40.25	35.24	60.00	50.00	-19.75	-14.76
20.368	40.70	30.85	60.00	50.00	-19.30	-19.15
23.409	45.91	38.66	60.00	50.00	-14.09	-11.34
23.677	45.77	37.42	60.00	50.00	-14.23	-12.58

Spec Margin = QP./Ave. - Limit, ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Only RFID #1 is on with 50 Ohm termination at antenna port.

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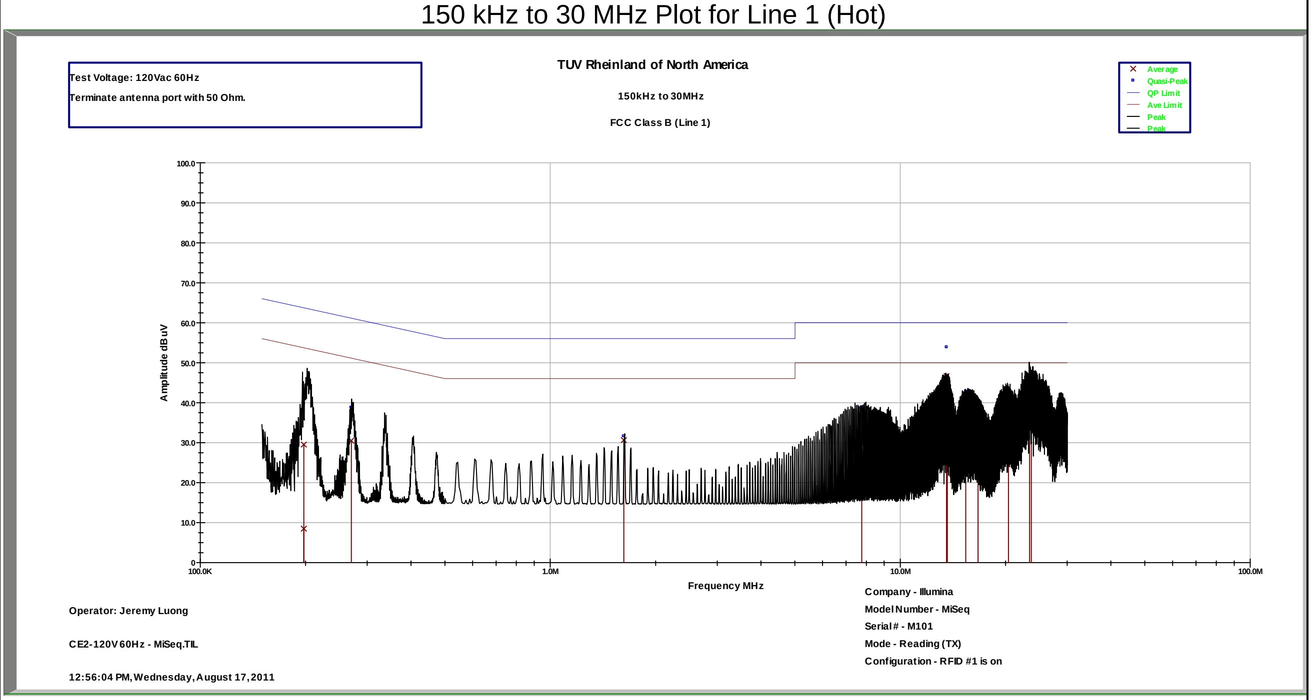
EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #1 with Attached Antenna	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber / ComPower, Line 1	**Performed by**	Jeremy Luong

150 kHz to 30 MHz Plot for Line 1 (Hot)



Notes: Meet FCC Class B limit.

SOP 2 Conducted Emissions

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EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #1 with Attached Antenna	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.107	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber / ComPower, Line 2	**Performed by**	Jeremy Luong

Frequency	**Quasi-Peak**	**Average**	**QP Limit**	**Ave Limit**	**QP Margin**	**Ave Margin**
MHz	**dBuV**	**dBuV**	**dBuV**	**dBuV**	**dB**	**dBuV**
0.202	45.47	39.38	64.50	54.50	-19.03	-15.12
0.270	37.58	30.38	62.57	52.57	-24.99	-22.20
1.620	33.53	33.07	56.00	46.00	-22.47	-12.93
7.489	40.17	37.10	60.00	50.00	-19.83	-12.90
13.560	45.85	42.15	60.00	50.00	-14.15	-7.85
15.929	42.70	38.46	60.00	50.00	-17.30	-11.54
19.981	43.83	37.90	60.00	50.00	-16.17	-12.10
22.820	44.86	35.40	60.00	50.00	-15.14	-14.60
23.021	45.16	36.87	60.00	50.00	-14.84	-13.13
23.279	44.93	38.13	60.00	50.00	-15.07	-11.87

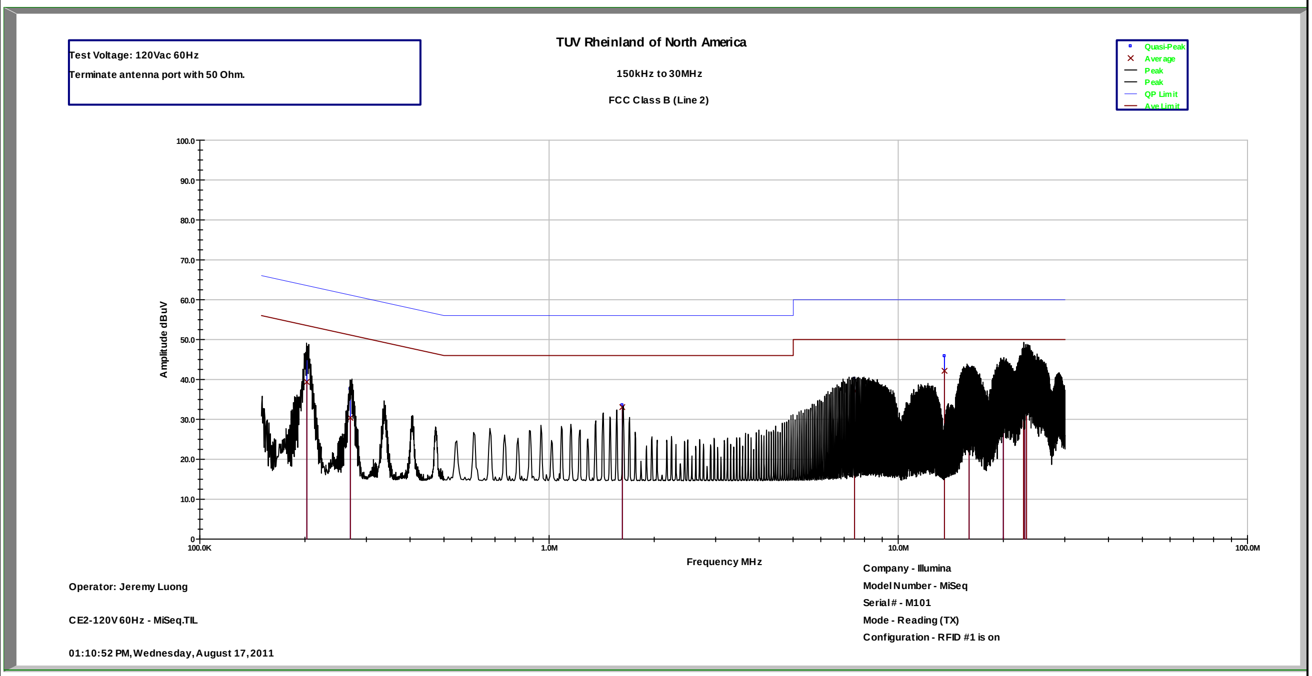
Spec Margin = QP./Ave. - Limit, ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Only RFID #1 is on with 50 Ohm termination at antenna port.

SOP 2 Conducted Emissions		Tracking # 31161819.002 Page 4 of 12	
EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #1 with Attached Antenna	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.107	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber/ ComPower, Line 2	**Performed by**	Jeremy Luong

150 kHz to 30 MHz Plot for Line 2 (Neutral)



Note: Meet FCC Class B Limit.

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EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #2 with Integrated Antenna	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber /ComPower, Line 1	**Performed by**	Jeremy Luong

Frequency	**Quasi-Peak**	**Average**	**QP Limit**	**Ave Limit**	**QP Margin**	**Ave Margin**
MHz	**dBuV**	**dBuV**	**dBuV**	**dBuV**	**dB**	**dBuV**
0.203	44.86	37.25	64.49	54.49	-19.63	-17.24
0.270	37.43	29.83	62.57	52.57	-25.14	-22.74
1.620	31.75	30.98	56.00	46.00	-24.25	-15.02
7.966	39.29	36.15	60.00	50.00	-20.71	-13.85
13.560	53.96	41.43	60.00	50.00	-6.04	-8.57
15.417	47.19	20.76	60.00	50.00	-12.81	-29.24
17.083	51.40	31.64	60.00	50.00	-8.60	-18.36
20.178	43.22	36.09	60.00	50.00	-16.78	-13.91
23.089	45.79	36.87	60.00	50.00	-14.21	-13.13
23.565	44.52	33.35	60.00	50.00	-15.48	-16.65

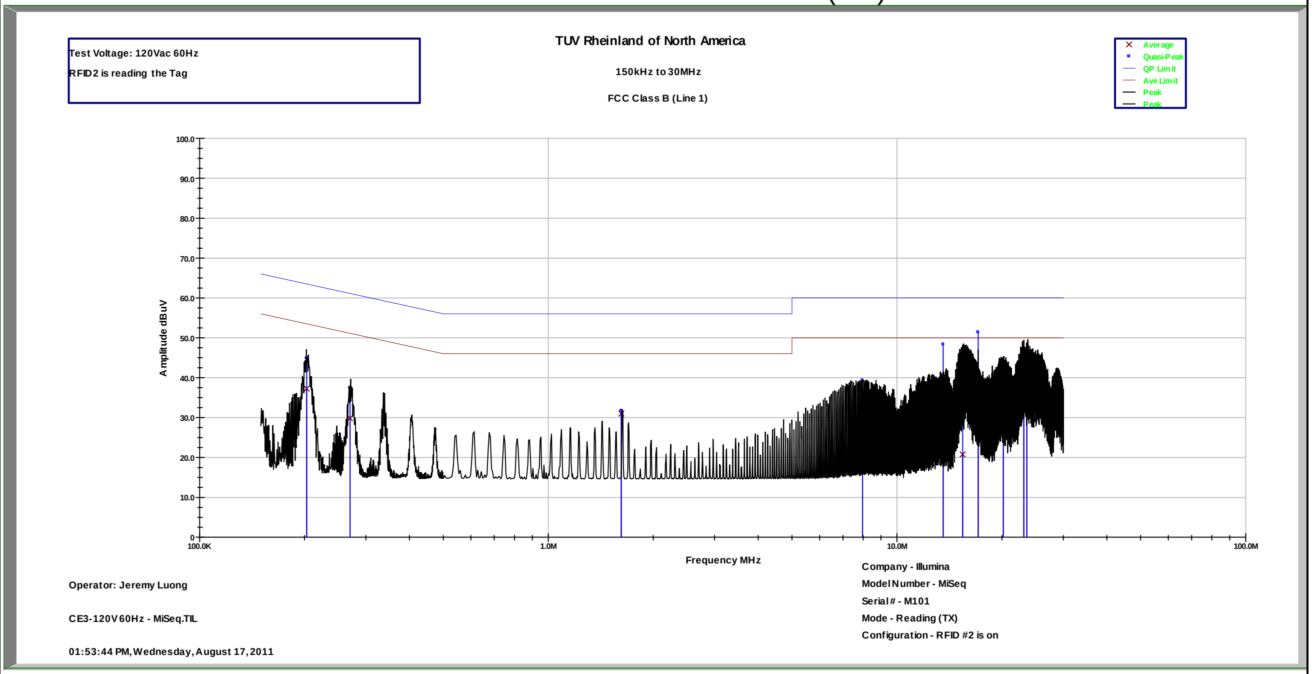
Spec Margin = QP./Ave. - Limit, ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Only RFID #2 is on with dummy tag as load.

SOP 2 Conducted Emissions		Tracking # 31161819.002 Page 6 of 12	
EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #2 with Integrated Antenna	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber / ComPower, Line 1	**Performed by**	Jeremy Luong

150 kHz to 30 MHz Plot for Line 1 (Hot)



Notes: Meet FCC Class B limit.

SOP 2 Conducted Emissions

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EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #2 with Integrated Antenna	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber / ComPower, Line 2	**Performed by**	Jeremy Luong

Frequency	**Quasi-Peak**	**Average**	**QP Limit**	**Ave Limit**	**QP Margin**	**Ave Margin**
MHz	**dBuV**	**dBuV**	**dBuV**	**dBuV**	**dB**	**dBuV**
0.202	45.46	39.87	64.50	54.50	-19.04	-14.63
0.271	37.19	29.92	62.55	52.55	-25.36	-22.63
1.621	33.22	32.61	56.00	46.00	-22.78	-13.39
7.690	40.26	35.51	60.00	50.00	-19.74	-14.49
13.560	51.14	35.47	60.00	50.00	-8.86	-14.53
14.419	24.25	20.16	60.00	50.00	-35.75	-29.84
16.250	51.77	25.08	60.00	50.00	-8.23	-24.92
17.084	52.02	26.93	60.00	50.00	-7.98	-23.07
22.958	44.25	31.84	60.00	50.00	-15.75	-18.16
23.564	45.10	33.24	60.00	50.00	-14.90	-16.76

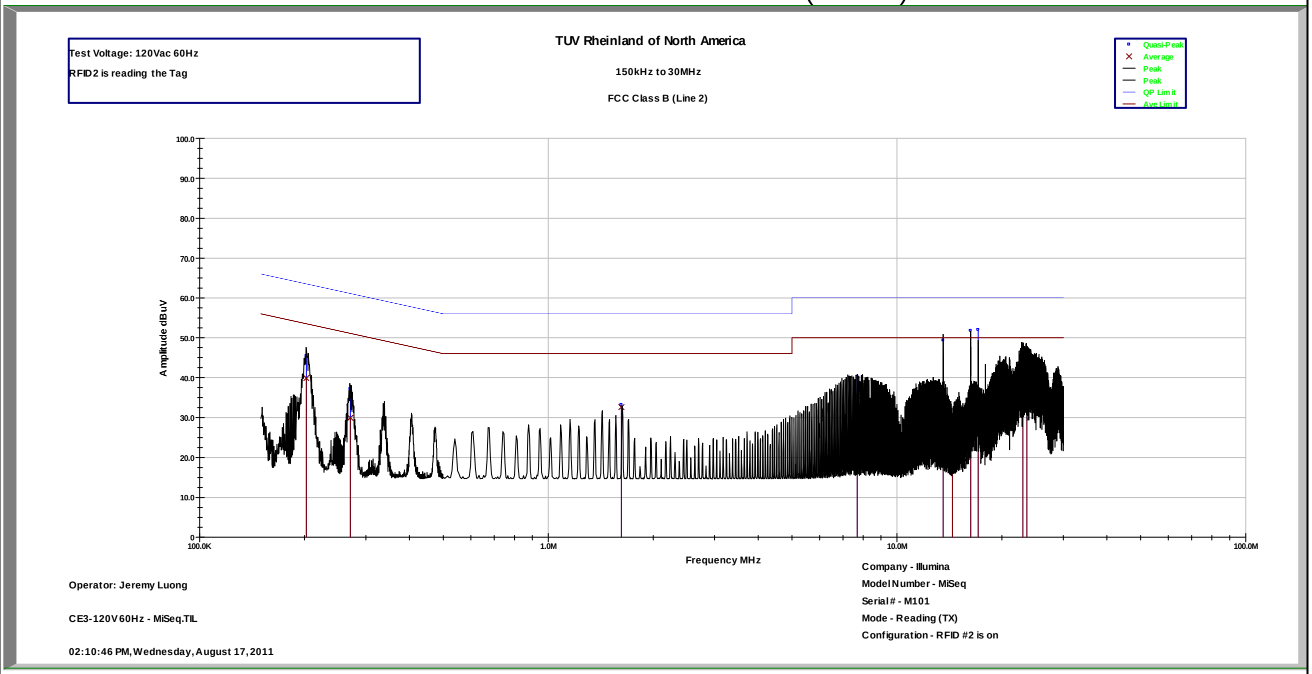
Spec Margin = QP./Ave. - Limit, ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Only RFID #2 is on with dummy tag as load.

SOP 2 Conducted Emissions		Tracking # 31161819.002 Page 8 of 12	
EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #2 with Integrated Antenna	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber/ ComPower, Line 2	**Performed by**	Jeremy Luong

150 kHz to 30 MHz Plot for Line 2 (Neutral)



Note: Meet FCC Class B Limit.

SOP 2 Conducted Emissions — Tracking # 31161819.002 Page 9 of 12

EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #3 with Integrated Antenna	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber /ComPower, Line 1	**Performed by**	Jeremy Luong

Frequency	Quasi-Peak	Average	QP Limit	Ave Limit	QP Margin	Ave Margin
MHz	**dBuV**	**dBuV**	**dBuV**	**dBuV**	**dB**	**dBuV**
0.202	45.84	38.18	64.50	54.50	-18.66	-16.32
0.270	38.77	31.22	62.57	52.57	-23.80	-21.35
1.553	29.84	27.26	56.00	46.00	-26.16	-18.74
7.962	40.13	37.93	60.00	50.00	-19.87	-12.07
12.151	45.29	40.26	60.00	50.00	-14.71	-9.74
13.561	53.74	40.86	60.00	50.00	-6.26	-9.14
15.993	43.45	39.16	60.00	50.00	-16.55	-10.84
19.903	44.14	37.50	60.00	50.00	-15.86	-12.50
19.979	44.14	37.61	60.00	50.00	-15.86	-12.39
23.017	45.92	38.14	60.00	50.00	-14.08	-11.86
23.349	46.28	39.04	60.00	50.00	-13.72	-10.96
24.028	45.60	38.32	60.00	50.00	-14.40	-11.68

Spec Margin = QP./Ave. - Limit, ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

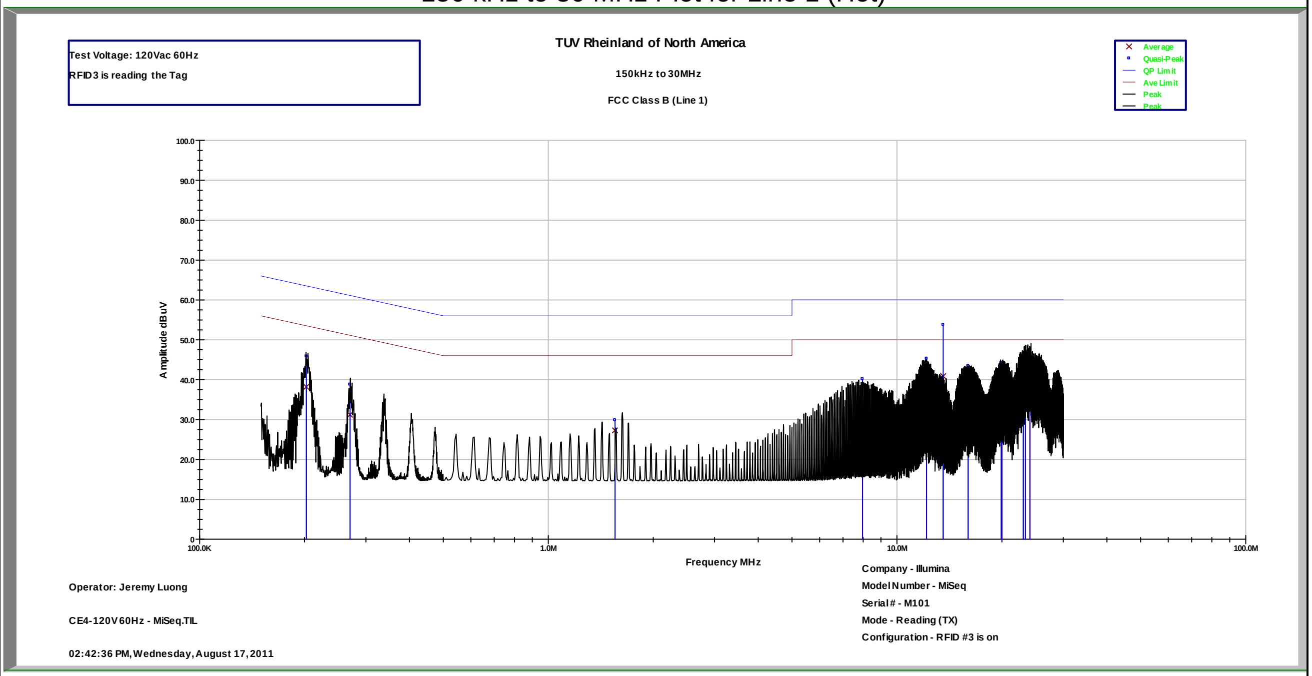
Notes: Only RFID #3 is on with dummy tag as load.

SOP 2 Conducted Emissions

Tracking # 31161819.002 Page 10 of 12

EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #3 with Integrated Antenna	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber / ComPower, Line 1	**Performed by**	Jeremy Luong

150 kHz to 30 MHz Plot for Line 1 (Hot)



Notes: Meet FCC Class B limit.

SOP 2 Conducted Emissions

Tracking # 31161819.002 Page 11 of 12

EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #3 with Integrated Antenna	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber / ComPower, Line 2	**Performed by**	Jeremy Luong

Frequency	**Quasi-Peak**	**Average**	**QP Limit**	**Ave Limit**	**QP Margin**	**Ave Margin**
MHz	**dBuV**	**dBuV**	**dBuV**	**dBuV**	**dB**	**dBuV**
0.203	45.51	39.44	64.50	54.50	-18.99	-15.06
0.271	37.64	30.51	62.55	52.55	-24.91	-22.05
1.621	33.23	32.54	56.00	46.00	-22.77	-13.46
7.692	40.49	38.27	60.00	50.00	-19.51	-11.73
13.561	52.66	40.31	60.00	50.00	-7.34	-9.70
16.198	40.77	36.20	60.00	50.00	-19.23	-13.80
20.242	43.01	36.68	60.00	50.00	-16.99	-13.32
20.717	41.72	35.27	60.00	50.00	-18.28	-14.73
23.478	45.78	37.51	60.00	50.00	-14.22	-12.49
23.754	44.91	37.40	60.00	50.00	-15.09	-12.60

Spec Margin = QP./Ave. - Limit, ± Uncertainty

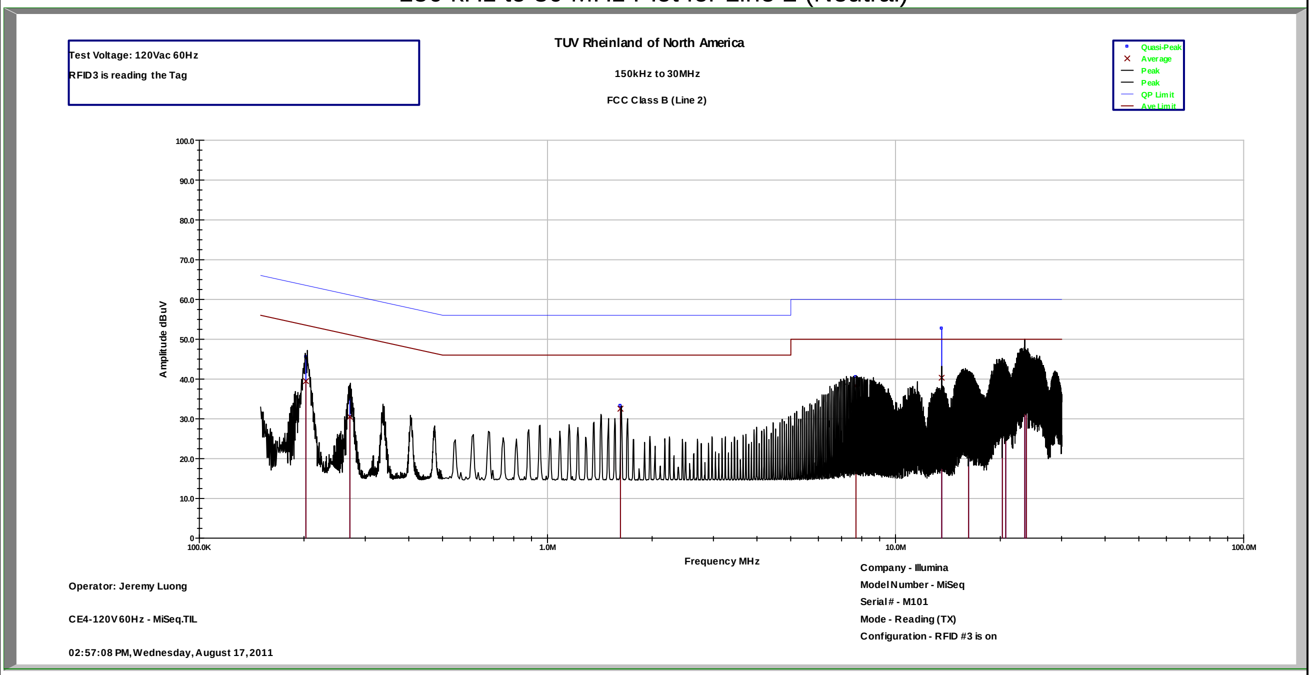
Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Only RFID #3 is on with dummy tag as load.

SOP 2 Conducted Emissions — Tracking # 31161819.002 Page 12 of 12

EUT Name	MiSeq System	**Date**	August 17, 2011
EUT Model	MiSeq System	**Temp / Hum in**	23° C / 37% rh
EUT Serial	M101	**Temp / Hum out**	N/A
EUT Config.	RFID #3 with Integrated Antenna	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.207	**RBW / VBW**	9kHz / 30 kHz
Lab/LISN	5m Chamber/ ComPower, Line 2	**Performed by**	Jeremy Luong

150 kHz to 30 MHz Plot for Line 2 (Neutral)



Note: Meet FCC Class B Limit.

4.8 Frequency Stability

In accordance with 47 CFR Part 15.225(e) the frequency stability of RFID devices must be such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual. The Manufacturer declares the operating temperature ranges of +19º to +25º C.

4.8.1 Test Methodology

The manufacturer of the equipment is responsible for ensuring that the frequency stability is such that emissions are always maintained within the band of operation under all conditions. This test performs according to ANSI C63.10-2009 Section 6.8

4.8.2 Manufacturer Declaration

The frequency stability of the reference oscillator sets the frequency stability of the RF transceiver signals. Per CFR47 Part 15.225 (e) and RSS 210 Sect. A2.6 (d), all of the RF signal should have ±0.01% or ±100ppm stability.
This stability accounts for room temp tolerance of the crystal oscillator circuit, frequency variation across temperature, and crystal ageing.

Worst case:
±100ppm at 13.56 GHz translates to a maximum frequency shift of ±1.356 kHz.

4.8.3 Test results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 9: Frequency Stability – Test Results

Temperature	Time	-6 dB Lower Edge (MHz)	+6 dB Upper Edge (MHz)	Center Frequency (MHz)	PPM
19°C	Start	13.55934000	13.56084000	13.56009000	6.64
	2 Min.	13.55932000	13.56083000	13.56007500	5.53
	5 Min	13.55932000	13.56083000	13.56007500	5.53
	10 min	13.55933000	13.56083000	13.56008000	5.90
22°C	Start	13.55922000	13.56082000	13.56002000	1.47
	2 Min.	13.55932000	13.56082000	13.56007000	5.16
	5 Min	13.55932000	13.56082000	13.56007000	5.16
	10 min	13.55932000	13.56082000	13.56007000	5.16
25°C	Start	13.55932000	13.56081000	13.56006500	4.79
	2 Min.	13.55932000	13.56081000	13.56006500	4.79
	5 Min	13.55932000	13.56080000	13.56006000	4.42
	10 min	13.55932000	13.56080000	13.56006000	4.42
Note: All frequency drifts from 13.56 MHz were less than ±100 ppm.					

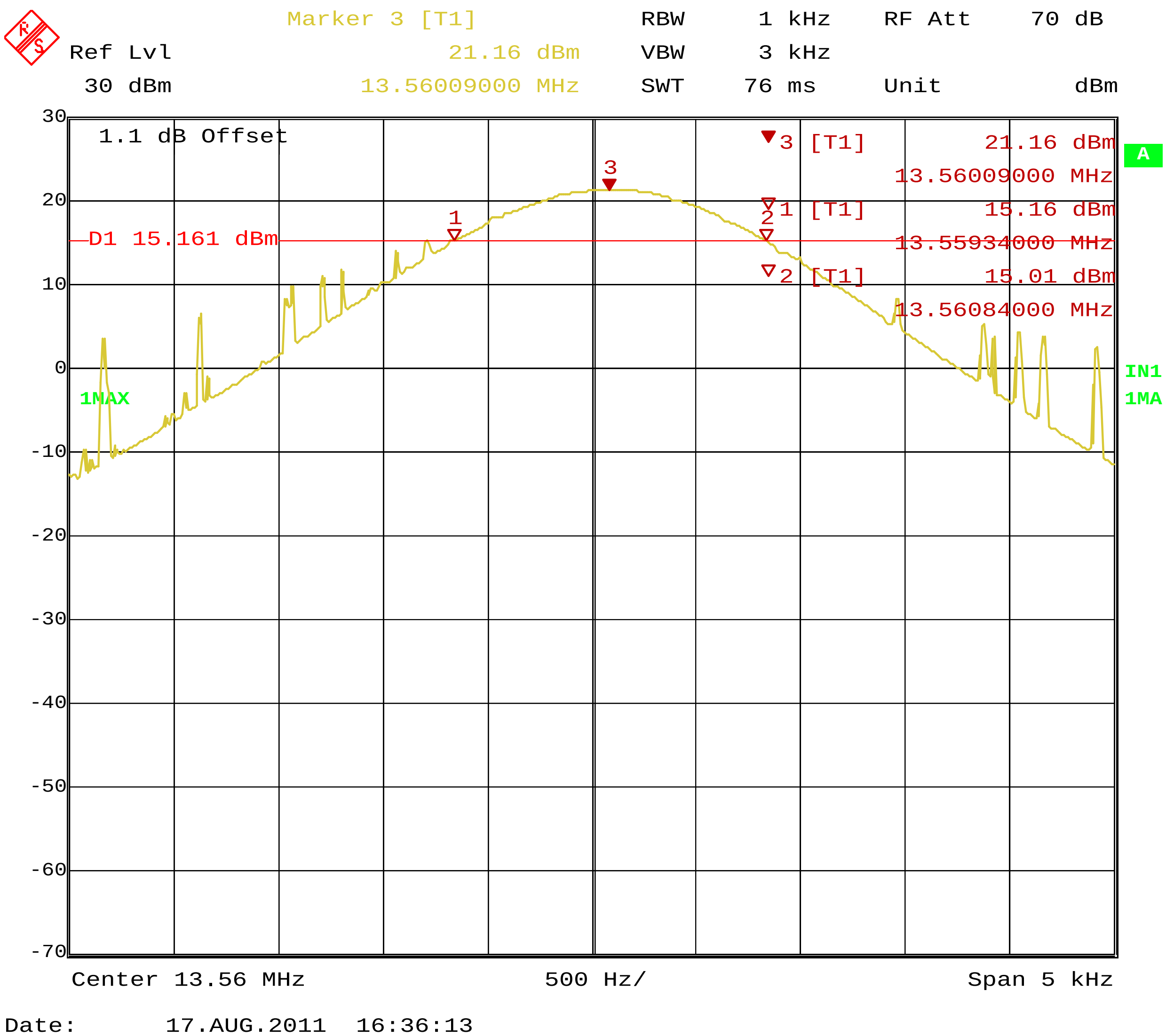


Figure 13: Frequency Stability at 19 °C - Start

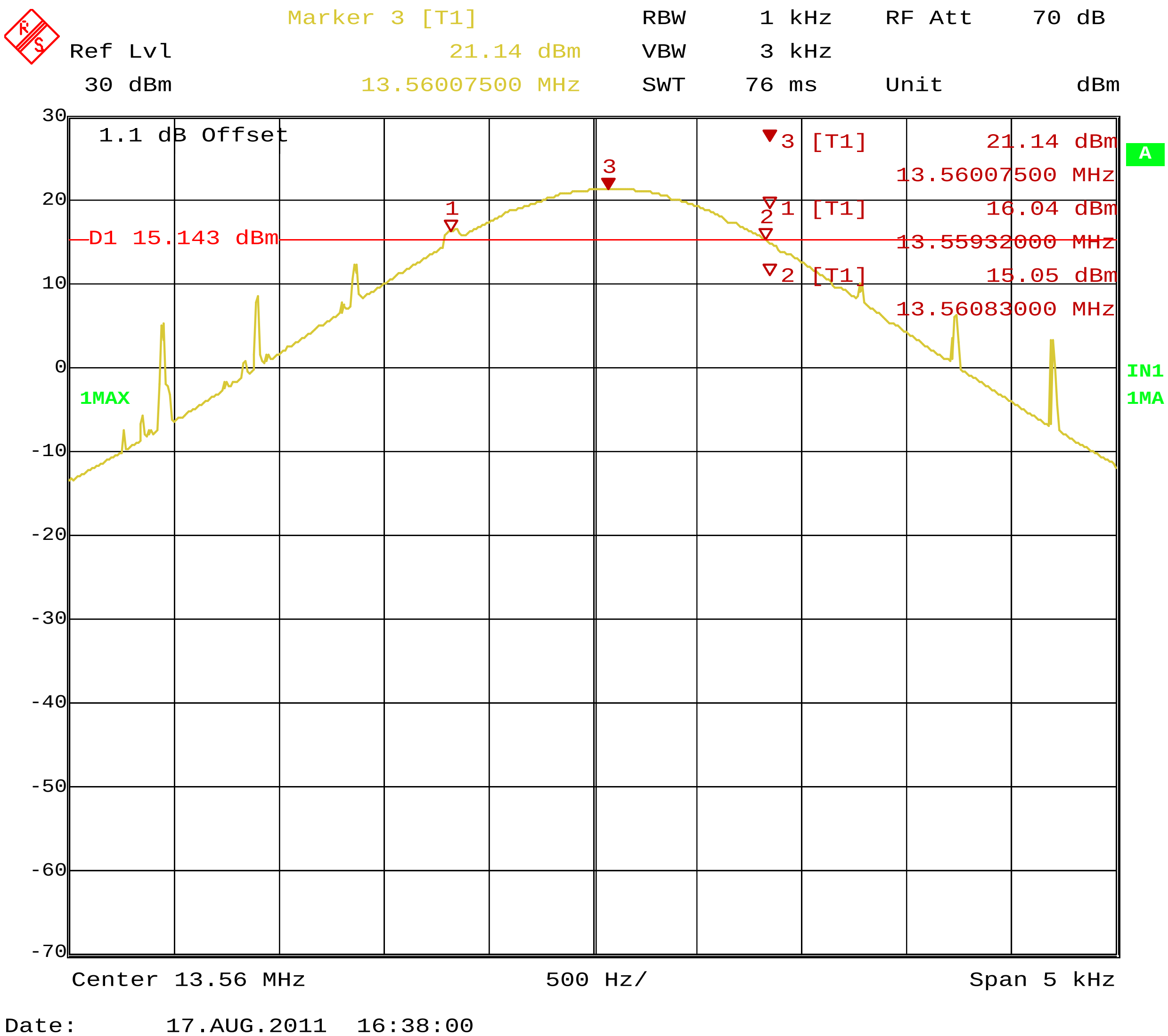


Figure 14: Frequency Stability at 19 °C – 2 min.

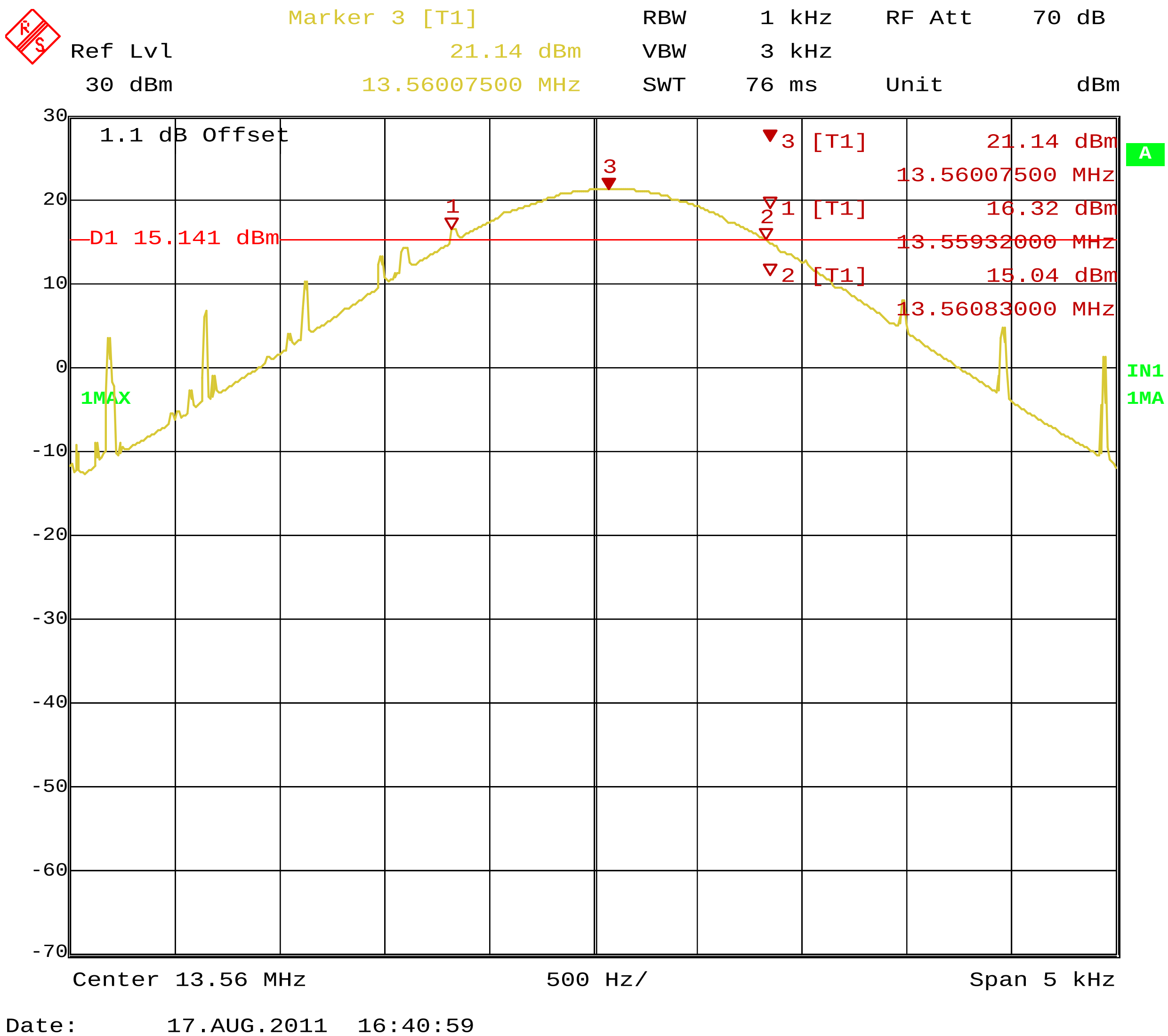


Figure 15: Frequency Stability at 19 °C – 5 min.

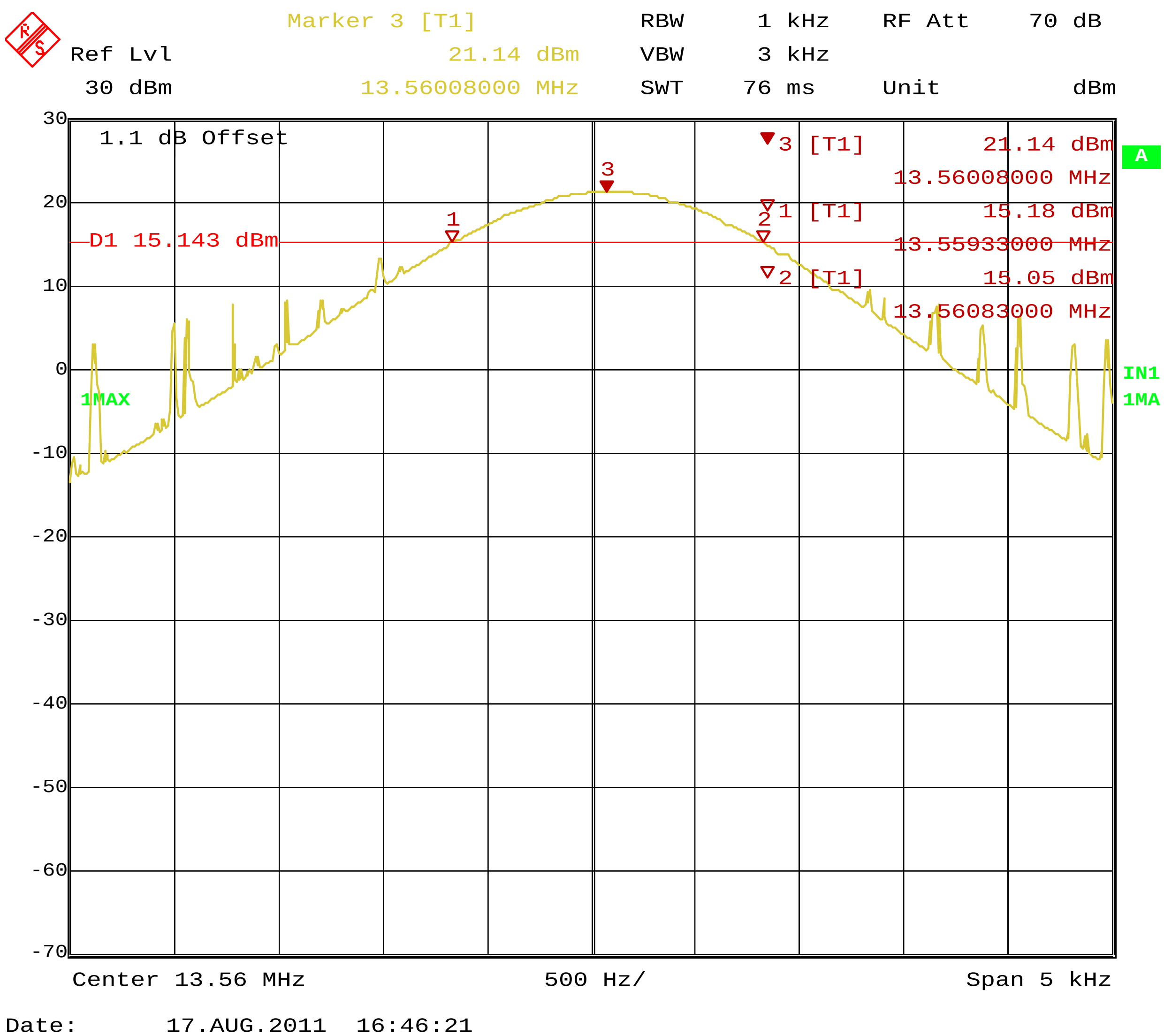


Figure 16: Frequency Stability at 19 °C – 10 min.

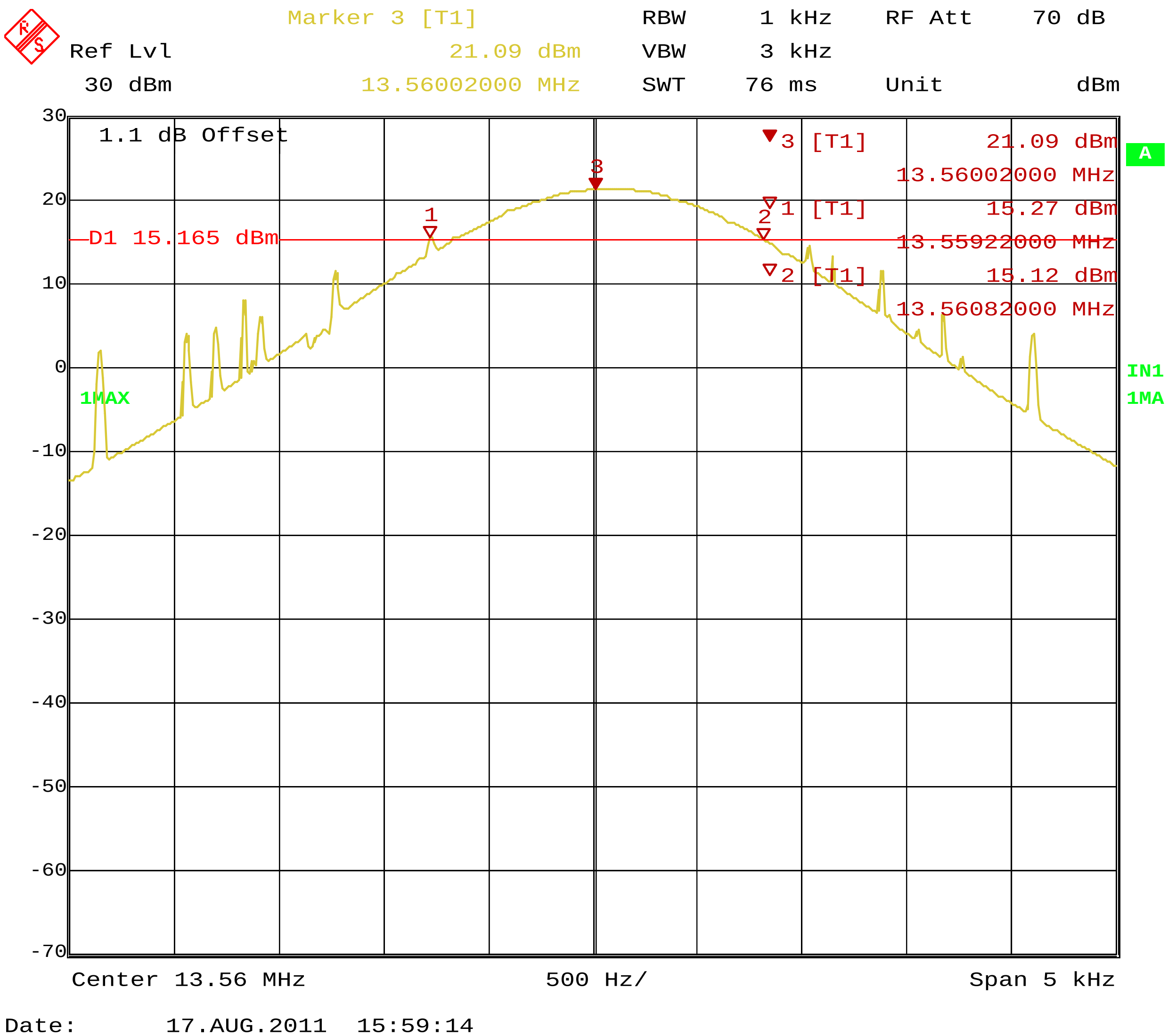


Figure 17: Frequency Stability at 22 °C - Start

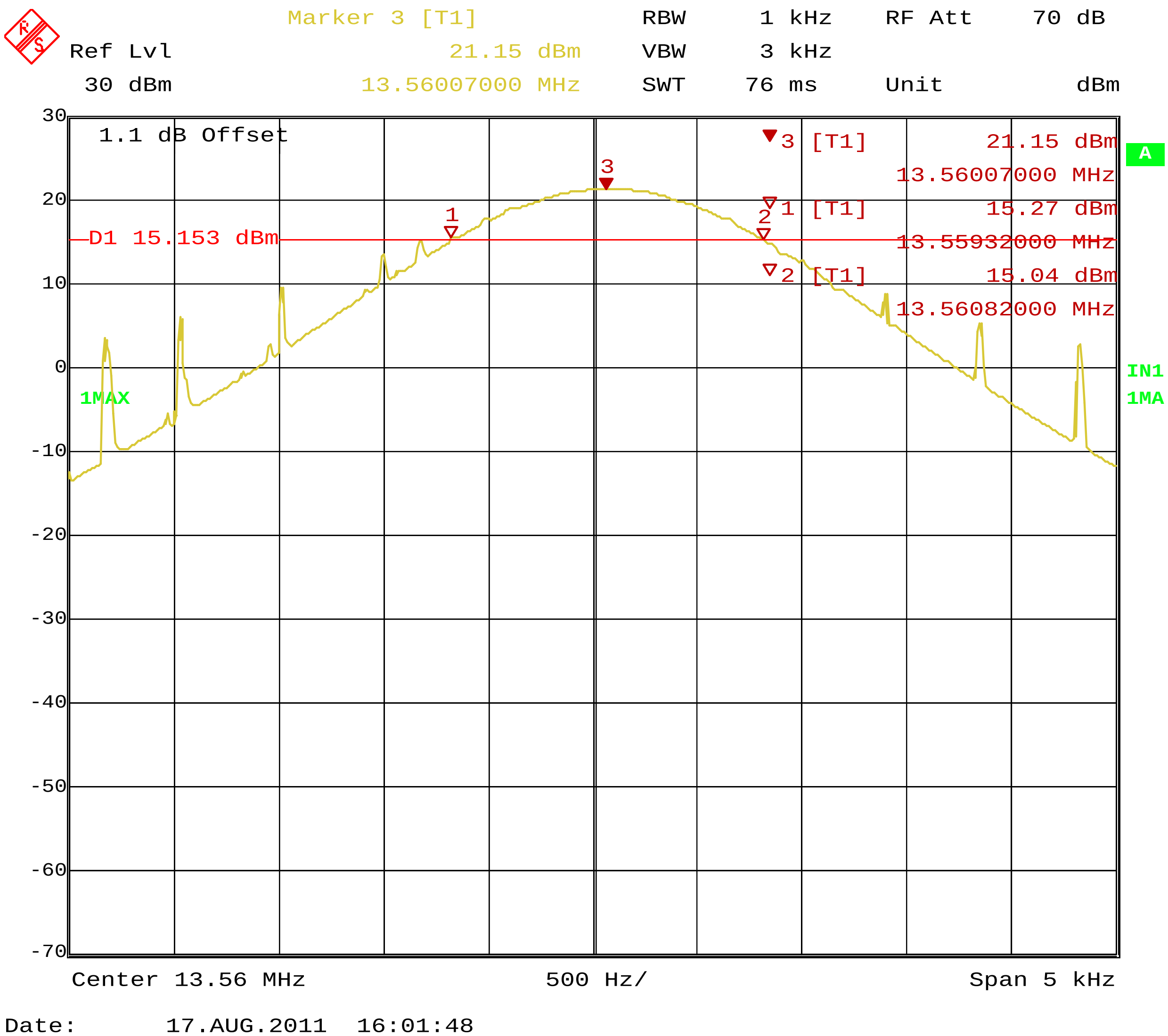


Figure 18: Frequency Stability at 22 °C – 2 min.

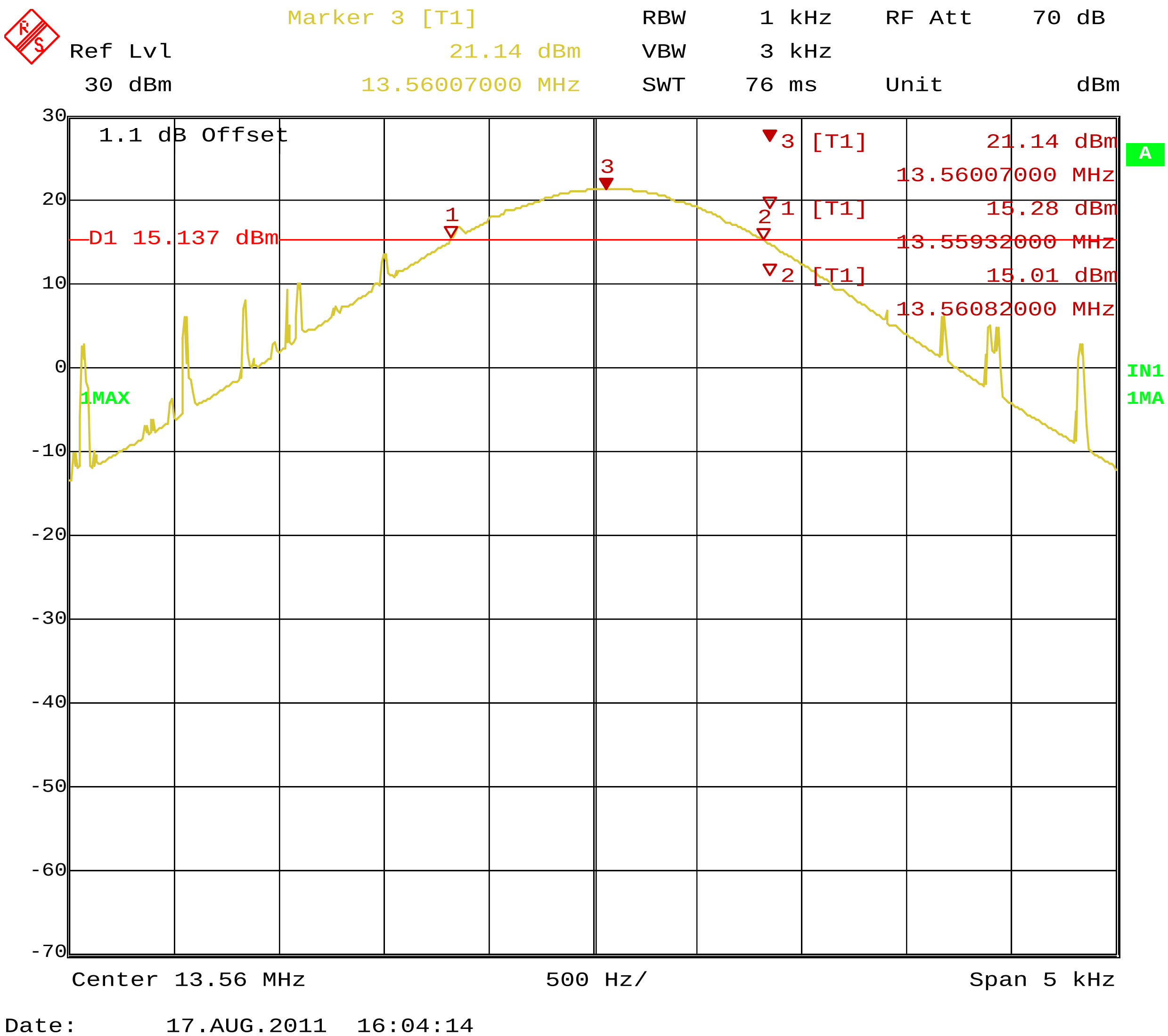


Figure 19: Frequency Stability at 22 °C – 5 min.

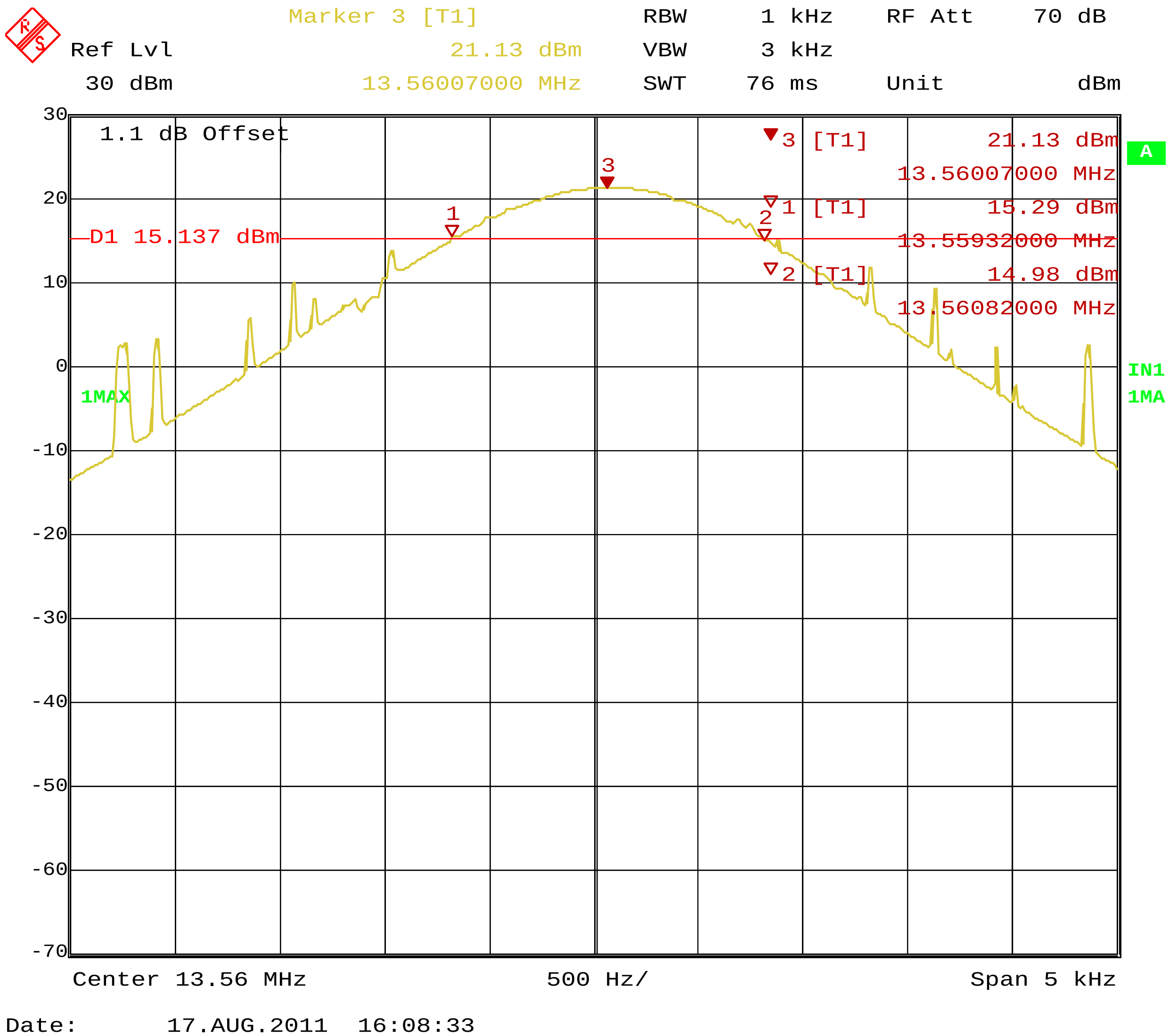


Figure 20: Frequency Stability at 22 °C – 10 min.

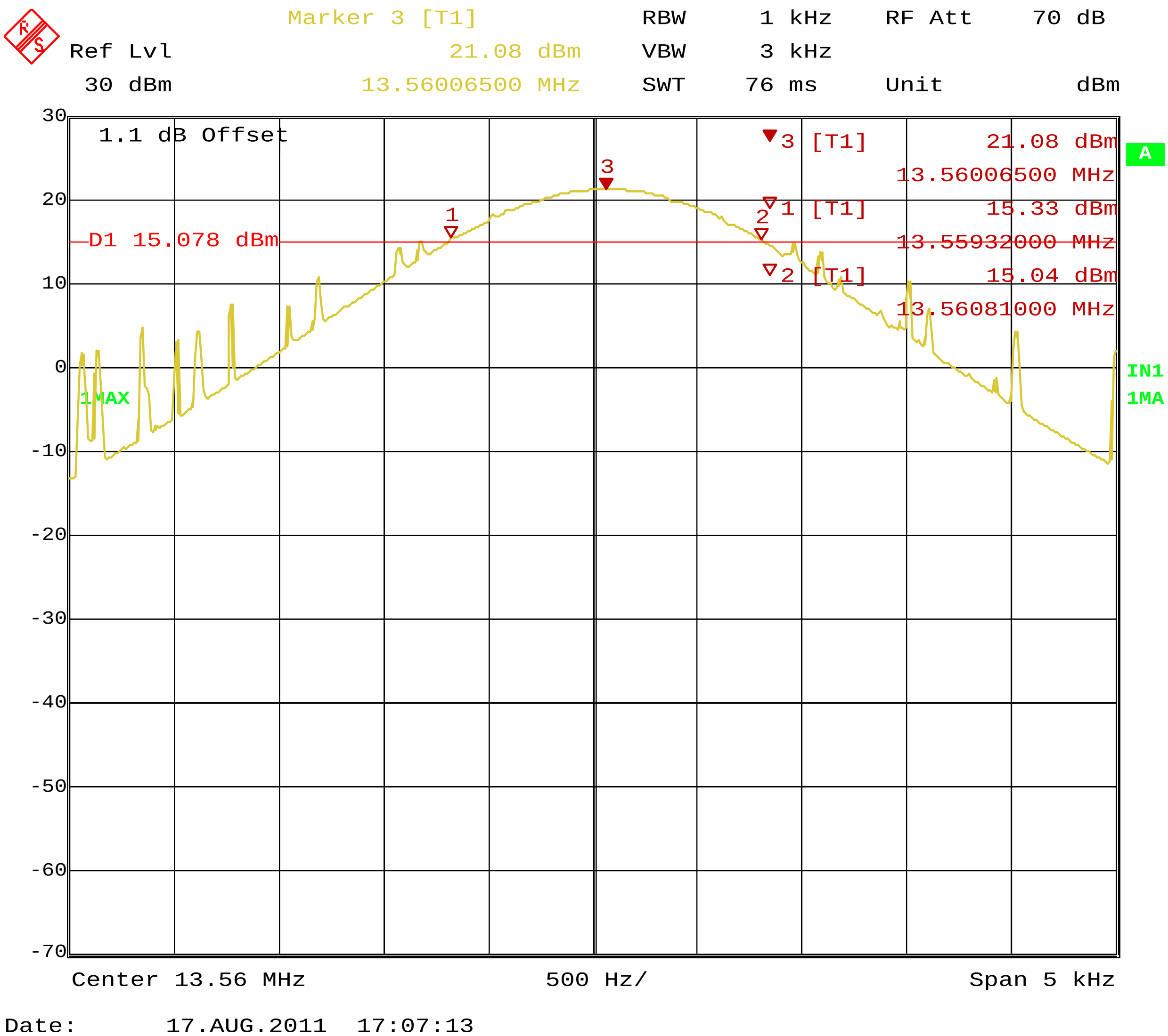


Figure 21: Frequency Stability at 25 °C - Start

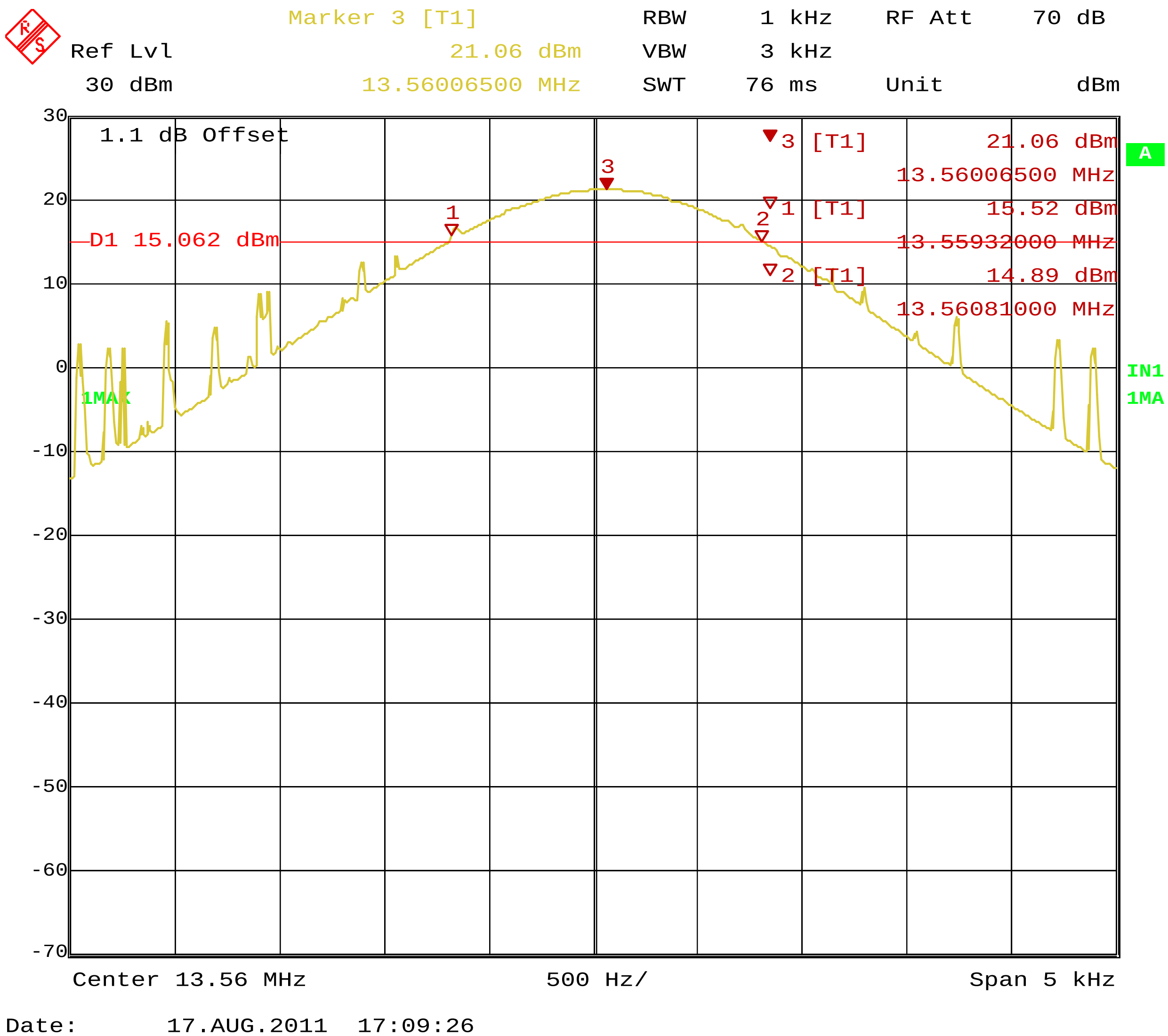


Figure 22: Frequency Stability at 25 °C – 2 min.

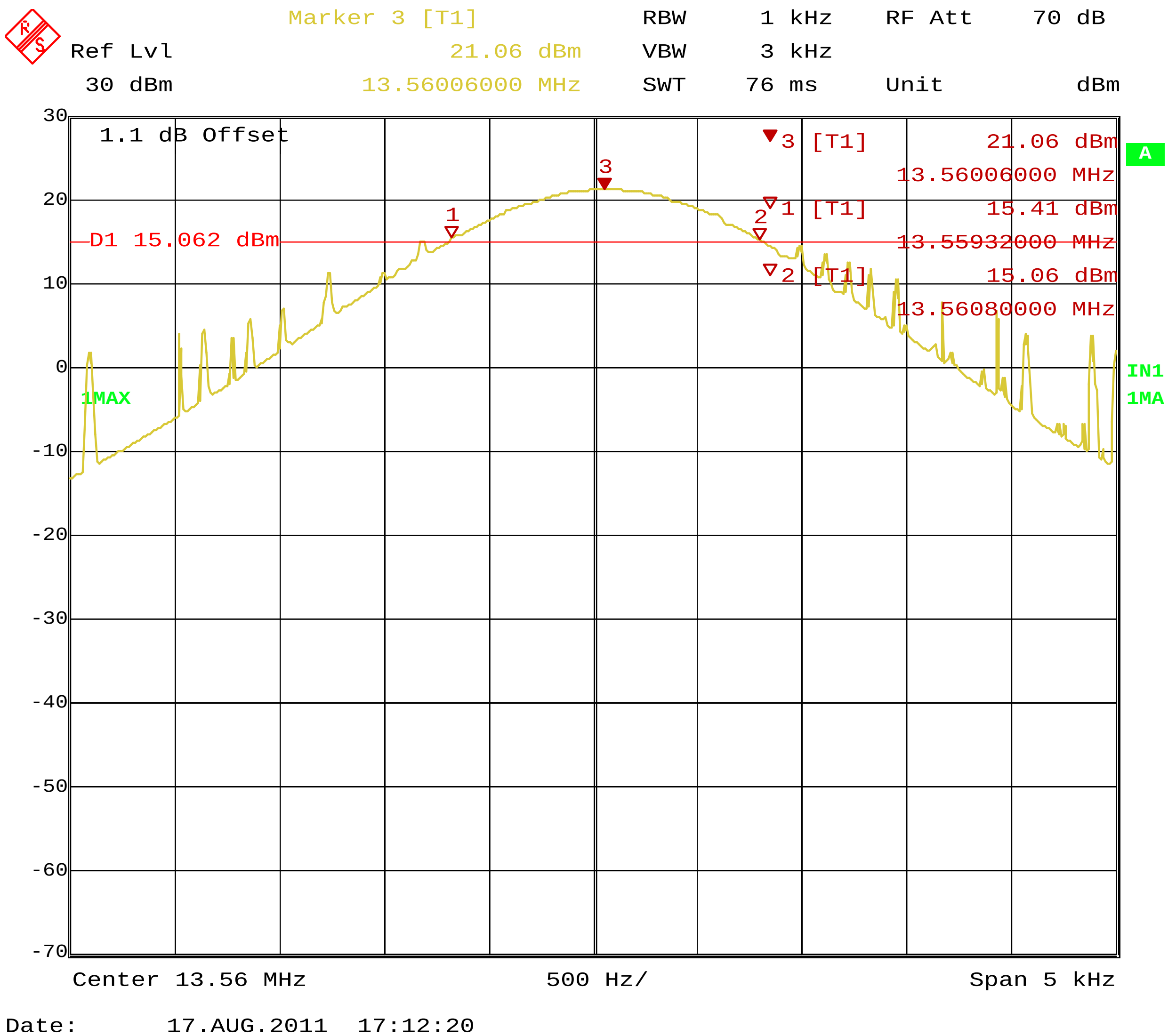


Figure 23: Frequency Stability at 25 °C – 5 min.

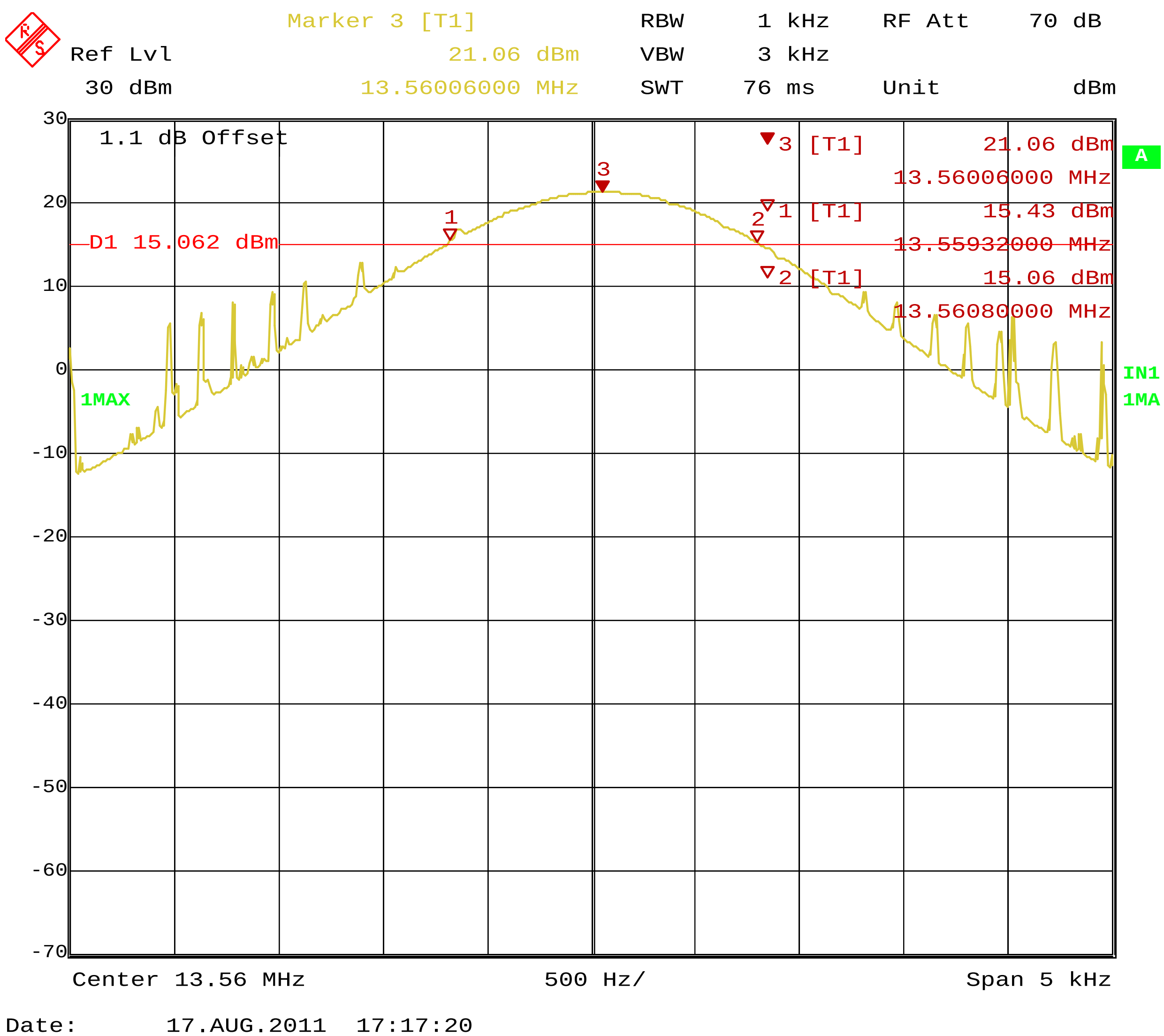


Figure 24: Frequency Stability at 25 °C – 10 min.

4.9 Voltage Variation

In accordance with 47 CFR Part 15.31 (e) intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

4.9.1 Test Methodology

The ac supply voltage was varied between 85% and 115% of the nominal rated supply voltage. The fundamental frequency was observed during the variation. The MiSeq System was powered 120V/60Hz by programmable power supply. The voltage was varied from 102Vac to 138Vac mean while the fundamental frequencies were observed and recorded for the maximum drift in ppm; part per millions.

4.9.2 Test results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s). The fundamental frequencies drifted less than ±100ppm.

Table 10: Voltage Variation – Test Results

Temperature	Time	-6 dB Lower Edge (MHz)	+6 dB Upper Edge (MHz)	Center Frequency (MHz)	PPM
102 Vac	Start	13.55932000	13.56081000	13.56006500	4.79
	2 Min.	13.55924000	13.56080000	13.56002000	1.47
	5 Min	13.55932000	13.56085000	13.56008500	6.27
	10 min	13.55926000	13.56080000	13.56003000	2.21
138 Vac	Start	13.55932000	13.56081000	13.56006500	4.79
	2 Min.	13.55930000	13.56080000	13.56005000	3.69
	5 Min	13.55932000	13.56083000	13.56007500	5.53
	10 min	13.55932000	13.56087000	13.56009500	7.01
Note: All frequency drifts were less than ±100 ppm from 13.56 MHz					

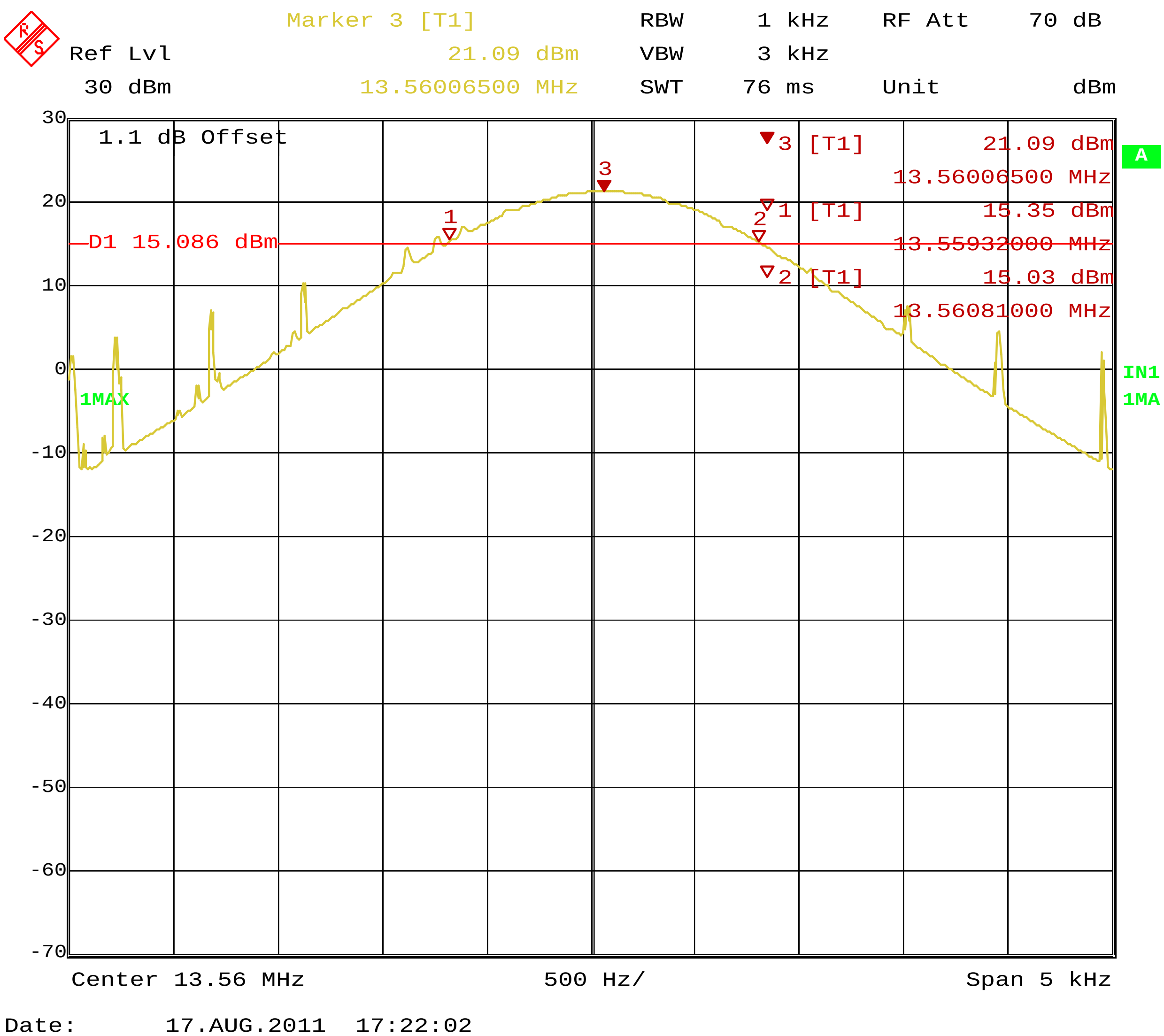


Figure 25: Voltage Variation at 102 V – Start.

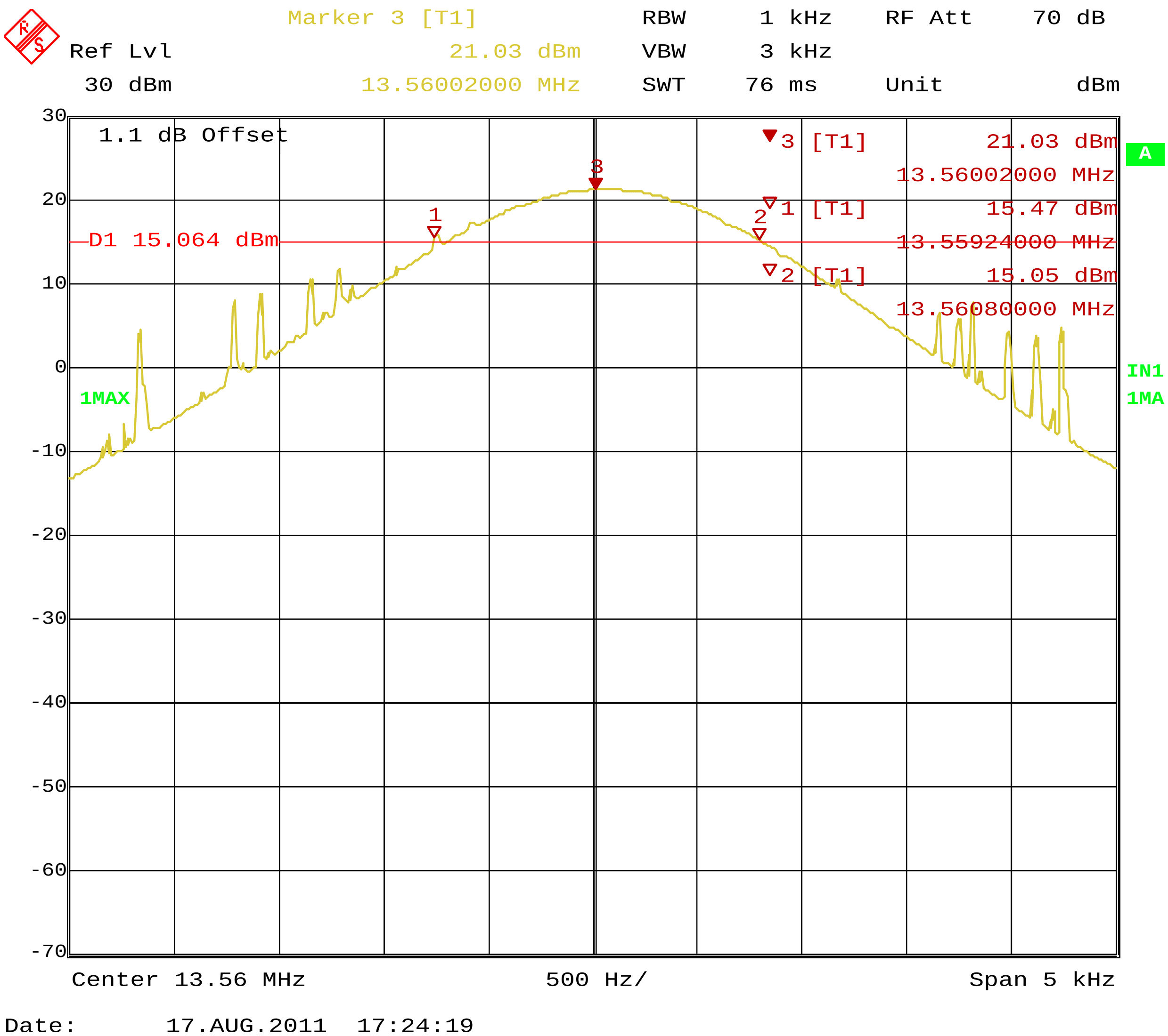


Figure 26: Voltage Variation at 102 V – 2 min.

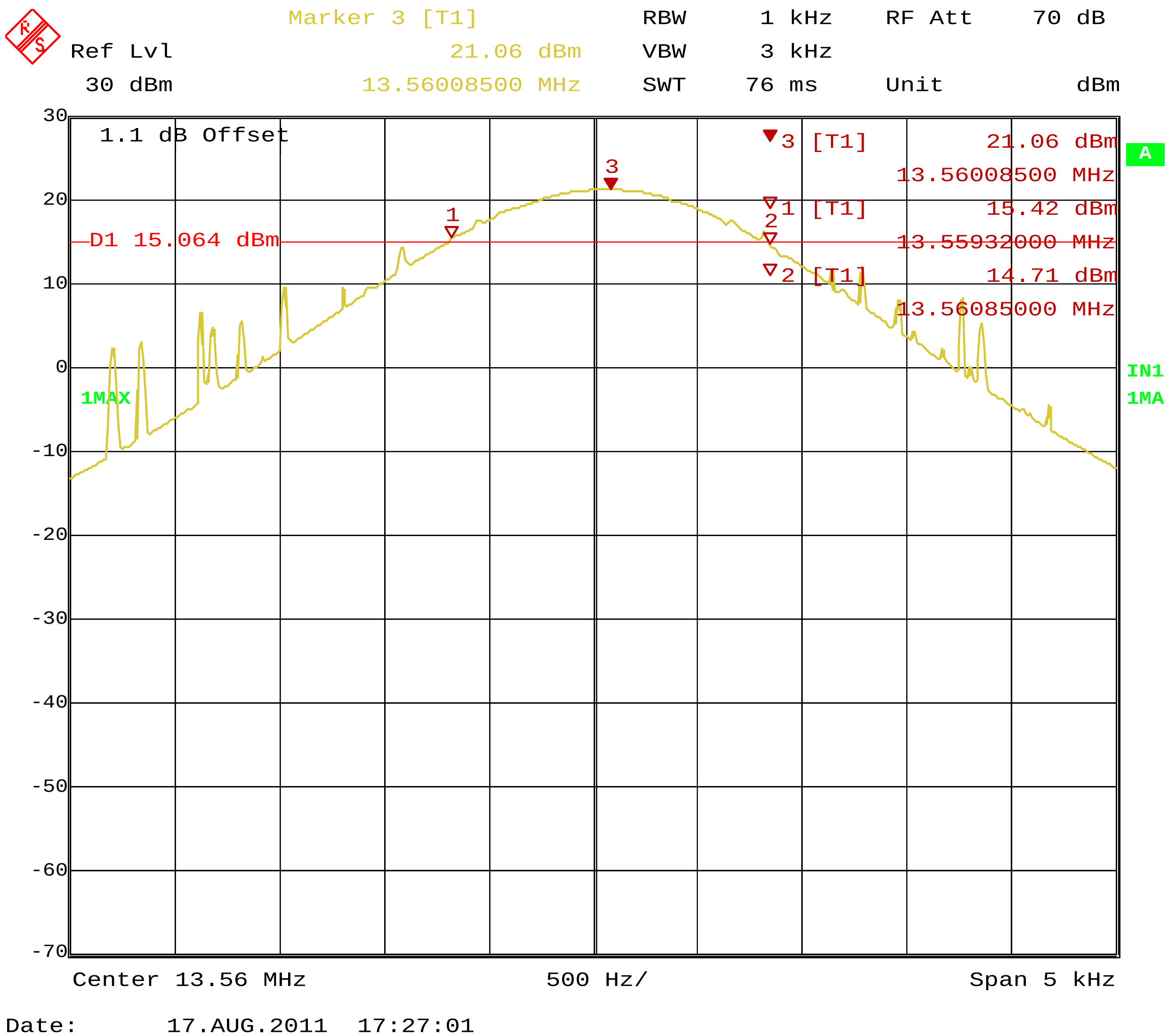


Figure 27: Voltage Variation at 102 V – 5 min.

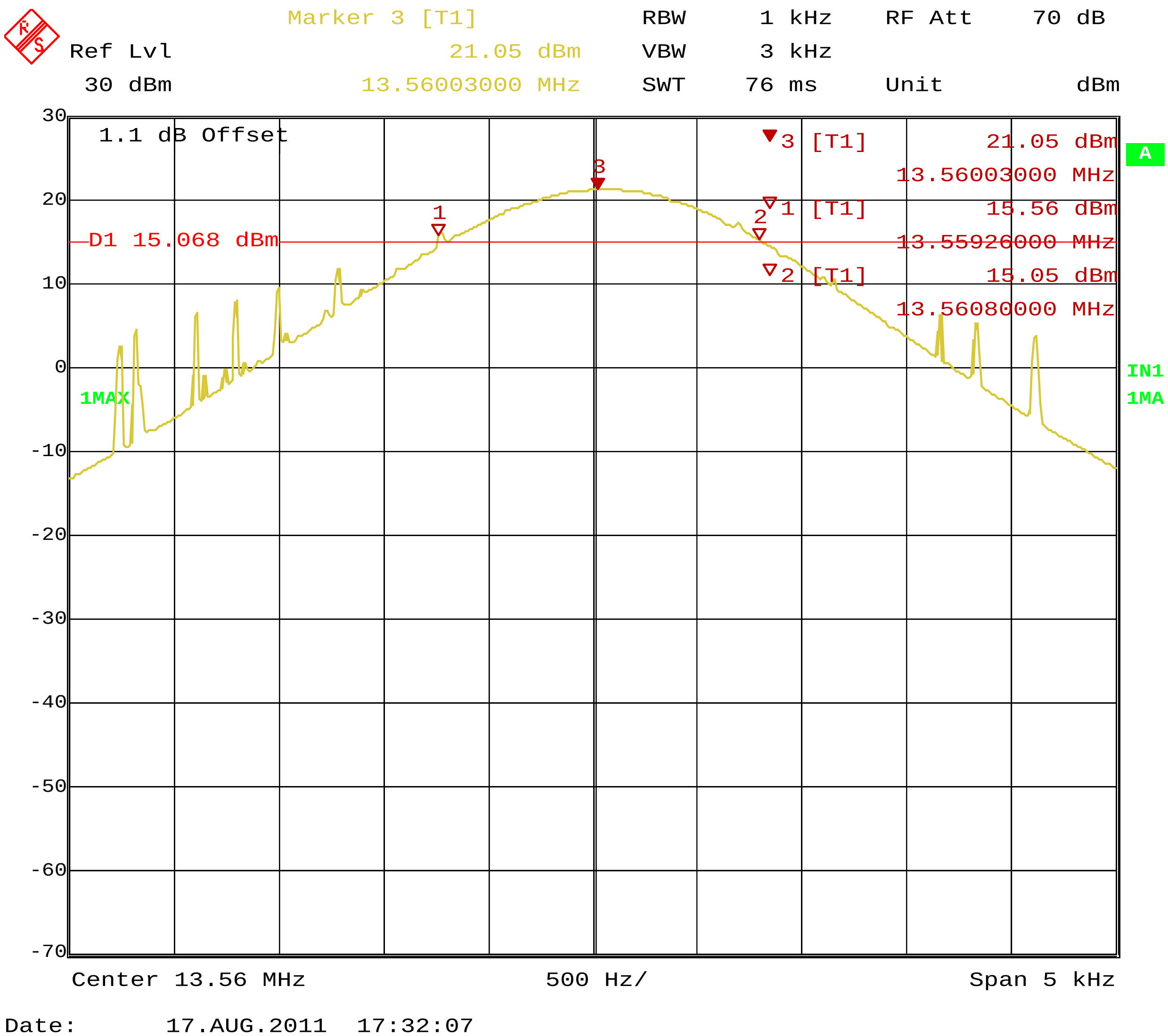


Figure 28: Voltage Variation at 102 V – 10 min.

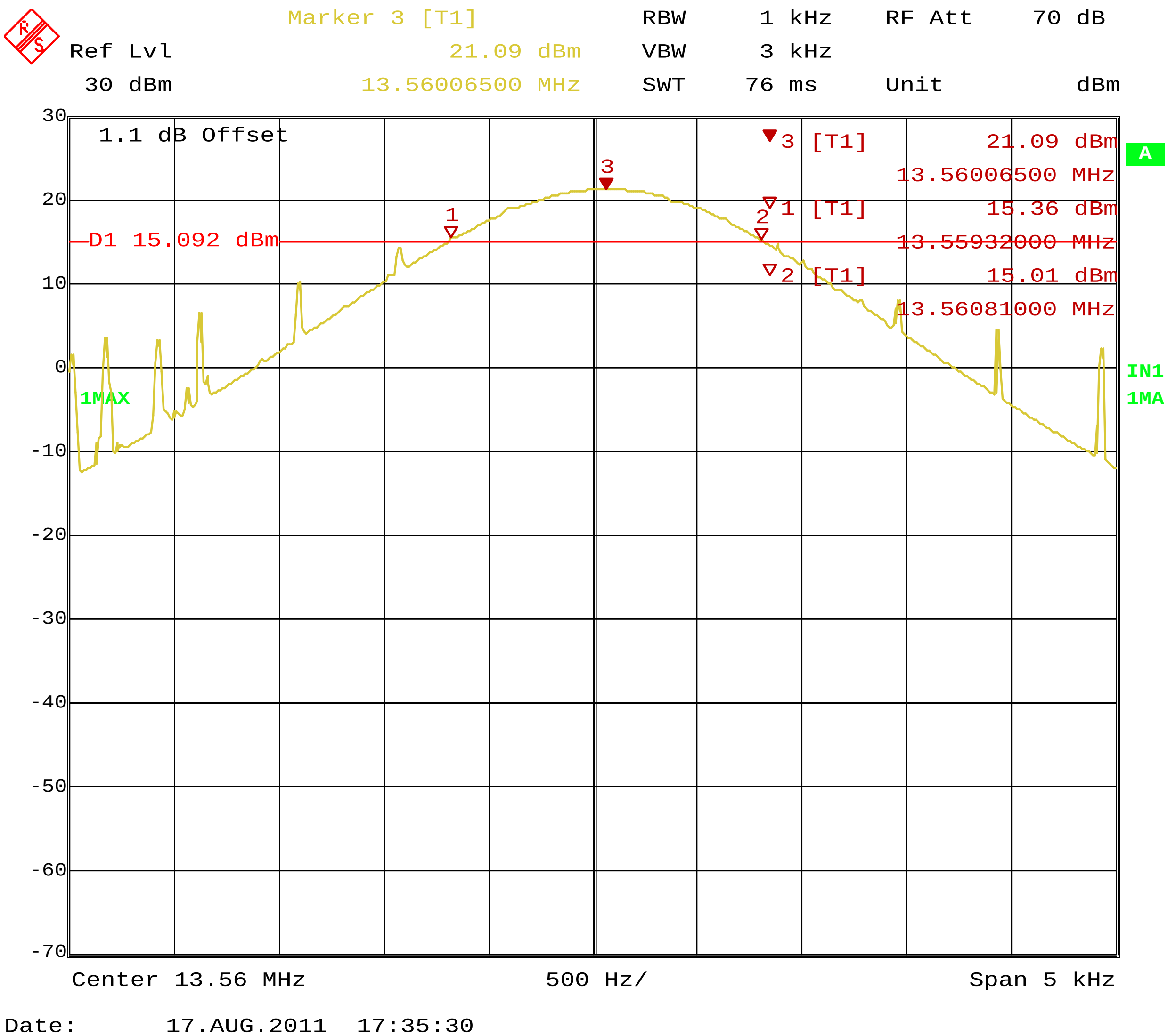


Figure 29: Voltage Variation at 138 V – Start.

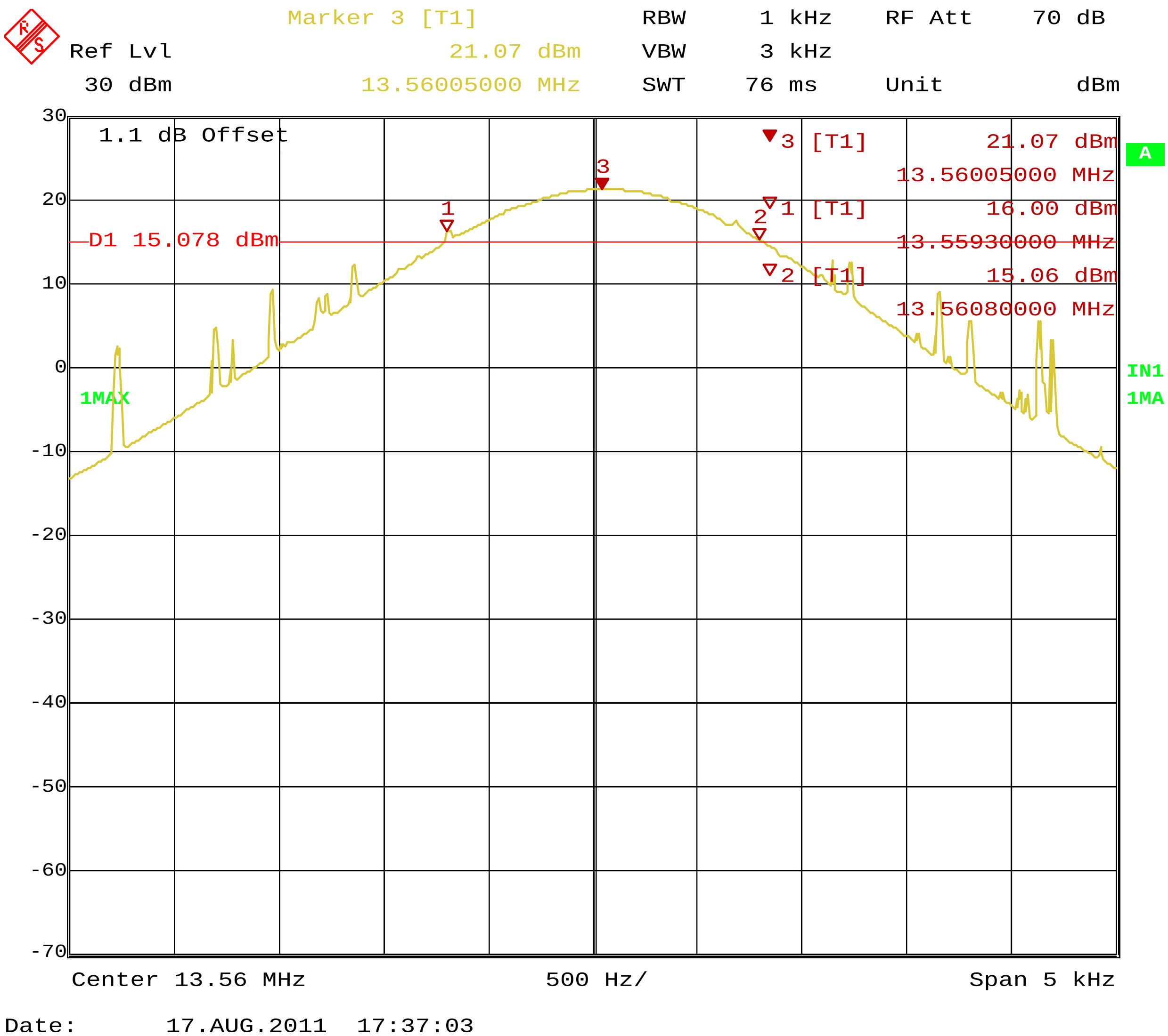


Figure 30: Voltage Variation at 138 V – 2 min.

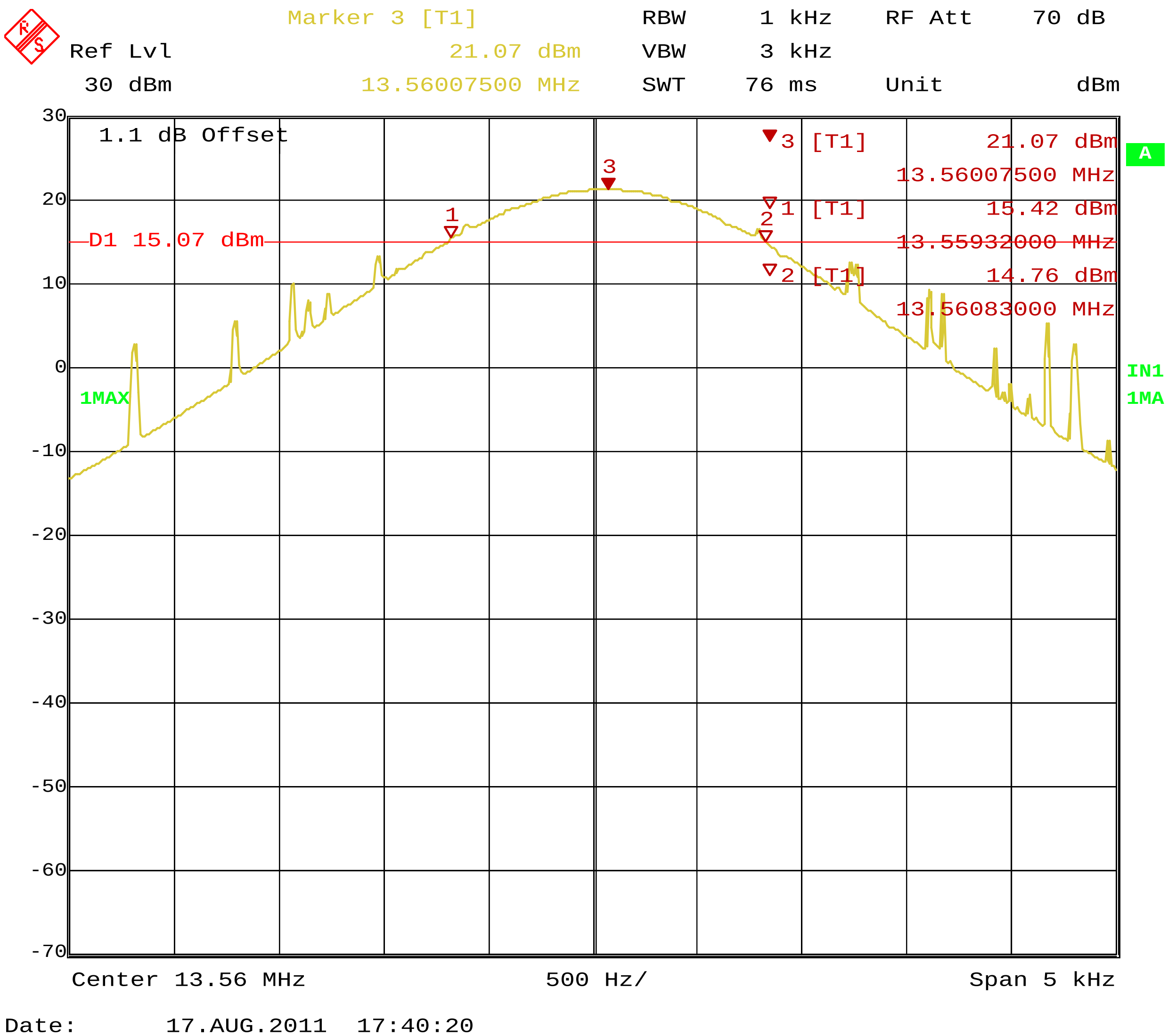


Figure 31: Voltage Variation at 138 V – 5 min.

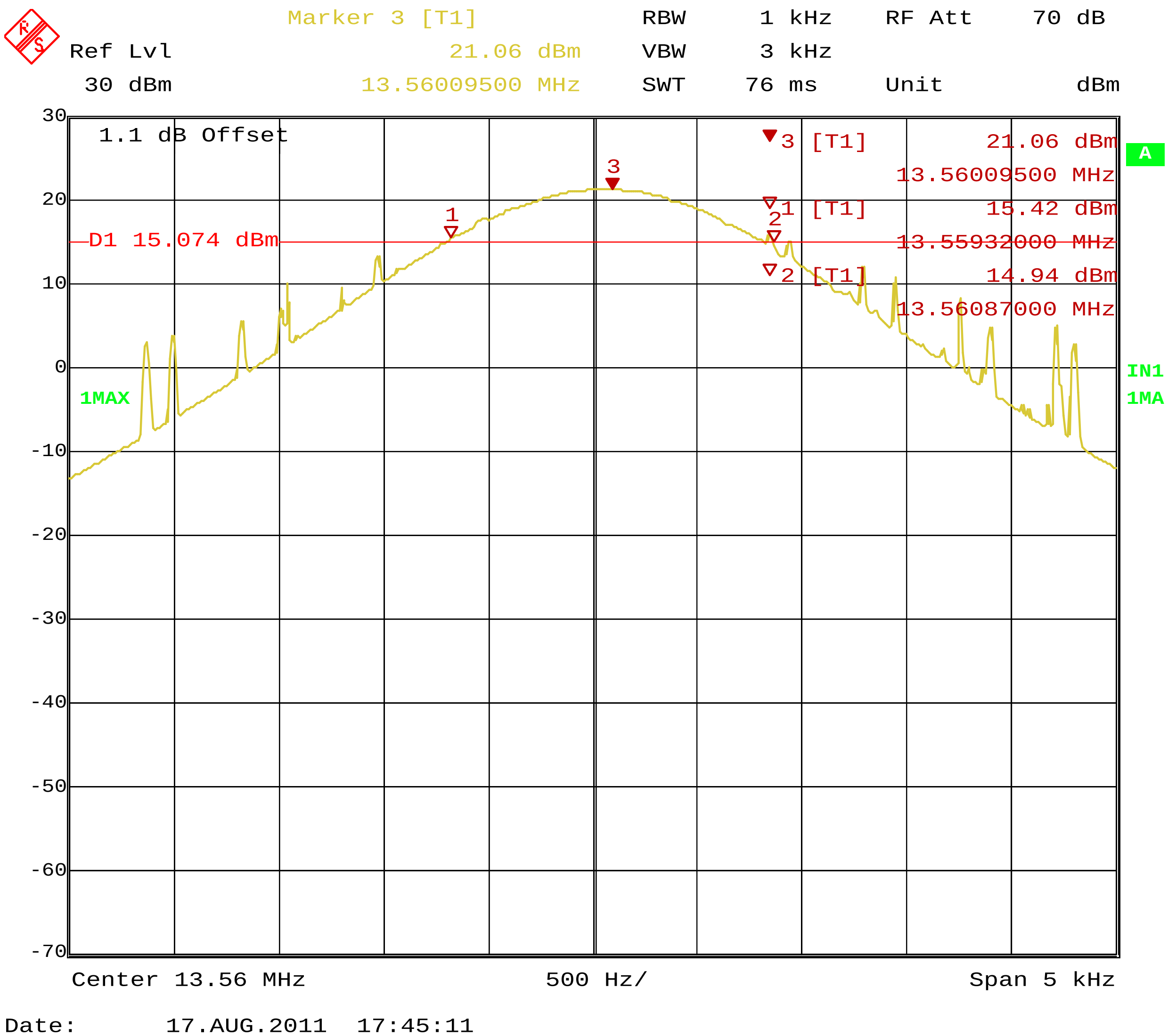


Figure 32: Voltage Variation at 138 V – 10 min.

5 Test Equipment List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Bilog Antenna	Sunol Science	JB3	A102606	02/18/2010	02/18/2012
Tuned Dipole Antenna	A.H Systems, Inc.	TDS-200/535-1	154	11/10/2010	11/10/2011
Tuned Dipole Antenna	A.H Systems, Inc.	TDS-200/535-2	154	11/10/2010	11/10/2011
Tuned Dipole Antenna	A.H Systems, Inc.	TDS-200/535-3	154	11/10/2010	11/10/2011
Tuned Dipole Antenna	A.H Systems, Inc.	TDS-200/535-4	154	11/10/2010	11/10/2011
Passive Loop Antenna	ETS-Lindgren	6511	66507	01/24/2011	01/24/2012
EMI Receiver	Hewlett Packard	8546A	3807A00445	02/05/2011	02/05/2012
Preselector	Hewlett Packard	85460A	3704A00407	02/05/2011	02/05/2012
Amplifier	Hewlett Packard	8447D	2944A07996	01/17/2011	01/17/2012
Spectrum Analyzer	Rhode&Schwarz	ESIB	832427/002	01/18/2011	01/18/2012
Spectrum Analyzer	Agilent	E4404B	MY41440636	08/19/2010	08/19/2011
Line Impedance Network Stabilization	Com Power	L1-200	12111	05/10/2011	05/10/2012
Thermo Chamber	Associated Environmental	SK-3102	5999	CNR	CNR
Thermometer	Fluke	52II	88650033	09/30/2011	09/30/2012
Power Supplier	Kikosui	PCR8000W	CM000912	01/19/2011	01/19/2012
Digital Multimeter	Fluke	177	92780312	01/17/2011	01/17/2012

* Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.

6 EMC Test Plan

6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

6.2 Customer

Table 11: Customer Information

Company Name	Illumina, Inc
Address	25861 Industrial Blvd.
City, State, Zip	Hayward, CA 94545
Country	USA
Phone	(510) 670-9319
Fax	(510) 670-9302

Table 12: Technical Contact Information

Name	Carol Rogers Escano
E-mail	cescano@illumina.com
Phone	(510) 670-9319
Fax	(510) 670-9302

6.3 Equipment Under Test (EUT)

Table 13: EUT Specifications

EUT Specification	
Dimensions: MiSeq System RFID Reader	 36 inches x 30 inches x 24 inches 2.156 inches x1.55 inches x 0.062 inches
Power Supply: MiSeq System RFID Reader	Cooler Master, Product No. RS-750-ACAA-E3 110 – 240 Vac, 10-6A, 60-50Hz 5 VDC, 70 mA
Environment	Controlled Laboratory
Operating Temperature Range:	19 to 25 degrees C
Multiple Feeds:	☐ Yes and how many ☒ No.RFID receive 5 Vdc from MiSeq power supply.
Hardware Version for Flow Cell RFID and PR2 RFID	Rev. A
Hardware Version for Chiller RFID	Rev. B
RFID Software Version	9.1.6 FPGA
Operating Mode	RFID Reader
Transmitter Frequency Band	13.56 MHz
Chipset Rated Power Output	100 mW
Power Setting @ Operating Channel	Fixed. Power controls by FPGA firmware.
Antenna Type	Attached on board
Modulation Type	☐ AM ☐ FM ☐ Phase ☒ Other describe: OOK
Date Rate	26.4 kbit/s.
Max. Duty Cycle	53.3%
Type of Equipment	☒ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☐ Other *describe:*
Note: 1. The manufacturer declared MiSeq System will only operate within 22 °C ± 3 °C. 2. All three RFID boards are identical.	

Table 14: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
Na	--	--	--	--
Note: No supporting device was used for testing				

Table 15: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
RFID Tag	Texas Instruments	RF-HDT-DVBB	E007808BD6534E3D	Loading the Chiller and PR2 RFID Readers
RFID Tag	HID Global GmbH	Piccolino	None	Loading the Flow Cell Reader
Note: Supporting Tags are passive devices.				

Table 16: Description of Sample used for Testing

Device	Serial Number	Configuration	Used For
Flow Cell RFID (#1)	15028859	Radiated Sample	Max. Carrier Field Strength Occupied Bandwidth Out of Band Emission TX Spurious Radiated Emission RX Spurious Radiated Emission AC Conducted Emission
Chiller RFID (#2)	15028858	Radiated Sample	Max. Carrier Field Strength Occupied Bandwidth Out of Band Emission TX Spurious Radiated Emission RX Spurious Radiated Emission AC Conducted Emission
PR2 RFID (#3)	15028860	Radiated Sample	Max. Carrier Field Strength Occupied Bandwidth Out of Band Emission TX Spurious Radiated Emission RX Spurious Radiated Emission AC Conducted Emission
Flow Cell RFID (#1)	15028859	Conducted Sample	Frequency Stability Voltage Variation
Note: All 3 RFIDs are identical except RFID #1 (Flow Cell) has removable antenna which connected via the custom made cable. Base on the similarity, only RFID #1 was selected to perform frequency stability and voltage variation.			

Table 17: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Description
Flow Cell RFID (#1)	Attached	Transmit & Receive	EUT faces up; X-Axis
Chiller RFID (#2)	Attached	Transmit & Receive	EUT faces up; X-Axis
PR2 RFID (#3)	Attached	Transmit & Receive	EUT faces up; X-Axis
Note: No preliminary testing was needed for all 3 orthogonal axis since all three RFIDs will installed on the X-Axis inside the tabletop MiSeq System.			

6.4 Test Specifications

Testing requirements

Table 18: Test Specifications

Emissions and Immunity	
Standard	Requirement
CFR 47 Part 15.225: 2010	All
RSS 210 Iss. 8 2010	All