

**TYCO SAFETY PRODUCTS  
SENSORMATIC  
EMC TEST REPORT**

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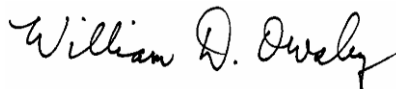
Model:  
AMB-4400  
Handheld EAS Deactivator

FCC ID: BVCAMB44  
IC: 3506A-AMB44

**Intentional Radiator  
15.247 (DSSS 2400 – 2483.5 MHz)**

**FCC**  
47 CFR, Part 15, Subpart B, and Subpart C  
**Industry Canada**  
ICES-003e, RSS GENe, RSS-210e

Date:  
Dec 19, 2013



EMC Engineer

6600 Congress Ave.  
Boca Raton, FL. 33487  
USA

Revision Level	Date	Reason
Rev. A	Dec. 22, 2013	Initial

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**1 SUMMARY OF RESULTS**

FCC 47 CFR Part 15.	Test Requirement	Test Limit	Comments
15.15 (b)	User Accessible Controls	Cannot change output power above limit.	The product contains no user accessible controls that increase transmission power above permitted levels.
15.31 (e)	Vary Input AC Mains Power	Does not increase the output power above the limit.	Complies.
13.33 (a)	Frequency range of radiated measurements	General Limits of 15.209, 150 kHz to 24 GHz.	E-field measurements comply
15.107	AC Conducted Emissions	Unintentional digital emissions subject to Class B limits of 15.107	Digital emissions determined by turning transmitter off. Complies.
15.109	Radiated Emissions Requirements	Unintentional digital emissions subject to Class B limits of 15.109	Digital emissions determined by turning transmitter off. Complies.
15.203	Antenna Connector	Permanently attached or unique coupling.	The antenna is permanently attached. Inverted F. Complies.
15.204(b)(c)	System and Antennas	Marketed as a system with authorized antenna types	Integral internal antenna. Complies.
15.207 (a) (b)	AC Conducted Emissions	General Limits.	Conducted emissions on AC side of DC supply. Complies.
15.205 (a) (b) 15.209 (a) (c)	Radiated Emission	Comply with limits in 15.209 (a). No intentional emissions in the restricted bands of 15.205	The radiated emissions comply with the general emission limits. Complies.
15.247 (a) (2)	Carrier Frequency Separation	DTS, 6 dB BW >500 kHz	Complies.
15.247 (b) (3)	Output Power	Maximum 1 W (30 dBm)	The EUT complies with the requirement. Max = 7 dBm. Complies.
15.247 (b) (4)	Maximum Antenna Gain	If gain of transmitting antenna is greater than 6 dBi, the output power shall be reduced by the amount exceeding 6 dBi.	Permanently attached integral antenna is less than 6 dBi. Complies.
15.247 (d)	100 kHz BW peak power	100 kHz BW outside band to 20 dB below 100 kHz in band for peak. 30 dB below for RMS.	Complies
15.247 (e)	DTS, the conducted power spectral density	Shall be < 8 dBm in any 3 kHz band	Complies
15.247 (i)	RF Exposure	Must ensure that RF MPE to the public falls within Commission Guidelines	Complies See RF Exposure Section.

**1.1 47 CFR Part 15, Subpart B / Subpart C**

Part	PARAMETER TO BE MEASURED	Applies	Comments
<b>SubPart B, Unintentional Radiators (Class B)</b>			
15.107(a)	Conducted Emission Limits, Digital Device, CLASS B	X	Complies
15.107(b)	Conducted Emission Limits, Digital Device, CLASS A		
15.109(a)	Radiated Emissions Limits, Digital Device, CLASS B	X	Complies
15.109(b)	Radiated Emissions Limits, Digital Device, CLASS A		
<b>SubPart C, Intentional Radiators (General Limit)</b>			
15.207	Conducted Disturbance (Conducted Emissions, 0.15-30 MHz)	X	Complies
15.209	Radiated Disturbance (Radiated Emissions, 0.009 to 10 GHz)	X	Complies
15.247(a)(2)	6 dB Bandwidth at least 500 kHz	X	Complies
15.247(b)(3)	1 Watt limit into max 6 dBi antenna	X	Complies
15.247(d)	100 kHz Out-of-band emission 20 dB< 100 kHz inband peak 100 kHz Out-of-band emission 30 dB< 100 kHz inband average Unwanted emissions below 15.209(a) if in 15.205(a) restricted bands.	X	Complies
15.247(e)	Power Spectral Density average < 8 dBm in any 3 kHz band	X	Complies

**Compliance with 15.203:**

This product is professionally installed and setup, therefore the device is compliant with the requirement of this clause.

**Compliance with 15.204:**

The antenna used with the transmitter is permanently mounted internal to the EUT.

**1.2 IC RSS GEN**

Clause	PARAMETER TO BE MEASURED	Applies	Comments
4.6.1	Occupied Bandwidth, 99%	X	
4.6.2	6 dB Bandwidth	X	1.64 MHz

## 2 GENERAL

### 2.1 Test Site Registration

The Tyco Safety Products / Sensormatic Electronics, LLC OATS located at 6600 Congress Ave. Boca Raton, FL. 33487 is registered with the FCC, number – 889978 and 616407, and with Industry Canada, number – 3506A-1.

### 2.2 Test Procedures

Both conducted and radiated emissions testing were performed according to the procedures in ANSI C63.4-2003, as required by 47 CFR Part 15 Subpart A Section 15.31(a)(3), 15.107, 15.109, 15.207, 15.209.

15.247 requirements were measured according to ANSI C63.10-2013 per FCC document 558074 D01 DTS Meas Guidance v03r01 - **“Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247”**

Accessory Equipment used during testing are all FCC DoC, Verified, or Certified products. This includes ITE power supplies.

The digital portion of the radio was evaluated according to the DoC procedures.

EUT was tested with modulation and without modulation in CW >98% duty cycle for worst case.

Radiated evaluations were performed in a pre-screen environment and the worst case was tested on the OATS. Multiple orientations of radio were evaluated to determine worst case.

Maximum conducted transmit power was measured at a temporary RF connector on the transmitter in place of the antenna.

### 2.3 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:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where:

RAW = Measured level before correction (dB $\mu$ V)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\text{dB}\mu\text{V/m} = 20 * \log * \mu\text{V/m}$$

Margin to Limit is calculated by subtracting corrected measurement from Limit.  
Positive margin indicates compliance. Negative margin indicates non-compliance

To convert dB $\mu$ V/m to dB $\mu$ A/m,

Reduce reading in dB $\mu$ V/m by 51.5 dB to convert to dB $\mu$ A/m.

**Per IC RSS-Gen, Ver. E, Section 4.8,**

The following formula may be used to convert field strength (FS) in volts/metre to transmitter output power (TP) in watts:

$$TP = (FS \times D) / (30 \times G)^2$$

Where D is the distance in meters between the two antennas and G is the antenna numerical gain referenced to isotropic gain.

(Note: In an open-area test measurement, the effect due to the metal ground plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.)

Effective Radiated Power is converted to Field Strength by the following:

The Friis transmission equation governs the interaction between two antennas in the far field:

$$P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi r)^2}, \quad (5)$$

where  $P_r$  is the power measured at the receive antenna output port;

$P_t$  is the power measured at the transmit antenna input port;

$G_t$  is the gain of the transmit antenna;

$G_r$  is the gain of the receive antenna;

$\lambda$  is the wavelength; and

$r$  is the separation between the two antennas (the range length).

The electric field generated at a point in the far field as a function of the transmitted power is given by

$$E = \frac{\sqrt{30 P_t G_t(\theta, \phi)}}{r}, \quad (12)$$

where  $E$  is the electric field generated at the distance  $r$  from the transmit antenna,

$P_t$  is the power measured at the transmit antenna input port,

$G_t(\theta, \phi)$  is the angle-dependent gain of the transmit antenna, and

$r$  is the distance from the transmit antenna to the test point (the range length)

Info: <http://www.ce-mag.com/archive/02/Spring/fogelle2.html>

Note:

power levels into a dipole results in an E-field at a distance according to power:  $(V^2) / R = P$

power flux density:  $s = PG / (4\pi r^2)$ , where  $\pi = 3.14$  and  $r = \text{distance}$

Field strength:  $e = \sqrt{120 \times \pi \times s} = \sqrt{30 \times P} / r$

A half-wave dipole has a 1.64 gain in its equatorial plane, therefore:

$$e = \sqrt{1.64 \times 30 \times P} / r = 7 \times \sqrt{P} / r$$

Field strength  $e = (7.02 \times \sqrt{ERP}) / d$ . ERP in Watts,  $d$  in meters.

Or Source Radiating (ERP)  $\rightarrow ERP = (e \times d / 7.02)^2$  in Watts, Volts/meter, meters

Conversion to dBuV from [http://www.compeng.com.au/emc\\_conversion\\_tables\\_rf\\_calculator2.aspx](http://www.compeng.com.au/emc_conversion_tables_rf_calculator2.aspx)

## 2.4 Uncertainty of Measurements

Combined Standard Uncertainty and Expanded Uncertainty using an expansion factor of 2. (estimated)		CISPR 16-4-2 Uncertainty Limits
Radiated Emissions = $\pm 1.56$ dB	Expanded Uncertainty = 3.12 dB	5.2 dB
Conducted Emissions = $\pm 1.12$ dB	Expanded Uncertainty = 2.24 dB	3.6 dB
Harmonic Current and Flicker = $\pm 2.6$ %	Expanded Uncertainty = 5.12 %	
Radiated Immunity = $\pm 2.15$ dB	Expanded Uncertainty = 4.3 dB	
ESD Immunity = 4.15 %	Expanded Uncertainty = 8.3 %	
EFT - Fast Transient Immunity = $\pm 2.82$ %	Expanded Uncertainty = 5.64 %	
Conducted Immunity = $\pm 1.83$ dB	Expanded Uncertainty = 2.24 dB	
Voltage Variation and Interruption = $\pm 1.7$ %	Expanded Uncertainty = 3.4 %	
Surge Immunity = $\pm 3.1$ %	Expanded Uncertainty = 6.2 %	

Uncertainty values were calculated based on methods in ETSI TR 100 028.

Per EN 302 208-1, Clause 7, the value of the measurement uncertainty for each measurement, shall be equal to or lower than the figures given below.

### Parameter Uncertainty

RF frequency	$\pm 1 \times 10^{-7}$
RF power, conducted	$\pm 0,75$ dB
RF power, radiated, valid up to 12,75 GHz	$\pm 6$ dB
Maximum frequency deviation for FM	$\pm 5$ %
Two-signal measurements	$\pm 4$ dB
Time	$\pm 5$ %
Temperature	$\pm 1$ K
Humidity	$\pm 5$ %



**3 DESCRIPTION AND CHARACTERISTICS OF THE EUT**

**3.1 Model / Type Designation**

The model or type designation may be either a single alphanumeric code or an alphanumeric/code divided into two parts.

1. Equipment Series  
AMB-4400

2. Equipment Specific  
AMB-4410

**3.1.1 Marketing And Installation Environment**

Either (FCC 15: Sub-part B, Class A or B) – Unintentional Radiator

Emissions Class A is non-residential, not advertised or marketed to general public.

or

Emissions Class B is anywhere; advertised and marketed to general public

And/or

FCC 15, Sub-part C – Intentional Radiator

This system is professionally installed.

**3.1.2 Overview**

This report is part of the application for FCC Certification of a IEEE 802.15.4 transceiver operating in the 2400-2483.5 MHz.

The EUT is a battery powered handheld device that is used to detect and deactivate EAS tags.

Synchronization with other units is provided by a radio link in the 2.4 GHz band to a FCC ID: BVCAMB43.

The EUT can be mounted together with a variety of barcode scanners which provides a signal that indicates a barcode has been read. The EUT then charges the deactivation circuit and begins a tag detection routine that triggers the deactivation circuit when an EAS tag is detected.

This unit is a single construction with numerous plastic adapters used to attach or mount the single unit to other devices made by other manufacturers.

There is also a battery charging station while the EUT is not in use.

**3.1.3 Environment**

Ambient temperature .....0°C to 50°C, (32°F to 122°F)

Relative humidity .....0 to 90%, non-condensing

**3.1.4 Frequency Characteristics and Internal Clocks**

Transmitter: IEEE 802.15.4 transceiver (DSSS)

Operating frequency ..... 2400-2483.5 MHz

EAS tag detection ..... 58 kHz

Clocks:

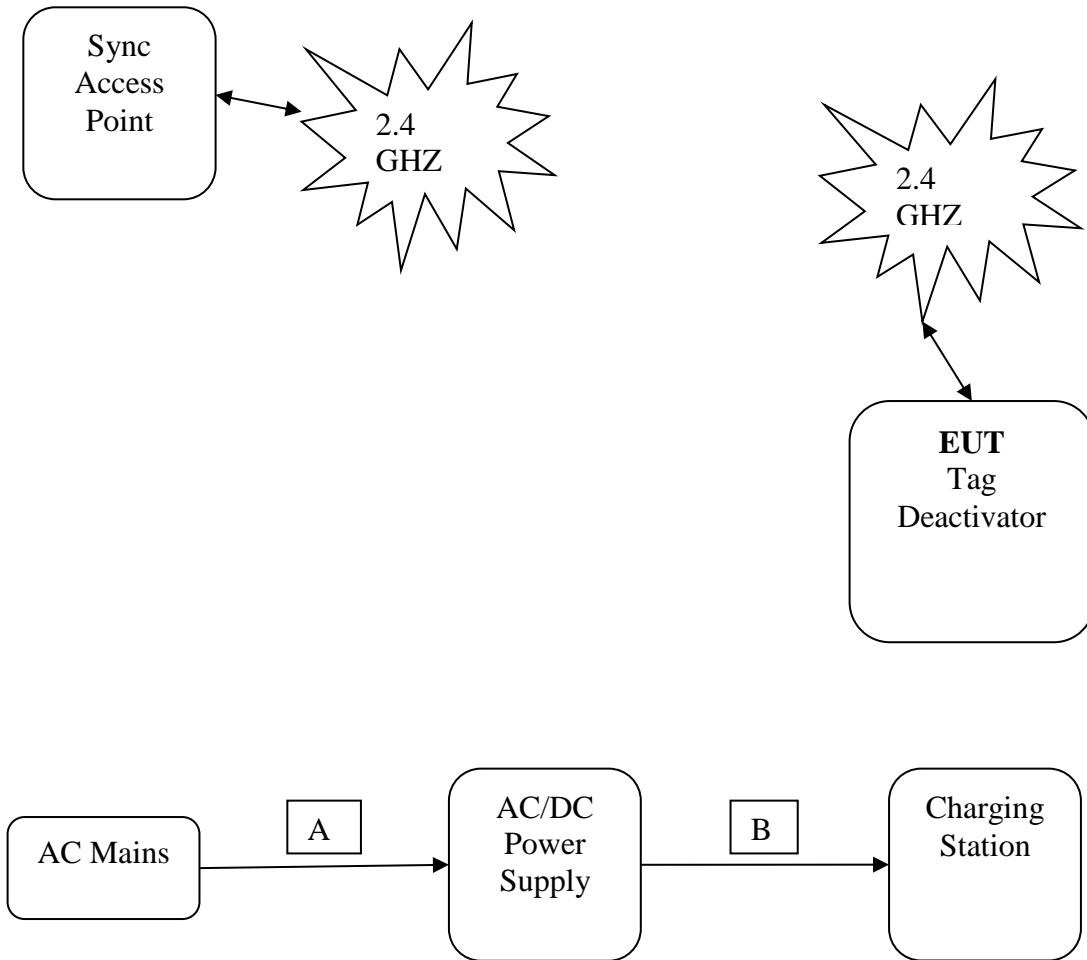
96 MHz

48 MHz

32 MHz

24 MHz

**3.2 TEST SET-UP BLOCK DIAGRAM**



**3.2.1 List Of Ports**

label	Function	Classification	Max Cable Length	Test Length	Cable Type/Description
A	AC pwr	AC power	2 meters	1.8 meters	Standard AC power cord
B	DC pwr	DC power	2 meters	1.5 meters	Low voltage 2 wire,
2.4 GHz	Radio sig	RF signal	na	na	na

### **3.2.2 Accessory Equipment Used During Testing**

AMB-4300 Sync Access Point (FCC ID:BVCAMB43)  
Charging Station

### **3.2.3 List of Power Supplies**

5606-0096-01 Sensormatic power supply

### **3.2.4 Accessory Equipment Declaration of Conformity**

All accessory equipment used during testing is commercially available off-the-shelf (COTS) FCC DoC or Verified devices.

**4 FCC TESTS****4.1 AC Conducted Emissions, FCC Part 15, Clause 15.107 And 15.207**

Limit : Class B limits of 15.107, and general limits of 15.207  
 Equipment operation : Charging  
 Line Voltage / Freq : 120V / 60 Hz  
 Temp : 22° C  
 Humidity : 52.0% RH  
 Date : 09/17/13  
 Equipment list asset numbers : 11, 37, 104.

## FCC Class B 15.107 and 15.207 limits

Frequency range	Quasi-peak (dBuV)	Average (dBuV)
0,15 - 0,50	66 - 56	56 - 46
0,50 - 5	56	46
5 - 30	60	50

## Measurement Results

Freq (kHz)	Peak (dBuV)	QP (dBuV)	Avg (dBuV)	QP/Avg Limit	QP/Avg Margin	Line	Comments
174.8	60.56	58.68	36.47	65	55	L1	Complies
181.3	60.23	57.71	37.74	64.5	54.5	L2	Complies
228.9	54.26	51.5	30.39	62.5	52.5	L1	Complies
229.8	54.23	52.35	32.63	62.4	52.4	L2	Complies
278.7	48.76	46.91	29.35	61	51	L1	Complies
275.2	49.5	46.69	26.42	61.5	51.5	L2	Complies

Figure 1. Conducted Emissions on Line 1 (L1) (peak hold over time)

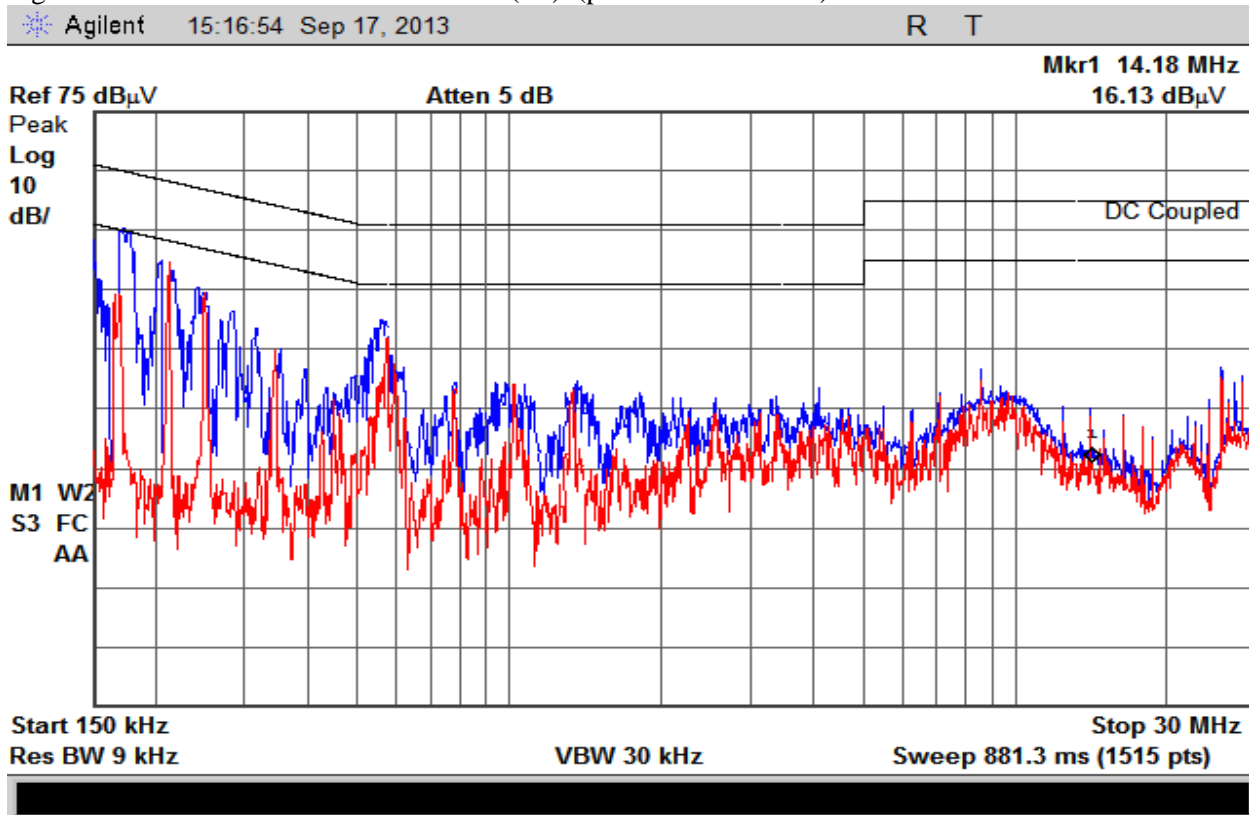
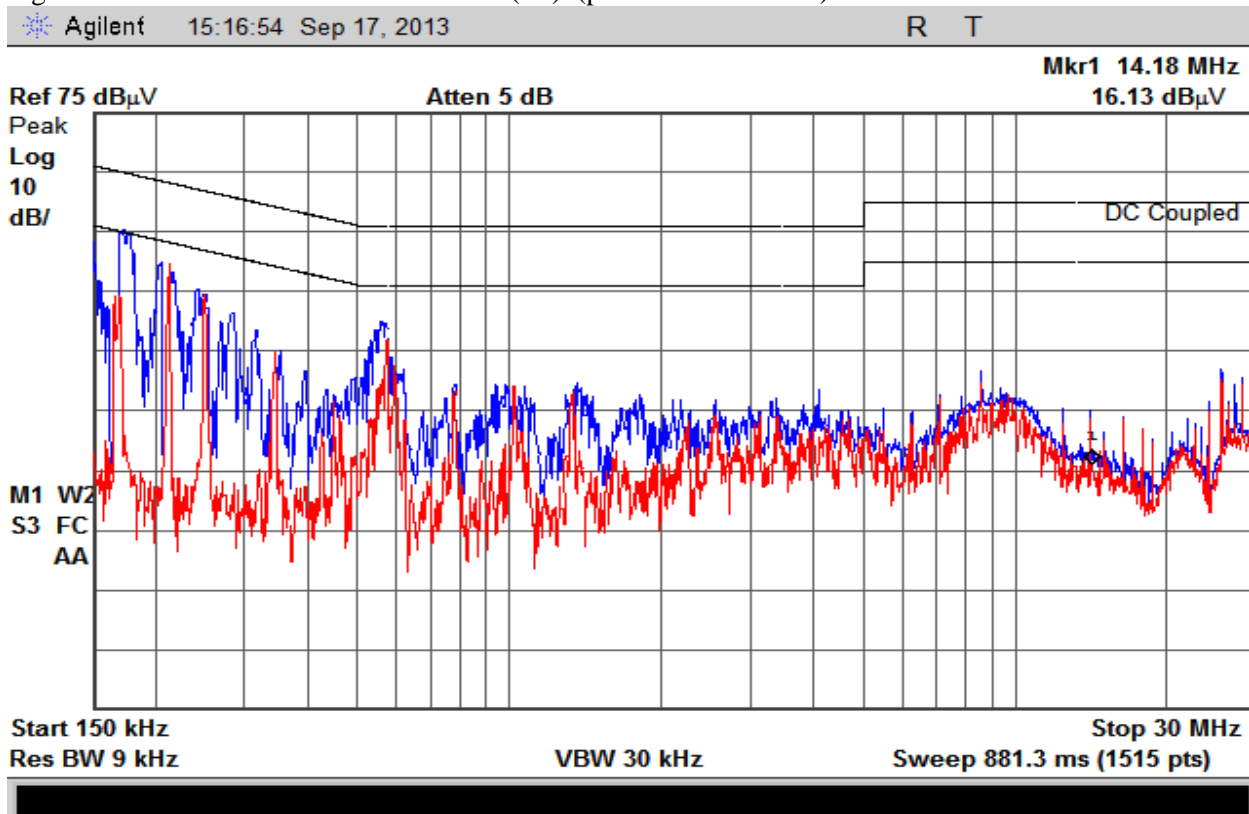
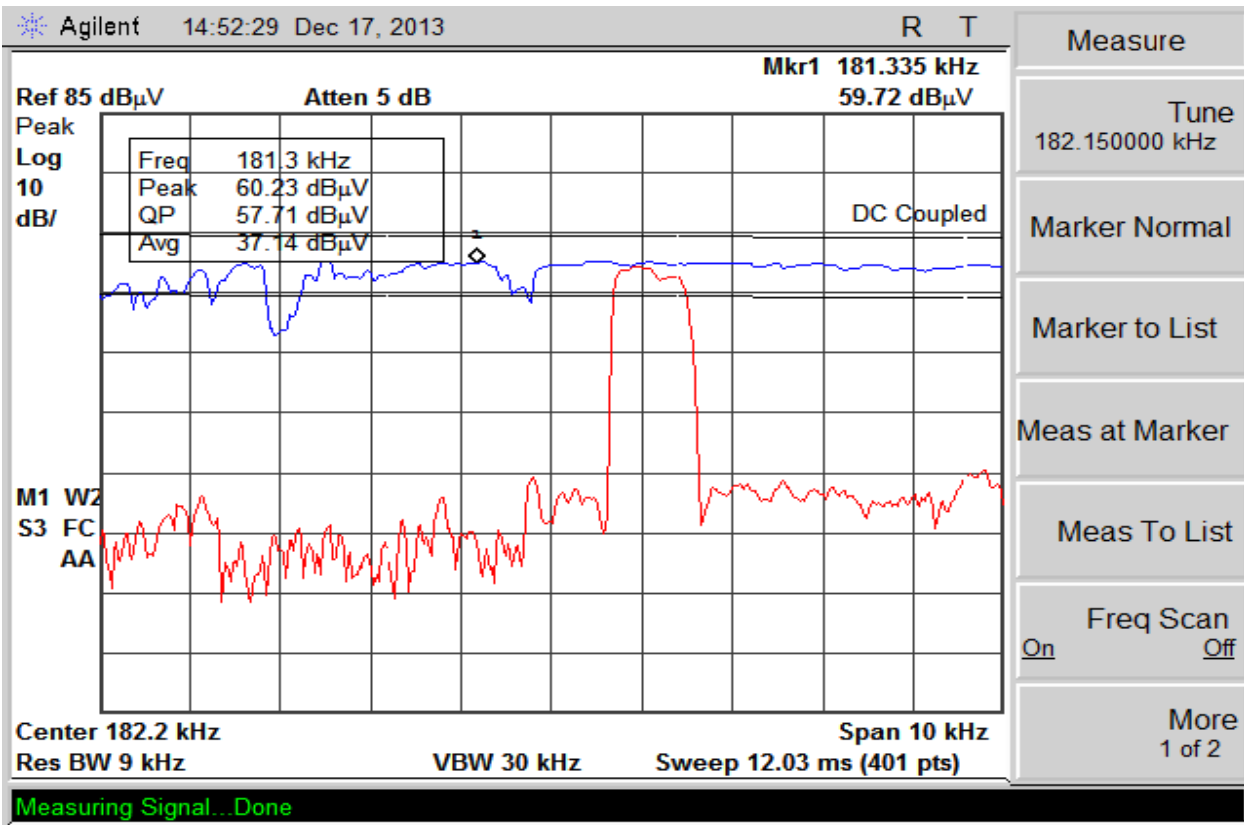
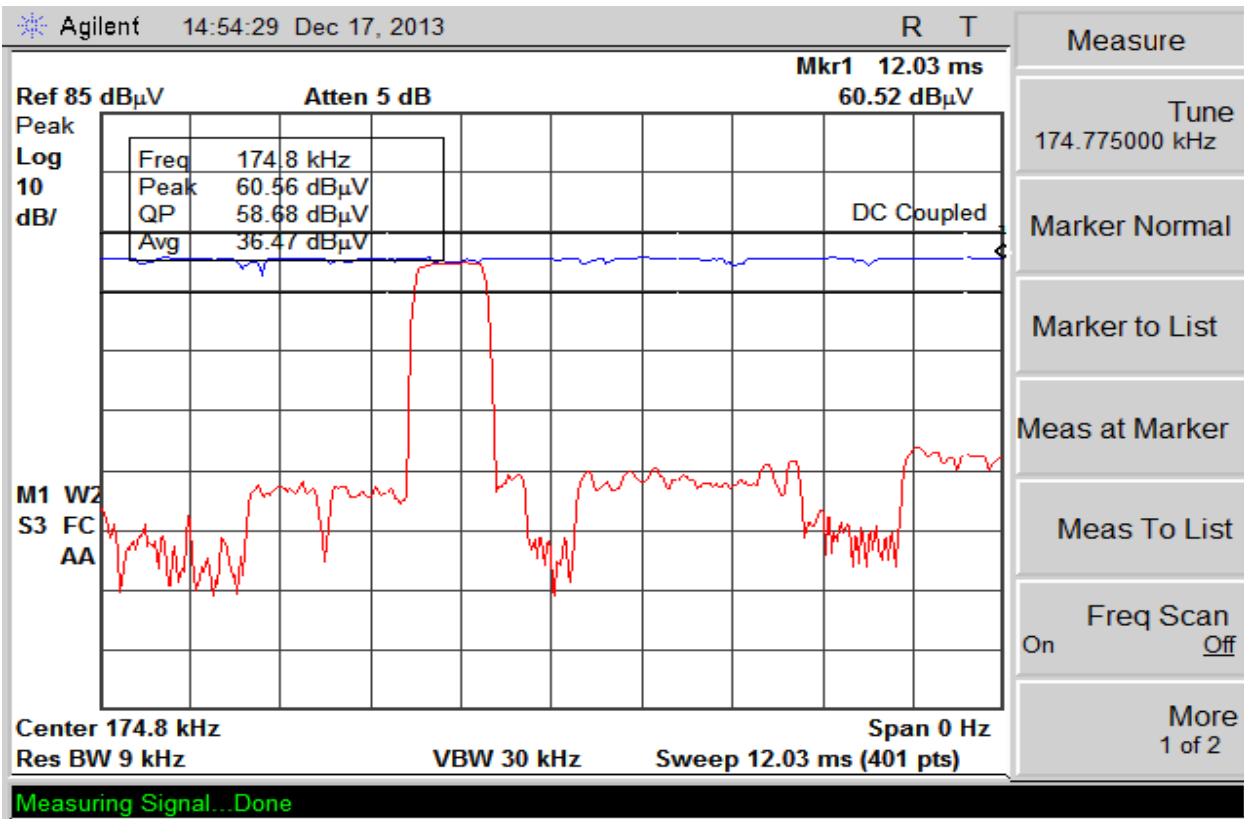
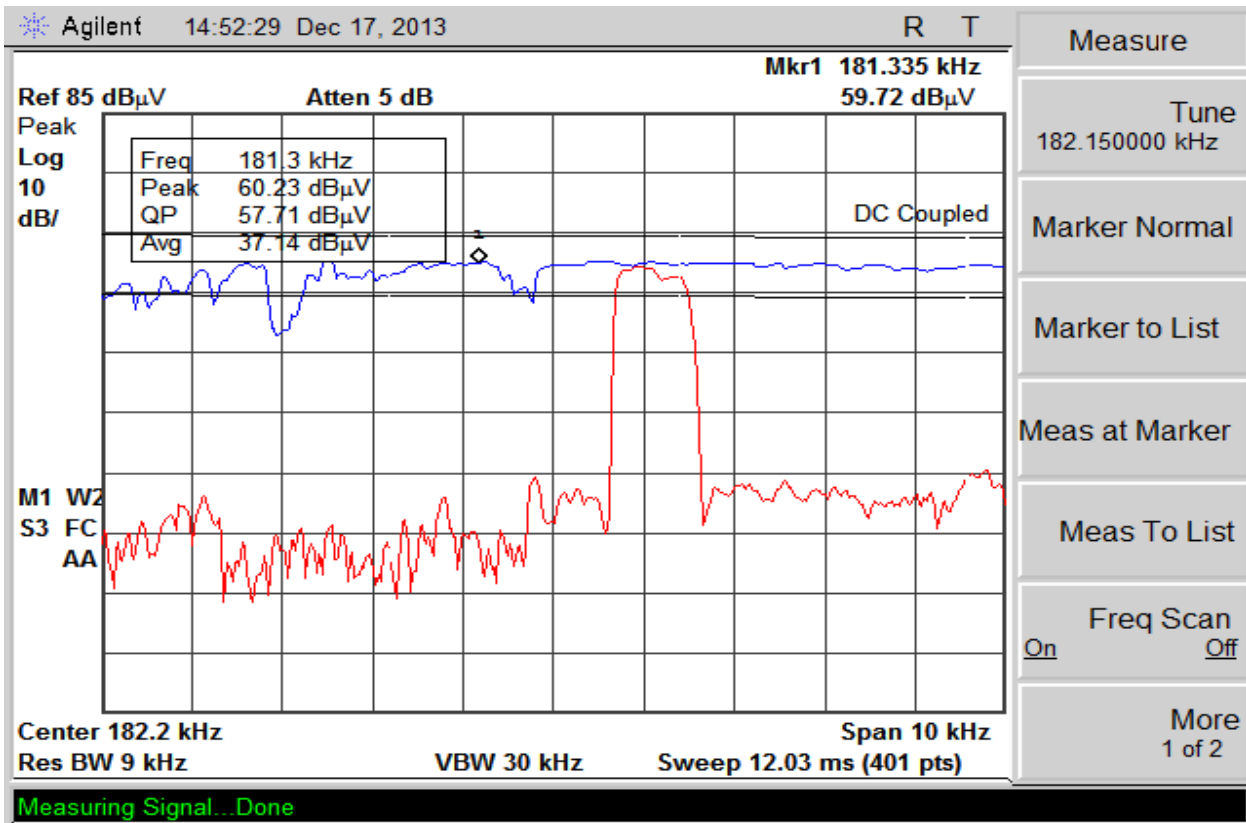


Figure 2. Conducted Emissions on Line 2 (L2) (peak hold over time)







Measure

Tune  
182.150000 kHz

Marker Normal

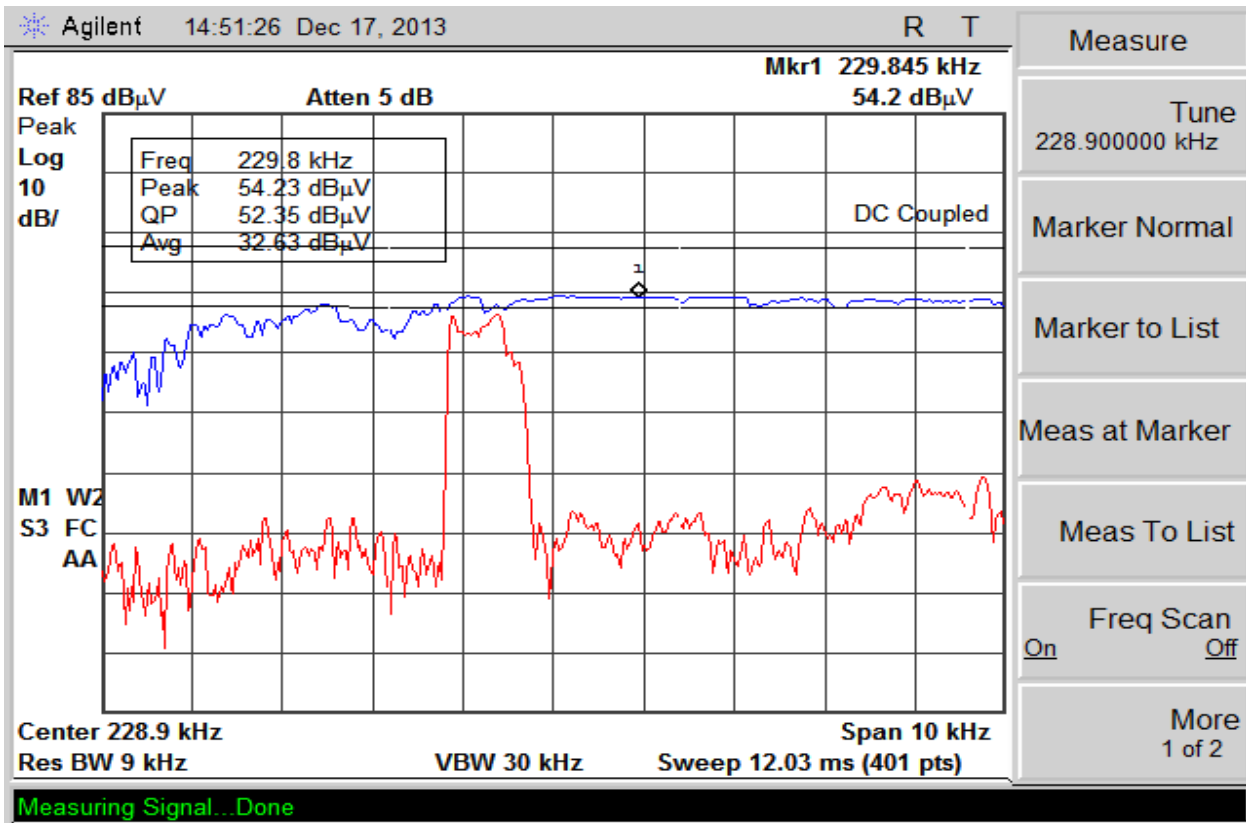
Marker to List

Meas at Marker

Meas To List

Freq Scan  
On Off

More  
1 of 2



Measure

Tune  
228.900000 kHz

Marker Normal

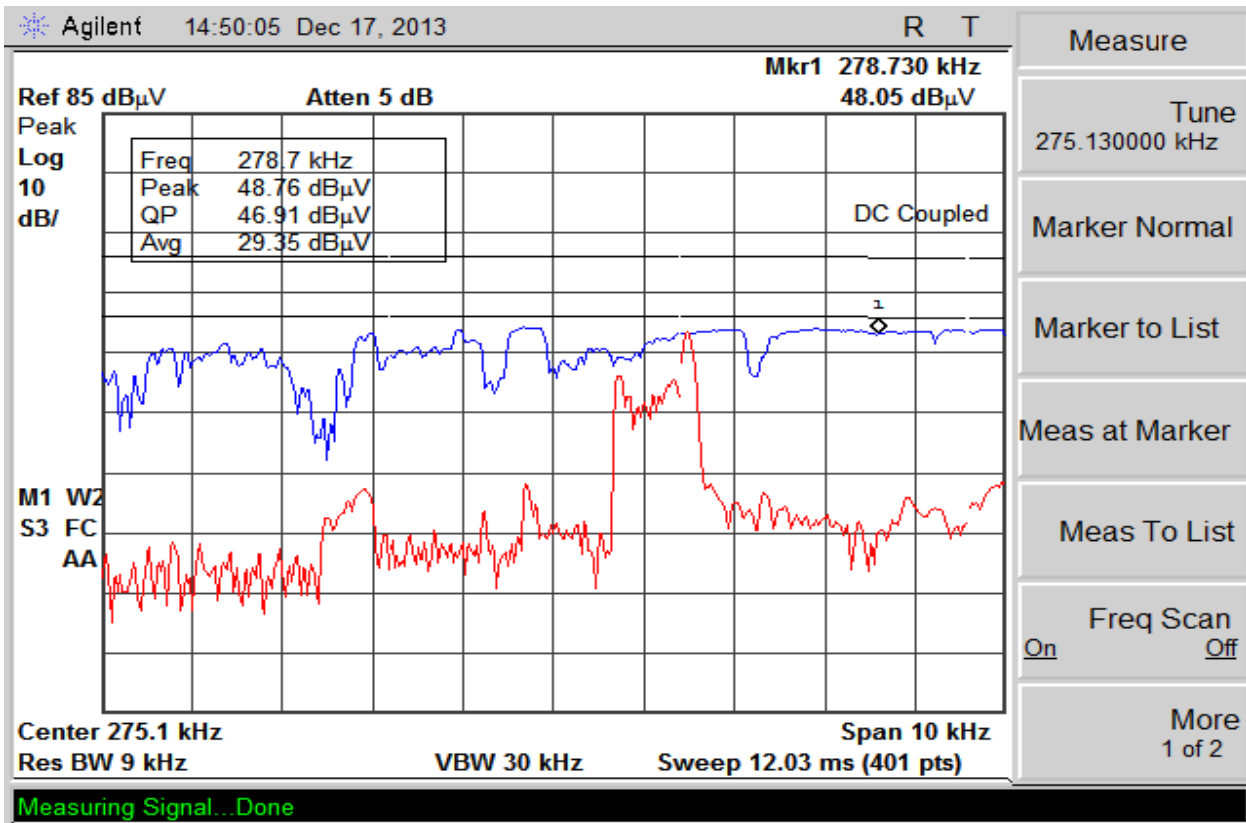
Marker to List

Meas at Marker

Meas To List

Freq Scan  
On Off

More  
1 of 2



Measure

Tune  
275.130000 kHz

Marker Normal

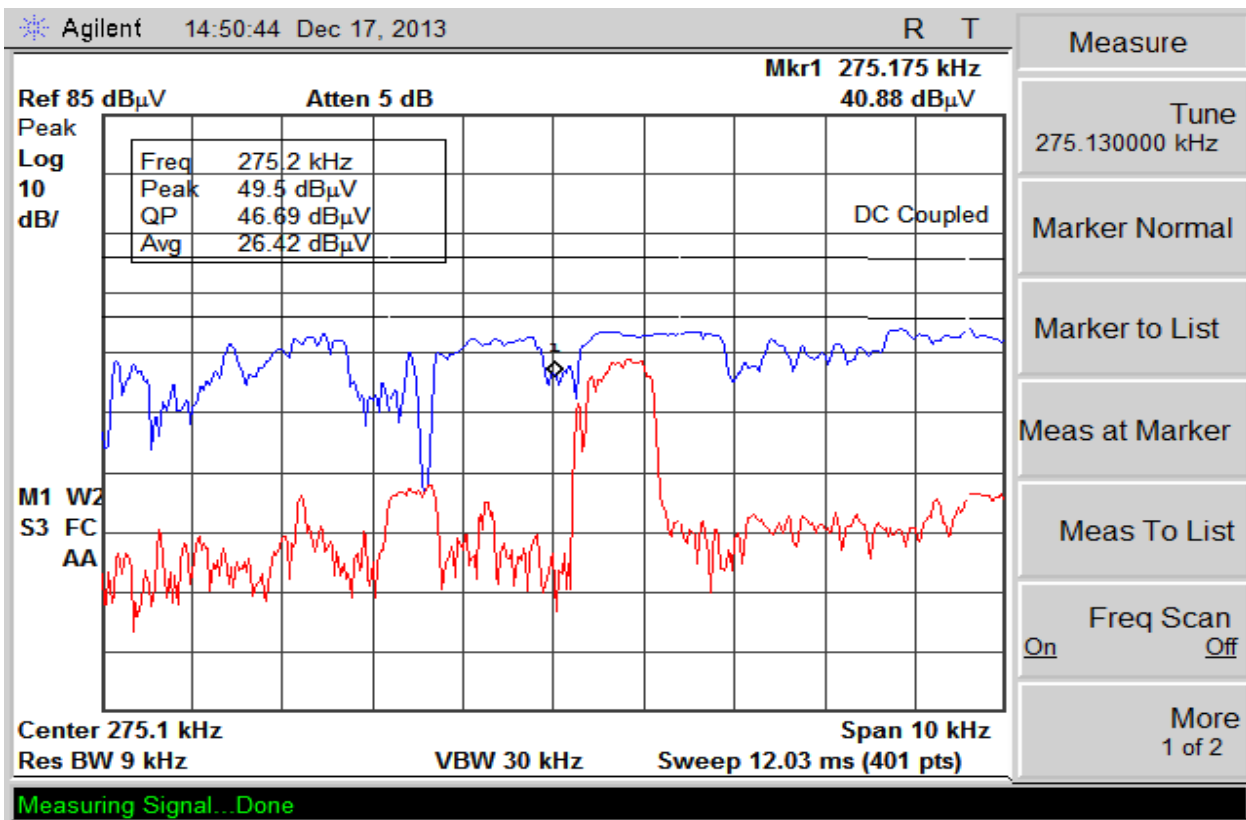
Marker to List

Meas at Marker

Meas To List

Freq Scan  
On Off

More  
1 of 2



Measure

Tune  
275.130000 kHz

Marker Normal

Marker to List

Meas at Marker

Meas To List

Freq Scan  
On Off

More  
1 of 2



**4.2 Radiated Emissions, FCC Part 15, Clause 15.109 and 15.209 (above 30 MHz)**

Limit : Class B  
 Equipment operation : Transmitting in 2.4 GHz band at full power – 7 dBm  
 Line Voltage / Freq : 120V / 60 Hz  
 Distance : 3 meters OATS  
 Temp : 23 C  
 Humidity : 55% RH  
 Date : 09/10/13  
 Equipment list asset numbers : 5, 6, 8, 104.

LIMIT FCC Part 15, Subpart B.

Class B digital devices at 3 meters, Subpart B and General Limits, Subpart C

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m) at 3 meters
30–88	100	<b>40</b>
88–216	150	<b>44</b>
216–960	200	<b>46</b>
Above 960	500	<b>54</b>

OATS Measurements:

		FCC 120 volts 60 Hz						Limit	
Freq (MHz)	QP (dBuV)	Antenna	Polarization	ant fac	cable fac	amp	Corrected	Class B	Margin
194	25.11	Bi-con #1	Horz	14.208	2.66	0	41.98	43.50	1.52
194	24.88	Bi-con #1	Vert	14.854	2.66	0	42.39	43.50	1.11
66.8	-0.6	Bi-con #1	Horz	9.032	1.28	0	9.71	40.00	30.29
66.8	9.2	Bi-con #1	Vert	9.311	1.28	0	19.79	40.00	20.21
353	9.2	LP #1	Horz	14.921	4.09	0	28.21	46.00	17.79
353	9.1	LP #1	Vert	14.776	4.09	0	27.97	46.00	18.03

Second and Third Harmonics

Freq (MHz)	(dBuV)	Antenna	Polarization	Cable/Ant fac	amp	Time Average	Corrected	Class B	Margin
4809.8	79.66 pk	Horn	Vert	6.055	28.57	-12 dB	45.15	54	8.85
7214.8	69.52 pk	Horn	Vert	14.18	29.96	-12 dB	41.74	54	12.26

Time average formula

$$20 * \log (\text{Duty Cycle}) = 20 * \log (0.25) = \underline{-12.04\text{dB}}$$

Frequency scans below.

Figure 1. Horizontal (peak hold over time)

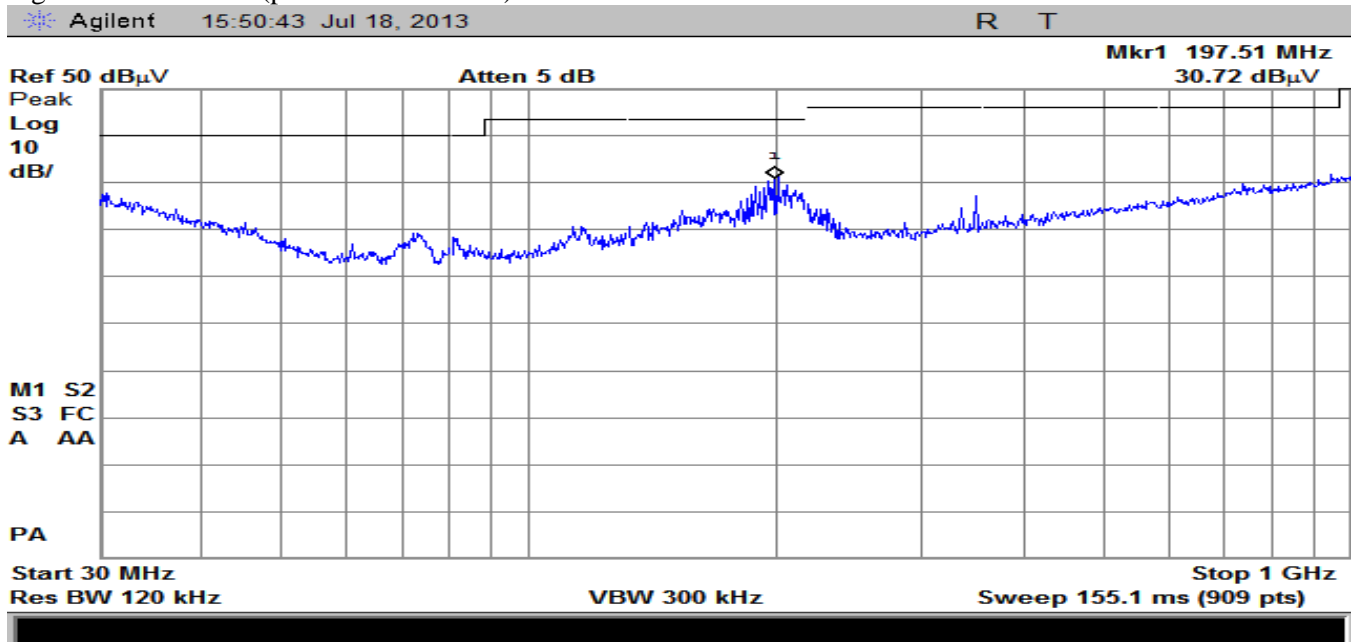
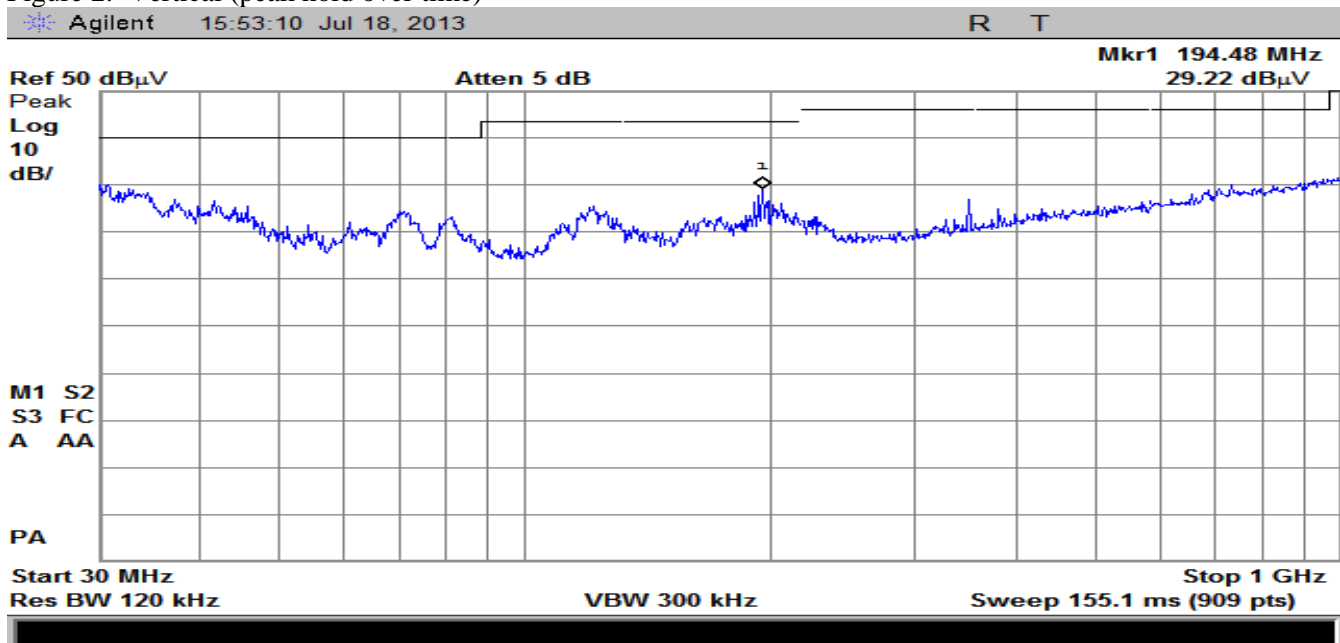
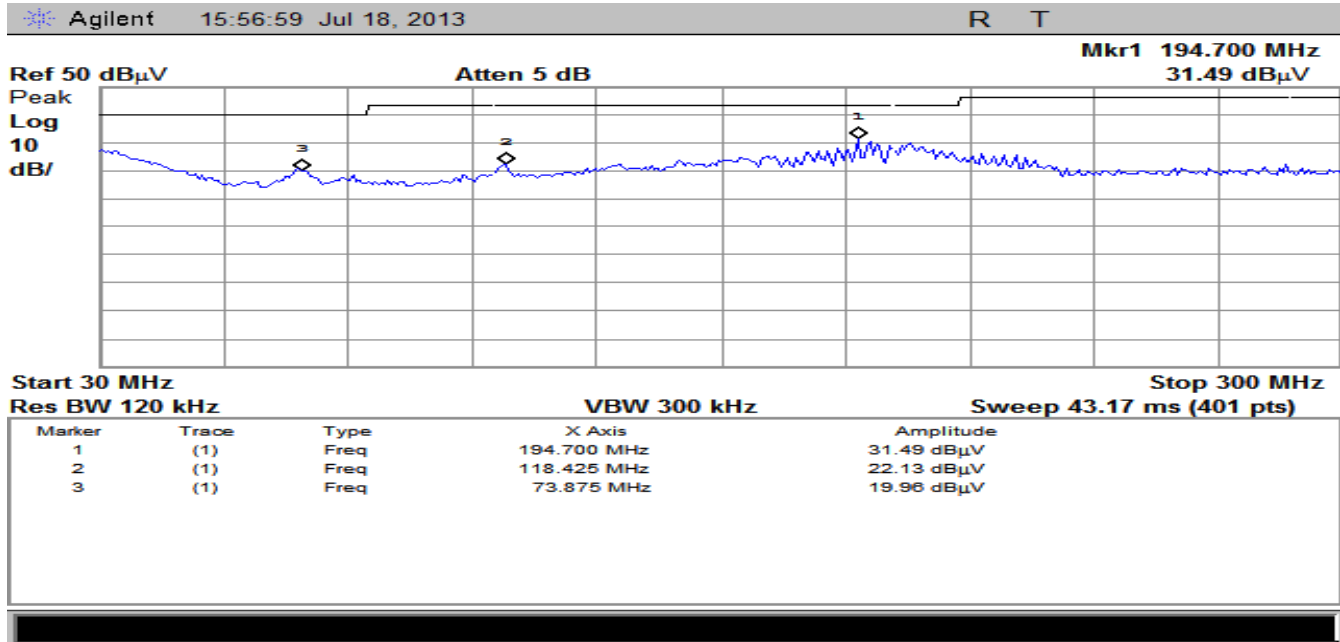


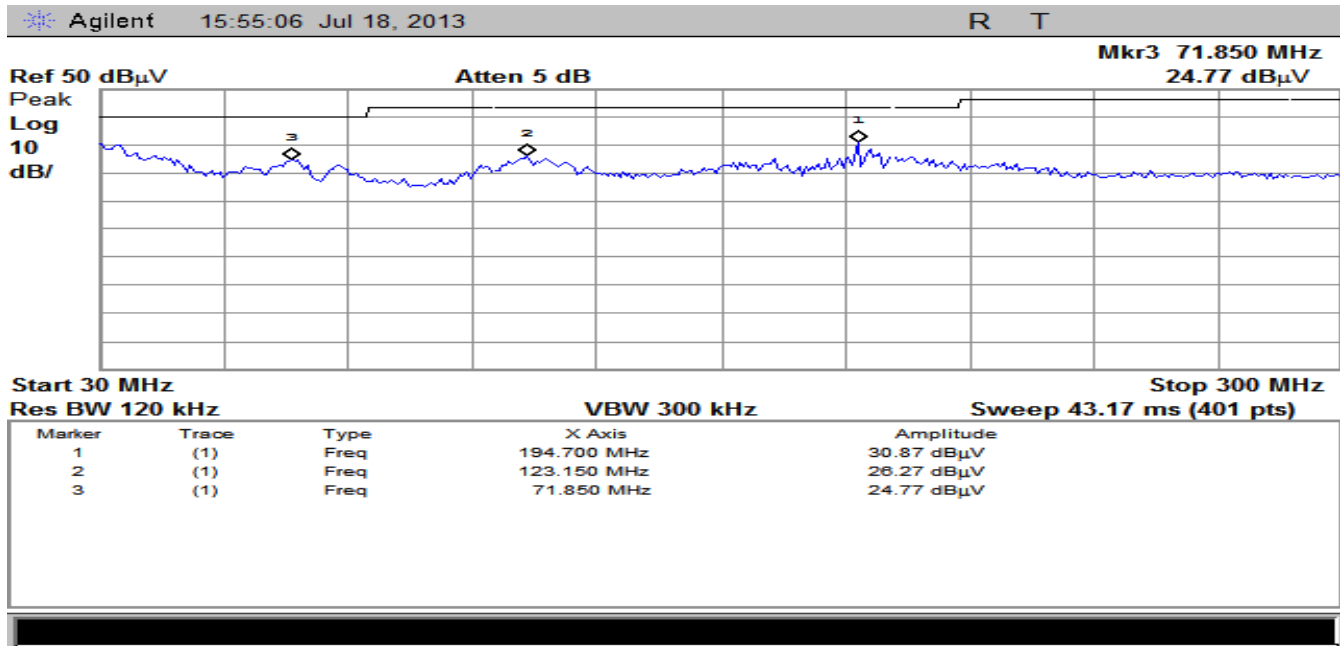
Figure 2. Vertical (peak hold over time)

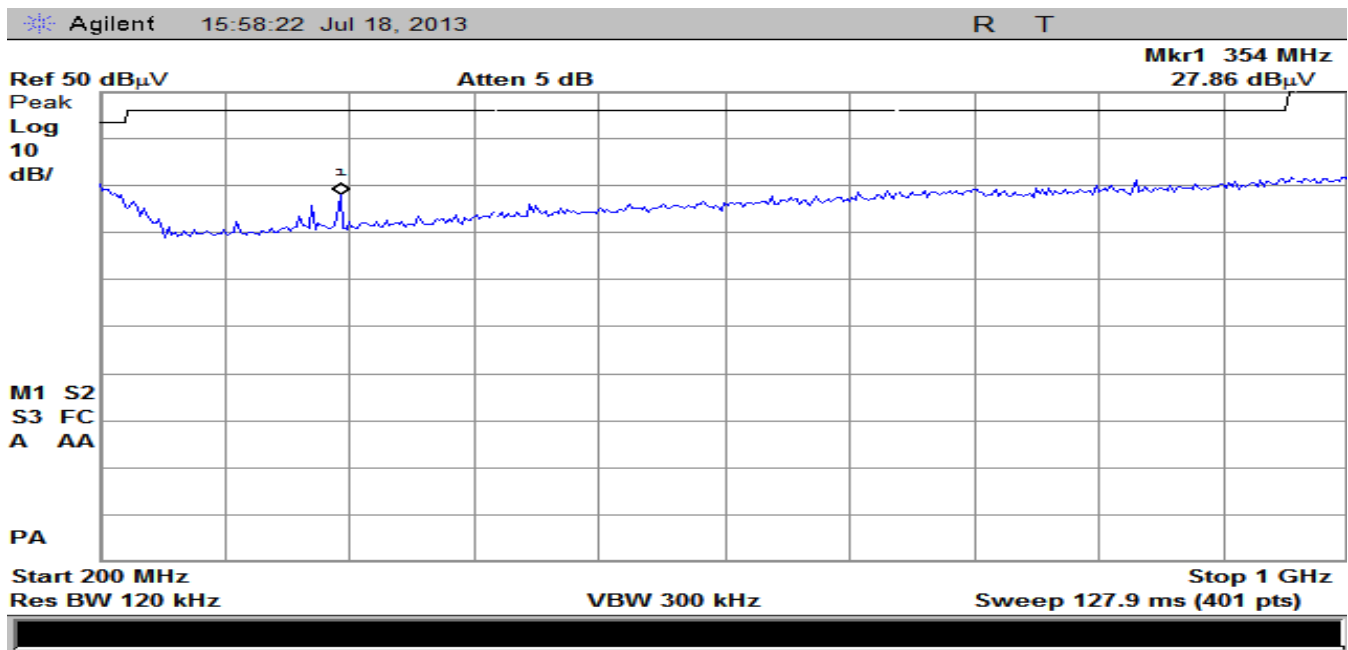
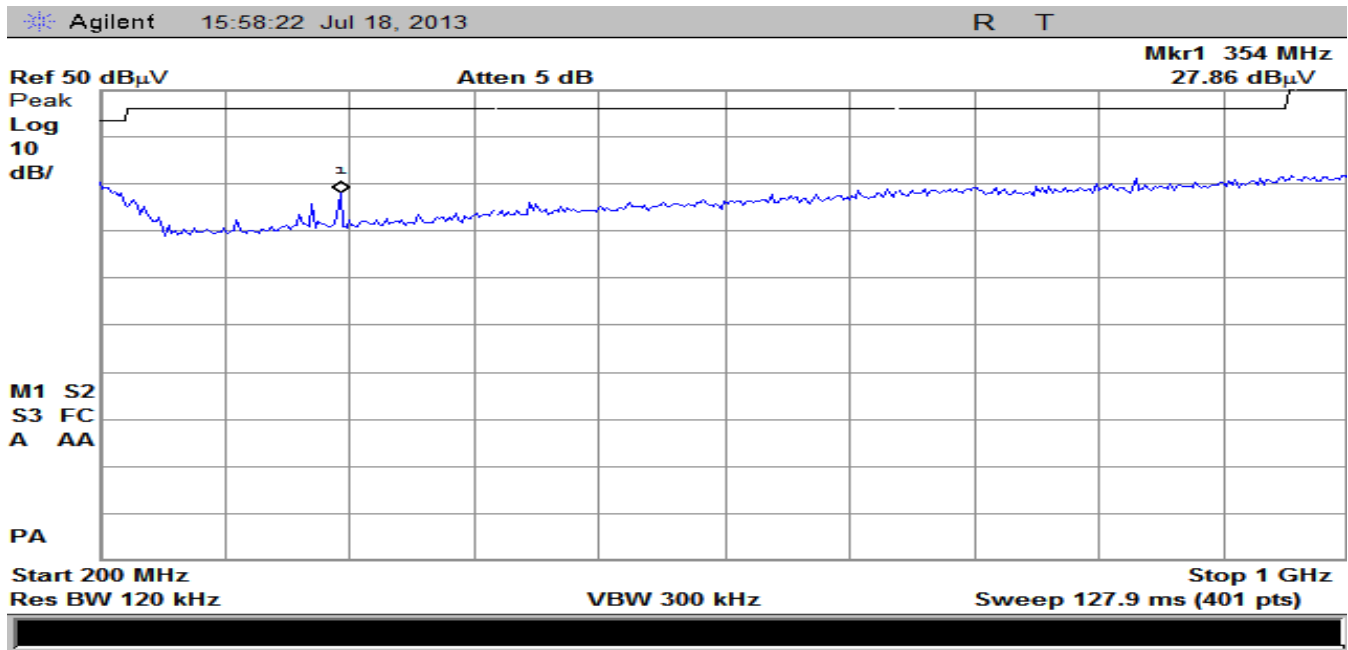


Hor



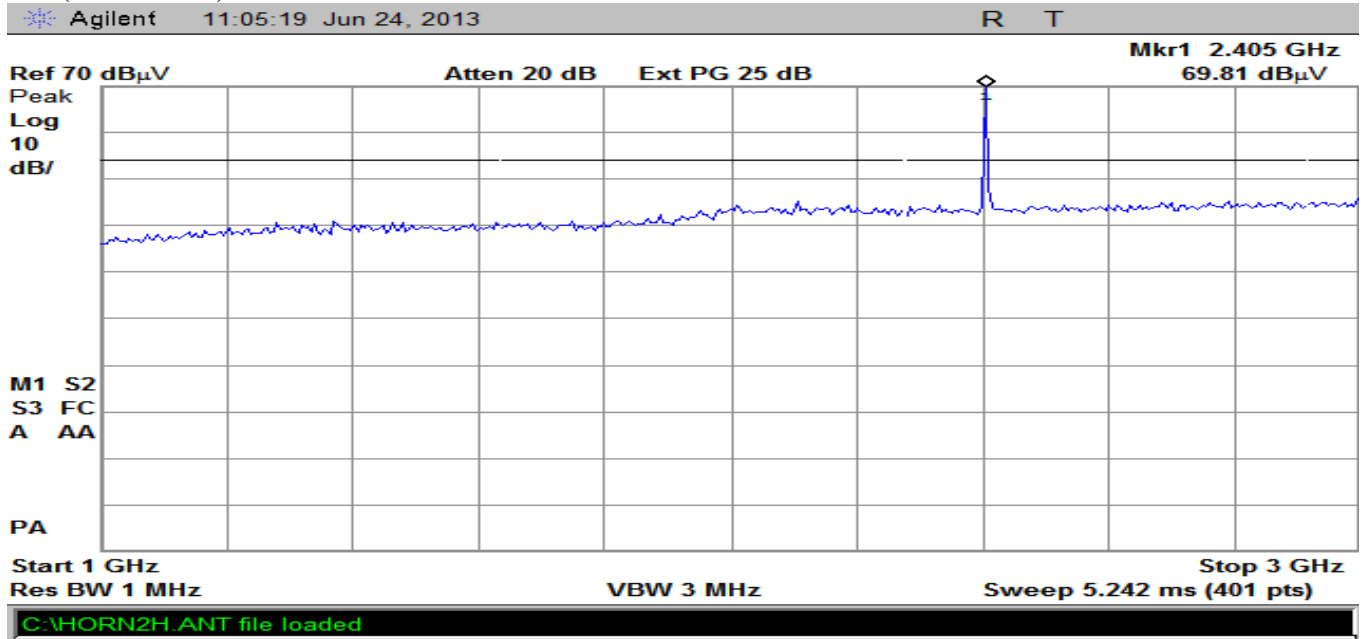
Ver



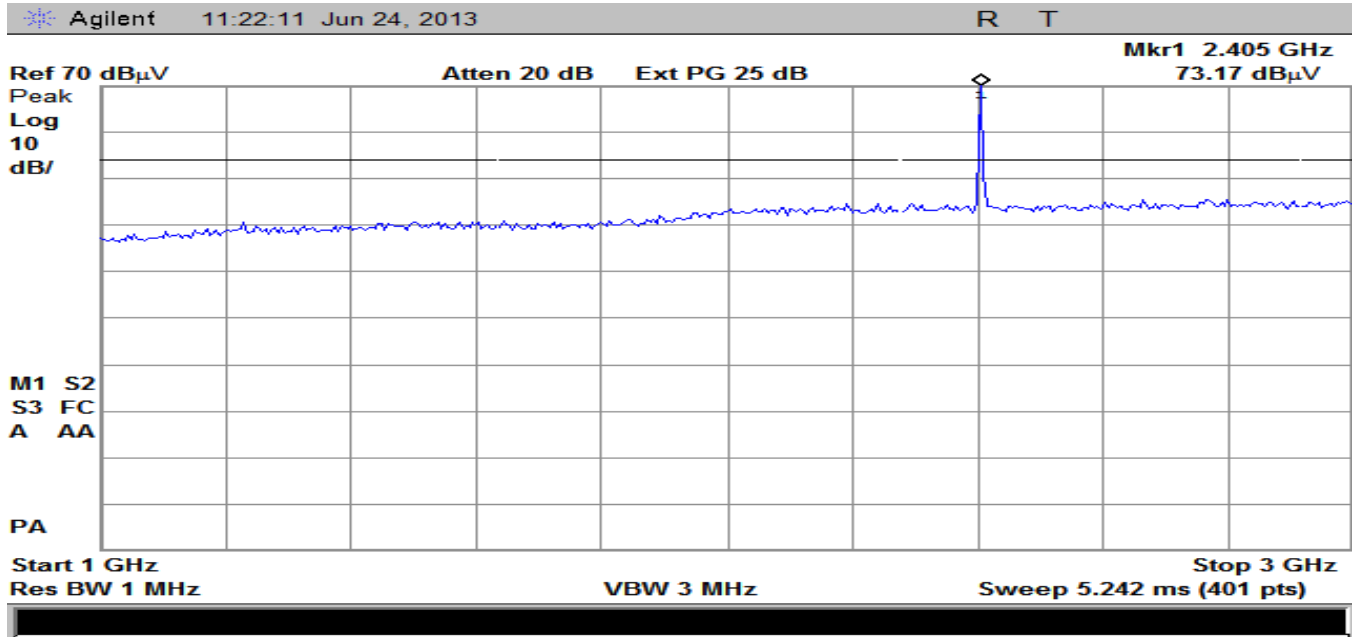


Scan above 1 GHz. Note reduced RBW to lower noise floor to find emissions.

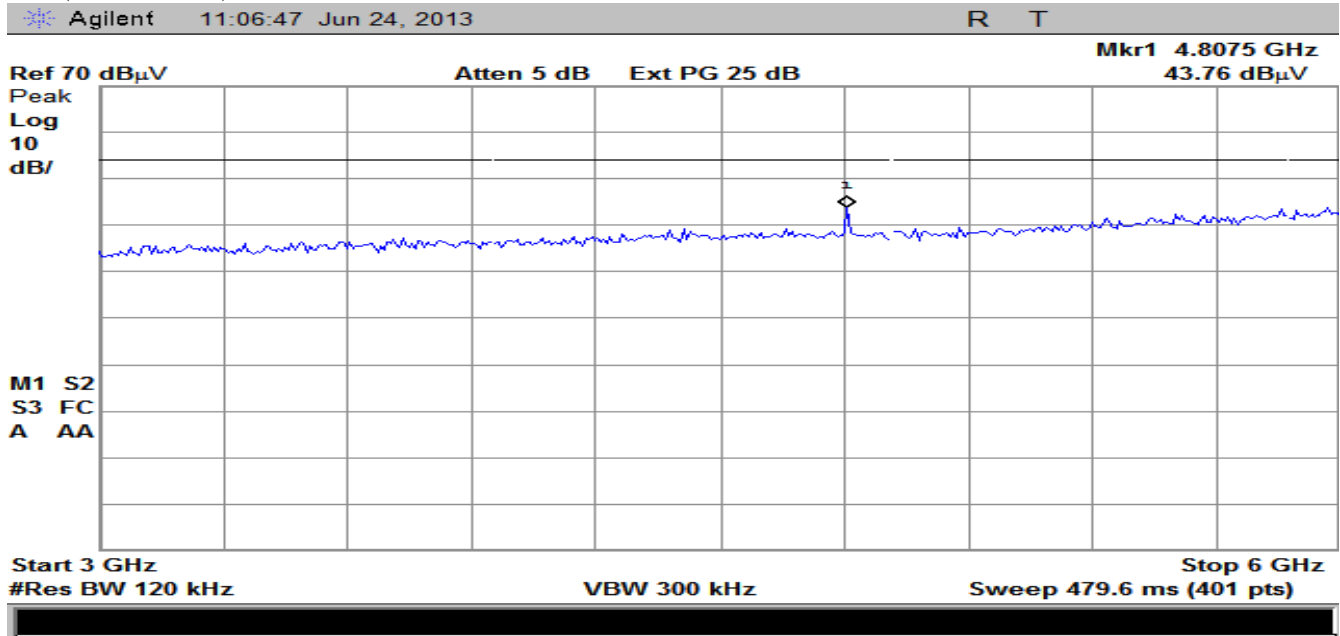
Hor (fundamental)



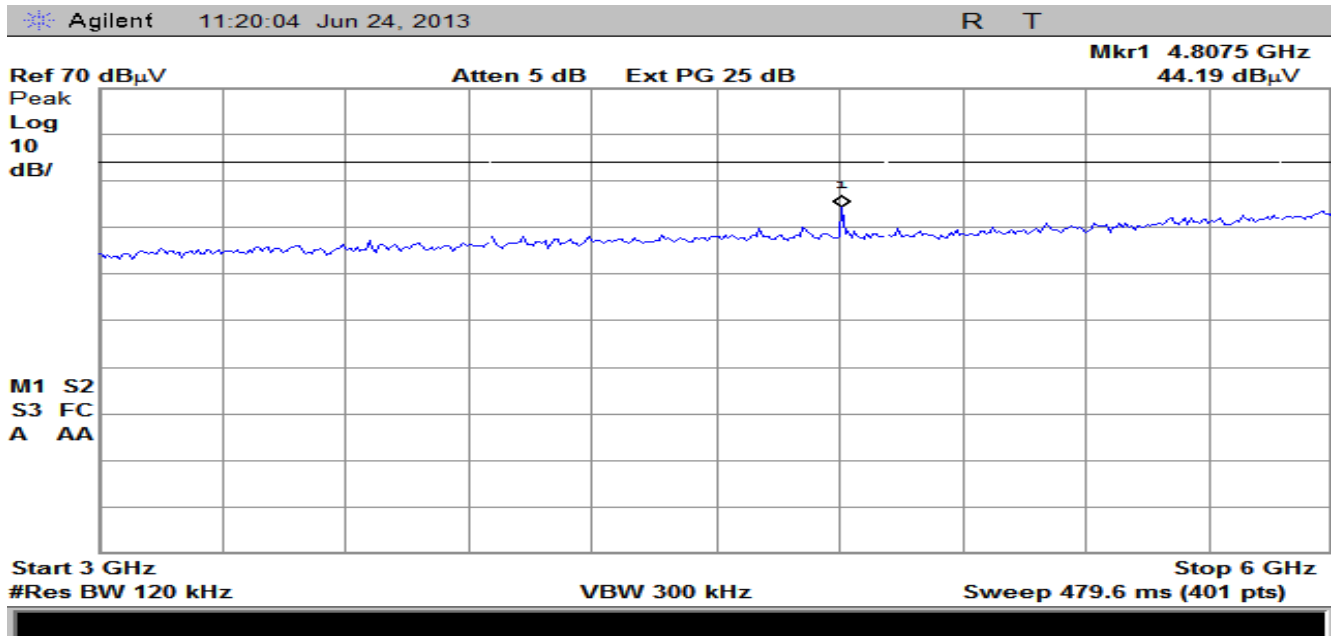
Ver



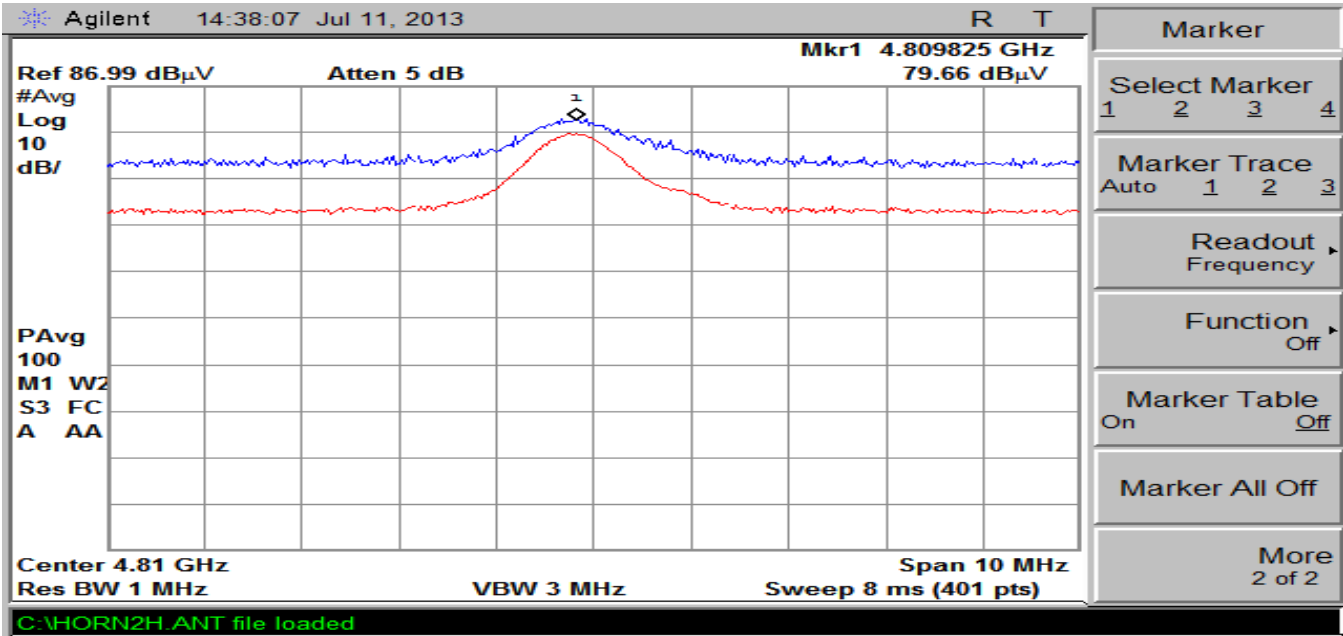
Hor (2<sup>nd</sup> harmonic)



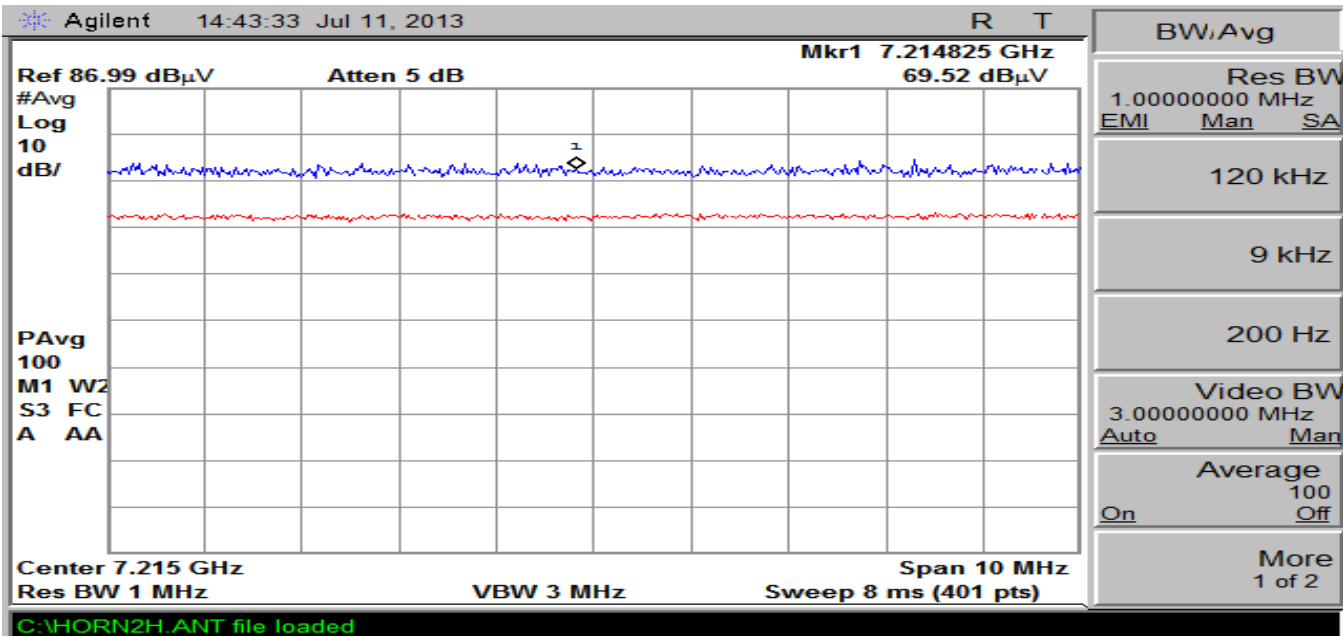
Ver



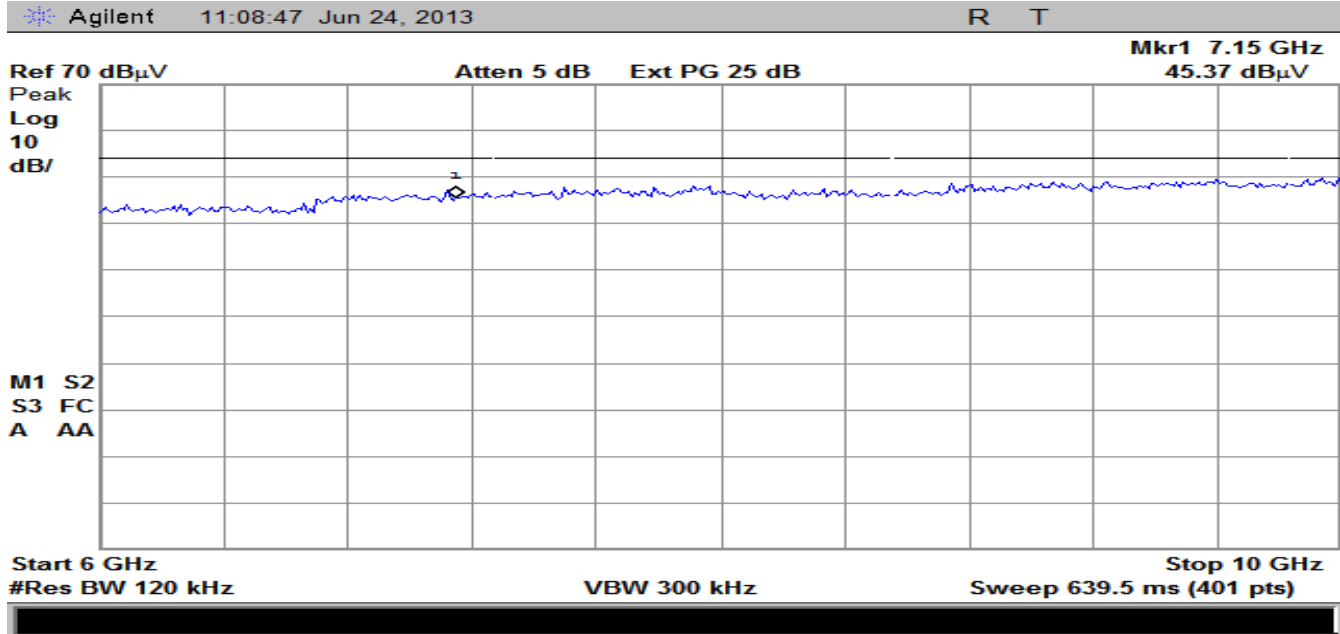
2<sup>nd</sup> Measured at 1 MHz RBW



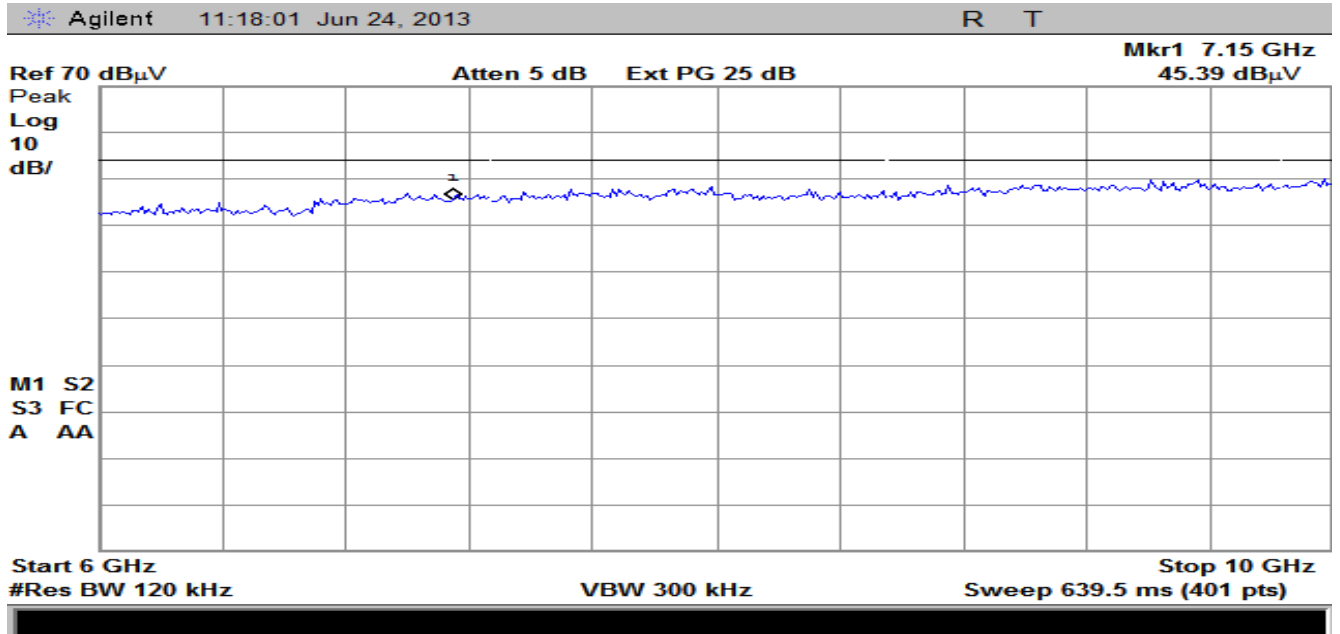
3<sup>rd</sup> Measure at 1 MHz RBW



Hor

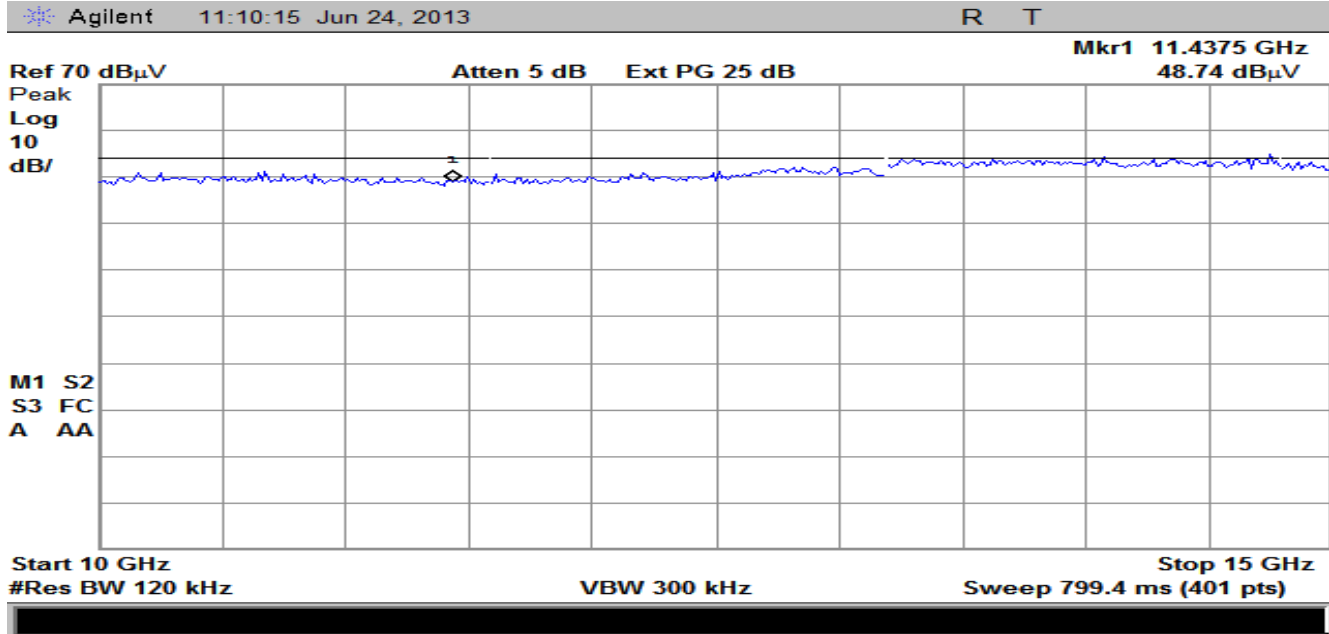


Ver

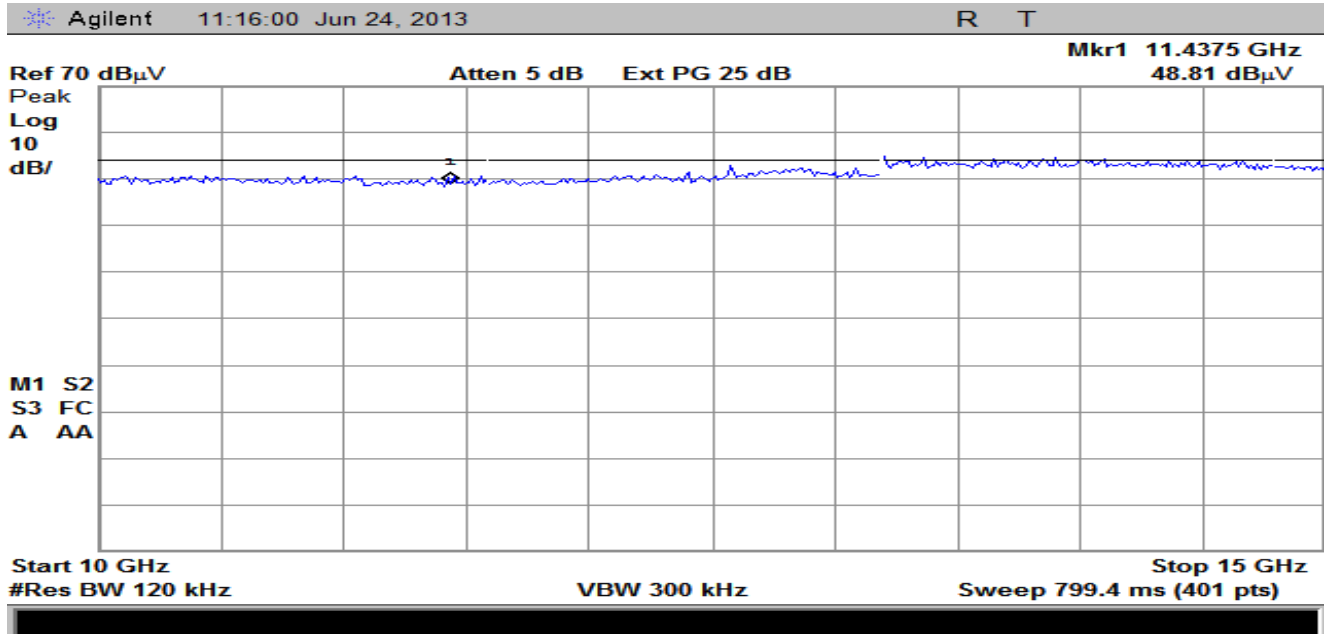




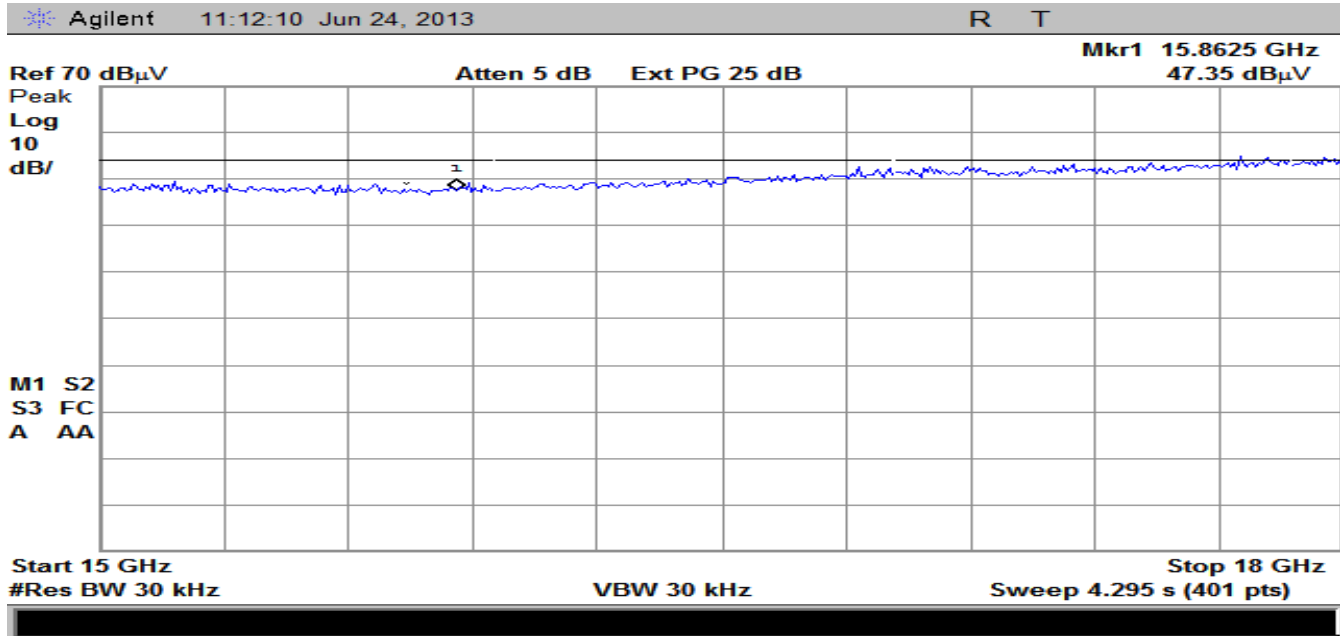
Hor



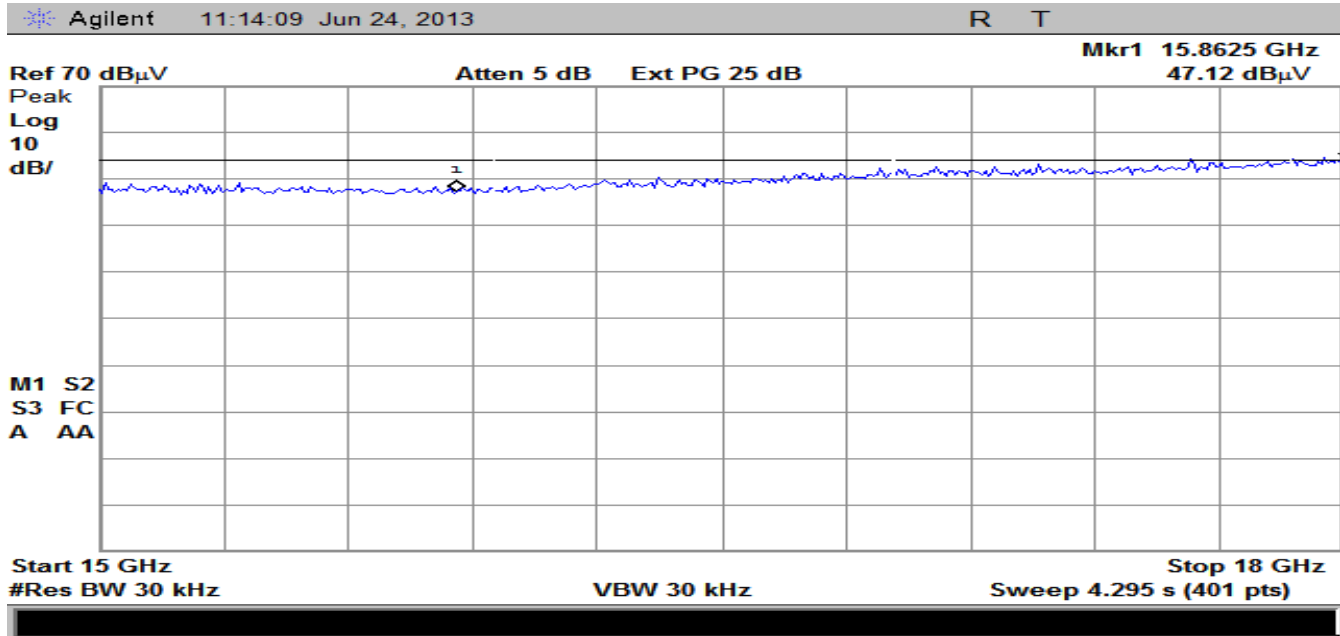
Ver



Hor

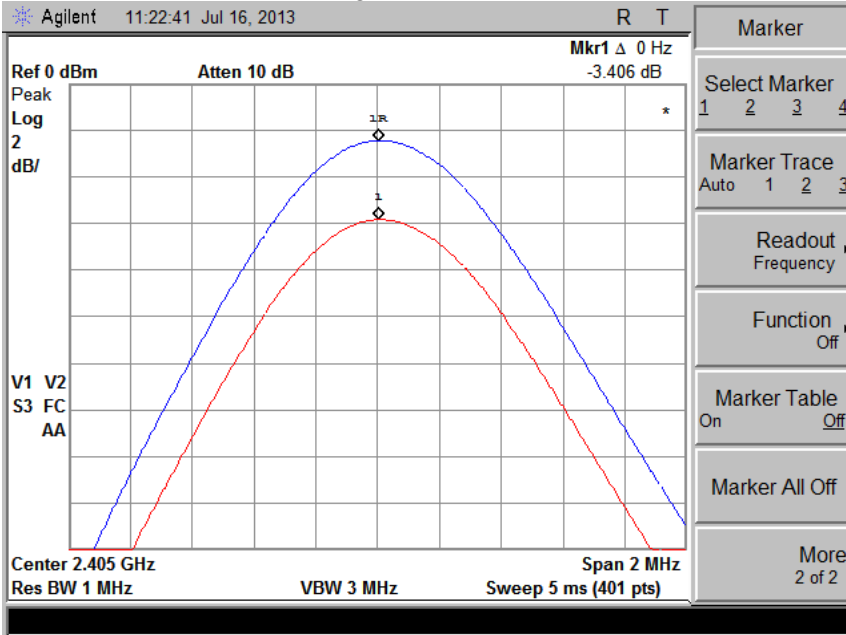


Ver



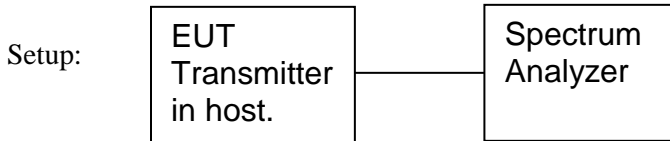
**4.3 Conducted RF measurements connection losses and setup.**

3 dB attenuator and connecting cable loss.



This value (-3.4 dB) is added back into measured values

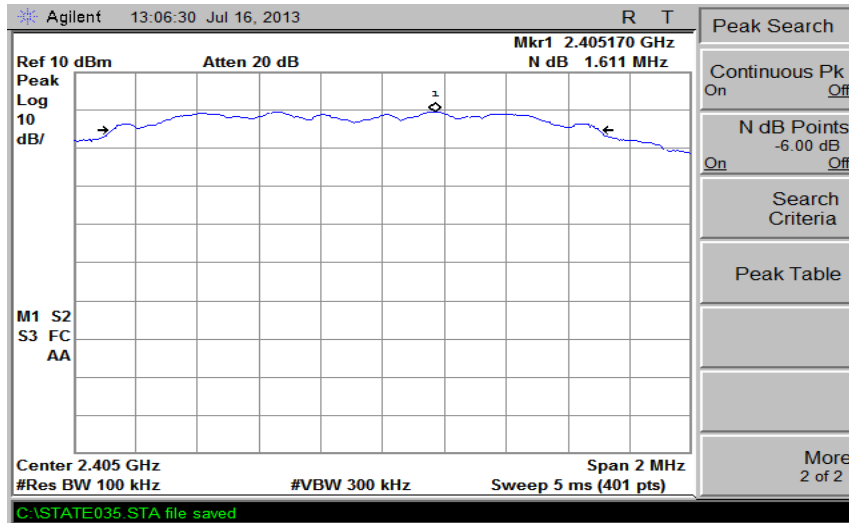
Equipment list asset numbers : 104.



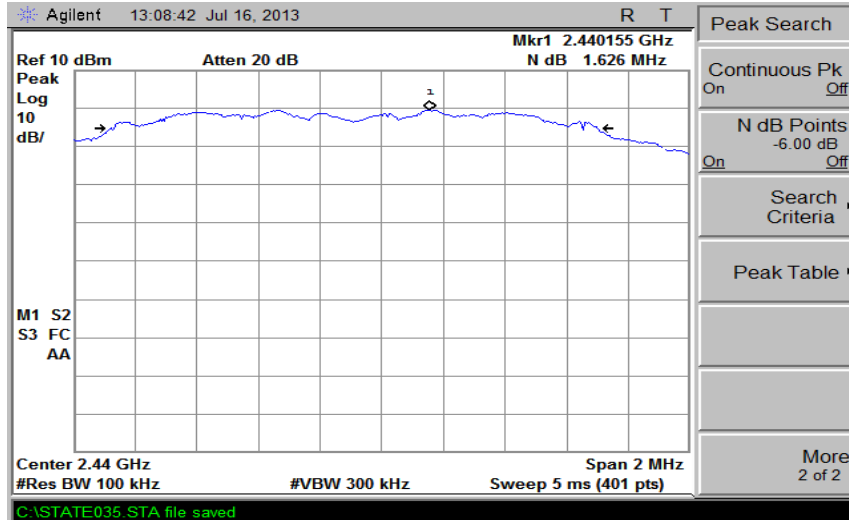
4.4 6 dB Emission Bandwidth. 15.247 (a)(2)

The minimum 6 dB bandwidth of a DTS transmission shall be at least 500 kHz.

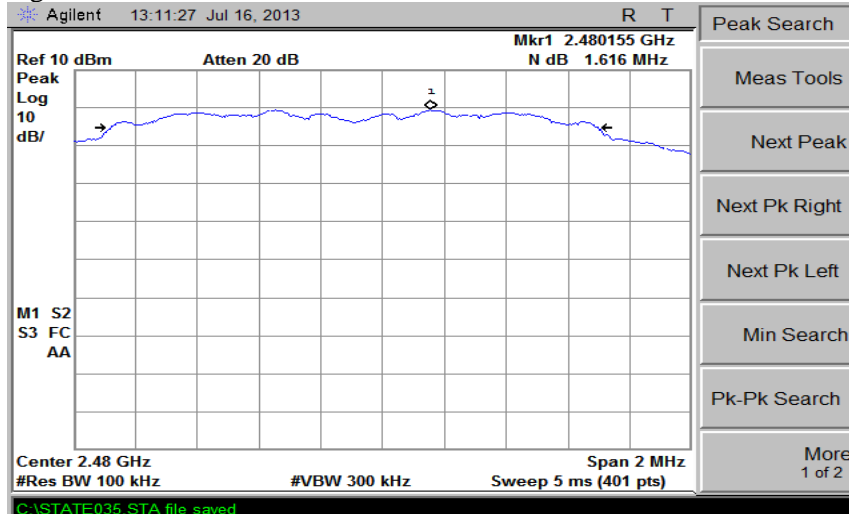
low



middle



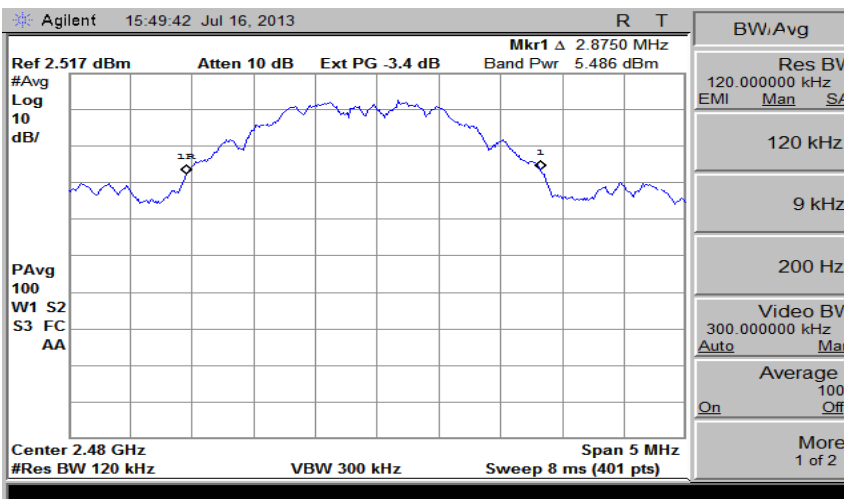
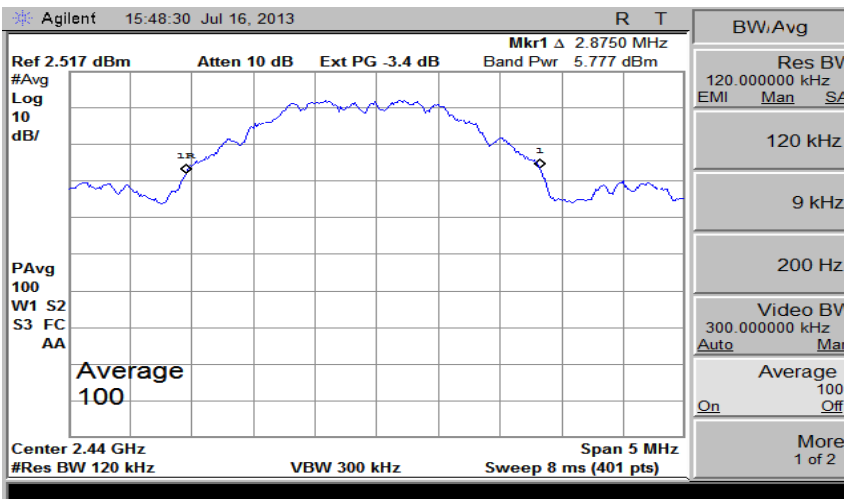
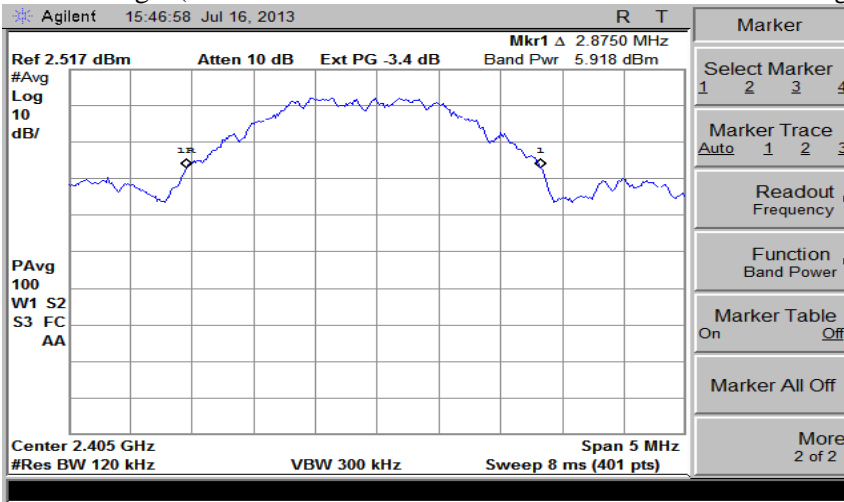
high



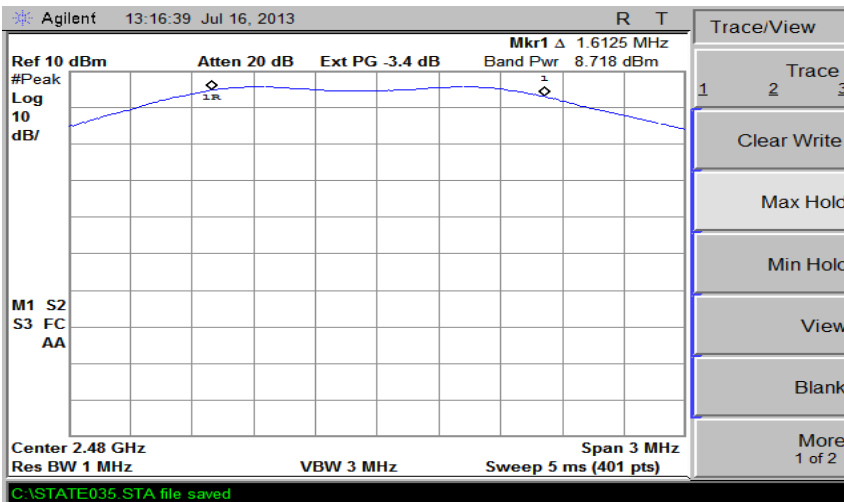
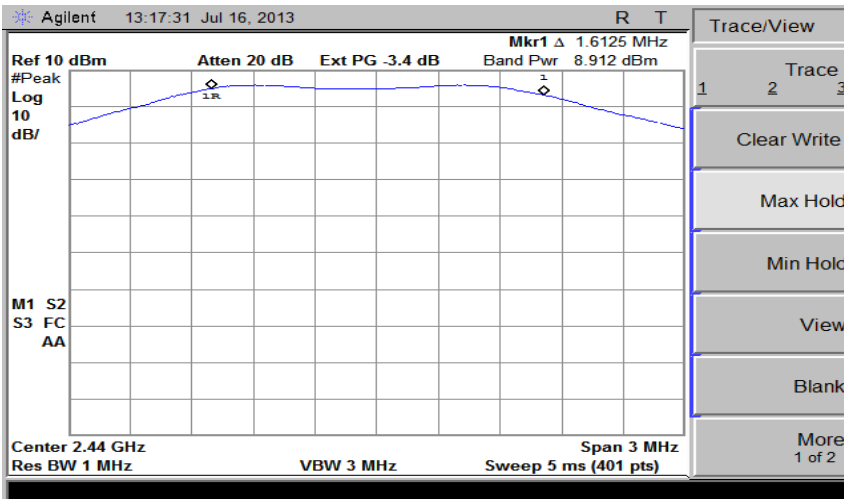
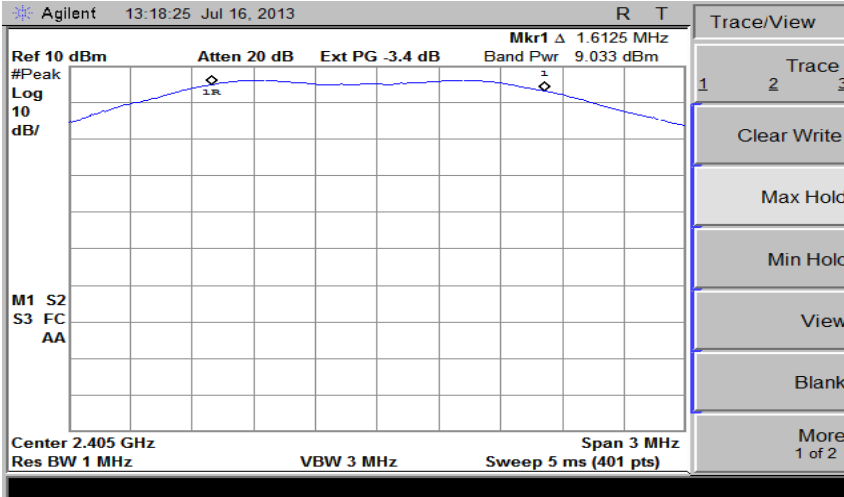
4.5 Max Conducted Power Output, 15.247 (b)(3)

The maximum output power limit for DTS devices is specified as 1 watt (30 dBm) when expressed in terms of either maximum **(average)** conducted output power or maximum **(peak)** conducted output power.

Max Average (5.9 dBm + 3.3 dBi AG + 0 dB = 9.2 dBm EIRP – 20log3 + 104.8 = 104.1 dBuV = 0.16 V/m)



Max Peak Conducted



**4.6 Spurious RF Conducted Emissions, 15.247 (d)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

**Restricted harmonics of the 2.4 GHz band**

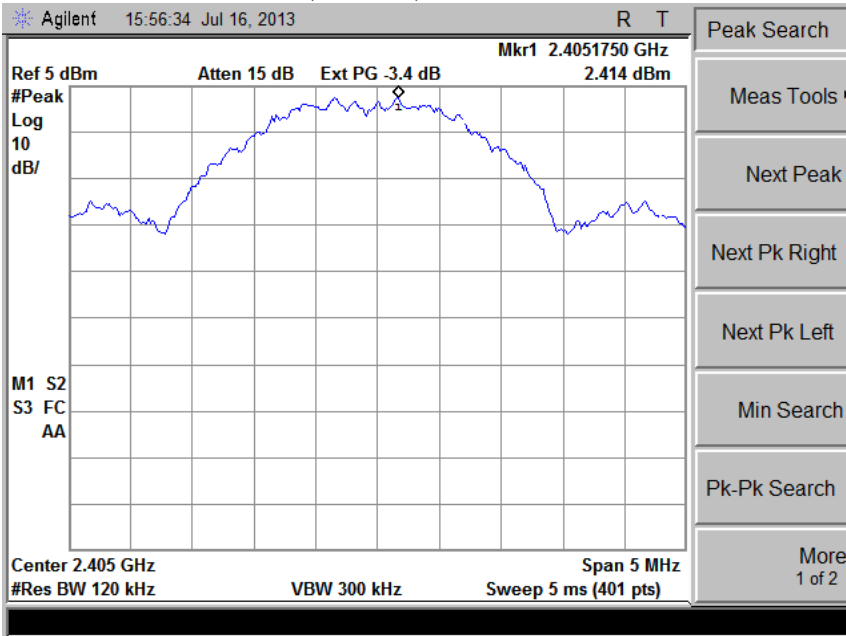
low		mid		high	
2.405		2.44		2.48	
4.81	r	4.88	r	4.96	r
7.215		7.32	r	7.44	r
9.62		9.76		9.92	
12.025	r	12.2	r	12.4	r
14.43		14.64		14.88	
16.835		17.08		17.36	
19.24	r	19.52	r	19.84	r
21.645		21.96		22.32	r
24.05		24.4		24.8	

highest emissions					
freq(MHz)	meas(dBm)	cable/att	result	delta ref	Restricted
7215	-52.81	8.35	-44.46	46.76	Y
4810	-69.29	5.56	-63.73	66.03	Y
249	-87.95	3.3	-84.65	86.95	Y
4958	-66.49	5.56	-60.93	63.23	Y
7438	-51.3	8.35	-42.95	45.25	Y
124000	-79.4	9.3	-70.1	72.4	Y
9620	-60.65	9.2	-51.45	53.75	N
12025	-74.23	9.3	-64.93	67.23	N
352	-88.08	3.4	-84.68	86.98	N
9917	-66.66	9.2	-57.46	59.76	

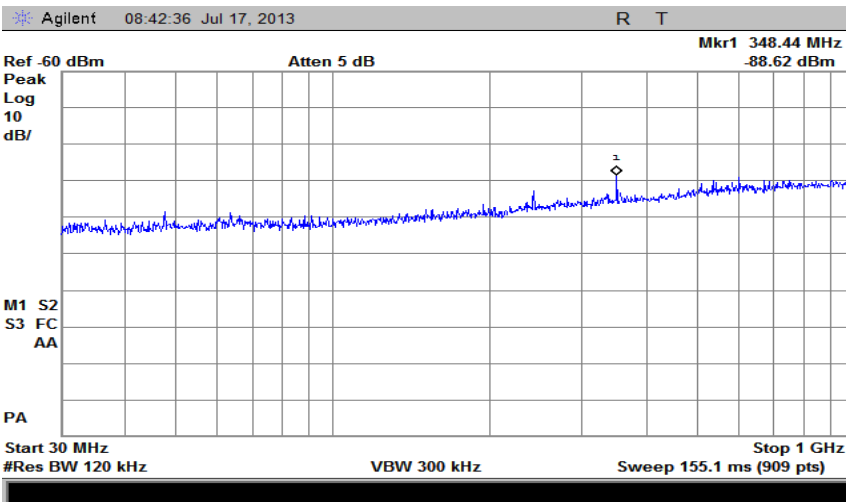
**Calculation for freq in restricted bands to convert to equivalent electric field strength**

freq	meas(dBm)	Ant_gain(dBi)		reflection	corr	result(dBuV)
7215	-52.81	3.3	-49.51	0	-49.51	45.747575
4810	-69.29	3.3	-65.99	0	-65.99	29.267575
249	-87.95	3.3	-84.65	4.7	-79.95	15.307575
4958	-66.49	3.3	-63.19	0	-63.19	32.067575
7438	-51.3	3.3	-48	0	-48	47.257575
12400	-79.4	3.3	-76.1	0	-76.1	19.157575

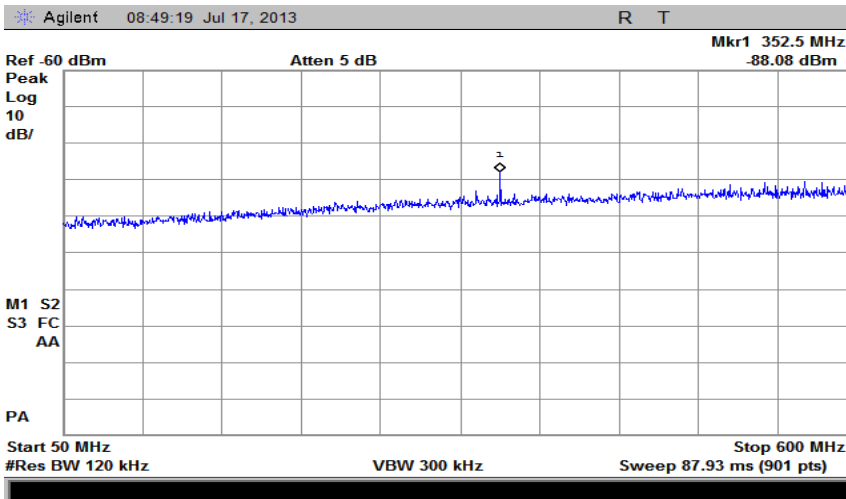
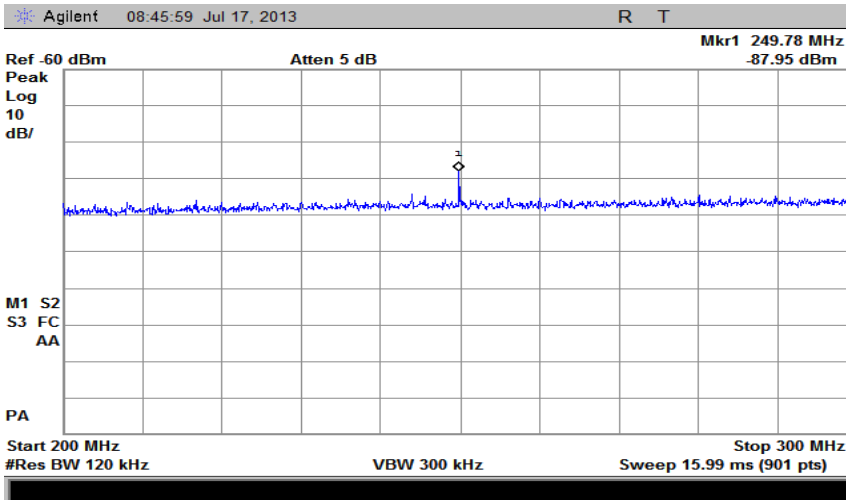
Reference Level in band. (2.4 dBm)



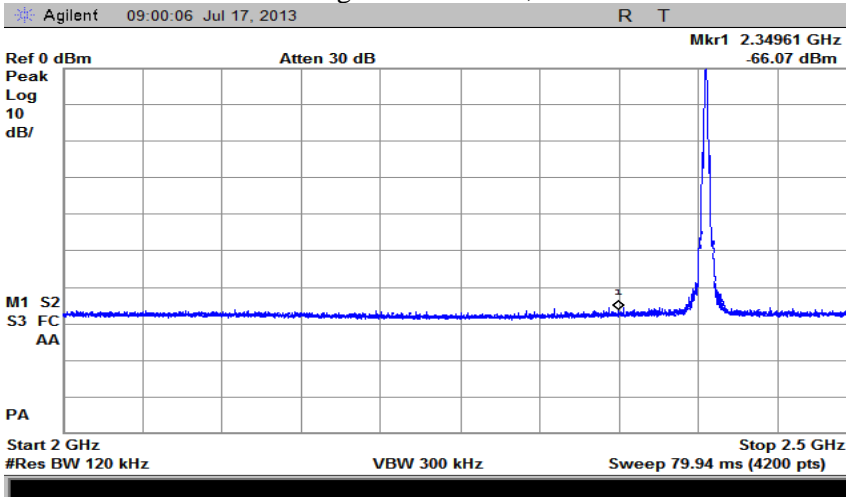
Scans with emissions follow.



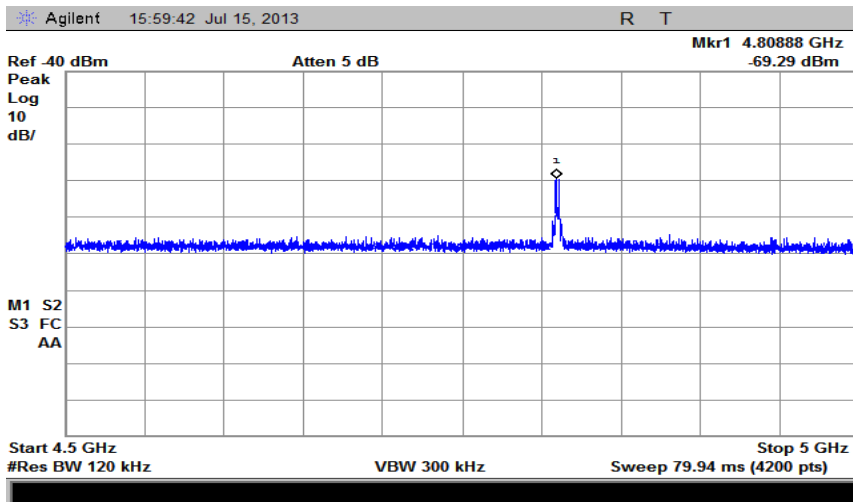




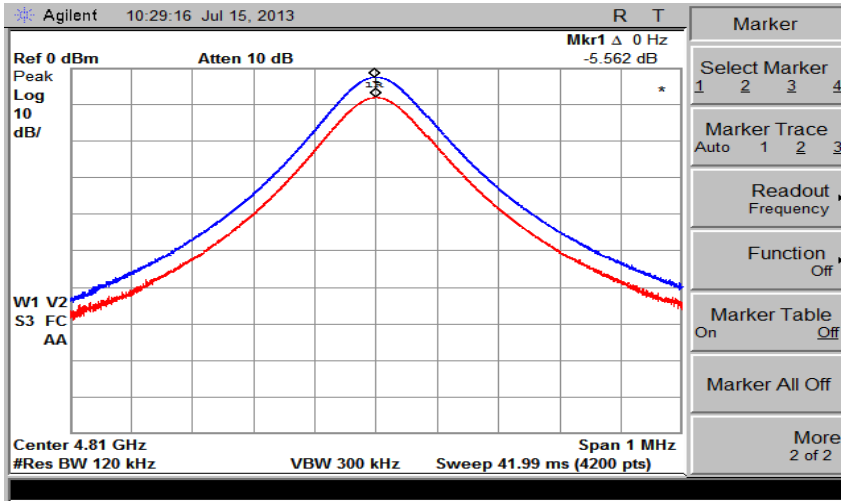
Low Fundamental. Band edge is 2400 MHz; emissions are more than 30 dB below the in band signal



2<sup>nd</sup> Harmonic. (-69.29 + 5.56 = -63.73 dBm)

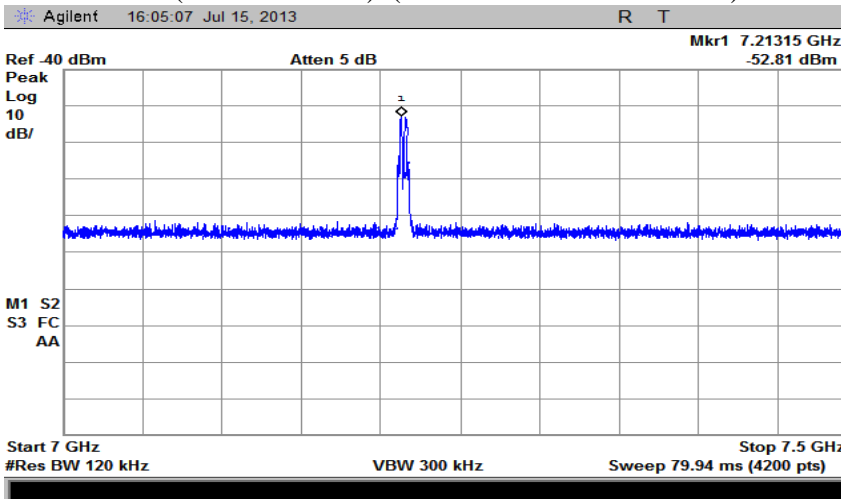


Cable and attenuator loss at 4810 MHz to add back in for level correction.

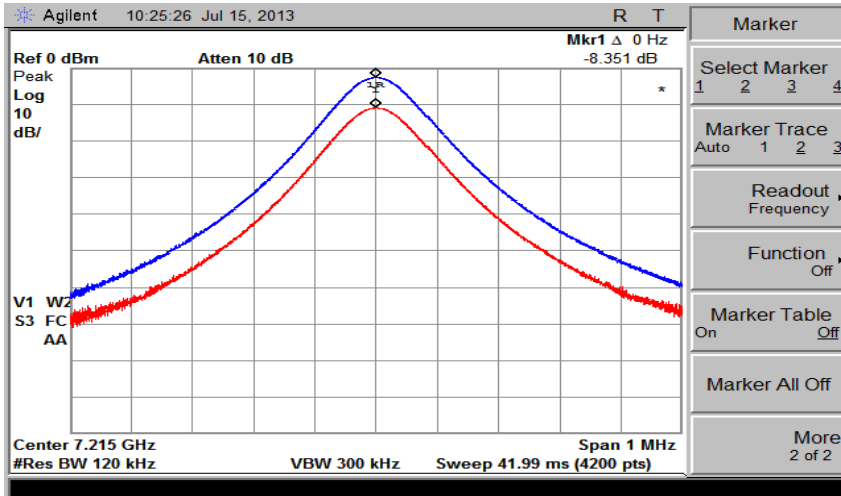


Scans between harmonics did not show any frequencies.

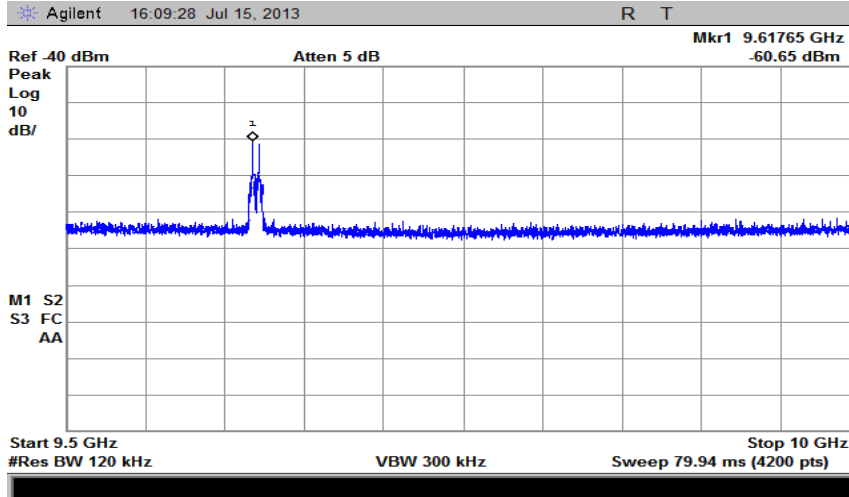
3<sup>rd</sup> Harmonic. (Restricted band)  $(-52.81 + 8.35 = -44.46 \text{ dBm})$



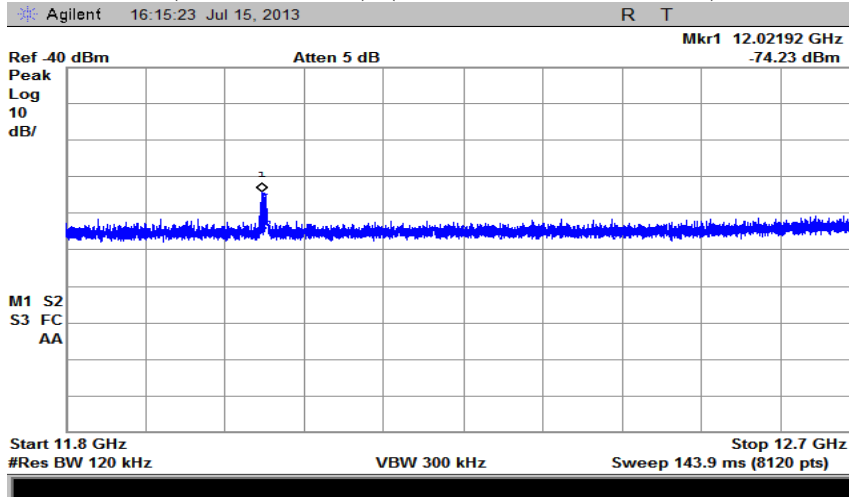
Cable and attenuator loss for level correction.



4<sup>th</sup> Harmonic (-60.65 + 9.2 = -51.45 dBm)



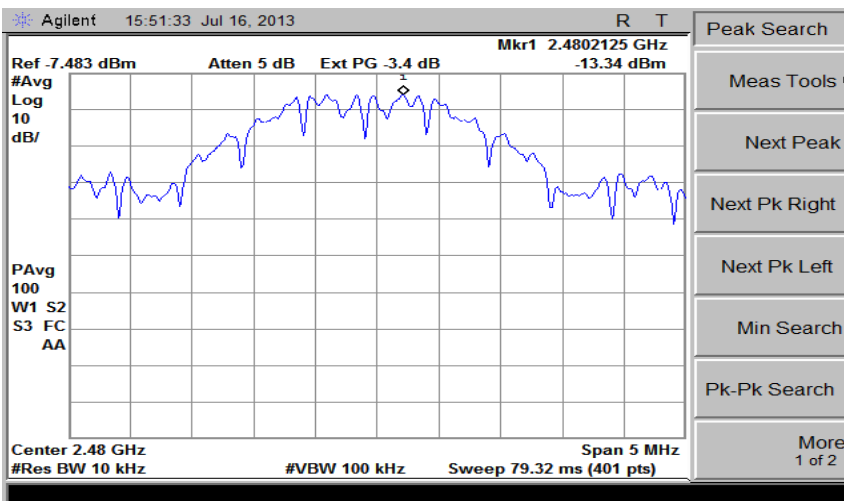
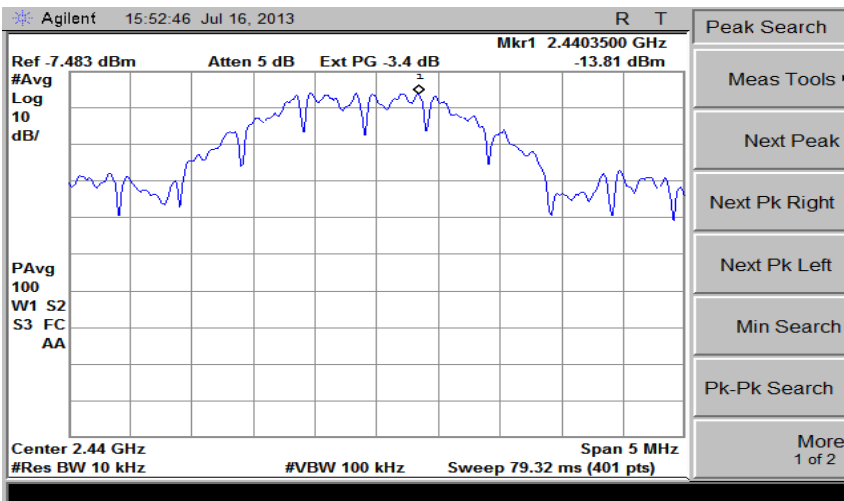
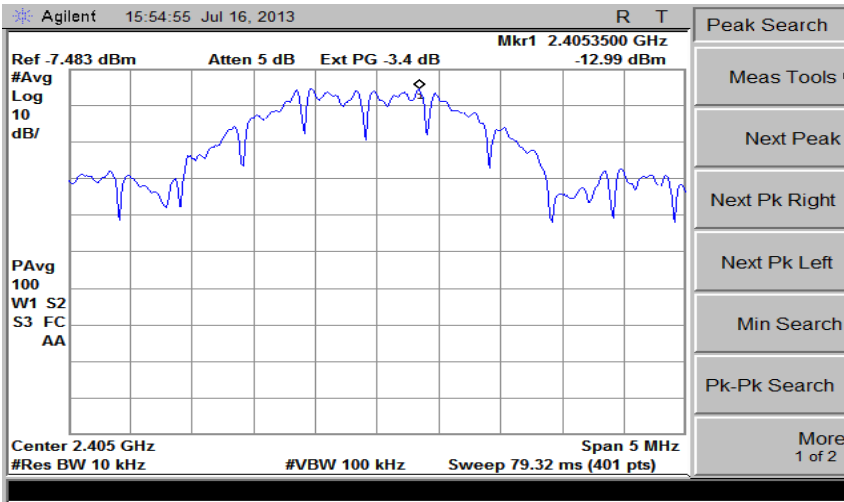
5<sup>th</sup> Harmonic (Restricted band) (-74.23 + 9.3 = -64.93 dBm)



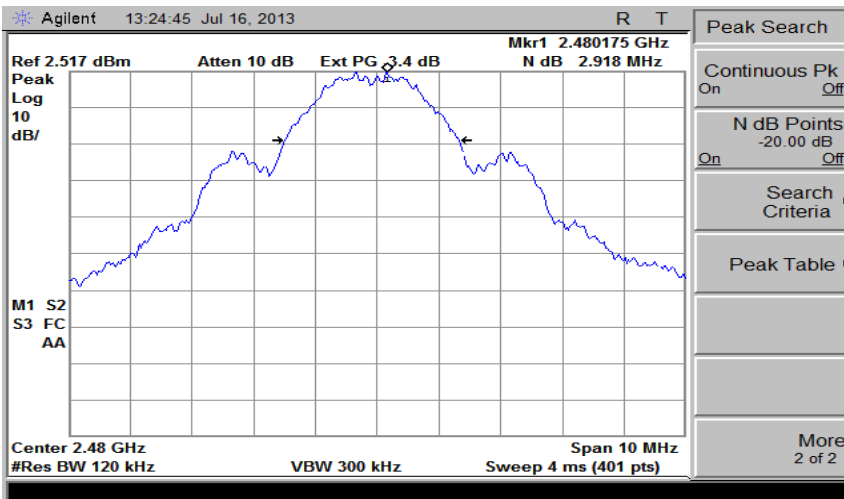
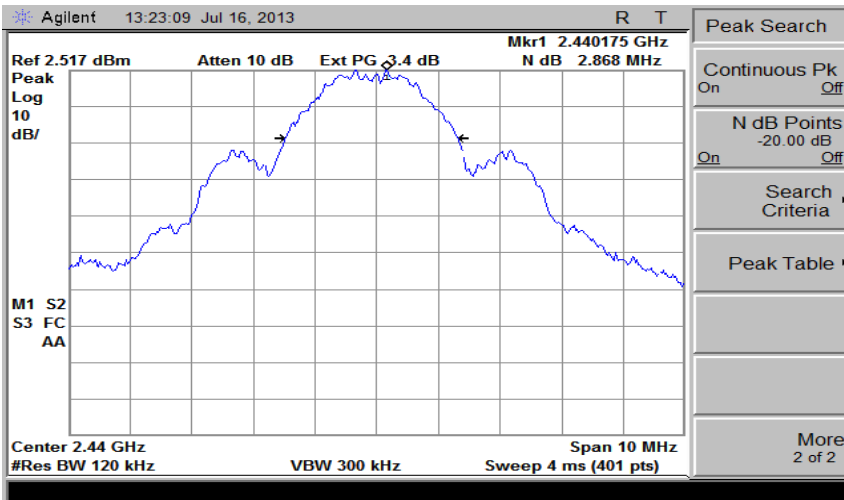
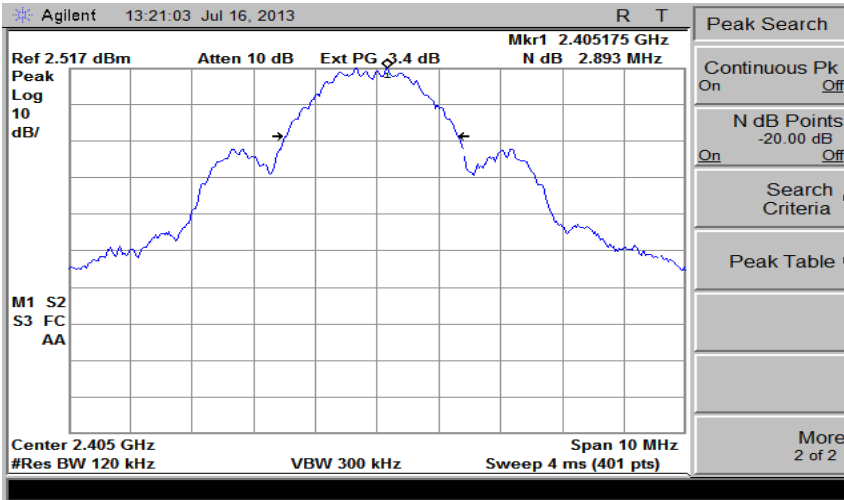
No more harmonics or emissions were detected in scans up to ten times the fundamental.

**4.7 Maximum power spectral density level in the fundamental emission. 15.247 (e)**

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.



### 4.8 20 dBc Bandwidth from highest level



**4.9 Input Voltage Variation, 15.31(e).**

Output power set to Maximum, 7 dBm.

Battery powered.

**4.10 RF Exposure Compliance Requirements per 15.247 (b) (5), 2.1093 (d)(1) Portable**

Operating Band Center Frequency = 2441.75 MHz, Range 2400-2483.5 MHz

EUT Max Output Power = 7 dBm

Antenna Gain = 3.3 dBi => Numeric Gain = 2.14

MPE Power Density Limit for General Population is  $S = 1 \text{ mW/cm}^2$

(CFR 47 Part 1.1310, Table 1)

**Minimum MPE safe distance (using equation below) = 0.92 cm**

Calculations:

Power Density  $P_d = (P_t * G) / (4 * \pi * d^2)$

Solve for d

$d^2 = (P_t * G) / (4 * \pi * P_d)$

$d = \text{SqrRoot}((P_t * G) / (4 * \pi * P_d))$

$d = \text{SqrRoot}((5.01 \text{ mWatt} * 2.14 \text{ gain}) / (4 * \pi * 1 \text{ mWatt/cm}^2))$

$d = \text{SqrRoot}((10.72 / 4 * \pi * 1) \text{ cm}^2)$

$d = \text{SqrRoot}(.853 / \pi) \text{ cm}^2$

$d = 0.92 \text{ cm}$

Where

$P_t$  = Transmit Power In mWatts

G = Numeric Antenna Gain

d = Distance in cm

$P_d$  = Power Density in mW / square cm

**Per IC: RSS-102i4, 4.2.**

Power Density Limit for General Population is  $S = 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$

Same as above;



## 5 EQUIPMENT LIST

ID	Description	Manufacturer	Model	Serial #	Last Ca	DueDate
4	58 kHz Filter	In House	unique	N/A	30-Aug-13	30-Aug-14
5	Double-Ridge Waveguide Horn	EMCO	3115	3006	31-Mar-13	30-Mar-15
6	Biconical Antenna	Electro Metrics	3110B	1017	18-May-12	18-May-14
7	Biconical Antenna	ETS	3110B	3380	31-Aug-13	30-Aug-15
8	Log Periodic Antenna	EMCO	3146	3909	31-Aug-13	30-Aug-15
9	Log Periodic Antenna	EMCO	3146	4731	18-May-12	18-May-14
10	Transient Limiter	Electro Metrics	EM 7600	187	13-Jan-13	12-Jan-15
11	Line Imp Stable Network	EMCO	3816/2NM	1018	04-Mar-13	04-Mar-14
12	Loop Antenna	Electro Metrics	ALP -70	163	30-Aug-13	29-Aug-15
13	Directional Coupler	Werlatone	C3910	6706	06-Mar-13	06-Mar-14
14	RF Power Meter	Boonton	4231-30	53701	06-Mar-13	06-Mar-14
16	Directional Coupler	Werlatone	C5673	11481	06-Mar-13	06-Mar-14
29	Log Periodic Antenna	EMCO	3146	3576	07-Aug-12	07-Aug-14
36	Coupling Decoupling Netwk	FCC	FCC-801-M3-16A	2036	04-Mar-13	04-Mar-14
37	Line Imp Stable Network	EMCO	3816/2NM	1064	04-Mar-13	04-Mar-14
39	Biconical Antenna	EMCO	3104C	4334	09-Aug-12	09-Aug-14
104	Spectrum Analyzer	Agilent	E7405A	MYY49510099	25-Jul-13	25-Jul-15
105	Spectrum Analyzer	Agilent	E7405A	MYY49510320	19-Jul-13	19-Jul-15
152	Dipole Antenna	EMCO	3121C	9701-1262	28-Dec-12	27-Dec-14
153	Signal Generator	Agilent	N5183A	MY50140589	06-Mar-13	06-Mar-14
154	Horn Antenna	ETS Lindgren	3115	00135941	07-Aug-12	07-Aug-14
155	Horn Antenna	ETS Lindgren	3116B	00122502	03-Feb-13	02-Feb-15
156	Loop Antenna	ETS Lindgren	6512	00123860	06-Aug-12	06-Aug-14
175	EMI Power Sensor	Boonton Electronics	51011-EMC	35804	06-Mar-13	06-Mar-14
176	Electrostatic Discharge Simulator	Kikusui Electronics	KES4021A	SE002201	08-May-13	08-May-15
177	Power Sensor	Boonton	51100-9E	35669	06-Mar-13	06-Mar-14
178	Signal Generator	Agilent	N5183A	MY50141499	06-Mar-13	06-Mar-14
187	Dual Directional Coupler	Werlatone	C6148-10	95097	06-Mar-13	06-Mar-14

**6 ANTENNA FACTORS.**

Date of Calibration = 4/May/2009

Date Printed: Monday, May 04, 2009 2:41 PM

Customer Name: Tyco Safety Products - Sensormatic

Antenna Manufacturer: Electro-Metrics

**Antenna Model: ALP-70 Loop**

Antenna Serial No.: 163

Temperature (Deg C): 21.0

Humidity (%): 50.0

Measurement Distance in Meters = 1.0

NOTES: ACF valid to 10 meters per NIST methods.

CAL CERT #: 2009042912

Freq (MHz)	E-field ACF (dB)	H-field ACF (dB)
0.01	75.6	24.1
0.02	71.6	20.2
0.03	68.3	16.9
0.04	65.5	14.0
0.05	63.6	12.2
0.06	61.1	9.7
0.07	59.6	8.2
0.08	58.5	7.0
0.09	57.8	6.4
0.10	56.8	5.4
0.20	51.8	0.4
0.30	48.5	-3.0
0.40	46.3	-5.1
0.50	45.0	-6.5
0.60	43.6	-7.8
0.70	42.8	-8.6
0.80	41.6	-9.8
0.90	41.1	-10.3
1.00	40.5	-11.0
2.00	38.2	-13.3
3.00	37.2	-14.3
4.00	37.0	-14.4
5.00	36.7	-14.8
6.00	37.6	-13.8
7.00	37.7	-13.8
8.00	37.7	-13.7
9.00	37.6	-13.9
10.00	37.6	-13.8
15.00	37.4	-14.0
20.00	37.2	-14.2
25.00	36.2	-15.2
30.00	37.4	-14.1

Date of Calibration = April 3, 2009  
 Date Printed: Friday, April 03, 2009 1:51 PM  
 Customer Name: Tyco Safety Products - Sensormatic  
 Antenna Manufacturer: EMCO  
**Antenna Model: 3104C Biconical**  
 Antenna Serial No.: 9009-4334  
 Temperature (Deg C). 3  
 Humidity (%). 65  
 Measurement Distance in Meters = 3  
 Antenna Polarization = VERT / HORZ  
 NOTES:

CAL CERT #: 2009033120

Freq (MHz)	Vertical ACF (dB)	Horizontal ACF (dB)
20.0000	17.7	20.6
21.0000	17.4	20.0
22.0000	16.4	18.6
23.0000	16.1	18.1
24.0000	15.3	16.9
25.0000	14.9	16.4
26.0000	14.2	15.5
27.0000	13.6	15.0
28.0000	13.0	14.3
29.0000	12.3	13.7
30.0000	11.9	13.3
31.0000	11.3	12.7
32.0000	11.0	12.4
33.0000	10.5	11.9
34.0000	10.3	11.7
35.0000	9.9	11.3
36.0000	9.8	11.3
37.0000	9.6	11.0
38.0000	9.6	11.0
39.0000	9.5	10.8
40.0000	9.5	10.7
40.0000	9.5	10.7
41.0000	9.6	10.7
42.0000	9.7	10.7
43.0000	9.9	10.6
44.0000	10.0	10.6
45.0000	10.2	10.7
46.0000	10.4	10.7
47.0000	10.5	10.7
48.0000	10.7	10.7
49.0000	11.0	10.8
50.0000	11.2	10.8
51.0000	11.4	10.8
52.0000	11.6	10.8
53.0000	11.9	10.9
54.0000	12.0	10.9
55.0000	12.1	11.0

56.0000	11.9	10.9
57.0000	11.9	11.0
58.0000	11.4	10.9
59.0000	11.2	10.9
60.0000	10.8	10.8
61.0000	10.5	10.8
62.0000	10.0	10.5
63.0000	9.7	10.4
64.0000	9.2	10.1
65.0000	8.9	9.9
66.0000	8.5	9.5
67.0000	8.2	9.3
68.0000	7.8	8.9
69.0000	7.6	8.6
70.0000	7.3	8.2
71.0000	7.2	7.9
72.0000	7.0	7.5
73.0000	7.0	7.3
74.0000	6.8	7.0
75.0000	6.8	6.8
75.0000	6.8	6.8
76.0000	6.7	6.5
77.0000	6.7	6.4
78.0000	6.6	6.3
79.0000	6.7	6.3
80.0000	6.7	6.3
81.0000	6.9	6.3
82.0000	7.2	6.4
83.0000	7.4	6.5
84.0000	7.6	6.7
85.0000	7.9	6.8
86.0000	8.2	7.1
87.0000	8.3	7.2
88.0000	8.7	7.6
89.0000	8.8	7.7
90.0000	9.1	8.0
91.0000	9.2	8.1
92.0000	9.5	8.5
93.0000	9.5	8.6

94.0000	9.8	8.9
95.0000	9.9	9.0
96.0000	10.2	9.4
97.0000	10.6	9.9
98.0000	11.4	11.2
99.0000	11.7	12.0
100.0000	11.7	11.7
101.0000	11.4	11.3
102.0000	11.6	11.4
103.0000	11.5	11.2
104.0000	11.8	11.5
105.0000	11.9	11.5
106.0000	12.1	11.8
107.0000	12.2	11.8
108.0000	12.5	12.1
109.0000	12.6	12.2
110.0000	12.9	12.6
111.0000	13.1	12.7
112.0000	13.5	13.2
113.0000	13.8	13.5
114.0000	14.3	14.2
115.0000	14.8	14.9
116.0000	15.6	15.7
117.0000	16.3	15.8
118.0000	16.3	15.3
119.0000	15.6	14.5
120.0000	15.0	14.1
121.0000	14.3	13.6
122.0000	14.1	13.5
123.0000	13.8	13.3
124.0000	13.6	13.3
125.0000	13.4	13.2
126.0000	13.4	13.3
127.0000	13.2	13.1
128.0000	13.1	13.2
129.0000	12.9	13.0
130.0000	13.0	13.2
131.0000	12.8	13.0
132.0000	12.8	13.2
133.0000	12.7	13.0
134.0000	12.8	13.1
135.0000	12.7	13.0
136.0000	12.8	13.0
137.0000	12.8	13.0
138.0000	12.8	13.1
139.0000	12.8	13.0
140.0000	12.8	13.0
141.0000	12.8	13.0
142.0000	12.9	13.1
143.0000	13.0	13.1

144.0000	13.0	13.2
145.0000	13.2	13.3
146.0000	13.3	13.4
147.0000	13.5	13.6
148.0000	13.7	13.8
149.0000	14.0	14.1
150.0000	14.2	14.2
151.0000	14.4	14.3
152.0000	14.3	14.2
153.0000	14.5	14.1
154.0000	14.5	13.9
155.0000	14.6	13.9
156.0000	14.7	13.8
157.0000	14.8	13.8
158.0000	14.7	13.7
159.0000	14.8	13.8
160.0000	14.8	13.8
161.0000	15.0	14.0
162.0000	15.1	14.0
163.0000	15.3	14.2
164.0000	15.4	14.2
165.0000	15.7	14.4
166.0000	15.7	14.4
167.0000	16.0	14.7
168.0000	15.9	14.7
169.0000	16.1	14.9
170.0000	16.1	15.0
171.0000	16.1	15.2
172.0000	16.1	15.2
173.0000	16.2	15.4
174.0000	16.3	15.5
175.0000	16.4	15.7
176.0000	16.5	15.8
177.0000	16.7	16.0
178.0000	16.8	16.1
179.0000	16.9	16.3
180.0000	17.0	16.4
181.0000	17.1	16.6
182.0000	17.1	16.7
183.0000	17.2	16.9
184.0000	17.2	17.0
185.0000	17.3	17.1
186.0000	17.3	17.2
187.0000	17.5	17.3
188.0000	17.6	17.5
189.0000	17.8	17.6
190.0000	17.8	17.7
191.0000	17.9	17.7
192.0000	17.8	17.5
193.0000	17.8	17.5

194.0000	17.7	17.3
195.0000	17.8	17.4
196.0000	17.7	17.4
197.0000	17.9	17.5
198.0000	17.8	17.4
199.0000	17.7	17.5
200.0000	17.6	17.3
201.0000	17.7	17.4
202.0000	17.6	17.3
203.0000	17.5	17.3
204.0000	17.4	17.3
205.0000	17.4	17.3
206.0000	17.2	17.2
207.0000	17.2	17.2
208.0000	17.2	17.2
209.0000	17.2	17.2
210.0000	17.1	17.1
211.0000	17.0	17.2
212.0000	16.9	17.0
213.0000	16.9	17.0
214.0000	16.8	16.9
215.0000	16.7	16.9
216.0000	16.6	16.8
217.0000	16.5	16.7
218.0000	16.5	16.7
219.0000	16.4	16.5
220.0000	16.5	16.4
221.0000	16.5	16.3
222.0000	16.4	16.2
223.0000	16.4	16.1
224.0000	16.2	16.1
225.0000	16.2	15.9
226.0000	16.0	16.0
227.0000	16.1	16.0
228.0000	16.1	15.9
229.0000	16.0	15.8
230.0000	16.1	15.7
231.0000	16.1	15.7
232.0000	16.2	15.7
233.0000	16.2	15.6
234.0000	16.3	15.7
235.0000	16.3	15.6
236.0000	16.5	15.7
237.0000	16.6	15.7
238.0000	16.6	15.7
239.0000	16.6	15.7
240.0000	16.7	15.7
241.0000	16.7	15.8
242.0000	16.8	15.9
243.0000	16.8	15.9

244.0000	16.9	16.0
245.0000	17.0	16.0
246.0000	17.0	16.1
247.0000	17.2	16.2
248.0000	17.2	16.3
249.0000	17.4	16.4
250.0000	17.4	16.5
251.0000	17.5	16.6
252.0000	17.5	16.7
253.0000	17.5	16.8
254.0000	17.5	17.0
255.0000	17.5	17.1
256.0000	17.6	17.3
257.0000	17.7	17.4
258.0000	17.9	17.5
259.0000	18.1	17.6
260.0000	18.2	17.7
261.0000	18.4	17.9
262.0000	18.5	18.0
263.0000	18.5	18.1
264.0000	18.6	18.3
265.0000	18.6	18.4
266.0000	18.6	18.6
267.0000	18.7	18.7
268.0000	18.7	18.8
269.0000	18.7	19.0
270.0000	18.8	19.1
271.0000	18.9	19.2
272.0000	18.9	19.3
273.0000	19.1	19.4
274.0000	19.2	19.5
275.0000	19.3	19.5
276.0000	19.4	19.6
277.0000	19.5	19.7
278.0000	19.6	19.7
279.0000	19.8	19.8
280.0000	19.9	19.9
281.0000	20.1	20.0
282.0000	20.1	20.1
283.0000	20.1	20.2
284.0000	20.1	20.3
285.0000	20.1	20.4
286.0000	20.2	20.6
287.0000	20.2	20.7
288.0000	20.3	21.0
289.0000	20.3	21.2
290.0000	20.5	21.3
291.0000	20.6	21.5
292.0000	20.6	21.7
293.0000	20.6	21.8

294.0000	20.7	21.8
295.0000	20.6	21.9
296.0000	20.6	22.0
297.0000	20.7	22.1

298.0000	20.7	22.2
299.0000	20.8	22.3
300.0000	20.8	22.4

Date of Calibration = April 3, 2009  
 Date Printed: Friday, April 03, 2009 1:41 PM  
 Customer Name: Tyco Safety Products - Sensormatic  
 Antenna Manufacturer: EMCO  
**Antenna Model: 3146 – Log periodic**  
 Antenna Serial No.: 9303-3576  
 Temperature (Deg C). 3  
 Humidity (%). 65  
 Measurement Distance in Meters = 3  
 Antenna Polarization = VERT / HORZ  
 NOTES:  
 CAL CERT #: 2009033116

Freq (MHz)	Vertical ACF (dB)	Horizontal ACF (dB)
200.0000	11.7	12.1
205.0000	11.6	12.1
210.0000	11.7	11.9
215.0000	11.6	11.7
220.0000	11.5	11.5
225.0000	11.2	11.4
230.0000	11.1	11.4
235.0000	11.5	11.6
240.0000	11.8	11.9
245.0000	12.2	12.1
250.0000	12.6	12.4
255.0000	12.6	12.6
260.0000	12.8	13.0
265.0000	12.9	13.2
270.0000	13.0	13.5
275.0000	13.3	13.6
280.0000	13.6	13.7
285.0000	13.9	13.8
290.0000	14.1	14.0
295.0000	14.1	14.1
300.0000	14.2	14.3
305.0000	14.5	14.8
310.0000	14.8	15.2
315.0000	14.8	15.1
320.0000	14.7	14.8
325.0000	14.7	14.6
330.0000	14.6	14.6
335.0000	14.3	14.7
340.0000	14.1	14.9
345.0000	14.2	14.9
350.0000	14.5	14.9
355.0000	14.8	14.8
360.0000	15.0	14.9
365.0000	15.3	15.0
370.0000	15.2	15.1
375.0000	15.1	15.2
380.0000	15.0	15.3

385.0000	15.4	15.5
390.0000	15.7	15.8
395.0000	15.5	15.9
400.0000	15.4	16.1
405.0000	15.5	16.0
410.0000	15.7	15.9
415.0000	16.0	16.1
420.0000	16.0	16.2
425.0000	15.9	16.4
430.0000	15.8	16.5
435.0000	15.9	16.5
440.0000	16.1	16.4
445.0000	16.4	16.5
450.0000	16.7	16.7
455.0000	16.9	16.9
460.0000	16.9	17.2
465.0000	16.9	17.3
470.0000	16.9	17.3
475.0000	17.1	17.4
480.0000	17.2	17.4
485.0000	17.5	17.5
490.0000	17.7	17.6
495.0000	17.9	17.9
500.0000	17.9	17.9
505.0000	18.0	18.2
510.0000	18.3	18.6
515.0000	18.5	19.0
520.0000	18.3	18.8
525.0000	18.0	18.6
530.0000	17.7	18.5
535.0000	17.6	18.6
540.0000	17.6	18.4
545.0000	17.9	18.3
550.0000	18.2	18.3
555.0000	18.3	18.6
560.0000	18.2	18.7
565.0000	18.1	18.8
570.0000	18.0	18.9
575.0000	18.2	18.7

580.0000	18.4	18.6
585.0000	18.7	18.8
590.0000	18.8	19.1
595.0000	18.7	19.2
600.0000	18.7	19.2
605.0000	18.7	19.1
610.0000	18.8	19.3
615.0000	19.0	19.5
620.0000	19.2	19.4
625.0000	19.4	19.4
630.0000	19.2	19.4
635.0000	19.2	19.4
640.0000	19.5	19.7
645.0000	19.7	19.9
650.0000	19.9	20.0
655.0000	20.1	20.1
660.0000	20.3	20.3
665.0000	20.4	20.4
670.0000	20.5	20.6
675.0000	20.5	20.7
680.0000	20.5	20.9
685.0000	20.4	20.9
690.0000	20.4	21.1
695.0000	20.4	21.0
700.0000	20.5	21.0
705.0000	20.6	21.0
710.0000	20.5	21.0
715.0000	20.5	21.0
720.0000	20.5	21.2
725.0000	20.7	21.3
730.0000	20.7	21.2
735.0000	20.7	21.2
740.0000	20.6	21.1
745.0000	20.6	21.2
750.0000	20.6	21.4
755.0000	20.6	21.4
760.0000	20.7	21.3
765.0000	20.7	21.4
770.0000	20.7	21.4
775.0000	20.7	21.4
780.0000	20.7	21.4
785.0000	20.7	21.4
790.0000	20.8	21.5
795.0000	20.9	21.6

800.0000	21.1	21.6
805.0000	21.0	21.7
810.0000	21.1	21.7
815.0000	21.1	21.8
820.0000	21.3	22.0
825.0000	21.4	22.1
830.0000	21.5	22.1
835.0000	21.6	22.2
840.0000	21.7	22.3
845.0000	21.7	22.4
850.0000	21.8	22.4
855.0000	21.9	22.5
860.0000	22.2	22.7
865.0000	22.4	22.9
870.0000	22.5	23.0
875.0000	22.6	23.1
880.0000	22.6	23.1
885.0000	22.5	23.2
890.0000	22.6	23.1
895.0000	22.6	23.1
900.0000	22.7	23.3
905.0000	22.7	23.3
910.0000	22.8	23.3
915.0000	22.8	23.2
920.0000	22.6	23.3
925.0000	22.6	23.4
930.0000	22.6	23.4
935.0000	22.7	23.4
940.0000	22.7	23.5
945.0000	22.7	23.6
950.0000	22.6	23.5
955.0000	22.7	23.6
960.0000	22.9	23.7
965.0000	22.9	23.9
970.0000	23.1	23.8
975.0000	23.1	23.8
980.0000	23.1	23.9
985.0000	23.2	23.9
990.0000	23.3	24.1
995.0000	23.5	24.4
1000.0000	23.6	24.4



Date of Calibration = 2/Apr/2009  
 Date Printed: Thursday, April 02, 2009 3:33 PM  
 Customer Name: Tyco Safety Products - Sensormatic  
 Antenna Manufacturer: EMCO  
**Antenna Model: 3115 Horn**  
 Antenna Serial No.: 3006  
 Temperature (Deg C): 20.0  
 Humidity (%): 37.0  
 Measurement Distance in Meters = 3.0  
 Antenna Polarization = VERT / HORZ  
 NOTES: Observed Pin Depth: -0.0003" from typical.  
 CAL CERT #: 2009033119

Freq (MHz)	Vertical ACF (dB)	Horizontal ACF (dB)
1000.0000	23.377	23.524
1500.0000	25.067	25.087
2000.0000	27.357	27.365
2500.0000	29.000	29.024
3000.0000	30.277	30.385
3500.0000	31.557	31.512
4000.0000	32.827	32.580
4500.0000	32.593	32.499
5000.0000	33.481	33.288
5500.0000	34.467	34.421
6000.0000	34.894	34.639
6500.0000	34.730	34.612
7000.0000	35.473	35.489
7500.0000	36.832	36.780
8000.0000	37.271	37.207
8500.0000	37.649	37.600
9000.0000	37.956	37.940

9500.0000	37.858	37.743
10000.0000	38.517	38.433
10500.0000	38.992	39.004
11000.0000	40.566	40.541
11500.0000	39.704	39.684
12000.0000	39.424	39.396
12500.0000	38.797	38.822
13000.0000	39.622	39.615
13500.0000	40.408	40.394
14000.0000	41.209	41.203
14500.0000	41.665	41.584
15000.0000	40.325	40.233
15500.0000	38.024	38.049
16000.0000	37.320	37.358
16500.0000	38.400	38.340
17000.0000	41.136	40.903
17500.0000	42.866	42.522
18000.0000	44.717	44.269