FCC Part 15.247 Certification Application

Industrie Canada RSS210 Certification Application

EMI Test Report
on
RF Module.
Model: 340-040101

FCC ID: OWS-NIC501
IC ID: 5975A-NIC501

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Report #: SSN01

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General Information

Unit(s) Under Test: I210 900MHz RF Module
Model(s): 340-040101

Product Description: "902 MHz AMI RF Module"

FCC ID: OWS-NIC501
IC ID: 5975A-NIC501

Tested For: Silver Spring Networks
2755 Campus Drive
Suite 205
San Mateo, CA 94403

Tested At: (Radiated Emissions)
BACL
1274 Anvilwood Ave.
Sunnyvale, CA 94089

(RF Conducted tests)
Silver Spring Networks
2755 Campus Drive
Suite 205
San Mateo, CA 94403

Tested By: Choon Sian Ooi, Test Engineer, BACL
David Waitt, (Independent Consultant)

Tested To: FCC CFR 47, Part 15.247, 900MHz FHSS

Test Date: May 2007

Requested Certifications: FCC Part 15 Subpart C certification
IC RSS-210 / Issue 6 Certification

Report Revision: A (Initial Version, 12 June 2007)

Detailed Product Information

The i210 RF board is a 900MHz FHSS module that SilverSpring intends to incorporate into its wireless utility power meters.

Number of hopping channels:	83
Operating Frequency Range:	902.3 MHz to 924.9 MHz
Channel spacing:	300kHz
RF Power Output:	30 dBm Max
Antenna Gain:	Approx 2.5 dBi
Antenna Type:	Single, Integral, Inverted ‘F’
Operating Voltage:	3.6 VDC @ approx 1.2 A (Max RF Xmit)
DUT:	Engineering prototype, equivalent to mass produced items
Modifications:	No modifications were made during the certification testing of the device.

Test Results Summary

This report presents the results of the tests that verify compliance with FCC Part 15.247 and

A brief results summary of all the in this report is below.

Part 15 Paragraph	RSS-210, Issue 6 Paragraph	Test	Results
15.247(b)(2)	A8.4(1)	Maximum Power	17.89 dBm Max 0.0615 W
15.247(a)(1)(i)	A8.1(3)	20dB Bandwidth	157.5 kHz Min
15.247(d) 15.205	A8.5 2.6	Out of Band Spurious Emissions Radiated Emissions in Restricted bands	 .61 dB in spec min @ 7316MHz (Restricted Band)
15.247(a)(1)(i)	A8.1(2)	Number of hopping channels	83
15.247(a)(1)(i)	A8.1(2)	Channel Spacing	300kHz

Test Facilities

All radiated emissions testing for 15.247 (15.205) were performed in chamber 1 at:

BACL
1274 Anvilwood Ave.
Sunnyvale, CA 94089

Testing was conducted in accordance with ANSI C63.4 (2003)

General:
Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data for chamber 1 has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Within the chamber, ambient levels are well below this requirement. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

Antenna, Antenna Mast and Turntable
The Horn antennas that are use to measure radiated emissions above 1000MHz are amounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

ANSI C63.4 specifies that the test height above the ground plane shall be 80cm unless the equipment is intended to be floor mounted. During the radiated emissions tests the equipment is positioned on a motorized turntable in conformance with the most recent ANSI requirements.

Equipment Lists

Instrument Calibration

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles.

The following test equipment was used to perform the testing

BACL Test Equipment

Manufacturer	Description	Model #	Asset #	Cal Due
Agilent	Spectrum Analyzer	E4440A	BACL00380	23 Feb 2008
AH Systems	Horn Antenna S/N 261	SAS 200/571	BACL00110	7 June 2009
HP	Power Supply	E3610	----	No Cal Reqd
	RF Cable, 5M		HFC0001	NA

Silver Spring Test Equipment:

Manufacturer	Description	Model #	Asset #	Cal Due
Agilent	Spectrum Analyzer	E4440A	Tech Rental & Services Asset 1034444	2 Feb 2008
HP	Power Supply	E3610	-----	No Cal Reqd

Test Methods

Unless otherwise noted in the specific test procedure, tests are performed at a low, middle and high channel band used by the device.. Unless otherwise noted, all testing was performed on these channels / frequencies.

902 - 928 MHz Band	
Channel	Freq(MHz)
Low	902.3
Mid	915.4
High	926.9

The device was running special diagnostic software to allow it to transmit random data on a particular channel indefinitely. This diagnostic software allowed the frequency hopping function to be disabled or enabled as tested required.

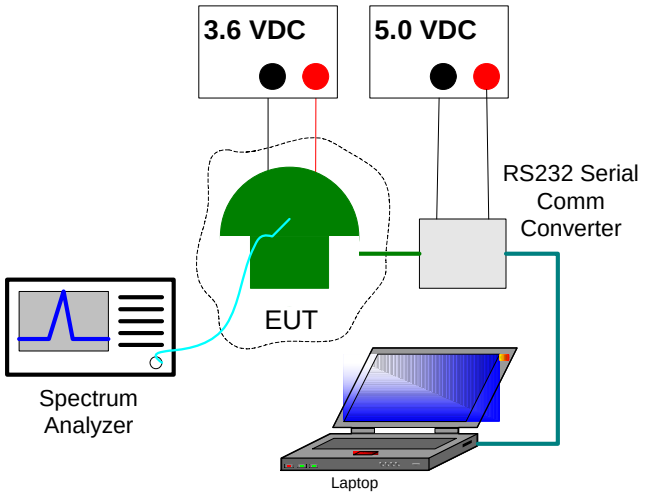
The diagnostic software also allowed variation of the RF transmit power. The maximum power setting that allowed compliance with the radiated emissions requirements (determined during testing) will be programmed into the configuration firmware of the module. This will ensure compliance with the FCC / IC radiated emissions requirements.

The tests listed below are performed using the basic “conducted” test setup shown below unless otherwise noted

Part 15	Test
15.247(b)(2)	RF Transmit power
15.247(a)(1)(i)	Bandwidth
15.247(a)(1)(i)	Number of hopping channels
15.247(a)(1)	Channel Spacing
15.247(a)(1)(i)	Time on channel

Basic Conducted RF Bench Test Setup

The bench top RF test setu0p is shown to the right. Unless otherwise noted, the support equipment for the bench tests is listed below.



Support Equipment				
Description	Model number	FCC ID or SN	Manufacturer	Power Cable
Laptop	A20	DOC	IBM	Laptop PS, unshielded
Serial Comm Converter	None	None	Silver Spring Networks	Ribbon cable , RS232 D9 cable
AC Adapter Power Supply	DMS050500-PSP-IC	None	CUI INC	Unshielded pair
Bench Top Power supply	E3610A	None	HP	Clip leads

Test Results

Detailed test procedures and test results are contained in the following sections. In cases where the test setup differs from the “Conducted RF Bench Top” test setup shown earlier, the test setup is also presented within that section of the test report.

Test Conditions			
Temperature	23C	**Humidity:**	Approx 55%
ATM pressure	1020 mBar	**Grounding:**	None
Tested By	David Waitt	**Date of Test:**	May 2007
Test Reference	Refer to individual test results		
Tested Freq Range	Test dependent		
Test Voltage	3.60 VDC		
Modifications	No modifications were made to the unit during the compliance testing		

Maximum RF Power Output at Antenna Terminals

Specifications:

FCC Specification: Paragraph: 15.247(b)(2)
IC Specification: RSS-210/6, A8.4(1)

Procedure:

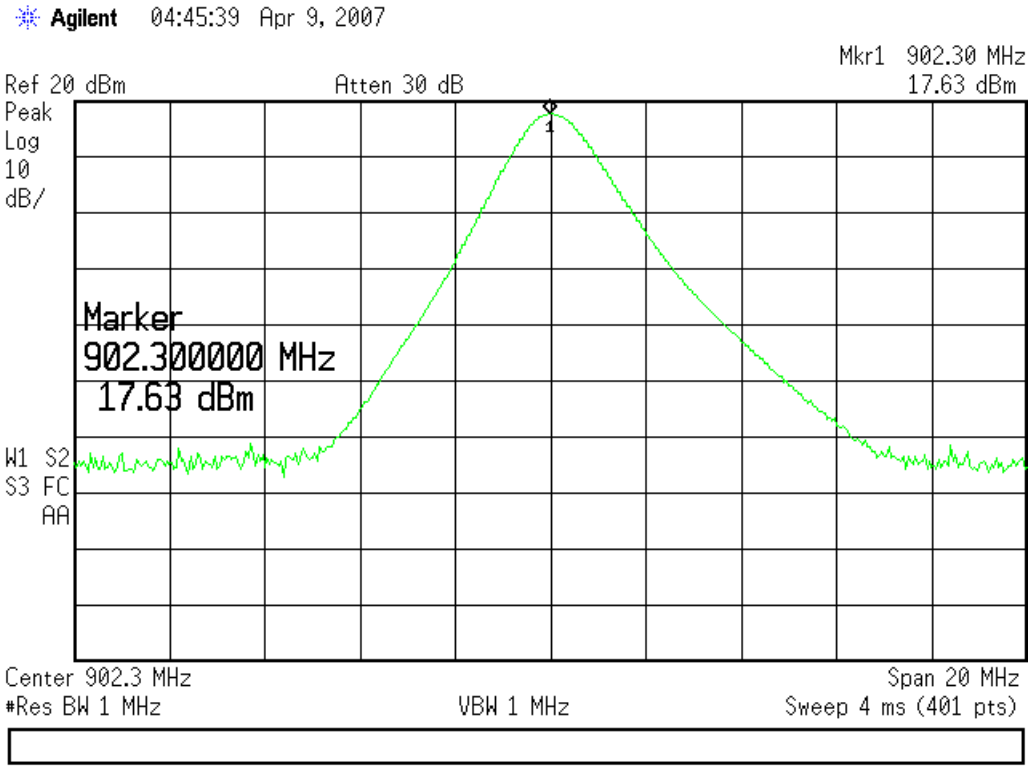
The test was configured as shown in the RF conducted bench top test setup. The unit was sequentially tuned to the test channels (Low, Mid and High) and configured to transmit random data (100% duty cycle). The RF transmit power was then measured on the spectrum analyzer.

Given that the channel BW is approximately 300KHz, the RBW and VBW was set to encompass the entire bandwidth of the channel and thus measure the total channel power. The RBW and VBW were set as follows:
RBW 1MHz
VBW 1 MHz

Results:

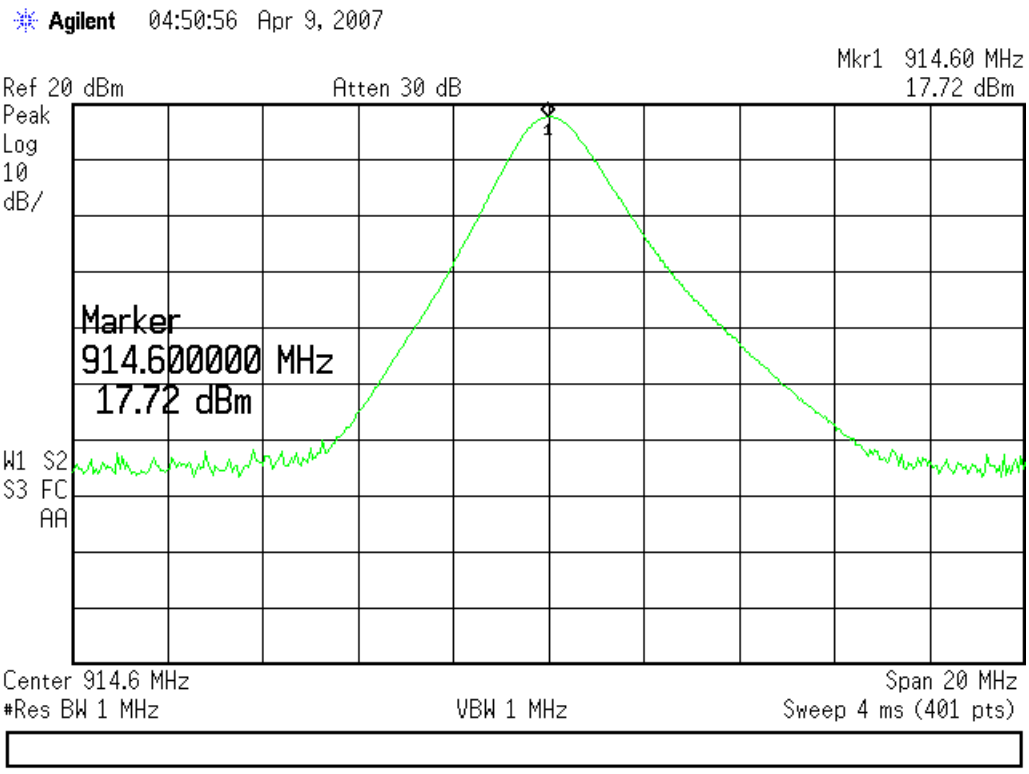
Measured RF power levels are below.

	Power (dBm)	Power (mW)	(**APPROX** Max EIRP) Assume 2.5 dBi
LOW	17.63	57.94	20.13
MID	17.72	59.16	20.22
HIGH	17.89	61.52	20.39

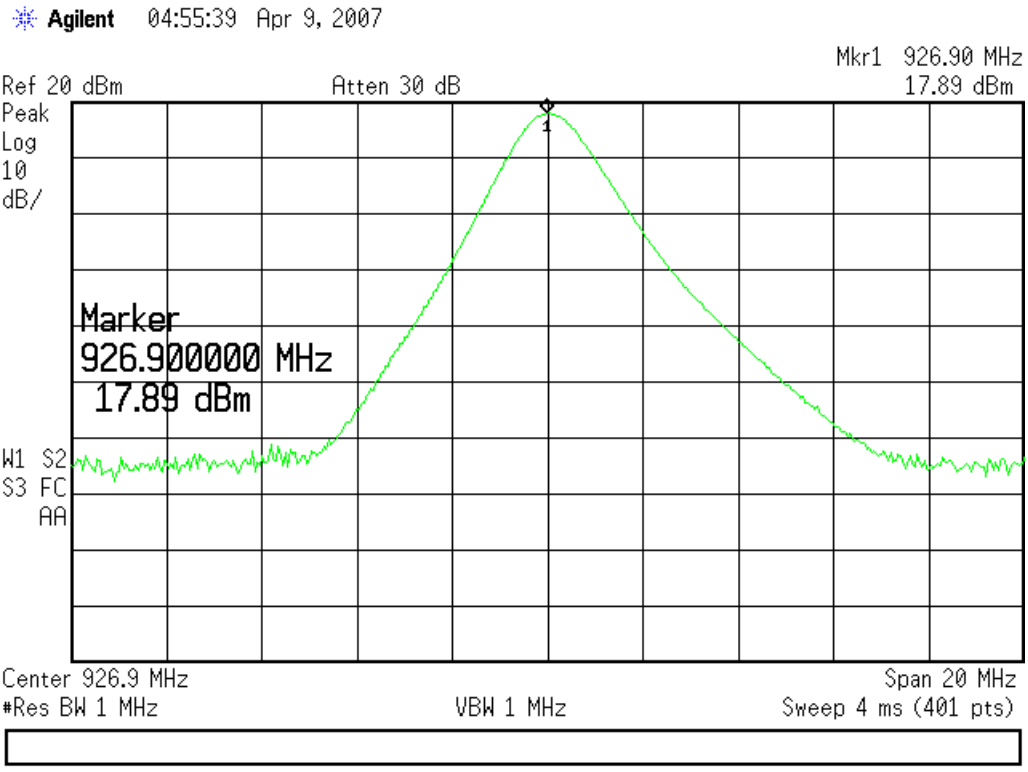


RF Power Out, Low Channel

RF Power Out, Middle Channel



RF Power Out, High Channel



20 dB Bandwidth

Specifications

FCC Specification: Paragraph 15.247(a)(1)(i)
IC Specification: RSS-210 / 6 A8.1(3)

Procedure:

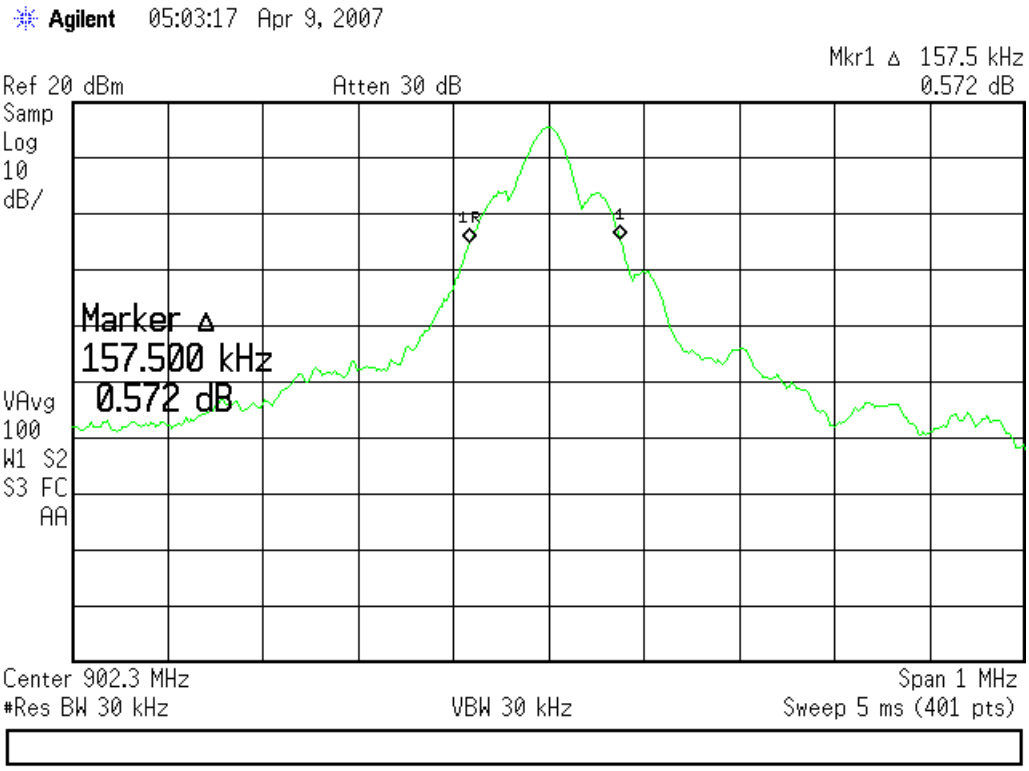
The 20 dB bandwidth was measured on the low middle and high channels of the 900 MHz band using the conducted RF test setup. The spectrum analyzer was configured for MAX HOLD and the trace allowed to stabilize. A peak search was performed and the then "Delta-Marker" used to locate the points at –20dB below the peak.

The bandwidth test was performed at the power settings that will be used in the final system.

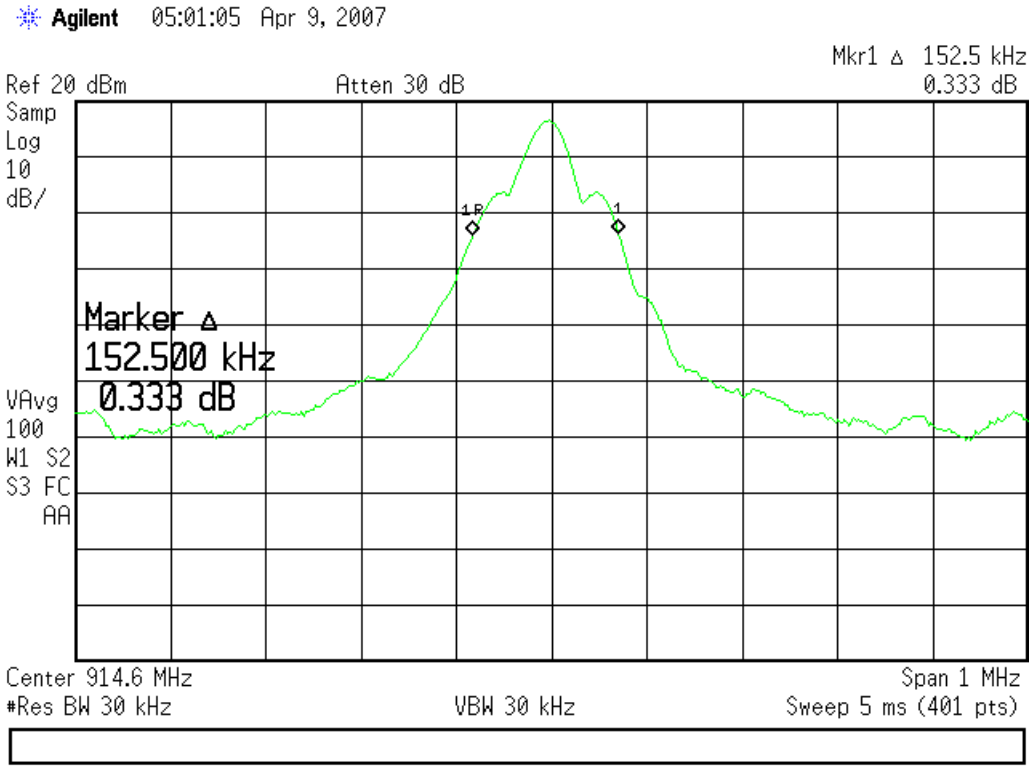
Results:

	20 dB BW (kHz)	Spec (kHz)	Delta (kHz)
LOW	**157.5**	500	342.5
MID	**152.5**	500	347.5
HIGH	**147.5**	500	352.5

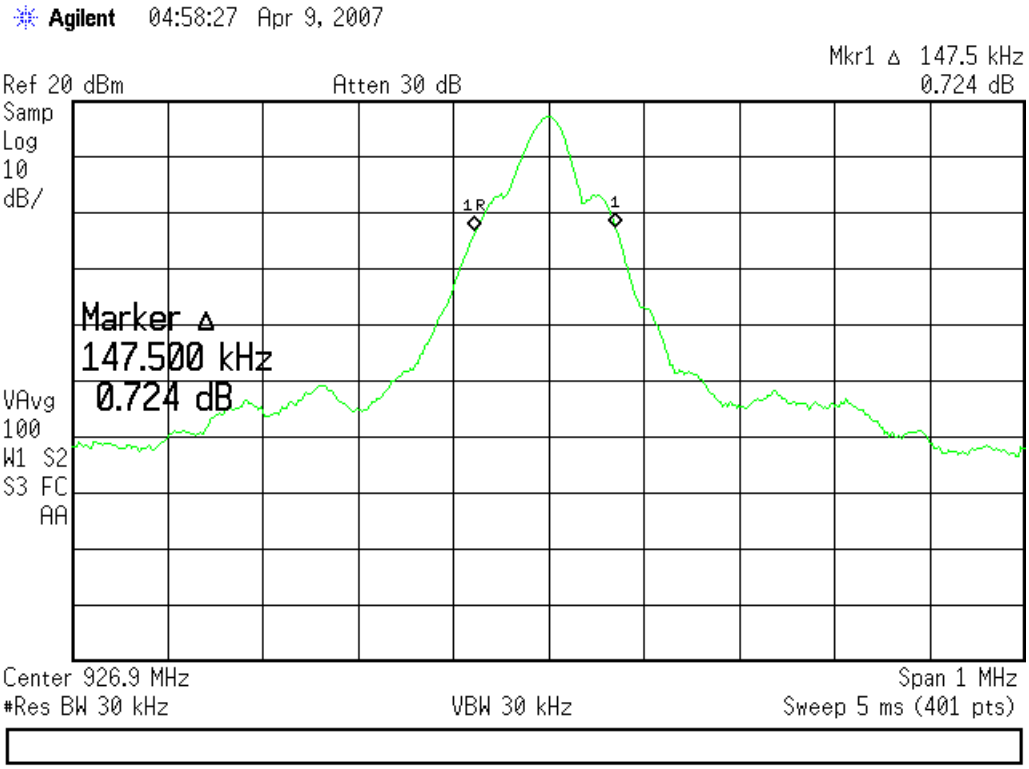
20 dB BW, LOW Channel



20 dB BW, MID Channel



20 dB BW, HIGH channel



900MHz Band Edge

Specifications:

FCC Specification: Paragraph 15.247(d)
IC Specification: RSS-210/6 A8.5

Procedure:

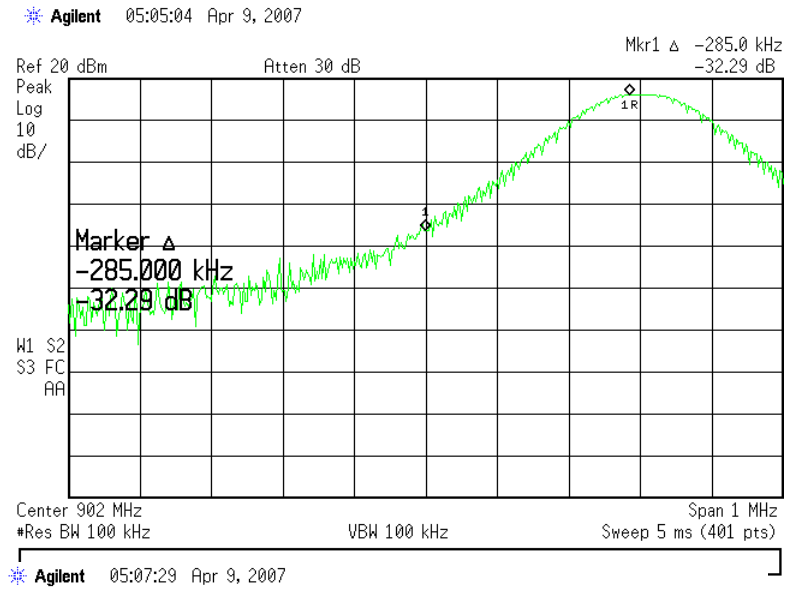
The test setup was configured as shown in the conducted test setup. The UUT was configured to continuously transmit random data on the low, and then the high test channel. The span of the analyzer was centered on the 902 and 928 MHz band edge respectively.

The RBW & VBW were set to 100 kHz. The trace was allowed to stabilize then a Peak-search and a marker delta measurement to the band edge was performed to verify that the RF power at the band edge was at least 20 dB below the peak of the fundamental level.

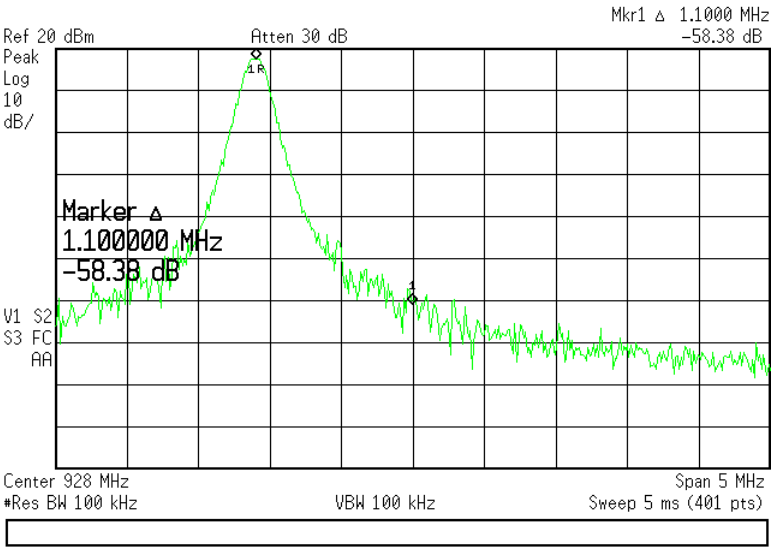
Results:

Level at 902 MHz: -32.29dBc Spec -20 dBc Min
Level at 928 MHz: -58.38dBc Spec -20 dBc Min

902 MHz Bandedge



928 MHz Bandedge



Radiated Emissions in Restricted Bands & Out of Band Radiated Emissions

Specifications:

FCC Specification: Paragraph 15.247(d)
IC Specification: RSS-210 / 6 Sec 2.6

Procedure:

This test was conducted inside a semi-anechoic chamber at BACL. The unit was placed on a rotating wooden table 80cm above the ground plane. A Horn antenna was secured to a mast 1 meter away. The unit was tested at each of the Low, Mid and High channels. The UUT was running in the diagnostic mode and set to transmit at maximum on each of the channels in turn. The test equipment was configured as shown below.

Out or band emissions starting at 1GHz were measured. There was no preamplifier or band reject filter used in the test setup to reject the fundamental signal.

In order to prevent the high level of the fundamental from creating harmonics within a pre-amp placed between the antenna and the spectrum analyzer, the preamp was removed from the typical test setup. Removing the preamplifier also reduced the available signal to noise ratio of the test system such that if harmonics were present they may not be detected because they were below the noise floor. To increase the signal to noise ratio, the measuring antenna was moved in to a distance of 1 meter. The test specification was adjusted from 54 to 63.5dBuV AVG to accommodate the 1 meter test distance. The peak limit is still 20dB above the AVG limit, at 83.5 dBuV.

The EUT was rotated 360 degrees and the height of the antenna adjusted from 1 to 4 meters above the ground plane to determine the maximum level of the emission. The level of the harmonic emission was measured in two modes, “Peak” and “Average” .

The spectrum analyzer reading made by the test software and the appropriate correction factors (antenna factor, cable loss,...) were then applied by BACL’s software to obtain a final corrected measurement.

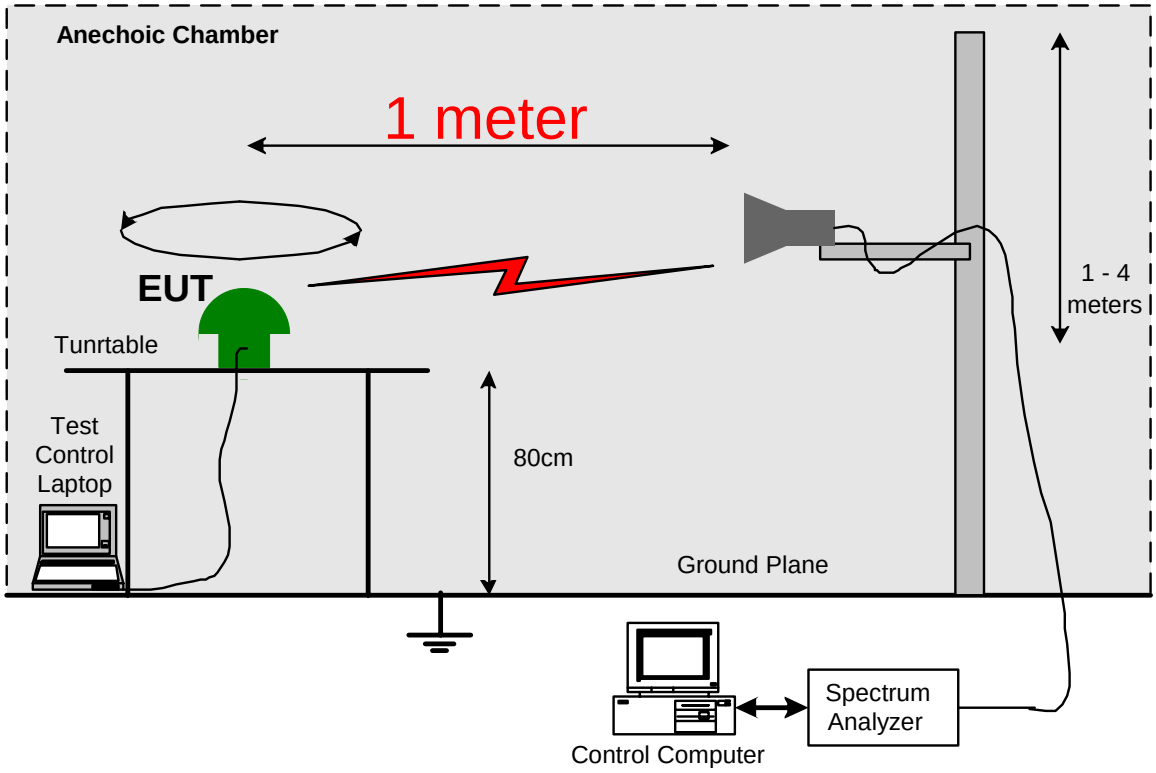
Preliminary emission scans were performed on the EUT in three orthogonal planes It was determined that the horizontal plane was the worst case. The final radiated emissions data was recorded with the EUT being horizontal. This procedure was performed for all of the channels outlined in the Test Methods section of this report.

The band up to 10 GHz was examined. The table below indicates the harmonics that fall within restricted bands.

CHAN	FUND	2	3	4	5	6	7	8	9	10
LOW	902.3	1804.6	2706.9	3609.2	4511.5	5413.8	6316.1	7218.4	8120.7	9023.0
MID	915.4	1830.8	2746.2	3661.6	4577.0	5492.4	6407.8	7323.2	8238.6	9154.0
HIGH	926.7	1853.4	2780.1	3706.8	4633.5	5560.2	6486.9	7413.6	8340.3	9267.0

15.205 Harmonic test tables

*NOTE: **RED** indicates a harmonic that falls within a restricted band and is subject to 15.205. The harmonics in Green are NOT in restricted bands and are subject to 15.209*



Radiated Emissions in Restricted Bands Test Setup

Support Equipment				
Description	Model number	FCC ID or SN	Manufacturer	Power Cable
Laptop	A20	DOC	IBM	Laptop PS, unshielded
Serial Comm Converter	None	None	Silver Spring Networks	Ribbon cable , RS232 D9 cable
AC Adapter Power Supply	DMS050500-PSP-IC	None	CUI INC	Unshielded pair
Bench Top Power supply	E3610A	None	HP	Clip leads

Test Conditions			
Temperature	22 C	Humidity:	63%
ATM pressure	29.97 in	Grounding:	None
Tested By	Choon, BACL	Date of Test:	May 2007
Test Reference	FCC Part 15.205 IC Paragraph RSS210, 6.2.3 (c)		
Setup Method	ANSI C63.4		
Tested Range	1 GHz to 10GHz		
Test Voltage	3.6 VDC		
Modifications	No modifications were made to the unit		

***NOTES**: For emissions in restricted bands, the limit of 15.209 was used. For all other emissions, the limit was set 20dB below the level of the fundamental.*

Restricted Band Peak Measurements: RBW = VBW = 1 MHz
Restricted Band Average Measurements: RBW =1MHz and VBW=10 Hz.
All other measurements, RBW = 1MHz and VBW = 3MHz, video averaging on (100 samples).

Results:

See detailed test results in APPENDIX A.

Test Information

Test Description:	FCC 15 C Spurious Emission
Test Engineer:	Choon Sian Ooi
EUT:	FHSS Device
Customer:	David Watt
Test Date:	2007-05-23
Project Number	T0705232
Comment	The measurement distance is 1 meter and without Preamplifier

Number of Hopping Channels

Specifications:

FCC Specification: Paragraph 15.247(a)(1)(i)
IC Specification: RSS-210 / 6 A8.1(2)

Procedure:

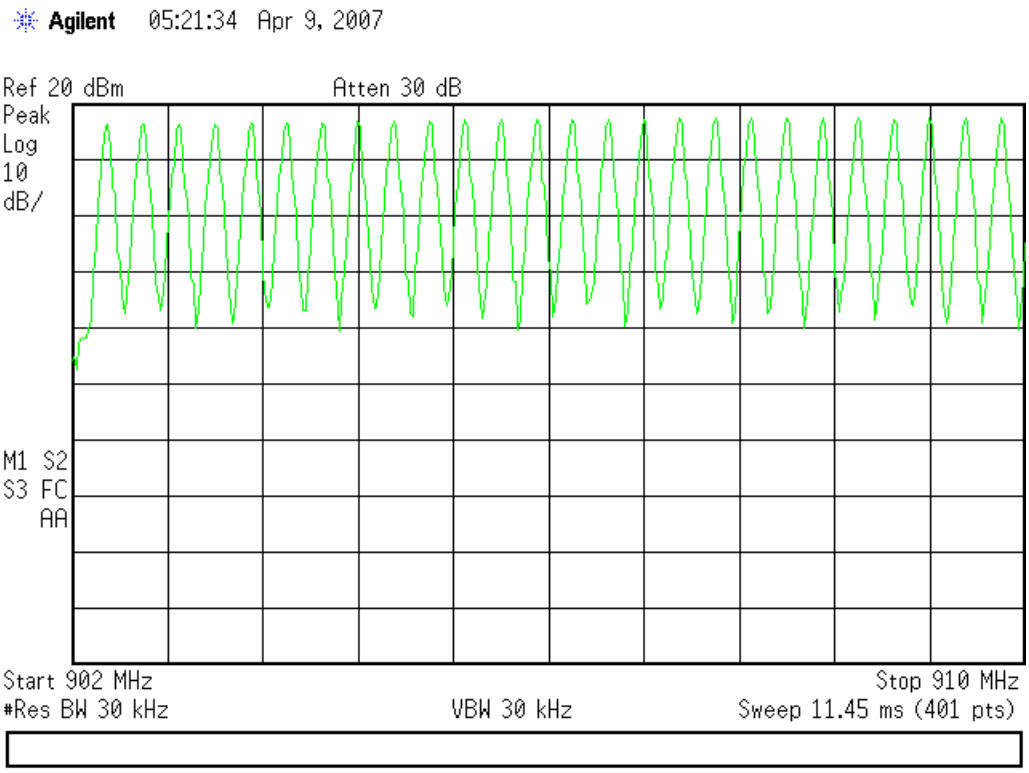
The test setup is as shown in the Conducted RF bench setup. The EUT was configured to hop sequentially through all of its channels. (This is not possible with the normal operating code). The spectrum analyzer was set to MAX HOLD to capture the number of hopping channels. The entire 902 - 928 MHz band was examined in three sub-bands. 902 - 910 MHz, 910 - 920MHz and 920 - 928 MHz. The results are below.

Results:

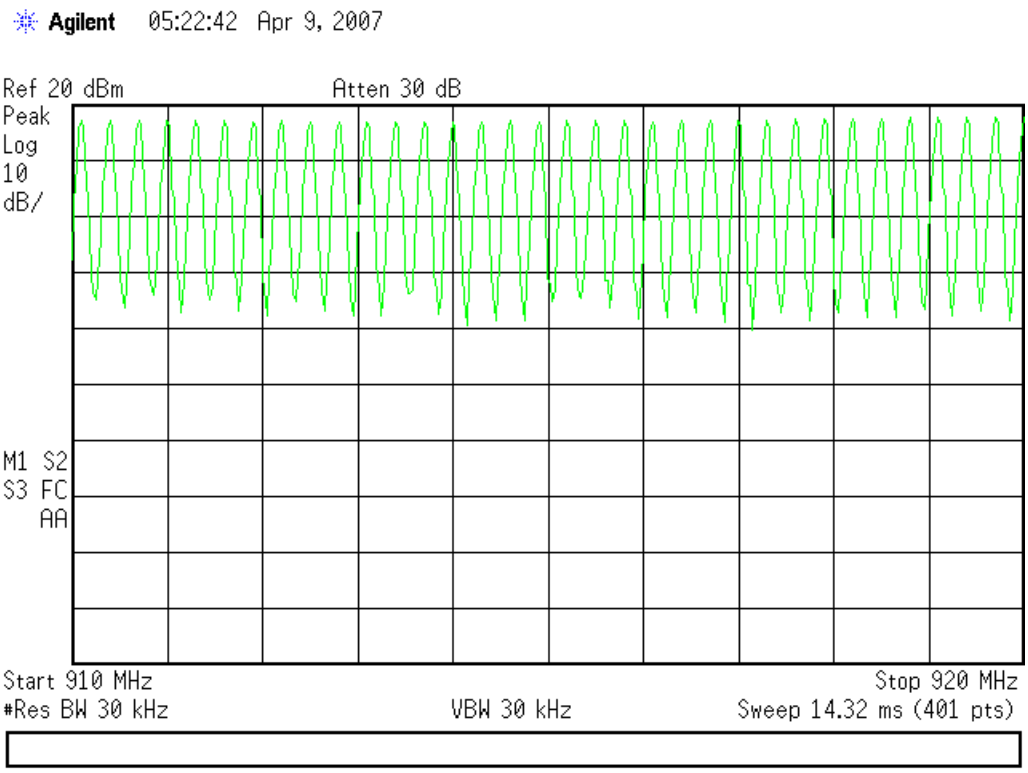
All 83 hopping channels were recorded.

From (MHz)	to (MHz)	Num of Channels
902	910	26
910	920	33
920	928	24
	TOTAL	**83**

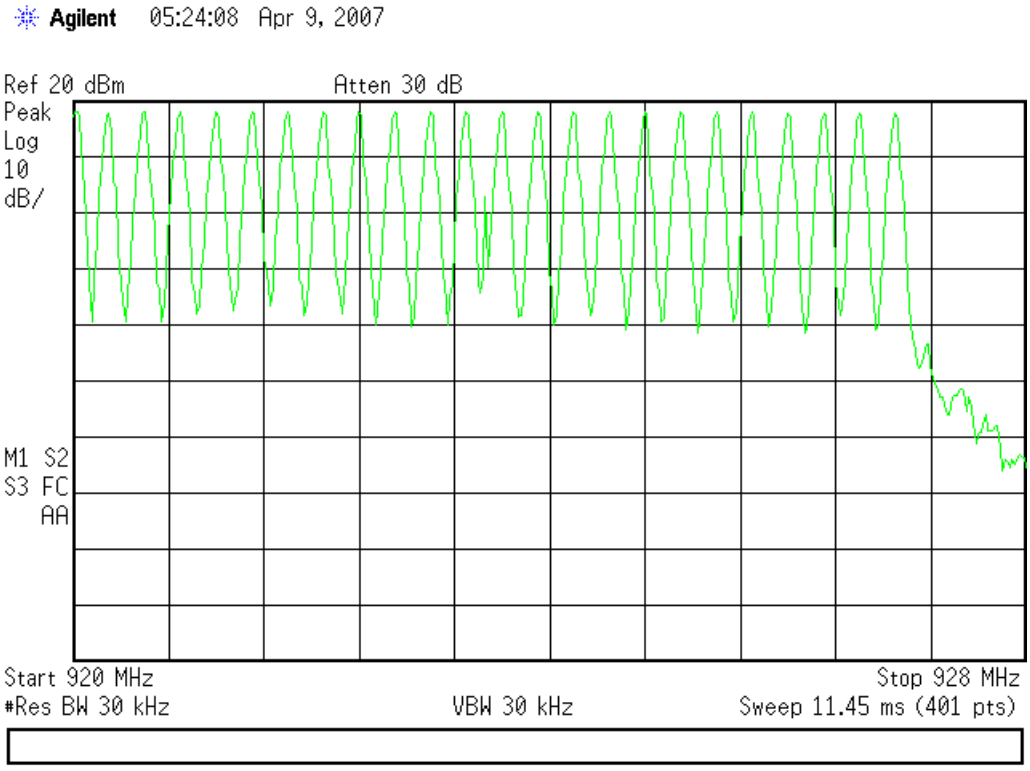
902 - 910 MHz (26 Chan)



910 - 920 MHz (33Chan)



920 - 928 MHz (24Chan)



Channel Spacing

Specifications:

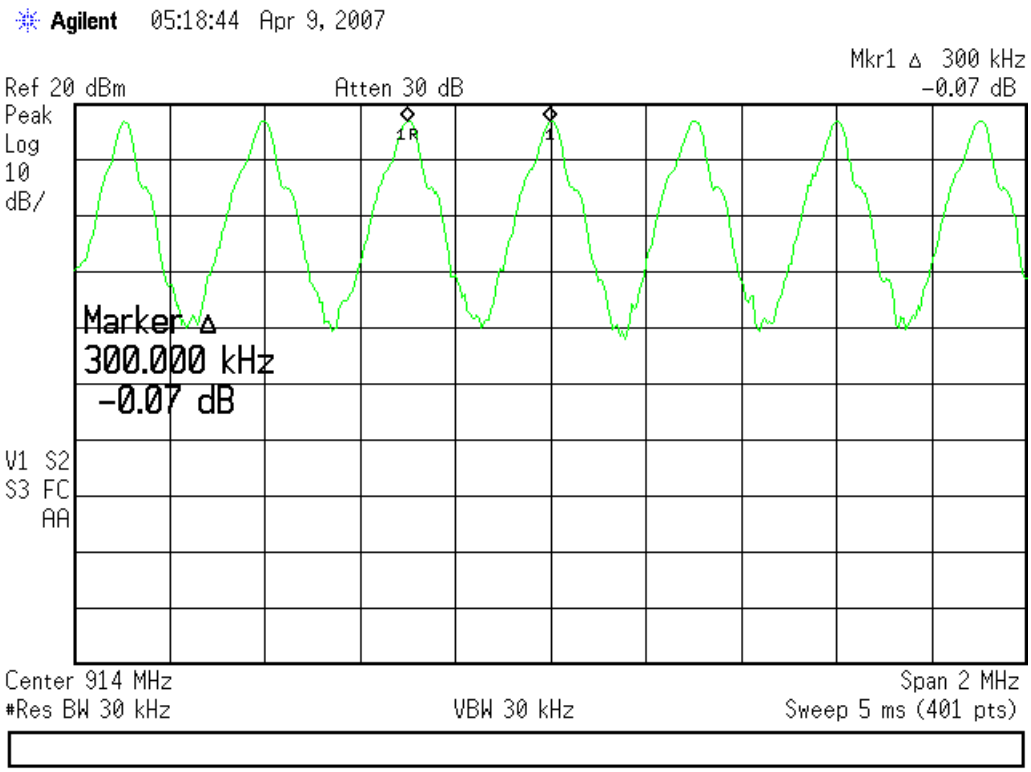
FCC Specification: Paragraph 15.247(a)(1)
IC Specification: RSS-210 / 6 A8.1(2)

Procedure:

The test setup is as shown in the Conducted RF bench setup. The EUT was configured to hop sequentially through all of its channels. (This is not possible with the normal operating code). The spectrum analyzer was set to MAX HOLD to capture a few of the sequential channel frequencies. The spectrum analyzer markers were used to determine the channel spacing. The results are below.

Results:

Channel spacing was measured at **300kHz**. The specification requires that the channel spacing be greater than the measured 20 dB BW. The 20 dB BW was measured at a maximum of 157.5 kHz.



Channel Dwell Time

Specifications:

FCC Specification: Paragraph 15.247(a)(1)
IC Specification: RSS-210 / 6 A8.1(2)

Procedure:

A communications link was established with the EUT. Random data packets were transmitted ove the link at a fixed packet size. Two packets lengths were investigated. The MAX size packet and the MIN size packet that the system utilizes. The long packet maximizes the time on channel for each “hit” but at the same time reduces the number of “hits” due to the fact that ti takes longer to traverse through the complete hopping sequence.
Conversely, with the minimum size packet, the time on channel for each :hit: is minimized, however the complete hopping sequence is traversed faster, resulting on more hits on that channel.

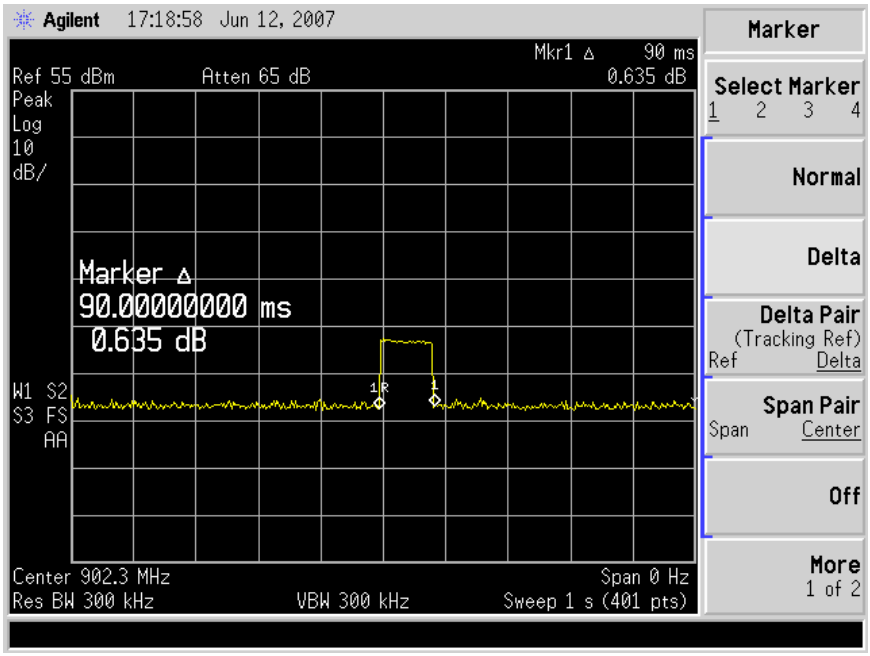
After determining the transmission time for each packet, The LOW, MID and HIGH channel were monitored with the spectrum analyzer on zero span and set to a 20S sweep time. RBW was set to 30 kHz to prevent hits on adjacent channels appearing as hits on the test channel (recall, there is a 300kHz channel spacing)

Results:

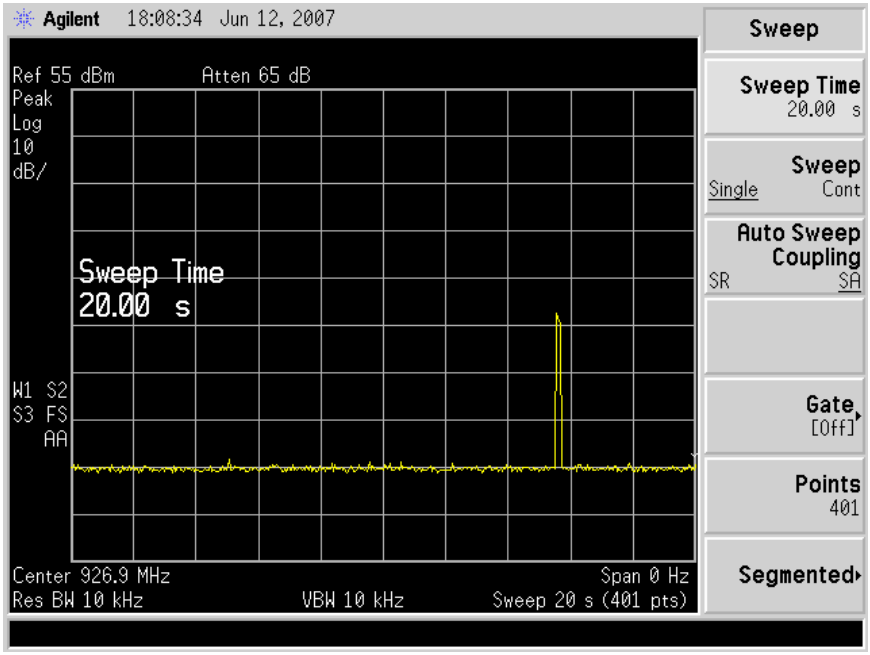
As expected there were more hits with the minimum packet size than the maximum packet size. The table blow summarizes the results. Plots follow.

	Time On Channel per 20 S (mS)				
Channel	Long Packet	Short Packet	Limit	Margin, Long	Margin, Short
High	90	21.6	400	310	378.4
Mid	180	21.6	400	220	378.4
Low	180	21.6	400	220	378.4

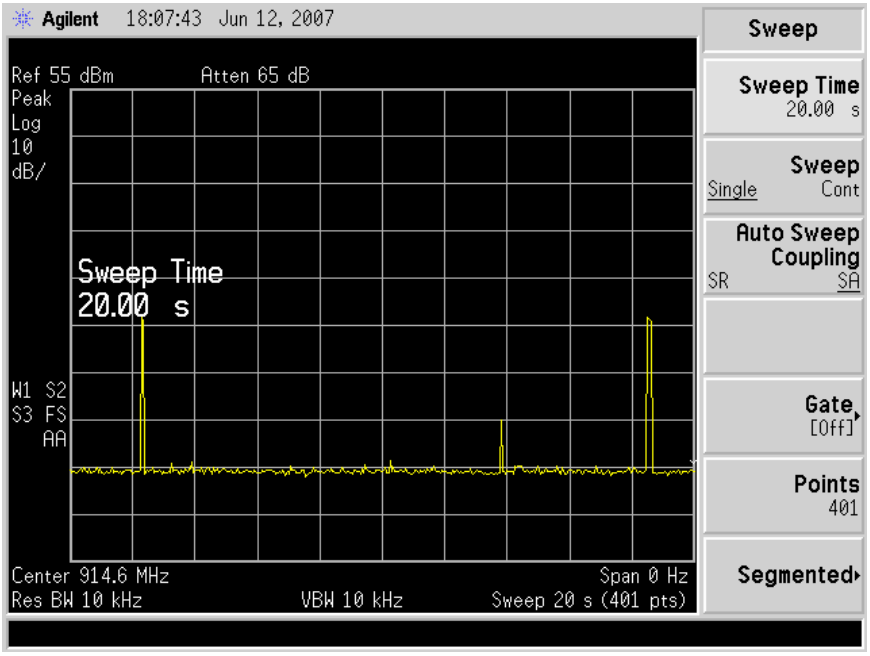
1. Long packet – packet length: 1024 bytes
Transmission time per burst: 90mS



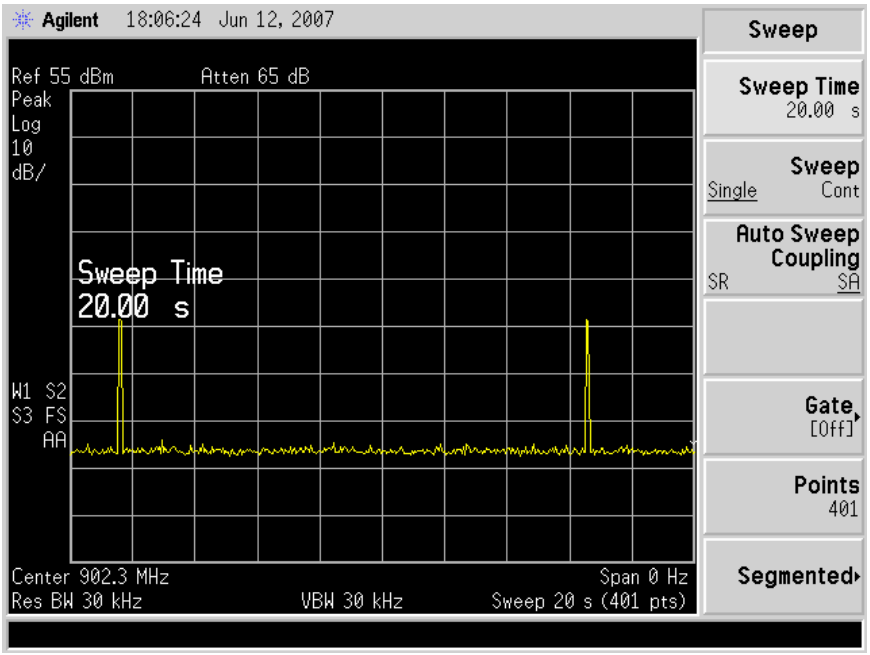
High channel 926.9MHz:
Dwell time per 20s: 90mS



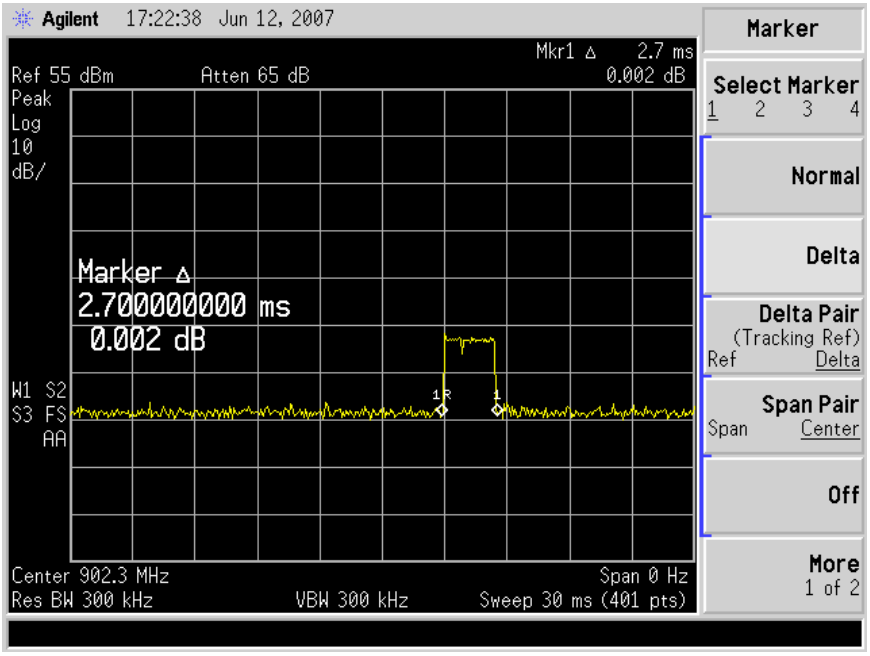
Mid channel: 914.6MHz
Dwell time per 20s: 180mS



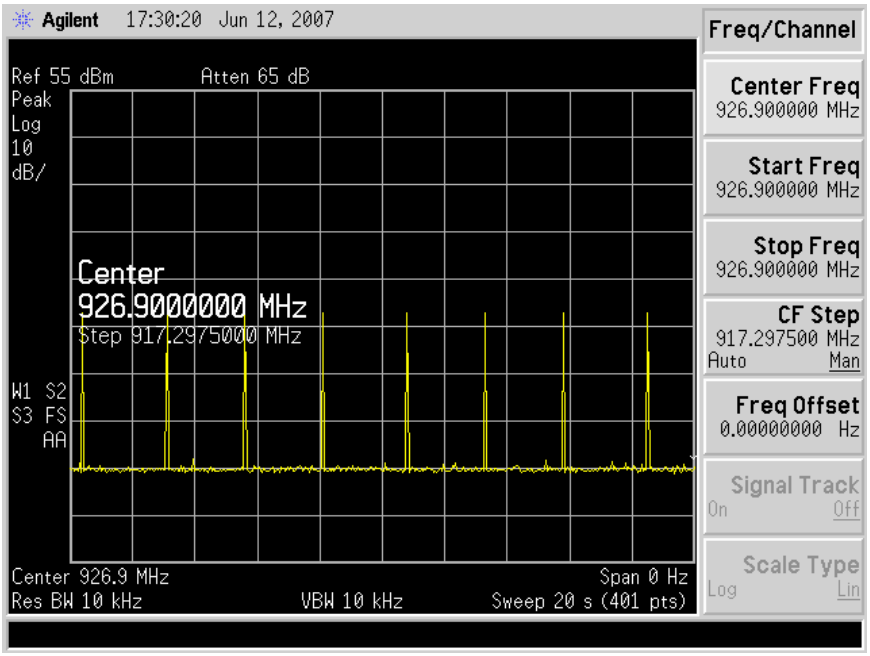
Low channel: 902.3MHz
Dwell time per 20s: 180mS



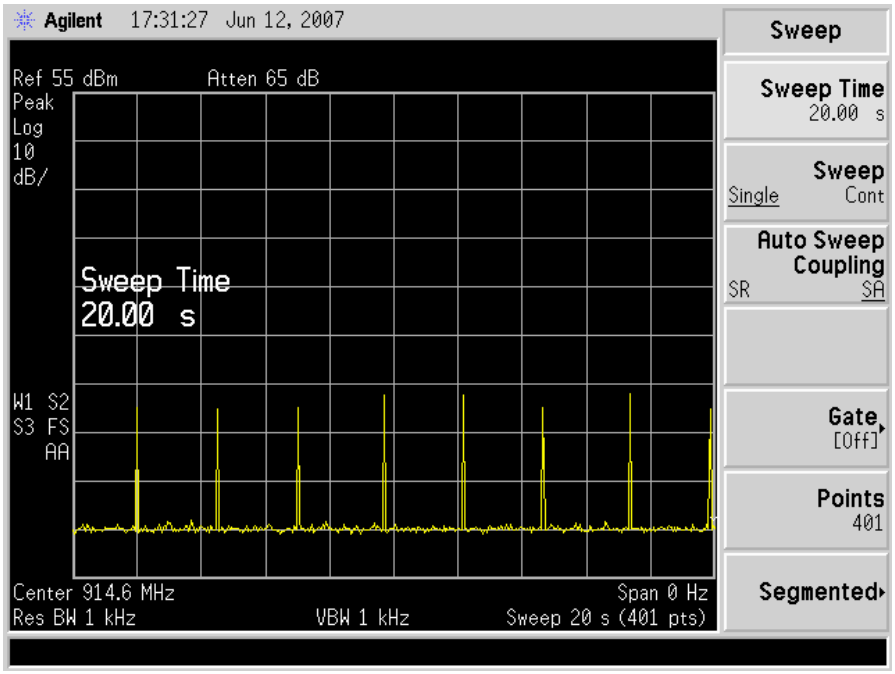
2. Short packet – packet length: 10 bytes
Transmission time per burst: 2.7mS



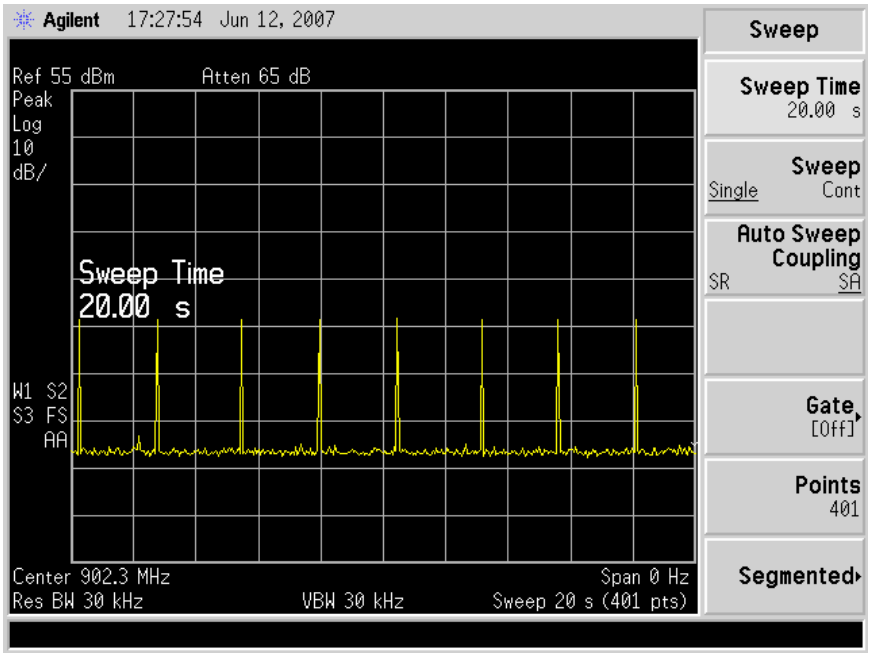
High channel 926.9MHz:
Dwell time per 20s: 21.6mS



Mid channel: 914.6MHz
Dwell time per 20s: 21.6mS



Low channel: 902.3MHz
Dwell time per 20s: 21.6mS



30MHz - 1 GHz Spurious Radiated Emissions

Specification:

FCC Specification: 15.109(f)
IC Specification: RSS210 / 6 A8.5

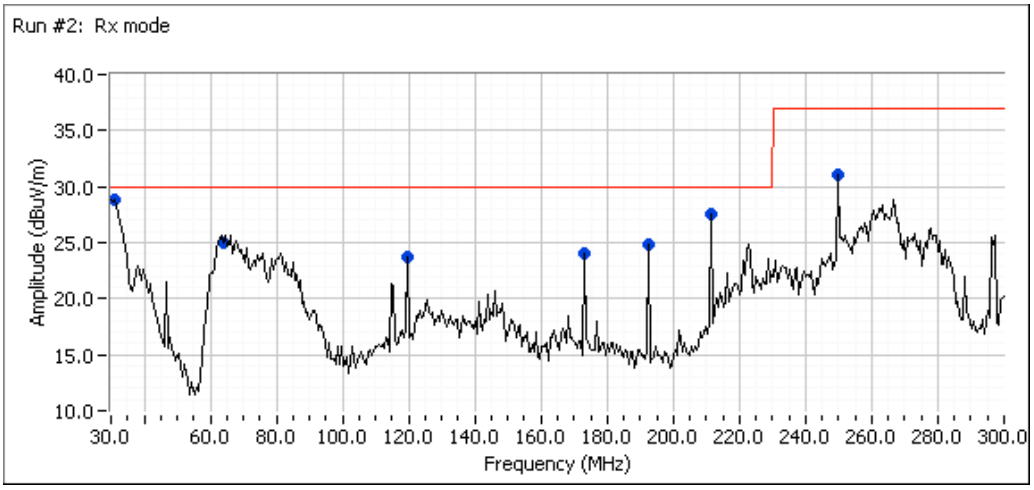
Procedure:

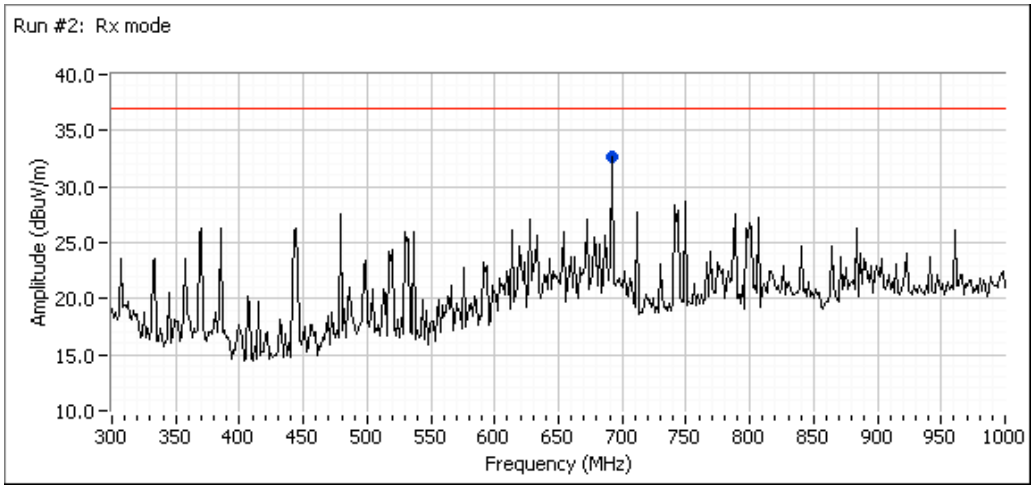
The test was configured as a standard ANSI C63.4 Class B radiated emissions test setup. The EUT was tested in both RCV and XMIT modes. The frequency range of 30 to 1000 MHz was scanned.

Results: (RCV mode)

The unit was set to receive only mode. Preliminary emissions were checked in all three orthogonal planes, the worst case results are presented. The units was tested in Receive mode and transmit mode

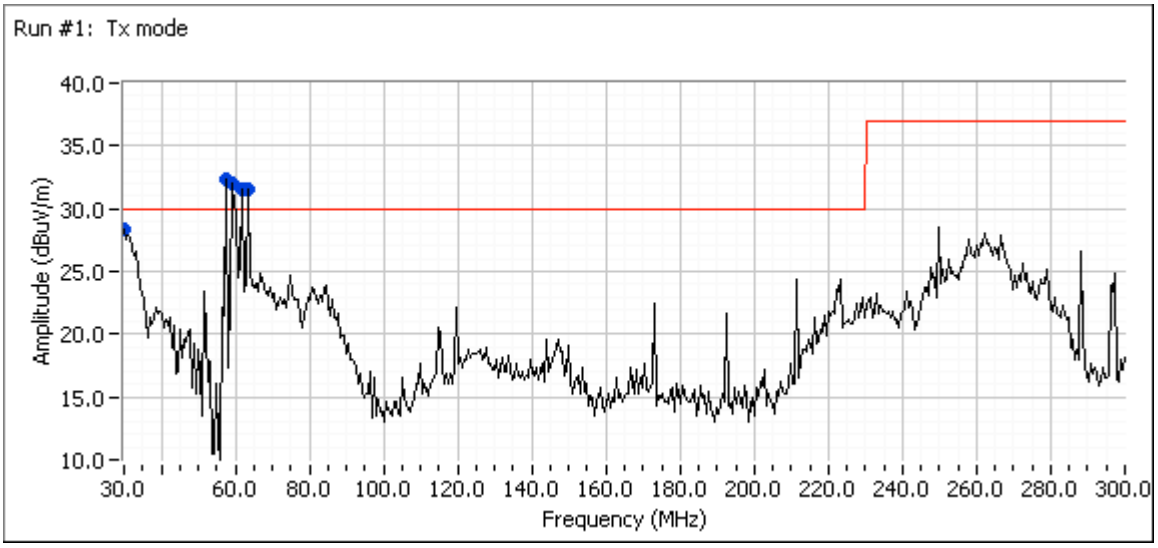
Frequency	Level	Pol	EN55022 B		Detector	Azimuth	Height
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters
211.203	28.2	H	30.0	-1.8	QP	171	4.0
691.202	32.8	H	37.0	-4.2	QP	288	1.0
249.606	31.0	H	37.0	-6.0	QP	140	4.0
192.005	23.8	H	30.0	-6.2	QP	107	4.0
172.805	23.4	H	30.0	-6.6	QP	99	3.5
30.451	23.0	V	30.0	-7.0	QP	232	1.0
120.007	20.4	V	30.0	-9.6	QP	160	1.0
64.249	19.8	V	30.0	-10.2	QP	200	2.5

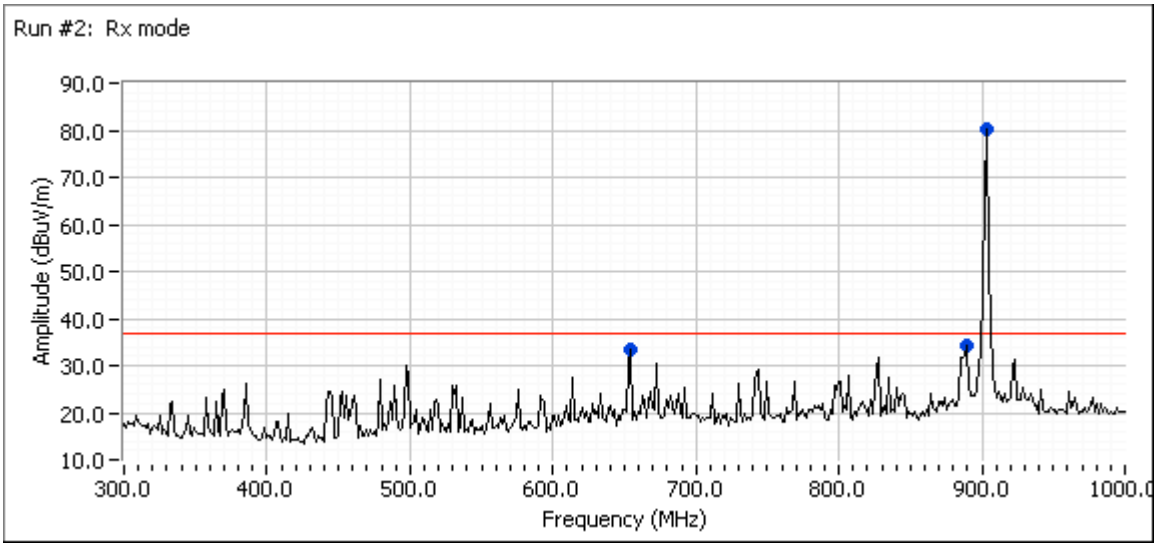




Results: (XMIT mode)

Frequency	Level	Pol	EN55022 B		Detector	Azimuth	Height
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters
652.804	33.0	H	37.0	-4.0	QP	234	1.0
30.351	23.3	V	30.0	-6.7	QP	26	1.0
62.977	19.9	V	30.0	-10.1	QP	36	1.5
62.529	17.9	V	30.0	-12.1	QP	48	3.0
59.775	14.7	V	30.0	-15.3	QP	100	1.5
58.084	10.2	V	30.0	-19.8	QP	177	1.0
890.175	16.7	V	37.0	-20.3	QP	203	3.5





AC Line Conducted Emissions

Specification:

CISPR 22

Procedure:

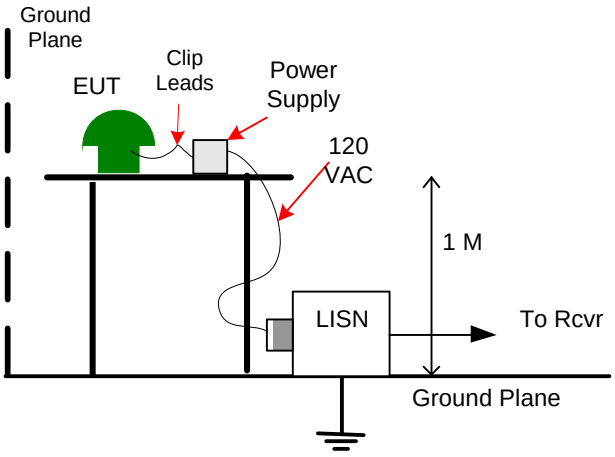
The test was set up according to the guidelines set forth in EN55022:1998 and FCC Part 2 for AC Line Conducted Emissions. The measurement used a LISN line on each AC line and an EMI receiver. A peak scan was made over the measurement frequency range (150 kHz to 30 MHz). The highest peaks were then marked and re-measured and quasi-peaked and averaged.

The test was configured as shown below. The product was tested with a generic power supply running on 120 VAC @ 60 Hz. The power supply provides 3.6 VDC to the EUT. The EUT was configured to transmit in order to draw the maximum current from the power supply. This results in the worst case conducted emissions.

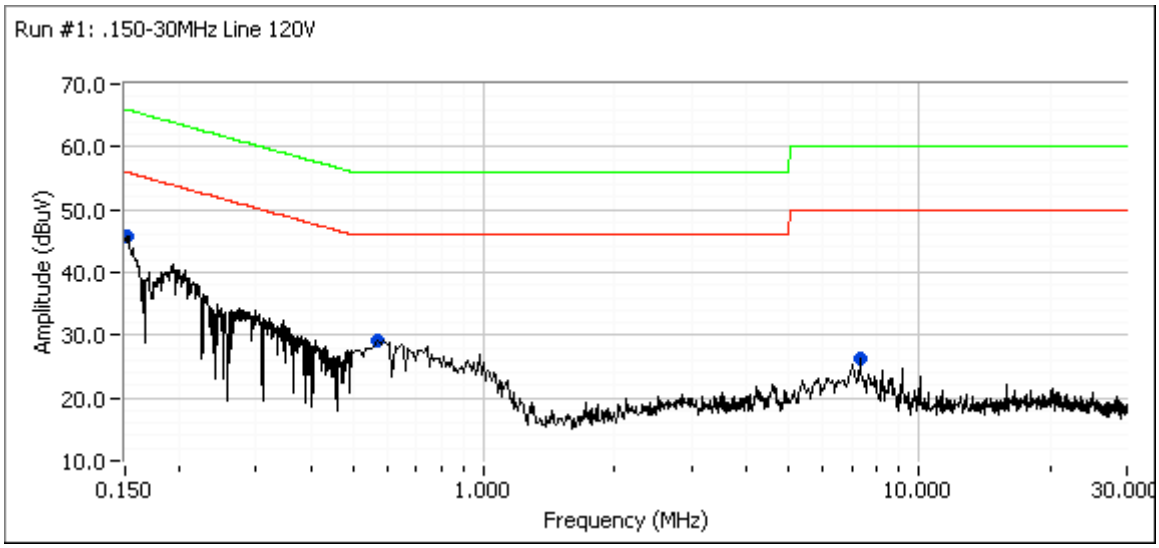
Results:

AC line Conducted Emissions, QP and AVG Results

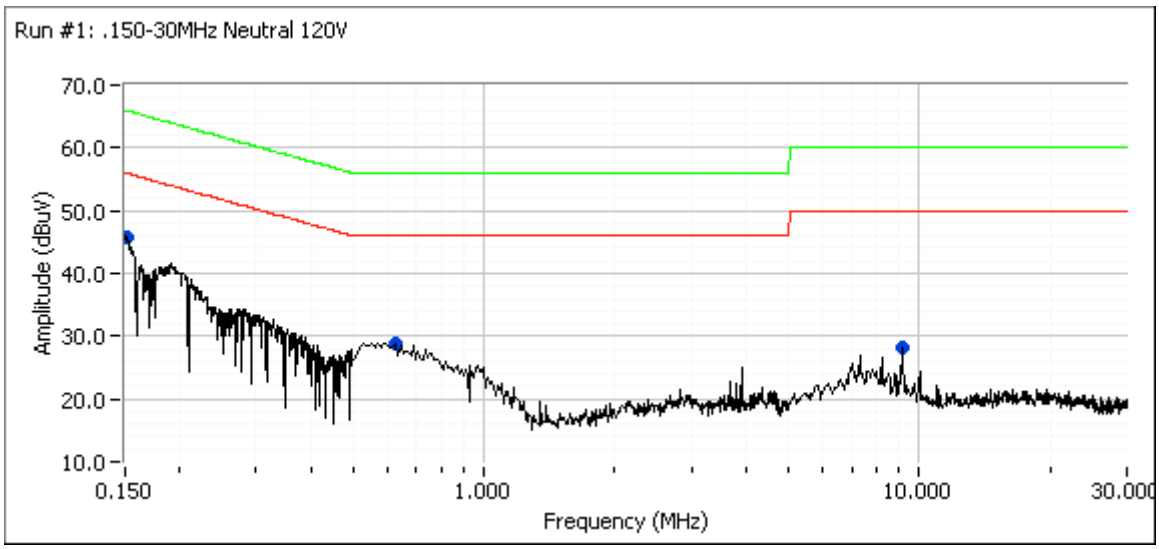
Frequency	Level	AC	EN55022 Class B		Detector
MHz	dBµV	Line	Limit	Margin	QP/Ave
0.151	38.7	Neutral	65.9	-27.2	QP
0.152	38.2	Line 1	65.9	-27.7	QP
9.136	20.0	Neutral	50.0	-30.0	AVG
7.305	18.7	Line 1	50.0	-31.3	AVG
0.566	22.1	Line 1	56.0	-33.9	QP
0.620	21.2	Neutral	56.0	-34.8	QP
9.136	24.4	Neutral	60.0	-35.6	QP
7.305	23.3	Line 1	60.0	-36.7	QP
0.566	6.0	Line 1	46.0	-40.0	AVG
0.620	5.7	Neutral	46.0	-40.3	AVG
0.151	15.3	Neutral	55.9	-40.6	AVG
0.152	15.2	Line 1	55.9	-40.7	AVG



AC Line conducted emissions, LINE



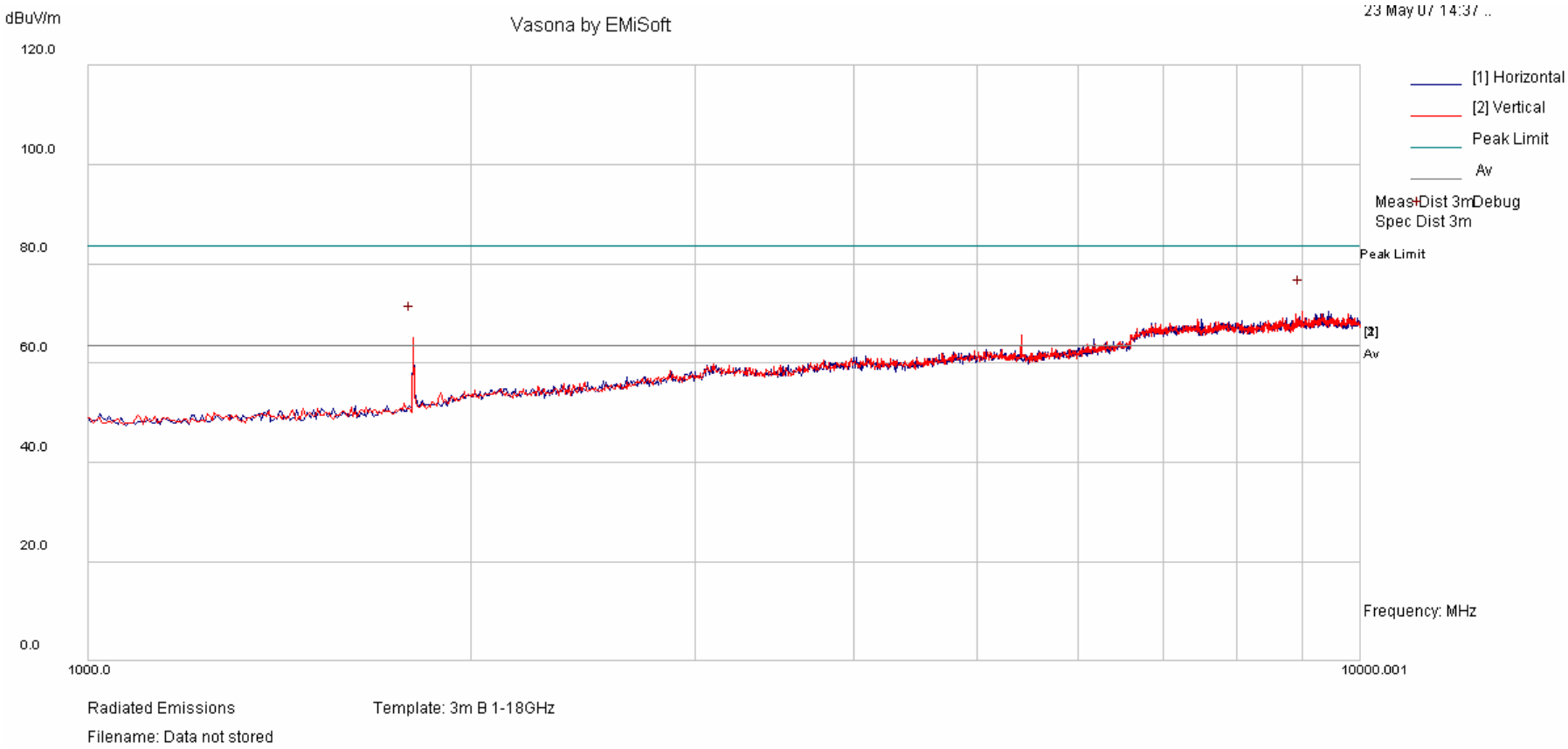
AC Line conducted emissions, NEUTRAL



Out of Band Radiated Emissions
Radiated Emissions in Restricted bands

APPENDIX A

Low Channel - Peak (RSW=1MHz, VSW= 1MHz)



Vasona Data : List of Debug Frequencies												
No	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Msmt Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1	9006.239	28.43	4.41	37.5	70.35	Peak [Scan]	V	100	0	83.5	-13.15	Pass
2	1802.87	37.48	2.05	25.68	65.22	Peak [Scan]	V	100	0	95.33	-30.11	Pass

Non Restricted Band Limit Calculation:

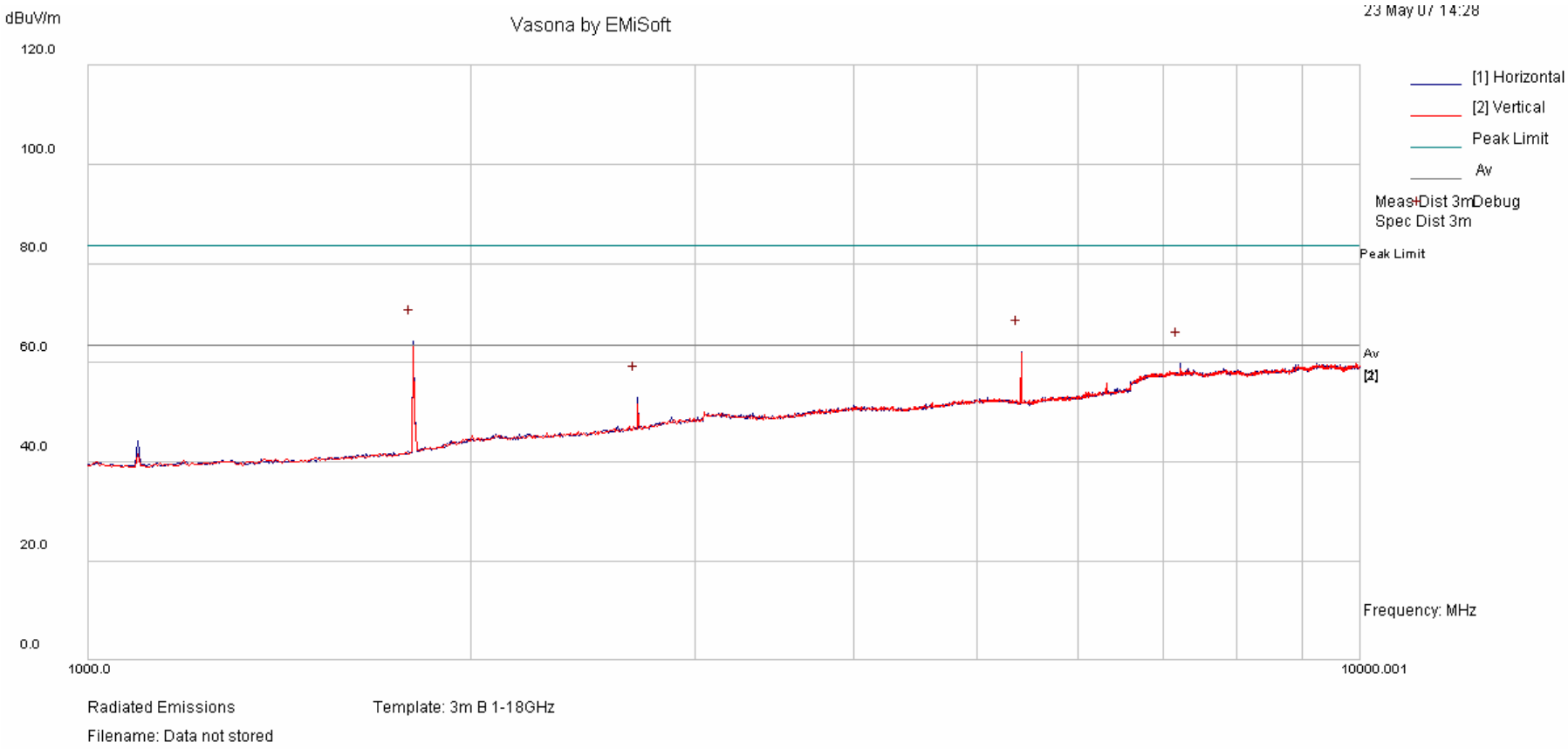
High Channel RF Power (dBm)	17.63
High Channel RF Power (dBm EIRP)	20.13
High Channel RF Power (dBuV @ 3M) (EIRP + 95.2)	115.33
Non Restricted Band Limit (-20dBc) (dBuV @ 3m)	**95.33**

NOTE

Value at 9006.239 MHz is noise Floor

No spur visible on AVG plot

Low Channel - Average (RSW=1MHz, VSW VSW=10Hz z)



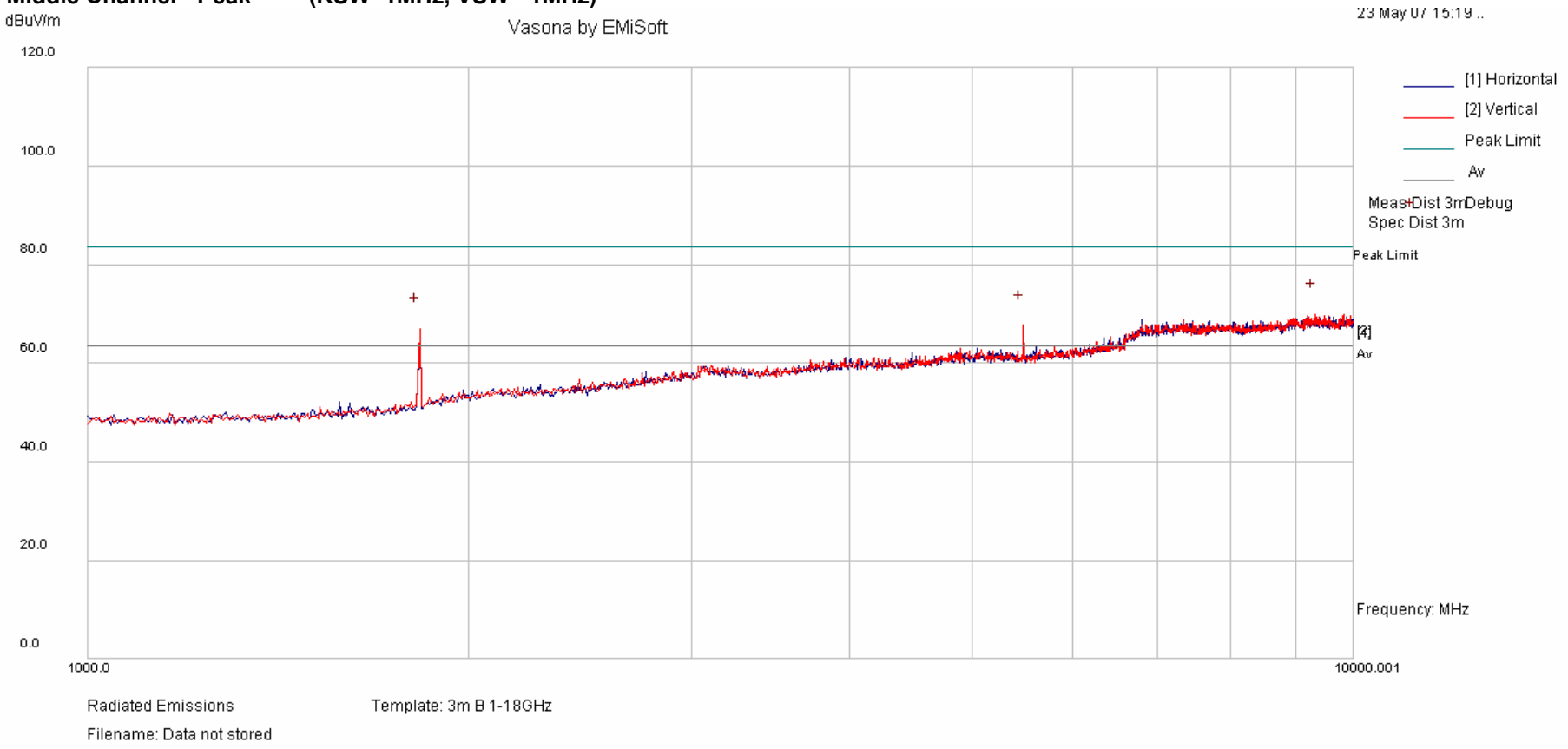
Vasona Data : List of Debug Frequencies												
No	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Msmt Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1	1802.87	36.66	2.05	25.68	64.39	Peak [Scan]	H	100	0	95.33	30.94	Pass
2	5412.976	25.15	3.38	33.67	62.2	Peak [Scan]	H	100	0	63.5	-1.3	Pass
3	7220.837	19.87	3.97	36.14	59.97	Peak [Scan]	H	100	0	95.33	59.19	Pass
4	2706.8	21.7	2.37	28.9	52.96	Peak [Scan]	H	100	0	63.5	-10.54	Pass

Non Restricted Band Limit Calculation:

High Channel RF Power (dBm)	17.63
High Channel RF Power (dBm EIRP)	20.13
High Channel RF Power (dBuV @ 3M) (EIRP + 95.2)	115.33
Non Restricted Band Limit (-20dBc) (dBuV @ 3m)	**95.33**

Peak Scans above below AVG Limits

Middle Channel - Peak (RSW=1MHz, VSW= 1MHz)



Vasona Data : List of Debug Frequencies												
No	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Msmt Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1	9331.879	27.71	4.54	37.57	69.81	Peak [Scan]	V	100	0	83.5	-13.69	Pass
2	5485.964	30.62	3.41	33.61	67.64	Peak [Scan]	V	100	0	95.42	-27.78	Pass
3	1830.942	39.07	2.04	25.98	67.09	Peak [Scan]	V	100	0	95.42	-28.33	Pass

Non Restricted Band Limit Calculation:

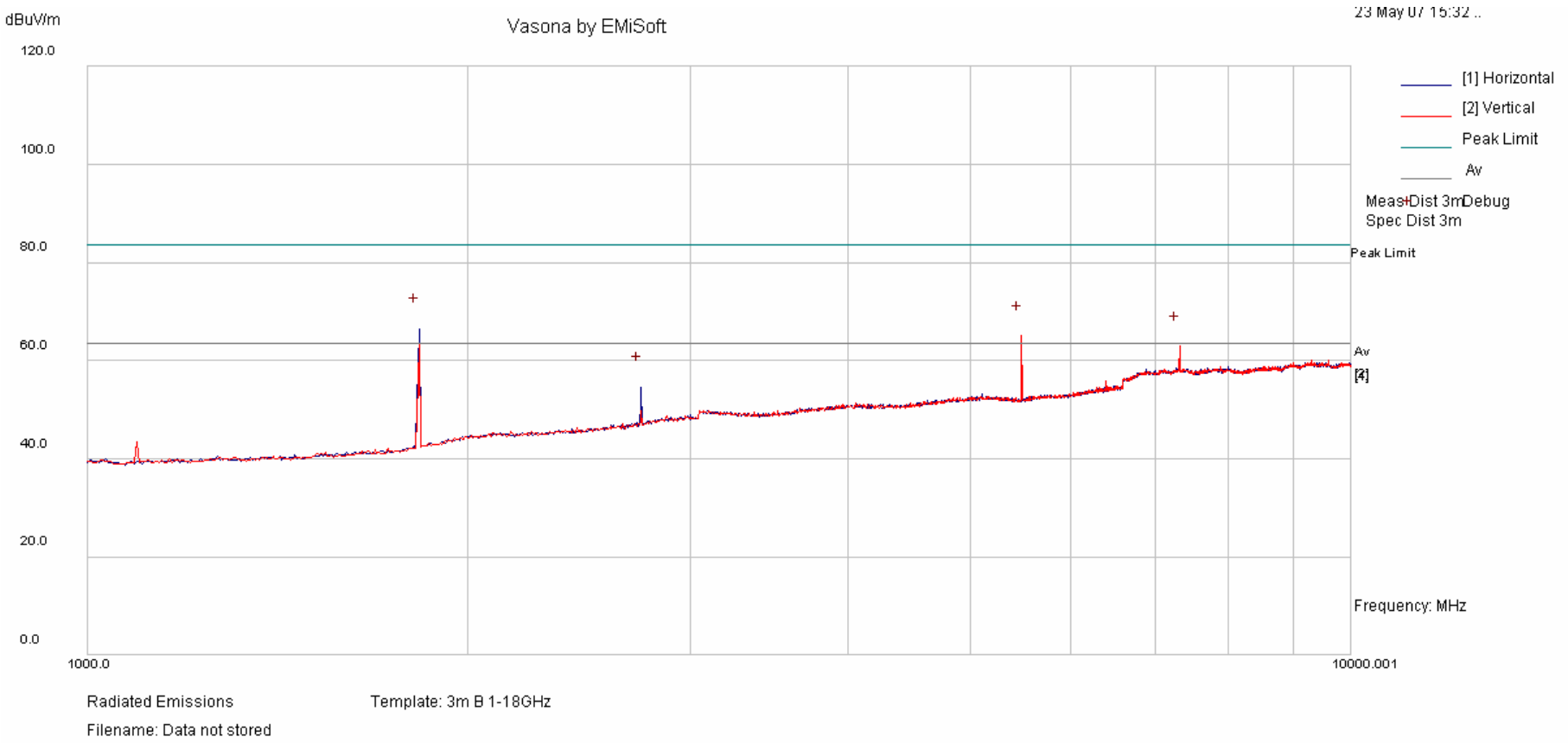
High Channel RF Power (dBm)	17.72
High Channel RF Power (dBm EIRP)	20.22
High Channel RF Power (dBuV @ 3M) (EIRP + 95.2)	115.42
Non Restricted Band Limit (-20dBc) (dBuV @ 3m)	**95.42**

NOTE

Value at 9331.879 MHz is noise floor

No spur visible on AVG plot

Middle Channel - Average (RSW=1MHz, V‹ VSW=10Hz z)

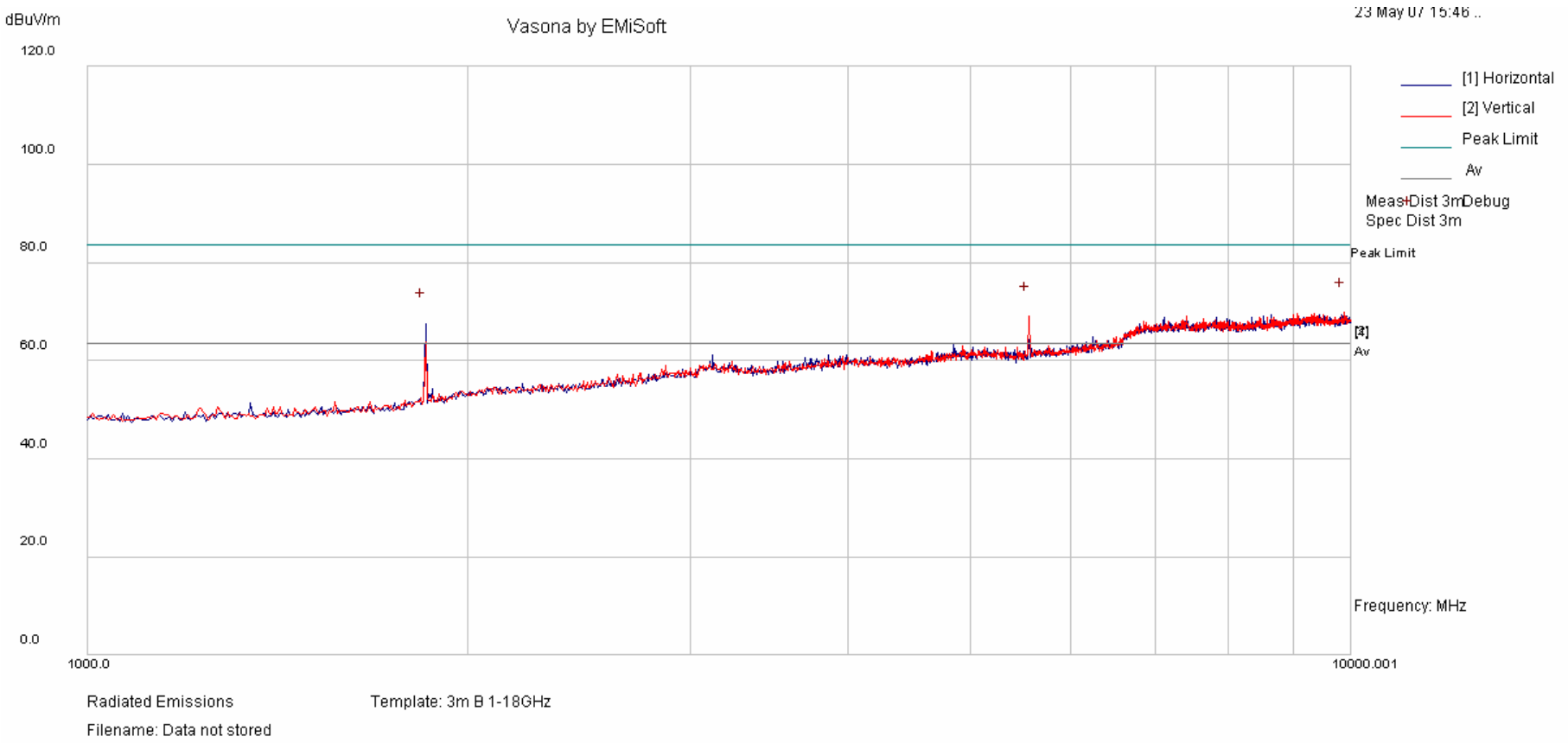


Vasona Data : List of Debug Frequencies												
No	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Msmt Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1	1830.942	38.46	2.04	25.98	66.48	AVG [Scan]	H	100	0	95.42	28.94	Pass
2	5485.964	28.03	3.41	33.61	65.05	AVG [Scan]	V	100	0	95.42	30.37	Pass
3	7316.283	22.71	3.99	36.19	62.89	AVG [Scan]	V	100	0	63.5	-0.61	Pass
4	2746.101	23.09	2.38	29.02	54.49	AVG [Scan]	H	100	0	63.5	-9.01	Pass

Non Restricted Band Limit Calculation:

High Channel RF Power (dBm)	17.72
High Channel RF Power (dBm EIRP)	20.22
High Channel RF Power (dBuV @ 3M) (EIRP + 95.2)	115.42
Non Restricted Band Limit (-20dBc) (dBuV @ 3m)	**95.42**

High Channel - Peak (RSW=1MHz, VSW= 1MHz)

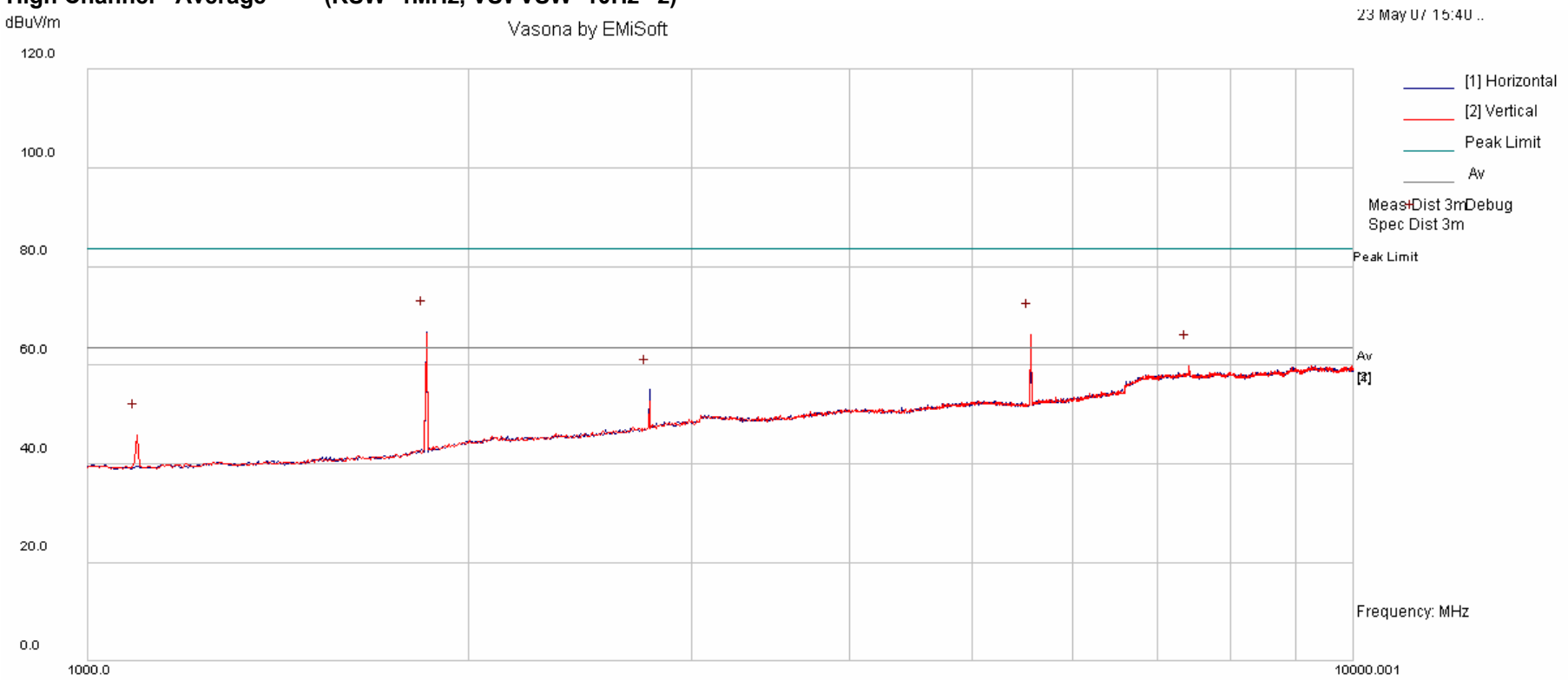


Vasona Data : List of Debug Frequencies												
No	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Msmt Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1	9870.868	27.3	4.72	37.75	69.77	Peak [Scan]	V	300	0	95.59	-25.82	pass
2	5558.952	31.86	3.44	33.67	68.98	Peak [Scan]	V	100	0	95.59	-26.61	pass
3	1853.4	39.21	2.03	26.22	67.46	Peak [Scan]	H	100	0	95.59	-28.13	pass

Non Restricted Band Limit Calculation:

High Channel RF Power (dBm)	17.89
High Channel RF Power (dBm EIRP)	20.39
High Channel RF Power (dBuV @ 3M) (EIRP + 95.2)	115.59
Non Restricted Band Limit (-20dBc) (dBuV @ 3m)	**95.59**

High Channel - Average (RSW=1MHz, VSV VSW=10Hz z)



Vasona Data : List of Debug Frequencies												
No	Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Msmt Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1	1853.4	38.48	2.03	26.22	66.73	AVG [Scan]	H	100	0	95.59	28.86	Pass
2	5558.952	29.08	3.44	33.67	66.2	AVG [Scan]	V	100	0	95.59	29.39	Pass
3	7417.343	19.64	4.01	36.25	59.9	AVG [Scan]	V	100	0	63.5	-3.6	Pass
4	2779.788	23.47	2.39	29.13	54.99	AVG [Scan]	H	100	0	63.5	-8.51	Pass
5	1095.446	20.79	1.56	23.4	45.76	AVG [Scan]	V	100	0	63.5	-17.74	Pass

Non Restricted Band Limit Calculation:

High Channel RF Power (dBm)	17.89
High Channel RF Power (dBm EIRP)	20.39
High Channel RF Power (dBuV @ 3M) (EIRP + 95.2)	115.59
Non Restricted Band Limit (-20dBc) (dBuV @ 3m)	**95.59**