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TEST REPORT

Report Number: **102092861LEX-001**
Project Number: **G102092861**

Report Issue Date: **5/21/2015**

Product Name: **AT150119US**

Standards: **Title 47 CFR Part 15 Subpart B and Part 95**

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510

Client:
3SI Security Systems
2055 N. Brown Road, Suite 225
Lawrencefille, GA 30043

Report prepared by

Bryan Taylor, Team Leader

Report reviewed by

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1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

2 Test Summary

Page	Test full name	FCC Reference	Result
7	Maximum Transmitter Output Power	2.1046, 95.639(e)	Pass
9	Occupied Bandwidth	2.1049, 95.629(c)	Pass
12	Conducted Spurious Emissions	2.1051, 95.635(c)(2)	Pass
15	Radiated Spurious Emissions (Transmitter)	2.1053, 95.635(c)(2	Pass
19	Frequency Stability	2.1055, 95.629(c)(2)	Pass
21	Receiver Spurious Emissions	15.109	Pass
---	Conducted Voltage Emissions	15.107	NA[1]

1 This test was not applicable since the test sample was battery powered and would never have any connections to the AC mains.

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	3SI Security Systems
Model Number	AT150119US
Serial Number	5773143697
Receive Date	5/12/2015
Test Start Date	5/12/2015
Test End Date	5/15/2015
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	216.475MHz
Modulation Type	None
Transmission Control	Test Commands
Maximum Output Power (Conducted)	10.63dBm
Test Channels	LPRS Channel 50 (Extra Band Frequencies)
Antenna Type	PCB / Internal
Operating Voltage	3.7VDC (Battery)

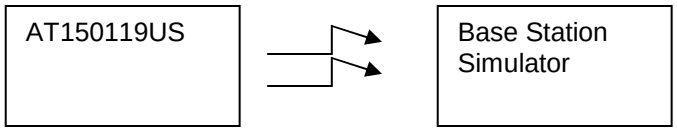
Description of Equipment Under Test
The AT150119US is an asset tracking and alert device equipped with a cellular transmitter module, GPS receiver, and a beacon transmitter. The beacon transmitter operates at 216.475MHz under FCC Rule Part 95.629(c) as an “Extra Band Channel”.

Operating modes of the EUT:

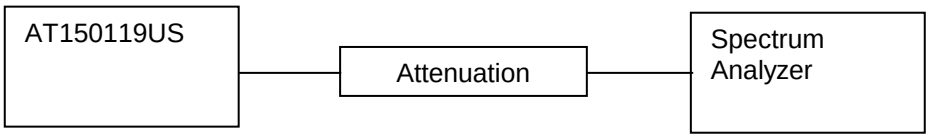
No.	**Descriptions of EUT Exercising**
1	Transmitting a 100% Duty cycle signal at 216.475MHz
2	Receive / idle mode

3.1 System setup including cable interconnection details, support equipment and simplified block diagram

3.2 EUT Block Diagram:



Block Diagram for Radiated Tests



Block Diagram for Conducted Tests at the Antenna Port

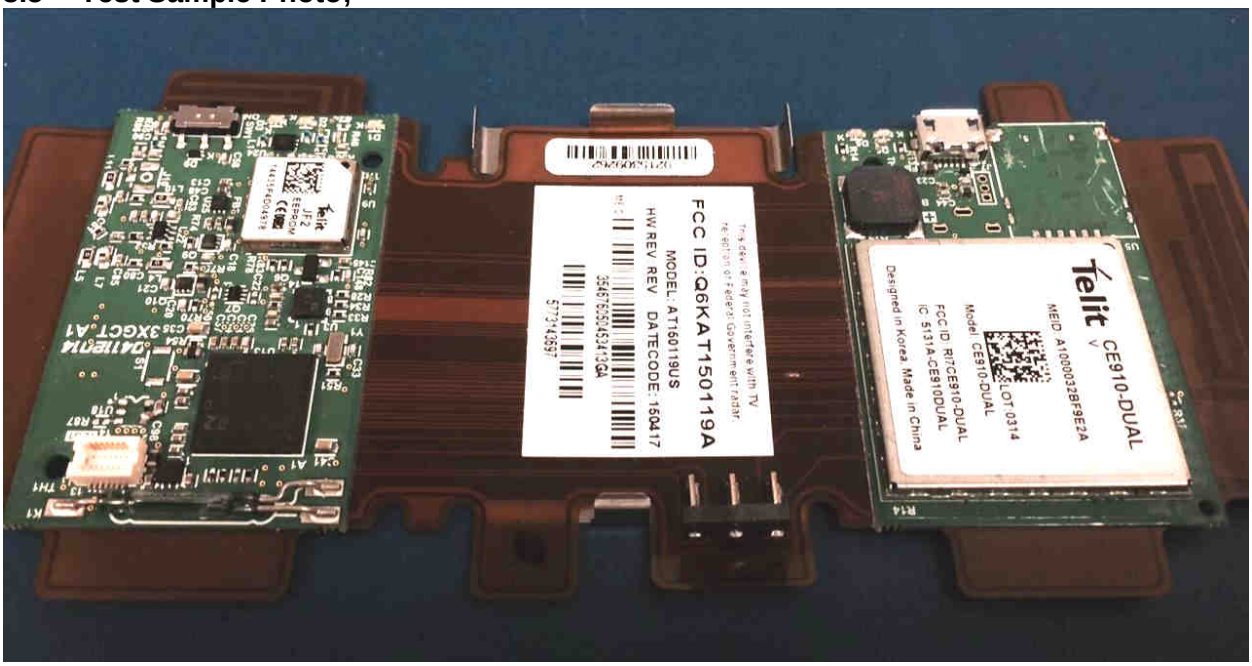
3.3 Cables:

None

3.4 Support Equipment:

None

3.5 Test Sample Photo;



Front Side

Back Side

4 Maximum Transmitter Output Power

4.1 Test Limits

§ 2.1046

For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in §2.1033(c)(8).

§ 95.639(e)

The maximum transmitter output power authorized for LPRS stations is 100 mW (20dBm).

4.2 Test Procedure

The transmitter output was connected to a calibrated coaxial cable, the other end of which was connected to a spectrum analyzer. The peak output power was measured and used along with the transmit antenna gain to compute the maximum effective radiated output power.

4.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/15/2014	9/15/2015

4.4 Results:

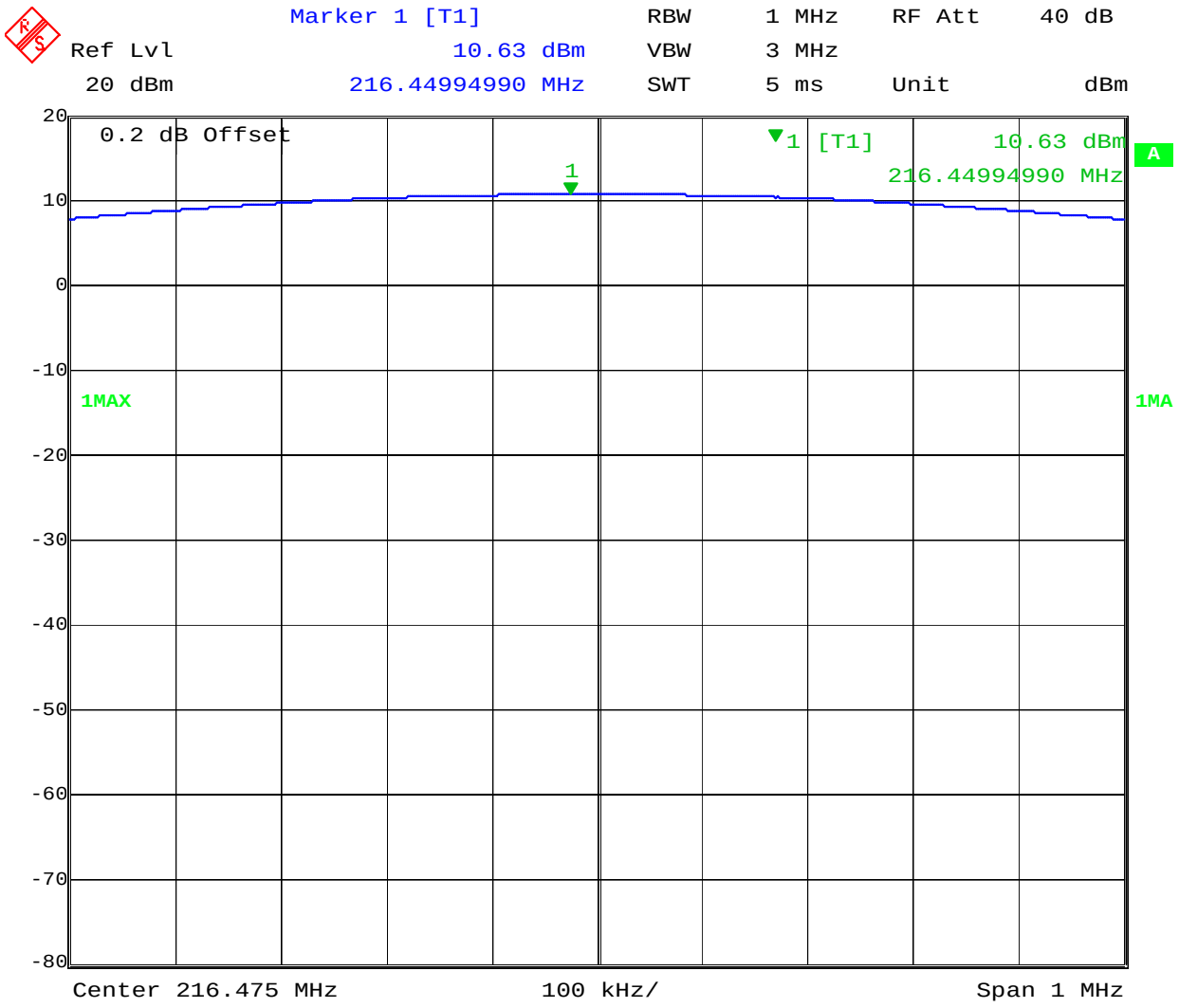
The maximum measured peak conducted power was 10.63dBm. The stated antenna gain is -36.4dBi. These values are used to calculate the maximum radiated output power via the following:

ERP = Conducted Output Power + Antenna Gain (dBi) - 2.15dB

The 2.15dB factor is used to convert from EIRP to ERP. The actual measured ERP is as follows:

ERP = 10.63dBm – 36.4dBi - =2.15dB
ERP = -27.92dBm

The maximum conducted output power and computed ERP is much less than the 100mW (20dBm) limit.



Maximum Conducted Output Power

5 Occupied Bandwidth

5.1 Test Limits

§2.1049:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

§95.629 (c):

Extra band channels. (1) The following table indicates extra band frequencies. The channel bandwidth is 50 kHz.

Channel No.	Center frequency (MHz)
50	216.475

*Partial table pertaining only to the channel being used by the test sample.

5.2 Test Procedure

The EUT was connected to a spectrum analyzer using a calibrated coaxial cable. The test sample was forced to transmit by using test commands provided by the manufacturer. The occupied bandwidth function of the analyzer was used measure the 99% power bandwidth. The ndB down function was used to measure the 26dB emission bandwidth.

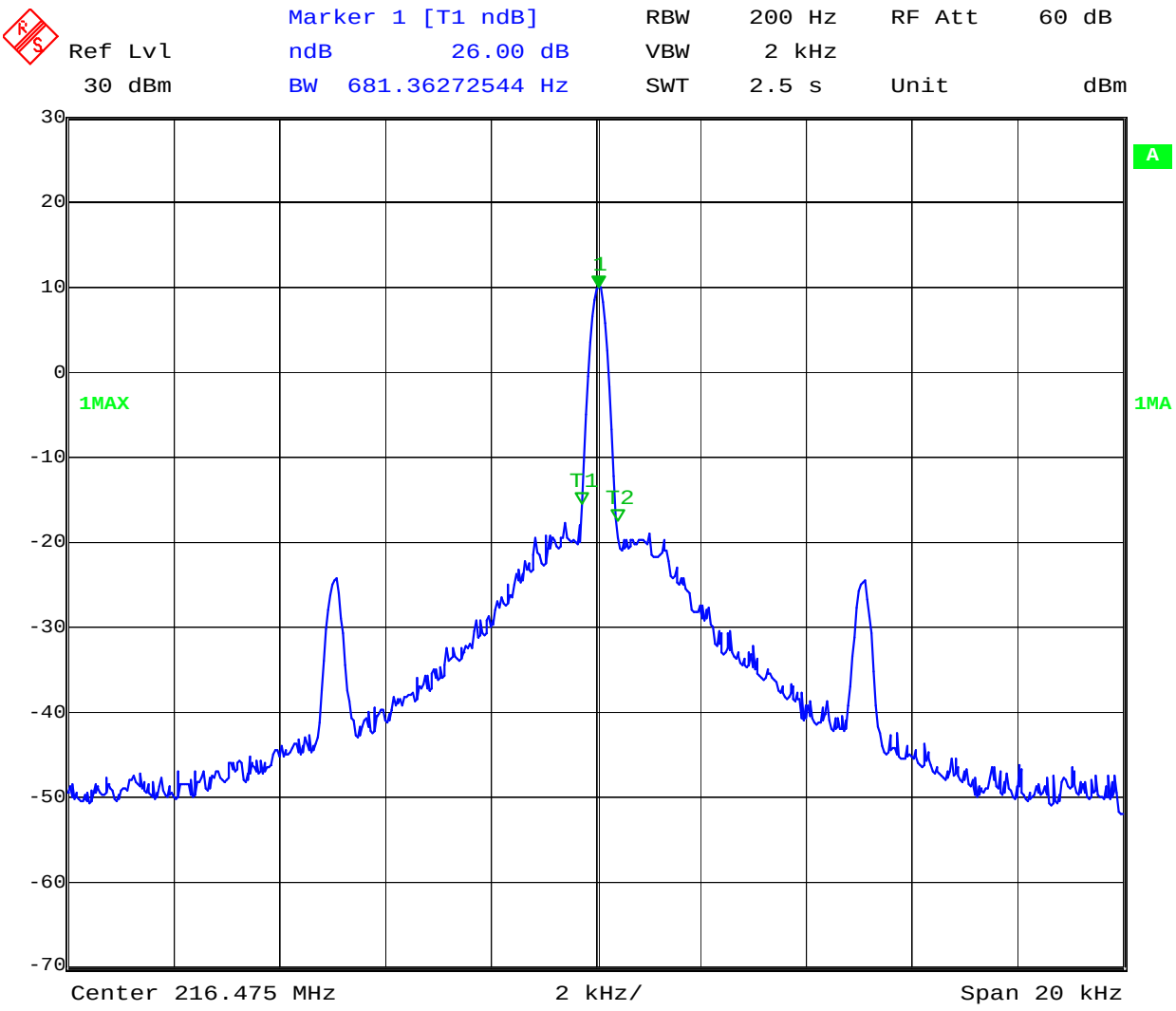
5.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/15/2014	9/15/2015

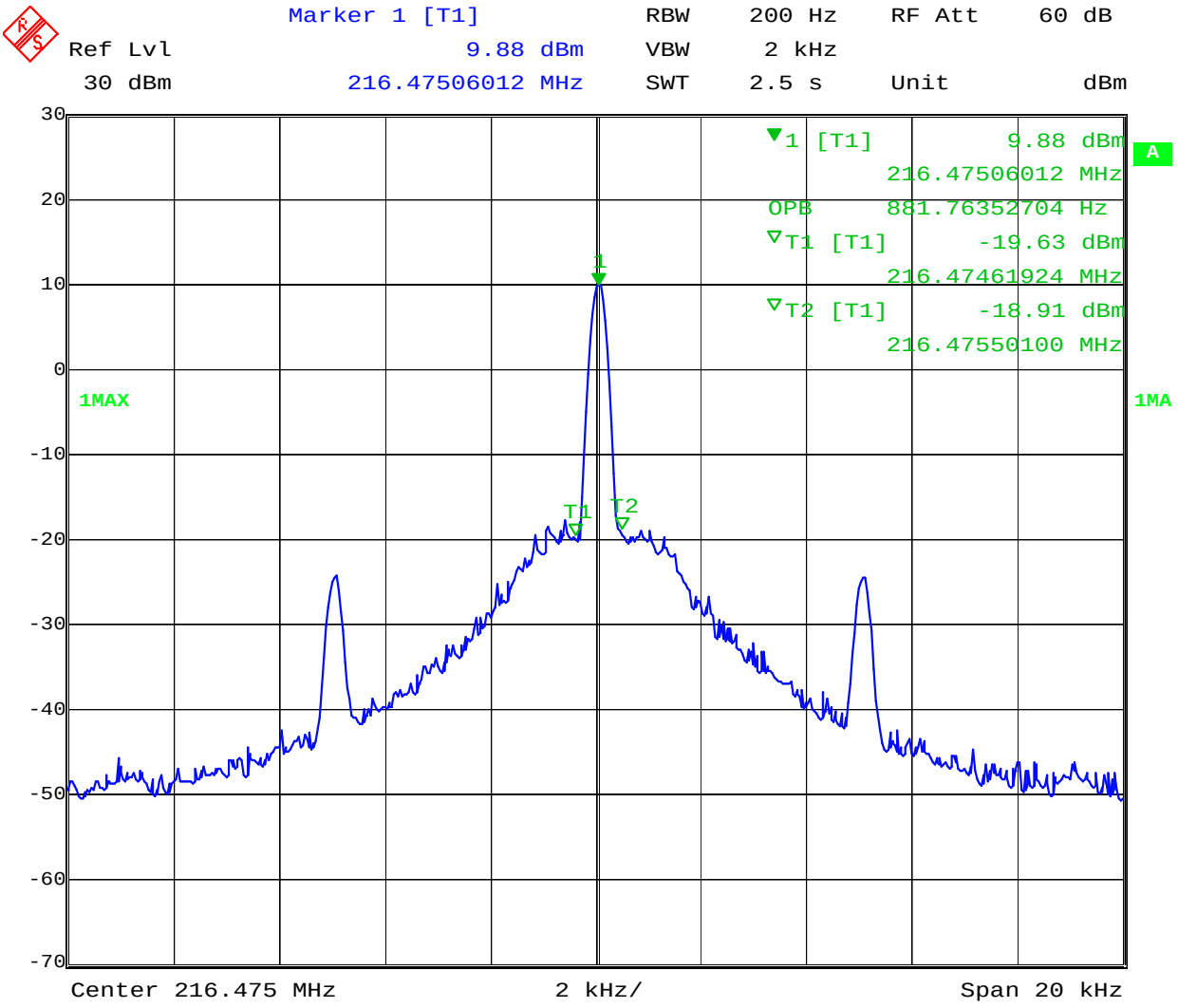
5.4 Results:

The 26dB emission bandwidth was found to be 681.4Hz.

The 99% occupied bandwidth was found to be 861.8Hz.



26dB Emission Bandwidth



99% Occupied Bandwidth

6 Conducted Spurious Emissions at Antenna Terminals

6.1 Test Limits

§ 2.1051

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 95.635

(c) For transmitters designed to operate in the LPRS, emissions shall be attenuated in accordance with the following:

(1) Emissions for LPRS transmitters operating on standard band channels (25 kHz) shall be attenuated below the unmodulated carrier in accordance with the following:
(i) Emissions 12.5 kHz to 22.5 kHz away from the channel center frequency: at least 30 dB; and
(ii) Emissions more than 22.5 kHz away from the channel center frequency: at least 43 + 10log(carrier power in watts) dB.

(2) Emissions for LPRS transmitters operating on extra band channels (50 kHz) shall be attenuated below the unmodulated carrier in accordance with the following:
(i) Emissions 25 kHz to 35 kHz from the channel center frequency: at least 30 dB; and
(ii) Emissions more than 35 kHz away from the channel center frequency: at least 43 + 10log(carrier power in watts) dB.

(3) Emissions for LPRS transmitters operating on narrowband channels (5 kHz) shall be attenuated below the power (P) of the highest emission, measured in peak values, contained within the authorized bandwidth (4 kHz) in accordance with the following:
(i) On any frequency within the authorized bandwidth: Zero dB;
(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 2 kHz up to and including 3.75 kHz: The lesser of 30 + 20(fd-2) dB, or 55 + 10 log(P), or 65 dB; and
(iii) On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth: At least 55 + 10 log(P) dB.

(4) Emissions from AMTS transmitters using a single 250 kHz channel shall be attenuated below the unmodulated carrier in accordance with the following:
(i) Emissions from 125 kHz to 135 kHz away from the channel center frequency; at least 30 dB; and
(ii) Emissions more than 135 kHz away from the channel center frequency; at least 43 + 10log(carrier power in watts) dB.

6.2 Test Procedure

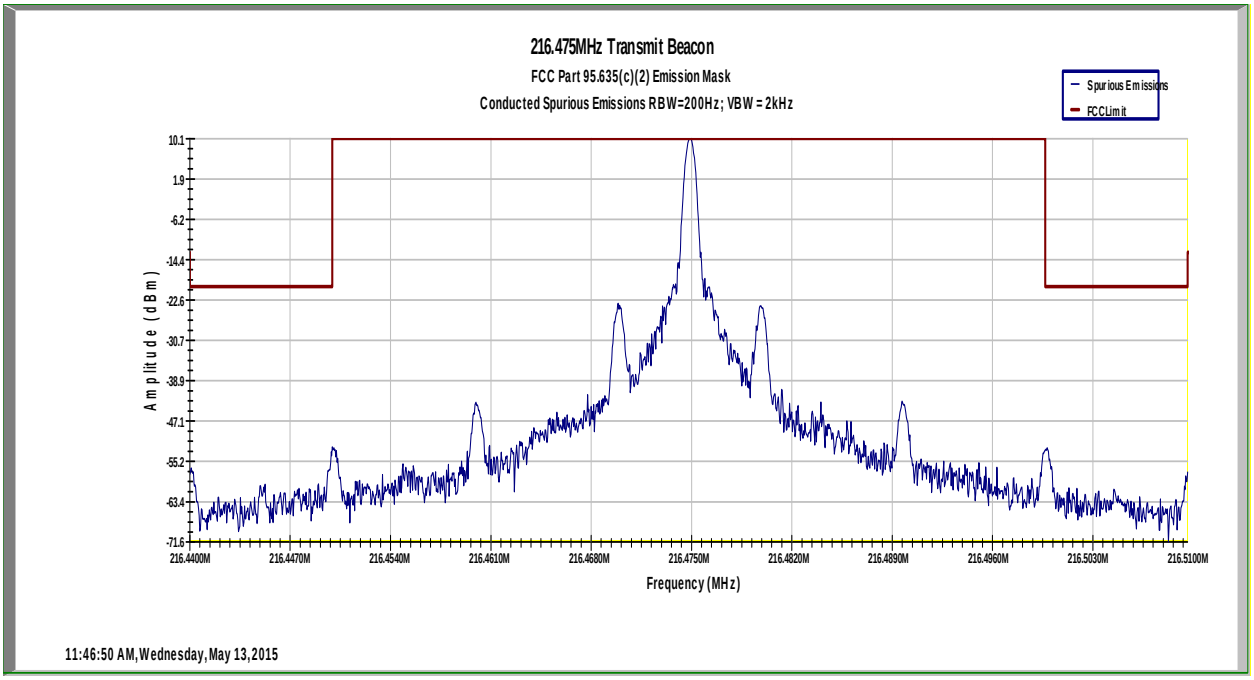
The EUT was connected to a spectrum analyzer using a calibrated coaxial cable. The test sample was forced to transmit by using test commands provided by the manufacturer. The spectrum analyzer was scanned from 30mHz – 3GHz in order to capture spurious emissions through the tenth harmonic of the fundamental signal.

6.3 Test Equipment Used:

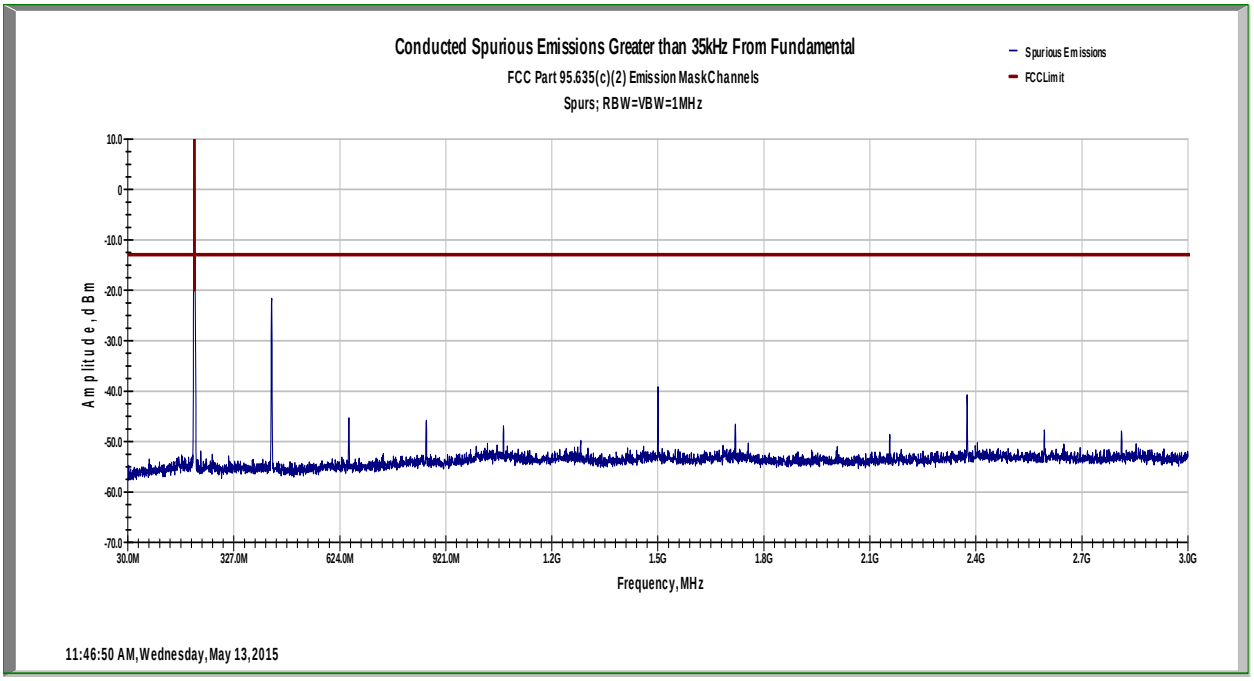
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/15/2014	9/15/2015

6.4 Results:

The following plots show that emissions within 35kHz of the fundamental meet the emission mask of FCC Part 95.635(c)(2). All spurious emissions greater than 35kHz away from the fundamental are attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.



Spurious Emissions Within 35kHz of Fundamental



Spurious Emissions Greater Than 35kHz From Fundamental

7 Radiated Spurious Emissions (Transmitter)

7.1 Test Limits

§ 2.1053

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

§ 95.635

(c) For transmitters designed to operate in the LPRS, emissions shall be attenuated in accordance with the following:

(2) Emissions for LPRS transmitters operating on standard band channels (25 kHz) shall be attenuated below the unmodulated carrier in accordance with the following:
(i) Emissions 12.5 kHz to 22.5 kHz away from the channel center frequency: at least 30 dB; and
(ii) Emissions more than 22.5 kHz away from the channel center frequency: at least 43 + 10log(carrier power in watts) dB.

(2) Emissions for LPRS transmitters operating on extra band channels (50 kHz) shall be attenuated below the unmodulated carrier in accordance with the following:
(i) Emissions 25 kHz to 35 kHz from the channel center frequency: at least 30 dB; and
(ii) Emissions more than 35 kHz away from the channel center frequency: at least 43 + 10log(carrier power in watts) dB.

(3) Emissions for LPRS transmitters operating on narrowband channels (5 kHz) shall be attenuated below the power (P) of the highest emission, measured in peak values, contained within the authorized bandwidth (4 kHz) in accordance with the following:
(i) On any frequency within the authorized bandwidth: Zero dB;
(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 2 kHz up to and including 3.75 kHz: The lesser of 30 + 20(fd-2) dB, or 55 + 10 log(P), or 65 dB; and
(iii) On any frequency beyond 3.75 kHz removed from the center of the authorized bandwidth: At least 55 + 10 log(P) dB.

(4) Emissions from AMTS transmitters using a single 250 kHz channel shall be attenuated below the unmodulated carrier in accordance with the following:
(i) Emissions from 125 kHz to 135 kHz away from the channel center frequency; at least 30 dB; and
(ii) Emissions more than 135 kHz away from the channel center frequency; at least 43 + 10log(carrier power in watts) dB.

7.2 Test Procedure

The EUT was placed on a non-conductive turntable. The measurement antenna was placed at a distance of 3 meters from the EUT. The EUT was forced to transmit at its maximum output power setting. During the tests, the antenna height and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The frequency range up to tenth harmonic was investigated in order to identify the spurious emission. Once the spurious emissions were identified, the power of the emission was determined using the substitution method described in TIA-603-C. The spurious emissions attenuation was calculated as the difference between radiated power at the fundamental frequency and at the spurious emissions frequency. Since the sample could be installed in any orientation, the emissions spectrum was investigated with the test sample positioned in 3 orthogonal axis and the worst case data presented.

7.3 Test Equipment Used:

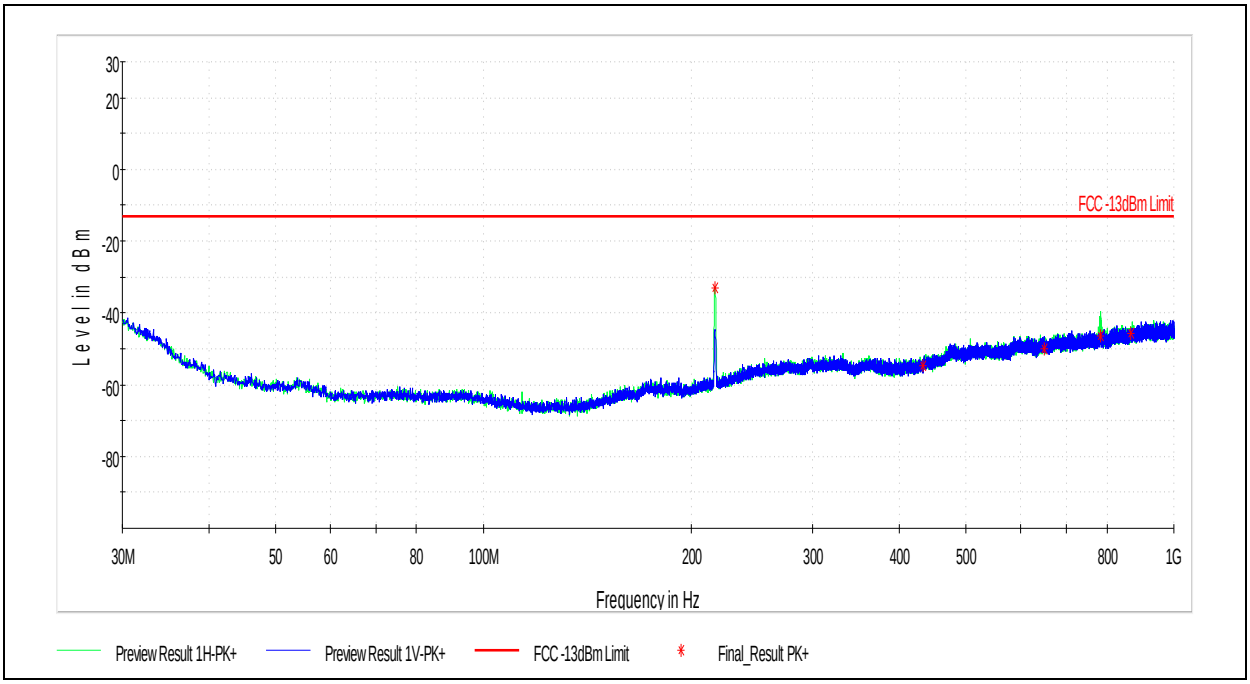
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	9/17/2014	9/17/2015
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/26/2014	11/26/2015
Bilog Antenna	2362	ETS	3142B	1/16/2015	1/16/2016
Bilog Antenna	00051864	ETS	3142C	1/20/2015	1/20/2016
Horn Antenna	00154521	ETS	3117	10/21/2014	10/21/2015
Horn Antenna	6556	ETS	3115	12/1/2014	12/1/2015
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use

7.4 Results:

All radiated spurious emissions were attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB which is equivalent to -13dBm. Since the sample could be installed in any orientation, the emissions spectrum was investigated with the test sample positioned in 3 orthogonal axis and the worst case data presented.

Worst Case Spurious Measurements (Bilog)

EUT Name:	AT150119US
Manufacturer:	3SI Security Systems
Test Engineer:	Bryan Taylor
Date:	5/14/2015
Temp/Humdiity/Pressure:	24.5C/45.5%/983.4mbar
Comment:	Transmitting on 216.475MHz

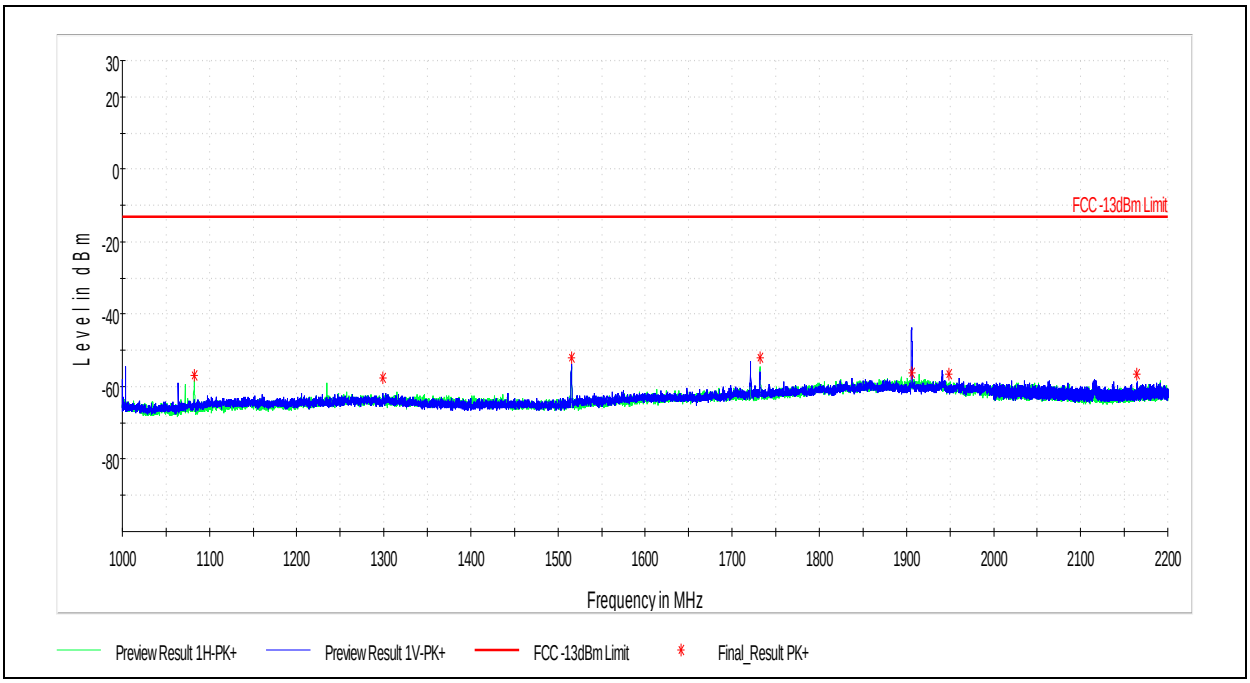


Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
216.478500 (Fundamental)	-32.90	-13.00	19.90	1000.000	100.4	H	179.0	-83.4
432.950000	-54.91	-13.00	41.91	1000.000	100.2	H	0.0	-77.9
649.425000	-50.20	-13.00	37.20	1000.000	100.2	H	0.0	-73.4
865.900000	-45.78	-13.00	32.78	1000.000	100.2	H	0.0	-70.4
782.360000	-46.37	-13.00	33.37	1000.000	244.9	H	43.0	-71.6

Worst Case Spurious Measurements (Horn)

EUT Name:	AT150119US
Manufacturer:	3SI Security Systems
Test Engineer:	Bryan Taylor
Date:	5/14/2015
Temp/Humdiity/Pressure:	24.5C/45.5%/983.4mbar
Comment:	Transmitting on 216.475MHz



Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1082.375000	-56.77	-13.00	43.77	1000.000	97.0	H	217.0	-99.8
1298.850000	-57.63	-13.00	44.63	1000.000	126.3	H	10.0	-97.4
1515.325000	-51.98	-13.00	38.98	1000.000	99.8	H	-11.0	-98.6
1731.800000	-52.03	-13.00	39.03	1000.000	97.9	H	10.0	-95.7
1948.275000	-56.71	-13.00	43.71	1000.000	97.9	H	10.0	-93.3
1905.900000	-56.07	-13.00	43.07	1000.000	180.1	H	150.0	-92.4
2164.750000	-56.62	-13.00	43.62	1000.000	159.0	H	10.0	-95.1

8 Frequency Stability

8.1 Test Limits

§ 2.1055, §95.629(c)(2)

LPRS transmitters operating on extra band channels must be maintained within a frequency stability of 50 parts per million.

8.2 Test Procedure

The equipment under test was connected to an spectrum analyzer operating in frequency count mode. The peak search function was used to measure the frequency at each temperature / voltage level.

8.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Environmental Chamber	32692	Thermotron	SM-8C	2/24/2015	2/24/2016
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/15/2014	9/15/2015

8.4 Results:

The table below show the frequency stability data remains within the 50ppm limit.

Frequency Stability Measurements

Operating Freqeuncy:	216,475,000	Hz
Channel:	192	
Reference Voltage:	3.7	VDC
Deviation Limit:	50	ppm

Voltage (%)	Voltage (VDC)	Temp (℃)	Measured Freq. (Hz)	Freq. Error (Hz)	Deviation (%)	Deviation (ppm)
100%	3.7	-30	216474946	54	0.0000249	0.2495
100%	3.7	-20	216475046	-46	-0.0000212	-0.2125
100%	3.7	-10	216475036	-36	-0.0000166	-0.1663
100%	3.7	0	216475029	-29	-0.0000134	-0.1340
100%	3.7	10	216474998	2	0.0000009	0.0092
100%	3.7	20	216475009	-9	-0.0000042	-0.0416
100%	3.7	30	216475044	-44	-0.0000203	-0.2033
100%	3.7	40	216474974	26	0.0000120	0.1201
100%	3.7	50	216474999	1	0.0000005	0.0046
100%	3.7	60	216474975	25	0.0000115	0.1155
115%	4.255	20	216475042	-42	-0.0000194	-0.1940
85%	2.775	20	216474978	22	0.0000102	0.1016

9 Receiver Spurious Emissions

9.1 Test Limits

§ 15.109

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)
30–88	100	40
88–216	150	43.5
216–960	200	46
Above 960	500	54

9.2 Test Procedure

ANSI C63.4: 2009

9.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBµV/m
RA = Receiver Amplitude in dBµV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

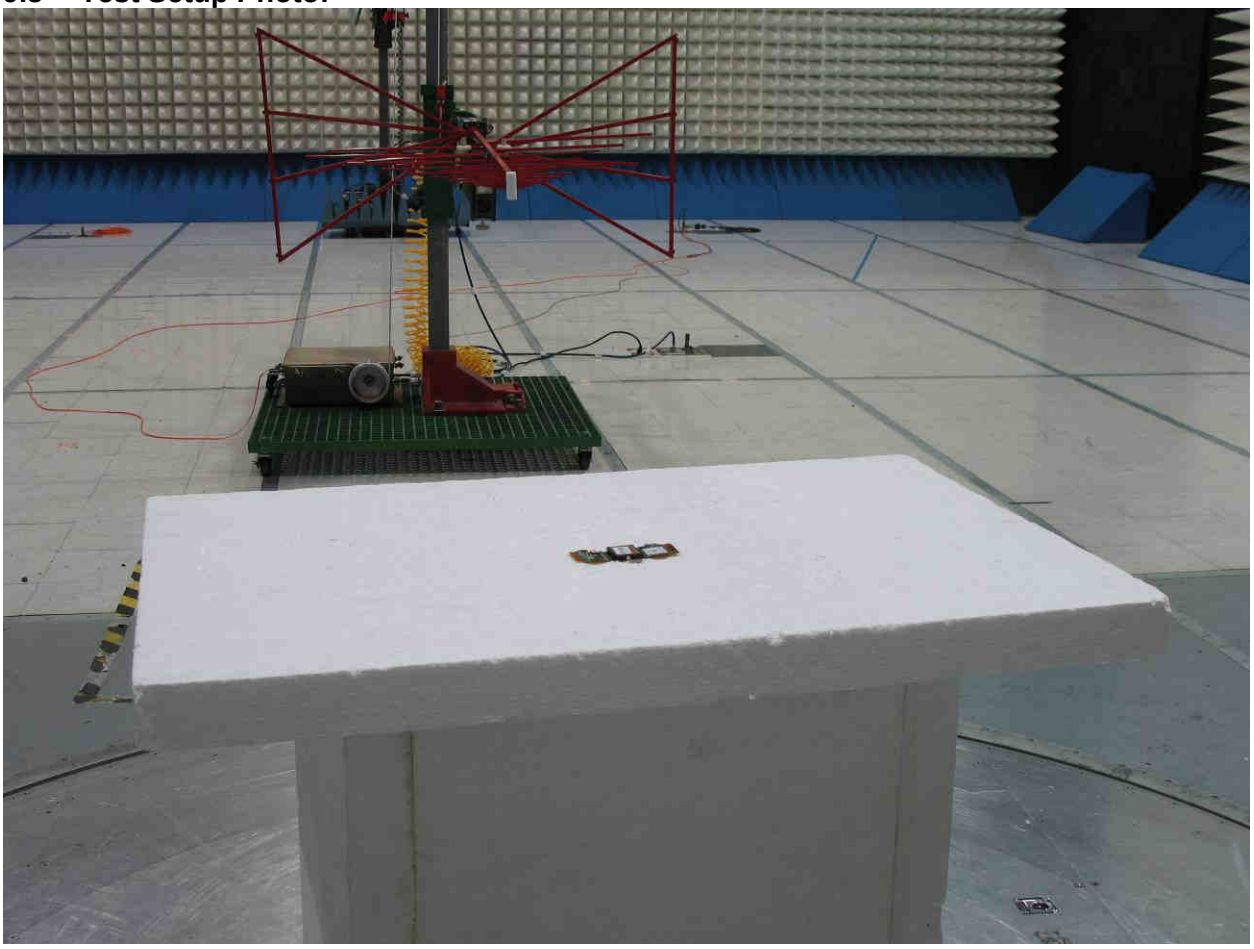
RA = 19.48 dBµV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBµV/m

9.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	9/17/2014	9/17/2015
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/26/2014	11/26/2015
Bilog Antenna	2362	ETS	3142B	1/16/2015	1/16/2016
Bilog Antenna	00051864	ETS	3142C	1/20/2015	1/20/2016
Horn Antenna	00154521	ETS	3117	10/21/2014	10/21/2015
Horn Antenna	6556	ETS	3115	12/1/2014	12/1/2015
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use

9.5 Test Setup Photo:

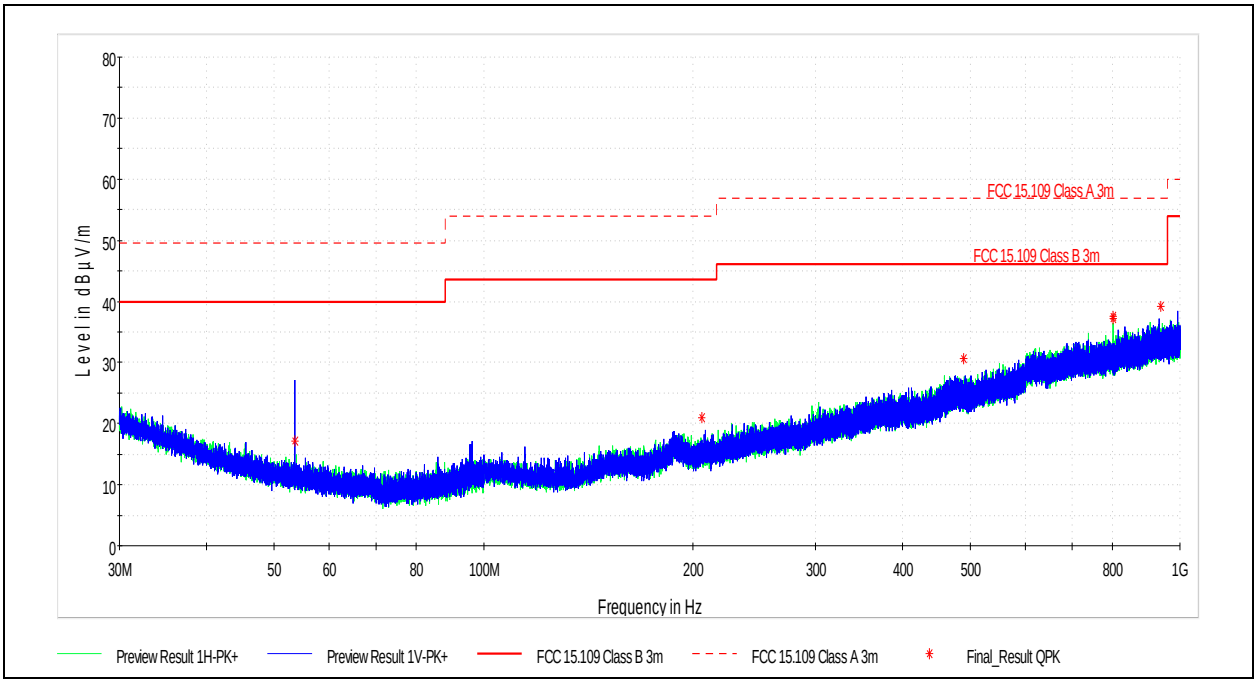


9.6 Results:

All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device.

Worst Case Spurious Measurements (Bilog)

EUT Name:	AT150119US
Manufacturer:	3SI Security Systems
Test Engineer:	Bryan Taylor
Date:	5/14/2015
Temp/Humdiity/Pressure:	24.5C/45.5%/983.4mbar
Comment:	Receive Mode

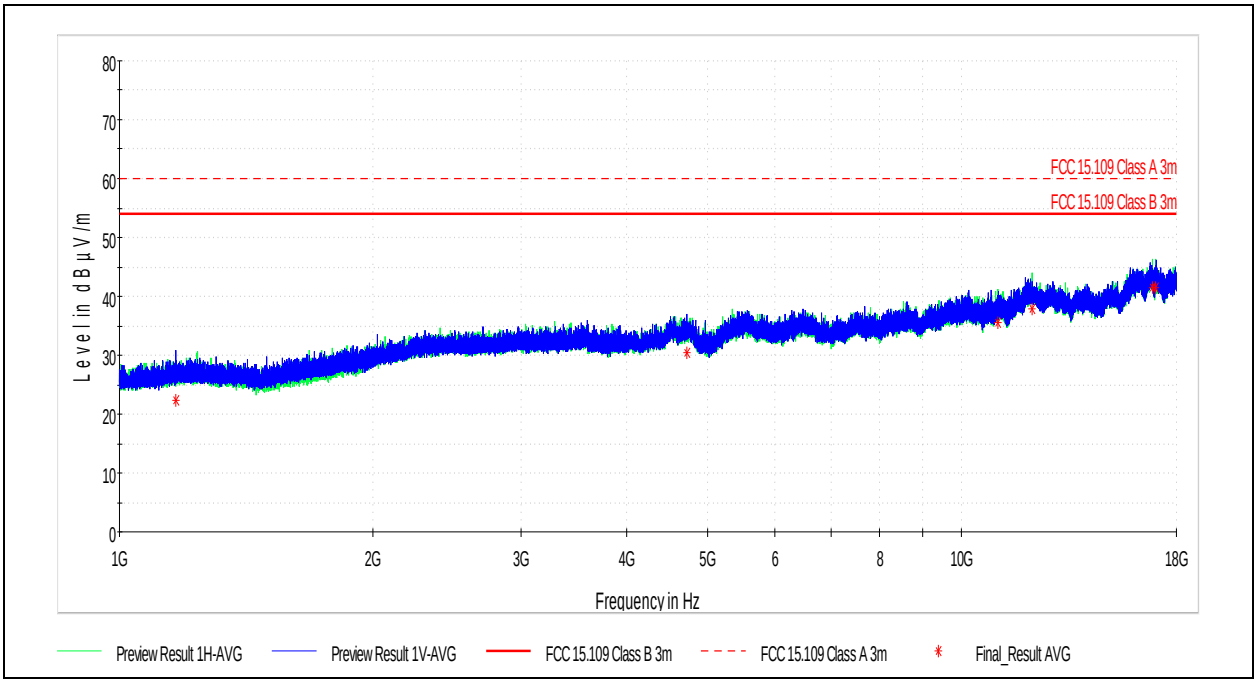


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
205.640000	21.00	43.52	22.52	120.000	401.4	V	55.0	13.9
488.620000	30.67	46.02	15.35	120.000	401.5	V	343.0	23.0
801.820000	37.12	46.02	8.90	120.000	380.6	V	311.0	27.8
801.840000	37.56	46.02	8.46	120.000	189.3	H	292.0	27.8
937.460000	39.11	46.02	6.91	120.000	142.5	V	0.0	30.1
53.606000	17.07	40.00	22.93	120.000	278.9	V	10.0	10.0

Worst Case Spurious Measurements (Horn)

EUT Name:	AT150119US
Manufacturer:	3SI Security Systems
Test Engineer:	Bryan Taylor
Date:	5/14/2015
Temp/Humdiity/Pressure:	24.5C/45.5%/983.4mbar
Comment:	Receive Mode



Final_Result

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1166.203700	22.25	54.00	31.75	1000.000	235.0	V	260.0	-1.6
4721.393100	30.41	54.00	23.59	1000.000	207.0	V	162.0	7.8
11055.991400	35.63	54.00	18.37	1000.000	148.0	H	300.0	15.4
12142.944400	37.87	54.00	16.13	1000.000	176.0	H	216.0	17.2
16878.983800	41.54	54.00	12.46	1000.000	269.0	H	50.0	21.6
17013.011300	41.48	54.00	12.52	1000.000	126.0	H	232.0	21.5

10 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

11 Revision History

Revision Level	Date	Report Number	Notes
0	5/21/2015	102092861LEX-001	Original Issue