Global EMC Inc. Labs

EMC & RF Test Report

As per

FCC Part 15 Subpart C:2015

&

RSS 247:2015

Unlicensed Intentional Radiators

on the

S6 Mobile Credit Card Reader

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Testing produced for

Square

See *Appendix A* for full customer & EUT details.

Industry Canada

LAB REGISTRATION #6844A-3

CE

FCC REGISTRATION #377448

ACCREDITED

Testing Laboratory Certificate #2555.01

Table of Contents

Report Scope

This report addresses the EMC testing and test results of the S6 Mobile Credit Card Reader from Square Inc. This unit is herein referred to as EUT (Equipment Under Test). Testing is performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

FCC Part 15 Subpart C:2015
RSS 247:2015

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.

Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Client	Square Inc.
Product	S6 Mobile Credit Card Reader
Standard(s)	FCC Part 15 Subpart C 15:2015 / RSS-247:2015

Summary

The results contained in this report relate only to the item(s) tested.

EUT FCC Certification #, FCC ID:	2AF3K-1SQHW
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Raymond Lee Au

Client	Square Inc.
Product	S6 Mobile Credit Card Reader
Standard(s)	FCC Part 15 Subpart C 15:2015 / RSS-247:2015

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass
FCC 15.205 RSS-Gen 8.10 (Table 6)	Restricted Bands for intentional operation	QuasiPeak Average	Pass
FCC 15.209 RSS-Gen 8.9 (Table 4 & 5)	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-247 5.2(1)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)3 RSS-247 5.4(4)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-247 5.4(6)(ii.)	Antenna Gain	< 6 dBi	Pass
FCC 15.247(d) RSS-247 5.5	Antenna conducted spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-247 5.2(2)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) IC Safety code 6	RF Energy Levels	Per requirements	Pass
Overall Result			**PASS**

See the following *Notes, Justifications, or Deviations* section for important information regarding these tests.

All tests were performed by Raymond Lee Au.

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a ‘PASS’ grade. If not ‘FAIL’ grade will be issued. Note that ‘PASS’ / ‘FAIL’ grade is independent of any measurement uncertainties.

Notes, Justifications, or Deviations

The following are justifications for tests not performed, deviations from the above listed specifications, and notes regarding the product or the testing.

The EUT is a portable credit card reader with BLE (2.402 – 2.480 MHz) and NFC RFID (13.56 MHz) capabilities. This report deals with the BLE characteristics and the device as a whole. See report # GEMC-FCC-23230BR1 for the report regarding the RFID characteristics.

All testing is performed with the RFID activated and constantly transmitting modulated data at its maximum power.

For the antenna requirement specified in FCC 15.203, the BLE antenna used is an Inverted F antenna soldered onto the PCB, which will be sealed within the unit's enclosure. It is not meant to be replicable by the user.

For the Restricted Bands of operation, the transmitter is designed to operate between 2.402 GHz and 2.480 GHz.

The EUT is not a hybrid system; FCC 15.247 (f) does not apply.

The EUT was tested in the three orthogonal axes. The worst case results are obtained with the EUT upright. Worst case results are presented for all tests.

The antenna gain for the 15.247 transmitter is 4 dBi.

The EUT operates using an internal battery rechargeable by USB. It does not have the means to plug into mains directly.

See separate RF Exposure Exhibit for this unit regarding the permissible RF exposure levels.

Testing of the 15.247 transmitter is performed according to procedures documented in FCC KDB Publication No. 558074 - Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247).

Applicable Standards, Specifications and Methods

ANSI C63.4:2009	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2009	- American national standard for testing unlicensed wireless devices
CFR 47 FCC 15:2015	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:2008	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
FCC KDB 558074	- FCC KDB 558074 Digital Transmission Systems, measurements and procedures
ICES-003:2012	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS-Gen:2014	- General Requirements and Information for the Certification of Radio Apparatus
RSS 210:2010	- Issue 8: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices
RSS 247:2015	- Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Sample calculation(s)

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)
Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)
Margin = 8 dB

Document Revision Status

Release 1 - November 29, 2015
Initial release.

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxiallary Equipment.

BW – Bandwidth. Unless otherwise stated, this is refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity

EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency

Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations

The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (ºC)	Humidity (%)	Pressure (kPa)
Nov. 9, 2015	Restricted Band Edges	RA	20-25ºC	30-45%	100 -103kPa
Nov. 9, 2015	Spurious Radiated Emissions	RA	20-25ºC	30-45%	100 -103kPa
Nov. 12, 2015	Bandwidth	RA	20-25ºC	30-45%	100 -103kPa
Nov. 9, 2015	Max Output Power	RA	20-25ºC	30-45%	100 -103kPa
Nov. 12, 2015	Antenna Conducted Spurious	RA	20-25ºC	30-45%	100 -103kPa
Nov. 12, 2015	Spectral Density	RA	20-25ºC	30-45%	100 -103kPa
Nov. 13, 2015	Power Lines Conducted Emissions	RA	20-25ºC	30-45%	100 -103kPa

Detailed Test Results Section

6 dB Bandwidth of Digitally Modulated Systems

Purpose

The purpose of this test is to ensure that the bandwidth occupied exceeds a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently wide. This also helps prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information.

Limits

The Limit is as specified in FCC Part 15.247(a)2 and RSS-247 5.2.

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

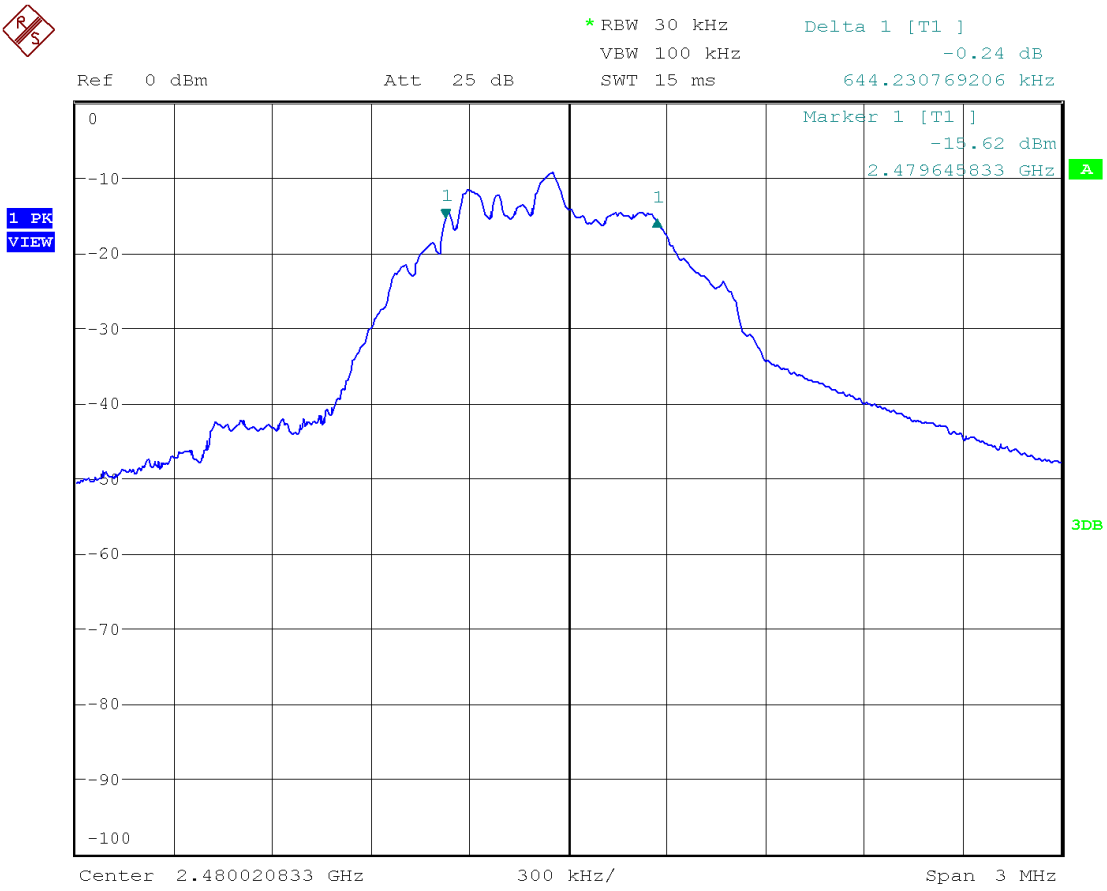
Results

The EUT passed. The minimum 6 dB BW measured was 644 kHz.

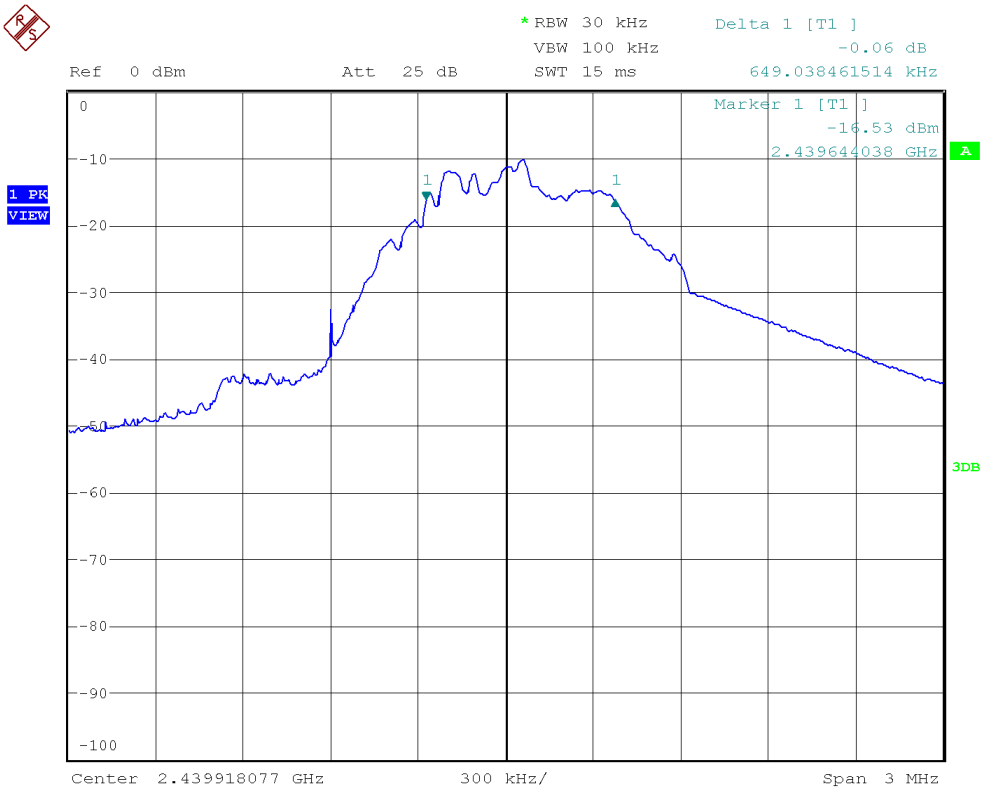
Graph(s)

The graphs below show the 6dB bandwidth during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute. Worst case results obtained are shown.

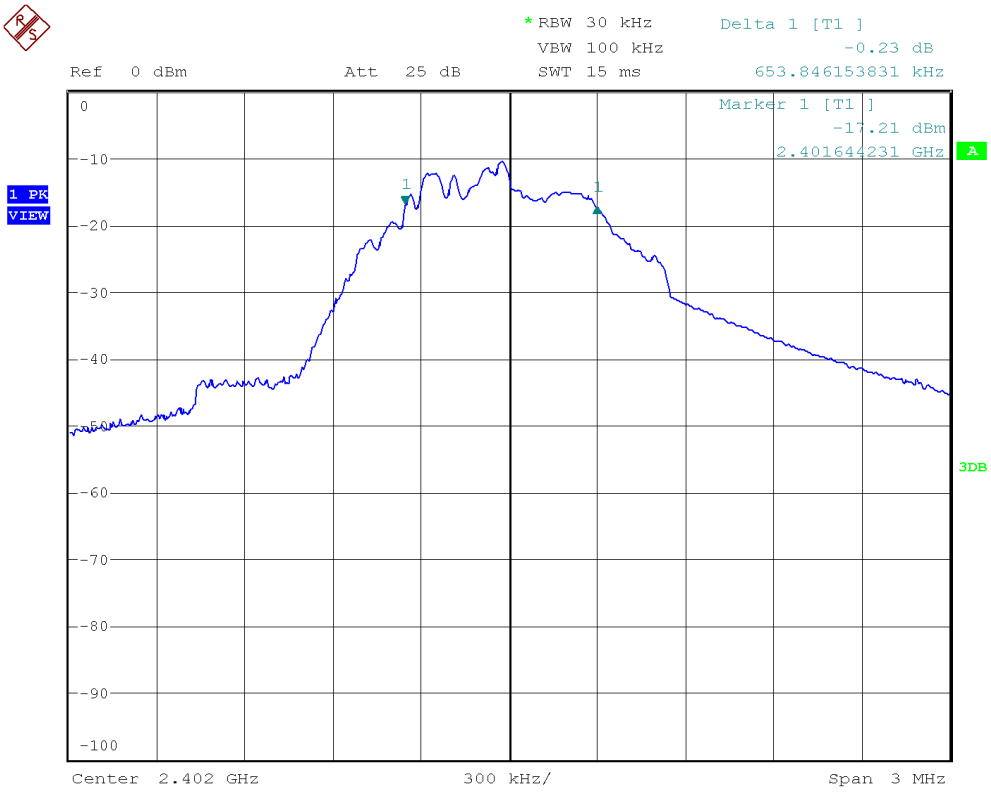
High Channel (2.480 GHz)
6 dB BW = 644.2 kHz



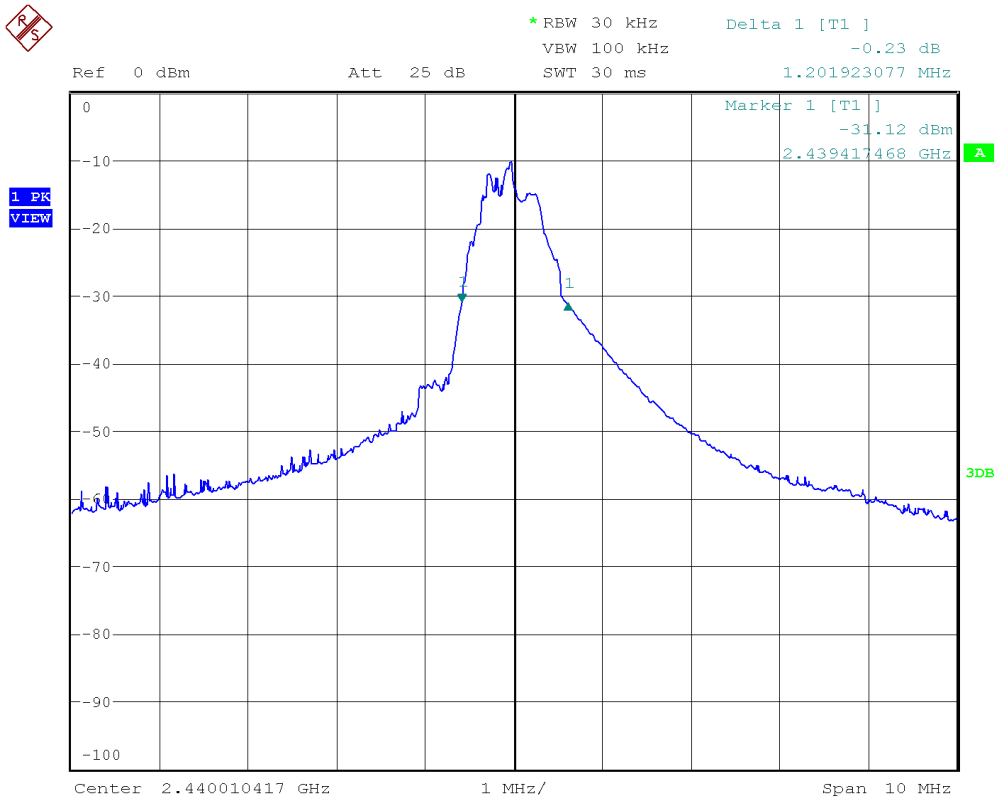
Middle Channel (2.440 GHz)
6 dB BW = 649.0 kHz



Low Channel (2.402 GHz)
6 dB BW = 653.8 kHz



For information purposes, maximum 20 dB bandwidth is 1.202 MHz.



Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	FSU	Rohde & Schwarz	Jan. 19, 2015	Jan. 19, 2017	GEMC 198

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Maximum Peak Conducted Power - Digital Modulation

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, that the maximum power does not exceed an amount which may create an excessive power level.

Limits

The limits are defined in FCC Part 15.247(b) and RSS-247 5.4(4).
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt (or 30 dBm = 125.2 dBµV at 3m distance).

Results

The EUT passed. The peak power output is -6.98 dBm (0.2 mW).

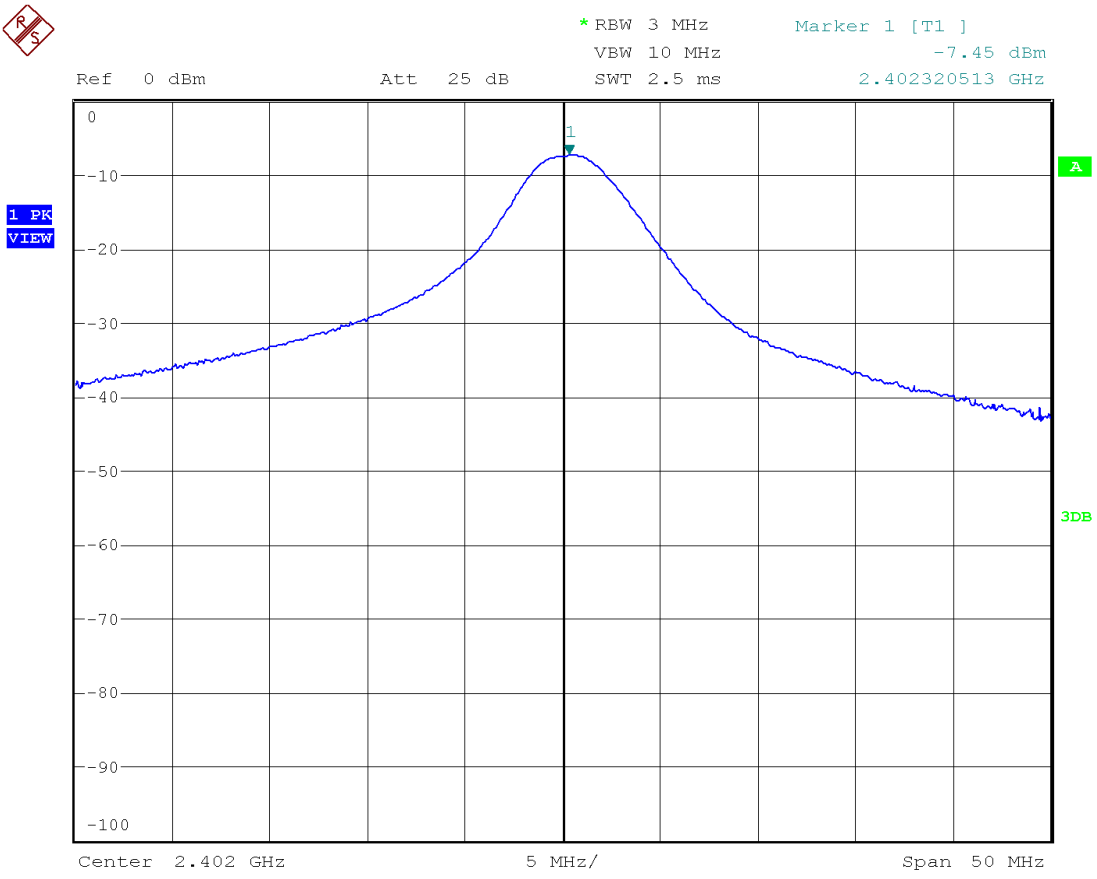
Table(s)

The table below shows the measured peak power output of the device. Peak measurements were made with a 3 MHz resolution bandwidth, during transmit operation of the EUT with continuous modulated data (>98%). Worst case plots are shown.

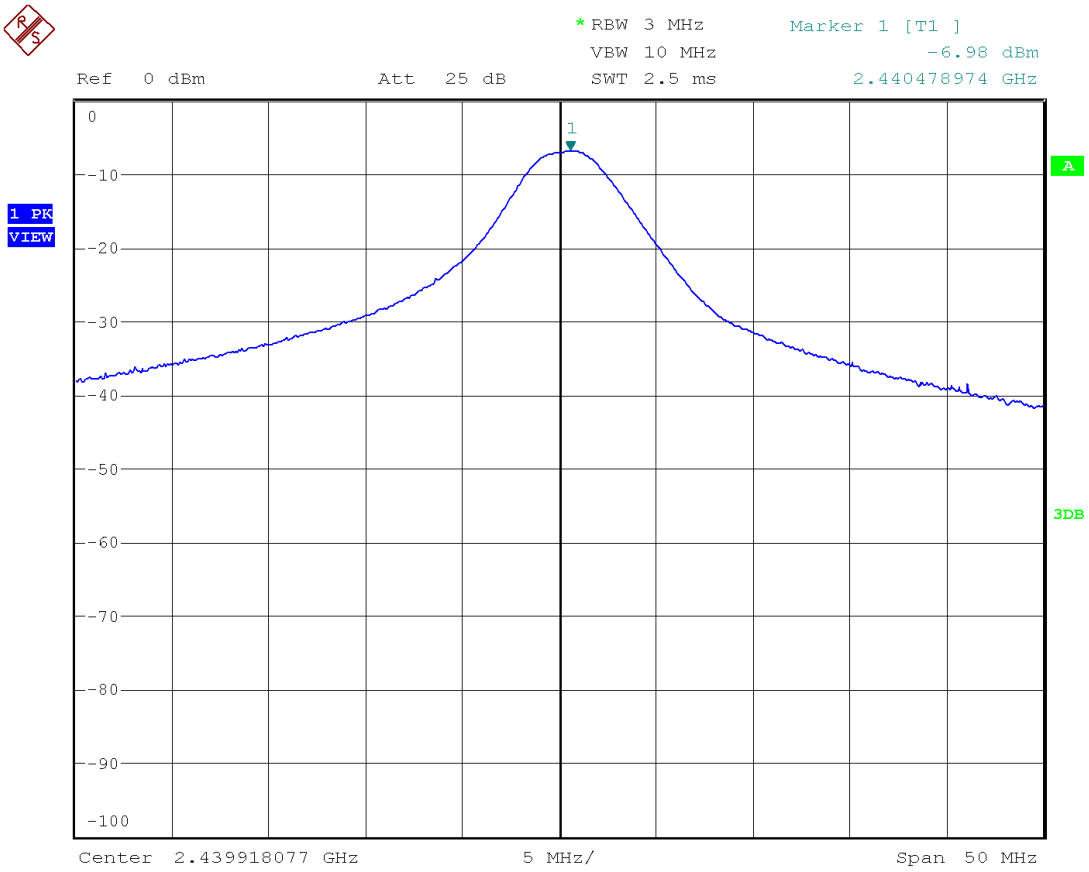
Maximum Peak Conducted Power

Channel	Test Frequency (MHz)	Detection mode	Output Power (dBm)	Emission limit (dBm)	Margin (dB)	Result
Low	2.402	Peak	-7.45	30.00	37.45	Pass
Middle	2.440	Peak	-6.98	30.00	36.98	Pass
High	2.480	Peak	-7.01	30.00	37.01	Pass

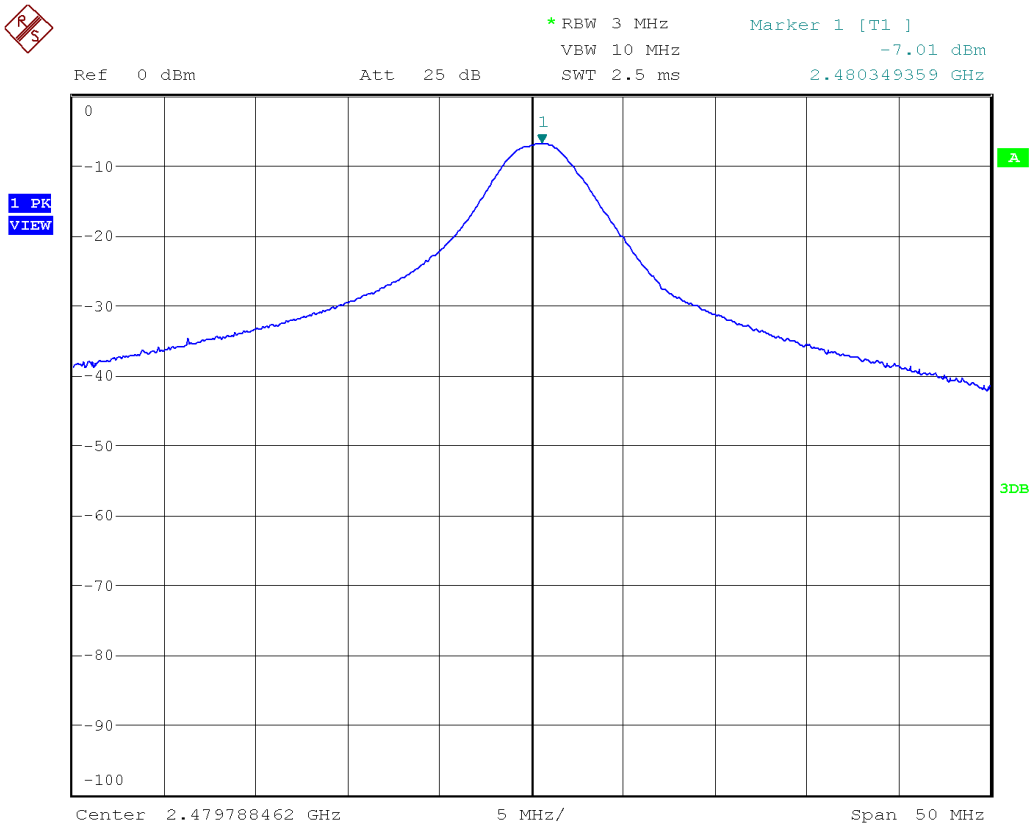
Low Channel



Middle Channel



High Channel



Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	FSU	Rohde & Schwarz	Jan. 19, 2015	Jan. 19, 2017	GEMC 198
Power Head	PH 2000	AR	Jan. 22, 2015	Jan. 22, 2017	GEMC 15
Power meter	PM 2002	AR	Jan. 21, 2015	Jan. 21, 2017	GEMC 16

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Maximum Peak Radiated Power - Digital Modulation

Purpose

The purpose of this test is to ensure that the maximum power output of the EUT does not exceed the limits specified, and allows verification that the antenna gain is < 6dBi.

Limits

The limits are defined in FCC Part 15.247(b) and RSS-247 5.4(4).
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt (or 30 dBm = 125.2 dBµV at 3m distance).

Results

The EUT passed. The peak radiated power output at 3 meters is 92.2 dBµV/m. The antenna gain does not exceed 6 dBi.

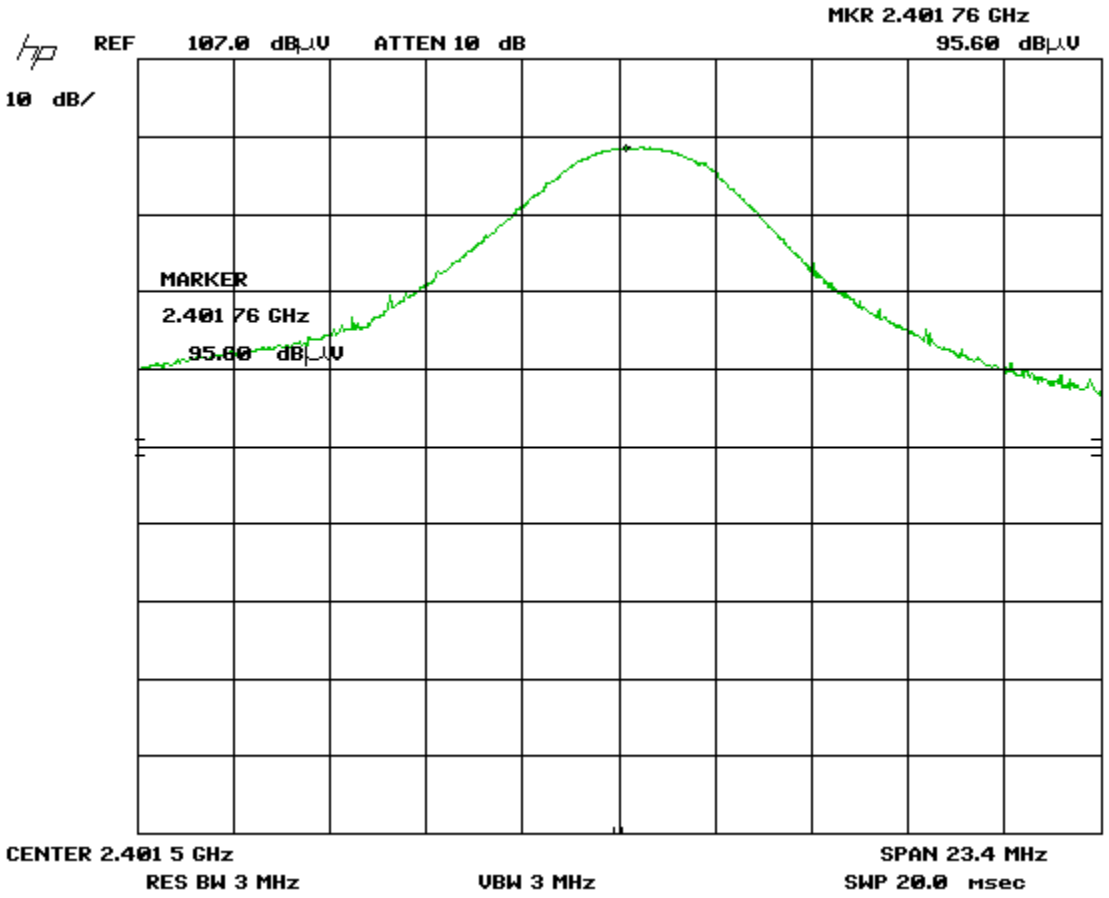
Table(s)

The table below shows the measured radiated peak power output of the device. Peak measurements were made with a 3 MHz resolution bandwidth, during transmit operation of the EUT with continuous modulated data (>98%). Worst case plots are shown.

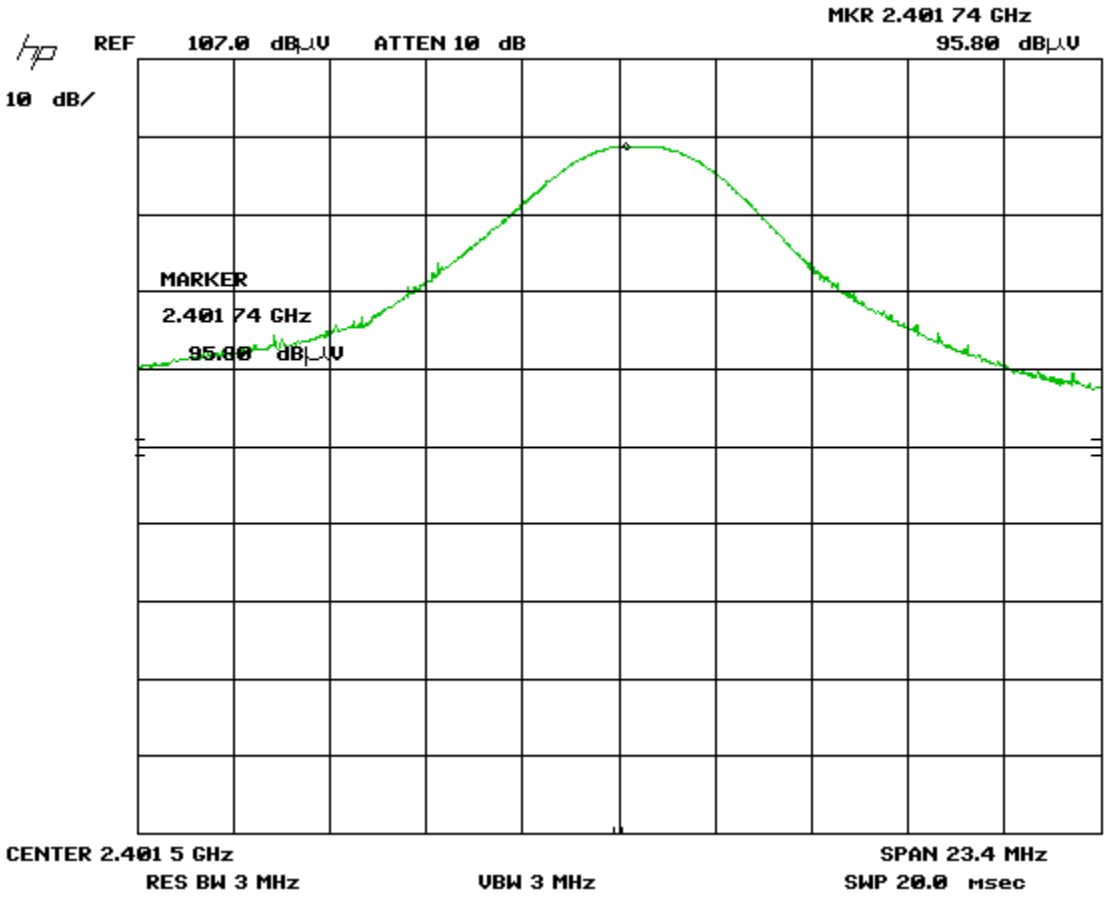
Maximum Peak Radiated Power

Test Frequency (MHz)	Channel	Detection mode	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Pre-selector	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit (dBm)	Margin (dB)	Result
2.402	Low	Peak	Vert	95.6	26.1	4.1	33.8	92.0	125.2	33.2	Pass
2.402	Low	Peak	Horz	95.8	26.1	4.1	33.8	**92.2**	125.2	33.0	Pass
2.446	Middle	Peak	Vert	94.2	26.1	4.1	33.8	90.6	125.2	34.6	Pass
2.446	Middle	Peak	Horz	94.5	26.1	4.1	33.8	90.9	125.2	34.3	Pass
2.48	High	Peak	Vert	92.4	26.1	4.1	33.8	88.8	125.2	36.4	Pass
2.48	High	Peak	Horz	94.3	26.1	4.1	33.8	90.7	125.2	34.5	Pass

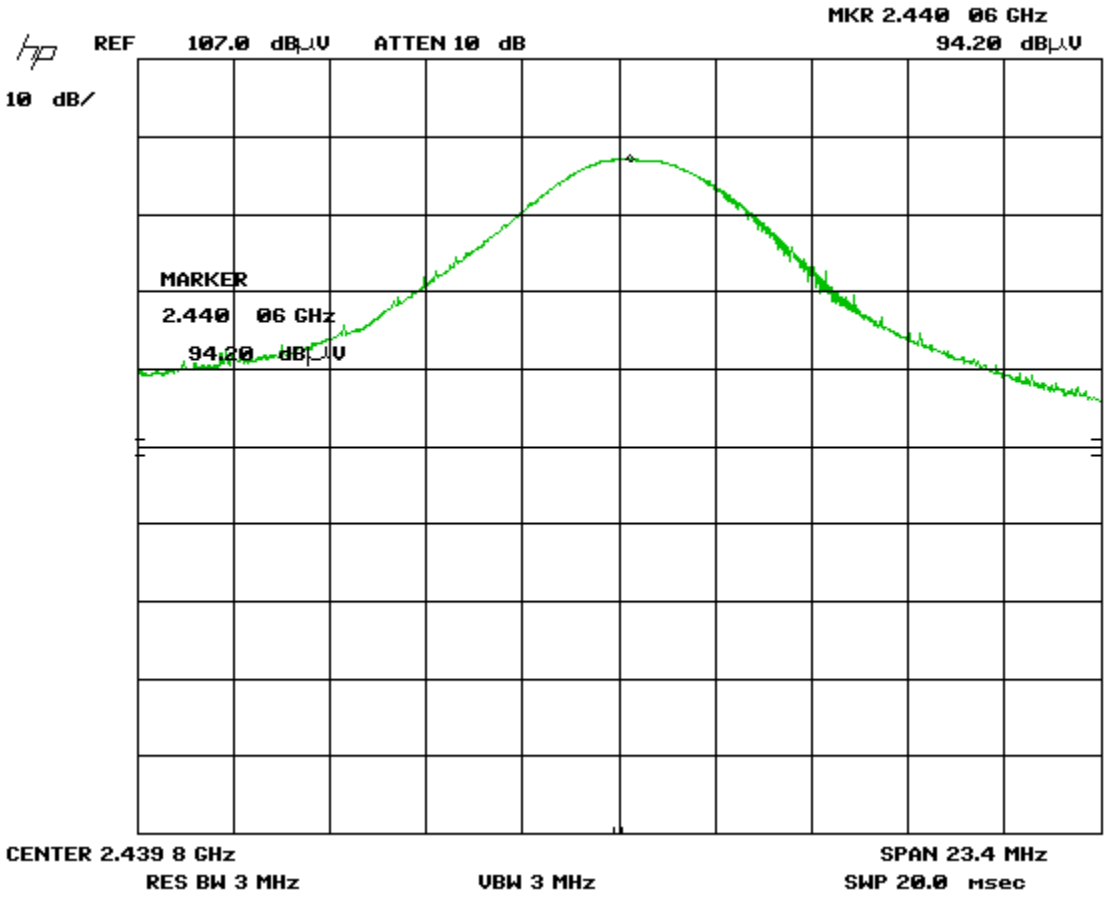
Low Channel
Vertical Antenna Polarity



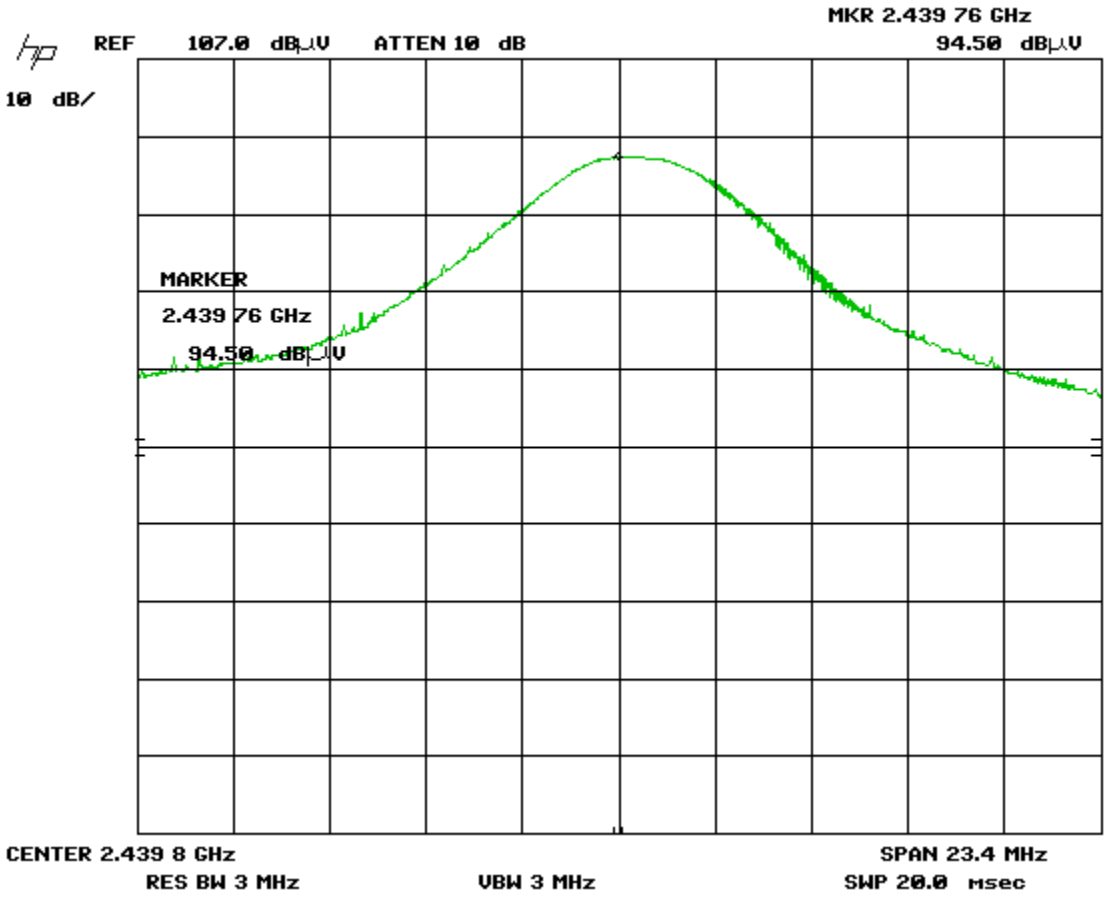
Low Channel
Horizontal Antenna Polarity



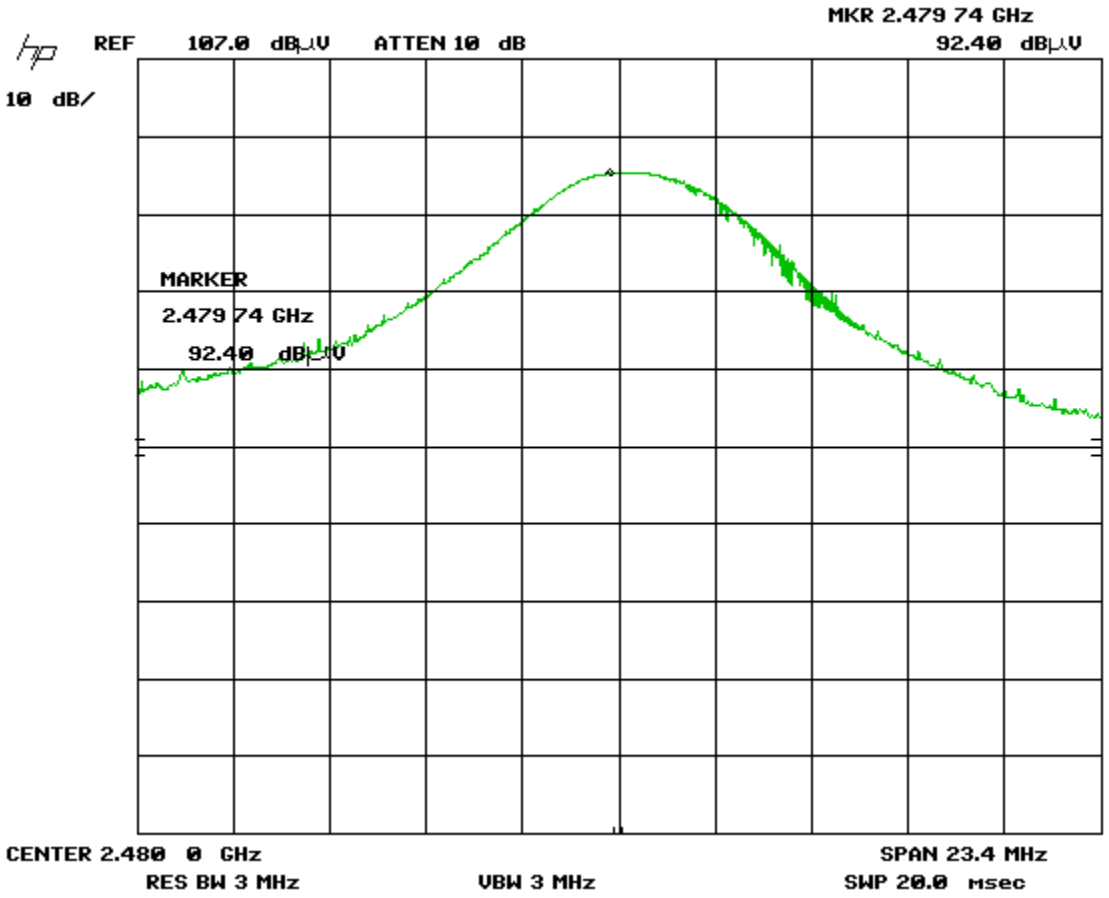
Middle Channel
Vertical Antenna Polarity



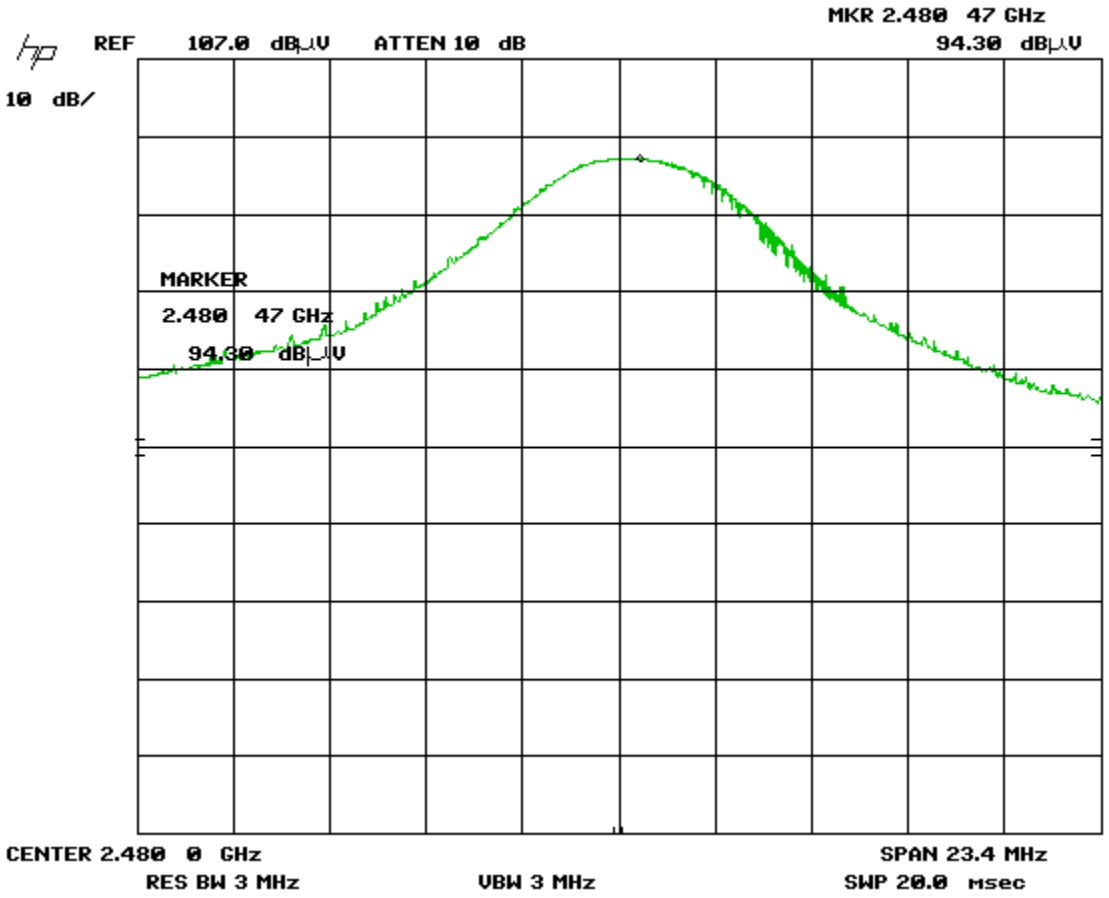
Middle Channel
Horizontal Antenna Polarity



High Channel
Vertical Antenna Polarity



High Channel
Horizontal Antenna Polarity



Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	May 21, 2014	May 21, 2016	GEMC 193
Horn Antenna	6878/24	Q-par	Sept 10, 2014	Sept 10, 2016	GEMC 6365
Pre-amp 1-26GHz	HP 8449B	HP	Sept. 9, 2014	Sept. 9, 2016	GEMC 6351
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

Antenna Spurious Conducted Emissions (-20 dBc Requirement)

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.

Limits

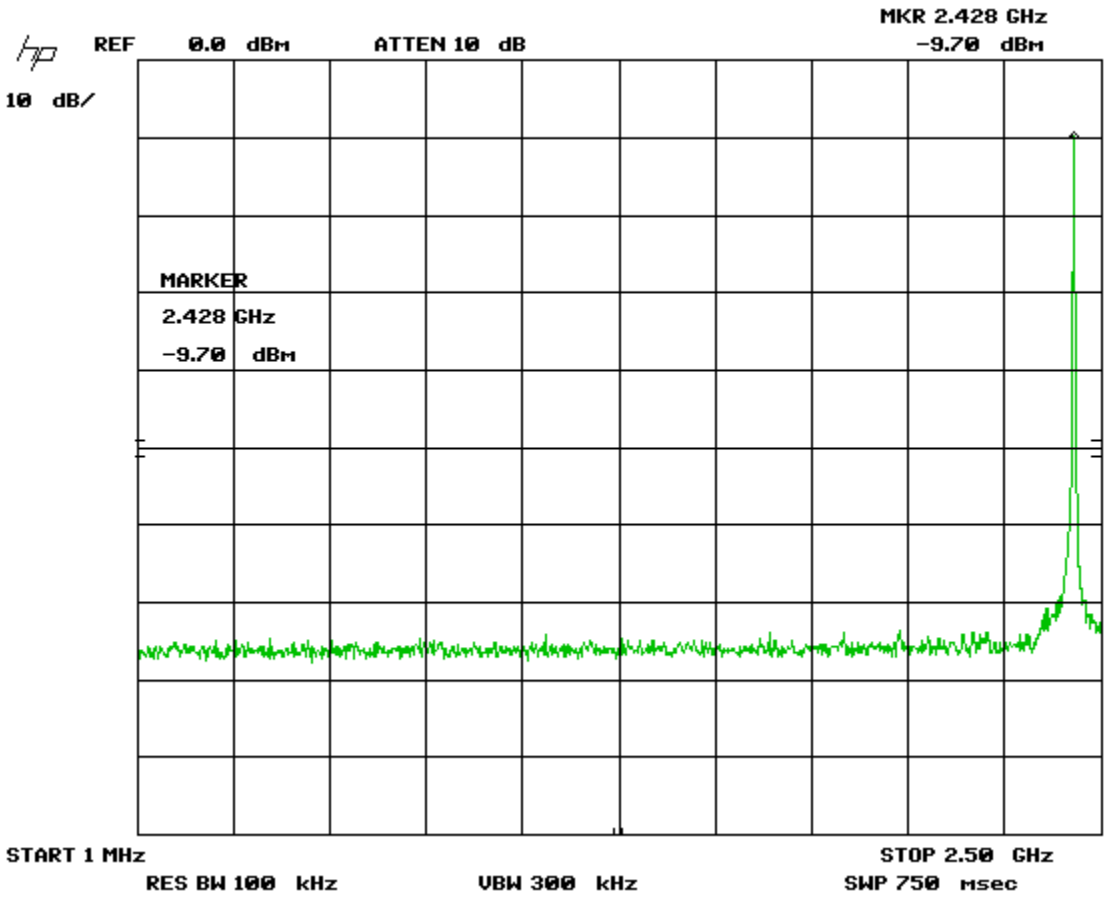
The limits are defined in FCC Part 15.247(d) and RSS-247 5.5. In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10th harmonic. This -20 dBc requirement also applies at the 'band edge' or 2.4 GHz and 2.4835 GHz.

Results

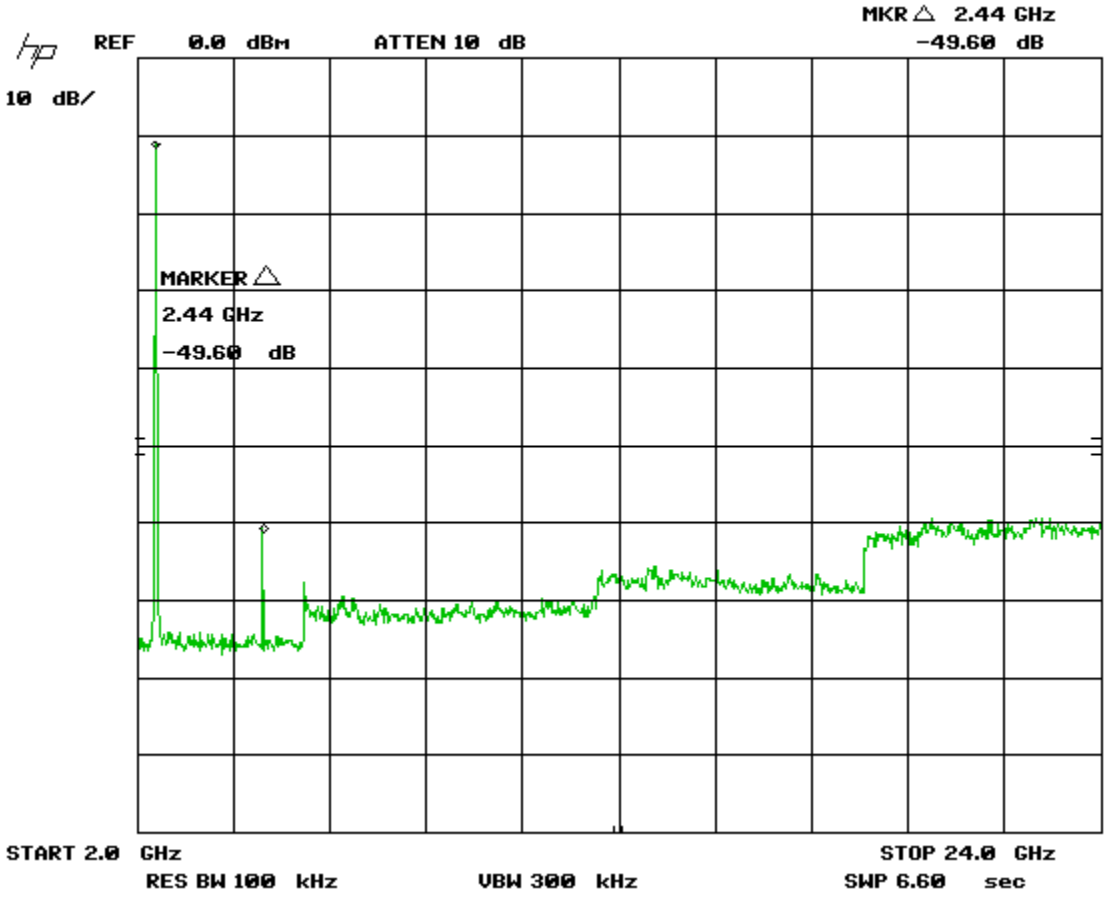
The EUT passes. Low, middle and high band was measured. The worst case is presented as a graph for the spectrum. The -20 dBc requirement is also shown for the lower band edge at 2.4 GHz in the low band, and for the high band edge at 2.4835 GHz in the high band.

Graph(s)

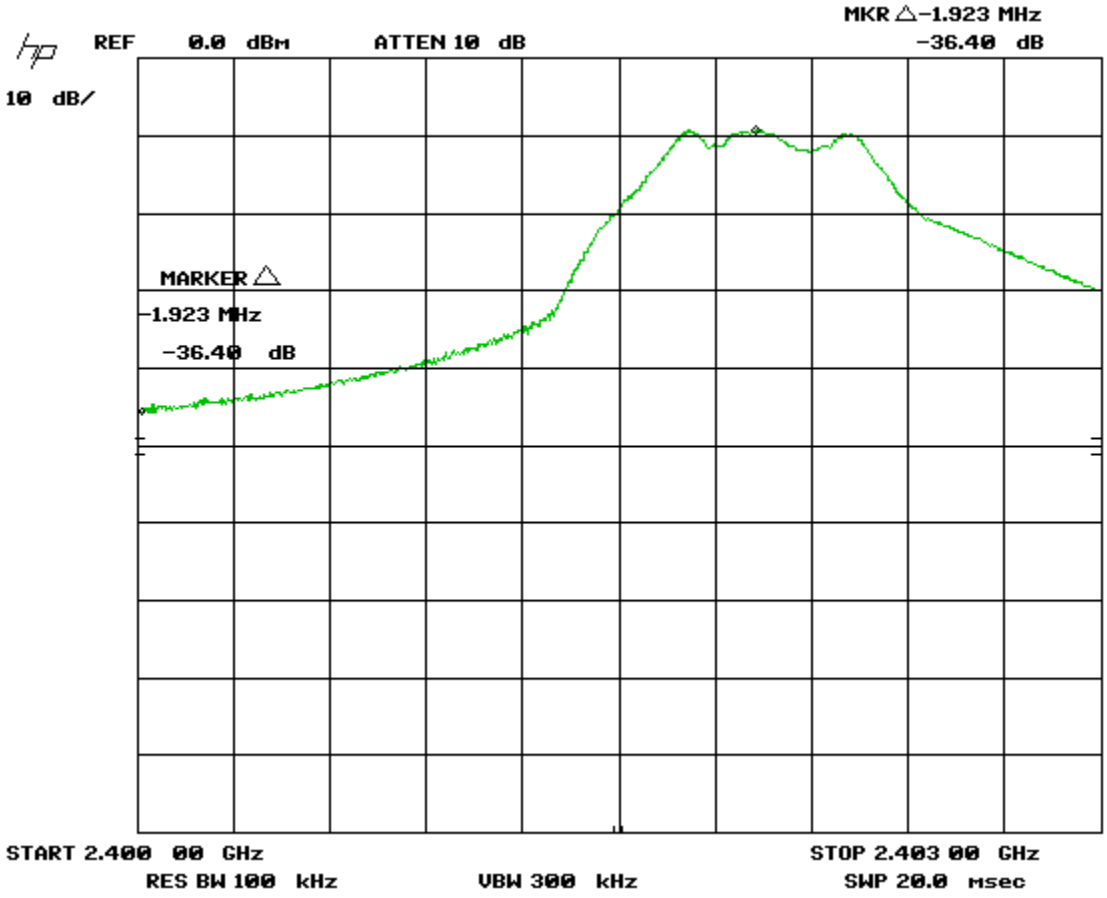
1 MHz – 2.5 GHz



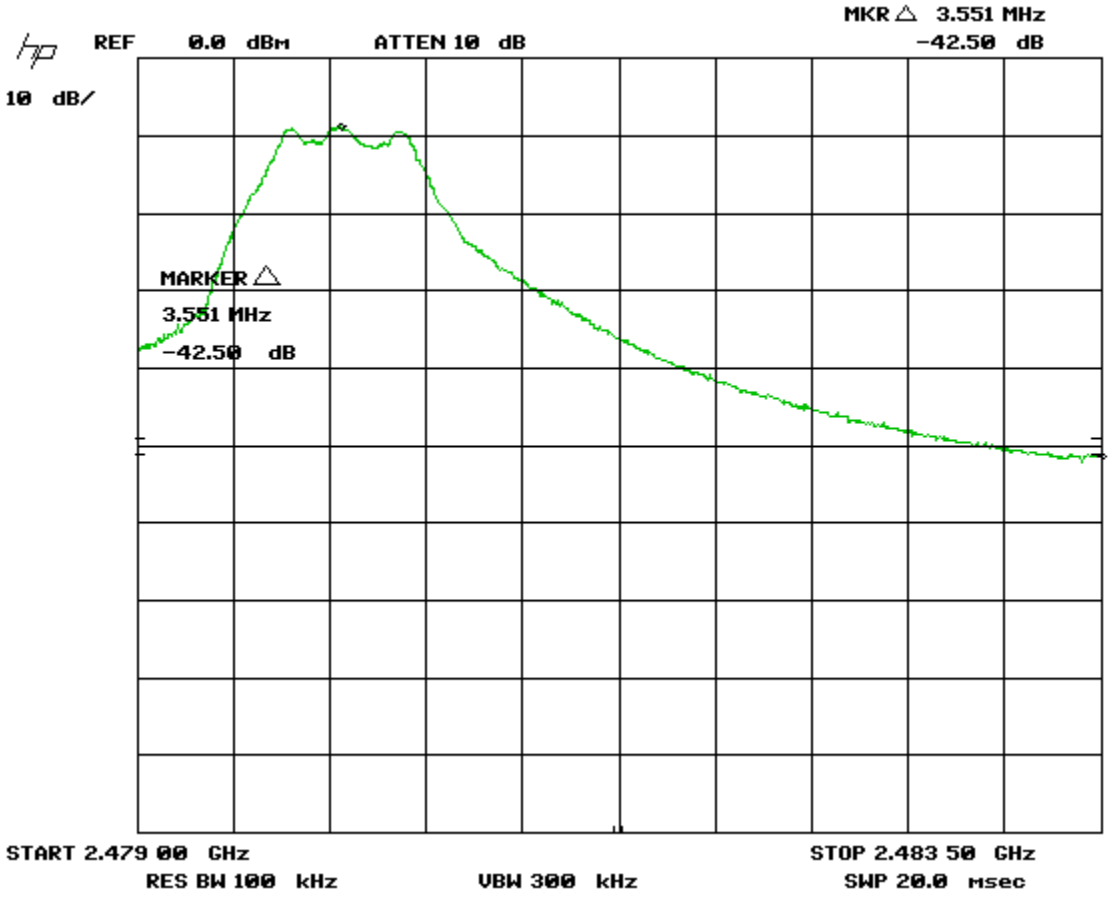
2 GHz – 24 GHz



2.4 GHz – 2.403 GHz
EUT transmitting at Low Channel
-20 dBc requirement is met at low band edge



2.479 GHz – 2.4835 GHz
EUT transmitting at High Channel
-20 dBc requirement is met at high band edge



Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	May 21, 2014	May 21, 2016	GEMC 193

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Power Spectral Density - Digital Modulation

Purpose

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation.

Limits

The limits are defined in FCC Part 15.247(e) and RSS-247 5.2(2).

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.

The method is given in Section 10.2 of FCC KDB 558074: June 5, 2014 (peak PSD).

Results

The EUT passed. Low, middle, and high channel was tested. Peak measurements were made for each with a 3 kHz resolution bandwidth, during transmit operation of the EUT with continuous modulated data (>98%). The power spectral density is < 8dBm.

Maximum Power Spectral Density

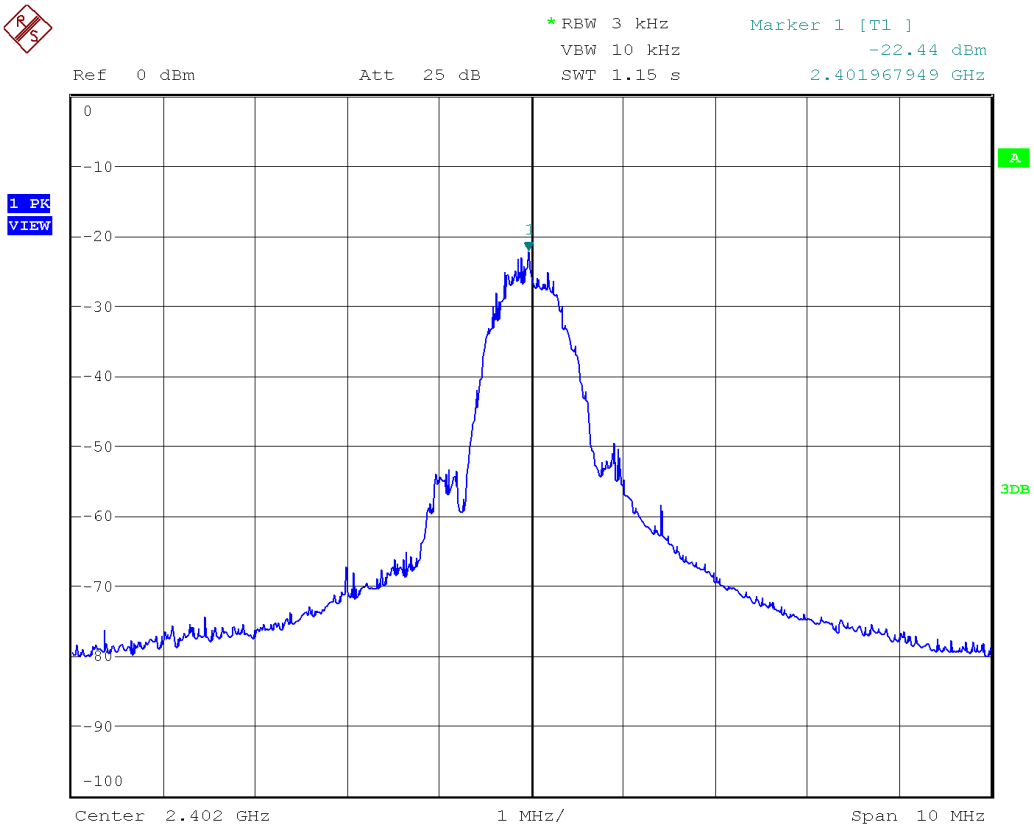
Channel	Test Frequency (MHz)	Detection mode	Output Power (dBm)	Emission limit (dBm)	Margin (dB)	Result
Lo	2.402	Peak	-22.44	8.0	30.44	Pass
Mi	2.440	Peak	-22.71	8.0	30.71	Pass
Hi	2.480	Peak	-21.43	8.0	29.43	Pass

Graph(s)

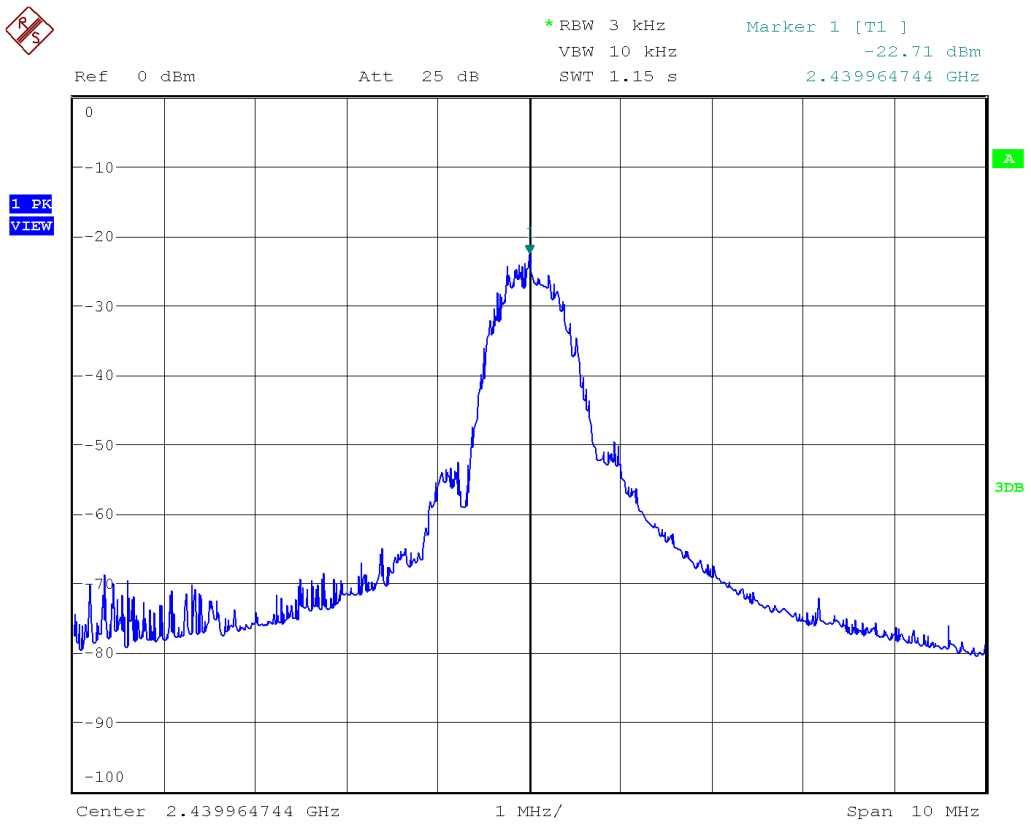
The graphs shown below show the power spectral density of the device during the operation of the EUT. Low, middle, and high channels were investigated, and worst cases are presented.

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

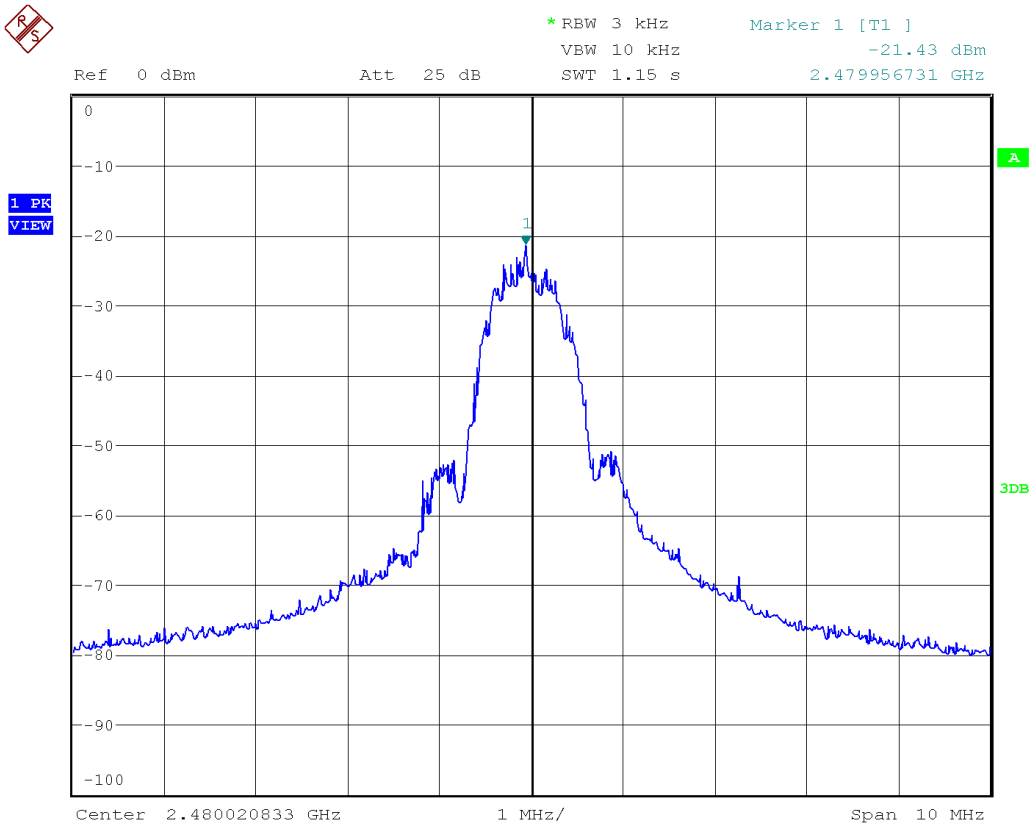
Low Channel



Middle Channel



High Channel



Date: 12.NOV.2015 20:09:29

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	FSU	Rohde & Schwarz	Jan. 19, 2015	Jan. 19, 2017	GEMC 198

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Radiated Emissions – 15.247, 15.209

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s) and Method

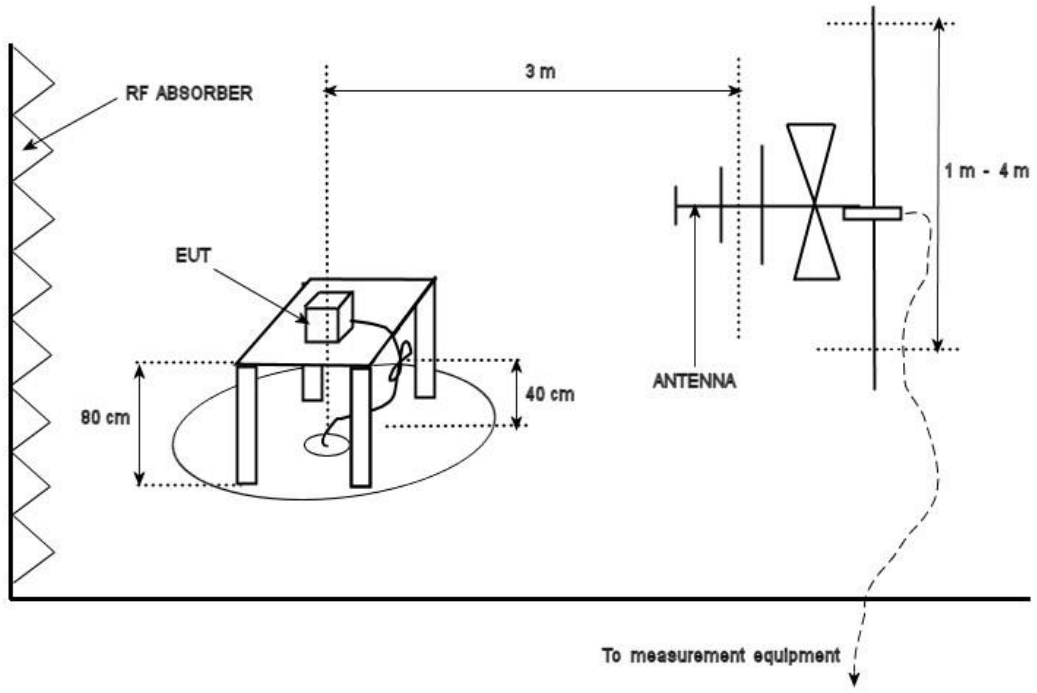
The method is as defined in ANSI C63.4:2009.
The limits are as defined in FCC Part 15, Section 15.209 and RSS-Gen 8.9 (Table 4 & 5):

The limits, as defined in FCC 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in FCC Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

0.009 MHz – 0.490 MHz, 2400/F(kHz) uV/m at 300 m[1]
0.490 MHz – 1.705 MHz, 24000/F(kHz) uV/m at 30 m[1]
1.705 MHz – 30 MHz, 30 uV/m at 30 m[1]
30 MHz – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.0 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54 dBuV/m[2]) at 3m
Above 1000 MHz, 500 uV/m (74 dBuV/m[3]) at 3m

[1]Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1.
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector.
[3]Limit is with 1 MHz measurement bandwidth and using a Peak detector.

Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graphs shown below are maximized peak measurement graphs, measured with a resolution bandwidth greater than or equal to, the final required detector and over a full 0-360° rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10^{th} harmonic.

Devices scanned may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m/3m) is applied.

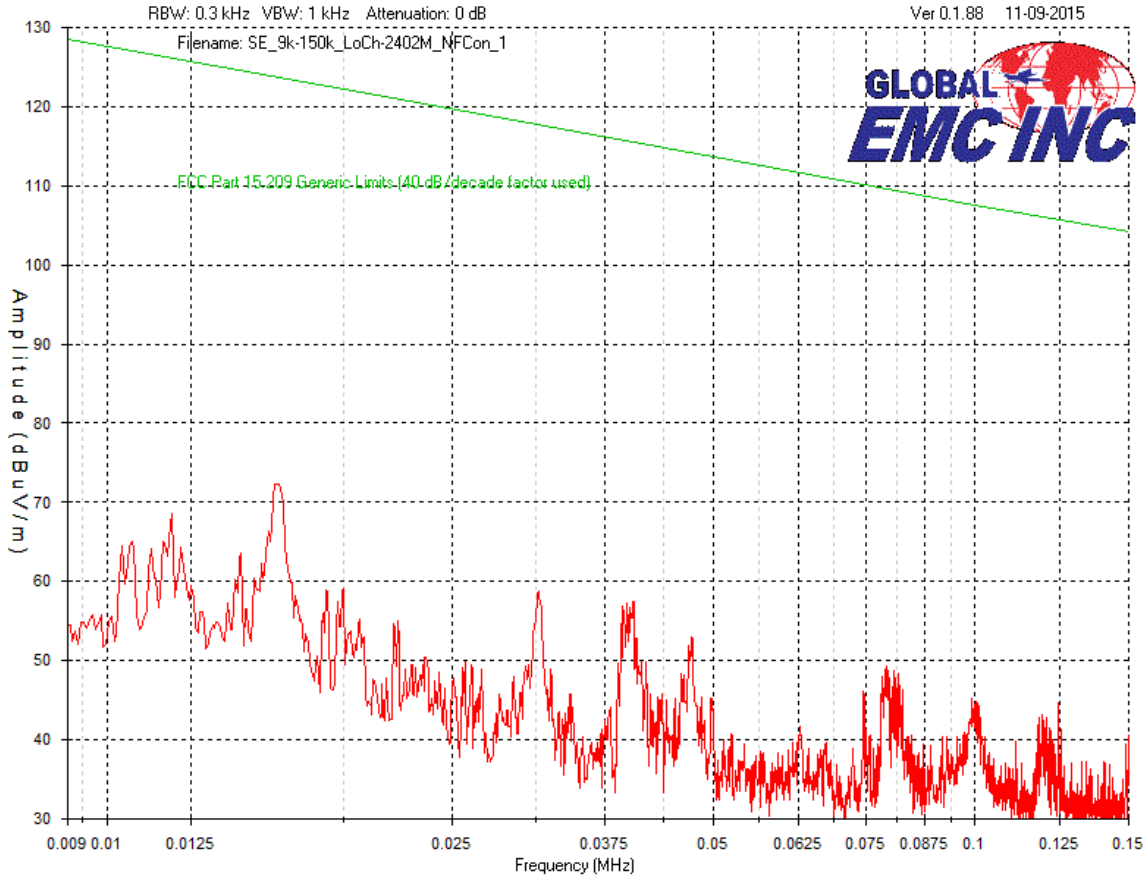
See final measurement section for all measurements.

Low, middle, and high channels were scanned. Worst case is presented.

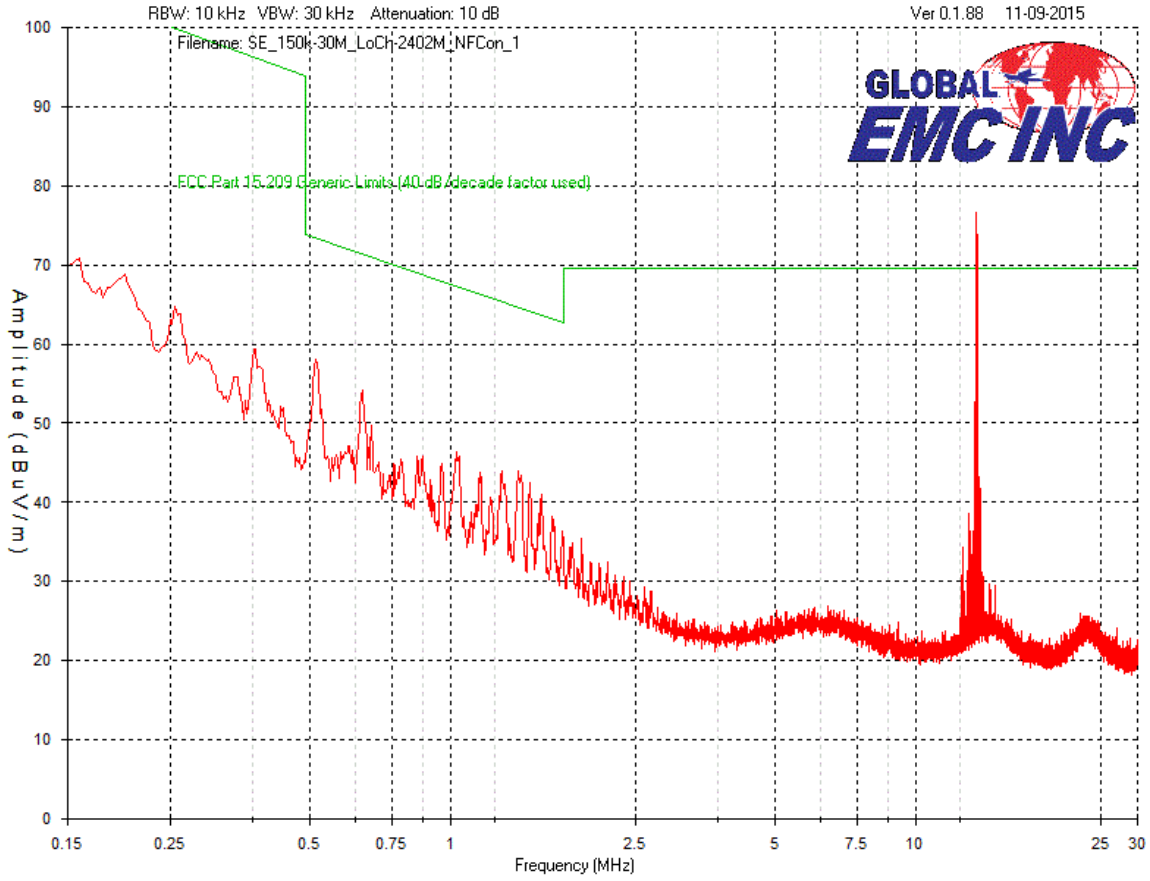
Both the BLE and the NFC transmitters are active and constantly transmitting modulated data at maximum power during testing.

Plots and measurements are made at a 3 meter distance.

Peak Emissions Graph
9 kHz to 150 kHz

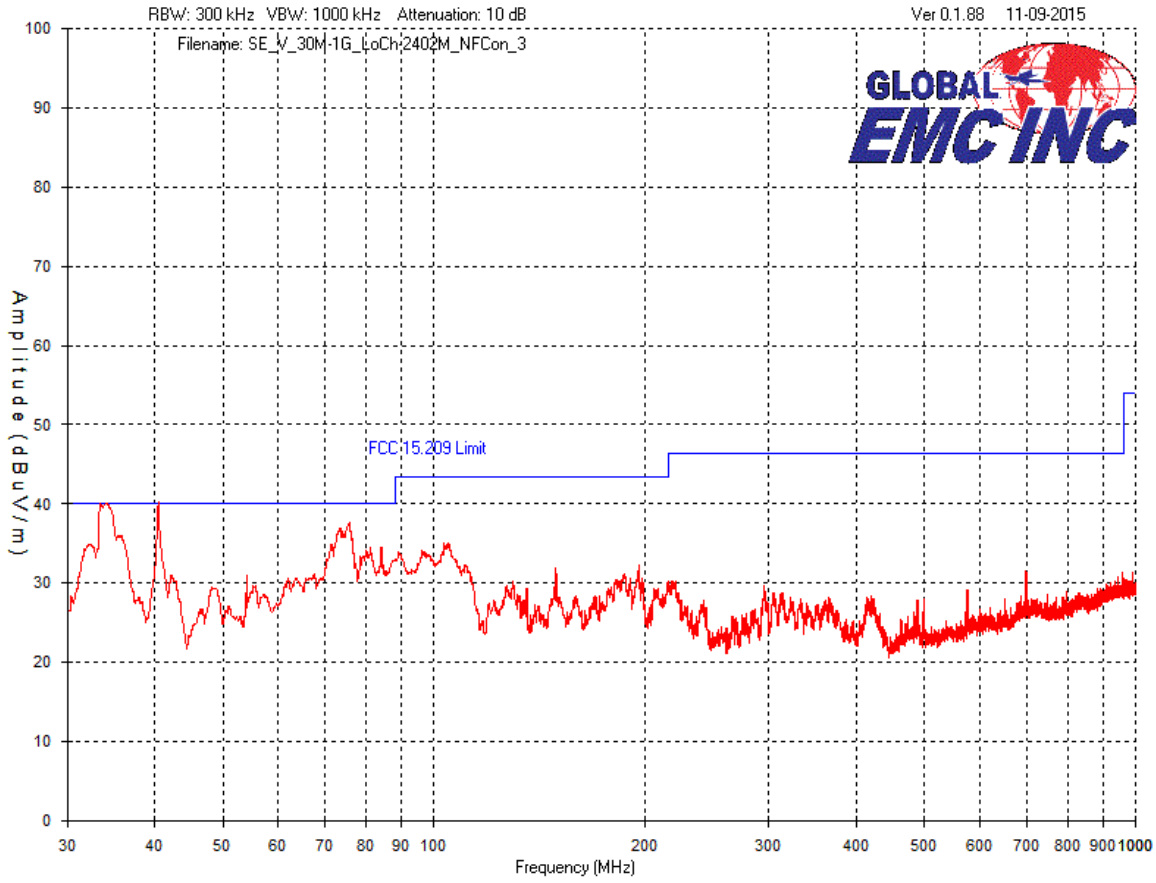


Peak Emissions Graph
150 kHz to 30 MHz

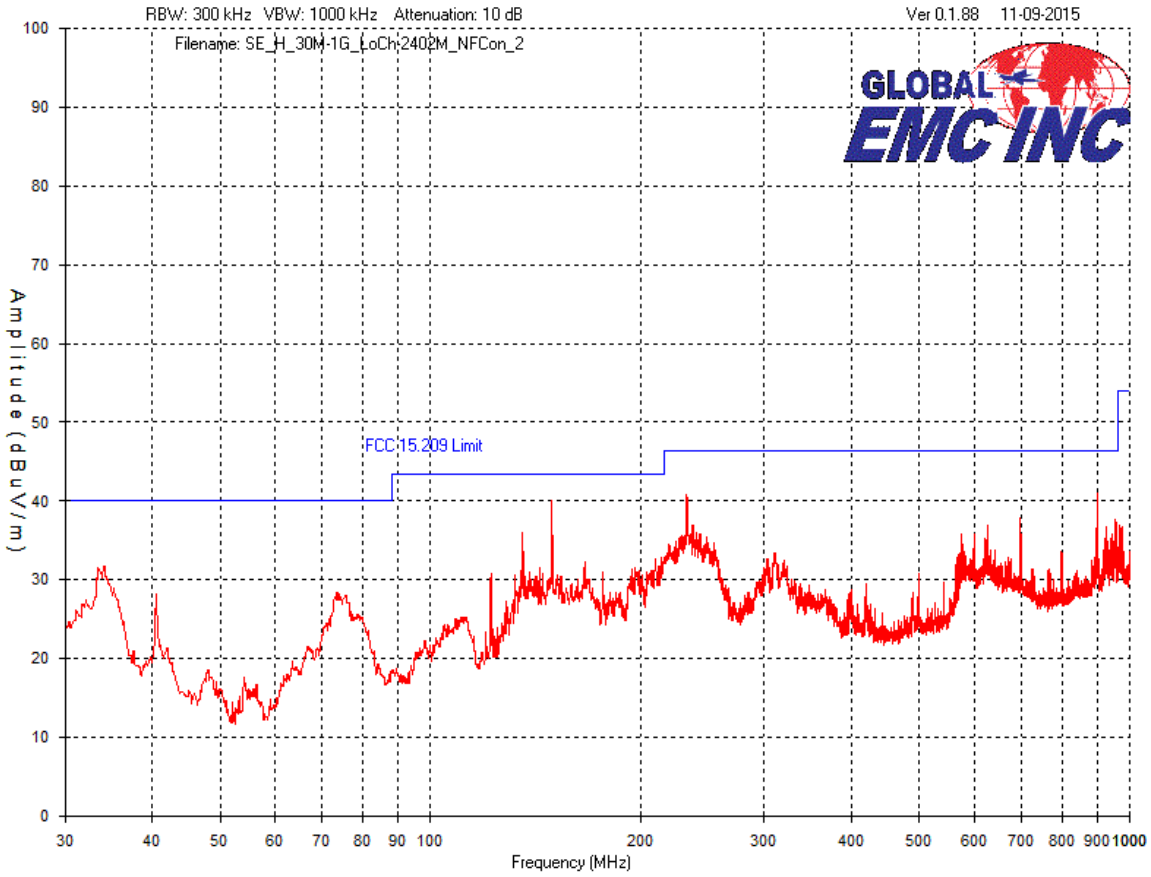


Note: Peak between 10 MHz – 25 MHz is the intentional transmission from the 13.56 MHz RFID. This is addressed in report # GEMC-FCC-23230BR1.

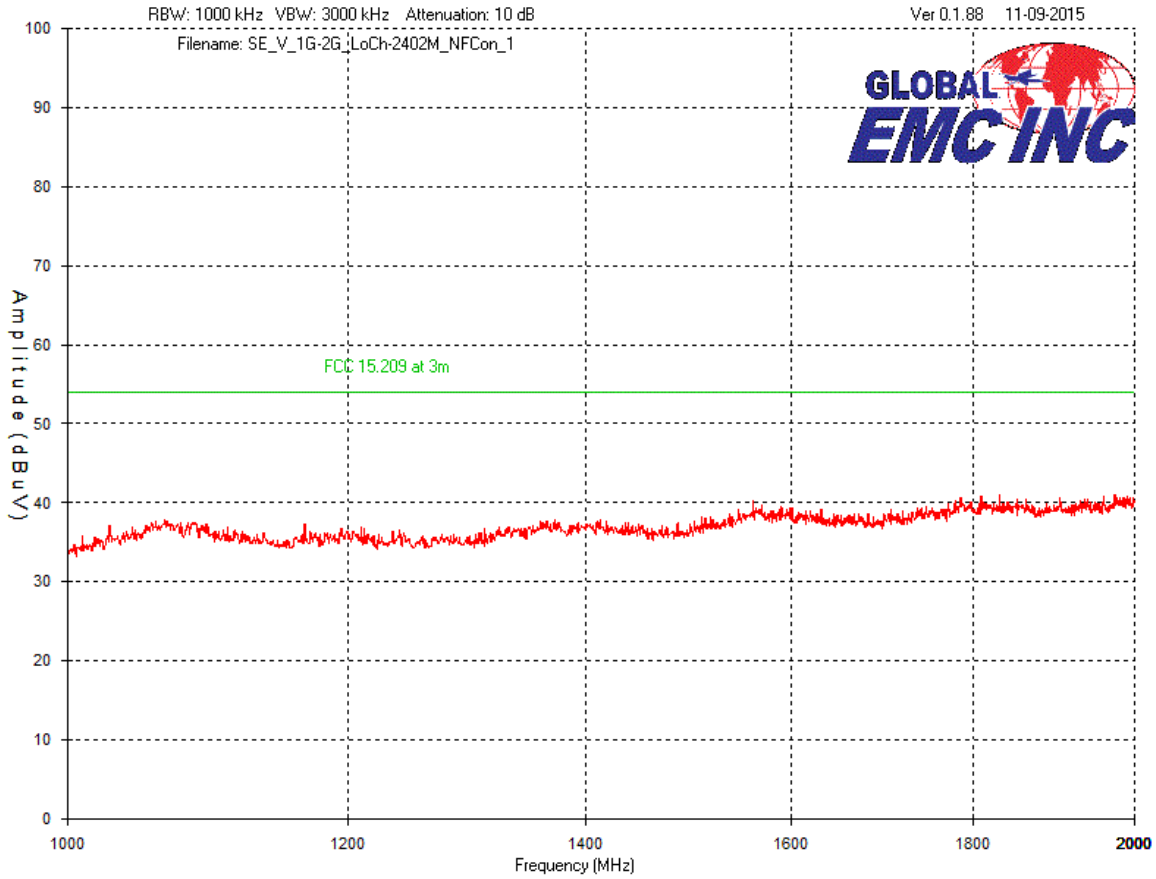
Peak Emissions Graph
Vertical Antenna Polarity
30 MHz to 1 GHz



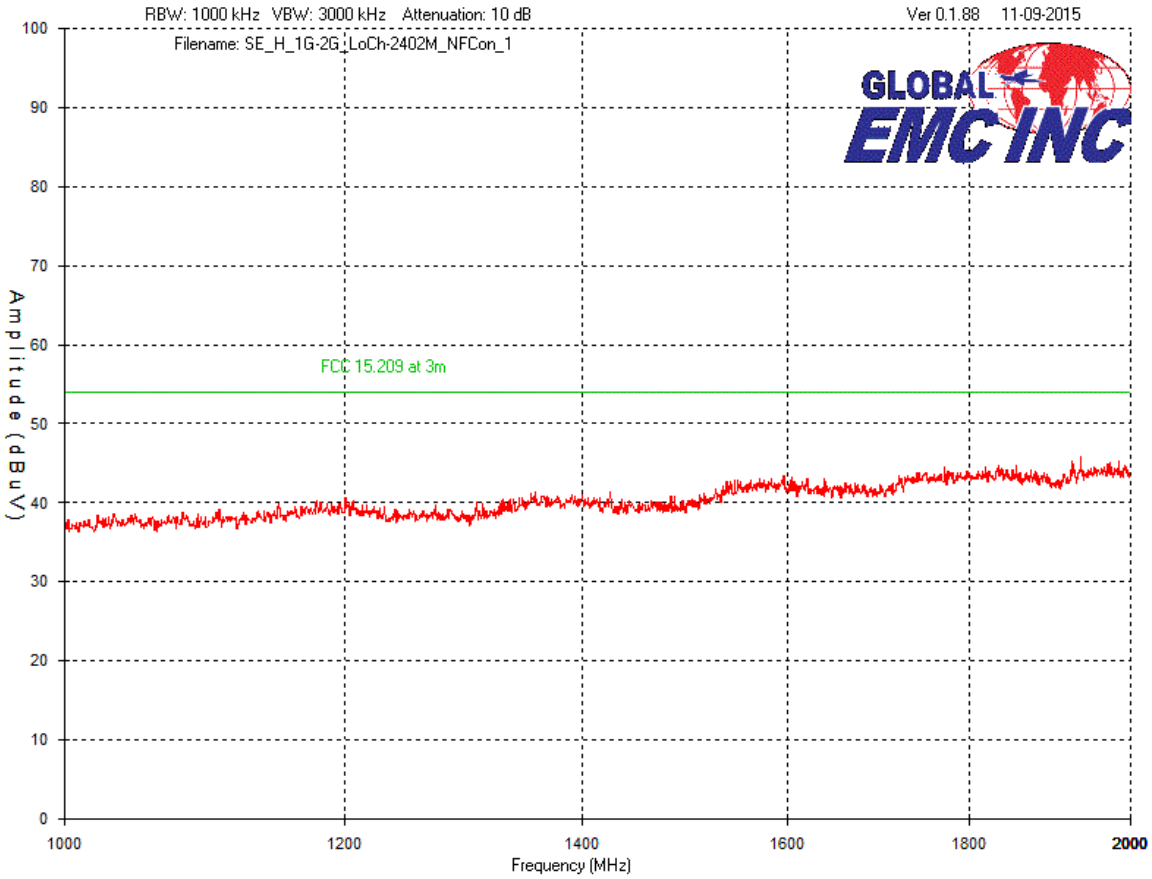
Peak Emissions Graph
Horizontal Antenna Polarity
30 MHz to 1 GHz



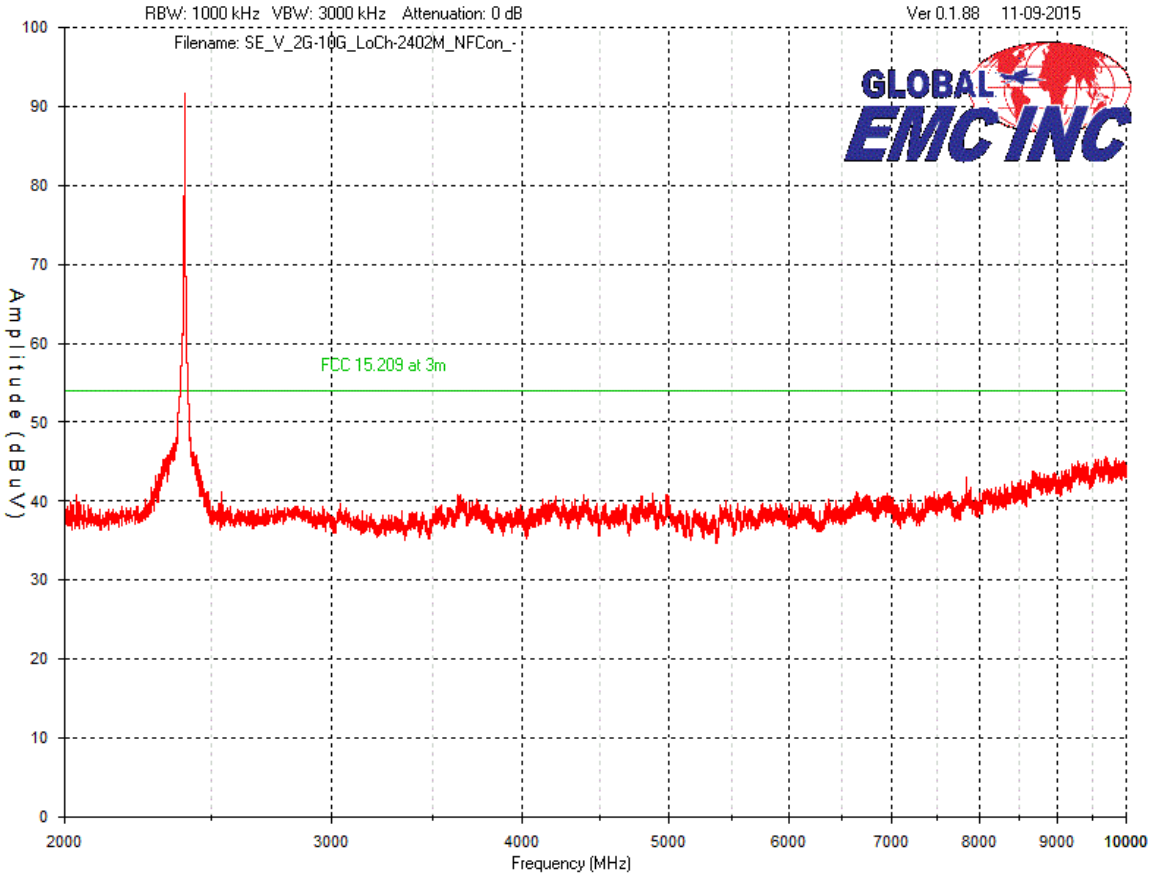
Peak Emissions Graph
Vertical Antenna Polarity
1 GHz to 2 GHz



Peak Emissions Graph
Horizontal Antenna Polarity
1 GHz to 2 GHz

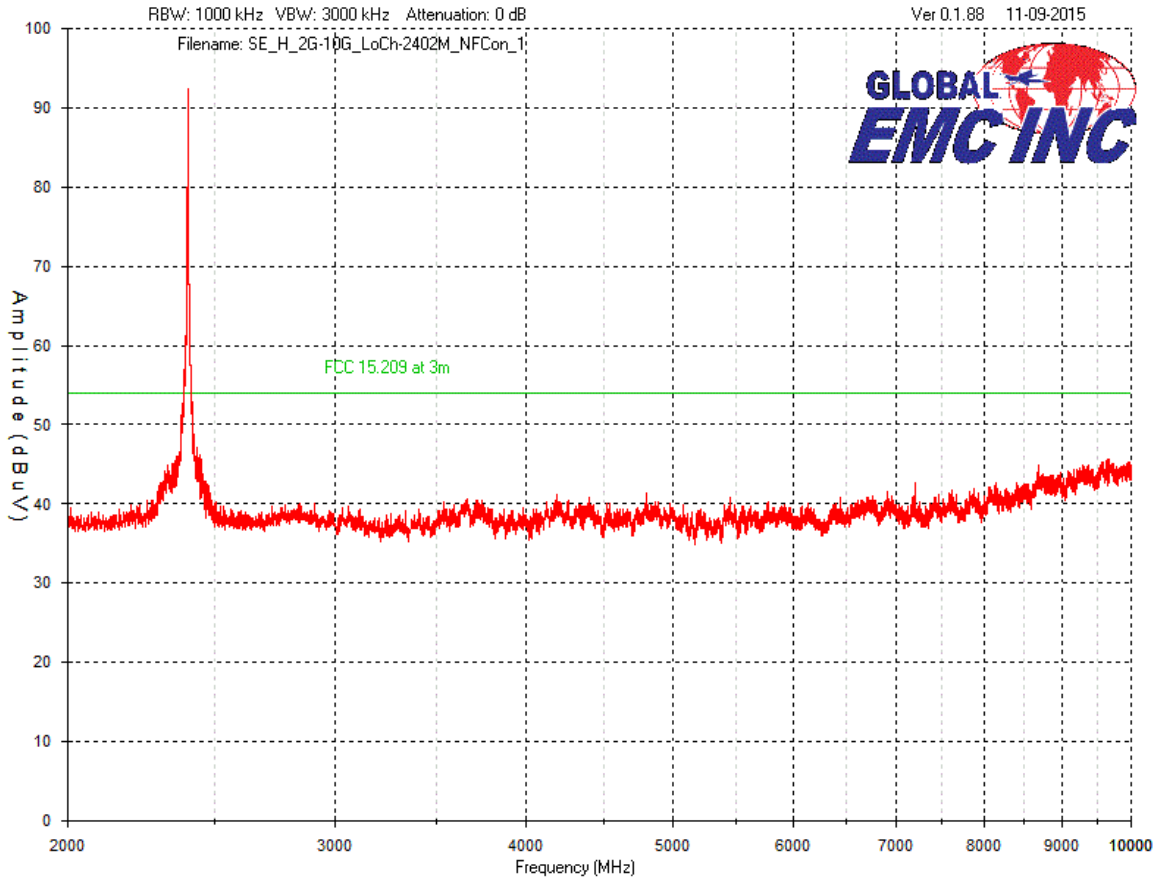


Peak Emissions Graph
Vertical Antenna Polarity
2 GHz to 10 GHz



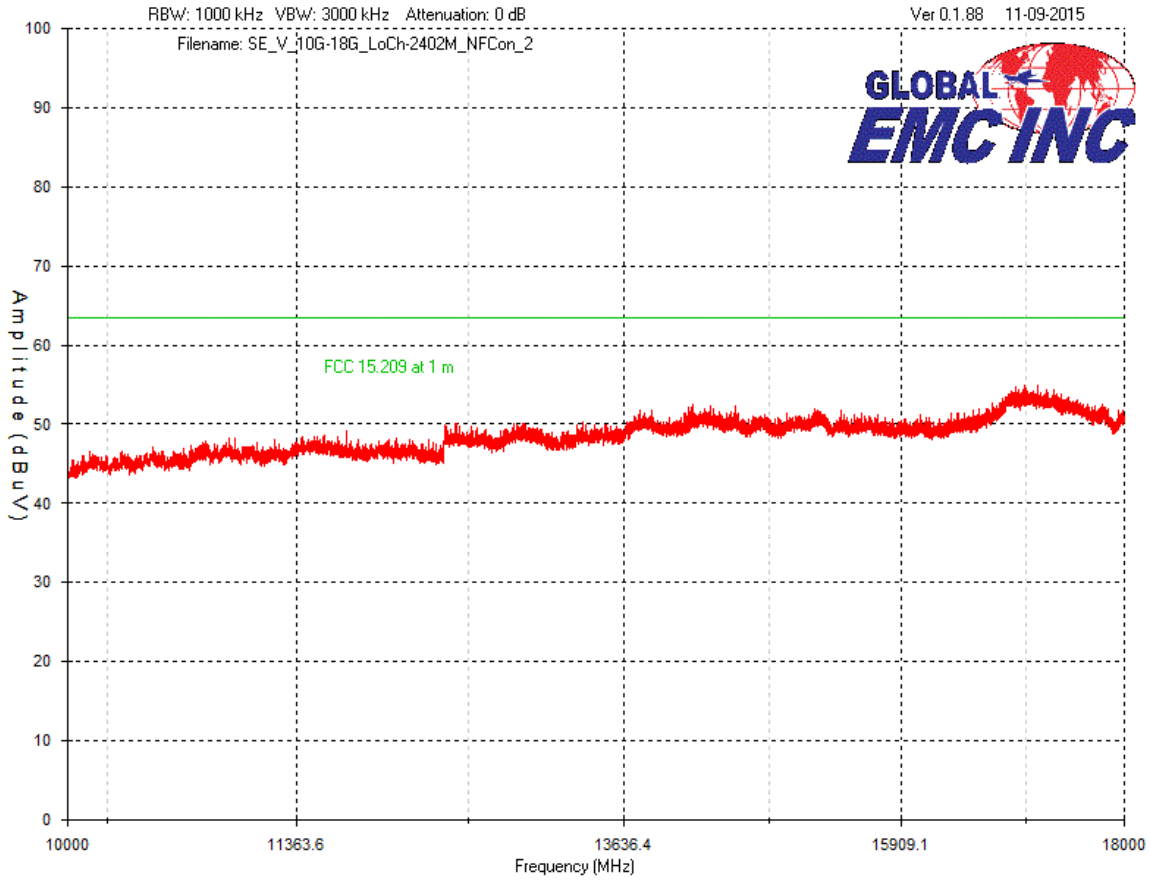
Note: Peak between 2000 MHz and 3000 MHz is the intentional transmission of the BLE at 2.4 GHz.

Peak Emissions Graph
Horizontal Antenna Polarity
2 GHz to 10 GHz

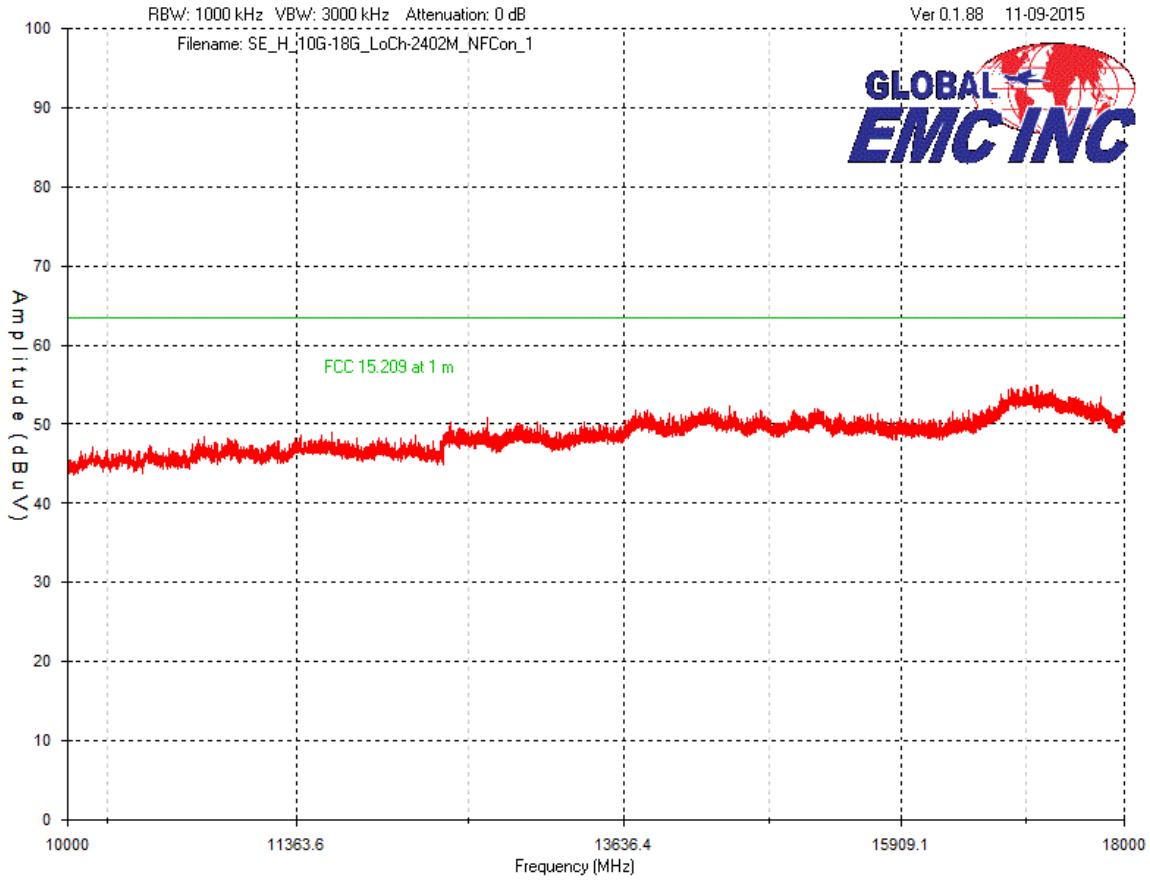


Note: Peak between 2000 MHz and 3000 MHz is the intentional transmission of the BLE at 2.4 GHz.

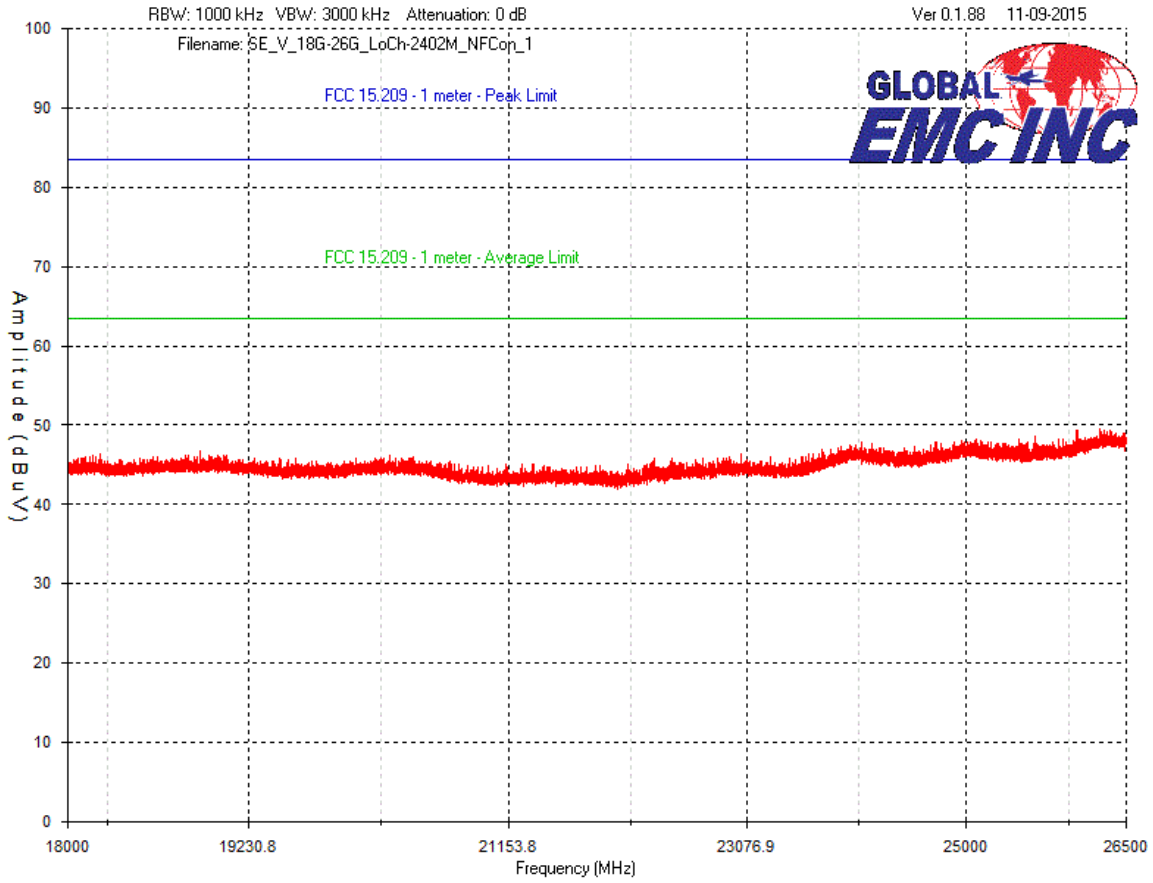
Peak Emissions Graph
Vertical Antenna Polarity
10 GHz to 18 GHz



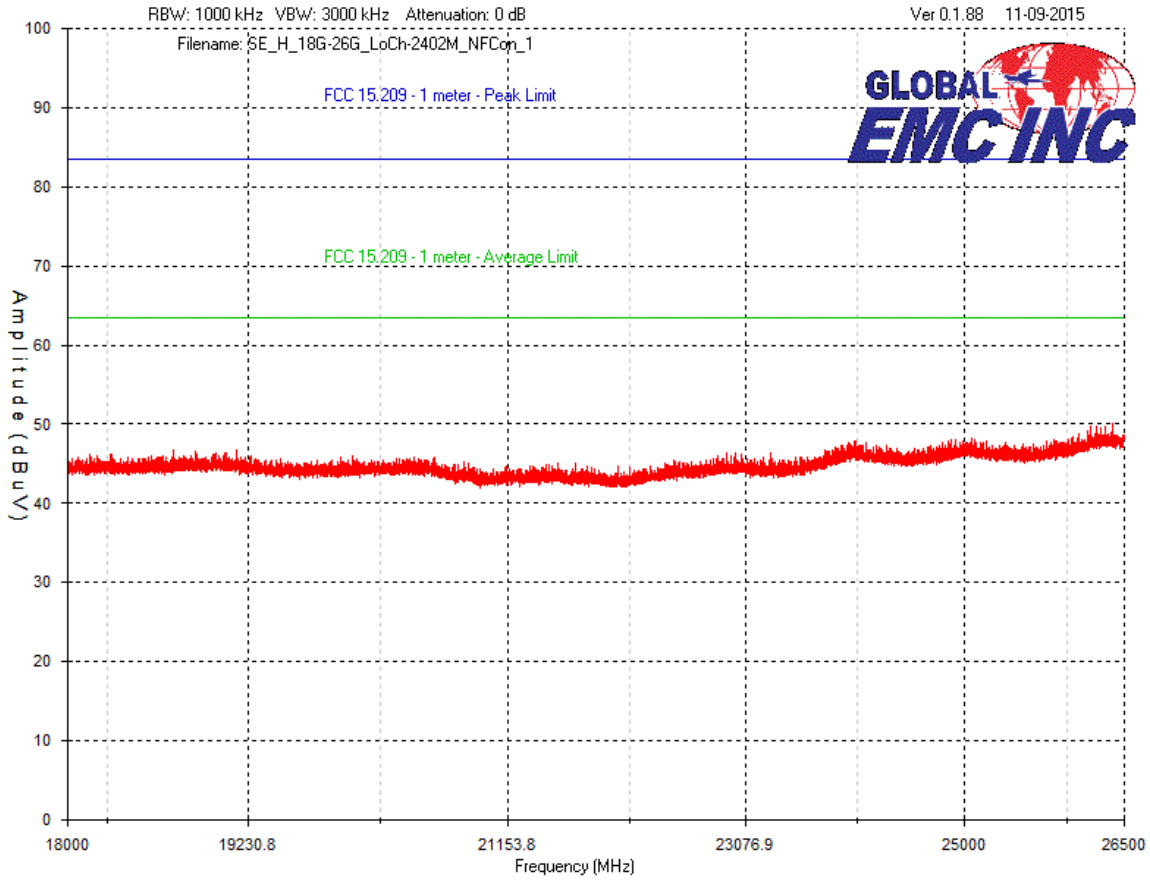
Peak Emissions Graph
Horizontal Antenna Polarity
10 GHz to 18 GHz



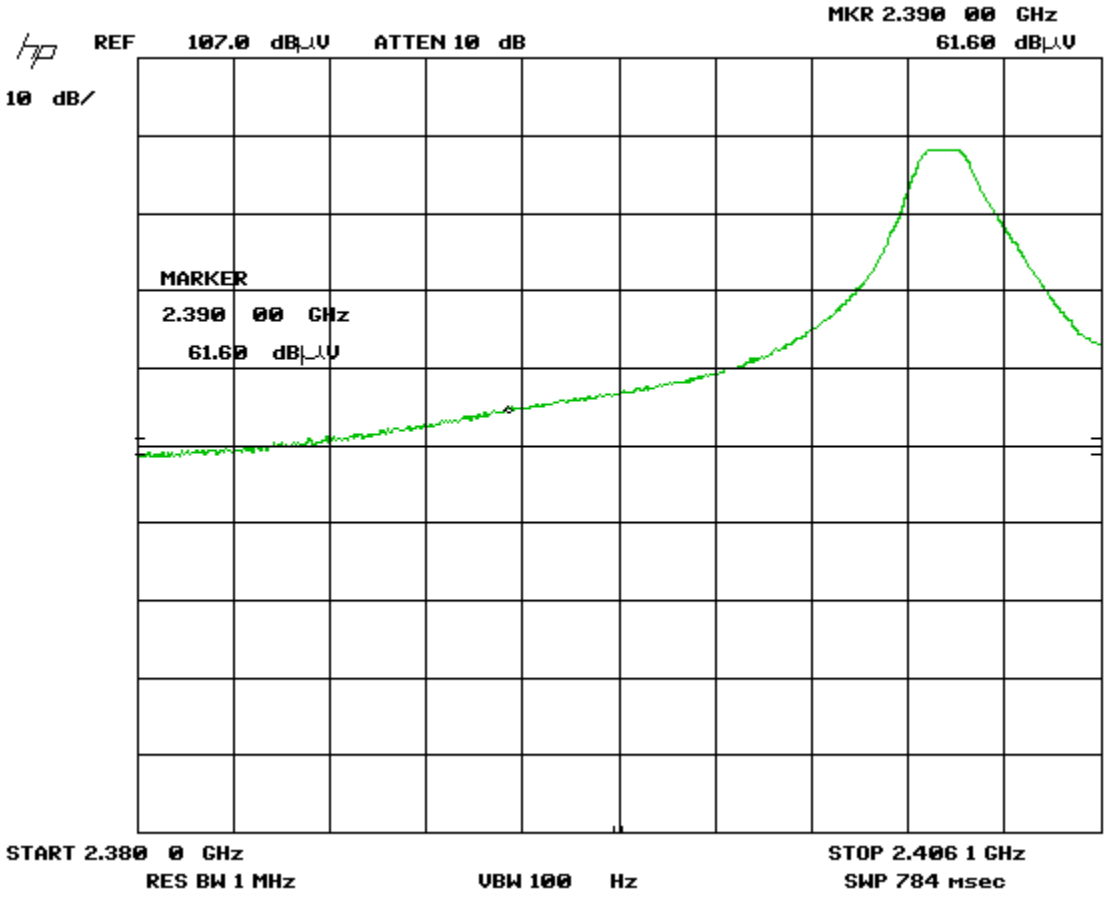
Peak Emissions Graph
Vertical Antenna Polarity
18 GHz to 26.5 GHz



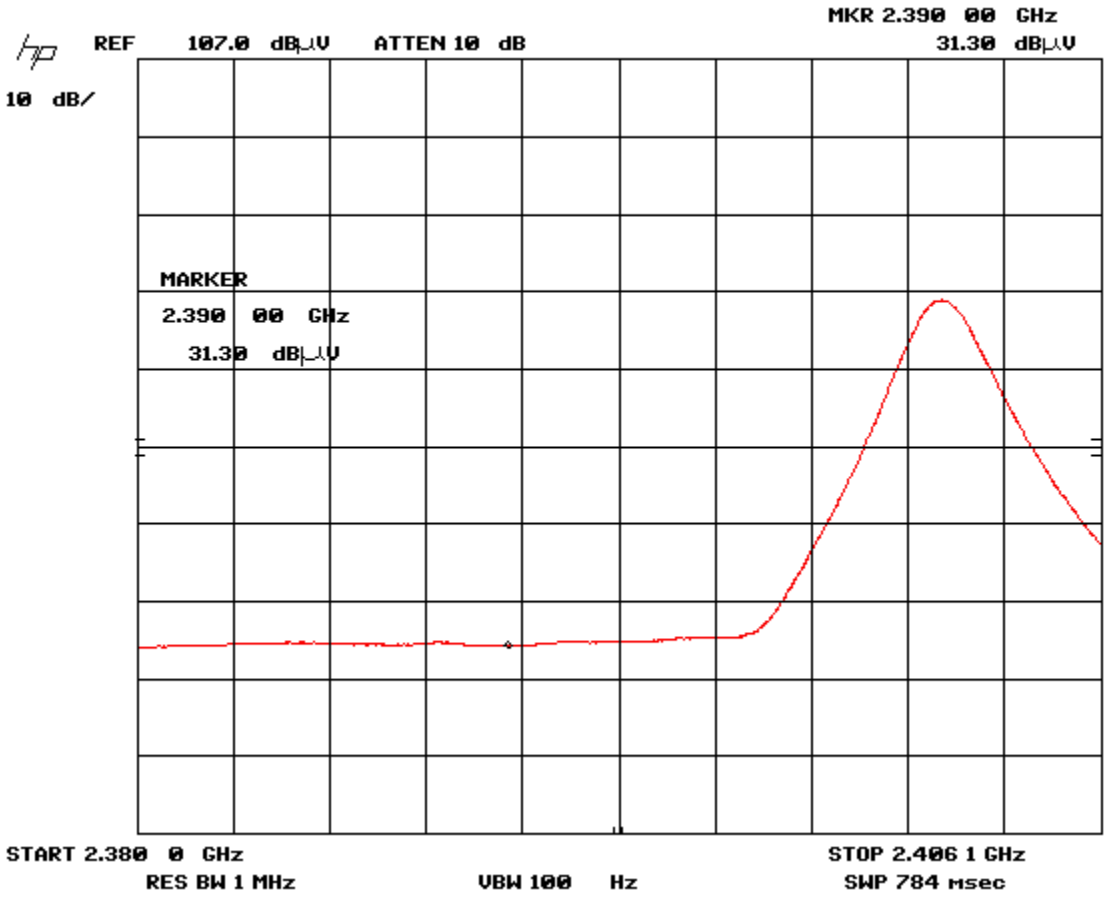
Peak Emissions Graph
Horizontal Antenna Polarity
18 GHz to 26.5 GHz



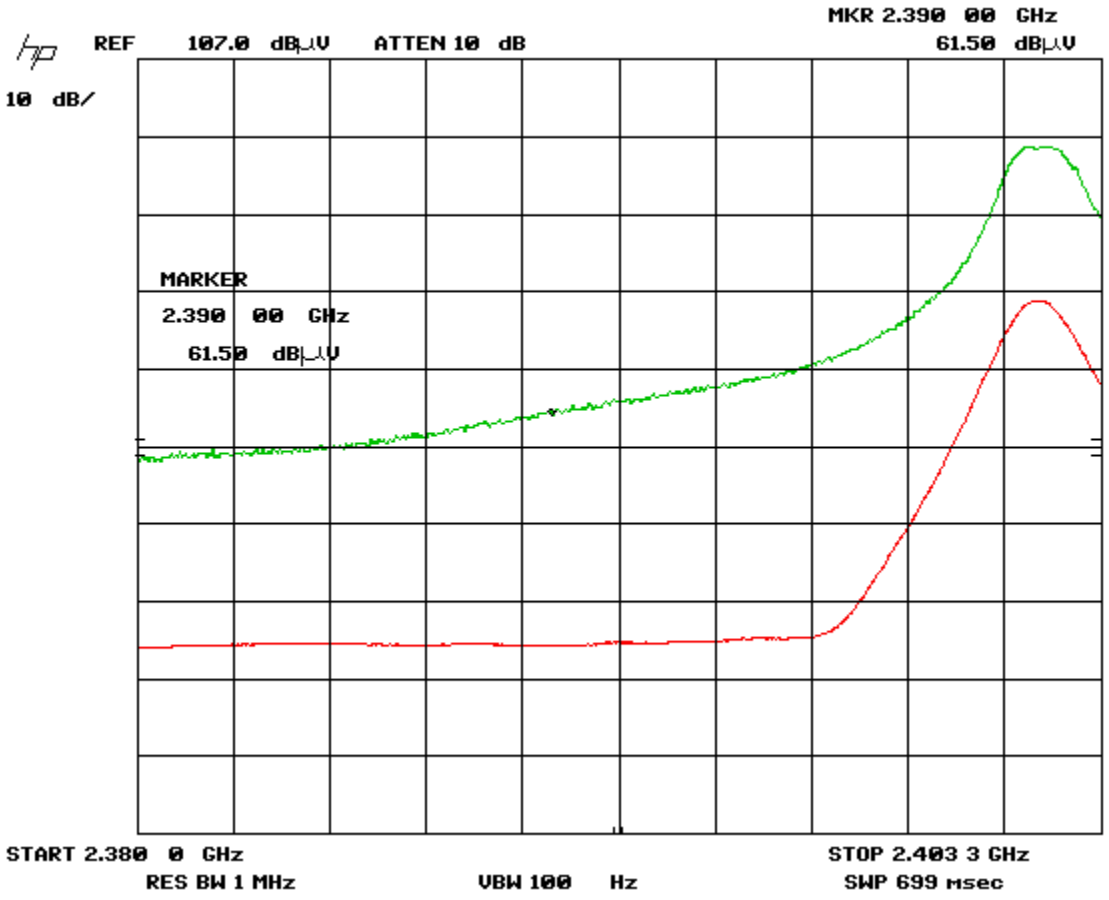
Restricted Band Edges Emissions Graph (Peak)
At 2.390 GHz, Horizontal Antenna Polarity
Low Channe1 (2402 MHz)



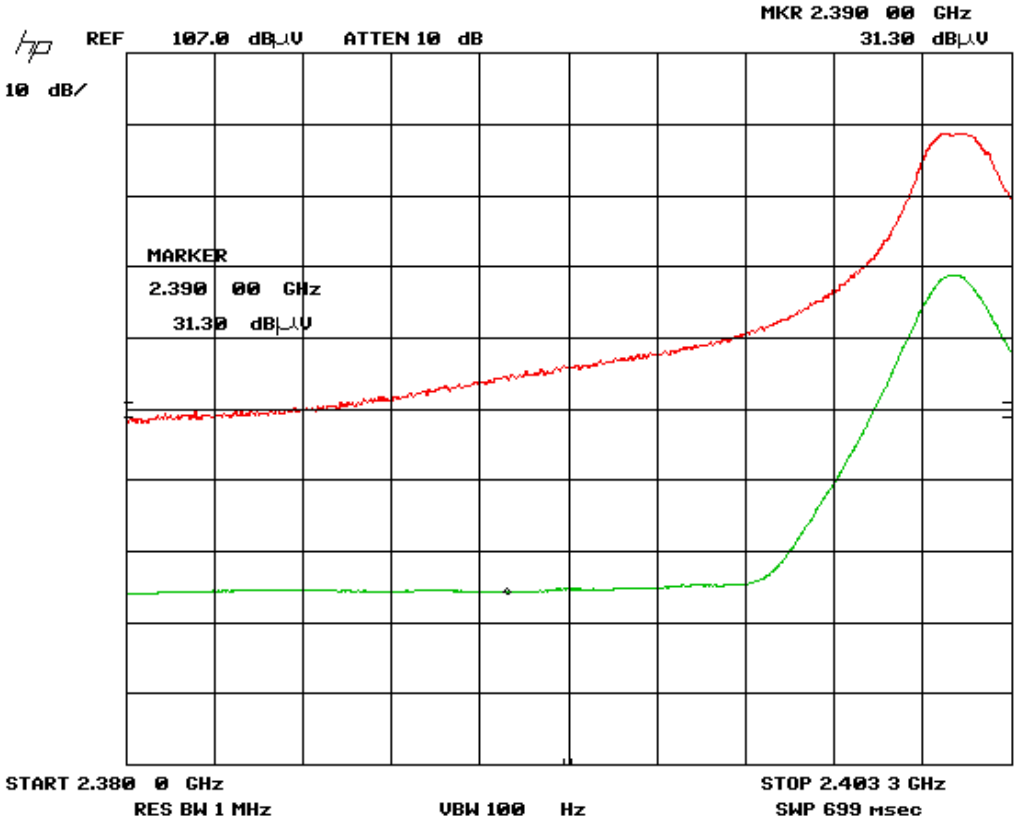
Restricted Band Edges Emissions Graph (Average)
At 2.390 GHz, Horizontal Antenna Polarity
Low Channe1 (2402 MHz)



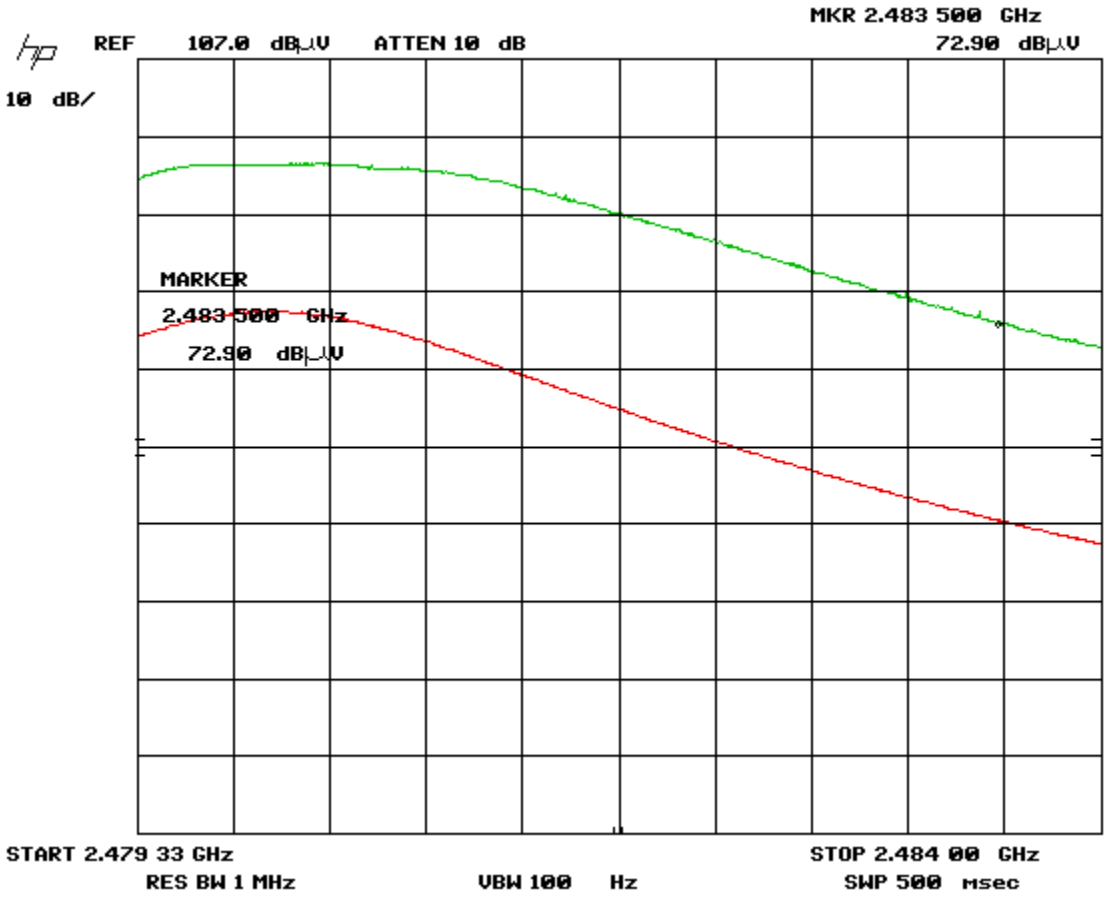
Restricted Band Edges Emissions Graph (Peak)
At 2.390 GHz, Vertical Antenna Polarity
Low Channe1 (2402 MHz)



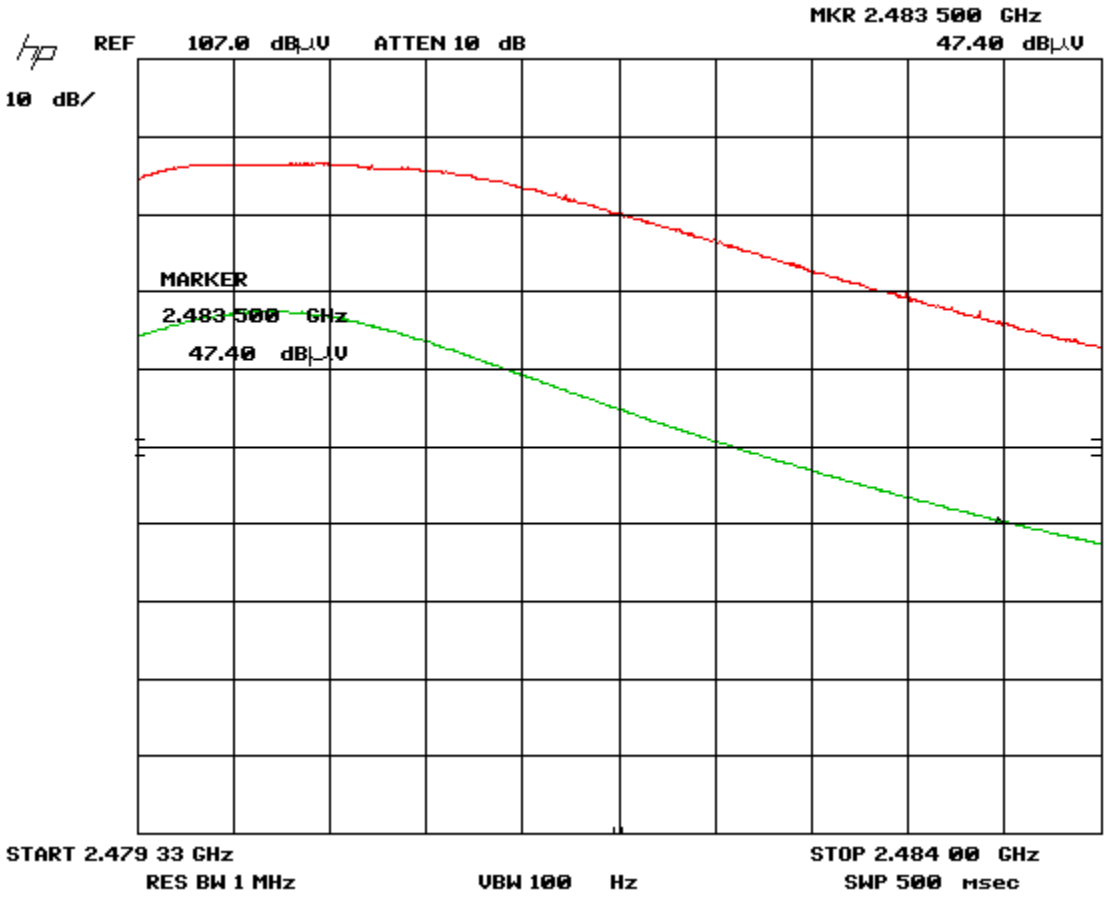
Restricted Band Edges Emissions Graph (Average)
At 2.390 GHz, Vertical Antenna Polarity
Low Channe1 (2402 MHz)



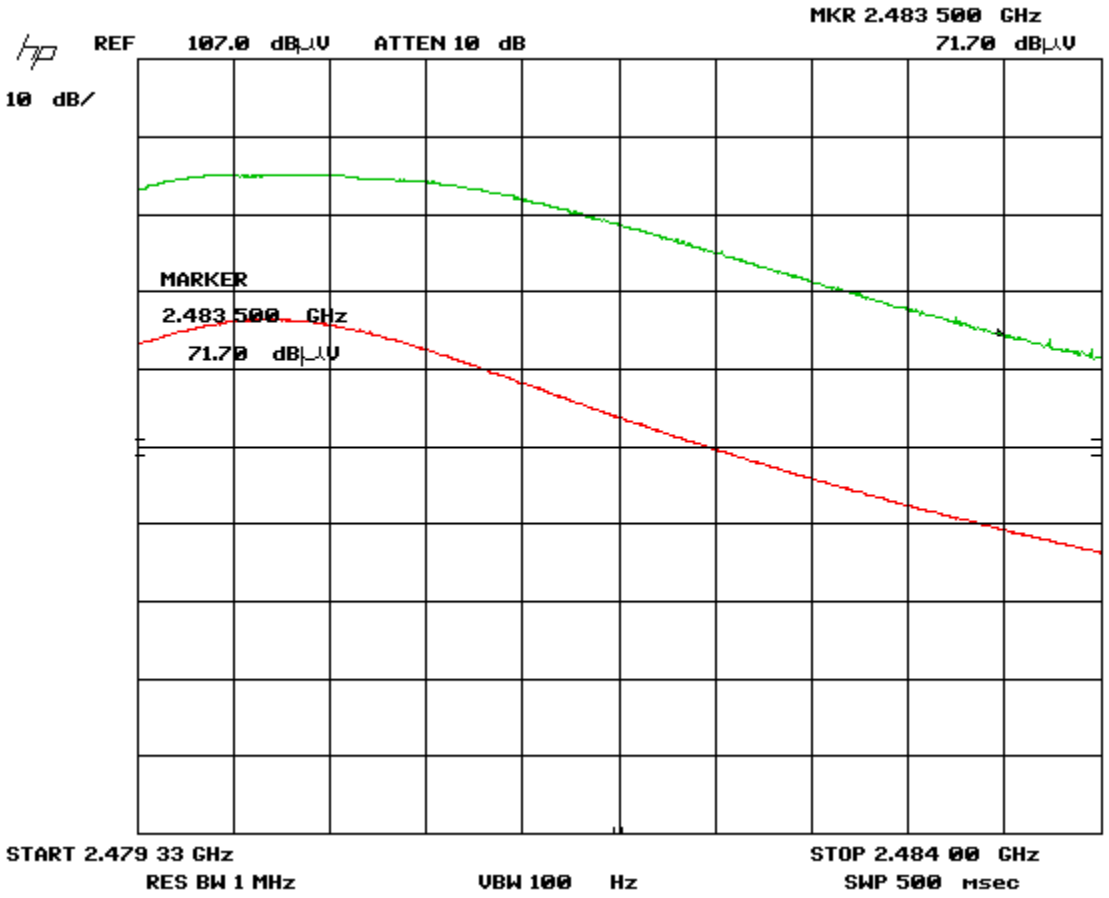
Restricted Band Edges Emissions Graph (Peak)
At 2.4835 GHz, Horizontal Antenna Polarity
High Channe1 (2480 MHz)



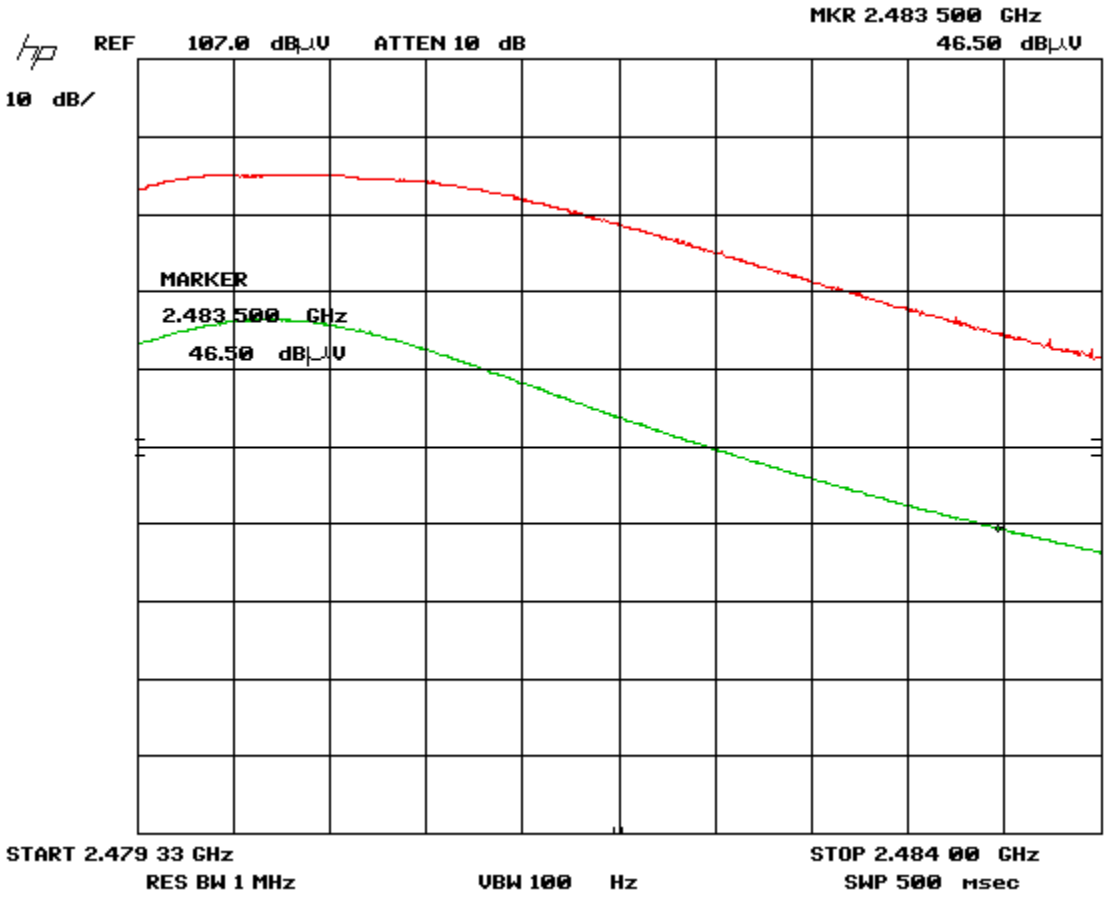
Restricted Band Edges Emissions Graph (Average)
At 2.4835 GHz, Horizontal Antenna Polarity
High Channe1 (2480 MHz)



Restricted Band Edges Emissions Graph (Peak)
At 2.4835 GHz, Vertical Antenna Polarity
High Channe1



Restricted Band Edges Emissions Graph (Average)
At 2.4835 GHz, Vertical Antenna Polarity
High Channe1 (2480 MHz)



Final Measurements

Table 1: Radiated Emissions
Spurious emissions
3m measurement distance

Test Frequency (MHz)	Detection mode	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Preselecor	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
Vertical Antenna Polarity									
40.5	QP	56.55	10.2	0.5	-33.1	34.15	40	5.85	Pass
33.5	QP	48.6	13.5	0.5	-33.1	29.5	40	10.5	Pass
75.7	QP	52.61	5.9	0.7	-33.2	26.01	40	13.99	Pass
195.9	Peak	54.3	10.3	1.1	-33.4	32.3	43.5	11.2	Pass
149.1	Peak	55.3	8.9	0.9	-33.2	31.9	43.5	11.6	Pass
129.5	Peak	54.8	7.8	0.9	-33.3	30.2	43.5	13.3	Pass
Horizontal Antenna Polarity									
149.0	Peak	63.4	9	0.9	-33.2	40.1	43.5	3.4	Pass
898.0	Peak	47	23.6	2.3	-31.8	41.1	46.4	5.3	Pass
232.2	Peak	61.3	11.9	1.2	-33.5	40.9	46.4	5.5	Pass
135.4	Peak	60.7	7.6	0.9	-33.2	36	43.5	7.5	Pass
34.1	Peak	48.2	16.2	0.5	-33.1	31.8	40	8.2	Pass
950.5	Peak	43.3	23.6	2.4	-31.5	37.8	46.4	8.6	Pass

Table 2: Radiated Emissions
Spurious emissions at restricted band edges
3m measurement distance

Test Frequency (MHz)	Detection mode	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Preselecor	Pre-Amp Gain dB	Received signal dB(µV/m)	Average Emission limit dB(µV/m)	Peak Emission limit dB(µV/m)	Average Margin dB(µV)	Peak Margin dB(µV)	Result
Horizontal Antenna Polarity											
2390	Peak	61.6	26.1	4	-33.8	57.9	---	74	---	16.1	Pass
2390	Avg.	31.3	26.1	4	-33.8	27.6	54	---	26.4	---	Pass
2483.5	Peak	72.9	26.1	4.1	-33.8	69.3	---	74	---	4.7	Pass
2483.5	Avg.	47.4	26.1	4.1	-33.8	43.8	54	---	10.2	---	Pass
Vertical Antenna Polarity											
2390	Peak	61.5	26.1	4	-33.8	57.8	---	74	---	16.2	Pass
2390	Avg.	31.3	26.1	4	-33.8	27.6	54	---	26.4	---	Pass
2483.5	Peak	71.7	26.1	4.1	-33.8	68.1	---	74	---	5.9	Pass
2483.5	Avg.	46.5	26.1	4.1	-33.8	42.9	54	---	11.1	---	Pass

Notes.

All harmonics are under the limits defined in FCC 15.209.

Peak = Peak measurement
QP = Quasi-Peak measurement
Avg. = Average measurement

Where peak values are under the quasi-peak and/or average limit, the emission passes the corresponding limit, and no measurement with the respective detector is required.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	May 21, 2014	May 21, 2016	GEMC 193
Quasi-Peak Adapter	85650A	HP	May 22, 2014	May 22, 2016	GEMC 194
Loop Antenna 30Hz – 1MHz	EM 6871	Electro-Metrics	Feb. 3, 2015	Feb. 3, 2017	GEMC 70
Loop Antenna 100kHz – 30MHz	EM 6872	Electro-Metrics	Feb. 3, 2015	Feb. 3, 2017	GEMC 71
BiLog Antenna	3142-C	ETS	Feb. 10, 2015	Feb. 10, 2017	GEMC 137
Horn Antenna	6878/24	Q-par	Sept 10, 2014	Sept 10, 2016	GEMC 6365
Horn Antenna 18 GHz - 26.5 GHz	SAS-572	A.H. Systems	Sept. 9, 2014	Sept. 9, 2016	GEMC 6371
18.0-26.5 GHz Harmonic Mixer	11970K	HP	Jan 28, 2014	Jan 28, 2016	GEMC 158
Preamp 9kHz - 2 GHz	CPA9231A	Chase	Sept. 9, 2014	Sept. 9, 2016	GEMC 6403
Pre-amp 1-26GHz	HP 8449B	HP	Sept. 9, 2014	Sept. 9, 2016	GEMC 6351
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The limits and method are as defined in 47 CFR FCC Part 15 Section 15.207, and RSS-Gen 8.8, Table 3.

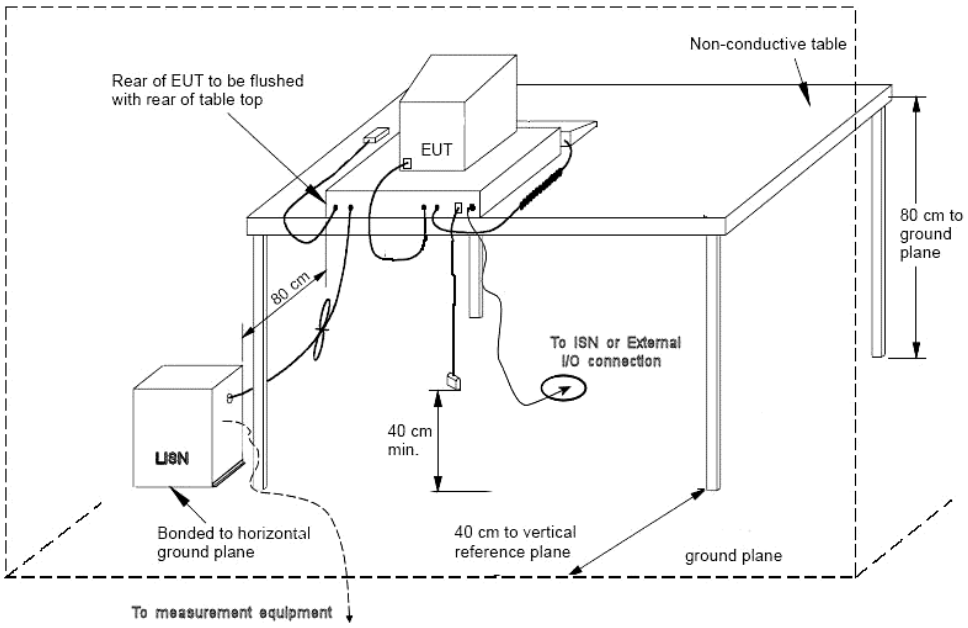
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth.

Typical Setup Diagram



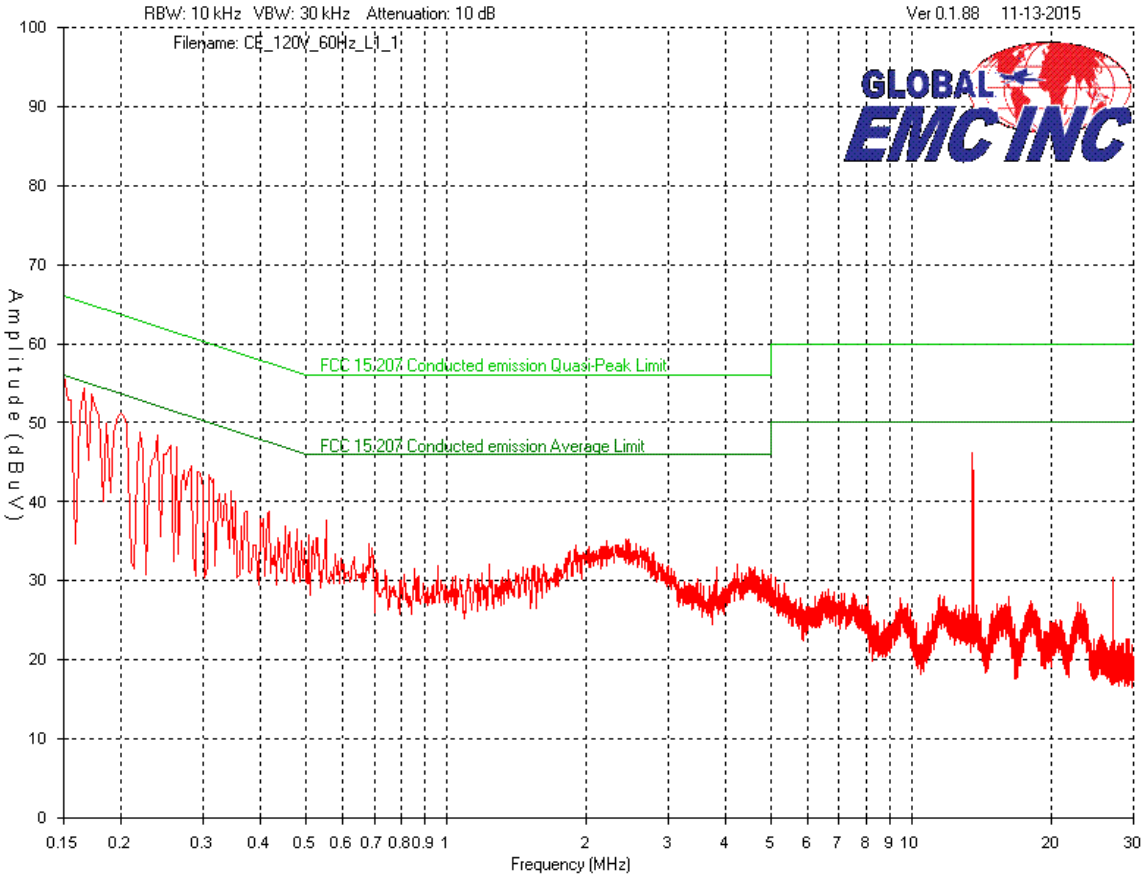
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-3.6 dB with a 'k=2' coverage factor and a 95% confidence level.

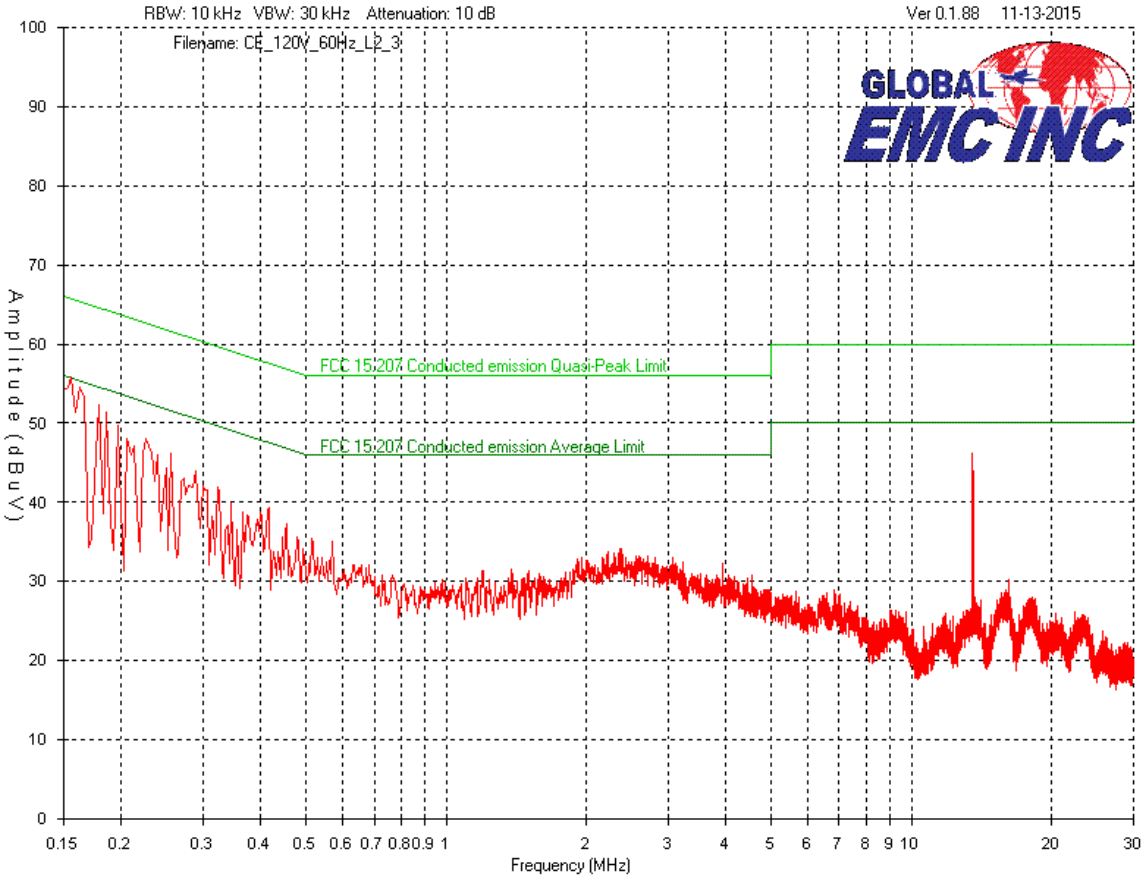
Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graphs shown below are peak measurement graphs, measured with a resolution bandwidth greater than or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings. Power line conducted emissions is performed with the BLE and NFC transmitters transmitting with constant modulated data at maximum output power.

Peak Emissions Graph - Line 1
120V, 60Hz



Peak Emissions Graph - Line 2
120V, 60Hz



Final Measurements

Emissions Table
120V, 60Hz

Test Frequency (MHz)	Detector	Received signal (dBµV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBµV)	Quasi-Peak Emission limit (dBµV)	Average Emission limit (dBµV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Line 1: Phase Line											
0.167	Peak	44.3	10	0.1	0	54.4	65.1	---	10.7	---	Pass
0.167	Avg.	28.42	10	0.1	0	38.52	---	55.1	---	16.58	Pass
0.173	Peak	43.4	10	0.1	0	53.5	64.8	---	11.3	---	Pass
0.173	Avg.	26.02	10	0.1	0	36.12	---	54.8	---	18.68	Pass
13.56	Peak	35.9	10	0.2	0.1	46.2	60	---	13.8	---	Pass
13.56	Avg.	35.72	10	0.2	0.1	46.02	---	50	---	3.98	Pass
0.200	Peak	41	10	0.1	0	51.1	63.6	53.6	12.5	2.5	Pass
0.153	Peak	42.8	10	0.1	0	52.9	65.8	55.8	12.9	2.9	Pass
0.240	Peak	38.4	10	0.1	0	48.5	62.1	52.1	13.6	3.6	Pass
Line 2: Neutral Line											
0.157	Peak	45.6	10	0.1	0	55.7	65.6	---	9.9	---	Pass
0.157	Avg.	28.77	10	0.1	0	38.87	---	55.6	---	16.73	Pass
0.180	Peak	42.2	10	0.1	0	52.3	64.5	---	12.2	---	Pass
0.180	Avg.	25.18	10	0.1	0	35.28	---	54.5	---	19.22	Pass
13.56	Peak	35.9	10	0.2	0.1	46.2	60	---	13.8	---	Pass
13.56	Avg.	36.16	10	0.2	0.1	46.46	---	50	---	3.54	Pass
0.187	Peak	41.3	10	0.1	0	51.4	64.2	54.2	12.8	2.8	Pass
0.196	Peak	39.5	10	0.1	0	49.6	63.8	53.8	14.2	4.2	Pass
0.226	Peak	37.9	10	0.1	0	48	62.6	52.6	14.6	4.6	Pass

Notes:

Peak = Peak measurement
Avg. = Average measurement

See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	FSU	Rohde & Schwarz	Jan. 19, 2015	Jan. 19, 2017	GEMC 198
LISN	FCC-LISN-50/250-16-2-01	FCC	Jan. 15, 2015	Jan. 15, 2017	GEMC 65
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Appendix A – EUT Summary

For further details for filing purposes, refer to filing package.

General EUT Description

Client Details	
Organization / Address	Square Inc. 1455 Market St. Suite 600 San Francisco, CA USA 95014
Contact	Kevin Ng
Phone	416-204-0032 x 85111
Email	kevinng@squareup.com
EUT (Equipment Under Test) Details	
EUT Model / Name	S6 (R12) Mobile Credit Card Reader
EUT is powered using	Internal Li-poly rechargable battery or USB
Input voltage range(s) (V)	5VDC +/- 10%
Frequency range(s) (Hz)	NFC (13.56 MHz), Bluetooth Low Energy (2.402 GHz - 2.480 GHz)
Rated input current (A)	500 mA
Nominal power consumption (W)	1W (NFC radio on)
Transmits RF energy? (describe)	NFC and BLE. Both radios can transmit simultaneously
Basic EUT functionality description	Mobile credit card reader that can read contact and contactless cards. It connects to host devices via BLE or USB
Modes of operation	1, on
Frequency of all clocks present in EUT	32.768 kHz, 13.56 MHz, 24 MHz
I/O connectors description	USB Micro-B connector
Peripherals required to exercise EUT	Laptop to issue commands to the unit to enable radios
Dimensions of product	L: 68 mm W: 68 mm H: 11 mm

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT & Test Setup Photographs'.

Appendix B – EUT and Test Setup Photographs

Note: These photos are for information purposes only.
Also refer to .PDF files that are separate from this test report.

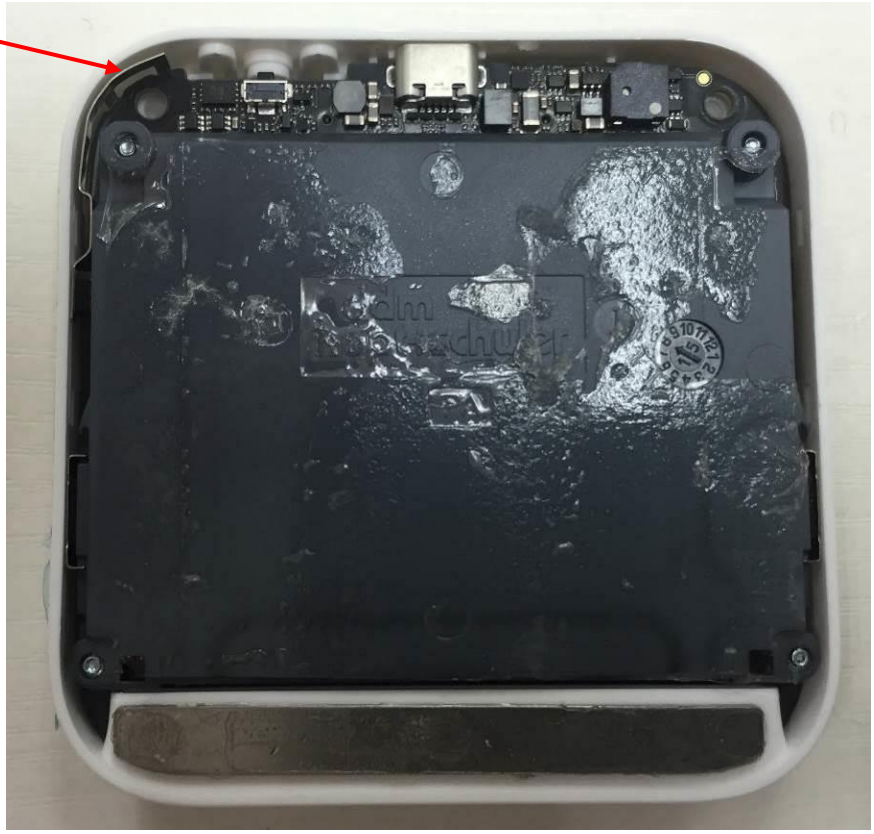
EUT – External view 1

EUT – External view 2

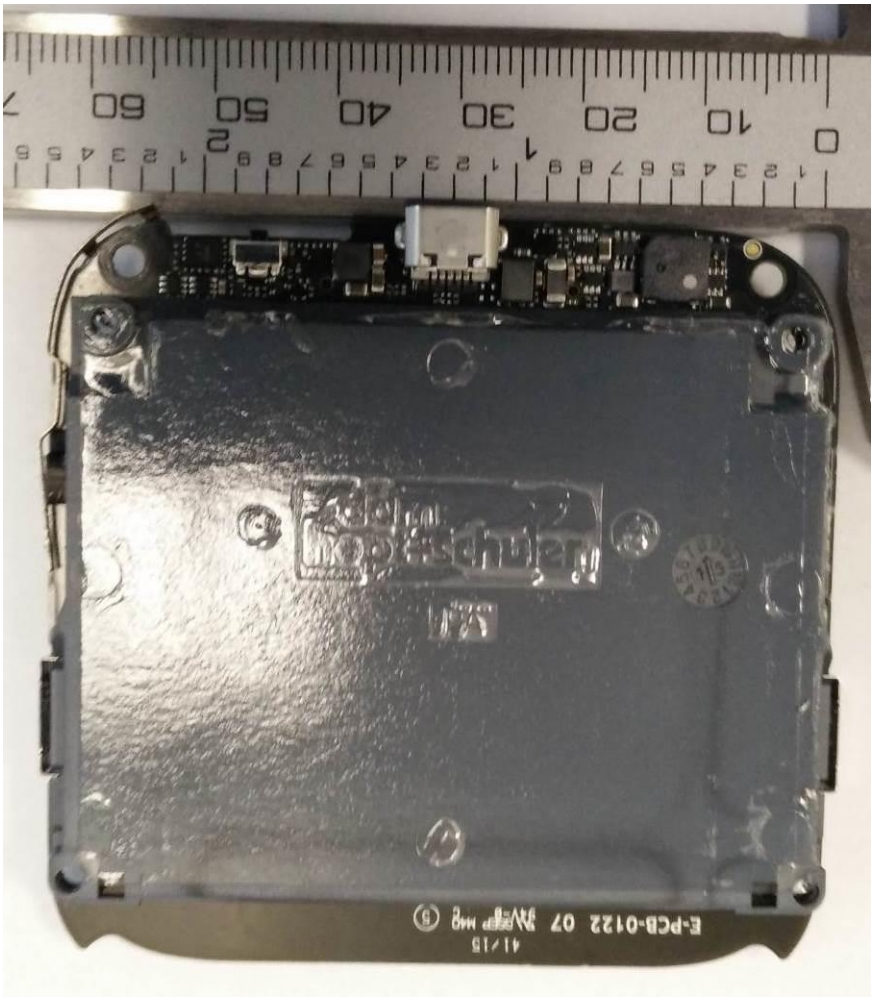
EUT – External view 3

EUT – Internal view 1
Enclosure Cover removed

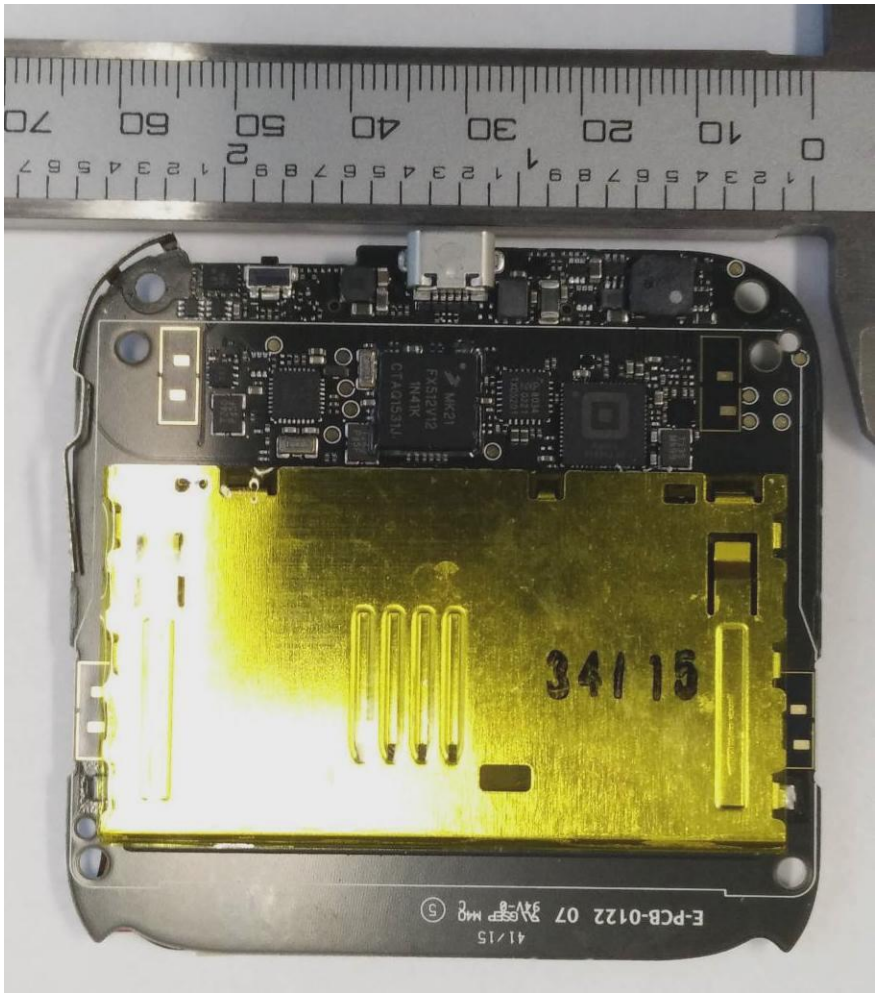
BLE antenna



EUT – Internal view 2
PCB, side 1, with cage

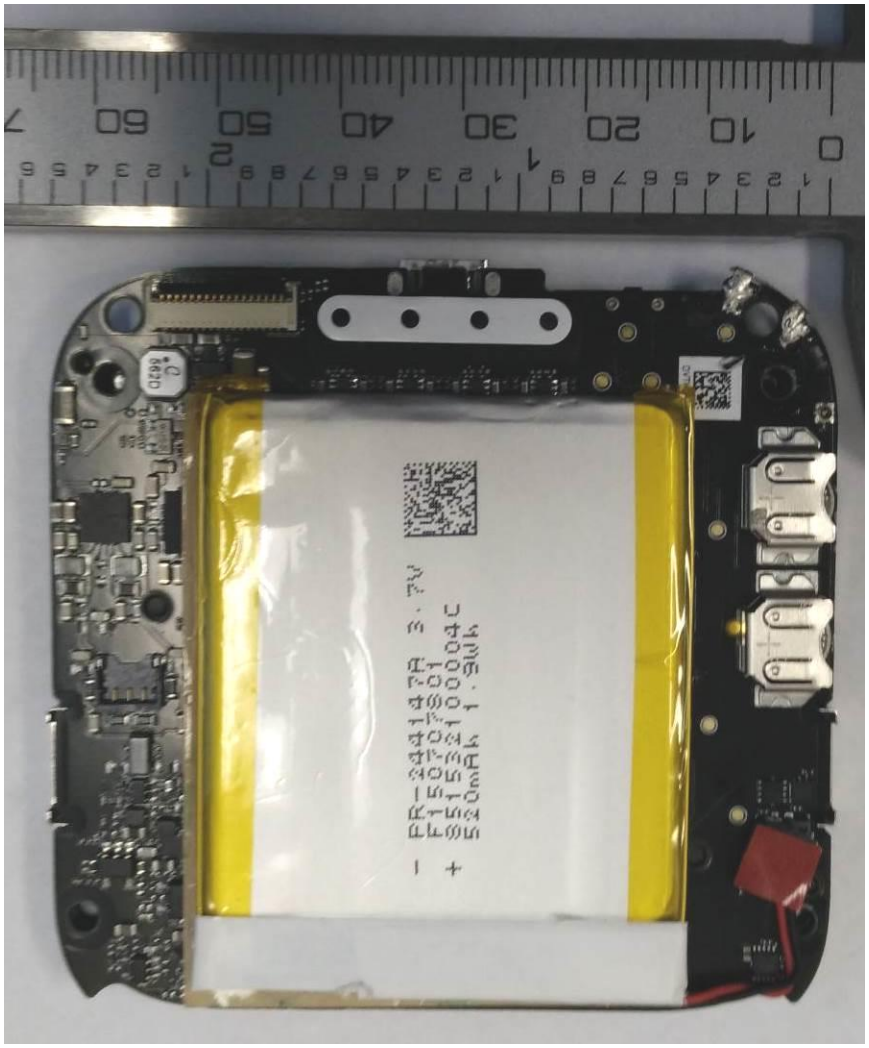


EUT – Internal view 3
PCB, side 1, cage removed

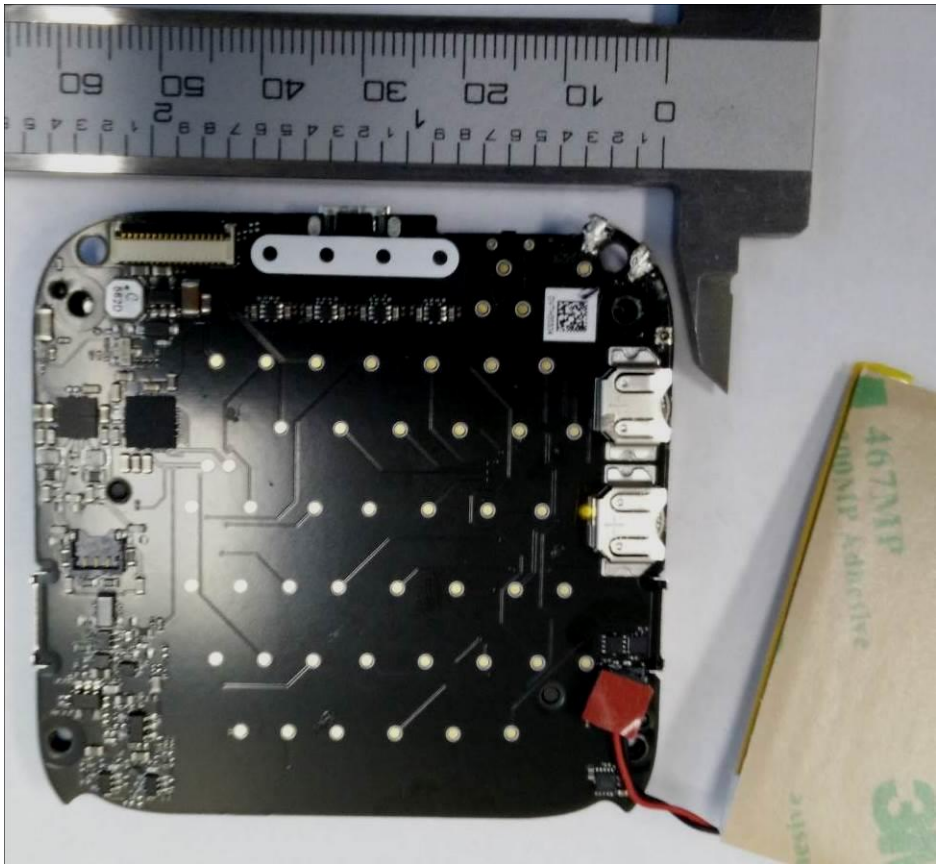


EUT – Internal view 4
PCB, side 1, cage removed, alternate angle

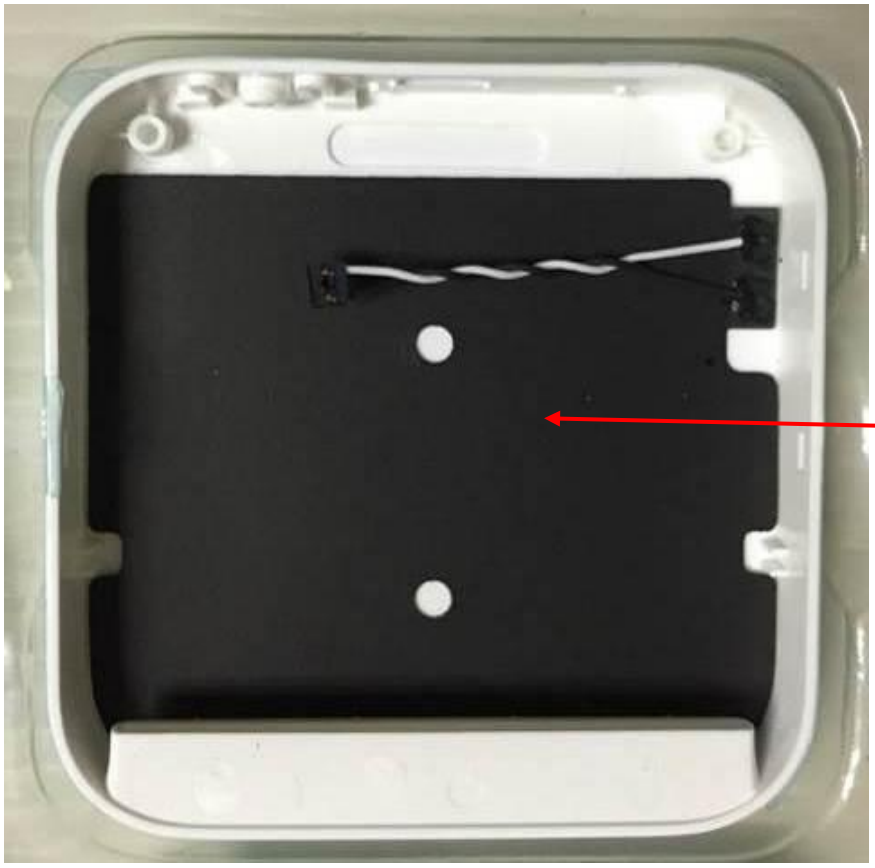
EUT – Internal view 5
PCB, side 2, with battery in place



EUT – Internal view 6
PCB, side 2, battery removed



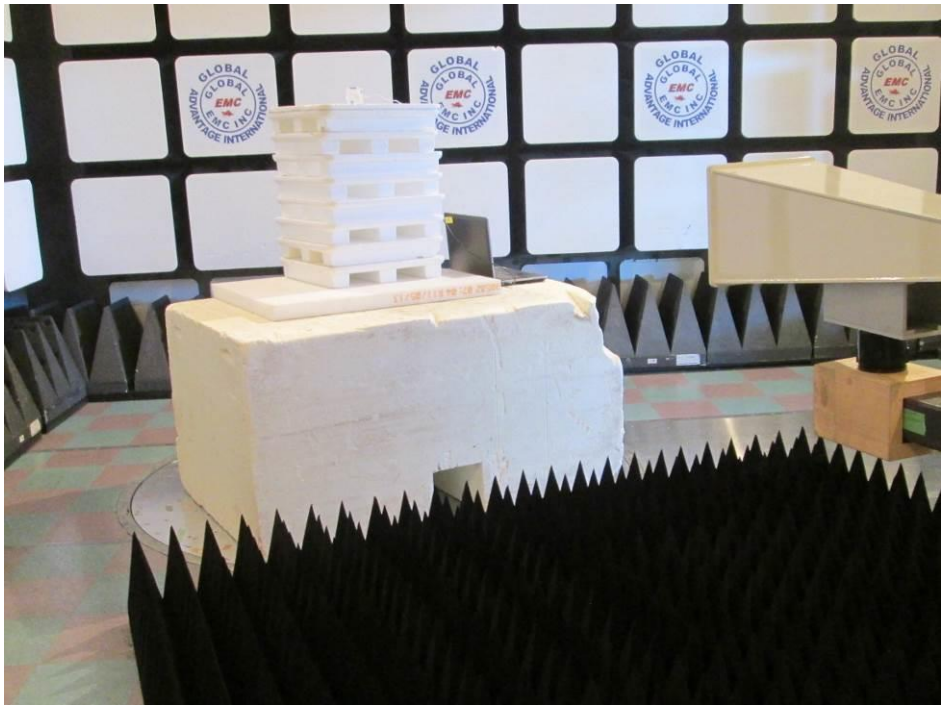
EUT – Internal view 7
NFC antenna, mounted to housing



Radiated Emissions Photo 1

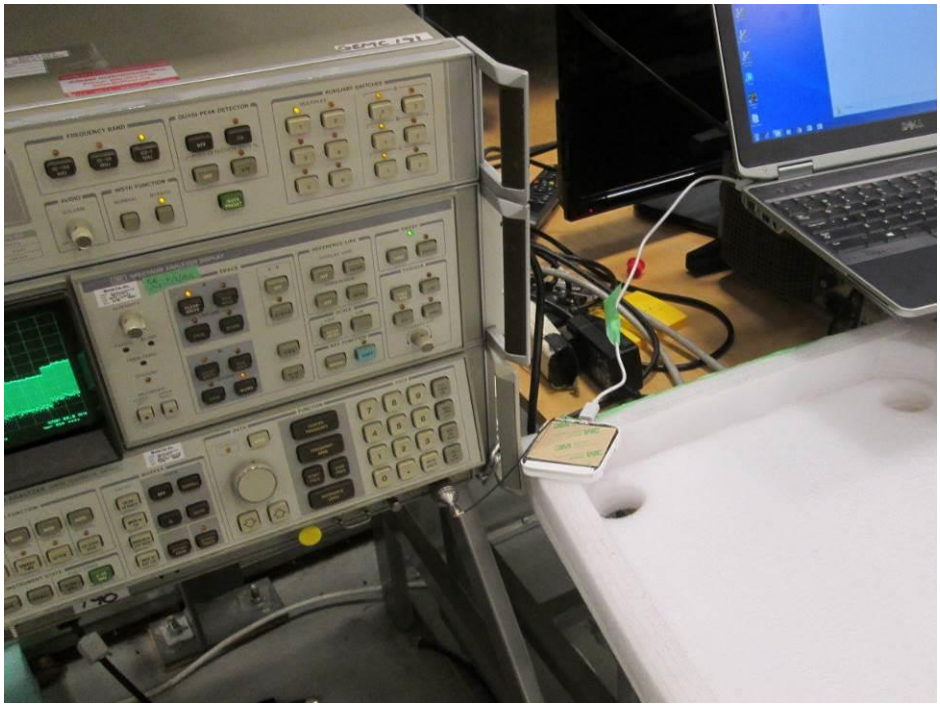
Radiated Emissions Photo 2

Radiated Emissions Photo 3



Radiated Emissions Photo 4

Conducted Measurements



Power Line Conducted Emissions