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TÜV SÜD

RF Test Report

As per

RSS 247 Issue 1:2015

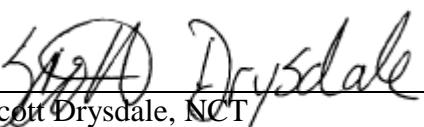
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FCC Part 15 Subpart C:2015

Unlicensed Intentional Radiators

on the

BLE-5100 Bluetooth Module



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Testing produced for
KABA
See Appendix A for full customer & EUT details.



REGISTRATION #6844B-1



Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Table of Contents

Table of Contents.....	2
Report Scope.....	3
Summary	4
Test Results Summary	5
Justifications, Descriptions, or Deviations.....	6
Applicable Standards, Specifications and Methods.....	8
Sample calculation(s).....	9
Document Revision Status	9
Definitions and Acronyms	10
Testing Facility	11
Calibrations and Accreditations.....	11
Testing Environmental Conditions and Dates	12
Detailed Test Results Section	13
Power Line Conducted Emissions	14
Radiated Emissions.....	21
6dB Bandwidth of Digitally Modulated Systems	36
Maximum conducted output power	46
Spurious Conducted Emissions.....	52
Power Spectral Density - DM	65
Appendix A – EUT Summary.....	70
Appendix B – EUT and Test Setup Photographs.....	72

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Report Scope

This report addresses the EMC verification testing and test results of the BLE-5100 Bluetooth Module Unit, herein referred to as EUT (Equipment Under Test) performed at TUV SUD Canada Labs.

The EUT was tested for compliance against the following standards:

RSS 247 Issue 1:2015 / FCC Part 15 Subpart C 15:2015

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 TUV SUD Canada Inc.

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

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Summary

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

EUT FCC Certification #, FCC ID:	QS83A8880
EUT Industry Canada Certification #, IC:	4562A-A38880
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Scott Drysdale

Client	Kaba Ilco Inc.	
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Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN	Restricted Bands for intentional operation	N/A	Pass
FCC 15.207 RSS-GEN	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-247 5.5	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)2 RSS-247 5.4.4	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-247 5.4.5	Antenna Gain	< 6 dBi	Pass See Justifications
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	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification and calculations
Overall Result			Pass

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



All tests were performed by Scott Drysdale.

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. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

Justifications, Descriptions, or Deviations

The following justifications for tests not performed descriptions, or deviations from the above listed specifications apply:

The duty cycle of the EUT during measurement was greater than or equal to 98%. Note that this duty cycle is performed in this special mode for test purposes only.

For the Antenna requirement specified in FCC 15.203 (RSS 247), this device can be configured with the following antenna(s), and the antenna connector type(s), and antenna gain; trace antenna.

This module was tested in a representative host, and is covered under the provisions of limited module approval, where the grantee attests they verify each host the module is to be installed in. Installation is performed by grantee prior to sale.

For the Restricted Bands of operation, the EUT is designed to only operate between 2.4 GHz and 2.4835 GHz.

For the power line conducted emissions requirements, the EUT is DC powered, however AC power line conducted emissions with powered via a representative AC-DC power source is included in this test report.

For the scope of this test report, radiated testing of the EUT host was pre-scanned in three orthogonal axis to maximize emissions. Additionally the antenna was scanned in each axis.

For maximum permissible exposure, this device operates at less than 1 Watt at 2.4GHz to 2.4835 GHz MHz and is designed to operate greater than 20 cm from personnel during normal operation. No testing is required, however worst case calculated exposure compliance is presented as separate exhibit.

A later revision of the standard may have been substituted in place of the previous dated referenced revision. The year of the specification used are listed under applicable standards. Using the later revision accomplishes the goal of ensuring compliance to the

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



intent of the previous specification, while allowing the laboratory to incorporate the extensions and clarifications made available by a later revision.

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Applicable Standards, Specifications and Methods

ANSI C63.4:2014 - Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

ANSI C63.10:2013 - American national standard for testing unlicensed wireless devices

CFR 47 FCC 15 - Code of Federal Regulations – Radio Frequency Devices

CISPR 22:2008 - Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement

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 247:2015 - Issue 1: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Sample calculation(s)

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)

Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)

Margin = 8.5 dB

Document Revision Status

Revision 1 - 1st release – June 6, 2016

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Definitions and Acronyms

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

AE – Auxiliary 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

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Testing Facility

Testing for EMC on the EUT was carried out at TUV SUD Canada labs in Montréal, Québec, 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 was performed under TUV SUD Canada was performed under accreditation by A2LA with a scope of accreditation listed under certificate number 2955.02.

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Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Testing Environmental Conditions and Dates

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

Date	Test	Init.	Temperature (°C)	Humidity (%)	Pressure (kPa)
Mar 2-7, 2016	Radiated	SD	20°C	30-45%	98 -103kPa
Mar 2-7, 2016	Antenna Conducted	SD	23°C	30-55%	98 -103kPa
Mar 2-7, 2016	Powerline conducted emissions	SD	23°C	30-55%	98 -103kPa

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Detailed Test Results Section

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

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 are as defined in 47 CFR FCC Part 15 Section 15.207

Method is as defined in ANSI C63.4.

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.

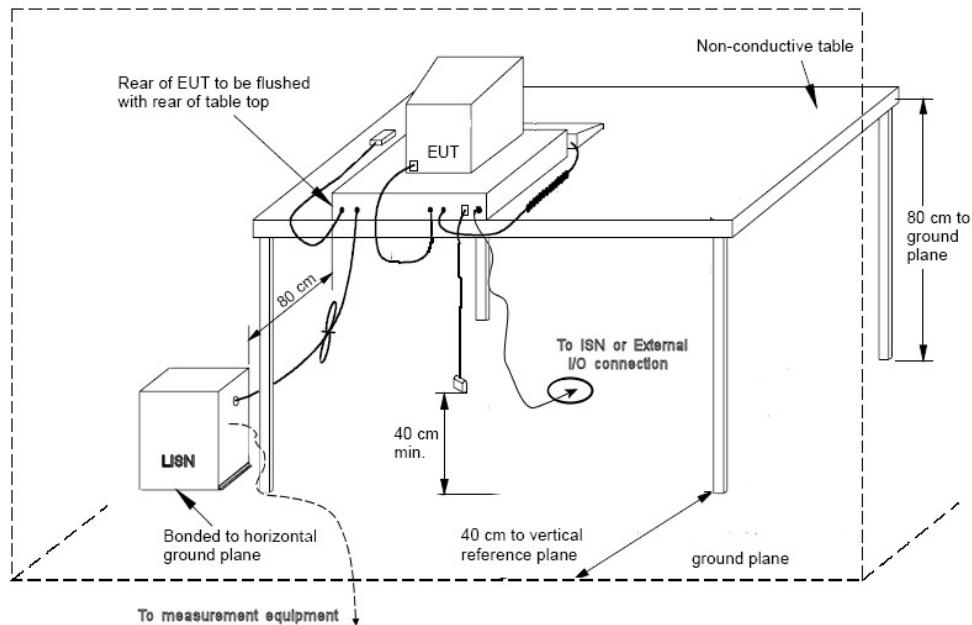
Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

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

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Typical Setup Diagram



Note: The vertical reference plane is optional as per ANSI C63.4 section 5.2.2

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

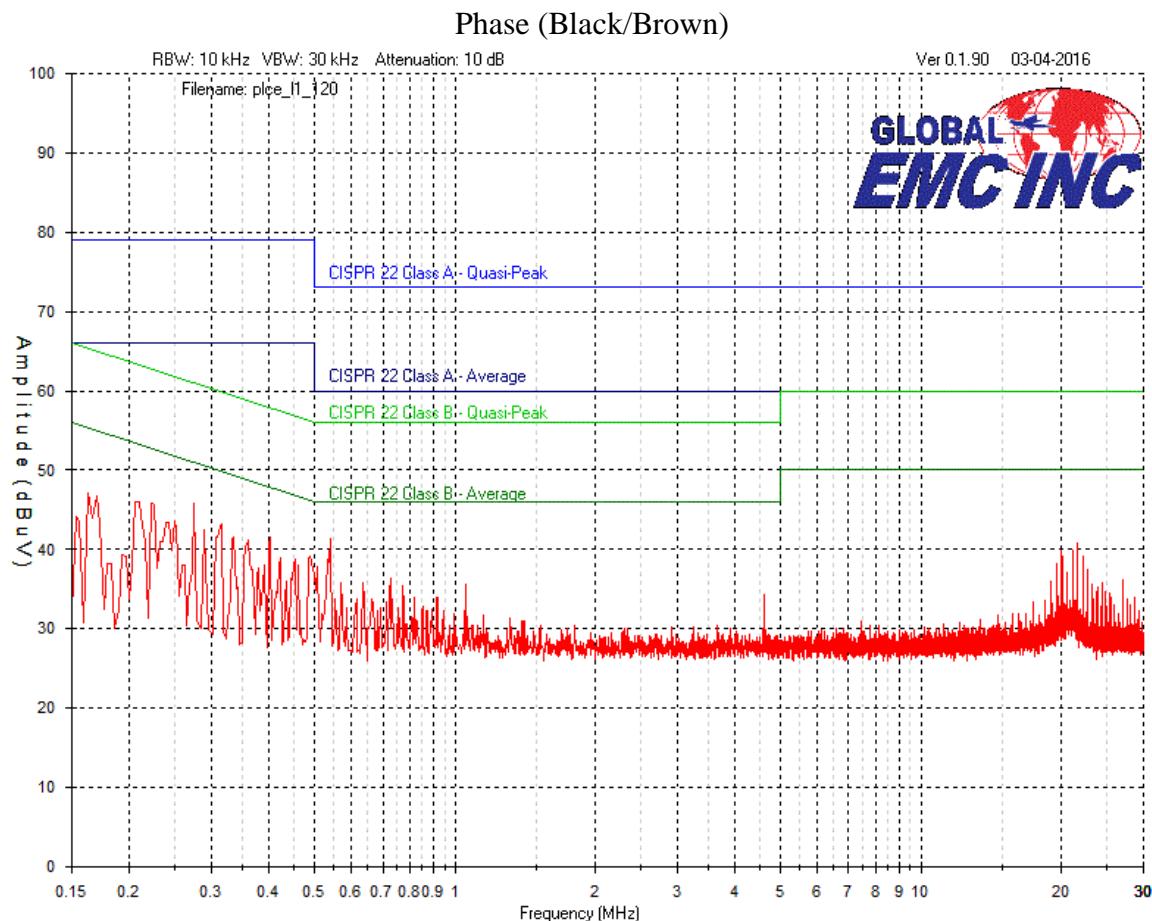
Measurement Uncertainty

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.

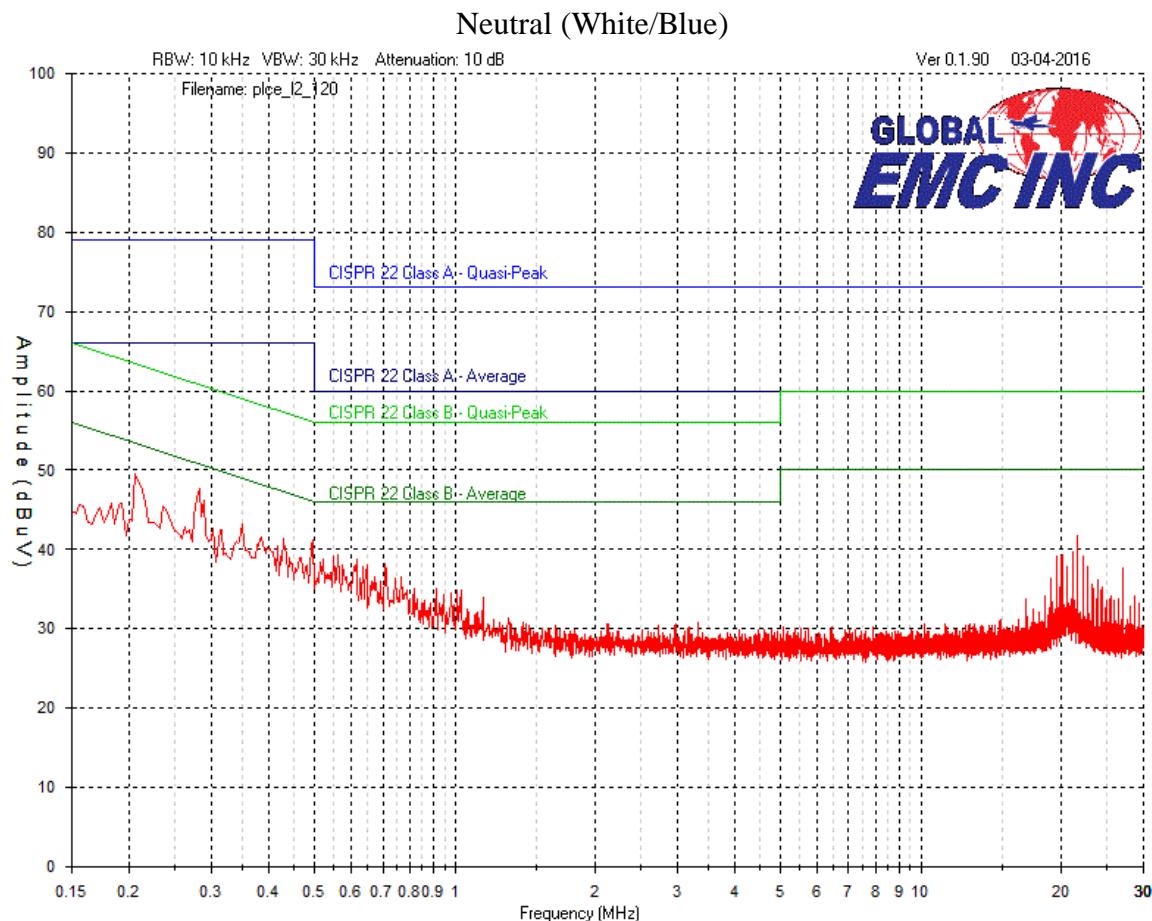
Preliminary Graphs

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 graph shown below is a peak measurement graph, 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.

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



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Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



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Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Final Measurements

Peak readings VS. Average Emissions reading table – Line 1

Frequency (MHz)	Raw (dBuV)	Atten Factor (dB)	LISN Factor (dB)	Cable (dB)	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
0.5414	31.2	10	0	0.2	41.4	46	4.6	Pass
0.276	35.2	10	0	0.6	45.8	50.9	5.1	Pass
0.4021	31.3	10	0	0.2	41.5	47.8	6.3	Pass
0.3158	32.7	10	0	0.5	43.2	49.8	6.6	Pass
0.223	35	10	0	0.9	45.9	52.7	6.8	Pass
0.4883	28.9	10	0	0.2	39.1	46.2	7.1	Pass

Peak readings Vs. Average Emissions reading table – Line 2

Frequency (MHz)	Raw (dBuV)	Atten Factor (dB)	LISN Factor (dB)	Cable (dB)	Level (dBuV)	Limit (dB)	Margin (dB)	Pass/Fail
0.2827	37	10	0	0.6	47.6	50.7	3.1	Pass
0.2064	38.6	10	0	1	49.6	53.3	3.7	Pass
21.715	31	10	0.2	0.5	41.7	50	8.3	Pass
21.1777	29	10	0.2	0.5	39.7	50	10.3	Pass
20.1329	28.7	10	0.2	0.5	39.4	50	10.6	Pass
20.05	28.5	10	0.2	0.5	39.2	50	10.8	Pass

Note: See ‘Appendix B – EUT & Test Setup Photographs’ for photos showing the test set-up for the highest line conducted emission

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Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset#
HP Spectrum Analyzer	8566B	HP	1-28-15	1-28-17	4169
Spectrum Analyzer Display	8566B	HP	1-28-15	1-28-17	4168
Quasi Peak Adapter	85650A	HP	1-28-15	1-28-17	4170
LISN	FCC-LISN-50/250-16-2-01	FCC	3-20-15	3-20-17	4005
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4025
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4026
Attenuator 10 dB	FP-50-10	Trilithic	1-28-15	1-28-17	4027

1: For cables and attenuators, verification dates apply.

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Radiated Emissions

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.

The limits are as defined in FCC Part 15, Section 15.209:

0.009 MHz – 0.490 MHz, 2400/F(kHz) uV/m at 300 m¹
 0.490 MHz – 1.705 MHz, 24000/F(kHz) uV/m at 30 m¹
 1.705 MHz – 30 MHz, 30 uV/m at 30 m¹
 30 MHz – 88 MHz, 100 uV/m (40.0 dBuV/m¹) at 3 m
 88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m¹) at 3 m
 216 MHz – 960 MHz, 200 uV/m (46.0 dBuV/m¹) at 3 m
 Above 960 MHz, 500 uV/m (54.0 dBuV/m¹) at 3 m
 Above 1000 MHz, 500 uV/m (54 dBuV/m²) at 3m
 Above 1000 MHz, 5000 uV/m (74 dBuV/m³) at 3m

¹Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

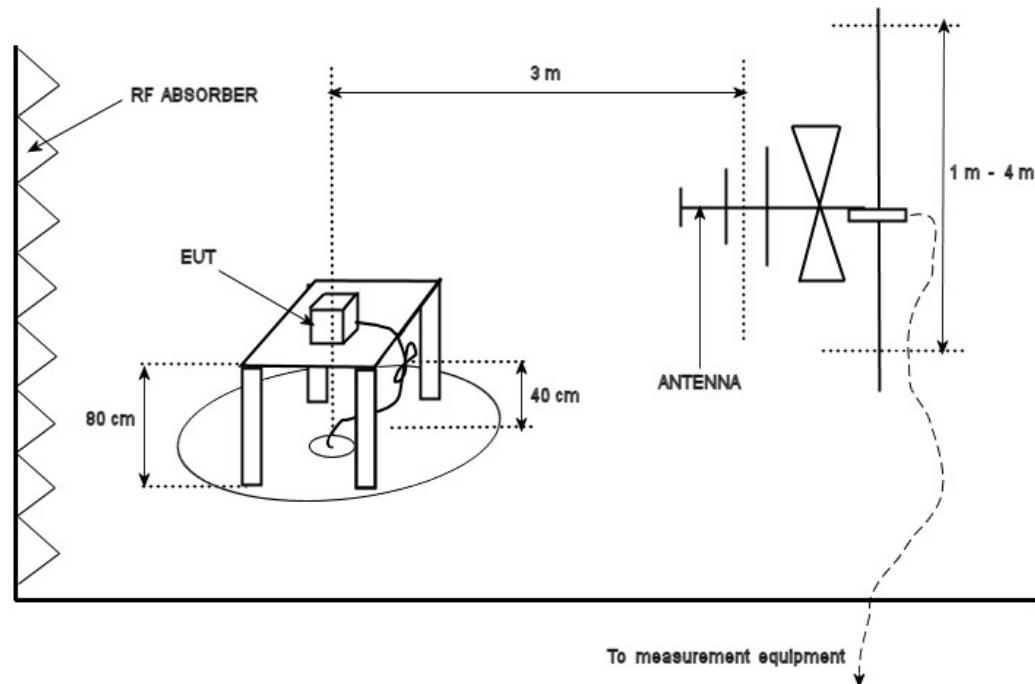
²Limit is with 1 MHz measurement bandwidth and using an Average detector

³Limit is with 1 MHz measurement bandwidth and using a Peak detector

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Typical Radiated Emissions Setup



Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

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 graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater than 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.

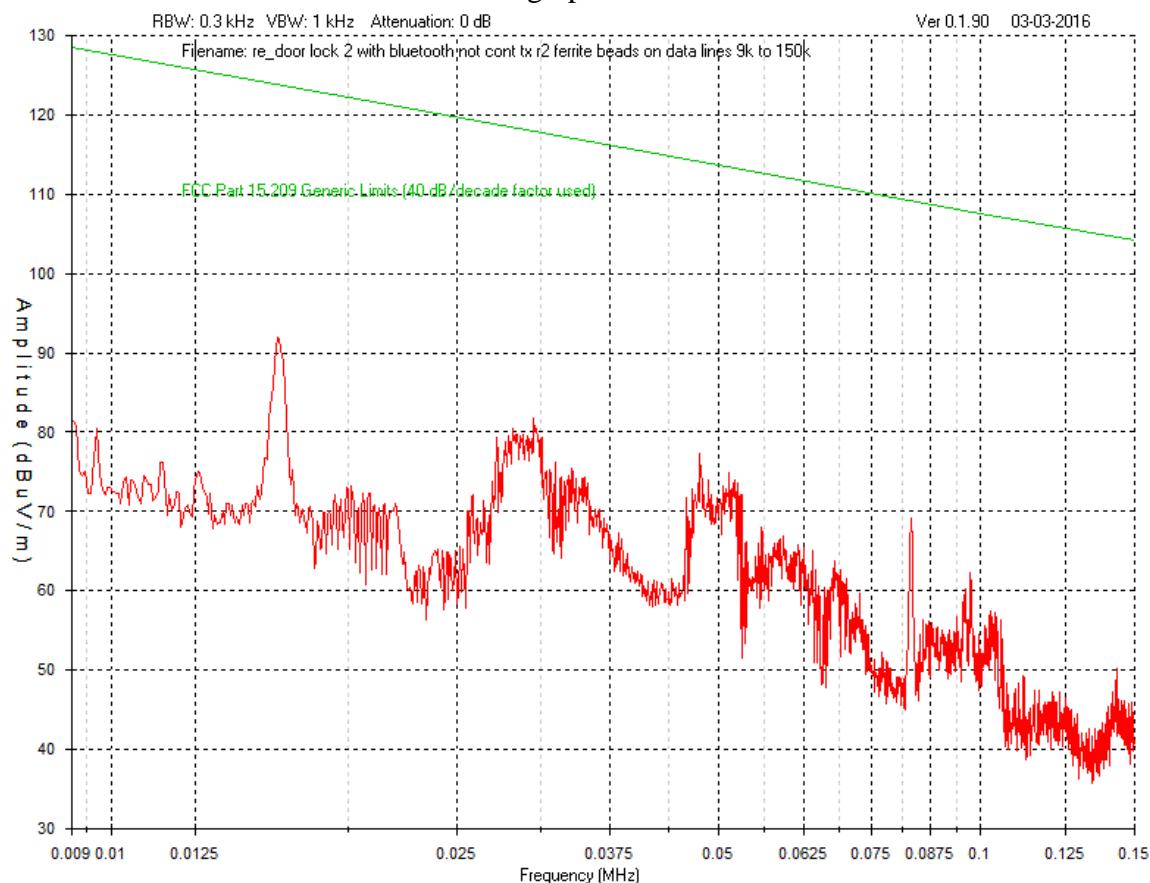
In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of a 25 GHz).

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.

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



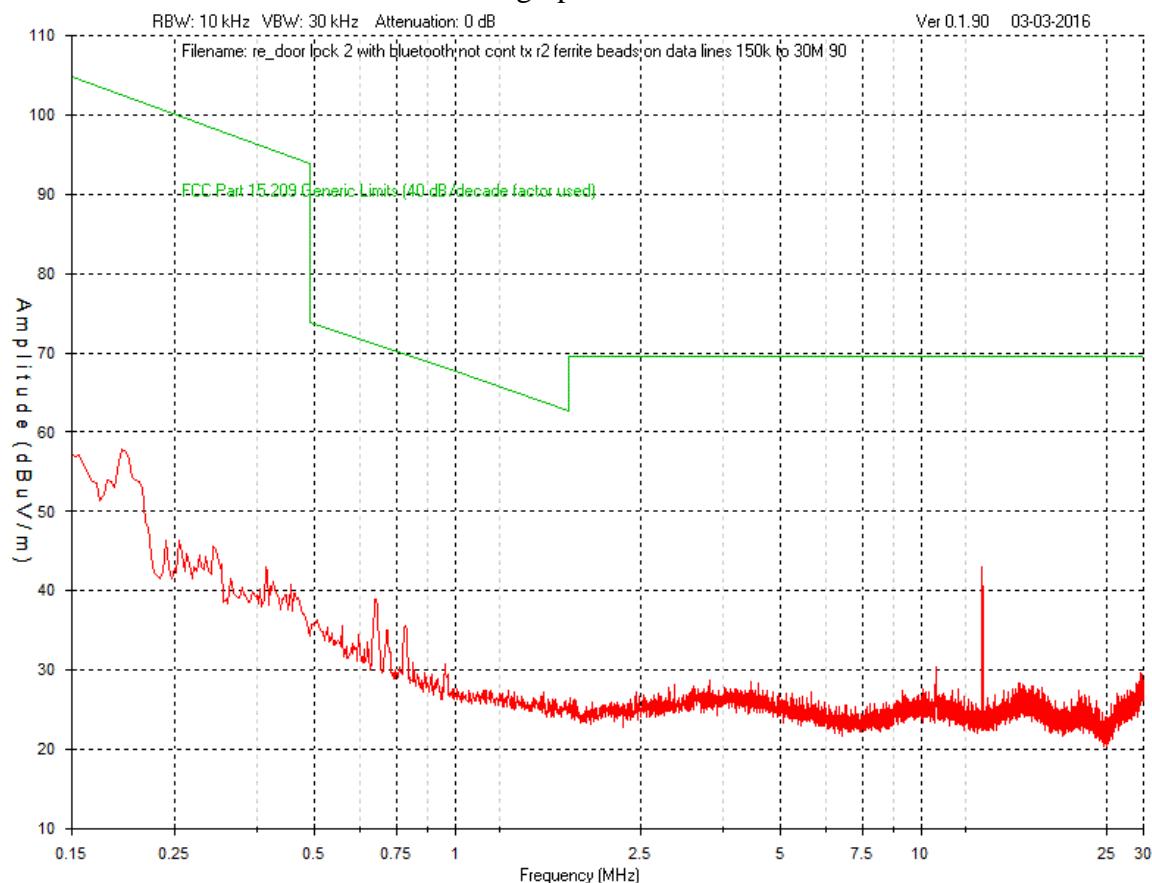
Peak emissions graph - 9 kHz to 150 KHz



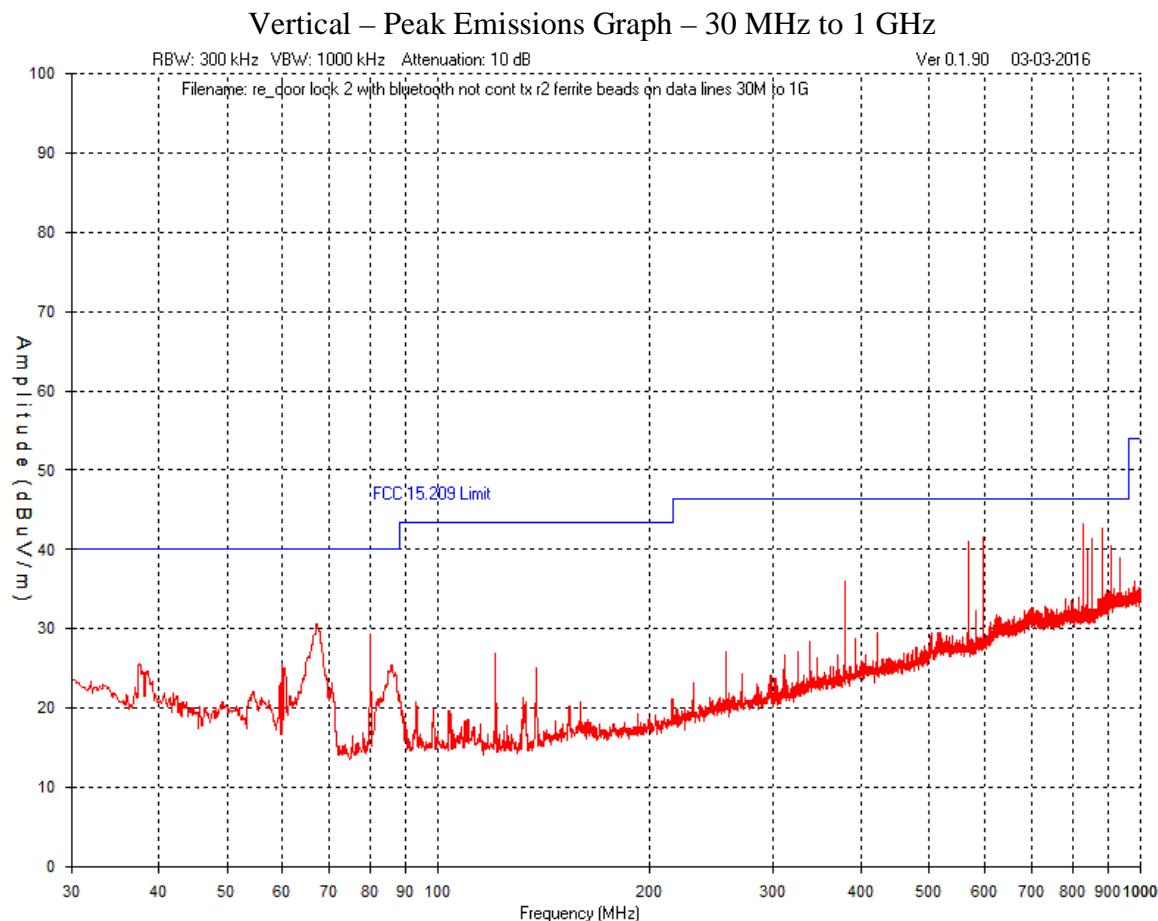
Client	Kaba Ilco Inc.
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Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Peak emissions graph - 150 kHz to 30 MHz

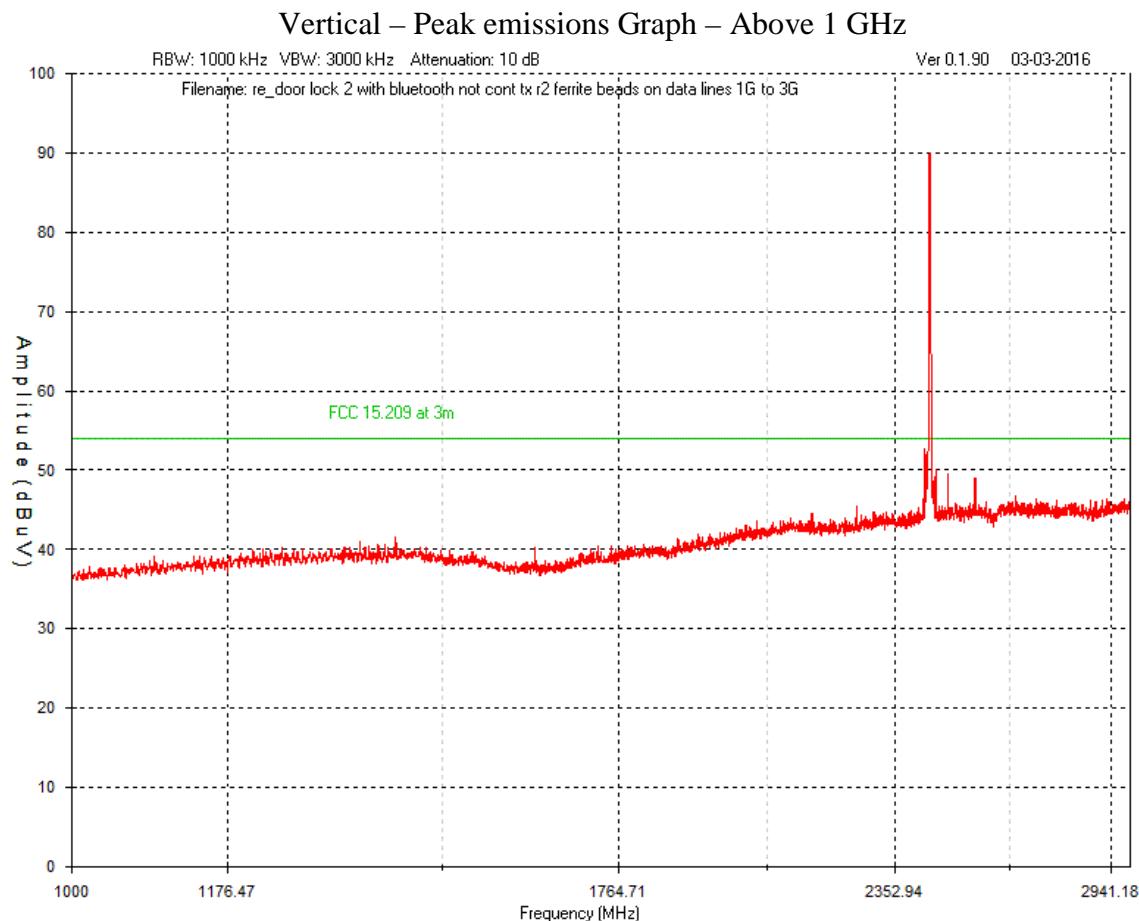


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Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



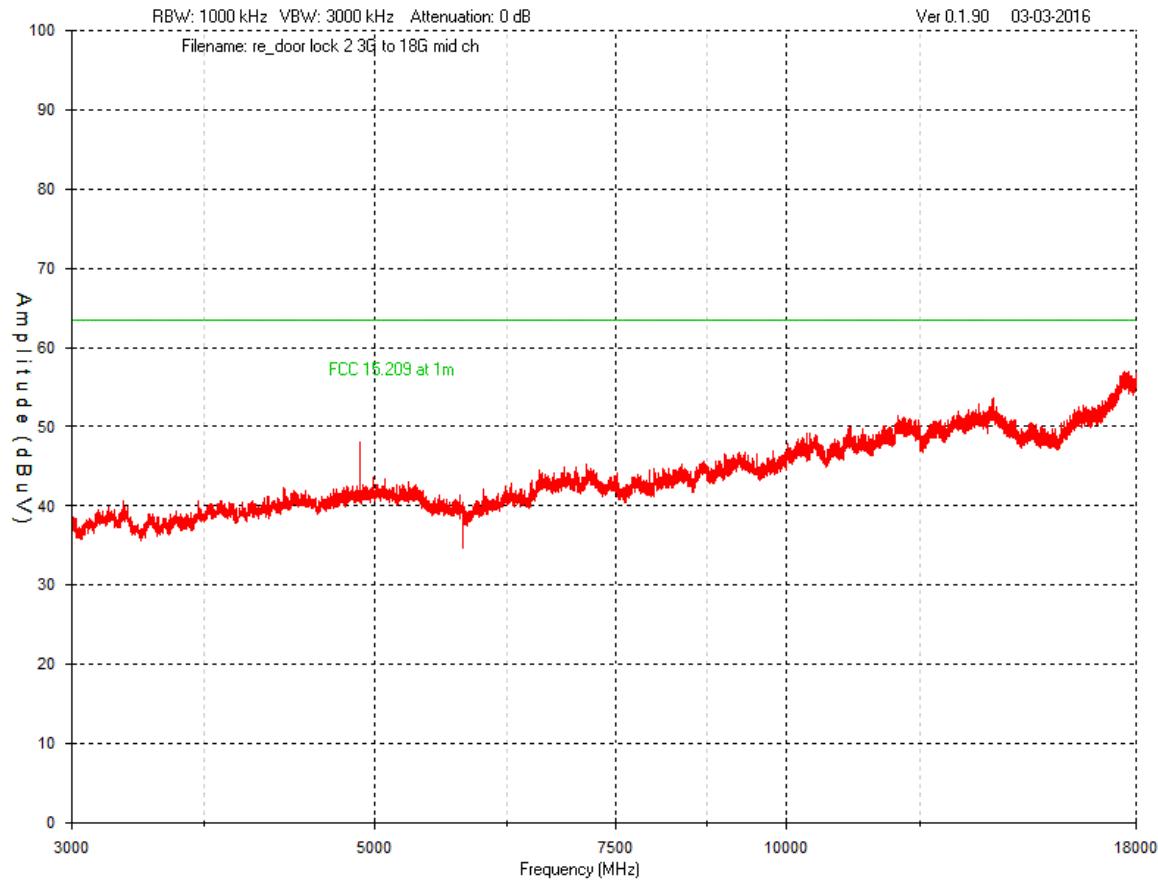
Low, Mid and High scanned, worst case or representative shown above.

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



Mid-channel shown as worst case. See table for details.

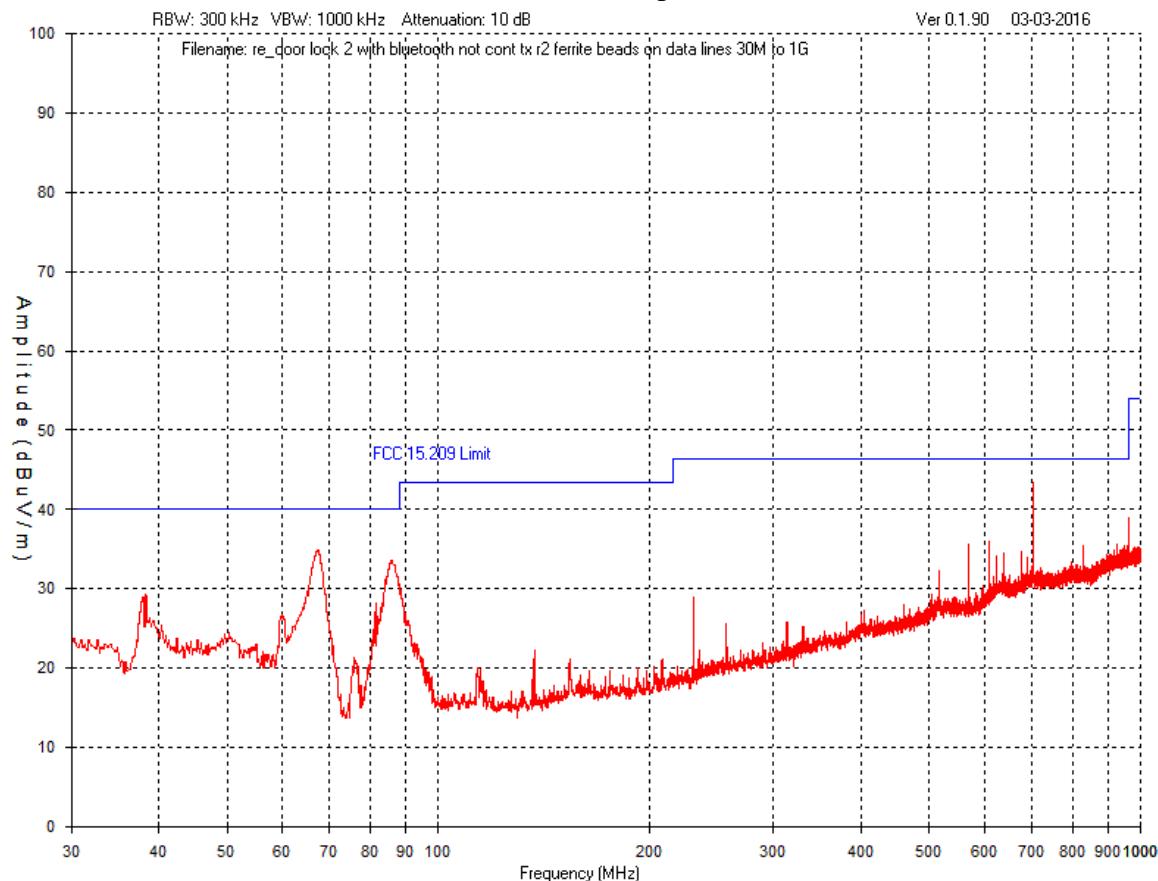
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Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Note: Emissions were scanned to 25 GHz, and no emissions above 18 GHz were detected. The system noise floor was below the applicable limit.

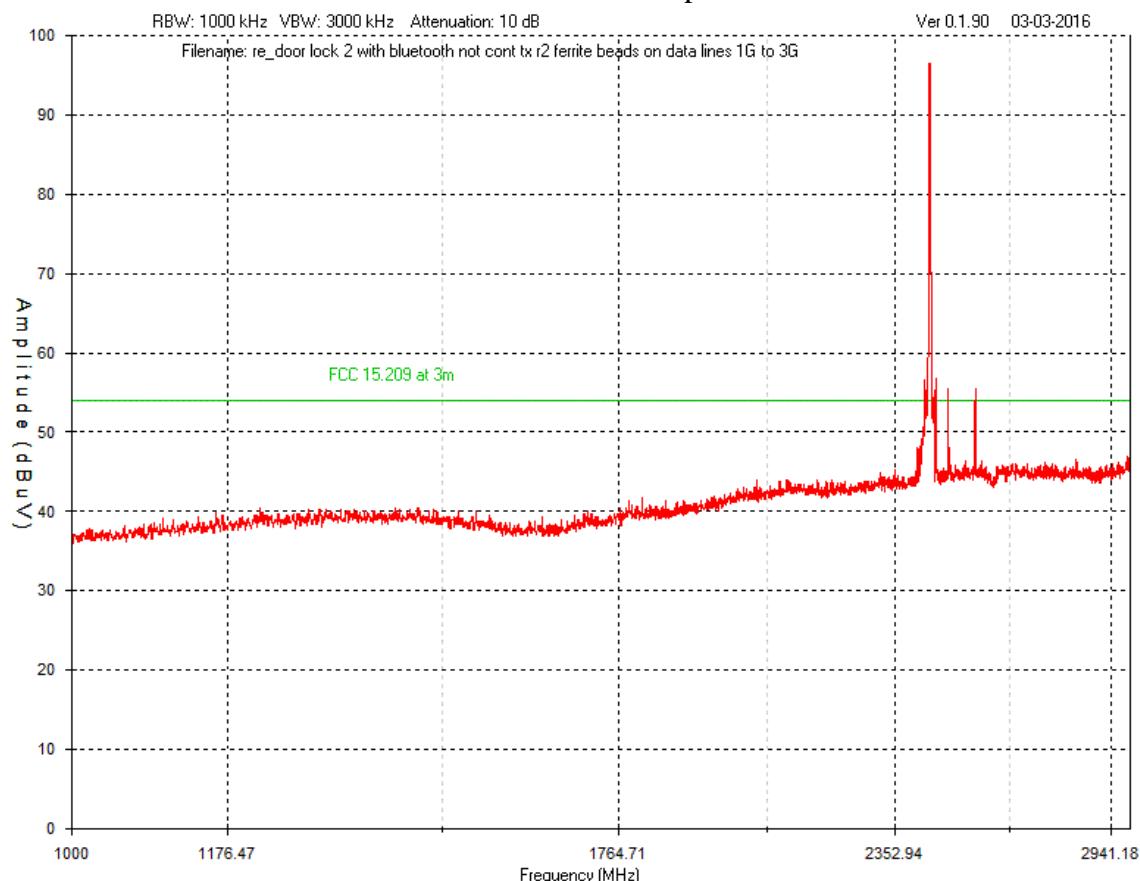
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Product	BLE-5100 Bluetooth Module	
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Horizontal – Peak Emissions Graph – 30 MHz to 1 GHz



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Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

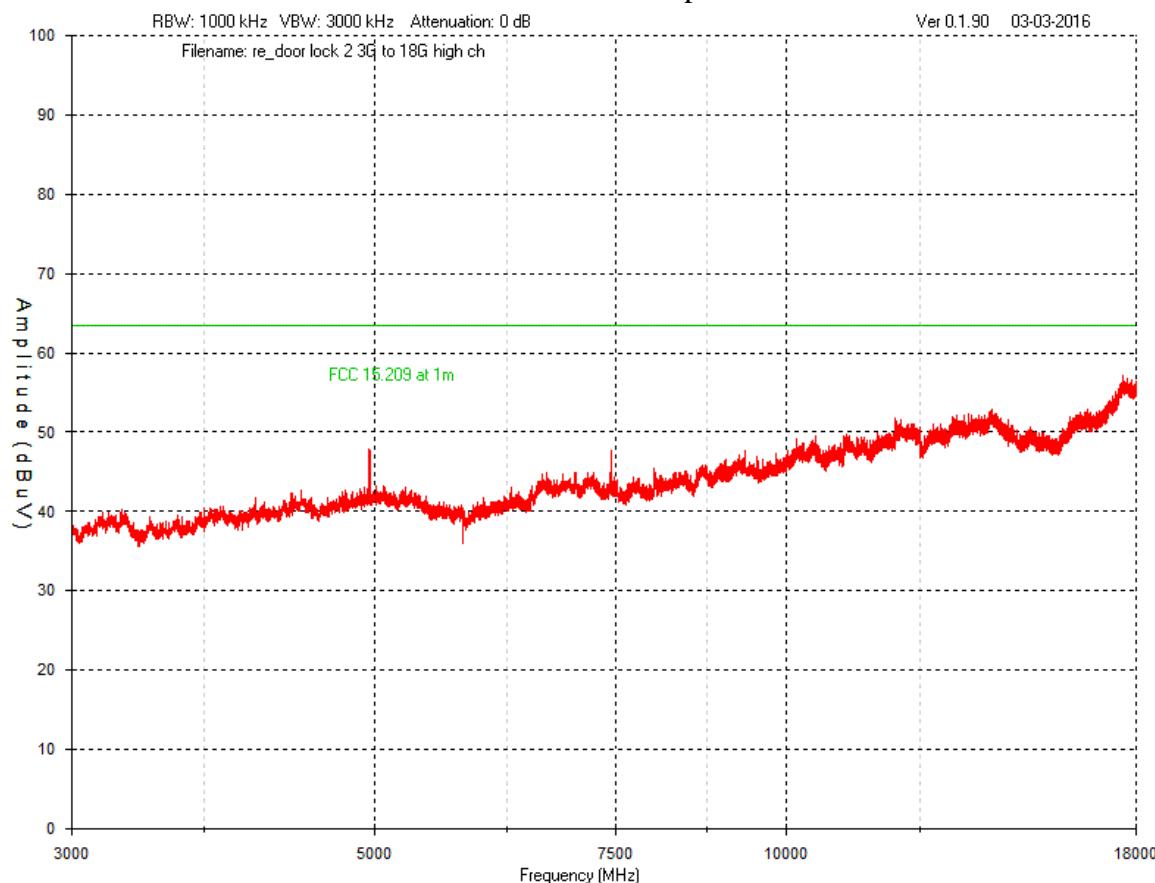
Horizontal – Peak Emissions Graph – Above 1 GHz



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Horizontal – Peak Emissions Graph – Above 1 GHz



Note: Emissions were scanned to 26 GHz, and no emissions were detected above 18- GHz and the system noise floor did not exceed the applicable limit

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Final Measurements

Note: In accordance with 15.247(d), only frequencies exceeding the 15.209 limit that occur within the bands listed in 15.205, need to be verified with a final detector.

For information purposes, the fundamental was measured at 3 meters.

Client	Kaba Ilco Inc.	
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Peak Emission Vs. QP Limit Reading Table – Vertical

Frequency (MHz)	Det. mode	Raw (dBuV)	Ant. (dB/m)	Att. (dB)	Cab. (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
826.758	PEAK	47.6	22.7	3	2.6	-32.8	43.1	46.4	3.3	Pass
880.205	PEAK	46.1	23.3	3	2.7	-32.5	42.6	46.4	3.8	Pass
595.51	PEAK	49.7	19.9	3	2.2	-33.2	41.6	46.4	4.8	Pass
853.239	PEAK	45.9	22.5	3	2.7	-32.6	41.5	46.4	4.9	Pass
568.641	PEAK	49.6	19.4	3	2.2	-33.2	41	46.4	5.4	Pass
908.529	PEAK	42.9	24	3	2.8	-32.3	40.4	46.4	6	Pass

Emission Reading Table – Horizontal

Frequency (MHz)	Det. mode	Raw (dBuV)	Ant. (dB/m)	Att. (dB)	Cab. (dB)	Amp (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
703.665	PEAK	48.4	22.7	3	2.4	-33	43.5	46.4	2.9	Pass
67.345	PEAK	57.2	7.3	3	0.8	-33.4	34.9	40	5.1	Pass
85.775	PEAK	54.9	8.2	3	0.9	-33.4	33.6	40	6.4	Pass
608.799	PEAK	43.3	20.6	3	2.3	-33.2	36	46.4	10.4	Pass
568.641	PEAK	44.3	19.4	3	2.2	-33.2	35.7	46.4	10.7	Pass
38.342	PEAK	46	12.4	3	0.6	-32.7	29.3	40	10.7	Pass

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Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Frequency (MHz)	Detection mode (Q-Peak)	Antenna polarity (Horz/Vert)	Raw signal dB(µV)	Antenna factor dB	Cable loss dB + Preselector	Attenuator dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	MARGIN dB(µV)	Result
Low Channel											
2402	Peak	Horz	95.2	30.6	5.2	0.0	33.0	98.0			PASS
2402	PEAK 3	Horz	96.5	30.6	5.2	0.0	33.0	99.3			PASS
2402	Peak	Vert	87.9	30.6	5.2	0.0	33.0	90.7			PASS
2402	PEAK 3	Vert	89.2	30.6	5.2	0.0	33.0	92.0			PASS
2402	Avg	Vert		30.6	5.2	0.0	33.0	2.8			PASS
2390	Peak	Horz	49.2	30.6	5.2	0.0	33.0	52.0	74.0	22.0	PASS
2390	Avg	Horz	32.9	30.6	5.2	0.0	33.0	35.7	54.0	18.3	PASS
2390	Peak	Vert	42.3	30.6	5.2	0.0	33.0	45.1	74.0	28.9	PASS
2390	Avg	Vert	32.5	30.6	5.2	0.0	33.0	35.3	54.0	18.7	PASS
2556.33	AVG	Horz	43.8	29.6	5.2	0.0	33.1	45.5	54	8.5	PASS
2485	AVG	Horz	44	29.4	5.1	0.0	33.1	45.4	54	8.6	Pass
Mid channel											
2445	Peak	Horz	95.1	30.6	5.2	0.0	33.0	97.9			Pass
2445	Peak	Vert	87.6	30.6	5.2	0.0	33.0	90.4			Pass
High channel											
2480	Peak	Horz	87.3	30.6	5.2	0.0	33.0	90.1			PASS
2480	Peak	Vert	95.0	30.6	5.2	0.0	33.0	97.8			PASS
2483.5	Peak	Horz	45.5	30.6	5.2	0.0	33.0	48.3	54.0	5.7	PASS
2483.5	Peak	Vert	46.6	30.6	5.2	0.0	33.0	49.4	54.0	4.6	PASS

Note: Fundamental readings were obtained for informational purposes only.

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date ¹	Next Calibration Date ¹	Asset #
Spectrum Analyzer Display	8566B	HP	1-28-15	1-28-17	4168
Spectrum Analyzer	8566B	HP	1-28-15	1-28-17	4169
Quasi Peak Adapter	85650A	HP	1-28-15	1-28-17	4170
BiLog Antenna	3142-C	ETS	2-10-15	2-10-17	137
Horn Antenna	ATH1G18G	AR	4-23-15	4-23-17	4003
Biconical Antenna	EM-6913	Electro-Metrics	4/28/15	4/28/17	4060
Log Periodic Antenna	LPA-25	Electro-Metrics	4/14/15	4/14/17	4087
Attenuator 3 dB	FP-50-3	Trilithic	1-28-15	1-28-17	4028
LNA pre-amp	LNA-1450	RF Bay Inc.	7/22/15	7/22/16	4089
1-26.5GHz preamp	8449B	Agilent	9-9-14	9-9-16	6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4026
Emission software	0.1.87	Global EMC	1-28-15	1-28-17	58

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

6dB 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 and RSS 247.

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.

Method

The DTS bandwidth method is as per FCC KDB 558074 Section 8.1 for the 6 dB BW. For the 20 dB BW, FCC KDB 558074, Section 2.0 references ANSI C63.10 for occupied bandwidth. ANSI C63.10 Section 6.9.1 was used for occupied bandwidth.

Results

The EUT passed. The minimum 6 dB BW measured was 672 kHz. For information purposes, the 99% occupied BW was measured to be 1.102 MHz

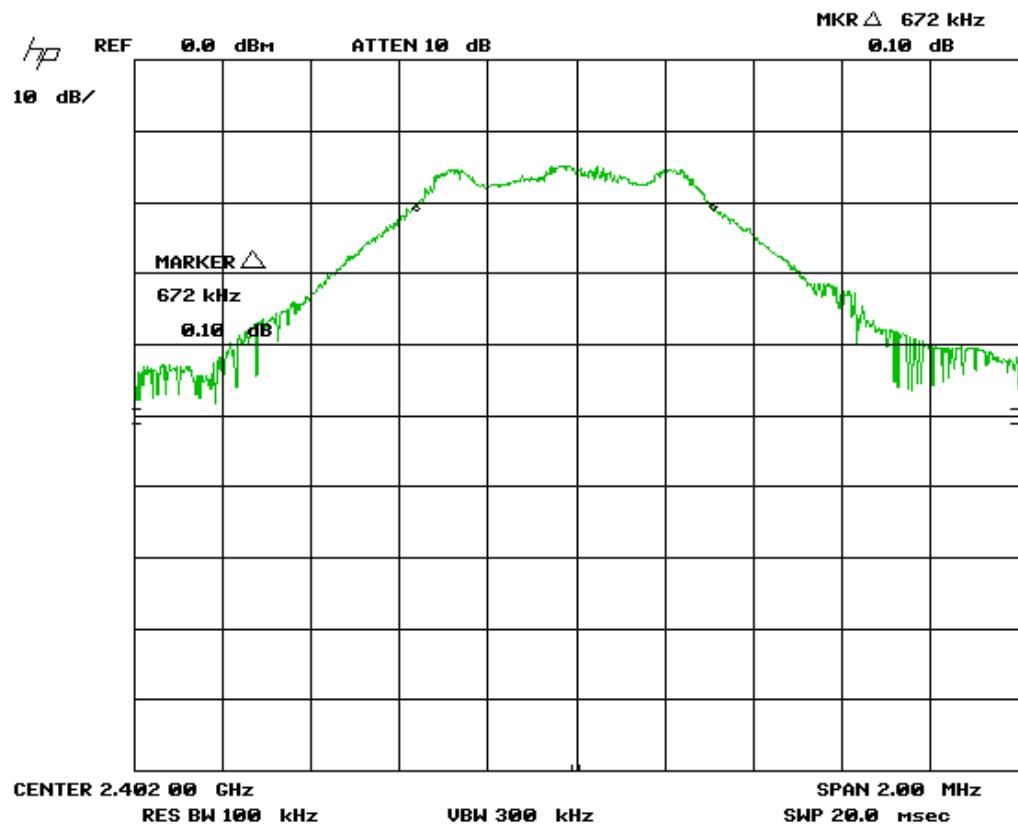
Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



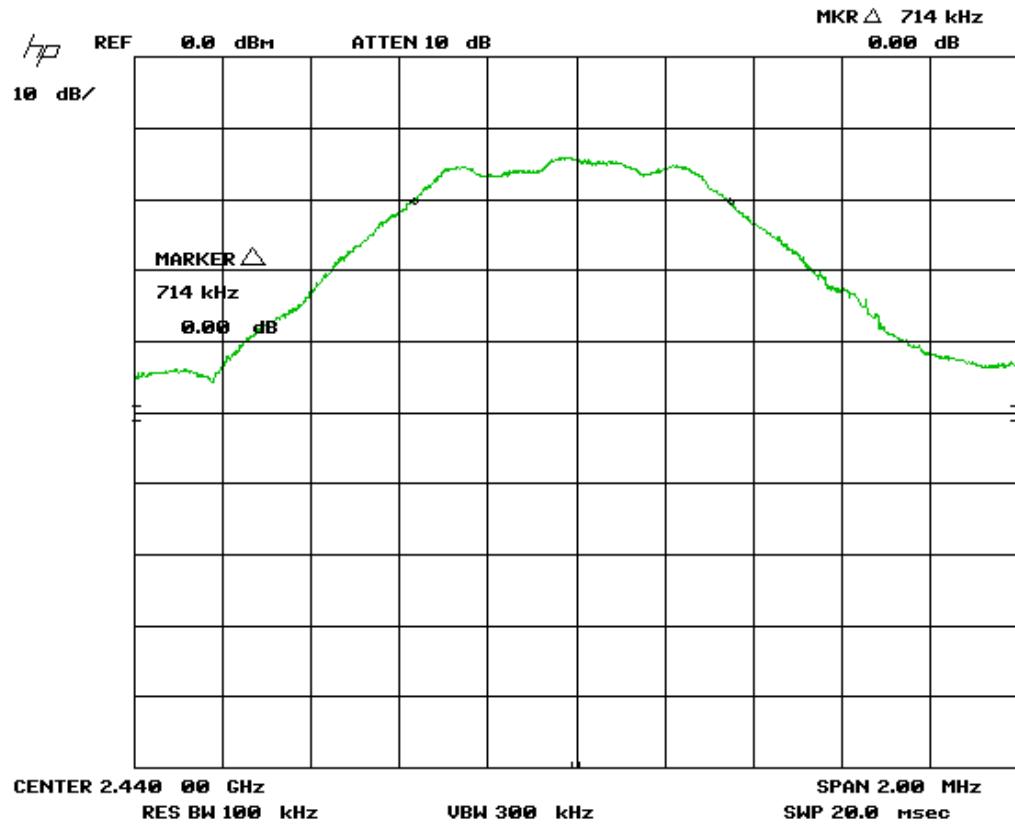
Graph(s)

The graphs shown below shows the channel spacing 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 then 1 minute.

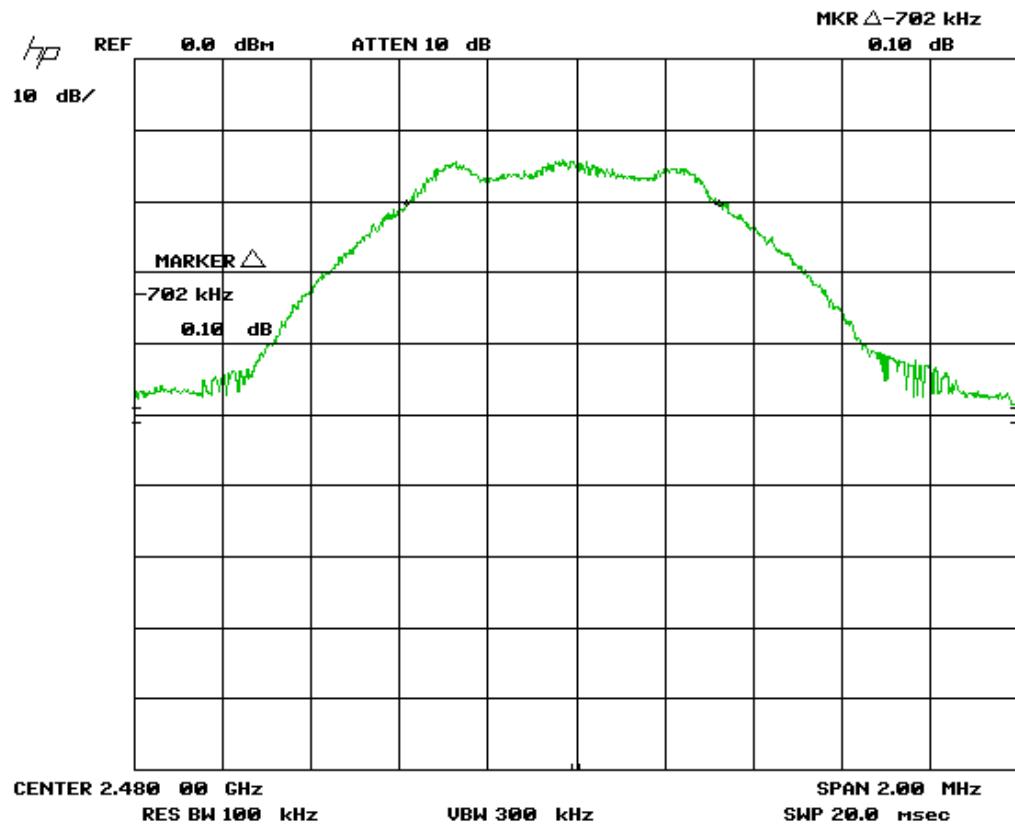
Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15

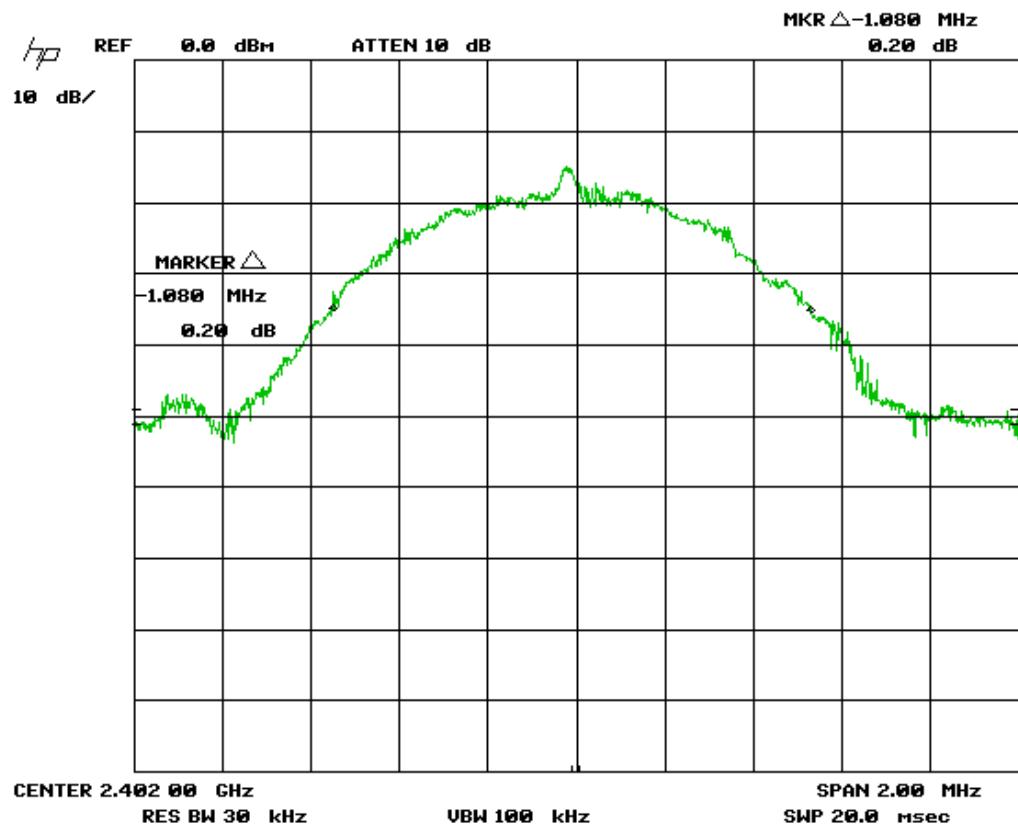


6 dB BW Low = 672 kHz

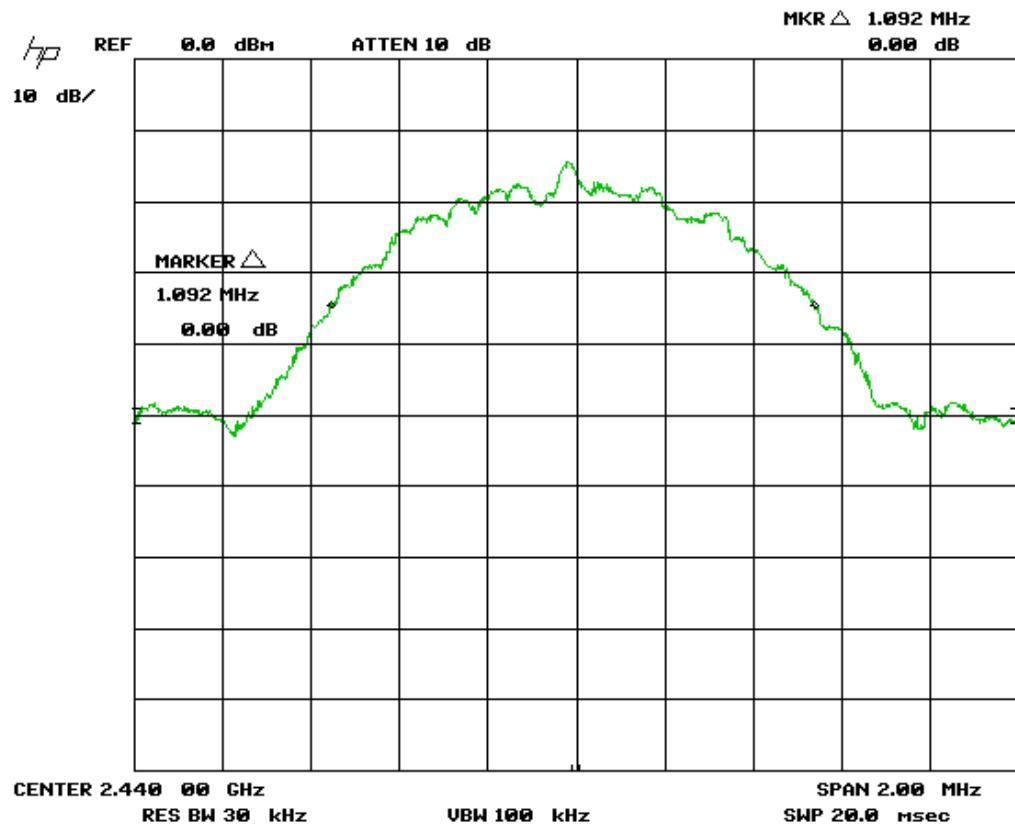
6 dB BW Mid = 714 kHz

6 dB BW High = 702 kHz

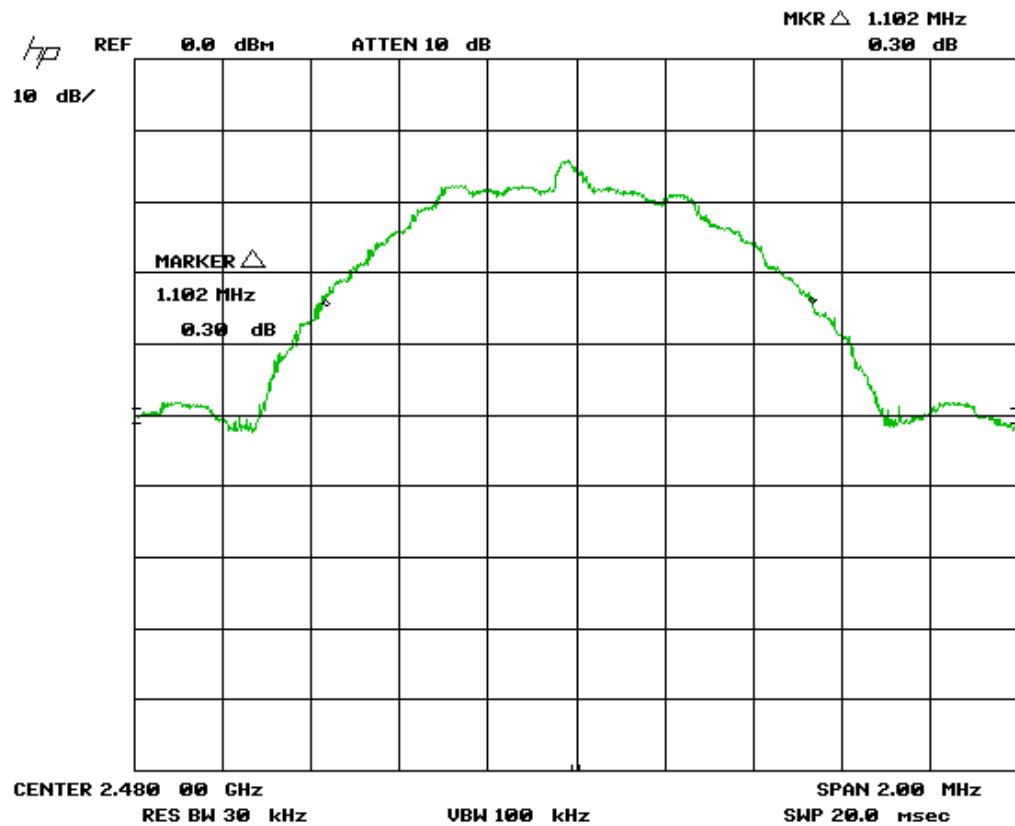
Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Occupied bw low = 1.08 MHz

Occupied bw mid = 1.092 MHz

Occupied bw high = 1.102 MHz

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



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

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 20 dB	FP-50-20	Trilithic	1-28-15	1-28-17	4038
Spectrum Analyzer	ESL6	Rohde & Schwarz	Nov 25, 2015	Nov 25, 2017	4169
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4029

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

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Maximum conducted output power

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.

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.

Method

Method was as per ANSI C63.10.

Results

The EUT passed. The maximum conducted (peak) output power measured was 29.63 dBm

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Table(s)

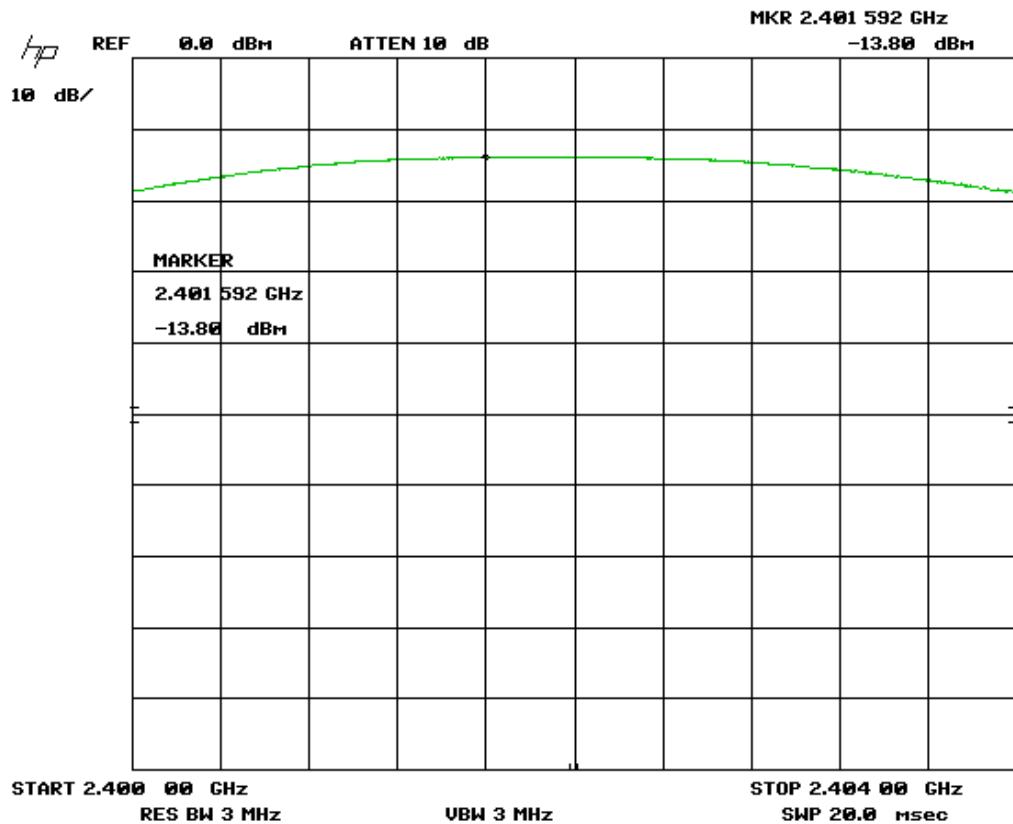
The tables shown below shows the Maximum conducted (peak) output power output of the device during the antenna conducted measurement during transmit operation of the EUT.

Band	Frequency (GHz)	Raw Peak Reading (dBm)	Atten.+Cable Factor(dB)	Maximum conducted (peak) output power (dBm)
Low	2.402	-13.8	16	2.2
Medium	2.440	-13.5	16	2.5
High	2.480	-13.6	16	2.4

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



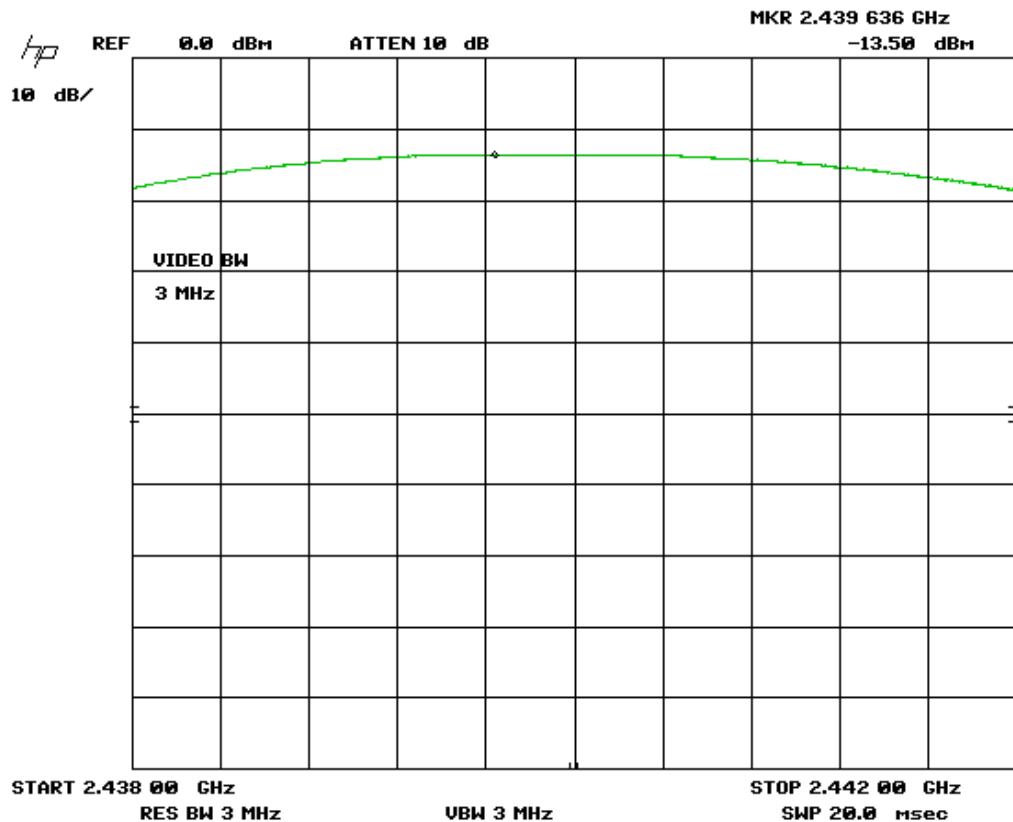
Low Channel– Maximum conducted peak output power



Note: 16 dB external loss.

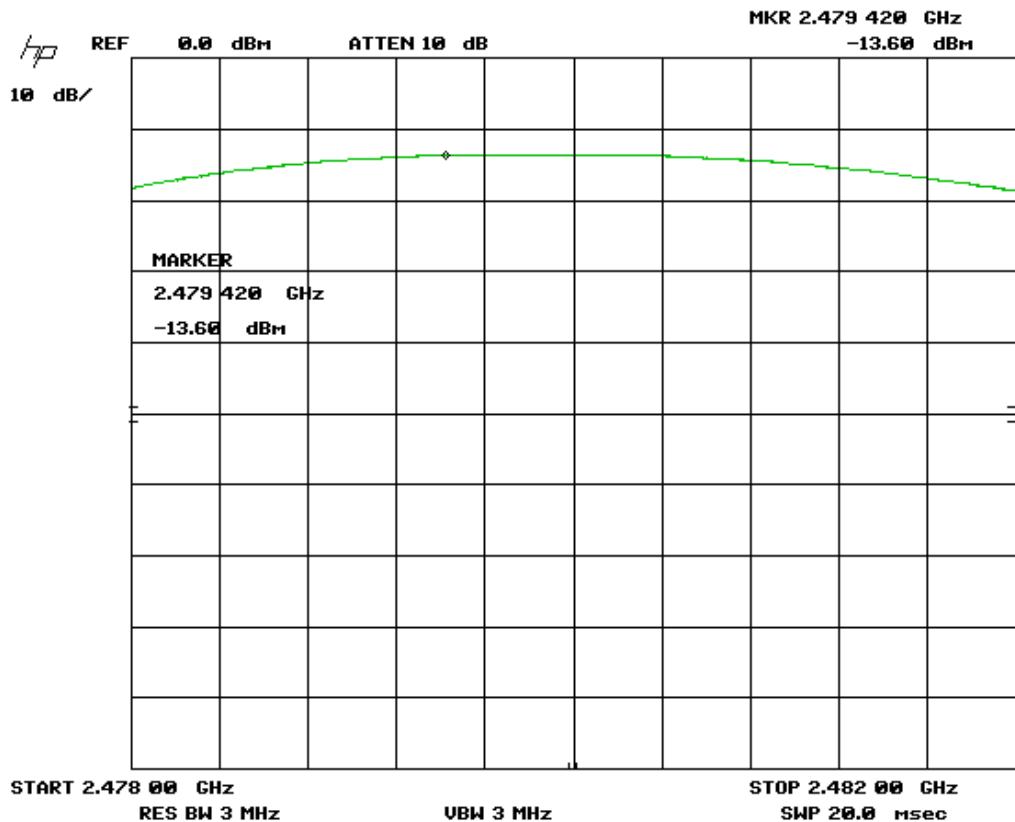
Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Mid Channel– Maximum conducted peak output power



Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

High Channel – Maximum conducted peak output power.



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

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 30 dB	FP-50-30	Trilithic	1-28-15	1-28-17	4041
Spectrum Analyzer	ESL6	Rohde & Schwarz	11-25-15	11-25-17	160
RF Cable 0.5m	LMR-400-0.5M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4029

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

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Spurious Conducted Emissions

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 15.247(d). As peak power was used, 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.

Method

Method was as per Ansi C 63.4.

Results

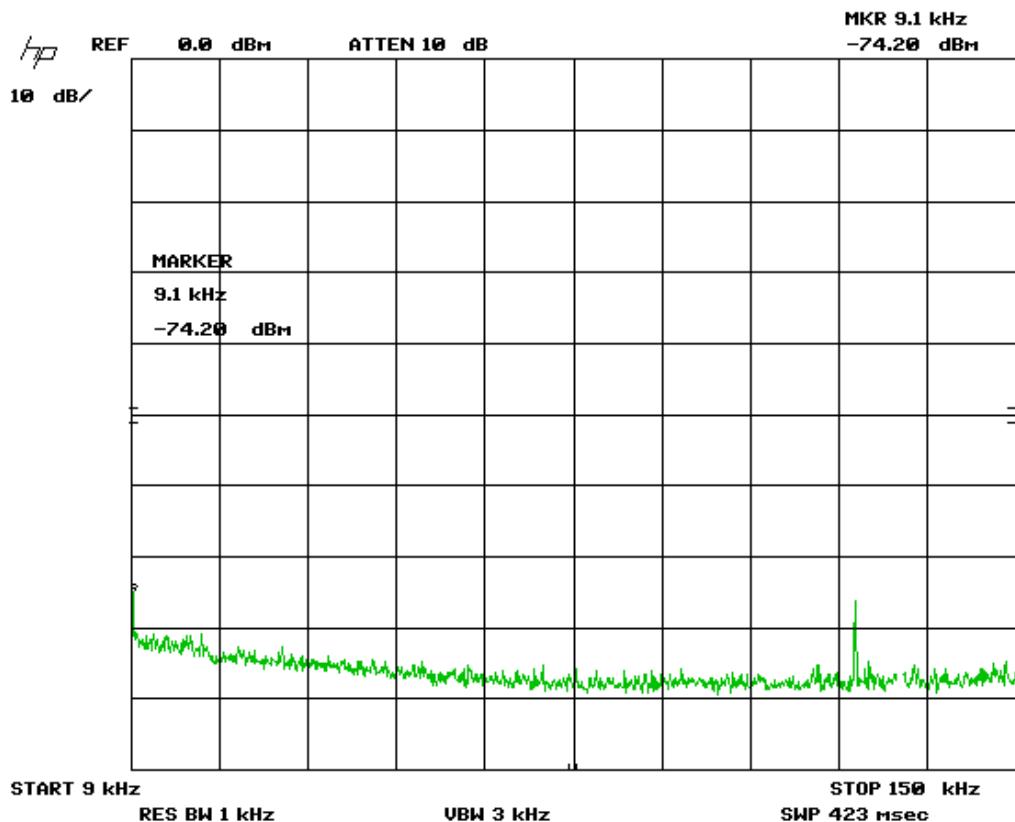
The EUT pass. Low, middle and high band was measured. The worst case for each mode is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band.

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

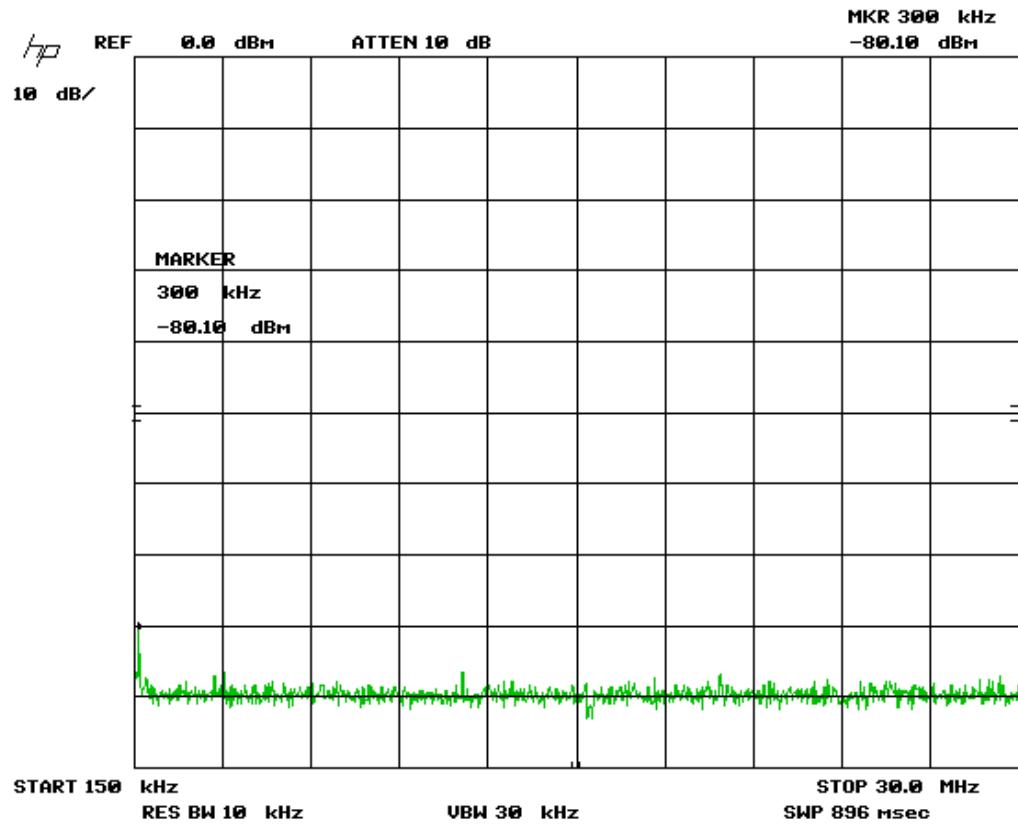
Graph(s)

The graphs shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. Note there was 20 dB of external attenuation taken during this measurement.

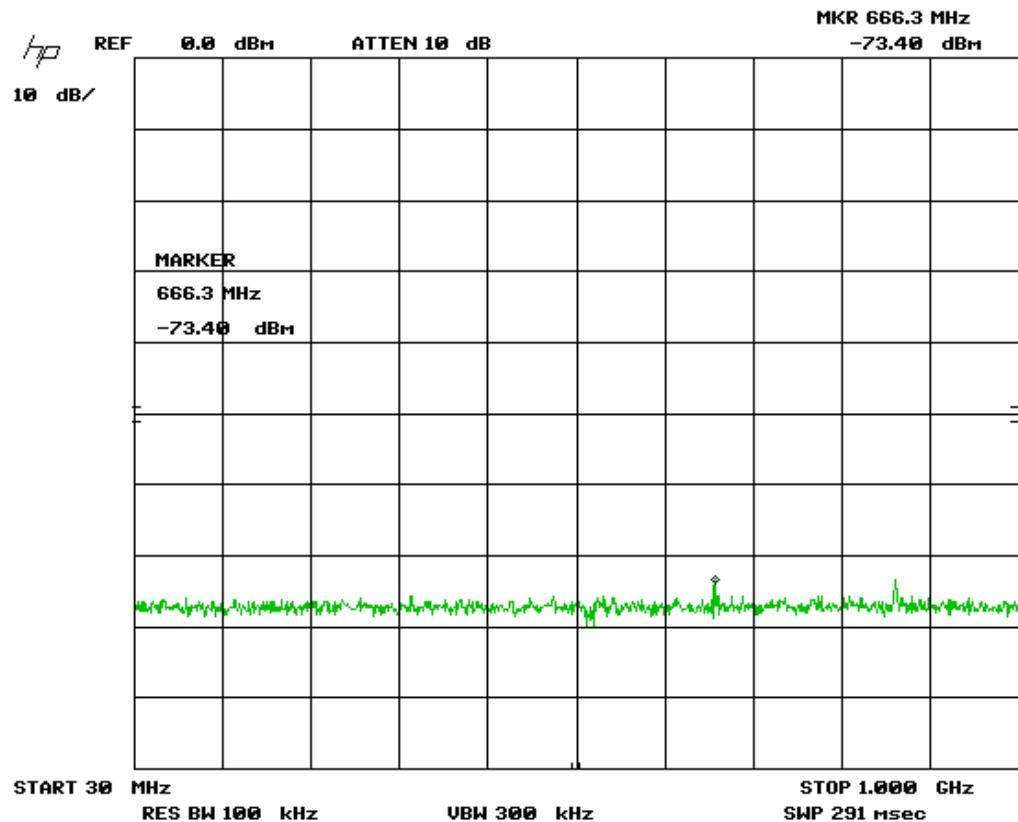
Frequencies below fundamental



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



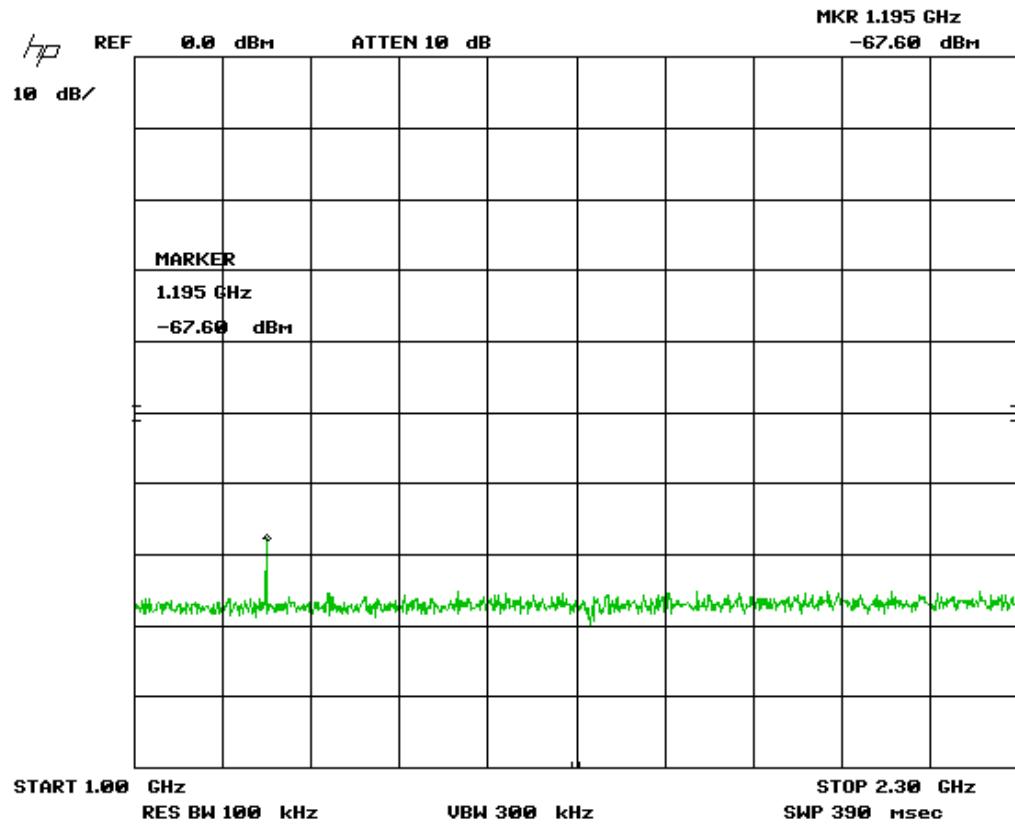
Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



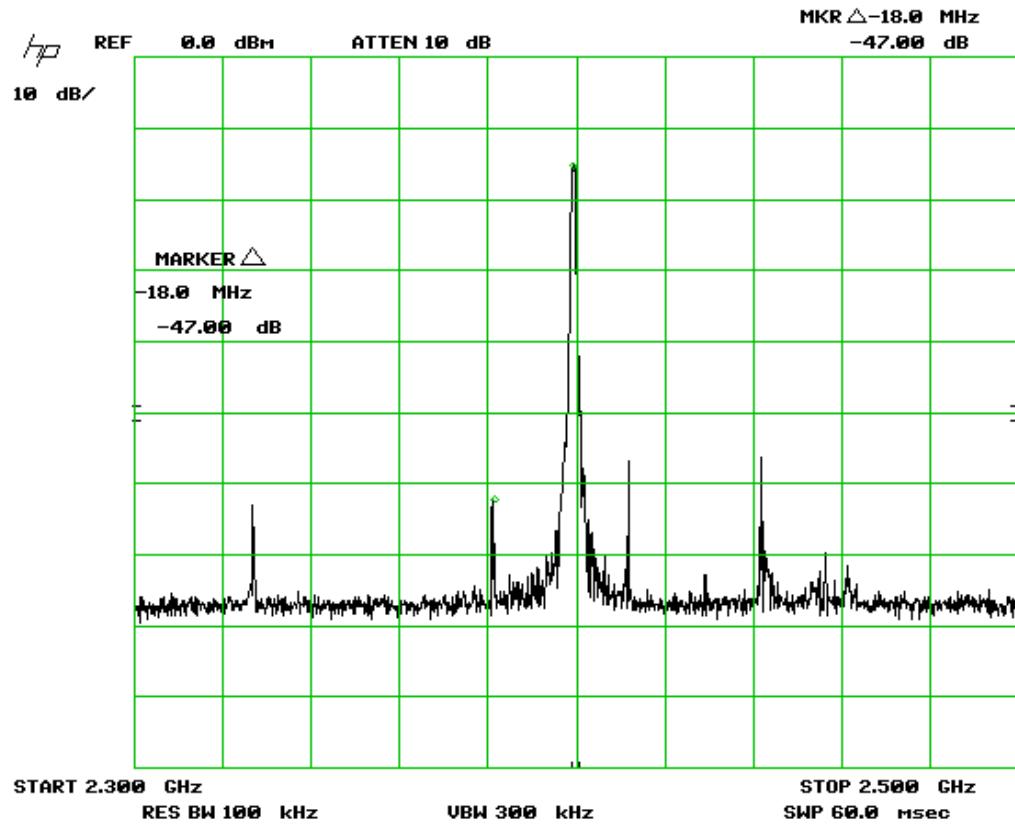
Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15

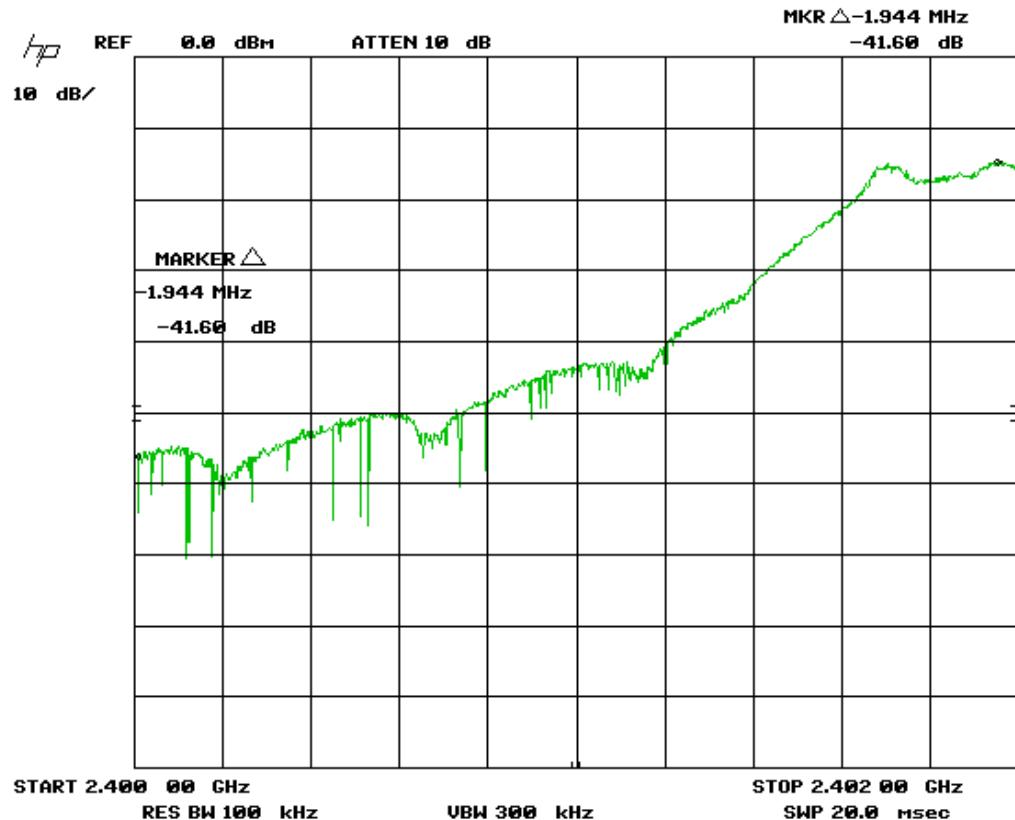


Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15

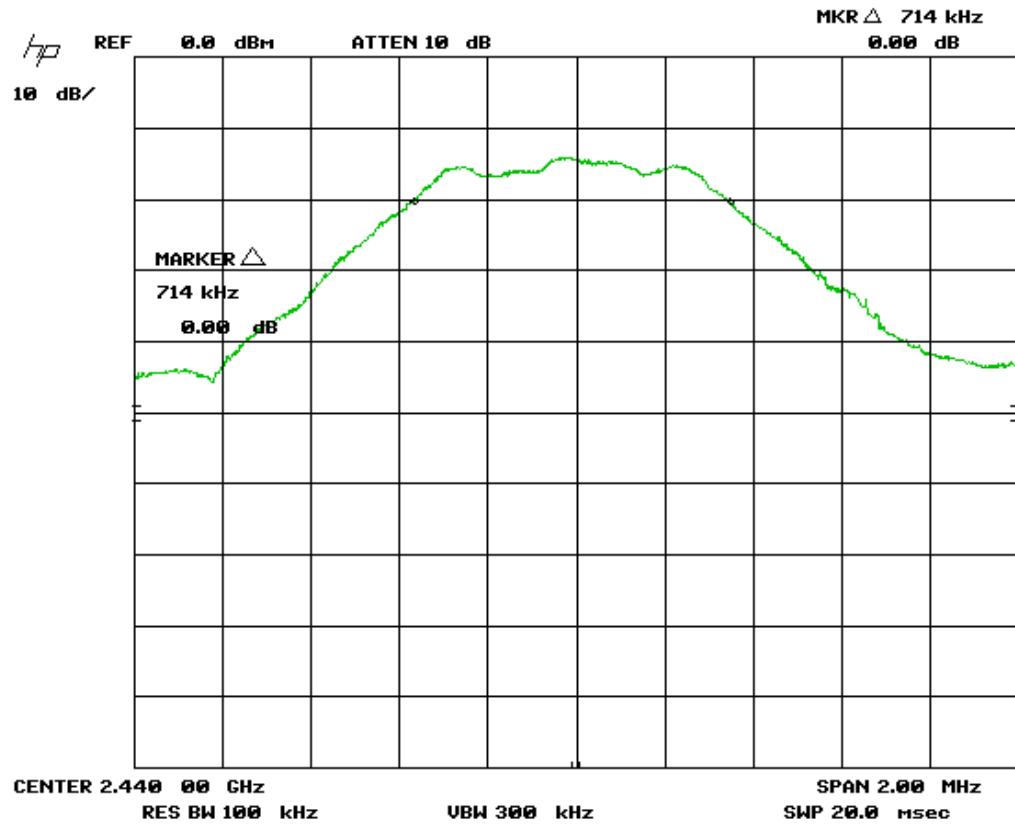


Worst case shown with low channel setting.

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15

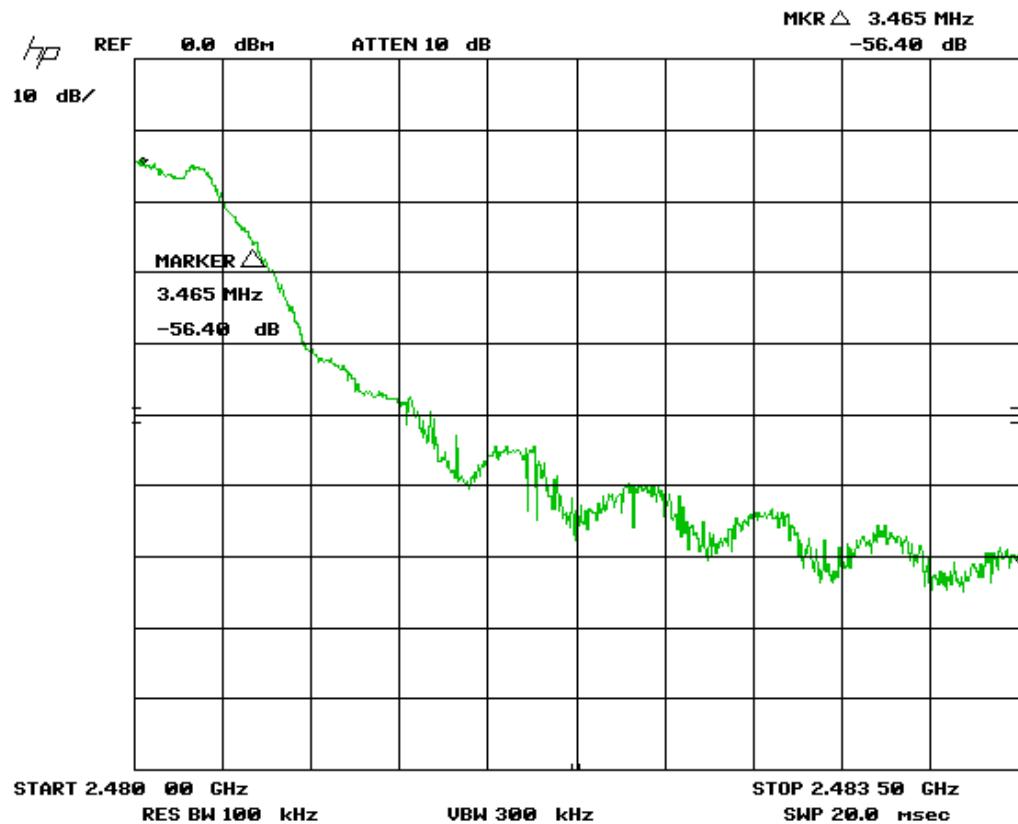


Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



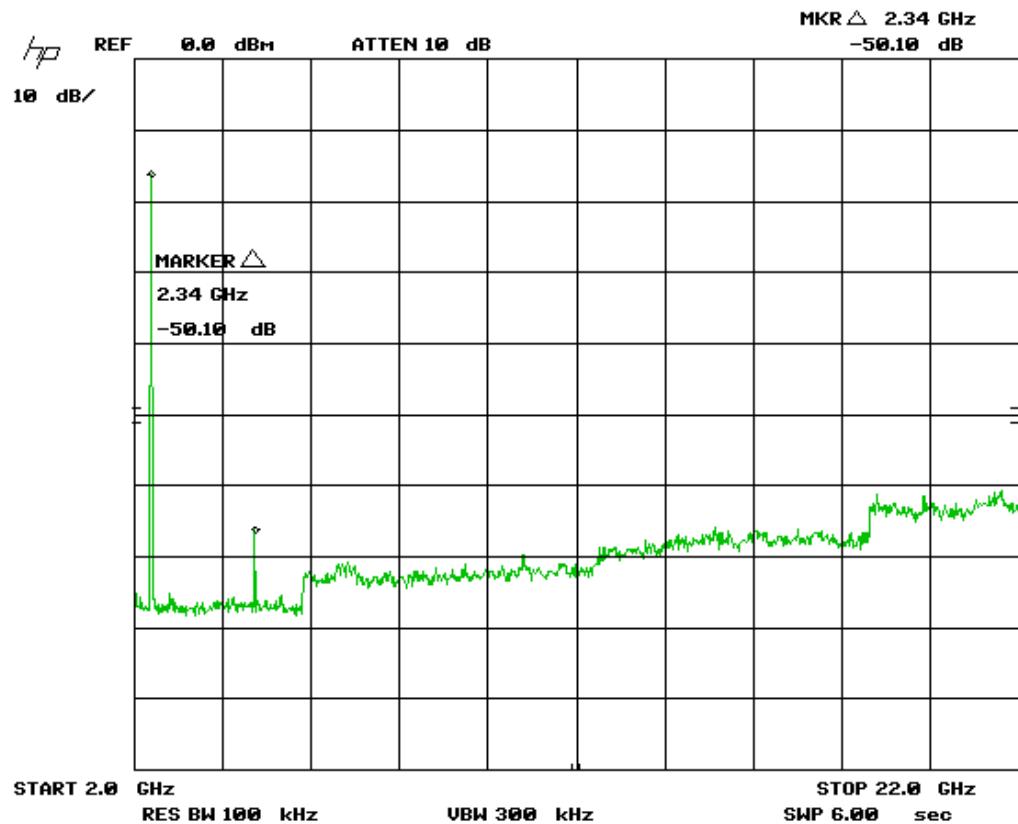
Mid channel shown above

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15

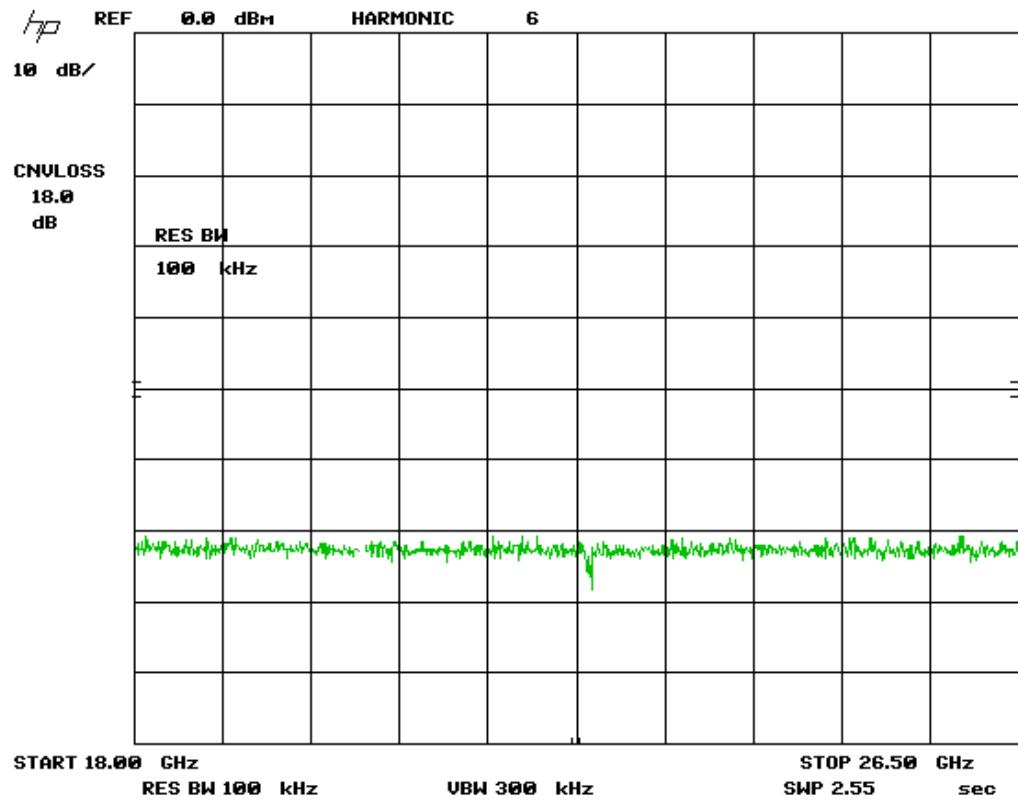


Worst case high channel shown above.

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date ¹	Next Calibration Date ¹	Asset #
Spectrum Analyzer Display	8566B	HP	1-28-15	1-28-17	4168
Spectrum Analyzer	8566B	HP	1-28-15	1-28-17	4169
Quasi Peak Adapter	85650A	HP	1-28-15	1-28-17	4170
Attenuator 3 dB	FP-50-3	Trilithic	1-28-15	1-28-17	4028
18.0-26.5 GHz Harmonic Mixer	11970K	HP	1-20-16	1-20-18	158
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	1-28-15	1-28-17	4026
Emission software	0.1.87	Global EMC	1-28-15	1-28-17	58

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Power Spectral Density - DM

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 15.247(e).

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

Method

Method was as per ANSI C63.10

Results

The EUT passed. Each mode was tested at low, medium, and high band. The worst case value is dBm as measured with a 3 kHz resolution bandwidth (maximum peak conducted PSD power).

Band	Frequency (GHz)	PSD
Low	2.402	-11.3
Medium	2.440	-10.0
High	2.480	-9.5

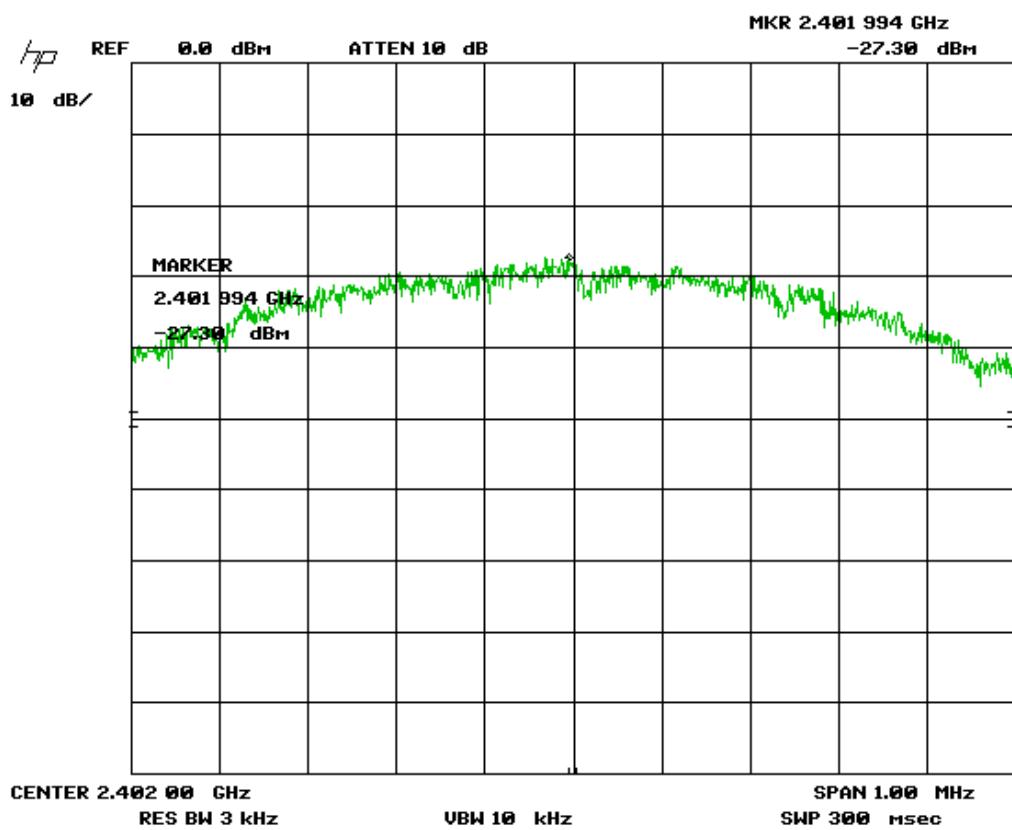
Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Graph(s)

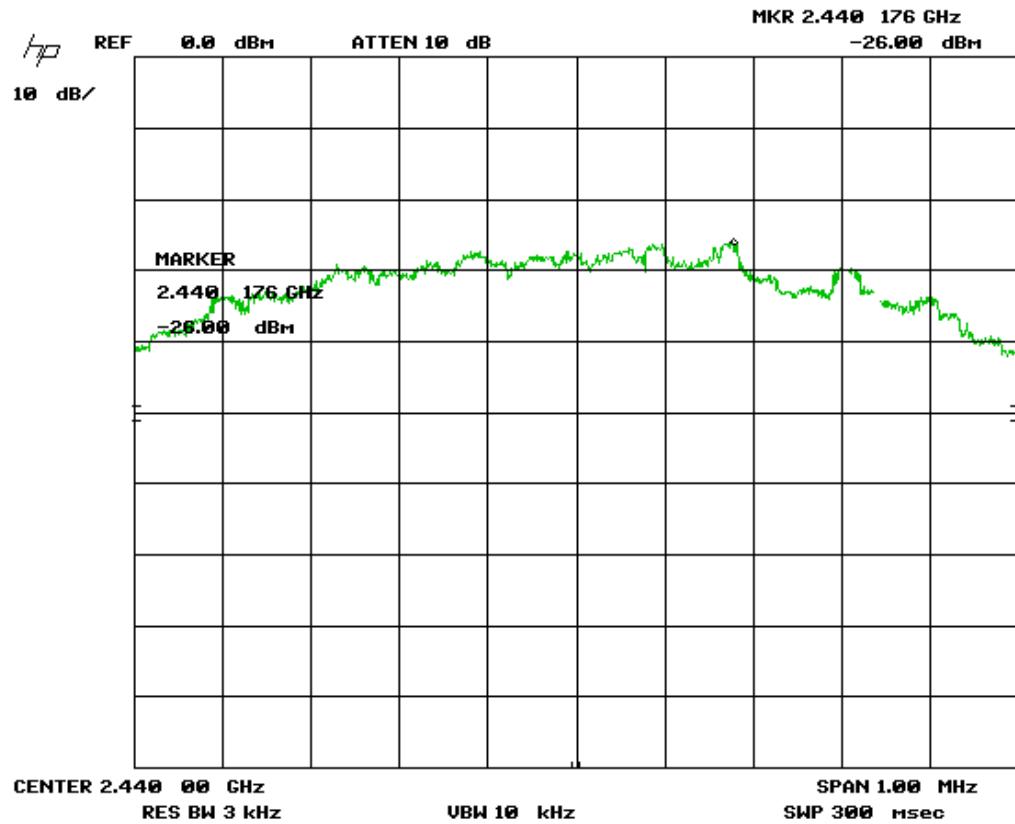
The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channel was investigated in each mode, with the worst case being presented.

Low channel

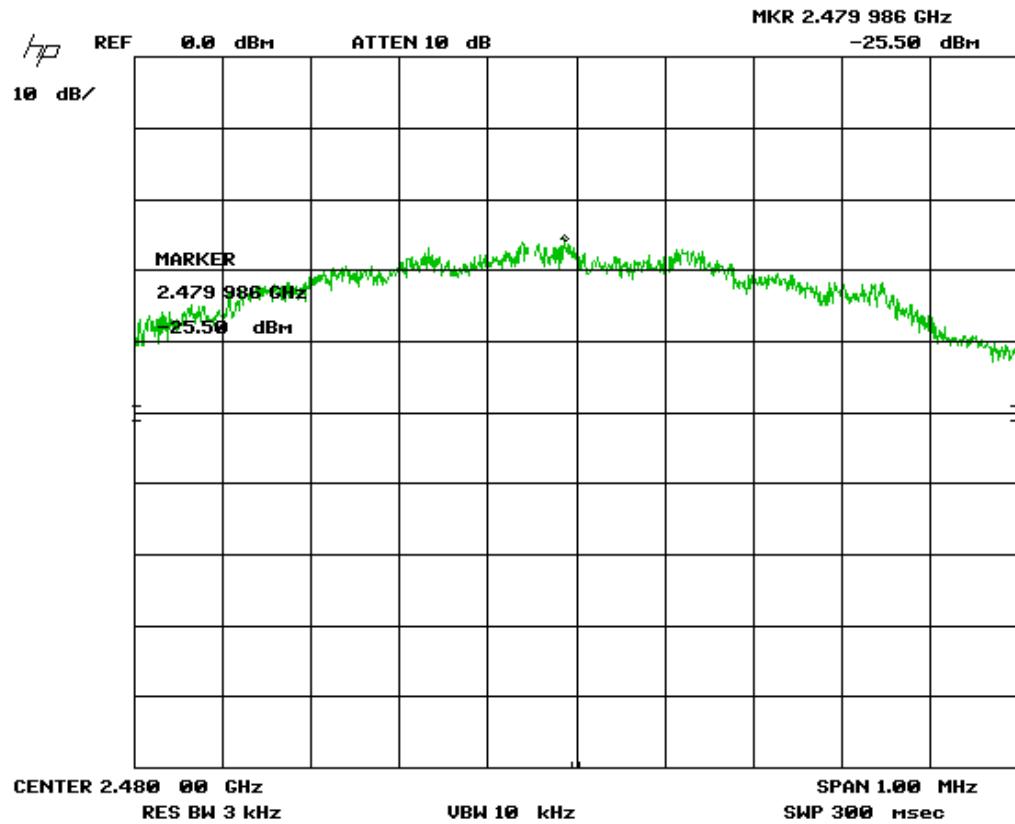


Note: 16 dB external

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



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

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	ESL6	Rohde & Schwarz	11-25-15	11-25-17	160
Spectrum Analyzer Display	8566B	HP	1-28-15	1-28-17	4168
Spectrum Analyzer	8566B	HP	1-28-15	1-28-17	4169
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	4039
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	4038

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

Client	Kaba Ilco Inc.	
Product	BLE-5100 Bluetooth Module	
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15	

Appendix A – EUT Summary

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

Client Details	
Organization / Address	Kaba 7301 Decarie Blvd. Montreal QC Canada
Contact	Michael Mosca
Phone	514-735-5410 ext. 749
Email	michael.mosca@kaba.com
EUT (Equipment Under Test) Details	
EUT Name (for report title)	BLE-5100 Bluetooth Module
Equipment category	Module
EUT is powered using	DC from host
Input voltage range(s) (V)	5VDC
Frequency range(s) (Hz)	NA
Rated input current (A)	500mA
Nominal power consumption (W)	2.5W
Number of power supplies in EUT	0
Transmits RF energy? (describe)	Yes Bluetooth.
Basic EUT functionality description	Bluetooth module
Modes of operation	
Customer to setup EUT on site?	Yes
I/O cable description	
Specify length and type	N/A
Peripherals required to exercise EUT	Sample host.
Ex. Signal generator	

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’. 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’.

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



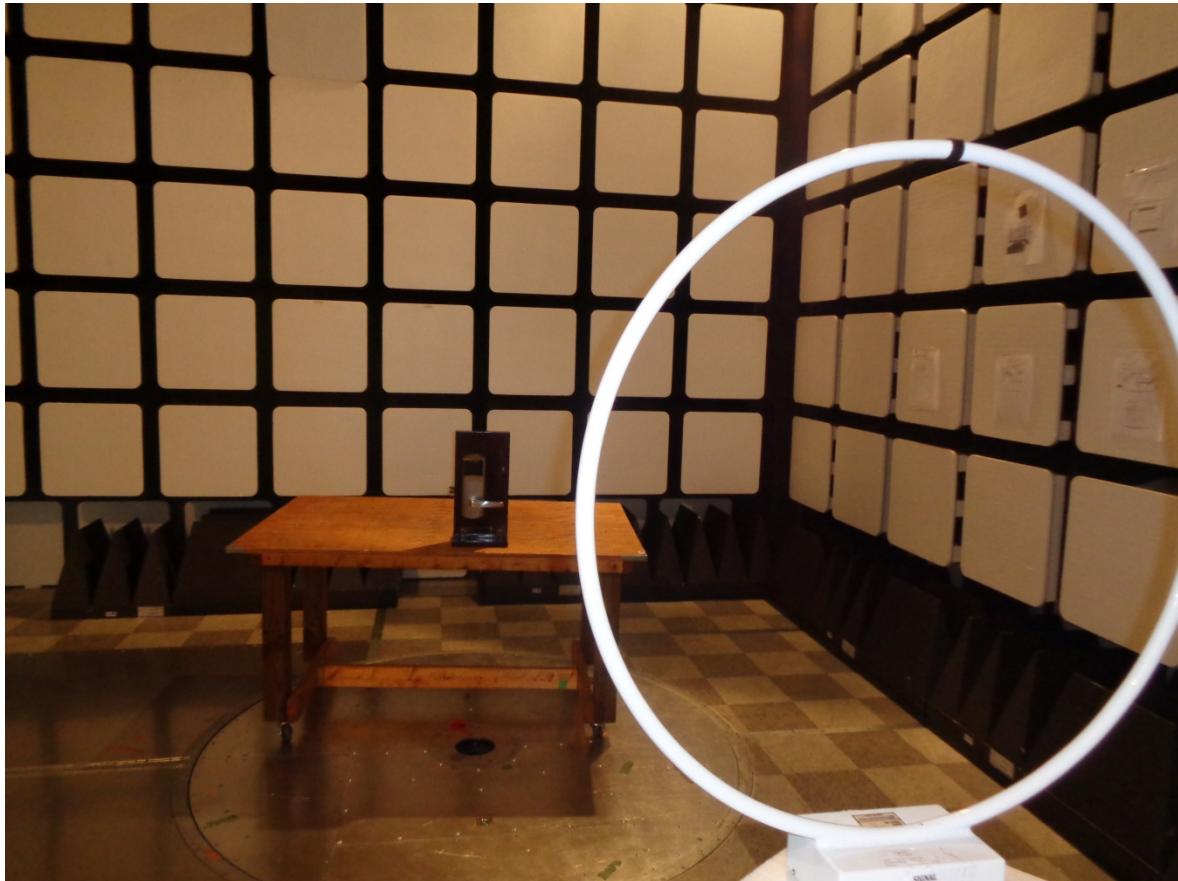
Appendix B – EUT and Test Setup Photographs

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



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

Radiated Emissions Below 30 MHz



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Radiated Emissions 30 MHz to 1 GHz



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Radiated Emissions above 1 GHz



Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15



Power Line Conducted Emissions



Note: Power line conducted emissions shown as measured with typical DC source used.

Client	Kaba Ilco Inc.
Product	BLE-5100 Bluetooth Module
Standard(s)	RSS 247 Issue 1/ FCC Part 15 Subpart C 15

