



LS RESEARCH, LLC

Wireless Product Development

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ENGINEERING TEST REPORT #313052 B

LSR Job #: C-1704

Compliance Testing of:

TiWi-BLE/TiWi-R2

Test Date(s):

April 27th to May 6th 2013

Prepared For:

LS Research
W66 N220 Commerce Court
Cedarburg, WI 53012

This Test Report is issued under the Authority of:

Khairul Aidi Zainal, Senior EMC Engineer

Signature:  Date: 6/26/2013

Test Report Reviewed by:

Adam Alger, EMC Engineer

Signature:  Date: 6-25-13

Report by:

Khairul Aidi Zainal, Senior EMC Engineer

Signature:  Date: 5/28/13

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Prepared For: LS Research	Name: TiWi-BLE/TiWi-R2
Report: TR 313052 B	Model: TiWi-BLE& TiWi-R2
LSR: C-1704	Serial: 3-016181, 3-030098

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LS Research, LLC in Review

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:



TESTING CERT #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01



Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756



Canada

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1
File Number: IC 3088-A
On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1
File Number: IC 3088



U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility – Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.
Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

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1.0 Summary of Test Report

The purpose of these tests is to request a Class II permissive change to FCC ID: TFB-TIWI1-01 and IC: 5969A-TIWI101, to add an antenna.

Between August 2012, April 2013 and May 2013 the TiWi-BLE/TiWi-R2 was tested and MEETS the following FHSS requirements:

Rule	Description	Procedure	Compliant	Note
FCC: 15.247(d) IC: RSS-210 A8.5	Radiated Emissions at Band-edge	ANSI C63.4-2003 ANSI C63.10-2009	Yes	1
FCC: 15.247(d) IC: RSS-210 A8.5	Radiated Harmonics	ANSI C63.4-2003 ANSI C63.10-2009	Yes	1
FCC: 15.247(d) IC: RSS-210 A8.5	Radiated Emissions	ANSI C63.4-2003 ANSI C63.10-2009	Yes	1
FCC: 15.109 IC: RSS-GEN	Receiver radiated Emissions	ANSI C63.4-2003 ANSI C63.10-2009	Yes	1
FCC: 15.247(b) IC: RSS-210 A8.4	Maximum Output Power	ANSI C63.10-2009 FCC Public Notice DA00-705 March, 2000	Yes	2
FCC: 15.247(a)(1) IC: RSS-210 A8.1(a)	Emission Bandwidth 20dB & 99%	ANSI C63.10-2009 FCC Public Notice DA00-705 March, 2000	Yes	2

Note 1: Tested in three orthogonal positions.

Note 2: RF Conducted measurement at antenna terminal.

2.0 Test Facilities

All testing was performed at:

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to the requirements of ISO/IEC 17025, 2005 "General Requirements for the Competence of Calibration and Testing Laboratories".

LS Research, LLC's scope of accreditation includes all test methods listed herein, unless otherwise noted.

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3.0 Client Information

Manufacturer Name:	LS Research
Address:	W66 N220 Commerce Court Cedarburg, WI 53012
Contact Person:	Brian Petted

3.1 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	TiWi-BLE/TiWi-R2
Model Number:	TiWi-BLE&TiWi-R2
Serial Number:	3-016181, 3-030098
FCC ID	TFB-TIWI1-01
IC Number	5969A-TIWI101

3.2 Product Description

The TiWi-BLE/TiWi-R2 module is a multi-standard module with support for WLAN (802.11 b/g/n), Bluetooth V2.1 and Bluetooth 4.0..

Bluetooth (FHSS):

Frequency Range (MHz)	2402-2480 MHz
RF Power In Watts (conducted)	Max 0.0063; Min 0.0054
Max Conducted Output Power (dBm)	8.0
Type of Modulation	GFSK
Transmitter Spurious (worst case) at 3 meters	48.7 dB μ V/m at 4880 MHz
Stepped (Y/N)	N
Step Value	N/A
Frequency Tolerance %,Hz, ppm	Better than 100 ppm
Antenna: Detachable / Non-detachable	Non-detachable
Antenna: Type	Ground coupled dipole
Antenna Gain (Peak)	3.0dBi
FCC Rule Part	Title 47 Part 15.247
Industry Canada Rule Part	RSS-210 Issue 8 2010
Modular Filing	Yes
RF Exposure Type	Mobile
Receiver Spurious (worst case) at 3 meters	40.0dB μ V/m at 115.4 MHz

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3.3 Modifications Incorporated In the EUT for Compliance Purposes

None.

3.4 Deviations & Exclusions from Test Specifications

None.

4.0 Conditions of Test

Environmental:

Temperature: 20-25° C
Relative Humidity: 30-60%
Atmospheric Pressure: 86-106 kPa

MainsVoltage:

3.3VDC from bench supply

5.0 Additional Information

The EUT was programmed from a laptop computer with LSR's proprietary control program. Once programmed the radio was powered from a bench supply at 3.3VDC.

6.0 Test Equipment

All test equipment is calibrated by a calibration laboratory accredited by A2LA to the requirements of ISO 17025. For a complete list of test equipment and calibration dates, see Appendix A. Unless otherwise noted, resolution bandwidth of measuring instrument used during testing for given frequency range, see below.

Frequency Range	Resolution Bandwidth
9 kHz – 150 kHz	200 Hz
150 kHz – 30 MHz	9 kHz
30 MHz – 1000 MHz	120 kHz
Above 1000 MHz	1MHz

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7.0 Conformance Summary

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247 (2011) and Industry Canada RSS-210, Issue 8 (2010)

If some emissions are seen to be within 3 dB of their respective limits:

As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

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Appendix A – Test Equipment



Date: 25-Apr-2013 Type Test: Radiated measurements Job #: C-1704
 Prepared By: Aidi Customer: Amritsu Quote #: 313052

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960 156	100MHz - 1GHz Analog Signal Generator	Agilent	N5181A	MY 49060062	6/30/2012	6/30/2013	Active Calibration
2	EE 960 158	RF Presetector	Agilent	N9039A	MY 40520110	6/29/2012	6/29/2013	Active Calibration
3	EE 960 157	3Hz - 13.2GHz Spectrum Analyzer	Agilent	E4445A	MY 48250225	6/29/2012	6/29/2013	Active Calibration
4	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4-138	5/16/2012	5/16/2013	Active Calibration
5	EE 960 160	0.8-21GHz LNA	Mini-Circuits	ZVA-213X-S+	977711030	9/17/2012	9/17/2013	Active Calibration
6	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	6/26/2012	6/26/2013	Active Calibration
7	AA 960004	Log Periodic Antenna	EMCO	93146	9512-4276	9/17/2012	9/17/2013	Active Calibration
8	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	1/29/2013	1/29/2014	Active Calibration
9	AA 960144	Phaselix	Core	ER00 100 10720	5800373	6/12/2011	6/12/2013	Active Calibration
10	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration
11	EE 960 146	Std. Gain Horn Ant. w/preamp	Adv. Micro / EMCO	WLA 622-4 / 3 160-09	123001	9/26/2012	9/26/2013	Active Calibration
12	EE 960 147	Pre-Amp	Adv. Micro	WLA 612	123101	2/12/2013	2/12/2014	Active Calibration
13	CC 000221C	Spectrum Analyzer	HP	E4407B	US39160256	6/5/2012	6/5/2013	Active Calibration

Project Engineer: [Signature] Quality Assurance: Peter Fiein



Date: 13-Aug-2012 Type Test: Conducted measurements Job #: C-1520
 Prepared By: Adam Customer: LSR Quote #: 312182

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960144	Phaselix	Core	ER00 100 10720	5800373	6/12/2011	6/12/2013	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration

Project Engineer: Adam Olyza Quality Assurance: [Signature]



Date: 25-Apr-2013 Type Test: Conducted Measurements Job #: C-1704
 Prepared By: Aidi Customer: Amritsu Quote #: 313052

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaselix	Core	ER00 100 1048.0	5546519	6/12/2011	6/12/2013	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration

Project Engineer: [Signature] Quality Assurance: Peter Fiein

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Appendix B – Test Data
B.1 – Radiated Emissions

Rule Part(s)	FCC: 15.247(d) / 15.205 / 15.209 / IC: RSS-210 A8.2 (b) / RSS-210 Section 2.2, 2.6, 2.7			
Measurement Procedure	ANSI C63.4 - 2003 ANSI C63.10 – 2009 FCC Public Notice DA00-705 March, 2000			
Test Location	LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber			
Test Distance	3 meters : 30 - 4000 MHz 1 meter: 4 - 26 GHz			
EUT Placement	80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-300 MHz	Log Periodic Dipole Array: 300-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz Peak Detector RBW: 120 kHz VBW: 300 kHz		1 - 26 GHz: Peak Detector RBW : 1MHz VBW: 3MHz (Peak Measurement) VBW: 10Hz (Average Measurement)	
Description of Measurement	<p>1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values.</p> <p>2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT</p> <p>3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.</p>			
Example Calculations	<p>Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)</p> <p><u>Generic example of reported data at 200 MHz:</u> Reported Measurement data = 18.2 (raw receiver measurement) + 15.8 (antenna factor) + 1.45 (cable factor) = 35.45 (dBμV/m).</p>			

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FCC Part 15.209 / IC RSS-210 Section 2.7 Limits:

Frequency (MHz)	3 m Limit ($\mu\text{V/m}$)	3 m Limit ($\text{dB}\mu\text{V/m}$)	Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Average (>1 GHz)

B.1.1 – Radiated Harmonics in Restricted Bands above 1 GHz

Manufacturer	LS Research
Date	April 30 th and May 6 th 2013
Operator	Mike Hintzke
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Test Voltage	3.3 VDC
Test Location	LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber
Rule Part	15.247 / 15.205 / 15.209
Measurement Procedure	ANSI C63.4 - 2003 ANSI C63.10-2009 FCC Public Notice DA00-705 March, 2000
Test Distance	3 meter (1-4 GHz) 1 meter (4-26 GHz)
EUT Placement	80 cm height non-conductive table centered on turn-table
Detectors	RBW 1MHz ,VBW 3MHz: Peak and RMS
Additional Notes	1) Tested in the worst case of continuous transmit GFSK modulated mode for radiated harmonics in restricted bands in low, mid, and high channels with EUT Antenna in three orthogonal positions.

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Table:
Bluetooth Radiated Harmonics in restricted bands

Lowest Channel (2402 MHz) Harmonics:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
4804	1.06	218	59.8	57.8	63.5	5.7	Horizontal	Side
12010	Note 1							
19216	1.00	172	57.6	52.2	74.0	21.8	Vertical	Vertical

Middle Channel (2440 MHz) Harmonics:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
4880	1.00	331	60.2	58.2	63.5	5.3	Horizontal	Side
7320	1.05	231	57.8	52.9	63.5	10.6	Horizontal	Flat
12200	Note 1							
19520	1.00	37	58.4	54.1	63.5	9.4	Horizontal	Vertical

Highest Channel (2480 MHz) Harmonics:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dB μ V/m)	Avg Reading (dB μ V/m)	Avg Limit (dB μ V/m)	Margin (dB)	Antenna Polarity	EUT orientation
4133	1.08	241	59.0	55.5	63.5	8.0	Horizontal	Side
4960	1.00	73	58.7	55.1	63.5	8.4	Horizontal	Side
7440	1.05	228	58.9	52.0	63.5	11.5	Horizontal	Flat
12400	1.00	25	55.0	45.1	63.5	18.4	Horizontal	Flat
19840	1.00	36.3	57.2	52.1	63.5	11.4	Horizontal	Side
22320	Note 1							

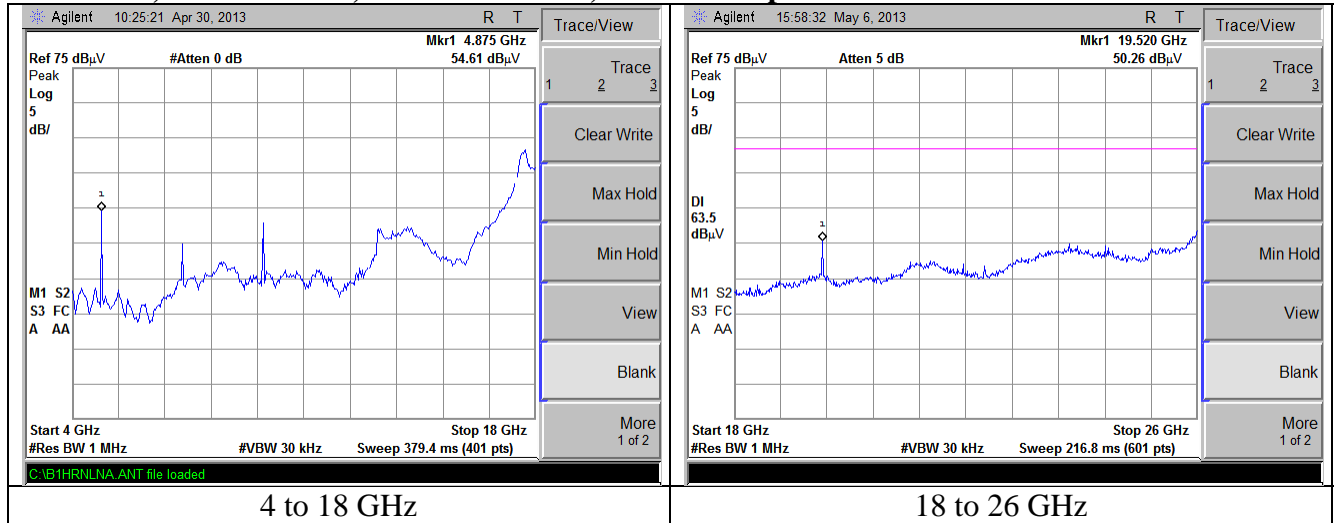
Notes:

1. Emission buried within system noise floor.
2. Measurements above 4 GHz were made at 1 meters of separation from the EUT. The limits were adjusted to reflect this measurement distance.

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**Plots:
Bluetooth Radiated Harmonics in restricted bands**

4-26 GHz, Vertical EUT, Middle Channel, GFSK max power



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B1.2 - Radiated Band-edge into restricted bands

Manufacturer	LS Research
Date	May 1 st – 2 nd 2013
Operator	Peter Feilen
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Test Voltage	3.3 VDC
Test Location	LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber
Rule Part	15.247 / 15.205 / 15.209
Measurement Procedure	ANSI C63.4 - 2003 ANSI C63.10-2009 FCC Public Notice DA00-705 March, 2000
Test Distance	3 meter
EUT Placement	80 cm height non-conductive table
Detectors	Peak and RMS:RBW 1MHz,VBW 3MHz;
Additional Notes	<ol style="list-style-type: none"> 1) Tested in continuous transmit modulated mode in low and high channels with EUT Antenna in three orthogonal positions. 2) Maximum levels recorded.

Example Calculation:

Peak Limit – Peak Reading = Peak Margin

Average Limit – Average Reading = Average Margin

Lower Band-edge 2310 – 2390 MHz

EUT Channel	EUT Mode	Peak (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Average (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)
Lowest	GFSK	55.8	74.0	18.2	45.0	54.0	9.0
Lowest	EDR2	56.4	74.0	17.6	45.1	54.0	8.9
Lowest	EDR3	59.8	74.0	14.2	45.4	54.0	8.6

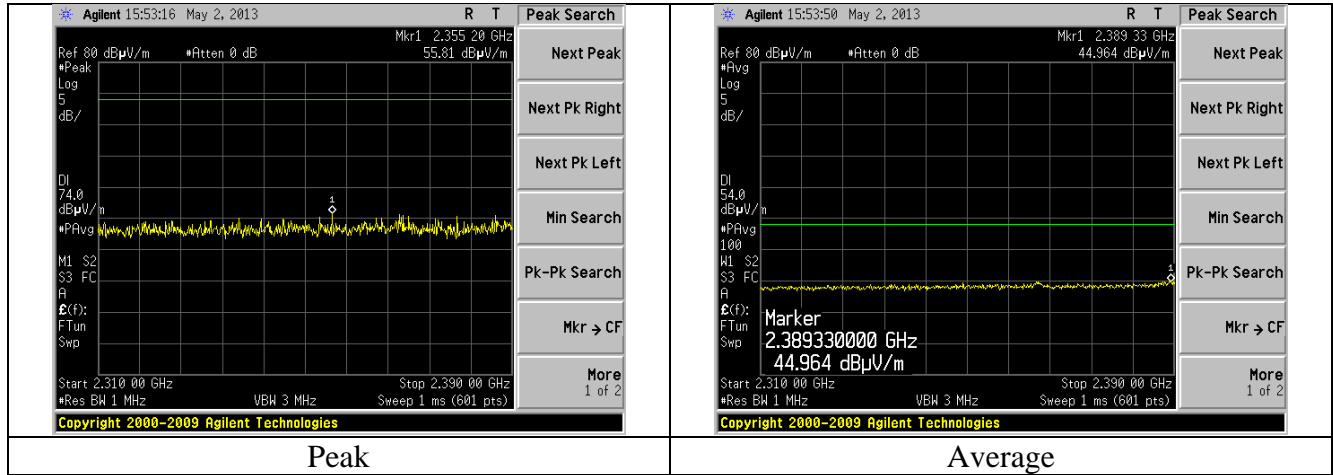
Upper Band-edge 2483.5 – 2500 MHz

EUT Channel	EUT Mode	Peak (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Average (dBμV/m)	Average Limit (dBμV/m)	Average Margin (dB)
Highest	GFSK	58.8	74.0	15.2	46.8	54.0	7.2
Highest	EDR2	63.3	74.0	10.7	53.5	54.0	0.5
Highest	EDR3	66.3	74.0	7.7	53.8	54.0	0.2

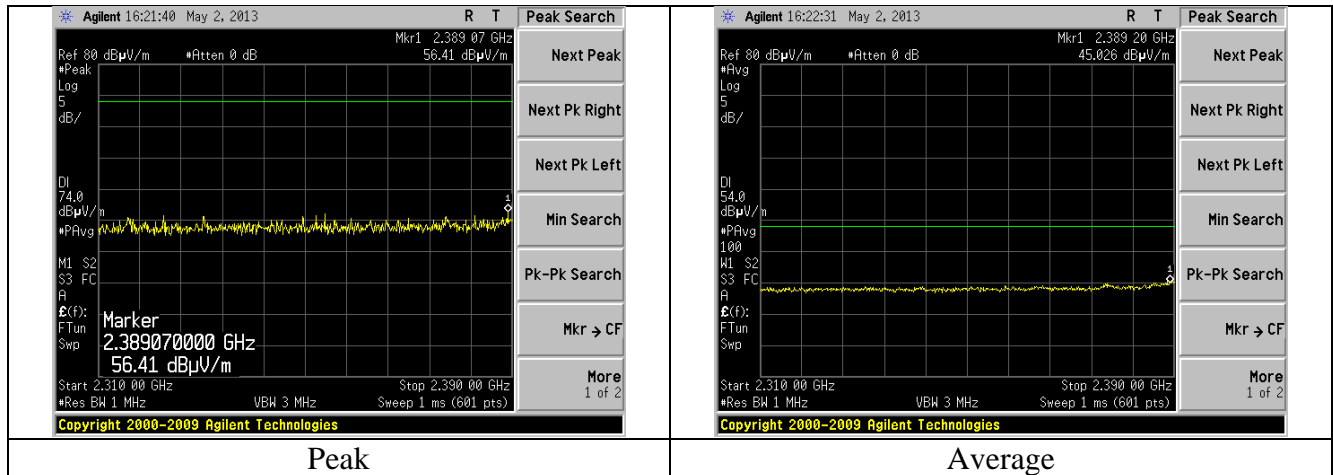
Plots:

Radiated Lower Band-edge into restricted bands

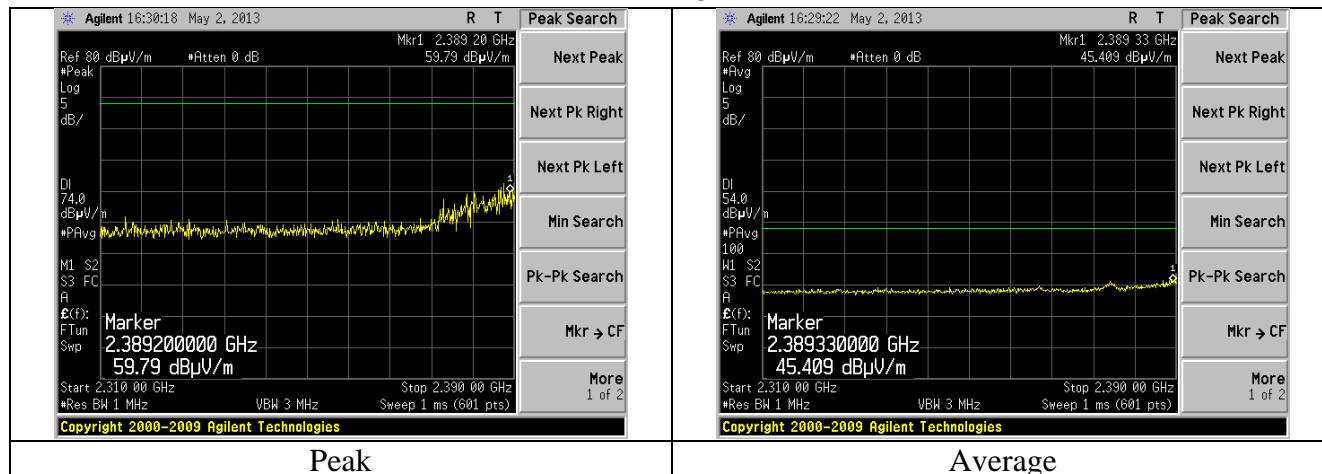
GFSK



EDR2

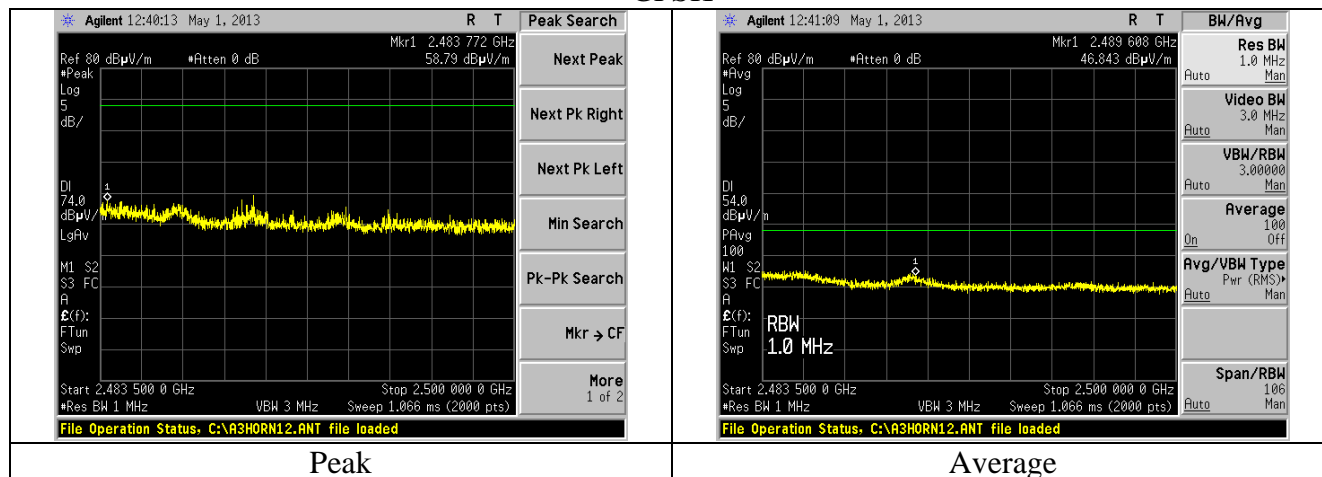


EDR3



Radiated Upper Band-edge into restricted bands

GFSK



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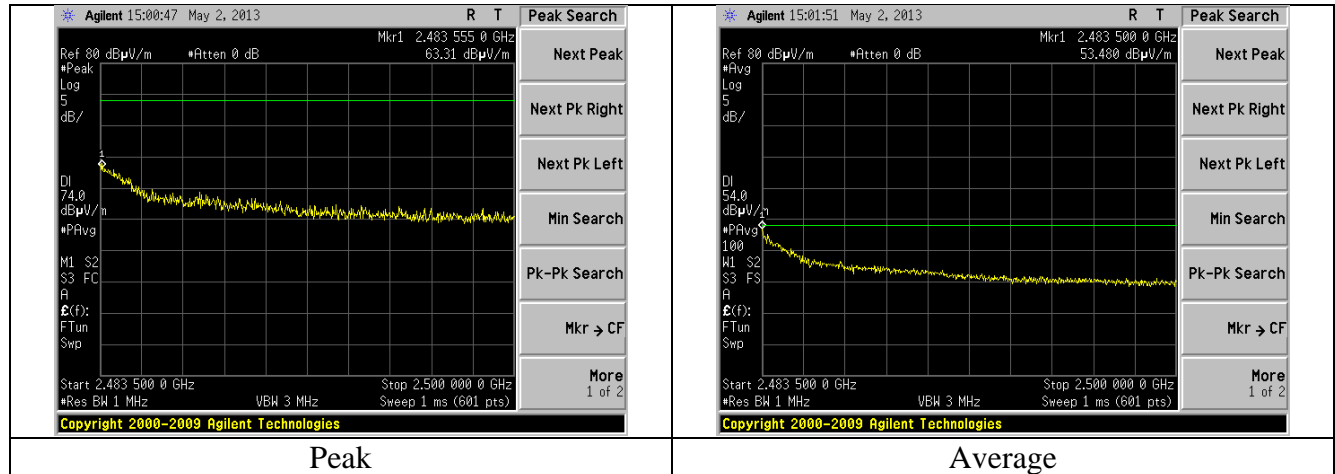
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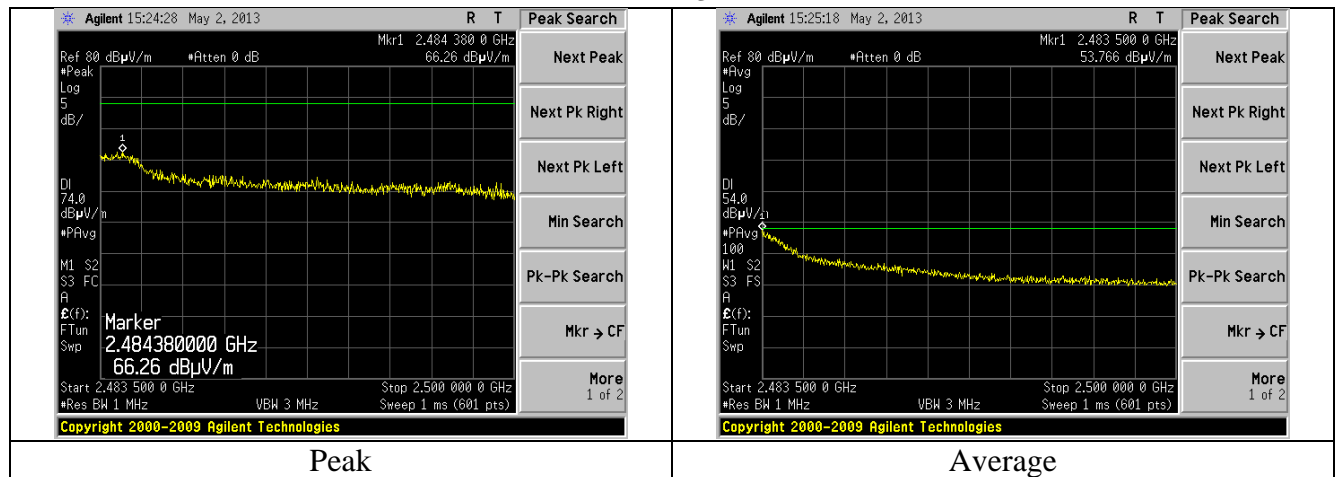
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EDR2



EDR3



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B.2.3 – Receive Mode Radiated Emissions

Manufacturer	LS Research
Date	April 30 th to May 2 nd 2013
Operator	Mike Hintzke
Temperature	20 - 25° C
Humidity	30 – 60%
Test Voltage	3.3 VDC
Test Location	LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber
Test Distance	3 meter (30 MHz to 4 GHz) 1 meter (4 GHz to 26 GHz)
EUT Placement	80 cm height non-conductive table
Measurements	Final
Detectors	Peak, Quasi-Peak, Average
Additional Notes	1) Emissions 30-1000MHz tested in receive mode on low, mid, high channels in three orientations. No significant difference noted in emissions from mode or channel selection. Worst case reported. 2) Emissions 1-26GHz tested in Bluetooth receive mode on low, mid, high channels in three orientations.

30-1000MHz

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
114.8	1.66	258	26.8	43.0	16.2	H	V
115.4	1.00	236	40.0	43.0	3.0	V	V
114.6	1.00	0	39.4	43.0	3.6	V	S
114.5	1.00	219	36.6	43.0	6.4	V	F
126.5	1.00	0	33.8	43.0	9.2	V	F
298.6	1.00	226	31.6	46.0	14.4	H	V
325.9	1.42	185	33.8	46.0	12.2	V	V
298.3	1.00	217	34.8	46.0	11.2	H	S
299.2	1.00	248	37.4	46.0	8.6	H	F
298.2	1.00	290	35.3	46.0	10.7	V	F

Notes:

1. Emissions seen in this range were not a function of EUT mode, channel or power level; likely related to the power supply.
2. H: Horizontal; V: Vertical; S: Side.

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Bluetooth Receive Mode 4-26 GHz

Frequency (GHz)	Height (m)	Azimuth (degree)	Peak Reading (dBμV/m)	Average Reading (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	Average Limit (dBμV/m)	Average Margin (dB)	Antenna Polarity	EUT orientation	Notes
1.795	1.00	0	38.4	27.2	74.0	35.6	54.0	26.8	H	V	1
2.435	1.00	0	36.0	29.9	74.0	38.0	54.0	24.2	H	V	1
3.830	1.00	0	45.8	35.6	74.0	28.2	54.0	18.4	H	V	1

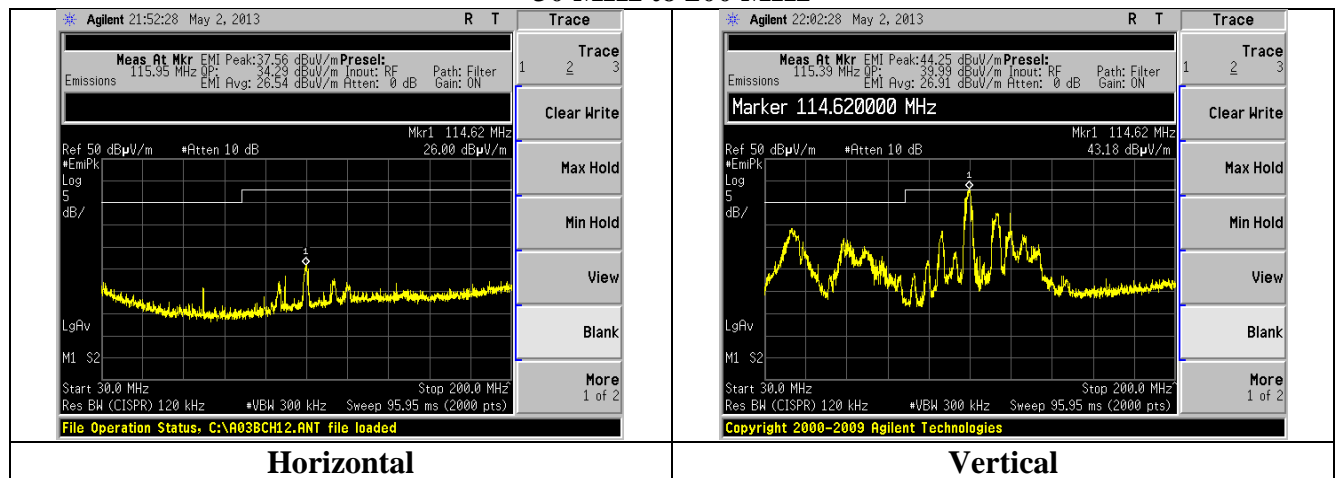
Notes:

1. Measurement of system noise floor
2. H: Horizontal; V: Vertical; S: Side.

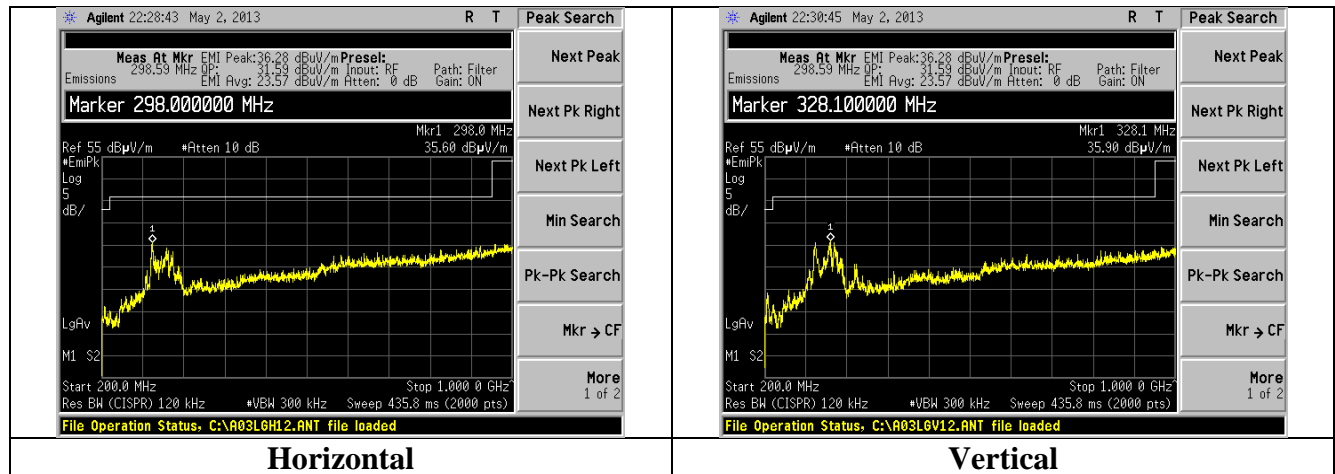
Plots:

Tested in three orthogonal positions

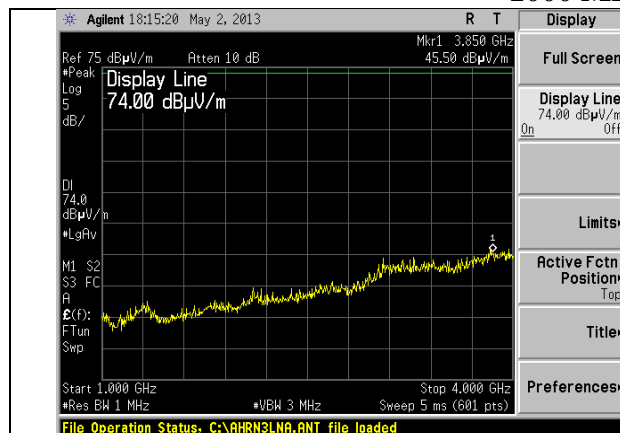
30 MHz to 200 MHz



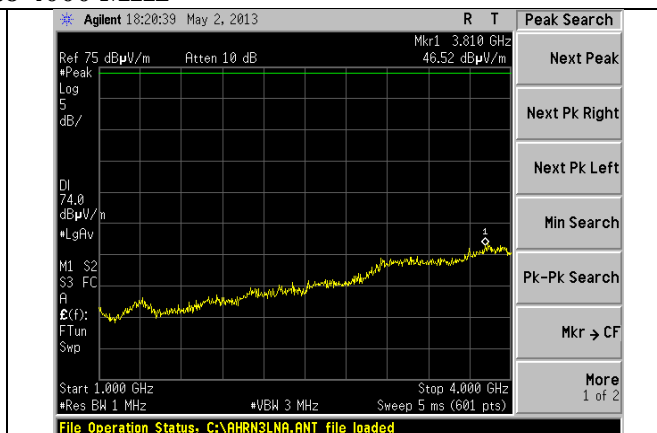
200 MHz to 1000 MHz



1000 MHz to 4000 MHz

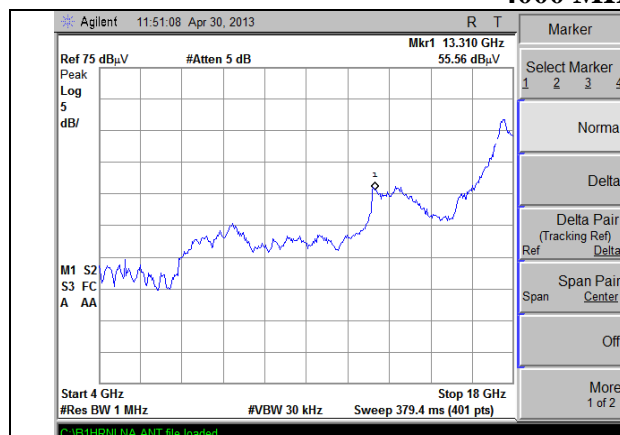


Horizontal



Vertical

4000 MHz to 26000 MHz



4000 to 18000 MHz



18000 to 26000 MHz

Prepared For: LS Research

Report: TR 313052 B

LSR: C-1704

Name: TiWi-BLE/TiWi-R2

Model: TiWi-BLE& TiWi-R2

Serial: 3-016181, 3-030098

B.3 – RF Conducted Emissions

Manufacturer	LS Research
Date	12-20-12, April 26 th 2013
Operator	Adam A, Khairul Aidi Zainal
Temp. / R.H.	20 - 25° C / 30-60% R.H.
Test Voltage	3.3 VDC
Test Location	LS Research, LLC – Bench Measurements
Rule Part	15.247
Measurement Procedure	DA 00-705 March 2000
Description of Measurement	A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.
Additional Notes	1) See below

A. Peak Output Power.

a. GFSK mode:

Channel	Frequency (MHz)	Original Reported Power (dBm)	Measured Power (dBm)
Lowest	2402	7.95	7.77
Middle	2441	7.70	7.61
Highest	2480	7.35	7.36

b. EDR2 mode:

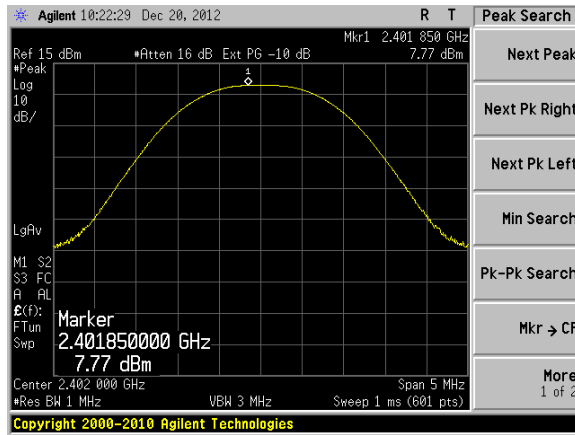
Frequency (MHz)	Pout (dBm)	Limit (dBm)	Margin (dB)
2402.0	7.6	30.0	22.4
2440.0	7.8	30.0	22.2
2480.0	7.4	30.0	22.6

c. EDR3 mode:

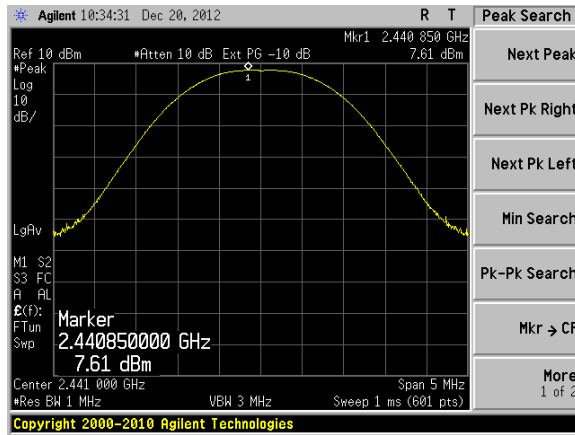
Frequency (MHz)	Pout (dBm)	Limit (dBm)	Margin (dB)
2402.0	8.2	30.0	21.8
2440.0	8.5	30.0	21.5
2480.0	8.2	30.0	21.8

Plots.

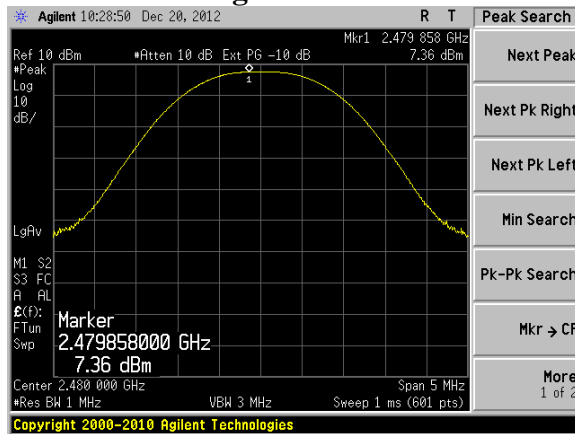
GFSK Mode. Low Channel



Middle Channel



High Channel



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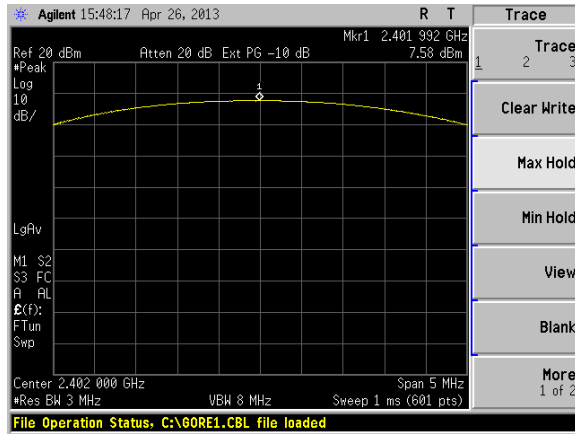
LSR: C-1704

Name: TiWi-BLE/TiWi-R2

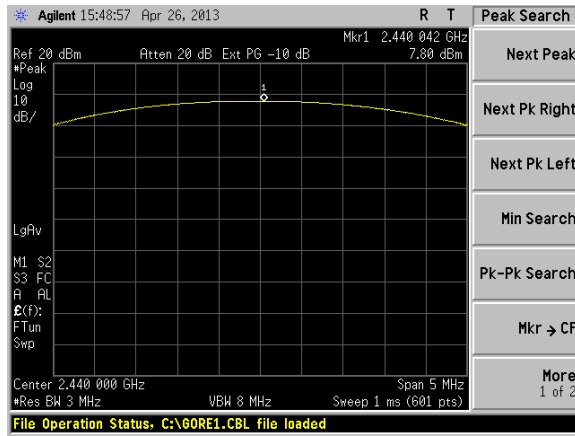
Model: TiWi-BLE& TiWi-R2

Serial: 3-016181, 3-030098

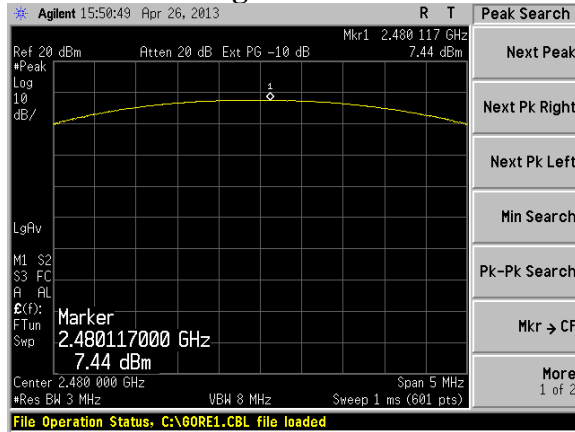
EDR2 Mode Low Channel



Middle Channel



High Channel



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Report: TR 313052 B

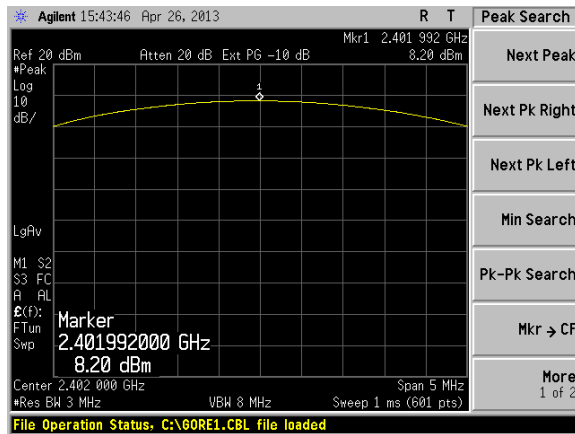
LSR: C-1704

Name: TiWi-BLE/TiWi-R2

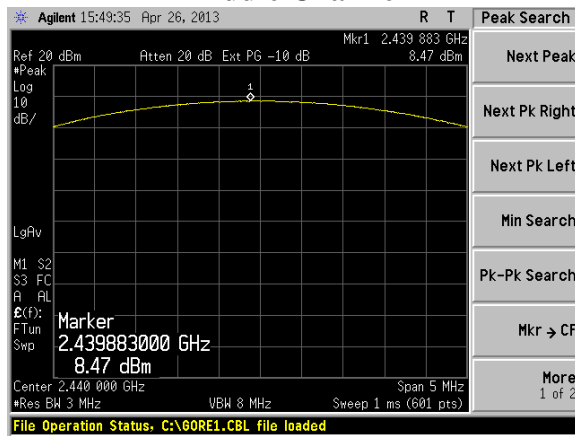
Model: TiWi-BLE& TiWi-R2

Serial: 3-016181, 3-030098

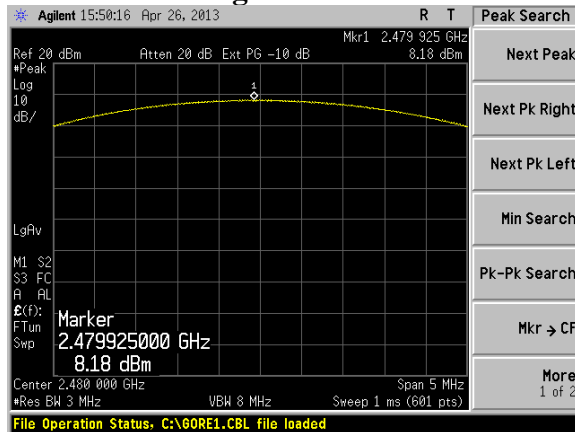
EDR3 Mode Low Channel



Middle Channel



High Channel



Prepared For: LS Research

Report: TR 313052 B

LSR: C-1704

Name: TiWi-BLE/TiWi-R2

Model: TiWi-BLE& TiWi-R2

Serial: 3-016181, 3-030098

B. Bandwidth.

GFSK:

Frequency (MHz)	20dB BW (kHz)	99% BW (kHz)
2402.0	885.3	827.2
2440.0	886.7	831.5
2480.0	885.4	836.0

EDR2:

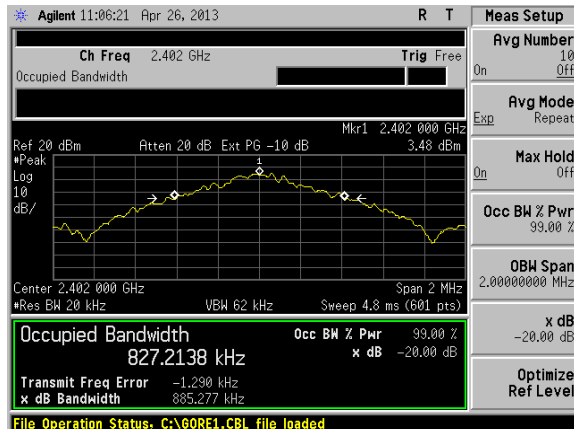
Frequency (MHz)	20dB BW (kHz)	99% BW (kHz)
2402.0	1381.0	1227.5
2440.0	1376.0	1223.3
2480.0	1375.0	1229.0

EDR3:

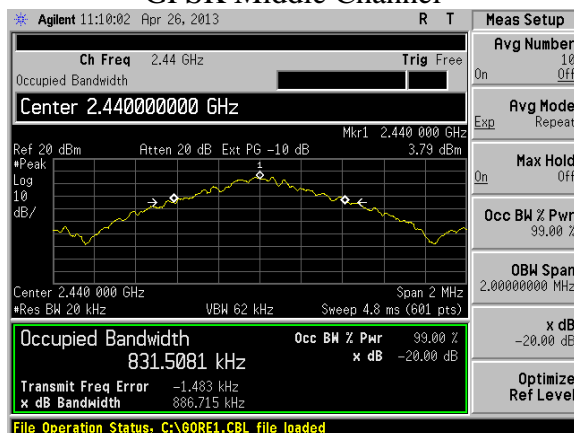
Frequency (MHz)	20dB BW (kHz)	99% BW (kHz)
2402.0	1357.0	1223.3
2440.0	1357.0	1221.7
2480.0	1357.0	1220.9

Plots.

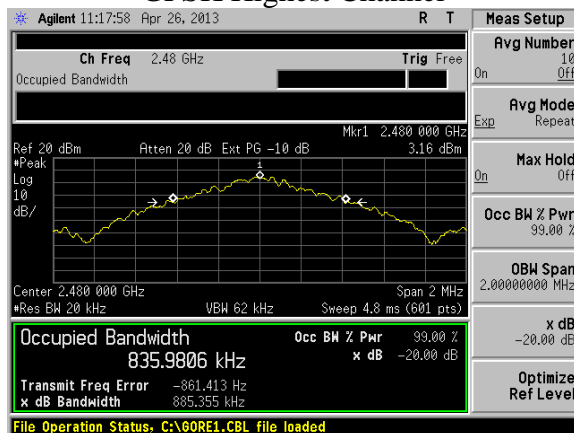
GFSK Low Channel



GFSK Middle Channel



GFSK Highest Channel



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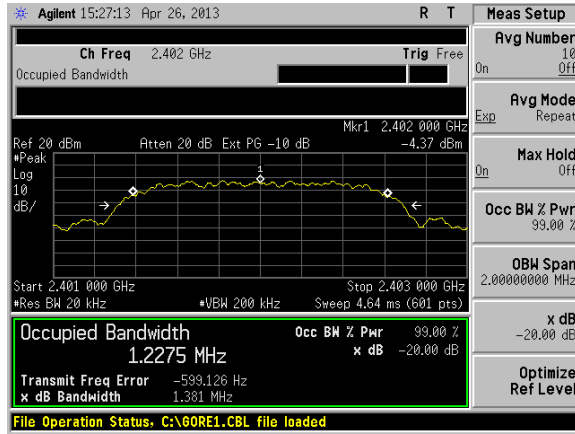
LSR: C-1704

Name: TiWi-BLE/TiWi-R2

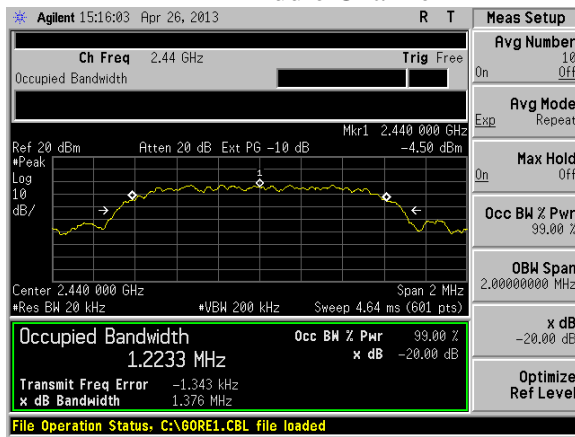
Model: TiWi-BLE& TiWi-R2

Serial: 3-016181, 3-030098

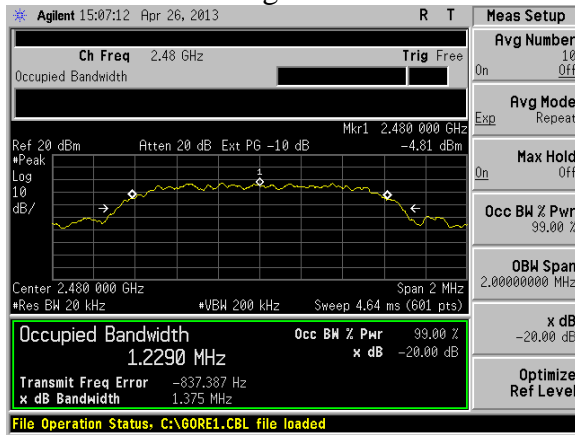
EDR2 Low Channel



EDR2 Middle Channel



EDR2 Highest Channel



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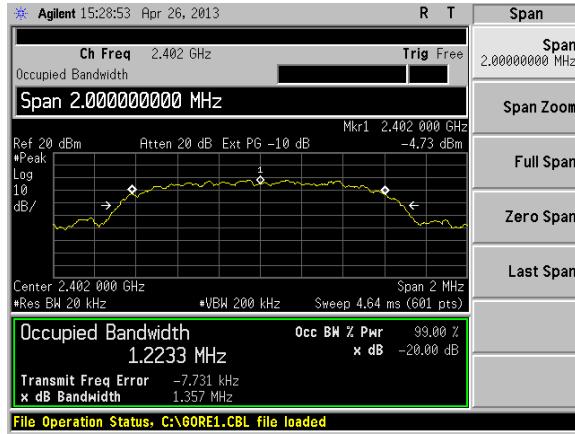
LSR: C-1704

Name: TiWi-BLE/TiWi-R2

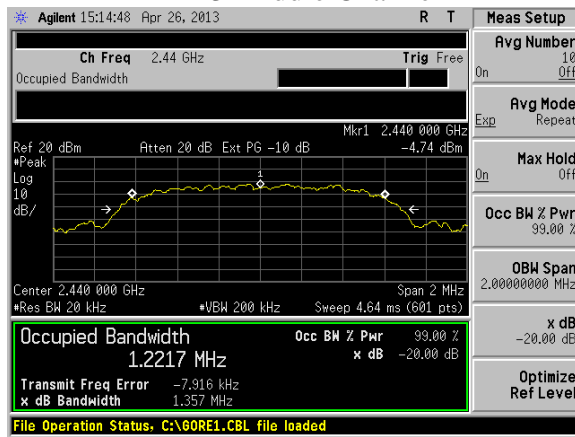
Model: TiWi-BLE& TiWi-R2

Serial: 3-016181, 3-030098

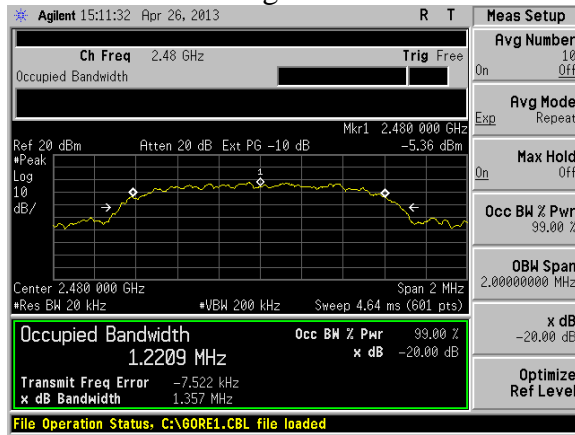
EDR3 Low Channel



EDR3 Middle Channel



EDR3 Highest Channel



Prepared For: LS Research

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Name: TiWi-BLE/TiWi-R2

Model: TiWi-BLE& TiWi-R2

Serial: 3-016181, 3-030098

Appendix C - Uncertainty Summary

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.82 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.88 dB
Radiated Emissions	3-Meter Chamber, Horn Antenna	4.85 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.32 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.63 dB
Absolute Conducted Emissions	Agilent PSA/ESA Series	1.38 dB
AC Line Conducted Emissions	Shielded Room/EMCO LISN	3.20 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	2.05 Volts/Meter
Conducted Immunity	3 Volts level	2.33 V
EFT Burst, Surge, VDI	230 VAC	54.4 V
ESD Immunity	Discharge at 15kV	3200 V
Temperature/Humidity	Thermo-hygrometer	0.64° / 2.88 %RH

Appendix D - References

Publication	Year	Title
FCC CFR Parts 0-15	2011	Code of Federal Regulations – Telecommunications
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
RSS-210 Annex 8	2010	Low-power License-exempt Radio communication Devices (All Frequency Bands): Category I Equipment
RSS-GEN Issue 3	2010	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

Appendix E – MPE Calculations

RF Technical Information:

Type of Evaluation (check one)	<input type="checkbox"/>	SAR Evaluation: Device Used in the Vicinity of the Human Head
	<input type="checkbox"/>	SAR Evaluation: Body-worn Device
	<input checked="" type="checkbox"/>	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

Evaluated against exposure limits: General Public Use Controlled Use

Duty Cycle used in evaluation: 100%

Standard used for evaluation: OET 65

Measurement Distance: 20 cm

RF Value: 0.005417 V/m A/m mW/cm²

Measured Computed Calculated

Prepared For: LS Research

Name: TiWi-BLE/TiWi-R2

Report: TR 313052 B

Model: TiWi-BLE& TiWi-R2

LSR: C-1704

Serial: 3-016181, 3-030098

END OF REPORT

Date	Version	Comments	Person
6-21-13	V0	Initial Draft Release	Aidi Zainal
6-25-13	V1	First Revision	Aidi Zainal
6-25-13	V1	Reviewed	Adam A

Prepared For: LS Research	Name: TiWi-BLE/TiWi-R2
Report: TR 313052 B	Model: TiWi-BLE& TiWi-R2
LSR: C-1704	Serial: 3-016181, 3-030098