

Test Report # TR 316356 B (FHSS)

Equipment Under Test: Sterling-LWB5 Module

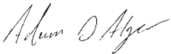
Test Date(s): February 15, 2017 March 22-23, 2017
March 2, 2017 April 4, 2017
March 29, 2017 May 6-7, 2017
February 20-21, 2017

Prepared for: LSR
Attn: Bill Steinike
W66N220 Commerce Court
Cedarburg, WI 53012

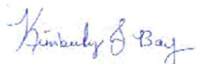
Report Issued by:

Signature:  Date: 5/9/2017

Report Reviewed by: Adam Alger, Quality Systems Engineer

Signature:  Date: 5/9/2017

Report Constructed by:

Signature:  Date: 5/1/2017

This test report may not be reproduced, except in full, without written approval of Laird Technologies, Inc.

CONTENTS

Laird Technologies Test Services in Review	3#
1# Test Report Summary	4#
2# Client Information	5#
2.1# Equipment Under Test (EUT) Information	5#
2.2# Product Description	5#
2.3# Modifications Incorporated for Compliance.....	5#
2.4# Deviations and Exclusions from Test Specifications	5#
2.5# Additional Information.....	6#
3# References	7#
4# Uncertainty Summary	8#
5# Test Data	9#
5.1# Antenna Port Conducted Emissions.....	9#
5.1.1# Antenna Port Conducted Emissions – Bandwidth	10#
5.1.2# Antenna Port Conducted Emissions – Power Out.....	14#
5.1.3# Antenna Port Conducted Emissions – 100 kHz Band Edge	18#
5.1.4# Antenna Port Conducted Emissions – Spurious Emissions	21#
5.1.5# Antenna Port Conducted Emissions – Carrier Frequency Separation	29#
5.1.6# Antenna Port Conducted Emissions – Number of Hopping Frequencies	31#
5.1.7# Antenna Port Conducted Emissions – Time of Occupancy	33#
5.2# Radiated Emissions	38#
5.2.1# Radiated – Restricted Band Edges	39#
5.2.2# Radiated – Spurious Emissions.....	43#
5.3# AC Mains Conducted Emissions	47#
5.3.1# AC Mains Conducted Emissions	48#
6# Revision History	50#

Laird Technologies Test Services in Review

The Laird Technologies, Inc. laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin 53012 USA is recognized through the following organizations:



A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein, unless otherwise noted.



Federal Communications Commission (FCC) – USA

Accredited recognition of two 3 meter Semi-Anechoic Chambers

Accredited Test Firm Registration Number: 953492



Innovation, Science and Economic Development Canada

ISED Site listing of two 3 meter Semi-Anechoic Chambers based on RSS-GEN – Issue 4

File Number: IC 3088A-2

File Number: IC 3088A-3

Company: Laird Technologies, Inc.	Page 3 of 50	Name: Sterling-LWB5
Report: TR 315356 B (FHSS)		Model: Sterling-LWB5
Job: C-2602		Serial: 00009, 00015, 00019, 00032

1 TEST REPORT SUMMARY

Between **February 15, 2017 and May 6, 2017**, the Equipment Under Test (EUT), **Sterling-LWB5 module**, as provided by **LSR** was tested to the following requirements:

Requirement	Description	Specification	Method	Result
FCC: 15.247 (a)(1) IC: RSS-247 5.1	Channel Separation, Number of Hopping frequencies, Time of Occupancy	FHS	ANSI C63.10	Pass
FCC: 2.1049 IC: RSS-GEN 6.6	Occupied Bandwidth	Reported	ANSI C63.10	Reported
FCC: 15.247 (b)(1) IC: RSS-247 5.4 (b)	Maximum Conducted Output Power	30 dBm	ANSI C63.10	Pass
FCC: 15.247 (d) IC: RSS-247 5.5	RF Spurious Emissions at the Transmitter Antenna Terminal	20 dBc	ANSI C63.10	Pass
FCC: 15.247 (d) IC: RSS-GEN 8.10	Spurious Radiated Emissions in Restricted Bands	FCC 15.209 RSS-GEN 8.9	ANSI C63.10	Pass
FCC: 15.207 IC: RSS-GEN 8.8	AC Power Line Conducted Emissions	0.150-30 MHz	ANSI C63.10	Pass

Notice:

The results relate only to the item tested and described in this report. Any modifications made to the equipment under test after the specified test date(s) may invalidate the data herein.

If the resulting measurement margin is seen to be within the uncertainty value, as listed in this report, the possibility exists that this unit may not meet the required limit specification if subsequently tested.

2 CLIENT INFORMATION

Company Name	LSR
Contact Person	Bill Steinike
Address	W66N220 Commerce Ct. Cedarburg, WI 53012

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	Sterling-LWB5 Module
Model Number	Sterling-LWB5
Serial Number	00009, 00015, 00019, 00032
FCC ID	TFB-1004
IC ID	5969A-1004

2.2 Product Description

The Sterling-LWB5 is a multi-standard module with support for WLAN (802.11 a/b/g/n/ac), Bluetooth 2.1+EDR, Bluetooth 3.0, and Bluetooth 4.1 (Bluetooth Low Energy) with multiple antenna options.

Chip Antenna: Johanson Part # 2450AD14A5500 peak gain 1.0 dBi (2.4 GHz) / 4.0 dBi (5.5 GHz)

U.FL Antenna port utilizes the following antenna options:

LSR Part #001-0009 2.4 GHz Dipole Antenna peak gain 2.0 dBi (2.4 GHz & 5.5 GHz)

LSR Part #001-0016 2.4 GHz FlexPIFA peak gain 2.5 dBi (2.4 GHz) / 3.0 dBi (5.5 GHz)

2.3 Modifications Incorporated for Compliance

None noted at time of test.

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test.

2.5 Additional Information

Module was powered at 3.3VDC using a variable DC power supply.

Bluetooth settings were programmed using Bluetooth RF Eval Tool Version 8.7.0.0. Modulation used: GFSK, EDR2, EDR3. Frequencies used: 2402 MHz, 2440 MHz, 2480 MHz.

3 REFERENCES

Publication	Edition	Date	AMD 1	AMD 2	Type
47 CFR, Parts 0-15 (FCC)		2017			
RSS 247	2	2017			
RSS GEN	4	2014			
ANSI C63.10		2013			

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of $k = 2$.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty $\pm$
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

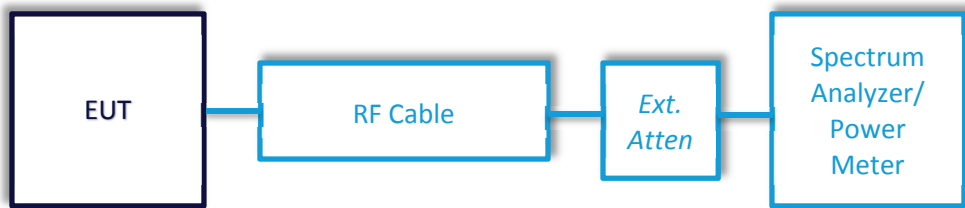
Parameter	ETSI U.C. $\pm$	U.C. $\pm$
Radio Frequency, from F0	1×10^{-7}	0.55×10^{-7}
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



5.1.1 Antenna Port Conducted Emissions – Bandwidth

Operator	Kimberly Bay
QA	Shane Dock
Test Date	February 15, 2017 / May 6, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21°C / 30% R.H. / 22°C / 35% R.H.
Requirement	FCC 15.247 (a)(1) / RSS-247 Section 5.1 (a)
Method	20 dB BW – ANSI C63.10 2013 Section 6.9.2 99% BW – ANSI C63.10 2013 Section 6.9.3

Test Parameters

Frequency	2402 MHz, 2440 MHz, 2480 MHz
Settings	RBW between 1% and 5% of OBW, VBW approx. 3 x RBW
EUT	GFSK, EDR2, EDR3, single channel mode, maximum power setting, random data pattern

Instrumentation



Date: 6-Feb-2017 Type Test: Bluetooth Conducted RF Measurements Job #: C-2602
Prepared By: Kim/Shane Customer: LSR Quote #: 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phasemeter	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification

Table – 20 dB Bandwidth

Channel	GFSK BW (MHz)	EDR2 BW (MHz)	EDR3 BW (MHz)
Low	0.923	1.329	1.255
Mid	0.923	1.321	1.259
High	0.922	1.320	1.261

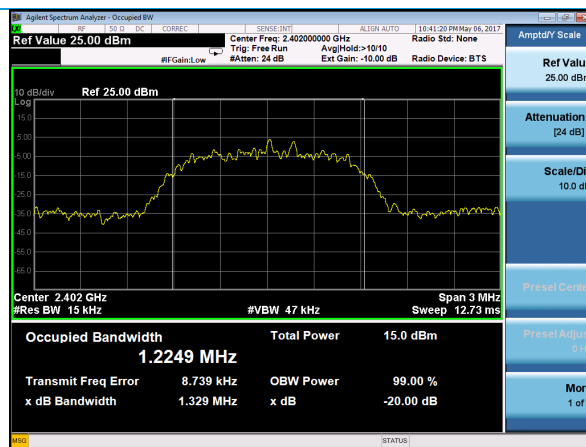
Table – 99% Bandwidth

Channel	GFSK BW (MHz)	EDR2 BW (MHz)	EDR3 BW (MHz)
Low	0.879	1.225	1.219
Mid	0.881	1.213	1.212
High	0.880	1.205	1.204

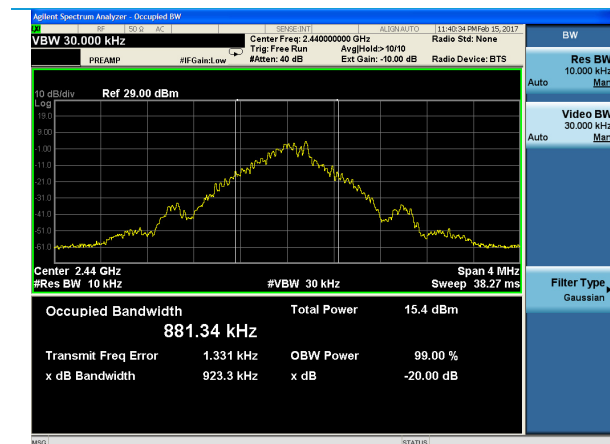
Plots - Bandwidth



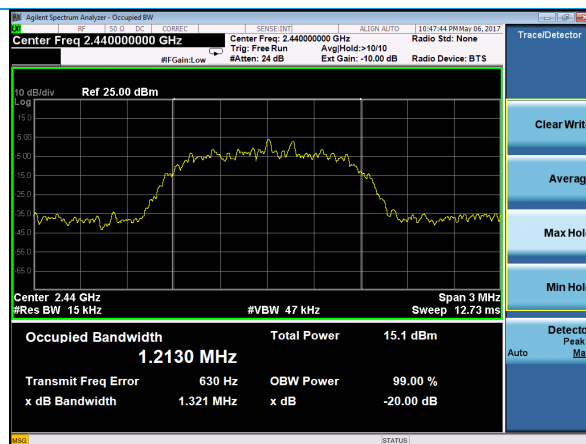
GFSK – Low Channel



EDR2 – Low Channel



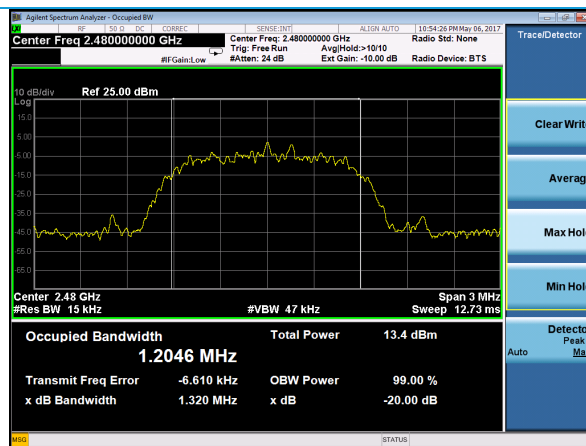
GFSK – Mid Channel



EDR2 – Mid Channel

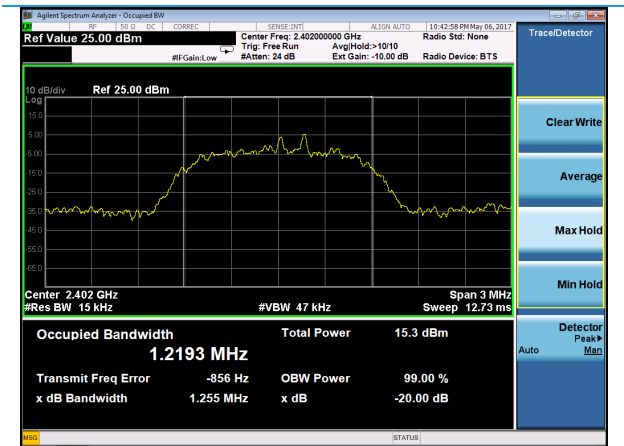


GFSK – High Channel

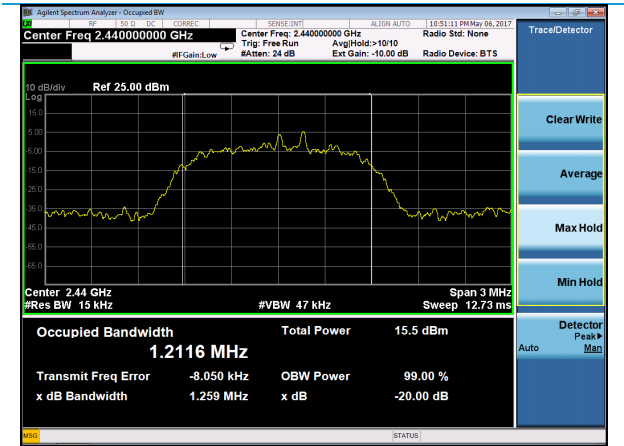


EDR2 – High Channel

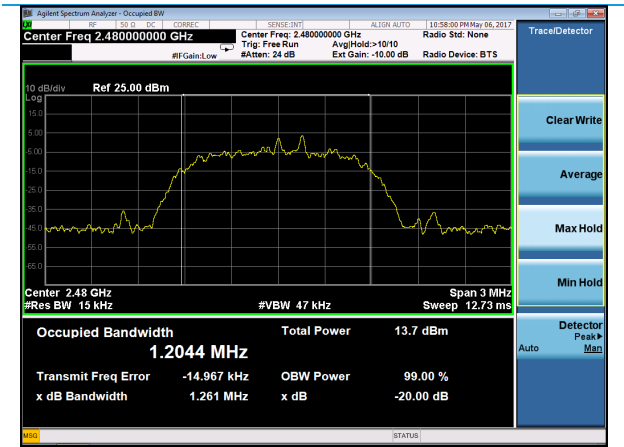
Plots – Bandwidth, continued



EDR3 – Low Channel



EDR3 – Mid Channel



EDR3 – High Channel

Company: Laird Technologies, Inc.	Page 13 of 50	Name: Sterling-LWB5
Report: TR 315356 B (FHSS)		Model: Sterling-LWB5
Job: C-2602		Serial: 00009, 00015, 00019, 00032

5.1.2 Antenna Port Conducted Emissions – Power Out

Operator	Kimberly Bay / Shane Dock
QA	Shane Dock / Kimberly Bay
Test Date	February 20, 2017 / March 29, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21°C / 31% R.H. / 22°C / 35% R.H.
Requirement	FCC 15.247 (b)(1) / RSS-247 Section 5.4 (b)
Method	ANSI C63.10 2013 Section 7.8.5

Limits:

For frequency hopping systems...

...operating in the 2400 to 2483.5 MHz band employing at least 75 non-overlapping hopping channels, the maximum conducted output power shall not exceed 1 Watt (30 dBm).

Test Parameters

Frequency	2402 MHz, 2440 MHz, 2480 MHz
Settings	RBW = 3 MHz, VBW ≥ 8 MHz
EUT	GFSK, EDR2, EDR3, single channel mode (H, M, L channels), maximum power setting, random data pattern

Instrumentation



Date : 6-Feb-2017

Type Test : Bluetooth Conducted RF Measurements

Job # : C-2602

Prepared By: Kim/Shane

Customer : LSR

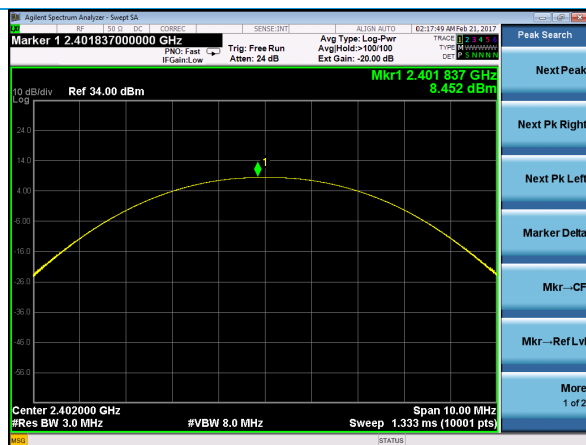
Quote #: 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phasemeter	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification

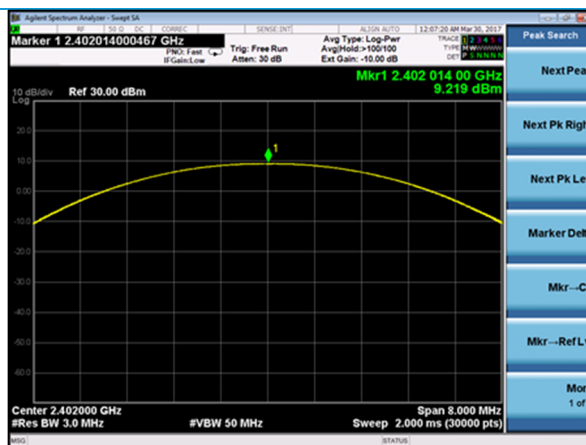
Table – Power Out

Channel	Limit (dBm)	GFSK (dBm)	Margin GFSK (dB)	EDR2 (dBm)	Margin EDR2 (dB)	EDR3 (dBm)	Margin EDR3 (dB)
Low	30	8.45	21.55	9.22	20.78	9.45	20.55
Mid	30	9.22	20.79	9.40	20.60	9.73	20.27
High	30	7.78	22.22	7.91	22.09	8.33	21.67

Plots – Power Out



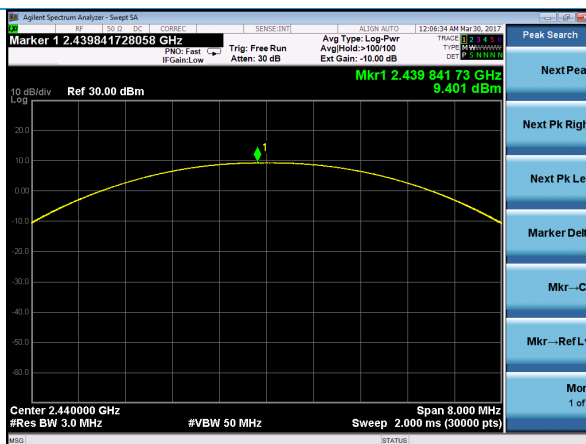
GFSK – Low Channel



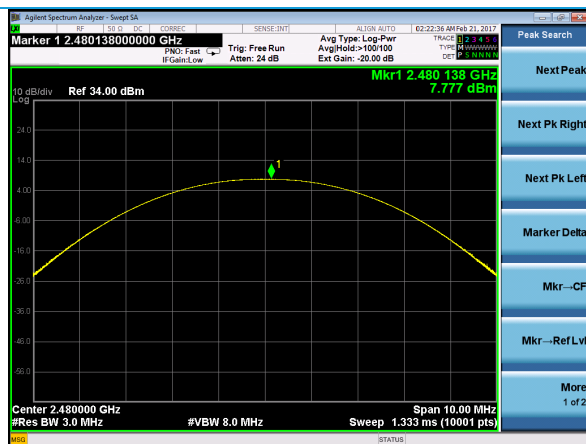
EDR2 – Low Channel



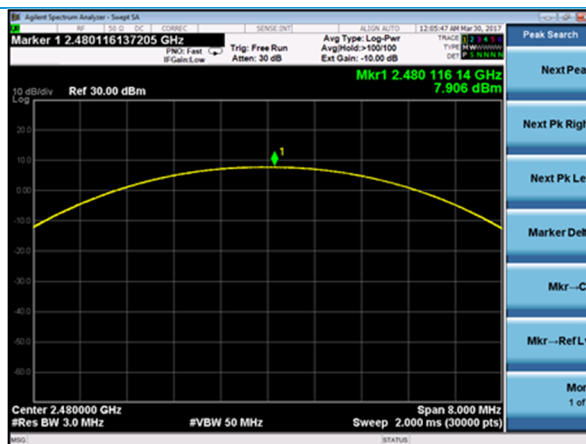
GFSK – Mid Channel



EDR2 – Mid Channel

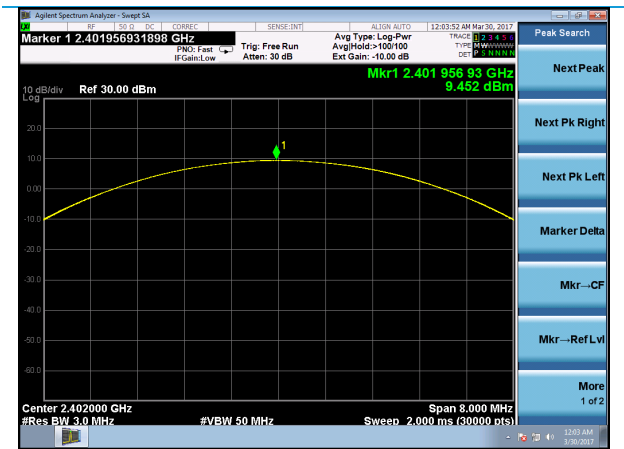


GFSK – High Channel

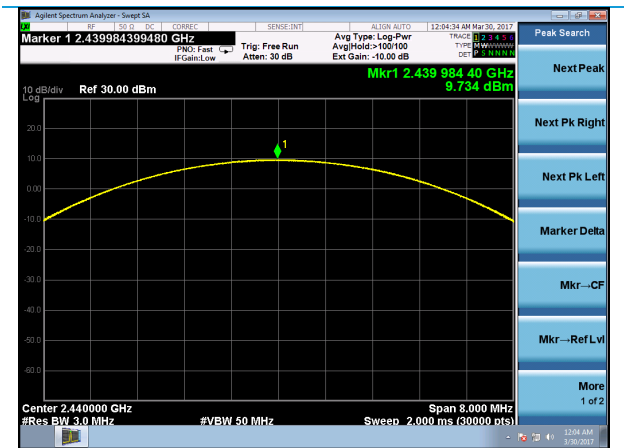


EDR2 – High Channel

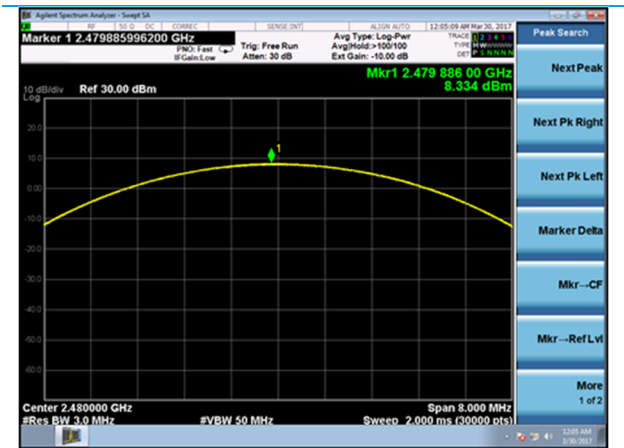
Plots – Power Out, continued



EDR3 – Low Channel



EDR3 – Mid Channel



EDR3 – High Channel

5.1.3 Antenna Port Conducted Emissions – 100 kHz Band Edge

Operator	Kimberly Bay / Shane Dock
QA	Shane Dock / Kimberly Bay
Test Date	February 20, 2017 / March 29, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21°C / 31% R.H. / 22°C / 35% R.H.
Requirement	FCC 15.247 (d) / RSS-247 Section 5.5
Method	ANSI C63.10 2013 Section 6.10.4

Limits:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating...

...the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Test Parameters

Frequency	2400 MHz to >2402 MHz, and < 2480 MHz to 2483.5 MHz
Settings	RBW = 100 kHz, VBW = 300 kHz
EUT	GFSK, EDR2, EDR3, single channel mode & hopping mode, maximum power setting, random data pattern

Instrumentation



Date : 6-Feb-2017

Type Test : Bluetooth Conducted RF Measurements

Job # : C-2602

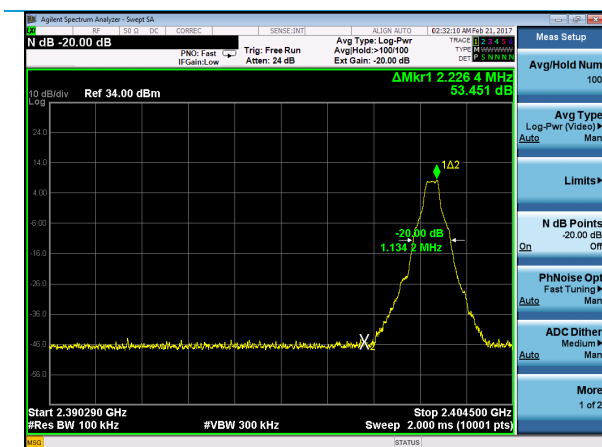
Prepared By: Kim/Shane

Customer : LSR

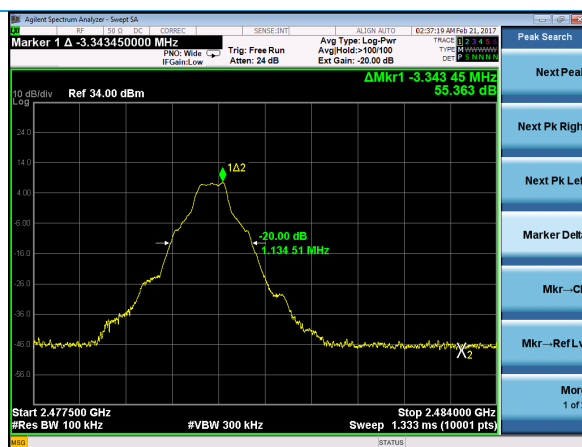
Quote # : 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phasemeter	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification

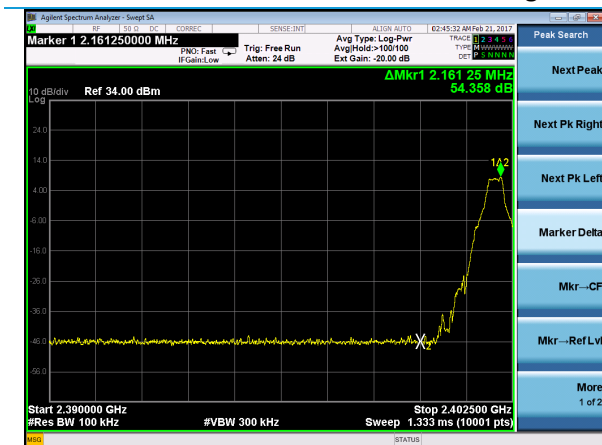
Plots – 100 kHz Band Edge



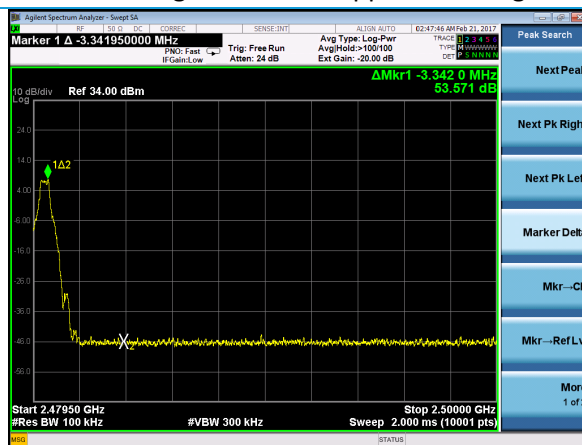
GFSK – Low Channel – Lower Band Edge



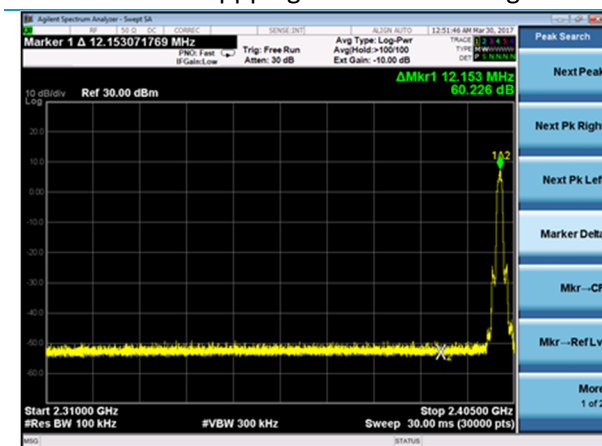
GFSK – High Channel – Upper Band Edge



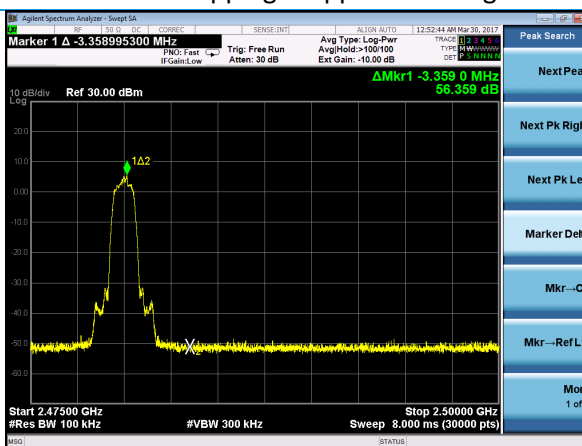
GFSK – Hopping – Lower Band Edge



GFSK – Hopping – Upper Band Edge

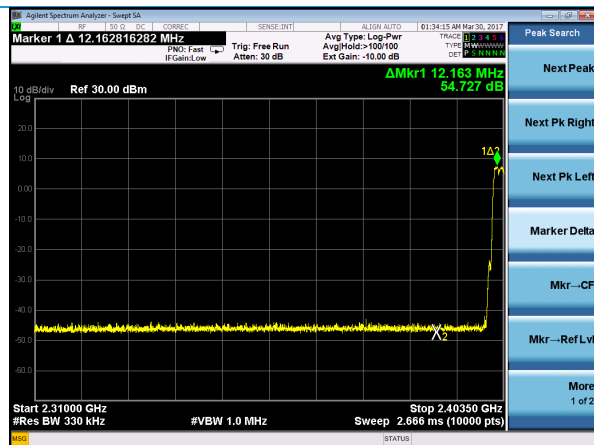


EDR2 – Low Channel – Lower Band Edge

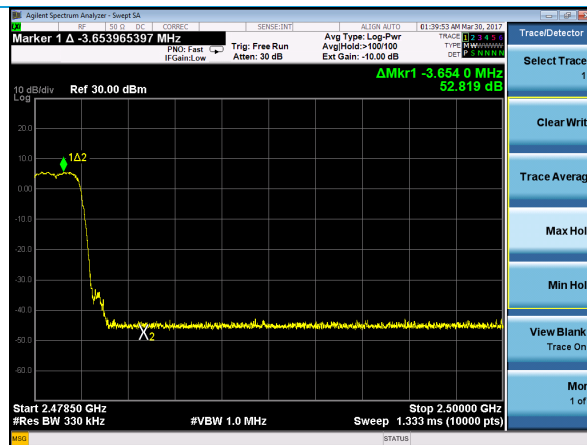


EDR2 – High Channel – Upper Band Edge

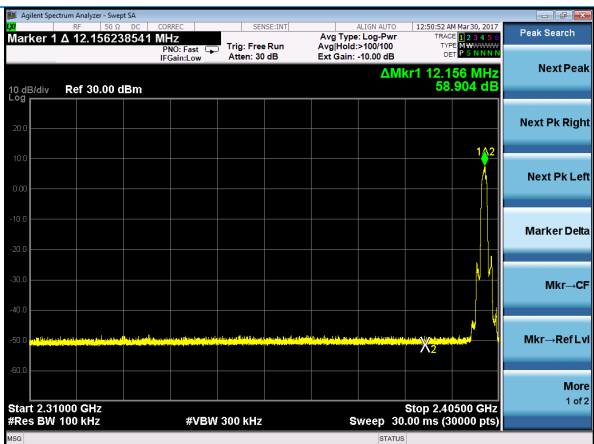
Plots – 100 kHz Band Edge, continued



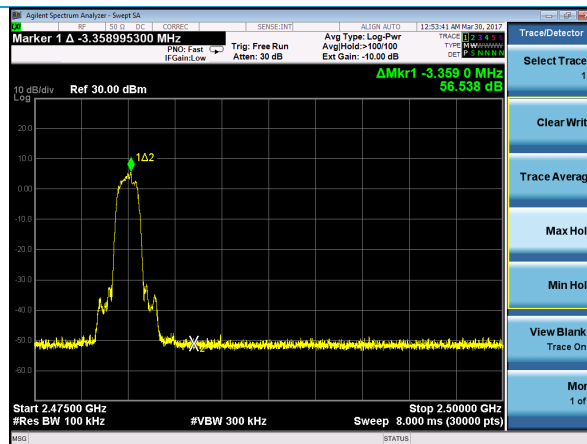
EDR2 – Hopping – Lower Band Edge



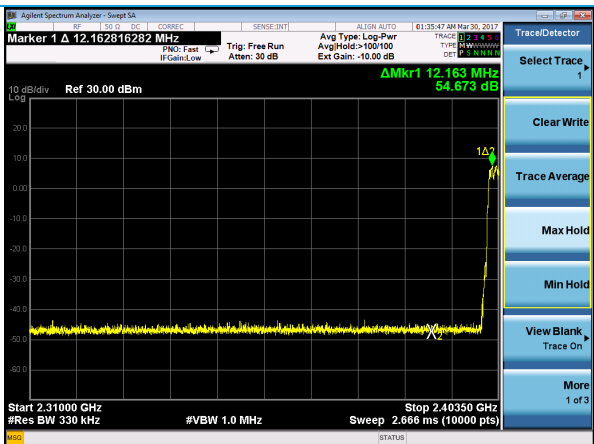
EDR2 – Hopping – Upper Band Edge



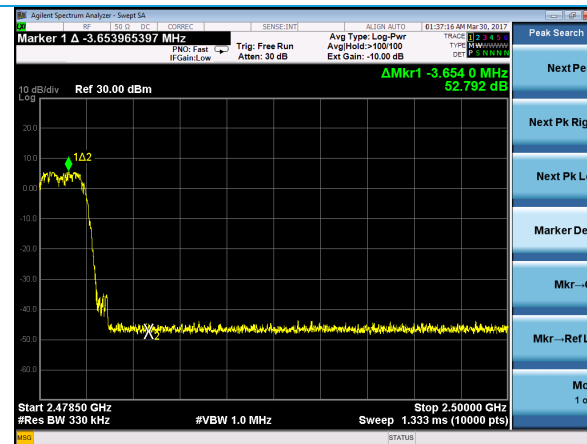
EDR3 – Low Channel – Lower Band Edge



EDR3 – High Channel – Upper Band Edge



EDR3 – Hopping – Lower Band Edge



EDR3 – Hopping – Upper Band Edge

5.1.4 Antenna Port Conducted Emissions – Spurious Emissions

Operator	Kimberly Bay / Shane Dock
QA	Shane Dock / Kimberly Bay
Test Date	February 20, 2017 / March 29, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21°C / 31% R.H. / 22°C / 35% R.H.
Requirement	FCC 15.247 (d)
Method	ANSI C63.10 2013 Section 7.8.8

Limits:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating...

...the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Test Parameters

Frequency	30 MHz – 25 GHz
Settings	RBW = 100 kHz, VBW = 300 kHz
EUT	GFSK, EDR2, EDR2, single channel mode (H, M, L channels), maximum power setting, random data pattern
Notes	No emissions found within 20 dB of the limit.

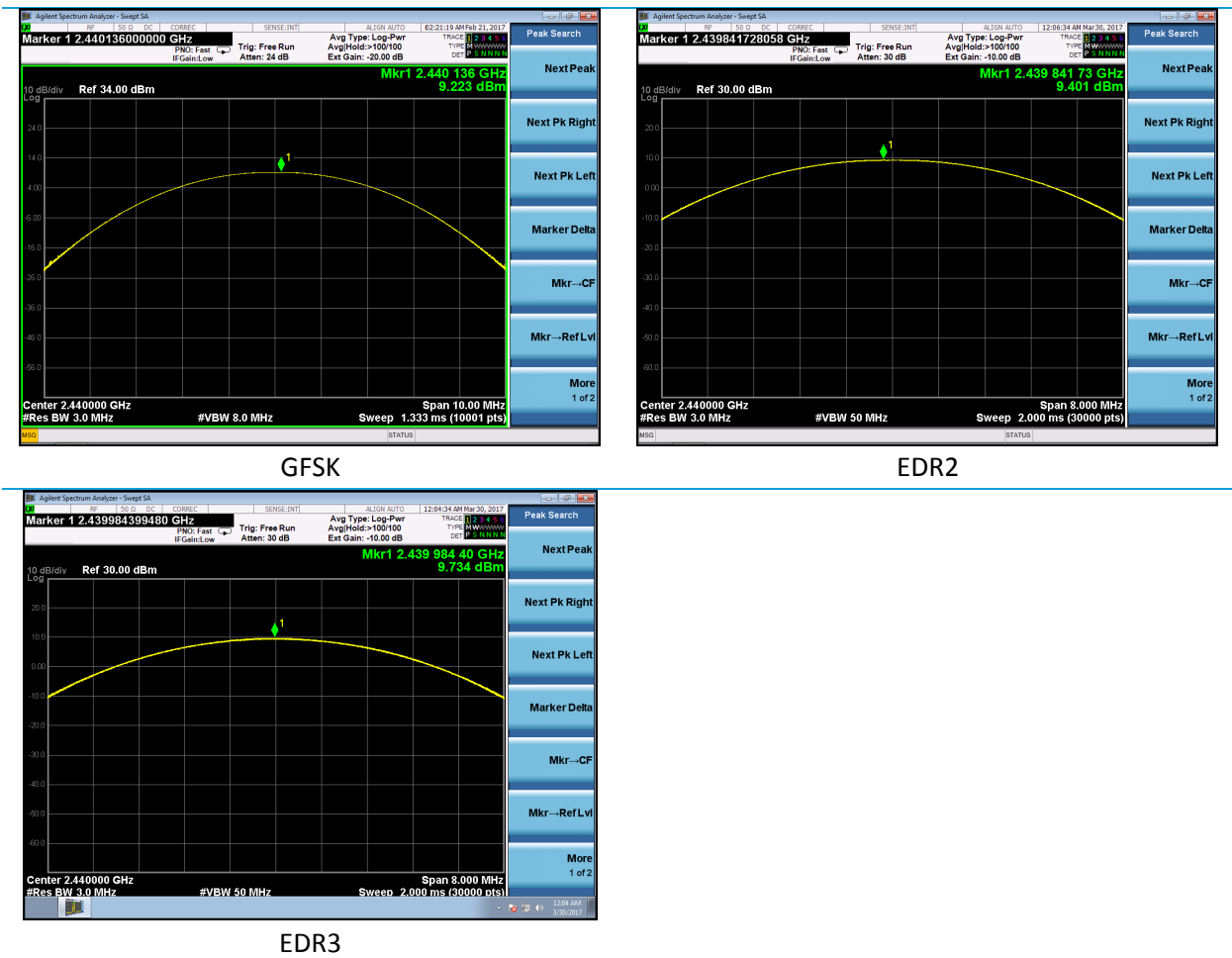
Instrumentation



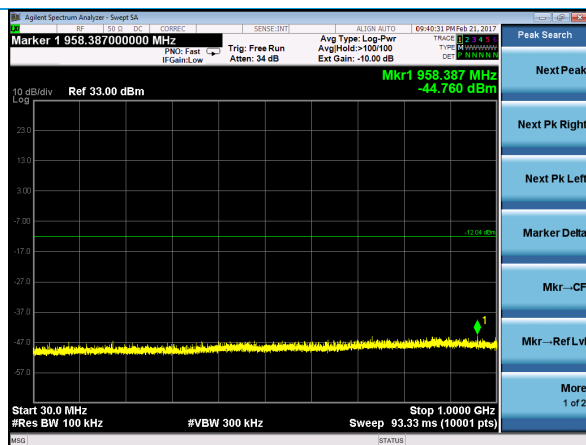
Date : 6-Feb-2017 Type Test : Bluetooth Conducted RF Measurements Job # : C-2602
Prepared By: Kim/Shane Customer : LSR Quote #: 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phasemeter	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification

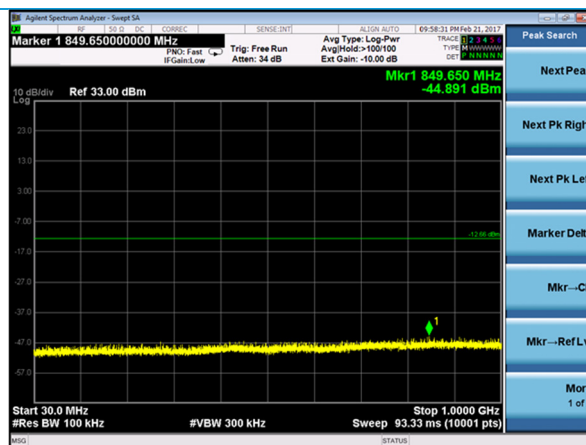
Plots – Reference Level for 100 kHz



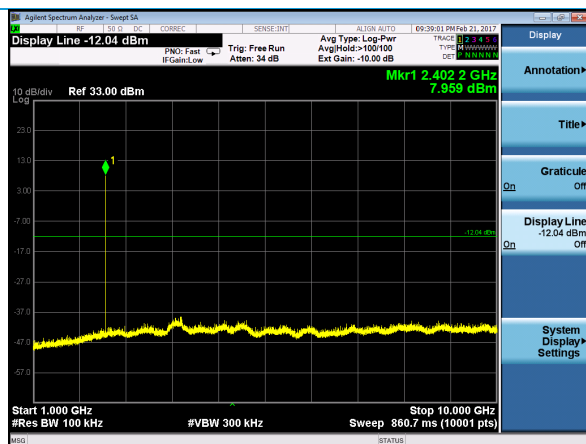
Plots – GFSK Spurious Emissions



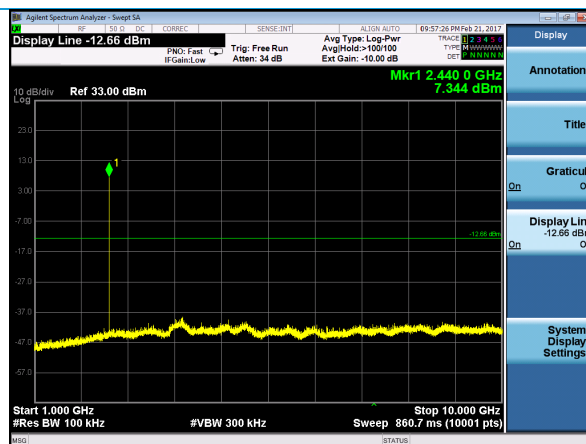
Low Channel – 30-1000 MHz



Mid Channel – 30-1000 MHz



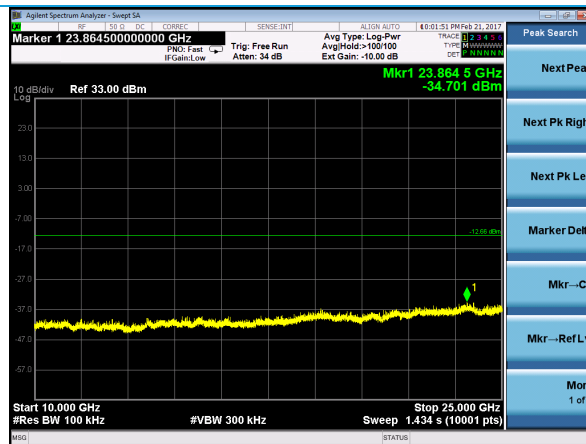
Low Channel – 1-10 GHz



Mid Channel – 1-10 GHz

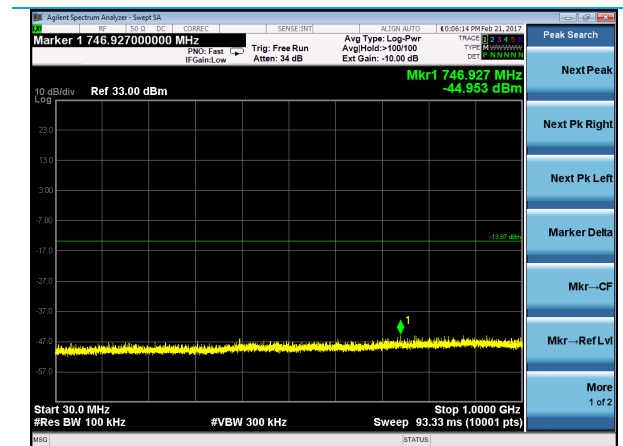


Low Channel – 10-25 GHz

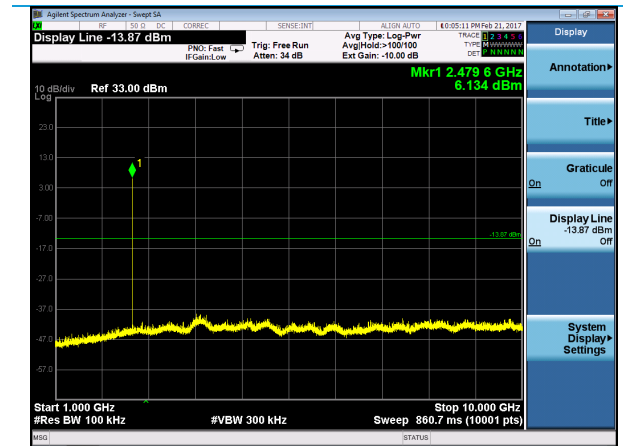


Mid Channel – 10-25 GHz

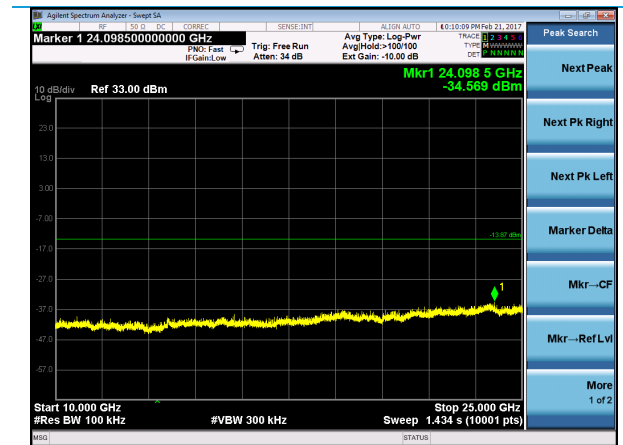
Plots – GFSK Spurious Emissions, continued



High Channel – 30-1000 MHz

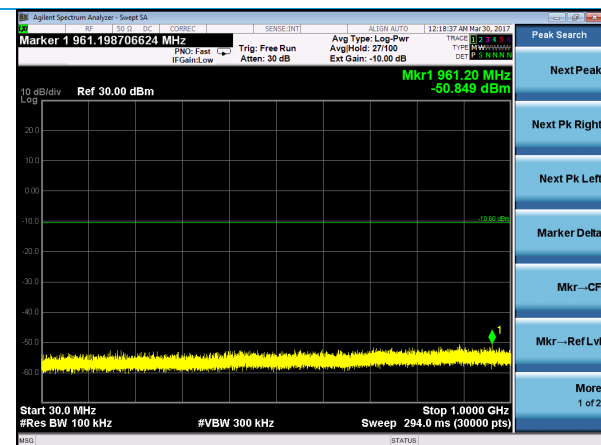


High Channel – 1-10 GHz

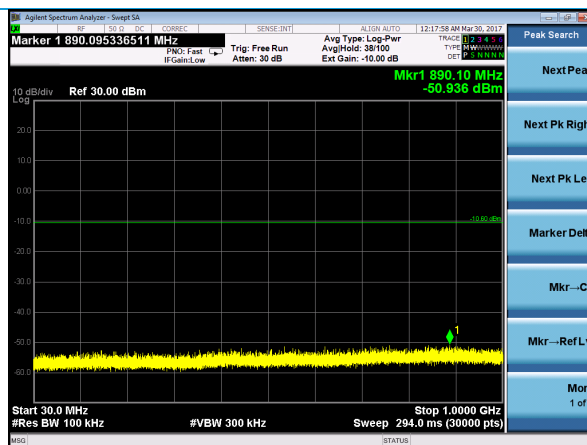


High Channel – 10-25 GHz

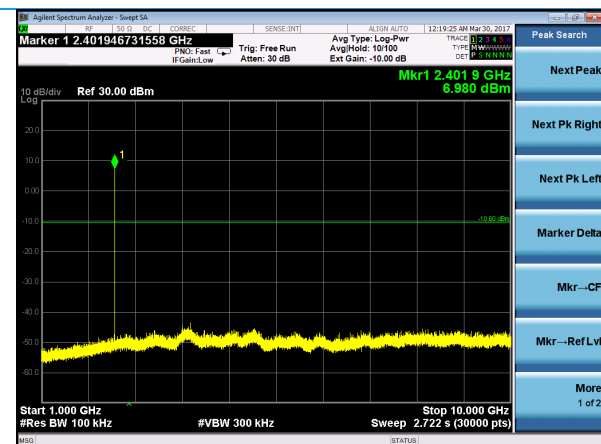
Plots – EDR2 Spurious Emissions



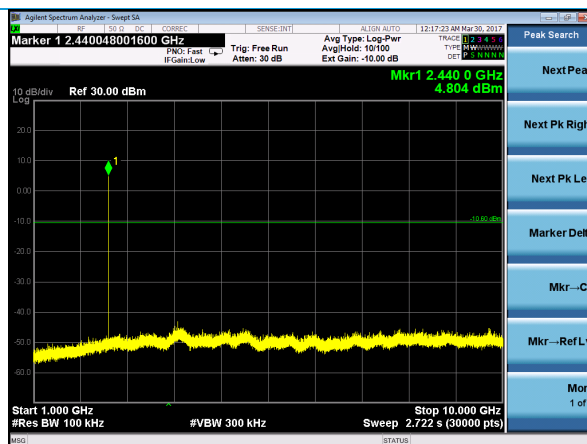
Low Channel – 30-1000 MHz



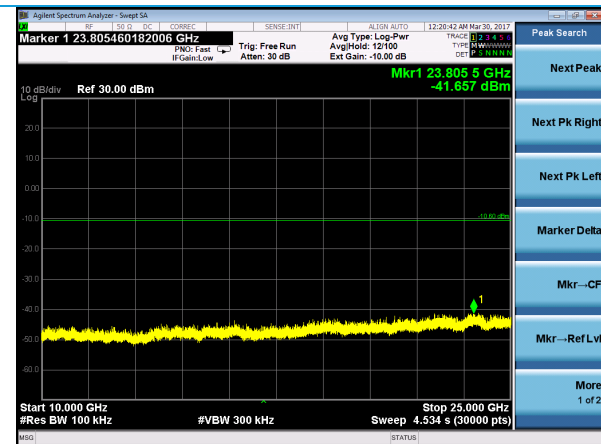
Mid Channel – 30-1000 MHz



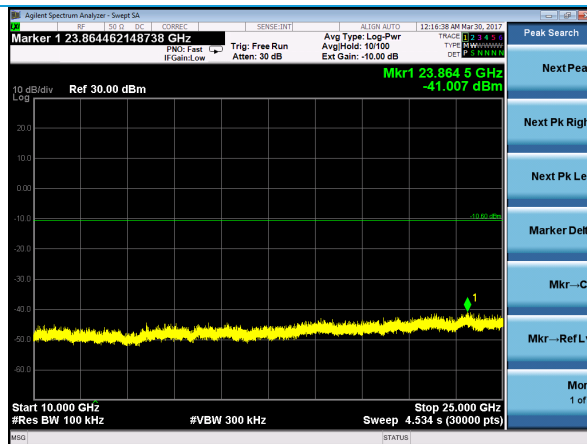
Low Channel – 1-10 GHz



Mid Channel – 1-10 GHz

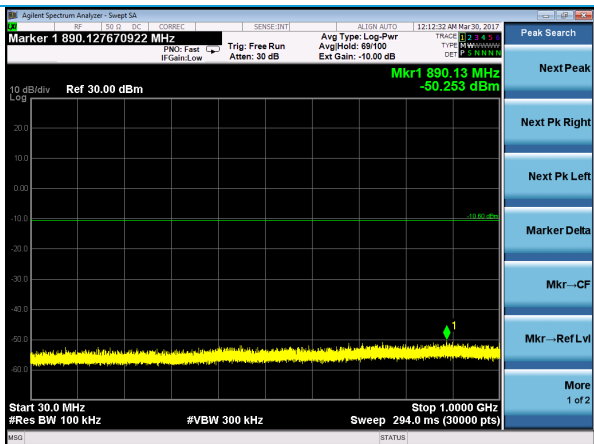


Low Channel – 10-25 GHz

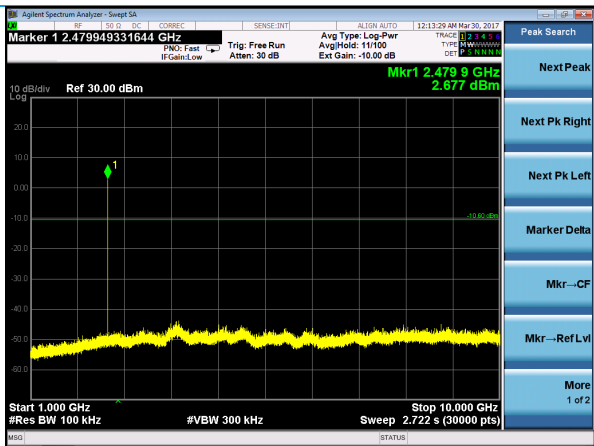


Mid Channel – 10-25 GHz

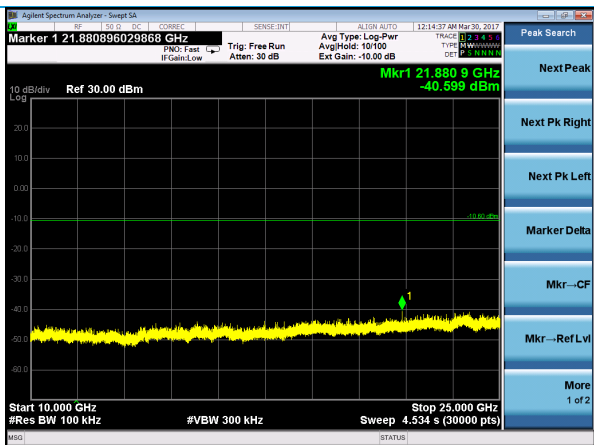
Plots – EDR2 Spurious Emissions, continued



High Channel – 30-1000 MHz

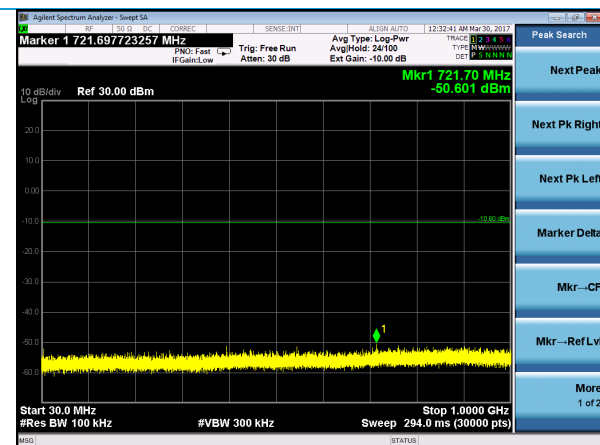


High Channel – 1-10 GHz

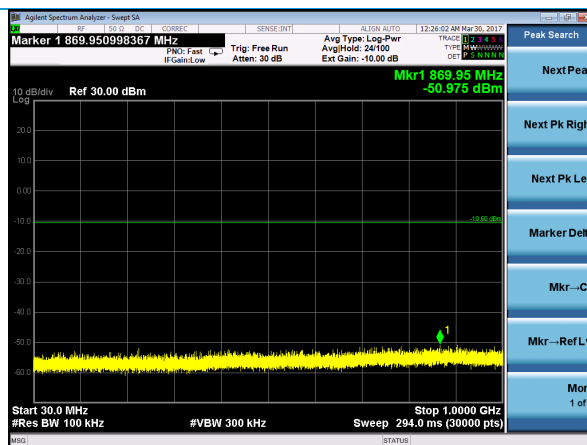


High Channel – 10-25 GHz

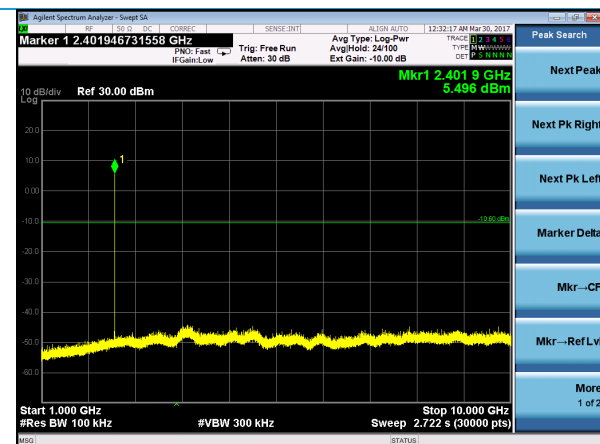
Plots – EDR3 Spurious Emissions



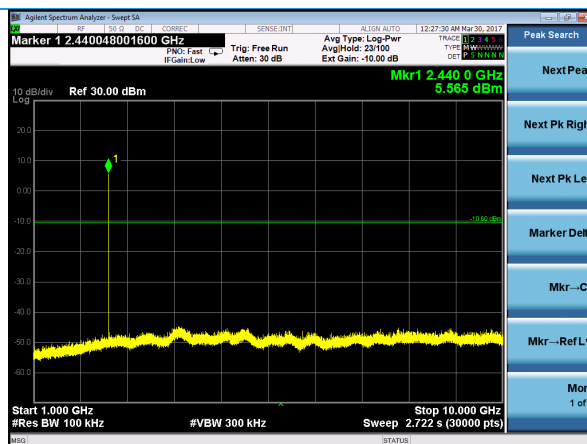
Low Channel – 30-1000 MHz



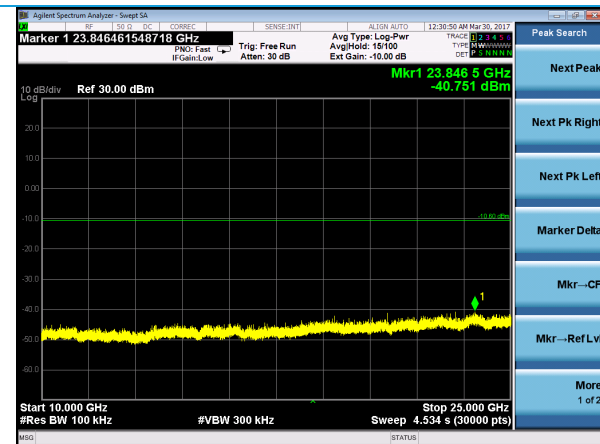
Mid Channel – 30-1000 MHz



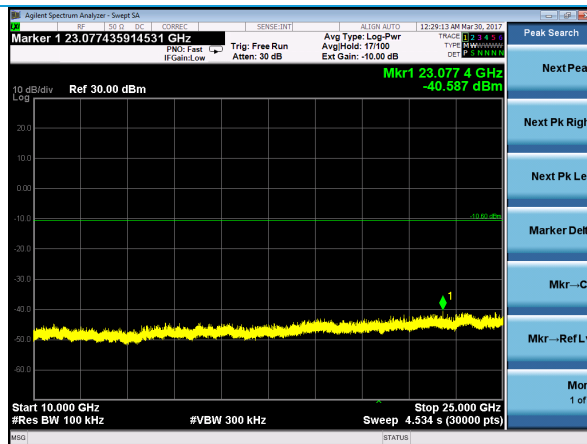
Low Channel – 1-10 GHz



Mid Channel – 1-10 GHz

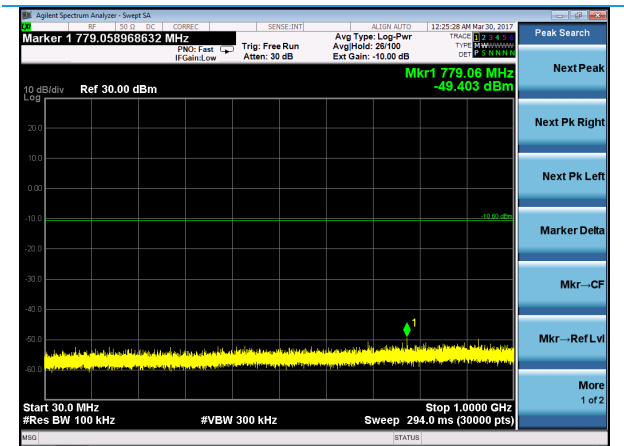


Low Channel – 10-25 GHz

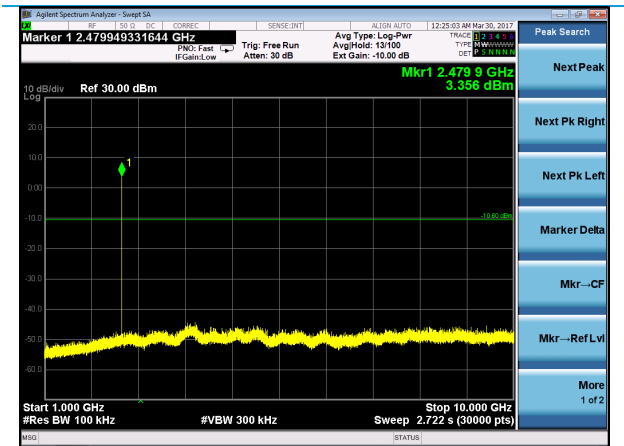


Mid Channel – 10-25 GHz

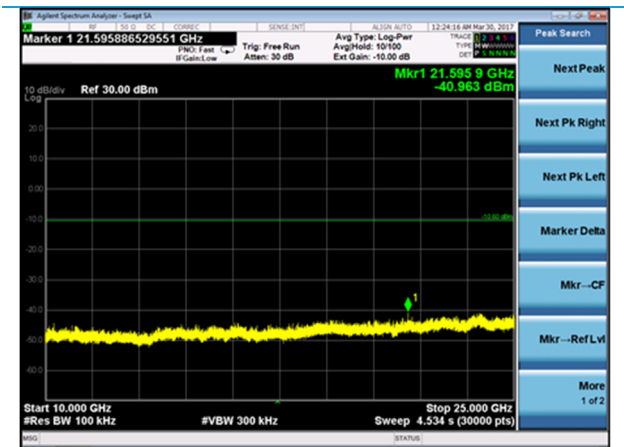
Plots – EDR3 Spurious Emissions, continued



High Channel – 30-1000 MHz



High Channel – 1-10 GHz



High Channel – 10-25 GHz

5.1.5 Antenna Port Conducted Emissions – Carrier Frequency Separation

Operator	Kimberly Bay
QA	Shane Dock
Test Date	February 20, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21°C / 31% R.H.
Requirement	FCC 15.247 (a)(1) / RSS-247 Section 5.1 (b)
Method	ANSI C63.10 2013 Section 7.8.2

Limits:

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW (21 dBm).

GFSK	≥ 0.615 MHz
EDR2	≥ 1.0 MHz
EDR3	≥ 1.0 MHz

Test Parameters

Frequency	2440.5 to 2442.5 MHz
Settings	RBW = 330 kHz, VBW = 1 MHz
EUT	GFSK, hopping mode, maximum power setting, random data pattern

Instrumentation



Date : 6-Feb-2017

Type Test : Bluetooth Conducted RF Measurements

Job # : C-2602

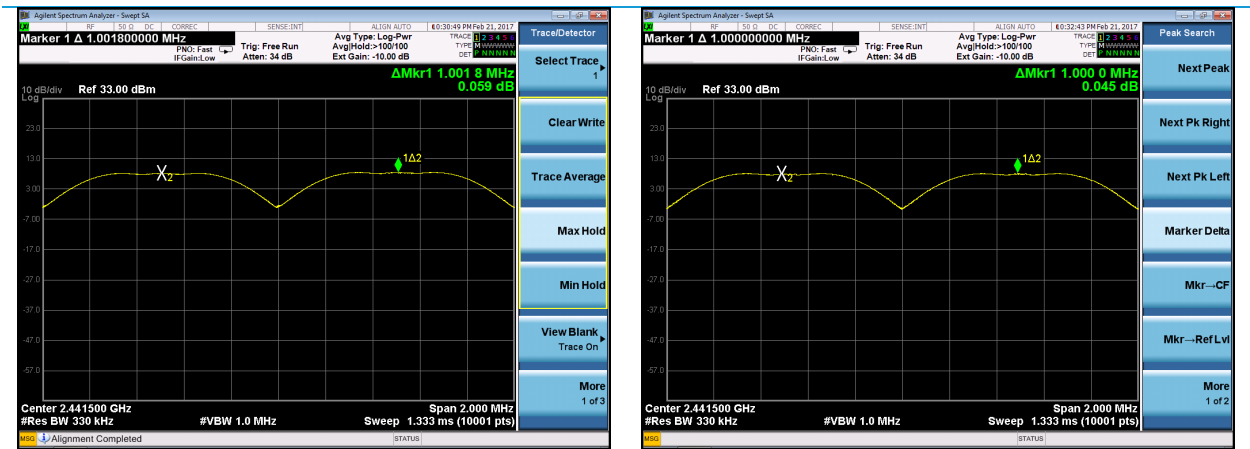
Prepared By : Kim/Shane

Customer : LSR

Quote # : 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification

Plots – Channel Separation



Adjacent Channels - Single Channel Mode
1 MHz channel separation

Adjacent Channels - Hopping Mode
1 MHz channel separation

5.1.6 Antenna Port Conducted Emissions – Number of Hopping Frequencies

Operator	Kimberly Bay
QA	Shane Dock
Test Date	February 20, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21°C / 31% R.H.
Requirement	FCC 15.247 (a)(1)(iii) / RSS-247 Section 5.1 (d)
Method	ANSI C63.10 2013 Section 7.8.3

Limits:

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Parameters

Frequency	2400 MHz to 2480.5 MHz
Settings	RBW = 330 kHz, VBW = 1 MHz
EUT	Hopping mode, GFSK, maximum power setting, random data pattern

Instrumentation



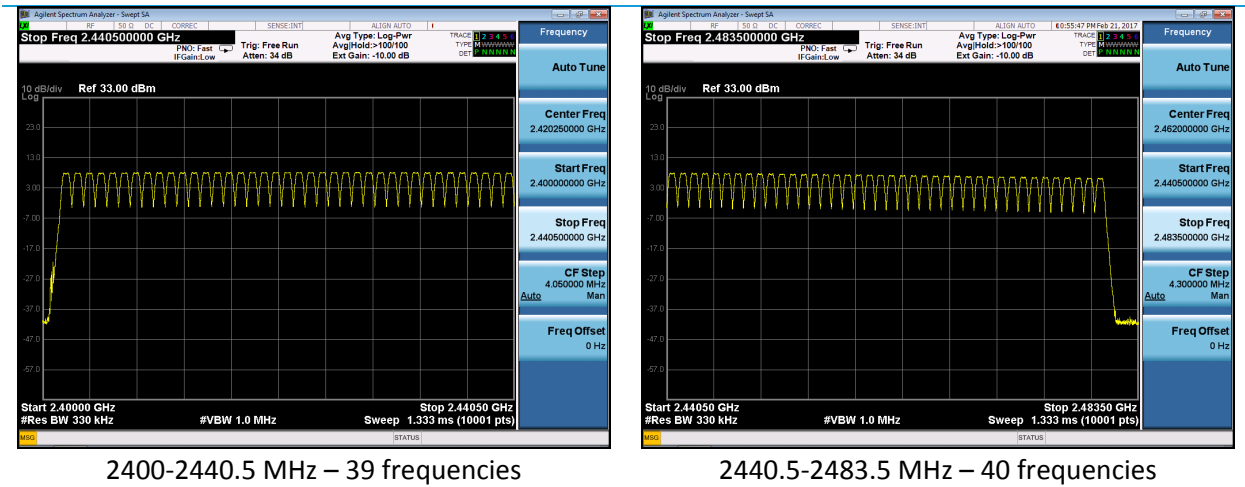
Date: 6-Feb-2017 Type Test: Bluetooth Conducted RF Measurements Job #: C-2602
 Prepared By: Kim/Shane Customer: LSR Quote #: 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phasemeter	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification

Table

Frequency Range	Number of Frequencies
2400-2440.5 MHz	39
2440.2-2483.5 MHz	40
Total = 79 Hopping frequencies	

Plots – Number of Hopping Frequencies



5.1.7 Antenna Port Conducted Emissions – Time of Occupancy

Operator	Kimberly Bay / Shane Dock
QA	Shane Dock / Kimberly Bay
Test Date	February 21, 2017 / March 29, 2017
Location	Conducted RF Test Bench
Temp. / R.H.	21°C / 28% R.H. / 22°C / 35% R.H.
Requirement	FCC 15.247 (a)(1)(iii) / RSS-247 Section 5.1 (d)
Method	ANSI C63.10 2013 Section 7.8.4

Limits:

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

0.4 seconds maximum in (79 hopping channels * 0.4 seconds) 31.6 seconds

Test Parameters

Frequency	2402 MHz, 2440 MHz, 2480 MHz
Settings	Zero span, RBW = 330 kHz, VBW = 1 GHz
EUT	Hopping mode, GFSK, EDR2, EDR2, maximum EUT power, random data pattern
Sample Calculation	(31.6s/5s) x (number of occurrences in 5s) x (single hop dwell time) = total dwell time Ex: (31.6s/5s) * 17 (occurrences in 5s) * 2.882ms (single hop dwell time) = 309.6ms total dwell time.

Instrumentation



Date : 5-Feb-2017

Type Test : Bluetooth Conducted RF Measurements

Job # : C-2602

Prepared By: Kim/Shane

Customer : LSR

Quote #: 316356

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	Spectrum Analyzer	Agilent	N9010A	MY53400236	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration
3	AA 960172	Cable - low loss 1m	A.H. Systems, Inc	SAC-26G-1	387	5/16/2016	5/16/2017	Active Verification

Table – GFSK Time of Occupancy

Channel (MHz)	Occurrences in 5s window	Occurrences in 31.6s window	single hop dwell time (ms)	Total Dwell time (ms)	Total Dwell time Limit (ms)
2402.0	17.0	107.4	2.882	309.6	400.0
2440.0	19.0	120.1	2.881	346.0	400.0
2480.0	17.0	107.4	2.882	309.6	400.0

Table – EDR2 Time of Occupancy

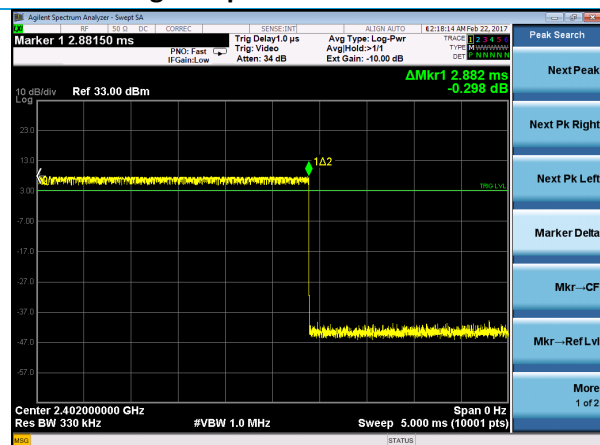
Channel (MHz)	Occurrences in 5s window	Occurrences in 31.6s window	single hop dwell time (ms)	Total Dwell time (ms)	Total Dwell time Limit (ms)
2402.0	19.0	120.1	2.889	346.9	400.0
2440.0	18.0	113.8	2.889	328.7	400.0
2480.0	16.0	101.1	2.889	292.1	400.0

Table – EDR3 Time of Occupancy

Channel (MHz)	Occurrences in 5s window	Occurrences in 31.6s window	single hop dwell time (ms)	Total Dwell time (ms)	Total Dwell time Limit (ms)
2402.0	16.0	101.1	2.892	292.4	400.0
2440.0	19.0	120.1	2.891	347.2	400.0
2480.0	16.0	101.1	2.891	292.3	400.0

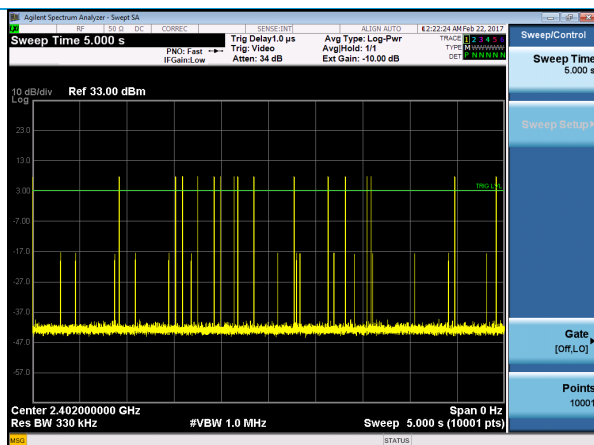
Plots – GFSK Time of Occupancy

Single Hop Dwell Time

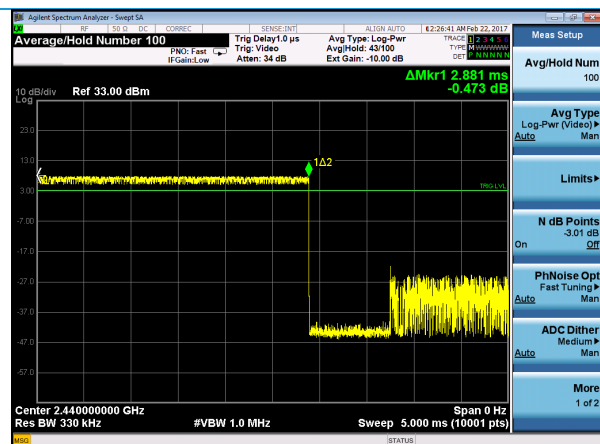


Low Channel

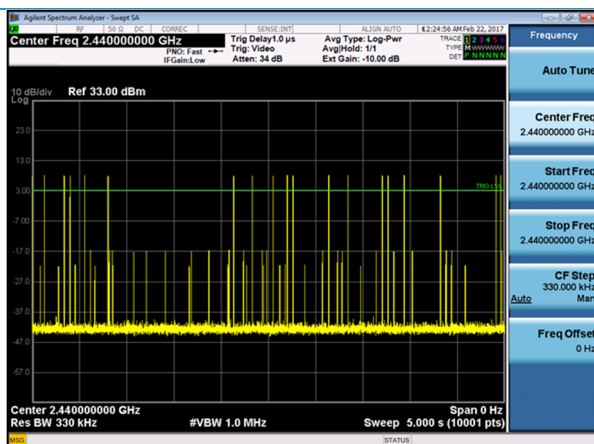
Occurrences in 5 sec Window



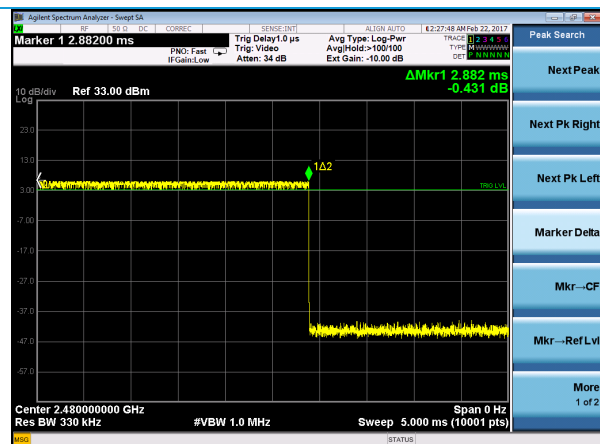
Low Channel



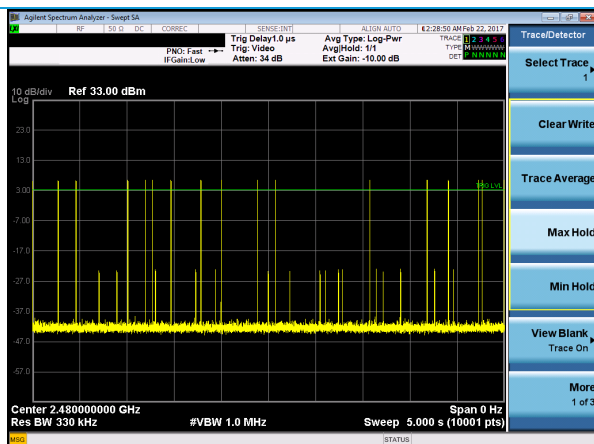
Mid Channel



Mid Channel



High Channel



High Channel