

RADIO TEST REPORT

(for Bluetooth Low Energy)

Project No. : JB-Z0189
Client : Sony Corporation
Address : 1-7-1 Konan Minato-ku Tokyo, 108-0075 Japan
Type of Equipment : Digital Music Player
Model No. : NW-WS623
Serial No. : 2000146, 2000177
FCC ID : AK8NWWS620
Regulation Applied : 47 CFR Part 15 Subpart C
Final Judgment : **Passed**
Sample Receipt : October 18, 2016
Testing : October 19, 2016 - November 03, 2016
Reported : November 14, 2016

Reported by :

Approved Signatory :



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Notice

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TESTING CERT #3203.01

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Note

- ☒-indicates that the listed condition, standard or equipment is applicable for this report.
☐-indicates that the listed condition, standard or equipment is not applicable for this report.

1. General Information

1.1. Description of Equipment Under Test (EUT)

General specification

Test Sample Condition : ☐ Prototype ☒ Pre-production ☐ Mass-production
Type of Equipment : Digital Music Player
Trade Name : SONY
Model No. : NW-WS623
Serial No. : 2000146, 2000177
Power Rating : DC 3.7 V (The EUT was supplied with the power from built-in battery)
Software Ver. : 0.81.00

Similar model (to be covered by this Report)

Model No. : NW-WS625
The EUT has the following series model.
The difference of each model is the memory capacity.
NW-WS623: 4 GB (EUT)
NW-WS625: 16 GB (Similar model)

Radio specification

Function of the Equipment : Transceiver
Operating Frequency : 2402 - 2480MHz
Modulation Type : GFSK
Channel Spacing : 2MHz
Channel Bandwidth : 2MHz
Number of channels : 40
Antenna Type : Inverted-F antenna
Antenna connector Type : None
Antenna Gain : +0.50 dBi
Operating Temperature : -5 to +45 deg.C

1.2. Summary of Test Result

47 CFR Part 15 Subpart C

1.3. Tested Methodology

Test Standard : 47 CFR Part15 Subpart C
 Test Method : ANSI C63.10 - 2013
 KDB 558074 D01 DTS Meas. Guidance v03r05

Test Condition

Radiated Spurious Emissions

Test Distance : ☒ 3 m ☐ 10m (9kHz - 30 MHz)
☒ 3 m ☐ 10m (30 - 1000 MHz)
☒ 3 m (1 - 25 GHz)

Dimensions of the EUT table : 0.8m (below 1GHz) or 1.5m (above 1GHz) height, 2m width and 1m depth.

1.4. Measurement Procedures

We performed the measurements in accordance with NV3-06, available upon the request.

- ☒ No deviation
☐ Deviation from the above procedure

The summary of the above procedure is mentioned below

Antenna-port Conducted Measurement

1. Antenna-port of the EUT was connected to the power sensor (Maximum peak conducted output power) or spectrum analyzer. (other test items).
2. For each EUT operation mode, the Antenna-port Conducted Measurements were measured with power meter or spectrum analyzer.

Test Item	Detector	RBW
* Antenna-port Conducted Measurements		
6dB Bandwidth	Peak	30 kHz
Maximum Peak Conducted Output Power	Peak	-
Power Spectral Density	Peak	3 kHz
Conducted Spurious Emissions for Band Edge	Peak	100 kHz

Radiated Spurious Emissions

1. The non-conductive table (EUT table) made of (☐ FRP, ☒ Styrene Foam, ☐ other non-conductive material) was placed in the center of the turntable.
2. The EUT was placed on the center of the tabletop.
3. The test antenna was placed away from the EUT at test distance.
4. The limits compensated the distance factor with follows;

$$9 \text{ kHz} - 490 \text{ kHz [Limit at 3m]} = [\text{Limit at 300m}] + 40\log(300[\text{m}] / 3[\text{m}])$$

$$490 \text{ kHz} - 30 \text{ MHz [Limit at 3m]} = [\text{Limit at 30m}] + 40\log(30[\text{m}] / 3[\text{m}])$$
5. Find the worst arrangement of the EUT as follows;
 - Rotate the turntable and/or scanning the antenna.
 - On every condition, explore the highest emissions with the spectrum analyzer.
(9 kHz - 25 GHz, peak detector)
6. On the worst arrangement of the EUT found in above, choose the three highest harmonics or spurious emissions on the spectrum data.(*excluding carrier band edges)
 The final measurements are performed with all test operating modes for these emissions as follows;

The test antenna and the turntable were performed with follows;

	9kHz - 30MHz	30MHz - 1000MHz	above 1GHz
Antenna	Loop Antenna	Bi-conical Antenna, Log-periodic Antenna	Horn Antenna
Antenna scanning range	1m, Vertical, 360 degrees	1 - 4m, Horizontal and Vertical	1 - 4m *, Horizontal and Vertical
Turntable rotating range	360 degrees	360 degrees	360 degrees

*: When the measurement frequencies above 1GHz, final measurements are performed keeping the antenna in the "cone of radiation" from EUT area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.

Instruments settings were carried out with follows;

	9 kHz - 90 kHz 110 kHz - 490 kHz	90 kHz- 110 kHz 490 kHz - 30 MHz	30 MHz - 1000 MHz	above 1GHz
Detector	Peak / Average	Quasi-peak	Quasi-peak	Peak / Average
RBW	200 Hz (6dB) or 9 kHz (6dB) *1	200 Hz (6dB) or 9 kHz (6dB) *1	120 kHz (6dB)	1 MHz (3dB)
VBW	N/A	N/A	N/A	3 MHz (for peak) 10 kHz (for average) *2
Instrument	EMI test receiver	EMI test receiver	EMI test receiver	Spectrum analyzer

*1: When the measurement frequencies below 150 kHz, RBW: 200 Hz was used.

*2: VBW setting (for average) was higher than 1/T. (T is the minimum transmission duration)

7. If the final measurement result exceeded the limit in non-restricted band(excluding carrier band edges), the measurement is carried out additionally with follows;

Measurement points

- Fundamental Frequency
- Frequency that exceeded the limit in non-restricted band (excluding carrier band edges)

	9 kHz - 150 kHz	150 kHz - 30MHz	above 30MHz
Detector	Peak	Peak	Peak
RBW	3 dB RBW: 300 Hz *	3 dB RBW: 10 kHz *	3 dB RBW: 100 kHz
Instrument	Spectrum analyzer	Spectrum analyzer	Spectrum analyzer

*: Correction factor of RBW was compensated to a measurement result by the following formula.

$$\text{C.F. of RBW [dB]} = 10 \cdot \log (100\text{kHz} / \text{used RBW})$$

8. If the final average measurement result exceeded the limit in the authorized band edge, the integration method is carried out with follows;

	2483.5 - 2485.5MHz
Detector	Peak
RBW	3 dB RBW: 100 kHz
Instrument	Spectrum analyzer
Function	Channel Power (integration BW : 1MHz)

9. Although these tests were performed other than open field area test site, adequate comparison measurements were confirmed against 30 m open field area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.

1.5. Test Facility

Address of Test Facility

Test Facility Name : Sony Global Manufacturing & Operations Corporation
EMC/ RF Test Laboratory, Main Lab.

Address : Kisarazu Site 8-4 Shiomi Kisarazu-shi Chiba, 292-0834 Japan

Phone : +81 438 37 2750

Radiated Spurious Emission

Semi-Anechoic chamber

☒ 4th Site

Antenna-port Conducted Measurements *

Shielded Room

☒ 4th Site SR1

*Note: This item contains the following

- 6dB Bandwidth
- Maximum Peak Conducted Output Power
- Power Spectral Density
- Conducted Spurious Emissions for Band Edge

A2LA Accreditation for Test Facility

The above test facility has been fully reported to A2LA and accepted as follows:

Effective dates: 2015-09-15 through 2017-10-31

1.6. Uncertainty

Test Item	Frequency	4th Site SR1
Conducted Output Power	1 - 6GHz	± 0.84 dB
Power Spectral Density, Conducted Spurious Emissions	below 6GHz	± 0.89 dB

Test Item	Frequency	4th Site	
AC Power-line Conducted Emissions	150kHz - 30MHz	± 3.34 dB	
Radiated Emissions	below 30 MHz	3m	± 2.59 dB
	30 - 300 MHz	3m	± 4.18 dB
	300 - 1000 MHz	3m	± 4.04 dB
	1 - 6 GHz	3m	± 4.63 dB
	6 - 18 GHz	3m	± 5.31 dB
	18 - 26.5 GHz	3m	± 5.78 dB

2. System Test Configuration

2.1. Validation

The system was configured for testing in a typical (as a customer would normally use it).
The tests were conducted with the worst case modes as follows.

2.2. Test Operating Conditions

The tests have been carried out the following conditions.

Test Items	Operating Mode	Data Rate	Test Channels
6dB Bandwidth, Maximum Peak Conducted Output Power, Power Spectral Density, Radiated Spurious Emissions	Bluetooth Low Energy	1 Mbps	2402 MHz, 2440 MHz, 2480 MHz
Conducted Spurious Emissions for Band Edge	Bluetooth Low Energy	1 Mbps	2402 MHz

The Software for Operating Mode

Name: Android Debug Bridge

Version: -

Special accessories needed for connecting the EUT to achieve compliance:

Item	Manufacturer	Model No.	Serial No.	Remark
Personal Computer	HP	K7U44AV-ACJA	JPA55142KP	-

2.3. EUT Modifications

- ☒ No equipment modification to achieve compliance to the standard levels was done during the tests.
☐ Equipment was modified to achieve compliance to the standard level as below.

Responsible Party Signature

Typed/ Print Name :

Responsible Party :

Position :

Date :

2.4. Configuration of Tested System

Antenna-port Conducted Measurements

The equipment under test (EUT)

Symbol	Item	Manufacturer	Model No.	Serial No.
A	Digital Music Player	SONY	NW-WS623	2000146

Support equipment for operation

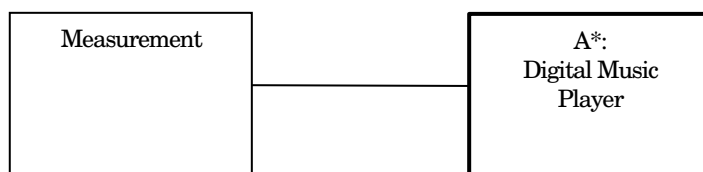
Symbol	Item	Manufacturer	Model No.	Serial No.
-	-	-	-	-

Type of cable

Symbol	Description	Identification (Manufacturer etc.)	Shielded YES / NO	Ferrite Core	Length (m)	Bundled
-	-	-	-	-	-	-

System configuration

*: EUT



Radiated Spurious Emissions Measurement

The equipment under test (EUT)

Symbol	Item	Manufacturer	Model No.	Serial No.
A	Digital Music Player	SONY	NW-WS623	2000177

Support equipment for operation

Symbol	Item	Manufacturer	Model No.	Serial No.
-	-	-	-	-

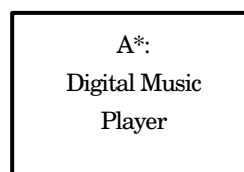
Type of cable

Symbol	Description	Identification (Manufacturer etc.)	Shielded YES / NO	Ferrite Core	Length (m)	Bundled
-	-	-	-	-	-	-

System configuration

*: EUT

BLE



3. Test Data

3.1. 6dB Bandwidth

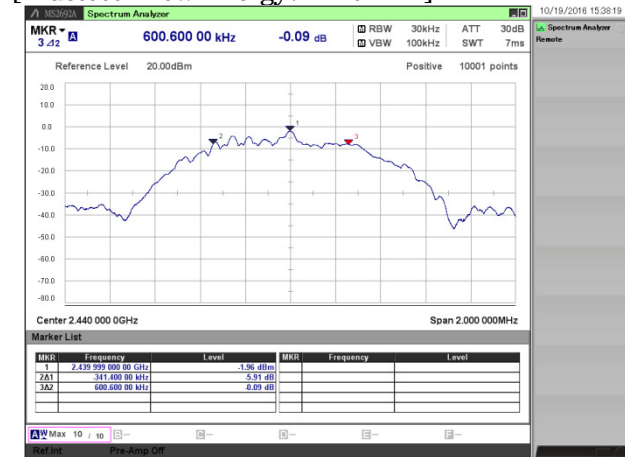
- | | |
|------------------------|---------------------|
| 1) Ambient temperature | : 22.4deg.C |
| 2) Relative humidity | : 69.3 % |
| 3) Date of measurement | : October 19, 2016 |
| 4) Measured by | : M.KOUGA |
| 5) Operating mode | : Transmitting mode |

Mode	Rate [Mbps]	Channel [MHz]	Result [MHz]	Limit [MHz]
BLE	1	2402	646.4	0.5
		2440	600.6	0.5
		2480	638.8	0.5

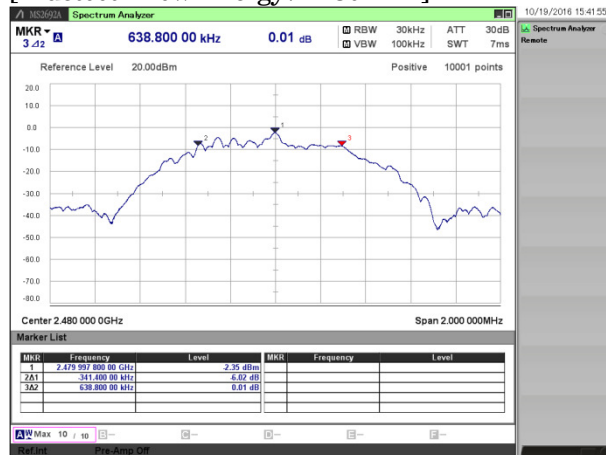
[Bluetooth Low Energy / 2402MHz]



[Bluetooth Low Energy / 2440MHz]



[Bluetooth Low Energy / 2480MHz]



3.2. Maximum Peak Conducted Output Power

- 1) Ambient temperature : 22.4deg.C
- 2) Relative humidity : 69.3 %
- 3) Date of measurement : October 19, 2016
- 4) Measured by : M.KOUGA
- 5) Operating mode : Transmitting mode

Maximum Peak Conducted Output Power

Mode	Rate [Mbps]	Channel [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result(PK) [dBm]	Result(PK) [W]	Limit [dBm]	Margin [dB]
BLE	1	2402	1.60	0.57	2.17	0.00165	30.0	27.83
		2440	1.50	0.58	2.08	0.00161	30.0	27.92
		2480	1.41	0.58	1.99	0.00158	30.0	28.01

Maximum Average Conducted Output Power (for SAR measurement)

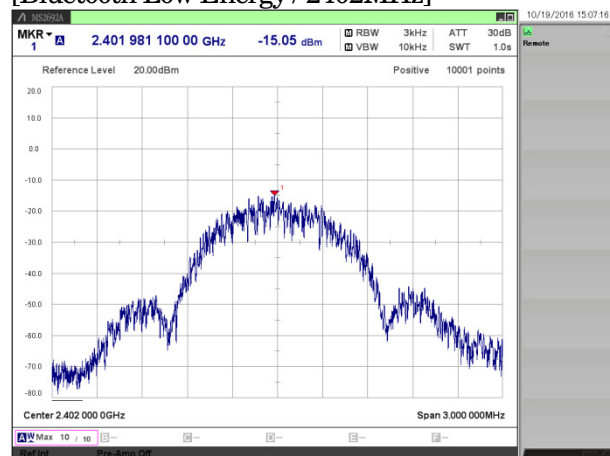
Mode	Rate [Mbps]	Channel [MHz]	Reading(AV) [dBm]	C.F. [dB]	Duty Factor [dB]	Result(AV) [dBm]	Result(AV) [W]
BLE	1	2402	-1.10	0.57	2.04	1.51	0.00142
		2440	-1.18	0.58	2.04	1.44	0.00139
		2480	-1.24	0.58	2.04	1.38	0.00137

3.3. Power Spectral Density

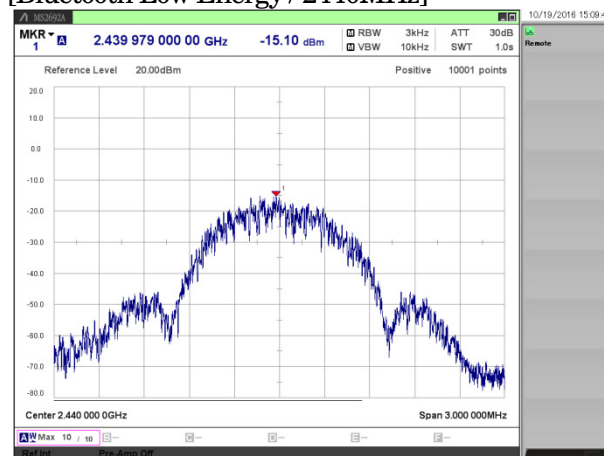
- | | |
|------------------------|---------------------|
| 1) Ambient temperature | : 22.4deg.C |
| 2) Relative humidity | : 69.3 % |
| 3) Date of measurement | : October 19, 2016 |
| 4) Measured by | : M.KOUGA |
| 5) Operating mode | : Transmitting mode |

Mode	Rate [Mbps]	Channel [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result(PK) [dBm]	Limit [dBm]	Margin [dB]
BLE	1	2402	-15.05	0.57	-14.48	8.0	22.48
		2440	-15.10	0.58	-14.52	8.0	22.52
		2480	-15.41	0.58	-14.83	8.0	22.83

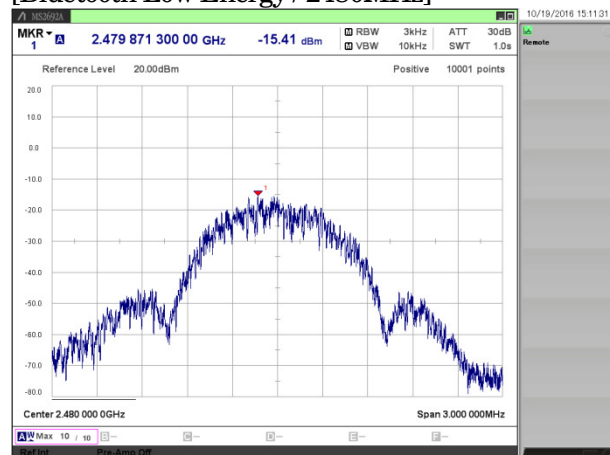
[Bluetooth Low Energy / 2402MHz]



[Bluetooth Low Energy / 2440MHz]



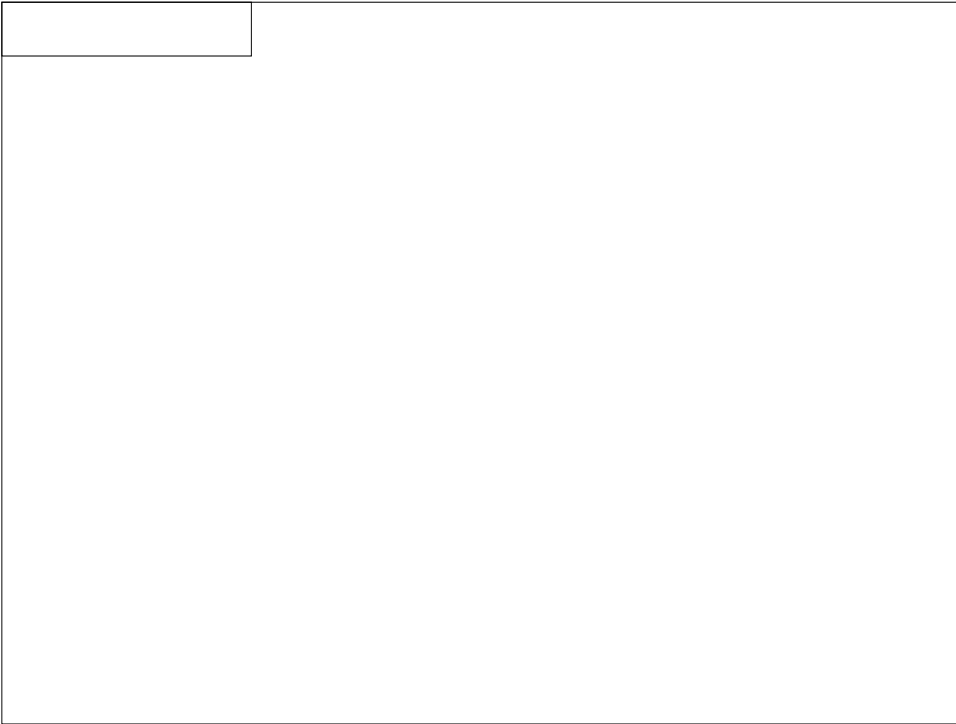
[Bluetooth Low Energy / 2480MHz]



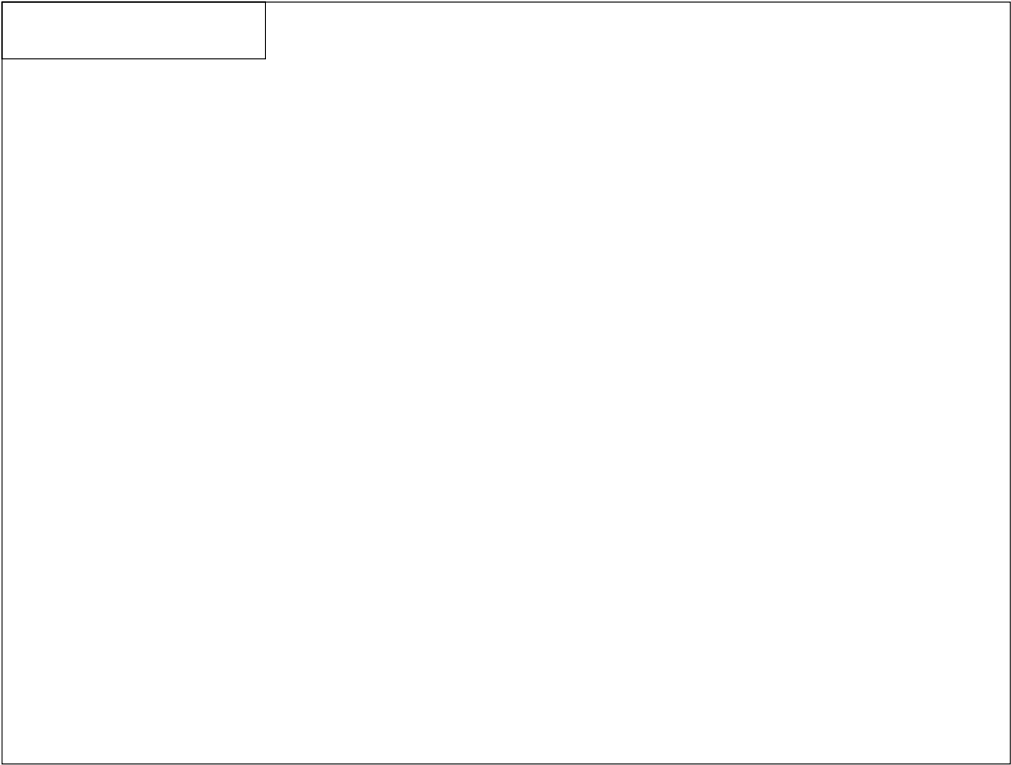
3.4. Radiated Spurious Emissions

1) Date of measurement			
9kHz - 30MHz	:	October 31, 2016	(all mode)
30MHz - 1000MHz	:	October 31, 2016	(all mode)
1GHz - 6GHz	:	November 02, 2016	(all mode) November 03, 2016 (band edge plot data)
6GHz - 18GHz	:	November 03, 2016	(all mode)
18GHz - 24.835GHz	:	November 03, 2016	(all mode)

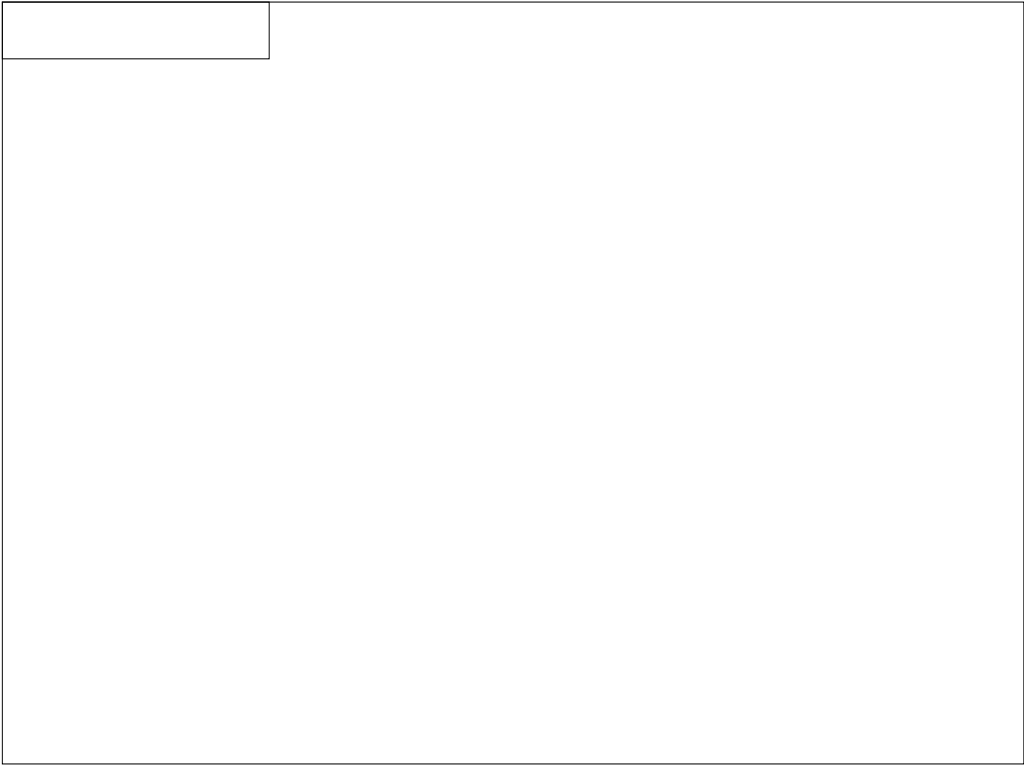
9 kHz - 30 MHz
[Bluetooth Low Energy (1 Mbps) / 2402MHz]



[Bluetooth Low Energy (1 Mbps) / 2440MHz]



[Bluetooth Low Energy (1 Mbps) / 2480MHz]

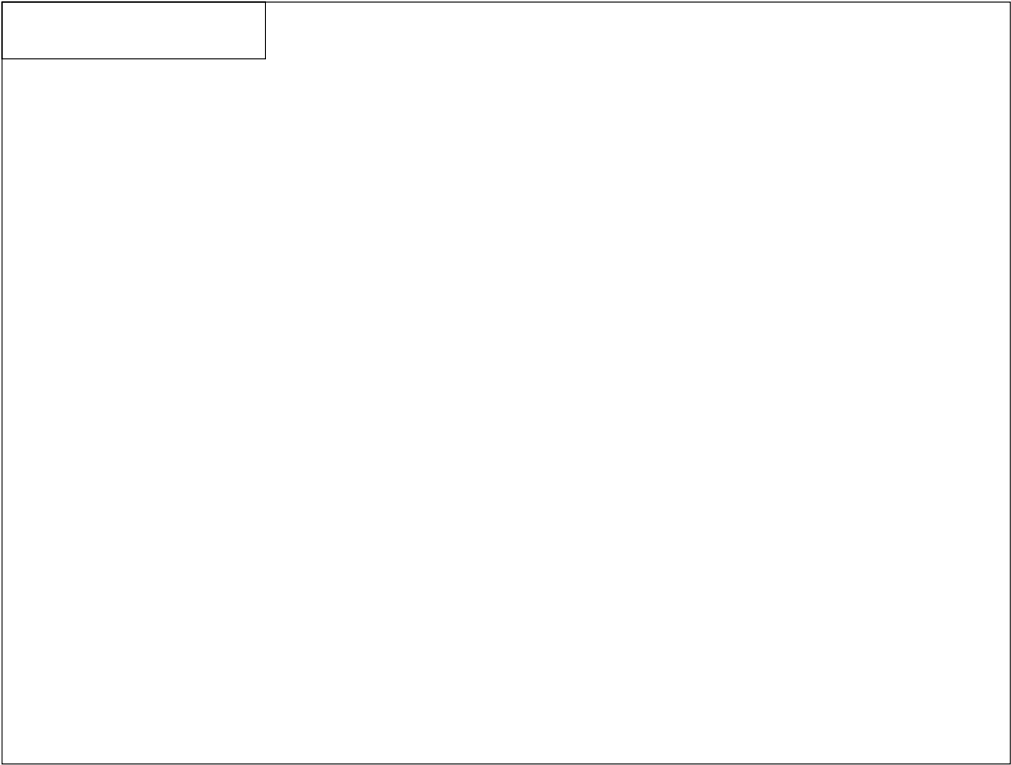


30 MHz - 1000 MHz

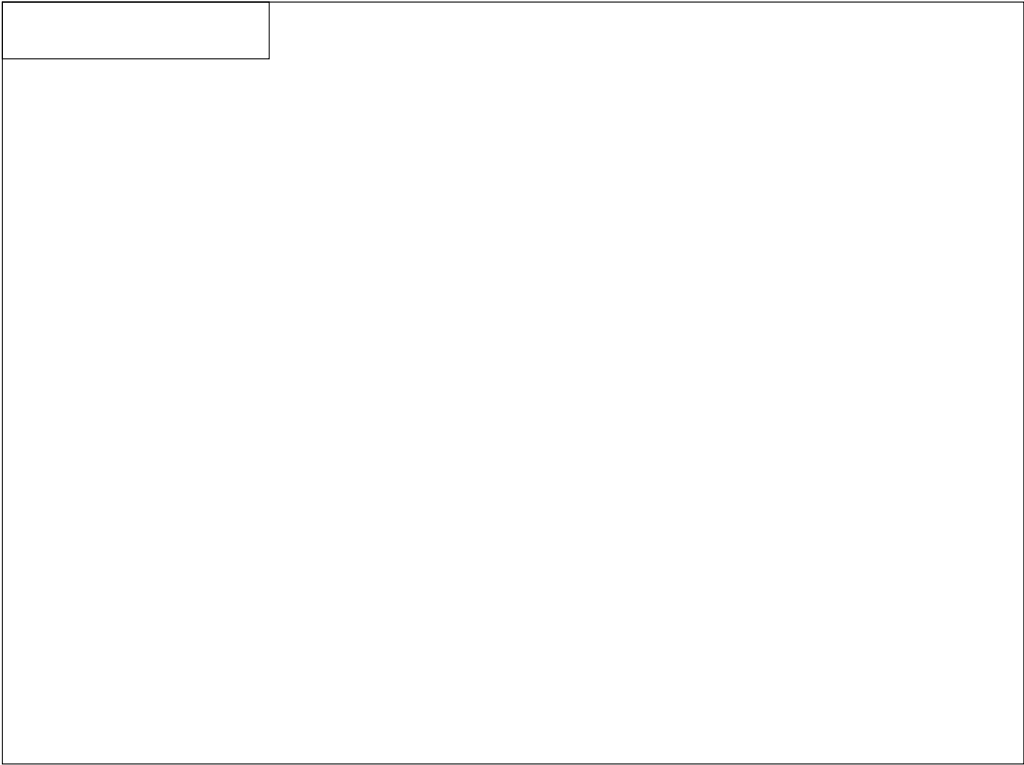
[Bluetooth Low Energy (1 Mbps) / 2402MHz]



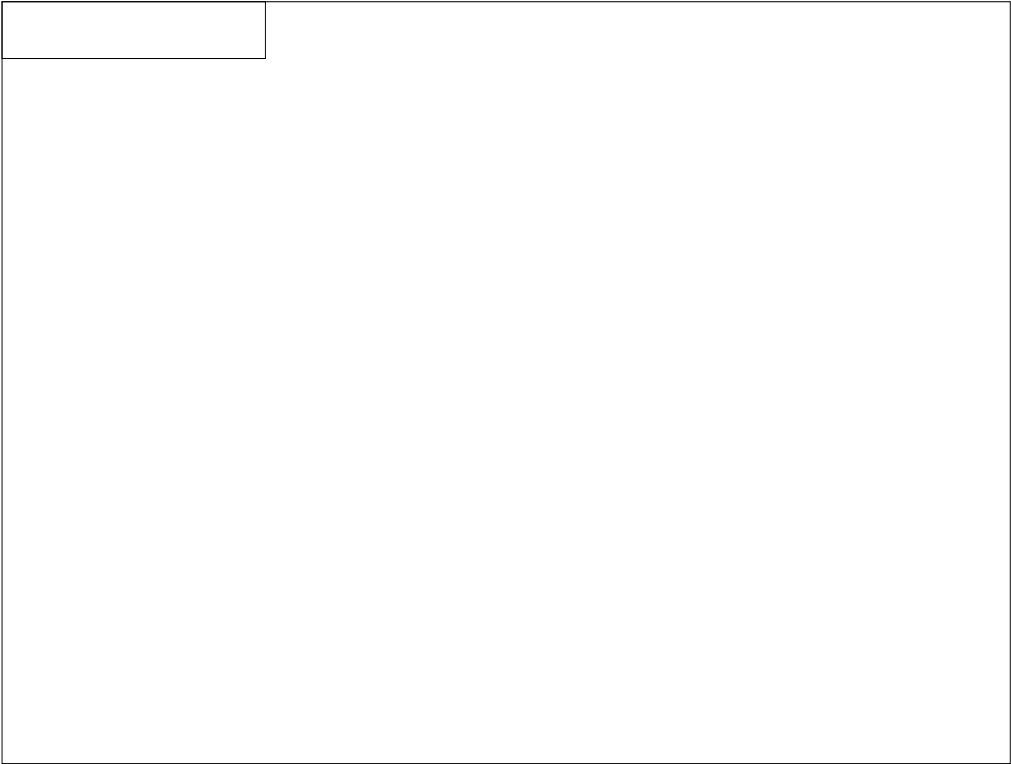
[Bluetooth Low Energy (1 Mbps) / 2440MHz]



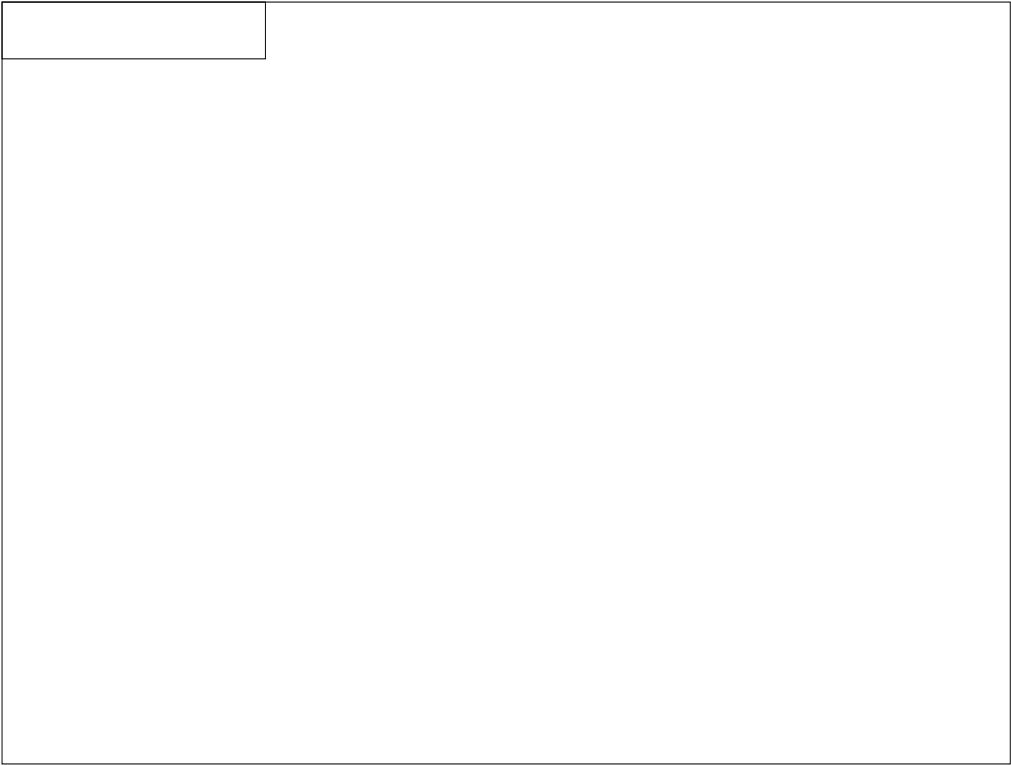
[Bluetooth Low Energy (1 Mbps) / 2480MHz]



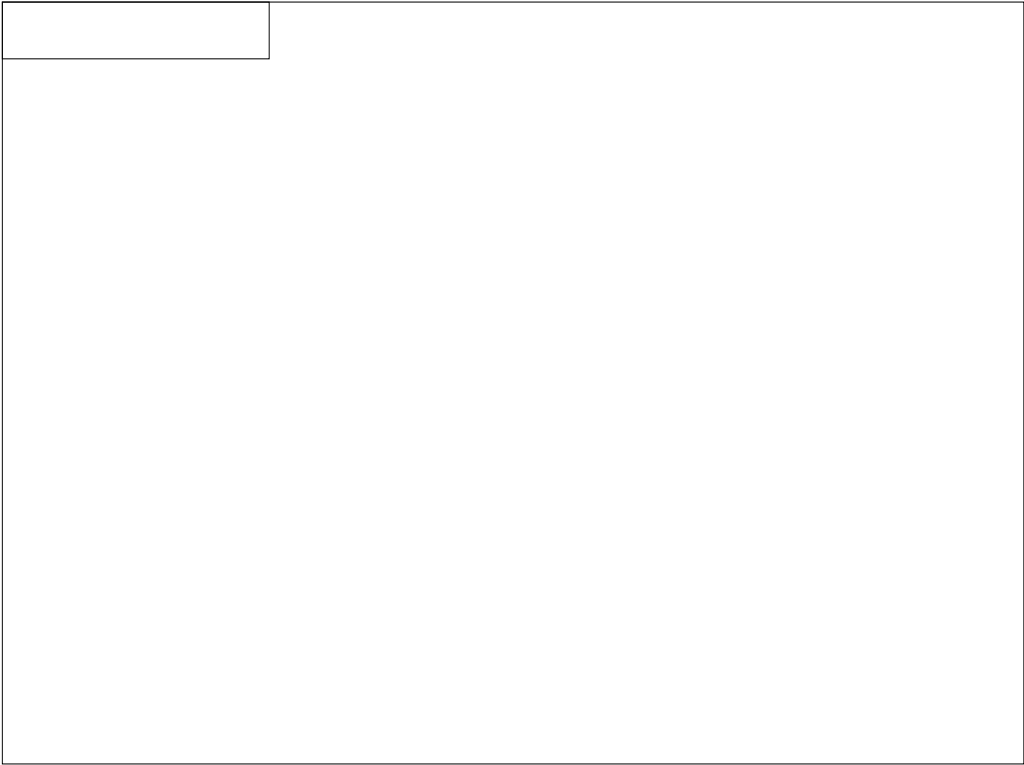
1GHz - 6 GHz
[Bluetooth Low Energy (1 Mbps) / 2402MHz]



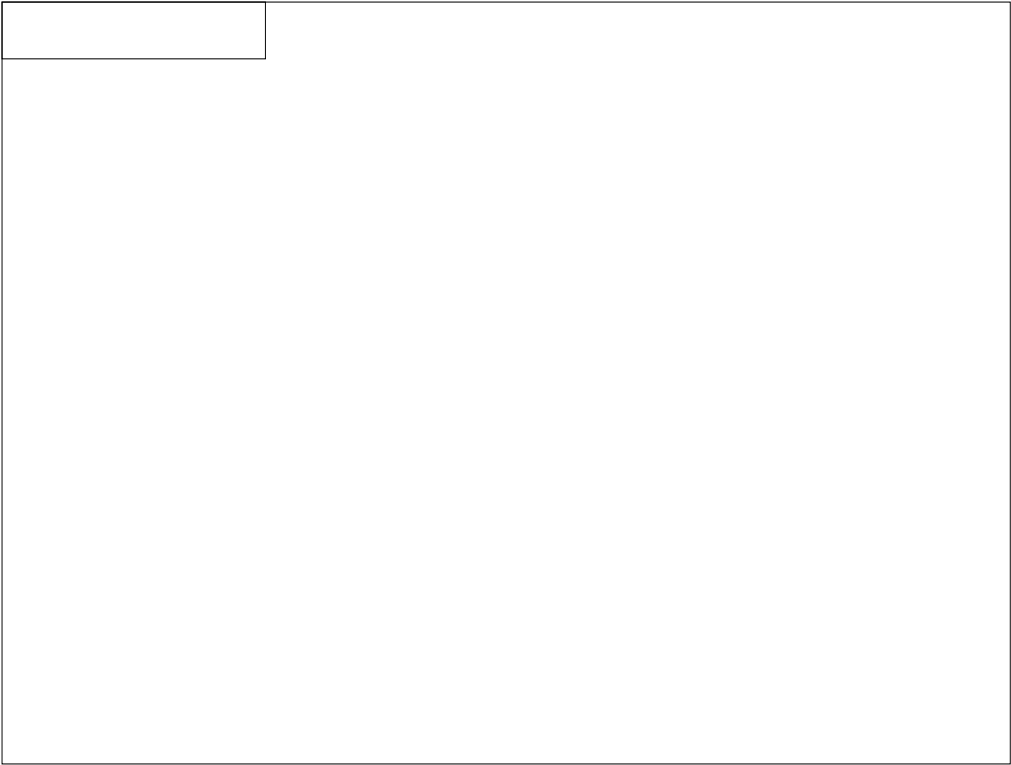
[Bluetooth Low Energy (1 Mbps) / 2440MHz]



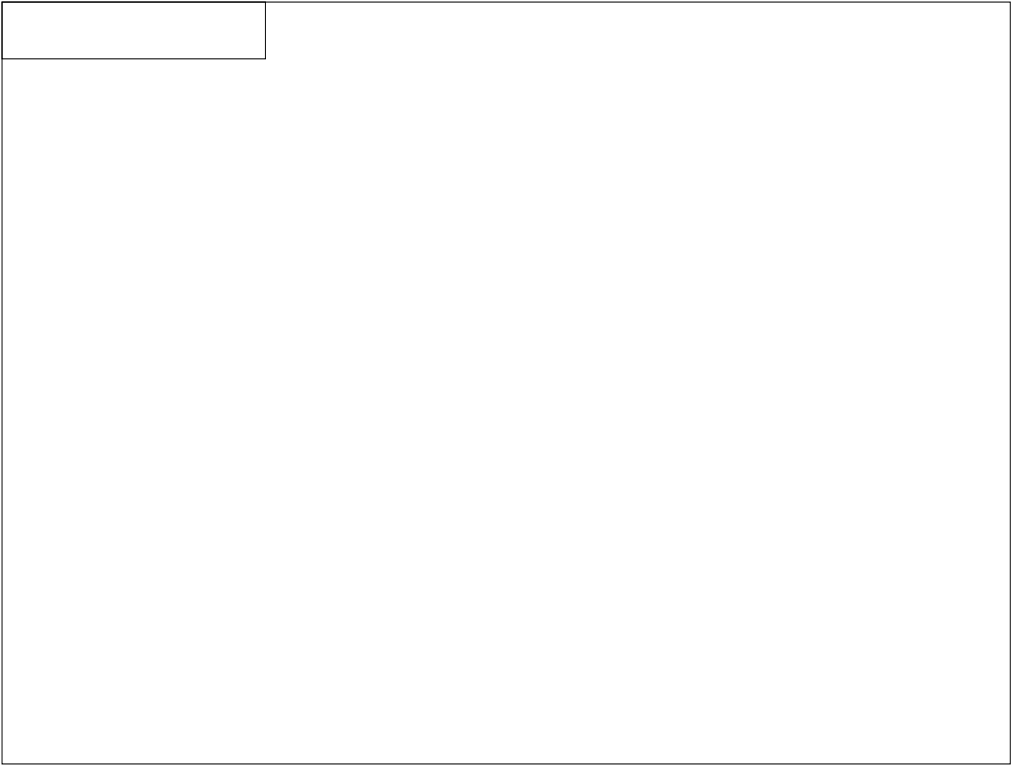
[Bluetooth Low Energy (1 Mbps) / 2480MHz]



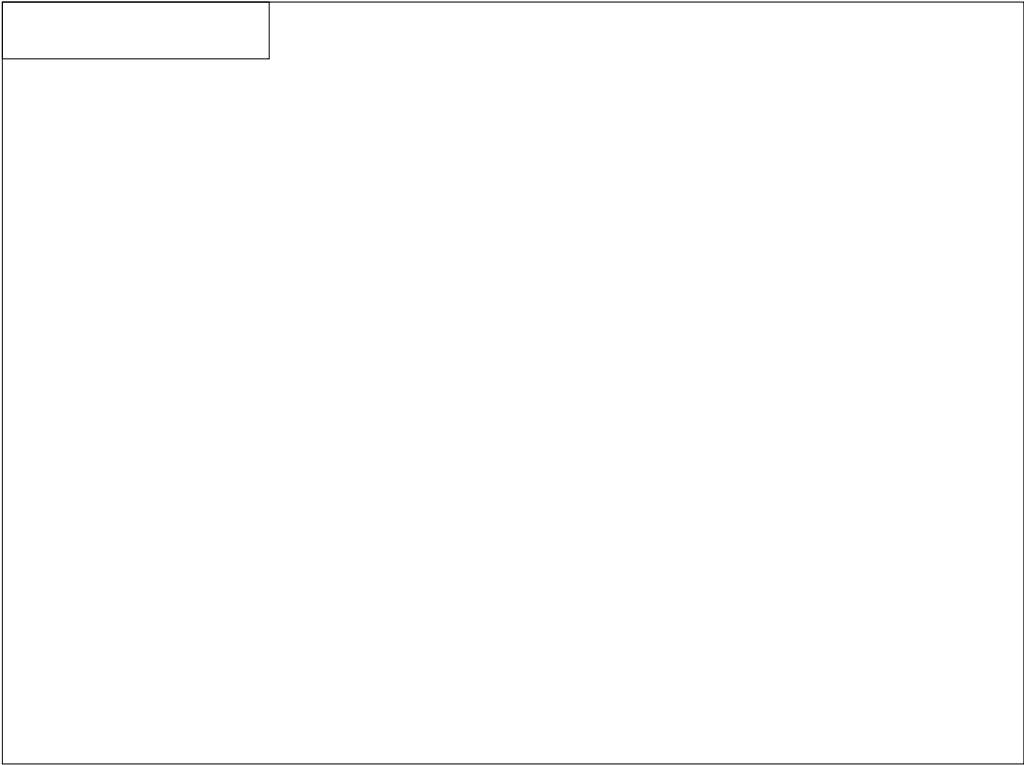
[Bluetooth Low Energy (1 Mbps) / 2402MHz]



[Bluetooth Low Energy (1 Mbps) / 2440MHz]



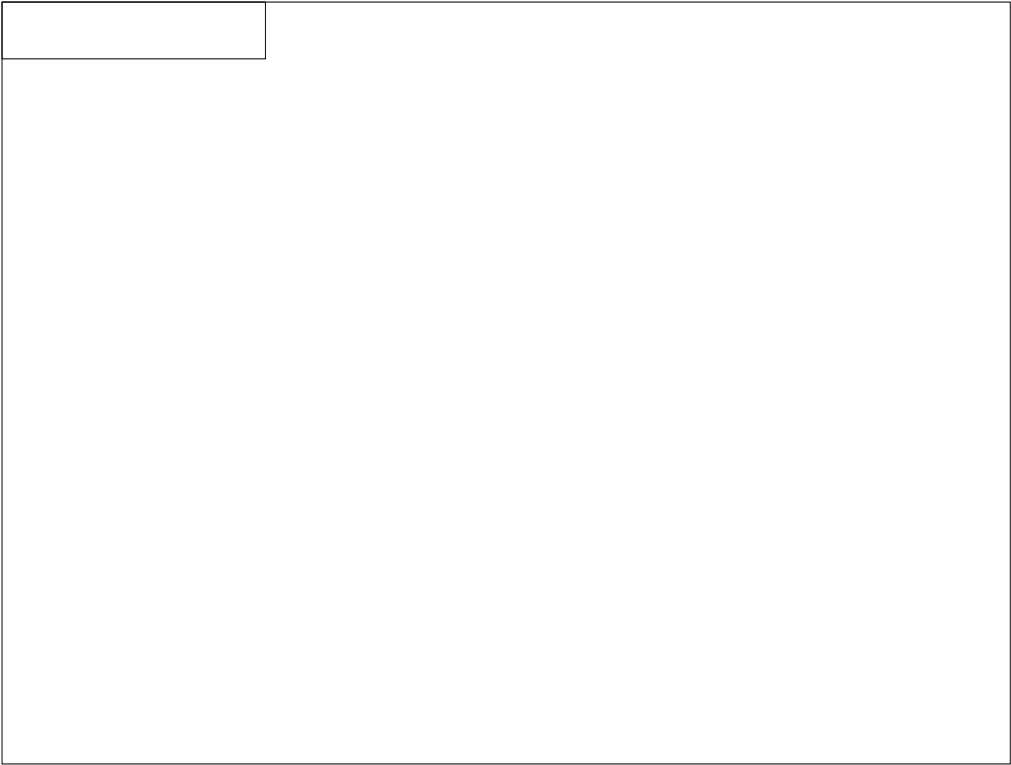
[Bluetooth Low Energy (1 Mbps) / 2480MHz]



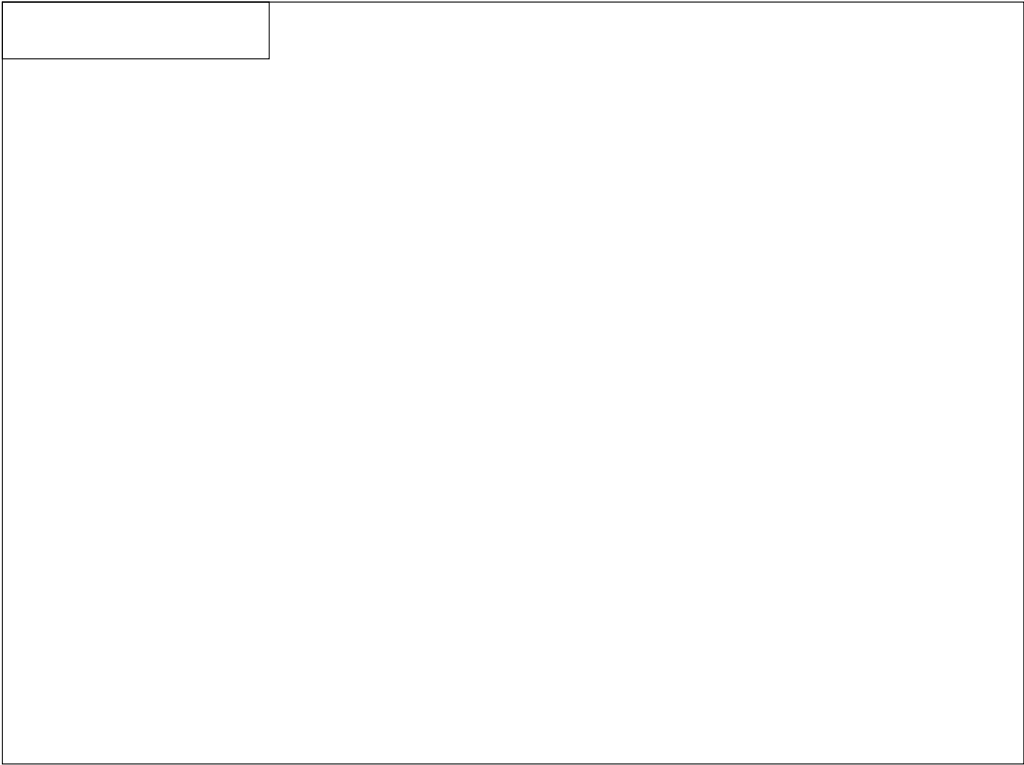
6 GHz - 18 GHz
[Bluetooth Low Energy (1 Mbps) / 2402MHz]



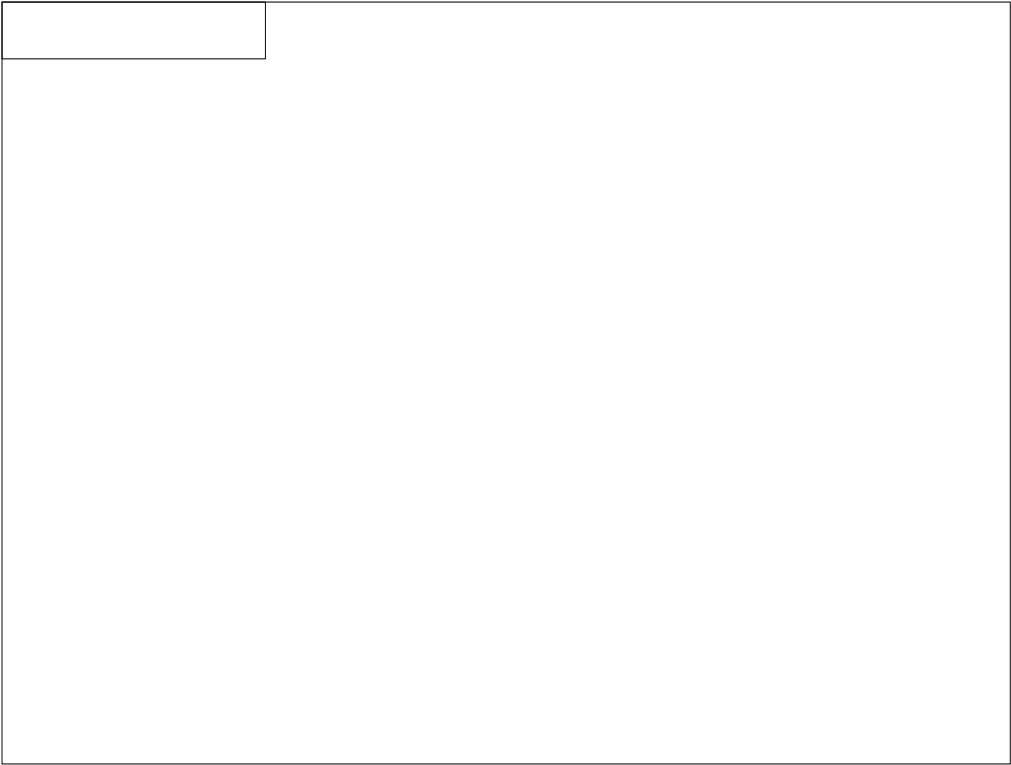
[Bluetooth Low Energy (1 Mbps) / 2440MHz]



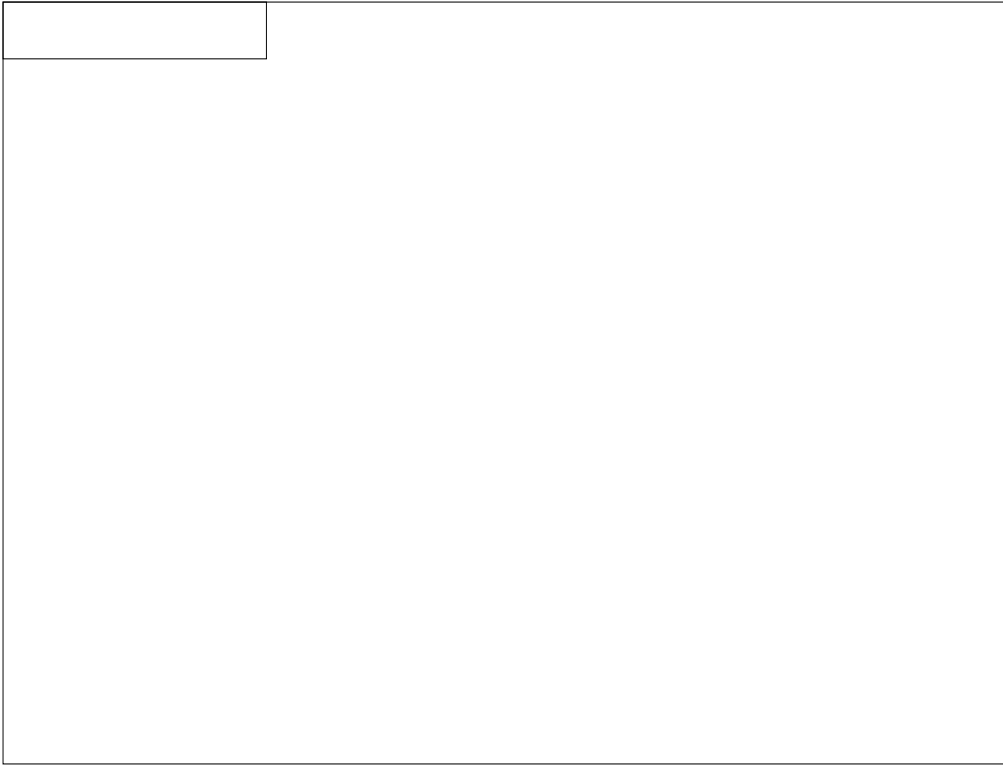
[Bluetooth Low Energy (1 Mbps) / 2480MHz]



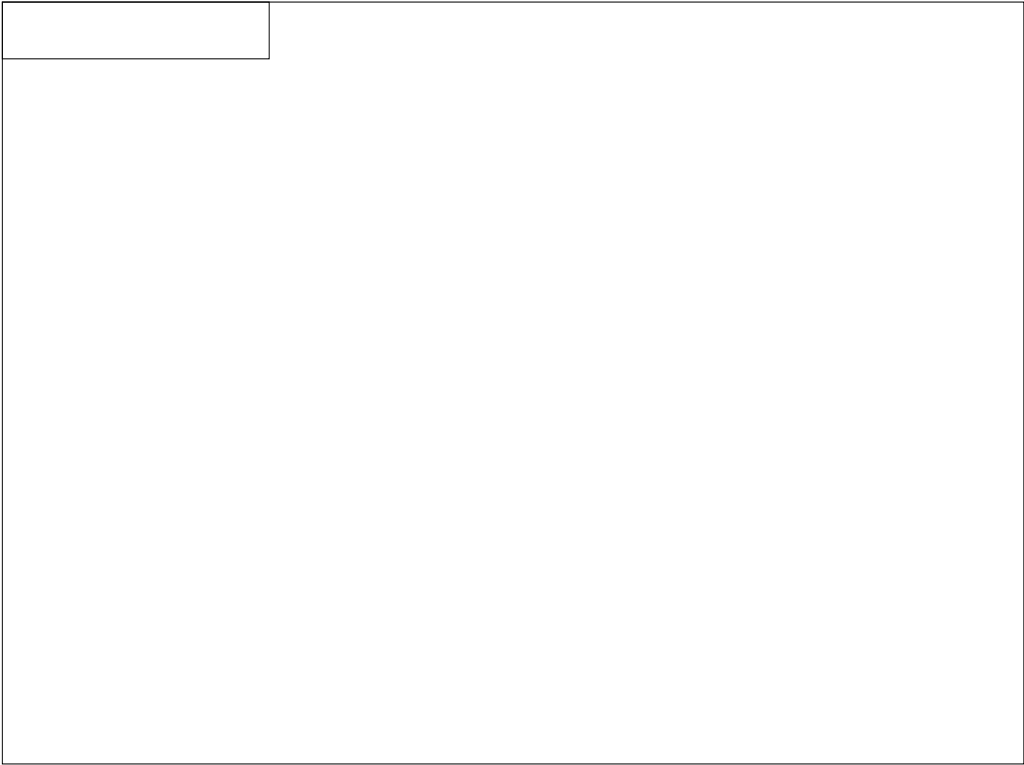
[Bluetooth Low Energy (1 Mbps) / 2402MHz]



[Bluetooth Low Energy (1 Mbps) / 2440MHz]



[Bluetooth Low Energy (1 Mbps) / 2480MHz]

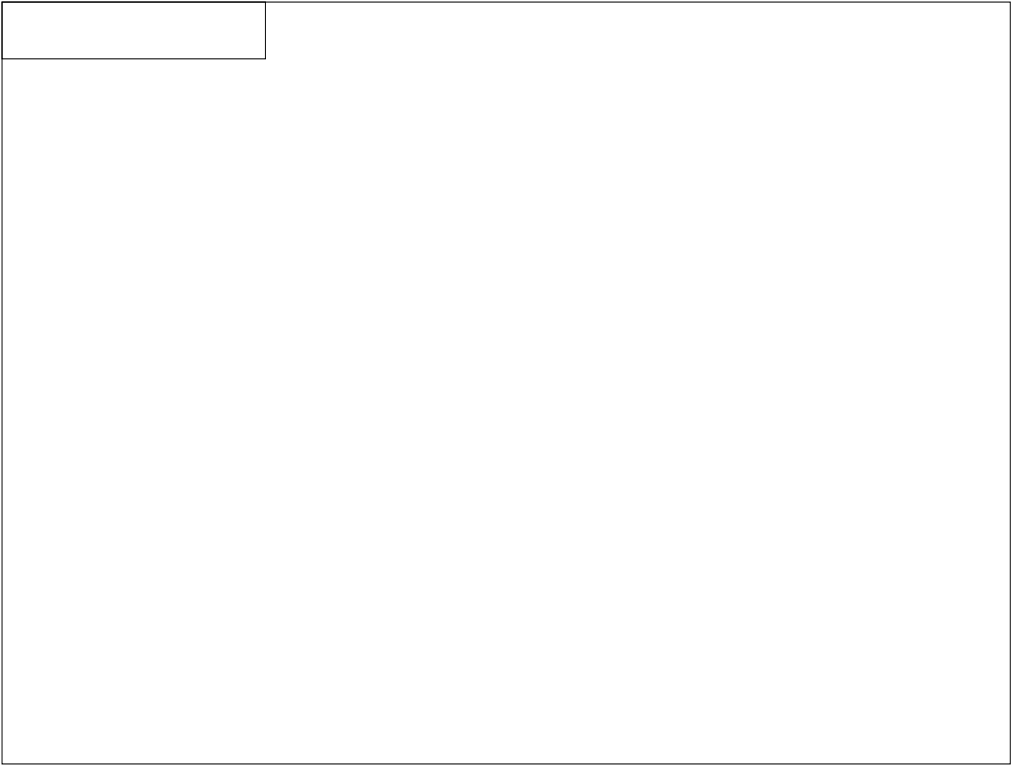


18 GHz - 24.835 GHz

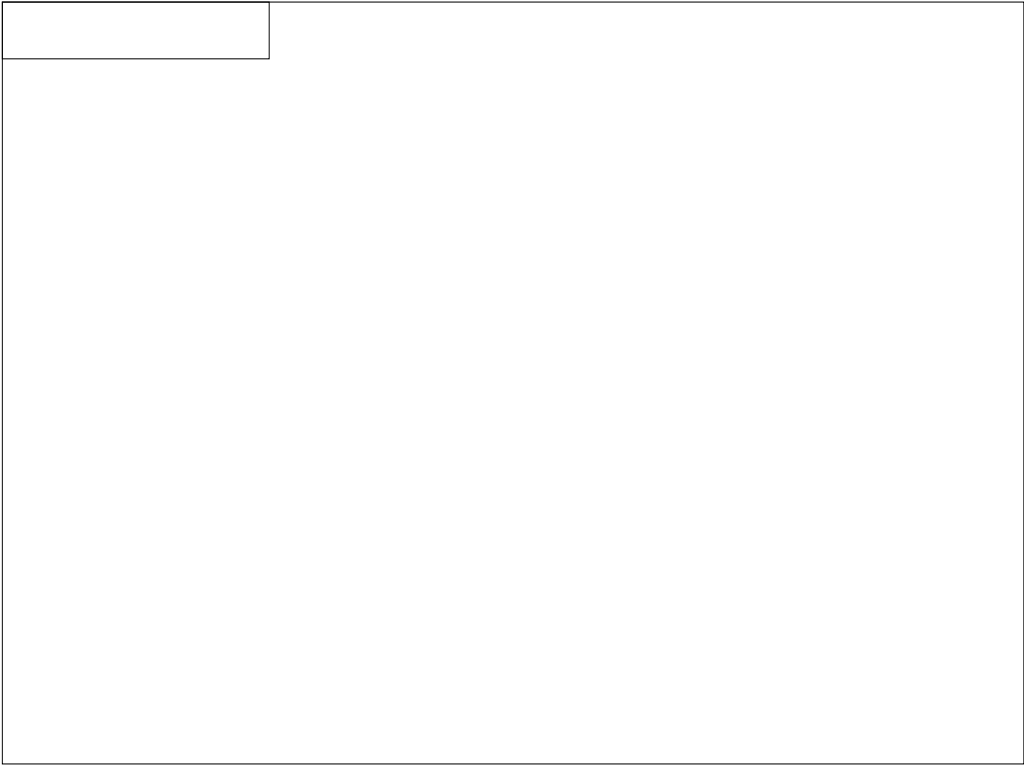
[Bluetooth Low Energy (1 Mbps) / 2402MHz]



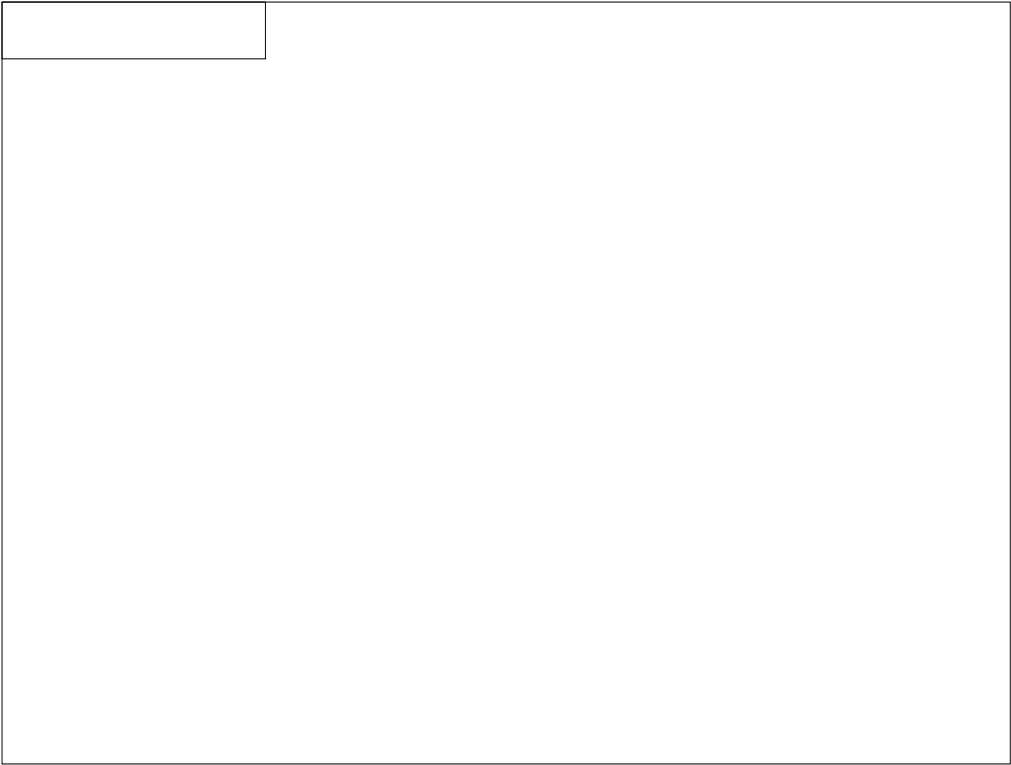
[Bluetooth Low Energy (1 Mbps) / 2440MHz]



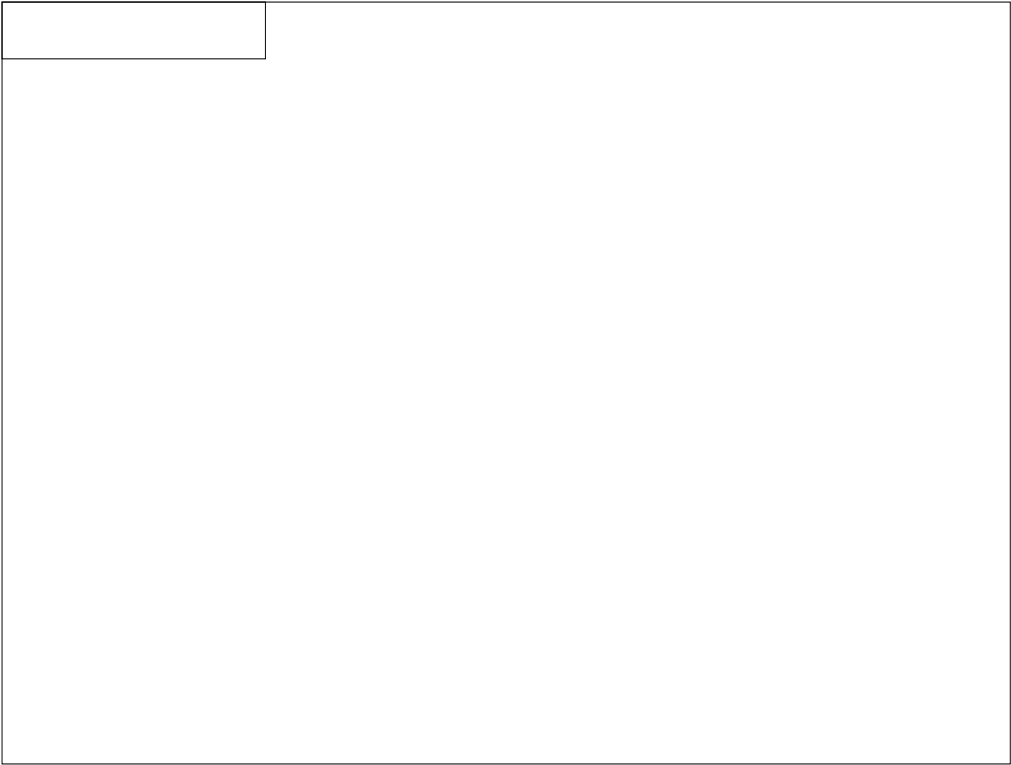
[Bluetooth Low Energy (1 Mbps) / 2480MHz]



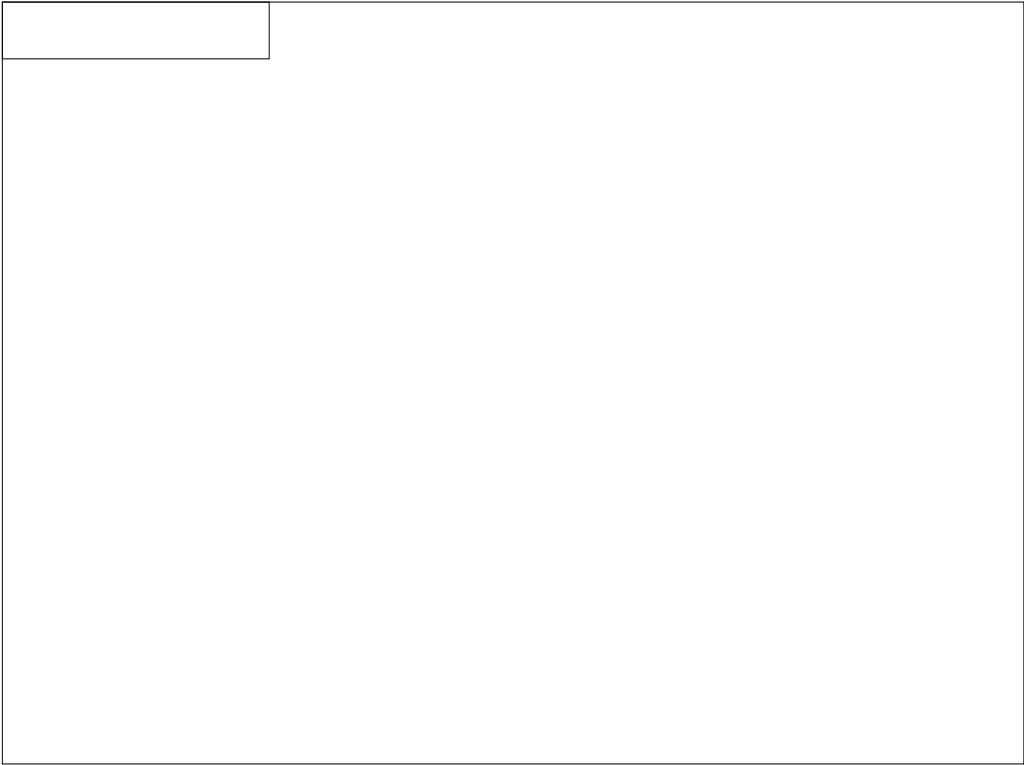
[Bluetooth Low Energy (1 Mbps) / 2402MHz]



[Bluetooth Low Energy (1 Mbps) / 2440MHz]



[Bluetooth Low Energy (1 Mbps) / 2480MHz]



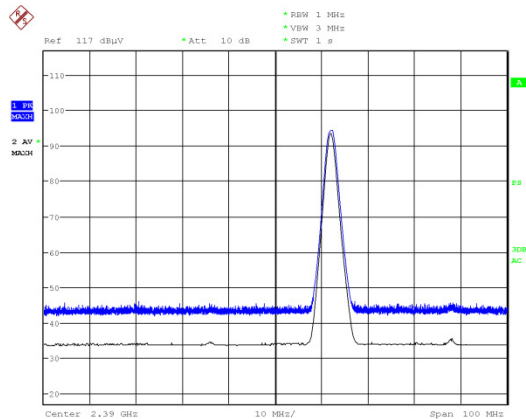
2.4GHz Restricted-Band Edge (Plot data)

These plot data show peak (trace blue) and average (trace black) spectrum for worst case emissions in the restricted-band edges. (Restricted band edges: below 2390MHz and above 2483.5MHz)

The result of the final radiated emissions measurement refers in previous pages.

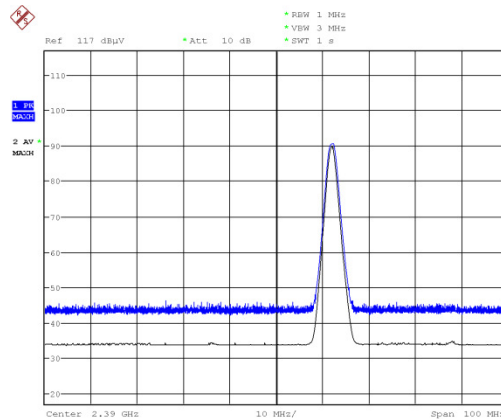
[Bluetooth Low Energy / 2402MHz]

Horizontal



Date: 3.NOV.2016 00:11:41

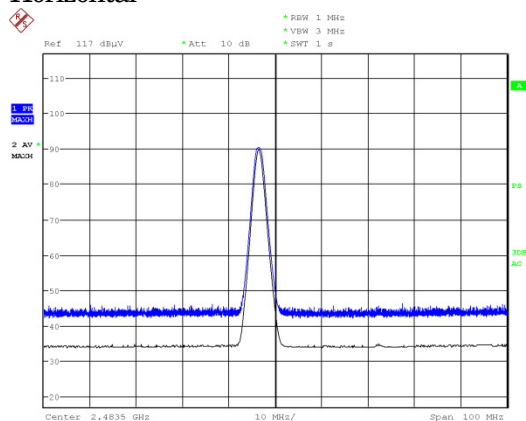
Vertical



Date: 3.NOV.2016 00:05:38

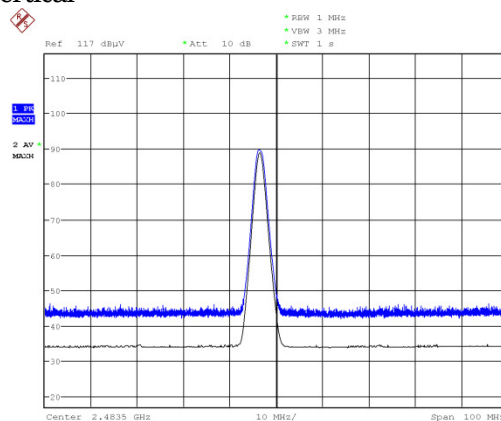
[Bluetooth Low Energy / 2480MHz]

Horizontal



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Vertical



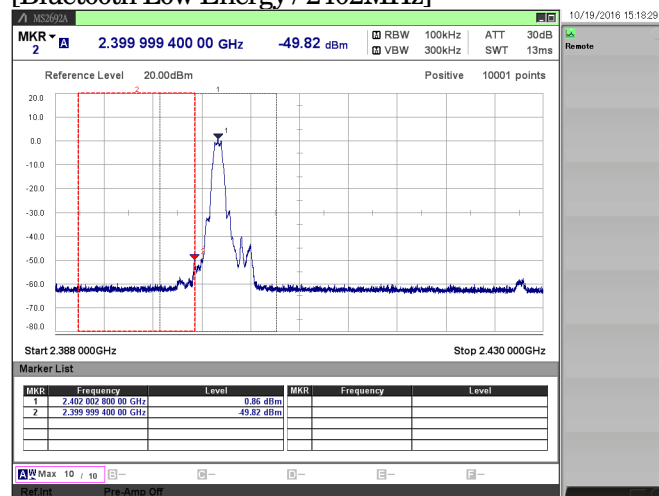
Date: 3.NOV.2016 00:48:29

3.5. Conducted Spurious Emissions for Band Edge

- | | |
|------------------------|---------------------|
| 1) Ambient temperature | : 22.4deg.C |
| 2) Relative humidity | : 69.3 % |
| 3) Date of measurement | : October 19, 2016 |
| 4) Measured by | : M.KOUGA |
| 5) Operating mode | : Transmitting mode |

Mode	Rate [Mbps]	Channel [MHz]	Frequency [MHz]	Reading(PK) [dBm]	C.F. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
BLE	1	2402	2400.00	-49.82	0.57	-49.25	-18.6	30.68
			2402.00	0.86	0.57	1.43	-	-

[Bluetooth Low Energy / 2402MHz]



4. Method of Calculation

4.1. Maximum Peak Conducted Output Power Measurement

Method of calculation : Software
The Software for Calculation Name : SW-316
Version : Ver.1.0

Test Result (PK) [dBm] = Meter Reading [dBm] + C.F. [dB]

Test Result (AV) [dBm] = Meter Reading [dBm] + C.F. [dB] + Duty Factor [dB]

Notes :

- (a) Meter Reading : Reading of the power meter.
- (b) C.F. : Attenuator Loss + EUT Cable Loss
- (c) Duty Factor : $10\log \{(\text{Tx ON Time} + \text{Tx OFF Time}) / (\text{Tx ON Time})\}$

4.2. Power Density Measurement

Method of calculation : Software
The Software for Calculation Name : SW-316
Version : Ver.1.0

Test Result [dBm] = Meter Reading [dBm] + C.F. [dB]

Notes :

- (a) Meter Reading : Reading of the spectrum analyzer.
- (b) C.F. : System Cable Loss + Attenuator Loss + EUT Cable Loss

4.3. Radiated Spurious Emission Measurement

Method of calculation : Software
The Software for Calculation Name : V-Scan
Version : Ver. 4.0.30

$$\text{Test Result [dBuV/m]} = \text{Meter Reading [dBuV]} + \text{C.F. [dB/m]}$$

Notes :

- (a) Meter Reading : Reading of the EMI test receiver or spectrum analyzer.
- (b) C.F. : ☒ Antenna Factor (including Balun Loss) + System GainLoss
: ☐ Antenna Factor (including Balun Loss) + System GainLoss + 20 log (3 m/ 10 m)

4.4. Conducted Spurious Emission for Band Edge Measurement

Method of calculation : Software
The Software for Calculation Name : SW-316
Version : Ver.1.0

$$\text{Test Result [dBm]} = \text{Meter Reading [dBm]} + \text{C.F. [dB]}$$

Notes :

- (a) Meter Reading : Reading of the spectrum analyzer.
- (b) C.F. : System Cable Loss + Attenuator Loss + EUT Cable Loss

5. List of Test Equipment

All test results are traceable to the national and/or international standards.

5.1. Antenna-port Conducted Measurements

4th Site Shielded Room 1

	Ctrl.#	Equipment	Model No.	Serial No.	Manufacturer	Cal.Int.	Last Cal.
x	-	Shield Room	B83117-B2432-T161	P26428	Albatross Project	-	-
x	W100	Spectrum Analyzer	MS2692A	6201338954	Anritsu	12	16.04.15
x	W006	Power Meter	N1911A	MY50000295	Keysight Technologies	12	16.10.03
x	W007	Power Sensor	N1922A	MY50180022	Keysight Technologies	12	16.10.03
-	W029	10dB Attenuator	8493C	76549	Keysight Technologies	12	16.08.01
x	WC05	RF Cable	SUCOFLEX 102	34287	HUBER + SUHNER	12	16.08.01
x	M720	Thermometer	TH-321	140044	AS ONE	12	16.06.02

5.2. Radiated Spurious Emissions

4th Site 10m Semi-Anechoic Chamber

	Ctrl.#	Equipment	Model No.	Serial No.	Manufacturer	Cal.Int.	Last Cal.
x	M506	EMC Chamber	None	-	TDK	12	16.06.04
x	M575	EMI Receiver	ESCI	100161	Rohde&Schwarz	12	15.11.09
x	M959	EMI TEST RECEIVER	ESU40	100041	Rohde&Schwarz	12	16.11.01
x	A073	Loop Antenna	HFH2-Z2	100171	Rohde&Schwarz	12	16.10.04
x	A043	Biconical Antenna	BBA9106	V5(91032598)	Schwarzbeck	12	16.06.01
x	A046	Log periodic Antenna	UHALP9108A1	0830	Schwarzbeck	12	16.06.01
x	A056	Horn Antenna	BBHA9120D	670	Schwarzbeck	12	16.01.27
x	A057	Horn Antenna	HAP06-18W	00000037	TOYO Corporation	12	16.06.02
x	A058	Horn Antenna	HAP18-26W	00000016	TOYO Corporation	12	16.01.26
-	CS037	Fourth Site RE Cable SYS1	-	-	EMC/RF Test Lab.	12	16.06.02
x	CS039	Fourth Site RE Cable SYS3	-	-	EMC/RF Test Lab.	12	16.06.04
x	CS054	Fourth Site EMF Cable SYS	-	-	EMC/RF Test Lab.	12	16.06.02
x	CS064/065	Fourth Site RE Cable SYS8	-	-	EMC/RF Test Lab.	12	16.06.04
x	M510	RF Selector	NS4900	0802-226	TOYO Corporation	12	16.06.02
x	M620	RF Pre-Amp	8447D	2944A10720	Keysight Technologies	12	16.06.04
x	M706	3dB Attenuator	8491A	MY39267782	Keysight Technologies	12	16.06.04
x	M831	GHz Filter Box	FB-G1	002	Sony GM&O	12	16.06.04
x	M798	Thermometer	AD-5640B	201501	AND	12	16.05.26

About calibration interval

Valid until the end of the month listed in "Cal. Int." column.