

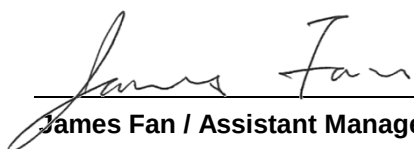
Japan Test Report

Equipment : Bluetooth v4.0 Dual-Mode UART HCI Module
Model No. : BT830-SA, BT830-ST
(Please refer to item 1.1.1 for more details.)
Brand Name : Laird Technologies
Applicant : Laird Technologies
Address : W66N220 Commerce Court, Cedarburg,
Wisconsin 53012, USA
Standard : ARIB STD-T66 Ver. 3.7
Received Date : Aug. 02, 2017
Tested Date : Aug. 18 ~ Aug. 21, 2017

Measurement was conducted by the following test method:
the test method of Ordinance Concerning Technical Regulations Conformity Certification
etc. of Specified Radio Equipment in Annex 1, the Ministry of Internal Affairs and
Communication notification in Annex "43" of Article 88, Paragraph 1 or the test method
more than equivalent.

We, International Certification Corp., would like to declare that the tested sample has been
evaluated and in compliance with the requirement of the above standards. The test results
contained in this report refer exclusively to the product. It may be duplicated completely for
legal use with the approval of the applicant. It shall not be reproduced except in full without
the written approval of our laboratory.

Reviewed by:


James Fan / Assistant Manager

Approved by:


Gary Chang / Manager

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APPENDIX A.1 TEST RESULTS FOR ANTENNA POWER

APPENDIX A.2 TEST RESULTS FOR ANTENNA POWER

APPENDIX B. TEST RESULTS FOR FREQUENCY TOLERANCE

APPENDIX C. TEST RESULTS FOR OCCUPIED BANDWIDTH

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APPENDIX E. TEST RESULTS FOR TRANSMITTER SPURIOUS EMISSIONS

APPENDIX F. TEST RESULTS FOR DWELL TIME

APPENDIX G. TEST RESULTS FOR INTERFERENCE PREVENTION FUNCTION

APPENDIX H. TEST RESULTS FOR RECEIVER SPURIOUS EMISSIONS

APPENDIX I. ANTENNA INFORMATION

Release Record

Report No.	Version	Description	Issued Date
JR442804-03AD	Rev. 01	Initial issue	Sep. 11, 2017

Summary of Test Results

Ref. Std. Clause	Description	Result
3.2(2)(3)	Antenna Power / Tolerances for antenna power	Pass
3.2(4)	Frequency Tolerance	Pass
3.2(6)	Transmitter Spurious Emission	Pass
3.2(7)	Occupied Bandwidth	Pass
3.2(8)	Spreading Bandwidth	Pass
3.2(9)	Spreading Factor	Pass
3.2(11)	Dwell time	Pass
3.4.1	Interference prevention function	Pass
3.3(1)	Receiver Spurious Emission	Pass

1 General Description

1.1 Information

1.1.1 Product Details

The following models are provided to this EUT.

Brand Name	Model Name	Product Name	Description
Laird Technologies	BT830-SA	Bluetooth v4.0 Dual-Mode UART HCI Module	chip antenna
	BT830-ST	Bluetooth v4.0 Dual-Mode UART HCI Module	trace to external antenna

1.1.2 Specification of the Equipment under Test (EUT)

Power Type	3.3Vdc from host 1.8Vdc from host
Type(s) of Modulation / Technology	FHSS / GFSK = 1Mbps, $\pi/4$ DQPSK = 2Mbps, 8DPSK = 3Mbps
Frequency Range (MHz)	2402 ~ 2480 MHz
Total Channel Number	79
HW Version	1.0
SW Version	1.0.0.7

1.1.3 Antenna Details

Ant. No.	EUT Model	Type	Ant. Brand / Model	Gain (dBi)	Connector
1	BT830-SA	Chip	ACX AT3216-B2R7HAA_3216	0.5	N/A
2	BT830-ST	Dipole	Nearson S181FL-L-RMM-2450S	2.0	UFL
3	BT830-ST	PCB Dipole	Laird EBL2449A1-15UFL	2.0	UFL
4	BT830-ST	Dipole	Laird MAF94190	2.0	UFL
5	BT830-ST	Dipole	Laird WRR2400- IP04-B(MAF94019)	1.5	UFL

Note: Please refer to Appendix I for more details about antenna pattern and other information.

1.1.4 Antenna Power

Operating Mode	Rated Power (mW/MHz)	Measured Conducted Power (mW/MHz)	Radiated Power (mW/MHz)
GFSK (non-AFH)	0.04	0.04406	0.06982
GFSK (AFH)	0.16	0.16788	0.26607
8DPSK (non-AFH)	0.04	0.01786	0.02831
8DPSK (AFH)	0.16	0.06839	0.10839

1.1.5 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

1.1.6 Test Tool and Power Setting

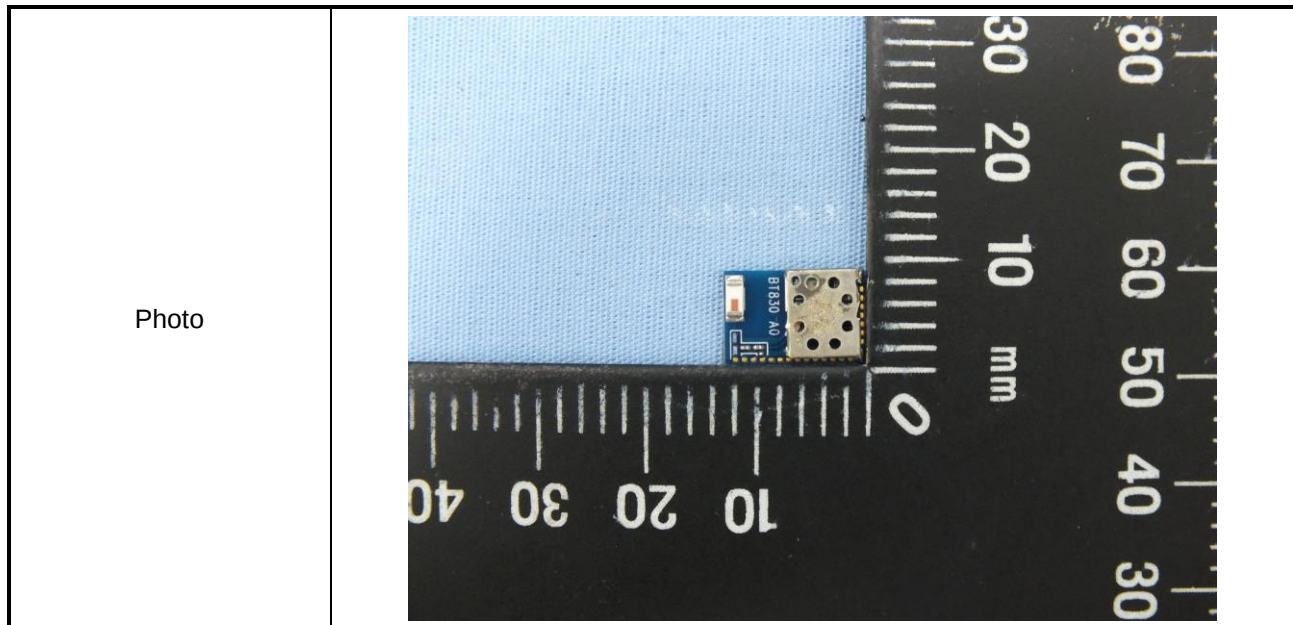
Test Tool
Blue Test3 v. 2.5

Power Setting			
Channel	Frequency (MHz)	GFSK	8DPSK
0	2402	Default	Default
39	2441	Default	Default
78	2480	Default	Default

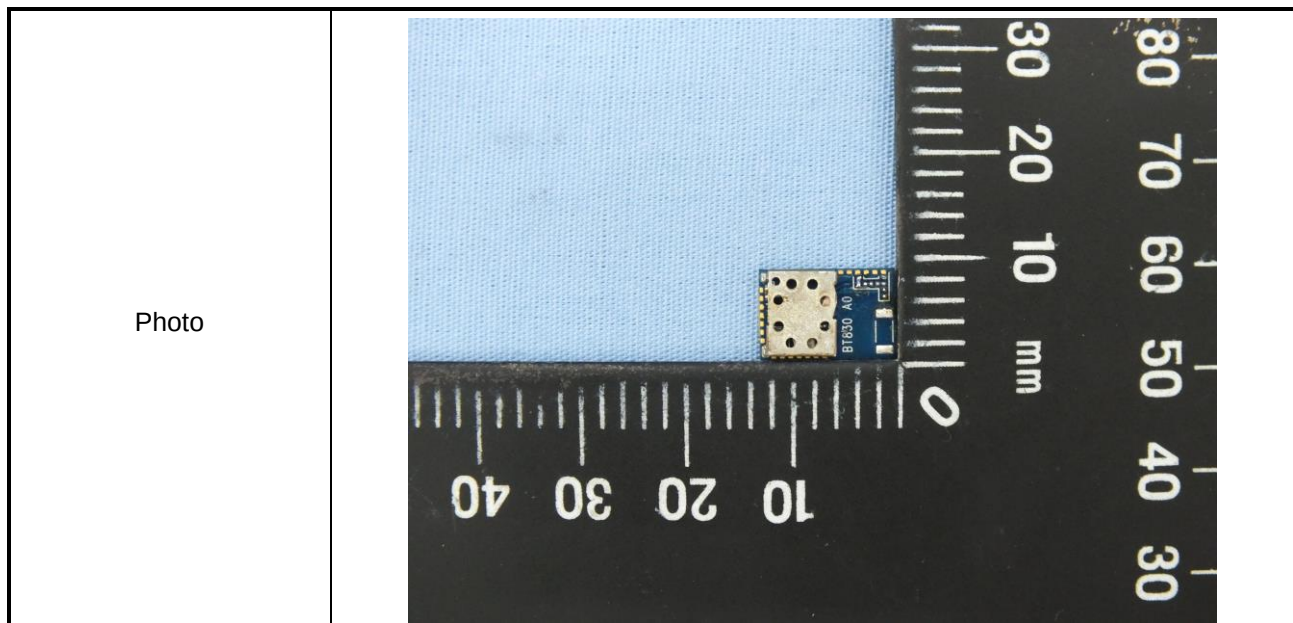
1.1.7 Protection Method for High Frequency and Modulation Section

Protected Method	Description
Shielding Case	RF and Modulation components are covered with shielding case and this shielding case is soldered

Mode: BT830-SA



Mode: BT830-ST



1.2 Test Equipment and Calibration Data

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Mar. 15, 2017	Mar. 14, 2018
Power Meter	Anritsu	ML2495A	1241002	Oct. 06, 2016	Oct. 05, 2017
Power Sensor	Anritsu	MA2411B	1207366	Oct. 06, 2016	Oct. 05, 2017
DC POWER SOURCE	GW INSTEK	GPC-6030D	EM892433	Oct. 20, 2016	Oct. 19, 2017
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101021	Apr. 28, 2017	Apr. 27, 2018
Note: Calibration Interval of instruments listed above is one year.					

1.3 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

ARIB STD-T66 Ver. 3.7

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

Measurement Uncertainty	
Parameters	Uncertainty
Frequency error	±33.988 Hz
Bandwidth	±33.988 Hz
Conducted power	±0.537 dB
TX Conducted emission	±2.308 dB
RX Conducted emission	±2.525 dB

2 Test Configuration

2.1 Testing Location and Conditions

Test Site	Site Category	Ambient Condition	Tested By
TH01-WS	OVEN Room	25°C / 65%	Chris Zeng

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test channel
Antenna Power	GFSK, 8DPSK	0 / 39 / 78
Frequency Tolerance	Un-modulation	0 / 39 / 78
Transmitter Spurious Emission	GFSK, 8DPSK	0 / 39 / 78
Occupied Bandwidth	GFSK, 8DPSK	0 / 39 / 78
Spreading Bandwidth	GFSK, 8DPSK	0 / 39 / 78
Spreading Factor	GFSK, 8DPSK	0 / 39 / 78
Dwell time	GFSK, 8DPSK	0 / 39 / 78
Receiver Spurious Emission	GFSK, 8DPSK	0 / 39 / 78

3 Transmitter Test Results

3.1 Antenna Power

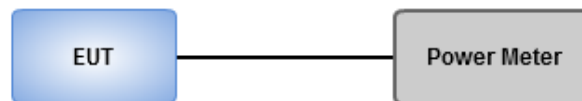
3.1.1 Limit of Antenna Power

Mode	Limit	Tolerance
1) FH, FH+DS, FH+OFDM	3 mW / MHz	+20 % , -80 %
2) OFDM(Narrow- bandwidht), DS	10 mW / MHz	
3) Other than 1) & 2)	10mW	
4) OFDM (Wide-band)	5 mW / MHz	

3.1.2 Test Procedures

1. Measure the total power by Power Meter in a state of hopping mode
2. Measure the burst ratio. Then calculate the real total power by burst ratio.
3. Calculate the mean power per 1MHz by dividing the total power by spread bandwidth
4. $\text{Output Power Density (mW/MHz)} = \text{Total Output Power (mW)} / \text{Burst Ratio} / \text{Spread Bandwidth (MHz)}$

3.1.3 Test Setup



3.1.4 Test Result of Maximum Transmit Power

Refer to Appendix A1, A2

3.2 Frequency Tolerance

3.2.1 Limit of Frequency Tolerance

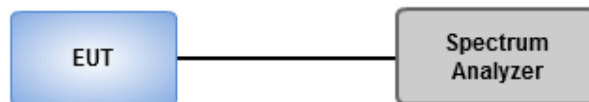
Frequency tolerance shall be +/- 50ppm.

3.2.2 Test Procedures

1. Set Span = 150kHz, RBW = 1kHz, VBW = 30kHz, Sweep time = Auto, detector = Peak.
2. Use Peak search function to find the max peak value and record this value (RF).
3. Calculate frequency tolerance by below formula
$$FT(ppm) = \{ (RF) - (MF) / (MF) \} \times 1000000$$

(FT: Frequency Tolerance, RF: Reading Frequency, MF: Measurement Frequency.)

3.2.3 Test Setup



3.2.4 Test Result of Frequency Tolerance

Refer to Appendix B

3.3 Occupied Bandwidth

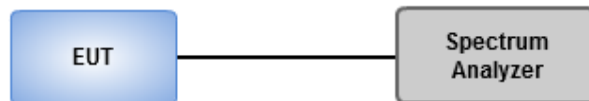
3.3.1 Limit of Occupied Bandwidth

Mode	Limit (MHz)
FH	83.5
FH+DS	83.5
FH+OFDM	83.5
OFDM(Narrow- bandwidht), DS	26
Others	26
OFDM (Wide-band)	38

3.3.2 Test Procedures

1. Set Span = 200MHz, RBW = VBW = 300kHz, detector = Peak, Sweep time = Auto.
2. Enable OBW function of spectrum analyzer to measure 99% bandwidth of total power.

3.3.3 Test Setup



3.3.4 Test Result of Occupied Bandwidth

Refer to Appendix C

3.4 Spreading Bandwidth and Factor

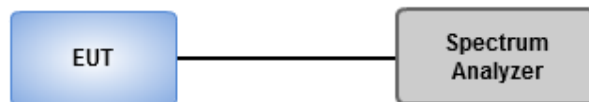
3.4.1 Limit of Spreading Bandwidth and Factor

Item	Limit
Spreading bandwidth	$\geq 500\text{kHz}$
Spreading factor for DSSS (operates at 2400~2483.5 MHz)	≥ 5
Spreading factor for DSSS (operates at 2471~2497 MHz)	≥ 10

3.4.2 Test Procedures

1. Set Span = 20MHz, RBW = VBW = 300kHz, detector = Peak, Sweep time = Auto.
2. Enable OBW (90%) function of spectrum analyzer to measure 90% bandwidth of total power.

3.4.3 Test Setup



3.4.4 Test Result of Spreading Bandwidth and Factor

Refer to Appendix D

3.5 Transmitter Spurious Emissions

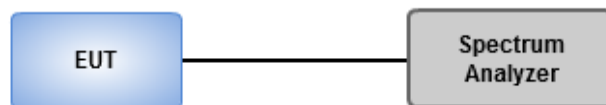
3.5.1 Limit of Transmitter Spurious Emissions

Item	Limits
Tx Spurious Emission	$\leq 2.5 \mu\text{W}$ ($2387\text{MHz} > f$; $2496.5\text{MHz} < f$).
	$\leq 25 \mu\text{W}$. ($2387\text{MHz} \leq f < 2400\text{MHz}$) and ($2483.5\text{MHz} < f \leq 2496.5\text{MHz}$).

3.5.2 Test Procedures

1. Set EUT to transmit at rated power and channel to perform test.
2. Set RBW = VBW = 1MHz, Detector type = Peak, Sweep time = Auto.
3. Following above setting of spectrum analyzer to measure spurious emission of 30~12500 MHz.

3.5.3 Test Setup



3.5.4 Test Result of Transmitter Spurious Emissions

Refer to Appendix E

3.6 Dwell time

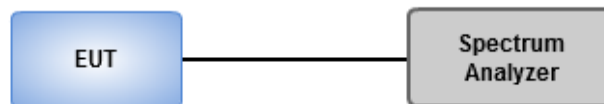
3.6.1 Limit of Dwell time

Limits	Shall be less than 0.4 second
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3.6.2 Test Procedures

1. Set EUT to transmit at rated power and channel to perform test.
2. Set RBW = VBW = 300kHz, Detector type = Peak, Span = Zero Span, Sweep time = 5 msec.
3. Use marker function to measure Burst on and off time.
4. Burst ratio = On Time / (On Time + Off time)

3.6.3 Test Setup



3.6.4 Test Result of Transmitter Spurious Emissions

Refer to Appendix F

3.7 Interference prevention function

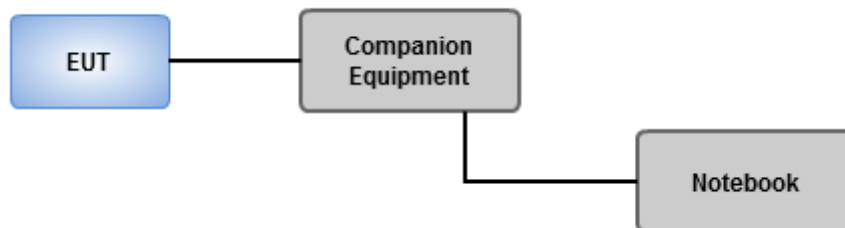
3.7.1 Limit of Interference Prevention Function

Limits
The identification code shall be 48 bits long

3.7.2 Test Procedures

1. Set EUT under operating mode and link up with companion equipment
2. Check communication status between EUT and companion equipment is normal
3. Confirm the MAC address of EUT

3.7.3 Test Setup



3.7.4 Test Result of Interference Prevention Function

Refer to Appendix G

4 Receiver Test Results

4.1 Receiver Spurious Emissions

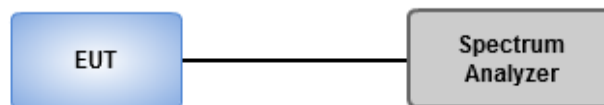
4.1.1 Limit of Receiver Spurious Emissions

Item	Limits
Rx Spurious Emission	$\leq 4\text{nW}$ ($f < 1\text{GHz}$).
	$\leq 20\text{nW}$ ($1\text{GHz} \leq f$).

4.1.2 Test Procedures

1. Set EUT under receiving condition to perform test
2. Set RBW = VBW = 100kHz, detector = Peak, Sweep time = Auto for emission measurement below 1GHz.
3. Set RBW = VBW=1MHz, detector = Peak, Sweep time = Auto for emission measurement above 1GHz.

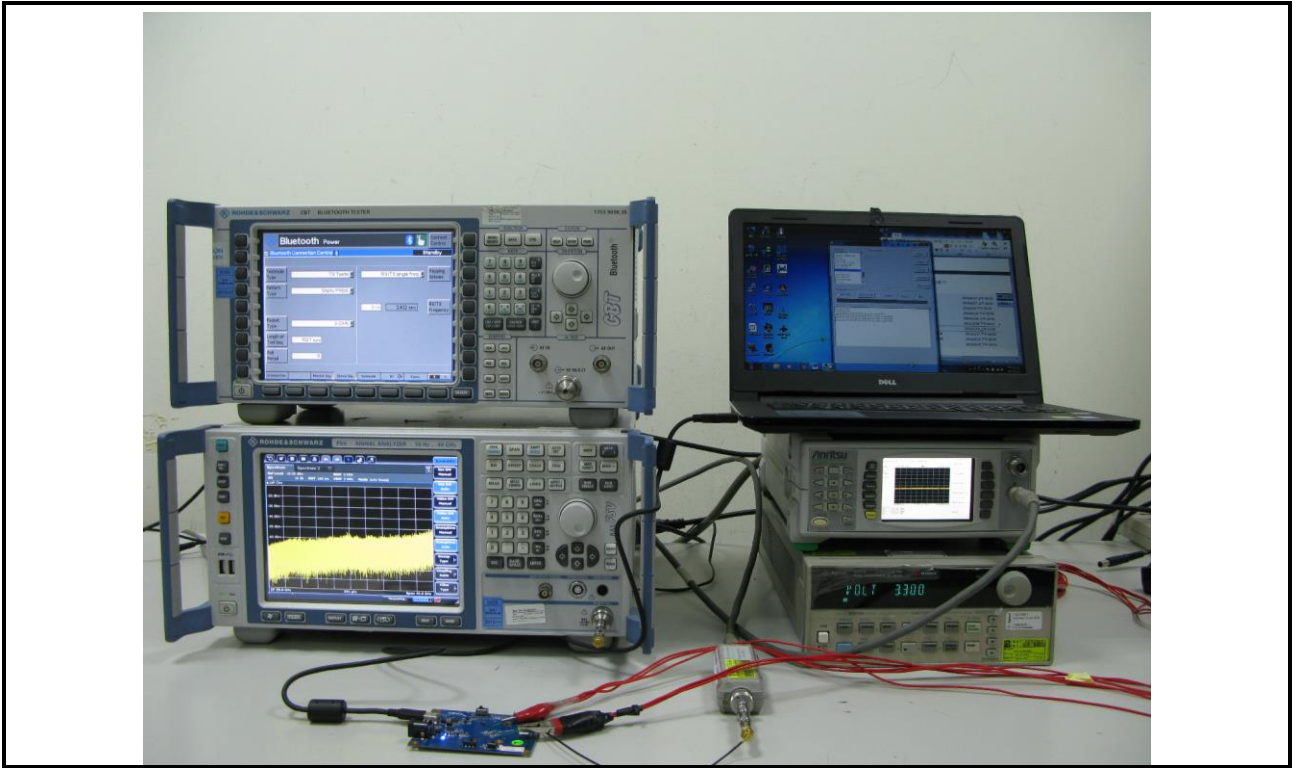
4.1.3 Test Setup



4.1.4 Test Result of Receiver Spurious Emissions

Refer to Appendix H

5 Photographs of the Test Configuration



6 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

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Kwei Shan

Tel: 886-3-271-8666

No. 3-1, Lane 6, Wen San 3rd
St., Kwei Shan District, Tao Yuan
City 333, Taiwan, R.O.C.

Kwei Shan Site II

Tel: 886-3-271-8640

No. 14-1, Lane 19, Wen San 3rd
St., Kwei Shan District, Tao Yuan
City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666

Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

==END==

**Summary**

Mode	Power (dBm/MHz)	Power (mW/MHz)	EIRP (dBm/MHz)	EIRP (mW/MHz)
BT-BR(1Mbps)	-	-	-	-
2.4-2.4835GHz	-13.56	0.04406	-11.56	0.06982
BT-EDR(3Mbps)	-	-	-	-
2.4-2.4835GHz	-17.48	0.01786	-15.48	0.02831
BT-BR-AFH(1Mbps)	-	-	-	-
2.4-2.4835GHz	-7.75	0.16788	-5.75	0.26607
BT-EDR-AFH(3Mbps)	-	-	-	-
2.4-2.4835GHz	-11.65	0.06839	-9.65	0.10839

PD = Antenna Power (Power Density)sum by **P1~PN**; **P1** = Port 1 PD

Result

Mode	Result	Gain (dBi)	EIRP (dBm/MHz)	EIRP (mW/MHz)	EIRP Lim. (mW/MHz)	Power (dBm/MHz)	Power (mW/MHz)
BT-BR(1Mbps)	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	2.00	-11.64	0.06855	4.91	-13.64	0.04325
2402MHz_Vmin	Pass	2.00	-11.56	0.06982	4.91	-13.56	0.04406
2402MHz_Vmax	Pass	2.00	-11.61	0.06902	4.91	-13.61	0.04355
BT-EDR(3Mbps)	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	2.00	-15.52	0.02805	4.91	-17.52	0.01770
2402MHz_Vmin	Pass	2.00	-15.52	0.02805	4.91	-17.52	0.01770
2402MHz_Vmax	Pass	2.00	-15.48	0.02831	4.91	-17.48	0.01786
BT-BR-AFH(1Mbps)	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	2.00	-5.81	0.26242	4.91	-7.81	0.16558
2402MHz_Vmin	Pass	2.00	-5.76	0.26546	4.91	-7.76	0.16749
2402MHz_Vmax	Pass	2.00	-5.75	0.26607	4.91	-7.75	0.16788
BT-EDR-AFH(3Mbps)	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	2.00	-9.78	0.10520	4.91	-11.78	0.06637
2402MHz_Vmin	Pass	2.00	-9.74	0.10617	4.91	-11.74	0.06699
2402MHz_Vmax	Pass	2.00	-9.65	0.10839	4.91	-11.65	0.06839

PD = Antenna Power (Power Density)sum by **P1~PN**; **P1** = Port 1 PD;

**Summary**

Mode	Result	Power (dBm/MHz)	Power (mW/MHz)	Declare (dBm/MHz)	Declare (mW/MHz)
BT-BR(1Mbps)	-	-	-	-	-
2.4-2.4835GHz	Pass	-13.56	0.04406	-13.56	0.04
BT-EDR(3Mbps)	-	-	-	-	-
2.4-2.4835GHz	Pass	-17.52	0.01770	-13.56	0.04
BT-BR-AFH(1Mbps)	-	-	-	-	-
2.4-2.4835GHz	Pass	-7.75	0.16788	-7.96	0.16
BT-EDR-AFH(3Mbps)	-	-	-	-	-
2.4-2.4835GHz	Pass	-11.65	0.06839	-7.96	0.16

Result

Mode	Result	Power (dBm/MHz)	Power (mW/MHz)	Declare (dBm/MHz)	Declare (mW/MHz)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-BR(1Mbps)	-	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	-13.64	0.04325	-13.56	0.04	-1.83	20	-80
2402MHz_Vmin	Pass	-13.56	0.04406	-13.56	0.04	0.01	20	-80
2402MHz_Vmax	Pass	-13.61	0.04355	-13.56	0.04	-1.14	20	-80
BT-EDR(3Mbps)	-	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	-17.52	0.01770	-13.56	0.04	-55.75	20	-80
2402MHz_Vmin	Pass	-17.52	0.01770	-13.56	0.04	-55.75	20	-80
2402MHz_Vmax	Pass	-17.48	0.01786	-13.56	0.04	-55.35	20	-80
BT-BR-AFH(1Mbps)	-	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	-7.81	0.16558	-7.96	0.16	3.49	20	-80
2402MHz_Vmin	Pass	-7.76	0.16749	-7.96	0.16	4.68	20	-80
2402MHz_Vmax	Pass	-7.75	0.16788	-7.96	0.16	4.93	20	-80
BT-EDR-AFH(3Mbps)	-	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	-11.78	0.06637	-7.96	0.16	-58.52	20	-80
2402MHz_Vmin	Pass	-11.74	0.06699	-7.96	0.16	-58.13	20	-80
2402MHz_Vmax	Pass	-11.65	0.06839	-7.96	0.16	-57.26	20	-80



Summary

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
BT-BR(1Mbps)	-	-	-	-	-	-	-
2.4-2.4835GHz	Pass	2.441G	2.44100671G	+ 2.749	+ /- 50	1	-



Result

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
BT-BR(1Mbps)	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	2.402G	2.40200379G	+ 1.578	+/- 50	1	-
2402MHz_Vmin	Pass	2.402G	2.40200375G	+ 1.562	+/- 50	1	-
2402MHz_Vmax	Pass	2.402G	2.40200374G	+ 1.555	+/- 50	1	-
2441MHz_Vnom	Pass	2.441G	2.44100671G	+ 2.749	+/- 50	1	-
2441MHz_Vmin	Pass	2.441G	2.44100666G	+ 2.729	+/- 50	1	-
2441MHz_Vmax	Pass	2.441G	2.44100662G	+ 2.711	+/- 50	1	-
2480MHz_Vnom	Pass	2.48G	2.48000465G	+ 1.873	+/- 50	1	-
2480MHz_Vmin	Pass	2.48G	2.48000461G	+ 1.861	+/- 50	1	-
2480MHz_Vmax	Pass	2.48G	2.48000458G	+ 1.847	+/- 50	1	-
BT-EDR(3Mbps)	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	2.402G	2.40200372G	+ 1.547	+/- 50	1	-
2402MHz_Vmin	Pass	2.402G	2.40200371G	+ 1.543	+/- 50	1	-
2402MHz_Vmax	Pass	2.402G	2.40200369G	+ 1.537	+/- 50	1	-
2441MHz_Vnom	Pass	2.441G	2.44100657G	+ 2.692	+/- 50	1	-
2441MHz_Vmin	Pass	2.441G	2.44100655G	+ 2.682	+/- 50	1	-
2441MHz_Vmax	Pass	2.441G	2.44100651G	+ 2.665	+/- 50	1	-
2480MHz_Vnom	Pass	2.48G	2.48000455G	+ 1.835	+/- 50	1	-
2480MHz_Vmin	Pass	2.48G	2.48000452G	+ 1.823	+/- 50	1	-
2480MHz_Vmax	Pass	2.48G	2.48000449G	+ 1.81	+/- 50	1	-
BT-BR-AFH(1Mbps)	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	2.402G	2.40200368G	+ 1.533	+/- 50	1	-
2402MHz_Vmin	Pass	2.402G	2.40200367G	+ 1.528	+/- 50	1	-
2402MHz_Vmax	Pass	2.402G	2.40200367G	+ 1.528	+/- 50	1	-
2441MHz_Vnom	Pass	2.441G	2.44100648G	+ 2.654	+/- 50	1	-
2441MHz_Vmin	Pass	2.441G	2.44100645G	+ 2.641	+/- 50	1	-
2441MHz_Vmax	Pass	2.441G	2.44100641G	+ 2.626	+/- 50	1	-
2480MHz_Vnom	Pass	2.48G	2.48000447G	+ 1.801	+/- 50	1	-
2480MHz_Vmin	Pass	2.48G	2.48000444G	+ 1.791	+/- 50	1	-
2480MHz_Vmax	Pass	2.48G	2.48000441G	+ 1.78	+/- 50	1	-
BT-EDR-AFH(3Mbps)	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	2.402G	2.40200366G	+ 1.525	+/- 50	1	-
2402MHz_Vmin	Pass	2.402G	2.40200365G	+ 1.521	+/- 50	1	-
2402MHz_Vmax	Pass	2.402G	2.40200365G	+ 1.52	+/- 50	1	-
2441MHz_Vnom	Pass	2.441G	2.44100637G	+ 2.61	+/- 50	1	-
2441MHz_Vmin	Pass	2.441G	2.4410063G	+ 2.583	+/- 50	1	-
2441MHz_Vmax	Pass	2.441G	2.44100627G	+ 2.569	+/- 50	1	-
2480MHz_Vnom	Pass	2.48G	2.4800044G	+ 1.773	+/- 50	1	-
2480MHz_Vmin	Pass	2.48G	2.48000437G	+ 1.763	+/- 50	1	-
2480MHz_Vmax	Pass	2.48G	2.48000435G	+ 1.755	+/- 50	1	-



Summary

Mode	Max-OBW (MHz)	ITU-Code	Min-OBW (MHz)
BT-BR(1Mbps)	-	-	-
2.4-2.4835GHz	78.661	78M7F1D	78.661
BT-EDR(3Mbps)	-	-	-
2.4-2.4835GHz	78.761	78M8G1D	78.761
BT-BR-AFH(1Mbps)	-	-	-
2.4-2.4835GHz	20.49	20M5F1D	20.49
BT-EDR-AFH(3Mbps)	-	-	-
2.4-2.4835GHz	20.765	20M8G1D	20.74

Max-OBW = Maximum 99% occupied bandwidth; **Min-OBW** = Minimum 99% occupied bandwidth;

Result

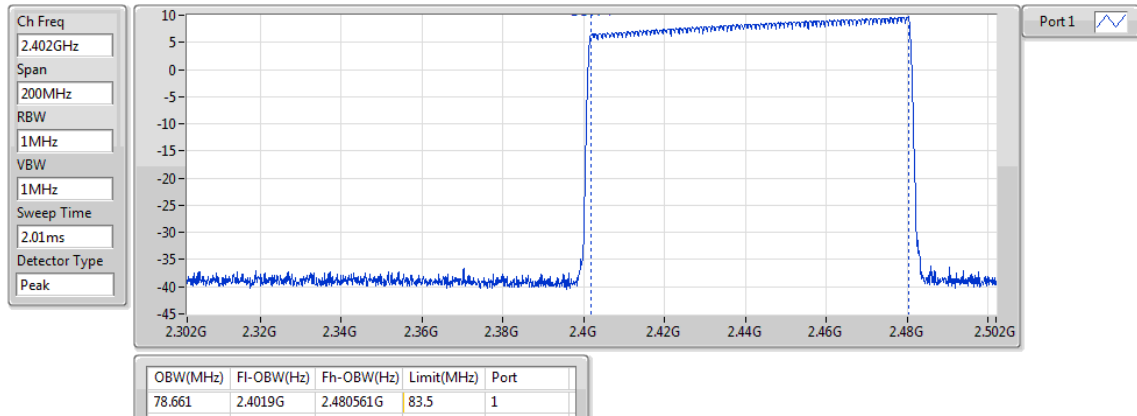
Mode	Result	Limit (MHz)	P1-OBW (MHz)
BT-BR(1Mbps)	-	-	-
2402MHz_Vnom	Pass	83.5	78.661
2402MHz_Vmin	Pass	83.5	78.661
2402MHz_Vmax	Pass	83.5	78.661
BT-EDR(3Mbps)	-	-	-
2402MHz_Vnom	Pass	83.5	78.761
2402MHz_Vmin	Pass	83.5	78.761
2402MHz_Vmax	Pass	83.5	78.761
BT-BR-AFH(1Mbps)	-	-	-
2402MHz_Vnom	Pass	83.5	20.49
2402MHz_Vmin	Pass	83.5	20.49
2402MHz_Vmax	Pass	83.5	20.49
BT-EDR-AFH(3Mbps)	-	-	-
2402MHz_Vnom	Pass	83.5	20.765
2402MHz_Vmin	Pass	83.5	20.74
2402MHz_Vmax	Pass	83.5	20.74

P1-OBW = Port 1 99% occupied bandwidth

BT-BR(1Mbps)

OBW

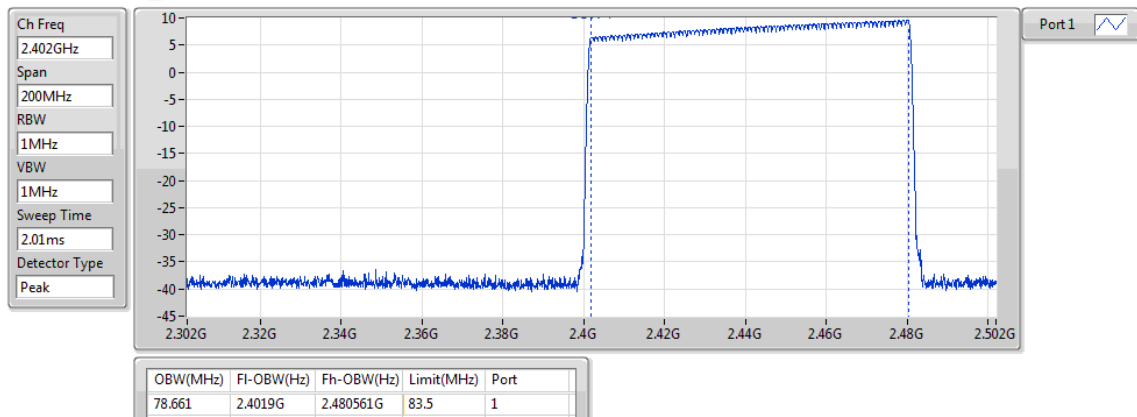
2402MHz_Vnom



BT-BR(1Mbps)

OBW

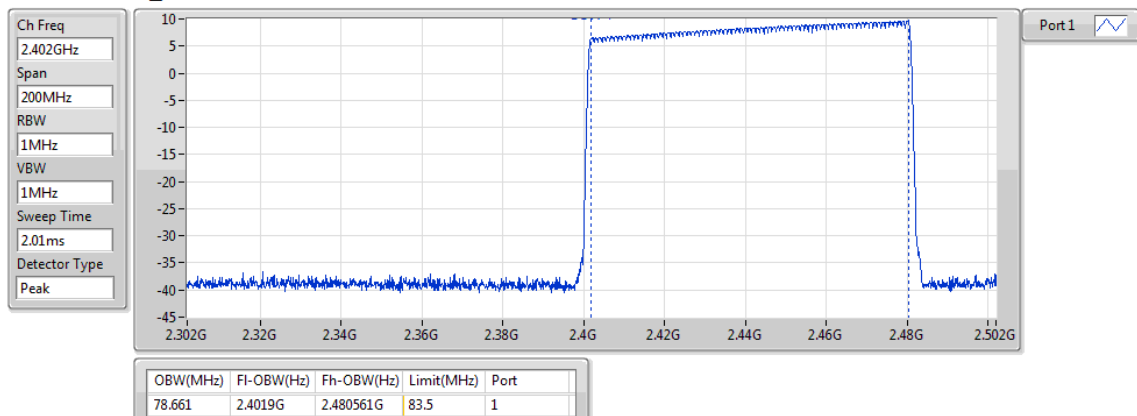
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BT-BR(1Mbps)

OBW

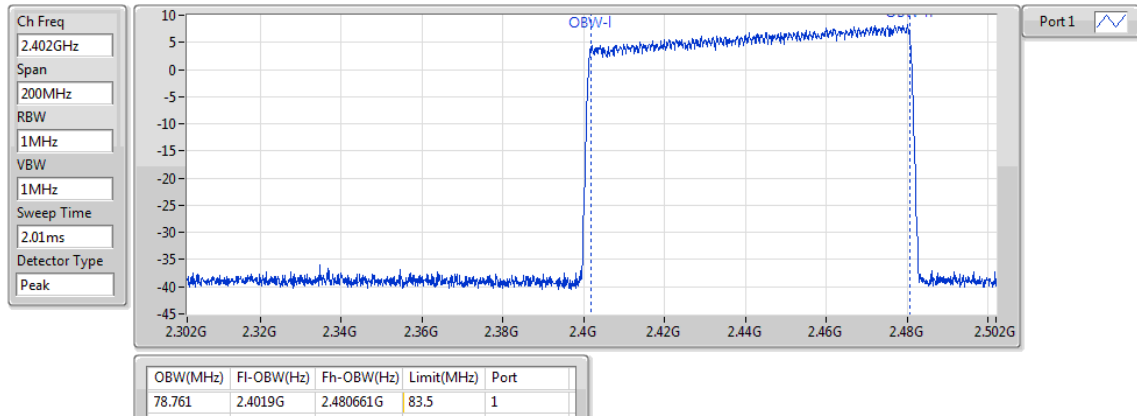
2402MHz_Vmax



BT-EDR(3Mbps)

OBW

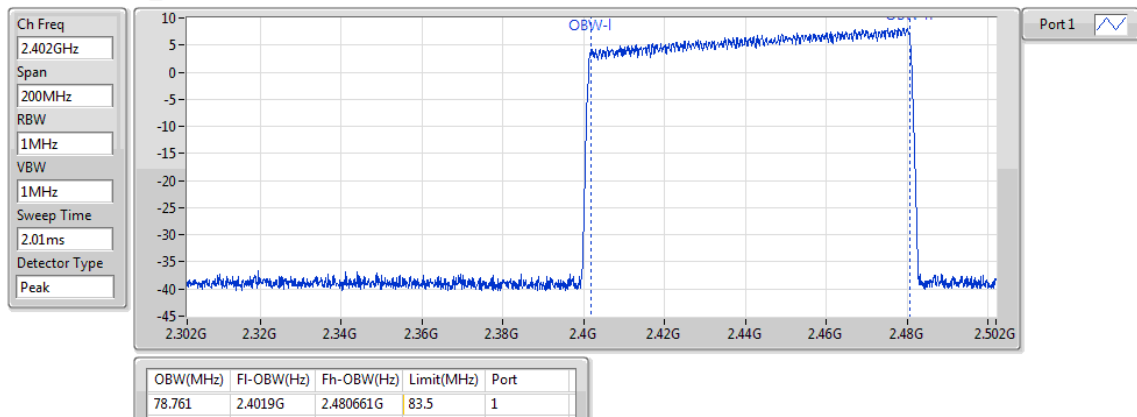
2402MHz_Vnom



BT-EDR(3Mbps)

OBW

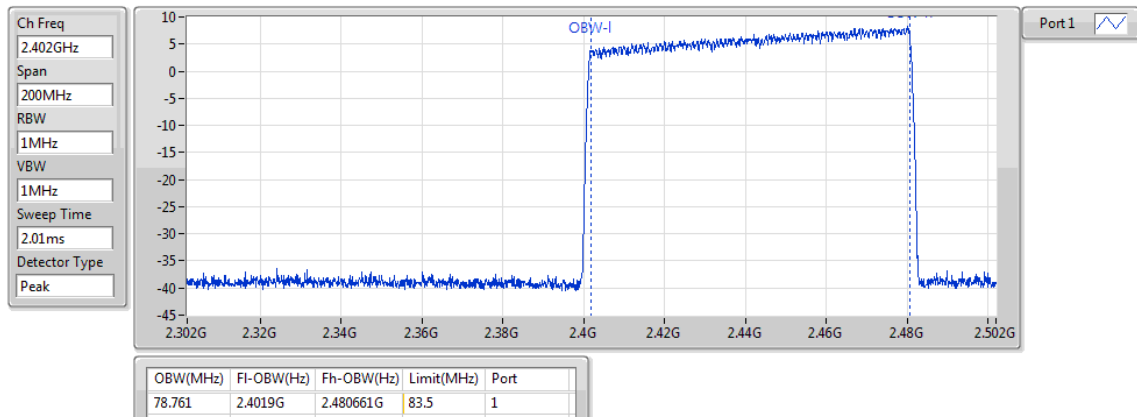
2402MHz_Vmin



BT-EDR(3Mbps)

OBW

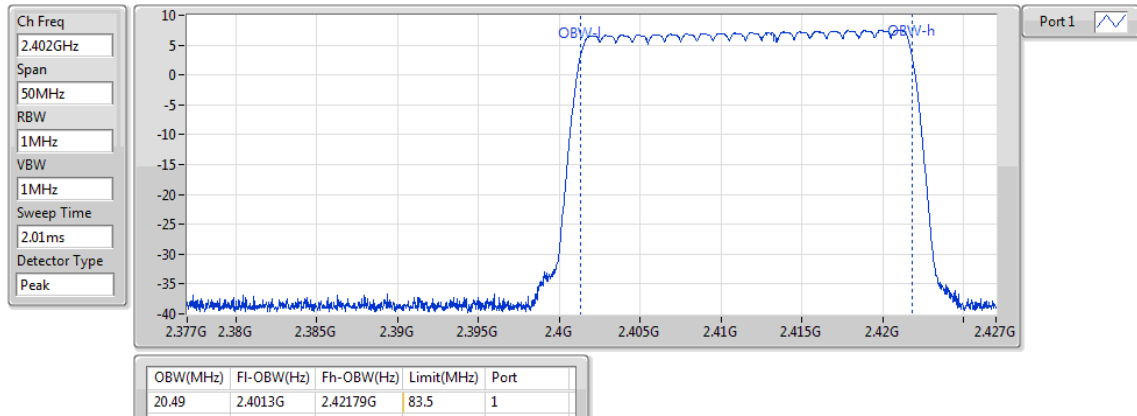
2402MHz_Vmax



BT-BR-AFH(1Mbps)

OBW

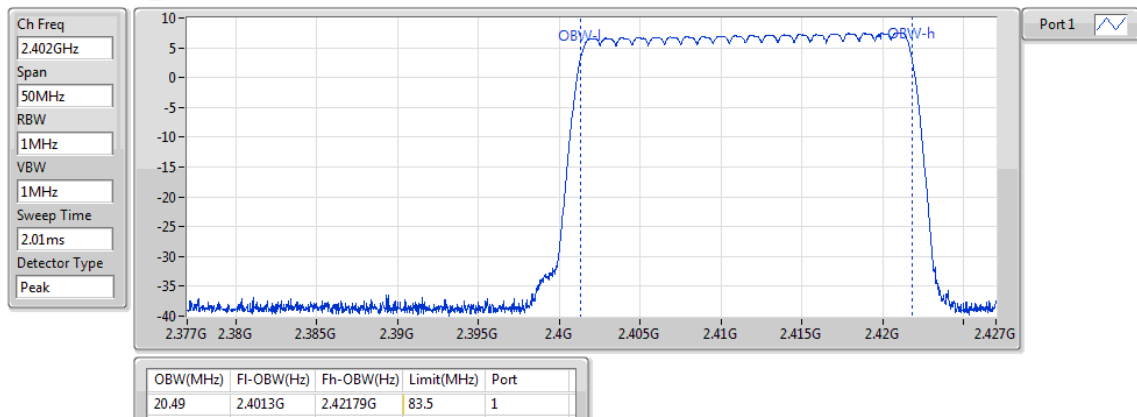
2402MHz_Vnom



BT-BR-AFH(1Mbps)

OBW

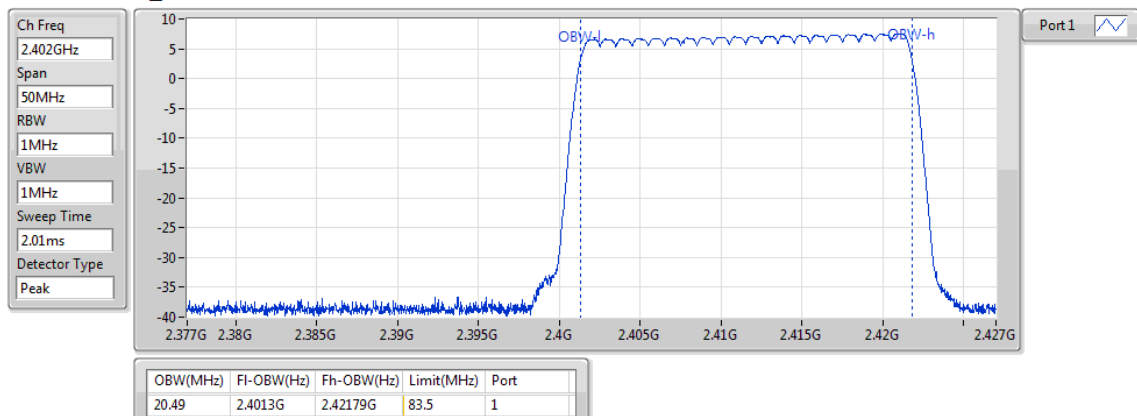
2402MHz_Vmin



BT-BR-AFH(1Mbps)

OBW

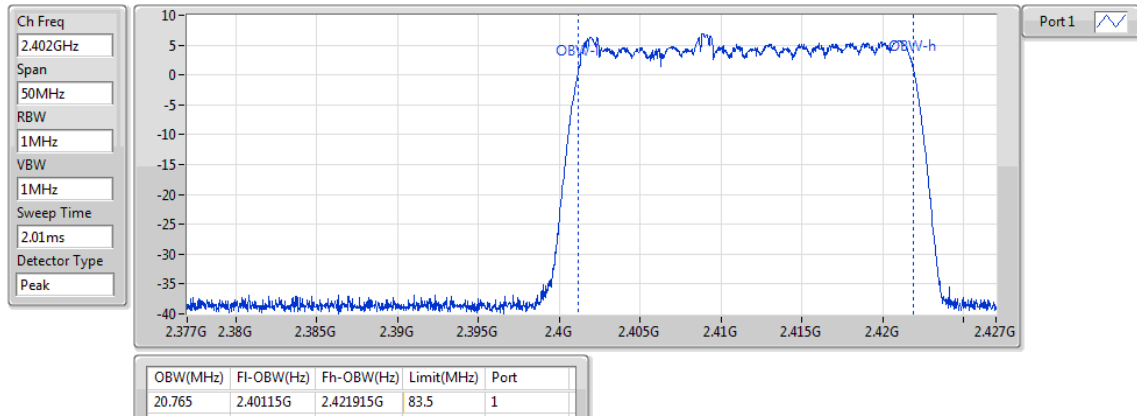
2402MHz_Vmax



BT-EDR-AFH(3Mbps)

OBW

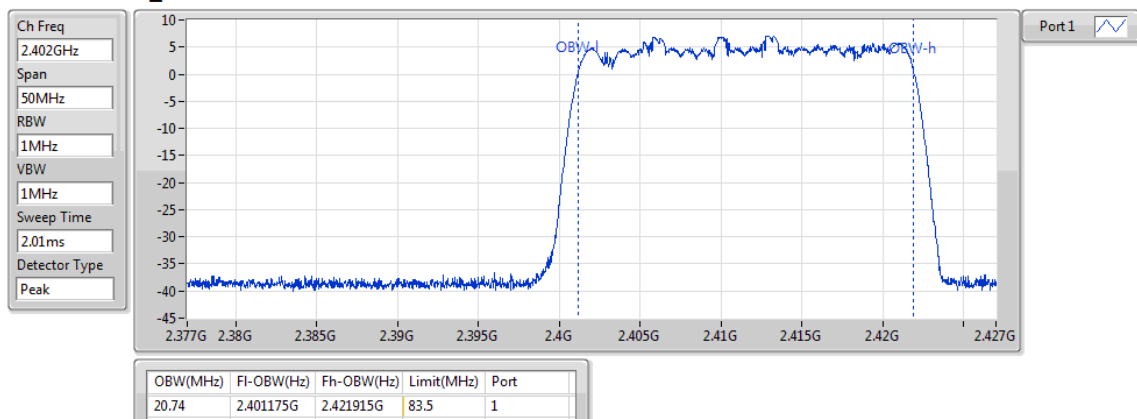
2402MHz_Vnom



BT-EDR-AFH(3Mbps)

OBW

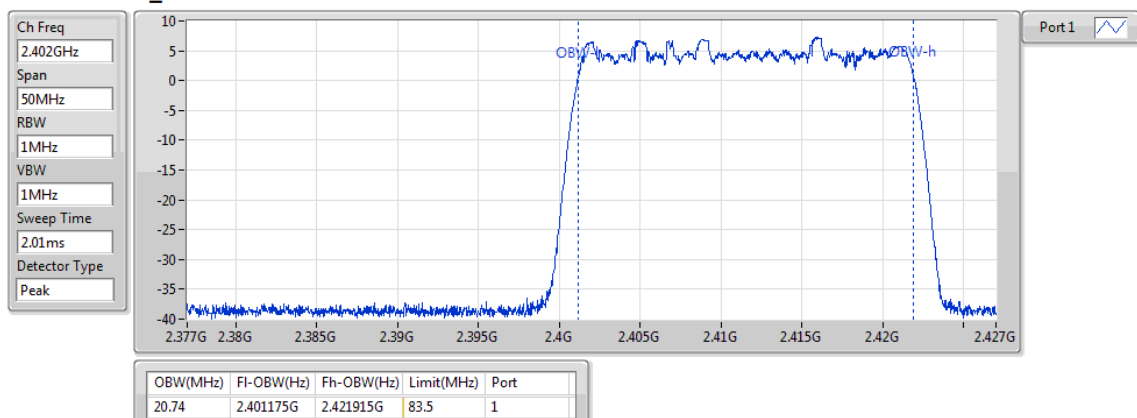
2402MHz_Vmin



BT-EDR-AFH(3Mbps)

OBW

2402MHz_Vmax



**Summary**

Mode	Max-SBW (Hz)	Min-SBW (Hz)	Max-SF	Min-SF
BT-BR(1Mbps)	-	-	-	-
2.4-2.4835GHz	70.665	70.665	70.665	70.665
BT-EDR(3Mbps)	-	-	-	-
2.4-2.4835GHz	70.365	70.265	70.365	70.265
BT-BR-AFH(1Mbps)	-	-	-	-
2.4-2.4835GHz	18.466	18.466	18.466	18.466
BT-EDR-AFH(3Mbps)	-	-	-	-
2.4-2.4835GHz	18.966	18.491	18.966	18.491

Max-SBW = Maximum spreading bandwidth; **Min-SBW** = Minimum spreading bandwidth;

Max-SF = Maximum spreading factor; **Min-SF** = Minimum spreading factor;

**Result**

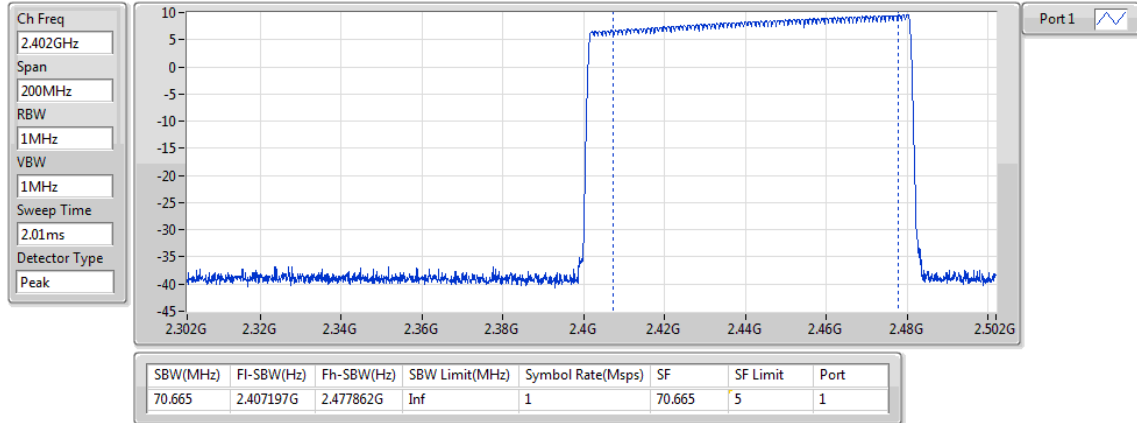
Mode	Result	P1-SF	Symbol Rate (Mps)	SF Limit	P1-SBW (MHz)
BT-BR(1Mbps)	-	-	-	-	-
2402MHz_Vnom	Pass	70.665	1	5	70.665
2402MHz_Vmin	Pass	70.665	1	5	70.665
2402MHz_Vmax	Pass	70.665	1	5	70.665
BT-EDR(3Mbps)	-	-	-	-	-
2402MHz_Vnom	Pass	70.365	1	5	70.365
2402MHz_Vmin	Pass	70.265	1	5	70.265
2402MHz_Vmax	Pass	70.365	1	5	70.365
BT-BR-AFH(1Mbps)	-	-	-	-	-
2402MHz_Vnom	Pass	18.466	1	5	18.466
2402MHz_Vmin	Pass	18.466	1	5	18.466
2402MHz_Vmax	Pass	18.466	1	5	18.466
BT-EDR-AFH(3Mbps)	-	-	-	-	-
2402MHz_Vnom	Pass	18.966	1	5	18.966
2402MHz_Vmin	Pass	18.766	1	5	18.766
2402MHz_Vmax	Pass	18.491	1	5	18.491

P1-SBW = Port 1 spreading bandwidth; **P1-SF** = Port 1 spreading factor;

BT-BR(1Mbps)

SBW

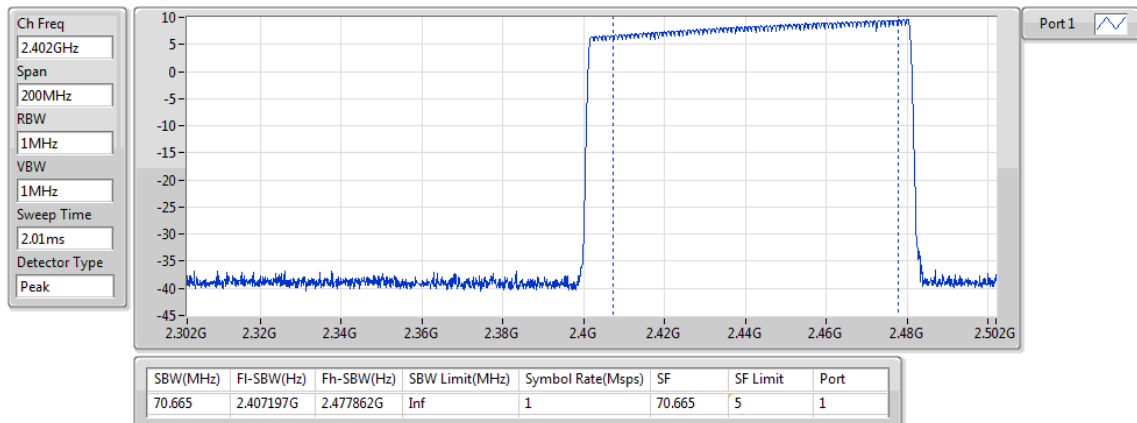
2402MHz_Vnom



BT-BR(1Mbps)

SBW

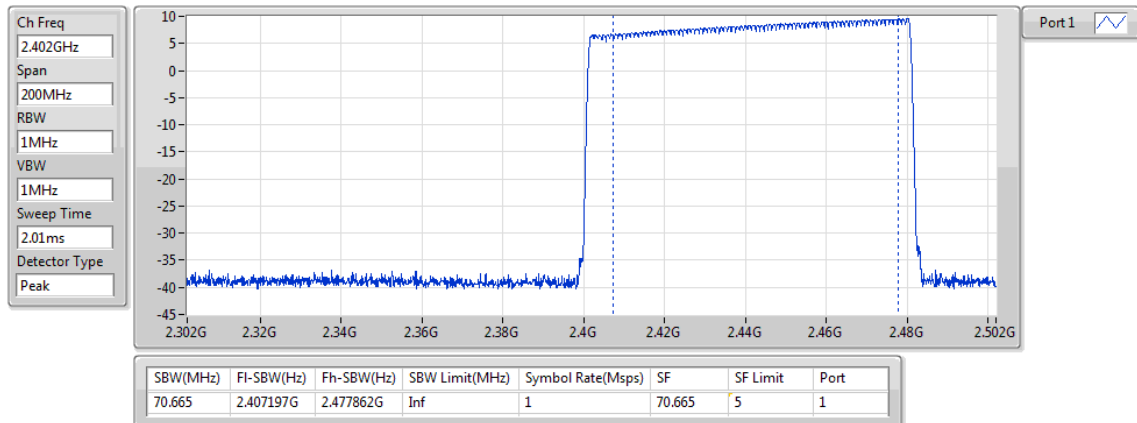
2402MHz_Vmin



BT-BR(1Mbps)

SBW

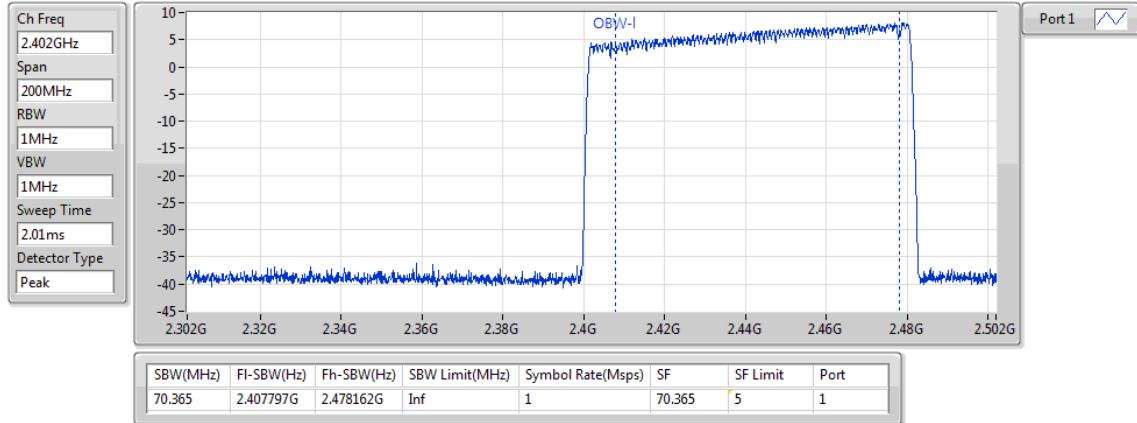
2402MHz_Vmax



BT-EDR(3Mbps)

SBW

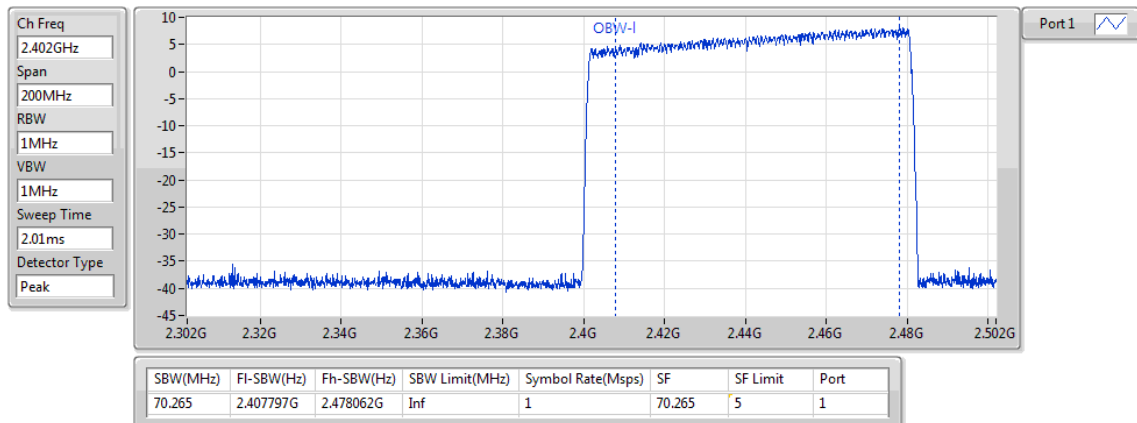
2402MHz_Vnom



BT-EDR(3Mbps)

SBW

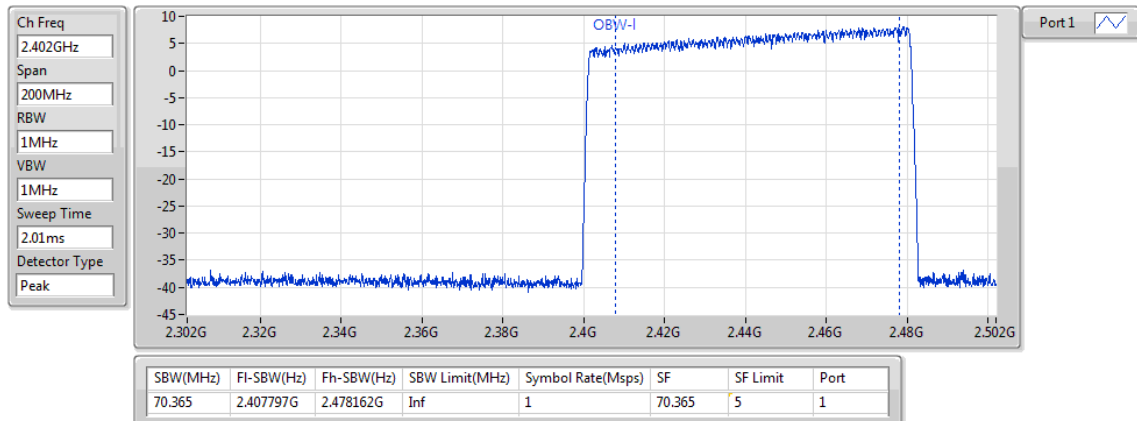
2402MHz_Vmin



BT-EDR(3Mbps)

SBW

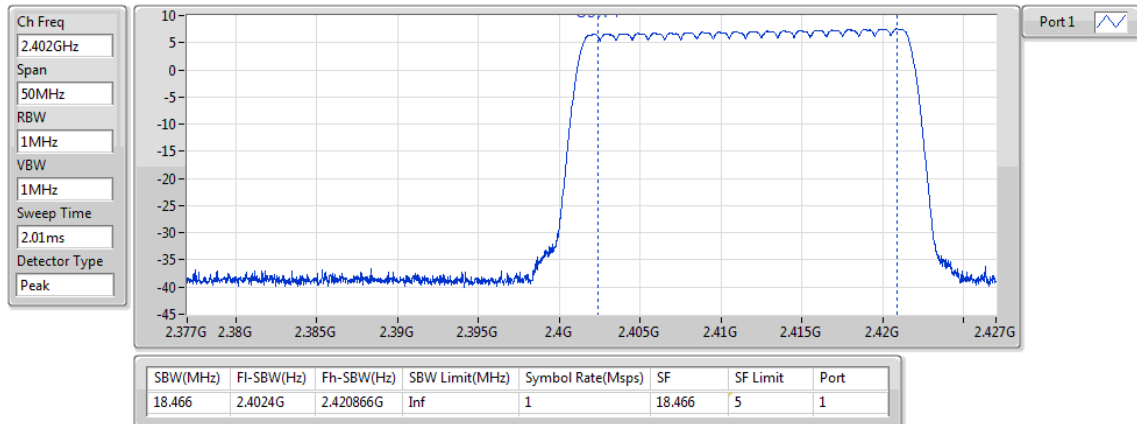
2402MHz_Vmax



BT-BR-AFH(1Mbps)

SBW

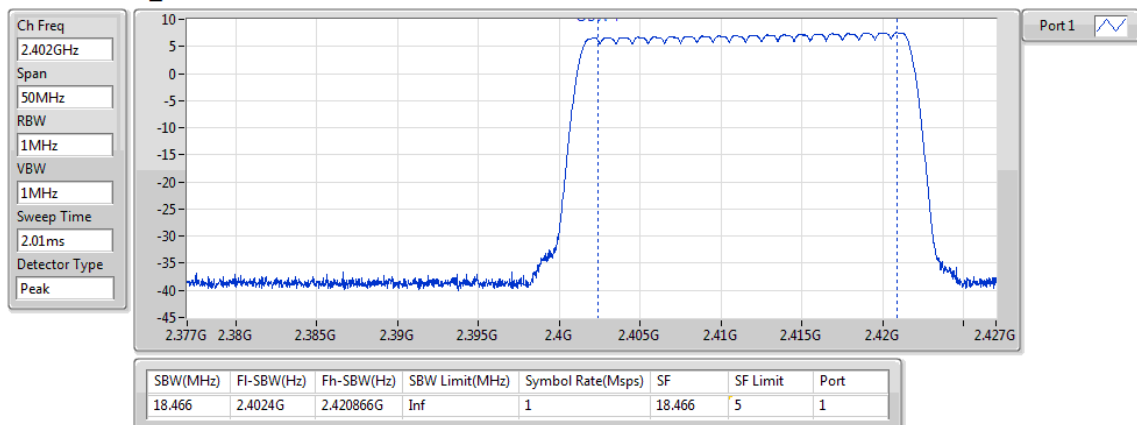
2402MHz_Vnom



BT-BR-AFH(1Mbps)

SBW

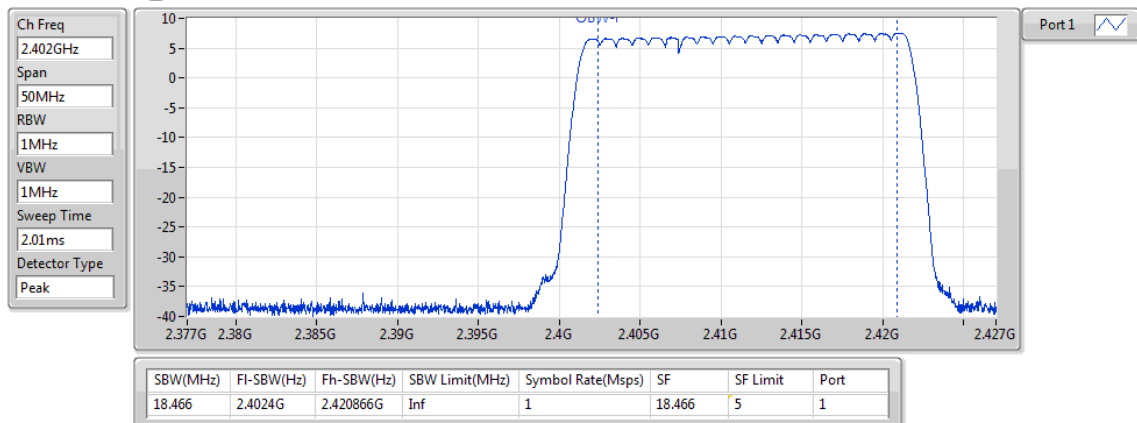
2402MHz_Vmin



BT-BR-AFH(1Mbps)

SBW

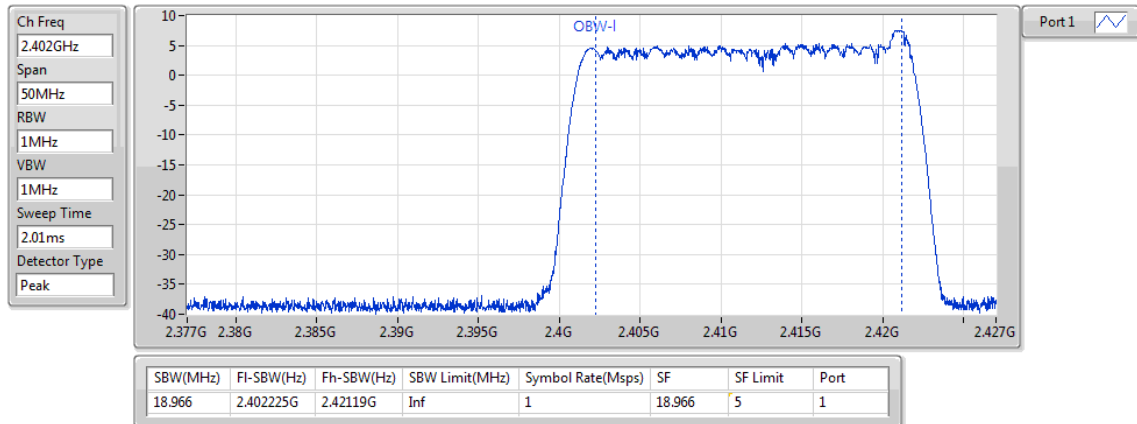
2402MHz_Vmax



BT-EDR-AFH(3Mbps)

SBW

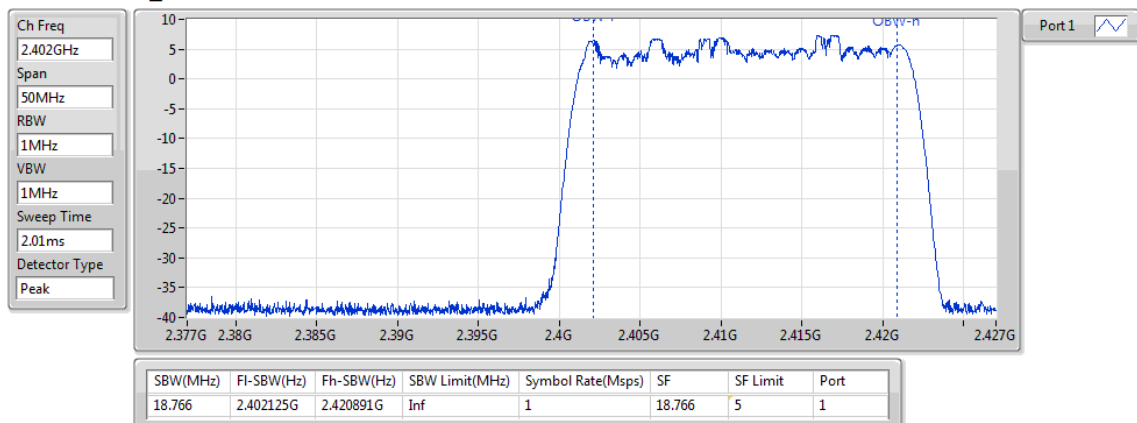
2402MHz_Vnom



BT-EDR-AFH(3Mbps)

SBW

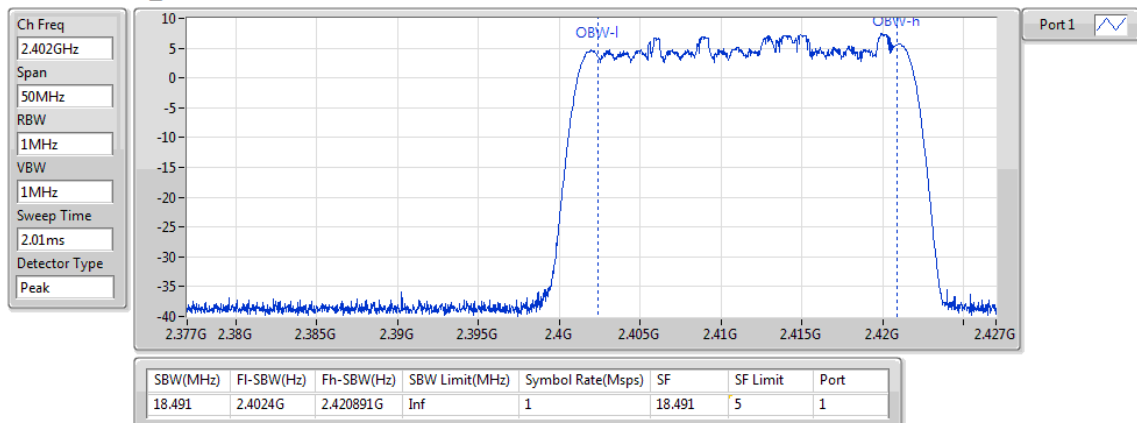
2402MHz_Vmin



BT-EDR-AFH(3Mbps)

SBW

2402MHz_Vmax

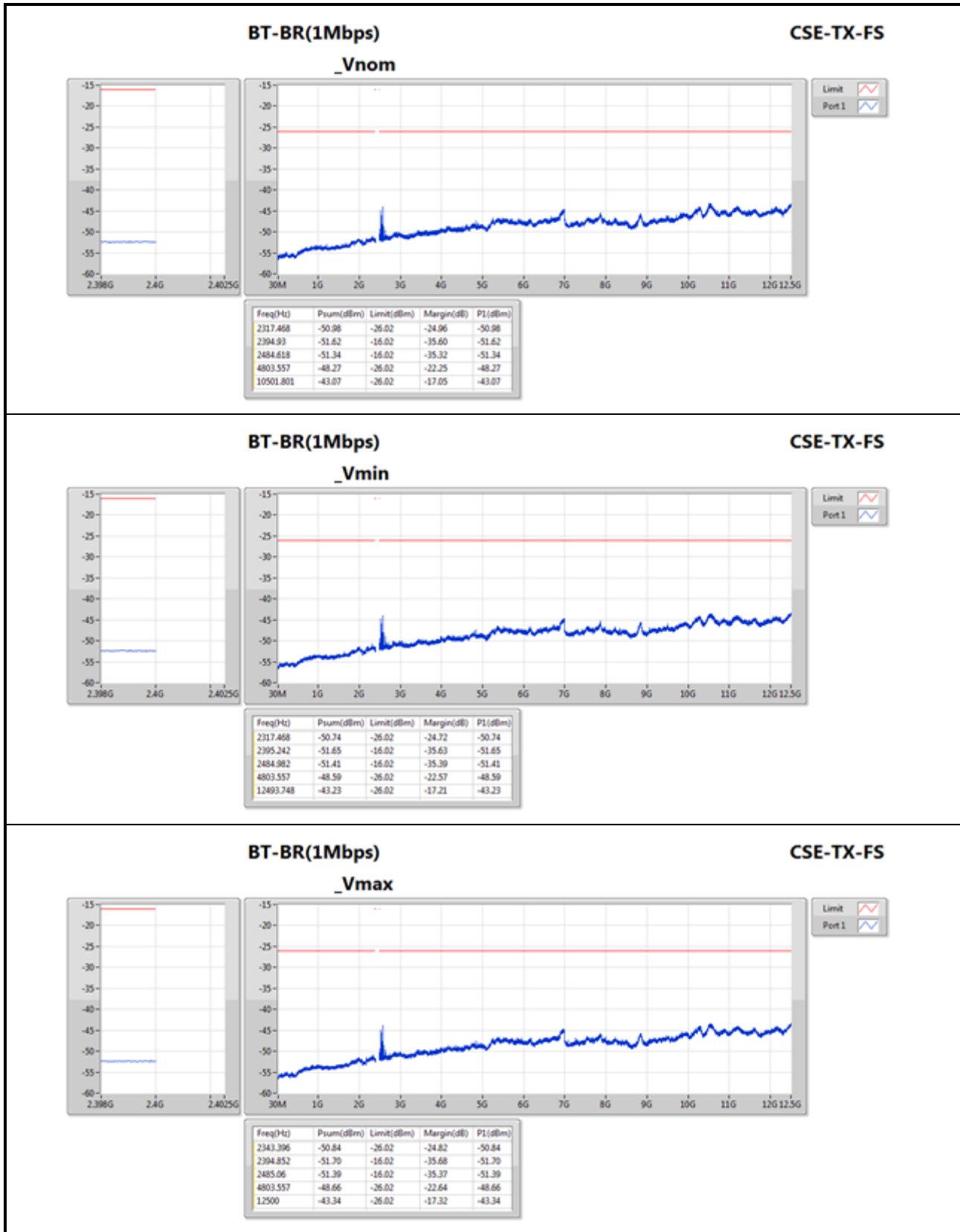


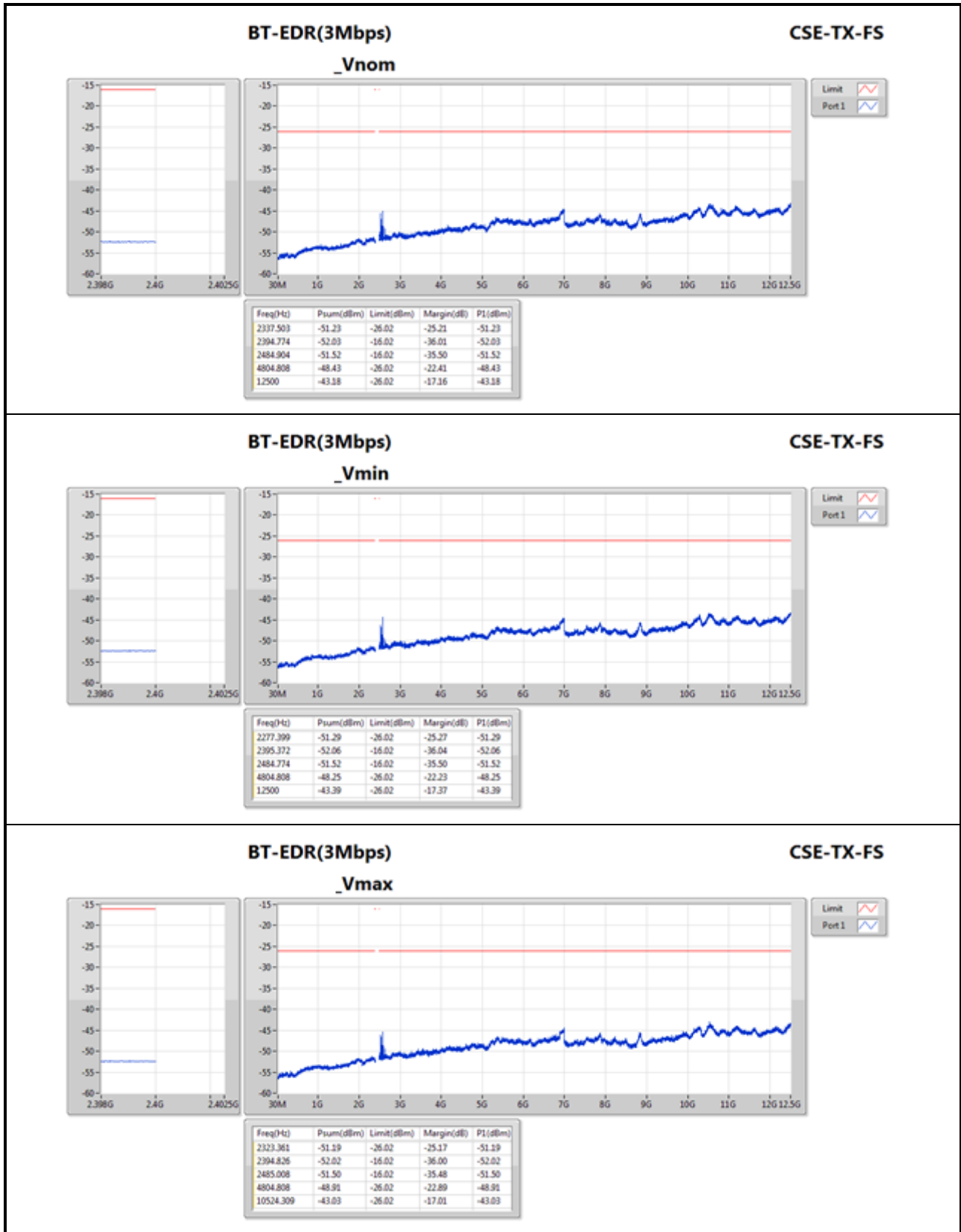
**Summary**

Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (uW/MHz)	Limit (dBm)	Limit (uW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (uW/MHz)
BT-EDR(3Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2.4-2.4835GHz	Pass	2.4965G	12.5G	1M	10524.309	-43.03	0.04979	-26.02	2.50035	-17.01	4.61	-43.03	0.04979

**Result**

Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (uW/MHz)	Limit (dBm)	Limit (uW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (uW/MHz)
BT-BR(1Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
Hopping_Vnom	Pass	30M	2.387G	1M	2317.468	-50.98	0.00797	-26.02	2.50035	-24.96	1.43	-50.98	0.00797
Hopping_Vnom	Pass	2.387G	2.4G	1M	2394.93	-51.62	0.00688	-16.02	25.00345	-35.60	1.47	-51.62	0.00688
Hopping_Vnom	Pass	2.4835G	2.4965G	1M	2484.618	-51.34	0.00734	-16.02	25.00345	-35.32	1.49	-51.34	0.00734
Hopping_Vnom	Pass	2.4965G	12.5G	1M	4803.557	-48.27	0.01488	-26.02	2.50035	-22.25	1.72	-48.27	0.01488
Hopping_Vnom	Pass	2.4965G	12.5G	1M	10501.801	-43.07	0.04931	-26.02	2.50035	-17.05	4.60	-43.07	0.04931
Hopping_Vmin	Pass	30M	2.387G	1M	2317.468	-50.74	0.00843	-26.02	2.50035	-24.72	1.43	-50.74	0.00843
Hopping_Vmin	Pass	2.387G	2.4G	1M	2395.242	-51.65	0.00684	-16.02	25.00345	-35.63	1.47	-51.65	0.00684
Hopping_Vmin	Pass	2.4835G	2.4965G	1M	2484.982	-51.41	0.00722	-16.02	25.00345	-35.39	1.49	-51.41	0.00722
Hopping_Vmin	Pass	2.4965G	12.5G	1M	4803.557	-48.59	0.01384	-26.02	2.50035	-22.57	1.72	-48.59	0.01384
Hopping_Vmin	Pass	2.4965G	12.5G	1M	12493.748	-43.23	0.04758	-26.02	2.50035	-17.21	5.68	-43.23	0.04758
Hopping_Vmax	Pass	30M	2.387G	1M	2343.396	-50.84	0.00825	-26.02	2.50035	-24.82	1.45	-50.84	0.00825
Hopping_Vmax	Pass	2.387G	2.4G	1M	2394.852	-51.70	0.00675	-16.02	25.00345	-35.68	1.47	-51.70	0.00675
Hopping_Vmax	Pass	2.4835G	2.4965G	1M	2485.06	-51.39	0.00726	-16.02	25.00345	-35.37	1.49	-51.39	0.00726
Hopping_Vmax	Pass	2.4965G	12.5G	1M	4803.557	-48.66	0.01362	-26.02	2.50035	-22.64	1.72	-48.66	0.01362
Hopping_Vmax	Pass	2.4965G	12.5G	1M	12500	-43.34	0.04633	-26.02	2.50035	-17.32	5.68	-43.34	0.04633
BT-EDR(3Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
Hopping_Vnom	Pass	30M	2.387G	1M	2337.503	-51.23	0.00753	-26.02	2.50035	-25.21	1.44	-51.23	0.00753
Hopping_Vnom	Pass	2.387G	2.4G	1M	2394.774	-52.03	0.00626	-16.02	25.00345	-36.01	1.47	-52.03	0.00626
Hopping_Vnom	Pass	2.4835G	2.4965G	1M	2484.904	-51.52	0.00705	-16.02	25.00345	-35.50	1.49	-51.52	0.00705
Hopping_Vnom	Pass	2.4965G	12.5G	1M	4804.808	-48.43	0.01437	-26.02	2.50035	-22.41	1.72	-48.43	0.01437
Hopping_Vnom	Pass	2.4965G	12.5G	1M	12500	-43.18	0.0481	-26.02	2.50035	-17.16	5.68	-43.18	0.0481
Hopping_Vmin	Pass	30M	2.387G	1M	2277.399	-51.29	0.00743	-26.02	2.50035	-25.27	1.42	-51.29	0.00743
Hopping_Vmin	Pass	2.387G	2.4G	1M	2395.372	-52.06	0.00622	-16.02	25.00345	-36.04	1.47	-52.06	0.00622
Hopping_Vmin	Pass	2.4835G	2.4965G	1M	2484.774	-51.52	0.00705	-16.02	25.00345	-35.50	1.49	-51.52	0.00705
Hopping_Vmin	Pass	2.4965G	12.5G	1M	4804.808	-48.25	0.01497	-26.02	2.50035	-22.23	1.72	-48.25	0.01497
Hopping_Vmin	Pass	2.4965G	12.5G	1M	12500	-43.39	0.04583	-26.02	2.50035	-17.37	5.68	-43.39	0.04583
Hopping_Vmax	Pass	30M	2.387G	1M	2323.361	-51.19	0.0076	-26.02	2.50035	-25.17	1.44	-51.19	0.0076
Hopping_Vmax	Pass	2.387G	2.4G	1M	2394.826	-52.02	0.00629	-16.02	25.00345	-36.00	1.47	-52.02	0.00629
Hopping_Vmax	Pass	2.4835G	2.4965G	1M	2485.008	-51.50	0.00708	-16.02	25.00345	-35.48	1.49	-51.50	0.00708
Hopping_Vmax	Pass	2.4965G	12.5G	1M	4804.808	-48.91	0.01286	-26.02	2.50035	-22.89	1.72	-48.91	0.01286
Hopping_Vmax	Pass	2.4965G	12.5G	1M	10524.309	-43.03	0.04979	-26.02	2.50035	-17.01	4.61	-43.03	0.04979





**Summary**

Mode	Max-Dwell (s)
BT-BR(1Mbps)	-
2.4-2.4835GHz	276.663877m
BT-EDR(3Mbps)	-
2.4-2.4835GHz	276.368276m
BT-BR-AFH(1Mbps)	-
2.4-2.4835GHz	142.823185m
BT-EDR-AFH(3Mbps)	-
2.4-2.4835GHz	147.095006m

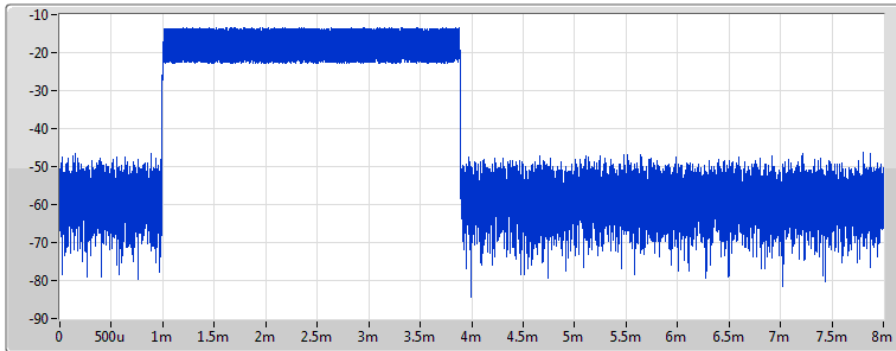
Result

Mode	Result	Period (s)	Dwell (s)	Limit (s)	Ch No.
BT-BR(1Mbps)	-	-	-	-	-
2402MHz_Vnom	Pass	28.266	276.663877m	400m	79
2402MHz_Vmin	Pass	28.266	276.663877m	400m	79
2402MHz_Vmax	Pass	28.266	276.663877m	400m	79
BT-EDR(3Mbps)	-	-	-	-	-
2402MHz_Vnom	Pass	28.146	276.368276m	400m	79
2402MHz_Vmin	Pass	28.106	275.951791m	400m	79
2402MHz_Vmax	Pass	28.146	276.368276m	400m	79
BT-BR-AFH(1Mbps)	-	-	-	-	-
2402MHz_Vnom	Pass	7.3864	142.798562m	400m	20
2402MHz_Vmin	Pass	7.3864	142.810874m	400m	20
2402MHz_Vmax	Pass	7.3864	142.823185m	400m	20
BT-EDR-AFH(3Mbps)	-	-	-	-	-
2402MHz_Vnom	Pass	7.5864	147.095006m	400m	20
2402MHz_Vmin	Pass	7.5064	145.543862m	400m	20
2402MHz_Vmax	Pass	7.3964	143.398711m	400m	20



BT-BR(1Mbps)

2402MHz



Period(s)	Dwell(s)	Limit(s)	Tx On(s)
28.266	276.663877m	400m	2.89925m

Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

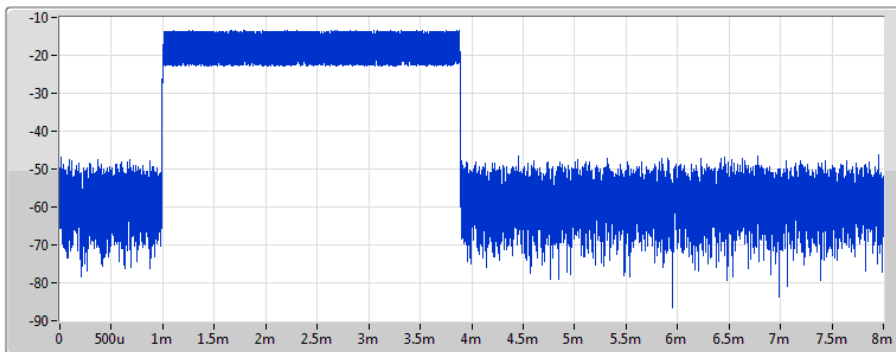
VBW
1MHz

Sweep Time
8ms

TX Time
2.89925ms

BT-BR(1Mbps)

2402MHz



Period(s)	Dwell(s)	Limit(s)	Tx On(s)
28.266	276.663877m	400m	2.89925m

Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

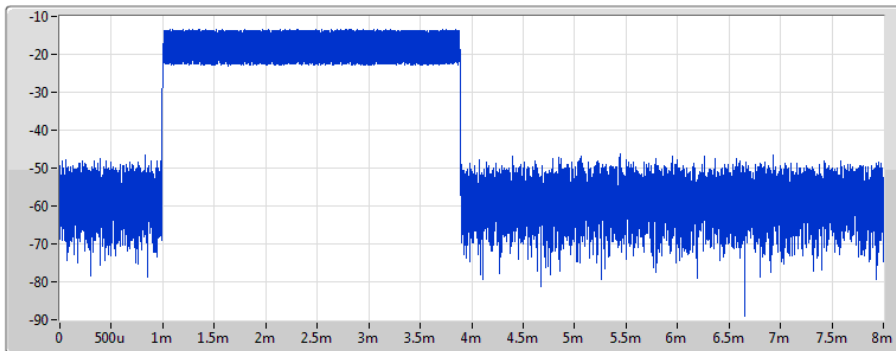
VBW
1MHz

Sweep Time
8ms

TX Time
2.89925ms

BT-BR(1Mbps)

2402MHz



Period(s)	Dwell(s)	Limit(s)	Tx On(s)
28.266	276.663877m	400m	2.89925m

Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

VBW
1MHz

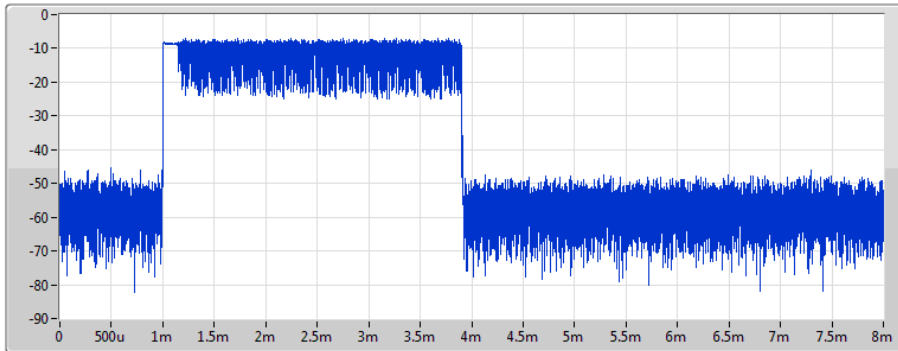
Sweep Time
8ms

TX Time
2.89925ms



BT-EDR(3Mbps)

2402MHz



Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

VBW
1MHz

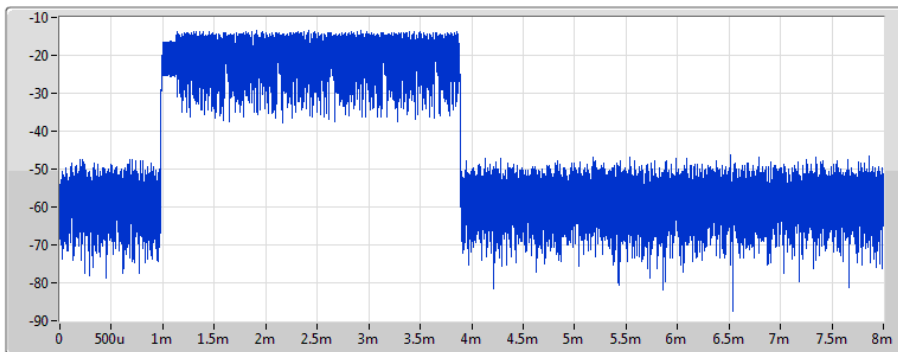
Sweep Time
8ms

TX Time
2.9085ms

Period(s)	Dwell(s)	Limit(s)	Tx On(s)
28.146	276.368276m	400m	2.9085m

BT-EDR(3Mbps)

2402MHz



Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

VBW
1MHz

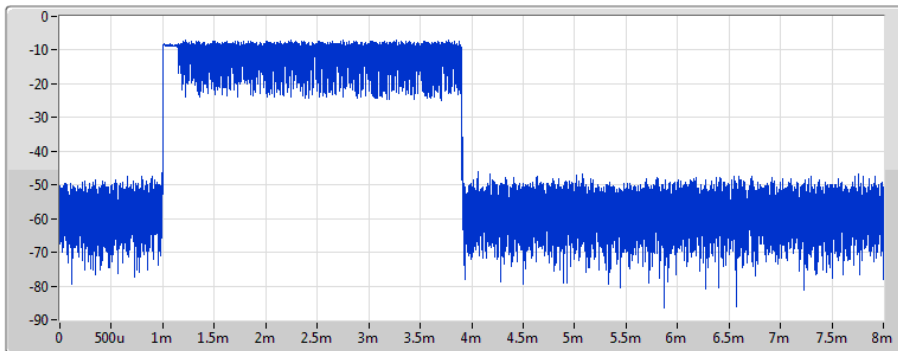
Sweep Time
8ms

TX Time
2.90825ms

Period(s)	Dwell(s)	Limit(s)	Tx On(s)
28.106	275.951791m	400m	2.90825m

BT-EDR(3Mbps)

2402MHz



Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

VBW
1MHz

Sweep Time
8ms

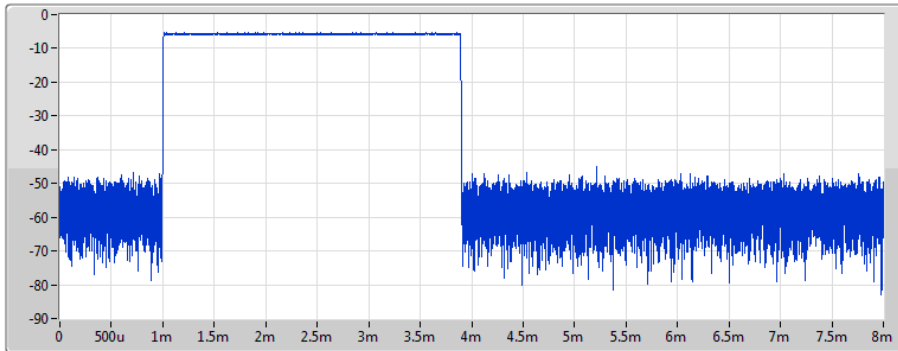
TX Time
2.9085ms

Period(s)	Dwell(s)	Limit(s)	Tx On(s)
28.146	276.368276m	400m	2.9085m



BT-BR-AFH(1Mbps)

2402MHz



Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

VBW
1MHz

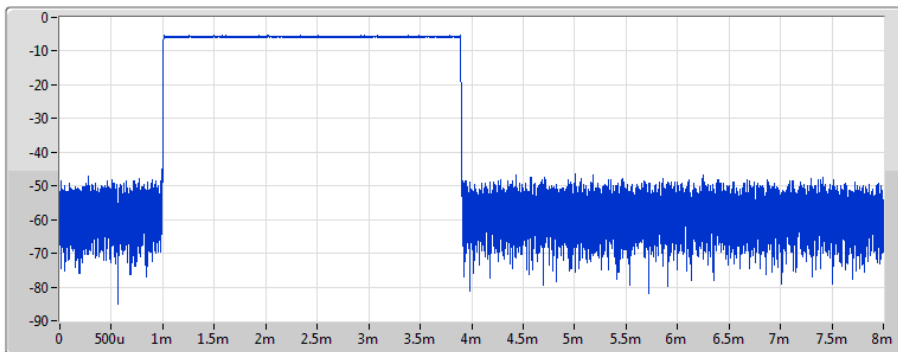
Sweep Time
8ms

TX Time
2.89975ms

Period(s)	Dwell(s)	Limit(s)	Tx On(s)
7.3864	142.798562m	400m	2.89975m

BT-BR-AFH(1Mbps)

2402MHz



Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

VBW
1MHz

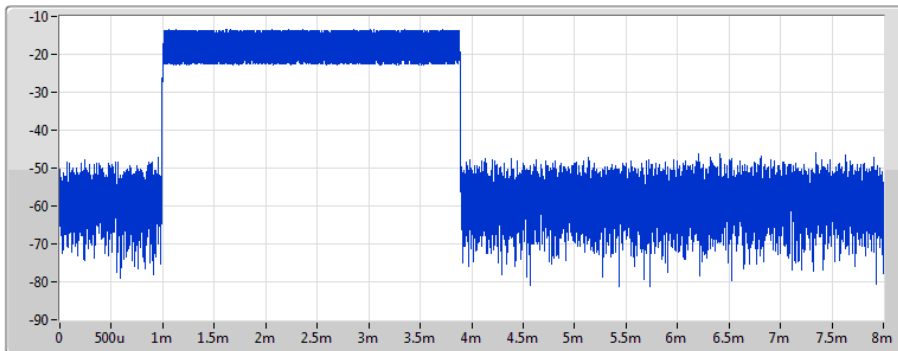
Sweep Time
8ms

TX Time
2.9ms

Period(s)	Dwell(s)	Limit(s)	Tx On(s)
7.3864	142.810874m	400m	2.9m

BT-BR-AFH(1Mbps)

2402MHz



Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

VBW
1MHz

Sweep Time
8ms

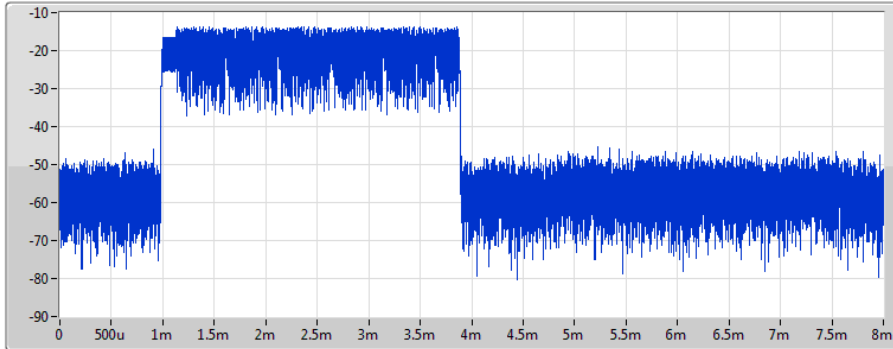
TX Time
2.90025ms

Period(s)	Dwell(s)	Limit(s)	Tx On(s)
7.3864	142.823185m	400m	2.90025m



BT-EDR-AFH(3Mbps)

2402MHz



Period(s)	Dwell(s)	Limit(s)	Tx On(s)
7.5864	147.095006m	400m	2.90825m

Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

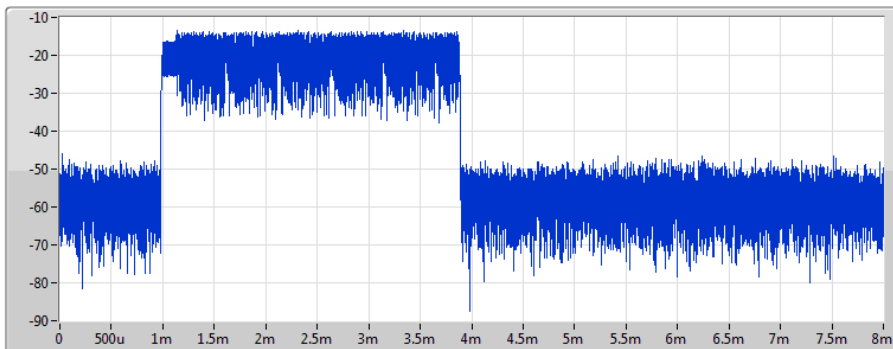
VBW
1MHz

Sweep Time
8ms

TX Time
2.90825ms

BT-EDR-AFH(3Mbps)

2402MHz



Period(s)	Dwell(s)	Limit(s)	Tx On(s)
7.5064	145.543862m	400m	2.90825m

Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

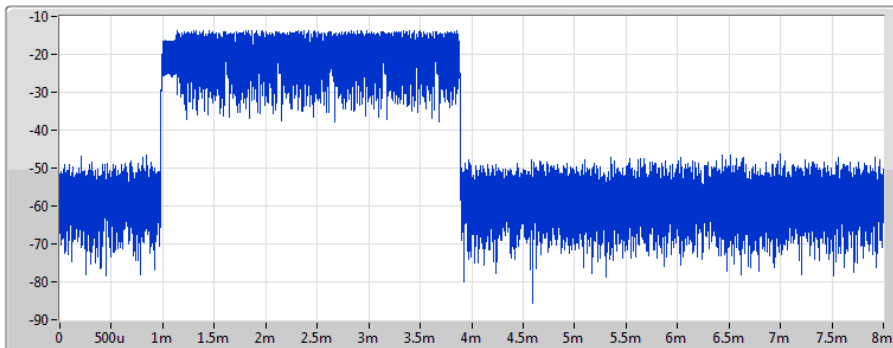
VBW
1MHz

Sweep Time
8ms

TX Time
2.90825ms

BT-EDR-AFH(3Mbps)

2402MHz



Period(s)	Dwell(s)	Limit(s)	Tx On(s)
7.3964	143.398711m	400m	2.908m

Dwell

Port 1

Ch Freq
2.402GHz

RBW
1MHz

VBW
1MHz

Sweep Time
8ms

TX Time
2.908ms

**Summary**

Mode	Result	ID Length	ID Limit
BT-BR(1Mbps)	-	-	-
2.4-2.4835GHz	Pass	00:17:23:D0:11:11	48 bits
BT-EDR(3Mbps)	-	-	-
2.4-2.4835GHz	Pass	00:17:23:D0:11:11	48 bits
BT-BR-AFH(1Mbps)	-	-	-
2.4-2.4835GHz	Pass	00:17:23:D0:11:11	48 bits
BT-EDR-AFH(3Mbps)	-	-	-
2.4-2.4835GHz	Pass	00:17:23:D0:11:11	48 bits

**Result**

Mode	Result	ID Length	ID Limit
BT-BR(1Mbps)	-	-	-
2402MHz_Vnom	Pass	00:17:23:D0:11:11	48 bits
2402MHz_Vmin	Pass	00:17:23:D0:11:11	48 bits
2402MHz_Vmax	Pass	00:17:23:D0:11:11	48 bits
BT-EDR(3Mbps)	-	-	-
2402MHz_Vnom	Pass	00:17:23:D0:11:11	48 bits
2402MHz_Vmin	Pass	00:17:23:D0:11:11	48 bits
2402MHz_Vmax	Pass	00:17:23:D0:11:11	48 bits
BT-BR-AFH(1Mbps)	-	-	-
2402MHz_Vnom	Pass	00:17:23:D0:11:11	48 bits
2402MHz_Vmin	Pass	00:17:23:D0:11:11	48 bits
2402MHz_Vmax	Pass	00:17:23:D0:11:11	48 bits
BT-EDR-AFH(3Mbps)	-	-	-
2402MHz_Vnom	Pass	00:17:23:D0:11:11	48 bits
2402MHz_Vmin	Pass	00:17:23:D0:11:11	48 bits
2402MHz_Vmax	Pass	00:17:23:D0:11:11	48 bits

**Summary**

Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Detector	Freq (MHz)	Psum (dBm)	Psum (nW)	Limit (dBm)
BT-BR(1Mbps)	-	-	-	-	-	-	-	-	-
2.4-2.4835GHz	Pass	30M	1G	100k	RMS	868.565	-76.00	0.0251	-53.98

**Result**

Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Detector	Freq (MHz)	Psum (dBm)	Psum (nW)	Limit (dBm)
BT-BR(1Mbps)	-	-	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	30M	1G	100k	RMS	951.015	-88.83	0.00131	-53.98
2402MHz_Vnom	Pass	1G	12.5G	1M	RMS	10510.5	-72.32	0.05862	-46.99
2402MHz_Vmin	Pass	30M	1G	100k	RMS	868.08	-76.06	0.02477	-53.98
2402MHz_Vmin	Pass	1G	12.5G	1M	RMS	12484.187	-72.37	0.058	-46.99
2402MHz_Vmax	Pass	30M	1G	100k	RMS	896.21	-88.00	0.00158	-53.98
2402MHz_Vmax	Pass	1G	12.5G	1M	RMS	12489.937	-71.84	0.06544	-46.99
2441MHz_Vnom	Pass	30M	1G	100k	RMS	896.21	-90.22	0.00095	-53.98
2441MHz_Vnom	Pass	1G	12.5G	1M	RMS	10530.625	-71.96	0.06373	-46.99
2441MHz_Vmin	Pass	30M	1G	100k	RMS	868.08	-76.94	0.02021	-53.98
2441MHz_Vmin	Pass	1G	12.5G	1M	RMS	10506.187	-72.22	0.06005	-46.99
2441MHz_Vmax	Pass	30M	1G	100k	RMS	951.015	-90.40	0.00091	-53.98
2441MHz_Vmax	Pass	1G	12.5G	1M	RMS	12465.5	-72.30	0.05892	-46.99
2480MHz_Vnom	Pass	30M	1G	100k	RMS	896.21	-87.58	0.00175	-53.98
2480MHz_Vnom	Pass	1G	12.5G	1M	RMS	10471.687	-72.26	0.05939	-46.99
2480MHz_Vmin	Pass	30M	1G	100k	RMS	868.565	-76.00	0.0251	-53.98
2480MHz_Vmin	Pass	1G	12.5G	1M	RMS	10527.75	-72.36	0.05812	-46.99
2480MHz_Vmax	Pass	30M	1G	100k	RMS	867.595	-77.96	0.01599	-53.98
2480MHz_Vmax	Pass	1G	12.5G	1M	RMS	12494.25	-72.34	0.05831	-46.99
BT-EDR(3Mbps)	-	-	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	30M	1G	100k	RMS	951.015	-91.49	0.00071	-53.98
2402MHz_Vnom	Pass	1G	12.5G	1M	RMS	12491.375	-71.96	0.06374	-46.99
2402MHz_Vmin	Pass	30M	1G	100k	RMS	951.015	-90.36	0.00092	-53.98
2402MHz_Vmin	Pass	1G	12.5G	1M	RMS	10529.187	-72.06	0.06229	-46.99
2402MHz_Vmax	Pass	30M	1G	100k	RMS	868.08	-78.42	0.01437	-53.98
2402MHz_Vmax	Pass	1G	12.5G	1M	RMS	12479.875	-72.18	0.06051	-46.99
2441MHz_Vnom	Pass	30M	1G	100k	RMS	951.015	-90.87	0.00082	-53.98
2441MHz_Vnom	Pass	1G	12.5G	1M	RMS	10504.75	-72.12	0.06133	-46.99
2441MHz_Vmin	Pass	30M	1G	100k	RMS	896.21	-91.24	0.00075	-53.98
2441MHz_Vmin	Pass	1G	12.5G	1M	RMS	10542.125	-72.53	0.05588	-46.99
2441MHz_Vmax	Pass	30M	1G	100k	RMS	867.595	-80.16	0.00964	-53.98
2441MHz_Vmax	Pass	1G	12.5G	1M	RMS	12489.937	-72.34	0.0583	-46.99
2480MHz_Vnom	Pass	30M	1G	100k	RMS	926.765	-91.49	0.00071	-53.98
2480MHz_Vnom	Pass	1G	12.5G	1M	RMS	12500	-72.08	0.06188	-46.99
2480MHz_Vmin	Pass	30M	1G	100k	RMS	951.015	-90.99	0.0008	-53.98
2480MHz_Vmin	Pass	1G	12.5G	1M	RMS	12494.25	-72.15	0.06095	-46.99
2480MHz_Vmax	Pass	30M	1G	100k	RMS	969.93	-91.25	0.00075	-53.98
2480MHz_Vmax	Pass	1G	12.5G	1M	RMS	12485.625	-72.30	0.05893	-46.99
BT-BR-AFH(1Mbps)	-	-	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	30M	1G	100k	RMS	867.595	-79.07	0.01239	-53.98
2402MHz_Vnom	Pass	1G	12.5G	1M	RMS	12485.625	-72.27	0.05925	-46.99
2402MHz_Vmin	Pass	30M	1G	100k	RMS	883.6	-91.52	0.00071	-53.98
2402MHz_Vmin	Pass	1G	12.5G	1M	RMS	12458.312	-72.40	0.05756	-46.99
2402MHz_Vmax	Pass	30M	1G	100k	RMS	957.805	-90.46	0.0009	-53.98
2402MHz_Vmax	Pass	1G	12.5G	1M	RMS	12488.5	-72.39	0.0577	-46.99
2441MHz_Vnom	Pass	30M	1G	100k	RMS	868.565	-80.55	0.00882	-53.98
2441MHz_Vnom	Pass	1G	12.5G	1M	RMS	10519.125	-72.28	0.05909	-46.99
2441MHz_Vmin	Pass	30M	1G	100k	RMS	920.945	-91.27	0.00075	-53.98
2441MHz_Vmin	Pass	1G	12.5G	1M	RMS	10524.875	-72.56	0.05542	-46.99
2441MHz_Vmax	Pass	30M	1G	100k	RMS	951.015	-90.99	0.0008	-53.98
2441MHz_Vmax	Pass	1G	12.5G	1M	RMS	10504.75	-72.31	0.05881	-46.99
2480MHz_Vnom	Pass	30M	1G	100k	RMS	868.565	-77.71	0.01695	-53.98
2480MHz_Vnom	Pass	1G	12.5G	1M	RMS	12500	-72.26	0.05943	-46.99



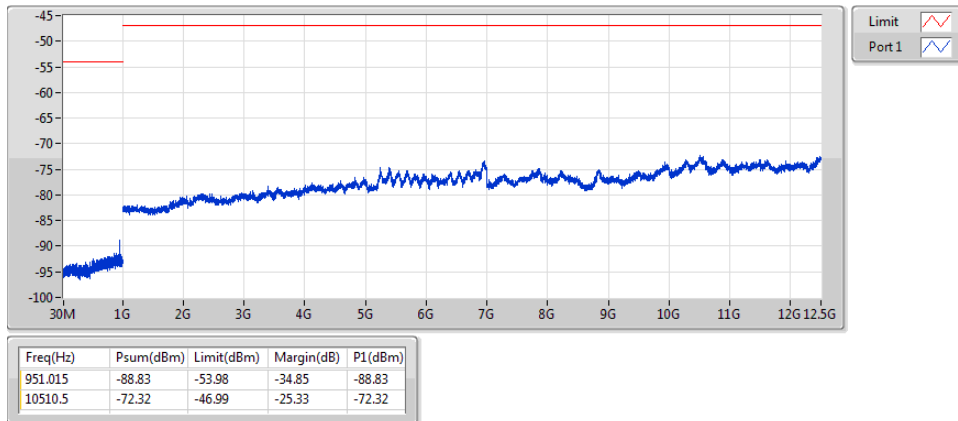
CSE-RX Secondary Radiated Emissions-FHSS Result

Appendix H

Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Detector	Freq (MHz)	Psum (dBm)	Psum (nW)	Limit (dBm)
2480MHz_Vmin	Pass	30M	1G	100k	RMS	868.08	-83.08	0.00492	-53.98
2480MHz_Vmin	Pass	1G	12.5G	1M	RMS	12489.937	-72.36	0.05803	-46.99
2480MHz_Vmax	Pass	30M	1G	100k	RMS	985.45	-91.07	0.00078	-53.98
2480MHz_Vmax	Pass	1G	12.5G	1M	RMS	12475.562	-72.26	0.05939	-46.99
BT-EDR-AFH(3Mbps)	-	-	-	-	-	-	-	-	-
2402MHz_Vnom	Pass	30M	1G	100k	RMS	992.725	-91.43	0.00072	-53.98
2402MHz_Vnom	Pass	1G	12.5G	1M	RMS	12495.687	-72.18	0.0605	-46.99
2402MHz_Vmin	Pass	30M	1G	100k	RMS	868.08	-80.43	0.00906	-53.98
2402MHz_Vmin	Pass	1G	12.5G	1M	RMS	12484.187	-72.12	0.06144	-46.99
2402MHz_Vmax	Pass	30M	1G	100k	RMS	977.69	-91.36	0.00073	-53.98
2402MHz_Vmax	Pass	1G	12.5G	1M	RMS	12500	-72.32	0.05859	-46.99
2441MHz_Vnom	Pass	30M	1G	100k	RMS	854.985	-91.04	0.00079	-53.98
2441MHz_Vnom	Pass	1G	12.5G	1M	RMS	12461.187	-72.47	0.05664	-46.99
2441MHz_Vmin	Pass	30M	1G	100k	RMS	867.11	-80.14	0.00969	-53.98
2441MHz_Vmin	Pass	1G	12.5G	1M	RMS	12492.812	-72.41	0.05739	-46.99
2441MHz_Vmax	Pass	30M	1G	100k	RMS	900.575	-91.04	0.00079	-53.98
2441MHz_Vmax	Pass	1G	12.5G	1M	RMS	12482.75	-72.42	0.05723	-46.99
2480MHz_Vnom	Pass	30M	1G	100k	RMS	962.655	-91.26	0.00075	-53.98
2480MHz_Vnom	Pass	1G	12.5G	1M	RMS	12474.125	-72.11	0.06145	-46.99
2480MHz_Vmin	Pass	30M	1G	100k	RMS	867.595	-80.37	0.00918	-53.98
2480MHz_Vmin	Pass	1G	12.5G	1M	RMS	12481.312	-72.19	0.06046	-46.99
2480MHz_Vmax	Pass	30M	1G	100k	RMS	988.845	-91.42	0.00072	-53.98
2480MHz_Vmax	Pass	1G	12.5G	1M	RMS	10519.125	-72.14	0.06103	-46.99

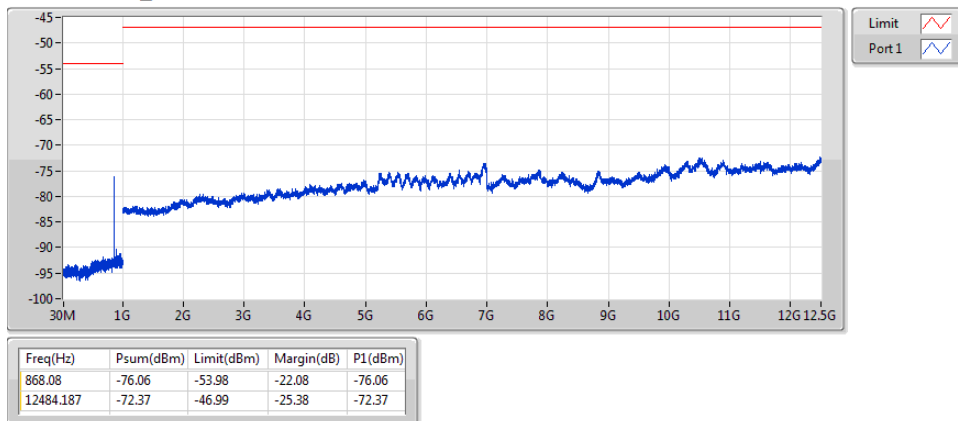
BT-BR(1Mbps)
2402MHz_Vnom

CSE-RX-FS



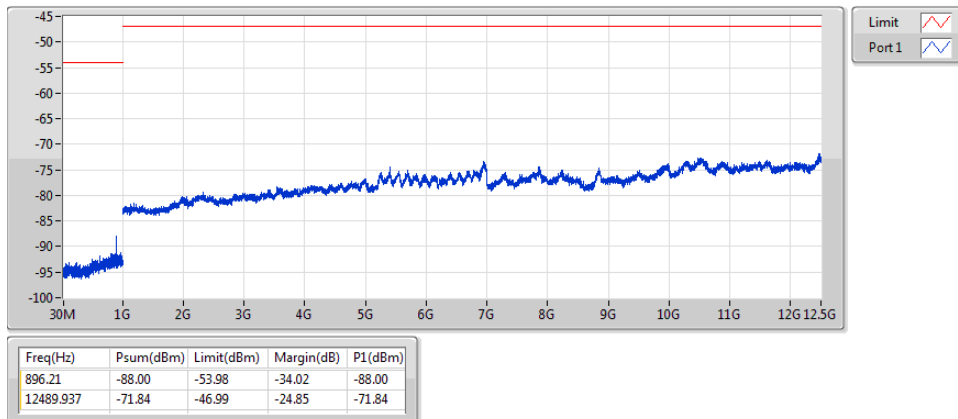
BT-BR(1Mbps)
2402MHz_Vmin

CSE-RX-FS



BT-BR(1Mbps)
2402MHz_Vmax

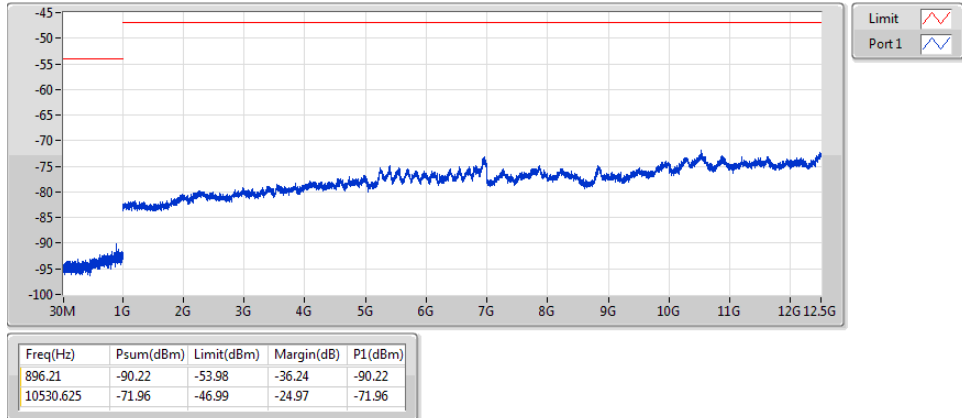
CSE-RX-FS



BT-BR(1Mbps)

CSE-RX-FS

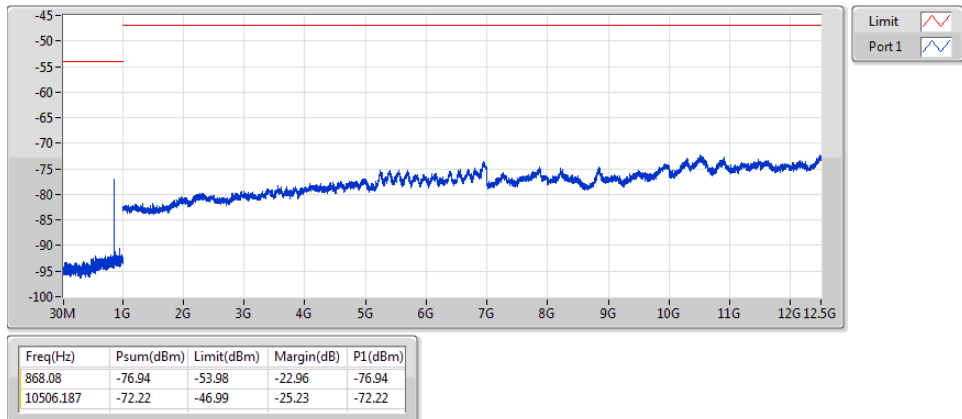
2441MHz_Vnom



BT-BR(1Mbps)

CSE-RX-FS

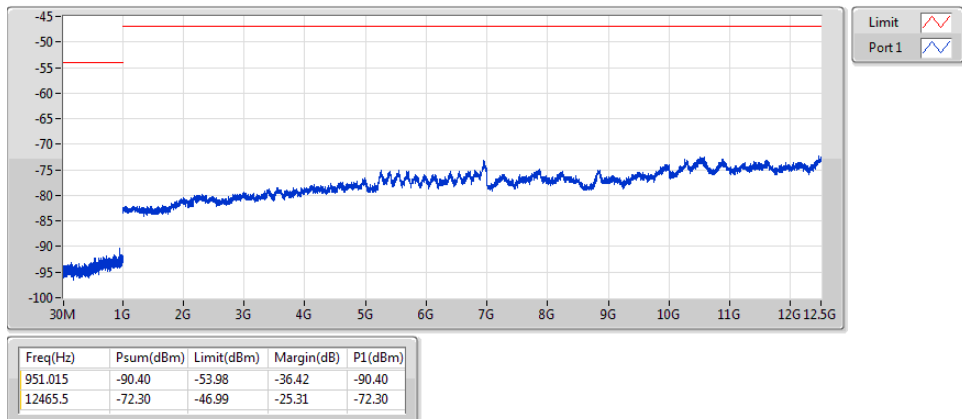
2441MHz_Vmin



BT-BR(1Mbps)

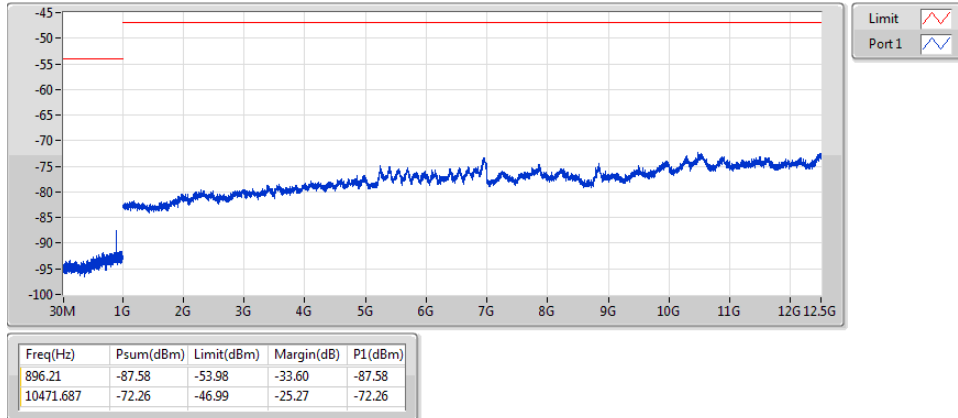
CSE-RX-FS

2441MHz_Vmax



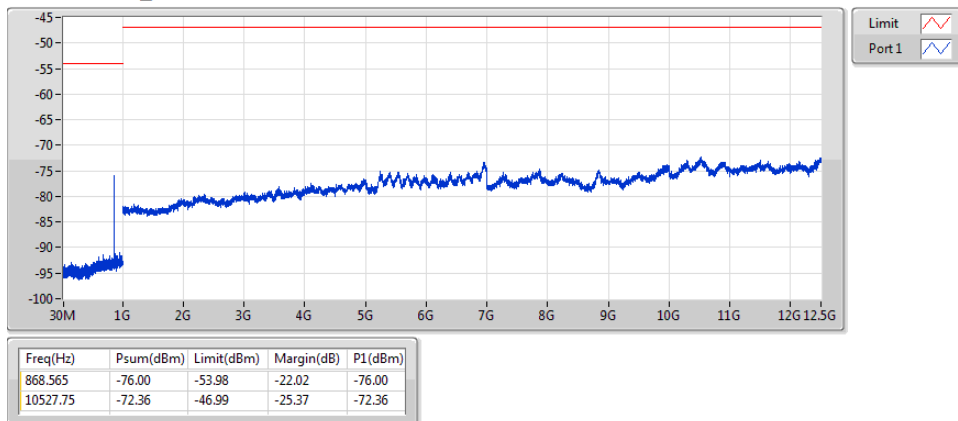
BT-BR(1Mbps)
2480MHz_Vnom

CSE-RX-FS



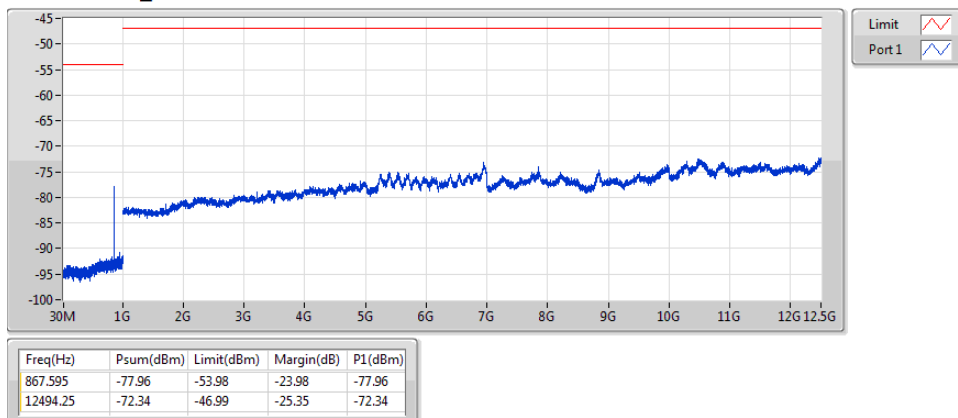
BT-BR(1Mbps)
2480MHz_Vmin

CSE-RX-FS



BT-BR(1Mbps)
2480MHz_Vmax

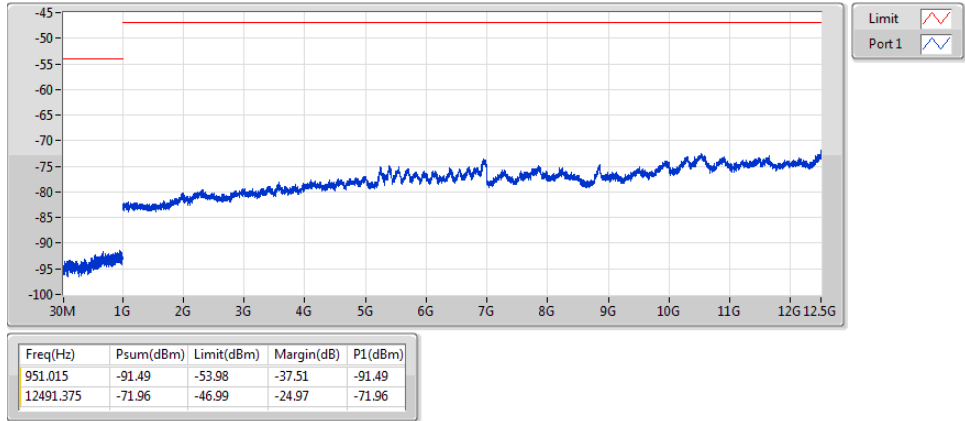
CSE-RX-FS



BT-EDR(3Mbps)

CSE-RX-FS

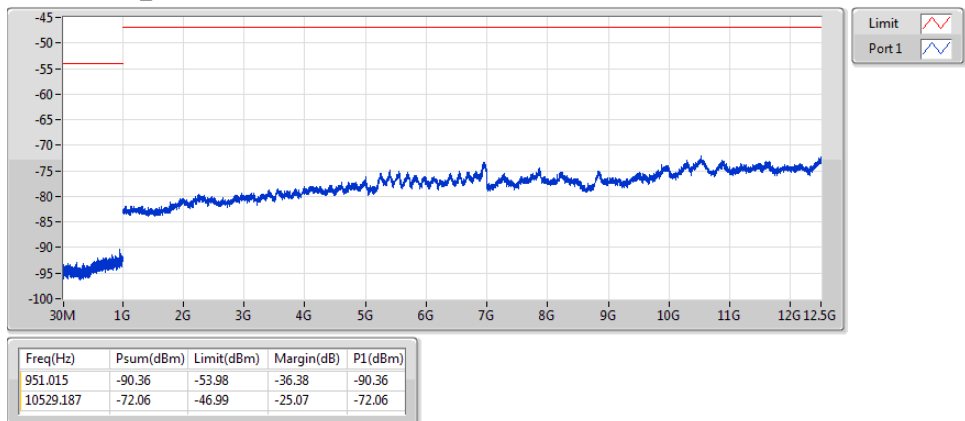
2402MHz_Vnom



BT-EDR(3Mbps)

CSE-RX-FS

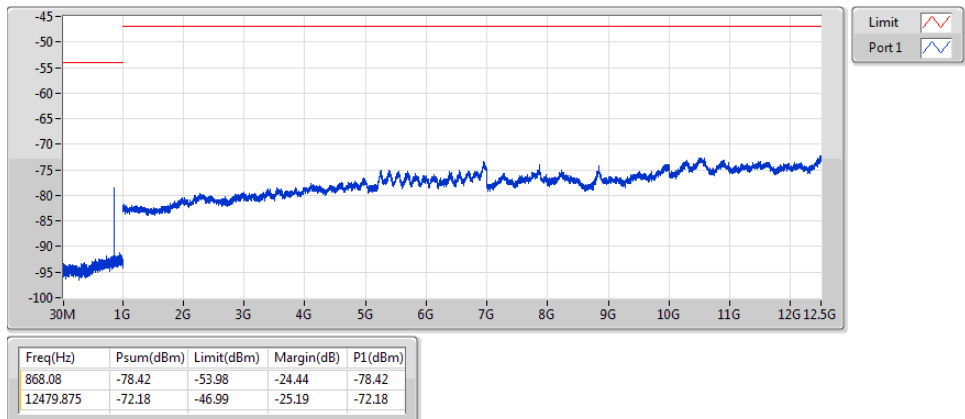
2402MHz_Vmin



BT-EDR(3Mbps)

CSE-RX-FS

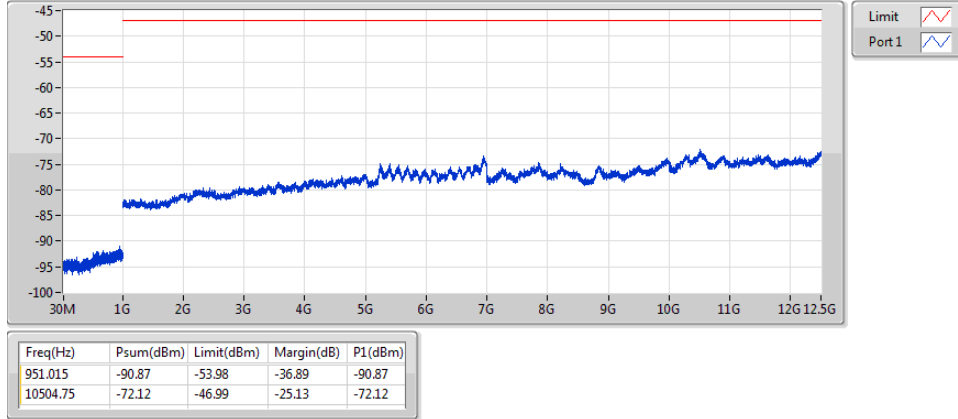
2402MHz_Vmax



BT-EDR(3Mbps)

CSE-RX-FS

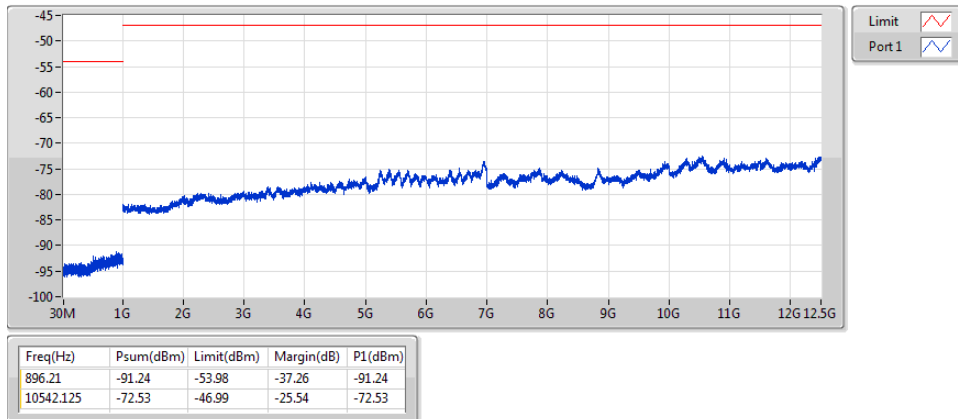
2441MHz_Vnom



BT-EDR(3Mbps)

CSE-RX-FS

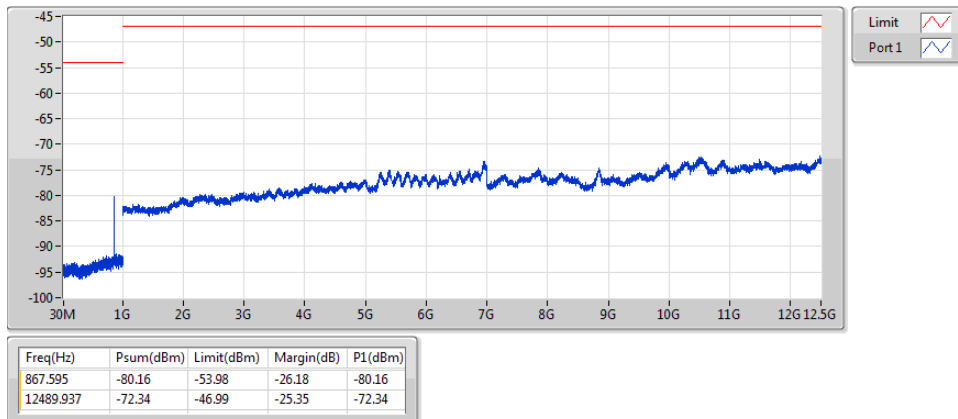
2441MHz_Vmin



BT-EDR(3Mbps)

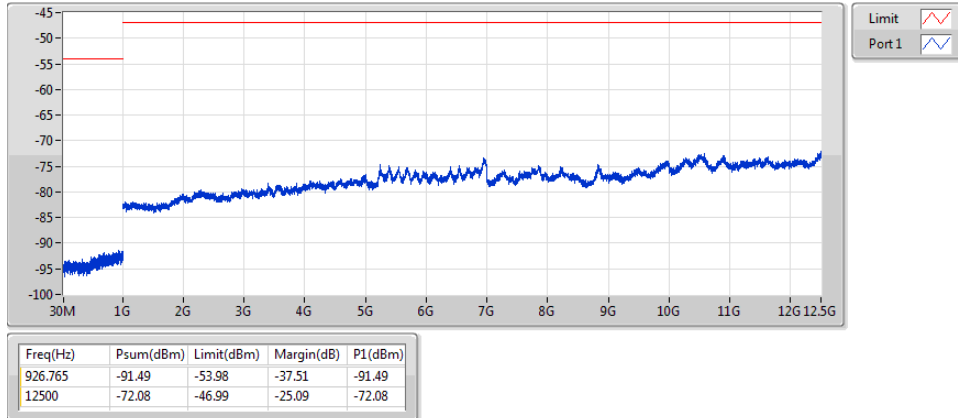
CSE-RX-FS

2441MHz_Vmax



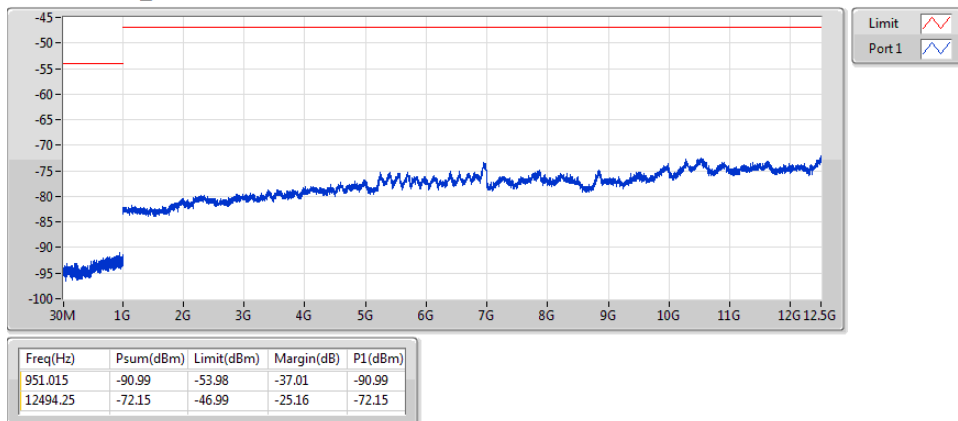
BT-EDR(3Mbps)
2480MHz_Vnom

CSE-RX-FS



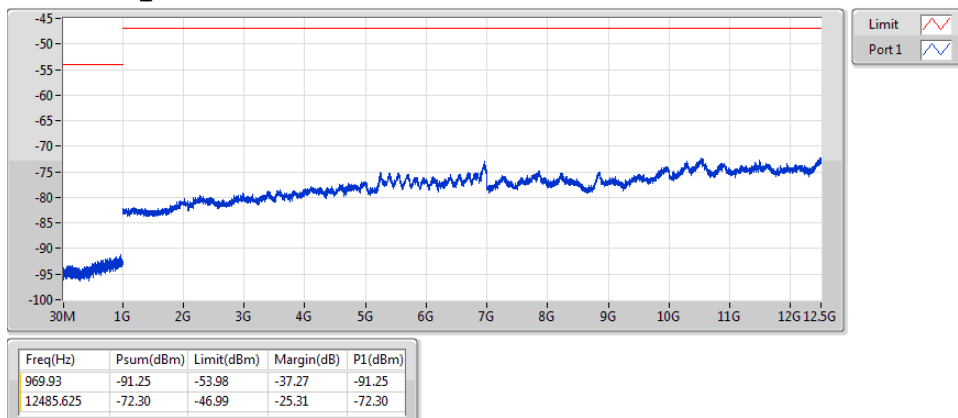
BT-EDR(3Mbps)
2480MHz_Vmin

CSE-RX-FS



BT-EDR(3Mbps)
2480MHz_Vmax

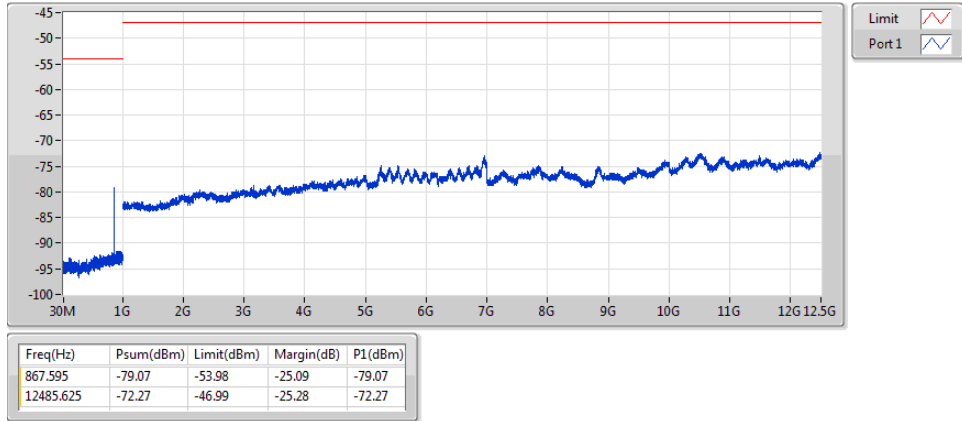
CSE-RX-FS



BT-BR-AFH(1Mbps)

CSE-RX-FS

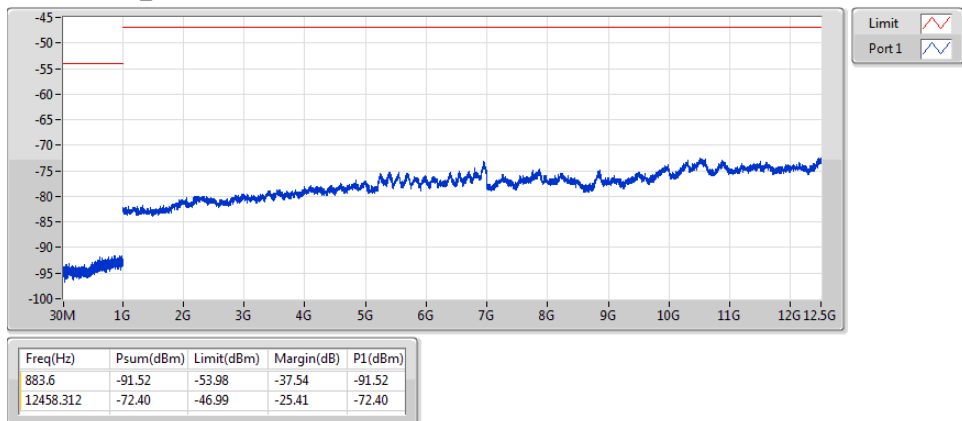
2402MHz_Vnom



BT-BR-AFH(1Mbps)

CSE-RX-FS

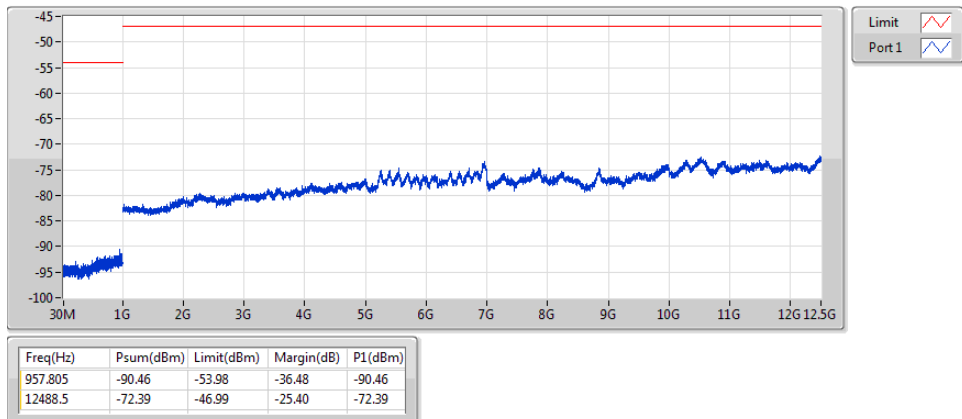
2402MHz_Vmin



BT-BR-AFH(1Mbps)

CSE-RX-FS

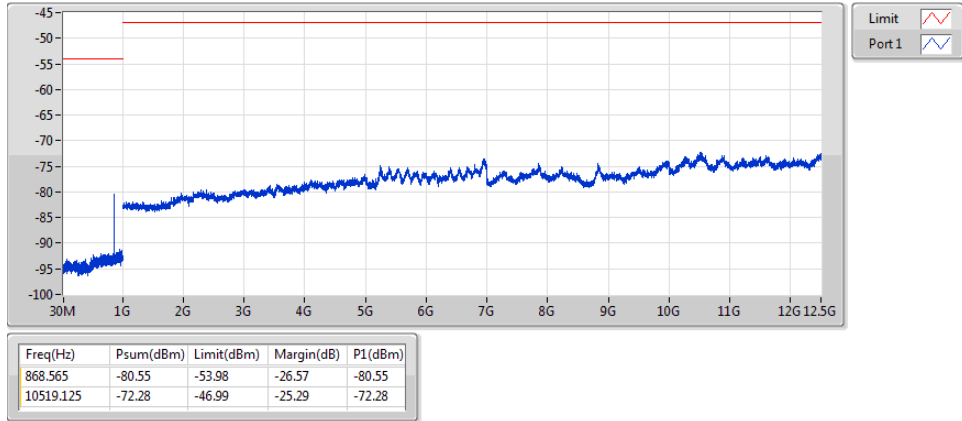
2402MHz_Vmax



BT-BR-AFH(1Mbps)

CSE-RX-FS

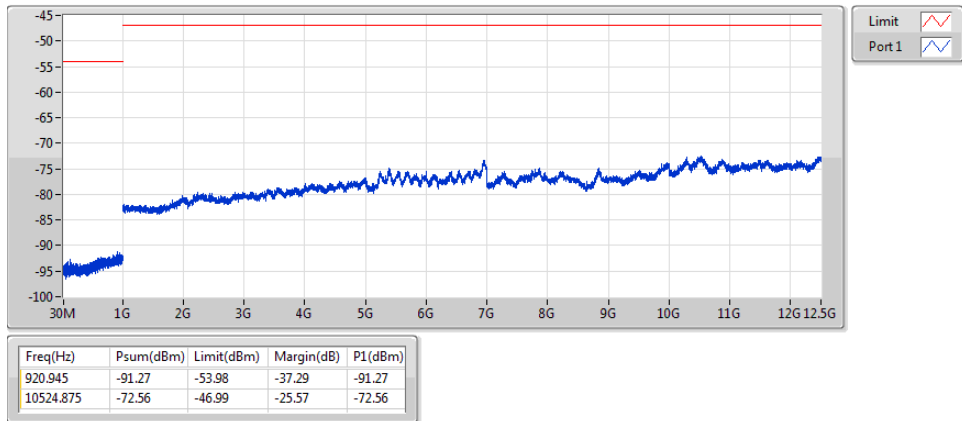
2441MHz_Vnom



BT-BR-AFH(1Mbps)

CSE-RX-FS

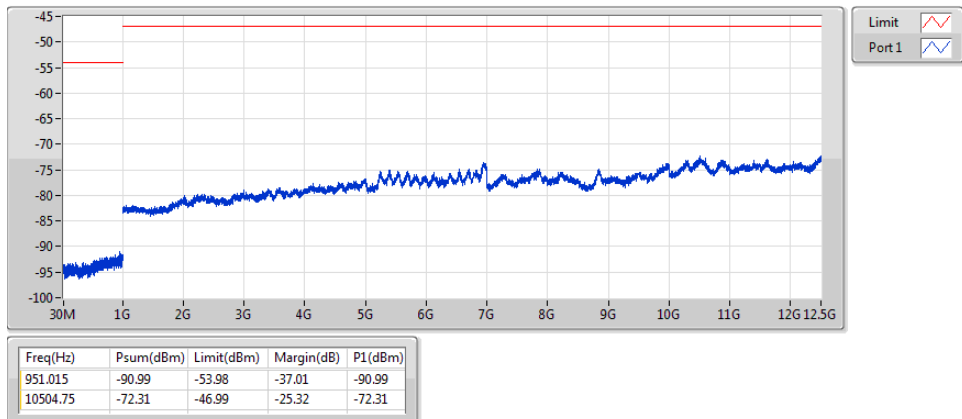
2441MHz_Vmin



BT-BR-AFH(1Mbps)

CSE-RX-FS

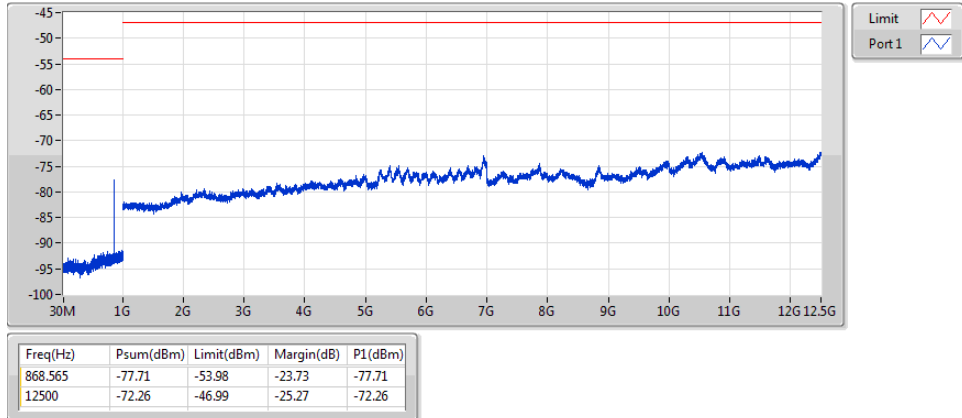
2441MHz_Vmax



BT-BR-AFH(1Mbps)

CSE-RX-FS

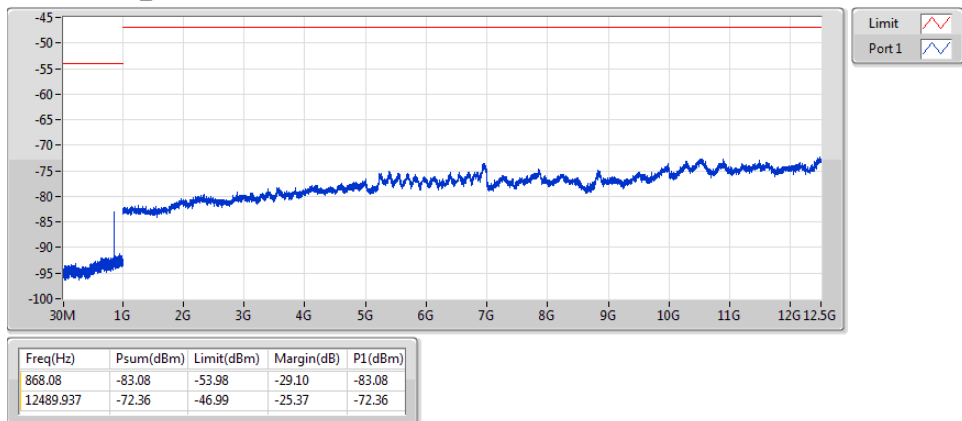
2480MHz_Vnom



BT-BR-AFH(1Mbps)

CSE-RX-FS

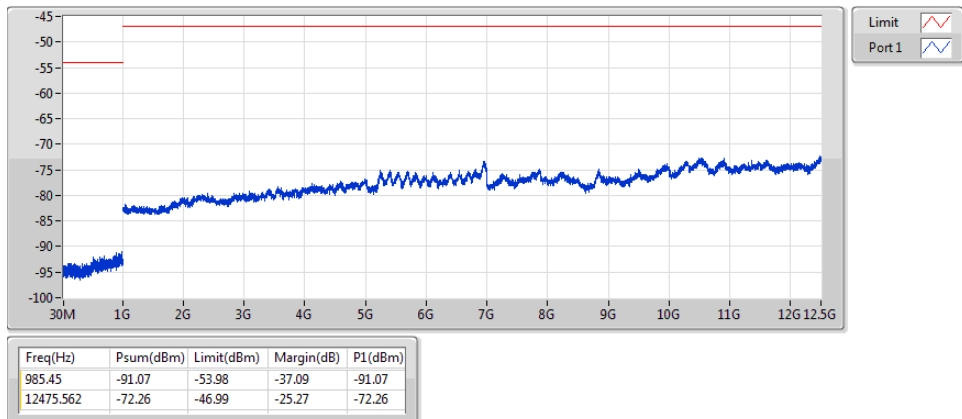
2480MHz_Vmin



BT-BR-AFH(1Mbps)

CSE-RX-FS

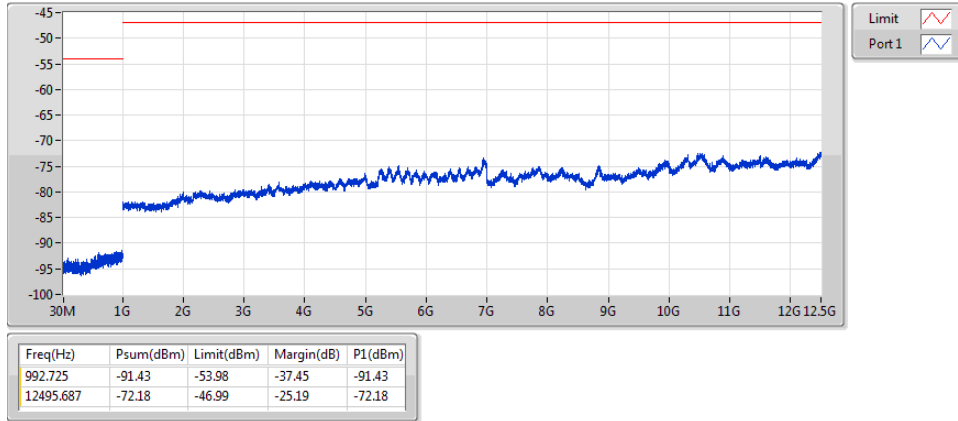
2480MHz_Vmax



BT-EDR-AFH(3Mbps)

CSE-RX-FS

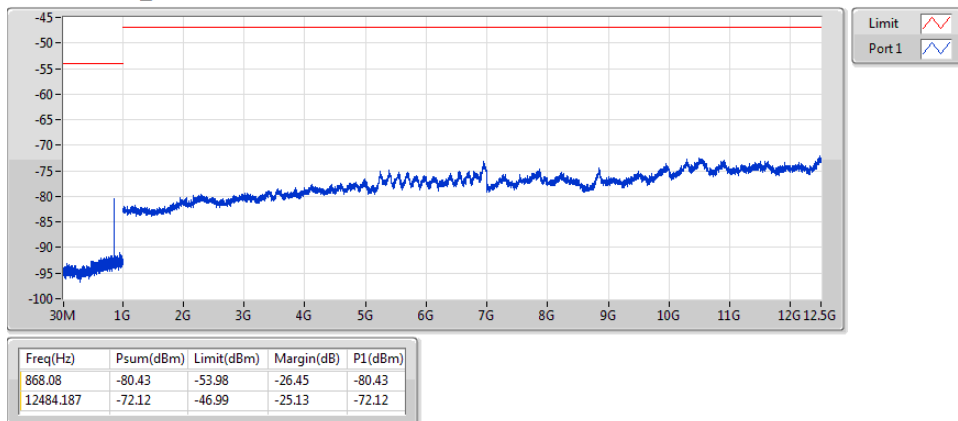
2402MHz_Vnom



BT-EDR-AFH(3Mbps)

CSE-RX-FS

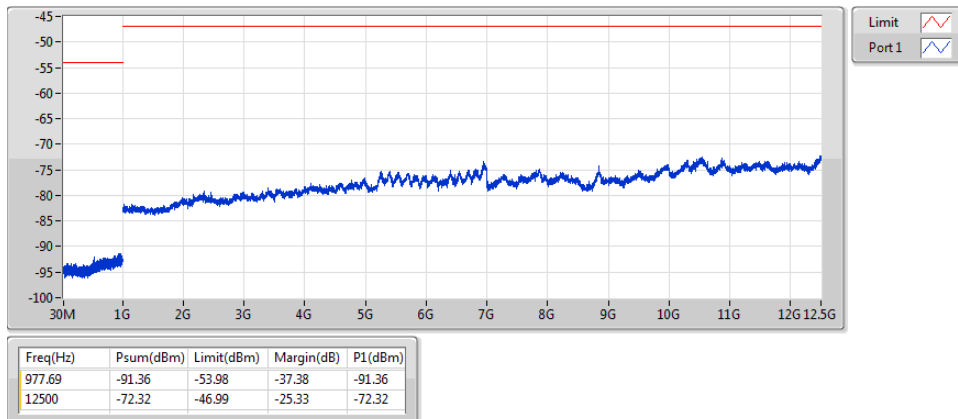
2402MHz_Vmin



BT-EDR-AFH(3Mbps)

CSE-RX-FS

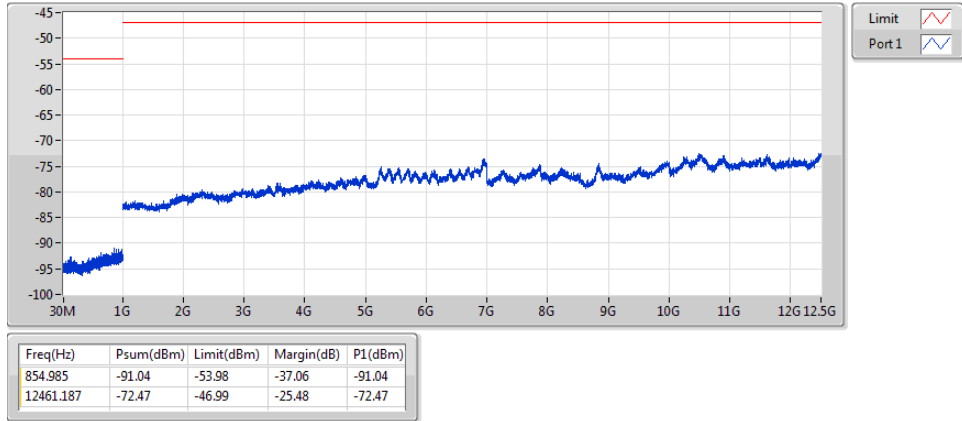
2402MHz_Vmax



BT-EDR-AFH(3Mbps)

CSE-RX-FS

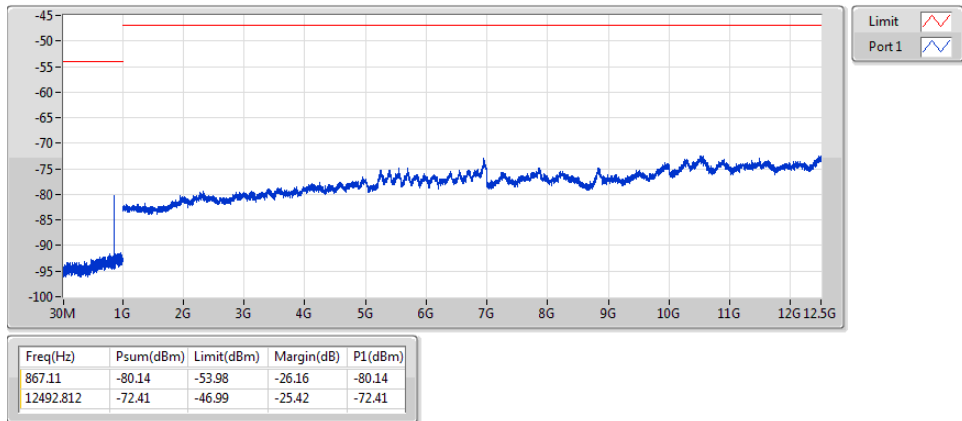
2441MHz_Vnom



BT-EDR-AFH(3Mbps)

CSE-RX-FS

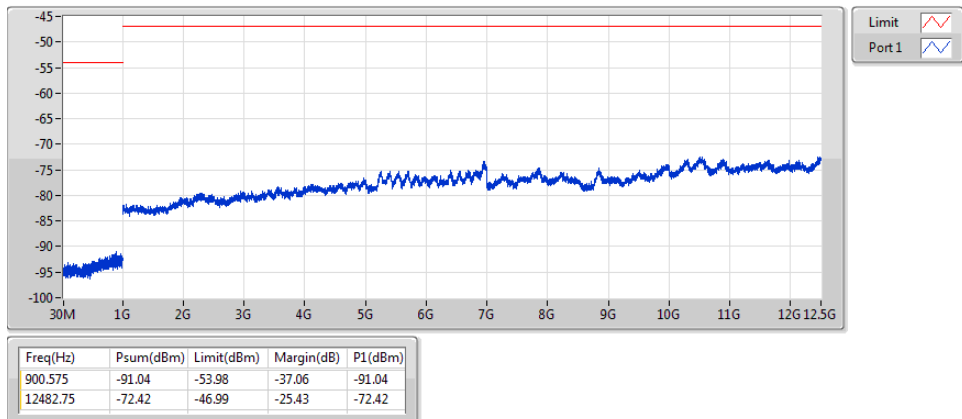
2441MHz_Vmin



BT-EDR-AFH(3Mbps)

CSE-RX-FS

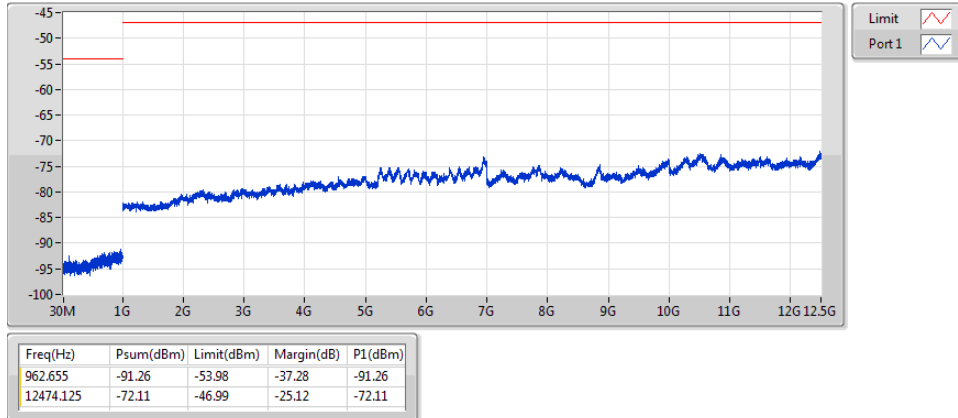
2441MHz_Vmax



BT-EDR-AFH(3Mbps)

CSE-RX-FS

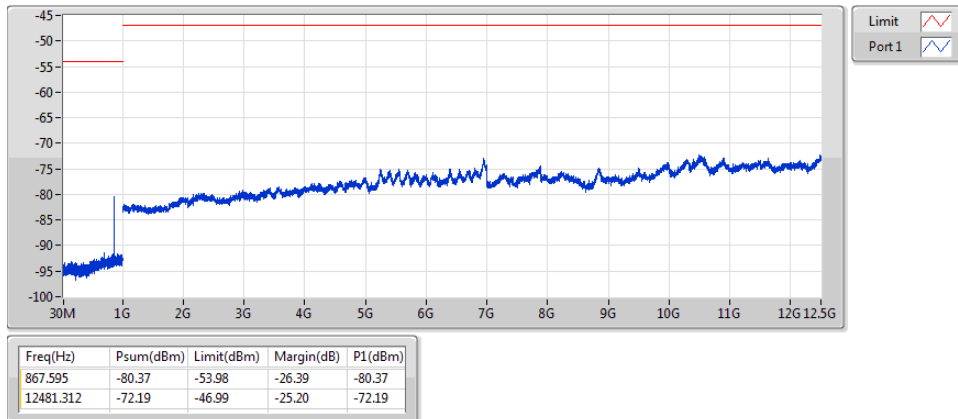
2480MHz_Vnom



BT-EDR-AFH(3Mbps)

CSE-RX-FS

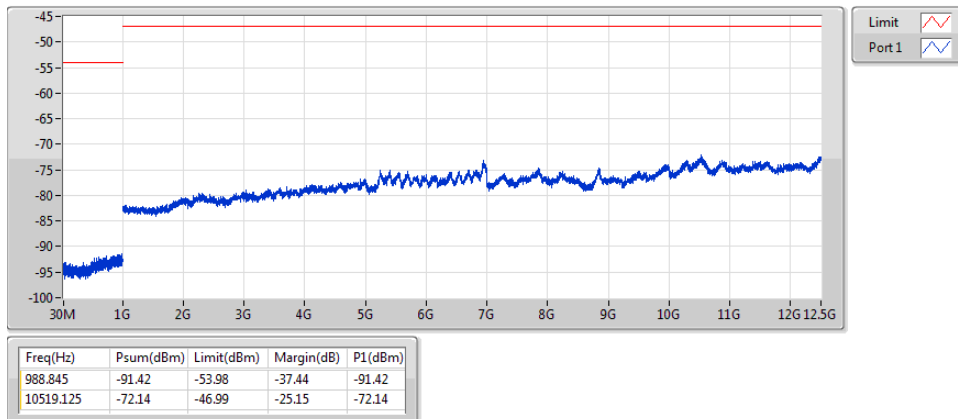
2480MHz_Vmin



BT-EDR-AFH(3Mbps)

CSE-RX-FS

2480MHz_Vmax



Appendix I. Antenna Information

AT3216 Series

Multilayer Chip Antenna

Features

- ❖ Monolithic SMD with small, low-profile and light-weight type.
- ❖ Wide bandwidth

Applications

- ❖ Bluetooth/Wireless LAN/Home RF
- ❖ ISM band 2.4GHz applications



Specifications

Part Number	Frequency Range (MHz)	Peak Gain (XZ-V)	Average Gain (XZ-V)	VSWR	Impedance
AT3216 -B2R7HAA	2400 ~ 2500	0.5 dBi typ.	-0.5 dBi typ.	2 max.	50 Ω

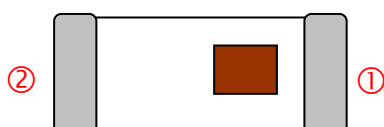
Q'ty/Reel (pcs) : 3,000pcs
 Operating Temperature Range : -40 ~ +85 °C
 Storage Temperature Range : +5 ~ +35 °C, Humidity 45~75%RH
 Storage Period : 12 months max.
 Power Capacity : 2W max.

Part Number

AT 3216 - B 2R7 HAA □ □
 ① ② ③ ④ ⑤ ⑥ ⑦

① Type	AT : Antenna	② Dimensions (L × W)	3.2× 1.6 mm
③ Material Code	B	④ Frequency Range	2R7=2700MHz
⑤ Specification Code	HAA	⑥ Packaging	T: Tape & Reel B: Bulk
⑦ Soldering	=lead-containing /LF=lead-free		

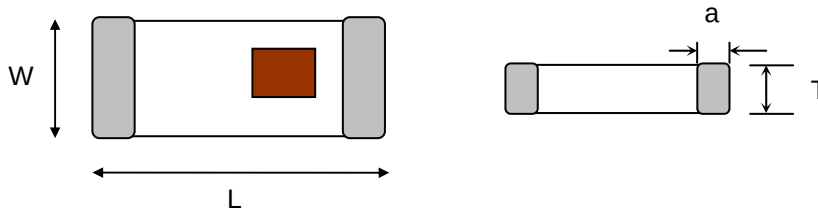
Terminal Configuration



No.	Terminal Name	No.	Terminal Name
①	Feeding Point	②	NC

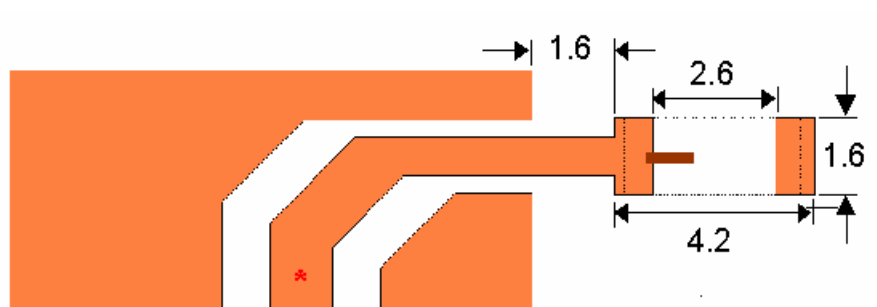
Dimensions and Recommended PC Board Pattern

Unit : mm

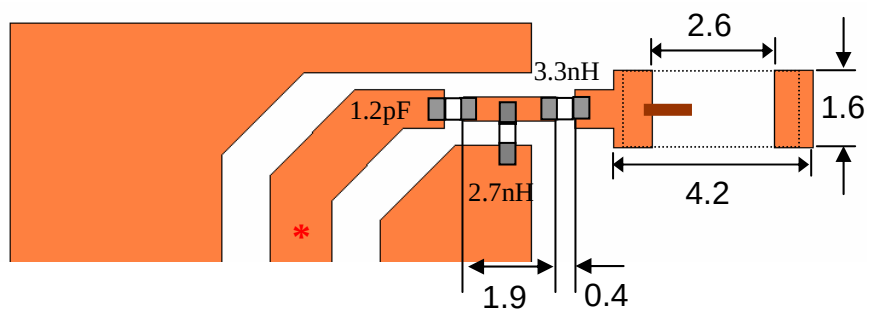


Mark	L	W	T	a
Dimensions	3.2 ± 0.2	1.6 ± 0.2	$1.3 + 0.1 / - 0.2$	0.5 ± 0.3

(a) Without Matching Circuits



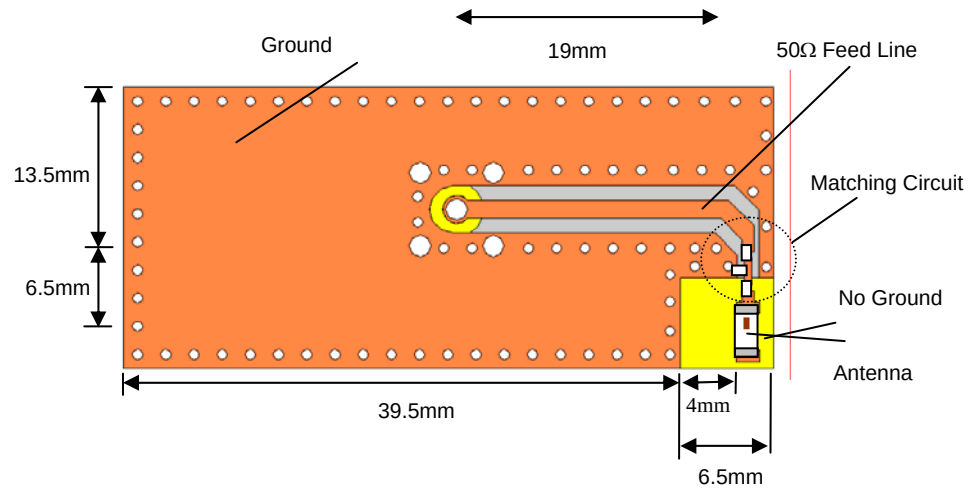
(b) With Matching Circuits



*Line width should be designed to match 50Ω characteristic impedance, depending on PCB material and thickness.

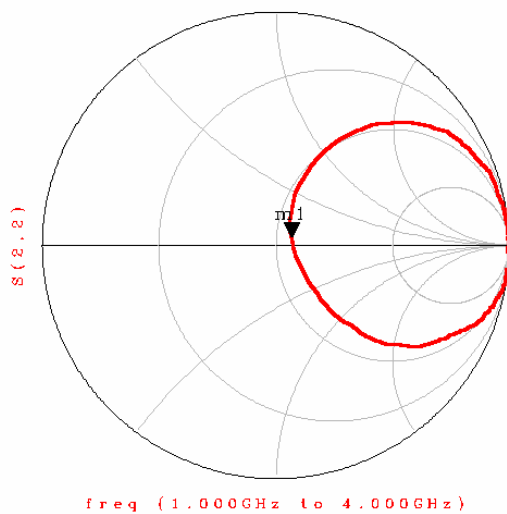
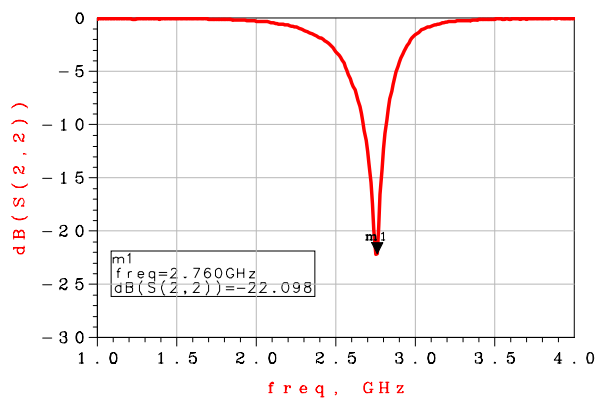
Typical Electrical Characteristics (T=25°C)

❖ Test Board

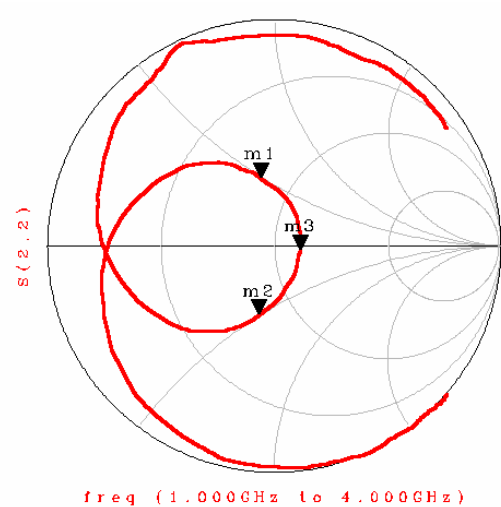
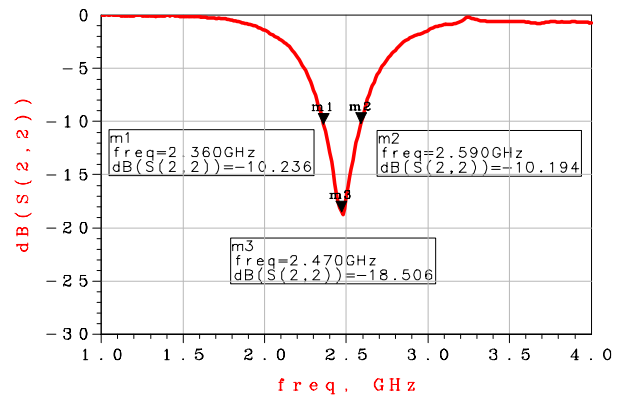


❖ Return Loss

(a) Without Matching Circuits

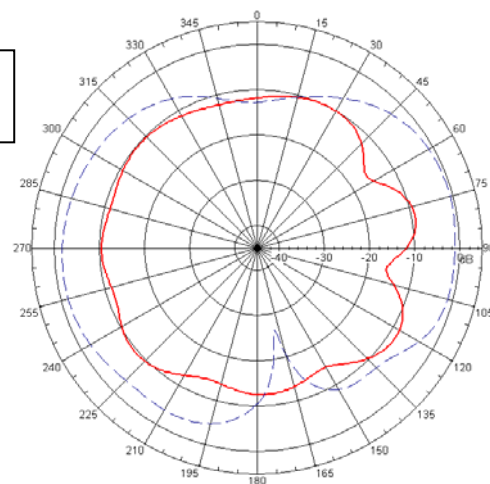
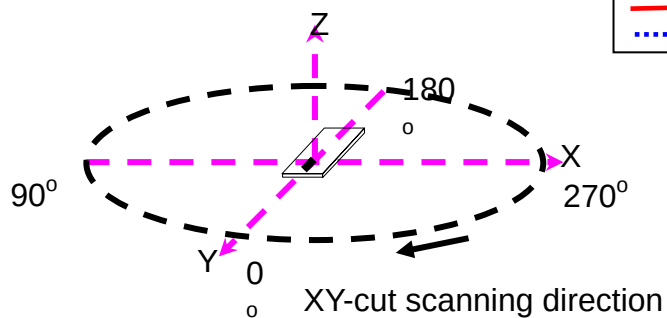


(b) With Matching Circuits

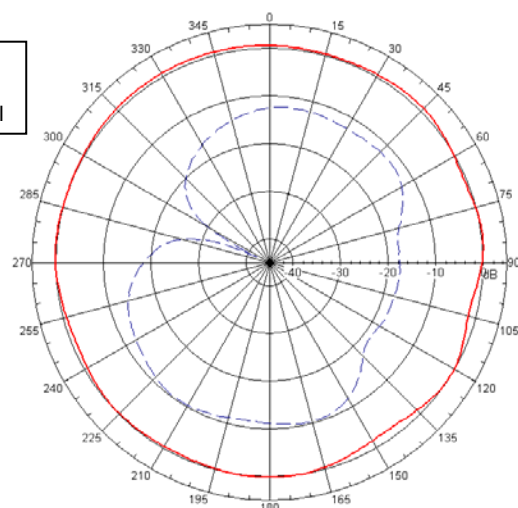
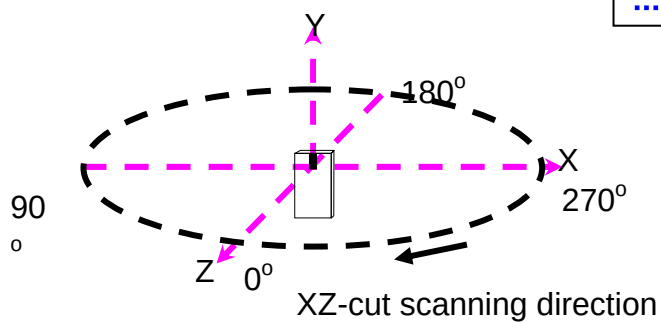


Radiation Patterns

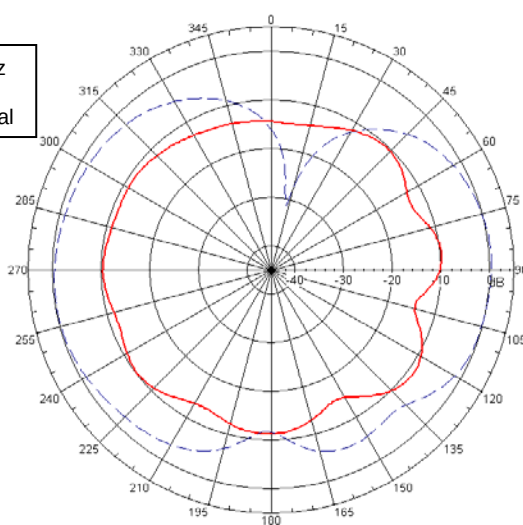
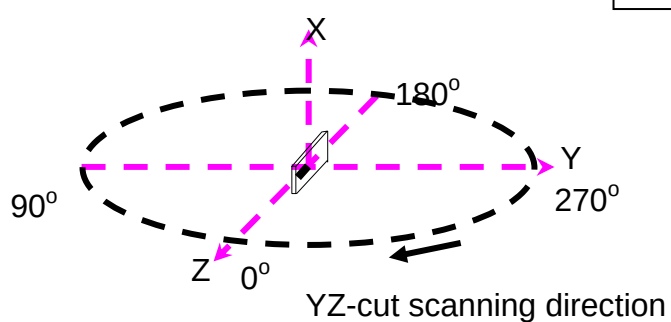
XY-V/XY-H



XZ-V/XZ-H



YZ-V/YZ-H



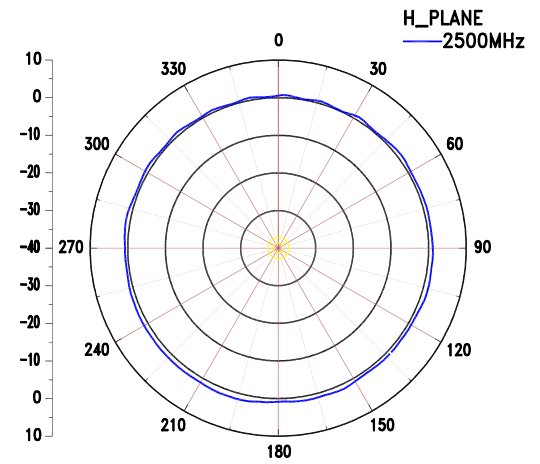
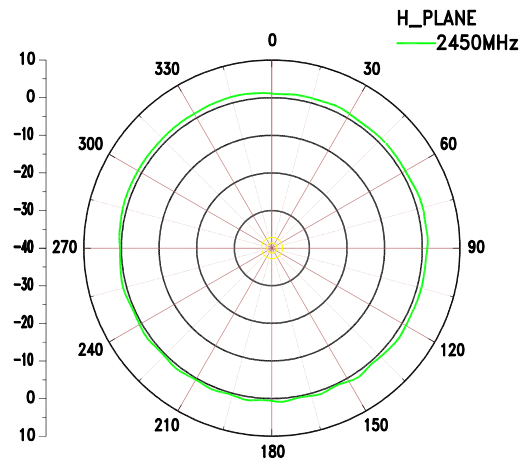
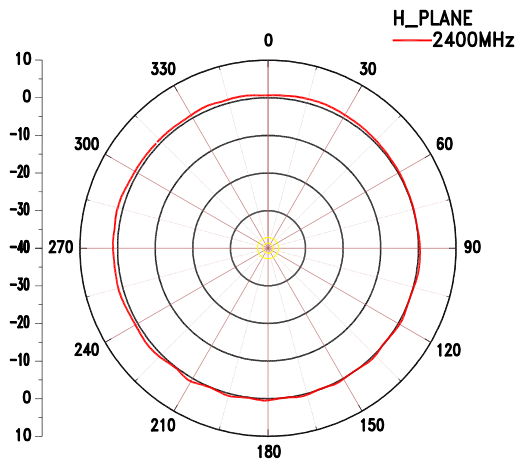
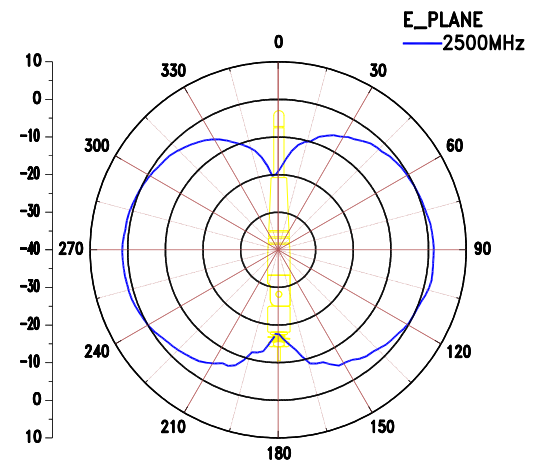
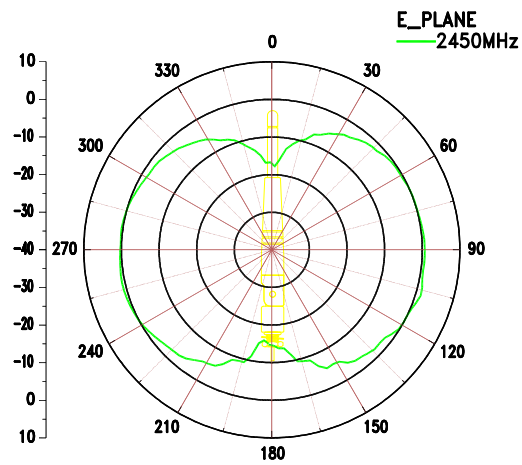
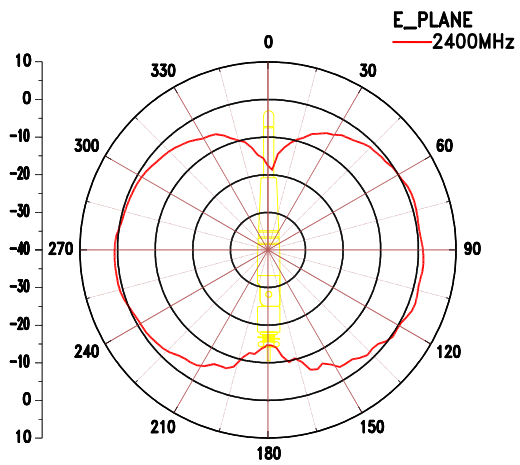
Advanced Ceramic X Corp.

16 Tzu Chiang Road, Hsinchu Industrial District Hsinchu Hsien 303, Taiwan

TEL:886-3-5987008 FAX:886-3-5987001

E-mail: acx@acxc.com.tw

<http://www.acxc.com.tw>



P/N S181FL-L-RMM-2450S

Alternative Connectors

.Straight MMCX Plug

P/N: S181FL-L-MM-2450S

ECN Date Description

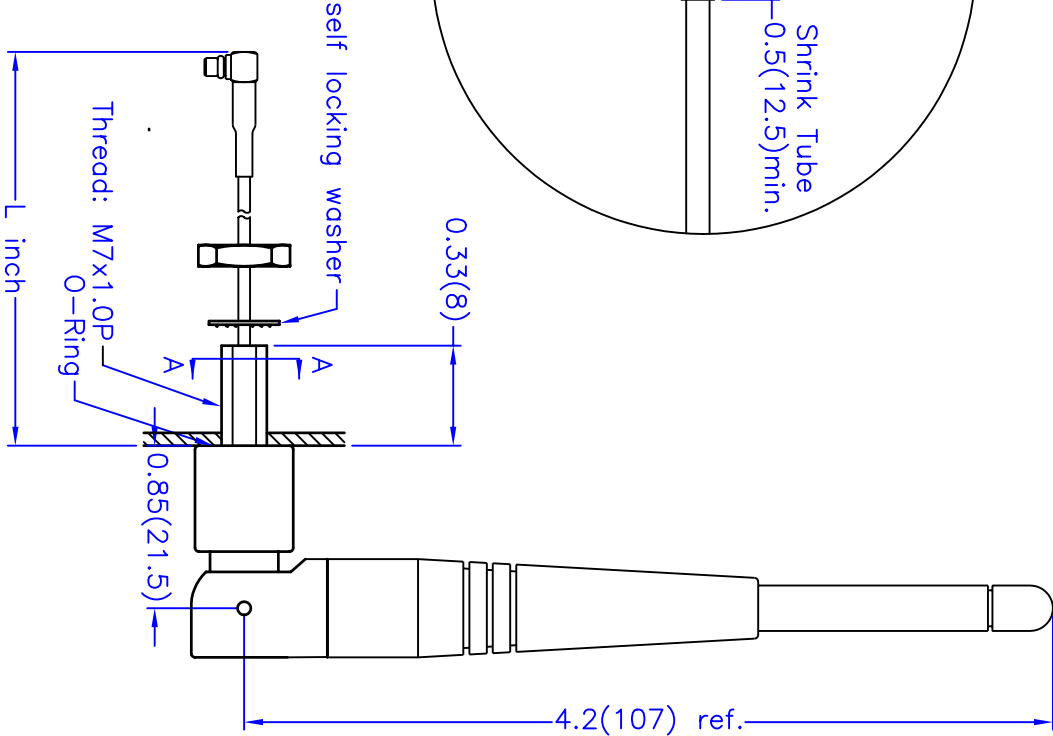
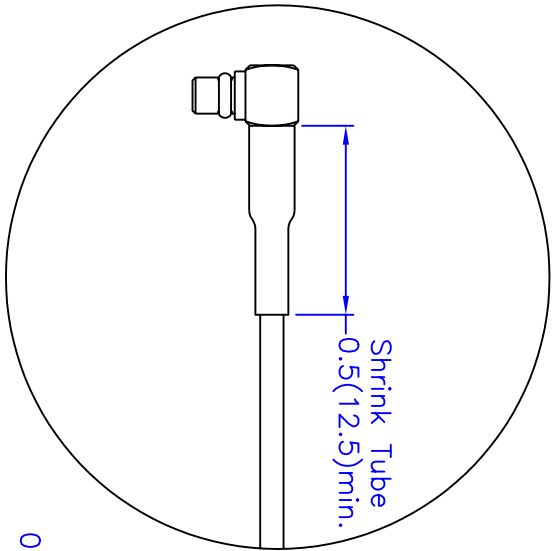
5/30/02	change mounting thread/hole from round to double D-cut
6/15/02	Supersede P/N S181FL-L-RMM-2450S-DR

Electrical Properties:

Frequency Range: 2.4~2.5 GHz
Impedance: 50Ω nominal
VSWR: <2.0:1
Gain: *2.0 dBi
Radiation: Omni
Polarization: Vertical
*Gain is measured under no flying lead.

Mechanical Properties:

Cable: M17/93-RG178; Harbour Industries
Cable Length: Standard length L=5 inches.
or to be specified.
Connector: R/A MMCX Plug(male);
Nearson 25-03M-TGG
Material:
Overmold: Polyurethane(Black); BASF
Swivel: Polyurethane(Black); BASF and
Polycarbonate(Black); Bayer
Operation Temp.: -20°C to +65°C
Storage Temp.: -30°C to +75°C



A-A view-Thread cross-section
0.236(6.0)



TITLE	2.4GHz Fixed Mount Swivel	DATE	SHEET
UNIT	Antenna — 181 Model		1 of 2
in.(mm)	DWG. NO. S181FL-L-RMM-2450S		
SCALE			
None			

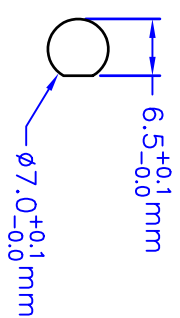
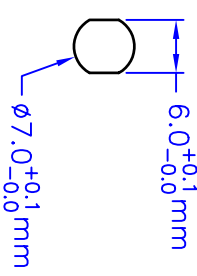
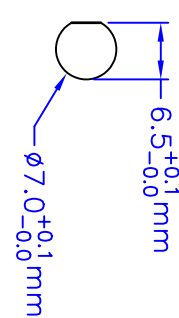
NEARSON

Alternative Connectors

.Straight MMCX Plug

P/N: S181FL-L-MM-2450S

ECN	Date	Description
	5/30/02	change mounting thread/hole from round to double D-cut
	6/15/02	Supersede P/N S181FL-L-RMM-2450S-DR

 round	 right D-cut
 double D-cut	 left D-cut

Recommended Mounting-Hole Dimensions

L (inch)	Attenuation (dB)
3"	0.20 dB
4"	0.27 dB
5"	0.33 dB
6"	0.40 dB
8"	0.53 dB
10"	0.66 dB
12"	0.79 dB

Flying Lead Cable Length v.s. Attenuation Table
Standard M17/93-RG178 Cable Measured @ 2.4GHz

TITLE	2.4GHz Fixed Mount Swivel Antenna — 181 Model	DATE	SHEET
UNIT	DWG. NO. S181FL-L-RMM-2450S		2 of 2
in.(mm)			
SCALE			
None			

NEARSON

<http://www.nearson.com>



The evolution of technology has brought the need to communicate everywhere and at all times without being confined to one space. Laird Technologies' internal wireless device antennas feature wide bandwidth to enhance the performance and application of portable wireless devices based on standards such as 802.11 and Bluetooth®. The antennas are specifically designed to be embedded inside devices for aesthetically pleasing integration with high durability.

FEATURES



- Versatile and easy to use antenna for 2.4 to 2.5 GHz Bluetooth® and IEEE 802.11 devices
- Designed for easy connection to radio cards
- Utilizes patented PCB Microsphere technology
- Has a ground plane incorporated into the resonator structure, therefore no additional ground plane is required to radiate efficiently
- Conformance to European RoHS Directive 2002/95/EC

MARKETS

- WiMAX

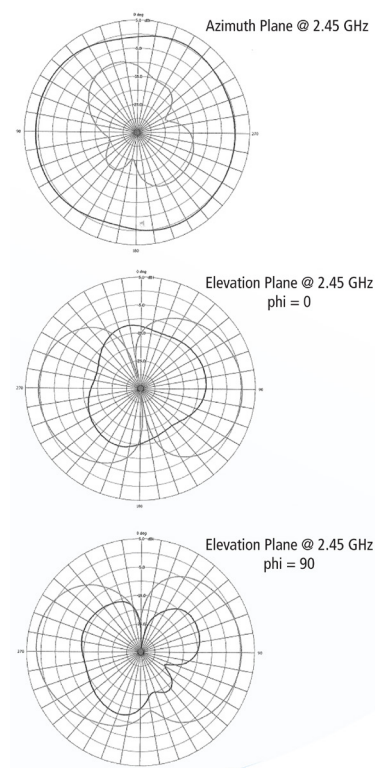
SPECIFICATIONS

PARAMETER	PERFORMANCE
Frequency range	2.4-2.5 GHz
Gain	2.0 dBi
Polarization	Linear
Impedance	50 ohms
VSWR	<2.0:1
Dimensions (L x W x H)	1.88 in x .5 in x .032 in
Weight	2 g

CABLE & CONNECTOR

PART #	CABLE TYPE	CABLE LENGTH	CONNECTOR
MAF94045	ø 1.13	100 mm	IPEX MHF
MAF94102	RG178	100mm	Flying lead
MAF94243	ø 1.13	203mm	IPEX MHF
MAF94452	ø 1.13	50mm	IPEX MHF
MAF95088	ø 1.13	165mm	IPEX MHF
EBL2449A1-15UFL	ø 1.13	150mm	IPEX MHF

ANTENNA PATTERNS



DiPole ComAer 2.4: WCR

External Wireless Device Antenna



Today's work and lifestyles require us to communicate anytime, anywhere whether on the move or sitting still. Bluetooth® and 802.11 standards make wireless connections to computer networks and other devices possible, while at the same time enabling freedom of movement.

Laird's practical and rugged external wireless device antennas are designed to fit into the portable devices used in office, industrial and home environments. The antennas feature flexible elements and many are 1/2-wave coaxial dipole design for reduced ground dependence and improved performance.

FEATURES



- 1/2-wave coaxial dipole
- Flexible element
- Snap-in
- Clutch allows 360° rotation
- FCC Part 15 compliant polarized connector

MARKETS

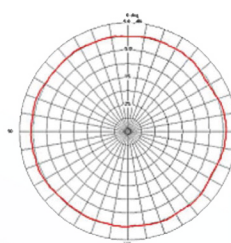
- Bluetooth® devices
- IEEE 802.11b/g devices

SPECIFICATIONS

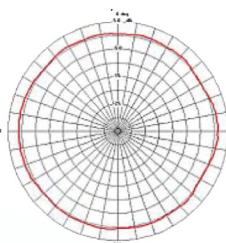
PARAMETER	PERFORMANCE
Frequency range	2.4-2.5 GHz
Gain	Peak: 2.0 dBi
Polarization	Vertical
Impedance	50 ohms
VSWR	1.5:1 max at resonance
Power Rating	50 watts
Dimensions (Length)	7.6 cm (90° Bent) or 10.8 cm (180°)
Temperature Range	-40° to +80°
Drop Test	1M

PART #	CABLE TYPE	CABLE LENGTH	CONNECTOR	KITTED W/SLEEVE
MAF94015	RG178	100	Flying Lead	Yes
MAF94017	RG178	100	IPEX MHF	Yes
MAF94190	ø 1.13	150	IPEX MHF	No
MAF94360	RG178	254	PEX MHF	No

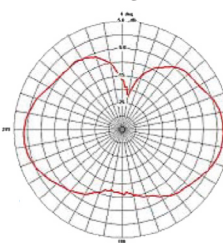
Antenna Bent @ 90°
Azimuth, 2.45 GHz



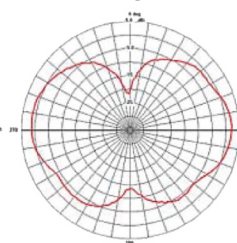
Antenna Bent @ 180°
Azimuth, 2.45 GHz



Elevation, phi=0
2.45 GHz



Elevation, phi=0
2.45 GHz



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ANT-DS-DIPOLE-WCR_0514

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External Two-Way Radio Antenna



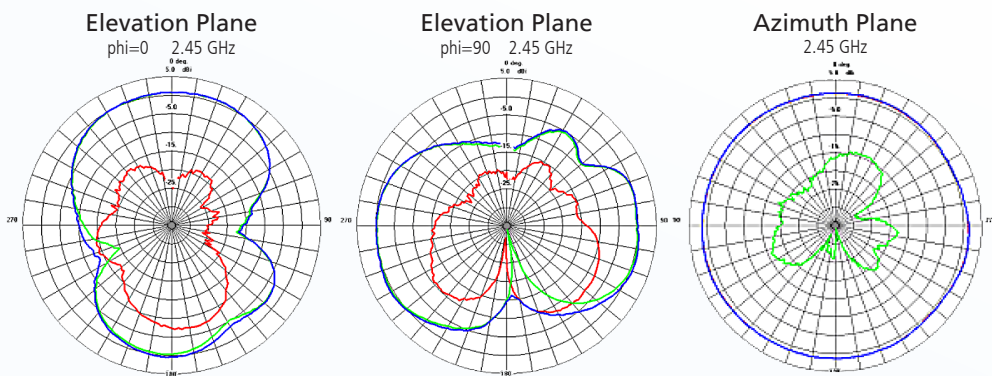
FEATURES

- Covers 802.11b for all U.S., European, and Japanese WLAN applications
- Center fed coaxial dipole with a coaxial cable pigtail

PARAMETER	SPECIFICATION
Frequency	2.4-2.5 GHz
Gain	1.5 dBi (2.45 GHz)
Polarization	Vertical, Omni-directional
Nominal Impedance	50 ohms
VSWR	2:1 max
Size (Length)	10.9 cm (180°) or 8.8 cm (90°)

FREQUENCIES AND CONNECTORS

MODEL #	PART #	COLOR	RG-178 CABLE	CONNECTOR
WRR2400- IP04-B	MAF94019	Black	100 mm	IPEX U.FL
WRR2400- IP04-G	MAF94048	Gray	100 mm	IPEX U.FL
WRR2400- FL04-B	MAF94027	Black	100 mm	Flying Lead
WRR2400- FL04-G	MAF94047	Gray	100 mm	Flying Lead



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www.lairdtech.com

ANT-DS-WRR 0609

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