

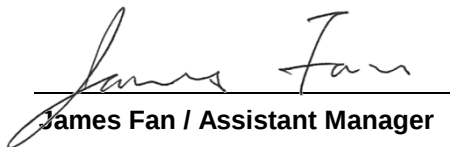
Japan Test Report

Equipment : Bluetooth 4.2 module (BLE only)
Model No. : BL652-SA
Brand Name : Laird
Applicant : Laird Technologies
Address : W66N220 Commerce Court, Cedarburg,
Wisconsin 53012, USA
Standard : Article 2 Paragraph 1 Item 19
Received Date : May 14, 2018
Tested Date : Jul. 19, 2016 (For original test)
Jun. 04 ~ Jun. 06, 2018 (For new test)

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 and ARIB STD-T66.

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

Table of Contents

1	GENERAL DESCRIPTION	5
1.1	Information.....	5
1.2	Test Equipment and Calibration Data	8
1.3	Testing Applied Standards	8
1.4	Measurement Uncertainty	9
2	TEST CONFIGURATION	10
2.1	Testing Location and Conditions	10
2.2	The Worst Test Modes and Channel Details	10
3	TRANSMITTER TEST RESULTS.....	11
3.1	Antenna Power	11
3.2	Frequency Tolerance	12
3.3	Occupied Bandwidth	13
3.4	Transmitter Spurious Emissions.....	14
3.5	Interference Prevention Function	15
4	RECEIVER TEST RESULTS	16
4.1	Receiver Spurious Emissions.....	16
5	PHOTOGRAPHS OF THE TEST CONFIGURATION	17
6	TEST LABORATORY INFORMATION	18
 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		
APPENDIX D. TEST RESULTS FOR TRANSMITTER SPURIOUS EMISSIONS		
APPENDIX E. TEST RESULTS FOR INTERFERENCE PREVENTION FUNCTION		
APPENDIX F. TEST RESULTS FOR RECEIVER SPURIOUS EMISSIONS		
APPENDIX G. ANTENNA INFORMATION		

Release Record

Report No.	Version	Description	Issued Date
JR662202-06AE	Rev. 01	Initial issue	Jul. 27, 2018

Summary of Test Results

Ref. Std. Clause	Description	Result
3.2(2)(3)	Antenna Power	Pass
3.2(4)	Frequency Tolerance	Pass
3.2(6)	Transmitter Spurious Emission	Pass
3.2(7)	Occupied Bandwidth	Pass
3.3(1)	Receiver Emission	Pass
3.4.1	Interference prevention function	Pass

1 General Description

1.1 Information

This report is issued as a supplementary report to original ICC report no. JR662202AE. The modification is concerned with adding 2 Mbps data rate by software setting.

All test items are evaluated for 2 Mbps data rate and test results of 1Mbps data rate were kept the same as recorded in original report.

1.1.1 Specification of the Equipment under Test (EUT)

Power Type	3.3Vdc from host
Type(s) of Modulation / Technology	GFSK / 1 Mbps GFSK / 2 Mbps
Frequency Range (MHz)	2402 ~ 2480 MHz
Total Channel Number	40
HW Version	A1
SW Version	28.7.3.0

1.1.2 Accessories

N/A

1.1.3 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Gain (dBi)
1	ACX	AT3216-B2R7HAA	Chip	N/A	0.5

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

1.1.4 Antenna Power

Operating Mode	Rated Power (mW)	Measured Conducted Power (mW)	Radiated Power (mW)
BT-LE(1Mbps)	3.5	3.09	3.470
BT-LE(2Mbps)	2.5	2.679	3.006

1.1.5 Channel List

Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
37	2402	9	2422	18	2442	28	2462
0	2404	10	2424	19	2444	29	2464
1	2406	38	2426	20	2446	30	2466
2	2408	11	2428	21	2448	31	2468
3	2410	12	2430	22	2450	32	2470
4	2412	13	2432	23	2452	33	2472
5	2414	14	2434	24	2454	34	2474
6	2416	15	2436	25	2456	35	2476
7	2418	16	2438	26	2458	36	2478
8	2420	17	2440	27	2460	39	2480

1.1.6 Test Tool and Power Setting

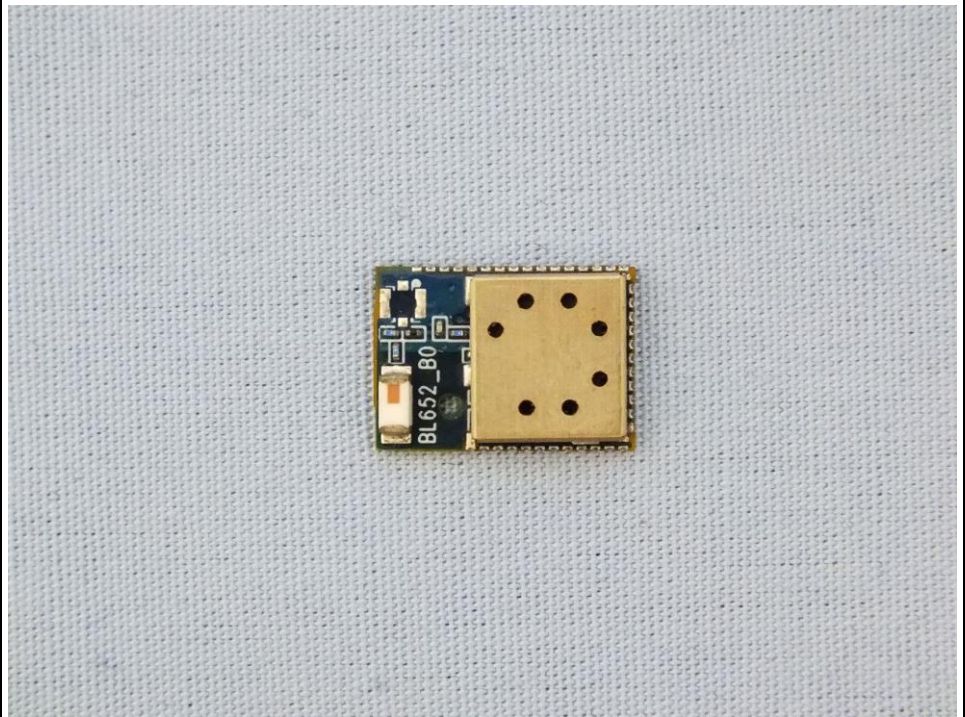
Mode	Test Tool
BT-LE(1Mbps)	nRFgo Studio v. 1.16.1.3119
BT-LE(2Mbps)	UwTerminal v7.94

Modulation Mode	Test Frequency (MHz)		
	2402	2440	2480
BT-LE(1Mbps)	Default	Default	Default
BT-LE(2Mbps)	Default	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

Photo



1.2 Test Equipment and Calibration Data

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test date	Jul. 19, 2016				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Feb. 17, 2016	Feb. 16, 2017
Power Meter	Anritsu	ML2495A	1241002	Sep. 21, 2015	Sep. 20, 2016
Power Sensor	Anritsu	MA2411B	1207366	Sep. 21, 2015	Sep. 20, 2016
DC POWER SOURCE	GW INSTEK	GPC-3060D	EM884797	Oct. 20, 2015	Oct. 19, 2016
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note 1: Calibration Interval of instruments listed above is one year.					
Note 2: Above instruments are calibrated by Electronics Testing Center					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test date	Jun. 04 ~ Jun. 06, 2018				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Apr. 16, 2018	Apr. 15, 2019
Power Meter	Anritsu	ML2495A	1241002	Oct. 16, 2017	Oct. 15, 2018
Power Sensor	Anritsu	MA2411B	1207366	Oct. 16, 2017	Oct. 15, 2018
DC POWER SOURCE	GW INSTEK	GPC-6030D	EM892433	Oct. 26, 2017	Oct. 25, 2018
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Note 1: Calibration Interval of instruments listed above is one year.					
Note 2: Above instruments are calibrated by Electronics Testing Center					

1.3 Testing Applied Standards

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

Article 2 Paragraph 1 Item 19

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 Frequency (MHz)
Antenna Power Frequency Tolerance Transmitter Spurious Emission Occupied Bandwidth Spreading Bandwidth Collateral Emission of Receiver Spreading Factor Interference prevention function	BT LE	2402 / 2440 / 2480

3 Transmitter Test Results

3.1 Antenna Power

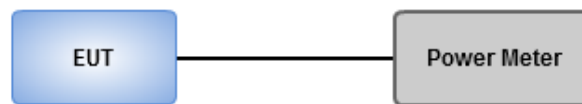
3.1.1 Limit of Antenna Power

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

Measure the total power by Power Meter

3.1.3 Test Setup



3.1.4 Test Result of Maximum Transmit Power

Reference Documents	Test Mode
Appendix A1, A2	BT-LE

3.2 Frequency Tolerance

3.2.1 Limit of Frequency Tolerance

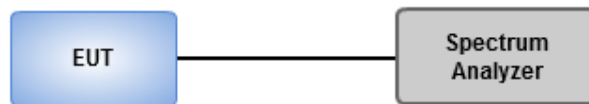
Frequency tolerance shall be +/- 50ppm.

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

Reference Documents	Test Mode
Appendix B	BT-LE

3.3 Occupied Bandwidth

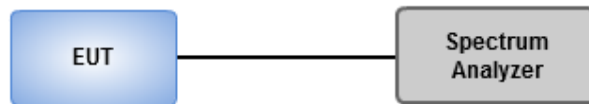
3.3.1 Limit of Occupied Bandwidth

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 = 40MHz, RBW = VBW = 300kHz, detector = Peak, Sweep time = Auto.
2. Enable OBW function of spectrum analyzer to measure OBW and capture test plot.

3.3.3 Test Setup



3.3.4 Test Result of Occupied Bandwidth

Reference Documents	Test Mode
Appendix C	BT-LE

3.4 Transmitter Spurious Emissions

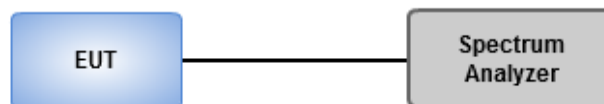
3.4.1 Limit of Transmitter Spurious Emissions

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 ($2483.5\text{MHz} < f \leq 2496.5\text{MHz}$).

3.4.2 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.

3.4.3 Test Setup



3.4.4 Test Result of Transmitter Spurious Emissions

Reference Documents	Test Mode
Appendix D	BT-LE

3.5 Interference Prevention Function

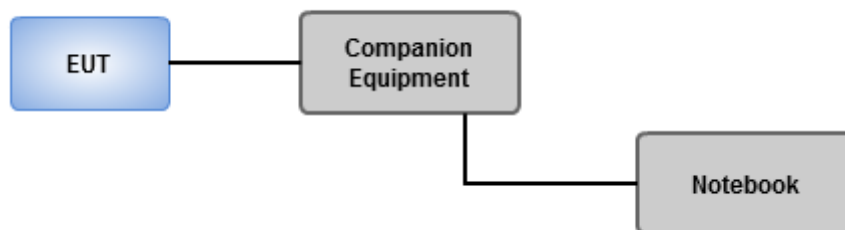
3.5.1 Limit of Interference Prevention Function

Limits
The identification code shall be 48 bits long

3.5.2 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

3.5.3 Test Setup



3.5.4 Test Result of Interference Prevention Function

Reference Documents	Test Mode
Appendix E	BT-LE

4 Receiver Test Results

4.1 Receiver Spurious Emissions

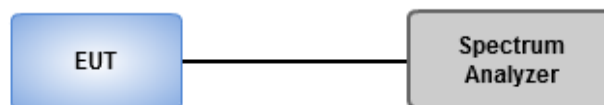
4.1.1 Limit of Receiver Spurious Emissions

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.

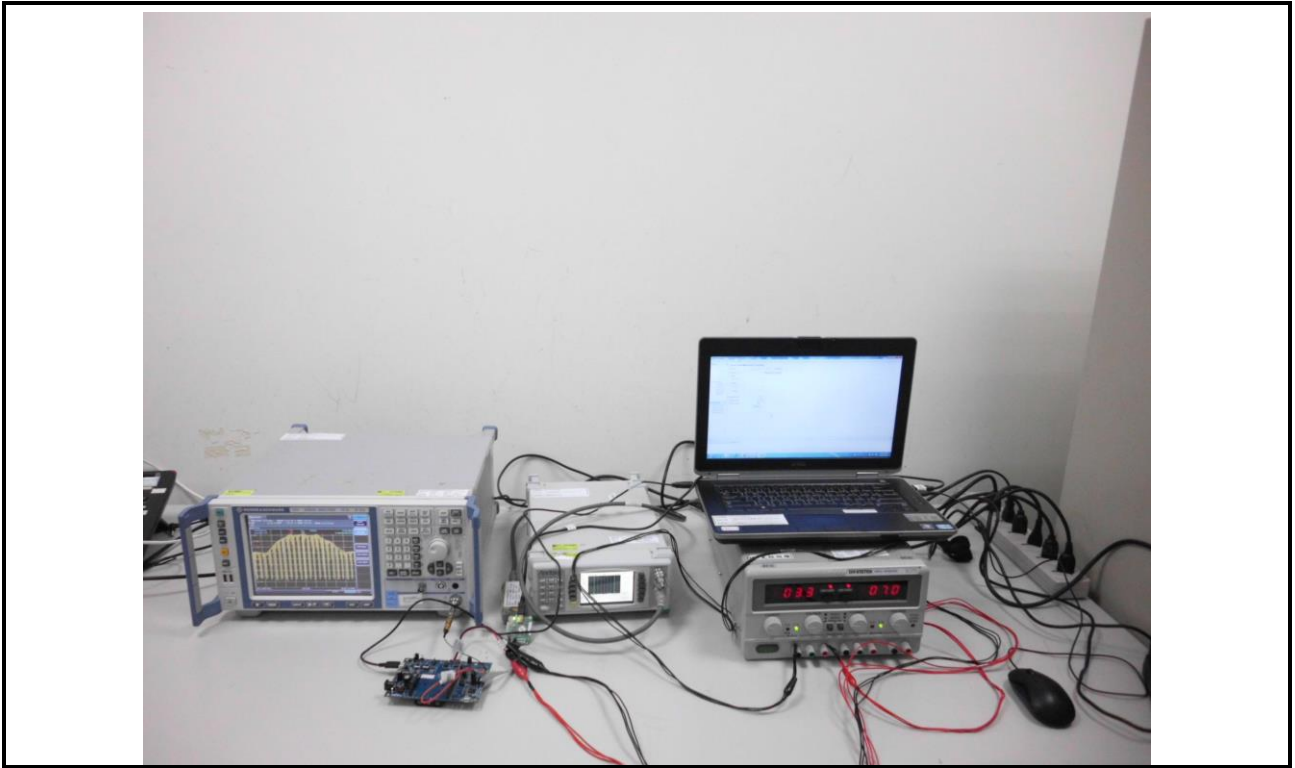
4.1.3 Test Setup



4.1.4 Test Result of Receiver Spurious Emissions

Reference Documents	Test Mode
Appendix F	BT-LE

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

Tel: 886-2-2601-1640

No. 30-2, Ding Fwu Tsuen, Lin Kou
District, New Taipei City, Taiwan,
R.O.C.

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==

Test results of 1 Mbps data rate

Appendix A 19-LE

1. Test Results

Test Voltage	V	Normal Voltage (3.3V)			High Voltage (3.6V)			Low Voltage (1.7V)			Remarks
Test Frequency	MHz	2402	2440	2480	2402	2440	2480	2402	2440	2480	Low/Mid/High of test frequency range
Measured Frequency	MHz	2401.9731	2439.9726	2479.9721	2401.9732	2439.9727	2479.9726	2401.9734	2439.9727	2479.9725	
Frequency Error	ppm	-11.20	-11.23	-11.25	-11.16	-11.19	-11.05	-11.07	-11.19	-11.09	Limit $\leq$ 50 ppm
Occupied Bandwidth	MHz	1.34	1.29	1.29	1.32	1.28	1.29	1.33	1.29	1.29	Limit $\leq$ 26 MHz (RB/VB : 300kHz)
Spread-spectrum Bandwidth	MHz	0.88	0.86	0.86	0.88	0.86	0.85	0.88	0.86	0.85	Spread Factor Limit $\geq$ 5 (DSSS and FHSS)
Unwanted Emission Intensity (Power emission within 1MHz bandwidth)	※ 1	μ W	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	Limit $\leq$ 0.25 μ W (-36 dBm)
	※ 2	μ W	0.0090	0.0072	0.0090	0.0082	0.0083	0.0102	0.0086	0.0102	Limit $\leq$ 2.5 μ W (-26 dBm)
	※ 3	μ W	1.8450	0.0108	0.0106	1.8450	0.0086	0.0098	1.8197	0.0095	Limit $\leq$ 25 μ W (-16 dBm)
	※ 4	μ W	0.0089	0.0089	0.2291	0.0095	0.0089	0.2208	0.0078	0.0083	Limit $\leq$ 25 μ W (-16 dBm)
	※ 5	μ W	0.0029	0.0019	0.0011	0.0027	0.0020	0.0013	0.0023	0.0018	Limit $\leq$ 2.5 μ W (-26 dBm)
Antenna Power (Measured Power)	mW	3.083	3.076	3.048	3.090	3.083	3.055	3.076	3.069	3.041	Limit $\leq$ 10 mW (10 dBm)
Antenna Power (Rated Power)	mW	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	Limit $\leq$ 10 mW (10 dBm)
Antenna Power Error	mW	-0.42	-0.42	-0.45	-0.41	-0.42	-0.45	-0.42	-0.43	-0.46	
	%	-11.91	-12.11	-12.92	-11.71	-11.91	-12.72	-12.11	-12.31	-13.12	Limit + 20% - - 80%
Limitation of Collateral Emission of Receiver	※ 6	nW	0.0012	0.0009	0.0013	0.0016	0.0012	0.0011	0.0011	0.0013	Limit $\leq$ 4 nW (-54 dBm)
	※ 7	nW	0.0942	0.0933	0.0652	0.0811	0.0887	0.0587	0.1026	0.0935	Limit $\leq$ 20 nW (-47 dBm)
Radio Interference Prevention Function	ID Code	Good, MAC Address :E6:F4:EA:4D:0C:0E									
	Carrier Sense	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR: Not Require

※ 1: Frequency Band 1 (30 MHz $\leq$ f $\leq$ 2387 MHz)※ 4: Frequency Band 4 (2496.5 MHz $\leq$ f < 12.5 GHz)※ 2: Frequency Band 2 (2387 MHz < f $\leq$ 2400 MHz)※ 5: Frequency Band 5 (30 MHz $\leq$ f < 1000 MHz)※ 3: Frequency Band 3 (2483.5 MHz $\leq$ f < 2496.5 MHz)※ 6: Frequency Band 6 (1000 MHz $\leq$ f < 12.5 GHz)

2. Antenna Power (Conducted Power)

Testing for Electrical Specification	Test Voltage	V	Normal Voltage (3.3V)			High Voltage (3.6V)			Low Voltage (1.7V)			Remarks
	Test Frequency	MHz	2402	2440	2480	2402	2440	2480	2402	2440	2480	
	Power Meter Raw from EUT	dBm	1.61	1.60	1.56	1.62	1.61	1.57	1.60	1.59	1.55	
	Cable Loss	dB	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	Refer to Calibration Result
	Duty Cycle Factor	dB	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	Duty Factor = $10 \times 10\text{Log}_{10}(1/\text{Duty Cycle})$
	Antenna Power (Conducted)	dBm	4.89	4.88	4.84	4.90	4.89	4.85	4.88	4.87	4.83	Limit $\leq$ 10 mW (10 dBm)
	Antenna Power (Conducted)	mW	3.083	3.076	3.048	3.090	3.083	3.055	3.076	3.069	3.041	
	Antenna Power Error	mW	-0.42	-0.42	-0.45	-0.41	-0.42	-0.45	-0.42	-0.43	-0.46	
		%	-11.91	-12.11	-12.92	-11.71	-11.91	-12.72	-12.11	-12.31	-13.12	Limit + 20% ~ - 80%
	Transmitter ON _{Time}	msec	0.4130									RBW : 1 MHz ; VBW : 1 MHz ; SP : 0Hz
Transmitter (ON+OFF) _{Time}	msec	0.6231										
Transmitter Duty Cycle	%	66.29%										

3. Transmission Radiation Angle Width (This test item will not be applied to the EIRP power is lower than 12.14dBm)

No.	Antenna Power	Antenna				Cable			Total Gain D=B+C	EIRP F=A+D	Permitted Angle	Judgement	Remarks (Antenna Model)
	A (dBm)	Type	Gain B (dBi)	3dB Beam-width Horizontal (Degree)	3dB Beam-width Vertical (Degree)	Model	Length (m)	Loss C (dB)					
1	4.90	Chip	0.50			-	-		0.50	5.40	360.00	Good	
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

4. Unwanted Emission Intensity

Test Voltage		V	Normal Voltage (3.3V)			High Voltage (3.6V)			Low Voltage (1.7V)			Remarks
Test Frequency		MHz	2402	2440	2480	2402	2440	2480	2402	2440	2480	
Unwanted Emission Frequency	※ 1	MHz	776.10	930.50	967.00	790.10	784.50	990.90	982.50	842.10	825.20	RBW : 100 kHz ; VBW : 100k Hz
	※ 2	MHz	2273.60	2307.70	2351.90	2273.60	2311.70	2351.90	2273.60	2311.70	2351.90	RBW : 1 MHz ; VBW : 1 MHz
	※ 3	MHz	2399.99	2391.86	2391.95	2399.97	2391.71	2391.80	2399.97	2392.22	2391.71	
	※ 4	MHz	2489.78	2487.93	2485.43	2490.17	2488.25	2485.32	2490.09	2488.22	2485.38	
	※ 5	MHz	4805.50	4877.50	4964.50	4805.50	4877.50	4964.50	4805.50	4877.50	4964.50	
Cable Loss	※ 1	dB	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	
	※ 2	dB	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	
	※ 3	dB	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	
	※ 4	dB	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	
	※ 5	dB	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	
Spectrum Raw	※ 1	dBm	-71.62	-71.89	-72.11	-71.69	-71.50	-72.36	-71.78	-71.65	-71.71	
	※ 2	dBm	-51.94	-52.92	-51.93	-52.36	-52.31	-51.40	-52.17	-51.42	-52.68	
	※ 3	dBm	-28.83	-51.17	-51.23	-28.83	-52.15	-51.56	-28.89	-51.71	-51.51	
	※ 4	dBm	-52.00	-52.00	-37.89	-51.71	-52.01	-38.05	-52.58	-52.31	-38.00	
	※ 5	dBm	-57.13	-59.08	-61.26	-57.40	-58.85	-60.56	-58.23	-59.15	-60.60	
Unwanted Emission Intensity	※ 1	dBm	-70.74	-71.01	-71.23	-70.81	-70.62	-71.48	-70.90	-70.77	-70.83	Limit ≤ 2.5 μW (-26 dBm)
	※ 2	dBm	-50.45	-51.43	-50.44	-50.87	-50.82	-49.91	-50.68	-49.93	-51.19	
	※ 3	dBm	-27.34	-49.68	-49.74	-27.34	-50.66	-50.07	-27.40	-50.22	-50.02	Limit ≤ 25 μW (-16 dBm)
	※ 4	dBm	-50.51	-50.51	-36.40	-50.22	-50.52	-36.56	-51.09	-50.82	-36.51	Limit ≤ 25 μW (-16 dBm)
	※ 5	dBm	-55.37	-57.32	-59.50	-55.64	-57.09	-58.80	-56.47	-57.39	-58.84	Limit ≤ 2.5 μW (-26 dBm)
Unwanted Emission Intensity	※ 1	μW	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	Limit ≤ 2.5 μW (-26 dBm)
	※ 2	μW	0.0090	0.0072	0.0090	0.0082	0.0083	0.0102	0.0086	0.0102	0.0076	
	※ 3	μW	1.8450	0.0108	0.0106	1.8450	0.0086	0.0098	1.8197	0.0095	0.0100	Limit ≤ 25 μW (-16 dBm)
	※ 4	μW	0.0089	0.0089	0.2291	0.0095	0.0089	0.2208	0.0078	0.0083	0.2234	Limit ≤ 25 μW (-16 dBm)
	※ 5	μW	0.0029	0.0019	0.0011	0.0027	0.0020	0.0013	0.0023	0.0018	0.0013	Limit ≤ 2.5 μW (-26 dBm)

※ 1: Frequency Band 1 (30 MHz $\leq$ f $\leq$ 1000 MHz)※ 5: Frequency Band 5 (2496.5 MHz $\leq$ f < 12.5 GHz)※ 2: Frequency Band 2 (1000 MHz < f $\leq$ 2387 MHz)※ 6: Frequency Band 6 (30 MHz $\leq$ f < 1000 MHz)※ 3: Frequency Band 3 (2387 MHz < f $\leq$ 2400 MHz)※ 7: Frequency Band 7 (1000 MHz $\leq$ f < 12.5 GHz)

International Certification Corp.

※ 4: Frequency Band 4 (2483.5 MHz ≤ f < 2496.5 MHz)

5. Limitation of Collateral Emission of Receiver

Test Voltage		V	Normal Voltage (3.3V)			High Voltage (3.6V)			Low Voltage (1.7V)			Remarks
Test Frequency		MHz	2402	2440	2480	2402	2440	2480	2402	2440	2480	
Spurious Emission Frequency	※ 6	MHz	624.50	88.30	624.50	624.50	624.50	624.50	32.10	64.40	64.40	1st 30MHz~1000MHz:: Maximum emission and
	※ 6	MHz	-	-	-	-	-	-	-	-	-	all emissions beyond 1/10 of the limitation
	※ 6	MHz	-	-	-	-	-	-	-	-	-	must be indicated.
	※ 7	MHz	4803.00	4886.00	4953.00	4803.00	4886.00	4953.00	4803.00	4886.00	4953.00	1st 1000MHz~12.5GHz:: Maximum emission and
	※ 7	MHz	-	-	-	-	-	-	-	-	-	all emissions beyond 1/10 of the limitation
	※ 7	MHz	-	-	-	-	-	-	-	-	-	must be indicated.
Cable Loss	※ 6	dB	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	1st
	※ 6	dB	-	-	-	-	-	-	-	-	-	2nd
	※ 6	dB	-	-	-	-	-	-	-	-	-	3rd
	※ 7	dB	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1st
	※ 7	dB	-	-	-	-	-	-	-	-	-	2nd
	※ 7	dB	-	-	-	-	-	-	-	-	-	3rd
Spectrum Raw	※ 6	dBm	-90.21	-91.28	-89.66	-88.97	-89.95	-90.31	-90.61	-89.63	-89.01	1st
	※ 6	dBm	-	-	-	-	-	-	-	-	-	2nd
	※ 6	dBm	-	-	-	-	-	-	-	-	-	3rd
	※ 7	dBm	-72.02	-72.06	-73.62	-72.67	-72.28	-74.07	-71.65	-72.05	-73.83	1st
	※ 7	dBm	-	-	-	-	-	-	-	-	-	2nd
	※ 7	dBm	-	-	-	-	-	-	-	-	-	3rd
Spurious Emission Intensity	※ 6	dBm	-89.33	-90.40	-88.78	-88.09	-89.07	-89.43	-89.73	-88.75	-88.13	1st Limit ≤ 4 nW (-54 dBm)
	※ 6	dBm	-	-	-	-	-	-	-	-	-	2nd RBW : 100 kHz ; VBW : 100 kHz
	※ 6	dBm	-	-	-	-	-	-	-	-	-	3rd
	※ 7	dBm	-70.26	-70.30	-71.86	-70.91	-70.52	-72.31	-69.89	-70.29	-72.07	1st Limit ≤ 20 nW (-47 dBm)
	※ 7	dBm	-	-	-	-	-	-	-	-	-	2nd RBW : 1 MHz ; VBW : 1 MHz
	※ 7	dBm	-	-	-	-	-	-	-	-	-	3rd
Spurious Emission Intensity	※ 6	nW	0.0012	0.0009	0.0013	0.0016	0.0012	0.0011	0.0011	0.0013	0.0015	Total Emission Power
	※ 6	nW	0.0012	0.0009	0.0013	0.0016	0.0012	0.0011	0.0011	0.0013	0.0015	1st Limit ≤ 4 nW (-54 dBm)
	※ 6	nW	-	-	-	-	-	-	-	-	-	2nd RBW : 100 kHz ; VBW : 100 kHz
	※ 6	nW	-	-	-	-	-	-	-	-	-	3rd
	※ 7	nW	0.0942	0.0933	0.0652	0.0811	0.0887	0.0587	0.1026	0.0935	0.0621	Total Emission Power
	※ 7	nW	0.0942	0.0933	0.0652	0.0811	0.0887	0.0587	0.1026	0.0935	0.0621	1st Limit ≤ 20 nW (-47 dBm)
	※ 7	nW	-	-	-	-	-	-	-	-	-	2nd RBW : 1 MHz ; VBW : 1 MHz
	※ 7	nW	-	-	-	-	-	-	-	-	-	3rd

※ 1: Frequency Band 1 (30 MHz ≤ f ≤ 1000 MHz)

※ 5: Frequency Band 5 (2496.5 MHz ≤ f < 12.5 GHz)

※ 2: Frequency Band 2 (1000 MHz < f ≤ 2387 MHz)

※ 6: Frequency Band 6 (30 MHz ≤ f < 1000 MHz)

※ 3: Frequency Band 3 (2387 MHz < f ≤ 2400 MHz)

※ 7: Frequency Band 7 (1000 MHz ≤ f < 12.5 GHz)

※ 4: Frequency Band 4 (2483.5 MHz ≤ f < 2496.5 MHz)

Calibration Result

1. Linearity Check

SG Output (dBm)	Spectrum Raw (dBm)	Power Meter Raw (dBm)	Remark
0	-1.3	-0.93	• SG Test Frequency : 2450 MHz • RBW : 1 MHz ; VBW : 1 MHz ; SP : 0Hz • ATT(30dB) ; Ref : 20 dBm
-5	-6.34	-5.88	
-10	-11.17	-10.84	
0	-1.64	-1.66	• SG Test Frequency : 5250 MHz • RBW : 1 MHz ; VBW : 1 MHz ; SP : 0Hz • ATT(30dB) ; Ref : 20 dBm
-5	-6.6	-6.62	
-10	-11.48	-11.58	

2. Frequency Accuracy Confirmation

SG Output (dBm)	Spectrum Raw (MHz)	Frequency Error (ppm)	Remark
2450	2450.0002	0.0816	• SG Output : 0dBm • RBW : 30 kHz ; VBW : 30 kHz ; SP : 300kHz • Limit $\leq$ 10% of frequency error limits
5250	5250.0012	0.2286	

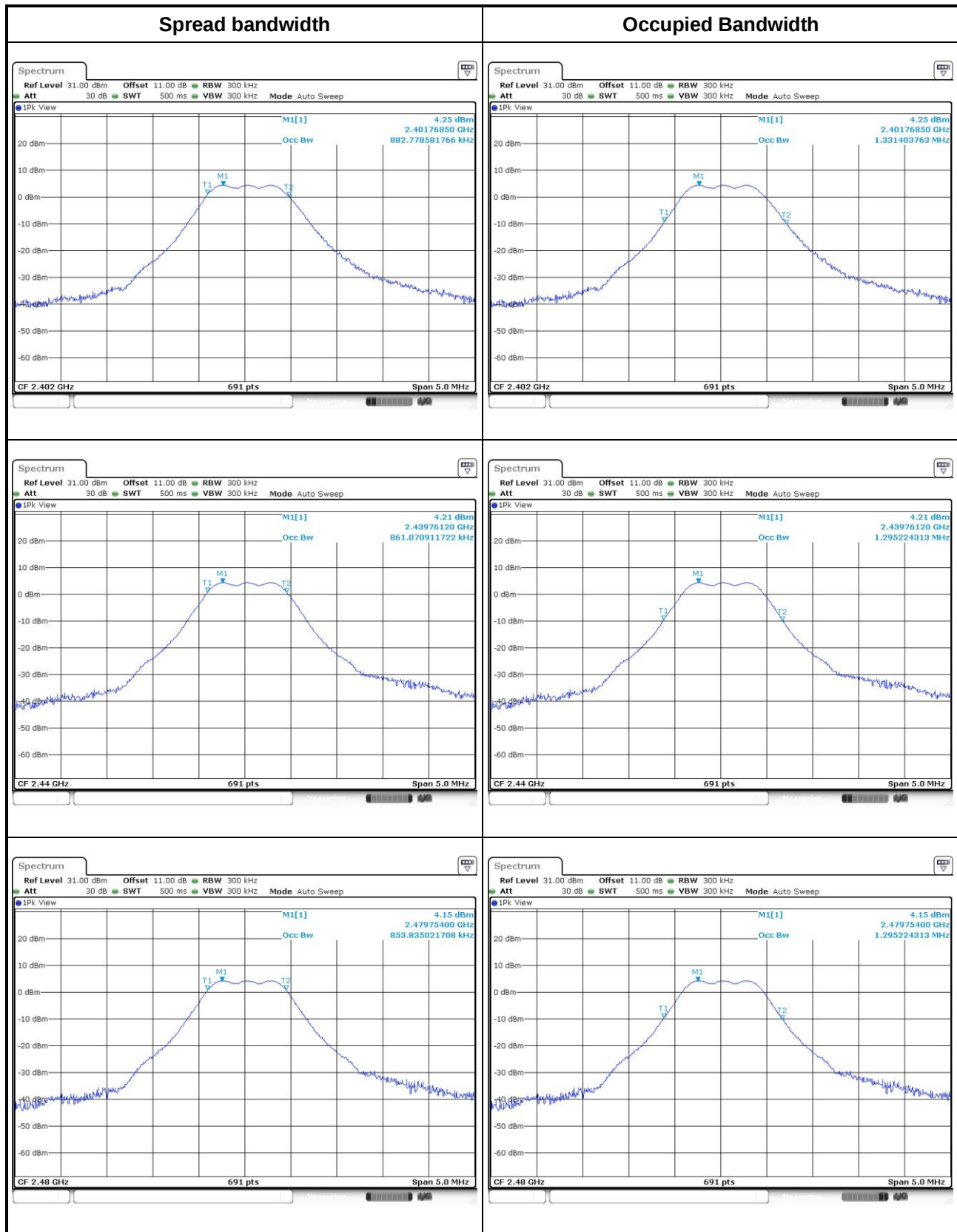
3. Cable Loss

SG Output (MHz)	Power Meter Raw Without Cable (dBm)	Power Meter Raw With Cable (dBm)	Cable Loss (dB)	Remark
1000	-0.23	-1.11	0.88	• SG Output : 0dBm
2450	-0.87	-2.36	1.49	
5250	-1.67	-3.43	1.76	
12500	-3.69	-9.37	5.68	
26000	-5.55	-19.13	13.58	

Test plots of 1 Mbps data rates

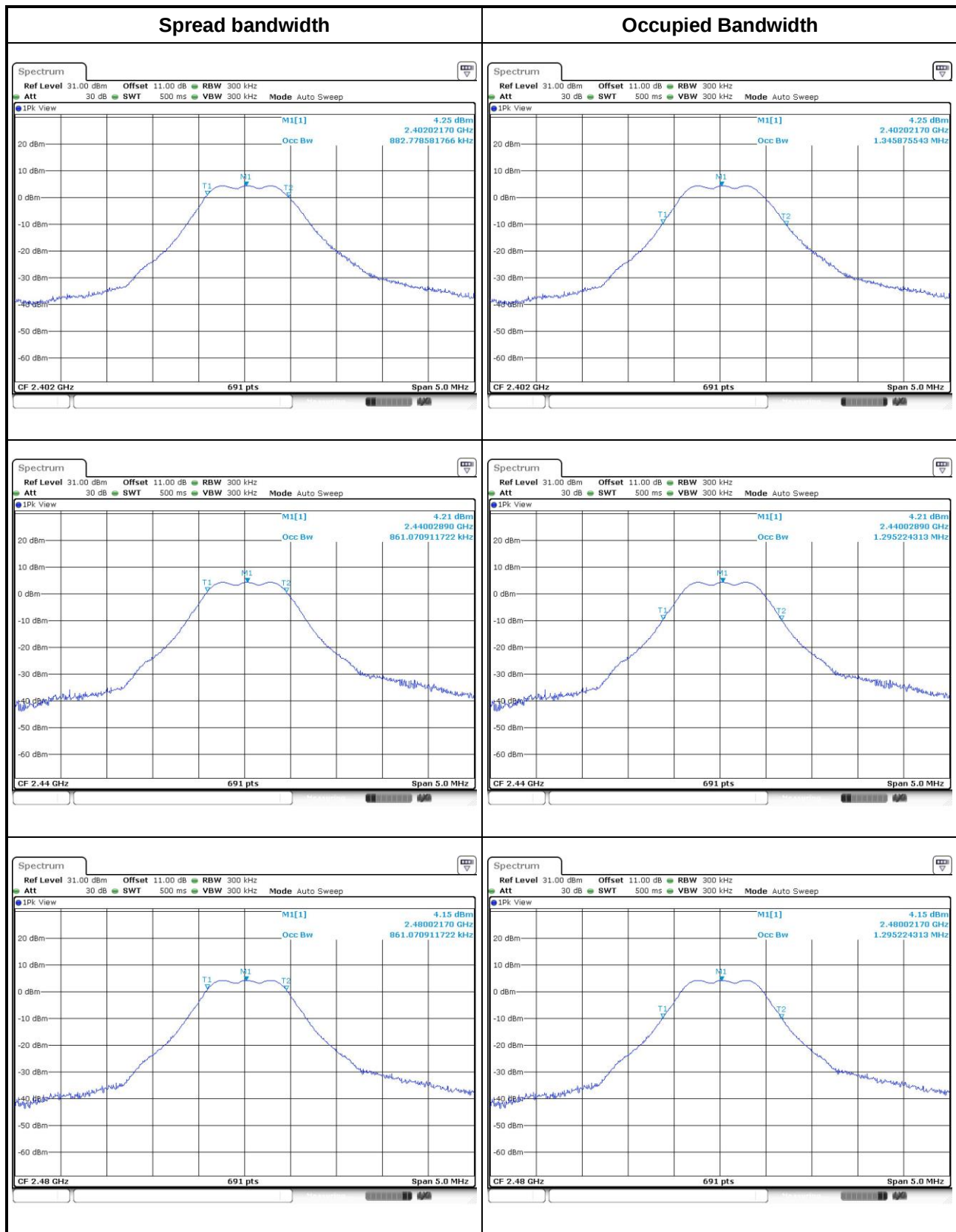
Occupied and Spread Bandwidth

1.7 Vdc



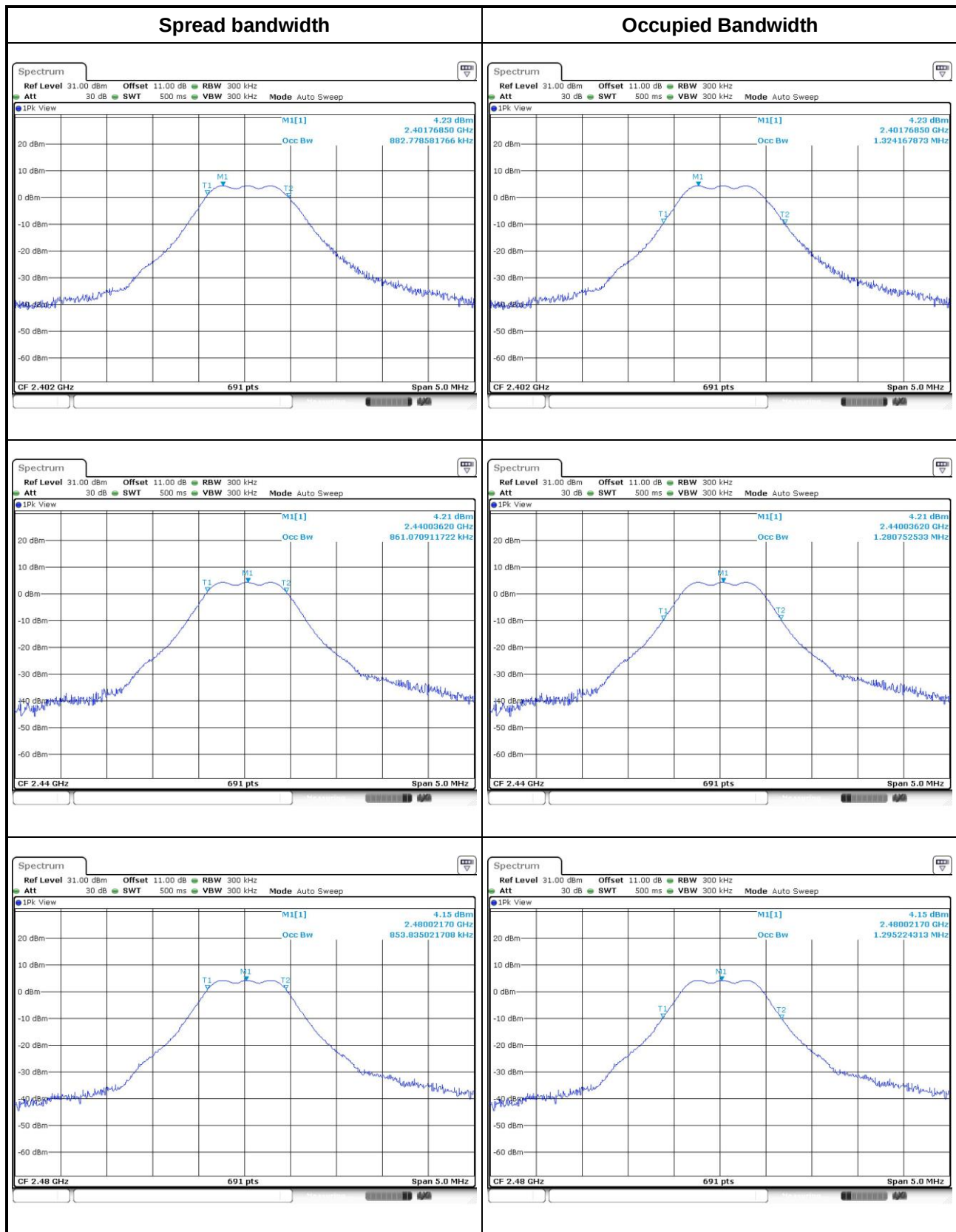
Test plots of 1 Mbps data rates

3.3 Vdc



Test plots of 1 Mbps data rates

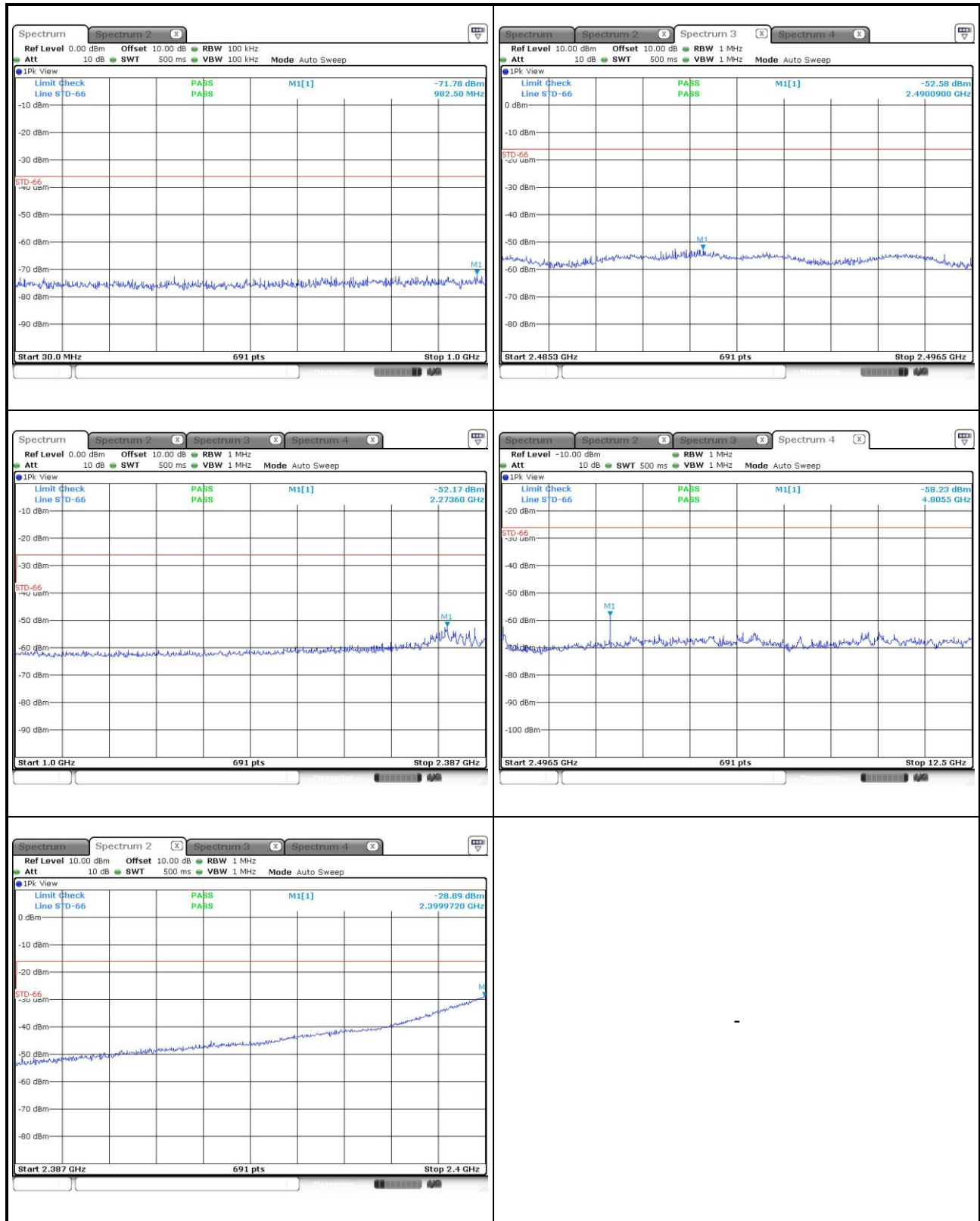
3.6 Vdc



Test plots of 1 Mbps data rates

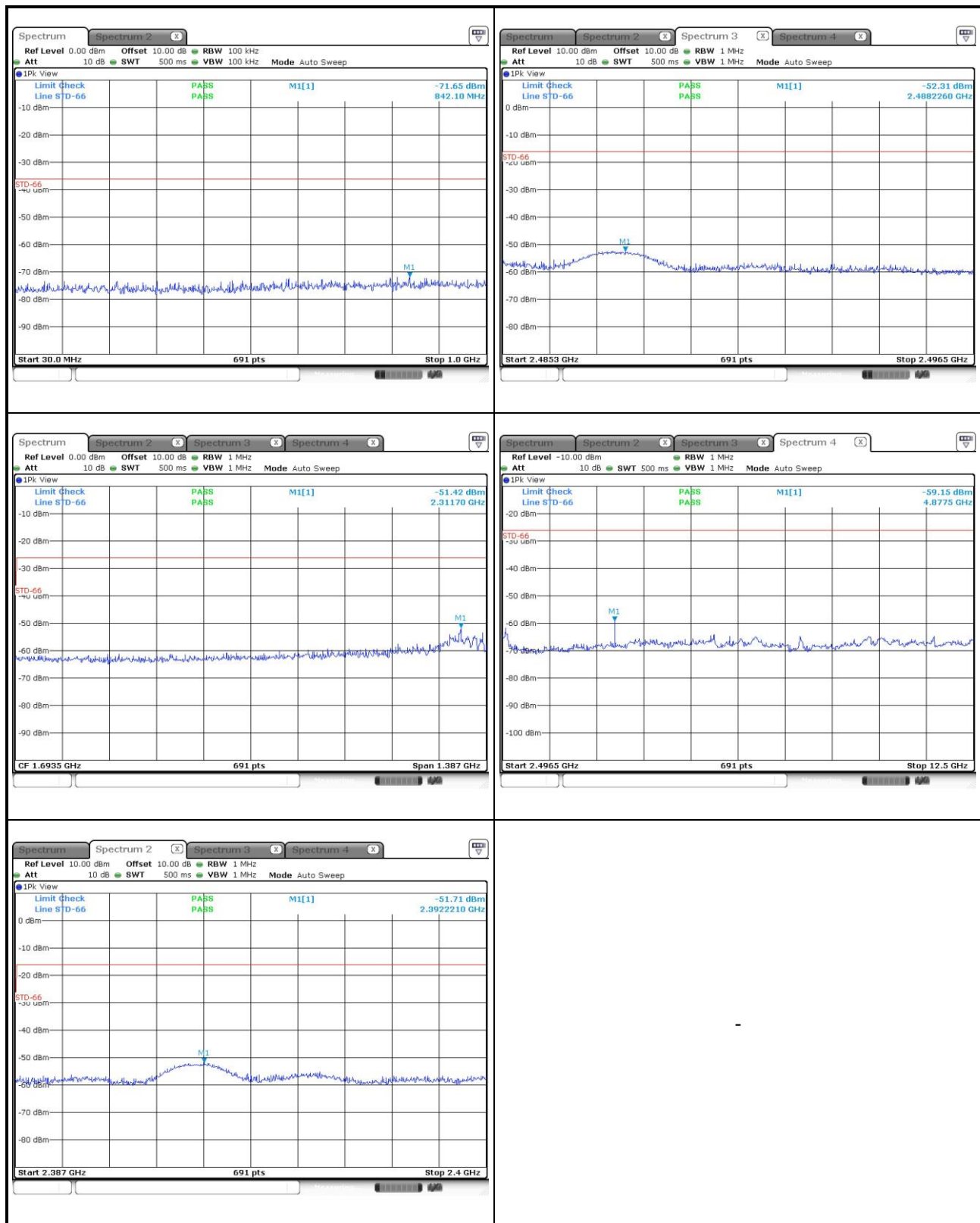
TX spurious Emission

1.7 Vdc / 2402 MHz



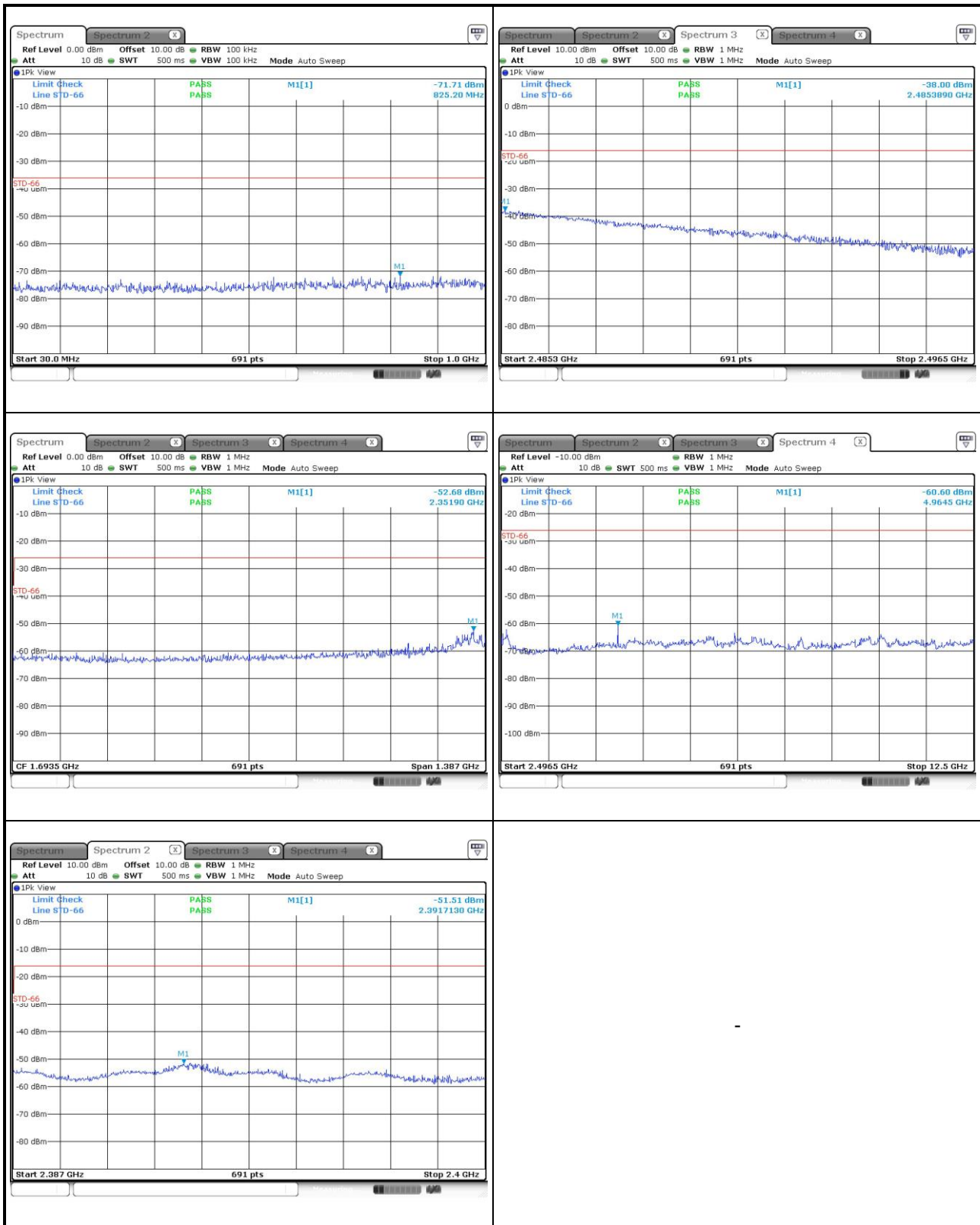
Test plots of 1 Mbps data rates

1.7 Vdc / 2440 MHz



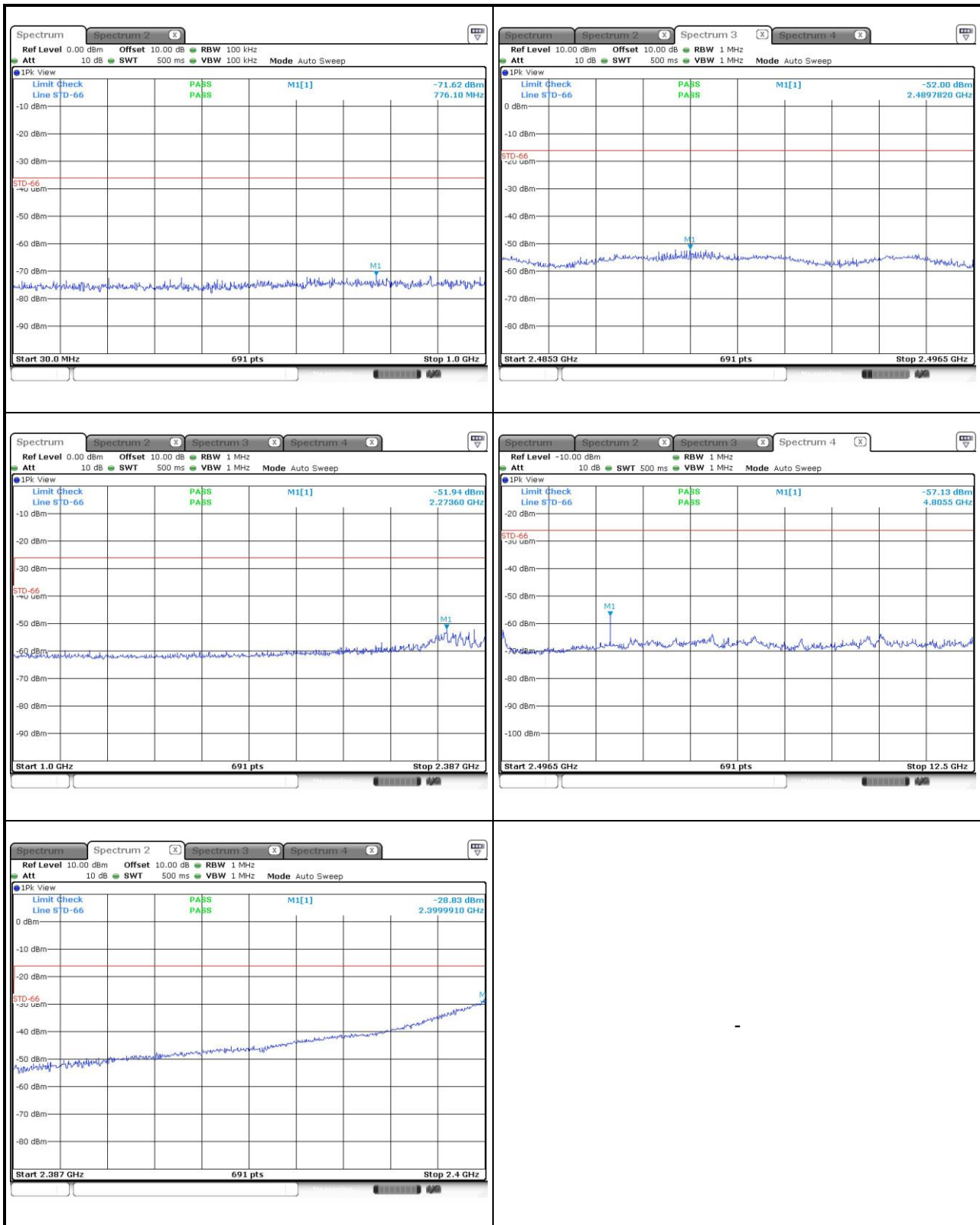
Test plots of 1 Mbps data rates

1.7 Vdc / 2480 MHz



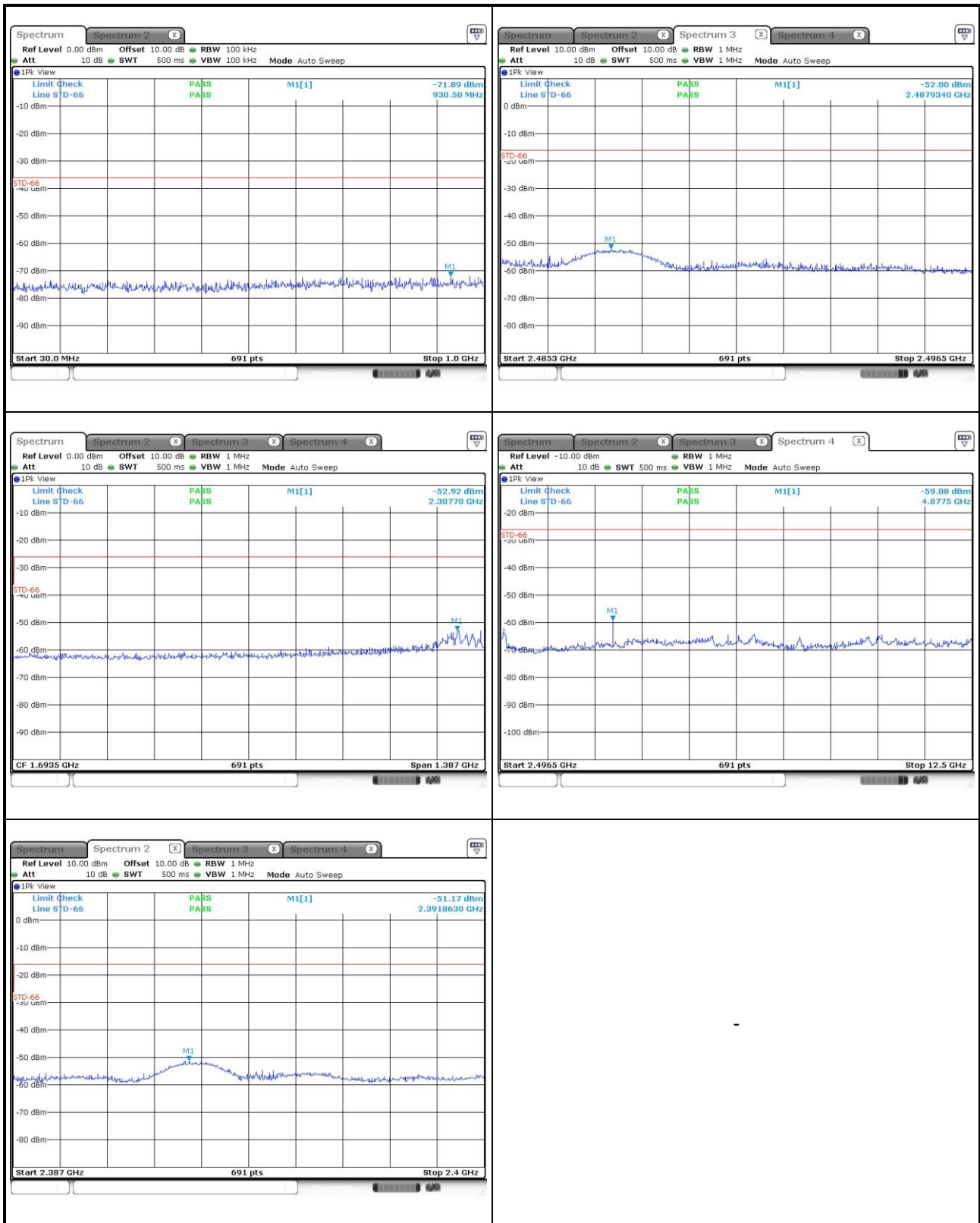
Test plots of 1 Mbps data rates

3.3 Vdc / 2402 MHz



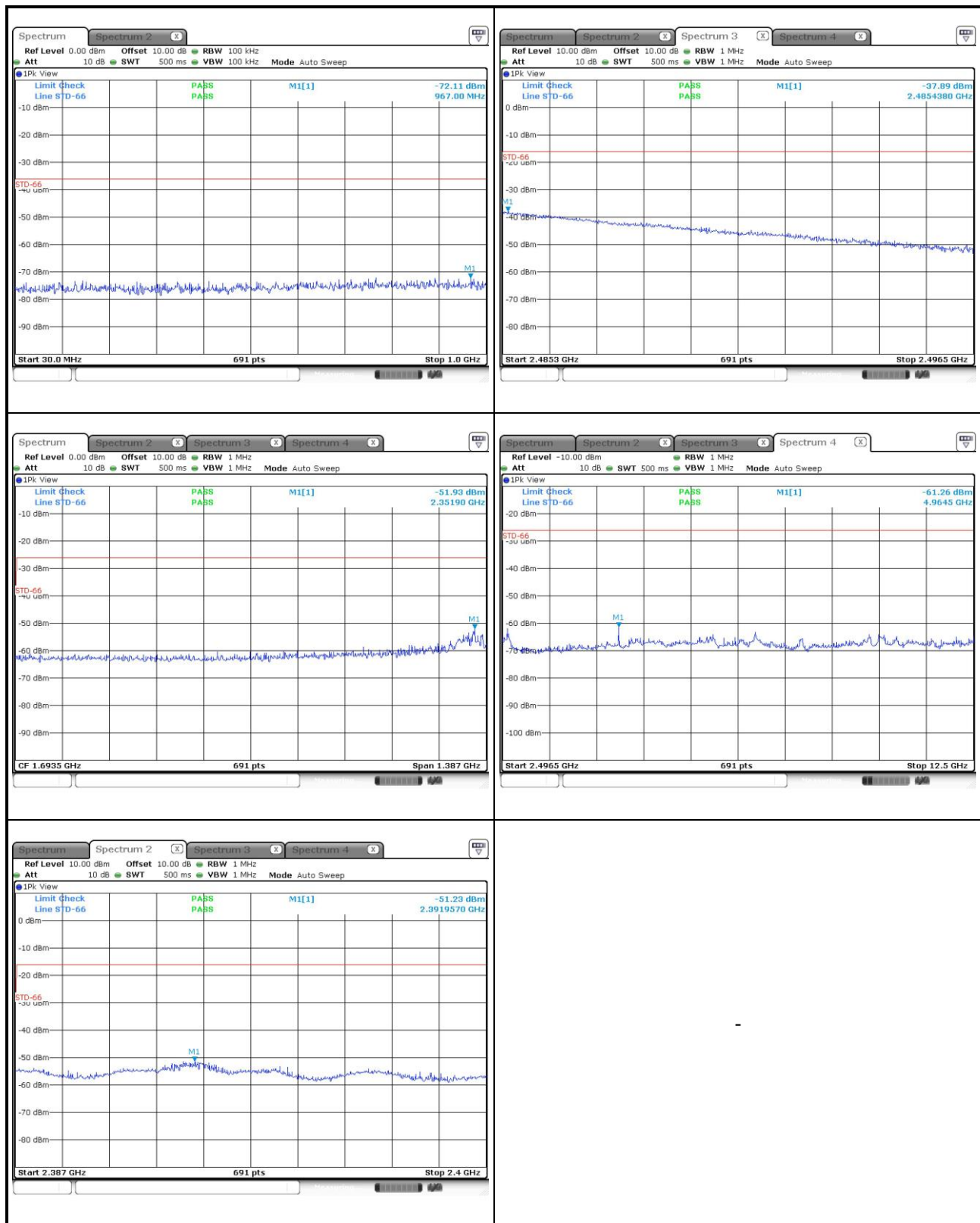
Test plots of 1 Mbps data rates

3.3 Vdc / 2440 MHz



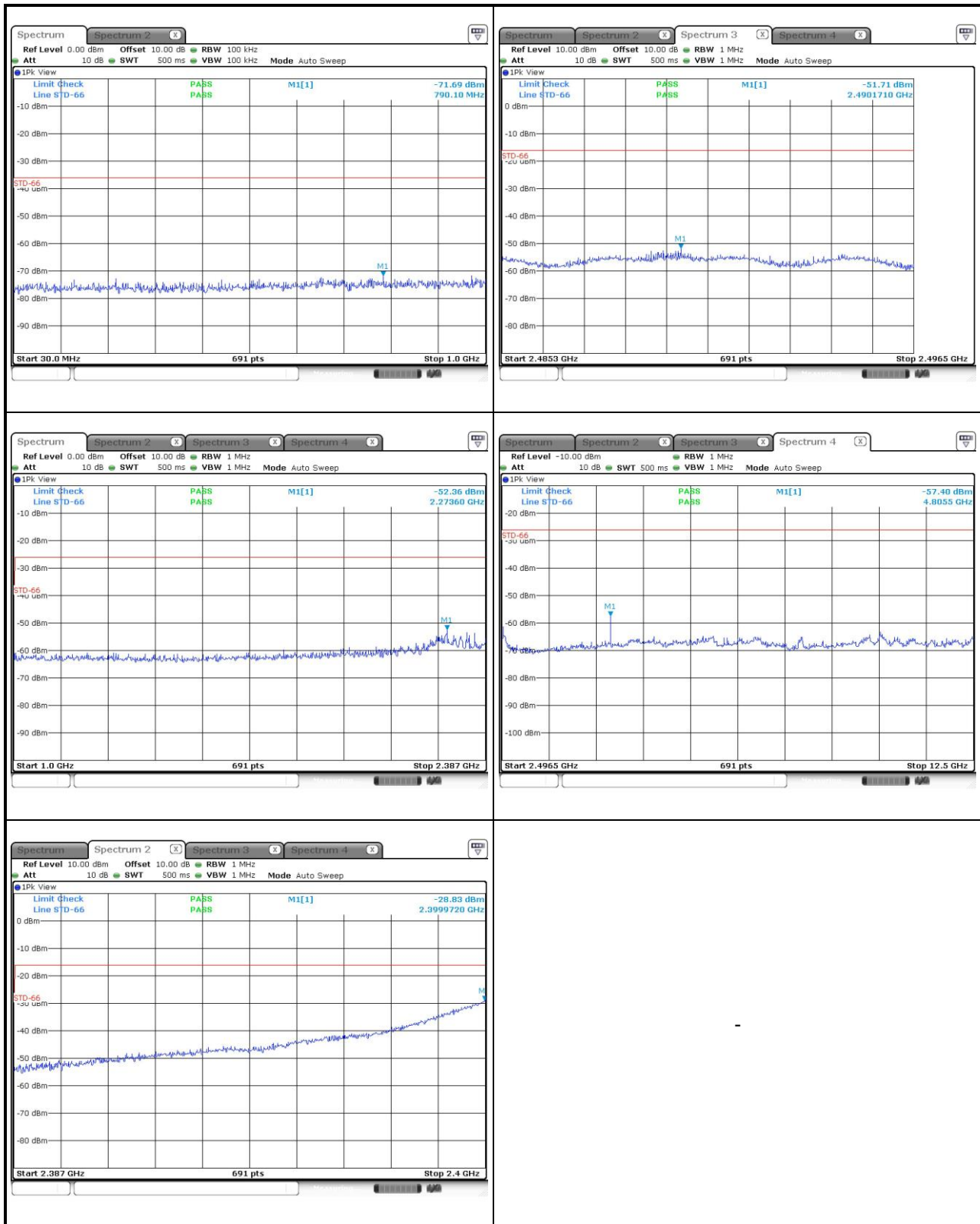
Test plots of 1 Mbps data rates

3.3 Vdc / 2480 MHz



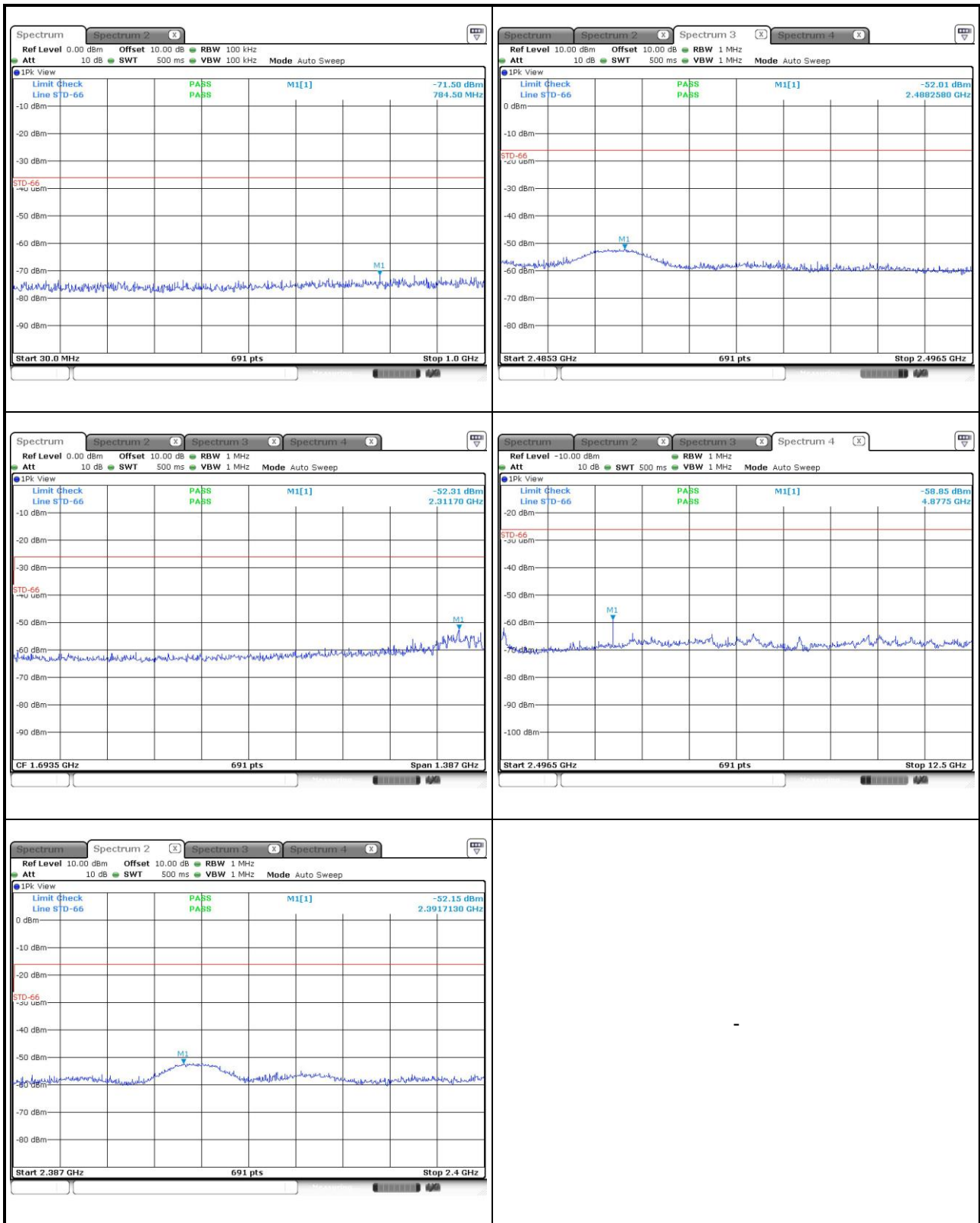
Test plots of 1 Mbps data rates

3.6 Vdc / 2402 MHz



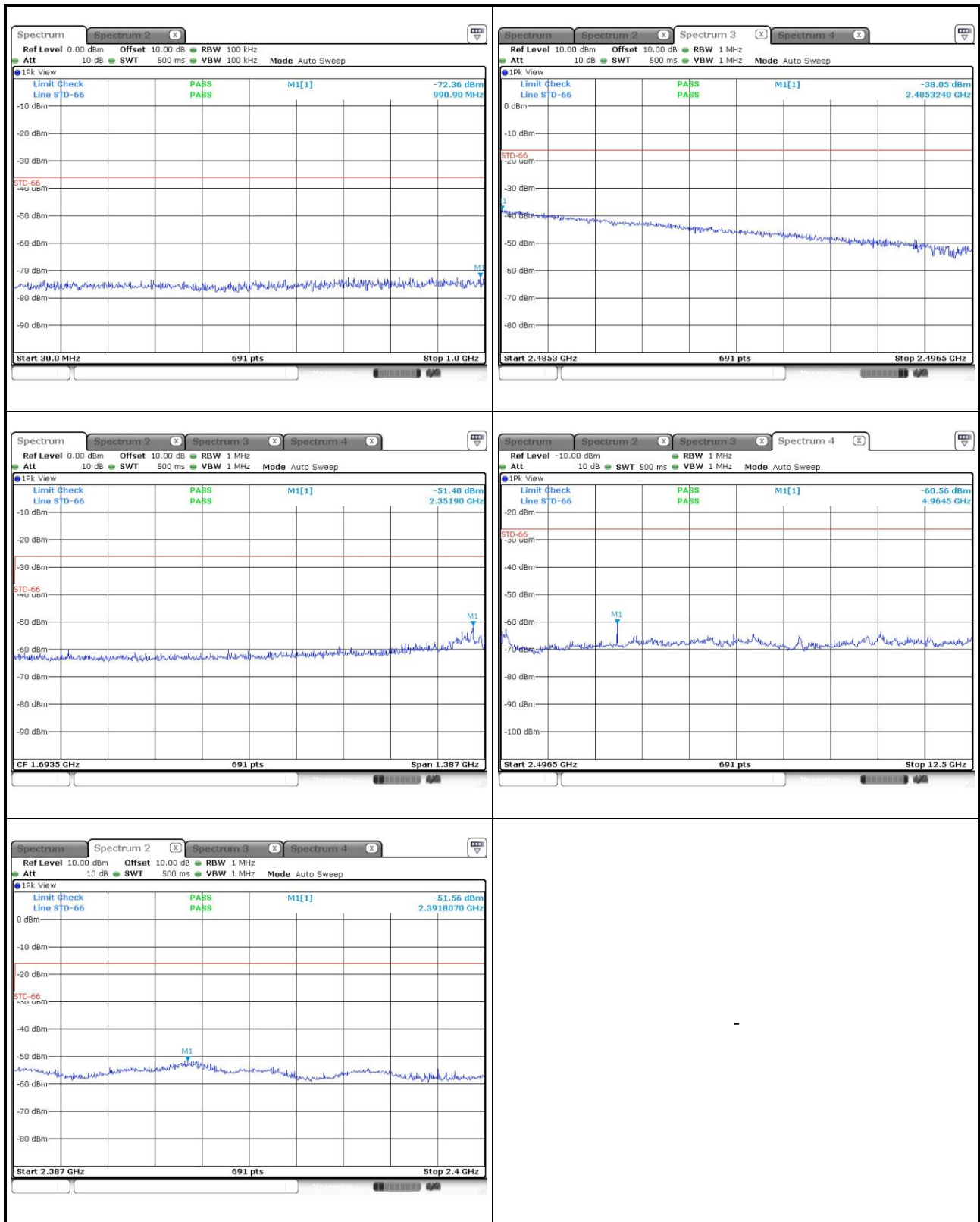
Test plots of 1 Mbps data rates

3.6 Vdc / 2440 MHz



Test plots of 1 Mbps data rates

3.6 Vdc / 2480 MHz

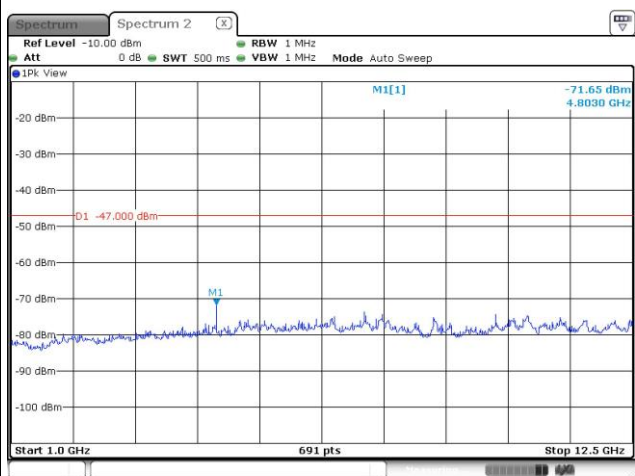
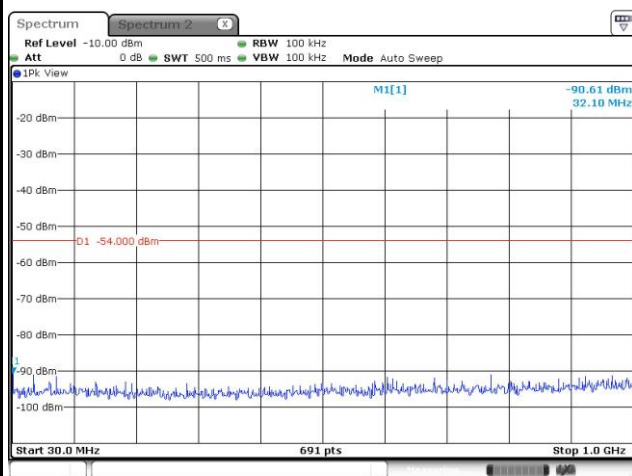


Test plots of 1 Mbps data rates

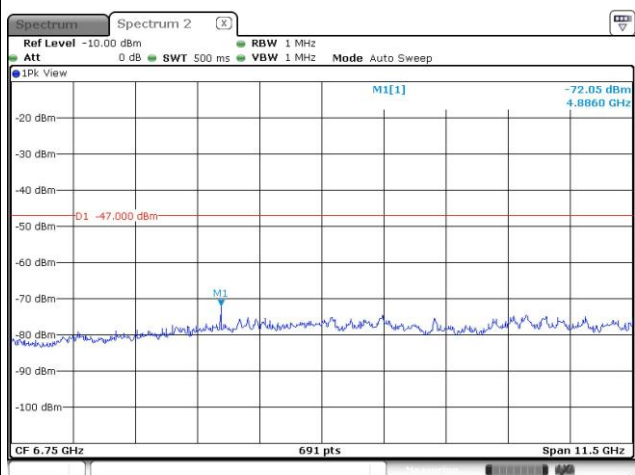
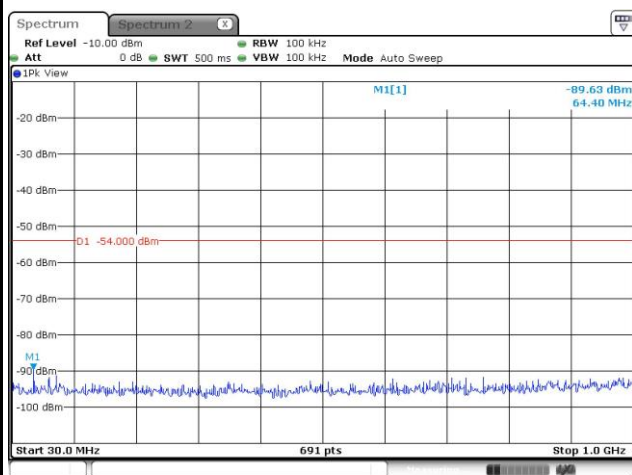
Receiver Emission

1.7 Vdc

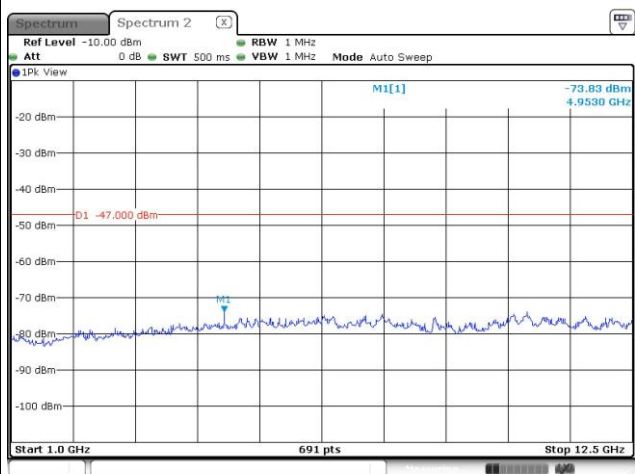
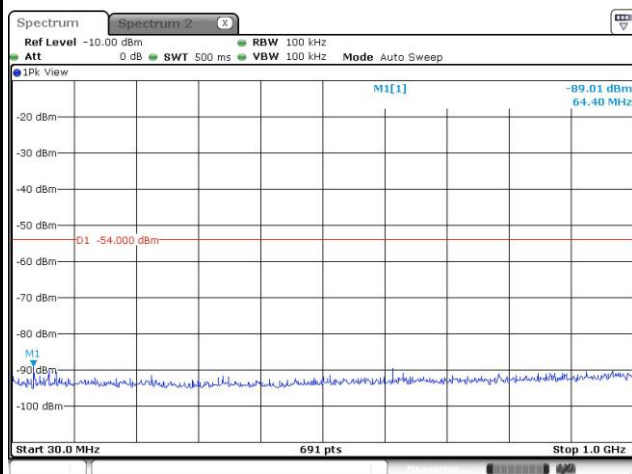
2402 MHz



2440 MHz

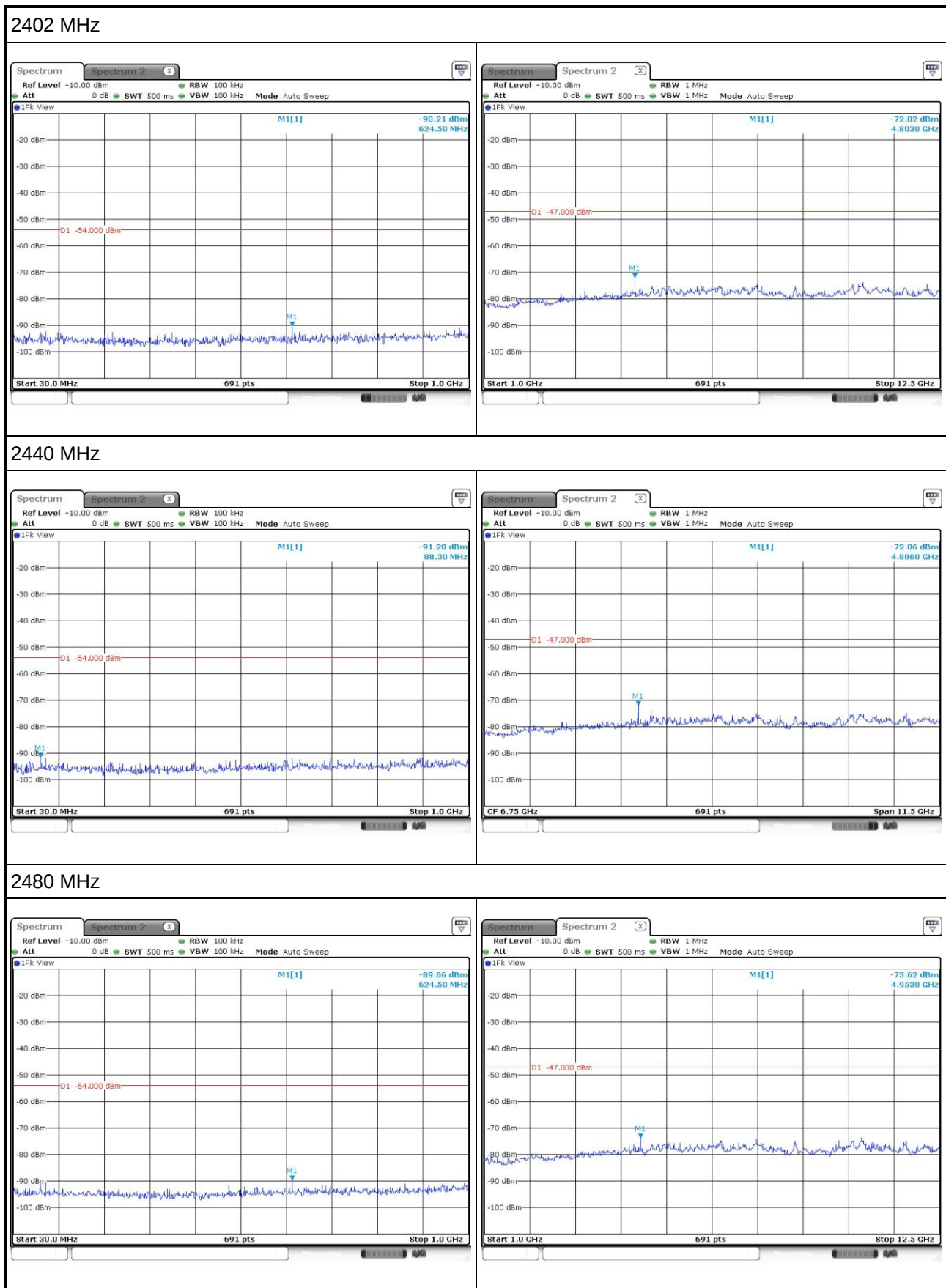


2480 MHz



Test plots of 1 Mbps data rates

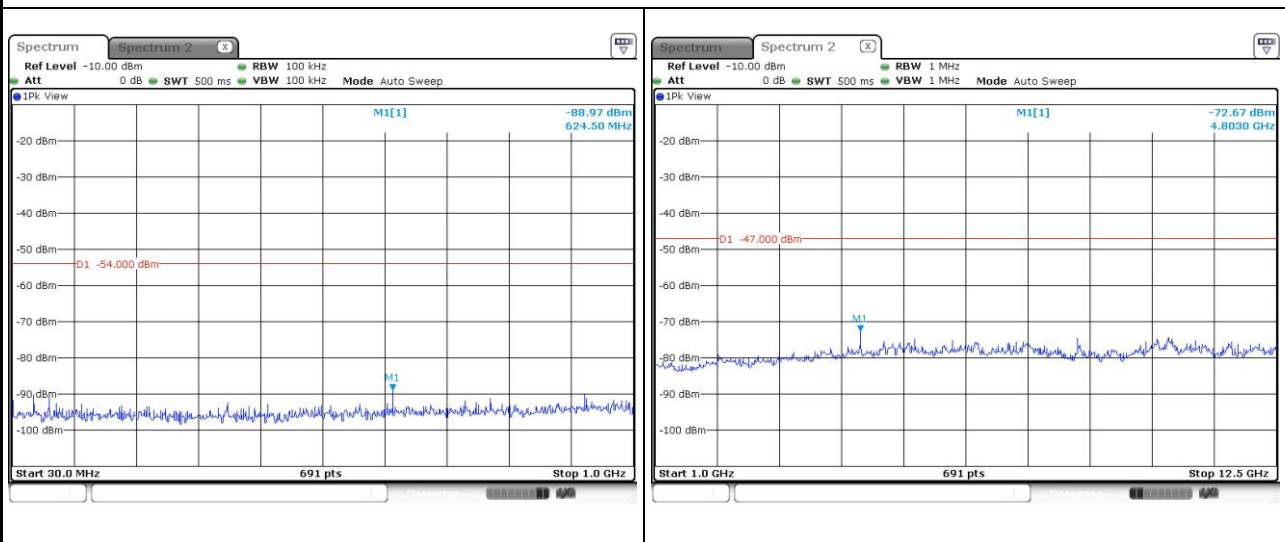
3.3 Vdc



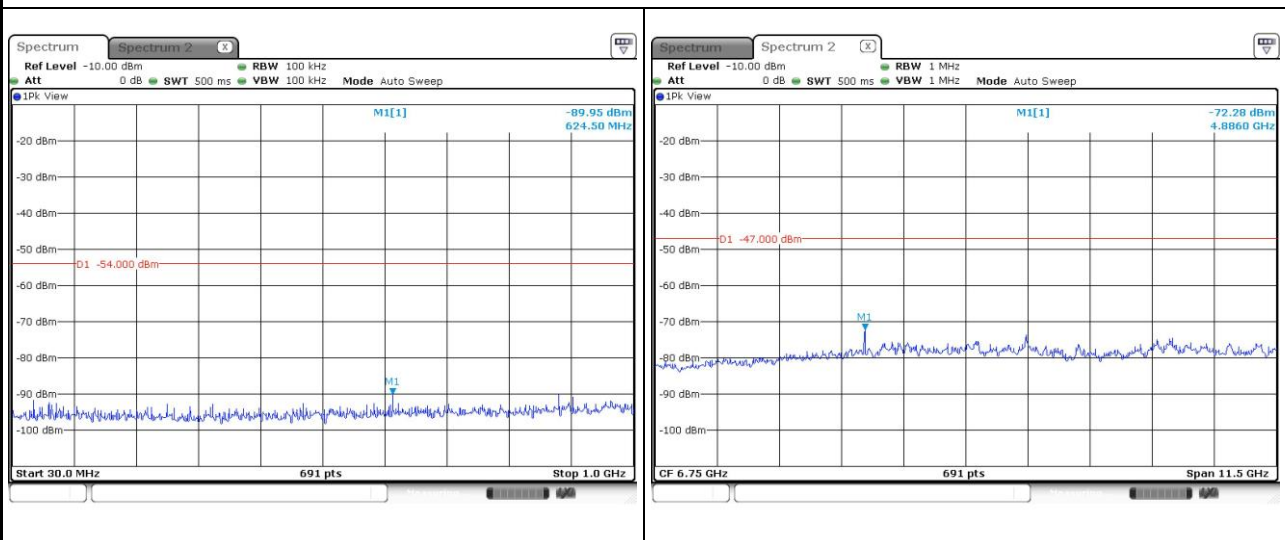
Test plots of 1 Mbps data rates

3.6 Vdc

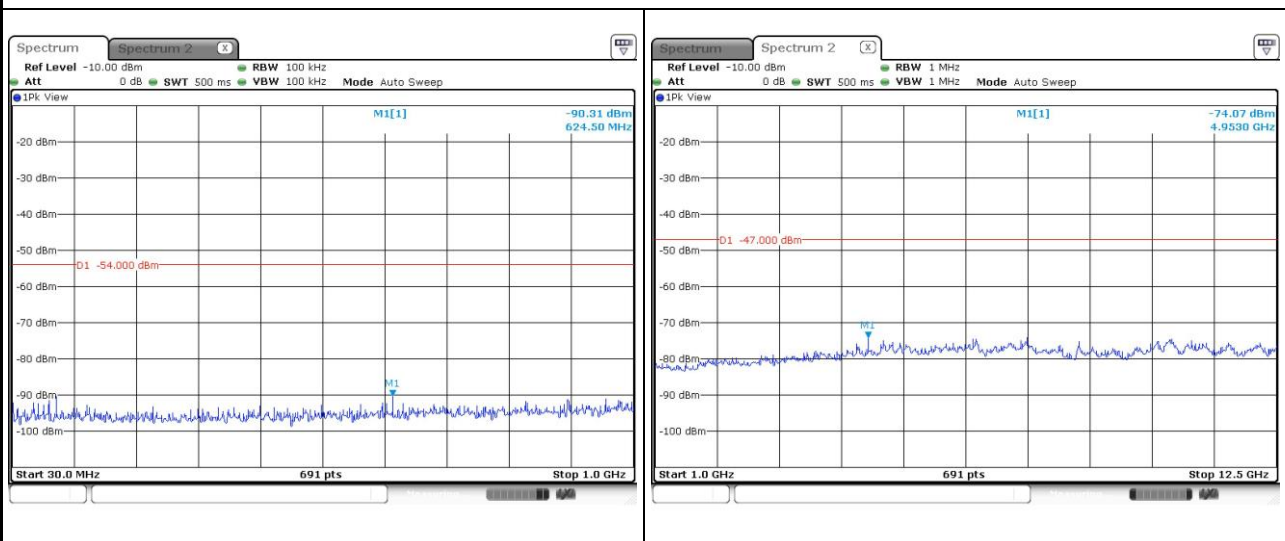
2402 MHz



2440 MHz



2480 MHz



Test results of 2 Mbps data rate



Power Tolerance-DTS Result

Appendix A.1

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	4.28	2.679	2.5	7.17	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE(2Mbps)	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	4.24	2.655	2.50	6.18	20	-80
2402MHz_TnomVmin	Pass	4.27	2.673	2.50	6.92	20	-80
2402MHz_TnomVmax	Pass	4.28	2.679	2.50	7.17	20	-80
2440MHz_TnomVnom	Pass	4.19	2.624	2.50	4.97	20	-80
2440MHz_TnomVmin	Pass	4.16	2.606	2.50	4.25	20	-80
2440MHz_TnomVmax	Pass	4.20	2.630	2.50	5.21	20	-80
2480MHz_TnomVnom	Pass	4.17	2.612	2.50	4.49	20	-80
2480MHz_TnomVmin	Pass	4.08	2.559	2.50	2.34	20	-80
2480MHz_TnomVmax	Pass	4.11	2.576	2.50	3.05	20	-80



Total Power-DTS Result

Appendix A.2

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE(2Mbps)	4.28	2.679	4.78	3.006

P1 = Port 1 output power; Power = Total power sum by P1;

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power (mW)	Power Lim. (mW)	EIRP (dBm)	EIRP (mW)	EIRP Lim. (mW)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	0.50	4.24	2.655	10	4.74	2.979	16.368
2402MHz_TnomVmin	Pass	0.50	4.27	2.673	10	4.77	2.999	16.368
2402MHz_TnomVmax	Pass	0.50	4.28	2.679	10	4.78	3.006	16.368
2440MHz_TnomVnom	Pass	0.50	4.19	2.624	10	4.69	2.944	16.368
2440MHz_TnomVmin	Pass	0.50	4.16	2.606	10	4.66	2.924	16.368
2440MHz_TnomVmax	Pass	0.50	4.20	2.630	10	4.70	2.951	16.368
2480MHz_TnomVnom	Pass	0.50	4.17	2.612	10	4.67	2.931	16.368
2480MHz_TnomVmin	Pass	0.50	4.08	2.559	10	4.58	2.871	16.368
2480MHz_TnomVmax	Pass	0.50	4.11	2.576	10	4.61	2.890	16.368

P1 = Port 1 output power; Power = Total power sum by P1;



Frequency Tolerance-DTS Result

Appendix B

Summary

Mode	Result	Ch (Hz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
2.4-2.4835GHz	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	2.48G	2.479967G	-13.306	±50	1	-



Frequency Tolerance-DTS Result

Appendix B

Result

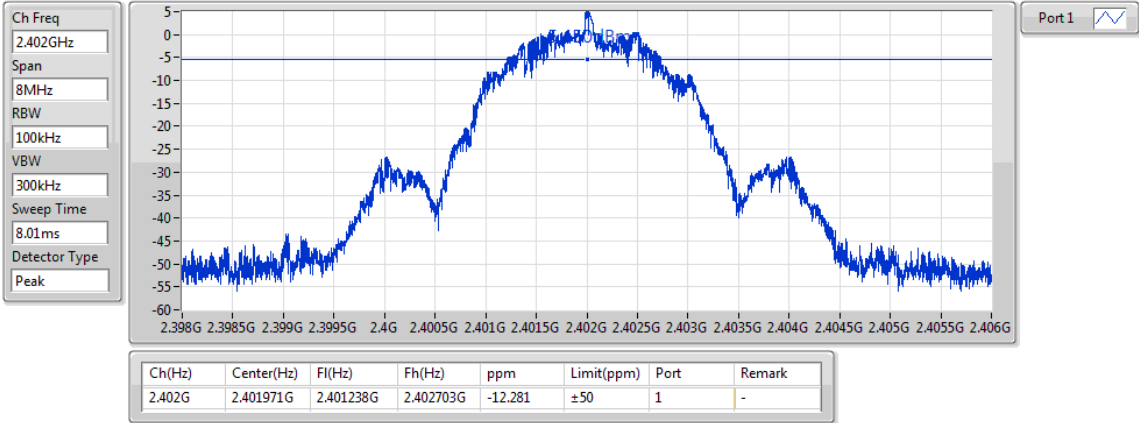
Mode	Result	Ch (Hz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
BT-LE(2Mbps)	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.402G	2.401971G	-12.281	±50	1	-
2402MHz_TnomVmin	Pass	2.402G	2.401981G	-8.118	±50	1	-
2402MHz_TnomVmax	Pass	2.402G	2.401981G	-8.014	±50	1	-
2440MHz_TnomVnom	Pass	2.44G	2.439983G	-7.172	±50	1	-
2440MHz_TnomVmin	Pass	2.44G	2.439981G	-7.787	±50	1	-
2440MHz_TnomVmax	Pass	2.44G	2.439983G	-6.967	±50	1	-
2480MHz_TnomVnom	Pass	2.48G	2.479968G	-13.004	±50	1	-
2480MHz_TnomVmin	Pass	2.48G	2.479967G	-13.306	±50	1	-
2480MHz_TnomVmax	Pass	2.48G	2.479969G	-12.5	±50	1	-



BT-LE(2Mbps)

Freq. Stability

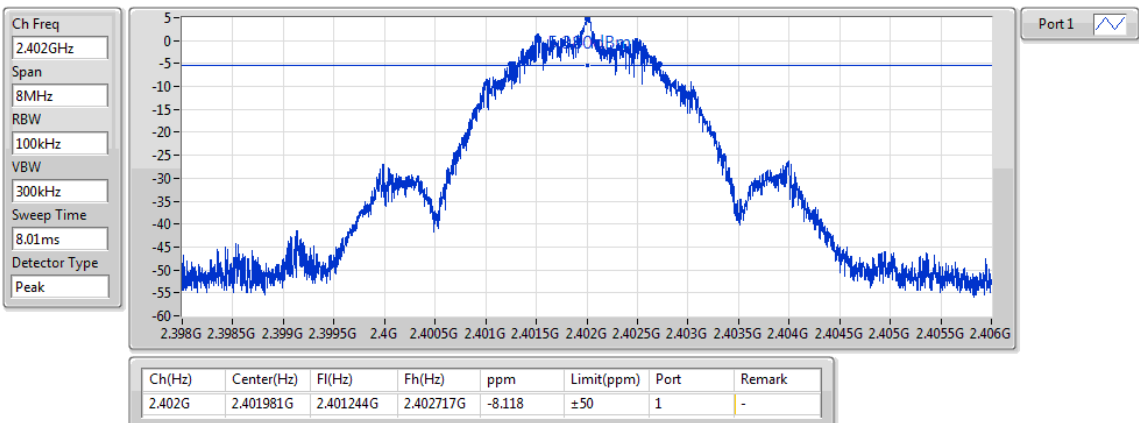
2402MHz_TnomVnom



BT-LE(2Mbps)

Freq. Stability

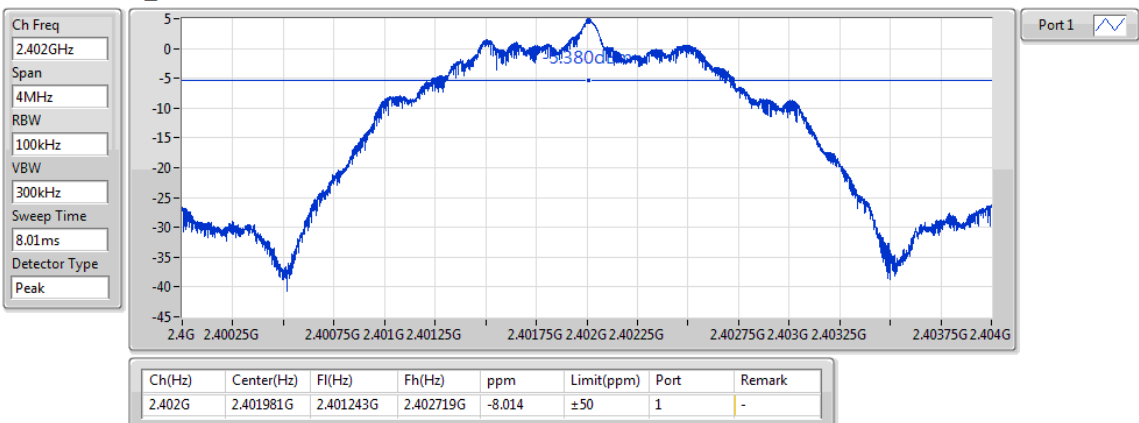
2402MHz_TnomVmin



BT-LE(2Mbps)

Freq. Stability

2402MHz_TnomVmax

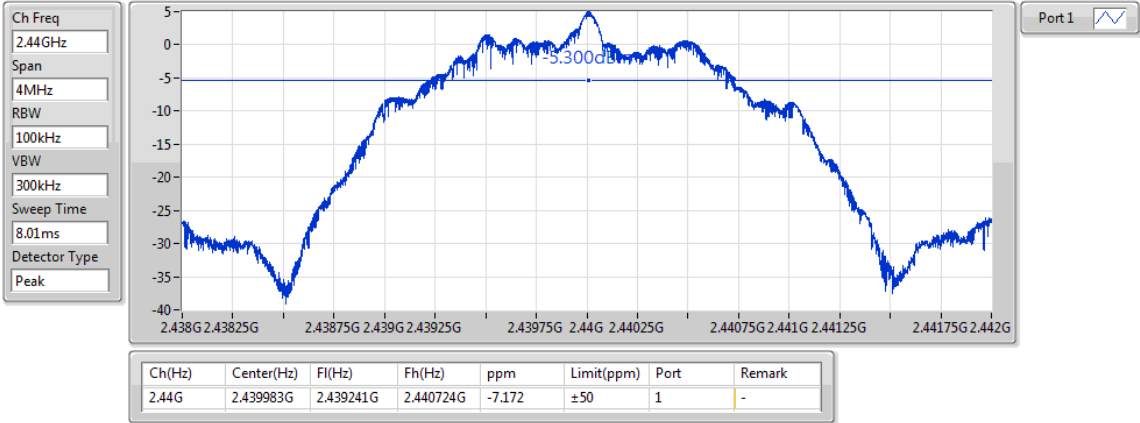




BT-LE(2Mbps)

Freq. Stability

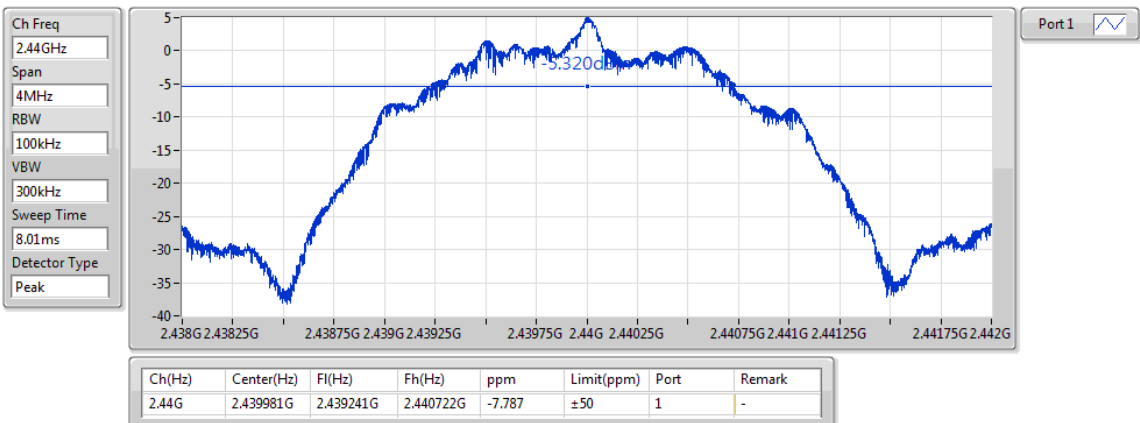
2440MHz_TnomVnom



BT-LE(2Mbps)

Freq. Stability

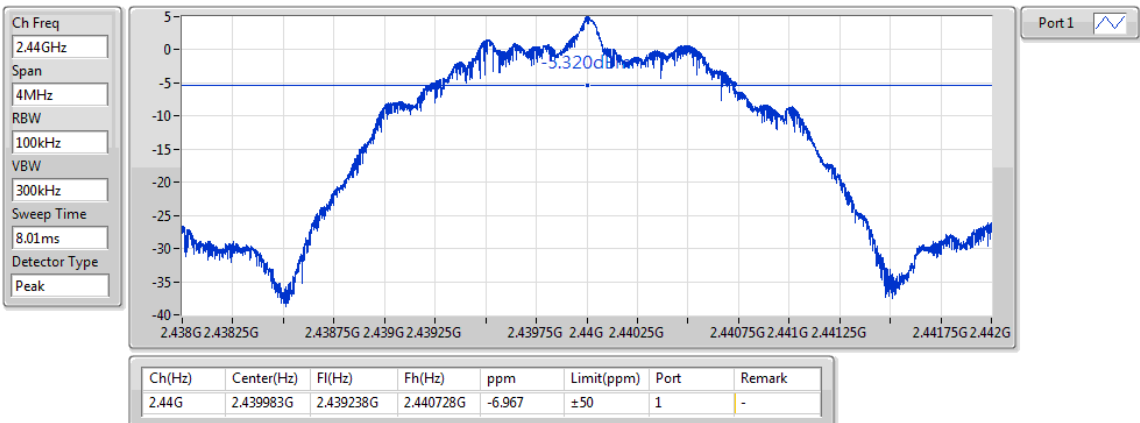
2440MHz_TnomVmin



BT-LE(2Mbps)

Freq. Stability

2440MHz_TnomVmax

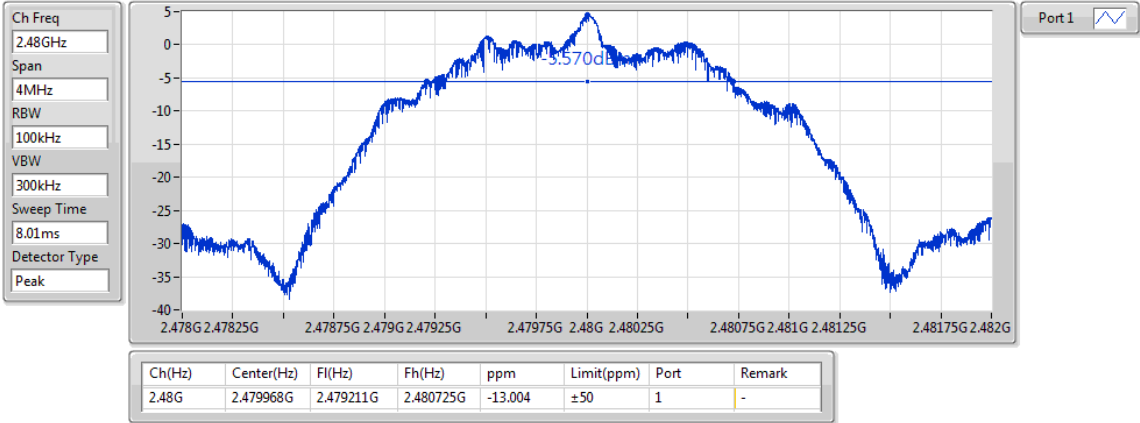




BT-LE(2Mbps)

Freq. Stability

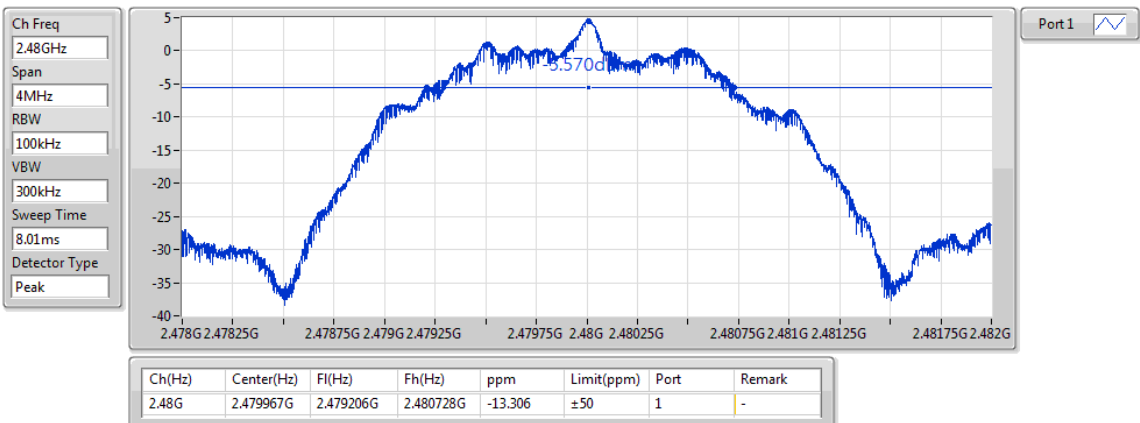
2480MHz_TnomVnom



BT-LE(2Mbps)

Freq. Stability

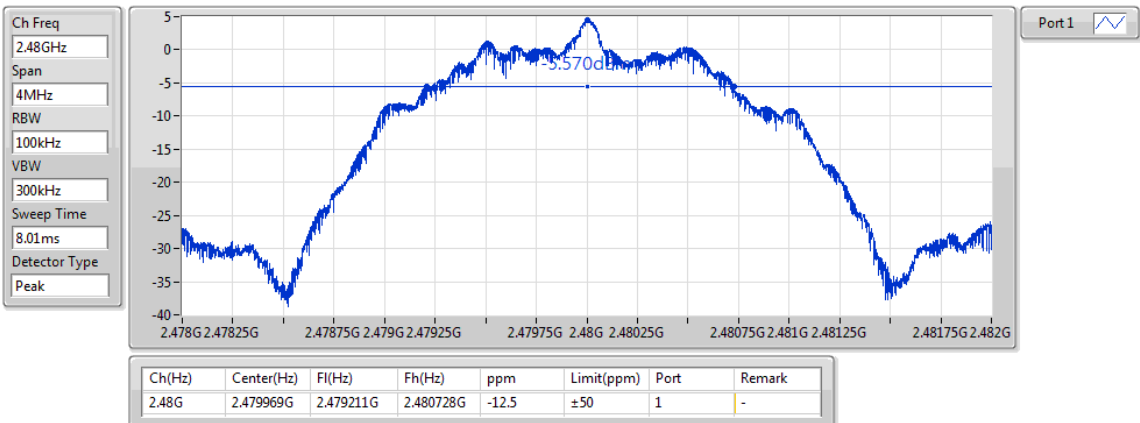
2480MHz_TnomVmin



BT-LE(2Mbps)

Freq. Stability

2480MHz_TnomVmax





Occupied Bandwidth-DTS Result

Appendix C

Summary

Mode	Max-OBW (MHz)	ITU-Code	Min-OBW (MHz)
2.4-2.4835GHz	-	-	-
BT-LE(2Mbps)	2.199	2M20F1D	2.191

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

Result

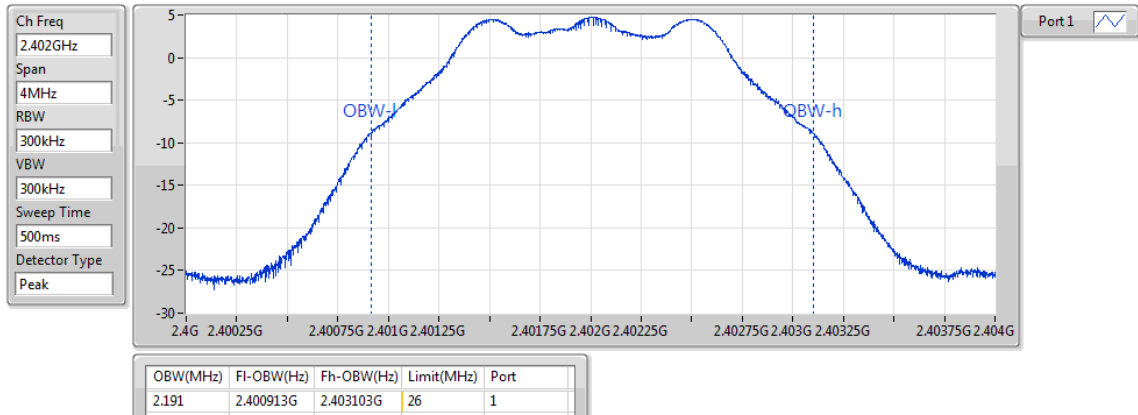
Mode	Result	Limit (MHz)	P1-OBW (MHz)
BT-LE(2Mbps)	-	-	-
2402MHz_TnomVnom	Pass	26	2.191
2402MHz_TnomVmin	Pass	26	2.191
2402MHz_TnomVmax	Pass	26	2.191
2440MHz_TnomVnom	Pass	26	2.195
2440MHz_TnomVmin	Pass	26	2.195
2440MHz_TnomVmax	Pass	26	2.195
2480MHz_TnomVnom	Pass	26	2.199
2480MHz_TnomVmin	Pass	26	2.199
2480MHz_TnomVmax	Pass	26	2.197

P1-OBW = Port 1 99% occupied bandwidth;

BT-LE(2Mbps)

OBW

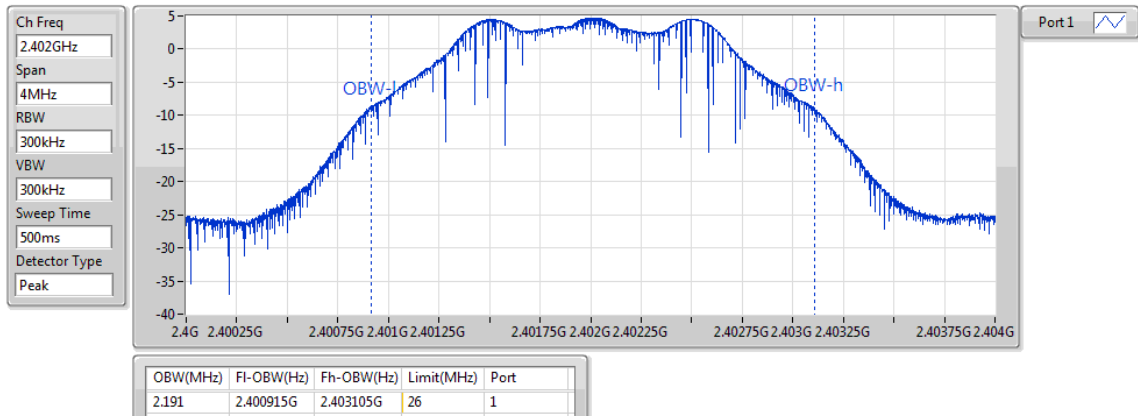
2402MHz_TnomVnom



BT-LE(2Mbps)

OBW

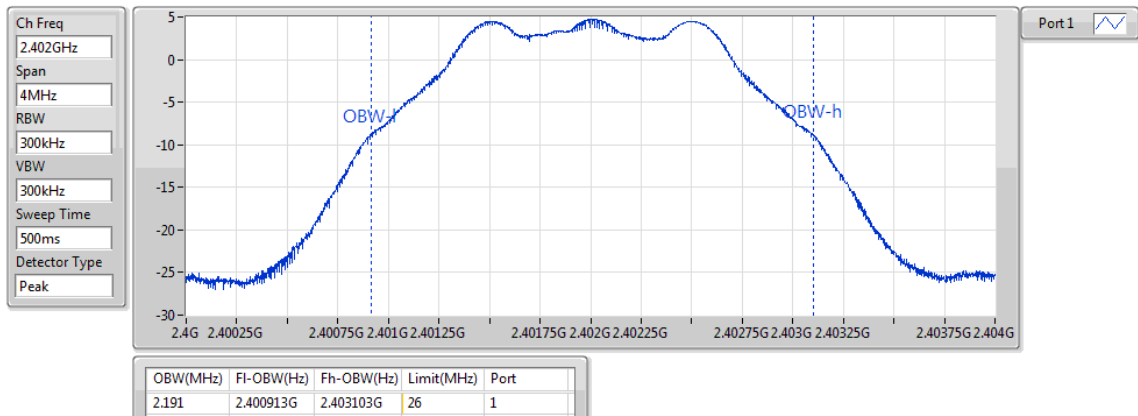
2402MHz_TnomVmin



BT-LE(2Mbps)

OBW

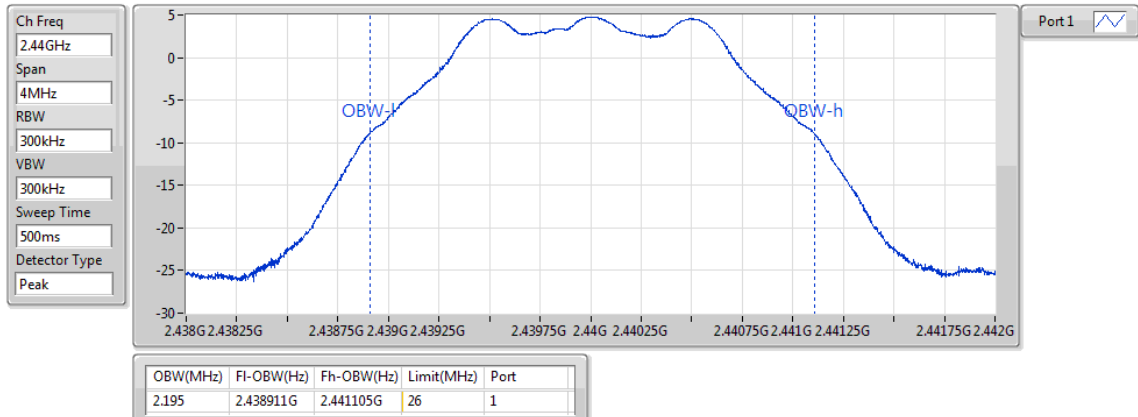
2402MHz_TnomVmax



BT-LE(2Mbps)

OBW

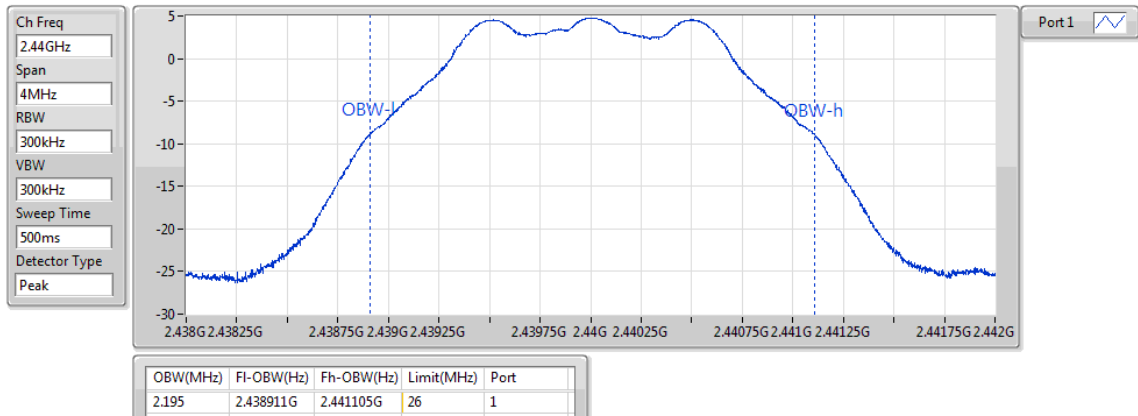
2440MHz_TnomVnom



BT-LE(2Mbps)

OBW

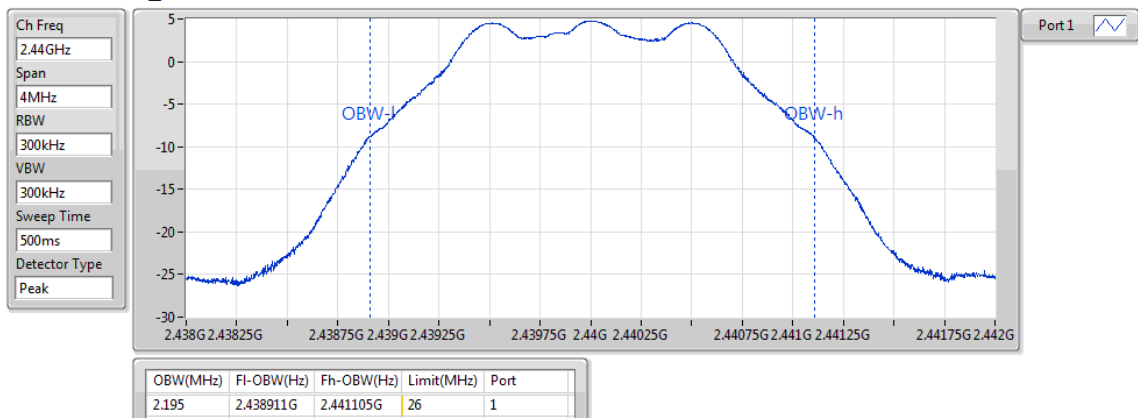
2440MHz_TnomVmin



BT-LE(2Mbps)

OBW

2440MHz_TnomVmax

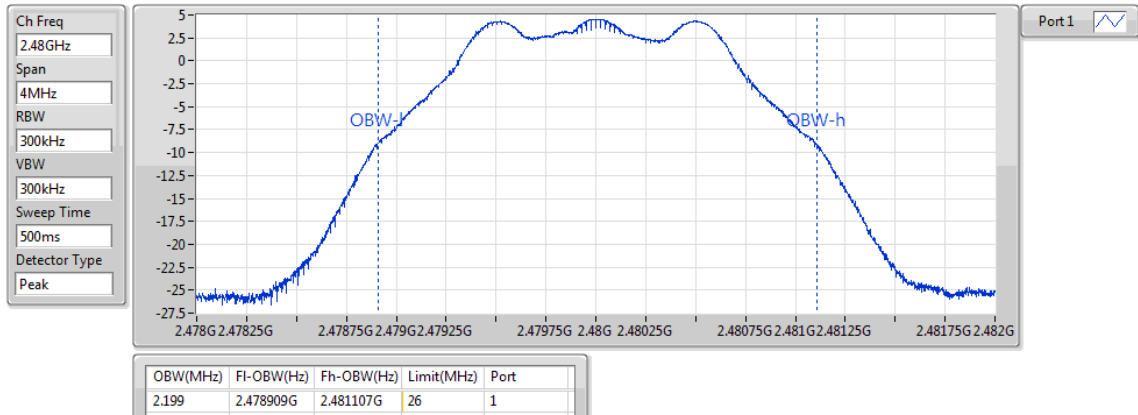




BT-LE(2Mbps)

OBW

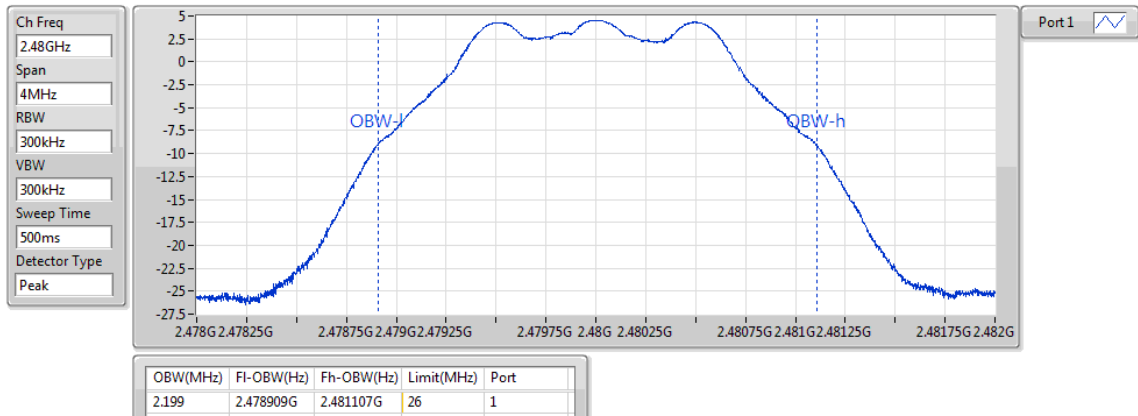
2480MHz_TnomVnom



BT-LE(2Mbps)

OBW

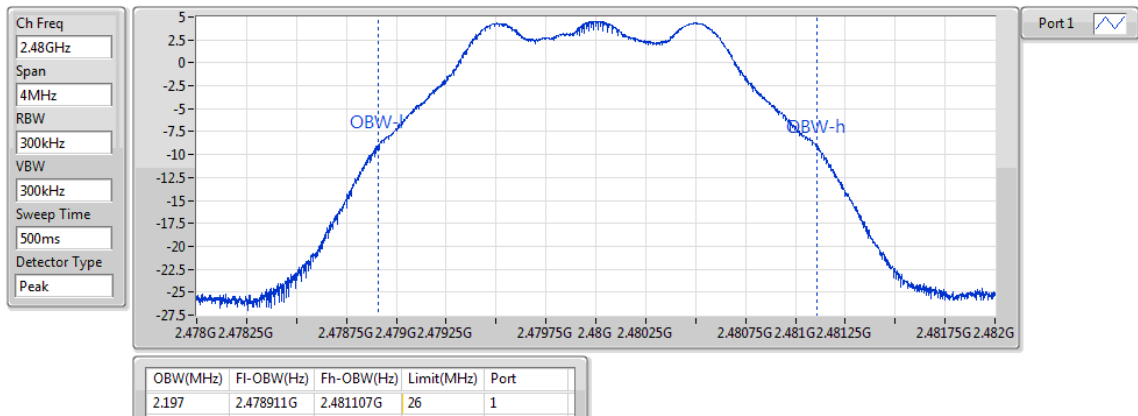
2480MHz_TnomVmin



BT-LE(2Mbps)

OBW

2480MHz_TnomVmax





CSE-TX Unwanted Emission Strength-DTS Result

Appendix D

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)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	2.387G	2.4G	1M	2399.974	-19.97	10.06932	-16.02	25	-3.95

**CSE-TX Unwanted Emission Strength-DTS Result****Appendix D****Result**

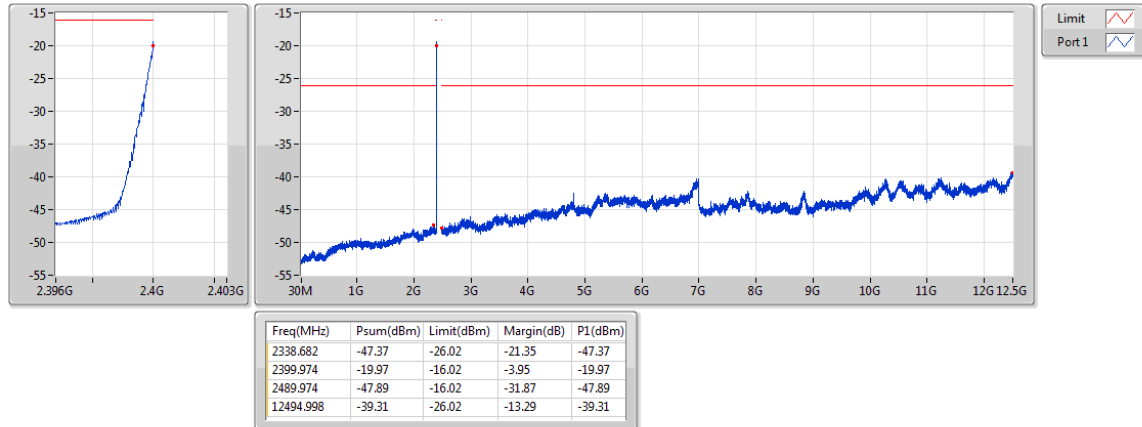
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (uW/MHz)	Limit (dBm)	Limit (uW/MHz)	Margin (dB)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	2.387G	1M	2338.682	-47.37	0.01832	-26.02	2.5	-21.35
2402MHz_TnomVnom	Pass	2.387G	2.4G	1M	2399.974	-19.97	10.06932	-16.02	25	-3.95
2402MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2489.974	-47.89	0.01626	-16.02	25	-31.87
2402MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12494.998	-39.31	0.11722	-26.02	2.5	-13.29
2402MHz_TnomVmin	Pass	30M	2.387G	1M	2298.613	-46.96	0.02014	-26.02	2.5	-20.94
2402MHz_TnomVmin	Pass	2.387G	2.4G	1M	2399.974	-20.51	8.89201	-16.02	25	-4.49
2402MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2490.104	-47.88	0.01629	-16.02	25	-31.86
2402MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12500	-39.21	0.11995	-26.02	2.5	-13.19
2402MHz_TnomVmax	Pass	30M	2.387G	1M	2341.039	-47.56	0.01754	-26.02	2.5	-21.54
2402MHz_TnomVmax	Pass	2.387G	2.4G	1M	2399.974	-20.05	9.88553	-16.02	25	-4.03
2402MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2489.766	-47.84	0.01644	-16.02	25	-31.82
2402MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12491.247	-38.72	0.13428	-26.02	2.5	-12.70
2440MHz_TnomVnom	Pass	30M	2.387G	1M	2351.645	-47.52	0.0177	-26.02	2.5	-21.50
2440MHz_TnomVnom	Pass	2.387G	2.4G	1M	2391.914	-48.13	0.01538	-16.02	25	-32.11
2440MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2488.05	-47.73	0.01687	-16.02	25	-31.71
2440MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12482.494	-39.10	0.12303	-26.02	2.5	-13.08
2440MHz_TnomVmin	Pass	30M	2.387G	1M	2341.039	-47.49	0.01782	-26.02	2.5	-21.47
2440MHz_TnomVmin	Pass	2.387G	2.4G	1M	2391.758	-48.04	0.0157	-16.02	25	-32.02
2440MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2487.946	-47.78	0.01667	-16.02	25	-31.76
2440MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12476.242	-38.69	0.13521	-26.02	2.5	-12.67
2440MHz_TnomVmax	Pass	30M	2.387G	1M	2376.394	-47.54	0.01762	-26.02	2.5	-21.52
2440MHz_TnomVmax	Pass	2.387G	2.4G	1M	2392.226	-48.11	0.01545	-16.02	25	-32.09
2440MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2488.154	-47.79	0.01663	-16.02	25	-31.77
2440MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12492.497	-39.10	0.12303	-26.02	2.5	-13.08
2480MHz_TnomVnom	Pass	30M	2.387G	1M	2336.325	-47.61	0.01734	-26.02	2.5	-21.59
2480MHz_TnomVnom	Pass	2.387G	2.4G	1M	2392.33	-48.08	0.01556	-16.02	25	-32.06
2480MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2483.526	-43.67	0.04295	-16.02	25	-27.65
2480MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12494.998	-39.23	0.1194	-26.02	2.5	-13.21
2480MHz_TnomVmin	Pass	30M	2.387G	1M	2330.432	-47.69	0.01702	-26.02	2.5	-21.67
2480MHz_TnomVmin	Pass	2.387G	2.4G	1M	2391.784	-48.11	0.01545	-16.02	25	-32.09
2480MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2483.526	-43.70	0.04266	-16.02	25	-27.68
2480MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12498.75	-38.67	0.13583	-26.02	2.5	-12.65
2480MHz_TnomVmax	Pass	30M	2.387G	1M	2316.29	-47.59	0.01742	-26.02	2.5	-21.57
2480MHz_TnomVmax	Pass	2.387G	2.4G	1M	2392.07	-48.16	0.01528	-16.02	25	-32.14
2480MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2483.578	-43.90	0.04074	-16.02	25	-27.88
2480MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12492.497	-39.08	0.12359	-26.02	2.5	-13.06



BT-LE(2Mbps)

CSE-TX-

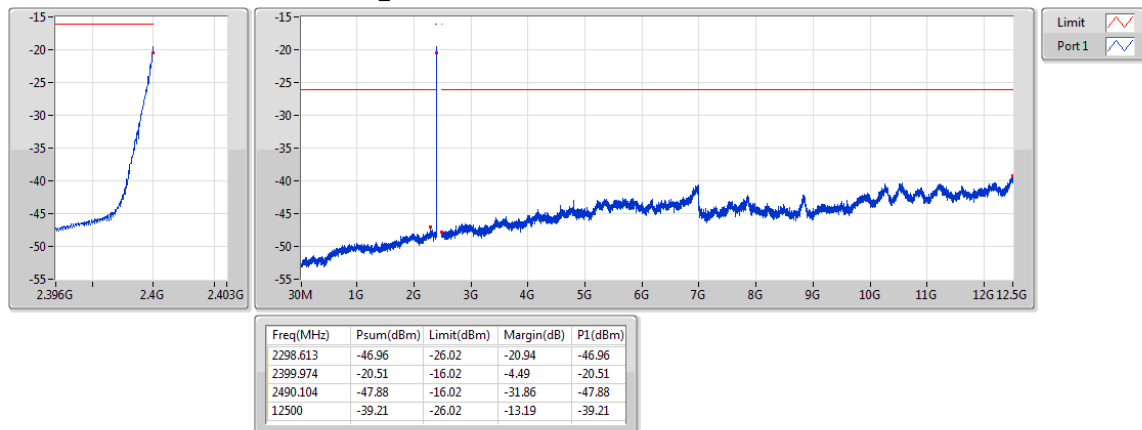
2402MHz_TnomVnom



BT-LE(2Mbps)

CSE-TX-

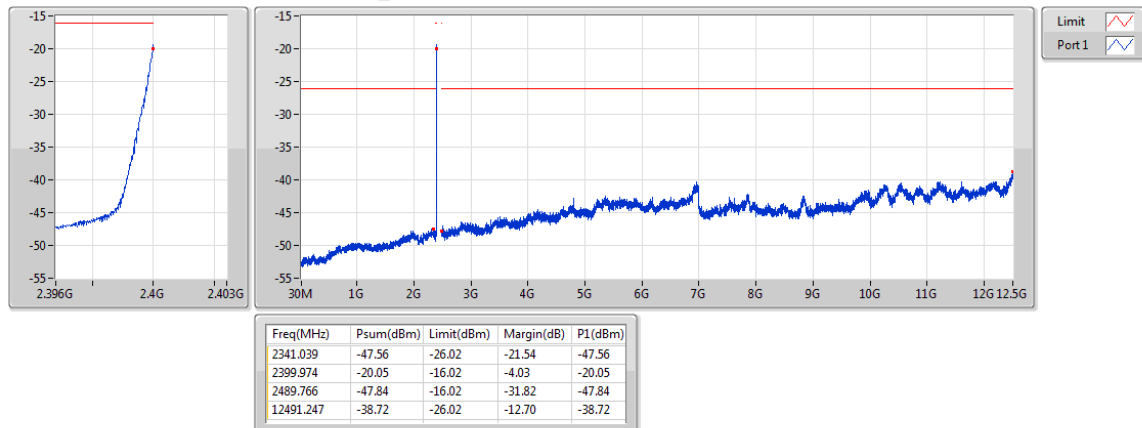
2402MHz_TnomVmin



BT-LE(2Mbps)

CSE-TX-

2402MHz_TnomVmax

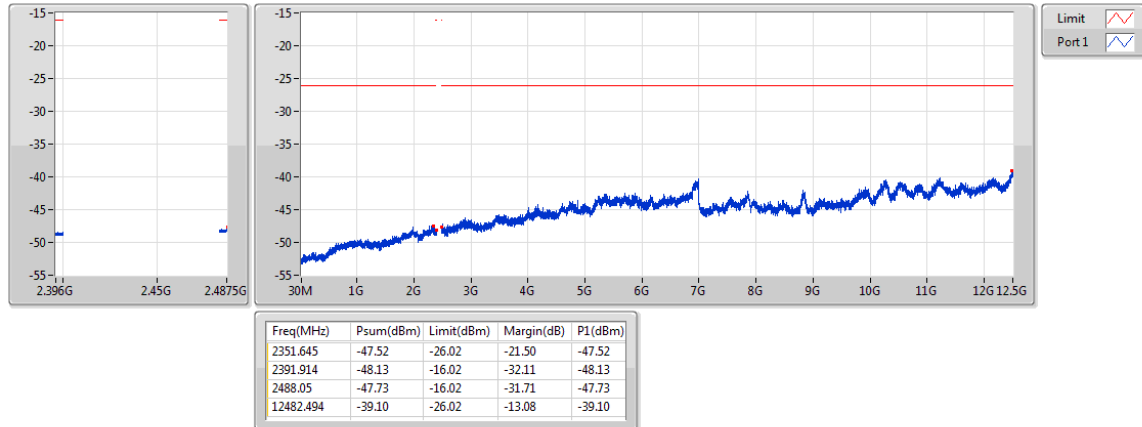




BT-LE(2Mbps)

CSE-TX-

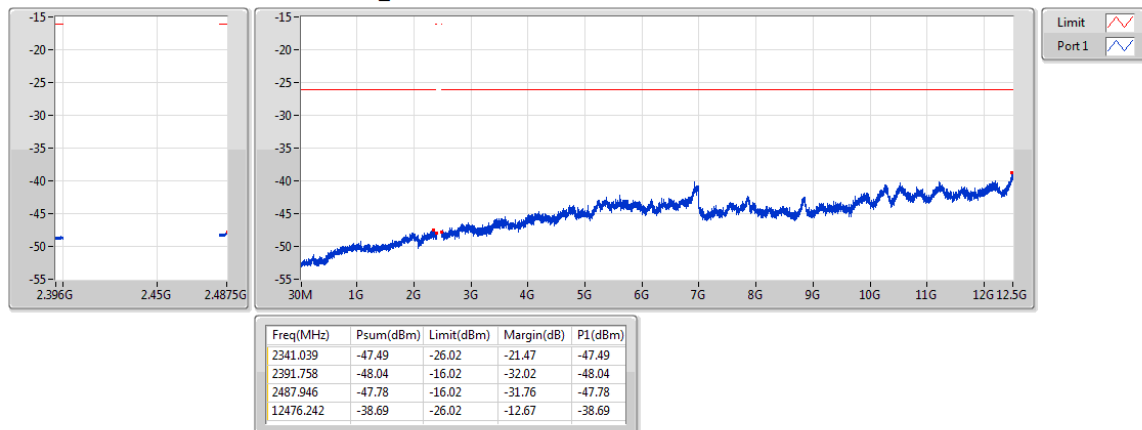
2440MHz_TnomVnom



BT-LE(2Mbps)

CSE-TX-

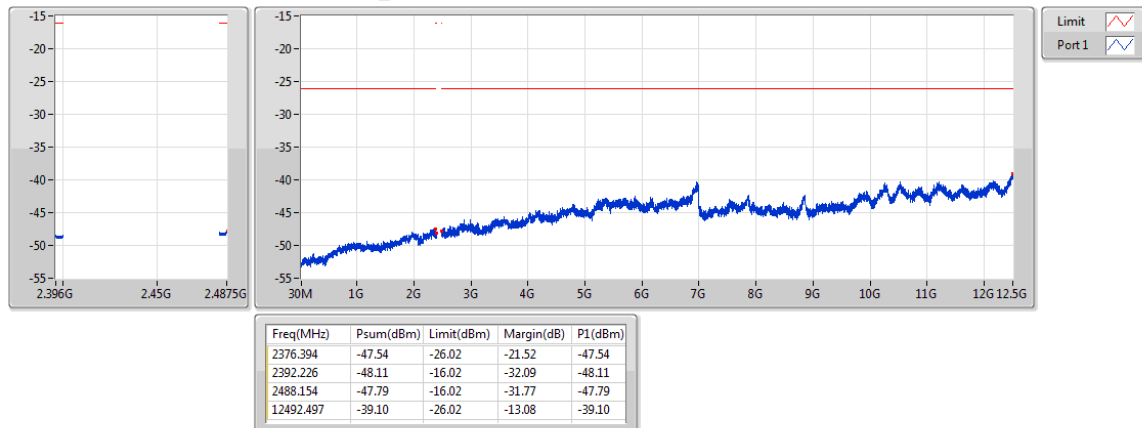
2440MHz_TnomVmin



BT-LE(2Mbps)

CSE-TX-

2440MHz_TnomVmax

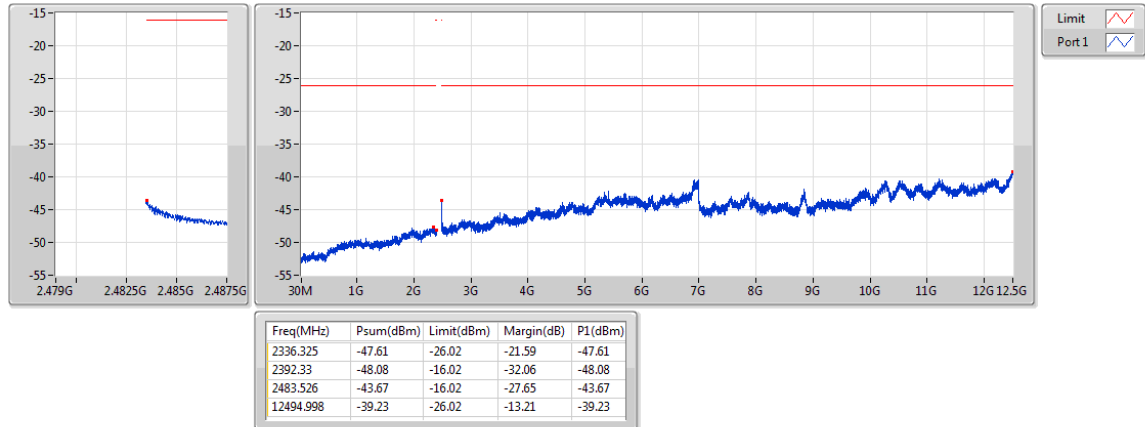




BT-LE(2Mbps)

CSE-TX-

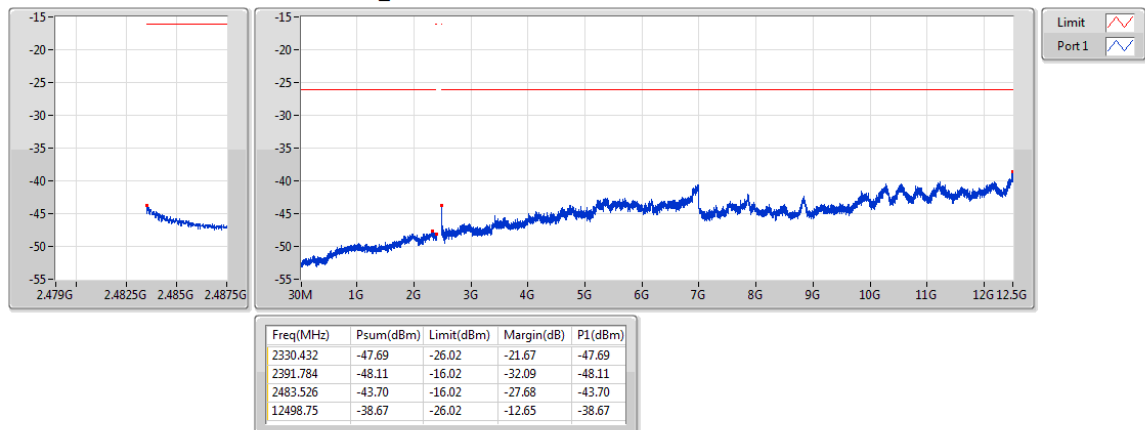
2480MHz_TnomVnom



BT-LE(2Mbps)

CSE-TX-

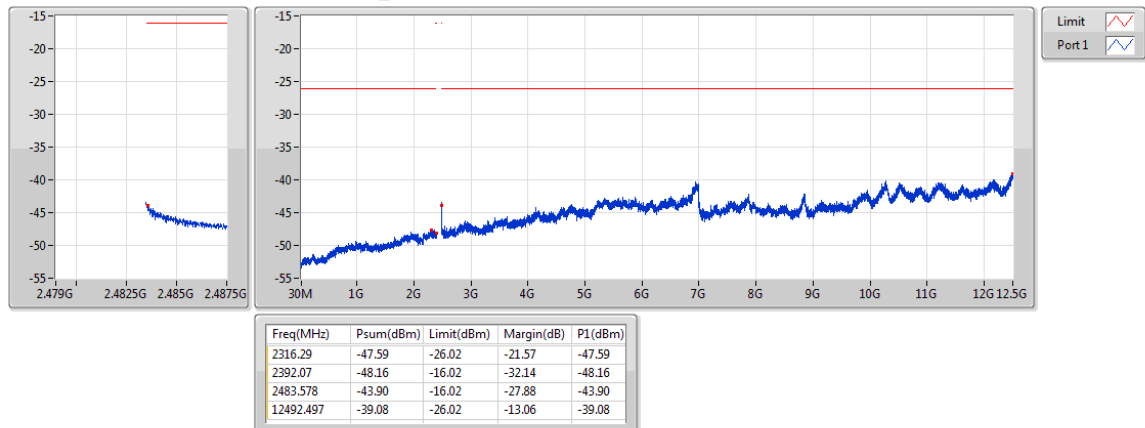
2480MHz_TnomVmin



BT-LE(2Mbps)

CSE-TX-

2480MHz_TnomVmax





Interference Prevention Function-DTSResult

Appendix E

Summary

Mode	Result	ID Length	ID Limit	Function
2.4-2.4835GHz	-	-	-	-
BT-LE(2Mbps)	Pass	CF:12:8D:C6:21:B6	48 bits	Good



Interference Prevention Function-DTSResult

Appendix E

Result

Mode	Result	ID Length	ID Limit	Function
BT-LE(2Mbps)	-	-	-	-
2402MHz_TnomVnom	Pass	CF:12:8D:C6:21:B6	48 bits	Good
2402MHz_TnomVmin	Pass	CF:12:8D:C6:21:B6	48 bits	Good
2402MHz_TnomVmax	Pass	CF:12:8D:C6:21:B6	48 bits	Good
2440MHz_TnomVnom	Pass	CF:12:8D:C6:21:B6	48 bits	Good
2440MHz_TnomVmin	Pass	CF:12:8D:C6:21:B6	48 bits	Good
2440MHz_TnomVmax	Pass	CF:12:8D:C6:21:B6	48 bits	Good
2480MHz_TnomVnom	Pass	CF:12:8D:C6:21:B6	48 bits	Good
2480MHz_TnomVmin	Pass	CF:12:8D:C6:21:B6	48 bits	Good
2480MHz_TnomVmax	Pass	CF:12:8D:C6:21:B6	48 bits	Good



CSE-RX Secondary Radiated Emissions-DTS Result

Appendix F

Summary

Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (nW/MHz)	Limit (dBm)	Limit (nW/MHz)	Margin (dB)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	1G	12.5G	1M	12489.937	-72.64	0.05445	-46.99	20	-25.65

**CSE-RX Secondary Radiated Emissions-DTS Result****Appendix F****Result**

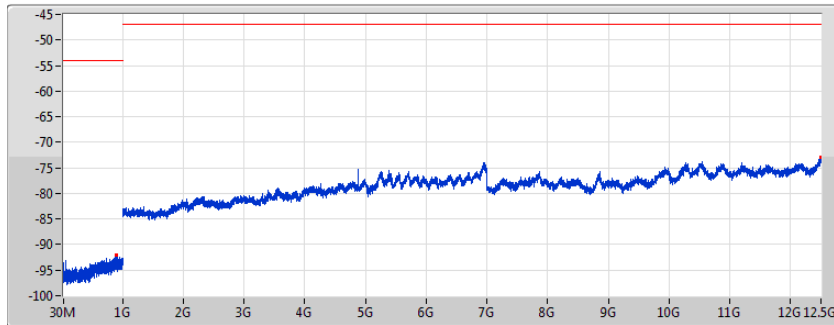
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (nW/MHz)	Limit (dBm)	Limit (nW/MHz)	Margin (dB)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	1G	100k	901.545	-91.95	0.00064	-53.98	4	-37.97
2402MHz_TnomVnom	Pass	1G	12.5G	1M	12494.25	-73.02	0.04989	-46.99	20	-26.03
2402MHz_TnomVmin	Pass	30M	1G	100k	965.08	-92.03	0.00063	-53.98	4	-38.05
2402MHz_TnomVmin	Pass	1G	12.5G	1M	12498.562	-73.10	0.04898	-46.99	20	-26.11
2402MHz_TnomVmax	Pass	30M	1G	100k	945.195	-92.30	0.00059	-53.98	4	-38.32
2402MHz_TnomVmax	Pass	1G	12.5G	1M	12498.562	-73.19	0.04797	-46.99	20	-26.20
2440MHz_TnomVnom	Pass	30M	1G	100k	967.505	-92.21	0.0006	-53.98	4	-38.23
2440MHz_TnomVnom	Pass	1G	12.5G	1M	12497.125	-73.04	0.04966	-46.99	20	-26.05
2440MHz_TnomVmin	Pass	30M	1G	100k	656.135	-92.28	0.00059	-53.98	4	-38.30
2440MHz_TnomVmin	Pass	1G	12.5G	1M	12497.125	-73.10	0.04898	-46.99	20	-26.11
2440MHz_TnomVmax	Pass	30M	1G	100k	931.615	-92.36	0.00058	-53.98	4	-38.38
2440MHz_TnomVmax	Pass	1G	12.5G	1M	12469.812	-73.06	0.04943	-46.99	20	-26.07
2480MHz_TnomVnom	Pass	30M	1G	100k	962.17	-92.20	0.0006	-53.98	4	-38.22
2480MHz_TnomVnom	Pass	1G	12.5G	1M	12489.937	-72.64	0.05445	-46.99	20	-25.65
2480MHz_TnomVmin	Pass	30M	1G	100k	943.74	-92.18	0.00061	-53.98	4	-38.20
2480MHz_TnomVmin	Pass	1G	12.5G	1M	12494.25	-73.13	0.04864	-46.99	20	-26.14
2480MHz_TnomVmax	Pass	30M	1G	100k	656.135	-91.86	0.00065	-53.98	4	-37.88
2480MHz_TnomVmax	Pass	1G	12.5G	1M	12491.375	-72.79	0.0526	-46.99	20	-25.80



BT-LE(2Mbps)

CSE-RX-

2402MHz_TnomVnom



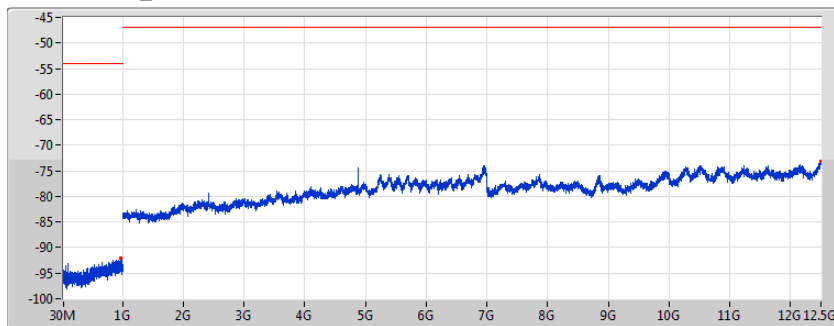
Limit
Port 1

Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
901.545	-91.95	-53.98	-37.97	-91.95
12494.25	-73.02	-46.99	-26.03	-73.02

BT-LE(2Mbps)

CSE-RX-

2402MHz_TnomVmin



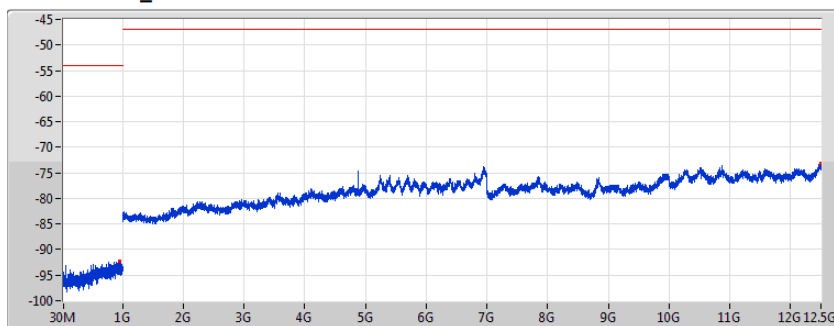
Limit
Port 1

Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
965.08	-92.03	-53.98	-38.05	-92.03
12498.562	-73.10	-46.99	-26.11	-73.10

BT-LE(2Mbps)

CSE-RX-

2402MHz_TnomVmax



Limit
Port 1

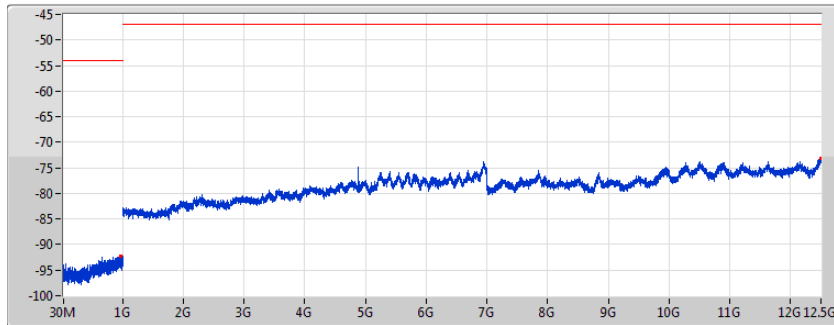
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
945.195	-92.30	-53.98	-38.32	-92.30
12498.562	-73.19	-46.99	-26.20	-73.19



BT-LE(2Mbps)

CSE-RX-

2440MHz_TnomVnom



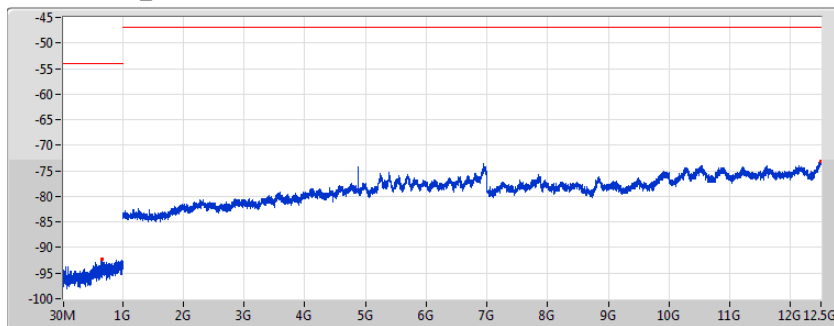
Limit
Port 1

Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
967.505	-92.21	-53.98	-38.23	-92.21
12497.125	-73.04	-46.99	-26.05	-73.04

BT-LE(2Mbps)

CSE-RX-

2440MHz_TnomVmin



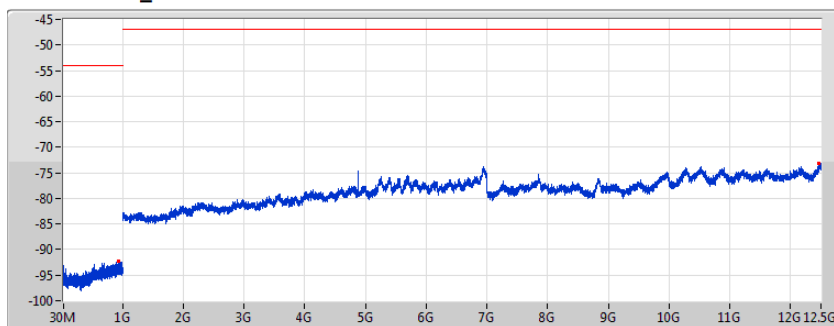
Limit
Port 1

Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
656.135	-92.28	-53.98	-38.30	-92.28
12497.125	-73.10	-46.99	-26.11	-73.10

BT-LE(2Mbps)

CSE-RX-

2440MHz_TnomVmax



Limit
Port 1

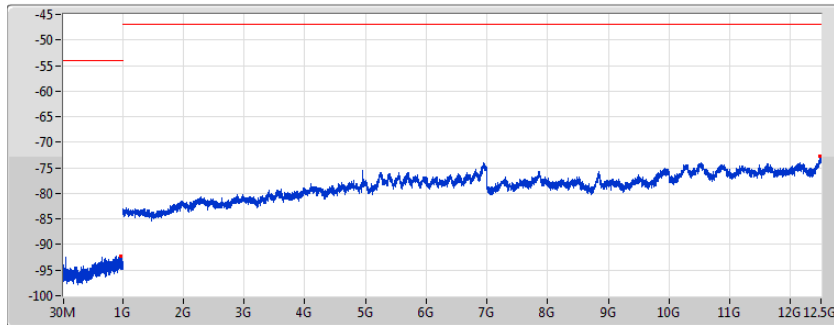
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
931.615	-92.36	-53.98	-38.38	-92.36
12469.812	-73.06	-46.99	-26.07	-73.06



BT-LE(2Mbps)

CSE-RX-

2480MHz_TnomVnom

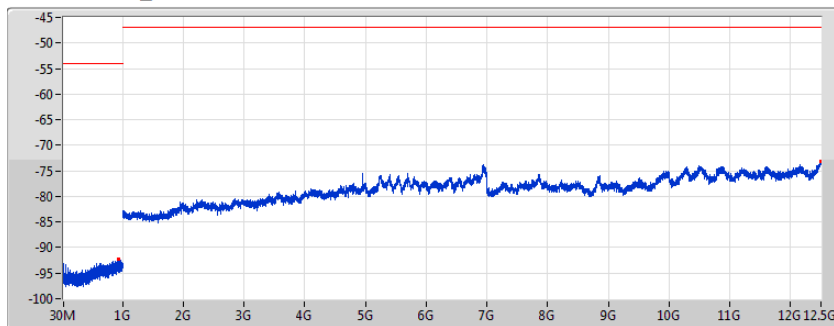


Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
962.17	-92.20	-53.98	-38.22	-92.20
12489.937	-72.64	-46.99	-25.65	-72.64

BT-LE(2Mbps)

CSE-RX-

2480MHz_TnomVmin

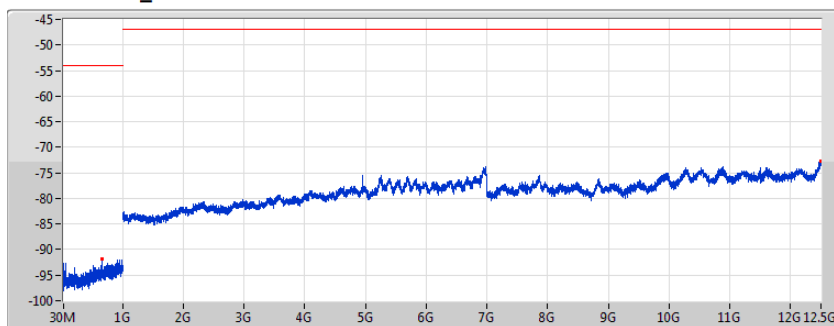


Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
943.74	-92.18	-53.98	-38.20	-92.18
12494.25	-73.13	-46.99	-26.14	-73.13

BT-LE(2Mbps)

CSE-RX-

2480MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
656.135	-91.86	-53.98	-37.88	-91.86
12491.375	-72.79	-46.99	-25.80	-72.79

Appendix G. 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

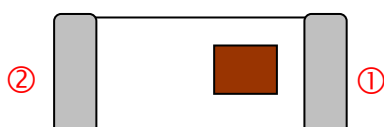
Q'ty/Reel (pcs) : 3,000pcs
 Operating Temperature Range : -40 ~ +85 °C
 Storage Temperature Range : +5 ~ +35 °C, Humidity 45~75%RH
 Storage Period : 12 months max.
 Power Capacity : 2W max.

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		

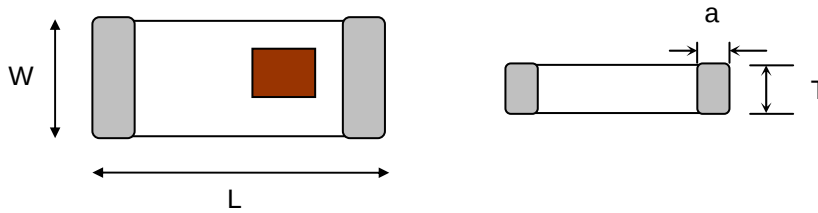
Terminal Configuration



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

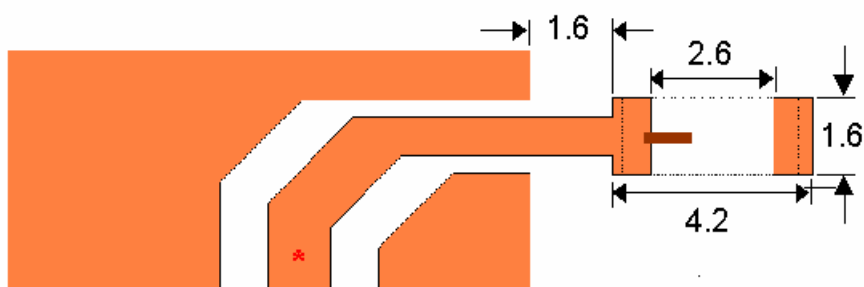
Dimensions and Recommended PC Board Pattern

Unit : mm

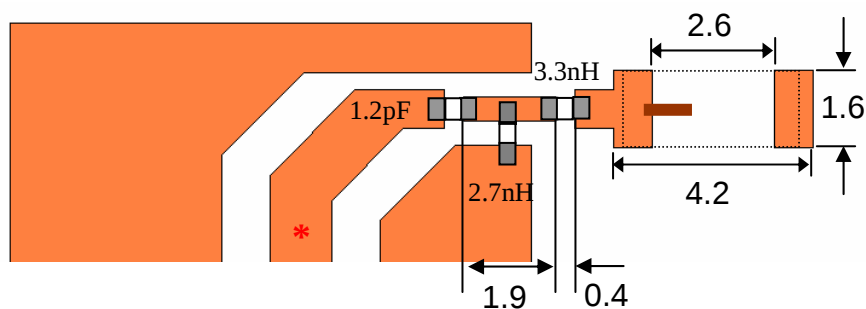


Mark	L	W	T	a
Dimensions	3.2±0.2	1.6±0.2	1.3+ 0.1/-0.2	0.5±0.3

(a) Without Matching Circuits



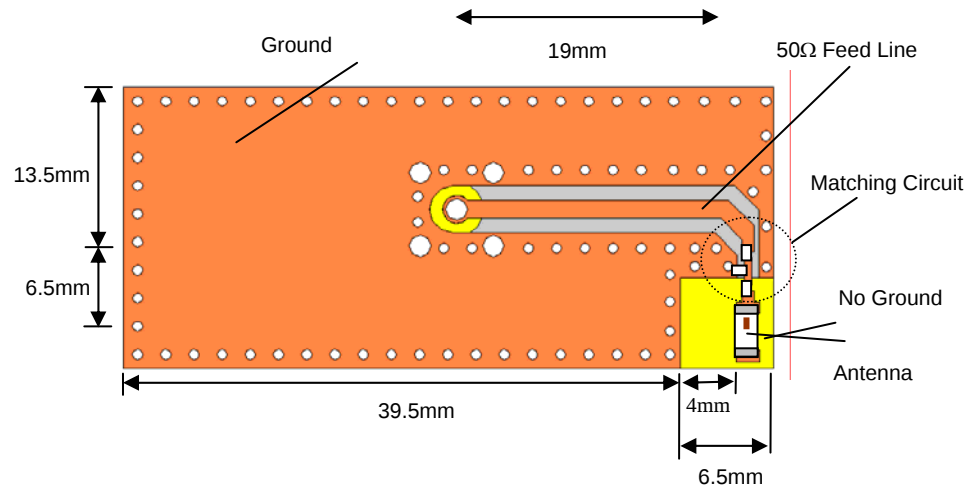
(b) With Matching Circuits



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

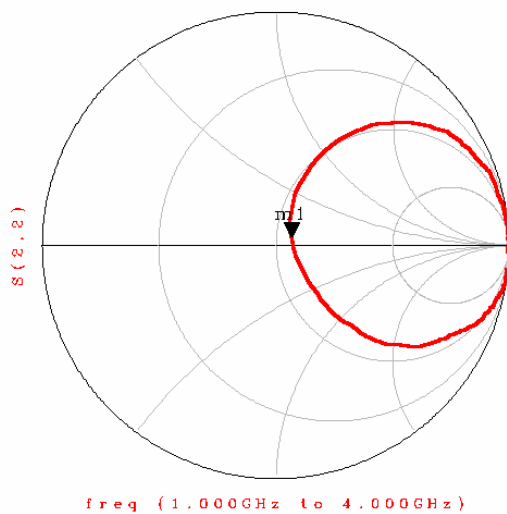
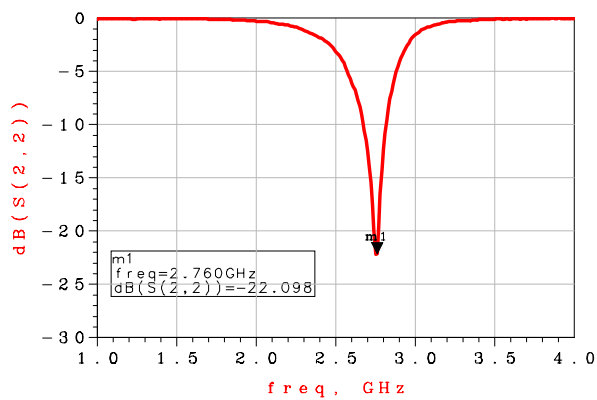
Typical Electrical Characteristics (T=25°C)

❖ Test Board

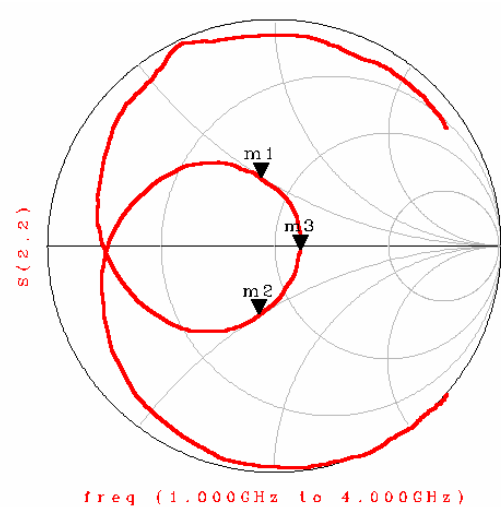
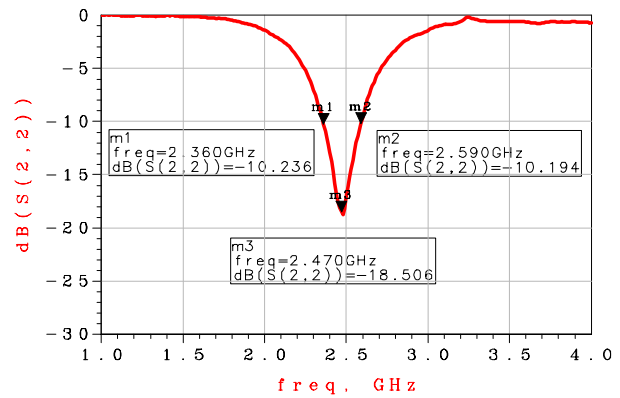


❖ Return Loss

(a) Without Matching Circuits

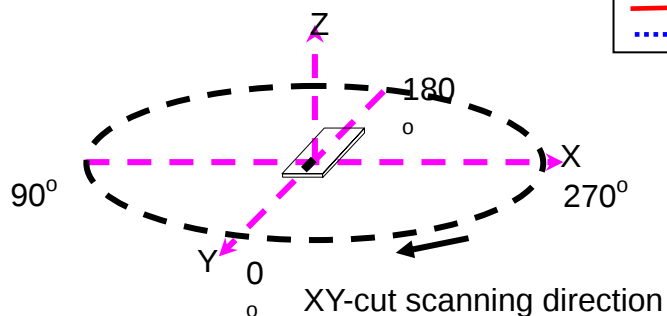


(b) With Matching Circuits

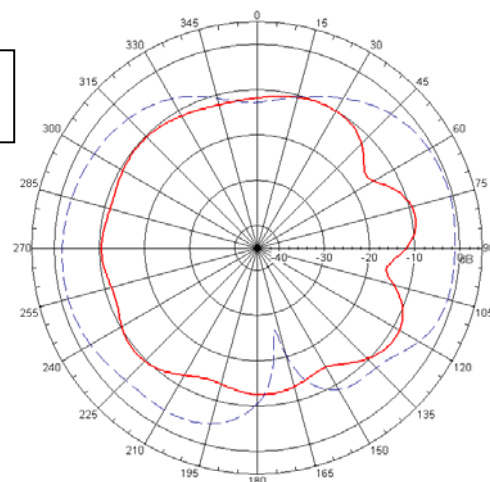


Radiation Patterns

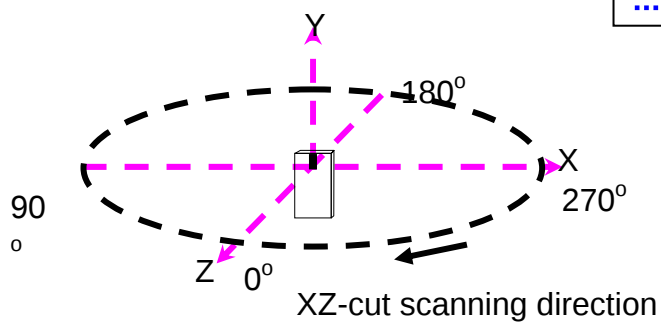
XY-V/XY-H



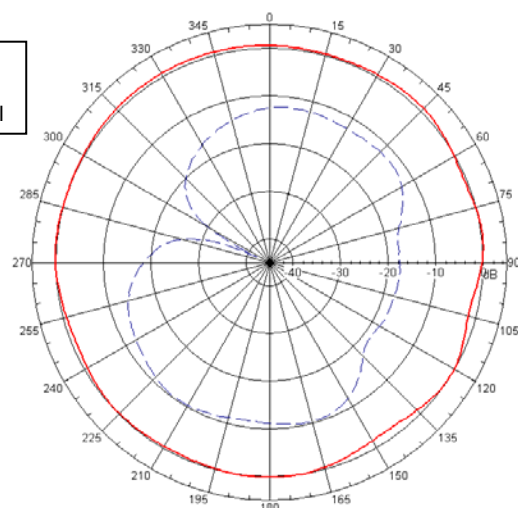
XY cut @2.45GHz
— Vertical
- - - Horizontal



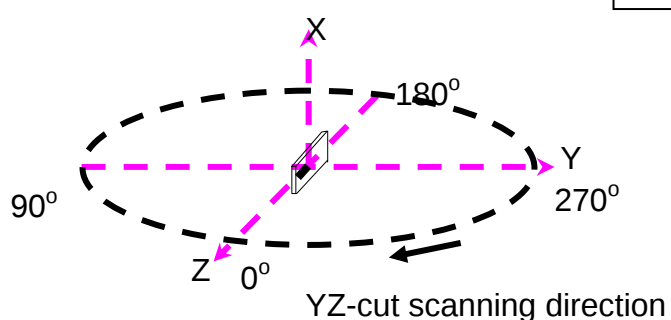
XZ-V/XZ-H



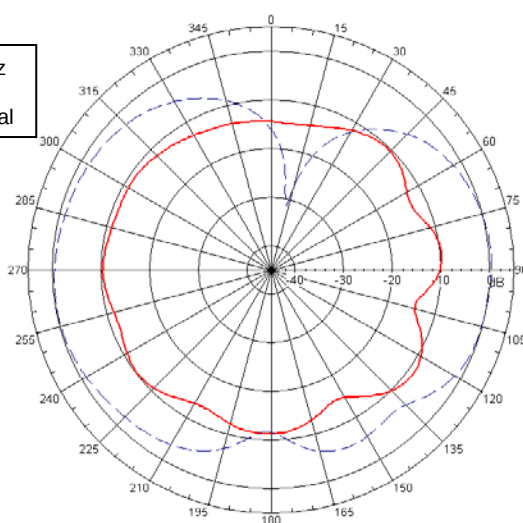
XZ cut @2.45GHz
— Vertical
- - - Horizontal



YZ-V/YZ-H



YZ cut @2.45GHz
— Vertical
- - - Horizontal



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>