Japan Test Report

Equipment	:	**Bluetooth 5.0 BLE Data Module**
Model No.	:	**BL654**
Brand Name	:	**Laird**
Applicant	:	**Laird Technologies**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**Article 2 Paragraph 1 Item 19**
Received Date	:	**Jan. 30, 2018**
Tested Date	:	**May 14, 2018**

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: **Approved by:**

James Fan / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

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Release Record

Report No.	Version	Description	Issued Date
JR813002	Rev. 01	Initial issue	Jun. 25, 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

1.1.1 Product Details

The following models are provided to this EUT.

Brand Name	Model Name	Product Name	Description
Laird	BL654	Bluetooth 5.0 BLE Data Module	With Printed PCB Antenna
			With Connector Type Antenna

1.1.2 Specification of the Equipment under Test (EUT)

Power Type	1.8Vdc & 3.3Vdc from host
Type(s) of Modulation / Technology	GFSK = 1Mbps, 2Mbps, 125 kbps, 500 kbps
Frequency Range (MHz)	2402 ~ 2480 MHz
Total Channel Number	40
HW Version	1.0
SW Version	29.1.1.0

1.1.3 Accessories

N/A

1.1.4 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Gain (dBi)	Remark
1	Laird	NanoBlue	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
2	Laird	FlexPIFA	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
3	Laird	FlexNotch	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
4	Mag.Layers	EDA-8709-2G4C1-B27-CY	Dipole	IPEX MHF4	2	Connector Type Antenna
5	Laird	mFlexPIFA	PIFA	IPEX MHF4	2	Connector Type Antenna
6	Laird	Laird NFC	NFC	N/A	N/A	Printed PCB Antenna & Connector Type Antenna
7	Laird	BL654-SA PCB printed antenna	Printed PCB	N/A	0	Printed PCB Antenna
8	Walsin	RFDPA870900SBAB8G1	Dipole	SMA	2	Connector Type Antenna

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

1.1.5 Antenna Power

Printed PCB Antenna

Data Rate	Operating Mode	Rated Power (mW)	Measured Conducted Power (mW)	Radiated Power (mW)
125 kbps	LE	6.00	5.715	5.715
500 kbps	LE	6.00	5.702	5.702
1 Mbps	LE	6.00	5.861	5.861
2 Mbps	LE	6.00	5.861	5.861

Connector Type Antenna

Data Rate	Operating Mode	Rated Power (mW)	Measured Conducted Power (mW)	Radiated Power (mW)
125 kbps	LE	6.00	5.715	9.057
500 kbps	LE	6.00	5.702	9.036
1 Mbps	LE	6.00	5.861	9.290
2 Mbps	LE	6.00	5.861	9.290

1.1.6 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

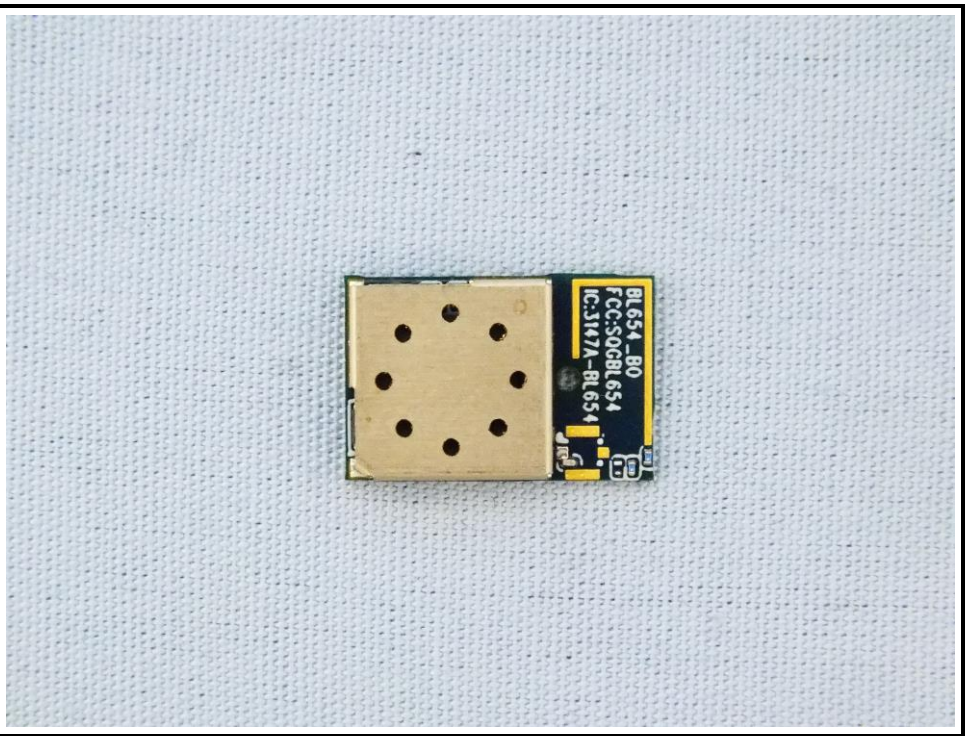
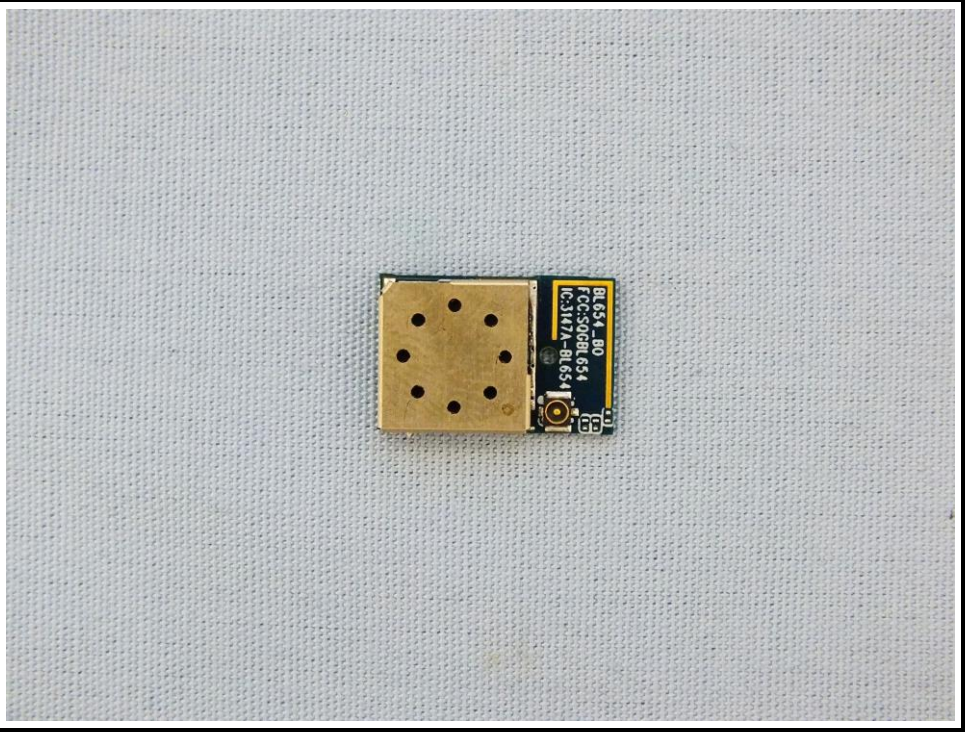
1.1.7 Test Tool and Power Setting

Test Tool
UwTerminal, v.7_94

Modulation Mode	Test Frequency (MHz)		
	2402	2440	2480
GFSK/125 kbps	8	8	8
GFSK/500 kbps	8	8	8
GFSK/1Mbps	8	8	8
GFSK/2Mbps	8	8	8

1.1.8 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 (Printed PCB Antenna)	
Photo (Connector Type Antenna)	

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	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℃ / 65%	Chris Zeng

2.2 Supporting Units

Support Unit	Brand	Model	FCC ID
Notebook	Inspiron 3000	CDD3L52	DoC

2.3 The Worst Test Modes and Channel Details

Test item	Mode	Data Rate	Test Frequency (MHz)	Test Configuration
Antenna Power	BT LE	125kbps 500kbps 1Mbps 2Mbps	2402 / 2440 / 2480	1, 2
Frequency Tolerance Transmitter Spurious Emission Occupied Bandwidth Spreading Bandwidth Collateral Emission of Receiver Spreading Factor Interference prevention function	BT LE	125kbps 500kbps 1Mbps 2Mbps	2402 / 2440 / 2480	2
Note: 1. Test configurations are listed as below: Configuration 1: Printed PCB Antenna Configuration 2: Connector Type Antenna				

3 Transmitter Test Results

3.1 Antenna Power

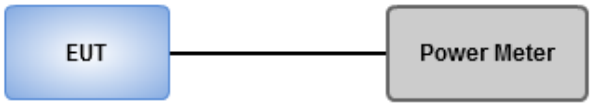
3.1.1 Limit of Antenna Power

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

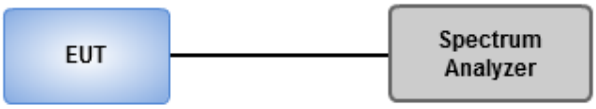
3.2.1 Limit of Frequency Tolerance

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) } × 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

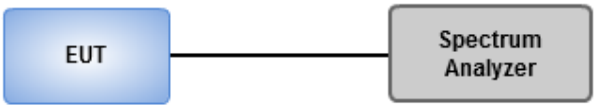
3.3.1 Limit of Occupied Bandwidth

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

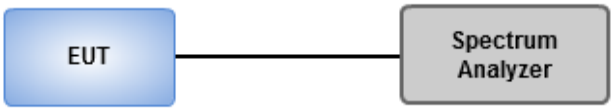
3.4.1 Limit of Transmitter Spurious Emissions

Item	Limits
Tx Spurious Emission	≤ 2.5 μW (2387MHz > f ; 2496.5MHz < f).
	≤ 25 μW. (2387MHz ≤ f < 2400MHz) and (2483.5MHz < f ≤ 2496.5MHz).

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

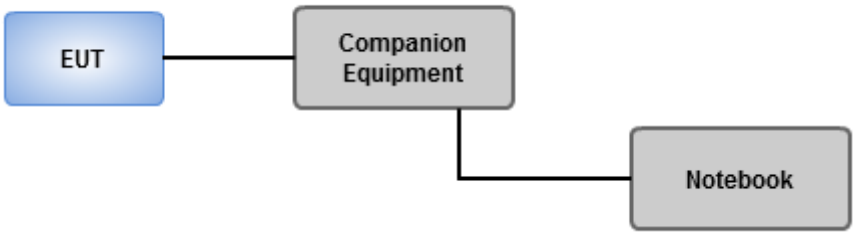
3.5.1 Limit of Interference Prevention Function

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

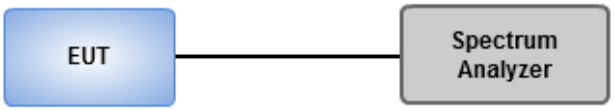
4.1.1 Limit of Receiver Spurious Emissions

Item	Limits
Rx Spurious Emission	≤ 4nW (f < 1GHz).
	≤ 20nW (1GHz ≤ 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.

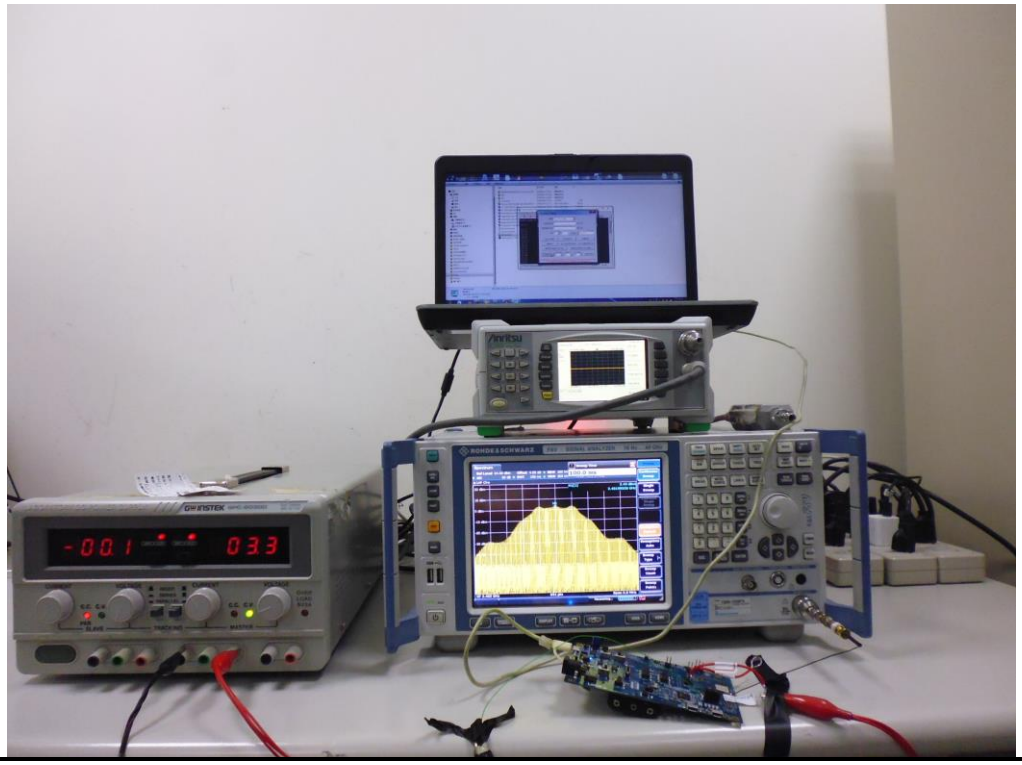
4.1.3 Test Setup



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	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	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==

Printed PCB Antenna

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE-(125kbps)	7.57	5.715	7.57	5.702

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)	P1 (dBm)
BT-LE-(125kbps)	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	0	7.56	5.702	10	7.56	5.702	16.368	7.56
2402MHz_TnomVmin	Pass	0	7.57	5.715	10	7.57	5.715	16.368	7.57
2402MHz_TnomVmax	Pass	0	7.57	5.715	10	7.57	5.715	16.368	7.57
2440MHz_TnomVnom	Pass	0	7.49	5.610	10	7.49	5.610	16.368	7.49
2440MHz_TnomVmin	Pass	0	7.50	5.623	10	7.50	5.623	16.368	7.5
2440MHz_TnomVmax	Pass	0	7.50	5.623	10	7.50	5.623	16.368	7.5
2480MHz_TnomVnom	Pass	0	7.38	5.470	10	7.38	5.470	16.368	7.38
2480MHz_TnomVmin	Pass	0	7.39	5.483	10	7.39	5.483	16.368	7.39
2480MHz_TnomVmax	Pass	0	7.39	5.483	10	7.39	5.483	16.368	7.39

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

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-	-
BT-LE-(125kbps)	Pass	7.57	5.715	7.78	6.00	-4.75	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE-(125kbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	7.56	5.702	7.78	6.00	-4.97	20	-80
2402MHz_TnomVmin	Pass	7.57	5.715	7.78	6.00	-4.75	20	-80
2402MHz_TnomVmax	Pass	7.57	5.715	7.78	6.00	-4.75	20	-80
2440MHz_TnomVnom	Pass	7.49	5.610	7.78	6.00	-6.49	20	-80
2440MHz_TnomVmin	Pass	7.50	5.623	7.78	6.00	-6.28	20	-80
2440MHz_TnomVmax	Pass	7.50	5.623	7.78	6.00	-6.28	20	-80
2480MHz_TnomVnom	Pass	7.38	5.470	7.78	6.00	-8.83	20	-80
2480MHz_TnomVmin	Pass	7.39	5.483	7.78	6.00	-8.62	20	-80
2480MHz_TnomVmax	Pass	7.39	5.483	7.78	6.00	-8.62	20	-80

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE-(500kbps)	7.56	5.702	7.56	5.702

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)	P1 (dBm)
BT-LE-(500kbps)	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	0	7.56	5.702	10	7.56	5.702	16.368	7.56
2402MHz_TnomVmin	Pass	0	7.55	5.689	10	7.55	5.689	16.368	7.55
2402MHz_TnomVmax	Pass	0	7.56	5.702	10	7.56	5.702	16.368	7.56
2440MHz_TnomVnom	Pass	0	7.48	5.598	10	7.48	5.598	16.368	7.48
2440MHz_TnomVmin	Pass	0	7.50	5.623	10	7.50	5.623	16.368	7.50
2440MHz_TnomVmax	Pass	0	7.51	5.636	10	7.51	5.636	16.368	7.51
2480MHz_TnomVnom	Pass	0	7.23	5.284	10	7.23	5.284	16.368	7.23
2480MHz_TnomVmin	Pass	0	7.31	5.383	10	7.31	5.383	16.368	7.31
2480MHz_TnomVmax	Pass	0	7.30	5.370	10	7.30	5.370	16.368	7.30

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

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-	-
BT-LE-(500kbps)	Pass	7.56	5.702	7.78	6.00	-4.97	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE-(500kbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	7.56	5.702	7.78	6.00	-4.97	20	-80
2402MHz_TnomVmin	Pass	7.55	5.689	7.78	6.00	-5.19	20	-80
2402MHz_TnomVmax	Pass	7.56	5.702	7.78	6.00	-4.97	20	-80
2440MHz_TnomVnom	Pass	7.48	5.598	7.78	6.00	-6.71	20	-80
2440MHz_TnomVmin	Pass	7.50	5.623	7.78	6.00	-6.28	20	-80
2440MHz_TnomVmax	Pass	7.51	5.636	7.78	6.00	-6.06	20	-80
2480MHz_TnomVnom	Pass	7.23	5.284	7.78	6.00	-11.93	20	-80
2480MHz_TnomVmin	Pass	7.31	5.383	7.78	6.00	-10.29	20	-80
2480MHz_TnomVmax	Pass	7.30	5.370	7.78	6.00	-10.49	20	-80

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE(1Mbps)	7.68	5.861	7.68	5.861

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)	P1 (dBm)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	0	7.67	5.848	10	7.67	5.848	16.368	7.67
2402MHz_TnomVmin	Pass	0	7.68	5.861	10	7.68	5.861	16.368	7.68
2402MHz_TnomVmax	Pass	0	7.68	5.861	10	7.68	5.861	16.368	7.68
2440MHz_TnomVnom	Pass	0	7.61	5.768	10	7.61	5.768	16.368	7.61
2440MHz_TnomVmin	Pass	0	7.63	5.794	10	7.63	5.794	16.368	7.63
2440MHz_TnomVmax	Pass	0	7.66	5.834	10	7.66	5.834	16.368	7.66
2480MHz_TnomVnom	Pass	0	7.35	5.433	10	7.35	5.433	16.368	7.35
2480MHz_TnomVmin	Pass	0	7.41	5.508	10	7.41	5.508	16.368	7.41
2480MHz_TnomVmax	Pass	0	7.41	5.508	10	7.41	5.508	16.368	7.41

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

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	7.67	5.848	7.78	6.00	-2.53	20	-80
2402MHz_TnomVmin	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80
2402MHz_TnomVmax	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80
2440MHz_TnomVnom	Pass	7.61	5.768	7.78	6.00	-3.87	20	-80
2440MHz_TnomVmin	Pass	7.63	5.794	7.78	6.00	-3.43	20	-80
2440MHz_TnomVmax	Pass	7.66	5.834	7.78	6.00	-2.76	20	-80
2480MHz_TnomVnom	Pass	7.35	5.433	7.78	6.00	-9.46	20	-80
2480MHz_TnomVmin	Pass	7.41	5.508	7.78	6.00	-8.20	20	-80
2480MHz_TnomVmax	Pass	7.41	5.508	7.78	6.00	-8.20	20	-80

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE(2Mbps)	7.68	5.861	7.68	5.861

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)	P1 (dBm)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	0	7.68	5.861	10	7.68	5.861	16.368	7.68
2402MHz_TnomVmin	Pass	0	7.68	5.861	10	7.68	5.861	16.368	7.68
2402MHz_TnomVmax	Pass	0	7.67	5.848	10	7.67	5.848	16.368	7.67
2440MHz_TnomVnom	Pass	0	7.58	5.728	10	7.58	5.728	16.368	7.58
2440MHz_TnomVmin	Pass	0	7.57	5.715	10	7.57	5.715	16.368	7.57
2440MHz_TnomVmax	Pass	0	7.58	5.728	10	7.58	5.728	16.368	7.58
2480MHz_TnomVnom	Pass	0	7.42	5.521	10	7.42	5.521	16.368	7.42
2480MHz_TnomVmin	Pass	0	7.41	5.508	10	7.41	5.508	16.368	7.41
2480MHz_TnomVmax	Pass	0	7.41	5.508	10	7.41	5.508	16.368	7.41

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

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80
2402MHz_TnomVmin	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80
2402MHz_TnomVmax	Pass	7.67	5.848	7.78	6.00	-2.53	20	-80
2440MHz_TnomVnom	Pass	7.58	5.728	7.78	6.00	-4.53	20	-80
2440MHz_TnomVmin	Pass	7.57	5.715	7.78	6.00	-4.75	20	-80
2440MHz_TnomVmax	Pass	7.58	5.728	7.78	6.00	-4.53	20	-80
2480MHz_TnomVnom	Pass	7.42	5.521	7.78	6.00	-7.99	20	-80
2480MHz_TnomVmin	Pass	7.41	5.508	7.78	6.00	-8.20	20	-80
2480MHz_TnomVmax	Pass	7.41	5.508	7.78	6.00	-8.20	20	-80

Connector Type Antenna

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE-(125kbps)	7.57	5.715	9.57	9.057

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)	P1 (dBm)
BT-LE-(125kbps)	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2	7.56	5.702	10	9.56	9.036	16.368	7.56
2402MHz_TnomVmin	Pass	2	7.57	5.715	10	9.57	9.057	16.368	7.57
2402MHz_TnomVmax	Pass	2	7.57	5.715	10	9.57	9.057	16.368	7.57
2440MHz_TnomVnom	Pass	2	7.49	5.610	10	9.49	8.892	16.368	7.49
2440MHz_TnomVmin	Pass	2	7.50	5.623	10	9.50	8.913	16.368	7.5
2440MHz_TnomVmax	Pass	2	7.50	5.623	10	9.50	8.913	16.368	7.5
2480MHz_TnomVnom	Pass	2	7.38	5.470	10	9.38	8.670	16.368	7.38
2480MHz_TnomVmin	Pass	2	7.39	5.483	10	9.39	8.690	16.368	7.39
2480MHz_TnomVmax	Pass	2	7.39	5.483	10	9.39	8.690	16.368	7.39

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

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-	-
BT-LE-(125kbps)	Pass	7.57	5.715	7.78	6.00	-4.75	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE-(125kbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	7.56	5.702	7.78	6.00	-4.97	20	-80
2402MHz_TnomVmin	Pass	7.57	5.715	7.78	6.00	-4.75	20	-80
2402MHz_TnomVmax	Pass	7.57	5.715	7.78	6.00	-4.75	20	-80
2440MHz_TnomVnom	Pass	7.49	5.610	7.78	6.00	-6.49	20	-80
2440MHz_TnomVmin	Pass	7.50	5.623	7.78	6.00	-6.28	20	-80
2440MHz_TnomVmax	Pass	7.50	5.623	7.78	6.00	-6.28	20	-80
2480MHz_TnomVnom	Pass	7.38	5.470	7.78	6.00	-8.83	20	-80
2480MHz_TnomVmin	Pass	7.39	5.483	7.78	6.00	-8.62	20	-80
2480MHz_TnomVmax	Pass	7.39	5.483	7.78	6.00	-8.62	20	-80

Summary

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
2.4-2.4835GHz	-	-	-	-	-	-	-
BT-LE-(125kbps)	Pass	2.44G	2.439993G	-2.766	±50	1	-

Result

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
BT-LE-(125kbps)	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.402G	2.401995G	-2.29	±50	1	-
2402MHz_TnomVmin	Pass	2.402G	2.401994G	-2.498	±50	1	-
2402MHz_TnomVmax	Pass	2.402G	2.401996G	-1.769	±50	1	-
2440MHz_TnomVnom	Pass	2.44G	2.439993G	-2.766	±50	1	-
2440MHz_TnomVmin	Pass	2.44G	2.439994G	-2.357	±50	1	-
2440MHz_TnomVmax	Pass	2.44G	2.439995G	-2.152	±50	1	-
2480MHz_TnomVnom	Pass	2.48G	2.479994G	-2.319	±50	1	-
2480MHz_TnomVmin	Pass	2.48G	2.479995G	-2.016	±50	1	-
2480MHz_TnomVmax	Pass	2.48G	2.479995G	-1.915	±50	1	-

Summary

Mode	Max-OBW (MHz)	ITU-Code	Min-OBW (MHz)
2.4-2.4835GHz	-	-	-
BT-LE-(125kbps)	1.262	1M26D1D	1.249

Max-OBW = Maximum99% occupied bandwidth; **Min-OBW** = Minimum99% occupied bandwidth;

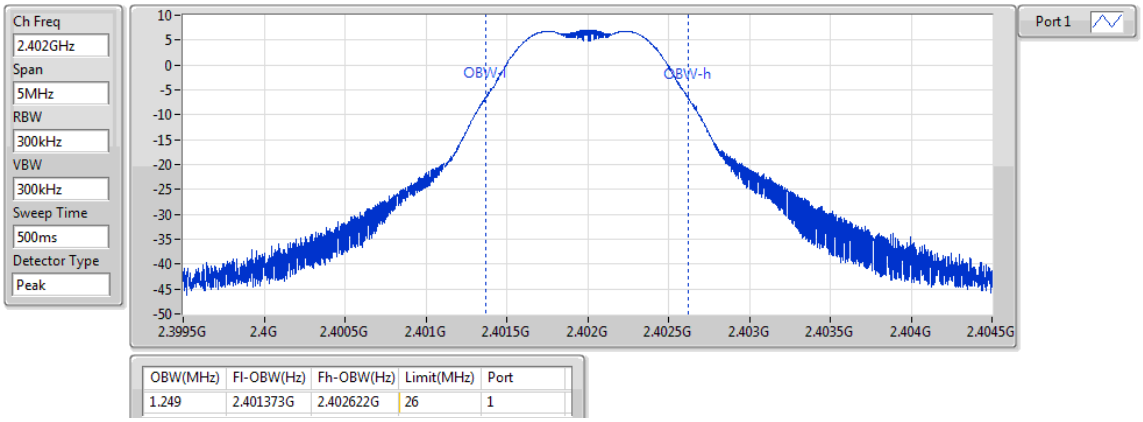
Result

Mode	Result	Limit (MHz)	P1-OBW (MHz)
BT-LE-(125kbps)	-	-	-
2402MHz_TnomVnom	Pass	26	1.249
2402MHz_TnomVmin	Pass	26	1.252
2402MHz_TnomVmax	Pass	26	1.249
2440MHz_TnomVnom	Pass	26	1.257
2440MHz_TnomVmin	Pass	26	1.257
2440MHz_TnomVmax	Pass	26	1.257
2480MHz_TnomVnom	Pass	26	1.262
2480MHz_TnomVmin	Pass	26	1.262
2480MHz_TnomVmax	Pass	26	1.262

P1-OBW = Port 1 99% occupied bandwidth

LE-125kbps_Nss1_1TX **OBW**

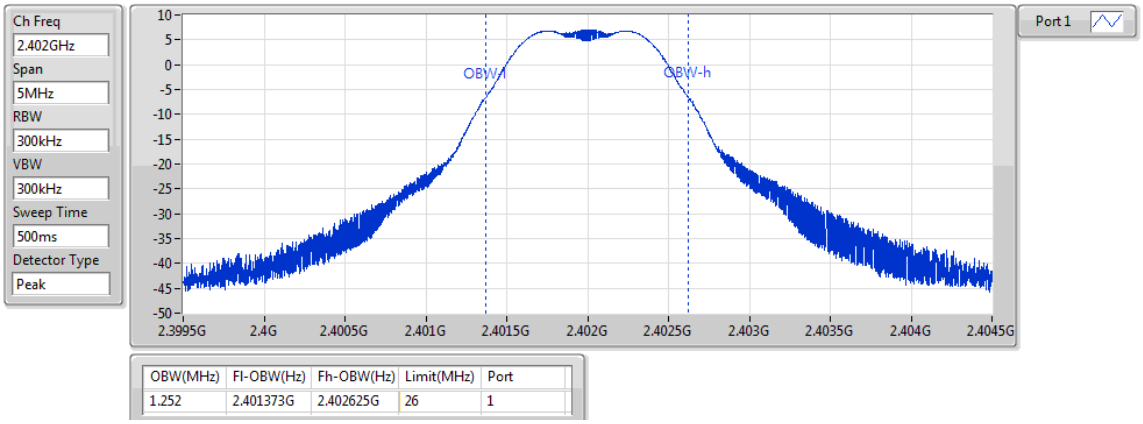
2402MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.249	2.401373G	2.402622G	26	1

LE-125kbps_Nss1_1TX **OBW**

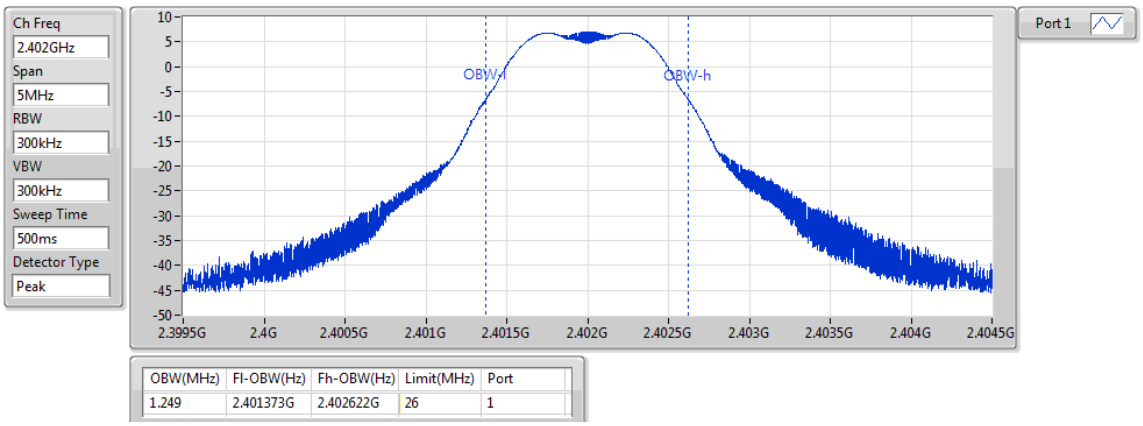
2402MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.252	2.401373G	2.402625G	26	1

LE-125kbps_Nss1_1TX **OBW**

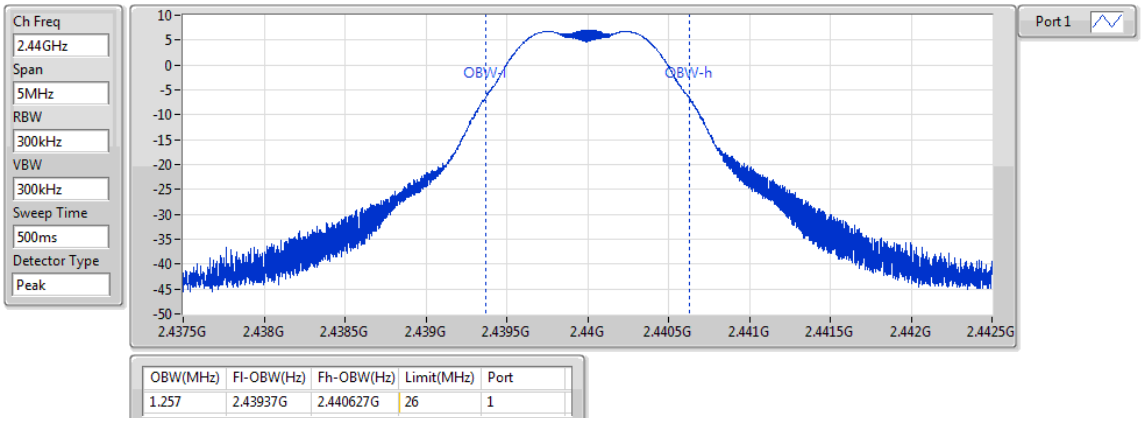
2402MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.249	2.401373G	2.402622G	26	1

LE-125kbps_Nss1_1TX **OBW**

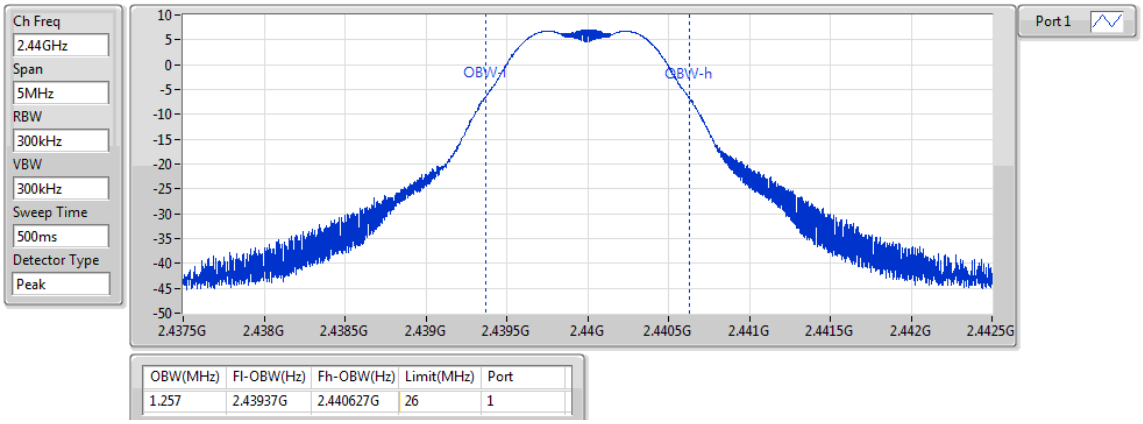
2440MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.257	2.43937G	2.440627G	26	1

LE-125kbps_Nss1_1TX **OBW**

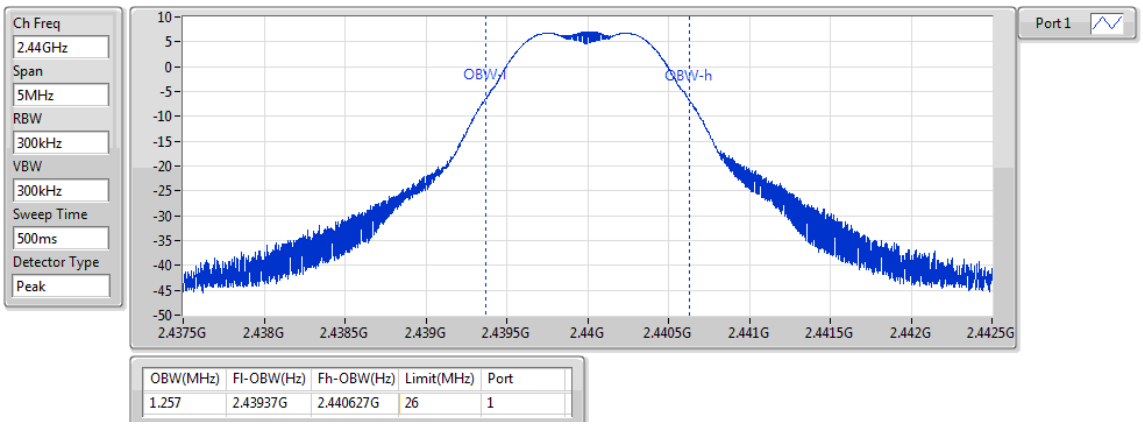
2440MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.257	2.43937G	2.440627G	26	1

LE-125kbps_Nss1_1TX **OBW**

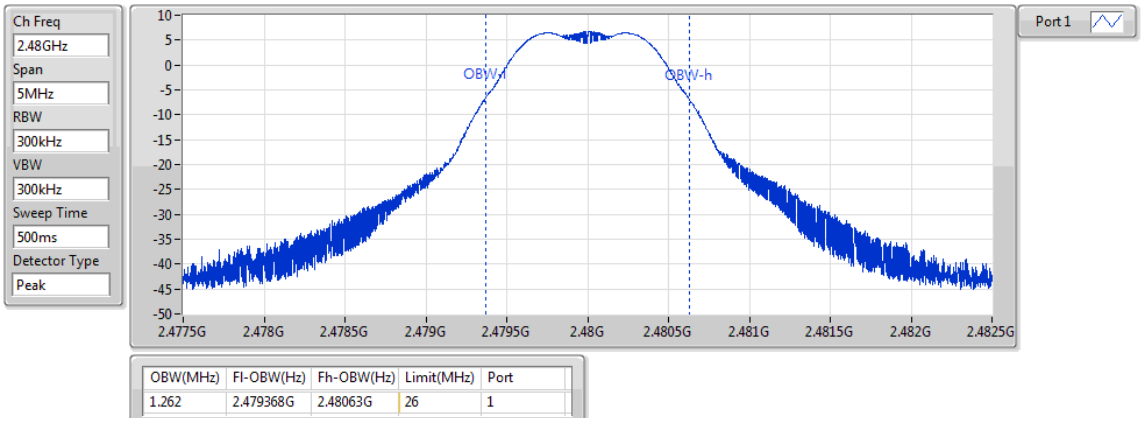
2440MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.257	2.43937G	2.440627G	26	1

LE-125kbps_Nss1_1TX **OBW**

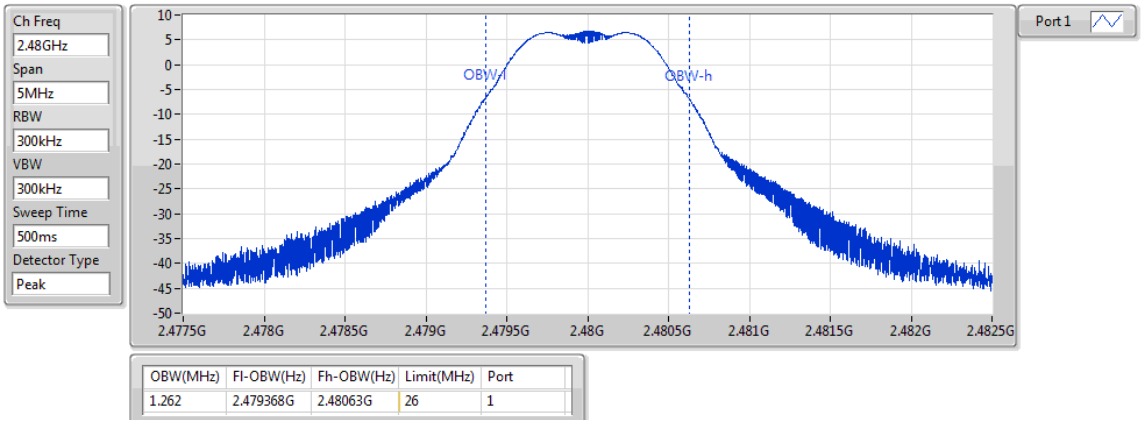
2480MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.262	2.479368G	2.48063G	26	1

LE-125kbps_Nss1_1TX **OBW**

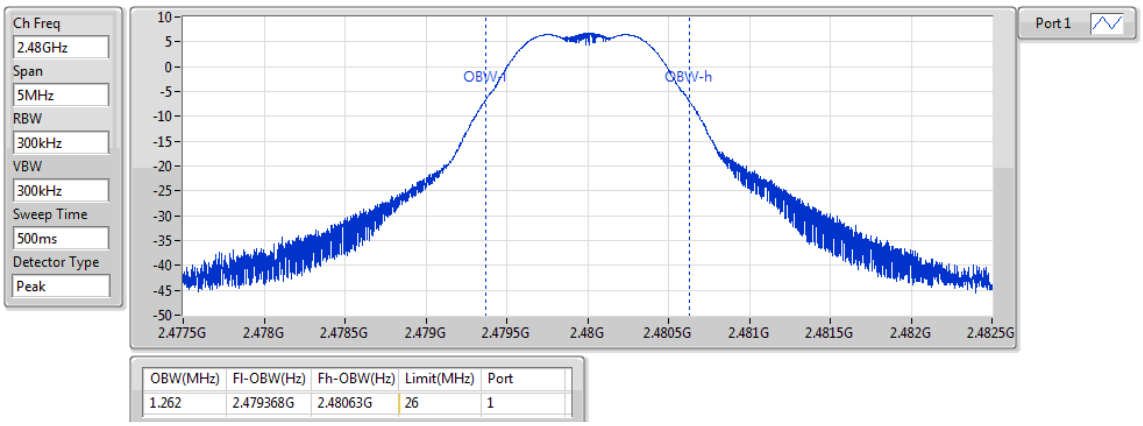
2480MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.262	2.479368G	2.48063G	26	1

LE-125kbps_Nss1_1TX **OBW**

2480MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.262	2.479368G	2.48063G	26	1

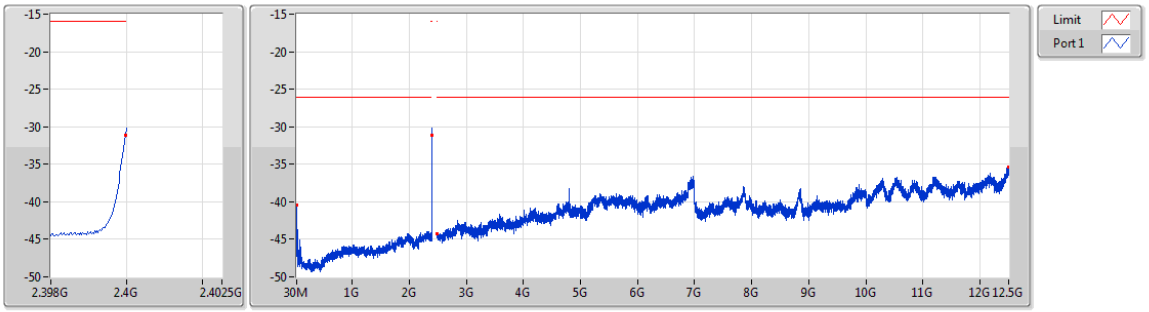
Summary

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)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE-(125kbps)	Pass	2.4965G	12.5G	1M	12496.249	-35.12	0.30761	-26.02	2.50035	-9.10	5.68	-35.12	0.30761

Result

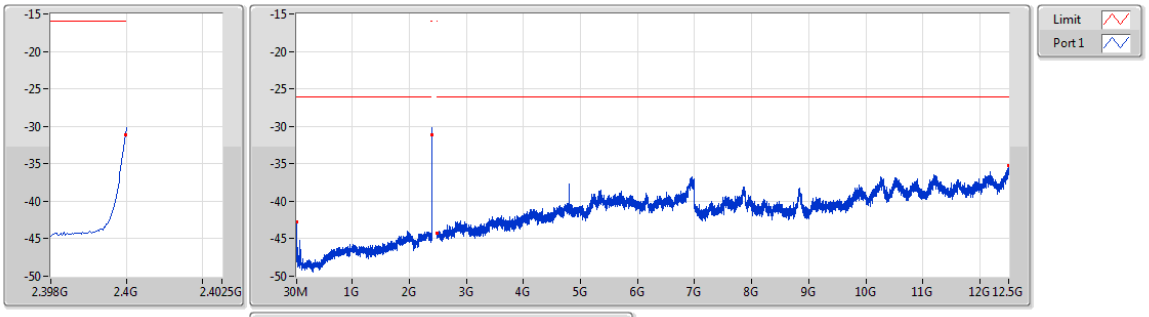
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (uW/MHz)	Limit (dBm)	Limit (uW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (uW/MHz)
LE-(125kbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	2.387G	1M	32.357	-40.37	0.09183	-26.02	2.50035	-14.35	0.26	-40.37	0.09183
2402MHz_TnomVnom	Pass	2.387G	2.4G	1M	2399.974	-31.08	0.77983	-16.02	25.00345	-15.06	1.47	-31.08	0.77983
2402MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2489.688	-44.19	0.03811	-16.02	25.00345	-28.17	1.49	-44.19	0.03811
2402MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12494.998	-35.42	0.28708	-26.02	2.50035	-9.40	5.68	-35.42	0.28708
2402MHz_TnomVmin	Pass	30M	2.387G	1M	32.357	-42.76	0.05297	-26.02	2.50035	-16.74	0.26	-42.76	0.05297
2402MHz_TnomVmin	Pass	2.387G	2.4G	1M	2399.974	-31.15	0.76736	-16.02	25.00345	-15.13	1.47	-31.15	0.76736
2402MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2490.104	-44.19	0.03811	-16.02	25.00345	-28.17	1.49	-44.19	0.03811
2402MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12492.497	-35.17	0.30409	-26.02	2.50035	-9.15	5.68	-35.17	0.30409
2402MHz_TnomVmax	Pass	30M	2.387G	1M	32.357	-37.60	0.17378	-26.02	2.50035	-11.58	0.26	-37.60	0.17378
2402MHz_TnomVmax	Pass	2.387G	2.4G	1M	2399.974	-31.11	0.77446	-16.02	25.00345	-15.09	1.47	-31.11	0.77446
2402MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2490.312	-44.17	0.03828	-16.02	25.00345	-28.15	1.49	-44.17	0.03828
2402MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12498.75	-35.44	0.28576	-26.02	2.50035	-9.42	5.68	-35.44	0.28576
2440MHz_TnomVnom	Pass	30M	2.387G	1M	2348.11	-43.65	0.04315	-26.02	2.50035	-17.63	1.45	-43.65	0.04315
2440MHz_TnomVnom	Pass	2.387G	2.4G	1M	2391.81	-44.45	0.03589	-16.02	25.00345	-28.43	1.47	-44.45	0.03589
2440MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2487.738	-44.14	0.03855	-16.02	25.00345	-28.12	1.49	-44.14	0.03855
2440MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12500	-35.13	0.3069	-26.02	2.50035	-9.11	5.68	-35.13	0.3069
2440MHz_TnomVmin	Pass	30M	2.387G	1M	2328.075	-43.46	0.04508	-26.02	2.50035	-17.44	1.44	-43.46	0.04508
2440MHz_TnomVmin	Pass	2.387G	2.4G	1M	2391.94	-44.57	0.03491	-16.02	25.00345	-28.55	1.47	-44.57	0.03491
2440MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2487.66	-44.06	0.03926	-16.02	25.00345	-28.04	1.49	-44.06	0.03926
2440MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12484.995	-35.24	0.29923	-26.02	2.50035	-9.22	5.67	-35.24	0.29923
2440MHz_TnomVmax	Pass	30M	2.387G	1M	2297.434	-43.92	0.04055	-26.02	2.50035	-17.90	1.43	-43.92	0.04055
2440MHz_TnomVmax	Pass	2.387G	2.4G	1M	2392.148	-44.48	0.03565	-16.02	25.00345	-28.46	1.47	-44.48	0.03565
2440MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2488.076	-44.14	0.03855	-16.02	25.00345	-28.12	1.49	-44.14	0.03855
2440MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12488.746	-35.52	0.28054	-26.02	2.50035	-9.50	5.67	-35.52	0.28054
2480MHz_TnomVnom	Pass	30M	2.387G	1M	2304.505	-43.68	0.04285	-26.02	2.50035	-17.66	1.43	-43.68	0.04285
2480MHz_TnomVnom	Pass	2.387G	2.4G	1M	2392.304	-44.57	0.03491	-16.02	25.00345	-28.55	1.47	-44.57	0.03491
2480MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2483.578	-43.70	0.04266	-16.02	25.00345	-27.68	1.49	-43.70	0.04266
2480MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12447.482	-35.40	0.2884	-26.02	2.50035	-9.38	5.65	-35.40	0.2884
2480MHz_TnomVmin	Pass	30M	2.387G	1M	2323.361	-43.73	0.04236	-26.02	2.50035	-17.71	1.44	-43.73	0.04236
2480MHz_TnomVmin	Pass	2.387G	2.4G	1M	2392.2	-44.54	0.03516	-16.02	25.00345	-28.52	1.47	-44.54	0.03516
2480MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2483.708	-43.81	0.04159	-16.02	25.00345	-27.79	1.49	-43.81	0.04159
2480MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12472.49	-35.31	0.29444	-26.02	2.50035	-9.29	5.67	-35.31	0.29444
2480MHz_TnomVmax	Pass	30M	2.387G	1M	32.357	-42.03	0.06266	-26.02	2.50035	-16.01	0.26	-42.03	0.06266
2480MHz_TnomVmax	Pass	2.387G	2.4G	1M	2392.226	-44.49	0.03556	-16.02	25.00345	-28.47	1.47	-44.49	0.03556
2480MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2483.526	-43.77	0.04198	-16.02	25.00345	-27.75	1.49	-43.77	0.04198
2480MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12496.249	-35.12	0.30761	-26.02	2.50035	-9.10	5.68	-35.12	0.30761

LE-125kbps_Nss1_1TX 2402MHz_TnomVnom **CSE-TX-**



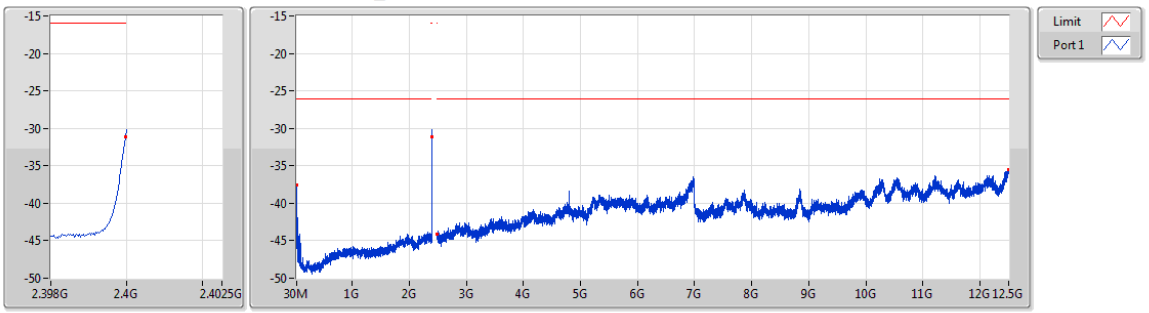
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-40.37	-26.02	-14.35	-40.37
2399.974	-31.08	-16.02	-15.06	-31.08
2489.688	-44.19	-16.02	-28.17	-44.19
12494.998	-35.42	-26.02	-9.40	-35.42

LE-125kbps_Nss1_1TX 2402MHz_TnomVmin **CSE-TX-**



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-42.76	-26.02	-16.74	-42.76
2399.974	-31.15	-16.02	-15.13	-31.15
2490.104	-44.19	-16.02	-28.17	-44.19
12492.497	-35.17	-26.02	-9.15	-35.17

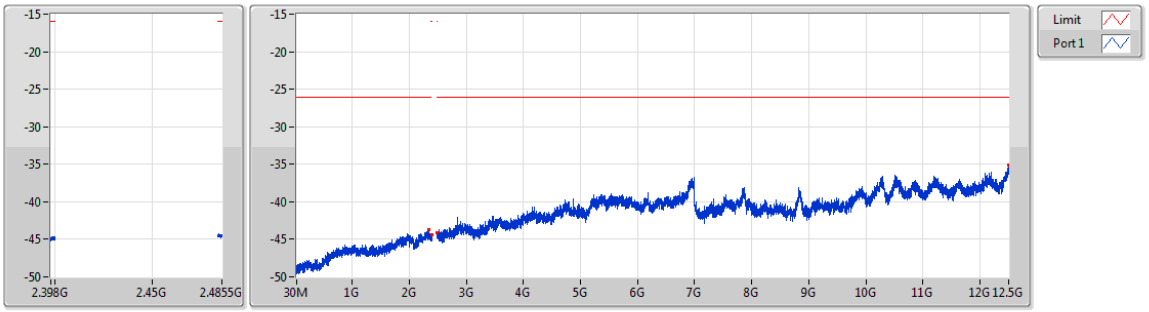
LE-125kbps_Nss1_1TX 2402MHz_TnomVmax **CSE-TX-**



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-37.60	-26.02	-11.58	-37.60
2399.974	-31.11	-16.02	-15.09	-31.11
2490.312	-44.17	-16.02	-28.15	-44.17
12498.75	-35.44	-26.02	-9.42	-35.44

LE-125kbps_Nss1_1TX **CSE-TX-**

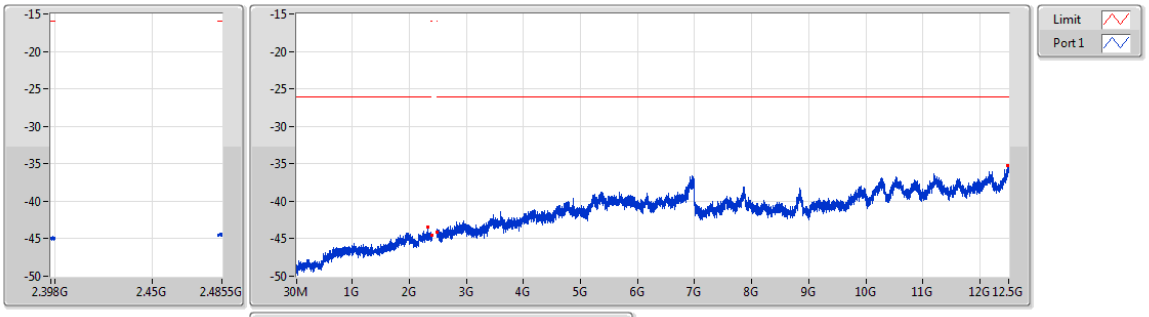
2440MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2348.11	-43.65	-26.02	-17.63	-43.65
2391.81	-44.45	-16.02	-28.43	-44.45
2487.738	-44.14	-16.02	-28.12	-44.14
12500	-35.13	-26.02	-9.11	-35.13

LE-125kbps_Nss1_1TX **CSE-TX-**

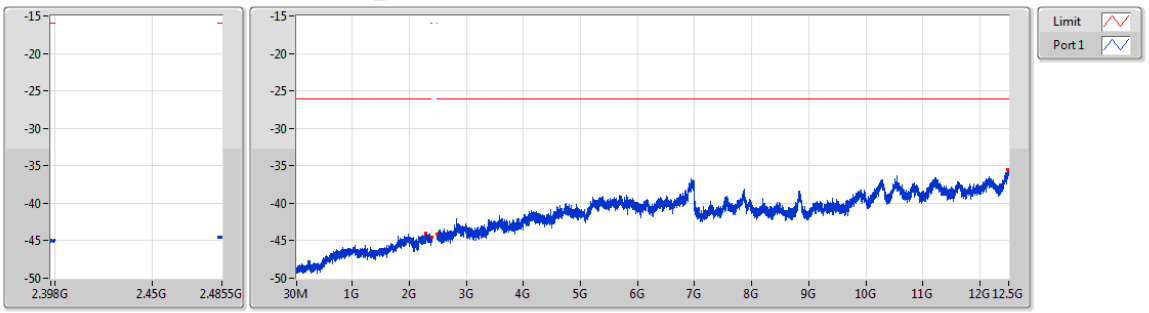
2440MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2328.075	-43.46	-26.02	-17.44	-43.46
2391.94	-44.57	-16.02	-28.55	-44.57
2487.66	-44.06	-16.02	-28.04	-44.06
12484.995	-35.24	-26.02	-9.22	-35.24

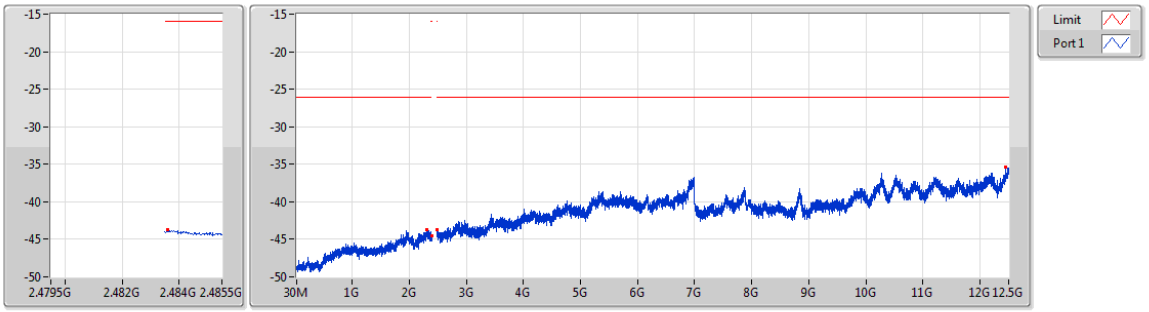
LE-125kbps_Nss1_1TX **CSE-TX-**

2440MHz_TnomVmax



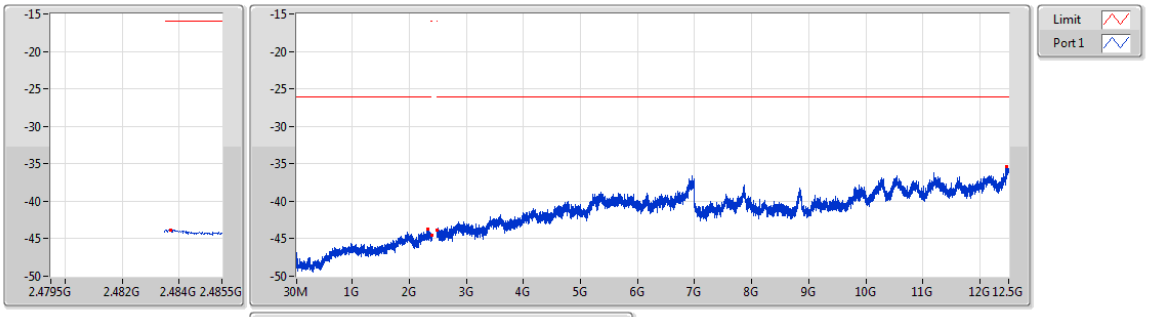
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2297.434	-43.92	-26.02	-17.90	-43.92
2392.148	-44.48	-16.02	-28.46	-44.48
2488.076	-44.14	-16.02	-28.12	-44.14
12488.746	-35.52	-26.02	-9.50	-35.52

LE-125kbps_Nss1_1TX 2480MHz_TnomVnom **CSE-TX-**



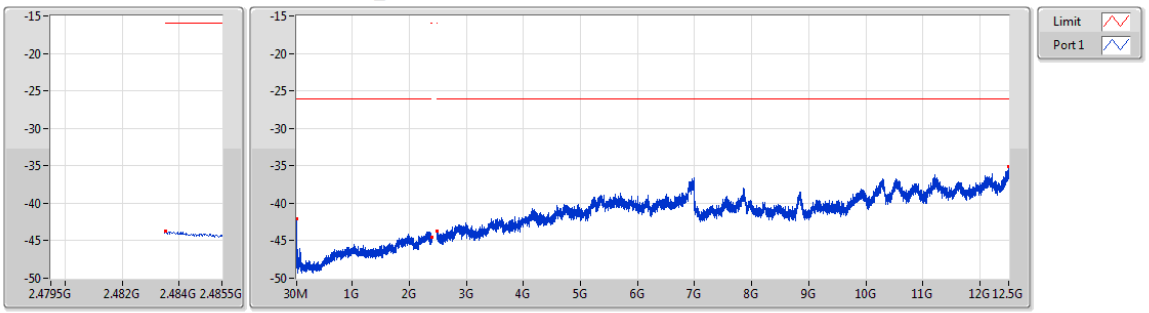
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2304.505	-43.68	-26.02	-17.66	-43.68
2392.304	-44.57	-16.02	-28.55	-44.57
2483.578	-43.70	-16.02	-27.68	-43.70
12447.482	-35.40	-26.02	-9.38	-35.40

LE-125kbps_Nss1_1TX 2480MHz_TnomVmin **CSE-TX-**



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2323.361	-43.73	-26.02	-17.71	-43.73
2392.2	-44.54	-16.02	-28.52	-44.54
2483.708	-43.81	-16.02	-27.79	-43.81
12472.49	-35.31	-26.02	-9.29	-35.31

LE-125kbps_Nss1_1TX 2480MHz_TnomVmax **CSE-TX-**



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-42.03	-26.02	-16.01	-42.03
2392.226	-44.49	-16.02	-28.47	-44.49
2483.526	-43.77	-16.02	-27.75	-43.77
12496.249	-35.12	-26.02	-9.10	-35.12

Summary

Mode	Result	ID Length	ID Limit	Function
2.4-2.4835GHz	-	-	-	-
BT-LE-(125kbps)	Pass	CD:DD:6C:DA:BD:17	48 bits	Good

Result

Mode	Result	ID Length	ID Limit	Function
BT-LE-(125kbps)	-	-	-	-
2402MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2402MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2402MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good

Summary

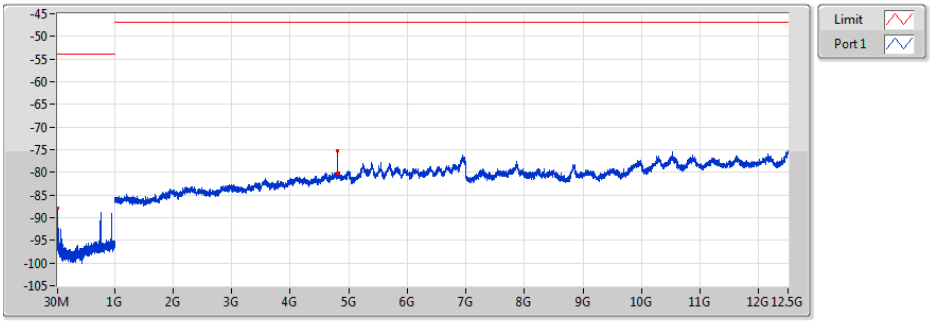
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (nW/MHz)	Limit (dBm)	Limit (nW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (nW/MHz)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE-(125kbps)	Pass	1G	12.5G	1M	10526.312	-68.37	0.14555	-46.99	19.99862	-21.38	4.61	-68.37	0.14555

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)	Loss (dB)	P1 (dBm)	P1 (nW/MHz)
BT-LE-(125kbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	1G	100k	31.94	-87.79	0.00166	-53.98	3.99945	-33.81	0.26	-87.79	0.00166
2402MHz_TnomVnom	Pass	1G	12.5G	1M	4802.187	-75.13	0.03069	-46.99	19.99862	-28.14	1.72	-75.13	0.03069
2402MHz_TnomVnom	Pass	1G	12.5G	1M	4803.625	-80.10	0.00977	-46.99	19.99862	-33.11	1.72	-80.10	0.00977
2402MHz_TnomVmin	Pass	30M	1G	100k	31.94	-86.79	0.00209	-53.98	3.99945	-32.81	0.26	-86.79	0.00209
2402MHz_TnomVmin	Pass	1G	12.5G	1M	4805.062	-80.50	0.00891	-46.99	19.99862	-33.51	1.72	-80.50	0.00891
2402MHz_TnomVmin	Pass	1G	12.5G	1M	10526.312	-69.48	0.11272	-46.99	19.99862	-22.49	4.61	-69.48	0.11272
2402MHz_TnomVmax	Pass	30M	1G	100k	32.425	-86.45	0.00226	-53.98	3.99945	-32.47	0.26	-86.45	0.00226
2402MHz_TnomVmax	Pass	1G	12.5G	1M	4803.625	-80.36	0.0092	-46.99	19.99862	-33.37	1.72	-80.36	0.0092
2402MHz_TnomVmax	Pass	1G	12.5G	1M	12478.437	-75.37	0.02904	-46.99	19.99862	-28.38	5.67	-75.37	0.02904
2440MHz_TnomVnom	Pass	30M	1G	100k	31.94	-83.33	0.00465	-53.98	3.99945	-29.35	0.26	-83.33	0.00465
2440MHz_TnomVnom	Pass	1G	12.5G	1M	4879.812	-81.10	0.00776	-46.99	19.99862	-34.11	1.72	-81.10	0.00776
2440MHz_TnomVnom	Pass	1G	12.5G	1M	10524.875	-70.18	0.09594	-46.99	19.99862	-23.19	4.61	-70.18	0.09594
2440MHz_TnomVmin	Pass	30M	1G	100k	32.425	-83.62	0.00435	-53.98	3.99945	-29.64	0.26	-83.62	0.00435
2440MHz_TnomVmin	Pass	1G	12.5G	1M	4879.812	-81.27	0.00746	-46.99	19.99862	-34.28	1.72	-81.27	0.00746
2440MHz_TnomVmin	Pass	1G	12.5G	1M	12500	-75.46	0.02844	-46.99	19.99862	-28.47	5.68	-75.46	0.02844
2440MHz_TnomVmax	Pass	30M	1G	100k	31.94	-85.45	0.00285	-53.98	3.99945	-31.47	0.26	-85.45	0.00285
2440MHz_TnomVmax	Pass	1G	12.5G	1M	4879.812	-81.56	0.00698	-46.99	19.99862	-34.57	1.72	-81.56	0.00698
2440MHz_TnomVmax	Pass	1G	12.5G	1M	10524.875	-74.71	0.03381	-46.99	19.99862	-27.72	4.61	-74.71	0.03381
2480MHz_TnomVnom	Pass	30M	1G	100k	771.565	-85.01	0.00316	-53.98	3.99945	-31.03	0.73	-85.01	0.00316
2480MHz_TnomVnom	Pass	1G	12.5G	1M	4958.875	-79.35	0.01161	-46.99	19.99862	-32.36	1.73	-79.35	0.01161
2480MHz_TnomVnom	Pass	1G	12.5G	1M	12497.125	-75.50	0.02818	-46.99	19.99862	-28.51	5.68	-75.50	0.02818
2480MHz_TnomVmin	Pass	30M	1G	100k	31.94	-81.18	0.00762	-53.98	3.99945	-27.20	0.26	-81.18	0.00762
2480MHz_TnomVmin	Pass	1G	12.5G	1M	4958.875	-78.68	0.01355	-46.99	19.99862	-31.69	1.73	-78.68	0.01355
2480MHz_TnomVmin	Pass	1G	12.5G	1M	10526.312	-68.37	0.14555	-46.99	19.99862	-21.38	4.61	-68.37	0.14555
2480MHz_TnomVmax	Pass	30M	1G	100k	32.425	-82.10	0.00617	-53.98	3.99945	-28.12	0.26	-82.10	0.00617
2480MHz_TnomVmax	Pass	1G	12.5G	1M	4958.875	-79.23	0.01194	-46.99	19.99862	-32.24	1.73	-79.23	0.01194
2480MHz_TnomVmax	Pass	1G	12.5G	1M	10526.312	-73.20	0.04786	-46.99	19.99862	-26.21	4.61	-73.20	0.04786

LE-125kbps_Nss1_1TX CSE-RX-

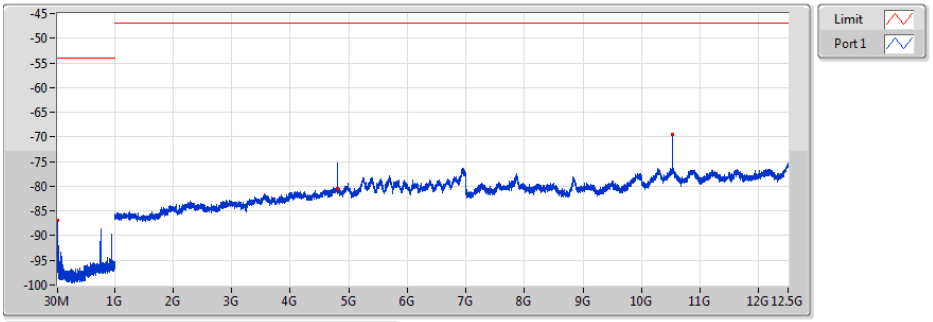
2402MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-87.79	-53.98	-33.81	-87.79
4802.187	-75.13	-46.99	-28.14	-75.13
4803.625	-80.10	-46.99	-33.11	-80.10

LE-125kbps_Nss1_1TX CSE-RX-

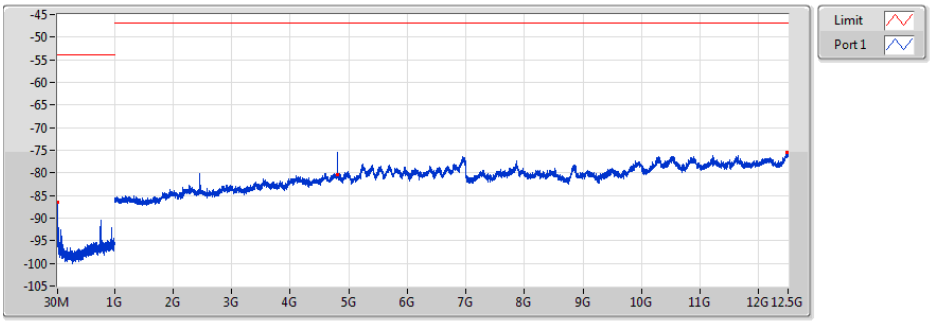
2402MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-86.79	-53.98	-32.81	-86.79
4805.062	-80.50	-46.99	-33.51	-80.50
10526.312	-69.48	-46.99	-22.49	-69.48

LE-125kbps_Nss1_1TX CSE-RX-

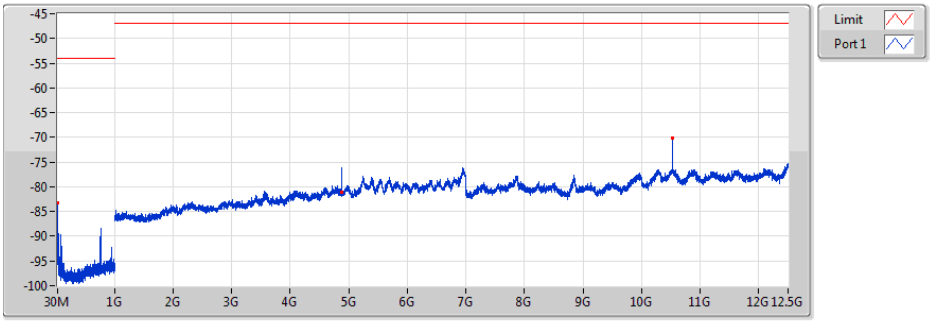
2402MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.425	-86.45	-53.98	-32.47	-86.45
4803.625	-80.36	-46.99	-33.37	-80.36
12478.437	-75.37	-46.99	-28.38	-75.37

LE-125kbps_Nss1_1TX CSE-RX-

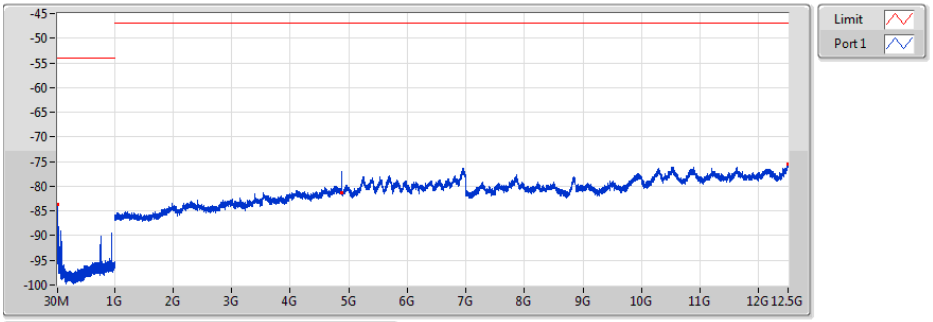
2440MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-83.33	-53.98	-29.35	-83.33
4879.812	-81.10	-46.99	-34.11	-81.10
10524.875	-70.18	-46.99	-23.19	-70.18

LE-125kbps_Nss1_1TX CSE-RX-

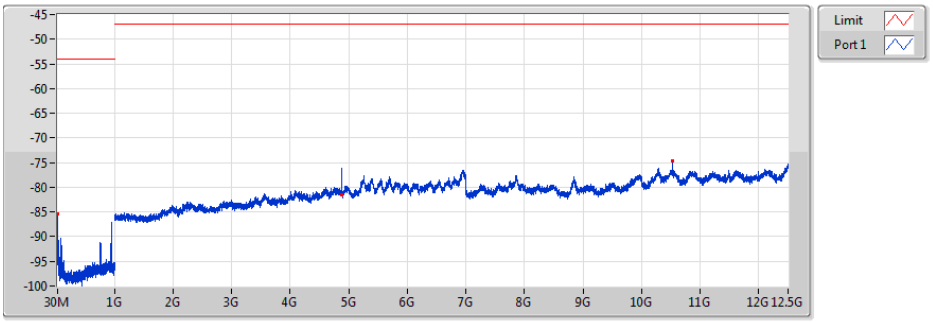
2440MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.425	-83.62	-53.98	-29.64	-83.62
4879.812	-81.27	-46.99	-34.28	-81.27
12500	-75.46	-46.99	-28.47	-75.46

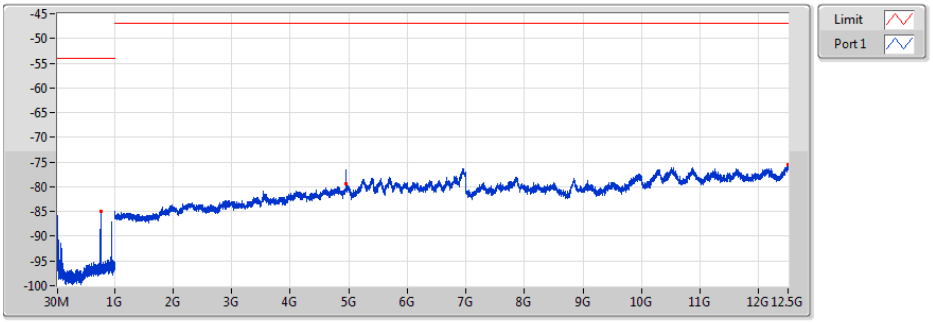
LE-125kbps_Nss1_1TX CSE-RX-

2440MHz_TnomVmax



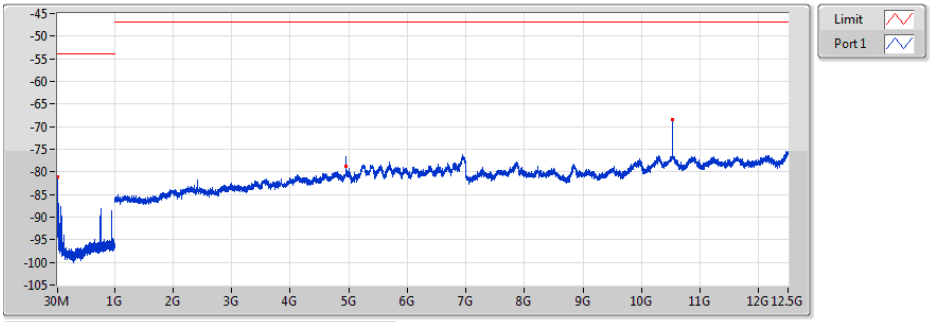
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-85.45	-53.98	-31.47	-85.45
4879.812	-81.56	-46.99	-34.57	-81.56
10524.875	-74.71	-46.99	-27.72	-74.71

LE-125kbps_Nss1_1TX CSE-RX-2480MHz_TnomVnom



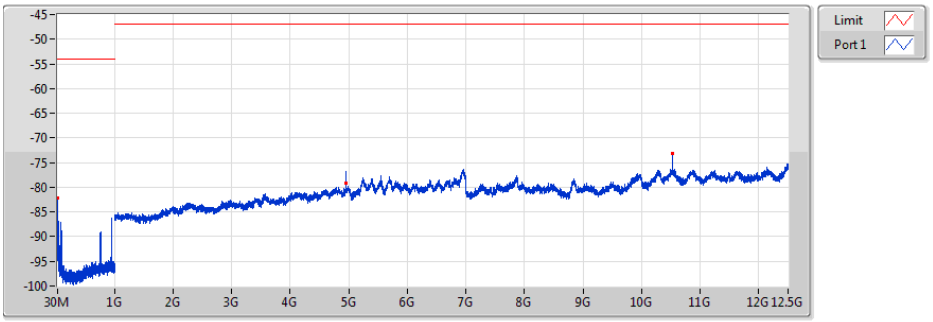
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
771.565	-85.01	-53.98	-31.03	-85.01
4958.875	-79.35	-46.99	-32.36	-79.35
12497.125	-75.50	-46.99	-28.51	-75.50

LE-125kbps_Nss1_1TX CSE-RX-2480MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-81.18	-53.98	-27.20	-81.18
4958.875	-78.68	-46.99	-31.69	-78.68
10526.312	-68.37	-46.99	-21.38	-68.37

LE-125kbps_Nss1_1TX CSE-RX-2480MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.425	-82.10	-53.98	-28.12	-82.10
4958.875	-79.23	-46.99	-32.24	-79.23
10526.312	-73.20	-46.99	-26.21	-73.20

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE-(500kbps)	7.56	5.702	9.56	9.036

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)	P1 (dBm)
BT-LE-(500kbps)	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2	7.56	5.702	10	9.56	9.036	16.368	7.56
2402MHz_TnomVmin	Pass	2	7.55	5.689	10	9.55	9.016	16.368	7.55
2402MHz_TnomVmax	Pass	2	7.56	5.702	10	9.56	9.036	16.368	7.56
2440MHz_TnomVnom	Pass	2	7.48	5.598	10	9.48	8.872	16.368	7.48
2440MHz_TnomVmin	Pass	2	7.50	5.623	10	9.50	8.913	16.368	7.50
2440MHz_TnomVmax	Pass	2	7.51	5.636	10	9.51	8.933	16.368	7.51
2480MHz_TnomVnom	Pass	2	7.23	5.284	10	9.23	8.375	16.368	7.23
2480MHz_TnomVmin	Pass	2	7.31	5.383	10	9.31	8.531	16.368	7.31
2480MHz_TnomVmax	Pass	2	7.30	5.370	10	9.30	8.511	16.368	7.30

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

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-	-
BT-LE-(500kbps)	Pass	7.56	5.702	7.78	6.00	-4.97	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE-(500kbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	7.56	5.702	7.78	6.00	-4.97	20	-80
2402MHz_TnomVmin	Pass	7.55	5.689	7.78	6.00	-5.19	20	-80
2402MHz_TnomVmax	Pass	7.56	5.702	7.78	6.00	-4.97	20	-80
2440MHz_TnomVnom	Pass	7.48	5.598	7.78	6.00	-6.71	20	-80
2440MHz_TnomVmin	Pass	7.50	5.623	7.78	6.00	-6.28	20	-80
2440MHz_TnomVmax	Pass	7.51	5.636	7.78	6.00	-6.06	20	-80
2480MHz_TnomVnom	Pass	7.23	5.284	7.78	6.00	-11.93	20	-80
2480MHz_TnomVmin	Pass	7.31	5.383	7.78	6.00	-10.29	20	-80
2480MHz_TnomVmax	Pass	7.30	5.370	7.78	6.00	-10.49	20	-80

Summary

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
2.4-2.4835GHz	-	-	-	-	-	-	-
BT-LE-(500kbps)	Pass	2.44G	2.439988G	-5.123	±50	1	-

Result

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
BT-LE-(500kbps)	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.402G	2.40199G	-4.267	±50	1	-
2402MHz_TnomVmin	Pass	2.402G	2.401989G	-4.684	±50	1	-
2402MHz_TnomVmax	Pass	2.402G	2.401988G	-4.892	±50	1	-
2440MHz_TnomVnom	Pass	2.44G	2.439988G	-4.918	±50	1	-
2440MHz_TnomVmin	Pass	2.44G	2.439988G	-5.123	±50	1	-
2440MHz_TnomVmax	Pass	2.44G	2.439993G	-3.074	±50	1	-
2480MHz_TnomVnom	Pass	2.48G	2.479989G	-4.637	±50	1	-
2480MHz_TnomVmin	Pass	2.48G	2.479988G	-4.839	±50	1	-
2480MHz_TnomVmax	Pass	2.48G	2.479988G	-4.839	±50	1	-

Summary

Mode	Max-OBW (MHz)	ITU-Code	Min-OBW (MHz)
2.4-2.4835GHz	-	-	-
BT-LE-(500kbps)	1.289	1M29D1D	1.277

Max-OBW = Maximum99% occupied bandwidth; **Min-OBW** = Minimum99% occupied bandwidth;

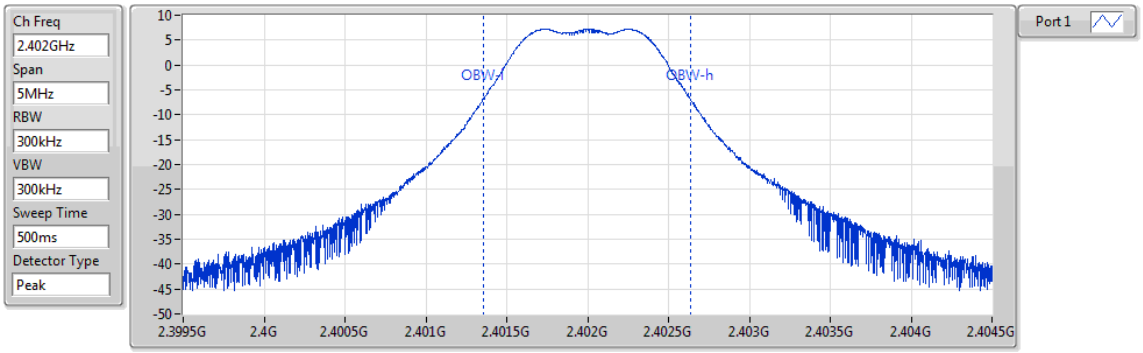
Result

Mode	Result	Limit (MHz)	P1-OBW (MHz)
BT-LE-(500kbps)	-	-	-
2402MHz_TnomVnom	Pass	26	1.277
2402MHz_TnomVmin	Pass	26	1.279
2402MHz_TnomVmax	Pass	26	1.279
2440MHz_TnomVnom	Pass	26	1.282
2440MHz_TnomVmin	Pass	26	1.284
2440MHz_TnomVmax	Pass	26	1.284
2480MHz_TnomVnom	Pass	26	1.289
2480MHz_TnomVmin	Pass	26	1.289
2480MHz_TnomVmax	Pass	26	1.289

P1-OBW = Port 1 99% occupied bandwidth;

LE-500kbps_Nss1_1TX **OBW**

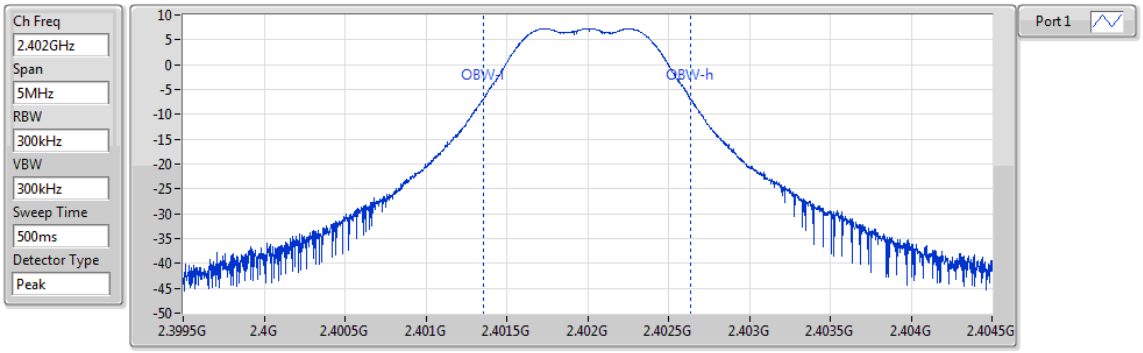
2402MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.277	2.401358G	2.402635G	26	1

LE-500kbps_Nss1_1TX **OBW**

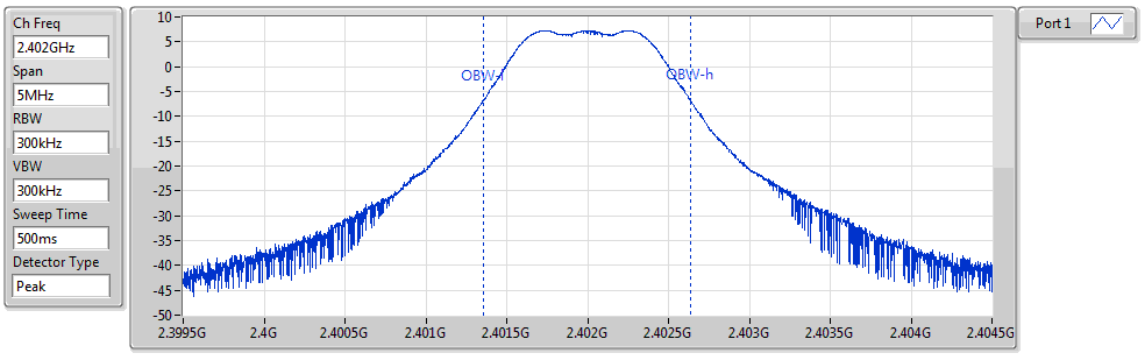
2402MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.279	2.401358G	2.402637G	26	1

LE-500kbps_Nss1_1TX **OBW**

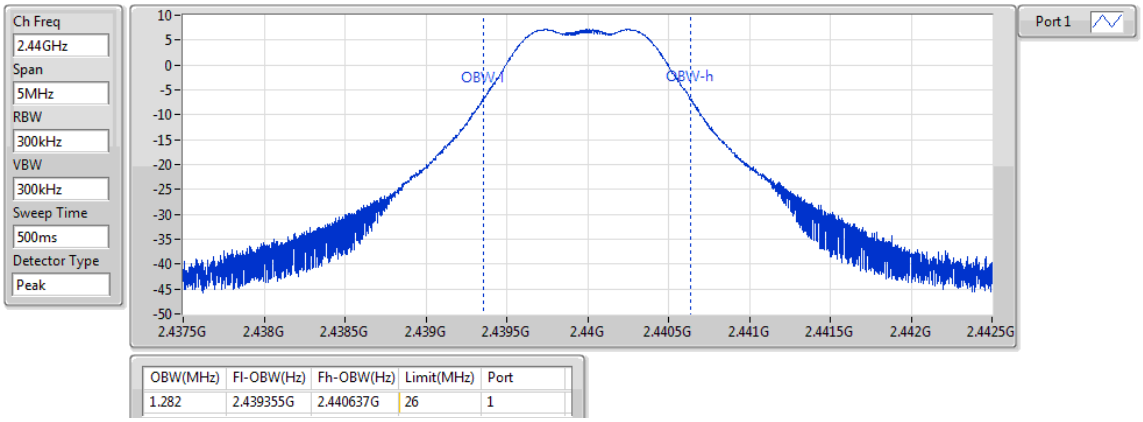
2402MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.279	2.401355G	2.402635G	26	1

LE-500kbps_Nss1_1TX **OBW**

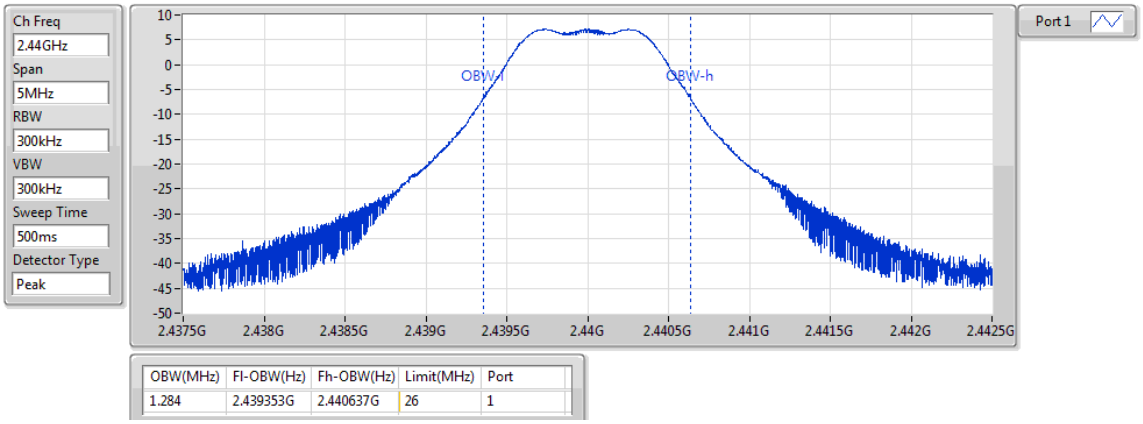
2440MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.282	2.439355G	2.440637G	26	1

LE-500kbps_Nss1_1TX **OBW**

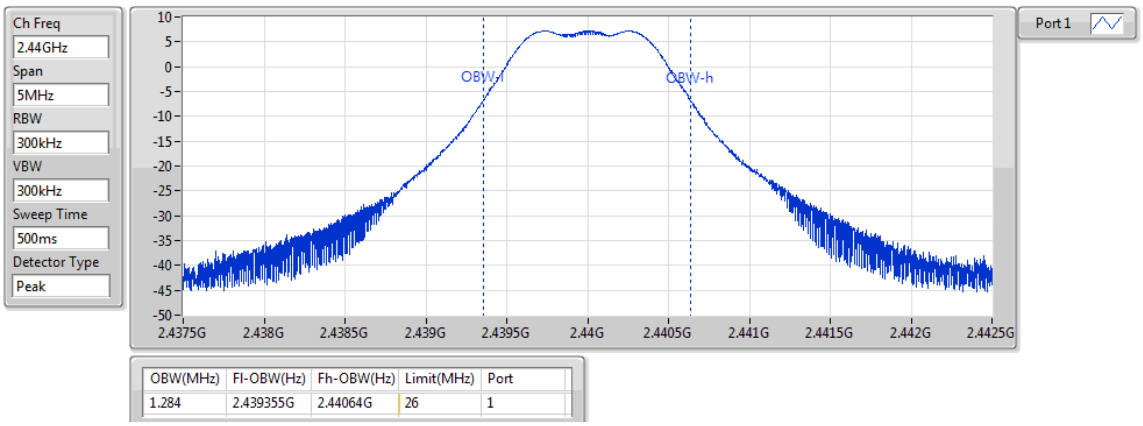
2440MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.284	2.439353G	2.440637G	26	1

LE-500kbps_Nss1_1TX **OBW**

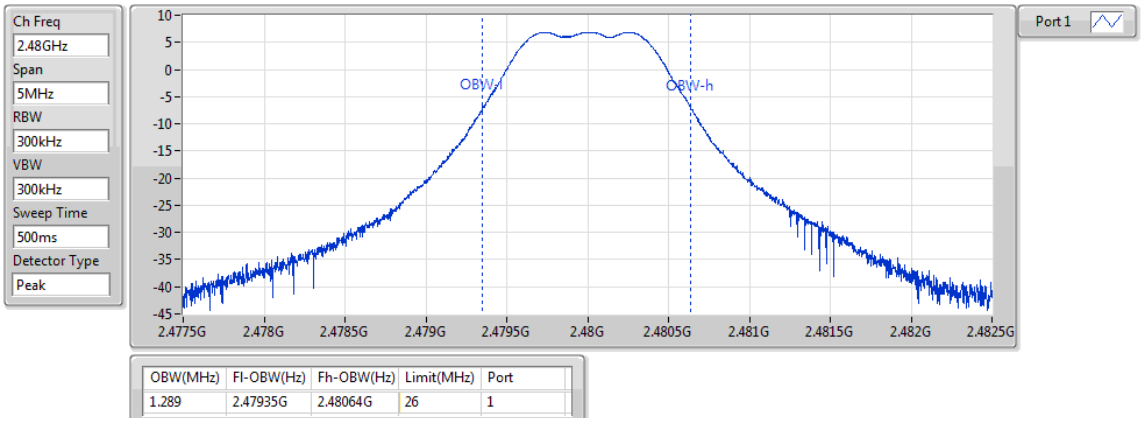
2440MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.284	2.439355G	2.44064G	26	1

LE-500kbps_Nss1_1TX **OBW**

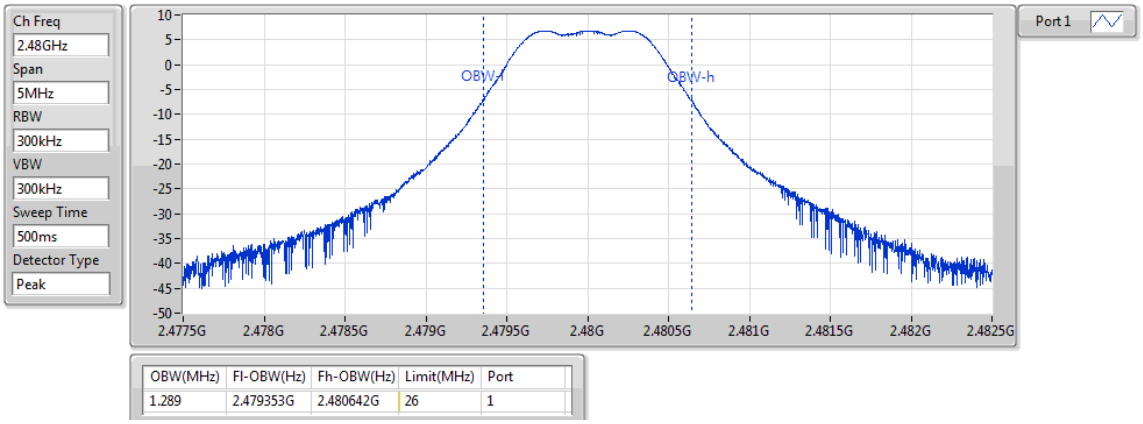
2480MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.289	2.47935G	2.48064G	26	1

LE-500kbps_Nss1_1TX **OBW**

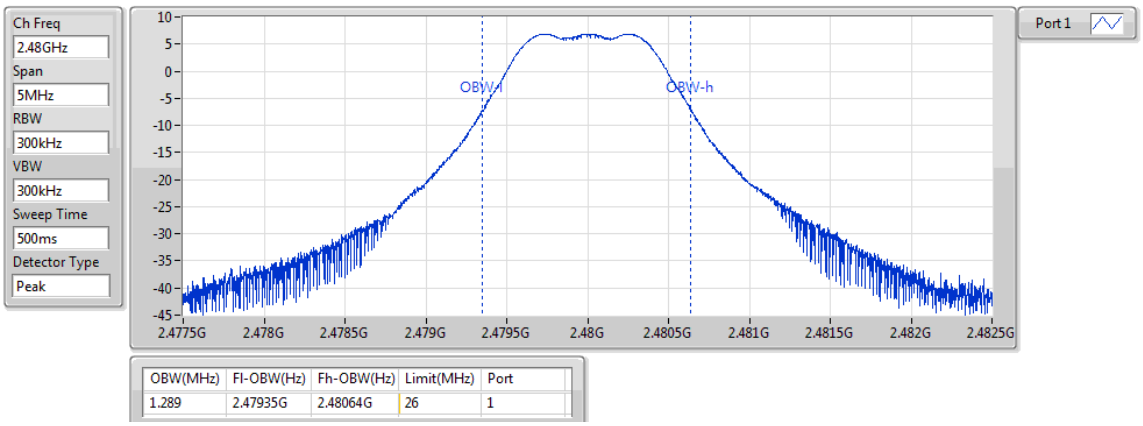
2480MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.289	2.479353G	2.480642G	26	1

LE-500kbps_Nss1_1TX **OBW**

2480MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.289	2.47935G	2.48064G	26	1

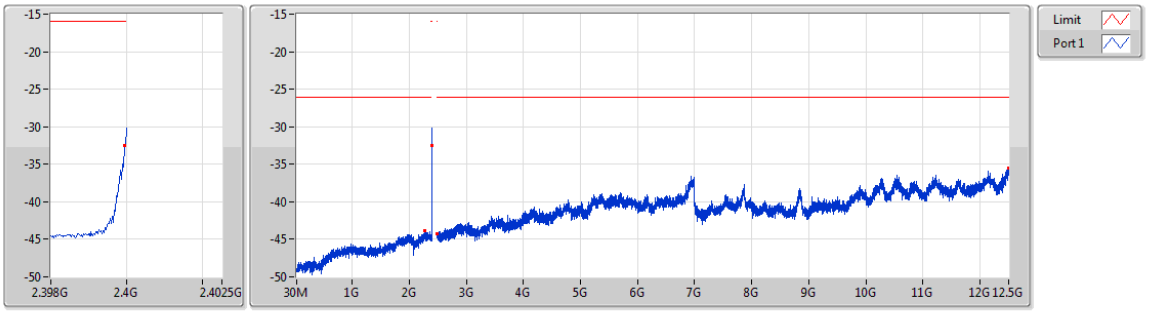
Summary

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)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE-(500kbps)	Pass	30M	2.387G	1M	87.746	-27.71	1.69434	-26.02	2.50035	-1.69	0.30	-27.71	1.69434

Result

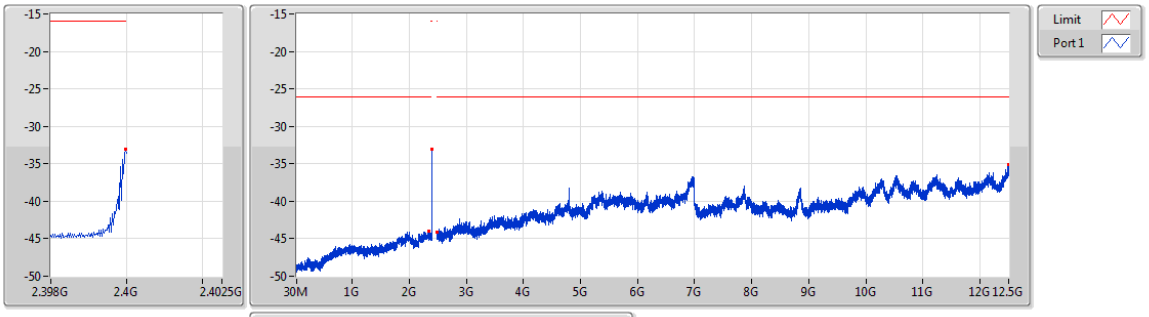
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (uW/MHz)	Limit (dBm)	Limit (uW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (uW/MHz)
BT-LE-(500kbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	2.387G	1M	32.357	-31.81	0.65917	-26.02	2.50035	-5.79	0.26	-31.81	0.65917
2402MHz_TnomVnom	Pass	2.387G	2.4G	1M	2399.948	-31.80	0.66069	-16.02	25.00345	-15.78	1.47	-31.80	0.66069
2402MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2494.082	-44.21	0.03793	-16.02	25.00345	-28.19	1.49	-44.21	0.03793
2402MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12489.996	-34.97	0.31842	-26.02	2.50035	-8.95	5.67	-34.97	0.31842
2402MHz_TnomVmin	Pass	30M	2.387G	1M	32.357	-31.53	0.70307	-26.02	2.50035	-5.51	0.26	-31.53	0.70307
2402MHz_TnomVmin	Pass	2.387G	2.4G	1M	2399.974	-31.60	0.69183	-16.02	25.00345	-15.58	1.47	-31.60	0.69183
2402MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2490.078	-44.20	0.03802	-16.02	25.00345	-28.18	1.49	-44.20	0.03802
2402MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12488.746	-35.37	0.2904	-26.02	2.50035	-9.35	5.67	-35.37	0.2904
2402MHz_TnomVmax	Pass	30M	2.387G	1M	32.357	-31.43	0.71945	-26.02	2.50035	-5.41	0.26	-31.43	0.71945
2402MHz_TnomVmax	Pass	2.387G	2.4G	1M	2399.948	-32.41	0.57412	-16.02	25.00345	-16.39	1.47	-32.41	0.57412
2402MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2490.182	-44.23	0.03776	-16.02	25.00345	-28.21	1.49	-44.23	0.03776
2402MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12500	-35.41	0.28774	-26.02	2.50035	-9.39	5.68	-35.41	0.28774
2440MHz_TnomVnom	Pass	30M	2.387G	1M	32.357	-32.01	0.62951	-26.02	2.50035	-5.99	0.26	-32.01	0.62951
2440MHz_TnomVnom	Pass	2.387G	2.4G	1M	2391.966	-44.48	0.03565	-16.02	25.00345	-28.46	1.47	-44.48	0.03565
2440MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2488.024	-44.15	0.03846	-16.02	25.00345	-28.13	1.49	-44.15	0.03846
2440MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12496.249	-35.22	0.30061	-26.02	2.50035	-9.20	5.68	-35.22	0.30061
2440MHz_TnomVmin	Pass	30M	2.387G	1M	32.357	-31.69	0.67764	-26.02	2.50035	-5.67	0.26	-31.69	0.67764
2440MHz_TnomVmin	Pass	2.387G	2.4G	1M	2391.706	-44.57	0.03491	-16.02	25.00345	-28.55	1.47	-44.57	0.03491
2440MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2487.868	-44.15	0.03846	-16.02	25.00345	-28.13	1.49	-44.15	0.03846
2440MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12496.249	-35.17	0.30409	-26.02	2.50035	-9.15	5.68	-35.17	0.30409
2440MHz_TnomVmax	Pass	30M	2.387G	1M	32.357	-31.92	0.64269	-26.02	2.50035	-5.90	0.26	-31.92	0.64269
2440MHz_TnomVmax	Pass	2.387G	2.4G	1M	2392.018	-44.58	0.03483	-16.02	25.00345	-28.56	1.47	-44.58	0.03483
2440MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2488.44	-44.22	0.03784	-16.02	25.00345	-28.20	1.49	-44.22	0.03784
2440MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12496.249	-35.00	0.31623	-26.02	2.50035	-8.98	5.68	-35.00	0.31623
2480MHz_TnomVnom	Pass	30M	2.387G	1M	32.357	-31.93	0.64121	-26.02	2.50035	-5.91	0.26	-31.93	0.64121
2480MHz_TnomVnom	Pass	2.387G	2.4G	1M	2392.044	-44.62	0.03451	-16.02	25.00345	-28.60	1.47	-44.62	0.03451
2480MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2483.682	-43.91	0.04064	-16.02	25.00345	-27.89	1.49	-43.91	0.04064
2480MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12487.496	-35.52	0.28054	-26.02	2.50035	-9.50	5.67	-35.52	0.28054
2480MHz_TnomVmin	Pass	30M	2.387G	1M	32.357	-32.60	0.54954	-26.02	2.50035	-6.58	0.26	-32.60	0.54954
2480MHz_TnomVmin	Pass	2.387G	2.4G	1M	2392.018	-44.51	0.0354	-16.02	25.00345	-28.49	1.47	-44.51	0.0354
2480MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2483.604	-43.83	0.0414	-16.02	25.00345	-27.81	1.49	-43.83	0.0414
2480MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12494.998	-35.28	0.29648	-26.02	2.50035	-9.26	5.68	-35.28	0.29648
2480MHz_TnomVmax	Pass	30M	2.387G	1M	87.746	-27.71	1.69434	-26.02	2.50035	-1.69	0.30	-27.71	1.69434
2480MHz_TnomVmax	Pass	2.387G	2.4G	1M	2387.156	-44.64	0.03436	-16.02	25.00345	-28.62	1.46	-44.64	0.03436
2480MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2483.708	-44.00	0.03981	-16.02	25.00345	-27.98	1.49	-44.00	0.03981
2480MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12488.746	-35.53	0.2799	-26.02	2.50035	-9.51	5.67	-35.53	0.2799

LE-500kbps_Nss1_1TX 2402MHz_TnomVnom **CSE-TX-**



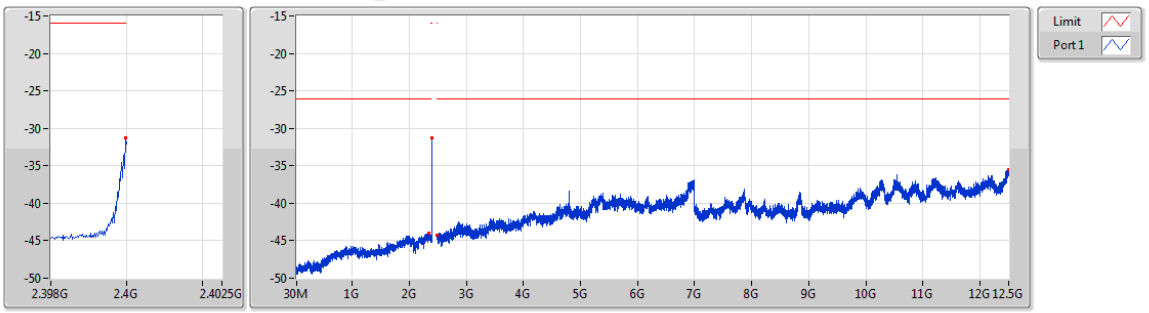
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2279.756	-43.91	-26.02	-17.89	-43.91
2399.948	-32.46	-16.02	-16.44	-32.46
2490.494	-44.20	-16.02	-28.18	-44.20
12491.247	-35.52	-26.02	-9.50	-35.52

LE-500kbps_Nss1_1TX 2402MHz_TnomVmin **CSE-TX-**



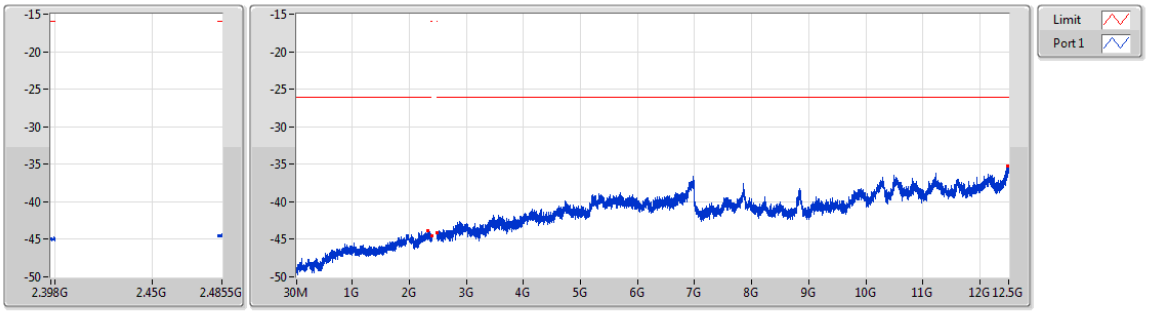
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2338.682	-43.98	-26.02	-17.96	-43.98
2399.974	-33.04	-16.02	-17.02	-33.04
2489.662	-44.14	-16.02	-28.12	-44.14
12500	-35.09	-26.02	-9.07	-35.09

LE-500kbps_Nss1_1TX 2402MHz_TnomVmax **CSE-TX-**



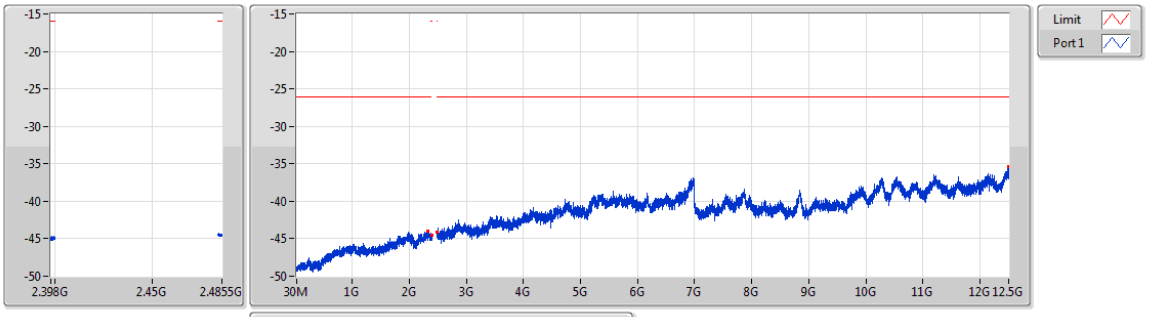
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2336.325	-43.93	-26.02	-17.91	-43.93
2399.974	-31.32	-16.02	-15.30	-31.32
2489.792	-44.23	-16.02	-28.21	-44.23
12496.249	-35.54	-26.02	-9.52	-35.54

LE-500kbps_Nss1_1TX 2440MHz_TnomVnom **CSE-TX-**



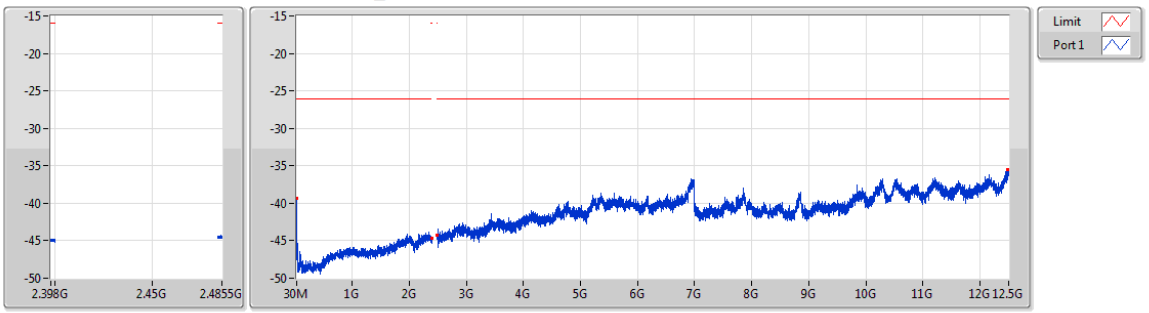
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2328.075	-43.91	-26.02	-17.89	-43.91
2392.174	-44.51	-16.02	-28.49	-44.51
2488.154	-44.16	-16.02	-28.14	-44.16
12489.996	-35.23	-26.02	-9.21	-35.23

LE-500kbps_Nss1_1TX 2440MHz_TnomVmin **CSE-TX-**



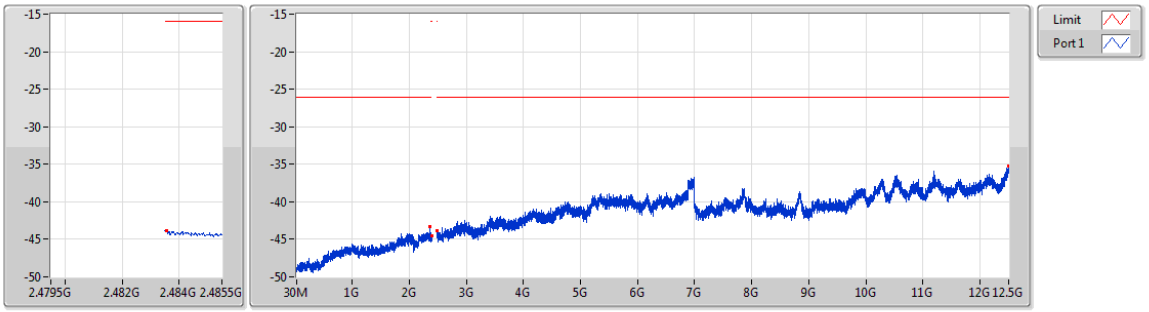
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2333.968	-43.99	-26.02	-17.97	-43.99
2391.55	-44.59	-16.02	-28.57	-44.59
2487.79	-44.17	-16.02	-28.15	-44.17
12500	-35.33	-26.02	-9.31	-35.33

LE-500kbps_Nss1_1TX 2440MHz_TnomVmax **CSE-TX-**



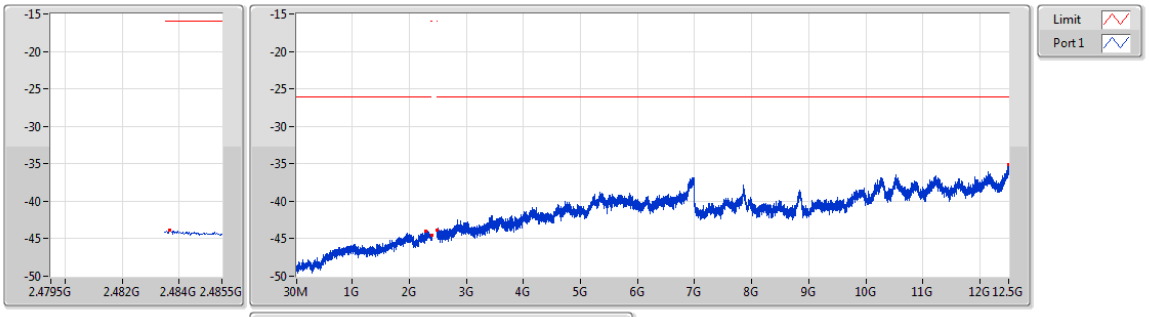
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-39.38	-26.02	-13.36	-39.38
2391.836	-44.62	-16.02	-28.60	-44.62
2487.92	-44.19	-16.02	-28.17	-44.19
12484.995	-35.47	-26.02	-9.45	-35.47

LE-500kbps_Nss1_1TX **CSE-TX-2480MHz_TnomVnom**



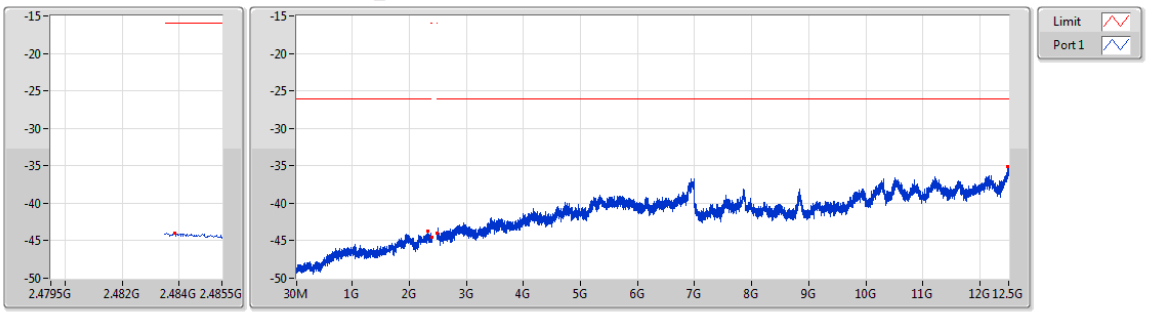
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2358.716	-43.28	-26.02	-17.26	-43.28
2391.94	-44.53	-16.02	-28.51	-44.53
2483.552	-43.89	-16.02	-27.87	-43.89
12496.249	-35.28	-26.02	-9.26	-35.28

LE-500kbps_Nss1_1TX **CSE-TX-2480MHz_TnomVmin**



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2283.292	-43.93	-26.02	-17.91	-43.93
2391.524	-44.54	-16.02	-28.52	-44.54
2483.656	-43.91	-16.02	-27.89	-43.91
12494.998	-35.16	-26.02	-9.14	-35.16

LE-500kbps_Nss1_1TX **CSE-TX-2480MHz_TnomVmax**



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2318.647	-43.77	-26.02	-17.75	-43.77
2392.148	-44.53	-16.02	-28.51	-44.53
2483.838	-43.99	-16.02	-27.97	-43.99
12482.494	-35.07	-26.02	-9.05	-35.07

Summary

Mode	Result	ID Length	ID Limit	Function
2.4-2.4835GHz	-	-	-	-
BT-LE-(500kbps)	Pass	CD:DD:6C:DA:BD:17	48 bits	Good

Result

Mode	Result	ID Length	ID Limit	Function
BT-LE-(500kbps)	-	-	-	-
2402MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2402MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2402MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good

Summary

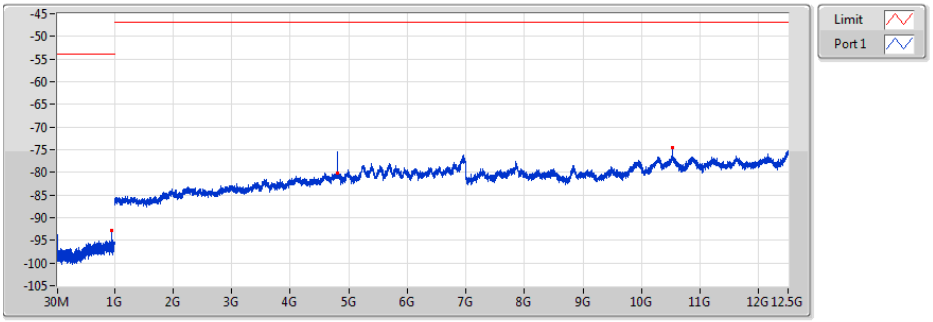
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (nW/MHz)	Limit (dBm)	Limit (nW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (nW/MHz)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE-(500kbps)	Pass	30M	1G	100k	39.7	-61.37	0.72946	-53.98	3.99945	-7.39	0.27	-61.37	0.72946

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)	Loss (dB)	P1 (dBm)	P1 (nW/MHz)
BT-LE-(500kbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	1G	100k	39.7	-63.42	0.45499	-53.98	3.99945	-9.44	0.27	-63.42	0.45499
2402MHz_TnomVnom	Pass	1G	12.5G	1M	4805.062	-80.71	0.00849	-46.99	19.99862	-33.72	1.72	-80.71	0.00849
2402MHz_TnomVnom	Pass	1G	12.5G	1M	12489.937	-75.50	0.02818	-46.99	19.99862	-28.51	5.67	-75.50	0.02818
2402MHz_TnomVmin	Pass	30M	1G	100k	31.94	-62.54	0.55719	-53.98	3.99945	-8.56	0.26	-62.54	0.55719
2402MHz_TnomVmin	Pass	1G	12.5G	1M	4805.062	-80.70	0.00851	-46.99	19.99862	-33.71	1.72	-80.70	0.00851
2402MHz_TnomVmin	Pass	1G	12.5G	1M	12479.875	-75.40	0.02884	-46.99	19.99862	-28.41	5.67	-75.40	0.02884
2402MHz_TnomVmax	Pass	30M	1G	100k	39.7	-63.42	0.45499	-53.98	3.99945	-9.44	0.27	-63.42	0.45499
2402MHz_TnomVmax	Pass	1G	12.5G	1M	4805.062	-80.60	0.00871	-46.99	19.99862	-33.61	1.72	-80.60	0.00871
2402MHz_TnomVmax	Pass	1G	12.5G	1M	12489.937	-75.52	0.02805	-46.99	19.99862	-28.53	5.67	-75.52	0.02805
2440MHz_TnomVnom	Pass	30M	1G	100k	39.7	-61.37	0.72946	-53.98	3.99945	-7.39	0.27	-61.37	0.72946
2440MHz_TnomVnom	Pass	1G	12.5G	1M	4879.812	-81.51	0.00706	-46.99	19.99862	-34.52	1.72	-81.51	0.00706
2440MHz_TnomVnom	Pass	1G	12.5G	1M	12495.687	-75.60	0.02754	-46.99	19.99862	-28.61	5.68	-75.60	0.02754
2440MHz_TnomVmin	Pass	30M	1G	100k	32.425	-63.30	0.46774	-53.98	3.99945	-9.32	0.26	-63.30	0.46774
2440MHz_TnomVmin	Pass	1G	12.5G	1M	4879.812	-81.92	0.00643	-46.99	19.99862	-34.93	1.72	-81.92	0.00643
2440MHz_TnomVmin	Pass	1G	12.5G	1M	12498.562	-75.25	0.02985	-46.99	19.99862	-28.26	5.68	-75.25	0.02985
2440MHz_TnomVmax	Pass	30M	1G	100k	32.425	-62.73	0.53333	-53.98	3.99945	-8.75	0.26	-62.73	0.53333
2440MHz_TnomVmax	Pass	1G	12.5G	1M	4879.812	-81.34	0.00735	-46.99	19.99862	-34.35	1.72	-81.34	0.00735
2440MHz_TnomVmax	Pass	1G	12.5G	1M	12500	-75.45	0.02851	-46.99	19.99862	-28.46	5.68	-75.45	0.02851
2480MHz_TnomVnom	Pass	30M	1G	100k	32.425	-63.24	0.47424	-53.98	3.99945	-9.26	0.26	-63.24	0.47424
2480MHz_TnomVnom	Pass	1G	12.5G	1M	4958.875	-79.38	0.01153	-46.99	19.99862	-32.39	1.73	-79.38	0.01153
2480MHz_TnomVnom	Pass	1G	12.5G	1M	10524.875	-72.95	0.0507	-46.99	19.99862	-25.96	4.61	-72.95	0.0507
2480MHz_TnomVmin	Pass	30M	1G	100k	39.7	-63.97	0.40087	-53.98	3.99945	-9.99	0.27	-63.97	0.40087
2480MHz_TnomVmin	Pass	1G	12.5G	1M	4958.875	-78.79	0.01321	-46.99	19.99862	-31.80	1.73	-78.79	0.01321
2480MHz_TnomVmin	Pass	1G	12.5G	1M	12498.562	-75.45	0.02851	-46.99	19.99862	-28.46	5.68	-75.45	0.02851
2480MHz_TnomVmax	Pass	30M	1G	100k	32.425	-62.96	0.50582	-53.98	3.99945	-8.98	0.26	-62.96	0.50582
2480MHz_TnomVmax	Pass	1G	12.5G	1M	4958.875	-79.75	0.01059	-46.99	19.99862	-32.76	1.73	-79.75	0.01059
2480MHz_TnomVmax	Pass	1G	12.5G	1M	12497.125	-75.25	0.02985	-46.99	19.99862	-28.26	5.68	-75.25	0.02985

LE-500kbps_Nss1_1TX CSE-RX-

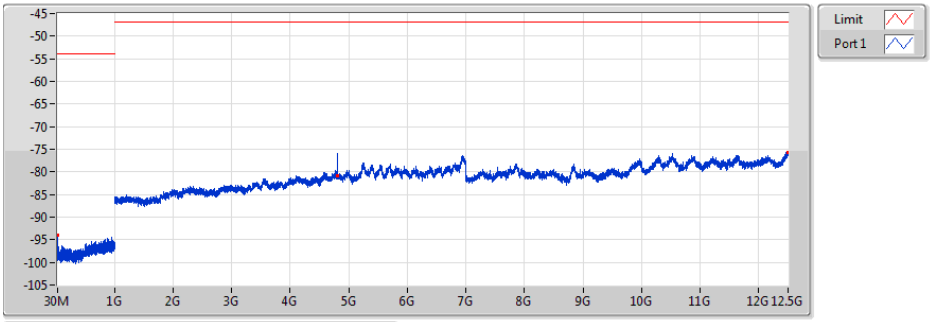
2402MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-92.81	-53.98	-38.83	-92.81
4803.625	-80.04	-46.99	-33.05	-80.04
10526.312	-74.60	-46.99	-27.61	-74.60

LE-500kbps_Nss1_1TX CSE-RX-

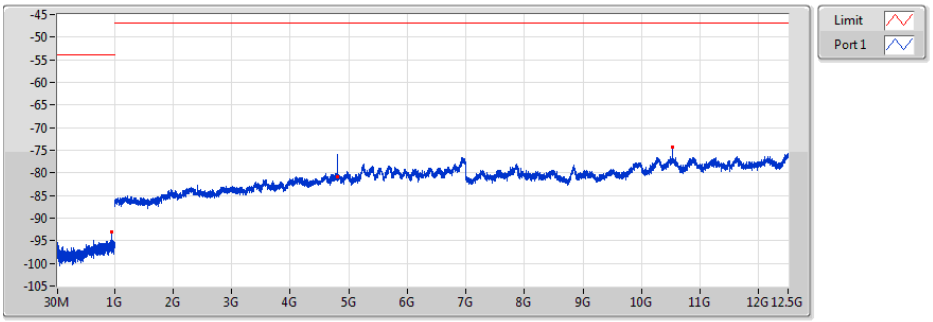
2402MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-93.92	-53.98	-39.94	-93.92
4803.625	-80.95	-46.99	-33.96	-80.95
12500	-75.59	-46.99	-28.60	-75.59

LE-500kbps_Nss1_1TX CSE-RX-

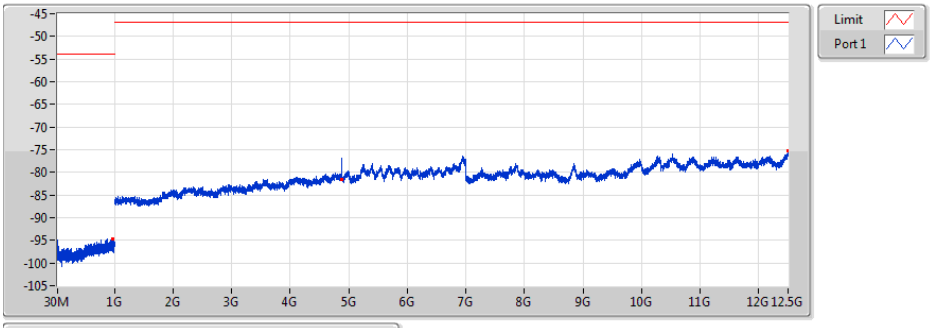
2402MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-93.01	-53.98	-39.03	-93.01
4803.625	-80.82	-46.99	-33.83	-80.82
10526.312	-74.22	-46.99	-27.23	-74.22

LE-500kbps_Nss1_1TX CSE-RX-

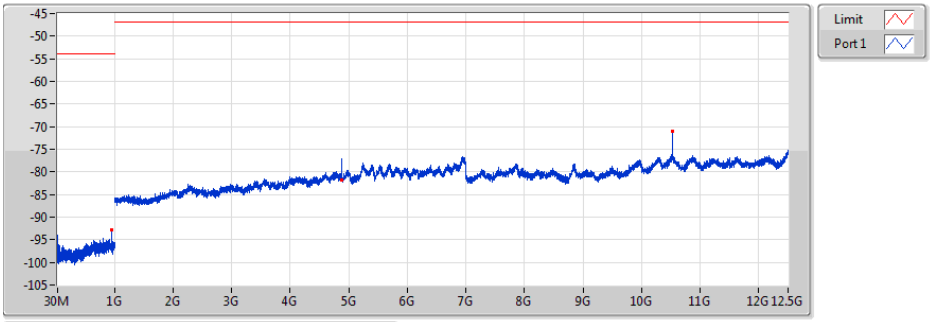
2440MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
971.385	-94.58	-53.98	-40.60	-94.58
4879.812	-81.65	-46.99	-34.66	-81.65
12492.812	-75.22	-46.99	-28.23	-75.22

LE-500kbps_Nss1_1TX CSE-RX-

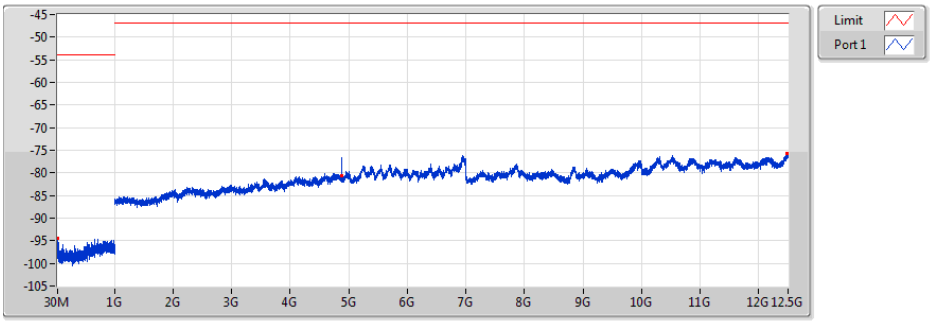
2440MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-92.88	-53.98	-38.90	-92.88
4879.812	-81.70	-46.99	-34.71	-81.70
10526.312	-70.93	-46.99	-23.94	-70.93

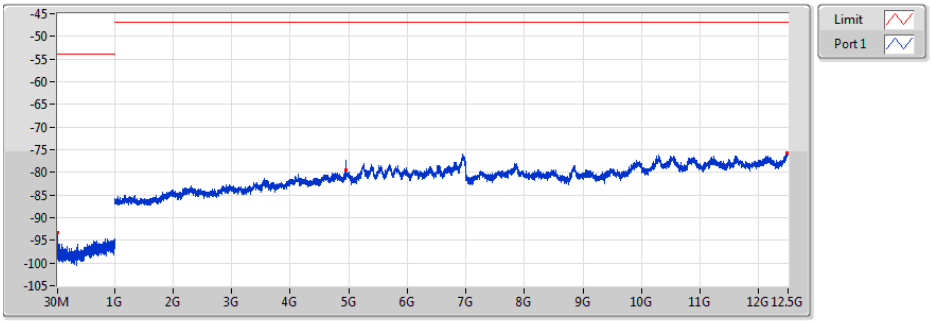
LE-500kbps_Nss1_1TX CSE-RX-

2440MHz_TnomVmax



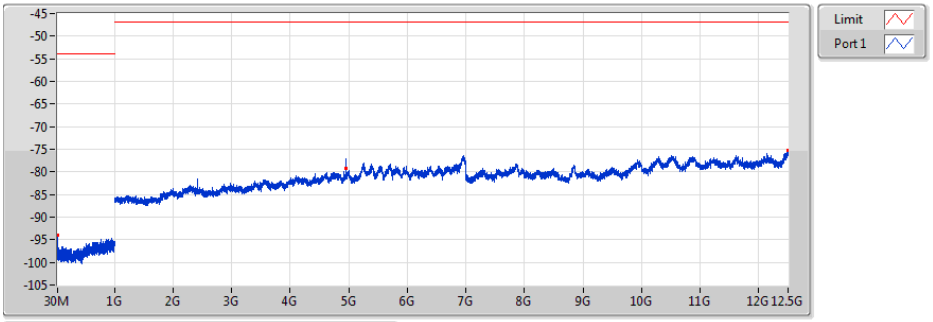
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-94.45	-53.98	-40.47	-94.45
4879.812	-80.68	-46.99	-33.69	-80.68
12488.5	-75.71	-46.99	-28.72	-75.71

LE-500kbps_Nss1_1TX CSE-RX-2480MHz_TnomVnom



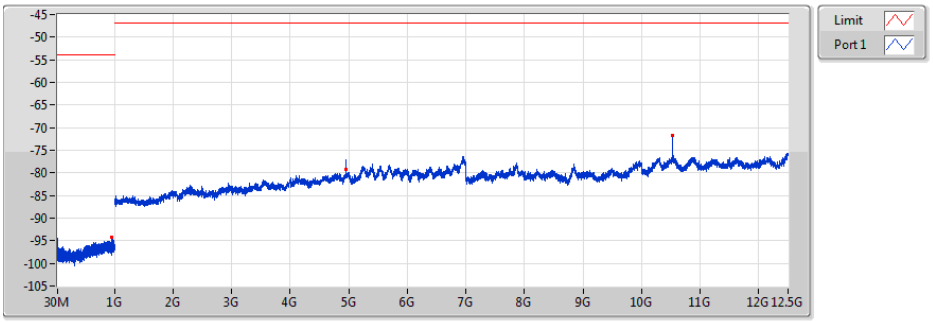
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-93.30	-53.98	-39.32	-93.30
4958.875	-79.50	-46.99	-32.51	-79.50
12475.562	-75.61	-46.99	-28.62	-75.61

LE-500kbps_Nss1_1TX CSE-RX-2480MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-94.01	-53.98	-40.03	-94.01
4958.875	-79.12	-46.99	-32.13	-79.12
12500	-75.24	-46.99	-28.25	-75.24

LE-500kbps_Nss1_1TX CSE-RX-2480MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-94.12	-53.98	-40.14	-94.12
4958.875	-79.24	-46.99	-32.25	-79.24
10524.875	-71.66	-46.99	-24.67	-71.66

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE(1Mbps)	7.68	5.861	9.68	9.290

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)	P1 (dBm)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2	7.67	5.848	10	9.67	9.268	16.368	7.67
2402MHz_TnomVmin	Pass	2	7.68	5.861	10	9.68	9.290	16.368	7.68
2402MHz_TnomVmax	Pass	2	7.68	5.861	10	9.68	9.290	16.368	7.68
2440MHz_TnomVnom	Pass	2	7.61	5.768	10	9.61	9.141	16.368	7.61
2440MHz_TnomVmin	Pass	2	7.63	5.794	10	9.63	9.183	16.368	7.63
2440MHz_TnomVmax	Pass	2	7.66	5.834	10	9.66	9.247	16.368	7.66
2480MHz_TnomVnom	Pass	2	7.35	5.433	10	9.35	8.610	16.368	7.35
2480MHz_TnomVmin	Pass	2	7.41	5.508	10	9.41	8.730	16.368	7.41
2480MHz_TnomVmax	Pass	2	7.41	5.508	10	9.41	8.730	16.368	7.41

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

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	7.67	5.848	7.78	6.00	-2.53	20	-80
2402MHz_TnomVmin	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80
2402MHz_TnomVmax	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80
2440MHz_TnomVnom	Pass	7.61	5.768	7.78	6.00	-3.87	20	-80
2440MHz_TnomVmin	Pass	7.63	5.794	7.78	6.00	-3.43	20	-80
2440MHz_TnomVmax	Pass	7.66	5.834	7.78	6.00	-2.76	20	-80
2480MHz_TnomVnom	Pass	7.35	5.433	7.78	6.00	-9.46	20	-80
2480MHz_TnomVmin	Pass	7.41	5.508	7.78	6.00	-8.20	20	-80
2480MHz_TnomVmax	Pass	7.41	5.508	7.78	6.00	-8.20	20	-80

Summary

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
2.4-2.4835GHz	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	2.48G	2.47999559G	-1.778	±50	1	-

Result

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
BT-LE(1Mbps)	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.402G	2.40199595G	-1.685	±50	1	-
2402MHz_TnomVmin	Pass	2.402G	2.40199592G	-1.699	±50	1	-
2402MHz_TnomVmax	Pass	2.402G	2.4019959G	-1.707	±50	1	-
2440MHz_TnomVnom	Pass	2.44G	2.439996G	-1.639	±50	1	-
2440MHz_TnomVmin	Pass	2.44G	2.43999595G	-1.66	±50	1	-
2440MHz_TnomVmax	Pass	2.44G	2.43999591G	-1.675	±50	1	-
2480MHz_TnomVnom	Pass	2.48G	2.4799956G	-1.775	±50	1	-
2480MHz_TnomVmin	Pass	2.48G	2.47999559G	-1.778	±50	1	-
2480MHz_TnomVmax	Pass	2.48G	2.47999559G	-1.778	±50	1	-

Summary

Mode	Max-OBW (MHz)	ITU-Code	Min-OBW (MHz)
2.4-2.4835GHz	-	-	-
BT-LE(1Mbps)	1.294	1M29F1D	1.284

Max-OBW = Maximum99% occupied bandwidth; **Min-OBW** = Minimum99% occupied bandwidth;

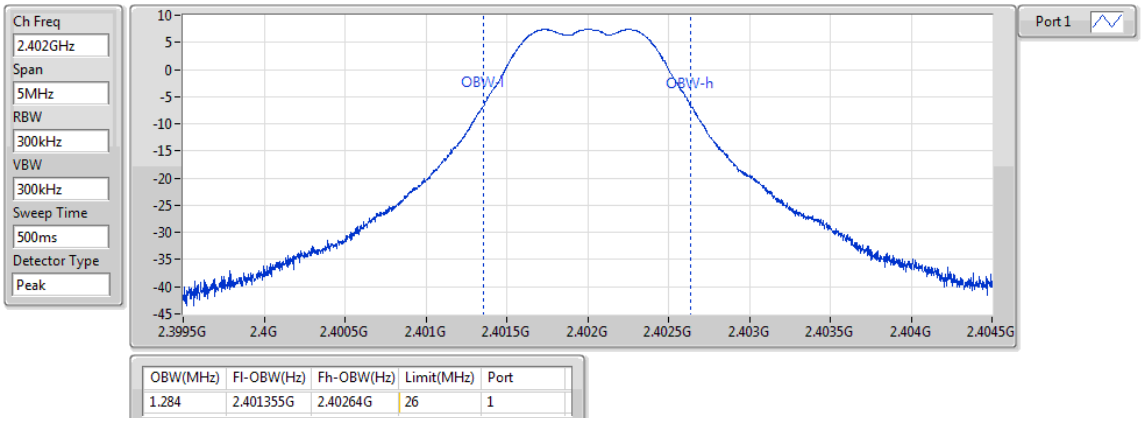
Result

Mode	Result	Limit (MHz)	P1-OBW (MHz)
BT-LE(1Mbps)	-	-	-
2402MHz_TnomVnom	Pass	26	1.284
2402MHz_TnomVmin	Pass	26	1.284
2402MHz_TnomVmax	Pass	26	1.284
2440MHz_TnomVnom	Pass	26	1.289
2440MHz_TnomVmin	Pass	26	1.289
2440MHz_TnomVmax	Pass	26	1.289
2480MHz_TnomVnom	Pass	26	1.294
2480MHz_TnomVmin	Pass	26	1.294
2480MHz_TnomVmax	Pass	26	1.294

P1-OBW = Port 1 99% occupied bandwidth;

BT-LE(1Mbps) **OBW**

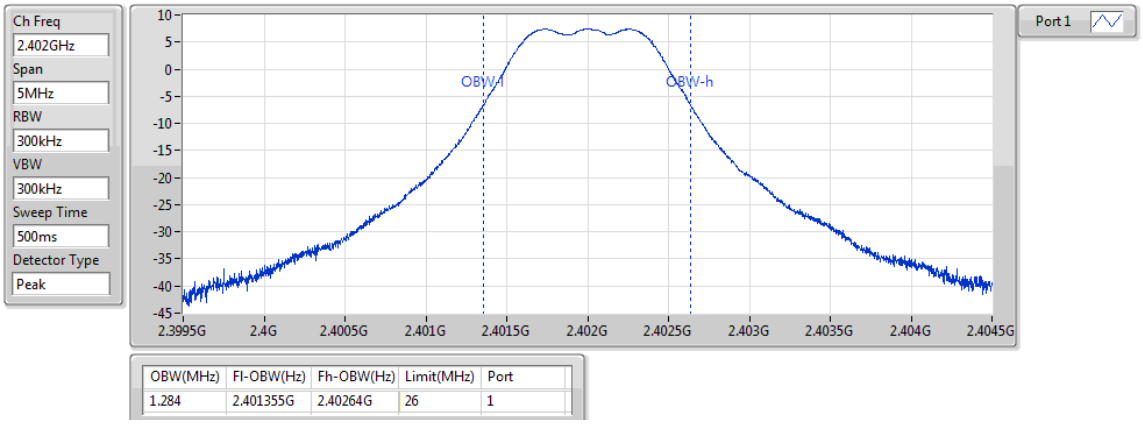
2402MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.284	2.401355G	2.40264G	26	1

BT-LE(1Mbps) **OBW**

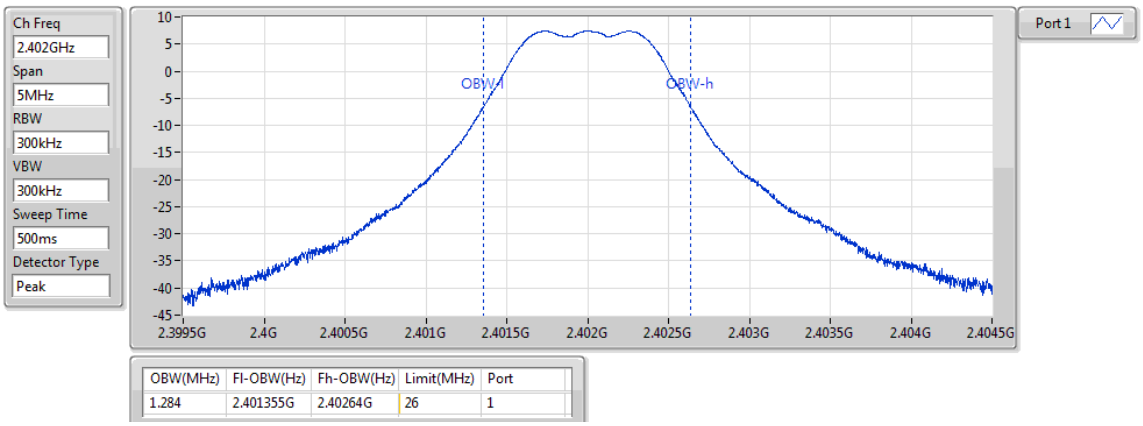
2402MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.284	2.401355G	2.40264G	26	1

BT-LE(1Mbps) **OBW**

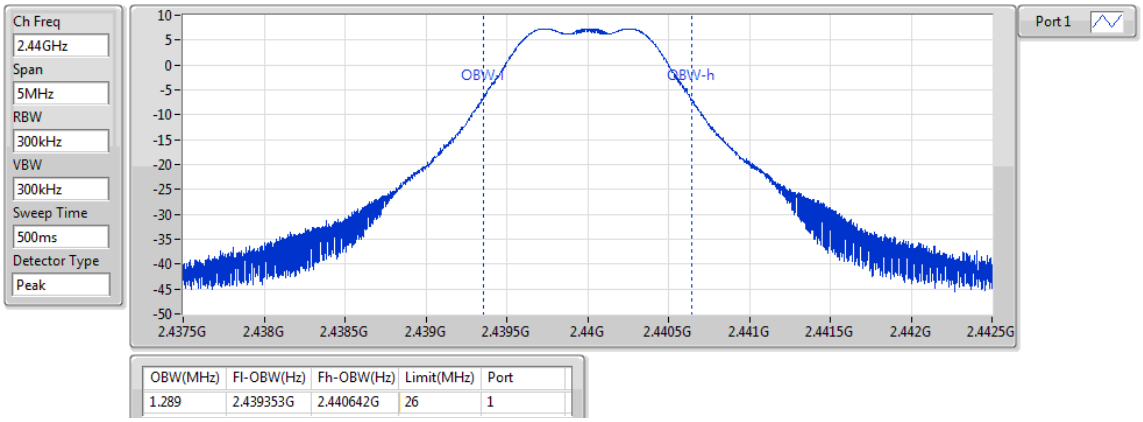
2402MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.284	2.401355G	2.40264G	26	1

BT-LE(1Mbps) **OBW**

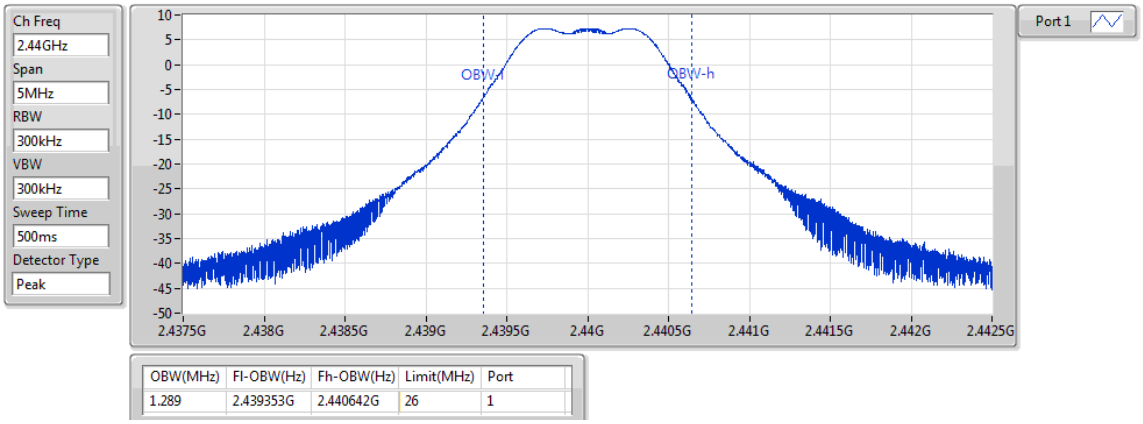
2440MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.289	2.439353G	2.440642G	26	1

BT-LE(1Mbps) **OBW**

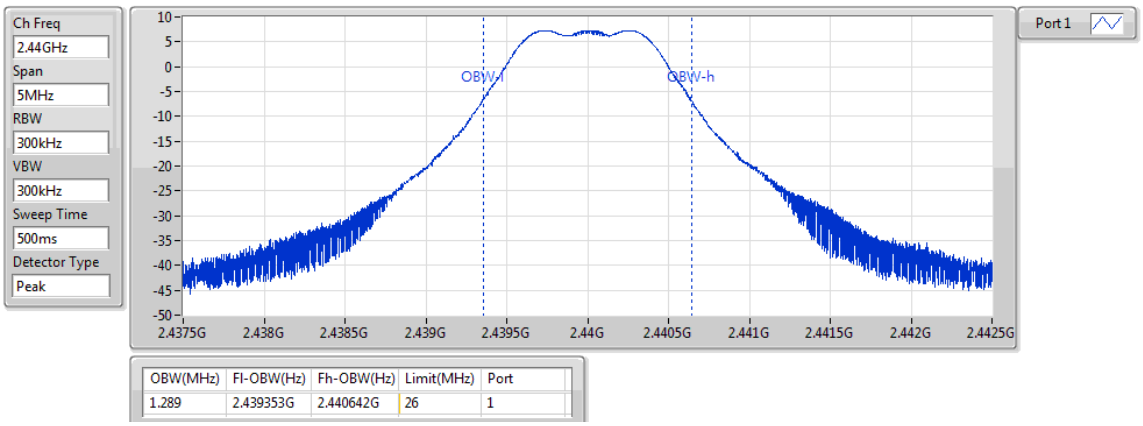
2440MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.289	2.439353G	2.440642G	26	1

BT-LE(1Mbps) **OBW**

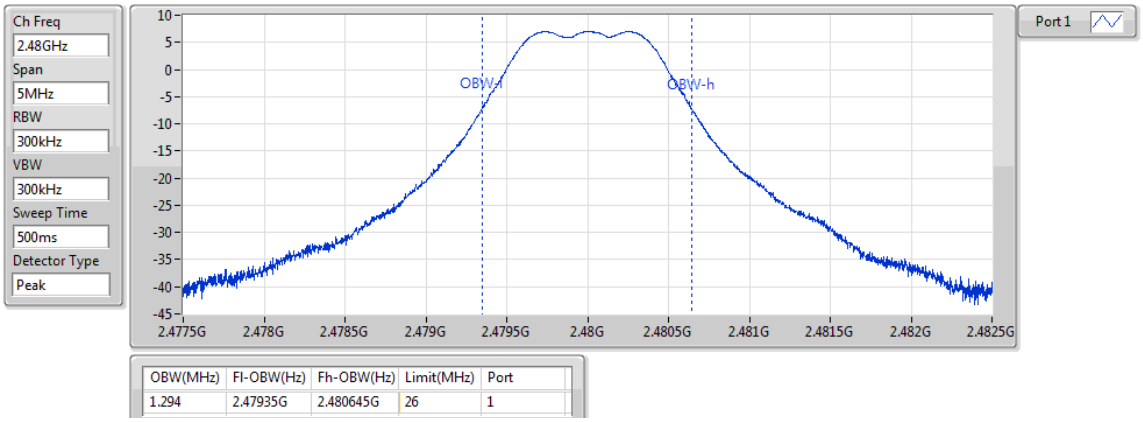
2440MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.289	2.439353G	2.440642G	26	1

BT-LE(1Mbps) **OBW**

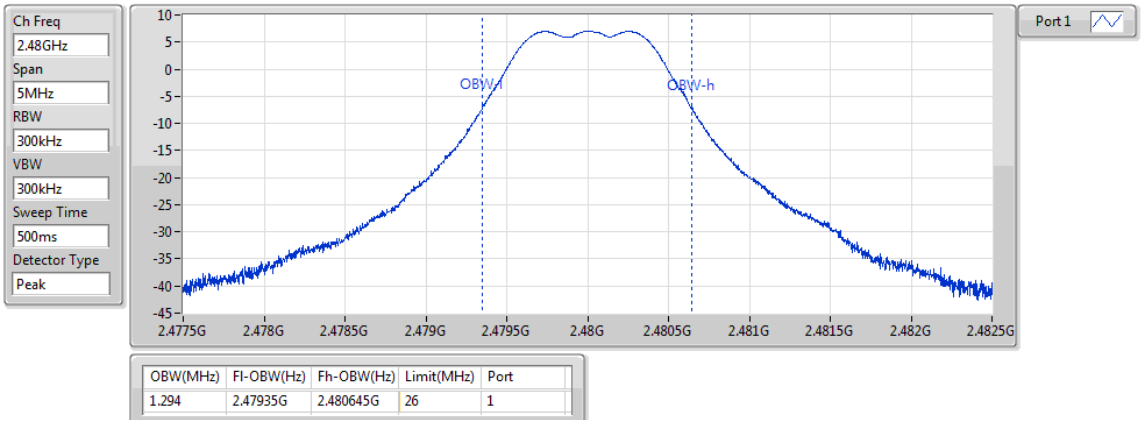
2480MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.294	2.47935G	2.480645G	26	1

BT-LE(1Mbps) **OBW**

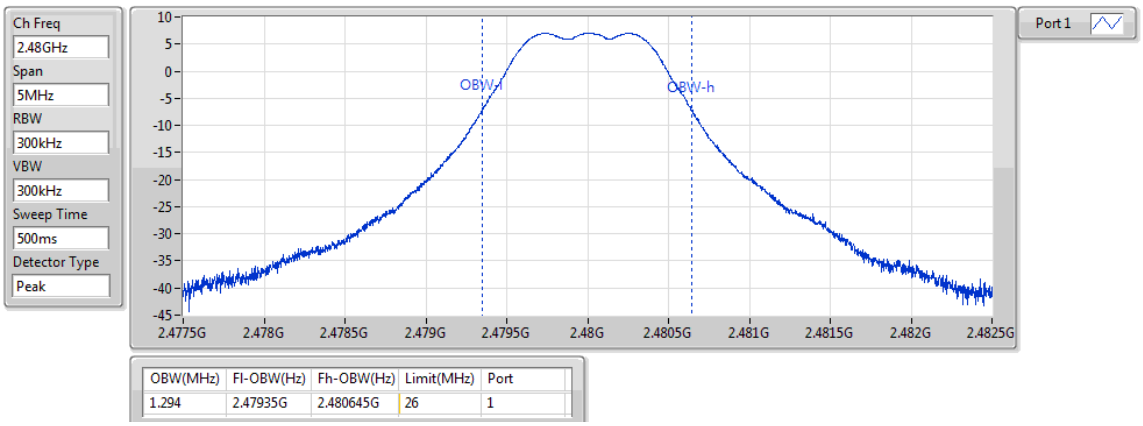
2480MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.294	2.47935G	2.480645G	26	1

BT-LE(1Mbps) **OBW**

2480MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
1.294	2.47935G	2.480645G	26	1

Summary

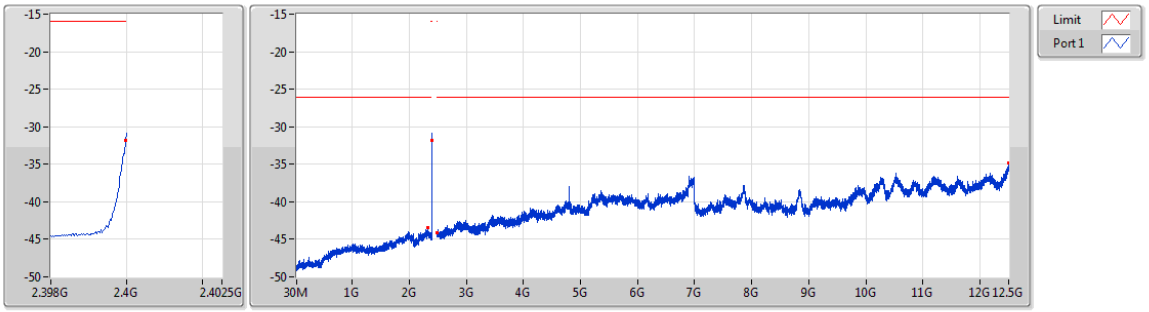
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (uW/MHz)	Limit (dBm)	Limit (uW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (uW/MHz)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	2.4965G	12.5G	1M	12493.748	-34.71	0.33806	-26.02	2.50035	-8.69	5.68	-34.71	0.33806

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-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	2.387G	1M	2330.432	-43.40	0.04571	-26.02	2.50035	-17.38	1.44	-43.40	0.04571
2402MHz_TnomVnom	Pass	2.387G	2.4G	1M	2399.974	-31.85	0.65313	-16.02	25.00345	-15.83	1.47	-31.85	0.65313
2402MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2484.28	-44.13	0.03864	-16.02	25.00345	-28.11	1.49	-44.13	0.03864
2402MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12498.75	-34.76	0.3342	-26.02	2.50035	-8.74	5.68	-34.76	0.3342
2402MHz_TnomVmin	Pass	30M	2.387G	1M	2315.111	-43.73	0.04236	-26.02	2.50035	-17.71	1.43	-43.73	0.04236
2402MHz_TnomVmin	Pass	2.387G	2.4G	1M	2399.974	-31.90	0.64565	-16.02	25.00345	-15.88	1.47	-31.90	0.64565
2402MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2490.234	-44.20	0.03802	-16.02	25.00345	-28.18	1.49	-44.20	0.03802
2402MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12498.75	-34.75	0.33497	-26.02	2.50035	-8.73	5.68	-34.75	0.33497
2402MHz_TnomVmax	Pass	30M	2.387G	1M	2372.858	-43.60	0.04365	-26.02	2.50035	-17.58	1.46	-43.60	0.04365
2402MHz_TnomVmax	Pass	2.387G	2.4G	1M	2399.974	-31.90	0.64565	-16.02	25.00345	-15.88	1.47	-31.90	0.64565
2402MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2489.792	-44.16	0.03837	-16.02	25.00345	-28.14	1.49	-44.16	0.03837
2402MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12500	-34.99	0.31696	-26.02	2.50035	-8.97	5.68	-34.99	0.31696
2440MHz_TnomVnom	Pass	30M	2.387G	1M	2339.86	-43.91	0.04064	-26.02	2.50035	-17.89	1.44	-43.91	0.04064
2440MHz_TnomVnom	Pass	2.387G	2.4G	1M	2392.018	-44.44	0.03597	-16.02	25.00345	-28.42	1.47	-44.44	0.03597
2440MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2487.764	-44.07	0.03917	-16.02	25.00345	-28.05	1.49	-44.07	0.03917
2440MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12487.496	-34.85	0.32734	-26.02	2.50035	-8.83	5.67	-34.85	0.32734
2440MHz_TnomVmin	Pass	30M	2.387G	1M	2306.862	-43.82	0.0415	-26.02	2.50035	-17.80	1.43	-43.82	0.0415
2440MHz_TnomVmin	Pass	2.387G	2.4G	1M	2392.148	-44.51	0.0354	-16.02	25.00345	-28.49	1.47	-44.51	0.0354
2440MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2487.998	-44.12	0.03873	-16.02	25.00345	-28.10	1.49	-44.12	0.03873
2440MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12494.998	-35.21	0.3013	-26.02	2.50035	-9.19	5.68	-35.21	0.3013
2440MHz_TnomVmax	Pass	30M	2.387G	1M	2322.182	-43.83	0.0414	-26.02	2.50035	-17.81	1.44	-43.83	0.0414
2440MHz_TnomVmax	Pass	2.387G	2.4G	1M	2391.862	-44.60	0.03467	-16.02	25.00345	-28.58	1.47	-44.60	0.03467
2440MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2488.258	-44.14	0.03855	-16.02	25.00345	-28.12	1.49	-44.14	0.03855
2440MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12483.744	-34.87	0.32584	-26.02	2.50035	-8.85	5.67	-34.87	0.32584
2480MHz_TnomVnom	Pass	30M	2.387G	1M	2181.941	-43.81	0.04159	-26.02	2.50035	-17.79	1.38	-43.81	0.04159
2480MHz_TnomVnom	Pass	2.387G	2.4G	1M	2391.862	-44.57	0.03491	-16.02	25.00345	-28.55	1.47	-44.57	0.03491
2480MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2483.578	-43.90	0.04074	-16.02	25.00345	-27.88	1.49	-43.90	0.04074
2480MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12491.247	-35.18	0.30339	-26.02	2.50035	-9.16	5.68	-35.18	0.30339
2480MHz_TnomVmin	Pass	30M	2.387G	1M	2324.539	-43.76	0.04207	-26.02	2.50035	-17.74	1.44	-43.76	0.04207
2480MHz_TnomVmin	Pass	2.387G	2.4G	1M	2399.766	-44.53	0.03524	-16.02	25.00345	-28.51	1.47	-44.53	0.03524
2480MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2483.526	-43.86	0.04111	-16.02	25.00345	-27.84	1.49	-43.86	0.04111
2480MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12493.748	-34.71	0.33806	-26.02	2.50035	-8.69	5.68	-34.71	0.33806
2480MHz_TnomVmax	Pass	30M	2.387G	1M	2336.325	-43.90	0.04074	-26.02	2.50035	-17.88	1.44	-43.90	0.04074
2480MHz_TnomVmax	Pass	2.387G	2.4G	1M	2396.256	-44.50	0.03548	-16.02	25.00345	-28.48	1.47	-44.50	0.03548
2480MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2483.604	-43.88	0.04093	-16.02	25.00345	-27.86	1.49	-43.88	0.04093
2480MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12479.993	-35.07	0.31117	-26.02	2.50035	-9.05	5.67	-35.07	0.31117

BT-LE(1Mbps) **CSE-TX-**

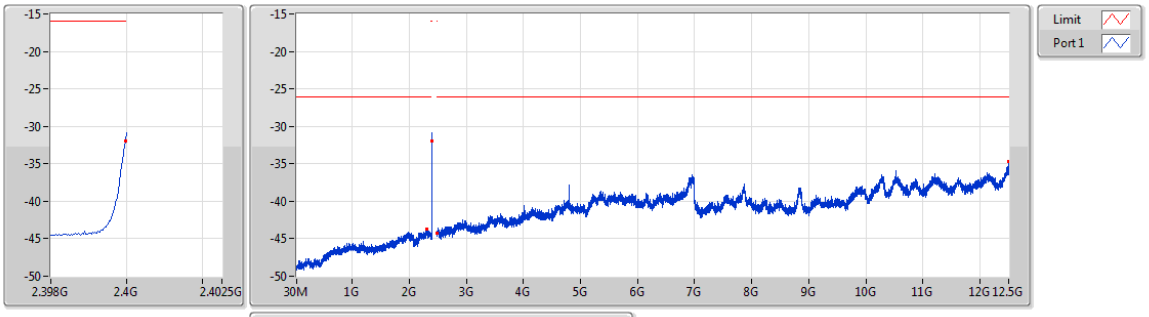
2402MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2330.432	-43.40	-26.02	-17.38	-43.40
2399.974	-31.85	-16.02	-15.83	-31.85
2484.28	-44.13	-16.02	-28.11	-44.13
12498.75	-34.76	-26.02	-8.74	-34.76

BT-LE(1Mbps) **CSE-TX-**

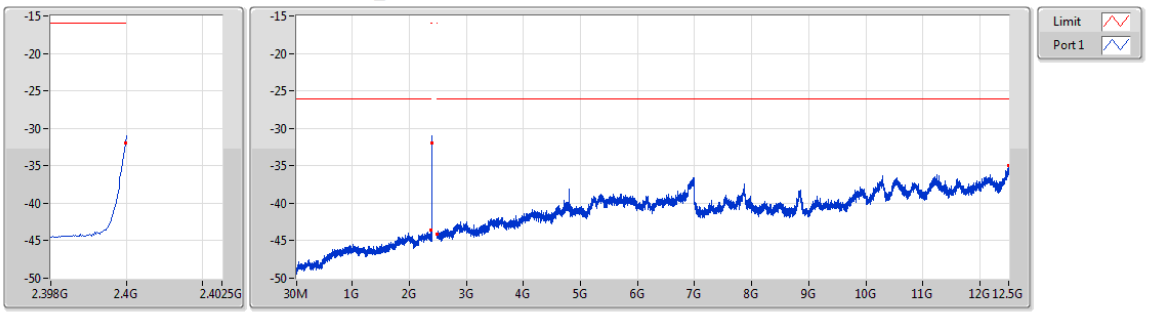
2402MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2315.111	-43.73	-26.02	-17.71	-43.73
2399.974	-31.90	-16.02	-15.88	-31.90
2490.234	-44.20	-16.02	-28.18	-44.20
12498.75	-34.75	-26.02	-8.73	-34.75

BT-LE(1Mbps) **CSE-TX-**

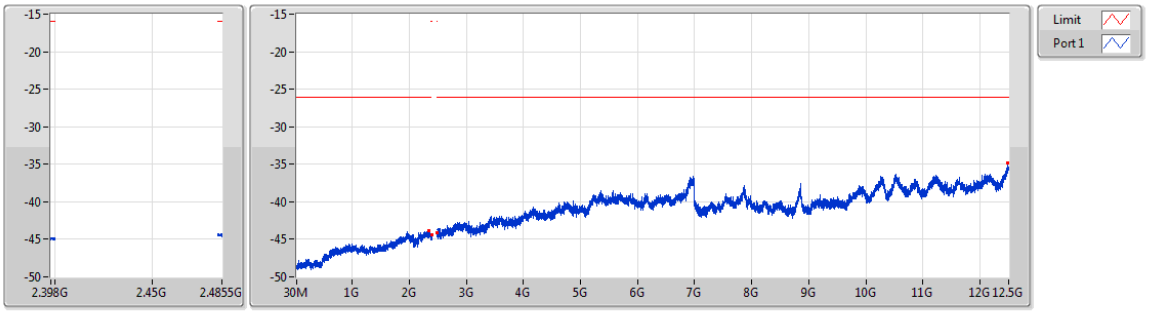
2402MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2372.858	-43.60	-26.02	-17.58	-43.60
2399.974	-31.90	-16.02	-15.88	-31.90
2489.792	-44.16	-16.02	-28.14	-44.16
12500	-34.99	-26.02	-8.97	-34.99

BT-LE(1Mbps) **CSE-TX-**

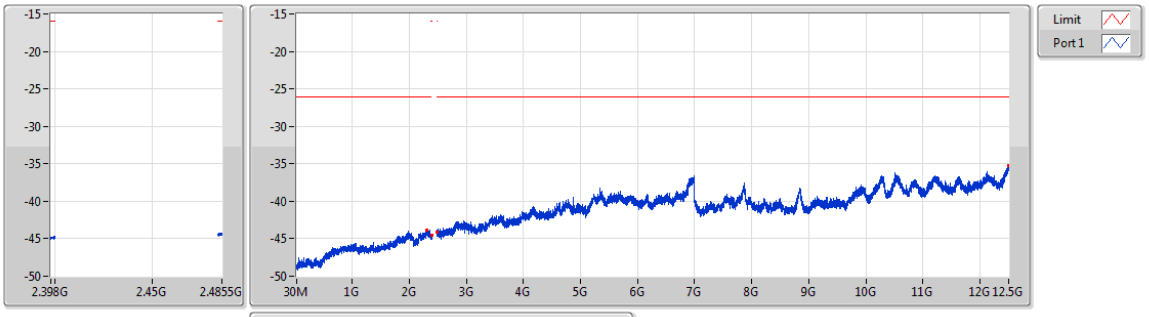
2440MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2339.86	-43.91	-26.02	-17.89	-43.91
2392.018	-44.44	-16.02	-28.42	-44.44
2487.764	-44.07	-16.02	-28.05	-44.07
12487.496	-34.85	-26.02	-8.83	-34.85

BT-LE(1Mbps) **CSE-TX-**

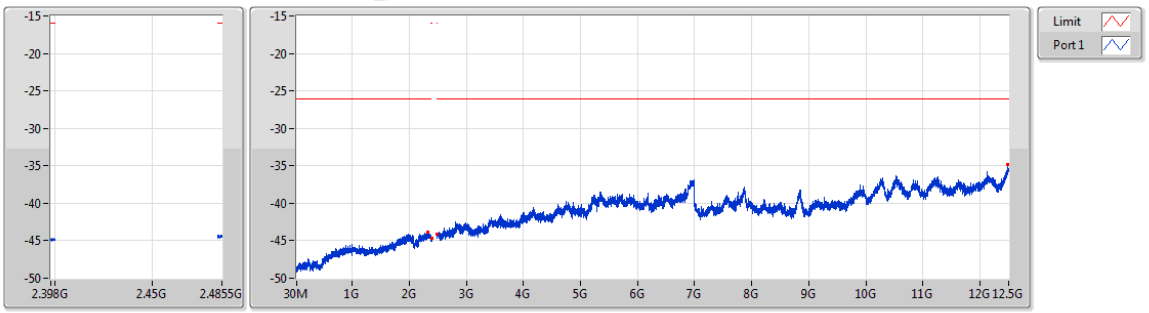
2440MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2306.862	-43.82	-26.02	-17.80	-43.82
2392.148	-44.51	-16.02	-28.49	-44.51
2487.998	-44.12	-16.02	-28.10	-44.12
12494.998	-35.21	-26.02	-9.19	-35.21

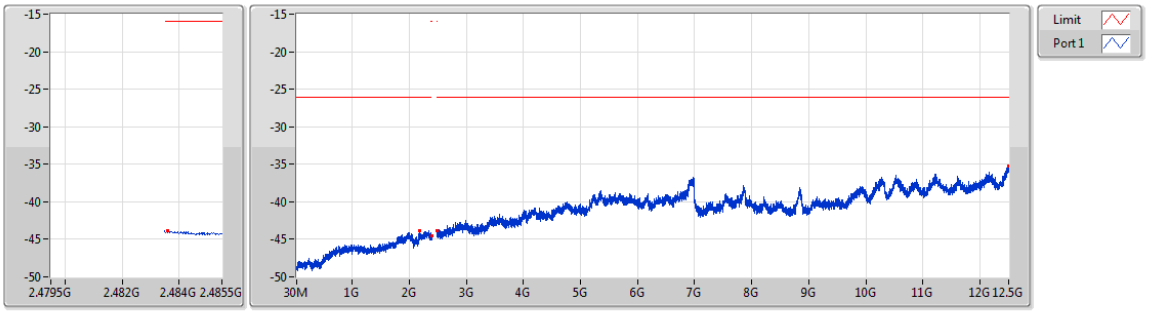
BT-LE(1Mbps) **CSE-TX-**

2440MHz_TnomVmax



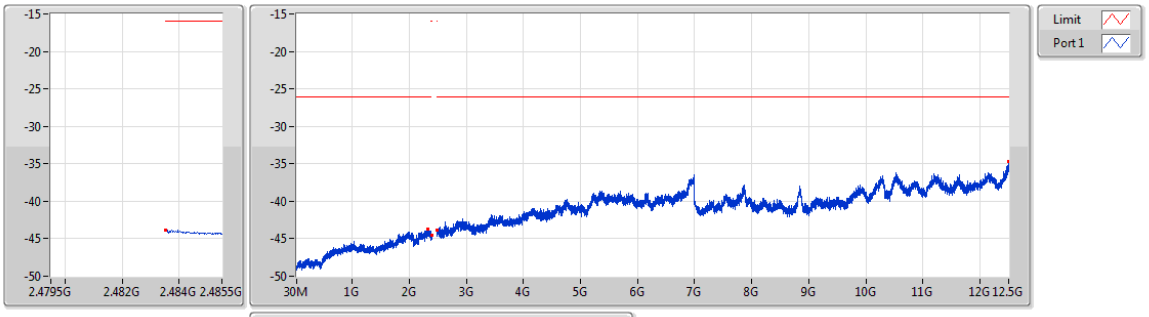
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2322.182	-43.83	-26.02	-17.81	-43.83
2391.862	-44.60	-16.02	-28.58	-44.60
2488.258	-44.14	-16.02	-28.12	-44.14
12483.744	-34.87	-26.02	-8.85	-34.87

BT-LE(1Mbps) CSE-TX-2480MHz_TnomVnom



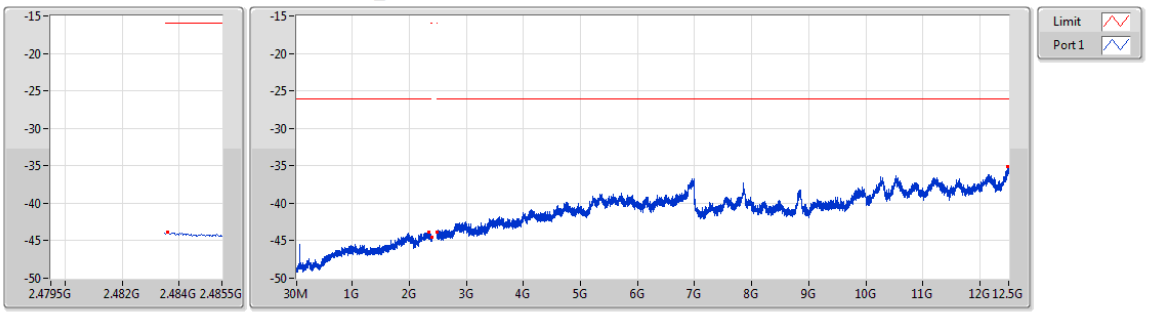
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2181.941	-43.81	-26.02	-17.79	-43.81
2391.862	-44.57	-16.02	-28.55	-44.57
2483.578	-43.90	-16.02	-27.88	-43.90
12491.247	-35.18	-26.02	-9.16	-35.18

BT-LE(1Mbps) CSE-TX-2480MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2324.539	-43.76	-26.02	-17.74	-43.76
2399.766	-44.53	-16.02	-28.51	-44.53
2483.526	-43.86	-16.02	-27.84	-43.86
12493.748	-34.71	-26.02	-8.69	-34.71

BT-LE(1Mbps) CSE-TX-2480MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
2336.325	-43.90	-26.02	-17.88	-43.90
2396.256	-44.50	-16.02	-28.48	-44.50
2483.604	-43.88	-16.02	-27.86	-43.88
12479.993	-35.07	-26.02	-9.05	-35.07

Summary

Mode	Result	ID Length	ID Limit	Function
2.4-2.4835GHz	-	-	-	-
BT-LE(1Mbps)	Pass	CD:DD:6C:DA:BD:17	48 bits	Good

Result

Mode	Result	ID Length	ID Limit	Function
BT-LE(1Mbps)	-	-	-	-
2402MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2402MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2402MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good

Summary

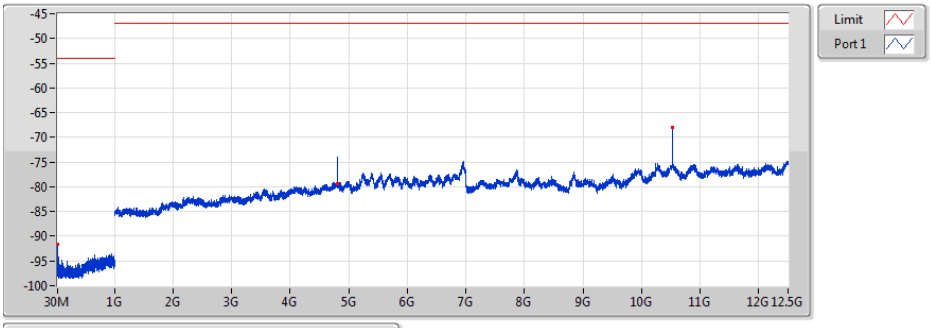
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (nW/MHz)	Limit (dBm)	Limit (nW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (nW/MHz)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE(1Mbps)	Pass	1G	12.5G	1M	10526.312	-67.98	0.15922	-46.99	19.99862	-20.99	4.61	-67.98	0.15922

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)	Loss (dB)	P1 (dBm)	P1 (nW/MHz)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	1G	100k	31.94	-91.61	0.00069	-53.98	3.99945	-37.63	0.26	-91.61	0.00069
2402MHz_TnomVnom	Pass	1G	12.5G	1M	4805.062	-79.39	0.01151	-46.99	19.99862	-32.40	1.72	-79.39	0.01151
2402MHz_TnomVnom	Pass	1G	12.5G	1M	10526.312	-67.98	0.15922	-46.99	19.99862	-20.99	4.61	-67.98	0.15922
2402MHz_TnomVmin	Pass	30M	1G	100k	953.925	-92.99	0.0005	-53.98	3.99945	-39.01	0.85	-92.99	0.0005
2402MHz_TnomVmin	Pass	1G	12.5G	1M	4802.187	-74.34	0.03681	-46.99	19.99862	-27.35	1.72	-74.34	0.03681
2402MHz_TnomVmin	Pass	1G	12.5G	1M	4805.062	-79.24	0.01191	-46.99	19.99862	-32.25	1.72	-79.24	0.01191
2402MHz_TnomVmax	Pass	30M	1G	100k	31.94	-92.83	0.00052	-53.98	3.99945	-38.85	0.26	-92.83	0.00052
2402MHz_TnomVmax	Pass	1G	12.5G	1M	4803.625	-79.58	0.01102	-46.99	19.99862	-32.59	1.72	-79.58	0.01102
2402MHz_TnomVmax	Pass	1G	12.5G	1M	10526.312	-70.87	0.08185	-46.99	19.99862	-23.88	4.61	-70.87	0.08185
2440MHz_TnomVnom	Pass	30M	1G	100k	31.94	-92.21	0.0006	-53.98	3.99945	-38.23	0.26	-92.21	0.0006
2440MHz_TnomVnom	Pass	1G	12.5G	1M	4879.812	-79.59	0.01099	-46.99	19.99862	-32.60	1.72	-79.59	0.01099
2440MHz_TnomVnom	Pass	1G	12.5G	1M	12500	-74.29	0.03724	-46.99	19.99862	-27.30	5.68	-74.29	0.03724
2440MHz_TnomVmin	Pass	30M	1G	100k	31.94	-93.05	0.0005	-53.98	3.99945	-39.07	0.26	-93.05	0.0005
2440MHz_TnomVmin	Pass	1G	12.5G	1M	4879.812	-80.81	0.0083	-46.99	19.99862	-33.82	1.72	-80.81	0.0083
2440MHz_TnomVmin	Pass	1G	12.5G	1M	10524.875	-72.67	0.05408	-46.99	19.99862	-25.68	4.61	-72.67	0.05408
2440MHz_TnomVmax	Pass	30M	1G	100k	31.94	-92.37	0.00058	-53.98	3.99945	-38.39	0.26	-92.37	0.00058
2440MHz_TnomVmax	Pass	1G	12.5G	1M	4879.812	-80.04	0.00991	-46.99	19.99862	-33.05	1.72	-80.04	0.00991
2440MHz_TnomVmax	Pass	1G	12.5G	1M	10526.312	-71.34	0.07345	-46.99	19.99862	-24.35	4.61	-71.34	0.07345
2480MHz_TnomVnom	Pass	30M	1G	100k	31.94	-92.14	0.00061	-53.98	3.99945	-38.16	0.26	-92.14	0.00061
2480MHz_TnomVnom	Pass	1G	12.5G	1M	4958.875	-77.84	0.01644	-46.99	19.99862	-30.85	1.73	-77.84	0.01644
2480MHz_TnomVnom	Pass	1G	12.5G	1M	10524.875	-69.06	0.12417	-46.99	19.99862	-22.07	4.61	-69.06	0.12417
2480MHz_TnomVmin	Pass	30M	1G	100k	31.94	-92.23	0.0006	-53.98	3.99945	-38.25	0.26	-92.23	0.0006
2480MHz_TnomVmin	Pass	1G	12.5G	1M	4958.875	-78.55	0.01396	-46.99	19.99862	-31.56	1.73	-78.55	0.01396
2480MHz_TnomVmin	Pass	1G	12.5G	1M	10524.875	-73.67	0.04295	-46.99	19.99862	-26.68	4.61	-73.67	0.04295
2480MHz_TnomVmax	Pass	30M	1G	100k	31.94	-92.43	0.00057	-53.98	3.99945	-38.45	0.26	-92.43	0.00057
2480MHz_TnomVmax	Pass	1G	12.5G	1M	4958.875	-78.28	0.01486	-46.99	19.99862	-31.29	1.73	-78.28	0.01486
2480MHz_TnomVmax	Pass	1G	12.5G	1M	10524.875	-73.10	0.04898	-46.99	19.99862	-26.11	4.61	-73.10	0.04898

BT-LE(1Mbps) **CSE-RX-**

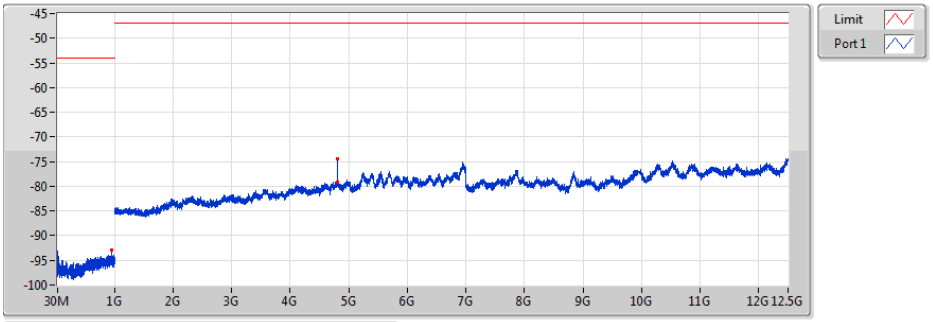
2402MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-91.61	-53.98	-37.63	-91.61
4805.062	-79.39	-46.99	-32.40	-79.39
10526.312	-67.98	-46.99	-20.99	-67.98

BT-LE(1Mbps) **CSE-RX-**

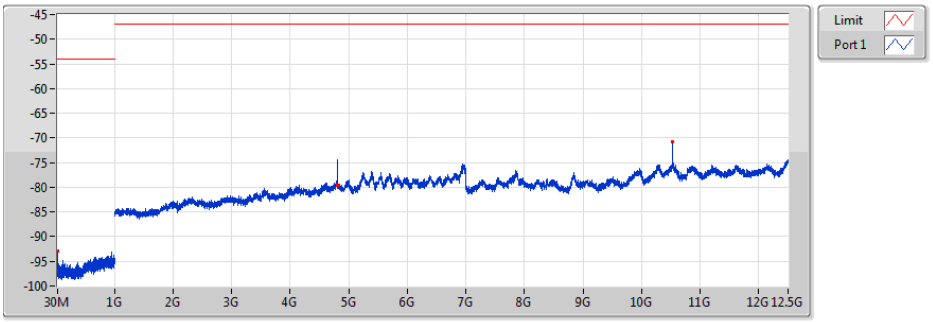
2402MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-92.99	-53.98	-39.01	-92.99
4802.187	-74.34	-46.99	-27.35	-74.34
4805.062	-79.24	-46.99	-32.25	-79.24

BT-LE(1Mbps) **CSE-RX-**

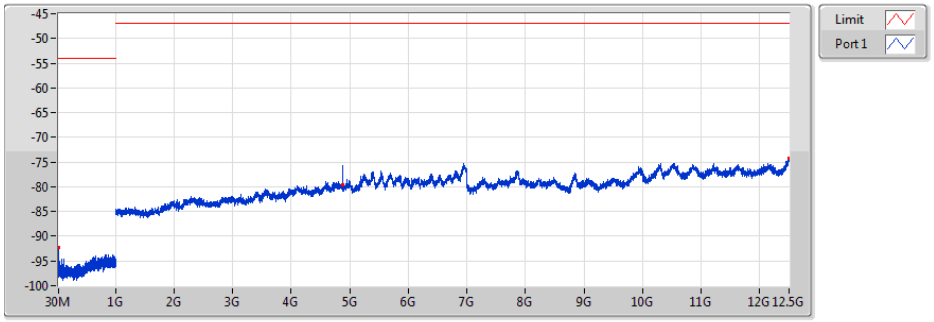
2402MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-92.83	-53.98	-38.85	-92.83
4803.625	-79.58	-46.99	-32.59	-79.58
10526.312	-70.87	-46.99	-23.88	-70.87

BT-LE(1Mbps) **CSE-RX-**

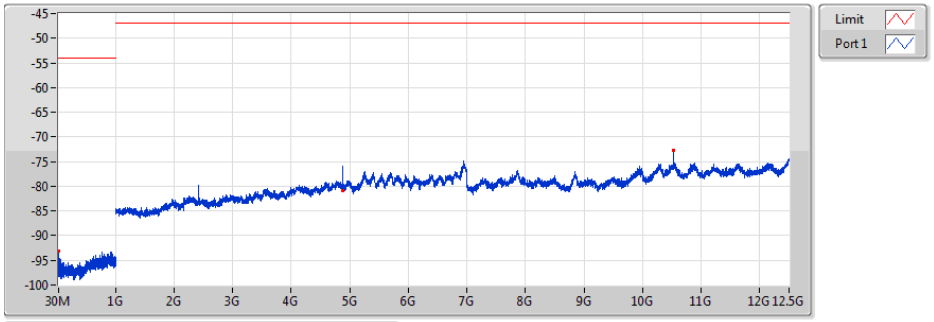
2440MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-92.21	-53.98	-38.23	-92.21
4879.812	-79.59	-46.99	-32.60	-79.59
12500	-74.29	-46.99	-27.30	-74.29

BT-LE(1Mbps) **CSE-RX-**

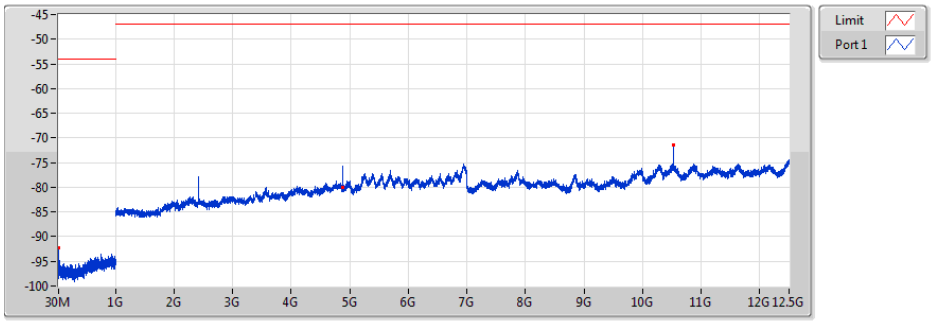
2440MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-93.05	-53.98	-39.07	-93.05
4879.812	-80.81	-46.99	-33.82	-80.81
10524.875	-72.67	-46.99	-25.68	-72.67

BT-LE(1Mbps) **CSE-RX-**

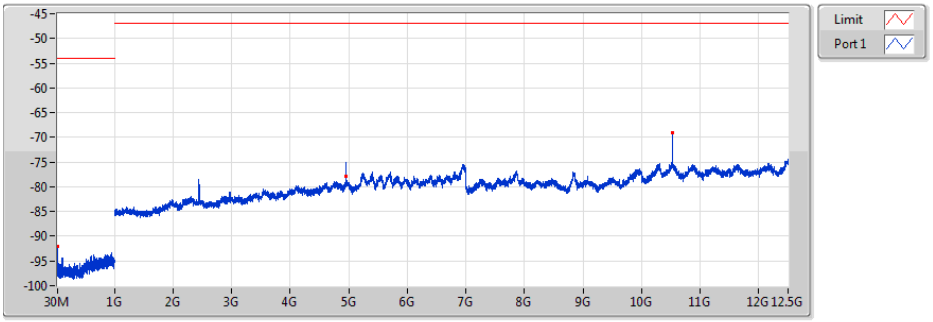
2440MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-92.37	-53.98	-38.39	-92.37
4879.812	-80.04	-46.99	-33.05	-80.04
10526.312	-71.34	-46.99	-24.35	-71.34

BT-LE(1Mbps) **CSE-RX-**

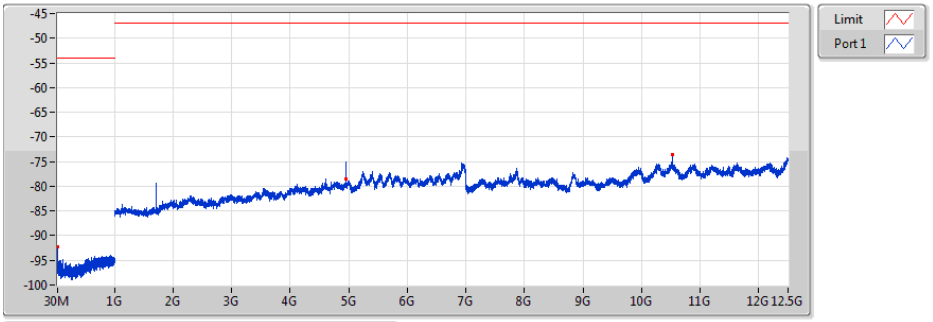
2480MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-92.14	-53.98	-38.16	-92.14
4958.875	-77.84	-46.99	-30.85	-77.84
10524.875	-69.06	-46.99	-22.07	-69.06

BT-LE(1Mbps) **CSE-RX-**

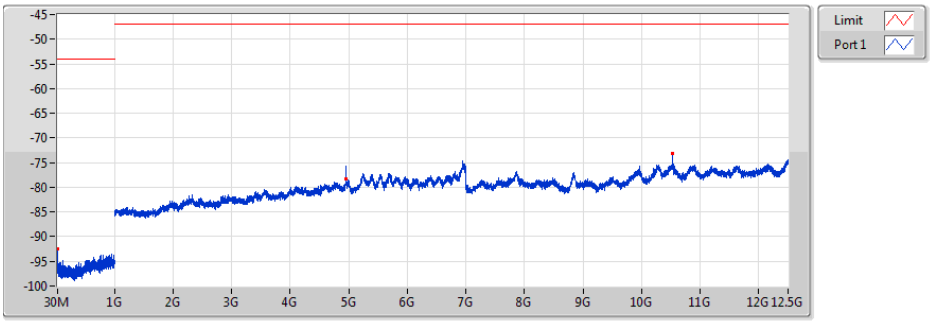
2480MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-92.23	-53.98	-38.25	-92.23
4958.875	-78.55	-46.99	-31.56	-78.55
10524.875	-73.67	-46.99	-26.68	-73.67

BT-LE(1Mbps) **CSE-RX-**

2480MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-92.43	-53.98	-38.45	-92.43
4958.875	-78.28	-46.99	-31.29	-78.28
10524.875	-73.10	-46.99	-26.11	-73.10

Summary

Mode	Power (dBm)	Power (mW)	EIRP (dBm)	EIRP (mW)
2.4-2.4835GHz	-	-	-	-
BT-LE(2Mbps)	7.68	5.861	9.68	9.290

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)	P1 (dBm)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2	7.68	5.861	10	9.68	9.290	16.368	7.68
2402MHz_TnomVmin	Pass	2	7.68	5.861	10	9.68	9.290	16.368	7.68
2402MHz_TnomVmax	Pass	2	7.67	5.848	10	9.67	9.268	16.368	7.67
2440MHz_TnomVnom	Pass	2	7.58	5.728	10	9.58	9.078	16.368	7.58
2440MHz_TnomVmin	Pass	2	7.57	5.715	10	9.57	9.057	16.368	7.57
2440MHz_TnomVmax	Pass	2	7.58	5.728	10	9.58	9.078	16.368	7.58
2480MHz_TnomVnom	Pass	2	7.42	5.521	10	9.42	8.750	16.368	7.42
2480MHz_TnomVmin	Pass	2	7.41	5.508	10	9.41	8.730	16.368	7.41
2480MHz_TnomVmax	Pass	2	7.41	5.508	10	9.41	8.730	16.368	7.41

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

Summary

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
2.4-2.4835GHz	-	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80

Result

Mode	Result	Power (dBm)	Power (mW)	Declare (dBm)	Declare (mW)	Tolerance (%)	Limit+ (%)	Limit- (%)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80
2402MHz_TnomVmin	Pass	7.68	5.861	7.78	6.00	-2.31	20	-80
2402MHz_TnomVmax	Pass	7.67	5.848	7.78	6.00	-2.53	20	-80
2440MHz_TnomVnom	Pass	7.58	5.728	7.78	6.00	-4.53	20	-80
2440MHz_TnomVmin	Pass	7.57	5.715	7.78	6.00	-4.75	20	-80
2440MHz_TnomVmax	Pass	7.58	5.728	7.78	6.00	-4.53	20	-80
2480MHz_TnomVnom	Pass	7.42	5.521	7.78	6.00	-7.99	20	-80
2480MHz_TnomVmin	Pass	7.41	5.508	7.78	6.00	-8.20	20	-80
2480MHz_TnomVmax	Pass	7.41	5.508	7.78	6.00	-8.20	20	-80

Summary

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
2.4-2.4835GHz	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	2.48G	2.47997G	-12.097	±50	1	-

Result

Mode	Result	Ch (MHz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
BT-LE(2Mbps)	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.402G	2.401976G	-10.148	±50	1	-
2402MHz_TnomVmin	Pass	2.402G	2.401981G	-8.066	±50	1	-
2402MHz_TnomVmax	Pass	2.402G	2.401979G	-8.847	±50	1	-
2440MHz_TnomVnom	Pass	2.44G	2.439973G	-11.27	±50	1	-
2440MHz_TnomVmin	Pass	2.44G	2.439974G	-10.502	±50	1	-
2440MHz_TnomVmax	Pass	2.44G	2.439976G	-9.99	±50	1	-
2480MHz_TnomVnom	Pass	2.48G	2.479976G	-9.829	±50	1	-
2480MHz_TnomVmin	Pass	2.48G	2.47997G	-12.097	±50	1	-
2480MHz_TnomVmax	Pass	2.48G	2.479973G	-10.837	±50	1	-

Summary

Mode	Max-OBW (MHz)	ITU-Code	Min-OBW (MHz)
2.4-2.4835GHz	-	-	-
BT-LE(2Mbps)	2.174	2M17F1D	2.164

Max-OBW = Maximum99% occupied bandwidth; **Min-OBW** = Minimum99% occupied bandwidth;

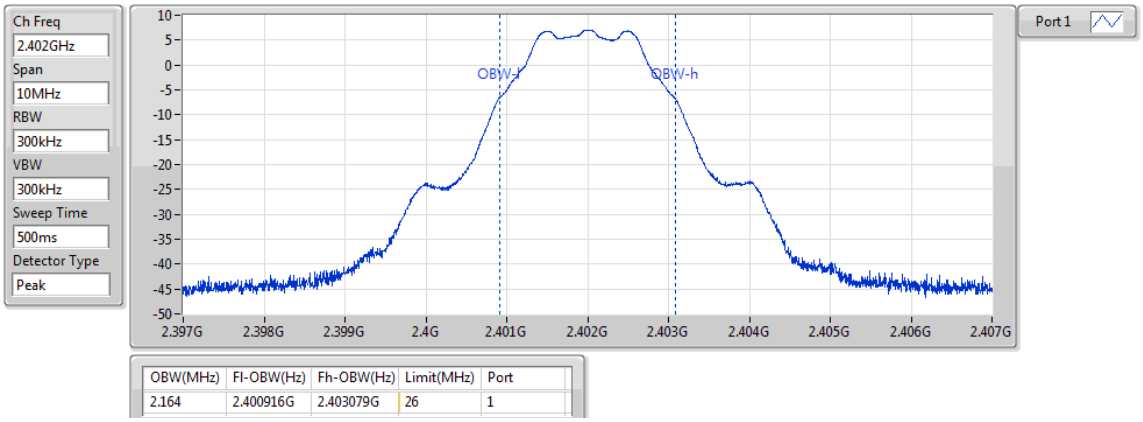
Result

Mode	Result	Limit (MHz)	P1-OBW (MHz)
BT-LE(2Mbps)	-	-	-
2402MHz_TnomVnom	Pass	26	2.164
2402MHz_TnomVmin	Pass	26	2.164
2402MHz_TnomVmax	Pass	26	2.164
2440MHz_TnomVnom	Pass	26	2.169
2440MHz_TnomVmin	Pass	26	2.169
2440MHz_TnomVmax	Pass	26	2.169
2480MHz_TnomVnom	Pass	26	2.174
2480MHz_TnomVmin	Pass	26	2.174
2480MHz_TnomVmax	Pass	26	2.174

P1-OBW = Port 1 99% occupied bandwidth;

BT-LE(1Mbps) **OBW**

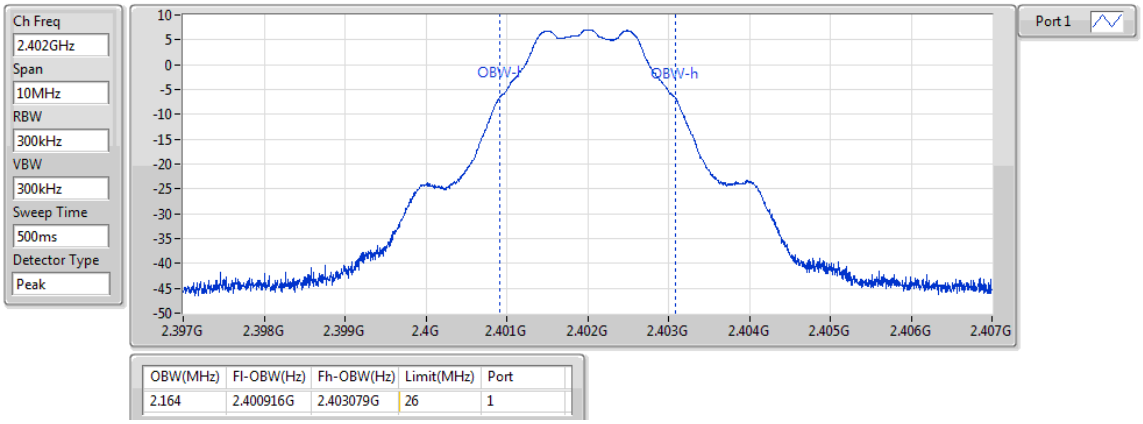
2402MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.164	2.400916G	2.403079G	26	1

BT-LE(1Mbps) **OBW**

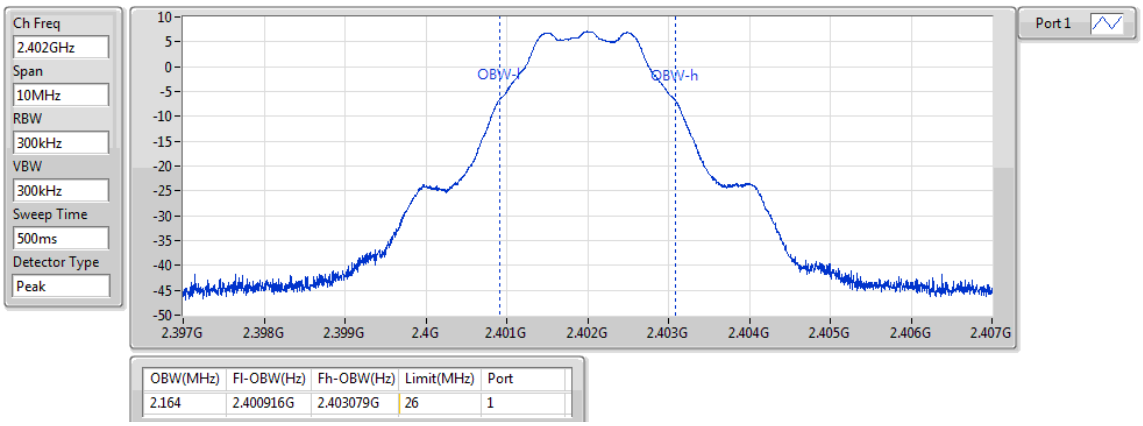
2402MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.164	2.400916G	2.403079G	26	1

BT-LE(1Mbps) **OBW**

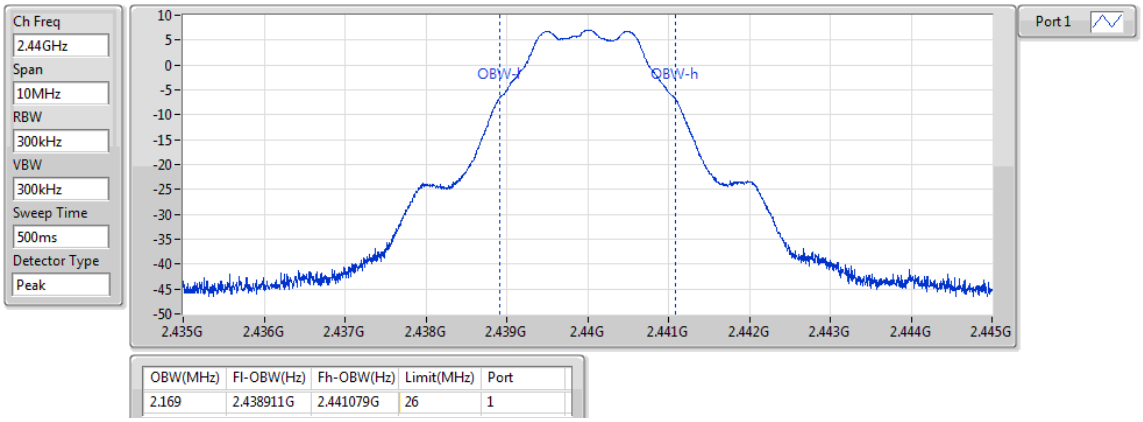
2402MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.164	2.400916G	2.403079G	26	1

BT-LE(1Mbps) **OBW**

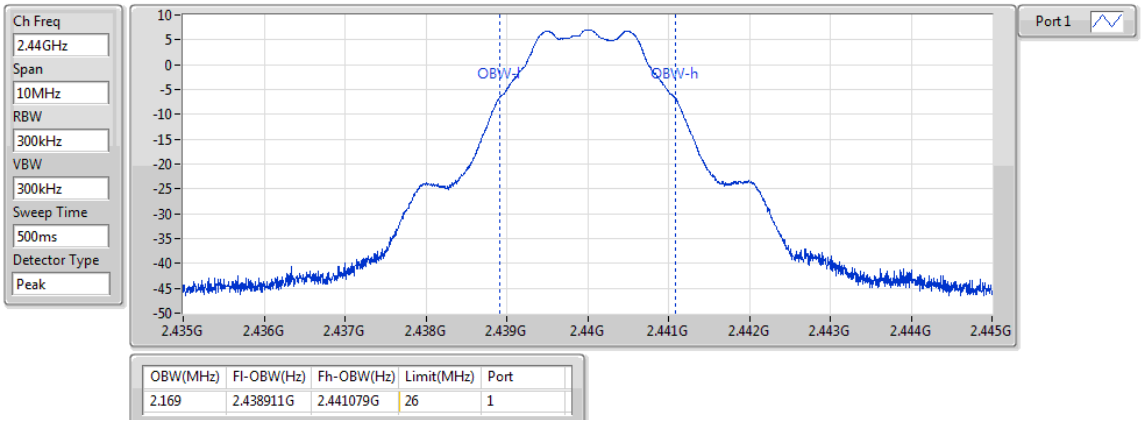
2440MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.169	2.438911G	2.441079G	26	1

BT-LE(1Mbps) **OBW**

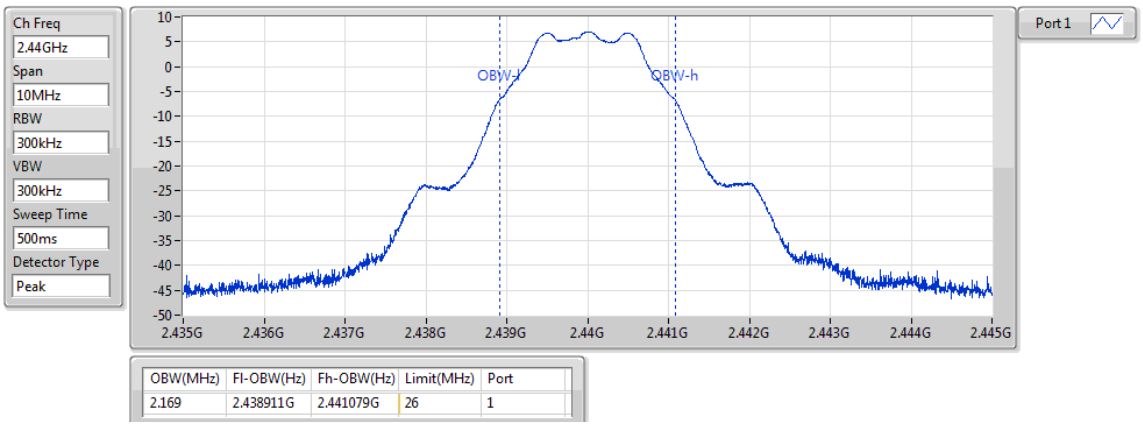
2440MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.169	2.438911G	2.441079G	26	1

BT-LE(1Mbps) **OBW**

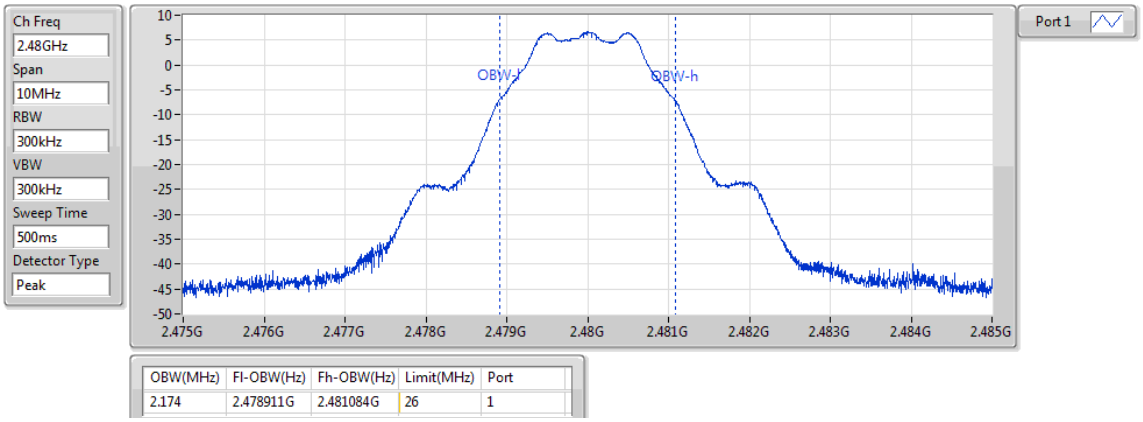
2440MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.169	2.438911G	2.441079G	26	1

BT-LE(1Mbps) **OBW**

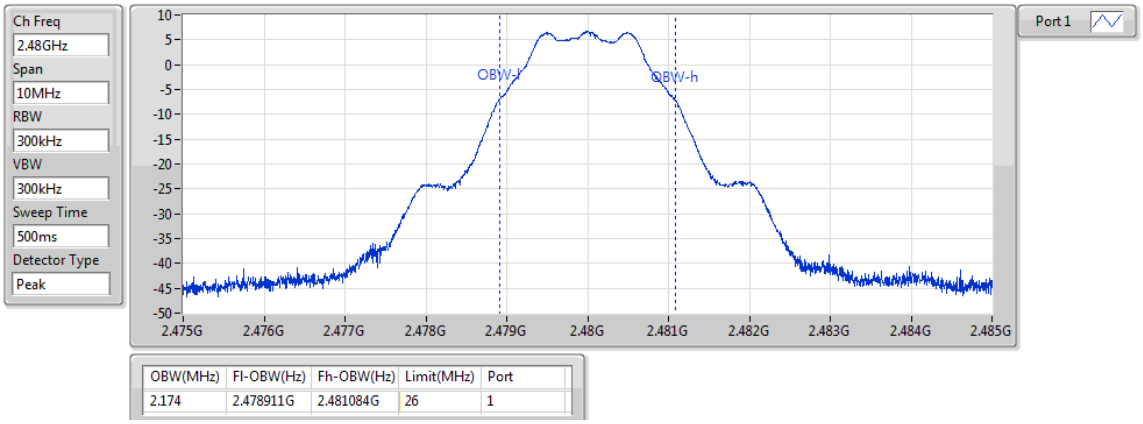
2480MHz_TnomVnom



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.174	2.478911G	2.481084G	26	1

BT-LE(1Mbps) **OBW**

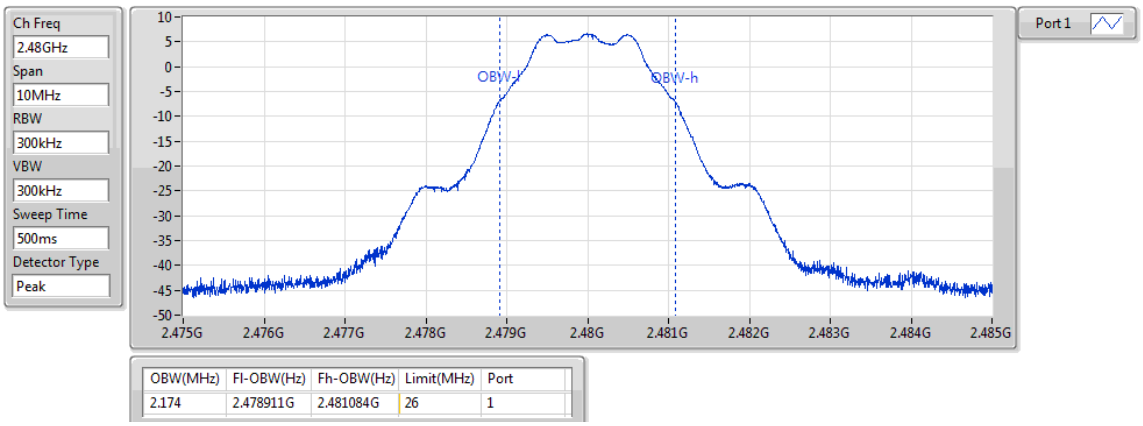
2480MHz_TnomVmin



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.174	2.478911G	2.481084G	26	1

BT-LE(1Mbps) **OBW**

2480MHz_TnomVmax



OBW(MHz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(MHz)	Port
2.174	2.478911G	2.481084G	26	1

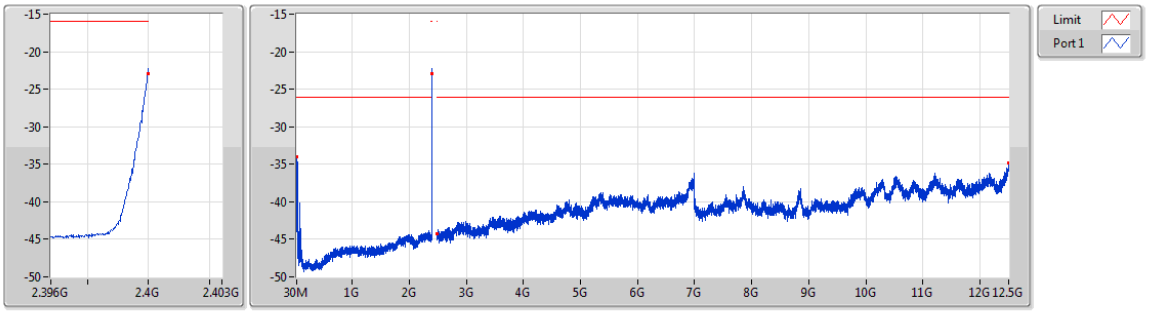
Summary

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)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	2.387G	2.4G	1M	2399.974	-22.84	5.19996	-16.02	25.00345	-6.82	1.47	-22.84	5.19996

Result

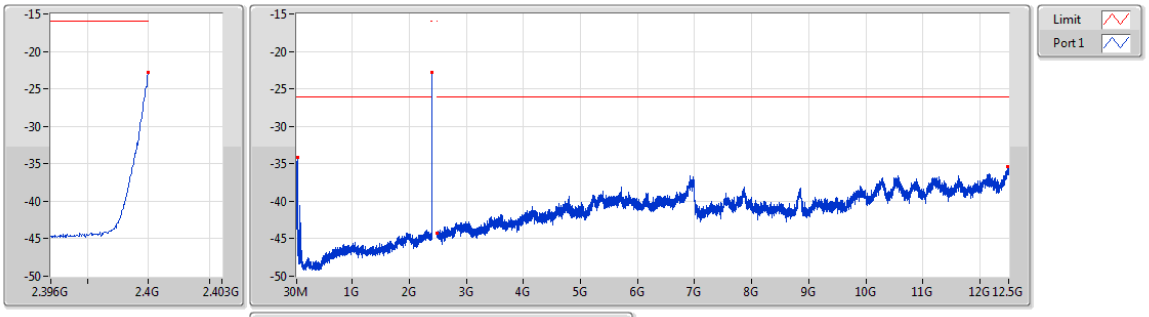
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (uW/MHz)	Limit (dBm)	Limit (uW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (uW/MHz)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	2.387G	1M	32.357	-34.01	0.39719	-26.02	2.50035	-7.99	0.26	-34.01	0.39719
2402MHz_TnomVnom	Pass	2.387G	2.4G	1M	2399.974	-22.94	5.08159	-16.02	25.00345	-6.92	1.47	-22.94	5.08159
2402MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2485.71	-44.21	0.03793	-16.02	25.00345	-28.19	1.49	-44.21	0.03793
2402MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12500	-34.88	0.32509	-26.02	2.50035	-8.86	5.68	-34.88	0.32509
2402MHz_TnomVmin	Pass	30M	2.387G	1M	42.964	-34.20	0.38019	-26.02	2.50035	-8.18	0.27	-34.20	0.38019
2402MHz_TnomVmin	Pass	2.387G	2.4G	1M	2399.974	-22.84	5.19996	-16.02	25.00345	-6.82	1.47	-22.84	5.19996
2402MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2490.026	-44.28	0.03733	-16.02	25.00345	-28.26	1.49	-44.28	0.03733
2402MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12476.242	-35.40	0.2884	-26.02	2.50035	-9.38	5.67	-35.40	0.2884
2402MHz_TnomVmax	Pass	30M	2.387G	1M	32.357	-33.24	0.47424	-26.02	2.50035	-7.22	0.26	-33.24	0.47424
2402MHz_TnomVmax	Pass	2.387G	2.4G	1M	2399.974	-22.84	5.19996	-16.02	25.00345	-6.82	1.47	-22.84	5.19996
2402MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2488.596	-44.17	0.03828	-16.02	25.00345	-28.15	1.49	-44.17	0.03828
2402MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12497.499	-35.48	0.28314	-26.02	2.50035	-9.46	5.68	-35.48	0.28314
2440MHz_TnomVnom	Pass	30M	2.387G	1M	32.357	-34.69	0.33963	-26.02	2.50035	-8.67	0.26	-34.69	0.33963
2440MHz_TnomVnom	Pass	2.387G	2.4G	1M	2391.914	-44.62	0.03451	-16.02	25.00345	-28.60	1.47	-44.62	0.03451
2440MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2487.842	-44.23	0.03776	-16.02	25.00345	-28.21	1.49	-44.23	0.03776
2440MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12494.998	-35.50	0.28184	-26.02	2.50035	-9.48	5.68	-35.50	0.28184
2440MHz_TnomVmin	Pass	30M	2.387G	1M	32.357	-33.50	0.44668	-26.02	2.50035	-7.48	0.26	-33.50	0.44668
2440MHz_TnomVmin	Pass	2.387G	2.4G	1M	2392.122	-44.66	0.0342	-16.02	25.00345	-28.64	1.47	-44.66	0.0342
2440MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2487.868	-44.20	0.03802	-16.02	25.00345	-28.18	1.49	-44.20	0.03802
2440MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12462.487	-35.17	0.30409	-26.02	2.50035	-9.15	5.66	-35.17	0.30409
2440MHz_TnomVmax	Pass	30M	2.387G	1M	32.357	-36.27	0.23605	-26.02	2.50035	-10.25	0.26	-36.27	0.23605
2440MHz_TnomVmax	Pass	2.387G	2.4G	1M	2387.988	-44.70	0.03388	-16.02	25.00345	-28.68	1.46	-44.70	0.03388
2440MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2487.686	-44.27	0.03741	-16.02	25.00345	-28.25	1.49	-44.27	0.03741
2440MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12487.496	-35.22	0.30061	-26.02	2.50035	-9.20	5.67	-35.22	0.30061
2480MHz_TnomVnom	Pass	30M	2.387G	1M	32.357	-33.24	0.47424	-26.02	2.50035	-7.22	0.26	-33.24	0.47424
2480MHz_TnomVnom	Pass	2.387G	2.4G	1M	2393.396	-44.74	0.03357	-16.02	25.00345	-28.72	1.47	-44.74	0.03357
2480MHz_TnomVnom	Pass	2.4835G	2.4965G	1M	2483.578	-43.54	0.04426	-16.02	25.00345	-27.52	1.49	-43.54	0.04426
2480MHz_TnomVnom	Pass	2.4965G	12.5G	1M	12492.497	-35.25	0.29854	-26.02	2.50035	-9.23	5.68	-35.25	0.29854
2480MHz_TnomVmin	Pass	30M	2.387G	1M	32.357	-33.24	0.47424	-26.02	2.50035	-7.22	0.26	-33.24	0.47424
2480MHz_TnomVmin	Pass	2.387G	2.4G	1M	2392.408	-44.66	0.0342	-16.02	25.00345	-28.64	1.47	-44.66	0.0342
2480MHz_TnomVmin	Pass	2.4835G	2.4965G	1M	2483.552	-43.50	0.04467	-16.02	25.00345	-27.48	1.49	-43.50	0.04467
2480MHz_TnomVmin	Pass	2.4965G	12.5G	1M	12482.494	-35.06	0.31189	-26.02	2.50035	-9.04	5.67	-35.06	0.31189
2480MHz_TnomVmax	Pass	30M	2.387G	1M	32.357	-33.25	0.47315	-26.02	2.50035	-7.23	0.26	-33.25	0.47315
2480MHz_TnomVmax	Pass	2.387G	2.4G	1M	2392.252	-44.69	0.03396	-16.02	25.00345	-28.67	1.47	-44.69	0.03396
2480MHz_TnomVmax	Pass	2.4835G	2.4965G	1M	2483.552	-43.36	0.04613	-16.02	25.00345	-27.34	1.49	-43.36	0.04613
2480MHz_TnomVmax	Pass	2.4965G	12.5G	1M	12473.741	-35.15	0.30549	-26.02	2.50035	-9.13	5.67	-35.15	0.30549

BT-LE(1Mbps) CSE-TX-2402MHz_TnomVnom



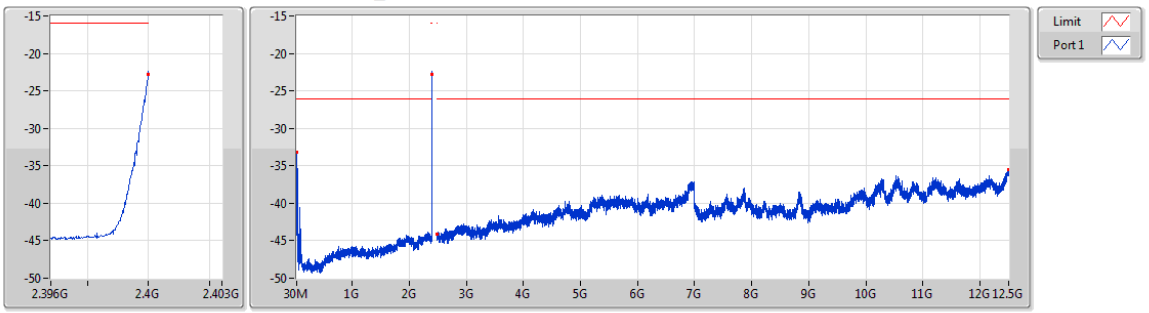
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-34.01	-26.02	-7.99	-34.01
2399.974	-22.94	-16.02	-6.92	-22.94
2485.71	-44.21	-16.02	-28.19	-44.21
12500	-34.88	-26.02	-8.86	-34.88

BT-LE(1Mbps) CSE-TX-2402MHz_TnomVmin



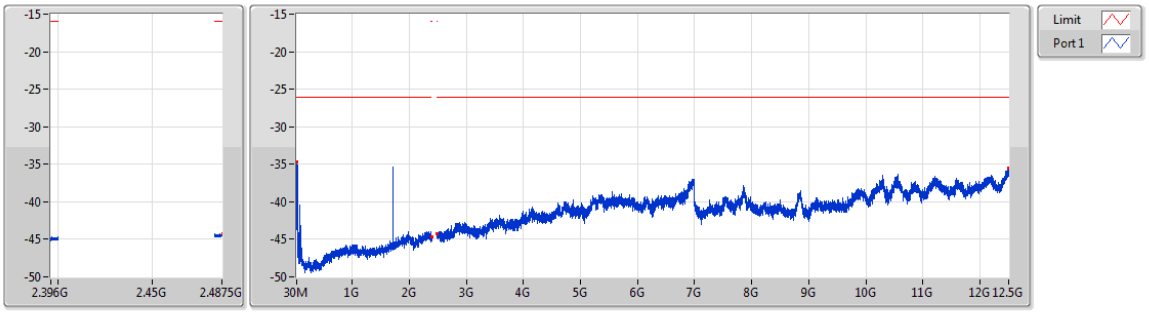
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
42.964	-34.20	-26.02	-8.18	-34.20
2399.974	-22.84	-16.02	-6.82	-22.84
2490.026	-44.28	-16.02	-28.26	-44.28
12476.242	-35.40	-26.02	-9.38	-35.40

BT-LE(1Mbps) CSE-TX-2402MHz_TnomVmax



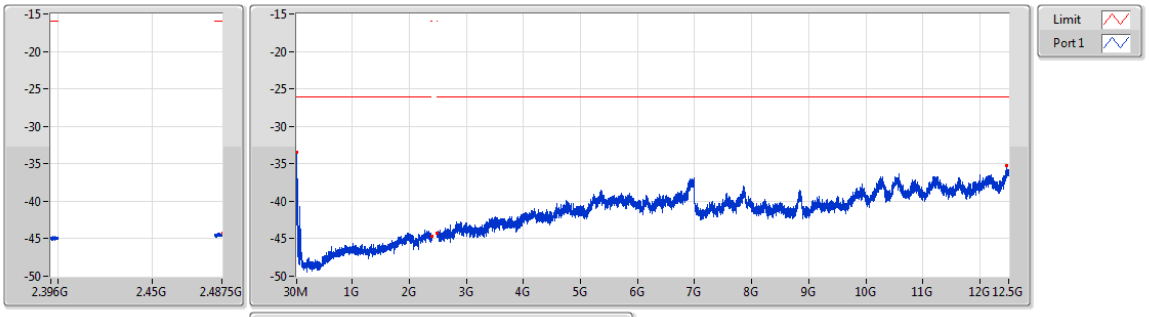
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-33.24	-26.02	-7.22	-33.24
2399.974	-22.84	-16.02	-6.82	-22.84
2488.596	-44.17	-16.02	-28.15	-44.17
12497.499	-35.48	-26.02	-9.46	-35.48

BT-LE(1Mbps) CSE-TX-2440MHz_TnomVnom



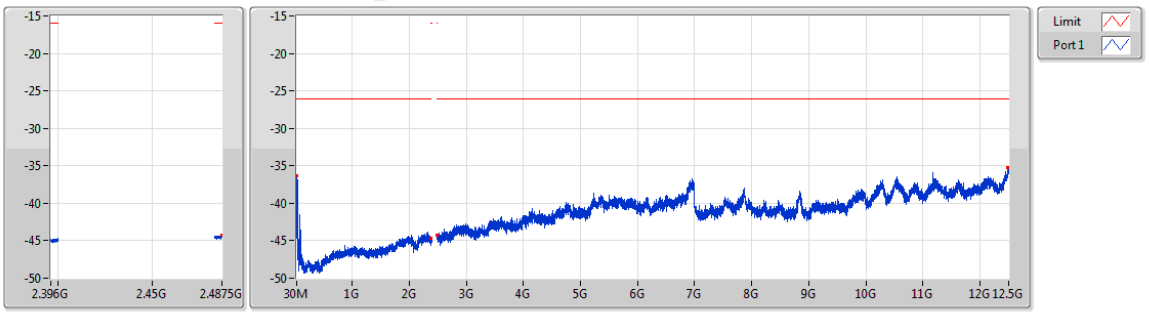
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-34.69	-26.02	-8.67	-34.69
2391.914	-44.62	-16.02	-28.60	-44.62
2487.842	-44.23	-16.02	-28.21	-44.23
12494.998	-35.50	-26.02	-9.48	-35.50

BT-LE(1Mbps) CSE-TX-2440MHz_TnomVmin



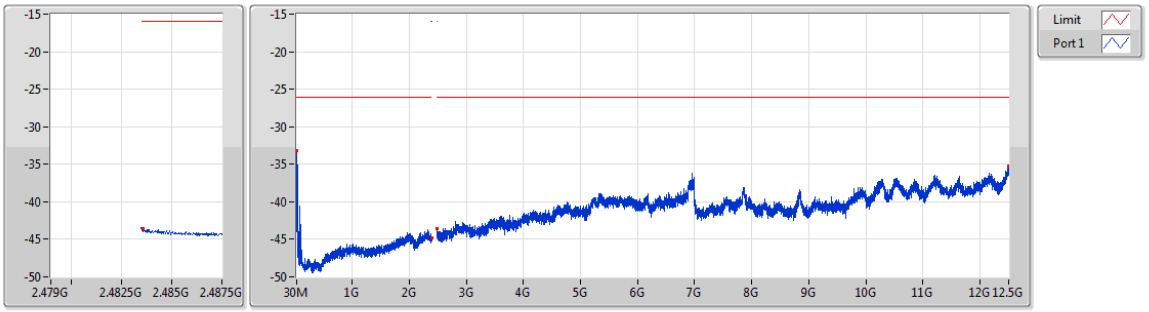
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-33.50	-26.02	-7.48	-33.50
2392.122	-44.66	-16.02	-28.64	-44.66
2487.868	-44.20	-16.02	-28.18	-44.20
12462.487	-35.17	-26.02	-9.15	-35.17

BT-LE(1Mbps) CSE-TX-2440MHz_TnomVmax



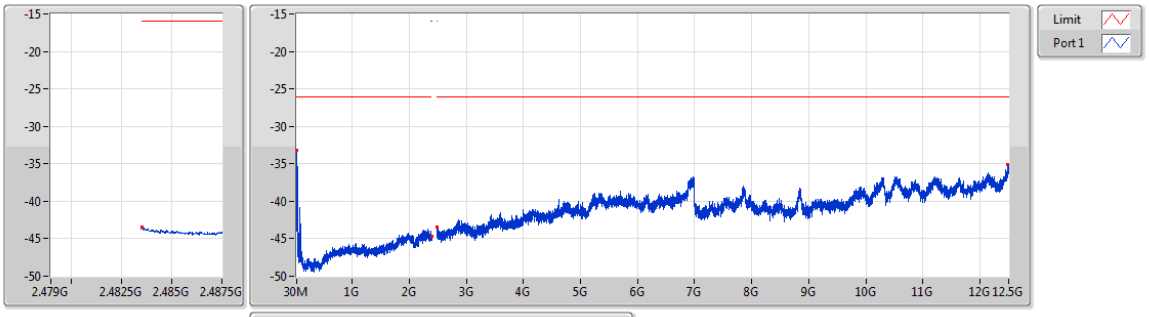
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-36.27	-26.02	-10.25	-36.27
2387.988	-44.70	-16.02	-28.68	-44.70
2487.686	-44.27	-16.02	-28.25	-44.27
12487.496	-35.22	-26.02	-9.20	-35.22

BT-LE(1Mbps) CSE-TX-2480MHz_TnomVnom



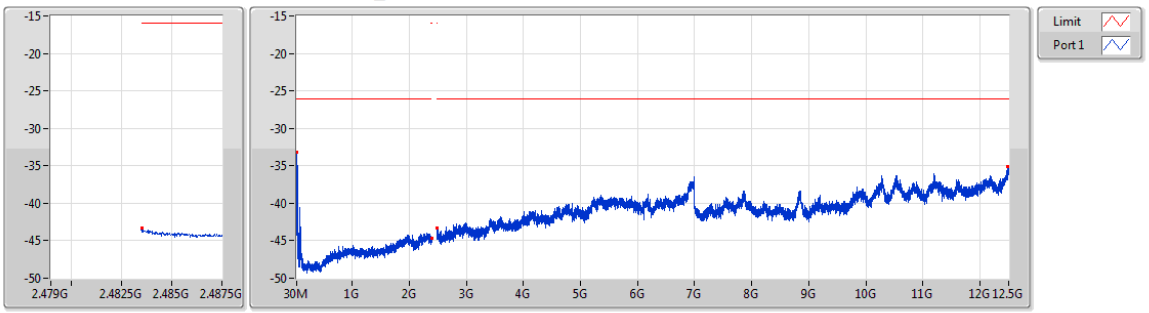
Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-33.24	-26.02	-7.22	-33.24
2393.396	-44.74	-16.02	-28.72	-44.74
2483.578	-43.54	-16.02	-27.52	-43.54
12492.497	-35.25	-26.02	-9.23	-35.25

BT-LE(1Mbps) CSE-TX-2480MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-33.24	-26.02	-7.22	-33.24
2392.408	-44.66	-16.02	-28.64	-44.66
2483.552	-43.50	-16.02	-27.48	-43.50
12482.494	-35.06	-26.02	-9.04	-35.06

BT-LE(1Mbps) CSE-TX-2480MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
32.357	-33.25	-26.02	-7.23	-33.25
2392.252	-44.69	-16.02	-28.67	-44.69
2483.552	-43.36	-16.02	-27.34	-43.36
12473.741	-35.15	-26.02	-9.13	-35.15

Summary

Mode	Result	ID Length	ID Limit	Function
2.4-2.4835GHz	-	-	-	-
BT-LE(2Mbps)	Pass	CD:DD:6C:DA:BD:17	48 bits	Good

Result

Mode	Result	ID Length	ID Limit	Function
BT-LE(2Mbps)	-	-	-	-
2402MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2402MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2402MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2440MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVnom	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVmin	Pass	CD:DD:6C:DA:BD:17	48 bits	Good
2480MHz_TnomVmax	Pass	CD:DD:6C:DA:BD:17	48 bits	Good

Summary

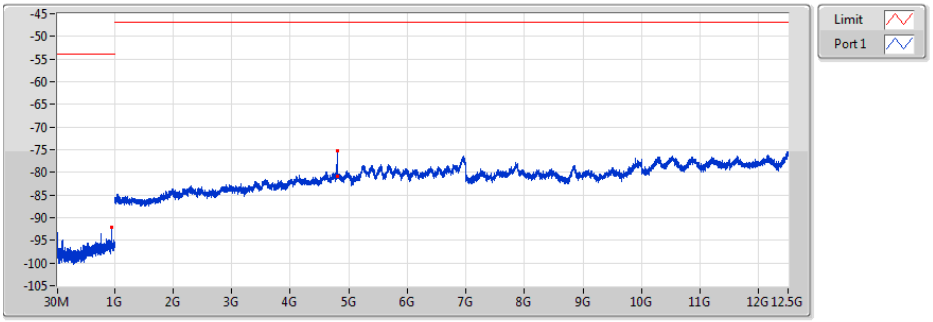
Mode	Result	F-Start (Hz)	F-Stop (Hz)	RBW (Hz)	Freq (MHz)	Psum (dBm)	Psum (nW/MHz)	Limit (dBm)	Limit (nW/MHz)	Margin (dB)	Loss (dB)	P1 (dBm)	P1 (nW/MHz)
2.4-2.4835GHz	-	-	-	-	-	-	-	-	-	-	-	-	-
BT-LE(2Mbps)	Pass	1G	12.5G	1M	10524.875	-69.58	0.11015	-46.99	19.99862	-22.59	4.61	-69.58	0.11015

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)	Loss (dB)	P1 (dBm)	P1 (nW/MHz)
BT-LE(2Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	30M	1G	100k	953.925	-92.11	0.00062	-53.98	3.99945	-38.13	0.85	-92.11	0.00062
2402MHz_TnomVnom	Pass	1G	12.5G	1M	4799.312	-75.15	0.03055	-46.99	19.99862	-28.16	1.72	-75.15	0.03055
2402MHz_TnomVnom	Pass	1G	12.5G	1M	4805.062	-80.95	0.00804	-46.99	19.99862	-33.96	1.72	-80.95	0.00804
2402MHz_TnomVmin	Pass	30M	1G	100k	953.925	-92.06	0.00062	-53.98	3.99945	-38.08	0.85	-92.06	0.00062
2402MHz_TnomVmin	Pass	1G	12.5G	1M	4799.312	-75.08	0.03105	-46.99	19.99862	-28.09	1.72	-75.08	0.03105
2402MHz_TnomVmin	Pass	1G	12.5G	1M	4805.062	-80.60	0.00871	-46.99	19.99862	-33.61	1.72	-80.60	0.00871
2402MHz_TnomVmax	Pass	30M	1G	100k	773.02	-93.70	0.00043	-53.98	3.99945	-39.72	0.73	-93.70	0.00043
2402MHz_TnomVmax	Pass	1G	12.5G	1M	4803.625	-80.80	0.00832	-46.99	19.99862	-33.81	1.72	-80.80	0.00832
2402MHz_TnomVmax	Pass	1G	12.5G	1M	10524.875	-75.00	0.03162	-46.99	19.99862	-28.01	4.61	-75.00	0.03162
2440MHz_TnomVnom	Pass	30M	1G	100k	31.94	-93.77	0.00042	-53.98	3.99945	-39.79	0.26	-93.77	0.00042
2440MHz_TnomVnom	Pass	1G	12.5G	1M	4879.812	-81.61	0.0069	-46.99	19.99862	-34.62	1.72	-81.61	0.0069
2440MHz_TnomVnom	Pass	1G	12.5G	1M	12491.375	-75.43	0.02864	-46.99	19.99862	-28.44	5.68	-75.43	0.02864
2440MHz_TnomVmin	Pass	30M	1G	100k	953.925	-91.97	0.00064	-53.98	3.99945	-37.99	0.85	-91.97	0.00064
2440MHz_TnomVmin	Pass	1G	12.5G	1M	4878.375	-81.58	0.00695	-46.99	19.99862	-34.59	1.72	-81.58	0.00695
2440MHz_TnomVmin	Pass	1G	12.5G	1M	10524.875	-69.58	0.11015	-46.99	19.99862	-22.59	4.61	-69.58	0.11015
2440MHz_TnomVmax	Pass	30M	1G	100k	31.94	-93.75	0.00042	-53.98	3.99945	-39.77	0.26	-93.75	0.00042
2440MHz_TnomVmax	Pass	1G	12.5G	1M	4879.812	-81.30	0.00741	-46.99	19.99862	-34.31	1.72	-81.30	0.00741
2440MHz_TnomVmax	Pass	1G	12.5G	1M	10526.312	-70.32	0.0929	-46.99	19.99862	-23.33	4.61	-70.32	0.0929
2480MHz_TnomVnom	Pass	30M	1G	100k	953.925	-91.83	0.00066	-53.98	3.99945	-37.85	0.85	-91.83	0.00066
2480MHz_TnomVnom	Pass	1G	12.5G	1M	4960.312	-80.46	0.00899	-46.99	19.99862	-33.47	1.73	-80.46	0.00899
2480MHz_TnomVnom	Pass	1G	12.5G	1M	12500	-74.96	0.03192	-46.99	19.99862	-27.97	5.68	-74.96	0.03192
2480MHz_TnomVmin	Pass	30M	1G	100k	953.925	-92.08	0.00062	-53.98	3.99945	-38.10	0.85	-92.08	0.00062
2480MHz_TnomVmin	Pass	1G	12.5G	1M	4958.875	-79.90	0.01023	-46.99	19.99862	-32.91	1.73	-79.90	0.01023
2480MHz_TnomVmin	Pass	1G	12.5G	1M	12494.25	-75.31	0.02944	-46.99	19.99862	-28.32	5.68	-75.31	0.02944
2480MHz_TnomVmax	Pass	30M	1G	100k	953.925	-93.02	0.0005	-53.98	3.99945	-39.04	0.85	-93.02	0.0005
2480MHz_TnomVmax	Pass	1G	12.5G	1M	4960.312	-80.75	0.00841	-46.99	19.99862	-33.76	1.73	-80.75	0.00841
2480MHz_TnomVmax	Pass	1G	12.5G	1M	12492.812	-75.48	0.02831	-46.99	19.99862	-28.49	5.68	-75.48	0.02831

BT-LE(1Mbps) **CSE-RX-**

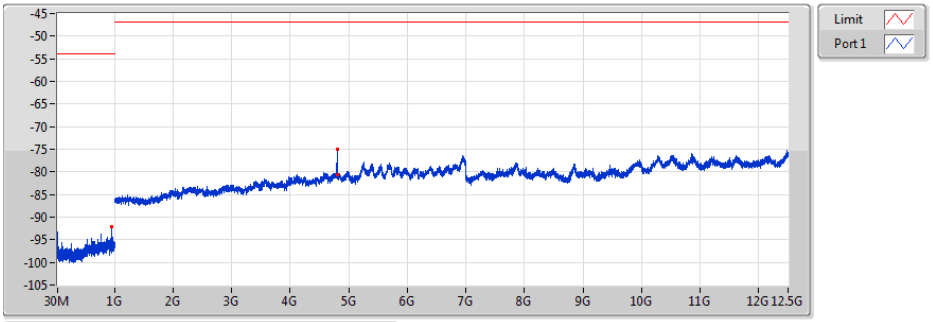
2402MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-92.11	-53.98	-38.13	-92.11
4799.312	-75.15	-46.99	-28.16	-75.15
4805.062	-80.95	-46.99	-33.96	-80.95

BT-LE(1Mbps) **CSE-RX-**

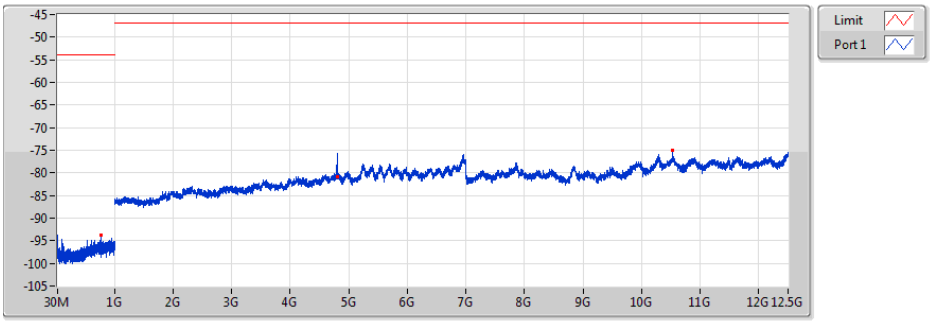
2402MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-92.06	-53.98	-38.08	-92.06
4799.312	-75.08	-46.99	-28.09	-75.08
4805.062	-80.60	-46.99	-33.61	-80.60

BT-LE(1Mbps) **CSE-RX-**

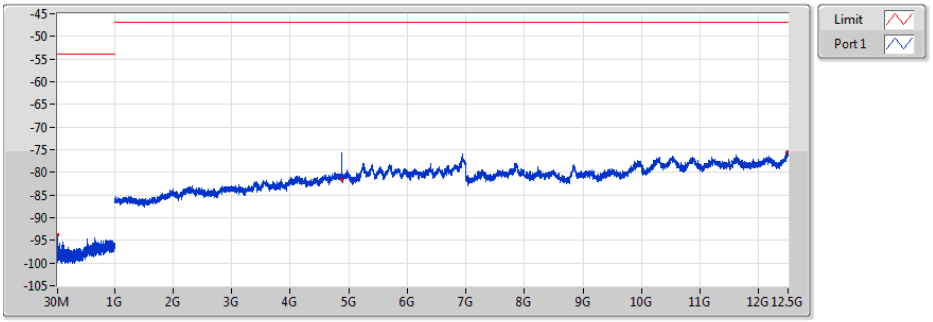
2402MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
773.02	-93.70	-53.98	-39.72	-93.70
4803.625	-80.80	-46.99	-33.81	-80.80
10524.875	-75.00	-46.99	-28.01	-75.00

BT-LE(1Mbps) **CSE-RX-**

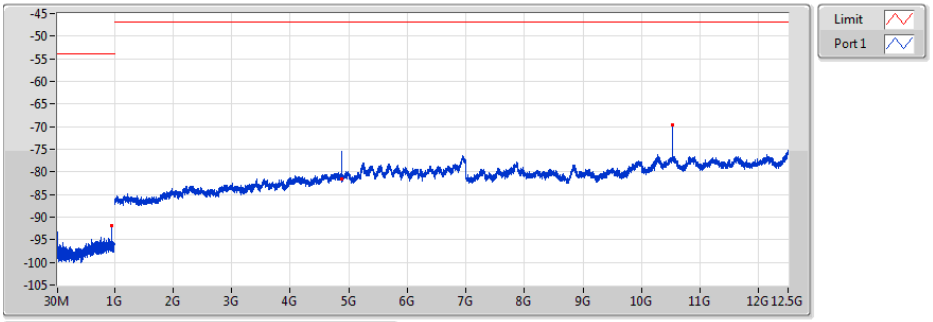
2440MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-93.77	-53.98	-39.79	-93.77
4879.812	-81.61	-46.99	-34.62	-81.61
12491.375	-75.43	-46.99	-28.44	-75.43

BT-LE(1Mbps) **CSE-RX-**

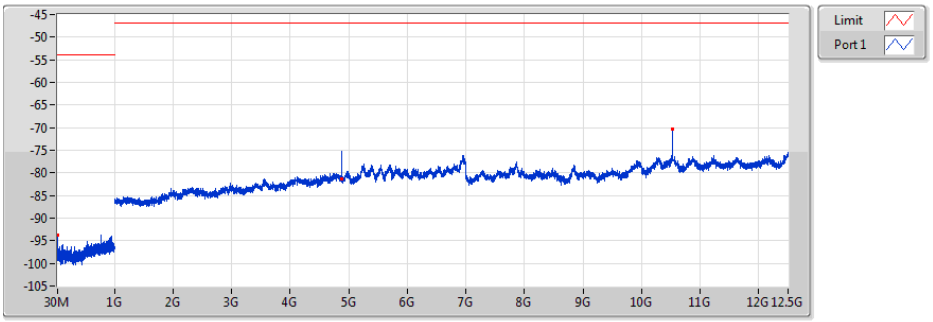
2440MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-91.97	-53.98	-37.99	-91.97
4878.375	-81.58	-46.99	-34.59	-81.58
10524.875	-69.58	-46.99	-22.59	-69.58

BT-LE(1Mbps) **CSE-RX-**

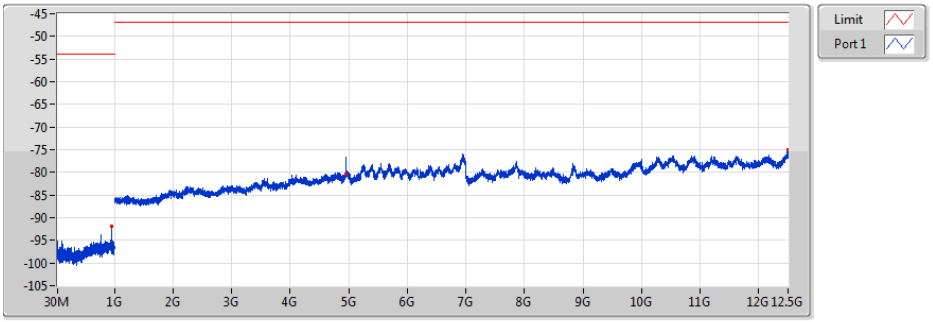
2440MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
31.94	-93.75	-53.98	-39.77	-93.75
4879.812	-81.30	-46.99	-34.31	-81.30
10526.312	-70.32	-46.99	-23.33	-70.32

BT-LE(1Mbps) **CSE-RX-**

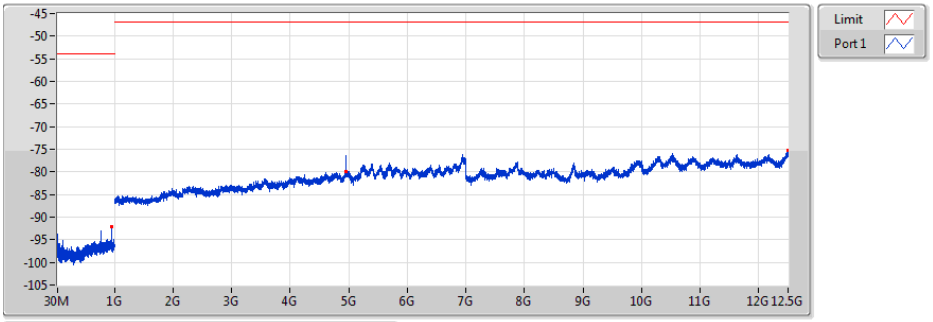
2480MHz_TnomVnom



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-91.83	-53.98	-37.85	-91.83
4960.312	-80.46	-46.99	-33.47	-80.46
12500	-74.96	-46.99	-27.97	-74.96

BT-LE(1Mbps) **CSE-RX-**

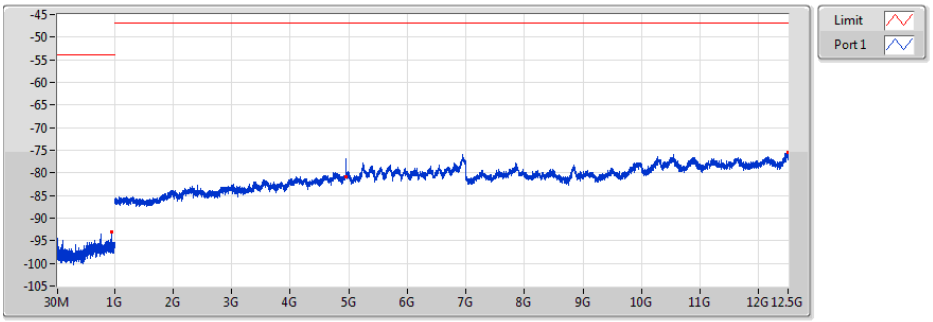
2480MHz_TnomVmin



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-92.08	-53.98	-38.10	-92.08
4958.875	-79.90	-46.99	-32.91	-79.90
12494.25	-75.31	-46.99	-28.32	-75.31

BT-LE(1Mbps) **CSE-RX-**

2480MHz_TnomVmax



Freq(MHz)	Psum(dBm)	Limit(dBm)	Margin(dB)	P1(dBm)
953.925	-93.02	-53.98	-39.04	-93.02
4960.312	-80.75	-46.99	-33.76	-80.75
12492.812	-75.48	-46.99	-28.49	-75.48

Appendix G. Antenna Information

NanoBlue

Embedded Internal Antenna

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 AND BENEFITS

- Versatile, easy-to-use for 2.4 to 2.5 GHz Bluetooth® and IEEE 802.11 devices
- Designed for an easy connection to radio cards
- Uses patented PCB Microsphere technology
- Has a ground plane incorporated into the resonator structure – no additional ground plane is required to radiate efficiently

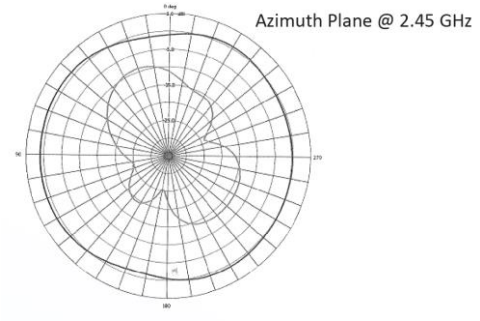
ELECTRICAL SPECIFICATIONS	
Operating Frequency (MHz)	2.4 – 2.5 GHz
VSWR – Max	<2.5:1
Gain (dBi)	2
Nominal Impedance (Ohms)	50
Polarization	Linear

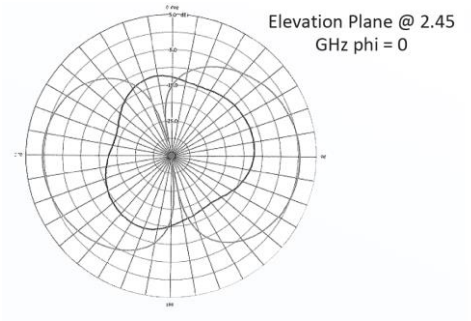
MECHANICAL SPECIFICATIONS	
Dimensions	47.75 mm (1.88 in) x 12.7 mm (0.5 in.) x 0.81 mm (0.032 in.)
Weight	2 g (0.071 oz.)

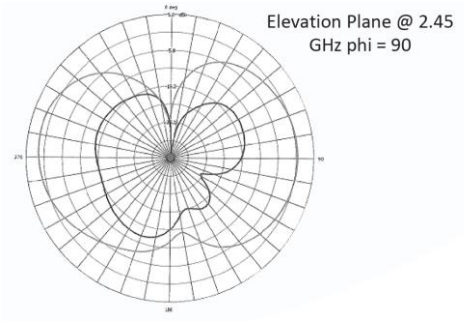
CONFIGURATION

PART NUMBER	CABLE LENGTH	CONNECTOR
MAF94045	100 mm, Ø 1.13 mm	IPEX MHF
MAF94102	100 mm, RG178	Flying Lead
EBL2400A1-10MHL4L	100 mm	MHF4

ANTENNA PATTERNS







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RoHS

2.4 GHz – 2.5 GHz FlexPIFA 2 dBi Antenna w/U.FL Cable, 100mm

ORDERING INFORMATION

Order Number	Description
001-0014	2.4 GHz FlexPIFA Antenna w/U.FL Cable, 100mm
001-0022	2.4 GHz FlexPIFA Antenna w/MHF4L Cable, 100mm

Table 1 Orderable Part Numbers

KEY FEATURES

- Can be installed on different non-conductive surfaces and thicknesses.
- Can be installed near metals or the human body.
- Can be installed on flat or curved surfaces.
- Quick and easy Installation
- Adhesive holds to surface during humidity exposure and hot/cold cycles.
- RoHS Compliant

SPECIFICATIONS

Specification	Value
Peak Gain	+2 dBi
Average Gain	>-1.5 dBi
Impedance	50 ohms
Type	Flexible Planar Inverted F Antenna (FlexPIFA)
Polarization	Linear
VSWR	< 2.0:1, 2400 - 2480 MHz
Frequency	2400 – 2480 MHz
Weight	1.13g
Size	40.1mm × 11mm × 2.5mm
Antenna Color	Clear Yellow
Adhesive	3M 100MP
Operating Temp	-40°C to +85°C
Connector Height	U.FL: 2.5mm Max
	MHF4L: 1.4mm Max

Table 2 Specifications

PHYSICAL DIMENSIONS (MM)

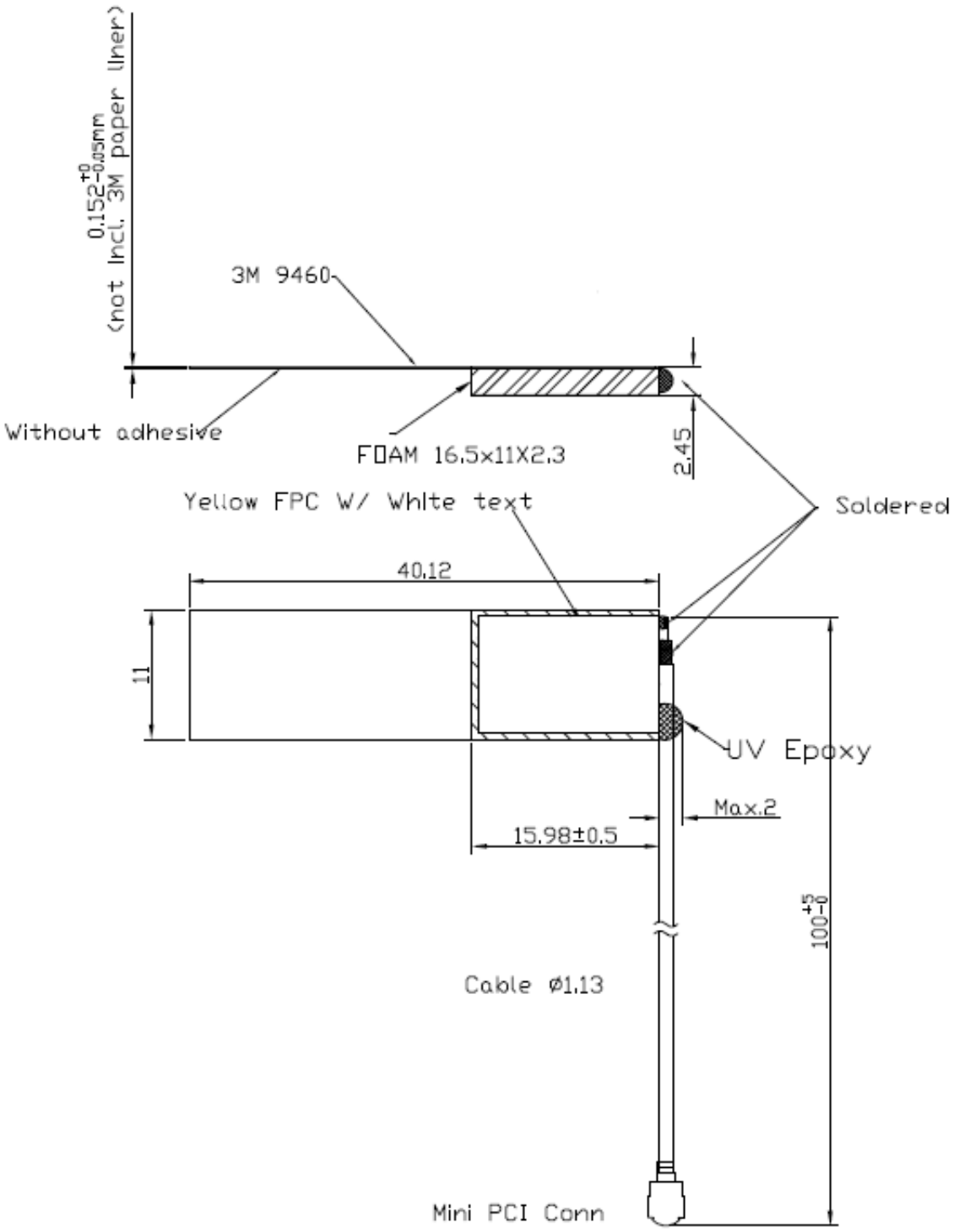


Figure 1 Physical Dimensions

TEST SETUP

Antenna measurements such as VSWR were measured with an Agilent E5071C Vector Network Analyzer. Radiation patterns were measured with a CMT Planar 804/1 Vector Network Analyzer in a Howland Company 3100 Chamber equivalent. Phase Center is 9 inches above the Phi positioner.

Flat surface measurements were done with the antenna centered on a 1.5 mm thick plate of Polycarbonate. Curved surface measurements were taken by placing the antenna on the inside and outside of different diameter PVC tubing.

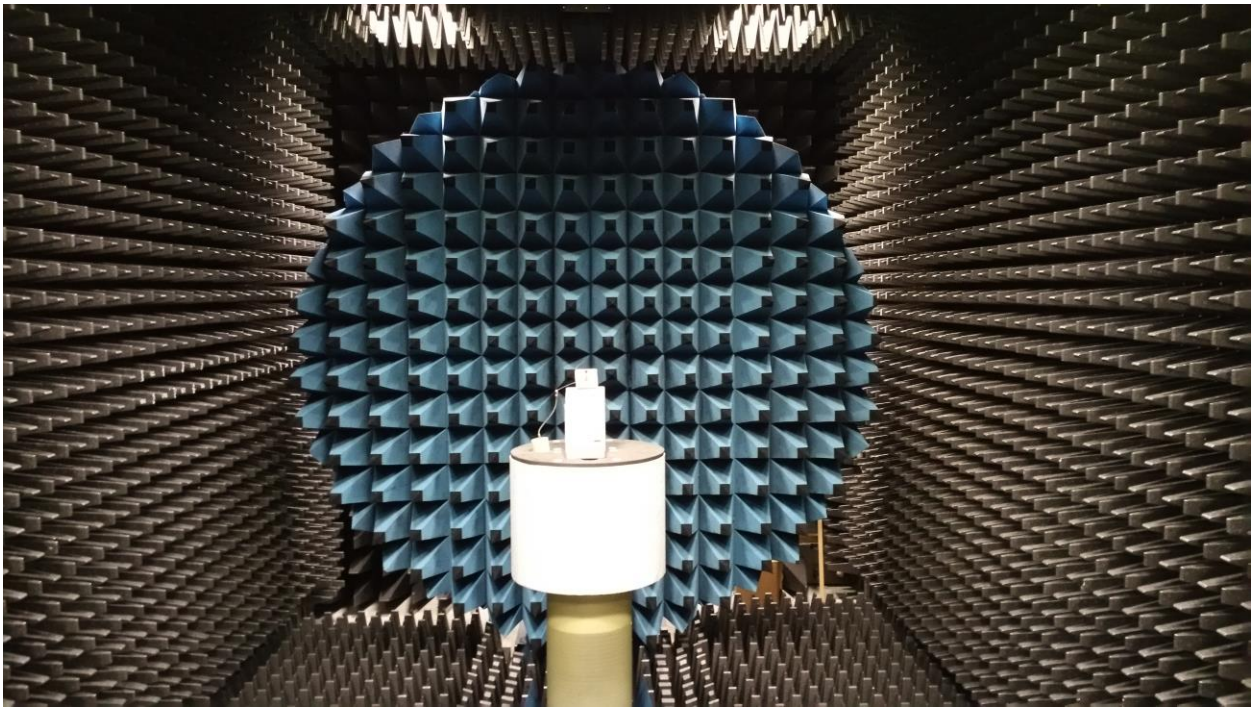


Figure 2 Antenna Chamber

FLAT SURFACE ANTENNA MEASUREMENTS

VSWR

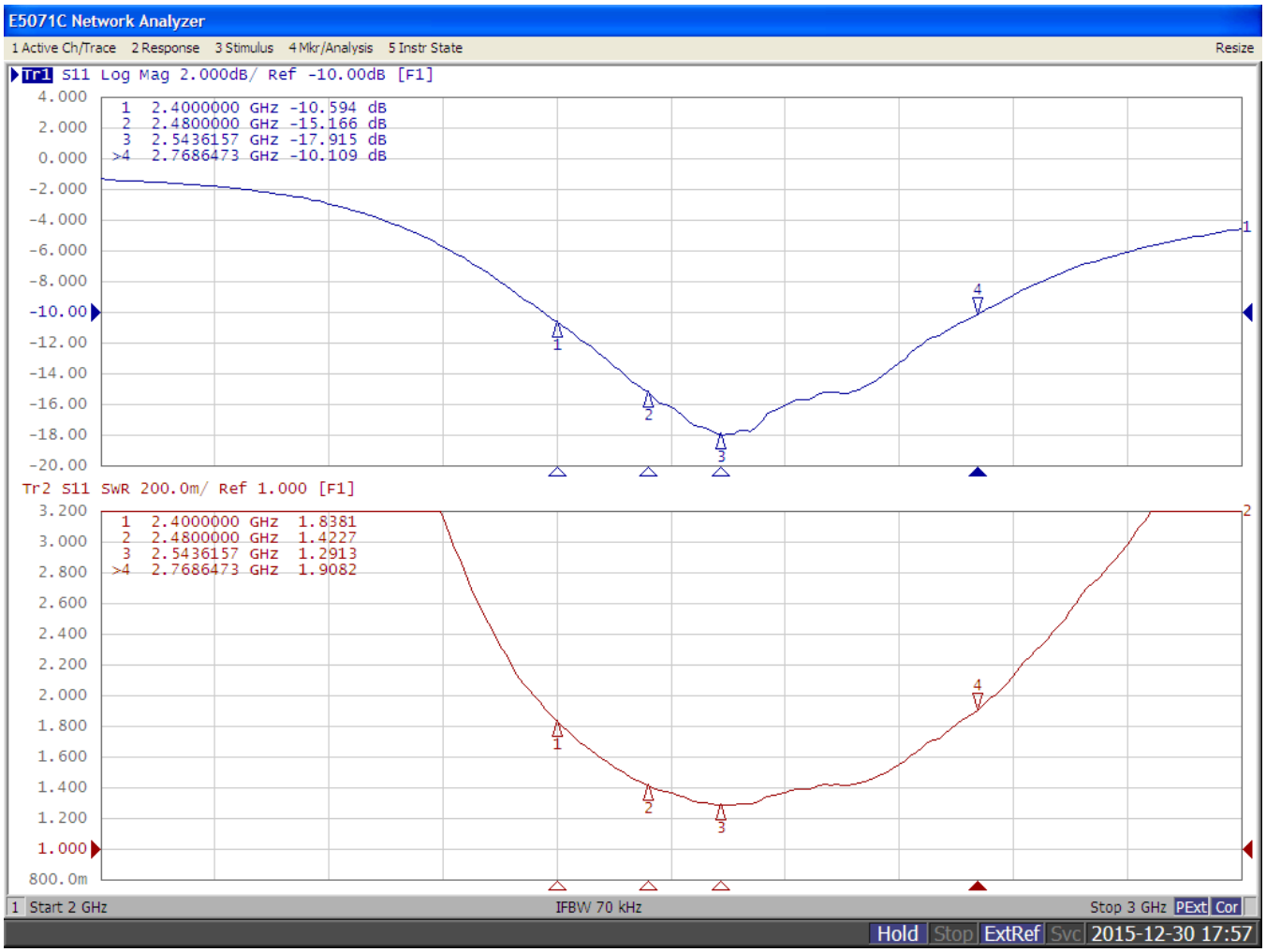


Figure 3 Antenna VSWR measured on a 1.5 mm thick plate of Polycarbonate

FLAT SURFACE ANTENNA RADIATION PERFORMANCE

FlexPIFA centered on a 1.5 mm thick plate of Polycarbonate

Antenna Measurement Set-Up:

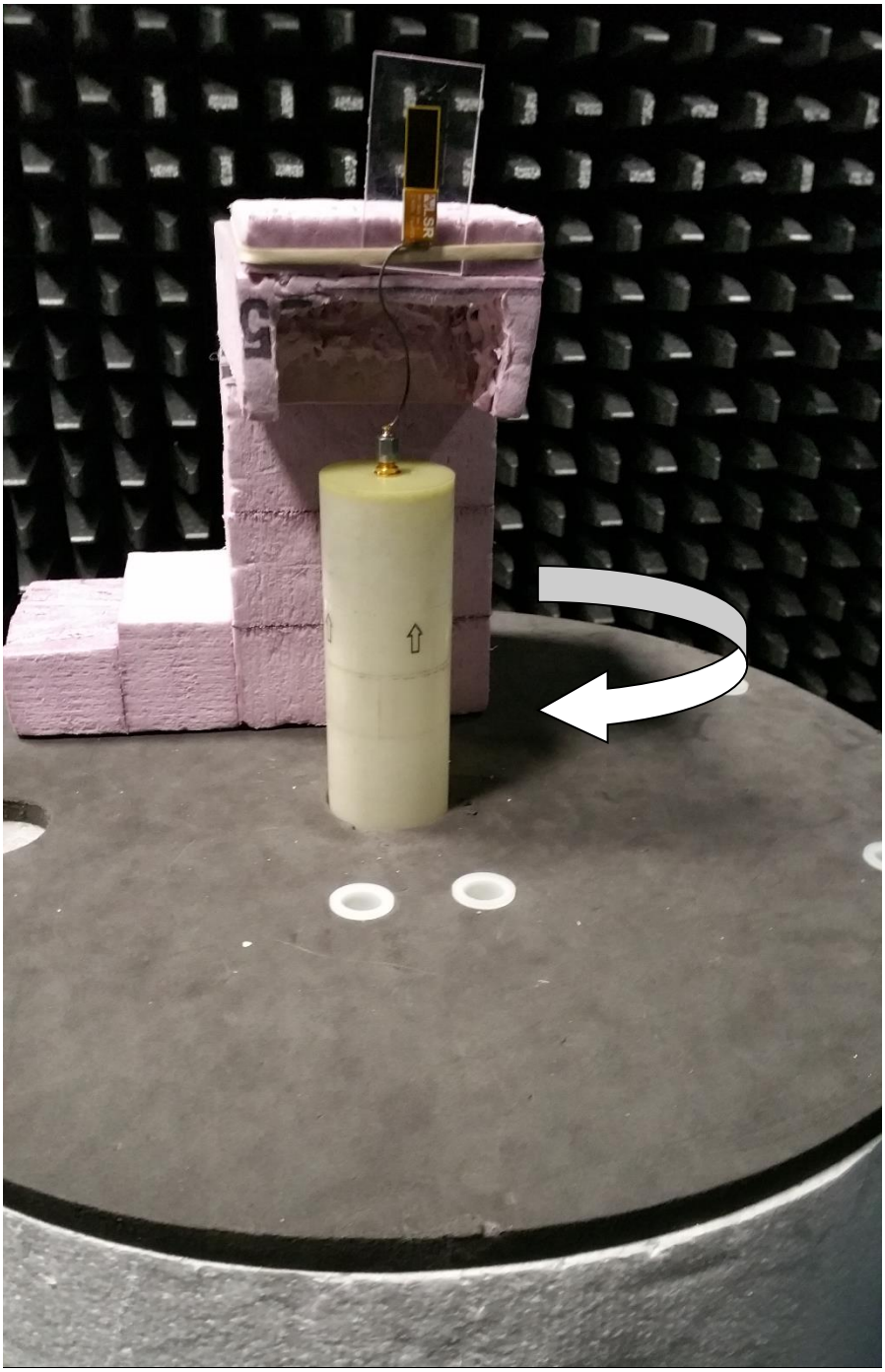


Figure 4 Flat Surface Set-Up

Azimuthal Conical Cuts at 2400 MHz:

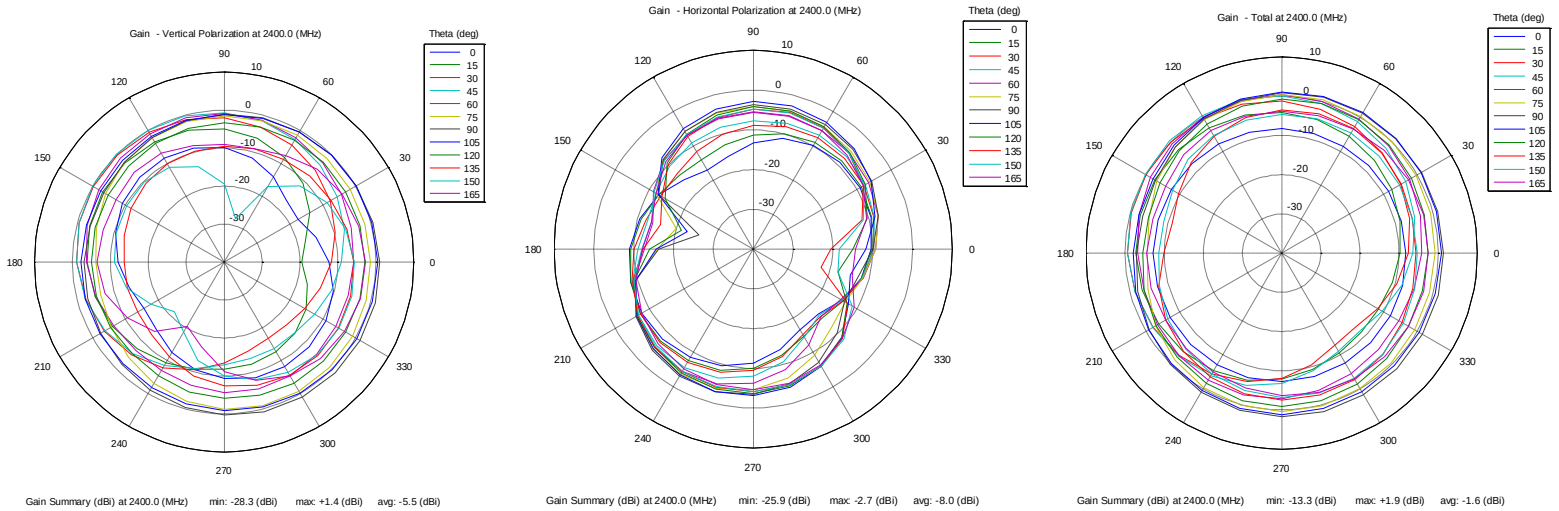


Figure 5 Vertical, Horizontal, and Total Gain Patterns

3D Plots at 2400 MHz:

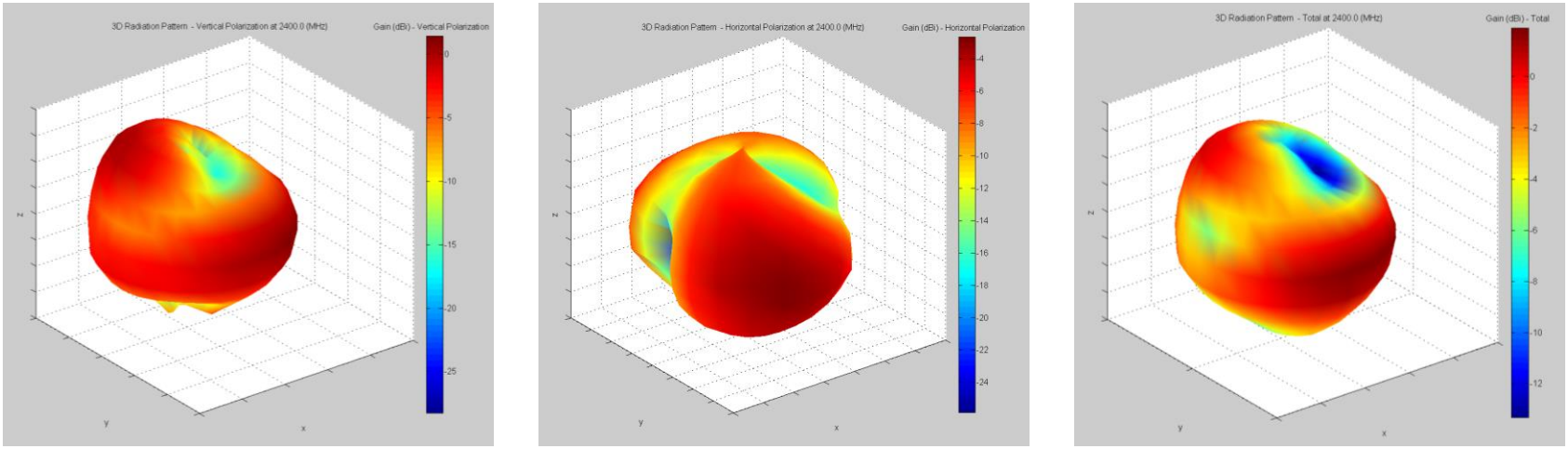


Figure 6 Vertical, Horizontal, and Total Gain Plots

Azimuthal Conical Cuts at 2440 MHz:

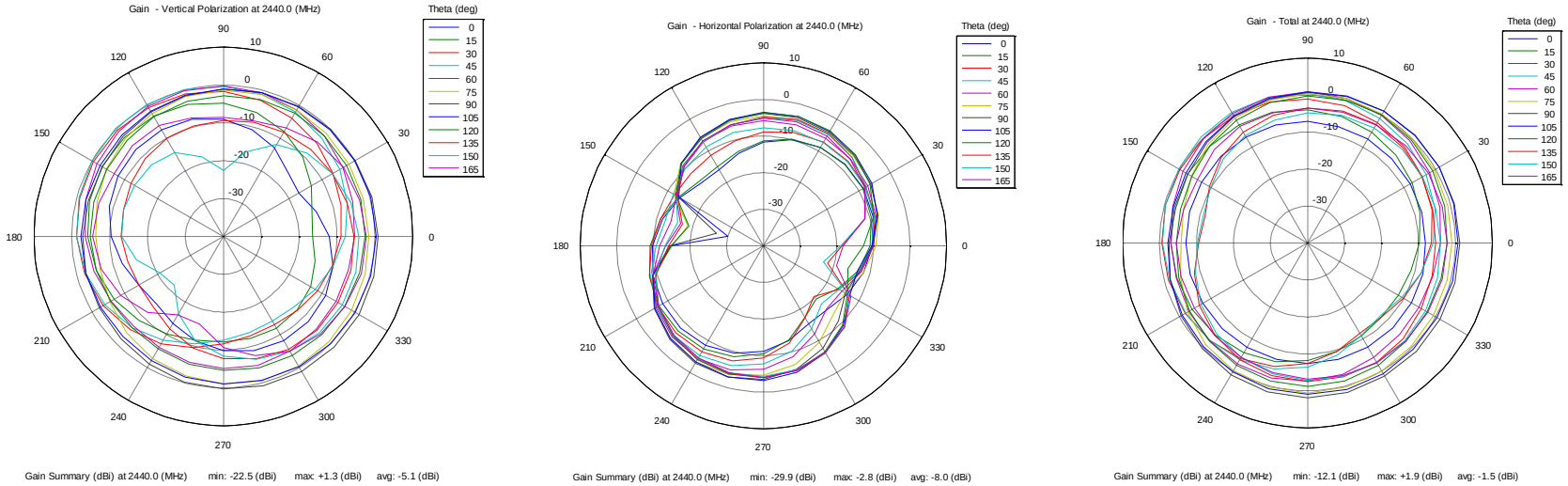


Figure 7 Vertical, Horizontal, and Total Gain Patterns

3D Plots at 2440 MHz:

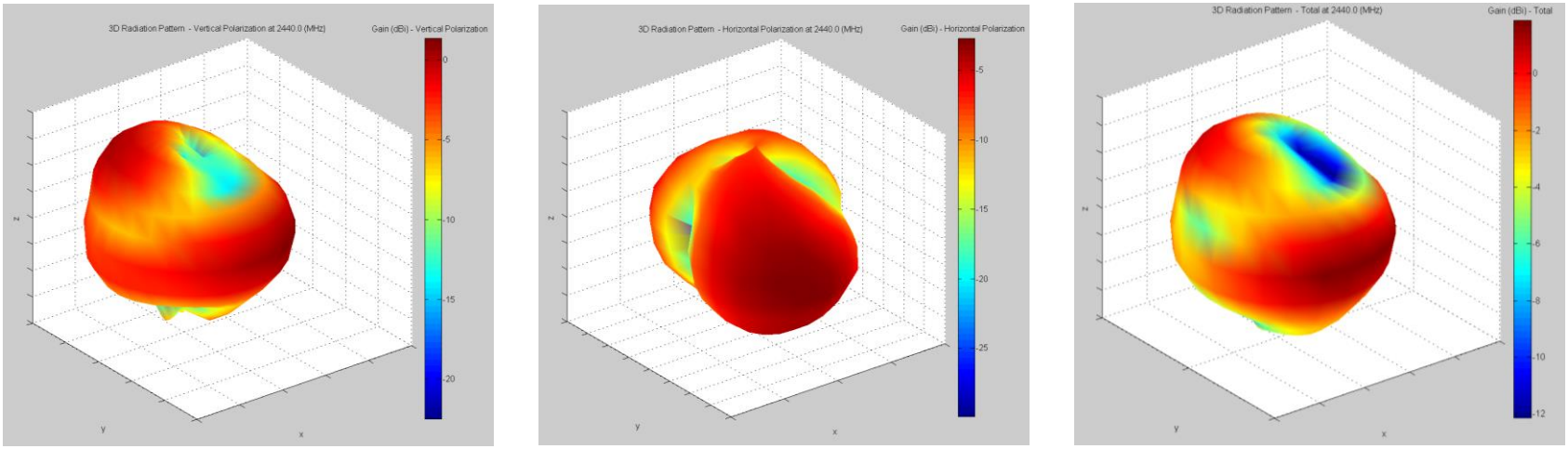


Figure 8 Vertical, Horizontal, and Total Gain Plots

Azimuthal Conical Cuts at 2480 MHz:

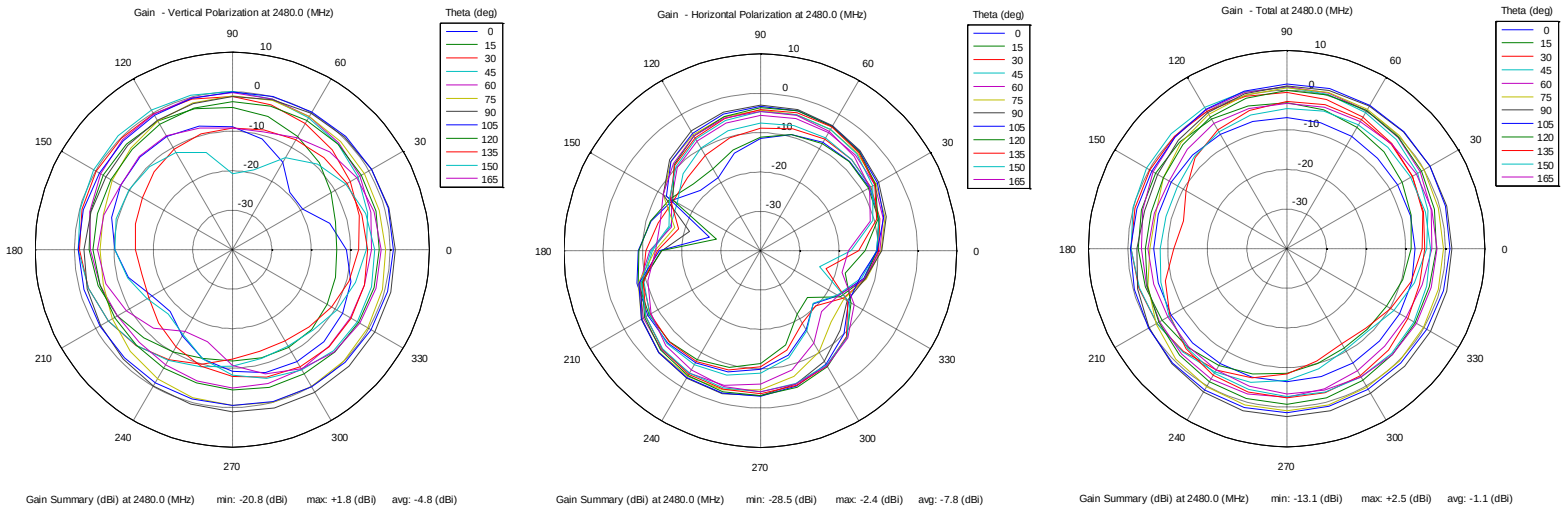


Figure 9 Vertical, Horizontal, and Total Gain Patterns

3D Plots at 2480 MHz:

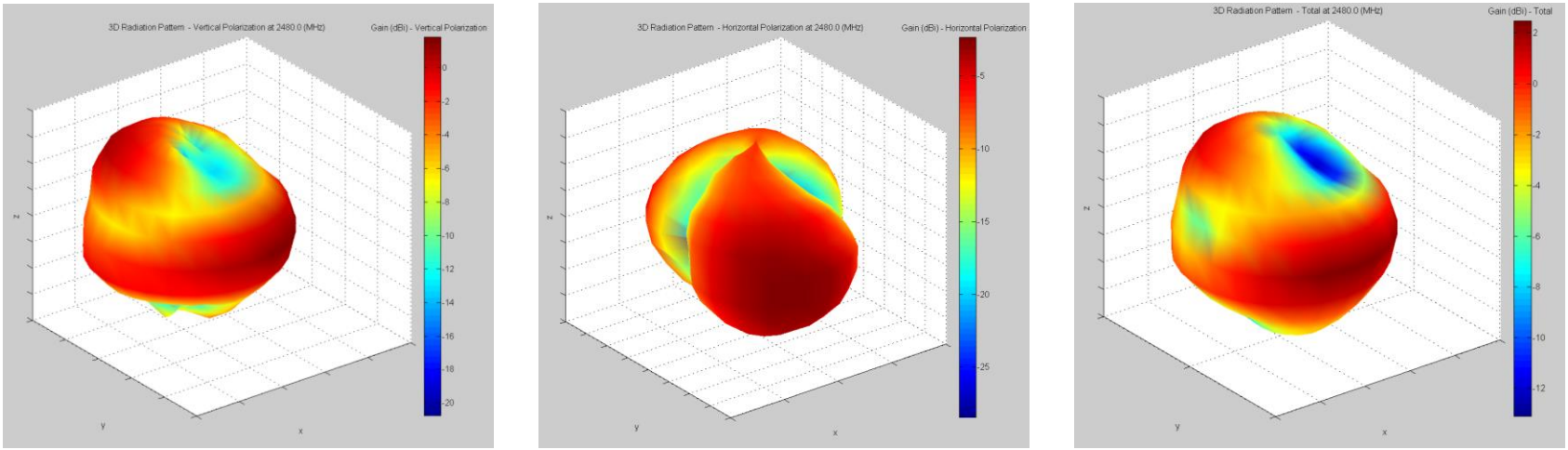


Figure 10 Vertical, Horizontal, and Total Gain Plots

CURVED SURFACE ANTENNA RADIATION PERFORMANCE

Flex PIFA inside 51 mm Inner Diameter PVC tube.

Antenna Measurement Set-Up:

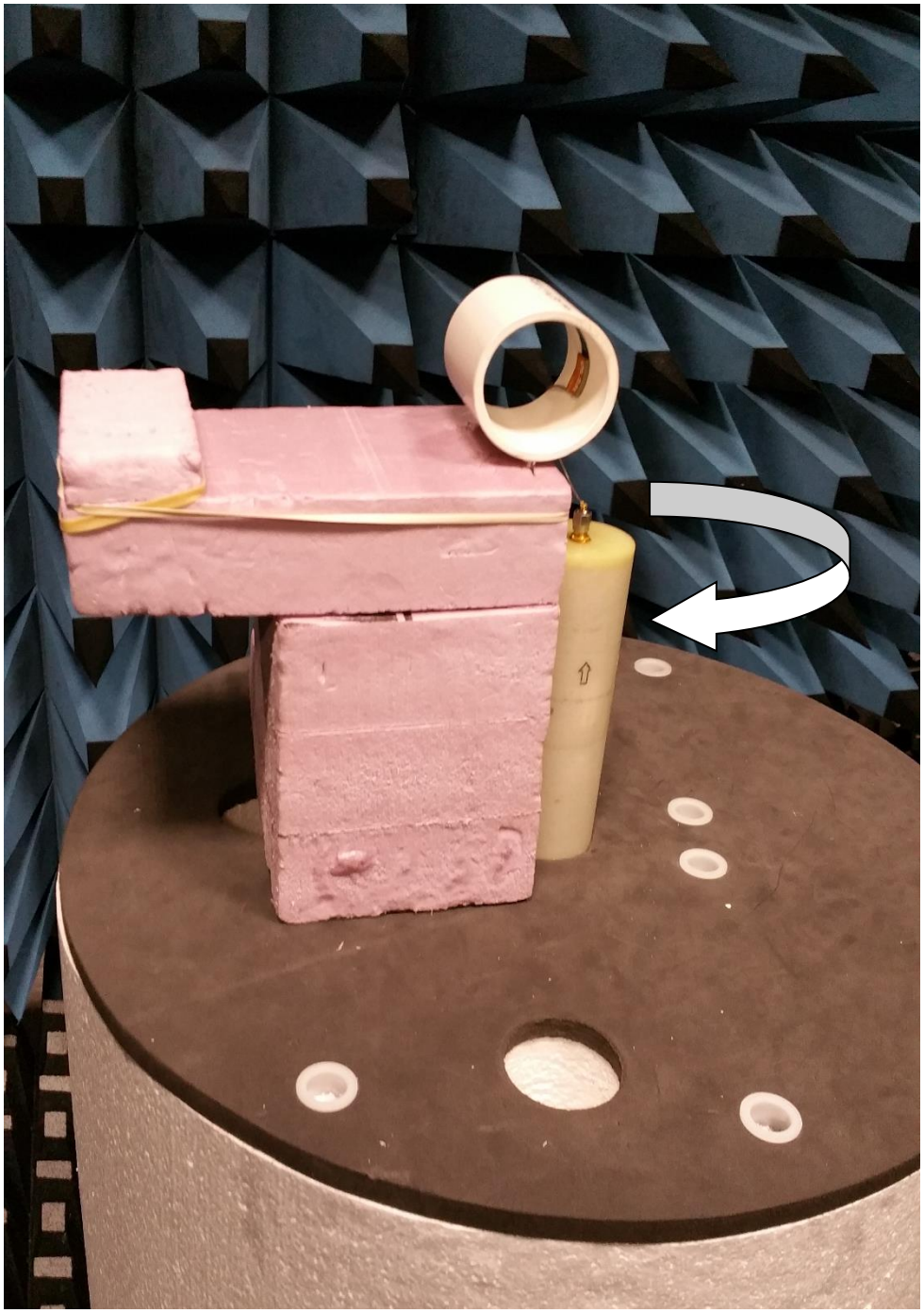


Figure 11 Concave Curve Set-Up

Azimuthal Conical Cuts at 2440 MHz:

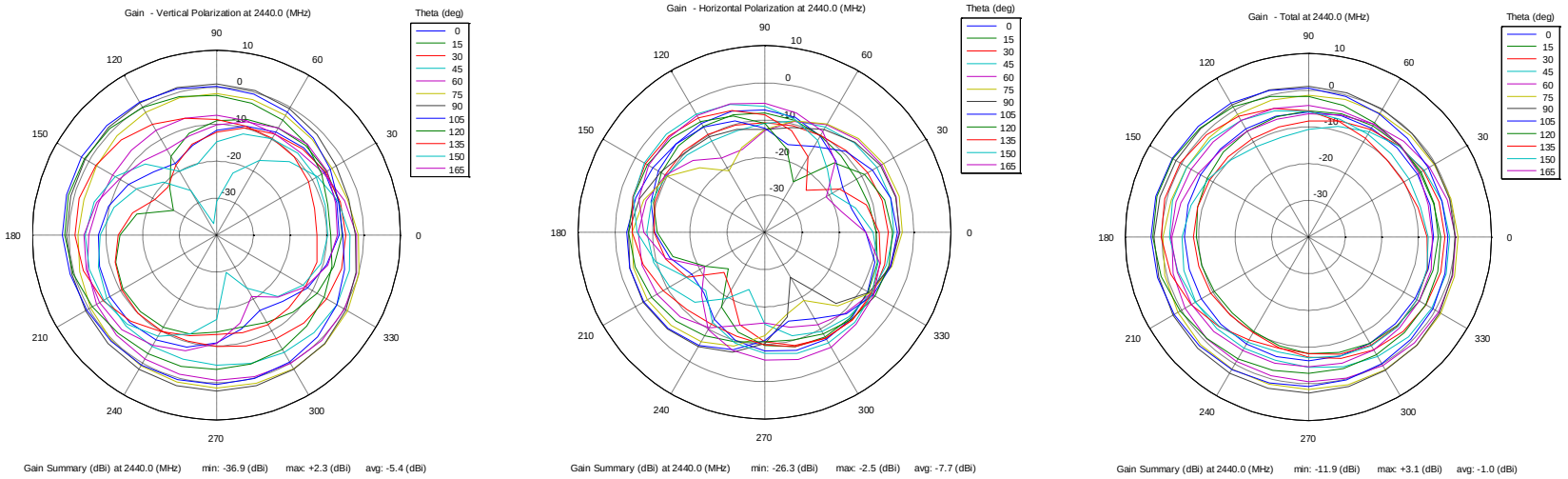


Figure 12 Vertical, Horizontal, and Total Gain Patterns

3D Plots at 2440 MHz:

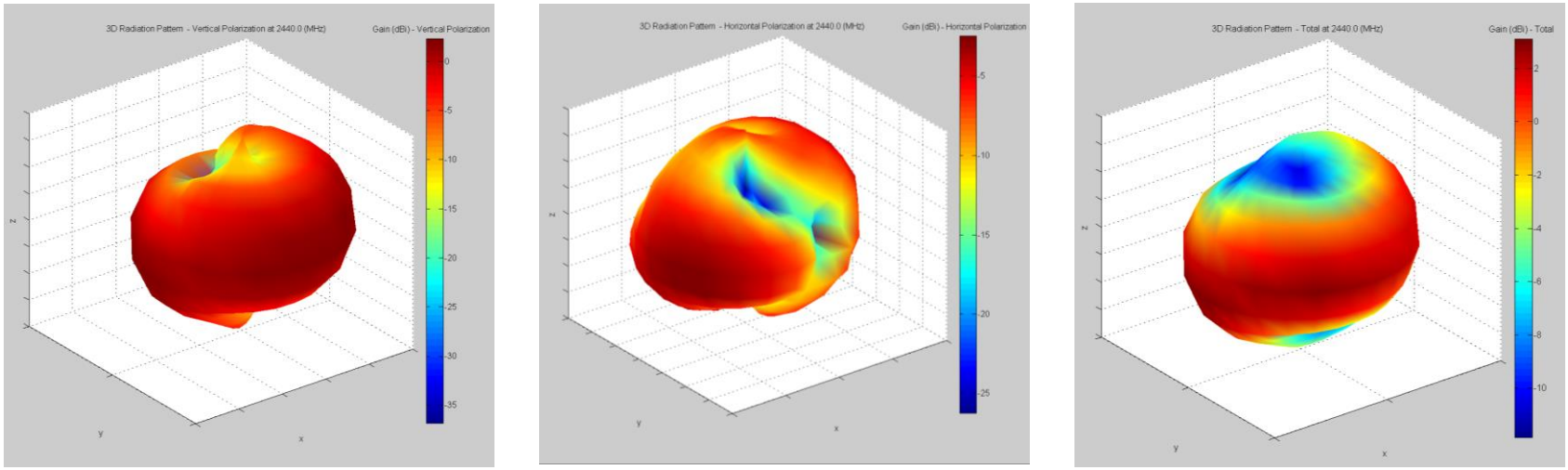


Figure 13 Vertical, Horizontal, and Total Gain Plots

Flex PIFA outside 60 mm Outer Diameter PVC tube.

Antenna Measurement Set-Up:

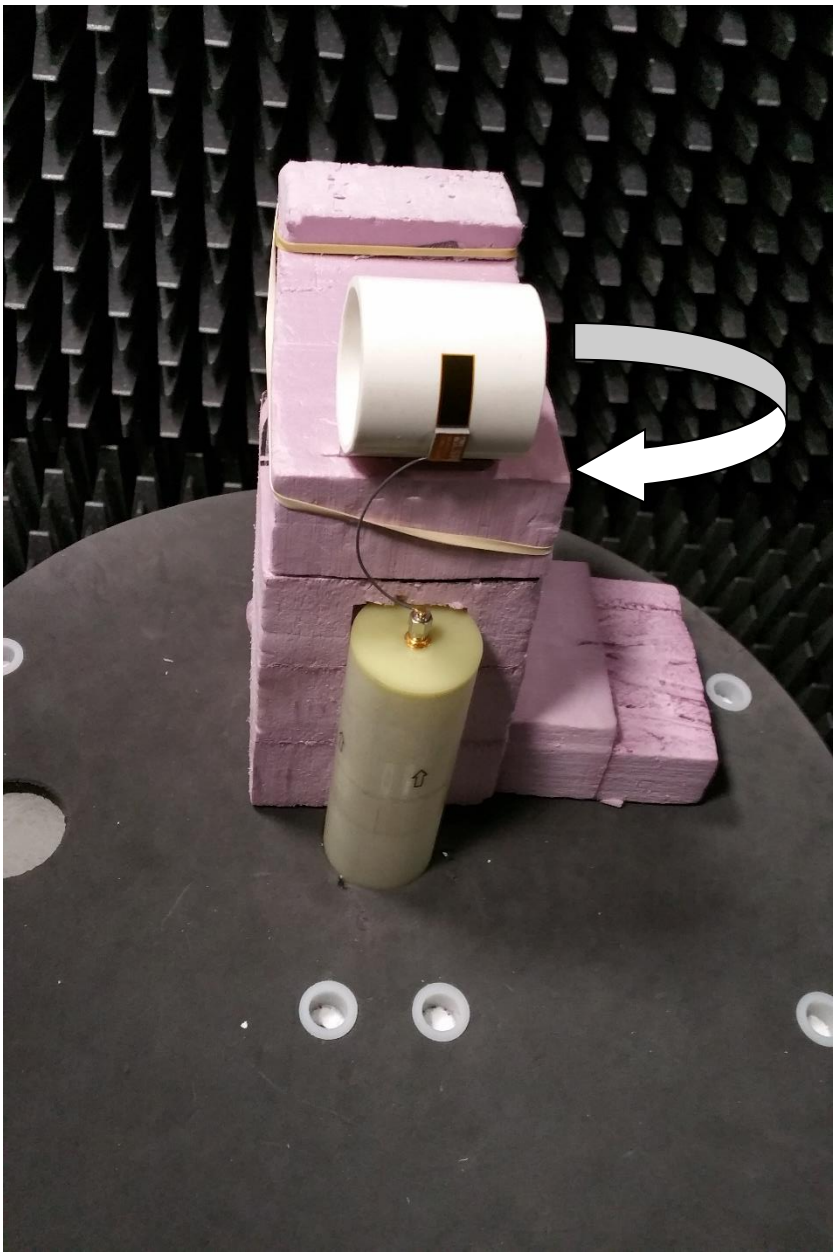


Figure 14 Convex Curve Set-Up

Azimuthal Conical Cuts at 2440 MHz:

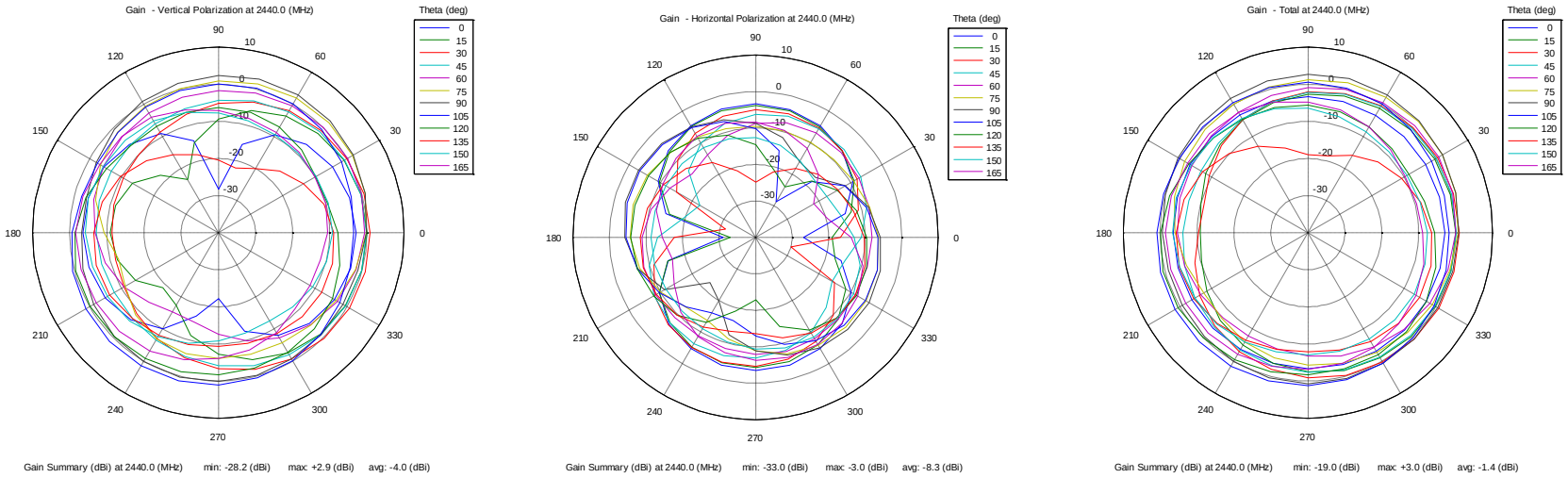


Figure 15 Vertical, Horizontal, and Total Gain Patterns

3D Plots at 2440 MHz:

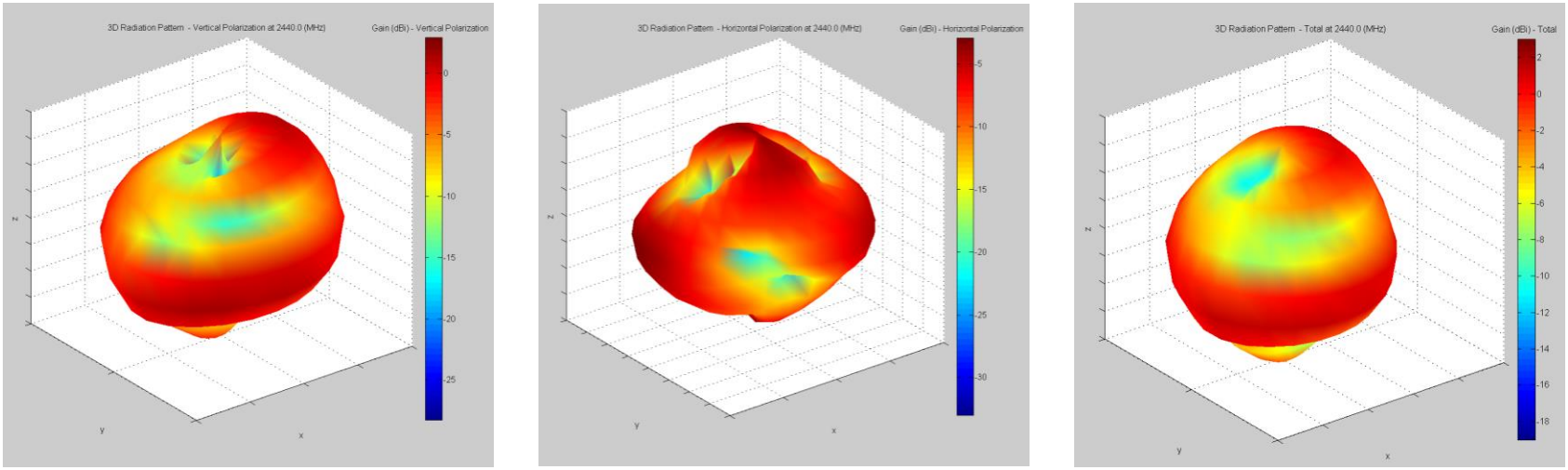


Figure 16 Vertical, Horizontal, and Total Gain Plots

OPTIMAL INSTALLATION GUIDE

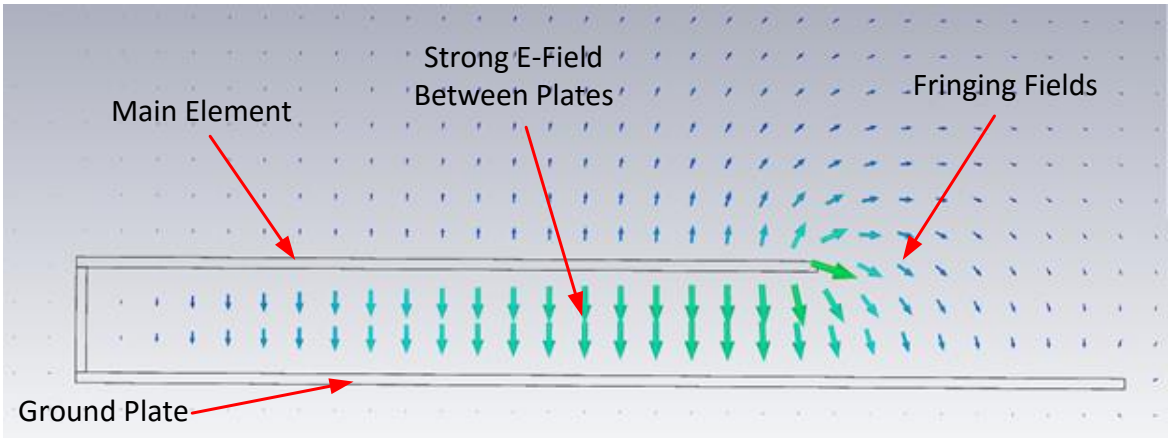


Figure 17 E-Field Radiation from FlexPIFA, Taken from CST Simulation

The main element should be kept clear of any non-metal objects (such as plastics) on top of it by at least 3 mm (see **Figure 18**). Similarly, the two long sides of the FlexPIFA should be kept clear of any non-metal object by at least 2 mm (See **Figure 19**). A 1 mm clearance should be observed from the ground wall to any non-metal object. Mounting the FlexPIFA in a situation that does not allow for these clearance recommendations may change the gain characteristics stated in the datasheet, which could impact overall range of the wireless system.

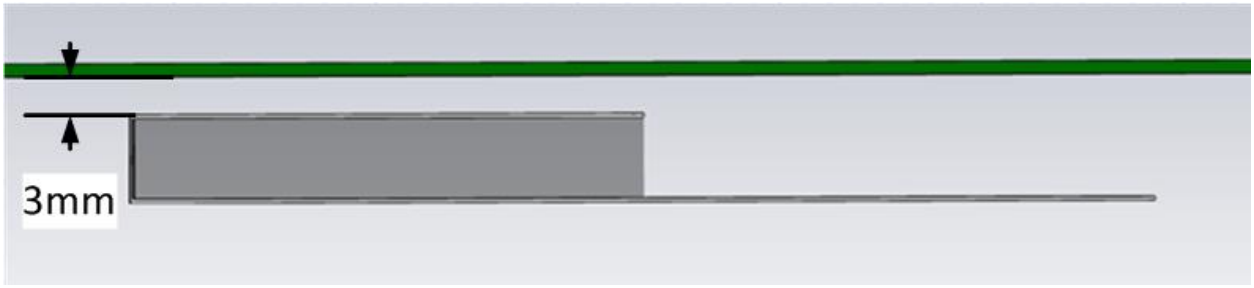
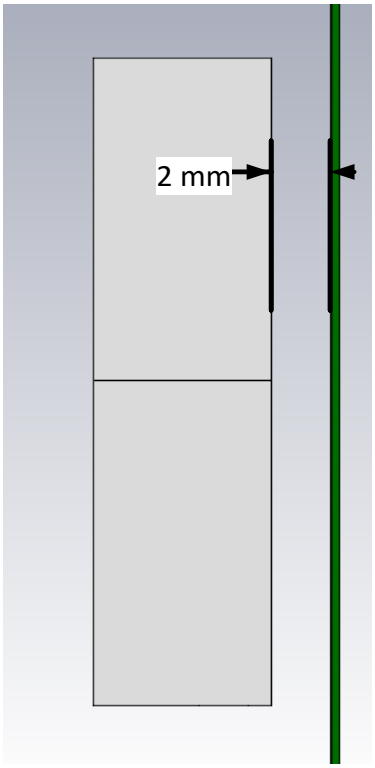
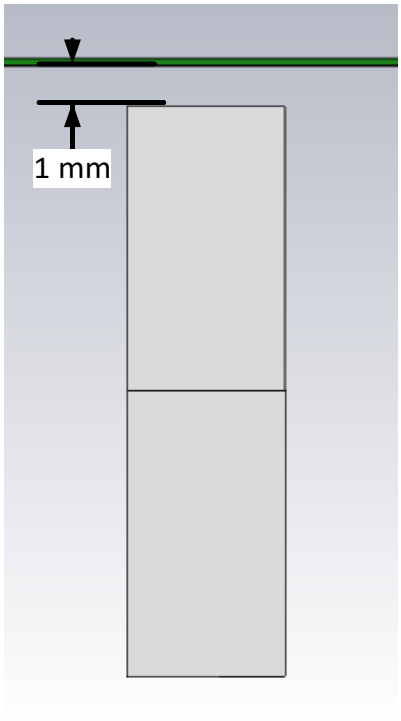


Figure 18 Top Clearance



Side Clearance



Ground Wall Clearance

Figure 19 Side and Ground Wall Clearance

The ideal material for the FlexPIFA to be mounted on is 1.5 mm thick polycarbonate for maximum performance. However, as previously mentioned, the FlexPIFA can tolerate other non-metallic surfaces and thicknesses and still radiate effectively. Depending on the type of material, the FlexPIFA may be detuned.

The coaxial cable feeding the FlexPIFA should be routed away from the antenna. Do not run the coaxial cable over the top of the FlexPIFA or near the tip of the main element. The cable should be routed as shown in **Figure 20**.

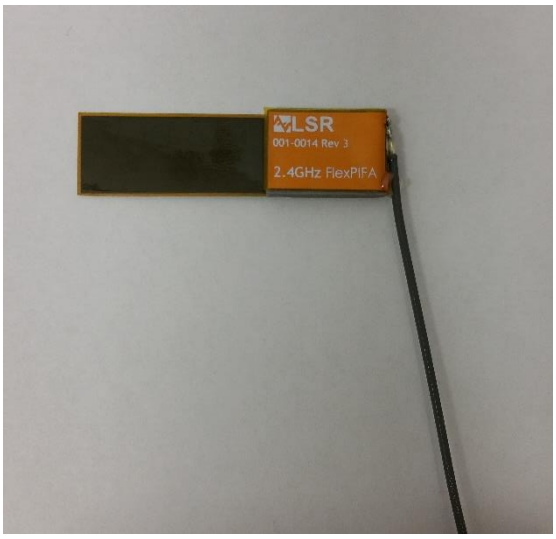


Figure 20 Recommended Cable Routing

As with any antenna, care should be taken not to place conductive materials or objects near the antenna (except as described in the next section). The radiated fields from the antenna will induce currents on the surface of the metal; as a result those currents then produce their own radiation. These re-radiating fields from the metal will interfere with the fields radiating from the FlexPIFA (this is true for any antenna). Other objects, such as an LCD display, placed in close proximity to the antenna may not affect its tuning but it can distort the radiation pattern. Materials that absorb electromagnetic fields should be kept away from the antenna to maximize performance. Common things to keep in mind when placing the antenna:

Wire Routing

Speakers – these generate magnetic fields

Metal Chassis and Frames

Battery Location

Proximity to Human Body

Display Screen – these will absorb radiation

Paint – do not use metallic coating or flakes

Flex Limits of the FlexPIFA

One of the unique features of the FlexPIFA is its ability to flex. However, due to the adhesive there are limits as to how much the antenna can be flexed and remain secured to the device. The FlexPIFA should not be flexed in a convex position with a radius less than 16mm. Going smaller than this may result in the antenna peeling off the surface over time. Should a tighter radius of curvature be required, it is recommended you contact LSR for assistance.

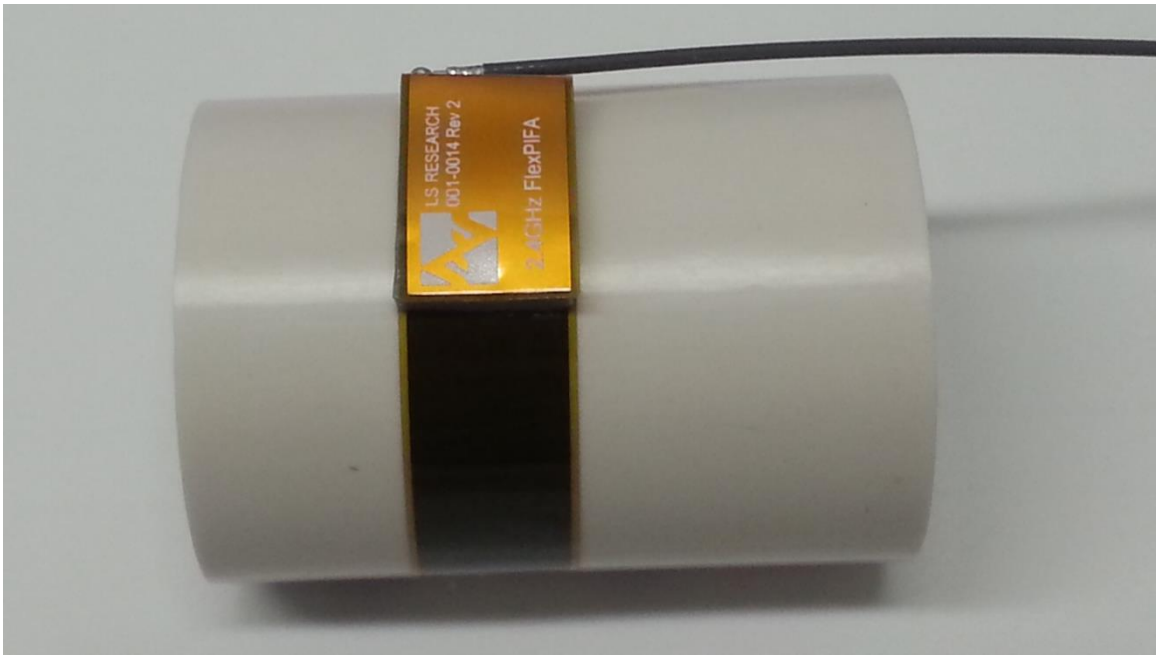


Figure 21 Convex Mounted

The FlexPIFA should not be flexed in a concave position with a radius less than 25mm. In this scenario, the limiting factor is performance. The ground plate of the antenna is pressed closer to the main element. As previously discussed in the introduction of this application note, the fringing fields developing off the end of the element are responsible for most of the radiation. In a concave position with a radius of curvature less than 25mm, the fringing fields are adversely affected and gain suffers. If a tighter radius of curvature is required, it is recommended you contact LSR for assistance.

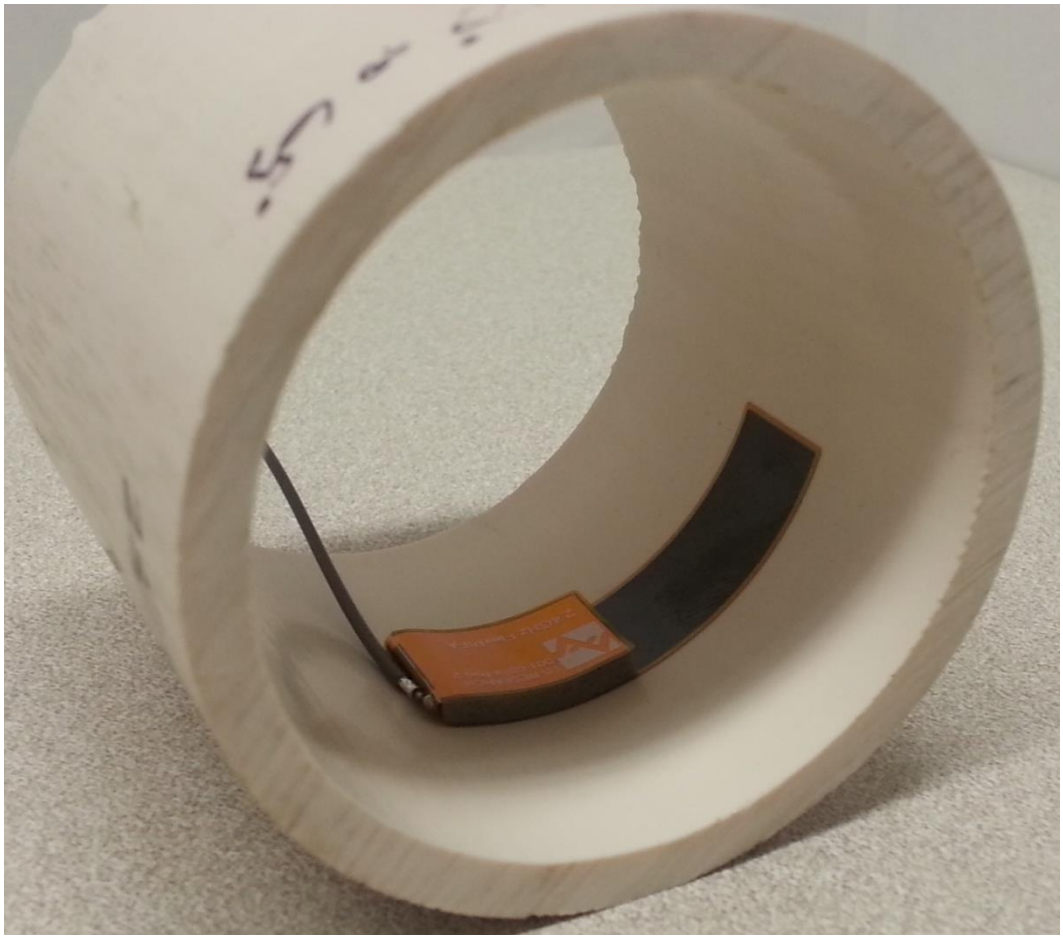


Figure 22 Concave Mounted

The FlexPIFA is not designed to be twisted or crumpled. The adhesive back should lay flush with the surface it is mounted on.

Mounting on Metal and Body Loaded Applications

The FlexPIFA can tolerate being mounted on conductive surfaces. There will be some detuning of the antenna, which translates into some gain reduction. Even though the FlexPIFA is optimized to work on non-metallic surfaces, it still radiates efficiently due to the fringing fields (Shown in **Figure 17**). The ground plate of the FlexPIFA carries the adhesive backing; placing the antenna onto a metal surface simply enlarges the size of the ground beneath the main element. Previously the fringing fields only interacted with the small ground of the FlexPIFA - however they are now interacting with the much larger ground. The fringing fields still develop and radiate, but the antenna will no longer tune as well to the 2.4 GHz frequency band. Consequently the VSWR increases and there is some loss in radiated power. If the FlexPIFA cannot meet your range requirements after being implemented on a metal surface, contact LSR Design Services for a custom antenna build to help meet your application needs.

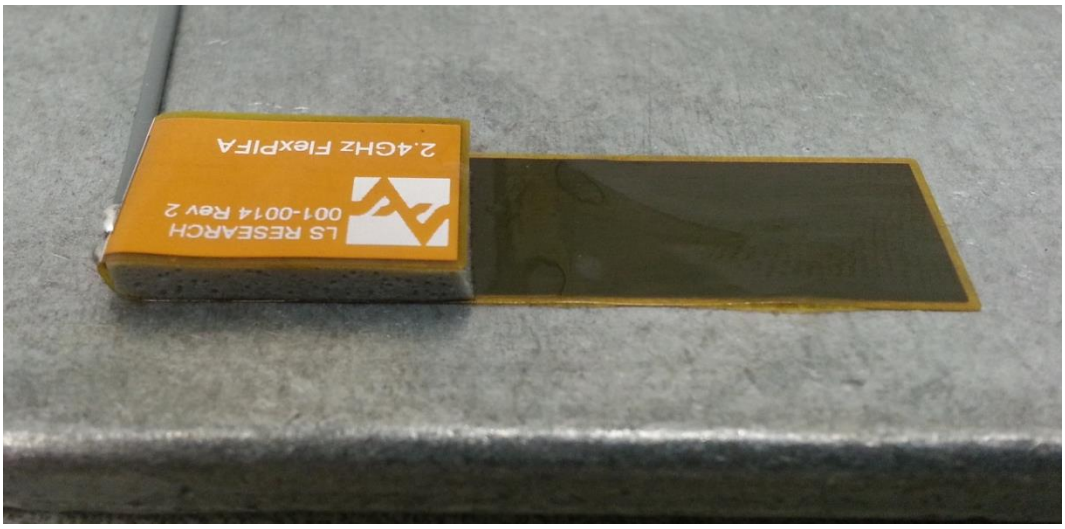


Figure 23 FlexPIFA Mounted on Metal

Do not mount the FlexPIFA where metal is within 10 mm above the main element (see **Figure 25**). Not only will this severely limit the radiation pattern (mainly due to the re-radiation problem previously described) it will detune the antenna inside of this range. Similarly, the two long sides of the FlexPIFA should be kept clear of any metal object by at least 5 mm. These keep out requirements pertain to **conductive** materials only, and are different from those listed in the previous sections which apply to **non-conductive** materials. In general, it is good practice to always keep metals as far away from the antenna as possible.

For the best performance, a spacer should be placed between the FlexPIFA and the conductive surface (see **Figure 24**). The spacer should be 1.5 mm thick polycarbonate. This will significantly improve performance and tuning of the FlexPIFA on a metal surface. Other non-conductive materials such as ABS plastic can be used; however polycarbonate will provide the best results.

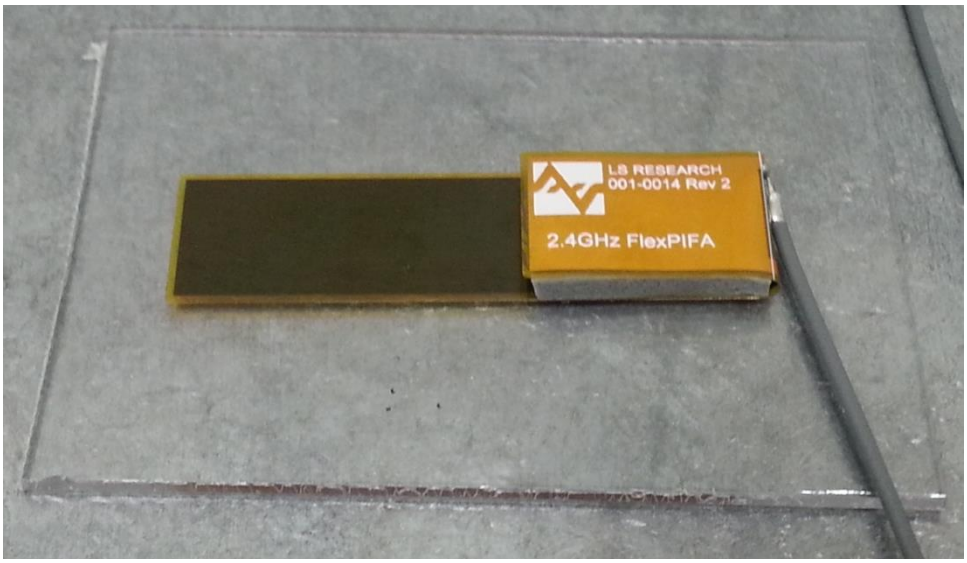


Figure 24 FlexPIFA Mounted on Metal Surface with 1.5mm Thick Polycarbonate Spacer

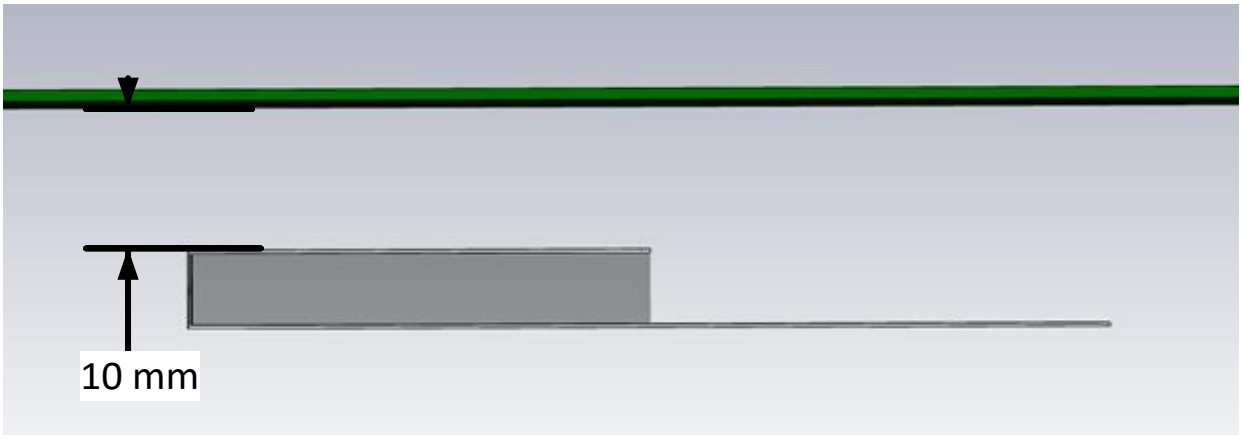


Figure 25 Metal near Main Element

For body worn applications, the FlexPIFA can tolerate the presence of the human body. It is not recommended that the antenna be mounted directly on body tissue, this will detune the FlexPIFA. Additionally the human body is an excellent absorber of 2.4GHz RF signals. As a result of this, expect a reduction in range due to the presence of a body. In a body worn application, the ground plate of the FlexPIFA should be closest to the body tissue. The main element should be pointed away from the body. Additionally, for handheld devices the FlexPIFA should be mounted in a location where it will not be covered by the hand. If the antenna is mounted in a location where the main element will be covered or near a human body, ensure that there is at least a 10mm separation distance between the main element and the body as shown in **Figure 25**. Additionally, when the FlexPIFA is mounted very close to body tissue, use a spacer to create separation distance between the body tissue and ground plate. This will ensure maximum performance and prevent the antenna from detuning. As previously mentioned, the ideal spacer material is 1.5 mm thick polycarbonate.

Quite often this separation distance between the body tissue and the FlexPIFA is already provided by the enclosure. **Figure 26** below is an example of a bracelet with the FlexPIFA integrated inside it. The enclosure provides enough spacing between the antenna and body tissue to prevent any major detuning. The enclosure is made of polycarbonate.

Figure 26 FlexPIFA Integrated into Bracelet

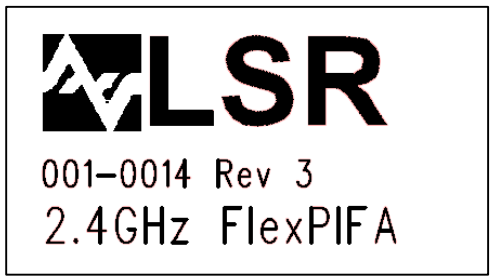
PRODUCT REVISION HISTORY

001-0014 (U.FL Connector)

Rev 1: Pre-Production Release

Rev 2: Initial Release

Rev 3: Changed Exposed Area of Solder Pads (Improve Soldering), Applying UV Glue (Strengthen Cable Joint) and increased top length from 15.2mm to 16.6mm – Silkscreen Side of FPC (Improve Tuning)



001-0022 (MHF4L Connector)

Rev 1: Initial Release

CONTACTING LSR

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Technical Support	forum.lsr.com
Sales Contact	sales@lsr.com

2.4 GHz – 2.5 GHz FlexNotch 2 dBi Antenna w/U.FL Cable, 100mm

ORDERING INFORMATION

Order Number	Description
001-0015	2.4 GHz FlexNotch Antenna w/U.FL Cable, 100mm
001-0023	2.4GHz FlexNotch Antenna w/ MHF4L Cable, 100mm

Table 1 Orderable Part Numbers

KEY FEATURES

- Can be installed on flat or curved surfaces.
- Simple custom options with trimming length.
- Quick and easy Installation
- Flexible, ultra-low profile
- RoHS Compliant
- Adhesive holds to surface during humidity exposure and hot/cold cycles

SPECIFICATIONS

Specification	Value
Peak Gain	+2 dBi
Average Gain	>-1.6 dBi
Impedance	50 ohms
Type	Flexible Notch
Polarization	Linear
VSWR	< 2.5:1, 2400 - 2480 MHz
Frequency	2400 – 2480 MHz
Weight	0.85g
Size	32.0mm × 21.08mm
Antenna Color	Clear Yellow
Adhesive	3M 100MP
Operating Temp	-40°C to +85°C

Table 2 Specifications

PHYSICAL DIMENSIONS (MM)

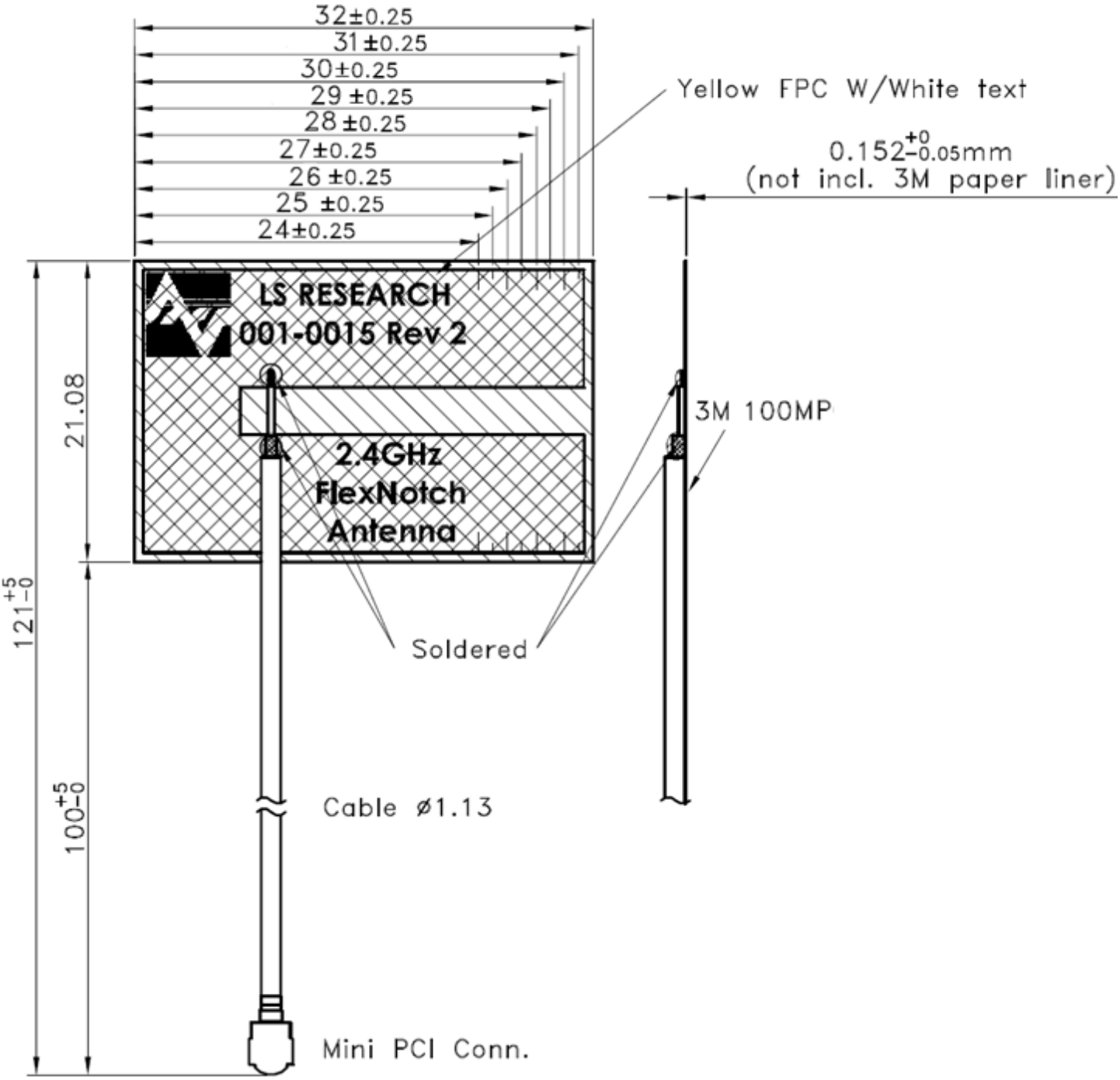


Figure 1 Physical Dimensions

TEST SETUP

Antenna measurements such as VSWR were measured with an Agilent E5071C Vector Network Analyzer. Radiation patterns were measured with an Agilent 5181A Signal Generator and Agilent E4445A Spectrum Analyzer in a 3 meter Anechoic Chamber.

Flat surface measurements were done with the antenna centered on a 1.5 mm thick plate of Polycarbonate.

FLAT SURFACE ANTENNA MEASUREMENTS

VSWR

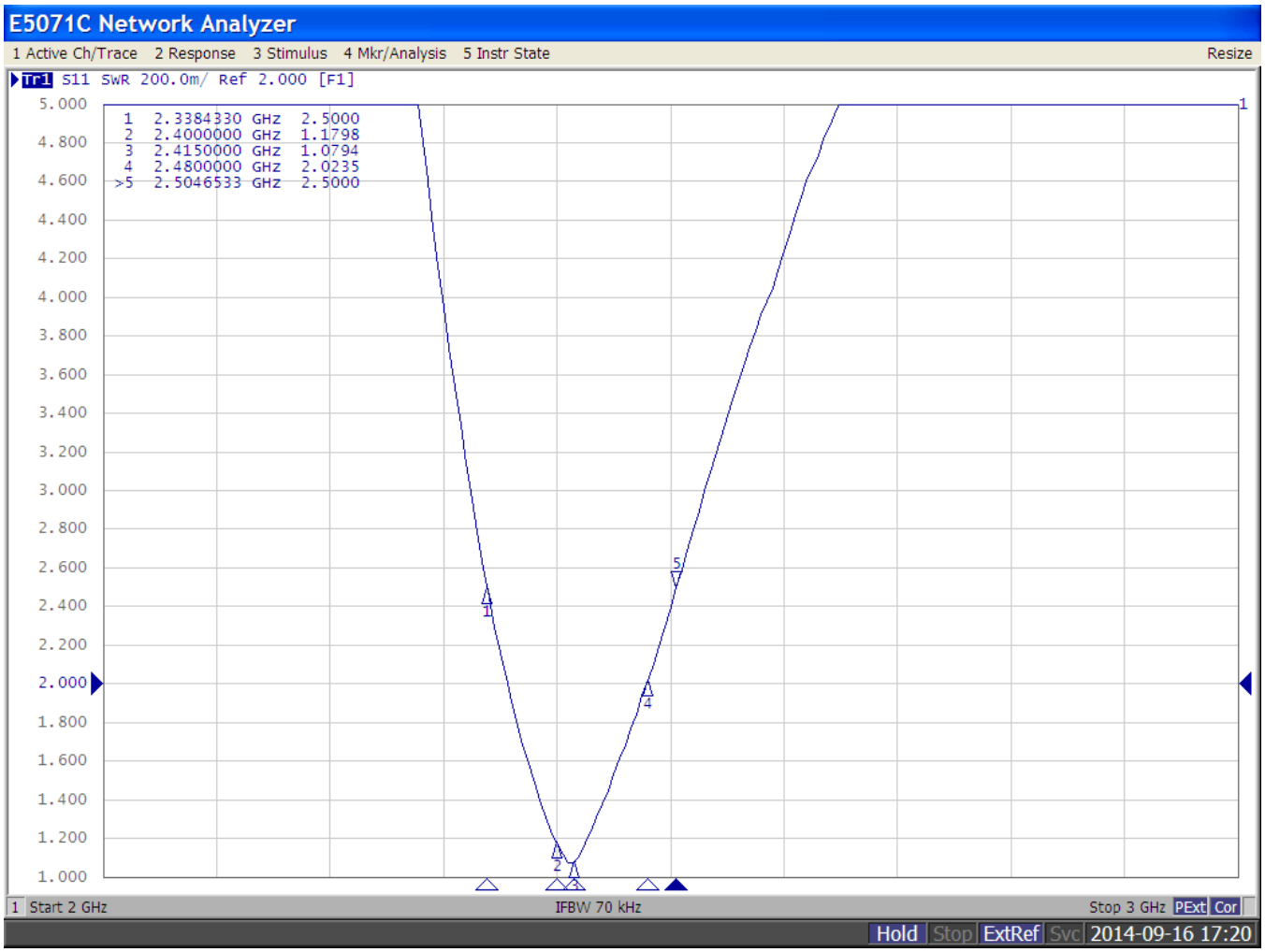


Figure 2 Antenna VSWR measured on a 1.5 mm thick plate of Polycarbonate

FLAT SURFACE ANTENNA RADIATION PERFORMANCE

FlexNotch centered on a 1.5 mm thick plate of Polycarbonate

Antenna Measurement Set-Up

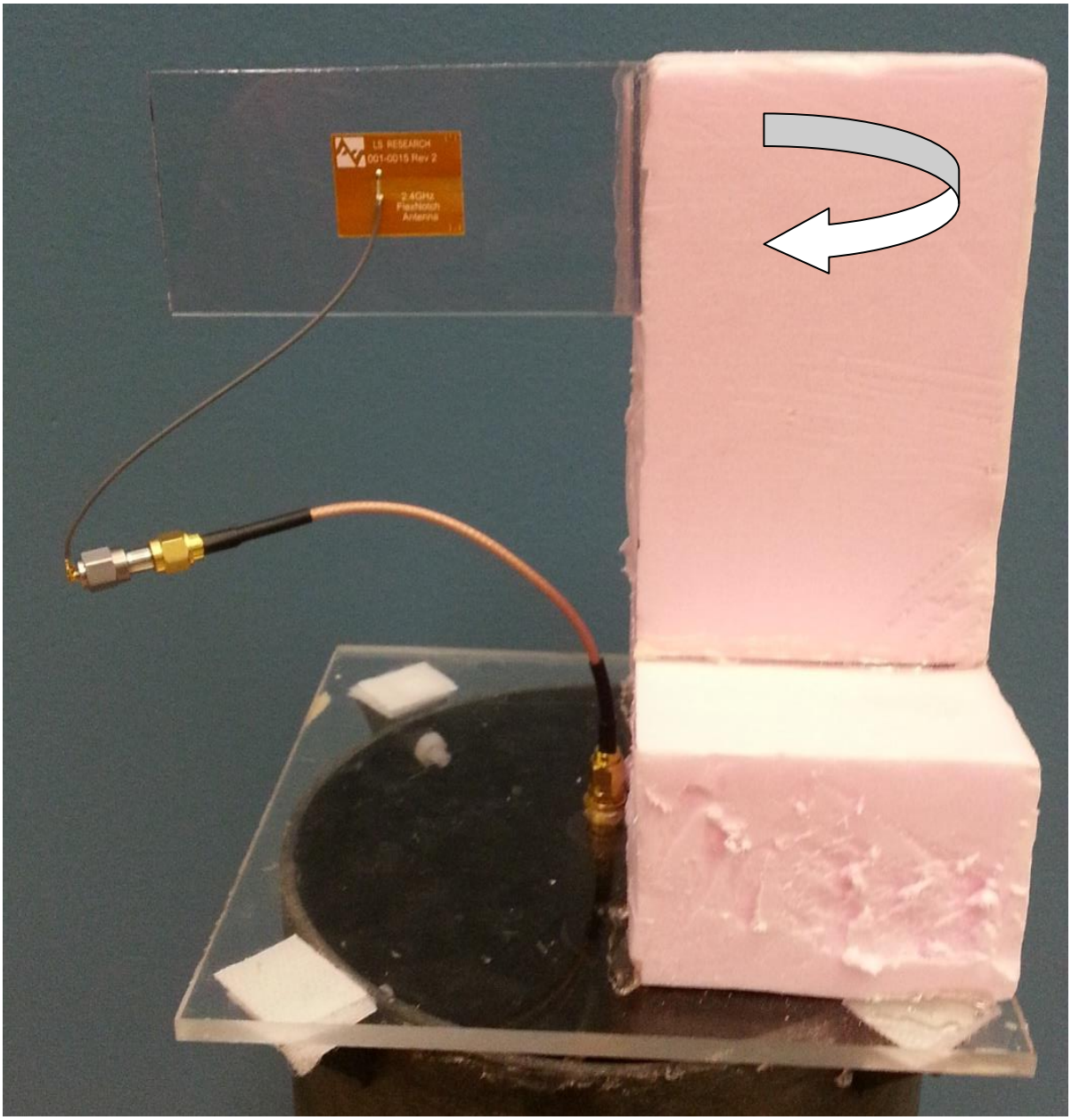


Figure 3 Horizontal Orientation Measurement

Horizontal Orientation at 2440 MHz:

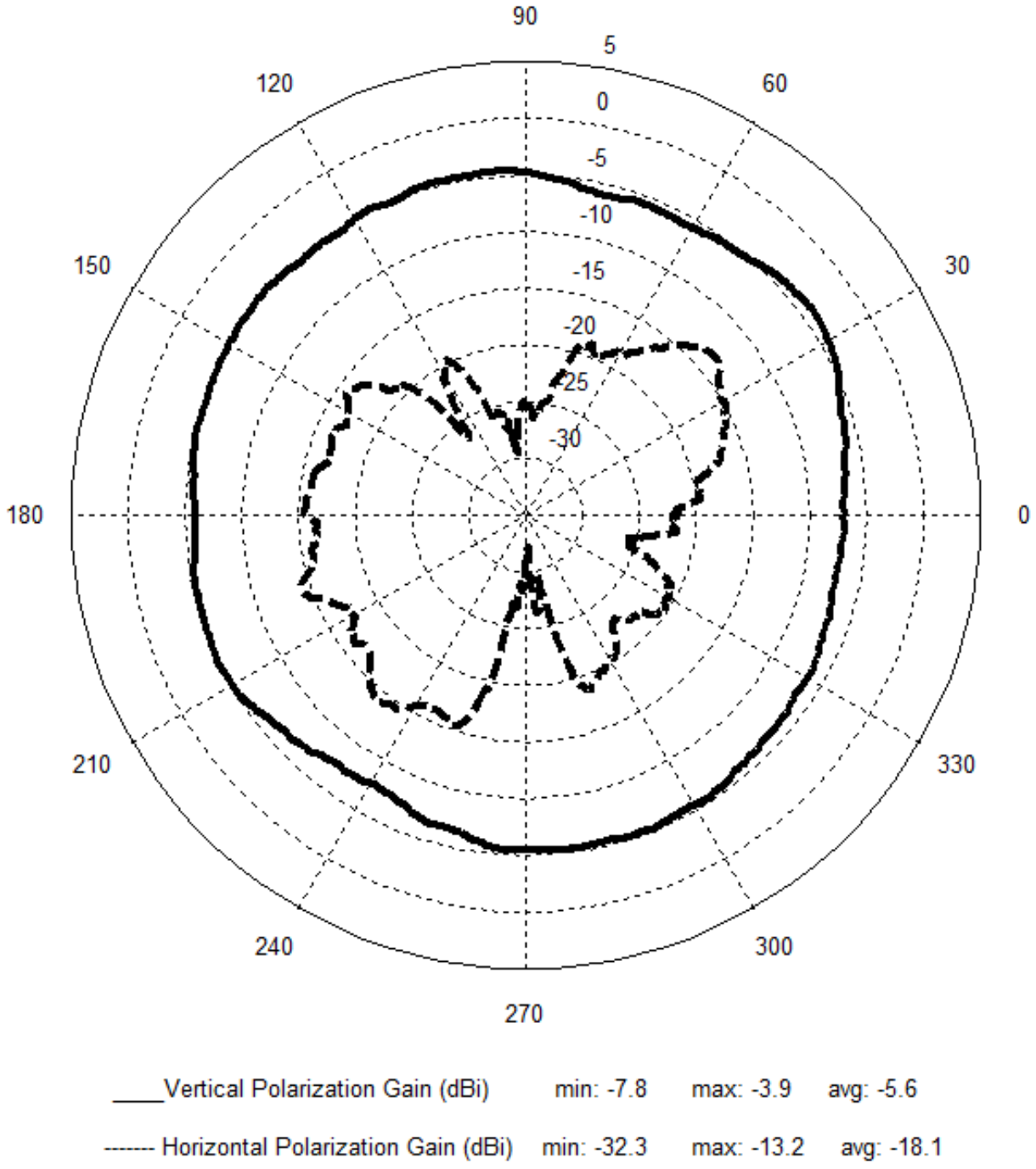


Figure 4 Horizontal Orientation Pattern

Antenna Measurement Set-Up

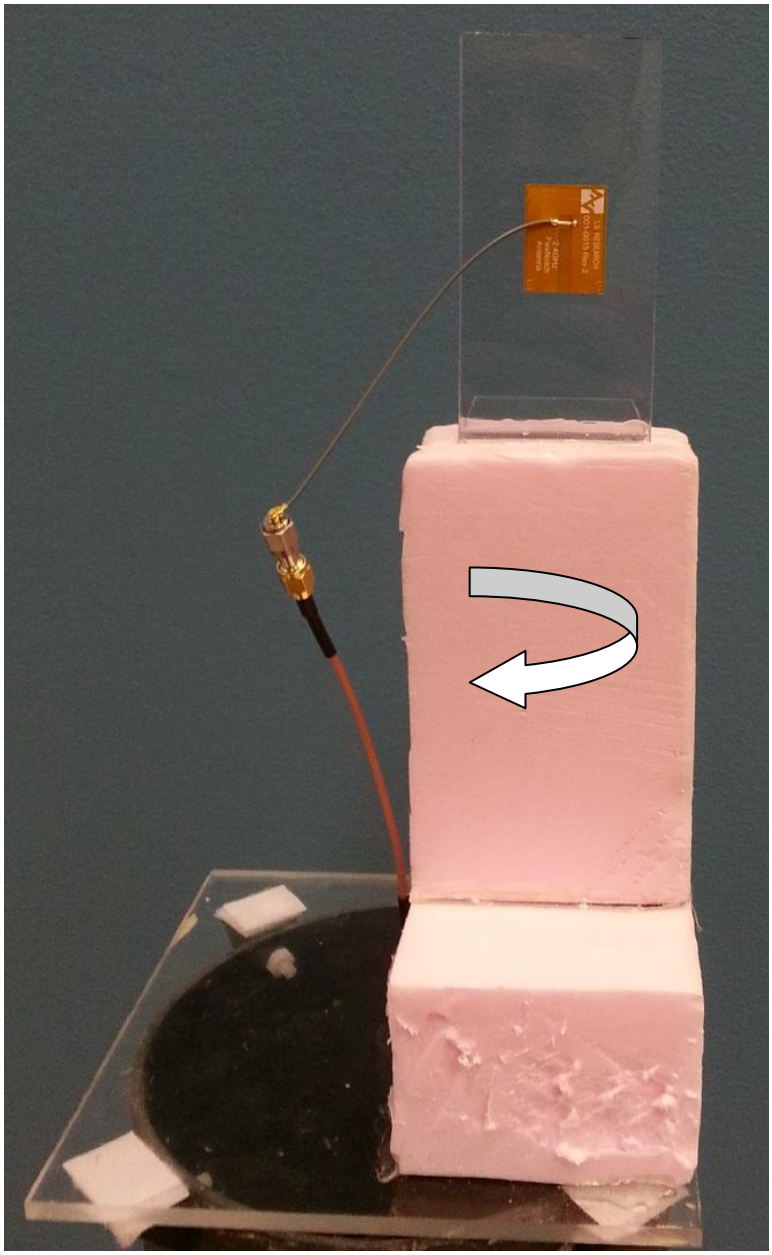


Figure 5 Vertical Orientation Measurement

Vertical Orientation at 2440 MHz:

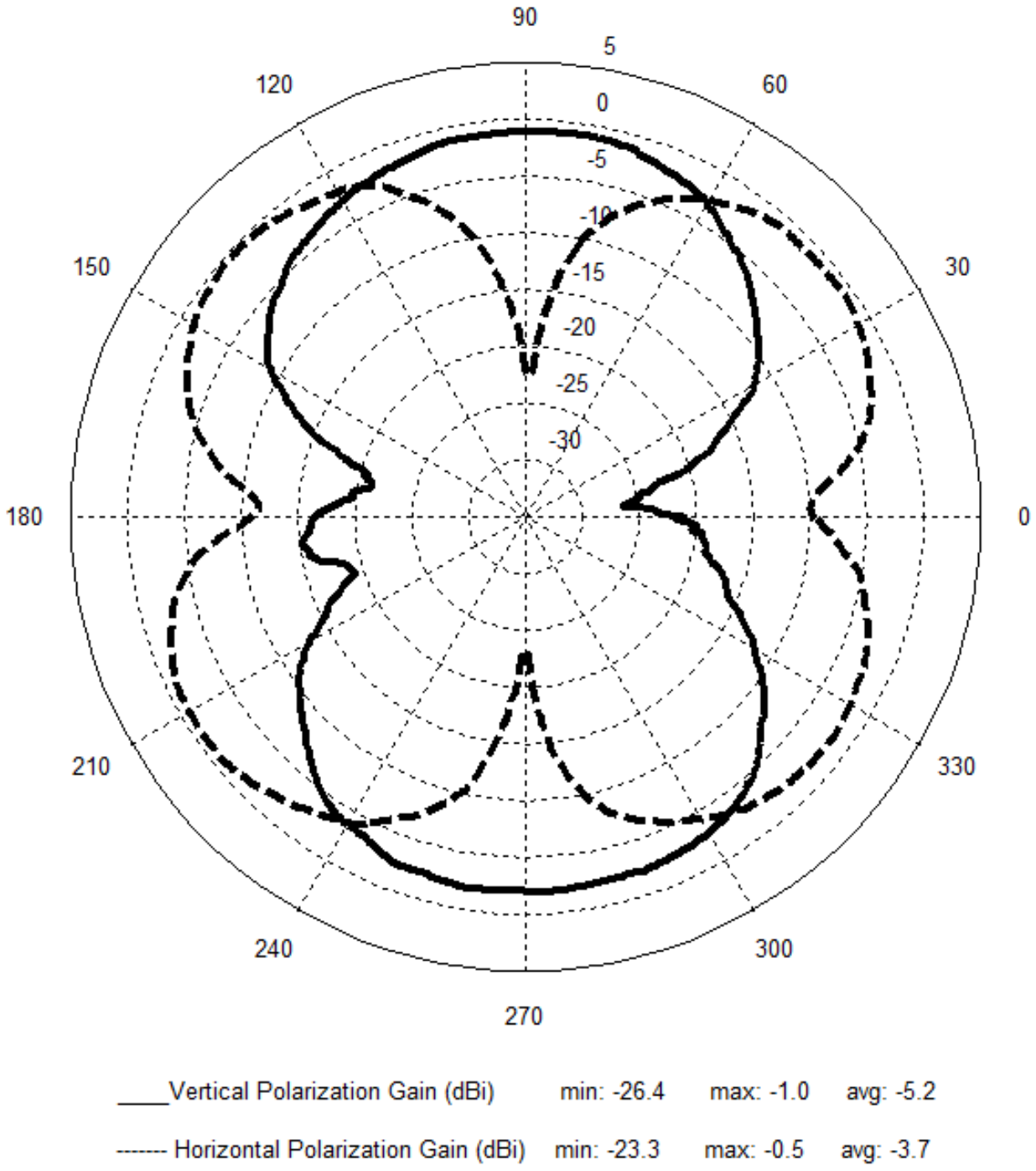


Figure 6 Vertical Orientation Pattern

Antenna Measurement Set-Up

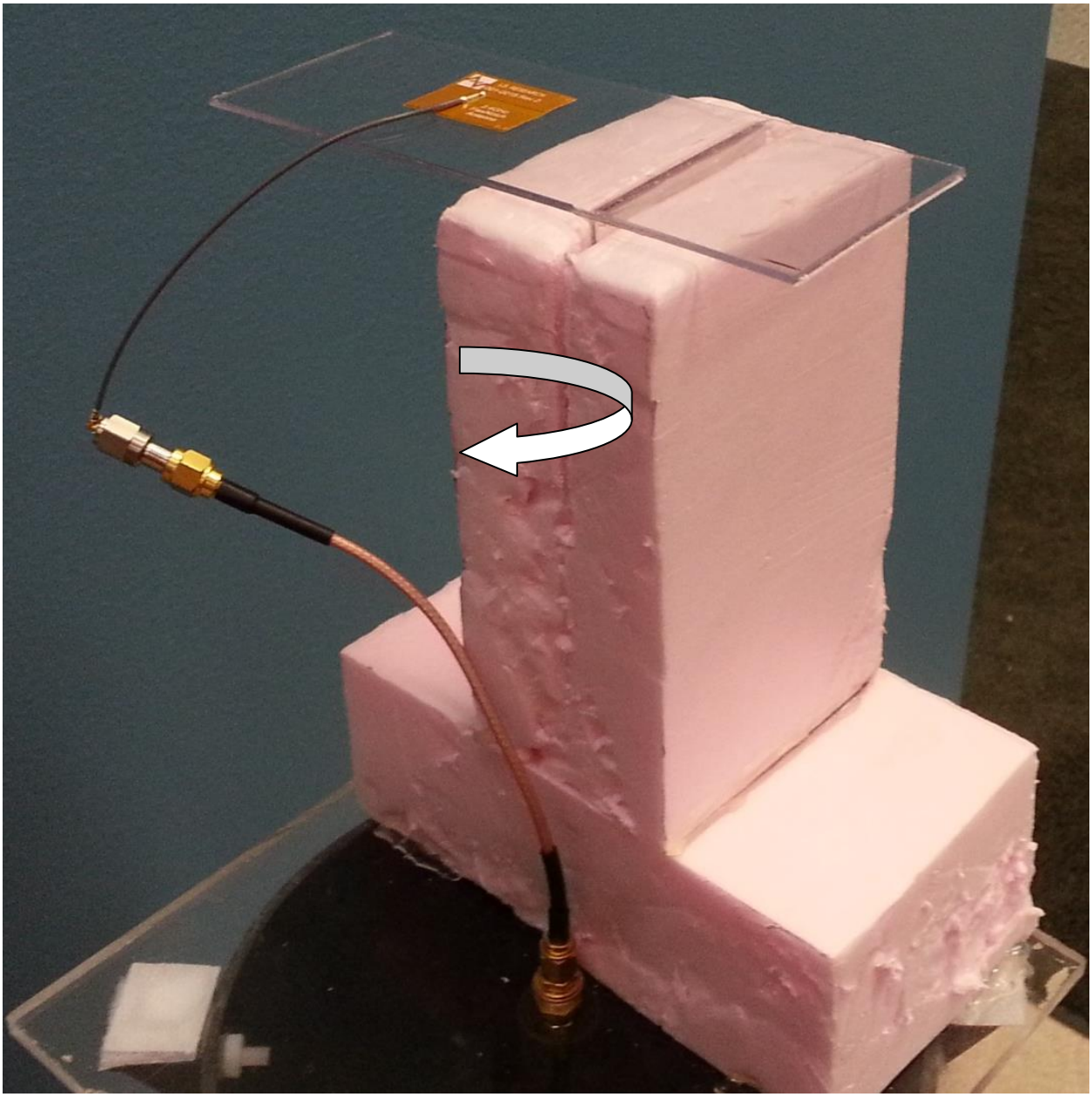


Figure 7 Flat Orientation Measurement

Flat Orientation at 2440 MHz:

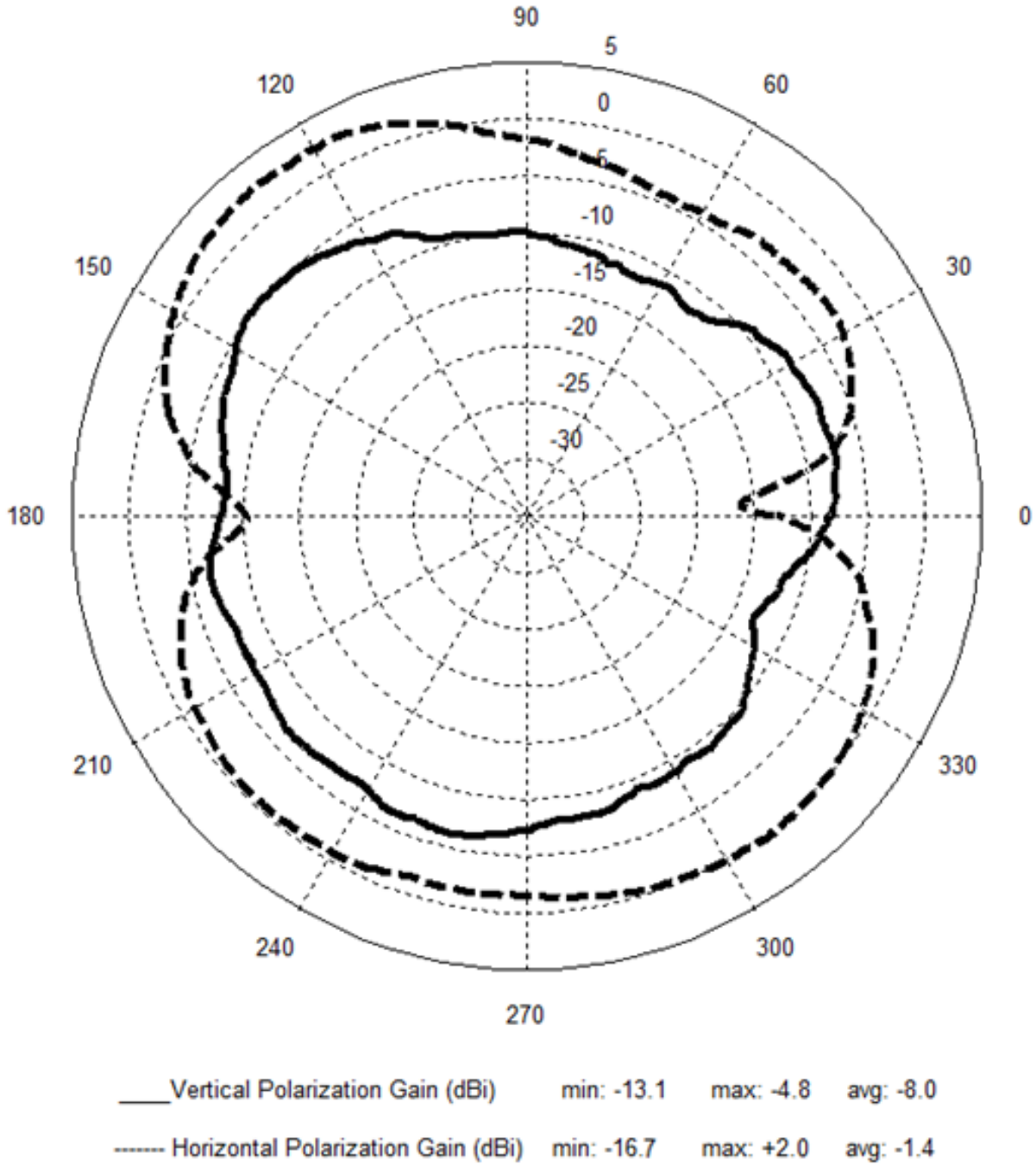


Figure 8 Flat Orientation Pattern

OPTIMAL INSTALLATION GUIDE

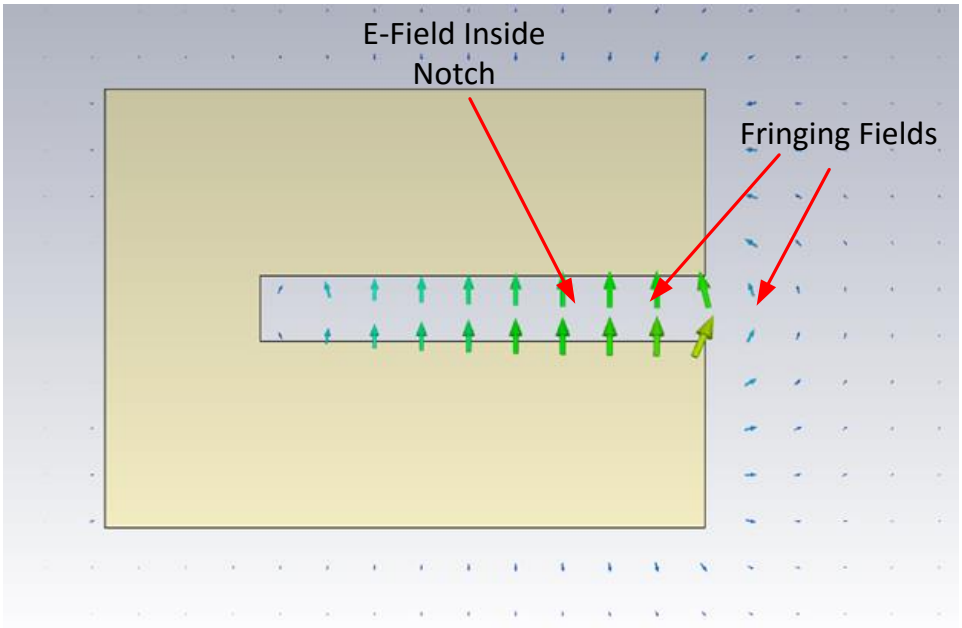


Figure 9 E-Field Radiation from FlexNotch, Taken from CST Simulation

The FlexNotch should be kept clear of any non-metal objects (such as plastics) on top of it by at least 5 mm (see **Figure 10**). Similarly, all four sides of the FlexNotch should be kept clear of any non-metal object by at least 1 mm (See **Figure 11** and **Figure 12**). Mounting the FlexNotch in a situation that does not allow for these clearance recommendations may change the gain characteristics stated in the datasheet, which could impact overall range of the wireless system.

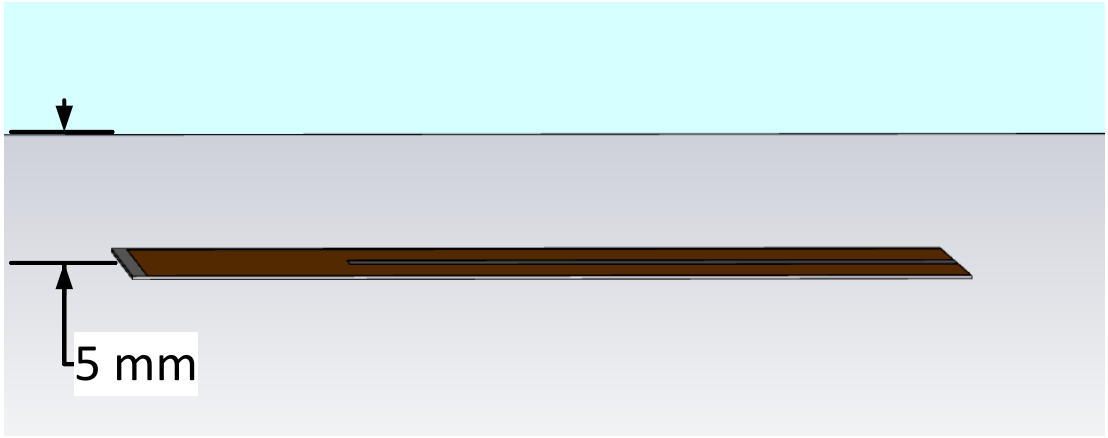
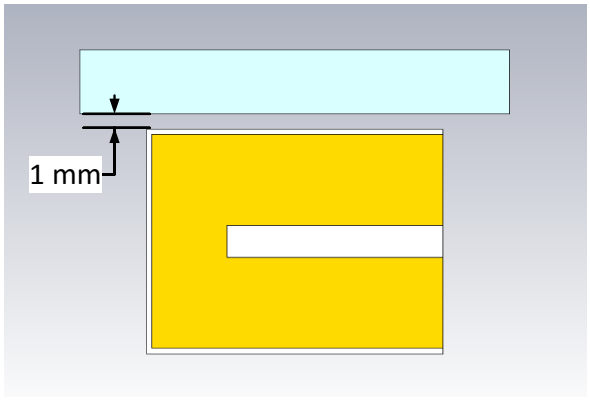
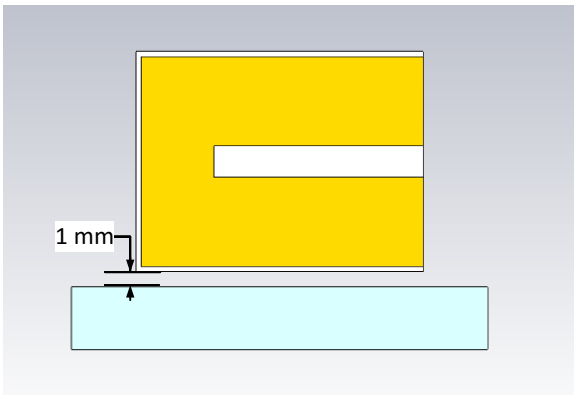


Figure 10 Above FlexNotch Clearance

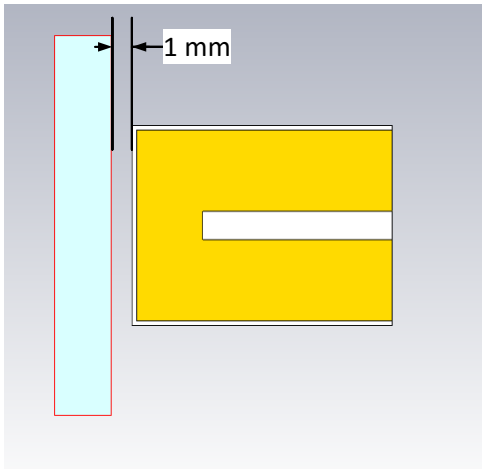


Top Clearance

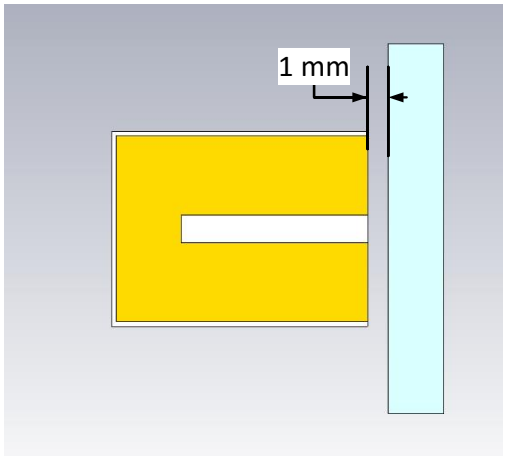


Bottom Clearance

Figure 11 Top and Bottom Clearance



Left 'Cold' Side Clearance

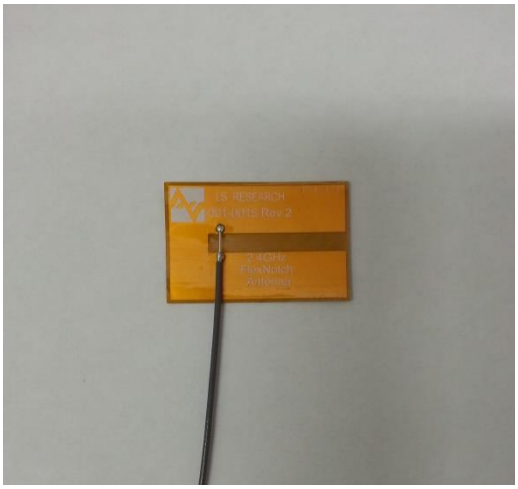


Open Side Clearance

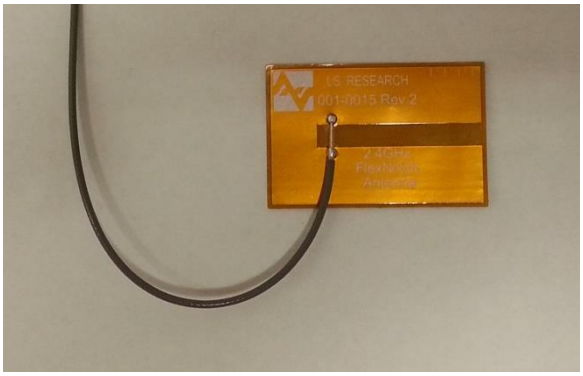
Figure 12 Open Side Clearance

The ideal material for the FlexNotch to be mounted on is 1.5 mm thick polycarbonate; this will result in maximum performance. If the FlexNotch is mounted on a different material, the tuning will change. This can cause a decrease in performance. LSR can retune the FlexNotch for specific implementations and different materials on request.

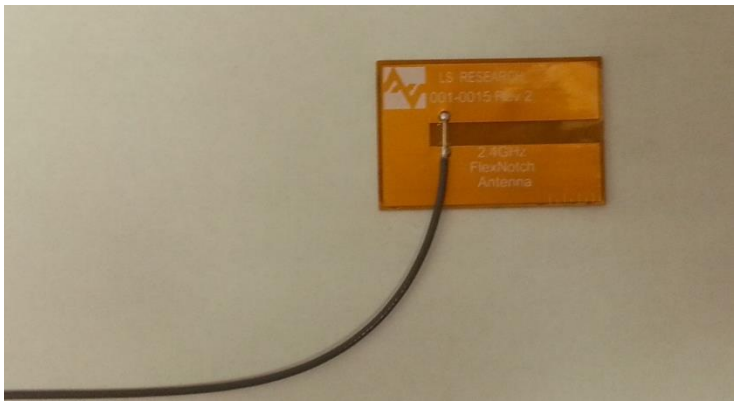
The coaxial cable feeding the FlexNotch should be routed away from the antenna. Do not run the coaxial cable above the FlexNotch or near the open end of the notch. The cable should be routed perpendicular to the side of the FlexNotch (this is the way the cable comes assembled), around the cold side, or away from the ground wall. All three of these options are shown in **Figure 13**.



Perpendicular to the side



Around the ‘Cold’ Side



Away from the Notch wall

Figure 13 Recommended Cable Routing

As with any antenna, care should be taken not to place conductive materials or objects near the antenna. The radiated fields from the antenna will induce currents on the conductive surface; as a result those currents then produce their own radiation. These re-radiating fields from the metal will interfere with the fields radiating from the FlexNotch (this is true for any antenna). Other objects, such as an LCD display, placed in close proximity to the antenna may not affect its tuning but it can distort the radiation pattern. Materials that absorb electromagnetic fields should be kept away from the antenna to maximize performance. Common things to keep in mind when placing the antenna:

Wire Routing

Speakers – these generate magnetic fields

Metal Chassis and Frames

Battery Location

Proximity to Human Body

Display Screen – these will absorb radiation

Paint – do not use metallic coating or flakes

Flex Limits of the FlexNotch

One of the unique features of the FlexNotch is its ability to flex. However, due to the adhesive there are limits as to how much the antenna can be flexed and remain secured to the device. The FlexNotch should not be flexed in a convex position with a radius less than 16 mm. Going smaller than this may result in the antenna peeling off the surface over time. Should a tighter radius of curvature be required, it is recommended you contact LSR Design Services for assistance.

Figure 14 Convex Mounted

The FlexNotch should not be flexed in a concave position with a radius less than 16 mm. Similar to the restrictions on the convex position, potential exists for the adhesive to peel off over time if the FlexNotch is bent beyond a 16 mm radius. If a tighter radius of curvature is required, it is recommended you contact LSR for assistance. The FlexNotch is not designed to be twisted or crumpled. The adhesive back should lay flush with the surface it is mounted on.

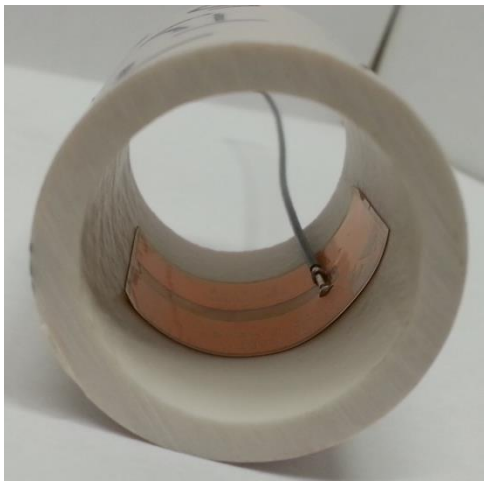


Figure 15 Concave Mounted

Mounting on Metal and Body Loaded Applications

The FlexNotch can tolerate being near conductive surfaces. A 1 mm clearance should be observed between the top, bottom, and cold sides of the FlexNotch from any metal (see **Figure 11**). Metal should be kept away from the open end of the FlexNotch by at least 10 mm. However, any metal in close proximity to the open end will disrupt the radiation pattern and could cause a decrease in antenna gain.

Keep any metal above the FlexNotch away by at least 10 mm; this will prevent the antenna from detuning. However this will still cause some distortion of the radiation pattern. **Do NOT mount the FlexNotch on a metal surface**.

These same guidelines also apply to body worn applications.

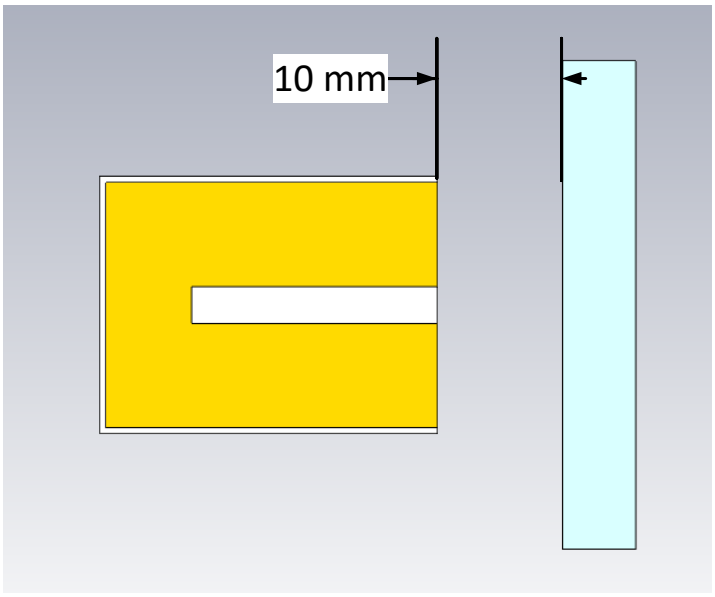


Figure 16 Open Side Metal Clearance

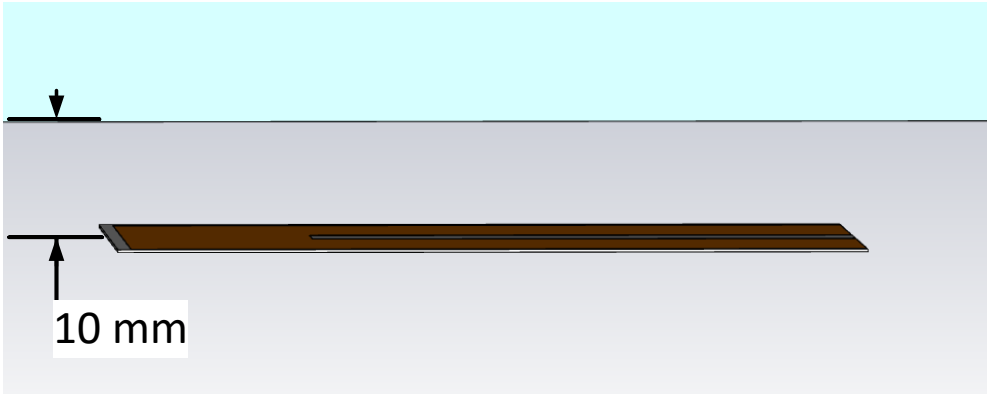


Figure 17 Above Notch Metal Clearance

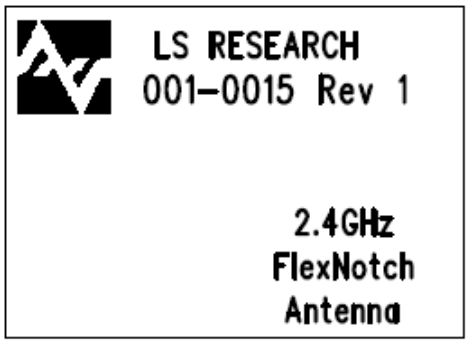
CUSTOMER SPECIFIC TUNING

LSR will assist with custom tuning of the antenna for your specific end product. Simply send LSR a sample of your enclosure or platform, and LSR will tune an antenna for you. LSR will send the results back indicating which trim mark the antenna should be cut to, to optimize performance. You then trim the antennas at time of assembly to the indicated hash mark, and stick to your product.

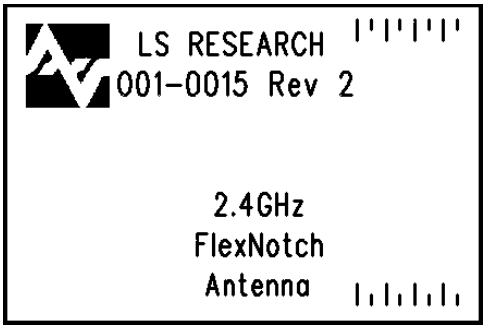
PRODUCT REVISION HISTORY

001-0015 (U.FL Connector)

Rev 1: Initial Production Release



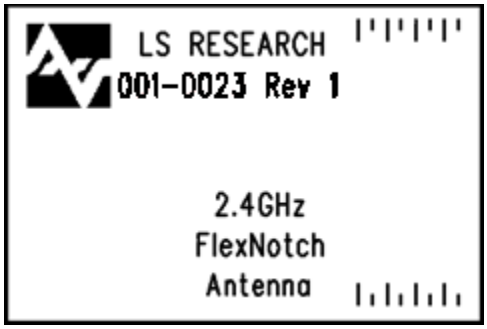
Rev 2:



- Added Cut Hash Marks in intervals of 1 mm (Small Mark) and 2 mm (Large Mark)

001-0023 (MHF4L Connector)

Rev 1: Initial Production Release



CONTACTING LSR

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Fax: 1(262) 375-4248

Website www.lsr.com

Technical Support forum.lsr.com

Sales Contact sales@lsr.com

APPROVAL SHEET
(RoHS)

CUSTOMER	:	**Laird**
CUSTOMER'S PART NO.	:	
DESCRIPTION	:	**RF ANTENNA ASSEMBLY**
PART NO.	:	**EDA-8709-2G4C1-B27-CY**
DATE	:	
AUTHORIZED BY	:	*Marco Hsu*

	FULLY APPROVED	PARTIALLY APPROVED	REJECTED
SIGN			
SUGGESTION			

美磊科技股份有限公司

MAG. LAYERS SCIENTIFIC-TECHNICS CO., LTD

HEAD OFFICE / HSINCHU PLANT

No 18, Tz-Chiang Road, Hsin-Chu Industrial Park, Hsin-Chu, Taiwan

TEL: +886-3-5972488 FAX: +886-3-5972477

http://www.maglayers.com.tw

E-mail：info@maglayers.com.tw

Contents

RF Antenna Assembly Specification

ELECTRICAL PROPERTIES

1.1	Frequency Range……	2.4GHz ~2.5GHz
1.2	Impedance……	50 Ohm Nominal
1.3	VSWR……	2 (Max)
1.4	Return Loss……	-10dB (Max)
1.5	Radiation……	Omni-directional (Only Antenna)
1.6	Gain(peak)……	2.0dBi (Only Antenna)
1.7	Cable Loss……	0.7dB
1.8	Polarization……	Linear Vertical
1.9	Admitted Power……	1W

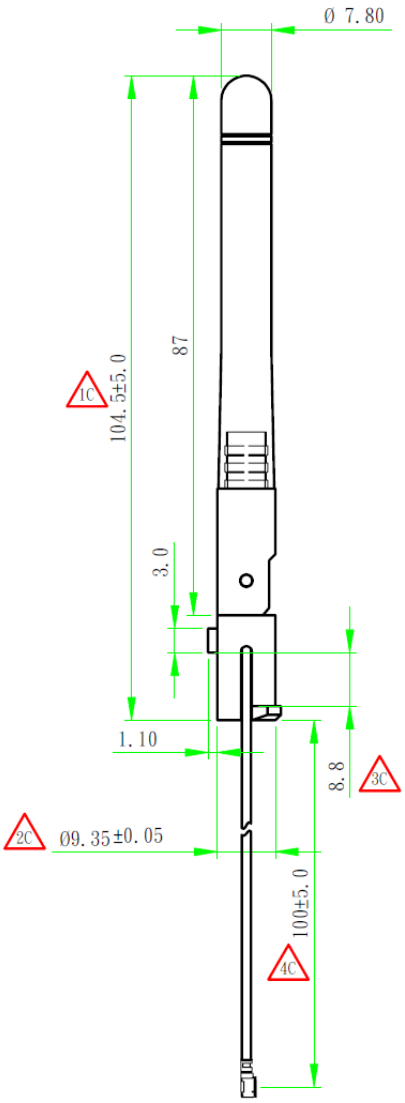
PHYSICAL PROPERTIES

2.1	Cable……	§ 1.13 Black
2.2	Antenna Cover……	TPEE
2.3	Antenna Base……	PC/PBT
2.4	Operating Temp……	-25℃ ~ +75℃
2.5	Storage Temp……	-30℃ ~ +75℃
2.6	Color……	Black
2.7	Connector……	IPEX Compatible(MHF4)

Mechanical Specification

LTR	DESCRIPTION	DATE	REQ. BY
A	NEW Release	12/05/12'	HWCHAN

RoHS COMPLIANT



MECHANICAL
Antenna Cover : TPEE
Antenna Base : PC/PBT
Color: Black

ELECTRICAL
Frequency : 2.4GHz
Cable : Coaxial Cable 1.13(Black)
Connector : IPEX Compatible(MHF4)

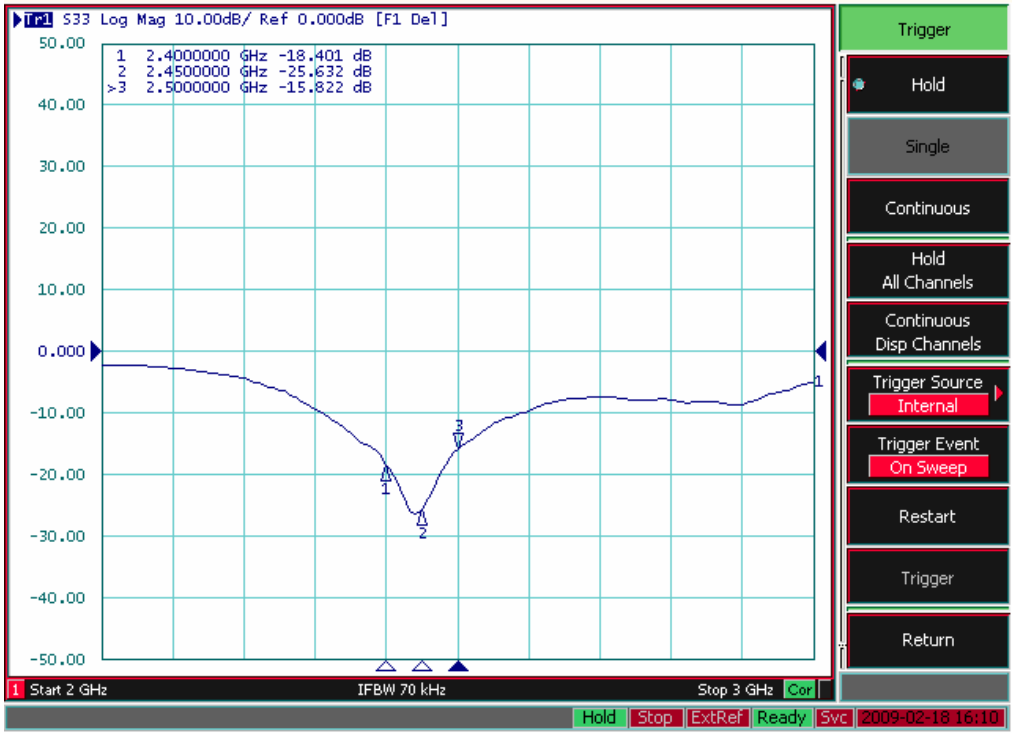
※凡標記△C記號者，為品管檢驗之尺寸

設計 DR. HWCHAN 2012/12/05	核准 APPD. Marco 2012/12/05	容許公差 TOLERANCE .XXX ±0.20 .XX ±0.35 .X ±0.50 X ±1.00 ANG ±5	品名 ARTICLE EDA-8709-2G4C1-B27
版本說明 REVISION NOTE			
MAGLAYERS			單位 UNIT: mm / 比例 SCALE: **** / 張數 SHEET: 1 / 版本 REV.: A

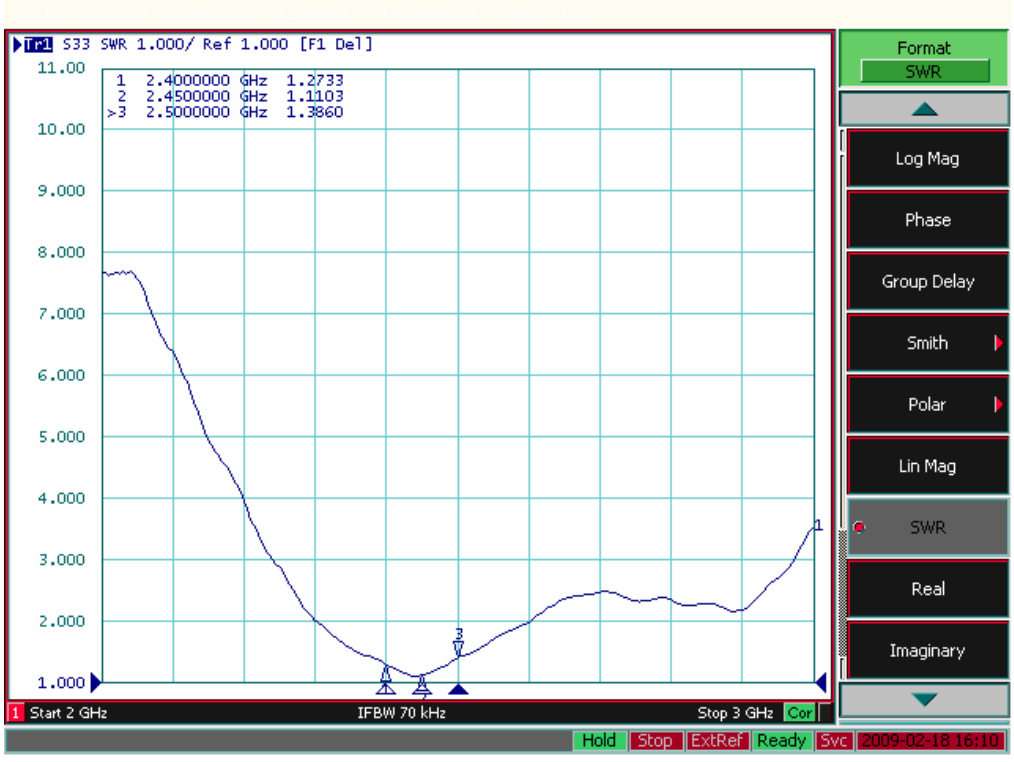
ELECTRICAL CHARACTERISTICS

P/NO: EDA-8709-2G4C1-B27
Spec: 2.4 GHz ~2.5GHz

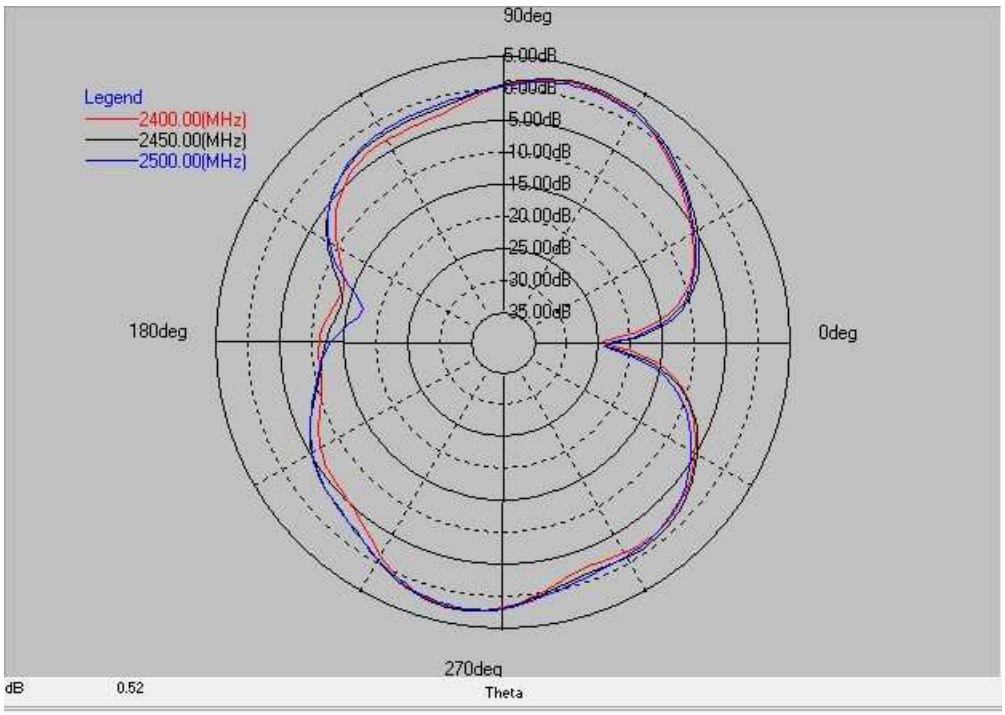
S11



VSWR

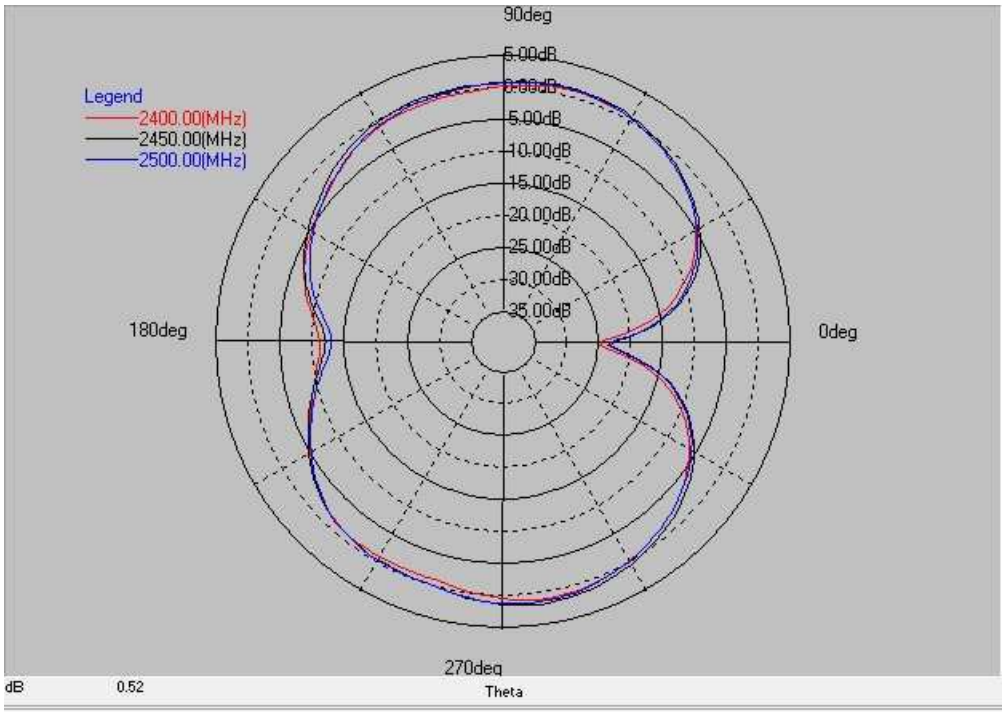


Frequency(MHz)：**2400~2500.**　　Pattern Field：**X-Z plane**



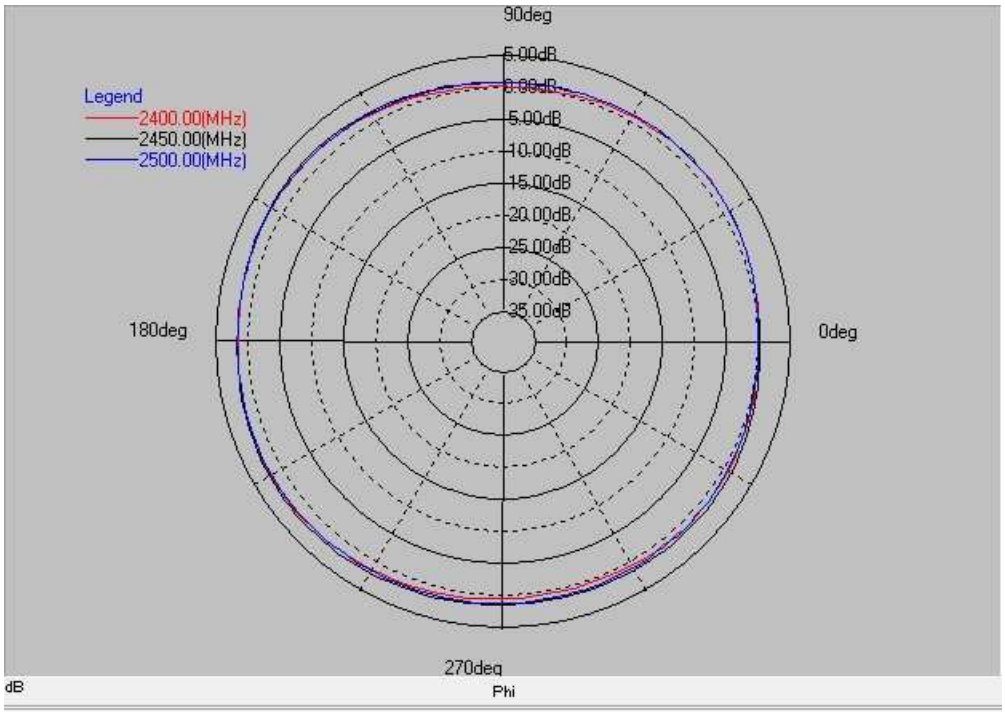
Layer	Max value	Min value	Average
2400(MHz)	2.05 dB	-24.34 dB	-2.61 dB
2450(MHz)	2.25 dB	-23.80 dB	-2.07 dB
2500(MHz)	2.16 dB	-24.13 dB	-2.29 dB

Frequency(MHz)：**2400~2500.**　Pattern Field：**Y-Z plane**



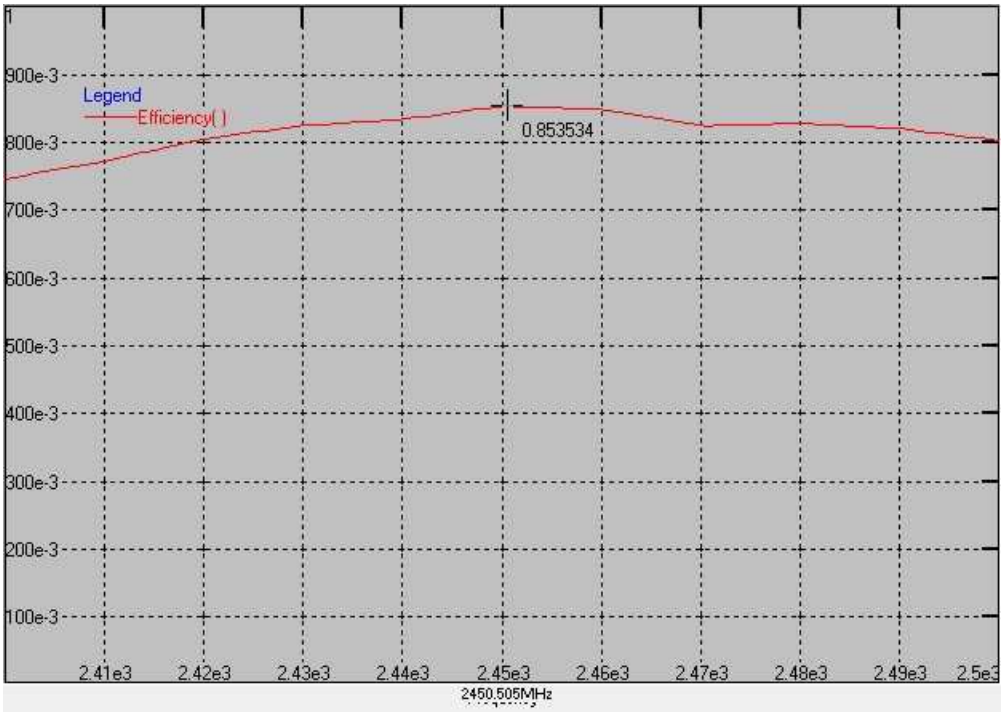
Layer	Max value	Min value	Average
2400(MHz)	0.89 dB	-24.94 dB	-2.45 dB
2450(MHz)	1.59 dB	-23.09 dB	-1.85 dB
2500(MHz)	1.30 dB	-23.44 dB	-2.16 dB

Frequency(MHz)：**2400~2500.**　Pattern Field：**X-Y plane**



Layer	Max value	Min value	Average
2400(MHz)	2.12 dB	-0.06 dB	1.02 dB
2450(MHz)	2.32 dB	0.34 dB	1.40 dB
2500(MHz)	1.91 dB	0.16 dB	1.15 dB

Antenna Efficiency



Maximum Efficiency At 2.4~2.5GHz: 85.35%

Datasheet

mFlexPIFA

2.4 – 2.5 GHz mFlexPIFA +2 dBi Antenna, 100 mm cable length with U.FL or MHF4 connector

Version 2.1

REVISION HISTORY

Version	Date	Notes	Contributors	Approver
2.0	15 Aug 2017	Initial Release on website		Sue White
2.1	20 Mar 2018	Added new antenna connector information; transitioned to new template; updated contact information		Jay White

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

CONTENTS

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

1 Ordering Information

Table 1: Ordering information

Order Number	Description
001-0030	mFlexPIFA – 2.4 GHz embedded metal FlexPIFA antenna, 100 mm cable length w/U.FL connector
EFA2400A3S-10MH4L	mFlexPIFA – 2.4 GHz embedded metal FlexPIFA antenna, 100 mm cable length w/MHF4 connector

2 Key Features

- Designed to be installed directly on metal
- Can be installed on different conductive surfaces and thicknesses
- Can be installed on flat or curved surfaces
- Quick and easy Installation
- Adhesive holds to surface during humidity exposure and hot/cold cycles
- RoHS compliant

3 Specifications

Table 2: mFlexPIFA specifications

Specification	Value
Peak Gain	+2 dBi
Average Gain	>-4.2 dBi
Impedance	50 ohms
Type	Flexible Planar Inverted F Antenna (FlexPIFA)
Polarization	Linear
VSWR	≤ 3.0:1, 2400 - 2480 MHz
Frequency	2400 - 2480 MHz
Weight	1.8 g
Size	25.4 mm × 23.4 mm × 2.5 mm
Antenna Color	Clear Yellow
Adhesive	3M 100MP
Operating Temp	-40°C to +85°C
Connector Height	U.FL: 2.5 mm maximum

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

4 Physical Dimensions

Note: All measurements are in millimetres (mm).

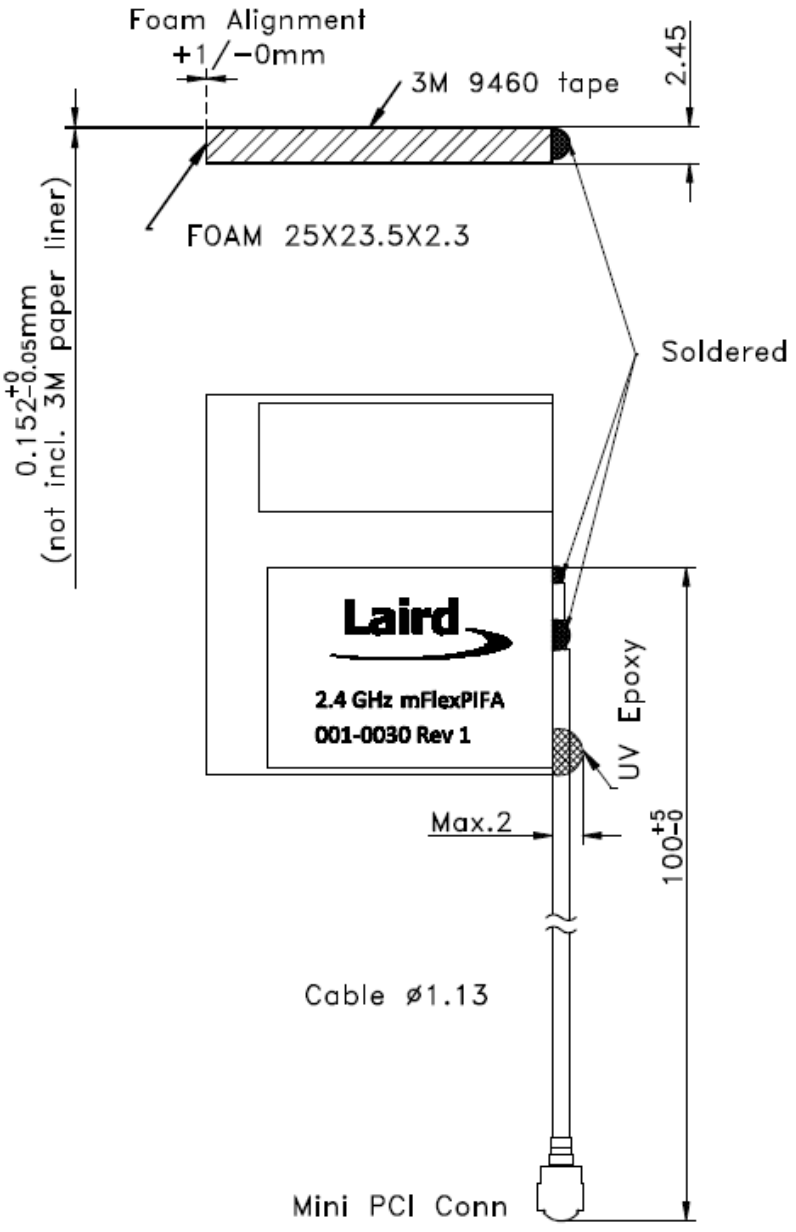


Figure 1: Physical dimensions

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

5 Test Setup

Antenna measurements such as VSWR are measured with an Agilent E5071C Vector Network Analyzer. Radiation patterns are measured with a CMT Planar 804/1 Vector Network Analyzer in a Howland Company 3100 Chamber equivalent. Phase Center is 9 inches above the Phi positioner.

Flat surface measurements are done with the antenna centered on a 100 x 100 mm, 0.35 mm thick brass plate. Curved surface measurements are taken by placing the antenna on a curved surface made of 0.35 mm thick brass.

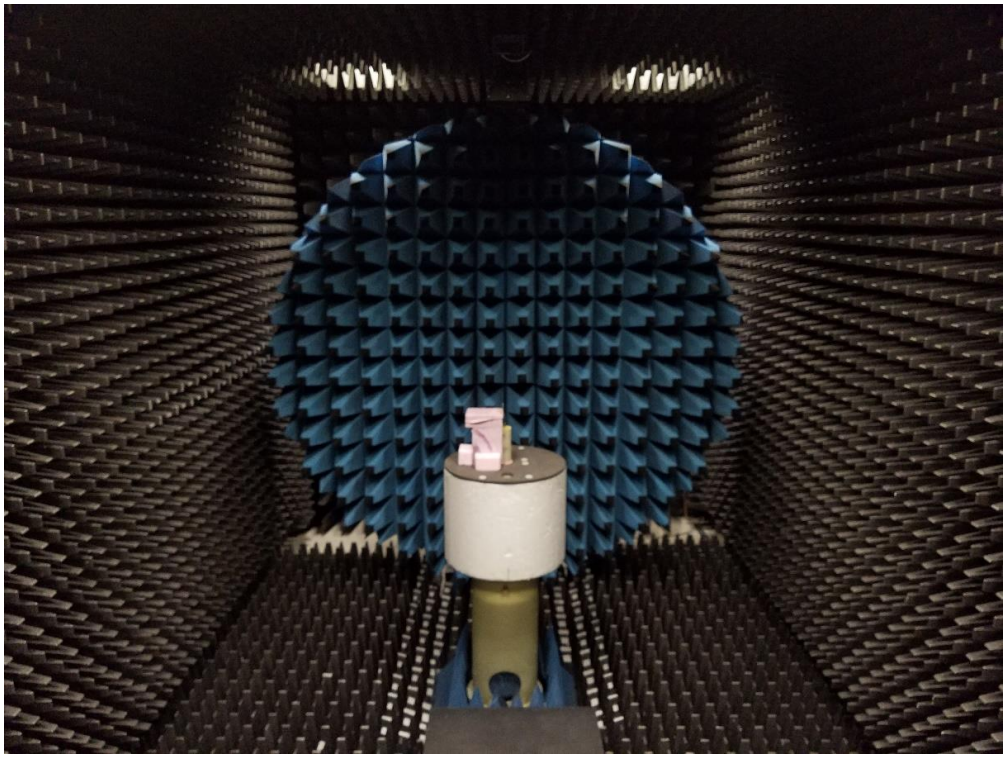


Figure 2 Antenna Chamber

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

6 Flat Surface Antenna Measurements

Return Loss

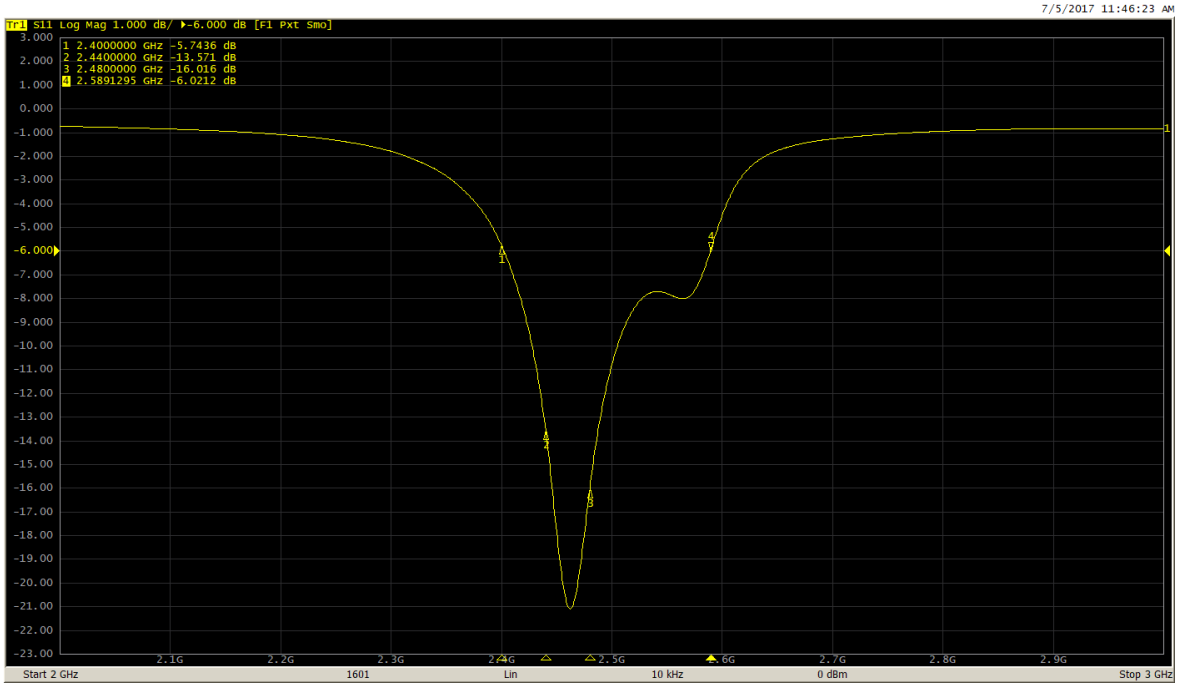


Figure 3: Return loss measured on a 0.35 mm thick, 100 x 100 mm brass plate

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Hong Kong: +852 2923 0610

7 Flat Surface Antenna Radiation Performance

7.1 Antenna Setup

The mFlexPIFA is centered on a 100 x 100 mm brass plate.

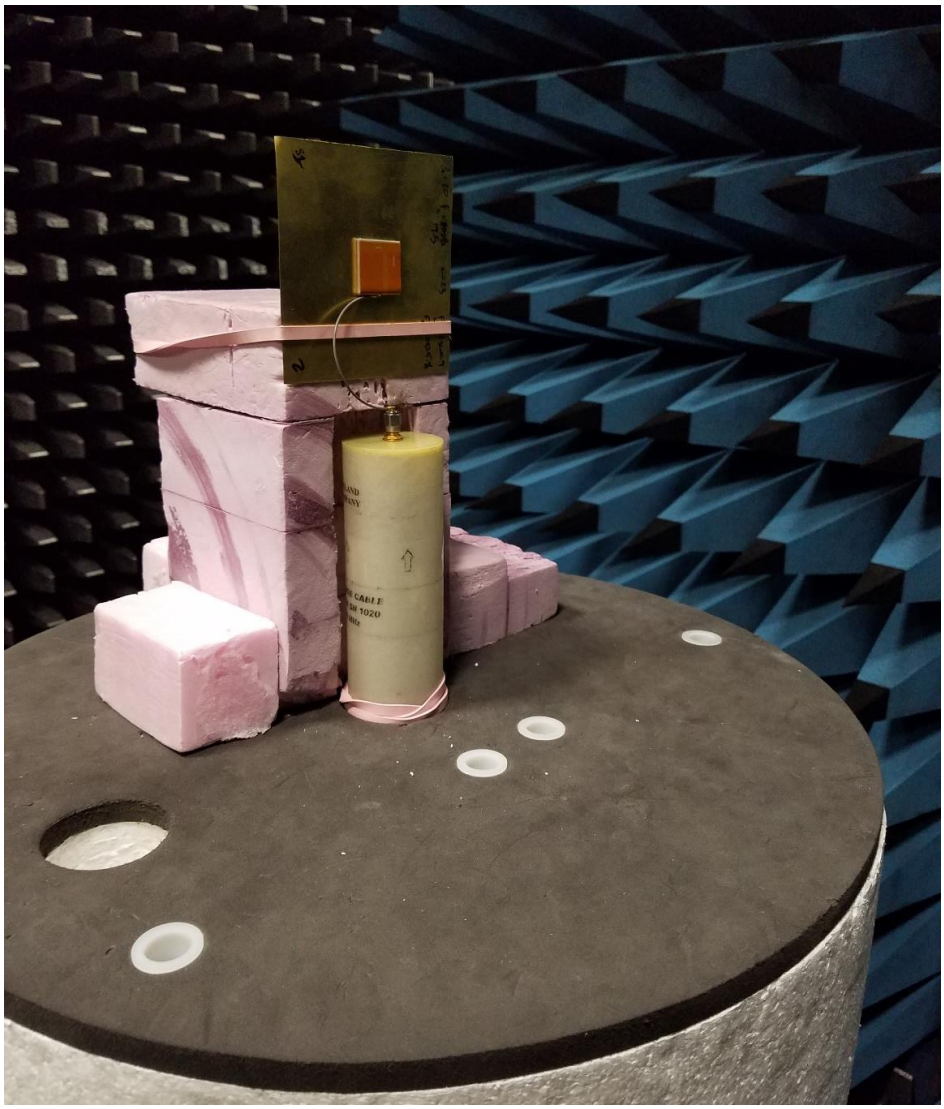

Figure 4: Flat surface setup

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7.2 Results – Flat Surface

2400 MHz

Azimuthal Conical Cuts at 2400 MHz

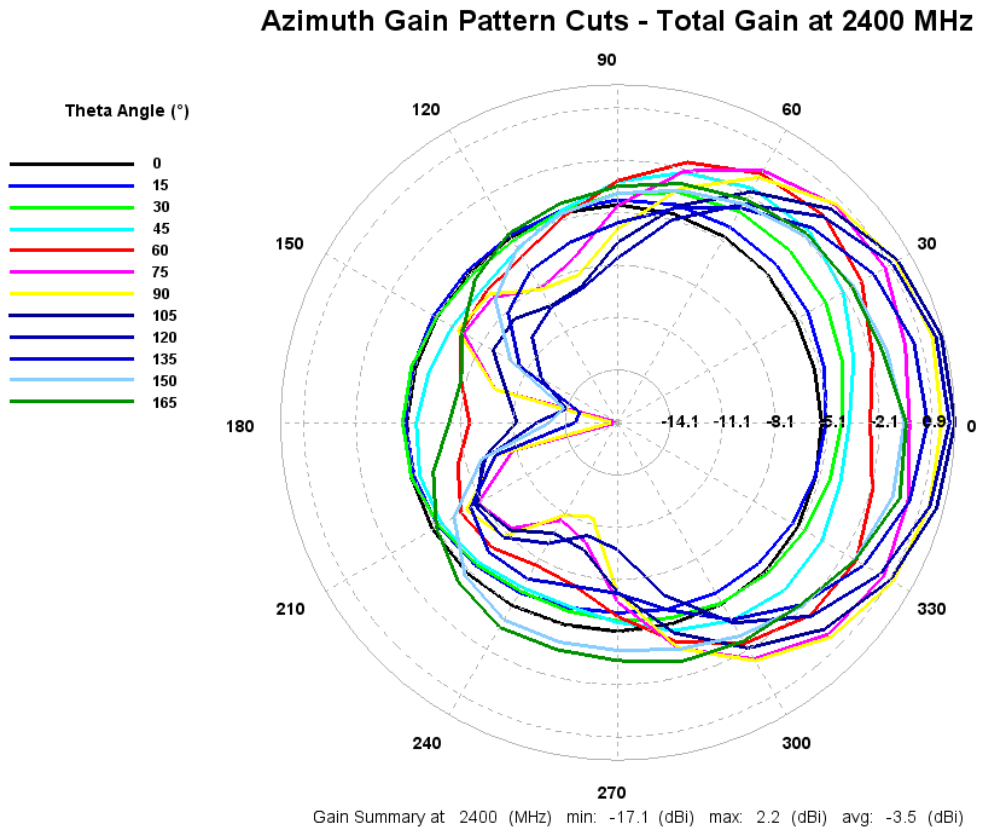

Figure 5: Total gain pattern – 2400 MHz

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Hong Kong: +852 2923 0610

3D Plots at 2400 MHz

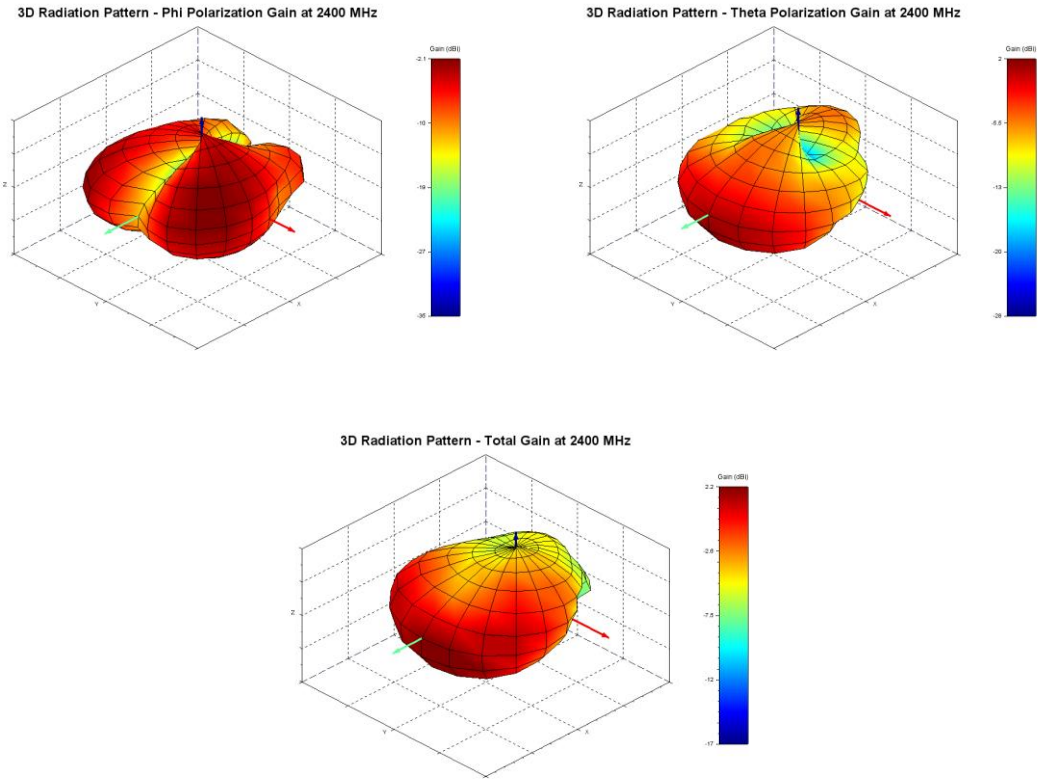

Figure 6: Phi, theta, and total gain plots – 2400 MHz

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2440 MHz

Azimuthal Conical Cuts at 2440 MHz

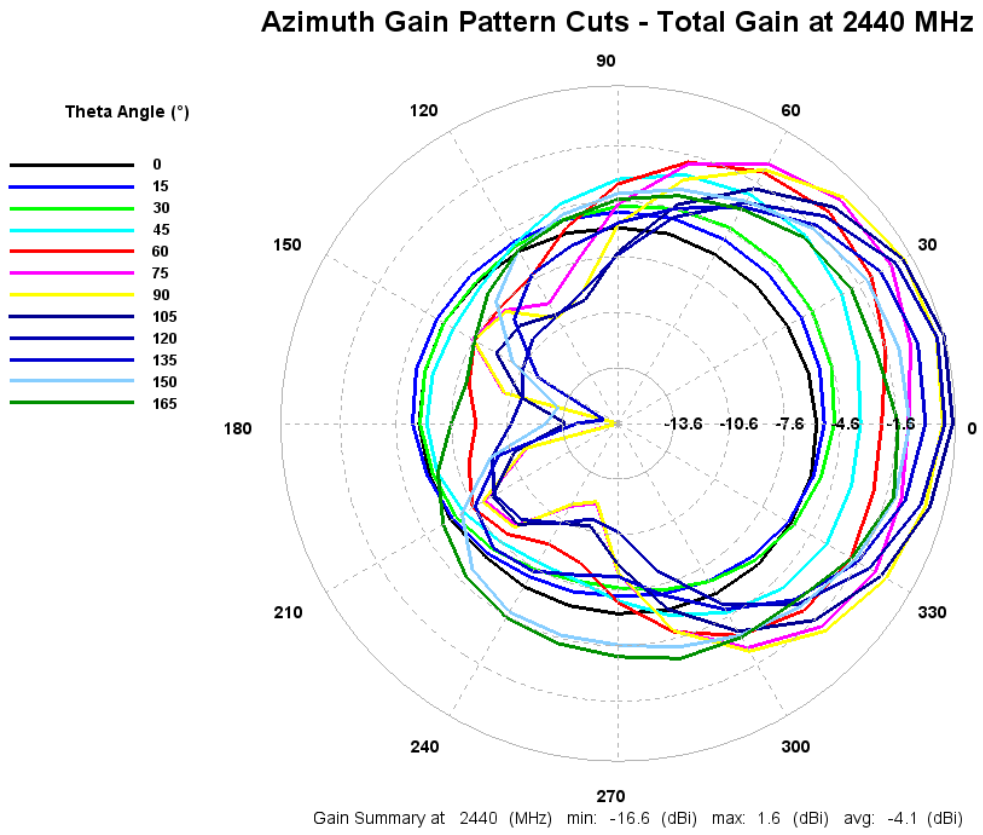

Figure 7: Total gain pattern – 2440 MHz

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

3D Plots at 2440 MHz

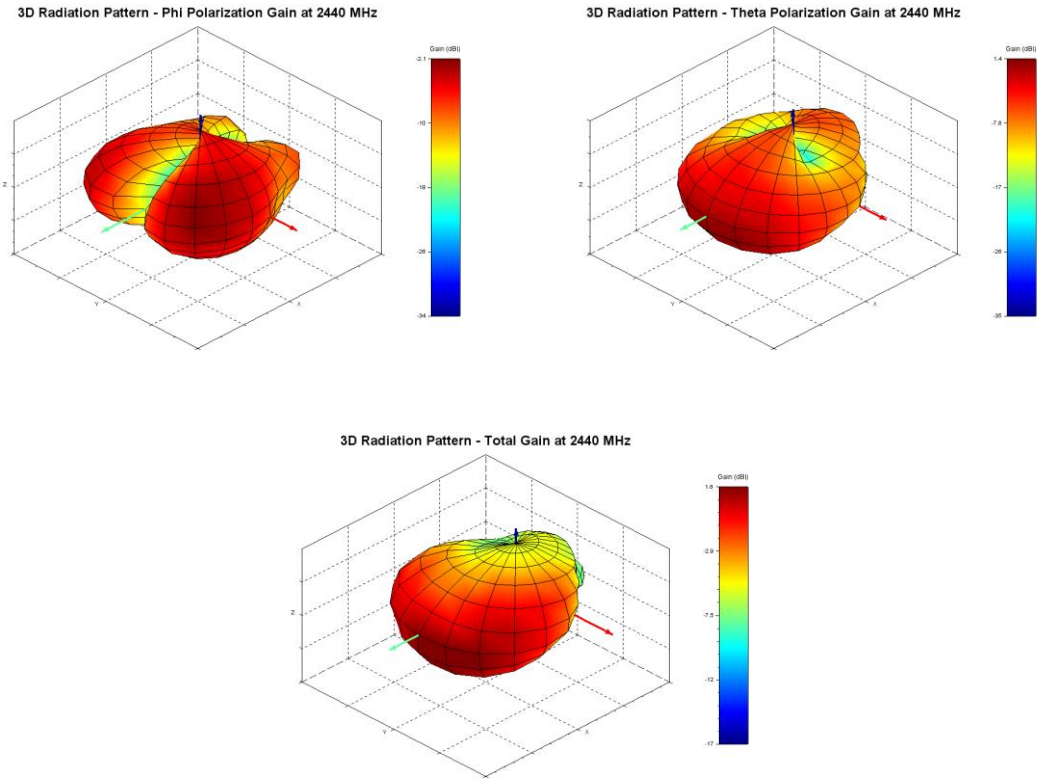

Figure 8: Phi, theta, and total gain plots – 2440 MHz

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Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

2480 MHz

Azimuthal Conical Cuts at 2480 MHz

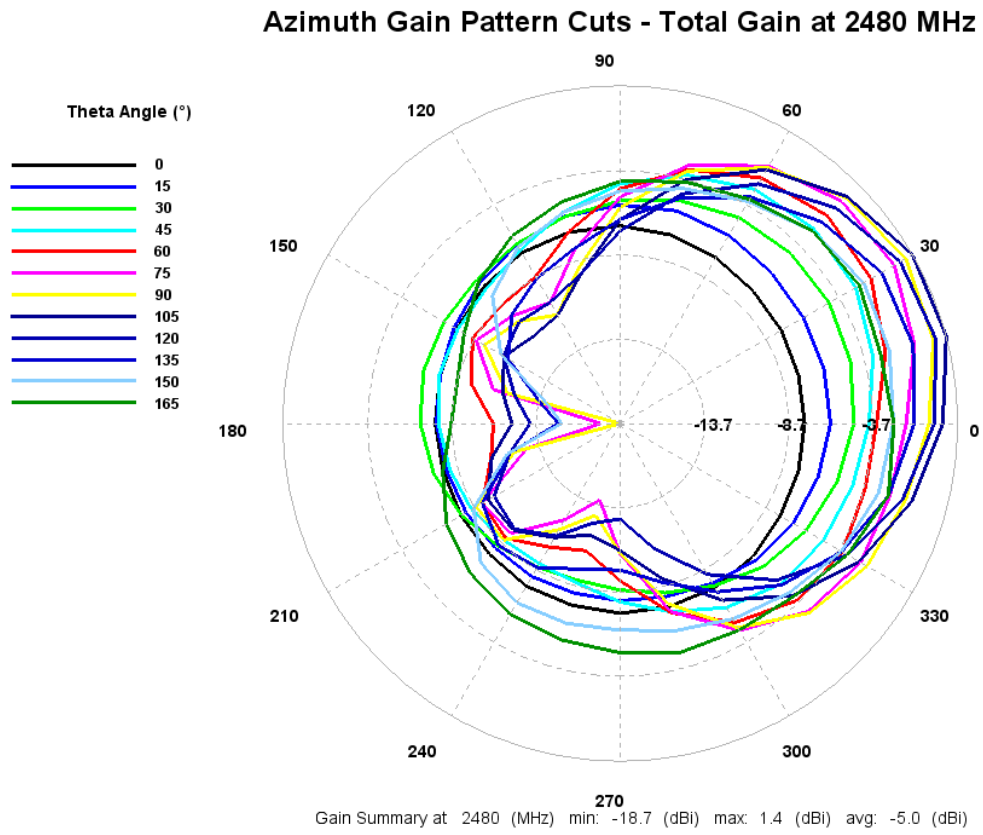

Figure 9: Total gain pattern – 2480 MHz

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

3D Plots at 2480 MHz

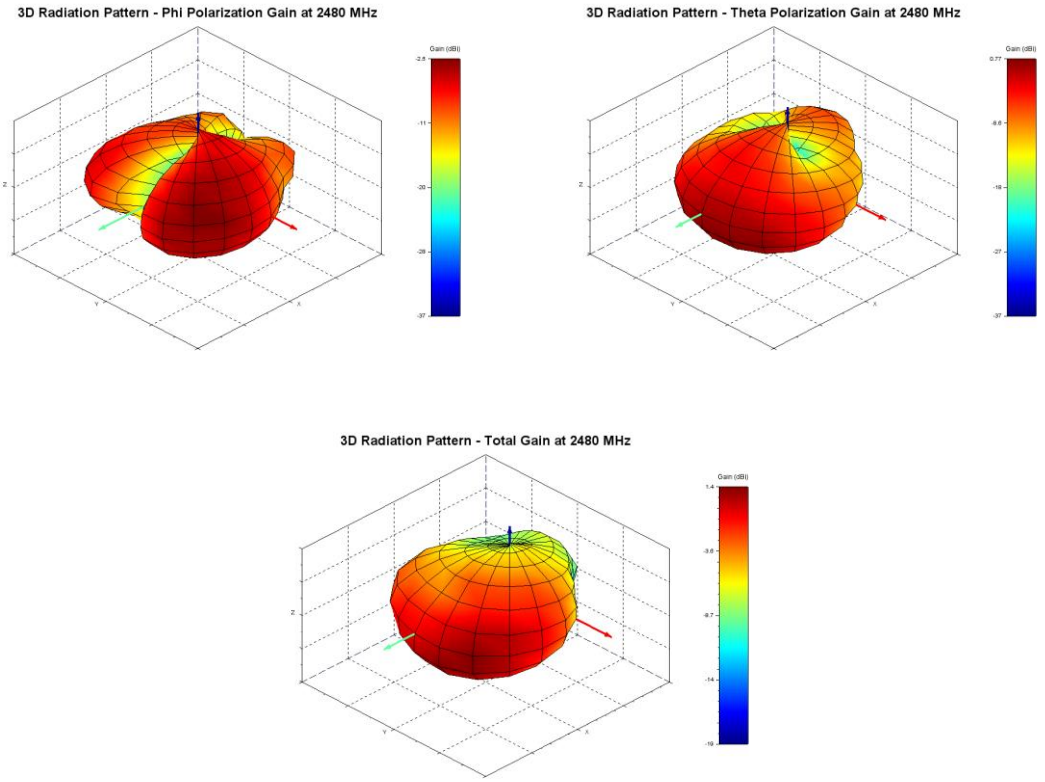

Figure 10: Phi, theta, and total gain plots – 2480 MHz

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Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

8 Curved Surface Antenna Radiation Performance

8.1 Antenna Setup

The mFlexPIFA is placed on the outside of a 60-mm outer diameter metal tube.

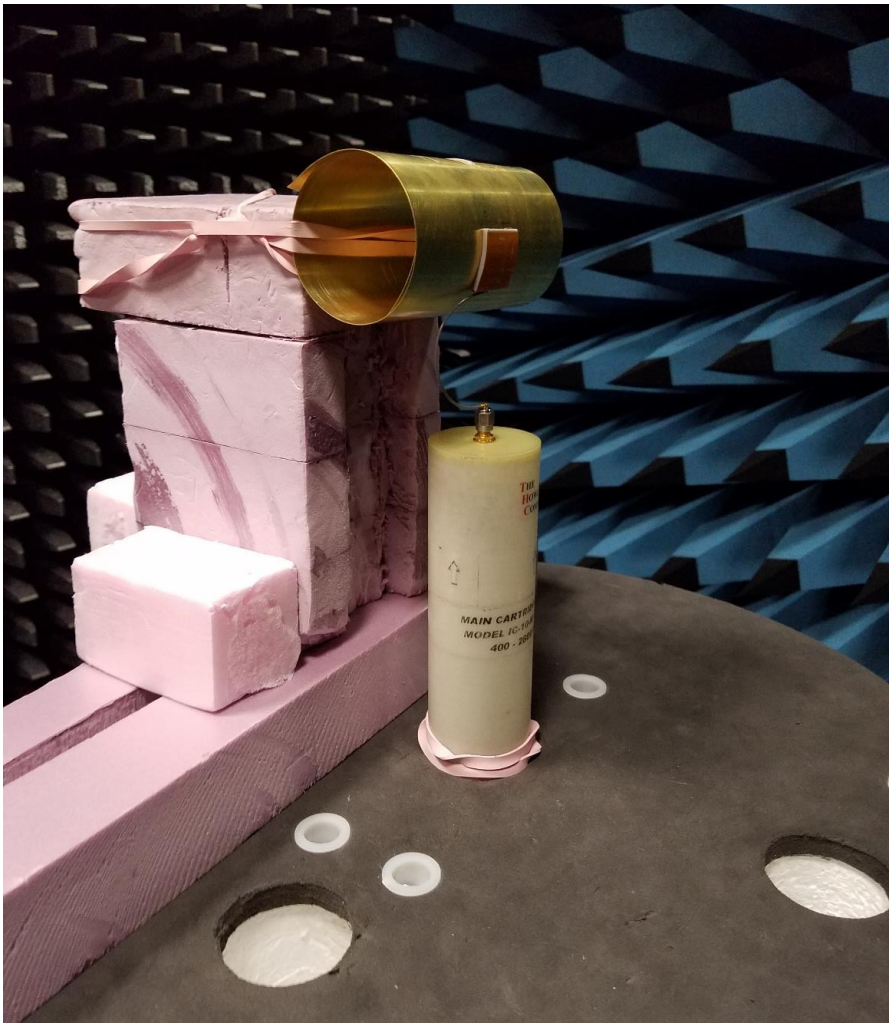

Figure 11: Convex curve setup

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8.2 Results – Curved Surface

2440 MHz

Azimuthal Conical Cuts at 2440 MHz

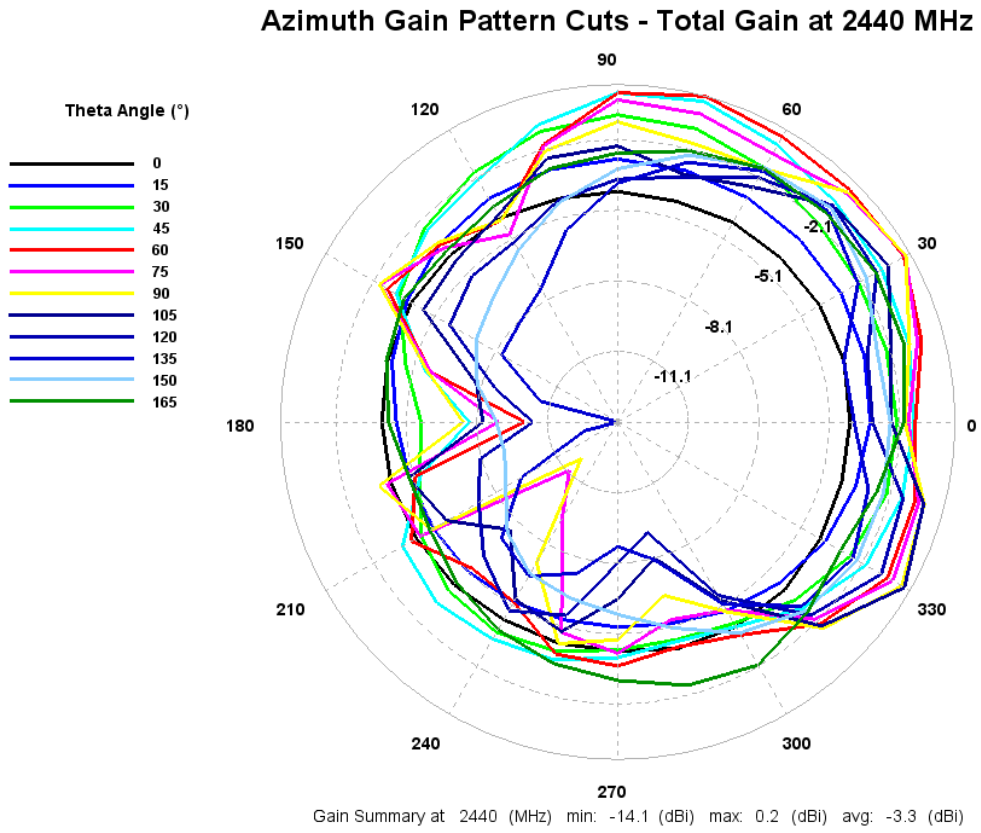

Figure 12: Total gain pattern – 2440 MHz

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Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

3D Plots at 2440 MHz

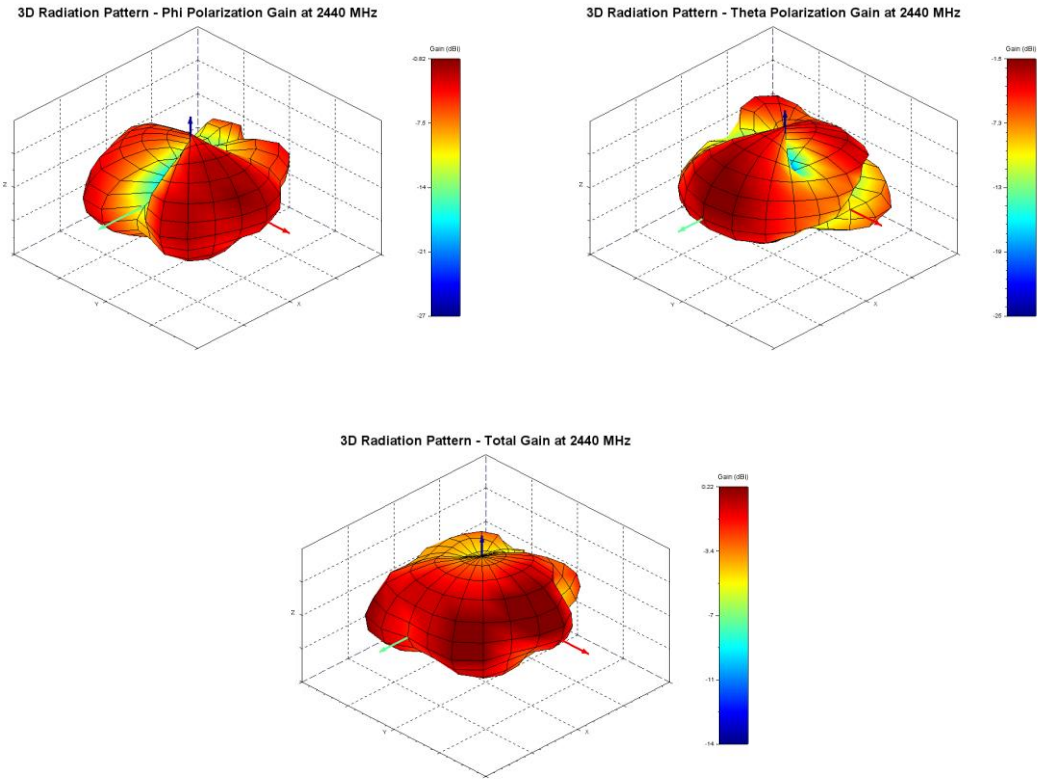

Figure 13: Phi, theta, and total gain plots – 2440 MHz

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Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

9 Optimal Installation Guide

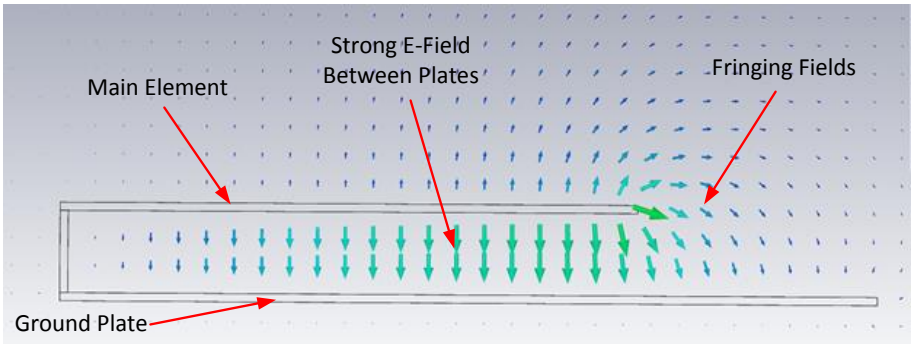

Figure 14: E-field radiation from the FlexPIFA. Taken from CST simulation

Keep the main element clear of any non-metal objects (such as plastics) on top of it by at least three millimeters (see Figure 15).

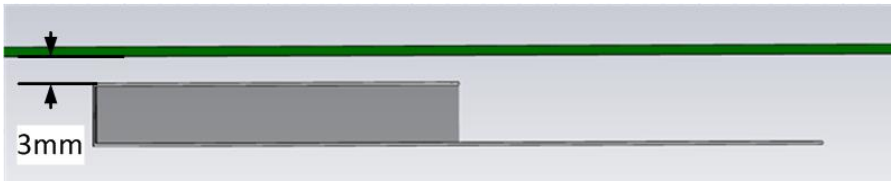

Figure 15: Top clearance

Similarly, keep the two long sides of the mFlexPIFA clear of any non-metal objects by at least two millimeters (see Figure 16). For metal objects, the top side of the mFlex should be kept clear by at least two millimeters and the bottom side of the mFlex at least 12 millimeters (see Figure 17).

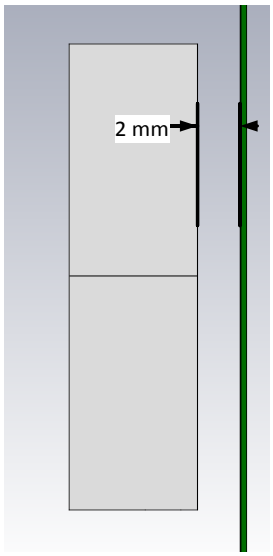

Figure 16: Non-metal side clearance

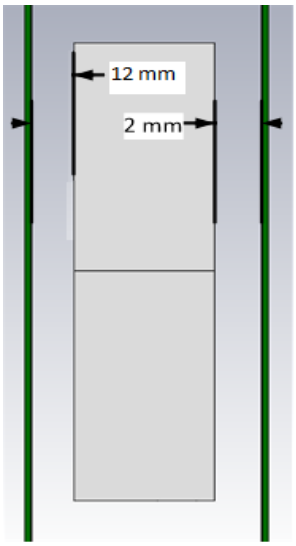

Figure 17: Metal side clearance

A one-millimeter clearance should be observed from the ground wall to any non-metal object (Figure 18). A 15-millimeter clearance should be observed for metal objects (Figure 19).

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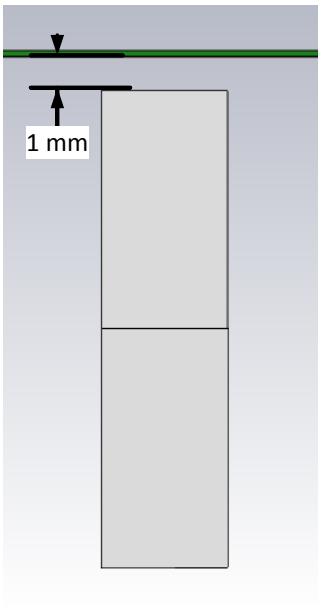

Figure 18: Non-metal ground wall clearance

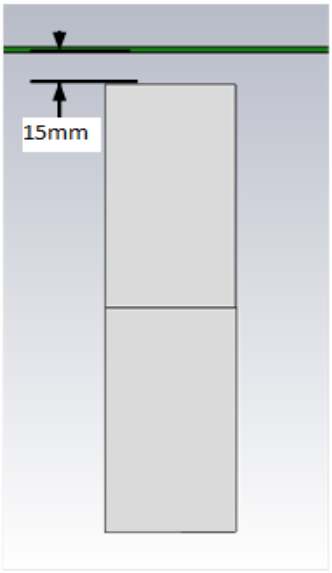

Figure 19: Metal ground wall clearance

Important! Mounting the mFlexPIFA in a situation that does not allow for these clearance recommendations may change the gain characteristics stated in the datasheet, which could impact overall range of the wireless system.

The ideal material for the mFlexPIFA to be mounted on (for maximum performance) is brass. However, as previously mentioned, the mFlexPIFA can tolerate other metallic surfaces and thicknesses and still radiate effectively. Depending on the type of material, the mFlexPIFA may be detuned.

The coaxial cable feeding the mFlexPIFA should be routed away from the antenna. Do not run the coaxial cable over the top of the mFlexPIFA or near the tip of the main element. The cable should be routed perpendicular to the side of the mFlexPIFA (this is the way the cable comes assembled) or away from the ground wall. These options are shown in Figure 20.

Perpendicular to the Side

Away from the Ground Wall

Figure 20: Recommended cable routing

As with any antenna, do not place objects near the antenna (except as described in the next section). Other objects, such as an LCD display, placed near the antenna may not affect its tuning but can distort the radiation pattern. Materials that absorb electromagnetic fields should be kept away from the antenna to maximize performance.

The following are some common things to keep in mind when placing the antenna:

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- Wire routing
- Speakers – These generate magnetic fields
- Battery location
- Proximity to human body
- Display screen – These absorb radiation

9.1 Flex Limits of the mFlexPIFA

One of the unique features of the mFlexPIFA is its ability to flex. However, due to the adhesive, there are limits to how much the antenna can be flexed and still remain secured to the device. The mFlexPIFA should not be flexed in a convex position with a radius less than 60 millimeters. Going smaller than this may result in the antenna peeling off the surface over time. Should a tighter radius of curvature be required, we recommend that you contact Laird/LSR Design Services for assistance.

Figure 21: Convex mounted

We do not recommend mounting the mFlexPIFA in a metal-enclosed concave position. In this scenario, the limiting factor is performance. The ground plate of the antenna is pressed closer to the main element. The fringing fields developing off the end of the element are responsible for most of the radiation. In a concave position, the fringing fields are adversely affected and gain suffers. This can also potentially create a Faraday's cage and cancel most of the RF radiation from the antenna.

If a concave position is required, we recommend that you contact Laird/LSR Design Services for assistance.

Note:	The mFlexPIFA is not designed to be twisted or crumpled. The adhesive back should lay flush with the surface on which it is mounted.

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10 Product Revision History

Rev 1: Initial Production Release

11 Contacting Laird

Headquarters Laird
W66 N220 Commerce Court
Cedarburg, WI 53012-2636
USA
Tel: 1(262) 375-4400
Fax: 1(262) 375-4248

Website: www.lairdtech.com

Technical Support: ews.support@lairdtech.com

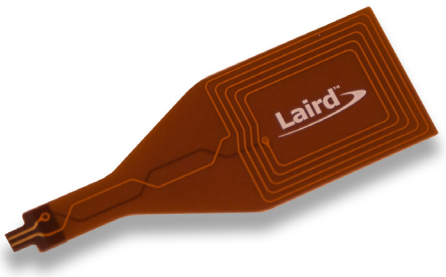
Sales Contact: cs-sales@lairdtech.com

Smart Technology. Delivered.

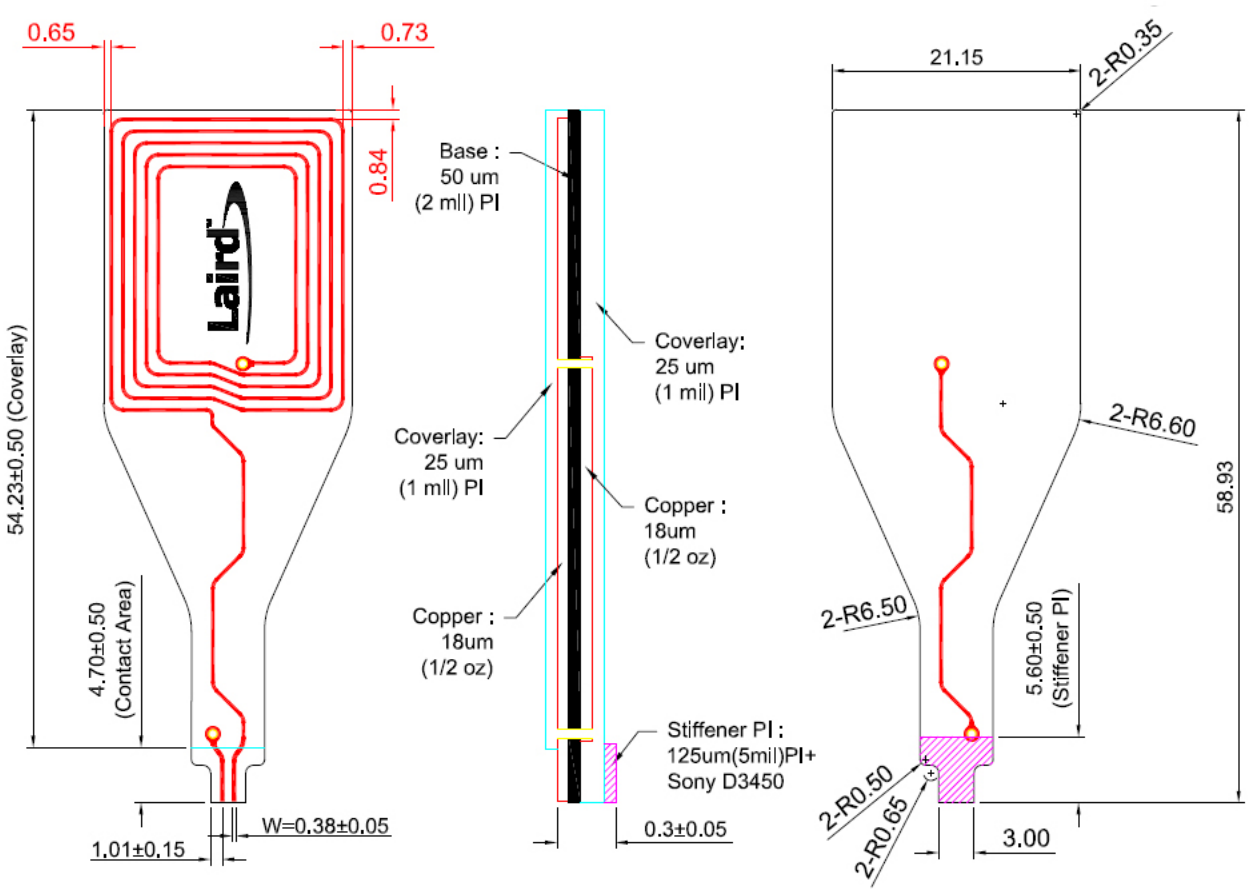
0600-00061

NFC Flex PCB Antenna

This NFC flex PCB antenna is included with the DVK-BL652-Sx products.
It was tested with the BL652 series of modules for NFC applications and use.



SPECIFICATIONS	
Frequency	13.56 MHz
NFC Antenna Type	Coiled Inductor
NFC Antenna Interface	Differential NFC port
Host Board NFC Antenna Mating Connector	Manufacturer - Molex MPN - 512810594 Description - FFC/FPC connector, right-angle, SMD/90d, dual contact, 1.2 mm mated height
Size	58.93 mm x 21.15 mm x 0.3 mm (dimensions include the contact area)



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Hong Kong: +852 2923 0610

Embedded Wireless Solutions Support Center:
http://ews-support.lairdtech.com

www.lairdtech.com/bluetooth

CS-PB-NFC 0917

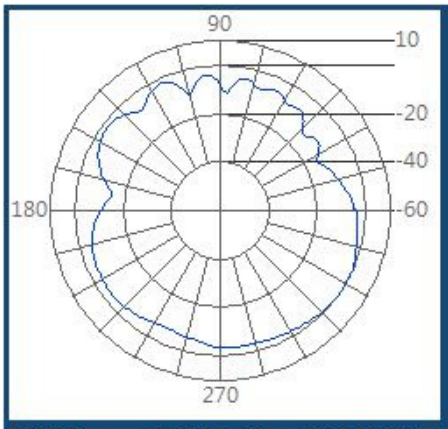
Datasheet

BL654 Printed PCB Antenna

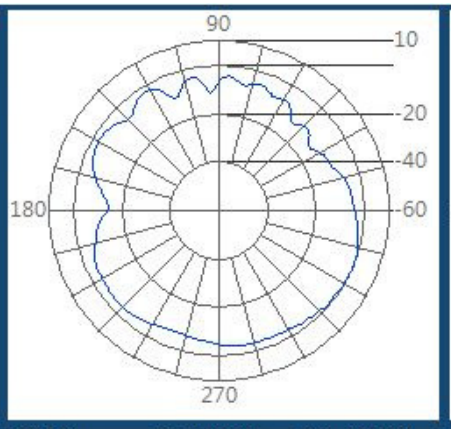
ANTENNA SPECIFICATION

MANUFACTURER	MODEL NAME	PEAK GAIN
LAIRD TECHNOLOGIES	BL654 Printed PCB Antenna	0dBi

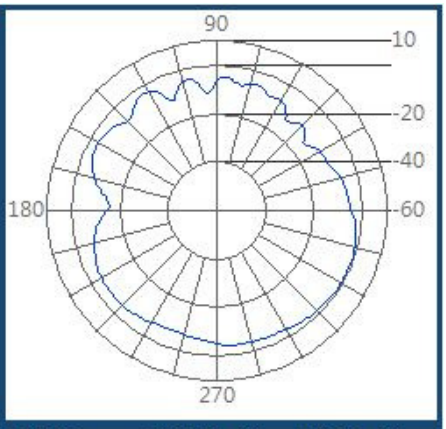
ANTENNA PATTERN



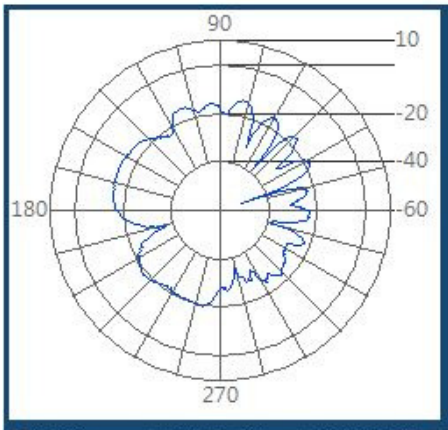
2.402GHz	PK -0.08 dBi	AV -4.54 dBi
Beam 360 °	Azimuth_Co_plane_B	



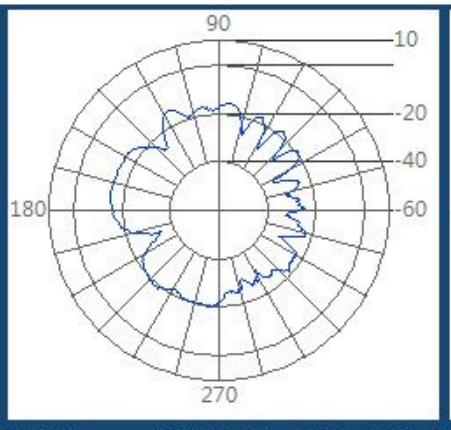
2.44GHz	PK -0.12 dBi	AV -4.69 dBi
Beam 360 °	Azimuth_Co_plane_M	



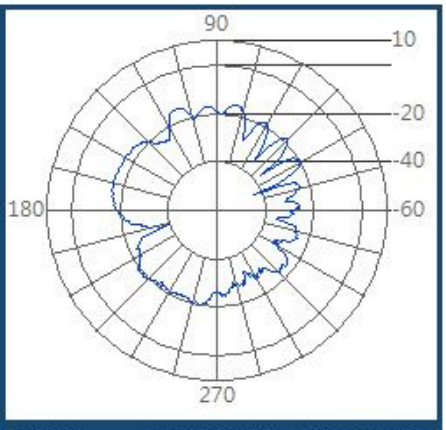
2.48GHz	PK -0.76 dBi	AV -5.2 dBi
Beam 215 °	Azimuth_Co_plane_T	



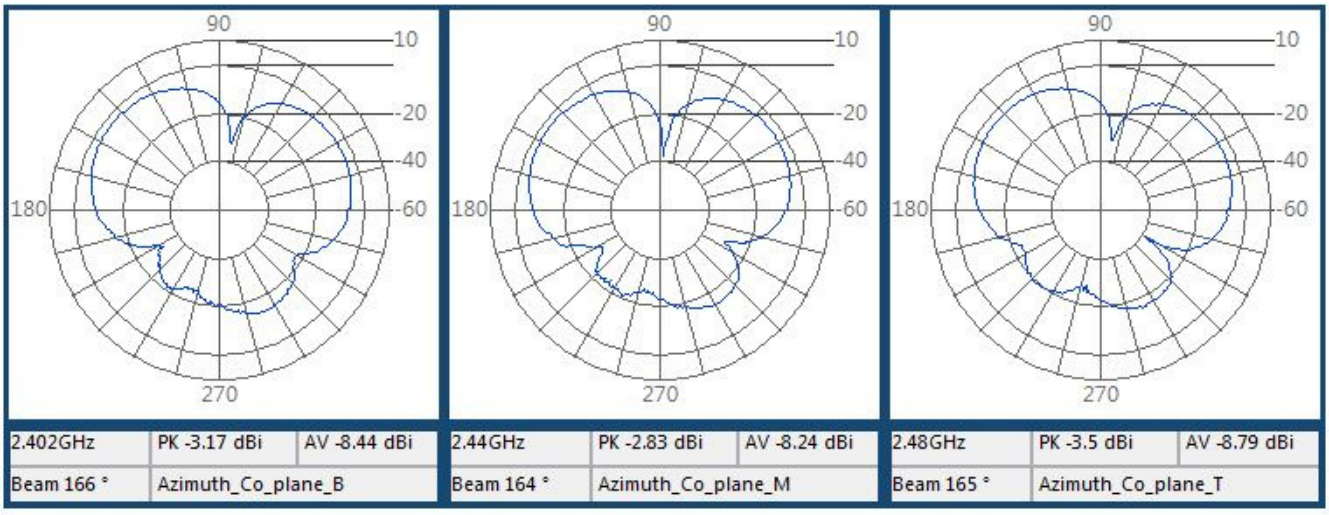
2.402GHz	PK -13.7 dBi	AV -19.69 dBi
Beam 119 °	Elevation_Co_plane_B	

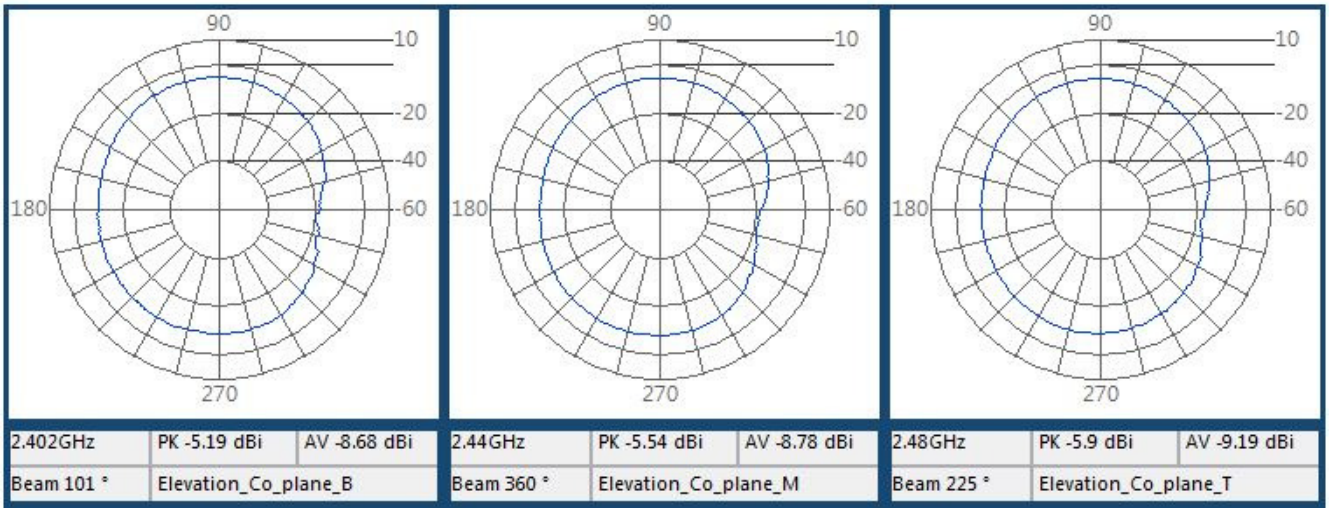


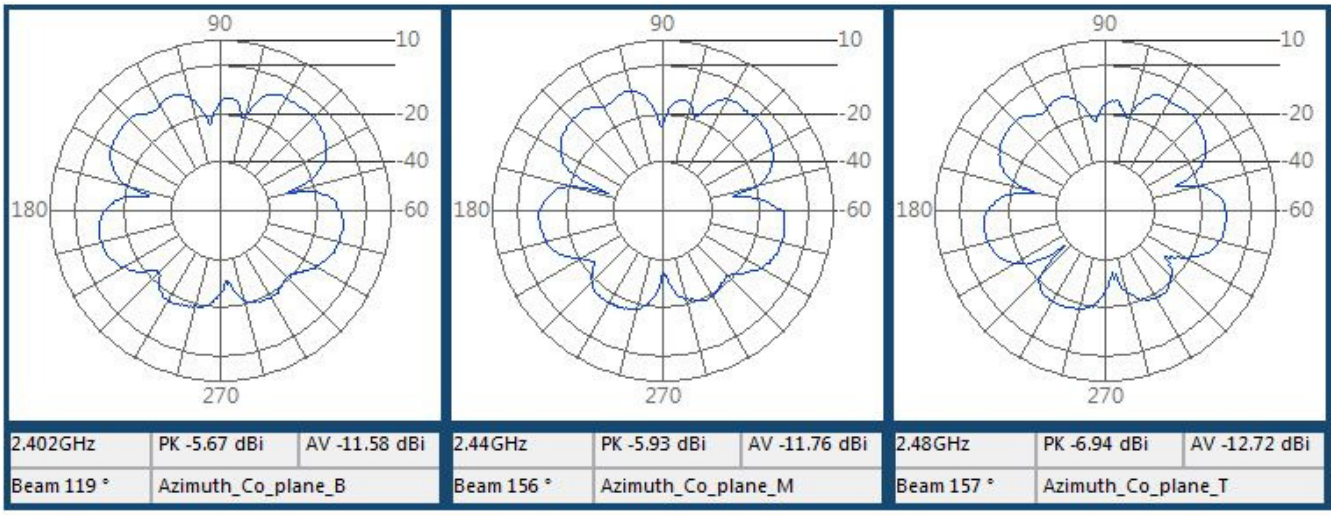
2.44GHz	PK -14.11 dBi	AV -20.1 dBi
Beam 104 °	Elevation_Co_plane_M	



2.48GHz	PK -14.99 dBi	AV -20.95 dBi
Beam 102 °	Elevation_Co_plane_T	


90
10
20
40
60
180
270
2.402GHz
PK -3.17 dBi
AV -8.44 dBi
Beam 166 °
Azimuth_Co_plane_B
2.44GHz
PK -2.83 dBi
AV -8.24 dBi
Beam 164 °
Azimuth_Co_plane_M
2.48GHz
PK -3.5 dBi
AV -8.79 dBi
Beam 165 °
Azimuth_Co_plane_T

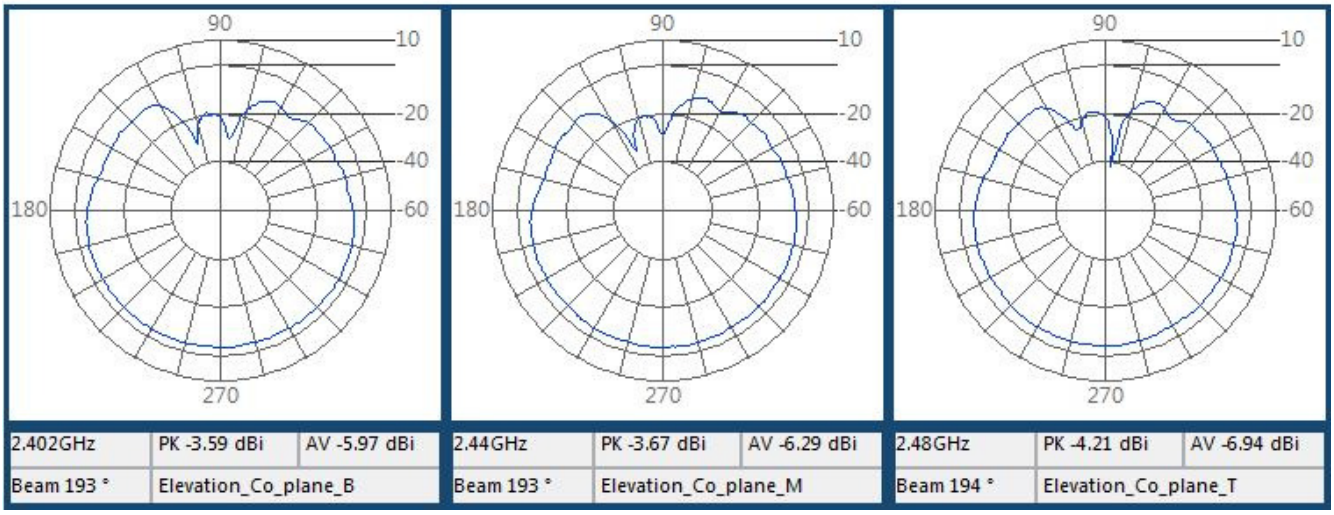

90
10
20
40
60
180
270
2.402GHz
PK -5.19 dBi
AV -8.68 dBi
Beam 101 °
Elevation_Co_plane_B
2.44GHz
PK -5.54 dBi
AV -8.78 dBi
Beam 360 °
Elevation_Co_plane_M
2.48GHz
PK -5.9 dBi
AV -9.19 dBi
Beam 225 °
Elevation_Co_plane_T



2.402GHz	PK -5.67 dBi	AV -11.58 dBi
Beam 119 °	Azimuth_Co_plane_B	

2.44GHz	PK -5.93 dBi	AV -11.76 dBi
Beam 156 °	Azimuth_Co_plane_M	

2.48GHz	PK -6.94 dBi	AV -12.72 dBi
Beam 157 °	Azimuth_Co_plane_T	



2.402GHz	PK -3.59 dBi	AV -5.97 dBi
Beam 193 °	Elevation_Co_plane_B	

2.44GHz	PK -3.67 dBi	AV -6.29 dBi
Beam 193 °	Elevation_Co_plane_M	

2.48GHz	PK -4.21 dBi	AV -6.94 dBi
Beam 194 °	Elevation_Co_plane_T	

APPROVAL SHEET

Dipole ANTENNA
2.4 GHz Single Band Working Frequency
Halogens Free Product
P/N: RFDPA870900SBAB8G1

Customer：_____

Customer ‘s Part No.：_____

Approval No.：_____

Issue Date：_____

*Contents in this sheet are subject to change without prior notice.

Version	Date	Description	Author
V01	2015 Sep.	New Release	PIPI

ELECTRICAL CHARACTERISTICS

Item	Specification
Working Frequency Range	2.4 ~ 2.5 GHz (Note-1)
Gain	2 dBi
Return Loss	-10dB(Max)
VSWR	2 max.
Polarization	Linear
Radiation Pattern	Omni-directional
Impedance	50Ω

*Note 1. Central Frequency should be defined after customers' application approval.

MATERIAL TABLE

Items	Description
Cable	RG178(Brown)
Antenna Cover	TPEE
Antenna Base	PC/PBT
Connector	Reverse SMA Plug
Color	Black
Brass Tube	Brass

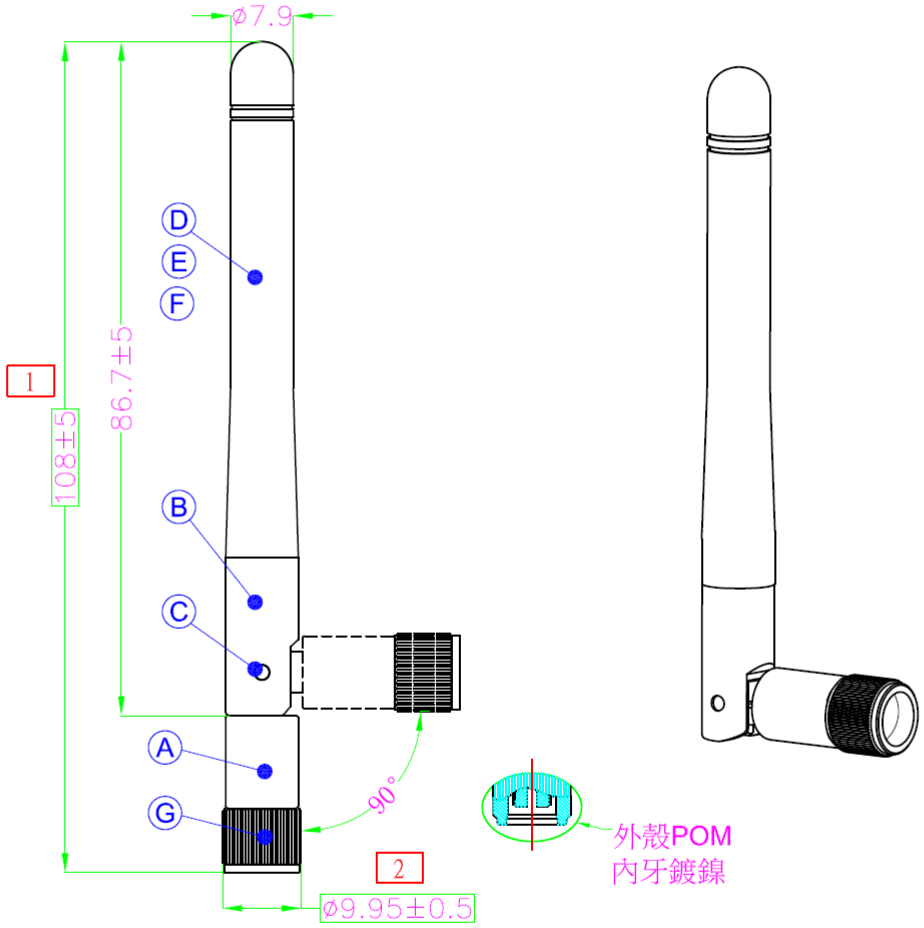
ORDERING RULE

RF	DPA	8709	00	S	B	A	B	8	G1
Type Code	**Product Code**	**Dipole Dimension (Unit: mm)**	**Cable Length (unit: cm)**	**Connector Brand**	**Type of Connector**	**Application**	**Project status**	**Wire Diameter**	**Project**
Walsin RF Device	DPA: Dipole Antenna	Per 2 digits of length, width e.g.: 8709 Length 86.7mm, Width 9.95mm	2 digits for cable length e.g.: 00 None Cable	A: N C:MCX D:IPEX III E: IPEX IV F: IPEX A13 H: Hirose I: IPEX M: MMCX S: SMA T: TNC U:MURATA N: None	A: Reverse Female B: Reverse Male F: Female M: Male N: None	0: 0GHz 3: 3GHz 5: 5 GHz 6: 6GHz A: 2.4GHz ISM band B: GSM 900/1800 dual band G: GPS band L: 2.4/5.2/5.8 GHz tri-band N: NFC T:LTE band W: WCDMA band	B: MP T:During Test X: Pile Run	0:None 1:∅0.81 3:∅1.13 6:RG316 7:∅1.37 8:RG178	01~99 series number

DIMENSIONS

ELECTRICAL
Frequency:2.4GHZ
Gain:2dBi

No.	MAT	MAT'L	Color	Q'TY
A	Antenna Down Base	PC+PBT	Black	1
B	Antenna Up Base	PC	Black	1
C	Rivet	POM	Black	2
D	Antenna Cover	TPEE	Black	1
E	Brass Tube	Brass	--	1
F	RG178 CABLE	--	Brown	1
G	Reverse SMA Plug	--	Black	1



※標記□記號者，為重點檢驗尺寸

LTR	DESCRIPTION	DATE	REQ. BY

設計 DR. HWCHAN 2013.08.29
核准 APPD.

容許公差 TOLERANCE
.XXX ±0.20
.XX ±0.35
.X ±0.50
X ±1.00
ANG ±5

品名 ARTICLE: RFDPA870900SBAB8G1

版本 REV. A

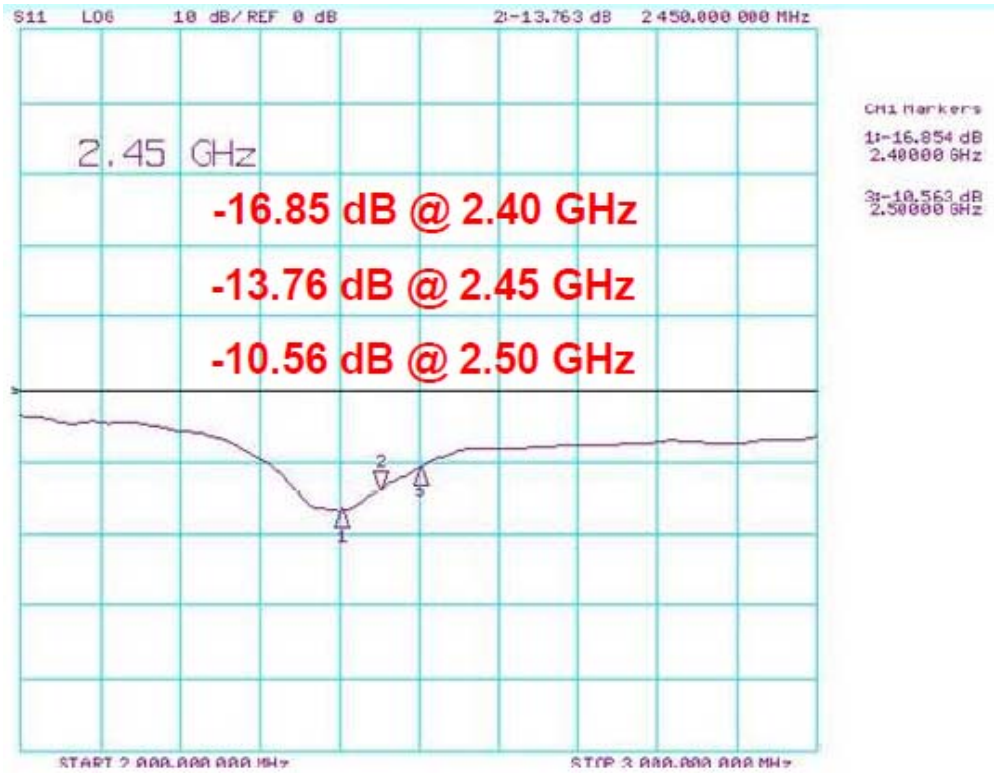
單位 UNIT: mm
比例 SCALE: ****
張數 SHEET: 1

華新科技股份有限公司
Walsin Technology Corporation

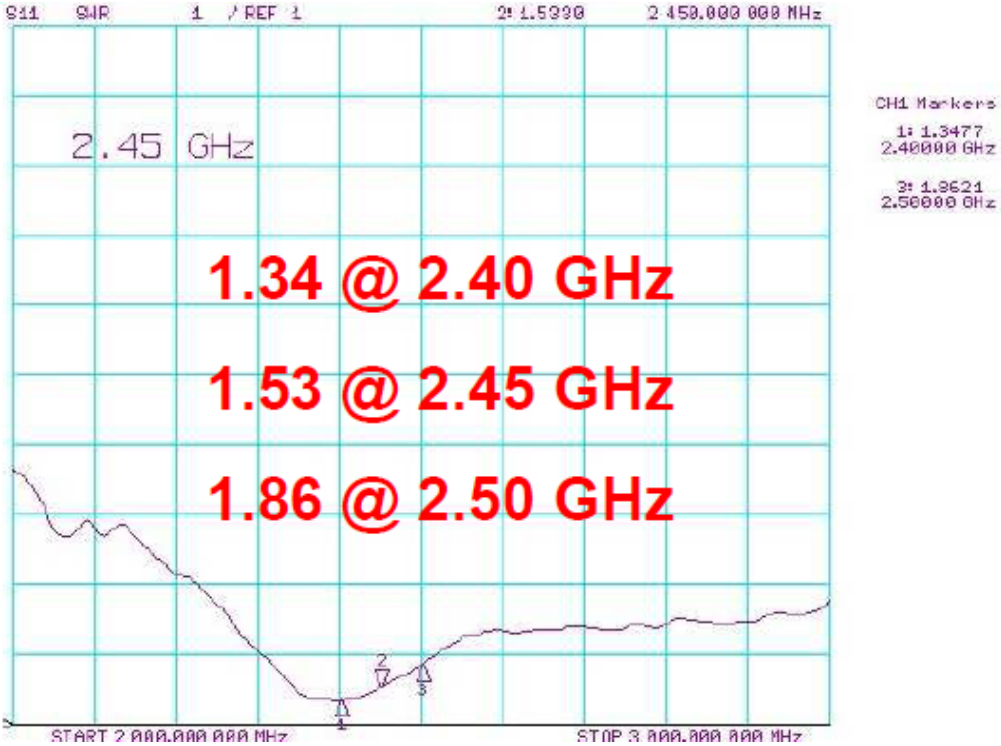
Test Report

■ELECTRICAL CHARACTERISTICS

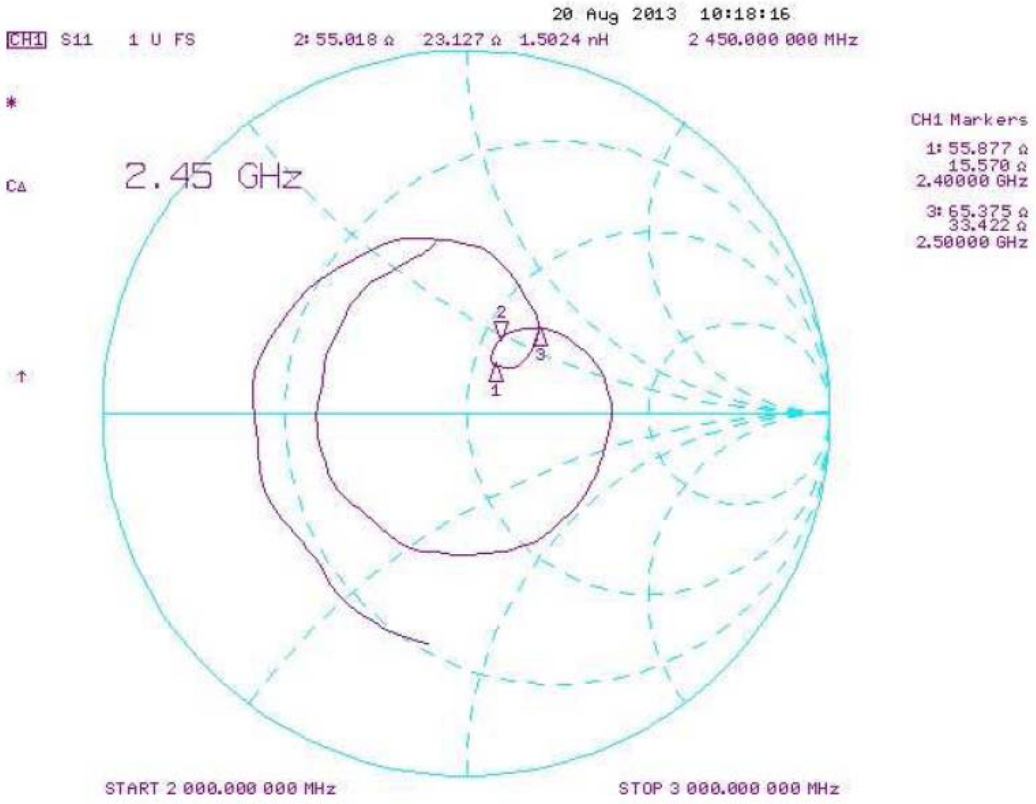
Return Loss



VSWR



Smith Chart


20 Aug 2013 10:18:16
CH1 S11 1 U FS
2: 55.018 Ω 23.127 Ω 1.5024 nH
2 450.000 000 MHz
2.45 GHz
CH1 Markers
1: 55.877 Ω
15.570 Ω
2.40000 GHz
3: 65.375 Ω
33.422 Ω
2.50000 GHz
START 2 000.000 000 MHz
STOP 3 000.000 000 MHz

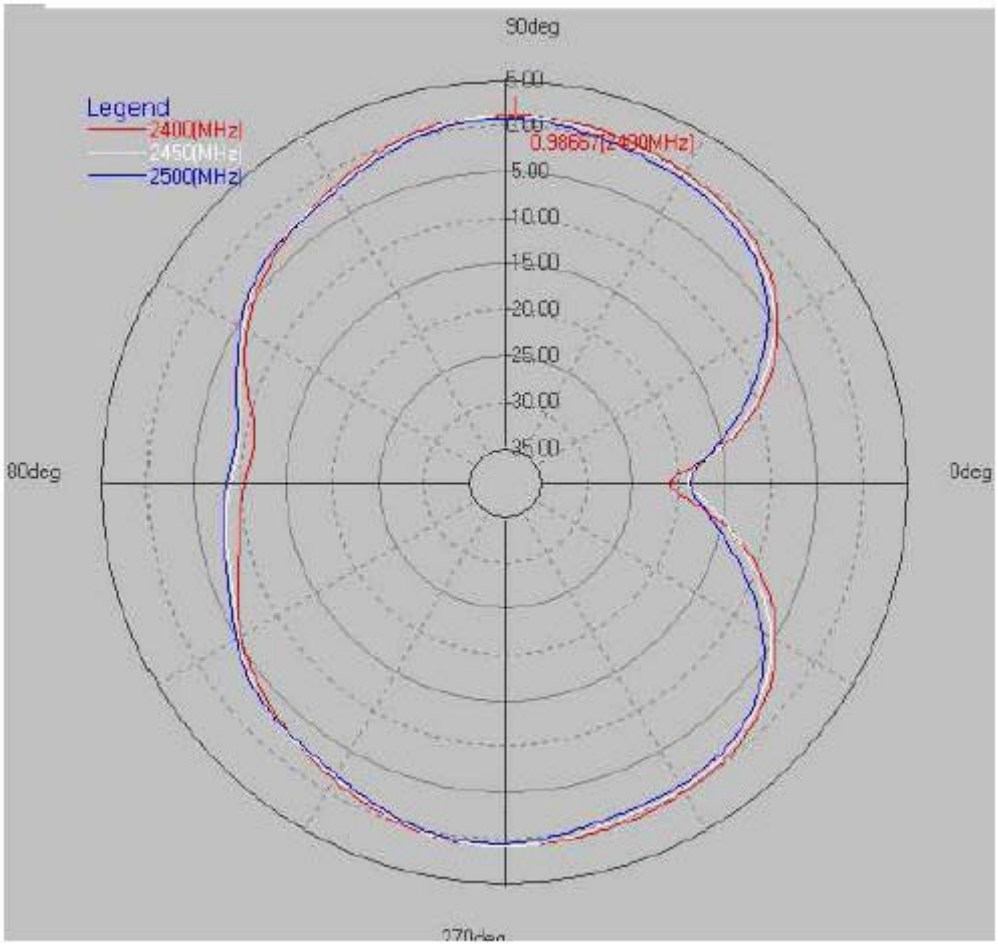
RADIATION PATTERN

2400~2500 MHz

X-Z Plane

Phi=0.00deg

Gain . dB



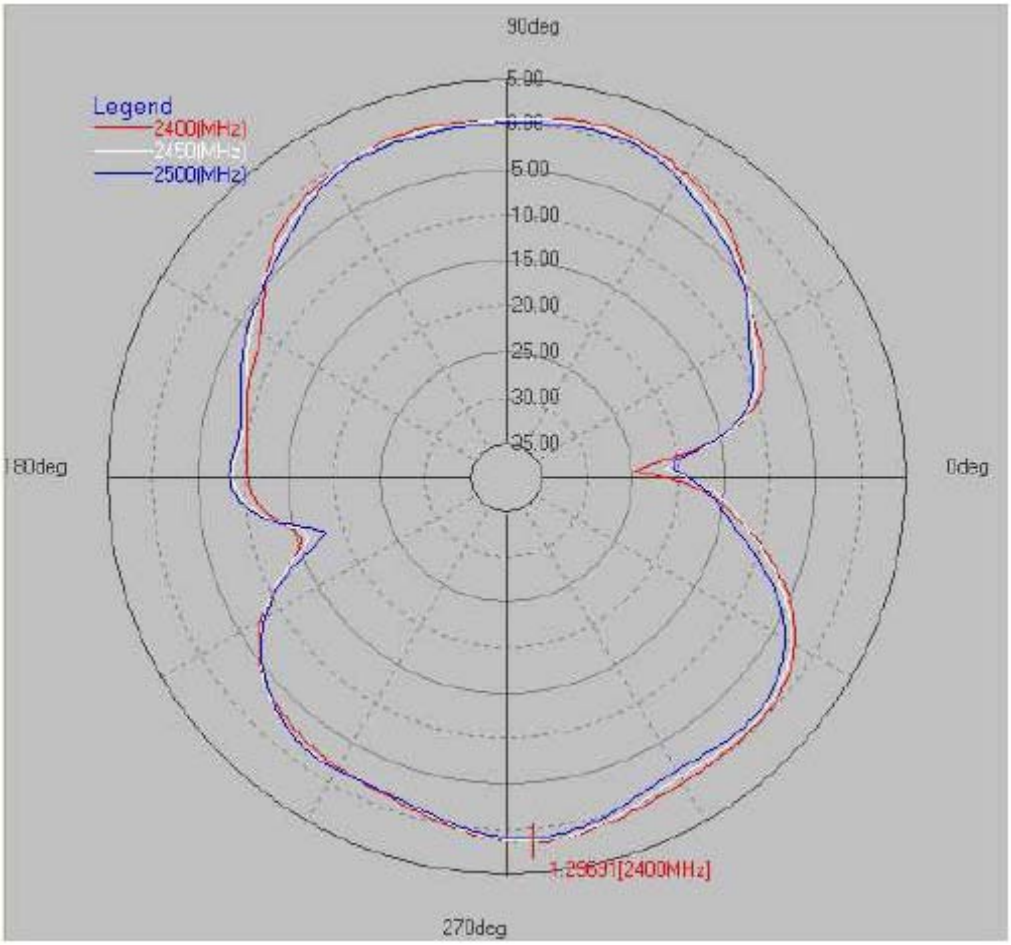
Frequency(GHz)	Peak (dB)		Average (dB)
	Max.	Min.	
2.40	1.89	-21.17	-2.25
2.45	1.92	-19.12	-2.41
2.50	1.81	-18.81	-2.74

2400~2500 MHz

Y-Z Plane

Phi=90.00deg

Gain . dB



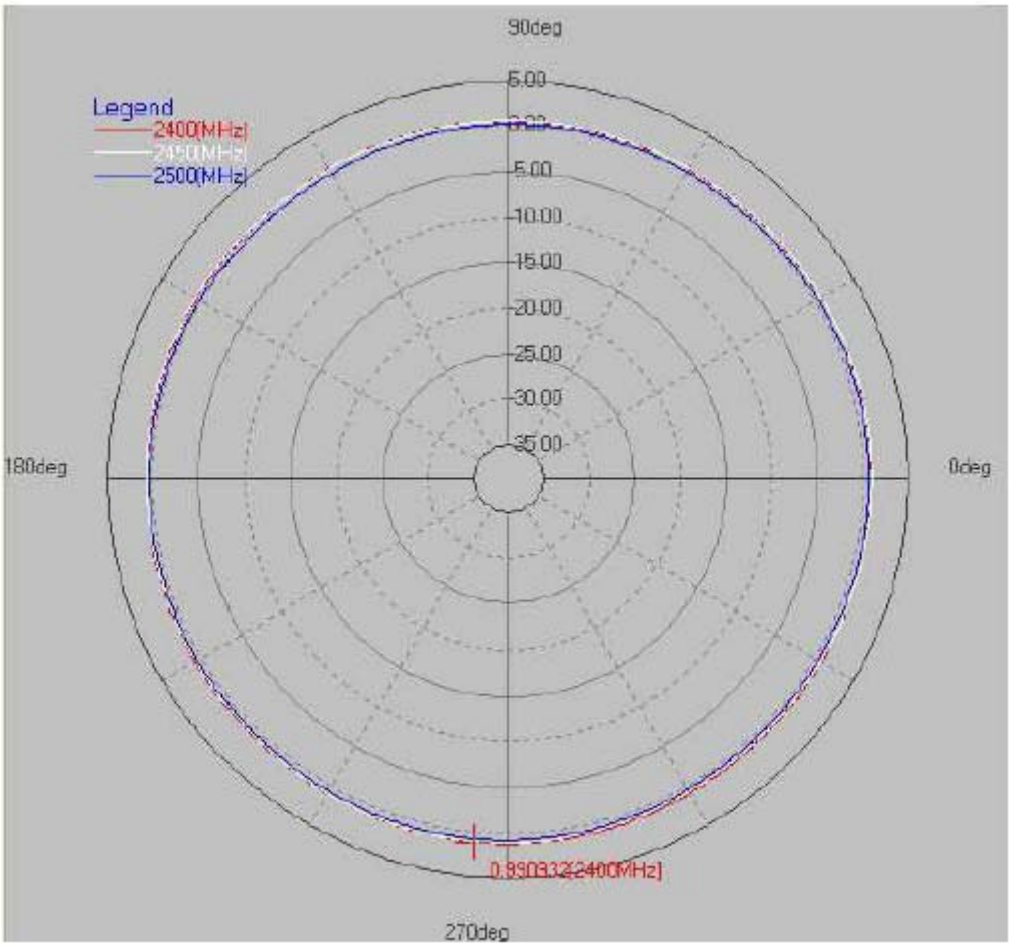
Frequency(GHz)	Peak (dB)		Average (dB)
	Max.	Min.	
2.40	2.04	-24.68	-2.25
2.45	2.00	-21.44	-2.47
2.50	1.81	-20.59	-2.84

2400~2500 MHz

X-Y Plane

Theta=90.00deg

Gain . dB



Frequency(GHz)	Peak (dB)		Average (dB)
	Max.	Min.	
2.40	1.89	0.35	0.70
2.45	1.90	0.36	0.68
2.50	1.80	-0.16	0.33

Package

蘇州華科電子有限公司

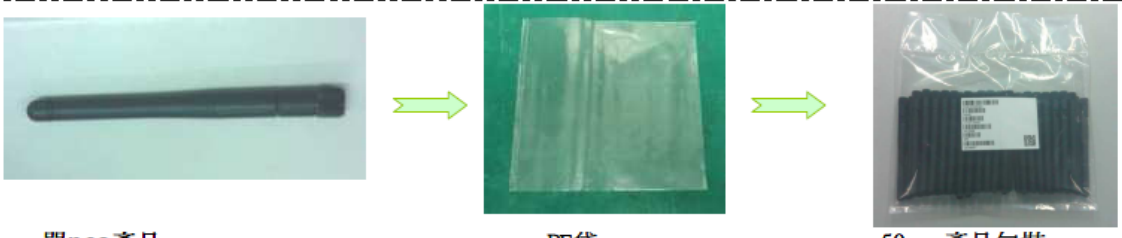
制品規格書

版別：1.0.0

客戶		品名	RFDPA870900SAXB8G1(2dBi)	發行編號		頁次	1/1

產品包裝圖示:

圖示一

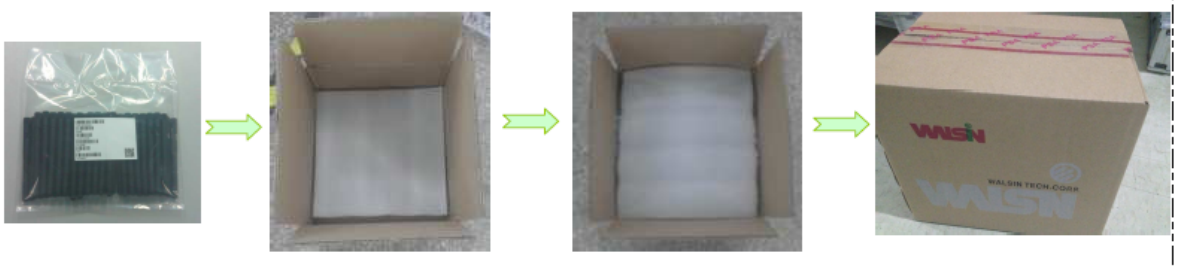


單pcs產品　　PE袋　　50pcs產品包裝

圖示二

珍珠棉　　外箱　　珍珠棉放進外箱中

圖示三



產品包裝說明：

1.將單PCS產品裝入PE袋中，每PE袋裝50PCS.(如圖示一)

2.將珍珠棉放入外箱中(如圖示二)

3.將裝好的成品(如圖示三)放入外箱中，每箱放1000pcs產品，上下各放1片珍珠棉。

4. 包裝材料規格

5.規格:長 210*寬230*厚度0.07mm

6.規格:長330*寬330*高8mm

7.規格:長350*寬350*高190mm

8.產品標簽需貼到最小包裝（參照出貨標籤粘貼SOP)

FORM NO: