

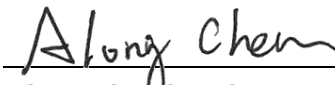
CE Test Report

Equipment : Bluetooth 5.2 BLE + 802.15.4 + NFC Module
Model No. : BL5340PA Series
Brand Name : Laird Connectivity
Applicant : Laird Connectivity LLC
Address : W66N220 Commerce Court, Cedarburg, WI
53012 United States Of America
Standard : EN 300 328 V2.2.2 (2019-07)
Received Date : Feb. 01, 2023
Tested Date : Apr. 21 ~ May 24, 2023

We, International Certification Corporation, 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 shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

Approved by:


Along Chen / Assistant Manager

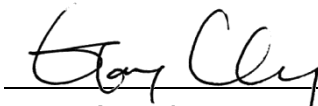

Gary Chang / Manager

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Appendix A. RF Output Power

Appendix B. Power Spectral Density

Appendix C. Occupied Channel Bandwidth

Appendix D. Transmitter Unwanted Emissions In The Out-Of-Band Domain

Appendix E. Transmitter Spurious Emissions

Appendix F. Receiver Spurious Emissions

Appendix G. Receiver Blocking

Release Record

Report No.	Version	Description	Issued Date
ER1O0405-01	Rev. 01	Initial issue	Jun. 20, 2023

Summary of Test Results

Ref. Std. Clause	Test Items	Measured	Result
4.3.2.2	RF Output Power	9.93 dBm.	Pass
4.3.2.3	Power Spectral Density	Meet the requirement of limit.	Pass
4.3.2.4	Duty Cycle, Tx-sequence, Tx-gap	Only for non-adaptive equipment.	N/A
4.3.2.5	Medium Utilisation (MU) factor	Only for non-adaptive equipment.	N/A
4.3.2.6	Adaptivity	The RF Output power is less than 10 dBm e.i.r.p. This item is not applicable.	N/A
4.3.2.7	Occupied Channel Bandwidth	Meet the requirement of limit.	Pass
4.3.2.8	Transmitter unwanted emissions in the out of band domain	Meet the requirement of limit.	Pass
4.3.2.9	Transmitter unwanted emissions in the spurious domain	Meet the requirement of limit.	Pass
4.3.2.10	Receiver spurious emissions	Meet the requirement of limit.	Pass
4.3.2.11	Receiver Blocking	Meet the requirement of limit.	Pass
4.3.2.12	Geo-location Capability	The device has no this capability.	N/A

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	Mode	Ch. Frequency (MHz)	Channel Number	Data Rate
2400~2483.5	IEEE 802.15.4-2006	2405-2480	11-26 [16]	250kbps
Note 1: IEEE 802.15.4-2006 uses DSSS-OQPSK modulation.				

1.1.2 Antenna Details

Ant. No.	Brand	Model	Type	Connector	2400-2500MHz	2400-2480MHz	Remarks
					Gain (dBi)		
1	Laird	NanoBlue	PCB Dipole	IPEX MHF4	2	---	External
2	Laird	FlexPIFA	PCB Dipole	IPEX MHF4	---	2	External
3	Mag.Layers	EDA-8709-2G4C1-B27-CY	Dipole	IPEX MHF4	2	---	External
4	Laird	mFlexPIFA	PIFA	IPEX MHF4	---	2	External
5	Laird	Laird NFC	spiral	---	---	---	Internal + External
6	Laird	BL5340 onboard printed PCB Trace antenna	Printed PCB	---	1.49	---	Internal
7	Laird	i-FlexPIFA	Inverted Ground Flexible Planar Inverted F Antenna (i-FlexPIFA)	---	---	3.1	External

1.1.3 EUT Operational Condition

Power Supply Type	3.3Vdc from host		
SW Version	bl5340pa_radio_test_v0.0.4		
Operational Climatic	☒ Tnom (20°C)	☒ Tmax (105°C)	☒ Tmin (-40°C)
Operational Voltage	☒ Vnom (3.30 Vdc)	☒ Vmax (3.60 Vdc)	☒ Vmin (3.00 Vdc)

1.1.4 Accessories

N/A

1.1.5 Channel List

Channel No.	Frequency (MHz)
11	2405
12	2410
13	2415
14	2420
15	2425
16	2430
17	2435
18	2440
19	2445
20	2450
21	2455
22	2460
23	2465
24	2470
25	2475
26	2480

1.1.6 Test Tool and Duty Cycle

Test Tool	Tera Term, Version: 4.74	
Duty Cycle and Duty Factor	Duty Cycle Of Test Signal (%)	Duty Factor (dB)
	100.00%	0

1.1.7 Power Index of Test Tool

External antenna

Modulation Mode	Test Frequency (MHz)	Power Index	
		Main chip (nRF5340)	FEM chip (nRF21540)
OQPSK	2405	neg16dBm	23(Gain=18)
OQPSK	2440	neg16dBm	23(Gain=18)
OQPSK	2480	neg16dBm	23(Gain=18)

Internal antenna

Modulation Mode	Test Frequency (MHz)	Power Index	
		Main chip (nRF5340)	FEM chip (nRF21540)
OQPSK	2405	neg16dBm	24(Gain=19)
OQPSK	2440	neg16dBm	23(Gain=18)
OQPSK	2480	neg16dBm	24(Gain=19)

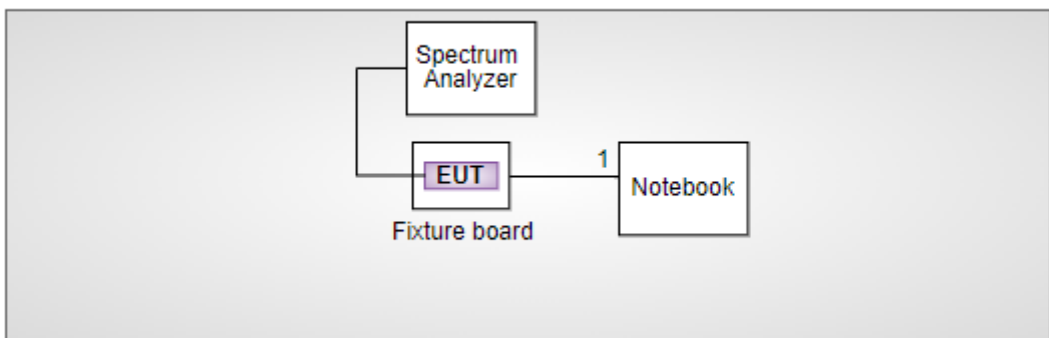
Note:

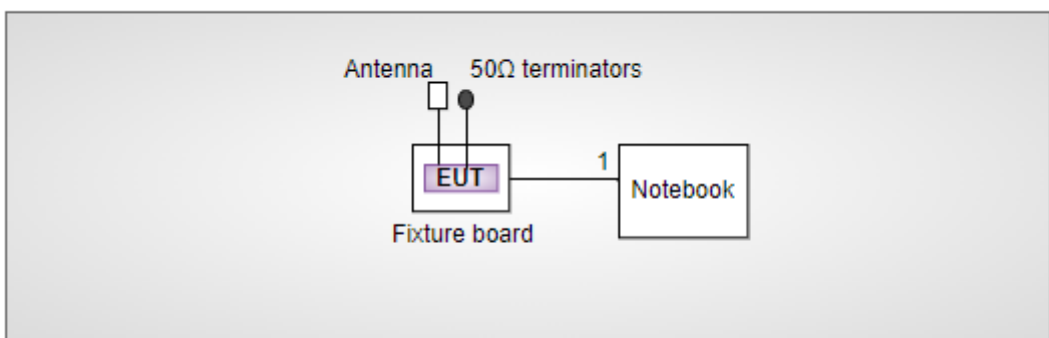
BL5340PA modules certified with FIXED default nRF21540 TX_Gain=POUTA_PROD=20dB±0.5dB (which is the TX_Gain value stored in the nRF21540 chip production by Nordic per chip to chip to hit the TX_Gain=POUTA_PROD=20dB±0.5dB). This particular certification sample had Nordic calibrated and stored TX_Gain value in decimal of 25." "BL5340PA consists of nRF5340 chip RF driving the nRF21540 Front end module (FEM) which is used in 20dB FIXED TX_Gain mode.

1.2 Local Support Equipment List

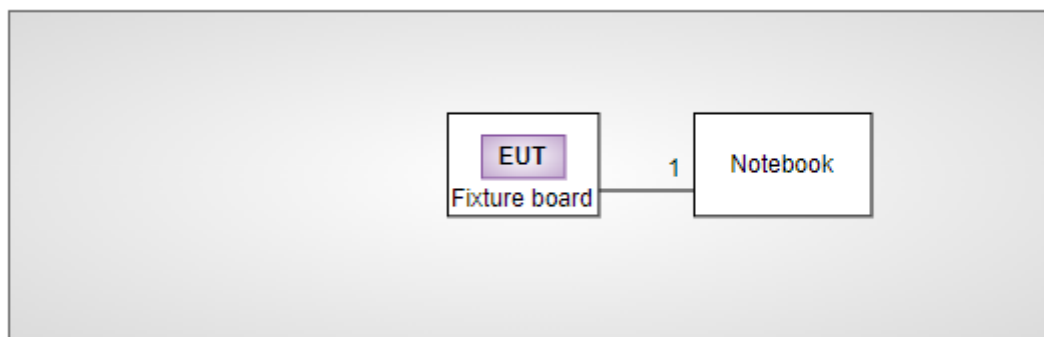
Support Equipment List					
No.	Equipment	Brand	Model	S/N	Remarks
1	Notebook	DELL	Latitude 3400	GKZLWZ2	---
2	50Ω terminators	---	---	---	Provided by applicant
3	Fixture board	---	---	---	---

1.3 Test Setup Chart

Test Setup Diagram (Conducted, External antenna)	
	
No.	Signal cable / Length (m)
1	USB, 1m shielded.

Test Setup Diagram (Radiated, External antenna)	
	
No.	Signal cable / Length (m)
1	USB, 1m shielded.

Test Setup Diagram (Radiated, Internal antenna)



No.	Signal cable / Length (m)
1	USB, 1m shielded.

1.4 Test Equipment List and Calibration Data

Test Item	Radiated Emissions				
Test Site	Fully-anechoic chamber 1 / (05CH01-WS)				
Test Date	Apr. 21 ~ Apr. 25, 2023				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	Agilent	N9010A	MY54200247	Oct. 24, 2022	Oct. 23, 2023
Bilog Antenna 30-1000MHz	SCHWARZBECK	VULB9168	9168-524	Dec. 20, 2022	Dec. 19, 2023
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	9120 D 1094	Nov. 04, 2022	Nov. 03, 2023
Preamplifier	Agilent	83017A	MY39501310	Nov. 07, 2022	Nov. 06, 2023
Preamplifier	EMC	EMC02325	980146	Oct. 26, 2022	Oct. 25, 2023
RF cable-1M	EMC	EMC104-35M-35M-1000	S/N:210904	Oct. 11, 2022	Oct. 10, 2023
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY16609/4	Oct. 11, 2022	Oct. 10, 2023
RF cable-4M	HUBER+SUHNER	SUCOFLEX104	MY15686/4	Oct. 11, 2022	Oct. 10, 2023
LF cable-3M	Woken	CFD400NL-LW	CFD400NL-005	Oct. 11, 2022	Oct. 10, 2023
LF cable-10M	Woken	CFD400NL-LW	CFD400NL-006	Oct. 11, 2022	Oct. 10, 2023
Measurement Software	AUDIX	e3	6.120210g	NA	NA

Note: Calibration Interval of instruments listed above is one year.

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Test Date	May 04 ~ May 22, 2023				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101486	Mar. 03, 2023	Mar. 02, 2024
TEMP&HUMIDITY CHAMBER	GIANT FORCE	GCT-225-40-SP-SD	MAF1212-002	Jun. 22, 2022	Jun. 21, 2023
Power Sensor	Agilent	U2021XA	MY53480019	Mar. 07, 2023	Mar. 06, 2024
Power Sensor	Agilent	U2021XA	MY53510003	Mar. 07, 2023	Mar. 06, 2024
Power Sensor	Agilent	U2021XA	MY54070003	Mar. 27, 2023	Mar. 26, 2024
Power Sensor	Agilent	U2021XA	MY54060013	Mar. 27, 2023	Mar. 26, 2024
RF cable	EMC	EMC104-35M-35M-1000	210928	Oct. 14, 2022	Oct. 13, 2023
RF Cable	EMC	EMC104-35M-35M-1000	210929	Oct. 14, 2022	Oct. 13, 2023
RF Cable	EMC	EMC104-35M-35M-1000	210930	Oct. 14, 2022	Oct. 13, 2023
RF Cable	EMC	EMC104-35M-35M-1000	210931	Oct. 14, 2022	Oct. 13, 2023
Measurement Software	Sporton	SENSE	5.10.7	NA	NA
Measurement Software	Agilent	EN RF test	1.1501125	NA	NA

Note: Calibration Interval of instruments listed above is one year.

Test Item	Receiver Blocking				
Test Site	(05CH02-WS)				
Test Date	May 24, 2023				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Signal Generator	ROHDE&SCHWARZ	SMBV100A	263146	Feb.06,2023	Feb.05,2024
RF Cable	HUBER+SUHNER	SUCOFLEX_104	500202/4	Oct.13,2022	Oct.12,2023
RF Cable	HUBER+SUHNER	SUCOFLEX_104	296088/4	Oct.13,2022	Oct.12,2023
RF Cable	HUBER+SUHNER	SUCOFLEX_104	329023/4	Oct.13,2022	Oct.12,2023
Combiner(1X2)	WOKEN	2WAYDIV	12101200003	Oct.13,2022	Oct.12,2023
Note: Calibration Interval of instruments listed above is one year.					

1.5 Testing Applied Standards

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

EN 300 328 V2.2.2 (2019-07)

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)).

Measurement Uncertainty		
Parameters	Uncertainty	Limit
Occupied Channel Bandwidth	±0.0034 %	±5 %
RF output power, conducted	±0.592 dB	±1.5 dB
Power Spectral Density, conducted	±0.583 dB	±3 dB
Unwanted Emissions, conducted	±2.715 dB	±3 dB
All emissions, radiated	±3.14 dB	±6 dB
Temperature	±0.4 °C	±3 °C
Supply voltages	±0.15 %	±3 %
Time	±0.1 %	±5 %

2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	TH01-WS, 05CH01-WS
Address of Test Site	No.3-1, Lane 6, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)
Test Site	05CH02-WS
Address of Test Site	No.14-1, Lane 19, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Frequency (MHz)	Conducted / Radiated measurement	TX/RX	Test Configuration
RF Output Power Power Spectral Density Occupied Channel Bandwidth	OQPSK	2405 / 2440 / 2480	Conducted	TX	1, 2
Transmitter unwanted emissions in the out of band domain	OQPSK	2405 / 2480	Conducted	TX	1, 2
Transmitter Spurious Emissions	OQPSK	2405 / 2480	Conducted	TX	1, 2
Receiver Spurious Emissions	OQPSK	2405 / 2480	Conducted	RX	1, 2
Transmitter Spurious Emissions	OQPSK	2405 / 2480	Radiated	TX	1 Note ³ , 2
Receiver Spurious Emissions	OQPSK	2405 / 2480	Radiated	RX	1 Note ³ , 2
Receiver Blocking	OQPSK	2405 / 2480	Conducted	RX	1, 2

NOTE:

- The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** result was found as the worst case and was shown in this report.
- Test configurations are listed as below:
 - Configuration 1: Power index of External antenna (Model: i-FlexPIFA) + Laird NFC
 - Configuration 2: Power index of Internal antenna + Laird NFC
- The 50Ω terminators are connected to antenna port of EUT for radiated emission measurement.
- nRF5340 chipset DCDC convertor Mode A : VREGRADIO DCDC on / VRERGMMAIN DCDC on / VREGH DCDC on
nRF5340 chipset DCDC convertor Mode B : VREGRADIO DCDC off / VRERGMMAIN DCDC off / VREGH DCDC off
Mode A is the worst case

3 Transmitter Test Results

3.1 RF Output Power

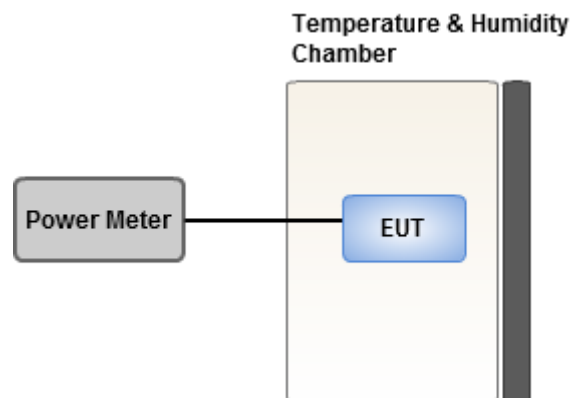
3.1.1 Limit of RF Output Power

The maximum RF output power shall be 20 dBm.

3.1.2 Test Procedures

Reference to clause 5.4.2.2 of ETSI EN 300 328 V2.2.2 (2019-07).

3.1.3 Test Setup



3.1.4 Test Results

Ambient Condition	19-22°C / 61-64%	Tested By	Alan Tang
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Refer to Appendix A.

3.2 Power Spectral Density

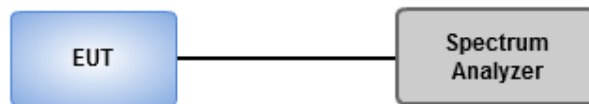
3.2.1 Limit of Power Spectral Density

The maximum Power Spectral Density is limited to 10 dBm per MHz.

3.2.2 Test Procedures

Reference to clause 5.4.3.2 of ETSI EN 300 328 V2.2.2 (2019-07).

3.2.3 Test Setup



3.2.4 Test Results

Ambient Condition	19-22°C / 61-64%	Tested By	Alan Tang
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Refer to Appendix B.

3.3 Occupied Channel Bandwidth

3.3.1 Limit of Occupied Channel Bandwidth

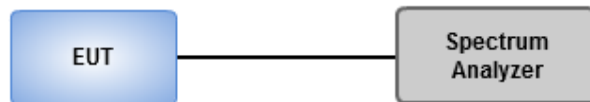
The Occupied Channel Bandwidth shall fall completely within 2.4~2.4835 GHz.

In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.

3.3.2 Test Procedures

Reference to clause 5.4.7.2 of ETSI EN 300 328 V2.2.2 (2019-07).

3.3.3 Test Setup



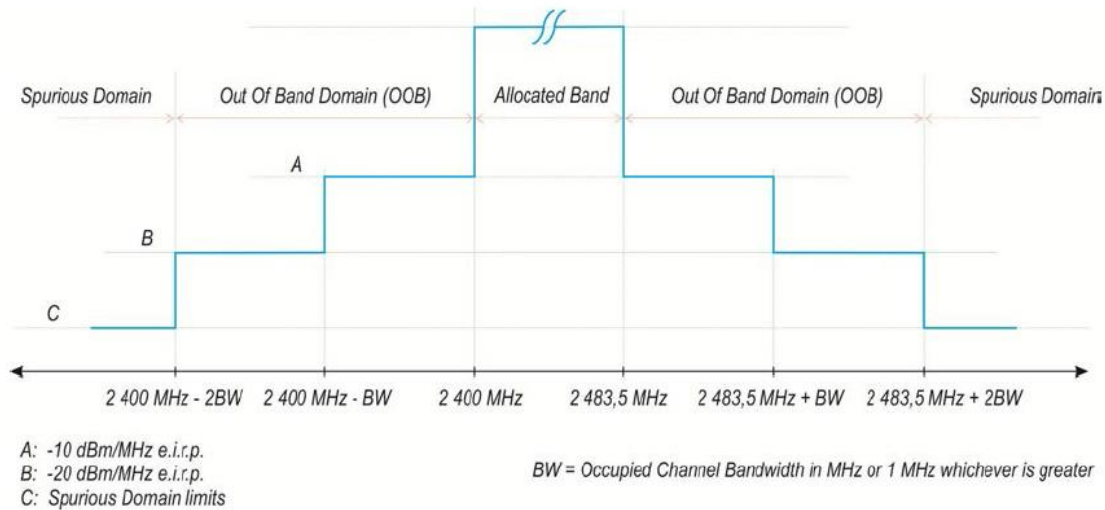
3.3.4 Test Results

Ambient Condition	19-22°C / 61-64%	Tested By	Alan Tang
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Refer to Appendix C.

3.4 Transmitter Unwanted Emissions in the Out-Of-Band Domain

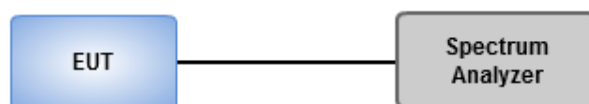
3.4.1 Limit of Transmitter Unwanted Emissions in the Out-Of-Band Domain



3.4.2 Test Procedures

Reference to clause 5.4.8.2 of ETSI EN 300 328 V2.2.2 (2019-07).

3.4.3 Test Setup



3.4.4 Test Results

Ambient Condition	19-22°C / 61-64%	Tested By	Alan Tang
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Refer to Appendix D.

3.5 Transmitter Unwanted Emissions in the Spurious Domain

3.5.1 Limit of Transmitter Unwanted Emissions in the Spurious Domain

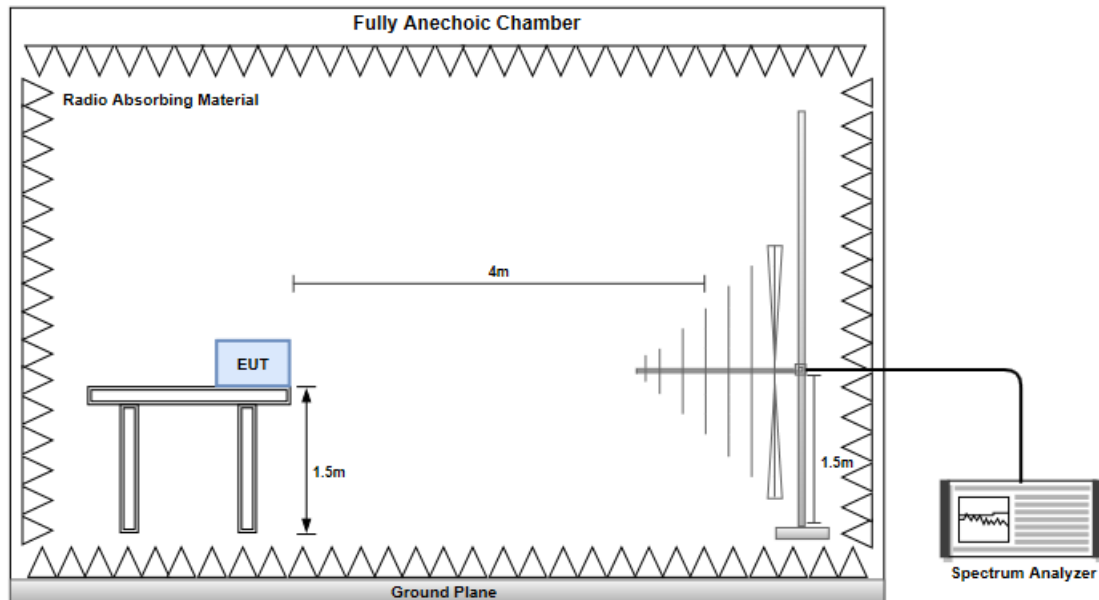
Frequency Range (MHz)	Maximum power (dBm)	Bandwidth (kHz)
30 to 47	-36	100
47 to 74	-54	100
74 to 87,5	-36	100
87,5 to 118	-54	100
118 to 174	-36	100
174 to 230	-54	100
230 to 470	-36	100
470 to 694	-54	100
694 to 1000	-36	100
1000 to 12750	-30	1000

3.5.2 Test Procedures

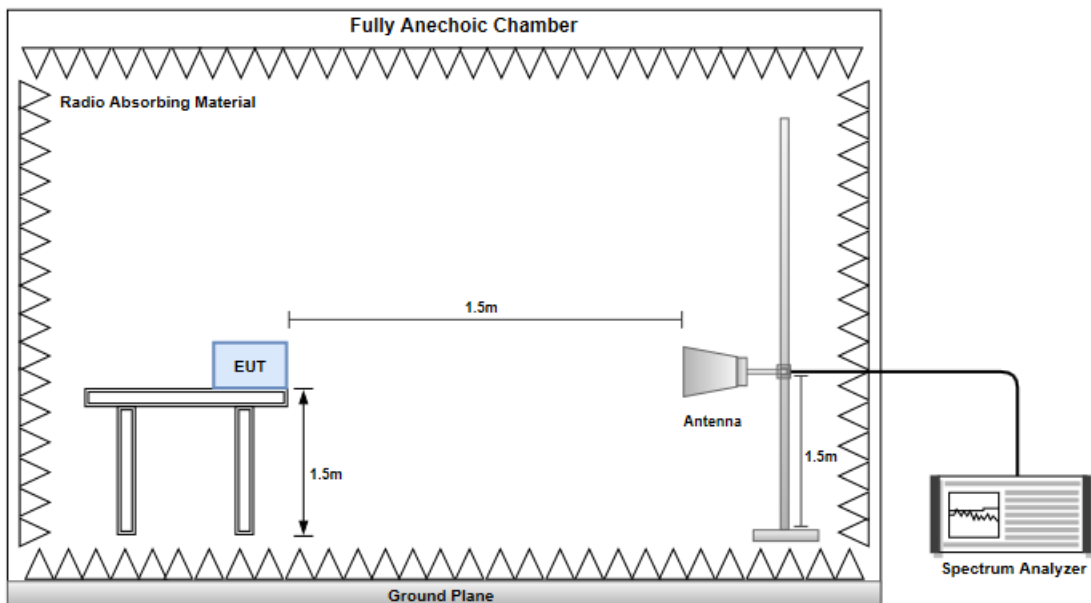
Reference to clause 5.4.9.2 of ETSI EN 300 328 V2.2.2 (2019-07).

3.5.3 Test Setup

Below 1GHz



Above 1 GHz



3.5.4 Test Results

Refer to Appendix E.

4 Receiver Test Results

4.1 Receiver Spurious Emissions

4.1.1 Limit of Receiver Spurious Emissions

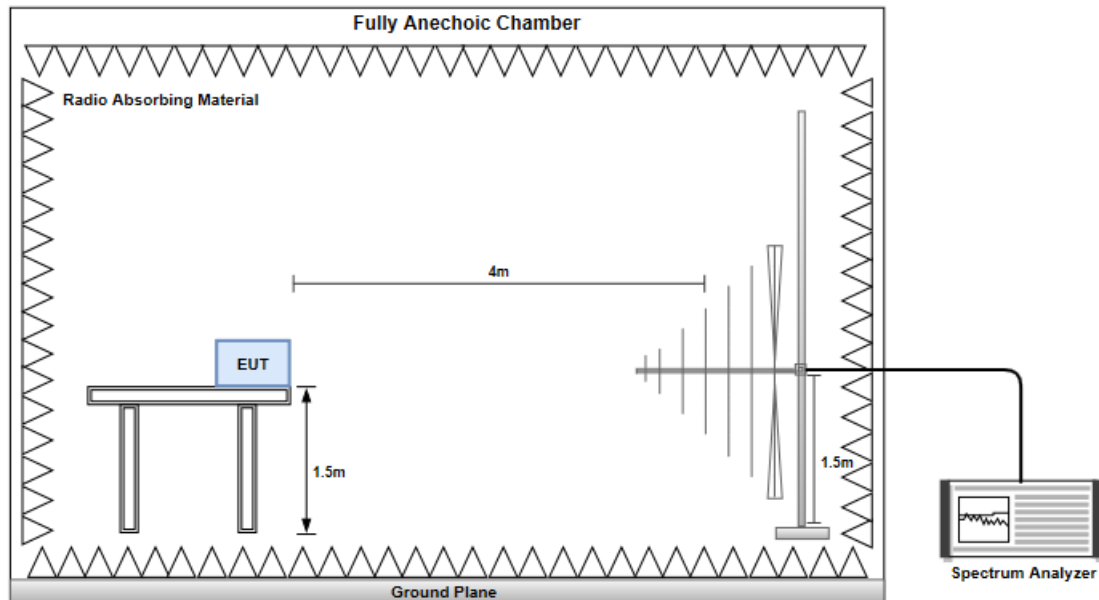
Frequency Range	Maximum power (dBm)	Measurement bandwidth (kHz)
30 MHz to 1 GHz	-57	100
Above 1 GHz to 12,75 GHz	-47	1000

4.1.2 Test Procedures

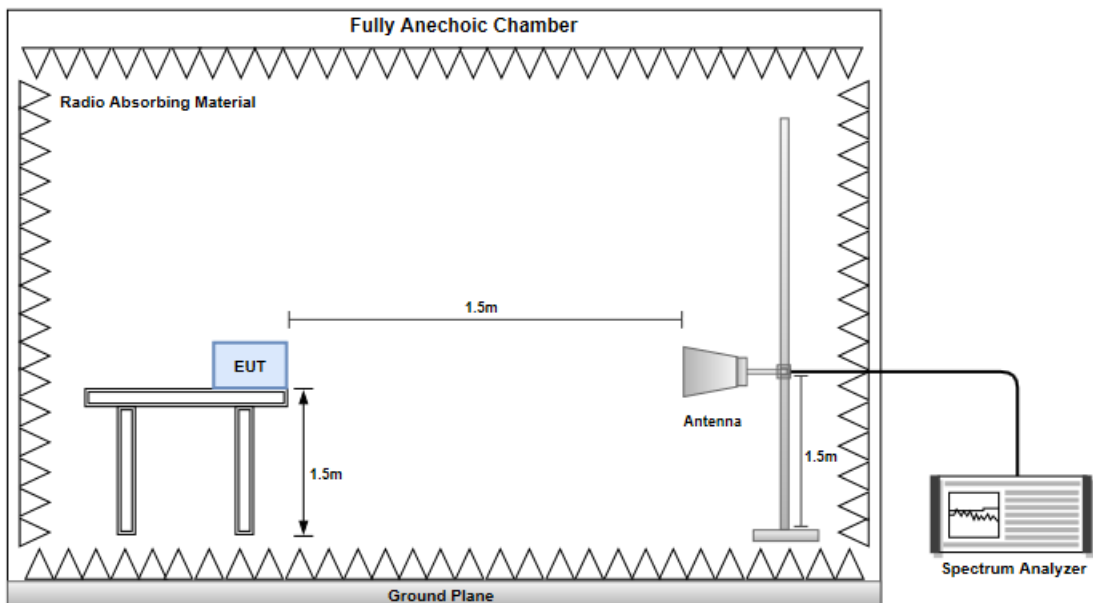
Reference to clause 5.4.10.2 of ETSI EN 300 328 V2.2.2 (2019-07).

4.1.3 Test Setup

Below 1GHz



Above 1 GHz



4.1.4 Test Results

Refer to Appendix F.

5 Receiver Blocking Test Results

5.1 Receiver Blocking

5.1.1 Limit of Receiver Blocking

Receiver Blocking Parameters for Receiver Category 1 Equipment Limit			
Wanted Signal Mean Power from Companion Device (dBm) (see notes 1 and 4)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm) (see note 4)	Type of Blocking Signal
$(-133 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}))$ or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}))$ or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 584 2 674		
Note 1: OCBW is in Hz. Note 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{\min} + 26 \text{ dB}$ where $P_{\min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. Note 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{\min} + 20 \text{ dB}$ where $P_{\min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. Note 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned.			

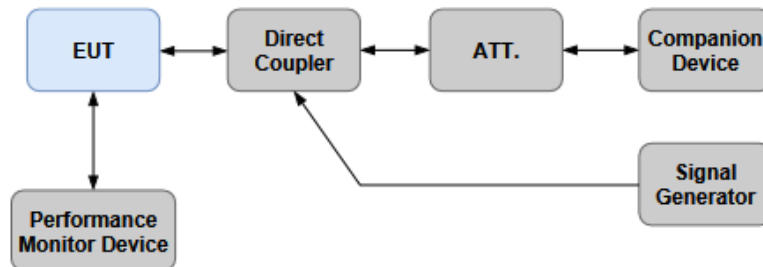
Receiver Blocking Parameters for Receiver Category 2 Equipment Limit			
Wanted Signal Mean Power from Companion Device (dBm) (see notes 1 and 3)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm) (see note 3)	Type of Blocking Signal
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 10 \text{ dB})$ or $(-74 \text{ dBm} + 10 \text{ dB})$ whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
Note 1: OCBW is in Hz. Note 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to $P_{\min} + 26 \text{ dB}$ where $P_{\min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. Note 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned.			

Receiver Blocking Parameters for Receiver Category 3 Equipment Limit			
Wanted Signal Mean Power from Companion Device (dBm) (see notes 1 and 3)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm) (see note 3)	Type of Blocking Signal
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 20 \text{ dB})$ or $(-74 \text{ dBm} + 20 \text{ dB})$ whichever is less	2 380 2 504 2 300 2 584	-34	CW
Note 1: OCBW is in Hz. Note 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative the test may be performed using a wanted signal up to $P_{\min} + 30 \text{ dB}$ where $P_{\min}$ is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. Note 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned.			

5.1.2 Test Procedures

Reference to clause 5.4.11.2 of ETSI EN 300 328 V2.2.2 (2019-07).

5.1.3 Test Setup



5.1.4 Test Results

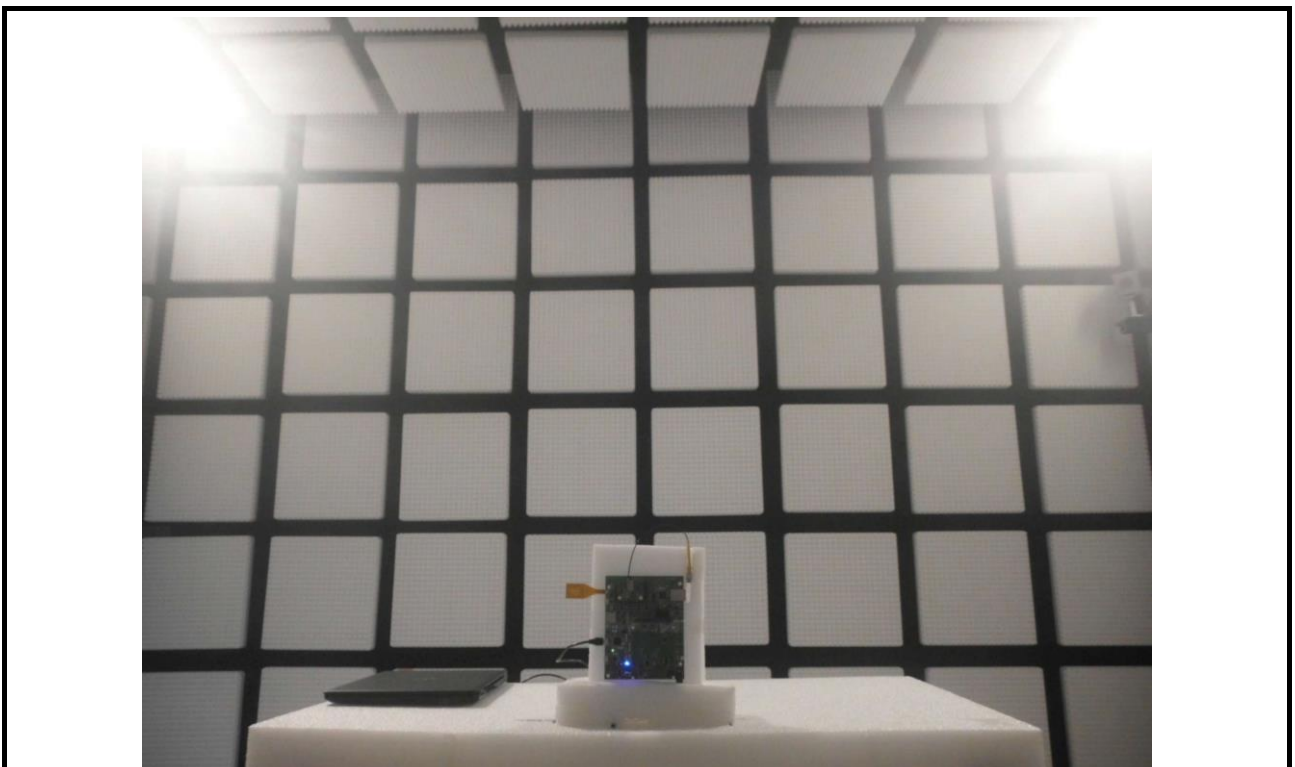
Ambient Condition	25°C / 65%	Tested By	Hugo Zhen
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Refer to Appendix G.

6 Photographs of the Test Configuration

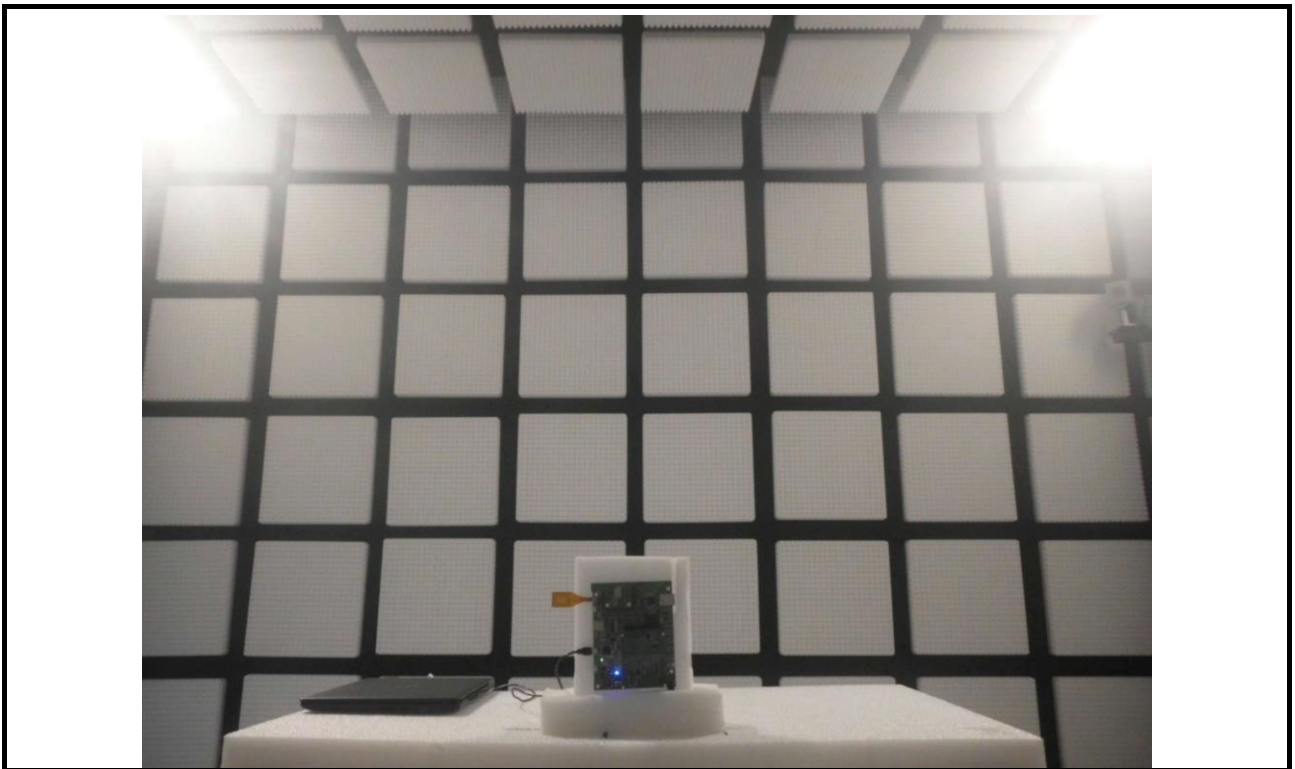
External Antenna

Spurious Emission Test (Radiated)

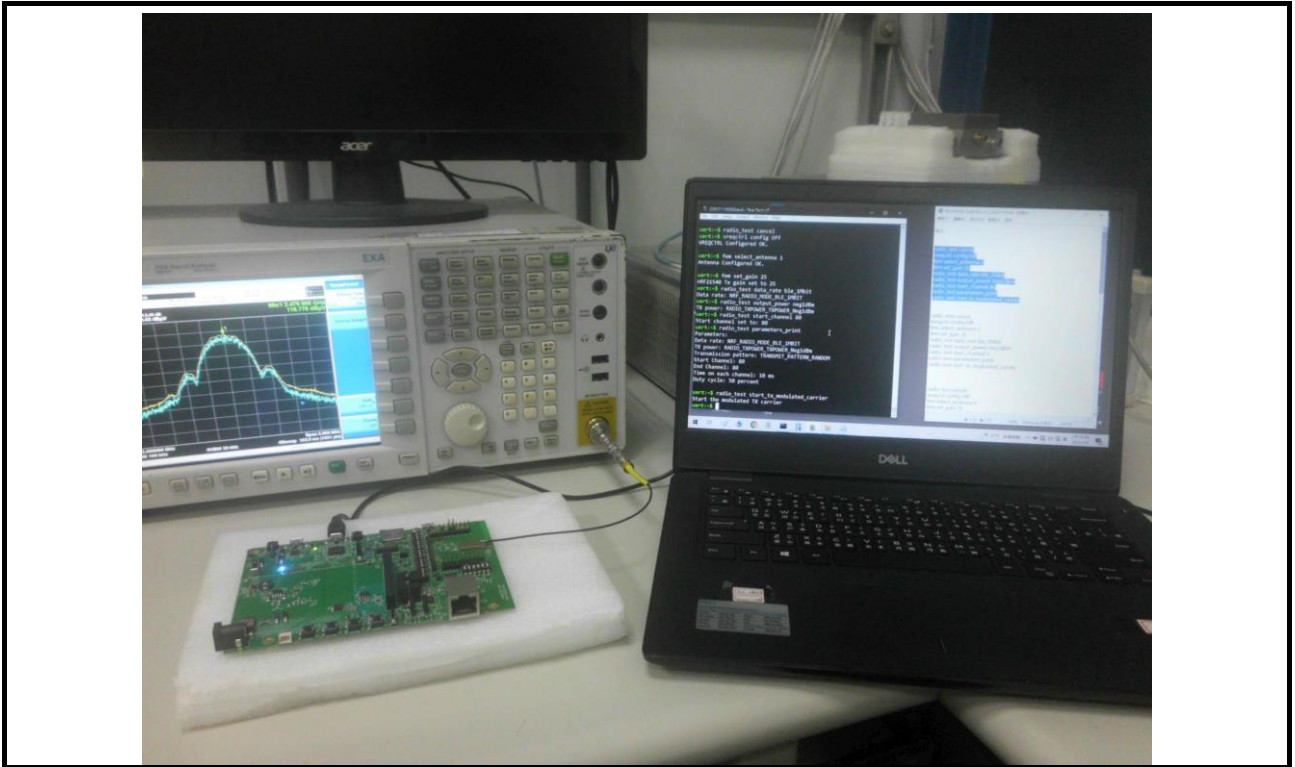


Internal Antenna

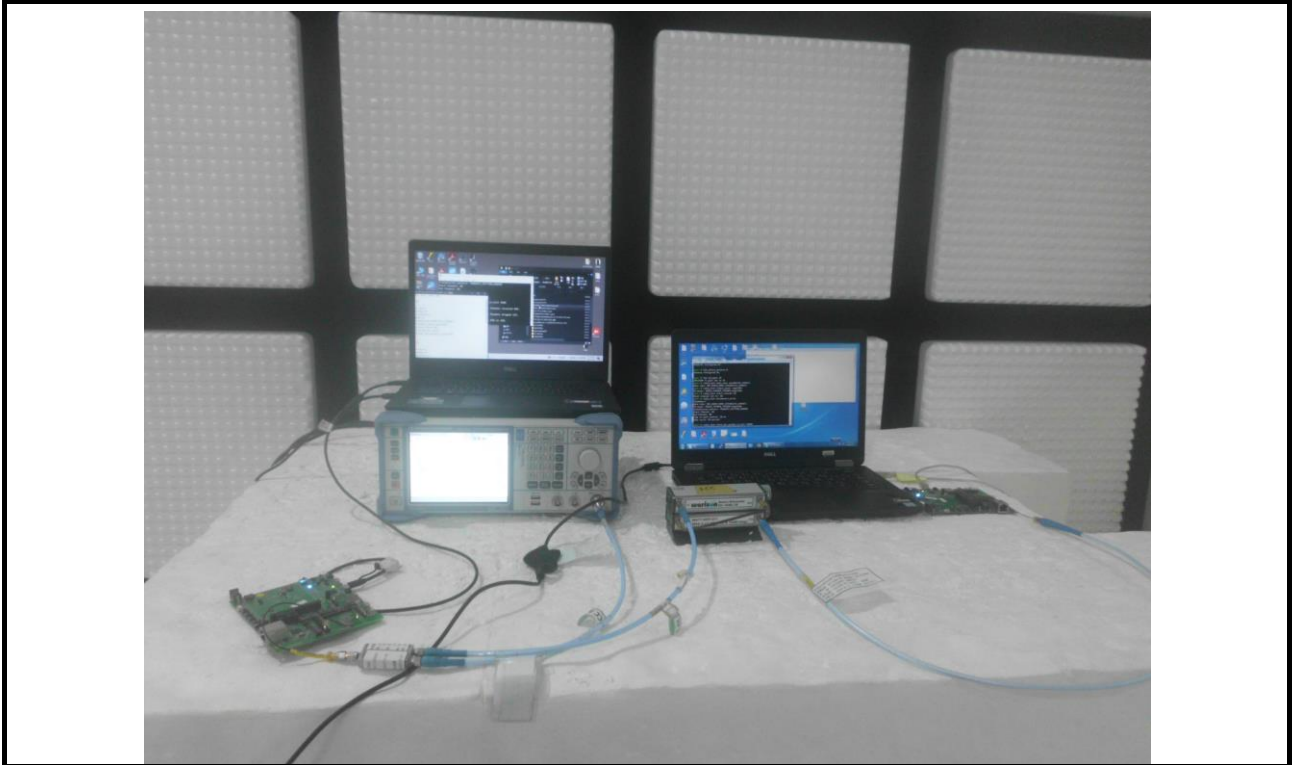
Spurious Emission Test



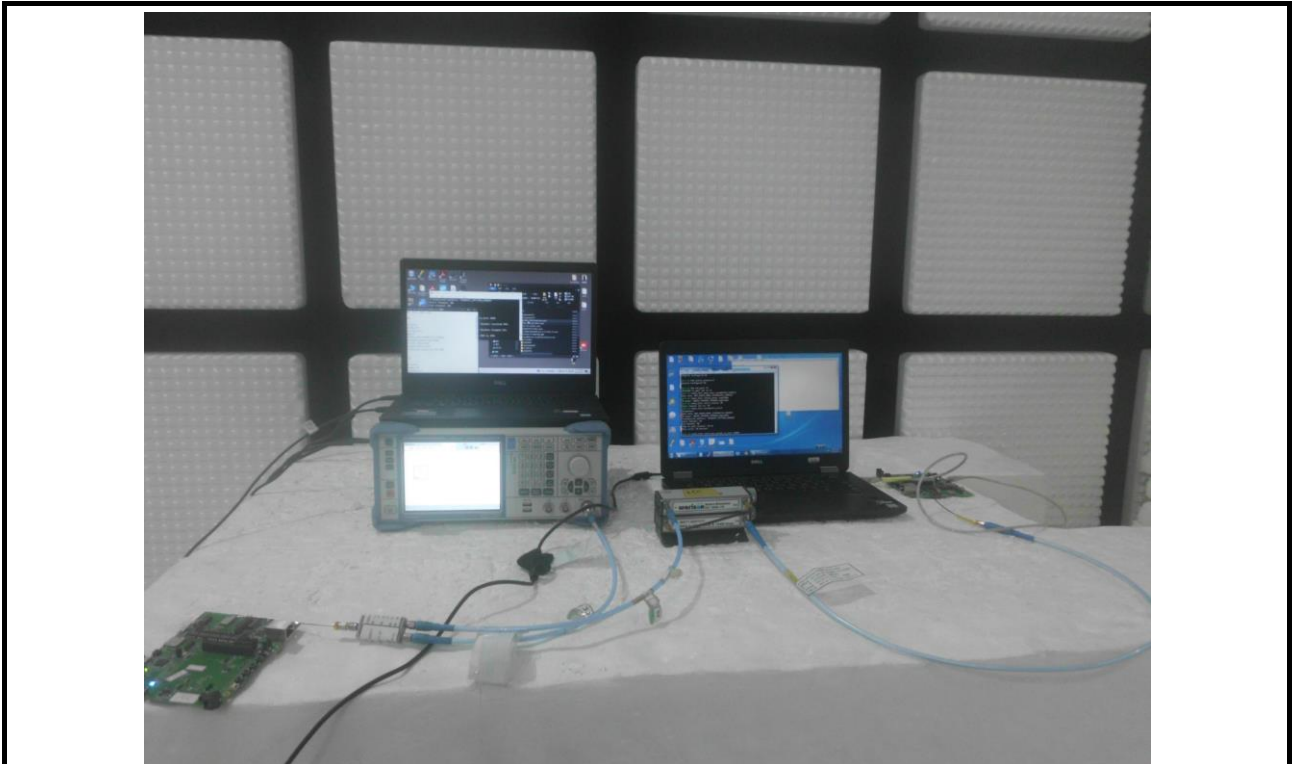
Spurious Emission Test (Conducted)



Receiver Blocking Test (*External Antenna*)



Receiver Blocking Test (*Internal Antenna*)



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

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

Linkou

Tel: 886-2-2601-1640

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

Kwei Shan

Tel: 886-3-271-8666

No.3-1, Lane 6, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)
No.2-1, Lane 6, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)

Kwei Shan Site II

Tel: 886-3-271-8640

No.14-1, Lane 19, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)

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

Tel: 886-3-271-8666

Fax: 886-3-318-0345

Email: ICC_Service@icertifi.com.tw

==END==

External Antenna

RF Output Power (dBm)					
Condition	Modulation Mode	Freq. (MHz)	EIRP Power (dBm)	Limit (dBm)	Results
T _{nom} V _{nom}	O-QPSK	2405	6.94	20	Pass
T _{min} V _{nom}	O-QPSK	2405	9.18	20	Pass
T _{max} V _{nom}	O-QPSK	2405	3.13	20	Pass
T _{nom} V _{nom}	O-QPSK	2440	7.64	20	Pass
T _{min} V _{nom}	O-QPSK	2440	9.93	20	Pass
T _{max} V _{nom}	O-QPSK	2440	3.77	20	Pass
T _{nom} V _{nom}	O-QPSK	2480	6.85	20	Pass
T _{min} V _{nom}	O-QPSK	2480	9.13	20	Pass

Note:

- 1) Test method is conducted.
- 2) EIRP = Measured conducted power + Antenna gain. (3.10dBi)

Internal Antenna

RF Output Power (dBm)					
Condition	Modulation Mode	Freq. (MHz)	EIRP Power (dBm)	Limit (dBm)	Results
T _{nom} V _{nom}	O-QPSK	2405	7.60	20	Pass
T _{min} V _{nom}	O-QPSK	2405	9.81	20	Pass
T _{max} V _{nom}	O-QPSK	2405	4.11	20	Pass
T _{nom} V _{nom}	O-QPSK	2440	7.24	20	Pass
T _{min} V _{nom}	O-QPSK	2440	9.37	20	Pass
T _{max} V _{nom}	O-QPSK	2440	3.61	20	Pass
T _{nom} V _{nom}	O-QPSK	2480	7.36	20	Pass
T _{min} V _{nom}	O-QPSK	2480	9.43	20	Pass

Note:

- 1) Test method is conducted.
- 2) EIRP = Measured conducted power + Antenna gain. (1.49dBi)

**External Antenna****Summary**

Mode	EIRP PD (dBm/MHz)
2.4-2.4835GHz	-
802.15.4_Nss1_1TX	5.89

RBW=1MHz

Result

Mode	Result	Gain (dBi)	PD (dBm/MHz)	EIRP PD (dBm/MHz)	EIRP PD Limit (dBm/MHz)
802.15.4_Nss1_1TX	-	-	-	-	-
2405MHz_Tnom	Pass	3.10	2.15	5.25	10.00
2445MHz_Tnom	Pass	3.10	2.79	5.89	10.00
2480MHz_Tnom	Pass	3.10	2.00	5.10	10.00

RBW=1MHz;

Port X = Port X power density;

**Internal Antenna****Summary**

Mode	EIRP PD (dBm/MHz)
2.4-2.4835GHz	-
802.15.4_Nss1_1TX	7.15

RBW=1MHz

Result

Mode	Result	Gain (dBi)	PD (dBm/MHz)	EIRP PD (dBm/MHz)	EIRP PD Limit (dBm/MHz)
802.15.4_Nss1_1TX	-	-	-	-	-
2405MHz_Tnom	Pass	1.49	4.42	5.91	10.00
2445MHz_Tnom	Pass	1.49	4.05	5.54	10.00
2480MHz_Tnom	Pass	1.49	5.66	7.15	10.00

RBW=1MHz;

Port X = Port X power density;

External Antenna

Summary

Mode	OBW (Hz)	ITU-Code
2.4-2.4835GHz	-	-
802.15.4_Nss1_1TX	2.361M	2M36D1D

OBW = 99% occupied bandwidth

Result

Mode	Result	Limit (Hz)	fl-OBW (Hz)	fh-OBW (Hz)	OBW (Hz)
802.15.4_Nss1_1TX	-	-	-	-	-
2405MHz_Tnom	Pass	2.4-2.4835G	2.403809G	2.406171G	2.361M
2445MHz_Tnom	Pass	2.4-2.4835G	2.443811G	2.44617G	2.359M
2480MHz_Tnom	Pass	2.4-2.4835G	2.478799G	2.481155G	2.356M

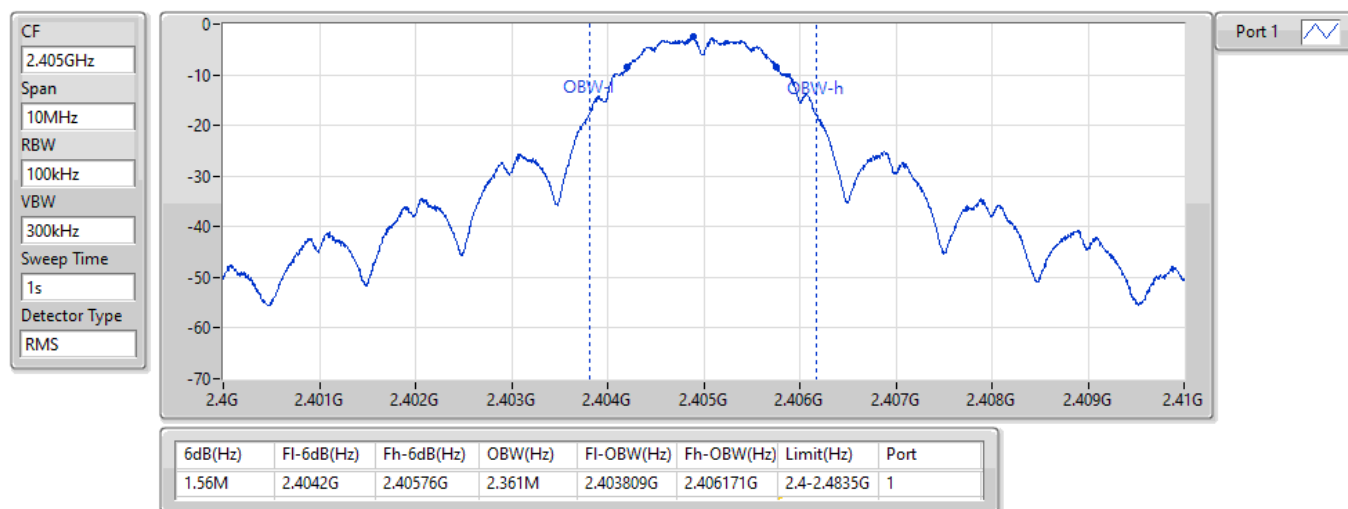
fl-OBW = fl lower edge 99% occupied bandwidth; fh-OBW = fh higher edge 99% occupied bandwidth; OBW = 99% occupied bandwidth;

N dB = 6dB down bandwidth

802.15.4_Nss1_1TX

EBW-DTS

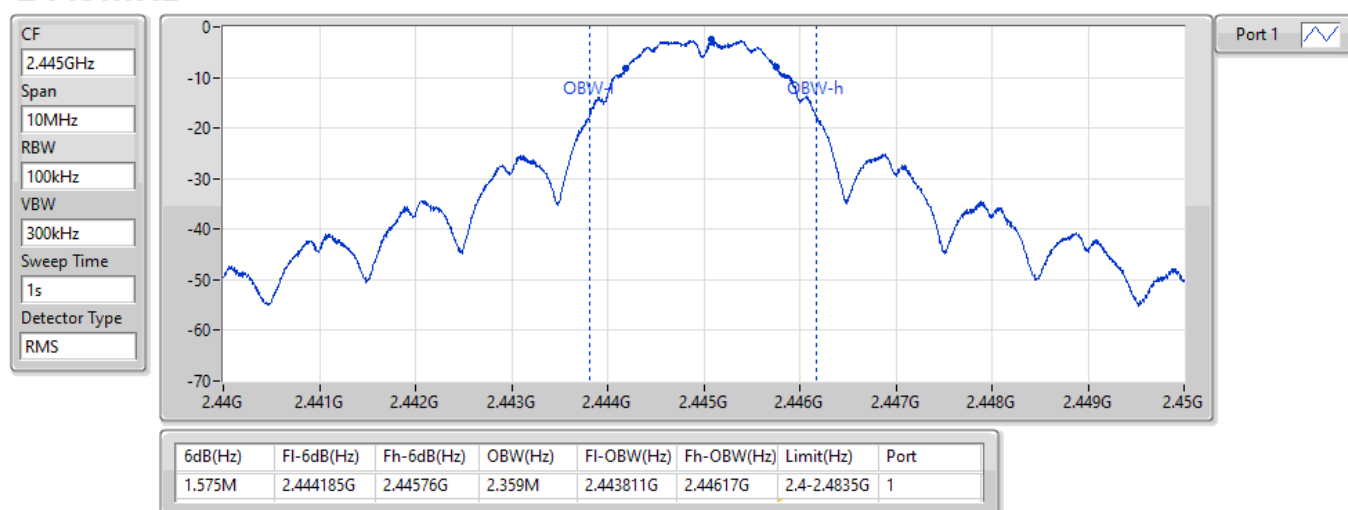
2405MHz



802.15.4_Nss1_1TX

EBW-DTS

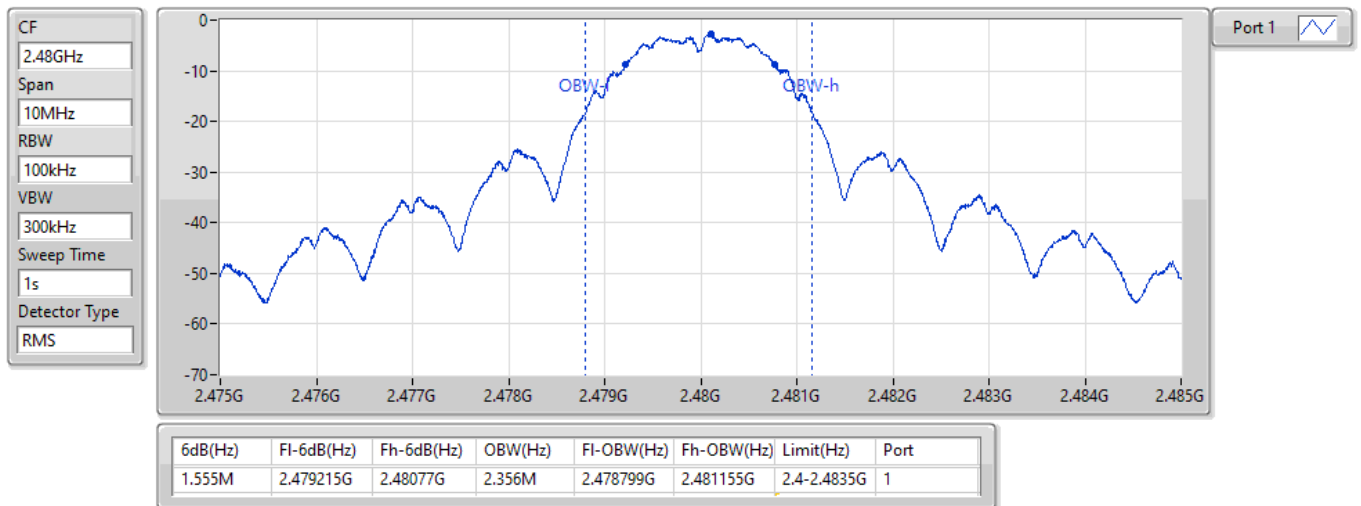
2445MHz



802.15.4_Nss1_1TX

EBW-DTS

2480MHz



**Internal Antenna****Summary**

Mode	OBW (Hz)	ITU-Code
2.4-2.4835GHz	-	-
802.15.4_Nss1_1TX	2.379M	2M38D1D

OBW = 99% occupied bandwidth

Result

Mode	Result	Limit (Hz)	fl-OBW (Hz)	fh-OBW (Hz)	OBW (Hz)
802.15.4_Nss1_1TX	-	-	-	-	-
2405MHz_Tnom	Pass	2.4-2.4835G	2.403799G	2.40616G	2.361M
2445MHz_Tnom	Pass	2.4-2.4835G	2.443789G	2.446169G	2.379M
2480MHz_Tnom	Pass	2.4-2.4835G	2.478796G	2.481152G	2.356M

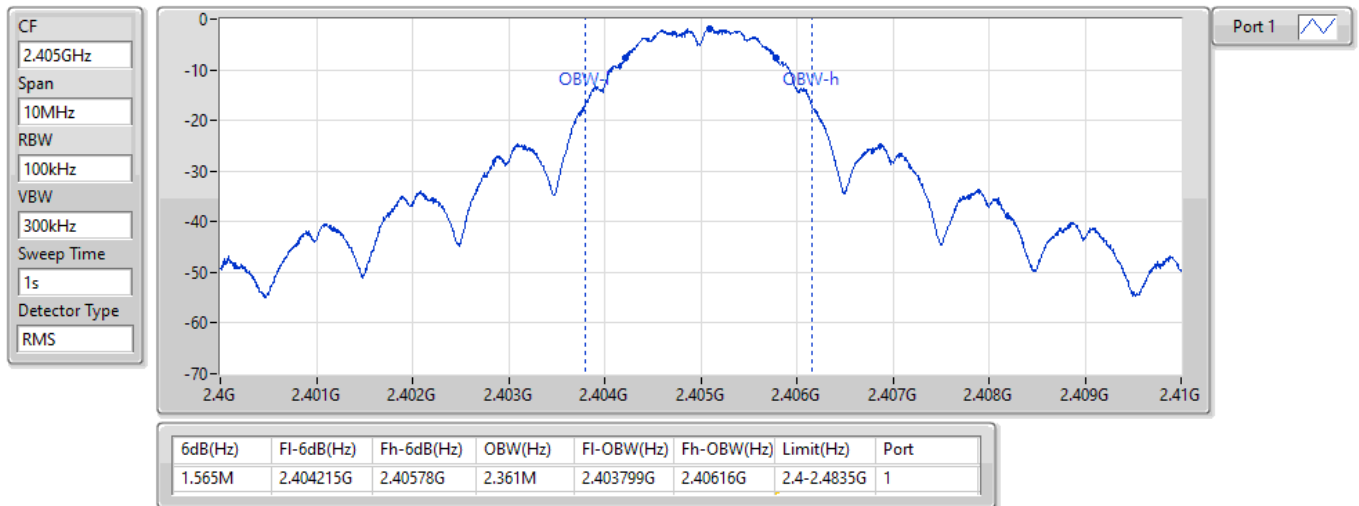
fl-OBW = fl lower edge 99% occupied bandwidth; fh-OBW = fh higher edge 99% occupied bandwidth; OBW = 99% occupied bandwidth;

N dB = 6dB down bandwidth

802.15.4_Nss1_1TX

EBW-DTS

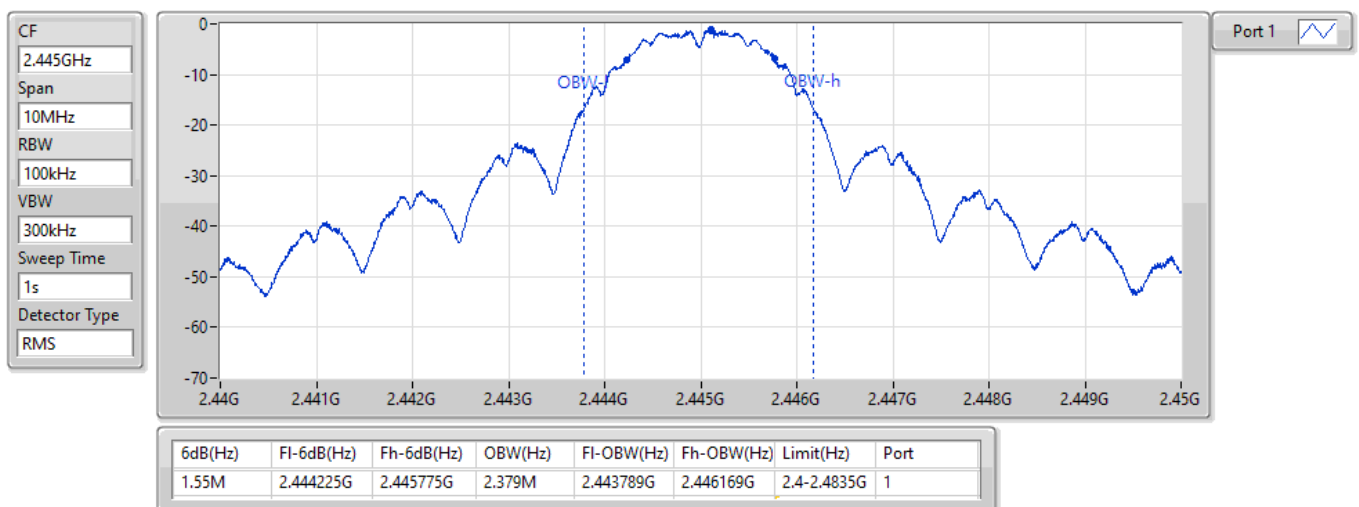
2405MHz



802.15.4_Nss1_1TX

EBW-DTS

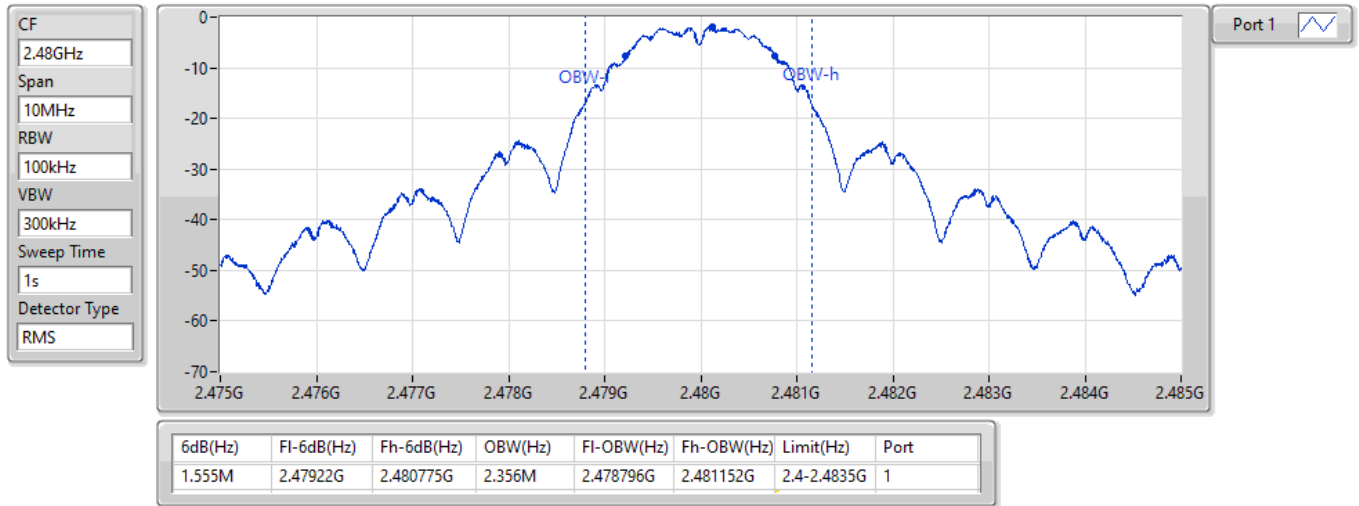
2445MHz



802.15.4_Nss1_1TX

EBW-DTS

2480MHz



**External Antenna****Summary**

Mode	EIRP-A (dBm)	Limit-A (dBm)	EIRP-B (dBm)	Limit-B (dBm)
2.4-2.4835GHz	-	-	-	-
802.15.4_Nss1_1TX	-25.51	-10	-35.76	-20

Result

Mode	Result	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)
802.15.4_Nss1_1TX	-	-	-	-	-	-	-
2405MHz_Tnom	Pass	2.397139G	-40.45	-20	2.3995G	-32.61	-10
2405MHz_Tnom	Pass	2.487722G	-46.93	-20	2.484G	-45.99	-10
2480MHz_Tnom	Pass	2.395788G	-46.82	-20	2.398144G	-47.10	-10
2480MHz_Tnom	Pass	2.486356G	-35.76	-20	2.484G	-25.51	-10

802.15.4_Nss1_1TX

MASK-DTS

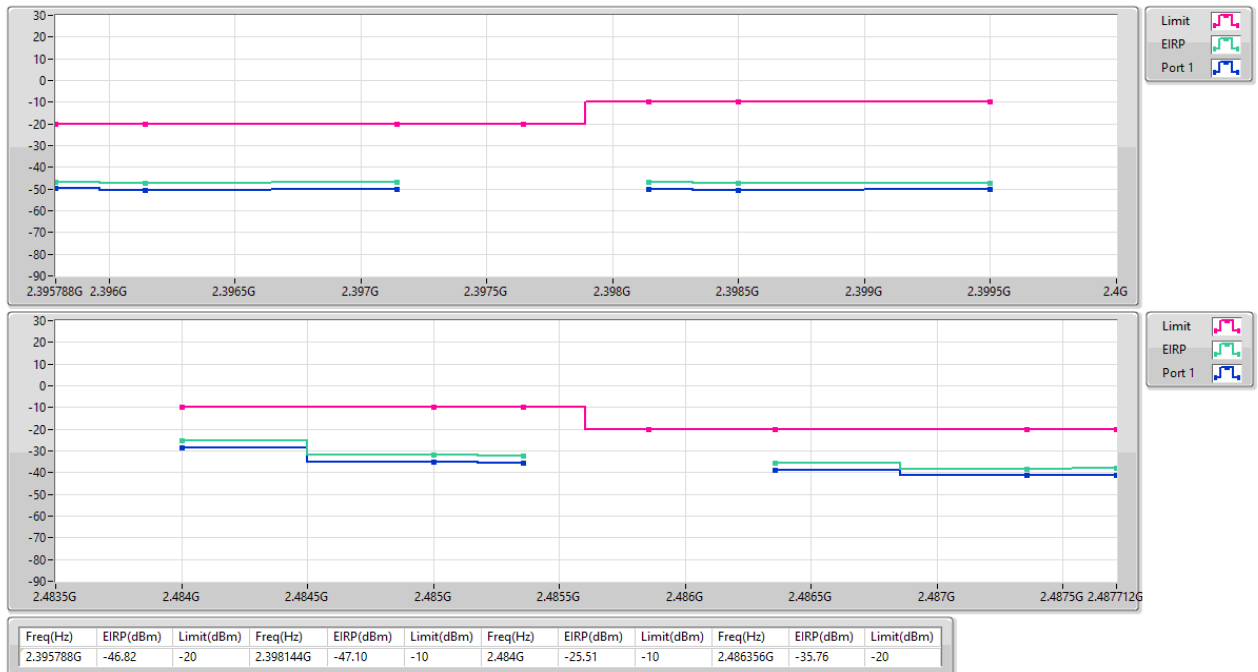
2405MHz_Tnom



802.15.4_Nss1_1TX

MASK-DTS

2480MHz_Tnom



**Internal Antenna****Summary**

Mode	EIRP-A (dBm)	Limit-A (dBm)	EIRP-B (dBm)	Limit-B (dBm)
2.4-2.4835GHz	-	-	-	-
802.15.4_Nss1_1TX	-26.24	-10	-35.88	-20

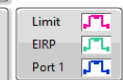
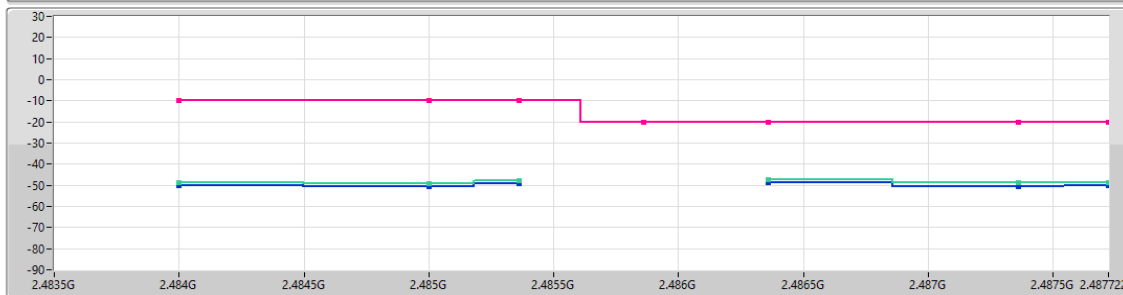
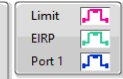
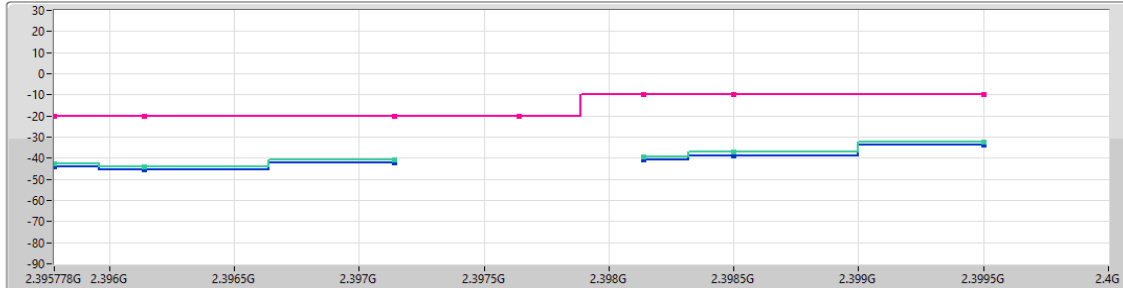
Result

Mode	Result	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)
802.15.4_Nss1_1TX	-	-	-	-	-	-	-
2405MHz_Tnom	Pass	2.397139G	-40.71	-20	2.3995G	-32.24	-10
2405MHz_Tnom	Pass	2.486361G	-47.41	-20	2.485361G	-47.82	-10
2480MHz_Tnom	Pass	2.395788G	-47.82	-20	2.398144G	-47.46	-10
2480MHz_Tnom	Pass	2.486356G	-35.88	-20	2.484G	-26.24	-10

802.15.4_Nss1_1TX

MASK-DTS

2405MHz_Tnom

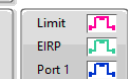
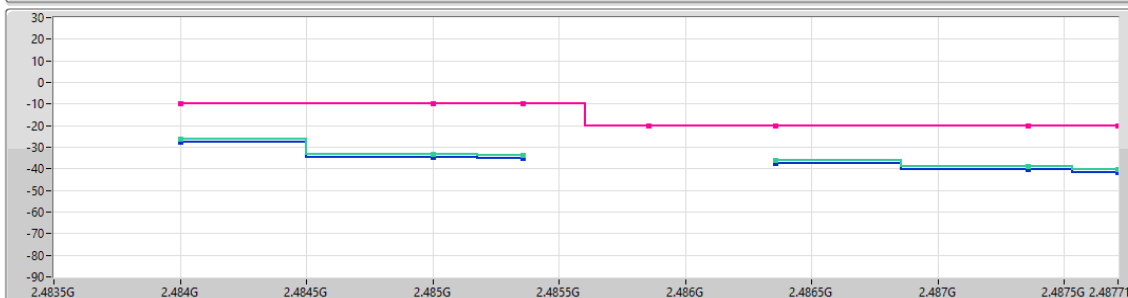
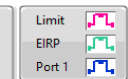
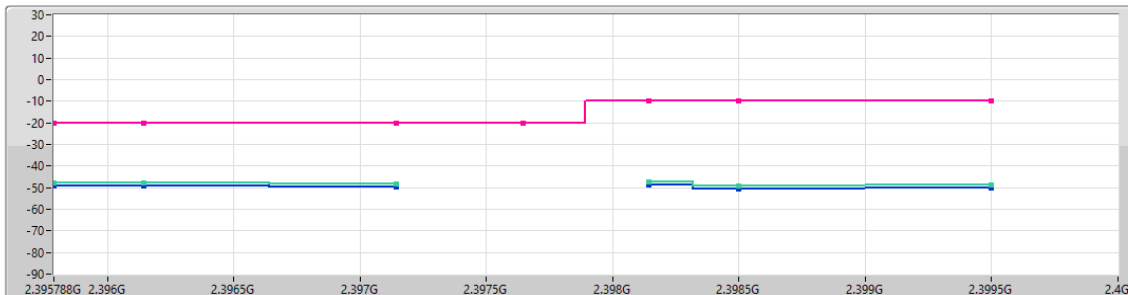


Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)
2.397139G	-40.71	-20	2.3995G	-32.24	-10	2.485361G	-47.82	-10	2.486361G	-47.41	-20

802.15.4_Nss1_1TX

MASK-DTS

2480MHz_Tnom

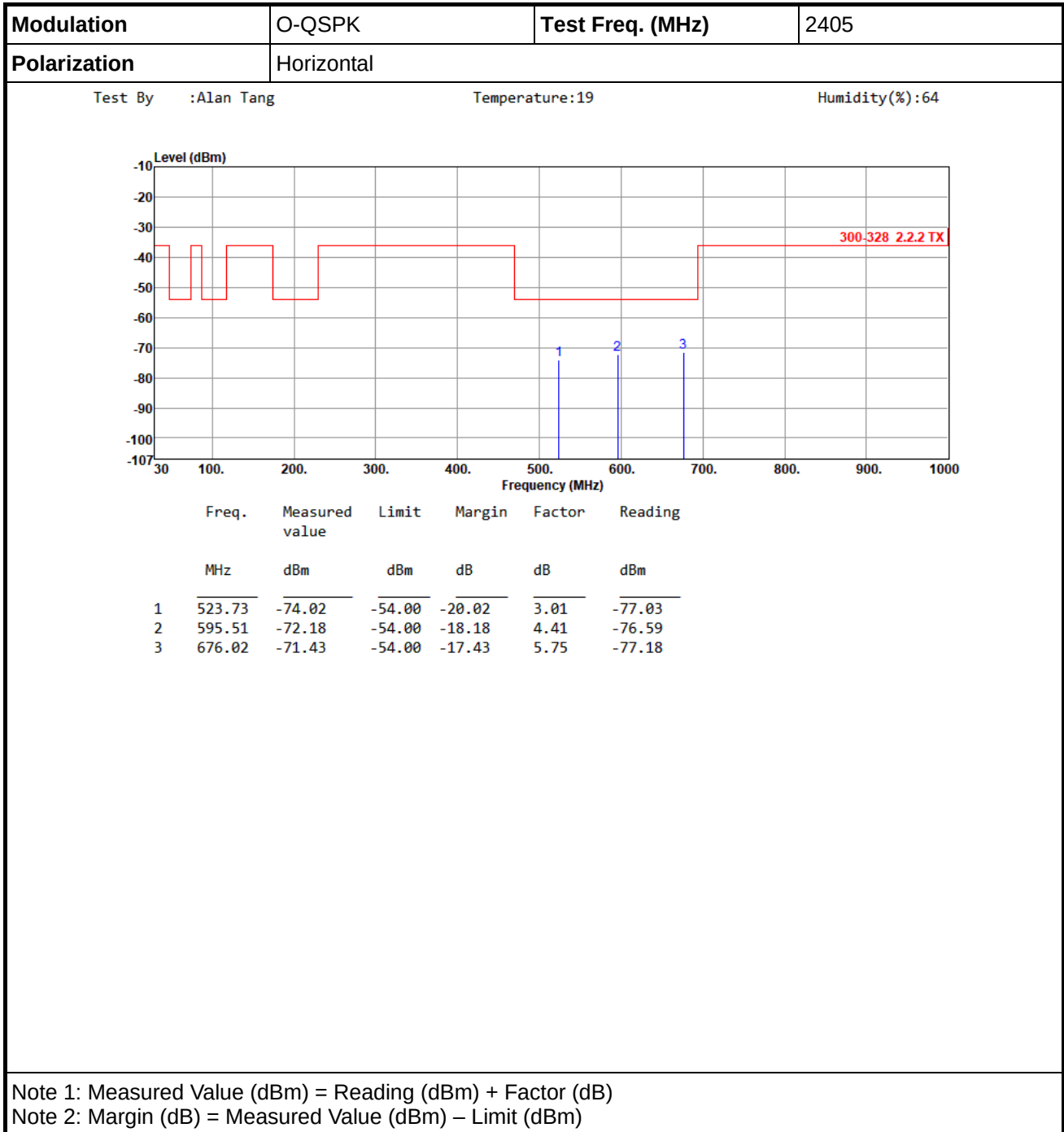


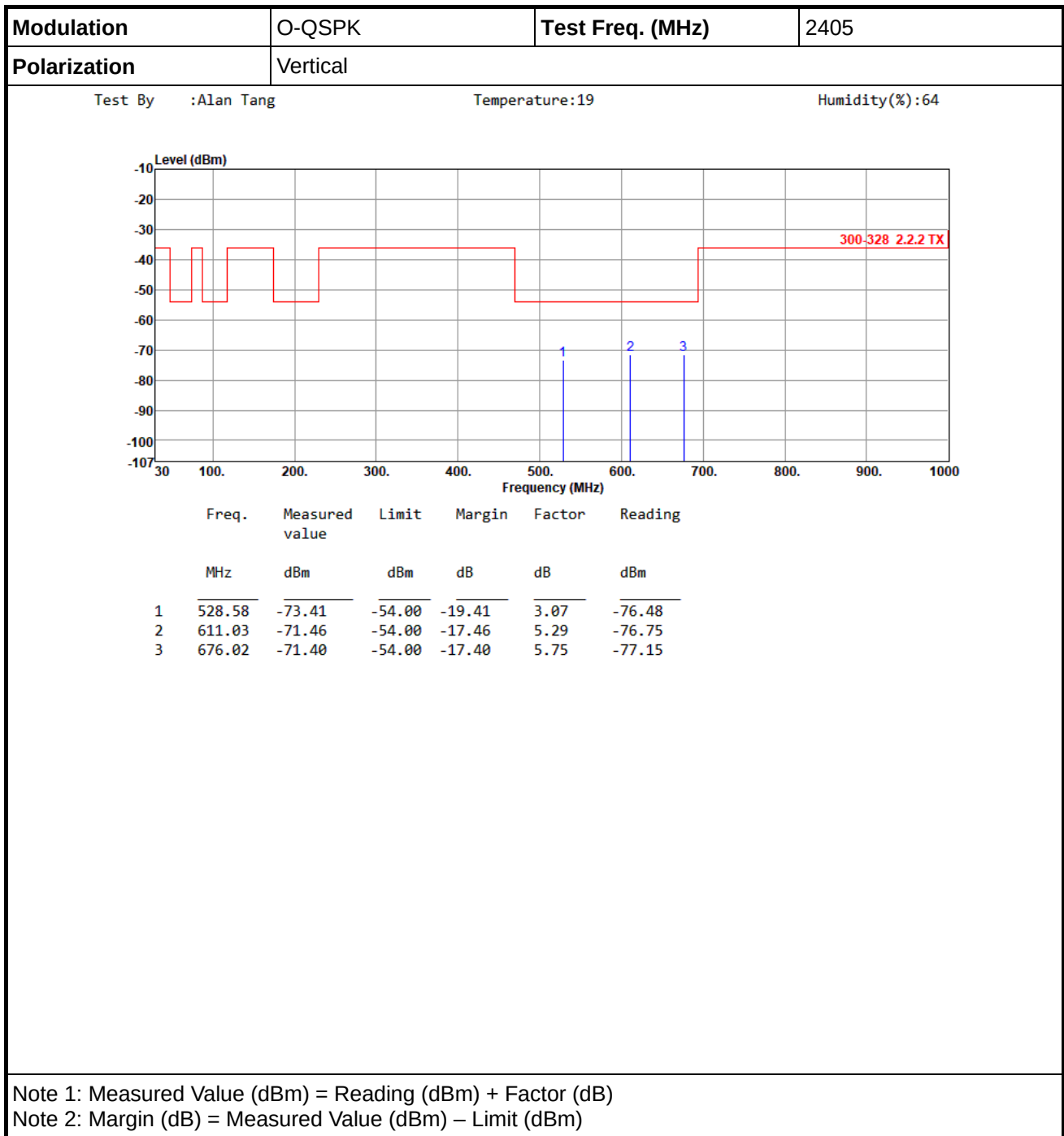
Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)
2.395788G	-47.82	-20	2.398144G	-47.46	-10	2.484G	-26.24	-10	2.486356G	-35.88	-20



External Antenna

Emissions (Below 1GHz)





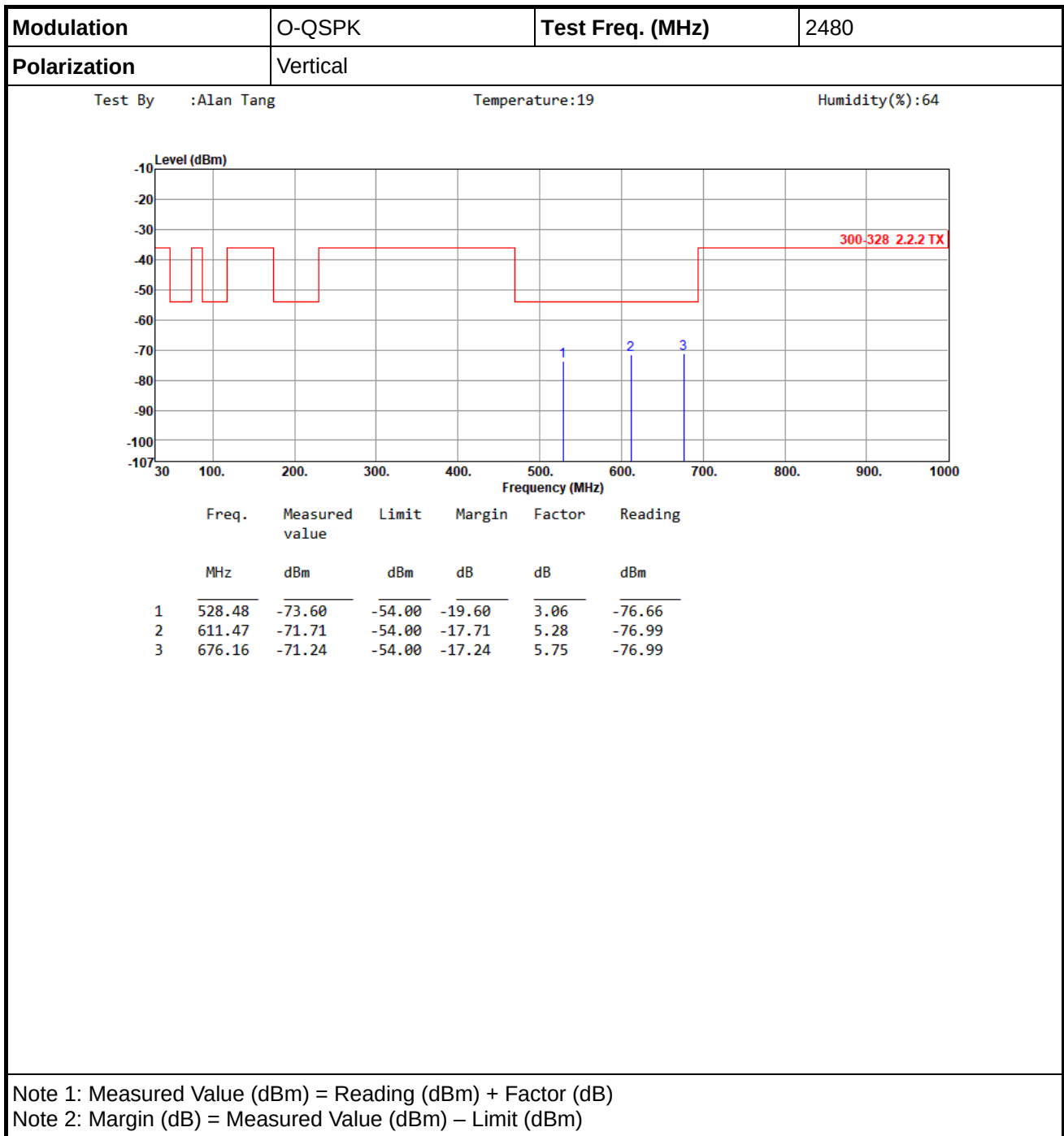
Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Horizontal		

Test By : Alan Tang
Temperature: 19
Humidity(%): 64

	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	523.48	-74.35	-54.00	-20.35	3.01	-77.36
2	595.36	-72.59	-54.00	-18.59	4.40	-76.99
3	676.12	-71.17	-54.00	-17.17	5.75	-76.92

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)

Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)





Emissions (Above 1GHz)

Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Horizontal		
Test By :Alan Tang			



Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Vertical		
Test By :Alan Tang			

Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Horizontal		
Test By :Alan Tang		Temperature:19	Humidity(%):64
Level (dBm) <			

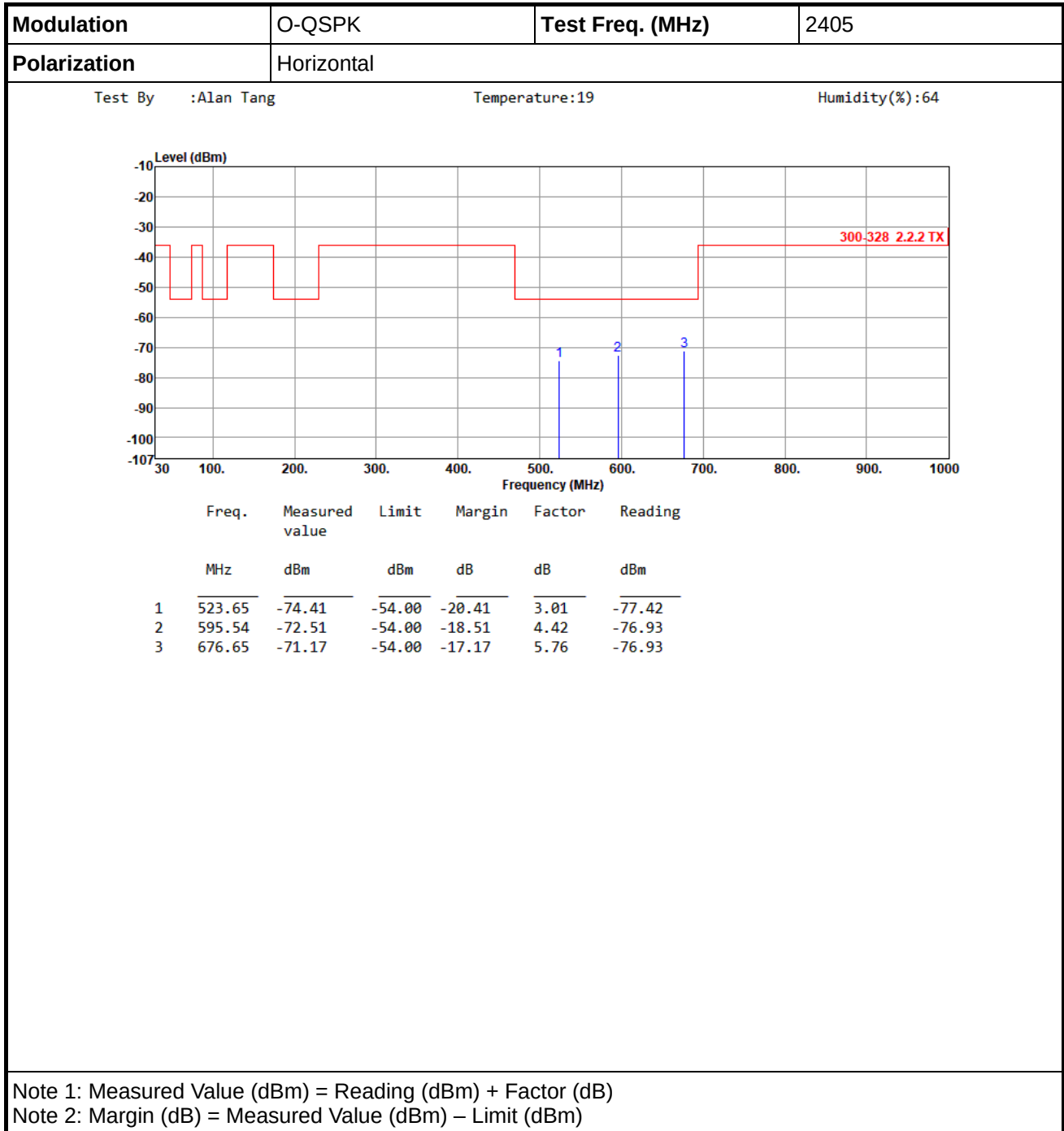


Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Vertical		
Test By :Alan Tang			



Internal Antenna

Emissions (Below 1GHz)



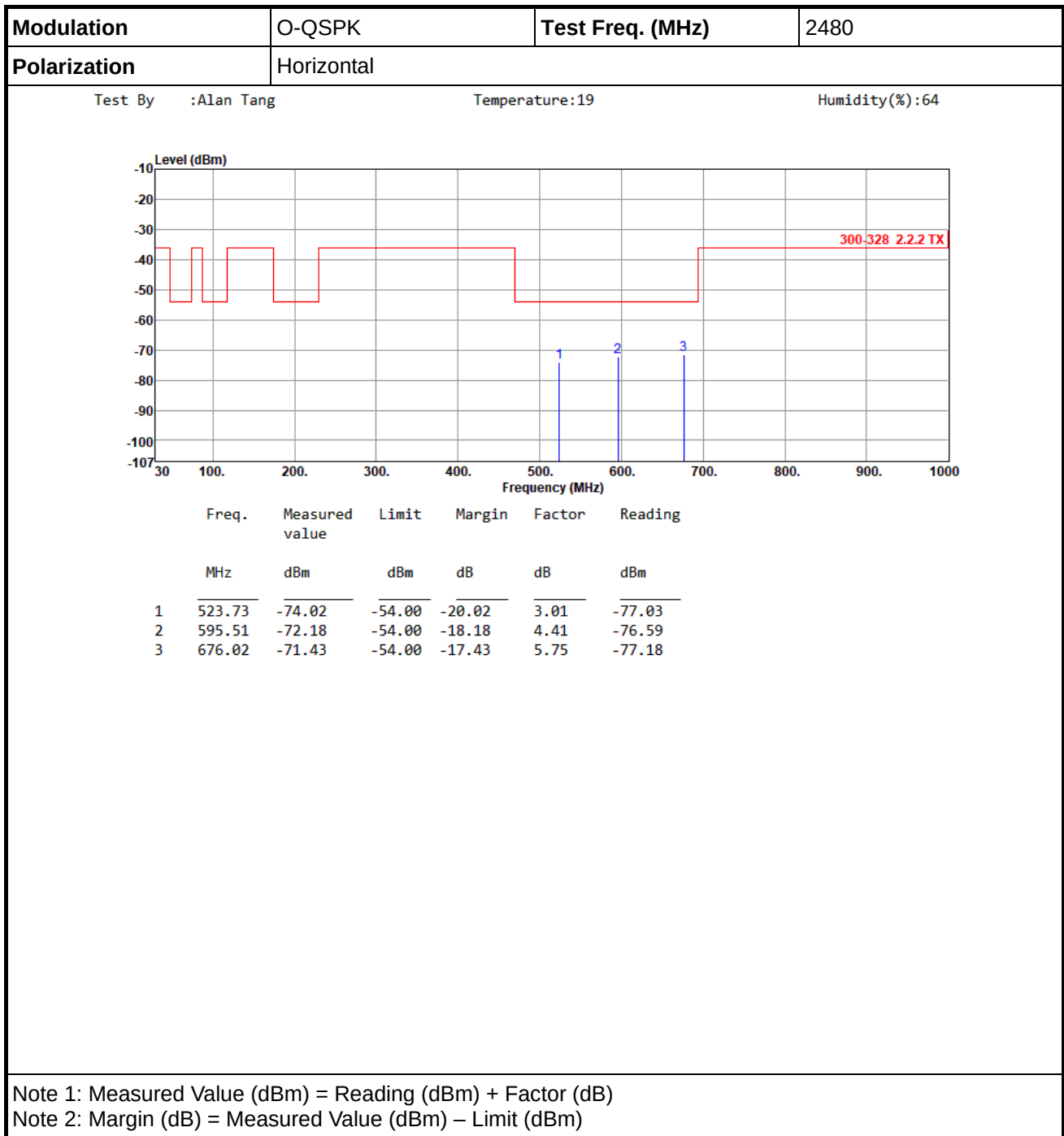
Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Vertical		

Test By : Alan Tang
Temperature: 19
Humidity(%): 64

	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	528.65	-73.48	-54.00	-19.48	3.07	-76.55
2	611.65	-71.65	-54.00	-17.65	5.28	-76.93
3	676.06	-71.16	-54.00	-17.16	5.75	-76.91

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)

Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)



Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Vertical		

Test By : Alan Tang
Temperature: 19
Humidity(%): 64

The spectrum plot displays the signal level in dBm across a frequency range from 30 to 1000 MHz. The red line shows the signal profile, which is mostly flat at -40 dBm with some initial fluctuations. Three specific frequency points are marked with blue vertical lines and labeled 1, 2, and 3. A red text label '300-328 2.2.2 TX' is located in the upper right portion of the plot area.

	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	528.58	-73.41	-54.00	-19.41	3.07	-76.48
2	611.03	-71.46	-54.00	-17.46	5.29	-76.75
3	676.02	-71.40	-54.00	-17.40	5.75	-77.15

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)

Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)



Emissions (Above 1GHz)

Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Horizontal		
Test By :Alan Tang			



Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Vertical		
Test By :Alan Tang			



Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Horizontal		
Test By :Alan Tang			

Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Vertical		

Test By : Alan Tang
Temperature: 19
Humidity(%): 64

	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.90	-55.66	-30.00	-25.66	9.50	-65.16
2	7440.29	-47.81	-30.00	-17.81	15.83	-63.64

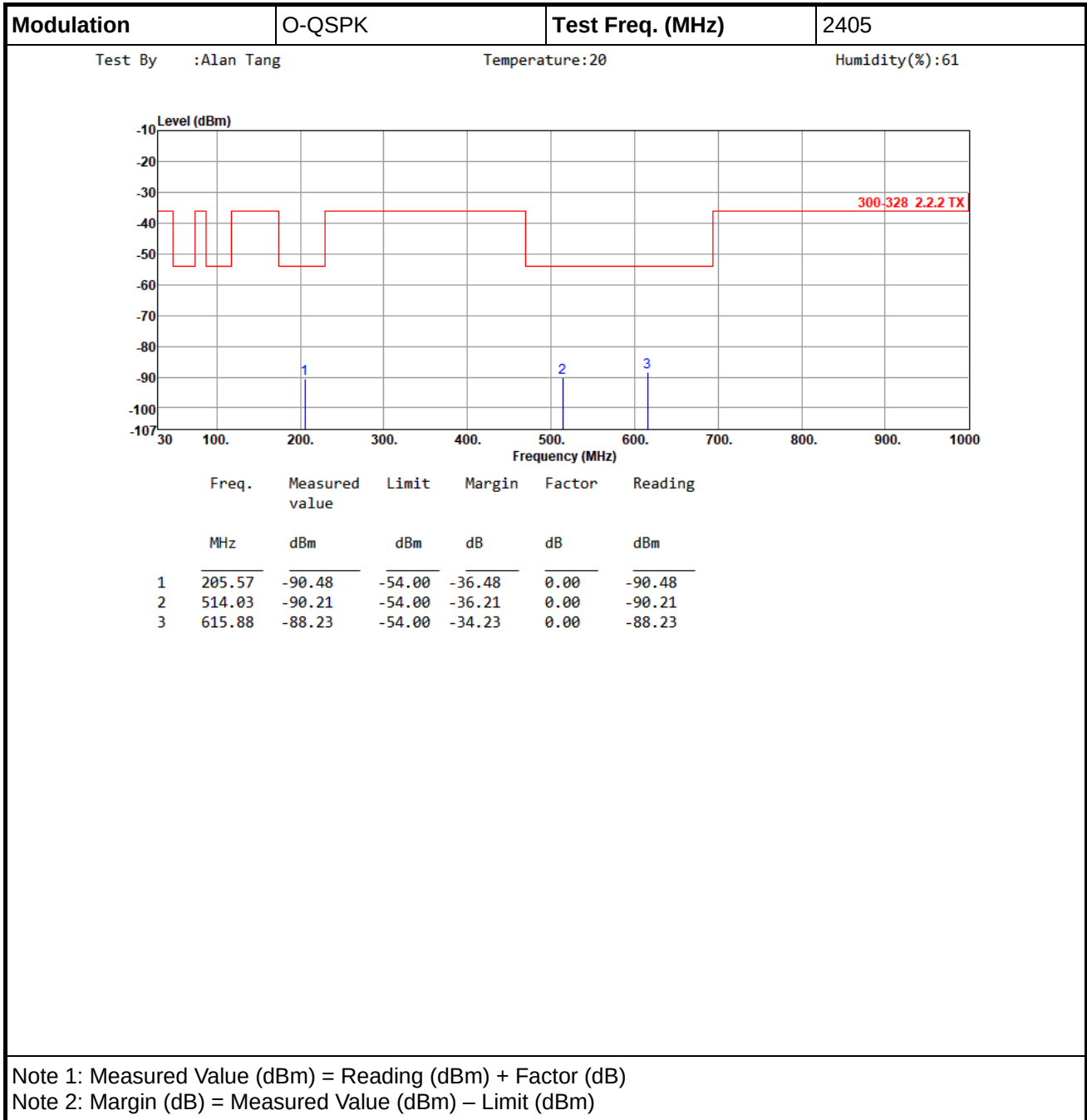
Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)

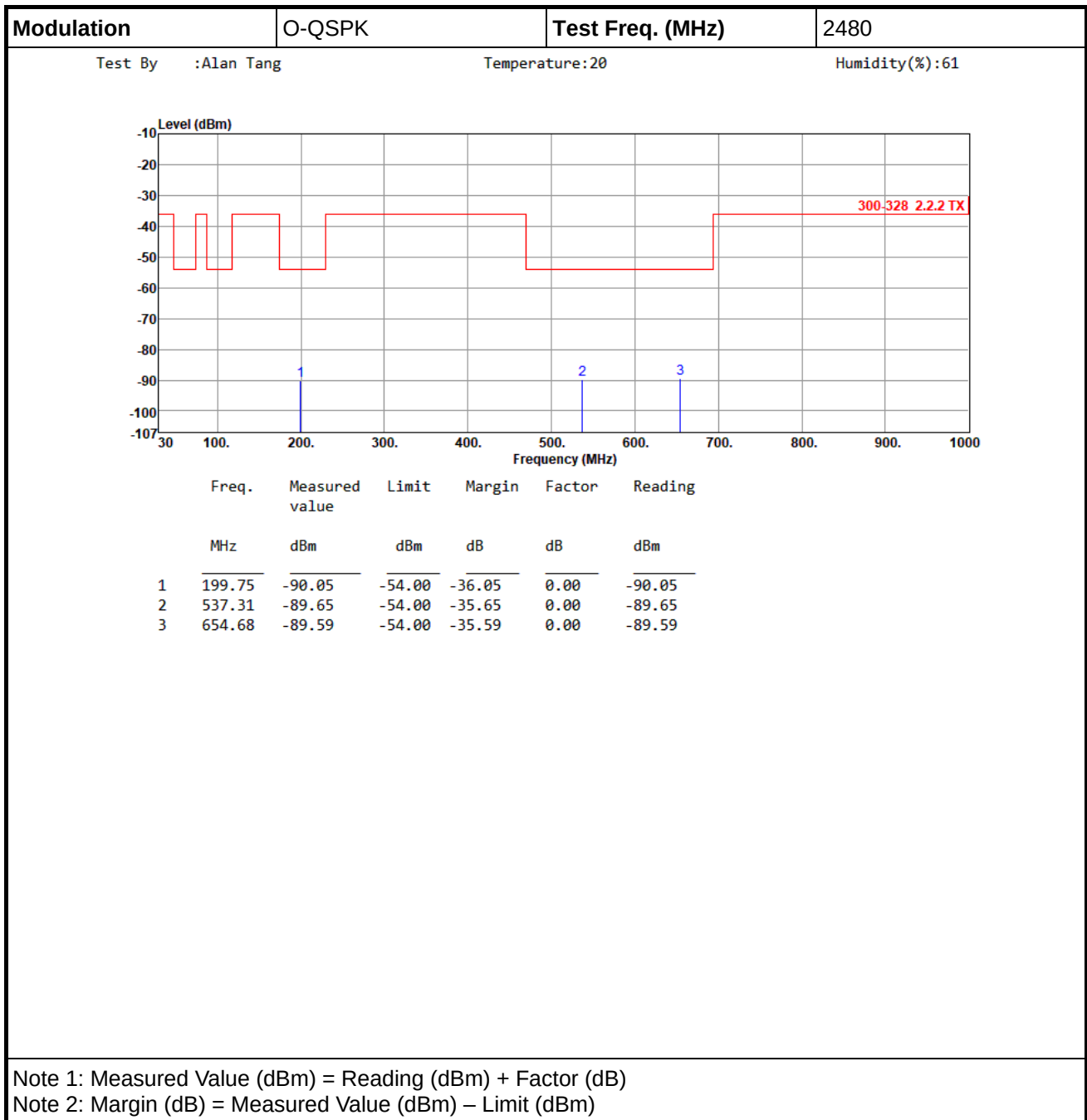
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)



External Antenna

Transmitter Conducted Unwanted Emissions (Below 1GHz)

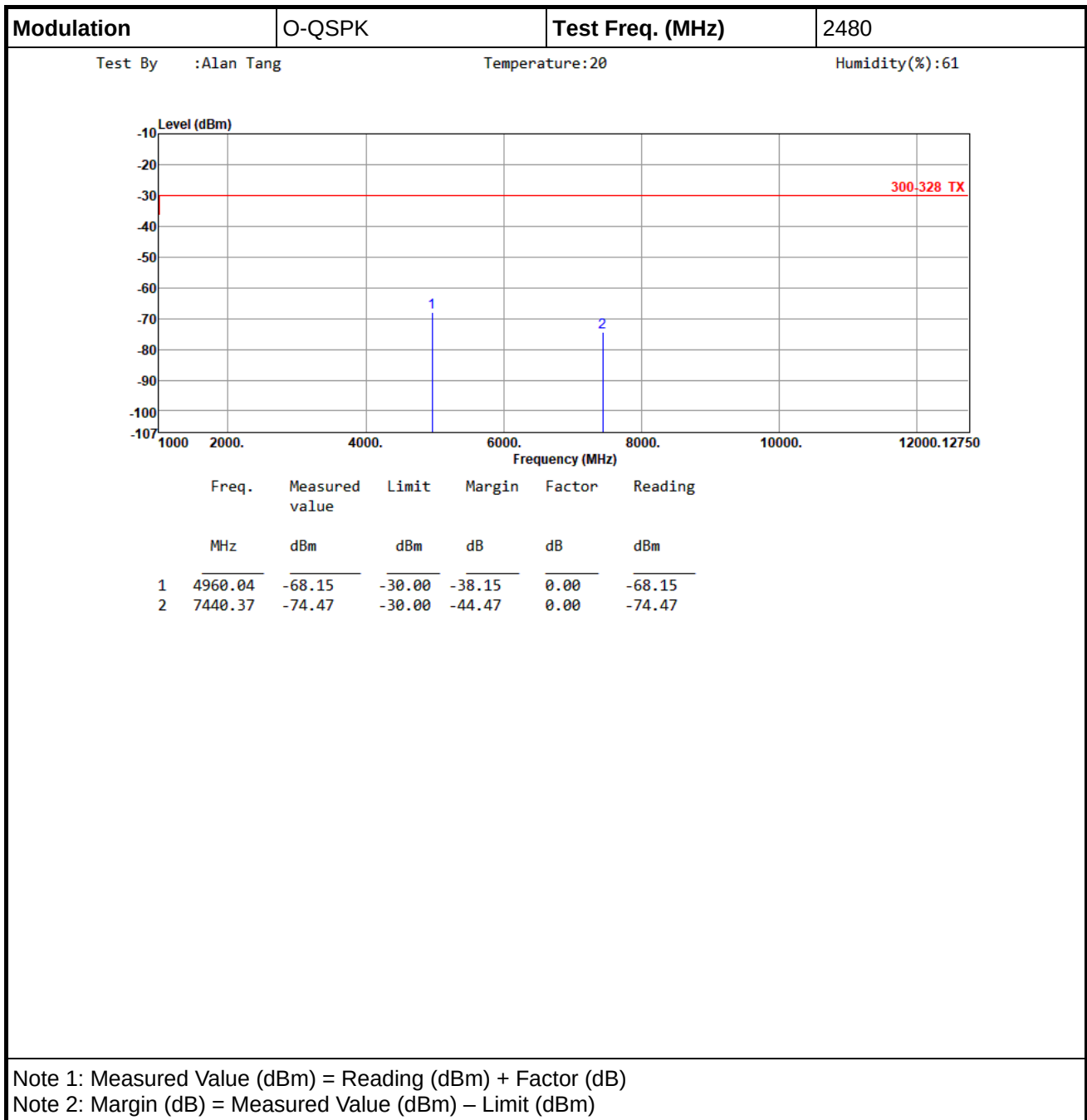






Transmitter Conducted Unwanted Emissions (Above 1GHz)

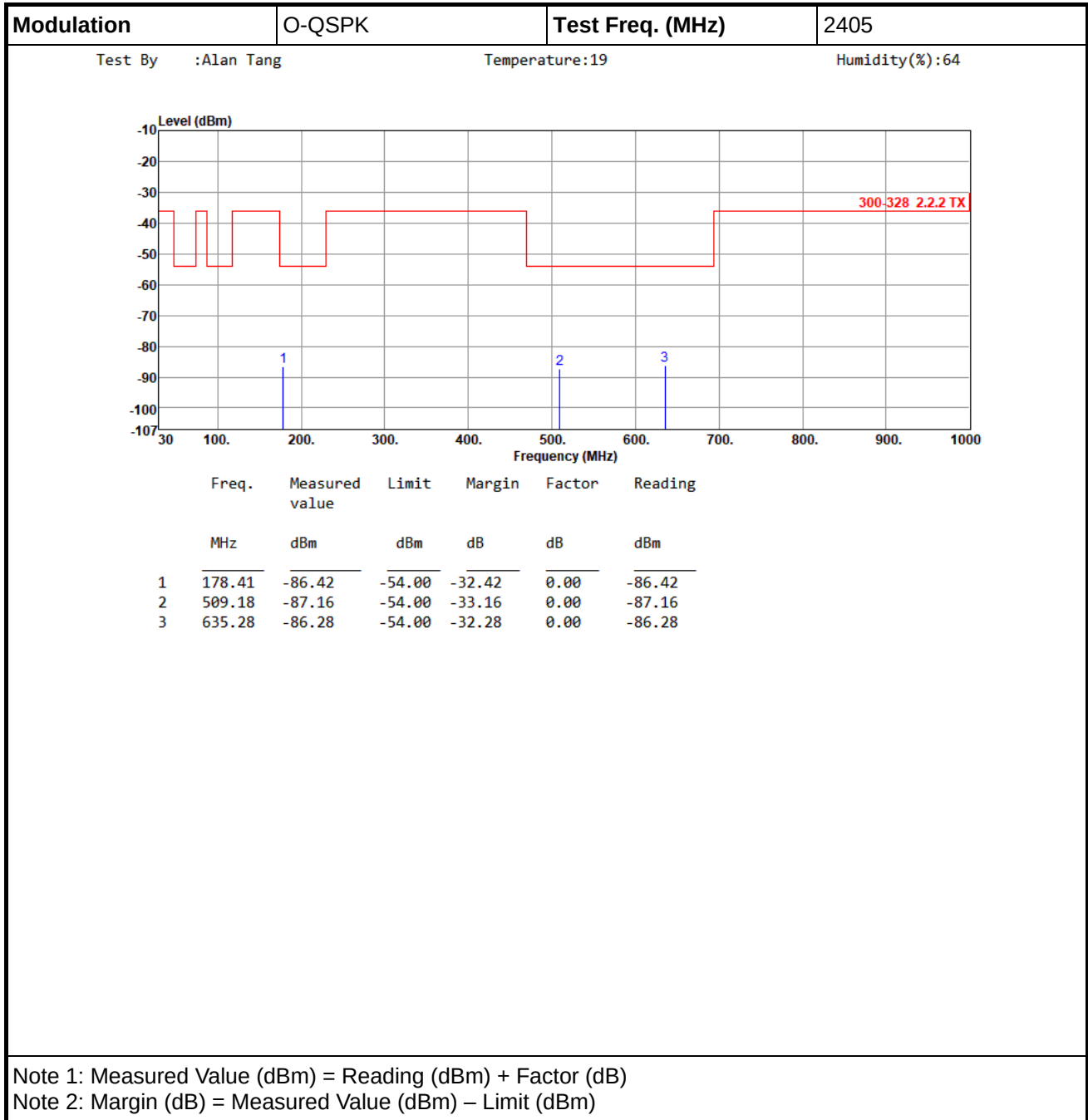
Modulation		O-QSPK		Test Freq. (MHz)		2405	
Test By :Alan Tang		Temperature:20				Humidity(%):61	
<							

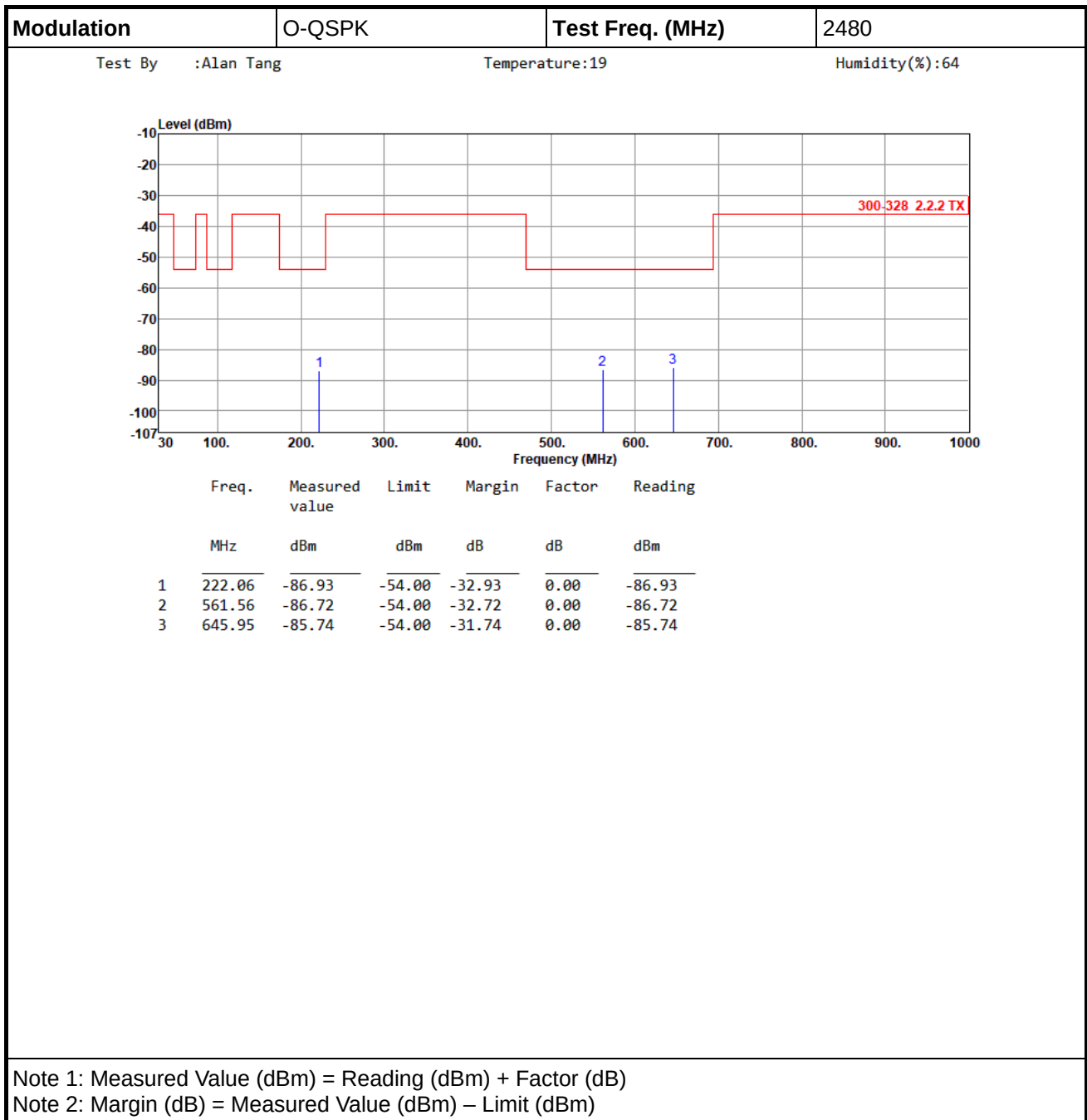




Internal Antenna

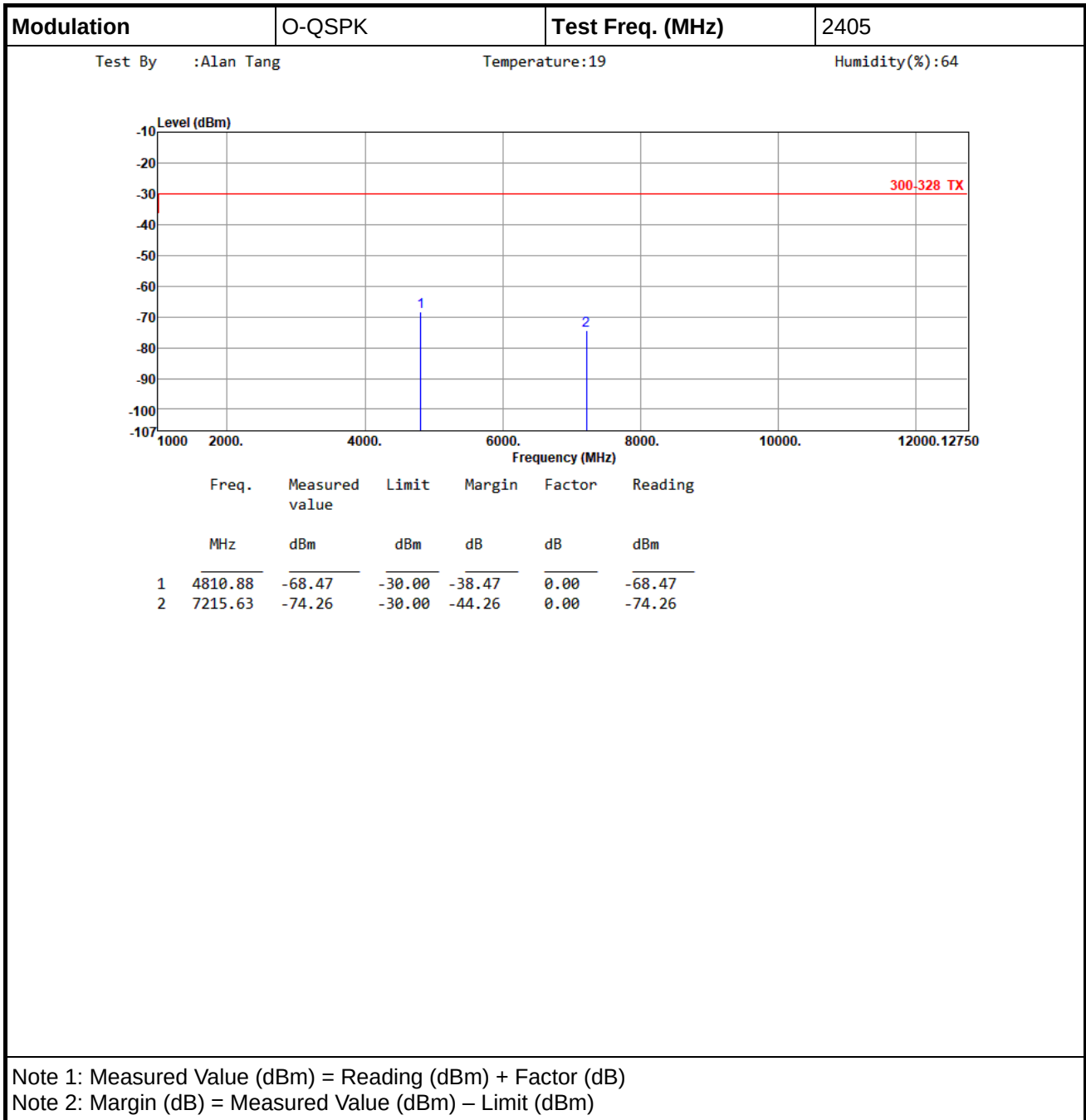
Transmitter Conducted Unwanted Emissions (Below 1GHz)

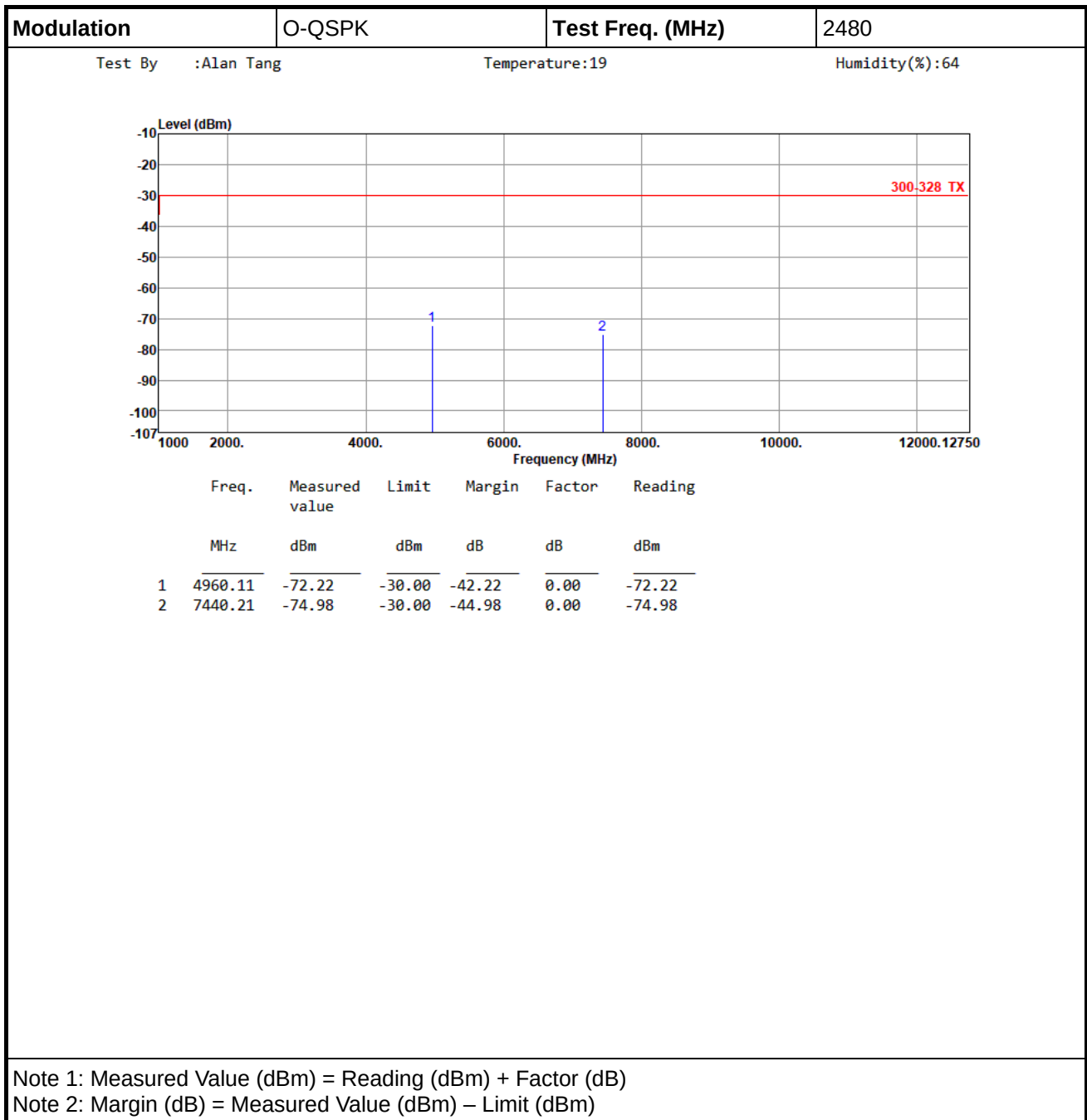






Transmitter Conducted Unwanted Emissions (Above 1GHz)







External Antenna

Emissions (Below 1GHz)

Modulation		O-QSPK		Test Freq. (MHz)		2405	
Polarization		Horizontal					
Test By		:Alan Tang		Temperature:19		Humidity(%):64	
Level (dBm)							



Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Vertical		
Test By :Alan Tang			



Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Horizontal		
Test By :Alan Tang			



Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Vertical		
Test By :Alan Tang			



Emissions (Above 1GHz)

Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Horizontal		
Test By :Alan Tang			

Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Vertical		

Test By :Alan Tang

Temperature:19

Humidity(%):64

	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4810.09	-54.33	-47.00	-7.33	9.58	-63.91

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)

Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Horizontal		
Test By :Alan Tang		Temperature:19	Humidity(%):64
Level (dBm) </			

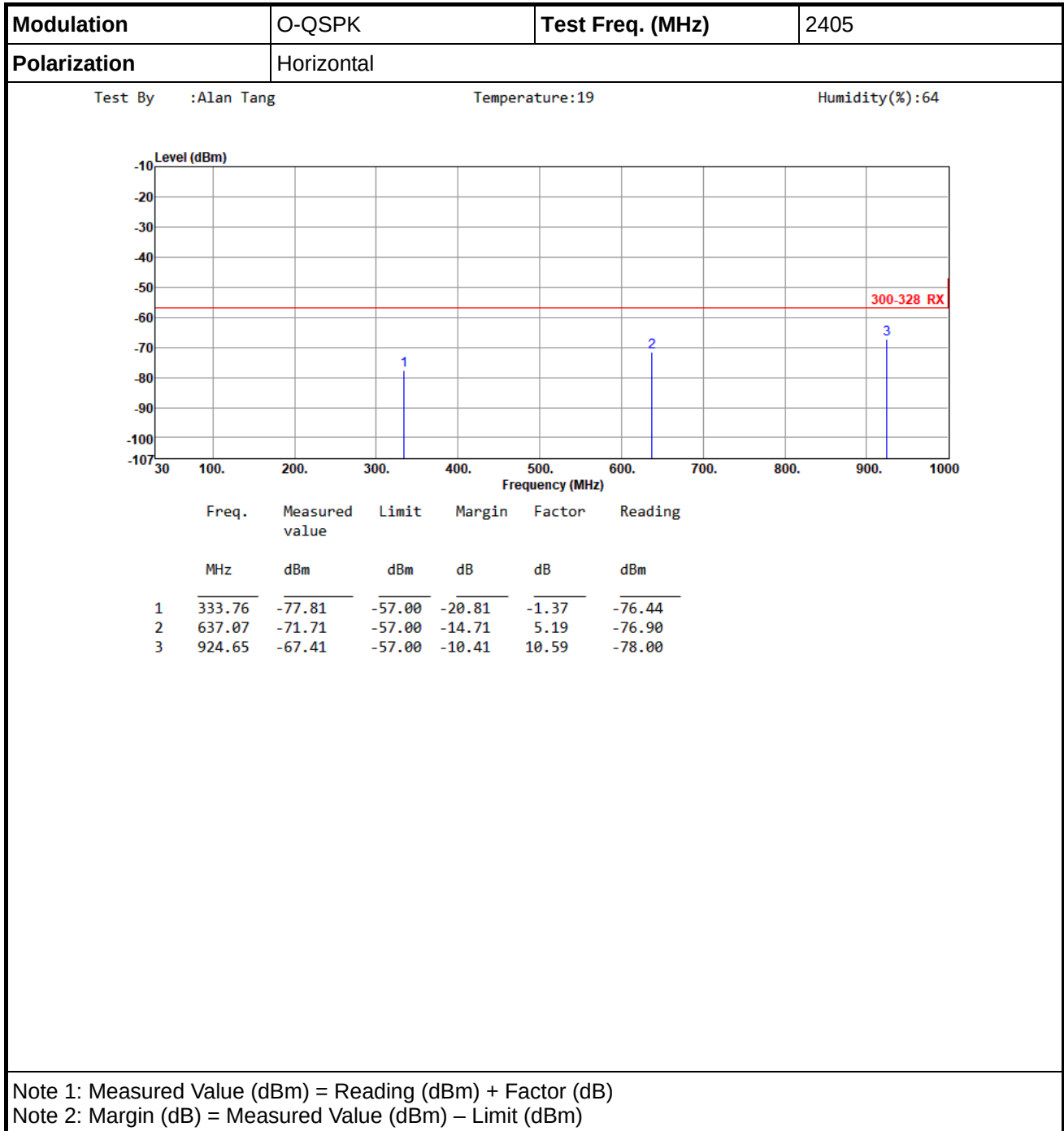


Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Vertical		
Test By :Alan Tang			



Internal Antenna

Emissions (Below 1GHz)



Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Vertical		

Test By : Alan Tang
Temperature: 19
Humidity(%): 64

	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	299.06	-73.35	-57.00	-16.35	-1.92	-71.43
2	560.07	-73.61	-57.00	-16.61	3.61	-77.22
3	874.54	-67.91	-57.00	-10.91	8.96	-76.87

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)

Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)



Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Horizontal		
Test By :Alan Tang			



Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Vertical		
Test By :Alan Tang			



Emissions (Above 1GHz)

Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Horizontal		
Test By :Alan Tang			



Modulation	O-QSPK	Test Freq. (MHz)	2405
Polarization	Vertical		
Test By :Alan Tang			



Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Horizontal		
Test By :Alan Tang			



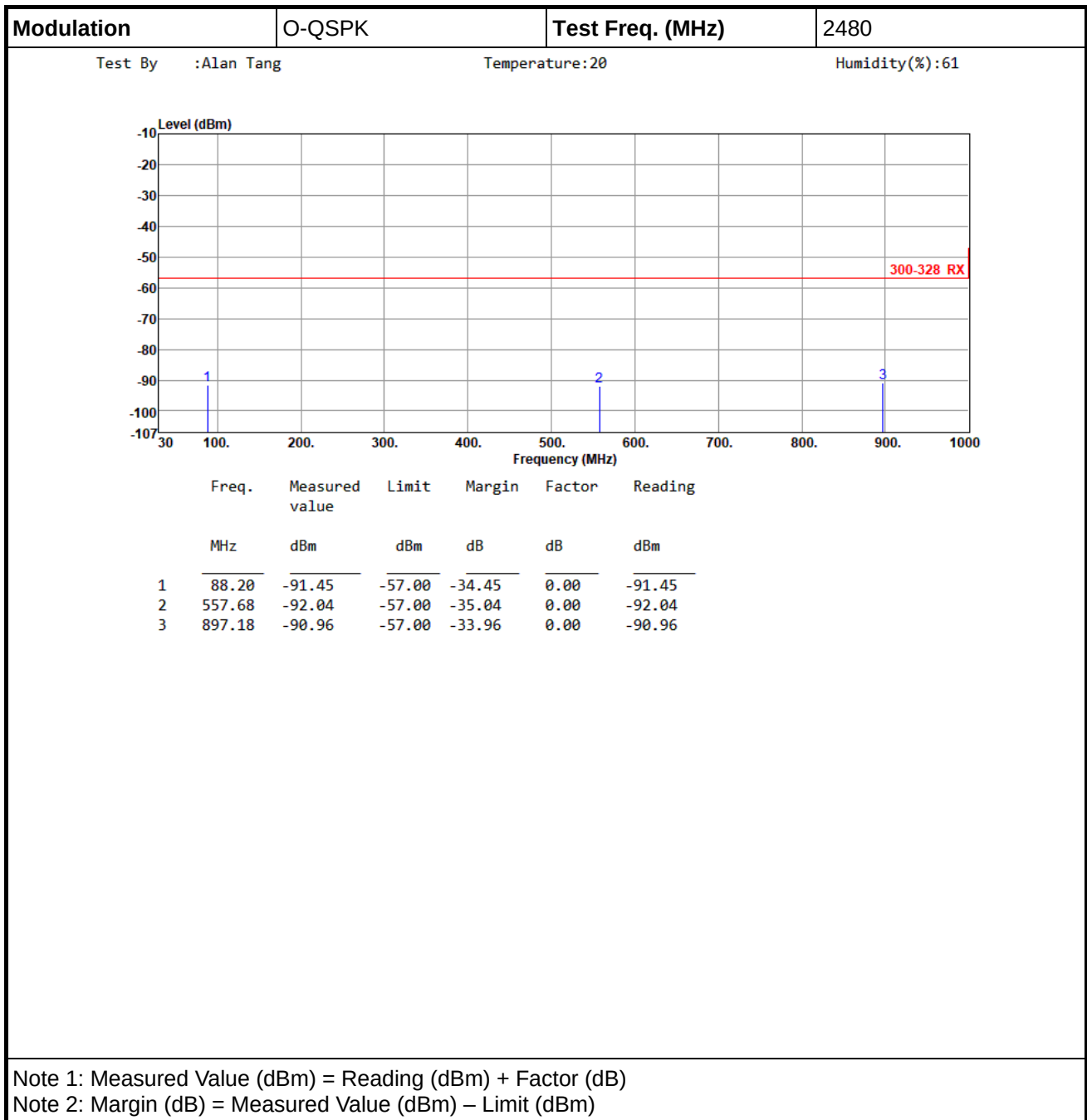
Modulation	O-QSPK	Test Freq. (MHz)	2480
Polarization	Vertical		
Test By :Alan Tang			



External Antenna

Receiver Conducted Unwanted Emissions (Below 1GHz)

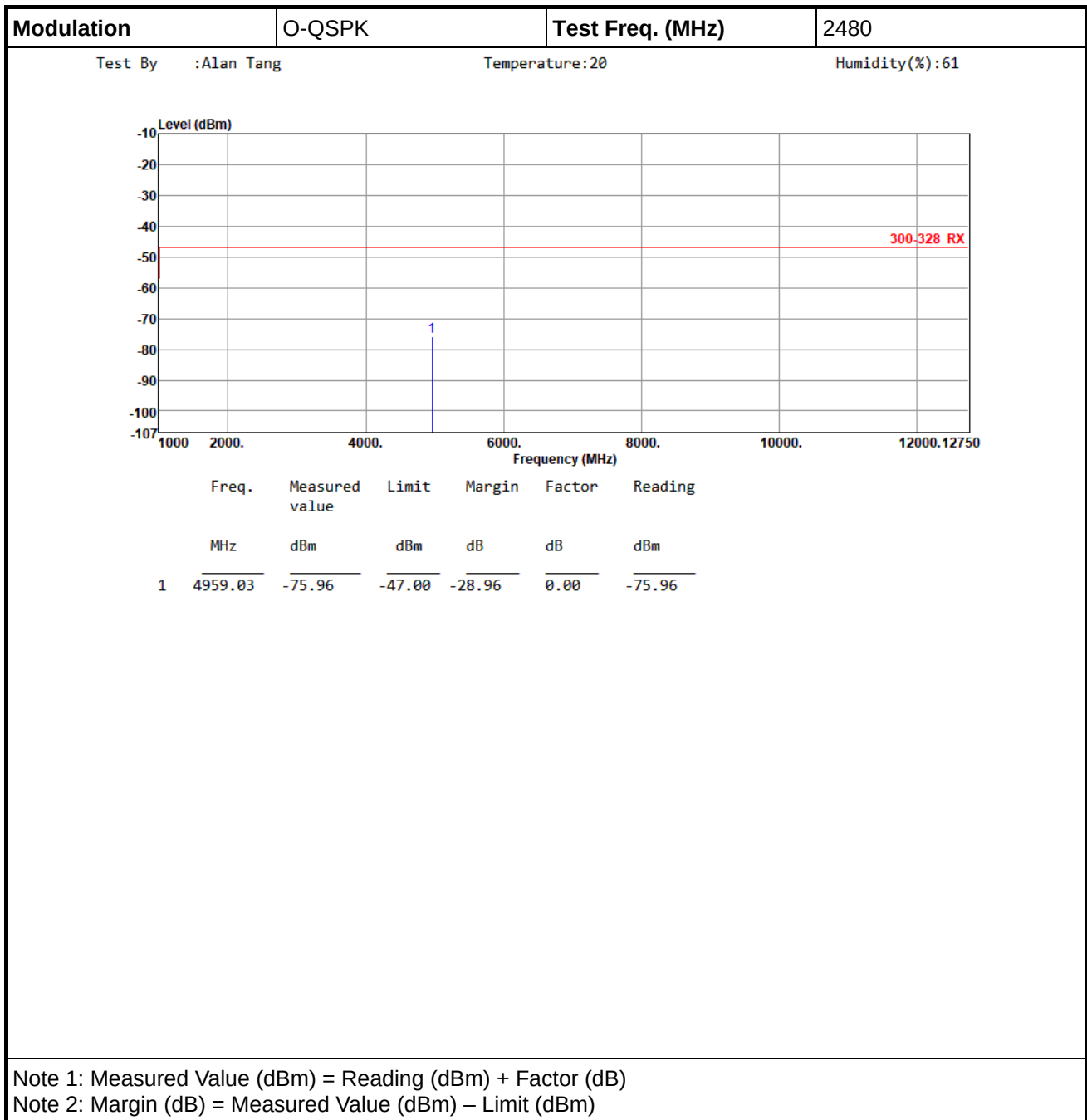
Modulation		O-QSPK		Test Freq. (MHz)		2405	
Test By		:Alan Tang		Temperature:20		Humidity(%):61	
Level (dBm) </							





Receiver Conducted Unwanted Emissions (Above 1GHz)

Modulation		O-QSPK		Test Freq. (MHz)		2405	
Test By :Alan Tang		Temperature:20				Humidity(%):61	
Level (dBm) <							



Internal Antenna

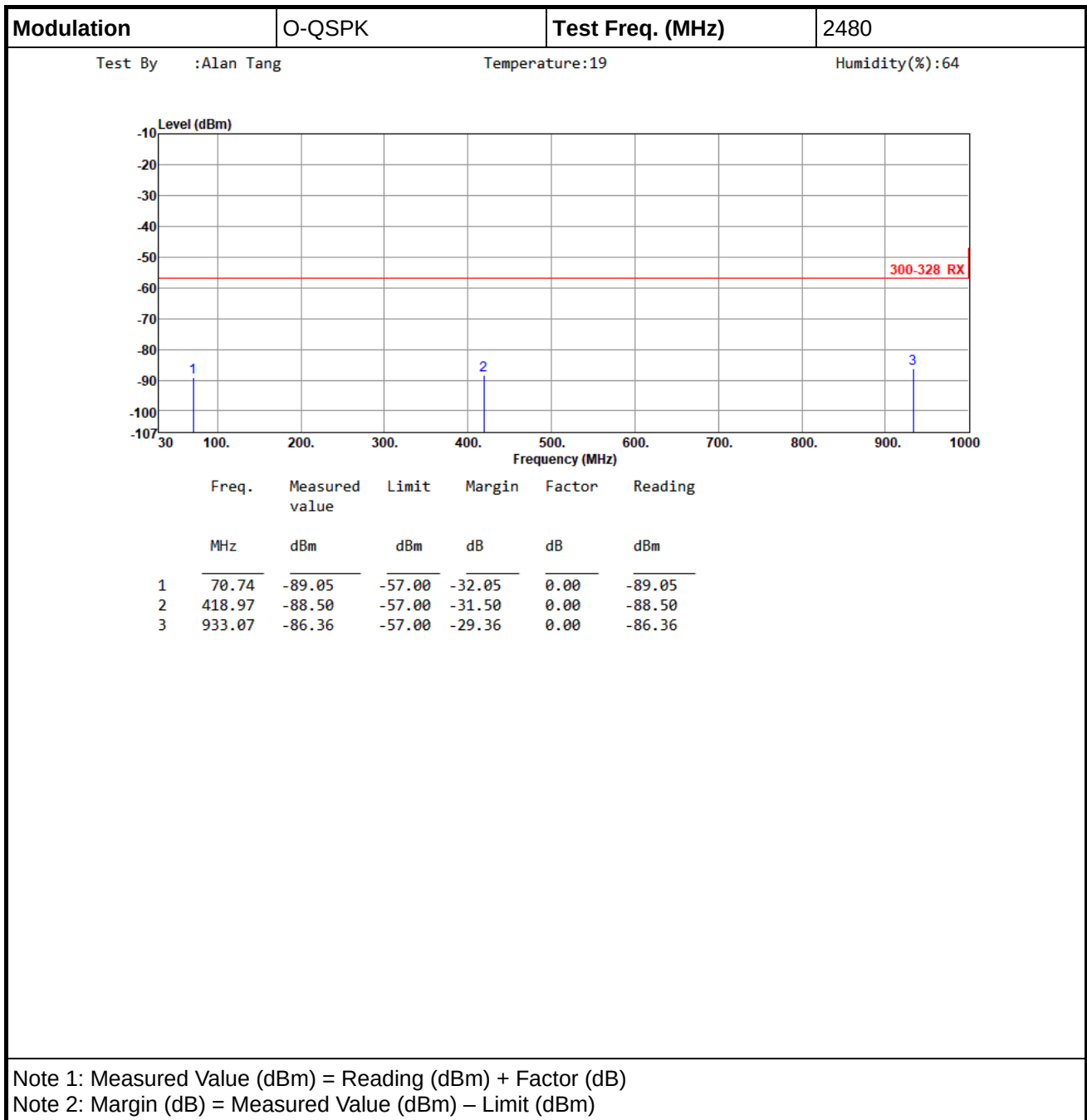
Receiver Conducted Unwanted Emissions (Below 1GHz)

Modulation	O-QSPK	Test Freq. (MHz)	2405
Test By : Alan Tang		Temperature: 19	
		Humidity(%): 64	

	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	62.01	-89.23	-57.00	-32.23	0.00	-89.23
2	425.76	-87.90	-57.00	-30.90	0.00	-87.90
3	932.10	-87.52	-57.00	-30.52	0.00	-87.52

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)

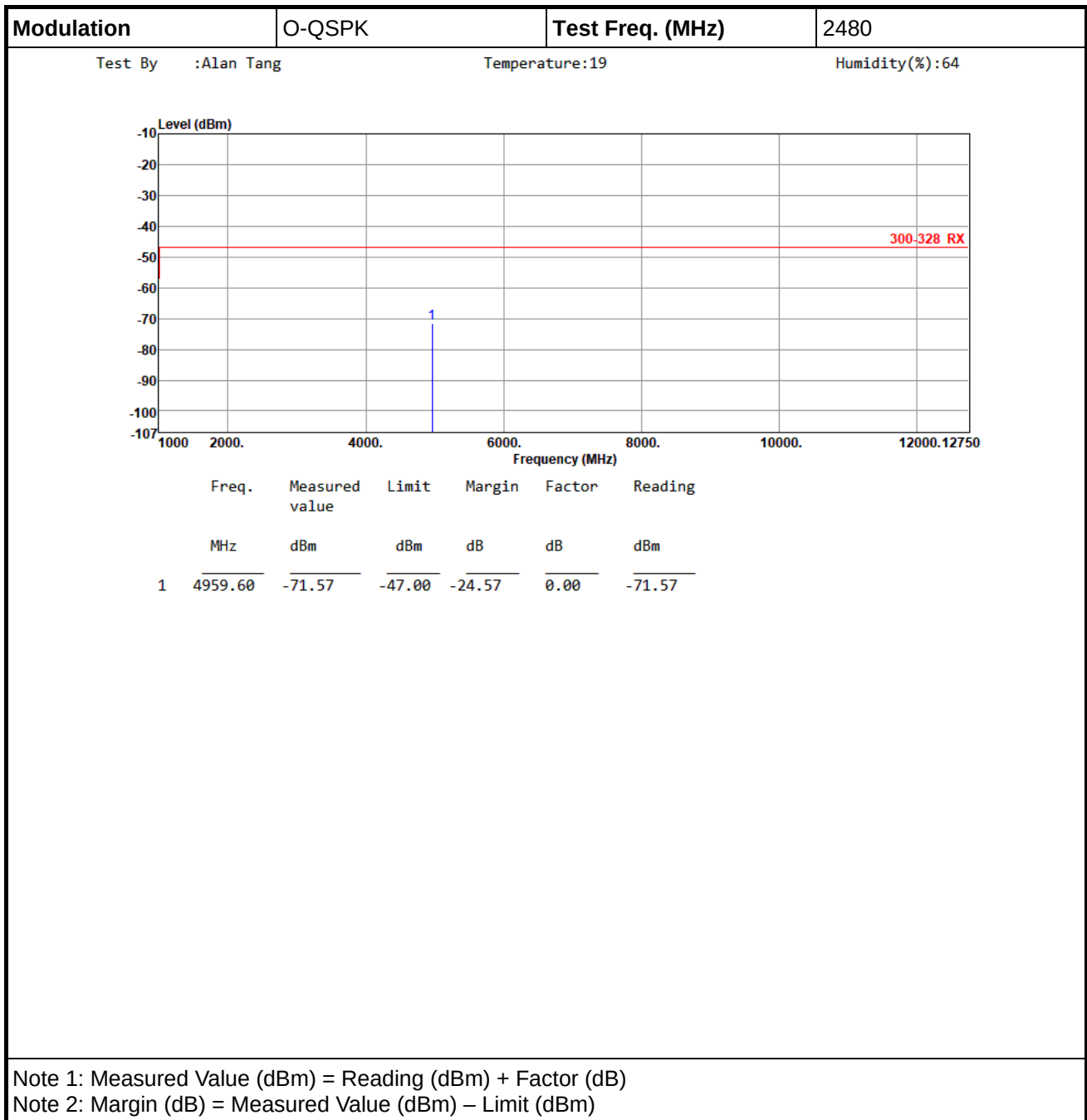
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)



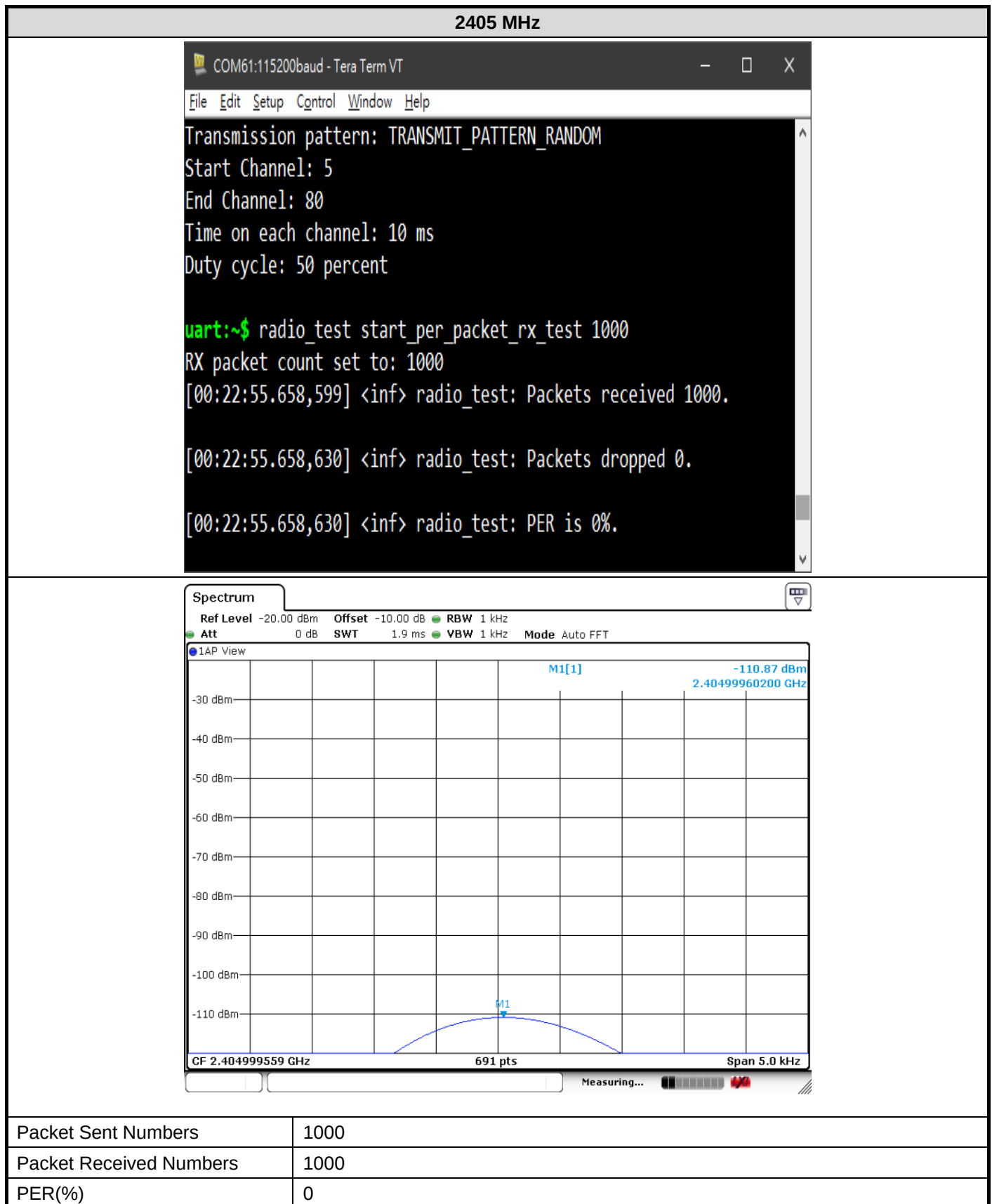


Receiver Conducted Unwanted Emissions (Above 1GHz)

Modulation		O-QSPK		Test Freq. (MHz)		2405	
Test By :Alan Tang		Temperature:19				Humidity(%):64	
Level (dBm)							

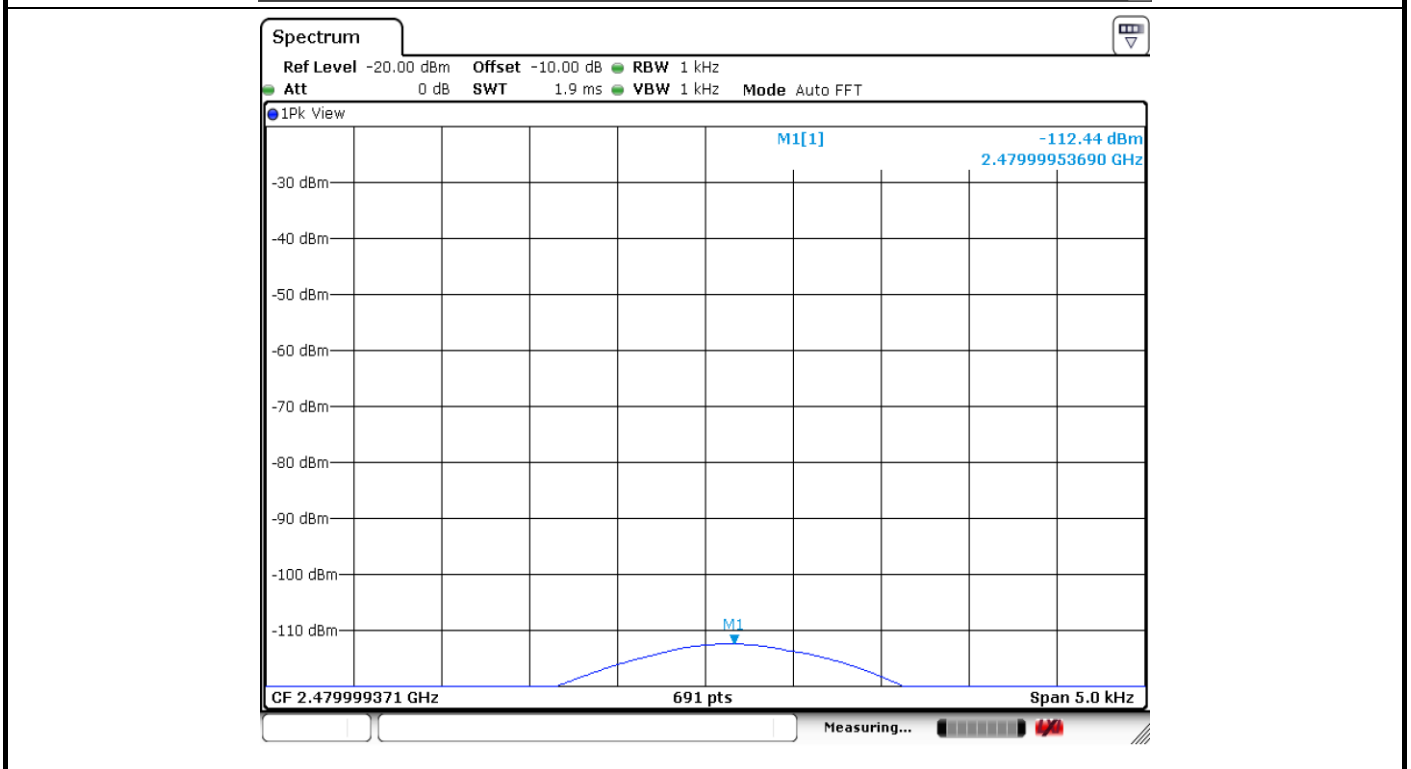
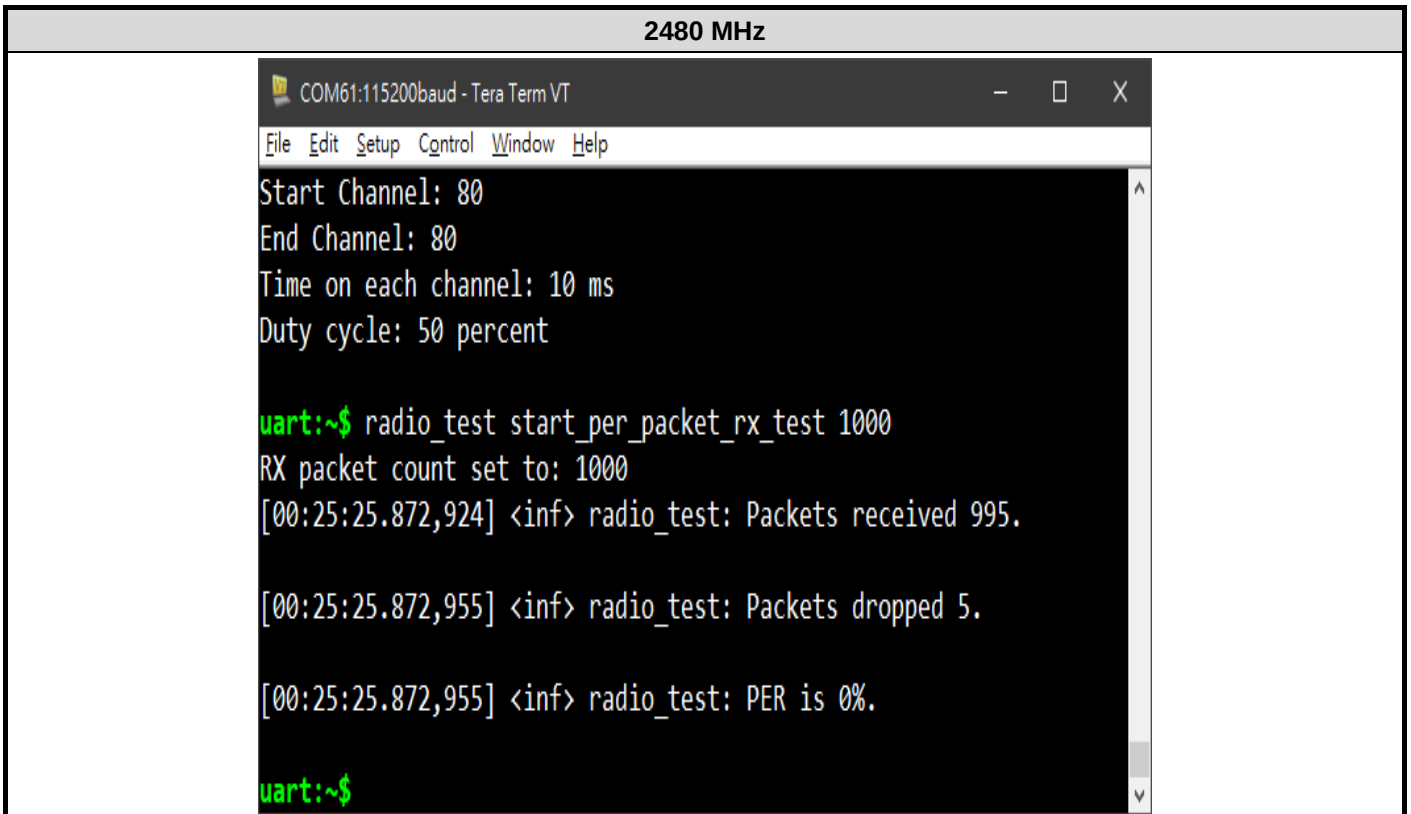


External Antenna





Receiver Category	2		
Performance Criteria Limit	PER ≤ 10 %		
Wanted Signal Mean Power from Companion Device (dBm)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm)	Test Result
-62.17	2380	-30.9	Pass
-62.17	2300	-30.9	Pass

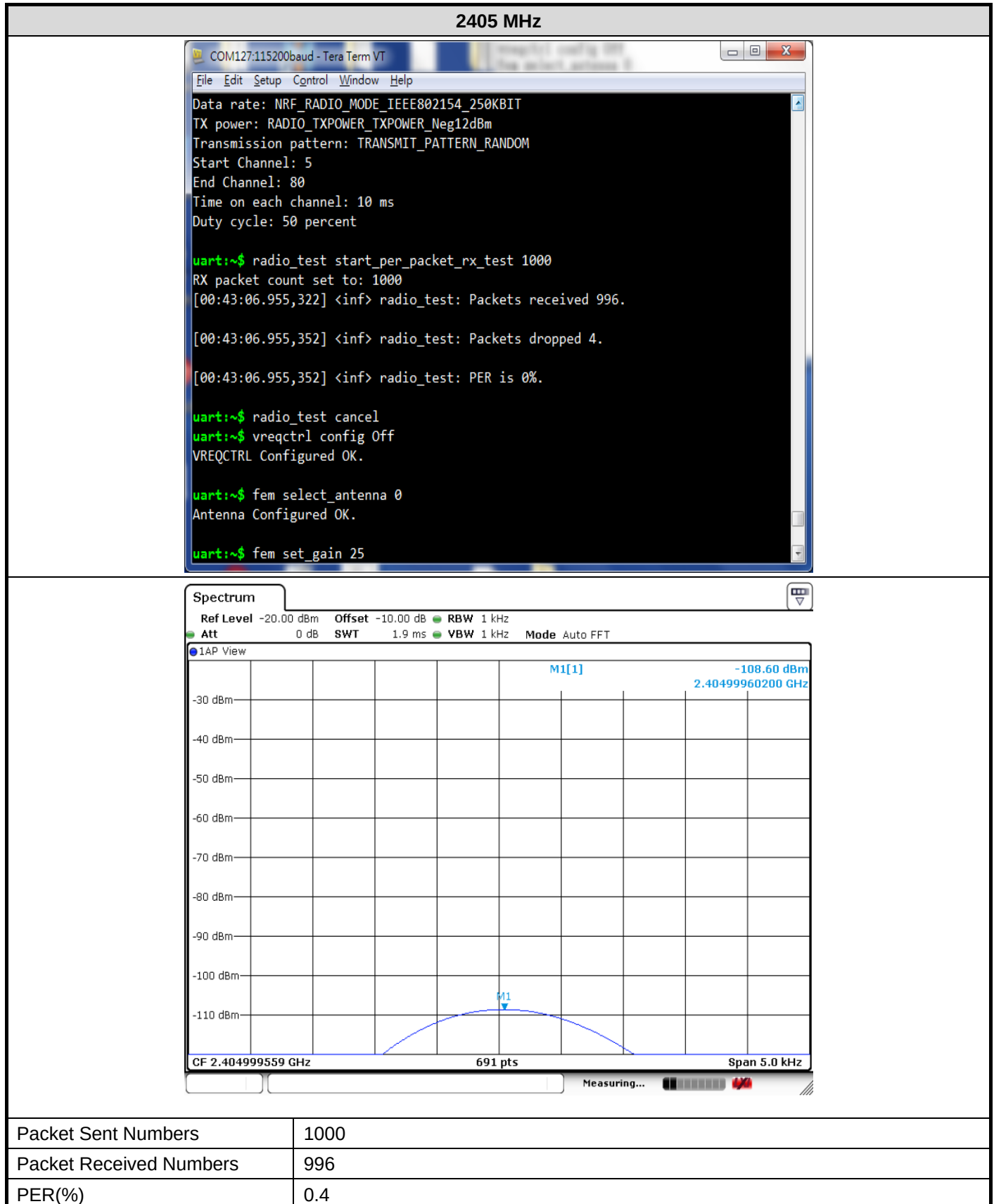


Packet Sent Numbers	1000
Packet Received Numbers	995
PER(%)	0.5



Receiver Category	2		
Performance Criteria Limit	PER ≤ 10 %		
Wanted Signal Mean Power from Companion Device (dBm)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm)	Test Result
-62.18	2504	-30.9	Pass
-62.18	2584	-30.9	Pass

Internal Antenna





Receiver Category	2		
Performance Criteria Limit	PER ≤ 10 %		
Wanted Signal Mean Power from Companion Device (dBm)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm)	Test Result
-63.78	2380	-32.51	Pass
-63.78	2300	-32.51	Pass

2480 MHz

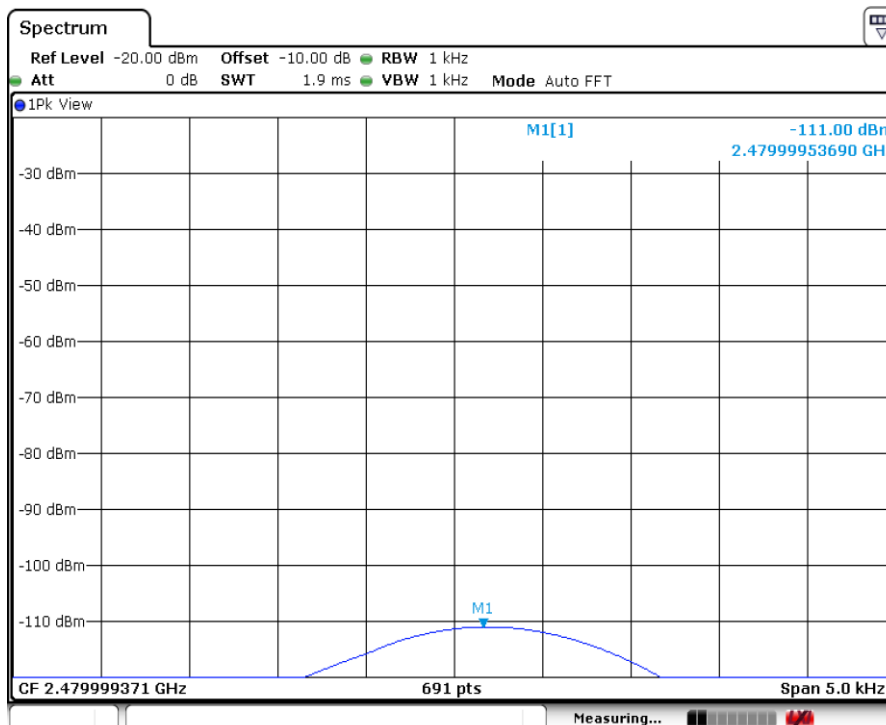
```
COM127:115200baud - Tera Term VT
File Edit Setup Control Window Help
TX power: RADIO_TXPOWER_TXPOWER_Neg12dBm
uart:~$ radio_test start_channel 80
Start channel set to: 80
uart:~$ radio_test parameters_print
Parameters:
Data rate: NRF_RADIO_MODE_IEEE802154_250KBIT
TX power: RADIO_TXPOWER_TXPOWER_Neg12dBm
Transmission pattern: TRANSMIT_PATTERN_RANDOM
Start Channel: 80
End Channel: 80
Time on each channel: 10 ms
Duty cycle: 50 percent

uart:~$ radio_test start_per_packet_rx_test 1000
RX packet count set to: 1000
[00:45:19.218,444] <inf> radio_test: Packets received 76.

[00:45:19.218,475] <inf> radio_test: Packets dropped 924.

[00:45:19.218,475] <inf> radio_test: PER is 92%.

uart:~$ radio_test cancel
uart:~$ vreqctrl config Off
VREQCTRL Configured OK.
```



Packet Sent Numbers	1000
Packet Received Numbers	924
PER(%)	7.6



Receiver Category	2		
Performance Criteria Limit	PER ≤ 10 %		
Wanted Signal Mean Power from Companion Device (dBm)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dBm)	Test Result
-63.79	2504	-32.51	Pass
-63.79	2584	-32.51	Pass