





FCC C2PC Test Report

FCC ID : SQG-PH45N

Equipment : 802.11a/b/g/n module

Model No. : PH45N

Brand Name : Laird Connectivity

Applicant : Laird Connectivity LLC

Address : W66N220 Commerce Court, Cedarburg, WI

53012 United States Of America

Standard : 47 CFR FCC Part 15.247

Received Date : Mar. 07, 2022

Tested Date : Apr. 07 ~ Apr. 22, 2022

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 Che๗/ Assistant Manager Gary Chang / Manag

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APPENDIX A. CONDUCTED OUTPUT POWER

APPENDIX B. UNWANTED EMISSIONS INTO RESTRICTED FREQUENCY BANDS

APPENDIX C. AC POWER LINE CONDUCTED EMISSIONS



Release Record

Report No.	Version	Description	Issued Date
FR811202-04AC	Rev. 01	Initial issue	May 18, 2022

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Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	AC Power Line Conducted Emission	[dBuV]:19.224MHz 30.14 (Margin -19.86dB) - AV	Pass
15.247(d)	Unwanted Emissions	[dBuV/m at 3m]: 2483.50MHz	Pass
15.209	Onwanted Emissions	53.43 (Margin -0.57dB) - AV	F a 3 3
15.247(b)(3)	Conducted Output Power	Max Power [dBm]: 21.96	Pass

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.

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1 General Description

1.1 Information

This report is prepared for FCC class II permissive change.

This report is issued as a supplementary report to original ICC report no. FR811202AC. The modification is concerned with following:

- ♦ New brand name, applicant name and address.
- ♦ Power Amplifer, Diplexer and RF Shielding Can changed.

Therefore, related test items had been performed and presented in the following sections.

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information								
Frequency Range (MHz)	IEEE Std. 802.11	Ch. Freq. (MHz)	Channel Number	Transmit Chains (N⊤x)	Data Rate / MCS			
2400-2483.5	b	2412-2462	1-11 [11]	1	1-11 Mbps			
2400-2483.5	g	2412-2462	1-11 [11]	1	6-54 Mbps			
2400-2483.5	n (HT20)	2412-2462	1-11 [11]	1	MCS 0-7			

Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.

Note 2: DSSS-DBPSK, DQPSK, CCK modulation

OFDM - BPSK, QPSK, 16QAM, 64QAM modulation.

1.1.2 Antenna Details

Ant.			Type Connect		Operating Frequencies (MHz) / Antenna Gain (dBi)				
No.	Model	Турс		2400~2483.5	5150~5250	5250~5350	5470~5725	5725~5850	
1	Laird	NanoBlade-IP04	PCB Dipole	IPEX U.FL	2	3.9	3.9	4	4

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.3Vdc from host
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1.1.4 Accessories

N/A

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1.1.5 Channel List

Channel	Frequency(MHz)
1	2412
2	2417
3	2422
4	2427
5	2432
6	2437
7	2442
8	2447
9	2452
10	2457
11	2462

1.1.6 Test Tool and Duty Cycle

Test Tool	Putty, V 0.60.0.0					
	Mode	Duty Cycle (%)	Duty Factor (dB)			
Duty Cycle and Duty	11b	100.00%	0.00			
Factor	11g	99.65%	0.02			
	HT20	98.89%	0.05			

1.1.7 Power Index of Test Tool

Modulation Mode	Test Frequency (MHz)	Power Index
11b	2412	18
11b	2437	18
11b	2462	15.5
11g	2412	15.5
11g	2437	18
11g	2462	15
HT20	2412	15.5
HT20	2437	17.5
HT20	2462	15

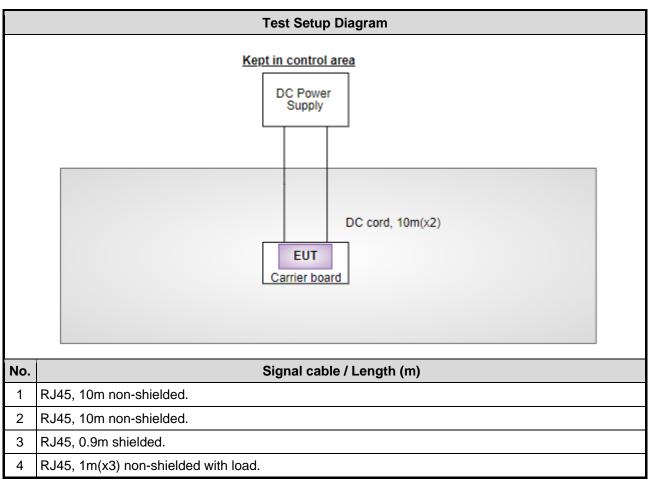
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1.2 Local Support Equipment List

	Support Equipment List							
No.	Equipment	Brand	Model	FCC ID	Remarks			
1	DC Power Supply	GWINSTEK	GPC-60300					
2	Carrier board	Laird	PH45N_EXTEN DER_A0					
3	Fixture	Laird	BB45NBT					
4	Notebook	DELL	Latitude E5470	DoC	Provided by applicant.			

1.3 Test Setup Chart



Note: The support notebook and fixture were disconnected from EUT and removed from test table when EUT is set to transmit/receive continuously.

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1.4 The Equipment List

Test Item	Conducted Emission								
Test Site	Conduction room 1 / (Conduction room 1 / (CO01-WS)							
Tested Date	Apr. 18, 2022	Apr. 18, 2022							
Instrument	Brand	Brand Model No. Serial No. Calibration Date Calibration Until							
Receiver	R&S	ESR3	101658	Feb. 16, 2022	Feb. 15, 2023				
LISN	R&S	ENV216	101295	Jan. 12, 2022	Jan. 11, 2023				
LISN (Support Unit)	SCHWARZBECK	NSLK 8127	8127667	Jan .07, 2022	Jan .06, 2023				
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 19, 2021	Oct. 18, 2022				
50 ohm terminal (Support Unit)	NA	50	04	May 25, 2021	May 24, 2022				
Measurement Software AUDIX e3 6.120210k NA NA NA									

Test Item	Radiated Emission							
Test Site	966 chamber3 / (03Cl	H03-WS)						
Tested Date	Apr. 07 ~ Apr. 08, 202	Apr. 07 ~ Apr. 08, 2022						
Instrument	Brand	Brand Model No. Serial No. Calibration Date Calibration Until						
Receiver	R&S	ESR3	101657	Mar. 15, 2022	Mar. 14, 2023			
Spectrum Analyzer	R&S	FSV40	101499	Mar. 08, 2022	Mar. 07, 2023			
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 08, 2021	Nov. 07, 2022			
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	May 06, 2021	May 05, 2022			
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Dec. 20, 2021	Dec. 19, 2022			
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170508	Jan. 11, 2022	Jan. 10, 2023			
Preamplifier	EMC	EMC02325	980187	Jul. 26, 2021	Jul. 25, 2022			
Preamplifier	Agilent	83017A	MY39501309	Sep. 06, 2021	Sep. 05, 2022			
Preamplifier	EMC	EMC184045B	980192	Jul. 14, 2021	Jul. 13, 2022			
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 05, 2021	Oct. 04, 2022			
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800 -001	Sep. 24, 2021	Sep. 23, 2022			
LF cable-3M	EMC	EMC8D-NM-NM-300 0	131103	Sep. 24, 2021	Sep. 23, 2022			
LF cable-13M	EMC	EMC8D-NM-NM-130 00	131104	Sep. 24, 2021	Sep. 23, 2022			
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Sep. 24, 2021	Sep. 23, 2022			
RF cable-8M	EMC	EMC104-SM-SM-80 00	181107	Sep. 24, 2021	Sep. 23, 2022			
Measurement Software	AUDIX	e3	6.120210g	NA	NA			
Note: Calibration Inter	rval of instruments liste	d above is one year.						

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Test Item	RF Conducted								
Test Site	(TH01-WS)								
Tested Date	Apr. 22, 2022								
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until				
Spectrum Analyzer	R&S	FSV40	101498	Nov. 29, 2021	Nov. 28, 2022				
Power Meter	Anritsu	ML2495A	1241002	Nov. 07, 2021	Nov. 06, 2022				
Power Sensor	Anritsu	MA2411B	1207366	Nov. 07, 2021	Nov. 06, 2022				
Measurement Software	Sporton	SENSE-15247_DTS	V5.10.7.17	NA	NA				
Note: Calibration Interval of instruments listed above is one year.									

1.5 Test Standards

47 CFR FCC Part 15.247 ANSI C63.10-2013

1.6 Reference Guidance

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

1.7 Deviation from Test Standard and Measurement Procedure

None

1.8 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					
Conducted power	±0.808 dB				
AC conducted emission	±2.92 dB				
Unwanted Emission ≤ 1GHz	±3.96 dB				
Unwanted Emission > 1GHz	±4.51 dB				

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2 Test Configuration

2.1 Testing Facility

Test Laboratory International Certification Corporation					
Test Site	CO01-WS, TH01-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	03CH03-WS				
Address of Test Site	No.14-1, Lane 19, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 333, Taiwan (R.O.C.)				

FCC Designation No.: TW0009FCC site registration No.: 207696

➤ ISED#: 10807C

➤ CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Frequency (MHz)	Data Rate	Test Configuration
AC Power Line Conducted Emission	11g	2437	6 Mbps	
Unwanted Emissions ≤ 1GHz	11g	2437	6 Mbps	
Unwanted Emissions >1GHz	HT20	2462	6 Mbps	
Conducted Output Power	11b 11g HT20	2412 / 2437 / 2462 2412 / 2437 / 2462 2412 / 2437 / 2462	1 Mbps 6 Mbps MCS 0	

NOTE:

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The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The Y-plane results were found as the worst case and were shown in this report.



3 Transmitter Test Results

3.1 Conducted Output Power

3.1.1 Limit of Conducted Output Power

Conducted power shall not exceed 1Watt.

Antenna gain <= 6dBi, no any corresponding reduction is in output power limit.

Antenna gain > 6dBi

Non Fixed, point to point operations.

The conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dB

Fixed, point to point operations

Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point Operations, maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

3.1.2 Test Procedures

A broadband RF power meter is used for output power measurement. The video bandwidth of power meter is greater than DTS bandwidth of EUT. If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power.

3.1.3 Test Setup



3.1.4 Test Results

Ambient Condition	22°C / 65%	Tested By	Aska Huang
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Refer to Appendix A.

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3.2 Unwanted Emissions into Restricted Frequency Bands

3.2.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit						
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)			
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300			
0.490~1.705	24000/F(kHz)	33.8 - 23	30			
1.705~30.0	30	29	30			
30~88	100	40	3			
88~216	150	43.5	3			
216~960	200	46	3			
Above 960	500	54	3			

Note 1:

Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

3.2.2 Test Procedures

- 1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
- 2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
- 3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

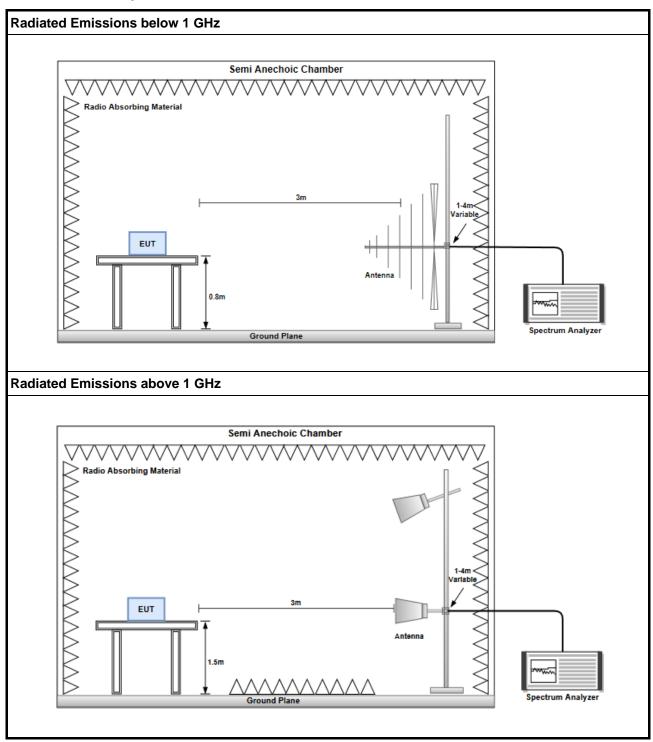
Note:

- 1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
- 2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
- RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

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3.2.3 Test Setup



3.2.4 Test Results

Refer to Appendix B.

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3.3 AC Power Line Conducted Emissions

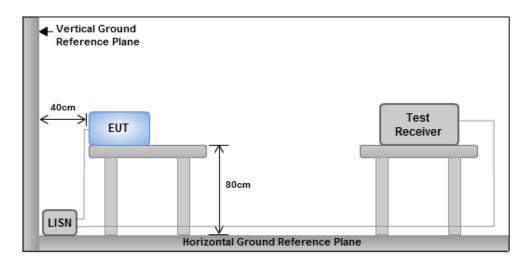
3.3.1 Limit of AC Power Line Conducted Emissions

Conducted Emissions Limit						
Frequency Emission (MHz) Quasi-Peak Average						
0.15-0.5	66 - 56 *	56 - 46 *				
0.5-5	56	46				
5-30	60	50				
Note 1: * Decreases with the logarithm of the frequency.						

3.3.2 Test Procedures

- 1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
- 2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
- 3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
- 4. This measurement was performed with AC 120V / 60Hz.

3.3.3 Test Setup



Note: 1. Support units were connected to second LISN.

Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

3.3.4 Test Results

Refer to Appendix C.

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4 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 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: 886-3-318-0345

Email: ICC Service@icertifi.com.tw

==END==

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Summary

Mode	Total Power	Total Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
802.11b_Nss1,(1Mbps)_1TX	17.43	0.05534
802.11g_Nss1,(6Mbps)_1TX	16.91	0.04909
802.11n HT20_Nss1,(MCS0)_1TX	16.86	0.04853

Result

Mode	Result	DG	Port 1	Total Power	Power Limit	EIRP	EIRP Limit
		(dBi)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)
802.11b_Nss1,(1Mbps)_1TX	-	-	-	-	-	-	-
2412MHz	Pass	2.00	17.43	17.43	30.00	19.43	36.00
2437MHz	Pass	2.00	17.29	17.29	30.00	19.29	36.00
2462MHz	Pass	2.00	15.13	15.13	30.00	17.13	36.00
802.11g_Nss1,(6Mbps)_1TX	-	-	-	-	-	-	-
2412MHz	Pass	2.00	14.83	14.83	30.00	16.83	36.00
2437MHz	Pass	2.00	16.91	16.91	30.00	18.91	36.00
2462MHz	Pass	2.00	14.19	14.19	30.00	16.19	36.00
802.11n HT20_Nss1,(MCS0)_1TX	-	-	-	-	-	-	-
2412MHz	Pass	2.00	16.68	16.68	30.00	18.68	36.00
2437MHz	Pass	2.00	16.86	16.86	30.00	18.86	36.00
2462MHz	Pass	2.00	14.32	14.32	30.00	16.32	36.00

DG = Directional Gain; Port X = Port X output power



Summary

Mode	Total Power	Total Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
802.11b_Nss1,(1Mbps)_1TX	20.02	0.10046
802.11g_Nss1,(6Mbps)_1TX	21.96	0.15704
802.11n HT20_Nss1,(MCS0)_1TX	21.88	0.15417

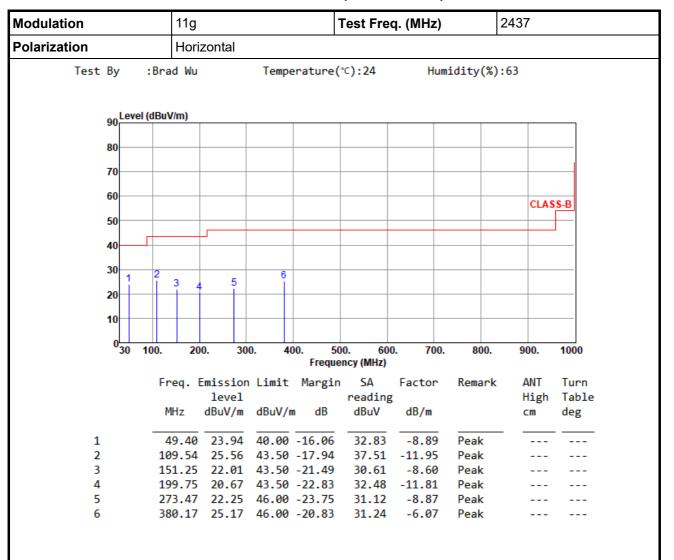
Result

Mode	Result	DG	Port 1	Total Power	Power Limit	EIRP	EIRP Limit
		(dBi)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)
802.11b_Nss1,(1Mbps)_1TX	-	-	-	-	-	-	-
2412MHz	Pass	2.00	20.02	20.02	30.00	22.02	36.00
2437MHz	Pass	2.00	19.95	19.95	30.00	21.95	36.00
2462MHz	Pass	2.00	18.05	18.05	30.00	20.05	36.00
802.11g_Nss1,(6Mbps)_1TX	-	-	-	-	-	-	-
2412MHz	Pass	2.00	21.69	21.69	30.00	23.69	36.00
2437MHz	Pass	2.00	21.96	21.96	30.00	23.96	36.00
2462MHz	Pass	2.00	21.41	21.41	30.00	23.41	36.00
802.11n HT20_Nss1,(MCS0)_1TX	-	-	-	-	-	-	-
2412MHz	Pass	2.00	21.09	21.09	30.00	23.09	36.00
2437MHz	Pass	2.00	21.88	21.88	30.00	23.88	36.00
2462MHz	Pass	2.00	20.91	20.91	30.00	22.91	36.00

DG = Directional Gain; Port X = Port X output power



Transmitter Radiated Unwanted Emissions (Below 1GHz)



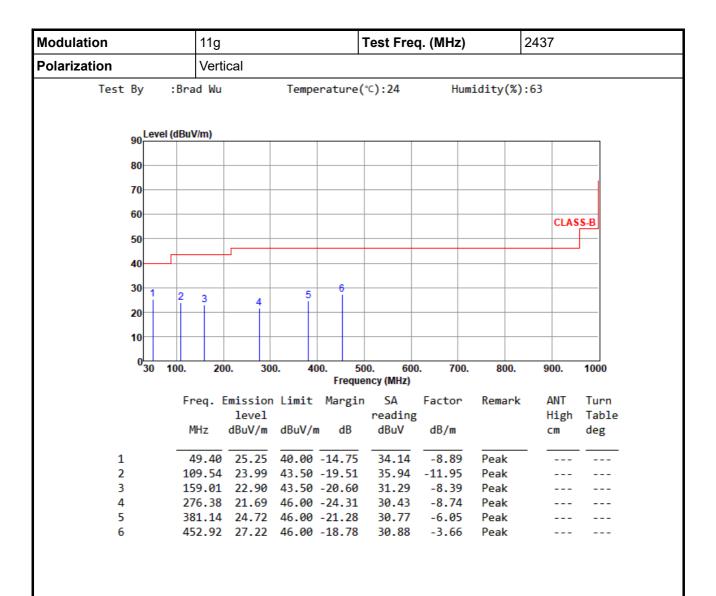
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)

*Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.





Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)

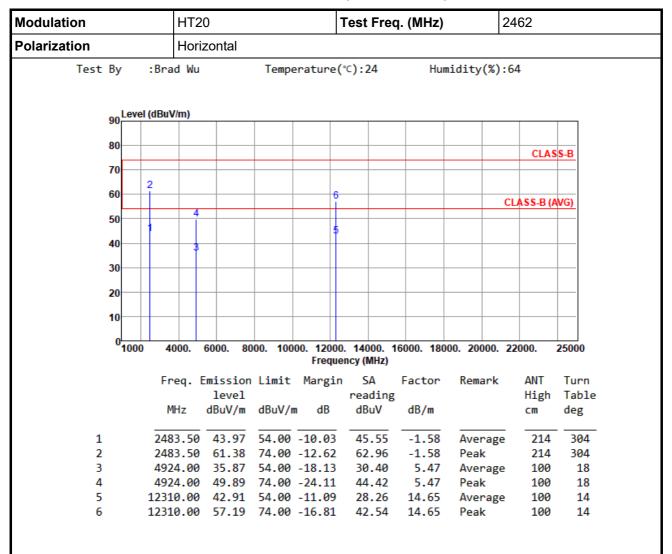
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.



Transmitter Radiated Unwanted Emissions (Above 1GHz)

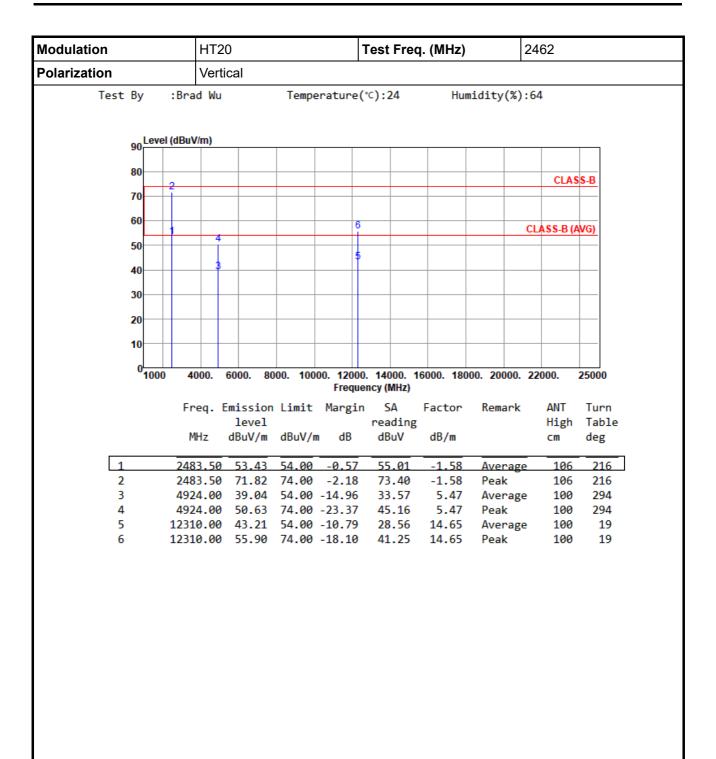


Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).



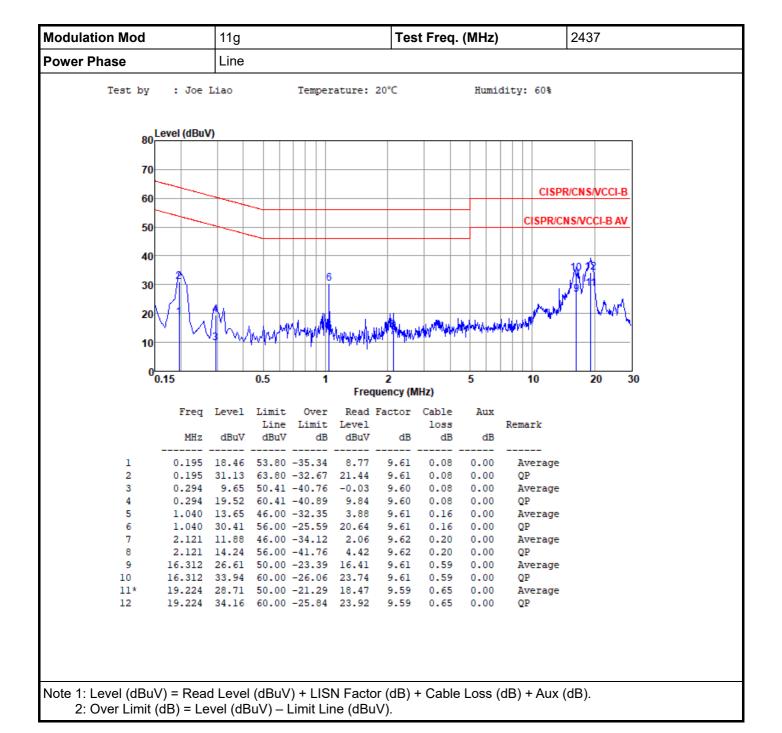


Note 1: Emission Level (dBuV/m) = SA Reading (dBuV) + Factor* (dB/m)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).





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