RF Exposure Evaluation Declaration

FCC ID: I88C424G

APPLICANT: Zyxel Communications Corporation

Application Type: Certification

Product: Indoor GPON HGU

Model No.: PMG5717-B10A, C424G

Trademark: ZYXEL, ADTRAN

Part Number: 1287781F1C

Test Procedure(s): KDB 447498 D01v06

FCC Classification: Digital Transmission System (DTS)
Unlicensed National Information Infrastructure (UNII)

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ACCREDITED TESTING LABORATORY CERTIFICATE #3628.01

The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standards through the calibration of the equipment and evaluated measurement uncertainty herein.

Revision History

Report No.	Version	Description	Issue Date	Note
1611RSU04003	Rev. 01	Initial report	02-08-2017	Valid

1. PRODUCT INFORMATION

1.1. Equipment Description

Product Name	Indoor GPON HGU
Model No.	PMG5717-B10A, C424G
Brand Name	ZYXEL, ADTRAN
Wi-Fi Specification	802.11a/b/g/n/ac
Frequency Range	**2.4GHz:** For 802.11b/g/n-HT20: 2412 ~ 2462 MHz For 802.11n-HT40: 2422 ~ 2452 MHz **5GHz:** For 802.11a/n-HT20: 5180~5320MHz, 5500~5700MHz, 5745~5825MHz For 802.11ac-VHT20: 5180~5320MHz, 5500~5720MHz, 5745~5825MHz For 802.11n-HT40: 5190~5310MHz, 5510~5670MHz, 5755~5795MHz For 802.11ac-VHT40: 5190~5310MHz, 5510~5710MHz, 5755~5795MHz For 802.11ac-VHT80: 5210MHz, 5290MHz, 5530MHz, 5610MHz, 5690MHz, 5775MHz
Type of Modulation	802.11b: DSSS 802.11g/a/n/ac: OFDM
Maximum Average Output Power	**For 2.4GHz Band:** 802.11b: 23.65dBm 802.11g: 23.75dBm 802.11n-HT20: 26.10dBm 802.11n-HT40: 26.09dBm **For 5GHz Band:** 802.11a: 25.73dBm 802.11n-HT20: 25.86dBm 802.11n-HT40: 25.40dBm 802.11ac-VHT20: 25.51 802.11ac-VHT40: 25.56 802.11ac-VHT80: 25.06dBm

1.2. Antenna Description

For 2.4GHz SISO Mode

Antenna Type	Mode	Frequency Band (GHz)	T_X Paths	Antenna Gain (dBi)	
				Ant 0	Ant 1
PCB Antenna	802.11b	2.4	1	3.4	--
	802.11g/n		2	3.4	2.7

For 2.4GHz MIMO mode

Antenna Type	Mode	Frequency Band (GHz)	T_X Paths	Directional Gain (dBi)	
				Non Beam Forming	Beam Forming
PCB Antenna	802.11n	2.4	2	2.92	--

Note:

1. The EUT not supports Beam Forming mode at 2.4GHz.
2. Completely uncorrelated signals include those transmitted in the following modes, if they are not combined with any correlated modes, such as beamforming:
   - Space Time Block Codes (STBC) or Space Time Codes (STC) for which different digital data is carried by each transmit antenna during any symbol period (e.g., WiMAX Matrix A [Alamouti coding]).
   - Spatial Multiplexing MIMO (SM-MIMO), for which independent data streams are sent to each transmit antenna (e.g., WiMAX Matrix B). WiMAX Matrix C, which adds diversity, also produces uncorrelated transmit signals.
3. Unequal antenna gains, with equal transmit powers. For antenna gains given by G_1, G_2, …, G_N dBi
   - transmit signals are uncorrelated, then
   - Directional gain = 10 log[($10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10}$)/$N_{ANT}$] dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

For 5GHz MIMO mode

Antenna Type	Frequency Band (GHz)	T_X Paths	Directional Gain (dBi)	
			Beam Forming	CDD
PCB Antenna	5150 ~ 5250	4	9.91	9.91
	5250 ~ 5350	4	6.90	6.90
	5470 ~ 5725	4	7.11	7.11
	5745 ~ 5850	4	10.13	10.13

Note:

1. The EUT support Beam Forming technology at 802.11n/ac mode, and support CDD technology at 802.11a mode.
2. Correlated signals include, but are not limited to, signals transmitted in any of the following modes:
   - Any transmit Beam Forming mode, whether fixed or adaptive (e.g., phased array modes, closed loop MIMO modes, Transmitter Adaptive Antenna modes, Maximum Ratio Transmission (MRT) modes, and Statistical Eigen Beam Forming (EBF) modes).
   - CDD signals are correlated and create unintended array gain that varies with signal bandwidth, antenna geometry, and cyclic delay values. Consequently, depending on system parameters, it may be appropriate to use different values of array gain for compliance with power limits versus compliance with powerspectral density limits.
3. Unequal antenna gains, with equal transmit powers. For antenna gains given by G_1, G_2, …, G_N dBi
   - transmit signals are correlated, then
   - Directional gain = 10 log[(10G1/20 + 10G2/20 + … + 10GN/20)2/NANT] dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

2. RF Exposure Evaluation

2.1. Limits

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (Minutes)
(A) Limits for Occupational/ Control Exposures				
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/ Uncontrolled Exposures				
300-1500	--	--	f/1500	6
1500-100,000	--	--	1	30

f= Frequency in MHz

Calculation Formula: $Pd = (Pout*G)/(4*pi*r^2)$

Where

Pd = power density in mW/cm^2

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

r = distance between observation point and center of the radiator in cm

Pd is the limit of MPE, $1mW/cm^2$. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

2.2. Test Result of RF Exposure Evaluation

Product	Indoor GPON HGU
Test Item	RF Exposure Evaluation

Antenna Gain: refer to the section 1.2

For 2.4GHz ISM Band:

Test Mode	Frequency Band (MHz)	Maximum Average Output Power (dBm)	Power Density at r = 20 cm (mW/cm^2)	Limit (mW/cm^2)
802.11b/g/n-HT20/ n-HT40	2412 ~ 2462	26.10	0.1588	1

For 5GHz UNII Band:

Test Mode	Frequency Band (MHz)	Maximum Average Output Power (dBm)	Power Density at r = 20 cm (mW/cm^2)	Limit (mW/cm^2)
802.11a/n-HT20/ n-H40/ac-VHT20 ac-VHT40/ac-VHT80	5180 ~ 5240	25.86	0.7512	1
	5260 ~ 5320	25.65	0.3579	1
	5500 ~ 5700	22.59	0.1857	1
	5745 ~ 5825	25.69	0.7599	1

CONCULISON:

Both of the 2.4GHz Wi-Fi and 5GHz Wi-Fi can transmit simultaneously. Therefore, the Max Power Density at r (20 cm) = $0.1588mW/cm^2 + 0.7599mW/cm^2 = 0.9187mW/cm^2 < 1mW/cm^2$

So the EUT complies with the FCC requirement.

The End