



# RADIO EXPOSURE TEST REPORT

FCC ID : I88EX3510-B1

Equipment : AX5700 WiFi6 Gigabit Ethernet Gateway

Brand Name : ZYXEL, Google Fiber

Model Name : EX3510-B1, C3510XZ, GRAX110Z

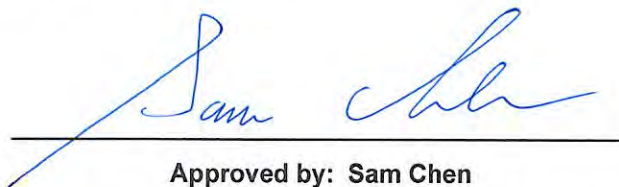
Applicant : Zyxel Communications Corporation  
No.2 Industry East RD. IX, Hsinchu Science Park,  
Hsinchu 30075, Taiwan

Manufacturer : Zyxel Communications Corporation  
No.2 Industry East RD. IX, Hsinchu Science Park,  
Hsinchu 30075, Taiwan

Standard : 47 CFR Part 2.1091

The product was received on May 23, 2022, and testing was started from Jun. 04, 2022 and completed on Jun. 15, 2022. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in 47 CFR Part 2.1091 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Hsinchu Laboratory, the test report shall not be reproduced except in full.



Approved by: Sam Chen

**Sporton International Inc. Hsinchu Laboratory**  
No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)



## **Table of Contents**

|                                                 |          |
|-------------------------------------------------|----------|
| <b>History of this test report.....</b>         | <b>3</b> |
| <b>Summary of Test Result.....</b>              | <b>4</b> |
| <b>1 General Description .....</b>              | <b>5</b> |
| 1.1 EUT General Information .....               | 5        |
| 1.2 Antenna Information .....                   | 6        |
| 1.3 Table for Multiple Listing .....            | 7        |
| 1.4 Accessories .....                           | 7        |
| 1.5 Applicable Standards .....                  | 7        |
| 1.6 Testing Location .....                      | 8        |
| <b>2 Maximum Permissible Exposure .....</b>     | <b>9</b> |
| 2.1 Limit of Maximum Permissible Exposure ..... | 9        |
| 2.2 MPE Calculation Method .....                | 9        |
| 2.3 MPE Exemption .....                         | 10       |
| 2.4 Calculated Result and Limit .....           | 11       |
| <b>Photographs of EUT v01</b>                   |          |



## History of this test report

TEL : 886-3-656-9065  
FAX : 886-3-656-9085  
Report Template No.: CB-A1\_1 Ver1.1

Page Number : 3 of 11  
Issued Date : Aug. 05, 2022  
Report Version : 01



## Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items          | Result (PASS/FAIL) | Remark |
|---------------|-----------------|---------------------|--------------------|--------|
| 2             | -               | Exposure evaluation | PASS               | -      |

**Declaration of Conformity:**

1. The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
2. The measurement uncertainty please refer to report "Measurement Uncertainty".

**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.

**Reviewed by: Sam Chen**

**Report Producer: Wendy Pan**



# 1 General Description

## 1.1 EUT General Information

| RF General Information |                                                  |                                                  |                                                                                                                                                                                                |
|------------------------|--------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Evaluation Mode        | Frequency Range (MHz)                            | Operating Frequency (MHz)                        | Modulation Type                                                                                                                                                                                |
| 2.4GHz WLAN            | 2400-2483.5                                      | 2412-2462                                        | 802.11b: DSSS (DBPSK, DQPSK, CCK)<br>802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM)<br>VHT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)<br>802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM) |
| 5GHz WLAN              | 5150-5250<br>5250-5350<br>5470-5725<br>5725-5850 | 5180-5250<br>5250-5320<br>5500-5720<br>5745-5825 | 802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM)<br>802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)<br>802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)                                 |

## 1.2 Antenna Information

| Ant. No.<br>(Define by manufacturer) | Antenna Position | RF Port | Brand Name | Model Name     | Ant. Type | Connector          | Modes of Operation |
|--------------------------------------|------------------|---------|------------|----------------|-----------|--------------------|--------------------|
| 2.4G-Ant.0                           | 2G Ant1          | 1       | WHAYU      | 65-034-000142B | PCB       | none (like solder) | 2.4GHz             |
| 2.4G-Ant.1                           | 2G Ant2          | 2       | WHAYU      | 65-034-000192B | PCB       | none (like solder) | 2.4GHz             |
| 2.4G-Ant.2                           | 2G Ant3          | 3       | WHAYU      | 65-034-000141B | PCB       | none (like solder) | 2.4GHz             |
| 5G-Ant.0                             | 5G Ant1          | 1       | WHAYU      | 65-034-000147B | PCB       | I-PEX              | 5GHz UNII 1~3      |
| 5G-Ant.1                             | 5G Ant2          | 2       | WHAYU      | 65-034-000195B | PCB       | I-PEX              | 5GHz UNII 1~3      |
| 5G-Ant.2                             | 5G Ant3          | 3       | WHAYU      | 65-034-000194B | PCB       | I-PEX              | 5GHz UNII 1~3      |
| 5G-Ant.3                             | 5G Ant4          | 4       | WHAYU      | 65-034-000193B | PCB       | I-PEX              | 5GHz UNII 1~3      |

| Antenna Position | RF Port | Gain (dBi)  |         |           |           |         |         |        |
|------------------|---------|-------------|---------|-----------|-----------|---------|---------|--------|
|                  |         | WLAN 2.4GHz |         |           | WLAN 5GHz |         |         |        |
|                  |         | 2400MHz     | 2450MHz | 2483.5MHz | UNII 1    | UNII 2A | UNII 2C | UNII 3 |
| 2G Ant1          | 1       | 3.64        | 3.76    | 3.35      | -         | -       | -       | -      |
| 2G Ant2          | 2       |             |         |           | -         | -       | -       | -      |
| 2G Ant3          | 3       |             |         |           | -         | -       | -       | -      |
| 5G Ant1          | 1       | -           | -       | -         | 4.22      | 4.47    | 4.36    | 5.32   |
| 5G Ant2          | 2       | -           | -       | -         |           |         |         |        |
| 5G Ant3          | 3       | -           | -       | -         |           |         |         |        |
| 5G Ant4          | 4       | -           | -       | -         |           |         |         |        |
| DG [1SS] (dBi)   |         | 4.98        | 3.84    | 3.1       | 5.59      | 6.52    | 5.51    | 5.95   |

Note1: The EUT equips seven antennas.

Note2: The above brand name, model name and type information were declared by manufacturer.

**For 2.4GHz function:**

**For IEEE 802.11b/g/n/VHT/ax mode (3TX/3RX):**

Port 1~3 can be used as transmitting/receiving antenna.

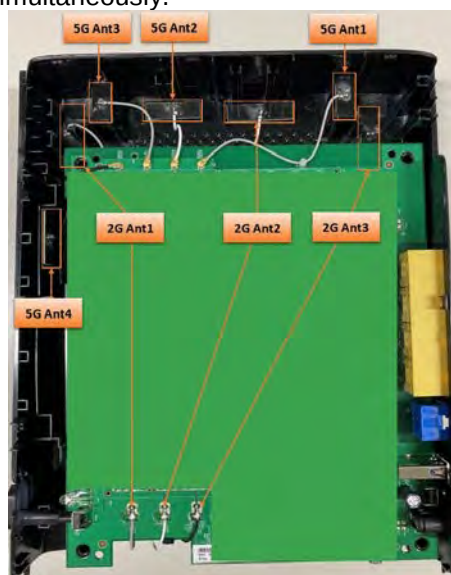
Port 1~3 could transmit/receive simultaneously.

**For 5GHz function:**

**For IEEE 802.11a/n/ac/ax mode (4TX/4RX):**

Port 1~4 can be used as transmitting/receiving antenna.

Port 1~4 could transmit/receive simultaneously.





### 1.3 Table for Multiple Listing

The brand/model names in the following table are all refer to the identical product.

| Brand Name   | Model Name            | Description                                                                                           |
|--------------|-----------------------|-------------------------------------------------------------------------------------------------------|
| ZYXEL        | EX3510-B1,<br>C3510XZ | All the models are identical, the difference model for difference brand served as marketing strategy. |
| Google Fiber | GRAX110Z              |                                                                                                       |

Note 1: From the above models, model: EX3510-B1 was selected as representative model for the test and its data was recorded in this report.

Note 2: The above information was declared by manufacturer.

### 1.4 Accessories

| Accessories                                                                                                                                                          |            |                 |                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------|-----------------------------------------------------|
| Equipment Name                                                                                                                                                       | Brand Name | Model Name      | Rating                                              |
| Adapter                                                                                                                                                              | MNC        | MAUS-1202503000 | INPUT: 100-240V ~ 50/60Hz, 0.8A<br>OUTPU: 12V, 2.5A |
| Others                                                                                                                                                               |            |                 |                                                     |
| Ethernet cable*1: Non-shielded, 1m, Color: Blue<br>Ethernet cable*1: Non-shielded, 1.8m, Color: Yellow<br>Note: Only one ethernet cable will be selected for market. |            |                 |                                                     |

### 1.5 Applicable Standards

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

- ♦ 47 CFR Part 2.1091
  - ♦ KDB 447498 D04 Interim General RF Exposure Guidance v01
- The following reference test guidance is not within the scope of accreditation of TAF.
- ♦ 47 CFR Part 1.1307
  - ♦ 47 CFR Part 1.1310



## 1.6 Testing Location

| Testing Location Information                              |                                                                                    |
|-----------------------------------------------------------|------------------------------------------------------------------------------------|
| Test Lab. : Sporton International Inc. Hsinchu Laboratory |                                                                                    |
| Hsinchu                                                   | ADD: No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.) |
| (TAF: 3787)                                               | TEL: 886-3-656-9065      FAX: 886-3-656-9085                                       |
|                                                           | Test site Designation No. TW3787 with FCC.                                         |
|                                                           | Conformity Assessment Body Identifier (CABID) TW3787 with ISED.                    |



## 2 Maximum Permissible Exposure

### 2.1 Limit of Maximum Permissible Exposure

(A) Limits for Occupational / Controlled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/ cm <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|------------------------------------------|------------------------------------------------------------------|
| 0.3-3.0               | 614                               | 1.63                              | *(100)                                   | <6                                                               |
| 3.0-30                | 1842/f                            | 4.89/f                            | *(900/f <sup>2</sup> )                   | <6                                                               |
| 30-300                | 61.4                              | 0.163                             | 1.0                                      | <6                                                               |
| 300-1500              | -                                 | -                                 | f/300                                    | <6                                                               |
| 1500-100,000          | -                                 | -                                 | 5                                        | <6                                                               |

(B) Limits for General Population / Uncontrolled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/ cm <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> , H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|------------------------------------------|------------------------------------------------------------------|
| 0.3-1.34              | 614                               | 1.63                              | *(100)                                   | <30                                                              |
| 1.34-30               | 824/f                             | 2.19/f                            | *(180/f <sup>2</sup> )                   | <30                                                              |
| 30-300                | 27.5                              | 0.073                             | 0.2                                      | <30                                                              |
| 300-1500              | -                                 | -                                 | f/1500                                   | <30                                                              |
| 1500-100,000          | -                                 | -                                 | 1.0                                      | <30                                                              |

Note: f = frequency in MHz ; \*Plane-wave equivalent power density

### 2.2 MPE Calculation Method

The MPE was calculated at 46 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \quad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

**E** = Electric field (V/m)

**P** = RF output power (W)

**G** = EUT Antenna numeric gain (numeric)

**d** = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$



## 2.3 MPE Exemption

Option (A): 1.1307(b)(3)(i)(A): Available maximum time-averaged power is < 1 mW

Option (B): 1.1307(b)(3)(i)(B): Device operates between 300 MHz and 6 GHz and the maximum time-averaged power or effective radiated power (ERP), whichever is greater, <= P<sub>th</sub>.

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left( \frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

$d$  = the separation distance (cm);

Option (C): 1.1307(b)(3)(i)(C): ERP is below a threshold calculated based on the distance

$R$  between the person and the antenna / radiating structure, where  $R > \lambda / 2 \pi$ .

| Single RF Sources Subject to Routine Environmental Evaluation |                       |
|---------------------------------------------------------------|-----------------------|
| RF Source frequency (MHz)                                     | Threshold ERP (watts) |
| 0.3-1.34                                                      | $1,920 R^2$ .         |
| 1.34-30                                                       | $3,450 R^2/f^2$ .     |
| 30-300                                                        | $3.83 R^2$ .          |
| 300-1,500                                                     | $0.0128 R^2 f$ .      |
| 1,500-100,000                                                 | $19.2 R^2$ .          |
| Note: $R$ is in meters, $f$ is in MHz.                        |                       |



## 2.4 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

| Mode     | DG (dBi) | Power (dBm) | EIRP (dBm) | Tolerance (dB) | Tune-up EIRP (dBm) | Tune-up EIRP (W) | Distance (cm) | S (mW/cm <sup>2</sup> ) | S Limit (mW/cm <sup>2</sup> ) |
|----------|----------|-------------|------------|----------------|--------------------|------------------|---------------|-------------------------|-------------------------------|
| 2.4G;D1D | 4.98     | 28.63       | 33.61      | 0.50           | 34.11              | 2.57632          | 46            | 0.09689                 | 1.00000                       |
| 5.2G;D1D | 5.59     | 29.94       | 35.53      | 0.46           | 35.99              | 3.97192          | 46            | 0.14937                 | 1.00000                       |
| 5.3G;D1D | 6.52     | 23.38       | 29.90      | 0.09           | 29.99              | 0.99770          | 46            | 0.03752                 | 1.00000                       |
| 5.6G;D1D | 5.51     | 23.96       | 29.47      | 0.50           | 29.97              | 0.99312          | 46            | 0.03735                 | 1.00000                       |
| 5.8G;D1D | 5.95     | 29.94       | 35.89      | 0.10           | 35.99              | 3.97192          | 46            | 0.14937                 | 1.00000                       |

Note: The above antenna gain was declared by manufacturer.

| MPE Exemption Option C |                    |       |                    |                   |                 |                   |               |
|------------------------|--------------------|-------|--------------------|-------------------|-----------------|-------------------|---------------|
| Frequency (MHz)        | $\lambda/2\pi$ (m) | R (m) | Tune-up EIRP (dBm) | Tune-up ERP (dBm) | Tune-up ERP (W) | ERP Threshold (W) | MPE Exemption |
| 2437                   | 0.0196             | 0.46  | 34.11              | 31.96             | 1.570           | 4.063             | Complies      |
| 5755                   | 0.0083             |       | 35.99              | 33.84             | 2.421           | 4.063             | Complies      |

Simultaneous Transmission Analysis Mode: WLAN 2.4GHz+WLAN 5GHz

| Simultaneous Transmissions Option C |       |                    |                   |                 |                   |                            |                                  |
|-------------------------------------|-------|--------------------|-------------------|-----------------|-------------------|----------------------------|----------------------------------|
| Frequency (MHz)                     | R (m) | Tune-up EIRP (dBm) | Tune-up ERP (dBm) | Tune-up ERP (W) | ERP Threshold (W) | Simultaneous Transmissions | Simultaneous Transmissions Limit |
| 2437                                | 0.46  | 34.11              | 31.96             | 1.570           | 4.063             | 0.98                       | <= 1                             |
| 5755                                |       | 35.99              | 33.84             | 2.421           | 4.063             |                            |                                  |

————THE END————