

## FCC 47 CFR MPE REPORT

AUDIO PRO AB

MULTIROOM WIFI PLAYER

Model Number: LINK2

FCC ID: 2AGNC-LINK2

|                          |                                                                     |
|--------------------------|---------------------------------------------------------------------|
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|                          |                                                                     |
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|                 |                             |
|-----------------|-----------------------------|
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## Maximum Permissible Exposure

### 1. Applicable Standards

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2m normally can be maintained between the user and the device.

#### 1.1. Limits for Maximum Permissible Exposure (MPE)

##### (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 Times   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)*                                | 6                                                                      |
| 30-300                | 61.4                              | 0.163                             | 1.0                                     | 6                                                                      |
| 300-1500              |                                   |                                   | F/300                                   | 6                                                                      |
| 1500-10000            |                                   |                                   | 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 Times   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)*                                | 30                                                                     |
| 30-300                | 27.5                              | 0.073                             | 0.2                                     | 30                                                                     |
| 300-1500              |                                   |                                   | F/1500                                  | 30                                                                     |
| 1500-10000            |                                   |                                   | 1.0                                     | 30                                                                     |

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

## 1.2. MPE Calculation Method

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

E = Electric Field (V/m)

P = Peak 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

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

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained

## 2. Conducted Power Result

### Antenna 1

| Mode                              | Frequency<br>(MHz) | Peak output power<br>(dBm) | Peak output power<br>(mW) | Target power<br>(dBm) |
|-----------------------------------|--------------------|----------------------------|---------------------------|-----------------------|
| GFSK                              | 2402               | 4.16                       | 2.61                      | 4±1                   |
|                                   | 2441               | 4.77                       | 3.00                      | 5±1                   |
|                                   | 2480               | 5.47                       | 3.52                      | 5±1                   |
| 8-DPSK                            | 2402               | 0.85                       | 1.22                      | 1±1                   |
|                                   | 2441               | 1.64                       | 1.46                      | 2±1                   |
|                                   | 2480               | 2.10                       | 1.62                      | 2±1                   |
| BLE                               | 2402               | 3.57                       | 2.28                      | 4±1                   |
|                                   | 2440               | 3.92                       | 2.47                      | 4±1                   |
|                                   | 2480               | 4.31                       | 2.70                      | 4±1                   |
| IEEE<br>802.11b                   | 2412               | 15.96                      | 39.45                     | 16±1                  |
|                                   | 2437               | 16.18                      | 41.50                     | 16±1                  |
|                                   | 2462               | 16.29                      | 42.56                     | 16±1                  |
| IEEE<br>802.11g                   | 2412               | 21.09                      | 128.53                    | 21±1                  |
|                                   | 2437               | 21.23                      | 132.74                    | 21±1                  |
|                                   | 2462               | 21.46                      | 139.96                    | 21±1                  |
| IEEE<br>802.11n<br>HT20<br>(2.4G) | 2412               | 21.00                      | 125.89                    | 21±1                  |
|                                   | 2437               | 21.12                      | 129.42                    | 21±1                  |
|                                   | 2462               | 21.33                      | 135.83                    | 21±1                  |
| IEEE<br>802.11a                   | 5180               | 17.202                     | 52.505                    | 17±1                  |
|                                   | 5200               | 17.617                     | 57.770                    | 18±1                  |
|                                   | 5240               | 18.051                     | 63.841                    | 18±1                  |
|                                   | 5745               | 17.021                     | 50.362                    | 17±1                  |
|                                   | 5785               | 16.080                     | 40.551                    | 16±1                  |
|                                   | 5825               | 16.012                     | 39.921                    | 16±1                  |
| IEEE<br>802.11n<br>HT20 (5G)      | 5180               | 12.097                     | 16.207                    | 12±1                  |
|                                   | 5200               | 12.496                     | 17.766                    | 12±1                  |
|                                   | 5240               | 13.095                     | 20.394                    | 13±1                  |
|                                   | 5745               | 12.214                     | 16.649                    | 12±1                  |
|                                   | 5785               | 11.260                     | 13.366                    | 11±1                  |
|                                   | 5825               | 11.038                     | 12.700                    | 11±1                  |

|                              |      |        |        |            |
|------------------------------|------|--------|--------|------------|
| IEEE<br>802.11ac<br>VHT20    | 5180 | 12.061 | 16.073 | $12 \pm 1$ |
|                              | 5200 | 12.541 | 17.951 | $13 \pm 1$ |
|                              | 5240 | 12.917 | 19.575 | $13 \pm 1$ |
|                              | 5745 | 12.138 | 16.361 | $12 \pm 1$ |
|                              | 5785 | 11.204 | 13.195 | $11 \pm 1$ |
|                              | 5825 | 10.947 | 12.437 | $11 \pm 1$ |
| IEEE<br>802.11n<br>HT40 (5G) | 5190 | 13.454 | 22.151 | $13 \pm 1$ |
|                              | 5230 | 14.294 | 26.878 | $14 \pm 1$ |
|                              | 5755 | 13.296 | 21.360 | $13 \pm 1$ |
|                              | 5795 | 12.384 | 17.314 | $12 \pm 1$ |
| IEEE<br>802.11ac<br>VHT40    | 5190 | 13.458 | 22.172 | $13 \pm 1$ |
|                              | 5230 | 14.437 | 27.778 | $14 \pm 1$ |
|                              | 5755 | 9.475  | 8.861  | $9 \pm 1$  |
|                              | 5795 | 12.433 | 17.511 | $12 \pm 1$ |
| IEEE<br>802.11ac<br>VHT80    | 5210 | 11.075 | 12.809 | $11 \pm 1$ |
|                              | 5775 | 9.599  | 9.118  | $10 \pm 1$ |

**Antenna 2**

| Mode                              | Frequency<br>(MHz) | Peak output power<br>(dBm) | Peak output power<br>(mW) | Target power<br>(dBm) |
|-----------------------------------|--------------------|----------------------------|---------------------------|-----------------------|
| IEEE<br>802.11b                   | 2412               | 15.75                      | 37.584                    | 16±1                  |
|                                   | 2437               | 15.78                      | 37.844                    | 16±1                  |
|                                   | 2462               | 16.06                      | 40.365                    | 16±1                  |
| IEEE<br>802.11g                   | 2412               | 20.92                      | 123.595                   | 21±1                  |
|                                   | 2437               | 20.99                      | 125.603                   | 21±1                  |
|                                   | 2462               | 21.12                      | 129.420                   | 21±1                  |
| IEEE<br>802.11n<br>HT20<br>(2.4G) | 2412               | 20.63                      | 115.611                   | 21±1                  |
|                                   | 2437               | 20.91                      | 123.310                   | 21±1                  |
|                                   | 2462               | 20.79                      | 119.950                   | 21±1                  |
| IEEE<br>802.11a                   | 5180               | 16.646                     | 46.196                    | 17±1                  |
|                                   | 5200               | 17.141                     | 51.773                    | 17±1                  |
|                                   | 5240               | 18.131                     | 65.028                    | 18±1                  |
|                                   | 5745               | 16.777                     | 47.610                    | 17±1                  |
|                                   | 5785               | 15.626                     | 36.526                    | 16±1                  |
|                                   | 5825               | 15.294                     | 33.838                    | 15±1                  |
| IEEE<br>802.11n<br>HT20 (5G)      | 5180               | 11.525                     | 14.207                    | 12±1                  |
|                                   | 5200               | 11.974                     | 15.754                    | 12±1                  |
|                                   | 5240               | 12.831                     | 19.191                    | 13±1                  |
|                                   | 5745               | 11.786                     | 15.087                    | 12±1                  |
|                                   | 5785               | 10.704                     | 11.760                    | 11±1                  |
|                                   | 5825               | 10.471                     | 11.146                    | 10±1                  |
| IEEE<br>802.11ac<br>VHT20         | 5180               | 11.382                     | 13.747                    | 11±1                  |
|                                   | 5200               | 11.886                     | 15.438                    | 12±1                  |
|                                   | 5240               | 12.889                     | 19.449                    | 13±1                  |
|                                   | 5745               | 11.694                     | 14.771                    | 12±1                  |
|                                   | 5785               | 10.730                     | 11.830                    | 11±1                  |
|                                   | 5825               | 10.431                     | 11.043                    | 10±1                  |
| IEEE<br>802.11n<br>HT40 (5G)      | 5190               | 12.678                     | 18.527                    | 13±1                  |
|                                   | 5230               | 13.852                     | 24.277                    | 14±1                  |
|                                   | 5755               | 12.680                     | 18.535                    | 13±1                  |
|                                   | 5795               | 11.595                     | 14.438                    | 12±1                  |

|                           |      |        |        |            |
|---------------------------|------|--------|--------|------------|
| IEEE<br>802.11ac<br>VHT40 | 5190 | 12.763 | 18.893 | $13 \pm 1$ |
|                           | 5230 | 13.764 | 23.790 | $14 \pm 1$ |
|                           | 5755 | 12.681 | 18.540 | $13 \pm 1$ |
|                           | 5795 | 11.574 | 14.368 | $12 \pm 1$ |
| IEEE<br>802.11ac<br>VHT80 | 5210 | 10.687 | 11.714 | $11 \pm 1$ |
|                           | 5775 | 9.274  | 8.461  | $9 \pm 1$  |

### 3. Calculated Result and Limit

#### Bluetooth

| Antenna | Worst Mode | Channel | MAX<br>Target<br>power<br>(dBm) | Antenna gain |          | Power<br>Density<br>(S)<br>(mW/cm <sup>2</sup> ) | Limited of<br>Power<br>Density<br>(S)<br>(mW/cm <sup>2</sup> ) | Test<br>Result |
|---------|------------|---------|---------------------------------|--------------|----------|--------------------------------------------------|----------------------------------------------------------------|----------------|
|         |            |         |                                 | (dBi)        | (Linear) |                                                  |                                                                |                |
| 1       | GFSK       | 2480    | 6                               | 2            | 1.585    | 0.00126                                          | 1                                                              | Complies       |

#### WLAN 2.4G SISO

| Antenna | Worst Mode      | Channel | MAX<br>Target<br>power<br>(dBm) | Antenna gain |          | Power<br>Density<br>(S)<br>(mW/cm <sup>2</sup> ) | Limited of<br>Power<br>Density<br>(S)<br>(mW/cm <sup>2</sup> ) | Test<br>Result |
|---------|-----------------|---------|---------------------------------|--------------|----------|--------------------------------------------------|----------------------------------------------------------------|----------------|
|         |                 |         |                                 | (dBi)        | (Linear) |                                                  |                                                                |                |
| 1       | IEEE<br>802.11g | 2462    | 22                              | 2            | 1.585    | 0.04997                                          | 1                                                              | Complies       |
| 2       | IEEE<br>802.11g | 2462    | 22                              | 2            | 1.585    | 0.04997                                          | 1                                                              | Complies       |

#### WLAN 2.4G MIMO

| Worst<br>Mode           | Channel | Target<br>power<br>(dBm)<br>Antenna 1 | Target<br>power<br>(dBm)<br>Antenna 2 | Power<br>Density<br>(S)<br>(mW/cm <sup>2</sup> )<br>Antenna 1 | Power<br>Density<br>(S)<br>(mW/cm <sup>2</sup> )<br>Antenna 2 | Total<br>Ratio | Limit<br>Ratio | Test<br>Result |
|-------------------------|---------|---------------------------------------|---------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|----------------|----------------|----------------|
| IEEE<br>802.11n<br>HT20 | 2462    | 22                                    | 22                                    | 0.04997                                                       | 0.04997                                                       | 0.09994        | 1              | Complies       |

**WLAN 5G SISO**

| Antenna | Worst Mode      | Channel | MAX<br>Target<br>power<br>(dBm) | Antenna gain |          | Power<br>Density<br>(S)<br>(mW/cm <sup>2</sup> ) | Limited of<br>Power<br>Density<br>(S)<br>(mW/cm <sup>2</sup> ) | Test<br>Result |
|---------|-----------------|---------|---------------------------------|--------------|----------|--------------------------------------------------|----------------------------------------------------------------|----------------|
|         |                 |         |                                 | (dBi)        | (Linear) |                                                  |                                                                |                |
| 1       | IEEE<br>802.11a | 5240    | 19                              | 2            | 1.585    | 0.02505                                          | 1                                                              | Complies       |
| 2       | IEEE<br>802.11a | 5240    | 19                              | 2            | 1.585    | 0.02505                                          | 1                                                              | Complies       |

**WLAN 5G MIMO**

| Worst<br>Mode           | Channel | Target<br>power<br>(dBm) | Target<br>power<br>(dBm) | Power<br>Density<br>(S)            | Power<br>Density<br>(S)            | Total<br>Ratio | Limit<br>Ratio | Test<br>Result |
|-------------------------|---------|--------------------------|--------------------------|------------------------------------|------------------------------------|----------------|----------------|----------------|
|                         |         | Antenna<br>1             | Antenna<br>2             | (mW/cm <sup>2</sup> )<br>Antenna 1 | (mW/cm <sup>2</sup> )<br>Antenna 2 |                |                |                |
| IEEE<br>802.11n<br>HT40 | 5230    | 15                       | 15                       | 0.00997                            | 0.00997                            | 0.01994        | 1              | Complies       |

**Bluetooth+ WLAN**

| MAX<br>Power Density<br>(S)<br>(mW/cm <sup>2</sup> )<br>Bluetooth | MAX<br>Power Density<br>(S)<br>(mW/cm <sup>2</sup> )<br>Ratio<br>WiFi | Total Ratio | Limit Ratio | Test Result |
|-------------------------------------------------------------------|-----------------------------------------------------------------------|-------------|-------------|-------------|
| 0.00126                                                           | 0.09994                                                               | 0.10120     | 1           | Complies    |

**Note: 1. only the worst case was recorded.**

**2. 2.4G wifi & 5G wifi can't transmit simultaneously.**

**End of Test Report**