

## FCC 47 CFR MPE REPORT

TCL Entertainment Solutions Limited

2.0 TCL• Roku TV Wireless Soundbar

Model Number: TSR1

Additional Model: TS120, TS1204, TDS1204, TS1204K, TDS1204K, FS1204, OS1204, AltoR1, Alto R, \*\*\*1204, TS7204, TS720, TDS7204, TS7204K, TDS7204K, FS7204, OS7204, AltoR7, \*\*\*7204 (“\*” can be any alphanumeric character including blank for marketing differences)

FCC ID: 2ARUDTSR1

|                          |                                                                        |
|--------------------------|------------------------------------------------------------------------|
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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

### Bluetooth Antenna

| Mode   | Frequency<br>(MHz) | Peak output<br>power (dBm) | Peak output<br>power (mW) | Target power<br>(dBm) | Antenna gain |          |
|--------|--------------------|----------------------------|---------------------------|-----------------------|--------------|----------|
|        |                    |                            |                           |                       | (dBi)        | (Linear) |
| GFSK   | 2480               | 4.99                       | 3.1550                    | $4 \pm 1$             | 2.5          | 1.778    |
| 8-DPSK | 2480               | 1.65                       | 1.4622                    | $1 \pm 1$             | 2.5          | 1.778    |
| BLE    | 2480               | 5.24                       | 3.3420                    | $5 \pm 1$             | 2.5          | 1.778    |

### WiFi Antenna 0

| Mode                   | Frequency<br>(MHz) | Peak output<br>power (dBm) | Peak output<br>power (mW) | Target power<br>(dBm) | Antenna gain |          |
|------------------------|--------------------|----------------------------|---------------------------|-----------------------|--------------|----------|
|                        |                    |                            |                           |                       | (dBi)        | (Linear) |
| IEEE 802.11b           | 2412               | 19.10                      | 81.2831                   | $19 \pm 1$            | 2.5          | 1.778    |
| IEEE 802.11g           | 2412               | 25.19                      | 330.3695                  | $25 \pm 1$            | 2.5          | 1.778    |
| IEEE 802.11n<br>HT20   | 2412               | 24.77                      | 299.9163                  | $24 \pm 1$            | 2.5          | 1.778    |
| IEEE 802.11n<br>HT40   | 2422               | 25.27                      | 336.5116                  | $25 \pm 1$            | 2.5          | 1.778    |
| IEEE 802.11a           | 5240               | 13.11                      | 20.4644                   | $13 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11n<br>HT20   | 5240               | 14.96                      | 31.3329                   | $14 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11ac<br>VHT20 | 5240               | 14.72                      | 29.6483                   | $14 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11n<br>HT40   | 5755               | 14.75                      | 30.4089                   | $14 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11ac<br>VHT40 | 5755               | 14.74                      | 24.8886                   | $14 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11ac<br>VHT80 | 5210               | 14.97                      | 30.4089                   | $14 \pm 1$            | 4.11         | 2.576    |

**WiFi Antenna 1**

| Mode                   | Frequency<br>(MHz) | Peak output<br>power (dBm) | Peak output<br>power (mW) | Target power<br>(dBm) | Antenna gain |          |
|------------------------|--------------------|----------------------------|---------------------------|-----------------------|--------------|----------|
|                        |                    |                            |                           |                       | (dBi)        | (Linear) |
| IEEE 802.11b           | 2412               | 19.01                      | 79.6159                   | $19 \pm 1$            | 2.5          | 1.778    |
| IEEE 802.11g           | 2412               | 25.50                      | 354.8134                  | $25 \pm 1$            | 2.5          | 1.778    |
| IEEE 802.11n<br>HT20   | 2412               | 24.58                      | 287.0781                  | $24 \pm 1$            | 2.5          | 1.778    |
| IEEE 802.11n<br>HT40   | 2422               | 24.96                      | 313.3286                  | $24 \pm 1$            | 2.5          | 1.778    |
| IEEE 802.11a           | 5745               | 13.94                      | 24.7742                   | $13 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11n<br>HT20   | 5745               | 15.88                      | 36.3915                   | $15 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11ac<br>VHT20 | 5745               | 15.60                      | 36.3078                   | $15 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11n<br>HT40   | 5755               | 16.00                      | 40.0867                   | $16 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11ac<br>VHT40 | 5755               | 16.01                      | 39.9945                   | $16 \pm 1$            | 4.11         | 2.576    |
| IEEE 802.11ac<br>VHT80 | 5775               | 15.87                      | 38.9942                   | $15 \pm 1$            | 4.11         | 2.576    |

## Calculated Result and Limit

### WiFi Antenna 0

| Mode                | Target power (dBm) | Antenna gain |          | Power Density (S) (mW/cm <sup>2</sup> ) | Limited of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|---------------------|--------------------|--------------|----------|-----------------------------------------|----------------------------------------------------|-------------|
|                     |                    | (dBi)        | (Linear) |                                         |                                                    |             |
| 2.4G Band           |                    |              |          |                                         |                                                    |             |
| GFSK                | 4.99               | 2.5          | 1.778    | 0.0011                                  | 1                                                  | Complies    |
| 8-DPSK              | 1.65               | 2.5          | 1.778    | 0.0005                                  | 1                                                  | Complies    |
| BLE                 | 5.24               | 2.5          | 1.778    | 0.0012                                  | 1                                                  | Complies    |
| IEEE 802.11b        | 19.25              | 2.5          | 1.778    | 0.0298                                  | 1                                                  | Complies    |
| IEEE 802.11g        | 25.19              | 2.5          | 1.778    | 0.1169                                  | 1                                                  | Complies    |
| IEEE 802.11n HT20   | 24.69              | 2.5          | 1.778    | 0.1042                                  | 1                                                  | Complies    |
| IEEE 802.11n HT40   | 25.27              | 2.5          | 1.778    | 0.1190                                  | 1                                                  | Complies    |
| 5G Band             |                    |              |          |                                         |                                                    |             |
| IEEE 802.11a        | 13.11              | 4.11         | 2.576    | 0.0105                                  | 1                                                  | Complies    |
| IEEE 802.11n HT20   | 14.96              | 4.11         | 2.576    | 0.0161                                  | 1                                                  | Complies    |
| IEEE 802.11ac VHT20 | 14.72              | 4.11         | 2.576    | 0.0152                                  | 1                                                  | Complies    |
| IEEE 802.11n HT40   | 14.83              | 4.11         | 2.576    | 0.0156                                  | 1                                                  | Complies    |
| IEEE 802.11ac VHT40 | 14.79              | 4.11         | 2.576    | 0.0154                                  | 1                                                  | Complies    |
| IEEE 802.11ac VHT80 | 14.97              | 4.11         | 2.576    | 0.0161                                  | 1                                                  | Complies    |

**WiFi Antenna 1**

| Mode                | Target power (dBm) | Antenna gain |          | Power Density (S) (mW/cm <sup>2</sup> ) | Limited of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|---------------------|--------------------|--------------|----------|-----------------------------------------|----------------------------------------------------|-------------|
|                     |                    | (dBi)        | (Linear) |                                         |                                                    |             |
| 2.4G Band           |                    |              |          |                                         |                                                    |             |
| IEEE 802.11b        | 19.01              | 2.5          | 1.778    | 0.0282                                  | 1                                                  | Complies    |
| IEEE 802.11g        | 25.50              | 2.5          | 1.778    | 0.1255                                  | 1                                                  | Complies    |
| IEEE 802.11n HT20   | 24.58              | 2.5          | 1.778    | 0.1016                                  | 1                                                  | Complies    |
| IEEE 802.11n HT40   | 24.96              | 2.5          | 1.778    | 0.1108                                  | 1                                                  | Complies    |
| 5G Band             |                    |              |          |                                         |                                                    |             |
| IEEE 802.11a        | 13.94              | 4.11         | 2.576    | 0.0127                                  | 1                                                  | Complies    |
| IEEE 802.11n HT20   | 15.61              | 4.11         | 2.576    | 0.0187                                  | 1                                                  | Complies    |
| IEEE 802.11ac VHT20 | 15.60              | 4.11         | 2.576    | 0.0186                                  | 1                                                  | Complies    |
| IEEE 802.11n HT40   | 16.03              | 4.11         | 2.576    | 0.0205                                  | 1                                                  | Complies    |
| IEEE 802.11ac VHT40 | 16.02              | 4.11         | 2.576    | 0.0205                                  | 1                                                  | Complies    |
| IEEE 802.11ac VHT80 | 15.91              | 4.11         | 2.576    | 0.0200                                  | 1                                                  | Complies    |

**WiFi Antenna 0+1**

| Mode                | Power Density (S) (mW/cm <sup>2</sup> )<br>Antenna 0 | Power Density (S) (mW/cm <sup>2</sup> )<br>Antenna 1 | Power Density (S) (mW/cm <sup>2</sup> )<br>Total | Limited of Power Density (S) (mW/cm <sup>2</sup> ) | Test Result |
|---------------------|------------------------------------------------------|------------------------------------------------------|--------------------------------------------------|----------------------------------------------------|-------------|
| 2.4G Band           |                                                      |                                                      |                                                  |                                                    |             |
| IEEE 802.11n HT20   | 0.1042                                               | 0.1016                                               | 0.2058                                           | 1                                                  | Complies    |
| IEEE 802.11n HT40   | 0.1190                                               | 0.1108                                               | 0.2298                                           | 1                                                  | Complies    |
| 5G Band             |                                                      |                                                      |                                                  |                                                    |             |
| IEEE 802.11n HT20   | 0.0161                                               | 0.0127                                               | 0.0288                                           | 1                                                  | Complies    |
| IEEE 802.11ac VHT20 | 0.0152                                               | 0.0187                                               | 0.0339                                           | 1                                                  | Complies    |
| IEEE 802.11n HT40   | 0.0156                                               | 0.0186                                               | 0.0342                                           | 1                                                  | Complies    |
| IEEE 802.11ac VHT40 | 0.0154                                               | 0.0205                                               | 0.0359                                           | 1                                                  | Complies    |
| IEEE 802.11ac VHT80 | 0.0161                                               | 0.0205                                               | 0.0366                                           | 1                                                  | Complies    |

Note: 2.4 and 5GHz bands are share an antenna, Cann't both the 2.4 and 5 GHz bands operate simultaneously.

**End of Test Report**