# IEEE C95.1

# KDB 447498 D01 v06

## 47 C.F.R. Part 1, Subpart I, Section 1.1310
## 47 C.F.R. Part 2, Subpart J, Section 2.1091

# RF EXPOSURE REPORT

## For
### AC1300 IoT Router

## Model: X10R

## Data Applies To: X10 ; X10S

## Trade Name: ASRock

### Issued for

## ASRock Incorporation

## 2F., No.37, Sec. 2, Jhongyang S. Rd., Beitou Dist., Taipei City 11270, Taiwan (R.O.C.)

### Issued by

## Compliance Certification Services Inc.
## Hsinchu Lab.
### NO. 989-1, Wenshan Rd., Shangshan Village,
### Qionglin Township, Hsinchu County 30741, Taiwan (R.O.C.)
### http://www.ccsrf.com
### service@ccsrf.com
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**TAF**
Testing Laboratory
0240

# Revision History

| Rev. | Issue Date | Revisions | Effect Page | Revised By |
|------|-----------|-----------|-------------|------------|
| 00 | 02/18/2017 | Initial Issue | All Page | Michelle Chiu |
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## 1. TEST REPORT CERTIFICATION

### We hereby certify that:

The equipment has been tested by Compliance Certification Services Inc., and found compliance with the requirement of the applicable standards. The test record, data evaluation and Equipment under Test (EUT) configurations represented herein are true and accurate accounts of the measurement of the sample's RF characteristics under the conditions specified in this report.
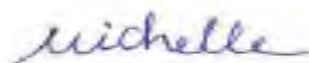
| APPLICABLE STANDARD | |
|---|---|
| **Standard** | **Test Result** |
| IEEE C95.1<br>KDB 447498 D01 v06<br>47 C.F.R. Part 1, Subpart I, Section 1.1310<br>47 C.F.R. Part 2, Subpart J, Section 2.1091 | No non-compliance noted |

*Approved by:*                              *Prepared by:*

Sb. Lu                                        Michelle Chiu
Sr. Engineer                                  Report coordinator

## 2. Limit

According to §15.247(i), 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 levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

## 3. EUT Specification

| | |
|---|---|
| **Product Name** | AC1300 IoT Router |
| **Model Number** | X10R |
| **Data Applies To** | X10 ; X10S |
| **Identify Number** | T161103D21 |
| **Received Date** | October 24, 2016 |
| **Frequency band (Operating)** | 802.11b/g/gn HT20, 802.11ac VHT20 Mode: 2412MHz ~ 2462MHz<br>802.11gn HT40 Mode: 2422MHz ~ 2452MHz<br>802.11a, 802.11ac VHT20, 802.11ac VHT40 Mode:<br>5180 MHz ~ 5240 MHz / 5745 MHz ~ 5825 MHz<br>802.11ac VHT40 Mode:<br>5190 MHz ~ 5230 MHz / 5755 MHz ~ 5795 MHz<br>802.11ac VHT80 Mode: 5210 MHz / 5775 MHz<br>Zigbee Mode: 2405MHz ~ 2480MHz<br>LoRa Mode: 902.5 MHz to 927.5 MHz |
| **Device category** | Mobile (>20cm separation) |
| **Exposure classification** | ☐  Occupational/Controlled exposure (S = 5mW/cm$^2$)<br>☒  General Population/Uncontrolled exposure<br>    (S=1mW/cm$^2$) |
| **Antenna Specification** | WiFi 2.4GHz Mode: Dipole Antenna × 2<br>Ant. 1 (Left) / Chain 0, Antenna Gain: 5.73dBi<br>Ant. 2 (Right) / Chain 1, Antenna Gain: 5.60 dBi<br>WiFi 5GHz Mode : Dipole Antenna × 2,<br>Ant. 1 (Left) / Chain 0 , Antenna Gain : 5.43 dBi<br>Ant. 2 (Right) / Chain 1, Antenna Gain : 5.28 dBi<br>ZigBee Mode: PIFA Antenna × 1, Antenna Gain : 2.55dBi<br>LoRa Mode: Dipole Antenna × 1, Antenna Gain : 1.17dBi<br>For Beamforming Directional Gain : 8.37dBi |

| | |
|---|---|
| **Maximum average output power** | IEEE 802.11b Mode: 24.05 dBm<br>IEEE 802.11g Mode: 21.94 dBm<br>IEEE 802.11ac VHT20 MCS0 Mode: 22.07 dBm<br>IEEE 802.11ac VHT40 MCS0 Mode: 17.16 dBm<br>Zigbee Mode: 14.05 dBm<br>LoRa Mode: 18.74 dBm<br>For Non-beamforming :<br>UNII Band 1/ Master:<br>IEEE 802.11a Mode: 20.45 dBm<br>IEEE 802.11ac VHT20 NSS1/MCS0 Mode: 20.40 dBm<br>IEEE 802.11ac VHT40 NSS1/MCS0 Mode: 19.29 dBm<br>IEEE 802.11ac VHT80 NSS1/MCS0 Mode: 15.10 dBm<br>UNII Band 1 / Client:<br>IEEE 802.11a Mode: 18.47 dBm<br>IEEE 802.11ac VHT20 NSS1/MCS0 Mode: 18.85 dBm<br>IEEE 802.11ac VHT40 NSS1/MCS0 Mode: 19.29 dBm<br>IEEE 802.11ac VHT80 NSS1/MCS0 Mode: 15.10 dBm<br>UNII Band 3:<br>IEEE 802.11a Mode: 22.27 dBm<br>IEEE 802.11ac VHT20 NSS1/MCS0 Mode: 22.25 dBm<br>IEEE 802.11ac VHT40 NSS1/MCS0 Mode: 22.32 dBm<br>IEEE 802.11ac VHT80 NSS1/MCS0 Mode: 20.03 dBm<br>For Beamforming<br>UNII Band 1 / Master :<br>IEEE 802.11ac VHT20 NSS1/MCS0 Mode: 19.03 dBm<br>IEEE 802.11ac VHT40 NSS1/MCS0 Mode: 18.16 dBm<br>IEEE 802.11ac VHT80 NSS1/MCS0 Mode: 15.73 dBm<br>UNII Band 1 / Client :<br>IEEE 802.11ac VHT20 NSS1/MCS0 Mode: 19.03 dBm<br>IEEE 802.11ac VHT40 NSS1/MCS0 Mode: 18.16 dBm<br>IEEE 802.11ac VHT80 NSS1/MCS0 Mode: 15.73 dBm<br>UNII Band 3:<br>IEEE 802.11ac VHT20 NSS1/MCS0 Mode: 20.36 dBm<br>IEEE 802.11ac VHT40 NSS1/MCS0 Mode: 20.25 dBm<br>IEEE 802.11ac VHT80 NSS1/MCS0 Mode: 19.16 dBm |
| **Evaluation applied** | MPE Evaluation* |

**Power Adapter:**

| No. | Manufacturer | Model No. | Power Input | Power Output |
|---|---|---|---|---|
| 1 | APD | WB-18D12R | 100-240Vac, 50-60Hz, 0.5A Max. | 12Vdc, 1.5A |

### The difference of the series model

| Model Number | Difference | |
|---|---|---|
| | **Function** | **External Antenna Quantity** |
| X10 | Router + Zigbee | 2 |
| X10R | Router + Zigbee+LoRa(Sub-G) | 3 |
| X10S | Router + Zigbee+LoRa(Sub-G) | 3 |

*Remark:*

*1. For more details, please refer to the User's manual of the EUT.*

*2. This submittal(s) (test report) is intended for FCC ID: 2AFEB-X10 filing.*

*3. The model X10R was considered the main model for testing.*

## 4. Test Results

*No non-compliance noted.*

**Calculation**

Given $E = \dfrac{\sqrt{30 \times P \times G}}{d}$ & $S = \dfrac{E^2}{3770}$

*Where*      *E = Field strength in Volts / meter*

*P = Power in Watts*

*G = Numeric antenna gain*

*d = Distance in meters*

*S = Power density in milliwatts / square centimeter*

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

*P (mW) = P (W) / 1000 and*

*d (cm) = d(m) / 100*

Yields

$$S = \frac{30 \times (P/1000) \times G}{377 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \textbf{\textit{Equation 1}}$$

*Where*      *d = Distance in cm*

*P = Power in mW*

*G = Numeric antenna gain*

*S = Power density in mW / cm²*

## 5. Maximum Permissible Exposure

Substituting the MPE safe distance using d = **20** cm into Equation 1:

$$S = 0.000199 \times P \times G$$

*Where*

*P = Power in mW*

*G = Numeric antenna gain*

*S = Power density in mW / cm$^2$*

| Mode | Frequency (MHz) | Power (dBm) | Ant. Gain (dBi) | Distance (cm) | Power density (mW/cm$^2$) | Limit (mW/cm$^2$) |
|---|---|---|---|---|---|---|
| IEEE 802.11b | 2437 | 24.05 | 5.73 | 20 | 0.1891 | 1 |
| IEEE 802.11g | 2437 | 21.94 | 5.73 | 20 | 0.1163 | 1 |
| IEEE 802.11ac VHT20 MCS0 | 2437 | 22.07 | 5.73 | 20 | 0.1199 | 1 |
| IEEE 802.11ac VHT40 MCS0 | 2437 | 17.16 | 5.73 | 20 | 0.0387 | 1 |
| Zigbee | 2405 | 14.05 | 2.55 | 20 | 0.0091 | 1 |
| LoRa | 902.5 | 18.74 | 1.17 | 20 | 0.0195 | 1 |
| For Non-beamforming : | | | | | | |
| UNII Band 1: | | | | | | |
| IEEE 802.11a | 5200 | 20.45 | 5.43 | 20 | 0.077 | 1 |
| IEEE 802.11ac VHT20 NSS1/MCS0 | 5200 | 20.40 | 5.43 | 20 | 0.0762 | 1 |
| IEEE 802.11ac VHT40 NSS1/MCS0 | 5230 | 19.29 | 5.43 | 20 | 0.059 | 1 |
| IEEE 802.11ac VHT80 NSS1/MCS0 | 5210 | 15.10 | 5.43 | 20 | 0.0225 | 1 |
| UNII Band 3: | | | | | | |
| IEEE 802.11a | 5745 | 22.27 | 5.43 | 20 | 0.1171 | 1 |
| IEEE 802.11ac VHT20 NSS1/MCS0 | 5745 | 22.25 | 5.43 | 20 | 0.1166 | 1 |
| IEEE 802.11ac VHT40 NSS1/MCS0 | 5755 | 22.32 | 5.43 | 20 | 0.1185 | 1 |
| IEEE 802.11ac VHT80 NSS1/MCS0 | 5775 | 20.03 | 5.43 | 20 | 0.0699 | 1 |

| For Beamforming : | | | | | | |
|---|---|---|---|---|---|---|
| **UNII Band 1:** | | | | | | |
| IEEE 802.11ac VHT20 NSS1/MCS0 | 5180 | 19.03 | 8.37 | 20 | 0.1093 | 1 |
| IEEE 802.11ac VHT40 NSS1/MCS0 | 5230 | 18.16 | 8.37 | 20 | 0.0895 | 1 |
| IEEE 802.11ac VHT80 NSS1/MCS0 | 5210 | 15.73 | 8.37 | 20 | 0.0511 | 1 |
| **UNII Band 3:** | | | | | | |
| IEEE 802.11ac VHT20 NSS1/MCS0 | 5745 | 20.36 | 8.37 | 20 | 0.1485 | 1 |
| IEEE 802.11ac VHT40 NSS1/MCS0 | 5755 | 20.25 | 8.37 | 20 | 0.1448 | 1 |
| IEEE 802.11ac VHT80 NSS1/MCS0 | 5775 | 19.16 | 8.37 | 20 | 0.1126 | 1 |

## Simultaneously MPE

Simultaneously MPE = MPE 1 / Limit 1 + MPE 2 / Limit2 + ……..

**WiFi / ZiBee 2.4GHz + 5GHz + LoRa Mode**

Simultaneously MPE = (0.1891 / 1) + (0.1485 / 1)+( 0.0195 / 1) = **0.3571 mW/cm$^2$**

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