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RF Exposure and Transmitter Power Considerations for the 600 Series Router

FCC ID: 2AASBH604V4

The 600 Series Router WLAN operates in the 5180 - 5240MHz and 5745 - 5825MHz frequency bands and uses 802.11a/n technologies. It supports 2x2 MIMO.

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Additionally, the Router contains a pre-approved 2G/ 3G/ 4G, cellular module with FCC ID: N7NMC7355.

The FCC requires that the calculated MPE be equal to or less than a given limit dependent on frequency at a distance of 20 cm from a device to the body of a user.

The following FCC Rule Parts and procedures are applicable:

Part 1.1310 – Radiofrequency radiation exposure limits

Part 2.1091 – Radiofrequency radiation exposure evaluation: mobile devices

KDB447498 D01 v06
Mobile and Portable Devices RF Exposure Procedures and Equipment Authorisation Policies

MAXIMUM TRANSMITTER POWER CONSIDERATIONS

Conducted power values are maximum average tune up with tolerance:

WLAN 5180 – 5240MHz

Power conducted = 35.48mW worst case (15.5dBm)

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Antenna Gain: +2.0dBi

EIRP = 17.5dBm = 56.23 mW (SISO)

EIRP = 20.5dBm = 112.20 mW (MIMO)

WLAN 5725 – 5825MHz

Power conducted = 125.9mW worst case (21.0dBm)

Antenna Gain: +2.0dBi

EIRP = 23.0dBm = 200.0 mW (SISO)

EIRP = 26.0dBm = 400.0 mW (MIMO)

MPE CALCULATIONS

The MPE calculation to calculate the safe operating distance for the user is.

$$S = EIRP/4 \pi R^2$$

Where S = Power density

EIRP = Effective Isotropic Radiated Power (EIRP = P x G)

P = Conducted Transmitter Power

G = Antenna Gain (relative to an isotropic radiator)

R = distance to the centre of radiation of the antenna (safe operating distance)

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For WLAN 5GHz (MIMO Worst Case)

Values:

Transmitter frequency range = 5725 MHz to 5825MHz

$EIRP_{MIMO}$ = 26.0dBm = 400.0 mW

R = 20cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 5GHz

S_{req1} = 1.0 mW/cm^2

Calculation:

$S = EIRP/4 \pi R^2$

$S = 400/(12.56 \times 20^2)$

$S = 400/(5024)$

S_1 = 0.08mW/ cm^2 (<1.0 mW/cm^2)

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For Cellular Module (2G Worst Case)

From FCC ID: N7NMC7355 grant MPE Evaluation v10r1

(Publically available document dated 06/26/2014)

MC7355 Module FCC MPE Evaluation v10r1

in

https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application_id=XKn%2F0H11NLRAZohoKoMMxg%3D%3D&fcc_id=N7NMC7355

The calculation demonstrates the requirements for WLAN co-location usage with the N7NMC7355 cellular module.

For 824-849MHz (GPRS Class 10) cellular operation, the FCC ID: N7NMC7355 grant MPE Evaluation shows this operating band to have the worst case power density:

Transmitter frequency range = 824-849MHz

EIRP = 29.98dBm = 1.0W (GPRS class 10; 3.0dBi antenna gain)

R = 20cm

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 824-849MHz operation:

$$S_{req2} = f/ 1500 \text{ mW/cm}^2$$

$$= 0.55 \text{ mW/ cm}^2$$

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Calculation:

$S = EIRP/4 \pi R^2$

$S = 1000/(12.56 \times 20^2)$

$S = 1000/(5024)$

$S_2 = 0.198$ mW/ cm^2

i.e.: < 0.55 mW/ cm^2

KDB447498 D01 v05 Section 7.2 SIMULTANEOUS TRANSMISSION CONSIDERATIONS

The Cellular antenna is situated 3.4cm away from the WLAN antennas, so the WLAN and cellular transmitters can be considered to be co-located with simultaneous transmission.

Ref. KDB447498 Section 7.2: Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0,

For the 600 Series router, summation of worst case calculated MPE ratios is

$$\Sigma MPE_{ratios} = (S_1/ S_{req1}) + (S_2/ S_{req2})$$

$$= 0.08/1.0 + 0.198/0.55$$

= 0.44

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Σ of MPE ratios<1.0, so in accordance with KDB447498 Section 7.2, simultaneous transmission test exclusion applies for the WLAN and Cellular transmitters.

Conclusion

The required 20cm RF exposure limits for General Population / Uncontrolled Exposure will not be exceeded for the 600 Series router using antennas having a maximum gain of 2.0 dBi for 5GHz WIFI and 3.0dBi cellular operation.

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