



Exhibit: RF Exposure – FCC

FCC ID: 2AAXW900MRM2

Report File #: 7169012990RFE-FCC-000

Client	Aarcomm Systems Inc.	
Product	RM2-900 MRTR Wireless Radio Module	
Standard(s)	FCC KDB 447498 v07	

RF Exposure Calculation (FCC)

Purpose

The purpose of this test is to ensure that the RF energy transmitted at a specified operating distance from the human body meets the criteria to be exempt from routine evaluation. The RF Exposure values are calculated based upon measurements obtained during testing and are compared to the applicable exposure limits for individual RF sources. If multiple RF sources are used within a host product, and they operate simultaneously, an additional exemption criterion based on total exposure from multiple RF sources is also applied. If the exemption criteria are not met, the RF sources may be required to undergo routine evaluation for RF Exposure.

Limit(s) and Method

The test method and exemption limits are defined in FCC KDB 447498 and FCC 1.1307(b)(3) and are applicable to both unintentional and intentional RF sources, whether portable, mobile, or fixed installations.

Individual RF Sources

For individual sources, the following three exemption criteria options are defined. Any of the three options may be used to determine the RF source to be exempt from routine evaluation if it meets the corresponding exemption limit.

Defined in FCC 1.1307(b)(3)(i)(A), Exemption Criteria Option A is based on the maximum time-averaged output power. The requirement is that this measurement must not exceed 1mW, regardless of separation distance, and in the frequency range of 100kHz-100GHz.

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Defined in FCC 1.1307(b)(3)(i)(B), Exemption Criteria Option B is based on SAR using the measurement of maximum time-averaged output power or ERP, whichever is greater. This option is applicable to separation distances of 0.5cm-40cm and in the frequency range of 300MHz-6GHz. The limit is defined below:

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

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

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

Defined in FCC 1.1307(b)(3)(i)(C), Exemption Criteria Option C is based on MPE using the ERP measurement. This option is only applicable for separation distances greater than or equal to the wavelength of the frequency under consideration divided by 2π , and in the frequency range of 300kHz-100GHz. The limit is defined below:

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	$1,920 R^2$
1.34	–	30	35.6 m	–	1.6 m	$3,450 R^2/f^2$
30	–	300	1.6 m	–	159 mm	$3.83 R^2$
300	–	1,500	159 mm	–	31.8 mm	$0.0128 R^2 f$
1,500	–	100,000	31.8 mm	–	0.5 mm	$19.2 R^2$
Subscripts L and H are low and high; λ is wavelength. From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.						

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Multiple RF Sources

For multiple sources, the following two exemption criteria options are defined. Exemption criteria for multiple RF sources is applicable if the EUT contains any RF sources that may operate simultaneously.

Defined in FCC 1.1307(b)(3)(ii)(A), the results of only the exemption criteria option A calculation for for each individual RF source shall be used to determine exemption for multiple RF sources. The criteria for exemption are defined below:

1. If the separation distance between each individual RF source is at least 2 centimeters, and each individual source meets exemption criteria option A for single RF sources.
2. If the sum of maximum output power of multiple RF sources is less than 1mW, the sources can be treated as a single source and are exempt based on exemption criteria option A for single RF sources.

Defined in FCC 1.1307(b)(3)(ii)(B), the exemption ratios calculated for each individual RF source shall be used to calculate the Total Exposure Ratio. This calculation includes exemption criteria calculated using Exemption Criteria Options B or C, or the measurement results of any RF source that may have been subject to routine evaluation. The limit is defined below:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

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Results

The EUT is exempt from routine evaluation of RF exposure based on the following calculations:

Single RF Source 1 Analysis – 900-928MHz Transmitter

The 900-928MHz transmitter has maximum output power at the low channel frequency of 902.25MHz. The separation distance is taken as 20cm for a worst-case scenario as the device is intended to operated at separation distances > 20cm. A duty cycle of 100% has also been used in the calculations as a worst-case scenario as the device's actual duty cycle is 26.8%.

Frequency (MHz): 902.25
 Separation Distance (cm): 20
 Antenna Gain (dBi): 5.4
 Conducted Power (dBm): 27.76
 Conducted Power (mW): 597.04
 ERP (mW): 1262.28

Exemption Criteria Option A:

Threshold Power = 1mW
 $597.035\text{mW} > 1\text{mW}$
 Option A is not applicable.

Exemption Criteria Option B:

Threshold Power = 1840.59mW
 $1262.28\text{mW} < 1840.59\text{mW}$
 Option B is applicable.
 Contribution Ratio = $1262.28/1840.59 = 0.69$

Exemption Criteria Option C:

$\lambda/2\pi = 0.053\text{m}$
 $R = 0.2\text{m}$
 $0.2\text{m} > 0.053\text{m}$
 ERP Threshold = 0.4620W
 $1.2623\text{W} > 0.4620\text{W}$
 Option C is not applicable.

Therefore, the RF source is exempt from routine evaluation based on Exemption Criteria Option B with contribution ratio of 0.69.

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Multiple RF Source Analysis

RF Exposure analysis for multiple RF sources is not applicable as the device has only one transmitter.