

# Assessment report

**REP014519-1R1ARFWL**

Date of issue: December 21, 2023

Applicant:

**Fujitsu Network Communications, Inc.**

Product:

**Tri Band RU for North America**

Model

**TB2 RU**

FCC ID

**CFD5G4RUTB**

Type of assessment:

**MPE Calculation Report**


Specifications:

- ◆ **FCC 47 CFR Part 1 Subpart I, §§1.1307, 1.1310**
- ◆ **FCC 47 CFR Part 2 Subpart J, §2.1091**
- ◆ **KDB 447498 D01 General RF Exposure Guidance v06**

Lab and test locations

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Date	December 21, 2023
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Limits of responsibility

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Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.

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## Section 1 Evaluation summary

### 1.1 MPE calculation for stand-alone transmission

#### 1.1.1 References, definition, and limits

In this section, MPE calculation is performed assuming EUT is configured to operate in a single supported frequency band with 2 correlated transmitting antennae. Each supported frequency band is evaluated separately.

FCC §2.1091(d)

- (2) For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from the whole-body SAR limits and listed in Table 1 in paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b) of this part, except for portable devices as defined in §2.1093 of this chapter as these evaluations shall be performed according to the SAR provisions in §2.1093.

**Table 1.1-1: Table 1 to §1.1310(e)(1)—Limits for Maximum Permissible Exposure (MPE)**

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(i) Limits for Occupational/Controlled Exposure</b>				
0.3–3.0	614	1.63	*(100)	≤6
3.0–30	1842 / f	4.89 / f	*(900 / f <sup>2</sup> )	<6
30–300	61.4	0.163	1.0	<6
300–1500			f / 300	<6
1500–100000			5	<6
<b>(ii) Limits for General Population/Uncontrolled Exposure</b>				
0.3–1.34	614	1.63	*(100)	<30
1.34–30	824 / f	2.19 / f	*(180 / f <sup>2</sup> )	<30
30–300	27.5	0.073	0.2	<30
300–1500			f / 1500	<30
1500–100000			1.0	<30

Notes: f = frequency in MHz. \* = Plane-wave equivalent power density.

Equation from Page 18 of OET Bulletin 64, Edition 97-01:

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (mW/cm<sup>2</sup> or W/m<sup>2</sup>)  
P = power input to the antenna (mW or W)  
G = power gain of the antenna in the direction of interest relative to an isotropic radiator  
R = distance to the center of radiation of the antenna (cm or m)

### 1.1.2 EUT technical information

Operational frequency	1995 - 2020 MHz (Band n70) 2110 – 2200 MHz (Band n66) 617-652MHz (Band 71)
Antenna type	External (The EUT is professionally installed)
Antenna gain	See below
Number of antennas	4 (2 simultaneous correlated transmitters)
Maximum transmitter conducted power	n66: 43.82 dBm maximum total channel power (1 carrier, one antenna port), (24.10 Watts) n70: 43.89 dBm maximum total channel power (1 carrier, one antenna port), (24.49 Watts) n71: 43.94 dBm maximum total channel power (1 carrier, one antenna port), (24.77 Watts)

The maximum permitted antenna gain is calculated based on the transmitter conducted power and the maximum permitted EIRP or EIRP density (as appropriate).

#### Band n66:

Maximum permitted EIRP density is 3280 W/MHz (65.16 dBm/MHz). From the measurement data, the maximum measured power density is 40.66 dBm/MHz (including 3.01 dB for 2 correlated MIMO antenna) therefore the maximum permitted antenna gain is  $(65.16 - 40.66) = 24.50$  dBi.

#### Band n70:

Maximum permitted EIRP density is 3280 W/MHz (65.16 dBm/MHz). From the measurement data, the maximum measured power density is 41.30 dBm/MHz (including 3.01 dB for 2 correlated MIMO antenna) therefore the maximum permitted antenna gain is  $(65.16 - 41.30) = 24.24$  dBi.

#### Band n71:

Maximum permitted EIRP density is 1000 W/MHz (60 dBm/MHz). From measurement data, the maximum measured power density is 41.87 dBm/MHz (including 3.01 dB for 2 correlated MIMO antenna) therefore the maximum permitted antenna gain is  $(60 - 41.87) = 18.13$  dBi.

Power data is taken from report REP014519-1R1TRFWL.

### 1.1.3 MPE exemption calculations

Note: In the calculations below, “number of antennas = 2” adds the correct  $10\log(2)$  correction to account for correlated output of 2 antenna ports (2 simultaneous correlated transmitter antennas for a given operating frequency band). For example, in band n66, the maximum single antenna gain is 24.50 dBi but the total system gain is 27.52 dBi reflecting the addition of  $10\log(2)=3.01$  dB for the 2 antennas.

#### Band n66:

Fundamental transmit (prediction) frequency:	2200 MHz
Maximum measured conducted peak output power:	43.82 dBm
Cable and/or jumper loss:	0 dB
Maximum peak power at antenna input terminal:	43.82 dBm
Tx On time:	1.000 ms
Tx period time:	1.000 ms
Average factor:	100 %
Maximum calculated average power at antenna input terminal:	24099 mW
Single Antenna gain (typical):	24.5 dBi
Number of antennas:	2
Total system gain:	27.51 dBi
<b>FCC limit:</b>	
<b>MPE limit</b> for uncontrolled exposure at prediction frequency:	1.000000 mW/cm <sup>2</sup>
	10.000000 W/m <sup>2</sup>
Minimum calculated prediction distance for compliance:	33 cm
Typical (declared) distance:	1040 cm
<b>Average power density at prediction frequency:</b>	0.999432 mW/cm <sup>2</sup>
	9.994325 W/m <sup>2</sup>
<b>Margin of Compliance:</b>	0.00 dB
Maximum allowable antenna gain:	27.51 dBi

**Band n70:**

Fundamental transmit (prediction) frequency:	2020 MHz
Maximum measured conducted peak output power:	43.89 dBm
Cable and/or jumper loss:	0 dB
Maximum peak power at antenna input terminal:	43.89 dBm
Tx On time:	1.000 ms
Tx period time:	1.000 ms
Average factor:	100 %
Maximum calculated average power at antenna input terminal:	24491 mW
Single Antenna gain (typical):	24.24 dBi
Number of antennas:	2
Total system gain:	27.25 dBi
<b>FCC limit:</b>	
<b>MPE limit</b> for uncontrolled exposure at prediction frequency:	1.000000 mW/cm <sup>2</sup>
	10.000000 W/m <sup>2</sup>
Minimum calculated prediction distance for compliance:	120 cm
Typical (declared) distance:	1018 cm
<b>Average power density at prediction frequency:</b>	0.998446 mW/cm <sup>2</sup>
	9.984460 W/m <sup>2</sup>
<b>Margin of Compliance:</b>	
Maximum allowable antenna gain:	0.01 dB
	27.26 dBi

**Band n71:**

Fundamental transmit (prediction) frequency:	620 MHz
Maximum measured conducted peak output power:	43.94 dBm
Cable and/or jumper loss:	0 dB
Maximum peak power at antenna input terminal:	43.94 dBm
Tx On time:	1.000 ms
Tx period time:	1.000 ms
Average factor:	100 %
Maximum calculated average power at antenna input terminal:	24774 mW
Single Antenna gain (typical):	18.13 dBi
Number of antennas:	2
Total system gain:	21.14 dBi
<b>FCC limit:</b>	
<b>MPE limit</b> for uncontrolled exposure at prediction frequency:	0.413333 mW/cm <sup>2</sup>
	4.133333 W/m <sup>2</sup>
Minimum calculated prediction distance for compliance:	120 cm
Typical (declared) distance:	788 cm
<b>Average power density at prediction frequency:</b>	0.412827 mW/cm <sup>2</sup>
	4.128266 W/m <sup>2</sup>
<b>Margin of Compliance:</b>	
Maximum allowable antenna gain:	0.01 dB
	21.15 dBi

## 1.1.4 Verdict

This worst case calculation is below the limit; therefore, the product is compliant with the RF exposure requirements for the declared distance.

## 1.2 MPE calculation for simultaneous transmission

### 1.2.1 References, definitions, and limits

In this section, MPE calculation is performed assuming EUT is configured to operate on all supported frequency bands. Each supported frequency band can operate with 2 (bands n70 and n71) or 3 carriers (band 66) with 2 correlated transmitting antennae. As such, MPE is calculated for the worst-case configuration: 3 x Band n66 operation (2 correlated antenna ports) + 2 x Band 70 operation (2 correlated antenna ports) + 2 x Band 71 operation (2 correlated antenna ports).

FCC §2.1091(d)

- (2) For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from the whole-body SAR limits and listed in Table 1 in paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b) of this part, except for portable devices as defined in §2.1093 of this chapter as these evaluations shall be performed according to the SAR provisions in §2.1093.

**Table 1.2-1: Table 1 to §1.1310(e)(1)—Limits for Maximum Permissible Exposure (MPE)**

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(i) Limits for Occupational/Controlled Exposure</b>				
0.3–3.0	614	1.63	*(100)	≤6
3.0–30	1842 / f	4.89 / f	*(900 / f <sup>2</sup> )	<6
30–300	61.4	0.163	1.0	<6
300–1500			f / 300	<6
1500–100000			5	<6
<b>(ii) Limits for General Population/Uncontrolled Exposure</b>				
0.3–1.34	614	1.63	*(100)	<30
1.34–30	824 / f	2.19 / f	*(180 / f <sup>2</sup> )	<30
30–300	27.5	0.073	0.2	<30
300–1500			f / 1500	<30
1500–100000			1.0	<30

Notes: f = frequency in MHz. \* = Plane-wave equivalent power density.

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density (mW/cm<sup>2</sup> or W/m<sup>2</sup>)  
P = power input to the antenna (mW or W)  
G = power gain of the antenna in the direction of interest relative to an isotropic radiator  
R = distance to the center of radiation of the antenna (cm or m)

## 1.2.2 EUT technical information

	Transmitter 1 (band n66 operation, 3 simultaneous carriers)	Transmitter 2 (band 70 operation, 2 simultaneous carriers)	Transmitter 3 (band 71 operation, 2 simultaneous carriers)
Prediction frequency	2200 MHz	2020 MHz	620 MHz
Antenna type	External	External	External
Antenna gain	24.5 dBi	24.24 dBi	18.13 dBi
Maximum transmitter conducted power	43.82 dBm (24.10 W)	43.89 dBm (24.49 W)	43.94 dBm (24.77 W)

## 1.2.3 MPE calculation

	Band 66 #1	Band 66 #2	Band 66 #3	Band 70 #1	Band 70 #2	Band 71 #1	Band 71 #2
Fundamental transmit (prediction) frequency:	2200 MHz	2200 MHz	2200 MHz	2020 MHz	2020 MHz	620 MHz	620 MHz
Maximum measured conducted peak output power:	43.82 dBm	43.82 dBm	43.82 dBm	43.89 dBm	43.89 dBm	43.94 dBm	43.94 dBm
Cable and/or jumper loss:	0 dB	0 dB	0 dB	0 dB	0 dB	0 dB	0 dB
Maximum peak power at antenna input terminal:	43.82 dBm	43.82 dBm	43.82 dBm	43.89 dBm	43.89 dBm	43.94 dBm	43.94 dBm
Tx On time:	1.000 ms	1.000 ms	1.000 ms	1.000 ms	1.000 ms	1.000 ms	1.000 ms
Tx period time:	1.000 ms	1.000 ms	1.000 ms	1.000 ms	1.000 ms	1.000 ms	1.000 ms
Average factor:	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Maximum calculated average power at antenna input terminal:	24.10 W	24.10 mW	24.10 mW	24.49 mW	24.49 mW	24.77 mW	24.77 mW
Single Antenna gain (typical):	24.5 dBi	24.5 dBi	24.5 dBi	24.24 dBi	24.24 dBi	18.13 dBi	18.13 dBi
Number of antennae:	2	2	2	2	2	2	2
Total system gain:	27.51 dBi	27.51 dBi	27.51 dBi	27.25 dBi	27.25 dBi	21.14 dBi	21.14 dBi
MPE limit for uncontrolled exposure at prediction frequency:	1.000 mW/cm <sup>2</sup>	1.000 mW/cm <sup>2</sup>	1.000 mW/cm <sup>2</sup>	1.000 mW/cm <sup>2</sup>	1.000 mW/cm <sup>2</sup>	1.000 mW/cm <sup>2</sup>	1.000 mW/cm <sup>2</sup>
	10.00 W/m <sup>2</sup>	10.00 W/m <sup>2</sup>	10.00 W/m <sup>2</sup>	10.00 W/m <sup>2</sup>	10.00 W/m <sup>2</sup>	10.00 W/m <sup>2</sup>	10.00 W/m <sup>2</sup>
Minimum calculated prediction distance for compliance:	33 cm	33 cm	33 cm	32 cm	32 cm	20 cm	20 cm
Typical (declared) distance:	2415 cm	2415 cm	2415 cm	2415 cm	2415 cm	2415 cm	2415 cm
Average power density at prediction frequency:	0.19 mW/cm <sup>2</sup>	0.19 mW/cm <sup>2</sup>	0.19 mW/cm <sup>2</sup>	0.18 mW/cm <sup>2</sup>	0.18 mW/cm <sup>2</sup>	0.04 mW/cm <sup>2</sup>	0.04 mW/cm <sup>2</sup>
	1.853 W/m <sup>2</sup>	1.853 W/m <sup>2</sup>	1.853 W/m <sup>2</sup>	1.774 W/m <sup>2</sup>	1.774 W/m <sup>2</sup>	0.440 W/m <sup>2</sup>	0.440 W/m <sup>2</sup>
Combined MPE compliance:							
Margin of Compliance:	7.32 dB	7.32 dB	7.32 dB	7.51 dB	7.51 dB	13.57 dB	13.57 dB
Maximum allowable antenna gain:	64.83 dBi	64.83 dBi	64.83 dBi	64.76 dBi	64.76 dBi	64.71 dBi	64.71 dBi
Average power density to MPE limit ratio:	0.185	0.185	0.185	0.177	0.177	0.044	0.044
Total sum of ratios:	0.999						
Maximum allowed sum of ratios:	1						

## Verdict

The calculation is below the limit; therefore, the product is passing the RF Exposure requirements for the declared distance.

End of test report