

RF Exposure Exhibit

EUT Name: Ranger 4.4

Model No.: R44-N11

CFR Part 1.1310

Prepared for:

Trapeze Software Group, Inc.
5265 Rockwell Drive NE, Cedar Rapids
Iowa 52402, U.S.A.

Prepared by:

TUV Rheinland of North America, Inc.
1279 Quarry Lane
Pleasanton, CA 94566
Tel: (925) 249-9123
Fax: (925) 249-9124
<http://www.tuv.com/>

Report/Issue Date: September 19, 2017

Report Number: 31762446.001

Contents

RF Exposure Exhibit	1
1 Test Methodology.....	3
1.1 RF Exposure Limit	3
1.2 EUT Operating Condition.....	5
1.3 MPE calculation.....	5
1.3.1 Antenna Gain	5
1.3.2 Conducted Output Power	5
1.3.3 Output Power into Antenna & RF Exposure value (Non-Beamforming Mode)	6
1.3.4 RF Exposure value when 3 radios operating simultaneously (Non-Beamforming Mode)	12
1.3.5 Output Power into Antenna & RF Exposure value (Beamforming Mode)	13
1.3.6 RF Exposure value when 3 radios operating simultaneously (Beamforming Mode).....	19
1.3.7 Sample Calculation	20

1 Test Methodology

In this document, we evaluate the RF Exposure to human body due the intentional transmission from the transmitter (EUT). The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

1.1 RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

The EUT is rated as operated within uncontrolled conditions. The applied limits are based on the exposure limitations for devices used by the general public within uncontrolled environment.

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
30-1500	...	...	F/300	6
1500-100000	...	...	1.0	6
(B)Limits For General Population / Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
30-1500	...	...	F(MHz)/1500MHz	30
1500-100000	...	...	1.0	30

F = Frequency in MHz

*=Plane wave equivalent density

According to RSS-102 Issue 5: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation

**RF FIELD STRENGTH LIMITS FOR DEVICES USED BY THE GENERAL PUBLIC
(UNCONTROLLED ENVIRONMENT)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000***	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10 ⁻⁴ $f^{0.5}$	6.67 x 10 ⁻⁵ f	616000/ $f^{1.2}$
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR). ***Exemption limit: at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1.31 x 10⁻² $f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz.				

1.3.7 Sample Calculation

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq

The Friss transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where;

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW G = gain of
antenna in linear scale

$\pi \approx 3.1416$

R = distance between observation point and center of the radiator in cm

1.2 EUT Operating Condition

The Ranger 4.4 R44-N11 is a rugged and compact vehicular computer utilizing Bluetooth, Bluetooth LE, WiFi and a cellular. The cellular radio supports WCDMA and LTE technologies

1.3 MPE calculation

1.3.1 Antenna Gain

The antennas used are:

1. Bluetooth LE 2.4 GHz internal, TUV Test Report 31762447.004
Integral antenna, 1 Chip antenna transceiver, Antenna peak gain: -4 dBi.
2. Bluetooth 2.4 GHz internal, TUV Test Report 31762447.004
Integral antenna, 1 Chip antenna transceiver, Antenna peak gain: -4 dBi.
3. WiFi 2.4 GHz internal, TUV Test Report 31762447.003
Integral antenna, Flex circuit PCB antenna transceiver, Antenna peak gain: +3 dBi.
4. LTE Band 2, 1.910 GHz, TUV Test Report 31762447.002
Integral antenna, Formed metal wideband antenna, maximum rated antenna peak gain: +4.5 dBi.
5. LTE Band 4, 1755 GHz, TUV Test Report 31762447.002
Integral antenna, Formed metal wideband antenna, maximum rated antenna peak gain: +4.5 dBi.
6. LTE Band 5, 0.849 GHz, TUV Test Report 31762447.002
Integral antenna, Formed metal wideband antenna, maximum rated antenna peak gain: +4.5 dBi.
7. LTE Band 12, 0.716 GHz, TUV Test Report 31762447.002
Integral antenna, Formed metal wideband antenna, maximum rated antenna peak gain: +4.5 dBi.
8. LTE Band 13, 0.849 GHz, TUV Test Report 31762447.002
Integral antenna, Formed metal wideband antenna, maximum rated antenna peak gain: +4.5 dBi.
9. WCDMA Band 2, 1.910 GHz, TUV Test Report 31762447.002
Integral antenna, Formed metal wideband antenna, maximum rated antenna peak gain: +4.5 dBi.
10. WCDMA Band 5, 1.910 GHz, TUV Test Report 31762447.002
Integral antenna, Formed metal wideband antenna, maximum rated antenna peak gain: +4.5 dBi.

1.3.2 Conducted Output Power

All stated values excluding antenna gain.

1. Bluetooth LE 2.480 GHz, TUV Test Report 31762447.004
Rated maximum power: 5 mW (6.99 dBm)
2. Bluetooth 2.480 GHz, TUV Test Report 31762447.004
Rated maximum power: 5 mW (6.99 dBm)
3. WiFi 2.462 GHz , TUV Test Report 31762447.003
Rated maximum power: 29mW (14.62 dBm)
4. LTE Band 2, 1.910 GHz, TUV Test Report 31762447.002
Rated maximum power: 200 mW (23.01 dBm)
5. LTE Band 4, 1.755 GHz, TUV Test Report 31762447.002
Rated maximum power: 200 mW (23.01 dBm)
6. LTE Band 5, 0.849 GHz, TUV Test Report 31762447.002
Rated maximum power: 200 mW (23.01 dBm)
7. LTE Band 12, 0.716 GHz, TUV Test Report 31762447.002
Rated maximum power: 200 mW (23.01 dBm)
8. LTE Band 13, TUV Test Report 31762447.002
Rated maximum power: 200 mW (23.01 dBm)
9. WCDMA Band 2, 1.910 GHz, TUV Test Report 31762447.002
Rated maximum power: 250 mW (23.98 dBm)
10. WCDMA Band 5, 1.910 GHz, TUV Test Report 31762447.002
Rated maximum power: 250 mW (23.98 dBm)

1.3.3 Output Power into Antenna & RF Exposure value (Non-Beamforming Mode)

01. Bluetooth LE – 2480 MHz:

Calculations for this report are based on highest rated power and its antenna gain identified at 2480 MHz. Result below is Non-Beamforming Mode. Calculation based on maximum rated output power of 6.99 dBm.

FCC:

Highest rated output Power:	6.99	dBm
The Gain of the antenna:	-4.00	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.005000345 Watts
or: 5.00035 mW
or: 5000.35 μ W
or: 6.99 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 2480 MHz

Power output with DC and antenna Gain (EIRP):

Power (dBm):	2.99
Power (mW):	1.991
Power (W):	0.001991

R = distance in 20 cm

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.0003960	mW/cm ²
Controlled Margin to Limit =	4.9996	mW/cm ²
Uncontrolled Margin to Limit =	0.9996	mW/cm ²

ISED:

Highest rated output Power:	6.99	dBm
The Gain of the antenna:	-4.00	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.005000345 Watts
or: 5.00035 mW
or: 5000.35 μ W
or: 6.99 dBm

Frequency range from 10 MHz to 40 GHz:
Frequency: 2480 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	2.99
Power (mW):	1.991
Power (W):	0.001991

R = distance in 20 cm

Controlled Exposures to Limit =	32.14564076	W/m ²
Uncontrolled Exposures Limit =	5.468947787	W/m ²
Pd =	0.003960	W/m ²
Controlled Margin to Limit =	32.1417	W/m ²
Uncontrolled Margin to Limit =	5.4650	W/m ²

02. Bluetooth – 2480 MHz:

Calculations for this report are based on highest rated power and its antenna gain identified at 2480 MHz. Result below is Non-Beamforming Mode. Calculation based on maximum rated output power of 6.99 dBm.

FCC:

Highest rated output Power:	6.99	dBm
The Gain of the antenna:	-4.00	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.005000345 Watts
or: 5.00035 mW
or: 5000.35 μ W
or: 6.99 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 2480 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	2.99
Power (mW):	1.991
Power (W):	0.001991

R = distance in 20 cm

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.0003960	mW/cm ²
Controlled Margin to Limit =	4.9996	mW/cm ²
Uncontrolled Margin to Limit =	0.9996	mW/cm ²

ISED:

Highest rated output Power:	6.99	dBm
The Gain of the antenna:	-4.00	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.005000345 Watts
 or: 5.00035 mW
 or: 5000.35 μ W
 or: 6.99 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 2480 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	2.99
Power (mW):	1.991
Power (W):	0.001991

R = distance in 20 cm

Controlled Exposures to Limit =	32.14564076	W/m ²
Uncontrolled Exposures Limit =	5.468947787	W/m ²
Pd =	0.003960	W/m ²
Controlled Margin to Limit =	32.1417	W/m ²
Uncontrolled Margin to Limit =	5.4650	W/m ²

03. WiFi - 2480 MHz:

Calculations for this report are based on highest rated power and its antenna gain identified at 2480 MHz. Result below is Non-Beamforming Mode. Calculation based on maximum rated output power of 10dBm.

FCC:

Highest rated output Power:	14.62	dBm
The Gain of the antenna:	3.00	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.028973436 Watts
or: 28.97344 mW
or: 28973.44 μ W
or: 14.62 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 2480 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	17.62
Power (mW):	57.810
Power (W):	0.057810

R = distance in 20 cm

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.0115009	mW/cm ²
Controlled Margin to Limit =	4.9885	mW/cm ²
Uncontrolled Margin to Limit =	0.9885	mW/cm ²

ISED:

Highest rated output Power:	14.62	dBm
The Gain of the antenna:	3.00	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.028973436 Watts
 or: 28.97344 mW
 or: 28973.44 μ W
 or: 14.62 dBm

Frequency range from 10 MHz to 40 GHz:
 Frequency: 2480 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	17.62
Power (mW):	57.810
Power (W):	0.057810

R = distance in 20 cm

Controlled Exposures to Limit =	32.14564076	W/m ²
Uncontrolled Exposures Limit =	5.468947787	W/m ²
Pd =	0.115009	W/m ²
Controlled Margin to Limit =	32.0306	W/m ²
Uncontrolled Margin to Limit =	5.3539	W/m ²

04. LTE Band 2 - 1910 MHz

Calculations for this report are based on highest rated power and its antenna gain. The Limit is based on the assigned upper band edge at 1910 MHz. Result below is Non-Beamforming Mode.

FCC:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 1910 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.1121321	mW/cm ²
Controlled Margin to Limit =	4.8879	mW/cm ²
Uncontrolled Margin to Limit =	0.8879	mW/cm ²

ISED:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:
Frequency: 1910 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures to Limit =	28.21063944	W/m ²
Uncontrolled Exposures Limit =	4.575027423	W/m ²
Pd =	1.121321	W/m ²
Controlled Margin to Limit =	27.0893	W/m ²
Uncontrolled Margin to Limit =	3.4537	W/m ²

05. LTE Band 4 - 1755 MHz

Calculations for this report are based on highest rated power and its antenna gain. The Limit is based on the assigned upper band edge at 1755 MHz. Result below is Non-Beamforming Mode.

FCC:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 1755 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.1121321	mW/cm ²
Controlled Margin to Limit =	4.8879	mW/cm ²
Uncontrolled Margin to Limit =	0.8879	mW/cm ²

ISED:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:
Frequency: 1755 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures to Limit =	27.04175084	W/m ²
Uncontrolled Exposures Limit =	4.317918917	W/m ²
Pd =	1.121321	W/m ²
Controlled Margin to Limit =	25.9204	W/m ²
Uncontrolled Margin to Limit =	3.1966	W/m ²

06. LTE Band 5 – 846.6 MHz

Calculations for this report are based on highest rated power and its antenna gain. The Limit is based on the assigned upper band edge at 846.6 MHz. Result below is Non-Beamforming Mode.

FCC:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 846.6 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures - Limit =	2.822	mW/cm ²
Uncontrolled Exposures - Limit =	0.5644	mW/cm ²
Pd =	0.1121321	mW/cm ²
Controlled Margin to Limit =	2.7099	mW/cm ²
Uncontrolled Margin to Limit =	0.4523	mW/cm ²

ISED:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:
Frequency: 846.6 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures to Limit =	18.78172073	W/m ²
Uncontrolled Exposures Limit =	2.623679755	W/m ²
Pd =	1.121321	W/m ²
Controlled Margin to Limit =	17.6604	W/m ²
Uncontrolled Margin to Limit =	1.5024	W/m ²

07. LTE Band 12 – 715.3 MHz

Calculations for this report are based on highest rated power and its antenna gain. The Limit is based on the assigned upper band edge at 715.3 MHz. Result below is Non-Beamforming Mode.

FCC:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 715.3 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures - Limit =	2.384333333	mW/cm ²
Uncontrolled Exposures - Limit =	0.476866667	mW/cm ²
Pd =	0.1121321	mW/cm ²
Controlled Margin to Limit =	2.2722	mW/cm ²
Uncontrolled Margin to Limit =	0.3647	mW/cm ²

ISED:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:
Frequency: 715.3 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures to Limit =	17.26395754	W/m ²
Uncontrolled Exposures Limit =	2.338259736	W/m ²
Pd =	1.121321	W/m ²
Controlled Margin to Limit =	16.1426	W/m ²
Uncontrolled Margin to Limit =	1.2169	W/m ²

08. LTE Band 13 – 787 MHz

Calculations for this report are based on highest rated power and its antenna gain. The Limit is based on the assigned upper band edge at 787 MHz. Result below is Non-Beamforming Mode.

FCC:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 787 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures - Limit =	2.623333333	mW/cm ²
Uncontrolled Exposures - Limit =	0.524666667	mW/cm ²
Pd =	0.1121321	mW/cm ²
Controlled Margin to Limit =	2.5112	mW/cm ²
Uncontrolled Margin to Limit =	0.4125	mW/cm ²

ISED:

Highest rated output Power:	23.01	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.199986187 Watts
or: 199.98619 mW
or: 199986.19 μ W
or: 23.01 dBm

Frequency range from 10 MHz to 40 GHz:
Frequency: 787 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	27.51
Power (mW):	563.638
Power (W):	0.563638

R = distance in 20 cm

Controlled Exposures to Limit =	18.10854734	W/m ²
Uncontrolled Exposures Limit =	2.496000285	W/m ²
Pd =	1.121321	W/m ²
Controlled Margin to Limit =	16.9872	W/m ²
Uncontrolled Margin to Limit =	1.3747	W/m ²

09. WCDMA Band 2 - 1907.6 MHz

Calculations for this report are based on highest rated power and its antenna gain. The Limit is based on the assigned upper band edge at 1907.6 MHz. Result below is Non-Beamforming Mode.

FCC:

Highest rated output Power:	24.00	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.251188643 Watts
or: 251.18864 mW
or: 251188.64 μ W
or: 24.00 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 1907.6 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	28.50
Power (mW):	707.946
Power (W):	0.707946

R = distance in 20 cm

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.1408413	mW/cm ²
Controlled Margin to Limit =	4.8592	mW/cm ²
Uncontrolled Margin to Limit =	0.8592	mW/cm ²

ISED:

Highest rated output Power:	24.00	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.251188643 Watts
or: 251.18864 mW
or: 251188.64 μ W
or: 24.00 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 1907.6 MHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	28.50
Power (mW):	707.946
Power (W):	0.707946

R = distance in 20 cm

Controlled Exposures to Limit =	28.1929099	W/m ²
---------------------------------	------------	------------------

Uncontrolled Exposures Limit =	4.571097962	W/m ²
--------------------------------	-------------	------------------

Pd =	1.401942	W/m ²
------	----------	------------------

Controlled Margin to Limit =	26.7910	W/m ²
------------------------------	---------	------------------

Uncontrolled Margin to Limit =	3.1692	W/m ²
--------------------------------	--------	------------------

10. WCDMA Band 5 - 846.6MHz

Calculations for this report are based on highest rated power and its antenna gain. The Limit is based on the assigned upper band edge at 846.6 MHz. Result below is Non-Beamforming Mode.

FCC:

Highest rated output Power:	23.98	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.250034536 Watts
or: 250.03454 mW
or: 250034.54 μ W
or: 23.98 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 846.6 GHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	28.48
Power (mW):	704.693
Power (W):	0.704693

R = distance in 20 cm

Controlled Exposures - Limit =	5	mW/cm ²
Uncontrolled Exposures - Limit =	1	mW/cm ²
Pd =	0.1401942	mW/cm ²
Controlled Margin to Limit =	4.8598	mW/cm ²
Uncontrolled Margin to Limit =	0.8598	mW/cm ²

ISED:

Highest rated output Power:	23.98	dBm
The Gain of the antenna:	4.50	dBi
Type of Measurement:	Conducted	Direct measurement at Antenna Port
Impedance:	50.00	Ω
Measurement Distance:	N/A	m
Time weighted Duty Cycle:	100.00	%

The Power Out would be: 0.250034536 Watts
or: 250.03454 mW
or: 250034.54 μ W
or: 23.98 dBm

Frequency range from 10 MHz to 40 GHz:

Frequency: 846.6 GHz

Power output with DC and antenna Gain (EiRP):

Power (dBm):	28.48
Power (mW):	704.693
Power (W):	0.704693

R = distance in 20 cm

Controlled Exposures to Limit =	18.78172073	W/m ²
Uncontrolled Exposures Limit =	2.623679755	W/m ²
Pd =	1.401942	W/m ²
Controlled Margin to Limit =	17.3798	W/m ²
Uncontrolled Margin to Limit =	1.2217	W/m ²

RF Exposure value radios operating simultaneously on all Bands (Non-Beamforming Mode)

Calculation Based on worst Case combination of simultaneous transmission.

Non-Beamforming Exposure result (FCC)

Technology	Operating Frequency (MHz)	Power Density (W/m ²)	Limit (W/m ²)	Ratio
BT BLE	2480	0.0003960	1	0.000396
BT	2480	0.0003960	1	0.000396
WiFi	2480	0.0115009	1	0.011501
LTE Band 2	1910	0.1121321	1	0.112132
LTE Band 5	846.6	0.1121321	1	0.112132
LTE Band 4	1755	0.1121321	0.5644	0.198675
LTE Band 12	715.3	0.1121321	0.4769	0.235144
LTE Band 13	787.0	0.1121321	0.5247	0.213721
WCDMA Band II	1907.6	0.1401942	1	0.140194
WCDMA Band V	846.6	0.1401942	0.5644	0.248395
		Result	Limit	Sum
Uncontrolled Exposure Limit		PASS	< 1	0.495436
Note: Minimum distance from the user must be at 20 cm Values stated in bold stated as simultaneously active and utilized for worst case scenario calculation.				

Non-Beamforming Exposure result (ISED)

Technology	Operating Frequency (MHz)	Power Density (W/m ²)	Limit (W/m ²)	Ratio
BT BLE	2480	0.003960	5.468948	0.000724
BT	2480	0.003960	5.468948	0.000724
WiFi	2480	0.115009	5.468948	0.021029
LTE Band 2	1910	1.121321	4.575027	0.245096
LTE Band 5	846.6	1.121321	4.317919	0.25969
LTE Band 4	1755	1.121321	2.623680	0.427385
LTE Band 12	715.3	1.121321	2.338260	0.479554
LTE Band 13	787.0	1.121321	2.496000	0.449247
WCDMA Band II	1907.6	1.401942	4.571098	0.306697
WCDMA Band V	846.6	1.401942	2.623680	0.534342
		Result	Limit	Sum
Uncontrolled Exposure Limit		PASS	< 1	0.556095
Note: Minimum distance from the user must be at 20 cm Values stated in bold stated as simultaneously active and utilized for worst case scenario calculation.				

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s). FCC: Minimum distance from the user must be at 20 cm.

ISED: Minimum distance from the user must be at 20 cm.

1.3.7 Sample Calculation

The Friss transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where;

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

$\pi \approx 3.1416$

R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

END OF REPORT