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# Report On

RF Exposure Assessment of the  
Nokia Siemens Networks  
Flexi Multiradio 10 Base Station (698-960 MHz and 1710-2690MHz)

Document 75925040 Report 02 Issue 1

January 2014



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**DATED**

29 January 2014



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## **SECTION 1**

### **REPORT SUMMARY**

RF Exposure Assessment of the  
Nokia Siemens Networks  
Flexi Multiradio 10 Base Station (698-960 MHz and 1710-2690MHz)



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## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the RF Exposure Assessment of the Nokia Siemens Networks Flexi Multiradio 10 Base Station (698-960 MHz and 1710-2690MHz) to the requirements of the applied test specifications.

Objective	To perform RF Exposure Assessment to determine the Equipment Under Test's (EUT's) compliance of the applied rules.
Applicant	Nokia Siemens Networks
Manufacturer	Nokia Solutions and Networks Oy
Manufacturing Description	Flexi Multiradio 10 Base Station
Model Number(s)	Flexi Multiradio 10 Base Station (698-960 MHz and 1710-2690 MHz)
Test Specification/Issue/Date	EN 50383: 2002 FCC KDB 447498 D01 v05r01 RSS-102 Issue 4 March 2010 Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard: 2003
Related Document(s)	Council Recommendation 1999/519/EC:1999 FCC CFR 47 Part 1: 2012 FCC CFR 47 Part 2: 2012 Health Canada's Safety Code 6 ARPANSA ICNIRP 1998 National Council on Radiation Protection and Measurements (NRP) - Report No. 86(1986) EN 50584:2002 EN 50585:2002 IEEE Std C95.1-2005 Australian Standard 2772.2 – 1988



## 1.2 BRIEF SUMMARY OF RESULTS

### 1.2.1 General Public Exposure Levels

Antenna Gain (Numeric)	Peak Output Power (mW)	Field	Calculated RF Exposure at 6.4 m (640cm)	General Public Exposure Limit	Application
43.652	40000	S	3.39 W/m <sup>2</sup>	3.515 W/m <sup>2</sup>	ICNIRP
		S	0.339 mW/cm <sup>2</sup>	0.469 mW/cm <sup>2</sup>	FCC 47 CFR § 1.1310
		S	3.39 W/m <sup>2</sup>	4.687 W/m <sup>2</sup>	Canada's RF Safety Code 6
		S	3.39 W/m <sup>2</sup>	3.515 W/m <sup>2</sup>	ARPANSA
		E	35.76 V/m	36.457 V/m	ICNIRP
		E	35.76 V/m	N/A V/m	FCC 47 CFR § 1.1310
		E	35.76 V/m	42.025 V/m	Canada's RF Safety Code 6
		E	35.76 V/m	36.324 V/m	ARPANSA
		H	0.09 A/m	0.098 A/m	ICNIRP
		H	0.09 A/m	N/A A/m	FCC 47 CFR § 1.1310
		H	0.09 A/m	0.111 A/m	Canada's RF Safety Code 6
		H	0.09 A/m	0.097 A/m	ARPANSA

The calculations have shown that they **meet** the General Public Exposure Levels described in the ICNIRP Guidelines, FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the Australian ARPANSA limits at **640cm**, the point of investigation.



### 1.2.2 Occupational Exposure Levels

Antenna Gain (Numeric)	Peak Output Power (mW)	Field	Calculated RF Exposure at 1.9 m (190cm)	Occupational Exposure Limit	Application
43.652	40000	S	38.49 W/m <sup>2</sup>	42.750 W/m <sup>2</sup>	ICNIRP
		S	3.849 mW/cm <sup>2</sup>	5 mW/cm <sup>2</sup>	FCC 47 CFR § 1.1310
		S	38.49 W/m <sup>2</sup>	50 W/m <sup>2</sup>	Canada's RF Safety Code 6
		S	38.49 W/m <sup>2</sup>	42.750 W/m <sup>2</sup>	ARPANSA
		E	120.46 V/m	124.056 V/m	ICNIRP
		E	120.46 V/m	N/A V/m	FCC 47 CFR § 1.1310
		E	120.46 V/m	137 V/m	Canada's RF Safety Code 6
		E	120.46 V/m	126.951 V/m	ARPANSA
		H	0.32 A/m	0.331 A/m	ICNIRP
		H	0.32 A/m	N/A A/m	FCC 47 CFR § 1.1310
		H	0.32 A/m	0.364 A/m	Canada's RF Safety Code 6
		H	0.32 A/m	0.337 A/m	ARPANSA

The calculations have shown that they **meet** the Occupational Exposure Levels described in the ICNIRP Guidelines, FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the Australian ARPANSA limits at **190 cm**, the point of investigation.



### 1.2.3 Product Information

### 1.2.4 Attestation

The wireless device described within this report has been shown to be capable of compliance with the basic restrictions related to human exposure to electromagnetic fields for both General public and Occupational. The calculations shown in this report were made in accordance the procedures specified in the applied test specification(s).

### 1.2.5 Technical Description

The Equipment under test was a Nokia Siemens Networks Flexi Multiradio 10 Base Station (698-960 MHz and 1710-2690MHz). A full technical description can be found in the manufacturer's documentation.

All reported calculations were carried out on the relevant information supplied for the Flexi Multiradio 10 Base Station (698-960 MHz and 1710-2690MHz) to demonstrate compliance with the applied test specification(s) the sample assessed was found to comply with the requirements of the applied rules.

## 1.3 SUMMARY

The RF exposure assessment is based upon the following criteria:

The Flexi Multiradio 10 Base Station (698-960 MHz and 1710-2690MHz) operates in the frequency range of 698-960 MHz and 1710-2690MHz.

Gain	16.4 dBi
Power	40 W
Distance General Public	6.4 m (640 cm)
Distance Occupational	1.9 m (190 cm)
Duty Cycle	100%

The distances are valid for antenna gain 16.4 dBi and 40W RF power. For other antenna gains and/or RF-power, the calculations should recalculate using formulas in page 12 in this report.





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## **SECTION 2**

### **TEST DETAILS**



## 2.1 RATIONALE FOR ASSESSMENT OF THE RF EXPOSURE

The aim of the assessment report is to evaluate the compliance boundary for a set of given input power(s) according to the basic restrictions (directly or indirectly via compliance with reference levels) related to human exposure to radio frequency electromagnetic fields.

The chosen assessment method to establish the compliance boundary in the far-field region is the reference method as defined in EN50383:2002 Clause 5.2; E-field or H-field calculation. The method of calculation used is defined in EN50383:2002; Clause 8.2.2, 8.2.3 and 8.2.4.

The calculated values have been compared with limits provided in the ICNIRP guidelines.

Calculations can be made in three separate regions, based on distance from the antenna. These are called:

- far-field region,
- radiating near-field region,
- reactive near-field region.

The theory that defines these regions is given in EN50383:2002 Annex A.

### Far-field region

As shown in EN50383 Annex A, the far-field calculations are accurate when the distance,  $r$ , from an antenna of length  $D$  to a point of investigation is greater than

$$r = \frac{2D^2}{\lambda}$$

Where,  $r$  is the distance from the antenna to the point of investigation.

### Radiating near-field region

The radiating near-field region of an antenna of length  $D$  as shown in EN50383 Annex A, this region is defined by

$$\frac{\lambda}{4} < r < \frac{2D^2}{\lambda}$$

### Reactive near-field region

The reactive near-field region of an antenna as shown in EN50383 Annex A, this region is defined by

$$r \leq \frac{\lambda}{4}$$

Where,  $r$  is the distance from the antenna to the point of investigation.

Recommend  $\lambda/4$  as the boundary between the radiated near-field and reactive near-field for RF exposure compliance assessment.



## 2.2 DEFINED LIMITS

Normative Reference: ICNIRP Advice on Limiting Exposure to Electromagnetic Fields (0-300GHz). Table A4, Reference Levels for General Public Exposure to Time Varying Electric & Magnetic Fields. Vol 15 No.2. 2004. The defined limits are in accordance with 47 CFR § 1.1310 Radiofrequency radiation exposure limits.

Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 703 MHz

Power density (W/m <sup>2</sup> )	= 3.515	ICNIRP
Power density (mW/cm <sup>2</sup> )	= 0.469	FCC 47 CFR § 1.1310
Power density (W/m <sup>2</sup> )	= 4.687	Canada's RF Safety Code 6
Power density (W/m <sup>2</sup> )	= 3.515	Australian Radiation Protection Series Publication No. 3
E-Field (Vm-1)	= 36.457	ICNIRP
E-Field (Vm-1)	= N/A	FCC 47 CFR § 1.1310
E-Field (Vm-1)	= 42.025	Canada's RF Safety Code 6
E-Field (Vm-1)	= 36.324	Australian Radiation Protection Series Publication No. 3
H-Field (Am-1)	= 0.098	ICNIRP
H-Field (Am-1)	= N/A	FCC 47 CFR § 1.1310
H-Field (Am-1)	= 0.111	Canada's RF Safety Code 6
H-Field (Am-1)	= 0.097	Australian Radiation Protection Series Publication No. 3

Reference levels for occupational exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 1710 MHz

Power density (W/m <sup>2</sup> )	= 42.750	ICNIRP
Power density (mW/cm <sup>2</sup> )	= 5	FCC 47 CFR § 1.1310
Power density (W/m <sup>2</sup> )	= 50	Canada's RF Safety Code 6
Power density (W/m <sup>2</sup> )	= 42.750	Australian Radiation Protection Series Publication No. 3
E-Field (Vm-1)	= 124.056	ICNIRP
E-Field (Vm-1)	= N/A	FCC 47 CFR § 1.1310
E-Field (Vm-1)	= 137	Canada's RF Safety Code 6
E-Field (Vm-1)	= 126.951	Australian Radiation Protection Series Publication No. 3
H-Field (Am-1)	= 0.331	ICNIRP
H-Field (Am-1)	= N/A	FCC 47 CFR § 1.1310
H-Field (Am-1)	= 0.364	Canada's RF Safety Code 6
H-Field (Am-1)	= 0.337	Australian Radiation Protection Series Publication No. 3



**2.3 ESTABLISHING WAVELENGTH AND 1/4 WAVELENGTH**

Frequency (MHz)	$\lambda = \frac{3 \times 10^8}{f}$		$\frac{\lambda}{4}$	
	m	cm	m	cm
703	0.42674253200569	42.674253200569	0.106685633001422	10.6685633001422
775.5	0.386847195357834	38.6847195357834	0.0967117988394584	9.67117988394584
793	0.378310214375788	37.8310214375788	0.094577553593947	9.4577553593947

Frequency (MHz)	$\lambda = \frac{3 \times 10^8}{f}$		$\frac{\lambda}{4}$	
	m	cm	m	cm
1710	0.175438596491228	17.5438596491228	0.043859649122807	4.3859649122807
2200	0.136363636363636	13.6363636363636	0.0340909090909091	3.40909090909091
2690	0.111524163568773	11.1524163568773	0.0278810408921933	2.78810408921933



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## 2.4 FAR FIELD CALCULATIONS

The following calculations are based on: 16.4 dBi gain antenna

P = 40 (Power (Watts)) or 40000 (Power milliwatts)  
G = 43.652 (Numeric Gain)  
r = 640 (Distance (centimetres)) or 6.4 (Distance (meters))

The power flux:

$$S = \frac{PG(\theta, \phi)}{4\pi r^2}$$

S = 3.39 W/m<sup>2</sup>  
S = 0.339 mW/cm<sup>2</sup>

The electric field strength:

$$E = \frac{\sqrt{30PG(\theta, \phi)}}{r}$$

E = 35.76 V/m

The magnetic field strength:

$$H = \frac{E}{\eta_0}$$

H = 0.09 A/m

The calculations meet the General Public Exposure Levels described in the ICNIRP Guidelines.  
The calculations meet the General Public Exposure Levels described in the FCC 47CFR§1.1310.  
The calculations meet the General Public Exposure Levels described in the Canada's RF Safety Code 6.  
The calculations meet the General Public Exposure Levels described in the Australian Radiation Protection Series Publication No. 3

The calculations meet the Occupational Exposure Levels described in the ICNIRP Guidelines.  
The calculations meet the Occupational Exposure Levels described in the FCC 47CFR§1.1310  
The calculations meet the Occupational Exposure Levels described in the Canada's RF Safety Code 6  
The calculations meet the Occupational Exposure Levels described in the Australian Radiation Protection Series Publication No. 3



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## **SECTION 3**

### **DISCLAIMERS AND COPYRIGHT**



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### 3.1 DISCLAIMERS AND COPYRIGHT

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