SGS Germany GmbH

Test Report No.: G2VG0006

Order No.: G2VG **Pages:** 11 **Munich,** Aug 20, 2014

Client:	Nokia Solutions and Networks US L.L.C.
Equipment Under Test:	Directional configuration (1) 20131014 Argon antenna version A Laird WXC2400SMRP-NS1
Manufacturer:	Nokia Solutions and Networks US L.L.C
Task:	Assessment of compliance with the requirements for safety of general public to radio frequency electromagnetic fields on base of
Test Specification(s):	• FCC 47 CFR § 1.1310 • RSS-102 Issue 4
Result:	The configuration meets the above cited requirements

The results relate only to the items tested as described in this test report.

edited by:	**Date**	**Signature**
Werner Qualification Engineer	Aug 20, 2014	
approved by:	**Date**	**Signature**
Bauer Lab Manager EMC	Aug 21, 2014	

This document was signed electronically.

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1 Summary

This assessment is based on calculations according to OET Bulletin 65 (97-01) and C95.3 (2002) to demonstrate the compliance with the basic restrictions related to general public exposure to radio frequency electromagnetic fields with respect to FCC 47 CFR § 1.1310 and RSS-102.

Flexi Zone Micro small cell, Directional configuration (1) consists of a Blue Tooth (BT) antenna (Laird WXC2400SMRP-NS1) and a directional (LTE) antenna (20131014 Argon antenna version A, LTE). Details of the configuration are given in section 4.

Flexi Zone Micro small cell, Directional configuration (1) is compliant with the cited standards at every point outside a distance R to the antenna.

Transmitters in operation	Distance R [m]	EIRP [W]	Power density[1] [W/m^2]	Limit [W/m^2]
LTE (20131014 Argon antenna version A)	1.60	78.49	9.76	10
Bluetooth (Laird WXC2400SMRP-NS1)	0.02[2]	0.01	7.96	10
LTE + Bluetooth	**1.60**	**78.50**	**9.76**	**10**

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The results of this assessment report refer exclusively to the item described in section 4 of this report

[1] taking into account 100% reflection

[2] near field to far field boarder

2 References

2.1 Specifications

[1] FCC 47 CFR §1.1310
Radiofrequency radiation exposure limits

[2] OET Bulletin 65, Edition 97-0, Evaluating Compliance with FCC, Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, Federal Communications Commission, Office of Engineering & Technology

[3] RSS-102 Issue 4 March 2010, Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), Industry Canada

[4] IEEE Std C95.3TM-2002 (Revision of IEEE Std C95.3-1991) IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz 300 GHz

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2.2 Glossary of Terms

EUA: Equipment under Test/Assessment
BT: Blue Tooth
GP: General Public
LTE: Long Term Evolution

2.3 Bibliographical Data

[5] Antenna Specification: 20131014 Argon antenna version A, Pulse Electronics, 2013

[6] Antenna Specification: 2.4 – 2.5 GHz Quarter Wave Omni Dipol , Laird WXC2400SMRP-NS1, NSN, DocID_tbd 0.6, 2013-09-30, Matt Schirmacher

[7] Operation data, NSN_Argon_BasestationEMErequest_2.xlsx, NSN, 01/2014,Terry Schwenk

[8] Test report: Argon antenna version A, 2170 MHz, Pulse Electronic, 2013-10-14

3 General Information

3.1 Identification of Client

Nokia Solutions and Networks US L.L.C.
1455 W Shure Drive
Arlington Heights, IL. 60004
Terry Schwenk

3.2 Test Laboratory

SGS Germany GmbH
Hofmannstraße 50
81379 München

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3.3 Time Schedule

Start of assessment:	Aug 14, 2014
End of assessment:	Aug 14, 2014

3.4 Participants

Name	Function
Helmut Werner	Editor / Assessment

4 Equipment Under Assessment (EUA)

- The EUA is a multi antenna configuration with a Blue Tooth (BT) antenna and a Directional antenna (LTE). The GPS Antenna was not part of the assessment because only the transmitting parts are relevant.

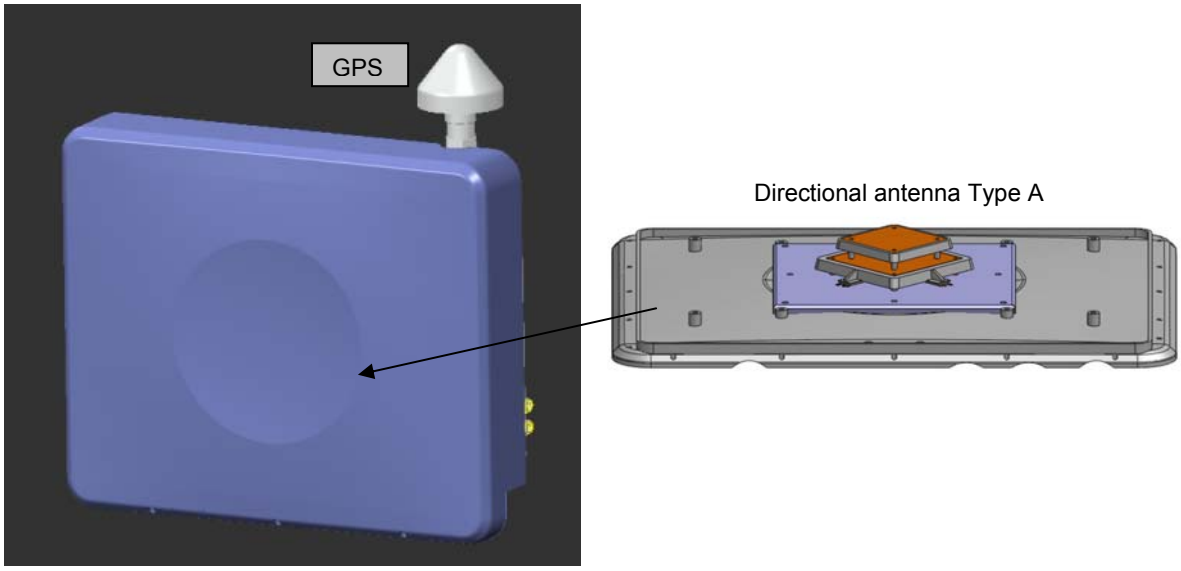

Figure 4-1 EUT: Directional configuration (1)

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4.1 Typical Configuration

The antenna is connected through a power connector and cable to the Transceiver as shown in Figure 4-2.

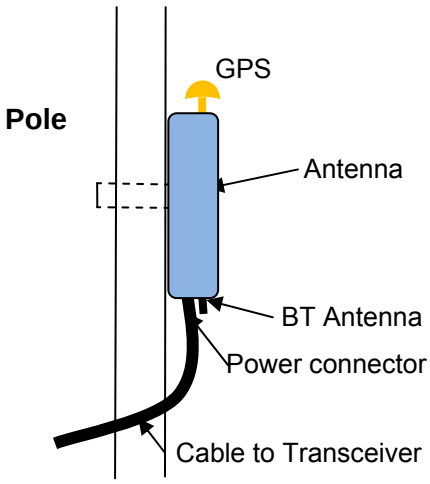

Figure 4-2 typical configuration

The operation data for Directional configuration (1) are given in Table 4-1 and [7]

Power (***P**out*)	Directional Antenna	5 W
Total connector loss		0.75dB
Total cable loss		0.0 dB
Total Loss (***L***) = Total connector loss + Total cable loss		0.75 dB
Number of transmitter unit (***N***)		2
Power at antenna input $= P_{out} N 10^{\frac{-L}{10}}$	LTE (Directional)	8.41 W
	BT	0.01 W
Antenna mounting height		≥ 4.6 m

Table 4-1 Antenna input data

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The antenna specification for Flexi Zone Micro small cell, Directional configuration (1) is given in Table 4-2 and [7].

Type	20131014 Argon antenna version A [5], [7]	(BT) Laird WXC2400SMRP-NS1 [6], [7]
Frequency (MHz)	1710 - 2170	2400 - 2483
Nominal Gain (dBi)	8.9 – 9.7	0 dBi
Polarization	X	vertical
Horizontal beam width (deg)	70	360
Vertical beam width (deg)	60	≥ 50
Electrical downtilt (deg)	0	0
Mechanical downtilt [deg] (optional)	15	0
Dimensions (mm)	285x343x62	61

Table 4-2 Antenna data

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit	Downlink (DL) operating band BS transmit UE receive	Duplex Mode
	F_{UL_low} – F_{UL_high}	F_{DL_low} – F_{DL_high}	
1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
4	1710 MHz – 1755 MHz	2110 MHz – 2155 MHz	FDD

Table 4-3 Operating Bands Supported

5 Evaluation of the EUA

5.1 Calculation

The calculation is based on OET Bulletin 65 (97-01) Section 2: Prediction Methods.

The equations for the truly worst-case prediction of power density[1] is applied. It takes into account a ground reflection of 100%. This is a worst – case prediction which overestimates the field strength in the near-filed. It covers also the conditions of C95.3 Annex B.2

$$S = \frac{(2)^2 PG}{4\pi R^2} = \frac{PG}{\pi R^2} = \frac{EIRP}{\pi R^2}$$ Eq (1)[3]

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S = power density [W/m^2]

P = power input to the antenna [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 [m]

Far field condition

R_{ff} = 0.6*D^2/λ

D: Maximum dimension of the antenna
λ: Wavelength

[3] OET Bulletin 65, Equation 6

5.2 Results

Antenna type	Maximum Dimension [m]	Wavelength [m]	R_{ff} [m]
20131014 Argon Version A	0.343	143E-3	0.49
Laird WXC2400SMRP-NS1	0.061	125E-3	0.02

Table 5-1 Calculation far field

Antenna type	P[W]	G[dBi]	G_{num}	Duty Cycle[4]	EIRP[W]
20131014 Argon Version A	8.41	9.70	9.33	100 %	78.49
Laird WXC2400SMRP-NS1	0.01	0.00	1.00	100 %	0.01
Total					78.50

Table 5-2 Calculation EIRP

Transmitters in operation	Distance [m]	EIRP [W]	Power density[5] [W/m^2]	Limit [W/m^2]
LTE (20131014 Argon Version A)	≥ 1.60	78.49	≤ 9.76	10
Bluetooth (Laird WXC2400SMRP-NS1)	≥ 0.02[6]	0.01	≤ 7.96	10
LTE + Bluetooth	≥ 1.60	78.50	≤ 9.76	10

Table 5-3 Compliance distance

The complete antenna configuration complies with the requirements of FCC 47 CFR § 1.1310 and RSS-102 Section 4.2 for general public electromagnetic exposure limits at a distance larger than 1.60 m

[4] Worst case assumption

[5] taking into account 100% reflection

[6] near field to far field boarder

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6 Annexes

ANNEX A: Exposure limits

FCC 47 CFR §1.1310, electromagnetic exposure limits (MPE) for general public.

Exposure Characteristics	Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Equivalent plane wave power density S (mW/cm^2)
General Population / Uncontrolled Exposure	0.3 – 3.0	614	1.63	100
	3.0 – 30	824/f	2.19/f	$180/f^2$
	30 – 300	27.5	0.073	0.2
	300 – 1500	--	--	f/1500
	1500 – 100,000	--	--	1.0

RSS-102 Section 4.2, RF Field Strength Limits for Devices Used by General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	$280/f$	$2.19/f$	-	6
10-30	28	$2.19/f$	-	6
30-300	28	0.073	2*	6
300-1500	$1.585\ f^{0.5}$	$0.0042\ f^{0.5}$	$f/150$	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000/f^{1.2}$

Note: f is frequency in MHz.

* Power density limit is applicable at frequencies greater than 100 MHz.

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