

RF Exposure Consideration

OneBASE, Pico Node B

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1 Introduction

1.1 Purpose

To estimate the RF energy absorption of a human body caused by a Pico Node B in operation, in order to compare with regulatory levels quantified in terms of Specific Absorption Rate (SAR)

1.2 Revision History

Ver.	Date	Author	Reviewers (FR indicated)	Comments
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1.3 Open issues

Ver.	Description
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1.4 References

OET Bulletin 65
Edition 97-01

Evaluating Compliance with FCC
Guidelines for Human Exposure to
Radio frequency Electromagnetic Fields

2 SAR Estimation

2.1 Transmitter specifications

Frequency bands, in accordance with 3GPP specifications:

Band I,	2110 to 2170 MHz, (type code: N4/US80D-R1L24-TE1)
Band II,	1930 to 1990 MHz, (type code: N4/US80D-R2L24-TE1)
Band III,	1805 to 1880 MHz, (type code: N4/US80D-R3L24-TE1)
Band IV,	2110 to 2155 MHz, (type code: N4/US80D-R4L24-TE1)
Band V,	869 to 894 MHz, (type code: N4/US80D-R5L24-TE1)
Band VIII,	925 to 960 MHz, (type code: N4/US80D-R8L24-TE1)

Base station maximum output power is 24dBm (250mW).

Modulation; QPSK, 16QAM and 64QAM

The in build antenna has a gain for Band I (2.1GHz) is 7.5dBi, 65deg (az) x 65deg (el)

The antenna gain of the other lower frequency bands is lower

2.2 FCC Limits

The below table including the limits for General Population/Uncontrolled Exposure is found in:

OET Bulletin 65, Edition 97-01, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields"

<i>Frequency Range (MHz)</i>	<i>Electric Field Strength (E) (V/m)</i>	<i>Magnetic Field Strength (H) (A/m)</i>	<i>Power Density (S) (mW/cm²)</i>	<i>Averaging Time E ₂, H ₂ or S (minutes)</i>
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
300-1500	--	--	$f/1500$	30
1500-100,000	--	--	1.0	30

 f =frequency in MHz

*Plane-wave equivalent power density

The latter two frequency ranges are applicable for the Pico Node B, base station. Depending on frequency variant the limits vary between 0.57 and 1 mW/cm^2

2.3 Worst case assumptions

In order to simplify the estimations a worst case scenario is assumed i.e.

-Max output power is assumed all the time. Power regulation is not considered nor is the fact that the control channels on an idle base station is typically transmitting with reduced power level not considered.

-The antenna gain 7.5dBi, is defined for Band I (2.1GHz). The antenna gain for the other lower frequency bands is lower. For the calculations 7.5dBi is used.

-An exposed person is assumed not to move around, which during an averaging period otherwise would reduce RF exposure

The Pico Node B radio base station is meant for indoor installation. Typical installation is on a wall in an office environment.

FCC is not giving clear guidance about how RF exposure shall be calculated in terms of what distance to the base station antenna shall be used.

-In the absence guidelines, 20cm is used. This is the same distance as Mobile Devices as defined by FCC

2.4 Calculated RF Exposure 20cm from base station

The relation between antenna gain and Effective Radiated Power, ERP

$$7.5dBi = 10 * \log_{10} \frac{P_{ERP}}{0.25W}$$

ERP considering the antenna gain is:

$$P_{ERP} = 0.25 * 10^{\frac{7.5}{10}} \approx 1.4W$$

The Power density S in mW/cm^2 is calculated:

$$A = 4 * \pi * r^2$$

$$\text{If } r = 0.2m, A \approx 0.5m^2$$

Hence, the power density is:

$$S = 1400 / 5000 = 0.28mW / cm^2$$