Report on the Exposure Calculation for

ip.access of the
E-Class Access Point, Model: 495X

In accordance with FCC CFR 47 Part 2.1091

Prepared for: ip.access Limited
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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorised Signatory	Matthew Russell	24 May 2019	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT
The calculations shown in this report were made in accordance with the procedures described in FCC CFR 47 Part 2.1091.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Calculation	Pete Dorey	24 May 2019	

EXECUTIVE SUMMARY
The calculation of exposure for this product was found to be compliant at 20 cm with CFR 47 Part 2.1091.

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Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	24 May 2019

Table 1

1.2 Introduction

Objective	To perform electromagnetic field exposure assessment to determine the equipment under test's (EUT's) compliance with the applied specifications.
Applicant	ip.access
Manufacturer	ip.access
Model Number(s)	E61 Band 48
Hardware Version(s)	Rev A
Software Version(s)	5978
Specification/Issue/Date	• FCC 47 CFR Part 2.1091: 2018
Order Number Date	PO41448 14 February 2019
Related Document(s)	• FCC 47 CFR Part 1.1310: 2018 • OET65:97 Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields • IEEE C95.3:2002 IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz–300 GHz

1.3 Brief Summary of Results

The wireless device described within this report was compliant with the restrictions related to human exposure to electromagnetic fields for both general public and worker/occupational exposures.

The calculations shown in this report were made in accordance with the procedures specified in the applied test specification(s).

1.3.1 Configuration 1 – LTE Band 48

Regional Requirement	RF Exposure Level at compliance boundary of 0.2 m							
	S Power Density (W/m^2)		E Field (V/m)		H Field (A/m)		B Field (µT)	
	Result	Limit	Result	Limit	Result	Limit	Result	Limit
FCC	0.59	50.00	14.86	N/A	0.0394	N/A	0.0495	N/A

Table 2 – Worker/Occupational Exposure Results

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.2 m.

Regional Requirement	RF Exposure Level at compliance boundary of 0.2 m							
	S Power Density (W/m^2)		E Field (V/m)		H Field (A/m)		B Field (µT)	
	Result	Limit	Result	Limit	Result	Limit	Result	Limit
FCC	0.59	10.00	14.86	N/A	0.0394	N/A	0.0495	N/A

Table 3 – General Public Exposure Results

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.2 m.

1.4 Product Information

1.4.1 Technical Description

Small Cell for LTE Spectrum.

1.4.2 Transmitter Description

The following radio access technologies and frequency bands are supported by the equipment under test.

Radio Access Technology	Antenna Port	Frequency Band	Minimum Frequency	Output Power	Duty Cycle
		MHz	MHz	dBm	%
LTE TDD	Integral	3550-3700	3550	23.98	74.3

Table 4 – Transmitter Description

1.4.3 Antenna Description

The following antennas are supported by the equipment under test.

Antenna No	Radio Access Technology	Antenna Model	Gain	Antenna length	Minimum Separation Distance
			dBi	cm	cm
1	LTE TDD	Integral	2	3.3	20

Table 5 – Antenna description

1.4.4 Equipment Configuration

Transmitting.

2 Assessment Details

2.1 Assessment Method

The assessment method is by calculation of the power density S, electric field strength E, magnetic field strength H or magnetic flux density B.

The calculation uses the spherical model applicable under far field conditions.

$$S = E \times H = \frac{E^2}{\eta} = H^2 \times \eta = \frac{P \times G_i}{4 \times \pi \times r^2}$$

Where:
η - Impedance of free space (377 ohm in far field)
P – Transmitter power W
G_i – Antenna gain ratio relative to isotropic
R – Separation distance m

The magnetic flux density is related to the magnetic field strength by a constant:

$$B = \mu_o \times H$$

Where:
μo – Permeability of free space 4xπ E-7 H/m

Where additional calculations are required by the regional specifications these are detailed below.

The far field region boundary depends on the frequency and wavelength and also on the antenna dimension. The boundary of the far field region is calculated below to demonstrate the validity of using the spherical model.

2.2 Individual Antenna Port Exposure Results

2.2.1 Calculation of Exposure at Specified Separation Distance

The frequencies shown in the tables below have been chosen based on the lowest possible frequency that the EUT can transmit. A full list of the regional requirements is shown in Annex A.

Regional Requirement	Antenna Port	RAT	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.2 m							
				S Power Density (W/m²)		E Field (V/m)		H Field (A/m)		B Field (μT)	
				Result	Limit	Result	Limit	Result	Limit	Result	Limit
FCC	1	LTE TDD	3550	0.59	50.00	14.86	N/A	0.0394	N/A	0.0495	N/A

Table 6 – Worker/Occupational Individual Transmitter Result

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.2 m.

Regional Requirement	Antenna Port	RAT	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.2 m							
				S Power Density (W/m^2)		E Field (V/m)		H Field (A/m)		B Field (µT)	
				Result	Limit	Result	Limit	Result	Limit	Result	Limit
FCC	1	LTE TDD	3550	0.59	10.00	14.86	N/A	0.0394	N/A	0.0495	N/A

Table 7 – General Public Individual Transmitter Result

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.2 m.

2.3 Combined Antenna Port RF Exposure Results

The product has a single transmitter therefore combined exposure is not applicable.

2.4 Far Field Region Boundary Results

The far field region boundary calculation result is shown in Table 8:

Near Field / Far Field Boundary		
RAT Name	Reactive Near Field Boundary (Wave Impedance Dependent)	Antennas - on axis Far Field Region (Ref: IEEE C95.3 Annex B.2,)
	λ/4 (m)	$2D^2/\lambda$ (m)
LTE TDD	0.0211	0.0258

Table 8 – Far Field Boundary

The table below shows the maximum calculated near field / far field region boundaries. The compliance boundary of 0.2 m is in the far field region and therefore, the approach described in section 2.1 is valid.

Field Region	Reactive Near Field Region	Radiating Near Field Region	Far Field Region
Maximum Boundary	< 0.0211 m	0.0211 – 0.0258 m	> 0.0258 m
Validity of Regions	Spherical model potential under-estimate: SAR assessment required	Spherical model over-estimate and conservative	Spherical model valid
Compliance Boundary Location	N/A	N/A	0.2

Table 9 – Assessment Method Validity

2.5 Uncertainty

The basic computation formulas presented in section 2.1 are conservative formulas for the estimation of RF field strength or power density. No uncertainty estimations are required when using these formulas but there is clear guidance on where and when these formulas are applicable.

For the estimate of S, E or H to be conservative, the transmitter power P and antenna gain G_i values shall be the upper bounds of uncertainty therefore maximum values are used.

The spherical formula is valid under far field conditions which are established in section 2.4.

ANNEX A

REGIONAL REQUIREMENTS

Frequency Range (MHz)	Power Density (mW/cm^2)Note 1	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0 - 0.3	-	-	-
0.3 - 3	100	614	1.63
3 - 30	900/f^2	1842/f	4.89/f
30 - 300	1	61.4	0.163
300 - 1500	f/300	-	-
1500 - 100000	5	-	-

Table A.1 – CFR 47 Pt1.1310 (2018) Worker/Occupational Limits

Frequency Range (MHz)	Power Density (mW/cm^2)Note 1	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0 - 0.3	-	-	-
0.3 - 3	100	614	1.63
3 - 30	180/f^2	824/f	2.19/f
30 - 300	0.2	27.5	0.073
300 - 1500	f/1500	-	-
1500 - 100000	1	-	-

Table A.2 – CFR 47 Pt1.1310 (2018) General Public Limits

Note 1: The calculations and limits presented in this report for power density are in units of W/m^2. The conversion factor is; 1 mW/cm^2 = 10 W/m^2.