Report on the Exposure Calculation of:

Neology UK
ANPR Camera, Model: IRIS P500

In accordance with FCC CFR 47 Part 1.1307

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FCC ID: WiFi module: XF6-RS9113DB
LTE modem: XMR201808EC25AF

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SIGNATURE			
			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Jon Kenny	Senior Engineer	Authorised Signatory	07 February 2020

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EXECUTIVE SUMMARY
The calculation of exposure for this product was found to be compliant at 100 cm with FCC CFR 47 Part 1.1307.

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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	07 February 2020

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	Neology UK
Manufacturer	Neology UK
Model Number(s)	IRIS P500 Part no. FC5742050112
Hardware Version(s)	PoE COAD Rev 1
Software Version(s)	OS 1.10.245 App 5.1.3854
Specification/Issue/Date	• FCC 47 CFR Part 1.1307: 2018
Order Number Date	1348-00 10/31/2019
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 - Single transmitter

Regional Requirement	RAT	RF Exposure Level at compliance boundary of 1 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	WiFi	0.01	50.00	1.54	N/A	0.0041	N/A	0.0051	N/A
FCC	LTE	0.05	23.27	4.35	N/A	0.0115	N/A	0.0145	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, 1 m.

Regional Requirement	RAT	RF Exposure Level at compliance boundary of 1 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	WiFi	0.01	10.00	1.54	N/A	0.0041	N/A	0.0051	N/A
FCC	LTE	0.05	4.65	4.35	N/A	0.0115	N/A	0.0145	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, 1 m.

1.3.1 Configuration 2 - Multiple transmitters

Regional Requirement	Calculated RF exposure level at compliance boundary of 1 m as a fraction of the limit			
	S Power Density	E Field	H Field	B Field
	Summation for simultaneous exposure; value to be <1			
FCC	0.0023	N/A	N/A	N/A

Table 4 – 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, 1 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 1 m as a fraction of the limit			
	S Power Density	E Field	H Field	B Field
	Summation for simultaneous exposure; value to be <1			
FCC	0.0114	N/A	N/A	N/A

Table 5 – 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, 1 m.

1.4 Product Information

1.4.1 Technical Description

P500 IRIS ANPR Camera with Wi-Fi and US 4G modem.

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	%
WiFi	1	2400-5850	2400	17	100
LTE	2	698-2690	698	25	100

Table 6 – 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	WiFi	Laird LSR 001-0012	2	11.4	100
2	LTE	Taoglas TG.10.0113	3	16.8	100

Table 7 – Antenna description

1.4.4 Equipment Configuration

WiFi and LTE transmitters operating simultaneously.

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:
μ_o – Permeability of free space 4 x π E-7 H/m

This assessment method of RF exposure is applicable to separation distances of 20 cm or more. Separation distances of less than 20 cm require a Specific Absorption Rate (SAR) assessment.

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 1 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	WiFi	2400	0.01	50.00	1.54	N/A	0.0041	N/A	0.0051	N/A
FCC	2	LTE	698	0.05	23.27	4.35	N/A	0.0115	N/A	0.0145	N/A

Table 8 – 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, 1 m.

Regional Requirement	Antenna Port	RAT	Frequency (MHz)	RF Exposure Level at compliance boundary of 1 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	WiFi	2400	0.01	10.00	1.54	N/A	0.0041	N/A	0.0051	N/A
FCC	2	LTE	698	0.05	4.65	4.35	N/A	0.0115	N/A	0.0145	N/A

Table 9 – 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, 1 m.

2.3 Combined Antenna Port RF Exposure Results

As the frequency of operation for each transmitter is not the same, in order to evaluate compliance with the limit which is dependent on frequency, the fractional exposure value is calculated: The calculated S power density is divided by the limit to get a fractional exposure value. The calculated E and H fields are divided by the limit and squared to get a fractional exposure value. The summation of the fractional RF exposure results for each transmitter provides the combined result. Any values less than one are compliant with the limit.

Calculations are made on an Excel spreadsheet and numbers may not add up exactly due to rounding.

FCC OET 65 specifies the method of summation in clause; Multiple-Transmitter Sites and Complex Environments; with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 1 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
			Summation for simultaneous exposure; value to be <1			
1	WiFi	2400	0.0001	N/A	N/A	N/A
2	LTE	698	0.0022	N/A	N/A	N/A
		Summation	0.0023	N/A	N/A	N/A

Table 10 – FCC Worker/Occupational Combined Exposure

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, 1 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 1 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
			Summation for simultaneous exposure; value to be <1			
1	WiFi	2400	0.0006	N/A	N/A	N/A
2	LTE	698	0.0108	N/A	N/A	N/A
		Summation	0.0114	N/A	N/A	N/A

Table 11 – FCC General Public Combined Exposure

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, 1 m.

2.4 Far Field Region Boundary Results

The far field region boundary calculation result is shown in Table 12:

Near Field / Far Field Boundary (Ref: IEEE C95.3 Annex B.2)			
RAT Name	Frequency MHz	Reactive Near Field Boundary (Wave Impedance Dependent)	Far Field Boundary (Antennas on axis)
		λ/4 (m)	$2D^2/\lambda$ (m)
WiFi	2400	0.0313	0.2079
LTE	698	0.1074	0.1313

Table 12 – Far Field

The table below shows the maximum calculated near field / far field region boundaries.

The compliance boundary of 1 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	<0.1074 m	0.1074 - 0.2079 m	> 0.2079 m
Validity of Regions	Spherical model potential under-estimate: SAR assessment required	Spherical model over-estimate and conservative	Spherical model valid
Compliance Boundary Distance Location	N/A	N/A	1 m

Table 13 – 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.