

RF EXPOSURE EVALUATION REPORT FROM UL

For: Wingtra AG

Product: WingtraRAY

FCC ID: 2AVC8-WINGTRA-RAY

Contains FCC ID: 2A3LJ-MAMWLE, NS9P2400, RYK-WPET236ACNBT, XPYUBX21BE01

RF Exposure Evaluation Report Serial No.:

UL/REGA1/15107211A

This RF Exposure Evaluation Report Is Issued Under The Authority Of Andrew Hoare, Head of Certification:  pp	
Written By: Marc Schmidt 	Checked By: Ernest Cheung 
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For: Wingtra AG
Product: WingtraRAY

1. Client Information

Company Name:	Wingtra AG
Address:	Giesshuebelstrasse 40 8045 Zurich Switzerland
Contact Name:	Lukas Sieber

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2. Description Of The Apparatus And Its Operational Environment

Brand Name:	Wingtra
Model / Type Reference:	WingtraRAY
Basic Direct Function:	Surveying drone with Radar / Cellular / 2.4/5GHz WLAN / 2.4GHz Telemetry / LoRa
Intended Operating Environment:	Outdoors

The WingtraRAY operates in the 60-60.25 GHz frequency band (center frequency: 60.125 GHz) using 2.4/5 GHz WLAN 802.11a/b/g/n, cellular 2G/3G/4G, 2.4 GHz proprietary FHSS and 900 MHz LoRa technologies.

The WingtraRAY uses integrated certified modules:

WLAN FCC ID: RYK-WPET236ACNBT
Cellular FCC ID: XPYUBX21BE01
2.4GHz Telemetry FCC ID: NS9P2400
LoRa FCC ID: 2A3LJ-MAMWLE

For: **Wingtra AG**
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3. Equipment Specifications

Equipment Category:	Radar / Cellular / 2.4/5GHz WLAN / 2.4GHz Telemetry / LoRa
Type of Unit:	Unmanned Aircraft
Operating Frequency Range:	
60 GHz Radar	60 – 60.25 GHz (center frequency: 60.125 GHz)
2.4GHz WLAN	2412 – 2462 MHz
5GHz WLAN	5180 – 5825 MHz
GSM850	824 – 849 MHz
GSM1900	1850 – 1910 MHz
WCDMA 2	1850 – 1910 MHz
WCDMA 5	824 – 849 MHz
LTE B2	1850 – 1910 MHz
LTE B4	1710 – 1755 MHz
LTE B5	824 – 849 MHz
LTE B12	699 – 716 MHz
LTE B13	777 – 787 MHz
LTE B26	814 – 849 MHz
LTE B41	2496 – 2690 MHz
2.4 GHz Telemetry	2401.6 – 2477.6 MHz
900 MHz LoRa	902.3 – 927.5 MHz
*RF Output Power (max. dBm):	
60 GHz Radar	14.0
WLAN 2.4GHz	17.4
WLAN 5GHz	16.4
GSM	22.5 (time-averaged: 1 UL slot -> 12.5% of 31.55dBm)
WCDMA	23.3
LTE	24.4
2.4 GHz Telemetry	19.8
900 MHz LoRa	14.6
*Antenna Gain (max. peak values dBi):	
60 GHz Radar	8.0
WLAN 2.4/5 GHz	6.1
GSM/WCDMA/LTE	7.85
2.4 GHz Telemetry	4.7
900 MHz LoRa	2.8

* Specification values have been supplied by the manufacturer. The maximum power and maximum antenna gain will be used in the calculations, as these will show worst case.

Radar + Cellular + 2.4/5GHz WLAN + 2.4GHz Telemetry + LoRa can operate simultaneously

For: Wingtra AG
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4. Methods and Procedures

Reference:	KDB 447498 D01 v06
Title:	RF Exposure Procedures and Equipment Authorisation Policies for Mobile and Portable Devices
Reference:	FCC §1.1310
Title:	Radiofrequency radiation exposure limits

For: Wingtra AG
Product: WingtraRAY

5. Calculations

5.1 MPE

The MPE calculation to calculate the safe operating distance for the user is.

$$S = \text{EIRP} / 4 \pi R^2$$

Where

- S = Power density
- EIRP = Effective Isotropic Radiated Power (EIRP = P x G)
- P = Conducted Transmitter Power
- G = Antenna Gain (relative to an isotropic radiator)
- R = distance to the centre of radiation of the antenna (safe operating distance)

Power Density Requirement

From table 1 (ii) - Limits for General Population/ Uncontrolled Exposure of FCC §1.1310 (1)(e) **for f > 1500MHz, $S_{\text{req}} = 1.0 \text{ mW/cm}^2$**

From table 1 (ii) - Limits for General Population/ Uncontrolled Exposure of FCC §1.1310 (1)(e) **for f = 300 - 1500MHz, $S_{\text{req}} = f/1500 \text{ mW/cm}^2$**

(f = operating frequency in MHz)

Note: the worst-case limit has been used for all Cellular bands

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VALUES

Frequency Range (MHz)	Operating Band	TX Conducted Power Average (dBm)	Antenna Gain (dBi)	EIRP (mW)	Power Density S mw/ cm ²		
					Limit S _{req}	Calculated S _n @ 25cm	S _n /S _{req}
60000 – 60250	Radar	14.0	8.0	158.5	1.00	0.0202	0.0202
2412 – 2462	WLAN	17.4	6.1	223.9	1.00	0.0285	0.0285
5180 – 5835	WLAN	16.4	6.1	177.8	1.00	0.0226	0.0226
824 – 849	2G ¹	22.5	7.85	1083.9	0.55	0.1380	0.2509
824 – 849	3G ¹	23.3	7.85	1303.2	0.55	0.1659	0.3016
699 – 716	4G ¹	24.4	7.85	1678.8	0.47	0.2138	0.4549
2401.6 – 2477.6	2.4 GHz Telemetry	19.8	4.7	281.8	1.00	0.0359	0.0359
902.3 – 927.5	900 MHz LoRa	14.6	2.8	55.0	0.60	0.0069	0.0115

NOTE 1: Lowest frequency used as this gives the worst-case limit value.

5.2 KDB447498 D01 v06 Section 7.2 SIMULTANEOUS TRANSMISSION CONSIDERATIONS

For simultaneous transmission:

As per KDB, summation of calculated MPE ratios (worst case):

$$\begin{aligned}
 \sum \text{MPE}_{\text{ratios}} &= (S_1 / S_{\text{req1}}) + (S_2 / S_{\text{req2}}) + (S_6 / S_{\text{req6}}) + (S_7 / S_{\text{req7}}) + (S_8 / S_{\text{req8}}) \\
 &= 0.0202 + 0.0285 + 0.4549 + 0.0359 + 0.0115 \\
 &= \mathbf{0.551}
 \end{aligned}$$

\sum of MPE ratios < 1.0, so in accordance with KDB447498 D01 V06 Section 7.2, simultaneous transmission test exclusion applies for the transmitters.

6. Conclusion

The required 25cm RF exposure limits for General Population/ Uncontrolled Exposure will not be exceeded for the WingtraRAY.