

FCC Radiofrequency Radiation Exposure Evaluation Report - MPE-Based Exemption

In accordance with the requirements of
FCC 47 CFR Part 1(1.1307), FCC 47 CFR Part 1(1.1310),
FCC 47 CFR Part 2(2.1093) and KDB 447498 D01

Product Name: VR All-in-one-Headset

Trademark: Pimax

Model Name: Crystal

Serial Model: N/A

Report No.: S22102101906008

FCC ID: 2ARKN-CRYSTAL

Prepared for

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TEST RESULT CERTIFICATION

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Product description

Product name : VR All-in-one-Headset
Trademark : Pimax
Model and/or type reference : Crystal
Serial Model : N/A
FCC 47 CFR Part 1(1.1307)
FCC 47 CFR Part 1(1.1310)
Standards : FCC 47 CFR Part 2(2.1093)
KDB 447498 D01

This device described above has been tested by Shenzhen NTEK. Testing has shown that this device is capable of compliance with FCC radiofrequency radiation exposure specified in FCC 47 CFR Part 2(2.1093). The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

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Date of Test

Date (s) of performance of tests : Feb. 08, 2023 ~ Oct. 13, 2023

Date of Issue : Oct. 13, 2023

Test Result : **Pass**

Prepared By
(Test Engineer)

: 

(Mukzi Lee)

Approved By
(Lab Manager)

: 

(Alex Li)

※ ※ Revision History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	Oct. 13, 2023	Mukzi Lee

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1 General Information

1.1 RF Exposure Requirements

For single RF sources:

MPE-Based Exemption:

Using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C)—Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3–1.34	1,920 R ² .
1.34–30	3,450 R ² /f ² .
30–300	3.83 R ² .
300–1,500	0.0128 R ² f.
1,500–100,000	19.2R ² .

For multiple RF sources:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

1.2 EUT Description

Device Information			
Product Name	VR All-in-one-Headset		
Trade Name	Pimax		
Model Name	Crystal		
Serial Model	N/A		
FCC ID	2ARKN-CRYSTAL		
Device Phase	Identical Prototype		
Exposure Category	General population / Uncontrolled environment		
Antenna Type	FPC Antenna		
Antenna Gain	ANT 1: 2.29 dBi; ANT 2: 1.26 dBi; Bluetooth(Module 2) ANT: 3.66 dBi;		
Device Operating Configurations			
Supporting Mode(s)	Bluetooth , WLAN 2.4G/5G/6G		
Test Modulation	Bluetooth(GFSK, $\pi/4$ -DQPSK, 8DPSK), WLAN(DSSS/OFDM/OFDMA)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	WLAN 2.4G	2412-2462	
	WLAN 5.2G	5180-5240	
	WLAN 5.3G	5260-5320	
	WLAN 5.6G	5500-5700	
	WLAN 5.8G	5745-5825	
	Bluetooth	2402-2480	
	WLAN 6G	5955~7095	

1.3 Test specification(s)

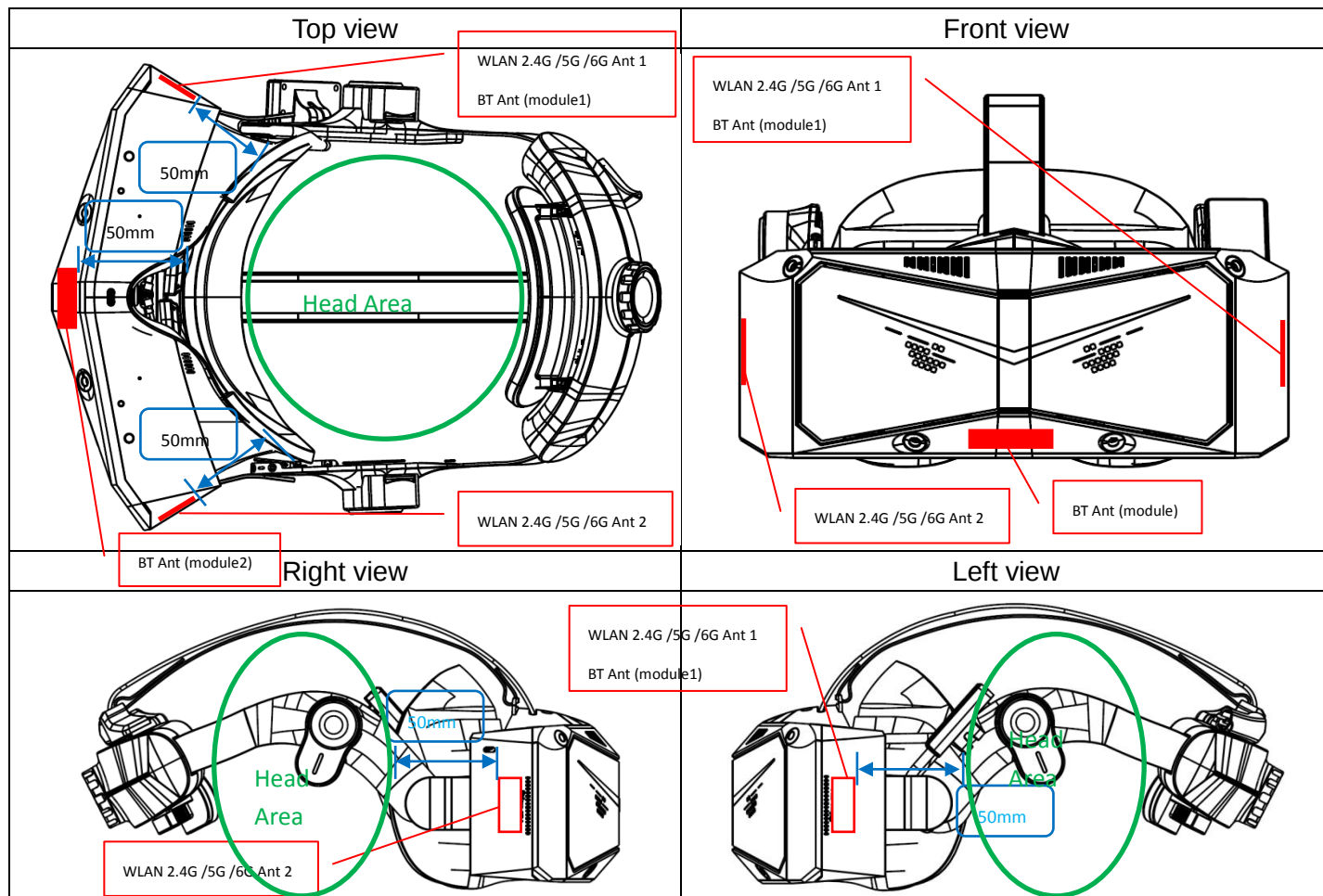
FCC 47 CFR Part 1(1.1307)
FCC 47 CFR Part 1(1.1310)
FCC 47 CFR Part 2(2.1093)
KDB 447498 D01 v06 General RF Exposure Guidance

1.4 Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

2 RF Exposure Evaluation

2.1 Antenna Location



Note: Since the confidentiality request of EUT, the antenna location example diagram see as above.

Under normal use conditions, the minimum separation distance between the human head and the antenna of VR Head-worn is 50mm, so this distance is used for calculations.

2.2 RF Output Power

BLE	Channel	Module 1 Output Power (dBm)			Module 2 Output Power (dBm)		
		Tune-up (dBm)	1M	2M	Tune-up (dBm)	1M	2M
	0CH	1.00	0.74	0.83	0	-0.59	-0.58
	19CH	3.00	2.25	2.32	0	-0.4	-0.41
	39CH	1.00	0.53	0.64	0	-0.63	-0.64

BR+EDR	Output Power (dBm)				
	Channel	Tune-up (dBm)	Data Rates		
			1M	2M	3M
	0CH	4.00	3.37	3.57	3.95
	39CH	6.00	4.72	4.92	5.24
	78CH	4.00	2.90	3.32	3.46

NOTE: Power measurement results of Bluetooth.

Mode	Channel	Frequency (MHz)	Tune-up (dBm)	Output Power (dBm)	Tune-up (dBm)	Output Power (dBm)	Tune-up (dBm)	Output Power (dBm)
			ANT1		ANT2		MIMO	
802.11ax20	1	5955	5.00	4.93	6.00	5.98	8.50	8.49
	45	6175	5.00	4.34	6.00	4.46	8.50	7.41
	93	6415	5.00	4.93	6.00	5.10	8.50	8.03
	97	6435	5.00	4.64	6.00	5.03	8.50	7.85
	105	6475	5.00	3.87	6.00	4.72	8.50	7.32
	113	6515	5.00	4.76	6.00	5.19	8.50	7.99
	117	6535	5.00	4.07	6.00	4.81	8.50	7.47
	149	6695	5.00	4.63	6.00	4.79	8.50	7.72
	181	6855	5.00	4.45	6.00	4.55	8.50	7.51
	189	6895	5.00	4.72	6.00	4.82	8.50	7.77
	209	6995	5.00	4.19	6.00	5.78	8.50	8.06
	229	7095	5.00	4.82	6.00	4.85	8.50	7.84
	185	6875	5.00	4.73	6.00	4.49	8.50	7.62
	3	5965	5.00	4.77	7.00	6.84	9.00	8.94
802.11ax40	43	6165	5.00	4.20	4.50	4.45	7.50	7.34
	91	6405	5.00	4.71	4.00	3.91	7.50	7.34
	99	6445	4.50	4.32	5.00	4.62	7.50	7.48
	107	6485	4.00	3.54	4.50	4.38	7.00	6.99
	123	6565	3.00	2.93	6.50	6.10	8.00	7.80
	147	6685	2.50	2.47	5.00	4.63	7.00	6.69
	179	6845	3.50	3.23	4.50	4.48	7.00	6.91
	195	6925	4.50	4.24	5.50	5.40	8.00	7.87
	211	7005	2.50	2.24	6.00	5.55	7.50	7.21
	227	7085	1.50	1.20	4.00	3.84	6.00	5.73
	187	6885	5.00	4.73	5.00	4.55	8.00	7.65
	115	6525	3.50	3.36	7.00	6.97	9.00	8.54
	7	5985	4.50	4.17	-0.50	-0.59	5.50	5.42
	39	6145	4.00	3.86	-3.00	-3.14	5.00	4.65
802.11ax80	87	6385	5.00	4.67	-2.00	-2.14	5.50	5.49
	103	6465	1.00	-0.96	-1.50	-1.53	2.00	1.76
	135	6625	2.50	2.01	-3.00	-3.19	3.50	3.16
	151	6705	3.00	2.82	-2.50	-2.95	4.00	3.84

	167	6785	4.00	3.93	-2.50	-2.88	5.00	4.76
	199	6945	-2.00	-2.45	-2.50	-2.79	0.50	0.41
	215	7025	-3.50	-4.04	-3.00	-3.36	0.00	-0.7
	183	6865	-2.00	-2.29	-4.00	-4.40	0.00	-0.22
	119	6545	-5.00	-5.25	-1.50	-1.87	0.00	-0.2
802.11ax160	15	6025	5.00	4.71	7.00	6.72	9.00	8.84
	47	6185	4.50	4.36	5.00	4.55	7.50	7.47
	79	6345	5.50	5.31	3.00	2.99	7.50	7.32
	143	6665	3.00	2.58	5.00	5.00	7.00	6.96
	207	6985	3.50	3.17	6.00	5.81	8.00	7.69
	175	6825	4.50	4.12	5.00	4.86	8.00	7.51
	111	6505	4.50	4.31	7.50	7.26	9.50	9.04

NOTE: Power measurement results of WLAN 6G.

2.3 RF Exposure Evaluation result

2.3.1 For single RF sources

For above 6GHz, in accordance with paragraph (b)(3)(i)(C) of eCFR 47 Part 1.1307:

Mode	Ant	Conducted output power (dBm)	Ant Gain (dBi)	E.I.R.P (dBm)	E.I.R.P _{max} Tune-up (dBm)	Total Power (dBm)	ERP _{max} (dBm)	ERP _{max} (W)	$\lambda/2\pi$ (m)	R (m)	f (GHz)	Threshold ERP (W)	MPE exemption
WLAN	1	4.31	2.29	6.6	7	11.12	8.97	0.008	0.008	0.05	5.955	0.048	Yes
6G	2	7.26	1.26	8.52	9								

NOTE: 1. Please see section 2.1 for separation distance.

2. For below 6GHz, Refer to report NO. S22102101906007

2.3.2 For multiple RF sources

Simultaneous Transmission Possibilities Configuration	Support
WLAN 2.4G + WLAN 5G	NO
WLAN 2.4G + WLAN 6G	NO
WLAN 2.4G + Bluetooth (Module 1)	NO
WLAN 2.4G + Bluetooth (Module 2)	YES*
WLAN 5G + Bluetooth (Module 1)	YES
WLAN 5G + Bluetooth (Module 2)	YES
WLAN 6G + Bluetooth (Module 1)	YES
WLAN 6G + Bluetooth (Module 2)	YES
WLAN 5G + WLAN 6G	NO
WLAN 2.4G + WLAN 5G + WLAN 6G	NO
WLAN 2.4G + WLAN 5G + WLAN 6G + Bluetooth (Module 1)	NO
WLAN 2.4G + WLAN 5G + WLAN 6G + Bluetooth (Module 2)	NO
WLAN 2.4G + WLAN 5G + WLAN 6G + Bluetooth (Module 1) + Bluetooth (Module 2)	NO
Bluetooth (Module 1) + Bluetooth (Module 2)	YES*
WLAN 5G + Bluetooth (Module 1) + Bluetooth (Module 2)	YES*
WLAN 6G + Bluetooth (Module 1) + Bluetooth (Module 2)	YES*
* Configuration is worst-case	

NOTE: For below 6GHz, Refer to report NO. S22102101906007

in accordance with section 4.3.2 b) of KDB447498 D01 v06:

Mode	Position	Pmax (dBm)	Pmax (mW)	Distance (mm)	f (GHz)	x	Estimated SAR (W/Kg)
Bluetooth (Module 1)	Head	6.00	3.98	50	2.48	7.5	0.017

Mode	Position	Pmax (dBm)	Pmax (mW)	Distance (mm)	f (GHz)	x	Estimated SAR (W/Kg)
Bluetooth (Module 2)	Head	0.00	1.00	50	2.48	7.5	0.004

in accordance with paragraph (d)(1) of eCFR 47 Part 2.1093:

Mode	f (GHz)	Ant	Ant Gain (dBi)	Conducted Power _{Max} (dBm)	E.I.R.P. _{max} (dBm)	E.I.R. P _{max} Tune- up (dBm)	E.I.R. P _{max} Tune- up (mW)	Distance (mm)	Evaluation Result (mW/m ²)	Total Evaluation Result (mW/m ²)	Limits (mW/ m ²)	Verdict
Module 1 802.11ax (HEW160)	6.505	1	2.29	4.31	6.60	7	5.01	50	0.015947	0.041221	1	PASS
		2	1.26	7.26	8.52	9	7.94	50	0.025274			

For multiple RF sources: Bluetooth (Module 1) + Bluetooth (Module 2)

Bluetooth (Module 1) SAR value(W/kg)	Bluetooth (Module 2) SAR value(W/kg)	Calculation Result (W/kg)	Limits	Verdict
0.017	0.004	0.021	1.6	PASS

For multiple RF sources: WLAN 6G + Bluetooth (Module 1) + Bluetooth (Module 2)

Mode	Evaluation Result (mW/m ²)	Limits (mW/m ²)	SAR Result (W/Kg)	Limits (W/Kg)	TER	Limits	Verdict
Bluetooth (Module 1)	-	-	0.017	1.6	0.054346	1	PASS
Bluetooth (Module 2)	-	-	0.004	1.6			
Module 1 WLAN 6G 802.11ax (HEW160)	0.041221	1	-	-			

NOTE: For below 6GHz, Refer to report NO. S22102101906007

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