

FCC Radiofrequency Radiation Exposure Evaluation Report - SAR-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.: S22102101906007

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

Standards : FCC 47 CFR Part 1(1.1307)
FCC 47 CFR Part 1(1.1310)
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:

SAR-Based Exemption:

Refer to FCC KDB 447498D01, the 1-g SAR and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where:

- $f(\text{GHz})$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

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)

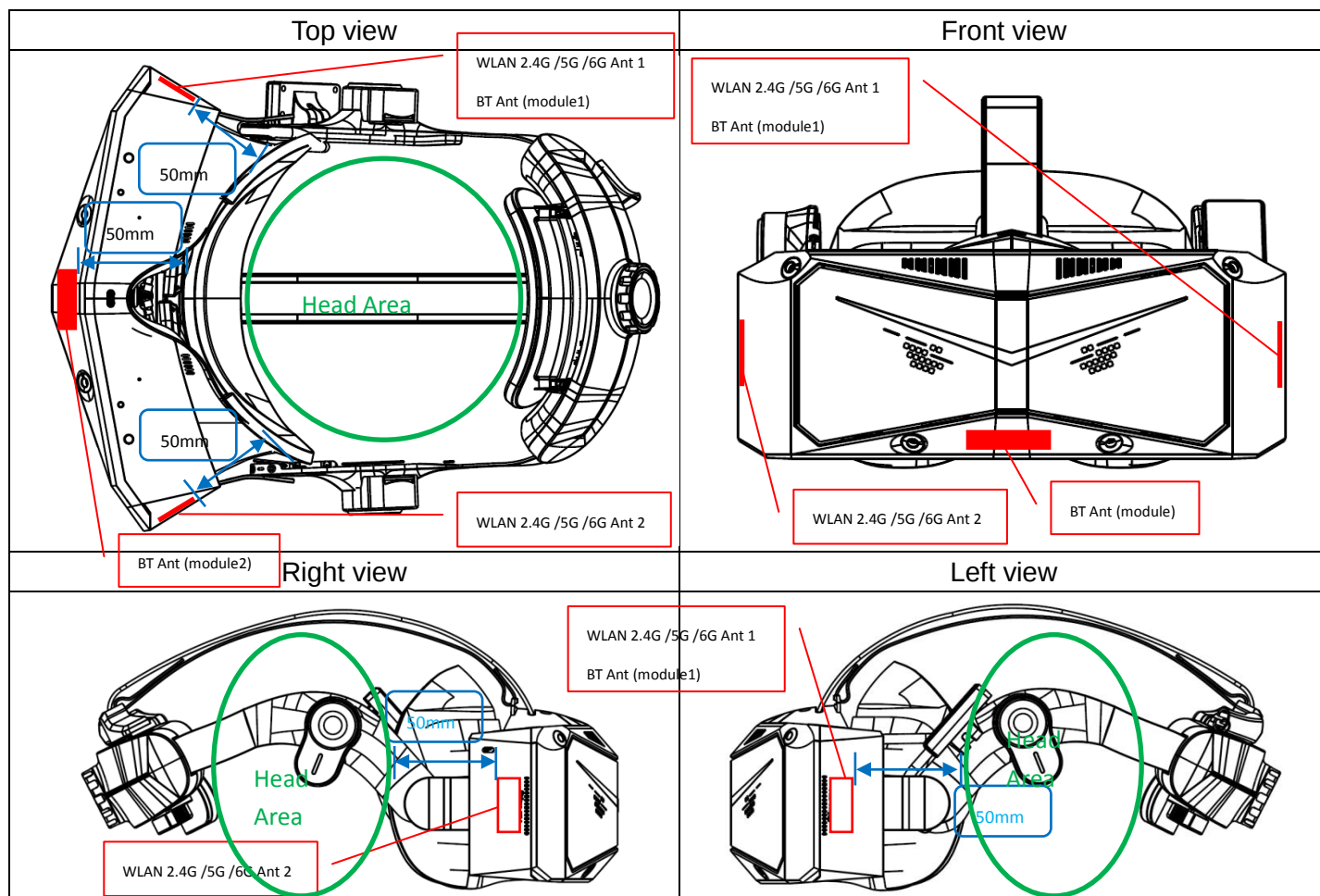
FCC 47 CFR Part 1(1.1307)
FCC 47 CFR Part 1(1.1310)
FCC 47 CFR Part 2(2.1093)
KDB 447498 D01 v06 General RF Exposure Guidance

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

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	
802.11b	1	2412	15.50	15.04	16.00	15.57	N/A	N/A
	6	2437	15.50	15.14	16.00	15.36	N/A	N/A
	11	2462	15.50	14.97	16.00	15.12	N/A	N/A
802.11g	1	2412	13.00	12.98	13.50	13.40	N/A	N/A
	6	2437	13.00	12.89	13.50	13.17	N/A	N/A
	11	2462	13.00	12.69	13.50	12.80	N/A	N/A
802.11n	1	2412	13.00	12.72	13.50	13.21	16.50	15.98

HT20	6	2437	13.00	12.81	13.50	13.18	16.50	16.01
	11	2462	13.00	12.63	13.50	12.68	16.50	15.67
802.11n HT40	3	2422	13.00	12.58	13.00	12.34	15.50	15.47
	6	2437	13.00	12.16	13.00	12.77	15.50	15.49
	9	2452	13.00	11.78	13.00	11.81	15.50	14.81
802.11AX 20	1	2412	13.00	12.75	13.50	13.33	16.50	16.06
	6	2437	13.00	12.85	13.50	13.21	16.50	16.04
	11	2462	13.00	12.69	13.50	12.67	16.50	15.69
802.11AX 40	3	2422	13.00	12.52	13.00	12.23	15.50	15.39
	6	2437	13.00	11.96	13.00	12.58	15.50	15.29
	9	2452	13.00	11.63	13.00	11.75	15.50	14.70

NOTE: Power measurement results of WLAN 2.4G.

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	
802.11a	36	5180	9.50	9.12	10.00	9.16	N/A	N/A
	40	5200	9.50	9.32	10.00	9.76	N/A	N/A
	48	5240	9.50	9.44	10.00	9.47	N/A	N/A
802.11n HT20	36	5180	9.50	9.06	10.00	9.02	12.50	12.05
	40	5200	9.50	9.23	10.00	9.65	12.50	12.46
	48	5240	9.50	9.26	10.00	9.36	12.50	12.32
802.11n HT40	38	5190	10.00	9.72	9.50	9.23	12.50	12.49
	46	5230	10.00	9.30	9.50	9.47	12.50	12.40
802.11ac VHT20	36	5180	9.50	9.09	10.00	9.06	12.50	12.08
	40	5200	9.50	9.27	10.00	9.65	12.50	12.47
	48	5240	9.50	9.27	10.00	9.39	12.50	12.34
802.11ac VHT40	38	5190	10.00	9.65	10.00	9.20	12.50	12.44
	46	5230	10.00	9.31	10.00	9.52	12.50	12.43
802.11ac VHT80	42	5210	9.50	9.24	9.50	9.29	12.50	12.27
802.11ac VHT160	50	5250	10.00	9.77	10.00	9.83	13.00	12.81
802.11ax 20	36	5180	9.50	9.18	10.00	9.11	12.50	12.16
	40	5200	9.50	9.24	10.00	9.70	12.50	12.48
	48	5240	9.50	9.41	10.00	9.44	12.50	12.44
802.11ax 40	38	5190	10.00	9.56	9.50	9.14	12.50	12.37
	46	5230	10.00	9.18	9.50	9.38	12.50	12.29
802.11ax 80	42	5210	9.50	9.41	9.50	9.35	12.50	12.39
802.11ax 160	50	5250	10.00	9.73	10.00	9.85	13.00	12.80

NOTE: Power measurement results of WLAN 5.2G.

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	
802.11a	52	5260	10.00	9.36	9.50	9.47	N/A	N/A
	56	5280	10.00	9.89	9.50	9.33	N/A	N/A
	64	5320	10.00	9.82	9.50	9.12	N/A	N/A
802.11n HT20	52	5260	10.00	9.41	9.50	9.38	13.00	12.41
	56	5280	10.00	9.74	9.50	9.27	13.00	12.52
	64	5320	10.00	9.93	9.50	9.05	13.00	12.52
802.11n HT40	54	5270	10.00	9.77	10.00	9.33	13.00	12.56
	62	5310	10.00	9.94	10.00	9.57	13.00	12.77
802.11ac VHT20	52	5260	10.00	9.33	9.50	9.36	13.00	12.36
	56	5280	10.00	9.76	9.50	9.23	13.00	12.51
	64	5320	10.00	9.92	9.50	8.97	13.00	12.48
802.11ac VHT40	54	5270	10.00	9.84	10.00	9.39	13.00	12.63
	62	5310	10.00	9.91	10.00	9.72	13.00	12.83
802.11ac VHT80	58	5290	10.00	9.53	10.00	9.53	13.00	12.54
802.11ax 20	52	5260	10.00	9.50	9.50	9.40	13.00	12.46
	56	5280	10.00	9.88	9.50	9.24	13.00	12.58
	64	5320	10.00	9.86	9.50	9.07	13.00	12.49
802.11ax 40	54	5270	10.00	9.71	10.00	9.29	13.00	12.51
	62	5310	10.00	9.88	10.00	9.58	13.00	12.74
802.11ax 80	58	5290	10.00	9.54	10.00	9.64	13.00	12.60

NOTE: Power measurement results of WLAN 5.3G.

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	
802.11a	100	5500	10.00	9.66	10.00	9.16	N/A	N/A
	120	5600	10.00	9.40	10.00	9.62	N/A	N/A
	140	5700	10.00	9.35	10.00	9.67	N/A	N/A
802.11n20	100	5500	10.00	9.60	10.00	9.14	12.50	12.39
	120	5600	10.00	9.33	10.00	9.59	12.50	12.47
	140	5700	10.00	9.15	10.00	9.66	12.50	12.42
802.11n40	102	5510	9.50	9.37	10.00	9.61	13.00	12.50
	118	5590	9.50	9.44	10.00	9.41	13.00	12.44
	134	5670	9.50	9.18	10.00	9.56	13.00	12.39
802.11ac (VHT20)	100	5500	10.00	9.63	10.00	8.98	12.50	12.33
	120	5600	10.00	9.34	10.00	9.56	12.50	12.46
	140	5700	10.00	9.18	10.00	9.56	12.50	12.39
802.11ac (VHT40)	102	5510	9.50	9.26	10.00	9.51	12.50	12.40
	118	5590	9.50	9.49	10.00	9.46	12.50	12.48

	134	5670	9.50	8.99	10.00	9.65	12.50	12.35
802.11ac (VHT80)	106	5530	10.00	8.99	10.00	9.55	12.50	12.29
	122	5610	10.00	9.52	10.00	9.40	12.50	12.47
802.11ac (VHT160)	114	5570	10.00	9.71	10.00	9.78	12.50	12.76
802.11ax 20	100	5500	10.00	9.64	10.00	8.99	12.50	12.34
	120	5600	10.00	9.35	10.00	9.53	12.50	12.45
	140	5700	10.00	9.20	10.00	9.60	12.50	12.42
802.11ax 40	102	5510	9.50	9.23	10.00	9.39	12.50	12.32
	118	5590	9.50	9.37	10.00	9.38	12.50	12.39
	134	5670	9.50	9.04	10.00	9.53	12.50	12.30
802.11ax 80	106	5530	10.00	9.02	9.50	9.49	13.00	12.27
	122	5610	10.00	9.56	9.50	9.46	13.00	12.52
802.11ax 160	114	5570	10.00	9.84	10.00	9.82	13.00	12.84

NOTE: Power measurement results of WLAN 5.6G.

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	
802.11a	149	5745	10.00	9.41	10.00	9.49	N/A	N/A
	157	5785	10.00	9.83	10.00	9.73	N/A	N/A
	165	5825	10.00	9.39	10.00	9.39	N/A	N/A
802.11n HT20	149	5745	10.00	9.28	10.00	9.91	13.00	12.62
	157	5785	10.00	9.73	10.00	9.63	13.00	12.69
	165	5825	10.00	9.28	10.00	9.27	13.00	12.28
802.11n HT40	151	5755	9.50	9.08	10.00	9.67	12.50	12.40
	159	5795	9.50	9.05	10.00	9.24	12.50	12.16
802.11ac VHT20	149	5745	10.00	9.24	10.00	9.92	13.00	12.60
	157	5785	10.00	9.72	10.00	9.58	13.00	12.66
	165	5825	10.00	9.26	10.00	9.26	13.00	12.27
802.11ac VHT40	151	5755	9.50	9.17	10.00	9.72	12.50	12.46
	159	5795	9.50	9.10	10.00	9.28	12.50	12.20
802.11ac VHT80	155	5775	9.50	9.36	9.50	9.34	12.50	12.36
802.11ax 20	149	5745	10.00	9.41	10.00	9.91	13.00	12.68
	157	5785	10.00	9.83	10.00	9.61	13.00	12.73
	165	5825	10.00	9.40	10.00	9.28	13.00	12.35
802.11ax 40	151	5755	9.00	8.96	10.00	9.53	12.50	12.26
	159	5795	9.00	8.87	10.00	9.14	12.50	12.02
802.11ax 80	155	5775	9.50	9.45	9.50	9.37	12.50	12.42

NOTE: Power measurement results of WLAN 5.8G.

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.

2.3 RF Exposure Evaluation result

2.3.1 For single RF sources

For below 6GHz, in accordance with section 4.3.1 a) of KDB447498 D01 v06:

Mode	P _{max} (dBm)	P _{max} (mW)	*Distance (mm)	f (GHz)	Calculation Result	SAR Exclusion threshold	SAR test exclusion
WLAN 2.4G	16.50	44.67	50	2.462	1.4	3	Yes
WLAN 5.2G	13.00	19.95	50	5.240	0.9	3	Yes
WLAN 5.3G	13.00	19.95	50	5.320	0.9	3	Yes
WLAN 5.6G	13.00	19.95	50	5.700	1	3	Yes
WLAN 5.8G	13.00	19.95	50	5.825	1	3	Yes
Bluetooth	6.00	3.98	50	2.480	0.1	3	Yes

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

2. For above 6GHz, Refer to report NO. S22102101906008

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 above 6GHz, Refer to report NO. S22102101906008

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

Mode	Position	Pmax (dBm)	Pmax (mW)	Distance (mm)	f (GHz)	x	Estimated SAR (W/Kg)
WLAN 2.4G	Head	16.50	44.67	50	2.462	7.5	0.187

Mode	Position	Pmax (dBm)	Pmax (mW)	Distance (mm)	f (GHz)	x	Estimated SAR (W/Kg)
WLAN 5G	Head	13.00	19.95	50	5.825	7.5	0.128

For multiple RF sources: WLAN 2.4G + Bluetooth (Module 2)

WLAN 2.4G SAR value(W/kg)	Bluetooth (Module 2) SAR value(W/kg)	Calculation Result (W/kg)	Limits	Verdict
0.187	0.004	0.191	1.6	PASS

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 5G + Bluetooth (Module 1) + Bluetooth (Module 2)

WLAN 5G SAR value(W/kg)	Bluetooth (Module 1) SAR value(W/kg)	Bluetooth (Module 2) SAR value(W/kg)	Calculation Result (W/kg)	Limits	Verdict
0.128	0.017	0.004	0.149	1.6	PASS

NOTE: For above 6GHz, Refer to report NO. S22102101906008

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