FCC Maximum Permissible RF Exposure (MPE) Estimation Report

In accordance with the requirements of

FCC 47 CFR Part 2(2.1091), ANSI/IEEE C95.1-1992 and

KDB 447498 D01

Product Name：	Smart Access Point
Trademark：	Relay2
Model Name：	RA320
Family Model：	N/A
Report No.：	S20021801005003
FCC ID：	2AAA9-RA320

Prepared for

Relay2, Inc.

Suite 209, 1525 McCarthy Blvd., Milpitas, CA 95035

Prepared by

Shenzhen NTEK Testing Technology Co., Ltd.

1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street, Bao'an District, Shenzhen 518126 P.R.China.

Tel.: +86-755-6115 9388 Fax.: +86-755-6115 6599

Website: http://www.ntek.org.cn

TEST RESULT CERTIFICATION

Applicant's name	:	Relay2, Inc.
Address	:	Suite 209, 1525 McCarthy Blvd., Milpitas, CA 95035
Manufacturer's Name	:	Amigo Technology Inc.
Address	:	9F.-5, No.266, Sec. 1, Wenhua 2nd Rd., Linkou Dist., New Taipei City 244, Taiwan (R.O.C.)

Product description

Product name	:	Smart Access Point
Trademark	:	Relay2
Model and/or type reference	:	RA320
Family Model	:	N/A
Standards	:	FCC 47 CFR Part 1(1.1310) FCC 47 CFR Part 2(2.1091) ANSI/IEEE C95.1-1992 KDB 447498 D01

This device described above has been tested by Shenzhen NTEK. Testing has shown that this device is capable of compliance with MPE specified in FCC 47 CFR Part 2(2.1091) and ANSI/IEEE C95.1-1992. 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.

This report shall not be reproduced except in full, without the written approval of Shenzhen NTEK, this document may be altered or revised by Shenzhen NTEK, personal only, and shall be noted in the revision of the document.

Date of Test

Date (s) of performance of tests : 18 Feb. 2020 ~ 14 Apr, 2020

Date of Issue : 14 Apr, 2020

Test Result : **Pass**

Prepared By (Test Engineer) : Cheng Jiawen

(Cheng Jiawen)

Approved By (Lab Manager) : Sam. Chen

(Sam Chen)

※ ※ Revision History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev.1.0	Initial Test Report Release	Jul. 12, 2019	Cheng Jiawen

TABLE OF CONTENTS

1 General Information

1.1 RF Exposure Requirements

1.1.1 RF Exposure Limits

Table - Limits For Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30
f = frequency in MHz * = Plane-wave equivalent power density				

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P_t * G_t}{4 * \pi * R^2}$$

Where:

S = Power density (mW/cm^2)
P_t = Conducted output power (dBm)
G_t = numeric gain of the antenna in the direction of interest relative to an isotropic radiator (dBi)
R= distance to the centre of radiation of the antenna (cm)
EIRP = $P_t * G_t$

The antenna of the product, under normal use condition is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20cm separation distance and the prohibition of operating to a person has been printed on the user's manual. Therefore, the S of the device is calculated with R=20cm, and if it is below the limit S, then we can conclude the device complies with the rules.

1.1.2 Additional Description

An estimation of MPE in this application for product is used to ensure if it complies to the rules of the standard in the regulation list above.
Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.
Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.
We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC's MPE limits for field strength and power density are given in 47CFR 1.1310(Table below).These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

1.2 EUT Description

Device Information			
Product Name	Smart Access Point		
Trade Name	Relay2		
Model Name	RA320		
Family Model	N/A		
FCC ID	2AAA9-RA320		
Device Phase	Identical Prototype		
Exposure Category	General population / Uncontrolled environment		
Antenna Type	2.4G/5Gwifi Antenna 1: Embedded Antenna Antenna 2: Embedded Antenna Antenna 3: Embedded Antenna Antenna 4: Embedded Antenna		
Antenna Gain	2.4G/5Gwifi Antenna 1: 2.74dBi for WLAN2.4G Antenna 2: 2.67dBi for WLAN2.4G Antenna 3: 4.17dBi for WLAN5G; Antenna 4: 3.59dBi for WLAN5G		
Device Operating Configurations			
Supporting Mode(s)	WLAN 2.4G/5.2G/5.8G		
Test Modulation	WLAN(DSSS/OFDM)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	WLAN 2.4G	2412-2462	
	WLAN 5.2G	5180-5240	
	WLAN 5.8G	5745-5825	

1.3 Test specification(s)

FCC 47 CFR Part 1(1.1310)
FCC 47 CFR Part 2(2.1091)
ANSI/IEEE C95.1-1992
KDB 447498 D01 General RF Exposure Guidance

1.4 Ambient Condition

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

2 RF Output Power

2.4Gwifi

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	802.11b	2412	Ant 1	13.33	-	30	Pass
NVNT	802.11b	2437	Ant 1	13.39	-	30	Pass
NVNT	802.11b	2462	Ant 1	12.65	-	30	Pass
NVNT	802.11b	2412	Ant 2	13.97	-	30	Pass
NVNT	802.11b	2437	Ant 2	13.59	-	30	Pass
NVNT	802.11b	2462	Ant 2	12.71	-	30	Pass
NVNT	802.11g	2412	Ant 1	13.2	-	30	Pass
NVNT	802.11g	2437	Ant 1	13.21	-	30	Pass
NVNT	802.11g	2462	Ant 1	12.42	-	30	Pass
NVNT	802.11g	2412	Ant 2	13.49	-	30	Pass
NVNT	802.11g	2437	Ant 2	13.35	-	30	Pass
NVNT	802.11g	2462	Ant 2	12.55	-	30	Pass
NVNT	802.11n(HT20)	2412	Ant 1	13.47	16.66	30	Pass
NVNT	802.11n(HT20)	2412	Ant 2	13.83		30	Pass
NVNT	802.11n(HT20)	2437	Ant 1	13.43	16.55	30	Pass
NVNT	802.11n(HT20)	2437	Ant 2	13.65		30	Pass
NVNT	802.11n(HT20)	2462	Ant 1	12.77	15.78	30	Pass
NVNT	802.11n(HT20)	2462	Ant 2	12.77		30	Pass
NVNT	802.11n(HT40)	2422	Ant 1	12.14	15.27	30	Pass
NVNT	802.11n(HT40)	2422	Ant 2	12.38		30	Pass
NVNT	802.11n(HT40)	2437	Ant 1	12.84	15.92	30	Pass
NVNT	802.11n(HT40)	2437	Ant 2	12.97		30	Pass
NVNT	802.11n(HT40)	2452	Ant 1	12.51	15.60	30	Pass
NVNT	802.11n(HT40)	2452	Ant 2	12.66		30	Pass

5.2Gwifi

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	802.11a	5180	Ant 1	10.42	0	--	24	Pass
NVNT	802.11a	5200	Ant 1	10.66	0	--	24	Pass
NVNT	802.11a	5240	Ant 1	10.42	0	--	24	Pass
NVNT	802.11a	5180	Ant 2	10.24	0	--	24	Pass
NVNT	802.11a	5200	Ant 2	10.56	0	--	24	Pass
NVNT	802.11a	5240	Ant 2	10.08	0	--	24	Pass
NVNT	802.11ac20	5180	Ant 1	10.71	0	13.50	23.1	Pass
NVNT	802.11ac20	5180	Ant 2	10.25	0		23.1	Pass
NVNT	802.11ac20	5200	Ant 1	10.85	0	13.77	23.1	Pass
NVNT	802.11ac20	5200	Ant 2	10.67	0		23.1	Pass
NVNT	802.11ac20	5240	Ant 1	10.66	0	13.46	23.1	Pass

NVNT	802.11ac20	5240	Ant 2	10.22	0		23.1	Pass
NVNT	802.11ac40	5190	Ant 1	10.35	0	12.99	23.1	Pass
NVNT	802.11ac40	5190	Ant 2	9.57	0		23.1	Pass
NVNT	802.11ac40	5230	Ant 1	9.31	0	12.48	23.1	Pass
NVNT	802.11ac40	5230	Ant 2	9.63	0		23.1	Pass
NVNT	802.11ac80	5210	Ant 1	9.93	0	12.52	23.1	Pass
NVNT	802.11ac80	5210	Ant 2	9.04	0		23.1	Pass
NVNT	802.11n(HT20)	5180	Ant 1	10.63	0	13.49	23.1	Pass
NVNT	802.11n(HT20)	5180	Ant 2	10.32	0		23.1	Pass
NVNT	802.11n(HT20)	5200	Ant 1	10.88	0	13.81	23.1	Pass
NVNT	802.11n(HT20)	5200	Ant 2	10.72	0		23.1	Pass
NVNT	802.11n(HT20)	5240	Ant 1	10.63	0	13.44	23.1	Pass
NVNT	802.11n(HT20)	5240	Ant 2	10.21	0		23.1	Pass
NVNT	802.11n(HT40)	5190	Ant 1	10.33	0	12.98	23.1	Pass
NVNT	802.11n(HT40)	5190	Ant 2	9.57	0		23.1	Pass
NVNT	802.11n(HT40)	5230	Ant 1	9.29	0	12.48	23.1	Pass
NVNT	802.11n(HT40)	5230	Ant 2	9.65	0		23.1	Pass

5.8Gwifi

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	802.11a	5745	Ant 1	10.08	0	--	30	Pass
NVNT	802.11a	5785	Ant 1	10.83	0	--	30	Pass
NVNT	802.11a	5825	Ant 1	9.74	0	--	30	Pass
NVNT	802.11a	5745	Ant 2	10.2	0	--	30	Pass
NVNT	802.11a	5785	Ant 2	10.07	0	--	30	Pass
NVNT	802.11a	5825	Ant 2	10.32	0	--	30	Pass
NVNT	802.11ac20	5745	Ant 1	10.46	0	13.47	29.1	Pass
NVNT	802.11ac20	5745	Ant 2	10.46	0		29.1	Pass
NVNT	802.11ac20	5785	Ant 1	10.93	0	13.45	29.1	Pass
NVNT	802.11ac20	5785	Ant 2	9.89	0		29.1	Pass
NVNT	802.11ac20	5825	Ant 1	9.77	0	13.05	29.1	Pass
NVNT	802.11ac20	5825	Ant 2	10.29	0		29.1	Pass
NVNT	802.11ac40	5755	Ant 1	10.33	0	13.18	29.1	Pass
NVNT	802.11ac40	5755	Ant 2	10.01	0		29.1	Pass
NVNT	802.11ac40	5795	Ant 1	10.78	0	13.54	29.1	Pass
NVNT	802.11ac40	5795	Ant 2	10.27	0		29.1	Pass
NVNT	802.11ac80	5775	Ant 1	10.13	0	12.76	29.1	Pass
NVNT	802.11ac80	5775	Ant 2	9.33	0		29.1	Pass
NVNT	802.11n(HT20)	5745	Ant 1	10.12	0	13.22	29.1	Pass
NVNT	802.11n(HT20)	5745	Ant 2	10.29	0		29.1	Pass
NVNT	802.11n(HT20)	5785	Ant 1	10.89	0	13.48	29.1	Pass
NVNT	802.11n(HT20)	5785	Ant 2	10.01	0		29.1	Pass
NVNT	802.11n(HT20)	5825	Ant 1	9.79	0	13.19	29.1	Pass
NVNT	802.11n(HT20)	5825	Ant 2	10.53	0		29.1	Pass
NVNT	802.11n(HT40)	5755	Ant 1	10.42	0	13.29	29.1	Pass

NVNT	802.11n(HT40)	5755	Ant 2	10.13	0		29.1	Pass
NVNT	802.11n(HT40)	5795	Ant 1	10.78	0	13.51	29.1	Pass
NVNT	802.11n(HT40)	5795	Ant 2	10.19	0		29.1	Pass

3 RF Exposure Evaluation

3.1 Operation in WLAN 2.4G

SISO

Antenna	Maximum output power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
Ant 1	13.47	2.74	16.21	41.78	20	0.0083	1	Pass
Ant 2	13.97	2.67	16.64	46.13	20	0.0092	1	Pass

3.2 Operation in WLAN 5G

SISO

Antenna	Maximum output power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
Ant 3	10.93	4.17	15.1	32.36	20	0.0064	1	Pass
Ant 4	10.72	3.59	14.31	26.98	20	0.0054	1	Pass

4 Exposure calculations for multiple sources

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE in accordance with the provisions of Table (A) and Table (B). To comply with the MPE, the fraction of the MPE in terms of E^2, H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity.

In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i}$$

The product also has multiple transmitters The Simultaneous Transmission Possibilities are as below:

Simultaneous Tx Combination	Configuration
1	WLAN 2.4G MIMO
2	WLAN 5.2G MIMO
3	WLAN 5.8G MIMO

4.1 Estimation for WLAN2.4G MIMO

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Calculation result	Conclusion
Ant 1	13.47	2.74	16.21	41.78	20	0.0083	1	0.0172	Pass
Ant 2	13.83	2.67	16.5	44.67	20	0.0089	1		

4.2 Estimation for WLAN5G MIMO

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Calculation result	Conclusion
Ant 3	10.88	4.17	15.05	31.99	20	0.0064	1	0.0118	Pass
Ant 4	10.72	3.59	14.31	26.98	20	0.0054	1		

Measurement Result For multiple Transmitting:
Because:
The 2.4Gwifi module has the maximum Power Density value 0.0172 mW/cm^2 in 2.4G MIMO transmitting mode;
The 5Gwifi module has the maximum Power Density value 0.118 mW/cm^2 in 5G MIMO transmitting mode;

So:
When BT & 802R8822 WIFI 5G MIMO mode& 802C2447 WIFI 5G MIMO mode transmitting simultaneously is the worst mode. The worst result as below:

Transmitting Mode	R(cm)	S (mW/cm^2)	Total S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
Wifi 2.4G MIMO Mode	20	0.0172	0.0290	1.000	Pass
Wifi 5G MIMO Mode		0.0118			

According to the Table above, we can conclude that the calculation results of all simultaneous transmission possibilities are less than 1, so it is into compliance.
Therefore the product also meets the requirements under multiple sources condition.

----------END----------