

FCC RF EXPOSURE EVALUATION REPORT

Product Name: GPON ONT
Trade Mark: HALNy
Model No.: HL-4GQV
Report Number: 200704006RFC-4
Test Standards: FCC 47 CFR Part 1 Subpart I
FCC ID: 2AWIZHL4GQV
Test Result: PASS
Date of Issue: October 15, 2020

Prepared for:

FIBRAIN sp.zo.o.
Poland, Zaczernie 190F, 36-062

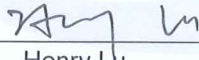
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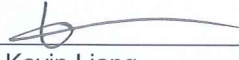
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Version

Version No.	Date	Description
V1.0	October 15, 2020	Original

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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	FIBRAIN sp.zo.o.
Address of Applicant:	Poland, Zaczernie 190F, 36-062
Manufacturer:	FIBRAIN sp.zo.o.
Address of Manufacturer:	Poland, Zaczernie 190F, 36-062

1.2 EUT INFORMATION

Product Name:	GPON ONT		
Model No.:	HL-4GQV		
Trade Mark:	HALNy		
DUT Stage:	Identical Prototype		
EUT Supports Function:	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
	5 GHz U-NII Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac
		5 470 MHz to 5 725 MHz	IEEE 802.11a/n/ac
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac
Sample Received Date:	July 4, 2020		
Sample Tested Date:	July 4, 2020 to August 19, 2020		

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

For 2.4 GHz ISM Band of Wi-Fi		
Frequency Band:	2400 MHz to 2483.5 MHz	
Frequency Range:	2412 MHz to 2462 MHz	
Support Standards:	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20, IEEE 802.11n-HT40	
Type of Modulation:	IEEE 802.11b: DSSS(CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM(64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT20: OFDM(64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT40: OFDM(64-QAM, 16-QAM, QPSK, BPSK)	
Data Rate:	IEEE 802.11b: Up to 11 Mbps IEEE 802.11g: Up to 54 Mbps IEEE 802.11n-HT20: Up to MCS15 IEEE 802.11n-HT40: Up to MCS15	
Number of Channels:	IEEE 802.11b: 11 IEEE 802.11g: 11 IEEE 802.11n-HT20: 11 IEEE 802.11n-HT40: 7	
Channel Separation:	5 MHz	
Antenna Type:	Chain 0	External Antenna
	Chain 1	External Antenna
Antenna Gain:	Chain 0	5 dBi
	Chain 1	5 dBi
Directional gain:	8.01 dBi	
Maximum Peak Power:	IEEE 802.11b: 24.26 dBm IEEE 802.11g: 24.76 dBm IEEE 802.11n-HT20: 26.54dBm IEEE 802.11n-HT40: 26.15 dBm	

For 5 GHz U-NII Bands of Wi-Fi		
Frequency Bands:	5150 MHz to 5250 MHz (U-NII-1)	
	5250 MHz to 5350 MHz (U-NII-2A)	
	5470 MHz to 5725 MHz (U-NII-2C)	
	5 725 MHz to 5 850 MHz (U-NII-3)	
Frequency Ranges:	5180 MHz to 5240 MHz	
	5260 MHz to 5320 MHz	
	5500 MHz to 5700 MHz	
	5 745 MHz to 5 825 MHz	
Support Standards:	IEEE 802.11a/n/ac	
TPC Function:	Not Support	
DFS Operational mode:	Master	
Type of Modulation:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	IEEE 802.11ac: OFDM(256QAM, 64QAM, 16QAM, QPSK, BPSK)	
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz	
	IEEE 802.11n-HT40/ac-VHT40: 40 MHz	
	IEEE 802.11ac-VHT80: 80 MHz	
Data Rate:	IEEE 802.11a: Up to 54 Mbps	
	IEEE 802.11n-HT20: Up to MCS31	
	IEEE 802.11n-HT40: Up to MCS31	
	IEEE 802.11ac-VHT20: Up to MCS8	

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Number of Channels:	IEEE 802.11ac-VHT40: Up to MCS9				
	IEEE 802.11ac-VHT80: Up to MCS9				
	5150 MHz to 5250 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11acVHT80				
	5250 MHz to 5350 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11acVHT80				
	5470 MHz to 5725 MHz: 11 for IEEE 802.11a/n-HT20/ac-VHT20 5 for IEEE 802.11n-HT40/ac-VHT40 2 for IEEE 802.11ac-VHT80				
Antenna Type:	5725 MHz to 5850 MHz: 5 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11ac-VHT80				
	Chain 0	External Antenna			
	Chain 1	External Antenna			
	Chain 2	External Antenna			
Antenna Gain:	Chain 0	5150 MHz to 5250 MHz: 5 dBi			
		5250 MHz to 5350 MHz: 5 dBi			
		5470 MHz to 5725 MHz: 5 dBi			
		5725 MHz to 5850 MHz: 5 dBi			
	Chain 1	5150 MHz to 5250 MHz: 5 dBi			
		5250 MHz to 5350 MHz: 5 dBi			
		5470 MHz to 5725 MHz: 5 dBi			
		5725 MHz to 5850 MHz: 5 dBi			
	Chain 2	5150 MHz to 5250 MHz: 5 dBi			
		5250 MHz to 5350 MHz: 5 dBi			
		5470 MHz to 5725 MHz: 5 dBi			
		5725 MHz to 5850 MHz: 5 dBi			
	Chain 3	5150 MHz to 5250 MHz: 5 dBi			
		5250 MHz to 5350 MHz: 5 dBi			
		5470 MHz to 5725 MHz: 5 dBi			
		5725 MHz to 5850 MHz: 5 dBi			
Maximum conducted output power (dBm):	SISO_Chain 0	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	11.86	11.52	9.82	13.52
	SISO_Chain 1	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	11.39	11.99	10.00	13.65
	SISO_Chain 2	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	6.22	7.49	6.82	7.12
	SISO_Chain 3	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	11.18	11.78	10.63	12.80
	MIMO_Chain 0+1+2+3	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3

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	IEEE 802.11n-HT20:	14.85	15.33	13.74	18.45
	IEEE 802.11n-HT40:	12.60	12.96	12.25	18.04
	IEEE 802.11ac-VHT20:	14.73	15.16	13.61	18.45
	IEEE 802.11ac-VHT40:	12.59	12.96	12.22	17.88
	IEEE 802.11ac-VHT80:	12.46	11.72	10.34	15.65

1.4 OTHER INFORMATION

Test channels for 2.4 GHz ISM Band of Wi-Fi				
Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11b	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11g	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT20	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT40	2422 MHz to 2452 MHz	Channel 3	Channel 6	Channel 9
		2422 MHz	2437 MHz	2452 MHz

Test channels for 5 GHz U-NII Bands of Wi-Fi				
Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11a IEEE 802.11n-HT20 IEEE 802.11ac-VHT20	5150 MHz to 5250 MHz	Channel 36	Channel 44	Channel 48
		5180 MHz	5220 MHz	5240 MHz
	5250 MHz to 5350 MHz	Channel 52	Channel 60	Channel 64
		5260 MHz	5300 MHz	5320 MHz
	5470 MHz to 5725 MHz	Channel 100	Channel 116	Channel 140
		5500 MHz	5580 MHz	5700 MHz
IEEE 802.11n-HT40 IEEE 802.11ac-VHT40	5150 MHz to 5250 MHz	Channel 149	Channel 157	Channel 161
		5745 MHz	5785 MHz	5805 MHz
	5250 MHz to 5350 MHz	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
	5470 MHz to 5725 MHz	Channel 54	--	Channel 62
		5270 MHz	--	5310 MHz
	5725 MHz to 5850 MHz	Channel 102	Channel 110	Channel 134
		5510 MHz	5550 MHz	5670 MHz
	5725 MHz to 5850 MHz	Channel 151	--	Channel 159
		5755 MHz	--	5795 MHz
IEEE 802.11ac-HT80	5150 MHz to 5250 MHz	--	Channel 42	--
		--	5210 MHz	--
	5250 MHz to 5350 MHz	--	Channel 58	--
		--	5290 MHz	--

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	5470 MHz to 5725 MHz	Channel 106	--	Channel 122
		5530 MHz	--	5610 MHz
	5725 MHz to 5850 MHz	--	Channel 155	--
		--	5775 MHz	--

1.5 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product, according to the specifications of the manufacturers. It must comply with the requirements of the following standards:

FCC 47 CFR Part 1 Subpart I

All test items have been performed and recorded as per the above standards

1.6 TEST LOCATION

All tests were performed at:

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1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories

CAB identifier: CN0032

FCC Accredited Lab.

Designation Number: CN1194

Test Firm Registration Number: 259480

1.8 DEVIATION FROM STANDARDS

None.

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1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

2. EQUIPMENT LIST

Please refer to the RF test report.



3. MPE EVALUATION

3.1 REFERENCE DOCUMENTS FOR EVALUATION

No.	Identity	Document Title
1	FCC 47 CFR Part 1 Subpart I	PROCEDURES IMPLEMENTING THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969
2	KDB 447498 D01 General RF Exposure Guidance v06	RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES

3.2 MPE COMPLIANCE REQUIREMENT

3.2.1 Limits

According to §1.1307(b)(1), system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

Limits for Occupational / Controlled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Times E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	F/300	6
1500-100000	/	/	5	6

Limits for General Population / Uncontrolled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Times E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-100000	/	/	1	30

Note: f = frequency in MHz: * = Plane-wave equivalents power density.

3.2.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

3.3 MPE CALCULATION METHOD

$$S = PG/4\pi R^2 = EIRP/4\pi R^2$$

S = power density (in appropriate units, e.g., mW/cm²)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor is normally numeric gain.

R = distance to the center of radiation of the antenna (in appropriate units, e.g., cm)

3.4 MPE CALCULATION RESULTS

Note: For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test

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report.

3.4.1 For WLAN

For Wi-Fi function, operating at 2412MHz to 2462 MHz for IEEE802.11b/g/n and operating at 5150 MHz to 5250 MHz for IEEE802.11a/n/ac and operating at 5250 MHz to 5350 MHz for IEEE802.11a/n/ac and operating at 5470 MHz to 5725 MHz for IEEE802.11a/n/ac and operating at 5725 MHz to 5850 MHz for IEEE802.11a/n/ac.

3.4.1.1 Antenna Type:

Chain 0: External Antenna

Chain 1: External Antenna

Chain 2: External Antenna

Chain 3: External Antenna

3.4.1.2 Antenna Gain:

Chain 0: 2412MHz to 2462 MHz: 5 dBi
5150 MHz to 5250 MHz: 5 dBi
5250 MHz to 5350 MHz: 5 dBi
5470 MHz to 5725 MHz: 5 dBi
5725 MHz to 5850 MHz: 5 dBi

Chain 1: Same as chain 0

Chain 2: Same as chain 0

Chain 3: Same as chain 0

For MIMO mode (4Tx/4Rx), there are four transmission antennas. Chain 0 ,Chain 1,Chain 2and Chain 3 used at the same time and antenna ports have uniform output powers. The Chain 0 ,Chain 1,Chain 2and Chain 3 antenna ports can be used alone. The transmit signals are correlated with each other.

$$\text{The directional gain} = G_{\text{ANT}} + 10 \log(N_{\text{ANT}}) \text{ dBi}$$

3.4.1.3 Results for WLAN

For SISO (1TX/1RX) Mode

Operating Mode		Freq.	Declared maximum conducted average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value
		(MHz)	(dBm)		(dBi)	(dBm)	(mW)	(mw/cm²)	
SISO	IEEE 802.11b	2412	23	1.5	5	29.5	891.2509	1	0.1773
		2437	23	1.5	5	29.5	891.2509	1	0.1773
		2462	23	1.5	5	29.5	891.2509	1	0.1773
	IEEE 802.11g	2412	24	1	5	30.0	1000.0000	1	0.1989
		2437	24	1	5	30.0	1000.0000	1	0.1989
		2462	24	1	5	30.0	1000.0000	1	0.1989
	IEEE 802.11a	5180	8	4	5	17	50.1187	1	0.0100
		5220	8	4	5	17	50.1187	1	0.0100
		5240	8	4	5	17	50.1187	1	0.0100
		5260	8	4	5	17	50.1187	1	0.0100
		5300	8	4	5	17	50.1187	1	0.0100
		5320	8	4	5	17	50.1187	1	0.0100
		5500	8	4	5	17	50.1187	1	0.0100

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Operating Mode	Freq.	Declared maximum conducted average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value
	(MHz)	(dBm)		(dBi)	(dBm)	(mW)	(mw/cm ²)	
	5580	8	4	5	17	50.1187	1	0.0100
	5700	8	4	5	17	50.1187	1	0.0100
	5745	10	4	5	19	79.4328	1	0.0158
	5785	10	4	5	19	79.4328	1	0.0158
	5825	10	4	5	19	79.4328	1	0.0158

For MIMO (4TX/4RX) Mode

Operating Mode		Freq.	Declared maximum conducte d average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value
		(MHz)	(dBm)		(dBi)	(dBm)	(mW)	(mw/cm ²)	
MIMO	IEEE 802.11n-HT20	2412	26	1	5	32	1584.8932	1	0.3153
		2437	26	1	5	32	1584.8932	1	0.3153
		2462	26	1	5	32	1584.8932	1	0.3153
	IEEE 802.11n-HT40	2422	26	1	5	32	1584.8932	1	0.3153
		2437	26	1	5	32	1584.8932	1	0.3153
		2452	26	1	5	32	1584.8932	1	0.3153
	IEEE 802.11n-HT20 IEEE 802.11ac-VHT20	5180	14	1	5	20	100.0000	1	0.0199
		5220	14	1	5	20	100.0000	1	0.0199
		5240	14	1	5	20	100.0000	1	0.0199
		5260	15	1	5	21	125.8925	1	0.0250
		5300	15	1	5	21	125.8925	1	0.0250
		5320	15	1	5	21	125.8925	1	0.0250
		5500	13	1	5	19	79.4328	1	0.0158
		5580	13	1	5	19	79.4328	1	0.0158
		5700	13	1	5	19	79.4328	1	0.0158
		5745	18	1	5	24	251.1886	1	0.0500
		5785	18	1	5	24	251.1886	1	0.0500
		5825	18	1	5	24	251.1886	1	0.0500
	IEEE 802.11n-HT40 IEEE 802.11ac-VHT40	5190	12	1	5	18	63.0957	1	0.0126
		5230	12	1	5	18	63.0957	1	0.0126
		5270	12	1	5	18	63.0957	1	0.0126
		5310	12	1	5	18	63.0957	1	0.0126
		5510	12	1	5	18	63.0957	1	0.0126
		5550	12	1	5	18	63.0957	1	0.0126
		5670	12	1	5	18	63.0957	1	0.0126
		5755	18	1	5	24	251.1886	1	0.0500
		5795	18	1	5	24	251.1886	1	0.0500
	IEEE 802.11ac-VHT80	5230	12	1	5	18	63.0957	1	0.0126
		5290	11	1	5	17	50.1187	1	0.0100
		5530	10	1	5	16	39.8107	1	0.0079
		5610	10	1	5	16	39.8107	1	0.0079
		5775	15	1	5	21	125.8925	1	0.0250

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3.4.2 Simultaneous Multi-band Transmission MPE Analysis

3.4.2.1 List of Mode for Simultaneous Multi-band Transmission

No.	Configurations	Support/Not Support
1	2.4G _WLAN +5G _WLAN	Support

3.4.2.2 Results for transmit simultaneously

No.	Configurations	Maximum MPE Value (mw/cm ²)			Limits (mw/cm ²)
		2.4G WLAN	5G WLAN	Transmit simultaneously	
1	2.4G _WLAN + 5G _WLAN	0.3153	0.0500	0.3653	1

Note 1: According to KDB 447498 D01 General RF Exposure Guidance v06, At the transmit simultaneously calculation method is as follows:

Transmit simultaneously MPE = Σ of MPE ratios

MPE ratios = Field strengths or power density / MPE limit at the test frequency

APPENDIX 1 PHOTOS OF TEST SETUP

N/A

APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.
