

RF Exposure Evaluation Report

APPLICANT : FIH CO., LTD.
EQUIPMENT : Internet Gateway
BRAND NAME : FIH
MODEL NAME : FWF100V5L
FCC ID : RYQFWF100V5L
STANDARD : 47 CFR Part 2.1091
FCC KDB 447498 D01 v06

The product evaluation date was started from Nov. 23, 2022 and completed on Dec. 29, 2022. We, Sporton International Inc. (Kunshan), would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.



Approved by: Si Zhang

Sporton International Inc. (Kunshan)

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA262206	Rev. 01	Initial issue of report.	Jan. 09, 2023



1. Administration Data

1.1. Testing Laboratory

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR01-KS	CN1257	314309

Applicant	
Company Name	FIH CO., LTD.
Address	No.4, Minsheng St., Tu-Cheng Dist., New Taipei City 23679, Taiwan

Manufacturer	
Company Name	FIH CO., LTD.
Address	No.4, Minsheng St., Tu-Cheng Dist., New Taipei City 23679, Taiwan



2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	Internet Gateway
Brand Name	FIH
Model Name	FWF100V5L
FCC ID	RYQFWF100V5L
Wireless Technology and Frequency Range	LTE Band 2 : 1850 MHz ~ 1910 MHz LTE Band 5 : 824 MHz ~ 849 MHz LTE Band 13 : 777 MHz ~ 787 MHz LTE Band 66 : 1710 MHz ~ 1755 MHz LTE Band 48: 3550 MHz ~ 3700 MHz 5G NR n2 : 1850 MHz ~ 1910 MHz 5G NR n5 : 824 MHz ~ 849 MHz 5G NR n48 : 3550 MHz ~ 3700 MHz 5G NR n66 : 1710 MHz ~ 1755 MHz 5G NR n77 : 3700 MHz ~ 3980 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz
Mode	LTE: QPSK, 16QAM, 64QAM 5G NR : CP-OFDM / DFT-s-OFDM, PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 2.4GHz 802.11ax HE20/HE40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac/ax VHT20/VHT40/VHT80/HE20/HE40/HE80
Antenna Gain	<ANT0> LTE Band 2 : 0.33 dBi LTE Band 5 : 0.20 dBi LTE Band 13 : 0.36 dBi LTE Band 66: 1.01 dBi 5G NR n5 : 0.20 dBi 5G NR n66 : 0.97 dBi <ANT1> LTE Band 2 : 0.19 dBi LTE Band 66: 0.19 dBi LTE Band 48: 0.97 dBi 5G NR n2 : 0.19 dBi 5G NR n48 : 0.97 dBi 5G NR n66 : -1.21 dBi 5G NR n77 : 0.85 dBi <ANT2> LTE Band 48: -0.04 dBi 5G NR n77 : 0.59 dBi <ANT4> WLAN2.4GHz: 5.05 dBi WLAN5.2GHz: 4.55 dBi WLAN5.3GHz: 4.76 dBi WLAN5.5GHz: 6.32 dBi WLAN5.8GHz: 6.66 dBi <ANT5> WLAN2.4GHz: 4.85 dBi WLAN5.2GHz: 6.81 dBi WLAN5.3GHz: 6.48 dBi WLAN5.5GHz: 5.89 dBi WLAN5.8GHz: 6.07 dBi
Antenna Type	ANT0&1&2: Monopole Antenna ANT4&5: Dipole Antenna
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. 5GNR n2/5/66/77 supports NSA and SA mode, and 5GNR n48 supports SA mode only.
3. The intra-band/inter-band ULCA and EN-DC mode combination could be referred to the product spec.
4. This device supports HPUE for 5GNR n77 with class 2 and class 1.5 power level, so HPUE has been performed to do MPE analysis.
5. 5GNR n77 supports MIMO mode at Ant1 and Ant2.
6. WLAN2.4GHz/WLAN5GHz all support SISO/MIMO mode, we only chose MIMO tune up power to perform MPE calculation conservatively for MIMO power is higher.
7. This device support beamforming for WLAN 2.4GHz 802.11ax HE20/HE40 and WLAN 5GHz 802.11ac/ax VHT20/VHT40/VHT80/HE20/HE40/HE80.
8. For WLAN CDD&Beamforming mode, the MPE calculation performed separately.

Comments and Explanations:

1. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.
2. The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer.

3. Maximum RF average output tune up power among production units

<LTE>

Mode		Maximum Average power(dBm)
LTE	Band 2	25.00
	Band 5	25.00
	Band 13	25.00
	Band 48	22.50
	Band 66	25.00

<5GNR>

Mode		Maximum Average power(dBm)
5GNR	n2	25.00
	n5	25.00
	n48	25.00
	n66	25.00
	n77-PC3	25.00
	n77-PC2	28.00
	n77-PC1.5	29.00

<2.4GHz WLAN >

Mode		Maximum Average Power (dBm)		
		ANT4	ANT5	ANT4+5
2.4GHz	802.11b	13.00	15.00	17.00
	802.11g	16.00	16.00	19.00
	802.11n-HT20	16.00	16.00	19.00
	802.11n-HT40	16.00	16.00	19.00
	802.11ax-HE20	16.00	16.00	19.00
	802.11ax-HE40	16.00	16.00	19.00

**<5GHz WLAN >**

Mode		Maximum Average Power (dBm)		
		ANT4	ANT5	ANT4+5
5.2GHz	802.11a	18.00	18.00	21.00
	802.11n-HT20	16.00	16.00	19.00
	802.11n-HT40	17.00	17.00	20.00
	802.11ac-VHT20	16.00	16.00	19.00
	802.11ac-VHT40	17.00	17.00	20.00
	802.11ac-VHT80	14.00	14.00	17.00
	802.11ax-HE20	17.00	18.00	20.00
	802.11ax-HE40	17.00	17.00	20.00
5.3GHz	802.11a	18.00	18.00	21.00
	802.11n-HT20	16.00	16.00	19.00
	802.11n-HT40	17.00	17.00	20.00
	802.11ac-VHT20	16.00	16.00	19.00
	802.11ac-VHT40	17.00	17.00	20.00
	802.11ac-VHT80	14.00	14.00	17.00
	802.11ax-HE20	17.00	17.00	20.00
	802.11ax-HE40	17.00	17.00	20.00
5.5GHz	802.11a	14.00	14.00	17.00
	802.11n-HT20	14.00	14.00	17.00
	802.11n-HT40	14.00	14.00	17.00
	802.11ac-VHT20	14.00	14.00	17.00
	802.11ac-VHT40	14.00	14.00	17.00
	802.11ac-VHT80	15.00	15.00	18.00
	802.11ax-HE20	14.00	14.00	18.00
	802.11ax-HE40	14.00	14.00	17.00
5.8GHz	802.11a	14.00	14.00	17.00
	802.11n-HT20	15.00	14.00	17.50
	802.11n-HT40	16.00	15.00	18.50
	802.11ac-VHT20	15.00	14.00	17.50
	802.11ac-VHT40	16.00	15.00	18.50
	802.11ac-VHT80	17.00	17.00	20.00
	802.11ax-HE20	15.00	14.00	17.50
	802.11ax-HE40	16.00	15.00	18.50
	802.11ax-HE80	17.50	16.50	20.50

Note: WLAN2.4GHz/WLAN5GHz all support SISO/MIMO mode, we only chose MIMO tune up power to perform MPE calculation conservatively for MIMO power is higher.

**<For Beamforming Mode>****<2.4GHz WLAN >**

Mode		Maximum Average Power (dBm)		
		ANT4	ANT5	ANT4+5
2.4GHz	802.11ax-HE20	13.00	13.00	16.00
	802.11ax-HE40	13.00	13.00	16.00

<5GHz WLAN >

Mode		Maximum Average Power (dBm)		
		ANT4	ANT5	ANT4+5
5.2GHz	802.11ac-VHT20	14.00	14.00	17.00
	802.11ac-VHT40	14.00	14.00	17.00
	802.11ac-VHT80	12.00	12.00	15.00
	802.11ax-HE20	15.00	15.00	18.00
	802.11ax-HE40	14.00	15.00	17.00
	802.11ax-HE80	12.00	12.00	15.00
5.3GHz	802.11ac-VHT20	14.00	14.00	17.00
	802.11ac-VHT40	14.00	14.00	17.00
	802.11ac-VHT80	12.00	12.00	15.00
	802.11ax-HE20	15.00	15.00	18.00
	802.11ax-HE40	14.00	14.00	17.00
	802.11ax-HE80	12.00	12.00	15.00
5.5GHz	802.11ac-VHT20	12.00	12.00	15.00
	802.11ac-VHT40	11.50	11.50	14.50
	802.11ac-VHT80	13.00	13.00	16.00
	802.11ax-HE20	12.00	12.00	15.00
	802.11ax-HE40	12.00	12.00	15.00
	802.11ax-HE80	13.00	13.00	16.00
5.8GHz	802.11ac-VHT20	12.00	12.00	15.00
	802.11ac-VHT40	13.00	13.00	16.00
	802.11ac-VHT80	14.00	14.00	17.00
	802.11ax-HE20	12.00	12.00	15.00
	802.11ax-HE40	13.00	13.00	16.00
	802.11ax-HE80	15.00	15.00	18.00

Note: This device support beamforming for WLAN 2.4GHz 802.11ax HE20/HE40 and WLAN 5GHz 802.11ac/ax VHT20 /VHT40/VHT80/HE20/HE40/HE80.

4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

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 Exposures				
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
300-1500			f/300	6
1500-100,000			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
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = Power Density

P = Output Power at Antenna Terminals

G = Gain of Transmit Antenna (linear gain)

R = Distance from Transmitting Antenna

5. Radio Frequency Radiation Exposure Evaluation

5.1. Standalone Power Density Calculation

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)	Power Density / Limit
LTE Band 2	1850.7	0.33	25.00	25.330	341.193	0.068	1.000	0.068
LTE Band 5	824.7	0.20	25.00	25.200	331.131	0.066	0.550	0.120
LTE Band 13	779.5	0.36	25.00	25.360	343.558	0.068	0.520	0.132
LTE Band 66	1710.7	1.01	25.00	26.010	399.025	0.079	1.000	0.079
LTE Band 48	3552.5	0.97	22.50	23.470	222.331	0.044	1.000	0.044
5G NR n2	1850.00	0.19	25.00	25.190	330.370	0.066	1.000	0.066
5G NR n5	824.00	0.20	25.00	25.200	331.131	0.066	0.549	0.120
5G NR n48	3550.00	0.97	25.00	25.970	395.367	0.079	1.000	0.079
5G NR n66	1710.00	0.97	25.00	25.970	395.367	0.079	1.000	0.079
5G NR n77	3700.00	0.85	29.00	29.850	966.051	0.192	1.000	0.192
2.4GHz WLAN	2412.0	5.05	19.00	24.050	254.097	0.051	1.000	0.051
5.2GHz WLAN	5180.0	6.81	21.00	27.810	603.949	0.120	1.000	0.120
5.3GHz WLAN	5260.0	6.48	21.00	27.480	559.758	0.111	1.000	0.111
5.5GHz WLAN	5500.0	6.32	18.00	24.320	270.396	0.054	1.000	0.054
5.8GHz WLAN	5745.0	6.66	20.00	26.660	463.447	0.092	1.000	0.092

Note:

1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. Chose the maximum RF output tune up power of all antennas among same frequency WWAN/WLAN bands and the maximum antenna gain to perform MPE calculation conservatively.
3. This device supports HPUE for 5G NR n77 with class 2 and class 1.5 power level, so HPUE(class 1.5) has been performed standalone power density calculation.

<For Beamforming mode>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)	Power Density / Limit
2.4GHz WLAN	2412.0	7.98	16.00	23.980	250.035	0.050	1.000	0.050
5.2GHz WLAN	5180.0	8.76	18.00	26.760	474.242	0.094	1.000	0.094
5.3GHz WLAN	5260.0	8.67	18.00	26.670	464.515	0.092	1.000	0.092
5.5GHz WLAN	5500.0	9.12	16.00	25.120	325.087	0.065	1.000	0.065
5.8GHz WLAN	5745.0	9.38	18.00	27.380	547.016	0.109	1.000	0.109

Note: The gain calculation method of WLAN TX beamforming mode is referenced to KDB 662911.

5.2. Collocated Power Density Calculation

WWAN Power Density / Limit	WLAN 2.4GHz Power Density / Limit	Σ (Power Density / Limit) of WWAN + WLAN 2.4GHz
0.192	0.051	0.243
WWAN Power Density / Limit	WLAN 5GHz Power Density / Limit	Σ (Power Density / Limit) of WWAN + WLAN 5GHz
0.192	0.120	0.312

ENDC:

LTE Power Density / Limit	5G NR Power Density / Limit	WLAN 2.4GHz Power Density / Limit	Σ (Power Density / Limit) of LTE + 5G NR + WLAN 2.4GHz
0.132	0.192	0.051	0.375
LTE Power Density / Limit	5G NR Power Density / Limit	WLAN 5GHz Power Density / Limit	Σ (Power Density / Limit) of LTE + 5G NR + WLAN 5GHz
0.132	0.192	0.120	0.444

LTE ULCA:

LTE Power Density / Limit	LTE Power Density / Limit t	WLAN 2.4GHz Power Density / Limit	Σ (Power Density / Limit) of LTE + LTE + WLAN 2.4GHz
0.132	0.132	0.051	0.315
LTE Power Density / Limit	LTE Power Density / Limit t	WLAN 5GHz Power Density / Limit	Σ (Power Density / Limit) of LTE + LTE + WLAN 5GHz
0.132	0.132	0.120	0.384

NR ULCA/MIMO:

LTE Power Density / Limit	LTE Power Density / Limit t	WLAN 2.4GHz Power Density / Limit	Σ (Power Density / Limit) of 5G NR + 5G NR + WLAN 2.4GHz
0.192	0.192	0.051	0.435
5G NR Power Density / Limit	5G NR Power Density / Limit	WLAN 5GHz Power Density / Limit	Σ (Power Density / Limit) of 5G NR + 5G NR + WLAN 5GHz
0.192	0.192	0.120	0.504

Note:

- For collocation analysis, 5G NR n77 is chosen for summation due to the highest (power density/limit) among all WWAN wireless modes.
- For collocation analysis, LTE Band 13 is chosen for summation due to the highest (power density/limit) among all LTE wireless modes.
- For collocation analysis, 5G NR n77 is chosen for summation due to the highest (power density/limit) among all 5G NR modes.
- Chose the worst power density among WLAN 2.4/5GHz to do co-located.
- Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission) / (corresponding MPE limit)], for WWAN + WLAN.
- Considering the WWAN and 5G NR module collocation with the WLAN transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 2 collocated transmitters is compliant.

Conclusion:

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

-----THE END-----