REPORT No.: SZ22020094S01

RF EXPOSURE EVALUATION REPORT

APPLICANT	:	Fell Technology AS
PRODUCT NAME	:	Waterguard Hub
MODEL NAME	:	W3701
BRAND NAME	:	Fell Technology AS
FCC ID	:	2AFOZW3701
STANDARD(S)	:	FCC 47 CFR Part 2(2.1091)
RECEIPT DATE	:	2022-02-21
TEST DATE	:	2022-04-02 to 2022-04-29
ISSUE DATE	:	2022-08-11

Edited by: Xie Yiyun

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MORLAB

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DIRECTORY

Change History		
Version	Date	Reason for Change
1.0	2022-08-11	First edition

1. Technical Information

Note: Provide by applicant.

1.1 Applicant and Manufacturer Information

Applicant:	Fell Technology AS
Applicant Address:	Bragernes Torg 2 3017 Drammen Norway
Manufacturer:	Fell Technology AS
Manufacturer Address:	Bragernes Torg 2 3017 Drammen Norway

1.2 Equipment under Test (EUT) Description

Product Name:	Waterguard Hub	
EUT No.:	2#	
Hardware Version:	1.0.0	
Software Version:	1.0.0	
Frequency Bands:	LTE CAT-M1 Band 2: 1850 MHz ~ 1910 MHz LTE CAT-M1 Band 4: 1710 MHz ~ 1755 MHz LTE CAT-M1 Band 12: 699 MHz ~ 716 MHz LTE CAT-M1 Band 13: 777 MHz ~ 787 MHz WLAN 2.4GHz: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz ISM Band: 906.5MHz- 922.5MHz	
Modulation Mode:	LTE: QPSK,16QAM 802.11b: DSSS 802.11g/n-HT20/40: OFDM Bluetooth LE: GFSK ISM: GFSK	
Antenna Type:	WWAN: Fixed Internal Antenna WLAN: Fixed Internal Antenna ISM: Fixed Internal Antenna	
Antenna Gain:	Frequency Bands	Antenna Gain (dBi)
	LTE CAT-M1 Band 2	3.0
	LTE CAT-M1 Band 4	3.0
	LTE CAT-M1 Band 12	-0.5
	LTE CAT-M1 Band 13	-0.5

	WLAN 2.4GHz	0.5
	Bluetooth	0.50
	ISM	1.40

Note:

When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.

1.3 Applied Reference Documents

Leading reference documents for testing:

Identity	Document Title	Method determination /Remark
FCC 47CFR Part 2(2.1091)	Radio Frequency Radiation Exposure Assessment: mobile devices	No deviation
KDB 447498 D04v01	General RF Exposure Guidance	No deviation
Note 1: The test item is not applicable. **Note 2:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.		

2. Device Category and RF Exposure Limit

Per user manual, Based on 47CFR 2.1091, this device belongs to mobile device category with General Population/Uncontrolled exposure.

Mobile Devices:

47CFR 2.1091(b)

For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.

General Population/Uncontrolled Exposure:

The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category, and the general population/uncontrolled exposure limits apply to these devices.

Table 1—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)
(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

f = frequency in MHz* = Plane-wave equivalent power density

3. RF Output Power

Remark: The output power of WWAN/WLAN/Bluetooth refers to the annex B of this report.

4. RF Exposure Assessment

➢ **Standalone Transmission Assessment**

Bands	Frequency (MHz)	Tune-up Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	PD (mW/cm²)	Limit Value (mW/cm²)
LTE CAT-M1 Band 2	1900	22	3.0	316.23	0.063	1
LTE CAT-M1 Band 4	1745	22	3.0	316.23	0.063	1
LTE CAT-M1 Band 12	711	21.5	-0.5	125.89	0.025	0.474
LTE CAT-M1 Band 13	782	20.5	-0.5	100.00	0.020	0.521
WLAN 2.4GHz	2462	20.5	0.5	125.89	0.025	1.0
Bluetooth	2402	2.5	0.5	2.00	0.000	1.0

Bands	Frequency (MHz)	Max. Emission E(dBμV/m)	Max. Emission (W)	EIRP (mW)	PD (mW/cm²)	Limit Value (mW/cm²)
ISM	906.5	62.14	0.0013	0.00049	0.000	0.604
	914.5	63.23	0.0015	0.00063	0.000	0.610
	922.5	64.39	0.0017	0.00082	0.000	0.615

Note:

1. According to KDB 447498, MPE assessment is based on source-based time-averaged maximum conducted output power of the RF channel requiring assessment, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.
2. MPE calculate method

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

Where: S= Power density (in appropriate units, e.g. mW/cm^2)

P = Time-average maximum tune-up power (in appropriate units, e.g. dBm)

G = numeric gain of the antenna (in appropriate units, e.g. dBi)

R = Separation distance to the centre of radiation of the antenna (20cm)

3. The maximum average emission refers to report (Report No.: SZ22020094W03).

➢ **Simultaneous Transmission Assessment:**

Multi-Band Simultaneous Transmission Consideration

Simultaneous Transmission Consideration	Position	Applicable Combination
	Hand/Body	ISM + Bluetooth

1. This device contains transmitters that may operate simultaneously, therefore simultaneous transmission analysis is required.
2. The worst condition for ISM & Bluetooth will be calculated for transmitting simultaneously.
   Formula: Result=Power density$_1$/ limit$_1$ + Power density$_2$/ limit$_2$≤1.

Transmission Bands	Power Density/ SAR	Limit	Simultaneous Transmission Result
ISM	0.000	0.615	0
Bluetooth	0.000	1.0	

➢ **Conclusion:**

According to 47 CFR §2.1091, this device complies with human exposure basic restrictions.

Annex A General Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Facilities and Accreditations

The FCC designation number is CN1192, the test firm registration number is 226174.

Note:

The main report is end here and the other Annex B will be submitted separately.

END OF REPORT

Annex B Conducted Power

Note:

Conducted power unit: dBm

The target power was recorded in the manufacture document.

Band 2

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				18700	18900	19100	
Frequency (MHz)				1860	1880	1900	
20	QPSK	1	0	20.92	20.87	21.12	22.00
20	QPSK	1	5	20.68	20.64	20.79	
20	QPSK	3	0	21.03	21.00	20.90	
20	QPSK	3	3	20.90	20.87	20.87	
20	QPSK	6	0	20.87	20.90	20.81	
20	16QAM	1	0	20.99	21.03	21.20	
20	16QAM	1	5	20.87	20.77	21.00	
20	16QAM	3	0	20.97	20.95	20.90	
20	16QAM	3	3	20.69	20.80	20.65	
20	16QAM	5	0	20.76	20.86	20.96	
Channel				18675	18900	19125	Tune-up limit (dBm)
Frequency (MHz)				1857.5	1880	1902.5	
15	QPSK	1	0	21.01	21.06	21.03	22.00
15	QPSK	1	5	20.46	20.74	20.88	
15	QPSK	3	0	20.96	21.06	21.11	
15	QPSK	3	3	20.79	20.92	20.88	
15	QPSK	6	0	20.83	20.90	20.84	
15	16QAM	1	0	20.86	21.19	21.02	
15	16QAM	1	5	20.81	21.07	20.65	
15	16QAM	3	0	20.90	21.03	20.85	
15	16QAM	3	3	20.77	20.72	20.77	
15	16QAM	5	0	20.81	21.05	20.94	
Channel				18650	18900	19150	Tune-up limit (dBm)
Frequency (MHz)				1855	1880	1905	
10	QPSK	1	0	20.85	20.92	21.04	22.00
10	QPSK	1	5	20.72	20.87	20.98	
10	QPSK	3	0	21.04	21.24	21.01	22.00
10	QPSK	3	3	20.92	20.99	20.97	
10	QPSK	6	0	19.93	20.02	19.86	21.00
10	16QAM	1	0	20.90	21.09	20.89	22.00
10	16QAM	1	5	20.68	20.87	20.86	
10	16QAM	3	0	20.86	21.04	20.70	22.00
10	16QAM	3	3	20.72	20.91	20.66	
10	16QAM	5	0	20.90	20.99	20.97	20.00
Channel				18625	18900	19175	Tune-up limit

Frequency (MHz)				1852.5	1880	1907.5	limit (dBm)
5	QPSK	1	0	20.80	20.84	20.97	22.00
5	QPSK	1	5	20.64	20.73	21.01	
5	QPSK	3	0	21.09	21.12	21.24	22.00
5	QPSK	3	3	20.94	20.98	21.00	
5	QPSK	6	0	19.94	19.97	19.87	21.00
5	16QAM	1	0	21.02	21.05	21.07	22.00
5	16QAM	1	5	20.92	20.93	20.97	
5	16QAM	3	0	21.01	21.05	20.85	22.00
5	16QAM	3	3	20.74	20.88	20.58	
5	16QAM	5	0	19.87	19.96	19.96	21.00
Channel				18615	18900	19185	Tune-up limit (dBm)
Frequency (MHz)				1851.5	1880	1908.5	
3	QPSK	1	0	20.77	20.85	20.86	22.00
3	QPSK	1	5	20.64	20.73	20.74	
3	QPSK	3	0	19.91	20.00	19.90	21.00
3	QPSK	3	3	19.70	19.79	19.74	
3	QPSK	6	0	18.78	18.88	18.73	20.00
3	16QAM	1	0	19.75	19.80	19.91	21.00
3	16QAM	1	5	19.64	19.64	19.77	
3	16QAM	3	0	18.68	18.86	18.85	20.00
3	16QAM	3	3	18.46	18.64	18.59	
3	16QAM	5	0	18.59	18.78	18.53	20.00
Channel				18607	18900	19193	Tune-up limit (dBm)
Frequency (MHz)				1850.7	1880	1909.3	
1.4	QPSK	1	0	19.33	18.64	20.88	22.00
1.4	QPSK	1	5	19.84	20.67	20.78	
1.4	QPSK	3	0	19.74	19.84	19.92	21.00
1.4	QPSK	3	3	19.54	19.73	19.75	
1.4	QPSK	6	0	19.74	18.83	18.74	20.00
1.4	16QAM	1	0	19.53	19.80	19.74	21.00
1.4	16QAM	1	5	19.73	19.66	19.58	
1.4	16QAM	3	0	19.80	18.91	18.75	20.00
1.4	16QAM	3	3	19.62	18.66	18.61	
1.4	16QAM	5	0	19.71	18.47	18.64	21.00

Band 4

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				20050	20175	20300	
Frequency (MHz)				1720	1732.5	1745	
20	QPSK	1	0	21.24	21.38	21.50	22.00
20	QPSK	1	5	21.02	21.17	21.36	
20	QPSK	3	0	21.15	21.42	21.48	
20	QPSK	3	3	20.92	21.26	21.26	
20	QPSK	6	0	20.96	21.23	21.31	
20	16QAM	1	0	21.20	21.30	21.54	
20	16QAM	1	5	20.91	21.06	21.38	
20	16QAM	3	0	20.96	21.23	21.38	
20	16QAM	3	3	20.79	21.08	21.20	
20	16QAM	5	0	21.02	21.17	21.38	
Channel				20025	20175	20325	Tune-up limit (dBm)
Frequency (MHz)				1717.5	1732.5	1747.5	
15	QPSK	1	0	21.25	21.45	21.49	22.00
15	QPSK	1	5	21.02	21.22	21.34	
15	QPSK	3	0	21.14	21.48	21.49	
15	QPSK	3	3	21.02	21.25	21.32	
15	QPSK	6	0	20.97	21.19	21.30	
15	16QAM	1	0	21.20	21.19	21.44	
15	16QAM	1	5	21.07	21.15	21.33	
15	16QAM	3	0	21.00	21.28	21.29	
15	16QAM	3	3	20.81	21.08	21.12	
15	16QAM	5	0	21.02	21.21	21.33	
Channel				20000	20175	20350	Tune-up limit (dBm)
Frequency (MHz)				1715	1732.5	1750	
10	QPSK	1	0	21.07	21.46	21.45	22.00
10	QPSK	1	5	20.93	21.27	21.31	
10	QPSK	3	0	21.14	21.50	21.44	22.00
10	QPSK	3	3	21.01	21.30	21.21	
10	QPSK	6	0	20.08	20.31	20.28	21.00
10	16QAM	1	0	21.21	21.33	21.26	22.00
10	16QAM	1	5	21.06	21.09	21.16	
10	16QAM	3	0	21.09	21.30	21.30	22.00
10	16QAM	3	3	20.73	21.18	21.09	
10	16QAM	5	0	21.03	21.34	21.30	22.00
Channel				19975	20175	20375	Tune-up limit

Frequency (MHz)				1712.5	1732.5	1752.5	limit (dBm)
5	QPSK	1	0	21.19	21.40	21.53	22.00
5	QPSK	1	5	20.97	21.07	21.39	
5	QPSK	3	0	21.20	21.43	21.43	22.00
5	QPSK	3	3	20.97	21.30	21.20	
5	QPSK	6	0	20.06	20.39	20.28	21.00
5	16QAM	1	0	21.15	21.33	21.48	22.00
5	16QAM	1	5	21.06	21.22	21.24	
5	16QAM	3	0	21.08	21.32	21.27	22.00
5	16QAM	3	3	20.83	21.14	21.05	
5	16QAM	5	0	20.19	20.33	20.34	21.00
Channel				19965	20175	20385	Tune-up limit (dBm)
Frequency (MHz)				1711.5	1732.5	1753.5	
3	QPSK	1	0	18.77	21.41	21.29	22.00
3	QPSK	1	5	20.76	21.21	21.16	
3	QPSK	3	0	19.89	20.29	20.33	21.00
3	QPSK	3	3	19.78	20.10	20.15	
3	QPSK	6	0	18.85	19.20	19.29	20.00
3	16QAM	1	0	19.76	20.13	20.34	21.00
3	16QAM	1	5	19.63	20.03	20.19	
3	16QAM	3	0	18.53	19.31	19.43	20.00
3	16QAM	3	3	18.54	18.92	19.29	
3	16QAM	5	0	18.77	19.16	19.17	20.00
Channel				19957	20175	20393	Tune-up limit (dBm)
Frequency (MHz)				1710.7	1732.5	1754.3	
1.4	QPSK	1	0	20.05	20.10	20.08	21.00
1.4	QPSK	1	5	19.93	20.23	20.08	
1.4	QPSK	3	0	19.50	20.26	20.18	21.00
1.4	QPSK	3	3	19.70	20.03	20.08	
1.4	QPSK	6	0	19.71	19.82	20.07	21.00
1.4	16QAM	1	0	19.69	20.22	20.06	21.00
1.4	16QAM	1	5	19.71	19.98	19.87	
1.4	16QAM	3	0	19.50	19.83	19.99	21.00
1.4	16QAM	3	3	19.50	19.83	20.01	
1.4	16QAM	5	0	19.71	19.82	20.25	21.00

Band 12

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				23060	23095	23130	
Frequency (MHz)				704	707.5	711	
10	QPSK	1	0	20.70	20.43	20.52	21.50
10	QPSK	1	5	20.34	20.35	20.34	
10	QPSK	3	0	20.58	20.61	20.63	21.50
10	QPSK	3	3	20.38	20.55	20.46	
10	QPSK	6	0	19.44	19.48	19.45	20.50
10	16QAM	1	0	20.80	20.65	20.84	21.50
10	16QAM	1	5	20.44	20.59	20.45	
10	16QAM	3	0	20.63	20.61	20.50	20.50
10	16QAM	3	3	20.30	20.44	20.40	
10	16QAM	5	0	20.61	20.63	20.74	21.50
Channel				23035	23095	23155	Tune-up limit (dBm)
Frequency (MHz)				701.5	707.5	713.5	
5	QPSK	1	0	20.47	20.58	20.56	21.50
5	QPSK	1	5	20.29	20.38	20.35	
5	QPSK	3	0	20.57	20.59	20.65	21.50
5	QPSK	3	3	20.42	20.52	20.46	
5	QPSK	6	0	19.48	19.52	19.47	20.50
5	16QAM	1	0	20.64	20.69	20.77	21.50
5	16QAM	1	5	20.46	20.62	20.59	
5	16QAM	3	0	20.50	20.75	20.43	20.50
5	16QAM	3	3	20.27	20.44	20.20	
5	16QAM	5	0	19.66	19.56	19.46	20.50
Channel				23025	23095	23165	Tune-up limit (dBm)
Frequency (MHz)				700.5	707.5	714.5	
3	QPSK	1	0	20.29	20.67	20.22	21.50
3	QPSK	1	5	20.01	20.36	19.87	
3	QPSK	3	0	19.45	19.60	19.36	20.50
3	QPSK	3	3	19.33	19.47	19.26	
3	QPSK	6	0	18.31	18.42	18.23	19.50
3	16QAM	1	0	19.59	19.45	19.40	20.50
3	16QAM	1	5	19.39	19.37	19.22	
3	16QAM	3	0	18.78	18.57	18.55	19.50
3	16QAM	3	3	18.54	18.30	18.17	
3	16QAM	5	0	18.52	18.37	18.20	19.50
Channel				23017	23095	23173	Tune-up limit

Frequency (MHz)				699.7	707.5	715.3	limit (dBm)
1.4	QPSK	1	0	20.21	20.63	20.28	21.50
1.4	QPSK	1	5	19.13	20.55	19.99	
1.4	QPSK	3	0	19.15	19.67	19.35	20.50
1.4	QPSK	3	3	19.03	19.43	19.23	
1.4	QPSK	6	0	19.20	18.39	18.12	19.50
1.4	16QAM	1	0	19.12	19.38	19.19	20.50
1.4	16QAM	1	5	19.12	19.12	18.99	
1.4	16QAM	3	0	19.12	18.60	18.23	19.50
1.4	16QAM	3	3	19.32	18.49	17.86	
1.4	16QAM	5	0	19.12	18.48	18.21	19.50

Band 13

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel					23230		
Frequency (MHz)					782		
10	QPSK	1	0		19.51		20.50
10	QPSK	1	5		19.58		
10	QPSK	3	0		19.73		20.50
10	QPSK	3	3		19.55		
10	QPSK	6	0		18.50		19.50
10	16QAM	1	0		19.59		20.50
10	16QAM	1	5		19.57		
10	16QAM	3	0		19.80		20.50
10	16QAM	3	3		19.55		
10	16QAM	5	0		19.67		20.50
Channel				23205	23230	23255	Tune-up limit (dBm)
Frequency (MHz)				779.5	782	784.5	
5	QPSK	1	0	19.68	19.77	20.00	20.50
5	QPSK	1	5	19.56	19.73	19.96	
5	QPSK	3	0	19.73	19.86	20.05	20.50
5	QPSK	3	3	19.55	19.67	19.88	
5	QPSK	6	0	18.50	18.63	18.94	19.50
5	16QAM	1	0	19.71	19.69	20.13	20.50
5	16QAM	1	5	19.68	19.73	19.94	
5	16QAM	3	0	19.76	19.88	20.06	20.50
5	16QAM	3	3	19.47	19.77	19.88	
5	16QAM	5	0	18.57	18.81	19.07	19.50

2.4GHz WLAN ANT 1

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Power Setting	Duty Cycle %
2.4GHz WLAN ANT 1	802.11b 1Mbps	CH 1	2412	18.47	19.00	0.00	88.34
		CH 6	2437	19.57	20.50	0.00	
		CH 11	2462	19.99	20.50	0.00	
	802.11g 6Mbps	CH 1	2412	17.74	18.50	0.00	87.84
		CH 6	2437	18.15	19.00	0.00	
		CH 11	2462	18.48	19.00	0.00	
	802.11n-HT20 MCS0	CH 1	2412	17.77	18.50	0.00	87.38
		CH 6	2437	18.19	19.00	0.00	
		CH 11	2462	18.53	19.50	0.00	
	802.11n-HT40 MCS0	CH 3	2422	18.06	19.00	0.00	88.18
		CH 6	2437	18.28	19.00	0.00	
		CH 9	2452	18.39	19.00	0.00	

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	
LE	CH 00	2402	2.05	1.57	
	CH 19	2440	1.96	1.57	
	CH 39	2480	1.63	1.31	
Tune-up Limit			2.50	2.50	
Duty Cycle %			100.00	100.00	