

RF EXPOSURE EVALUATION

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in §1.1307(b)

FCC ID: 2AT7Z-GHUB0203

EUT Specification

EUT	Gravio Hub 2
Frequency band (Operating)	<input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input checked="" type="checkbox"/> WLAN: 5.18GHz ~ 5.24GHz <input checked="" type="checkbox"/> WLAN: 5.745GHz ~ 5.825GHz <input checked="" type="checkbox"/> Others: 2.402GHz~2.480GHz BLE <input checked="" type="checkbox"/> Others: 2.405GHz~2.480GHz Zigbee
Device category	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others _____
Exposure classification	<input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm ²) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm ²)
Antenna diversity	<input type="checkbox"/> Single antenna <input checked="" type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input type="checkbox"/> Tx/Rx diversity
Max. output power	BLE: 0.68dBm (0.0012W) Zigbee: 9.15dBm (0.0082W) 2.4G WiFi: 14.70dBm (0.0295W) 5.1G WiFi: 16.49dBm (0.0446W) 5.8G WiFi: 16.10dBm (0.0407W)
Antenna gain (Max)	BLE: 0.5 dBi Zigbee: 3.52dBi 2.4G WiFi: 0.5 dBi 5.1G WiFi: 1.0 dBi 5.8G WiFi: 1.0 dBi
Evaluation applied	<input checked="" type="checkbox"/> MPE Evaluation <input type="checkbox"/> SAR Evaluation

Limits for Maximum Permissible Exposure(MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density(mW/cm ²)	Average Time
(A) Limits for Occupational/Control Exposures				
300-1500	--	--	F/300	6
1500-100000	--	--	5	6

(B) Limits for General Population/Uncontrol Exposures				
300-1500	--	--	F/1500	6
1500-100000	--	--	1	30

Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = Power density in mW/cm^2

P_{out} = output power to antenna in Mw

G = gain of antenna in linear scale

$\pi = 3.1416$

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, $1mW/cm^2$. If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

Measurement Result

BLE & 2.4GHz WiFi & Zigbee:

Operating Mode	Channel Frequency	Measured Power	Tune up tolerance	Max. Tune up Power	Antenna Gain	Power density at 20cm	Power density Limits (mW/cm^2)
	(MHz)	(dBm)	(dBm)	(dBm)	(dBi)	(mW/cm^2)	
802.11b	2412	14.70	14.70±1	15.70	0.5	0.0083	1
	2437	14.69	14.69±1	15.69	0.5	0.0083	1
	2462	14.66	14.66±1	15.66	0.5	0.0082	1
802.11g	2412	4.98	4.98±1	5.98	0.5	0.0009	1
	2437	5.13	5.13±1	6.13	0.5	0.0009	1
	2462	5.10	5.10±1	6.10	0.5	0.0009	1
802.11n (HT20)	2412	4.98	4.98±1	5.98	0.5	0.0009	1
	2437	5.09	5.09±1	6.09	0.5	0.0009	1
	2462	5.06	5.06±1	6.06	0.5	0.0009	1
802.11n (HT40)	2422	4.68	4.68±1	5.68	0.5	0.0008	1
	2437	4.40	4.40±1	5.40	0.5	0.0008	1
	2452	3.69	3.69±1	4.69	0.5	0.0007	1
BLE 1M	2402	0.29	0.29±1	1.29	0.5	0.0003	1
	2440	0.68	0.68±1	1.68	0.5	0.0003	1
	2480	0.51	0.51±1	1.51	0.5	0.0003	1
Zigbee	2405	9.15	9.15±1	10.15	3.52	0.0046	1
	2440	7.80	7.80±1	8.80	3.52	0.0034	1
	2480	6.84	6.84±1	7.84	3.52	0.0027	1

5.1G & 5.8G WiFi:

Operating Mode	Channel Frequency	Measured Power	Tune up tolerance	Max. Tune up Power	Antenna Gain	Power density at 20cm	Power density Limits
	(MHz)	(dBm)	(dBm)	(dBm)	(dBi)	(mW/ cm ²)	(mW/cm ²)
802.11a	5180	15.73	15.73 ± 1	16.73	1.0	0.0118	1
	5200	15.44	15.44 ± 1	16.44	1.0	0.0110	1
	5240	16.46	16.46 ± 1	17.46	1.0	0.0140	1
	5745	15.98	15.98 ± 1	16.98	1.0	0.0125	1
	5785	15.55	15.55 ± 1	16.55	1.0	0.0113	1
	5825	15.54	15.54 ± 1	16.54	1.0	0.0113	1
802.11n (HT20)	5180	15.49	15.49 ± 1	16.49	1.0	0.0112	1
	5200	15.35	15.35 ± 1	16.35	1.0	0.0108	1
	5240	16.33	16.33 ± 1	17.33	1.0	0.0135	1
	5745	16.04	16.04 ± 1	17.04	1.0	0.0127	1
	5785	15.81	15.81 ± 1	16.81	1.0	0.0120	1
	5825	15.97	15.97 ± 1	16.97	1.0	0.0125	1
802.11n (HT40)	5190	15.55	15.55 ± 1	16.55	1.0	0.0113	1
	5230	16.41	16.41 ± 1	17.41	1.0	0.0138	1
	5755	16.10	16.10 ± 1	17.10	1.0	0.0128	1
	5795	15.91	15.91 ± 1	16.91	1.0	0.0123	1
802.11ac (VHT20)	5180	15.64	15.64 ± 1	16.64	1.0	0.0116	1
	5200	15.66	15.66 ± 1	16.66	1.0	0.0116	1
	5240	16.49	16.49 ± 1	17.49	1.0	0.0141	1
	5745	16.01	16.01 ± 1	17.01	1.0	0.0126	1
	5785	15.86	15.86 ± 1	16.86	1.0	0.0122	1
	5825	15.82	15.82 ± 1	16.82	1.0	0.0120	1
802.11ac (VHT40)	5190	15.65	15.65 ± 1	16.65	1.0	0.0116	1
	5230	16.47	16.47 ± 1	17.47	1.0	0.0140	1
	5755	16.03	16.03 ± 1	17.03	1.0	0.0126	1
	5795	16.02	16.02 ± 1	17.02	1.0	0.0126	1
802.11ac (VHT80)	5210	15.31	15.31 ± 1	16.31	1.0	0.0107	1
	5775	15.43	15.43 ± 1	16.43	1.0	0.0110	1

4G Module:

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 2.0 / 2.0 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Operating Band	Frequency (MHz)	Antenna Gain (dBi)	Max Conducted Average Output Power (dBm)	Output Power to Antenna (dBm)	EIRP(ERP) Limit (dBm)	Output Power to Antenna (mw)	Power Density at R = 20 cm (mW/cm2)	Limit (mW/cm2)	Gain according to EIRP (dBi)	Gain according to Pd (dBi)	Max Gain Allowed (dBi)	conclusion
GSM850	824.2	2.29	25.81	25.95	38.45	381.0658	0.1284	0.5495	14.79	8.60	8.60	Pass
GSM1900	1850.2	1.59	22.81	24.40	33.00	190.9853	0.0548	1.0000	10.19	14.20	10.19	Pass
WCDMA B2	1852.4	1.59	25.00	26.59	33.00	316.2278	0.0907	1.0000	8.00	12.01	8.00	Pass
WCDMA B4	1712.4	2.00	25.00	27.00	30.00	316.2278	0.0997	1.0000	5.00	12.01	5.00	Pass
WCDMA B5	826.4	2.29	25.00	25.14	38.45	316.2278	0.1066	0.5509	15.60	9.42	9.42	Pass
LTE B2	1850.7	1.59	25.00	26.59	33.00	316.2278	0.0907	1.0000	8.00	12.01	8.00	Pass
LTE B4	1710.7	2.00	25.00	27.00	30.00	316.2278	0.0997	1.0000	5.00	12.01	5.00	Pass
LTE B5	824.70	2.29	25.00	25.14	38.45	316.2278	0.1066	0.5498	15.60	9.41	9.41	Pass
LTE B7	2502.50	3.00	25.00	28.00	33.00	316.2278	0.1255	1.0000	8.00	12.01	8.00	Pass
LTE B12	699.70	3.26	25.00	26.11	34.77	316.2278	0.1333	0.4665	11.92	8.70	8.70	Pass
LTE B13	779.50	4.45	25.00	27.30	34.77	316.2278	0.1753	0.5197	11.92	9.16	9.16	Pass
LTE B25	1850.7	1.59	25.00	26.59	33.00	316.2278	0.0907	1.0000	8.00	12.01	8.00	Pass
LTE B26(814-824)	814.7	2.53	25.00	25.38	50.00	316.2278	0.1126	0.5431	27.15	9.36	9.36	Pass
LTE B26(824-849)	824.7	2.53	25.00	25.38	38.45	316.2278	0.1126	0.5498	15.60	9.41	9.41	Pass
LTE B38	2572.5	2.06	25.00	27.06	33.00	316.2278	0.1011	1.0000	8.00	12.01	8.00	Pass
LTE B41	2498.5	3.00	25.00	28.00	33.00	316.2278	0.1255	1.0000	8.00	12.01	8.00	Pass

Remark: Refer to report No. HR/2019/1001601 for EUT test Max Conducted Output Power value.

Please refer to FCC ID: XMR201903EG25G for details.

Note: BT, Zigbee, WIFI, GSM, WCDMA and LTE cannot support simultaneous transmission.