- RF Exposure (Balance Flex Antenna)

1-1. FCC Regulation

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Limits for Maximum Permissive Exposure: RF exposure is calculated.

Frequency Range	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [㎽/㎠]	Averaging Time [minute]
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/1 500	30
1 500 ~ 15 000	/	/	1.0	30

f=frequency in ㎒, *= plane-wave equivalent power density

MPE (Maximum Permissive Exposure) Prediction
Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2 \quad \left(\Rightarrow R = \sqrt{PG/4\pi S} \right)$$

S = power density [㎽/㎠]

P = Power input to antenna [㎽]

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna [㎝]

1-2. IC Regulation

According to RSS-102 Issue 5

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

• below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);

• at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;

• at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);

• at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;

• at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

2. RF Exposure Compliance Issue

The information should be included in the user's manual:
This appliance and its antenna must not be co-located or operation in conjunction with any other antenna or transmitter. A minimum separation distance of 20 ㎝ must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

3-1. Calculation Result of RF Exposure (FCC)

WLAN (2.4 GHz)

- Maximum tune up tolerance

Mode	Frequency [MHz]l	Max tune up power [dBm]	Max tune up power [㎽]	Ant Gain [dBi]	Ant Gain [Linear scale]	Power Density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
2.4 GHz	2 437	27.88	613.76	4.58	2.87	0.350 54	1.000 00

WLAN (5 GHz)

- Maximum tune up tolerance

Mode	Frequency [MHz]l	Max tune up power [dBm]	Max tune up power [㎽]	Ant Gain [dBi]	Ant Gain [Linear scale]	Power Density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
U-NII-1	5 200	13.42	21.98	5.49	3.54	0.015 47	1.000 00
U-NII-2A	5 280	15.22	33.27	5.76	3.77	0.024 94	1.000 00
U-NII-2C	5 580	16.17	41.40	5.44	3.50	0.028 79	1.000 00
U-NII-3	5 785	24.35	272.27	5.24	3.34	0.180 97	1.000 00

3-2. Calculation Result of RF Exposure (IC)

WLAN (2.4 GHz)

- Maximum tune up tolerance

Mode	Frequency [MHz]	Max tune up power [dBm]	Ant Gain [dBi]	E.I.R.P [dBm]	E.I.R.P [mW/]	Limit [mW/]
2.4 GHz	2 437	27.88	4.58	32.46	1 761.98	2 684.03

WLAN (5 GHz)

- Maximum tune up tolerance

Mode	Frequency [MHz]	Max tune up power [dBm]	Ant Gain [dBi]	E.I.R.P [dBm]	E.I.R.P [mW/]	Limit [mW/]
U-NII-1	5 200	13.42	5.49	18.91	77.75	4 525.27
U-NII-2A	5 280	15.22	5.76	20.98	125.36	4 608.50
U-NII-2C	5 580	16.17	5.44	21.61	144.72	4 714.49
U-NII-3	5 785	24.35	5.24	29.59	909.67	4 903.14

Note.
1. The power density Pd (5th column) at a distance of 20 cm calculated from the friis transmission formula is far below the limit of 1 mW/cm².
2. Unequal antenna gains, with equal transmit powers. For antenna gains given by G1, G2, …, GN dB i
(i) If transmit signals are correlated, then
Directional gain = 10 log[(10G 1 /20 + 10G 2 /20 + … + 10G N /20)2/NANT] dB i [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

Antenna gain

Antenna \ Band	2.4 GHz	5 GHz U-NII-1	5 GHz U-NII-2A	5 GHz U-NII-2C	5 GHz U-NII-3
ANT 0	4.30	4.70	5.30	4.90	4.80
ANT 1	1.80	5.20	5.70	4.80	4.10
ANT 0 + ANT 1	4.58	5.49	5.76	5.44	5.24