MPE Calculation

Applicant:	Coulisse B.V.
Address:	Vonderweg 48, 7468 DC Enter, THE NETHERLANDS
Product:	HONEYCOMB MOTOR
FCC ID.:	ZY4CM08B1
Model No.:	CM-08
Reference RF report #	709502408754-00B, 709502408754-00C

According to subpart 15.247(i)and subpart §1.1307(b)(1), 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 level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
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/1500	30
1,500–100,000	/	/	1.0	30

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

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:
Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);

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 (appropriate units, e.g., cm);

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Calculated Data for BLE: Line Antenna

Maximum peak output power at antenna input terminal (dBm):	-1.22
Maximum peak output power at antenna input terminal (mW):	0.76
Prediction distance (cm):	20
Antenna Gain, typical (dBi):	2.2
Maximum Antenna Gain (numeric):	1.70
The worst case is power density at predication frequency at 20 cm (mW/cm^2):	0.00025
MPE limit for general population exposure at prediction frequency (mW/cm^2):	1.0

The max power density 0.00025 (mW/cm^2) < 1 (mW/cm^2)
Result: Compliant

Calculation method for 433.92MHz SRD

Per the test report included herein, for 433.92MHz SRD

According to C63.10 Annex G

$EIRP = pt \times gt = (E \times d)^2 / 30$

where
pt is the transmitter output power in watts
gt is the numeric gain of the transmitting antenna (dimensionless)
E is the electric field strength in V/m
d is the measurement distance in meters (m)
transmitter output power for 433.92MHz SRD Function

Field strength (E):	85.13 (dBuV/m) = 0.0181 (V/m)
Measurement Distance(dMeas):	3 (m)
Equivalent Isotropically Radiated Power(EIRP):	0.000098W=0.098mW

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:
Predication of MPE limit at a given distance
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
PG = 0.185mW (in appropriate units, e.g., mW);
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:
The max power density $0.098/4\pi R^2 = 1.9497*10^{-5} (mW/cm^2) < 0.28928$ (mW/cm2)

Result: Compliant

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Simultaneous transmission of MPE test exclusion for worst case configuration

BLE: the ratio is 0.00025/1
433.92MHz SRD:the ratio is $1.9497*10^{-5}$ / 0.28928=$6.7398*10^{-5}$

The sum of the MPE ratios for all simultaneous transmitting antennas:
0.00025+$6.7398*10^{-5}$=0.00032

As the sum of MPE ratios for all simultaneous transmitting antennas is ≤ 1.0, simultaneous transmission MPE test exclusion will be applied.

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