

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: **2A3NS-THOR**

EUT Specification

EUT	Robotic Lawn Mower
Frequency band (Operating)	☒ BT: 2.402GHz ~ 2.480GHz ☒ BLE: 2.402GHz ~ 2.480GHz ☒ WIFI: 2.412GHz ~ 2.462GHz ☐ WIFI: 5.180GHz ~ 5.240GHz ☐ WIFI: 5.260GHz ~ 5.320GHz ☐ WIFI: 5.500GHz ~ 5.700GHz ☐ WIFI: 5.745GHz ~ 5.825GHz
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation)
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm ²) ☒ General Population/Uncontrolled exposure (S=1mW/cm ²)
Antenna diversity	☒ Single antenna ☐ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☐ Tx/Rx diversity
Max. output power	BT DH5: 6.16 dBm 2DH5: 6.95 dBm 3DH5: 7.51 dBm BLE BLE 1M: 6.35 dBm BLE 2M: 6.47 dBm 2.4G WIFI IEEE 802.11b: 16.27 dBm IEEE 802.11g: 16.41 dBm IEEE 802.11n-HT20: 16.40 dBm IEEE 802.11ax HE20: 15.92 dBm
Antenna gain (Max)	BT: 5.2 dBi BLE: 5.2 dBi 2.4G WIFI: 1.5 dBi

Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation
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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/cm², 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=20cm

P_d the limit of MPE, 1mW/cm². 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.

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation

$$\sum_{k=1}^c \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

$Evaluated_k$: the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

$Exposure\ Limit_k$: either the general population/uncontrolled maximum permissible exposure (MPE) or specific Absorption rate (SAR) limit for each fixed, mobile, or portable RF source k .

Measurement Result

BT:

Mode	Max Measured Power (dBm)	Tune up tolerance (dBm)	Max tune up conducted power(dBm)	Output Peak power (mW)	Ant. Gain (dBi)	Ant. Gain (numeric)	Power density at 20cm (mW/cm ²)	Power density Limits (mW/cm ²)	Results
DH5	6.16	6±1	7	5.012	5.2	3.311	0.003302	1	PASS
2DH5	6.95	7±1	8	6.310	5.2	3.311	0.004156	1	PASS
3DH5	7.51	8±1	9	7.943	5.2	3.311	0.005233	1	PASS

BLE:

Mode	Max Measured Power (dBm)	Tune up tolerance (dBm)	Max tune up conducted power(dBm)	Output Peak power (mW)	Ant. Gain (dBi)	Ant. Gain (numeric)	Power density at 20cm (mW/cm ²)	Power density Limits (mW/cm ²)	Results
BLE 1M	6.35	6±1	7	5.012	5.2	3.311	0.003302	1	PASS
BLE 2M	6.47	6±1	7	5.012	5.2	3.311	0.003302	1	PASS

2.4G WIFI:

Mode	Max Measured Power (dBm)	Tune up tolerance (dBm)	Max tune up conducted power(dBm)	Output Peak power (mW)	Ant. Gain (dBi)	Ant. Gain (numeric)	Power density at 20cm (mW/cm ²)	Power density Limits (mW/cm ²)	Results
802.11b	16.27	16±1	17	50.119	1.5	1.413	0.014084	1	PASS
802.11g	16.41	16±1	17	50.119	1.5	1.413	0.014084	1	PASS
802.11n HT20	16.40	16±1	17	50.119	1.5	1.413	0.014084	1	PASS
802.11ax HE20	15.92	16±1	17	50.119	1.5	1.413	0.014084	1	PASS

Maximum Simultaneous transmission MPE Ratio for Bluetooth & 2.4G WIFI & 2G

Maximum MPE ratio (Bluetooth)	Maximum MPE ratio (2.4G WIFI)	Maximum MPE ratio (2G)	Σ MPE ratios	Limit	Results
0.005233	0.014084	0.233667	0.233667	1.000	Pass

Maximum Simultaneous transmission MPE Ratio for Bluetooth & 2.4G WIFI & 3G

Maximum MPE ratio (Bluetooth)	Maximum MPE ratio (2.4G WIFI)	Maximum MPE ratio (3G)	Σ MPE ratios	Limit	Results
0.005233	0.014084	0.193502	0.193502	1.000	Pass

Maximum Simultaneous transmission MPE Ratio for Bluetooth & 2.4G WIFI & 4G

Maximum MPE ratio (Bluetooth)	Maximum MPE ratio (2.4G WIFI)	Maximum MPE ratio (4G)	Σ MPE ratios	Limit	Results
0.005233	0.014084	0.337310	0.356627	1.000	Pass

Note:

1. 2G & 3G & 4G maximum power of comes from the of the module certified report: **HR/2019/1001602**.
2. 2G & 3G & 4G not supported transmit simultaneously(declared by client).
3. 2G & 3G & 4G antenna gain:

Original antenna gain			New antenna gain		
Operating Band	Frequency (MHz)	Antenna Gain (dBi)	Operating Band	Frequency (MHz)	Antenna Gain (dBi)
GSM850	824.2	2.29	GSM850	824.2	2.10
GSM1900	1850.2	1.59	GSM1900	1850.2	1.20
WCDMA B2	1852.4	1.59	WCDMA B2	1852.4	1.20
WCDMA B4	1712.4	2.00	WCDMA B4	1712.4	1.80
WCDMA B5	826.4	2.29	WCDMA B5	826.4	2.10
LTE B2	1850.7	1.59	LTE B2	1850.7	1.20
LTE B4	1710.7	2.00	LTE B4	1710.7	1.80
LTE B5	824.70	2.29	LTE B5	824.70	2.10
LTE B7	2502.50	3.00	LTE B7	2502.50	2.80
LTE B12	699.70	3.26	LTE B12	699.70	3.00
LTE B13	779.50	4.45	LTE B13	779.50	4.20
LTE B25	1850.7	1.59	LTE B25	1850.7	1.20

LTE B26(814-824)	814.7	2.53	LTE B26(814-824)	814.7	2.10
LTE B26(824-849)	824.7	2.53	LTE B26(824-849)	824.7	2.10
LTE B38	2572.5	2.06	LTE B38	2572.5	2.00
LTE B41	2498.5	3.00	LTE B41	2498.5	2.80

Signature:



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