

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)

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) |
|--|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| (A) Limits for Occupational/Controlled Exposure | | | | |
| 0.3-3.0 | 614 | 1.63 | *100 | 6 |
| 3.0-30 | 1842/f | 4.89/f | *900/f ² | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1,500 | | | f/300 | 6 |
| 1,500-100,000 | | | 5 | 6 |
| (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 |
| 300-1,500 | | | f/1500 | 30 |
| 1,500-100,000 | | | 1.0 | 30 |

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

MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 * P * G}}{d} \qquad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 * P * G}{377 * D^2}$$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

Measurement Result

Operation Frequency: GFSK: 905 MHz~926.5MHz

Antenna Type: Antenna Type: Stamped metal inverted-F antenna

Antenna gain: Antenna: -2.3 dBi

R=20cm

OCW=120KHz-jeweller

| Channel Freq. (MHz) | modulation | conducted power | Tune-up power (dBm) | Max | | Antenna | | Evaluation result | Power density Limits |
|---------------------|------------|-----------------|---------------------|---------------|-------|---------|---------|-------------------|----------------------|
| | | (dBm) | | tune-up power | | Gain | | | |
| | | | | (dBm) | (mW) | (dBi) | Numeric | | |
| 905.00 | GFSK | 6.595 | 7±1 | 8 | 6.310 | -1.00 | 0.79 | 0.0010 | 0.60 |
| 915.85 | GFSK | 6.734 | 7±1 | 8 | 6.310 | -1.00 | 0.79 | 0.0010 | 0.61 |
| 926.5 | GFSK | 7.031 | 7±1 | 8 | 6.310 | -1.00 | 0.79 | 0.0010 | 0.62 |

OCW=140KHz-wings

| Channel Freq. (MHz) | modulation | conducted power | Tune-up power (dBm) | Max | | Antenna | | Evaluation result | Power density Limits |
|---------------------|------------|-----------------|---------------------|---------------|-------|---------|---------|-------------------|----------------------|
| | | (dBm) | | tune-up power | | Gain | | | |
| | | | | (dBm) | (mW) | (dBi) | Numeric | | |
| 905.00 | GFSK | 6.091 | 6±1 | 7 | 5.012 | -1.00 | 0.79 | 0.0008 | 0.60 |
| 915.85 | GFSK | 5.592 | 6±1 | 7 | 5.012 | -1.00 | 0.79 | 0.0008 | 0.61 |
| 926.5 | GFSK | 6.707 | 6±1 | 7 | 5.012 | -1.00 | 0.79 | 0.0008 | 0.62 |

13.56

Transmit power:

| Frequency (MHz) | EIRP power (dBuV/m) | EIRP power (dBm) |
|-----------------|---------------------|------------------|
| 13.56 | 77.9 | -17.36 |

$$\text{EIRP} = E - 104.8 + 20 \log(D)$$

EIRP=conducted power + antenna gain

antenna gain: -7dBi;

| Channel Freq. (MHz) | modulation | conducted power | Tune-up power (dBm) | Max | | Antenna | | Evaluation result | Power density Limits |
|---------------------|------------|-----------------|---------------------|---------------|-------|---------|---------|-------------------|----------------------|
| | | (dBm) | | tune-up power | | Gain | | | |
| | | | | (dBm) | (mW) | (dBi) | Numeric | | |
| 13.56 | ASK | -10.36 | -10±1 | -9 | 0.126 | -7 | 0.20 | 0.0001 | 0.00904 |

BLE**Measurement Result**

Operation Frequency: 2402MHz~2480MHz

Power density limited: 1mW/ cm²

Antenna Type: F-inverted antenna

Antenna gain: -4.6dBi;

R=20cm

mW=10^(dBm/10)

antenna gain Numeric=10^(dBi/10)

| Channel Freq. (MHz) | modulation | conducted power (dBm) | Tune-up power (dBm) | Max | | Antenna | | Evaluation result (mW/cm ²) | Power density (mW/cm ²) |
|---------------------|------------|-----------------------|---------------------|---------------|-------|---------|---------|---|-------------------------------------|
| | | | | tune-up power | | Gain | | | |
| | | | | (dBm) | (mW) | (dBi) | Numeric | | |
| 2402 | GFSK-1M | -1.14 | -1±1 | 0 | 1.000 | -4.6 | 0.35 | 0.0001 | 1 |
| 2440 | | -1.05 | -1±1 | 0 | 1.000 | -4.6 | 0.35 | 0.0001 | 1 |
| 2480 | | -0.66 | -1±1 | 0 | 1.000 | -4.6 | 0.35 | 0.0001 | 1 |
| 2402 | GFSK-2M | -1.36 | -1±1 | 0 | 1.000 | -4.6 | 0.35 | 0.0001 | 1 |
| 2440 | | -1.23 | -1±1 | 0 | 1.000 | -4.6 | 0.35 | 0.0001 | 1 |
| 2480 | | -0.82 | -1±1 | 0 | 1.000 | -4.6 | 0.35 | 0.0001 | 1 |

Conclusion:

For the max result : 0.0010 ≤ 0.60 for Max Power Density, compliance RF exposure..

Note: This product does not support simultaneous delivery.


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