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Report Template Version: V04
Report Template Revision Date: 2018-07-06

# RF Exposure Evaluation Report

| | |
|---|---|
| **Report No.:** | CQASZ20210300364E-02 |
| **Applicant:** | SPIRIT LLC |
| **Address of Applicant:** | 1400 NW 159th ST ( BAY 101 ) Miami Gardens , FL 33169 |
| **Equipment Under Test (EUT):** | |
| **EUT Name:** | MARINE |
| **Model No.:** | MRX1 |
| **Brand Name:** | DS18 |
| **FCC ID:** | 2AYOQ-MRX1 |
| **Standards:** | 47 CFR Part 1.1307 |
| | 47 CFR Part 2.1091 |
| | KDB447498D01 General RF Exposure Guidance v06 |
| **Date of Receipt:** | 2021-3-29 |
| **Date of Test:** | 2021-3-29 to 2021-4-13 |
| **Date of Issue:** | 2021-4-13 |
| **Test Result :** | **PASS*** |

***In the configuration tested, the EUT complied with the standards specified above**

***Tested By:*** Jun Li

***(Jun Li)***

***Reviewed By:*** Ares Liu

***( Ares Liu )***

***Approved By:*** Sheek.Luo

***( Sheek Luo )***

# 1 Version

**Revision History Of Report**

| Report No. | Version | Description | Issue Date |
|---|---|---|---|
| CQASZ20210300364E-02 | Rev.01 | Initial report | 2021-4-13 |

# 2 Contents

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# 3 General Information

## 3.1 Client Information

| | |
|---|---|
| Applicant: | SPIRIT LLC |
| Address of Applicant: | 1400 NW 159th ST ( BAY 101 ) Miami Gardens , FL 33169 |
| Manufacturer: | SPIRIT LLC |
| Address of Manufacturer: | 1400 NW 159th ST ( BAY 101 ) Miami Gardens , FL 33169 |
| Factory: | Eastern Partner Limited |
| Address of Factory: | Room 1413, ICC Tower ,Fuhau San Road,Futian CBD,Shenzhen 518048,China |

## 3.2 General Description of EUT

| | |
|---|---|
| Product Name: | MARINE |
| Model No.: | MRX1 |
| Trade Mark: | DS18 |
| Hardware Version: | 1121-00MX1-KB02 |
| Software Version: | S1 |
| EUT Supports Radios application: | Bluetooth dual mode: 2402-2480MHz |
| Power Supply: | DC 12V |

## 3.3 General Description of BT Classic

| | |
|---|---|
| Operation Frequency: | 2402MHz~2480MHz |
| Bluetooth Version: | V4.2 |
| Modulation Technique: | Frequency Hopping Spread Spectrum(FHSS) |
| Modulation Type: | GFSK, π/4DQPSK |
| Transfer Rate: | 1Mbps/2Mbps |
| Number of Channel: | 79 |
| Hopping Channel Type: | Adaptive Frequency Hopping systems |
| Product Type: | ☐ Mobile ☐ Portable ☒ Fix Location |
| Test Software of EUT: | FCCAssist 2.4 |
| Antenna Type: | PCB antenna |
| Antenna Gain: | -0.58dBi |

# 4 RF Exposure Evaluation

## 4.1 RF Exposure Compliance Requirement

### 4.1.1 Limits

According to FCC Part1.1310: 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 part1.1307(b)

TABLE 1—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 Exposures** | | | | |
| 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 |
| 300–1500 | ..... | ..... | f/300 | 6 |
| 1500–100,000 | ..... | ..... | 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 |
| 300–1500 | ..... | ..... | f/1500 | 30 |
| 1500–100,000 | ..... | ..... | 1.0 | 30 |

F= Frequency in MHz

Friis Formula

Friis transmission formula: $Pd = (Pout*G)/(4* Pi * R^2)$

Where

Pd = power density in mW/cm2

Pout = 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

Pd id the limit of MPE, 1 mW/cm2 . If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

### 4.1.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

**1) For BT Classic**

Antenna Gain: -0.58dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 0.87 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

**Measurement Data**

| GFSK mode | | | | |
|---|---|---|---|---|
| Test channel | Peak Output Power (dBm) | Tune up tolerance (dBm) | Maximum tune-up Power | |
| | | | (dBm) | (mW) |
| Lowest(2402MHz) | -6.310 | -7.5±1.0 | -6.5 | 0.224 |
| Middle(2441MHz) | -5.430 | -6.5±1.0 | -5.5 | 0.282 |
| Highest(2480MHz) | -4.030 | -5±1.0 | -4 | 0.398 |
| π/4DQPSK mode | | | | |
| Test channel | Peak Output Power (dBm) | Tune up tolerance (dBm) | Maximum tune-up Power | |
| | | | (dBm) | (mW) |
| Lowest(2402MHz) | -5.540 | -6.5±1.0 | -5.5 | 0.282 |
| Middle(2441MHz) | -4.670 | -6±1.0 | -5 | 0.316 |
| Highest(2480MHz) | -3.240 | -4.5±1.0 | -3.5 | 0.447 |

The worst case:

| **Maximum tune-up Power (mW)** | **Antenna Gain (dBi)** | **Power Density at R = 20 cm ($mW/cm^2$)** | **Limit** | **Result** |
|---|---|---|---|---|
| 0.447 | -0.58 | 0.00008 | 1.0 | PASS |

Note: 1) Refer to report No. CQASZ20210400364E-02 for EUT test Max Conducted Peak Output Power value.

2) Pd = (Pout*G)/(4* Pi * $R^2$)=(0.447*0.87)/(4*3.1416*$20^2$)= 0.00007

BDR and BLE can not simultaneous transmitting at same time.