

RF EXPOSURE REPORT



Applicant: CASTLES TECHNOLOGY CO., LTD.
6F., NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT,
NEW TAIPEI CITY 23143, TAIWAN (R.O.C)

Manufacturer: CASTLES TECHNOLOGY CO., LTD.
6F., NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT,
NEW TAIPEI CITY 23143, TAIWAN (R.O.C)

Product Name: POS Terminal

Brand Name: 

Model No.: S2L

Model Difference: N/A

Report Number: TESA2307000436ES

FCC ID WIYS2L001

Date of EUT Received: July 24, 2023

Issue Date: December 07, 2023

Approved By _____

John Yeh

We hereby certify that:

The above equipment was evaluate by SGS Taiwan Ltd. The evaluation in this report is in compliance with FCC Rule Part §2.1091.

The results of this report relate only to the sample identified in this report.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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| Revision History | | | | | |
|------------------|----------|----------------------------|---------------|------------|--------|
| Report Number | Revision | Description | Issue Date | Revised By | Remark |
| TESA2307000436ES | 00 | Original | Nov. 3, 2023 | Candice Li | |
| TESA2307000436ES | 01 | Modify comments | Nov. 28, 2023 | Candice Li | * |
| TESA2307000436ES | 02 | Modify comments | Dec. 7, 2023 | Candice Li | * |
| TESA2307000436ES | 03 | Modify Section 2.3, 2.4 | Dec. 7, 2023 | Candice Li | * |
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Note:

- 1、The remark "*" indicates modification of the report upon requests from certification body.

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1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

1.1 Product Description

| | |
|-------------------------|---|
| Product Name: | POS Terminal |
| Brand Name: |  |
| Model No.: | S2L |
| Model Difference: | N/A |
| Hardware Version: | V1A.00 |
| Software Version: | N/A |
| EUT Series No.: | 173232315138 |
| Product Name of Module: | Smart module |
| Brand Name of Module: |  |
| Model No. of Module: | SNM758 |
| Module FCC ID: | WIYSNM758L |
| Power Supply: | 12Vdc from Adapter |

1.2 Evaluation site

| Laboratory | Site Address | FCC Designation number | ISED Company Number | CAB Identifier |
|---|--|------------------------|---------------------|----------------|
| SGS Taiwan Ltd. Central RF Lab. (TAF code 3702) | <input type="checkbox"/> No. 134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, 24803, Taiwan. | TW0027 | 4620A | TW3702 |
| | <input checked="" type="checkbox"/> No. 2, Keji 1st Rd., Guishan Township, Taoyuan County, 333 Taiwan. | TW0028 | 4620E | |
| | <input type="checkbox"/> 1F, No. 8, Alley 15, Lane 120, Sec. 1, Nei Hu Road, Nei Hu District, Taipei City, 222 Taiwan. | TW0029 | 23862 | |

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1.3 Antenna Information:

1.3.1 BT / WLAN 2.4GHz

| Antenna Type | Supplier | Antenna Part No. | Freq. (MHz) | Peak Antenna Gain (dBi) |
|--------------|----------|------------------|-------------|-------------------------|
| PIFA | AWAN | ALP6P-10000 | 2.4GHz | 0.39 |

1.3.2 WLAN 5GHz

| Antenna Type | Supplier | Antenna Part No. | Note |
|--------------|----------|------------------|-------|
| PIFA | AWAN | ALP6P-10000 | Ant 1 |

| Operating Frequency (MHz) | Ant 1 Peak Gain (dBi) |
|---------------------------|-----------------------|
| 5150.0 ~ 5250.0 | 1.77 |
| 5725.0 ~ 5850.0 | 0.82 |

Note: Antenna information is provided by the applicant.

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1.4 Rated Power

1.4.1 Bluetooth / WLAN 2.4GHz

| Mode | Freq. Range (MHz) | Channels | Modulation Technology | Max Output Power (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Worst Case |
|------------|-------------------|----------|------------------------------|------------------------|--------------------|--------------|------------|
| BR+EDR | 2402-2480 | 79 | GFSK + π /4DQPSK + 8DPSK | 8.58 | 0.39 | 8.97 | |
| WLAN2.4GHz | 2412-2462 | 11 | DSSS & OFDM | 14.53 | 0.39 | 14.92 | V |

1.4.2 WLAN 5GHz:

| 802.11 | Freq. Range (MHz) | Modulation Technology | Max. Output Power Include Tolerance (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Worst Case |
|--------------------|-------------------|-----------------------|---|--------------------|--------------|------------|
| a | 5150~5250 | OFDM | 10.96 | 1.77 | 12.73 | V |
| | 5725~5850 | | 8.34 | 0.82 | 9.16 | |
| n HT20 ac VHT20 | 5150~5250 | | 10.86 | 1.77 | 12.63 | |
| | 5725~5850 | | 8.59 | 0.82 | 9.41 | |
| n HT40 ac VHT40 | 5150~5250 | | 9.65 | 1.77 | 11.42 | |
| | 5725~5850 | | 8.31 | 0.82 | 9.13 | |
| ac VHT80 | 5150~5250 | | 3.54 | 1.77 | 5.31 | |
| | 5725~5850 | | 6.81 | 0.82 | 7.63 | |

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2 FCC MAXIMUM PERMISSIBLE EXPOSURE (MPE)

2.1 FCC Standard Applicable

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission’s guideline.

This is a Mobile device for WLAN/BT, the MPE is required.

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

Limits for Maximum Permissive Exposure (MPE)

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm ²) | 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 |
| 300-1500 | / | / | f/1500 | 30 |
| 1500-100000 | / | / | 1.0 | 30 |

f = frequency in MHz

* = Plane-wave equipment power density

Prediction of MPE limit at a given distance

$$S = PG / 4\pi R^2$$

Where: 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

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2.2 Power Density Calculation (Worst Case) of WLAN/BT

| Operation Mode | Evaluation Frequency (MHz) | Operation Distance (cm) | Max. Output Power Include Tolerance (dBm) | Antenna Gain (dBi) | Max. EIRP (mW) | Power Density (PD) (mW/cm ²) | Limit (mW/cm ²) | Pass / Fail | Power Density / Limit |
|----------------|----------------------------|-------------------------|---|--------------------|----------------|--|-----------------------------|-------------|-----------------------|
| BT | 2480.00 | 20 | 8.58 | 0.39 | 7.89 | 0.0016 | 1.000 | Pass | 0.002 |
| WLAN 2.4G | 2442.00 | 20 | 14.53 | 0.39 | 31.05 | 0.006 | 1.000 | Pass | 0.006 |
| WLAN 5G | 5180.00 | 20 | 10.96 | 1.77 | 18.75 | 0.004 | 1.000 | Pass | 0.004 |

Note: For conservativeness, the lowest uplink frequency of each band is used to determine the MPE limit of that band.

2.3 FCC NFC

Based on KDB447498D01v06 4.3.1 c), SAR test exclusion threshold for NFC(13.56MHz) shall be evaluated as below,

- For test separation distances ≤ 50 mm, the power threshold determined by the equation in 4.3.1 c) 1) for 50 mm and 100 MHz is multiplied by $\frac{1}{2}$
- The power threshold at 50mm/100 MHz in 4.3.1 b) is multiplied by $[1 + \log(100/f(\text{MHz}))]$ where f is 13.56MHz
- The power threshold in 4.3.1 b) is $[\text{Power allowed at numeric threshold for 50 mm in 4.3.1 a)} + [(\text{test separation distance} - 50 \text{ mm}) \cdot (f(\text{MHz})/150)] \text{ mW}$, for 100 MHz to 1500 MHz where test separation distance is 50mm, frequency is 100MHz.
- Power allowed at numeric threshold for 50 mm in 4.3.1 a) is $[3/\sqrt{f(\text{GHz})}] \cdot (\text{test separation distance})$

Hence, SAR test exclusion threshold is calculated in reverse sequence:

- $[3/\sqrt{0.01}] \cdot 50 = 474.3416\text{mW}$
- $474.3416 + (50-50) \cdot (100/150) = 474.3416\text{mW}$
- $474.3416 \cdot [1 + \log(100/13.56)] = 885.9470\text{mW}$
- $885.9470 \cdot 0.5 = 442.974\text{mW}$

So the SAR test exclusion power threshold for NFC(13.56MHz) is 442.974mW(equal to 26.464dBm).

Also, the maximum power of NFC is -40.19dBm (converted from 34.97dBuV/m at 30m) and it is far below the exclusion threshold (26.464dBm), so SAR test for NFC can be excluded.

Step c:

| Frequency (MHz) | E-FIELD dBuV/m | Test Distance (m) | EIRP (dBm) | EIRP (mW) | Threshold (mW) |
|-----------------|----------------|-------------------|------------|-----------|----------------|
| 13.56 | 34.97 | 30 | -40.19 | 0.000096 | 442.974 |

Note:

$$\text{EIRP (dBm)} = (\text{E-FIELD(dBuV/m)} + 20\log(d(m)) - 104.7)$$

$$\text{EIRP(mW)} = (10^{(\text{EIRP(dBm)}/10)})$$

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Based on KDB447498D01v06 4.3.2 b), when an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

1) $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})} / x] \text{ W/kg}$, for test separation distances $\leq 50 \text{ mm}$, where $x = 7.5$ for 1-g SAR and $x = 18.75$ for 10-g SAR.

Using the most conservative test separation distance 5mm, so the estimated 1g-SAR for NFC would be 0.000015 W/Kg.

$$[0.000096/5] \cdot [\sqrt{0.01356/7.5}] = 0.000015 \text{ W/Kg}$$

2.4 Simultaneous Transmission Calculation

| Operation Mode | SAR/Limit or Power Density/Limit | TER |
|----------------|----------------------------------|-------|
| NFC | 0.00000094 | 0.012 |
| BT | 0.002 | |
| WLAN 2.4G | 0.006 | |
| WLAN 5G | 0.004 | |

Note:

- The simultaneous transmission is compliant because the $[\Sigma \text{ of (the highest measured SAR for each standalone antenna configuration, adjusted for maximum tune-up tolerance)} / 1.6 \text{ W/kg}] + [\Sigma \text{ of MPE ratios}] \leq 1.0$.

~ End of Report ~

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