

## Maximum Permissible Exposure (MPE) Evaluation Report

**Report No. : 161200452TWN-001**

**Model No. : A001**

**Issued Date : Feb. 17, 2017**

**Applicant:** Tetrascience Inc.  
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**Test Method/ Standard: FCC 1.1310**

**Test By:** Intertek Testing Services Taiwan Ltd.  
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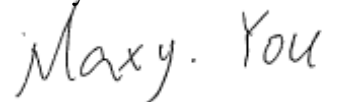
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**The test report was prepared by:**

  
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**The test report was reviewed by:**



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**Title** Senior Engineer



### Revision History

| Report No.       | Issue Date    | Revision Summary |
|------------------|---------------|------------------|
| 161200452TWN-001 | Feb. 17, 2017 | Original report  |

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## Summary of Tests

### **MPE Evaluation meet FCC OET No. 65: 1997, IEEE C95.1-2005**

| Test           | Reference                                    | Results  |
|----------------|----------------------------------------------|----------|
| MPE Evaluation | FCC Guidelines for Human Exposure IEEE C95.1 | Complies |

## 1. General information

### 1.1 Identification of the EUT

Product: TetraScience Link  
Model No.: A001  
Operating Frequency: 1. 2402MHz ~ 2480MHz for BT 4.0  
2. 2412 MHz ~ 2462 MHz for 802.11b, 802.11g, 802.11n HT20  
Channel Number: 1. 2402+2 k MHz, k=0~39 for BT 4.0  
2. 2412+5 k, k=0 ~ 11 for 802.11b, 802.11g, 802.11n HT20  
Access scheme: DSSS, OFDM, GFSK  
Rated Power: DC 5 V from adapter  
Power Cord: N/A  
Sample Received: Dec. 30, 2016  
Sample condition: Workable  
Test Date(s): Feb. 06, 2017 ~ Feb. 10, 2017

Note 1: The test report only allows to be revised within three years from its original issued date unless further standard or the requirement was noticed.

Note 2: When determining the test conclusion, the Measurement Uncertainty of test has been considered.

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### 1.2 Adapter information

The EUT will be supplied with a power supply from below list:

| No.       | Brand   | Model no.  | Specification                                            |
|-----------|---------|------------|----------------------------------------------------------|
| Adapter 1 | PHIHONG | PCS15R-050 | I/P: 100-240 Vac, 50/60 Hz, 0.5 A<br>O/P: 5.0 Vdc, 3.0 A |

### 1.3 Antenna description

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain: 1.5 dBi  
Antenna Type: Dipole Antenna  
Connector Type: RP-SMA type



#### 1.4 Peripherals equipment

| Peripherals | Brand | Model No.     | Serial No. | Description of Data Cable |
|-------------|-------|---------------|------------|---------------------------|
| Notebook PC | DELL  | Latitude D610 | 1YWZK1S    | N/A                       |

## 2. Test specifications

### 2.1 Introduction

The EUT operates in the 2.4 GHz. Due to the EUT (include antenna) at its normal operation distance is at least 20 cm from the human body, the EUT was defined as a Mobile Device.

With individual verifying, the maximum output power was found out 1 Mbps data rate for 802.11b mode, 6 Mbps data rate for 802.11g mode, MCS0 data rate for 802.11n HT 20 mode.

The reason to do the MPE Evaluation is to avoid the RF hazard to human body. The maximum output power and gain of the antenna were used to calculate the limited Power density (S) at 20 cm distance away from the product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 and Safety Code 6 are followed.

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.

## 2.2 RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b) and KDB 447498 D01 General RF Exposure Guidance v06.

### SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and $\leq 50$ mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

| MHz  | 5   | 10  | 15  | 20  | 25  | mm                                      |
|------|-----|-----|-----|-----|-----|-----------------------------------------|
| 150  | 39  | 77  | 116 | 155 | 194 | SAR Test<br>Exclusion<br>Threshold (mW) |
| 300  | 27  | 55  | 82  | 110 | 137 |                                         |
| 450  | 22  | 45  | 67  | 89  | 112 |                                         |
| 835  | 16  | 33  | 49  | 66  | 82  |                                         |
| 900  | 16  | 32  | 47  | 63  | 79  |                                         |
| 1500 | 12  | 24  | 37  | 49  | 61  |                                         |
| 1900 | 11  | 22  | 33  | 44  | 54  |                                         |
| 2450 | 10  | 19  | 29  | 38  | 48  |                                         |
| 3600 | 8   | 16  | 24  | 32  | 40  |                                         |
| 5200 | 7   | 13  | 20  | 26  | 33  |                                         |
| 5400 | 6   | 13  | 19  | 26  | 32  |                                         |
| 5800 | 6   | 12  | 19  | 25  | 31  |                                         |
|      |     |     |     |     |     |                                         |
| MHz  | 30  | 35  | 40  | 45  | 50  | mm                                      |
| 150  | 232 | 271 | 310 | 349 | 387 | SAR Test<br>Exclusion<br>Threshold (mW) |
| 300  | 164 | 192 | 219 | 246 | 274 |                                         |
| 450  | 134 | 157 | 179 | 201 | 224 |                                         |
| 835  | 98  | 115 | 131 | 148 | 164 |                                         |
| 900  | 95  | 111 | 126 | 142 | 158 |                                         |
| 1500 | 73  | 86  | 98  | 110 | 122 |                                         |
| 1900 | 65  | 76  | 87  | 98  | 109 |                                         |
| 2450 | 57  | 67  | 77  | 86  | 96  |                                         |
| 3600 | 47  | 55  | 63  | 71  | 79  |                                         |
| 5200 | 39  | 46  | 53  | 59  | 66  |                                         |
| 5400 | 39  | 45  | 52  | 58  | 65  |                                         |
| 5800 | 37  | 44  | 50  | 56  | 62  |                                         |

**Note:** 10-g Extremity SAR Test Exclusion Power Thresholds are 2.5 times higher than the 1-g SAR Test Exclusion Thresholds indicated above. These thresholds do not apply, by extrapolation or other means, to occupational exposure limits.

### SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and > 50 mm

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table.

| MHz  | 50  | 60  | 70  | 80  | 90  | 100 | 110 | 120 | 130 | 140  | 150  | 160  | 170  | 180  | 190  | mm |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|----|
| 100  | 474 | 481 | 487 | 494 | 501 | 507 | 514 | 521 | 527 | 534  | 541  | 547  | 554  | 561  | 567  | mW |
| 150  | 387 | 397 | 407 | 417 | 427 | 437 | 447 | 457 | 467 | 477  | 487  | 497  | 507  | 517  | 527  |    |
| 300  | 274 | 294 | 314 | 334 | 354 | 374 | 394 | 414 | 434 | 454  | 474  | 494  | 514  | 534  | 554  |    |
| 450  | 224 | 254 | 284 | 314 | 344 | 374 | 404 | 434 | 464 | 494  | 524  | 554  | 584  | 614  | 644  |    |
| 835  | 164 | 220 | 275 | 331 | 387 | 442 | 498 | 554 | 609 | 665  | 721  | 776  | 832  | 888  | 943  |    |
| 900  | 158 | 218 | 278 | 338 | 398 | 458 | 518 | 578 | 638 | 698  | 758  | 818  | 878  | 938  | 998  |    |
| 1500 | 122 | 222 | 322 | 422 | 522 | 622 | 722 | 822 | 922 | 1022 | 1122 | 1222 | 1322 | 1422 | 1522 |    |
| 1900 | 109 | 209 | 309 | 409 | 509 | 609 | 709 | 809 | 909 | 1009 | 1109 | 1209 | 1309 | 1409 | 1509 |    |
| 2450 | 96  | 196 | 296 | 396 | 496 | 596 | 696 | 796 | 896 | 996  | 1096 | 1196 | 1296 | 1396 | 1496 |    |
| 3600 | 79  | 179 | 279 | 379 | 479 | 579 | 679 | 779 | 879 | 979  | 1079 | 1179 | 1279 | 1379 | 1479 |    |
| 5200 | 66  | 166 | 266 | 366 | 466 | 566 | 666 | 766 | 866 | 966  | 1066 | 1166 | 1266 | 1366 | 1466 |    |
| 5400 | 65  | 165 | 265 | 365 | 465 | 565 | 665 | 765 | 865 | 965  | 1065 | 1165 | 1265 | 1365 | 1465 |    |
| 5800 | 62  | 162 | 262 | 362 | 462 | 562 | 662 | 762 | 862 | 962  | 1062 | 1162 | 1262 | 1362 | 1462 |    |

### SAR Test Exclusion Thresholds for < 100 MHz and < 200 mm

Approximate SAR test exclusion power thresholds at selected frequencies and test separation distances are illustrated in the following table.

| MHz  | < 50 | 50   | 60   | 70   | 80   | 90   | 100  | 110  | 120  | 130  | 140  | 150  | 160  | 170  | 180  | 190  | mm |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|----|
| 100  | 237  | 474  | 481  | 487  | 494  | 501  | 507  | 514  | 521  | 527  | 534  | 541  | 547  | 554  | 561  | 567  | mW |
| 50   | 308  | 617  | 625  | 634  | 643  | 651  | 660  | 669  | 677  | 686  | 695  | 703  | 712  | 721  | 729  | 738  |    |
| 10   | 474  | 948  | 961  | 975  | 988  | 1001 | 1015 | 1028 | 1041 | 1055 | 1068 | 1081 | 1095 | 1108 | 1121 | 1135 |    |
| 1    | 711  | 1422 | 1442 | 1462 | 1482 | 1502 | 1522 | 1542 | 1562 | 1582 | 1602 | 1622 | 1642 | 1662 | 1682 | 1702 |    |
| 0.1  | 948  | 1896 | 1923 | 1949 | 1976 | 2003 | 2029 | 2056 | 2083 | 2109 | 2136 | 2163 | 2189 | 2216 | 2243 | 2269 |    |
| 0.05 | 1019 | 2039 | 2067 | 2096 | 2125 | 2153 | 2182 | 2211 | 2239 | 2268 | 2297 | 2325 | 2354 | 2383 | 2411 | 2440 |    |
| 0.01 | 1185 | 2370 | 2403 | 2437 | 2470 | 2503 | 2537 | 2570 | 2603 | 2637 | 2670 | 2703 | 2737 | 2770 | 2803 | 2837 |    |

### 2.3 RF Exposure calculations

From §FCC 1.1310 table 1, the maximum permissible RF exposure for an uncontrolled environment is 1 mW/(cm<sup>2</sup>) (or 10 W/m<sup>2</sup>)\*

Power density (S) is calculated by the following formula:

$$S = (P * G) / 4\pi R^2$$

where, S = Power density (mW/cm<sup>2</sup>)

P = Output power to antenna (mW)

R = Distance between radiating structure and observation point (cm)

G = Gain of antenna in numeric

$\pi = 3.1416$

Example:

Assume a mobile device operates at 2412MHz and its maximum output power is 50mW, and the maximum gain of antenna is 1 (numeric) /0dBi.

then the power density (S) =  $(50 * 1) / 4 * \pi * 20^2 = 0.00995$  (mW/cm<sup>2</sup>) (or = 0.0995 W/m<sup>2</sup>)

### 2.4 Operation mode

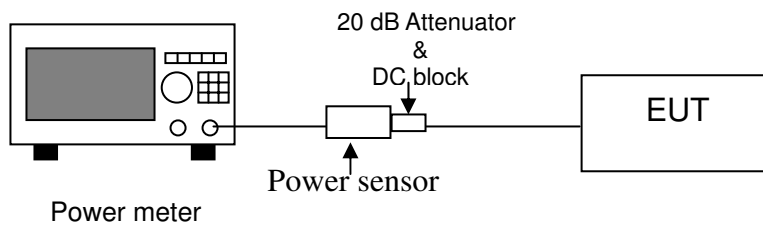
TX-MODE is based on the program “TeraTerm” and the program can select different frequency and modulation.

## 2.5 Test equipment

| Equipment    | Brand         | Model No.     | Serial No. | Calibration Date | Next Calibration Date |
|--------------|---------------|---------------|------------|------------------|-----------------------|
| Power Meter  | Anritsu       | ML2495A       | 0844001    | 2016/11/09       | 2017/11/08            |
| Power Sensor | Anritsu       | MA2411B       | 0738452    | 2016/11/09       | 2017/11/08            |
| RF Cable     | Mini-Circuits | CBL-4FT-SMSM+ | CB0003     | 2016/05/05       | 2017/05/04            |

Note: The above equipments are within the valid calibration period.

## 2.6 Test Set-up



**Remark: Cable loss = 1.5 dB**

### 3. Test results

#### For WiFi 2.4GHz

| Mode                    | Ch | Frequency (MHz) | Antenna Gain0 (numeric) | Output power to antenna 0 (dBm) | Tune-up Power Tolerance (dB) | Max Tune-up Power (dBm) | Max Tune-up Power (mW) | Power density (mW/cm <sup>2</sup> ) | Limit of power density (mW/cm <sup>2</sup> ) | Distance (cm) |
|-------------------------|----|-----------------|-------------------------|---------------------------------|------------------------------|-------------------------|------------------------|-------------------------------------|----------------------------------------------|---------------|
| 802.11b (chain0)        | 1  | 2412            | 1.41                    | 0.47                            | 2.00                         | 2.47                    | 1.77                   | 0.0005                              | 1.0                                          | 20            |
|                         | 6  | 2437            | 1.41                    | 0.58                            | 2.00                         | 2.58                    | 1.81                   | 0.0005                              | 1.0                                          | 20            |
|                         | 11 | 2462            | 1.41                    | 0.08                            | 2.00                         | 2.08                    | 1.61                   | 0.0005                              | 1.0                                          | 20            |
| 802.11g (chain0)        | 1  | 2412            | 1.41                    | 4.34                            | 2.00                         | 6.34                    | 4.31                   | 0.0012                              | 1.0                                          | 20            |
|                         | 6  | 2437            | 1.41                    | 1.30                            | 2.00                         | 3.30                    | 2.14                   | 0.0006                              | 1.0                                          | 20            |
|                         | 11 | 2462            | 1.41                    | 2.41                            | 2.00                         | 4.41                    | 2.76                   | 0.0008                              | 1.0                                          | 20            |
| 802.11n (HT20) (chain0) | 1  | 2412            | 1.41                    | 4.25                            | 2.00                         | 6.25                    | 4.22                   | 0.0012                              | 1.0                                          | 20            |
|                         | 6  | 2437            | 1.41                    | 4.48                            | 2.00                         | 6.48                    | 4.45                   | 0.0012                              | 1.0                                          | 20            |
|                         | 11 | 2462            | 1.41                    | 3.24                            | 2.00                         | 5.24                    | 3.34                   | 0.0009                              | 1.0                                          | 20            |

The Notice in Installation Manual has been stated as below:

While installing and operating this transmitter, the radio frequency exposure limit of 1 mW/ (cm<sup>2</sup>) may be exceeded at distances close to the transmitter. Therefore, the user must maintain a minimum distance of 20 cm from the device at all time.

#### For BT 4.0

| Mode   | Channel | Frequency (MHz) | Antenna Gain0 (numeric) | Output power to antenna 0 (dBm) | Tune-up Power Tolerance (dB) | Max Tune-up Power (dBm) | Max Tune-up Power (mW) | Power density (mW/cm <sup>2</sup> ) | Limit of power density (mW/cm <sup>2</sup> ) | Distance (cm) |
|--------|---------|-----------------|-------------------------|---------------------------------|------------------------------|-------------------------|------------------------|-------------------------------------|----------------------------------------------|---------------|
| BT 4.0 | Low     | 2402            | 1.41                    | 8.87                            | 2.00                         | 10.87                   | 12.22                  | 0.0034                              | 1.0                                          | 20            |
|        | Middle  | 2442            | 1.41                    | 8.15                            | 2.00                         | 10.15                   | 10.35                  | 0.0029                              | 1.0                                          | 20            |
|        | High    | 2480            | 1.41                    | 6.90                            | 2.00                         | 8.90                    | 7.76                   | 0.0022                              | 1.0                                          | 20            |

The Notice in Installation Manual has been stated as below:

While installing and operating this transmitter, the radio frequency exposure limit of 1 mW/ (cm<sup>2</sup>) may be exceeded at distances close to the transmitter. Therefore, the user must maintain a minimum distance of 20 cm from the device at all time.

The worst value of BT 4.0 band is 0.0034 mW/ cm<sup>2</sup>. The worst value of WiFi 2.4GHz band is 0.0012 mW/ cm<sup>2</sup>. When the BT 4.0 and 2.4GHz are transmitting at the same time, the worst MPE value is 0.0034+0.0012=0.0046 mW/ cm<sup>2</sup>. It is also met the limit.