

TEST REPORT

According to ANSI/IES LM-80-15
For

Shenzhen Refond Optoelectronic Co., Ltd.

C 5th Floor, Konka R&D Building, No. 28 of Street 12, South Tech Area, Nanshan District, Shenzhen, China.

Model: 5050

| | |
|---|-------------------------------------|
| Report Type: 6000 Hours Test Report | Product Type: LED Package |
| Test Engineer: | Pote Wang |
| Report Number: | R2DG170425053-10 |

Test Date: 2017-05-03

| | |
|-----------------------|---|
| | Blake Zhang / EE Engineer |
| Test Facility: | Test facility was located at No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China. |
| Prepared By: | Bay Area Compliance Laboratories Corp. (Dongguan). No.69,Pulongcun ,Puxinhu Industrial Area, Tangxia , Dongguan, Guangdong, China. Tel: +86-0769-86858888 Fax:+86-0769-86858588 |
| Accreditation: | The IAS Accreditation Number TL-460. |

Note: The test data was only valid for the test sample(s). This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

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Bay Area Compliance Laboratories Corp. (Dongguan)

No.69, Pulongcun, Puxinhu Industrial Area Tangxia ,
Dongguan, Guangdong, China.
The IAS Accreditation Number TL-460

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1 - General Information

1.1 Description of LED Light Sources

Sample Size:

75 PCS sam0.502 Sources

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2 - Summary of Test Result

| Data Set: | Sample Size | Failures Observed: | Test Interval | Test Duration | α : | β : | Reported TM-21 L ₇₀ Lifetime | Reported TM-21 L ₉₀ Lifetime |
|-----------|-------------|--------------------|---------------|---------------|------------|-----------|---|---|
| 1 | 25 | 0 | 1000hrs | 6000hrs | 2.118E-06 | 1.003 | >36000hrs | >36000hrs |
| 2 | 25 | 0 | 1000hrs | 6000hrs | 2.388E-06 | 1.002 | >36000hrs | >36000hrs |
| 3 | 25 | 0 | 1000hrs | 6000hrs | 2.773E-06 | 1.001 | >36000hrs | >36000hrs |

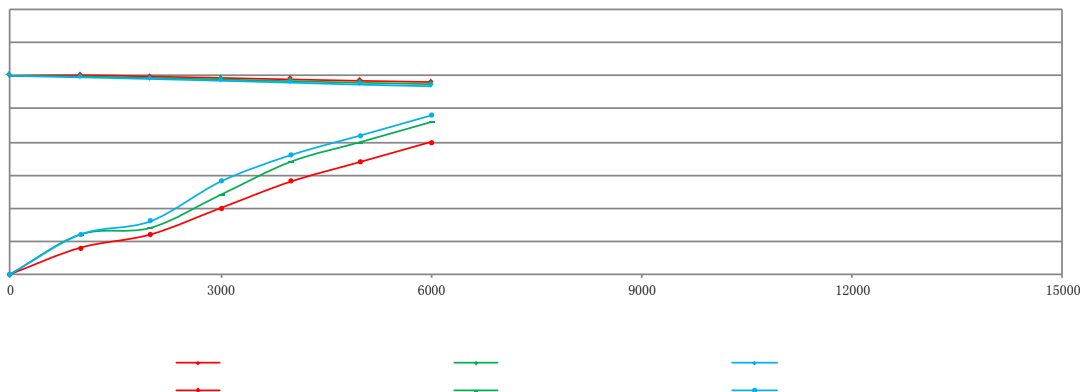
Average Lumen Maintenance (Percentage of Initial Luminous Flux)

| Data Set: | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
|-----------|---------|---------|---------|---------|---------|---------|
| 1 | 100.10% | 99.90% | 99.69% | 99.46% | 99.25% | 99.06% |
| 2 | 99.91% | 99.69% | 99.46% | 99.20% | 98.96% | 98.74% |
| 3 | 99.78% | 99.53% | 99.26% | 98.97% | 98.67% | 98.43% |

Average Chromaticity Shift

| Data Set: | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
|-----------|---------|---------|---------|---------|---------|---------|
| 1 | 0.0004 | 0.0006 | 0.0010 | 0.0014 | 0.0017 | 0.0020 |
| 2 | 0.0006 | 0.0007 | 0.0012 | 0.0017 | 0.0020 | 0.0023 |
| 3 | 0.0006 | 0.0008 | 0.0014 | 0.0018 | 0.0021 | 0.0024 |

Average Lumen Maintenance and Chromaticity Shift VS. Time



3 - Test Data

3.1 Data Set 1, 55°C, 20mA (Lumen Maintenance)

| No. | Q _D | Lumen Maintenance (%) | | | | | |
|-----|----------------|-----------------------|---------|---------|---------|---------|---------|
| | 0hr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
| 1 | 13.55 | 100.15 | 99.93 | 99.78 | 99.63 | 99.48 | 99.41 |
| 2 | 13.51 | 100.07 | 99.93 | 99.70 | 99.48 | 99.19 | 99.11 |

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3.2 Data Set 1, 55°C, 20mA (Forward Voltage)

| No. | Forward Voltage (V) | | | | | | |
|-----|---------------------|---------|---------|---------|---------|---------|---------|
| | 0hr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
| 1 | 7.506 | 7.524 | 7.496 | 7.521 | 7.516 | 7.515 | 7.511 |
| 2 | 7.487 | 7.504 | 7.484 | 7.501 | 7.497 | 7.485 | 7.502 |
| 3 | 7.498 | 7.517 | 7.490 | 7.513 | 7.509 | 7.498 | 7.515 |
| 4 | 7.504 | 7.522 | 7.495 | 7.519 | 7.514 | 7.513 | 7.513 |
| 5 | 7.507 | 7.521 | 7.500 | 7.524 | 7.518 | 7.517 | 7.528 |
| 6 | 7.517 | 7.535 | 7.517 | 7.532 | 7.527 | 7.521 | 7.536 |
| 7 | 7.518 | 7.529 | 7.514 | 7.531 | 7.526 | 7.520 | 7.527 |
| 8 | 7.521 | 7.539 | 7.517 | 7.536 | 7.531 | 7.528 | 7.533 |
| 9 | 7.530 | 7.547 | 7.522 | 7.544 | 7.539 | 7.527 | 7.541 |
| 10 | 7.515 | 7.533 | 7.514 | 7.529 | 7.524 | 7.512 | 7.533 |
| 11 | 7.507 | 7.535 | 7.516 | 7.532 | 7.531 | 7.515 | 7.533 |
| 12 | 7.485 | 7.504 | 7.477 | 7.500 | 7.499 | 7.485 | 7.507 |
| 13 | 7.481 | 7.493 | 7.480 | 7.496 | 7.494 | 7.480 | 7.493 |
| 14 | 7.507 | 7.517 | 7.503 | 7.521 | 7.518 | 7.513 | 7.527 |
| 15 | 7.472 | 7.491 | 7.479 | 7.496 | 7.492 | 7.488 | 7.498 |
| 16 | 7.490 | 7.503 | 7.482 | 7.502 | 7.497 | 7.483 | 7.507 |
| 17 | 7.501 | 7.520 | 7.494 | 7.519 | 7.514 | 7.510 | 7.520 |
| 18 | 7.496 | 7.515 | 7.493 | 7.513 | 7.513 | 7.496 | 7.519 |
| 19 | 7.476 | 7.488 | 7.469 | 7.492 | 7.493 | 7.476 | 7.498 |

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0mA (Chromaticity Shift)

| CCT(K) | 0.01 (0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008 0.009 0.010 0.011 0.012 0.013 0.014 0.015 0.016 0.017 0.018 0.019 0.020 0.021 0.022 0.023 0.027 0.030) | | | | | |
|--------|--|---------|---------|---------|---------|---------|
| | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
| 17239 | 0.0004 | 0.0008 | 0.0011 | 0.0014 | 0.0017 | 0.0019 |
| 19568 | 0.0005 | 0.0004 | 0.0006 | 0.0010 | 0.0011 | 0.0014 |
| 19339 | 0.0005 | 0.0010 | 0.0007 | 0.0008 | 0.0013 | 0.0017 |
| 17164 | 0.0006 | 0.0008 | 0.0012 | 0.0013 | 0.0016 | 0.0017 |
| 18763 | 0.0003 | 0.0003 | 0.0009 | 0.0011 | 0.0013 | 0.0020 |
| 24861 | 0.0004 | 0.0007 | 0.0010 | 0.0011 | 0.0015 | 0.0017 |
| 18756 | 0.0001 | 0.0001 | 0.0010 | 0.0012 | 0.0014 | 0.0021 |
| 18777 | 0.0002 | 0.0003 | 0.0009 | 0.0014 | 0.0016 | 0.0022 |
| 22387 | 0.0003 | 0.0006 | 0.0010 | 0.0014 | 0.0017 | 0.0022 |
| 19454 | 0.0004 | 0.0007 | 0.0010 | 0.0015 | 0.0017 | 0.0023 |
| 19271 | 0.0002 | 0.0004 | 0.0009 | 0.0014 | 0.0016 | 0.0019 |
| 21216 | 0.0006 | 0.0012 | 0.0009 | 0.0015 | 0.0016 | 0.0019 |
| 21975 | 0.0006 | 0.0013 | 0.0012 | 0.0016 | 0.0018 | 0.0019 |
| 19602 | 0.0004 | 0.0006 | 0.0010 | 0.0016 | 0.0018 | 0.0022 |
| 19197 | 0.0003 | 0.0006 | 0.0013 | 0.0016 | 0.0017 | 0.0020 |
| 20084 | 0.0002 | 0.0005 | 0.0018 | 0.0023 | 0.0027 | 0.0030 |
| 19989 | 0.0002 | 0.0006 | 0.0008 | 0.0011 | 0.0013 | 0.0020 |
| 20632 | 0.0002 | 0.0006 | 0.0009 | 0.0013 | 0.0014 | 0.0016 |
| 21012 | 0.0004 | 0.0006 | 0.0010 | 0.0015 | 0.0018 | 0.0020 |

3.4 Data Set 2, 85°C, 20mA (Lumen Maintenance)

| No. | Φ D | Lumen Maintenance (%) | | | | | |
|-----|--------------|-----------------------|---------|---------|---------|---------|---------|
| | Ohr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
| 26 | 13.25 | 99.85 | 99.77 | 99.47 | 99.17 | 98.87 | 98.72 |
| 27 | 13.44 | 99.93 | 99.55 | 99.48 | 99.33 | 99.18 | 98.88 |
| 28 | 13.27 | 99.77 | 99.70 | 99.40 | 99.10 | 98.87 | 98.72 |
| 29 | 13.33 | 99.55 | 99.32 | 99.10 | 98.87 | 98.80 | 98.65 |
| 30 | 13.36 | 99.85 | 99.40 | 99.18 | 98.95 | 98.65 | 98.43 |
| 31 | 13.45 | 99.93 | 99.55 | 99.33 | 98.96 | 98.66 | 98.36 |
| 32 | 13.27 | 99.77 | 99.70 | 99.40 | 99.17 | 99.02 | 98.79 |
| 33 | 13.30 | 100.15 | 99.92 | 99.77 | 99.47 | 99.17 | 98.87 |
| 34 | 13.18 | 99.70 | 99.54 | 99.24 | 99.17 | 98.94 | 98.71 |
| 35 | 13.41 | 99.85 | 99.48 | 99.11 | 98.81 | | |

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3.5 Data Set 2, 85°C, 20mA (Forward Voltage)

| No. | Forward Voltage (V) | | | | | | |
|-----|---------------------|---------|---------|---------|---------|---------|---------|
| | 0hr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
| 26 | 7.490 | 7.522 | 7.498 | 7.518 | 7.520 | 7.501 | 7.519 |
| 27 | 7.497 | 7.515 | 7.497 | 7.511 | 7.513 | 7.503 | |

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3.6 Data Set 2, 85°C, 20mA (Chromaticity Shift)

| No. | x | y | CCT(K) | Chromaticity Shift | | | | | |
|-----|--------|--------|--------|--------------------|---------|---------|---------|---------|---------|
| | | | | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
| 26 | 0.1838 | 0.4160 | 19812 | 0.0005 | 0.0004 | 0.0010 | 0.0016 | 0.0017 | 0.0023 |
| 27 | 0.1818 | 0.4158 | 20693 | 0.0006 | 0.0006 | 0.0013 | 0.0016 | 0.0020 | 0.0023 |
| 28 | 0.1829 | 0.4140 | 21914 | 0.0004 | 0.0007 | 0.0009 | 0.0015 | 0.0019 | 0.0022 |
| 29 | 0.1842 | 0.4140 | 21310 | 0.0007 | 0.0005 | 0.0017 | 0.0022 | 0.0026 | 0.0028 |
| 30 | 0.1847 | 0.4145 | 20652 | 0.0004 | 0.0004 | 0.0009 | 0.0014 | 0.0019 | 0.0022 |
| 31 | 0.1823 | 0.4162 | 20186 | 0.0007 | 0.0011 | 0.0012 | 0.0016 | 0.0020 | 0.0023 |
| 32 | 0.1844 | 0.4136 | 21554 | 0.0006 | 0.0008 | 0.0015 | 0.0019 | 0.0024 | 0.0027 |
| 33 | 0.1847 | 0.4162 | 19292 | 0.0006 | 0.0004 | 0.0009 | 0.0014 | 0.0019 | 0.0022 |
| 34 | 0.1860 | 0.4135 | 20958 | 0.0005 | 0.0007 | 0.0013 | 0.0017 | 0.0022 | 0.0025 |
| 35 | 0.1824 | 0.4161 | 20219 | 0.0002 | 0.0003 | 0.0011 | 0.0017 | 0.0020 | 0.0022 |
| 36 | 0.1842 | 0.4129 | 22327 | 0.0004 | 0.0003 | 0.0011 | 0.0014 | 0.0018 | 0.0022 |
| 37 | 0.1827 | 0.4152 | 20869 | 0.0008 | 0.0008 | 0.0013 | 0.0016 | 0.0022 | 0.0025 |
| 38 | 0.1858 | 0.4153 | 19568 | 0.0006 | 0.0004 | 0.0010 | 0.0013 | 0.0016 | 0.0019 |

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3.7 Data Set 3, 105°C, 20mA (Lumen Maintenance)

| No. | Φ D | Lumen Maintenance (%) | | | | | |
|-----|--------------|-----------------------|---------|---------|---------|---------|---------|
| | Ohr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
| 51 | 13.35 | 99.93 | 99.48 | 99.18 | 98.95 | 98.80 | 98.50 |
| 52 | 13.35 | 100.07 | 99.85 | 99.48 | 99.18 | 98.73 | 98.50 |
| 53 | 13.19 | 99.92 | 99.77 | 99.39 | 99.01 | 98.71 | 98.48 |
| 54 | 13.40 | 99.78 | 99.70 | 99.40 | 99.10 | 98.73 | 98.58 |
| 55 | 13.45 | 99.70 | 99.26 | 99.03 | 98.88 | 98.59 | 98.29 |
| 56 | 13.33 | 99.55 | 99.17 | 99.10 | 98.80 | 98.50 | 98.27 |
| 57 | 13.47 | 99.48 | 99.18 | 98.89 | 98.74 | 98.29 | 98.07 |
| 58 | 13.16 | 99.54 | 99.39 | 99.16 | 98.94 | 98.71 | 98.18 |
| 59 | 13.39 | 99.70 | 99.55 | 99.18 | 98.81 | 98.58 | 98.36 |
| 60 | 13.33 | 99.92 | 99.55 | 99.17 | 98.87 | 98.65 | 98.42 |
| 61 | 13.24 | 99.77 | 99.40 | 99.09 | 98.79 | 98.49 | 98.34 |
| 62 | 13.35 | 99.85 | 99.63 | 99.48 | 99.25 | 98.95 | 98.80 |
| 63 | 13.47 | 99.78 | 99.63 | 99.55 | 99.18 | 98.96 | 98.89 |
| 64 | 13.41 | 99.70 | 99.55 | 99.33 | 99.11 | 98.73 | 98.36 |
| 65 | 13.23 | 99.85 | 99.77 | 99.40 | 99.09 | 98.72 | 98.19 |

3.8 Data Set 3, 105°C, 20mA (Forward Voltage)

| No. | Forward Voltage (V) | | | | | | |
|--------|---------------------|---------|---------|---------|---------|---------|---------|
| | 0hr(Initial) | 1000hrs | 2000hrs | 3000hrs | 4000hrs | 5000hrs | 6000hrs |
| 51 | 7.487 | 7.508 | 7.485 | 7.504 | 7.508 | 7.501 | 7.502 |
| 52 | 7.477 | 7.496 | 7.478 | 7.492 | 7.495 | 7.481 | 7.490 |
| 53 | 7.503 | 7.532 | 7.507 | 7.527 | 7.529 | 7.524 | 7.535 |
| 54 | 7.480 | 7.501 | 7.490 | 7.504 | 7.506 | 7.498 | 7.512 |
| 55 | 7.479 | 7.491 | 7.473 | 7.493 | 7.495 | 7.480 | 7.492 |
| 56 | 7.484 | 7.508 | 7.496 | 7.508 | 7.510 | 7.504 | 7.508 |
| 57 | 7.480 | 7.493 | 7.481 | 7.495 | 7.496 | 7.491 | 7.503 |
| 58 | 7.486 | 7.504 | 7.479 | 7.500 | 7.501 | 7.496 | 7.508 |
| 59 | 7.471 | 7.489 | 7.465 | 7.484 | 7.484 | 7.479 | 7.483 |
| 60 | 7.503 | 7.528 | 7.510 | 7.530 | 7.530 | 7.518 | 7.538 |
| 61 | 7.487 | 7.500 | 7.480 | 7.502 | 7.502 | 7.497 | 7.500 |
| 62 | 7.475 | 7.496 | 7.478 | 7.498 | 7.499 | 7.486 | 7.502 |
| 63 | 7.493 | 7.505 | 7.490 | 7.508 | 7.508 | 7.494 | 7.514 |
| 64 | 7.497 | 7.517 | 7.490 | 7.512 | 7.512 | 7.497 | 7.519 |
| 65 | 7.491 | 7.509 | 7.490 | 7.505 | 7.505 | 7.491 | 7.512 |
| 66 | 7.491 | 7.518 | 7.491 | 7.513 | 7.513 | 7.502 | 7.519 |
| 67 | 7.489 | 7.518 | 7.491 | 7.513 | 7.513 | 7.507 | 7.519 |
| 68 | 7.473 | 7.502 | 7.483 | 7.498 | 7.502 | 7.492 | 7.502 |
| 69 | 7.477 | 7.501 | 7.480 | 7.496 | 7.496 | 7.488 | 7.502 |
| 70 | 7.495 | 7.519 | 7.498 | 7.521 | 7.521 | 7.513 | 7.527 |
| 71 | 7.467 | 7.486 | 7.466 | 7.487 | 7.548 | 7.481 | 7.494 |
| 72 | 7.487 | 7.500 | 7.480 | 7.501 | 7.500 | 7.495 | 7.500 |
| 73 | 7.512 | 7.528 | 7.509 | 7.530 | 7.530 | 7.524 | 7.536 |
| 74 | 7.494 | 7.523 | 7.503 | 7.519 | 7.517 | 7.502 | 7.524 |
| 75 | 7.482 | 7.501 | 7.480 | 7.496 | 7.495 | 7.482 | 7.502 |
| Avg. | 7.486 | 7.507 | 7.487 | 7.505 | 7.509 | 7.497 | 7.510 |
| Med. | 7.487 | 7.504 | 7.485 | 7.504 | 7.506 | 7.496 | 7.508 |
| st dev | 0.0108 | 0.0128 | 0.0121 | 0.0127 | 0.0144 | 0.0130 | 0.0146 |
| Min. | 7.467 | 7.486 | 7.465 | 7.484 | 7.484 | 7.479 | 7.483 |
| Max. | 7.512 | 7.532 | 7.510 | 7.530 | 7.548 | 7.524 | 7.538 |



3.9 Data Set 3, 105°C, 20mA (Chromaticity Shift)

| No. | \bar{x} | σ |
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