TEST REPORT

According to ANSI/IES LM-80-15

Report Type	Lumen Maintenance Test 15000 Hours
Report Number	RA2022011803-A4
Report Date	Dec 21, 2023
Customer	Bridgelux Inc.
Test Item	Bridgelux LED products, F90 COB V29
Product Model #	BXRE-27G1KF0
Test Date	Feb 22, 2022 – Nov 27,2023
Test Standard	ANSI/IES LM-80-15: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
Decision Rule	N/A (No conformity decision is required for this test)
Test Facility	Bridgelux Kaistar Testing Laboratory 101 Xiang Xing Rd., Xiang An Branch, Torch Hi-Tech Industrial Development Zone, Xiamen, China 361101
Accreditation	IAS Accreditation Number TL-855

Prepared by: Lanlan Wu	Audit by：Yale Hong	Verified by: Robert Lo
Lanlan wu	Yale Hong	Robert Lo

***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 Kaistar Lighting Corp.*

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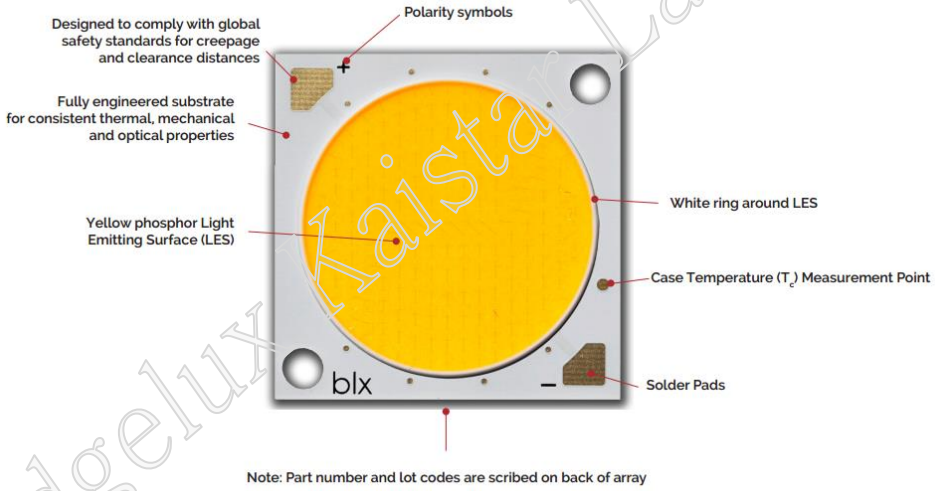
Tested Product Information

DUT manufacturer	Bridgelux Inc.
DUT identification / model number	BXRE-27G1KF0
Description of DUT	LED array
Nominal CCT	2700 K
Total input power	163 W
Typical voltage	56.6 VDC
Drive current per array and per LED die	2880 mA per array, 180 mA per LED die
Average current density per LED die	358.8 mA/mm2
Average power density per LED die	1.32 W/mm2
Minimum die edge to die edge spacing	0.10mm

20 pieces of LED samples are randomly selected from different production dates.

Drawing of BXRE-27G1KF0:

This report covers the following products:



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Test Specifications

Description of Auxiliary Equipment

- Photometry Tester: Automated LED tester
- Temperature control systems to achieve and maintain required conditions
- Software controlled power supply to provide regulated constant currents to drive LED light sources in life testing

Operating Cycle and Ambient Conditions

Sample case temperature and ambient conditions:

Surrounding Temperature	Actual Case Temperature	Nominal Case Temperature	Relative Humidity
53℃	55℃	55℃	<60%
83℃	85℃	85℃	<60%

- Nominal temperatures are 55℃ ,85℃ ; actual case temperatures are maintained not lower by more than 2 ℃ than the nominal during life testing.
- Temperature of the air surrounding DUTs is controlled to be less than 5℃ below the case temperature.
- Airflow is kept to minimum to maintain the required temperature uniformity.

Physical Condition of DUTs at each Photometry Measurement

- No cracks
- No discoloration
- No electrical discontinuity

LED Light Source Monitoring Interval

Measurements have been taken for Tc of 55℃ ,85℃ after the following durations:

0, 1000, 2000, 3000, 4000, 5000, 6000 7000 8000 9000 10000 11000 12000 13000 14000 15000 hours.

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Initial Photometry Measurement

Initial luminous flux, forward voltage and correlated color temperature at photometric measurement current

Data Set 1 (Tc = 55℃ If=2880mA)

NO	1	2	3	4	5	6	7	8	9	10	AVG	Med	Sdet	Max	Min
Initial Flux,lm	26079	26082	26222	26257	25960	26016	26324	26239	26279	25801	26126	26152	166.3	26324	25801
Forward Voltage,V	56.5	56.5	56.5	56.5	56.7	56.5	56.6	56.6	56.5	56.7	56.6	56.5	0.1	56.7	56.5
CCT,K	2839	2848	2829	2828	2837	2827	2831	2900	2832	2824	2840	2832	22.4	2900	2824

Data Set 2 (Tc = 85℃ If=2880mA)

NO	1	2	3	4	5	6	7	8	9	10	AVG	Med	Sdet	Max	Min
Initial Flux,lm	26092	26217	26147	26246	25993	26290	26376	26341	26276	26208	26219	26232	116.0	26376	25992
Forward Voltage,V	56.6	56.7	56.7	56.5	56.8	56.6	56.6	56.6	56.8	56.7	56.7	56.7	0.1	56.8	56.5
CCT,K	2897	2840	2900	2829	2847	2838	2836	2848	2848	2832	2852	2844	25.6	2900	2829

Ambient temperature during lumen and chromaticity measurements was maintained at 25℃ ±2℃.

Test Results

Summary of lumen maintenance test results

Data Set	Sample Size	Failures Observed	Tc (C)	Drive Current [IF] mA	Test Duration (Hours)	Average Lumen Maintenance	Reported L70(15k) (Hours)	Reported L90(15k) (Hours)
1	10	0	55℃	2880	15000	95.88%	>83000	44000
2	10	0	85℃	2880	15000	94.71%	>83000	38000

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Detailed Lumen Maintenance Data

Table 1: Lumen maintenance at Tc = 55℃ If=2880mA

Hours	1	2	3	4	5	6	7	8	9	10	AVG	Med	Sdet	Max	Min
0	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%
1000	100.2%	100.4%	100.4%	100.2%	100.1%	100.3%	100.3%	100.2%	100.5%	99.8%	100.2%	100.3%	0.2%	100.5%	99.8%
2000	99.1%	99.5%	98.5%	98.7%	98.9%	98.7%	98.8%	98.1%	99.0%	98.0%	98.7%	98.8%	0.5%	99.5%	98.0%
3000	99.1%	99.7%	98.7%	98.7%	99.3%	98.9%	98.9%	98.2%	99.0%	97.9%	98.8%	98.9%	0.5%	99.7%	97.9%
4000	98.4%	99.4%	98.2%	98.1%	98.9%	98.2%	98.3%	97.4%	98.4%	97.3%	98.3%	98.2%	0.6%	99.4%	97.3%
5000	98.5%	99.2%	97.8%	97.9%	98.4%	98.3%	98.4%	97.3%	98.5%	97.2%	98.1%	98.3%	0.6%	99.2%	97.2%
6000	97.9%	99.0%	97.8%	97.9%	98.4%	97.4%	97.6%	96.7%	97.9%	96.9%	97.7%	97.8%	0.7%	99.0%	96.7%
7000	97.7%	98.9%	97.4%	97.5%	98.5%	97.7%	98.1%	96.9%	97.9%	97.2%	97.8%	97.7%	0.6%	98.9%	96.9%
8000	96.7%	97.9%	96.3%	96.6%	97.4%	96.6%	96.8%	95.9%	96.9%	96.0%	96.7%	96.6%	0.6%	97.9%	95.9%
9000	96.4%	97.7%	95.9%	96.0%	97.2%	95.6%	96.2%	95.0%	96.3%	95.3%	96.2%	96.1%	0.8%	97.7%	95.0%
10000	96.0%	97.6%	95.9%	96.0%	97.1%	95.4%	96.3%	95.0%	96.1%	95.1%	96.0%	96.0%	0.8%	97.6%	95.0%
11000	95.9%	97.5%	95.8%	95.8%	96.8%	95.6%	96.1%	94.6%	95.8%	95.0%	95.9%	95.8%	0.8%	97.5%	94.6%
12000	95.4%	97.2%	95.4%	95.3%	96.5%	95.4%	96.0%	94.5%	95.8%	94.8%	95.6%	95.4%	0.8%	97.2%	94.5%
13000	95.6%	97.7%	95.4%	95.4%	97.1%	95.4%	96.0%	94.7%	96.1%	95.2%	95.9%	95.5%	0.9%	97.7%	94.7%
14000	95.6%	97.5%	95.3%	95.7%	97.4%	95.1%	95.8%	94.4%	95.7%	95.1%	95.8%	95.6%	1.0%	97.5%	94.4%
15000	96.1%	97.5%	95.4%	95.5%	96.8%	95.6%	96.0%	94.6%	96.2%	95.0%	95.9%	95.8%	0.8%	97.5%	94.6%

Figure 1: Lumen maintenance at Tc = 55℃ If=2880 mA

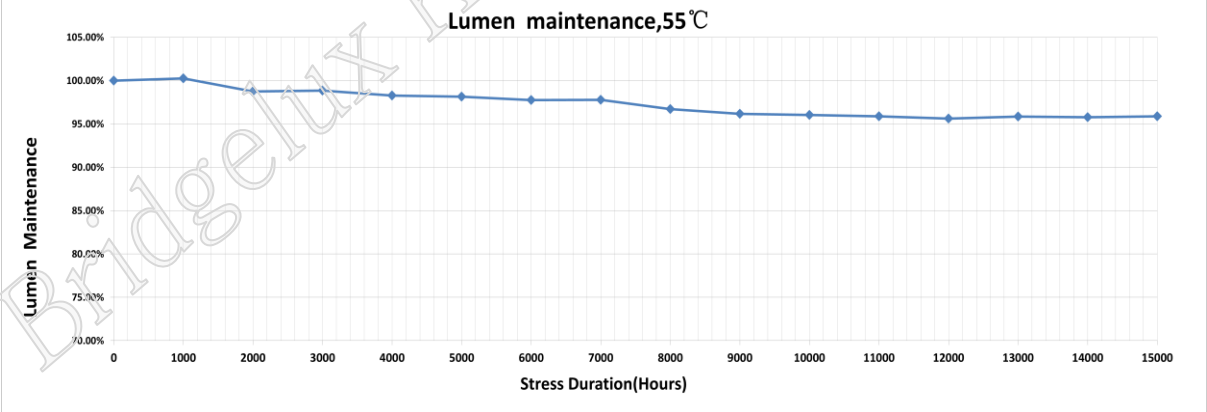
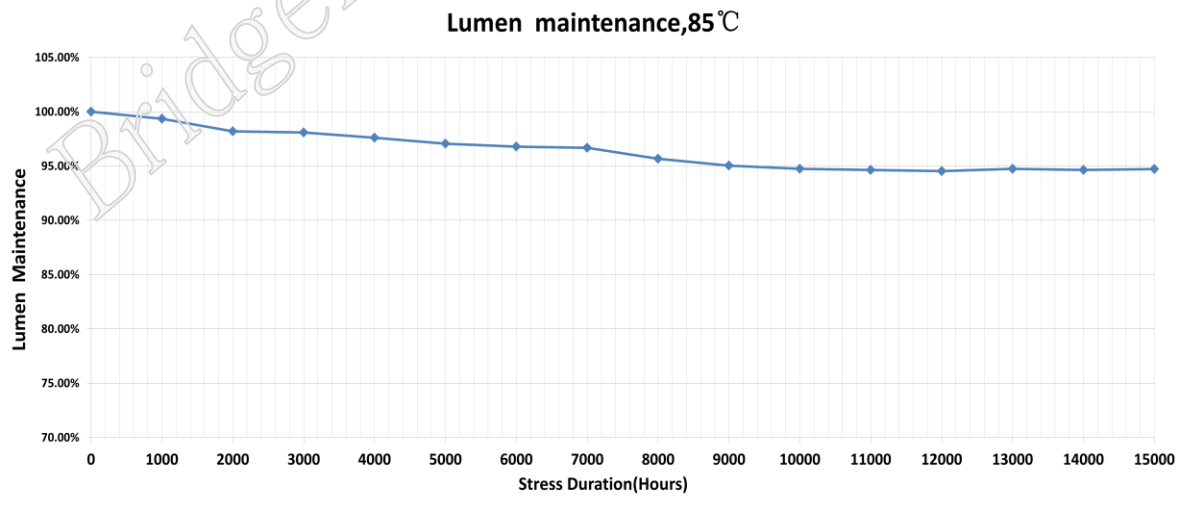


Table 2: Lumen maintenance at Tc = 85℃ If=2880 mA

Hours	1	2	3	4	5	6	7	8	9	10	AVG	Med	Sdet	Max	Min
0	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	100.0%	100.0%
1000	99.3%	98.9%	99.4%	99.3%	99.1%	99.2%	99.6%	99.8%	99.2%	99.5%	99.3%	99.3%	0.3%	99.8%	98.9%
2000	98.2%	97.6%	98.5%	97.8%	97.8%	97.6%	98.3%	99.1%	98.3%	98.6%	98.2%	98.3%	0.5%	99.1%	97.6%
3000	98.0%	97.3%	98.6%	97.7%	97.6%	97.5%	98.4%	99.3%	98.1%	98.5%	98.1%	98.0%	0.6%	99.3%	97.3%
4000	97.6%	96.8%	98.1%	97.1%	96.7%	97.0%	97.9%	99.0%	97.6%	98.1%	97.6%	97.6%	0.7%	99.0%	96.7%
5000	97.9%	98.0%	96.6%	97.8%	98.6%	96.6%	94.9%	97.9%	96.9%	95.5%	97.1%	97.4%	1.2%	98.6%	94.9%
6000	96.7%	95.2%	97.9%	96.3%	95.5%	95.7%	97.6%	98.6%	96.8%	97.6%	96.8%	96.7%	1.1%	98.6%	95.2%
7000	96.5%	94.9%	98.0%	96.1%	95.0%	95.5%	97.8%	98.5%	96.5%	98.0%	96.7%	96.5%	1.3%	98.5%	94.9%
8000	95.9%	94.0%	97.0%	95.3%	93.5%	94.5%	96.8%	97.6%	95.1%	97.0%	95.7%	95.6%	1.4%	97.6%	93.5%
9000	95.5%	93.3%	96.7%	94.8%	93.0%	93.9%	96.6%	97.4%	92.5%	96.7%	95.0%	95.2%	1.8%	97.4%	92.5%
10000	94.5%	92.4%	96.3%	94.4%	92.5%	93.4%	96.3%	97.0%	94.3%	96.4%	94.7%	94.5%	1.7%	97.0%	92.4%
11000	94.3%	92.6%	96.1%	94.4%	92.2%	93.3%	96.1%	97.1%	94.2%	96.2%	94.6%	94.3%	1.7%	97.1%	92.2%
12000	94.5%	92.4%	96.1%	94.3%	91.9%	93.0%	96.2%	96.9%	93.9%	96.1%	94.5%	94.4%	1.7%	96.9%	91.9%
13000	94.9%	91.9%	96.7%	94.4%	91.6%	93.1%	96.6%	97.2%	94.2%	96.8%	94.7%	94.6%	2.1%	97.2%	91.6%
14000	95.0%	91.5%	96.6%	94.3%	91.3%	92.7%	96.7%	97.2%	94.1%	96.9%	94.6%	94.6%	2.2%	97.2%	91.3%
15000	95.2%	91.6%	96.9%	94.4%	91.0%	93.0%	96.6%	97.9%	93.9%	96.8%	94.7%	94.8%	2.4%	97.9%	91.0%

Figure 2: Lumen maintenance at Tc = 85℃ If=2880 mA



Detailed Chromaticity Shift Data
Ambient temperature during chromaticity measurements was maintained at 25℃ ±2℃

Table 1: Chromaticity shift (Delta u'v') at Tc = 55℃ If=2880mA

Hours	1	2	3	4	5	6	7	8	9	10	AVG	Med	Sdet	Max	Min
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1000	0.0026	0.0025	0.0029	0.0027	0.0027	0.0029	0.0030	0.0028	0.0028	0.0030	0.0028	0.0028	0.0002	0.0030	0.0025
2000	0.0023	0.0025	0.0026	0.0026	0.0025	0.0029	0.0026	0.0023	0.0026	0.0025	0.0025	0.0025	0.0002	0.0029	0.0023
3000	0.0023	0.0023	0.0024	0.0024	0.0025	0.0028	0.0024	0.0023	0.0024	0.0026	0.0024	0.0024	0.0002	0.0028	0.0023
4000	0.0023	0.0026	0.0027	0.0025	0.0026	0.0026	0.0028	0.0025	0.0024	0.0025	0.0026	0.0025	0.0001	0.0028	0.0023
5000	0.0031	0.0030	0.0028	0.0030	0.0030	0.0033	0.0029	0.0027	0.0031	0.0030	0.0030	0.0030	0.0002	0.0033	0.0027
6000	0.0027	0.0030	0.0029	0.0028	0.0029	0.0029	0.0027	0.0024	0.0027	0.0029	0.0028	0.0028	0.0002	0.0030	0.0024
7000	0.0035	0.0033	0.0032	0.0034	0.0036	0.0036	0.0034	0.0031	0.0033	0.0037	0.0034	0.0034	0.0002	0.0037	0.0031
8000	0.0040	0.0041	0.0043	0.0042	0.0044	0.0046	0.0044	0.0043	0.0043	0.0045	0.0043	0.0043	0.0002	0.0046	0.0040
9000	0.0035	0.0033	0.0036	0.0035	0.0036	0.0035	0.0034	0.0031	0.0034	0.0035	0.0034	0.0035	0.0001	0.0036	0.0031
10000	0.0025	0.0025	0.0029	0.0030	0.0029	0.0027	0.0030	0.0025	0.0027	0.0029	0.0028	0.0028	0.0002	0.0030	0.0025
11000	0.0030	0.0032	0.0033	0.0031	0.0034	0.0033	0.0031	0.0029	0.0030	0.0034	0.0032	0.0032	0.0002	0.0034	0.0029
12000	0.0023	0.0028	0.0027	0.0029	0.0029	0.0030	0.0029	0.0026	0.0026	0.0031	0.0028	0.0028	0.0002	0.0031	0.0023
13000	0.0034	0.0033	0.0035	0.0035	0.0036	0.0037	0.0037	0.0033	0.0036	0.0036	0.0035	0.0036	0.0002	0.0037	0.0033
14000	0.0031	0.0033	0.0033	0.0034	0.0035	0.0032	0.0032	0.0029	0.0032	0.0033	0.0032	0.0033	0.0002	0.0035	0.0029
15000	0.0042	0.0041	0.0042	0.0041	0.0042	0.0045	0.0044	0.0039	0.0043	0.0043	0.0042	0.0042	0.0002	0.0045	0.0039

Figure 1: Chromaticity shift (Delta u'v') at Tc = 55℃ If=2880 mA

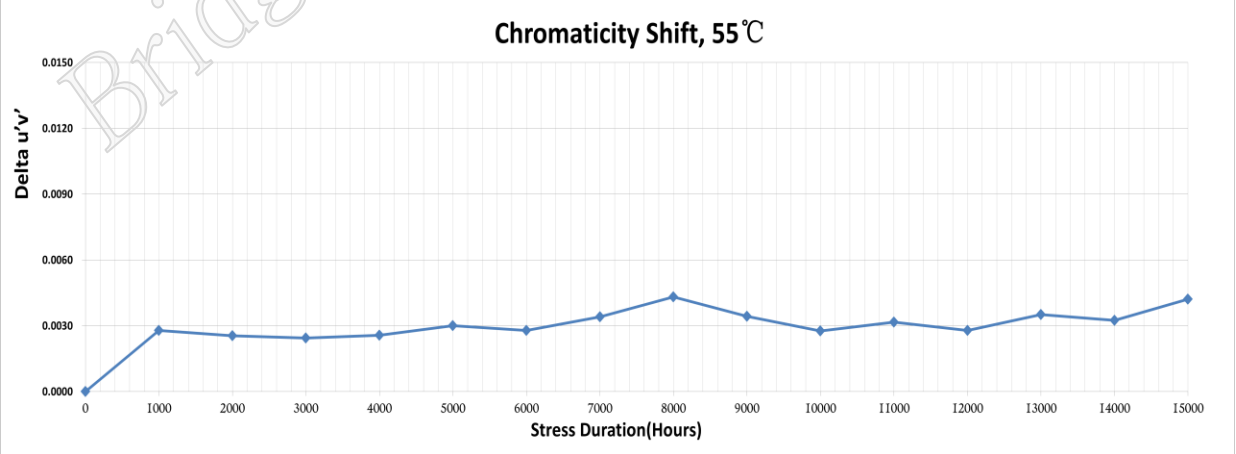
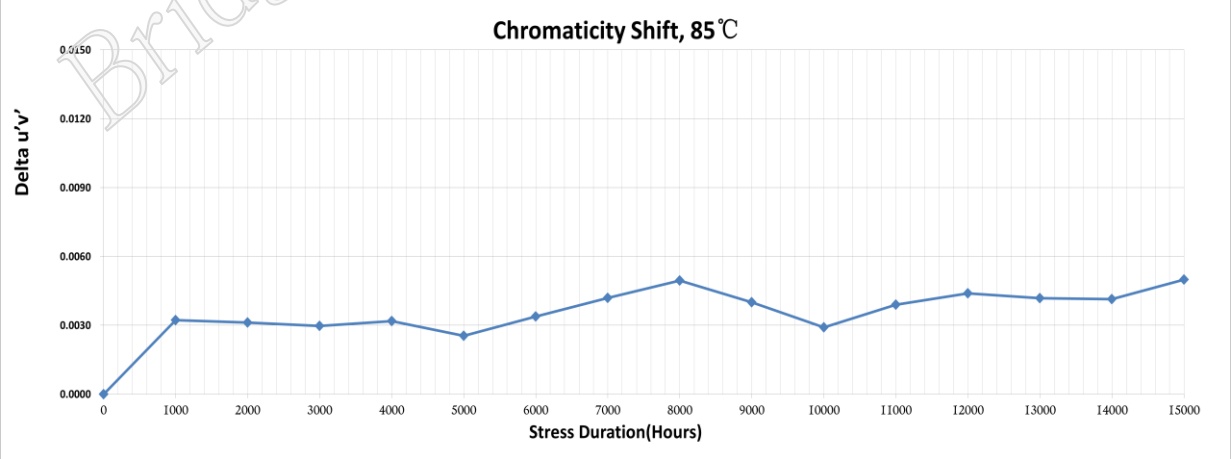


Table 2: Chromaticity shift (Delta u'v') at Tc = 85℃ If=2880mA

Hours	1	2	3	4	5	6	7	8	9	10	AVG	Med	Sdet	Max	Min
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1000	0.0030	0.0035	0.0032	0.0032	0.0036	0.0036	0.0032	0.0029	0.0031	0.0030	0.0032	0.0032	0.0003	0.0036	0.0029
2000	0.0031	0.0035	0.0031	0.0030	0.0035	0.0034	0.0028	0.0027	0.0032	0.0029	0.0031	0.0031	0.0003	0.0035	0.0027
3000	0.0028	0.0034	0.0027	0.0028	0.0033	0.0033	0.0028	0.0028	0.0029	0.0028	0.0030	0.0028	0.0003	0.0034	0.0027
4000	0.0030	0.0037	0.0030	0.0029	0.0037	0.0036	0.0030	0.0028	0.0034	0.0028	0.0032	0.0030	0.0004	0.0037	0.0028
5000	0.0012	0.0027	0.0029	0.0029	0.0024	0.0021	0.0021	0.0018	0.0046	0.0021	0.0025	0.0023	0.0009	0.0046	0.0012
6000	0.0027	0.0040	0.0030	0.0030	0.0041	0.0041	0.0029	0.0028	0.0040	0.0031	0.0034	0.0030	0.0006	0.0041	0.0027
7000	0.0036	0.0049	0.0039	0.0039	0.0050	0.0046	0.0036	0.0039	0.0049	0.0037	0.0042	0.0039	0.0006	0.0050	0.0036
8000	0.0046	0.0058	0.0047	0.0046	0.0057	0.0054	0.0046	0.0045	0.0052	0.0043	0.0049	0.0047	0.0005	0.0058	0.0043
9000	0.0035	0.0049	0.0036	0.0036	0.0049	0.0046	0.0035	0.0035	0.0044	0.0034	0.0040	0.0036	0.0006	0.0049	0.0034
10000	0.0023	0.0036	0.0024	0.0025	0.0038	0.0034	0.0024	0.0025	0.0037	0.0024	0.0029	0.0025	0.0006	0.0038	0.0023
11000	0.0034	0.0050	0.0035	0.0035	0.0048	0.0046	0.0033	0.0033	0.0045	0.0033	0.0039	0.0035	0.0007	0.0050	0.0033
12000	0.0041	0.0053	0.0041	0.0041	0.0054	0.0048	0.0036	0.0039	0.0050	0.0037	0.0044	0.0041	0.0007	0.0054	0.0036
13000	0.0037	0.0050	0.0038	0.0039	0.0052	0.0047	0.0036	0.0035	0.0047	0.0037	0.0042	0.0038	0.0006	0.0052	0.0035
14000	0.0037	0.0052	0.0038	0.0037	0.0050	0.0048	0.0035	0.0034	0.0047	0.0035	0.0041	0.0038	0.0007	0.0052	0.0034
15000	0.0047	0.0060	0.0046	0.0047	0.0057	0.0058	0.0042	0.0044	0.0055	0.0044	0.0050	0.0047	0.0007	0.0060	0.0042

Figure 2: Chromaticity shift (Delta u'v') at Tc = 85℃ If=2880 mA



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Observation of LED Light Source Failures

No optical, electrical or mechanical failure of any LED light source was found during life testing.

Appendix

Photometric Measurement Uncertainty

The tester is calibrated annually and the calibration data ensures <1.20% (k=2) uncertainty of measurement.

Gauge Study Results

Gauge study shows the following results:

R&R:	1.06%
Standard Deviation:	0.05%

Equipment List

1)
Description: DC Power Supply
Manufacturer: Vektrex
Model: SS200
Last Calibration Date: 2023/04/28
Next Calibration Due Date: 2024/04/27
2)
Description: X Y-TEST
Manufacturer: HON-JER TECHNOLOGY
Model: HJ-FST-400
Last Calibration Date: 2023/04/15
Next Calibration Due Date: 2024/04/14
3)
Description: Digital Thermometer
Manufacturer: OMEGA
Model: HH801B
Last Calibration Date: 2023/04/16
Next Calibration Due Date: 2024/04/15
4)
Description: Digital Multimeter
Manufacturer: Fluke
Model: 289C
Last Calibration Date: 2023/07/13
Next Calibration Due Date: 2024/07/12

THE END OF TEST REPORT

Lab Accreditation Certificate

INTERNATIONAL ACCREDITATION SERVICE®

CERTIFICATE OF ACCREDITATION

This is to attest that

BRIDGELUX KAISTAR LABORATORY

NO.101, XIANG XING ROAD, XIANG AN BRANCH, TORCH HI-TECH INDUSTRIAL DEVELOPMENT ZONE
XIAMEN, GUA 361101, PEOPLE'S REPUBLIC OF CHINA

Testing Laboratory TL-855

has met the requirements of AC89, *IAS Accreditation Criteria for Testing Laboratories*, and has demonstrated compliance with ISO/IEC Standard 17025:2017, *General requirements for the competence of testing and calibration laboratories.* This organization is accredited to provide the services specified in the scope of accreditation.

Effective Date August 8, 2023

President

Visit www.iasonline.org for current accreditation information.

SCOPE OF ACCREDITATION

International Accreditation Service, Inc.

3060 Saturn Street, Suite 100, Brea, California 92821, U.S.A. | www.iasonline.org

BRIDGELUX KAISTAR LABORATORY

www.bridgelux.com

Contact Name Vivek Chidambaram **Contact Phone** +86 9255838522

Accredited to ISO/IEC 17025:2017 *Effective Date August 8, 2023*

Photometric & Reliability Testing	
ANSI/ESDA/JEDEC JS-001	Electrostatic Discharge (ESD) Sensitivity Testing Human Body Model (HBM)
ANSI/IES LM-80-08	Measuring lumen maintenance of LED light sources
ANSI/IES LM-80-15	Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
CIE Pub. 13.3:1995	Method of measuring and specifying color rendering properties of light sources
CIE Pub. 15:2004	Colorimetry
IES LM-58-13	Spectroradiometric Measurement Methods for Light Sources
IES LM-82-12	Characterization of LED light engines and LED lamps for electrical and photometric properties as a function of temperature
IES TM-21-11	Projecting Long Term Lumen Maintenance of LED Light Sources
IES TM-30-15	IES Method for Evaluating Light Source Color Rendition
IES TM-30-18	IES Method for Evaluating Light Source Color Rendition
JEDEC J-STD-020	Moisture Reflow Sensitivity Classification for Nonhermetic Surface Mount Devices
JESD22-A100	Cycled Temperature-Humidity-Bias Life Test
JESD22-A101	Steady-State Temperature-Humidy Bias Life Test
JESD22-A103	High Temperature Storage Life
JESD22-A104	Temperature Cycling
JESD22-A105	Power and Temperature Cycling
JESD22-A108	Temperature, Bias, and Operating Life
JESD22-A113	Pre-condition of Plastic Surface Mount Devices Prior to Reliability Testing
JESD22-A119	Low Temperature Storage Life