



# IESNA LM-80-08

MEASURING LUMEN MAINTENANCE OF LED LIGHT SOURCES

## MEASUREMENT AND TEST REPORT

For

### Hongli Zhihui Group Co.,Ltd. Guangzhou Branch

Room 316, Building 2, No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China

**Model:HL-LM004H384W-40B18C12(Ra2)**

<b>Report Type:</b> 10000 Hours Test Report	<b>Product Type:</b> LED Array
<b>Test Engineer:</b> Daniel Duan	<i>Daniel Duan</i>
<b>Report Number:</b> RSZ150309507-10-10000-M3	
<b>Test Date:</b> 2015-03-11 to 2016-05-05	
<b>Report Date:</b> 2019-01-12	
<b>Reviewed By:</b> Jeanne Han /EE Manager	<i>Jeanne Han</i>
<b>Revised Note:</b>	The previous report RSZ150309507-10-10000-M2 is replaced by this report on 2019-01-12
<b>Prepared By:</b>	Bay Area Compliance Laboratories Corp. (Dongguan). No.69, Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China. Tel: +86-0769-86858888 Fax:+86-0769-86858588

**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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## 1 - General Information

### 1.1 Description of LED Light Sources

Devices tested

Part Number:	HL-LM004H384W-40B18C12(Ra2)
Part Type:	LED Array
Nominal CCT:	2700K
Power:	80.4W
Current Density per LED die:	442.86mA/mm <sup>2</sup>
Power Density per LED die:	1.3737W/mm <sup>2</sup>
CRI:	80
Die Spacing:	0.35mm

Family products covered by this report:

According to ENERGY STAR<sup>®</sup> Requirements for the Use of LM-80 Data, the following products can be covered by this report base on the information and declaration provided by manufacturer. The information of these models shows that the covered products meet all section 4 requirements of ENERGY STAR<sup>®</sup> Requirements for the Use of LM-80 Data (September 28, 2017)

Model type	Model name	CRI (typ.)	CCT (typ.)	Series	Parallel	Power density (W/mm <sup>2</sup> )	Current density per LED die (mA/mm <sup>2</sup> )	Current per die (mA)	Distance between of dies	Current (mA)
Tested model	HL-LM004H384W-40B18C12(Ra2)	80	2700K	12	18	0.1025	442.86	120	0.35	2160
Multiple models	HL-LM004H384W-40B18C12(Ra2)	80	3000K	12	18	0.1025	442.86	120	0.35	2160
		80	4000K	12	18	0.1025	442.86	120	0.35	2160
		80	5000K	12	18	0.1025	442.86	120	0.35	2160
		80	5700K	12	18	0.1025	442.86	120	0.35	2160
		80	6500K	12	18	0.1025	442.86	120	0.35	2160
Multiple models	HL-LM004H384W-35B16C12(Ra2)	80	2700K	12	16	0.0911	442.86	120	0.45	1920
		80	3000K	12	16	0.0911	442.86	120	0.45	1920
		80	4000K	12	16	0.0911	442.86	120	0.45	1920
		80	5000K	12	16	0.0911	442.86	120	0.45	1920
		80	5700K	12	16	0.0911	442.86	120	0.45	1920
Multiple models	HL-LM004H384W-20B10C12(Ra2)	80	2700K	12	10	0.0735	442.86	120	0.62	1200
		80	3000K	12	10	0.0735	442.86	120	0.62	1200
		80	4000K	12	10	0.0735	442.86	120	0.62	1200
		80	5000K	12	10	0.0735	442.86	120	0.62	1200
		80	5700K	12	10	0.0735	442.86	120	0.62	1200
Multiple models	HL-LM004H384W-25B12C12(Ra2)	80	2700K	12	12	0.0854	442.86	120	0.47	1440
		80	3000K	12	12	0.0854	442.86	120	0.47	1440
		80	4000K	12	12	0.0854	442.86	120	0.47	1440
		80	5000K	12	12	0.0854	442.86	120	0.47	1440
		80	5700K	12	12	0.0854	442.86	120	0.47	1440
Multiple models	HL-LM004H384W-30B14C12(Ra2)	80	2700K	12	14	0.0996	442.86	120	0.48	1680
		80	3000K	12	14	0.0996	442.86	120	0.48	1680
		80	4000K	12	14	0.0996	442.86	120	0.48	1680
		80	5000K	12	14	0.0996	442.86	120	0.48	1680
		80	5700K	12	14	0.0996	442.86	120	0.48	1680
Multiple models	HL-LM004H384W-30B14C12(Ra2)	80	6500K	12	14	0.0996	442.86	120	0.48	1680

Model type	Model name	CRI (typ.)	CCT (typ.)	Series	Parallel	Power density (W/mm <sup>2</sup> )	Current density per LED die (mA/mm <sup>2</sup> )	Current per die (mA)	Distance between of dies	Current (mA)
Multiple models	HL-LM004H384W-25B7C18(Ra2)	80	2700K	18	7	0.0598	442.86	120	1.08	840
		80	3000K	18	7	0.0598	442.86	120	1.08	840
		80	4000K	18	7	0.0598	442.86	120	1.08	840
		80	5000K	18	7	0.0598	442.86	120	1.08	840
		80	5700K	18	7	0.0598	442.86	120	1.08	840
		80	6500K	18	7	0.0598	442.86	120	1.08	840
Multiple models	HL-LM004H384W-17B8C12(Ra2)	80	2700K	12	8	0.0588	442.86	120	1.08	960
		80	3000K	12	8	0.0588	442.86	120	1.08	960
		80	4000K	12	8	0.0588	442.86	120	1.08	960
		80	5000K	12	8	0.0588	442.86	120	1.08	960
		80	5700K	12	8	0.0588	442.86	120	1.08	960
		80	6500K	12	8	0.0588	442.86	120	1.08	960
Multiple models	HL-LM004H384W-50B2C54(Ra2)	80	2700K	54	2	0.0661	442.86	120	0.89	240
		80	3000K	54	2	0.0661	442.86	120	0.89	240
		80	4000K	54	2	0.0661	442.86	120	0.89	240
		80	5000K	54	2	0.0661	442.86	120	0.89	240
		80	5700K	54	2	0.0661	442.86	120	0.89	240
		80	6500K	54	2	0.0661	442.86	120	0.89	240
Multiple models	HL-LM004H384W-40B2C42(Ra2)	80	2700K	42	2	0.0498	442.86	120	1.24	240
		80	3000K	42	2	0.0498	442.86	120	1.24	240
		80	4000K	42	2	0.0498	442.86	120	1.24	240
		80	5000K	42	2	0.0498	442.86	120	1.24	240
		80	5700K	42	2	0.0498	442.86	120	1.24	240
		80	6500K	42	2	0.0498	442.86	120	1.24	240
Multiple models	HL-LM004H384W-24B2C26(Ra2)	80	2700K	26	2	0.0318	442.86	120	1.35	240
		80	3000K	26	2	0.0318	442.86	120	1.35	240
		80	4000K	26	2	0.0318	442.86	120	1.35	240
		80	5000K	26	2	0.0318	442.86	120	1.35	240
		80	5700K	26	2	0.0318	442.86	120	1.35	240
		80	6500K	26	2	0.0318	442.86	120	1.35	240
Multiple models	HL-LM004H384W-30B4C15(Ra2)	80	2700K	15	4	0.0367	442.86	120	0.89	480
		80	3000K	15	4	0.0367	442.86	120	0.89	480
		80	4000K	15	4	0.0367	442.86	120	0.89	480
		80	5000K	15	4	0.0367	442.86	120	0.89	480
		80	5700K	15	4	0.0367	442.86	120	0.89	480
		80	6500K	15	4	0.0367	442.86	120	0.89	480
Multiple models	HL-LM004H384W-40B6C14(Ra2)	80	2700K	14	6	0.0318	442.86	120	1.35	720
		80	3000K	14	6	0.0318	442.86	120	1.35	720
		80	4000K	14	6	0.0318	442.86	120	1.35	720
		80	5000K	14	6	0.0318	442.86	120	1.35	720
		80	5700K	14	6	0.0318	442.86	120	1.35	720
		80	6500K	14	6	0.0318	442.86	120	1.35	720
Multiple models	HL-LM004H384W-50B6C18(Ra2)	80	2700K	18	6	0.0661	442.86	120	0.89	720
		80	3000K	18	6	0.0661	442.86	120	0.89	720
		80	4000K	18	6	0.0661	442.86	120	0.89	720
		80	5000K	18	6	0.0661	442.86	120	0.89	720
		80	5700K	18	6	0.0661	442.86	120	0.89	720
		80	6500K	18	6	0.0661	442.86	120	0.89	720
Multiple models	HL-LMH04D90W-40B18C12(Ra2)	80	2700K	12	18	0.0992	260.50	120	0.67	2160
		80	3000K	12	18	0.0992	260.50	120	0.67	2160
		80	3500K	12	18	0.0992	260.50	120	0.67	2160
		80	4000K	12	18	0.0992	260.50	120	0.67	2160
		80	5000K	12	18	0.0992	260.50	120	0.67	2160
		80	5700K	12	18	0.0992	260.50	120	0.67	2160
		80	6000K	12	18	0.0992	260.50	120	0.67	2160
		80	6500K	12	18	0.0992	260.50	120	0.67	2160

Model type	Model name	CRI (typ.)	CCT (typ.)	Series	Parallel	Power density (W/mm <sup>2</sup> )	Current density per LED die (mA/mm <sup>2</sup> )	Current per die (mA)	Distance between of dies	Current (mA)
Multiple models	HL-LMH04D90W-35B16C12(Ra2)	80	2700K	12	16	0.0882	260.50	120	0.52	1920
		80	3000K	12	16	0.0882	260.50	120	0.52	1920
		80	3500K	12	16	0.0882	260.50	120	0.52	1920
		80	4000K	12	16	0.0882	260.50	120	0.52	1920
		80	5000K	12	16	0.0882	260.50	120	0.52	1920
		80	5700K	12	16	0.0882	260.50	120	0.52	1920
		80	6000K	12	16	0.0882	260.50	120	0.52	1920
		80	6500K	12	16	0.0882	260.50	120	0.52	1920
Multiple models	HL-LMH04D90W-25B12C12(Ra2)	80	2700K	12	12	0.0661	260.50	120	0.54	1440
		80	3000K	12	12	0.0661	260.50	120	0.54	1440
		80	3500K	12	12	0.0661	260.50	120	0.54	1440
		80	4000K	12	12	0.0661	260.50	120	0.54	1440
		80	5000K	12	12	0.0661	260.50	120	0.54	1440
		80	5700K	12	12	0.0661	260.50	120	0.54	1440
		80	6000K	12	12	0.0661	260.50	120	0.54	1440
		80	6500K	12	12	0.0661	260.50	120	0.54	1440
Multiple models	HL-LMH04D90W-22B11C12(Ra2)	80	2700K	12	11	0.0606	260.50	120	0.67	1320
		80	3000K	12	11	0.0606	260.50	120	0.67	1320
		80	3500K	12	11	0.0606	260.50	120	0.67	1320
		80	4000K	12	11	0.0606	260.50	120	0.67	1320
		80	5000K	12	11	0.0606	260.50	120	0.67	1320
		80	5700K	12	11	0.0606	260.50	120	0.67	1320
		80	6000K	12	11	0.0606	260.50	120	0.67	1320
		80	6500K	12	11	0.0606	260.50	120	0.67	1320
Multiple models	HL-LM071D94W-40B18C12(Ra2)	80	2700K	12	18	0.0978	211.36	120	0.39	2160
		80	3000K	12	18	0.0978	211.36	120	0.39	2160
		80	3500K	12	18	0.0978	211.36	120	0.39	2160
		80	4000K	12	18	0.0978	211.36	120	0.39	2160
		80	5000K	12	18	0.0978	211.36	120	0.39	2160
		80	5700K	12	18	0.0978	211.36	120	0.39	2160
		80	6000K	12	18	0.0978	211.36	120	0.39	2160
		80	6500K	12	18	0.0978	211.36	120	0.39	2160
Multiple models	HL-LM071D94W-35B16C12(Ra2)	80	2700K	12	16	0.087	211.36	120	0.5	1920
		80	3000K	12	16	0.087	211.36	120	0.5	1920
		80	3500K	12	16	0.087	211.36	120	0.5	1920
		80	4000K	12	16	0.087	211.36	120	0.5	1920
		80	5000K	12	16	0.087	211.36	120	0.5	1920
		80	5700K	12	16	0.087	211.36	120	0.5	1920
		80	6000K	12	16	0.087	211.36	120	0.5	1920
		80	6500K	12	16	0.087	211.36	120	0.5	1920
Multiple models	HL-LM071D94W-25B12C12(Ra2)	80	2700K	12	12	0.0652	211.36	120	0.52	1440
		80	3000K	12	12	0.0652	211.36	120	0.52	1440
		80	3500K	12	12	0.0652	211.36	120	0.52	1440
		80	4000K	12	12	0.0652	211.36	120	0.52	1440
		80	5000K	12	12	0.0652	211.36	120	0.52	1440
		80	5700K	12	12	0.0652	211.36	120	0.52	1440
		80	6000K	12	12	0.0652	211.36	120	0.52	1440
		80	6500K	12	12	0.0652	211.36	120	0.52	1440
Multiple models	HL-LM071D94W-22B11C12(Ra2)	80	2700K	12	11	0.0598	211.36	120	0.65	1320
		80	3000K	12	11	0.0598	211.36	120	0.65	1320
		80	3500K	12	11	0.0598	211.36	120	0.65	1320
		80	4000K	12	11	0.0598	211.36	120	0.65	1320
		80	5000K	12	11	0.0598	211.36	120	0.65	1320
		80	5700K	12	11	0.0598	211.36	120	0.65	1320
		80	6000K	12	11	0.0598	211.36	120	0.65	1320
		80	6500K	12	11	0.0598	211.36	120	0.65	1320

Model type	Model name	CRI (typ.)	CCT (typ.)	Series	Parallel	Power density (W/mm <sup>2</sup> )	Current density per LED die (mA/mm <sup>2</sup> )	Current per die (mA)	Distance between of dies	Current (mA)
Multiple models	HL-LM071D42W-40B18C12(Ra2)	80	2700K	12	18	0.0992	241.56	120	0.67	2160
		80	3000K	12	18	0.0992	241.56	120	0.67	2160
		80	3500K	12	18	0.0992	241.56	120	0.67	2160
		80	4000K	12	18	0.0992	241.56	120	0.67	2160
		80	5000K	12	18	0.0992	241.56	120	0.67	2160
		80	5700K	12	18	0.0992	241.56	120	0.67	2160
		80	6000K	12	18	0.0992	241.56	120	0.67	2160
		80	6500K	12	18	0.0992	241.56	120	0.67	2160
Multiple models	HL-LM071D42W-35B16C12(Ra2)	80	2700K	12	16	0.0882	241.56	120	0.52	1920
		80	3000K	12	16	0.0882	241.56	120	0.52	1920
		80	3500K	12	16	0.0882	241.56	120	0.52	1920
		80	4000K	12	16	0.0882	241.56	120	0.52	1920
		80	5000K	12	16	0.0882	241.56	120	0.52	1920
		80	5700K	12	16	0.0882	241.56	120	0.52	1920
		80	6000K	12	16	0.0882	241.56	120	0.52	1920
		80	6500K	12	16	0.0882	241.56	120	0.52	1920
Multiple models	HL-LM071D42W-25B12C12(Ra2)	80	2700K	12	12	0.0661	241.56	120	0.54	1440
		80	3000K	12	12	0.0661	241.56	120	0.54	1440
		80	3500K	12	12	0.0661	241.56	120	0.54	1440
		80	4000K	12	12	0.0661	241.56	120	0.54	1440
		80	5000K	12	12	0.0661	241.56	120	0.54	1440
		80	5700K	12	12	0.0661	241.56	120	0.54	1440
		80	6000K	12	12	0.0661	241.56	120	0.54	1440
		80	6500K	12	12	0.0661	241.56	120	0.54	1440
Multiple models	HL-LM071D42W-22B11C12(Ra2)	80	2700K	12	11	0.0606	241.56	120	0.67	1320
		80	3000K	12	11	0.0606	241.56	120	0.67	1320
		80	3500K	12	11	0.0606	241.56	120	0.67	1320
		80	4000K	12	11	0.0606	241.56	120	0.67	1320
		80	5000K	12	11	0.0606	241.56	120	0.67	1320
		80	5700K	12	11	0.0606	241.56	120	0.67	1320
		80	6000K	12	11	0.0606	241.56	120	0.67	1320
		80	6500K	12	11	0.0606	241.56	120	0.67	1320
Multiple models	HL-LML04H421W-40B18C12(Ra2)	80	2700K	12	18	0.0579	401.85	70	0.7	1260
		80	3000K	12	18	0.0579	401.85	70	0.7	1260
		80	3500K	12	18	0.0579	401.85	70	0.7	1260
		80	4000K	12	18	0.0579	401.85	70	0.7	1260
		80	5000K	12	18	0.0579	401.85	70	0.7	1260
		80	5700K	12	18	0.0579	401.85	70	0.7	1260
		80	6000K	12	18	0.0579	401.85	70	0.7	1260
		80	6500K	12	18	0.0579	401.85	70	0.7	1260
Multiple models	HL-LML04H421W-35B16C12(Ra2)	80	2700K	12	16	0.0514	401.85	70	0.8	1120
		80	3000K	12	16	0.0514	401.85	70	0.8	1120
		80	3500K	12	16	0.0514	401.85	70	0.8	1120
		80	4000K	12	16	0.0514	401.85	70	0.8	1120
		80	5000K	12	16	0.0514	401.85	70	0.8	1120
		80	5700K	12	16	0.0514	401.85	70	0.8	1120
		80	6000K	12	16	0.0514	401.85	70	0.8	1120
		80	6500K	12	16	0.0514	401.85	70	0.8	1120
Multiple models	HL-LML04H421W-25B12C12(Ra2)	80	2700K	12	12	0.0386	401.85	70	0.83	840
		80	3000K	12	12	0.0386	401.85	70	0.83	840
		80	3500K	12	12	0.0386	401.85	70	0.83	840
		80	4000K	12	12	0.0386	401.85	70	0.83	840
		80	5000K	12	12	0.0386	401.85	70	0.83	840
		80	5700K	12	12	0.0386	401.85	70	0.83	840
		80	6000K	12	12	0.0386	401.85	70	0.83	840
		80	6500K	12	12	0.0386	401.85	70	0.83	840

Model type	Model name	CRI (typ.)	CCT (typ.)	Series	Parallel	Power density (W/mm <sup>2</sup> )	Current density per LED die (mA/mm <sup>2</sup> )	Current per die (mA)	Distance between of dies	Current (mA)
Multiple models	HL-LML04H421W-22B11C12(Ra2)	80	2700K	12	11	0.0354	401.85	70	0.95	770
		80	3000K	12	11	0.0354	401.85	70	0.95	770
		80	3500K	12	11	0.0354	401.85	70	0.95	770
		80	4000K	12	11	0.0354	401.85	70	0.95	770
		80	5000K	12	11	0.0354	401.85	70	0.95	770
		80	5700K	12	11	0.0354	401.85	70	0.95	770
		80	6000K	12	11	0.0354	401.85	70	0.95	770
		80	6500K	12	11	0.0354	401.85	70	0.95	770
Multiple models	HL-LM024H384W-40B2C40(Ra2)	80	2700K	40	2	0.0367	442.86	120	1.15	240
		80	3000K	40	2	0.0110	442.86	120	1.15	240
		80	3500K	40	2	0.0110	442.86	120	1.15	240
		80	4000K	40	2	0.0110	442.86	120	1.15	240
		80	5000K	40	2	0.0110	442.86	120	1.15	240
		80	5700K	40	2	0.0110	442.86	120	1.15	240
		80	6000K	40	2	0.0110	442.86	120	1.15	240
		80	6500K	40	2	0.0110	442.86	120	1.15	240
Multiple models	HL-LM024H384W-50B2C50(Ra2)	80	2700K	50	2	0.0459	442.86	120	1.05	240
		80	3000K	50	2	0.0110	442.86	120	1.05	240
		80	3500K	50	2	0.0110	442.86	120	1.05	240
		80	4000K	50	2	0.0110	442.86	120	1.05	240
		80	5000K	50	2	0.0110	442.86	120	1.05	240
		80	5700K	50	2	0.0110	442.86	120	1.05	240
		80	6000K	50	2	0.0110	442.86	120	1.05	240
		80	6500K	50	2	0.0110	442.86	120	1.05	240
Multiple models	HL-LM024H384W-60B2C60(Ra2)	80	2700K	50	2	0.0459	442.86	120	0.88	240
		80	3000K	50	2	0.0110	442.86	120	0.88	240
		80	3500K	50	2	0.0110	442.86	120	0.88	240
		80	4000K	50	2	0.0110	442.86	120	0.88	240
		80	5000K	50	2	0.0110	442.86	120	0.88	240
		80	5700K	50	2	0.0110	442.86	120	0.88	240
		80	6000K	50	2	0.0110	442.86	120	0.88	240
		80	6500K	50	2	0.0110	442.86	120	0.88	240
Multiple models	HL-LM024D90W-40B2C40(Ra2)	80	2700K	40	2	0.0459	316.33	150	1.04	300
		80	3000K	40	2	0.0138	316.33	150	1.04	300
		80	3500K	40	2	0.0138	316.33	150	1.04	300
		80	4000K	40	2	0.0138	316.33	150	1.04	300
		80	5000K	40	2	0.0138	316.33	150	1.04	300
		80	5700K	40	2	0.0138	316.33	150	1.04	300
		80	6000K	40	2	0.0138	316.33	150	1.04	300
		80	6500K	40	2	0.0138	316.33	150	1.04	300
Multiple models	HL-LM024D90W-50B2C50(Ra2)	80	2700K	50	2	0.0574	316.33	150	0.94	300
		80	3000K	50	2	0.0138	316.33	150	0.94	300
		80	3500K	50	2	0.0138	316.33	150	0.94	300
		80	4000K	50	2	0.0138	316.33	150	0.94	300
		80	5000K	50	2	0.0138	316.33	150	0.94	300
		80	5700K	50	2	0.0138	316.33	150	0.94	300
		80	6000K	50	2	0.0138	316.33	150	0.94	300
		80	6500K	50	2	0.0138	316.33	150	0.94	300
Multiple models	HL-LM024D90W-60B2C60(Ra2)	80	2700K	50	2	0.0574	316.33	150	0.78	300
		80	3000K	50	2	0.0138	316.33	150	0.78	300
		80	3500K	50	2	0.0138	316.33	150	0.78	300
		80	4000K	50	2	0.0138	316.33	150	0.78	300
		80	5000K	50	2	0.0138	316.33	150	0.78	300
		80	5700K	50	2	0.0138	316.33	150	0.78	300
		80	6000K	50	2	0.0138	316.33	150	0.78	300
		80	6500K	50	2	0.0138	316.33	150	0.78	300

## 1.2 Standards Used:

- IESNA LM-80-08: IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
- CIE 127:2007: Measurement of LEDs (This standard was not accredited by IAS).
- ENERGY STAR® Requirements for the Use of LM-80 Data (This standard was not accredited by IAS)

## 1.3 Test Facility

The testing facility used by Bay Area Compliance Laboratories Corp. (Dongguan). is located at No.69, Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

## 1.4 Description of Auxiliary Equipment

Device	Manufacture	Model No	Serial No	Test Range	Calibration date	Calibration due date
1.0m integrating sphere	SENSING	SCD-20008	N/A	N/A	2015-07-17	2016-07-16
spectroradiometer	SENSING	SCD-20008	N/A	N/A	2015-07-17	2016-07-16
DC Power Supply	Hanshenpuyuan	HSPY-100-05	2013010210003	N/A	2015-05-05	2016-05-04
Standard Light Source	EVERFINE	D062	1011093	3000K	2015-09-17	2016-09-16
Multi-channel DC source	Taishan Xingguang	T01000F2	ST04392	0~5V,0~40A	2015-09-17	2016-09-16
Adjustable constant-current DC switching power supply	GUTE	DK-60V50A	120 5037	3000W	2015-09-23	2016-09-22
Digital CC&CV DC Power Supply	EVERFINE	WY5015	11060010	(50/15A)	2016-03-04	2017-03-03

## 1.5 Operating Cycle

Samples are driven with a constant direct current (DC)

## 1.6 Ambient Conditions

For lumen maintenance test, samples were operated in thermal chambers with minimal ambient airflow. For long term reliability test, the case temperature was controlled by mounting several thermocouples on a sample reliability stress board at the designated thermal measurement point, as shown in APPENDIX. The ambient temperature  $T_A$  was measured by several thermocouples at a distance of 5 mm above the reliability test board. The relative humidity within chamber was less than 65%.

For photometry measurement, temperature was set to  $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ , RH <65%.

## 1.7 Photometry Measurement Uncertainty

The uncertainty of the light output measurements is  $U=1.59\%$  ( $K=2$ ), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is  $U=21\text{K}$  ( $K=2$ ), at the 95% confidence level. This calibration results traceable to the NATIONAL INSTITUTE OF METROLOGY (NIM).



## 1.8 Sample Set

### Sampling Method:

LED samples for IESNA LM-80 testing consist of units built from a minimum of three manufacturing lots with each manufacturing lot built from different wafer lots built on non-consecutive days.

These manufacturing lots are picked to represent a wide parametric distribution.

### Sample Size:

Total 30Pcs;

Each Ts test condition 15Pcs

The samples tested at Ts 85°C and Ts 105°C were received at 2015-03-09 and tested during 2015-03-11 to 2016-05-05. The samples were numbered from 1 to 15 and 16 to 30.

#### Data Set 1: 85°C, 2160mA

Part Number:	HL-LM004H384W-40B18C12(Ra2)
Number of Units:	15
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =84.1°C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =82.5°C
Life Test Drive Current:	I <sub>F</sub> =2160mA
Measurement Current:	I <sub>F</sub> = 2160mA

#### Data Set 2: 105°C, 2160mA

Part Number:	HL-LM004H384W-40B18C12(Ra2)
Number of Units:	15
Actual Case Temperature(T <sub>S</sub> ):	T <sub>S</sub> =104.5°C
Actual Ambient Temperature(T <sub>A</sub> ):	T <sub>A</sub> =103.1°C
Life Test Drive Current:	I <sub>F</sub> = 2160mA
Measurement Current:	I <sub>F</sub> = 2160mA

## 2 - Summary of Test Result

<b>Data Set:</b>	<b>Data Set 1, 85°C, 2160mA</b>
Number of Units:	15
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h,10000h
Average. Lumen Maintenance at 7000 hours:	97.23%
Average. Lumen Maintenance at 10000 hours:	96.18%
Average Chromaticity Shift at 7000 hours( $\Delta u'v'$ ):	0.0013
Average Chromaticity Shift at 10000 hours( $\Delta u'v'$ ):	0.0019
Reported TM-21 L <sub>70</sub> Lifetime:	>55,000 hours

<b>Data Set:</b>	<b>Data Set 2, 105°C, 2160mA</b>
Number of Units:	15
Failures Observed:	0
Test Interval and Test Duration:	0h,1000h,2000h,3000h,4000h,5000h,6000h,7000h,8000h,9000h,10000h
Average. Lumen Maintenance at 7000 hours:	95.38%
Average. Lumen Maintenance at 10000 hours:	93.90%
Average Chromaticity Shift at 7000 hours( $\Delta u'v'$ ):	0.0016
Average Chromaticity Shift at 10000 hours( $\Delta u'v'$ ):	0.0022
Reported TM-21 L <sub>70</sub> Lifetime:	>55,000 hours

### 3 - Test Data

#### 3.1 Data Set 1, 85°C, 2160mA (Lumen Maintenance)

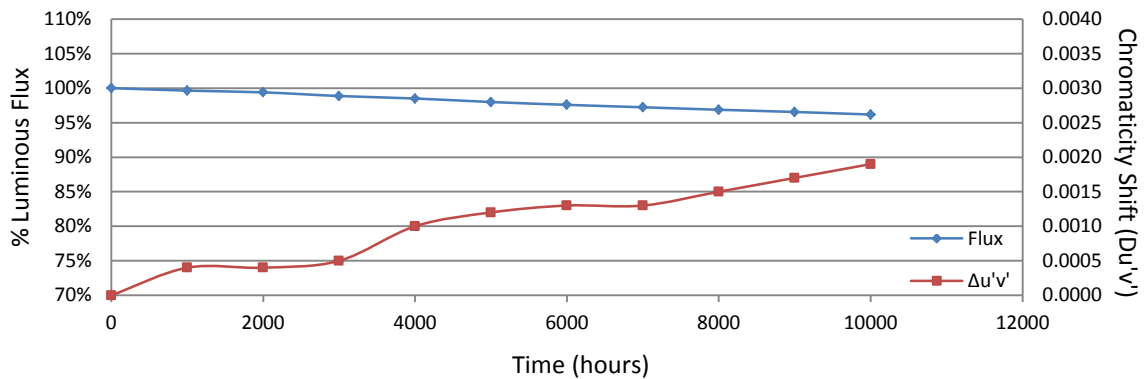
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)									
			0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	37.22	10353.93	99.25	98.98	98.31	97.80	97.10	96.46	96.20	95.67	95.22	94.90
2	37.25	10182.79	100.30	100.08	99.53	99.28	98.96	98.20	97.94	97.78	96.91	96.62
3	37.13	10641.20	98.86	98.78	98.15	97.81	97.40	97.06	96.81	96.72	96.16	95.75
4	37.21	10268.36	99.89	99.74	99.62	99.19	98.61	97.91	97.64	97.55	97.34	96.98
5	37.31	10225.58	98.89	98.66	98.12	97.54	97.32	96.85	96.39	96.01	95.94	95.37
6	37.20	10256.14	99.47	99.05	98.55	98.17	97.75	97.61	97.16	96.93	96.54	96.26
7	37.25	10292.81	99.72	99.44	99.38	99.08	98.18	97.91	97.65	96.92	96.91	96.64
8	37.22	10329.48	99.17	99.07	98.16	98.04	97.48	97.44	96.99	96.41	96.04	95.85
9	37.27	10231.69	100.18	99.95	99.41	99.27	98.59	98.49	97.94	97.33	96.90	96.49
10	37.21	10433.39	100.23	99.76	99.03	98.69	97.86	97.62	97.17	96.88	96.50	95.93
11	37.26	10140.01	100.27	100.09	99.74	99.24	98.69	98.03	97.67	97.09	97.01	96.51
12	37.29	10146.12	100.62	100.41	99.62	99.21	98.88	98.77	98.51	98.49	98.12	97.90
13	37.16	10317.26	98.21	97.68	97.22	97.11	96.82	96.77	96.51	96.09	95.83	95.37
14	37.16	10549.52	99.72	99.46	98.85	98.36	98.19	97.55	97.11	96.86	96.63	96.42
15	37.36	10317.26	99.82	99.69	99.15	98.74	97.95	97.07	96.81	96.30	96.19	95.76
Ave.	37.23	10312.37	99.64	99.39	98.86	98.50	97.99	97.58	97.23	96.87	96.55	96.18
Med.	37.22	10292.81	99.72	99.46	99.03	98.69	97.95	97.61	97.16	96.88	96.54	96.26
st dev	0.06	140.09	0.6630	0.7014	0.7415	0.7221	0.6733	0.6566	0.6477	0.7325	0.7016	0.7445
Min.	37.13	10140.01	98.21	97.68	97.22	97.11	96.82	96.46	96.20	95.67	95.22	94.90
Max.	37.36	10641.20	100.62	100.41	99.74	99.28	98.96	98.77	98.51	98.49	98.12	97.90

#### TM-21 Projection:

**Test Duration:** 10,000 hours  
**Failures Observed:** 0  
 $\alpha$ : 3.679E-06  
 $\beta$ : 0.998  
**Calculated L<sub>70</sub>:** 96,000 hours  
**Reported L<sub>70</sub>:** >55,000 hours

### 3.2 Data Set 1, 85°C, 2160mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )									
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
1	0.2627	0.5288	2690	0.0006	0.0009	0.0011	0.0018	0.0023	0.0020	0.0023	0.0027	0.0030	0.0033
2	0.2630	0.5299	2680	0.0004	0.0006	0.0009	0.0017	0.0018	0.0018	0.0019	0.0016	0.0014	0.0014
3	0.2630	0.5295	2680	0.0004	0.0007	0.0009	0.0011	0.0013	0.0013	0.0013	0.0017	0.0025	0.0029
4	0.2645	0.5286	2654	0.0004	0.0005	0.0009	0.0011	0.0013	0.0016	0.0017	0.0017	0.0023	0.0024
5	0.2637	0.5294	2668	0.0005	0.0005	0.0014	0.0013	0.0016	0.0018	0.0018	0.0016	0.0014	0.0014
6	0.2655	0.5293	2632	0.0001	0.0002	0.0004	0.0011	0.0014	0.0015	0.0016	0.0018	0.0018	0.0020
7	0.2636	0.5297	2668	0.0003	0.0001	0.0003	0.0010	0.0011	0.0009	0.0011	0.0017	0.0019	0.0021
8	0.2641	0.5292	2660	0.0004	0.0005	0.0001	0.0007	0.0008	0.0013	0.0012	0.0017	0.0019	0.0022
9	0.2632	0.5295	2678	0.0006	0.0005	0.0002	0.0009	0.0010	0.0015	0.0013	0.0012	0.0011	0.0013
10	0.2630	0.5291	2684	0.0002	0.0000	0.0004	0.0009	0.0014	0.0018	0.0016	0.0013	0.0013	0.0014
11	0.2626	0.5272	2700	0.0004	0.0002	0.0002	0.0009	0.0010	0.0006	0.0005	0.0006	0.0010	0.0013
12	0.2648	0.5290	2648	0.0004	0.0001	0.0001	0.0007	0.0008	0.0009	0.0008	0.0017	0.0017	0.0018
13	0.2649	0.5288	2646	0.0005	0.0006	0.0001	0.0004	0.0005	0.0008	0.0009	0.0009	0.0010	0.0012
14	0.2634	0.5297	2672	0.0004	0.0004	0.0005	0.0003	0.0007	0.0009	0.0008	0.0011	0.0014	0.0020
15	0.2624	0.5299	2694	0.0003	0.0002	0.0005	0.0006	0.0010	0.0009	0.0010	0.0015	0.0019	0.0019
Ave.	0.2636	0.5292	2670	0.0004	0.0004	0.0005	0.0010	0.0012	0.0013	0.0013	0.0015	0.0017	0.0019
Med.	0.2634	0.5293	2672	0.0004	0.0005	0.0004	0.0009	0.0011	0.0013	0.0013	0.0016	0.0017	0.0019
st dev	0.0009	0.0007	19.2853	0.0001	0.0003	0.0004	0.0004	0.0005	0.0004	0.0005	0.0005	0.0006	0.0006
Min.	0.2624	0.5272	2632	0.0001	0.0000	0.0001	0.0003	0.0005	0.0006	0.0005	0.0006	0.0010	0.0012
Max.	0.2655	0.5299	2700	0.0006	0.0009	0.0014	0.0018	0.0023	0.0020	0.0023	0.0027	0.0030	0.0033



**3.3 Data Set 2, 105°C, 2160mA (Lumen Maintenance)**

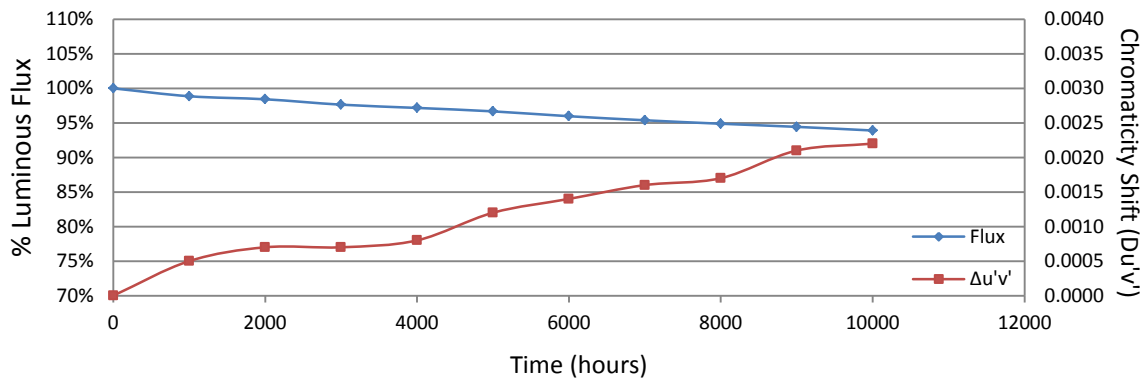
No.	V <sub>F</sub> (V)	Φ(lm)	Lumen Maintenance (%)									
			Ohr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
16	37.12	10573.97	98.90	98.68	97.71	97.47	96.79	96.20	95.68	94.95	94.58	93.88
17	37.37	10121.67	101.68	101.16	100.43	99.78	98.99	98.15	97.60	97.56	97.50	97.09
18	37.15	10390.61	97.85	97.55	97.09	96.34	95.60	94.94	94.41	93.73	93.70	93.46
19	37.33	10140.01	100.88	100.53	99.80	99.48	98.87	98.52	97.98	97.32	96.81	96.17
20	37.20	10121.67	98.61	98.09	97.52	96.99	96.56	95.61	95.06	95.00	94.45	94.31
21	37.13	10647.32	99.39	98.67	97.70	96.98	96.24	95.42	94.90	94.70	93.92	93.15
22	37.07	10628.98	98.06	97.68	97.45	96.97	96.53	95.58	95.06	94.58	94.17	93.61
23	37.17	10421.17	98.63	98.22	97.66	97.13	96.74	95.93	95.40	94.52	94.11	93.41
24	37.13	10384.49	98.24	98.19	96.96	96.52	96.37	95.48	94.95	94.39	94.20	93.74
25	37.18	10378.38	98.50	98.25	97.51	96.78	96.13	95.42	94.88	94.68	93.83	93.24
26	37.07	10616.75	98.18	97.50	96.71	96.47	96.28	95.81	95.01	94.74	93.80	93.17
27	37.06	10586.19	97.29	96.72	96.51	95.79	95.11	94.47	93.95	93.33	92.84	92.33
28	37.15	10439.50	98.12	97.39	96.20	96.03	95.92	95.34	94.81	93.90	93.62	93.30
29	37.15	10396.72	98.46	98.10	97.03	96.76	96.49	96.03	95.12	94.69	94.36	93.85
30	37.19	10402.83	100.13	99.63	98.39	98.11	97.48	96.67	95.92	95.15	94.54	93.83
Ave.	37.16	10416.68	98.86	98.42	97.64	97.17	96.67	95.97	95.38	94.88	94.43	93.90
Med.	37.15	10402.83	98.50	98.19	97.51	96.97	96.49	95.61	95.06	94.69	94.17	93.61
st dev	0.09	178.62	1.1915	1.1963	1.1480	1.1447	1.0636	1.0905	1.0835	1.1494	1.1977	1.2088
Min.	37.06	10121.67	97.29	96.72	96.20	95.79	95.11	94.47	93.95	93.33	92.84	92.33
Max.	37.37	10647.32	101.68	101.16	100.43	99.78	98.99	98.52	97.98	97.56	97.50	97.09

**TM-21 Projection:**

**Test Duration:** 10,000 hours  
**Failures Observed:** 0  
**α:** 5.690E-06  
**β:** 0.994  
**Calculated L<sub>70</sub>:** 62,000 hours  
**Reported L<sub>70</sub>:** >55,000 hours

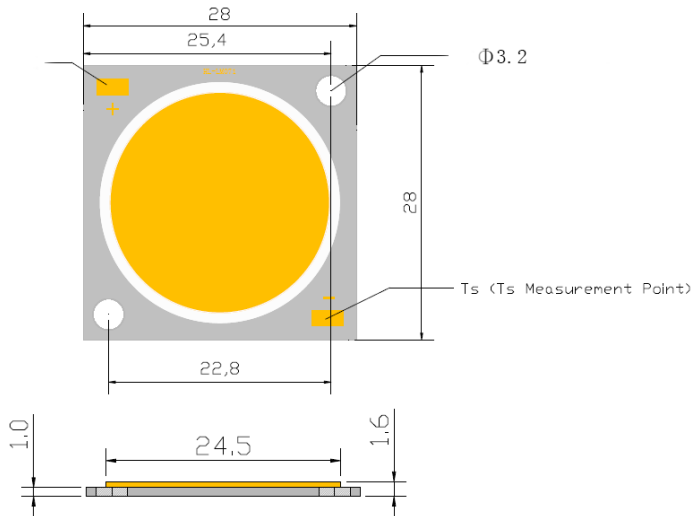
### 3.4 Data Set 2, 105°C, 2160mA (Chromaticity Shift)

No.	u'	v'	CCT(K)	Chromaticity Shift ( $\Delta u'v'$ )									
				0hr(Initial)	1000hrs	2000hrs	3000hrs	4000hrs	5000hrs	6000hrs	7000hrs	8000hrs	9000hrs
16	0.2635	0.5299	2670	0.0002	0.0008	0.0009	0.0005	0.0009	0.0009	0.0012	0.0014	0.0021	0.0025
17	0.2632	0.5290	2680	0.0001	0.0004	0.0003	0.0003	0.0013	0.0016	0.0019	0.0016	0.0020	0.0022
18	0.2633	0.5276	2682	0.0003	0.0004	0.0006	0.0007	0.0011	0.0012	0.0015	0.0019	0.0024	0.0026
19	0.2643	0.5298	2654	0.0001	0.0005	0.0006	0.0006	0.0009	0.0011	0.0012	0.0013	0.0015	0.0016
20	0.2645	0.5276	2658	0.0005	0.0008	0.0010	0.0010	0.0016	0.0019	0.0021	0.0026	0.0032	0.0036
21	0.2631	0.5296	2680	0.0002	0.0009	0.0009	0.0009	0.0010	0.0010	0.0012	0.0017	0.0019	0.0018
22	0.2643	0.5303	2652	0.0025	0.0021	0.0021	0.0021	0.0024	0.0024	0.0025	0.0021	0.0021	0.0014
23	0.2627	0.5292	2690	0.0004	0.0004	0.0004	0.0006	0.0010	0.0011	0.0013	0.0016	0.0022	0.0025
24	0.2636	0.5281	2676	0.0006	0.0006	0.0006	0.0007	0.0014	0.0015	0.0017	0.0020	0.0025	0.0024
25	0.2636	0.5292	2670	0.0005	0.0003	0.0007	0.0009	0.0015	0.0019	0.0021	0.0022	0.0026	0.0027
26	0.2643	0.5300	2654	0.0002	0.0007	0.0008	0.0009	0.0010	0.0011	0.0012	0.0013	0.0015	0.0016
27	0.2647	0.5296	2648	0.0005	0.0002	0.0002	0.0004	0.0006	0.0008	0.0011	0.0013	0.0013	0.0012
28	0.2638	0.5299	2664	0.0000	0.0004	0.0004	0.0013	0.0017	0.0019	0.0020	0.0022	0.0024	0.0024
29	0.2641	0.5289	2662	0.0002	0.0007	0.0007	0.0008	0.0010	0.0011	0.0012	0.0014	0.0015	0.0019
30	0.2630	0.5300	2680	0.0003	0.0008	0.0009	0.0009	0.0012	0.0009	0.0010	0.0013	0.0017	0.0018
Ave.	0.2637	0.5292	2668	0.0005	0.0007	0.0007	0.0008	0.0012	0.0014	0.0016	0.0017	0.0021	0.0022
Med.	0.2636	0.5296	2670	0.0003	0.0006	0.0007	0.0008	0.0011	0.0011	0.0013	0.0016	0.0021	0.0022
st dev	0.0006	0.0009	13.0494	0.0006	0.0005	0.0004	0.0004	0.0004	0.0005	0.0005	0.0004	0.0005	0.0006
Min.	0.2627	0.5276	2648	0.0000	0.0002	0.0002	0.0003	0.0006	0.0008	0.0010	0.0013	0.0013	0.0012
Max.	0.2647	0.5303	2690	0.0025	0.0021	0.0021	0.0021	0.0024	0.0024	0.0025	0.0026	0.0032	0.0036



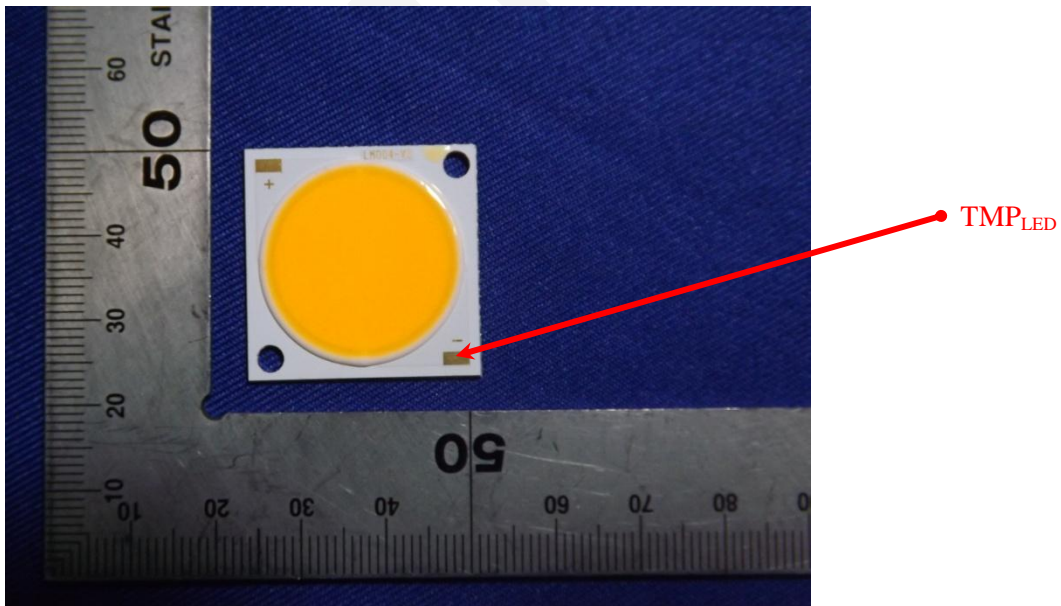
## Attachment A – EUT Photo

### A.1 Mechanical Dimensions (Ta = 25°C)



All dimensions are in millimeter

### A.2 EUT Photo



**Attachment B – Report Revision**

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Report Number	Report Date	Contents
RSZ150309507-10-10000	2017-05-11	Original report.
RSZ150309507-10-10000-M1	2017-12-11	Update the Family Declaration in page 3 to 12.
RSZ150309507-10-10000-M2	2018-01-25	Update the Description of LED Light Sources in page 3. Update the Standards Used in page 8. Update the Mechanical Dimensions Photo in page 15.
RSZ150309507-10-10000-M3	2019-01-12	Update Company name and address on page 1. Update the Power Density per LED die on page 3.

\*\*\*\*\*END OF REPORT\*\*\*\*\*