



**THE DATASHEET OF
SPHWAHDNL251ZW2D3**



High Voltage LED Series
Chip on Board

COB D-Gen.3



High efficacy COB LED package
well-suited for use in spotlight applications

Features & Benefits

- Chip on Board (COB) solution makes it easy to design in
- Simple assembly reduces manufacturing cost
- Low thermal resistance
- InGaN/GaN MQW LED with long time reliability

Applications

- Spotlight / Downlight
- LED Retrofit Bulbs
- Outdoor Illumination



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1. Characteristics

a) Absolute Maximum Rating

Item	Symbol	Model	Rating	Unit	Condition
Ambient / Operating Temperature	T_a	-	-40 ~ +105	°C	-
Storage Temperature	T_{stg}	-	-40 ~ +120	°C	-
LED Junction Temperature	T_J	-	150	°C	-
Case Temperature	T_c	-	115	°C	-
		LC003D	230 / 8.8		-
		LC006D	460 / 17.5		-
		LC009D	690 / 26.3		-
		LC013D	920 / 35.0		-
		LC016D	1150 / 43.8		-
Forward Current / Power Dissipation	I_F / P_D	LC019D	1380 / 52.6	mA / W	-
		LC026D	1840 / 70.1		-
		LC033D	2300 / 87.6		-
		LC040D	2760 / 105.1		-
		LC060D	2760 / 157.7		-
		LC080D	4140 / 231.3		-
ESD (HBM)	-	-	±2	kV	-

b) Electro-optical Characteristics (I_F = Sorting Current, $T_J = 85\text{ }^\circ\text{C}$)

Item	Unit	Model	Rank	Min.	Typ.	Max.	
Forward Voltage (V_F)	V	All model	YZ	31.0	34.0	37.0	
			1Z	60W	46.8	51.0	55.2
				80W	46.8	50.0	52.5
Color Rendering Index (R_a)	-	All model	3	70	-	-	
			5	80	-	-	
			7	90	-	-	
Beam Angle	$^\circ$	-	-	-	115	-	
Nominal Power / Sorting Current	W / mA	LC003D	-	-	3.1 / 90	-	
		LC006D	-	-	6.1 / 180	-	
		LC009D	-	-	9.2 / 270	-	
		LC013D	-	-	12.2 / 360	-	
		LC016D	-	-	15.3 / 450	-	
		LC019D	-	-	18.4 / 540	-	
		LC026D	-	-	24.5 / 720	-	
		LC033D	-	-	30.6 / 900	-	
		LC040D	-	-	36.7 / 1080	-	
		LC060D	-	-	55.1 / 1080	-	
		LC080D	-	-	81.0 / 1620	-	
Thermal Resistance (Junction to chip case)	$^\circ\text{C/W}$	LC003D	-	-	2.43	-	
		LC006D	-	-	1.41	-	
		LC009D	-	-	0.94	-	
		LC013D	-	-	0.81	-	
		LC016D	-	-	0.64	-	
		LC019D	-	-	0.57	-	
		LC026D	-	-	0.45	-	
		LC033D	-	-	0.38	-	
		LC040D	-	-	0.30	-	
		LC060D	-	-	0.23	-	
		LC080D	-	-	0.15	-	

Notes:

- 1) The COB is tested in pulsed condition at rated test current (10 ms pulse width) and rated temperature ($T_J = T_C = T_a = 85\text{ }^\circ\text{C}$)
- 2) Samsung maintains measurement tolerance of: forward voltage = $\pm 5\%$, CRI = ± 1
- 3) Refer to the derating curve, '3. Typical Characteristics Graph' designed within the range.

c) Luminous Flux Characteristics (I_F = Sorting Current)

Model	CRI (R _a) Min.	Nominal CCT (K)	Flux Rank	Flux@ T _J = 85 °C (lm)			
				Min.	Typ.	Max.	
LC003D	80	2700	D3	451	475	-	
		3000	D3	474	499	-	
		3500	D3	488	514	-	
		4000	D3	498	524	-	
		5000	D3	502	529	-	
		5700	D3	502	529	-	
		6500	D3	498	524	-	
	90	2700	D3	386	407	-	
		3000	D3	406	428	-	
		3500	D3	419	441	-	
		4000	D3	427	450	-	
		5000	D3	431	453	-	
		80	2700	D3	898	946	-
			3000	D3	944	994	-
3500	D3		972	1023	-		
4000	D3		991	1043	-		
5000	D3		1000	1052	-		
5700	D3		1000	1052	-		
6500	D3		991	1043	-		
LC006D	90	2700	D3	769	809	-	
		3000	D3	809	851	-	
		3500	D3	833	877	-	
		4000	D3	850	895	-	
		5000	D3	857	902	-	

Notes:

- 1) The COB is tested in pulsed operating condition at rated test current (10 ms pulse width) and rated temperature (T_J = T_C = 85 °C).
- 2) Samsung maintains measurement tolerance of: Luminous flux = ±7 %, CRI = ±1

Model	CRI (Ra) Min.	Nominal CCT (K)	Flux Rank	Flux@ T _J = 85 °C (lm)		
				Min.	Typ.	Max.
LC009D	70	3000	D3	1515	1594	-
		4000	D3	1543	1624	-
		5000	D3	1571	1653	-
	80	2700	D3	1334	1405	-
		3000	D3	1402	1476	-
		3500	D3	1443	1519	-
		4000	D3	1472	1550	-
		5000	D3	1485	1563	-
		5700	D3	1485	1563	-
		6500	D3	1472	1550	-
		2700	D3	1142	1202	-
		3000	D3	1201	1264	-
	90	3500	D3	1237	1302	-
		4000	D3	1263	1329	-
		5000	D3	1273	1340	-
70		3000	D3	1989	2094	-
		4000	D3	2026	2133	-
	5000	D3	2063	2171	-	
	80	2700	D3	1753	1845	-
		3000	D3	1842	1939	-
		3500	D3	1896	1996	-
4000		D3	1934	2036	-	
5000		D3	1950	2053	-	
5700		D3	1950	2053	-	
90	6500	D3	1934	2036	-	
	2700	D3	1500	1579	-	
	3000	D3	1578	1661	-	
	3500	D3	1625	1710	-	
	4000	D3	1658	1745	-	
	5000	D3	1672	1760	-	

Notes:

- 2) The COB is tested in pulsed operating condition at rated test current (10 ms pulse width) and rated temperature (T_J = T_C = 85 °C).
- 2) Samsung maintains measurement tolerance of: Luminous flux = ±7 %, CRI = ±1

Model	CRI (R _a) Min.	Nominal CCT (K)	Flux Rank	Flux@ T _J = 85 °C (lm)		
				Min.	Typ.	Max.
LC016D	70	3000	D3	2562	2697	-
		4000	D3	2609	2747	-
		5000	D3	2657	2797	-
	80	2700	D3	2257	2376	-
		3000	D3	2372	2497	-
		3500	D3	2442	2570	-
		4000	D3	2490	2622	-
		5000	D3	2511	2644	-
		5700	D3	2511	2644	-
		6500	D3	2490	2622	-
		2700	D3	1932	2033	-
		3000	D3	2032	2139	-
	90	3500	D3	2093	2203	-
		4000	D3	2136	2248	-
		5000	D3	2154	2267	-
70		3000	D3	3059	3220	-
		4000	D3	3116	3280	-
	5000	D3	3172	3339	-	
LC019D	80	2700	D3	2695	2837	-
		3000	D3	2833	2982	-
		3500	D3	2916	3069	-
		4000	D3	2974	3130	-
		5000	D3	2999	3157	-
		5700	D3	2999	3157	-
	90	6500	D3	2974	3130	-
		2700	D3	2307	2428	-
		3000	D3	2426	2554	-
		3500	D3	2499	2630	-
		4000	D3	2550	2684	-
		5000	D3	2572	2707	-

Notes:

- 3) The COB is tested in pulsed operating condition at rated test current (10 ms pulse width) and rated temperature (T_J = T_C = 85 °C).
- 2) Samsung maintains measurement tolerance of: Luminous flux = ±7 %, CRI = ±1

Model	CRI (R _a) Min.	Nominal CCT (K)	Flux Rank	Flux@ T _J = 85 °C (lm)			
				Min.	Typ.	Max.	
LC026D	70	3000	D3	4019	4230	-	
		4000	D3	4093	4308	-	
		5000	D3	4167	4387	-	
	80	2700	D3	3541	3727	-	
		3000	D3	3721	3917	-	
		3500	D3	3830	4032	-	
		4000	D3	3907	4112	-	
		5000	D3	3939	4147	-	
		5700	D3	3939	4147	-	
		6500	D3	3907	4112	-	
		90	2700	D3	3030	3190	-
			3000	D3	3187	3355	-
	3500		D3	3282	3455	-	
	LC033D	70	4000	D3	3350	3526	-
			5000	D3	3379	3556	-
3000			D3	4973	5235	-	
80		4000	D3	5065	5332	-	
		5000	D3	5157	5429	-	
		2700	D3	4382	4612	-	
		3000	D3	4605	4847	-	
		3500	D3	4740	4989	-	
		4000	D3	4834	5089	-	
		5000	D3	4875	5132	-	
		5700	D3	4875	5132	-	
		6500	D3	4834	5089	-	
90		2700	D3	3750	3947	-	
		3000	D3	3944	4152	-	
		3500	D3	4062	4276	-	
	4000	D3	4146	4364	-		
	5000	D3	4181	4401	-		

Notes:

- 4) The COB is tested in pulsed operating condition at rated test current (10 ms pulse width) and rated temperature (T_J = T_C = 85 °C).
- 2) Samsung maintains measurement tolerance of: Luminous flux = ±7 %, CRI = ±1

Model	CRI (R _a) Min.	Nominal CCT (K)	Flux Rank	Flux@ T _j = 85 °C (lm)		
				Min.	Typ.	Max.
LC040D	70	3000	D3	6118	6440	-
		4000	D3	6232	6560	-
		5000	D3	6345	6679	-
	80	2700	D3	5391	5675	-
		3000	D3	5665	5963	-
		3500	D3	5831	6138	-
		4000	D3	5948	6261	-
		5000	D3	5998	6313	-
		5700	D3	5998	6313	-
	90	6500	D3	5948	6261	-
		2700	D3	4614	4856	-
		3000	D3	4853	5108	-
		3500	D3	4997	5260	-
		4000	D3	5100	5369	-
	LC060D	70	5000	D3	5144	5415
3000			D3	9042	9518	-
4000			D3	9209	9694	-
80		5000	D3	9377	9870	-
		2700	D3	7967	8386	-
		3000	D3	8372	8813	-
		3500	D3	8617	9071	-
		4000	D3	8790	9253	-
		5000	D3	8864	9330	-
90		5700	D3	8864	9330	-
		6500	D3	8790	9253	-
		2700	D3	6818	7177	-
		3000	D3	7172	7549	-
		3500	D3	7385	7774	-
			4000	D3	7537	7934
		5000	D3	7602	8002	-

Notes:

- 5) The COB is tested in pulsed operating condition at rated test current (10 ms pulse width) and rated temperature (T_J = T_C = 85 °C).
- 2) Samsung maintains measurement tolerance of: Luminous flux = ±7 %, CRI = ±1

Model	CRI (Ra) Min.	Nominal CCT (K)	Flux Rank	Flux@ T _J = 85 °C (lm)		
				Min.	Typ.	Max.
LC080D	70	3000	D3	13409	14115	-
		4000	D3	13657	14376	-
		5000	D3	13906	14637	-
	80	2700	D3	11815	12437	-
		3000	D3	12416	13069	-
		3500	D3	12779	13452	-
		4000	D3	13035	13721	-
		5000	D3	13144	13836	-
		5700	D3	13144	13836	-
		6500	D3	13035	13721	-
		2700	D3	10111	10643	-
		3000	D3	10635	11195	-
	90	3500	D3	10952	11529	-
		4000	D3	11178	11766	-
		5000	D3	11273	11867	-

Notes:

- 6) The COB is tested in pulsed operating condition at rated test current (10 ms pulse width) and rated temperature (T_J = T_C = 85 °C).
- 2) Samsung maintains measurement tolerance of: Luminous flux = ±7 %, CRI = ±1

2. Product Code Information

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
S	P	H	W	H	A	H	D	N	G	2	5	Y	Z	W	3	D	3

Digit	PKG Information	Code	Specification
1 2 3	Samsung Package High Power	SPH	
4 5	Color	WH	White
6	Product Version	A	
7 8	Form Factor	HD	COB
9	Lens Type	N	No lens
10	Wattage or Model	A B C D E F G H K L M	LC003D LC006D LC009D LC013D LC016D LC019D LC026D LC033D LC040D LC060D LC080D
11	Internal Code	2	
12	CRI & Sorting Temperature	3 5 7	Min. 70 (85°C) Min. 80 (85°C) Min. 90 (85°C)
13 14	Forward Voltage (V)	YZ 1Z	31.0~37.0 46.8~55.2 (60W) 46.8~52.5 (80W)
15	CCT (K)	W V U T R Q P	2700K 3000K 3500K 4000K 5000K 5700K 6500K
16	MacAdam Step	1 2 3	MacAdam 1-step MacAdam 2-step MacAdam 3-step
17 18	Luminous Flux (Lm)	D3	COB D-series Gen.3 level

a) Binning Structure

※ LCoo_3D ($I_f = 90 \text{ mA}$, $T_j = 85 \text{ }^\circ\text{C}$)

CRI(R_a) Min.	Nominal CCT(K)	Product Code	V_f Rank	Color Rank	Flux Rank	Flux Range (Φ_v , lm)	
80	2700	SPHWAHDNA25YZW1D3	YZ	W1	D3	451 ~	
		SPHWAHDNA25YZW2D3		W2			
	3000	SPHWAHDNA25YZV1D3	YZ	V1	D3	474 ~	
		SPHWAHDNA25YZV2D3		V2			
	3500	SPHWAHDNA25YZU1D3	YZ	U1	D3	488 ~	
		SPHWAHDNA25YZU2D3		U2			
	4000	SPHWAHDNA25YZT1D3	YZ	T1	D3	498 ~	
		SPHWAHDNA25YZT2D3		T2			
	5000	SPHWAHDNA25YZR2D3	YZ	R2	D3	502 ~	
		SPHWAHDNA25YZR3D3		R3			
	5700	SPHWAHDNA25YZQ2D3	YZ	Q2	D3	502 ~	
		SPHWAHDNA25YZQ3D3		Q3			
	6500	SPHWAHDNA25YZP2D3	YZ	P2	D3	498 ~	
		SPHWAHDNA25YZP3D3		P3			
	90	2700	SPHWAHDNA27YZW1D3	YZ	W1	D3	386 ~
			SPHWAHDNA27YZW2D3		W2		
3000		SPHWAHDNA27YZV1D3	YZ	V1	D3	406 ~	
		SPHWAHDNA27YZV2D3		V2			
3500		SPHWAHDNA27YZU1D3	YZ	U1	D3	419 ~	
		SPHWAHDNA27YZU2D3		U2			
4000		SPHWAHDNA27YZT1D3	YZ	T1	D3	427 ~	
		SPHWAHDNA27YZT2D3		T2			
5000		SPHWAHDNA27YZR2D3	YZ	R2	D3	431 ~	
		SPHWAHDNA27YZR3D3		R3			

※ LCoo6D(I_F = 180 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Color Rank	Flux Rank	Flux Range (Φ _v , lm)	
80	2700	SPHWAHDNB25YZW1D3	YZ	W1	D3	898 ~	
		SPHWAHDNB25YZW2D3		W2			
	3000	SPHWAHDNB25YZV1D3	YZ	V1	D3	944 ~	
		SPHWAHDNB25YZV2D3		V2			
	3500	SPHWAHDNB25YZU1D3	YZ	U1	D3	972 ~	
		SPHWAHDNB25YZU2D3		U2			
	4000	SPHWAHDNB25YZT1D3	YZ	T1	D3	991 ~	
		SPHWAHDNB25YZT2D3		T2			
	5000	SPHWAHDNB25YZR2D3	YZ	R2	D3	1000 ~	
		SPHWAHDNB25YZR3D3		R3			
	5700	SPHWAHDNB25YZQ2D3	YZ	Q2	D3	1000 ~	
		SPHWAHDNB25YZQ3D3		Q3			
	6500	SPHWAHDNB25YZP2D3	YZ	P2	D3	991 ~	
		SPHWAHDNB25YZP3D3		P3			
	90	2700	SPHWAHDNB27YZW1D3	YZ	W1	D3	769 ~
			SPHWAHDNB27YZW2D3		W2		
3000		SPHWAHDNB27YZV1D3	YZ	V1	D3	809 ~	
		SPHWAHDNB27YZV2D3		V2			
3500		SPHWAHDNB27YZU1D3	YZ	U1	D3	833 ~	
		SPHWAHDNB27YZU2D3		U2			
4000		SPHWAHDNB27YZT1D3	YZ	T1	D3	850 ~	
		SPHWAHDNB27YZT2D3		T2			
5000		SPHWAHDNB27YZR2D3	YZ	R2	D3	857 ~	
		SPHWAHDNB27YZR3D3		R3			

※ LCoogD(I_F = 270 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Color Rank	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWWAHDNC23YZV2D3	YZ	V2	D3	1515 ~	
		SPHWWAHDNC23YZV3D3		V3			
	4000	SPHWWAHDNC23YZT2D3	YZ	T2	D3	1543 ~	
		SPHWWAHDNC23YZT3D3		T3			
	5000	SPHWWAHDNC23YZR2D3	YZ	R2	D3	1571 ~	
		SPHWWAHDNC23YZR3D3		R3			
80	2700	SPHWWAHDNC25YZW1D3	YZ	W1	D3	1334 ~	
		SPHWWAHDNC25YZW2D3		W2			
	3000	SPHWWAHDNC25YZV1D3	YZ	V1	D3	1402 ~	
		SPHWWAHDNC25YZV2D3		V2			
	3500	SPHWWAHDNC25YZU1D3	YZ	U1	D3	1443 ~	
		SPHWWAHDNC25YZU2D3		U2			
	4000	SPHWWAHDNC25YZT1D3	YZ	T1	D3	1472 ~	
		SPHWWAHDNC25YZT2D3		T2			
	5000	SPHWWAHDNC25YZR2D3	YZ	R2	D3	1485 ~	
		SPHWWAHDNC25YZR3D3		R3			
	5700	SPHWWAHDNC25YZQ2D3	YZ	Q2	D3	1485 ~	
		SPHWWAHDNC25YZQ3D3		Q3			
	6500	SPHWWAHDNC25YZP2D3	YZ	P2	D3	1472 ~	
		SPHWWAHDNC25YZP3D3		P3			
	90	2700	SPHWWAHDNC27YZW1D3	YZ	W1	D3	1142 ~
			SPHWWAHDNC27YZW2D3		W2		
		3000	SPHWWAHDNC27YZV1D3	YZ	V1	D3	1201 ~
			SPHWWAHDNC27YZV2D3		V2		

		SPHWAHDNC27YZU1D3		U1		
	3500	SPHWAHDNC27YZU2D3	YZ	U2	D3	1237 ~
		SPHWAHDNC27YZT1D3		T1		
	4000	SPHWAHDNC27YZT2D3	YZ	T2	D3	1263 ~
		SPHWAHDNC27YZR2D3		R2		
	5000	SPHWAHDNC27YZR3D3	YZ	R3	D3	1273 ~

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※ LCo13D(I_F = 360 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Color Rank	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWWAHDND23YZV2D3	YZ	V2	D3	1989 ~	
		SPHWWAHDND23YZV3D3		V3			
	4000	SPHWWAHDND23YZT2D3	YZ	T2	D3	2026 ~	
		SPHWWAHDND23YZT3D3		T3			
	5000	SPHWWAHDND23YZR2D3	YZ	R2	D3	2063 ~	
		SPHWWAHDND23YZR3D3		R3			
80	2700	SPHWWAHDND25YZW1D3	YZ	W1	D3	1753 ~	
		SPHWWAHDND25YZW2D3		W2			
	3000	SPHWWAHDND25YZV1D3	YZ	V1	D3	1842 ~	
		SPHWWAHDND25YZV2D3		V2			
	3500	SPHWWAHDND25YZU1D3	YZ	U1	D3	1896 ~	
		SPHWWAHDND25YZU2D3		U2			
	4000	SPHWWAHDND25YZT1D3	YZ	T1	D3	1934 ~	
		SPHWWAHDND25YZT2D3		T2			
	5000	SPHWWAHDND25YZR2D3	YZ	R2	D3	1950 ~	
		SPHWWAHDND25YZR3D3		R3			
	5700	SPHWWAHDND25YZQ2D3	YZ	Q2	D3	1950 ~	
		SPHWWAHDND25YZQ3D3		Q3			
	6500	SPHWWAHDND25YZP2D3	YZ	P2	D3	1934 ~	
		SPHWWAHDND25YZP3D3		P3			
	90	2700	SPHWWAHDND27YZW1D3	YZ	W1	D3	1500 ~
			SPHWWAHDND27YZW2D3		W2		
		3000	SPHWWAHDND27YZV1D3	YZ	V1	D3	1578 ~
			SPHWWAHDND27YZV2D3		V2		

		SPHWHAMDND27YZU1D3		U1		
	3500	SPHWHAMDND27YZU2D3	YZ	U2	D3	1625 ~
		SPHWHAMDND27YZT1D3		T1		
	4000	SPHWHAMDND27YZT2D3	YZ	T2	D3	1658 ~
		SPHWHAMDND27YZR2D3		R2		
	5000	SPHWHAMDND27YZR3D3	YZ	R3	D3	1672 ~

90

※ LCo16D(I_F = 450 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Color Rank	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWWAHDNE23YZV2D3	YZ	V2	D3	2562 ~	
		SPHWWAHDNE23YZV3D3		V3			
	4000	SPHWWAHDNE23YZT2D3	YZ	T2	D3		
		SPHWWAHDNE23YZT3D3		T3			
	5000	SPHWWAHDNE23YZR2D3	YZ	R2	D3		
		SPHWWAHDNE23YZR3D3		R3			
80	2700	SPHWWAHDNE25YZW1D3	YZ	W1	D3	2257 ~	
		SPHWWAHDNE25YZW2D3		W2			
	3000	SPHWWAHDNE25YZV1D3	YZ	V1	D3	2372 ~	
		SPHWWAHDNE25YZV2D3		V2			
	3500	SPHWWAHDNE25YZU1D3	YZ	U1	D3	2442 ~	
		SPHWWAHDNE25YZU2D3		U2			
	4000	SPHWWAHDNE25YZT1D3	YZ	T1	D3	2490 ~	
		SPHWWAHDNE25YZT2D3		T2			
	5000	SPHWWAHDNE25YZR2D3	YZ	R2	D3	2511 ~	
		SPHWWAHDNE25YZR3D3		R3			
	5700	SPHWWAHDNE25YZQ2D3	YZ	Q2	D3	2511 ~	
		SPHWWAHDNE25YZQ3D3		Q3			
	6500	SPHWWAHDNE25YZP2D3	YZ	P2	D3	2490 ~	
		SPHWWAHDNE25YZP3D3		P3			
	90	2700	SPHWWAHDNE27YZW1D3	YZ	W1	D3	1932 ~
			SPHWWAHDNE27YZW2D3		W2		
		3000	SPHWWAHDNE27YZV1D3	YZ	V1	D3	2032 ~
			SPHWWAHDNE27YZV2D3		V2		

		SPHWAHDNE27YZU1D3		U1		
	3500	-----	YZ	-----	D3	2093 ~
		SPHWAHDNE27YZU2D3		U2		
		-----		-----		
		SPHWAHDNE27YZT1D3		T1		
90	4000	-----	YZ	-----	D3	2136 ~
		SPHWAHDNE27YZT2D3		T2		
		-----		-----		
		SPHWAHDNE27YZR2D3		R2		
	5000	-----	YZ	-----	D3	2154 ~
		SPHWAHDNE27YZR3D3		R3		

※ LCo19D(I_F = 540 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Color Rank	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWWAHDNF23YZV2D3	YZ	V2	D3	3059 ~	
		SPHWWAHDNF23YZV3D3		V3			
	4000	SPHWWAHDNF23YZT2D3	YZ	T2	D3	3116 ~	
		SPHWWAHDNF23YZT3D3		T3			
	5000	SPHWWAHDNF23YZR2D3	YZ	R2	D3	3172 ~	
		SPHWWAHDNF23YZR3D3		R3			
80	2700	SPHWWAHDNF25YZW1D3	YZ	W1	D3	2695 ~	
		SPHWWAHDNF25YZW2D3		W2			
	3000	SPHWWAHDNF25YZV1D3	YZ	V1	D3	2833 ~	
		SPHWWAHDNF25YZV2D3		V2			
	3500	SPHWWAHDNF25YZU1D3	YZ	U1	D3	2916 ~	
		SPHWWAHDNF25YZU2D3		U2			
	4000	SPHWWAHDNF25YZT1D3	YZ	T1	D3	2974 ~	
		SPHWWAHDNF25YZT2D3		T2			
	5000	SPHWWAHDNF25YZR2D3	YZ	R2	D3	2999 ~	
		SPHWWAHDNF25YZR3D3		R3			
	5700	SPHWWAHDNF25YZQ2D3	YZ	Q2	D3	2999 ~	
		SPHWWAHDNF25YZQ3D3		Q3			
	6500	SPHWWAHDNF25YZP2D3	YZ	P2	D3	2974 ~	
		SPHWWAHDNF25YZP3D3		P3			
	90	2700	SPHWWAHDNF27YZW1D3	YZ	W1	D3	2307 ~
			SPHWWAHDNF27YZW2D3		W2		
		3000	SPHWWAHDNF27YZV1D3	YZ	V1	D3	2426 ~
			SPHWWAHDNF27YZV2D3		V2		

		SPHWAHDF27YZU1D3		U1		
	3500	SPHWAHDF27YZU2D3	YZ	U2	D3	2499 ~
		SPHWAHDF27YZT1D3		T1		
90	4000	SPHWAHDF27YZT2D3	YZ	T2	D3	2550 ~
		SPHWAHDF27YZR2D3		R2		
	5000	SPHWAHDF27YZR3D3	YZ	R3	D3	2572 ~

※ LCo26D(I_F = 720 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Color Rank	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWHHDNG23YZV2D3	YZ	V2	D3	4019 ~	
		SPHWHHDNG23YZV3D3		V3			
	4000	SPHWHHDNG23YZT2D3	YZ	T2	D3		
		SPHWHHDNG23YZT3D3		T3			
	5000	SPHWHHDNG23YZR2D3	YZ	R2	D3		
		SPHWHHDNG23YZR3D3		R3			
80	2700	SPHWHHDNG25YZW1D3	YZ	W1	D3	3541 ~	
		SPHWHHDNG25YZW2D3		W2			
	3000	SPHWHHDNG25YZV1D3	YZ	V1	D3	3721 ~	
		SPHWHHDNG25YZV2D3		V2			
	3500	SPHWHHDNG25YZU1D3	YZ	U1	D3	3830 ~	
		SPHWHHDNG25YZU2D3		U2			
	4000	SPHWHHDNG25YZT1D3	YZ	T1	D3	3907 ~	
		SPHWHHDNG25YZT2D3		T2			
	5000	SPHWHHDNG25YZR2D3	YZ	R2	D3	3939 ~	
		SPHWHHDNG25YZR3D3		R3			
	5700	SPHWHHDNG25YZQ2D3	YZ	Q2	D3	3939 ~	
		SPHWHHDNG25YZQ3D3		Q3			
	6500	SPHWHHDNG25YZP2D3	YZ	P2	D3	3907 ~	
		SPHWHHDNG25YZP3D3		P3			
	90	2700	SPHWHHDNG27YZW1D3	YZ	W1	D3	3030 ~
			SPHWHHDNG27YZW2D3		W2		
		3000	SPHWHHDNG27YZV1D3	YZ	V1	D3	3187 ~
			SPHWHHDNG27YZV2D3		V2		

		SPHWWAHDNG27YZU1D3		U1		
	3500	SPHWWAHDNG27YZU2D3	YZ	U2	D3	3282 ~
		SPHWWAHDNG27YZT1D3		T1		
90	4000	SPHWWAHDNG27YZT2D3	YZ	T2	D3	3350 ~
		SPHWWAHDNG27YZR2D3		R2		
	5000	SPHWWAHDNG27YZR3D3	YZ	R3	D3	3379 ~

※ LCo33D(I_F = 900 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Color Rank	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWAHDNH23YZV2D3	YZ	V2	D3	4973 ~	
		SPHWAHDNH23YZV3D3		V3			
	4000	SPHWAHDNH23YZT2D3	YZ	T2	D3	5065 ~	
		SPHWAHDNH23YZT3D3		T3			
	5000	SPHWAHDNH23YZR2D3	YZ	R2	D3	5157 ~	
		SPHWAHDNH23YZR3D3		R3			
80	2700	SPHWAHDNH25YZW1D3	YZ	W1	D3	4382 ~	
		SPHWAHDNH25YZW2D3		W2			
	3000	SPHWAHDNH25YZV1D3	YZ	V1	D3	4605 ~	
		SPHWAHDNH25YZV2D3		V2			
	3500	SPHWAHDNH25YZU1D3	YZ	U1	D3	4740 ~	
		SPHWAHDNH25YZU2D3		U2			
	4000	SPHWAHDNH25YZT1D3	YZ	T1	D3	4834~	
		SPHWAHDNH25YZT2D3		T2			
	5000	SPHWAHDNH25YZR2D3	YZ	R2	D3	4875 ~	
		SPHWAHDNH25YZR3D3		R3			
	5700	SPHWAHDNH25YZQ2D3	YZ	Q2	D3	4875 ~	
		SPHWAHDNH25YZQ3D3		Q3			
	6500	SPHWAHDNH25YZP2D3	YZ	P2	D3	4834 ~	
		SPHWAHDNH25YZP3D3		P3			
	90	2700	SPHWAHDNH27YZW1D3	YZ	W1	D3	3750 ~
			SPHWAHDNH27YZW2D3		W2		
		3000	SPHWAHDNH27YZV1D3	YZ	V1	D3	3944 ~
			SPHWAHDNH27YZV2D3		V2		

		SPHWAHDNH27YZU1D3		U1		
	3500	.....	YZ	.....	D3	4062 ~
		SPHWAHDNH27YZU2D3		U2		
		<hr/>				
		SPHWAHDNH27YZT1D3		T1		
90	4000	.....	YZ	.....	D3	4146 ~
		SPHWAHDNH27YZT2D3		T2		
		<hr/>				
		SPHWAHDNH27YZR2D3		R2		
	5000	.....	YZ	.....	D3	4181 ~
		SPHWAHDNH27YZR3D3		R3		

※ LCo₄oD(I_F = 1080 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Color Rank	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWAHDNK23YZV2D3	YZ	V2	D3	6118 ~	
		SPHWAHDNK23YZV3D3		V3			
	4000	SPHWAHDNK23YZT2D3	YZ	T2	D3	6232 ~	
		SPHWAHDNK23YZT3D3		T3			
	5000	SPHWAHDNK23YZR2D3	YZ	R2	D3	6345 ~	
		SPHWAHDNK23YZR3D3		R3			
80	2700	SPHWAHDNK25YZW1D3	YZ	W1	D3	5391 ~	
		SPHWAHDNK25YZW2D3		W2			
	3000	SPHWAHDNK25YZV1D3	YZ	V1	D3	5665 ~	
		SPHWAHDNK25YZV2D3		V2			
	3500	SPHWAHDNK25YZU1D3	YZ	U1	D3	5831 ~	
		SPHWAHDNK25YZU2D3		U2			
	4000	SPHWAHDNK25YZT1D3	YZ	T1	D3	5948 ~	
		SPHWAHDNK25YZT2D3		T2			
	5000	SPHWAHDNK25YZR2D3	YZ	R2	D3	5998 ~	
		SPHWAHDNK25YZR3D3		R3			
	5700	SPHWAHDNK25YZQ2D3	YZ	Q2	D3	5998 ~	
		SPHWAHDNK25YZQ3D3		Q3			
	6500	SPHWAHDNK25YZP2D3	YZ	P2	D3	5948 ~	
		SPHWAHDNK25YZP3D3		P3			
	90	2700	SPHWAHDNK27YZW1D3	YZ	W1	D3	4614 ~
			SPHWAHDNK27YZW2D3		W2		
		3000	SPHWAHDNK27YZV1D3	YZ	V1	D3	4853 ~
			SPHWAHDNK27YZV2D3		V2		

		SPHWAHDNK27YZU1D3		U1		
	3500	.....	YZ	.....	D3	4997 ~
		SPHWAHDNK27YZU2D3		U2		
		<hr/>				
		SPHWAHDNK27YZT1D3		T1		
90	4000	.....	YZ	.....	D3	5100 ~
		SPHWAHDNK27YZT2D3		T2		
		<hr/>				
		SPHWAHDNK27YZR2D3		R2		
	5000	.....	YZ	.....	D3	5144 ~
		SPHWAHDNK27YZR3D3		R3		

※ LCo6oD(I_F = 1080 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Chrom. Bin	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWAHDNL231ZV2D3	1Z	V2	D3	9042 ~	
		SPHWAHDNL231ZV3D3		V3			
	4000	SPHWAHDNL231ZT2D3	1Z	T2	D3	9209 ~	
		SPHWAHDNL231ZT3D3		T3			
	5000	SPHWAHDNL231ZR2D3	1Z	R2	D3	9377 ~	
		SPHWAHDNL231ZR3D3		R3			
80	2700	SPHWAHDNL251ZW1D3	1Z	W1	D3	7967 ~	
		SPHWAHDNL251ZW2D3		W2			
	3000	SPHWAHDNL251ZV1D3	1Z	V1	D3	8372 ~	
		SPHWAHDNL251ZV2D3		V2			
	3500	SPHWAHDNL251ZU1D3	1Z	U1	D3	8617 ~	
		SPHWAHDNL251ZU2D3		U2			
	4000	SPHWAHDNL251ZT1D3	1Z	T1	D3	8790 ~	
		SPHWAHDNL251ZT2D3		T2			
	5000	SPHWAHDNL251ZR2D3	1Z	R2	D3	8864 ~	
		SPHWAHDNL251ZR3D3		R3			
	5700	SPHWAHDNL251ZQ2D3	1Z	Q2	D3	8864 ~	
		SPHWAHDNL251ZQ3D3		Q3			
	6500	SPHWAHDNL251ZP2D3	1Z	P2	D3	8790 ~	
		SPHWAHDNL251ZP3D3		P3			
	90	2700	SPHWAHDNL271ZW1D3	1Z	W1	D3	6818 ~
			SPHWAHDNL271ZW2D3		W2		
		3000	SPHWAHDNL271ZV1D3	1Z	V1	D3	7172 ~
			SPHWAHDNL271ZV2D3		V2		

		SPHWAHDNL271ZU1D3		U1		
	3500	.....	1Z	.....	D3	7385 ~
		SPHWAHDNL271ZU2D3		U2		
		<hr/>				
		SPHWAHDNL271ZT1D3		T1		
90	4000	.....	1Z	.....	D3	7537 ~
		SPHWAHDNL271ZT2D3		U2		
		<hr/>				
		SPHWAHDNL271ZR2D3		R2		
	5000	.....	1Z	.....	D3	7602 ~
		SPHWAHDNL271ZR3D3		R3		

※ LCo8oD(I_F = 1620 mA, T_J = 85 °C)

CRI(R _a) Min.	Nominal CCT(K)	Product Code	V _F Rank	Chrom. Bin	Flux Rank	Flux Range (Φ _v , lm)	
70	3000	SPHWWAHDNM231ZV2D3	1Z	V2	D3	13409 ~	
		SPHWWAHDNM231ZV3D3		V3			
	4000	SPHWWAHDNM231ZT2D3	1Z	T2	D3	13657 ~	
		SPHWWAHDNM231ZT3D3		T3			
	5000	SPHWWAHDNM231ZR2D3	1Z	R2	D3	13906 ~	
		SPHWWAHDNM231ZR3D3		R3			
80	2700	SPHWWAHDNM251ZW1D3	1Z	W1	D3	11815 ~	
		SPHWWAHDNM251ZW2D3		W2			
	3000	SPHWWAHDNM251ZV1D3	1Z	V1	D3	12416 ~	
		SPHWWAHDNM251ZV2D3		V2			
	3500	SPHWWAHDNM251ZU1D3	1Z	U1	D3	12779 ~	
		SPHWWAHDNM251ZU2D3		U2			
	4000	SPHWWAHDNM251ZT1D3	1Z	T1	D3	13035 ~	
		SPHWWAHDNM251ZT2D3		T2			
	5000	SPHWWAHDNM251ZR2D3	1Z	R2	D3	13144 ~	
		SPHWWAHDNM251ZR3D3		R3			
	5700	SPHWWAHDNM251ZQ2D3	1Z	Q2	D3	13144 ~	
		SPHWWAHDNM251ZQ3D3		Q3			
	6500	SPHWWAHDNM251ZP2D3	1Z	P2	D3	13035 ~	
		SPHWWAHDNM251ZP3D3		P3			
	90	2700	SPHWWAHDNM271ZW1D3	1Z	W1	D3	10111 ~
			SPHWWAHDNM271ZW2D3		W2		
		3000	SPHWWAHDNM271ZV1D3	1Z	V1	D3	10635 ~
			SPHWWAHDNM271ZV2D3		V2		

	3500	SPHWWAHDNM271ZU1D3	1Z	U1	D3	10952 ~
		SPHWWAHDNM271ZU2D3		U2		
90	4000	SPHWWAHDNM271ZT1D3	1Z	T1	D3	11178 ~
		SPHWWAHDNM271ZT2D3		T2		
	5000	SPHWWAHDNM271ZR2D3	1Z	R2	D3	11273 ~
		SPHWWAHDNM271ZR3D3		R3		

b) Chromaticity Region & Coordinates (I_f = Sorting Current, T_j = 85 °C)



MacAdam Ellipse (W1, W2)					
Step	CIE x	CIE y	θ	a	b
1-step	0.4578	0.4101	53.70	0.0027	0.0014
2-step	0.4578	0.4101	53.7	0.0054	0.0028

MacAdam Ellipse (V1, V2, V3)					
Step	CIE x	CIE y	θ	a	b
1-step	0.4338	0.4030	53.22	0.0028	0.0014
2-step	0.4338	0.4030	53.22	0.0056	0.0027
3-step	0.4338	0.4030	53.22	0.0083	0.0041

MacAdam Ellipse (U1, U2, U3)					
Step	CIE x	CIE y	θ	a	b
1-step	0.4073	0.3917	54.00	0.0031	0.0014
2-step	0.4073	0.3917	54.00	0.0062	0.0028
3-step	0.4073	0.3917	54.00	0.0093	0.0041

MacAdam Ellipse (T1, T2, T3)					
Step	CIE x	CIE y	θ	a	b
1-step	0.3818	0.3797	53.72	0.0031	0.0013
2-step	0.3818	0.3797	53.72	0.0063	0.0027
3-step	0.3818	0.3797	53.72	0.0094	0.0040

MacAdam Ellipse (R2, R3)					
Step	CIE x	CIE y	θ	a	b
2-step	0.3447	0.3553	59.62	0.0055	0.0024
3-step	0.3447	0.3553	59.62	0.0082	0.0035

MacAdam Ellipse (Q2, Q3)					
Step	CIE x	CIE y	θ	a	b
2-step	0.3287	0.3417	59.10	0.0050	0.0021
3-step	0.3287	0.3417	59.10	0.0075	0.0032

MacAdam Ellipse (P2, P3)					
Step	CIE x	CIE y	θ	a	b
2-step	0.3123	0.3282	58.57	0.0045	0.0019
3-step	0.3123	0.3282	58.57	0.0067	0.0029

Note:

Samsung maintains measurement tolerance of: $C_x, C_y = \pm 0.005$

3. Typical Characteristics Graphs

a) Spectrum Distribution (I_f = Sorting Current, T_j = 85 °C)

CRI Ra 80+



CRI Ra 90+



CRI Ra 70+



b) Forward Current Characteristics ($T_J = 85\text{ }^\circ\text{C}$)

1) LC003D



2) LC006D



3) LC009D



4) LC013D



5) LC016D



6) LC019D



7) LC026D



8) LC033D



9) LC040D



10) LC060D



11) LC080D



c) Temperature Characteristics (I_F = Sorting Current)



d) Color Shift Characteristics ($T_J = 85^\circ\text{C}$, I_F = Sorting Current, CRI = 80+)



e) Beam Angle Characteristics (I_F = Sorting Current, $T_J = 85^\circ\text{C}$)



f) Derating Characteristics

1) LC003D



2) LC006D



3) LC009D4) LC0013D



5) LC016D



6) LC0019D



7) LC026D



8) LC0033D



9) LC040D



10) LC060D



11) LC080D



4. Outline Drawing & Dimension

※ Model : LC003D, LC006D, LC009D, LC013D



- 1. Unit: mm
- 2. Tolerance: ± 0.3 mm

Item	Dimension	Tolerance	Unit
Length	13.5	±0.15	mm
Width	13.5	±0.15	mm
Height	Dam	±0.20	mm
	Substrate	±0.10	mm
LES Diameter	Light Emitting Surface	±0.30	mm

Note: Denoted product information above is only an example
(LC013D38030 :LC013D, Gen3, Ra80, 3000K)

※ Model : LC016D, LC019D, LC026D, LC033D



- 1. Unit: mm
- 2. Tolerance: ± 0.3 mm

Item	Dimension	Tolerance	Unit
Length	19.0	±0.15	mm
Width	19.0	±0.15	mm
Height	Dam	0.5	±0.20
	Substrate	1.0	±0.10
LES Diameter	Light Emitting Surface	14.5	±0.30

Note: Denoted product information above is only an example
 (LC026D38030 : LC026D, Gen3, CRI80+, 3000K)

※ Model : LC040D, LC060D, LC080D



1. Unit: mm
 2. Tolerance: ± 0.3 mm

Item	Dimension	Tolerance	Unit
Length	28.0	±0.15	mm
Width	28.0	±0.15	mm
Height	Dam	±0.20	mm
	Substrate	±0.10	mm
LES Diameter	Light Emitting Surface	±0.30	mm

Note: Denoted product information above is only an example
 (LC040D38030 : LC040D, Gen3, CRI80+, 3000K)

5. Reliability Test Items & Conditions

a) Test Items

Test Item	Test Condition	Test Hour / Cycle
Wet High Temperature Operating Life Test (WHTOL)	60 °C, 90 % RH,, DC Derating, I _F	1000 h
High Temperature Operating Life Test (HTOL)	85 °C, DC Derating, I _F	1000 h
Low Temperature Operating Life Test (LTOL)	-40 °C, DC,DeratingI _F	1000 h
High Temperature Storage	110 °C	1000 h
Low Temperature Storage	-40 °C	1000 h
Wet High Temperature Storage Test	85°C, 85% RH	1000h
Temperature Cycling	-45 °C / 15min ~ 125 °C / 15min Temperature change within 5min	500 cycle
Powered Temperature Cycle (PTC)	-40 °C/ 85 °C each 10 min, 20 min transfer power on/off each 5 min, DC Derating, I _F = max	100 cycles
ESD (HBM)	R ₁ : 10 MΩ R ₂ : 1.5 kΩ C: 100 pF V: ±2 kV	5 times
Vibrations Variable Frequency	20~ 80 Hz (displacement: 0.06 inch, max. 20 g) 80 ~ 2 kHz (max. 20 g) min. frequency ↔max. frequency 4 min transfer	4 times
Mechanical Shock Test	1500g, 0.5 ms each of the 6 surfaces (3 axis x 2 sides)	5 times
Hydrogen Sulphide(H ₂ S)	25 °C 75%R.H. H ₂ S concentration 15ppm	504h

b) Criteria for Judging the Damage

Item	Symbol	Test Condition (T _c = 25 °C)	Limit	
			Min.	Max.
Forward Voltage	V _F	I _F = Sorting Current	L.S.L. * 0.9	U.S.L. * 1.1
Luminous Flux	Φ _v	I _F = Sorting Current	L.S.L * 0.7	U.S.L * 1.3

6. Label Structure

a) Label Structure



Note: Denoted bincode and product code above is only an example (see description on page 5)

Bin Code:

ⒶⒷ: Forward Voltage bin (refer to page 9)

ⒸⒹ: Chromaticity bin (refer to page 21)

ⒺⒻ: Luminous Flux bin (refer to page 5-8)

b) Lot Number

The lot number is composed of the following characters:



① ③④⑤⑥⑦⑧⑨ / 1ⒶⒷⒸ / xxxx pcs

① : Production site (S: Giheung, Korea, G: Tianjin, China)

② : 4(LED)

③ : Product state (A: Normal, B: Bulk, C: First Production, R: Reproduction, S: Sample)

④ : Year (Z: 2015, A: 2016, B: 2017...)

⑤ : Month (1~9, A, B, C)

⑥⑦⑧⑨ : Day (1~9, A, B~V)

ⒶⒷⒸ : Product serial number (001 ~ 999)

7. Packing Structure

※ Model : L003D, LC006D, LC009D, LC013D

Packing material	Max. quantity in pcs of COB	Dimension(mm)			
		Length	Width	Height	Tolerance
Tray	50	200	200	8	1
Anti-Static Bag	250 (5 trays)	320	270	-	+/- 0.5
Outer Box (Small)	500 (2 bags)	225	225	65	5
Outer Box (Middle)	1000 (4 bags)	225	225	130	5

a) Packing Structure



b) Tray



※ Model : LC016D, LC019D, LC026D, LC033D

Packing material	Max. quantity in pcs of COB	Dimension(mm)			
		Length	Width	Height	Tolerance
Tray	25	200	200	8	1
Anti-Static Bag	125 (5 trays)	320	270	-	+/- 0.5
Outer Box (Small)	250 (2 bags)	225	225	65	5
Outer Box (Middle)	500 (4 bags)	225	225	130	

a) Packing Structure



※ Small Box

※ Middle Box

b) Tray



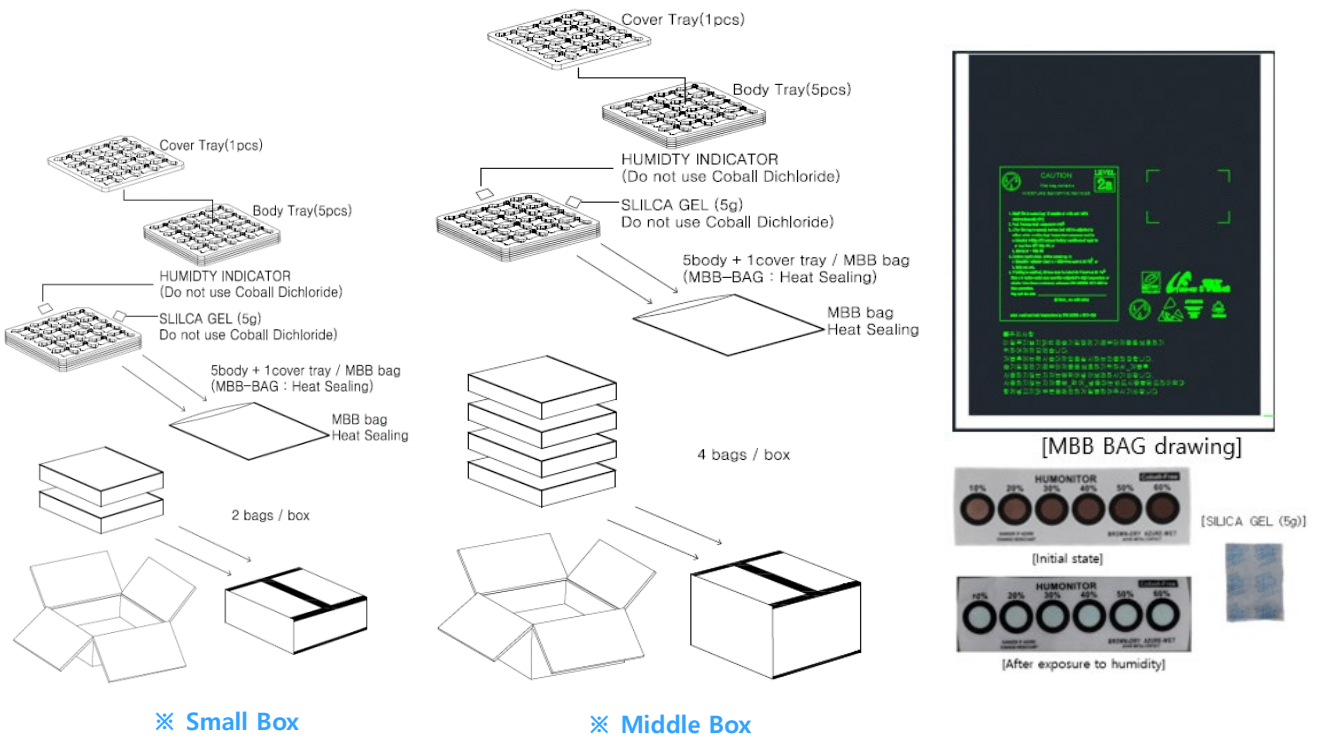
※ Small Box

※ Middle Box

※ Model : LC040D, LC060D, LC080D

Packing material	Max. quantity in pcs of COB	Dimension(mm)			
		Length	Width	Height	Tolerance
Tray	16	200	200	8	1
Anti-Static Bag	80 (5 trays)	320	270	-	+/- 0.5
Outer Box (Small)	160 (2 bags)	225	225	65	5
Outer Box (Middle)	320 (4 bags)	225	225	130	5

a) Packing Structure



b) Tray



8. Precautions in Handling & Use

- 1) This device should not be used in any type of fluid such as water, oil, organic solvent, etc. Some solvent-based cleaning agent may damage the silicone resins used in the device.
- 2) LEDs must be stored in a clean environment. Shelf life of sealed bags is 12 months at temperature 0~40 °C, 0~90 % RH.
- 3) After storage bag is opened, device subjected to soldering (wiring), or other high temperature processes must be:
 - a. Mounted within 672 hours (28 days) at an assembly line with a condition of no more than 30 °C / 60 % RH, or
 - b. Stored at <10 % RH
- 4) Repack unused products with anti-moisture packing, fold to close any opening and then store in a dry place.
- 5) Devices require baking before mounting, if humidity card reading is >60 % at 23 ± 5 °C.
- 6) Devices must be baked for 1 hour at 60 ± 5 °C, if baking is required.
- 7) The LEDs are sensitive to the static electricity and surge current. It is recommended to use a wrist band or anti-electrostatic glove when handling the LEDs. If voltage exceeding the absolute maximum rating is applied to LEDs, it may cause damage or even destruction to LED devices. Damaged LEDs may show some unusual characteristics such as increase in leakage current, lowered turn-on voltage, or abnormal lighting of LEDs at low current.
- 8) The thermal management is one of the most critical factors for the LED lighting system. Especially the LED junction temperature should not exceed the absolute maximum rating while operation of LED lighting system.
For more information, please refer to Application Note 'Mechanical & Thermal Guide for COB'.
- 9) In case of driving LEDs around the minimum current level (I_{f_min}), chips might exhibit different brightness due to the variation in I-V characteristics of each one. This is normal and does not adversely affect the performance of product.
- 10) VOCs (Volatile Organic Compounds) can be generated from adhesives, flux, hardener or organic additives used in luminaires (fixtures). Transparent LED silicone encapsulant is permeable to those chemicals and they may lead to a discoloration of encapsulant when they exposed to heat or light. This phenomenon can cause a significant loss of light emitted (output) from the luminaires. In order to prevent these problems, we recommend users to know the physical properties of materials used in luminaires and they must be carefully selected.
- 11) The resin area is very sensitive, please do not handle, press, touch, rub, clean, or pick by with tweezers on it. Instead, please pick at the handling area as indicated below.



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