Application Note (Instruction Manual)

AC-ALL™

EggDrop®

Innovative AC driving engine
for Down light & Spot light

Contents

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1. Product name method

(ex. Eggdrop)

Product Family	PCB Size/shape	Power	CRI+CCT	IV	Module type	Option

Eggdrop

EDC	57	C	XXW	X	XX	XXXV	A	0	0	0	V1_0
EggDrop	PCB 'size'=	'C'= Circular	'Power'=	'7'=	'27'=	Input	type	Management code			
			4 Watt	70Ra+	2700K						
			6 Watt	'8'=	'30'=	Voltage	'A'=A				
	38mm Ø		8 Watt	80Ra+	3000K						
	47mm Ø		9 watt	'9'=	'35'=						
	57mm Ø		10 Watt	90Ra+	3500K	230V	'B'=B				
			12 Watt		'40'=						
			15 Watt		4000K						
			20Watt		'50'=	Or	'C'=C				
			30Watt		5000K						
			40Watt		'57'=	120V					
					5700K						

1) Additional explanation

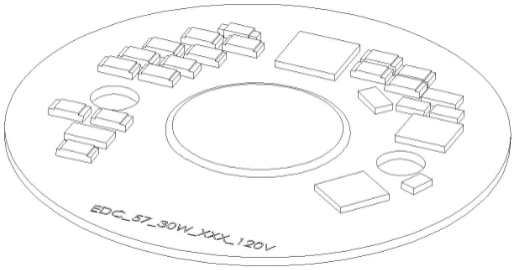
Product Family	Product Section		Product Description PCB > shape > Watt > CRI+CCT > IV > Type > Management code
AC Module	Eggdrop	EDC	EDC_57C_XXW_XXX_XXXV_A000_V1_0

2. Product Description

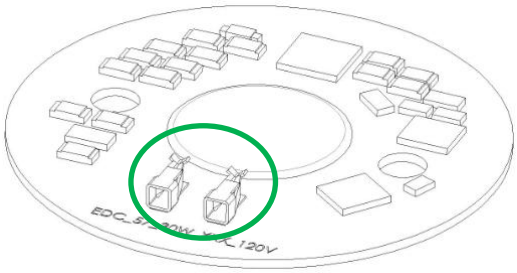
AC-ALL™, Lumens AC Driverless Modules/Engines, provides excellent solutions for lighting designers and manufacturers. It is designed to be run on AC direct current so as to bring you the most design flexibility. With its patented Dimming and Flicker solutions, AC-ALL™ enables you to enhance the value of your lighting products the most. EggDrop®-COB of the AC-ALL series is specially designed for Downlight, Spot light, etc. Built on Lumens Flip-Chip COB and AC direct technology, EggDrop®-COB can provide you a comprehensive solution to achieve an industry-leading combination of light quality and efficacy.

Unlike the conventional DC type LED module, EggDrop® is an AC type DOB (Driver on Board) LED module. The integrated LED chips and circuit components on the PCB allow the EggDrop® to operate on AC. Thus, the driverless (no power supply) EggDrop® provides sufficient space and design freedom for the user. The advanced and progressive concept of the EggDrop® helps the user to easily handle and install the product. The EggDrop® is available from 10W to 40W. The EggDrop® is built with a 150'C thermal protection and surge & over current protection circuit. These functions enable the EggDrop® to be safely operated in different types of environment.

As shown on the chart below, the EggDrop® is available in 4 different options. The options definitely offer a wide variety of selection for the user.



Type 1



Type 2
Connector (terminal)

- Option 1 : Holder
- Option 2 : Thermal Pad

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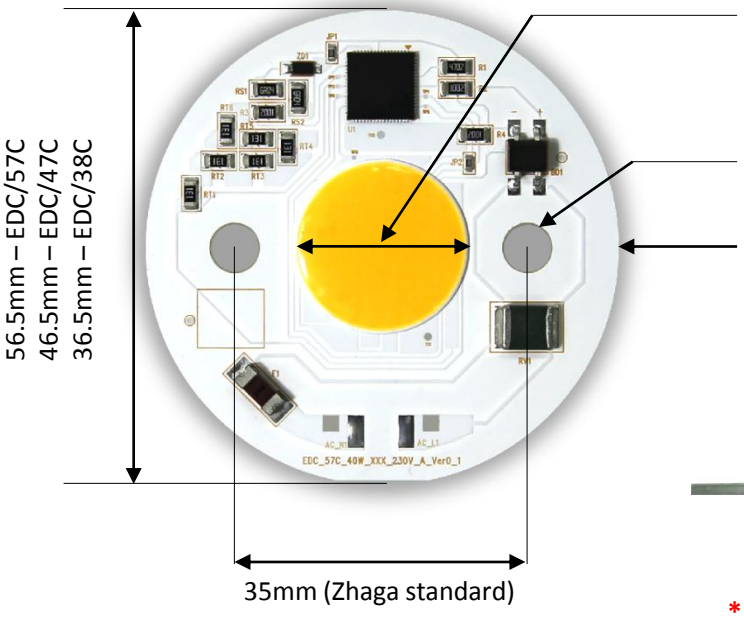
1) Mechanical Dimension



LES

Ø10 : EDC/38C/4W, 6W, 8W
Ø13 : EDC/47C/9W, 10W, 12W, 15W
Ø14 : EDC/57C/10W, 15W, 20W
Ø21 : EDC/57C/30W, 40W

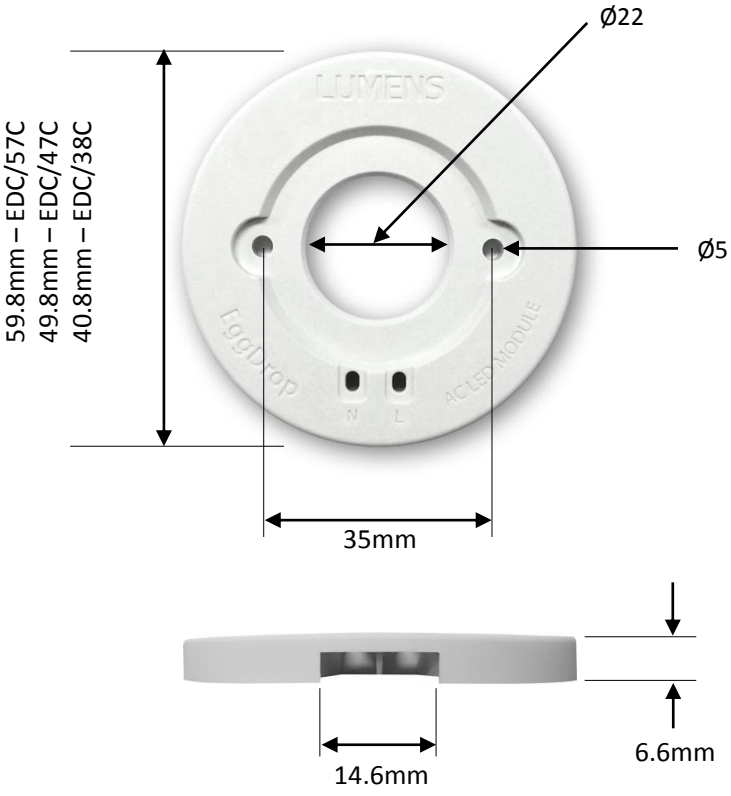
Hole Ø5.5

Outer Size

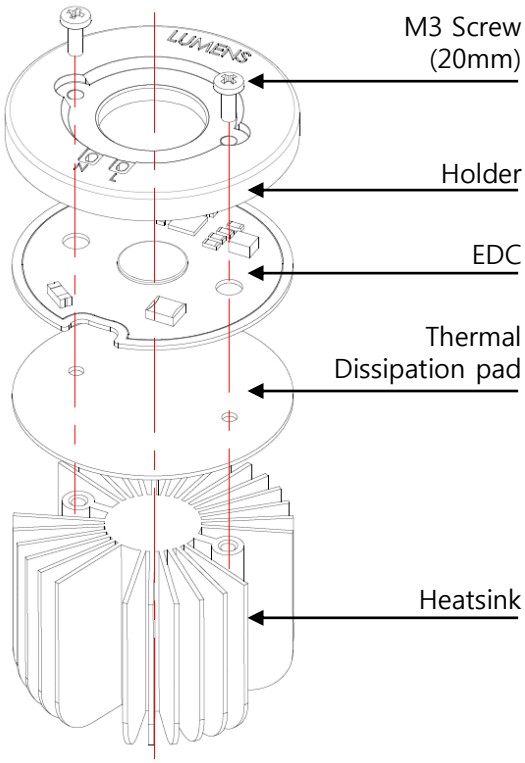
Ø38 : EDC/38C/4W,6W,8W
Ø47 : EDC/47C/9W, 10W, 12W, 15W
Ø57 : EDC/57C/10W, 15W, 20W, 30W, 40W

* LES = Light Emitted Surface

Optional Item (Lamp Holder)



※General assembly guide



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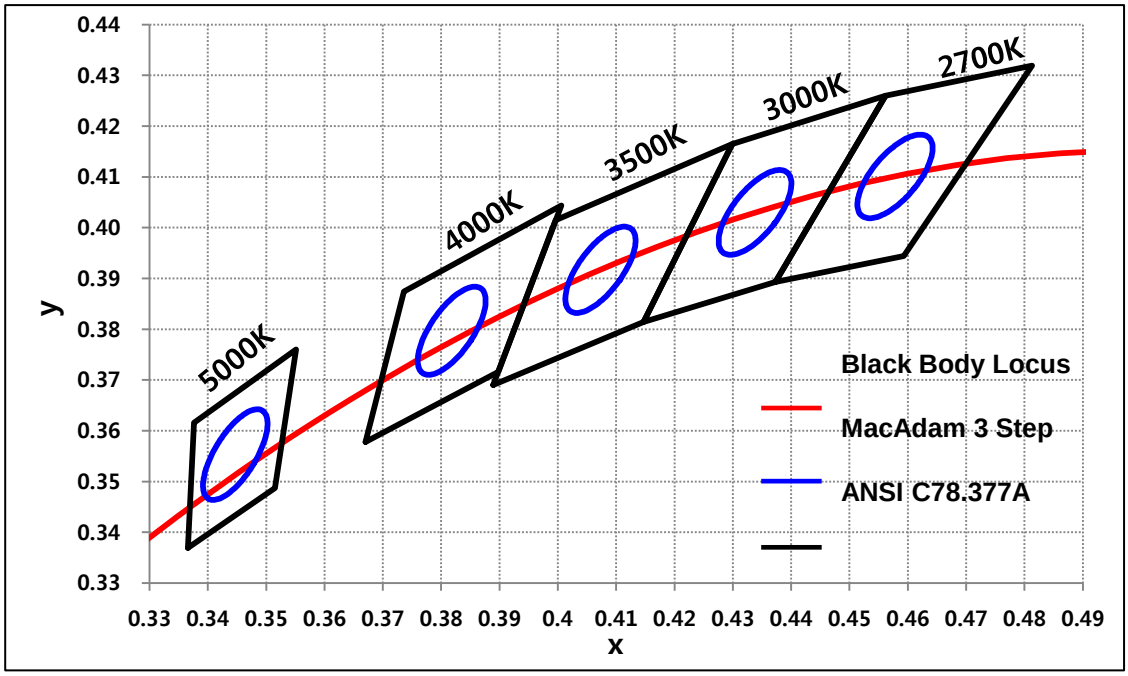
3. Optical Properties

1) Chromaticity Bins

Lumens complies with the ANSI C78.377A standard for its chromaticity bin structure. For each ANSI quadrangle for the CCT range of 2700K to 5000K, Lumens provides 5 bins.



CCT(K)	x	y	CCT(K)	x	y	CCT(K)	x	y
5000K	0.3366	0.3369	3500K	0.3889	0.3690	2700K	0.4373	0.3893
	0.3376	0.3616		0.3996	0.4015		0.4562	0.4260
	0.3551	0.3760		0.4299	0.4165		0.4813	0.4319
	0.3515	0.3487		0.4147	0.3814		0.4593	0.3944
4000K	0.3670	0.3578	3000K	0.4147	0.3814			
	0.3736	0.3874		0.4299	0.4165			
	0.4006	0.4044		0.4562	0.4260			
	0.3898	0.3716		0.4373	0.3893			

CCT(K)	Center		Ellipse Parameter		
	x	y	Axis a	Axis b	Angle(°)
5000K	0.3447	0.3553	0.00822	0.00354	59.6
4000K	0.3818	0.3797	0.00939	0.00402	53.7
3500K	0.4073	0.3917	0.00927	0.00414	54.0
3000K	0.4338	0.4030	0.00834	0.00408	53.2
2700K	0.4578	0.4101	0.00810	0.00420	53.7

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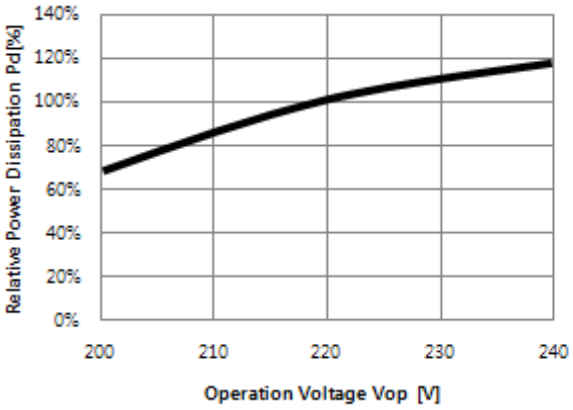
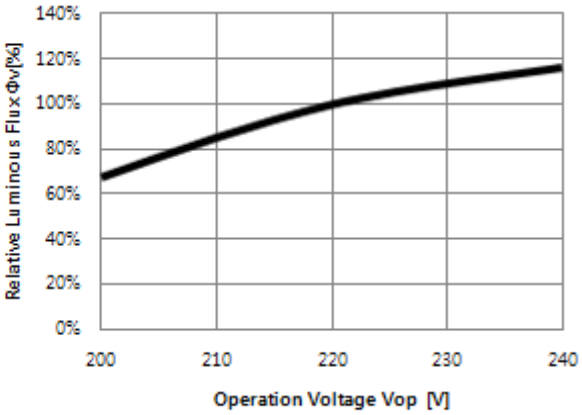
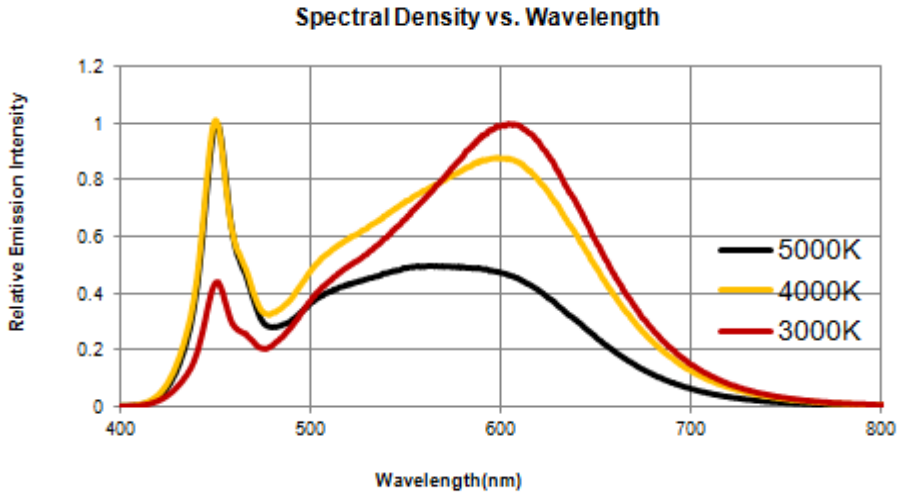
2) Spectral Power Distribution

Voltage Characteristics(Ta=25℃)

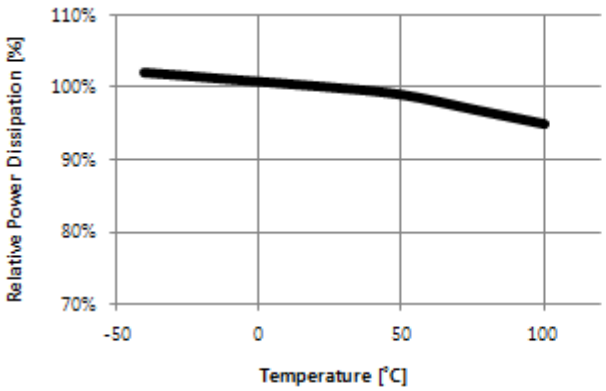


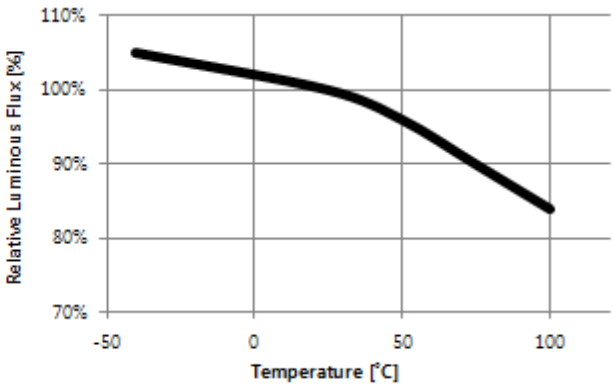


Spectrum Characteristics(Ta=25℃)



Temperature Characteristics





4. Thermal Management

1) Significance of heat dissipation

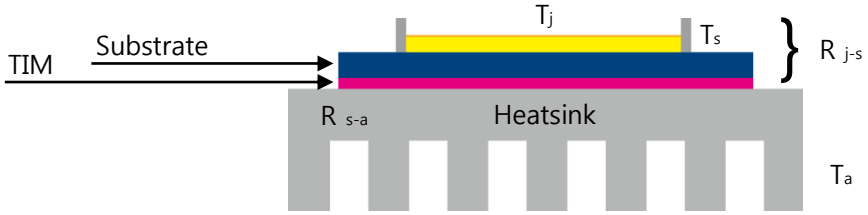
The package of the COB radiates light and heat according to the input power. However, the surface area of an COB is quite small, and the COB itself is expected to release little heat into the atmosphere. An external radiator such as a heat sink is thus required. The heat dissipation structure up to the connection portion of the external radiator uses mainly heat conduction.

Regarding COB, to control the junction temperature of the LED T_j is important. The T_j must be kept from exceeding the absolute maximum rating in the specifications under any conditions. As direct measurement of the junction temperature of a light-emitting diode inside a package is difficult, the temperature of a particular part on the external package (the case temperature) T_c [°C] is normally measured. T_j [°C] is calculated using the thermal resistance between the junction and the case R_{j-c} [°C/W], and the emitted heat amount that is nearly equal to the input power P_d [W]. The heat generated at the LED can be conducted to the external radiator efficiently because the package structure for the EggDrop®-COB minimizes the thermal resistance R_{j-c}.

For example, the package of the COB is connected to an external heat sink with TIM (thermal interface material), is shown in Fig. 1. The heat generated from COB in the junction section of the LED diode is transferred mainly to the heat dissipation structure by thermal conduction. The thermal resistance R_{j-s} is between the junction section and the substrate side of the package outer shell, and also the specific thermal resistance value of the COB ($R_{j-s} = R_{COB}$).

$$T_j = (R_{j-s} \cdot P_d) + T_s = ((R_{j-s} + R_{s-a}) \cdot P_d) + T_a$$

- T_j : Junction temperature [℃]
- T_s : Case temperature, bottom of package [℃]
- T_a : Ambient temperature [℃]
- P_d : Input power of LED package [W]
- R_{j-s} : Thermal resistance from junction to case [K/W or ℃/W]
- R_{s-a} : Thermal resistance from case to ambient [K/W or ℃/W]



(Fig. 1. Cross-section of COB LED)

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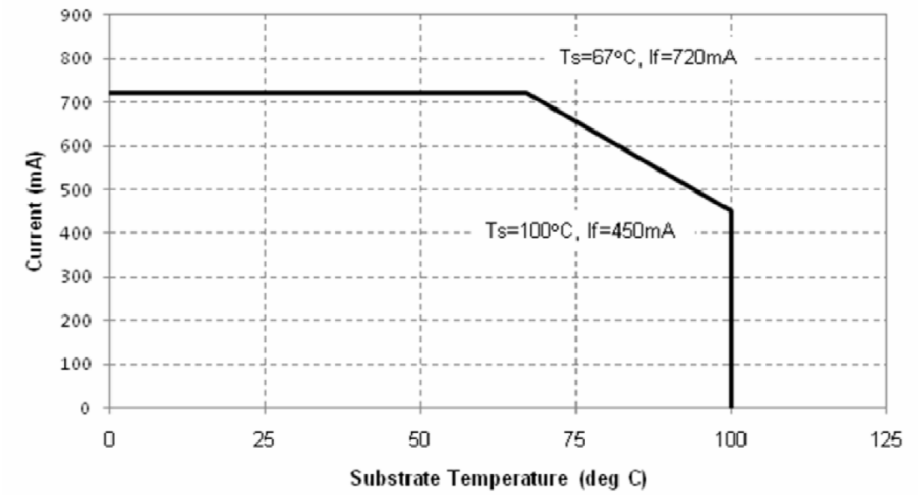
2) Thermal Design of COB LED

Thermal management of COB LEDs must be considered during the design phase of applications. The driving conditions and the temperature surrounding the LEDs in the application should be conformed to the maximum ratings in specification. The definition of package thermal resistance *Rj-s is from junction to the bottom of substrate. As shown in Fig. 2, the de-rating curve* gives the maximum driving current versus case (or substrate) temperature (Ts) for different operating limits and was based on the thermal resistance.

From Fig.2, the maximum driving current IF of package is 720mA. When the operating condition setting is base on it, the substrate temperature should be under 67℃ as shown of the horizontal line. Fig.2 also shows that the limitation of operating temperature of Ts is 100℃, and the driving current should be under 450mA in the condition.



(Fig. 2. De-rating curve – The operating limits

The operating limitation of each COB data sheet shows that the maximum current and Ts conditions under which the COB operates successfully. In order to design for an LED system, even choices one model of light engine as COB, the demonstrated Ts and Ta must be different due to use different heat dissipation structures at same input power. And the junction temperature must be re-evaluated. For an LED module system, the definition of total thermal resistance *Rj-a is from* junction to ambient and the *Rj-a= Rj-s + Rs-a . De-rating curve gives the maximum driving conditions* for different system thermal resistances and the Tj also kept at temperature not exceeding the maximum rating.

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3) Thermal Simulation

In package component level, good thermal conduction in the structure is most important. When heat generated from chip diode, it transfer through the component into assembly module outside the package and dissipated to the ambient environment. When performing the thermal simulations as assumptions must be determined and the operating boundary conditions must be checked.

Computational fluid dynamics (CFD) analysis is one of simulation tools for solving thermal conduction, convection, and radiation to evaluate the thermal design. This method proposes for quick and inexpensive for design adjustments. Simulations usually show the answers and depending to the approach taken, just like due to the boundary condition setting of interface between materials and heat spreading path assuming, it may not always be equal to actual situation. After simulating or optimizing the design, building a prototype to double confirmed the performance is always recommended.

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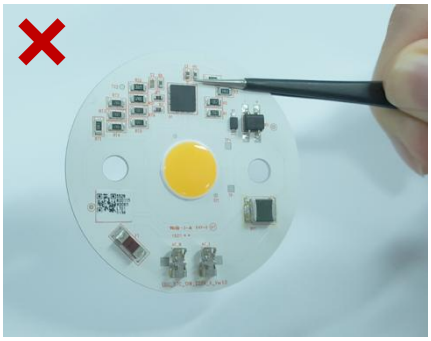
5. Handling Guide

1) General Handling Guides

1. The LES of PCB comes with a protective film solely upon PCB delivery. The holder comes with a protective film upon both PCB and holder delivery.
2. The customer has full responsibility regarding safety issues once the customer purchases the PCB for assembly. We highly recommend using our designated standard holder for safe usage.
3. Remove protective film after installation. When power is on, the attached protective film could affect the lumen output.

Incorrect

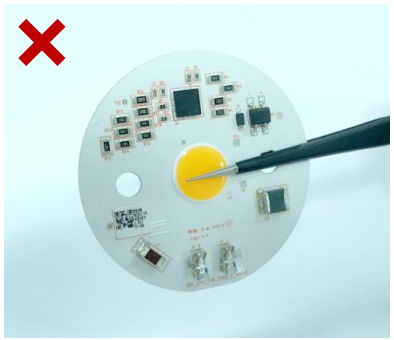


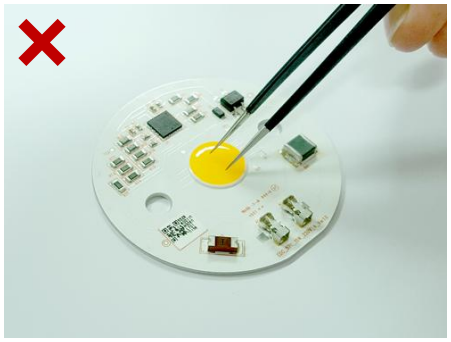
· Do not use tweezers

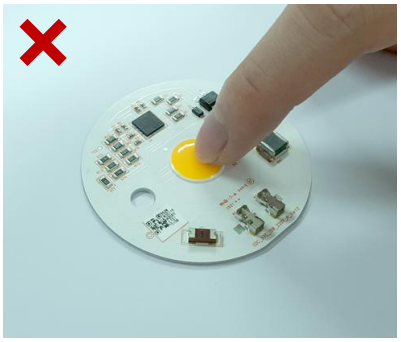
· Do not touch with naked hands

· Do not stack the products

Incorrect







Do not touch LES with hands, tweezers, or other metal.

The LES part is composed of the light emitting area and white dam area. Please avoid use of anything sharp to press, put stress on, rub, attach or make contact with the LES. They might negatively affect the function, performance and reliability of the product.

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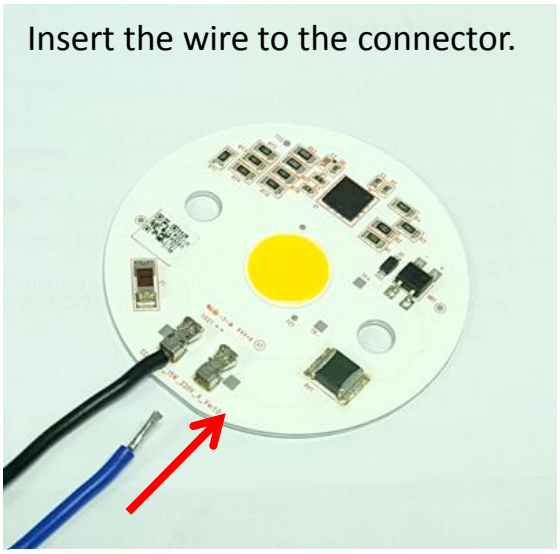
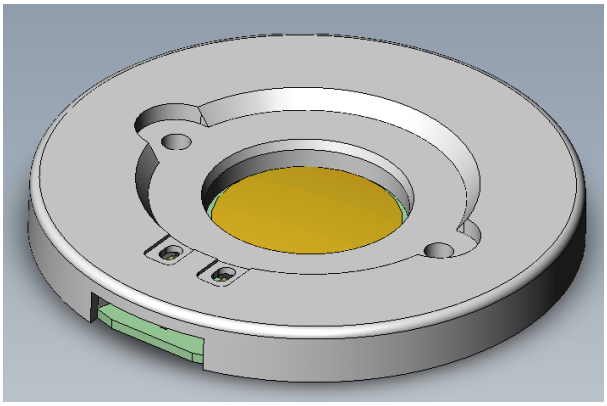
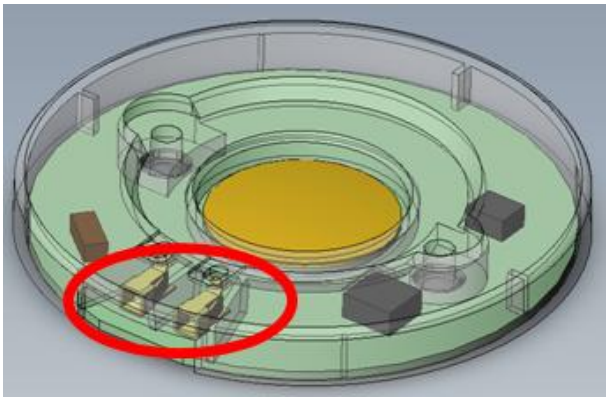
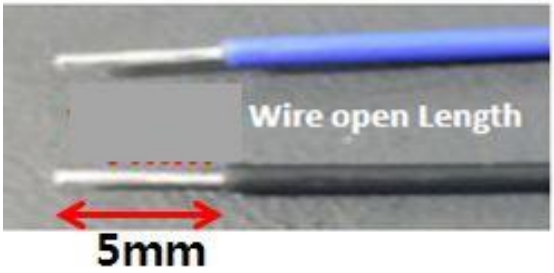
2) Wire Connection (Terminal Type)

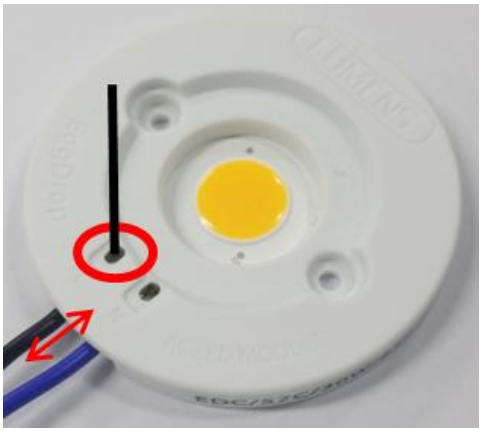








※ Wire spec. : 0.5~0.75mm^2 (AWG 20~18)



Push down the hole with a sharp object to pull the wire from the connector when disconnects.

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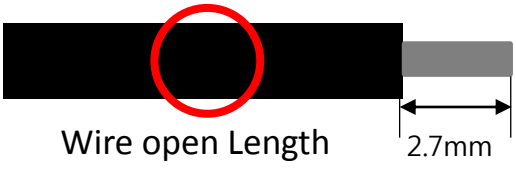
3) Wire Connection (Solder Type)

1. Products shall be heated to a temperature of 150℃ before soldering.
   Ensure not to be over 150℃ to avoid any potential of problem.
   Lumens strongly recommends Soldering iron and hot plate together for soldering wire connection.


- Set a hot plate on 150℃.
- Set a soldering iron on 400℃.
- Soldering iron tip is recommendable.

2. Strip 2.7mm (±0.1mm) of wire for soldering wire connection and ensure not to be stripped off jacket of the wire by a soldering iron to avoid shock or any serious problem.



Eggdrop COB Module		Wire Gauge		Wire Strip Length	
		AWG (min)	mm²	inch	mm
EDC38 C	4W	18	0.823	0.106	2.7
	6W	18	0.823	0.106	2.7
	8W	18	0.823	0.106	2.7
EDC47 C	9W	18	0.823	0.106	2.7
	12W	18	0.823	0.106	2.7
	15W	18	0.823	0.106	2.7
EDC57 C	10W	18	0.823	0.106	2.7
	15W	18	0.823	0.106	2.7
	20W	18	0.823	0.106	2.7
	30W	18	0.823	0.106	2.7
	40W	18	0.823	0.106	2.7

- Recommended cable size

3. Pre-solder on solder pad and cable with a soldering iron.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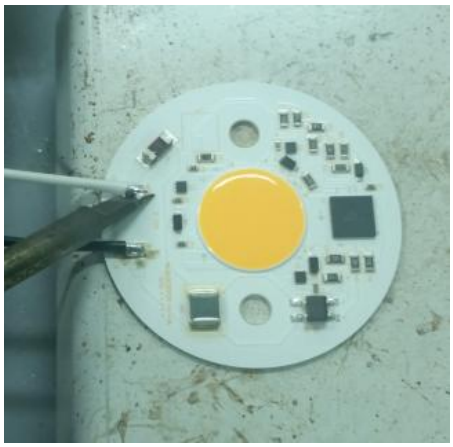
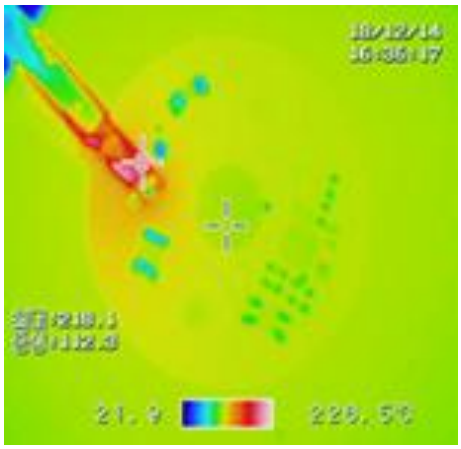
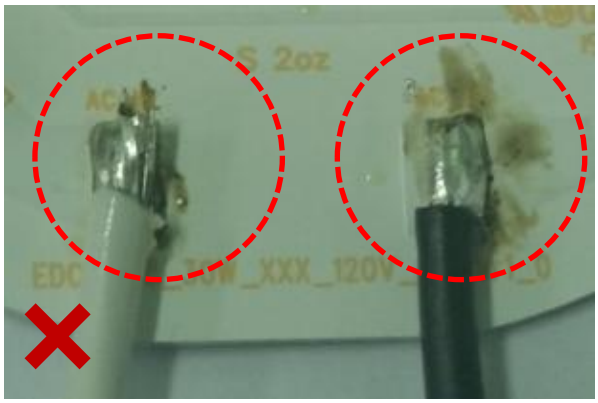
4. Solder with a soldering iron after 5-6 sec since you put Eggdrop COB on hot plate (150℃).
   During soldering, always wear anti-static wrist band, shoes and clothes for the safety.

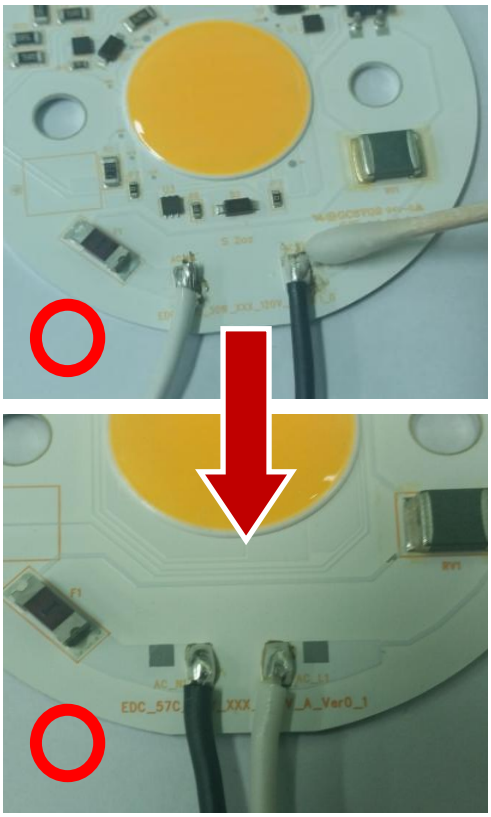




5. Ensure wires soldered to a product to avoid solder-pad lifting or any damage to the product.

6. Remove solder flux after soldering.





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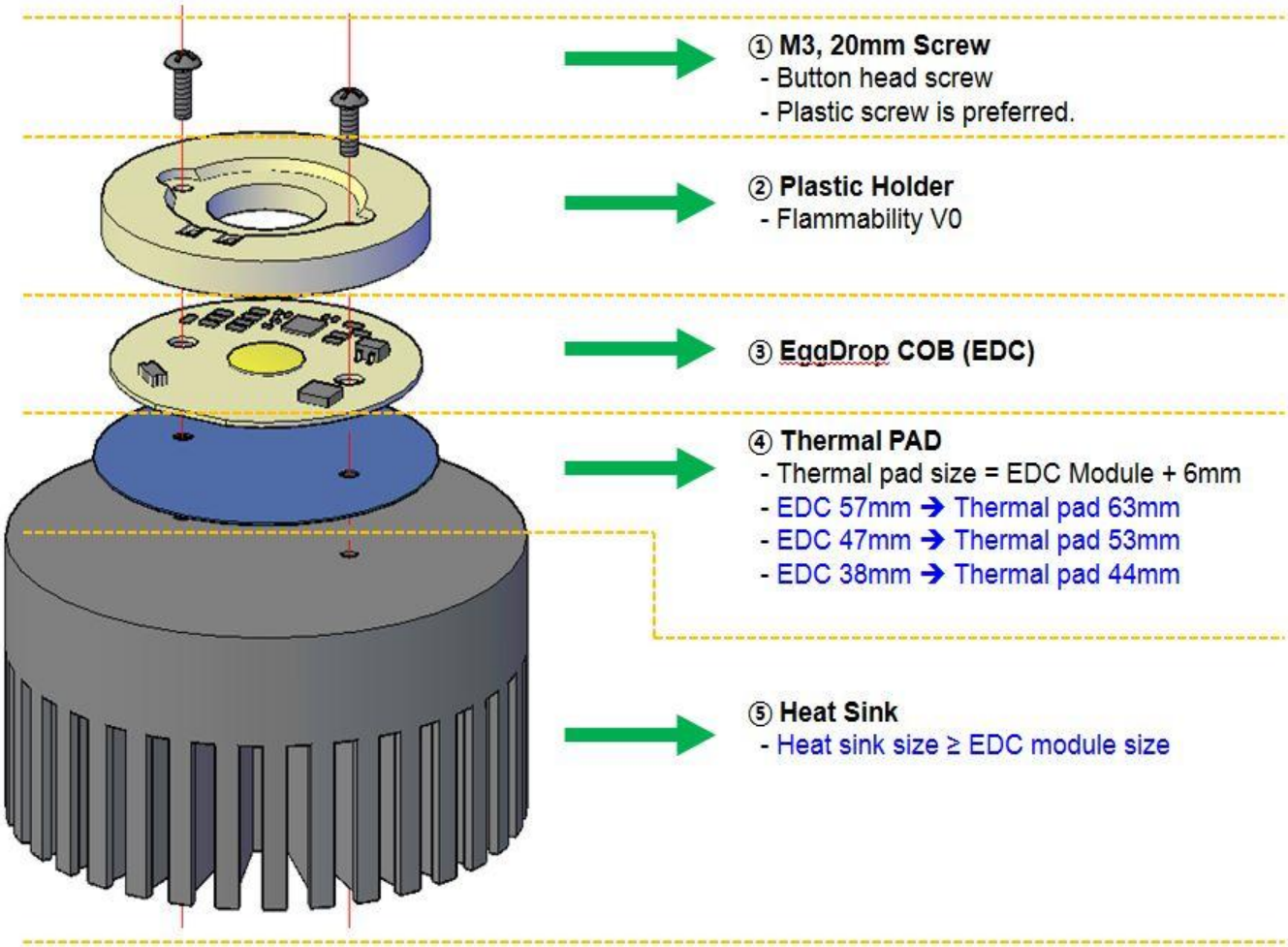
6. Mechanical Assembly Guide

1) General Assembly Guide – 1

→ *Basically, one full set is composed of holder, EDC, thermal pad & heat sink.*



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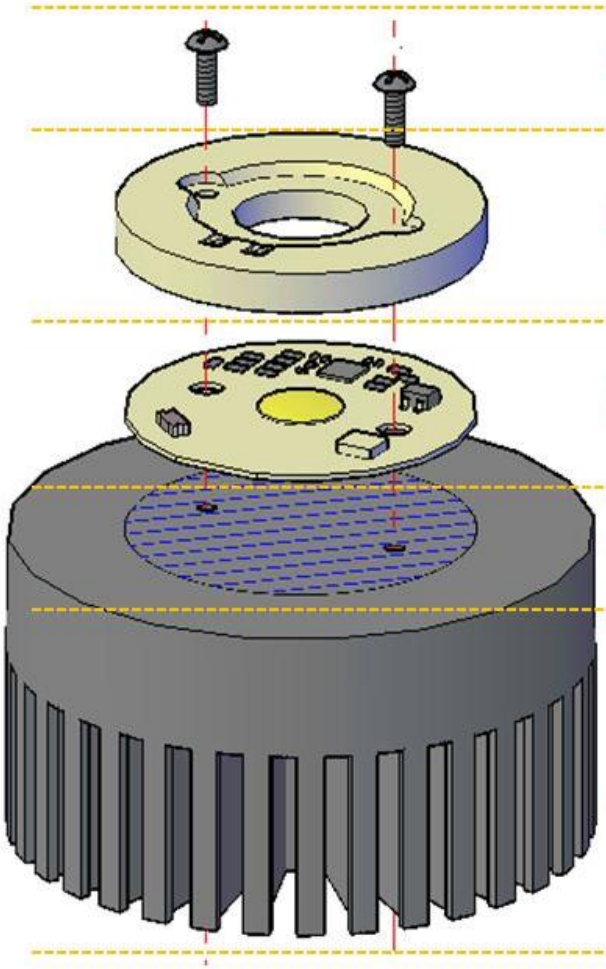
2) General Assembly Guide – 2

→ In case of assembly without pad.



① **M3, 20mm Screw**
- Button head screw
- Plastic screw is preferred.

② **Plastic Holder**
- Flammability V0

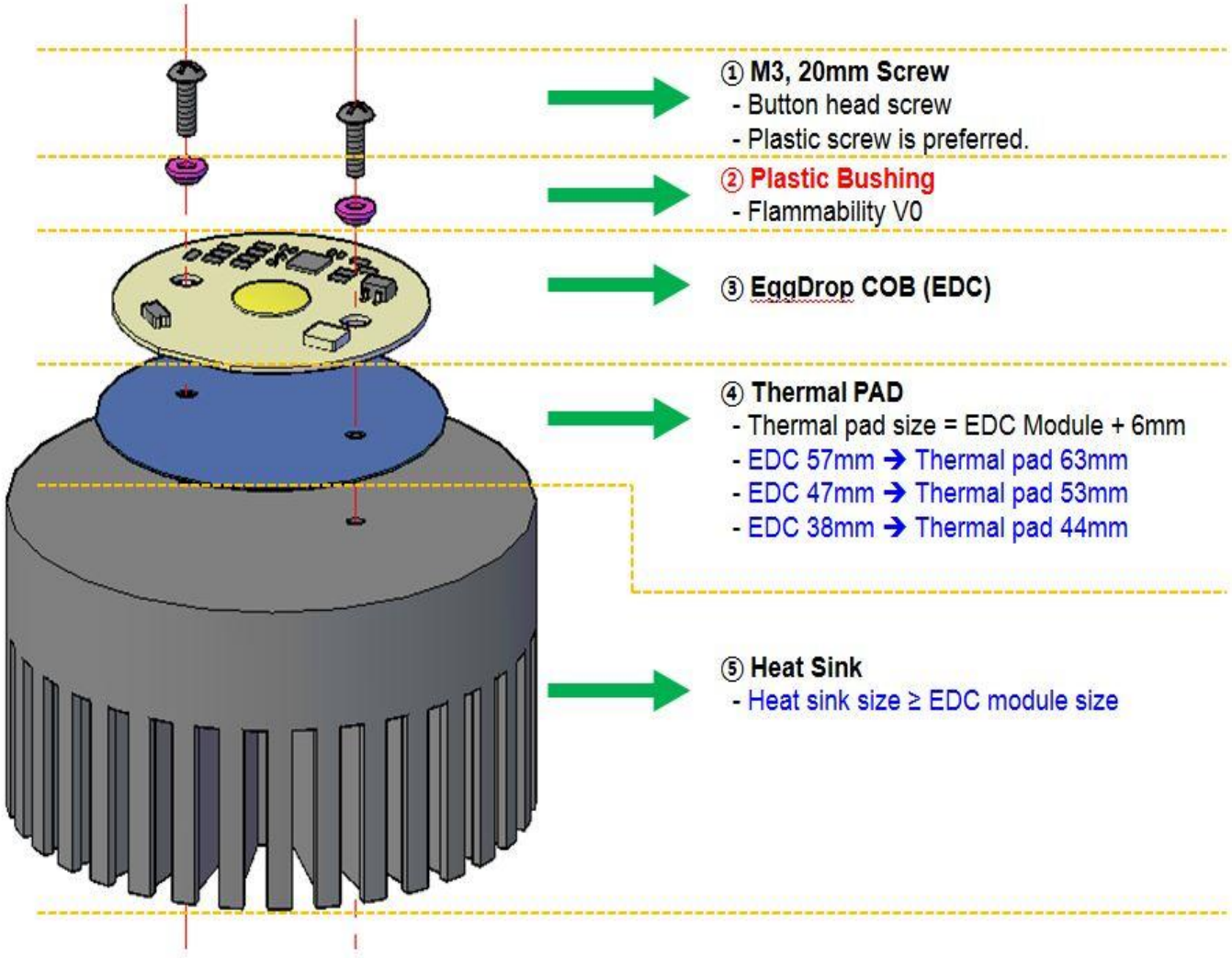
③ **EggDrop COB (EDC)**

④ **Thermal Grease**
- Thermal grease area = EDC Module
- EDC 57mm → Thermal grease area 57mm
- EDC 47mm → Thermal grease area 47mm
- EDC 38mm → Thermal grease area 38mm

⑤ **Heat Sink**
- Heat sink size ≥ EDC module size

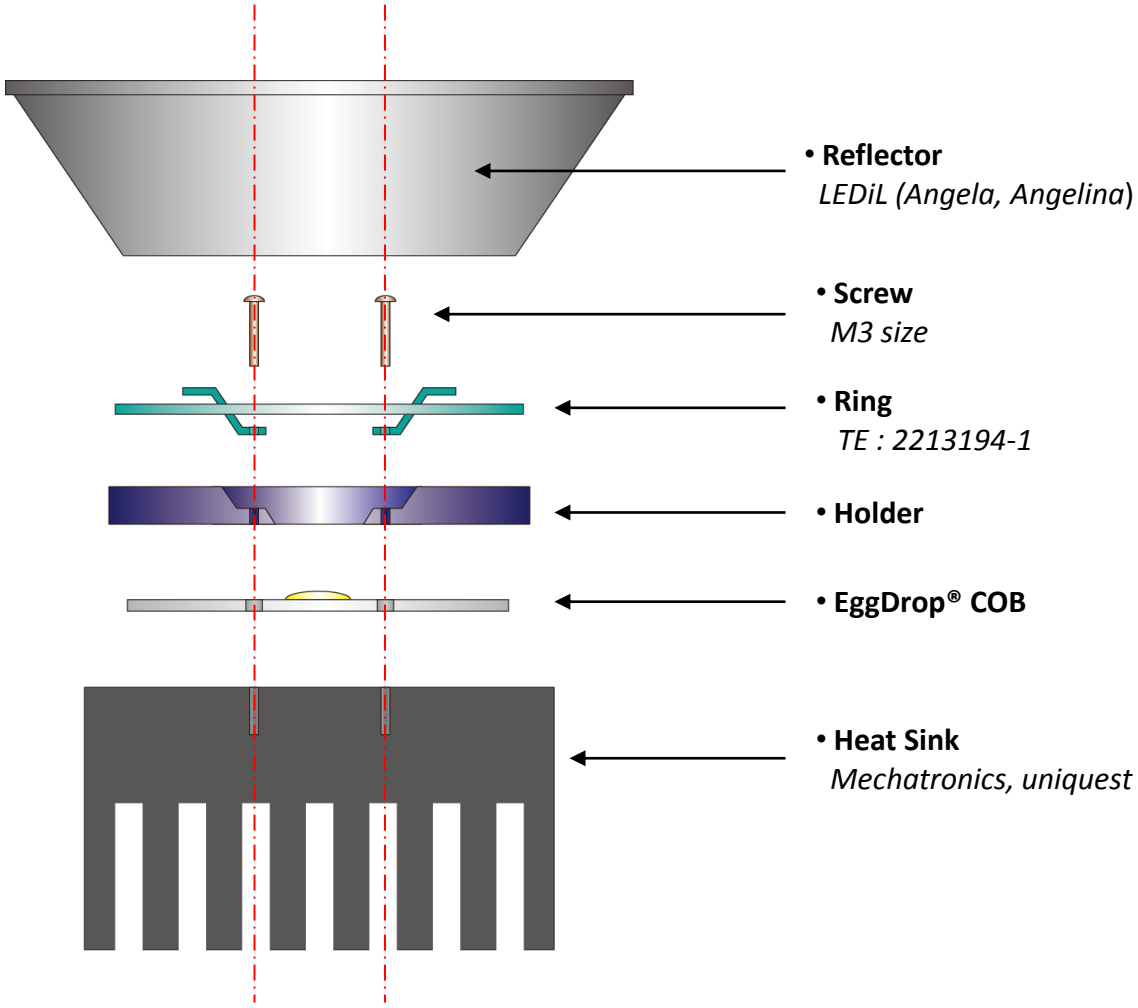
3) General Assembly Guide – 3

→ In case of assembly without holder, Plastic bushing is recommended for electrical isolation



4) General Assembly Guide – 4

→ For LEDiL type reflector (Outer side of holder)



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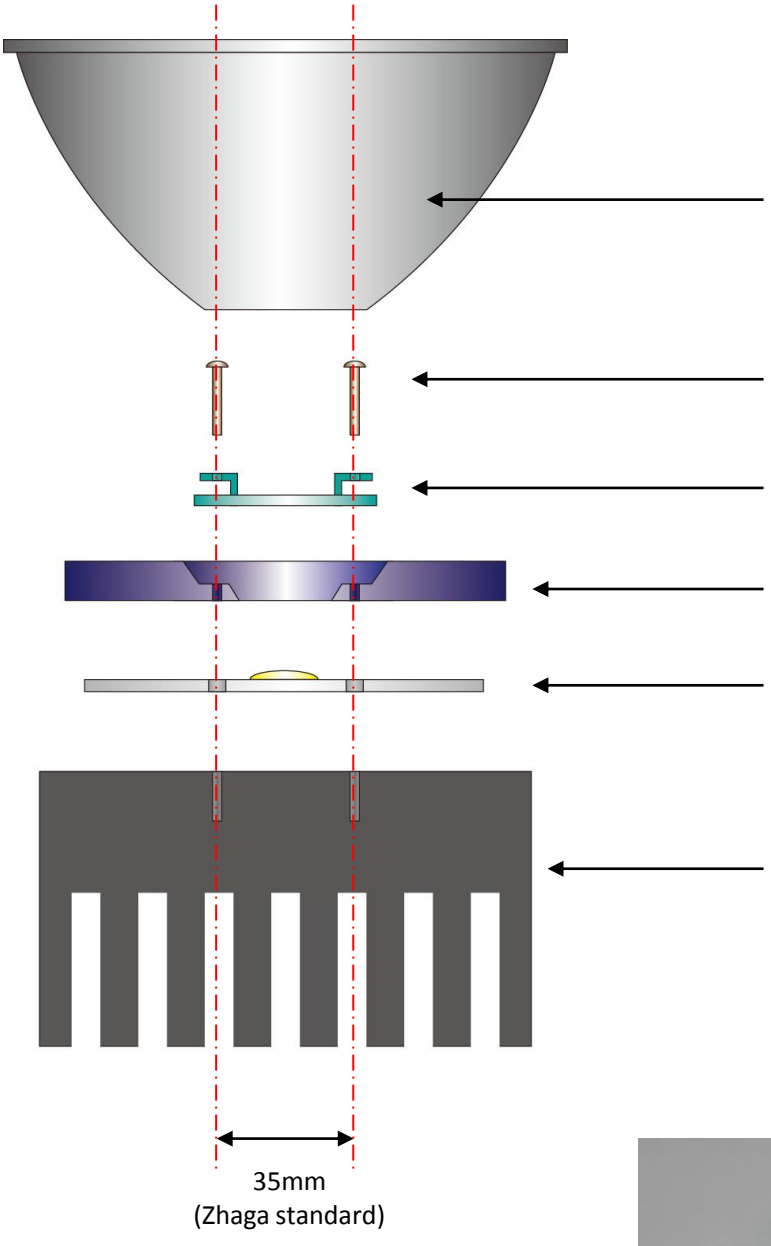
5) General Assembly Guide – 5

→ For Nata type reflector (Inner side of holder)



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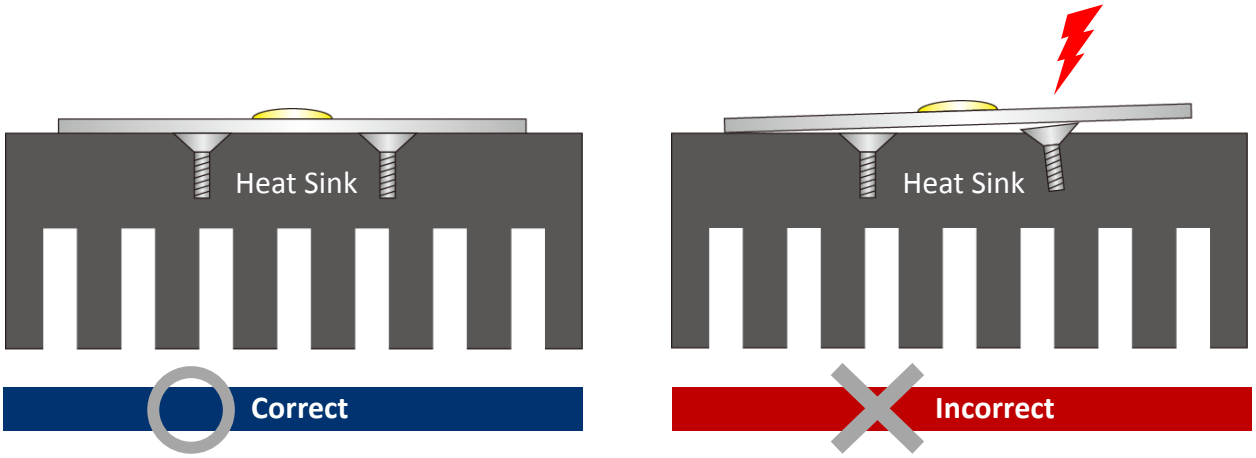
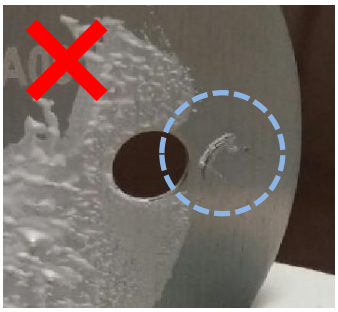
6) General Assembly Guide – 6

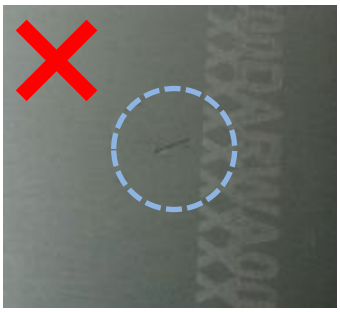
1. The contact surface of Product and Heat sink or luminaire shall be always cleaned without any foreign materials and kept flat.

2. Use caution when assembling a product to the heat sink or luminaire not to cause any damage on the PCB surface by uneven, convex contact surface or improper stress forces. It can cause safety issues such as withstand voltage. Lumens strongly recommends using thermal pad on the surface instead of thermal grease.





↑ PCB damaged by improperly assembled screws



↑ PCB damaged by burrs

7. Heat Sink & Thermal Pad

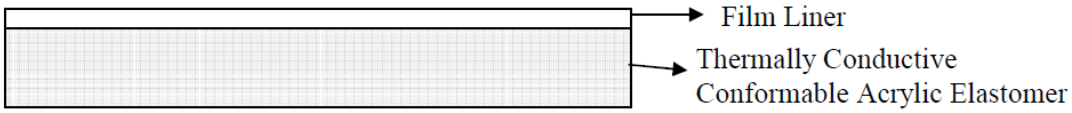
1) Heat Sink Specification

EDC Model	~ 10W	20W	30W, 40W
Dimension (mm)	Ø95 x H40	Ø95 x H50	Ø95 x H80
Weight (g)	270	365	585
Consumption power (W)	20	30	50
Tc. Temperature(℃)(1)	≤70	≤70	≤70
production method	Extrusion		
Material	A6063−T5		
Surface Treatment	Black Anodized		

2) Thermal Pad Specification

- 4W ~ 30W ➔ 2W/mk (thickness = 0.5mm)
- 40W ➔ 5W/mk (thickness = 0.5mm)

Property	Method	Value
Thermal conductivity (W/m-K)	QTM-500	2.0
Flammability	UL94	V-0
Density (g/cm^3,@25C)	TS-TM-441	1.85
Hardness (Shore 00)	TS-KOR-217	70
Volume resistivity (Ω-cm)	JIS K6249	$3.3x10^{12}$
Dielectric Strength (kV/mm)	ASTM D149	23



Product thickness : 0.5, 1.0, 1.5 & 2.0mm
- Tolerance : +/- 10%

Through lamination process, up to 20mm thick product is available.

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8. ESD Control

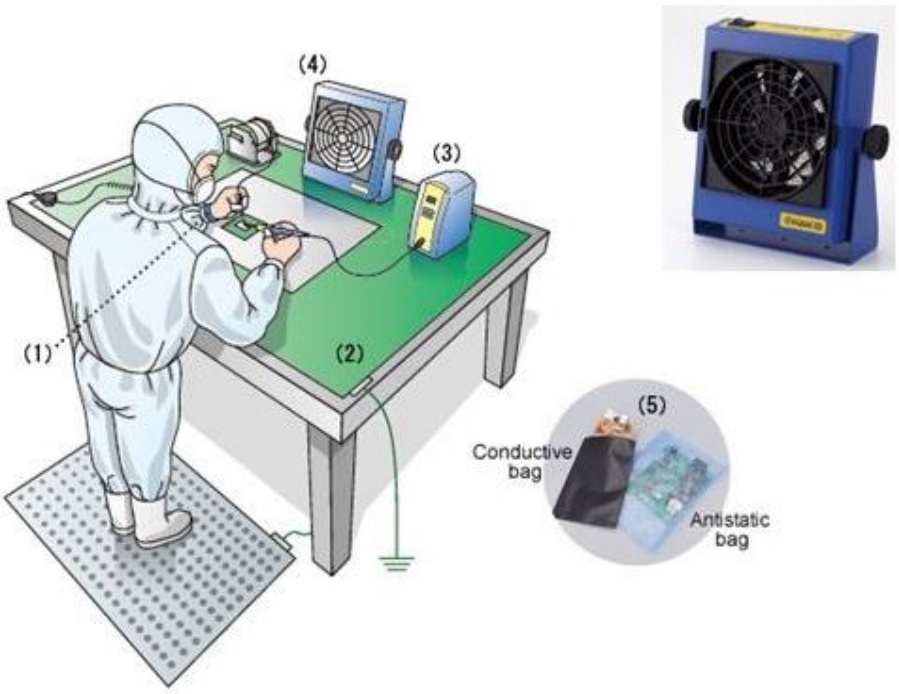
1. Ground the worker.
   - Wear an antistatic wrist strap.

2. Ground the surface of the work bench and ground the tools and other apparatus.
   - Lay the ESD protective mat on the work bench to ground it.

3. Remove from the area all materials (static producing materials) which tend to cause static electricity problems.
   - Use the ESD protective tools.

4. Use ionization or other charge mitigating techniques to neutralize the charge if removing the static charge by grounding is not possible.
   - Use the static eliminator (ionizer).

5. Place sensitive items in appropriate protective packaging when transporting or moving to storage from areas in which the above three points are being enforced.
   - Store in antistatic bag.



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※ Cautions

1. Do use proper wire in terms of thickness.
2. *Always make sure to discharge prior to wire soldering.*
3. Do not use wires that are ripped or damaged.
4. Do not add or change wires while product is active.
5. Wires shall not protrude beyond solder pads and excessive solder flux shall be cleaned in order to minimize the potential for contamination.
6. Do use heat sink which fits capacity of each AC module.
7. It is strongly recommended to insert thermal pad for better thermal performance.
   - Please refer to the drawing of the PCB for accurate dimension of thermal pad.
   - Thickness of Recommended Thermal pad : Minimum 0.5mm
8. Please use carefully when using thermal grease instead of thermal pad, to avoid catastrophic mechanical damage to the LED.
9. Do not make any modification or change on product.
10. It is recommended to store product under the condition of 5~30℃ and humidity less than 40% RH. When storing products for a long period of time before usage, please put silica gel with product into dry bag or anti-static bag.

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