

Carclo Optics

Guide to choosing secondary optics

Introduction

To quote from Pirelli's advertisement for tyre's, "Power is nothing without control" and equally the same analogy can be drawn with light. Seldom will the end user care about the total amount of light an LED radiates, rather what counts is where the light is going and how bright it is. Sending the light in the desired direction and obtaining the required brightness means controlling and directing the light output from the LED. (And it must not be forgotten that it is often just as important that light is kept away from other areas.) To do this usually requires more than just the pointing the LED's clear lens, (the primary optic), in the right direction. For the majority of applications producing the illumination in the required area and at the desired level requires additional or secondary optics. This guide aims to help in the selection of the best secondary optics and with the calculation of the illumination levels that will be achieved.



Information you need before you start

Although it sounds obvious, the first steps in selecting the best secondary optics for an application is to determine what illumination levels you want to achieve and over what area. Then from these two figures the total amount of light that will be needed can be calculated. Once you know how much light you need, it is then possible to decide what type of LED is required and how many. Only when the inputs to the optics, (the type and number of LED's), and the outputs, (the illumination level and beam shape), have been defined can the secondary optics be specified.



Carclo Technical Plastics (Slough)

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Guide to choosing secondary optics

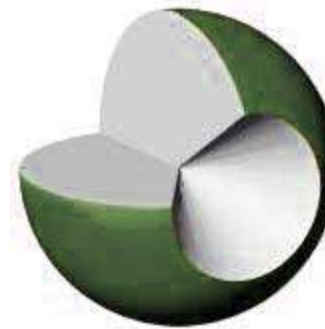
Quantifying light output

Often the first problem that someone new to lighting design has is defining the requirement in specific terms that can be used to calculate how much light is required. Carclo uses the metric system of light units for all our data sheets.

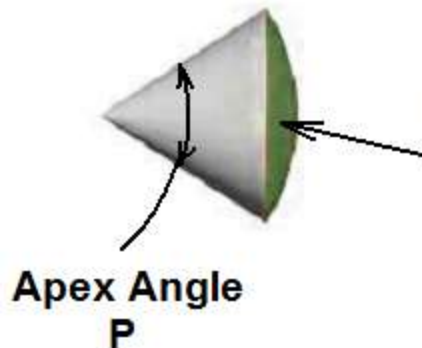
The metric unit of measurement for light seen by the human eye is called the lumen. The lumen is used to quantify the total amount of light radiated by a visible light source, in this case the LED. However what is important in most applications is how bright the light will be and this depends on what area the light is concentrated into.

To specify what illumination level is needed on a surface you need to calculate how much light is needed per square meter of surface. This unit of measurement is called Lux and is the amount of total light in lumens divided by the area being illuminated. Lux can be measured with a light meter.

If you need to specify the brightness of a light that is viewed at a significant distance, the unit of measurement to use is the candela. Candela is defined as the amount of light in lumens being radiated into each steradian of solid angle. (To calculate solid angle, imagine putting the light at the centre of a sphere with a radius of 1 meter. The amount of surface area in meters squared of the sphere that the light passes through is equivalent to the solid angle in steradians.)



The removed cone has an apex solid angle of 1 Steradian



Solid Angle
 Ω

The solid angle of a cone with an apex angle of Ω is given by:

$$\Omega = 2\pi (1 - \cos(P))$$

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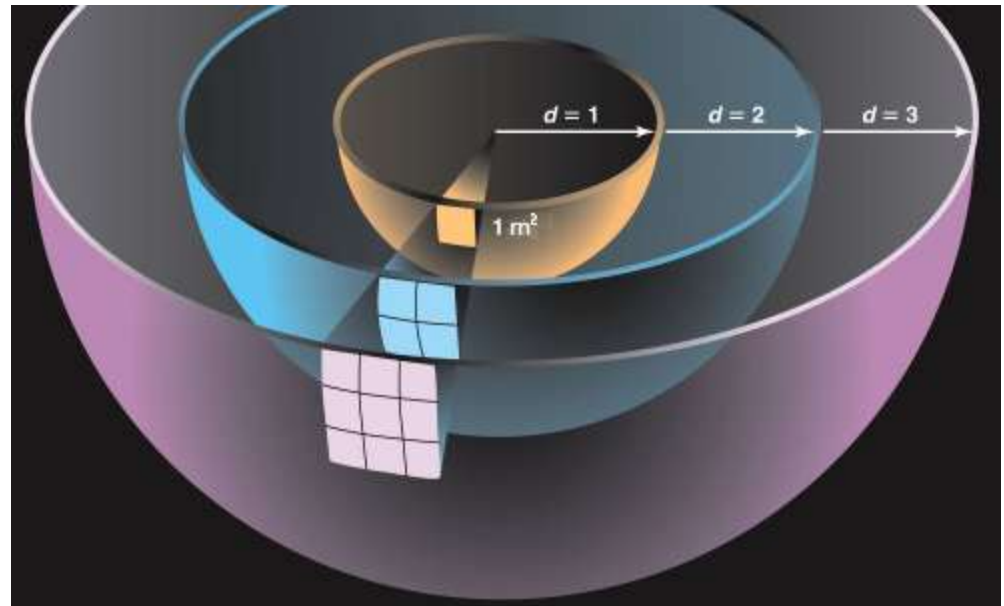
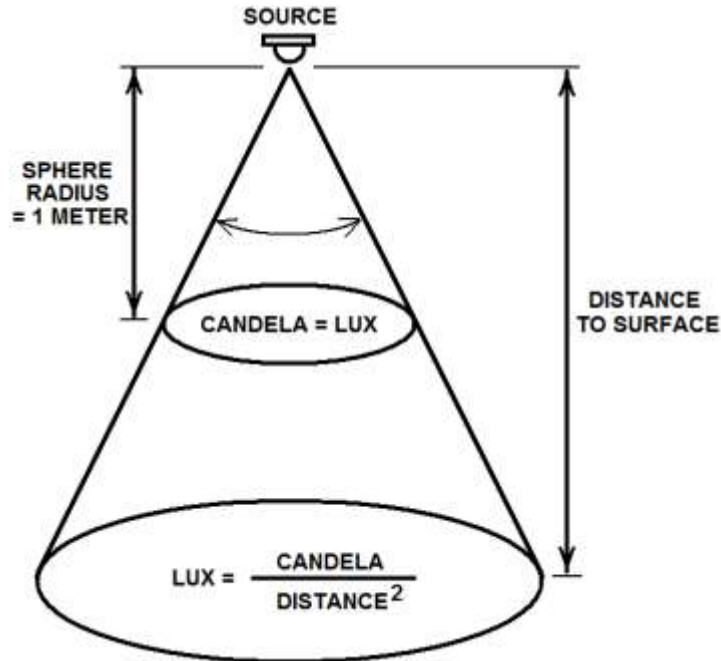
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Converting from Candela to Lux

To convert from Candela values to Lux: Divide the Candela values by the square of the distance in meters from the light source to your illuminated surface.

Converting from Lux to Candela.

To convert from Lux to Candela: Multiply the Lux values by the square of the distance in meters from the light source to your illuminated surface.



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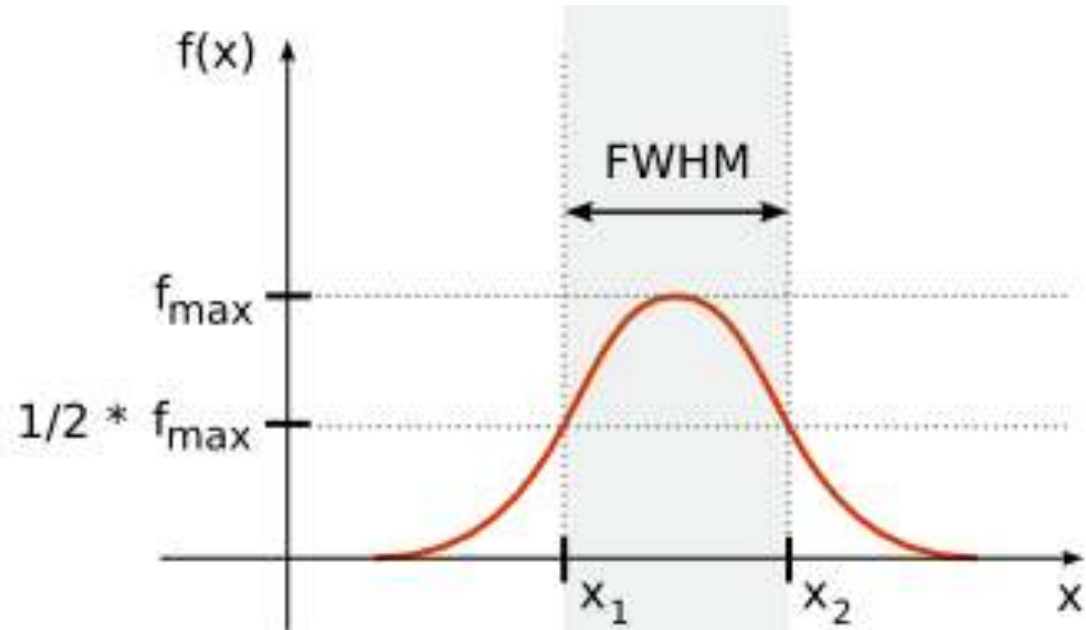
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Specifying the beam width

It is impossible to produce a perfect beam of light that does not spread out. The finite size of the emitting region of the LED source means that the light will diverge. How much the light spreads out depends on the emitting area of the LED chip and the type of secondary optics that are used. For this reason the beam widths that a secondary optic produces have been measured with each LED type that it can be used with

Secondary optics are characterised by how wide a beam they produce. The beam width is quoted as an angular width rather than a physical beam size at a given distance. The angular width the optics produce is usually specified by measuring the angular separation between the directions, (x_1 and x_2) at which the intensity has fallen to half its peak value, ($f_{\max}$). This value is called the Full Width Half Maximum (FWHM) divergence.

It is important to note that it is **not** possible to calculate from the FWHM beam width how big the beam will look to the human eye. The visible size will depend on other factors such as the ambient lighting conditions and the colour LED that is being used. In very low ambient lighting conditions the beam will look far larger than the FWHM size because the observer looking at the spot of light can see clearly the very faint edges of the distribution. Against a bright background the beam size will look much more like the spot size that would be calculated from the FWHM angular width.



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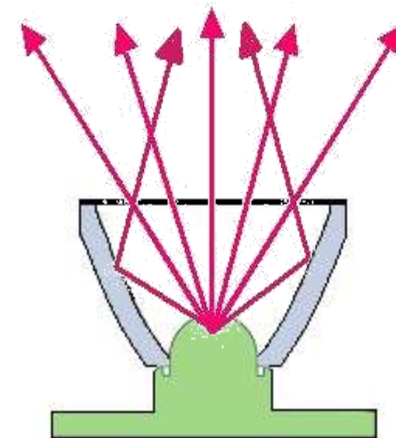
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Selecting Secondary Optics

The type of optics that will best suit an application are mainly determined by the beam width of the illumination that you want to produce. The type of LED selected as the light source will also effect the choice of optic. At the present time there is no industry standard package for high power LED's, different manufacturers have used different encapsulation techniques. Because of this some of Carclo's range of optics have variants particularly optimised for certain LED types.

Reflectors

To produce very wide beams, (up to 80 degrees FWHM) a reflector is the best choice. Reflectors have good efficiency and have a very sharp beam edge. The Carclo 80 degree reflector produces a very even circle of light and is ideally suited for applications such as the luminaries used on petrol station forecourts.



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TIR Optics

To produce smooth circular beams with FWHM angular widths between 12 and 35 degrees a Total Internal Reflecting (TIR) optic is the optimum solution. To produce elliptical beams the TIR optics are available with a linear ripple surface that generates an even intensity line. The classic 20mm diameter range of TIR optics are available for a wide range of LED types.

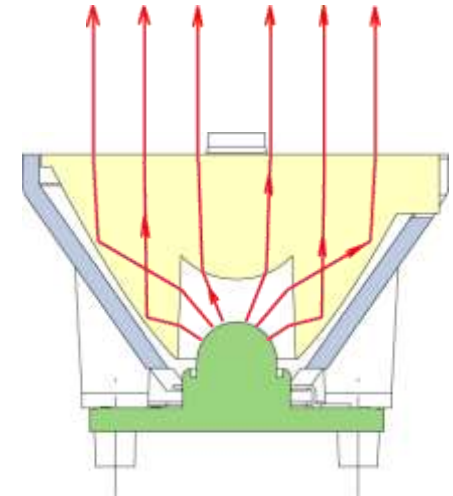
By using a proprietary frosted surface on the front of the optics Carclo are able to vary the angular beam width while maintaining a smooth profile without compromising the optical efficiency.

Elliptical beams are created through the use of linear ripple profiles moulded on the top surface of the TIR optics.

A range of larger 26.5mm diameter TIR optics is designed to produce narrow divergence output beams.

Manufactured in lens quality polycarbonate, Carclo's TIR optics have much higher temperature resistance than acrylic optics, (up to 125°C compared with 95°C) and carry a UL rating. These one piece optics are tough and impact resistant but precautions should be taken to prevent them from coming in to contact with organic solvents or vapour.

**Diagram showing
light ray paths
through a TIR optic**



**Picture showing
Carclo 20mm
diameter frosted
optics**



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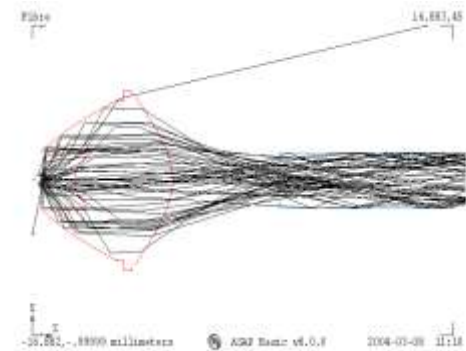
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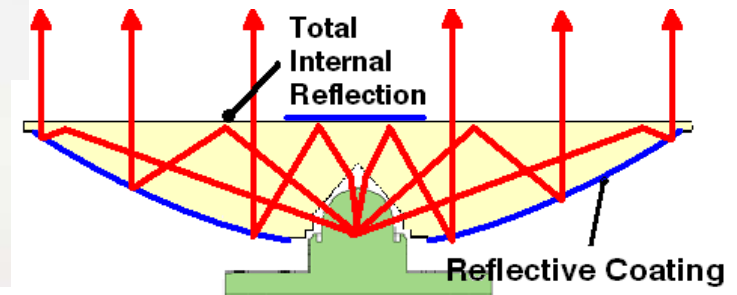
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Specialist Optics

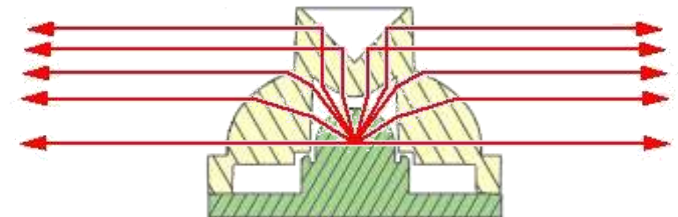
To focus the light from an LED on to the end of a fibre bundle Carclo manufacture a standard 20mm diameter lens with an integrated focusing lens. Optimised for NA 0.5 fibre bundles with diameters of between 8 - 12mm this optic can be used to make compact microscope illumination systems.



To produce the narrowest of beams Carclo manufacture catadioptric reflector optics. These are available in 50mm and 60mm diameters. The ability to create very tight beams with FWHM divergence as small as 3 degrees makes them ideally suited to applications such as beacons and spot lights.



To create a narrow beam of light that covers 360 degrees around the LED Carclo manufacture side emitter optics for a number of LED's. These are ideally suited to a wide range of applications such as beacons and runway lighting. They also have applications in large area backlighting where they can be used to couple light in to standard 10mm thick PMMA or Polycarbonate sheets.



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Holders for LED Optics

When mounting secondary optics it should be remembered that positioning the optics at the correct height relative to the LED is essential if you are to obtain the best efficiency and the correct beam width. Equally important is the alignment of the optic axis to the LED chip. If not correctly positioned the output beam will become uneven and offset. The axial placement accuracy required is dependent on the beam width of the optic. Generally the wider the beam divergence of the optic the more tolerant it will be of axial displacement. As a general guide, an accuracy of ± 0.2 mm is required for the optics that produce the narrowest beams, although for the widest beams this can be relaxed to ± 0.4 mm.

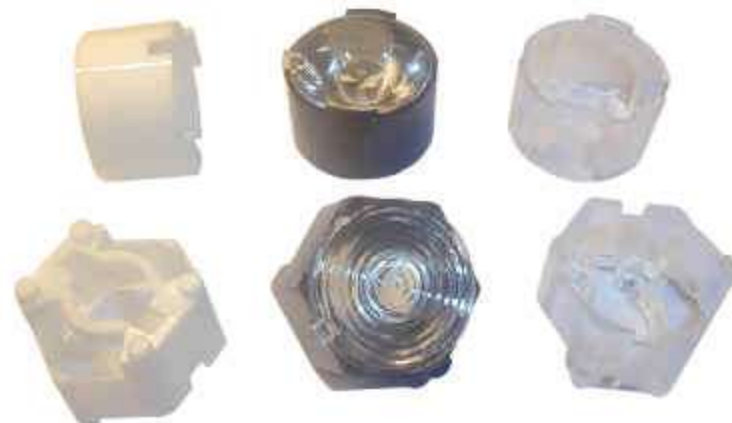
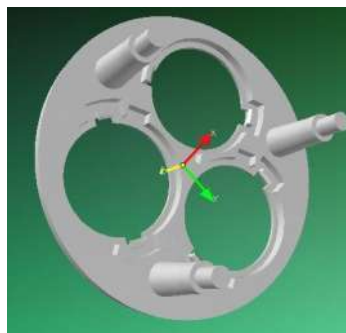
To help users mount their optics at the correct focus height and to correctly align them to the LED chip Carclo supply a range of optic holders that mount on the PCB and locate the optics to the LED base.

All optical plastics can be damaged by organic solvents. In particular the optical surfaces can fog if exposed to organic solvent vapour. It is therefore very important that only low vapour adhesives are used for gluing holders to circuit boards.

Standard circular holders are for mounting both the 20mm and 26.5mm diameter to a wide range of LED types.

Many LED's are now available ready mounted on hexagonal 'starboard' style PCB's. Carclo has a range 'starboard' specific holders for many LED types.

Holders are available for mounting optics as triples in the standard 50mm diameter 'MR16' style fittings.



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LUXEON® I

20 & 26.5mm

Range

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LUXEON® I 20mm range

Part No.	Description	White			Red/Amber			Cyan/Green			Warm White		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10003	Plain Tight	8.0	84%	20	10.4	81%	16	9.6	82%	13	9.0	80%	10
10138	Frosted Narrow	12	87%	12	15	83%	11	15	87%	8.3	14	84%	7.0
10003/15	Ripple Medium	19	81%	5.2	13	81%	7.2	15	88%	7.3	17	81%	4.6
10139	Frosted Medium	22	83%	3.4	20	77%	4.8	20	80%	3.7	22	76%	3.0
10003/25	Ripple Wide	34	81%	2.3	16	80%	3.4	28	86%	2.7	18	80%	3.0
10140	Frosted Wide	35	81%	2.6	43	74%	1.6	34	78%	2.1	44	72%	1.3
10170	Wide angle reflector	79	91%	1.0	77	85%	1.3	78	92%	1.1	64	93%	1.4
10003/L25	Elliptical	40 X 11	78%	5.1	38 X 12	80%	4.4	40 X 14	85%	4.2	54 X 13	79%	3.0
10192	Elliptical Orthogonal*	10.6 X 40	78	5.1	1.9 X 38.2	80	4.4	13.7 X 39	85	4.2	12.8 X 35.5	79	3.0
10034	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter											

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description	Part No.	Colour	Description
10012	Black	Circular custom boards	10109	Black	Triple holder 50 mm dia
10024	Clear	Circular custom boards	10110	White	Triple holder 50 mm dia
10035	White	Circular custom boards	10270	White	50mm Triple holder long leg
10026	Black	Star boards	10280	White	50 mm Triple holder short leg
10036	Clear	Star boards	10290	Black	50 mm Triple holder Long leg
10037	White	Star boards	10300	Black	50 mm Triple holder short leg
10041	Black	Triple holder 45 mm dia			
10042	White	Triple holder 45 mm dia			



Available from Future Lighting Solutions
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LUXEON® I 20mm assembled in holder 10012

Part No.	Description	White			Red/Amber			Cyan/Green			Warm White		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10800	Plain Tight	8.0	84%	20	10.4	81%	16	9.6	82%	13	9.0	80%	10
10801	Frosted Narrow	12	87%	12	15	83%	11	15	87%	8.3	14	84%	7.0
10802	Ripple Medium	19	81%	5.2	13	81%	7.2	15	88%	7.3	17	81%	4.6
10803	Frosted Medium	22	83%	3.4	20	77%	4.8	20	80%	3.7	22	76%	3.0
10804	Ripple Wide	34	81%	2.3	16	80%	3.4	28	86%	2.7	18	80%	3.0
10805	Frosted Wide	35	81%	2.6	43	74%	1.6	34	78%	2.1	44	72%	1.3
10806	Wide angle reflector	79	91%	1.0	77	85%	1.3	78	92%	1.1	64	93%	1.4
10807	Elliptical	40 X 11	78%	5.1	38 X 12	80%	4.4	40 X 14	85%	4.2	54 X 13	79%	3.0
10808	Elliptical Orthogonal*	10.6 X 40	78	5.1	1.9 X 38.2	80	4.4	13.7 X 39	85	4.2	12.8 X 35.5	79	3.0

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#Full Width Half Maximum i.e. total viewing angle



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LUXEON® I 20mm assembled in holder 10026

Part No.	Description	White			Red/Amber			Cyan/Green			Warm White		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10809	Plain Tight	8.0	84%	20	10.4	81%	16	9.6	82%	13	9.0	80%	10
10810	Frosted Narrow	12	87%	12	15	83%	11	15	87%	8.3	14	84%	7.0
10811	Ripple Medium	19	81%	5.2	13	81%	7.2	15	88%	7.3	17	81%	4.6
10812	Frosted Medium	22	83%	3.4	20	77%	4.8	20	80%	3.7	22	76%	3.0
10813	Ripple Wide	34	81%	2.3	16	80%	3.4	28	86%	2.7	18	80%	3.0
10814	Frosted Wide	35	81%	2.6	43	74%	1.6	34	78%	2.1	44	72%	1.3
10815	Wide angle reflector	79	91%	1.0	77	85%	1.3	78	92%	1.1	64	93%	1.4
10816	Elliptical	40 X 11	78%	5.1	38 X 12	80%	4.4	40 X 14	85%	4.2	54 X 13	79%	3.0
10817	Elliptical Orthogonal*	10.6 X 40	78	5.1	1.9 X 38.2	80	4.4	13.7 X 39	85	4.2	12.8 X 35.5	79	3.0

*Orthogonal is the elliptical beam turned through 90deg

#Full Width Half Maximum i.e. total viewing angle



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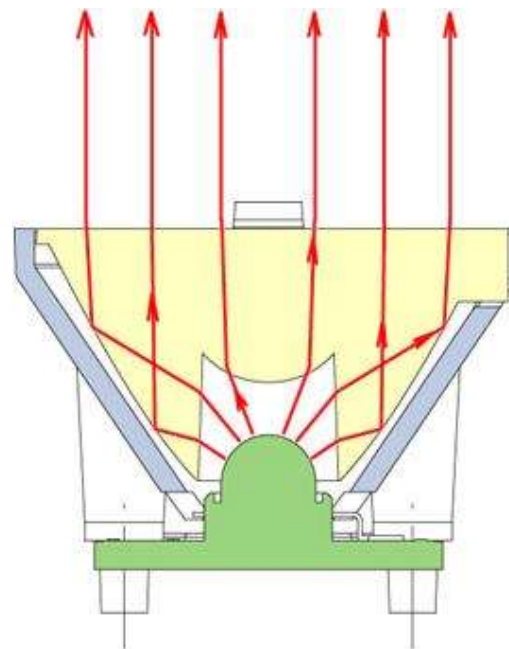
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LUXEON® I 26.5mm range

Part No.	Description	White			Red/Amber			Cyan/Green			Warm White		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10048	Plain Tight	5.4	89%	50	6.8	85%	30	6.5	87%	35	11	79%	9.4
10124	Frosted Narrow	7.1	87%	29	9.8	84%	22	9.8	87%	23	13	79%	7.2
10108	Frosted Medium	18	87%	5.0	20	84%	5.2	20	85%	5.2	25	77%	2.7
10260	Frosted Wide												
10049	Elliptical	47 X 6.8	83%	6.4	42 X 12	81%	4.5	45 X11	82%	5.5	41 X 17	75%	2.5
10224	Elliptical Orthogonal*	6.8 X 47	83%	6.4	12 X 42	81%	4.5	11 X 45	82%	5.5	17 X 41	75%	2.5
10234	Elliptical Ramp optic	45 x 9	86%	14.8	44 x 11.8	87%	5.2	45 x 13	88%	4.9	45 x 20	80%	2.2

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10064	Black	Holder long legs
10065	White	Holder long legs
10172	Black	Holder 0.8mm legs
10173	White	Holder 0.8mm legs
10174	Black	Holder no legs
10175	White	Holder no legs



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LUXEON® I 26.5mm assembled in holder 10064

Part No.	Description	White			Red/Amber			Cyan/Green			Warm White		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10900	Plain Tight	5.4	89%	50	6.8	85%	30	6.5	87%	35	11	79%	9.4
10901	Frosted Narrow	7.1	87%	29	9.8	84%	22	9.8	87%	23	13	79%	7.2
10902	Frosted Medium	18	87%	5.0	20	84%	5.2	20	85%	5.2	25	77%	2.7
10903	Frosted Wide												
10904	Elliptical	47 X 6.8	83%	6.4	42 X 12	81%	4.5	45 X11	82%	5.5	41 X 17	75%	2.5
1090	Elliptical Orthogonal*	6.8 X 47	83%	6.4	12 X 42	81%	4.5	11 X 45	82%	5.5	17 X 41	75%	2.5
10906	Elliptical Ramp optic	45 x 9	86%	14.8	44 x 11.8	87%	5.2	45 x 13	88%	4.9	45 x 20	80%	2.2

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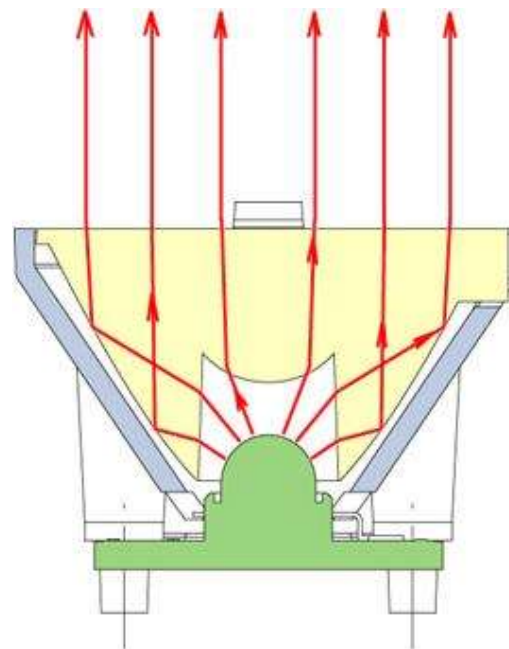
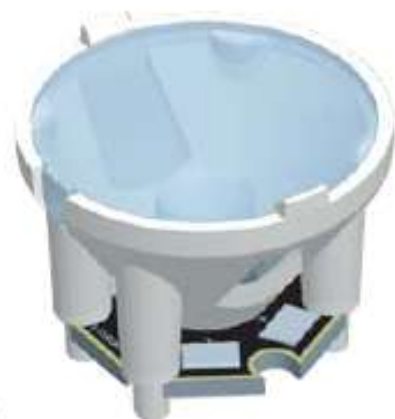


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LUXEON® III

20 & 26.5mm

Range

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LUXEON® III 20mm range

Part No.	Description	White			Red			Blue			Green		
		FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm
10003	Plain Tight	6.9	82%	17	14	82%	8.1	9.0	87%	16	10	87%	19
10138	Frosted Narrow	14	88%	6.2	18	88%	6.5	14	87%	10	14	87%	10
10003/15	Ripple Medium	20	86%	4.7	22	88%	4.5	16	87%	6.0	16	87%	6.0
10139	Frosted Medium	20	85%	2.9	25	86%	3.5	19	84%	4.2	20	84%	4.3
10003/25	Ripple Wide	32	84%	2.2	26	87%	2.8	31	86%	2.8	27	85%	2.7
10140	Frosted Wide	35	80%	1.6	43	81%	1.5	37	80%	1.5	37	80%	1.5
10170	Wide Angle Reflector	72	91%	0.9	68	90%	1.2	75	93%	1.6	75	93%	1.6
10003/L25	Elliptical	40 x 11	83%	4.2	42 x 18	84%	3.5	39 x 12	85%	3.7	38 x 13	84%	3.8
10192	Elliptical Orthogonal	11 x 40	83%	4.2	17 x 44	87%	3.3	12 x 39	85%	3.9	13 x 38	84%	3.8
10034	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter											

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description	Part No.	Colour	Description
10012	Black	Circular custom boards	10109	Black	Triple holder 50 mm dia
10024	Clear	Circular custom boards	10110	White	Triple holder 50 mm dia
10035	White	Circular custom boards	10270	White	50mm Triple holder long leg
10043	Black	Star boards	10280	White	50 mm Triple holder short leg
10045	Clear	Star boards	10290	Black	50 mm Triple holder Long leg
10044	White	Star boards	10300	Black	50 mm Triple holder short leg
10041	Black	Triple holder 45 mm dia			
10042	White	Triple holder 45 mm dia			



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e-mail: sales@carclo-optics.com Tel: 0044 (0) 1753 575011 Fax: 0044 (0) 1753 811359



LUXEON® III 20mm assembled in holder 10012

Part No.	Description	White			Red			Blue			Green		
		FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm
10800	Plain Tight	6.9	82%	17	14	82%	8.1	9.0	87%	16	10	87%	19
10801	Frosted Narrow	14	88%	6.2	18	88%	6.5	14	87%	10	14	87%	10
10802	Ripple Medium	20	86%	4.7	22	88%	4.5	16	87%	6.0	16	87%	6.0
10803	Frosted Medium	20	85%	2.9	25	86%	3.5	19	84%	4.2	20	84%	4.3
10804	Ripple Wide	32	84%	2.2	26	87%	2.8	31	86%	2.8	27	85%	2.7
10805	Frosted Wide	35	80%	1.6	43	81%	1.5	37	80%	1.5	37	80%	1.5
10806	Wide Angle Reflector	72	91%	0.9	68	90%	1.2	75	93%	1.6	75	93%	1.6
10807	Elliptical	40 x 11	83%	4.2	42 x 18	84%	3.5	39 x 12	85%	3.7	38 x 13	84%	3.8
10808	Elliptical Orthogonal	11 x 40	83%	4.2	17 x 44	87%	3.3	12 x 39	85%	3.9	13 x 38	84%	3.8

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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LUXEON® III 20mm assembled in holder 10043

Part No.	Description	White			Red			Blue			Green		
		FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm
10818	Plain Tight	6.2	89%	17	14	82%	8.1	9.0	87%	16	10	87%	19
10819	Frosted Narrow	14	88%	6.2	18	88%	6.5	14	87%	10	14	87%	10
10820	Ripple Medium	20	86%	4.7	22	88%	4.5	16	87%	6.0	16	87%	6.0
10821	Frosted Medium	20	85%	2.9	25	86%	3.5	19	84%	4.2	20	84%	4.3
10822	Ripple Wide	32	84%	2.2	26	87%	2.8	31	86%	2.8	27	85%	2.7
10823	Frosted Wide	35	80%	1.6	43	81%	1.5	37	80%	1.5	37	80%	1.5
10824	Wide Angle Reflector	72	91%	0.9	68	90%	1.2	75	93%	1.6	75	93%	1.6
10825	Elliptical	40 x 11	83%	4.2	42 x 18	84%	3.5	39 x 12	85%	3.7	38 x 13	84%	3.8
10826	Elliptical Orthogonal	11 x 40	83%	4.2	17 x 44	87%	3.3	12 x 39	85%	3.9	13 x 38	84%	3.8

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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LUXEON® III 26.5mm range

Part No.	Description	White			Red			Blue			Green		
		FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm
10048	Plain Tight	5.7	89%	28	10.7	93%	16.5	5.6	91%	53	6.4	92%	53
10124	Frosted Narrow	9	89%	16	15	93%	9.2	8.3	90%	25	9.3	92%	25
10108	Frosted Medium	20	88%	3.7	24	89%	3.8	18	87%	5.4	18.2	87%	5.4
10260	Frosted Wide												
10049	Elliptical	45 x 10	88%	3.7	41 x 14	88%	4.7	46 x 11	87%	4.3	44 x 13	85%	4.3
10224	Elliptical Orthogonal	10 x 45	88%	3.7	14 x 46	88%	4.1	11 x 46	87%	4.3	13 x 44	85%	4.3
10234	Elliptical Ramp optic	45 x 10	88%	5.9	44 x 14	91%	4.6	47 x 9	88%	8.2	45 x 12	88%	5.0

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle

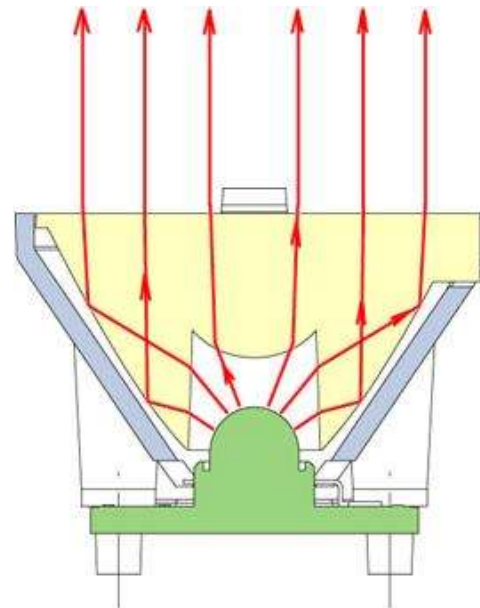


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Part No.	Colour	Description
10076	Black	Holder long legs
10077	White	Holder long legs
10111	Black	Holder 0.8mm legs
10112	White	Holder 0.8mm legs
10174	Black	Holder no legs
10175	White	Holder no legs

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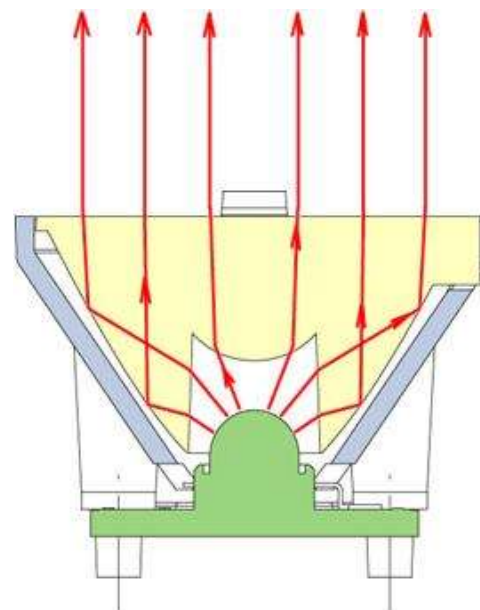
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LUXEON® III 26.5mm assembled in holder 10076

Part No.	Description	White			Red			Blue			Green		
		FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm
10907	Plain Tight	5.7	89%	28	10.7	%	16.5	5.6	91%	53	6.4	92%	53
10908	Frosted Narrow	9	89%	16	15	93%	9.2	8.3	90%	25	9.3	92%	25
10909	Frosted Medium	20	88%	3.7	24	89%	3.8	18	87%	5.4	18.2	87%	5.4
10910	Frosted Wide												
10911	Elliptical	45 x 10	88%	3.7	41 x 14	88%	4.7	46 x 11	87%	4.3	44 x 13	85%	4.3
10912	Elliptical Orthogonal	10 x 45	88%	3.7	14 x 46	88%	4.1	11 x 46	87%	4.3	13 x 44	85%	4.3
10913	Elliptical Ramp optic	45 x 10	88%	5.9	44 x 14	91%	4.6	47 x 9	88%	8.2	45 x 12	88%	5.0

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



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LUXEON[®] V

20 & 26.5mm

Range

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LUXEON® V 20mm range

Part No.	Description	White			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10003	Plain Tight	17	83%	6.4	18	86%	10
10138	Frosted Narrow	19	88%	5.0	21	83%	8
10003/15	Ripple Medium	27	87%	3.3	27	87%	5.7
10139	Frosted Medium	25	85%	3.1	29	83%	4.6
10003/25	Ripple Wide	54	85%	1.8	34	84%	3.6
10140	Frosted Wide	42	80%	1.5	46	80%	2.5
10170	Wide angle reflector	77	92%	1.1	75	95%	2.9
10003/L25	Elliptical	39 X 19	84%	3.0	43 X 20	83%	4.6
10192	Elliptical Orthogonal*	19 X 39	84%	3.0	22 X 46	83%	4.4
10034	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter					

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description	Part No.	Colour	Description
10012	Black	Circular custom boards	10109	Black	Triple holder 50 mm dia
10024	Clear	Circular custom boards	10110	White	Triple holder 50 mm dia
10035	White	Circular custom boards	10270	White	50mm Triple holder long leg
10043	Black	Star boards	10280	White	50 mm Triple holder short leg
10045	Clear	Star boards	10290	Black	50 mm Triple holder Long leg
10044	White	Star boards	10300	Black	50 mm Triple holder short leg
10041	Black	Triple holder 45 mm dia			
10042	White	Triple holder 45 mm dia			



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LUXEON® V 20mm assembled in holder 10012

Part No.	Description	White			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10800	Plain Tight	17	83%	6.4	18	86%	10
10801	Frosted Narrow	19	88%	5.0	21	83%	8
10802	Ripple Medium	27	87%	3.3	27	87%	5.7
10803	Frosted Medium	25	85%	3.1	29	83%	4.6
10804	Ripple Wide	54	85%	1.8	34	84%	3.6
10805	Frosted Wide	42	80%	1.5	46	80%	2.5
10806	Wide angle reflector	77	92%	1.1	75	95%	2.9
10807	Elliptical	39 X 19	84%	3.0	43 X 20	83%	4.6
10808	Elliptical Orthogonal*	19 X 39	84%	3.0	22 X 46	83%	4.4

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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LUXEON® V 20mm assembled in holder 10043

Part No.	Description	White			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10818	Plain Tight	17	83%	6.4	18	86%	10
10819	Frosted Narrow	19	88%	5.0	21	83%	8
10820	Ripple Medium	27	87%	3.3	27	87%	5.7
10821	Frosted Medium	25	85%	3.1	29	83%	4.6
10822	Ripple Wide	54	85%	1.8	34	84%	3.6
10823	Frosted Wide	42	80%	1.5	46	80%	2.5
10824	Wide angle reflector	77	92%	1.1	75	95%	2.9
10825	Elliptical	39 X 19	84%	3.0	43 X 20	83%	4.6
10826	Elliptical Orthogonal*	19 X 39	84%	3.0	22 X 46	83%	4.4

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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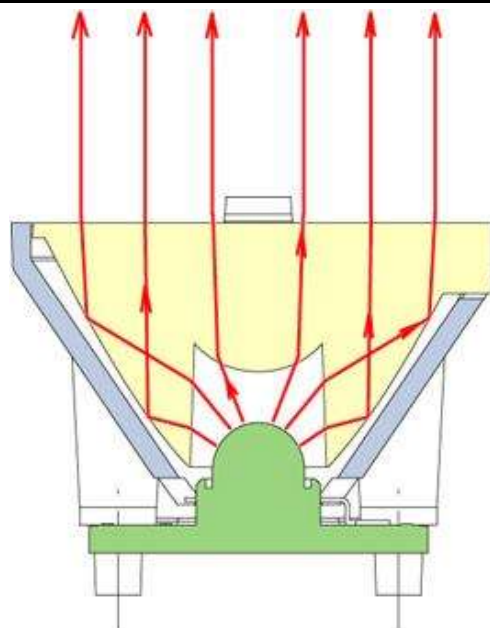
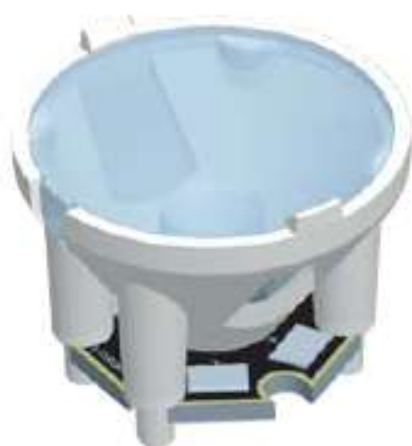
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LUXEON® V 26.5mm range

Part No.	Description	White			Blue		
		FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm
10048	Plain Tight	12	88%	13	12	91%	18
10124	Frosted Narrow	13	87%	12	16	90%	13.3
10108	Frosted Medium	22	87%	4.4	26	90%	5.3
10260	Frosted Wide						
10049	Elliptical	42 x 14	86%	3.9	45 x 15	87%	6.1
10224	Elliptical Orthogonal	14 x 42	86%	3.9	16 x 46	84%	3.1
10234	Elliptical Ramp optic	45 x 14	86%	4.1	45 x 14	87%	4.1

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10076	Black	Holder long legs
10077	White	Holder long legs
10111	Black	Holder 0.8mm legs
10112	White	Holder 0.8mm legs
10174	Black	Holder no legs
10175	White	Holder no legs



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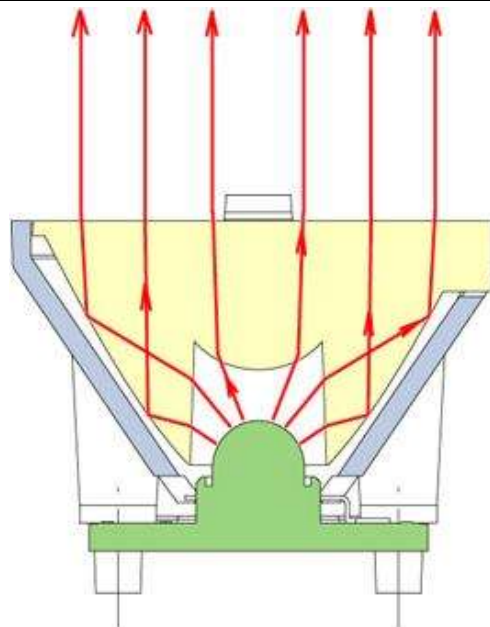
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LUXEON® V 26.5mm assembled in holder 10076

Part No.	Description	White			Blue		
		FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm
10907	Plain Tight	12	88%	13	12	91%	18
10908	Frosted Narrow	13	87%	12	16	90%	13.3
10909	Frosted Medium	22	87%	4.4	26	90%	5.3
10910	Frosted Wide						
10911	Elliptical	42 x 14	86%	3.9	45 x 15	87%	6.1
10912	Elliptical Orthogonal	14 x 42	86%	3.9	16 x 46	84%	3.1
10913	Elliptical Ramp optic	45 x 14	86%	4.1	45 x 14	87%	4.1

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



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LUXEON[®] K2

20 & 26.5mm

Range

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LUXEON® K2 20mm range

Part No.	Description	White			TTFC White			Red/Amber			Cyan/Green		
		FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm	FWHM	EFF	Cd/lm
10003	Plain Tight	7.9	84%	28	7	85%	28.7	8.2	89%	28	8.6	91%	18
10138	Frosted Narrow	15	88%	9.2	10	88.3%	17.5	11	89%	18	14	89%	8.7
10003/15	Ripple Medium	19	82%	5.4	27	84%	4.4	13	90%	11	14	90%	7.3
10139	Frosted Medium	20	80%	4.1	18	87.4%	5.4	20	90%	6.1	20	88%	3.9
10003/25	Ripple Wide	32	81%	2.3	42	87.2%	2.1	15	90%	5.2	18	90%	3.3
10140	Frosted Wide	43	75%	1.34	UNDER	DEVEL	OPMENT	42	73%	2.7	42	76%	2.0
10170	Wide angle reflector	70	92%	0.73	69	92.5%	0.87	72	91%	2.2	62	91.5%	0.7
10003/L25	Elliptical	39 X 10	80%	4.4	44 x 8	87.8%	6.62	38 x 11	89%	7.0	40 x 13.7	89%	3.8
10192	Elliptical Orthogonal*	10 X 39	80%	4.4	48 x 8	88.9%	5.8	11 x 38	89%	7.0	13.7 x 40	89%	3.8
10034	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter											

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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Part No.	Colour	Description
10119	Black	Holder Circular
10120	Clear	Holder Circular
10121	White	Holder Circular
10272	White	50mm Triple holder long leg
10282	White	50 mm Triple holder short leg
10292	Black	50 mm Triple holder Long leg
10302	Black	50 mm Triple holder short leg



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LUXEON® K2 20mm assembled to holder 10119

Part No.	Description	White			TTC White			Red/Amber			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10827	Plain Tight	7.9	84%	28	7	855	28.7	8.2	89%	28	8.6	91%	18
10828	Frosted Narrow	15	88%	9.2	10	88%	17.5	11	89%	18	14	89%	8.7
10829	Ripple Medium	19	82%	5.4	27	84%	4.4	13	90%	11	14	90%	7.3
10830	Frosted Medium	20	80%	4.1	18	87%	5.4	20	90%	6.1	20	88%	3.9
10831	Ripple Wide	32	81%	2.3	42	87%	2.1	15	90%	5.2	18	90%	3.3
10832	Frosted Wide	43	75%	1.34				42	73%	2.7	42	76%	2
10833	Wide angle reflector	70	92%	0.73	69	92%	0.71	72	91%	2.2	62	91%	0.7
10834	Elliptical	39 X 10	80%	4.4	44 X 8	87%	6.62	38 X 11	89%	7	40 X14	89%	3.8
10835	Elliptical Orthogonal*	10 X 39	80%	4.4	8 X 44	88.%	5.8	11 X 38	89%	7	14 X 40	89%	3.8

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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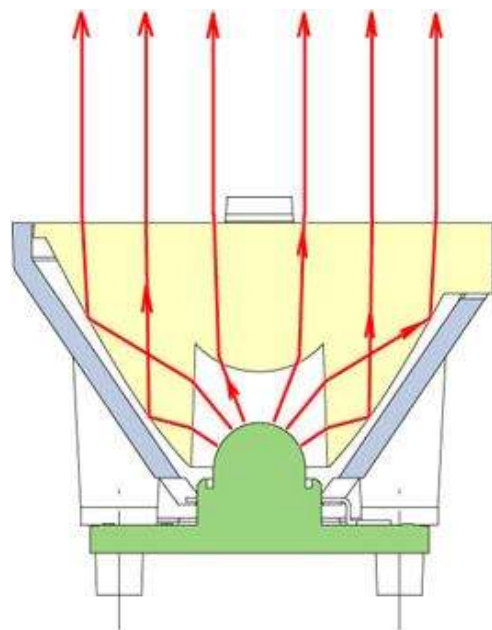
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LUXEON® K2 26.5mm range

Part No.	Description	White			Natural White			Red/Amber			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10048	Plain Tight	6.5	85%	48	7.1	89%	43	6.6	89%	30	6.9	90%	45
10124	Frosted Narrow	7.9	86%	33	5	85%	20	10.2	89%	27	9.4	89%	20
10108	Frosted Medium	18	83%	5.8	21	86%	4.6	19	86%	6	19	85%	4.2
10260	Frosted Wide												
10049	Elliptical	40 x 8.7	89%	7.0	43 x 7.6	86%	7.9	40 x 7.3	86%	10.3	41 x 7.5	87%	7.8
10224	Elliptical Orthogonal*	8.7 x 40	89%	7.0	8.3 x 48	85%	6.9	7.3 x 40	86%	10.3	7.5 x 41	87%	7.8
10234	Elliptical Ramp optic	46 x 7.4	90%	7.5	45 x 7.6	89%	7.9	45 x 7.4	90%	8.7	45 x 7.4	88%	7.8

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10122	Black	Holder Circular
10123	White	Holder Circular
10230	Black	With stake able legs
10231	White	With stake able legs
10232	Black	legs flat on Board
10233	White	legs flat on Board
10256	Black	K2 legged with 2.4 feet
10257	White	K2 legged with 2.4 feet
10258	Black	K2 Legged with 1.2 Feet
10260	White	K2 Legged with 1.2 Feet



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LUXEON® K2 26.5mm assembled in holder 10230

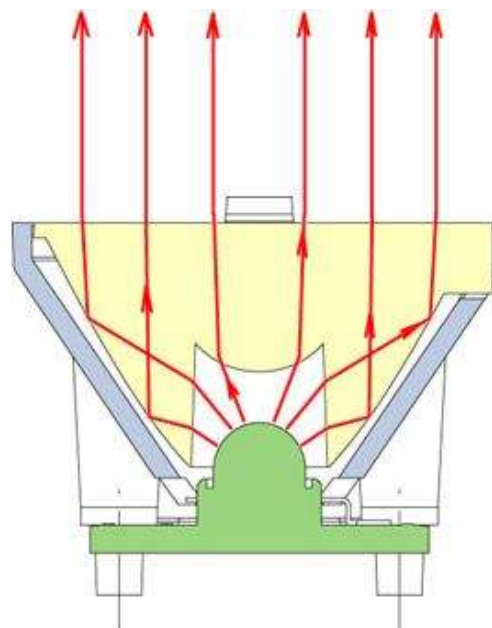
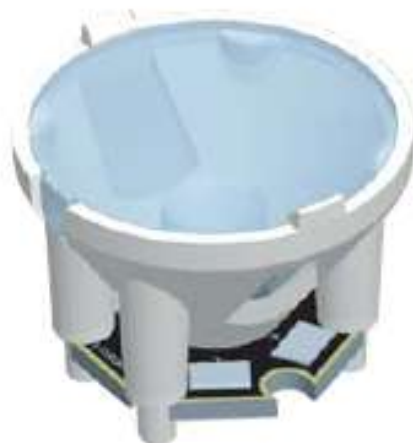
Part No.	Description	White			Natural White			Red/Amber			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/l _{cdlim}	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10915	Plain Tight	6.5	85%	48	7.1	89%	43	6.6	89%	30	6.9	90%	45
10916	Frosted Narrow	7.9	86%	33	5	85%	20	10.2	89%	27	9.4	89%	20
10917	Frosted Medium	18	83%	5.8	21	86%	4.6	19	86%	6	19	85%	4.2
10918	Frosted Wide												
10919	Elliptical	40 x 8.7	89%	7.0	43 x 7.6	86%	7.9	40 x 7.3	86%	10.3	41 x 7.5	87%	7.8
10920	Elliptical Orthogonal*	8.7 x 40	89%	7.0	8.3 x 48	85%	6.9	7.3 x 40	86%	10.3	7.5 x 41	87%	7.8
10921	Elliptical Ramp optic	46 x 7.4	90%	7.5	45 x 7.6	89%	7.9	45 x 7.4	90%	8.7	45 x 7.4	88%	7.8

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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e-mail: sales@carclo-optics.com Tel: 0044 (0) 1753 575011 Fax: 0044 (0) 1753 811359



LUXEON® Rebel

20 & 10mm

Range

Carclo Technical Plastics (Slough)

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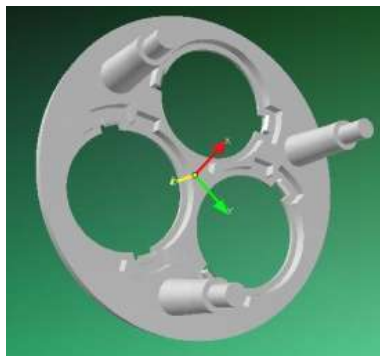
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LUXEON® REBEL 20mm range

Part No.	Description	White			Natural White			Red/Amber			Green			Blue		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10193	Plain Tight	8.7	86%	24				7	87%	37	6.5	84%	49	6.5	84%	49
10194	Frosted Narrow	12	87%	16				10.8	88%	19	10	85%	24.3	10	85%	25.4
10208	Ripple Medium	19	83%	6.7				13	81%	11	19	86%	13.8	19	86%	13.8
10195	Medium Frosted	19	83%	5.0				17	86%	6.3	19	82%	10	19	82%	10
10209	Ripple Wide	24	79%	3.1				14	81%	4.9	23	83%	6.3	23	83%	6.3
10196	Wide Frosted	35	74%	2.0				35	74%	2.0	40	77.5%	3.9	40	78%	3.9
10197	Elliptical	45 x 9.5	82%	6.0				40 x 9.4	84%	7.3	46 x 10	84%	11.7	46 x 10	84%	11.7
10198	Elliptical Orthogonal*	9.5 x 40	81%	6.0				9.4 x 40	84%	7.3	10 x 50	85%	10.8	10 X 50	85%	10.8
10356	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter under development														

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10235	Black	Holder
10236	White	Holder
10237	Clear	Holder
10279	White	50mm Triple holder long leg
10289	White	50 mm Triple holder short leg
10299	Black	50 mm Triple holder Long leg
10309	Black	50 mm Triple holder short leg



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LUXEON® REBEL assembled in Holder 10235

Part No.	Description	White			Natural White			Red/Amber			Green			Blue		
		FWHM*	EFF	Cd/lm	FWHM*	EFF	Cd/lm	FWHM*	EFF	Cd/lm	FWHM*	EFF	Cd/lm	FWHM*	EFF	Cd/lm
10845	Plain tight	8.7	86%	24				7	87%	37	6.5	84%	49	6.5	84%	49
10846	Frosted Narrow	12	83%	16				10.8	88%	19	10	85%	25	10	85%	25.4
10847	Ripple medium	16	81%	6.6				13	81%	11	19	86%	13.8	19	86%	13.8
10848	Frosted medium	18	83%	5.0				17	86%	6.3	19	82%	10	19	82%	10
10849	Ripple Wide	22	81%	2.5				14	81%	4.9	23	83%	6.3	23	83%	6.3
10850	Frosted Wide	35	74%	2				35	74%	2	40	77%	3.9	40	78%	3.9
10851	Elliptical	40 X 9.5	81%	6				40 X 9.4	84%	7.3	46 X 10	84%	11.7	46 X 10	84%	11.7
10852	Elliptical Orthogonal*	9.5 X 40	81%	6				9.4 X 40	84%	7.3	10 X 46	85%	10.8	10 X 46	85%	10.8

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



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Carclo Technical Plastics (Slough)

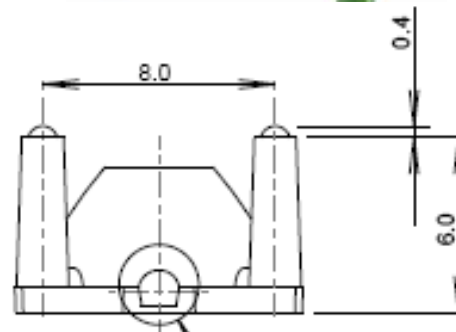
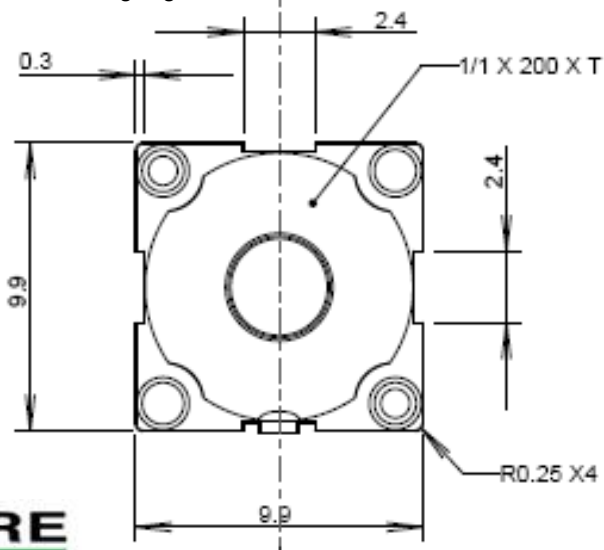
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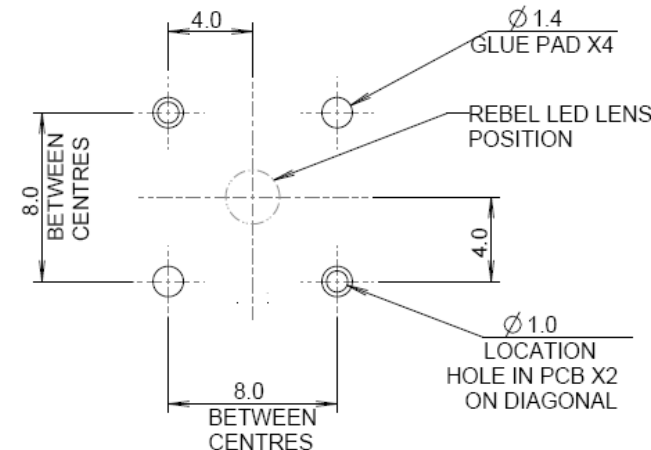
LUXEON® REBEL 10mm range

Part No.	Description	White			Natural White			Red/Amber			Green			Blue		
		FWHM*	EFF	Cd/lm	FWHM*	EFF	Cd/lm	FWHM*	EFF	Cd/lm	FWHM*	EFF	Cd/lm	FWHM*	EFF	Cd/lm
10412	Plain medium	18.4	85%	6.5				16.4	82%	6.3	18.6	84%	7	18.6	84%	7
10413	Frosted medium															
10414	Frosted Wide															
10415	Elliptical															
10416	Elliptical Orthogonal*															

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



PCB GLUE PAD AND ALIGNMENT HOLE LAYOUT DIMENSIONS



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LUXEON®

Side Emitter

Range

Carclo Technical Plastics (Slough)

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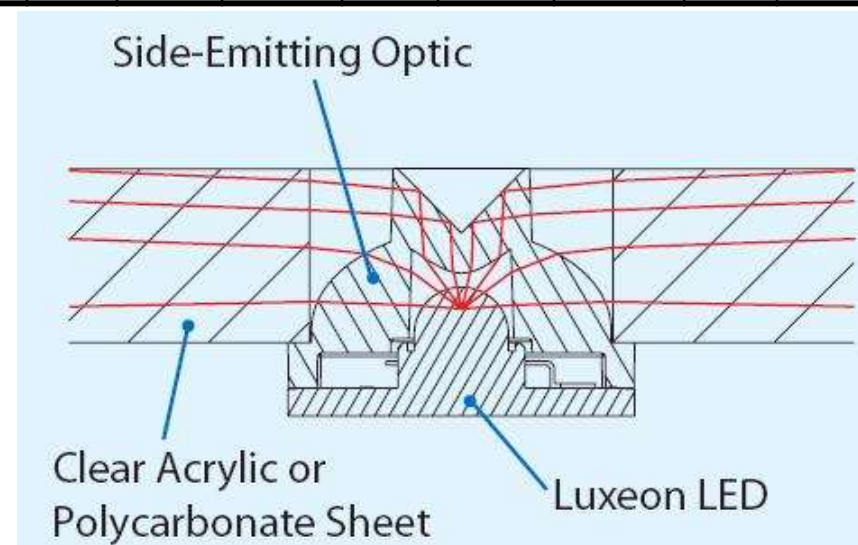
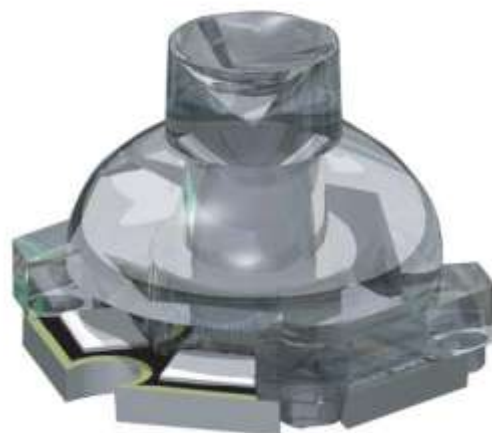
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Side Emitters for LUXEON® LED's

Part No.	Description	White			Natural White			Warm White			Red/Amber			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10071	LUXEON® I Star				N/A	N/A	N/A									
10040	LUXEON® III Star				N/A	N/A	N/A	N/A	N/A	N/A						
10040	LUXEON® V Star				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
10099	LUXEON® I/flat base				N/A	N/A	N/A									
10099	LUXEON® III flat base				N/A	N/A	N/A	N/A	N/A	N/A						
10099	LUXEON® V flat base				N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
10126	LUXEON® K2															
10267	LUXEON® Rebel															

#Full Width Half Maximum i.e. total viewing angle



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LUXEON®

Other Optics

Carclo Technical Plastics (Slough)

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Other Optics for the LUXEON® range

Part No.	Description	White			Neutral White			Warm White			Red/Amber			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10025	50mm Optic LUXEON® I	3.0	74%	145	N/A	N/A	N/A	7.0	76%	91	4.6	80%	72	4.9	72%	60.3
10025	50mm Optic LUXEON®III	3.0	75%	89	N/A	N/A	N/A	N/A	N/A	N/A	5	80%	46	3.9	73%	96
10025	50mm Optic LUXEON®V	6.2	73%	35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.4	67%	24
10144	60mm Optic LUXEON®I	3.8	81%	145	N/A	N/A	N/A	2.7	88%	92	3.0	84%	136	2.9	80%	222
10144	60mm Optic LUXEON®III	3.2	82%	74	N/A	N/A	N/A	N/A	N/A	N/A	5	81%	79	3.1	71%	221
10144	60mm Optic LUXEON®V	6.0	82%	37	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7	75%	34
10144	60mm Optic LUXEON®K2	3.1	77%	187	3.2	80%	181	2.9	80%	189.9	3	83%	209	3.1	78%	169
10144+10145	60mm Optic LUXEON®I	38 X 3	79%	17	N/A	N/A	N/A	37 X 3	79%	10.6	37 X 3	80%	15.6	38 X 3	79%	14.5
10144+10145	60mm Optic LUXEON®III	38 X 3	80%	15	N/A	N/A	N/A	N/A	N/A	N/A	38 X 5	76%	10.1	38 X 3	73%	16.5
10144+10145	60mm Optic LUXEON®V	37 X 6	78%	7.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	38 X 7	73%	7.1
10144+10145	60mm Optic LUXEON®K2	38 X 3.1	73%	14.5	38 X 3	75%	14.6	38x2.4	75%	16	38 X 3	79%	16.5	38 X 3	74%	13.8

#Full Width Half Maximum i.e. total viewing angle



•We have a holder Part number 10146 which holds the optic 10144 and the spreader lens 10145 in the correct place

•This can be brought as a built up assembly of Optic 10144 and holder 10146 under part number 10147



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Cree® XR

20 mm

Range

Carclo Technical Plastics (Slough)

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e-mail: sales@carclo-optics.com Tel: 0044 (0) 1753 575011 Fax: 0044 (0) 1753 811359



CREE XR[®], XR-E[®] & XR-C[®] 20mm range

Part No.	Description	White XR			Red/Amber XR			Cyan/Green XR			White XR-E			White XR-C		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10199	Plain Tight	13	87%	6.7	13	91%	19	10	90%	15.9	8.4	91%	31	5.3	89%	49
10200	Frosted Narrow	16	87%	5.6	14	91%	15	13	90%	9.0	10	90%	17	9.6	86%	19
10210	Ripple Medium	25	89%	3.0	16	90%	7.7	18	91%	5	16	88%	6.9	12	87%	9.5
10201	Frosted Medium	23	87%	2.8	21	89%	5.3	22	89%	3.26	20	89%	4.2	18	84%	4.4
10211	Ripple Wide	47.9	84%	1.4	24	86%	2.5	41	84%	2.1	44	86%	1.8	42	86%	1.6
10202	Frosted Wide	35.6	81%	1.8	36.2	88.%	1.6	36	89%	1.5	36	84%	2	39	81%	1.97
10203	Elliptical	39 x 16	85%	3.2	37 x 14	90%	4.7	47 x 12	89%	3.44	41 x 10	90%	5.1	41 x 8.4	84%	7.1
10204	Elliptical Orthogonal*	16 x 39	85%	3.2	14 x 37	90%	4.7	13 x 48	89%	31	10 x 41	90%	5.1	8.4 x 41	84%	7.1
10357	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter In development														

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10205	Black	Cree XR, XRE, XRC Holder
10206	Clear	Cree XR, XRE, XRC Holder
10207	White	Cree XR, XRE, XRC Holder
10276	White	50mm Triple holder long leg
10286	White	50 mm Triple holder short leg
10296	Black	50 mm Triple holder Long leg
10306	Black	50 mm Triple holder short leg



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03 January 2008

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CREE XR[®], XR-E[®] & XR-C[®] 20mm assembled in 10205

Part No.	Description	White XR			Red/Amber XR			Cyan/Green XR			White XR-E			White XR-C		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10861	Plain Tight	13	87%	6.7	13	91%	19	10	90%	15.9	8.4	91%	31	5.3	89%	49
10862	Frosted Narrow	16	87%	5.6	14	91%	15	12	90%	9.0	10	90%	17	9.6	86%	19
10863	Ripple Medium	25	89%	3.0	16	90%	7.7	15	90%	5.	16	88%	6.9	12	87%	9.5
10864	Frosted Medium	23	87%	2.8	21	89%	5.3	22	89%	3.26	20	89%	4.2	18	84%	4.4
10865	Ripple Wide	44.8	86%	1.8	24	86%	2.5	40	86%	1.53	44	86%	1.8	41	86%	1.6
10866	Frosted Wide	36	84%	2	36.2	88.%	1.6	38	86.8%	1.52	36	84%	2	39	81%	1.97
10867	Elliptical	39 x 16	85%	3.2	37 x 14	90%	4.7	40 x 13	89%	3.44	41 x 10	90%	5.1	41 x 8.4	84%	7.1
10868	Elliptical Orthogonal*	16 x 39	85%	3.2	14 x 37	90%	4.7	13 x 40	89%	3.3	10 x 41	90%	5.1	8.4 x 41	84%	7.1

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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Osram[®] Dragon 20 & 26.5mm Range

Carclo Technical Plastics (Slough)

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Osram Golden DRAGON® LW W5SG 20mm range

Part No.	Description	White			Red/Amber			Green			Blue		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10193	Plain Tight	8.2	86%	13	5.4	85%	49	6.6	85%	23	5.8	83%	25
10194	Frosted Narrow	13	89%	11	9.7	87%	5.6	10	90%	14	10	87%	13
10208	Ripple Medium	21	91%	4.8	14	91%	10	16	85%	6.0	15	87%	6.0
10195	Medium Frosted	21	85%	3.8	19	83%	5.6	22	85%	3.8	21	83%	3.8
10209	Ripple Wide	18.7	83%	3.3	14	83%	9.5	17	85%	4.2	18	88%	4.5
10196	Wide Frosted	32	84%	2.3	32	89%	6.2	32	85%	2.9	31	86%	3.25
10197	Elliptical	40 X 10	87%	5	43 X 6.8	87%	9.6	42 X 8.6	88%	5.5	44 X 7.6	86%	5.4
10198	Elliptical Orthogonal*	10 X 40	87%	5	6.8 X 43	87%	9.6	8.6 X 42	88%	5.5	7.6 X 44	85%	5.5
10356	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter											

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10148	Black	Osram Dragon Holder
10149	Clear	Osram Dragon Holder
10150	White	Osram Dragon Holder
10276	White	50mm Triple holder long leg
10286	White	50 mm Triple holder short leg
10296	Black	50 mm Triple holder Long leg
10306	Black	50 mm Triple holder short leg



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Osram Golden DRAGON® W5SG 20mm in holder 10148

Part No.	Description	White			Red/Amber			Green			Blue		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10877	Plain Tight	8.2	86%	13	5.4	85%	49	6.6	85%	23	5.8	83%	25
10878	Frosted Narrow	13	89%	11	9.7	87%	5.6	10	90%	14	10	87%	13
10879	Ripple Medium	21	91%	4.8	14	91%	10	16	85%	6.0	15	87%	6.0
10880	Medium Frosted	21	85%	3.8	19	83%	5.6	22	85%	3.8	21	83%	3.8
10881	Ripple Wide	18.7	83%	3.3	14	83%	9.5	17	87%	4.2	18	88%	4.5
10882	Wide Frosted	32	84%	2.3	32	89%	6.2	32	85%	2.9	31	86%	3.25
10883	Elliptical	40 X 10	87%	5	43 X 6.8	87%	9.6	42 X 8.6	88%	5.5	44 X 7.6	86%	5.4
10884	Elliptical Orthogonal*	10 X 40	87%	5	6.8 X 43	87%	9.6	8.6 X 42	88%	5.5	7.6 X 44	85%	5.5

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



OSRAM
Opto Semiconductors

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Osram Golden DRAGON® LW W5SG 26.5mm range

Part No.	Description	White			Red/Amber			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10048	Plain Tight	5.6	87%	31	4.0	87%	88	5.6	87%	35
10124	Frosted Narrow	8.0	88%	22	7.7	80%	37	8.4	86%	17
10108	Frosted Medium	19	86%	5.1	19	79%	7.3	20	83%	4.9
10260	Frosted Wide									
10049	Elliptical	46 X 7.8	82%	5.9	44 X 7.9	72%	7.9	43 X 9.9	83%	4.6
10224	Elliptical Orthogonal*	7.8 X 45	82%	5.9	7.9 X 44	72%	7.9	9.9 X 43	83%	4.6
10234	Elliptical Ramp optic									

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10086	Black	Holder Circular
10087	White	Holder Circular



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Osram Golden DRAGON® LW W5SG 26.5mm 10086

Part No.	Description	White			Red/Amber			Cyan/Green		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10938	Plain Tight	5.6	87%	31	4.0	87%	88	5.6	87%	35
10939	Frosted Narrow	8.0	88%	22	7.7	80%	37	8.4	86%	17
10940	Frosted Medium	19	86%	5.1	19	79%	7.3	20	83%	4.9
10941	Frosted Wide									
10942	Elliptical	46 X 7.8	82%	5.9	44 X 7.9	72%	7.9	43 X 9.9	83%	4.6
10943	Elliptical Orthogonal*	7.8 X 45	82%	5.9	7.9 X 44	72%	7.9	9.9 X 43	83%	4.6
10944	Elliptical Ramp optic									

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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Osram Golden Dragon® LW W5SM 20mm range

Part No.	Description	White			Red/Amber			Green			Blue		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10193	Plain Narrow	5.4	90%	30	5.0	87%	55	6.2	88%	26	5.7	87%	26
10194	Tight Frosted	10	89%	15	9.3	87%	25	10	87%	14	10	87%	14
10208	Ripple Medium	14	91%	6.9	13	89%	11	14	88%	6.5	15	88%	6.5
10195	Medium Frosted	19	86%	4.2	17	85%	6.6	19	87%	4.1	19	87%	4.1
10209	Ripple Wide	16	86%	3.42	13	86%	4.8	16	87%	4.4	16	87%	4.4
10196	Wide Frosted	32	84%	2.3	31.6	86%	2.97	32	84.0%	2.8	32	84.0%	2.8
10197	Elliptical	39 x 7.8	87%	6.0	39 x 6.4	85%	9.2	41 x 8.7	88%	5.4	41 X 8.7	88%	5.3
10198	Elliptical Orthogonal*	7.8 x 39	87%	6.9	6.4 x 39	85%	9.2	8.7 x 41	88%	5.4	8.7 X 41	88%	5.4
10356	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter											

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10148	Black	Osram Dragon Holder
10149	Clear	Osram Dragon Holder
10150	White	Osram Dragon Holder
10276	White	50mm Triple holder long leg
10286	White	50 mm Triple holder short leg
10296	Black	50 mm Triple holder Long leg
10306	Black	50 mm Triple holder short leg

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Osram Golden Dragon® w5SM 20mm in holder10148

Part No.	Description	White			Red/Amber			Green			Blue		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10877	Plain Narrow	5.4	90%	30	5.0	87%	55	6.2	88%	26	5.7	87%	26
10878	Tight Frosted	10	89%	15	9.3	87%	25	10	87%	14	10	87%	14
10879	Ripple Medium	14	91%	6.9	13	89%	11	14	88%	6.5	15	88%	6.5
10880	Medium Frosted	19	86%	4.2	17	85%	6.6	19	87%	4.1	19	87%	4.1
10881	Ripple Wide	16	86%	3.42	13	86%	4.8	16	87%	4.4	16	87%	4.4
10882	Wide Frosted	32	84%	2.3	31.6	86%	2.97	32	84.0%	2.8	32	84.0%	2.8
10883	Elliptical	39 x 7.8	87%	6.0	39 x 6.4	85%	9.2	41 x 8.7	88%	5.4	41 X 8.7	88%	5.3
10884	Elliptical Orthogonal*	7.8 x 39	87%	6.9	6.4 x 39	85%	9.2	8.7 x 41	88%	5.4	8.7 X 41	88%	5.4

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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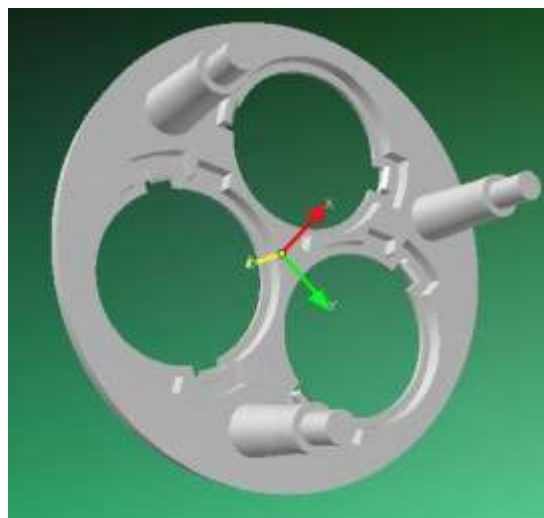
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Osram Platinum Dragon® LW W5SN 20mm range

Part No.	Description	White			Red/Amber			Green			Blue		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10193	Plain Tight	5.9	86%	36	5.0	92%	59	5.8	89%	52	5.8	89%	40
10194	Frosted Narrow	10.4	88%	24	9.6	91%	24.5	10.3	90%	23	10	90%	18.8
10208	Ripple Medium	16	89%	7.1	14.6	91%	10.3	17.5	91%	9.6	17.6	91%	7.4
10195	Medium Frosted	20	85%	4.7	18.6	88%	6.6	20.1	86%	6.3	19.5	87%	5.3
10209	Ripple Wide	17	83%	3.3	13.3	86%	4.8	17.2	87%	4.4	16.9	88%	3.7
10196	Wide Frosted	31.7	85%	2.3	31.7	86%	2.9	32.3	83%	3.0	32	84%	2.6
10197	Elliptical	47 x 8	89%	6.7	44 X 6.4	91%	9.7	45 x 7.4	89%	9.5	45 X 7.6	89%	7.2
10198	Elliptical Orthogonal*	8 x 49	89%	6.4	47 X 6.3	90%	8.7	7.2 x 49	88%	8.6	48 X 6.9	89%	6.8
10356	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter											

*Orthogonal is the elliptical beam turned through 90deg.
#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10148	Black	Osram Dragon Holder
10149	Clear	Osram Dragon Holder
10150	White	Osram Dragon Holder
10276	White	50mm Triple holder long leg
10286	White	50 mm Triple holder short leg
10296	Black	50 mm Triple holder Long leg
10306	Black	50 mm Triple holder short leg



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Osram Platinum Dragon® w5SN 20mm in holder 10148

Part No.	Description	White			Red/Amber			Green			Blue		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10877	Plain Tight	5.9	86%	36	5.0	92%	59	5.8	89%	52	5.8	89%	40
10878	Frosted Narrow	10.4	88%	24	9.6	91%	24.5	10.3	90%	23	10	90%	18.8
10879	Ripple Medium	16	89%	7.1	14.6	91%	10.3	17.5	91%	9.6	17.6	91%	7.4
10880	Medium Frosted	20	85%	4.7	18.6	88%	6.6	20.1	86%	6.3	19.5	87%	5.3
10881	Ripple Wide	17	83%	3.3	13.3	86%	4.8	17.2	87%	4.4	16.9	88%	3.7
10882	Wide Frosted	31.7	85%	2.3	31.7	86%	2.9	32.3	83%	3.0	32	84%	2.6
10883	Elliptical	47 x 8	89%	6.7	44 X 6.4	91%	9.7	45 x 7.4	89%	9.5	45 X 7.6	89%	6.8
10884	Elliptical Orthogonal*	8 x 47	89%	6.8	49 X 6.9	88%	6.4	7.2 x 49	88%	8.6	48 X 6.9	89%	6.8

*Orthogonal is the elliptical beam turned through 90deg.

#Full Width Half Maximum i.e. total viewing angle



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Seoul Semiconductor P4 20 & 26.5mm Range

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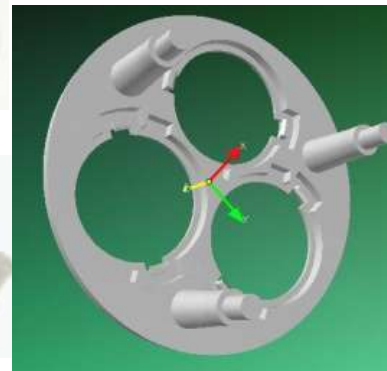
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Seoul Semiconductor P4® 20mm range

Part No.	Description	White (Cool White W42180-1B-USXOI)			White (Warm White)		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10003	Plain Tight	10.5	79%	14			
10138	Frosted Narrow	15.4	82%	4.41			
10003/15	Ripple Medium	27.3	89%	3.4			
10139	Frosted Medium	23.8	80%	2.46			
10003/25	Ripple Wide	41.4	88%	1.6			
10140	Frosted Wide	42.7	74.%	0.9			
10170	Wide angle reflector	80.9	92%	0.82			
10003/L25	Elliptical	44 X 15	81%	2.1			
10192	Elliptical Orthogonal*	14 X 49	81%	2.13			
10034	Fibre	Optimised for coupling into 0.5NA fibre bundles of 8 - 12mm diameter					

#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10363	Black	Round SSC P4
10364	Clear	Round SSC P4
10365	White	Round SSC P4
10043	Black	Star holders SSCP4
10044	White	Star holders SSCP4
10045	Clear	Star holders SSCP4
10273	White	50mm Triple holder long leg
10283	White	50 mm Triple holder short leg
10293	Black	50 mm Triple holder Long leg
10303	Black	50 mm Triple holder short leg

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Seoul Semiconductor P4® 20mm in holder 10363

Part No.	Description	White (Cool White W42180-1B-USXOI)			White (Warm White)		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10885	Plain Tight beam Optic in Black holder	10.5	79%	14			
10886	Frosted Narrow beam Optic in Black holder	15.4	82%	4.41			
10887	Frosted Medium beam Optic in Black holder	23.8	80%	2.46			
10888	Frosted Wide beam Optic in Black holder	42.7	74.4%	0.9			
10889	Elliptical beam Optic in Black holder	44 X 15	81%	2.1			
10890	Elliptical 90degbeam Optic in Black holder	14 X 49	81%	2.13			
10891	Wide reflector in black holder						

#Full Width Half Maximum i.e. total viewing angle



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Seoul Semiconductor P4[®] 20mm in holder 10043

Part No.	Description	White (Cool White W42180-1B-USXOI)			White (Warm White)		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10818	Plain Tight beam Optic in Black holder	10.5	79%	14			
10819	Frosted Narrow beam Optic in Black holder	15.4	82%	4.41			
10820	Ripple Medium beam optic in black holder	27.3	89%	3.4			
10821	Frosted Medium beam Optic in Black holder	23.8	80%	2.46			
10822	Ripple Wide beam optic in Black holder	41.4	88%	1.6			
10823	Frosted Wide beam Optic in Black holder	42.7	74. %	0.9			
10824	Wide reflector in black holder	80.9	92%	0.82			
10825	Elliptical beam Optic in Black holder	44 X 15	81%	2.1			
10826	Elliptical 90degbeam Optic in Black holder	14 X 49	81%	2.13			

#Full Width Half Maximum i.e. total viewing angle



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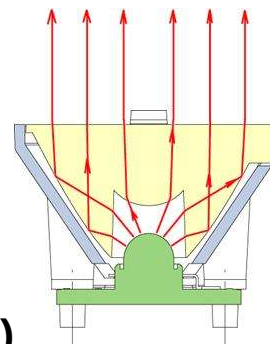
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Seoul Semiconductor P4® 26.5mm range

Part No.	Description	White (Cool White W42180-1B-USXOI)			White (Warm White)		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10048	Plain Tight beam Optic	5.24	89.7%	19.56			
10124	Frosted Narrow beam Optic	9.6	88%	10.7			
10108	Frosted Medium beam Optic i	20	84%	3.13			
10260	Frosted Wide beam optics						
10049	Elliptical beam Optic	33 X 7.5	86%	4.14			
10224	Elliptical beam turned 90 deg Optic	10.7 X 48	87%	3.79			
10234	Elliptical Ramped edges beam Optic	45 x 9.9	87%	4.4			

#Full Width Half Maximum i.e. total viewing angle



Part No.	Colour	Description
10230	Black	With stake able legs
10231	White	With stake able legs
10232	Black	legs flat on Board
10233	White	legs flat on Board
10256	Black	2.4mm legs
10257	White	2.4mm legs
10258	Black	1.2mm legs
10259	White	1.2mm legs

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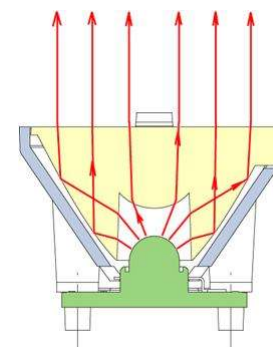
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Seoul Semiconductor P4® 26.5mm range

Part No.	Description	White (Cool White W42180-1B-USXOI)			White (Warm White)		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10945	Plain Tight beam Optic in holder long legs	5.24	89.7%	19.56			
10946	Frosted Narrow beam Optic in holder long legs	9.4	88%	9.61			
10947	Frosted Medium beam Optic in holder long legs	20	84%	3.13			
10948	Frosted Wide beam optics in holder long legs						
10949	Elliptical beam Optic in holder long legs	33 X 7.5	86%	4.14			
10950	Elliptical beam turned 90 deg Optic in holder long legs	7.5 X33	86%	4.14			
10951	Elliptical Ramped edges beam Optic in holder long legs	TBA	TBA	TBA			

#Full Width Half Maximum i.e. total viewing angle



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Seoul Semiconductor P4 Side Emitter

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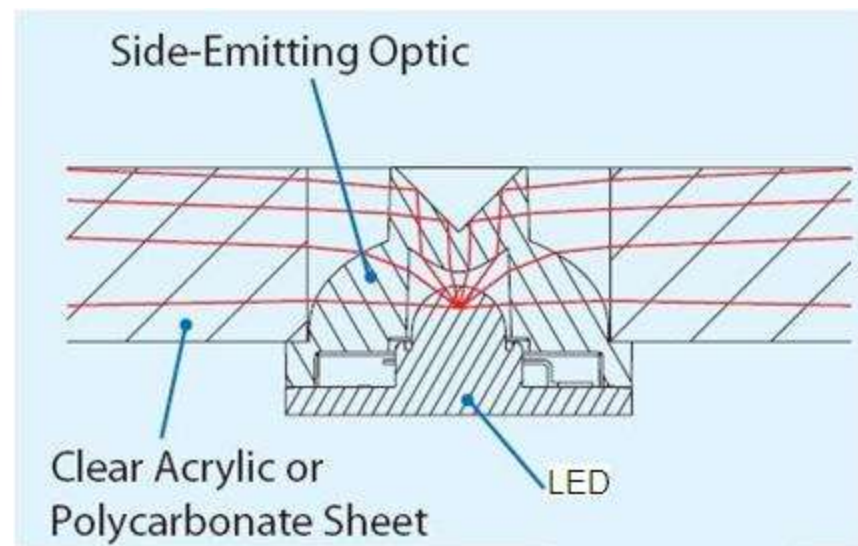
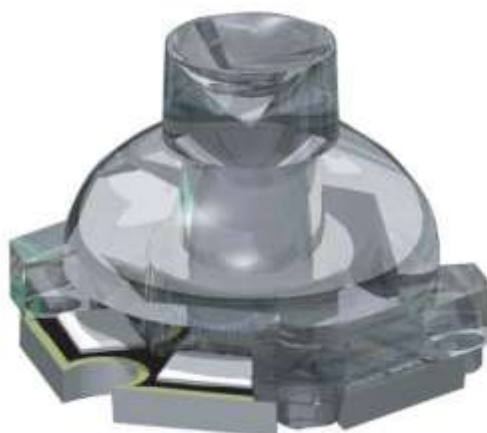
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Side Emitters for Seoul Semiconductor P4®

Part No.	Description	White			Natural White		
		FWHM#	EFF	Cd/lm	FWHM#	EFF	Cd/lm
10040	Side emitter for P4 Star board						

#Full Width Half Maximum i.e. total viewing angle



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General Triple Holder 20 Range

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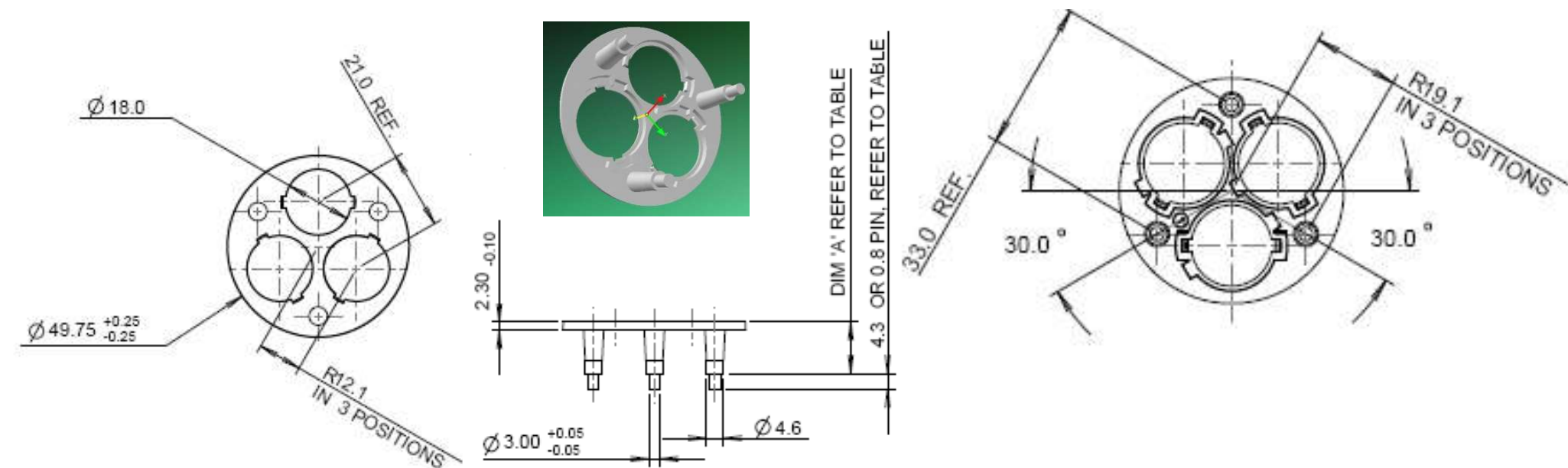
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Tripler Optic holder 50mm MR16 replacement

LED Manufacturer And Type	Optic Range 20mm	Triple Holder Height Dim A	Part Numbers			
			White 4.3mm Long Pin	White 0.8mm Short Pin	Black 4.3mm Long Pin	Black 0.8mm Short Pin
Luxeon 1/3/5W	Standard	14.0	10270	10280	10290	10300
Luxeon K2	Standard	13.6	10272	10282	10292	10302
Luxeon Rebel	0.8mm Offset	12.2	10279	10289	10299	10309
Cree XR series	1.4mm Offset	12.8	10276	10286	10296	10306
Osram Dragon	0.8mm Offset	12.8	10276	10286	10296	10306
Seoul Semi P4	Standard	13.4	10273	10283	10293	10303



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