DATA SHEET

TITAN™

LED LIGHT ENGINES

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TITAN™ LED LIGHT ENGINES

Lamina LED light engines are manufactured by combining high brightness LEDs from industry-leading LED manufacturers with our own proprietary thermal packaging technology. This technology is a performance breakthrough for LED packaging, a key factor in determining LED life and reliability. This unmatched thermal performance allows Lamina to densely cluster multiple LEDs to achieve exceptionally high luminous intensity in very small footprints.

The Lamina Titan is available in Warm White (3050K), Daylight White (4700K) and RGB. The Titan Warm White delivers 600+ lumens from a single point. An enhanced red and orange color spectrum and a CRI of 80 make this product ideal for incandescent and halogen replacements. The Titan RGB, through three independently controlled input/output channels (red, green and blue), produces any of 16 million beautifully saturated and blended colors (including white with variable color temperature) from a single point source.

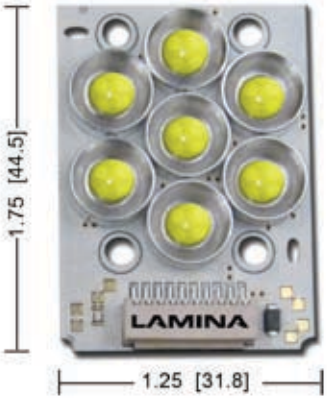
Titan LED light engines are configured with a single cavity populated with multiple LEDs to deliver the maximum usable light. The Titan makes possible applications which, until now, could only be accomplished with traditional lighting sources.

Features:

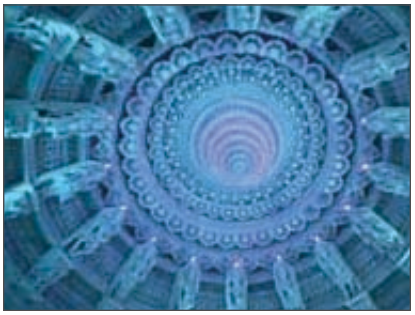
- Integral EZ-Connector™ eliminates the need for soldering
- Designed for popular drive currents from 1050mA to 1400mA
- Lamina narrow, medium and wide beam optics are available
- Isolated metal base makes wiring in series or parallel possible on a common heat sink
- Integrated ESD protection - 4,000V HBM
- Superior thermal performance for unmatched reliability
- Long life and high lumen maintenance
- Lamina Heat Sinks and Developer Kits available for rapid prototyping

The unsurpassed technical benefits found in the Titan result in unparalleled ease of design and integration. They feature the lowest thermal resistance of any LED package on the market. Our patented multi-layer on metal package design allows the most efficient path to dissipate the heat generated by the LED. This low thermal resistance gives you the choice to use a smaller heat sink or to run your parts at a higher power rating while still maintaining a safe junction temperature.

Lamina provides unmatched product integration support. Our experienced Application Engineers, knowledgeable in LED design integration, optics, thermal management, and electronics are just a phone call away. To request a sample or to speak with an Application Engineer, call us at 800-808-5822 or +1 609-265-1401.



APPLICATIONS



Characteristics

Flux Characteristics - Lumens Junction Temperature, T_j=25ºC

Table 1.

Product Number	Color	Drive Current (mA)	TYP / MIN (lm)	Drive Current (mA)	TYP / MIN (lm)
NT-52D1-0430	Warm White	1050	771 / 616	1400	930 / 744
NT-52D0-0429	Daylight White	1050	1146 / 916	1400	1360 / 1088
NT-53F0-0428	Red	1050	304 / 194	1400	435 / 278
	Green	1050	527 / 421	1400	685 / 548
	Blue	1050	134 / 107	1400	183 / 146
NT-51E0-0481	Amber	1050	578 / 462	—	—
NT-52B1-0469	Blue	1050	244 / 195	—	—
NT-52C1-0470	Green	1050	942 / 753	—	—
NT-51A0-0468	Red	1050	570 / 364	—	—

Optical Characteristics

Table 2.

Note: 1. 2θ, 1/2, Total off-axis angle from source center line where the intensity is 1/2 of the peak value.

Product Number	Color	Color Temp. TYP (K)	Total Incl. Angle	[1]View Angle	TYP / MIN CRI	Dominant Wave Length MIN / MAX (nm)
NT-52D1-0430	Warm White	3050	140º	60º	78 / 70	—
NT-52D0-0429	Daylight White	4700	140º	61º	68 / 60	—
	Red	—	130º	61º	—	619 / 629
NT-53F0-0428	Green	—	130º	62º	—	515 / 535
	Blue	—	130º	58º	—	460 / 470
NT-51E0-0481	Amber	—	130º	64º	—	584 / 594
NT-52B1-0469	Blue	—	130º	61º	—	460 / 470
NT-52C1-0470	Green	—	130º	60º	—	515 / 535
NT-51A0-0468	Red	—	130º	54º	—	619 / 629

Typical Illuminance Characteristics

Table 3.

Product Number	Color	Drive Current (mA)	cbcp	Illuminance (Lux) Distance from Source [M] 1	2	5	10	Illuminance (fc) Distance from Source [FT] 3.3	6.6	16.4	32.8
NT-52D1-0430	Warm White	1050	740	739.6	184.9	29.6	7.4	68.7	17.2	2.7	0.7
		1400	978	978.4	244.6	39.1	9.8	90.9	22.7	3.6	0.9
NT-52D0-0429	Daylight White	1050	1064	1063.8	266.0	42.6	10.6	98.8	24.7	4.0	1.0
		1400	1262	1262.5	315.6	50.5	12.6	117.3	29.3	4.7	1.2
NT-53F0-0428	RGB - Red	1050	292	292.3	73.1	11.7	2.9	27.2	6.8	1.1	0.3
		1400	418	418.2	104.6	16.7	4.2	38.9	9.7	1.6	0.4
	RGB - Green	1050	461	461.0	115.3	18.4	4.6	42.8	10.7	1.7	0.4
		1400	599	599.2	149.8	24.0	6.0	55.7	13.9	2.2	0.6
	RGB - Blue	1050	124	124.3	31.1	5.0	1.2	11.5	2.9	0.5	0.1
		1400	170	169.7	42.4	6.8	1.7	15.8	3.9	0.6	0.2
NT-51E0-0481	Amber	1050	532	531.9	133.0	21.3	5.3	49.4	12.4	2.0	0.5
NT-52B1-0469	Blue	1050	226	226.4	56.6	9.1	2.3	21.0	5.3	0.8	0.2
NT-52C1-0470	Green	1050	849	848.6	212.2	33.9	8.5	78.8	19.7	3.2	0.8
NT-51A0-0468	Red	1050	538	538.4	134.6	21.5	5.4	50.0	12.5	2.0	0.5

Characteristics

Driving Lamina Light Engines

Lamina Titan light engines are designed to operate under current controlled conditions, either constant current, PWM or other current control methods. The Titan is designed to operate using commercially available driver sources from many electronic power supply companies. Lamina's Application Engineering team can assist with the proper selection of drivers and your own drive current design.

Connecting power to high brightness LEDs in the past has been challenging. Lamina has developed EZConnect boards and wire harnesses to make assembly fast and reliable.

Electrical Performance Characteristics Junction Temperature, T_j =25ºC

Table 4.

Product Number	Color	Forward Voltage (VDC) Typ.	Forward Voltage (VDC) Max.	Typical Power (W)	Typical Temperature Coefficient of Forward Voltage (mV/ºC)	Current (mA)	Typical Thermal Resistance Junction to Case (ºC/W)
NT-52D1-0430	Warm White	19.8	24.8	20.8	-6.12	1050	0.9
NT-52D0-0429	Daylight White	19.8	24.8	20.8	-9.29	1050	0.9
NT-53F0-0428	Red	6.9	8.6	7.3	-3.55	1050	1.4
	Green	11.4	14.2	12.0	-5.2	1050	1.4
	Blue	10.5	13.1	11.0	-7.87	1050	1.4
				NT-53F0-0428 RGB Combined Typical			0.5
NT-51E0-0481	Amber	14.5	18.1	15.2	TBD	1050	0.9
NT-52B1-0469	Blue	19.7	24.6	20.7	TBD	1050	0.9
NT-52C1-0470	Green	21.2	26.3	22.2	TBD	1050	0.9
NT-51A0-0468	Red	13.3	16.6	14.0	TBD	1050	0.9

Minimum, Typical, and Absolute Maximum Ratings, Warm White (NT-52D1-0430) and Daylight White (NT-52D0-0429)

Table 5.

	Symbol	Min.	Typ.	Max.	Unit
Thermal Resistance[1]	T_R	-	0.9	1.2	ºC/W
Insulation Resistance[2]	-	1.0	-	-	MΩ
Electrical Isolation[3]	-	100	-	-	V
Reverse Current	-	-	-	50	mA
Reverse Voltage	-	-	-	5	V
LED Junction Temperature[4]	T_J	-	-	+115	ºC
Storage Temperature	-	-40	-	+100	ºC
Assembly Temperature	-	-	-	+210	ºC
ESD Sensitivity	-	-	-	4000	V
Current	-	-	-	1400	mA DC

Notes:
1. Thermal resistance including thermal grease (Wakefield P/N 120), as measured from LED junction to heat sink.
2. Insulation resistance between any terminal and base.
3. Electrical isolation voltage between any terminal and base.
4. Lower junction temperatures improve lumen maintenance.

Minimum, Typical, and Absolute Maximum Ratings, RGB (NT-53F0-0428)

Table 7.

	Symbol	Min.	Typ.	Max.	Unit
Thermal Resistance[1]	T_R	-	0.5	0.7	ºC/W
Thermal Resistance Per Color[5]	-	-	1.4	1.8	ºC/W
Insulation Resistance[2]	-	1.0	-	-	MΩ
Electrical Isolation[3]	-	100	-	-	V
Reverse Current	-	-	-	50	mA
Reverse Voltage	-	-	-	5	V
LED Junction Temperature[4]	T_J	-	-	+125	ºC
Storage Temperature	-	-40	-	+100	ºC
Assembly Temperature	-	-	-	+100	ºC
ESD Sensitivity	-	-	-	4000	V
Current Per Color	-	-	-	1500	mA DC

Notes:
1. Total thermal resistance all colors on, including thermal grease (Wakefield P/N 120), as measured from LED junction to heat sink.
2. Insulation resistance between any terminal and base.
3. Electrical isolation voltage between any terminal and base.
4. Lower junction temperatures improve lumen maintenance.
5. Thermal resistance including thermal grease (Wakefield P/N 120), as measured from LED junction to heat sink.

Spectral Distribution @1050mA, 25ºC Heat Sink

Warm White (NT-52D1-0430)

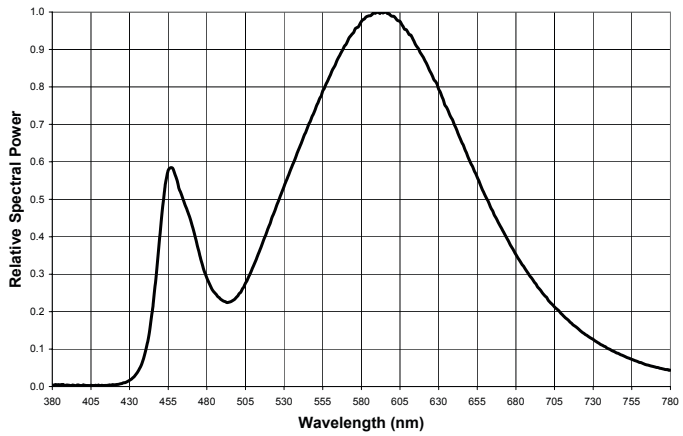


Figure 1a.

Daylight White (NT-52D0-0429)

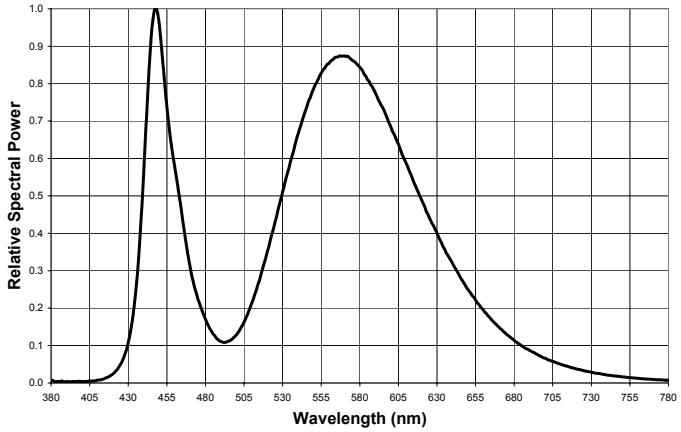


Figure 1b.

RGB (NT-53F0-0428)

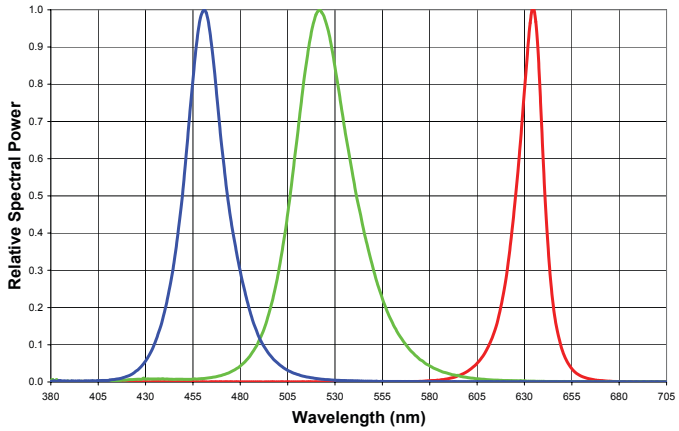
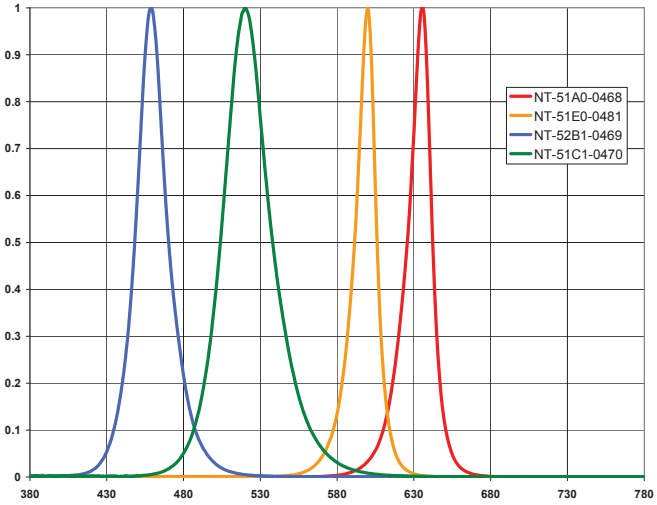


Figure 1c.

Spectral Distribution @1050mA, 25ºC Heat Sink

Figure 1d.

Blue (NT-52B1-0469), Green (NT-52C1-0470),
Amber (NT-51E0-0481), and Red (NT-51A0-0468)



Typical relative Forward Current vs. Forward Voltage

Figure 2a.

Warm White (NT-52D1-0430)

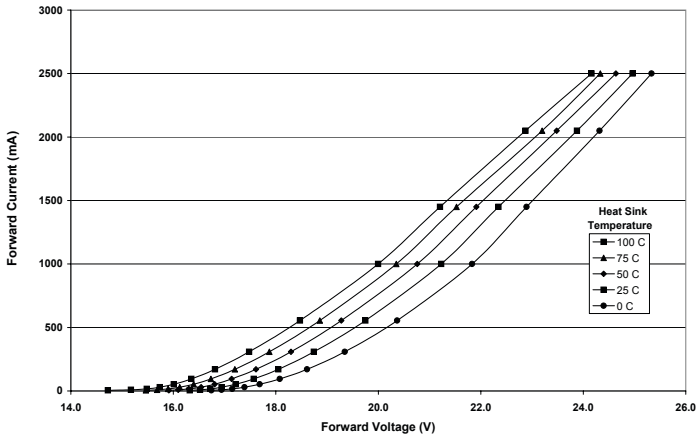
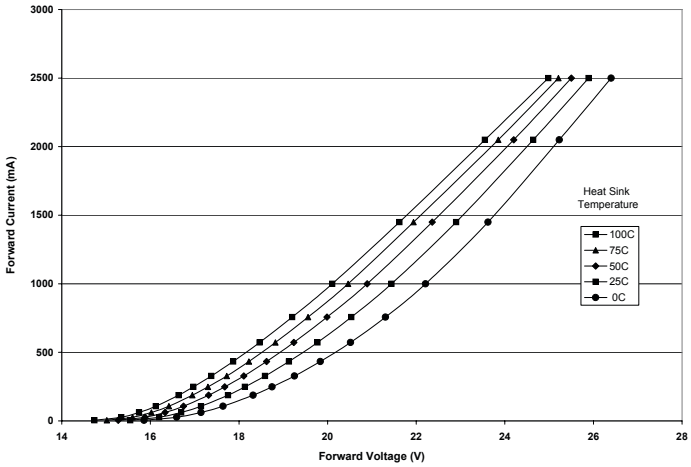


Figure 2b.

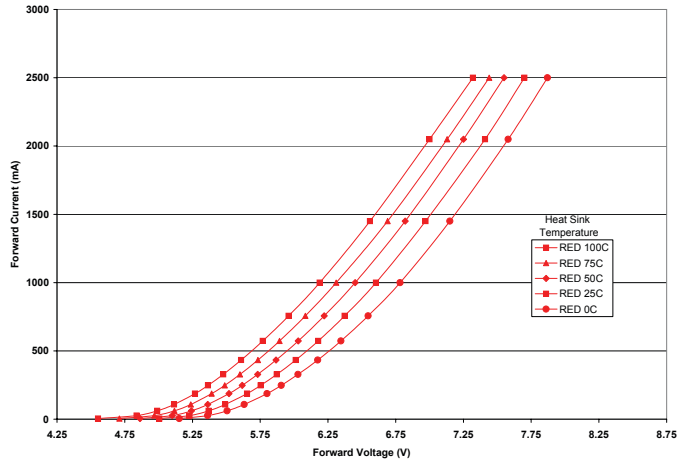
Daylight White (NT-52D0-0429)



Typical relative Forward Current vs. Forward Voltage

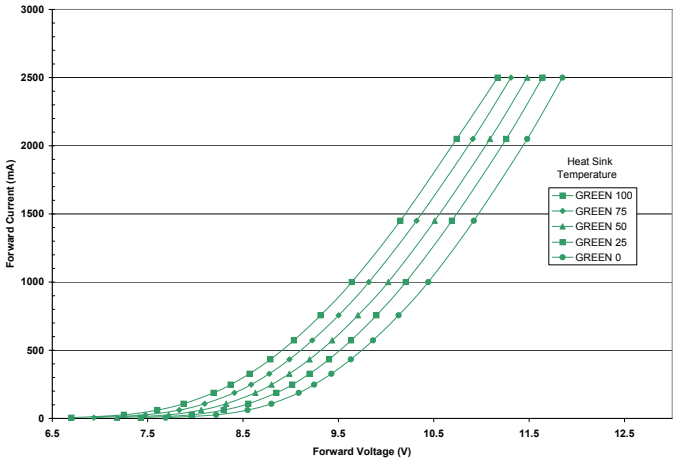
RGB Red (NT-53F0-0428)

Figure 2c.



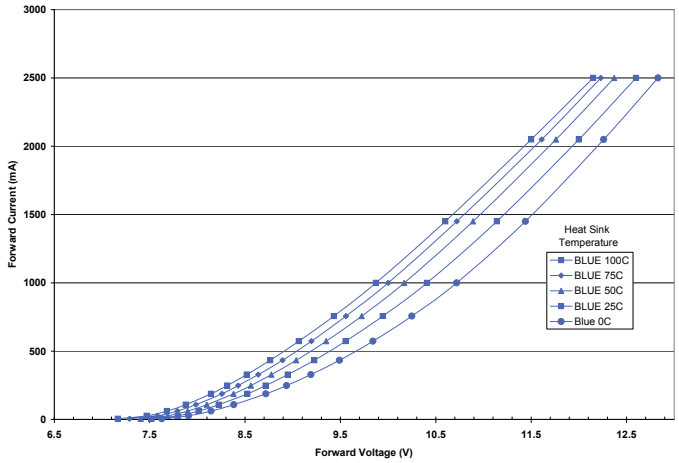
RGB Green (NT-53F0-0428)

Figure 2d.



RGB Blue (NT-53F0-0428)

Figure 2e.



Typical relative Forward Current vs. Forward Voltage

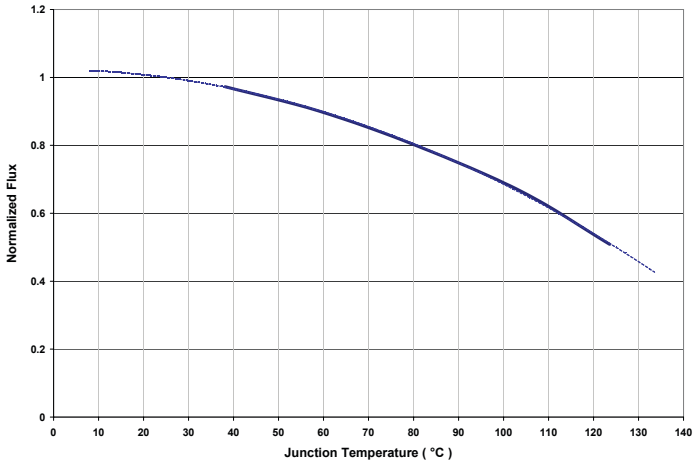
Blue (NT-52B1-0469), Green (NT-52C1-0470),
Amber (NT-51E0-0481), and Red (NT-51A0-0468)

Figure 2f.

Available 2nd Quarter

Relative Luminous Flux vs. Junction Temperature

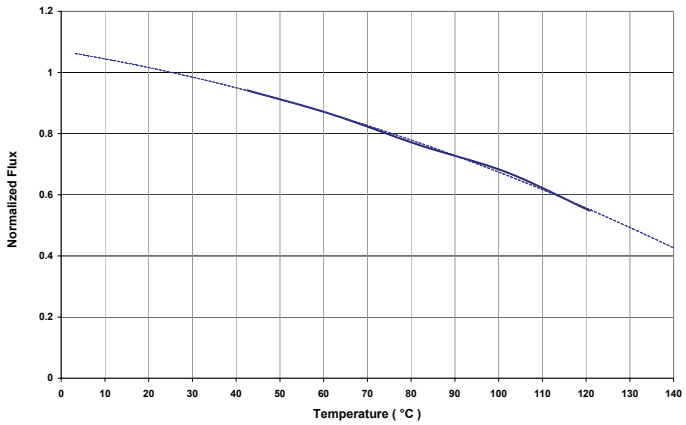
Warm White (NT-52D1-0430)



---- Projected
—— Measured

Figure 3a.

Daylight White (NT-52D0-0429)

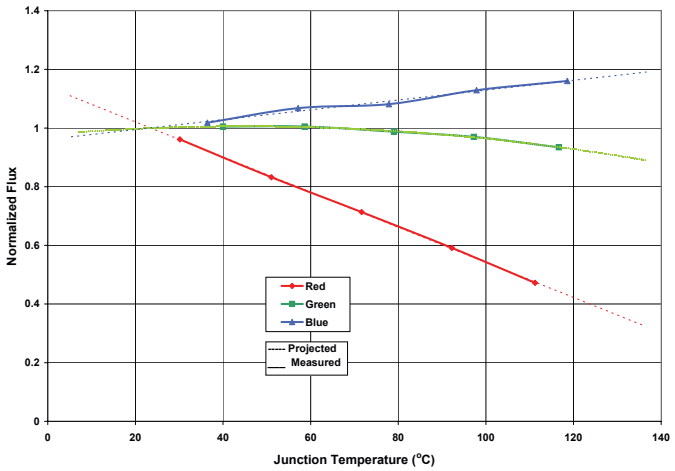


---- Projected
—— Measured

Figure 3b.

Typical relative Forward Current vs. Forward Voltage

RGB (NT-53F0-0428)



---- Projected
—— Measured

Figure 3c.

Blue (NT-52B1-0469), Green (NT-52C1-0470),
Amber (NT-51E0-0481) and Red (NT-51A0-0468)

Figure 3d.

Available 2nd Quarter 2008

Flux vs. Current

Warm White (NT-52D1-0430)

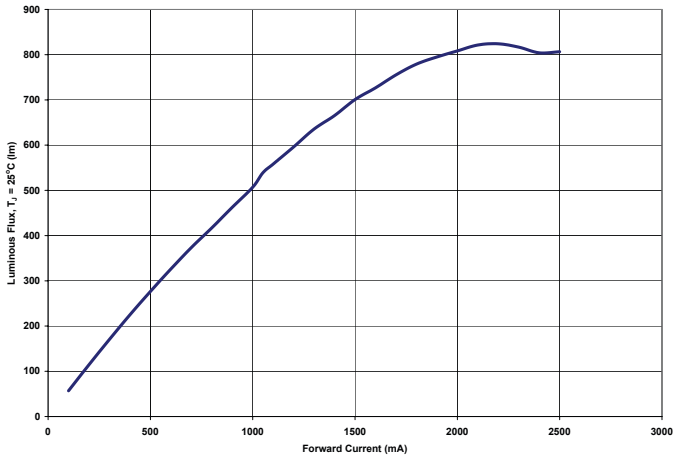


Figure 4a.

Flux vs. Current

Daylight White (NT-52D0-0429)

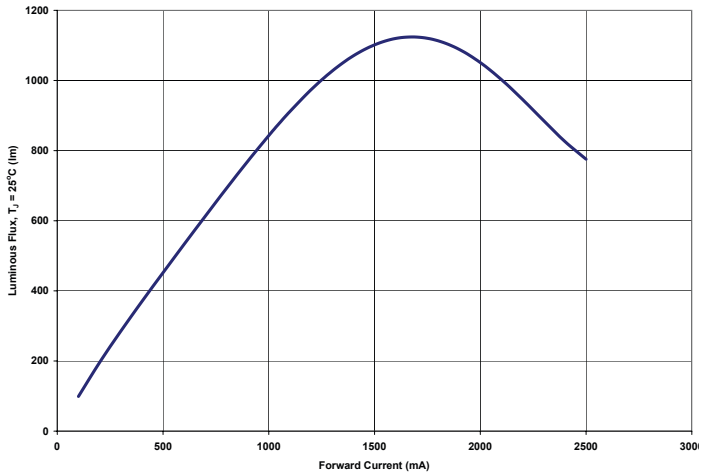


Figure 4b.

RGB (NT-53F0-0428)

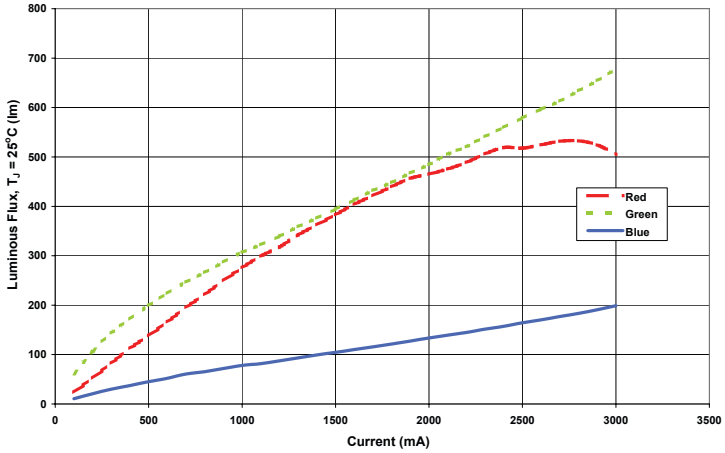


Figure 4c.

Blue (NT-52B1-0469), Green (NT-52C1-0470),
Amber (NT-51E0-0481), and Red (NT-51A0-0468)

Figure 4d.

Available 2nd Quarter 2008

Efficacy vs. Current

Warm White (NT-52D1-0430)

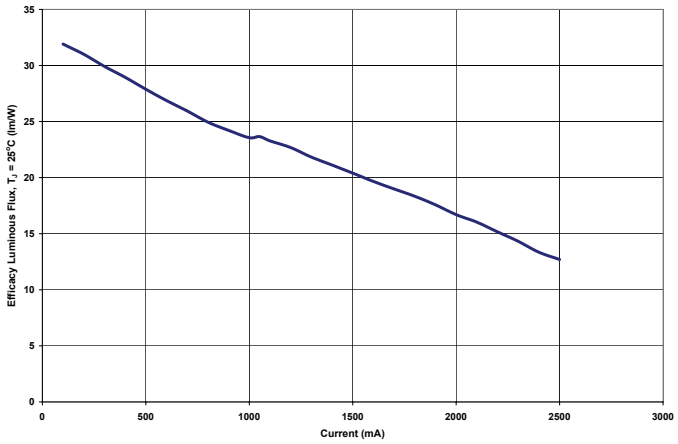


Figure 5a.

Daylight White (NT-52D0-0429)

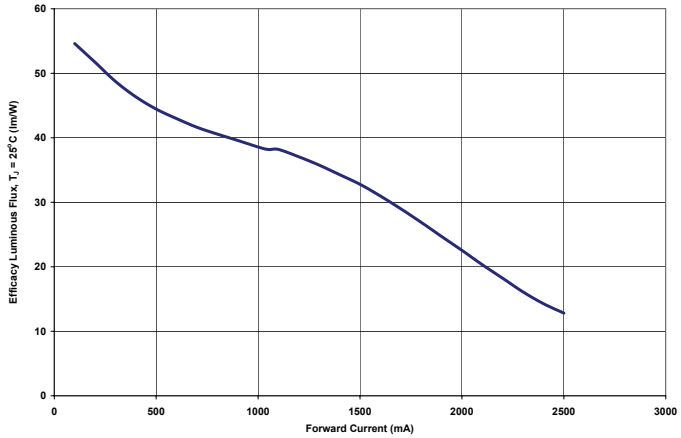


Figure 5b.

RGB (NT-53F0-0428)

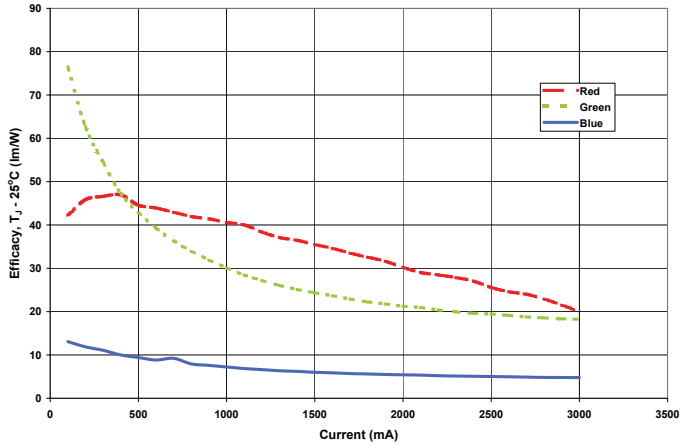


Figure 5c.

Efficacy vs. Current

Blue (NT-52B1-0469), Green (NT-52C1-0470),
Amber (NT-51E0-0481), and Red (NT-51A0-0468)

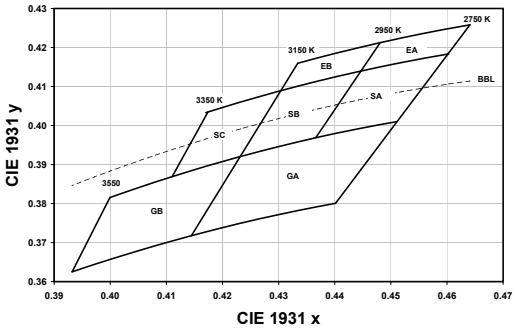
Figure 5d.

Available 2nd Quarter 2008

Bin Structure

Warm White (NT-52D1-0430)

Figure 6a. CIE Reference 1931, 2°

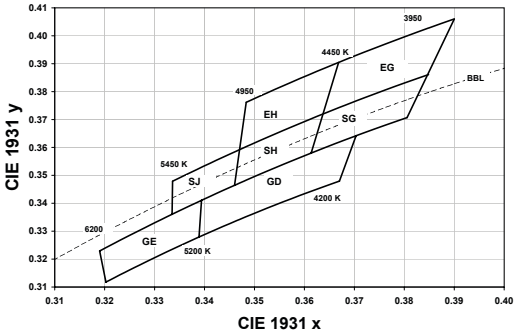


Bin Code	X	Y	Typical CCT (K)
EB	0.4481 0.4448 0.4305 0.4334	0.4212 0.4140 0.4089 0.4159	3050
EA	0.4641 0.4603 0.4448 0.4481	0.4258 0.4183 0.4140 0.4212	2850
SC	0.4305 0.4232 0.4110 0.4174	0.4089 0.3920 0.3869 0.4034	3250
SB	0.4448 0.4366 0.4232 0.4305	0.4140 0.3968 0.3920 0.4089	3050
SA	0.4603 0.4510 0.4366 0.4448	0.4183 0.4009 0.3968 0.4140	2850
GB	0.4232 0.4144 0.3932 0.3999	0.3920 0.3717 0.3625 0.3815	3350
GA	0.4510 0.4401 0.4144 0.4232	0.4009 0.3800 0.3717 0.3920	2950

Table 7a. Note: Typical relative Warm White Bin NT-52D1-0430.

Daylight White (NT-52D0-0429)

Figure 6b. CIE Reference 1931, 2°



Bin Code	X	Y	Typical CCT (K)
EH	0.3668 0.3637 0.3469 0.3483	0.3904 0.3719 0.3591 0.3761	4700
EG	0.3900 0.3848 0.3637 0.3668	0.4060 0.3861 0.3719 0.3904	4200
SJ	0.3469 0.3460 0.3335 0.3336	0.3591 0.3464 0.3360 0.3479	5200
SH	0.3637 0.3613 0.3460 0.3469	0.3719 0.3580 0.3464 0.3591	4700
SG	0.3848 0.3805 0.3613 0.3637	0.3861 0.3706 0.3580 0.3719	4200
GE	0.3394 0.3389 0.3202 0.3190	0.3410 0.3279 0.3117 0.3229	5700
GD	0.3703 0.3670 0.3389 0.3394	0.3641 0.3479 0.3279 0.3410	4700

Figure 7b. Note: Typical relative Daylight White Bin NT-52D0-0429.

Projected Lumen Maintenance

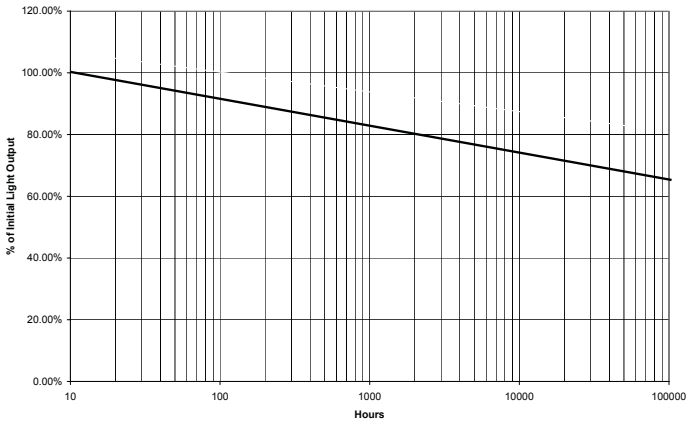
Lifetime for solid-state devices (LEDs) is typically defined in terms of lumen maintenance - the percentage of initial light output remaining after a specified period of time.

The Warm White (NT-52D1-0430) and Daylight White (NT-52D0-0429) will deliver 70% lumen maintenance at 50,000 hours of operation at a forward current of 1050mA. This projection is based on constant current operation with junction temperature maintained at or below 120ºC. The RGB (NT-53F0-0428) will deliver, 70% lumen maintenance at 50,000 hours of operation at a forward current of 1050mA. This projection is based on constant current operation with junction temperature maintained at or below 120ºC.

This performance is based on independent test data. Lamina's historical data from tests run on similar material systems, and internal reliability testing. Observation of design limits included in this data sheet is required in order to achieve this project lumen maintenance.

Warm White (NT-52D1-0430), Daylight White (NT-52D0-0429), and RGB (NT-53F0-0428)

Figure 7a.



Blue (NT-52B1-0469), Green (NT-52C1-0470), Amber (NT-51E0-0481), and Red (NT-51A0-0468)

Figure 7b.

Available 2nd Quarter 2008

Relative Luminous Intensity

Warm White (NT-52D1-0430)
and Daylight White (NT-52D0-0429)

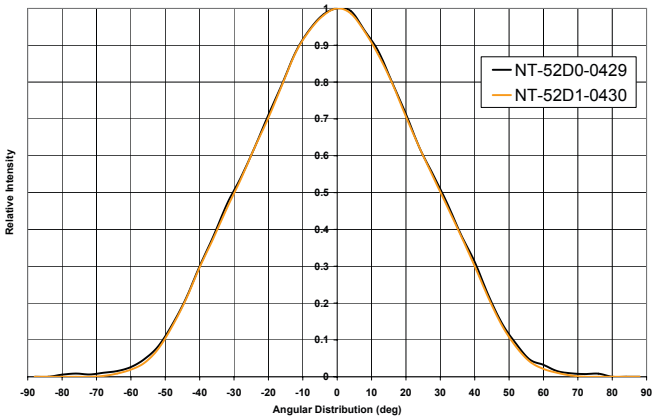


Figure 8a.

RGB (NT-53F0-0428)

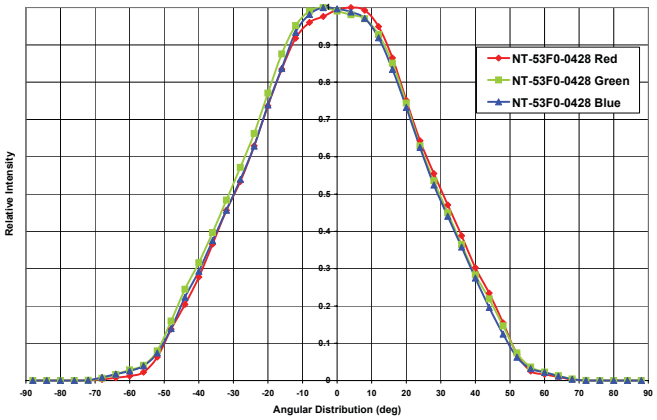


Figure 8b.

Blue (NT-52B1-0469), Green (NT-52C1-0470),
Amber (NT-51E0-0481), and Red (NT-51A0-0468)

Figure 8c.

Available 2nd Quarter 2008

Relative Luminous Intensity

Warm White (NT-52D1-0430) and
Daylight White (NT-52D0-0429)

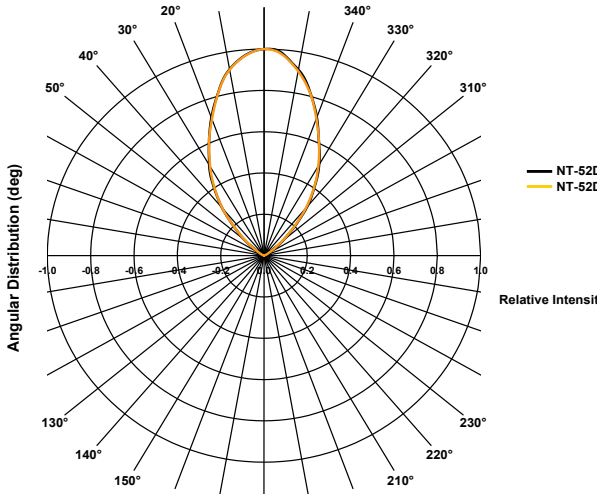


Figure 9a.
Typical Beam Pattern - Lamina's Titan™ LED light engines project a 108º - 132º (2θ,1/2, 50% of peak value) Lambertian radiation pattern. Narrower beam distributions can be produced by use of selected popular LED optics. Please contact Lamina Application Engineering for support with your optical needs.

RGB (NT-53F0-0428)

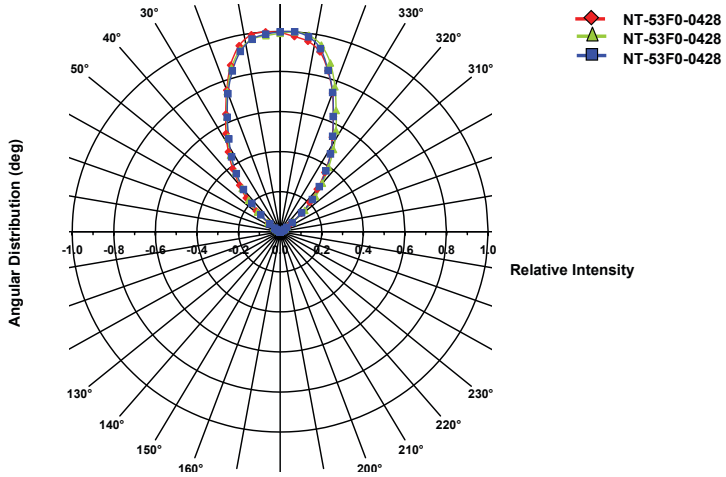


Figure 9b.

Blue (NT-52B1-0469), Green (NT-52C1-0470),
Amber (NT-51E0-0481), and Red (NT-51A0-0468)

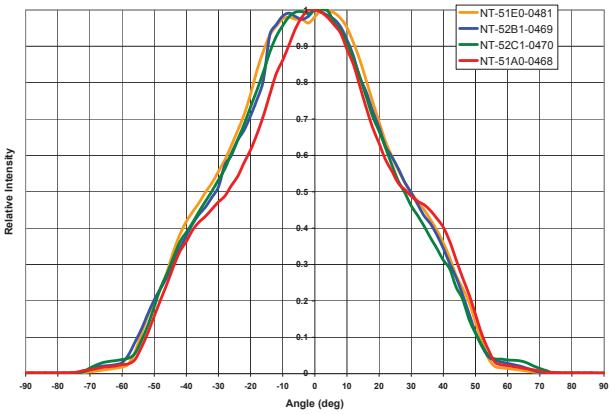


Figure 9c.

Mechanical Dimensions

Warm White (NT-52D1-0430) and
Daylight White (NT-52D0-0429)

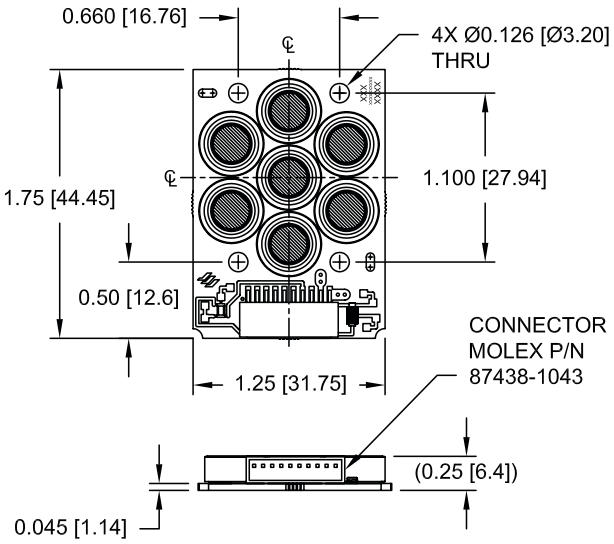


Figure 10a.
All dimensions are for reference only. Do not handle device by the lens. Care must be taken to avoid damage to the lens. Drawing not to scale.

Units: Inches [millimeters]

RGB (NT-53F0-0428)

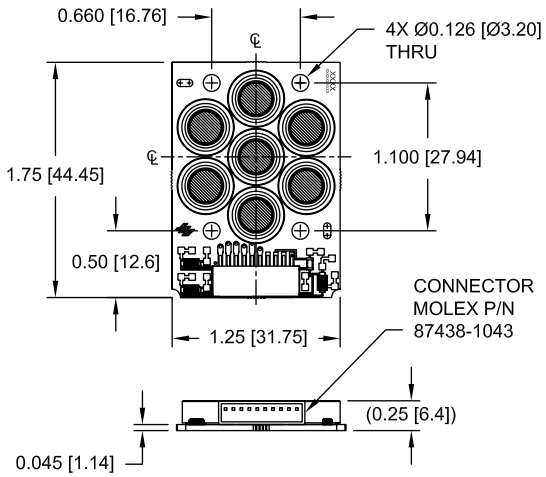


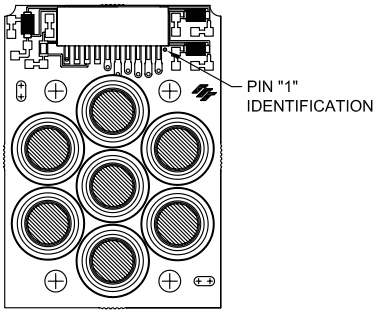
Figure 10b.
Do not handle device by the lens. Care must be taken to avoid damage to the lens. Drawing not to scale.

Units: Inches [millimeters]

Thermal Design
Proper thermal design is essential to achieving maximum life and performance. There are many ways you can reduce the junction temperature of your product and increase its useful life. Heat sinks, both active and passive, come in many styles and sizes. Choosing the correct heat sink for your design will maximize the performance and add to the unique aesthetic quality of your product. Thermal tape is not recommended for attachment to heat sinks.

The thermal design experts at Lamina are ready to assist you with your design. Visit www.laminalighting.com where you can download helpful white papers and get specifications for our other products including heat sinks, optics and drivers for the Titan™ Series of LED Light Engines.

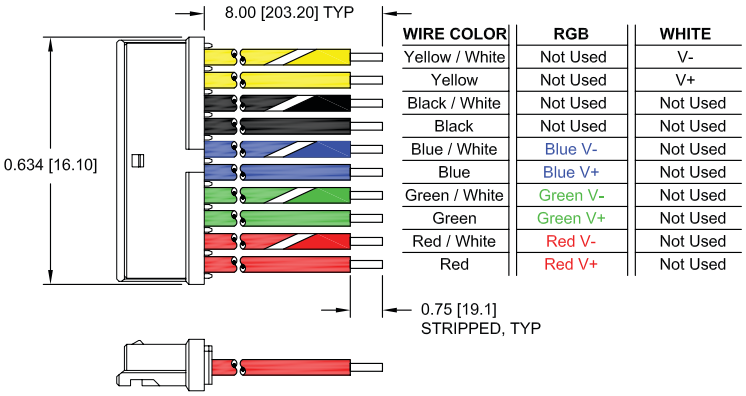
Electrical Connections



PIN NUMBER	RGB	WHITE
1	Red V+	Not Used
2	Red V-	Not Used
3	Green V+	Not Used
4	Green V-	Not Used
5	Blue V+	Not Used
6	Blue V-	Not Used
7	Not Used	Not Used
8	Not Used	Not Used
9	Not Used	V+
10	Not Used	V-

Figure 11.
For optimal thermal performance, thermal grease or epoxy should be added beneath the entire surface of the LED array. All dimensions are for reference only.

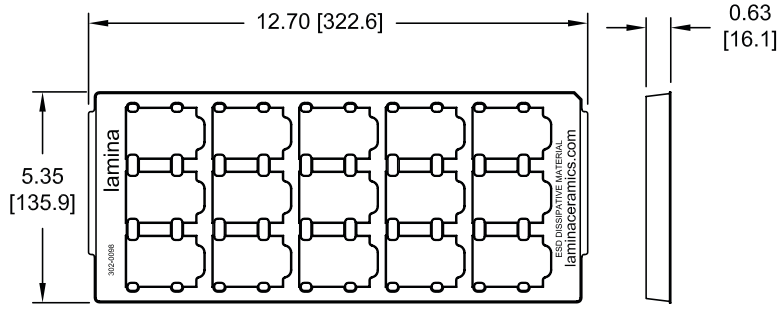
Wiring Harness



WIRE COLOR	RGB	WHITE
Yellow / White	Not Used	V-
Yellow	Not Used	V+
Black / White	Not Used	Not Used
Black	Not Used	Not Used
Blue / White	Blue V-	Not Used
Blue	Blue V+	Not Used
Green / White	Green V-	Not Used
Green	Green V+	Not Used
Red / White	Red V-	Not Used
Red	Red V+	Not Used

Figure 12.
Do not handle device by the lens. Care must be taken to avoid damage to the lens. Drawing not to scale.

Packaging Trays



TRAY HOLDS 15 UNITS

Figure 13.

Units: Inches [millimeters]

Patents and Connections

Patents

Lamina's light engines may be covered by pending patents and/or one or more of the following U.S. and/or International patents 5876536, 6709749 B, 595880, 6017642, 5565262, 5681444, 5653834, 5581876, 5847935, 5514451, 5747931, 5925203, 5725808, 5929510, 5858145, 5866240, 5953203, 6055151, 614076, 6011330, 6399230, 6914501, 6168490, 6191934, 614075, 6160469, 6300267, 6471805, 6518502, 6739047, 6720859, 6759940, 6518502, 6670856 B1, 6720859, 6713862 B2, WO 00/47399, WO 00/26152, WO 98/19339, 5082804, ZL99808762.9, 69623930, 69628549, 69629572, 805785, 69628549, 843621, 932500, 805785, 812258, 843621, 932500, 805785, 812258, 843621, 932500, 805785, 812258, 843621, 932500, 3327556, 3267299, 3226281, 3405545, 320630, 295695, 284068, 546471, 805785, 812258, 843621, 6455930, 6759940, 6713862, 7095053, 7098483.

Electrical Connections

The Titan™ LED light engines connectors for solderless connections to Lamina's wiring harness.

For more information refer to Lamina's Connection application note which can be found on the website at www.laminalighting.com.

Functional test: Parts may be illuminated for functional test using a constant current source set at 25% of Drive Current for no more than two seconds without heat sink. Voltage compliance of the power source should be no greater than max forward voltage +5V.

1. Optical and electrical specifications are given for the specified drive @ 25ºC junction temperature.

2. When using constant current LED drivers with high compliance voltage (Advance, LEDworks, etc. or a custom driver) the output of the supply must be connected to the part before power is applied to the input of the supply.

Assembly and Packaging

Assembly Recommendations

Lamina's Series Light Engines are designed for attachment to a heat sink with conductive epoxy, or screw down for flange mount devices with thermal grease in the joint. For attachment using screws, a 2-56 UNC round head or metric equivalent M2 X 0.4 cheese head screw, 18-8 SS is recommended. When mounting the light engine, position the three screws in the center of each of the three slots. Tighten the three screws evenly, first to about 0.89 inch pounds (10 Newton-centimeter), and then tighten each to a maximum torque of 4 inch pounds (45 Newton-centimeter). Flatness requirement of the surface that the light engine is mounted to is 0.001 inch/inch (1mm/meter).

Receiving Parts and Packaging Trays

Your parts will arrive in either custom fitted trays or on easy to use tape and reel packaging. This packaging was designed to provide the necessary protection during shipment and to take up the least amount of space in your storage area.

Notes

1. This product uses silicone materials for superior optical performance. Do not expose the part to fluids that may react with silicone compounds. See Dow Chemical Form 45-0113D-01, Silicone Fluid Resistance Guide.

2. Ray trace models are available upon request.

3. Lamina may make process or materials changes affecting the performance or other characteristics of our products. These products supplied after such changes will continue to meet published specifications, but may not be identical to product supplied as samples or under prior orders.

4. All specifications are based on mounting the LED array to a heat sink using the specified hardware and thermal grease Wakefield 120. The heat sink must meet the specified flatness requirement. Mounting using screws and thermal tape may damage the device.

RoHS and Warranty

Lamina Light Engines Comply with RoHS Restrictions

Lamina Light Engines are compliant with all of the criteria proposed by the European RoHS Directive 2002/95/EC for hazardous material content in electronic and electrical equipment as listed in Annex 1A and 1B of the WEEE Directive.

In addition to containing no mercury, Lamina's LED Light Engines have the following environmental advantages over traditional light sources:

- High energy efficiency
- Long lifetime
- Fully dimmable
- Very low IR and UV radiation

For attachment of electrical connections Lamina recommends the use of lead-free solder.

Warranty Statement

Lamina Lighting Incorporated (Seller) extends warranty on goods produced by the Seller for one (1) year from original date of shipment, that the goods sold hereunder are new and free from substantive defects in workmanship and materials. This warranty extends only to the Buyer and not to indirect purchasers or users. Seller's liability under the foregoing warranty is limited to replacement of goods or repair of defects or refund of the purchase price at the Seller's sole option. The above warranty does not apply to defects resulting from the improper or inadequate maintenance, unauthorized modification, improper use or operation outside of Seller's specifications for the product, abuse, neglect or accident. THE ABOVE WARRANTY IS EXCLUSIVE AND NO OTHER WARRANTY, WHETHER WRITTEN OR ORAL, IS EXPRESSED OR IMPLIED. LAMINA LIGHTING INCORPORATED SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. - LAMINA LIGHTING INCORPORATED - June 21, 2006

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