



Japan Display Inc.

LumiFree
New Light Distribution Control Technology

LumiFree Business Development and Planning Dept
Japan Display Inc.



Japan Display Inc.

LumiFree Basic Information

- Combination with LCD Technology-

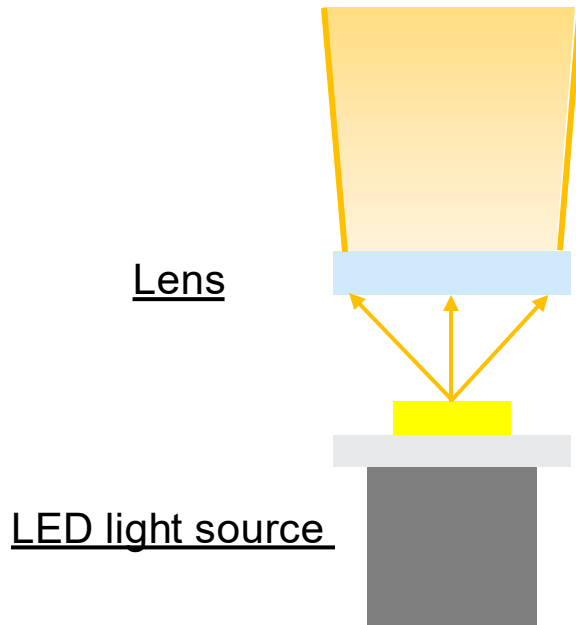
Freedom for Light, Beauty for the World

What is LumiFree?

**LumiFree is a device which can control the shape of light(Light distribution) by integrated into a luminaire.
The diffusion of light will be controlled easily by the device, and create various shape of light.**

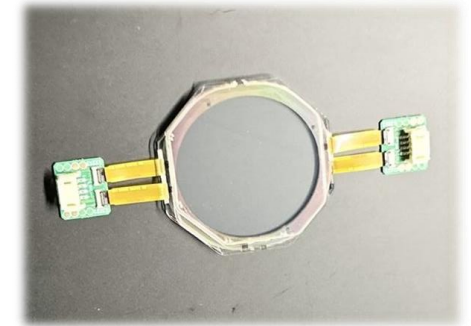
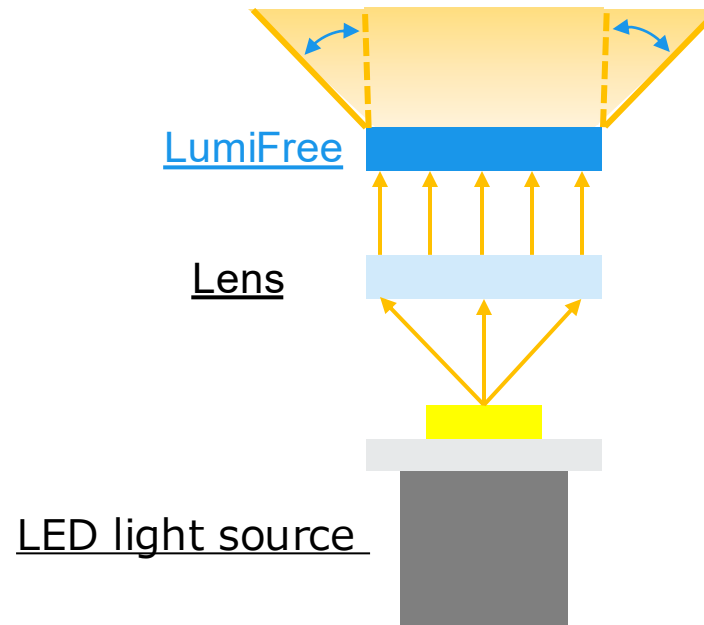
Current LED Lighting Fixtures

Output light was controlled by optics Lens
≡ Fixed Light

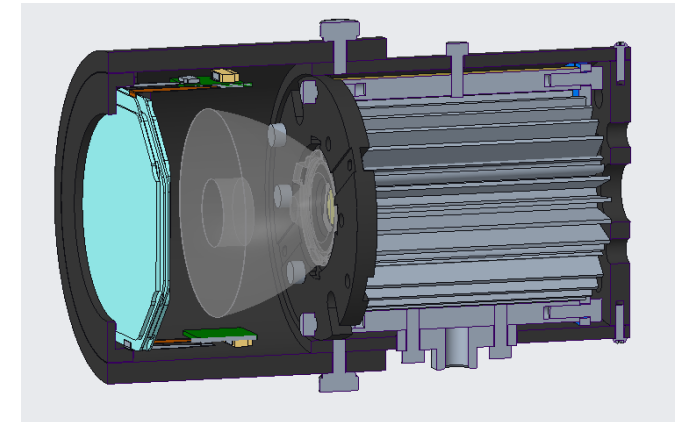


LumiFree equipment

Change output shape by diffusing light
≡ Free shape of light



LumiFree (φ50mm)



Luminaire incorporating with LumiFree

LumiFree enable independent diffusion of light vertically and horizontally through electrical control.
With just one fixture, it's possible to provide a variety of different lighting options without changing the fixture.

OFF

Diffusion

Horizontal Line

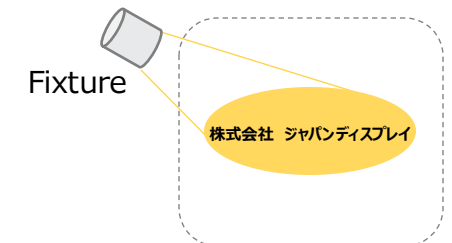
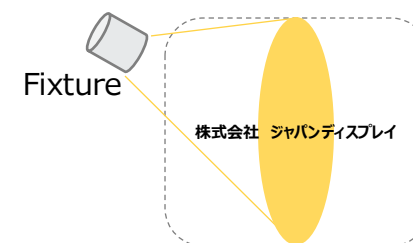
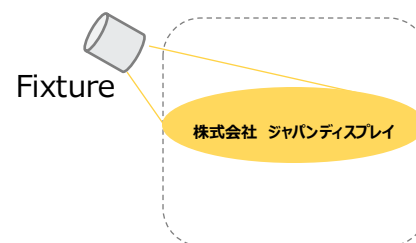
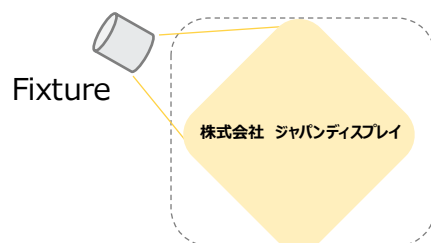
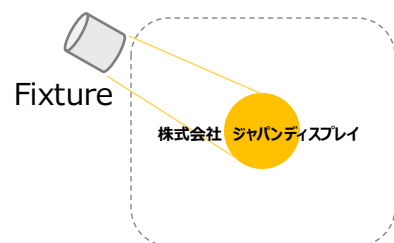
Vertical Line

Ellipse

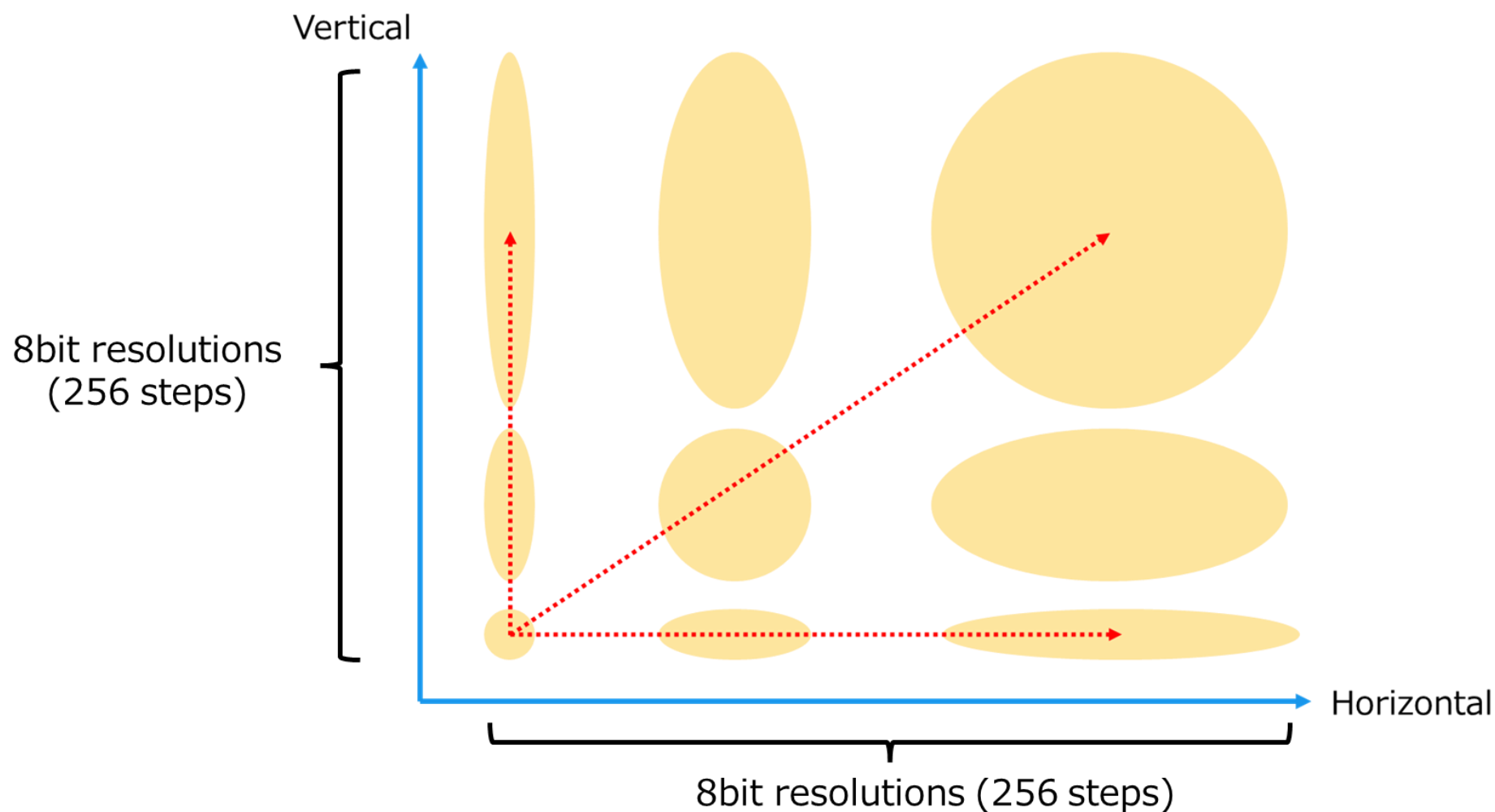
Example



Light distribution image



Light distribution can be controlled with 8-bit resolution (256 steps) on both the X and Y axes. LumiFree enables unprecedented spatial expressions by generating diverse patterns of light.



**This is a feature that cannot be achieved with other methods.
JDI would like to make new VALUE with this feature and the advantages of Lighting products.**



Precision

Very precise control is possible.

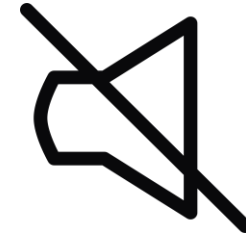
High repeatable due to the electric control.



Fast

Fast distribution speed

Can be used in the places where instantaneous changes are necessary.



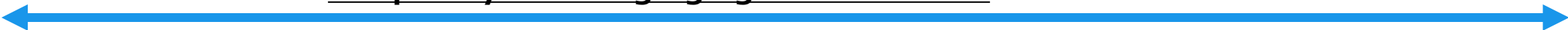
Silence

Electrical control makes operation quieter

It can be used at sites with strict environmental noise restrictions.

JDI believe that LumiFree technology can bring innovation to every lighting scenario.
We would like to create value in collaboration.

Frequency of changing light distribution



Once a week to once a month



Use every few hours



Use every second or minute



Scene	Museums, Boutiques, etc.	Luxury spaces such as hotels, building, etc.	Night upper light, stage, theatre, etc.
LED Type	Dimmer ~ Tunable White	Tunable White ~ RGBW	RGBW
LED Power	Low ~ Middle Power	Middle Power	High Power

Lighting fixtures adopting LumiFree have been selected as "Tottori Prefecture Trial Order Target Products" and introduced to multiple facilities in Tottori Prefecture.

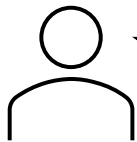
Tottori Prefectural Museum

It was used for the exhibition of "Drifted Animals in Tottori Prefecture corner".



LumiFree Adopted lighting fixture.

It is being utilized for the eye-catching exhibition of "Architeuthis dux Steenstrup 1857 's imbibed Specimen"



This equipment is utilized for lighting nature exhibition specimens. By using lighting fixtures equipped with LumiFree, the light distribution can be adjusted freely, allowing for effective lighting even for large specimens like the Architeuthis dux. The use of technology from Tottori has enabled such lighting effects, which is greatly appreciated. Curators have provided highly positive feedback, noting that the addition of lighting effects has enhanced the attractiveness of the exhibits for visitors.

Lighting fixtures adopting LumiFree have been selected as "Tottori Prefecture Trial Order Target Products" and introduced to multiple facilities in Tottori Prefecture.

Tottori Warabekan

(Tottori museum of children's songs)

It was used for the lighting at "Utano Hiroba (Square of Melodies)."

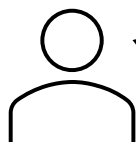


Tottori Warabekan
Building exterior



Exhibition Image

Customer Voice



With conventional lighting fixtures, brightness unevenness occurred when illuminating signs. But with LumiFree, it was possible to effectively and beautifully illuminate the signs. Additionally, it was very user-friendly to be able to adjust the lighting angle and aspect ratio freely through the app without having to climb a ladder. It was also great to be able to make fine adjustments while the materials were in place.

Tottori Prefectural Museum of Art

Adopted as lighting equipment to be utilized at the "Prefectural Citizen Gallery."

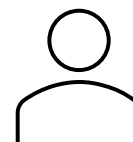


Tottori Prefectural Museum of Art
Building exterior



Exhibition Image

Customer Voice



Our Gallery has a high ceiling of 4 meters, and we receive various requests from event organizers regarding the lighting range, color, brightness, etc., depending on the size, number, and style of the artworks. It has been very helpful to have a product that can meet these requests.

With a thickness of 4.5mm, it allows for a compact design compared to mechanical control components.
The power consumption during light distribution changes is only a few dozen of mW.

LumiFree (φ50mm)



LumiFree Spec	Φ50mm	Φ105mm
Size	61.2mm x 61.2mm (Glass part only)	116.2mm x 116.2mm (Glass part only)
Effective area	φ50.0mm	φ105.0mm
Thickness	4.5mm	
Weight	30.0g	118.0g
Input flux	1,000 ~ 2,000 lm	2,000 ~ 3,000 lm
Transmittance	around 80%	
Light distribution characteristics (1/2 beam angle)	Max around 80°	
Sample	available	available

Product Promotion video

https://www.youtube.com/watch?v=1nq1GF_Bq94

Product Demonstration with BLE Control

https://youtu.be/rl_U5ih38Wc

Product Demonstration with DMX Control

<https://youtu.be/j-ArfANg-I4>

Product Demonstration with DMX program @ Japan Lighting Fair 2023

<https://www.youtube.com/watch?v=Dcg9sUqjnYQ>

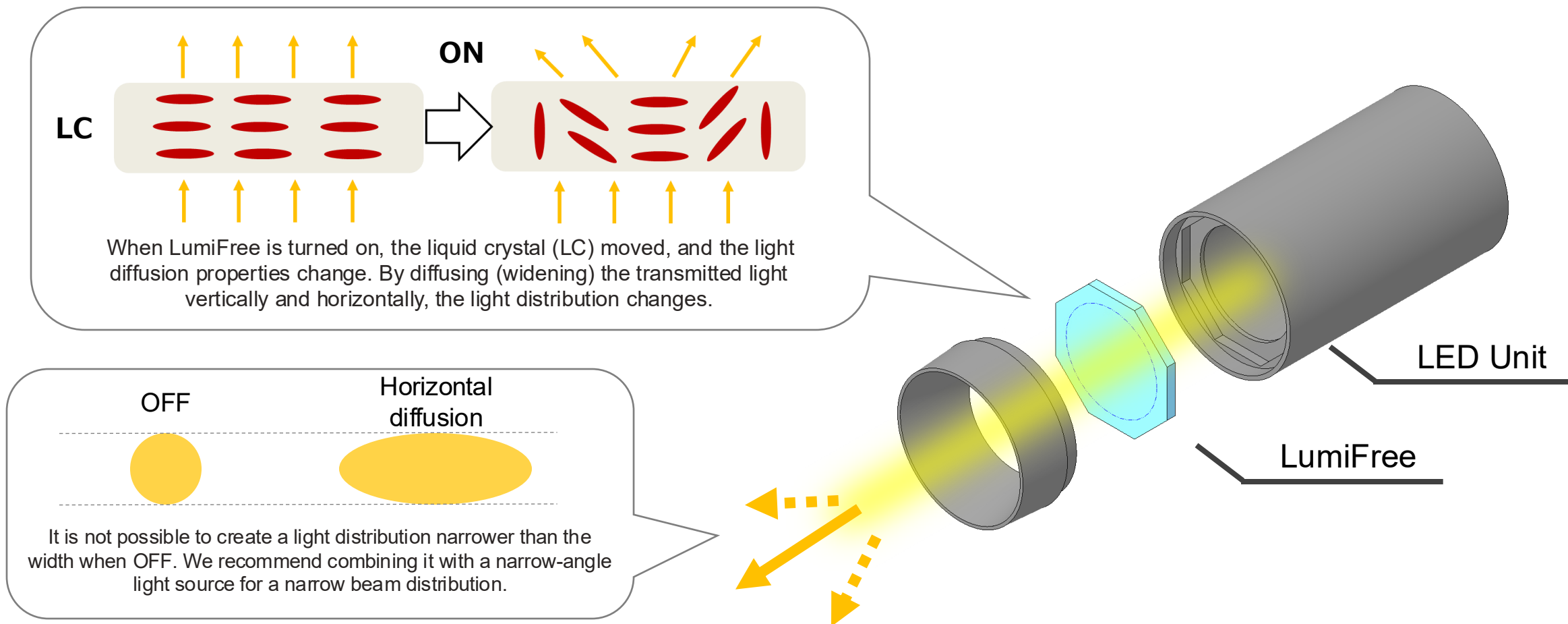


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Characteristic Information

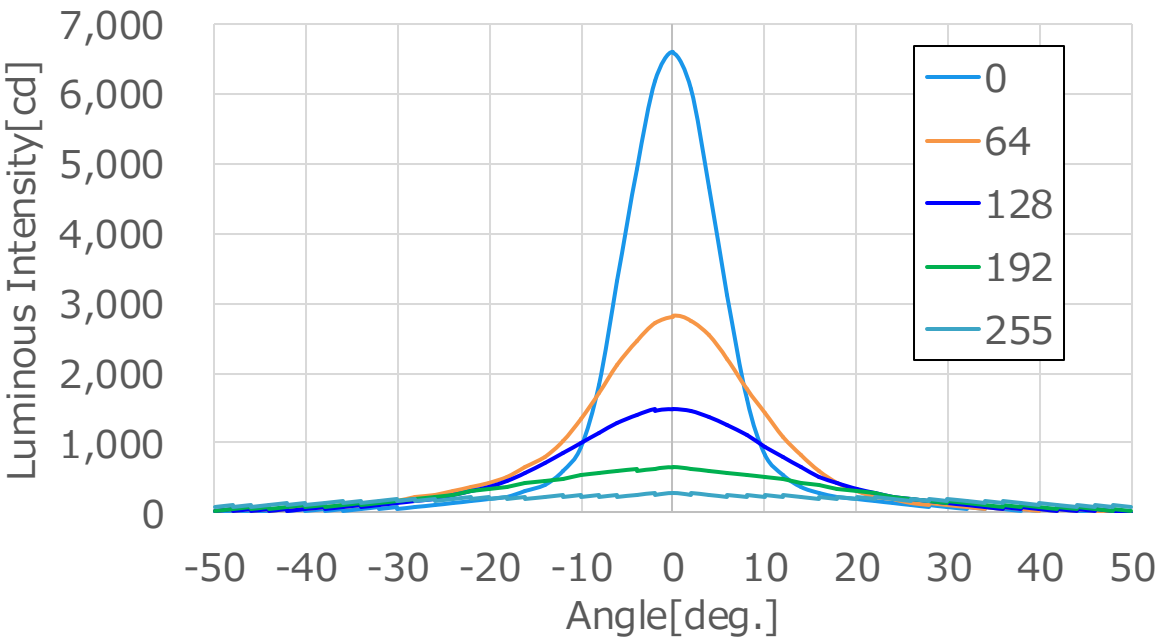
Freedom for Light, Beauty for the World

**Control light distribution by diffusing light passing through LumiFree.
It is recommended for installation on the outgoing side of the luminaire and in combination
with a narrow-angle light source.**



Light spreads to about 80 degrees at 1/2 Beam angle.

Optical data of LumiFree with 1/2 and 1/10 Beam angle measurements at different step values.

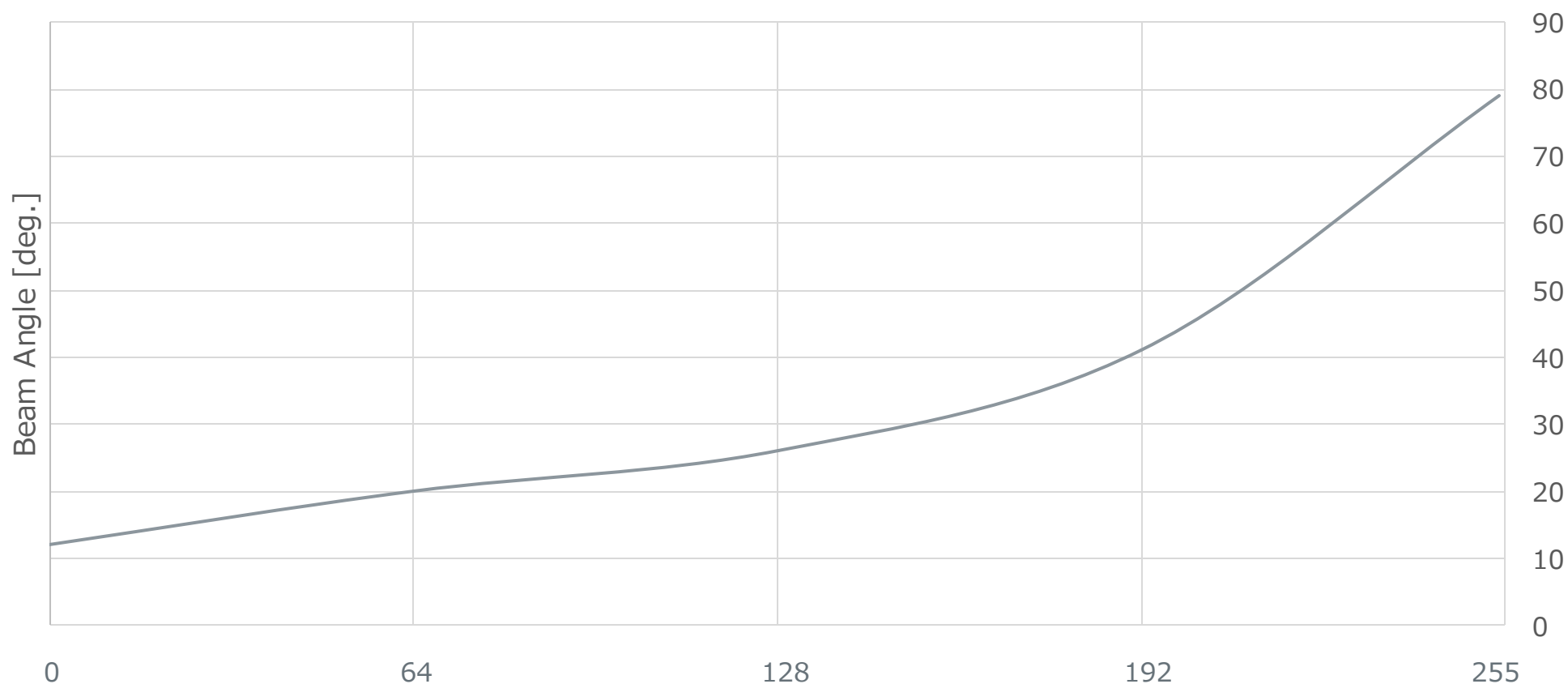


Step Value	1/2 Beam Angle [deg.]	1/10 Beam Angle [deg.]
0 step (LumiFree off)	12	22
64 step	20	46
128 step	26	58
192 step	41	94
255 step	79	137

The table shows the results of measurement by JDI and is for reference only.

**LumiFree allows control of light distribution angle in 256 steps from 0-255.
LumiFree can be used at any illuminance angle.**

Light distribution characteristics at each step (with a light source's 1/2 beam angle of 12 degrees).



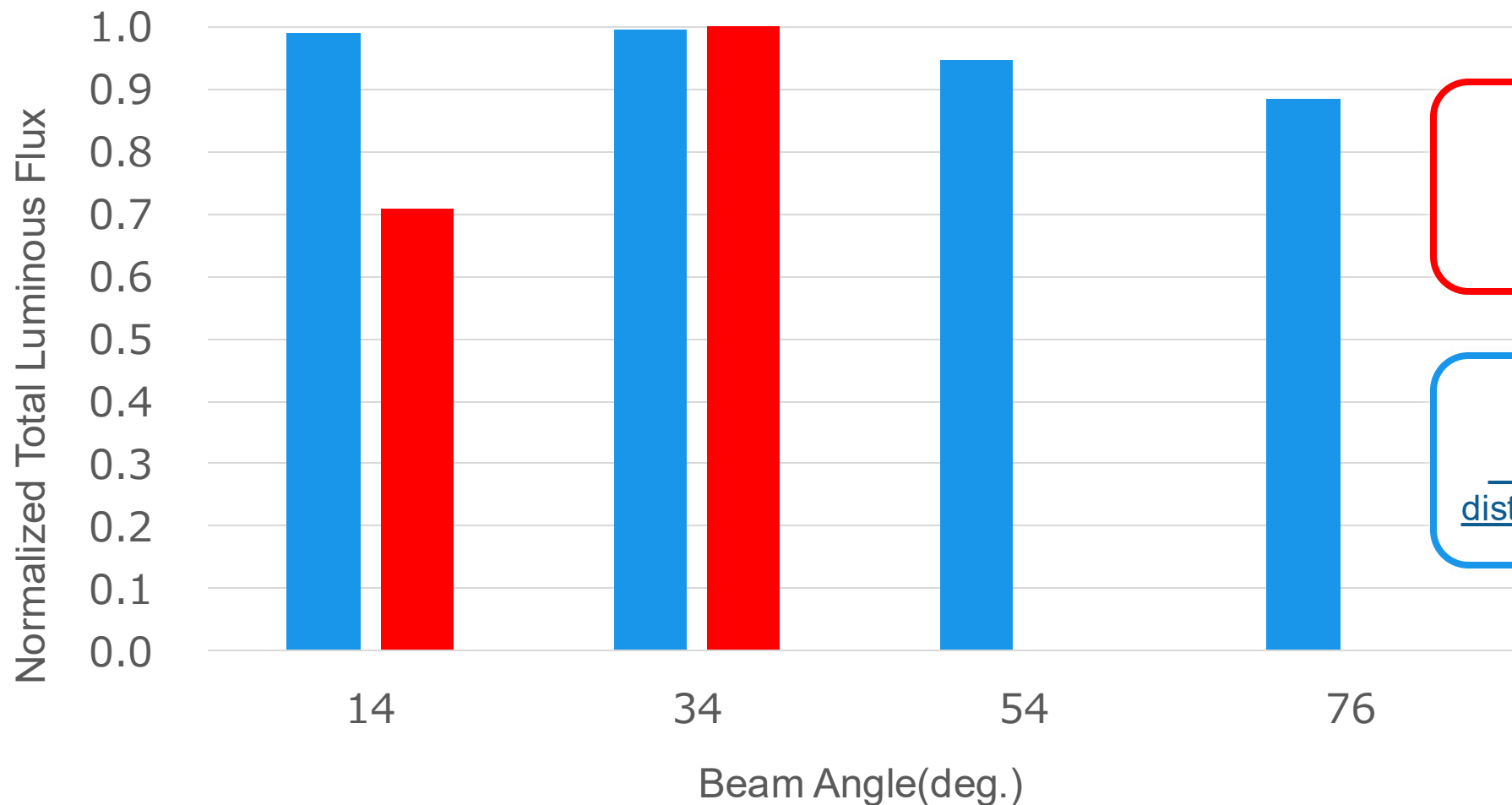
**Data measured using LumiFree in combination with high color-rendering light fixtures.
A slight decrease in Ra was observed.**

Changes in color rendering characteristics with Ra90 LED light sources (based on JDI measurement results).

	Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
only LED module	94.1	94.5	97.4	99.1	95.4	94.9	97.1	92.1	82.0	58.8	93.7	97.4	87.2	95.4	99.3	89.6
with LumiFree (OFF : 0 step)	93.3	93.3	96.6	99.5	94.6	93.6	97.2	91.7	80.2	55.1	92.2	96.9	87.0	94.3	99.2	87.8
with LumiFree (ON : 255 step)	93.2	93.2	96.8	99.5	94.4	93/5	97.5	91.2	79.4	54.3	92.5	96.9	87.9	94.2	99.3	87.5

Lens method have a limited range of variable light distribution and involve significant light loss.

LumiFree combines a wide range of variable light distribution with low light loss.



Lens Method : Red
Light loss occurs during light distribution changes

LumiFree : Blue
Combining Wide variable light distribution range with low light loss

Note:
Prepared by JDI based on data from lens-based variable light distribution luminaires.



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Summary of LumiFree features FAQ

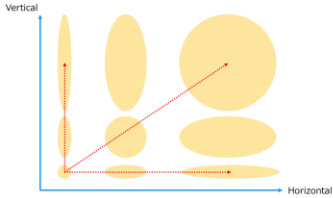
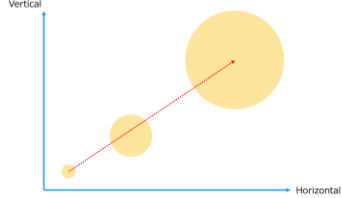
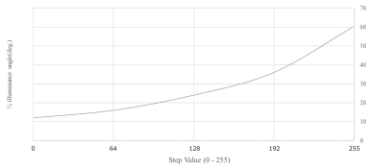
Freedom for Light, Beauty for the World

It is possible to add a new function of adjustable light distribution while retaining the dimming, color adjustment, and color control functions that conventional LED lighting fixtures have.

	<u>LumiFree Lighting</u>	<u>Conventional LED Lighting</u>
Light Source	LED	LED
Brightness Control	→ ※Use LED dimming function	Use LED dimming function
Color Control	→ ※Use full-color LED or LED color control function	Use full-color LED or LED color control function
Light Distribution Active Control	Possible Control through voltage applied to LC panel	Not possible
Energy Efficiency	Approx. 80% ※LumiFree causes 20% drop	-

Comparison with Other Light Distribution Methods



Method	Liquid Crystal Method	Motor Method
	JDI	Motor and Fresnel Lens
Possible Beam Control	○ : Adjustable light distribution in a flexible shape. 	× : Size control only 
Control Smoothness	○ : Continuously adjustable. 	× : 3-5 point positions.
Product Stability	○ : Based on JDI LCD technology. The adjustable light distribution function enables maintenance-free and longer lifetime.	× : Variable motor mechanism needs maintenance. scraping, greasing, etc.
Antinomy in use	○ : Limited light loss.	Large loss of light utilization efficiency when variable light distribution is used

- Q: Are rectangle and square shapes possible with current LumiFree Version?
- A: Not possible currently.

- Q: Dose LumiFree has any Mass production achievement?
- A: Please refer to the "LumiFree-equipped Products" section on our homepage.

- Q: What kind of Control system does LumiFree use?
- A: I2C signal or other facilities provided by partner.

- Q: What is the Lifetime of LumiFree?
- A: Can operate more than 50000h under the condition of a surrounding temperature of 80°C. *

- Q: Can LumiFree be installed outdoors?
- A: Since LumiFree is currently developed for indoor use only, it requires protection (UV, humidity, etc.) for outdoor use.

- Q : What is the power consumption?
- A : The power consumption of the LumiFree main unit is around several tens of milliwatts.

***Temperature:** LumiFree MDL surrounding temperature taking account of LED heat, etc.

Lifetime: The time during which light enters LumiFree until the transmittance at the center decreases by 20% under the condition of a surrounding temperature of 80°C.

The Lifetime data is based on JDI's test result, may vary depending on the usage environment.

Thank you so much

- This measurement data is from JDI's tests and is for reference only.
- This measurement data is not representative for all light sources.
- Since the optical characteristics of LumiFree depend on the light source it is paired with, please evaluate LumiFree with your light source of choice.
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