Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Panasonic Chanel Models for Image Sensor-based Communication

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Abstract: Channel models for image sensor-based visible light communication

Purpose: Call for Channel Models Response

Channel Models

- Panasonic proposes three channel models for image sensor-based communication protocols
  - Transmitter as “Light Panel” model
  - Transmitter as “LCD Signage” model
  - Transmitter as “Spot Light with Reflection Panel” model

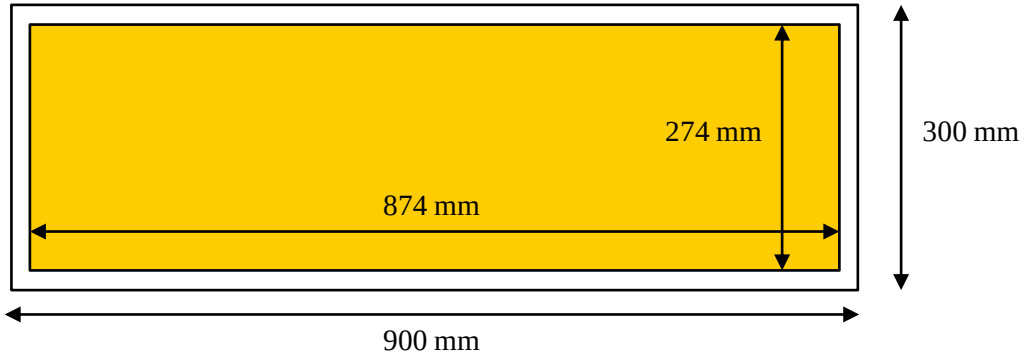
Model Design Basis

- The models were designed for application A1 in the TCD (Offline to Online Marketing / Public Information System)
- Time difference of multipath arrivals was not considered because the difference is negligibly small to signal frequency of image sensor-based communication protocol
- The models were designed with commercial products that have typical specifications
- Flat white image was shown on the panel/screen because the image varies by purpose and there is no typical one

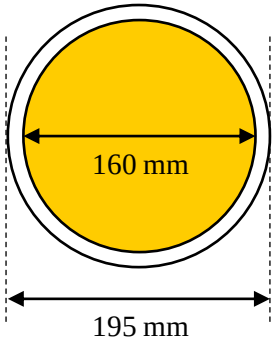
Light Panel - Size

Light panel (Transmitting light)

Photo will be shown
in updated version

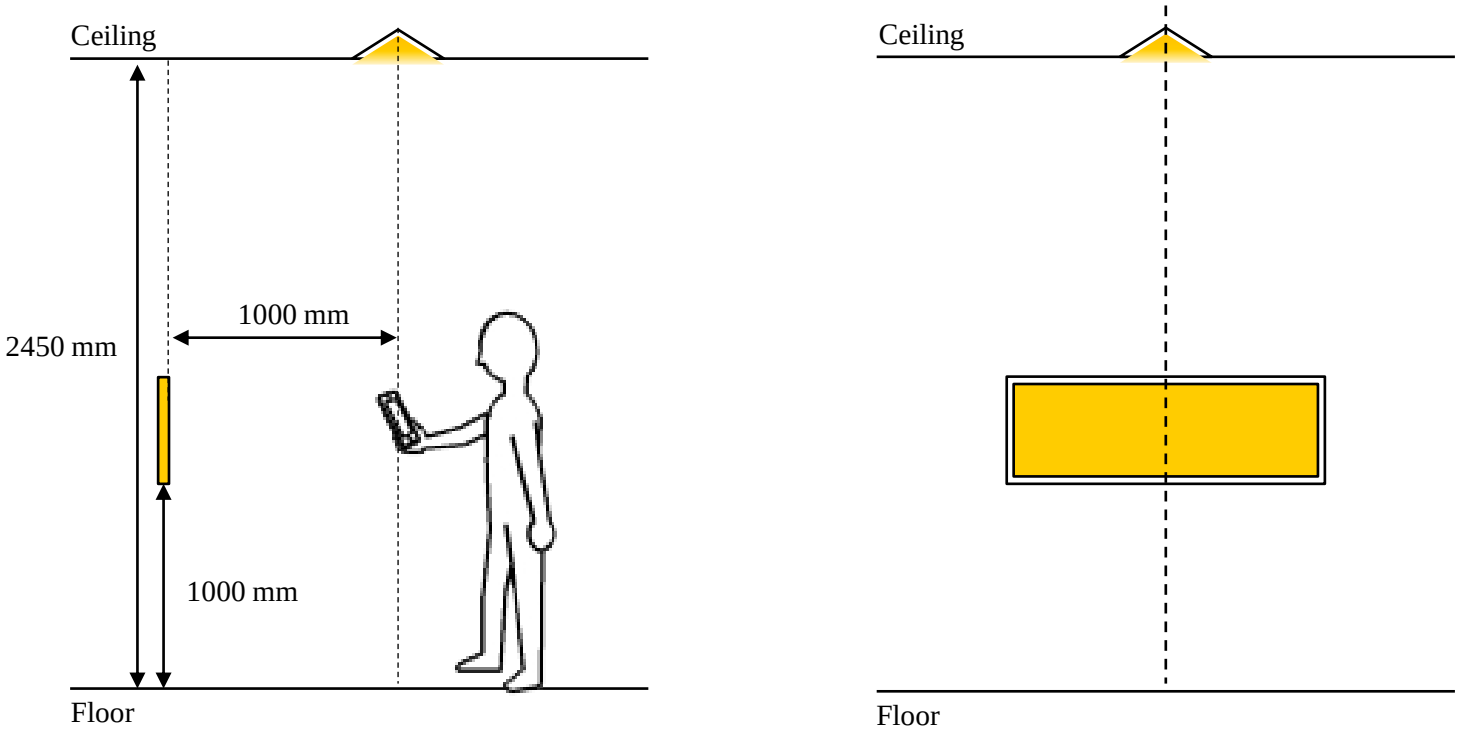


Down light (Ambient light)

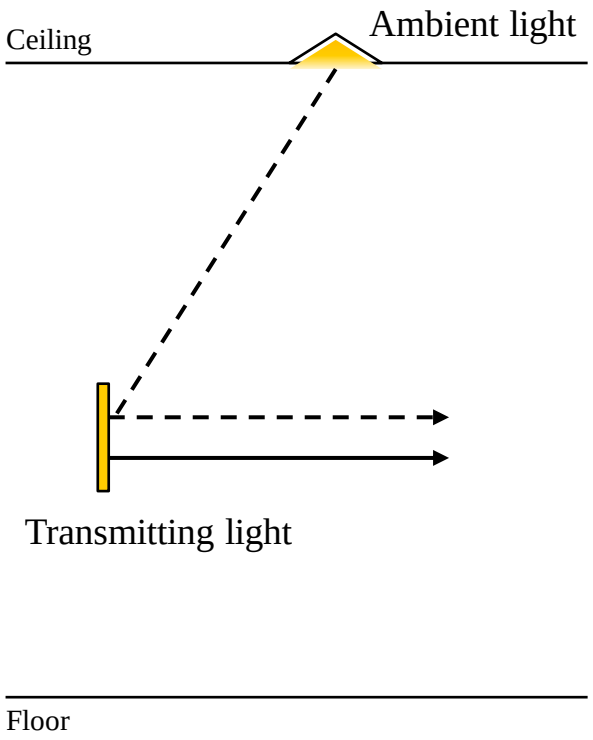


Light-emitting part

Light Panel - Layout



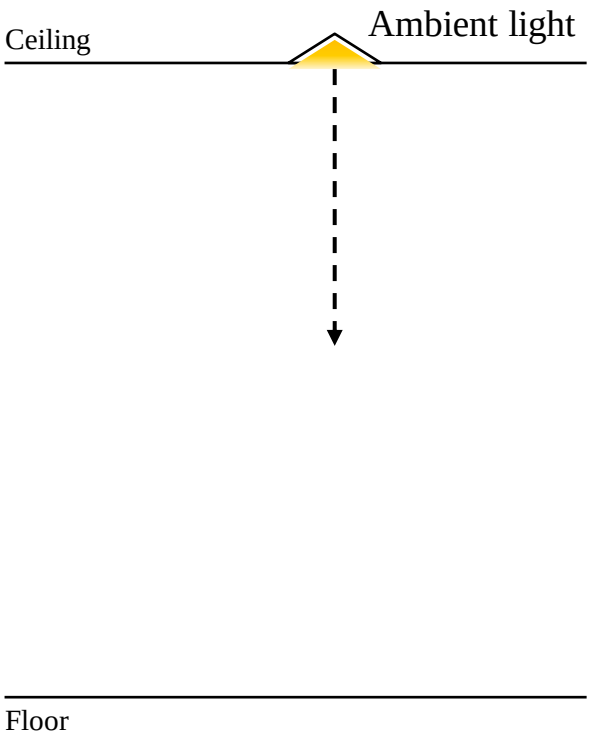
Light Panel - Luminance



Transmitting light	ON	ON
Ambient light	ON	OFF
Horizontal angle (Vertical angle = 0)	Luminance [cd/m^2]	
0	552	533
10	554	532
20	557	538
30	575	554
40	583	564
50	610	597
60	626	610
70	617	608
80	571	566
Vertical angle (Horizontal angle = 0)	Luminance [cd/m^2]	
+30	707	690
+20	682	662
+10	630	613
0	552	533
-10	607	587
-20	604	588
-30	612	594

Vertical angle > 0 is ceiling side angle, and that < 0 is floor side angle.

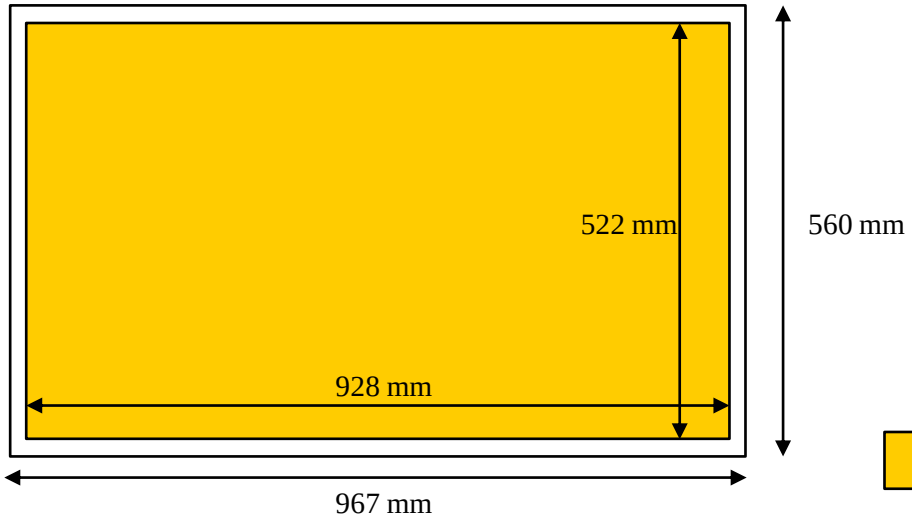
Ambient Light - Luminance



Angle	Luminance [cd/m^2]
0	57280
10	54720
20	53440
30	41440
40	32800
50	23520
60	17280
70	3328
80	194

Digital Signage - Size

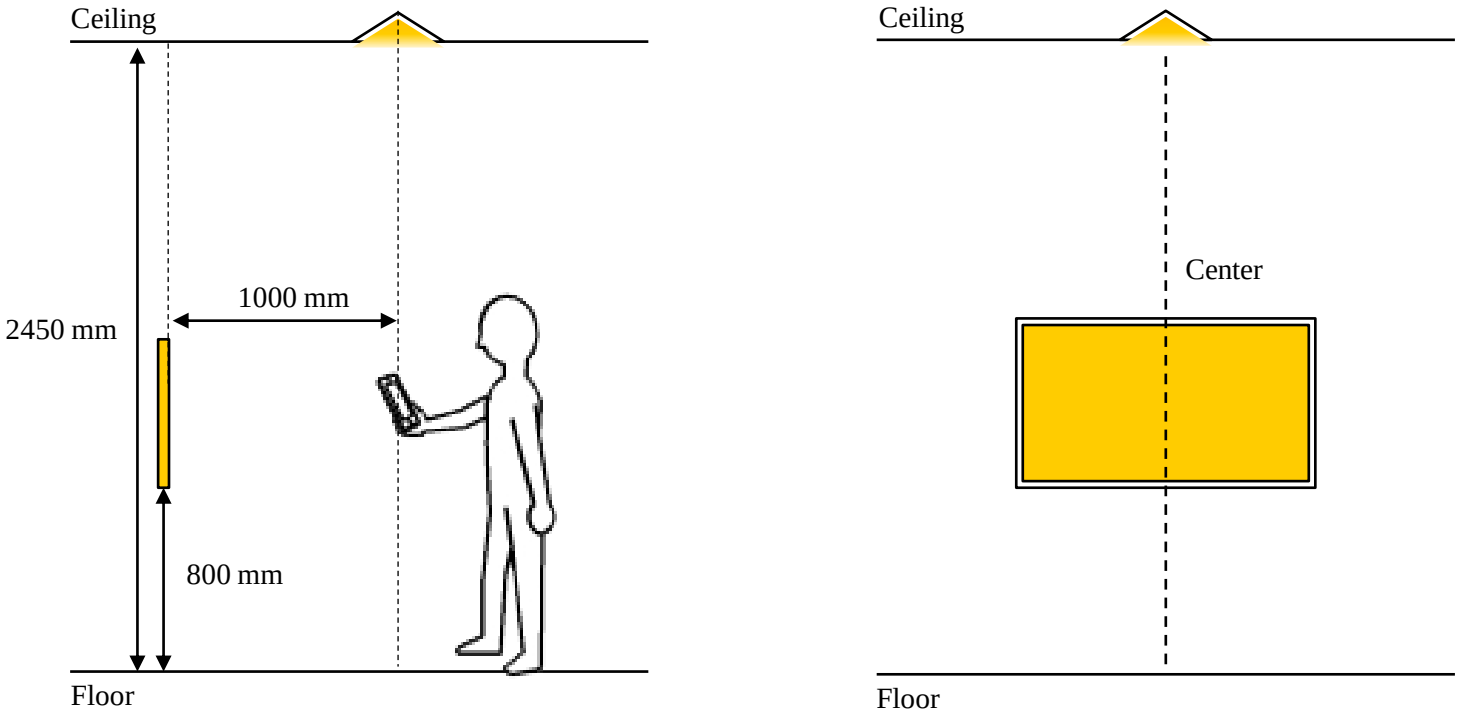
LCD signage (Transmitting light)



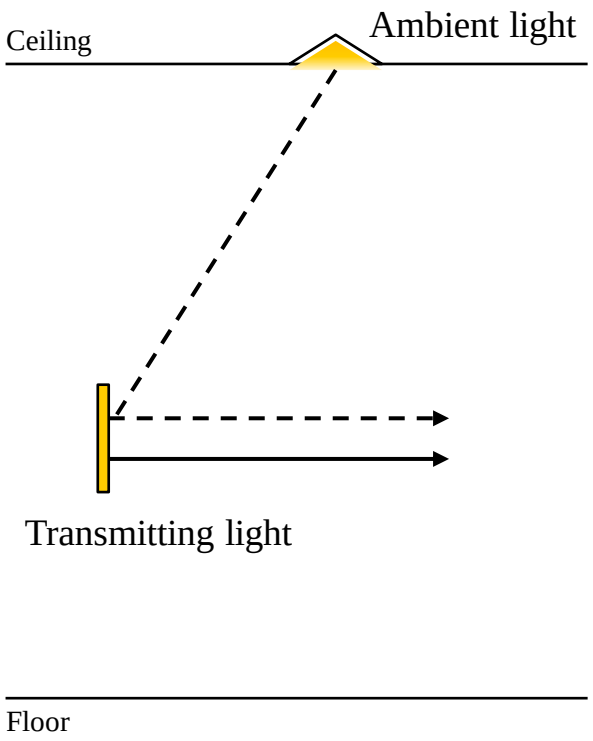
Down light (Ambient light)

(Same)

Light Panel - Layout



Digital Signage - Luminance



Transmitting light	ON	ON
Ambient light	ON	OFF
Horizontal angle (Vertical angle = 0)	Luminance [cd/m²]	
0	818	819
10	817	818
20	809	807
30	771	772
40	688	693
50	550	573
60	352	335
70	234	223
80	125	127
Vertical angle (Horizontal angle = 0)	Luminance [cd/m²]	
+30	611	607
+20	713	710
+10	806	796
0	818	819
-10	740	737
-20	593	581
-30	419	414

Vertical angle > 0 is ceiling side angle, and that < 0 is floor side angle.

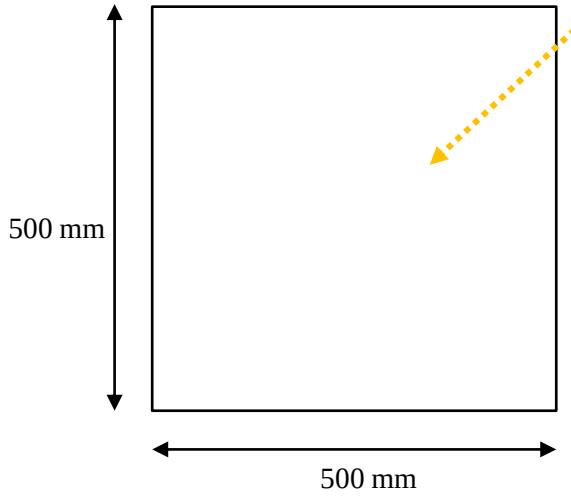
Reflected Light - Size

Down light (Ambient light)

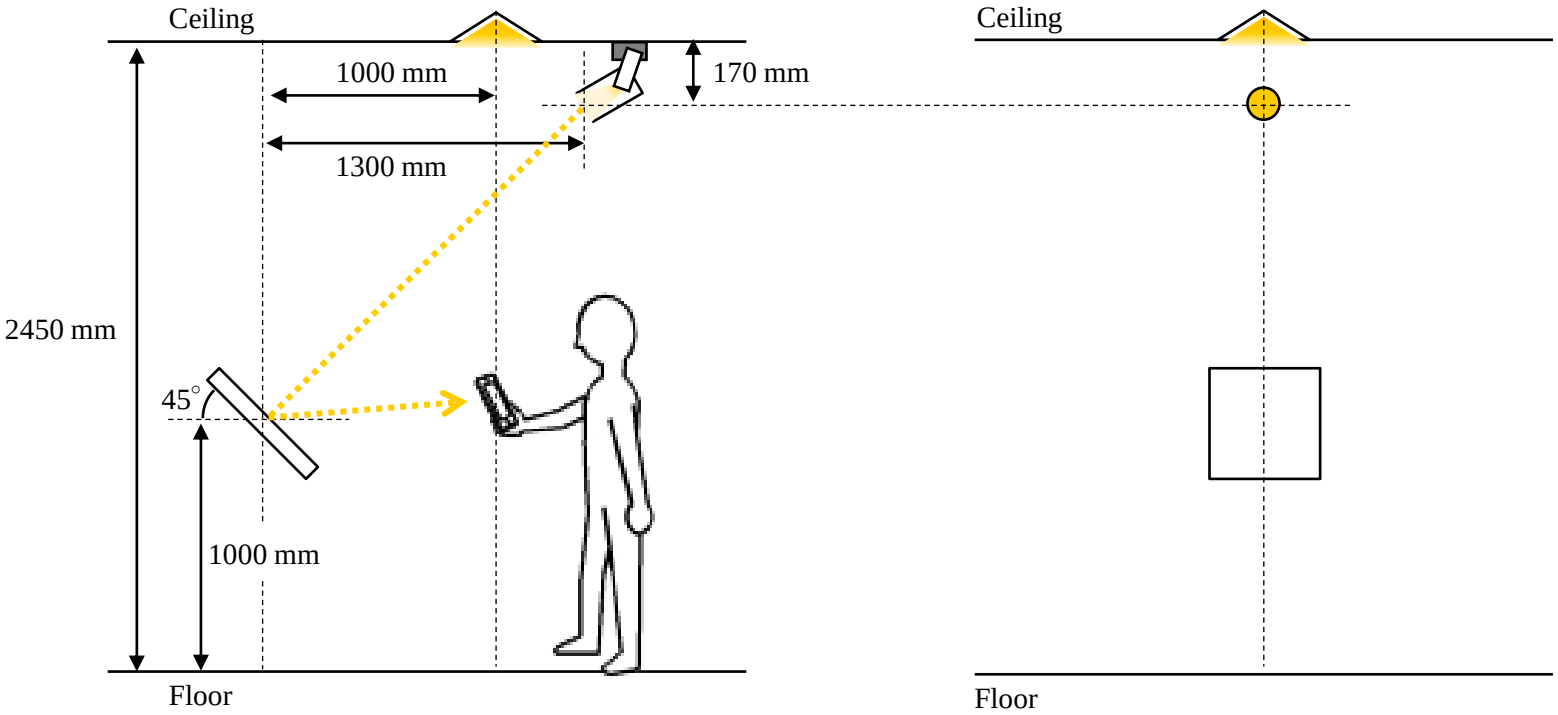
(Same)

Spot light (Transmitting light)

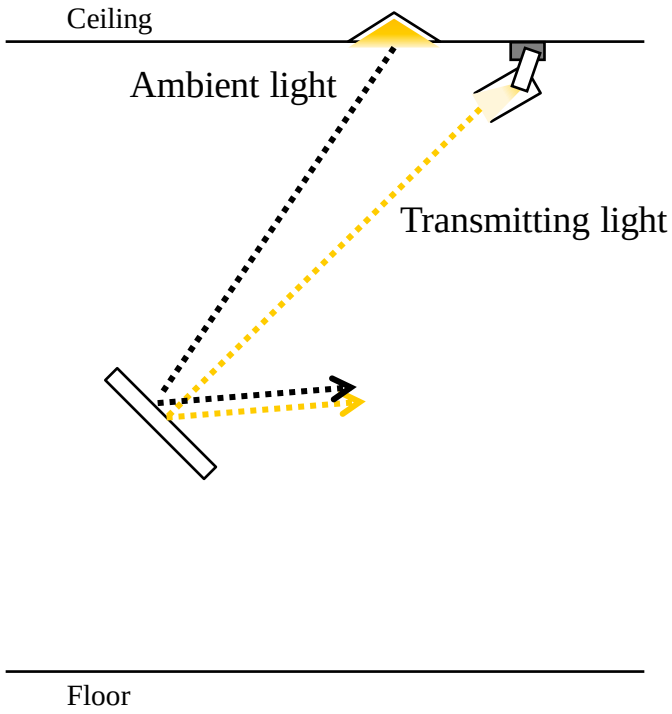
Reflection panel



Reflected Light - Layout



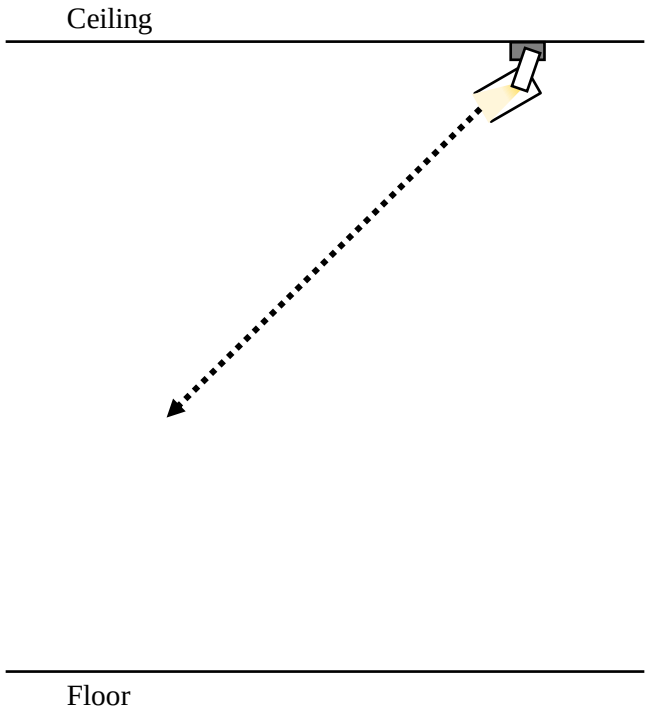
Reflected Light - Luminance



Transmitting light	ON	ON
Ambient light	ON	OFF
Horizontal angle (Vertical angle = 0)	Luminance [cd/m²]	
0	912	882
10	909	872
20	898	858
30	880	850
40	835	802
50	816	796
60	768	740
70	702	670
80	493	491
Vertical angle (Horizontal angle = 0)	Luminance [cd/m²]	
+30	970	933
+20	950	910
+10	920	891
0	912	882
-10	857	821
-20	836	793
-30	595	576

Vertical angle > 0 is ceiling side angle, and that < 0 is floor side angle.

Spot Light - Luminance



Angle	Luminance [cd/m^2]
0	705600
10	425600
20	61600
30	24800
40	9280
50	6064
60	4688
70	2944
80	693