

# Projector light quick-math

version 1.3

## Definitions and assumptions

Here is some rule-of-thumb formulas that can be run off a plain calculator to help figure out projector, light, and contrast information. There is a spreadsheet that is more flexible and accurate, but it's therefore more complex.

“Ambient Light” means the light that strikes the screen when the projector is off.  
“Width” is a measurement of the image width on the screen.

To keep things simple, this document assumes that:

1. Measurements are in:
  - feet
  - lumens
  - footcandles
2. Screen gain is 1
3. The system is front projection
4. There are no lens losses
5. Projector contrast ratio is insignificant

**Note:** If your calculator doesn't have an  $\chi^2$  button, you can just use  $Width \times Width$  anytime the formula has  $Width^2$ .

## Super-simplified Formula

In addition to the assumptions listed above, these super-simple formulas assume a 3:4 aspect ratio.

Contrast goal of 5:1. The image will look pretty good.

$$Proj.Lumens = Width^2 \times Ambient\ Light \times 3.75$$

Contrast goal of 10:1. The image will “jump”. It will be very good looking, though still not like a movie theater.

$$Proj.Lumens = Width^2 \times Ambient\ Light \times 7.5$$

## Simplified Formula

These are a bit more complex, but are also more flexible.

## Projector Luminance Unknown

This formula is to determine how “big” of a projector you will need.

$$Proj.Lumens = Width^2 \times Ambient\ Light \times K$$

K= "3.75" -- 5:1 contrast on a 3:4 screen

"7.5" -- 10:1 contrast on a 3:4 screen

"2.8125" -- 5:1 contrast on a 16:9 screen

"5.625" -- 10:1 contrast on a 16:9 screen

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## Measure Contrast

If you have a projector, a pure white image, and want to know the real-world (not theoretical) contrast ratio.

$$\text{Contrast Ratio} = \text{White} \div \text{Black}$$

"white" - brightness of a pure white image

"black" - brightness of image black, or ambient light

## Theoretical Contrast

This is the one to use if you would like to predict the theoretical contrast ratio.

$$\text{Contrast Ratio} = \text{Proj. Lumens} \div \text{Width}^2 \times \text{Aspect Ratio} \times \text{Ambient light}$$

aspect ratio --

".75" for 3:4

".5625" for 16:9

## Measure Projector

What if you want to know the real-world brightness of a projector? To get ANSI lumens requires following ANSI procedures for the measuring process - probably not really needed for our purposes. It certainly wouldn't qualify as "simplified."

$$\text{Proj. Lumens} = \text{Width}^2 \times \text{Aspect Ratio} \times (\text{White} - \text{Ambient Light})$$

aspect ratio --

".75" for 3:4

".5625" for 16:9

"white" - brightness of a pure white image

## Summary

We can't trust the ANSI Lumens number in the projector brochure. Often it's close, sometimes it's not. Also projectors and lamps can dim over time so it's good to design for more lumens than we really need.

These formulas are to make our guesses more accurate - but there are still lots of variables that make it impossible to truly predict what a projected image will look like.

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