

Polarizer Surface Treatment: Nanostructures with Mega Impact

As passionate display engineers, we appreciate the beauty of a bright and clear LCD display. But often the experience is marred by ambient light. Whether from the sun or from interior lighting, this often causes distracting reflections that detract from an enjoyable experience.

No Polarizer Treatment



Polarizer Treatment

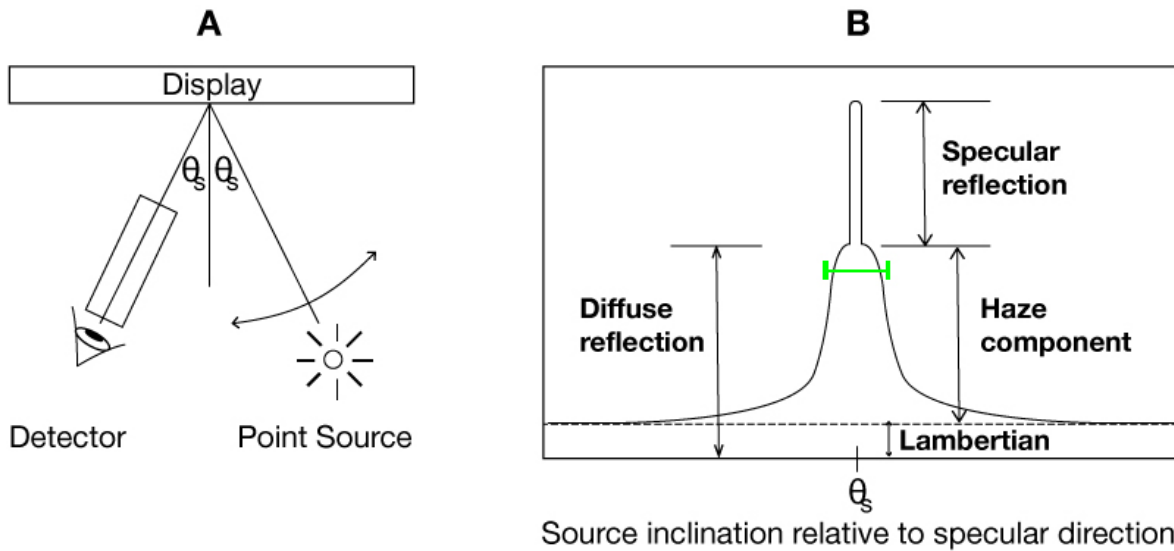


What does this mean for your viewers?

You can have the narrowest bezel, widest viewing angle and the most engaging content, but the customer may only be able to see the harsh store lighting reflected in the screen. Not only does this ruin picture quality—screen reflection is also one of the key reasons for eye fatigue, leading to distractions and an inability to watch the screen for long periods. Essentially, this leads to less engagement, missed opportunities, and ultimately, lost revenue.

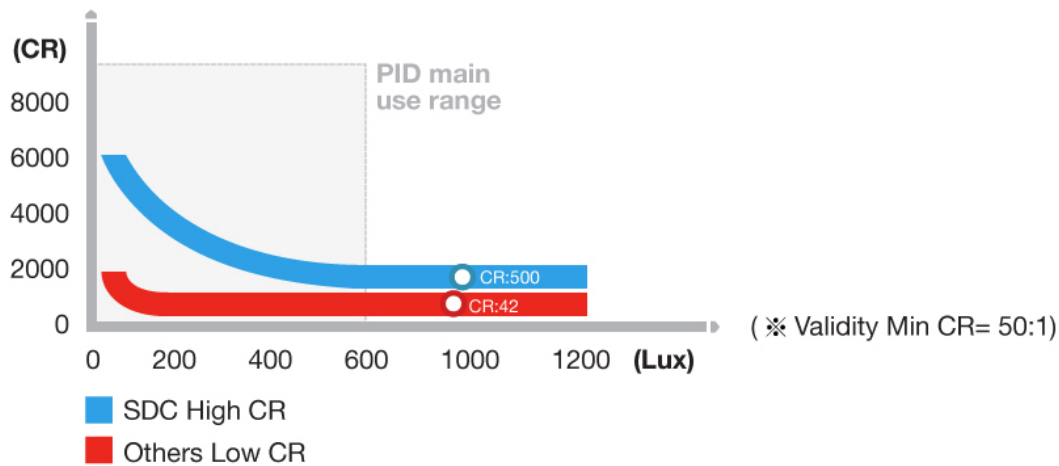
What causes this problem?

Almost all PID installations are in well-lit spaces such as store lobbies and outdoors. Ambient or external light is reflected off the smooth surface of the LCD display, as shown in the illustration below.



The issue is that as ambient light illumination increases, the contrast ratio perceived by the user deteriorates:

Contrast Ratio (CR) and Illumination



The two types of light reflection and their impact on readability

- Specular reflection is the mirror-like reflection of light from a surface, in which light from a single incoming direction (a ray) is reflected into a single outgoing direction
- Lambertian reflectance is when an object has a matte appearance, meaning light is diffusely reflected, resulting in the same level of brightness from every angle

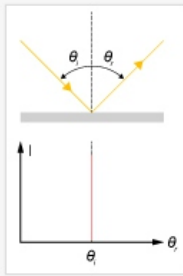


Figure 1A: Specular, mirror like reflection. The inclination of the reflected beam is identical to the inclination of the incident beam.

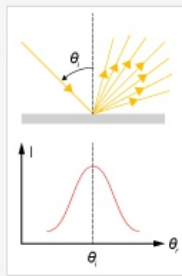


Figure 1B: Reflection haze, the incident light beam is scattered about the specular direction. The intensity of reflection in the specular direction is reduced.

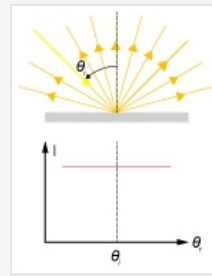


Figure 1C: Ideal (i.e. Lambertian) scattering of the incident beam. The reflected radiant power is constant for all angles of inclination.

Figure 1: Illustration of the basic types of reflection – specular (mirror like, left), haze (center) and Lambertian diffuse (right). The geometry is shown in the upper part, the intensity versus angle of inclination of a detector is shown in the lower part of the diagrams.

Source

So in order to improve screen’s readability in ambient light, specular reflection needs to be reduced and Lambertian reflectance must be increased.

How can we achieve this solution?

You can use a polarizing anti-glare haze film to increase the readability of your screens. These treatments contain microstructures that help diffuse rather than reflect the light. When applied, they form a hard coating on the surface of the screen with microscopic undulations that disperse light in multiple directions, preventing light from directly entering the eyes and effectively eliminating glare. Often buyers were quoted the total haze, but our research concluded that of the two layers it was the outer layer that was most critical in improving the display experience.

Importance of outer v. inner haze layers

Diffuse reflection highly depends on outer haze rate

Items		Haze 25% A type	Haze 25% B type
SEM image (surface)			
Haze Spec.	Outer	11%	23%
	Inner	14%	2%
Reflection	Specular	60%	38%
	Haze + Lambertian (diffuse)	40%	62%

As we can see, it's the outer haze layer that has the most impact on the optical characteristics of the display.

Samsung Display's unique solution:

Our products come inbuilt with 7th generation haze polarizers, specially developed for PID products. The haze properties are enhanced by increasing the outer polarizer haze from 12% to 23%, increasing the diffusion portion of the light from 51% to 62%. This not only increases the haze property, but also sharply reduces the "cloudy mura" seen in dark rooms, where areas of the screen can grey out, reducing visibility. Samsung Display panels look great in low and bright light environments. Additionally, this improvement is achieved with an overall reduction in total haze from 44% to 25%.

See below for a list of other fantastic benefits.

The benefits of 7th Generation Haze Polarizers

Items		As-is	To-be
Generation		4th	7th
Total haze		44%	25%
Outer haze		12%	23%
Reflection	Diffuse portion (SCE/SCI)	51%	62%
	SCI (specular)	6.1%	5.2%
	SCE (diffuse)	3.1%	3.3%
Cloudy mura @dark room			

What SDC PID panels provide versus the competition

Characteristics	Samsung Display High Haze Panel	Others Low Haze Panel
Prevents eye fatigue	✓	✗
Allows long screen viewing	✓	✗
Prevents color change	✓	✗
Prevents background reflection	✓	✗
Side change rate	Same	Same

Conclusion

The addition of an external high haze polarizing film reduces screen reflection, increases [contrast ratio](#), and enhances color and brightness, helping create the crispest and most natural display.
