Light Transmission and Touch Panels

By Gary L. Barrett, Chief Technical Officer

Touch International 2222 W. Rundberg Lane, Suite 100 Austin, TX 78745 **T** 512.832.8292 **F** 512.832.8291

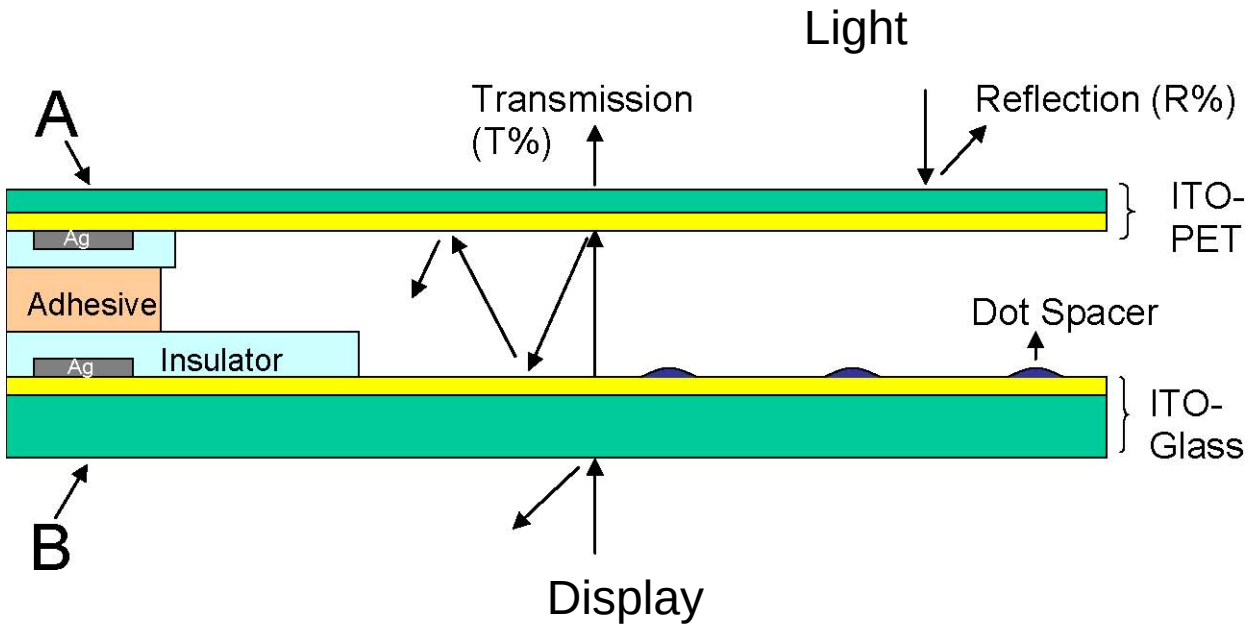
The physics of light passing through a transparent medium

The appearance of the display seen through a touch panel is generally of utmost importance to touch and pen-input users. Most touch screen companies will quote the amount of light passing through the touch panel, ordinarily 83%-89%, as a measure of how "good' the touch panel is. However, the way the touch panel is used and the characteristics of the display often dictate what is best; for example, Touch International manufactures a part with only 40% light transmission (for an airplane instrument) that is ideal for that application.

As a basis of comparison, 95% of light will pass through window glass. All light does not pass through for three important reasons:

1). some of the light is reflected off of the first surface of the glass. For example, seeing your image in a window is a demonstration of the reflection.
2). the glass itself absorbs or traps some of the light. Looking through the edge of American float glass you will see its color as green or blue.
3). the light passing through the glass moves at different speeds and is refracted when it exits. A prism, for example, shows a rainbow as a result of this light speed difference.

Figure 1



Light Behavior Through a Standard Resistive Touch Panel

Note that because various colored light passes through mediums differently, light around 540 nm is typically used as a standard to measure light transmission.

As another useful measure of light behavior is that the total light passing through the touch panel is approximately equivalent to the multiplicand of the amount of light passing through each of the mediums. For example, the amount of light passing through two pieces of window glass will be 95% x 95% = 90%.

Light and Touch Technology.

There are a number of competing touch technologies -- more coming from Touch International soon, but only four are viable in today's market. Below is the typical amount of light that passes through each respectively:

Resistive	**83%**
Capacitive	**87%**
Surface Acoustic Wave	**89%**
Infra-red	**100%**

Resistive uses a glass and plastic "stack up" (shown in figure 1) that consumes the most light. Capacitive uses glass that has the same anti-glare overcoat as surface acoustic wave, and one or two layers of a transparent thin film. Surface Acoustic Wave uses a glass sensor with an anti-glare overcoat. For Infra-red, the actual touch screen itself transmits 100% of the light that passes through it, however, this can be reduced by five to ten percent depending on if a protective coating is used on the front of the display or if glass or other materials are placed in front of the screen.

Anti-reflection Coatings

Light can be manipulated using extremely thin (measured in angstroms) films. These anti-reflective thin-films work by either: 1). Trapping the light that would be reflected; or 2). Adjusting the speed of the light passing through the medium to eliminate refraction. The result is that you will not be able to see your reflection in an anti-reflective surface. Controlling the speed of light passing through the medium makes all colors arrive at the surface at the same time, enhancing the "brightness"; the average camera lens, for example, has anti-reflective films (generally referred to as anti-chromatic) to make sure all of the colors hit the film at the proper place instead of where the lens might refract them.

Using anti-reflective coatings can raise the light transmission on a (typical) 83% resistive touch panel to 95% (the same as window glass), but at a substantial cost. Eliminating reflections from the touch screen for an outdoor application, however, may be worth the additional cost.

Until recently, anti-reflective thin-films could not be used on the first surface (the front) of a touch panel. This was because the oil left from one's finger was enough to alter the properties of the anti-reflective thin-film stack. In addition, the thin-films were quite vulnerable to wearing off. Today, however, a hard coat, which does not cling to finger oils has been incorporated into the anti-reflective stack.

Polarizers and Privacy Filters

Polarizers may also be incorporated into touch panels. Although the off-viewing angle of the display is altered, the light transmission is minutely affected. Polarizers can be used to make privacy filters for such things as ATM's, or on the back of the touch panel to "lift" the image from an LCD display; the latter is not often done because it requires the LCD manufacturer to remove the polarizer from the LCD.

Optical Gel's

Another way to improve the light transmission through the touch panel is to eliminate the refraction loss between the back of the touch panel and the front of the display. This is typically done with an optical gel which eliminates the air-to-glass interface by sealing the display to the touch panel. While it was common practice to do this with capacitive touch panels over CRT's, the procedure has largely fallen out of practice because the small improvement in light transmission was not worth the cost. The use of a gel between touch panels and LCD's is becoming more common, but the improvement in light transmission must be weighed against the image distortion (often seen as rainbow patterns) resulting from the impact on the LCD.

Reducing Light Transmission

For some displays, most notably LED and Vacuum Florescent (VFD), reducing the light transmission enhances the clarity of the display. This is typically done by incorporating a dark, neutral gray filter into the touch panel. The effect is to reduce the light passing through the touch panel, thereby reflecting the light from the display surface, because these displays are emissive, greatly increases the contrast.

Similarly, color filters, which also reduce light transmission, can be incorporated into the touch screen for a variety of reasons. These include:

- Changing the colors on the display to match other instruments in the cluster
- Altering the apparent persistence of phosphor decay on something such as a radar scope
- Adapting instruments for use with night-vision goggles

Summary

For most applications, the light transmission through standard touch panels has proved to be adequate. At a higher cost, however, the use of anti-reflective or optical gels can improve the quality of the image seen on the display. As is so often the case, only a cost/benefit analysis can determine if the additional cost is worth the improvements for a specific application or project.

For More Information:

If you would like additional information about touch screens or Touch International, please visit our web site at www.touchinternational.com or call us at 512.832.8292

About Touch International:

Touch International is a leading provider of high-quality touch screen components manufactured for OEM's, Systems Integrators, and Value Added Resellers. Building on a legacy of integrity, reliability, quality, and technology expertise, Touch International makes it easy and affordable to integrate touch components into computer panels and displays.