Filters and Other Touch Screen Enhancements

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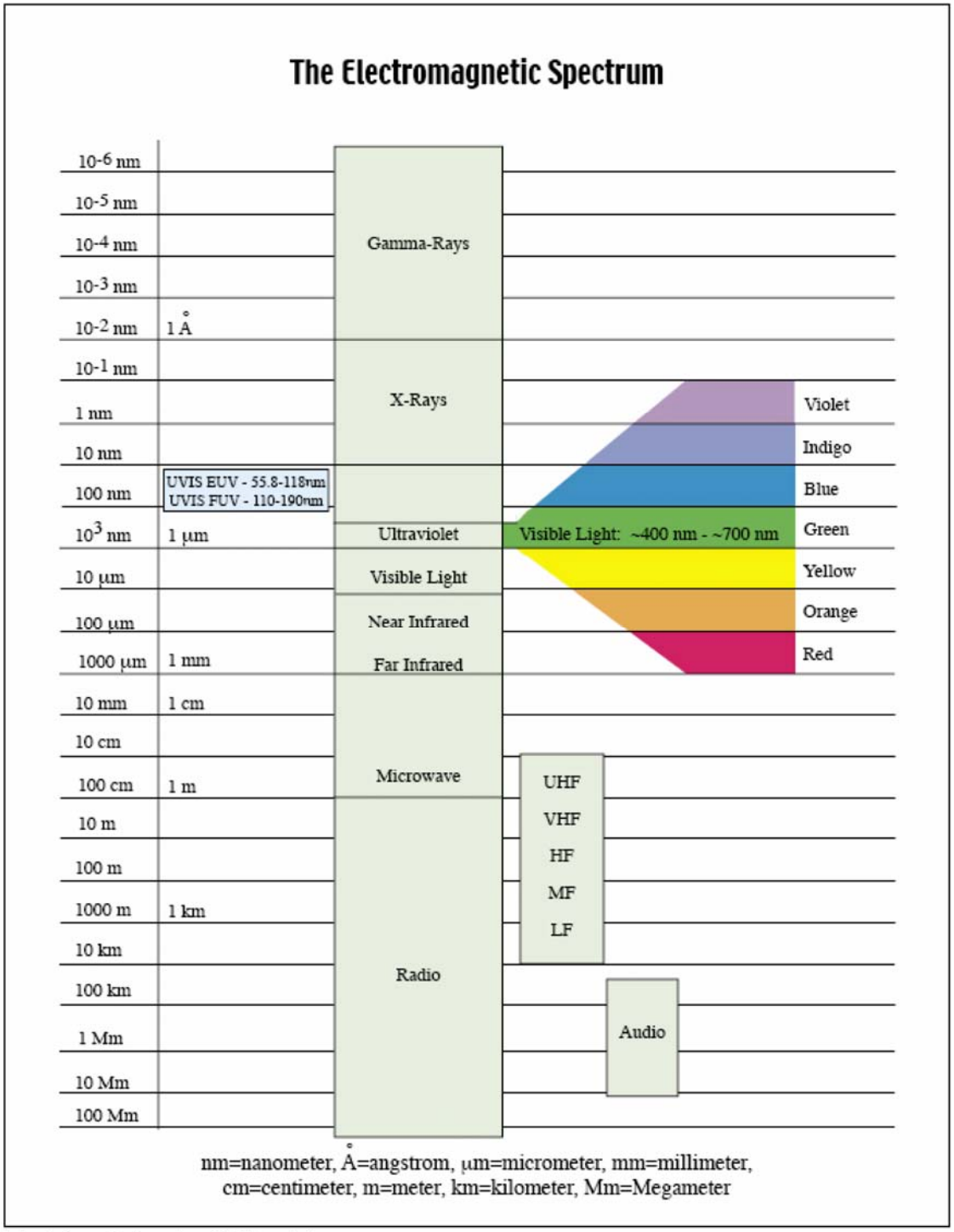
This is a paper describing the EMI and Optics filters that are currently manufactured by Touch International.

Touch International can incorporate a number of filters and light guides into the touch panels to achieve a variety of customer needs. In addition, all of these transparent devices are available as non-touch filters. The filters fall into two categories of 1) reducing electromagnetic emissions or interference (EMI) and 2) optics to manipulate the physics of light.

EMI filters

Electromagnetic Interference filters are designed to reduce emissions in the radio frequency (RF) range of the electromagnetic spectrum (see below). At the lowest levels of emissions, the US Federal communications division, and CE in Europe, requires manufacturers of electrical equipment to limit the levels of RF emission. The FCC has two categories, Class A for electrical equipment used in offices, and Class B, for home use, which is more restrictive, and does not allow any interference with radio or television operations. At the other end of concern are so-called “Tempest” limits, which seek to stop enemies from scanning remote devices and conducing espionage, and are so restrictive, one cannot even know what is needed to meet the filter requirements. In between are filters, primarily for military or aerospace environments that seek to stop interference with navigation instruments or limit the ability of “enemy sniffers” to find and target a location.

Within the RF range, the filters can be tuned for specific frequencies, and the filter that is good at blocking one frequency, may be less effective for another. TI offers two EMI filter types, low ohm ITO and blackened mesh.



(chart from University of Nebraska)

Resistive and Capacitive Touch Screen Filters
The thin film ITO used in most touch screens will aid any device in meeting FCC Class A and Class B requirements. This is because the electronics attached to the touch screen act to "absorb" the EMI and ultimately "bleed" the noise to ground. Thus a secondary benefit of resistive or capacitive touch screens is to act as a simple EMI filter.

Low Ohm Thin Film
One way to trap many emissions in the RF range is to use a very low ohm transparent thin film on the back of the touch screen. Many RF emissions can be trapped by put-ting the EMI emitter (device) in a copper box and connecting the box to ground. Using a low ohm ITO and connecting this to the EMI shield in the device's cabinet is similar to enclosing the device in a copper box. The transparent low ohm transparent ITO is the part of the "box" which sits over the display.

In the past, because of its low resistance, gold was used as the transparent thin film, but it had a number of problems, including a deep coloration of the display. Most recently Touch International has developed a very low ohm material, which is in the range of 4 ohms per square, has a neutral color, and a light transmission rate of around 90%. TI uses silver bus bars for conductivity, copper conductive tape, and wire mesh for larger form factors (50, 80,100, OPI). This level of EMI "clamping" is generally good enough for most aerospace applications. Touch International offers .5, 2, 4, 8, 10, and 100 Ohm films, which can be exposed or sandwiched. The Ohm thin film is ideal for medical, military, and aerospace.

Mesh Filters
A second, more effective method is to use a tarnished silver mesh of either 50 holes-per-inch or 100 holes-per-inch, which has been bonded between, usually, two pieces of glass. The bonding process serves to hold the mesh flat so that it does not further disturb the optics. The bonding also maintains the mesh holes at a uniform size, an-other requirement for clamping this frequency of emission.

Although the science is beyond this white paper, the size and frequency of the holes and the high-conductivity of the silver mesh are excellent at stopping a certain range of emissions. The light transmission is good because nothing blocks the light passing through the holes. However, the mesh does block some small portion of the screen, and resulting "morea effect" can be a mild annoyance, though less than being discovered and attacked by the enemy forces.

Filters for Light Optics
These filters are for manipulating emissions in the 400nm to 700nm range, we call visible light, and in the 880nm to 1200nm, we call infra-red. Instead of blocking these emissions, these filters mostly seek to manipulate the properties of light. Touch International offers a variety of finishes, polarizes, retarders, EMI Windows, Broad Band PET, anti-reflective, and light control film for privacy. TI filters have been used in POS, tab-lets, kiosks, aerospace, and hospital applications.

Privacy Filters
Most do not always want to share everything on their computer screens. Having a child read the text on your laptop to all of the nearby passengers on an airplane might or might not be amusing. Having strangers read you PIN code on an ATM from the side might be costly. Countries where there is a lot of text messaging on public transit vehicles think privacy filters important. Privacy filters stop off-axis viewing of the display. The film is manufactured by creating chemical louvers that let the light come straight through, but block the light on either side so the image cannot be read.

DBEF Filters
Display Brightness Enhancement Film are micro prisms, formed onto a sheet, which collect and focus the backlight into bright spots. This filter makes a display which is perceived to be brighter than the rating of the backlight.

Contrast Enhancement
Touch International can incorporate color filters into the touch screen. The purposes vary widely. For example, radar scopes fitted with touch panels have used a specific colors filter to adjust the persistence of the phosphor. Some airline cockpits use LED displays, and a neutral gray can enhance the ability to read the display. Night vision systems can make use of filters incorporated into the touch to "tone down" the bright-ness of some displays. Most of Touch International's customers for the color and contrast enhancement filters are for the aerospace sector.

Anti-Reflective
With the growing number of outdoor touch applications and with the advent of HR (highly reflective) LCDs, the production of touch screens using anti-reflective coatings are increasing. The amount of light which passes through a solid is impacted both by its color absorption and the bending of light at the air/surface interface. For example, a glass window passes about 95% of the light; while the color absorption is minimal, the bending of the light going in and coming out of the glass "uses" up about 5% of the light. One can see the impact of this phenomenon as a reflection from the first surface. Oddly, by adding purple tinged anti-reflective materials to glass, the light transmission rate can exceed the ordinary 95%.

Almost all touch screens put a silica coating on the first surface to diffuse the reflective light and reduce the mirror effect. This is called an anti-glare coating, not to be con fused with an anti-reflective coating. Anti-glare coatings are relatively inexpensive and enhance the scratch resistance of the touch panel. However, anti-glare coatings diffuse the image and consequently reduce the sharpness of the display image, reducing visual clarity. The amount of diffusion is measured as the haze factor.

Anti-reflective (AR) coatings are very thin. Measured in ratio of the size of a light wave, these coatings literally trap light within the AR coating. When the touch screen does not reflect light, the image behind the touch panel will be brighter and certainly more easily read. However, creating anti-reflective coatings, which is an extremely precise process, is very expensive and can easily make a touch panel 200 to 400 percent more expensive

than a standard touch panel. Today, all four surfaces-- the backside, two interior, and front-- can be AR treated, though any combination can also be selected. Obviously, the fewer the surfaces treated, the lower the cost.

Until recently the first surface (front) could not be treated with an anti-reflective coating. This was because the AR coatings are delicate (would not take the wear of millions of touches), and the thickness of the oil from a fingerprint altered the thickness of the coating and nullified the effect. However, the first generation of hard, fingerprint resistant AR coatings has just become available. Because of the cost, AR coatings are used for relatively few applications, such as those that would expose expensive instrumentation to outdoor environments.

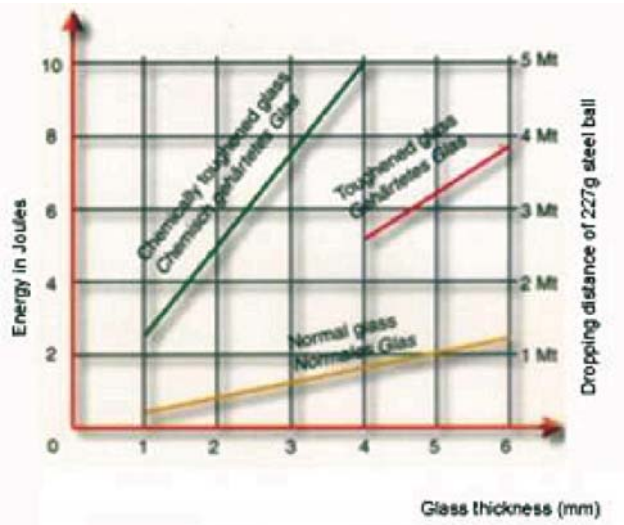
Persistence Filters
Decay rates of phosphors, particularly those on radar-scopes, can distract controllers. By index matching the phosphor colors, the decay rate can be accelerated so as to not be noticeable.

Color Matching
As more devices incorporate alphanumeric displays, designers can find that the color of each display is quite different. Color filters can be added to the touch screen which will adjust the color of the various displays to appear to have the same color.

Flame Retardant
Touch International has had much success within the Aerospace markets. One of the main requirements for this market is the FAR 25.853 vertical burn. A cross section of a touch screen is exposed to flame and must self extinguish within 12 seconds or 60 seconds depending on the diagonal length. One of the main issues is that the typical materials used in standard touch screens once ignited tend to "wick", or continue to burn once lit. The base material structures that Touch International can implement within a custom design have been formulated to pass the 12 and 60 second vertical burn test dictated by the FAA without deleterious effects to the light transmission rate.

Vandal Guard
Many touch screens are used in unsupervised public access devices. There are rare occurrences in which bricks have been thrown at bus information terminals and gunshots to gaming terminals. Chemically bathed and strengthened glass, 8 and 16 hours. Standard is 3 or 4 mm, but can go to 6mm. Touch International produces a number of touch panels and replacement glass to address these problems (standard or tempered glass). In order of “toughness”, here are options.

Chemically Strengthened Glass
Chemical strengthening is a process by which glass has small surface ions (sodium) re-placed with big ones (potassium) under extreme heat for sixteen hours, and results in glass being put into tension. Because of this extra surface tension, the glass strength is five times more resistant to breakage than that of standard float glass (chart from www.xinology.com).



Graph comparing impact resistance

Tempered Glass

Tempered glass is about 2.5 times as strong as standard float glass. Tempered glass is made by heating the glass to near plastic state and then rapidly cooling it. Because this process requires the glass be moved on rollers to heat and cool both sides, typically minor ripples are left in the glass which can be objectionable. However, much thicker glass can be heat tempered, so a part with extremely high vandal resistance (even bullet proof) can be manufactured.

Safety Glass

Safety glass is made by autoclaving two surfaces together under extreme heat and pressure. Between the two (usually) glass layers is a material which holds the pieces together so that if broken, sharp shards do not fly off and present a danger (thus "safety"). Both tempered and chem. strengthened glass can be used to give this product exceptional strength.

Scratch Resistant Glass

Some applications may require a surface which cannot be scratched or sand blasted. Touch-International has three solutions.

Tin-Oxide Coatings

Tin Oxide is harder than glass and has up to 7H hardness. Crystals of Tin Oxide are use in sanding abrasives. This is the same coating that is use in the large format capacitive glass, so this product has a natural resistance to scratching.

Diamond Evaporative Coatings
A diamond-like substance can be deposited by chemical vapor deposition (CVD). When combined with an ion scrub, the resulting surface is almost as hard diamond, the most scratch resistant material known. The material has a slight coloration, and is thin, but offers excellent scratch resistance.

Sapphire Glass
Sapphire glass is not glass, but is a grown Aluminum Oxide crystal. Second to diamond in scratch resistance, this material is clearer and thicker than the carbon based diamond material. Sapphire glass is most commonly used on store scanners in which it is said that the stainless steel bezel will scratch before the sapphire glass will.