



**iTouch “Touch-on-Tube” Surface Wave Technology
from Elo TouchSystems
Creates Exciting New Breakthrough
for Gaming Industry**

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Elo's iTouch "Touch-on-Tube" Surface Wave Technology Heralds Breakthrough for Gaming Machines

To be successful, video gaming machines must attract players, offer a terrific playability experience to keep them engaged, and be available to play at all times. A touch interface provides the simplest, most direct way for a person to interact with a video gaming machine — and the most versatile. Casinos can attract the “new computer generation” by providing the wide spectrum of play and graphics quality they demand. With a touch interface, players can stay with the same machine and effortlessly switch back and forth between games simply by touching an icon. So players play longer, trying their luck at multiple games without ever moving from one machine.

With Elo's introduction of the breakthrough iTouch “touch-on-tube” surface wave technology, game attraction, retention, and playability go to a higher level. iTouch removes all visual barriers between the player and the CRT tube itself. iTouch lets players place their fingers exactly where they belong — in direct contact with the CRT — so nothing stands in the way of perfect graphics and precise control. And, because iTouch technology uses the CRT faceplate, it is much safer and far more durable than even bonded touchscreen overlay solutions.

Furthermore, because clarity in performance and the ability to withstand rough use are paramount in the amusement and gaming industry, iTouch-based video gaming machines incorporate the added resilience of surface wave technology. This means that the game will continue to work even if the CRT is scratched, or coated with dust or cigarette ash, or after cleaned-up spillage. The inherently stable, “drift-free” operation eliminates the need for frequent recalibration, and the touch system is impervious to damage from cleaning fluids.

***Elo TouchSystems:
the Company Behind iTouch Technology***
iTouch “touch-on-tube” surface wave technology is the latest innovation from Elo TouchSystems, the global leader in touch technology. Elo develops, manufactures, and markets a complete

line of touch products that simplify the interface between people and computers. Although Elo's name may not be widely recognized among the general public, its touchscreens are used every day by people in casinos, stores, airports, malls, restaurants, factories, office buildings, and hotel and corporate lobbies. Elo has installed millions of touchscreens throughout the world and has been both the pioneer and leader in transforming touchscreens from a specialized tool into a mainstream input device.

Engineers at Elo have repeatedly redefined the leading edge of the touch industry. Today, the company holds or controls over 60 patents relating to various touchscreen products, including many on surface wave technology — the foundation for iTouch technology.

Surface Wave Technology: the iTouch Foundation

Elo offers customers a broad range of touchscreen technology choices: surface wave technology — the foundation for iTouch technology — five-wire resistive, four-wire resistive, and infrared technology.

Elo's brand name for its line of surface wave touchscreens that incorporate a glass overlay is IntelliTouch. Known for their clarity, resolution, and light transmission, Elo's IntelliTouch touchmonitors feature a stable, “drift-free” operation that ensures a touch response that is always accurate.

When first introduced in 1987, surface wave technology marked a major breakthrough in the industry. The touchscreens that use it were, and still are, the first and only ones constructed solely of glass, with no need for plastic layers, conductive coatings, or special CRT bezels. With nothing but glass between the user and an image on screen, surface wave touchscreens offer unmatched clarity and durability. When Elo harnessed this technology in its IntelliTouch product line, this family of touchscreens quickly

became a favorite among developers of highly graphical public display systems, such as those found in video-gaming terminals, kiosks, and computer-based training systems.

Elo built on its IntelliTouch surface wave technology to create a “touch-on-tube” solution it calls iTouch technology. With iTouch, Elo has taken surface wave technology — already proven to be reliable, stable, and capable of delivering high-resolution images — another step into the future by eliminating even the clear glass layer between the viewer and the display.

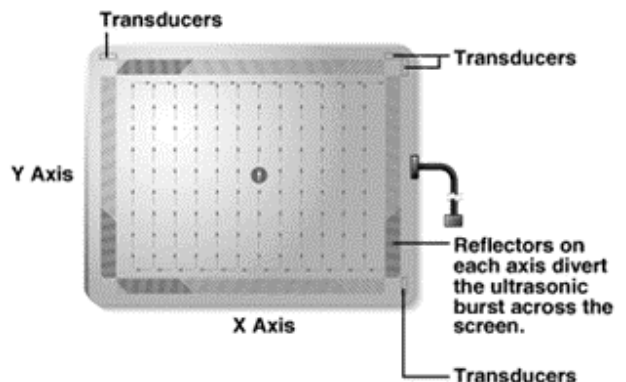
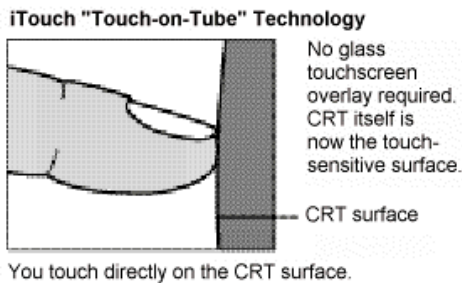
How iTouch “Touch-on-Tube” Surface Wave Technology Works

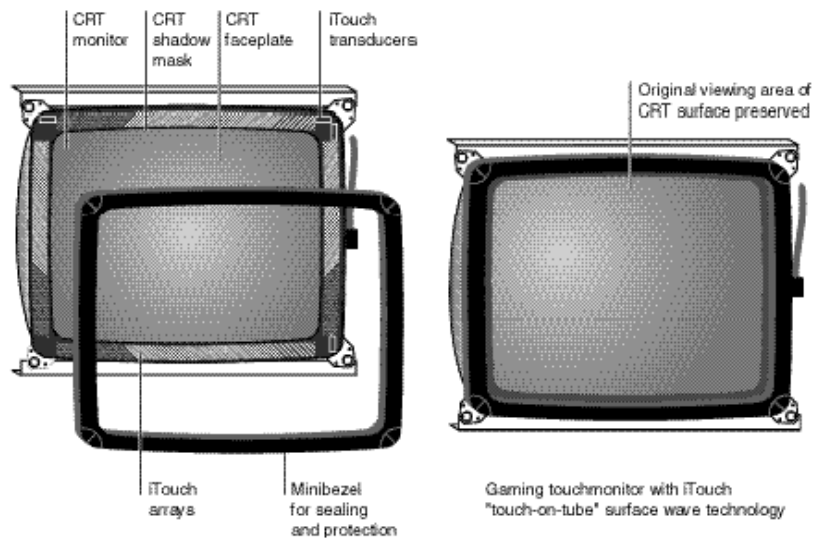
As with the first surface wave touchscreens, the touch technology used to create iTouch represents a major breakthrough. iTouch technology eliminates glass overlays by using surface waves directly on the CRT surface for touch sensing. With no intervening glass, the user sees the highest-quality image possible, with all the sharpness, contrast, and color depth the monitor designers intended. Because the CRT itself becomes a touch sensor — yielding 100 percent light transmission, color purity and clarity — the player’s attention is grabbed by graphics that are as eye-catching as the day they were created. And, there is no yellowish tint, sparkle, or glare to distract the player from the game.

How does iTouch “touch-on-tube” surface wave technology work? Each X- or Y-axis has a transmitting and receiving piezoelectric transducer and a set of reflector stripes on the outside edge of the CRT. The touchscreen controller sends a five-megahertz burst to the transmitting transducers, which convert the electrical signal into surface acoustic waves — mechanical waves that propagate in the surface of materials such as glass. A special pattern of reflector stripes diverts the burst to create a uniform density of acoustic wave energy across the surface of the CRT.

A light touch with a finger, gloved hand, or soft stylus absorbs a portion of the wave. The resulting change in the received signal is analyzed by the controller and digitized into X- and Y-coordinates. In addition to sensing the location of a touch, surface wave is the only touch technology that can also sense the pressure of a touch — the “Z” axis. A Z-axis level is also determined by measuring how much signal was absorbed. This pressure-sensing capability adds an exciting and unique dimension to gaming machines using iTouch displays because the increased control allows players to do things with games that couldn’t be done before, such as using 3-D buttons to manipulate images.

The result is an extremely fast, sensitive, accurate touch without any overlay affecting the image quality.





The Advantages of “Touch-on-Tube” Technology

Breakthroughs in materials, equipment, and processing come together in a proprietary process that enables Elo to make the CRT surface touch-sensitive. In fact, Elo is the only company offering a “touch-on-tube” product.

The new iTouch “touch-on-tube” solution offers important advantages over touchscreen overlays, especially those that use capacitive technology. It takes advantage of both the great natural strength and the clarity of the CRT faceplate. The surface of the CRT is ground and polished to optical specifications — unlike overlay touchscreens, which use “float window glass” made to architectural specifications.

Capacitive technology relies on a rigid glass substrate coated with a resistive material and a thin glass top layer. The drawback to these coatings and the glass overlay is that they reduce the amount of light transmitted from the display, thus reducing the contrast and depth of color in the image. Light transmission for the leading capacitive screen is 85 percent; iTouch displays, with no overlay, transmit 100 percent of the light from the CRT.

The capacitive screen problem of reduced contrast and washed-out colors due to optical reflection from the layers of glass and coated surfaces is

especially pronounced in bright light. In addition, the image on capacitive displays can be degraded by fuzziness, mirror effects and by “sparkling” — the presence of moiré patterns caused by interactions between the antiglare surface and the display.

Because Elo’s iTouch technology interposes no plastic or glass overlays between the viewer and the display, it has none of these drawbacks and delivers the brightest, sharpest, most colorful image possible. The brightness of the image is further enhanced by the anti-reflection coating on the CRT surfaces — a coating not present on overlays. And, because CRTs don’t have the antiglare etching or “frosting” used on capacitive overlays, the CRT image is as sharp as possible. Just the way the CRT manufacturers engineered it.

Capacitive technology senses a touch by drawing a small amount of current through the user’s body to electrical ground when the capacitive touchscreen is touched. The touch position is determined by the ratio of current drawn from the screen’s four corners. Changes of capacitance in the environment or user (such as humidity in the air, the presence of metal around the touchscreen, or finger dryness) can affect the accuracy of the touch position reported. A capacitive touchscreen that “drifts” must be recalibrated to restore accuracy.

Recalibration means more than the simple remote reboot used to reset a computer — it requires a knowledgeable person physically present at the touch display. Sometimes anti-static carpets must be placed in front of capacitive-based touch games.

In contrast, surface wave technology is inherently stable and accurate. Sensing the coordinates of a touch depends on knowing the speed of acoustic wave energy in glass (which is very stable over wide environmental conditions) and the ability of the controller chip to measure time, another very precise and stable technology. The “drift-free” operation of iTouch displays thus ensures reliable, consistent performance, without the need for expensive on-site recalibrations.

iTouch displays also offer a solution to problems encountered with capacitive touchscreens installed in video gaming machines located in colder, dry climates. Sometimes, users will get an unpleasant shock when first touching a capacitive screen as they discharge their static electricity. Also, users wearing winter gloves, or the disposable gloves given out in some casinos, or sometimes callused fingers, are often unable to activate a capacitive touchscreen, since the touch doesn’t conduct the electrical current necessary for a capacitive touchscreen to sense a touch. A gloved hand is not a problem for iTouch displays; they respond to every touch.

Elo developed the new iTouch “touch-on-tube” surface wave technology specifically to retain the brightness, color, and clarity of the original display — without compromise. iTouch also maintains the inherent no-drift operation, stable performance, and proven reliability of surface wave technology. In fact, all of the key features of surface wave technology remain unchanged; Elo’s latest innovation to touch technology simply takes surface wave technology to a higher level of performance.

The minibezel includes a precision-engineered watertight seal. Flush to the edge and less than 1mm high when compressed, coins will not fit in the gap.

The OEM can use any materials to interface with the minibezel. Cabinet doors do not have to maintain a precision seal as the minibezel is fixed in position.

iTouch for Casino Owners

Using Elo's iTouch "touch-on-tube" surface wave technology in video gaming and amusement machines meets the needs of casino owners in four key areas:

Better Playability

- Crisp, clear images with less reflection and glare keep players playing longer because it's a more enjoyable experience.
- There are no false "averaged double touches" during fast play. This could open a whole new dimension in fun if game manufacturers use this feature to develop multi-player games where quick responses are rewarded. Friends being able to share the new generation of amusement games without interference is a competitive opportunity for game makers.
- Touch positioning is more precise because the player touches the CRT itself, not an overlay, and iTouch technology does not drift out of calibration over time. This also allows game manufacturers to use smaller touch targets.
- Player interactivity can be enhanced by software developers who use the unique, pressure-sensitive Z-axis to provide additional facets to game-play, such as 3-D button feedback.

Player Attraction

- The iTouch-enhanced machine's attention-grabbing, eye-catching graphics draws more players to the game because placing the touch sensor directly on the CRT faceplate results in 100 percent light transmission.
- The game maker's optics investment for better distinguishing graphics, animation, and video is preserved because iTouch's technology displays crisp, clear images with their original color purity. There are no yellowish tints, no extra reflections, no fuzziness from antiglare coatings, and no "sparkle," as with capacitive overlays.

Higher Machine Uptime

- iTouch "touch-on-tube" surface wave technology keeps working even if the CRT is scratched. Due to the strong signal provided by iTouch technology and intelligent programming, the controller adjusts the digital mapping and retains touch sensitivity in the area of the scratch. And the faceplate glass is much harder than ordinary overlay glass.
- iTouch technology keeps working even with dust, cigarette ash, gum, and wiped-up liquid spills on the touchscreen surface because digital remapping prevents contamination "dead spots".
- No routine recalibration is required because the stability inherent with surface wave technology prevents drift. In fact, there are none of the calibration or operational problems found with capacitive touchscreens, even when using a two-prong, nongrounded electrical connection.
- iTouch "touch-on-tube" surface wave technology works anywhere, with any user because touch performance is unaffected by surrounding metal, heat, cold, humidity, sweaty or callused fingers, players wearing gloves, stray capacitance, EMI, or RFI, or static electricity.

Longer Machine Life

- There is less risk of breakage or damage by vandalism with iTouch "touch-on-tube" surface wave technology because gameplay is directly on the CRT faceplate, which is stronger than even a bonded touchscreen overlay.
- iTouch technology is unaffected by cleaning solutions — including ammonia and vinegar — because of the new materials used for the surface wave arrays and the excellent durability of today's CRT anti-reflective coatings.
- iTouch technology is unaffected by casual abuse because the screens are sealable against spilled food and drinks.
- The iTouch-enhanced machine keeps working even if the CRT is intentionally scratched.

iTouch for Gaming Machine OEMs

When Elo developed iTouch “touch-on-tube” surface wave technology, it kept a keen eye on the needs of the manufacturers of gaming and amusement machines and the demands made of them. We believe iTouch touchmonitors more than meet these needs, in the following ways:

Competitive differentiation: higher player attraction and increased playability.

As discussed above, the more appealing game display of an iTouch-enhanced gaming machine makes it stand out among those of other game makers using old capacitive technology. The increase in attraction rate and better playability leads to a more successful game in the casinos.

Lower total installed cost for touchmonitor

Elo offers iTouch “touch-on-tube” surface wave technology as a complete touchmonitor solution, which means that:

- One vendor takes full responsibility for the touchmonitor solution, reducing logistics and purchasing costs associated with managing multiple vendors or consignment materials.
- Inventory is reduced because there is no longer a need to carry separate components and miscellaneous integration parts.
- OEMs can save manufacturing space, labor, cleaning, inspection, and quality costs.
- OEMs can save on the cost of operator training because resin bonding or touchscreen integration is no longer required, at either the OEM or the third-party plant.

- There is no yield loss or rework in manufacturing due to integration problems such as touchscreen breakage or dirt penetration between display and overlay.
- iTouch technology offers high durability and reliability because the iTouch touch sensor is unaffected by cleaning solutions, scratches, or other contaminants, and the built-in minibezel protects the transducers and wiring from damage in the field and provides a splash-proof seal.

Elo is OEM's best long-term partner

- Elo works with the game maker to optimize the touchmonitor's fit into the game, especially in areas such as machine enclosure sealing. Elo's minibezel can function both as a seal for the touch sensor and as a sealing surface for the game enclosure.
- As the trend toward higher-quality monitors continues, Elo can leverage its commercial volume in monitors to keep OEM's costs down.
- As some models migrate to flat panel displays, Elo also offers the best solution there as well with the strongest and clearest touchscreen overlay in the industry — SecureTouch, Elo's tempered (safety) glass version of its surface wave technology. It has all the advantages of surface wave technology without any laminations necessary.

So, whether you're a game maker or a casino owner, iTouch technology is the clear choice for video gaming machines. It's a winner!

Hands-On Answers to iTouch Questions

iTouch “touch-on-tube” surface wave technology has redefined the concepts of touchscreen and touchmonitor. As such, it has also raised some questions. Elo has gathered some of the most common of these questions.

Q1: Can the CRT be touched and does the CRT tube show “wear” from repeated touches?

A1: Users have been touching CRT’s for years with infrared, one of the oldest touch technologies, and never had problems. The earlier anti-reflective (AR) coatings used on CRTs were subject to some wear over time. However, anti-reflective coating technology has vastly improved over the years. Today, CRTs are made with a variety of coatings that are carefully designed to improve the optical properties of the CRT surface.

Elo has tested AR coatings to 10,000,000 finger touches with no signs of wear. Elo also passes industry standard tests for surface durability: MIL-C-675C(AR) Coating of Glass Optical Elements (Anti-Reflection) section 3.8.4.1, Severe Abrasion Resistance, ASTM D 3363-92a Standard Test Method for Film Hardness by Pencil Test, and abrasion with steel wool (based on MIL-C-675C(AR)). In all cases, wear was present on a capacitive touchscreen (date code 10/99) before the CRT surface. So if you have not seen wear on a capacitive touchscreen, you will not see it on iTouch.

Q2: Does the monitor have to be heated to a high temperature — i.e. 400°C — in order to cure the surface wave “frit” pattern on the tube?

A2: No, the process is done at room temperature.

Q3: Is Elo introducing this technology for the first time to the gaming industry?

A3: Elo has sold 19-inch and 21-inch on-tube touchmonitors for nearly a year as a standard product. In April 1999, we introduced iMac with iTouch technology as a tabletop kiosk for rave reviews. We feel the technology is well proven and ready for introduction to the gaming industry. Surface wave is now the most popular technology with Japanese gaming and amusement OEMs.

Q4: How fast is the touch?

A4: The surface acoustic wave travels across the surface of the glass at a speed of about 3 meters per millisecond. A complete X- and Y-axis scan takes less than one millisecond. The rest of the time it takes for an IntelliTouch controller to pass its X-, Y- and Z-information to the host is spent ensuring that the system reports touches exactly where they occur and when they occur. Since iTouch “touch-on-tube” surface wave technology is naturally so reliable and accurate, the controller gives the most information — and the most accurate information — in the shortest time. Professional players love it because they can use two hands.

Q5: Is the touch affected by vibration?

A5: No. iTouch “touch-on-tube” surface wave technology uses 5-MHz surface acoustic waves, with a wavelength of less than half a millimeter, that are completely immune to vibrations or electromagnetic interference from other electronic equipment. Capacitive touchscreens have a special setup procedure to avoid interference with CRT scanning signals. As far as “normal” vibrations, such as audible sound or building vibrations, most of these have frequencies of 20 to 1000 Hz — 1/5000 of the frequency of operation for iTouch. There is absolutely no effect on the highly tuned surface acoustic wave transducers from any unintended sound or vibration.

Q6a: What happens if the CRT breaks but the touchscreen still works?

A6a: Like many electronic products, a CRT has a finite lifetime. So, when the CRT wears out, replace it with a CRT with iTouch that can be installed as usual, keeping the existing controller along with the monitor electronics. This approach is similar to current norms where logistics and labor costs normally dictate that the old touchscreen overlay is not reused. In addition, for touchscreens bonded to the CRT to improve optics, there is a strong possibility that an overlay touchscreen would be broken during the “debonding” process.

It is worth noting that the CRT faceplate is virtually unbreakable. It is as thick as Elo's rugged SecureTouch touchscreen that can withstand a high impact force that would disable other touchscreens. Most overlay touchscreens need to be reinforced by laminating with a resin in order to approach the strength of a touchmonitor with iTouch.

CRT faceplates are typically cast from annealed glass with a gradual increase in thickness from the center of the panel to the peripheral region. The faceplates are bonded to the funnel of the tube and reinforced with an implosion band. The "unitized" construction and mechanical design enhances the strength of the tube. UL Safety Standard 14181 requires that the CRTs, after preconditioning at 150°C for 48 hours, must withstand a 51mm steel ball impact of 7J. Also, safe integrity must be maintained after a missile impact involving a 2.3Kg steel missile impacted on the face plate inducing 7J to 20J. In addition, the tube is subjected to a thermal shock test entailing scratching of the face plate with a diamond scribe or a glass cutter forming a cross-hatched pattern, then quenching the scratched faceplate with liquid nitrogen or heat shocking the scratched faceplate with a molten glass rod, then quenching it with water.

Q6b: What happens if the touchscreen breaks but the CRT still works?

A6b: The most common causes of overlay touchscreen failure are (a) the corners are damaged and break, (b) the overlay is completely smashed and (c) scratches disable the touchscreen to the point it becomes non-usable. These causes of failure are not present in iTouch technology. iTouch technology turns the CRT faceplate itself into a touch sensor, so there are no overhanging corners to cause problems when opening and closing the machine because the overlay has been eliminated. And, because iTouch utilizes surface wave technology, even a deep scratch does not affect performance. (See Question 13.) In addition, the built-in minibezel protects the touchscreen transducers and wiring from damage in the field. (See Question 10.)

Q7: What maintenance does a touchmonitor with iTouch require in the field?

A7: Just the usual housekeeping maintenance for any screen in a public access environment so people will want to use the display. CRTs with iTouch are unaffected by normal dirt and greasy fingerprints.

Q8: Is iTouch less "sensitive" than overlay surface wave touchscreens? Does an etched or polished surface make a difference?

A8: While touchscreen overlays use a window glass made to architectural specifications, CRT glass is a higher-quality glass that is ground and polished to optical specifications. The result is an acoustic signal for iTouch that is more than an order of magnitude higher in strength than on overlay glass. This higher signal translates into greater sensitivity because the signal-to-noise ratio is much higher. Higher signal strength also allows the system to withstand even higher levels of contaminants such as food, dirt, and grime.

Q9: How does a touchmonitor with iTouch deal with liquids on the screen?

A9: Most games are serviced from the front. As a result, the gaskets used to protect the inside of the cabinet are not usually watertight. If someone accidentally spills a drink on the front face, the liquid is likely to drain past the gasket. Only a touchmonitor with iTouch comes with a preformed minibezel that makes the touch functionally resistant to the spill.

iTouch "touch-on-tube" surface wave technology will not work while liquid is actually running down the screen — and most players won't use a machine in this condition anyway. Once the liquid is wiped off the CRT, iTouch technology resumes operation without intervention or recalibration. Any drops of stationary liquid or food are mapped out immediately as a contaminant and do not interrupt the touchscreen's performance.

Q10: Can dirt, grime, or residue disable the touch sensor?

A10: The minibezel design will not allow buildup of residue that would affect the operation of the touchscreen. The normal cleaning and maintenance casinos perform to make a machine attractive for player use is not even required for a touchmonitor with iTouch.

Q11: Does a touchmonitor with iTouch require special materials to seal?

A11: A touchmonitor with iTouch does require sealing, and as the supplier of a one-stop touchmonitor solution, Elo assumes responsibility for engineering the seal. The touchmonitor with iTouch comes from Elo factory-sealed, with no additional sealing necessary at the OEM production facility, or the casino floor. In fact, the iTouch seal can be designed in conjunction with the OEM to provide a special mounting location for an internal drip gutter that channels spills away from any sensitive or hazardous spots within the machine. The OEM can use any materials to interface with the minibezel.

Q12: Does iTouch “touch-on-tube” surface wave technology reduce the viewing area of the monitor?

A12: No. The arrays, transducers, and minibezel for iTouch are completely outside the viewing area of the CRT. In addition, there is no “overhang” from a touchscreen overlay past the CRT.

Q13: How deep can a scratch be before iTouch “touch-on-tube” surface wave technology is disabled?

A13: The surface of a CRT — like any glass, including any surface wave or capacitive touchscreen overlay — can be scratched if enough force is used with a hard object. The result of this kind of vandalism is the same as for vandalism anywhere — it doesn’t look good. With surface wave technology, however, even a deep scratch does not affect performance. The Elo controller notices the slight change in signal level (less than 10 percent with a very deep scratch) and compensates for it.

Q14: How similar is iTouch “touch-on-tube” surface wave technology to infrared technology?

A14: Because neither uses an overlay, both iTouch and infrared technology preserve 100 percent of the optics to provide clear, crisp colors and eye-catching graphics. iTouch’s surface wave technology is the gaming industry’s preferred technology due to higher resolution, speed and no parallax on CRTs.

Q15: What other products does Elo produce using iTouch “touch-on-tube” surface wave technology?

A15: Elo produces Apple’s iMac with iTouch technology, as well as 19-inch and 21-inch touchmonitors. The larger touchmonitors have already been sold to customers since early 1999, with good field experience and excellent customer feedback. Among the leading customers for the 19-inch touchmonitors with iTouch is a European gaming OEM.

Q16: What about static electricity with iTouch?

A16: Static is normally generated from electrical build-up within the CRT or from simply walking around the carpeted casino floor. Modern CRTs include a slightly conductive film that dissipates the static, so it is not present at machine turn-on. A static discharge may still be present with older machines. However, this small amount of static is normally dissipated during play. Static electricity does not affect the performance of a touchmonitor with iTouch in any way.

Q17: Is iTouch “touch-on-tube” surface wave technology a higher-cost solution?

A17: No. iTouch technology provides better performance at a similar cost. OEMs may be able to reduce total installed cost, factoring in the savings in reduced purchasing and logistics costs, elimination of bonding overlay touchscreens, freeing up of valuable manufacturing space, and reduced training time, inventory, and manpower needs.

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