top glass substrate. FIG. 5*a* shows a finished soda-lime top glass **500**, showing two layers on the top of top glass **500** and a shield on the bottom of the top glass. In particular, ITO **566** can be formed on the top of top glass **500** and patterned to form column traces. Sol-Gel **560** of 0.025 thickness and an optical index similar to that of ITO **566** can then be formed on ITO **566** and patterned to form vias **572**. Vias **572** can be filled with a conductive material. Metal **570** can then be formed and patterned over Sol-Gel **560** to form traces along the borders of the subassembly. A second layer of ITO **568** can then be formed and patterned over metal **570** and Sol-Gel **560** to form row traces. Sol-Gel **560** can have dielectric properties which can enable the row and column traces formed in ITO layers **566** and **568** to experience a mutual capacitance between them at crossover points and act as touch sensors. ITO rows and columns **566** and **568** can have a resistivity of 10 to 200 ohms per square and are formed as 0.030 lines and spaces. Metal **570** can have a resistivity of 0.2 ohms per square and formed as 0.030 lines and spaces. Vias **572** connect metal traces **570** to the bottom ITO **566**.

[0056] Bottom ITO layer **562** having a resistivity of 500 ohms per square can then be applied to the bottom of top glass **500**, and then covered by temporary protective film **564**. ITO **562** can act a shield for the sensing columns. Note that the exemplary third upper layer subassembly of FIG. 5*b* can require an additional cover (not shown). The exemplary third upper layer subassembly can then be scribed and cut into individual parts.

[0057] FIG. 5*b* shows top glass **500** after it has been scribed and broken into individual parts, with dashed line **574** symbolically representing the two ITO layers on top of the top glass and separated by the Sol-Gel dielectric. In FIG. 5*d*, FPC **576** can be attached using ACF **586**, and IC **532** can be bonded to FPC **576** instead of directly to the traces on the substrate, because IC **532** would interfere with the ability of the glass assembly to be flush-mounted to a cover.

[0058] FIG. 5*c* shows the step of removing protective layer **564**, and grounding the bottom side ITO **562** using conductive tape **578** for shielding LCD noise.

[0059] FIG. 5*d* shows the exemplary third upper layer subassembly that can be bonded to LCD module **519** using optically clear PSA **580**, and cover **582** that can be bonded to the exemplary third upper layer subassembly using optically clear adhesive **584**, which should be thicker (e.g. 0.100) then the FPC attached to the top of glass.

[0060] A number of different computing systems can be operable with the touchscreen stackups described above according to embodiments of this invention. A touchscreen, which can include a sensor panel and a display device (e.g. an LCD module), can be connected to other components in the computing system through connectors integrally formed on the sensor panel, or using flex circuits. The computing system can include one or more panel processors and peripherals, and a panel subsystem. The one or more processors can include, for example, ARM968 processors or other processors with similar functionality and capabilities. However, in other embodiments, the panel processor functionality can be implemented instead by dedicated logic such as a state machine. Peripherals can include, but are not limited to, random access memory (RAM) or other types of memory or storage, watchdog timers and the like.

[0061] The panel subsystem can include, but is not limited to, one or more analog channels, channel scan logic and driver logic. The channel scan logic can access RAM, autonomously read data from the analog channels and provide control for the analog channels. This control can include multiplexing columns of the multi-touch panel to analog channels. In addition, channel scan logic can control the driver logic and stimulation signals being selectively applied to rows of the multi-touch panel. In some embodiments, the panel subsystem, panel processor and peripherals can be integrated into a single application specific integrated circuit (ASIC).

[0062] Driver logic can provide multiple panel subsystem outputs and can present a proprietary interface that drives a high voltage driver. The high voltage driver can provide level shifting from a low voltage level (e.g. complementary metal oxide semiconductor (CMOS) levels) to a higher voltage level, which can provide a better signal-to-noise (S/N) ratio for noise reduction purposes. Panel subsystem outputs can be sent to a decoder and a level shifter/driver, which can selectively connect one or more high voltage driver outputs to one or more panel row inputs through a proprietary interface and can enable the use of fewer high voltage driver circuits in the high voltage driver. Each panel row input can drive one or more rows in a multi-touch panel. In some embodiments, the high voltage driver and decoder can be integrated into a single ASIC. However, in other embodiments the high voltage driver and decoder can be integrated into the driver logic, and in still other embodiments the high voltage driver and decoder can be eliminated entirely.

[0063] The computing system can also include a host processor for receiving outputs from the panel processor and performing actions based on the outputs that can include, but are not limited to, moving an object such as a cursor or pointer, scrolling or panning, adjusting control settings, opening a file or document, viewing a menu, making a selection, executing instructions, operating a peripheral device connected to the host device, answering a telephone call, placing a telephone call, terminating a telephone call, changing the volume or audio settings, storing information related to telephone communications such as addresses, frequently dialed numbers, received calls, missed calls, logging onto a computer or a computer network, permitting authorized individuals access to restricted areas of the computer or computer network, loading a user profile associated with a user's preferred arrangement of the computer desktop, permitting access to web content, launching a particular program, encrypting or decoding a message, and/or the like. The host processor can also perform additional functions that may not be related to panel processing, and can be coupled to program storage and a display device such as an LCD for providing a user interface (UI) to a user of the device.

[0064] As mentioned above, the multi-touch panel can in some embodiments include a capacitive sensing medium having a plurality of row traces or driving lines and a plurality of column traces or sensing lines separated by a dielectric. In some embodiments, the dielectric material can be transparent, such as PET or glass. The row and column traces can be formed from a transparent conductive medium such as ITO or antimony tin oxide (ATO), although other non-transparent materials such as copper can also be used. In some embodiments, the row and column traces can be perpendicular to each other, although in other embodiments other non-orthogonal orientations are possible. For example, in a polar coordinate system, the sensing lines can be concentric circles and the driving lines can be radially extending lines (or vice versa). It should be understood, therefore, that the terms "row" and "column," "first dimension" and "second dimen-