TABLE 1-continued

Illustrative Dimensions		
Label	Description	Size
f	Capacitive plate separation	0.25 mm
g	Sense trace width	300 μm
h	Sense trace (425) separation	0.67 mm

[0023] It will be recognized that the precise size of each element is a design decision that may be determined by the size of the display area (e.g., unit **100**) and the desired resolution. It will also be recognized that overlapping conductive traces **210** (e.g., trace **425**) and **220** (e.g., traces **430** and **435**) form capacitive elements that operate in a manner described in the aforementioned pending patent application.

[0024] It is noted that in the architecture illustrated in FIGS. **4** and **5**, traces **210** substantially cover one surface of clear substrate **200** while traces **215** only minimally cover one surface of clear substrate **205**. As a result, a user may see visual artifacts caused by the difference in the index of refraction between the surface of substrate **200** substantially coated with conductive traces and the surface of substrate **205** which is only minimally coated. To reduce these visual artifacts, it has been found beneficial to coat the surface of substrate **205** continuously with the transparent or translucent conductive trace material which has a similar index of refraction as the conductive trace material. For example, the same surface of substrate **205** that includes traces **215** (e.g., traces **420** and **425**), may be coated with the same conductive material as long as this coating is electrically isolated from traces **215**. This can be done, for example, by providing a insulating barrier (e.g., **415**) around each trace **215**. Other illustrative materials suitable for this purpose include, but are not limited to, aluminum oxide, scandium oxide or optiNDEX (a polymer coating) from Brewer Science.

[0025] Referring to FIG. **6**, a portion of force and location sensitive display unit **600** is shown in schematic form. In accordance with one embodiment of the invention, during operation drive circuit **605** stimulates each combination of inverted drive lines and a drive frame in sequence while simultaneously sensing all force and location associated traces via sense circuit **610**. For example, during a first time period (T_1) inverted drive lines **615** and **620** are driven with a pulse train of a first polarity while drive frame **630** is driven with a pulse train of an opposite polarity. While this is occurring, sense circuit **610**"reads" or senses each of its inputs across all columns of the display. During a second time period (T_2), inverted drive lines **620** and **625** are driven with a pulse train of the first polarity while drive frame **635** is driven with a pulse train of the opposite polarity. During time period T_2, sense circuit **610** again reads each of its inputs. This process is repeated until all rows in the display unit have been driven, after which the process repeats. As described, each pixel generates one signal related to a location measurement (e.g., through common sense pad **445**) and two signals related to force measurement (e.g., from pads **430** and **435**). In one embodiment, the average of the measure force signals is used as "the" force signal. In another embodiment, the maximum (or minimum) of the two signals is used.

[0026] In one embodiment, each pulse train comprises 12 pulses (0 to 18 volts), having a 50% duty cycle and a frequency of between approximately 100 and 300 Kilohertz ("KHz"). In the embodiment of FIG. **6**, sense circuit **610** is shown as simultaneously reading all column inputs. It will be recognized, however, that this is not necessary. For example, the operation of sensing a row's change in capacitance signals could be multiplexed so that for each row (e.g., inverted drive lines **615** and **620** and drive frame **640**), a first portion of columns are sensed during a first time period, a second portion of columns are sensed during a second time period and so on until all columns are sensed. After this process is completed, the next set of inverted drive lines and drive frame may be stimulated.

[0027] In accordance with the invention, the illustrative architecture of FIGS. **4**, **5** and **6** provide two values for each pixel during each scan operation (see discussion above). A first value represents the capacitance due to where the user touches the display unit. This value should be as independent of force as possible. The second value represents the force applied to the display unit. This value should be as independent of where the force is applied as possible. The arrangement of drive frames **405**, inverted drive lines **410** and sensing lines **420** and **425** are arranged to provide this independence. For example, it will be recognized that the mutual capacitance between a drive frame (e.g., **405**) and a force output line (e.g., one of conductive paths **420**) is directly proportional to their overlap area (e.g., 30 μm×4.5 mm) and inversely proportional to plate separation (e.g., 10 μm at no force and 7 μm at full force). The same is true for each inverted drive line. However, because drive frames and inverted drive lines are driven with opposite polarity signals, they tend to counteract one another (that is, the different polarities tend to counteract the charge transferred between the sensing path and drive frame and between the sensing path and the inverted drive frame). Thus, in the illustrated embodiment, inverted drive lines are used to cancel some of the charge transfer due to location sensing paths **425** overlapping the "legs" of drive frame **405**. Thus, the use of inverted drive lines ensures that the location and force output signals are substantially independent.

[0028] Various changes in the materials, components, circuit elements, as well as in the details of the illustrated operational methods are possible without departing from the scope of the following claims.

1. A force and touch sensitive component, comprising:

a first transparent layer;

a second transparent layer;

first conductive traces abutted to a first surface of the first transparent layer;

second conductive traces abutted to a second surface of the second transparent layer; and

deformable members interposed between the first and second transparent members, wherein

the first and second conductive traces are configured to generate a first signal indicative of a force applied to the first transparent layer and a second signal indicative of a location on the first transparent layer at which the force is applied.