RESISTIVE TOUCH SCREEN WITH VARIABLE RESISTIVITY LAYER

FIELD OF THE INVENTION

[0001] This invention relates to resistive touch screens and more particularly, to the formation of a resistive layer in the resistive touch screen.

BACKGROUND OF THE INVENTION

[0002] Resistive touch screens are widely used in conventional CRTs and in flat-panel display devices in computers and in particular with portable computers. **FIGS. 2 and 3** show a portion of a prior art four-wire resistive touch screen **10**, which includes a transparent substrate **12**, having a first conductive layer **14** defining a touch area. This conductive layer typically comprises indium tin oxide (ITO) or conductive polymers such as polythiophene. A flexible transparent cover sheet **16** includes a second conductive layer **18** that is physically separated from the first conductive layer **14** by spacer dots **20**. Conductive patterns **30** having lower resistance than the conductive layer **14** defining an edge area are arranged over the conductive layer **14** at opposite edges of the conductive layer **14** on transparent substrate **12**. The conductive patterns **30** are provided by an additional layer of material that is in electrical contact with conductive layer **14**. Conductive patterns **30** are also provided in electrical contact with and at opposite edges of the conductive layer **18** on the flexible transparent cover sheet **16** (because of the four conductive patterns **30** this is commonly referred to as a four-wire design). The shape of these conductive patterns **30** can be adjusted to improve the linearity of the response of the touch screen. See for example U.S. Pat. No. 4,625,075 issued Nov. 25, 1986 to Jaeger. These conductive patterns **30** are used to provide electrical connection to the conductive layers **14** and **18**.

[0003] In an alternative design (commonly called a five-wire design) all four conductive strips **30** are located on the substrate **12** and the second conductive layer **18** is the so-called fifth wire. The five-wire design may also utilize specially chosen patterns for the four conductors **30** on substrate **12** to improve the linearity of the device response.

[0004] The flexible transparent cover sheet **16** is deformed, for example by finger pressure, to cause the first and second conductive layers **14** and **18** to come into electrical contact. A voltage is applied across the conductive layers **14** via electrical connections **33** and a resulting signal is measured on the electrical connections **31** connected to layer **18** to determine the location of the touch in one direction. The voltage is then applied across the conductive layer **18** and the signal is measured on the electrical connection **33** to determine the location of the touch in the orthogonal direction. The conductive layers **14** and **18** have a resistance selected to optimize power usage and position sensing accuracy.

[0005] In conventional prior-art manufacturing processes, the conductors **30** are made of silver inks screen printed onto the conductive layers **14** and **18**. In practice, this process has a number of disadvantages. First, the silver inks are costly and the screen printing process is expensive in that additional manufacturing steps and materials are needed. Second, unless they are carefully prepared and printed, the silver inks do not adhere well to the conductive layers. Moreover, the process of adhering the inks to the conductive layers may require high temperatures, creating problems for other materials in a touch screen or associated display system. Furthermore, the width of the edge area of the touch screen may need to be relatively large to accommodate the patterns used to linearize the response of the touch screen.

[0006] There is a need therefore for an improved means to provide conductive patterns for a resistive touch screen and a method of making the same that can reduce the width of the edge area, improve the robustness of the touch screen and reduce the cost of manufacture.

SUMMARY OF THE INVENTION

[0007] The need is met by providing a resistive touch screen that includes a transparent substrate defining a touch area; a first layer of conductive material formed on the transparent substrate and extending over the touch area; an electrical connection to the first layer of conductive material; a transparent flexible cover sheet; a second layer of conductive material formed on the transparent flexible cover sheet, the cover sheet being mounted in a spaced apart relationship from the substrate, whereby a touch in the touch area results in an a electrical contact between the first and second layers of conductive material at the point of touch; an electrical connection to the second layer of conductive material; and at least one of the first or second layers of conductive material having a variable conductivity.

Advantages

[0008] The touch screen of the present invention has the advantages that it is simple to manufacture, reduces costs, and provides a larger active area.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] **FIG. 1** is a schematic diagram showing a cross sectional view of a four-wire touch screen according to the present invention;

[0010] **FIG. 2** is a schematic diagram illustrating a prior art four-wire touch screen;

[0011] **FIG. 3** is a schematic diagram showing a side view of the prior art four-wire touch screen;

[0012] **FIG. 4** is a schematic diagram illustrating a side view of process for manufacturing a touch screen according to the present invention;

[0013] **FIG. 5** is an end view of the manufacturing process;

[0014] **FIG. 6** is a topographical representation of a variable conductive layer having continuous variation in the touch area according to the one embodiment of the present invention;

[0015] **FIG. 7** is a schematic diagram of a variable conductive layer having width variation in the edge area according to the one embodiment of the present invention;

[0016] **FIG. 8** is a schematic diagram of a variable conductive layer having thickness variation in the edge area according to the one embodiment of the present invention; and