

IN-CELL TOUCH-SENSITIVE PANEL

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Taiwan Patent Application Serial Number 098104590, filed on Feb. 13, 2009, the full disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The invention is related to a method for calculating a coordinate of a touch position of a touch-sensitive LCD panel, and more particularly to a touch-sensitive LCD panel, wherein the relative circuit of the touch-sensitive functions is designed in the touch-sensitive LCD panel.

BACKGROUND

[0003] It is important to apply touch-sensitive technology to a liquid crystal display (LCD) panel. Recently, a touch-sensitive panel (e.g. resistance type, capacity type, infrared ray type or surface acoustic wave type touch-sensitive panel) is generally extra attached on the LCD panel to order to realize touch-sensitive function. Referring to FIG. 1, a resistance type touch-sensitive panel **50** is widely applied to various terminal products because of simple manufacture processes and low cost. According to the resistance type touch-sensitive panel **50**, the touch position can be certainly determined by using a plurality of conductive lines (e.g. four or five conductive lines), measuring a variation in voltage of conductive lines, and calculating the touch position. However, the extra attached touch-sensitive panel will result in the optical loss and relative characteristic loss of the LCD panel.

[0004] In order to solve the above-mentioned problem, an in-cell touch-sensitive panel is developed recently. In other words, relative circuit of the touch-sensitive functions is designed in the LCD panel. When the touch-sensitive LCD panel is manufactured, the circuit of the touch-sensitive function can be finished simultaneously. Such touch-sensitive LCD panel has no optical loss, but has touch-sensitive function.

[0005] For example, referring to FIG. 2, U.S. Patent Publication Number 2008/0122800 A1, entitled "Touch-sensitive Liquid Crystal Display Panel With Built-in Touch Mechanism And Method For Driving Same," discloses that a touch-sensitive liquid crystal display (LCD) panel **10** includes a first substrate **20**, a second substrate **30** and a liquid crystal (LC) layer **40**. The second substrate **30** is opposite to the first substrate **20**. The liquid crystal layer **40** is disposed between the first substrate **20** and the second substrate **30**. An electrode layer **24** is formed on the first substrate **20**, and includes a plurality of scan and data lines. The scan and data lines cross each other, thereby defining a plurality of pixel regions. A plurality of conductive pads **22** are arranged to be corresponding to and electrically connected to the scan lines of the electrode layer **24**. A conductive layer **32** is disposed between the second substrate **30** and the LC layer **40**. A plurality of conductive protrusions **34** are located on the conductive layer **32**, and there is a predetermined gap between each of the conductive protrusions **34** and a corresponding conductive pad **22**.

[0006] The first substrate **20** belongs to a thin film transistor (TFT) substrate **12** which utilizes the scan lines to calculate a coordinate of touch position. However, scan signals of the

scan lines are possibly disturbed accordingly. Furthermore, the second substrate **30** belongs to a color filter (CF) substrate **14** which already includes a transparent electrode **38**. However, the conductive layer **32** and a flat insulating layer **36** must be extra added so as to increase manufacture cost and time. In addition, a plurality of spacers **42** are adapted to keep a predetermined gap between the TFT substrate **12** and the CF substrate **14** for accommodating the LC layer **40**. However, the spacers **42** and the conductive protrusions **34** must be finished by different manufacture processes so as to also increase manufacture time.

[0007] Accordingly, there exists a need for a touch-sensitive LCD panel capable of solving the above-mentioned problems.

SUMMARY

[0008] The present invention provides an in-cell touch-sensitive panel includes TFT and CF substrates. The TFT substrate includes a net-shaped readout circuit and a plurality of conductive pads arranged in array manner. The net-shaped readout circuit includes a plurality of widthwise and lengthwise readout lines, wherein the widthwise readout lines are electrically connected to the lengthwise readout lines. The conductive pads are electrically connected to the net-shaped readout circuit. The CF substrate includes a plurality of spacers, a plurality of protrudent portions and a transparent electrode. The spacers are adapted to keep a first gap between the TFT and CF substrates. The protrudent portions are arranged to be corresponding to the conductive pads, and there is a second gap between the protrudent portion and the conductive pad. The transparent electrode covers the spacers and the protrudent portions.

[0009] The relative circuit of the touch-sensitive functions is designed in the touch-sensitive LCD panel of the present invention. When the touch-sensitive LCD panel is manufactured, the circuit of the touch-sensitive function can be finished simultaneously. The touch-sensitive LCD panel of the present invention has no optical loss, but has touch-sensitive function. Furthermore, it is not necessary to extra add a conventional conductive layer and a conventional flat insulating layer so as not to increase manufacture cost and time. In addition, the spacers and the protrudent portions can be made by the same material and by the same manufacture processes so as not to also increase manufacture time.

[0010] The foregoing, as well as additional objects, features and advantages of the invention will be more apparent from the following detailed description, which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Embodiments of the present invention are illustrated by way of example, and not by limitation, in the figures of the accompanying drawings, wherein elements having the same reference numeral designations represent like elements throughout and wherein:

[0012] FIG. 1 is perspective and enlarged cross-sectional views of a resistance type touch-sensitive panel in the prior art;

[0013] FIG. 2 is a cross-sectional view of a touch-sensitive LCD panel in the prior art;

[0014] FIG. 3 is a cross-sectional view of a touch-sensitive LCD panel according to an embodiment of the present invention;