DISPLAY UNIT, MANUFACTURING METHOD THEREOF AND ELECTRONIC DEVICE EQUIPPED WITH SAME

BACKGROUND OF THE INVENTION

The present invention relates to a display unit having a touch switch, a manufacturing method of the same, and an electronic device equipped with such a display unit.

Heretofore, as shown in FIG. **7**, as a method for disposing a transparent touch switch on a liquid crystal display, a transparent touch switch **4** is adhered and secured by a double coated adhesive **10** having a thickness of about 0.5 mm to 1 mm and provided at the periphery of a liquid crystal display which is concealed and held between at least two transparent substrates **1***a* and **1***b*, and optical films **2***a* and **2***b* are pasted on the surface of the transparent substrates.

However, when the transparent touch switch is disposed on the liquid crystal display, the image quality thereof degrades because light coming from the outside is reflected on the surface of the transparent touch switch and on the surface between the transparent touch switch and the display panel. In particular, the screen is darkened and the image quality degrades remarkably when the touch switch is placed on a reflective type liquid crystal display.

SUMMARY OF THE INVENTION

It is an object of the present invention to improve the image quality of a display unit equipped with a transparent touch switch.

Another object of the present invention is to provide a method for manufacturing a display unit equipped with a transparent touch switch and having an improved image quality.

Another object of the present invention is to provide an electronic device having a display unit equipped with a transparent touch switch and having an improved image quality.

In order to solve the above-mentioned problem in the prior art, the foregoing and other objects of the present invention are carried out by a display unit comprising a transparent touch switch and a liquid crystal display having a display surface. The display surface of the liquid crystal display is adhered to the back of an input area of the transparent touch switch by clear adhesive. The transparent touch switch is preferably of an analog resistance film type, a digital resistance film type, an electrostatic capacity type or an ultrasound type. The liquid crystal display is formed and supported between two transparent films or transparent substrates. Because this arrangement allows the reflectance between the transparent touch switch and the liquid crystal display to be reduced as compared to the prior art display units, the image quality is improved.

In another embodiment of the display unit of the present invention, clear fillers are mixed into the clear adhesive. By this construction, uneven display which is otherwise caused by the hardening and shrinkage of the clear adhesive when a touch switch having a large input area is adhered may be suppressed without damaging the image quality.

In another aspect, a method is provided for manufacturing a display unit according to the present invention. A transparent touch switch is provided and a clear adhesive is applied to at least an input area on a rear surface of the transparent touch switch. The transparent touch switch is then turned over and aligned with a liquid crystal display such that the rear surface of the transparent touch switch having the clear adhesive confronts a display surface of the liquid crystal display. After the adhesive begins to form a drip, the transparent touch switch is slowly and continuously moved towards the liquid crystal display. The clear adhesive is allowed to flow between the transparent touch switch and the liquid crystal display until the clear adhesive expands to a predetermined area on the display surface of the liquid crystal display. Thereafter, the clear adhesive is cured and the transparent touch switch and liquid crystal display are laminated together. By this manufacturing method, the clear adhesive is allowed to be filled between the transparent touch switch and the liquid crystal display without the formation of bubbles therein.

In another aspect of the present invention, there is provided an electronic device having a display unit in which a transparent touch switch is adhered surface-to-surface, at least at an input area thereof, with a display surface of a liquid crystal display by a clear adhesive, and an input pen having a mechanism for absorbing a force applied to the transparent touch switch. Because the input pen allows the force applied to the transparent touch switch to be suppressed below a predetermined value, no uneven display occurs on the display surface of the liquid crystal display.

The display unit constructed as described above allows the image quality to be improved and may be manufactured readily without requiring an expensive manufacturing machine.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a display unit according to an embodiment of the present invention;

FIG. **2** is a cross-sectional view of a display unit according to another embodiment of the present invention;

FIG. **3** is a flowchart for explaining a method for manufacturing the display unit of the present invention;

FIGS. **4**(A)–**4**(C) are explanatory views showing a sequence of steps for manufacturing the display unit of the present invention;

FIG. **5** is an explanatory view showing how bumps and bubbles are formed between a touch switch and a liquid crystal display when the touch switch is moved too rapidly toward the liquid crystal display during a lamination step;

FIG. **6** is a cross-sectional view of a special pen for use in an electronic device of the present invention; and

FIG. **7** is a side view of a prior art display unit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be explained below with reference to the drawings.

[First Embodiment]

FIG. **1** is a schematic side view showing a first embodiment of the inventive display unit. In the display unit of the present embodiment, a liquid crystal display comprises a liquid crystal layer sandwiched between two transparent substrates (e.g., glass) **1***a* and **1***b* each having a thickness of, for example, 0.7 mm. A polarizing plate **2***a* and a polarizing plate **2***b* adhered to a reflecting plate (not shown) are attached to the transparent substrates **1***a* and **1***b*, respectively. A driver IC **3** for driving the liquid crystal display is mounted at a terminal section of the transparent substrates **1***a*. A touch switch **4** of an analog resistance film type using, for example, 0.7 mm thick glass is adhered on the display side of the liquid crystal display by a clear adhesive **5**. The clear adhesive **5** surrounds the periphery of the liquid crystal