(19) Japan Patent Office (JP)

(12) Japanese Unexamined Patent Application Publication (A)

(11) Patent Application Publication No.
JP 2003-68795 A
(P2003-68795A)

(43) Publication Date March 7, 2003 (Heisei 15)

(51) Int. Cl.[7]	Identification Symbol	FI	Theme Code (Reference)
H01L 21/60	311	H01L 21/60	311S 2H092
G02F 1/1345		G02F 1/1345	5F044

Examination Request: Not requested Number of Claims: 7 OL (Total 17 pages)

(21) Application No. JP 2001-255354 (P2001-255354)

(22) Date of Filing August 24, 2001 (Heisei 13)

(71) Applicant 000005049
Sharp Corporation
22-22 Nagaike-cho, Abeno-ku, Osaka, Osaka-fu

(72) Inventor Soji Shiota
c/o Sharp Corporation, 22-22 Nagaike-cho, Abeno-ku, Osaka-shi, Osaka-fu

(72) Inventor Keigo Aoki
c/o Sharp Corporation, 22-22 Nagaike-cho, Abeno-ku, Osaka-shi, Osaka-fu

(74) Agent 100080034
Kenzo Hara, Patent Attorney

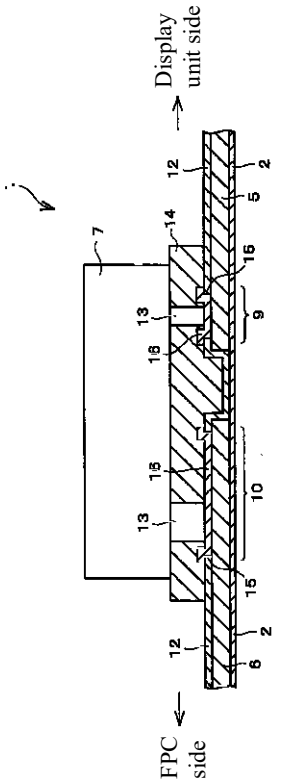
Continued on last page

(54) [Title of Invention] DISPLAY DEVICE AND MANUFACTURING METHOD OF SAME

(57) [Abstract]

[Problem] To provide a display device and a method for manufacturing the same, wherein various drive ICs can be mounted at low cost.

[Resolution Means] A protective film 12 formed so as to cover input and output wiring 5 and 6. Thus, corrosion of the input and output wiring 5 and 6 is prevented. Furthermore, an opening 15 having an area larger than a bump electrode 13 is formed so as to surround the connection portion between the bump electrode 13 and input and output contact pads 9 and 10. Thus, a drive IC 7 having different intervals between the bump electrodes 13 can be mounted at a low cost.



[Scope of Patent Claims]

[Claim 1] A display device comprising a drive IC mounted on a board via an adhesive layer, bump electrodes formed on the board side of the drive IC, and wiring having contact pads at its tip portions that face the bump electrodes, wherein the display device further comprises a protective film formed to cover the wiring, and an opening having an area larger than the bump electrodes is formed in the protective film so as to surround the connection portion between the bump electrodes and the contact pads.

[Claim 2] The display device according to claim 1, wherein the opening has a rectangular shape with a longer side in a short direction or a long direction of the drive IC.

[Claim 3] The display device according to claim 1 or 2, wherein the opening is formed in plurality along the wiring.

[Claim 4] The display device according to any one of claims 1 to 3, wherein the contact pads are arranged in a staggered manner, and the openings are arranged in a staggered manner corresponding to the contact pads.

[Claim 5] The display device according to any one of claims 1 to 4, wherein an inspection pad electrically connected to the contact pad is provided on the board.

[Claim 6] The display device according to any one of claims 1 to 5, wherein the adhesive layer is provided so as to cover the entire region in a connection portion between the bump electrode and the contact pad.

[Claim 7] A method for manufacturing the display device according to any one of claims 1 to 6, wherein
the entire adhesive layer is heated and cured after the bump electrode and the contact pad are connected.

[Detailed Description of Invention]

[0001]

[Technical Field of Invention] The present invention relates to a display device in which a display panel such as a liquid crystal panel or organic EL (electroluminescence: electroluminescence) and a drive IC (Integrated Circuit) for driving the display panel are electrically connected, and a method for manufacturing the same.

[0002]

[Conventional Art] In a liquid crystal display device, which is an example of a display device, a liquid crystal drive IC has been mounted on a liquid crystal panel having a liquid crystal layer sandwiched between a pair of boards. Also, a structure using TCP (Tape Carrier Package) is generally known as this mounting structure.

[0003] Also, in recent years, chip-on-glass (COG) liquid crystal display devices with liquid crystal drive ICs mounted on bare chips on liquid crystal panels have been seen in view of low cost, high reliability, thickness reduction, and the like. In such a liquid crystal display device of recent years, a connection method in which a projection-like bump electrode is formed on an electrode of a liquid crystal drive IC and a liquid crystal panel and the liquid crystal drive IC are face-down bonded is generally used. The face-down bonding connection refers to mounting the liquid crystal drive IC directly on the board while the electrode of the IC for driving the liquid crystal is directed toward the board.

[0004] The following two main methods are used for such face-down bonding connections.

[0005] One method is a method for connecting a liquid crystal panel and a liquid crystal drive IC by melting solder formed as a bump electrode on the liquid crystal drive IC. The other method is a method for connecting the liquid crystal panel and the liquid crystal drive IC by means of an anisotropic conductive adhesive in which a bump electrode is formed from a metal such as Au and conductive particles are diffused and mixed in a conductive paste or an insulating adhesive.

[0006] In a connection method using the latter anisotropic conductive adhesive, *the conductive particles in* the anisotropic conductive adhesive are sandwiched between a bump electrode on a liquid crystal drive IC and input and output contact pads on a display board of a liquid crystal panel. Thus, the liquid crystal drive IC and the display board of the liquid crystal panel are electrically connected.

[0007] In the connection method using the anisotropic conductive adhesive, there are advantages in that: the connection pitch can be determined only by considering the size of the bump electrode, so the circuit design can be easily performed Since the insulating adhesive in the anisotropic conductive adhesive is filled between the electrodes; the electrodes can be easily insulated from each other; and the like. Because of these advantages, the connection method using an anisotropic conductive adhesive has become the mainstream in the COG system.

[0008] Even among anisotropic conductive adhesives, a conventional liquid crystal display device in which a liquid crystal panel and a liquid crystal drive IC are face-down bonded by using an anisotropic conductive film called an ACF (Anisotropic Conductive Film) is described below.

[0009] As illustrated in FIG. 17, a conventional liquid crystal display device 100 is provided with a liquid crystal panel 200, a display unit 400, output wiring 500..., input wiring 600..., liquid crystal drive ICs 700 . . . , and an FPC (Flexible Printed Circuit) 800.

[0010] Also, as illustrated in FIG. 18, the connection area 300 (the area surrounded by the dashed line in the figure) of the liquid crystal driving ICs 700 . . . in the liquid crystal panel 200has output contact pads 900 . . . , input contact pads 1000 . . . , and FPC input terminals 1100 . . . formed therein. Note that in FIG. 18, in order to clarify the configuration of the liquid crystal panel 200, the liquid crystal driving IC 700 . . . is illustrated removed from the liquid crystal panel 200.

[0011] The liquid crystal panel 200 is a plate for mounting the above-mentioned components. The display unit 400 displays a desired image based on the data signals and scanning signals

from the liquid crystal drive ICs 700 . . . A desired image is displayed on the basis of the data signal and the scanning signal from.

[0012] The output wiring 500 . . . supplies data signals and scanning signals to the display unit 400 . . . and connects the display unit 400 to the liquid crystal driving ICs 700 . . . is connected to. The input wiring 600 . . . is used to input data signals and power to the liquid crystal drive ICs 700 . . . and connects the FPC 800 described later to the liquid crystal drive ICs 700 . . . is connected to.

[0013] The liquid crystal drive ICs 700 . . . generate data signals and scanning signals for displaying images on the display unit 400. Furthermore, as described above, the liquid crystal drive ICs 700 . . . is connected to the output wiring 500 . . . via the output contact pad 900 . . . , and is also connected to the input wiring 600 . . . via the input contact pad 1000 . . .. The detailed connection status will be described later.

[0014] The FPC 800 supplies data signals and power to the input wiring 600 . . . and is connected to an external circuit (not illustrated) via the FPC input terminals 1100 . . . connected to an external circuit (not shown).

[0015] The output contact pads 900 . . . electrically connect the output wiring 500 . . . and the liquid crystal drive ICs 700 . . . and short-circuit to the output wiring 500 . . .. Furthermore, the input contact pads 1000 . . . electrically connect the input wiring 600 . . . and the liquid crystal drive ICs 700 . . . and short-circuit to the input wiring 600 . . .

[0016] The FPC input terminals 1100 . . . connect the FPCs 800 . . . via bump electrodes 1300 . . . and is short-circuited to the input wiring 600 . . .

[0017] The output wiring 500 . . . , the input wiring 600 . . . , the output contact pads 900 . . . , the input contact pads 1000 . . . , and the FPC input terminals 1100 . . . are formed from the same conductor as the panel electrode wiring (not illustrated) that forms the display unit 400.

[0018] Due to the above configuration, the liquid crystal display device 100 generates data signals and scanning signals in the liquid crystal drive ICs 700 . . . based on image information from an external circuit, and displays an image on the display unit 400.

[0019] Next, the connection state between the liquid crystal drive IC 700 and the liquid crystal panel 200 will be described in more detail.

[0020] As illustrated in FIG. 19, the liquid crystal drive IC 700 is connected to the output wiring 500 . . . and the input wiring 600 . . . via bump electrodes 1300 . . . formed on the bottom of the liquid crystal drive IC 700 (on the other side of the page) and ACF 1400 also formed on the bottom of the liquid crystal drive IC 700.

[0021] Note that in FIG. 19, in order to clarify the connection state of the liquid crystal drive IC 700, the output wiring 500 . . . and the output contact pads 900 . . . are illustrated as being continuously molded, and the input wiring 600 . . . and the input contact pads 1000 . . . are illustrated as being continuously molded. However, in reality, as illustrated in FIG. 18, the output contact pads 900 . . . are formed, for example, in an octagonal shape, at the tip of the output wiring 500 . . . , and input contact pads 1000 . . . are formed, for example, in an octagonal shape, at the tip of the input wiring 600 . . ..

[0022] That is, as illustrated in FIG. 20, the ACF 1400 is sandwiched between the liquid crystal drive IC 700, the output wiring 500, the input wiring 600, and the liquid crystal panel 200. Thus, the liquid crystal drive IC 700 is fixed to the liquid crystal panel 200.

[0023] In addition, metal films 1500 . . . formed on the output contact pad 900 and the input contact pad 1000 and the bump electrodes 1300 . . . formed on the back surface of the liquid crystal drive IC 700 are electrically connected by conductive particles in the ACF 1400. Thus, the liquid crystal drive IC 700, the output wiring 500, and the input wiring 600 are electrically connected.

[0024] Furthermore, the ACF 1400 shields the connection portions between the bump electrodes 1300 . . . and the metal films 1500 . . .. As a result, the ACF 1400 serves as a light shielding film that prevents the liquid crystal drive IC 700 from malfunctioning due to photovoltaic power generated in the liquid crystal panel 200 (FIG. 17).

[0025] A resin mold 1700 is provided so as to cover the upper part of the output wiring 500 and the input wiring 600 and the side surfaces of the ACF 1400 and the liquid crystal drive IC 700.

[0026] In this way, the resin mold 1700 prevents the output wiring 500 . . . via bump electrodes 1300 . . . from being exposed and corroding.

[0027] Next, an electrical connection process between the liquid crystal panel 200 and the liquid crystal drive IC 700 will be described.

[0028] First, the ACF 1400 is crimped on the output wiring 500 and the input wiring 600. While heating the ACF 1400, the liquid crystal drive IC 700 is crimped on the ACF 1400 by using a tool head.

[0029] As a result, the ACF 1400 is sandwiched between the output contact pads 900 and the input contact pads 1000 and the bump electrodes 1300 . . . formed on the liquid crystal drive IC 700. *Here,* the ACF 1400 contains conductive particles, and thus the output contact pad 900 and the input contact pad 1000 are electrically connected to the bump electrodes 1300 . . ..

[0030] Then, a resin mold 1700 is provided on the side face of the liquid crystal drive IC 700. Thus, corrosion of the output wiring 500 and the input wiring 600 is prevented.

[0031]

[Problem to Be Solved by Invention] Recently, drive ICs such as liquid crystal drive ICs of various sizes have been become commercially available. Therefore, the arrangement of bump

electrodes in the drive IC is often different for each product, and the need to produce a display device using the drive IC with different standards is increased.

[0032] However, the bump electrode of the COG type drive IC and a plurality of contact pads provided in the connection region of the drive IC are in one-to-one positional relationship, and the pattern design is dedicated to each drive IC to be mounted.

[0033] Therefore, in order to mount a drive IC having a different bump electrode arrangement, it is necessary to change the design such as the position of the contact pad. Thus, there is a problem in that the manufacturing costs increase.

[0034] The present invention is considered in light of the above problems, and an object thereof is to provide a display device capable of mounting various driving ICs at a low cost and a method for manufacturing such.

[0035]

[Means for Solving Problem] In order to solve the foregoing problems, the display device of the present invention is provided with a driving IC mounted on a board via an adhesive layer, bump electrodes formed on the board side of the drive IC, and wiring having contact pads at its tip portions that face the bump electrodes, wherein the display device is further provided with a protective film formed to cover the wiring, and an opening having an area larger than the bump electrodes is formed in the protective film so as to surround the connection portion between the bump electrodes and the contact pads.

[0036] That is, in recent years, drive ICs of various sizes have been commercially available. Therefore, the arrangement of bump electrodes in the drive IC is also often different from product to product.

[0037] When changing the design such as the position of the contact pad to mount a drive IC having a different bump electrode arrangement, this may lead to increased manufacturing costs.

[0038] *Therefore,* in the present invention, an opening having an area larger than that of the bump electrode is formed in a protective film that covers the wiring so as to surround the connection portion between the bump electrode and the contact pad.

[0039] According to the above configuration, a gap is formed between the bump electrode and the opening. That is, even when mounting a drive IC having a different disposition of bump electrodes, the bump electrodes and the contact pads can be electrically connected without changing the position of the contact pads or the shape of the opening.

[0040] Therefore, various drive ICs can be mounted, and the manufacturing costs can be reduced.

[0041] Furthermore, in order to solve the problems described above, the display device of the present invention has, in the configuration described above, the opening is a rectangle with a longer side in the short direction or long direction of the driving IC.

[0042] That is, the bump electrodes of the drive IC are often arranged side by side along the short direction and the long direction of the drive IC. Therefore, in the drive ICs of different types, the interval between the bump electrodes in the short direction or the long direction of the drive IC is often different.

[0043] Therefore, in particular, in the present invention, the openings are formed such that the sides of the driving IC in the short direction or long direction are long rectangles.

[0044] Thus, different types of drive ICs can be mounted to accurately correspond to the interval of bump electrodes in the short direction or long direction of the drive IC.

[0045] As such, in addition to the effect of the display device of the above configuration, instances of design changes made to mount different types of drive ICs are reduced, reliably achieving reduction in manufacturing costs.

[0046] Furthermore, in order to solve the foregoing problems, in the above configuration, the display device of the present invention has the opening formed in plurality along the wiring.

[0047] That is, in the present invention, the opening is formed in plurality along the wiring in the protective film covering the wiring.

[0048] According to the above configuration, the bump electrode and the contact pad can be electrically connected by using any of the openings formed in the plurality of openings. Therefore, it is possible to widen the permissible range of mountable bump electrode intervals.

[0049] As such, in addition to the effect of the display device of the above configuration, more drive ICs can be mounted without increasing manufacturing costs.

[0050] Furthermore, in order to solve the foregoing problems, for the display device of the present invention in the above configuration, the contact pads are arranged in a staggered manner, and the openings are arranged in a staggered manner corresponding to the contact pads.

[0051] According to the above configuration, the contact pads are disposed in a staggered manner on the board. Therefore, it is possible to effectively utilize the space on the substrate and increase the area per contact pad.

[0052] As such, the connection resistance between the contact pad and the bump electrode becomes small, and power consumption of the display device can be reduced.

[0053] Moreover, the openings and the contact pads are arranged in a staggered manner, and thus it becomes possible to mount the drive IC in which the bump electrodes are disposed in a staggered manner on the substrate.

[0054] As such, in addition to the effect of the display device of the above configuration, it is possible to mount even more types of display devices without an accompanying increase in manufacturing costs.

[0055] Furthermore, in order to solve the foregoing problem, the display device of the present invention in the above

configuration is provided with an inspection pad electrically connected to the contact pad on the substrate.

[0056] According to the above configuration, the inspection pad is electrically connected to the contact pad.

[0057] Therefore, by bringing the inspection probe into contact with the inspection pad, it becomes possible to inspect the display panel via the contact pad.

[0058] As such, in addition to the effect of the display device of the above configuration, inspection of the display device can be easily performed.

[0059] Furthermore, in order to solve the foregoing problems, in the display device of the present invention in the above configuration, the adhesive layer is provided so as to cover the entire region in the connection portion between the bump electrode and the contact pad.

[0060] According to the above configuration, the entire region of the connection portion between the bump electrode and the contact pad is covered by the adhesive layer.

[0061] Thus, corrosion can be prevented in the connection portion between the bump electrode and the contact pad.

[0062] Furthermore, in order to solve the foregoing problems, the method for manufacturing the display device of the present invention is, a method for manufacturing a display device of any of the above configurations, wherein the entire adhesive layer is heated and cured after the bump electrode and the contact pad are connected.

[0063] That is, when a display device is mounted on a passenger car or the like, it may be used in an environment of high temperature and high humidity, where the connection portion between the bump electrode and the contact pad is prone to corrosion.

[0064] *Therefore,* in the present invention, in particular, the entire adhesive layer is heat cured after the bump electrodes and contact pads are connected. Thus, the entire adhesive layer can be completely cured, and corrosion resistance can be increased in the connection portion between the bump electrode and the contact pad.

[0065] Therefore, it is possible to provide a display device that stably operates even in an environment where the connection portion is prone to corrosion.

[0066]

[Embodiments of Invention] [Embodiment 1] Embodiments of the present invention will be described as follows based on the drawings.

[0067] As illustrated in FIG. 2, the liquid crystal display device (display device) 1 of the present embodiment is provided with a liquid crystal panel 2 (substrate), a display unit 4, output wiring (wiring) 5 . . . , input wiring (wiring) 6 . . . , a liquid crystal drive ICs (drive ICs) 7 . . . , and an FPC 8.

[0068] Also, as illustrated in FIG. 3, the connection area 3 of the liquid crystal drive ICs 7 . . . has output contact pads (contact pads) 9 . . . , input contact pads (contact pads) 10 . . . , and FPC input terminals 11 . . . formed therein. The configuration of each component is the same as that of the conventional liquid crystal display device 100 described based on FIG. 17 and FIG. 18, except for the connection state between the liquid crystal drive ICs 7 . . . and the liquid crystal panel 2, which is a feature of the present invention, so description thereof will be omitted.

[0069] Next, the connection state between the liquid crystal drive IC 7 and the liquid crystal panel 2 will be described in more detail.

[0070] As illustrated in FIG. 4, the liquid crystal drive IC 7 is rectangular and is connected to the output wiring 5... and the input wiring 6 . . . via bump electrodes 13 . . . made of a metal such as Au formed on the bottom (the other side of the page) of the liquid crystal drive IC 7, and an ACF (adhesive layer) 14 also formed on the bottom of the liquid crystal drive IC 7.

[0071] Note that in FIG. 4, in order to clarify the connection state of the liquid crystal drive IC 7, the output wiring 5 . . . and the output contact pads 9 . . . are illustrated as being continuously molded, and the input wiring 6 . . . and the input contact pads 10 . . . are illustrated as being continuously molded. However, in reality, as illustrated in FIG. 3, the output contact pads 9 . . . are formed, for example, in an octagonal shape, at the tip of the output wiring 5 . . . , and input contact pads 10 . . . are formed, for example, in an octagonal shape, at the tip of the input wiring 6 . . .. This is also the case in the descriptions of FIG. 8 to FIG. 14, which will be discussed later.

[0072] The output wiring 5... and the input wiring 6 . . . (on the front side of the paper) are covered by a protective film 12 made of silicon nitride or the like.

[0073] Furthermore, rectangular openings 15 . . . are formed in the protective film 12 . . . above the output contact pads 9 . . . and the input contact pads 10 . . . so as to surround the bump electrodes 13.

[0074] Of the openings 15 . . . , those formed above the output contact pads 9 . . . are formed in a rectangular shape slightly larger than the bump electrode 13.

[0075] Furthermore, the openings 15 . . . formed above the input contact pads 10... are formed in a rectangular shape with their long sides extending in the short direction of the liquid crystal drive IC 7. For example, in contrast to the bump electrode 13 having a size of approximately 50×100 (μm), an opening 15 having a size of approximately 70×310 (μm) is formed.

[0076] Note that in reality, the metal film 16, which will be described later, is sandwiched between the bump electrodes 13 . . . and output contact pads 9 . . . and the input contact pads 10 . . . , but in FIG. 4, the metal film 16 is omitted from the illustration in order to clarify the configuration of the opening 15 . . . This is also the case in the descriptions of FIG. 8 to FIG. 14, which will be discussed later.

[0077] Next, the connection state between the liquid crystal drive IC 7 and the liquid crystal panel 2 will be described based on FIG. 1.

[0078] As illustrated in FIG. 1, an ACF 14 is sandwiched between the liquid crystal drive IC 7, the output wiring 5, the input wiring 6, and the liquid crystal panel 2. Thus, the liquid crystal drive IC 7 is fixed to the liquid crystal panel 2.

[0079] Furthermore, a metal film 16 . . . is formed on the output contact pad 9 and the input contact pad 10 so as to close the opening 15. The metal films 16 . . . formed in this way and the bump electrodes 13 . . . formed on the back surface of the liquid crystal drive IC 7 are electrically connected by conductive particles in the ACF 14. Thus, the liquid crystal drive IC 7 is electrically connected to the output wiring 5 and the input wiring 6.

[0080] The metal film 16 is an ITO (Indium Tin Oxide: indium tin oxide) film or an A1 (aluminum) film.

[0081] Note that the output contact pad 9 and the input contact pad 10 may be provided without the metal film 16. That is, as illustrated in FIG. 5, it is also possible to electrically connect the bump electrodes 13 . . . to the output contact pads 9 and input contact pads 10 by directly contacting them.

[0082] As illustrated in FIG. 1, the ACF 14 covers the connection portion between the bump electrodes 13 . . . and the metal films 16 . . .. As a result, the connection portion between the bump electrode 13... and the metal film 16... is prevented from corroding. The ACF 14 serves as a light shielding film that prevents the liquid crystal drive IC 7 from malfunctioning due to photovoltaic power generated in the liquid crystal panel 2 (FIG. 2).

[0083] The protective film 12 is provided so as to cover the upper surfaces of the output wiring 5 and the input wiring 6. Thus, the protective film 12 prevents the output wiring 5 and the input wiring 6 from being exposed and corroding.

[0084] Furthermore, as illustrated in FIG. 6, a second protective film 12a may be provided below the protective film 12. In this configuration, the metal film 16 on the input contact pad 10 is formed on the second protective film 12a. Thus, it is also possible to electrically connect the bump electrode 13 to the input contact pad 10.

[0085] Furthermore, as illustrated in the same drawing, it is also possible to provide an output wiring 5 between the protective film 12 and the second protective film 12a. In this case, it can be said that the metal film 16 itself is an output wiring 5. Thus, the bump electrode 13 and the output wiring 5 are brought into direct contact with each other, creating an electrical connection.

[0086] Note that in the present embodiment, the opening 15 is provided only on the output contact pad 9 and the input contact pad 10 but is not necessarily limited to this configuration. That is, as long as the connection area between the bump electrode 13 and the metal film 16 can be secured, the opening 15 may be provided on the output wiring 5 or the input wiring 6.

[0087] Next, a connection method of the liquid crystal drive IC 7 will be described.

[0088] First, as illustrated in FIG. 1, the protective film 12 is provided on the output wiring 5 and the input wiring 6, and the metal films 16 . . . are formed to close the openings 15 . . . to be formed.

[0089] Then, the ACF 14 is thermocompression-bonded on the protective film 12. Then, the bump electrode 13 is aligned with the output contact pad 9 and the core contact pad 10 by using an alignment device that is not illustrated in the drawing.

[0090] After the alignment is completed, the liquid crystal drive IC 7 is crimped onto the ACF 14 using a tool head while heating the ACF 14. At this time, the heating temperature is preferably about 180°C, and it is preferable to crimp at about 70 MPa.

[0091] The liquid crystal drive IC 7 and the liquid crystal panel 2 can be connected by the above process.

[0092] Next, the effect of connecting the liquid crystal drive IC 7 as in the above configuration will be described.

[0093] For example, a case where a liquid crystal drive IC 7 in which the interval in the short direction of the liquid crystal drive IC 7 between bump electrodes 13 . . . is different from the liquid crystal drive IC 7 illustrated in FIG. 1 is connected to a liquid crystal panel 2 , as illustrated in FIG. 7, will be described.

[0094] In such a case, as described above, the opening 15 on the input contact pad 10 is formed into a long rectangle in the short direction of the IC 7 for driving the liquid crystal A metal film 16 for closing the opening 15 on the core contact pad 10 is also formed so as to be longer in the short direction of the liquid crystal drive IC 7.

[0095] That is, even when the intervals between the bump electrodes 13 . . . are different, the bump electrodes 13 on the input contact pad 10 and the metal film 16 can be electrically connected. Thus, the liquid crystal drive IC 7 in which a bump electrode interval differs may be connected to the input and output wiring 5 and 6 without changing the position of the contact pad, and it is possible to achieve a reduction in manufacturing costs.

[0096] Note that in the present embodiment, as illustrated in FIG. 4, the opening 15 formed on the input contact pad 10 is formed so as to be longer in the short direction of the liquid crystal drive IC 7 but is not necessarily limited thereto.

[0097] That is, as illustrated in FIG. 8, the openings 15 . . . formed on the input contact pads 9 . . . may be configured to be elongated in the short direction of the liquid crystal driver IC 7. This allows the liquid crystal driving IC 7 to be connected to the input and output wiring 5 and 6 without changing the position of the contact pad, even when the interval between the bump electrodes 13 . . . is different, and also reduces manufacturing costs.

[0098] Alternatively, as illustrated in FIG. 9, both the openings 15 . . . formed on the input contact pads 9 . . . and the openings 15 . . . formed on the input contact pads 10 . . . may be formed so that they are elongated in the short direction of the liquid crystal drive IC 7. This makes it possible to increase the tolerance for the interval between the bump electrodes 13 . . . that can be

connected to the liquid crystal panel 2, making it possible to connect more liquid crystal driver ICs 7 to the liquid crystal panel 2.

[0099] Alternatively, as illustrated in FIG. 10, the openings 15 . . . formed on the input contact pads 10 . . . may be formed in a rectangular shape having an area about twice that of the bump electrode 13. This makes it possible to increase the tolerance for the interval between the bump electrodes 13 . . . that can be connected to the liquid crystal panel 2, making it possible to connect more liquid crystal driver ICs 7 to the liquid crystal panel 2.

[0100] Furthermore, in the present embodiment, as illustrated in FIG. 4, the output contact pads 9 . . . and the input contact pads 10 . . . are arranged side by side in the long direction of the liquid crystal driving IC 7 but are not necessarily limited to this configuration.

[0101] That is, as illustrated in FIG. 11, a part of the input contact pad 10 and an opening 15 formed on it may be arranged in the short direction of IC 7 for driving the liquid crystal.

[0102] Thus, the liquid crystal drive IC 7 in which a part of the bump electrode 13 is arranged in a short direction can be connected to the liquid crystal panel 2 (FIG. 2), and the area of each input contact pad 10 can be increased. As such, the connection resistance between the input contact pad 10 and the bump electrode 13 becomes small, and power consumption may be reduced.

[0103] [Embodiment 2] Another embodiment of the present invention is as follows when described based on the drawings. Note that for convenience of description, the same member numerals are assigned in the same configuration as embodiment 1, and description thereof is omitted.

[0104] Furthermore, the configuration of the present embodiment is the same as that of the embodiment 1 described above, except that a plurality of openings 15 are provided for one protective film 12, as described later. Therefore, only this portion will be described below.

[0105] As illustrated in FIG. 12, the protective films 12 . . . on each output contact pad 9 . . . has two openings 15 . . . arranged side by side along the output wiring 5 . . . They are arranged side by side.

[0106] By configuring as above, even when the interval between the bump electrodes 13 . . . in the short direction of the liquid crystal drive IC 7 is different, any of the multiple openings 15 formed can be used to electrically connect the bump electrode 13 . . . on the output contact pad 9 . . . to the metal film (not illustrated). Thus, the liquid crystal drive IC 7 in which a bump electrode interval differs may be connected to the input and output wiring 5 and 6 without changing the position of the contact pad, and it is possible to achieve a reduction in manufacturing costs.

[0107] Note that in the present embodiment, the configuration is not limited to the configuration provided with two openings 15 and may be provided with three or more openings 15. Furthermore, the configuration is not limited to a configuration in which a plurality of openings 15 are provided on the output contact pad 9, and may be a configuration in which a plurality of openings 15 are provided on the input contact pad 10.

[0108] [Embodiment 3] Yet another embodiment of the present invention is as follows when described based on the drawings. Note that for convenience of description, the same member numerals are assigned in the same configuration as the above embodiments, and the description thereof is omitted.

[0109] Furthermore, in the present embodiment, the configuration is the same as that of embodiment 1 described above except that as described below the output contact pad 9 and the opening 15 formed thereon are disposed in a staggered manner. Therefore, this portion will be described below.

[0110] As illustrated in FIG. 13 the output contact pads 9 . . . and the openings 15 . . . formed thereon are arranged in a two-step staggered manner. Moreover, the openings 15... are formed into a rectangular shape such that the short direction of the liquid crystal drive IC 7 is longer.

[0111] By configuring as above, when mounting a liquid crystal drive IC 7, in which a plurality of the bump electrodes 13 . . . is arranged in a staggered manner, onto a liquid crystal panel, even when the interval between the bump electrodes 13 . . . differs, the bump electrodes 13 . . . on the output contact pads 9 . . . and the metal film (not illustrated) may be electrically connected. Thus, the IC for liquid crystal driving 7 in which a bump electrode interval differs may be connected to the input and output wiring 5 and 6 without changing the position of the contact pad, and it is possible to achieve a reduction in manufacturing costs.

[0112] Moreover, it is possible to increase the area of each output contact pad 9. Therefore, the connection resistance between the output contact pad 9 and the bump electrode 13 becomes small, and power consumption may be reduced.

[0113] Note that the input contact pad 10 may be arranged in a staggered manner, and is not necessarily limited to the above configuration. Furthermore, the contact pad is not necessarily limited to being arranged in a two-step staggered manner, and may be arranged in a three-step staggered manner.

[0114] Moreover, as described in embodiment 2, it is possible to arrange a plurality of the opening 15 in parallel along the input and output wiring 5 and 6.

[0115] [Embodiment 4] Another embodiment of the present invention is described as follows based on the drawings. Note that for convenience of description, the same member numerals are assigned in the same configuration as the above embodiments, and description thereof is omitted.

[0116] Furthermore, in the present embodiment, the configuration is the same as that of embodiment 1 described above except for the configuration described below. Therefore, this portion will be described below.

[0117] That is, in the present embodiment, the inspection pads 17 . . . are arranged in parallel in the long direction of the IC for liquid crystal driving 7 on the liquid crystal panel 2 (FIG. 2) as illustrated in FIG. 14 and the inspection pads 17 . . . are electrically connected to the output contact pads 9 . . . by the output wiring 5.... Moreover, for the protective films 12... on the output wiring 5..., openings for inspection 18... are formed on the inspection pads 17 . . . .

[0118] Due to the above configuration, it is possible to insert an inspection probe (not illustrated) from the openings for inspection 18..., electrically connect the inspection probe and the inspection pads 17 . . . , and inspect the display panel 2.

[0119] Note that in the present embodiment, the output contact pads 9 . . . are arranged in a two-step staggered manner as in embodiment 3. Furthermore, the openings 15 . . . are formed into a rectangular shape in which the short direction of the liquid crystal drive IC 7 is long.

[0120] Thus, it is possible to achieve an effect similar to the configuration of embodiment 3 above, that is, connecting the liquid crystal drive IC 7 in which a bump electrode interval differs to the input and output wiring 5 and 6 without changing the position of the contact pad, and reducing manufacturing cost. Moreover, the connection resistance between the output contact pad 9 and the bump electrode 13 becomes small, and power consumption may be reduced.

[0121] Note that when the inspection pads 17 . . . are arranged at a narrow pitch and it is difficult to electrically connect the inspection probe and inspection pads 17 . . . , it is also perform an inspection of the display panel by connecting the inspection probe to the output contact pads 9 . . . from the openings 15 . . . .

[0122] [Embodiment 5] Another embodiment of the present invention is described as follows based on the drawings. Note that for convenience of description, the same member numerals are assigned in the same configuration as the above embodiments, and description thereof is omitted.

[0123] Incidentally, the width of the liquid crystal drive IC 7 in embodiment 1 described based on FIG. 7 is such a length that covers the output contact pad 9 but does not cover the input contact pad 10. Therefore, the ACF 14 formed on the input contact pad 10 may not completely cover the metal film 16 closing the opening 15 formed on the input contact pad 10.

[0124] In such a case, a resin mold (not illustrated) is arranged so as to cover an upper surface of the metal film 16 and a side surface of the liquid crystal drive IC 7. Thus, corrosion of the metal film 16 may be prevented, and the connection portion between the metal film 16 and the input contact pad 10 may be completely shielded from light. Therefore, it is possible to ensure the operational reliability of the liquid crystal display device 1.

[0125] Alternatively, it is also possible to ensure the operational reliability of the liquid crystal display device 1 by the configuration of the present embodiment described below.

[0126] That is, as illustrated in FIG. 15, the ACF 14 is arranged so as to block all of the metal film 16 on the input contact pad 10. Thus, corrosion of the metal film 16 may be prevented, and the connection portion between the metal film 16 and the input contact pad 10 may be completely shielded from light without providing a mold resin. Therefore, it is possible to ensure the operational reliability of the liquid crystal display device 1.

[0127] Note that the liquid crystal drive IC 7 is heated and crimped to the ACF 14 using a tool head. Therefore, in a portion of the ACF 14 separated from the IC liquid crystal drive IC 7, that is, in a peripheral edge part 14a of the ACF 14, the ACF 14 may be insufficiently heated and in an uncured state.

[0128] In such an uncured state, when installed in a vehicle or the like, there is a high risk that the connection portion of the bump electrode 13 and the input and output contact pads 9 and 10 will corrode due to the usage environment being high temperature and high humidity.

[0129] *As such,* as illustrated in FIG. 16, after arranging the ACF 14 so as to block all of the metal film 16 on the input contact pad 10 and connecting the bump electrodes 13 . . . and the output contact pad 9 and the input contact pad 10, the entire ACF 14 is spot-heated by IR (infrared radiation: infrared rays) or the like.

[0130] Thus, the peripheral edge part 14a of the ACF 14 may be completely cured. Therefore, even in an environment where there is a high risk that the connection portion of the bump electrode 13 and the input and output contact pads 9 and 10 will corrode, it is possible to reliably prevent corrosion and stably operate the liquid crystal display device 1.

[0131] Note that it is also possible to perform the above spot heating at the same time as connecting the bump electrodes 13 . . . and the output contact pad 9 and the input contact pad 10. It is also possible to heat the ACF 14 by atmosphere heating using post-curing instead of spot heating. Note that post-curing refers to a reflow furnace or oven or the like for welding solder used to mount components on printed circuit boards.

[0132] Furthermore, in the above embodiments, the present invention has been described when applying to a liquid crystal display device as a display device, but it is not necessarily limited to this. That is, it is also possible to apply the present invention to a display device provided with a display panel such as an organic EL and a drive IC (integrated circuit) that drives the display panel.

[0133] Note that the display device of the present invention may be configured as a display device provided with a display panel in which a light modulation layer is held between a pair of substrates, and a drive IC that is electrically connected to the display panel via an adhesive layer, the display device being composed of a plurality of a bump electrode provided on the drive IC, a contact pad provided on one substrate of the display panel disposed so as to face the bump electrodes, an uppermost layer protective film provided on the contact pad, and an opening provided on the uppermost layer protective film, the opening

being disposed on the contact pad and extended in the short direction of the drive IC.

[0134] According to the above configuration, when performing an electrical connection between the drive IC, which has differing intervals for bump electrodes for input and for output, and the display panel to each other, this may be performed without an accompanying change in the design of the connection region of the drive IC of the display panel, such as a position change of the output or input contact pad of the drive IC. Consequently, standardization of the drive IC may be achieved, and it is possible to cut material costs.

[0135] Furthermore, in the display device of the above configuration, the display device of the present invention may be configured such that the opening is extended in the long direction of the IC for driving as well.

[0136] According to the above configuration, drive ICs, wherein the interval between the bump electrodes of the drive ICs is different from each other in both the short direction and long direction of the drive ICs, may be connected to the same display panel without an accompanying change in the design of the display panel.

[0137] Furthermore, in the display device of the above configuration, the display device of the present invention may be configured such that the contact pads and the openings disposed on the contact pads are disposed in a staggered manner.

[0138] According to the above configuration, the interval between adjacent output contact pads and the openings may be sufficiently secured, so that the output contact pads and the openings may be disposed at a narrow pitch. Consequently, the interval of each bump electrode arranged more on the input or output side makes it is possible to connect a small drive IC having a narrower pitch. Furthermore, it is possible to connect a drive IC having a larger number of bump electrodes.

[0139] Furthermore, in the display device of the above configuration, the display device of the present invention may be configured provided with an inspection pad electrically connected to the contact pad.

[0140] According to the above configuration, an inspection may be performed on the display panel by connecting the inspection probe to the inspection pad via the openings arranged in a row. Moreover, electrical connection with the drive IC may be achieved using the openings arranged in a staggered manner.

[0141] Furthermore, when the inspection pads are disposed at a narrow pitch and it is difficult to connect the inspection probe and the inspection pad, a panel inspection may be performed by connecting the inspection probe to the output contact pad via the openings disposed in a staggered manner.

[0142] Furthermore, in the display device of the above configuration, the display device of the present invention may be configured such that the openings are covered by the adhesive layer.

[0143] According to the above configuration, there is no region in which a contact pad is exposed, so corrosion of the contact pads may be prevented.

[0144]

[Effect of Invention] As described above, in the display device of the present invention, an opening having an area larger than that of the bump electrode is formed on the protective film to surrounded the connection portion between the bump electrode and the contact pad.

[0145] According to the above configuration, even when mounting a drive IC having a different disposition of bump electrodes, the bump electrodes and the contact pads can be electrically connected without changing the position of the contact pads or the shape of the opening.

[0146] As such, an effect is exhibited in which various drive ICs can be mounted and a reduction in manufacturing costs can be achieved.

[0147] Furthermore, in the display device of the present invention, as described above, in the above configuration, the opening is a rectangle having a long side in the short direction or long direction of the drive IC.

[0148] According to the above configuration, different types of drive ICs can be mounted to appropriately correspond to the interval of bump electrodes in the short direction or long direction of the drive IC.

[0149] As such, in addition to the effect of the display device of the above configuration, an effect is exhibited in which instances of design changes made to mount different types of drive ICs are reduced and a reduction in manufacturing costs can be achieved.

[0150] Furthermore, as described above, in the above configuration, the display device of the present invention has a plurality of the opening formed along the wiring.

[0151] That is, in the present invention, a plurality of the opening is formed along the wiring in the protective film covering the wiring.

[0152] According to the above configuration, it is possible to widen the permissible range of mountable bump electrode intervals.

[0153] As such, in addition to the effect of the display device of the above configuration, an effect is exhibited in which more drive ICs can be mounted without increasing manufacturing costs.

[0154] Furthermore, as described above, for the display device of the present invention in the above configuration, the contact pads are arranged in a staggered manner, and the openings are arranged in a staggered manner corresponding to the contact pads.

[0155] According to the above configuration, it is possible to effectively utilize the space on the substrate and increase the area per contact pad.

[0156] As such, in addition to the effect from the display device of the above configuration, an effect is exhibited in which the

connection resistance between the contact pad and the bump electrode is reduced, and the power consumption of the display device can be reduced.

[0157] Moreover, because the openings are arranged in a staggered manner, it becomes possible *t*o mount the drive IC in which the bump electrodes are disposed in a staggered manner on the substrate.

[0158] As such, in addition to the effect of the display device of the above configuration, an effect is exhibited in which it is possible to mount even more types of display devices without an accompanying increase in manufacturing costs.

[0159] Furthermore, as described above, the display device of the present invention in the above configuration is provided with an inspection pad electrically connected to the contact pad on the substrate.

[0160] According to the above configuration, by bringing the inspection probe into contact with the inspection pad, it becomes possible to inspect the display panel via the contact pad.

[0161] As such, in addition to the effect of the display device of the above configuration, an effect is exhibited in which inspection of the display device can be easily performed.

[0162] Furthermore, as described above, in the display device of the present invention in the above configuration, the adhesive layer is provided so as to cover the entire region in the connection portion between the bump electrode and the contact pad.

[0163] According to the above configuration, the entire region of the connection portion between the bump electrode and the contact pad is covered by the adhesive layer.

[0164] Thus, in addition to the effects of the display device of the above configuration, corrosion can be reliably prevented in the connection portion between the bump electrode and the contact pad.

[0165] Furthermore, a method for manufacturing the display device of the present invention is, as described above, a method for manufacturing a display device of any of the above configurations*, wherein* the entire adhesive layer is heated and cured after the bump electrode and the contact pad are connected.

[0166] According to the above method, corrosion resistance can be increased in the connection portion between the bump electrode and the contact pad.

[0167] As such, an effect is exhibited in which is possible to provide a display device that operates stably even in an environment where the connection portion is prone to corrosion.

[Brief Description of Drawings]

[FIG. 1] A cross-sectional view of one embodiment of a display device in the present invention, and a cross-sectional view of a B-B' line arrow view of the display device in FIG. 4.

[FIG. 2] A plan view illustrating a schematic configuration of one embodiment of the display device of the present invention.

[FIG. 3] A plan view illustrating the display device of FIG. 2 in a state in which the drive IC is removed.

[FIG. 4] A plan view illustrating an enlarged A portion of the display device of FIG. 2.

[FIG. 5] A cross-sectional view illustrating yet another embodiment of the display device of the present invention.

[FIG. 6] A cross-sectional view illustrating yet another embodiment of the display device of the present invention.

[FIG. 7] A cross-sectional view illustrating a state in which the drive IC in the display device of FIG. 1 is replaced with a drive IC having a different bump electrode interval.

[FIG. 8] A plan view illustrating yet another embodiment of the display device of the present invention.

[FIG. 9] A plan view illustrating yet another embodiment of the display device of the present invention.

[FIG. 10] A plan view illustrating yet another embodiment of the display device of the present invention.

[FIG. 11] A plan view illustrating yet another embodiment of the display device of the present invention.

[FIG. 12] A plan view illustrating yet another embodiment of the display device of the present invention.

[FIG. 13] A plan view illustrating yet another embodiment of the display device of the present invention.

[FIG. 14] A plan view illustrating yet another embodiment of the display device of the present invention.

[FIG. 15] A cross-sectional view illustrating yet another embodiment of the display device of the present invention.

[FIG. 16] A cross-sectional view illustrating a state in which a peripheral edge part of the ACF is cured in the display device of FIG. 15.

[FIG. 17] A plan view illustrating a schematic configuration of a conventional display device.

[FIG. 18] A plan view illustrating the display device of FIG. 17 in a state in which the drive IC is removed.

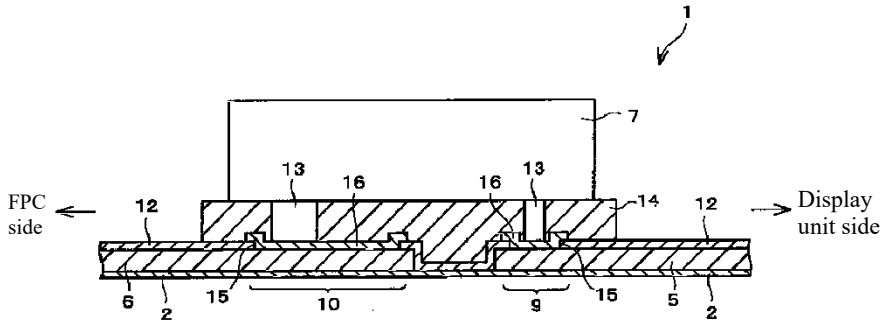
[FIG. 19] A plan view illustrating an enlarged A1 portion of the display device of FIG. 17.

[FIG. 20] A cross-sectional view of a C-C' line arrow view section of the display device of FIG. 19.

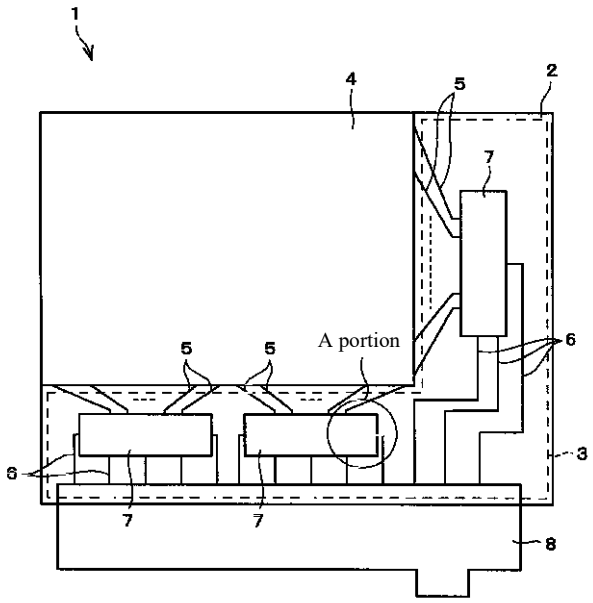
[Description of Reference Numerals]

1 Liquid crystal display device (display device)
2 Liquid crystal panel (substrate)
5 Output wiring (wiring)
6 Input wiring (wiring)
7 Liquid crystal drive IC (drive IC)
9 Output contact pad (contact pad)
10 Input contact pad (contact pad)
12 Protective film
13 Bump electrode
14 ACF (adhesive layer)
15 Opening
17 Inspection pad

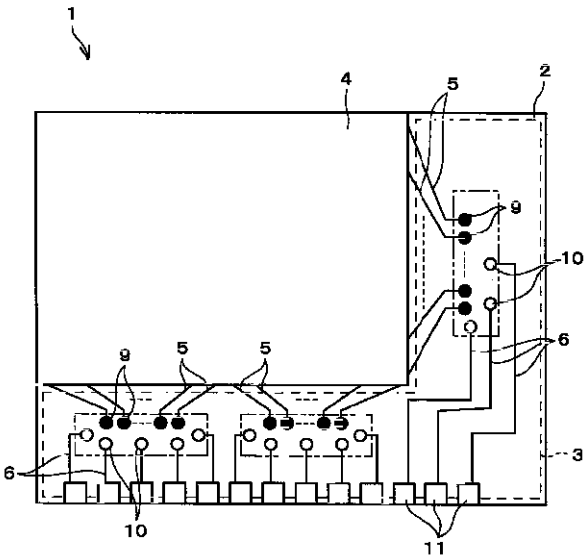
[FIG. 1]



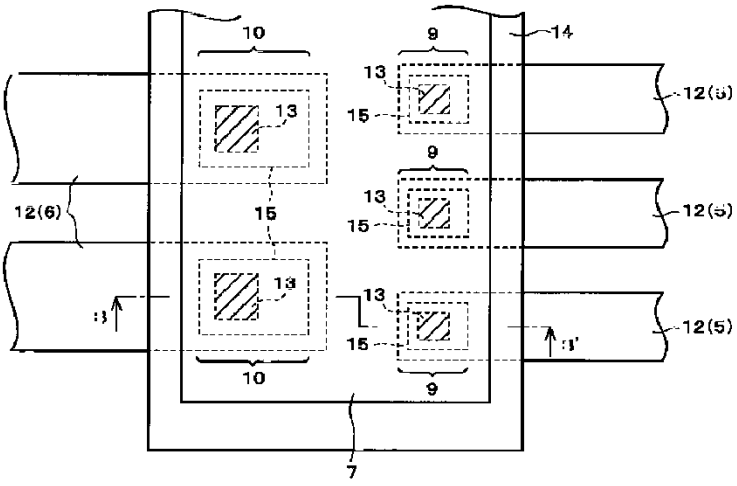
[FIG. 2]



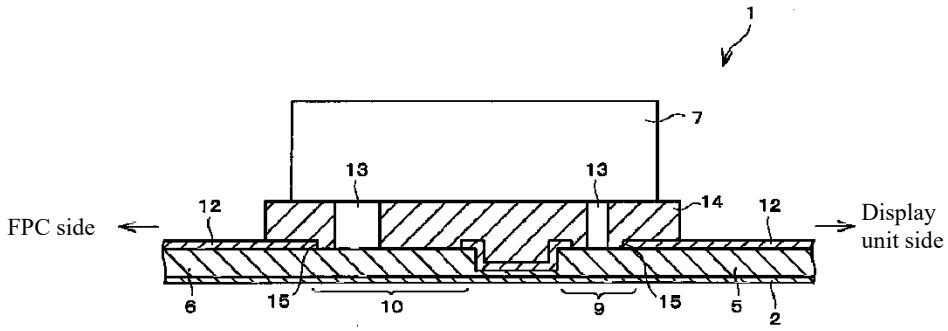
[FIG. 3]



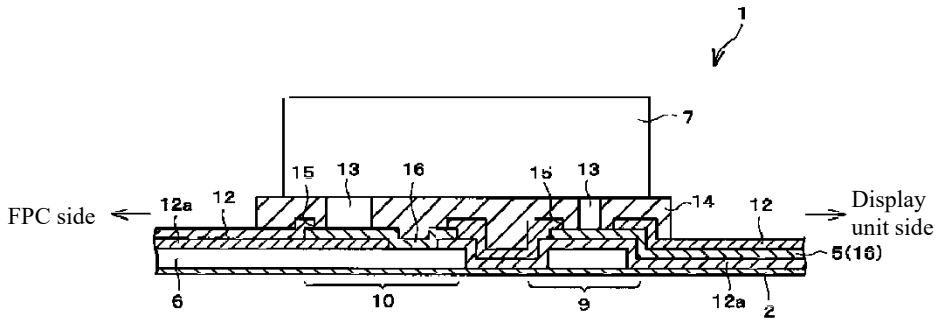
[FIG. 4]



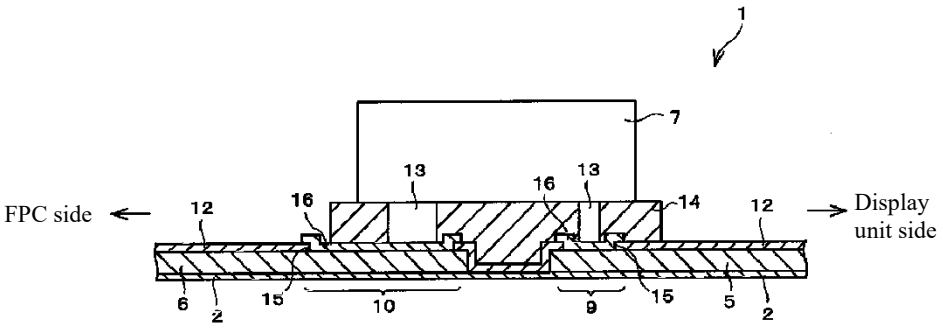
[FIG. 5]



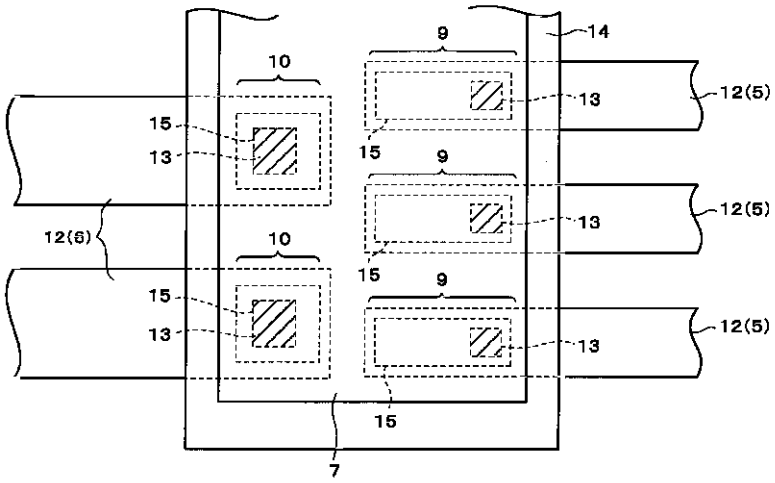
[FIG. 6]



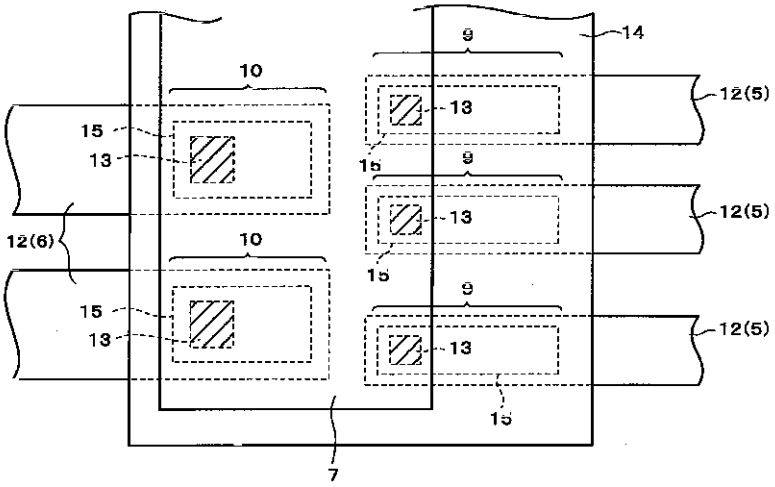
[FIG. 7]



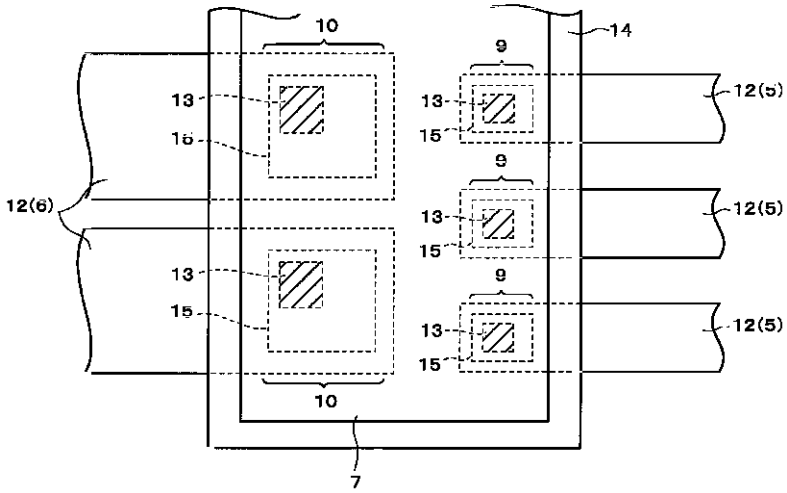
[FIG. 8]



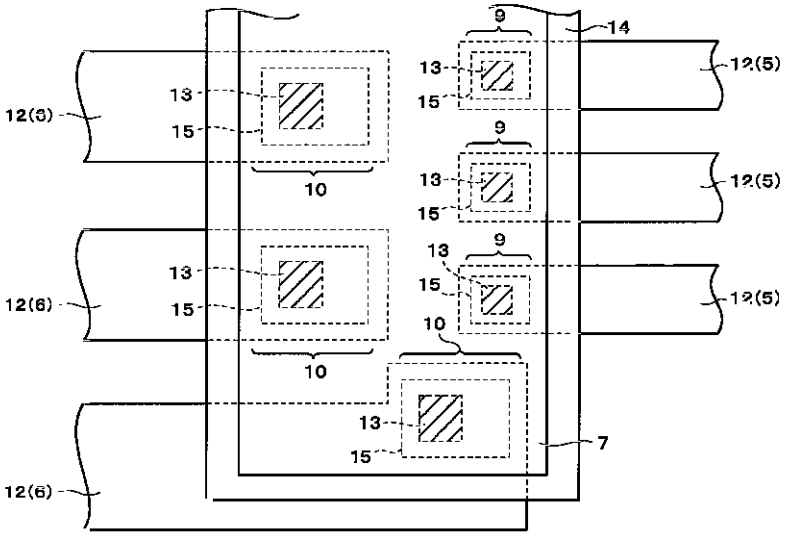
[FIG. 9]



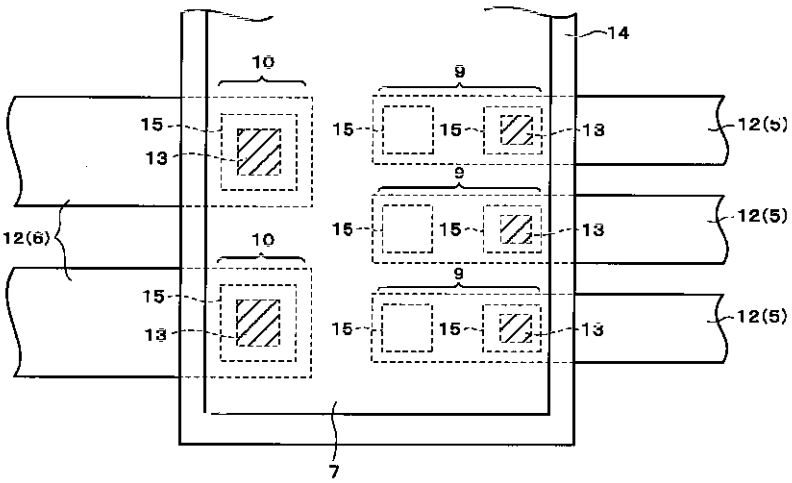
[FIG. 10]



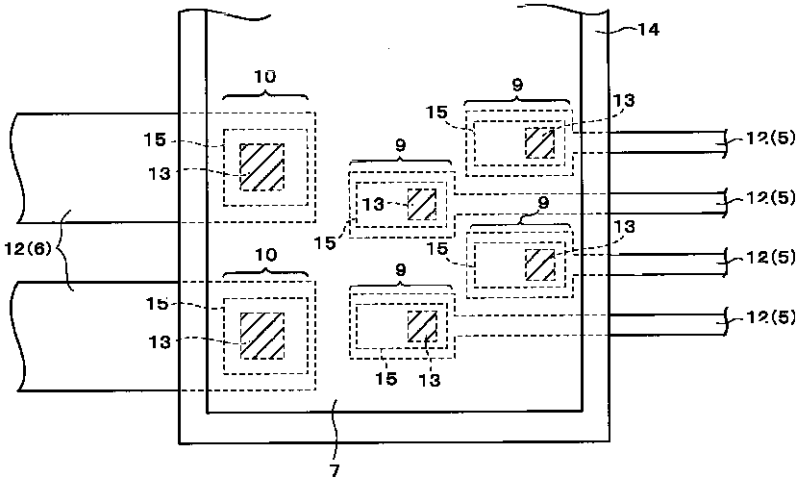
[FIG. 11]



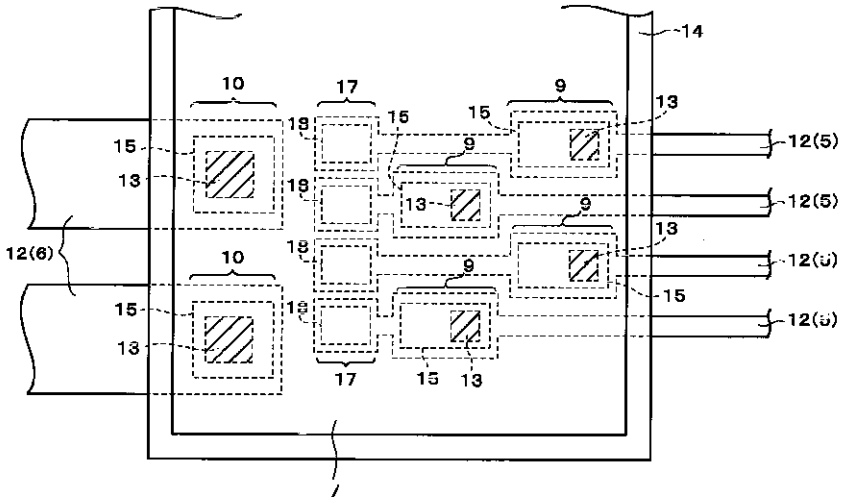
[FIG. 12]



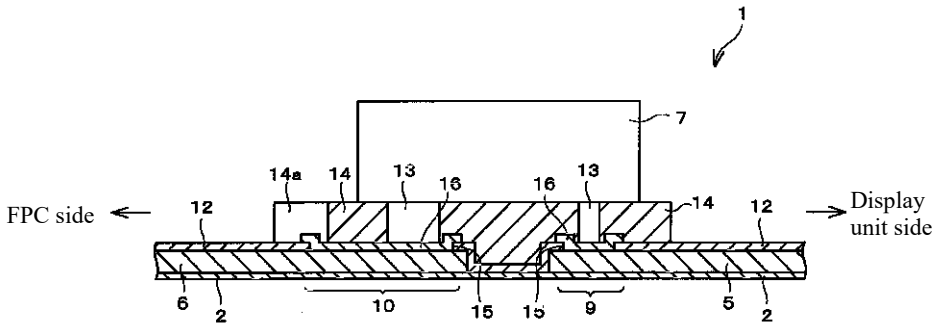
[FIG. 13]



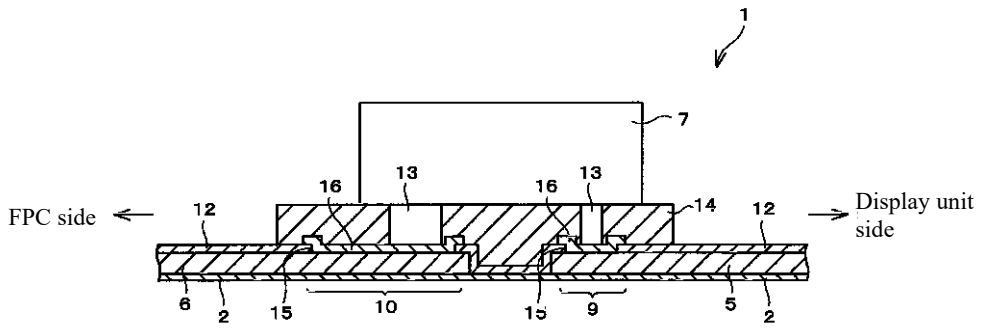
[FIG. 14]



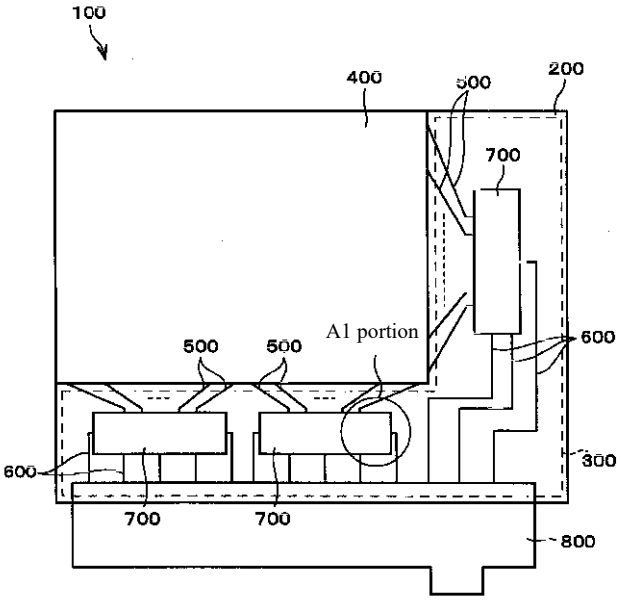
[FIG. 15]



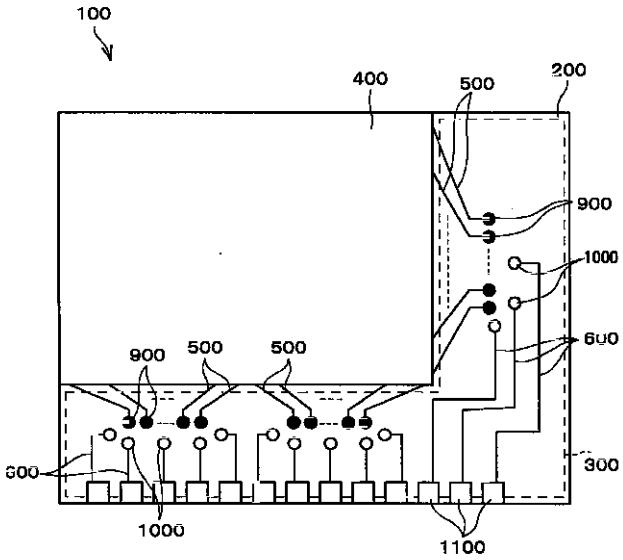
[FIG. 16]



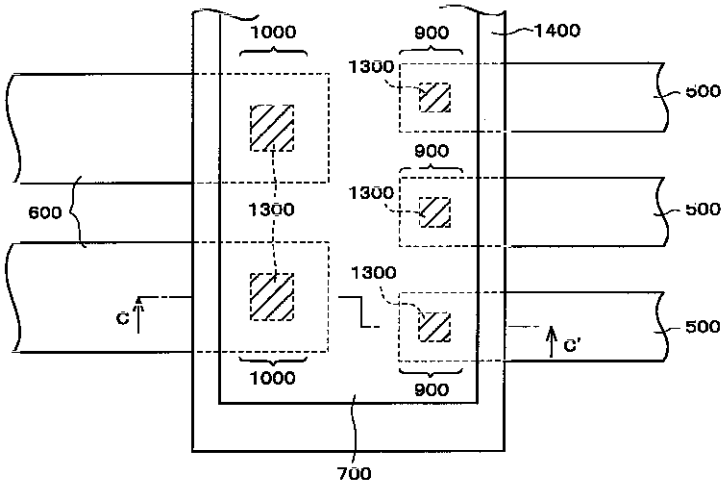
[FIG. 17]



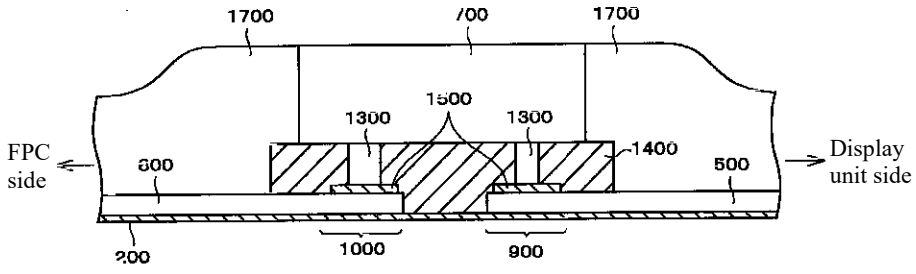
[FIG. 18]



[FIG. 19]



[FIG. 20]



Continued from front page

F Term (Reference) 2H092 GA50 GA59 GA60 JB56 JB77
NA17 NA27
5F044 KK06 KK12 LL09 QQ01