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ELECTRONIC COMPONENT AND METHOD FOR MANUFACTURING THE SAME

Abstract

An electronic component capable of improving degree of freedom in design. The electronic component comprises glass board including top surface, bottom surface, first side surface, and second side surface, outer surface conductor that is provided on at least first side surface among first side surface and second side surface and is at least a part of passive element, and terminal electrode embedded in glass board so as to be exposed from bottom surface and electrically connected to outer surface conductor. A terminal electrode penetrates glass board from first side surface to second side surface, and height dimension of glass board, which is distance between top surface and bottom surface, is smaller than width dimension of glass board, which is distance between first side surface and second side surface.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATION [0001] This application claims benefit of priority to International Patent Application No. PCT/JP2023/030131, filed Aug. 22, 2023, and to Japanese Patent Application 2022-195680 filed Dec. 7, 2022, the entire content of each are incorporated herein by reference.

BACKGROUND
Technical Field
[0002] The present disclosure relates to an electronic component and a method for manufacturing the same.
Background Art
[0003] Conventionally, as an electronic component, there is an electronic component described in JP-A-2020-174169. The electronic component includes a glass board including a bottom surface, a coil provided on the glass board, and a terminal electrode provided on the glass board and electrically connected to the coil. The bottom conductor of the coil is provided on the bottom surface of the glass board, and the terminal electrode is provided on the bottom surface of the glass board.
SUMMARY
[0004] In the conventional electronic component, since the bottom conductor and the terminal electrode are provided on the same bottom surface of the glass board, the bottom conductor and the terminal electrode interfere with each other, and the degree of freedom in designing the electronic component cannot be improved.
[0005] Therefore, the present disclosure provides an electronic component capable of improving a degree of freedom in design and a method for manufacturing the electronic component.
[0006] Accordingly, an electronic component according to an aspect of the present disclosure includes a glass board including a top surface, a bottom surface, a first side surface, and a second side surface; an outer surface conductor that is provided on at least the first side surface of the first side surface and the second side surface and is at least a part of a passive element; and a terminal electrode embedded in the glass board so as to be exposed from the bottom surface and electrically connected to the outer surface conductor. The terminal electrode penetrates the glass board from the first side surface to the second side surface, and a height dimension of the glass board, which is a distance between the top surface and the bottom surface, is smaller than a width dimension of the glass board, which is a distance between the first side surface and the second side surface.
[0007] According to the above aspect, since the first side surface on which the outer surface conductor of the passive element is provided and the bottom surface on which the terminal electrode is provided are different surfaces, the outer surface conductor and the terminal electrode can be designed without being affected by each other, and the degree of freedom in designing the electronic component is improved.

[0008] In addition, since the terminal electrode penetrates the glass board from the first side surface to the second side surface, the terminal electrode extends in the width direction from the first side surface to the second side surface in a state of being embedded in the glass board. In the absence of the terminal electrode, when the height dimension is smaller than the width dimension, the glass board is easily bent in the height direction from the bottom surface toward the top surface, but since the terminal electrode extends in the width direction in a state of being embedded in the glass board, the bending strength of the glass board in the height direction can be improved.
[0009] Further, a method for manufacturing an electronic component according to one aspect of the present disclosure includes a step of preparing a glass mother board including a first surface and a second surface; a step of providing, in the first surface, two or more in a direction parallel to a first side, and two or more singulated regions in a direction parallel to the third side, the singulated regions being defined by the first side and a second side that have a length smaller than a distance between the first surface and the second surface and are parallel to each other, and the third side and a fourth side that are orthogonal to the first side and are parallel to each other; a step of forming a through hole penetrating the mother board from the first surface to the second surface in each of all the singulated regions, and filling a conductor in the through hole to form a terminal electrode; a step of forming an outer surface conductor that is at least a part of a passive element on the first surface in each of all the singulated regions; and a step of singulating each of all the singulated regions to manufacture a plurality of electronic components.
[0010] According to the above aspect, it is possible to manufacture an electronic component capable of improving the degree of freedom in design. In addition, it is possible to manufacture an electronic component capable of improving the bending strength of the glass board in the height direction.
[0011] According to the electronic component and the method for manufacturing the same according to one aspect of the present disclosure, the degree of freedom in designing the electronic component can be improved.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0012] FIG. **1** is a side view of a first embodiment of an electronic component as viewed from a first side surface side.
[0013] FIG. **2** is a cross-sectional view taken along line II-II of FIG. **1**.
[0014] FIG. **3**A is an explanatory view for explaining a method for manufacturing an electronic component.
[0015] FIG. **3**B is an explanatory view for explaining the method for manufacturing an electronic component.
[0016] FIG. **3**C is an explanatory view for explaining the method for manufacturing an electronic component.
[0017] FIG. **3**D is an explanatory view for explaining the method for manufacturing an electronic component.
[0018] FIG. **3**E is an explanatory view for explaining the method for manufacturing an electronic component.
[0019] FIG. **4** is a side view of a second embodiment of an electronic component as viewed from a first side surface side.
[0020] FIG. **5** is a side view of a third embodiment of an electronic component as viewed from a first side surface side.
[0021] FIG. **6** is a cross-sectional view taken along line VI-VI of FIG. **5**.
[0022] FIG. **7** is a side view of a fourth embodiment of an electronic component as viewed from a

first side surface side.
[0023] FIG. **8** is a cross-sectional view taken along line VIII-VIII of FIG. **7**.
[0024] FIG. **9** is a side view of a fifth embodiment of an electronic component as viewed from a first side surface side.
[0025] FIG. **10** is a side view of a sixth embodiment of an electronic component as viewed from a first side surface side.
[0026] FIG. **11** is a side view of a seventh embodiment of an electronic component as viewed from a first side surface side.
[0027] FIG. **12** is a side view of an electronic component according to an eighth embodiment as viewed from a first side surface side.
[0028] FIG. **13** is a side view of a ninth embodiment of an electronic component as viewed from a first side surface side.
[0029] FIG. **14** is a side view of a tenth embodiment of an electronic component as viewed from a first side surface side.
[0030] FIG. **15** is a side view of an eleventh embodiment of an electronic component as viewed from a first side surface side.
[0031] FIG. **16** is a cross-sectional view taken along line XVI-XVI of FIG. **15**.
[0032] FIG. **17** is a side view of a twelfth embodiment of an electronic component as viewed from a first side surface side.
[0033] FIG. **18** is a side view of a thirteenth embodiment of an electronic component as viewed from a first side surface side.
[0034] FIG. **19** is a side view of a fourteenth embodiment of an electronic component as viewed from a first side surface side.
[0035] FIG. **20** is a cross-sectional view taken along line XX-XX of FIG. **19**.

DETAILED DESCRIPTION

[0036] Hereinafter, an electronic component according to one aspect of the present disclosure will be described in detail with reference to the illustrated embodiments. Note that the drawings include some schematic drawings, and may not reflect actual dimensions and ratios.

First Embodiment

[Overview Configuration]

[0037] FIG. **1** is a side view of an electronic component **1** as viewed from a first side surface side. FIG. **2** is a cross-sectional view taken along line II-II of FIG. **1**. As shown in FIGS. **1** and **2**, the electronic component **1** includes a glass board **10**, an inductor element **2**, a first terminal electrode **41**, and a second terminal electrode **42**. The inductor element **2** corresponds to an example of a "passive element" described in the claims. The electronic component **1** is, for example, a surface mount electronic component used for a high frequency signal transmission circuit.
[0038] The glass board **10** has a top surface **10***t* and a bottom surface **10***b* located on opposite sides, and a first side surface **10***s***1** and a second side surface **10***s***2** located on opposite sides.
[0039] The inductor element **2** includes a first coil conductor **21** provided on the first side surface **10***s***1** and a second coil conductor **22** provided on the second side surface **10***s***2**. The first coil conductor **21** and the second coil conductor **22** correspond to an example of an "outer surface conductor" described in the claims.
[0040] Each of the first terminal electrode **41** and the second terminal electrode **42** is embedded in the glass board **10** so as to be exposed from the bottom surface **10***b*, and is electrically connected to the first coil conductor **21** and the second coil conductor **22**.
[0041] The first terminal electrode **41** and the second terminal electrode **42** each penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. A height dimension H of the glass board **10**, which is a distance between the top surface **10***t* and the bottom surface **10***b*, is smaller than a width dimension W of the glass board **10**, which is a distance between the first side surface **10***s***1** and the second side surface **10***s***2**.

[0042] Here, the relationship of "the height dimension H is smaller than the width dimension W" refers to a relationship satisfying at least one of "the maximum distance (height dimension H) between the top surface **10***t* and the bottom surface **10***b* is smaller than the minimum distance (width dimension W) between the first side surface **10***s***1** and the second side surface **10***s***2**" or "an average distance (height dimension H) between the top surface **10***t* and the bottom surface **10***b* is smaller than an average distance (width dimension W) between the first side surface **10***s***1** and the second side surface **10***s***2**".
[0043] According to the above configuration, since the first side surface **10***s***1** on which the first coil conductor **21** is provided and the second side surface **10***s***2** on which the second coil conductor **22** is provided are surfaces different from the bottom surface **10***b* on which the first terminal electrode **41** and the second terminal electrode **42** are provided, the first coil conductor **21** and the second coil conductor **22** and the first terminal electrode **41** and the second terminal electrode **42** can be designed without being affected by each other, and the degree of freedom in designing the electronic component **1** is improved.
[0044] In addition, since the first terminal electrode **41** and the second terminal electrode **42** each penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**, the first terminal electrode **41** and the second terminal electrode **42** each extend in the width direction (Y direction) from the first side surface **10***s***1** to the second side surface **10***s***2** in a state of being embedded in the glass board **10**. In the absence of the first terminal electrode **41** and the second terminal electrode **42**, when the height dimension H is smaller than the width dimension W, the glass board **10** is easily bent in the height direction (Z direction) from the bottom surface **10***b* toward the top surface **10***t*, but since the first terminal electrode **41** and the second terminal electrode **42** extend in the width direction in a state of being embedded in the glass board **10**, the bending strength of the glass board **10** in the height direction can be improved.
[0045] In addition, since the height dimension H is smaller than the width dimension W, the height dimension H of the glass board **10** can be reduced, whereby the height of the electronic component **1** can be reduced.
[0046] Note that the passive element may be a capacitor element, a resistor, or the like instead of the inductor element. Further, the outer surface conductor which is at least a part of the passive element may be provided on at least the first side surface among the first side surface and the second side surface. In addition, at least one terminal electrode may be provided. [Preferred Configuration of Each Member]
(Glass Board **10**)
[0047] The glass board **10** is a rectangular parallelepiped having a length, a width, and a height. The glass board **10** has a first end surface **10***e***1** and a second end surface **10***e***2** on both end sides in the length direction, a first side surface **10***s***1** and a second side surface **10***s***2** on both end sides in the width direction, and a bottom surface **10***b* and a top surface **10***t* on both end sides in the height direction. That is, an outer surface **100** of the glass board **10** includes the first end surface **10***e***1** and the second end surface **10***e***2**, the first side surface **10***s***1** and the second side surface **10***s***2**, and the bottom surface **10***b* and the top surface **10***t*. The bottom surface **10***b* is a surface facing the mounting substrate side when the electronic component **1** is mounted on the mounting substrate.
[0048] In this specification, the outer surface **100** of the glass board **10** does not simply mean a surface facing the outer peripheral side of the glass board **10**, but is a surface serving as a boundary between the outside and the inside of the glass board **10**. In addition, "above the outer surface **100** of the glass board **10**" refers to not an absolute direction such as a vertical upward direction defined in the direction of gravity, but a direction toward the outside with respect to the outer surface **100** as a boundary between the outside and the inside with the outer surface **100** as a reference. Therefore, "above the outer surface **100**" is a relative direction determined by the direction of the outer surface **100**. In addition, "above" with respect to an element includes not only an upper position away from the element, that is, an upper position via another object on the element or a

spaced-apart upper position, but also a position (on) immediately above the element in contact with the element.

[0049] Hereinafter, for convenience of description, a direction from the first end surface **10*e*1** to the second end surface **10*e*2** in the length direction (longitudinal direction) of the glass board **10** is referred to as an X direction. In addition, a direction from the first side surface **10*s*1** toward the second side surface **10*s*2** in the width direction of the glass board **10** is defined as a Y direction. In addition, a direction from the bottom surface **10*b*** toward the top surface **10*t*** in the height direction of the glass board **10** is defined as a Z direction. The X direction, the Y direction, and the Z direction are directions orthogonal to each other, and form a right-handed coordinate system when arranged in the order of X, Y, and Z.

[0050] The glass board **10** has an insulating property. The glass board **10** is preferably, for example, a glass board having photosensitivity represented by FoturanII (registered trademark of SchottAG). In particular, the glass board **10** preferably contains cerium oxide (ceria: CeO2), and in this case, the cerium oxide serves as a sensitizer, and processing by photolithography becomes easier.

[0051] However, since the glass board **10** can be processed by machining such as drilling and sandblasting, dry/wet etching processing using a photoresist/metal mask, laser processing, or the like, it may be a glass plate having no photosensitivity. The glass board **10** may be obtained by sintering a glass paste, or may be formed by a known method such as a float method.

[0052] The height dimension H of the glass board **10** is smaller than the width dimension W of the glass board **10**. A length dimension L of the glass board **10**, which is a distance between the first end surface **10*e*1** and the second end surface **10*e*2**, is larger than the width dimension W of the glass board **10**.

[0053] Here, the relationship of “the length dimension Lis smaller than the width dimension W” refers to a relationship satisfying at least one of “the maximum distance (length dimension L) between the first end surface **10*e*1** and the second end surface **10*e*2** is smaller than the minimum distance (width dimension W) between the first side surface **10*s*1** and the second side surface **10*s*2**” or “an average distance (length dimension L) between the first end surface **10*e*1** and the second end surface **10*e*2** is smaller than an average distance (width dimension W) between the first side surface **10*s*1** and the second side surface **10*s*2**”.

(Inductor Element **2**)

[0054] The inductor element **2** includes a coil **20**, a first lead conductor **25** connected to a first end of the coil **20**, and a second lead conductor **26** connected to a second end of the coil **20**. The coil **20** is spirally wound along the axis AX. The first lead conductor **25** is connected to the first terminal electrode **41**. The second lead conductor **26** is connected to the second terminal electrode **42**.

[0055] The axis AX of the coil **20** is arranged parallel to the bottom surface **10*b*** of the glass board **10**. According to this, when the electronic component **1** is mounted on the mounting substrate such that the bottom surface **10*b*** of the glass board **10** faces the mounting substrate, the axis AX of the coil **20** is horizontal to the mounting substrate, so that the decrease in the L value and the Q value due to the eddy current flowing through the mounting substrate hardly occurs. “Parallel” includes not only that the axis AX is completely parallel to the bottom surface **10*b***, but also that the axis AX is substantially parallel, for example, slightly inclined with respect to the bottom surface **10*b***.

[0056] The coil **20** includes a plurality of first coil conductors **21**, a plurality of second coil conductors **22**, a plurality of first through conductors **23**, and a plurality of second through conductors **24**. In the coil **20**, the first through conductor **23**, the second coil conductor **22**, the second through conductor **24**, and the first coil conductor **21** are electrically connected in this order to form a spiral. The number of turns of the coil **20** is a plurality of turns. The number of turns of the coil **20** may be less than 1 turn.

[0057] The plurality of first through conductors **23** penetrate the glass board **10** from the first side surface **10*s*1** to the second side surface **10*s*2**. Therefore, the plurality of first through conductors **23** extend in the width direction (Y direction) in a state of being embedded in the glass board **10**.

Therefore, the bending strength of the glass board **10** in the height direction (Z direction) can be further improved.

[0058] The plurality of first through conductors **23** extend from the second coil conductor **22** toward the first coil conductor **21** and are arranged along the axis AX. The first through conductor **23** extends in a direction orthogonal to the first side surface **10***s***1** and the second side surface **10***s***2**. All the first through conductors **23** are arranged in parallel along the X direction. The first through conductors **23** are arranged on the bottom surface **10***b* side with respect to the axis AX.

[0059] The plurality of second through conductors **24** penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. Therefore, the plurality of second through conductors **24** extend in the width direction (Y direction) in a state of being embedded in the glass board **10**. Therefore, the bending strength of the glass board **10** in the height direction (Z direction) can be further improved.

[0060] The plurality of second through conductors **24** extend from the second coil conductor **22** toward the first coil conductor **21** and are arranged along the axis AX. The second through conductor **24** extends in a direction orthogonal to the first side surface **10***s***1** and the second side surface **10***s***2**. All the second through conductors **24** are arranged in parallel along the X direction. The second through conductor **24** is provided on the side opposite to the first through conductor **23** with respect to the axis AX. That is, the second through conductor **24** is arranged on the top surface **10***t* side with respect to the axis AX.

[0061] The plurality of first coil conductors **21** are provided on the first side surface **10***s***1**. The first coil conductor **21** has a shape extending in the Z direction. All the first coil conductors **21** are arranged in parallel along the X direction. The first end (pad portion) of the first coil conductor **21** is connected to the end of the first through conductor **23**. The second end (pad portion) of the first coil conductor **21** is connected to the end of the second through conductor **24**.

[0062] The plurality of second coil conductors **22** are provided on the second side surface **10***s***2**. The second coil conductor **22** is slightly inclined in the X direction and extends in the Z direction. All the second coil conductors **22** are arranged in parallel along the X direction. The first end (pad portion) of the second coil conductor **22** is connected to the end of the first through conductor **23**. The second end (pad portion) of the second coil conductor **22** is connected to the end of the second through conductor **24**.

[0063] The first lead conductor **25** is provided on the first side surface **10***s***1**. The first lead conductor **25** has a shape extending in the Z direction. The first end (pad portion) of the first lead conductor **25** is connected to the end of the first through conductor **23**. The second end of the first lead conductor **25** is connected to the side surface of the first terminal electrode **41**.

[0064] The second lead conductor **26** is provided on the first side surface **10***s***1**. The second lead conductor **26** has a shape extending in the Z direction. The first end (pad portion) of the second lead conductor **26** is connected to the end of the second through conductor **24**. The second end of the second lead conductor **26** is connected to the side surface of the second terminal electrode **42**.

[0065] The first coil conductor **21** and the second coil conductor **22** are made of a conductive material such as copper, silver, gold, or an alloy thereof. The first coil conductor **21** and the second coil conductor **22** may be a metal film formed by plating, vapor deposition, sputtering, or the like, or may be a metal sintered body obtained by applying and sintering a conductor paste. The materials of the first through conductor **23** and the second through conductor **24** are the same as the materials of the first coil conductor **21** and the second coil conductor **22**.

[0066] The first coil conductor **21** and the second coil conductor **22** are preferably formed by a semi-additive method, whereby the first coil conductor **21** and the second coil conductor **22** having low electric resistance, high accuracy, and high aspect ratio can be formed. The first through conductor **23** and the second through conductor **24** can be formed in a through hole formed in advance in the glass board **10** using the materials and manufacturing methods exemplified for the first coil conductor **21** and the second coil conductor **22**.

[0067] The first lead conductor **25** and the second lead conductor **26** can be formed by the same material and method as those of the first coil conductor.

(First Terminal Electrode **41** and Second Terminal Electrode **42**)

[0068] The first terminal electrode **41** is embedded in the glass board **10** so as to be exposed from the bottom surface **10***b*, the first side surface **10***s***1**, and the second side surface **10***s***2**. The first terminal electrode **41** is provided on the first end surface **10***e***1** side with respect to the center of the glass board **10** in the X direction.

[0069] The second terminal electrode **42** is embedded in the glass board **10** so as to be exposed from the bottom surface **10***b*, the first side surface **10***s***1**, and the second side surface **10***s***2**. The second terminal electrode **42** is provided on the second end surface **10***e***2** side with respect to the center of the glass board **10** in the X direction.

[0070] The first terminal electrode **41** and the second terminal electrode **42** can be formed by the same material and method as those of the first coil conductor. The first terminal electrode **41** and the second terminal electrode **42** may have a plating layer.

[0071] The first terminal electrode **41** is connected to the first lead conductor **25** which is the first end of the inductor element **2**. The second terminal electrode **42** is connected to the second lead conductor **26** which is the second end of the inductor element **2**.

(Method for Manufacturing Electronic Component **1**)

[0072] Next, a method for manufacturing the electronic component **1** will be described with reference to FIGS. **3**A to **3**E.

[0073] As shown in FIG. **3**A, a glass mother board **1000** including a first surface **1000***a* and a second surface **1000***b* is prepared. The first surface **1000***a* includes the first side surface **10***s***1**, and the second surface **1000***b* includes the second side surface **10***s***2**. As the mother board **1000**, for example, FoturanII can be used. Since the mother board **1000** generally contains an oxide such as silicon, lithium, aluminum, or cerium, it can cope with high-precision photolithography.

[0074] A plurality of singulated regions **1100** are provided on the first surface **1000***a*. In FIG. **3**A, the singulated region **1100** is indicated by hatching. The singulated region **1100** is defined by a first side **1101**, a second side **1102**, a third side **1103**, and a fourth side **1104**. The first side **1101** and the second side **1102** are parallel to each other, and the third side **1103** and the fourth side **1104** are parallel to each other. The third side **1103** and the fourth side **1104** are orthogonal to the first side **1101**. That is, the singulated region **1100** has a quadrangular shape.

[0075] The first side **1101** and the second side **1102** each have a length smaller than the distance between the first surface **1000***a* and the second surface **1000***b*. The distance between the first surface **1000***a* and the second surface **1000***b* corresponds to the dimension W of the glass board **10**. The length of each of the first side **1101** and the second side **1102** corresponds to the height dimension H of the glass board **10**. The length of each of the third side **1103** and the fourth side **1104** corresponds to the length dimension L of the glass board **10**.

[0076] Two or more singulated regions **1100** are provided in a direction (Z direction) parallel to the first side **1101**, and two or more singulated regions **1100** are provided in a direction (X direction) parallel to the third side **1103**. In this embodiment, a total of four singulated regions **1100**, two in the Z direction and two in the X direction, are provided.

[0077] As shown in FIG. **3**B, in each of all the singulated regions **1100**, a first through hole **1001**, a second through hole **1002**, a third through hole **1003**, and a fourth through hole **1004** penetrating the mother board **1000** from the first surface **1000***a* to the second surface **1000***b* are formed. In FIG. **3**B, the singulated region **1100** is indicated by a two-dot chain line.

[0078] The first through hole **1001** is a portion where the first through conductor **23** is formed. The second through hole **1002** is a portion where the second through conductor **24** is formed. The third through hole **1003** is a portion where the first terminal electrode **41** is formed. The fourth through hole **1004** is a portion where the second terminal electrode **42** is formed.

[0079] As a method for forming the first to fourth through holes **1001** to **1004**, for example, a portion where the through hole is to be formed is irradiated with ultraviolet rays and crystallized by heat treatment (for example, firing) to form a crystallized portion, and the crystallized portion is removed by etching to form the through hole.

[0080] As shown in FIG. **3**C, the first through hole **1001** is filled with a conductor to form the first through conductor **23**. The second through hole **1002** is filled with a conductor to form the second through conductor **24**. The third through hole **1003** is filled with a conductor to form the first terminal electrode **41**. The fourth through hole **1004** is filled with a conductor to form the second terminal electrode **42**. The first through conductor **23**, the second through conductor **24**, the first terminal electrode **41**, and the second terminal electrode **42** are formed by, for example, a semi-additive method.

[0081] Thereafter, in each of all the singulated regions **1100**, the first coil conductor **21**, the first lead conductor **25**, and the second lead conductor **26** are formed on the first surface **1000***a*, and the second coil conductor **22** is formed on the second surface **1000***b*.

[0082] As shown in FIG. **3**D, a cut region **1200** between the adjacent singulated regions **1100** is irradiated with ultraviolet rays and crystallized by heat treatment (for example, firing) to form a crystallized portion. The cut region **1200** corresponds to a cutting line when the mother board **1000** is divided into individual pieces. In FIG. **3**D, a crystallized portion of the cut region **1200** is indicated by hatching for convenience.

[0083] The crystallized portion of the cut region **1200** is removed by etching, and as shown in FIG. **3**E, each of all the singulated regions **1100** is divided to manufacture a plurality of electronic components **1**. Although the mother board **1000** is singulated by etching the crystallized portion, the mother board **1000** may be singulated by a dicer, a laser, or the like.

[0084] According to the above manufacturing method, since the mother board **1000** having two singulated regions **1100** in the Z direction and two singulated regions **1100** in the X direction is segmented, the mother board **1000** is less likely to be cracked. On the other hand, in a case where the mother board having two or more singulated regions only in the X direction is singulated, the height dimension H is smaller than the width dimension W in each singulated region, and thus, when the mother board is cut from the Z direction, the mother board is cut along a direction in which the height dimension His smaller. As described above, the mother board is cut along a direction in which the strength of the mother board is weak, so that the glass board is likely to be cracked.

Second Embodiment

[0085] FIG. **4** is a side view of a second embodiment of an electronic component as viewed from a first side surface side. The second embodiment is different from the first embodiment in the position of the coil of the inductor element. This different configuration will be described below. The other configurations are the same as those of the first embodiment, and are denoted by the same reference numerals as those of the first embodiment, and the description thereof will be omitted.

[0086] As shown in FIG. **4**, in an electronic component **1**A of the second embodiment, an axis AX of a coil **20**A of an inductor element **2**A is perpendicular to a bottom surface **10***b* of a glass board **10**. According to this, when the electronic component **1**A is mounted on the mounting substrate such that the bottom surface **10***b* of the glass board **10** faces the mounting substrate, the axis AX of the coil **20**A is perpendicular to the mounting substrate, so that magnetic coupling between the electronic component **1**A and another component adjacent thereto can be reduced on the mounting substrate. The term “perpendicular” includes not only that the axis AX is completely perpendicular to the bottom surface **10***b* but also that the axis AX and the bottom surface **10***b* are substantially perpendicular, for example, an angle formed by the axis AX and the bottom surface **10***b* is 80° to 100°.

[0087] The plurality of first through conductors **23** penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. All the first through conductors **23** are arranged in parallel along the Z direction. The first through conductors **23** are arranged on the first end surface **10***e***1** side with respect to the axis AX.

[0088] The plurality of second through conductors **24** penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. All the second through conductors **24** are arranged in parallel along the Z direction. The second through conductor **24** is provided on the side opposite to the first through conductor **23** with respect to the axis AX. That is, the second through conductor **24** is arranged on the second end surface **10***e***2** side with respect to the axis AX.

[0089] The plurality of first coil conductors **21** are provided on the first side surface **10***s***1**. The first coil conductor **21** is slightly inclined in the Z direction and extends in the X direction. All the first coil conductors **21** are arranged in parallel along the Z direction.

[0090] The plurality of second coil conductors **22** are provided on the second side surface **10***s***2**. The second coil conductor **22** extends in the X direction. All the second coil conductors **22** are arranged in parallel along the Z direction.

[0091] The electronic component **1**A of the second embodiment has the same effect as that of the electronic component **1** of the first embodiment. That is, according to the above configuration, since the first side surface **10***s***1** on which the first coil conductor **21** is provided and the second side surface **10***s***2** on which the second coil conductor **22** is provided are surfaces different from the bottom surface **10***b* on which the first terminal electrode **41** and the second terminal electrode **42** are provided, the first coil conductor **21** and the second coil conductor **22** and the first terminal electrode **41** and the second terminal electrode **42** can be designed without being affected by each other, and the degree of freedom in designing the electronic component **1**A is improved.

[0092] In addition, since the first terminal electrode **41** and the second terminal electrode **42** each penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**, the first terminal electrode **41** and the second terminal electrode **42** each extend in the width direction (Y direction) from the first side surface **10***s***1** to the second side surface **10***s***2** in a state of being embedded in the glass board **10**. As a result, the bending strength of the glass board **10** in the height direction (Z direction) can be improved.

[0093] In addition, since the height dimension H is smaller than the width dimension W, the height dimension H of the glass board **10** can be reduced, whereby the height of the electronic component **1**A can be reduced.

[0094] The plurality of first through conductors **23** extend in the width direction (Y direction) in a state of being embedded in the glass board **10**. Therefore, the bending strength of the glass board **10** in the height direction (Z direction) can be further improved.

[0095] The plurality of second through conductors **24** extend in the width direction (Y direction) in a state of being embedded in the glass board **10**. Therefore, the bending strength of the glass board **10** in the height direction (Z direction) can be further improved.

Third Embodiment

[0096] FIG. **5** is a side view of a third embodiment of an electronic component as viewed from a first side surface side. FIG. **6** is a cross-sectional view taken along line VI-VI in FIG. **5**. The third embodiment is different from the first embodiment in the configuration of the passive element. This different configuration will be described below. The other configurations are the same as those of the first embodiment, and are denoted by the same reference numerals as those of the first embodiment, and the description thereof will be omitted.

[0097] As shown in FIGS. **5** and **6**, in an electronic component **1**B of the third embodiment, the passive element is a capacitor element **3**. The capacitor element **3** includes a first flat plate electrode **31**, a second flat plate electrode **32**, a dielectric film **33**, a first lead conductor **35**, and a second lead conductor **36**. The first flat plate electrode **31**, the second flat plate electrode **32**, the first lead conductor **35**, and the second lead conductor **36** correspond to an example of an “outer surface conductor” described in the claims.

[0098] The first flat plate electrode **31** is provided on the first side surface **10***s***1**, and the second flat plate electrode **32** is provided on the first flat plate electrode **31**. The dielectric film **33** is provided between the first flat plate electrode **31** and the second flat plate electrode **32**. Each of the first flat plate electrode **31** and the second flat plate electrode **32** extends along the X direction. The dielectric film **33** extends along the X direction and covers both ends of the first flat plate electrode **31** in the Z direction.

[0099] The first lead conductor **35** is provided on the first side surface **10***s***1**. The first lead conductor **35** has a shape extending in the Z direction. The first end of the first lead conductor **35** is connected to the second flat plate electrode **32**. The second end of the first lead conductor **35** is connected to the side surface of the first terminal electrode **41**.

[0100] The second lead conductor **36** is provided on the first side surface **10***s***1**. The second lead conductor **36** has a shape extending in the Z direction. The first end of the second lead conductor **36** is connected to the first flat plate electrode **31**. The second end of the second lead conductor **36** is connected to the side surface of the second terminal electrode **42**.

[0101] According to the electronic component **1**B of the second embodiment, stray capacitance between the electronic component **1**B and the ground of the mounting substrate is less likely to occur as compared with the case where the capacitor element **3** is provided on the bottom surface **10***b*. In addition, the parasitic inductance can be reduced as compared with the case where the capacitor element **3** is provided on the top surface **10***t*.

[0102] The electronic component **1**B of the second embodiment has the same effect as that of the electronic component **1** of the first embodiment. That is, since the first side surface **10***s***1** on which the first flat plate electrode **31** and the second flat plate electrode **32** are provided is a surface different from the bottom surface **10***b* on which the first terminal electrode **41** and the second terminal electrode **42** are provided, the first flat plate electrode **31** and the second flat plate electrode **32** and the first terminal electrode **41** and the second terminal electrode **42** can be designed without being affected by each other, and the degree of freedom in designing the electronic component **1**B is improved.

[0103] In addition, since the first terminal electrode **41** and the second terminal electrode **42** each penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**, the first terminal electrode **41** and the second terminal electrode **42** each extend in the width direction (Y direction) from the first side surface **10***s***1** to the second side surface **10***s***2** in a state of being embedded in the glass board **10**. As a result, the bending strength of the glass board **10** in the height direction (Z direction) can be improved.

[0104] In addition, since the height dimension H is smaller than the width dimension W, the height dimension H of the glass board **10** can be reduced, whereby the height of the electronic component **1**B can be reduced.

Fourth Embodiment

[0105] FIG. **7** is a side view of a fourth embodiment of an electronic component as viewed from a first side surface side. FIG. **8** is a cross-sectional view taken along line VIII-VIII of FIG. **7**. The fourth embodiment is different from the third embodiment in the configuration of the capacitor element. This different configuration will be described below. The other configurations are the same as those of the third embodiment, and are denoted by the same reference numerals as those of the third embodiment, and the description thereof will be omitted.

[0106] As shown in FIGS. **7** and **8**, in an electronic component **1**C of the fourth embodiment, a capacitor element **3**C includes a plurality of first flat plate electrodes **31**C, a plurality of second flat plate electrodes **32**C, a first support conductor **37**, and a second support conductor **38**. The first flat plate electrode **31**C, the second flat plate electrode **32**C, the first support conductor **37**, and the second support conductor **38** correspond to an example of an “outer surface conductor” described in the claims.

[0107] The plurality of first flat plate electrodes **31**C penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. Therefore, the plurality of first flat plate electrodes

31C extend in the width direction (Y direction) in a state of being embedded in the glass board **10**. The first flat plate electrode **31**C extends in a direction parallel to the YZ plane. All the first flat plate electrodes **31**C are arranged in parallel along the X direction.

[0108] The plurality of second flat plate electrodes **32**C penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. Therefore, the plurality of second flat plate electrodes **32**C extend in the width direction (Y direction) in a state of being embedded in the glass board **10**. The second flat plate electrode **32**C extends in a direction parallel to the YZ plane. All the second flat plate electrodes **32**C are arranged in parallel along the X direction.

[0109] The first support conductor **37** penetrates the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. Therefore, the first support conductor **37** extends in the width direction (Y direction) in a state of being embedded in the glass board **10**. The first support conductor **37** includes a first portion **371** extending in a direction parallel to the XY plane and a second portion **372** connected to the first portion **371** and extending in a direction parallel to the YZ plane. The first portion **371** is arranged on the top surface **10***t* side, and the second portion **372** is arranged on the second end surface **10***e***2** side. A plurality of first flat plate electrodes **31**C are connected to the first portion **371**. The second portion **372** is connected to the second terminal electrode **42**.

[0110] The second support conductor **38** penetrates the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. Therefore, the second support conductor **38** extends in the width direction (Y direction) in a state of being embedded in the glass board **10**. The second support conductor **38** includes a first portion **381** extending in a direction parallel to the XY plane and a second portion **382** connected to the first portion **381** and extending in a direction parallel to the YZ plane. The first portion **381** is arranged on the bottom surface **10***b* side, and the second portion **382** is arranged on the first end surface **10***e***1** side. A plurality of first flat plate electrodes **31**C are connected to the first portion **381**. The second portion **382** is connected to the first terminal electrode **41**.

[0111] The plurality of first flat plate electrodes **31**C and the plurality of second flat plate electrodes **32**C are alternately arranged along the X direction. That is, the plurality of first flat plate electrodes **31**C and the plurality of second flat plate electrodes **32**C form a comb teeth structure. A part of the glass board **10** exists between the first flat plate electrode **31**C and the second flat plate electrode **32**C. That is, a part of the glass board **10** functions as a dielectric of the capacitor element **3**C.

[0112] The electronic component **1**C of the fourth embodiment has the same effect as that of the electronic component **1**B of the third embodiment. That is, since the first side surface **10***sl* and the second side surface **10***s***2** on which the first flat plate electrode **31**C and the second flat plate electrode **32**C are provided are surfaces different from the bottom surface **10***b* on which the first terminal electrode **41** and the second terminal electrode **42** are provided, the first flat plate electrode **31**C and the second flat plate electrode **32**C and the first terminal electrode **41** and the second terminal electrode **42** can be designed without being affected by each other, and the degree of freedom in designing the electronic component **1**C is improved.

[0113] In addition, since the first terminal electrode **41** and the second terminal electrode **42** each penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**, the first terminal electrode **41** and the second terminal electrode **42** each extend in the width direction (Y direction) from the first side surface **10***s***1** to the second side surface **10***s***2** in a state of being embedded in the glass board **10**. As a result, the bending strength of the glass board **10** in the height direction (Z direction) can be improved.

[0114] In addition, since the height dimension H is smaller than the width dimension W, the height dimension H of the glass board **10** can be reduced, whereby the height of the electronic component **1**C can be reduced.

[0115] The plurality of first flat plate electrodes **31**C extend in the width direction (Y direction) in a

state of being embedded in the glass board **10**. Therefore, the bending strength of the glass board **10** in the height direction (Z direction) can be further improved.
[0116] The plurality of second flat plate electrodes **32**C extend in the width direction (Y direction) in a state of being embedded in the glass board **10**. Therefore, the bending strength of the glass board **10** in the height direction (Z direction) can be further improved.
Fifth Embodiment
[0117] FIG. **9** is a side view of a fifth embodiment of an electronic component as viewed from a first side surface side. The fifth embodiment is different from the fourth embodiment in the configuration of the dielectric. This different configuration will be described below. The other configurations are the same as those of the fourth embodiment, and are denoted by the same reference numerals as those of the fourth embodiment, and the description thereof will be omitted.
[0118] As shown in FIG. **9**, in an electronic component **1**D of the fifth embodiment, the capacitor element **3**C has a dielectric **34** between the first flat plate electrode and the second flat plate electrode. The dielectric **34** is made of a material different from the glass material of the glass board **10**. The glass material is a material in an amorphous state that is not crystallized. The dielectric **34** is made of, for example, crystallized glass, air, a high dielectric material other than glass, or the like.
[0119] In the electronic component **1**D of the fifth embodiment, a material having a dielectric constant higher than that of the glass board **10** is used for the dielectric **34**, so that a large capacitance can be obtained. In addition, by using a material having a dielectric loss smaller than that of the glass board for the dielectric **34**, a high Q value can be obtained.
[0120] Further, the electronic component **1**D of the fifth embodiment has the same effect as that of the electronic component **1**C of the fourth embodiment in other configurations.
Sixth Embodiment
[0121] FIG. **10** is a side view of a sixth embodiment of an electronic component as viewed from a first side surface side. The sixth embodiment is different from the first embodiment in the configuration of the passive element. This different configuration will be described below. The other configurations are the same as those of the first embodiment, and are denoted by the same reference numerals as those of the first embodiment, and the description thereof will be omitted.
[0122] As shown in FIG. **10**, in an electronic component **1**E of the sixth embodiment, the passive element includes an inductor element **2** and a capacitor element **3**. The inductor element **2** has the same configuration as that of the inductor element **2** of the electronic component **1** of the first embodiment. The capacitor element **3** has the same configuration as that of the capacitor element **3** of the electronic component **1**B of the third embodiment. The inductor element **2** is arranged on the second end surface **10***e***2** side (second terminal electrode **42** side), and the capacitor element **3** is arranged on the first end surface **10***e***1** side (first terminal electrode **41** side). The inductor element **2** and the capacitor element **3** are electrically connected in series.
[0123] The inductor element **2** includes a coil **20** and a second lead conductor **26**. The coil **20** includes a first coil conductor **21**, a second coil conductor **22**, a first through conductor **23**, and a second through conductor **24**. The first coil conductor **21** is provided on the first side surface **10***s***1**. The second coil conductor **22** is provided on the second side surface **10***s***2**. The first through conductor **23** and the second through conductor **24** penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. The second lead conductor **26** is connected to the second terminal electrode **42**.
[0124] The capacitor element **3** includes a first flat plate electrode **31**, a second flat plate electrode **32**, a dielectric film **33**, a first lead conductor **35**, and a second lead conductor **36**. The first flat plate electrode **31**, the second flat plate electrode **32**, the first lead conductor **35**, and the second lead conductor **36** are provided above the first side surface **10***s***1**. The first lead conductor **35** is connected to the first terminal electrode **41**. The second lead conductor **36** is connected to the first through conductor **23** which is the first end of the coil **20**.

[0125] Since the electronic component **1**E of the sixth embodiment includes the inductor element **2** and the capacitor element **3**, an LC circuit can be realized. The number of each of the inductor element **2** and the capacitor element **3** may be plural.
[0126] Further, the electronic component **1**E of the sixth embodiment has the same effects as those of the electronic component **1** of the first embodiment and the electronic component **1**B of the third embodiment in other configurations.
Seventh Embodiment
[0127] FIG. **11** is a side view of a seventh embodiment of an electronic component as viewed from a first side surface side. The seventh embodiment is different from the sixth embodiment in the configuration of the glass board. This different configuration will be described below. The other configurations are the same as those of the sixth embodiment, and are denoted by the same reference numerals as those of the sixth embodiment, and the description thereof will be omitted.
[0128] As shown in FIG. **11**, in an electronic component **1**F of the seventh embodiment, a glass board **10**F has a first portion **101** and a second portion **102**. A height dimension H**2** of the second portion **102** is smaller than a height dimension H**1** of the first portion **101**. The height dimension H**1** of the first portion **101** and the height dimension H**2** of the second portion **102** are smaller than a width dimension W of the glass board **10**F. The capacitor element **3** is provided in the first portion **101**, and the inductor element **2** is provided in the second portion **102**.
[0129] In the electronic component **1**F of the seventh embodiment, the space provided in the step in the height direction between the first portion **101** and the second portion **102** can be effectively used. Note that three or more portions having different height dimensions may be provided on the glass board **10**F, and a plurality of steps may be provided on the glass board **10**F.
[0130] Furthermore, the electronic component **1**F of the seventh embodiment has the same effect as that of the electronic component **1**E of the sixth embodiment in other configurations.
Eighth Embodiment
[0131] FIG. **12** is a side view of an electronic component according to an eighth embodiment as viewed from a first side surface side. The eighth embodiment is different from the sixth embodiment in the configuration of the glass board. This different configuration will be described below. The other configurations are the same as those of the sixth embodiment, and are denoted by the same reference numerals as those of the sixth embodiment, and the description thereof will be omitted.
[0132] As shown in FIG. **12**, in an electronic component **1**G of the eighth embodiment, the length dimension L of the glass board **10**G is twice or more the width dimension W of the glass board **10**G. The axial length of the coil **20** is twice or more the axial length of the coil **20** of the sixth embodiment.
[0133] In the electronic component **1**G of the eighth embodiment, since the length dimension L of the glass board **10**G can be increased, the inductor element **2** and the capacitor element **3** can be increased in size, and the performance can be improved. In addition, since it is possible to increase the size by increasing the length dimension L, it is not necessary to increase the width dimension of the glass board **10**G. For this reason, it is not necessary to increase the lengths of the terminal electrodes **41** and **42** in the width direction, and manufacturing is facilitated, and it is not necessary to increase the lengths of the through conductors **23** and **24** in the width direction, and the diameters of the through conductors **23** and **24** can be reduced.
[0134] Furthermore, the electronic component **1**G of the eighth embodiment has the same effect as that of the electronic component **1**E of the sixth embodiment in other configurations.
Ninth Embodiment
[0135] FIG. **13** is a side view of a ninth embodiment of an electronic component as viewed from a first side surface side. The ninth embodiment is different from the sixth embodiment in the number of terminal electrodes. This different configuration will be described below. The other configurations are the same as those of the sixth embodiment, and are denoted by the same

reference numerals as those of the sixth embodiment, and the description thereof will be omitted.
[0136] As shown in FIG. **13**, an electronic component **1**H of the ninth embodiment further includes a third terminal electrode **43**. The third terminal electrode **43** is embedded in the glass board **10** so as to be exposed from the bottom surface **10***b*. The third terminal electrode **43** penetrates the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**.
[0137] The third terminal electrode **43** is located between the first terminal electrode **41** and the second terminal electrode **42** along the X direction. The third terminal electrode **43** is connected between the inductor element **2** and the capacitor element **3**. Specifically, the third terminal electrode **43** is connected to the second lead conductor **36**.
[0138] In the electronic component **1**H of the ninth embodiment, more terminal electrodes **41**, **42**, and **43** can be provided, and a more complicated circuit can be realized. In addition, since the third terminal electrode **43** extends in the width direction (Y direction) in a state of being embedded in the glass board **10**, the bending strength in the height direction (Z direction) of the glass board **10** can be further improved. There may be four or more terminal electrodes.
[0139] Furthermore, the electronic component **1**H of the ninth embodiment has the same effect as that of the electronic component **1**E of the sixth embodiment in other configurations.
Tenth Embodiment
[0140] FIG. **14** is a side view of a tenth embodiment of an electronic component as viewed from a first side surface side. The tenth embodiment is different from the first embodiment in the configuration of the terminal electrode. This different configuration will be described below. The other configurations are the same as those of the first embodiment, and are denoted by the same reference numerals as those of the first embodiment, and the description thereof will be omitted.
[0141] As shown in FIG. **14**, in an electronic component **1**J of the tenth embodiment, a first terminal electrode **41**J is further exposed from the first end surface **10***e***1**. Specifically, the first terminal electrode **41**J has a first portion **411** and a second portion **412** connected to the first portion **411**. The first portion **411** extends along the bottom surface **10***b*, and the second portion **412** extends along the first end surface **10***e***1**. That is, the first terminal electrode **41**J is an L-shaped electrode. The first portion **411** is exposed from the bottom surface **10***b*, and the second portion **412** is exposed from the first end surface **10***e***1**. The first portion **411** and the second portion **412** each penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**.
[0142] A second terminal electrode **42**J is further exposed from the second end surface **10***e***2**. Specifically, the second terminal electrode **42**J has a first portion **421** and a second portion **422** connected to the first portion **421**. The first portion **421** extends along the bottom surface **10***b*, and the second portion **422** extends along the second end surface **10***e***2**. That is, the second terminal electrode **42**J is an L-shaped electrode. The first portion **421** is exposed from the bottom surface **10***b*, and the second portion **422** is exposed from the second end surface **10***e***2**. The first portion **421** and the second portion **422** each penetrate the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**.
[0143] In the electronic component **1**J of the tenth embodiment, when the electronic component **1**J is mounted on the mounting substrate such that the bottom surface **10***b* of the glass board **10** faces the mounting substrate, solder also adheres to the portion of the first terminal electrode **41**J exposed from the first end surface **10***e***1**, so that the inclination of the electronic component **1**J and the solder ball can be suppressed, and the mounting strength can be improved. Similarly, solder also adheres to the portion of the second terminal electrode **42**J exposed from the second end surface **10***e***2**, so that the inclination of the electronic component **1**J and the solder ball can be suppressed, and the mounting strength can be improved.
[0144] Further, the electronic component **1**J of the tenth embodiment has the same effect as that of the electronic component **1** of the first embodiment in other configurations.
Eleventh Embodiment
[0145] FIG. **15** is a side view of an eleventh embodiment of an electronic component as viewed

from a first side surface side. FIG. **16** is a cross-sectional view taken along line XVI-XVI of FIG. **15**. The eleventh embodiment is different from the first embodiment in that a protective layer is provided. This different configuration will be described below. The other configurations are the same as those of the first embodiment, and are denoted by the same reference numerals as those of the first embodiment, and the description thereof will be omitted.

[0146] As shown in FIGS. **15** and **16**, the electronic component **1**K of the eleventh embodiment has a first protective layer **15** and a second protective layer **16**. The electronic component **1**K may have one of the first protective layer **15** and the second protective layer **16**.

[0147] The first protective layer **15** is provided on the first side surface **10***s***1** and covers the first coil conductor **21**, the first lead conductor **25**, and the second lead conductor **26**. When viewed from a direction orthogonal to the first side surface **10***s***1**, the first protective layer **15** has the same size as that of the first side surface **10***s***1** of the glass board **10**. The first protective layer **15** has an insulating property and is made of, for example, a resin such as epoxy or polyimide.

[0148] Preferably, the first protective layer **15** is colored. The first protective layer **15** is colored, for example, green or blue, and the transparency of the first protective layer **15** is lower than the transparency of the glass material of the glass board **10**. The glass material is a material in an amorphous state that is not crystallized.

[0149] The second protective layer **16** is provided on the second side surface **10***s***2** and covers the second coil conductor **22**. When viewed from the direction orthogonal to the second side surface **10***s***2**, the second protective layer **16** has the same size as that of the second side surface **10***s***2** of the glass board **10**. The second protective layer **16** has an insulating property and is made of, for example, a resin such as epoxy or polyimide.

[0150] Preferably, the second protective layer **16** is colored. The second protective layer **16** is colored, for example, green or blue, and the transparency of the second protective layer **16** is lower than the transparency of the glass material of the glass board **10**.

[0151] In the electronic component **1**K of the eleventh embodiment, since the first protective layer **15** is provided, the first coil conductor **21**, the first lead conductor **25**, and the second lead conductor **26** are protected, and the reliability is improved. In addition, the exposed region of the glass board **10** is reduced, and the strength of the electronic component **1**K can be improved. When the terminal electrodes **41** and **42** are mounted on the mounting substrate using solder, it is possible to prevent the solder from adhering to the first coil conductor **21**, the first lead conductor **25**, and the second lead conductor **26**. In addition, although stress is generated in the glass board **10** due to a difference in linear expansion coefficient between the first protective layer **15** and the glass board **10**, since the width dimension W of the glass board **10** is large, occurrence of warpage in the width direction (Y direction) of the glass board **10** can be reduced. Preferably, since the first protective layer **15** is colored, it can be detected by a laser sensor or a camera.

[0152] The same applies to the second protective layer **16**. That is, the second coil conductor **22** is protected and reliability is improved. In addition, the exposed region of the glass board **10** is reduced, and the strength of the electronic component **1**K can be improved. In addition, it is possible to prevent the solder from adhering to the second coil conductor **22**. In addition, even if the second protective layer **16** is provided, since the width dimension W of the glass board **10** is large, occurrence of warpage in the width direction (Y direction) of the glass board **10** can be reduced. Preferably, since the second protective layer **16** is colored, it can be detected by a laser sensor or a camera.

[0153] Further, the electronic component **1**K of the eleventh embodiment has the same effect as that of the electronic component **1** of the first embodiment in other configurations.

Twelfth Embodiment

[0154] FIG. **17** is a side view of a twelfth embodiment of an electronic component as viewed from a first side surface side. The twelfth embodiment is different from the eleventh embodiment in the size of the protective layer. This different configuration will be described below. The other configurations are the same as those of the eleventh embodiment, and are denoted by the same reference numerals as those of the eleventh embodiment, and the description thereof will be omitted.

[0155] As shown in FIG. **17**, in the electronic component **1**L of the twelfth embodiment, the first protective layer **15** is located inside the outer periphery of the first side surface **10***s***1** of the glass board **10** when viewed from the direction orthogonal to the first side surface **10***s***1**. Similarly, when viewed from the direction orthogonal to the second side surface **10***s***2**, the second protective layer **16** is located inside the outer periphery of the second side surface **10***s***2** of the glass board **10**. It is sufficient that only the first protective layer **15** among the first protective layer **15** and the second protective layer **16** satisfies the above configuration.

[0156] In the electronic component **1**L of the twelfth embodiment, since the first protective layer **15** is smaller than the outer periphery of the first side surface **10***s***1**, processing of the glass board **10** is facilitated. For example, when the glass board **10** is cut, a portion of the glass board **10** to be cut can be crystallized and cut by etching. In addition, for example, in the case of cutting with a dicer, it is possible to prevent the first protective layer **15** from being peeled off from the glass board **10** by a load of the dicer.

[0157] The same applies to the second protective layer **16**. That is, since the second protective layer **16** is smaller than the outer periphery of the second side surface **10***s***2**, processing of the glass board **10** is facilitated when the glass board **10** is cut. In addition, when the glass board **10** is cut with a dicer, it is possible to prevent the second protective layer **16** from being peeled off from the glass board **10** by the load of the dicer.

[0158] Further, the electronic component **1**L of the twelfth embodiment has the same effect as that of the electronic component **1**K of the eleventh embodiment in other configurations.

Thirteenth Embodiment

[0159] FIG. **18** is a side view of a thirteenth embodiment of an electronic component as viewed from a first side surface side. The thirteenth embodiment is different from the twelfth embodiment in the configuration of the end surface of the glass board. This different configuration will be described below. The other configurations are the same as those of the twelfth embodiment, and are denoted by the same reference numerals as those of the twelfth embodiment, and the description thereof will be omitted.

[0160] As shown in FIG. **18**, in an electronic component **1**M of the thirteenth embodiment, the first end surface **10***e***1** of the glass board **10** is colored. Specifically, the first end surface **10***e***1** of the glass board **10** is formed of a crystallized portion **10***a*. In FIG. **18**, the crystallized portion **10***a* is indicated by hatching for convenience. The crystallized portion **10***a* is a portion which is crystallized in the glass board **10**. The transparency of the crystallized portion **10***a* is lower than the transparency of the non-crystallized glass material of the glass board **10**. The crystallized portion **10***a* can be formed by irradiating a portion of the glass board **10** to be crystallized with ultraviolet rays and then performing heat treatment (For example, firing).

[0161] Similarly, the second end surface **10***e***2** of the glass board **10** is colored. Specifically, the second end surface **10***e***2** of the glass board **10** is formed of a crystallized portion **10***a*. It is sufficient that only the first end surface **10***e***1** among the first end surface **10***e***1** and the second end surface **10***e***2** satisfies the above configuration.

[0162] In the electronic component **1**M of the thirteenth embodiment, since the first end surface **10***e***1** is colored, it can be detected by a laser sensor or a camera. Similarly, since the second end surface **10***e***2** is colored, it can be detected by a laser sensor or a camera. In addition to the crystallized portion **10***a*, the end surface may be colored by another method such as coloring separately. For example, a colored resin layer may be provided on the end surface.

[0163] Furthermore, the electronic component **1**M of the thirteenth embodiment has the same effect as that of the electronic component **1**L of the twelfth embodiment in other configurations.

Fourteenth Embodiment

[0164] FIG. **19** is a side view of a fourteenth embodiment of an electronic component as viewed from a first side surface side. FIG. **20** is a cross-sectional view taken along line XX-XX of FIG. **19**. The fourteenth embodiment is different from the third embodiment in that an inductor element is added. This different configuration will be described below. The other configurations are the same as those of the third embodiment, and are denoted by the same reference numerals as those of the third embodiment, and the description thereof will be omitted.
[0165] As shown in FIGS. **19** and **20**, in the electronic component **1**N of the fourteenth embodiment, the first coil conductor **21** of the inductor element **2** is provided on the first flat plate electrode **31** and the second flat plate electrode **32** of the capacitor element **3** on the first side surface **10***s***1**. The first flat plate electrode **31** and the second flat plate electrode **32** correspond to an example of an “outer surface conductor” described in the claims. The first coil conductor **21** corresponds to an example of a “wiring layer” described in the claims.
[0166] The inductor element **2** has the same configuration as that of the inductor element **2** of the first embodiment. The capacitor element **3** has the same configuration as that of the capacitor element **3** of the third embodiment. Therefore, the inductor element **2** and the capacitor element **3** will not be described in detail.
[0167] The electronic component **1**N further includes a first protective layer **15**, a second protective layer **16**, and a third protective layer **17**. The first protective layer **15** is provided on the first side surface **10***s***1**, the second protective layer **16** is provided on the second side surface **10***s***2**, and the third protective layer **17** is provided on the first protective layer **15**. The first protective layer **15**, the second protective layer **16**, and the third protective layer **17** have the same configurations as those of the first protective layer **15** and the second protective layer **16** of the twelfth embodiment. Therefore, detailed description of the first protective layer **15**, the second protective layer **16**, and the third protective layer **17** is omitted.
[0168] The capacitor element **3** includes a first flat plate electrode **31**, a second flat plate electrode **32**, a dielectric film **33**, a first lead conductor **35**, and a second lead conductor **36**. The first flat plate electrode **31**, the second flat plate electrode **32**, the dielectric film **33**, the first lead conductor **35**, and the second lead conductor **36** are provided on the first side surface **10***s***1**. The capacitor element **3** is covered with the first protective layer **15**. The first lead conductor **35** is connected to the first terminal electrode **41**, and the second lead conductor **36** is connected to the second terminal electrode **42**.
[0169] The inductor element **2** includes a coil **20**, a first lead conductor **25**, and a second lead conductor **26**. The first lead conductor **25** and the second lead conductor **26** are provided on the first side surface **10***s***1** and covered with the first protective layer **15**. The first lead conductor **25** is connected to the first terminal electrode **41**, and the second lead conductor **26** is connected to the second terminal electrode **42**. That is, the inductor element **2** and the capacitor element **3** are electrically connected in parallel.
[0170] The coil **20** includes a first coil conductor **21**, a second coil conductor **22**, a first through conductor **23**, and a second through conductor **24**. Each of the first through conductor **23** and the second through conductor **24** penetrates the glass board **10** from the first side surface **10***s***1** to the second side surface **10***s***2**. The second coil conductor **22** is provided on the second side surface **10***s***2**. The second coil conductor **22** is covered with the second protective layer **16**.
[0171] The first coil conductor **21** is provided on the first protective layer **15** and covered with the third protective layer **17**. The first coil conductor **21** is connected to the first through conductor **23** and the second through conductor **24** via the via conductor **27** penetrating the first protective layer **15**. That is, the first coil conductor **21** is located on the first flat plate electrode **31** and the second flat plate electrode **32**.
[0172] In other words, the first flat plate electrode **31** and the second flat plate electrode **32** are arranged inside the coil **20**. Specifically, a part of the capacitor element **3** is provided between the first coil conductor **21** and the second coil conductor **22** of the coil **20** and between the first through

conductor **23** and the second through conductor **24**. The “inside the coil **20**” refers to a region surrounded by two surfaces in contact with the inner peripheries of the first through conductor **23** and the second through conductor **24** facing each other and two surfaces in contact with the inner peripheries of the first coil conductor **21** and the second coil conductor **22** facing each other.

[0173] In the electronic component **1**N of the fourteenth embodiment, a more complicated circuit can be realized without increasing the height dimension of the electronic component **1**N.

[0174] Further, the electronic component **1**N of the fourteenth embodiment has the same effects as those of the electronic component **1** of the first embodiment and the electronic component **1**B of the third embodiment in other configurations.

[0175] Note that the present disclosure is not limited to the above-described embodiments, and can be modified in design without departing from the gist of the present disclosure. For example, the respective feature points of the first to fourteenth embodiments may be variously combined.

[0176] The present disclosure includes the following aspects.

[0177] <1> An electronic component comprising a glass board including a top surface, a bottom surface, a first side surface, and a second side surface; an outer surface conductor that is provided on at least the first side surface among the first side surface and the second side surface and is at least a part of a passive element; and a terminal electrode embedded in the glass board so as to be exposed from the bottom surface and electrically connected to the outer surface conductor. The terminal electrode penetrates the glass board from the first side surface to the second side surface. Also, and a height dimension of the glass board, which is a distance between the top surface and the bottom surface, is smaller than a width dimension of the glass board, which is a distance between the first side surface and the second side surface.

[0178] <2> The electronic component according to <1>, in which the passive element is an inductor element, and in which the inductor element includes a through conductor connected to the outer surface conductor and penetrating the glass board from the first side surface to the second side surface.

[0179] <3> The electronic component according to <2>, in which the inductor element includes a coil that is spirally wound along an axis and includes the outer surface conductor and the through conductor, and in which the axis of the coil is parallel to the bottom surface.

[0180] <4> The electronic component according to <2>, in which the inductor element includes a coil that is spirally wound along an axis and includes the outer surface conductor and the through conductor, and in which the axis of the coil is perpendicular to the bottom surface.

[0181] <5> The electronic component according to <1>, in which the passive element is a capacitor element, in which the outer surface conductor includes a first flat plate electrode provided on the first side surface and a second flat plate electrode provided on the first flat plate electrode, and in which the capacitor element includes a dielectric film provided between the first flat plate electrode and the second flat plate electrode.

[0182] <6> The electronic component according to <1>, in which the passive element is a capacitor element, and in which the outer surface conductor includes a first flat plate electrode penetrating the glass board from the first side surface to the second side surface, and a second flat plate electrode facing the first flat plate electrode and penetrating the glass board from the first side surface to the second side surface.

[0183] <7> The electronic component according to <6>, in which the capacitor element includes a dielectric made of a material different from a glass material of the glass board between the first flat plate electrode and the second flat plate electrode.

[0184] <8 The electronic component according to <1>, in which the passive element includes an inductor element and a capacitor element.

[0185] <9> The electronic component according to any one of <1> to <8>, in which the glass board has a first portion and a second portion having a height dimension smaller than a height dimension of the first portion.

[0186] <10> The electronic component according to any one of <1> to <9>, in which the glass board includes a first end surface and a second end surface, and in which a length dimension of the glass board, which is a distance between the first end surface and the second end surface, is twice or more a width dimension of the glass board.
[0187] <11> The electronic component according to any one of <1> to <10>, in which there are three or more terminal electrodes.
[0188] <12> The electronic component according to any one of <1> to <11>, in which the glass board includes a first end surface and a second end surface, and in which the terminal electrode is further exposed from the first end surface.
[0189] <13> The electronic component according to any one of <1> to <12>, further including a protective layer provided on the first side surface and covering the outer surface conductor.
[0190] <14> The electronic component according to <13>, in which the protective layer is colored.
[0191] <15> The electronic component according to <13> or <14>, in which the protective layer is located inside an outer periphery of the first side surface of the glass board when viewed from a direction orthogonal to the first side surface.
[0192] <16> The electronic component according to any one of <1> to <15>, in which the glass board includes a first end surface and a second end surface, and in which the first end surface is colored.
[0193] <17> The electronic component according to any one of <1> to <16>, further including a wiring layer on the outer surface conductor on the first side surface.
[0194] <18> A method for manufacturing an electronic component, the method comprising a step of preparing a glass mother board including a first surface and a second surface; a step of providing, in the first surface, two or more in a direction parallel to a first side, and two or more singulated regions in a direction parallel to the third side, the singulated regions being defined by the first side and a second side that have a length smaller than a distance between the first surface and the second surface and are parallel to each other, and the third side and a fourth side that are orthogonal to the first side and are parallel to each other; a step of forming a through hole penetrating the mother board from the first surface to the second surface in each of all the singulated regions, and filling a conductor in the through hole to form a terminal electrode; a step of forming an outer surface conductor that is at least a part of a passive element on the first surface in each of all the singulated regions; and a step of singulating each of all the singulated regions to manufacture a plurality of electronic components.

Claims

1. An electronic component comprising: a glass board comprising a top surface, a bottom surface, a first side surface, and a second side surface; an outer surface conductor that is on at least the first side surface among the first side surface and the second side surface and is at least a part of a passive element; and a terminal electrode embedded in the glass board and exposed from the bottom surface and electrically connected to the outer surface conductor, wherein the terminal electrode penetrates the glass board from the first side surface to the second side surface, and a height dimension of the glass board, which is a distance between the top surface and the bottom surface, is smaller than a width dimension of the glass board, which is a distance between the first side surface and the second side surface.
2. The electronic component according to claim 1, wherein the passive element is an inductor element, and the inductor element comprises a through conductor connected to the outer surface conductor and penetrating the glass board from the first side surface to the second side surface.
3. The electronic component according to claim 2, wherein the inductor element comprises a coil that is spirally wound along an axis and comprises the outer surface conductor and the through conductor, and the axis of the coil is parallel to the bottom surface.

4. The electronic component according to claim 2, wherein the inductor element comprises a coil that is spirally wound along an axis and comprises the outer surface conductor and the through conductor, and the axis of the coil is perpendicular to the bottom surface.
5. The electronic component according to claim 1, wherein the passive element is a capacitor element, the outer surface conductor comprises a first flat plate electrode on the first side surface and a second flat plate electrode on the first flat plate electrode, and in which the capacitor element comprises a dielectric film between the first flat plate electrode and the second flat plate electrode.
6. The electronic component according to claim 1, wherein the passive element is a capacitor element, and the outer surface conductor comprises a first flat plate electrode penetrating the glass board from the first side surface to the second side surface, and a second flat plate electrode facing the first flat plate electrode and penetrating the glass board from the first side surface to the second side surface.
7. The electronic component according to claim 6, wherein the capacitor element comprises a dielectric including a material different from a glass material of the glass board between the first flat plate electrode and the second flat plate electrode.
8. The electronic component according to claim 1, wherein the passive element comprises an inductor element and a capacitor element.
9. The electronic component according to claim 1, wherein the glass board has a first portion and a second portion having a height dimension smaller than a height dimension of the first portion.
10. The electronic component according to claim 1, wherein the glass board comprises a first end surface and a second end surface, and a length dimension of the glass board, which is a distance between the first end surface and the second end surface, is twice or more a width dimension of the glass board.
11. The electronic component according to claim 1, wherein there are three or more terminal electrodes.
12. The electronic component according to claim 1, wherein the glass board comprises a first end surface and a second end surface, and the terminal electrode is further exposed from the first end surface.
13. The electronic component according to claim 1, further comprising: a protective layer on the first side surface and covering the outer surface conductor.
14. The electronic component according to claim 13, wherein the protective layer is colored.
15. The electronic component according to claim 13, wherein the protective layer is inside an outer periphery of the first side surface of the glass board when viewed from a direction orthogonal to the first side surface.
16. The electronic component according to claim 1, wherein the glass board comprises a first end surface and a second end surface, and the first end surface is colored.
17. The electronic component according to claim 1, further comprising: a wiring layer on the outer surface conductor on the first side surface.
18. The electronic component according to claim 2, wherein the glass board has a first portion and a second portion having a height dimension smaller than a height dimension of the first portion.
19. The electronic component according to claim 2, wherein the glass board comprises a first end surface and a second end surface, and a length dimension of the glass board, which is a distance between the first end surface and the second end surface, is twice or more a width dimension of the glass board.
20. A method for manufacturing an electronic component, the method comprising: preparing a glass mother board comprises a first surface and a second surface; providing, in the first surface, two or more in a direction parallel to a first side, and two or more singulated regions in a direction parallel to a third side, the singulated regions being defined by the first side and a second side that have a length smaller than a distance between the first surface and the second surface and are parallel to each other, and the third side and a fourth side that are orthogonal to the first side and are

parallel to each other; forming a through hole penetrating the mother board from the first surface to the second surface in each of all the singulated regions, and filling a conductor in the through hole to form a terminal electrode; and forming an outer surface conductor that is at least a part of a passive element on the first surface in each of all the singulated regions; and singulating each of all the singulated regions to manufacture a plurality of electronic components.