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TRANSFORMER MODULE

Abstract

A transformer module may include a first bobbin unit around which a primary coil is wound and a second bobbin unit around which a secondary coil is wound and that accommodates at least a portion of the first bobbin unit.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority to Korean Patent Application No. 10-2024-0024597, filed in the Korean Intellectual Property Office on Feb. 20, 2024, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to a transformer module, and more particularly, relates to a transformer module for reducing noise generated in an SMPS and decreasing parasitic capacitance.

BACKGROUND

[0003] In order to implement stable operation of an electronic product by improving the quality of power supplied to the electronic product, a filter for removing or minimizing electromagnetic interference (EMI) noise have become increasingly important.

[0004] In particular, in the mobility sector, a hybrid vehicle (HEV), a plug-in hybrid vehicle (PHEV), an electric vehicle (EV), and a fuel cell vehicle (FCEV) have attracted attention as environmentally friendly vehicles of the future that will replace vehicles powered by fossil fuels.

[0005] Various types of power conversion devices are used in relation to electric vehicles that are being actively commercialized. For example, an on-board charger (OBC) for charging a high-voltage battery from the outside may be used. In another example, a low-voltage DC-DC converter (LDC) for converting power from a high-voltage battery to a low-voltage battery (e.g., a 12V low-voltage battery) may be used.

[0006] Electromagnetic interference noise may be generated, maintained, and amplified in the process of charging the high-voltage battery from the outside or in the process of converting the power from the high-voltage battery to the low-voltage battery, and the electromagnetic interference noise may affect the transmission and supply of the power and may cause a malfunction of a load that receives the power (e.g., headlights, wipers, an ECU, and the like that are driven by power supplied from a low-voltage battery).

[0007] Meanwhile, in relation to the structure of a transformer, the area where the primary coil is wound and the area where the secondary coil is wound may partially overlap each other to decrease parasitic capacitance and reduce noise when each of the primary coil and the secondary coil forms a wound shape. Depending on the above-described structure, the space occupied by the transformer may be decreased, and thus the transformer may be made compact. However, despite the structure described above, there is a demand for a transformer capable of implementing stable winding of the primary coil and the secondary coil and high power conversion efficiency.

[0008] In addition, efforts for making a transformer module compact and minimizing the area occupied by the transformer module when the transformer module is mounted on a substrate are being made.

PATENT DOCUMENT

[0009] (Patent Document 1) Korean Patent No. 10-2359297 (Feb. 8, 2022)

SUMMARY

[0010] The present disclosure has been made to solve the above-mentioned problems occurring in the prior art while advantages achieved by the prior art are maintained intact.

[0011] An aspect of the present disclosure provides a compact transformer module for decreasing parasitic capacitance and minimizing noise.

[0012] The technical problems to be solved by the present disclosure are not limited to the

aforementioned problems, and any other technical problems not mentioned herein will be clearly understood from the following description by those skilled in the art to which the present disclosure pertains.

[0013] According to an aspect of the present disclosure, a transformer module includes a first bobbin unit around which a primary coil is wound and a second bobbin unit around which a secondary coil is wound and that accommodates at least a portion of the first bobbin unit.

[0014] The first bobbin unit may include a first winding part on which the primary coil is wound around a portion of an outer peripheral surface of the first winding part, and the second bobbin unit may include a second winding part on which the secondary coil is wound around a portion of an outer peripheral surface of the second winding part. The outer peripheral surface of the first winding part may correspond to an inner peripheral surface of the second winding part and may be covered by the second winding part.

[0015] The first winding part may include a first winding area where the primary coil is directly wound around an outer peripheral surface of the first winding area, a first side plate formed at one end of the first winding area to protrude outward from the outer peripheral surface of the first winding area, a second side plate formed at an opposite end of the first winding area to protrude outward from the outer peripheral surface of the first winding area, the second side plate being configured to face the first side plate, and at least one first winding area partition unit that is formed between the first side plate and the second side plate and that protrudes outward from the outer peripheral surface of the first winding area.

[0016] The second winding part may include a second winding area where the secondary coil is directly wound around an outer peripheral surface of the second winding area, a third side plate formed at one end of the second winding area to protrude outward from the outer peripheral surface of the second winding area, a fourth side plate formed at an opposite end of the second winding area to protrude outward from the outer peripheral surface of the second winding area, the fourth side plate being configured to face the third side plate, and at least one second winding area partition unit that is formed between the third side plate and the fourth side plate and that protrudes outward from the outer peripheral surface of the second winding area, and the at least one first winding area partition unit and the at least one second winding area partition unit may be formed at the same position in a longitudinal direction.

[0017] Each of the at least one first winding area partition unit and the at least second winding area partition unit may be formed in the same number, n. Each of the primary coil and secondary coil may be wound to form (n+1) channels by the at least one first winding area partition unit and the at least one second winding area partition unit (n being an integer of 1 or more).

[0018] A second side plate outer surface of the second side plate and a fourth side plate inner surface of the fourth side plate may make surface-to-surface contact with each other, and a first side plate outer surface of the first side plate and a third side plate outer surface of the third side plate may be arranged on the same plane by the surface contact between the second side plate outer surface and the fourth side plate inner surface.

[0019] The first bobbin unit may further include a first extension part that extends outward from one end of the first winding part by a certain length, and the first extension prat may include a first step portion that extends in a longitudinal direction from a first side plate formed at one end of a first winding area of the first winding part and a second step portion that protrudes outward from the first step portion in a width direction and forms a step of a first thickness with the first step portion.

[0020] The second bobbin unit may further include a second extension part that extends outward from one end of the second winding part by a certain length, and the second extension part may include a first fixing portion that extends in the longitudinal direction from a third side plate formed at one end of a second winding area of the second winding part and a second fixing portion that protrudes inward from the first fixing portion in the width direction and protrudes downward

from an upper surface of the first fixing portion by a second thickness.
[0021] The first thickness formed by the first step portion and the second step portion and the second thickness of the second fixing portion may correspond to each other to guide insertion of the first winding part into the second winding part, and the first bobbin unit may be located in a correct position with respect to the second bobbin unit.
[0022] The first bobbin unit may further include a first terminal portion that protrudes from one end of a first extension part that extends outward from one end of the first winding part by a certain length, the second bobbin unit may further include a second terminal portion that protrudes from one end of a second extension part that extends outward from one end of the second winding part by a certain length, and the first terminal portion and the second terminal portion may be spaced apart from each other.
[0023] The first bobbin unit may further include a first terminal portion that protrudes from one end of a first extension part that extends outward from one end of the first winding part by a certain length, the second bobbin unit may further include a second terminal portion that protrudes from one end of a second extension part that extends outward from one end of the second winding part by a certain length, and the first terminal portion and a one-side second terminal portion of the second terminal portion may be arranged on the same line.
[0024] The first bobbin unit may further include a first extension part that extends outward from one end of the first winding part by a certain length, and the second bobbin unit may further include a second extension par that extends outward from one end of the second winding part by a certain length. The first extension part may include a side protruding portion that protrudes outward in a width direction, and the second extension part may include a side receiving portion that is recessed outward in the width direction and that has a shape corresponding to a shape of the side protruding portion. The side protruding portion may be accommodated in the side receiving portion to guide insertion of the first winding part into the second winding part, and the first bobbin unit may be located in a correct position with respect to the second bobbin unit.
[0025] The first bobbin unit may further include a first terminal portion including a plurality of first terminals that protrude from one end of a first extension part that extends outward from one end of the first winding part by a certain length. The second bobbin unit may further include a second terminal portion including a plurality of second terminals that protrude from one end of a second extension part that extends outward from one end of the second winding part by a certain length. Each of the plurality of first terminals and the plurality of second terminals may extend in a longitudinal direction or a width direction.
[0026] The transformer module may further include a cap unit that covers at least a portion of the first bobbin unit and at least a portion of the second bobbin unit, and the cap unit may cover at least a portion of the outer peripheral surface of the first winding part and at least a portion of the outer peripheral surface of the second winding part.
[0027] The cap unit may include a cap unit upper-surface portion that covers an upper portion of the second winding part, a pair of cap unit side portions that cover opposite ends of the first winding part and the second winding part, and a pair of cap fixing portions that extend inward from the pair of cap unit side portions toward the first bobbin unit and the second bobbin unit in a longitudinal direction.
[0028] The transformer module may further include a core unit including a core center portion that penetrates the first bobbin unit and the second bobbin unit, and a core side portion that is spaced apart from the core center portion and that covers at least a portion of an outside of the first bobbin unit and at least a portion of an outside of the second bobbin unit.
[0029] The transformer module may further include a bending unit that surrounds at least a portion of an outer surface of the core unit.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The above and other objects, features and advantages of the present disclosure will be more apparent from the following detailed description taken in conjunction with the accompanying drawings:

[0031] FIG. **1** is a perspective view of a transformer module according to a disclosed embodiment of the present disclosure;

[0032] FIG. **2** is a perspective view of the transformer module excluding a cap unit according to the disclosed embodiment of the present disclosure;

[0033] FIG. **3** is an exploded perspective view of the transformer module according to the disclosed embodiment of the present disclosure;

[0034] FIG. **4** is a view for explaining a first bobbin unit, which is a component of the transformer module, according to the disclosed embodiment of the present disclosure;

[0035] FIG. **5** is a view for explaining a second bobbin unit, which is a component of the transformer module, according to the disclosed embodiment of the present disclosure;

[0036] FIG. **6** is a view for explaining a relationship between the first bobbin unit and the second bobbin unit in the transformer module according to the disclosed embodiment of the present disclosure;

[0037] FIG. **7** is a perspective view of a transformer module according to another embodiment of the present disclosure;

[0038] FIG. **8** is an exploded perspective view of the transformer module according to the other embodiment of the present disclosure;

[0039] FIG. **9** is a perspective view of a transformer module according to another embodiment of the present disclosure; and

[0040] FIG. **10** is an exploded perspective view of the transformer module according to the other embodiment of the present disclosure.

DETAILED DESCRIPTION

[0041] The above and other aspects, features, and advantages of the present disclosure will become apparent from the following description of embodiments given in conjunction with the accompanying drawings. However, the present disclosure is not limited to the embodiments disclosed herein and may be implemented in various different forms. Herein, the embodiments are provided to provide complete disclosure of the present disclosure and to provide thorough understanding of the present disclosure to those skilled in the art to which the present disclosure pertains, and the scope of the present disclosure should be limited only by the accompanying claims and equivalents thereof.

[0042] It will be understood that, although the terms first, second, etc. may be used herein to describe various components, these components should not be limited by these terms. These terms are only used to distinguish one component from another component. Thus, a first component mentioned below could be termed a second component without departing from the spirit of the present disclosure.

[0043] Through the specification, identical reference numerals refer to identical components.

[0044] The features of various embodiments of the present disclosure can be partially or entirely coupled to or combined with each other and can be interlocked and operated in technically various ways as can be fully understood by those skilled in the art, and the embodiments can be carried out independently of or in association with each other.

[0045] Meanwhile, the potential effects that may be expected by the technical features of the present disclosure that are not specifically mentioned in the specification of the present disclosure are treated as being described in this specification, and this embodiment is provided to more fully

describe the present disclosure for those skilled in the art. Thus, the contents illustrated in the drawings may be exaggerated compared to the actual implementation of the present disclosure, and detailed descriptions of components determined to unnecessarily make subject matters of the present disclosure obscure will be omitted or briefly described.

[0046] Hereinafter, disclosed embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[0047] FIG. **1** is a perspective view of a transformer module **1** according to a disclosed embodiment of the present disclosure, and FIG. **2** is a perspective view of the transformer module excluding a cap unit according to the disclosed embodiment of the present disclosure.

[0048] Referring to FIGS. **1** and **2**, the transformer module **1** according to the disclosed embodiment of the present disclosure may include a first bobbin unit **100** and a second bobbin unit **200**. In addition, the transformer module **1** according to the disclosed embodiment of the present disclosure may include a coil unit (not illustrated) and a core unit **300**.

[0049] The first bobbin unit **100** may be a component around which a primary coil is wound. In more detail, the primary coil of the coil unit may be wound around an outer peripheral surface of at least a portion of the first bobbin unit **100**. As current flows through the primary coil, magnetic flux may be generated, and an induced electromotive force may be generated.

[0050] The second bobbin unit **200** may be a component around which a secondary coil is wound. In more detail, the secondary coil of the coil unit may be wound around an outer peripheral surface of at least a portion of the second bobbin unit **200**. As current flows through the secondary coil, magnetic flux may be generated, and an induced electromotive force may be generated. The second bobbin unit **200** may accommodate at least a portion of the first bobbin unit **100**. As the second bobbin unit **200** accommodates the at least a portion of the first bobbin unit **100**, the primary coil wound around the outer peripheral surface of the at least a portion of the first bobbin unit **100** may be more safely protected from an external environment, and the area around which the primary coil is wound and the area around which the secondary coil is wound may at least partially overlap each other. Accordingly, the magnitude of parasitic capacitance generated in a power conversion process may be decreased, and noise (that is, EMI noise) may be minimized.

[0051] Although the coil unit is not clearly illustrated in the drawings accompanied to describe the transformer module according to the present disclosure, the coil unit may be wound around a first winding area **111** (refer to FIGS. **2** to **4**) of a first winding part **110** (refer to FIGS. **2** to **4**) and a second winding area **211** (refer to FIGS. **3** and **4**) of a second winding part **210** (refer to FIGS. **3** and **4**). The coil unit may include the primary coil and the secondary coil. The primary coil may be wound around the first winding area **111**, and the secondary coil may be wound around the second winding area **211**.

[0052] The core unit **300** may serve to absorb and/or form magnetic flux generated from the above-described coil unit and transfer a voltage generated in the primary coil to the secondary coil. The core unit **300** may serve as a passage that coverts power in the primary coil into power in the secondary coil.

[0053] Hereinafter, detailed components of the transformer module **1** according to the disclosed embodiment of the present disclosure will be described in more detail.

[0054] FIG. **3** is an exploded perspective view of the transformer module **1** according to the disclosed embodiment of the present disclosure, FIG. **4** is a view for explaining the first bobbin unit **100**, which is a component of the transformer module **1**, according to the disclosed embodiment of the present disclosure, and FIG. is a view for explaining the second bobbin unit **200**, which is a component of the transformer module **1**, according to the disclosed embodiment of the present disclosure.

[0055] Referring to FIGS. **1** to **5**, the first bobbin unit **100**, which is a component of the transformer module **1** according to the disclosed embodiment of the present disclosure, may include the first winding part **110**. The first winding part **110** may be an area around which the primary coil is

wound in the first bobbin unit **100**. That is, the primary coil may be wound around a portion of an outer peripheral surface of the first winding part **110**. Accordingly, the wound primary coil may generate magnetic flux to generate an induced electromotive force.

[0056] The second bobbin unit **200**, which is a component of the transformer module **1** according to the disclosed embodiment of the present disclosure, may include the second winding part **210**. The second winding part **210** may be an area around which the secondary coil is wound in the second bobbin unit **200**. That is, the secondary coil may be wound around a portion of an outer peripheral surface of the second winding part **210**. Accordingly, the wound secondary coil may generate magnetic flux to generate an induced electromotive force or may transfer transferred power to a load.

[0057] Meanwhile, the outer peripheral surface of the first winding part **110** may correspond to the inner peripheral surface of the second winding part **210**. The outer peripheral surface of the first winding part **110** may be covered by the second winding part **210**. For example, the size of the outer width w**1** on the first winding part side, which represents the outer peripheral surface of the first winding part **110**, may correspond to the inner width w**2** on the second winding part side, which represents the inner peripheral surface of the second winding part **210**. In more detail, the outer width w**1** on the first winding part side may be less than or equal to the inner width w**2** on the second winding part side. Accordingly, the outer peripheral surface of the first winding part **110** may be entirely covered by the second winding part **210**. Thus, the primary coil wound around the first winding part **110** may be more safely protected from an external environment, and a decrease in parasitic capacitance and minimization of noise may be achieved.

[0058] Hereinafter, detailed components of the first winding part **110** will be described in more detail.

[0059] In the first bobbin unit **100** of the transformer module **1** according to the disclosed embodiment of the present disclosure, the first winding part **110** may include the first winding area **111**. The first winding area **111** may be an area where the primary coil is directly wound around the outer peripheral surface thereof. The first winding area **111** may include at least one channel first winding area **111***a*, **111***b*, **111***c*, and **111***d*. For example, the first winding area **111** may include the first channel first winding area **111***a*, the second channel first winding area **111***b*, the third channel first winding area **111***c*, and the fourth channel first winding area **111***d*, and the channel first winding areas **111***a*, **111***b*, **111***c*, and **111***d* may form a plurality of channels in correspondence with the second winding area **211** to be described below.

[0060] The first winding part **110** may include a first side plate **112**. The first side plate **112** may be formed at one end of the first winding area **111** to protrude outward from the outer peripheral surface of the first winding area **111**. The first side plate **112** may have a width and/or a height greater than the width (e.g., a length parallel to the y-axis) and/or or the height (e.g., a length parallel to the z-axis) of the first winding area **111**. The first side plate **112** may prevent the primary coil wound around the first winding area **111** from passing over the first side plate **112** and departing from the first winding part **110** to one side.

[0061] The first winding part **110** may include a second side plate **113**. The second side plate **113** may be formed at an opposite end of the first winding area **111** to protrude outward from the outer peripheral surface of the first winding area **111**. The second side plate **113** may have a width and/or a height greater than the width (e.g., a length parallel to the y-axis) and/or or the height (e.g., a length parallel to the z-axis) of the first winding area **111**. The second side plate **113** may be formed to face the first side plate **112** in the longitudinal direction (e.g., a direction parallel to the x-axis). The second side plate **113** may prevent the primary coil wound around the first winding area **11** from passing over the second side plate **113** and departing from the first winding part **110** to the opposite side.

[0062] The first winding part **110** may include at least one first winding area partition unit **114** formed on the first winding area **111**. In more detail, the at least one first winding area partition unit

114 may be formed between the first side plate **112** and the second side plate **113** and may protrude outward from the outer peripheral surface of the first winding area **111**. As illustrated in FIGS. **3** and **4**, the first winding area partition unit **114** may include three first winding area partition units **114***a*, **114***b*, and **114***c*, and due to the first winding area partition units **114***a*, **114***b*, and **114***c*, the first winding area **111** may include the first channel first winding area **111***a* having a first length d**11**, the second channel first winding area **111***b* having a second length d**12**, the third channel first winding area **111***c* having a third length d**13**, and the fourth channel first winding area **111***d* having a fourth length d**14**. That is, depending on the number of first winding area partition units **114**, the channel first winding areas **111***a*, **111***b*, **111***c*, and **111***d* one more than the number of first winding area partition units **114** may be formed.

[0063] Hereinafter, detailed components of the second winding part **210** will be described in more detail.

[0064] In the second bobbin unit **200** of the transformer module **1** according to the disclosed embodiment of the present disclosure, the second winding part **210** may include the second winding area **211**. The second winding area **211** may be an area where the secondary coil is directly wound around the outer peripheral surface thereof. The second winding area **211** may include at least one channel second winding area **211***a*, **211***b*, **211***c*, and **211***d*. For example, the second winding area **211** may include the first channel second winding area **211***a*, the second channel second winding area **211***b*, the third channel second winding area **211***c*, and the fourth channel second winding area **211***d*. The channel second winding areas **211***a*, **211***b*, **211***c*, and **211***d* may form a plurality of channels in correspondence with the above-described first winding area **111**.

[0065] The second winding part **210** may include a third side plate **212**. The second side plate **212** may be formed at one end of the second winding area **211** to protrude outward from the outer peripheral surface of the second winding area **211**. The third side plate **212** may have a width and/or a height greater than the width (e.g., a length parallel to the y-axis) and/or or the height (e.g., a length parallel to the z-axis) of the second winding area **211**. The third side plate **212** may prevent the secondary coil wound around the second winding area **211** from passing over the third side plate **212** and departing from the second winding part **210** to one side.

[0066] The second winding part **210** may include a fourth side plate **213**. The fourth side plate **213** may be formed at an opposite end of the second winding area **211** to protrude outward from the outer peripheral surface of the second winding area **211**. The fourth side plate **213** may have a width and/or a height greater than the width (e.g., a length parallel to the y-axis) and/or or the height (e.g., a length parallel to the z-axis) of the second winding area **211**. The fourth side plate **213** may be formed to face the third side plate **212** in the longitudinal direction (e.g., a direction parallel to the x-axis). The fourth side plate **213** may prevent the secondary coil wound around the second winding area **211** from passing over the fourth side plate **213** and departing from the second winding part **210** to the opposite side.

[0067] The second winding part **210** may include at least one second winding area partition unit **214** formed on the second winding area **211**. In more detail, the at least one second winding area partition unit **214** may be formed between the third side plate **212** and the fourth side plate **213** and may protrude outward from the outer peripheral surface of the second winding area **211**. As illustrated in FIGS. **3** to **5**, the second winding area partition unit **214** may include three second winding area partition units **214***a*, **214***b*, and **214***c*, and due to the second winding area partition units **214***a*, **214***b*, and **214***c*, the second winding area **211** may include the first channel second winding area **211***a* having a fifth length d**21**, the second channel second winding area **211***b* having a sixth length d**22**, the third channel second winding area **211***c* having a seventh length d**23**, and the fourth channel second winding area **211***d* having an eighth length d**24**. That is, depending on the number of second winding area partition units **214**, the channel second winding areas **211***a*, **211***b*, **211***c*, and **211***d* one more than the number of second winding area partition units **214** may be formed.

[0068] Hereinafter, a physical relationship between the first bobbin unit **100** and the second bobbin unit **200** in the transformer module **1** according to the disclosed embodiment of the present disclosure will be described in more detail.
[0069] First, a relationship between the first winding part **110** of the first bobbin unit **100** and the second winding part **210** of the second bobbin unit **200** in the transformer module **1** according to the disclosed embodiment of the present disclosure will be described.
[0070] FIG. **6** is a view for explaining a relationship between the first bobbin unit **100** and the second bobbin unit **200** in the transformer module **1** according to the disclosed embodiment of the present disclosure.
[0071] Referring to FIGS. **1** to **6**, the at least one first winding area partition unit **114** and the at least one second winding area partition unit **214** may be formed at the same position in the longitudinal direction (e.g., a direction parallel to the x-axis) As illustrated in FIG. **6**, the first winding area partition units **114***a*, **114***b*, and **114***c* may be arranged on the same planes as the corresponding second winding area partition units **214***a*, **214***b*, and **214***c*, respectively. Accordingly, the channel first winding areas **111***a*, **111***b*, **111***c*, and **111***d* and the channel second winding areas **211***a*, **211***b*, **211***c*, and **211***d* may be formed to correspond to each other. For example, the first length d**11** of the first channel first winding area **111***a* may correspond to the fifth length d**21** of the first channel second winding area **211***a*. The second length d**12** of the second channel first winding area **111***b* may correspond to the sixth length d**22** of the second channel second winding area **211***b*. The third length d**13** of the third channel first winding area **111***c* may correspond to the seventh length d**23** of the third channel second winding area **211***c*. The fourth length d**14** of the fourth channel first winding area **111***d* may correspond to the eighth length d**24** of the fourth channel second winding area **211***d*. Accordingly, the coil unit wound around the first channel winding area **111***a* and **211***a*, the coil unit wound around the second channel winding area **111***b* and **211***b*, the coil unit wound around the third channel winding area **111***c* and **211***c*, and the coil unit wound around the fourth channel winding area **111***d* and **211***d* may have the same wound length. Thus, parasitic capacitance may be decreased, and noise may be minimized. In addition, as the coil unit is uniformly wound, a difference in capacitance between the plurality of channels may be minimized, and thus the electrical stability of the transformer module may be further improved.
[0072] Although, as illustrated in FIGS. **1** to **6**, the at least one first winding area partition unit **114** includes three first winding area partition units and the at least one second winding area partition unit **214** includes three second winding area partition units, the number of first winding area partition units and the number of second winding area partition units are not necessarily limited thereto. Each of the at least one first winding area partition unit **114** and the at least one second winding area partition units **214**, is formed in the same number, n. For example, the at least one first winding area partition unit **114** may include n first winding area partition units, and the at least one second winding area partition unit **214** may include n second winding area partition units. In this case, n may be an integer of 1 or more. The at least one first winding area partition unit **114** may include n first winding area partition units arranged at equal intervals between the first side plate **112** and the second side plate **113**, and the at least one second winding area partition unit **214** may include n second winding area partition units arranged at equal intervals between the third side plate **212** and the fourth side plate **213**. Due to the n first winding area partition units and the n second winding area partition units, each of the primary coil and the secondary coil may be wound to form (n+1) channels. Accordingly, the transformer module **1** according to the disclosed embodiment of the present disclosure may have a structure capable of forming a required number of channels optimized for power conversion of an electronic product.
[0073] Meanwhile, depending on the structure in which the first winding part **110** of the first bobbin unit **100** is accommodated in the second winding part **210** of the second bobbin unit **200**, the coil unit wound around each of the first winding area **111** and the second winding area **211** may be located in a correct position. In more detail, a second side plate outer surface **1131** that is an

outer surface (e.g., a portion formed parallel to the yz-plane toward the negative x-axis direction) of the second side plate **113** may make surface-to-surface contact with a fourth side plate inner surface **2131** that is an inner surface (e.g., a portion formed parallel to the yz-plane toward the positive x-axis direction) of the fourth side plate **213**. That is, the first winding part **110** may be inserted to the position where the fourth side plate inner surface **2131** is formed, and the second side plate outer surface **1131** may physically interfere with the fourth side plate inner surface **2131** such that a movement of the second side plate outer surface **1131** in the longitudinal direction (e.g., in the negative x-axis direction in which the first winding part **110** is inserted into the second winding part **210**) is limited. Accordingly, the first winding part **110** may be positioned at a certain position in relation to the second winding part **210**. In particular, the first winding area **111** and the second winding area **211** may be arranged to correspond to each other.

[0074] Due to the surface contact between the second side plate outer surface **1131** and the fourth side plate inner surface **2131**, a first side plate outer surface **1121** that is an outer surface (e.g., a portion formed parallel to the yz-plane toward the positive x-axis direction) of the first side plate **112** and a third side plate outer surface **2121** that is an outer surface (e.g., a portion formed parallel to the yz-plane toward the positive x-axis direction) of the third side plate **212** may be arranged on the same plane. That is, the first side plate outer surface **1121** and the third side plate outer surface **2121** may be arranged on the same plane so that a receiving space **216** of the second winding part **210** may be sealed so as to be safely protected from an external environment. Accordingly, the primary coil of the coil unit wound around the first winding part **110** may be safely protected.

[0075] Hereinafter, a first extension part **120** of the first bobbin unit **100** and a second extension part **220** of the second bobbin unit **200** will be described.

[0076] Referring to FIGS. **1** to **6**, the first bobbin unit **100**, which is a component of the transformer module **1** according to the disclosed embodiment of the present disclosure, may include the first extension part **120**. For example, the first extension part **120** may extend a certain length from one end of the first winding part **110** in the outer longitudinal direction (e.g., the x-axis direction).

[0077] The first extension part **120** may include a first step portion **121** and a second step portion **122**. For example, the first step portion **121** may extend in the longitudinal direction (e.g., the positive x-axis direction) from the first side plate **112** formed at the one end of the first winding area **111** of the first winding part **110**. The first step portion **121** may form a central portion in the first extension part **120** based on the width direction. The second step portion **122** may protrude outward from the first step portion **121** in the width direction. The second step portion **122** may form a step of a first thickness t**1** with the first step portion **121**. In more detail, the second step portion **122** may protrude from the first step portion **121** to opposite sides in the width direction, and the upper surface of the second step portion **122** may be recessed in the lower direction (e.g., the negative z-axis direction) by the first thickness t**1** with respect to the upper surface of the first step portion **121**.

[0078] Correspondingly, the second bobbin unit **200**, which is a component of the transformer module **1** according to the disclosed embodiment of the present disclosure, may include the second extension part **220**. For example, the second extension part **220** may extend outward from one end of the second winding part **210** by a certain length. In this case, the direction in which the second extension part **220** extends from the one end of the second winding part **210** may be the same direction (e.g., the positive x-axis direction) as the direction in which the first extension part **120** extends from the one end of the first winding part **110**.

[0079] The second extension part **220** may include a first fixing portion **221** and a second fixing portion **222**. For example, the first fixing portion **221** may extend in the longitudinal direction (e.g., the positive x-axis direction) from the third side plate **212** formed at the one end of the second winding area **211** of the second winding part **210**. The first fixing portion **221** may have an elongated shape in the up-down direction (e.g., the positive z-axis direction or the negative z-axis direction) to cover the above-described first extension part **120** from the outside in the width

direction. The second fixing portion **222** may protrude inward from the first fixing portion **221** in the width direction. The second fixing portion **222** may protrude downward from the upper surface of the first fixing portion **221** by a second thickness t**2**.

[0080] Meanwhile, the first thickness t**1** of the step formed between the first step portion **121** and the second step portion **122** and the second thickness t**2** of the second fixing portion **22** may correspond to each other. For example, the first thickness t**1** may be equal to the second thickness t**2**. Accordingly, in the process in which the first winding part **110** of the first bobbin unit is inserted to be accommodated in the second winding part **210** of the second bobbin unit **200**, a kind of rail structure may be formed to guide the insertion of the first winding part **110**. In addition, depending on the relationship between the first thickness t**1** and the second thickness t**2**, a movement of the first winding part **110** of the first bobbin unit **100** in the up-down direction may be limited after the first winding part **110** of the first bobbin unit **100** is accommodated in the second winding part **210** of the second bobbin unit **200**, and thus the first bobbin unit **100** may be located in a correct position with respect to the second bobbin unit **200** to form a stable assembly structure.

[0081] The transformer module **1** according to the disclosed embodiment of the present disclosure may further include the core unit **300**. At least a portion of the core unit **300** may penetrate the first bobbin unit **100** and the second bobbin unit **200**, and the remaining portion of the core unit **300** may cover the outside of the first bobbin unit **100** and the outside of the second bobbin unit **200**.

[0082] In more detail, the core unit **300** may include a core center portion **301** that penetrates the first bobbin unit **100** and the second bobbin unit **200**. To accommodate the core center portion **301**, the first winding part **110** of the first bobbin unit **100** may include a first core receiving hole **115** that is open in the longitudinal direction, and the second winding part **210** of the second bobbin unit **200** may include a second core receiving hole **215** that is open in the longitudinal direction. When the core unit **300** is formed by coupling a first core unit **310** and a second core unit **320**, a first core center portion **311** of the first core unit **310** may be inserted through one side of the first core receiving hole **115** and one side of the second core receiving hole **215**, and a second core center portion **321** of the second core unit **320** may be inserted through an opposite side of the first core receiving hole **115** and an opposite side of the second core receiving hole **215**.

[0083] The core unit **300** may include a core side portion **302** that covers at least a portion of the outside of the first bobbin unit **100** and at least a portion of the outside of the second bobbin unit **200**. For example, the core side portion **302** may cover at least a portion of opposite side surfaces of the second bobbin unit **200** that face in the width direction. The core side portion **302** may be spaced apart from the core center portion **301**. When the core unit **300** is formed by coupling the first core unit **310** and the second core unit **320**, a pair of first core side portions **312** of the first core unit **310** and a pair of second core side portions **322** of the second core unit **320** may cover part of an outer portion of the second winding part **210** of the second bobbin unit **200** that faces in the width direction.

[0084] In the transformer module **1** according to the disclosed embodiment of the present disclosure, a protruding portion **123** and a concave portion **124** may be formed at the bottom of the first extension part **120** of the first bobbin unit **100**, and a space for connecting the primary coil to a first terminal **131** of a first terminal portion **130** may be formed by the protruding portion **123** and the concave portion **124**. The second bobbin unit **200** may also be connected with a second terminal **231** of a second terminal portion **230** through a coil receiving passage formed at the bottom of the second extension part **220**. If necessary, the second terminal portion **230** may include a one-side second terminal portion **230***a* and an opposite-side second terminal portion **230***b*, and the one-side second terminal portion **230***a* and the opposite-side second terminal portion **230***b* may include a one-side second terminal **231***a* and an opposite-side second terminal **231***b*, respectively. Accordingly, the secondary coil may be connected to the corresponding second terminal portion **230** to form a power conversion and transmission path.

[0085] In the transformer module **1** according to the disclosed embodiment of the present

disclosure, the first bobbin unit **100** may include the first terminal portion **130**. The first terminal portion **130** may protrude from one end of the first extension part **120** that extends outward from the one end of the first winding part **110** by the certain length. The first terminal portion **130** may include a plurality of first terminals **131**. The first terminal portion **130** may extend a certain length from the bottom of the one end of the first extension part **120** in the lower direction (e.g., the negative z-axis direction). The first terminal portion **130** may form a mechanical and electrical connection with a substrate (not illustrated) by being inserted into the substrate and soldered to the substrate, such that the transformer module **1** according to the disclosed embodiment of the present disclosure performs a transformer function.

[0086] In the transformer module **1** according to the disclosed embodiment of the present disclosure, the second bobbin unit **200** may include the second terminal portion **230**. The second terminal portion **230** may protrude from one end of the second extension part **220** that extends outward from the one end or the opposite ends of the second winding part **210** by the certain length. The second terminal portion **230** may include a plurality of second terminals **231**. The second terminal portion **230** may extend a certain length from the bottom of the one end of the second extension part **220** in the lower direction (e.g., the negative z-axis direction). The second terminal portion **230** may form a mechanical and electrical connection with the substrate (not illustrated) by being inserted into the substrate and soldered to the substrate, such that the transformer module **1** according to the disclosed embodiment of the present disclosure performs a transformer function.

[0087] Meanwhile, the first terminal portion **130** and the second terminal portion **230** may be spaced apart from each other. In more detail, the first terminal portion **130** and the second terminal portion **230** may be inserted into the substrate, but may be spaced apart from each other at a certain interval in a certain direction (e.g., a direction parallel to the x-axis). That is, a safe distance may be secured between the first terminal portion **130** and the second terminal portion **230**. Since the first terminal portion **130** and the second terminal portion **230** are spaced apart from each other, electrical influence between the plurality of first terminals **131** of the first terminal portion **130** and the plurality of second terminals **231** of the second terminal portion **230** may be minimized. Accordingly, the transformer module **1** may be applied to a high-voltage and high-power system (e.g., an 800V-class system) to perform a transformer function.

[0088] Hereinafter, the cap unit **400**, which is a component of the transformer module **1** according to the disclosed embodiment of the present disclosure, will be described. However, the cap unit **400** may also be included in a transformer module **2** and a transformer module **3** according to other embodiments to be described below.

[0089] Referring to FIGS. **1** and **3**, the transformer module **1** according to the disclosed embodiment of the present disclosure may further include the cap unit **400**. The cap unit **400** may cover at least a portion of the first bobbin unit **100** and at least a portion of the second bobbin unit **200**. The cap unit **400** may serve to minimize physical and electrical interference between the coil unit wound around each of the first bobbin unit **100** and the second bobbin unit **200** and other components when the transformer module **1** according to the disclosed embodiment of the present disclosure is disposed inside an electronic product. For example, the cap unit **400** may cover at least a portion of the outer peripheral surface of the first winding part **110** of the first bobbin unit **100** and at least a portion of the outer peripheral surface of the second winding part **210** of the second bobbin unit **200**. Substantially, the cap unit **400** may cover at least a portion of the outer peripheral surface of the second winding part **210** of the second bobbin unit **200** because the outer peripheral surface of the first winding part **110** corresponds to the inner peripheral surface of the second winding part **210** so that the outer peripheral surface of the first winding part **110** is covered by the second winding part **210**.

[0090] The cap unit **400** may include a cap unit upper-surface portion **410**, a pair of cap unit side portions **420**, and a pair of cap fixing portions **430**.

[0091] The cap unit upper-surface portion **410** may cover an upper portion of the second winding part **210**. In more detail, the cap unit upper-surface portion **410** may be spaced apart from the upper portion of the second winding part **210** by a certain height. Accordingly, the cap unit upper-surface portion **410** may prevent other objects from interfering with the second winding part **210**. Meanwhile, the cap unit upper-surface portion **410** may include a pin indication portion recessed from the upper surface thereof by a certain depth in the lower direction. The pin indication portion may indicate the position where the first pin of the first bobbin unit **100** and/or the second bobbin unit **200** is disposed in the transformer module **1** according to the disclosed embodiment of the present disclosure.
[0092] The pair of cap unit side portions **420** may cover opposite ends of the first winding part **110** and the second winding part **210**. In more detail, one of the pair of cap unit side portions **420** may be formed to face toward the first side plate **112** of the first winding part **110** and the third side plate **212** of the second winding part **210**. That is, the one of the pair of cap unit side portions **420** may cover the one end of the first winding part **110** and the one end of the second winding part **210**. In addition, the other one of the pair of cap unit side portions **420** may be formed to face toward the second side plate **113** of the first winding part **110** and the fourth side plate **213** of the second winding part **210**. That is, the other one of the pair of cap unit side portions **420** may cover the opposite end of the first winding part **110** and the opposite end of the second winding part **210**. As described above, the pair of cap unit side portions **420** may cover the first winding part **110** and the second winding part **210**, thereby safely protecting the first winding part **110**, the second winding part **210**, and the coil unit wound around the first winding part **110** and the second winding part **210** from an external environment.
[0093] The cap unit **400** may include the pair of cap fixing portions **430**. The pair of cap fixing portions **430** may extend inward from the pair of cap unit side portions **420** toward the first bobbin unit **100** and the second bobbin unit **200** in the longitudinal direction (e.g., a direction parallel to the x-axis) One of the pair of cap fixing portions **430** may extend from a distal end of one cap unit side portion toward the first side plate **112** of the first winding part **110** and the third side plate **212** of the second winding part **210**, and the other cap fixing portion may extend from a distal end of the other cap unit side portion toward the second side plate **113** of the first winding part **110** and the fourth side plate **213** of the second winding part **210**. The pair of cap fixing portions **430** may be disposed on the first extension part **120** of the first bobbin unit **100** and/or the second extension part **220** of the second bobbin unit **200** and may be disposed under the core unit **300**. Accordingly, the cap unit **400** may form a stable arrangement structure in the transformer module **1** according to the disclosed embodiment of the present disclosure and may safely protect the first winding part **110**, the second winding part **210**, the coil unit wound around the first winding part **110** and the second winding part **210**, and the core unit **300** from an external environment.
[0094] Hereinafter, the transformer module **2** according to another embodiment of the present disclosure will be described. In describing the transformer module **2** according to the other embodiment of the present disclosure, contents identical to the above-described ones will be briefly described or will be omitted from the description.
[0095] FIG. **7** is a perspective view of the transformer module **2** according to the other embodiment of the present disclosure, and FIG. **8** is an exploded perspective view of the transformer module **2** according to the other embodiment of the present disclosure.
[0096] Referring to FIGS. **7** and **8**, the transformer module **2** according to the other embodiment of the present disclosure may include a first bobbin unit **100′**, a second bobbin unit **200′**, a core unit **300**, and a cap unit **400**. At least a portion of the shape of the first bobbin unit **100′** and at least a portion of the shape of the second bobbin unit **200′** may be different from those in the transformer module **1** according to the disclosed embodiment of the present disclosure described above.
[0097] In more detail, the first bobbin unit **100′** may include a first terminal portion **130′**. The first terminal portion **130′** may protrude in one direction (e.g., the lower direction) from one end of a

first extension part **120** that extends outward from one end of a first winding part **110** by a certain length. The first terminal portion **130′** may include a plurality of first terminals **131′**. The second bobbin unit **200′** may include a second terminal portion **230**. The second terminal portion **230** may protrude in one direction (e.g., the lower direction) from one end of a second extension part **220′** that extends outward from one end and/or opposite ends of a second winding part **210** by a certain length. The second terminal portion **230** may include a plurality of second terminals **231**.

[0098] Meanwhile, in the transformer module **2** according to the other embodiment of the present disclosure, the first terminal portion **130′** and a one-side second terminal portion **230***a* of the second terminal portion **230** may be arranged on the same line. That is, the plurality of first terminals **131′** of the first terminal portion **130′** and the plurality of second terminals **231** of the one-side second terminal portion **230***a* of the second terminal portion **230** may be arranged on a straight line (e.g., a virtual straight line parallel to the y-axis). When the first terminal portion **130′** and the second terminal portion **230** are arranged on the same line, a safe distance between the first terminal portion **130′** and the second terminal portion **230** may be short, and thus the transformer module **2** may be applied to a relatively low-voltage and low-power system (e.g., a 400V-class system) to perform a transformer function. In addition, the length occupied by the first bobbin unit **100′** may be shortened by the first terminal portion **130′**, and thus the transformer module **2** according to the other embodiment of the present disclosure may minimize the area that the transformer module **2** occupies when mounted on a substrate.

[0099] Hereinafter, the transformer module **3** according to another embodiment of the present disclosure will be described. In describing the transformer module **3** according to the other embodiment of the present disclosure, contents identical to the above-described ones will be briefly described or will be omitted from the description.

[0100] FIG. **9** is a perspective view of the transformer module **3** according to the other embodiment of the present disclosure, and FIG. **10** is an exploded perspective view of the transformer module **3** according to the other embodiment of the present disclosure.

[0101] Referring to FIGS. **9** and **10**, the transformer module **3** according to the other embodiment of the present disclosure may include a first bobbin unit **100″**, a second bobbin unit **200″**, a core unit **300**, and a cap unit **400**.

[0102] The first bobbin unit **100″** may include a first extension part **120″** that extends outward from one end of a first winding part **110** by a certain length, and the second bobbin unit **200″** may include a second extension part **220″** that extends outward from one end and/or opposite ends of a second winding part **210** by a certain length. In this case, the first extension part **120″** may include a side protruding portion **122″** rather than the above-described second step portion **122**. For example, the first extension part **120″** may include the side protruding portion **122″** that protrudes outward in the width direction (e.g., opposite directions parallel to the y-axis). The side protruding portion **122″** may be formed at a middle height of the first extension part **120″**. The side protruding portion **122″** may have a semicircular cross-section. However, the position where the side protruding portion **122″** is formed and the shape of the side protruding portion **122″** may be modified in some cases.

[0103] The second extension part **220″** may include a side receiving portion **222″** rather than the above-described second fixing portion **222**. For example, the side receiving portion **222″** may be recessed outward in the width direction (e.g., opposite directions parallel to the y-axis) and may have a position and a shape that correspond to the position and the shape of the side protruding portion **122″**. For example, when the side protruding portion **122″** has a semicircular cross-section at the middle height of the first extension part **120″**, the side receiving portion **222″** may have a semicircular recessed cross-section at a middle height of the second extension part **220″**.

[0104] Since the side protruding portion **122″** and the side receiving portion **222″** have mutually corresponding shapes, in a process in which the first winding part **110** of the first bobbin unit **100″** is inserted to be accommodated in the second winding part **210** of the second bobbin unit **200″**, a

kind of rail structure may be formed to guide the insertion of the first winding part **110**. That is, the side protruding portion **122**″ may be accommodated in the side receiving portion **222**″ to guide the insertion of the first winding part **110** into the second winding part **210**. Depending on the relationship between the corresponding shapes of the side protruding portion **122**″ and the side receiving portion **222**″, a movement of the first winding part **110** of the first bobbin unit **100**″ in the up-down direction may be limited after the first winding part **110** of the first bobbin unit **100**″ is accommodated in the second winding part **210** of the second bobbin unit **200**″, and thus the first bobbin unit **100**″ may be located in a correct position with respect to the second bobbin unit **200**″ to form a stable assembly structure.

[0105] Meanwhile, in the transformer module **3** according to the other embodiment of the present disclosure, the first bobbin unit **100**″ may include a first terminal portion **130**″, and the second bobbin unit **200**″ may include a second terminal portion **230**″. In more detail, the first bobbin unit **100**″ may include the first terminal portion **130**″ including a plurality of first terminals **131**″ protruding from one end of the first extension part **120**″ that extends outward from the one end of the first winding part **110** by the certain length, and the second bobbin unit **200**″ may include the second terminal portion **230**″ including a plurality of second terminals **231**″ protruding from one end of the second extension part **220**″ that extends outward from the one end and/or the opposite ends of the second winding part **210** by the certain length. The second terminal portion **230**″ may include a one-side second terminal portion **230**″*a* formed at one end with respect to the second winding part **210** and an opposite-side second terminal portion **230**″*b* formed at an opposite end with respect to the second winding part **210**. Each of the plurality of first terminals **131**″ and the plurality of second terminals **231**″ may extend in the longitudinal direction (e.g., a direction parallel to the x-axis) and/or the width direction (e.g., a direction parallel to the y-axis). That is, since each of the plurality of first terminals **131**″ and the plurality of second terminals **231**″ has a structure extending in the longitudinal direction or the width direction, the transformer module **3** according to the other embodiment of the present disclosure may function as a surface mount device (SMD). As described above, at least one of the first terminal portion **130**″ of the first bobbin unit **100**″ or the second terminal portion **230**″ of the second bobbin unit **200**″ may extend horizontally (in the width direction or the longitudinal direction of the bobbin unit) so as to be surface mounted on a substrate. Thus, the number of holes formed in the substrate may be decreased, and the space utilization of the substrate may be improved.

[0106] The transformer module **3** according to the other embodiment of the present disclosure may further include a bending unit **500**. The bending unit **500** may be formed to surround at least a portion of the outer surface of the core unit **300** described above. In more detail, the bending unit **500** may be formed to surround the lateral periphery of the core unit **300**. The inner surface of the bending unit **500** may have a shape corresponding to the outer surface of the core unit **300** and may stably surround the core unit **300**. The bending unit **500** may stably couple a first core unit **310** and a second core unit **320** of the core unit **300** such that the first core unit **310** and the second core unit **320** are not separated from each other. In addition, the bending unit **500** may prevent the outer surface of the core unit **300** from making direct contact with the cap unit **400**, thereby minimizing an influence of the cap unit **400** on the core unit **300**.

[0107] According to the above-described contents, the transformer module **1** according to the disclosed embodiment of the present disclosure may decrease parasitic capacitance generated in a power conversion process and may minimize noise.

[0108] At least a portion of the first bobbin unit **100** may be accommodated in the second bobbin unit **200**. Thus, the transformer module **1** according to the disclosed embodiment of the present disclosure may be made compact, and an electronic product including the transformer module **1** may be made compact.

[0109] In the transformer module **1** according to the disclosed embodiment of the present disclosure, the primary coil and the secondary coil may be physically spaced apart from each other

through the dual structure of the first bobbin unit **100** and the second bobbin unit **200**, and electrical interference and/or a short circuit between the coils may be prevented.

[0110] In the transformer module **1** according to the disclosed embodiment of the present disclosure, the plurality of channels may be easily formed by the at least one winding area partition unit **114** or **214** included in each of the first bobbin unit **100** and the second bobbin unit **200**.

[0111] In the transformer module **1** according to the disclosed embodiment of the present disclosure, the difference in capacitance between the plurality of channels may be minimized, and thus the electrical stability of the transformer module **1** may be improved.

[0112] The primary coil wound around the outer peripheral surface of a portion of the first bobbin unit **100** may be safely protected from an external environment by the coupling structure of the first bobbin unit **100** and the second bobbin unit **200**.

[0113] The first terminal portion **130** of the first bobbin unit **100** may be spaced apart from the second terminal portion **230** of the second bobbin unit **200** at a certain interval by the first extension part **120**. Thus, the transformer module **1** may be applied to a relatively high-voltage and high-power system.

[0114] When the first terminal portion **130** of the first bobbin unit **100′** and the second terminal portion **230** of the second bobbin unit **200′** are formed on the same line, the transformer module **2** may be applied to a relatively low-voltage and low-power system and may have a more compact structure, thereby minimizing the space occupied.

[0115] At least one of the first terminal portion **130″** of the first bobbin unit **100″** or the second terminal portion **230″** of the second bobbin unit **200″** may extend horizontally (in the width direction or the longitudinal direction of the bobbin unit) so as to be surface mounted on the substrate. Thus, the number of holes formed in the substrate may be decreased, and the space utilization of the substrate may be improved.

[0116] The cap unit **400** may cover at least a portion of the first bobbin unit **100**, at least a portion of the second bobbin unit **200**, and at least a portion of the core unit **300**. Thus, the first bobbin unit **100**, the second bobbin unit **200**, and the core unit **300** may be safely protected from an external environment.

[0117] The core unit **300** may form a stable coupling structure by the bending unit **500** that covers the outer surface of the core unit **300**.

[0118] In addition, the structural features and effects obtained by the components commonly included in the transformer module **1** according to the disclosed embodiment of the present disclosure and the transformer module **2** and the transformer module **3** according to the other embodiments of the present disclosure may be mutually shared.

[0119] As described above, the transformer module according to the disclosed embodiment of the present disclosure may decrease parasitic capacitance generated in a power conversion process and may minimize noise.

[0120] At least a portion of the first bobbin unit may be accommodated in the second bobbin unit. Thus, the transformer module according to the disclosed embodiment of the present disclosure may be made compact, and an electronic product including the transformer module may be made compact.

[0121] In the transformer module according to the disclosed embodiment of the present disclosure, the primary coil and the secondary coil may be physically spaced apart from each other through the dual structure of the first bobbin unit and the second bobbin unit, and electrical interference and/or a short circuit between the coils may be prevented.

[0122] In the transformer module according to the disclosed embodiment of the present disclosure, the plurality of channels may be easily formed by the at least one winding area partition unit included in each of the first bobbin unit and the second bobbin unit.

[0123] In the transformer module according to the disclosed embodiment of the present disclosure, the difference in capacitance between the plurality of channels may be minimized, and thus the

electrical stability of the transformer module may be improved.
[0124] The primary coil wound around the outer peripheral surface of a portion of the first bobbin unit may be safely protected from an external environment by the coupling structure of the first bobbin unit and the second bobbin unit.
[0125] The first terminal portion of the first bobbin unit may be spaced apart from the second terminal portion of the second bobbin unit at a certain interval by the first extension part. Thus, the transformer module may be applied to a relatively high-voltage and high-power system.
[0126] When the first terminal portion of the first bobbin unit and the second terminal portion of the second bobbin unit are formed on the same line, the transformer module may be applied to a relatively low-voltage and low-power system and may have a more compact structure, thereby minimizing the space occupied.
[0127] At least one of the first terminal portion of the first bobbin unit or the second terminal portion of the second bobbin unit may extend horizontally (in the width direction or the longitudinal direction of the bobbin unit) so as to be surface mounted on the substrate. Thus, the number of holes formed in the substrate may be decreased, and the space utilization of the substrate may be improved.
[0128] The cap unit may cover at least a portion of the first bobbin unit, at least a portion of the second bobbin unit, and at least a portion of the core unit. Thus, the first bobbin unit, the second bobbin unit, and the core unit may be safely protected from an external environment.
[0129] The core unit may form a stable coupling structure by the bending unit that covers the outer surface of the core unit.
[0130] Hereinabove, although the present disclosure has been described with reference to exemplary embodiments and the accompanying drawings, the present disclosure is not limited thereto, but may be variously modified and altered by those skilled in the art to which the present disclosure pertains without departing from the spirit and scope of the present disclosure claimed in the following claims.

Claims

1. A transformer module comprising: a first bobbin unit around which a primary coil is wound; and a second bobbin unit around which a secondary coil is wound, the second bobbin unit being configured to accommodate at least a portion of the first bobbin unit.
2. The transformer module of claim 1, wherein the first bobbin unit includes a first winding part on which the primary coil is wound around a portion of an outer peripheral surface of the first winding part, wherein the second bobbin unit includes a second winding part on which the secondary coil is wound on a portion of an outer peripheral surface of the second winding part, and wherein the outer peripheral surface of the first winding part corresponds to an inner peripheral surface of the second winding part and is covered by the second winding part.
3. The transformer module of claim 2, wherein the first winding part includes: a first winding area where the primary coil is directly wound around an outer peripheral surface of the first winding area; a first side plate formed at one end of the first winding area to protrude outward from the outer peripheral surface of the first winding area; a second side plate formed at an opposite end of the first winding area to protrude outward from the outer peripheral surface of the first winding area, the second side plate being configured to face the first side plate; and at least one first winding area partition unit formed between the first side plate and the second side plate and configured to protrude outward from the outer peripheral surface of the first winding area.
4. The transformer module of claim 3, wherein the second winding part includes: a second winding area where the secondary coil is directly wound around an outer peripheral surface of the second winding area; a third side plate formed at one end of the second winding area to protrude outward from the outer peripheral surface of the second winding area; a fourth side plate formed at an

opposite end of the second winding area to protrude outward from the outer peripheral surface of the second winding area, the fourth side plate being configured to face the third side plate; and at least one second winding area partition unit formed between the third side plate and the fourth side plate and configured to protrude outward from the outer peripheral surface of the second winding area, and wherein the at least one first winding area partition unit and the at least one second winding area partition unit are formed at the same position in a longitudinal direction.

5. The transformer module of claim 4, wherein each of the at least one first winding area partition unit and the at least one second winding area partition units, is formed in the same number, n, and wherein each of the primary coil and secondary coil is wound to form (n+1) channels by the at least one first winding area partition unit and at least one second winding area partition units (n being an integer of 1 or more).

6. The transformer module of claim 4, wherein a second side plate outer surface of the second side plate and a fourth side plate inner surface of the fourth side plate make surface-to-surface contact with each other, and wherein a first side plate outer surface of the first side plate and a third side plate outer surface of the third side plate are arranged on the same plane by the surface contact between the second side plate outer surface and the fourth side plate inner surface.

7. The transformer module of claim 2, wherein the first bobbin unit further includes a first extension part configured to extend outward from one end of the first winding part by a certain length, and wherein the first extension part includes: a first step portion configured to extend in a longitudinal direction from a first side plate formed at one end of a first winding area of the first winding part; and a second step portion configured to protrude outward from the first step portion in a width direction and form a step of a first thickness with the first step portion.

8. The transformer module of claim 7, wherein the second bobbin unit further includes a second extension part configured to extend outward from one end of the second winding part by a certain length, and wherein the second extension part includes: a first fixing portion configured to extend in the longitudinal direction from a third side plate formed at one end of a second winding area of the second winding part; and a second fixing portion configured to protrude inward from the first fixing portion in the width direction and protrude downward from an upper surface of the first fixing portion by a second thickness.

9. The transformer module of claim 8, wherein the first thickness formed by the first step portion and the second step portion and the second thickness of the second fixing portion correspond to each other to guide insertion of the first winding part into the second winding part, and the first bobbin unit is located in a correct position with respect to the second bobbin unit.

10. The transformer module of claim 2, wherein the first bobbin unit further includes a first terminal portion configured to protrude from one end of a first extension part, the first extension part being configured to extend outward from one end of the first winding part by a certain length, wherein the second bobbin unit further includes a second terminal portion configured to protrude from one end of a second extension part, the second extension part being configured to extend outward from one end of the second winding part by a certain length, and wherein the first terminal portion and the second terminal portion are spaced apart from each other.

11. The transformer module of claim 2, wherein the first bobbin unit further includes a first terminal portion configured to protrude from one end of a first extension part, the first extension part being configured to extend outward from one end of the first winding part by a certain length, wherein the second bobbin unit further includes a second terminal portion configured to protrude from one end of a second extension part, the second extension part being configured to extend outward from one end of the second winding part by a certain length, and wherein the first terminal portion and a one-side second terminal portion of the second terminal portion are arranged on the same line.

12. The transformer module of claim 2, wherein the first bobbin unit further includes a first extension part configured to extend outward from one end of the first winding part by a certain

length, wherein the second bobbin unit further includes a second extension part configured to extend outward from one end of the second winding part by a certain length, wherein the first extension part includes a side protruding portion configured to protrude outward in a width direction, wherein the second extension part includes a side receiving portion recessed outward in the width direction, the side receiving portion having a shape corresponding to a shape of the side protruding portion, and wherein the side protruding portion is accommodated in the side receiving portion to guide insertion of the first winding part into the second winding part, and the first bobbin unit is located in a correct position with respect to the second bobbin unit.

13. The transformer module of claim 2, wherein the first bobbin unit further includes a first terminal portion including a plurality of first terminals configured to protrude from one end of a first extension part, the first extension part being configured to extend outward from one end of the first winding part by a certain length, wherein the second bobbin unit further includes a second terminal portion including a plurality of second terminals configured to protrude from one end of a second extension part, the second extension part being configured to extend outward from one end of the second winding part by a certain length, and wherein each of the plurality of first terminals and the plurality of second terminals extends in a longitudinal direction or a width direction.

14. The transformer module of claim 2, further comprising: a cap unit configured to cover at least a portion of the first bobbin unit and at least a portion of the second bobbin unit, wherein the cap unit covers at least a portion of the outer peripheral surface of the first winding part and at least a portion of the outer peripheral surface of the second winding part.

15. The transformer module of claim 14, wherein the cap unit includes: a cap unit upper-surface portion configured to cover an upper portion of the second winding part; a pair of cap unit side portions configured to cover opposite ends of the first winding part and the second winding part; and a pair of cap fixing portions configured to extend inward from the pair of cap unit side portions toward the first bobbin unit and the second bobbin unit in a longitudinal direction.

16. The transformer module of claim 1, further comprising: a core unit including a core center portion configured to penetrate the first bobbin unit and the second bobbin unit, and a core side portion spaced apart from the core center portion and configured to cover at least a portion of an outside of the first bobbin unit and at least a portion of an outside of the second bobbin unit.

17. The transformer module of claim 16, further comprising: a bending unit configured to surround at least a portion of an outer surface of the core unit.