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Attorneys for Plaintiff
Halo Electronics, Inc.

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF CALIFORNIA
(SAN FRANCISCO DIVISION)

| | |
|---|---|
| HALO ELECTRONICS, INC.,<br><br>Plaintiff,<br><br>v.<br><br>BEL FUSE INC.,<br>ELEC & ELTEK (USA) CORPORATION,<br>WURTH ELECTRONICS MIDCOM, INC., and<br>XFMRS, INC.,<br><br>Defendants. | Civil Action No. _____<br><br>**COMPLAINT FOR PATENT INFRINGEMENT**<br><br>**DEMAND FOR JURY TRIAL** |

Plaintiff, Halo Electronics, Inc. files this Complaint and demand for jury trial seeking relief for patent infringement by the Defendants. Halo Electronics, Inc. states and alleges the following:

## JURISDICTION AND VENUE

1. This is an action for patent infringement arising under the patent laws of the United States, 35 U.S.C. §§ 100 *et seq.* This Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

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2. This Court has personal jurisdiction over each of the Defendants because each Defendant has substantial and continuous contacts within this judicial district and/or because each Defendant has committed acts of patent infringement within this judicial district, including placing infringing products into the stream of commerce under circumstances such that each Defendant reasonably should have anticipated being subject to suit in this judicial district. The Court also has personal jurisdiction over each of the Defendants because the acts of patent infringement are aimed at this judicial district and/or have effect in this judicial district.

3. Venue is proper in this District pursuant to 28 U.S.C. §§ 1391(b) and (c) and 1400(b).

**INTRADISTRICT ASSIGNMENT**

4. Pursuant to Civ. L.R. 3-2(c), this matter is assignable on a district-wide basis.

**THE PARTIES**

5. Plaintiff Halo Electronics, Inc. ("Halo") is a corporation organized and existing under the laws of the state of Nevada. Halo's headquarters is located at 3005 East Post Road Front, Las Vegas, Nevada. Halo maintains a place of business at 1861 Landings Drive, Mountain View, California.

6. Defendant Bel Fuse Inc. ("Bel Fuse"), is a corporation organized and existing under the laws of the state of Delaware, with its principal place of business located at 206 Van Vorst Street, Jersey City, New Jersey 07302.

7. Defendant Elec & Eltek (USA) Corporation ("E&E"), is a corporation organized and existing under the laws of the state of California, with its principal place of business at 25255 Cabot Road, Suite 201, Laguna Hills, CA 92653. Upon information and belief, E&E does business as E&E Magnetic Products Ltd.

8. Defendant Wurth Electronics Midcom, Inc. ("Midcom"), is a corporation organized and existing under the laws of the state of South Dakota, with its principal place of business located at 121 Airport Drive, Watertown, SD 57201.

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9. Defendant XFMRS, Inc. ("XFMRS"), is a corporation organized and existing under the laws of the state of Indiana, with its principal place of business at 7570 E. Landersdale Road, Camby, Indiana 46113.

**COUNT I**

**(PATENT INFRINGEMENT)**

10. Halo restates and realleges the preceding paragraphs of this Complaint.

11. On August 12, 1997, United States Patent No. 5,656,985 ("the '985 patent") entitled "Electronic Surface Mount Package" was duly and legally issued by the United States Patent and Trademark Office. Halo owns the '985 patent by assignment. A true and correct copy of the '985 patent is attached as Exhibit A.

12. On October 2, 2001, United States Patent No. 6,297,720 ("the '720 patent") entitled "Electronic Surface Mount Package" was duly and legally issued by the United States Patent and Trademark Office. Halo owns the '720 patent by assignment. A true and correct copy of the '720 patent is attached as Exhibit B.

13. On October 2, 2001, United States Patent No. 6,297,721 ("the '721 patent") entitled "Electronic Surface Mount Package" was duly and legally issued by the United States Patent and Trademark Office. Halo owns the '721 patent by assignment. A true and correct copy of the '721 patent is attached as Exhibit C.

14. On November 20, 2001, United States Patent No. 6,320,489 ("the '489 patent") entitled "Electronic Surface Mount Package With Extended Side Retaining Wall" was duly and legally issued by the United States Patent and Trademark Office. Halo owns the '489 patent by assignment. A true and correct copy of the '489 patent is attached as Exhibit D.

15. On February 5, 2002, United States Patent No. 6,344,785 ("the '785 patent") entitled "Electronic Surface Mount Package" was duly and legally issued by the United States Patent and Trademark Office. Halo owns the '785 patent by assignment. A true and correct copy of the '785 patent is attached as Exhibit E.

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16. On December 16, 2003, United States Patent No. 6,662,431 ("the '431 patent") entitled "Electronic Surface Mount Package" was duly and legally issued by the United States Patent and Trademark Office. Halo owns the '431 patent by assignment. A true and correct copy of the '431 patent is attached as Exhibit F.

17. Defendant Bel Fuse has been and is infringing, actively inducing others to infringe, and/or contributing to the infringement of the '985, '720, '721, '489, '785, and '431 patents by making, using, selling, and/or offering to sell surface-mount transformers embodying the patented inventions and/or devices that have or contain an electronic surface-mount package embodying the patented inventions, including, but not limited to, part number S558-5500-12-F.

18. Bel Fuse was given notice of the '985, '720, '721, '489, and '785 patents by Halo at least as early as July 2002.

19. Bel Fuse has been and is infringing the '985, '720, '721, '489, '785 patents with knowledge of one or more of the patents, and thus Bel Fuse's infringement is willful.

20. Defendant XFMRS has been and is infringing, actively inducing others to infringe, and/or contributing to the infringement of the '985, '720, '721, '489, '785, and '431 patents by making, using, selling, and/or offering to sell surface-mount transformers embodying the patented inventions and/or devices that have or contain an electronic surface-mount package embodying the patented inventions, including, but not limited to, part number XF0013B4.

21. XFMRS was given notice of the '985, '720, '721, '489, and '785 patents by Halo at least as early as July 2002.

22. XMFRS has been and is infringing the '985, '720, '721, '489, '785 patents with knowledge of one or more of the patents, and thus XMFRS's infringement is willful.

23. Defendant Midcom has been and is infringing, actively inducing others to infringe, and/or contributing to the infringement of the '985, '720, '721, '489, '785, and '431 patents by making, using, selling, and/or offering to sell surface-mount transformers embodying the patented inventions and/or devices that have or contain an electronic surface-mount package embodying the patented inventions, including, but not limited to, part number EDFP-G48.

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24. Midcom, Inc., predecessor to Defendant Wurth Electronics Midcom, Inc., was given notice of the '985, '720, '721, '489, and '785 patents by Halo at least as early as July 2002.

25. Midcom has been and is infringing the '985, '720, '721, '489, '785 patents with knowledge of one or more of the patents, and thus Midcom's infringement is willful.

26. Defendant E&E has been and is infringing, actively inducing others to infringe, and/or contributing to the infringement of the '985, '720, '721, '489, '785, and '431 patents by making, using, selling, and/or offering to sell surface-mount transformers embodying the patented inventions and/or devices that have or contain an electronic surface-mount package embodying the patented inventions, including, but not limited to, part number 824-00119.

27. Upon information and belief, E&E had knowledge of one or more of the '985, '720, '721, '489, '785, and '431 patents before the date of this Complaint.

28. Upon information and belief, E&E has been and is infringing the '985, '720, '721, '489, '785, and '431 patents with knowledge of one or more of the patents, and thus E&E's infringement is willful.

29. Upon information and belief, Defendants will continue to infringe the '985, '720, '721, '489, '785, and '431 patents unless and until they are enjoined by this Court.

30. The Defendants have caused and will continue to cause Halo irreparable injury and damage by infringing the '985, '720, '721, '489, '785, and '431 patents. Halo will suffer further irreparable injury, for which it has no adequate remedy at law, unless and until the Defendants are enjoined from infringing the '985, '720, '721, '489, '785, and '431 patents.

**PRAYER FOR RELIEF**

WHEREFORE, Halo respectfully requests that this Court:

(1) Enter judgment that Defendants have infringed the '985, '720, '721, '489, '785, and '431 patents;

(2) Enter an order permanently enjoining Defendants and their officers, agents, employees, attorneys, and all persons in active concert or participation with any of them, from infringing the '985, '720, '721, '489, '785, and '431 patents;

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(3) Award Halo damages in an amount sufficient to compensate it for Defendants' infringement of the '985, '720, '721, '489, '785, and '431 patents, together with prejudgment and post-judgment interest and costs under 35 U.S.C. § 284;

(4) Treble the damages awarded to Halo under 35 U.S.C. § 284 by reason of Defendants' willful infringement of the '985, '720, '721, '489, '785, and '431 patents;

(5) Declare this case to be "exceptional" under 35 U.S.C. § 285 and award Halo its attorney fees, expenses, and costs incurred in this action; and

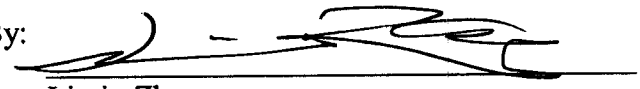
(6) Award Halo such other and further relief as this Court deems just and proper.

**DEMAND FOR JURY TRIAL**

Halo demands a jury trial on all issues so triable.

Dated: December 7, 2007

FISH & RICHARDSON P.C.

By: 

Limin Zheng

Attorneys for Plaintiff Halo Electronics, Inc.

Complaint.doc

# EXHIBIT A

US005656985A

# United States Patent [19]

Lu et al.

[11] Patent Number: 5,656,985

[45] Date of Patent: Aug. 12, 1997

[54] **ELECTRONIC SURFACE MOUNT PACKAGE**

[75] Inventors: **Peter Lu**, Flowermound, Tex.; **Jeffrey Heaton**, Cupertino; **James W. Heaton**, Los Altos, both of Calif.; **Peter Loh Hong Pao**, Hong Kong, China; **Robert Lake Hang Lam**, Hong Kong, China; **Tsang Kei Sun**, Hong Kong, Hong Kong

[73] Assignee: **Halo Electronics, Inc.**, Redwood City, Calif.

[21] Appl. No.: **513,573**

[22] Filed: **Aug. 10, 1995**

[51] **Int. Cl.**[6] ..... **H01F 15/10**; H01F 27/02

[52] **U.S. Cl.** ..... **336/96**; 174/52.4; 336/65; 336/192; 336/229; 361/821

[58] **Field of Search** ..... 174/52.4; 361/821; 336/229, 192, 65, 90, 96

[56] **References Cited**

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|---|---|---|---|
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| 5,307,041 | 4/1994 | Kato et al. | 336/192 |

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| | | | |
|---|---|---|---|
| 38-20060 | 9/1963 | Japan | 336/229 |
| 5-275253 | 10/1993 | Japan | 336/229 |

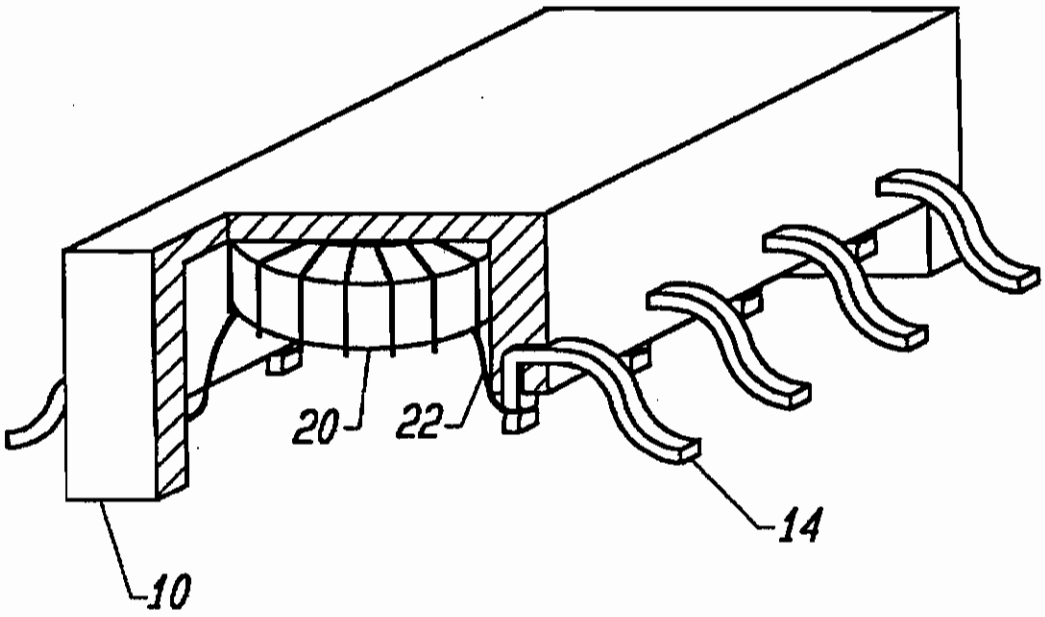
*Primary Examiner*—Thomas J. Kozma

*Attorney, Agent, or Firm*—Trial & Technology Law Group

[57] **ABSTRACT**

An electronic surface mount package provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so their respective wires are separate from one another so as to prevent arcing. The case is opened at the bottom which prevents harm from expansion or cracking.

**8 Claims, 5 Drawing Sheets**



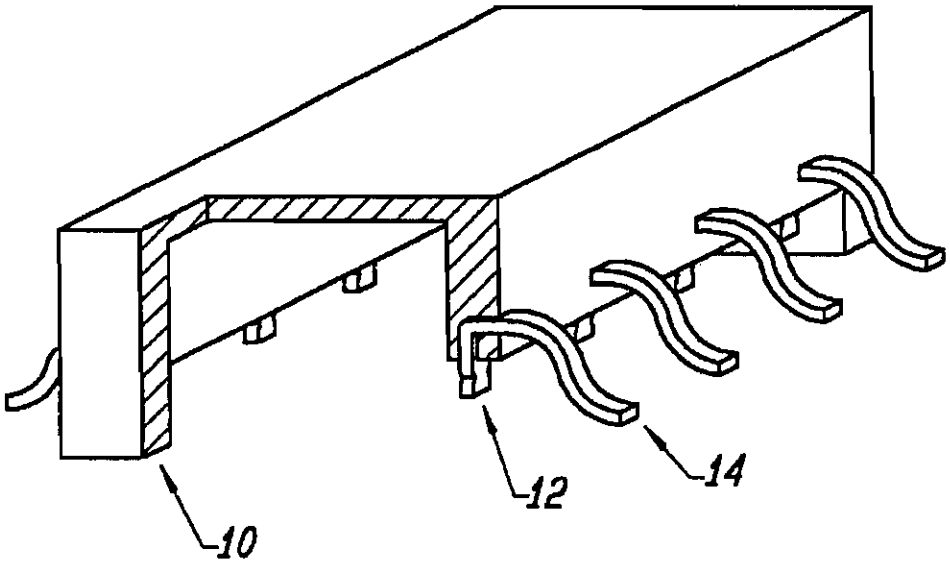



FIG. 1

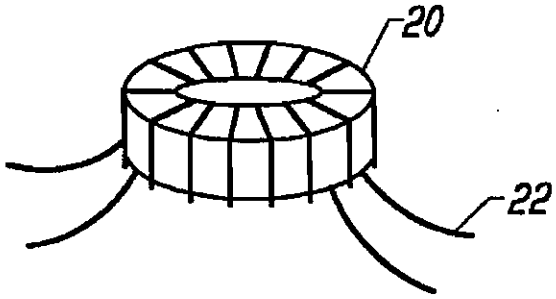



FIG. 2

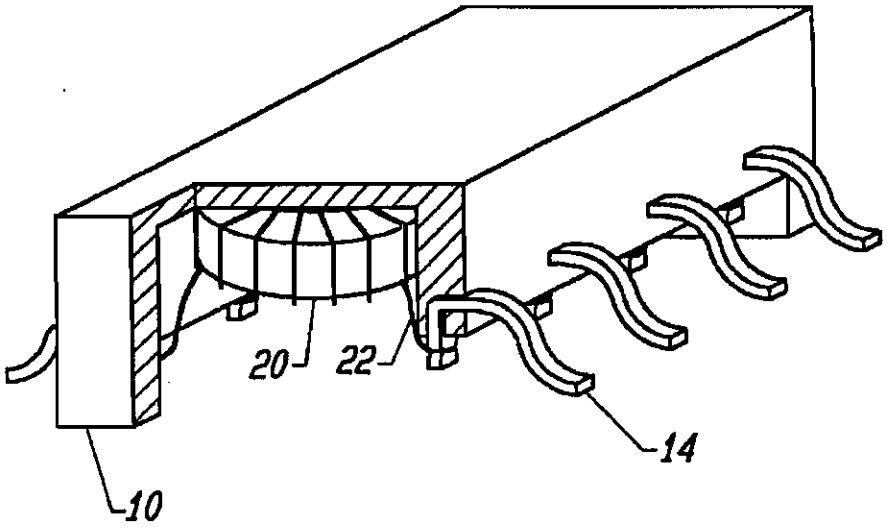



FIG. 3

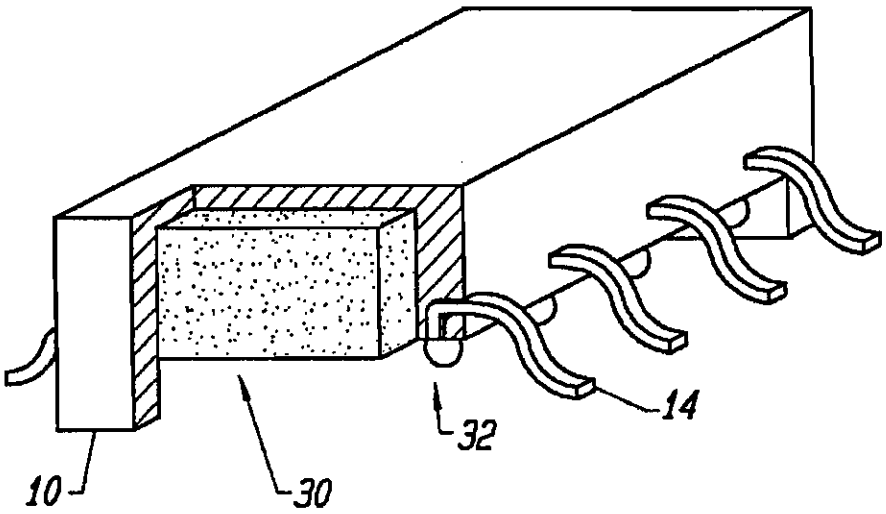



FIG. 4

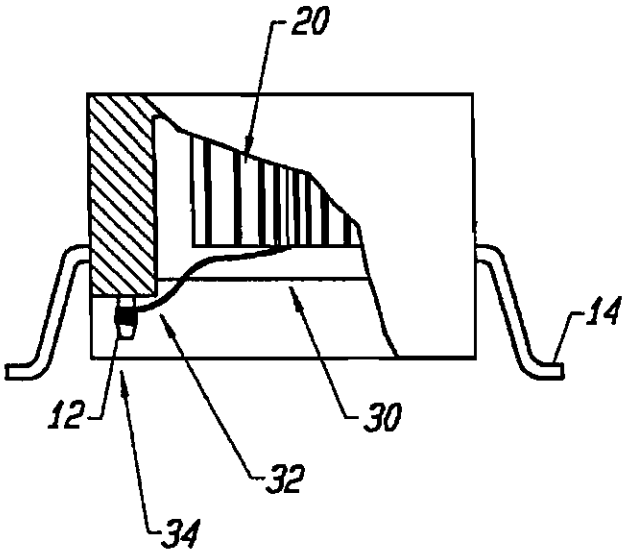



FIG. 5

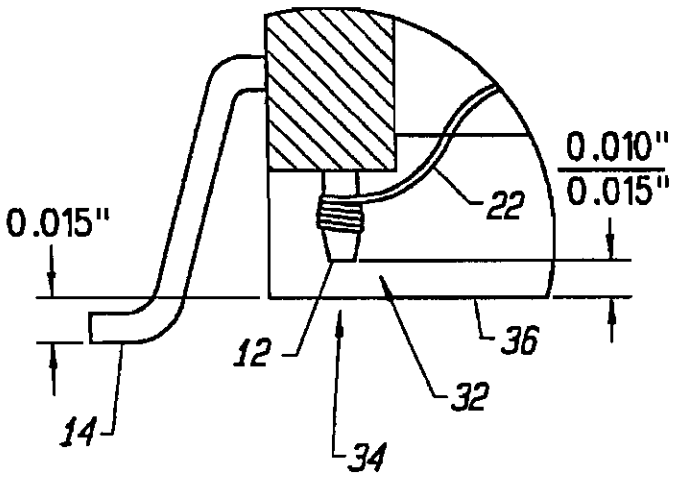



FIG. 6

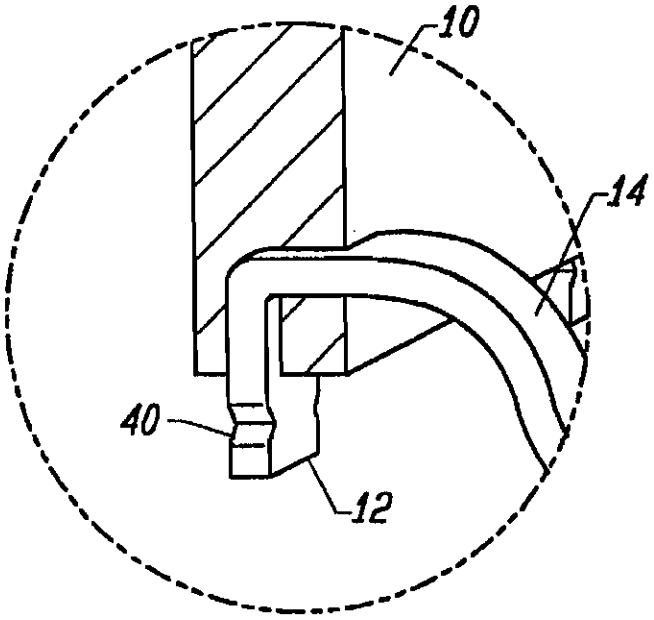



FIG. 7

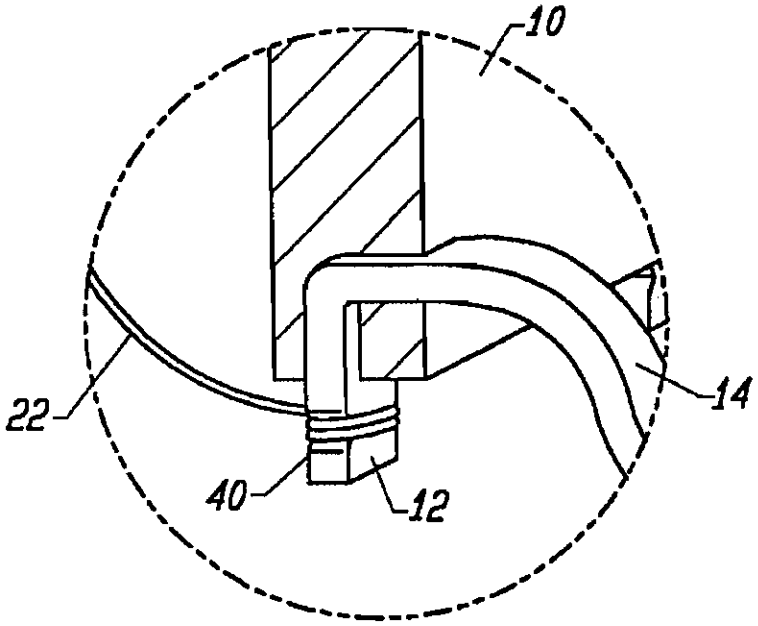



FIG. 8

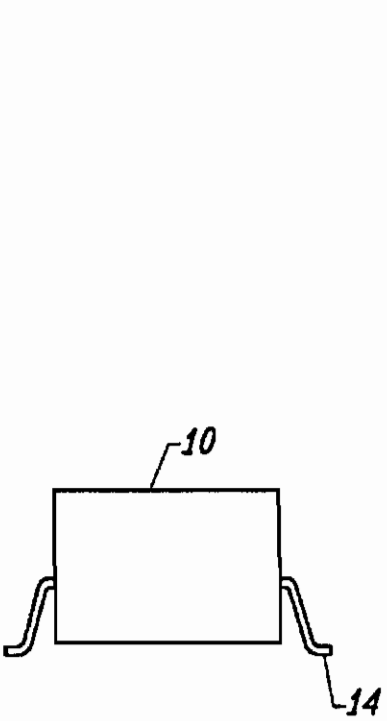



FIG. 9A

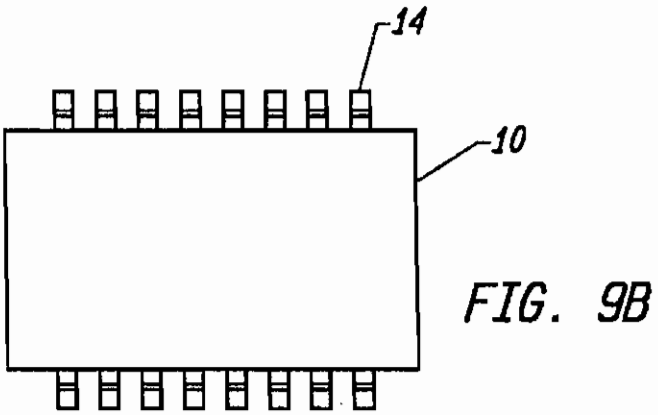



FIG. 9B

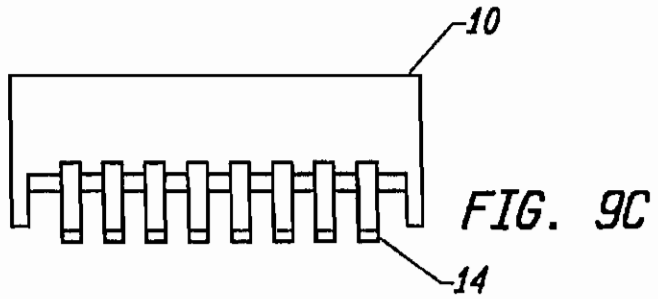



FIG. 9C

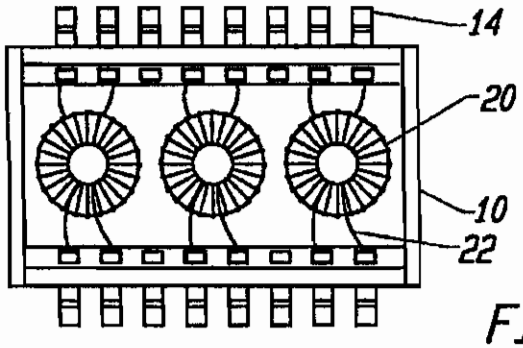



FIG. 9D

# ELECTRONIC SURFACE MOUNT PACKAGE

## BACKGROUND OF THE INVENTION

The present invention relates to an electronic surface mount package or case. Electronic surface mount packages are utilized in applications in which one or more individual toroid transformers are embodied within the surface mount package.

Wires coming off the transformers are electronically tied to pins on the package for connection to an electronic device. Typically, the electronic surface mount packages are mounted on a printed circuit board for utilization in the electronic device.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved electronic surface mount package.

Briefly, according to one preferred embodiment, the present invention provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so that the respective wires are separated from one another so as to avoid arcing. The case is open at the bottom which prevents harm from expansion or cracking.

Other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

FIG. 1 shows an electronic surface mount package in three-dimensional view according to the present invention.

FIG. 2 shows a wound toroid transformer.

FIG. 3 shows the connection of the toroid transformer of FIG. 2 within the electronic surface mount package of FIG. 1.

FIG. 4 within the electronic surface mount package of FIG. 1 after terminations have been soldered.

FIG. 5 and 6 show relationship between a safeguard (standoff) and the electronic surface-mount package's foot seating plane and inner terminal posts, respectively.

FIG. 7 shows a close-up of the pin configuration of FIG. 1 and how it is molded inside the wall of the body of the package.

FIG. 8 shows wire wrapped around the pin or post of FIG. 7.

FIGS. 9A–9D show end, top, side, and bottom views of electronic surface mount package according to the present invention.

## DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, where like numerals indicate like components. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the



invention to those embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

FIG. 1 shows an electronic surface mount transformer package or case **10** in three-dimensional view. FIG. 1 shows a cut-away of the generally rectangular empty case **10** with pins **14** molded into the case **10**, together with notched post **12** upon which a wire is wound. Typically, tin-Lead plated copper alloy terminals are molded into the wall of the package **10** with the terminals extending through and below the bottom of the wall. The outer portion of the package **10** is formed to meet specified footing requirements. The inner post **12** serves as a terminal for internal wire termination use. The package material is made of a type of thermal plastic which is in compliance with UL V-94 requirement for flammability.

FIG. 2 shows a wound toroid transformer **20** with wire **22** wrapped around the transformer **20**. The toroid core is typically made of ferrite or iron material and the winding of wire **22** is done manually with fine insulated magnet wire.

FIG. 3 shows a cut-away of the molded part with the toroid **20** mounted inside and showing the wire **22** as it is then attached to post **14**. The wires **22** are pulled with minimum tension and wrapped around the terminal post **14** for two to two and a half turns. This operation is done when the case has been placed bottom side up.

FIG. 4 shows a silicone compound **30** poured inside the cavity with wire terminations that have been soldered with high temperature solder (95 Ag/5Sn) **32** and the package has been properly cleaned. The case **10** is then filled with soft silicone material to protect the transformer and to meet environmental requirements.

FIGS. 5 and 6 show the relationships between the safe guard (stand off) **34** and package's foot seating plane and inner terminal posts **12***a*. FIG. 5 shows the standoff **34**, in which the parts typically are placed automatically by machine onto a PC board. They are pressed down, as it is desirable to have some limitation of how far they can be pressed. It is also desirable that the post **12** does not touch the PC board, and so the end standoffs **34** do not allow that to happen.

FIG. 6 shows the distance in relationship between the end of the post **12** and where the PC board **36** is located and also where the standoff **34** ends. The PC board **36** would be at the base of the foot.

In FIG. 6, the typical clearance of 0.015 inches from the safe guard **34** to the seating plane is to avoid interference to the coplanarity of the package. There is also a gap between the safe guard **34** and terminal post **12** to prevent the solder joints from touching the circuit board due to an over forced pick and place operation.

Inside the package **10**, there may be two, three, or more individual toroidal transformers. Wires coming off of the transformers are connected to the outside world. For example, the pins may be mounted on a printed circuit board in an electronic device. The lead frame pins are injection molded and the shape of the post upon which the wire is wound from the toroidal transformer is notched. This allows for the wires to be separated from pin to pin, and for soldering to be much more efficient.

FIG. 7 shows a closeup of the pin **12** and how pin **12** is molded inside the wall of the body and also the notch effect **40** of the pin **12**. The post **14** is notched so that the wires are kept away from one another (post to post) which is very desirable. The separation is desirable so as to avoid arcing.

FIG. 8 shows the wire 22 wrapped around the pin or post 12.

FIGS. 9A–9D show end, top, side, and bottom views, respectively, of the electronic surface mount package 10. The embodiment shown in FIGS. 9A–9D provide an industrial standard surface mount footprint and package dimensions which are auto pick and placeable. In addition, special design consideration has been applied to thermal expansion of materials to ensure that the package will stand all normal reflow processes with low cost, easy manufacturing, and high reliability.

In the industry, many manufacturers have used a two-piece construction, a base and a cover, and the case is backfilled with epoxy. In some processes, the coefficients of expansion of the epoxy that has been backfilled, plus the toroid itself, tend to cause the two pieces to separate. The base separates from the top, and as a result, it can end up cracking. The present invention provides a one-piece construction (an open bottom) only with the silicone filling to protect the toroid. The case is open at the bottom, thus allowing for nothing to expand or crack.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and it should be understood that many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

We claim:

1. An electronic surface mount package comprising:

a one piece construction package having a side wall and an open bottom,

a plurality of toroid transformers carried within said package by a soft silicone material, said toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within and extending from the bottom of said package, each of the said pins extending through a bottom of said side wall and having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively.

2. An electronic surface mount package comprising:

a construction package having a side wall and an open bottom,

a plurality of toroid transformers carried within said package by a soft silicone material, said toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within and extending from the bottom of said package, each of said pins extending through a bottom of said side wall and having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively.

3. A package as in claim 2 wherein said construction package is one piece.

4. The package of claim 3 wherein said construction package has an open bottom.

5. The package of claim 4 wherein said posts are separated from one another so as to avoid arcing.

6. An electronic surface mount package for mounting on a printed circuit board in an electronic device, said electronic surface mount package comprising:

a one piece construction package having a side wall and an open bottom,

a plurality of toroid transformers carried within said package by a soft silicone material, said toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within and extending from the bottom of said package, each of said pins extending through a bottom of said side wall and having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively.

7. The package as in claim 6 further including a standoff for maintaining a distance between the bottom of said pins and said printed circuit board.

8. An electronic surface mount package comprising:

a construction package having a side wall and an open bottom,

at least one toroid transformer carried within said package by a soft silicone material, said toroid transformer having a wire wrapped thereon,

at least one terminal pin molded within and extending from the bottom of said package, said pin extending through a bottom of said side wall and having a notched post upon which said wire from said transformer is wrapped and soldered thereon.

* * * * *

# UNITED STATES PATENT AND TRADEMARK OFFICE
# CERTIFICATE OF CORRECTION

PATENT NO : 5,656,985
DATED : August 12, 1997
INVENTOR(S): Lu et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the title page item [75] Inventors,

Please delete "Peter Loh Hong Pao" and replace with -- Peter Loh Hang Pao --.

Please delete "Robert Lake Hang Lam" and replace with -- Robert Loke Hang Lam --.

Signed and Sealed this

Twenty-third Day of December, 1997

*Attest:*

BRUCE LEHMAN

*Attesting Officer*

*Commissioner of Patents and Trademarks*

# EXHIBIT B

US006297720B1

(12) **United States Patent**
**Lu et al.**

(10) **Patent No.: US 6,297,720 B1**
(45) **Date of Patent: *Oct. 2, 2001**

(54) **ELECTRONIC SURFACE MOUNT PACKAGE**

(75) Inventors: **Peter Lu**, Flower Mound, TX (US); **Jeffrey Heaton**, Cupertino; **James W. Heaton**, Los Altos, both of CA (US); **Tsang Kei Sun**, Kowloon (HK); **Peter Loh Hang Pao**, Kowloon (HK); **Robert Loke Hang Lam**, Kowloon (HK)

(73) Assignee: **Halo Electronics, Inc.**, Redwood City, CA (US)

( * ) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **08/773,555**

(22) Filed: **Dec. 27, 1996**

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 08/513,573, filed on Aug. 10, 1995, now Pat. No. 5,656,985.

(51) **Int. Cl.**[7] ..... **H01F 27/02**; H01F 27/209

(52) **U.S. Cl.** ..... **336/96**; 336/192; 336/229; 336/90

(58) **Field of Search** ..... 336/229, 192, 336/65, 90, 96; 174/52.4; 361/821

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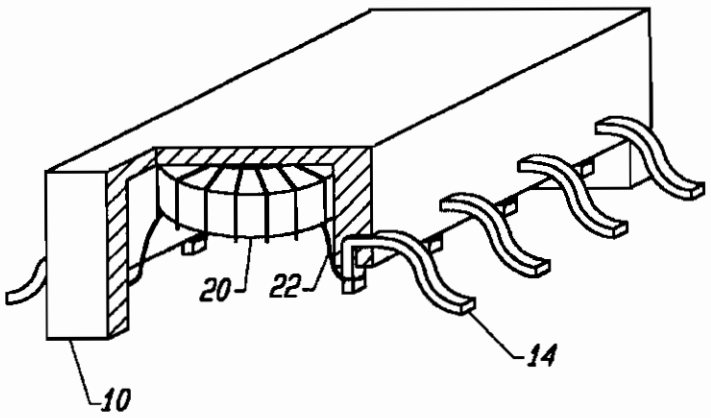
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*Primary Examiner*—Anh Mai
(74) *Attorney, Agent, or Firm*—Trial & Technology Law Group

(57) **ABSTRACT**

An electronic surface mount package provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so their respective wires are separate from one another so as to prevent arcing. The case is opened at the bottom which prevents harm from expansion or cracking. A reinforcement beam is located laterally across the bottom of the package to provide mechanical strength for the case.

**8 Claims, 6 Drawing Sheets**



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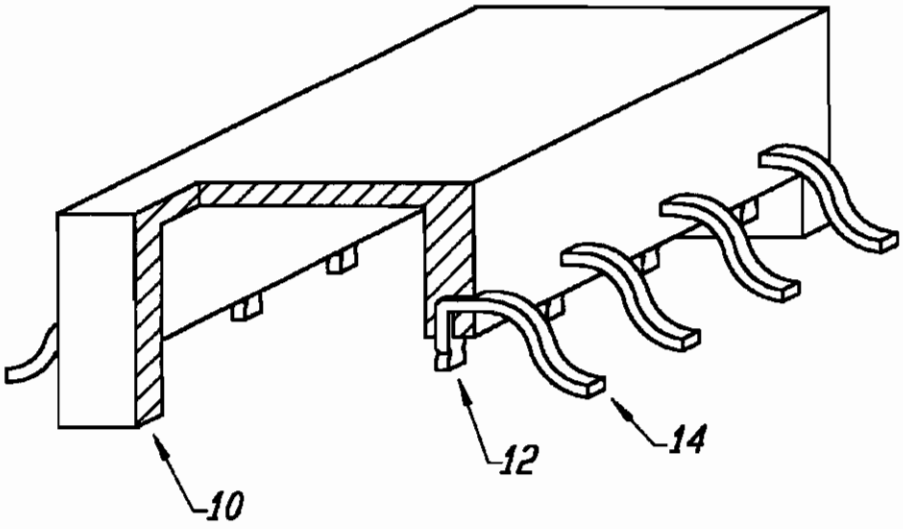



FIG. 1

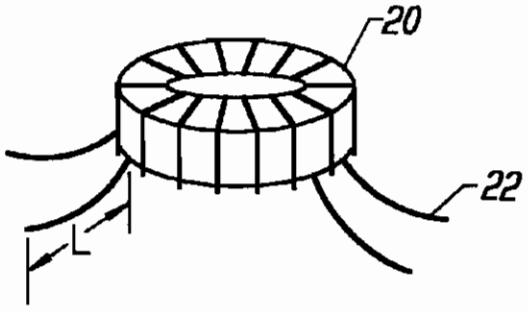



FIG. 2

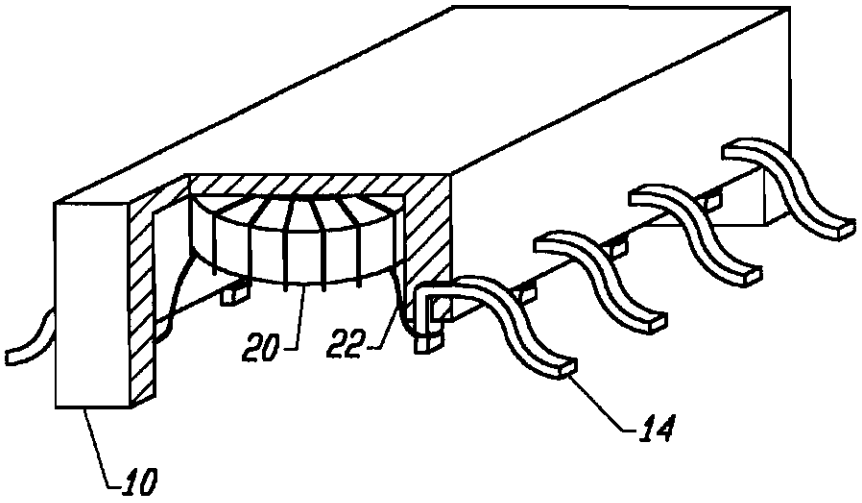



FIG. 3

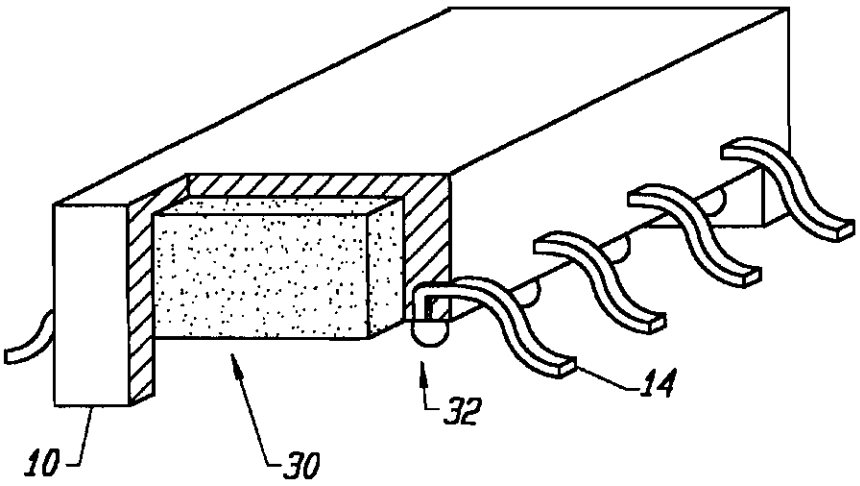



FIG. 4

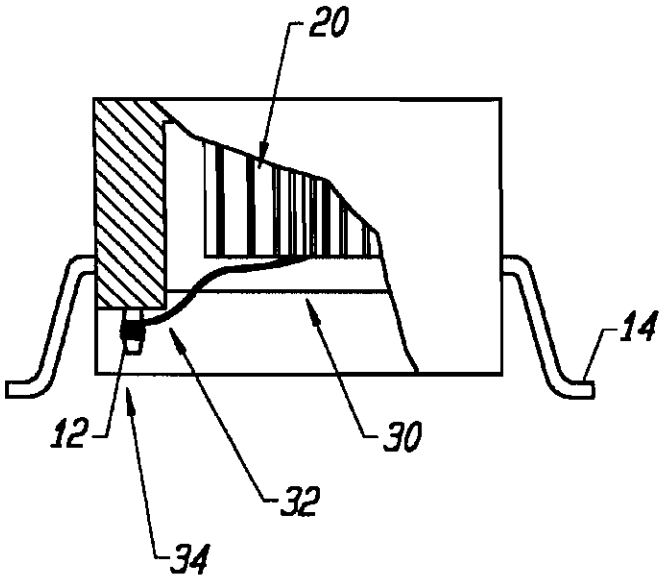



FIG. 5

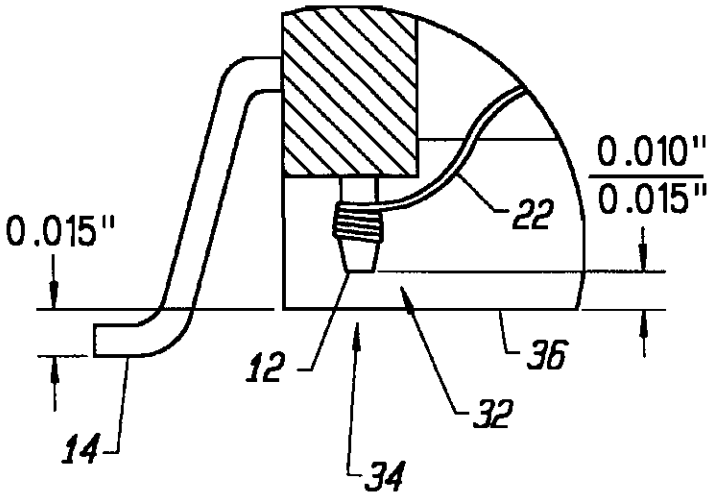



FIG. 6

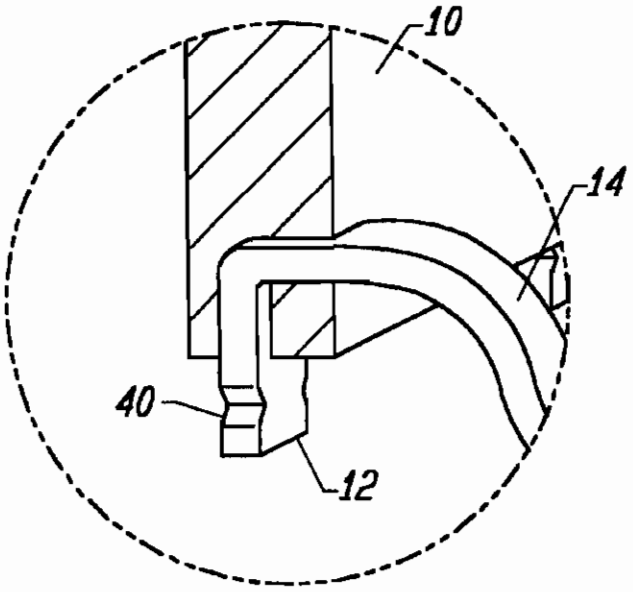



FIG. 7

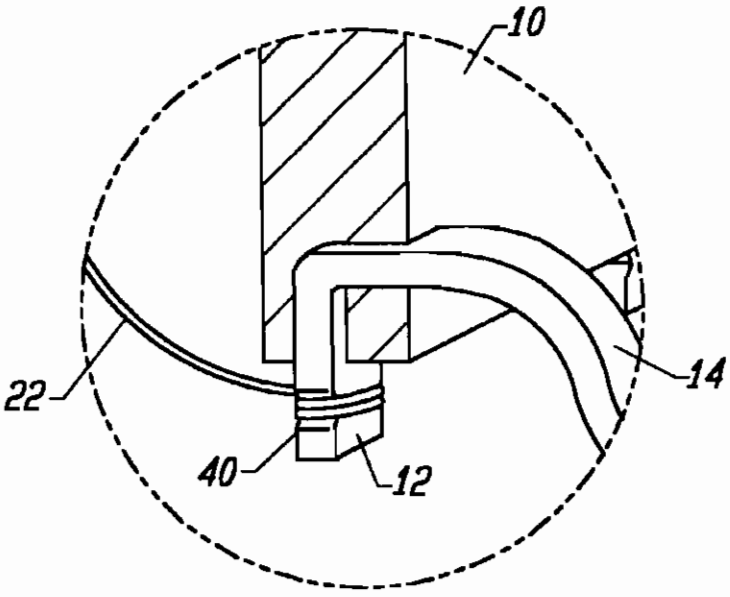



FIG. 8

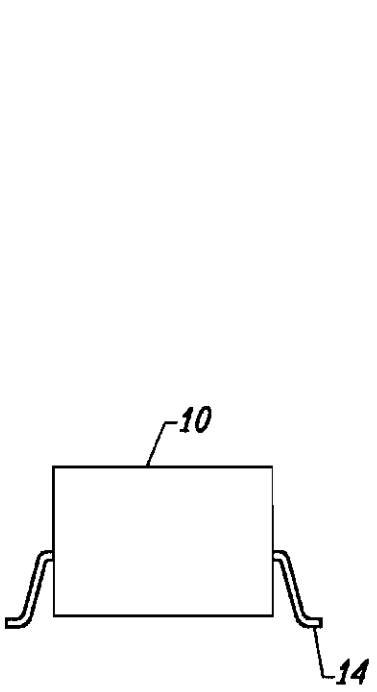



FIG. 9A

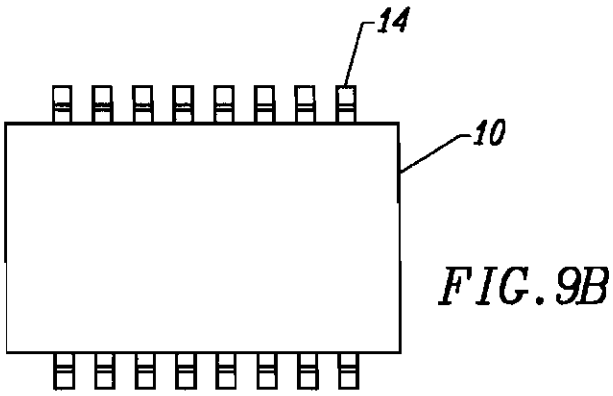



FIG. 9B

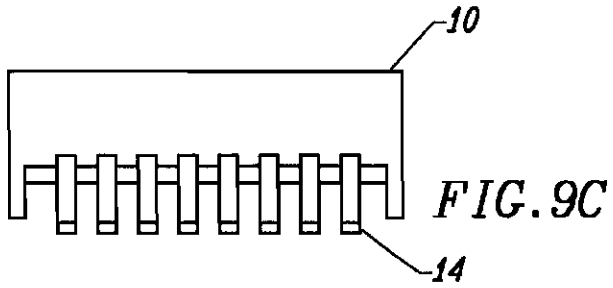



FIG. 9C

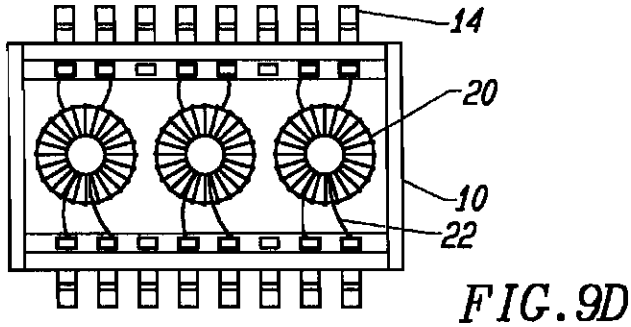



FIG. 9D

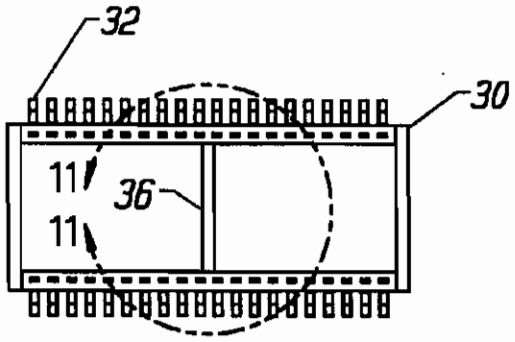



FIG. 10

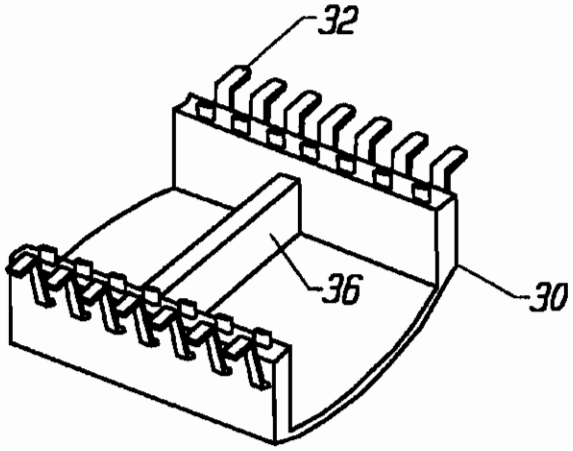



FIG. 11

# ELECTRONIC SURFACE MOUNT PACKAGE

## CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part of application entitled ELECTRONIC SURFACE MOUNT PACKAGE, Ser. No. 08/513,573, filed Aug. 10, 1995 now U.S. Pat. No. 5,656,985, issued Aug. 12, 1997 and assigned to the same Assignee as the present application.

## BACKGROUND OF THE INVENTION

The present invention relates to an electronic surface mount package or case. Electronic surface mount packages are utilized in applications in which one or more individual toroid transformers are embodied within the surface mount package.

Wires coming off the transformers are electronically tied to pins on the package for connection to an electronic device. Typically, the electronic surface mount packages are mounted on a printed circuit board for utilization in the electronic device.

It is widely known in the local area magnetic industry that when surface mount toroidal magnetics which are encapsulated in hard plastics go through infra-red soldering processes, the magnetic components (ferrite) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which makes the part unusable. In view of the foregoing, it would be highly desirable to provide an improved electronic surface mount package which avoids the cracking and expansion problems described above.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved electronic surface mount package.

Briefly, according to one preferred embodiment, the present invention provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound and soldered. The wire which is wound and soldered around each terminal pin/post is from a respective toroid transformer carried within the package. Each of the posts are notched so that the respective wires are separated from one another so as to avoid arcing. The case is open at the bottom which prevents cracking and allows for the toroidal expansion. The present invention also includes a reinforcement beam that is disposed laterally or sidewise across the bottom of the package to provide extra support in the mechanical strength of the case.

Other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

FIG. **1** shows an electronic surface mount package in three-dimensional view according to the present invention.

FIG. **2** shows a wound toroid transformer.

FIG. **3** shows the connection of the toroid transformer of FIG. **2** within the electronic surface mount package of FIG. **1**.



FIG. **4** shows the electronic surface mount package of FIG. **1** after wire terminations have been soldered.

FIG. **5** and **6** show relationships between a safeguard (standoff) and the electronic surface-mount package's foot seating plane and inner terminal posts, respectively.

FIG. **7** shows a close-up of the pin configuration of FIG. **1** and how it is molded inside the wall of the body of the package.

FIG. **8** shows wire wrapped around the pin or post of FIG. **7**.

FIGS. **9A–9D** show end, top, side, and bottom views of electronic surface mount package according to the present invention.

FIG. **10** shows a bottom view of a **40** pin package according to the present invention.

FIG. **11** shows an enlarged sectional view of FIG. **10** illustrating a reinforcement beam.

## DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, where like numerals indicate like components. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to those embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

As will be described in more detail below, the present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicone material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pin-posts do not touch a PCB when mounted by a user.

As described above, it is known that when the parts go through an infra-red soldering process, the magnetic components (ferrite toroids) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicone material which allows for expansion during the soldering process, rather than trying to contain the components within a closed case or package. Hence, with the open construction, the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicone material"). The wires from the toroids are wound around and soldered to the pin-posts. This construction solves the cracking and expansion problems described above, as will now be described in conjunction with FIGS. **1–11**.

FIG. **1** shows an electronic surface mount transformer package or case **10** in three-dimensional view. FIG. **1** shows a cut-away of the empty case **10** with pins **14** molded into the case **10**, together a the notched post **12** upon which a wire is wound. Post **12** has an hour-glass shape which facilitates the winding of wire around post **12**, as will be described. Typically, tin-lead plated copper alloy terminals

are molded into the wall of the package **10**. The outer portion of the package **10** is formed to meet specified footing requirements. The inner post **12** serves as a terminal for internal wire termination use. The package material is made of type of thermal plastic which is in compliance with UL V-94 requirement for flammability.

FIG. **2** shows a wound toroid transformer **20** with wire **22** wrapped around the transformer **20**. The toroid core is typically made of ferrite material and the winding of wire **22** is done manually with fine insulated magnet wire.

FIG. **3** shows a cut-away of the molded part with the toroid **20** mounted inside and showing the wire **22** as it is then attached to post **14**. The wires **22** are pulled with minimum tension and wrapped around the terminal post **14** for two to two and a half turns. This operation is done when the case has been placed bottom side up.

FIG. **4** shows a silicone compound **30** poured inside the cavity with wire terminations that have been soldered with high temperature solder (95 Ag/5Sn) **32** and the package has been properly cleaned. The case **10** is then filled with soft silicone material (preferably a soft epoxy type material) to protect the transformer and to meet environmental requirements.

FIGS. **5** and **6** show the relationships between the safe guard (stand off) **34** and package's foot seating plane and inner terminal posts **12***a*. FIG. **5** shows the standoff **34**, in which the parts typically are placed automatically by machine onto a PC board. They are pressed down, as it is desirable to have some limitation of how far they can be pressed. It is also desirable that the post **12** does not touch the PC board, and so the end standoffs **34** do not allow that to happen. In a preferred embodiment, post **12** is oriented substantially perpendicular to, but does not touch, PC board.

FIG. **6** shows the distance in relationship between the end of the post **12** and where the PC board **36** is located and also where the standoff **34** ends. The PC board **36** would be at the base of the foot.

In FIG. **6**, the typical clearance of 0.015 inches from the safe guard **34** to the seating plane is to avoid interference to the coplanarity of the package. There is also a gap between the safe guard **34** and terminal post **12** to prevent the solder joints from touching the circuit board due to an over forced pick and place operation.

Inside the package **10**, there may be two, three, or more individual toroidal transformers. Wires coming off of the transformers are connected to the outside world. For example, the pins may be mounted on a printed circuit board in an electronic device. The leaf frame pins are injection molded into the body and which allows for an exposed notched post upon which the wire is wound from the toroidal transformer. This allows for the wires to be separated from pin to pin, and for soldering to be much more efficient.

FIG. **7** shows a closeup of the hour-glass shaped pin **12** and how pin **12** is molded inside the wall of the body and also the notch effect **40** of the pin **12**. The post **14** is notched so that the wires are kept away from another, post to post, which is very desirable. The separation is desirable so as to avoid arcing.

FIG. **8** shows the wire **22** wrapped around the pin or post **12**.

FIGS. **9**A–**9**D show end, top, side, and bottom views, respectively, of the electronic surface mount package **10**. The embodiment shown in FIGS. **9**A–**9**D provide an industrial standard surface mount footprint and package dimensions which are auto pick and placeable. In addition, special design consideration has been applied to thermal expansion of materials to ensure that the package will stand all normal re-flow processes with low cost, easy manufacturing, and high reliability.

In the industry, most manufacturers have used a two-piece construction, a base and a cover, and the case is backfilled with hard epoxy. In some processes, the coefficients of expansion of the epoxy that has been backfilled tends to cause the two pieces to separate. The base separates from the top, and as a result, can end up cracking. The present invention provides a one-piece open construction (an open bottom) only with the soft silicone filling to protect the toroid. The case is open at the bottom, thus allowing the toroids to expand naturally without cracking the body of the part.

FIG. **10** shows a bottom view of a **40** pin package **30** which includes pins **32** which includes a reinforcement beam **36** laterally disposed across the bottom of the case or package **30** reinforcement beam **36** provides extra support for improving the mechanical strength of the package **30**.

FIG. **11** shows an enlarged sectional view of the package **30** of FIG. **10** in which the reinforcement beam **36** is disposed laterally or sidewise across the bottom of the package or case **30**. The **40** pin surface mount package shown in FIGS. **10** and **11** include the reinforcement beam **36** which provides extra support to the mechanical strength of the package **30**. This provides for an improved mechanically stable package **30** which when undergoing an IR (infrared) re-flow process and also maintain the coplanarity of the leads or pins **32** shown in FIG. **11**.

Although FIG. **11** shows one reinforcement beam **36** laterally disposed across the bottom of the case or package **30**, it would be apparent to one of ordinary skill in the art that additional reinforcement beams can he located on the bottom of the case or package **30** as the situation warrants.

It should become apparent that various desirable features of the present invention have been shown and described. In the present invention, the pin termination is not flush mounted but rather extends from the bottom of the package. Further, the termination is wound and soldered to the extended pin-post assembly, as shown in FIGS. **1** and **3**–**8**. The use of a soft silicone material (such as soft epoxy) to carry the toroid transformers within the case or package acts to encapsulate or support the toroid transformer within the case or package.

The present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicone material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pin-posts do not touch a PCB when mounted hy a user.

It is widely known that when the toroidal magnetics are mounted in hard plastic packages, the infra-red soldering processes cause the magnetic components (ferrite) to expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicone material which allows for expansion during the soldering process, rather than contain the components within a closed case or package. Hence, with the open construction,

the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicone material") such that when the wires are wound around and soldered to the pin-posts, the cracking and expansion problems described above are avoided.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and it should be understood that many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.

What is claimed is:

1. An electronic surface mount package for mounting onto the surface of a printed circuit board in an electronic device, said package comprising:

a one piece open construction package having a side wall,

a plurality of toroid transformers within said package, said toroid transformers each having wires wound thereon,

a plurality of terminal pins molded within the side wall of said package, the ends of the terminal pins forming solder posts and extending through and below the bottom of said side wall,

said solder posts each having an hour-glass shaped notch upon which said wires from said transformers are wrapped and soldered thereon, respectively,

the other end of each of the terminal pins extending in gull wing fashion outwardly from the side wall and below the bottom of the package for mounting onto the surface of the printed circuit board.

2. An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

a one piece open construction package having a side wall,

a plurality of toroid transformers within said package in a soft silicone material, said toroid transformers each having wires wound thereon,

a plurality of terminal pins molded within the side wall of said package, the ends of the terminal pins forming solder posts extending through and below the bottom of said side wall, said solder posts each having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively,

the other end of each of the terminal pins extending outwardly from the side wall and below the bottom of the package for mounting onto the surface of the printed circuit board.

3. An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

a construction package having a side wall and an open bottom,

a plurality of toroid transformers within said package in a soft silicone material, said toroid transformers each having wires wound thereon,

a plurality of terminal pins molded within the side wall of said package, the ends of the pins forming solder posts extending through and below the bottom of said side wall, said solder posts each having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively.

4. An electronic surface mount package for mounting onto the surface of a printed circuit board in an electronic device, said electronic surface mount package comprising:

a one piece open construction package having a side wall,

a plurality of toroid transformers within said package in a soft silicone material, said toroid transformers each having wires wound thereon,

a plurality of terminal pins molded within the side wall of said package, the ends molded pins forming solder posts extending through and below the bottom of said side wall, said solder posts each having a notched post upon which said wires from said transformers are wrapped and soldered thereon, respectively.

5. The package as in claim 4 further including a standoff for maintaining a distance between the bottom of said pins and said printed circuit board.

6. An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

an open construction package having a side wall,

at least one toroid transformer within said package in a soft silicone material, said toroid transformer having a wire wound thereon,

at least one terminal pin molded within the side wall of said package, said one end forming a solder post extending through and below the bottom of said side wall said solder post having a notched post upon which said wire from said transformer is wrapped and soldered thereon.

7. The package as in claim 6 wherein the package includes an end wall to form a safe guard and wherein said one end of said terminal pin extends below the bottom of the side wall but does not extend below the safe guard.

8. The package as in claim 7 wherein the terminal pin has another end which extends in wing like fashion through the other side of the side wall below the bottom of the package to form a surface mounting portion for mounting on the surface of the printed circuit board.

* * * * *

# EXHIBIT C

US006297721B1

(12) **United States Patent**
**Lu et al.**

(10) **Patent No.: US 6,297,721 B1**
(45) **Date of Patent: *Oct. 2, 2001**

(54) **ELECTRONIC SURFACE MOUNT PACKAGE**

(75) Inventors: **Peter Lu**, Flower Mound, TX (US); **Jeffrey Heaton**, Cupertino; **James W. Heaton**, Los Altos, both of CA (US); **Tsang Kei Sun**, Kowloon (HK); **Peter Loh Hang Pao**, Kowloon (HK); **Robert Loke Hang Lam**, Kowloon (HK)

(73) Assignee: **Halo Electronics, Inc.**, Redwood City, CA (US)

( * ) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/977,407**

(22) Filed: **Nov. 24, 1997**

**Related U.S. Application Data**

(60) Division of application No. 08/773,555, filed on Dec. 27, 1996, which is a continuation-in-part of application No. 08/513,573, filed on Aug. 10, 1995, now Pat. No. 5,656,985.

(51) **Int. Cl.**[7] ..... **H01F 27/02**; H01F 27/28

(52) **U.S. Cl.** ..... **336/96**; 336/192; 336/229; 336/65; 361/821

(58) **Field of Search** ..... 174/52.4, 50; 361/821, 361/752; 336/192, 229, 65, 96, 90

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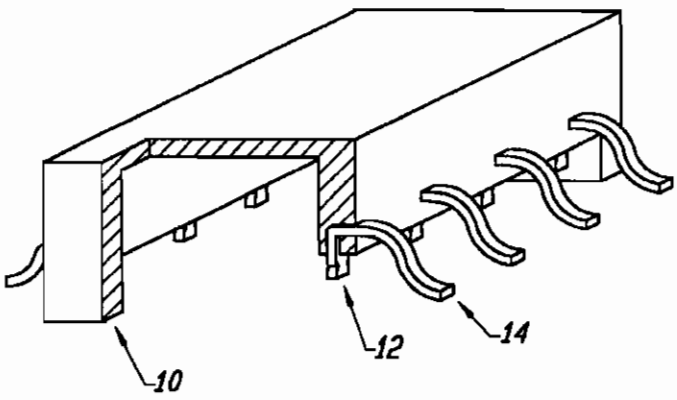
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*Primary Examiner*—Anh Mai
(74) *Attorney, Agent, or Firm*—Trial & Technology Law Group

(57) **ABSTRACT**

An electronic surface mount package provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so their respective wires are separate from one another so as to prevent arcing. The case is opened at the bottom which prevents harm from expansion or cracking. A reinforcement beam is located laterally across the bottom of the package to provide mechanical strength for the case.

**7 Claims, 6 Drawing Sheets**



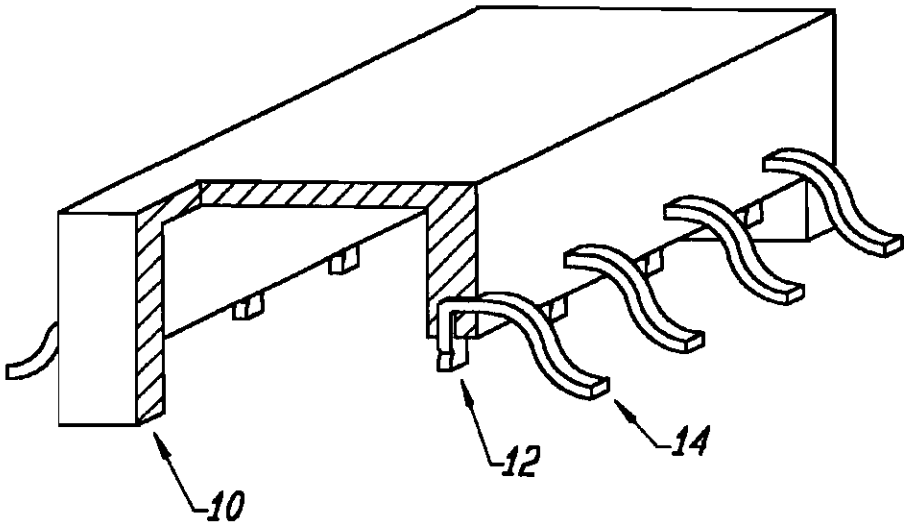



FIG. 1

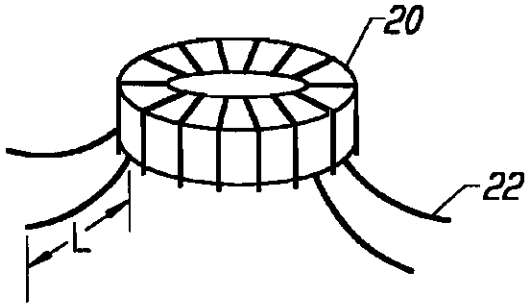



FIG. 2

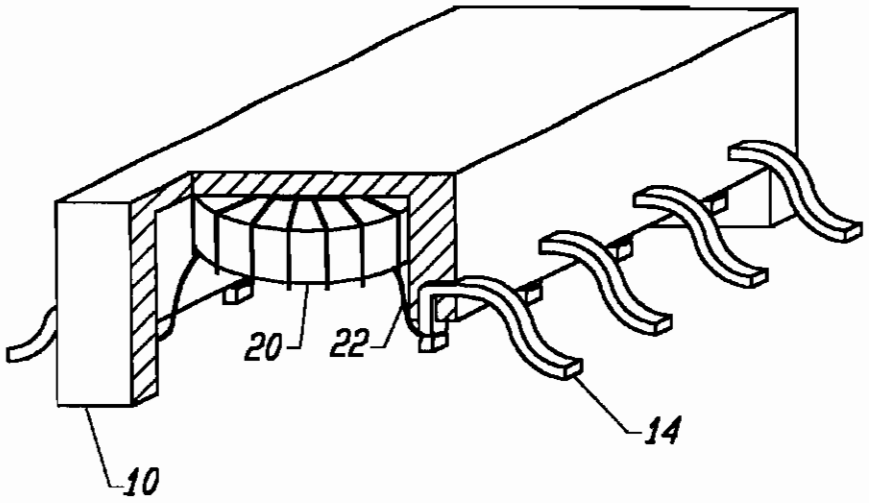



FIG. 3

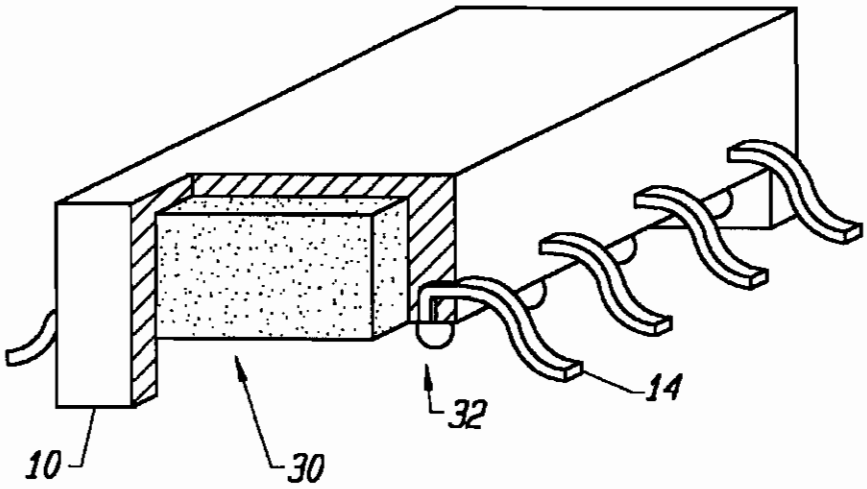



FIG. 4

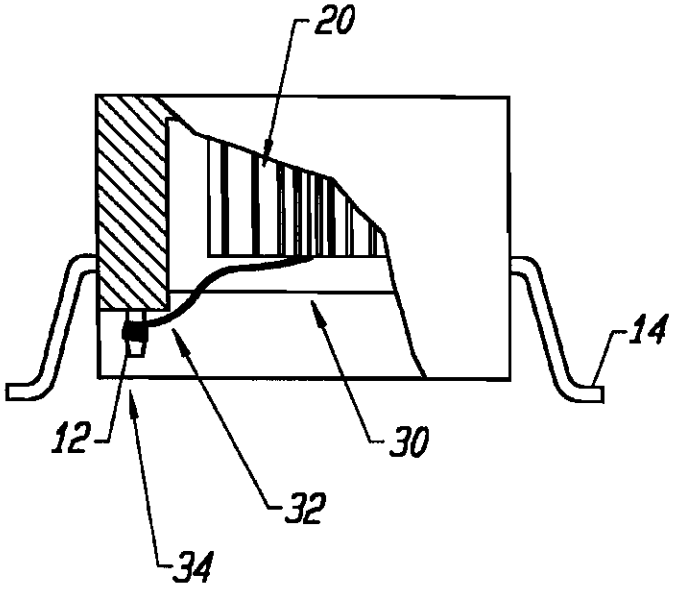



FIG. 5

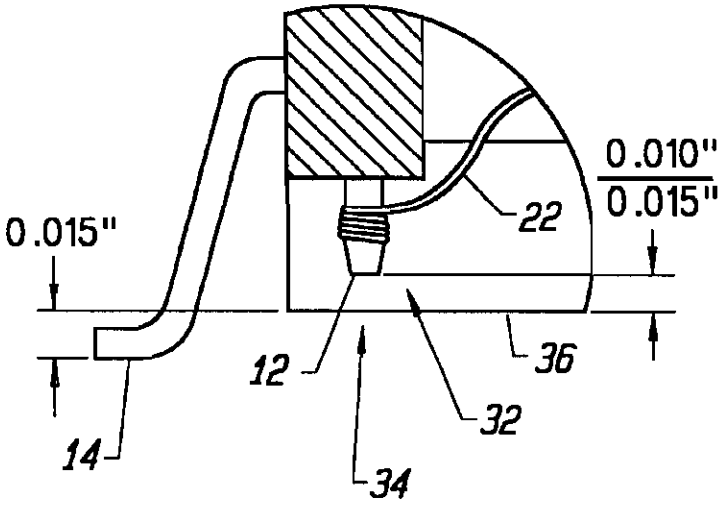



FIG. 6

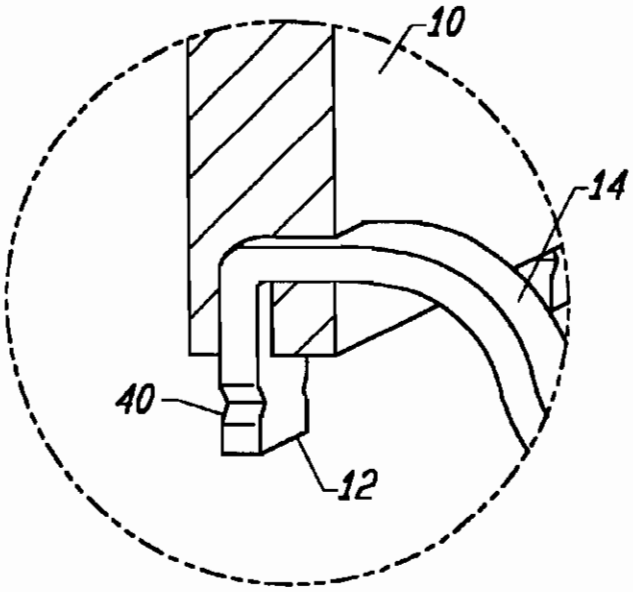



FIG. 7

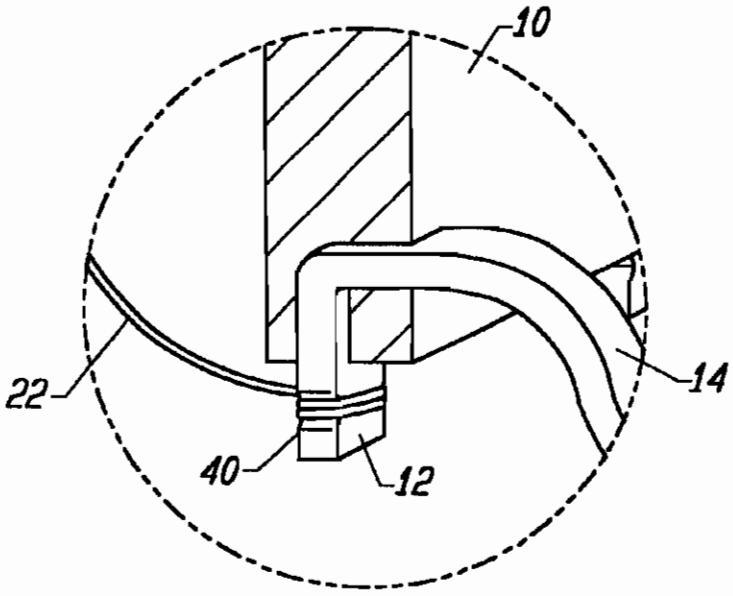



FIG. 8

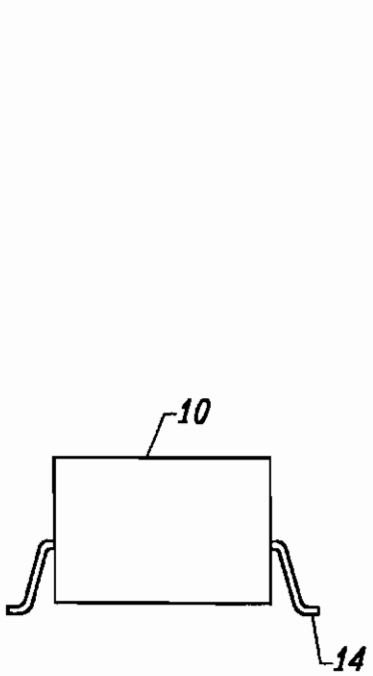



FIG. 9A

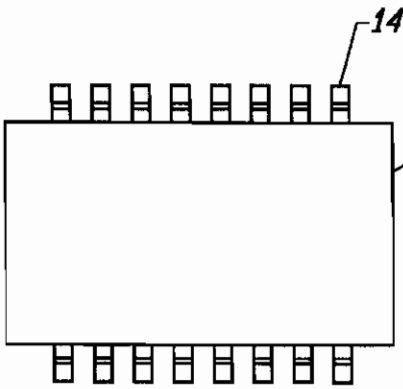



FIG. 9B

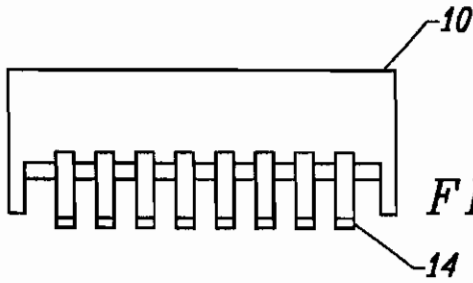



FIG. 9C

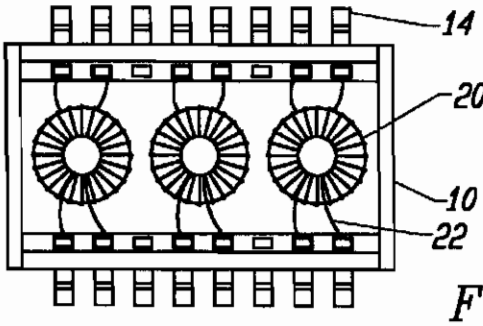



FIG. 9D

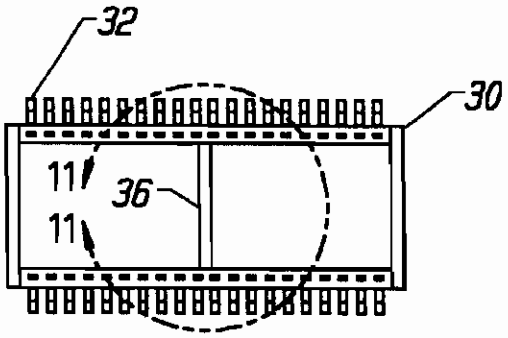



FIG. 10

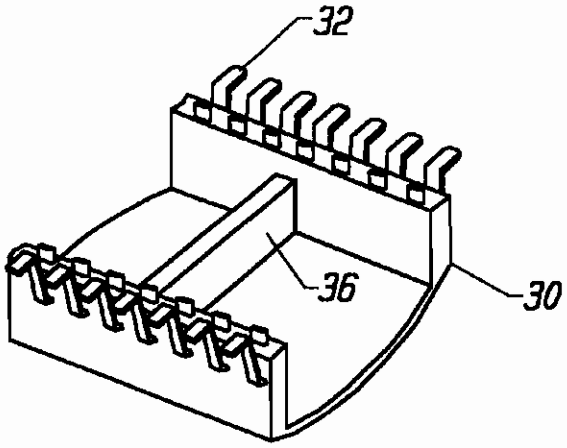



FIG. 11

# ELECTRONIC SURFACE MOUNT PACKAGE

## CROSS REFERENCE TO RELATED APPLICATIONS

This is a divisional of pending application Ser. No. 08/773,555 filed on Dec. 27, 1996 which is a continuation-in-part of prior application Ser. No. 08/513,573 filed on Aug. 10, 1995, now U.S. Pat. No. 5,656,985.

## BACKGROUND OF THE INVENTION

The present invention relates to an electronic surface mount package or case. Electronic surface mount packages are utilized in applications in which one or more individual toroid transformers are embodied within the surface mount package.

Wires coming off the transformers are electronically tied to pins on the package for connection to an electronic device. Typically, the electronic surface mount packages are mounted on a printed circuit board for utilization in the electronic device.

It is widely known in the local area magnetic industry that when surface mount toroidal magnetics which are encapsulated in hard plastics go through infra-red soldering processes, the magnetic components (ferrite) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which makes the part unusable. In view of the foregoing, it would be highly desirable to provide an improved electronic surface mount package which avoids the cracking and expansion problems described above.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved electronic surface mount package.

Briefly, according to one preferred embodiment, the present invention provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound and soldered. The wire which is wound and soldered around each terminal pin/post is from a respective toroid transformer carried within the package. Each of the posts are notched so that the respective wires are separated from one another so as to avoid arcing. The case is open at the bottom which prevents cracking and allows for the toroidal expansion. The present invention also includes a reinforcement beam that is disposed laterally or sidewise across the bottom of the package to provide extra support in the mechanical strength of the case.

Other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the. principles of the invention:

FIG. **1** shows an electronic surface mount package in three-dimensional view according to the present invention.

FIG. **2** shows a wound toroid transformer.

FIG. **3** shows the connection of the toroid transformer of FIG. **2** within the electronic surface mount package of FIG. **1**.



FIG. **4** shows the electronic surface mount package of FIG. **1** after wire terminations have been soldered.

FIGS. **5** and **6** show relationships between a safeguard (standoff) and the electronic surface-mount package's foot seating plane and inner terminal posts, respectively.

FIG. **7** shows a close-up of the pin configuration of FIG. **1** and how it is molded inside the wall of the body of the package.

FIG. **8** shows wire wrapped around the pin or post of FIG. **7**.

FIGS. **9A–9D** show end, top, side, and bottom views of electronic surface mount package according to the present invention.

FIG. **10** shows a bottom view of a 40 pin package according to the present invention.

FIG. **11** shows an enlarged sectional view of FIG. **10** illustrating a reinforcement beam.

## DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, where like numerals indicate like components. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to those embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

As will be described in more detail below, the present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicon type material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pin-posts do not touch a PCB when mounted by a user.

As described above, it is known that when the parts go through an infra-red soldering process, the magnetic components (ferrite toroids) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicon type material which allows for expansion during the soldering process, rather than trying to contain the components within a closed case or package. Hence, with the open construction, the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicon type material"). The wires from the toroids are wound around and soldered to the pin-posts. This construction solves the cracking and expansion problems described above, as will now be described in conjunction with FIGS. **1–11**.

FIG. **1** shows an electronic surface mount transformer package or case **10** in three-dimensional view. FIG. **1** shows a cut-away of the empty case **10** with pins **14** molded into the case **10**, together a the notched post **12** upon which a wire is wound. Post **12** has an hour-glass shape which facilitates the winding of wire around post **12**, as will be

described. Typically, tin-lead plated copper alloy terminals are molded into the wall of the package **10**. The outer portion of the package **10** is formed to meet specified footing requirements. The inner post **12** serves as a terminal for internal wire termination use. The package material is made of type of thermal plastic which is in compliance with UL V-94 requirement for flammability.

FIG. **2** shows a wound toroid transformer **20** with wire **22** wrapped around the transformer **20**. The toroid core is typically made of ferrite material and the winding of wire **22** is done manually with fine insulated magnet wire.

FIG. **3** shows a cut-away of the molded part with the toroid **20** mounted inside and showing the wire **22** as it is then attached to post **14**. The wires **22** are pulled with minimum tension and wrapped around the terminal post **14** for two to two and a half turns. This operation is done when the case has been placed bottom side up.

FIG. **4** shows a silicon compound **30** poured inside the cavity with wire terminations that have been soldered with high temperature solder (95 Ag/5Sn) **32** and the package has been properly cleaned. The case **10** is then filled with soft silicone material (preferably a soft epoxy type material) to protect the transformer and to meet environmental requirements.

FIGS. **5** and **6** show the relationships between the safe guard (stand off) **34** and package's foot seating plane and inner terminal posts **12***a*. FIG. **5** shows the standoff **34**, in which the parts typically are placed automatically by machine onto a PC board. They are pressed down, as it is desirable to have some limitation of how far they can be pressed. It is also desirable that the post **12** does not touch the PC board, and so the end standoffs **34** do not allow that to happen. In a preferred embodiment, post **12** is oriented substantially perpendicular to, but does not touch, PC board.

FIG. **6** shows the distance in relationship between the end of the post **12** and where the PC board **36** is located and also where the standoff **34** ends. The PC board **36** would be at the base of the foot.

In FIG. **6**, the typical clearance of 0.015 inches from the safe guard **34** to the seating plane is to avoid interference to the coplanarity of the package. There is also a gap between the safe guard **34** and terminal post **12** to prevent the solder joints from touching the circuit board due to an over forced pick and place operation.

Inside the package **10**, there may be two, three, or more individual toroidal transformers. Wires coming off of the transformers are connected to the outside world. For example, the pins may be mounted on a printed circuit board in an electronic device. The leaf frame pins are injection molded into the body and which allows for an exposed notched post upon which the wire is wound from the toroidal transformer. This allows for the wires to be separated from pin to pin, and for soldering to be much more efficient.

FIG. **7** shows a closeup of the hour-glass shaped pin **12** and how pin **12** is molded inside the wall of the body and also the notch effect **40** of the pin **12**. The post **14** is notched so that the wires are kept away from another, post to post, which is very desirable. The separation is desirable so as to avoid arcing.

FIG. **8** shows the wire **22** wrapped around the pin or post **12**.

FIGS. **9A–9D** show end, top, side, and bottom views, respectively, of the electronic surface mount package **10**. The embodiment shown in FIGS. **9A–9D** provide an industrial standard surface mount footprint and package dimensions which are auto pick and placeable. In addition, special design consideration has been applied to thermal expansion of materials to ensure that the package will stand all normal re-flow processes with low cost, easy manufacturing, and high reliability.

In the industry, most manufacturers have used a two-piece construction, a base and a cover, and the case is backfilled with hard epoxy. In some processes, the coefficients of expansion of the epoxy that has been backfilled tends to cause the two pieces to separate. The base separates from the top, and as a result, can end up cracking. The present invention provides a one-piece open construction (an open bottom) only with the soft silicon filling to protect the toroid. The case is open at the bottom, thus allowing the toroids to expand naturally without cracking the body of the part.

FIG. **10** shows a bottom view of a **40** pin package **30** which includes pins **32** which includes a reinforcement beam **36** laterally disposed across the bottom of the case or package **30** reinforcement beam **36** provides extra support for improving the mechanical strength of the package **30**.

FIG. **11** shows an enlarged sectional view of the package **30** of FIG. **10** in which the reinforcement beam **36** is disposed laterally or sidewise across the bottom of the package or case **30**. The **40** pin surface mount package shown in FIGS. **10** and **11** include the reinforcement beam **36** which provides extra support to the mechanical strength of the package **30**. This provides for an improved mechanically stable package **30** which when undergoing an IR (infrared) re-flow process and also maintain the coplanarity of the leads or pins **32** shown in FIG. **11**.

Although FIG. **11** shows one reinforcement beam **36** laterally disposed across the bottom of the case or package **30**, it would be apparent to one of ordinary skill in the art that additional reinforcement beams can be located on the bottom of the case or package **30** as the situation warrants.

It should become apparent that various desirable features of the present invention have been shown and described. In the present invention, the pin termination is not flush mounted but rather extends from the bottom of the package. Further, the termination is wound and soldered to the extended pin-post assembly, as shown in FIGS. **1** and **3–8**. The use of a soft silicon type material (such as soft epoxy) to carry the toroid transformers within the case or package acts to encapsulate or support the toroid transformer within the case or package.

The present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicon type material within an open construction package and which utilizes a portion of the-case as a standoff to ensure that the pin-posts do not touch a PCB when mounted by a user.

It is widely known that when the toroidal magnetics are mounted in hard plastic packages, the infra-red soldering processes cause the magnetic components (ferrite) to expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicon type material which allows for expansion during the soldering process, rather than contain the components within a closed case or package. Hence, with the open construction,

the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicon type material") such that when the wires are wound around and soldered to the pin-posts, the cracking and expansion problems described above are avoided.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and it should be understood that many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described iu order to best explain the principles of the iuvention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

What is claimed is:

**1** An electronic surface mount package for mounting onto a printed circuit board comprising:

a one piece construction package having a side wall and an open bottom,

a plurality of toroid transformers within said package, said toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within and extending through and below a bottom of said side wall, one end of each of said pins having a notched solder post upon which said wires from said transformers are wrapped and soldered thereon, respectively,

the other end of each of said terminal pins extending in gull wing fashion outwardly from and below the bottom of the side wall for mounting onto the surface of the printed circuit board, and

at least one reinforcement beam located laterally along the bottom of said package to provide improved mechanical strength of said package.

**2**. An electronic surface mount package for mounting onto a printed circuit board comprising:

a construction package having a side wall and an open bottom,

a plurality of toroid transformers within said package, said toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within and extending through and below a bottom of said side wall, one end of each of said pins having a notched solder post upon which said wires from said transformers are wrapped and soldered thereon, respectively,

the other end of each of said terminal pins extending in gull wing fashion outwardly from and below the bottom of the side wall for mounting onto the surface of the printed circuit board, and

at least one reinforcement beam located laterally along the bottom of said package to provide improved mechanical strength of said package.

**3**. A package as in claim **2** wherein said construction package is one piece.

**4**. The package of claim **3** wherein said construction package has an open bottom.

**5**. The package of claim **4** wherein said posts are separated from one another so as to avoid arcing.

**6**. An electronic surface mount package for mounting onto a printed circuit board in an electronic device, said electronic surface mount package comprising:

a one piece construction package having a side wall and an open bottom,

a plurality of toroid transformers within said package, said toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within and extending through and below a bottom of said side wall, one end of each of said pins having a notched solder post upon which said wires from said transformers are wrapped and soldered thereon, respectively,

the otber end of eacb of said terminal pins extending in gull wing fashion outwardly from and below tbe bottom of tbe side wall for mounting onto the surface of the printed circuit board, and

at least one reinforcement beam located laterally along the bottom of said package to provide improved mechanical strength of said package.

**7**. The package as in claim **6** further including a standoff for maintaining a distance between said terminal pins and said printed circuit board.

* * * * *

# EXHIBIT D

US006320489B1

(12) **United States Patent**
**Lu et al.**

(10) **Patent No.: US 6,320,489 B1**
(45) **Date of Patent: Nov. 20, 2001**

(54) **ELECTRONIC SURFACE MOUNT PACKAGE WITH EXTENDED SIDE RETAINING WALL**

(75) Inventors: **Peter Lu**, Flower Mound, TX (US); **Jeffrey Heaton**, Cupertino; **James W. Heaton**, Los Altos, both of CA (US); **Peter Loh Hang Pao**, Kowloon (HK); **Robert Loke Hang Lam**, Kowloon (HK); **Tsang Kei Sun**, Kowloon (HK)

(73) Assignee: **Halo Electronics, Inc.**, Redwood City, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/977,400**

(22) Filed: **Nov. 24, 1997**

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 08/773,555, filed on Dec. 27, 1996, which is a continuation-in-part of application No. 08/513,573, filed on Aug. 10, 1995, now Pat. No. 5,656,985.

(51) **Int. Cl.**[7] ..... **H01F 27/02**; H01F 27/29

(52) **U.S. Cl.** ..... **336/96**; 336/192; 336/90; 336/229

(58) **Field of Search** ..... 174/52.4, 50; 361/821, 361/752; 336/192, 229, 65, 96, 90

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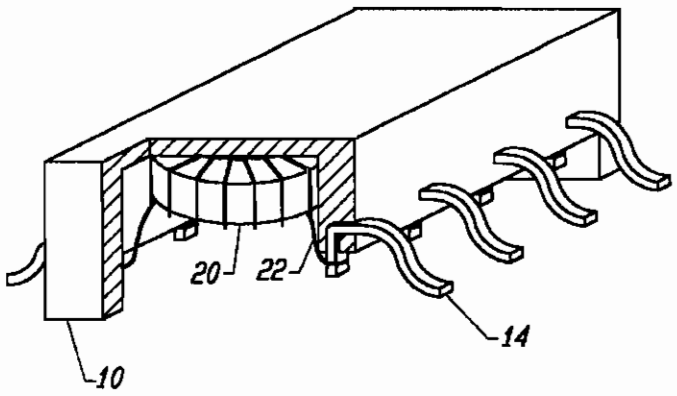
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*Primary Examiner*—Anh Mai
(74) *Attorney, Agent, or Firm*—Trial & Technology Law Group

(57) **ABSTRACT**

The electronic surface mount package according to the present invention includes a one piece construction package having end walls, a side wall and an open bottom; a plurality of toroid transformers carried within the package by a soft silicone material wherein the toroid transformers each have wires wrapped thereon; a plurality of terminal pins molded within and extending from the bottom of the package wherein each of the pins extend through a bottom portion of the side wall and have a notched post upon which the wires from said transformers are wrapped and soldered thereon, respectively; and wherein the end walls have a first height H1 to form a standoff or safe guard between the foot seating plane of the package and the terminal pins; and wherein the outer portion of the side wall extends between the end walls such that the side wall has a second height H2 which is less than said first height H1. The extended side retaining wall provides for improved containment of the soft silicone material within the package. The extended side retaining wall also provides for improved coverage of the wire wrapped solder posts. In addition, since the height H2 of the extended side retaining wall is less than the height H1 of the safe guard, the mounting of the package onto a printed circuit board with the extended side retaining wall allows for cleaning of the PCB with wash liquids which can flow freely under the package under the portion of the extended side wall which is less in height than the height of the safeguard (H1<H2).

**8 Claims, 9 Drawing Sheets**



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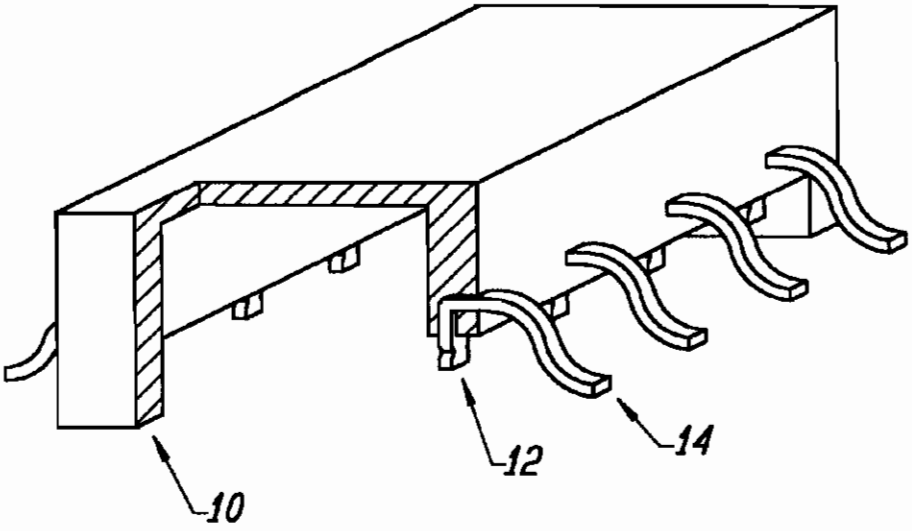



FIG. 1

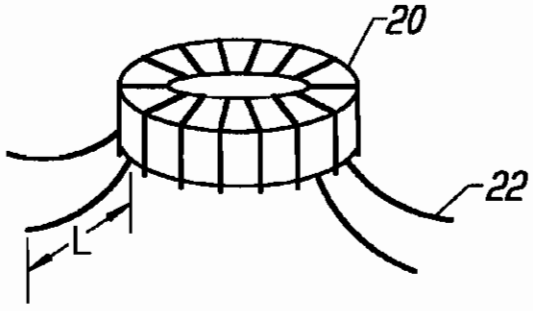



FIG. 2

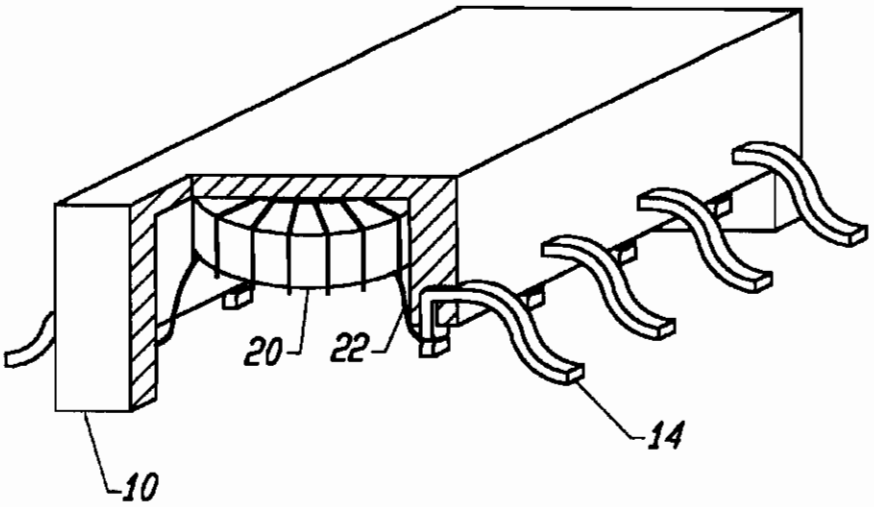



FIG. 3

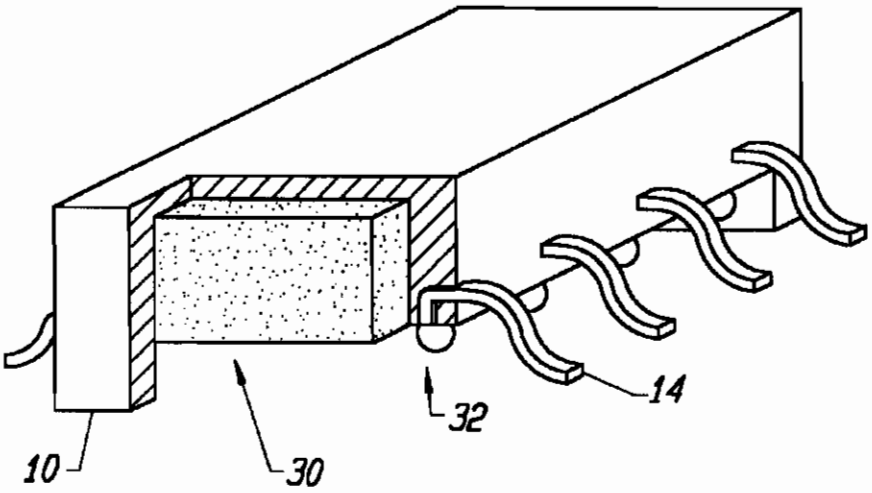



FIG. 4

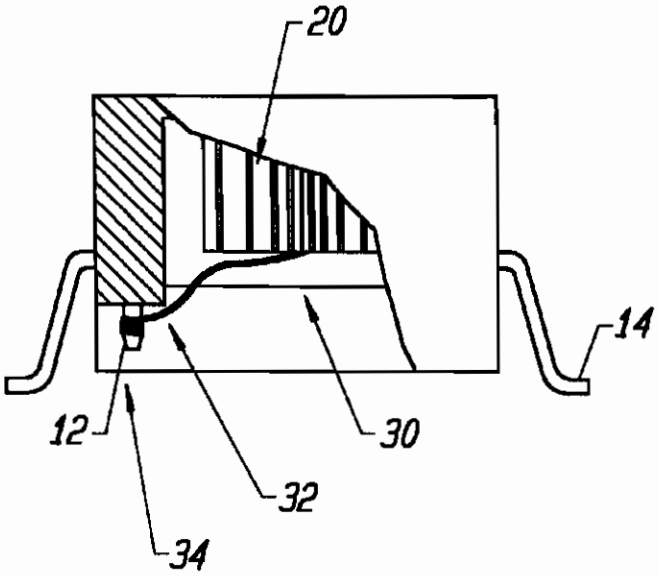



FIG. 5

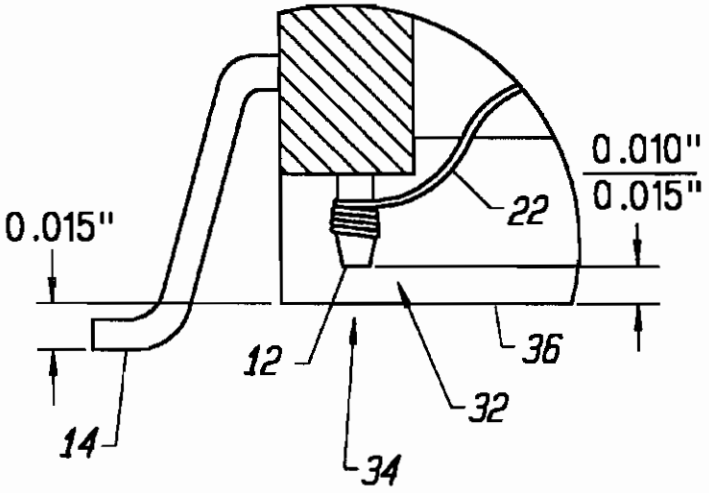



FIG. 6

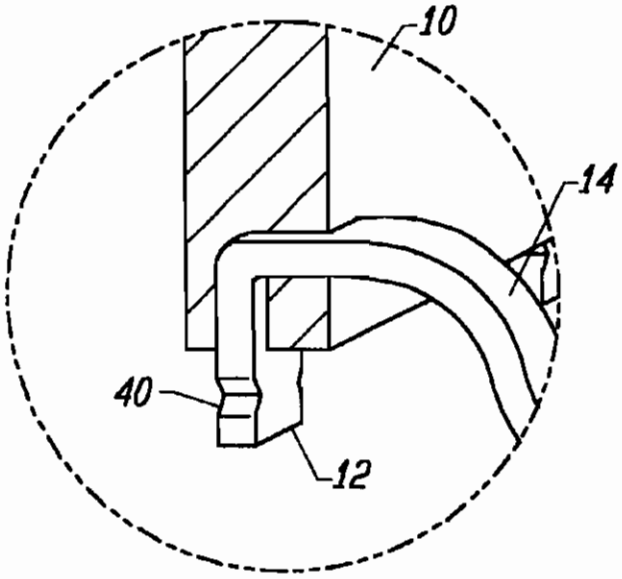



FIG. 7

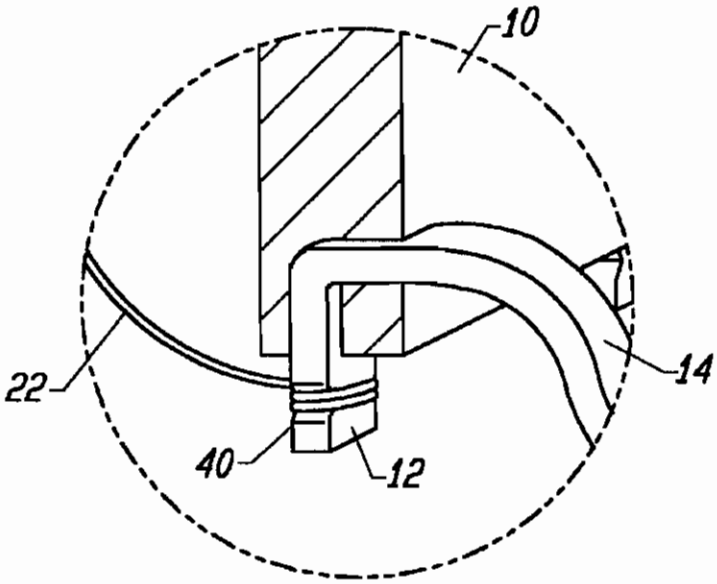



FIG. 8

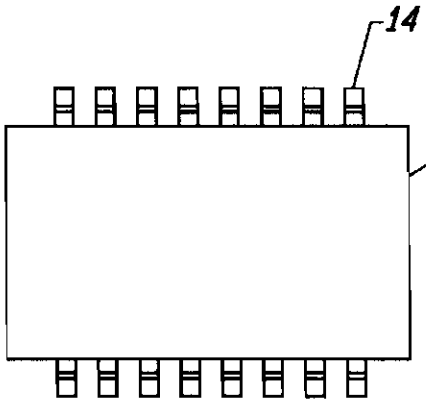



FIG. 9B

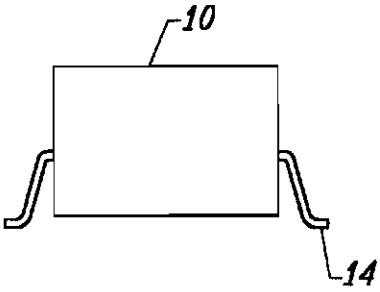



FIG. 9A

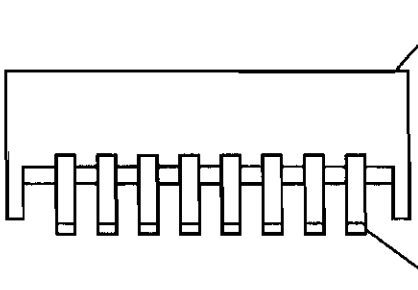



FIG. 9C

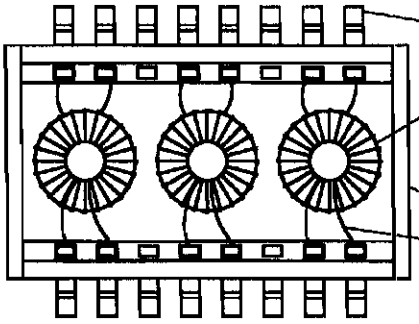



FIG. 9D

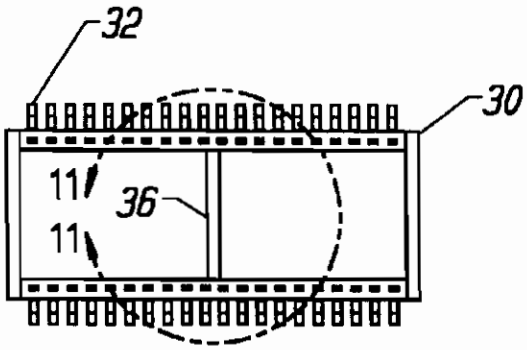



FIG. 10

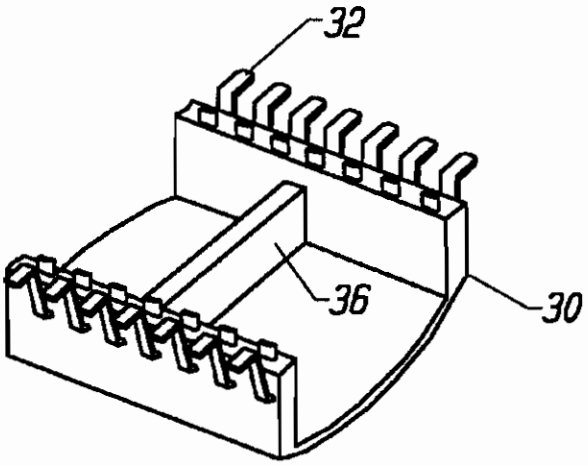



FIG. 11

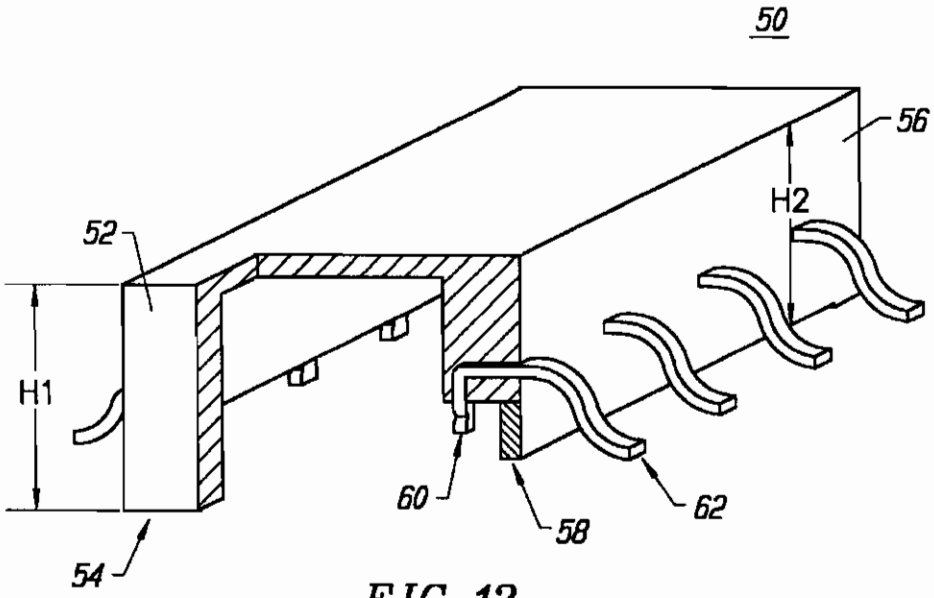



FIG. 12

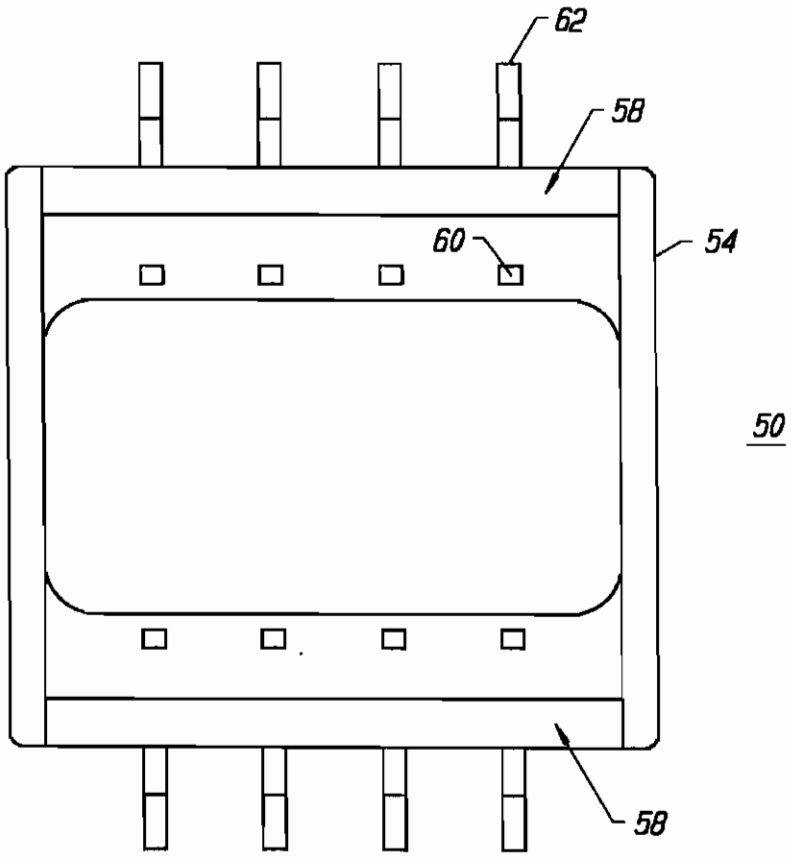



FIG. 13

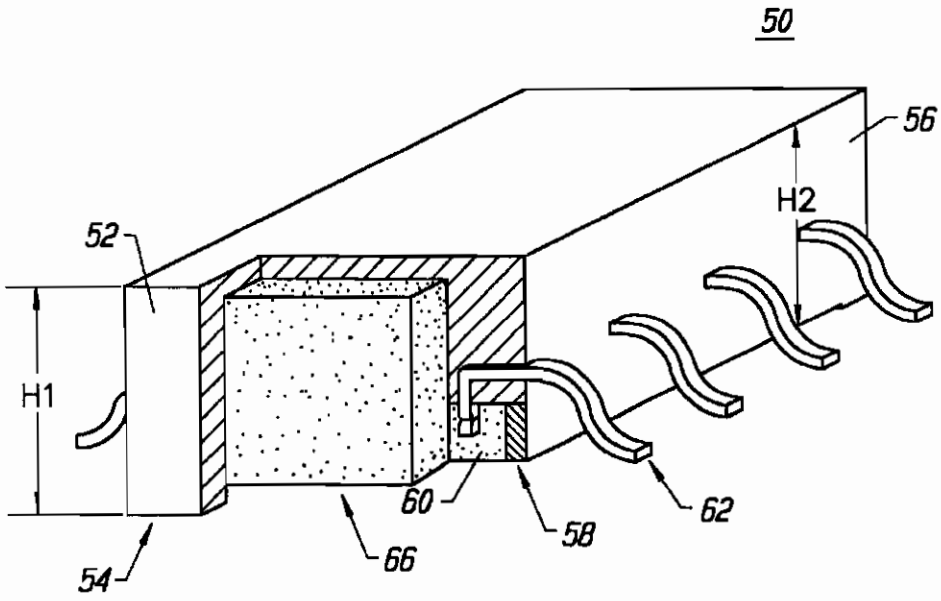



FIG. 14

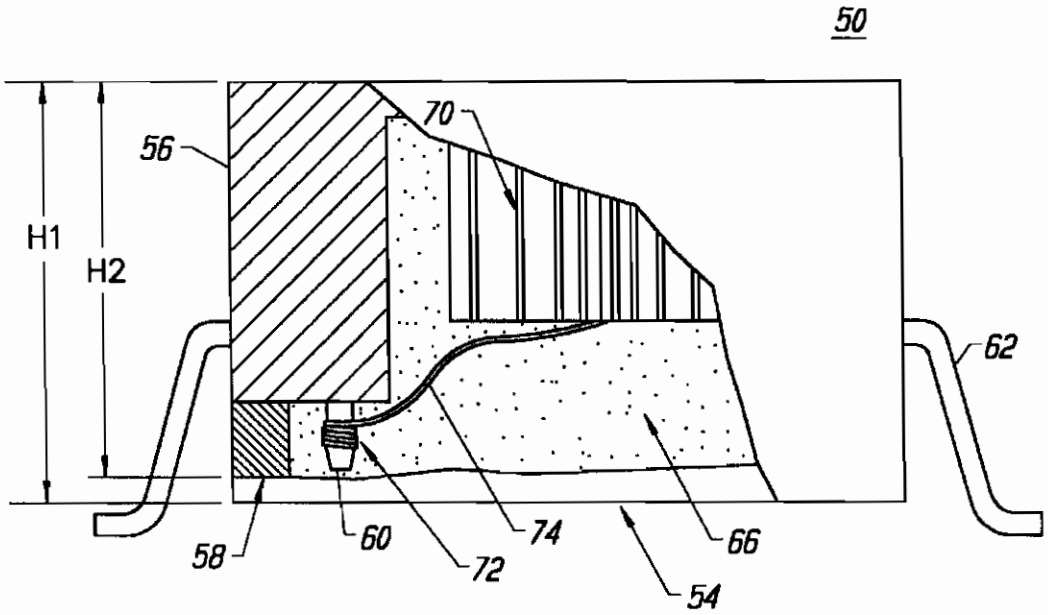



FIG. 15

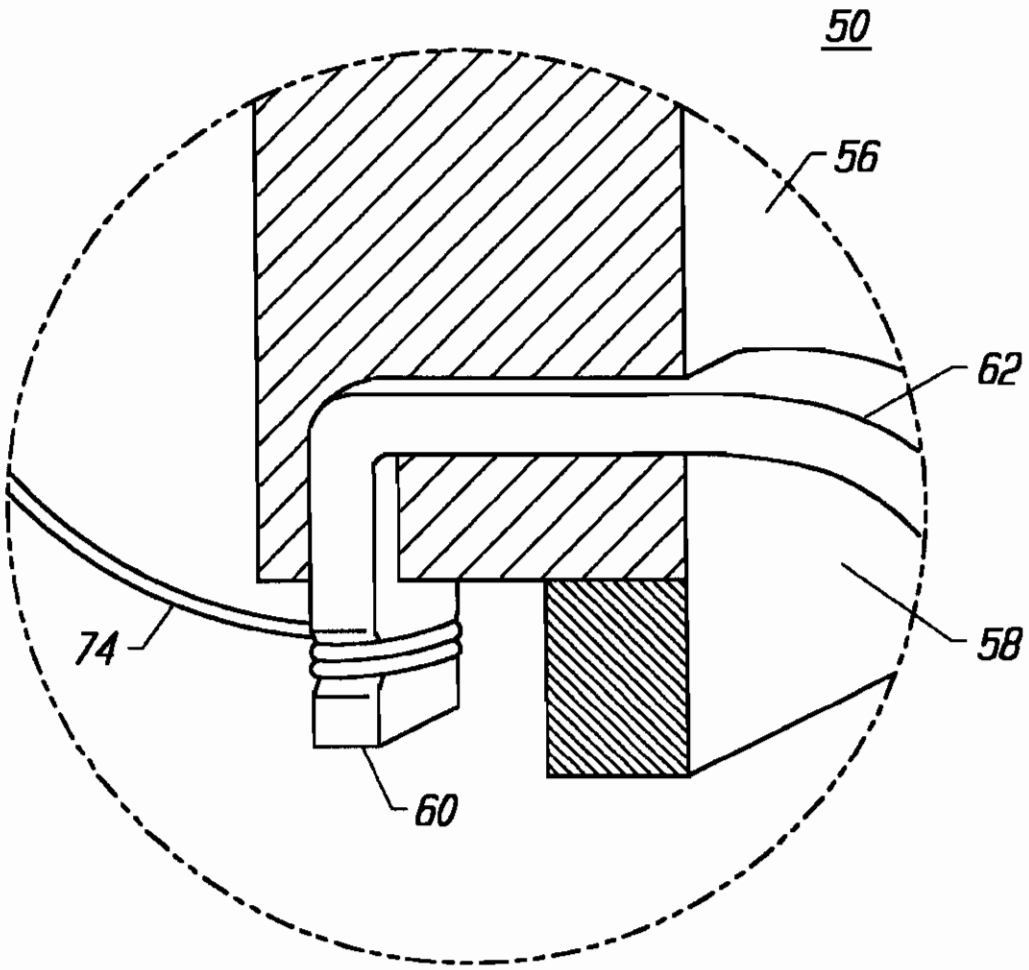



FIG. 16

# ELECTRONIC SURFACE MOUNT PACKAGE WITH EXTENDED SIDE RETAINING WALL

## CROSS REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part of copending continuation-in-part application entitled ELECTRONIC SURFACE MOUNT PACKAGE, Ser. No. 08/773,555 filed Dec. 27, 1996, which is a continuation-in-part application of Ser. No. 08/513,573, filed Aug. 10, 1995, now U.S Pat. No. 5,656,985, and assigned to the same Assignee as the present application.

## BACKGROUND OF THE INVENTION

The present invention relates to an electronic surface mount package or case and more particularly to an electronic surface mount package with an extended side retaining wall. Electronic surface mount packages are utilized in applications in which one or more individual toroid transformers are embodied within the surface mount package.

Wires coming off the transformers are electronically tied to pins or posts on the package for connection to an electronic device. Typically, the electronic surface mount packages are mounted on a printed circuit board for utilization in the electronic device.

It is widely known in the local area magnetic industry that when surface mount toroidal magnetics which are encapsulated in hard plastics go through infra-red soldering processes, the magnetic components (ferrite) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which makes the part unusable. The electronic surface package described in the cross-referenced U.S. Pat. No. 5,656,985 provides a soft silicone type material to encapsulate (carry) a plurality of toroid transformers within the package. The toroid transformers in turn are electrically connected to a plurality of terminal posts molded within the package. In view of the foregoing, it would be highly desirable to provide an improved electronic surface mount package which avoids the cracking and expansion problems described above and in addition provides additional coverage for the terminal pins to which the toroids are electrically connected as well as additional coverage for the soft silicone type material which encapsulates the toroids within the package.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved electronic surface mount package.

According to one preferred embodiment, the present invention provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound and soldered. The wire which is wound and soldered around each terminal pin/post is from a respective toroid transformer carried within the package. Each of the posts are notched so that the respective wires are separated from one another so as to avoid arcing. The case is open at the bottom which prevents cracking and allows for the toroidal expansion. A soft silicone type material is added to the open package to provide support (to carry) the toroid transformers. In one embodiment, the present invention also includes a reinforcement beam that is disposed laterally or sidewise across the bottom of the package to provide extra support in the mechanical strength of the case. In another



embodiment, the present invention also includes an extended side retaining wall for retaining the soft silicone type material and providing additional coverage of the soft silicone material the end walls have a first height H1 to form a standoff or safe guard between the foot seating plane of the package and the terminal pins; and the outer portion of the side wall extends between the end walls such that the side wall has a second height H2 which is less than said first height H1. The mounting of the package onto a printed circuit board (PCB) with the extended side retaining wall according to the present invention allows for cleaning of the PCB with wash liquids which can flow freely under the package under the portion of the extended side wall, since the height of the extended side retaining wall (H2) is less than the height of the safeguard H1 (H2<H1). The extended side retaining wall provides for improved containment of the soft silicone material within the package. The extended side retaining wall also provides for improved coverage of the wire wrapped solder posts.

Other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

FIG. **1** shows an electronic surface mount package in three-dimensional view according to the present invention.

FIG. **2** shows a wound toroid transformer.

FIG. **3** shows the connection of the toroid transformer of FIG. **2** within the electronic surface mount package of FIG. **1**.

FIG. **4** shows the electronic surface mount package of FIG. **1** after wire terminations have been soldered.

FIGS. **5** and **6** show relationships between a safeguard (standoff) and the electronic surface-mount package's foot seating plane and inner terminal posts, respectively.

FIG. **7** shows a close-up of the pin configuration of FIG. **1** and how it is molded inside the wall of the body of the package.

FIG. **8** shows wire wrapped around the pin or post of FIG. **7**.

FIGS. **9A–9D** show end, top, side, and bottom views of electronic surface mount package according to the present invention.

FIG. **10** shows a bottom view of a **40** pin package according to the present invention.

FIG. **11** shows an enlarged sectional view of FIG. **10** illustrating a reinforcement beam.

FIG. **12** shows a three dimensional view of an electronic surface mount package with extended side retaining wall according to the present invention.

FIG. **13** shows a bottom view of the electronic surface mount package with extended side retaining wall according to the present invention.

FIG. **14** shows a more detailed view of the electronic surface mount package with extended side retaining wall according to the present invention.

FIG. **15** shoes a cross sectional end view of the electronic surface mount package with extended side retaining wall according to the present invention.

FIG. **16** shows a close up view of one terminal pin contained within the electronic surface mount package with extended side retaining wall according to the present invention.

## DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, where like numerals indicate like components. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to those embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

As will be described in more detail below, the present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicone material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pinposts do not touch a PCB when mounted by a user.

As described above, it is known that when the parts go through an infra-red soldering process, the magnetic components (ferrite toroids) can expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicone material which allows for expansion during the soldering process, rather than trying to contain the components within a closed case or package. Hence, with the open construction, the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicone material"). The wires from the toroids are wound around and soldered to the pin-posts. This construction solves the cracking and. expansion problems described above, as will now be described in conjunction with FIGS. **1–17**.

FIG. **1** shows an electronic surface mount transformer package or case **10** in three-dimensional view. FIG. **1** shows a cut-away of the empty case **10** with pins **14** molded into the case **10**, together a the notched post **12** upon which a wire is wound. Post **12** has an hour-glass shape which facilitates the winding of wire around post **12**, as will be described. Typically, tin-lead plated copper alloy terminals are molded into the wall of the package **10** with the terminals extending through and below the bottom of the wall. The outer portion of the package **10** is formed to meet specified footing requirements. The inner post **12** serves as a terminal for internal wire termination use. The package material is made of type of thermal plastic which is in compliance with UL V-94 requirement for flammability.

FIG. **2** shows a wound toroid transformer **20** with wire **22** wrapped around the transformer **20**. The toroid core is typically made of ferrite material and the winding of wire **22** is done manually with fine insulated magnet wire.

FIG. **3** shows a cut-away of the molded part with the toroid **20** mounted inside and showing the wire **22** as it is then attached to post **14**. The wires **22** are pulled with minimum tension and wrapped around the terminal post **14** for two to two and a half turns. This operation is done when the case has been placed bottom side up.

FIG. **4** shows a silicone compound **30** poured inside the cavity with wire terminations that have been soldered with high temperature solder (95 Ag/5Sn) **32** and the package has been properly cleaned. The case **10** is then filled with soft silicone material (preferably a soft epoxy type material) to protect the transformer and to meet environmental requirements.

FIGS. **5** and **6** show the relationships between the safe guard (stand off) **34** and package's foot seating plane and inner terminal posts **12***a*. FIG. **5** shows the standoff **34**, in which the parts typically are placed automatically by machine onto a PC board. They are pressed down, as it is desirable to have some limitation of how far they can be pressed. It is also desirable that the post **12** does not touch the PC board, and so the end standoffs **34** do not allow that to happen. In a preferred embodiment, post **12** is oriented substantially perpendicular to, hut does not touch, PC board.

FIG. **6** shows the distance in relationship between the end of the post **12** and where the PC board **36** is located and also where the standoff **34** ends. The PC board **36** would be at the base of the foot.

In FIG. **6**, the typical clearance of 0.015 inches from the safe guard **34** to the seating plane is to avoid interference to the coplanarity of the package. There is also a gap between the safe guard **34** and terminal post **12** to prevent the solder joints from touching the circuit board due to an over forced pick and place operation.

Inside the package **10**, there may be two, three, or more individual toroidal transformers. Wires coming off of the transformers are connected to the outside world. For example, the pins may be mounted on a printed circuit board in an electronic device. The leaf frame pins are injection molded into the body and which allows for an exposed notched post upon which the wire is wound from the toroidal transformer. This allows for the wires to be separated from pin to pin, and for soldering to be much more efficient.

FIG. **7** shows a closeup of the hour-glass shaped pin **12** and how pin **12** is molded inside the wall of the body and also the notch effect **40** of the pin **12**. The post **14** is notched so that the wires are kept away from another, post to post, which is very desirable. The separation is desirable so as to avoid arcing.

FIG. **8** shows the wire **22** wrapped around the pin or post **12**.

FIGS. **9A–9D** show end, top, side, and bottom views, respectively, of the electronic surface mount package **10**. The embodiment shown in FIGS. **9A–9D** provide an industrial standard surface mount footprint and package dimensions which are auto pick and placeable. In addition, special design consideration has been applied to thermal expansion of materials to ensure that the package will stand all normal re-flow processes with low cost, easy manufacturing, and high reliability.

In the industry, most manufacturers have used a two-piece construction, a base and a cover, and the case is backfilled with hard epoxy. In some processes, the coefficients of expansion of the epoxy that has been backfilled tends to cause the two pieces to separate. The base separates from the top, and as a result, can end up cracking. The present invention provides a one-piece open construction (an open bottom) only with the soft silicone filling to protect the toroid. The case is open at the bottom, thus allowing the toroids to expand naturally without cracking the body of the part.

FIG. **10** shows a bottom view of a **40** pin package **30** which includes pins **32** which includes a reinforcement beam **36** laterally disposed across the bottom of the case or package **30** reinforcement beam **36** provides extra support for improving the mechanical strength of the package **30**.

FIG. **11** shows an enlarged sectional view of the package **30** of FIG. **10** in which the reinforcement beam **36** is disposed laterally or sidewise across the bottom of the package or case **30**. The **40** pin surface mount package shown in FIGS. **10** and **11** include the reinforcement beam **36** which provides extra support to the mechanical strength of the package **30**. This provides for an improved mechanically stable package **30** which when undergoing an IR (infrared) re-flow process and also maintain the coplanarity of the leads or pins **32** shown in FIG. **11**.

Although FIG. **11** shows one reinforcement beam **36** laterally disposed across the bottom of the case or package **30**, it would be apparent to one of ordinary skill in the art that additional reinforcement beams can be located on the bottom of the case or package **30** as the situation warrants.

It should become apparent that various desirable features of the present invention have been shown and described. In the present invention, the pin termination is not flush mounted but rather extends from the bottom of the package. Further, the termination is wound and soldered to the extended pin-post package, as shown in FIGS. **1** and **3–8**. The use of a soft silicone material (such as soft epoxy) to carry the toroid transformers within the case or package acts to encapsulate or support the toroid transformer within the case or package.

## ELECTRONIC SURFACE MOUNT PACKAGE WITH EXTENDED SIDE RETAINING WALL EMBODIMENT

The features of the electronic surface mount package with extended side retaining wall embodiment will now be described in conjunction with FIGS. **12–16**. The electronic surface mount package according to the present invention includes a one piece construction package having end walls, a side wall and an open bottom; a plurality of toroid transformers carried within the package by a soft silicone material wherein the toroid transformers each have wires wrapped thereon; a plurality of terminal pins molded within and extending from the bottom of the package wherein each of the pins extend through a bottom portion of the side wall and have a notched post upon which the wires from said transformers are wrapped and soldered thereon, respectively; and wherein the end walls have a first height H1 to form a standoff or safe guard between the foot seating plane of the package and the terminal pins; and wherein the outer portion of the side wall extends between the end walls such that the side wall has a second height H2 which is less than said first height H1.

FIG. **12** shows a three dimensional view of an electronic surface mount package **50** with a side wall **56** having an extended side retaining wall portion **58** according to the present invention. The view shown in FIG. **12** is similar to that view shown in FIG. **1**, with the addition of the extended side retaining wall portion **58**. The end wall **52** forms a safeguard **54** shown in FIG. **12**, and which is similar to safeguard **34** shown in FIGS. **5** and **6**. The end wall **52** has a height H1. The solder post **60** and leads **62** shown in FIG. **12** are also similar to posts **12** and leads **14** shown in FIG. **1**. As can be seen in FIG. **12**, the extended side retaining wall portion **58** extends from the remaining portion of side wall **56** so as to form a projection or ledge. Preferably, the height H2 of the side wall **56** including the extended side retaining wall portion **58** is less than the height H1 of the end wall (H2<H1).

As will be understood, the extended side retaining wall outer portion **58** provides for improved containment of the soft silicone material within the package. The extended side retaining wall portion **58** also provides for improved coverage of the wire wrapped solder posts **60**. In addition, since the height H2 of the extended side retaining wall portion **58** is less than the height H1 of the safe guard **54**, the mounting of the package **50** onto a printed circuit board with the extended side retaining wall portion **58** allows for cleaning of the PCB with wash liquids which can flow freely under the package **50** under the portion of the extended side wall portion **58** which is less in height than the height of the safeguard (H2<H1).

FIG. **13** shows a bottom view of the package **50** of FIG. **12**, in which the side retaining wall portion **58** is located between the respective safeguards (end walls) **54**. The bottom of each terminal pin **60** can also be seen, as well as the leads **62**. For clarity purposes, the bottom view of the package shown in FIG. **13** does not include the toroid transformers and silicone material shown in FIGS. **5,6** and **9-D**. However, a complete electronic surface mount package **50** according to the present invention would include the toroid transformers and a soft silicone material.

FIG. **14** shows a more detailed three dimensional view of the electronic surface mount package **50** with extended side retaining wall portion **58** according to the present invention. The package **50** shown in FIG. **14** includes the side wall **56** with the extended side retaining wall portion **58**, terminal posts **60**, leads **62**, end wall **52** which forms safeguard **54**, and soft silicone material **66**. It can be seen in FIG. **14** that the extended side retaining wall portion **66** provides additional coverage of the soft silicone material **66** as well as more coverage of the posts **60**. Also, because the height H2 of the side wall **56** is less than the height H1 of the end wall (safeguard) **52**, the mounting of the package **50** onto a printed circuit board with the extended side retaining wall portion **58** allows for cleaning of the PCB with wash liquids which can flow freely under the package **50** under the portion of the extended side wall portion **58** which is less in height than the height of the safeguard (H2<H1).

FIG. **15** shows a cross sectional end view of the electronic surface mount package **50** with extended side retaining wall portion **58** according to the present invention. The package **50** shown in FIG. **15** includes the toroid transformer **70** carried by the soft silicone material **66**, safeguard **54**, lead **62**, side wall **56** including the extended side retaining wall portion **58** and the terminal post **60** with wire **74** wrapped thereon and soldered by solder joint **72**. It can be seen in FIG. **15** that the side wall **56** including the extended side retaining wall portion **58** has a height H2 which is less than the height Hi of the safe guard (end wall) **54**. As previously described, the end walls **52** have a first height Hi to form a standoff or safe guard **54** between the foot seating plane of the package **50** and the terminal posts **60**, and the outer portion **58** of the side wall **56** extends between the end walls **52** such that the side wall **56** has a second height H2 which is less than said first height Hi. The mounting of the package **50** onto a printed circuit board (PCB) with the extended side retaining wall portion **58** according to the present invention allows for cleaning of the PCB with wash liquids which can flow freely under the package **50** under the portion of the extended side wall **58**, since the height of the extended side retaining wall (H2) is less than the height of the safeguard H1 (H2<H1). As also previously described, the extended

side retaining wall **58** provides for improved containment or coverage of the soft silicone material **66** within the package **50**. The extended side retaining wall portion **58** also provides for improved coverage of the wire wrapped solder posts **60**.

FIG. **16** shows a close up view of one terminal post **60** contained within the electronic surface mount package **50** with extended side retaining wall portion **58** according to the present invention FIG. **16** shows the terminal post **60** with wire **74** wrapped thereon. FIG. **16** clearly shows the improved extended coverage of the soldered terminal posts **60** by the extended side retaining wall portion **58** according to the present invention.

The present invention is directed toward applications for packages mounted on a printed circuit board in an electronic device, which requires very low current and voltages, and is for DC voltages only. The present invention provides for a low power application in which the package includes one or more toroidal transformers which are carried or supported by a soft silicone material within an open construction package and which utilizes a portion of the case as a standoff to ensure that the pin-posts do not touch a PCB when mounted by a user.

It is widely known that when the toroidal magnetics are mounted in hard plastic packages, the infra-red soldering processes cause the magnetic components (ferrite) to expand significantly. When using a hard epoxy type material, it has been found that the magnetic component expansion can often cause cracking of the package or case, which is highly undesirable. The present invention solves this problem by providing an open design within which is placed a soft silicone material which allows for expansion during the soldering process, rather than contain the components within a closed case or package. Hence, with the open construction, the present invention has no bottom at all. In addition, the magnetic components are not mounted on anything but rather are encapsulated or supported ("carried by a soft silicone material") such that when the wires are wound around and soldered to the pin-posts, the cracking and expansion problems described above are avoided.

As has been described, the electronic surface mount package according to the present invention includes a one piece construction package having end walls, a side wall and an open bottom; a plurality of toroid transformers carried within the package by a soft silicone material wherein the toroid transformers each have wires wrapped thereon; a plurality of terminal pins molded within and extending from the bottom of the package wherein each of the pins extend through a bottom portion of the side wall and have a notched post upon which the wires from said transformers are wrapped and soldered thereon, respectively; and wherein the end walls have a first height H1 to form a standoff or safe guard between the foot seating plane of the package and the terminal pins; and wherein the outer portion of the side wall extends between the end walls such that the side wall has a second height H2 which is less than said first height H1.

The extended side retaining wall provides for improved containment of the soft. silicone material within the package. The extended side retaining wall also provides for improved coverage of the wire wrapped solder posts. In addition, since the height H2 of the extended side retaining wall is less than the height H1 of the safe guard, the mounting of the package onto a printed circuit board with the extended side retaining wall allows for cleaning of the PCB with wash liquids which can flow freely under the package under the portion of the extended side wall which is less in height than the height of the safeguard (H2<H1).

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and it should be understood that many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.

What is claimed is:

**1.** An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

a one piece construction package having end walls, a side wall and an open bottom,

a plurality of toroid transformers within said package by a soft silicone material, said toroid transformers each having wires wrapped thereon;

a plurality of terminal pins molded within and extending from the bottom of said package, each of said pins extending through a bottom portion of said side wall and below the inner portion of said side wall and having a notched solder post upon which said wires from said transformers are wrapped and soldered thereon, respectively;

said end walls having a first height Hi to form a standoff or safe guard between the surface of a printed circuit board and said terminal pins;

the outer portion of said side wall extending between said end walls and having a second height H2 which is less than said first height H1.

**2.** An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

a construction package having end walls, a side wall and an open bottom,

a plurality of toroid transformers within said package by a soft silicone material, said toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within and extending from the bottom of said package, each of said pins extending through a bottom portion of said side wall and below the inner portion of said side wall and having notched solder posts upon which said wires from said transformers are wrapped and soldered thereon, respectively;

said end walls having a first height H1 to form a standoff or safe guard between the surface of a printed circuit board and said terminal pins;

the outer portion of said side wall extending between said end walls and having a second height H2 which is less than said first height H1.

**3.** A package as in claim **2** wherein said construction package is one piece.

**4.** The package of claim **3** wherein said posts are separated from one another so as to avoid arcing.

**5.** An electronic surface mount package for mounting onto the surface of a printed circuit board in an electronic device, said electronic surface mount package comprising:

a one piece construction package having end walls, a side wall and an open bottom,

a plurality of toroid transformers within said package by a soft silicone material, said toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within and extending from the bottom of said package, each of said pins extending through a bottom portion of said side wall and below the inner portion of said side wall and having a notched solder post upon which said wires from said transformers are wrapped and soldered thereon, respectively,

said end walls having a first height H1 to form a standoff or safe guard between the surface of a printed circuit board and said terminal pins;

the outer portion of said side wall extending between said end walls and having a second height H2 which is less than said first height H1.

**6**. The package as in claim **5** further including a standoff for maintaining a distance between the bottom of said pins and said printed circuit board.

**7**. An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

a construction package having end walls, a side wall and an open bottom,

at least one toroid transformer within said package by a soft silicone material, said toroid transformer having a wire wrapped thereon,

at least one terminal pin molded within and extending from the bottom of said package, said pin extending through a bottom portion of said side wall and below the inner portion of said side wall and having a notched solder post upon which said wire from said transformer is wrapped and soldered thereon,

said end walls having a first height H1 to form a standoff or safe guard between the surface of a printed circuit board and said terminal pins;

the outer portion of said side wall extending between said end walls and having a second height H2 which is less than said first height H1.

**8**. An electronic surface mount package for mounting onto the surface of a printed circuit board in an electronic device, said package comprising:

a one piece open construction package having end walls, side walls and an open bottom,

a plurality of toroid transformers within said package, said toroid transformers each having a side wall and wires wound thereon,

a plurality of terminal pins molded within and extending through a bottom of said side wall and below the inner portion of said side wall, each of said pins having a hour-glass shaped notched solder post upon which said wires from said transformers are wrapped thereon, respectively,

said end walls having a first height Hi to form a standoff or safe guard between the surface of a printed circuit board and said terminal pins;

the outer portion of said side wall extending between said end walls and having a second height H2 which is less than said first height H1.

* * * * *

# EXHIBIT E

US006344785B1

(12) **United States Patent**
**Lu et al.**

(10) **Patent No.: US 6,344,785 B1**
(45) **Date of Patent: *Feb. 5, 2002**

(54) **ELECTRONIC SURFACE MOUNT PACKAGE**

(75) Inventors: **Peter Lu**, Flower Mound, TX (US); **Jeffrey Heaton**, Cupertino; **James W. Heaton**, Los Altos, both of CA (US); **Peter Loh Hang Pao**, Kowloon (HK); **Robert Loke Hang Lam**, Wonderland Villas (HK); **Tsang Kei Sun**, Kowloon (HK)

(73) Assignee: **Halo Electronics, Inc.**, Redwood City, CA (US)

( * ) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **08/906,952**

(22) Filed: **Aug. 6, 1997**

**Related U.S. Application Data**

(63) Continuation of application No. 08/513,573, filed on Aug. 10, 1995, now Pat. No. 5,656,985.

(51) **Int. Cl.**[7] ..... **H01F 27/02**
(52) **U.S. Cl.** ..... **336/96**; 336/90; 336/192
(58) **Field of Search** ..... 336/192, 229, 336/65, 96, 90; 174/52.4, 50; 361/821, 752

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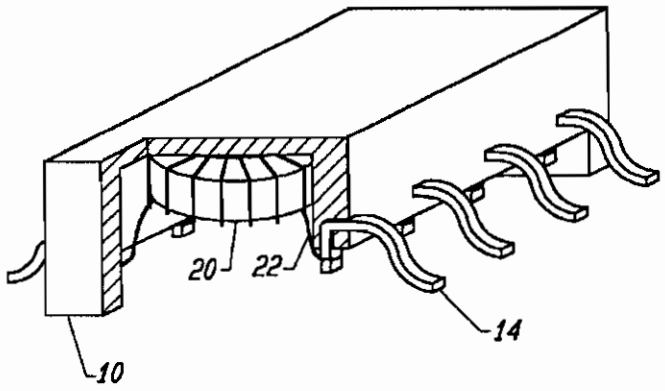
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*Primary Examiner*—Anh Mai
(74) *Attorney, Agent, or Firm*—Stephen E. Baldwin

(57) **ABSTRACT**

An electronic surface mount package provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so their respective wires are separate from one another so as to prevent arcing. The case is opened at the bottom which prevents harm from expansion or cracking.

**34 Claims, 5 Drawing Sheets**



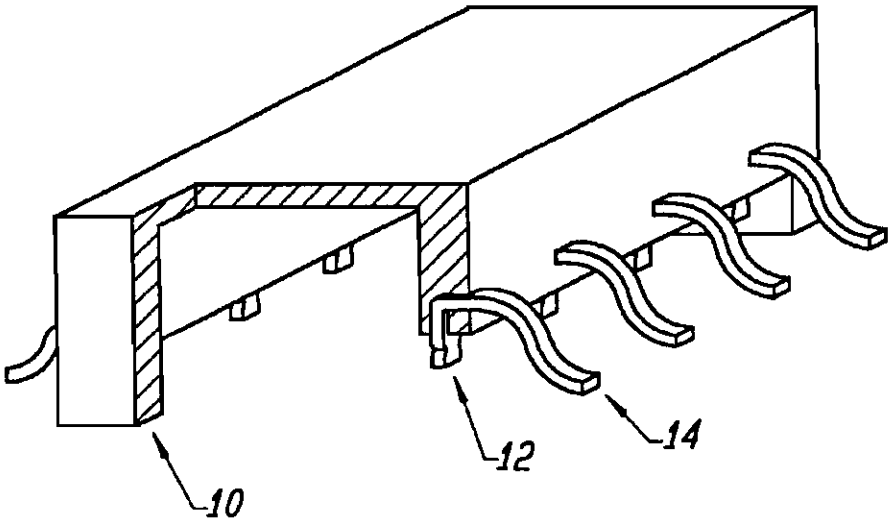



FIG. 1

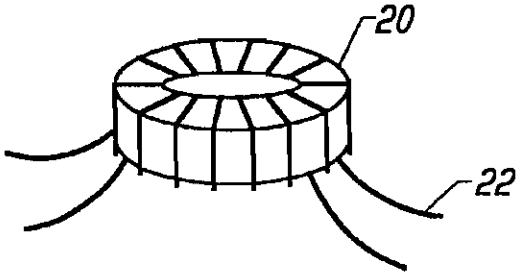



FIG. 2

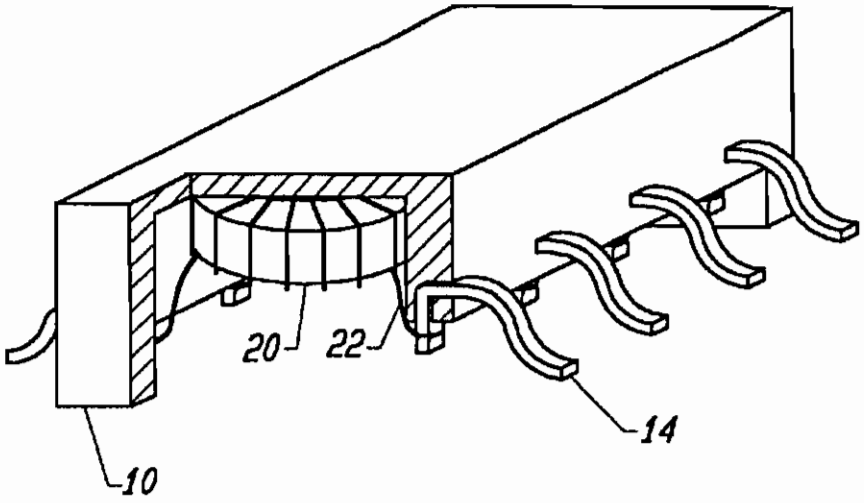



FIG. 3

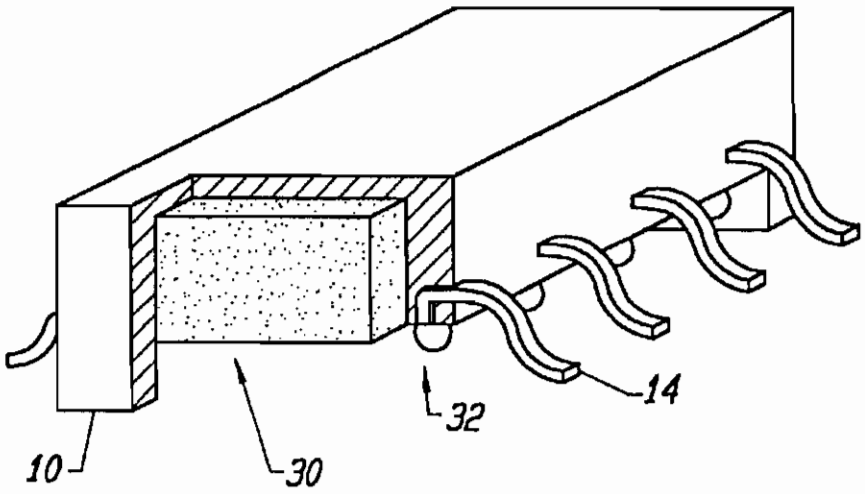



FIG. 4

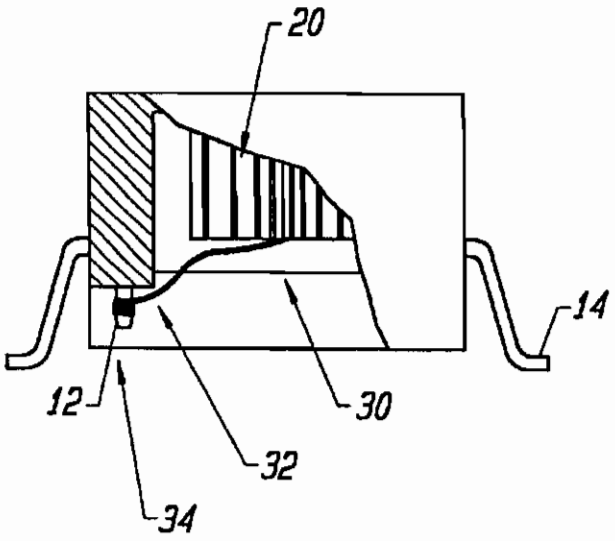



FIG. 5

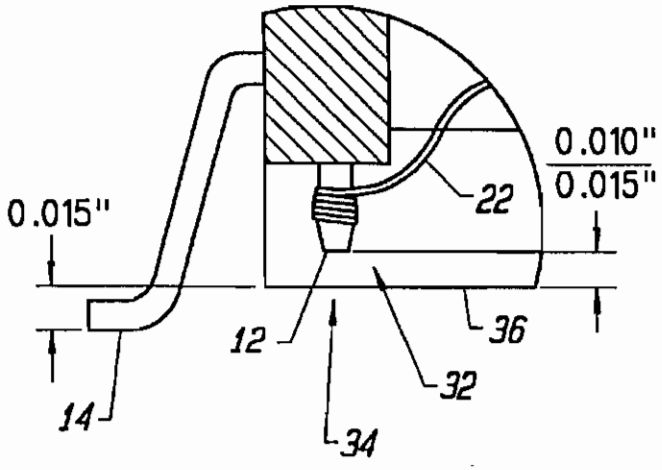



FIG. 6

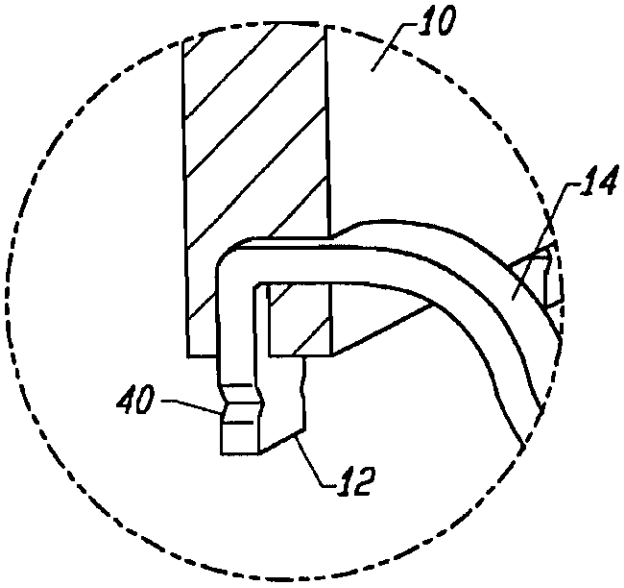



FIG. 7

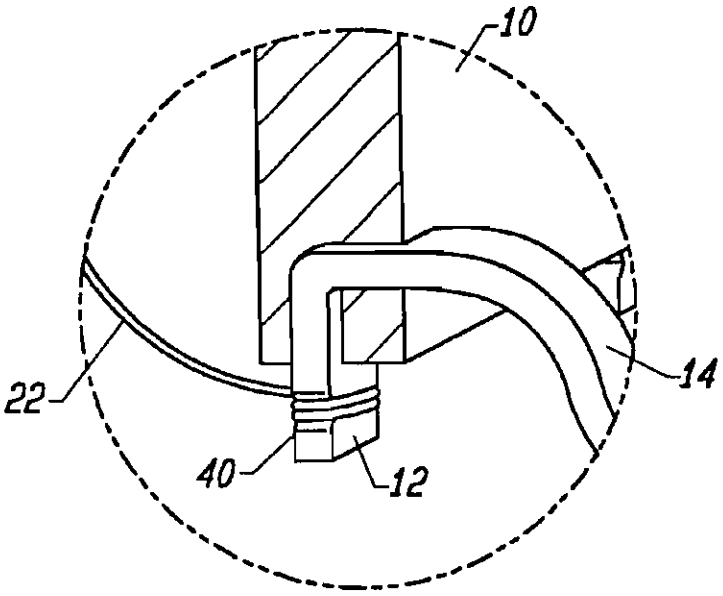



FIG. 8

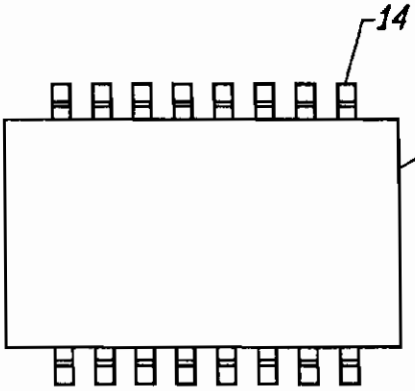



FIG. 9B

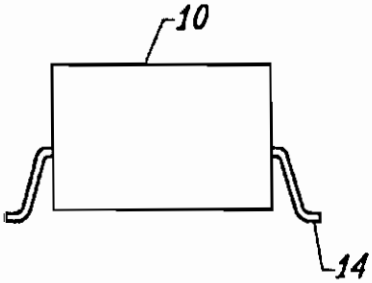



FIG. 9A

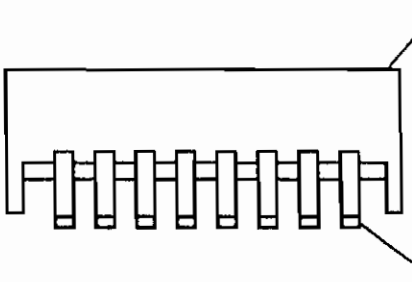



FIG. 9C

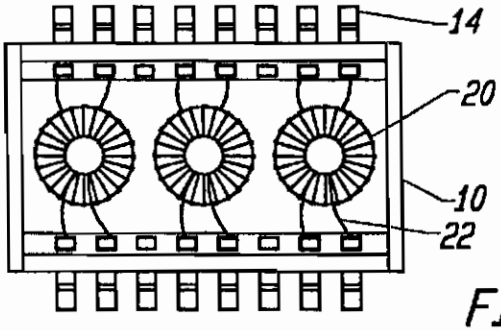



FIG. 9D

# ELECTRONIC SURFACE MOUNT PACKAGE

This application is a continuation of Ser. No. 08/513,573 filed on Aug. 10, 1995 U.S. Pat. No. 5,656,985

## BACKGROUND OF THE INVENTION

The present invention relates to an electronic surface mount package or case. Electronic surface mount packages are utilized in applications in which one or more individual toroid transformers are embodied within the surface mount package.

Wires coming off the transformers are electronically tied to pins on the package for connection to an electronic device. Typically, the electronic surface mount packages are mounted on a printed circuit board for utilization in the electronic device.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved electronic surface mount package.

Briefly, according to one preferred embodiment, the present invention provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so that the respective wires are separated from one another so as to avoid arcing. The case is open at the bottom which prevents harm from expansion or cracking.

Other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

FIG. **1** shows an electronic surface mount package in three-dimensional view according to the present invention.

FIG. **2** shows a wound toroid transformer.

FIG. **3** shows the connection of the toroid transformer of FIG. **2** within the electronic surface mount package of FIG. **1**.

FIG. **4** shows the electronic surface mount package of FIG. **1** after wire terminations have been soldered.

FIGS. **5** and **6** show relationships between a safeguard (standoff) and the electronic surface-mount package's foot seating plane and inner terminal posts, respectively.

FIG. **7** shows a close-up of the pin configuration of FIG. **1** and how it is molded inside the wall of the body of the package.

FIG. **8** shows wire wrapped around the pin or post of FIG. **7**.

FIGS. **9A–9D** show end, top, side, and bottom views of electronic surface mount package according to the present invention.

## DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, where like numerals



indicate like components. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to those embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

FIG. **1** shows an electronic surface mount transformer package or case **10** in three-dimensional view. FIG. **1** shows a cut-away of the generally rectangular empty case **10** with pins **14** molded into the case **10**, together with notched post **12** upon which a wire is wound. Typically, tin-Lead plated copper alloy terminals are molded into the wall of the package **10**. The outer portion of the package **10** is formed to meet specified footing requirements. The inner post **12** serves as a terminal for internal wire termination use. The package material is made of a type of thermal plastic which is in compliance with UL V-94 requirement for flammability.

FIG. **2** shows a wound toroid transformer **20** with wire **22** wrapped around the transformer **20**. The toroid core is typically made of ferrite or iron material and the winding of wire **22** is done manually with fine insulated magnet wire.

FIG. **3** shows a cut-away of the molded part with the toroid **20** mounted inside and showing the wire **22** as it is then attached to post **14**. The wires **22** are pulled with minimum tension and wrapped around the terminal post **14** for two to two and a half turns. This operation is done when the case has been placed bottom side up.

FIG. **4** shows a silicon compound **30** poured inside the cavity with wire terminations that have been soldered with high temperature solder (95 Ag/5 Sn) **32** and the package has been properly cleaned. The case **10** is then filled with soft silicone material to protect the transformer and to meet environmental requirements.

FIGS. **5** and **6** show the relationships between the safe guard (stand off) **34** and package's foot seating plane and inner terminal posts **12***a*. FIG. **5** shows the standoff **34**, in which the parts typically are placed automatically by machine onto a PC board. They are pressed down, as it is desirable to have some limitation of how far they can be pressed. It is also desirable that the post **12** does not touch the PC board, and so the end standoffs **34** do not allow that to happen.

FIG. **6** shows the distance in relationship between the end of the post **12** and where the PC board **36** is located and also where the standoff **34** ends. The PC board **36** would be at the base of the foot.

In FIG. **6**, the typical clearance of 0.015 inches from the safe guard **34** to the seating plane is to avoid interferenee to the coplanarity of the package. There is also a gap between the safe guard **34** and terminal post **12** to prevent the solder joints from touching the circuit hoard due to an over forced pick and place operation.

Inside the package **10**, there may be two, three, or more individual toroidal transformers. Wires coming off of the transformers are connected to the outside world. For example, the pins may be mounted on a printed circuit board in an electronic device. The lead frame pins are injection molded and the shape of the post upon which the wire is wound from the toroidal transformer is notcbed. This allows for the wires to be separated from pin to pin, and for soldering to be much more efficient.

FIG. **7** shows a closeup of the pin **12** and how pin **12** is molded inside the wall of the body and also the notch effect **40** of the pin **12**. The post **14** is notched so that the wires are kept away from one another (post to post) which is very desirable. The separation is desirable so as to avoid arcing.

FIG. 8 shows the wire 22 wrapped around the pin or post 12.

FIGS. 9A–9D show end, top, side, and bottom views, respectively, of the electronic surface mount package 10. The embodiment shown in FIGS. 9A–9D provide an industrial standard surface mount footprint and package dimensions which are auto pick and placeable. In addition, special design consideration has been applied to thermal expansion of materials to ensure that the package will stand all normal reflow processes with low cost, easy manufacturing, and high reliability.

In the industry, many manufacturers have used a two-piece construction, a base and a cover, and the case is backfilled with epoxy. In some processes, the coefficients of expansion of the epoxy that has been backfilled, plus the toroid itself, tend to cause the two pieces to separate. The base separates from the top, and as a result, it can end up cracking. The present invention provides a one-piece construction (an open bottom) only with the silicon filling to protect the toroid. The case is open at the bottom, thus allowing for nothing to expand or crack.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and it should be understood that many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

What is claimed is:

1. An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

a side wall with a bottom end,

a plurality of toroid transformers within the package, the toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within the side wall, each of the pins extending through the side wall and having a solder post with an end upon which the wires from the transformers are respectively wrapped and soldered thereon, each of the post ends extending beyond the bottom end of the side wall.

2. The package of claim 1 wherein the plurality of toroid transformers are carried within the package by a soft silicone material.

3. The package of claim 1 wherein the side wall has an exterior surface which defines the periphery of the package and each of the solder post ends extends from within the periphery of the package and beyond the bottom of the side wall.

4. The package of claim 1 wherein the side wall defines an interior space within the package and each of the post ends extends from the interior space and beyond the bottom of the side wall.

5. The package of claim 4 wherein each of the solder post ends extends from within the periphery in a direction parallel to the side wall.

6. The package of claim 1 wherein the construction package is one piece.

7. The package of claim 1 wherein each of the pins has a notch near the post end upon which the wires from the transformers are wrapped.

8. The package of claim 1 wherein the posts are separated from one another so as to avoid arcing.

9. An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

a side wall and a standoff, the standoff defining a foot seating plane for the surface mount of the package, the side wall having a bottom end with an elevation higher than the standoff so as to be above and beyond the foot seating plane;

a plurality of toroid transformers within the package, the toroid transformers each having wires wrapped thereon,

a plurality of terminal pins molded within the package, each of the pins having a solder post with an end upon which the wires from the transformers are respectively wrapped and soldered thereon, the solder post ends extending beyond the bottom end of the side wall to a position above the foot seating plane.

10. The package of claim 9 wherein each of the pins has a notch near the post end upon which the wires from the transformers are wrapped.

11. The package of claim 9 wherein the construction package is one piece.

12. The package of claim 9 wherein the construction package has an open bottom.

13. The package of claim 9 wherein the posts are separated from one another so as to avoid arcing.

14. The package of claim 9 wherein the side wall defines an interior space within the package and each of the post ends extends from the interior space and beyond the bottom of the side wall.

15. The package of claim 14 wherein each of the post ends extends from within the periphery in a direction parallel to the side wall.

16. The package of claim 9 wherein the plurality of toroid transformers are within the package and secured by a soft silicone material.

17. The package of claim 9 wherein the standoff is a pair of end walls with the side wall extending on opposing sides therebetween.

18. An electronic surface mount package for mounting onto the surface of a circuit board, the package comprising:

a side wall having a bottom end;

a standoff for surface mounting the package to the circuit board;

a gap between the bottom end of the side wall and the standoff;

a plurality of toroid transformers within the package, the toroid transformers each having wire wrapped thereon,

a plurality of terminal pins molded within the package, each of the pins having a solder post with an end upon which the wires from the transformers are respectively wrapped and soldered thereon, each of the solder post ends extending into and terminating within the gap.

19. The package of claim 18 wherein the standoff is a pair of end walls with the side wall extending on opposing sides therebetween.

20. The package of claim 18 wherein the construction package is one piece.

21. The package of claim 18 wherein the construction package has an open bottom.

22. The package of claim 18 wherein the posts are separated from one another so as to avoid arcing.

23. The package of claim 18 wherein the side wall defines an interior space within the package and each of the post ends extends from the interior space and beyond the bottom of the side wall.

24. The package of claim 23 wherein each of the post ends extends from within the periphery in a direction parallel to the side wall.

25. The package of claim 18 wherein the plurality of toroid transformers are within the package and secured by a soft silicone material.

26. An electronic surface mount package for mounting onto the surface of a printed circuit board comprising:

a one piece package having an open bottom and a side wall with a bottom end;

a plurality of toroid transformers each having wires wrapped thereon;

means for encapsulating the plurality of toroid transformers within the package;

a plurality of terminal pins molded within and extending from the bottom of the package, each of the pins extending through the side wall and having a solder post with an end upon which the wires from the transformers are respectively wrapped and soldered thereon.

27. The package of claim 26 wherein the standoff is a pair of end walls with tbe side wall extending on opposing sides therebetween.



28. The package of claim 26 wherein each of the post ends extends beyond the bottom end of the side wall.

29. The package of claim 26 wherein the carrying means includes encapsulating the plurality of toroid transformers within the package by a soft silicone material.

30. The package of claim 26 wherein the construction package is one piece.

31. The package of claim 26 wherein the posts are separated from one another so as to avoid arcing.

32. The package of claim 26 wherein the side wall defines an interior space within the package and each of the post ends extends from the interior space and beyond the hottom of the side wall.

33. The package of claim 32 wherein each of the post ends extends from within the peripbery in a direction parallel to the side wall.

34. The package of claim 26 wherein the package includes a standoff defining a foot seating plane for the surface mount of the package, the side wall having a bottom end with an elevation higher than the standoff so as to be above and beyond the foot seating plane, the post ends extending beyond the bottom end of the side wall to a position above the foot seating plane.

* * * * *

# EXHIBIT F

US006662431B1

(12) **United States Patent**
**Lu et al.**

(10) **Patent No.: US 6,662,431 B1**
(45) **Date of Patent: Dec. 16, 2003**

(54) **ELECTRONIC SURFACE MOUNT PACKAGE**

(75) Inventors: **Peter Lu**, Flower Mound, TX (US); **Jeffrey Heaton**, Cupertino, CA (US); **James W. Heaton**, Los Altos, CA (US); **Peter Loh Hang Pao**, Kowloon (HK); **Robert Loke Hang Lam**, Kowloon (HK); **Tsang Kei Sun**, Kowloon (HK)

(73) Assignee: **Halo Electronics, Inc.**, Mt. View, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/072,309**

(22) Filed: **Feb. 5, 2002**

**Related U.S. Application Data**

(63) Continuation of application No. 08/906,952, filed on Aug. 6, 1997, now Pat. No. 6,344,785.

(51) **Int. Cl.**[7] ..... **H01F 7/06**

(52) **U.S. Cl.** ..... **29/602.1**; 29/606; 336/192

(58) **Field of Search** ..... 336/192, 229, 336/65, 96; 29/602.1, 605, 606

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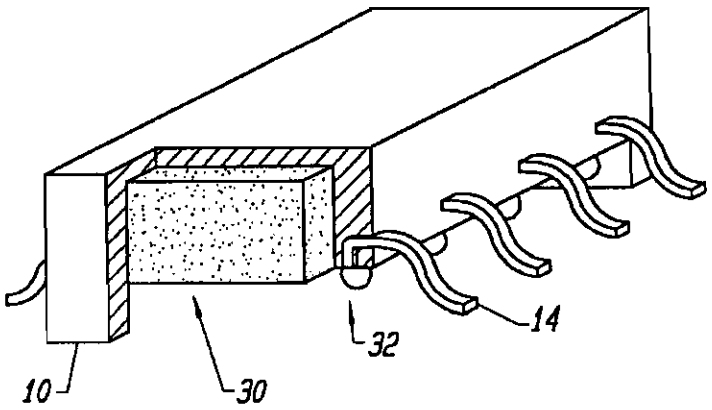
* cited by examiner

*Primary Examiner*—Anh Mai
(74) *Attorney, Agent, or Firm*—Stephen E. Baldwin

(57) **ABSTRACT**

An electronic surface mouut package provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so their respective wires are separate from one another so as to prevent arcing. The case is opened at the bottom which prevents harm from expansion or cracking.

**5 Claims, 5 Drawing Sheets**



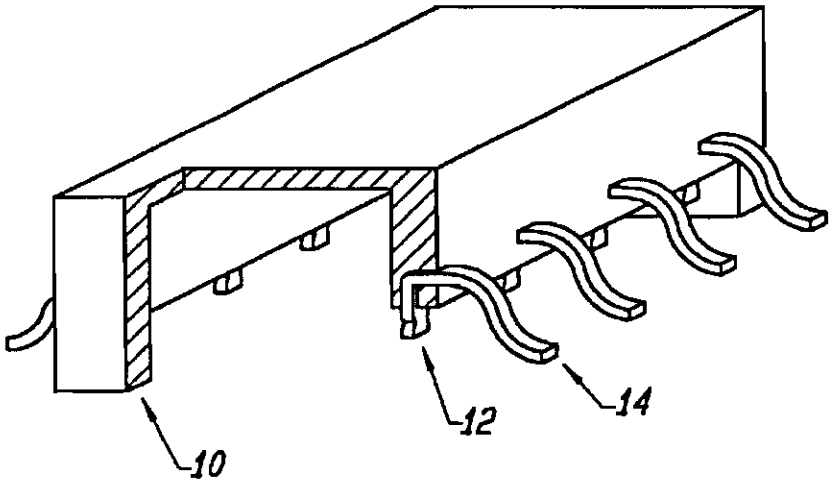



FIG. 1

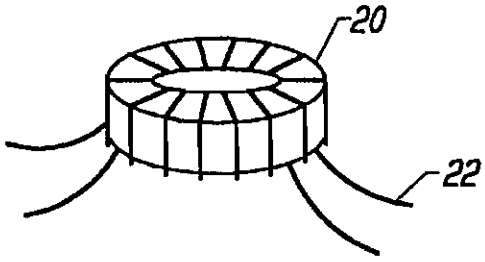



FIG. 2

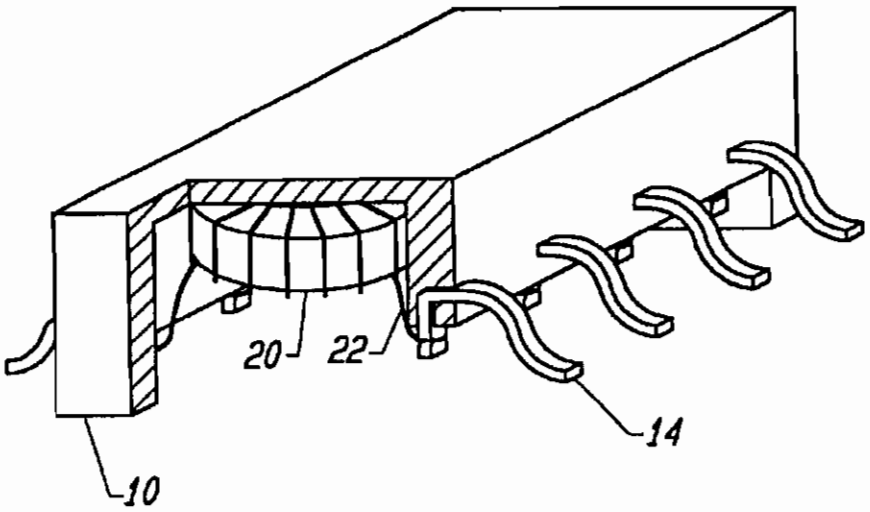



FIG. 3

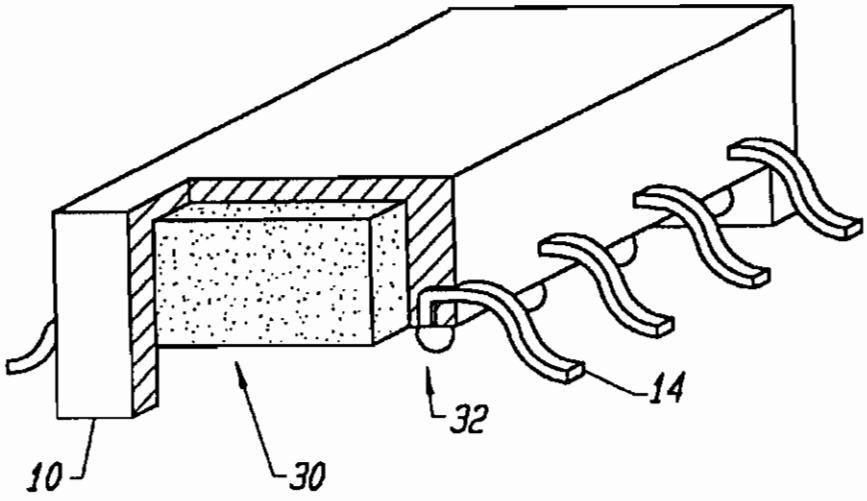



FIG. 4

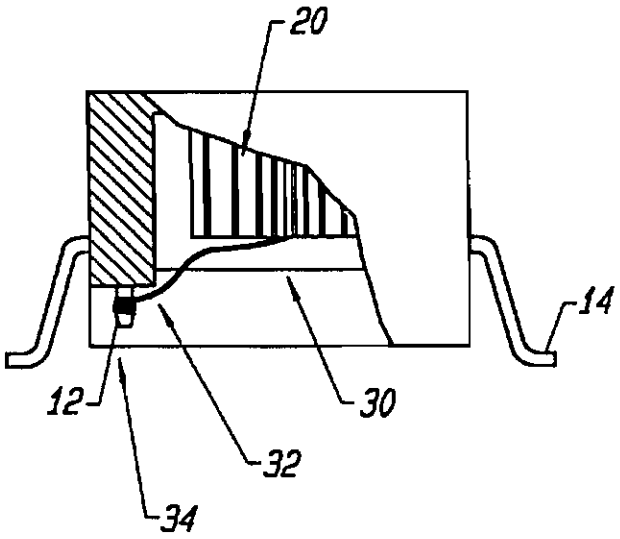



FIG. 5

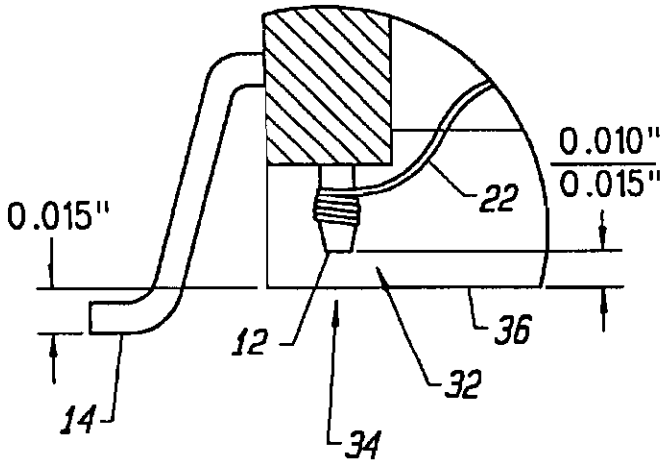



FIG. 6

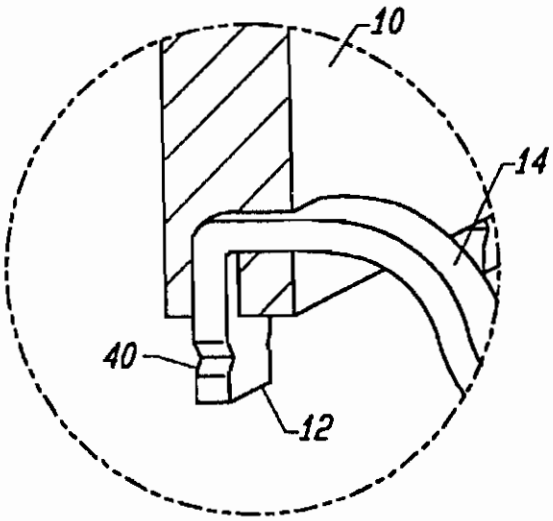



FIG. 7

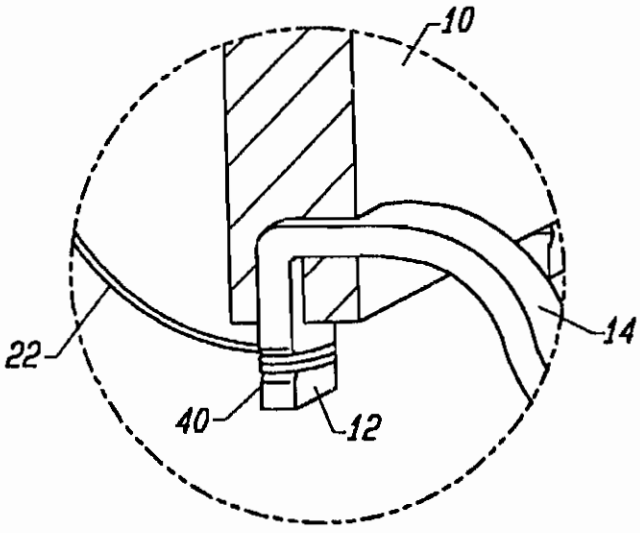



FIG. 8

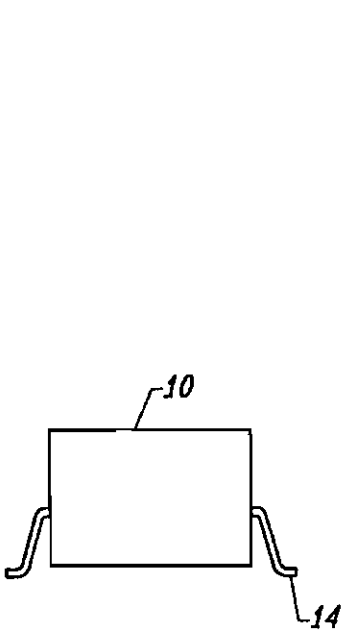



FIG. 9A

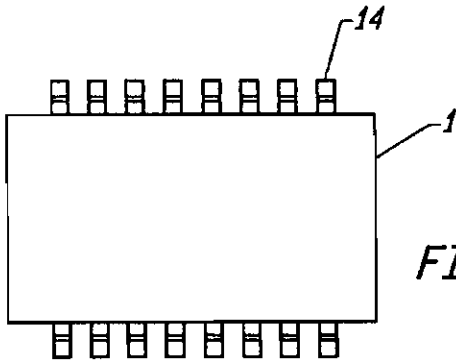



FIG. 9B

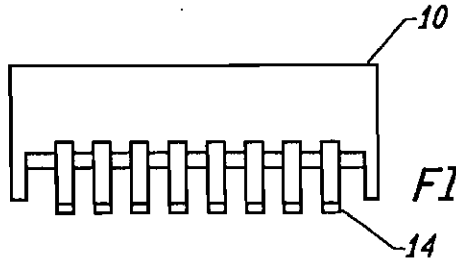



FIG. 9C

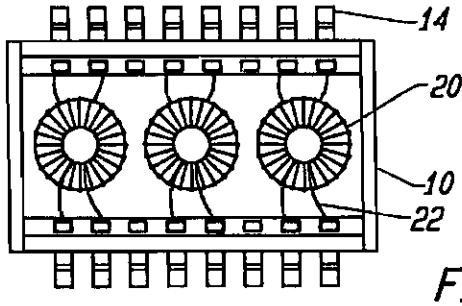



FIG. 9D

# ELECTRONIC SURFACE MOUNT PACKAGE

This is a continuation of Ser. No. 08/906,952, filed Aug. 6, 1997 now U.S. Pat. No. 6,344,785.

## BACKGROUND OF THE INVENTION

The present invention relates to an electronic surface mount package or case. Electronic surface mount packages are utilized in applications in which one or more individual toroid transformers are embodied within the surface mount package.

Wires coming off the transformers are electronically tied to pins on the package for connection to an electronic device. Typically, the electronic surface mount packages are mounted on a printed circuit board for utilization in the electronic device.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved electronic surface mount package.

Briefly, according to one preferred embodiment, the present invention provides a one piece construction package (with an open bottom) with one or more terminal pins molded into the package. Each of the pins have a notched post upon which a wire is wound which is from a toroid transformer carried within the package. Each of the posts are notched so that the respective wires are separated from one another so as to avoid arcing. The case is open at the bottom which prevents harm from expansion or cracking.

Other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention:

FIG. **1** shows an electronic surface mount package in three-dimensional view according to the present invention.

FIG. **2** shows a wound toroid transformer.

FIG. **3** shows the connection of the toroid transformer of FIG. **2** within the electronic surface mount package of FIG. **1**.

FIG. **4** shows the electronic surface mount package of FIG. **1** after wire terminations have been soldered.

FIG. **5** and **6** show relationships between a safeguard (standoff) and the electronic surface-mount package's foot seating plane and inner terminal posts, respectively.

FIG. **7** shows a close-up of the pin configuration of FIG. **1** and how it is molded inside the wall of the body of the package.

FIG. **8** shows wire wrapped around the pin or post of FIG. **7**.

FIGS. 9A–9D show end, top, side, and bottom views of electronic surface mount package according to the present invention.

## DETAILED DESCRIPTION OF THE DRAWINGS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings, where like numerals



indicate like components. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to those embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.

FIG. **1** shows an electronic surface mount transformer package or case **10** in three-dimensional view. FIG. **1** shows a cut-away of the generally rectangular empty case **10** with pins **14** molded into the case **10**, together with notched post **12** upon which a wire is wound. Typically, tin-Lead plated copper alloy terminals are molded into the wall of the package **10**. The outer portion of the package **10** is formed to meet specified footing requirements. The inner post **12** serves as a terminal for internal wire termination use. The package material is made of a type of thermal plastic which is in compliance with UL V-94 requirement for flammability.

FIG. **2** shows a wound toroid transformer **20** with wire **22** wrapped around the transformer **20**. The toroid core is typically made of ferrite or iron material and the winding of wire **22** is done manually with fine insulated magnet wire.

FIG. **3** shows a cut-away of the molded part with the toroid **20** mounted inside and showing the wire **22** as it is then attached to post **14**. The wires **22** are pulled with minimum tension and wrapped around the terminal post **14** for two to two and a half turns. This operation is done when the case has been placed bottom side up.

FIG. **4** shows a silicon compound **30** poured inside the cavity with wire terminations that have been soldered with high temperature solder (95 Ag/5Sn) **32** and the package has been properly cleaned. The case **10** is then filled with soft silicone material to protect the transformer and to meet environmental requirements.

FIGS. **5** and **6** show the relationships between the safe guard (stand off) **34** and package's foot seating plane and inner terminal posts **12***a*. FIG. **5** shows the standoff **34**, in which the parts typically are placed automatically by machine onto a PC board. They are pressed down, as,it is desirable to have some limitation of how far they can be pressed. It is also desirable that the post **12** does not touch the PC board, and so the end standoffs **34** do not allow that to happen.

FIG. **6** shows the distance in relationship between the end of the post **12** and where the PC board **36** is located and also where the standoff **34** ends. The PC board **36** would be at the base of the foot.

In FIG. **6**, the typical clearance of 0.015 inches from the safe guard **34** to the seating plane is to avoid interference to the coplanarity of the package. There is also a gap between the safe guard **34** and terminal post **12** to prevent the solder joints from touching the circuit board due to an over forced pick and place operation.

Inside the package **10**, there may be two, three, or more individual toroidal transformers. Wires coming off of the transformers are connected to the outside world. For example, the pins may be mounted on a printed circuit board in an electronic device. The lead frame pins are injection molded and the shape of the post upon which the wire is wound from the toroidal transformer is notched. This allows for the wires to be separated from pin to pin, and for soldering to be much more efficient.

FIG. **7** shows a closeup of the pin **12** and how pin **12** is molded inside the wall of the body and also the notch effect **40** of the pin **12**. The post **14** is notched so that the wires are kept away from one another (post to post) which is very desirable. The separation is desirable so as to avoid arcing.

FIG. **8** shows the wire **22** wrapped around the pin or post **12**.

FIGS. **9A–9D** show end, top, side, and bottom views, respectively, of the electronic surface mount package **10**. The embodiment shown in FIGS. **9A–9D** provide an industrial standard surface mount footprint and package: dimensions which are auto pick and placeable. In addition, special design consideration has been applied to thermal expansion of materials to ensure that the package will stand all normal reflow processes with low cost, easy manufacturing, and high reliability.

In the industry, many manufacturers have used a two-piece construction, a base and a cover, and the case is backfilled with epoxy. In some processes, the coefficients of expansion of the epoxy that has been backfilled, plus the toroid itself, tend to cause the two pieces to separate. The base separates from the top, and as a result, it can end up cracking. The present invention provides a one-piece construction (an open bottom) only with the silicon filling to protect the toroid. The case is open at the bottom, thus allowing for nothing to expand or crack.

The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and it should be understood that many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.



What is claimed is:

**1**. A method of making an electronic surface mount package, the method comprising the steps for:

forming a package having a side wall with a bottom end;

encapsulating a plurality of toroid transformers within the package with a resilient material;

molding a plurality of terminal pins within the side wall, each of the pins extending through the side wall and having a solder post end, each of the post ends extending beyond the bottom end of the side wall; and

wrapping and soldering the wires from the transformers to the solder post ends for each of the pins.

**2**. The method of claim **1** wherein the resilient material is a soft silicone material.

**3**. A method of making an electronic surface mount package, the method comprising the steps for:

molding a one piece construction package having a side wall with a bottom end and a plurality of terminal pins within and extending from the bottom of the package;

encapsulating and carrying a plurality of toroid transformers within the package; and

wrapping and soldering the wires from the transformers to an end of a solder post for each of the pins.

**4**. The method of claim **3** wherein the step for encapsulating and carrying the plurality of toroid transformers pours a resilient material into the package and subsequently sets the resilient material.

**5**. The method of claim **3** wherein the resilient material is a soft silicone material.

* * * * *