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(54) **PASSIVE ALTERABLE ELECTRICAL COMPONENT**

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***G06F 17/00*** (2006.01)
***H05K 3/00*** (2006.01)
***G06F 17/50*** (2006.01)

(52) **U.S. Cl.**
CPC ....... ***H05K 3/0005*** (2013.01); ***G06F 17/5072*** (2013.01); *H05K 2201/09963* (2013.01)

(58) **Field of Classification Search**
USPC ........................................................ 716/137
See application file for complete search history.

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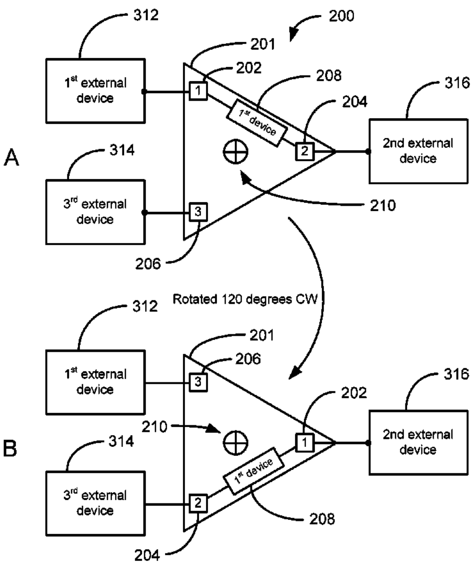
(74) *Attorney, Agent, or Firm* — Kenneth Altshuler

(57) **ABSTRACT**

A passive electrical component is described including a substrate, at least a first, second and third electrically conductive pad, each disposed on the substrate and at least a first electrical device fixedly attached to the first pad and the second pad. The first electrical device is electrically connected to the first and second pads. The third pad is devoid of electrical connection to either the first or the second pads. The component is recognizable by both a Computer Aided Design program and an automated component assembly machine.

**20 Claims, 12 Drawing Sheets**



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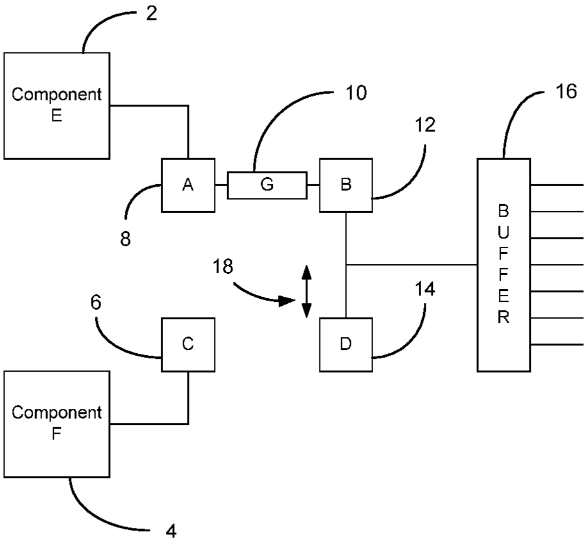


FIG. 1A *Prior Art*

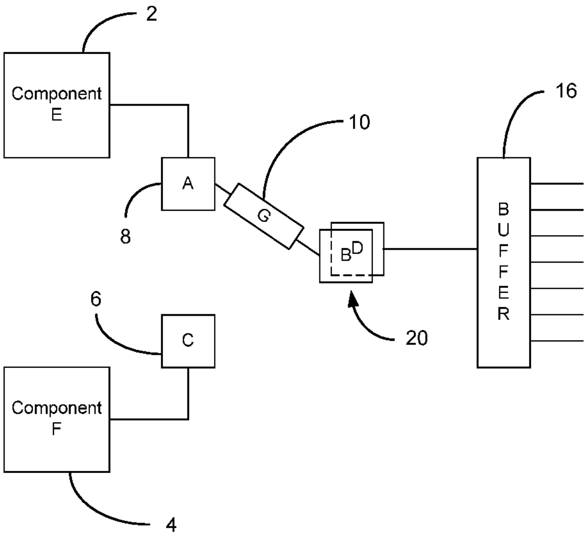


FIG. 1B *Prior Art*

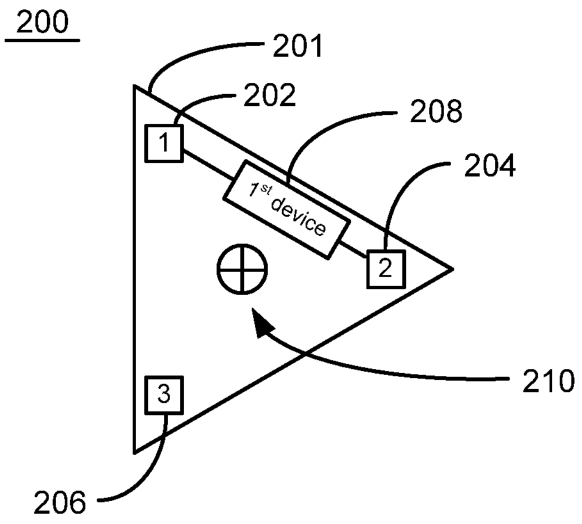

200
201
202
208
204
1
1st device
2
3
210
206

FIG. 2A

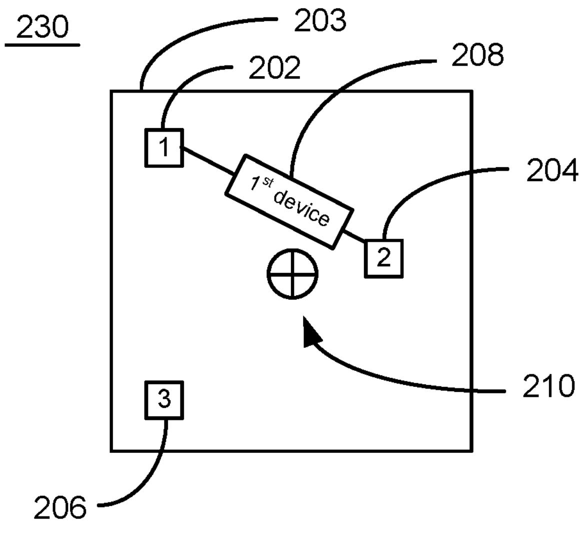

230
203
202
208
204
1
1st device
2
3
210
206

FIG. 2B

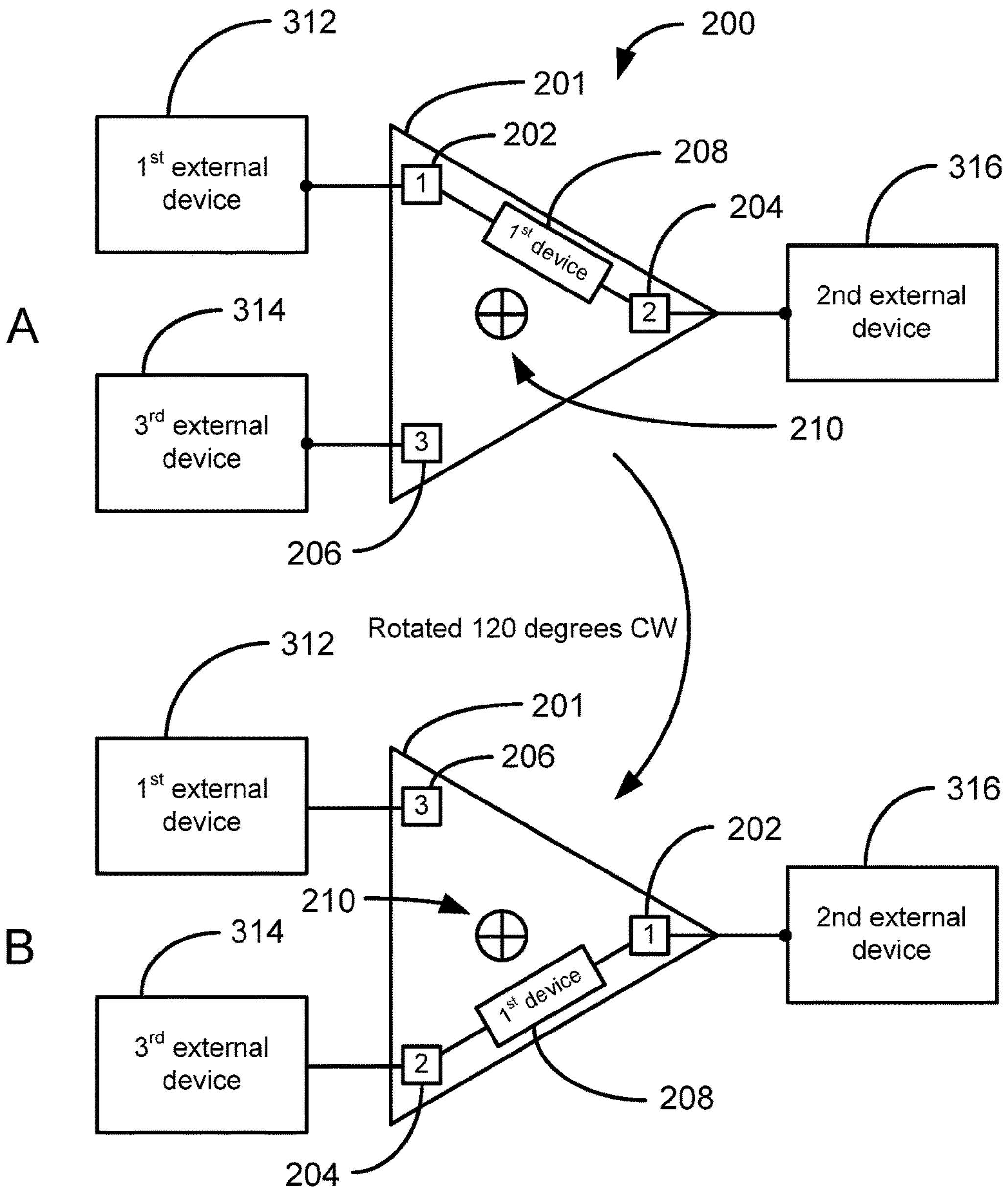

312
200
201
202
208
316
204
1st external device
1
1st device
2
2nd external device
A
314
3rd external device
3
210
206
Rotated 120 degrees CW
312
201
206
316
1st external device
3
202
2nd external device
210
1
B
314
1st device
3rd external device
2
208
204

FIG. 3A

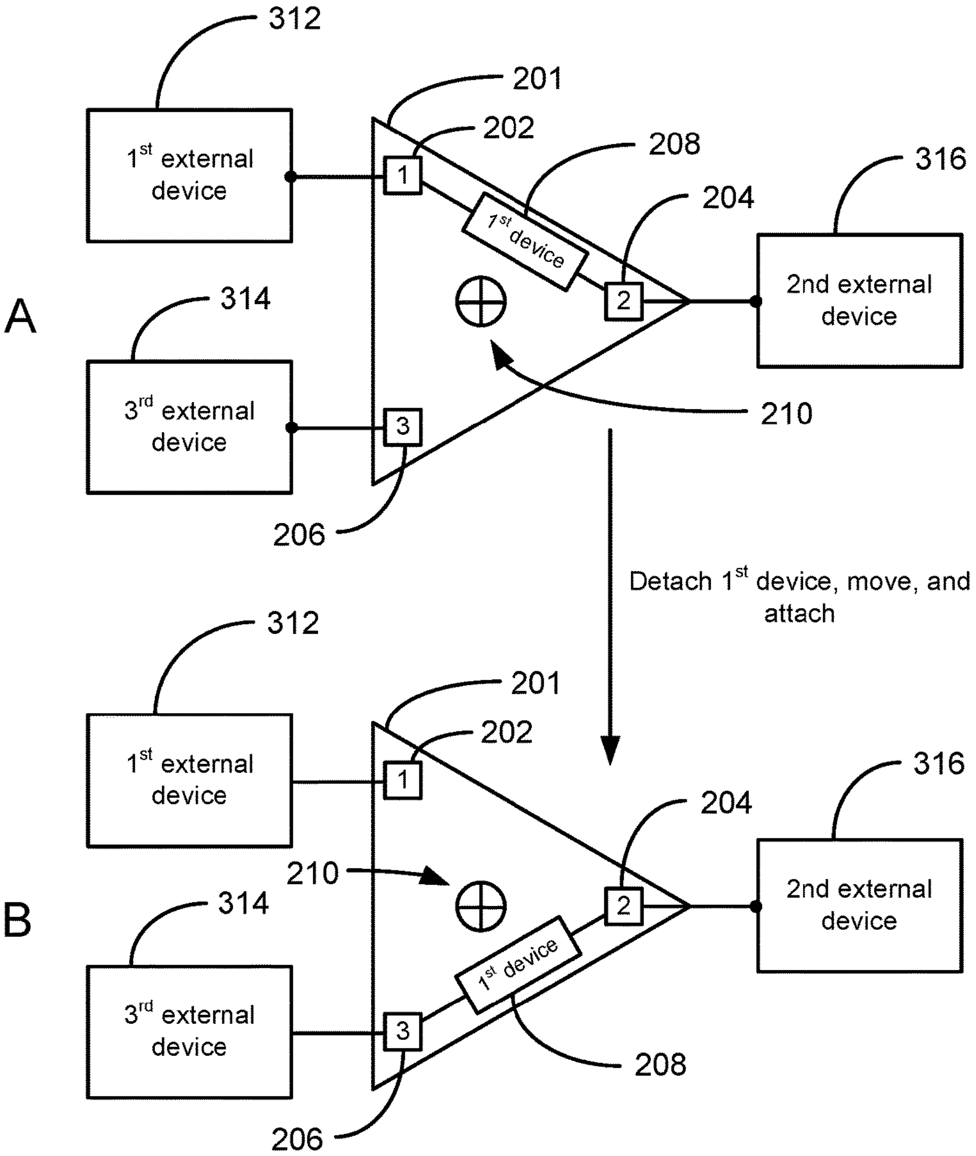

312
201
202
208
204
316
1st external device
1
1st device
2
2nd external device
A
314
3rd external device
3
210
206
Detach 1st device, move, and attach
312
201
202
1st external device
1
204
316
210
2
2nd external device
B
314
1st device
3rd external device
3
208
206

FIG. 3B

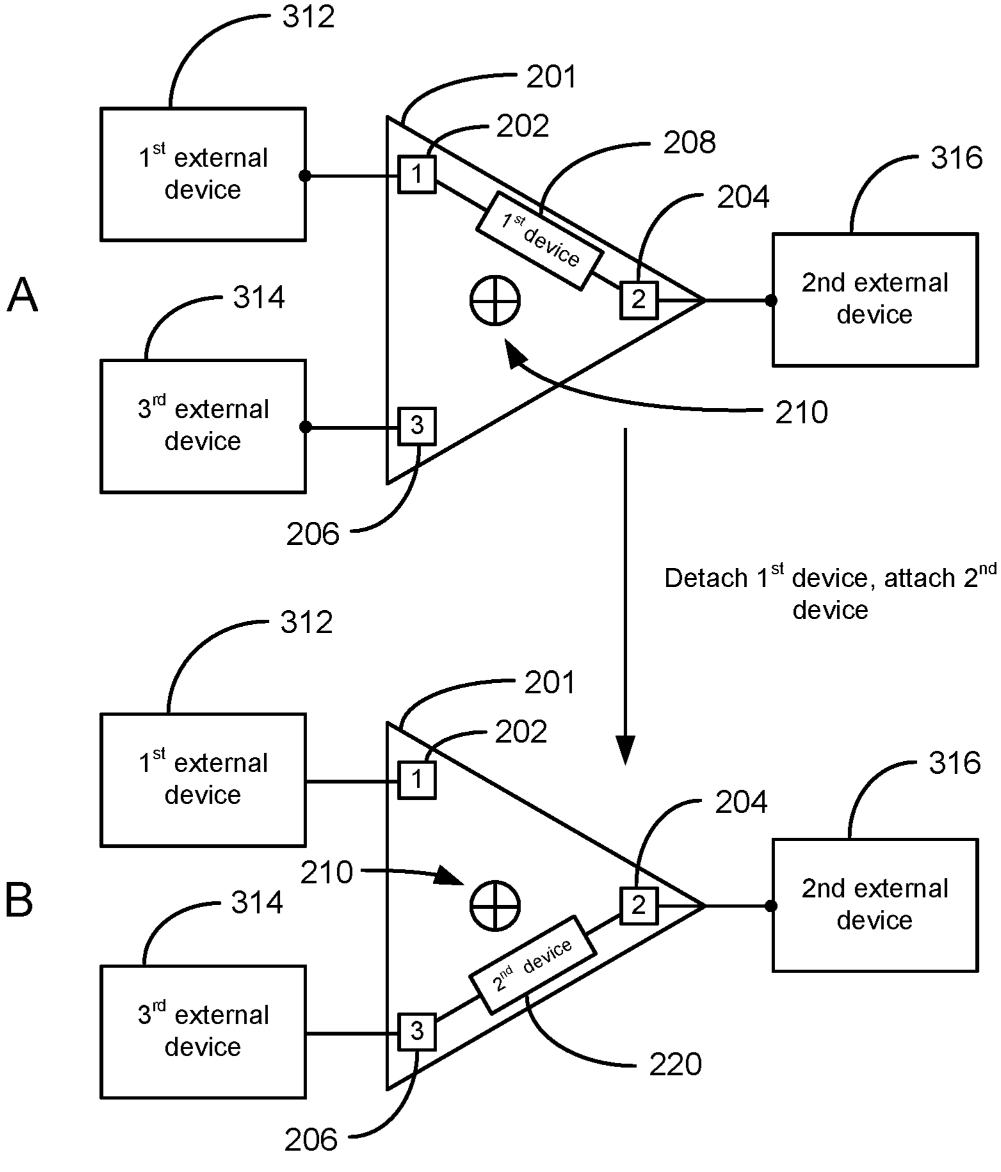

312
201
202
208
204
316
1st external device
1
1st device
2
2nd external device
A
314
3rd external device
3
210
206
Detach 1st device, attach 2nd device
312
201
202
1st external device
1
204
316
210
2
2nd external device
B
314
2nd device
3rd external device
3
220
206

FIG. 3C

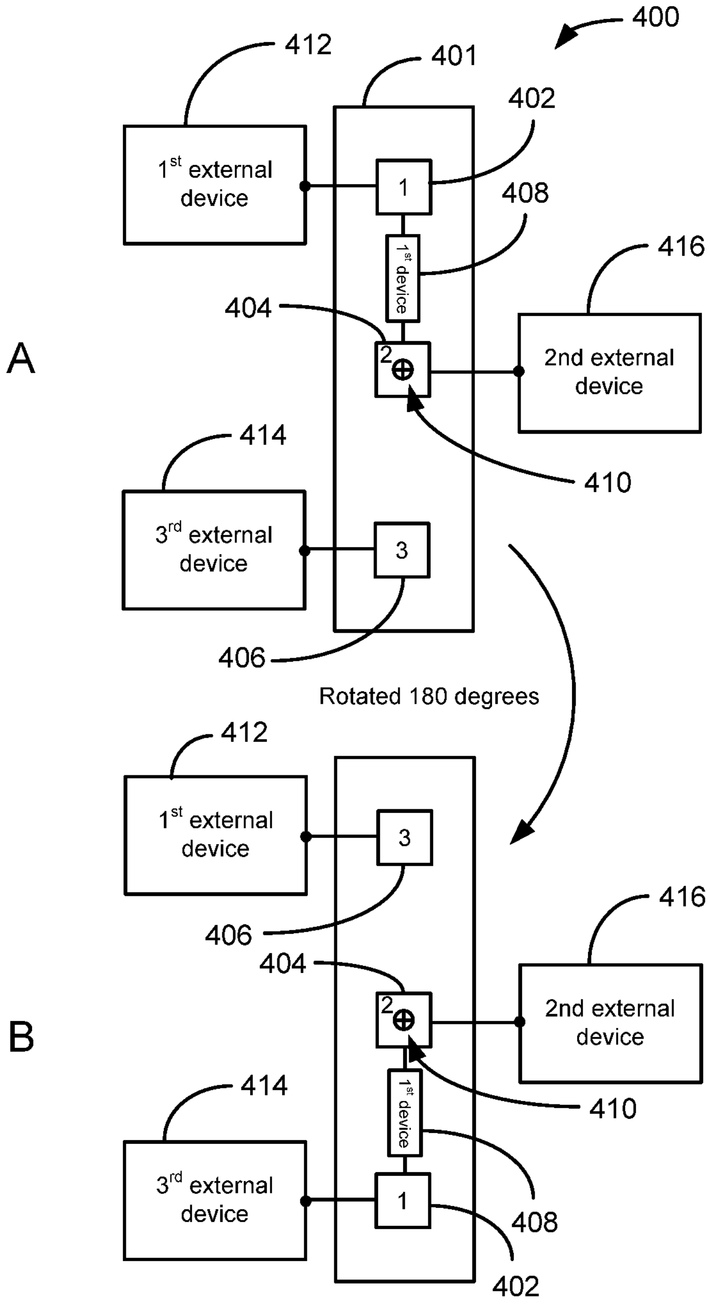

400
412
401
402
$1^{st}$ external device
1
408
$1^{st}$ device
416
404
A
2
2nd external device
410
414
$3^{rd}$ external device
3
406
Rotated 180 degrees
412
$1^{st}$ external device
3
416
406
404
2
2nd external device
B
410
414
$1^{st}$ device
$3^{rd}$ external device
408
1
402

FIG. 4

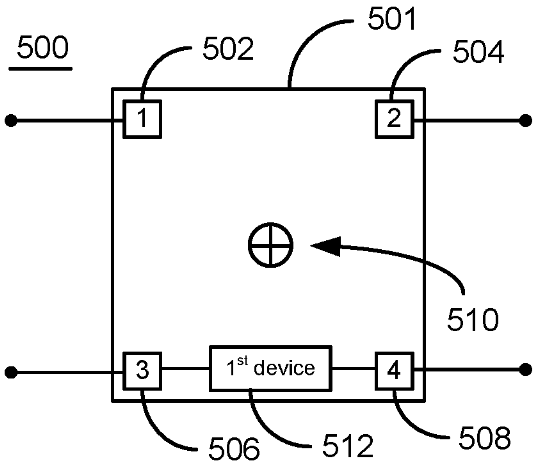

500
502
501
504
1
2
510
3
1st device
4
506
512
508

FIG. 5A

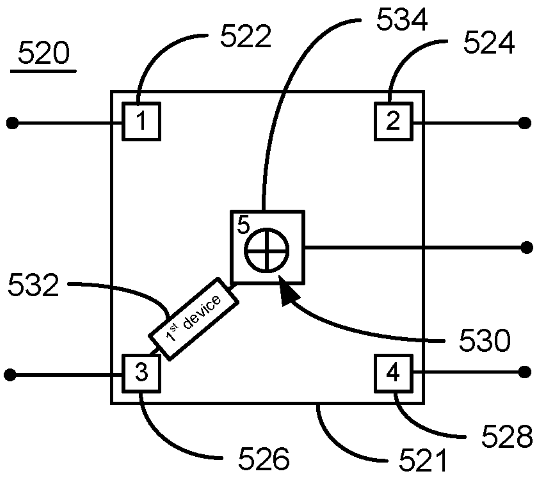

520
522
534
524
1
2
5
532
1st device
530
3
4
526
521
528

FIG. 5B

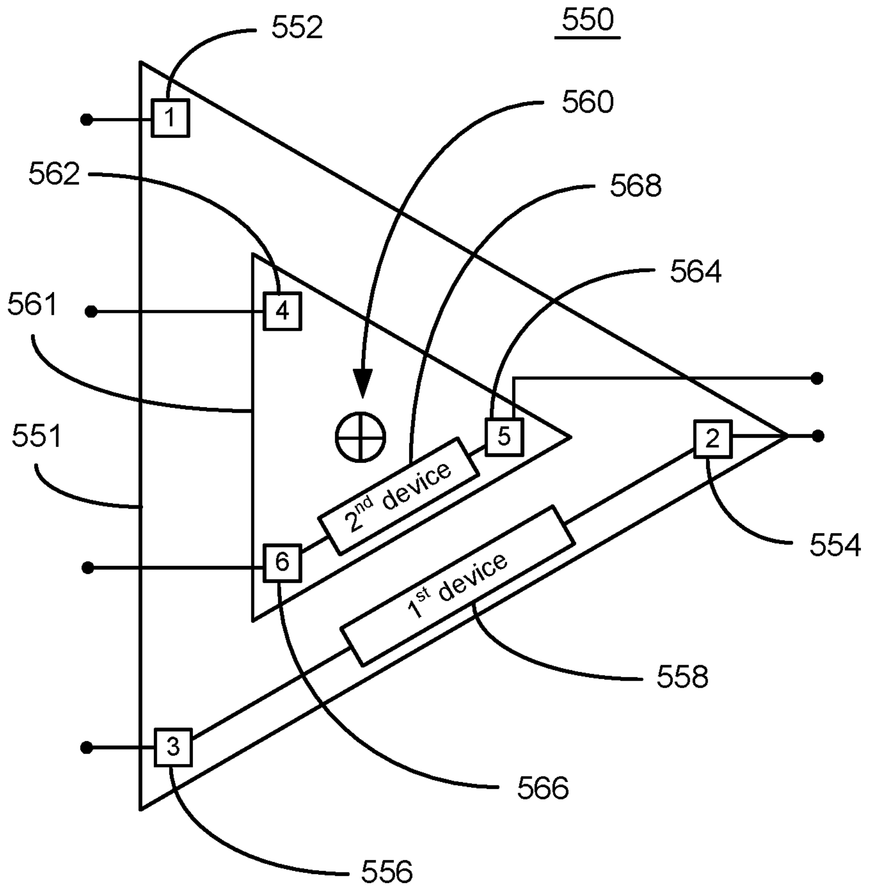

550
552
560
562
568
564
561
551
1
4
5
2
6
3
2nd device
1st device
554
558
566
556

FIG. 5C

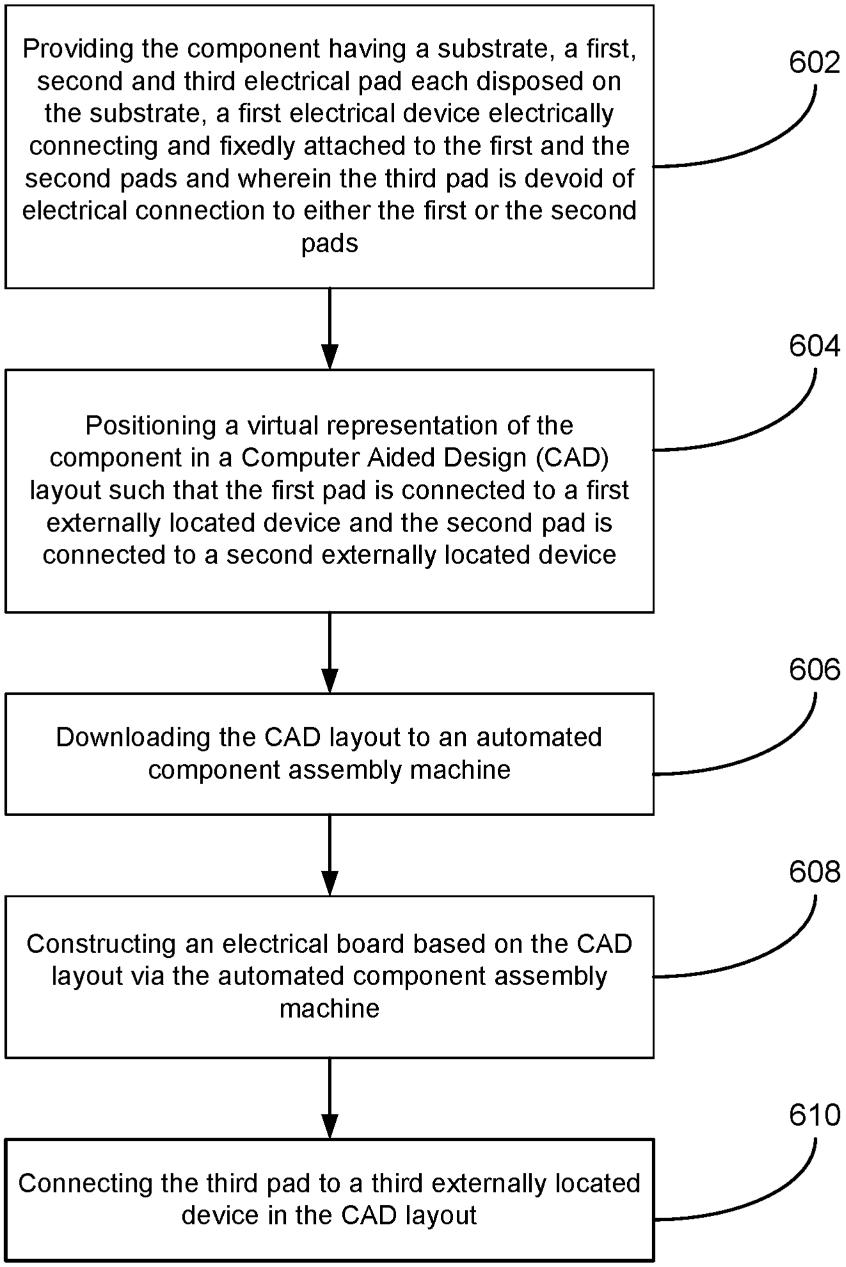
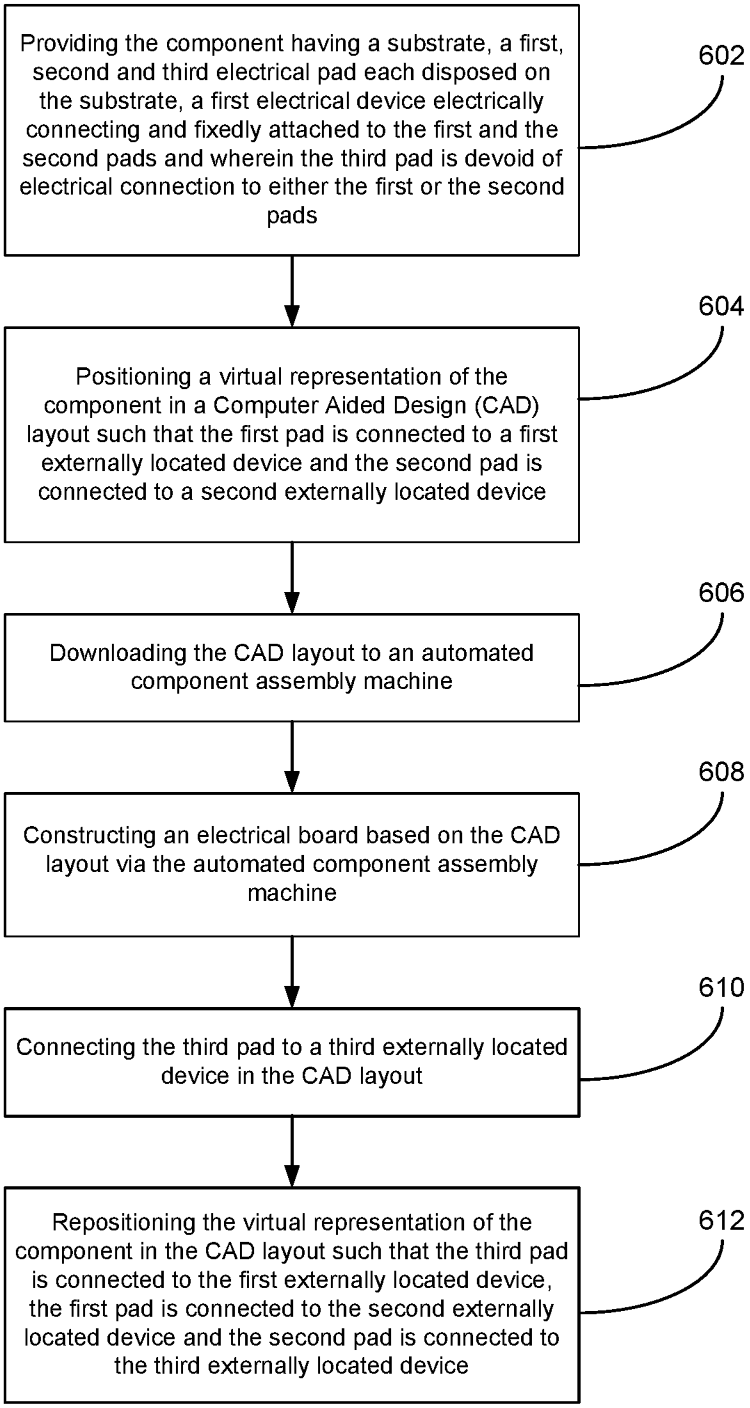

Providing the component having a substrate, a first, second and third electrical pad each disposed on the substrate, a first electrical device electrically connecting and fixedly attached to the first and the second pads and wherein the third pad is devoid of electrical connection to either the first or the second pads
602
Positioning a virtual representation of the component in a Computer Aided Design (CAD) layout such that the first pad is connected to a first externally located device and the second pad is connected to a second externally located device
604
Downloading the CAD layout to an automated component assembly machine
606
Constructing an electrical board based on the CAD layout via the automated component assembly machine
608
Connecting the third pad to a third externally located device in the CAD layout
610

FIG. 6A



Providing the component having a substrate, a first, second and third electrical pad each disposed on the substrate, a first electrical device electrically connecting and fixedly attached to the first and the second pads and wherein the third pad is devoid of electrical connection to either the first or the second pads

Positioning a virtual representation of the component in a Computer Aided Design (CAD) layout such that the first pad is connected to a first externally located device and the second pad is connected to a second externally located device

Downloading the CAD layout to an automated component assembly machine

Constructing an electrical board based on the CAD layout via the automated component assembly machine

Connecting the third pad to a third externally located device in the CAD layout

Repositioning the virtual representation of the component in the CAD layout such that the third pad is connected to the first externally located device, the first pad is connected to the second externally located device and the second pad is connected to the third externally located device

FIG. 6B

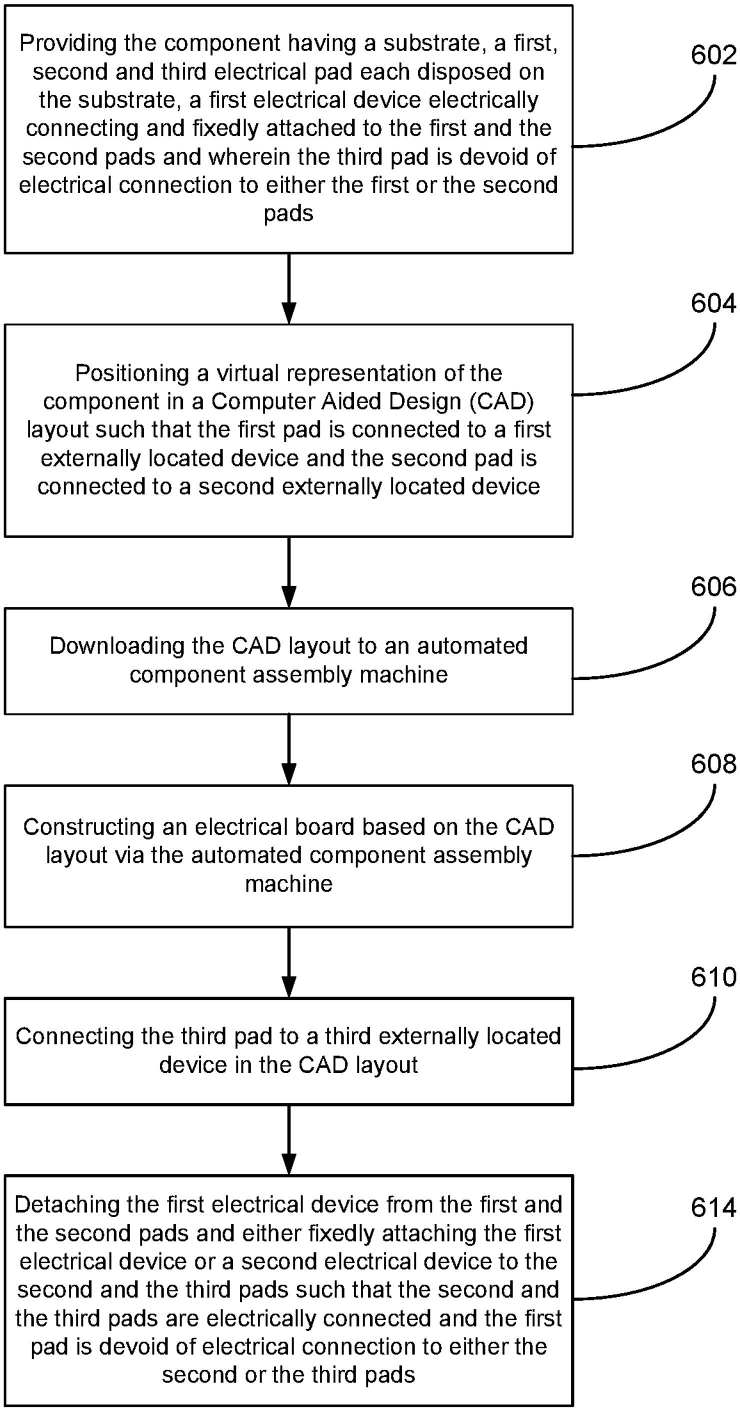

Providing the component having a substrate, a first, second and third electrical pad each disposed on the substrate, a first electrical device electrically connecting and fixedly attached to the first and the second pads and wherein the third pad is devoid of electrical connection to either the first or the second pads
602
Positioning a virtual representation of the component in a Computer Aided Design (CAD) layout such that the first pad is connected to a first externally located device and the second pad is connected to a second externally located device
604
Downloading the CAD layout to an automated component assembly machine
606
Constructing an electrical board based on the CAD layout via the automated component assembly machine
608
Connecting the third pad to a third externally located device in the CAD layout
610
Detaching the first electrical device from the first and the second pads and either fixedly attaching the first electrical device or a second electrical device to the second and the third pads such that the second and the third pads are electrically connected and the first pad is devoid of electrical connection to either the second or the third pads
614

FIG. 6C

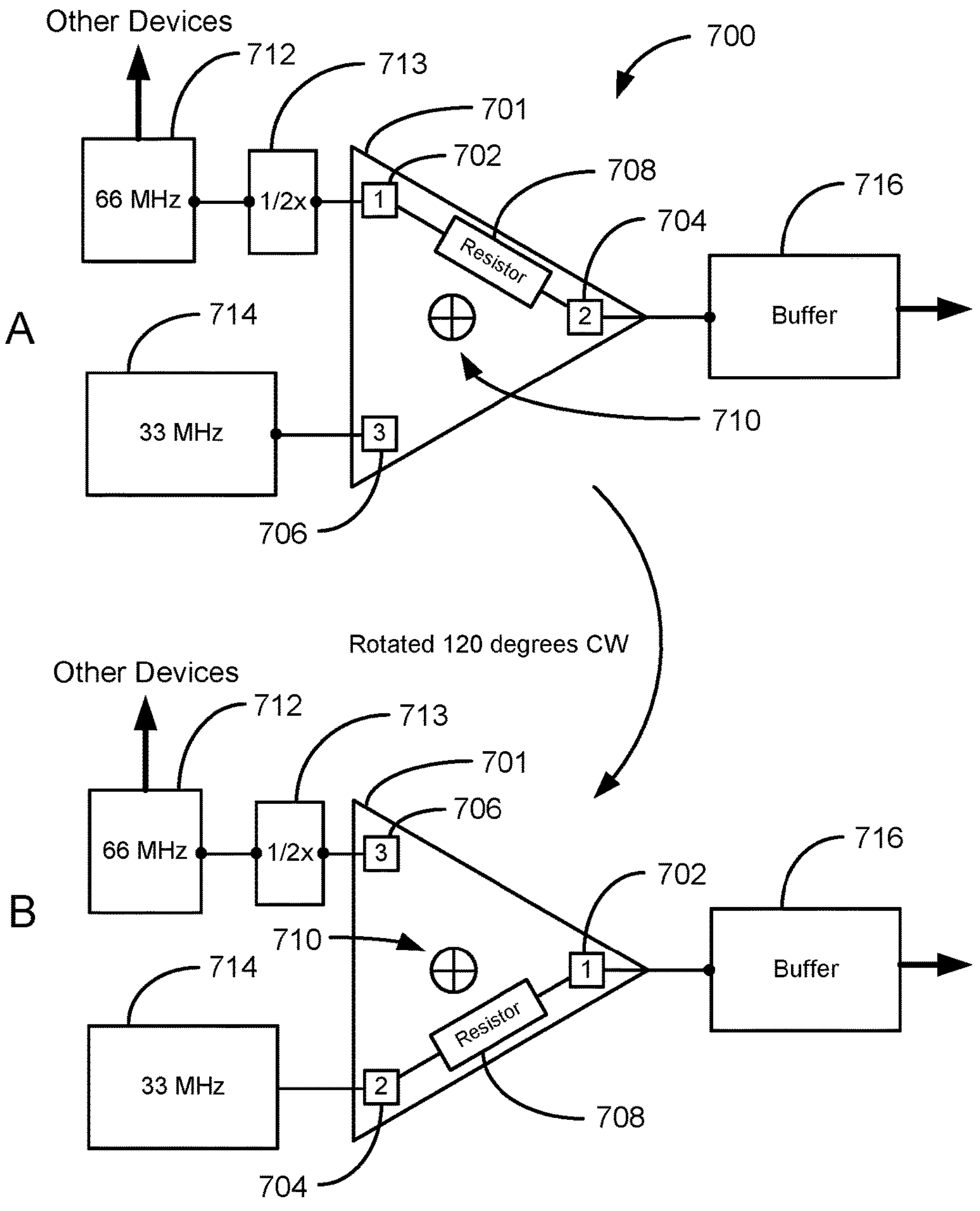

Other Devices
712
713
701
702
700
708
704
716
66 MHz
1/2x
1
Resistor
2
Buffer
A
714
33 MHz
3
710
706
Rotated 120 degrees CW
Other Devices
712
713
701
706
702
716
66 MHz
1/2x
3
B
710
1
Buffer
714
Resistor
33 MHz
2
708
704

FIG. 7

# PASSIVE ALTERABLE ELECTRICAL COMPONENT

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional application of U.S. Ser. No. 11/752,759, filed May 23, 2007, the entire disclosure of which is incorporated herein by reference.

## FIELD OF THE INVENTION

The present invention is directed to a passive alterable electrical component that is useful in providing flexibility with circuit board design options when using a computer aided design package that is downloadable to an automated component assembly machine.

## BACKGROUND OF THE INVENTION

For years, engineers have used Computer Aided Design (CAD) programs to develop electrical component layout designs that are tailored to meet specific electrical functionality. Most CAD programs not only provide functional predictions of the electrical component layout designs but are also capable of exporting the layout designs to automated component assembly machines that build physical electrical boards of the layout designs based on the CAD layout designs. Generally, a CAD program allows for one origin location associated with each electrical component chosen in a layout design. The origin location of each component is understood by an automated component assembly machine which will, consequently, dispose each chosen electrical component on a physical electrical substrate board based on the origin location.

In certain instances, components atypically arranged in a layout may generate certain errors in some CAD programs and automated component assembly machines; FIGS. **1**A and **1**B exemplify such an atypical layout. Shown herein is an example of one layout that includes a circuit electrically connected to a primary component and a backup component that is not electrically connected to the circuit, however, is capable of being connected to the circuit. As shown in FIG. **1**A, primary component-E **2** is connected to buffer component **16** via pad-A **8**, pad-B **12** and component G **10**. As shown backup component-F **4** is not connected to the buffer component **16** because pad-C **6** and pad-D **14** are not connected. For example, if the primary component-E **2** generates a noise sensitive electrical signal, such as an output, the placement of pad-D **14** may be suboptimal because the termination distance **18** of pad-D **14** may cause noise generation due to signal reflection. Likewise, if component-F **4** were connected to the buffer component **16** instead of component-E **2**, noise may be generated by signal reflection from pad-B **12**; assuming pad-B **12** was a termination point. FIG. **1**B would provide a solution to the problem for FIG. **1**A because pad-B **12** and pad-D **14** are substantially superimposed, creating pad-B/D **20** thereby eliminating reflection due to the termination distance **18**. The problem is some CAD programs will not allow a commonly shared pad in the location of pad-B/D **20** or overlaying pads, such as pad-B/D **20**. Furthermore, attempts to download a shared pad or overlaying pads will cause certain automated component assembly machines to register an error with possibly substantial manual effort to overcome the error.

In an effort to improve the user friendliness of certain automated component assembly machines and their associated CAD programs, both methods and apparatuses are disclosed herein. It is to innovations related to this subject matter that the claimed invention is generally directed.

## SUMMARY OF THE INVENTION

The present invention relates generally to a passive alterable electrical component that is useful in providing flexibility with circuit board design options when using a computer aided design package that is downloadable to an automated component assembly machine.

Embodiment of the present invention can therefore comprise a passive electrical component comprising: a substrate; at least a first, second and third electrically conductive pad, each disposed on the substrate; at least a first electrical device fixedly attached to the first pad and the second pad and making an electrical connection therebetween, the third pad devoid of electrical connection to either the first or the second pads, and wherein the component is recognizable by both a Computer Aided Design program and an automated component assembly machine.

Another embodiment of the present invention can therefore comprise a method of using a switchable passive electrical component, the method comprising the acts of: providing the component having a substrate, a first, second and third electrically conductive pad each disposed on the substrate, a first electrical device electrically connecting and fixedly attached to the first and the second pads, and wherein the third pad is devoid of electrical connection to either the first or the second pads; positioning a virtual representation of the component in a Computer Aided Design (CAD) layout such that the first pad is electrically connected to a first externally located device and the second pad is electrically connected to a second externally located device; downloading the CAD layout to an automated component assembly machine; and constructing an electrical board based on the CAD layout via the automated component assembly machine.

Yet another embodiment of the present invention can therefore comprise a component with a passive alterable electrical pathway, the component comprising: at least a first, second and third electrically conductive pad; at least a first electrical device fixedly attached to the first pad and the second pad and making an electrical connection therebetween, the third pad devoid of electrical connection to either the first or the second pads; and a substrate supporting the first, second and third pads, the substrate moveable between a first orientation and a second orientation, the first orientation having a first external device electrically connected to the first pad, a second external device electrically connected to the second pad and a third external device electrically connected to the third pad, wherein the first external device is electrically linked to the second external device and the third external device is devoid of any electrical link via the component to either the second external device or the first external device, the second orientation having the second external device electrically connected to the first pad, the third external device electrically connected to the second pad and the first external device electrically connected to the third pad wherein the third external device is electrically linked to the second external device and the first external device is devoid of any electrical link via the component to either the second external device or the third external device.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A and **1**B are block diagrams of a prior art configurations.

FIG. **2**A is an illustration of a passive electrical component arrangement consistent with certain embodiments of the present invention.

FIG. **2**B shows an alternative substrate embodiment of a passive electrical component arrangement consistent with embodiments of the present invention.

FIG. **3**A is an illustration of another embodiment of the present invention showing a passive electrical component connected with external electrical devices and oriented in two optional arrangements.

FIG. **3**B is an illustration of another embodiment of the present invention wherein a passive electrical component connected with external electrical devices and constructed showing two optional arrangements.

FIG. **3**C is an illustration of yet another embodiment of the present invention wherein a passive electrical component connected with external electrical devices constructed showing two optional arrangements.

FIG. **4** is an illustration of yet another embodiment of the present invention wherein a passive electrical component is connected with external electrical devices and is oriented showing two optional arrangements.

FIG. **5**A-**5**C are illustrations of alternative embodiments of passive electrical component arrangements consistent with certain embodiments of the present invention.

FIG. **6**A-C are flow charts of method acts that are consistent with certain embodiments of the present invention.

FIG. **7** illustrates in a block diagram format a commercial embodiment of a passive electrical component arranged with external components consistent with embodiments of the present invention.

## DETAILED DESCRIPTION

Referring to the drawings in general, and more specifically to FIG. **2**A, shown therein is a block diagram of a passive electrical component arrangement **200** constructed in accordance with an embodiment of the present invention. In what follows, similar or identical structures may be identified using identical callouts.

The passive electrical component arrangement **200** illustrated in FIG. **2**A can comprise a substrate **201** and at least a first electrically conductive pad **202**, a second electrically conductive pad **204** and third electrically conductive pad **206**, each disposed on the substrate **201**. The first pad **202** and the second pad **204** are electrically connected via at least a first electrical device **208** fixedly attached to the first pad **202** and the second pad **204**. The first electrical device **208** can be fixedly attached by solder joints, adhesive, a mechanical fastener or an alternative means that prevents the first electrical device **208** from becoming disconnected, except when selectively desired. Unlike a moveable link between pads, such as a pivoting switch for example, a fixedly attached electrical device, such as the first electrical device **208**, can reduce the effective discontinuity in the transmission line generated, such as through a base plane on the substrate **201** or other reference or return path (i.e. an active return path), for example. As illustrated, the first pad **202**, second pad **204** and third pad **206** are arranged in a triangular array, as is the shape of the substrate **201** in this embodiment. The third pad **206** is devoid of any contact with the first pad **202** or the second pad **204** via the component **200**. The component **200** provides at least one solution over the prior art of FIGS. **1**A and **1**B because it is recognizable to Computer Aided Design (CAD) programs (i.e., component **200** can accommodate certain programming rules in a CAD system) in addition to automated component assembly machines. The component **200** can be identifiably placed (i.e., identified and placed), in the virtual sense by a CAD program or in the actual construction of an electrical board assembly, based on an origin location **210**. In one embodiment of the present invention, the component **200** (or any like component within the scope and spirit of the present invention) is sealed. A sealed component can be a component that is substantially sealed with a polymer resin which, in yet another embodiment, hermetically seals the component. The component by virtue of being sealed can be protected from flash heat, light, environmental contamination, environmental elements, such as air, water, etc. Another embodiment of a sealed component can be a component that is substantially encased in plastic covering (or other material providing the same function) wherein the covering can, in one embodiment, conform to the shape of the component, for example.

FIG. **2**B shows an alternative substrate embodiment of a passive electrical component arrangement **230** which is similar to the component **200** of FIG. **2**A. As shown in this illustration, the component **230** has a first electrically conductive pad **202**, a second electrically conductive pad **204** and third electrically conductive pad **206**, each disposed on the substrate **203**. The first pad **202** and the second pad **204** are electrically connected via at least a first electrical device **208** fixedly attached to the first pad **202** and the second pad **204**. The third pad **206** is devoid of any contact with the first pad **202** or the second pad **204** via the component **230**. As illustrated, the first pad **202**, second pad **204** and third pad **206** are arranged in a triangle, though the shape of the substrate **203** in this embodiment is square. The shape of a substrate, such as the square substrate **203**, can be circular, elliptical, polygonal, an any other shape so long as the substrate, such as substrate **203**, provides support to pads and devices without departing from the scope and spirit of the present invention.

FIG. **3**A is an illustration of another embodiment of the present invention wherein a passive electrical component is electrically connected with external electrical devices and is oriented showing two optional arrangements. As illustrated, component **200** of FIG. **2**A is electrically linked with a first external device **312**, second external device **316** and a third external device **314**. More specifically, in orientation A (the upper arrangement) the first external device **312** is electrically connected to the first pad **202**, the second external device **316** is electrically connected to the second pad **204** and the third external device **314** is electrically connected to the third pad **206**. The first external device **312** is electrically linked with the second external device **316** via the first device **208** and first and second pads **202** and **204**, respectively. The third external device **314** is not linked to either the first external device **312** or the second external device **316**. In orientation B (the lower arrangement), the component **200** has been rotated 120° clockwise about the origin location **210** in the same plane as the pads **202**, **204** and **206**. The first external device **312** is electrically connected to the third pad **206**, the second external device **316** is electrically connected to the first pad **202** and the third external device **314** is electrically connected to the second pad **204**. The third external device **314** is electrically linked with the second external device **316** via the first device **208** and first and second pads **202** and **204**, respectively. The first external device **312** is not linked to either the third external device **314** or the second external device **316**. Hence, either the first external device **312** or third external device **314** can be electrically connected to the second external device **316** via the component **200**. In this embodiment, the connection to the second external device **316** via the first device **208** enjoys close to perfect controlled resistance, and minimizes any deviation from the transmission line model effect of discontinuity given a differential signal, because the fixedly attached first device **208** provides two optional paths to the second external device **316** depending on the rotation of the component **200**.

FIG. **3**B is an illustration of another embodiment of the present invention wherein a passive electrical component is electrically connected with external electrical devices and is constructed showing two optional arrangements. Arrangement A (the upper arrangement) illustrates the first external device **312** electrically connected to the first pad **202**, the second external device **316** electrically connected to the second pad **204** and the third external device **314** electrically connected to the third pad **206**. The first external device **312** is electrically linked with the second external device **316** via the first device **208** and first and second pads **202** and **204**, respectively. The third external device **314** is not linked to either the first external device **312** or the second external device **316**. In arrangement B (the lower arrangement), the first device **208** has been detached from the first pad **202** and the second pad **204** and re-attached to the third pad **206** and second pad **204**. In the interest of providing an example of detaching a fixedly attached component, such as the first component **208**, detachment can be accomplished by applying heat to solder joints at pads **202** and **204** and reattaching can be accomplished by soldering new joints at the pads **204** and **206** with the leads to the first device **208**. Such an operation can be done by a machine or an operator. Hence, in arrangement B, the third external device **314** is electrically linked with the second external device via pad two **204** and pad three **206** and the first device **208**.

FIG. **3**C is an illustration of yet another embodiment of the present invention wherein a passive electrical component is electrically connected with external electrical devices and is constructed showing two optional arrangements. Arrangement A (the upper arrangement) illustrates the first external device **312** electrically connected to the first pad **202**, the second external device **316** electrically connected to the second pad **204** and the third external device **314** electrically connected to the third pad **206**. The first external device **312** is electrically linked with the second external device **316** via the first device **208** and first and second pads **202** and **204**, respectively. The third external device **314** is not linked to either the first external device **312** or the second external device **316**. In arrangement B (the lower arrangement), the first device **208** has been detached from the first pad **202** and the second pad **204**, and a second device **220** has been fixedly attached to the third pad **206** and second pad **204**. Hence, in arrangement B, the third external device **314** is electrically linked with the second external device via pad two **204** and pad three **206** and the second device **220**.

FIG. **4** is an illustration of yet another embodiment of the present invention wherein a passive electrical component is electrically connected with external electrical devices and is oriented showing two optional arrangements. As illustrated, component **400** comprises a first electrical pad **402**, a second electrical pad **404** and a third electrical pad **406** that are disposed in a linear arrangement on a rectangular substrate **401**. The component **400** is electrically linked with a first external device **412**, second external device **414** and a third external device **416**. More specifically, in orientation A (the upper arrangement) the first external device **412** is electrically connected to the first pad **402**, the second external device **416** is electrically connected to the second pad **404** and the third external device **414** is electrically connected to the third pad **406**. The first external device **412** is electrically linked with the second external device **416** via the first device **408** and first and second pads **402** and **404**, respectively. The third external device **414** is not linked to either the first external device **412** or the second external device **416**. In orientation B (the lower arrangement), the component **400** has been rotated 180° about the origin location **410**, as shown. The first external device **412** is electrically connected to the third pad **406**, the second external device **416** is electrically connected to the second pad **404** and the third external device **414** is electrically connected to the first pad **402**. The third external device **414** is electrically linked with the second external device **416** via the first device **408** and first and second pads **402** and **404**, respectively. The first external device **412** is not linked to either the third external device **414** or the second external device **416**. Hence, regarding both orientations A and B, either the first external device **412** or third external device **414** can be electrically connected to the second external device **416** via the component **400**.

FIG. **5**A-**5**C are illustrations of alternative embodiments of passive electrical component arrangements. FIG. **5**A shows a passive electrical component arrangement **500** comprising four electrical pads. More specifically, a first electrical pad **502**, a second electrical pad **504**, a third electrical pad **506** and a fourth electrical pad **508**, each disposed at the corners of a square substrate **501**. The third pad **506** and the fourth pad **508** are electrically electrically connected via at least a first electrical device **512** fixedly attached to the third pad **506** and the fourth pad **508**. The first pad **502** and the second pad **504** are devoid of any contact with any other pad via the component **500**. The component **500** can be identifiably placed, in the virtual sense by a CAD program or in the actual construction of an electrical board assembly, based on an origin location **510**.

FIG. **5**B shows another alternative embodiment of a passive electrical component arrangement **520** comprising five electrical pads. More specifically, a first electrical pad **522**, a second electrical pad **524**, a third electrical pad **526**, a fourth electrical pad **528** and a fifth electrical pad **534**, wherein pads one, two, three and four **522**, **524**, **526** and **528**, respectively, are disposed at the corners of a square substrate **521** and the fifth pad **534** is disposed in the center of the substrate **521**. The third pad **526** and the fifth pad **534** are electrically connected via at least a first electrical device **532** fixedly attached to the third pad **526** and the fifth pad **534**. Pads one, two, three and four **522**, **524**, **526** and **528**, respectively, are devoid of any contact with any other pad via the component **520**. The component **520** can be identifiably placed, in the virtual sense by a CAD program or in the actual construction of an electrical board assembly, based on an origin location **530**, which is located substantially where the fifth pad **534** is disposed.

FIG. **5**C shows another alternative embodiment of a passive electrical component arrangement **550**. As illustrated, the component **550** comprises a first electrical pad **552**, a second electrical pad **554**, a third electrical pad **556**, a fourth electrical pad **562**, a fifth electrical pad **564** and a sixth electrical pad **566**. The first, second and third pads, **552**, **554** and **556**, respectively, are disposed in an outer triangular arrangement on a first triangular substrate **551** and the fourth, fifth and sixth pads **562**, **564** and **566**, respectively, are disposed in an inner triangle arrangement on a second triangular substrate **561**. In an alternative embodiment, the pads **552**, **554**, **556**, **562**, **564** and **566** can be arranged as shown herein and disposed on a single substrate. The second pad **554** and the third pad **556** are electrically

electrically connected via a first electrical device **558** fixedly attached to the second pad **554** and the third pad **556**. The fifth pad **564** and the sixth pad **566** are electrically electrically connected via a second electrical device **568** fixedly attached to the fifth pad **564** and the sixth pad **566**. The first pad **552** and the fourth pad **562** are devoid of any contact with any other pad via the component **550**. The component **550** can be identifiably placed, in the virtual sense by a CAD program or in the actual construction of an electrical board assembly, based on an origin location **560**, which is located substantially in the center of the component **550**.

Referring now to FIG. **6**A; shown therein is a method to practice using a switchable passive electrical component consistent with embodiments of the present invention. It should be recognized that the steps presented in the described embodiments of the present invention do not require any particular sequence unless otherwise stated. Also, similar elements are used from FIGS. **3**A-3C for purposes of illustration in this embodiment but are not intended to limit the methods presented herein the elements of FIGS. **3**A-3C. As indicated in block **602**, a passive electrical component **200** is provided with a substrate **201**, a first, second and third electrical pad **202**, **204** and **206**, respectively, each disposed on the substrate **201**, a first electrical device **208** electrically connecting and fixedly attached to the first and the second pads **202** and **204**. The third pad **206** is devoid of electrical connection to either the first or the second pads **202** and **204**. Block **604** identifies an act of positioning a virtual representation of the component **200** in a Computer Aided Design (CAD) layout such that the first pad **202** is electrically connected to a first externally located electrical device **312** and the second pad **204** is electrically connected to a second externally located electrical device **316**. As can be appreciated by a skilled artisan, a CAD layout can include hundreds, if not thousands, of electrical components of various configurations and functions. Block **606** identifies an act of downloading the CAD layout, component **200** included, to an automated component assembly machine (not shown). Block **608** indicates the act of constructing a physical electrical board based on the CAD layout via the automated component assembly machine. Block **610** identifies an act of connecting the third pad **206** to a third externally located electrical device **314**. As previously discussed, an external device, such as the first external device **312**, can be a device that generates a high speed signal, such as a something having a rise time in the vicinity of less than 1 nano-second.

FIG. **6**B is an alternative embodiment of the present invention which includes all of the acts **602**, **604**, **606**, **608** and **610** of FIG. **6**A but further includes an act **612** of repositioning the virtual representation of the component **200** in the CAD layout such that the third pad **206** is electrically connected to the first externally located device **312**, the first pad **202** is electrically connected to the second externally located device **316** and the second pad **204** is electrically connected to the third externally located device **314**. This is illustrated in FIG. **3**A and, as shown in FIG. **6**B, can be accomplished by rotating the component **200** about the point of origin **210** in a CAD program in a CAD layout design, connecting the external devices **312**, **314** and **316** as shown and then building a Printed Circuit Board Assembly (PCBA) from the layout design.

FIG. **6**C is another alternative embodiment of the present invention which includes all of the acts **602**, **604**, **606**, **608** and **610** of FIG. **6**A but further includes an act **614** detaching the first electrical device **208** from the first and the second pads **202** and **204** and either fixedly attaching the first electrical device **208**, as shown in FIG. **3**B, or a second electrical device **220**, as shown in FIG. **3**C, to the second and the third pads **204** and **206** such that the second and the third pads **204** and **206** are electrically connected and the first pad **202** is devoid of electrical connection to either the second or the third pads **204** and **206**. The first device **208** can be detached by cutting the first device **208** from the substrate **201** or if soldered in place, melting solder joints and removing the first device **208**. If the first device **208** is damaged during the detaching process, a second device **220** may be required.

Embodiments of the present invention can be commercially practiced in a Spectra Logic tape library bridge processor circuit board prototype manufactured by Spectra Logic of Boulder, Colo. The bridge processor circuit board prototype can include at least one passive electrical component **700** arranged as shown in FIG. **7** to facilitate a variety of different circuit board solutions such as improving iterative "tuning" of the design without significant loss of time due to circuit board reconstruction. The passive electrical component **700** can provide flexibility with circuit board design options after the circuit board has been fabricated, such as postponing some electrical design decisions. Furthermore, passive electrical components, such as the component **700**, can provide improved materials management, such as a bill of materials reel or other inventory disposition arrangement, over the nuisance of excessive parts with noise generating stubs as discussed in conjunction with FIGS. **1**A and **1**B. The passive electrical component arrangement of FIG. **7** can advantageously provide a minimally altered circuit board design after the circuit board prototype has been optimized.

As illustrated in FIG. **7**, a passive electrical component **700**, electrically connected with external electrical devices, is shown constructed with two optional arrangements, namely arrangements A and B. Arrangement A (the upper arrangement) illustrates a 66 MHz generating clock device **712** that is halved to 33 MHz by a clock divider device **713** when electrically connected in series. The 33 MHz signal is provided to an external buffer device **716** electrically connected to the 66 MHz clock device **712** and clock divider device **713** via a first pad **702**, a second pad **704** and a 20-ohm resistor element **708**. A 33 MHz generating clock device **714** is electrically connected to a third pad **706**. The 33 MHz clock device **714** is not linked to either the 66 MHz clock device **712**, the clock divider device **713** or the external buffer device **716**. The 66 MHz clock device **712** provides a 66 MHz signal that is used by other devices, however in this embodiment, the buffer device **716** requires a 33 MHz clock signal, and therefore, the 66 MHz clock signal is halved by the clock divider device **713**. The non-divided 33 MHz clock device **714** is constructed on the prototype board for potential use by the component **700** in the event the 66 MHz clock device **712** and the clock divider device **713** is suboptimal (such as the potential for phase relationship problems, for example).

In the event, arrangement A is indeed suboptimal, arrangement B (the lower arrangement) can provide a simple design change without any change to the footprint (i.e., the component layout arrangement) on a PCBA of arrangement A. Furthermore, arrangement B provides a solution wherein the component **700** has balanced, or similar, characteristic impedance between arrangement A and B, due to a differential signal relative a ground plane associated with the substrate **701**, and further provides a low angle electrical path, and hence low noise often caused by right angle electrical paths, between the clock devices **712** and **714** and the buffer device **716**. As is illustrated in arrangement B, the component **700** can simply be rotated 120° clockwise about the origin location **710** in Expedition PCB CAD program by Mentor Graphics Co. of Wilsonville, Oreg. 97070, and virtually constructed as shown in arrangement B. Also, as shown in arrangement B, the 66 MHz clock device **712** and clock divider device **713** is electrically connected to the third pad **706**, the external buffer device **716** is electrically connected to the first pad **702** and the 33 MHz clock device **714** is electrically connected to the second pad **704**. The 33 MHz clock device **714** is electrically linked with external buffer device **716** via the resistor **708** and first and second pads **702** and **704**, respectively. The 66 MHz clock device **712** and clock divider device **713** are not linked to either the 33 MHz clock device **714** or the external buffer device **716**. The CAD representation can then be downloaded to a Pick and Place circuit board assembly machine, such as by Panasonic located in Osaka, Japan and constructed on a new circuit board in arrangement B. Optionally, arrangement A can be provided with an open space in the place of the 33 MHz component **714** in anticipation of a component different from the 33 MHz component **714**. In yet another optional embodiment, the resistor **708** of arrangement A can be removed and replaced in the arrangement B, resembling the pad layout in arrangement B of FIG. **3**B.

It is to be understood that even though numerous characteristics and advantages of various embodiments of the present invention have been set forth in the foregoing description, together with the details of the structure and function of various embodiments of the invention, this disclosure is illustrative only, and changes may be made in detail, especially in matters of structure and arrangement of parts within the principles of the present invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed. For example, alternate board layouts and features specific to design needs can be used with a passive electrical component consistent with embodiments of the present invention, such as the passive electrical component **200** for example, while still maintaining substantially the same functionality without departing from the scope and spirit of the present invention. Another example can include various external devices that are not necessarily high speed components electrically connected to the passive electrical component while still maintaining substantially the same functionality without departing from the scope and spirit of the present invention. Although the preferred embodiments described herein are directed to high speed external components, such as a clock device **714**, an internal resistor component, such as the resistor **708**, and other related componentry, it will be appreciated by those skilled in the art that the teachings of the present invention can be applied to other systems and storage media, without departing from the spirit and scope of the present invention.

It will be clear that the present invention is well adapted to attain the ends and advantages mentioned as well as those inherent therein. While presently preferred embodiments have been described for purposes of this disclosure, numerous changes may be made which readily suggest themselves to those skilled in the art and which are encompassed in the spirit of the invention disclosed.

What is claimed is:

**1**. A method of using a switchable passive electrical component, the method comprising the acts of:

providing said component having a substrate, a first, second and third electrically conductive pad each attached on said substrate, a first electrical device electrically connecting and fixedly attached to said first and said second pads, and wherein said third pad is never electrically connected to either said first or said second pads, said component possessing a point of origin;

positioning a virtual representation of said component in a Computer Aided Design (CAD) layout by identifying said point of origin such that said first pad is electrically connected to a first externally located device and said second pad is electrically connected to a second externally located device;

repositioning said virtual representation of said component in said CAD layout by rotating about said point of origin so that said third pad is electrically connected to said first externally located device, said first pad is electrically connected to said second externally located device;

downloading said CAD layout to an automated component assembly machine; and

constructing an electrical board based on said CAD layout via said automated component assembly machine.

**2**. The method of claim **1** wherein said virtual representation is positioned such that said third pad is electrically connected to a third externally located device in said CAD layout.

**3**. The method of claim **2** wherein said second pad is electrically connected to said third externally located device.

**4**. The component of claim **3** wherein said first, said second and said third pads are arranged substantially in an equilateral triangular array having said point of origin substantially in the center of said array and wherein said repositioning step is accomplished by rotating said component 120 degrees about said point of origin.

**5**. The method of claim **2** further comprising detaching said first electrical device from said first and said second pads and either fixedly attaching said first electrical device or a second electrical device to said second and said third pads such that said second and said third pads are electrically connected and said first pad is devoid of electrical connection to either said second or said third pads.

**6**. The method of claim **1** wherein said first electrical device is a resistor.

**7**. The method of claim **1** further comprising rotating said component about said point of origin such that said third pad is electrically connected to said first externally located device, said first pad is electrically connected to said second externally located device, and said second pad is electrically connected to said third externally located device.

**8**. The method of claim **1** wherein said pads are arranged in a triangle.

**9**. The method of claim **1** wherein said component is hermetically sealed.

**10**. The method of claim **1** further comprising providing a fourth, a fifth, and a sixth electrically conductive pad, wherein each of said fourth, said fifth and said sixth pads is disposed on said substrate and at least a second electrical device fixedly attached to said fourth pad and said fifth pad, said second electrical device electrically connecting said fourth pad with said fifth pad, said sixth pad devoid of an electrical connection with any other pad on said substrate.

**11**. A method comprising:

providing a component possessing electrically conductive first, second and third pads pad disposed on a substrate, and a conductive element electrically linking said first pad to said second pad, said third pad not electrically connected to either said first or said second pad;

generating a virtual representation of said component in a Computer Aided Design (CAD) layout;

arranging a first orientation of said virtual representation of said component to electrically connect said first pad to a first external electrical device, said second pad to a second external electrical device, and said third pad to a third external electrical device;

rotating said virtual representation of said component in said CAD layout in a second orientation to electrically connect said second pad to said first external electrical device, said third pad to said second electrical external device, and said first pad to said third electrical external device; and

constructing a physical layout of said first orientation from said CAD layout.

**12**. The method of claim **11** wherein said first orientation electrically connects said first external device to a first electrical pathway and said second orientation electrically connects said first external device to a second electrical pathway.

**13**. The method of claim **11** wherein said conductive element is a resistor.

**14**. The method of claim **11** further comprising physically rotating said component back to said first orientation after said instructing step.

**15**. The method of claim **11** further comprising downloading said CAD layout to an automated component assembly machine before said constructing step.

**16**. The method of claim **11** wherein said pads are arranged in a triangle on said substrate.

**17**. The method of claim **11** wherein there are no other pads on said substrate.

**18**. A method comprising:

providing a component possessing electrically conductive first, second and third pads pad disposed on a substrate, and a conductive element electrically linking said first pad to said second pad, said third pad not electrically connected to either said first or said second pad;

generating a virtual representation of said component in a Computer Aided Design (CAD) layout;

arranging a first orientation of said virtual representation in said CAD layout of said component to electrically connect said first pad to a first external electrical device, said second pad to a second external electrical device, and said third pad to a third external electrical device to construct a first electrical pathway between said first external electrical device and said second external electrical device, said virtual representation of said component adapted to be rotated in a second orientation to electrically connect said second pad to said first external electrical device, said third pad to said second electrical external device, and said first pad to said third electrical external device to construct a second electrical pathway between said first external electrical device and said second external electrical device; and

constructing a physical layout of said arrangement from said CAD layout.

**19**. The method of claim **18** further comprising after said arranging step of said first orientation, arranging said component in said second orientation by rotating said component.

**20**. The method of claim **18** wherein said pads are disposed on said substrate in a triangle.

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