

Description

An optical isolator may be used in an electrical circuit to allow signal propagation in a forward direction while maintaining voltage and current isolation between the input and output of the optical isolator. Such an isolator includes a light emitting diode (LED) at the input, a photodiode at the output and an optically transmissive high breakdown voltage isolation gap separating the LED and the photodiode. In order to achieve optimum isolator performance the size of the isolation gap and the alignment of the LED and the photodiode must be maintained accurately during manufacture.

One prior art attempt to automate optical isolator manufacture, described in US Patent No. 4,446,375 and shown in Figures 1A-C hereof, has been to align the LED and the photodiode during fabrication by folding the LED lead and the separate LED bond lead into place over the detector in two ninety degree steps. Although the use of such a folded lead frame technique decreases the assembly time for each isolator a complex folding apparatus is required to make the two 90° folds which lie along different axes and errors in the placement of the folds may affect the accuracy of the LED-photodiode alignment. During folding, damage to the bond wires may occur because the LED lead and the LED bond lead are not securely attached together and because the dielectric sheet between the LED and the photodiode dice is free to rest against and damage the LED and photodiode bond wires. As additionally described in US Patent No. 3,925,801 and shown in Figure 2 hereof, the size of the isolation gap in many prior art optical isolators is determined by the thickness of a dielectric sheet located between the LED and the photodiode. The insertion of such a sheet during manufacture has often resulted in bond wire damage.

US-A-3 839 782 discloses a method for using a lead frame for the manufacture of electrical devices having semiconductor chips placed in a face-to-face relationship. A single lead frame initially incorporates integral first and second portions which are subsequently separated by severing joining bars. This enables one portion to be relocated, after inversion, on the other portion and interlocked therewith so that certain semiconductor sections can be placed in a facing relationship. GB-A-2 107 929 discloses an optocoupler wherein a lead frame of integral construction has portions adjacent a mid-axis on which semiconductor elements are located. One of these portions and a lead bonding portion is bent over a mid-axis so that the semiconductor element portions are in facing relationship.

The present invention is defined by the appended Claims.

In accordance with the illustrated preferred embodiment of the present invention, an optical isolator is manufactured simply and repeatably using standard form lead frames. Prior to die attachment and wire bonding of the optical isolator, the LED and photodiode attachment portions of the lead frame are displaced to a common plane located below the plane of the remainder of the lead frame. The entire LED section of the lead frame is then rotated 180 degrees about a pair of hinge pins until it is coplanar with the photodiode section of the lead frame. After rotation is completed the hinge pins are stamped to eliminate spring back of the rotated LED section of the lead frame. A clear resin is injected between two dielectric sheets attached to the outer surfaces of the LED and photodiode leads to form a light guide between the LED and the photodiode. The optical isolator is encapsulated and the protruding leads are cut and bent to the desired final package shape. In an alternate preferred embodiment of the present invention, a first dielectric sheet is attached to the outer surface of either the LED or the photodiode lead and a second dielectric sheet is positioned between the LED and the photodiode dice. The second sheet rests upon (and adheres to adhesive on) the first sheet and extends between the dice at an angle so that damage to the dice and to the bond wires is avoided.

Other features and advantages of the present invention will appear from the following description.

Figures 1A-C show a prior art optocoupler having a folded lead frame construction.

Figure 2 shows a prior art optocoupler having a dielectric sheet compressed between the LED and the photodiode.

Figure 3 shows an optical isolator lead frame in accordance with the preferred embodiment of the present invention.

Figures 4A-B are a flow chart of the optical isolator assembly steps in accordance with the preferred embodiment of the present invention.

Figures 5-11 show various stages in the assembly of the optical isolator in accordance with the flow chart of Figure 4.

Figure 12 shows an alternate preferred embodiment of the present invention in which a dielectric sheet is positioned between the LED and photodiode dice at a tilted angle.

Figure 13 is a flow chart of the assembly steps of the alternate preferred embodiment shown in Figure 12.

Figures 1 and 2 show optocouplers which are fabricated according to the prior art. Figures 1A-C illustrate two 90° folding steps, described in U.S. Patent No. 4,446,375, which have been used in the manufacture of prior art optocouplers to align the LED and the photodiode. Figure 2 shows an op-

tocoupler, described in U.S. Patent No. 3,925,801, which uses the thickness of a single dielectric sheet compressed between the LED and the photodiode dice to establish the size of the isolation gap.

Figure 3 shows a lead frame 1 which is used in the assembly of an optical isolator in accordance with the preferred embodiment of the present invention. The lead frame 1 is 0,254mm (.010 inch) thick and is fabricated from alloy 42 (42% nickel, 58% iron) in a well known manner. The hatched regions are plated with gold to facilitate later die attach and wire bond operations and for the sake of clarity these plated regions are not shown in the other Figures. Two side rails 3 and 5 provide longitudinal stability for the lead frame 1 which is approximately 213,36mm (8.4 inches) in length and one inch in width. Repeated tie rails 21 and 23 provide lateral stability to the lead frame 1. Ten each alternating LED sections 11 and photodiode sections 13 are located on lead frame 1 and each individual section is divided about arms 17 and seats 19 into identical left and right halves. The LED sections 11 are attached to side rails 3 and 5 by 0,3556mm (.014 inch) wide hinge pins 31, 33 and the photodiode sections 13 are attached to side rails 3 and 5 by dam bar ends 35, 37. During fabrication each left pair of LED sections 11 and photodiode sections 13 will be combined to form one optical isolator. Each right pair will be combined into one optical isolator in a like manner. A total of twenty optical isolators in standard integrated circuit 8-lead packages will be fabricated upon the single lead frame 1.

Figures 4A-B are a flow chart of the various assembly steps which are performed during the manufacture of an optical isolator in accordance with the present invention. The individual assembly steps for a single optical isolator 103 are discussed below in connection with Figures 5-11. During automated assembly all of the optical isolators on the lead frame 1 would be fabricated sequentially.

Figure 5 shows the lead frame 1 after performance of step 41 in which attachment portions 81 and 83 are down set below the plane of side rails 3 and 5. The down set operation may easily be performed using well known stamping techniques and the amount of down set is predetermined to set the size of the isolation gap. For an isolation gap of 0,254mm (.010 inch) in the preferred embodiment, each of the attachment portions 81, 83 was down set a distance of 0,4826mm (.019 inch) although this downset distance may vary with the thickness of different LED and photodiode dice. The seat 19 is down set by an amount equal to the thickness of the arm 17, i.e., 0,254mm (.010 inch), to set coplanar alignment of the LED section 11 with the photodiode section 13 after rotation by

allowing the arm 17 to rest against the down set area of the seat 19. After rotation is completed, the two sections 81 and 83 will be located equidistantly above and below the plane of the side rails 3, 5.

Figure 6 shows steps 43 and 45 in which the die attach and wire bond operations are performed upon lead frame 1 in a conventional manner. An LED die 91 and an optional buffer die 93 are attached to an LED lead 95 and a photodiode die 97 is attached to a photodiode lead 99. Various bond wires are attached to the other leads shown as required. The LED 91 is a high speed gallium arsenide phosphide device of the type described in U.S. Patent No. 3,836,793 which is incorporated herein by reference. The LED 91 has a thickness of approximately 0,1524mm (.006 inch) and the photodiode 97 has a thickness of approximately 0,3048mm (.012 inch).

Figure 7 shows the first of the combination steps 47 which are outlined in greater detail in the flow chart of Figure 4B. For the sake of clarity, only the left section of the lead frame 1 is shown in Figures 7-9. In combination operation step 61, the tie rail 21 of LED section 11 is severed from both of the side rails 3 and 5. This leaves the LED section 11 attached only at the laterally aligned hinge pins 31, 33 and longitudinal rotation about the hinge pins is possible. The dam bar ends 35 and 37 of the photodiode section 13 are not severed and, consequently, the photodiode section 13 remains rigidly attached to the side rails 3 and 5.

In step 63, the LED section 11 is rotated approximately 15° upwards about the hinge pins 31 and 33. The rotational movements of steps 63-69 may be made in a single step or in multiple steps as required for the particular combination apparatus used. Since the lead frame 1 is configured for a standard 8-lead package, standard integrated circuit processing equipment may be used. Of course, persons of ordinary skill in the art will be well able to reconfigure the lead frame 1 to allow rotation of the photodiode section 13 instead of rotation of the LED section 11.

Figure 8 shows step 65 in which the LED section 11 is rotated to approximately 90° relative to the plane of the side rails 3, 5. In step 67 (not shown), the LED section 11 is rotated to approximately 165°. Of course, the entire 180° rotation could be performed in a single step instead of in the multiple steps used in the preferred embodiment.

Figure 9 shows step 69 in which pressure pads of the combination apparatus press the LED section 11 to a fully 180° rotated position coplanar with side rails 3, 5 and photodiode section 13. At this point, the arm 17 is seated against the down set area of the seat 19 and damage to the two dice may be avoided if the lead frame 1 is accidentally

bumped. The arm 17 and the seat 19 may be spot welded together to provide additional stability during transfer molding. Since, unlike certain prior art devices, the size of the isolation gap is not set by compression of a dielectric sheet between the dice 91, 97 damage to the dice 91, 97 does not occur.

In order to prevent rotational spring back of the LED section 11 from the 180° rotated position the two hinge pins 31, 33 are stamped and thereby flattened. The width of each of hinge pins 31, 33 must be greater than the thickness of side rails 3 and 5 so that swaging can occur. But, the hinge pins 31, 33 widths must not be so great that excessive material cold flows during stamping thereby causing buckling or deformation of portions of the lead frame 1. In the preferred embodiment, widths in the range of 0,3048mm (.012inch) to 0,4064mm (.016inch) were used.

Figure 10 shows a close-up cross sectional view of the optical isolator 103 after completion of the step 47. The LED 91 is positioned correctly over the photodiode 97 across an isolation gap 101. The size of the isolation gap 101 is determined in step 41 by the amount of down set of attachment portions 81, 83 and seat 19 and by the thicknesses of the dice 91 and 97. The leads 95 and 99 are coplanar which permits the use of standard transfer molding apparatus in step 53 and eliminates flashing on the bond leads during molding.

Figure 11 shows steps 49-55 in which final packaging of the optical isolator 103 is performed. In step 49, two dielectric sheets 111, 113 are attached to the outer surfaces of leads 95 and 99. Sheets 111, 113 may be made from any nonconductive material such as 0,07112mm (.0028 inch) thick commercially available DuPont Company Kapton tape which is cut to 2,54 by 2,54mm (.100 by .100 inch) in size and which has an adhesive coating on one side. In step 51, an optically transmissive silicone resin such as Dow Corning Company's Hipec Q1-4939 semiconductor protective coating is injected into the isolation gap 101 between sheets 111 and 113 to form a light guide 115. By using surface tension forces, the sheets 111, 113 limit the resin flow to the desired location and preclude structural weakening of the optical isolator 103 which could be caused by excessive resin flow. The resin effectively encapsulates the dice 91, 93, 97 within the light guide 115 and thereby reduces the risk of damage to the optical isolator 103 during thermal shock or temperature cycling.

In step 53, standard transfer molding techniques are used to encapsulate the entire optical isolator 103 in an opaque package 117 of, e.g., Nitto Electric Industrial Co. MP-101S transfer molding compound. Finally, in step 55, all of the leads

including leads 95 and 99 are cut from side rails 3, 5 and tie rails 21, 23 and the leads are bent to the desired packaged shape.

Figure 12 shows an alternate preferred embodiment of the present invention in which a dielectric sheet 131 is positioned within the isolation gap 101 between dice 91, 97. Figure 13 is a flow chart of the assembly of the optical isolator 121 shown in Figure 12 using a number of steps common to the flow chart of Figure 4A. In step 151 the sheet 113 shown in Figure 11 or any other rigid material sheet is attached to the lead 99 using the adhesive layer on the upper surface of the sheet 113. In step 153 a second dielectric sheet 131 is placed on top of the die 97 touching the end of sheet 113 and adhering to the adhesive layer thereon so that the sheet 131 is angled away from the bond wires thereby avoiding damage to the bond wires. The tilted angling of sheet 131 creates a wedge shaped cavity between the sheet 131 and the die 97 in which resin 133 is contained in the desired position for transmitting light to the photodiode die 97. The sheet 131 is 3,175mm by 3,175mm (.125 inch by .125 inch) in size and may be fabricated from a piece of DuPont Company FEP number 200C20 material.

In step 155 resin 133, discussed above with reference to Figure 11, is applied between the sheet 131 and the die 97 and in step 157 the resin is briefly cured to attain a gel consistency. Performance of the combination operations of step 47 does not result in damage to the dice 91, 97 because the size of the isolation gap 101 is determined by the amount of down set and not by compression of the sheet 131 between the dice 91, 97 as is often done in the prior art. Damage to the bond wires is avoided since the sheet 131 rests against the sheet 113 and the edge of die 97 and is thereby tilted at an angle and avoids contact with the bond wires. In step 161, additional resin 133 is applied between the sheet 131 and the die 91. The resin is cured to a gel consistency in step 163 and it is completely cured in step 165 before final steps 53, 55 are performed.

The sheet 131 has the effect of increasing the breakdown voltage of the optical isolator 121 since it has a greater breakdown voltage than does the resin 133. It also serves to increase the length of any air gap present at the interface between the resin 133 and the molding compound 117 and minimizes the effect of air bubbles within the resin 133. The angled presence of the sheet 131 creates a properly positioned and resin filled wedge shaped cavity which conducts light between the die 91, 97 and which also allows a smaller amount of resin 133 to be used so that the amount of resin that may wet the leads 95, 99 is reduced. This decrease in lead wetting results in the attainment of

superior moisture penetration resistance properties by the optical isolator 121.

Claims

1. Method for fabricating an optical isolator on a lead frame (1) having two side rails (3, 5) and alternating LED sections (11) and photodiode sections (13), each section (11, 13) being attached to the side rails (3, 5) by a pair of hinge pins (31, 33) lying in the plane of the side rails (3, 5), the method comprising the steps of:
 - downsetting both an LED attachment portion (81) of the LED section (11) and a photodiode attachment portion (83) of the photodiode section (13) to a downset plane below the plane of the side rails (3, 5);
 - attaching a photodiode die (97) to a photodiode lead (99) of the downset photodiode attachment portion (83);
 - attaching an LED die (91) to an LED lead (95) of the downset LED attachment portion (81); and
 - rotating one of the sections (11, 13) about its pair of hinge pins (31, 33) thereby positioning the LED die (91) over and proximate the photodiode die (97) and separated therefrom by an isolation gap (101).
2. Method as in Claim 1, wherein the LED section (11) is rotated in the rotation step.
3. Method as in Claim 1, wherein the photodiode section (13) is rotated in the rotation step.
4. Method as in Claim 1, wherein the downset plane is substantially parallel to the side rail plane and is located a predetermined downset distance therebelow and wherein twice the downset distance is substantially equal to the sum of the thickness of the isolation gap (110) plus the thickness of the LED die (91) plus the thickness of the photodiode die (97) plus the thickness of the lead frame (1).
5. Method as in Claim 4, wherein one of the sections (11, 13) is rotated approximately 180° during the rotation step.
6. Method as in Claim 5, further comprising, after the rotation step, the step of swaging the hinge pins (31, 33).
7. Method as in Claim 6, wherein the hinge pins (31, 33) each have a width greater than the thickness of each of the side rails (3, 5) and no greater than 160% of the side rail thickness.
8. Method as in Claim 1, further comprising after the rotation step the step of creating a light guide (115) within the isolation gap (101) between the LED die (91) and the photodiode die (97).
9. Method as in Claim 10, wherein the step of creating a light guide (115) comprises the steps of:
 - applying a first sheet (111) to a backside of the LED lead (95) opposite the isolating gap (101);
 - applying a second sheet (113) to a backside of the photodiode lead (99) opposite the isolation gap (101); and
 - filling a cavity between the first and second sheets (111, 113) with an optically transmissive material (115) such that the isolation gap (101) is filled with the material (115).
10. Method as in Claim 1, wherein:
 - the one of the attachment portions (81, 83) further comprises a laterally extending arm (17) which is coplanar with the side rails (3, 5); and
 - the other of the attachment portions (81, 83) further comprises a laterally extending seat (19); and
 - wherein the method further comprises after the step of downsetting the step of jogging down the seat (19) by an amount substantially equal to the thickness of the arm (17) such that the arm (17) rests upon the jogged down portion of the seat (19) after completion of the rotation step.
11. Method as in Claim 10, further comprising after the rotation step the step of attaching together the seat (19) and the arm (17).
12. Method as in Claim 1, wherein the LED attachment section (11) is rotated after the further steps of attaching a first sheet (113) to a backside of the photodiode lead (99) such that an end of the first sheet (113) extends beyond the end of the photodiode lead (99), and attaching an isolation sheet (131) at the end of the first sheet (113) and to an edge of the photodiode die (97) such that the isolation sheet (131) overlays the photodiode die (97) at an angle whereby the angled portion of the isolation sheet (131) is positioned within the isolation gap (101) separating the LED die (91) and the photodiode die (97).
13. Method as in Claim 12, further comprising after the step of attaching the isolation sheet (131), the steps of swaging the hinge pins (31, 33).



superior moisture penetration resistance properties by the optical isolator 121.

Claims

1. Method for fabricating an optical isolator on a lead frame (1) having two side rails (3, 5) and alternating LED sections (11) and photodiode sections (13), each section (11, 13) being attached to the side rails (3, 5) by a pair of hinge pins (31, 33) lying in the plane of the side rails (3, 5), the method comprising the steps of:
 - downsetting both an LED attachment portion (81) of the LED section (11) and a photodiode attachment portion (83) of the photodiode section (13) to a downset plane below the plane of the side rails (3, 5);
 - attaching a photodiode die (97) to a photodiode lead (99) of the downset photodiode attachment portion (83);
 - attaching an LED die (91) to an LED lead (95) of the downset LED attachment portion (81); and
 - rotating one of the sections (11, 13) about its pair of hinge pins (31, 33) thereby positioning the LED die (91) over and proximate the photodiode die (97) and separated therefrom by an isolation gap (101).
2. Method as in Claim 1, wherein the LED section (11) is rotated in the rotation step.
3. Method as in Claim 1, wherein the photodiode section (13) is rotated in the rotation step.
4. Method as in Claim 1, wherein the downset plane is substantially parallel to the side rail plane and is located a predetermined downset distance therebelow and wherein twice the downset distance is substantially equal to the sum of the thickness of the isolation gap (110) plus the thickness of the LED die (91) plus the thickness of the photodiode die (97) plus the thickness of the lead frame (1).
5. Method as in Claim 4, wherein one of the sections (11, 13) is rotated approximately 180° during the rotation step.
6. Method as in Claim 5, further comprising, after the rotation step, the step of swaging the hinge pins (31, 33).
7. Method as in Claim 6, wherein the hinge pins (31, 33) each have a width greater than the thickness of each of the side rails (3, 5) and no greater than 160% of the side rail thickness.
8. Method as in Claim 1, further comprising after the rotation step the step of creating a light guide (115) within the isolation gap (101) between the LED die (91) and the photodiode die (97).
9. Method as in Claim 10, wherein the step of creating a light guide (115) comprises the steps of:
 - applying a first sheet (111) to a backside of the LED lead (95) opposite the isolating gap (101);
 - applying a second sheet (113) to a backside of the photodiode lead (99) opposite the isolation gap (101); and
 - filling a cavity between the first and second sheets (111, 113) with an optically transmissive material (115) such that the isolation gap (101) is filled with the material (115).
10. Method as in Claim 1, wherein:
 - the one of the attachment portions (81, 83) further comprises a laterally extending arm (17) which is coplanar with the side rails (3, 5); and
 - the other of the attachment portions (81, 83) further comprises a laterally extending seat (19); and
 - wherein the method further comprises after the step of downsetting the step of jogging down the seat (19) by an amount substantially equal to the thickness of the arm (17) such that the arm (17) rests upon the jogged down portion of the seat (19) after completion of the rotation step.
11. Method as in Claim 10, further comprising after the rotation step the step of attaching together the seat (19) and the arm (17).
12. Method as in Claim 1, wherein the LED attachment section (11) is rotated after the further steps of attaching a first sheet (113) to a backside of the photodiode lead (99) such that an end of the first sheet (113) extends beyond the end of the photodiode lead (99), and attaching an isolation sheet (131) at the end of the first sheet (113) and to an edge of the photodiode die (97) such that the isolation sheet (131) overlays the photodiode die (97) at an angle whereby the angled portion of the isolation sheet (131) is positioned within the isolation gap (101) separating the LED die (91) and the photodiode die (97).
13. Method as in Claim 12, further comprising after the step of attaching the isolation sheet (131), the steps of swaging the hinge pins (31, 33)



after said rotation and inserting an optically transmissive material (115) into the isolation gap (101) between the isolation sheet (131) and the photodiode die (97).

Revendications

1. Procédé de fabrication d'un isolateur optique sur un châssis conducteur (1) comportant deux membrures latérales (3, 5) et des sections à diodes émettrices de lumière (11) et des sections à photodiodes (13) qui sont disposées en alternance, chaque section (11, 13) étant fixée sur les membrures latérales (3, 5) par une paire de pivots d'articulation (31, 33) situées dans le plan des membrures latérales (3, 5), le procédé comprenant les étapes consistant à :
 - rabattre à la fois une partie (81) de fixation de diode émettrice de lumière de la section à diodes émettrices de lumière (11) et une partie (83) de fixation de photodiode de la section à photodiodes (13) jusque dans un plan de rabattement situé en dessous du plan des membrures latérales (3, 5) ;
 - fixer un support de photodiode (97) sur un conducteur de photodiode (99) de la partie rabattue (83) de fixation de photodiode ;
 - fixer un support de diode émettrice de lumière (91) sur un conducteur (95) de diode émettrice de lumière de la partie rabattue (81) de fixation de diode émettrice de lumière ;
 - faire tourner une des sections (11, 13) autour de sa paire de pivots d'articulation (31, 33) afin de positionner ainsi le support (91) de diode émettrice de lumière sur et à proximité du support de photodiode (97) et de le séparer de ce dernier par un intervalle d'isolation (101).
2. Procédé selon la revendication 1, dans lequel la section à diodes émettrices de lumière (11) est tournée dans l'étape de rotation.
3. Procédé selon la revendication 1 dans lequel la section à photodiodes (13) est tournée dans l'étape de rotation.
4. Procédé selon la revendication 1, dans lequel le plan de rabattement est sensiblement parallèle au plan des membrures latérales et est situé à une distance prédéterminée de rabattement en dessous de celui-ci et, dans le procédé, le double de la distance de rabattement est sensiblement égal à la somme de l'épaisseur de l'intervalle d'isolation (110), plus l'épaisseur du support (91) de diodes émettrices de lumière, plus l'épaisseur du support (97) de photodiode, plus l'épaisseur du châssis conducteur (1).
5. Procédé selon la revendication 4, dans lequel une des sections (11, 13) est tournée approximativement de 180° pendant l'étape de rotation.
6. Procédé selon la revendication 5, comprenant en outre, après l'étape de rotation, l'étape de refoulement des pivots d'articulation (31, 33).
7. Procédé selon la revendication 6, dans lequel les pivots d'articulation (31, 33) ont chacun une largeur plus grande que l'épaisseur de chacune des membrures latérales (3, 5) et non supérieure à 160 % de l'épaisseur des membrures latérales.
8. Procédé selon la revendication 1, comprenant en outre, après l'étape de rotation, l'étape de création d'un guide de lumière (115) à l'intérieur de l'intervalle d'isolation (101) entre le support (91) de diode émettrice de lumière et le support (97) de photodiode (97).
9. Procédé selon la revendication 10, dans lequel l'étape de création d'un guide de lumière (115) comprend les étapes consistant à :
 - placer une première feuille (111) sur le côté arrière du conducteur (95) de diode émettrice de lumière à l'opposé de l'intervalle d'isolation (101) ;
 - placer une seconde feuille (113) sur un côté arrière du conducteur (99) de photodiode qui est opposé à l'intervalle d'isolation (101) ; et
 - remplir une cavité, existant entre la première et la seconde feuille (111, 113), avec une matière optiquement transmissive (115) de telle sorte que l'intervalle d'isolation (101) soit rempli de cette matière (115).
10. Procédé selon la revendication 1, dans lequel :
 - une des parties de fixation (81, 83) comprend en outre une branche (17) s'étendant latéralement et qui est coplanaire avec les membrures latérales (3, 5) ; et
 - l'autre desdites parties de fixation (81, 83) comprend en outre un siège (19) s'étendant latéralement ; et
 - le procédé comprend en outre, après l'étape de rabattement, l'étape d'abaissement du siège (19) d'une distance sensiblement égale à l'épaisseur de la bran-

che (17) de telle sorte que cette branche (17) repose sur la partie abaissée du siège (19) après terminaison de l'étape de rotation.

11. Procédé selon la revendication 10, comprenant en outre, après l'étape de rotation, l'étape consistant à fixer ensemble le siège (19) et la branche (17).

12. Procédé selon la revendication 1, dans lequel la section (11) de fixation de diodes émettrices de lumière est tournée après les autres étapes consistant à fixer une première feuille (113) sur un côté arrière du conducteur (99) de photodiode de telle sorte qu'une extrémité de la première feuille (113) s'étende au delà de l'extrémité du conducteur (99) de photodiode, et à fixer une feuille d'isolation (131) à l'extrémité de la première feuille (113) ainsi que sur un bord du support (97) de photodiode de telle sorte que la feuille d'isolation (131) s'écarte du support de photodiode (97) d'un certain angle afin que la partie inclinée de la feuille d'isolation (131) soit positionnée à l'intérieur de l'intervalle d'isolation (101) séparant le support (91) de diode émettrice de lumière et le support (97) de photodiode.

13. Procédé selon la revendication 12, comprenant en outre, après l'étape de fixation de la feuille d'isolation (131), les étapes consistant à refouler les pivots d'articulation (31, 33) après ladite rotation et à insérer une matière optiquement transmissive (115) dans l'intervalle d'isolation (101) entre la feuille d'isolation (131) et le support de photodiode (97).

Patentansprüche

1. Verfahren zur Herstellung eines optischen Isolators auf einem Anschlußrahmen (1) mit zwei Seitenschienen (3,5) und alternierenden LED-Bereichen (11) und Photodioden-Bereichen (13), wobei jeder Bereich (11, 13) über zwei in der Ebene der Seitenschienen (3, 5) liegende Scharnierstege (31, 33) an den Seitenschienen (3, 5) befestigt ist, mit folgenden Verfahrensschritten:

- Absenken sowohl eines LED-Befestigungsabschnitts (81) des LED-Bereiches (11) als auch eines Photodioden-Befestigungsabschnitts (83) des Photodiodenbereiches (13) auf eine unter der Ebene der Seitenschienen (3, 5) liegende Absenkeebene,
- Befestigen eines Photodioden-Halbleiterplättchens (Photodioden-Die) (97) an ei-

nem Photodioden-Anschlußstück (99) des abgesenkten Photodioden-Befestigungsabschnitts (83),

- Befestigen eines LED-Halbleiterplättchens (LED-Die) (91) an einem LED-Anschlußstück (95) des abgesenkten LED-Befestigungsabschnitts (81) und
- Drehen eines der Bereiche (11, 13) um seine beiden Scharnierstege (31, 33) und dabei Positionieren des LED-Halbleiterplättchens (91) über und in unmittelbarer Nähe von dem Photodioden-Halbleiterplättchen (97), wobei die beiden Halbleiterplättchen durch einen Trennspalt (101) getrennt sind.

2. Verfahren nach Anspruch 1, bei dem beim Dreh-Schritt der LED-Bereich (11) gedreht wird.

3. Verfahren nach Anspruch 1, bei dem beim Dreh-Schritt der Photodiodenbereich (13) gedreht wird.

4. Verfahren nach Anspruch 1, bei dem die Absenkeebene im wesentlichen parallel zur Ebene der Seitenschienen verläuft und um eine vorgegebene Absenkhöhe darunter angeordnet ist und bei dem die doppelte Absenkhöhe im wesentlichen gleich der Summe aus der Breite des Trennspalts (101), der Dicke des LED-Halbleiterplättchens (91), der Dicke des Photodioden-Halbleiterplättchens (97) und der Stärke des Anschlußrahmens (1) ist.

5. Verfahren nach Anspruch 4, bei dem einer der Bereiche (11, 13) während des Dreh-Schrittes um etwa 180° gedreht wird.

6. Verfahren nach Anspruch 5, bei dem ferner die Scharnierstege (31, 33) nach dem Drehschnitt gequetscht werden.

7. Verfahren nach Anspruch 6, bei dem die Breite der Scharnierstege (31, 33) größer ist als die Stärke jeder Seitenschiene (3, 5) und nicht größer als 160% der Stärke der Seitenschienen.

8. Verfahren nach Anspruch 1, bei dem ferner nach dem Drehschritt in dem Trennspalt (101) zwischen dem LED-Halbleiterplättchen (91) und dem Photodioden-Halbleiterplättchen (97) eine Lichtführung (115) geschaffen wird.

9. Verfahren nach Anspruch 8, bei dem der Verfahrensschritt, eine Lichtführung (115) zu schaffen, folgende Schritte aufweist:

- Anbringen einer ersten Folie (111) an eine dem Trennspace (101) abgewandte Rückseite des LED-Anschlußstückes (95),
 - Anbringen einer zweiten Folie (113) an eine dem Trennspace (101) abgewandte Rückseite des Photodioden-Anschlußstückes (99) und
 - Füllen eines Hohlraums zwischen der ersten und der zweiten Folie (111, 113) mit einem lichtdurchlässigen Werkstoff (115), so daß der Trennspace (101) mit diesem Werkstoff (115) aufgefüllt ist.
10. Verfahren nach Anspruch 1, bei dem
- einer der Befestigungsabschnitte (81, 83) ferner einen sich seitlich erstreckenden Arm (17) aufweist, der mit den Seitenschienen (3, 5) in einer Ebene liegt, und
 - der andere Befestigungsabschnitt (81, 83) ferner eine sich seitlich erstreckende Auflagefläche (19) aufweist,
 - wobei das Verfahren nach dem Absenkschritt einen weiteren Verfahrensschritt aufweist, bei dem die Auflagefläche (19) um eine der Stärke des Armes (17) im wesentlichen gleiche Strecke nach unten versetzt wird, so daß der Arm (17) nach Beendigung des Dreh-Schrittes auf dem nach unten versetzten Abschnitt der Auflagefläche (19) aufliegt.
11. Verfahren nach Anspruch 10, bei dem weiterhin nach dem Drehschnitt die Auflagefläche (19) und der Arm (17) fest miteinander verbunden werden.
12. Verfahren nach Anspruch 1, bei dem der LED-Befestigungsabschnitt (11) nach einem zusätzlichen Verfahrensschritt gedreht wird, bei welchem eine erste Folie (113) an einer Rückseite des Photodioden-Anschlußstückes (99) so befestigt wird, daß sich ein Ende der ersten Folie (113) über das Ende des Photodioden-Anschlußstückes (99) erstreckt, und eine Trennfolie (131) am Ende der ersten Folie (113) und an einer Kante des Photodioden-Halbleiterplättchens (97) derart befestigt wird, daß diese Trennfolie (131) das Photodioden-Halbleiterplättchen (97) schräg überlagert, wobei der schräge Abschnitt der Trennfolie (131) in dem Trennspace (101) liegt und das LED-Halbleiterplättchen (91) und das Photodioden-Halbleiterplättchen (97) trennt.
13. Verfahren nach Anspruch 12, bei dem ferner nach dem Befestigen der Trennfolie (131) die Scharnierstege (31, 33) gequetscht werden,

und zwar nach der Drehung und nach dem Einfügen eines lichtdurchlässigen Werkstoffes (115) in den Trennspace (101) zwischen die Trennfolie (131) und das Photodioden-Halbleiterplättchen (97).

