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Zero insertion force mount for fixing and making contact with circuit subassemblies on a substrate

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The invention relates to a zero insertion force mount for fixing and making contact with circuit subassemblies on a substrate, having a plurality of contact elements and a zero insertion force device.

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In modular electronic systems with variable configuration, a system circuit board with one or with a plurality of installation spaces (slots) is usually provided. The slots are respectively populated with a modular component, depending on the requirements on the system or on the level of expansion of the system, or remain unpopulated.

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A typical example of such a modular system is a computer system (PC, workstation, server) with a working memory which can be expanded, slots for memory modules being provided on the system circuit board in the form of insertion mounts and being populated with memory modules, depending on the desired size of the working memory.

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Normal memory modules such as SIMMs (single in-line memory modules) and DIMMs (dual in-line memory modules) have contact surfaces arranged along a contact edge of the memory module, on one side or both sides, in order to make electrical contact. When the memory module is installed in the slot, the memory module is inserted with the contact edge into the insertion mount (edge connector). For this purpose, the insertion mount has, on inner sides of a holding device formed as a groove, contact elements which correspond to the contact surfaces of the memory modules and which, during

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population, are deformed and exert a spring force resulting from the deformation on a memory module arranged in the holding device.

5 The number of contact elements per insertion mount is 168 for memory configurations with SDRAM components (synchronous dynamic random access memory), 184 for memory configurations with DDRI components (double data rate I DRAM), and about 240 for those with DDRII
10 components (double data rate II DRAM). In general, for faster concepts for memory configurations, an increasing number of contact elements is to be expected in the insertion mounts.

15 With each contact element, the expenditure of force needed for fixing and removing the memory modules increases. The stressing of the system circuit board when fitting the memory modules rises and, to the same extent, so does the probability of damage to sensitive
20 structures on the system circuit board or to the contact elements of the insertion mount. Thus, normal insertion mounts for memory modules are nowadays specified for only about 25 insertion cycles.

25 However, the contact force exerted by each contact element may not be reduced significantly since, as the contact force decreases, the reliability of making contact is reduced.

30 In particular for testing semiconductor devices, use is made of test sockets with ZIF mechanisms (zero insertion force mechanisms), with which population of the test socket which in particular looks after the contact elements of the test socket is possible.

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Such a test socket is illustrated schematically in cross section in figure 2. The test socket 11 is

arranged on a substrate surface 30 of a substrate 3 and has a zero insertion force device 9. A semiconductor device 21' is provided on a carrier 22 which has contact-making devices 13'. Each contact-making device 13' is assigned a contact recess 14 in the test socket 11, said recess being bounded on one side by a section of a contact-making device 13.

The zero insertion force device 9 comprises a lever arm 91 that can be rotated about an axis of rotation 94, a slide 95 that can move parallel to a substrate surface 30, and a conversion device 93. The conversion device 93 converts a rotation of the lever arm 91 into a displacement of the slide 95. The slide has a limiting element 12 for each contact recess 14.

In an unpopulated state of the test socket 11, in this case the limiting elements 12 are arranged on the side of the contact recesses 14 respectively located opposite the contact-making devices 13.

When the carrier 22 is fed into the test socket 11, the contact-making devices 13' of the carrier 22 in the contact recesses 14 are in each case arranged between one of the contact-making devices 13 of the test socket 11 and one of the limiting elements 12 of the slide 95. As a result of rotation of the lever arm 91 in the counterclockwise direction, the slide 95 is moved to the left. In the process, the contact-making devices 13' of the carrier 22 are clamped in between one of the contact-making devices 13 and one of the limiting elements 12 in each case. The carrier 22 is therefore connected mechanically and electrically to the substrate 3.

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Using such a test socket, illustrated in figure 2, however, making contact for example with DIMMs with

rows of contact surfaces arranged on both sides along a contact edge of the memory module is not possible. In this case, contact elements would have to be provided in the contact recesses of the test socket of figure 2
5 for both sides of the contact edge and connected to the substrate by fixed contact-making devices. However, the slide 95 would then no longer be movable.

A zero insertion force mount of a different kind for
10 memory modules is disclosed by US 6,371,781 (Jones et al.). In this case, before the actual fitting of the memory modules at the slot, mechanical adapters having snap-in connectors are fixed to the memory modules, for example screwed or riveted. When fitted at the slot,
15 the snap-in connectors latch into prepared matching pieces of the zero insertion force mount. The snap-in connectors then press the contact elements onto the memory module in the fitted state. In this case, the insertion force needed for fitting is reduced by the
20 wedge-like design of the snap-in connectors.

The disadvantage with such a zero insertion force mount is in particular the high expenditure and the high space requirement. The high space requirement is
25 disadvantageous in particular in an arrangement of a plurality of such insertion mounts beside one another since, with the distance of the slots from one another, propagation time differences of signals fed into memory modules provided in the insertion mounts also increase.
30 It is precisely for future, fast systems that such zero insertion force mounts can be used only conditionally.

It is therefore an object of the present invention to provide a zero insertion force mount for fixing and
35 making contact with circuit subassemblies having contact surfaces arranged on two mutually opposite surfaces in which the circuit subassemblies can be

arranged close beside one another and no mechanical changes have to be made on the latter in order to fit said mount with circuit subassemblies.

5 In an arrangement of the type mentioned at the beginning, according to the invention this object is achieved by the features specified in the defining part of patent claim 1. Advantageous developments of the invention emerge from the subclaims.

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The zero insertion force mount according to the invention therefore has a zero insertion force device and a plurality of holding devices arranged beside one another and parallel to one another to be populated
15 with circuit subassemblies. Mechanical components needed for a zero insertion force device can, at least to some extent, be assigned to more than one single holding device. The space requirement per holding device is therefore reduced. Together with the
20 arrangement of the holding device in a common insulating body (connector block), as compared with known solutions, the result is a very low space requirement of the zero insertion force device per holding device (slot). Circuit subassemblies arranged
25 in the holding devices can be arranged very close beside one another. Propagation time differences of signals fed into the circuit subassemblies are minimized.

30 The zero insertion force device, in a stressed state, fixes the circuit subassemblies arranged in or on the holding devices (5) by means of a pressing force exerted via the contact elements. In a released state, the pressing force exerted by the contact elements is
35 at least reduced by the zero insertion force device.

Furthermore, in the released state of the zero insertion force device, the circuit subassemblies can be fed into the holding devices or removed without significant expenditure of force. In the process, the probability that damage will occur during the feeding or removal of the circuit subassemblies is advantageously reduced. In addition, the contact elements are not subjected to any wear as a result of insertion cycles.

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In a preferred embodiment of the zero insertion force mount according to the invention, the zero insertion force device is actuated by means of a lever arm. In a first position of the lever arm, the zero insertion force mount is in a released state, in which the circuit subassemblies are removed or fed in. In a second position of the lever arm, the zero insertion force mount is in the stressed state, in which the circuit subassemblies are fixed and contact is made with them.

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Rotation of the lever arm about an axis of rotation during the transition between the two positions is converted by means of a conversion device into a displacement of reinforcements of the zero insertion force device.

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Fixing the lever arm in the second position, corresponding to the stressed state, is required in order to make reliable contact and is preferably carried out by means of a spring force.

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According to a preferred embodiment of the zero insertion force mount according to the invention, the spring force is exerted by the conversion device. The conversion device is then formed approximately as a body of elliptical cross section, which, at least to

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some extent, is formed from a resilient material, for example an elastomer, and is arranged along the axis of rotation of the lever arm. In this case, the body preferably extends over a length which corresponds
5 approximately to a longitudinal extent of the holding devices.

The contact elements of a holding device in each case are arranged in a front row of contacts and a rear row
10 of contacts. If the holding devices are in each case formed as a groove or slot in an insulating body, then the two rows of contacts are in each case arranged opposite one another, directly or with an offset, on inner sides of the groove or the slot, running along
15 the holding device.

The contact elements of each row are connected to one another in a mechanically rigid manner. Furthermore, via the reinforcements of the zero insertion force
20 mount, in each case all the front and/or all the rear rows of contacts are connected to one another in a mechanically rigid manner.

According to the zero insertion force mount according
25 to the invention, in each case a plurality of, but preferably all the rows of contacts of at least one type, can be deformed and/or displaced jointly by the zero insertion force device.

30 Preferably, only the contact elements in each case of one type of a row of contacts can be deformed and/or displaced jointly by the reinforcement. The contact elements of the rows of contacts of the respective other type are fixed. The zero insertion force mount
35 according to the invention in this case preferably has spring elements which exert a force on the fixed contact elements in the direction of the deformable

and/or displaceable contact elements, and in this way support the reliable making of contact with a circuit subassembly arranged in the holding device.

5 The spring elements are preferably formed from a resilient material. In a particularly preferred embodiment of the zero insertion force mount according to the invention, the spring elements of a row of contacts in each case form a unit and are formed as a
10 common spring element.

The common spring element is then preferably formed as a body of elliptical cross section in each case extending at least over the entire length of the rows
15 of contacts and formed of a resilient material, for example an elastomer. The common spring element is preferably arranged at the level of a contact region of the contact elements, on a mounting side facing away from the contact region. In this case, the contact
20 region of a contact element is the region in which the contact element makes contact with the contact surfaces of a circuit device arranged in the holding device.

The zero insertion force mount preferably has a solid
25 insulating body, in which the holding devices are in each case formed as a groove or slot. The insulating body reinforces the zero insertion force mount and fixes the contact elements in an electrically insulating way. The slots permit simple adjustment of
30 the circuit subassemblies relative to the contact elements and mechanically stabilize the circuit subassemblies arranged in the slots.

All the contact elements can have contact-making
35 devices, by means of which the individual contact elements can be electrically conductively connected to signal lines arranged on or in the substrate. In a

particularly preferred way, however, contact connections are provided in the zero insertion force mount according to the invention, and in each case electrically connect to one another mutually
5 corresponding contact elements of different rows of contacts switching the same bus signal to the circuit subassemblies. As a result, the number and action of reflection points acting on the bus signals and formed by the contact elements and contact-making devices 8,
10 and a parasitic capacitance or parasitic effects of the zero insertion force mount can be reduced.

On each holding device, further devices known to those skilled in the art have to be provided as required for
15 supporting the fitting operation and for fixing the circuit subassemblies in the holding devices. Such devices are, for example, additional guide aids, coding devices against wrong fitting, ejection mechanisms and locking means.

20 In the following text, the invention will be explained in more detail using figures, the same reference symbols being used for mutually corresponding components. In the figures:

25 **fig. 1** shows a schematic cross section of an arrangement having a zero insertion force mount according to the invention according to one exemplary embodiment of the invention, in the released and stressed state,
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fig. 2 shows a schematic cross section through an arrangement with a conventional test socket,

fig. 3 shows a schematic plan view of the arrangement having a zero insertion force mount according to the invention according to the exemplary
35 embodiment of the invention, in the released state, and

fig. 4 shows a perspective illustration of an arrangement comprising two contact elements and a contact connection provided between the contact elements according to the exemplary embodiment of the zero insertion force mount according to the invention.

Fig. 2 has already been explained at the beginning.

A zero insertion force mount 1 is illustrated in each case in fig. 1a and fig. 1b. The zero insertion force mount 1 is in this case arranged on a substrate surface 30 of a substrate 3. Arranged in an insulating body 4, of the zero insertion force mount 1, beside one another and parallel to one another, is a plurality of holding devices 5, in each case formed as a slot in the insulating body 4.

Provided on inner sides 51 of the holding devices 5, located opposite one another, directly or with an offset, are front rows of contacts 72 and rear rows of contacts 73 of contact elements 7, 7'. In each case corresponding contact elements 7, 7' of different rows of the same type are electrically conductively connected to one another via contact connections 10. The contact elements 7 of the front rows of contacts 72 are fixed in the insulating body 4. Spring elements 71 act on the contact elements 7 of the front rows of contacts 72. The spring elements 71 exert a force in the direction of the opposite rear rows of contacts 73. The contact elements 7' of the rear rows 73 are connected to one another in a mechanically rigid manner.

A number of the contact elements 7 have contact-making devices 8 for electrical connection to signal lines arranged on or in the substrate 3.

The zero insertion force device 9 comprises a lever arm 91 which can be rotated about an axis of rotation 94, a reinforcement 92 that can move parallel to a substrate surface 30, and a conversion device 93. The conversion
5 device 93 transforms a rotation of the lever arm 91 into a displacement of the reinforcement 92 parallel to the substrate surface 30. The reinforcement connects the rear rows of contacts 73 in a mechanically rigid manner.

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In fig. 1a, the zero insertion force mount is illustrated in a released state. The lever arm 91 is in a first position. The spring elements 71 are relieved of stress, as is the conversion device 93.
15 The spacing of contact regions 70 between two contact elements 7 located opposite one another, directly or with an offset, is maximal.

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In this state, the circuit subassemblies 2 can be inserted into the slots of the holding devices 5 without an opposing force exerted by the contact elements 7 having to be overcome in the process.

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Following the insertion of the circuit subassemblies 2 into the slots of the holding device 5, the lever arm 91 is moved in the counterclockwise direction, until it is aligned substantially parallel to the substrate surface 30. Because of the elliptical cross section of the conversion device 94, the reinforcement 92 is
30 displaced to the left in the process. The contact elements 7 of the rear row of contacts 73, connected to the reinforcement 92 in a mechanically rigid manner, are forced in the direction of the front rows of contacts 72 in the contact region. The spacing of
35 contact regions 70 between two contact elements 7 located opposite one another, directly or with an offset, is reduced.

If a circuit subassembly 2 is arranged in a holding device 5' in this case, then, in a stressed state, which is illustrated in fig. 1b, said circuit
5 subassembly 2 is in each case fixed between the front row of contacts 72 and the rear row of contacts 73, the spring elements 71 and the conversion device 93 exerting a contact force, needed for making contact, on the contact elements 7. Furthermore, fig. 1b reveals
10 that, in the stressed state shown of the zero insertion force mount 1, the lever arm 91 is aligned substantially parallel to the substrate surface 30.

In fig. 3, the zero insertion force mount illustrated
15 in fig. 1 is shown in a plan view. At the same time, the arrangement of the contact elements 7, 7' in relation to one another is additionally revealed by fig. 3. In this case, the contact elements 7, 7' in each case lie directly opposite rows of contacts 72, 73
20 assigned to a holding device 5 in this example. However, if required, it is also possible to arrange the contact elements 7, 7' to be located opposite one another with an offset.

25 Furthermore, fig. 3 reveals that the conversion device 93 is arranged along the axis of rotation 94 and has a longitudinal extent which corresponds substantially to a longitudinal extent of the holding devices 5.

30 In fig. 4, two pairs 7, 7 and 7', 7' of contact elements 7, 7' in each case connected by means of a contact connections 10 are illustrated. In this case, the contact elements 7, 7' respectively assigned to a common holding device 5 are located opposite one
35 another with an offset.

List of reference symbols

1	insertion mount
10	contact connection
11	test socket
12	limiting element
13, 13'	contact pin
14	contact recess
2	circuit subassembly
21, 21'	semiconductor device
22	carrier
3	substrate
30	substrate surface
4	insulating body
5, 5'	holding device
51	inner side
6	contact surface
7, 7'	contact element
70	contact region
71	spring element
72	front row of contacts
73	rear row of contacts
8	contact-making device
9	zero insertion force device
91	lever arm
92	reinforcement
93	conversion device
94	axis of rotation
95	slide

Patent claims

1. A zero insertion force mount (1) for fixing and making contact with circuit subassemblies (2) on a substrate (3), having a plurality of contact elements (7) and a zero insertion force device (9), defined by
5 - a plurality of holding devices (5) for holding the circuit subassemblies (2).
- 10 2. The zero insertion force mount as claimed in claim 1, wherein, by means of the zero insertion force device (9), in a stressed state, the circuit subassemblies (2) arranged in or on the holding devices (5) are fixed by means of a pressing force exerted via the contact
15 elements (7) and, in a released state, the pressing force exerted by the contact elements (7) on the circuit subassemblies (2) is at least reduced.
3. The zero insertion force mount as claimed in either of claims 1 or 2, wherein, in the released state
20 of the zero insertion force device (9), the circuit subassemblies (2) can be fed into the holding devices (5) and removed without any force acting counter to a pressing force exerted on the contact elements (7).
- 25 4. The zero insertion force mount as claimed in one of claims 1 to 3, defined by a lever arm (91) which belongs to the zero insertion force device (9) and, during a change from a first into a second position, sets the zero insertion force device (9) into the
30 stressed state and, during a change from the second into the first position, sets the zero insertion force device (9) into the released state.
- 35 5. The zero insertion force mount as claimed in claim 4, defined by a conversion device (93) which belongs to the zero insertion force device (9) and transforms a

rotation of the lever arm (91) about an axis of rotation (94) into a displacement of reinforcements (92) of the zero insertion force device (9).

5 6. The zero insertion force mount as claimed in claim 5, wherein the lever arm (91) can be fixed in the second position by the conversion device (93).

7. The zero insertion force mount as claimed in claim
10 6, wherein the lever arm (91) can be fixed in the second position by the conversion device (93) by means of a spring force.

8. The zero insertion force mount as claimed in one
15 of claims 5 to 7, wherein the conversion device (93) is formed as a body with an elliptical cross section arranged substantially along the axis of rotation (94) of the lever arm (91) and formed of a resilient material.

20 9. The zero insertion force mount as claimed in one of claims 1 to 8, wherein the contact elements (7) of a holding device (5) are in each case arranged in a front row of contacts (72) and in a rear row of contacts (73)
25 located opposite the front row of contacts (72) on a circuit subassembly (2) arranged in or on the holding device (5), the contact elements (7) of a row of contacts (72, 73) are in each case connected to one another in a mechanically rigid manner, and the contact
30 elements (7) of at least one of the rows of contacts (72, 73) in each case are deformable and/or displaceable jointly, at least in sections.

10. The zero insertion force mount as claimed in claim
35 9, wherein in each case a plurality of front (72) and/or rear (73) rows of contacts are connected to one another in a mechanically rigid manner by means of the

reinforcements (92), and the contact elements (7) in each case of the front (72) and/or the rear (73) rows of contacts are deformable and/or displaceable jointly.

5 11. The zero insertion force mount as claimed in claim 10, wherein in each case at least sections of the contact elements (7) of one of the front (72) or the rear (73) rows of contacts are deformable and/or displaceable jointly, and the contact elements of the
10 respective other row of contacts are fixed.

12. The zero insertion force mount as claimed in claim 11, defined by a spring element (71) that exerts a force acting on the fixed contact elements (7) in the
15 direction of the deformable and/or displaceable contact elements (7).

13. The zero insertion force mount as claimed in claim 12, wherein the spring elements (71) are formed of a
20 resilient material.

14. The zero insertion force mount as claimed in one of claims 11 to 13, wherein the spring elements of a row of contacts (72, 73) are in each case formed as a
25 common spring element (71) forming a unit.

15. The zero insertion force mount as claimed in claim 14, wherein the common spring element (71) is formed as a body with an elliptical cross section which in each
30 case extends substantially over the entire length of the rows of contacts (72, 73), is arranged at the height of a contact region (70) of the contact elements (7) on a mounting side facing away from the contact region (70) and is formed of a resilient material.

35 16. The zero insertion force mount as claimed in one of claims 1 to 15, defined by an insulating body (4),

in which the holding devices (5) are in each case formed as a groove for holding the circuit subassemblies (2).

5 17. The zero insertion force mount as claimed in one of claims 1 to 16, defined by a plurality of contact connections (10) connecting respectively corresponding contact elements (7) of a plurality of rows of contacts (72, 73) electrically to one another.

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18. A zero insertion force mount (1) for fixing and making contact with circuit subassemblies (2) on a substrate (3), comprising

- a plurality of holding devices (5) for holding the
15 circuit subassemblies (2),

- a plurality of contact elements (7) in each case assigned to a holding device (5) and arranged in a front row of contacts (72) and in a rear row of contacts (73) opposite the front row of contacts (72)
20 on a circuit subassembly (2) arranged in or on the holding device (5), the contact elements (7) of a row of contacts (72, 73) in each case being connected to one another in a mechanically rigid manner, and the contact elements (7) in each case of at least one of
25 the rows of contacts (72, 73) being deformable and/or displaceable jointly, at least in sections, and

- a zero insertion force device (9) having a lever arm (91) which, during a change from a first into a second position, sets the zero insertion force device (9) into
30 a stressed state and, during a change from the second into the first position, sets the zero insertion force device (9) into a released state, defined by a conversion device (93) which belongs to the zero insertion force device (9) and transforms a rotation of
35 the lever arm (91) about an axis of rotation (94) into a displacement of reinforcements (92) of the zero insertion force device (9), in each case a plurality of

front (72) and/or rear (73) rows of contacts being connected to one another in a mechanically rigid manner by means of the reinforcements (92), the contact elements (7) in each case of the front (72) or the rear
5 (73) rows of contacts being deformable and/or displaceable jointly and the contact elements of the respective other row of contacts being fixed.