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Arrangement, plug-in mount and contact element for
fixing and contacting switching assemblies on a
5 substrate

The invention relates to an arrangement for fixing and
contacting a switching assembly, having contact areas,
on a substrate, comprising signal lines arranged on the
10 substrate and a plug-in mount, having at least one
receiving device and contact elements, for being loaded
with the switching assembly and for mounting on the
substrate. The invention also relates to a plug-in
mount and contact elements for such an arrangement.

15 In the case of modular electronic systems with variable
configuration, a system board with a mounting location
or a plurality of mounting locations for modular
components is usually provided. The mounting locations
20 are respectively loaded with a modular component in
accordance with the requirements for the system or with
the expansion stage of the system, or remain unloaded.
The interfaces of the modular components are in this
case necessarily the same or compatible with one
25 another. Beyond that, no functional similarity of the
modular components is required. The modular components
are, for instance, switching assemblies such as memory
modules or interface modules.

30 The mounting locations are usually formed as plug-in
mounts which are fixed on a substrate, for instance a
system board (motherboard). The plug-in mounts also
respectively establish an electrical connection between
signal lines on the substrate and contact areas on the
35 switching assemblies.

The plug-in mounts make it possible for switching assemblies to be easily exchanged, or easily retrofitted.

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A typical example of such a modular system is a computer system (PC, workstation, server) with an expandable main memory, mounting locations (slots) for memory modules being provided on the system board in the form of plug-in mounts and being loaded with memory modules in accordance with the desired size of the main memory. Since the number of mounting locations in a system is based on a maximum expansion, generally one or more plug-in mounts are unloaded. Since, furthermore, a bus system with a smaller number of memory modules allows a higher data transmission rate, maximum expansion of the system is also deliberately dispensed with in applications where speed is relevant.

20 With higher clock rates and data transmission rates to and from the memory modules, the requirements imposed on the forming of the signal lines of the bus system increase. To ensure higher clock rates on the bus systems, generally short signal lines, lowest possible parasitic capacitances, inductances and resistances, and also the smallest possible number of reflection points along the signal lines are required.

Even in the unloaded state, arrangements with customary plug-in mounts have a high parasitic capacitance and at least one considerably disruptive reflection point. This is explained below on the basis of figure 3.

The arrangement represented in figure 3 shows a plug-in mount 1 arranged on a substrate 3. The plug-in mount 1 comprises an insulating body 4, in which a receiving

device 5 for receiving a switching assembly 2 is provided. The switching assembly 2 has contact areas 6. Arranged in the receiving device 5 are contact pins 9 each with a contact element 7 and a contact device 8. The contact devices 8 are connected in an electrically conducting manner to signal lines 32, 32' arranged on or in the substrate 3.

10 In the illustration on the right of figure 3, the plug-in mount 1 is loaded with a switching assembly 2 arranged in the receiving device 5. The contact elements 7 contact the respectively corresponding contact areas 6.

15 In the illustration on the left of figure 3, the plug-in mount 1 is unloaded. The contact elements 7 respectively form an antenna-like stub of assigned signal lines 32, 32'. This stub forms a capacitance, which deforms a signal shape of a signal transmitted on the signal line 32, or delays the signal. End points and edges of the contact elements 7 are reflection locations. Signals reflected there act as interference signals for the signals transmitted on the signal lines 32, 32'. In general, customary plug-in mounts in high-speed bus systems in the empty, unloaded state lead to increased interferences and, as a result, restrict the possible data transmission rate within the bus system.

30 It is therefore an object of the invention to provide an arrangement in which the signal integrity in a configurable modular system is improved in comparison with conventional arrangements when it is in an incomplete system configuration. A second object of the invention is to provide a plug-in mount for an arrangement according to the invention. In addition,

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it is an object of the invention to provide a contact element for a plug-in mount according to the invention.

- 5 In a first aspect of the present invention is as expressed in claim 1. In a second aspect of the invention is as expressed in claim 3. In a third aspect the present invention is as expressed in claim 12. In a fourth aspect, the invention is as expressed in claim 13.
- 10 Advantageous developments of the arrangement according to the invention emerge from the subordinate patent claims.

In the case of an arrangement according to the invention, contact elements of a plug-in mount in the unloaded state
15 of the plug-in mount therefore do not have contact with signal lines embossed on a substrate. The contact elements are connected in an electrically conducting manner to the signal lines of a bus system exclusively in the loaded state of the plug-in mount.

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The arrangement according to the invention has in the unloaded state no reflection locations and no additional, parasitic capacitances which impair the signal integrity on the signal lines. The arrangement according to the
25 invention makes higher clock and data transmission rates possible for bus systems in the case of incomplete system configurations.

To be specific, the arrangement according to the invention
30 for fixing and contacting switching assemblies on a substrate comprises signal lines arranged on the substrate which have contact zones on a surface of the substrate

facing the plug-in mount. Furthermore, the arrangement according to the invention comprises a plug-in mount with at least one receiving device and contact elements which in the loaded state of the plug-in mount respectively lie
5 opposite corresponding contact areas of a switching assembly arranged in the receiving device and contact said assembly.

The contact elements are formed furthermore in such a way
10 that, in the loaded state of the arrangement, the contact elements are electrically contacted respectively in a first contact region with one of the contact zones on the substrate.

15 In an unloaded state, without a switching assembly arranged in the receiving device, the contact elements are electrically isolated from the contact zones.

The receiving device is preferably formed as a groove in a
20 insulating body. The contact elements are respectively provided in rows on one or two inner surfaces of the groove and lying opposite contact areas arranged on at least one edge of the switching assembly. In addition, if required, the receiving device has customary specialist formations,
25 such as coding devices, additional guiding and fixing elements or an ejecting mechanism.

In the case of a further preferred embodiment of the arrangement according to the invention, the contact
30 elements arranged in the plug-in mount are provided in such a way that they are displaceable at least in a direction perpendicular to the substrate. In this case, the contact

element is in a position remote from the substrate in the unloaded state and in a position near the substrate in the loaded state. In the near position, the contact element rests on the corresponding contact zone, while in the
5 remote position the contact element is electrically isolated from the contact zone.

A particularly preferred form of the arrangement according to the invention the first contact regions of the contact
10 elements may be without contact with respect to the contact zones of the signal lines.

In the loaded state, the contact elements in the first contact region contact the corresponding contact zones of
15 the signal lines and in the second contact region contact the corresponding contact areas of the switching assembly.

Such a contact element can be realized in various ways, for instance be formed in a u-shaped manner, the second contact region being formed on one of the legs of the u-shaped contact element and the first contact region being formed on the crosspiece. The contact element is preferably formed in an annular manner and fixed at an anchoring point to the inner side of the receiving device. By being formed as a ring, the contact element is made more rigid and able to undergo mechanical loading.

According to a further form of the arrangement according to the invention, the first and second contact regions of a contact element are respectively arranged such that they can be pivoted about a common axis of rotation and offset with respect to one another by an angle which is preferably at least 20 degrees. In the unloaded state, at least one of the contact regions or a mechanical lever element is located at least partly in the feed path of a switching assembly to be arranged in the receiving device of the plug-in mount. The feeding of the switching assembly has the effect that both contact regions of the contact element are pivoted into a loading position, in which the contact regions electrically contact the contact zones or contact areas. Furthermore, during the feeding of the switching assembly, a spring force device, for instance a torsional moment of the axis of rotation, is tensioned. When the switching assembly is removed, the spring force device pivots the contact element back again into the starting position, in which the first contact region is not contacting the contact zone. An advantageous form of this arrangement is obtained if the contact arms are offset with respect to one another by about 45 to 135 degrees or 160 to 180 degrees.

According to a further particularly preferred embodiment of the arrangement according to the invention, the signal lines on the substrate have interruption points and two partial contact zones, which are arranged on either side of the interruption point and can be bridged by the first contact region of the contact element corresponding to the signal line, so that in the loading case the two partial contact zones of the signal line are respectively electrically connected to one another.

This embodiment of the invention is particularly advantageous, because the line lengths of the signal lines are adapted to the actual system expansion in a very easy and economical way. It merely has to be ensured that the plug-in mounts are loaded in a fixed sequence. The signal lines of the bus system are interrupted at the first unloaded plug-in mount and are respectively lengthened further as required by simple loading. As a result, the clock rate can be adapted to the respective system configuration.

In the case of continuous uninterrupted loading of the plug-in mounts, starting from a control module arranged on the substrate or on a further plug-in mount, a first partial contact zone is oriented with respect to the control module and a second partial contact zone is oriented with respect to the unloaded plug-in mounts.

Terminating zones, which are respectively electrically connected to a termination, which may also be arranged on the rear side of the substrate, are advantageously provided on the surface of the substrate.

The contact elements additionally have for this purpose a third contact region. By means of the third contact

region, a terminating zone and the first partial contact zone are respectively connected in an electrically conducting manner in the unloaded state, while the terminating zone is isolated from the first partial contact zone in the loaded state. In the case of this embodiment of the arrangement according to the invention, the signal lines are terminated at the first unloaded plug-in mount respectively during continuous uninterrupted loading of the plug-in mounts. The arrangement of the termination is consequently adapted to the respective system configuration in a very easy and economical way.

The contact zones are preferably provided with a greater transverse extent than the signal lines, in order to increase a contacting area with the contact elements. As a result, a smaller contact resistance and more reliable contacting are achieved.

The greater transverse extent leads to a reduced impedance of the signal lines and consequently to a mismatch. The mismatch when there is a short contact zone in relation to a wavelength of a signal transmitted on the signal line can be compensated by an increased impedance, that is portions of smaller transverse extent of the signal line, before and/or after the contact zone.

Since, however, in the case of contact zones with a greater transverse extent the transitions between the signal lines and the contact zones also form reflection points, according to a further preferred embodiment the contact zones are provided with the same cross section as the signal lines. Reliable contacting is then ensured by a coating of the contact zones with a

particularly suitable material, for instance a gold alloy.

An arrangement according to the invention of the type
5 described also comprises in each case a plug-in mount according to the invention, as already described in connection with the arrangement according to the invention.

10 Similarly, a plug-in mount according to the invention of the type described also has in each case a plurality of contact elements according to the invention, as already described in connection with the arrangement according to the invention.

15 The invention is explained in more detail below on the basis of the figures, the same reference numerals being used for components which correspond to one another. In the figures:

20 figure 1 shows a schematic cross section of an arrangement according to the invention on the basis of a first exemplary embodiment of the invention,

25 figure 2 shows a schematic representation of a line-bus system,

30 figure 3 shows a schematic cross section of a conventional arrangement,

35 figure 4 shows a schematic cross section of an arrangement according to the invention on the basis of a second exemplary embodiment of the invention,

figure 5 shows a plan view of a substrate in a detail of an arrangement according to the invention with signal lines having contact zones on the basis of the first or second exemplary embodiment of the arrangement according to the invention and

figure 6 shows a schematic cross section of an arrangement according to the invention on the basis of a third exemplary embodiment of the invention and a plan view of a substrate in a detail of the arrangement.

Of these, figure 3 has already been explained at the beginning.

The arrangement represented in figure 1 shows a plug-in mount 1 according to the invention, arranged on a substrate 3. The plug-in mount 1 in this case comprises an insulating body 4, in which a receiving device 5, formed as a groove, for receiving a switching assembly 2 is formed. The switching assembly 2 has contact areas 6. Arranged in the receiving device 5 are annular, elastic contact elements 7, which are respectively fixed at an anchoring point 73 provided on an inner side 51 of the receiving device 5.

The substrate 3 has signal lines 32 with contact zones 34. In the region of the contact zones 34, the signal lines 32 are formed on the surface of the substrate 3 without any covering insulation. In addition, the contact zones 34 may be coated with a material which has good contact properties. The contact zones 34 are in this case respectively arranged underneath corresponding contact elements 7.

In the illustration on the left of figure 1, the plug-in mount 1 is represented in the unloaded state. The contact elements 7 are in the relaxed state and without contact with respect to the respectively corresponding contact zones 34 on the substrate 3. In an extent parallel to the surface of the substrate 3, the contact elements 7 extend into a feed path of a switching assembly 2 to be arranged in the receiving device 5.

10 If a plug-in mount 1 is then loaded, in that a switching assembly 2 is fed into the receiving device 5, the contact elements 7 are compressed in a direction horizontal to the surface of the substrate 3. At the same time, the extent of the contact elements 7 in the direction perpendicular to the surface of the substrate 3 increases.

In the illustration on the right of figure 1, the plug-in mount 1 is shown loaded with a switching assembly 2 arranged in the receiving device 5. The contact elements 7 are respectively contacting the contact zones 34 of the signal lines 32 on the substrate 3 in a first contact region 701 and the contact areas 6 on the switching assembly 2 in a second contact region 702.

25 If the switching assembly 2 is removed from the receiving device 5, the contact elements 7 relax and revert to the original shape. The contacting between the contact element 7 and the corresponding contact zones 34 is discontinued.

In the unloaded state, the contact elements 7 are electrically isolated from the signal lines 32 and do not form any parasitic impedance or any reflection point for signals transmitted on the signal lines 32.

In figure 2, an arrangement with a line-bus system (stub bus) with signal lines 32 routed between a control module 31 and terminations 36 is schematically represented. The system has two mounting locations for memory modules 2. The mounting locations are provided as plug-in mounts 1. For each plug-in mount 1, a stub 33 is respectively provided from the signal lines 32 of the line-bus system.

10 The arrangement represented in figure 4 differs from the arrangement shown in figure 1 in the form of the contact elements 7. The two contact regions 701, 702 of a contact element 7 are arranged on different contact arms of the contact element 7. The contact arms are in this case provided such that they can pivot about a common axis of rotation 74.

In the illustration on the left of figure 4, the plug-in mount 1 is unloaded. The contact elements 7 are in the relaxed state. The contact arms having the first contact regions 701 are without contact with respect to the contact zones 34 on the substrate 3. The contact arms having the second contact region 702 extend into a feed path of a switching assembly 2 to be arranged in the receiving device 5. Chance contacting between the contact elements 7 and the contact zones 34, for instance due to mechanical vibration, is avoided by the contact elements 7 bearing against inner sides 51 of the receiving devices 5.

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If a plug-in mount 1 is then loaded, in that a switching assembly 2 is arranged in the receiving device 5, the contact arms having the second contact regions 702 are pivoted away from the switching assembly 2. At the same time, the other contact arm, respectively, with the first contact region 701, is

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pivoted in a direction toward the surface of the substrate 3.

In the illustration on the right of figure 4, the plug-in mount 1 is loaded with a switching assembly 2 arranged in the receiving device 5. The contact elements 7 are respectively contacting the contact zones 34 of the signal lines 32 on the substrate 3 in a first contact region 701 and the contact areas 6 on the switching assembly 2 in a second contact region 702.

When the plug-in mount 1 is loaded, a spring force device, which in the simplest case is realized by a torsional moment of the axis of rotation 74, is tensioned at the same time. If the switching assembly 2 is removed from the receiving device 5, the spring force devices relax and the contact elements 7 pivot back again into the starting position.

Figure 5 respectively shows portions of signal lines 32 with contact zones 34 in the plan view of a substrate 3. In this case, the routing of the signal lines 32 respectively represented on the left is obtained if contact zones 34 are arranged in two rows lying offset opposite one another in a way corresponding to an arrangement of corresponding contact areas of the switching assemblies. The routing of the signal lines 32 respectively represented on the right is obtained if the contact areas of the switching assemblies lie in two rows directly opposite one another.

In figure 5a, the contact zones 34 are provided with a greater transverse extent than the signal lines 32, in order to increase a contacting area with the contact elements. As a result, a smaller contact resistance and more reliable contacting are achieved. However,

the transitions between the signal lines 32 and the contact zones 34 form reflection points and the widened contact zones 34 form a reduced impedance.

5 In figure 5b, the contact zones 34 are provided with the same transverse extent of the signal lines 32, whereby reflection points are avoided and the impedance is not reduced. Reliable contacting is ensured by a coating of the contact zones 34 with a particularly
10 suitable material, for instance a gold alloy.

A further arrangement with contact elements 7 with contact regions 701, 702 provided on pivotable contact arms is shown in figure 6.

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The plug-in mount represented in figure 6a has in this case contact elements 7 with an additional contact region 703 arranged on a third contact arm. In the unloaded state, the third contact region 703
20 respectively contacts a terminating zone 34' arranged on the surface of the substrate.

The terminating zones 34' are connected in an electrically conducting manner respectively by means of
25 via holes 35 to terminations 36 fixed on a rear side of the substrate 3 facing away from the plug-in mount 1.

The contact zones arranged on the surface of the substrate 3 facing the plug-in mount 1 are divided into
30 partial contact zones 341 and 342 lying opposite one another at an interruption point 37.

In the illustration on the left of figure 6a, the plug-in mount 1 is unloaded. The contact elements 7 are in
35 the relaxed state. The contact arms having the first contact regions 701 are without contact with respect to

the second partial contact zones 342 on the substrate 3 and extend into a feed path of a switching assembly 2 to be arranged in the receiving device 5.

5 As represented in the upper part of figure 6b, in the unloaded state the first partial contact zone 341 is respectively connected in an electrically conducting manner to the assigned terminating zone 34' by means of the third contact region 703. The corresponding
10 partial contact zones 341 and 342, on the other hand, are isolated from one another, so that the signal lines 32 leading to a control module 31 end at the first partial contact zones 341 or the terminations 36.

15 Consequently, in the case of continuous successive loading of the plug-in locations 1 of a system, a signal line 32 is terminated by a first unloaded plug-in mount in a convenient manner without further measures. The termination always takes place at the
20 point suitable for it, without further intervention. In this way, the signal lines 32 can be advantageously shortened by removing unused portions 32'.

If a plug-in mount is then loaded and a switching
25 assembly 2 arranged in the receiving device 5, the contact arms having the first contact regions 701 are pivoted in the direction of the surface of the substrate 3. At the same time, the contact arms with the third contact regions 703 are pivoted away from the
30 surface of the substrate 3.

In the illustration on the right of figure 6a, the plug-in mount 1 is loaded with a switching assembly 2 arranged in the receiving device 5. The contact
35 elements 7 bridge the interruption points 37 respectively with the first contact regions 701, so

that the corresponding partial regions 341, 342 are connected in an electrically conducting manner. On the other hand, the electrical connections between the first partial contact zone 341 and the terminating zone 34' respectively are discontinued.

In the loaded state, the terminations 36 assigned to the plug-in mount 1 are therefore electrically isolated from the signal lines 32, as represented in the lower part of figure 6b. The bridging of the interruption points 37 by the second contact regions 702 has the effect that the signal lines 32 are lengthened, for example to a following plug-in mount or termination.

When the switching assembly 2 is removed from the receiving device 5, the contact element 7 pivots back again into the original position.

The terminations 36 assigned to a plug-in mount 1 are arranged symmetrically on the rear side, so that a common V_{TT} line (V_{TT} island) 38 can be provided in an easy way.

List of designations

- 1 plug-in mount
- 2 switching assembly
- 3 substrate
- 31 control module
- 32 signal line
- 32' portion of the signal line
- 33 stub
- 34 contact zone
- 341 first partial contact zone
- 342 second partial contact zone
- 34' terminating zone
- 35 via hole
- 36 termination
- 37 interruption point
- 38 V_{TT} line
- 4 insulating body
- 5 receiving device
- 51 inner side
- 6 contact area
- 7 contact element
- 701 first contact region
- 702 second contact region
- 703 third contact region
- 73 anchoring point
- 74 axis of rotation
- 8 contact device
- 9 contact pin

Claims:

1. An arrangement for fixing and contacting a switching assembly, having contact areas, on a substrate, comprising
 - signal lines arranged on the substrate and
 - 5 - a plug-in mount, having at least one receiving device and contact elements, for being loaded with a switching assembly and for mounting on the substrate, wherein
 - the signal lines have contact zones on a surface of the substrate facing the plug-in mount,
 - 10 - in an unloaded state of the arrangement, without a switching assembly arranged in the receiving device, at least one contact element is electrically isolated from the contact zones and
 - in a loaded state of the arrangement, with a switching assembly arranged in the receiving device, the at least one contact element is electrically
 - 15 contacted in a first contact region with at least one of the contact zones on the substrate and in a second contact region with at least one contact area on the switching assembly, wherein the contact elements
 - are formed as contact spring elements which are relaxed in the unloaded state and tensioned in the loaded state and are respectively elastically
 - 20 deformable in a direction perpendicular to the substrate and parallel to the substrate and
 - in the unloaded state of the plug-in mount, have a minimal extent in the direction perpendicular to the substrate and a maximum extent in the direction parallel to the substrate and

- in the loaded state have a maximum extent in the direction perpendicular to the substrate and a minimal extent in the direction parallel to the substrate.
2. The arrangement as claimed in claim 1, wherein the contact elements are
- 5 respectively formed substantially elliptically, are fixed at an anchoring point to the inner sides of the receiving device and are arranged substantially perpendicular to the surfaces of the substrate and of the loaded switching assembly.
3. An arrangement for fixing and contacting a switching assembly, having contact
- 10 areas, on a substrate, comprising
- signal lines arranged on the substrate and
 - a plug-in mount, having at least one receiving device and contact elements, for being loaded with a switching assembly and for mounting on the substrate, wherein
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- the signal lines have contact zones on a surface of the substrate facing the plug-in mount,
 - in an unloaded state of the arrangement, without a switching assembly arranged in the receiving device, at least one contact element is electrically isolated from the contact zones and
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- in a loaded state of the arrangement, with a switching assembly arranged in the receiving device, the at least one contact element is electrically contacted in a first contact region with at least one of the contact zones on the substrate and in a second contact region with at least one contact area on the switching assembly, wherein

- the first and second contact regions of a contact element are respectively arranged such that they can be pivoted about a common axis of rotation and offset with respect to one another,
 - in the unloaded state at least one of the contact regions or a mechanical lever device is located at least partly in a feed path of the switching assembly and
 - can be pivoted by feeding a switching assembly into the receiving device.
4. The arrangement as claimed in either of claims 1 to 3, wherein the plug-in mount has a multiplicity of contact elements.
5. The arrangement as claimed in one of claims 1 to 4, wherein the plug-in mount has an insulating body, the receiving device is formed as a groove in the insulating body and the contact elements are arranged on at least one inner surface of the receiving device and lying opposite contact areas arranged on at least one edge of the switching assembly.
6. The arrangement as claimed in claim 5, wherein the contact elements are arranged on two inner surfaces of the receiving device lying opposite one another.
7. The arrangement as claimed in one of claims 1 to 6, wherein the contact elements are arranged in the plug-in mount in such a way that they are displaceable at least in a direction perpendicular to the substrate and are located at a point remote from the substrate in the unloaded state and at a point near the substrate in the loaded state.
8. The arrangement as claimed in one of claims 1 to 7, wherein

- at least one signal line on the substrate has an interruption point and two partial contact zones, which are arranged on either side of the interruption point, a first partial contact zone being oriented toward a control module, and
- 5 - in the loaded state, the two partial contact zones of the signal line are respectively electrically connected to one another by means of the first contact region of the contact element corresponding to the signal line.
- 9. The arrangement as claimed in claim 8, wherein the at least one contact element has a third contact region and provided on the surface of the substrate is at least one terminating zone, connected in an electrically conducting manner to a
10 termination; in the unloaded state the terminating zone is connected in an electrically conducting manner to the first partial contact zone by means of the third contact region and in the loaded state the terminating zone is electrically isolated from the first partial zone.
- 15 10. The arrangement as claimed in one of claims 1 to 9, wherein the contact zones or the partial contact zones and the terminating zones have a greater transverse extent than the signal lines.
- 11. The arrangement as claimed in one of claims 1 to 10, wherein the contact zones or the partial contact zones and the terminating zones consist of a gold alloy or
20 are coated with a gold alloy.
- 12. A plug-in mount for fixing and contacting a switching assembly on a substrate, having at least one receiving device for a switching assembly and contact elements, which comprises at least one of the features of a plug-in mount according to one of the arrangements as claimed in one of claims 1 to 8.

13. A contact element for a plug-in mount for fixing and contacting a switching assembly on a substrate, which comprises at least one of the features of a contact element according to one of the arrangements as claimed in one of claims 1 to 8.