Title: Contact probe for a testing head for testing high-frequency devices

DESCRIPTION

Field of application

The present invention relates to a contact probe for a testing head of an apparatus for testing electronic devices integrated on a semiconductor wafer, and the following description is made with reference to this application field with the only purpose of simplifying the exposition thereof.

Prior art

As it is well known, a probe head or testing head is essentially a device adapted to electrically connect a plurality of contact pads of a microstructure, in particular an electronic device that is integrated on a wafer, with corresponding channels of a testing machine that performs the functionality testing, in particular electric, thereof, or the test, generically.

The test, which is performed on integrated devices, is particularly useful in detecting and isolating defective circuits as early as in the production phase. Normally probe heads are therefore used for electric tests of devices integrated on wafers before cutting and assembling them inside a chip containment package.

Generally, a probe head comprises a high number of contact elements or contact probes formed by special alloys with good electrical and mechanical properties and provided with at least one contact portion for a corresponding plurality of contact pads of a device under test.

A so-called “vertical probe head” essentially comprises a plurality of contact probes retained by at least one pair of plates or guides that are substantially plate-shaped and parallel to each other. Said guides are provided with suitable holes and are arranged at a certain distance from each other in order to leave a free space or air gap for the movement and possible deformation of the contact probes. In particular, the pair of guides comprises an upper guide and a lower guide, both provided with respective guide holes within which the contact probes axially slide, usually made of wires of special alloys with good electric and mechanical properties.

The good connection between the contact probes and the contact pads of the device under test is ensured by pressing the probe head on the device itself, the contact probes, which are movable within the guide holes made

in the upper and lower guides, undergoing, during said pressing contact, a bending inside the air gap between the two guides and a sliding inside such guide holes.

Furthermore, the bending of the contact probes in the air gap can be helped through an appropriate configuration of the probes themselves or their guides, as schematically illustrated in figure 1, where, for the sake of simplicity of illustration, a unique contact probe of the plurality of contact probes usually comprised in a probe head has been shown, the probe head illustrated being of the so-called shifted-plate type.

In particular, figure 1 schematically shows a probe head 1 comprising at least one upper plate or guide 2 and a lower plate or guide 3, having respective upper guide holes 2a and lower guide holes 3a within which at least one contact probe 4 slides.

The contact probe 4 has at least one end portion or contact tip 4a, the terms end or tip indicating here and in the following an end portion, which is not necessarily pointed. In particular, the contact tip 4a abuts onto a contact pad 5a of a device under test 5, performing the mechanical and electric contact between said device and a testing apparatus (not represented), which said probe head forms an end element of.

In some cases, the contact probes are fixedly fastened to the head itself at the upper guide: such probe heads are referred to as “blocked probe heads”. Alternatively, probe heads are used with unblocked probes, i.e. probes not fixedly fastened, but held interfaced to a board through a micro-contact board: such probe heads are referred to as “unblocked probe heads”. The micro-contact board is usually called “space transformer” since, besides contacting the probes, it also allows spatially redistributing the contact pads formed thereon with respect to the contact pads present on the device under test, in particular relaxing the distance constraints between the centers of the pads themselves.

In this case, as illustrated in Figure 1, the contact probe 4 has a further contact tip 4b, in practice indicated as contact head, towards a plurality of contact pads 6a of said space transformer 6. Good electric contact between probes and space transformer is ensured analogously to the contact with the device under test by pressing the contact heads 4b of the contact probes 4 onto the contact pads 6a of the space transformer 6.

The upper guide 2 and the lower guide 3 are suitably spaced by an air gap 7 that allows the deformation of the contact probes 4 and ensures the contact of tip and contact head of the contact probes 4 with the contact pads of the device under test 5 and of the space transformer 6, respectively.

The correct working of a probe head is known to be basically linked to two parameters: the vertical movement, or overtravel, of the contact probes and the horizontal movement, or scrub, of the contact tips of such contact probes. These features should be evaluated and calibrated in the manufacturing step of a probe head, since the good electric connection between probes and the device under test should always be ensured.

It is likewise important to ensure that the pressing contact of the contact tips onto the contact pads of the device under test is not so high as to cause the probe or the pad itself to break.

This problem is strongly felt in the case of the so-called short probes, namely probes with limited body height, in particular with dimensions less than 5000 μm. Probes of this type are for instance used for high-frequency applications, the reduced length of the probes limiting the connected self-inductance phenomenon. In particular, the term “probes for high-frequency applications” indicates probes that are capable of carrying signals whose frequencies are greater than 1 GHz.

There is now the need to produce probe heads capable of carrying signals at ever higher frequencies up to the radiofrequencies, with a consequent drastic reduction in length of the contact probes, so as to enable these signals to be carried without adding noise, for instance due to the above-mentioned self-inductance phenomenon.

However, in this case, the reduced length of the body of the probes dramatically increases the stiffness of the probe itself, which implies an increase in the force applied by the respective contact tip onto the contact pads of a device under test, which can lead to the breakage of said pads, with irreparable damage to the device under test, which is to be avoided. Even more dangerously, the increase in the stiffness of the contact probe due to the reduction in the length of its body also increases the risk of breakage of the probes themselves.

The technical problem of the present invention is to provide a testing head whose contact probes have structural and functional features so as to allow

using them in high-frequency applications, at the same time maintaining a sufficient elasticity and therefore reducing the risk of breakage thereof and of the contact pads of a device under test which they are in contact with, without adding noise to the signals carried by the same, overcoming the limitations and drawbacks which still affect the known solutions.

Summary of the invention

The solution idea at the basis of the present invention is to provide a contact probe wherein only one section thereof, comprising a contact tip in contact with a device under test, is electrically conductive, this conductive section having a length less than 1000 μm, preferably less than 500 μm, and being adapted to contact conductive tracks or portions of a guide of a testing head in which the probe is housed, the rest of the probe being electrically non-conductive and comprising a contact head abutting onto a support plate, this contact head thus realizing just a mechanical contact with said support plate.

Based on this solution idea, the above technical problem is solved by a contact probe for a testing head of an apparatus for testing electronic devices, the contact probe comprising a body extending along a longitudinal axis between a first end portion and a second end portion, the second end portion being adapted to contact pads of a device under test, this contact probe being characterized in that it comprises a first section, which extends along the longitudinal axis from the first end portion and is made of an electrically non-conductive material, and a second section, which extends along the longitudinal axis from the second end portion up to the first section, this second section being electrically conductive and extending over a distance less than 1000 μm.

More particularly, the invention comprises the following additional characteristics, taken individually or in combination if required.

According to an aspect of the present invention, the contact probe may have an overall length comprised between 3 mm and 10 mm, this length being measured along the longitudinal axis.

According to another aspect of the present invention, the second section may be entirely made of a conductive material and may be connected to the non-conductive first section, or it may be made of the same electrically non-conductive material of the first section and it may be coated by a conductive

coating material.

Alternatively, the first section may be made of a semiconductor material and the second section may be made of the same semiconductor material of the first section, the semiconductor material at the second section being doped so that the second section is electrically conductive.

The present invention also refers to testing head for an apparatus for testing electronic devices, comprising at least one guide provided with a plurality of guide holes for housing a respective plurality of contact probes, this testing head being characterized in that those contact probes are made as above indicated, this at least one guide comprising electrical connection means adapted to be electrically contacted by the second section of the contact probes.

According to an aspect of the present invention, the at least one guide may be a lower guide arranged at the second section of the contact probes.

According to another aspect of the present invention, the electrical connection means can comprise conductive tracks extending from the guide holes.

In particular, the conductive tracks may be arranged on a face of the at least one guide and/or may be embedded in the at least one guide.

Furthermore, the conductive tracks may be connected to respective pads made on the at least one guide.

According to an aspect of the present invention, at least two contact probes may be electrically connected by at least one of those conductive tracks and/or by a circuit component.

According to another aspect of the present invention, the electrical connection means may comprise at least one conductive portion which includes and electrically connects the holes of at least one group of the guide holes to each other, this group housing a corresponding group of the contact probes.

According to yet another aspect of the present invention, the at least one conductive portion can be arranged on a face of the at least one guide or can be embedded in the at least one guide.

Furthermore, the conductive portion may be in the form of a plurality of conductive layers, each of those conductive layers including and electrically

connecting the holes of a respective group of the guide holes to each other, each of those conductive layers being adapted to contact the second section of a corresponding group of the contact probes, wherein contact probes of each corresponding group are adapted to carry a same type of signal.

According to an aspect of the present invention, at least a portion of the inner surface of the guide holes can be covered by a conductive portion connected to the electrical connection means, the second section of those contact probes being adapted to electrically contact the conductive portion of those guide holes.

Finally, the testing head of the present invention may comprise further contact probes adapted to carry a signal from a device under test directly to a support plate associated with the testing head, these further contact probes being adapted to carry power signals and/or ground signals and/or low frequency signals between the device under test and the support plate.

The features and advantages of the contact probe and of the testing head according to the invention will become apparent from the following description of an embodiment thereof, given by way of non-limiting example with reference to the accompanying drawings.

Brief description of the drawings

In those drawings:

- figure 1 schematically shows a contact probe for a testing head according to the prior art;

- figure 2 schematically shows a contact probe according to the present invention;

- figure 3 schematically shows a testing head comprising the contact probe of figure 2;

- figures 4 and 5 schematically show a testing head according to alternative embodiments of the present invention;

- figure 6 schematically shows a perspective sectional view of a testing head according to the present invention, wherein a guide thereof comprises surface conductive tracks embedded therein;

- figures 7 and 8 schematically show a testing head according to embodiments of the present invention, wherein a guide thereof comprises

conductive portions; and

- figure 9 schematically shows a testing head according to an embodiment of the present invention.

Detailed description

With reference to those figures, and in particular to figure 2, a contact probe for a testing head of an apparatus for testing electronic devices integrated on semiconductor wafer is globally and schematically indicated with the reference number 10.

It is worth noting that the figures represent schematic views and are not drawn to scale, but instead they are drawn so as to emphasize the important features of the invention. Moreover, in the figures, the different elements are depicted in a schematic manner, their shape varying depending on the application desired. It is also noted that in the figures the same reference numbers refer to elements that are identical in shape or function. Finally, particular features described in relation to an embodiment illustrated in a figure are also applicable to the other embodiments illustrated in the other figures.

As it will be illustrated in greater detail in the following, the contact probe 10 is adapted to be housed in a testing head for testing high-frequency electronic devices.

The contact probe 10 comprises a body 10' which extends along a longitudinal axis H-H between a first end portion or contact head 10a and a second end portion or contact tip 10b, the terms contact head and contact tip indicating here and in the following portions which are not necessarily pointed. The first end portion 10a is adapted to abut onto a support plate, whereas the second end portion 10b is adapted to contact pads of a device under test.

Advantageously according to the present invention, the contact probe 10 is divided into two sections that follow each other along the longitudinal axis H-H, these sections having different electrical conductivity properties.

In particular, the contact probe 10 comprises a first section S1, which extends along the longitudinal axis H-H from the first end portion 10a and is made of an electrically non-conductive material, and a second section S2, which extends along the longitudinal axis H-H from the second end portion

10b up to the first section S1, the second section S2 being instead electrically conductive.

In other words, the first end portion 10a of the contact probe 10 is only included in the first section S1, which does not include the second end portion 10b, whereas the latter is only included in the second section S2, which thus does not include the first end portion 10a.

The contact probe 10 has an overall length comprised between 3 and 10 mm, this length indicating herein a dimension measured along the longitudinal axis H-H.

Suitably, the second section S2 extends from the second end portion 10b over a distance less than 1000 μm, preferably less than 500 μm, so that the contact probe 10, and the testing head housing it, is particularly suitable for testing high-frequency devices. In fact, the second end portion 10b of the contact probe 10 carries out an electrical and mechanical contact with the contact pads of the device under test, whereas the first end portion 10a is adapted to only carry out a mechanical contact with the support plate. In this way, the first section S1 is not adapted to carry signals, which are only carried in the second section S2, having length less than 1000 μm and thus much less with respect to the overall length of the contact probe 10.

In this way, the first section S1, having length much greater than that of the second section S2, ensures a good bending capacity for the contact probe 10 during its contact with the contact pads of the device under test, thus avoiding breakage of the same and/or of the contact pads of the device. Suitably, for the first section S1, materials adapted to maximize said damping effect during the contact with the device under test are used.

According to an embodiment of the present invention, the second section S2 is entirely made of a conductive material and is suitably connected to the non-conductive first section S1, for instance by means of a glue, an adhesive layer or a locally weldable metal layer (for instance weldable by laser welding), or in any other suitable way.

Alternatively, the second section S2 of the contact probe 10 is made of the same electrically non-conductive material of the first section S1 and is then coated by a conductive coating material. In this way, the contact probe 10 thus comprises a core made of a non-conductive material and only the second section S2 is coated by the conductive coating material.

It is noted that the material which the first non-conductive section S1 is made of is selected from a semiconductor material, preferably silicon, or in general a non-metal insulating material (such as for instance a reinforced polymeric material), whereas the conductive material which the second conductive section S2 is made of is selected from metal materials, preferably copper or palladium alloys, or doped semiconductors.

Consequently, in the present description, the term "electrically non-conductive material" indicates both insulating materials and semiconductors.

According to a further embodiment of the present invention, the entire contact probe 10 is made of a semiconductor material and only one portion thereof, corresponding to the second section S2, is doped in order to form said conductive section S2. In other words, the first section S1 is made of a semiconductor material and the second section S2 is made of the same semiconductor material, which is doped with conductive material so that said second portion S2 is electrically conductive. In this embodiment, it is also possible to cover the second section S2 with a further layer of conductive material in order to increase the contact resistance of the contact probe 10.

In this case, as previously mentioned, the semiconductor material is preferably silicon, whereas the doping material is selected for instance from phosphorus or boron.

As previously mentioned, a plurality of contact probes 10 of the above described type is housed in a testing head for testing electronic devices integrated on a semiconductor wafer, this testing head being indicated herein with the reference number 20, as schematically illustrated in figure 3.

It is pointed out that, for the sake of simplicity of illustration, the testing head 20 is represented in the figures as comprising a limited number of contact probes 10, even if it may obviously comprise any number of contact probes according to the needs and/or circumstances, the figures being provided just by way of non-limiting example of the present invention.

The second end portion 10b of each contact probe 10 is adapted to abut onto contact pads 11 of a device under test integrated on a semiconductor wafer 12, whereas the first end portion 10a is adapted to abut onto a

support plate 13 associated with the testing head 20, wherein this support plate may be for instance a printed-circuit board (PCB).

The testing head 20 comprises at least one guide 21 provided with a plurality of guide holes 22 adapted to house a corresponding plurality of contact probes 10.

Advantageously according to the present invention, the guide 21 is a lower guide arranged at the second section S2 of each contact probe 10, so that the inner walls of the guide holes 22 of the guide 21 are capable of contacting this second section S2, in particular through electrical connection means comprised in the guide 21.

In this regard, still referring to figure 3, the electrical connection means of the guide 21 comprise suitable conductive tracks 23 which extend from the guide holes 22 and are adapted to extract and carry the signal carried by the contact probes 10, in particular by the second section S2, these conductive tracks 23 being adapted to be electrically contacted by the second section S2.

Consequently, the guide 21 provides for the routing of signals (for example towards the PCB associated with the testing head 20) by means of the conductive tracks 23 which extend therein, and therefore it also performs the function usually performed by the space transformers associated with the known testing heads.

In the embodiment of figure 3, the conductive tracks 23 are adapted to directly contact the second section S2 of the contact probe 10, namely the contact between the section S2 of the contact probe 10 and the conductive track 23 is a sliding contact ensured by the thickness of the conductive track 23 itself, which is embedded in the guide 21 and emerges at the guide hole 22.

As illustrated in figure 4, the conductive track 23 may also be a surface conductive track, namely it may be arranged on a face of the guide 21 (the face Fa in the example of the figure), this conductive track 23 emerging in any case always at the guide hole 22.

It is evident that, although figure 4 shows a surface conductive track 23 arranged on face Fa of the guide 21 (i.e. on an upper face thereof according to the local reference system of the figures), the conductive track 23 could also be arranged on face Fb, opposite to the face Fa (i.e. on a lower face

thereof according to the local reference system of the figures), of the guide 21, as well as on any other face thereof.

According to a preferred embodiment of the present invention, illustrated in figure 5, at least one portion of the inner surface of the guide holes 22 is covered by a conductive portion 22w. Still more preferably, the inner surface of the guide holes 22 is entirely covered by the conductive portion 22w. In this way, the conductive section S2 is capable of contacting the conductive portion 22w of the guide holes 22 through a sliding contact, so that the signal carried by the contact probe 10, in particular by the section S2, can be extracted at the guide holes 22 through the conductive tracks 23, which are connected to the conductive portions 22w, in particular they extend therefrom.

Furthermore, it is pointed out that the guide 21 may comprise both surface conductive tracks and conductive tracks embedded therein, as schematically shown in figure 6.

In general, when several conductive tracks 23 extend both on face Fa and/or on face Fb of the guide 21 and inside it, these conductive tracks 23 are arranged on different levels from the surface of the guide 21. The number of levels of the guide 21 where the conductive tracks 23 are arranged may vary according to the needs and/or circumstances, in particular according to the number of signals to be carried and therefore according to the complexity of the routing pattern to be performed in the guide 21. For instance, it is possible to provide for a configuration in which a first level comprises tracks adapted to carry a first type of signal and a second level comprises tracks adapted to carry a second type of signal.

As previously mentioned, the contact between the contact probe 10, in particular the second section S2 thereof, and the walls of the guide holes 22, preferably provided with the conductive portion 22w, is a sliding contact that ensures the electric connection between the second section S2 and the conductive portion 22w (or possibly directly with the conductive track 23).

Suitably, still referring to figure 6, the conductive tracks 23 (in particular an end thereof opposite to the end at the guide holes 22) are connected to respective contact pads 25, which are arranged on a face of the guide 21 (the face Fa in the example of figure 6). In this way, it is possible to extract a respective signal from the testing head 20 and carry it for instance to a

PCB connected to the testing head 20.

Furthermore, in the case of conductive tracks 23 embedded in the guide 21, the end portions of these conductive tracks 23 emerge on a face thereof, so as to allow the electrical connection between said conductive tracks 23 and the respective contact pads 25.

Referring now to figure 7, according to an embodiment of the present invention, the testing head 20 comprises a conductive portion 24 acting as electrical connection means which includes and electrically connects a group 22' of the guide holes 22 housing a corresponding group of contact probes 10, wherein this conductive portion 24 can be used in addition or alternatively to the conductive tracks 23.

In this way, at least two contact probes 10 can be electrically connected by at least one conductive track 23 or by the conductive portion 24 of the guide 21, this conductive portion 24 covering an area of the guide 21 that includes the group 22' of guide holes housing the contact probes that are to be short-circuited.

In case only two contact probes 10 need to be short-circuited, it is preferable to use one conductive track 23 as electrical connection means between them, whereas in case a plurality of contact probes 10 need to be short-circuited, it is preferable to use a conductive portion 24 as electrical connection means between them, this conductive portion 24 forming a common conductive plane for said contact probes 10.

The possibility to electrically connect different contact probes, in particular the possibility to electrically connect the second section S2 of different contact probes, is particularly advantageous in case two or more contact pads of the device under test need to be short-circuited, since it is possible to implement a configuration of the loop-back type, considerably shortening the path of the signals which do not pass through the entire contact probe from and towards the test apparatus but they stop at the conductive track or at the common conductive plane, with consequent advantages in terms of frequency performance of the testing head 20 as a whole.

Still referring to figure 7, the conductive portion 24 is embedded in the guide 21, forming a conductive plane inside the guide 21, this figure illustrating, as a non-limiting example of the present invention, a testing head 20 comprising an embedded conductive portion 24 and a surface conductive

track 23.

Alternatively, according to an embodiment not illustrated in the figures, the conductive portion 24 may be arranged on a surface portion of the guide 21, in particular on its face Fa or on its opposite face Fb, or it may be arranged on both faces Fb and Fb.

Furthermore, according to an embodiment shown in figure 8, the conductive portion 24 is in the form of a plurality of overlapped conductive layers 24a-24n, each of which includes and electrically connects a corresponding group 22a-22n of the guide holes 22. In this way, each conductive layer 24a-24n is adapted to contact a corresponding group of the contact probes 10 according to the present invention, in particular their second section S2, wherein contact probes of each corresponding group are adapted to carry a same type of signal.

In this way, the guide 21 is a multilayer comprising a plurality of non-conductive layers, preferably a ceramic multilayer, the conductive layers 24a-24n being arranged on said non-conductive layers, which electrically insulate a conductive layer from the following one.

In particular, each of the conductive layers 24a-24n is arranged on a face of a corresponding non-conductive layer of the guide 21 and has a lower area than an area of said face.

Alternatively, each of the conductive layers 24a-24n covers a face of a corresponding non-conductive layer except for areas where guide holes housing contact probes that must not be short-circuited are formed.

Obviously, the conductive layers 24a-24n may also comprise surface layers arranged on at least one of the exposed faces Fa and Fb of the guide 21, or they may only be embedded in the guide 21, as illustrated in figure 8.

In case the contact probes to be short-circuited are close (for instance alternated) to the contact probes that must not be short-circuited, the conductive portion 24 (or alternatively each conductive layer 24a-24n) is locally interrupted by non-conductive zones, so as not to electrically connect contact probes intended to carry different signals. Consequently, the non-conductive zones locally prevent the electrical connection between adjacent contact probes intended to carry different signals.

For instance, in case of a plurality of conductive layers 24a-24n, the non-

conductive zones of a specific conductive layer are formed at the guide holes housing contact elements which must not be short-circuited by this specific conductive layer, whereas this specific layer covers at least partially the walls of the guide holes housing contact elements which must be short-circuited by it.

Furthermore, according to an embodiment not illustrated in the figures, the metalizations of two guide holes, or even of two conductive portions 24, in contact with the second section S2 of the probes 10, can be electrically connected by means of a circuit component, such as for instance a filtering capacitor, so as to optimize the loop-back technique, since this filtering capacitor is positioned as near as possible to the contact tips of the probes.

Obviously, the circuit component may also be any other circuit component adapted to specific needs, such as for instance an inductor or a resistor or even a relay.

It is further noted that the testing head 20 may also comprise more than one guide in addition to the lower guide 21, for instance an intermediate guide and/or an upper guide (not illustrated in the figures), according to solutions known in the field.

The probe head 20, in addition to the contact probes 10 according to the present invention, may also comprise contact probes 10bis made according to the prior art (i.e. entirely made of a conductive material), these contact probes 10bis being housed in corresponding guide holes 22bis, as illustrated in figure 9. Consequently, the testing head 20 generally comprises a first group of contact probes 10 according to the present invention and a second group of contact probes 10bis according to the prior art.

While the contact probes 10 are preferably adapted to carry high-frequency signals thanks to the reduced length of their second conductive section S2, the contact probes 10bis are generally adapted to carry ground or power signals or even low-frequency input/output signals, i.e. signals that can be carried by probes of the known type without suffering self-inductance problems, in any case greatly simplifying the routing of signals by the guide 21.

In this case, the contact probes 10bis are thus adapted to carry the signal from the device under test directly to the support plate 13, which comprises

suitable conductive pads 14 against which the contact heads of theses probes 10bis are adapted to abut.

Finally, it is pointed out that what has been stated above regarding the contact probes 10 according to the present invention is also valid for the contact probes 10bis of the known type, namely it is possible to provide for conductive portions which short-circuit these contact probes 10bis of the known type.

In conclusion, the present invention provides a contact probe wherein only one section thereof, comprising a contact tip in contact with a device under test, is electrically conductive, this conductive section having a length less than 1000 μm, preferably less than 500 μm, and being adapted to contact conductive tracks or portions of a guide of a testing head in which the probe is housed, the rest of the probe being electrically non-conductive and comprising a contact head abutting onto a support plate, this contact head thus realizing just a mechanical contact with said support plate.

Advantageously according to the present invention, the illustrated testing head is particularly performing in high-frequency applications, thanks to the reduced dimensions of the conductive section of the contact probes, this section being intended to carry the signals and having a length less than 1000 μm and thus much less than that of the contact probes according to the prior art.

The distinctive feature of the present invention is thus the possibility of carrying the signal only through the conductive section towards conductive tracks made on the lower guide of the probe head, the rest of the probe being non-conductive and only acting as a mechanical support that ensures a contact with a support plate (i.e. a PCB or any other support) and the desired bending of the contact probe, at the same time avoiding that such remaining non-conductive portion of the probe acts as an antenna or stub, since the signal is not carried therein.

In other words, the conductive section of the contact probe according to the present invention acts as a very short probe and thus eliminates the disadvantageous self-inductance problem of the probes of the known type, this contact probe perfectly working from the mechanical point of view thanks to the presence of the second non-conductive portion, thus solving the technical problem of the present invention.

Therefore, the proposed solution allows effectively testing high-frequency devices, obviating the stiffness of the short probes, drastically reducing the possibility of breakage of the contact probes themselves and at the same time ensuring a suitable reduction in the pressure exerted by them, avoiding any breakage of the contact pads of the devices under test onto which the contact probes abut.

It is also possible to obtain a testing head with improved performance in terms of signal filtering, thanks to the presence of suitable circuit components, in particular capacitors that connect two contact probes to each other.

Finally, the possibility of adopting a hybrid configuration, wherein further contact probes are adapted to carry specific signals, greatly simplifies the routing of signals by the guide, which according to the present invention acts as a space transformer. This is mainly useful in case of several signals to be carried through the testing head. For instance, by means of these further contact probes it is possible to carry power signals and/or ground signals, namely signals which do not need particularly short contact probes, whereas high-frequency signals, requiring short probes in order to avoid self-inductance problems, are carried in the conductive section of the probes according to the present invention.

Obviously, a person skilled in the art, in order to meet particular needs and specifications, can carry out several changes and modifications to the contact probe and to the testing head described above, all included in the protection scope of the invention as defined by the following claims.

CLAIMS

1. A contact probe (10) for a testing head of an apparatus for testing electronic devices, said contact probe (10) comprising a body (10') extending along a longitudinal axis (H-H) between a first end portion (10a) and a second end portion (10b), said second end portion (10b) being adapted to electrically contact pads (11) of a device under test, said contact probe (10) being characterized in that it comprises a first section (S1), which extends along said longitudinal axis (H-H) from said first end portion (10a) and is made of an electrically non-conductive material, and a second section (S2), which extends along said longitudinal axis (H-H) from said second end portion (10b) up to said first section (S1), said second section (S2) being electrically conductive and extending over a distance less than 1000 μm, wherein said sections (S1, S2) follow each other along the longitudinal axis (H-H) of the contact probe (10) so that the first end portion (10a) is only included in the first section (S1) and the second end portion (10b) is only included in the second section (S2), and wherein the first end portion (10a) is adapted to perform only a mechanical contact.

2. The contact probe (10) according to claim 1, characterized in that it has an overall length comprised between 3 mm and 10 mm, said length being measured along said longitudinal axis (H-H).

3. The contact probe (10) according to claim 1 or 2, characterized in that said second section (S2) is entirely made of a conductive material and is connected to said non-conductive first section (S1), or in that said second section (S2) is made of the same electrically non-conductive material of said first section (S1) and is coated by a conductive coating material.

4. The contact probe (10) according to claim 1 or 2, characterized in that said first section (S1) is made of a semiconductor material and said second section (S2) is made of the same semiconductor material of said first section (S1), said semiconductor material at said second section (S2) being doped so that said second section (S2) is electrically conductive.

5. A testing head (20) for an apparatus for testing electronic devices, comprising at least one guide (21) provided with a plurality of guide holes (22) for housing a respective plurality of contact probes (10), said testing head (20) being characterized in that said contact probes (10) are made according to any one of the preceding claims, said at least one guide (21) comprising electrical connection means adapted to be electrically contacted

by said second section (S2) of said contact probes (10).

6. The testing head (20) according to claim 5, characterized in that said at least one guide (21) is a lower guide arranged at said second section (S2) of said contact probes (10).

7. The testing head (20) according to claim 5 or 6, characterized in that said electrical connection means comprise conductive tracks (23) extending from said guide holes (22).

8. The testing head (20) according to claim 7, characterized in that said conductive tracks (23) are arranged on a face (Fa, Fb) of said at least one guide (21) and/or are embedded in said at least one guide (21).

9. The testing head (20) according to claim 7 or 8, characterized in that said conductive tracks (23) are connected to respective pads (25) made on said at least one guide (21).

10. The testing head (20) according to any one of the claims from 7 to 9, characterized in that at least two contact probes (10) are electrically connected by at least one of said conductive tracks (23) and/or by a circuit component.

11. The testing head (20) according to any one of the claims from 5 to 10, characterized in that said electrical connection means comprise at least one conductive portion (24) which includes and electrically connects the holes of at least one group (22') of said guide holes (22) to each other, said group (22') housing a corresponding group of said contact probes (10).

12. The testing head (20) according to claim 11, characterized in that said at least one conductive portion (24) is arranged on a face (Fa, Fb) of said at least one guide (21) or is embedded in said at least one guide (21).

13. The testing head (20) according to claim 11, characterized in that said conductive portion (24) is in the form of a plurality of conductive layers (24a-24n), each of said conductive layers (24a-24n) including and electrically connecting the holes of a respective group (22a-22n) of said guide holes (22) to each other, each of said conductive layers (24a-24n) being adapted to contact said second section (S2) of a corresponding group of said contact probes (10), wherein contact probes of each corresponding group are adapted to carry a same type of signal.

14. The testing head (20) according to any one of the claims from 5 to 13, characterized in that at least a portion of the inner surface of said guide

holes (22) is covered by a conductive portion (22w) connected to said electrical connection means, said second section (S2) of said contact probes (10) being adapted to electrically contact said conductive portion (22w) of said guide holes (22).

15. The testing head (20) according to any one of the claims from 5 to 14, comprising further contact probes (10bis) adapted to carry a signal from a device under test directly to a support plate (13) associated with said testing head (20), said further contact probes (10bis) being adapted to carry power signals and/or ground signals and/or low frequency signals between said device under test and said support plate (13).