MicroContact

FINE-PITCH ADAPTER CONTACTING SOLUTIONS FOR MICROELECTRONICS

CONTENT

PRECISE ADAPTER

THE LEADING TECHNOLOGY IN PRECISION, TEST POINT DENSITY AND QUALITY

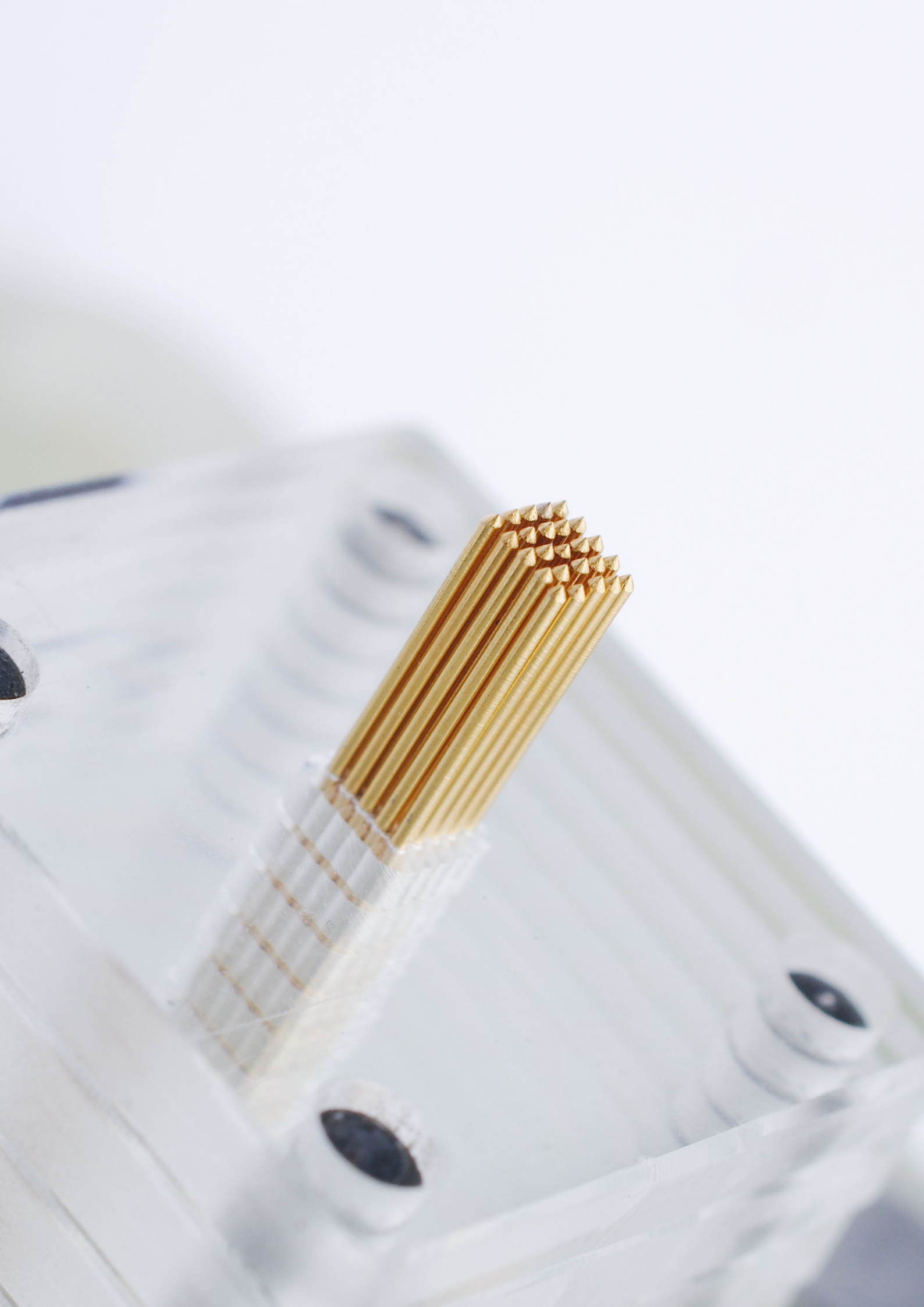
Our rigid needle adapter for assembled and bare substrates allows the contacting of the finest test structures and test point distances, resulting in the optimization of the layout, a larger test density and the reduction of production costs.

Thanks to very long tool´s endurance and to the fact that maintenance work can be carried out autonomously and in a short time, maintenance costs remain low.

In the bare board testing, the test points can be contacted with a diameter of 40µm at pitch distances of 80µm. Partially, more than 450 test points / cm^2 can be achieved. Even the most sensitive surfaces can also be contacted.

Due to the precise needle guidance and the small lateral play, even the finest structures on assembled substrates can be tapped. For Sirius-adapters, the needles protrude perpendicular from the adapter with minimal wobbling, by which the test points can be realized even smaller and contacted even closer to the components. Only with the reduction of the test point from ø0.8mm to ø0.2mm can the needed test point area be reduced by 16 times.

We are happy to assist you in solving your challenges. Thanks to optimal internal processes, suitable software for drilling and close cooperation between all involved departments, it is possible to achieve delivery times of only 3 weeks



FINE-PITCH ADAPTERS IN USE

The real benefits of the fine-pitch adapters become apparent only if a test system with integrated camera system is used, which can correct larger offsets of the printed circuit boards. As an example, here are two solutions from MicroContact.

MCit

The manual tester MCit permits single-sided contacting of 200µm structures over an area of 4“ x 4“ or 8“ x 8“. The substrate to be tested is fitted by hand and the positioning in X, Y and the rotation are corrected using adjusting screws with the use of monitors. After the position is corrected, the substrate is pushed into the contacting unit and contacted pneumatically. Adapters of other machine types can be used by means of an insert, so that the development department can optimise and test the diagnostic program in advance.

MCom

The fully automated MCom permits double-sided contacting on 40µm structures. To achieve this contacting accuracy, the substrates are measured optically and then contacted in the contacting unit using the fine-pitch adapter. The handling set up is customized according to customer specifications and can process everything from the thinnest films to thick multilayer products. In the picture, an inline machine with two contacting units and two measurement systems can be seen, with which twice the output can be achieved. The MCom is, however, also available with a stack, magazine or tray handling.

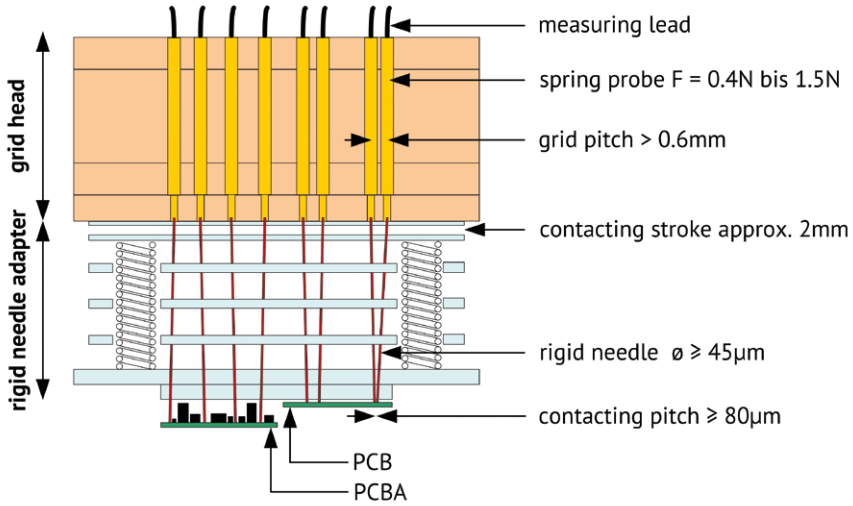
All microtesters from MicroContact are built customized and optimized for their respective products. The product range includes small manuel test systems, semi-automatic machines, and large, fully-automatic machines. For the parts handling, 4-arm and 6-arm robots are used, with which a very accurate positioning can be achieved in combination with camera systems. Detailed information to the microtesters can be found on our homepage: **www.microcontact.ch**

OPERATING PRINCIPLE

In the rigid needle adapter, the needles are guided very precisely, so that they have a minimal lateral play. This allows contacting to the finest structures with smallest test point distances and avoids damage to the substrate surface.

On the following pages, the rigid needle adapter will be explained in more detail.

The rigid needles are deflected from the test point to the spring probes of the grid. By pressing the grid head to the adapter, the needles are on the top on the substrate and press against the spring probes in the grid. Thus, according to the particular spring probe, a contacting force from 0.4N to 1.5N is generated per rigid needle. Due to this principle contact distances can be realized starting with 80µm and up to 280 spring probes / cm^2 can be integrated into the grid.

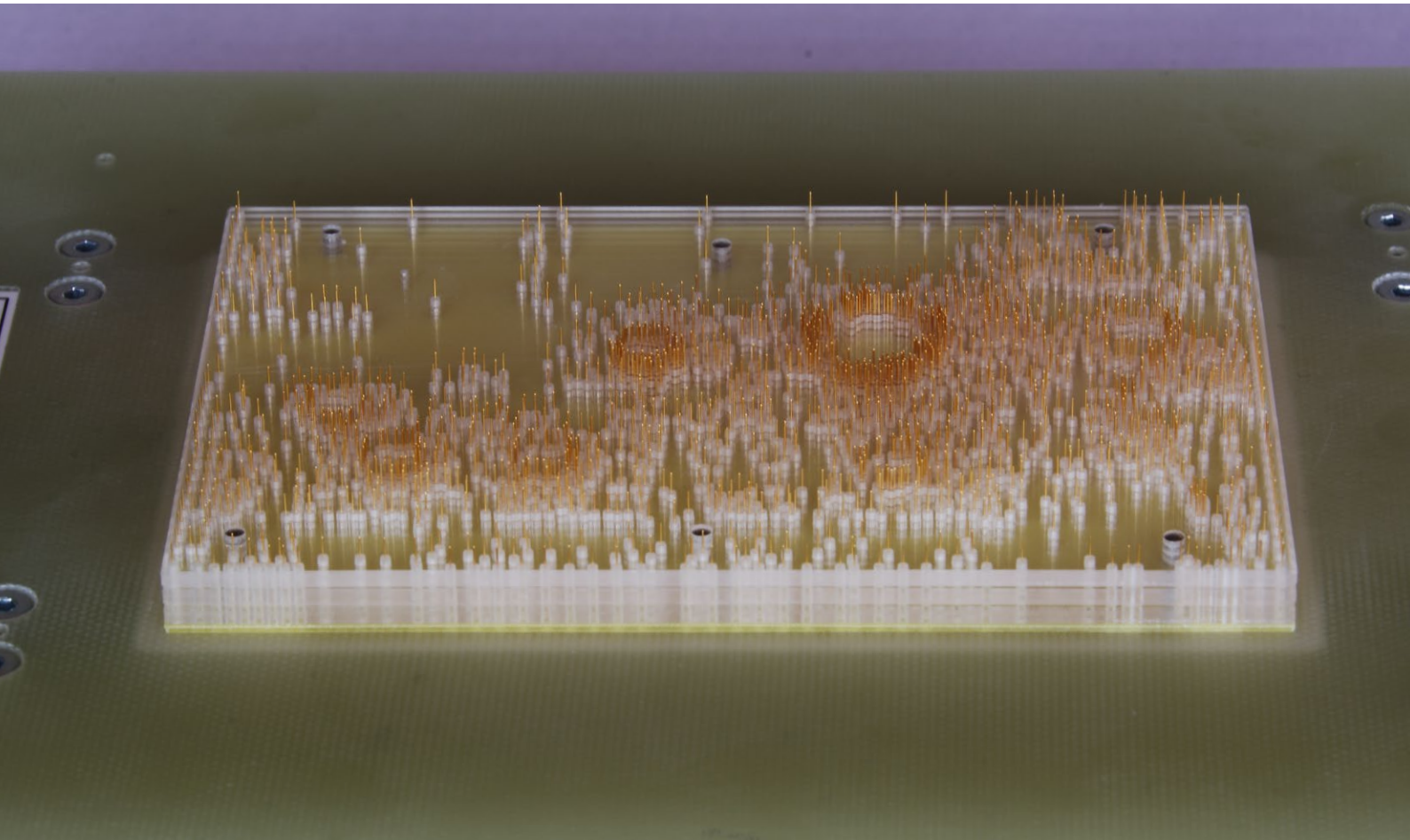


LONG SERVICE LIVES

In optimal conditions, up to 500'000 contacting strokes can be realised with the rigid needles. The wear of the rigid needle (the flattening of the tip) depends on both the spring force applied and the material on which the contact is made. The service costs remain low because only the rigid needles have to be exchanged.

The spring probe specifically manufactured for this purpose permits service lives that greatly exceed 1 million contact cycles.

The wear of the adapter head itself is very low, as the movement of the rigid needles in the adapter is negligible.



SPECIFICATIONS

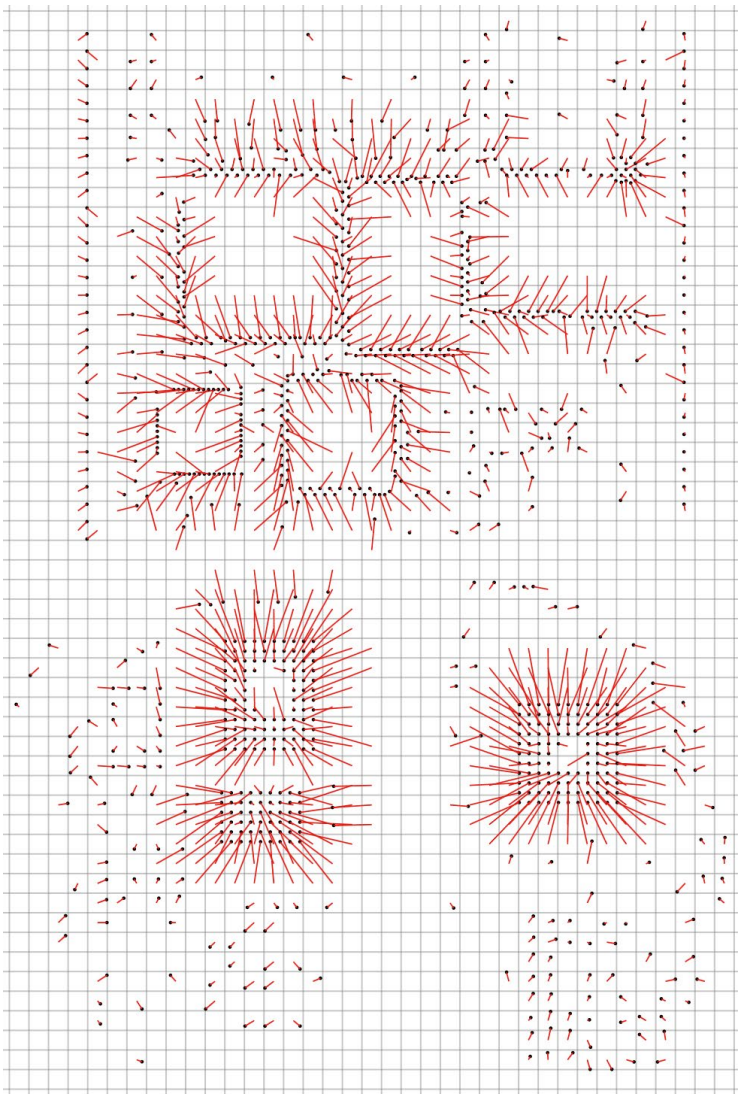
The adapter can be built up of a variety of rigid needles and spring probes. The choice is defined in terms of the required pitch, the current load and the desired contacting force. Thicker rigid needles are preferred whenever possible for stability and service reasons.

The rigid needle adapters are manufactured according to customer specifications. From the feasibility matrix it is evident which spring probe can be combined with which rigid needle.

feasibility matrix	rigid needles in the adapter						
spring probes in grid head	**Ø 45µm rigid needle** >80µm contacting pitch	**Ø 70µm rigid needle** >120µm contacting pitch	**Ø 100µm rigid needle** >150µm contacting pitch	**Ø130µm rigid needle** >200µm contacting pitch	**Ø 180µm rigid needle** >250µm contacting pitch	**Ø 300µm rigid needle** >400µm contacting pitch	**Ø 450µm rigid needle** >550µm contacting pitch
0.6mm grid pitch 0.4N contacting force 280 spring probes / cm²	A	A	B	C	D		
0.7mm grid pitch 0.6N contacting force 200 spring probes / cm²		A	B	C	D		
1.0mm grid pitch 0.8N contacting force 100 spring probes / cm²					D	E	F
1.0mm grid pitch 1.5N contacting force 100 spring probes / cm²					D	E	F
	PCB				PCB & PCBA		

Possible continuous and pulsed current/10ms:

A	$I_{continous}$ = 0.2 A / I_{pulse} = 0.4 A
B	$I_{continous}$ = 0.3 A / I_{pulse} = 0.9 A
C	$I_{continous}$ = 0.6 A / I_{pulse} = 1.8 A
D	$I_{continous}$ = 1.0 A / I_{pulse} = 3.0 A
E	$I_{continous}$ = 2.0 A / I_{pulse} = 6.0 A
F	$I_{continous}$ = 3.0 A / I_{pulse} = 9.0 A



Conversion of test points to the grid

- In the square centers are the spring probes.
- The black dots are the test points of the substrate.
- The red lines show the deflected rigid needles.

SIRIUS-ADAPTER TECHNOLOGY

The Sirius-technology is the shining star of adapters and the market leader in terms of precision, test point density and contacting quality.
Thanks to an ingenious needle control, wobbling is reduced to a minimum, which accordingly increases precision in contacting.
By extension and due to the perpendicular positioning of the needles to the adapter, the Sirius-technology is suitable for very sensitive substrate surfaces, for the finest of structures, or for contacting components that are very close alongside one another.

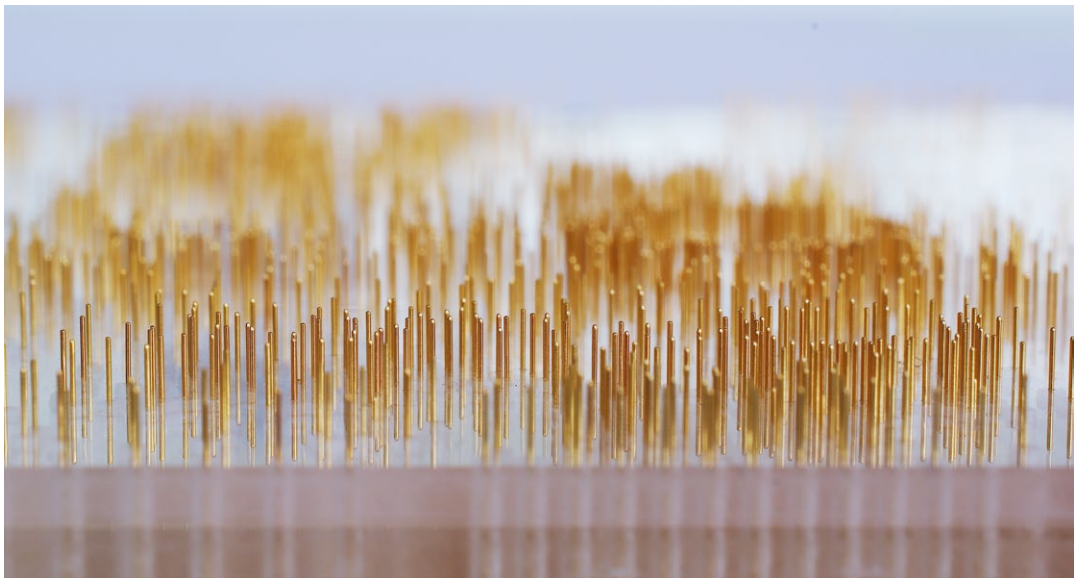
UNIQUE POSSIBILITIES FOR THE FUNCTIONAL TEST

By reducing the test point size from market standard ø0.8mm to ø0.12mm, the net test area can be reduced by 45 times. Such small test points can be set much easier by the layouter. It is now possible to increase the test depth by means of further tappable signals, for example by directly contacting on open circuit paths.

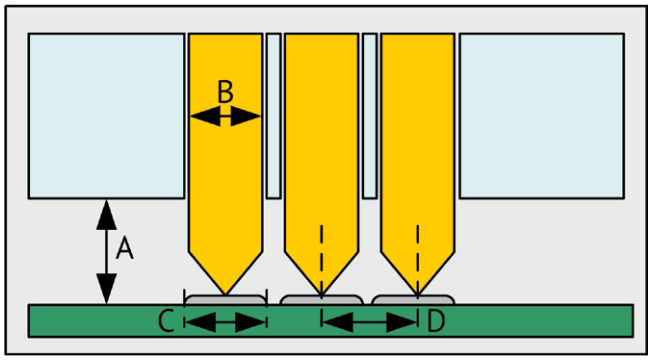
COMPONENT HEIGHT VERSUS NEEDLE DIAMETER

To contact assembled substrates, longer rigid needles are used so that the needles protrude from the adapter. The highest components and bonding wires define the distance between the adapter and the substrate. The rigid needle diameter and the requirements of the test point size and pitch are a result of this distance. Recesses for individual components in the adapter make it possible to position the adapter closer to the substrate and, in this way, to contact finer test structures.

The values provided in the table below are the guideline values outlining which structures can be contacted with which rigid needles. The smallest possible test point is, of course, also dependent on the positioning accuracy of the test system.

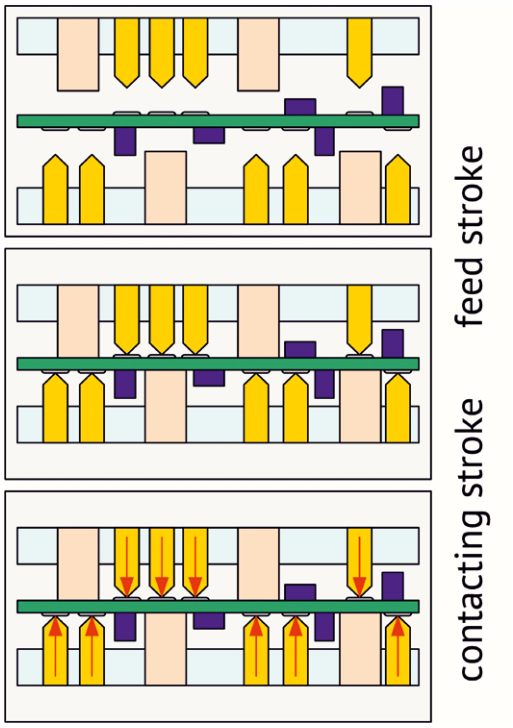


NEEDLE PROTRUSION AND RESULTING MINIMUM REQUIREMENTS



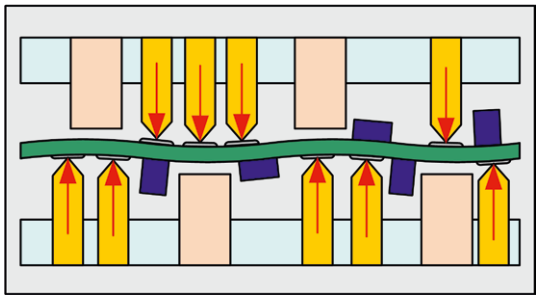
	needle protrusion A	Ø rigid needle B	test point C	pitch D
PCB	0mm – 0.1mm	0.045mm	0.04mm	0.08mm
PCBA	0mm – 2mm	0.18mm	0.10mm	0.25mm
	2mm – 4mm	0.30mm	0.12mm	0.40mm
	4mm – 6mm	0.30mm	0.15mm	0.40mm

ADVANTAGES OF THE 2-STROKE ADAPTER



The **2-stroke adapter** offers the great advantage that, with the feed stroke, the substrate is supported by the push rods in a stable manner and no force is exerted on the substrate.

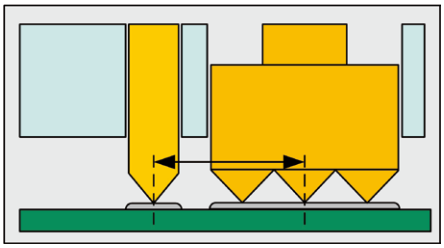
Only with the contacting stroke the contacting force is applied to the substrate via the rigid needles.



In the case of the **1-stroke adapter**, the spring probes already exert their contacting force before the push rods can support the substrate. In this state, this leads to a deformation and thus to a greater load on the substrate.

INTEGRATION OF HIGH CURRENT PROBES

With the integration of high current probes in the rigid needle adapter, finer structures are also made possible for printed circuit boards with high current requirements. The test points for the function test can be tapped with the rigid needles on small structures, while only the high current test needles require correspondingly large areas.
This possibility also allows the test area to be minimized and the test depth to be increased, even in the case of high-current products.



DISTANCE FROM THE RIGID NEEDLE TO HIGH CURRENT PROBE
(Example HCP-118 ø ⩽2.0 mm / KS-112 ø2.2mm)

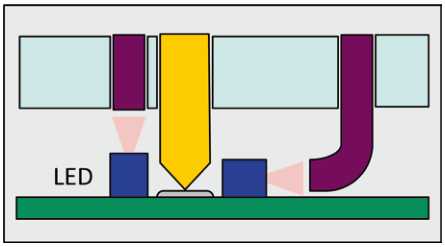
1. *1/2 rigid needle ø300µm*	150µm
2. *1/2 needle play in the guide bore*	10µm
3. *Minimal distance from HCP to needle*	200µm
4. *1/2 sleeve KS-112 ø2200µm*	1100µm
Total:	**1460µm**

DISTANCE FROM THE RIGID NEEDLE TO HIGH CURRENT PROBE
(Example HCP-118 ø ⩾2.5mm / KS-112 ø2.2mm)

1. *1/2 rigid needle ø300µm*	150µm
2. *1/2 needle play in the guide bore*	10µm
3. *Minimal distance from HCP to needle*	200µm
4. *1/2 high-current head HCP-118 ø2.5mm*	1250µm
5. *high-current needle play*	100µm
Total:	**1710µm**

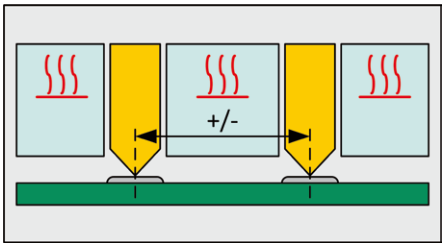
EQUIPMENT OPTIONS

The rigid needle adapter can be equipped with the most diverse elements to enable the desired test. On the following pages, a few options are listed which can be realized.



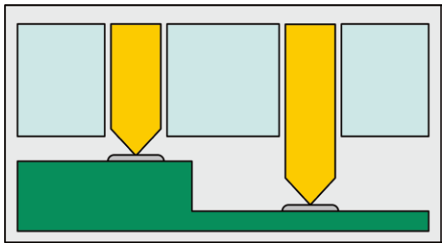
OPTICAL ELEMENTS

In the adapter, optical fibres can be integrated, with which optical elements can be controlled or addressed. In the adapter the light signals are converted into electrical values and, in this way, made available to the measuring system as a signal. The optical fibres can be integrated vertically as well as horizontally in the front of the adapter. The simultaneous contacting close to the light guides can also be realized with the rigid needles.



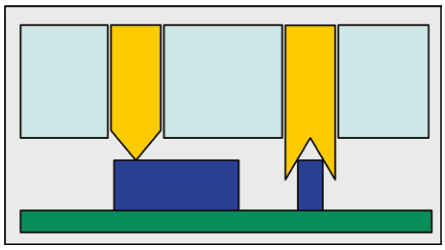
HOT TEST

In order for the adapter to have the correct size at the working temperature during the hot test, the expansion coefficient of the material is taken into account during production. The cooling system in the adapter ensures a controlled temperature for the adapter and the grid head so that the same service lives are achieved as at room temperature. For the hot test we recommend to define the test points 50µm larger so that certain variations in the adapter can be compensated for.



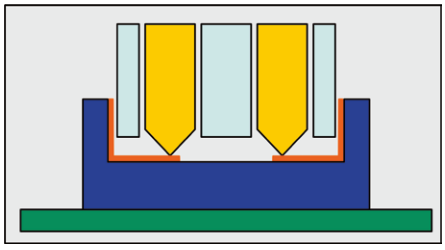
RIGID NEEDLE LENGTHS

Small differences in height on the substrate are absorbed by the spring probes. If there are more than 0.5mm between the contacting levels, rigid needles of different length are used so that an optimal contacting force acts on all test points. If, for example, the connection between the substrate and GND is to be made first, a slightly longer rigid needle can be used.



DIRECT CONTACTING TO COMPONENTS

Components can be directly contacted with pointed needles or crowns. However, test points are preferable to direct contacting, since an open soldering point may be temporarily closed by the contacting force on the component and the error is thereby not recognized.

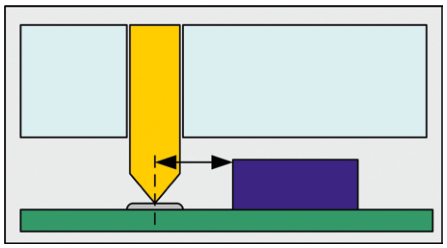


CONTACTING TO CONNECTORS

Fine-pitch connectors can easily be contacted by passing the adapter through the insides of the connector and positioning the rigid needles on the pins. By means of this guide, the rigid needles can also contact fine pin structures on the connector base. Alternatively, the pins can also be tapped off laterally, which is then a sliding contact, which causes greater wear on the rigid needles.

CONTACTING BESIDE COMPONENTS

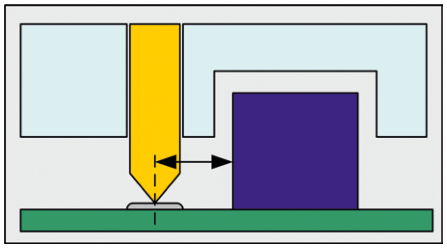
If rigid needles are placed close to a component, the following suggestions must be observed in the design phase and the tolerance calculations must be carried out accordingly. Here are some examples with guide values. For independently-made calculations, the tolerances of the respective products and production processes must be applied. In order to test the contacting position, the test point marks should be checked in advance on a bare substrate.



DISTANCE WITH PROTRUDING RIGID NEEDLES

1.	*1/2 rigid needle ø300µm*	150µm
2.	*1/2 needle play in the guide born*	10µm
3.	*Min. distance from component to needle*	200µm
4.	*Position tolerance from component to the fiducial*	300µm
5.	*Positioning accuracy of the machine*	10µm

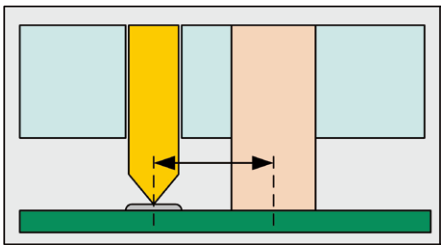
Total: 670µm



DISTANCE WITH ADAPTER RECESS

1.	*1/2 rigid needle ø300µm*	150µm
2.	*1/2 needle play in the guide born*	10µm
3.	*Min. distance from component to needle*	300µm
4.	*Wall thickness of adapter*	100µm
5.	*Position tolerance from component to the fiducial*	300µm
6.	*Positioning accuracy of the machine*	10µm

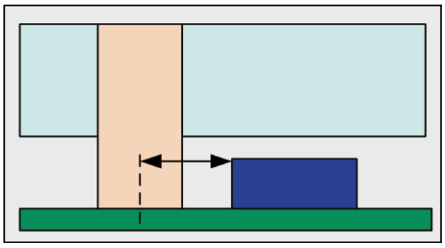
Total: 870µm



DISTANCE RIGID NEEDLE NEXT TO PUSH ROD

1. *1/2 rigid needle ø300µm*	150µm
2. *Wall thickness*	500µm
3. *1/2 push rod ø1000µm*	500µm

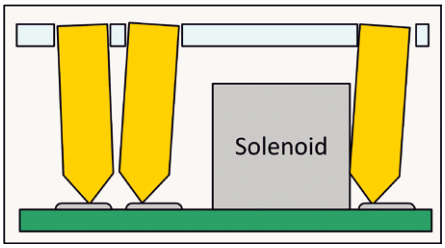
Total: 1150µm



DISTANCE PUSH ROD NEXT TO COMPONENT

1. *1/2 push rod ø1000µm*	500µm
2. *Min. distance from push rod to component*	200µm
3. *Position tolerance from component to fiducial*	300µm
4. *Positioning accuracy of the machine*	10µm

Total: 1010µm

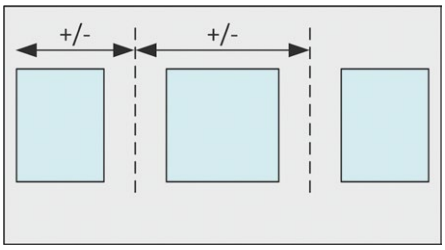


MAGNETISM

If coils are induced on the substrate during the function test, they can magnetically charge the nearby rigid needles. If the rigid needles protrude far out of the adapter, they are affected by the magnetism so that the needles are attracted to the solenoid or two needles are attracted to each other. In addition, there is also the danger that the needles attract small metallic particles, possibly resulting in a short circuit between two very close rigid needles.

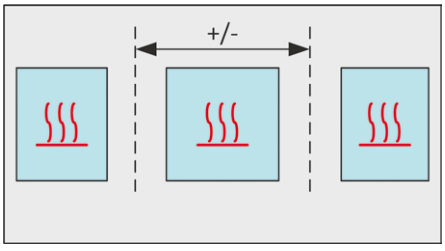
TOLERANCES OF THE ADAPTER

In order to contact 40µm test points, the adapters, the tolerances and the necessary manufacturing processes have to be mastered. The tolerances listed here must be observed for every fine-pitch adapter in order to achieve the greatest possible accuracy.



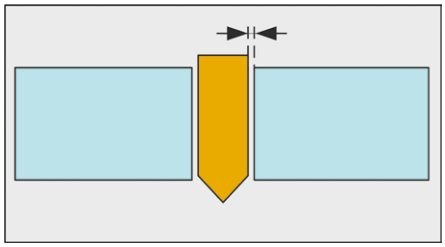
TOLERANCE OF THE BORES

The positioning accuracy of the drilling machine directly affects the adapter accuracy. In the drilling process, it must be observed that the guide holes are clean and straight.



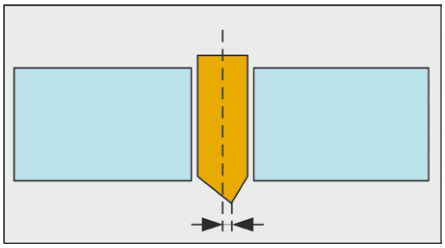
THERMAL EXPANSION

The adapter is manufactured at 23°C to 25°C and is thus also manufactured for this application temperature. If the adapter is used in a warmer working environment, the adapter expands with the corresponding material constant. This temperature difference can be taken into account in the production process by scaling the adapter accordingly.



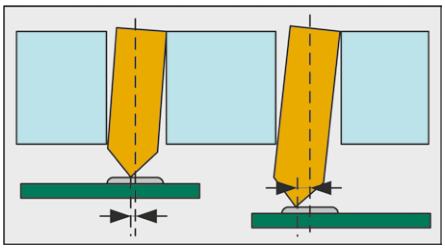
LATERAL PLAY

The size of the needle hole in the adapter is defined accordingly so that the rigid needles have only minimal lateral play. The further the rigid needles protrude out of the adapter, the larger the lateral play. This is the reason why larger test points are required for assembled substrates.



TIP CENTRE

The tip of the rigid needle can be slightly eccentric to the center, which results in a minimal tolerance. This tolerance is further increased by the deflected rigid needle, since the needle tip is positioned at a maximum from the center of the borehole. The Sirius technology prevents this.

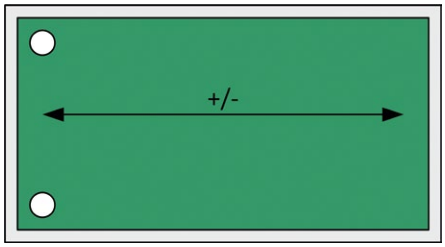


DISTANCE TO THE SUBSTRATE

With the rigid needle adapter, it is important that the distance between the adapter and the substrate is strictly observed, otherwise the highly deflected rigid needles have a lateral misalignment on the substrate. The Sirius-technology prevents this misalignment.

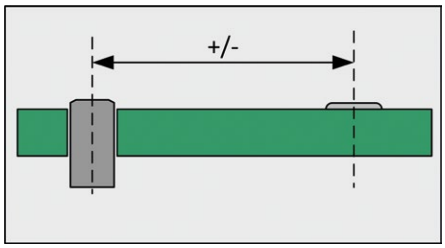
TOLERANCES OF THE SUBSTRATE

The substrates have several tolerances, which must be taken into account during contacting. If the substrate is detected with a camera system and then contacted correctly using the offset values, certain tolerances can be omitted and smaller test points can be contacted.



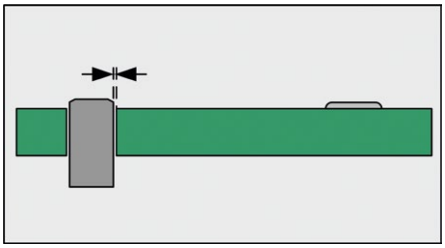
SHRINKAGE AND EXPANSION

In the process of manufacturing, the effective size of the substrate can deviate from the design, whereby the test structures shift accordingly. If the substrate is put through in several steps, this deviation is correspondingly reduced. In addition, this can be taken into account in the manufacture of the adapter by means of scaling.



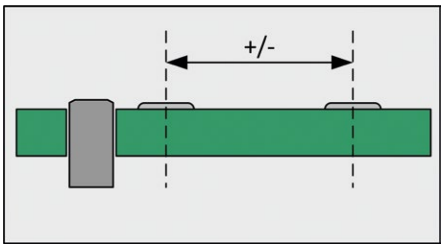
POSITION OF THE MOUNTING BORE

The holes in the substrate are produced in a different process than the layout. This deviation between print layout and drill layout has a direct effect on the positioning accuracy of the substrate. This tolerance can be eliminated only by the optical detection and alignment of the product or adapter.



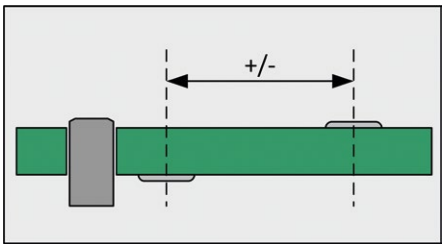
SIZE OF THE MOUNTING BORE

The mounting bore hole must be designed that the substrate can be placed well over the mounting pin. The difference between the mounting pin and the mounting hole affects the position tolerance of the test piece. If spring mounting pins are used, this play can be slightly minimized.



TOLERANCE OF THE LAYOUT

The layout of the test points has a tolerance which can be warped, twisted or shrunk in the X and Y directions. If the substrate is optically detected, it is advantageous if the fiducials and the layout of the test points are produced in the same process.

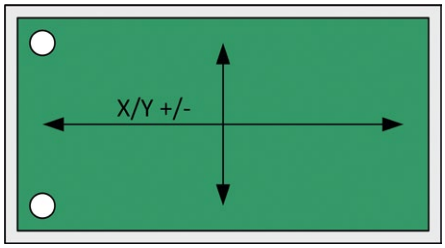


OFFSET OF THE OUTER LAYERS

Particularly in the case of multilayer substrates, a position offset can occur between the outer layers. If the substrate is contacted from both sides, this works with small test structures only with an optical detection of both test sides and the corresponding two-sided correction of the contacting positions.

TOLERANCES OF THE TEST MACHINE

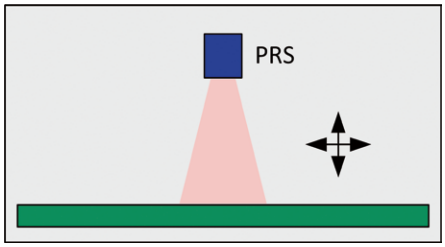
In addition to the fine-pitch adapter, the contacting of small test structures requires a precise contacting system, which can process the offset values detected by the camera system. In the following, some factors are listed which must be included in the tolerance calculation.



SUBSTRATE POSITIONING

If the substrate is positioned with axes under the camera and the contacting, the following factors have an influence on the tolerance:

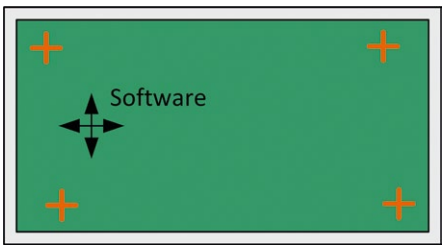
- Positioning accuracy of the glass scale or drive
- Perpendicular alignment of the guide rails
- Pre-loading and smooth running on the guide rails
- Vibration in the system



ACCURACY OF THE CAMERA DETECTION

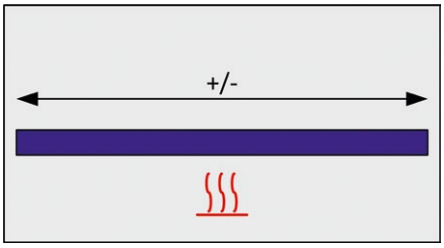
If the position of the substrate is detected by a camera system, the following factors must be taken into account:

- Resolution of the camera system
- Size of the camera field of view
- Illumination of the substrate
- Colour, shape and size of the fiducials



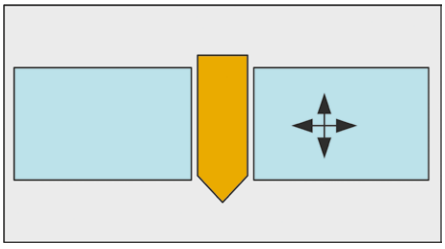
POSITION CALCULATION

The software uses the fiducials to determine the contact position.
More fiducials allow a more accurate calculation. The position in the X and Y directions can be defined by a fiducial.
With two fiducials, the twisting of the substrate can additionally be determined.
Ideally four fiducials are acquired, which increases accuracy and also detects shrinkage, strain or trapezoidal distortion from usage.



THERMAL EXPANSION

If the machine is heated only slightly during operation, all components expand according to their material coefficients. The glass scale is also affected and can affect the position between the camera and the contacting.
Through the use of temperature sensors, this expansion can be compensated by means of the machine software.



POSITION TOLERANCE OF THE ADAPTER

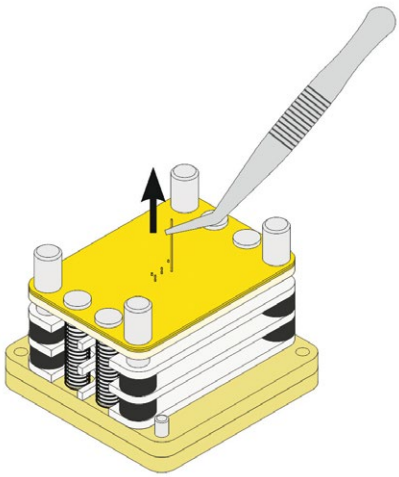
The adapter takes over the corresponding position in the contacting via guide pins.
The guide pins and the adapter have an offset in relation to the mounting system, which can be eliminated by the imprinting and the input of an adapter offset correction.

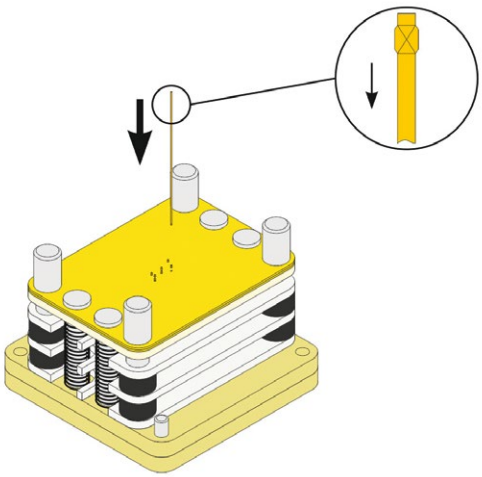
MAINTENANCE OF THE RIGID NEEDLE ADAPTER

Maintenance of the rigid needle adapter can be carried out independently by trained personnel. The rigid needles are pulled out and replaced with a pair of tweezers. The spring probes in the grid can easily be exchanged with a pair of pliers and the placement tool.

CHANGE OF RIGID NEEDLE

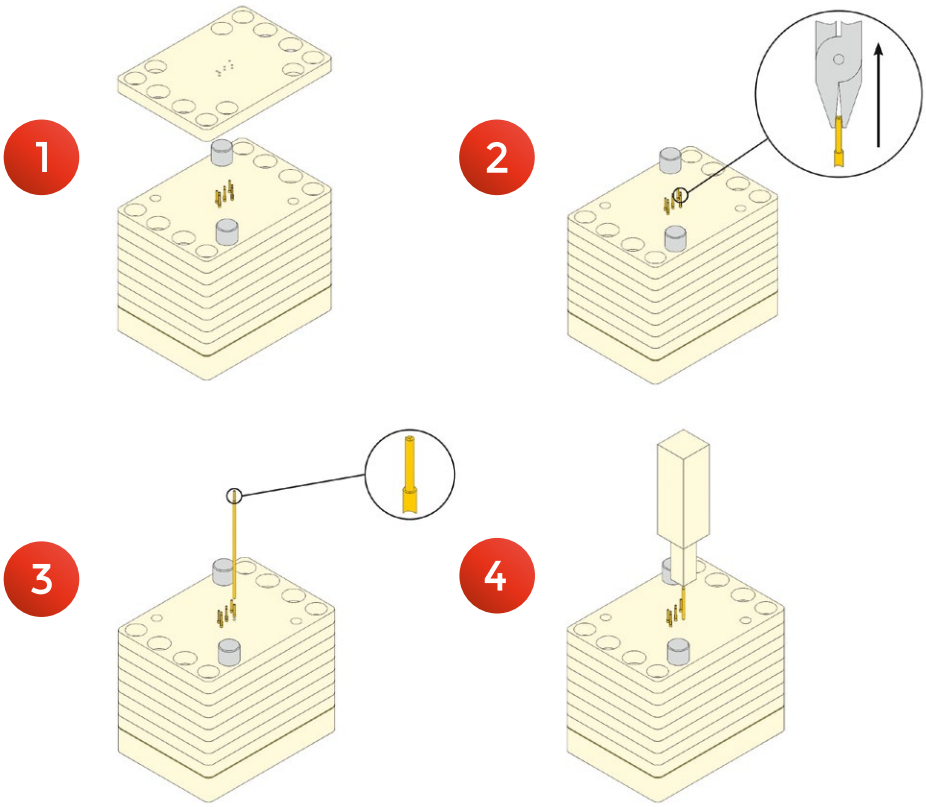
- Place the adapter on a flat surface with the back facing up.
- Pull out the defected rigid needle with the tweezers in the direction of the arrow.
- Fit in the new rigid needle. The pinch must protrude upwards.
- Insert the rigid needle up to the pinch with a little force.





CHANGE OF SPRING PROBE

- Place grid on a plane surface.
- Loosen screws.
- Carefully pull the top plate (ZW51) off the pins.
- Grasp the spring probe with the pliers at the head and pull it out vertically.
- Press in the new spring probe as far as possible without force.
- Press the spring probe with the placement tool and some force up to the stop.
- The ZW51 plate must be centered on the spring probes and put on without force.
- Screw the grid and verify it with the centering tool.



ATTENTION:

After assembly, all spring probes must be checked to see whether they are fed through the holes and spring. If this is not the case, the ZW51 plate must be removed and replaced again as described above.

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