Design and Structure

Application Areas

Test Probes are used in the manufacture of electronic products to test PCBs. When fitted in test adapters, they carry out in-circuit tests and function tests. The aim is to optimize production by raising quality and reducing costs, factors which are caused by faulty components.
The test probe also plays an important part in the automotive industry, where it is used in test modules for testing connectors in cable harnesses. This means that the test probe is an important link in meeting the high quality standards found in automobile manufacture.
Interface Pin Blocks create an electrical contact between two components. As battery probes, they are used, for example, wherever it is necessary to charge the rechargeable batteries in mobile devices such as scanners, card readers, communication devices, etc.
The special design of the test probes which are used here adapts perfectly to an extremely wide range of contact situations. The probes guarantee a clean connection on almost all surfaces, including with ambient conditions in which oscillations and vibrations could affect the contacting. Irrespective of the specified installation height of the interface pin blocks, the test probes compensate for unevenness and differing heights on the contact surfaces. These features ensure a perfect and safe electrical contact. When positioned in the right place and used correctly, the interface pins can achieve up to 1 million contact cycles.
One typical application for interface pins is their use in interface pin blocks. They can be used for the secure connection of two PCBs which, by means of flexible contacting technology, can be connected and disconnected as often as required. This especially flexible connection of the interface pin blocks requires only a contact surface which is larger than the diameter of the probe head, so it offers considerable advantages when compared with connectors, which always require a precise connection. Additional arguments in favour of the use of interface pin blocks include the absence of insertion and withdrawal forces, and minimal wear and tear.

Design

In its basic construction, a test probe consists of three parts (see fig. 1). The electrical contact to the test piece is created by the plunger, which, together with a spring, is inside the barrel. The individual parts are connected moveably with each other by means of mechanical re-shaping of the barrel.

Barrel

The barrel protects the moving parts. At the same time, small tolerances ensure precise plunger guidance. The barrels are manufactured using deep drawing or machining processes. In some cases, ventilation drill holes are needed to ensure optimal coating.

Plunger

The plunger must conform to very high standards. It is a moving part which must be low-wear but at the same time highly conductive. Close tolerances must be included in the above criteria when plungers are used for small centers. The plungers are manufactured with maximum precision on long-turning lathes and then refined. In most cases, the plunger is coated with gold. Plungers are manufactured of hardened fine-grained steel for use in heavy-duty operating time situations. The emphasis is on tips with extra penetration, for example pointed tips. Aged copper-beryllium (CuBe is used for plungers, especially when high demands are made of electrical conductivity for longterm constancy. With regard to environmental aspects, these are taken care of by the 100% wet-processing of the beryllium and by the coating on the plungers. Test probes with CuBe plungers are suitable for measurement tasks in the case of potential difference and for high-voltage applications. The brass plunger design with equally good conductivity is suitable for low-wear applications, e.g. charging contacts with very short travel and non-aggressive tip styles.
Alternatively, the plungers are fitted with different improvement coatings which, in addition to the electrical conducting and contact characteristics, are intended to satisfy specific requirements in respect of abrasion resistance and corrosion protection.

Spring

For the most part, springs are manufactured of spring steel wire of the maximum strength category with a special surface finish. The working temperature range for these springs between -30°C and +120°C also determines the operating temperature range for the complete spring contact probes. High-strength stainless steel wire is used with higher temperatures up to +250°C and increased demands on corrosion protection.
However, with this wire, it is not possible to achieve such high strength or spring force values as with spring steel wire.
Normally, gold is used as a surface plating because it reduces wear and improves the contact

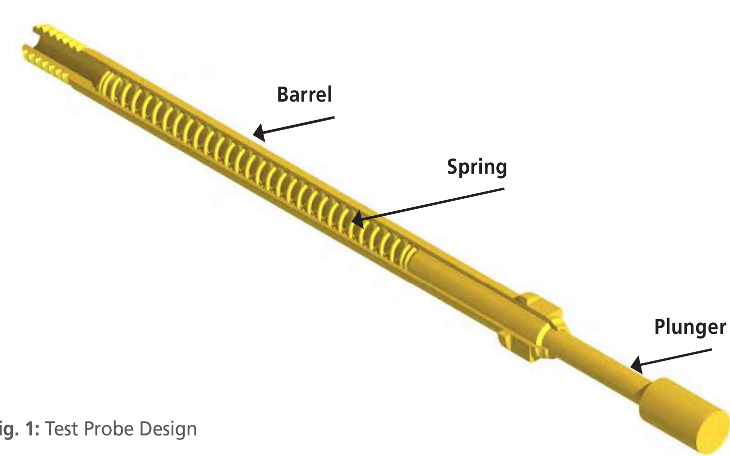


Fig. 1: Test Probe Design

characteristics. The coating is applied in such a way that the structural characteristics of the high-strength spring material are affected as little as possible. In special cases, the springs are silver-coated (improved conductivity). In most cases, stainless steel springs are not given an additional coating, and they are used when temperatures are very high or for maximum heating. The rated spring force of the spring contact probes refers to the working travel, which, as a rule, is 4/5ths of the maximum permitted plunger stroke travel.

Materials

Steel

PTR uses steel as the standard material for the plungers. The stability of this material is good in comparison with others, and is extremely suitable for aggressive probe tips such as the "pointed tip" or the "chisel". The electrical properties are improved by the preferred gold coating.

Copper Beryllium

Copper beryllium is superior to steel in respect of the long-term stability of the electrical properties. Adding beryllium allows the materials to be easily processed, without completely losing the excellent properties of the copper.

Brass

Brass is a relatively soft material which is good for manufacturing purposes. Because of the high copper content, the electrical properties are also good, and for this reason, the material is mainly used for receptacles and barrels. However, brass is also a very popular plunger material for battery charging contacts, which normally do not have to withstand a very high number of load cycles.

Bronze

Bronze is used as a base material for receptacles and barrels; it offers good electrical properties and can be both turned and deep drawn.

Nickel Silver

Nickel silver is a very interesting material for receptacles because it is especially corrosion-proof and can be manufactured using the deep drawing process. Its copper content also makes it an acceptable conductor.

Spring Steel

High-strength spring steel is what is normally used to manufacture springs. It provides excellent properties which permit the manufacture of test probes with long operating times and balanced forces. The temperature range is from -30°C to 120°C. The springs are coated with gold or silver.

Stainless Steel

Stainless steel is used for springs in situations which require greater temperature stability than those which require standard springs. Temperatures from -40°C to 250°C (max. period of one hour) are possible. Good corrosion resistance is an additional advantage of stainless steel.

Coatings

In all cases an intermediate nickel coating is used for protection in order to prevent diffusion of the material.

Hard Gold

Hard gold has a passive surface, so it is an ideal electrical contact partner with very good chemical resistance. The special gold alloy, with a micro hardness of up to 400 HV, is much harder than pure gold, but there are limits with regard to wear behaviour. The abrasion behaviour can be influenced positively if the conditions of use are optimised, for example by the avoidance of radial movements.

Rhodium

Rhodium is one of the platinum metals. A very high level of wear resistance is achieved because of the very high degree of hardness of up to 1000 HV. However, because of the stored oxygen, a higher level of layer brittleness must be expected. This problem can be reduced by means of a special layer build-up and reduced layer thicknesses. However, rhodium plating is unsuitable when heavy impact loads are involved. If the brittle and very thin rhodium layer is damaged, this may have a negative effect on the initially good electrical contact characteristics.

Nickel (chemical)

Nickel is distinguished by even layer deposition with excellent contour accuracy, which is especially advantageous for the function of pointed tips and sharp-edged tip styles. This nickel-plating has a micro hardness of approx. 600 HV, which can, as an option, be increased to 1000 HV and more by means of subsequent heat treatment. This is accompanied by very good wear resistance. Maximum corrosion resistance is achieved by the intercalation of phosphorus. However, the resulting inactive surface does not result in such good contacts as those of gold or rhodium.

Silver

Silver provides the best electrical conductivity among metals, which is why it is used, for example, for high-current applications. In this case, the spring of the test probe used is silver-coated in order to increase conductivity. In addition, some of the probe tips in the high-current range are fitted with caps made of a silver alloy, because this prevents restrictions to the conductivity caused by contact pitting.

Receptacles and Assembly

Receptacles

Receptacles are fitted firmly in the relevant probe location boards in order to permit the replacement of the spring contacts without wiring work when the limit to the operating life (see page 14) is reached.
Base materials for the receptacles are:

- Bronze
- Nickel Silver or
- Brass.

Gold plating ensures good electrical properties, with nickel underneath for corrosion protection.

Types of Receptacles

PTR offers receptacles with a range of connection types. In addition to standard products such as crimp, solder and wire wrap connections (see fig. 1), solutions for special fields of application are available.

- **Threaded Receptacles for screwable Test Probes**
  (see fig. 2)
  This type of receptacle is used in so-called test benches which test the functionality of cable harnesses. The screwing of the test probes into the receptacle prevents unintended twisting of the test probes out of the receptacle caused by the abrupt stroke movements of the test modules.

- **Threaded Receptacles with a drill hole in the solder cup**
  (see fig. 2)
  This receptacle is sealed vacuum-tight when the wire is soldered on.

- **Easy Replacement Receptacles for Switching Test Probes**
  (see fig. 2)
  In this case, wiring takes place twice on the receptacle and no longer on the switching test probe itself. During maintenance work, the switching test probe can be replaced without the need for any other wiring work.

- **Receptacles with a non-rotating feature**
  (see fig. 2)
  This type of receptacle makes it possible to position the test probes precisely in respect of the test piece. This solution is used especially with the so-called spade-shaped head style.

- **Insulation Receptacles**
  (see fig. 2)
  This type of receptacle is deployed when test probes are used in a conductive carrier material. In this case, the insulation receptacle holds the actual receptacle of the test probe.

- **Pre-wired Receptacles**
  (see fig. 1)
  These receptacles are already fitted with a component lead which the customer can adapt to the required individual length.

- **Receptacles for different extension heights**
  (see fig. 3)
  As standard, the receptacle is pressed into the carrier material as far as the stop. The receptacle type fitted with a press ring permits different extension heights – it is inserted to a specified distance by means of a special insertion tool. So-called distance rings are an alternative to this and are placed over the receptacle before it is pressed into the carrier material. Distance rings are available for different series and extension heights.

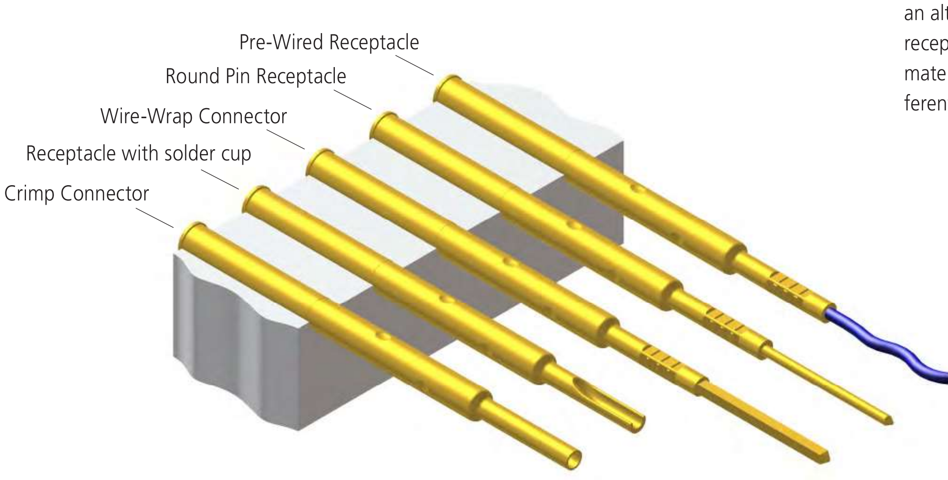


Fig 1: Standard Types of Receptacles

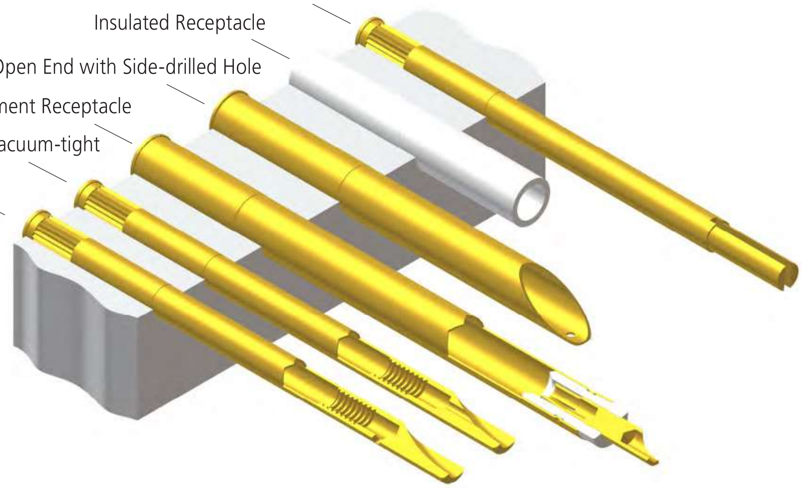


Fig. 2: Individual Types of Receptacles

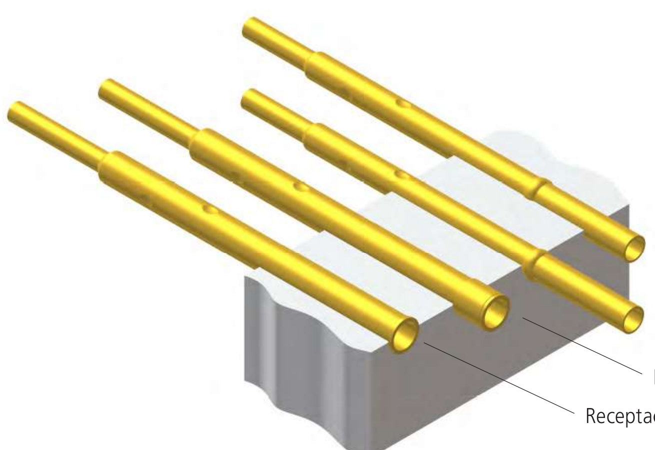


Fig. 3: Types of Receptacles for Different Extension Heights

Assembly Holes

In order to achieve an optimal fit of the receptacles in the probe location board, the assembly holes must be drilled very carefully. The drill diameters listed in the data sheets for the individual series are the values based on our experience. These guideline values are dependent on the following conditions:

- Use of hard metal drills
- RPM of the drill tool 26,000 … 35,000 rpm
- Advance 0.6 … 0.8 m/min
- Material as described in the data sheet
- Probe location board thickness 10.0 mm
- Drilling under vacuum swarf removal device

Deviations from these influencing variables may result in other drill diameters.

Trial drillings are recommended in every case.

Lateral Play

Quality and Operating Life

Test Point Accuracy

The test point accuracy which can be achieved is determined by the tolerances in the adapter (play, displacement of the receptacle drill holes), the deviations of the test points and the lateral play of a fitted spring contact probe (see fig. 1). This occurs as a result of the play between the plunger and receptacle required for the plunger movement and also of manufacturing tolerances (see fig. 2). The amount of lateral play at the plunger tip is also dependent on the length of the plunger in relation to the effective plunger guide length.

Shear forces which deflect the spring contact probe during use also affect the amount of lateral play.

Optimal pinpointing is achieved by a combination of spring contact probes with the shortest possible travel, double plunger guides and minimal adapter tolerance, or even the use of plate guides. Depending on the test probe series which is being used, the test point accuracy – which is dependent on the amount of lateral play – can be reduced to less than 0.8 mm and down to 0.1 mm.

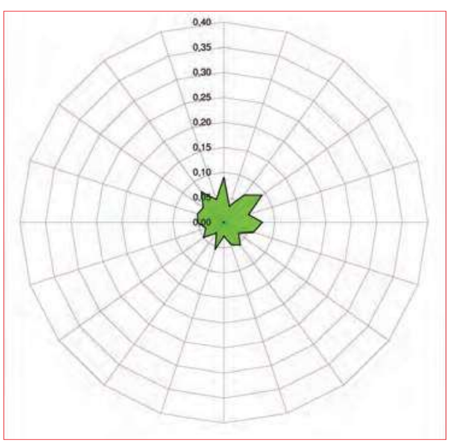


Fig 1: Test Point Accuracy (mm)

Fig 2: Lateral Play

Quality and Operating Life

When in use, Test Probes are subjected to high demands in respect of function and operating life. From development to dispatch, the manufacture of PTR test probes takes place in accordance with optimised procedures. A quality assurance system according to EN 29001/ISO 9001 guarantees process security. Tests are carried out by means of load change tests in order to optimise materials and the constructional design of test probes. Functional capability and operating life are subjected to continuous monitoring in our reliability testing facilities (see fig. 3).

As a rule, the maximum operating life of a test probe depends on the following factors:

- As low a spring force as possible in relation to the spring diameter and stroke travel
- Correct axial load, avoidance of shear forces
- Maintenance of the recommended working travel
- Precise and gentle insertion of the test probe into the receptacle
- Avoidance of harmful external influences e.g. soiling, high moisture content of aggressive media, high temperature load
- Contacting only in current-free or zero-potential state
- As low a current load as possible

Of course, the level of actual durability also depends on the requirements of each user, e.g. limit values for continuity resistances, degree of soiling, or operating characteristics.

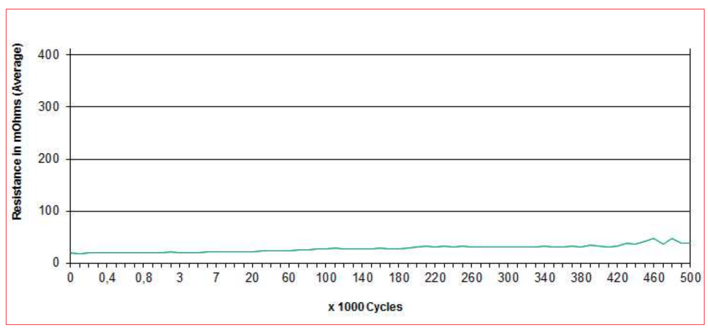


Fig. 3: Life Circle for Series 1025/E (Example)

Highlights

Test Head for Horizontal Contacts in Connectors

Horizontal contacts, as found for example in the Mitsumi Connector, are often a problem for the cable sector because of the need for wear-free testing, and PTR developed test head PK 808 for this purpose. During the test, and shortly before the end of the insertion process, the integrated springs are pressed horizontally onto the contacts. This gentle method of contacting is especially low-wear and creates a secure connection.

Fig 1: Mitsumi Connector with test head

ICT Test for Minimal Center Situations

With the new 1004/E series, minimal center contacting is now also possible for in-circuit and function tests. The installation height is based on the E-series standards and is an optimal supplement in the test adapter for the well-known 1008/E and 1012/E series. Of course, the different receptacle types are also available for the series. They are always fitted with a press ring, because this permits a high level of flexibility for the adapter equipment. We also offer the tried-and-tested V and V4 chisel heads for the contacting of soiled and oxidized PCBs.

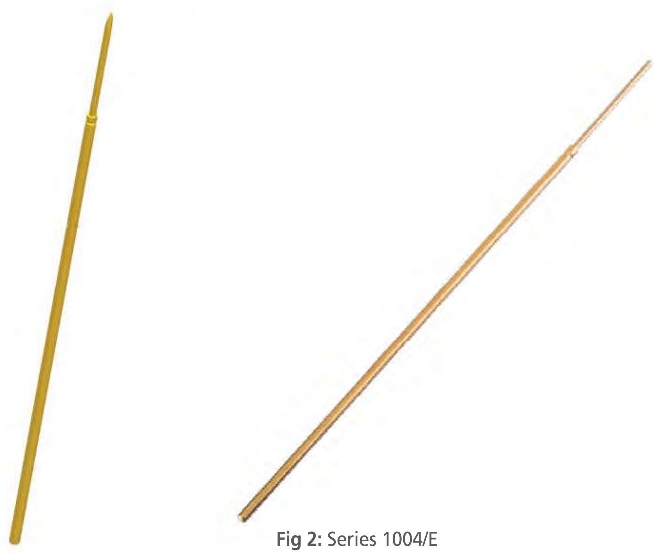


Fig 2: Series 1004/E

PCB Testing and Contacting for High-Frequency Applications

We have added the 7840 series to our product range of High-Frequency Test Probes. The 7840 series offers a contacting opportunity for PCB layouts with differing heights. This makes use of two external earthing pins, which, individually sprung, ensure a secure contact. The complete probe tip springs the rigid signal pin in the middle, and this protects both the test piece and the test probe. The pin can be used up to 4 GHz and has an impedance of 50 Ω.

Fig 3: Series 7840/G

Tip Styles


Form A
90° Concave
For connector pins, wire-wrap pins and straight / curved terminals. To be used under clean conditions because contamination can cause failures.


Form A6
90° Concave, self-cleaning
For connector pins, wire-wrap pins and straight / curved terminals. The head has special grooves that protect the contact area from contamination.


Form B
30° pointed tip
For strip conductors, throughplating, soldering points and test pads.


Form BST
Steel Needle
A sharp steel needle with a long implement life for reliable penetration of flux and dirt on uncleaned printed boards or component groups and for SMD contacts.


Form BST3
Tri-Needle
Three-needle form of very aggressive character for reliable penetration of flux and dirt on uncleaned printed circuit boards.

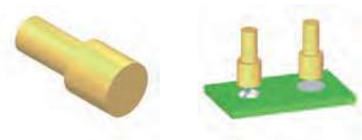

Form C
Serrated
A universal head for straight or curved component leads, wire-wrap posts and connector pins.


Form CS
Serrated with overlapping plastic insulation
Presence test of component legs. The overlapping plastic insulation avoids electrical contact when connector pins are missing.

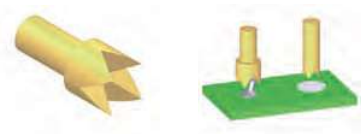

Form D
Round Head
Used to test circuits or gold pads. Do not leave marks on the test area. Also used for testing sockets in connectors.


Form E
90° Convex
Plated-through holes, pads and lands or sockets in connectors.

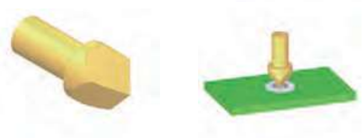

Form EB
Press Fitted Steel Needle
Very aggressive and robust steel needle. Especially designed for testing contaminated areas.



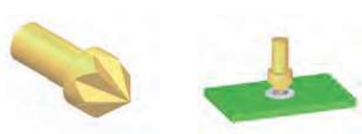
Form F
Flat head
Especially for gold pads and convex areas, cleaned contact points. Avoids marks on the contact area.



Form G
Four-point crown
For component leads, soldering points and test pads, when there is no strong contamination.

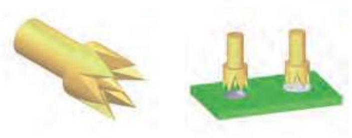


Form H
Pyramid
Plated-through holes and pads. The sharp edges cut through oxides and contaminants.

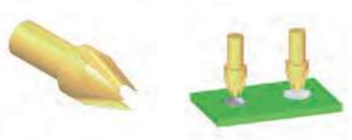


Form K
Star
See tip style "H", but with higher contact penetration. Used also for rotating test probes.
It cuts through oxides and contaminants.

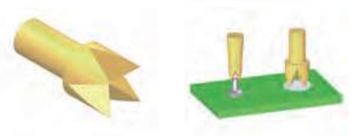
Form M
Tulip with overlapping middle edge
The combination of crown and central tip ensures contact reliability at almost all test points.
Overlapping middle edge is fixing the head.



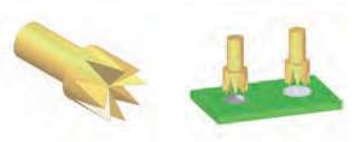
Form M1
Tulip
The combination of crown and central tip ensures contact reliability at almost all test points.



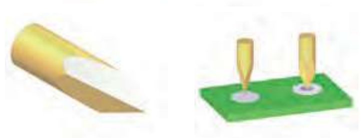
Form N
Three point crown - self-cleaning
Designed to test contaminated printed circuit boards. The special cut of the tip allows contaminates to fall out easily.



Form Q
Four-point crown - self-cleaning
Designed to test contaminated printed circuit boards. The special cut of the tip allows contaminates to fall out easily.

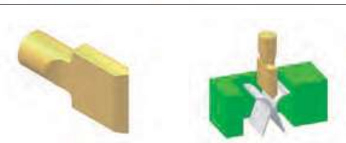


Form Q8
Eight-point crow, self-cleaning
Designed to test strong contaminated component legs. High centering efficiency.



Form V
Chisel
Tip with extra penetration of open and closed throughplating, and for level contact surfaces.
Penetrates flux and dirt.

Form D1xxx
Round head
Designed for position test of sockets in connectors.



Form Y
Spade
For application with test probes in connector systems.

Article Designation - Test Probes

3010 /2GW5 – F1 – 1.3N – Au – 2.3 C /SH4.0

3010	/2GW5	F1	1.3N	Au	2.3	C	/SH4.0
1	2	3	4	5	6	7	8

1 Test Probe - Series Designation

2 Special Design of the Barrel

/D	Rotating Test Probes
/F	Typ Opener
/G	Thread Design
/R	Knurl
/S	Plug-In Connector
/V	Non-Rotating Design
/W	Interchangeable without Soldering
/Number	Collar Height (mm)
/Number	*(second part)* Adjustment Area of the Extension Height

3 Tip Style

Different Letters
(see page 16)

4 Spring Force (N)

Value	In General $^{4}/_{5}$ of max. Travel

5 Tip Plating

Ag	Silver
Au	Gold
CB	Copper-Beryllium
HTK	Plastic
Ni	Nickel
Rh	Rhodium

6 Tip Diameter (mm)

Selected Tip Style

7 Tip Material

C	Copper-Beryllium (CuBe)
M	Brass (CuZn)

8 Additional Information

L	For Connector L 4000
/MHx.x	Full Travel (mm)
/SHx.x	Switch (mm)
/X x Y	Connector Pin Diameter x Connector Pin Length (mm)

Article Designation - Receptacles

H 1025 /12 C

(1) H 1025 — (2) /12 — (3) C

1 Receptacle - Series Designation

2 Special Design of Receptacle

/G	Thread
/R	Knurl
/S	Chamfered Design
/SEV	Switching Element
/.V	Non-Rotating Design
/...V	Vacuum-Tight Design
/W	Interchangeable without Soldering
/Number	Collar Height (mm)

3 Connection Type

C	Crimp Connection
L	Soldering Connection
SEV	Vacuum-Tight Switching Element
ST	Additionally Roller-Burnishing
V xx	Pre-Wired Receptacles with Length
W	Wire Wrap Connection
WR	Round Posts
- Number	Receptacles Length (mm)

Article Designation - Distance Rings

ZRG 1021 /2

(1) ZRG 1021 — (2) /2

1 Distance Ring - Series Designation

2 Length

/Number Distance Ring Length (mm)

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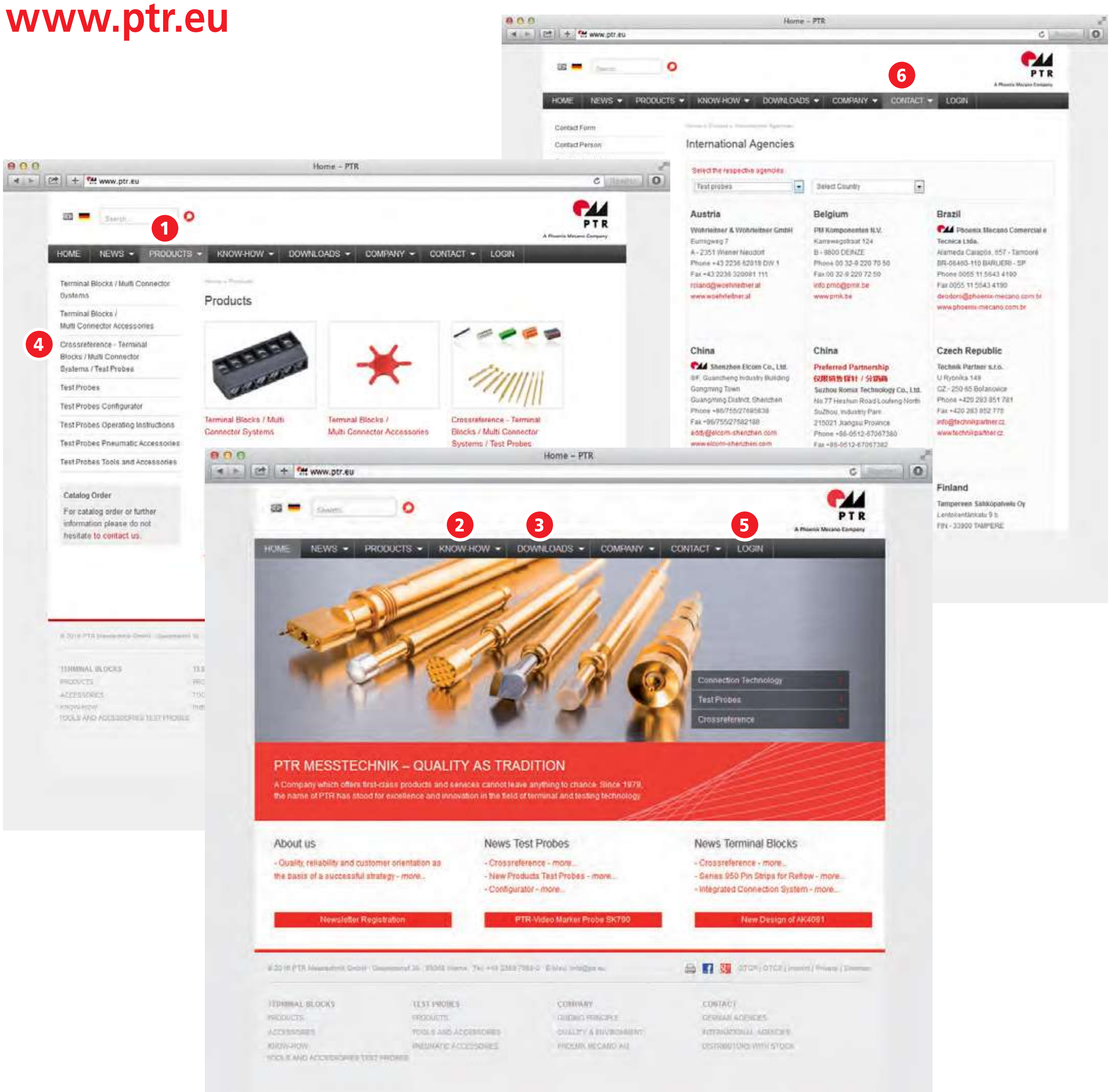

1 Products

- Product search with individual search criteria
- Product data sheets with technical drawings
- PDF generation
- Test Probes - product configurator
- Sample order
- Quotation order
- Terminal Blocks / Multi Connector Systems

2 Know How

- Background knowledge and more detailed information on our products

3 Downloads

- Catalogues
- Certificates
- Statements of conformity
- Brochures

4 Cross-Reference

- Recoding of competitor article designations to PTR designations

5 Login Area

- Premium service for registered customers
- Download 3D-files

6 Contact

- Your contacts worldwide