Application Note

SKEDD
Technology, Advantages & Application

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1 Introduction

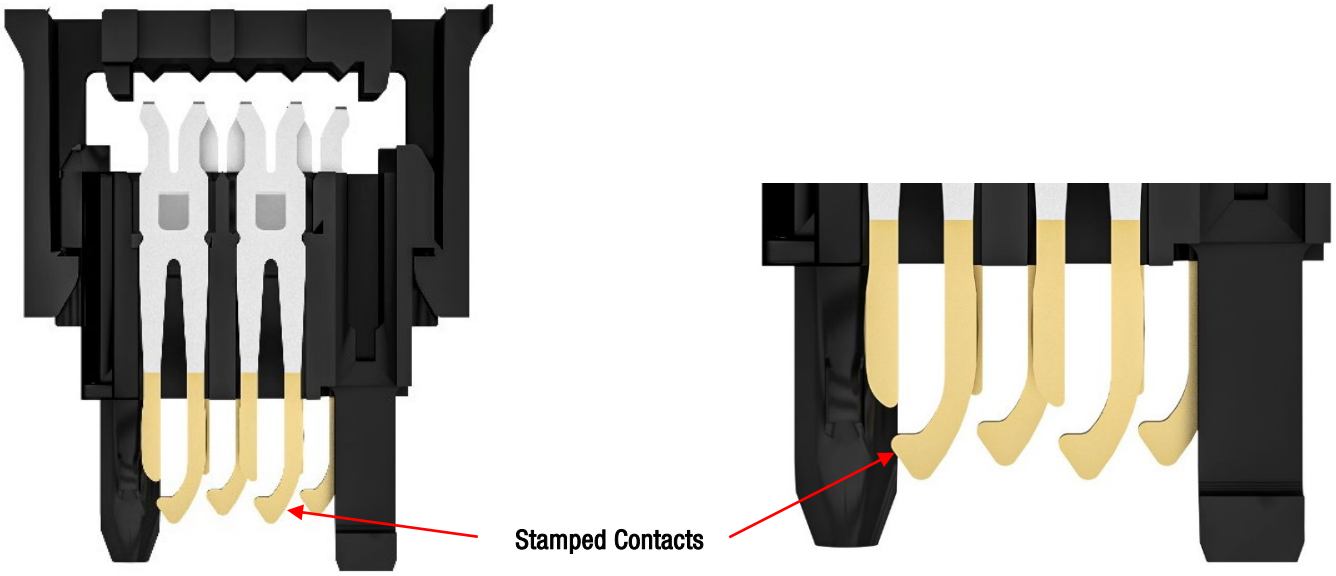
SKEDD is a technology developed by Würth Elektronik with which connectors can be connected to the circuit board directly without soldering. This type of contact offers considerable advantages over soldered connectors.

The REDFIT IDC (insulation displacement connector) is the first series of connectors from Würth Elektronik which comes with SKEDD technology. In the meantime, renowned companies worldwide trust the advantages of SKEDD technology. In this Product Guide you will learn about the advantages of SKEDD and suitable applications for using SKEDD.

2 SKEDD functionality

At the heart of SKEDD technology are innovatively designed stamped contacts, which provide an electrically stable connection directly in the through-hole plating (via) of the PCB. The pre-stressing arising during contacting ensures a stable electrical connection even in case of intense vibration.

The use of high-performance alloys as the contact material enables a high contact force, which safeguards the electrical connection given high mechanical requirements. SKEDD technology thus provides a stable electrical connection (Figures 1 and 2)



Figures 1 and 2: SKEDD Stamped Contacts

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2.1. The difference to press-fit technique with solid pins

In a solid press-fit connection, the high forces during connection create a gas-tight connection between the contact members. The through-hole plating of the circuit board adapts to the contact through the press-fit process.

SKEDD technology means there is no permanent deformation of the through-hole plating. Only the SKEDD forks are pre-stressed and spring back to their original position once the connection is released. This means that SKEDD is utilizes the elastically section of the copper material (Figure 3)

The widest possible elastic range is essential for compensating hole and offset tolerances, whereby an appropriate contact force must be guaranteed. This range is influenced by the selection of suitable materials and a design that forms the ideal compromise between rigidity and elasticity.

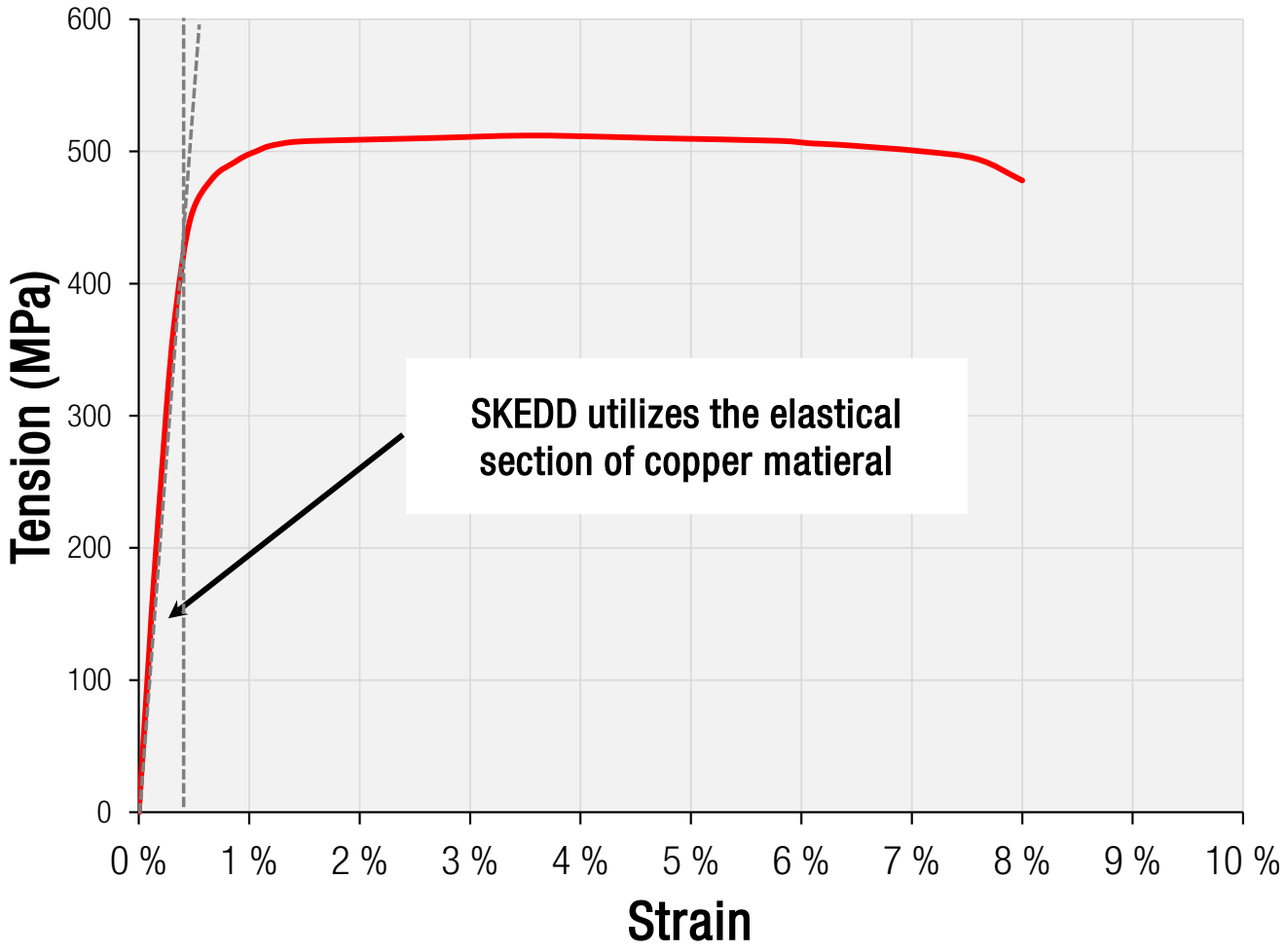

Figure 3: Tension and elongation behavior of copper material

2.2. Vibration resistance

Thanks to the low insertion forces (compared to conventional press-fit contacts), SKEDD connectors can be manually inserted into the circuit board. Nevertheless, the spring force of the contacts is sufficient to ensure a very stable electrical connection, even during intense vibration. This is ensured with vibration tests, which test the mechanical stability of the connector on the circuit board as well as the quality of the electrical connection (Figure 4).

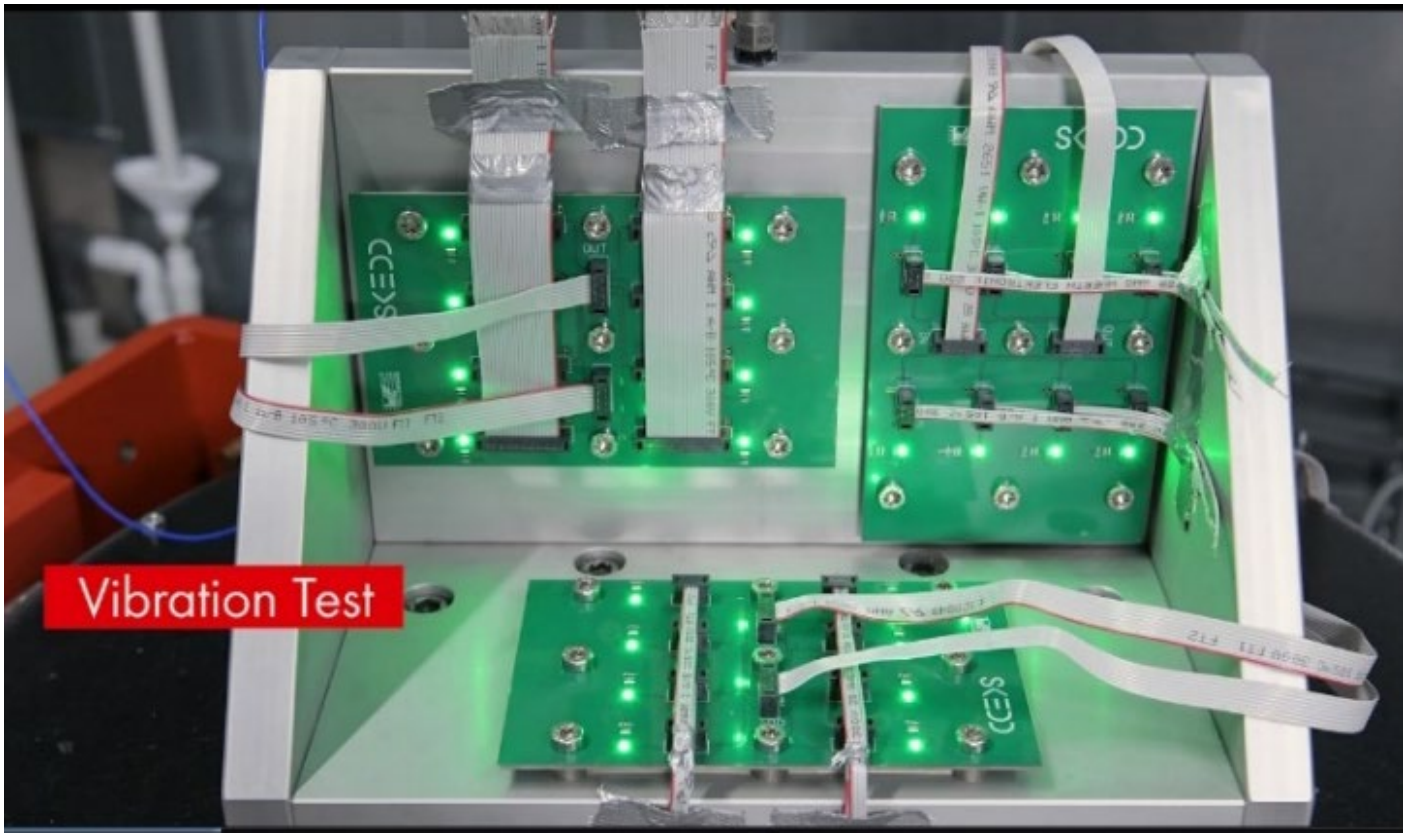

Figure 4: Test setup for vibration test

For example, the REDFIT IDC is tested for 7.5 hours at accelerations of up to 10 g (maximum accelerations of up to 5 g occurred during the launch of a Space Shuttle). It is ensured that no contact interruptions >1 µs occur even under high mechanical load.

On the Würth Elektronik YouTube page you can also find a video showing REDFIT IDC testing. You can find more details about reliability at www.we-online.com/redfit

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3 REDFIT IDC properties

As a signal connector, the REDFIT IDC is the first connector from Würth Elektronik eiSos available with SKEDD technology (Figure 5). With a 1.27 mm pitch, the REDFIT IDC is no larger than comparable signal connectors such as box headers.

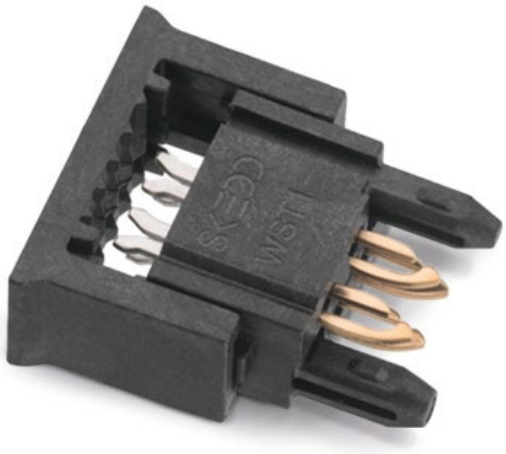

Figure 5: REDFIT IDC SKEDD connector

The contact springs come with selective plating. A tin layer enables an optimal IDC connection. The SKEDD spring contacts are ENIG (Electroless Nickel Immersion Gold) plated to ensure optimal signal quality, also over long periods.

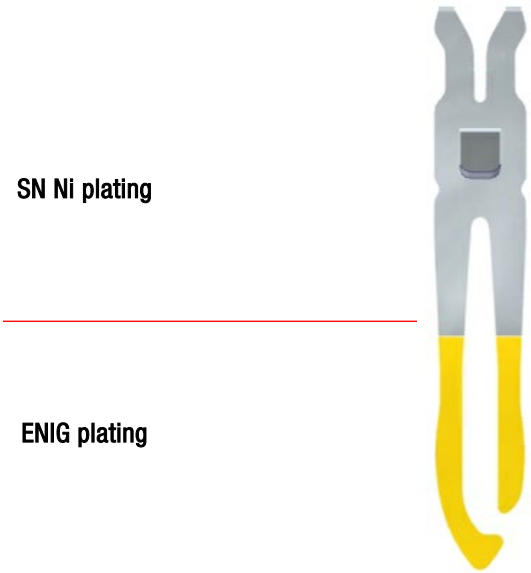

Figure 6: Contact plating SKEDD

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The housing of the REDFIT IDC comes with two additional plastic pins, which secure the connector to the board (Figure 7). As the diameter of the plastic pins is different, these pins provide reverse polarity protection.

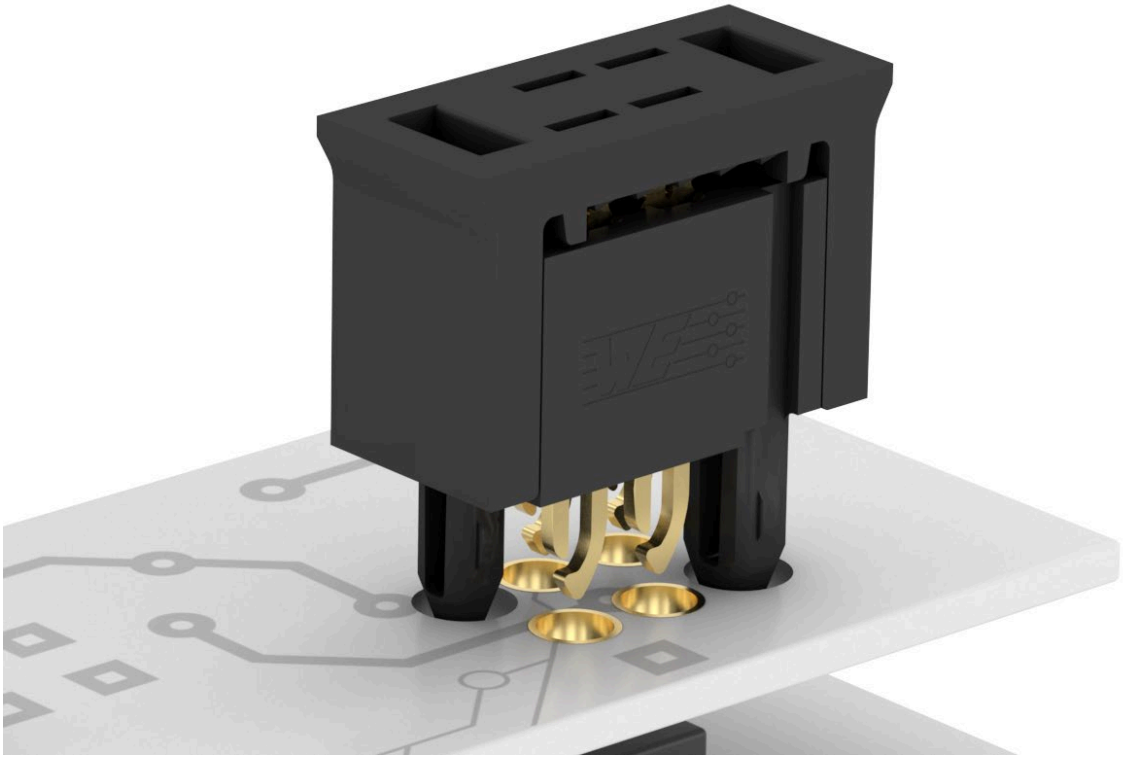

Figure 7: Protection against reverse polarity with plastic pins

Manufactured out of LCP plastic, the housing is flame-retardant. LCP plastic complies with the UL94 V0 rating.

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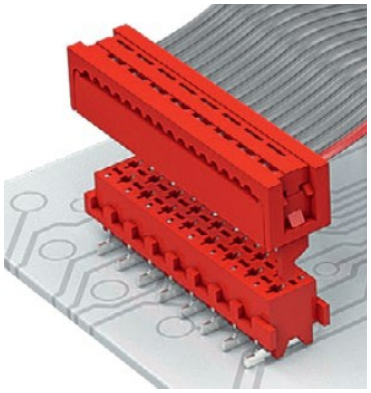
4 SKEDD advantages

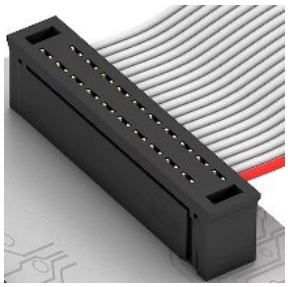
SKEDD technology provides a wealth of advantages which are used in the REDFIT IDC.

- Mating connectors no longer necessary
- Solderless connection technology
- Connector can be retrofitted without a soldering process
- Simple maintenance
- No thermal processes
- Can be hand-mounted
- PCB mountable on both sides
- Ideal debugging connector

4.1. Mating connectors no longer necessary

SKEDD technology allows direct plugging into the PCB. The connector does not need to be placed and soldered on the PCB (Figures 8 and 9).





Figures 8 and 9: no need of PCB counterpart using SKEDD

This saving yields further advantages::

- Fewer potential sources of electronic faults
- Low contact resistance
- Weight reduction
- Cost saving
- For expandable systems, the connector base can be omitted. Only the layout on the PCB is required.

SKEDD enables electrical connection without a connector base and thus reduces sources of electrical faults by eliminating one connection level. In addition, a permanently low contact resistance of maximum 10 µΩ is achieved. Under adverse conditions such as heat, moisture or vibrations, the permanently low contact resistance ensures high signal quality. Not only is the total weight of the system lowered, but the costs for circuit board interfaces can also be reduced.

4.2. Cost-neutral with optional system expansion

With the REDFIT IDC, systems can be prepared for expansions at almost no extra cost. While conventional connectors require a socket to be soldered in to expand the system in the future (e.g. through optional peripherals or similar), SKEDD technology allows sufficient space for the connector layout on the board. If required, a REDFIT IDC can be connected retrospectively (Figure 10).

This means that the costs for extensions are only incurred when they are actually needed.

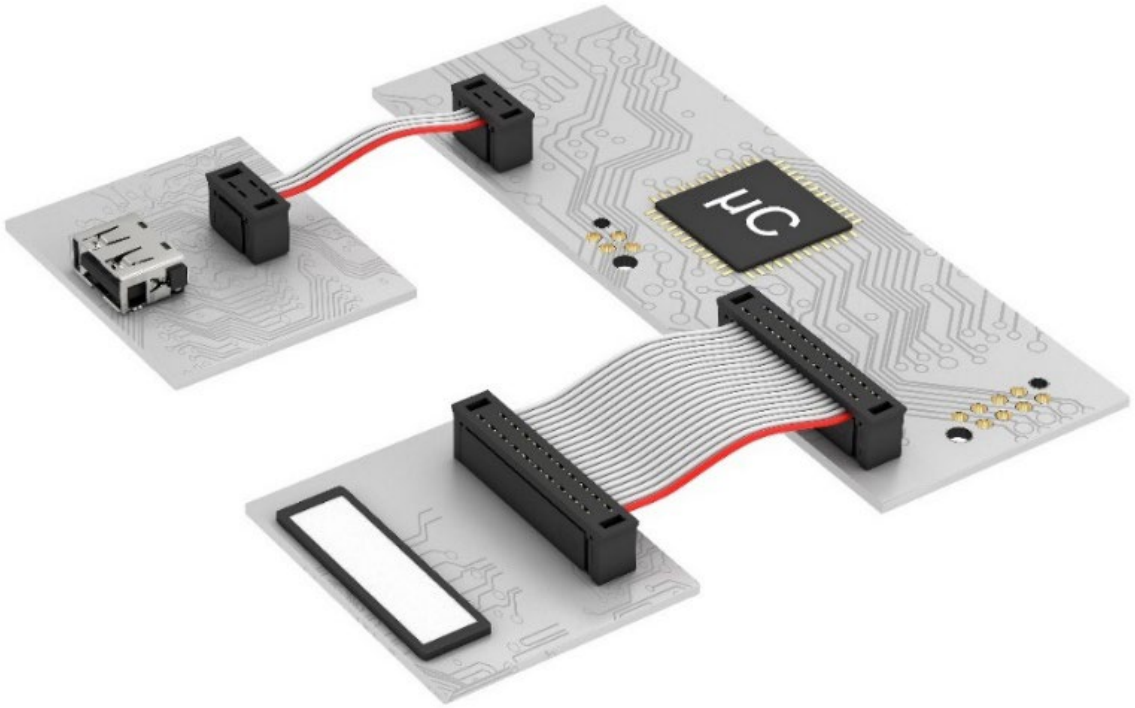


Figure 10: Easy and cost neutral system expansion while placing layouts

4.3. Solderless Mounting

If the entire process of a soldered connection is considered, costs of at least 0.11 € per component are incurred for the soldering and component placement processes alone (data from REFA [German Association for Work Design, Business Organization and Business Development], collected by electronics manufacturers over 10 years) (Table 1).

THT-placement		
Hourly rate	36	€
Handling time per component	2	sec.
Component placement	6	sec.
Manual optical inspection	3	sec.
Total	**11**	**sec.**
Costs	**0.11**	**€/piece**

Table 1: Average costs of soldering process (REFA data)

So SKEDD technology can save further costs compared to soldered connectors. There is no need for component placement or soldering a connector base. The SKEDD connector is mounted after soldering.

The use of SKEDD components, such as the REDFIT IDC, often allows boards to be produced completely without THT solder components, which results in further savings potential. This saves expensive THT soldering processes with manual component placement or selective soldering.

In the case of maintenance, it is usually not possible to comply with the necessary circuit board processing guidelines, e.g. drying before soldering. If the circuit board is reheated, then delamination or the popcorn effect may occur. Thanks to SKEDD technology, the connector can be replaced by hand without additional soldering or thermal stress.

Conclusion

Solderless mounting of the REDFIT IDC allows boards to be realized without the THT soldering process. This results in major cost reductions. At the same time, the REDFIT IDC offers the reliability of soldered connectors.

For expandable systems (e.g. access control extended to include retina scanning) the REDFIT IDC offers major advantages.

4.4. Toolless Mounting

No additional tools are required for final REDFIT IDC mounting. Connectors with SKEDD technology can be plugged and unplugged by hand (Figure 11). Despite toolless mounting, a stable and reliable fit is guaranteed up to an acceleration of 10 g.

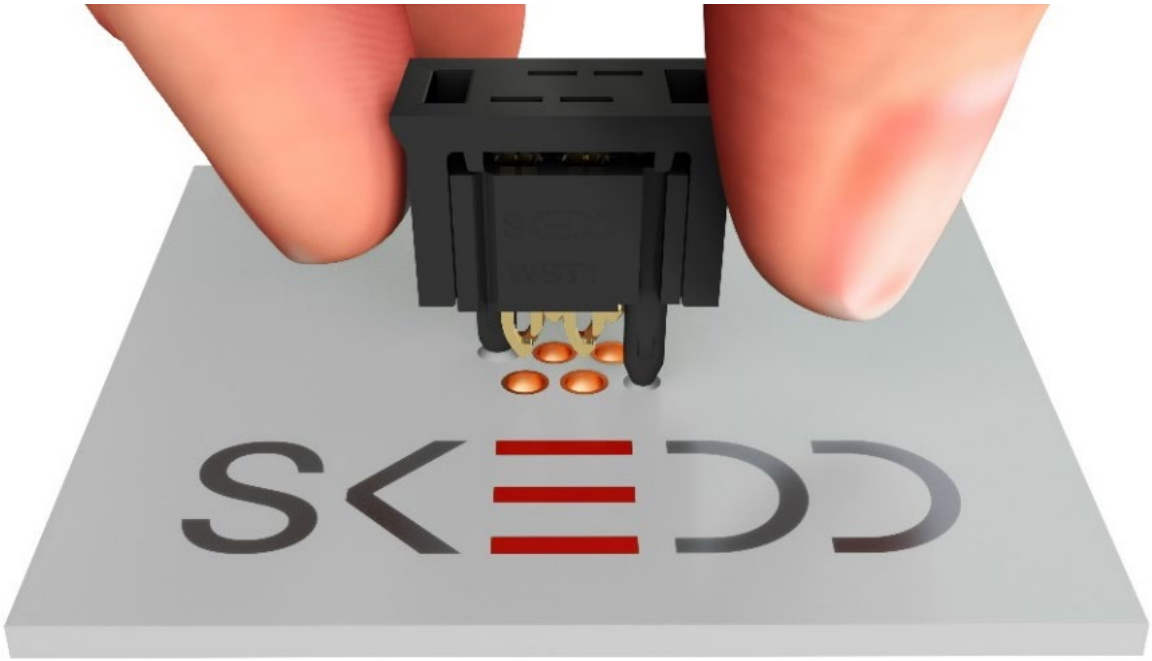


Figure 11: Toolless mounting

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4.5. Double-sided component placement

Since the REDFIT IDC requires no soldering, it can be mounted from both sides, regardless of the direction of component placement on the PCB. For application on the underside of the PCB, the layout must be placed mirrored on the bottom layer (Figure 12). Miniaturization of all components on the PCB reduces the space available for plug connections. Mounting on the opposite side to component placement solves this problem.

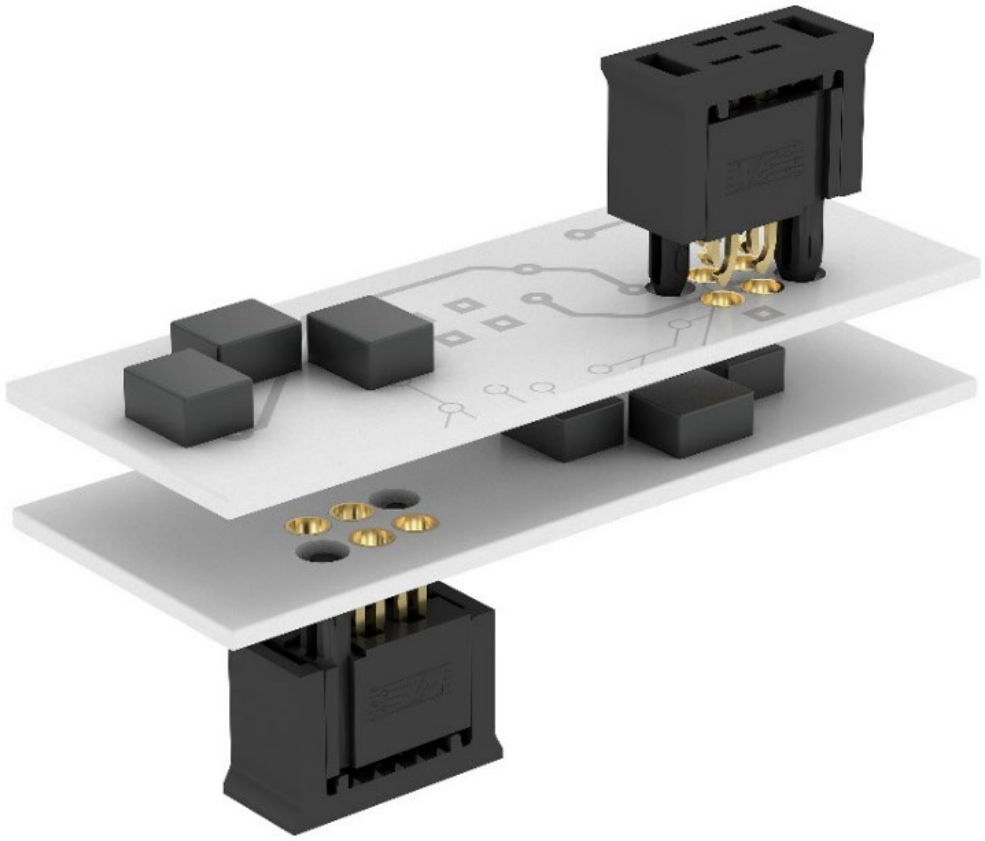

Figure 12: easy double sided placement

4.6. Daisy Chaining

In order to implement bus systems, the REDFIT IDC can be connected in series. With daisy chaining, several connectors can be pressed onto the same ribbon cable (Figure 13).

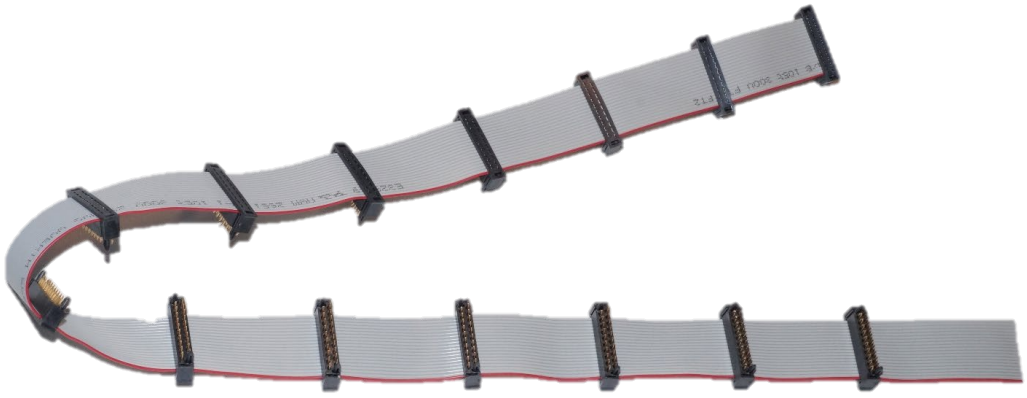

Figure 13: Examples for daisy chaining

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4.7. Debugging

The advantages of SKEDD technology make it very suitable for debugging applications. Often plug connections are only needed briefly to upload or debug programs. For this purpose, the REDFIT IDC no longer requires a mating connector to be soldered, but only the layout needs to be on the board. With its size, REDFIT IDC can be accommodated on almost all PCBs and at the same time is easy to operate. The plastic pins allow the REDFIT IDC to be firmly secured on the board during the programming process and ensures a reliable connection without having to fix the connector by hand.

In order to optimize the REDFIT IDC for debugging applications, a second board layout was developed, which increases the number of mating cycles to 50 and makes plugging and unplugging the REDFIT IDC even more convenient. Only the vibration stability of 10 g cannot be ensured with this layout. If this is needed for debugging applications, the permanent layout can still be used.

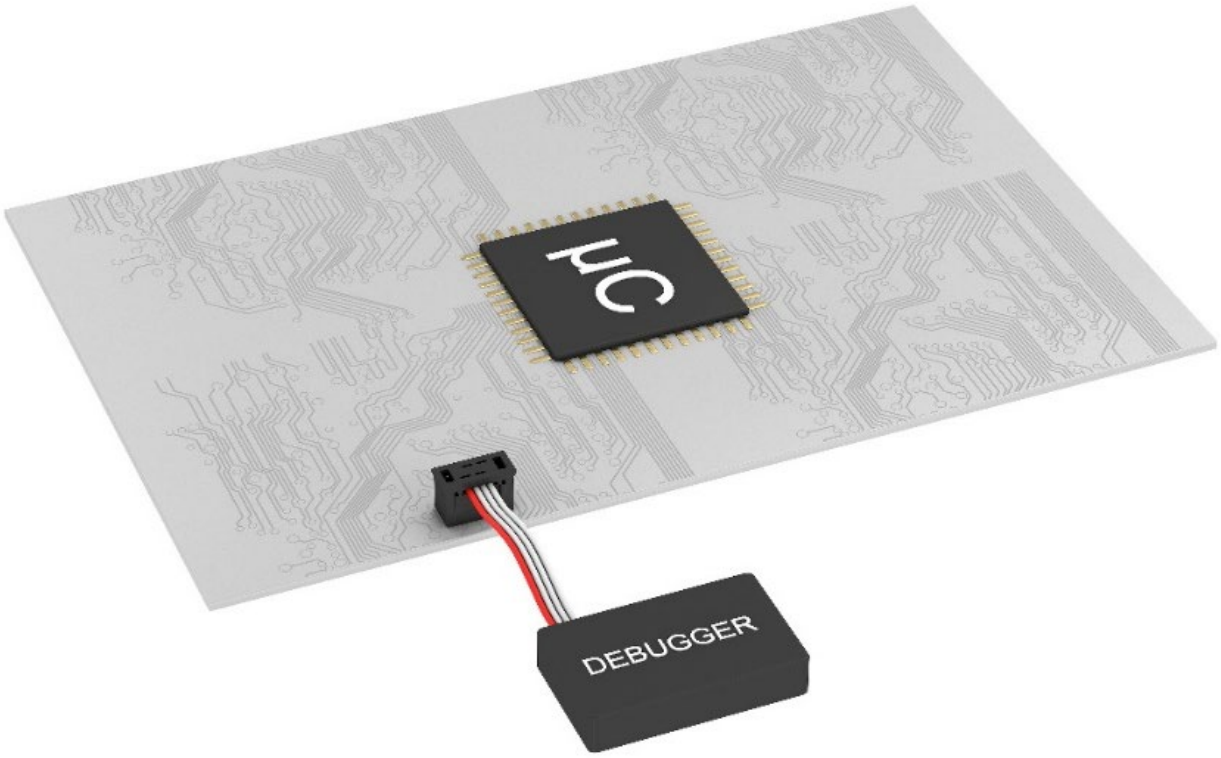

Figure 14: SKEDD at debugging application

Adapters are required to simplify use of the REDFIT IDC as an interface for common debuggers. Layouts for four common types of adapter board are available on the Würth Elektronik homepage. You can find more debugging layout examples under the following link: www.we-online.com/redfit.

Conclusion

A separate circuit board layout available for debugging applications. This reduces the REDFIT IDC insertion forces thus doubling of the number of mating cycles possible.

Since no connector base is required for debugging, this can be saved with SKEDD technology.

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5 Prefabricated cables

Würth Elektronik offers prefabricated cables directly out of the catalog (Figure 15).

This allows the customer to source a component and they only have to carry out final assembly. Fabrication and the soldering process, etc. are therefore history. Furthermore, the storage of several components is no longer necessary.

Figure 15: Prefabricated cables

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6 Price advantages

The advantages of SKEDD technology described in the previous section result in a price advantage over conventional solder connectors. This not only optimizes processes, but also reduces costs. The advantages are shown in table 2.

	Connectors and mating connectors	SKEDD	SKEDD prefabricated cable from WE
Material logistics	4 parts	2 parts	1 part
Number of suppliers	Up to 2 for connector & fabricator	1 & fabricator	1
Component placement	2 components	N/A	N/A
Soldering	2 components	N/A	N/A
Fabrication	2 components	2 components	N/A
Electrical interfaces	6	4 - 30% potential modes of failure	4 - 30% potential modes of failure
Overall mounting process	• Placement of two connectors • Soldering both connectors • Fabricating the two mating connectors • Mounting the mating connectors on the PCB	• Fabricating of two SKEDD connectors • Mounting the SKEDD connectors on the PCB	• Mounting the SKEDD connectors on the PCB

Table 2: Price advantages using SKEDD technology

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7 Qualification and reliability of REDFIT IDC

The reliability of SKEDD technology has been demonstrated through several qualifications, tests and in practice. Established companies like Phoenix Contact, Lumberg and Diehl rely on SKEDD technology.

The following tests are performed on the basis of common standards to ensure the function and reliability of the REDFIT IDC.

7.1. Electrical tests in accordance with:

- Connectors for electronic equipment - Tests and measurements - Part 2-1:
  Tests of electrical continuity and contact resistance - Test 2a: Contact resistance; Millivolt level method (IEC 60512-2-1:2002)
  - ✓ max. 10mΩ Contact Resistance
- Connectors for electronic equipment - Test and measurement methods - Part 3-1:
  Insulation tests - Test 3a: Isolation resistance (IEC 60512-3-1:2002)
  - ✓ Measure points: between adjacent terminals. Result: RISO> 1000MΩ
- Connectors for electronic equipment - Measurement and test methods - Part 4-1:
  Voltage stress tests - Test 4a: Voltage proof (IEC 60512-4-1:2003)
  - ✓ Measure points: between adjacent terminals. Result: No flashover or puncture/break-down at 500V AC

7.2. Mechanical tests in accordance with:

- Environmental influences - Part 2-6: Test methods - Test Fc: Vibration (sinusoidal) (IEC 60068-2-6:2007)
  - ✓ Endurance time per axis: 2h 30min; Frequency rate: 10-150Hz; peak – peak max. 1,5 mm; no Microcuts >1µs detected
- Environmental influences - Part 2-27: Test methods - Test Ea and guidance: Shock (IEC 60068-2-27:2008)
  - ✓ Form of vibration: half-sine; Acceleration: 490 m/s² (50g); Nominal pulse (D): 6ms; Number of shocks: 3/axis; Direction: 6 test directions (±X, ±Y, ±Z)

7.3. Environmental audits in accordance with:

- Environmental influences - Part 2-14: Test methods - Test N: Change of temperature (IEC 60068-2-14:2009)
  - ✓ Conditions: -25°C*/+105°C°; Dwell time: 30min; Cycles: 500;
- Environmental influences - Part 2-30: Test methods - Test Db: Damp heat, cyclic (12 + 12 hours) (IEC 60068-2-30:2005)
  - ✓ Temperature: +40±2°C/+25±3°C; Time/Cycle = 24h for 1 cycle; Duration: 500h; Humidity: 95% RH
- Environmental influences - Part 2-2: Test methods - Test B: Dry heat (IEC 60068-2-2:2007)
  - ✓ Temperature: +105±2°C°; Duration: 500h

The REDFIT IDC connector is RoHS and REACH compliant and contains no SVHC (substance of very high concern) substances.

Conclusion:

The REDFIT IDC is tested according to common connector standards and is very reliable even under adverse conditions.

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8 Requirements and processing the REDFIT IDC

8.1. Requirements for the circuit board

The REDFIT IDC connector requires a circuit board thickness of 1.6 mm. Depending on the application, different layouts are recommended (Figure 16).

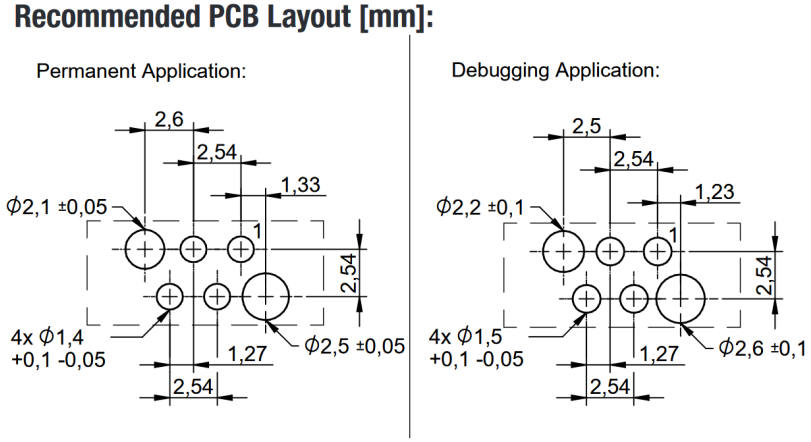

Figure 16: Recommended PCB layout based on application

The extended tolerance fields for press-fit elements must be used in the manufacture of the circuit boards.

Due to solderless mounting and contacting in the via, SKEDD technology does not require any annular ring. However, this is not technically feasible in production. For this reason, the pad size is reduced to a minimum (Figure 17).

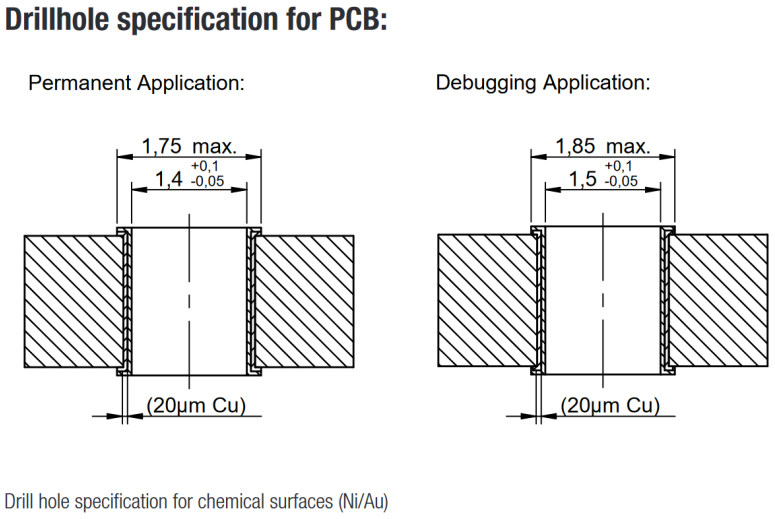

Figure 17: Drill hole specification based on application

The REDFIT IDC is approved for ENIG-plated PCBs. This ensures optimal signal quality.

8.2. REDFIT IDC board layout - permanent vs. debugging

The permanent layout of the REDFIT IDC ensures that the connector guarantees error-free signal transmission even under high mechanical loads (shocks up to 50 g and vibrations up to 10 g). This layout is suitable for applications with high demands placed on mechanical stability and a maximum of 10 mating cycles.

With the debugging layout, the mechanical stability is reduced in order to increase the number of mating cycles. This layout is suitable for applications with up to 50 mating cycles, whereby only low mechanical stability is required, such as for debugging microcontrollers.

All layouts are available on the Würth Elektronik homepage, for Eagle and Altium.

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8.3. Processing the REDFIT IDC

Hand pliers and a hand lever press are available for fabricating connectors and cables (Figures 18 and 19). Alternatively, prefabricated cables can be purchased directly from Würth Elektronik, also in large quantities.

Figures 18 and 19: Hand plier and hand lever press for SKEDD IDC processing

The supports necessary for pressing the IDC connection, with the hand lever press, can be produced with a 3D printer. The 3D data required for this are available on the Würth Elektronik homepage:

www.we-online.com/katalog/WST_IDC_PRESS.

8.4. Information on solderability

SKEDD technology is designed for plugging directly into the circuit board and is therefore not suitable for a soldering process.

The REDFIT IDC must be mounted after soldering, as the soldering process can cause thermal damage to the IDC connection or the ribbon cable.

Re-soldering is also not specified. Concerns about mechanical stability can be excluded. The REDFIT IDC SKEDD connector is approved up to 10 g for the permanent layout. Further information is provided in the section on reliability.

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