**Flex-rigid multilayer boards are already proving their value in daily applications. For example, as a solution for combining resistors in a multi-layer stack, anti-pad and bonding pads. In this case, internal resistors and resistors were also used. Here, all typical challenges are met: high positional stability and reliability, simple assembly, resistance against acids, pressure humidity and aggressive environmental conditions are all accepted. resistors are also suitable for use in line with high-quality connectors and, as an assembly process for the bonding resistors was avoided.**

**The flex-rigid technology was also re-used in the re-design of an MAC device inside data centre, a central monitor administration in an available board flex PCB conducted the devices to be updated consistently and securely. Additionally, by connecting the flexible PCB twelve position contact between contacts were achieved and an integrated protection prod- uced a stable assembly process. In this flexible region, the PCBs could be removed by hand, without the need for tools or special processing.**

Flex-rigid PCBs and ZIF connectors

**Particular advantages of flex-rigid PCBs**

- **It is possible to increase the complexity of mechanical designs, while also improving the degree of freedom for optimised housing solutions.**
- **Improved reliability**
- **Cost savings in procurement and logistics**
- **Reduced handling costs**
- **Less complexity and expense in design and development.**

**Using flex-rigid technology to create ZIF contacts is becoming more widespread, as it offers a number of benefits:**

- **Installing in cramped components**
- **Improved reliability**
- **Cost savings in procurement and logistics**
- **Reduced handling costs**
- **Less complexity and expense in design and development.**

**About Würth Elektronik**

Würth Elektronik is an innovative, flexible manufacturer of electronics and electromechanical solutions, ranging from traditional PCBs to modern applications. In the automotive industry, Würth Elektronik specializes in developing high-quality solutions for the most demanding requirements. Our portfolio includes a wide range of technologies, from traditional PCBs to modern solutions, such as ZIF connectors and Flex-rigid technology.**

**Würth Elektronik offers the best contact between flex-rigid PCBs and ZIF connectors.**

**Niederlinden, July 2010 – PCB specialist Würth Elektronik once again demonstrates their competence in system solutions and customer support, true offering one-stop flex-rigid PCB solutions with ZIF contacts and custom designed ZIF connectors. Customers from diverse fields such as industry, automo- tive, medical care and digital image processing benefit from Würth Elektronik’s particular problem solving approach. Most notably in the two key points: quality and cost. This makes flex-rigid and Flex-rigid PCBs an affordable and effective choice for maximum use of complex circuit technologies in the minimum space, in particular with respect to system costs.**

**Würth Elektronik GmbH & Co. KG**

Circuit Board Technology - Tec Report - Issue 08 - July 2010
Flex-rigid PCBs and ZIF connectors

Various options for ZIF connections

Suitable connections between flex and rigid PCBs on one hand andflex rigid PCBs on the other can be realized using flexible printed circuits (FPCs) by Würth Elektronik and ZIF connectors. There are no specific specifications on the drawings; however, Würth Elektronik's designers of the new ZIF connector paid particular attention to the production panelisation for cost reduction purposes. For example, the contact arrangement is created between the ZIF connector, which is soldered onto the PCB, and the contact position: For flex PCBs, a stiffener is affixed to the contact area; which means that high-precision milling to obtain the required thickness can be omitted. The contact can be easily inserted into the connector by holding it at these "ears". An idea originating from PCB technology: "Ears" behind the ZIF contact improves handling; the contact can be easily inserted into the connector by holding it at these "ears".

In short, for FPCs, there is a difference in the contact area, resulting in a higher spring force upon flex-rigid FPCs. Würth Elektronik utilizes cost-effective precision depth milling to obtain the required thickness.

In Figure 6, three cases are presented: 1) A traditional solution, in which case milling to obtain the required thickness is needed. The connection area is created between the ZIF connector, which is soldered onto the PCB, and the contact position. 2) If an extension of the stiffened area is not suitable, the tabs in the flex area must be set in the stiffened area (FR4 depth milling). 3) If the customer agrees to extend the contact stiffener into the flex area, stable tabs can be set in various ways: The upper variant has tabs in the flex area directly beside the stiffener. The lower variant shows the tab located in the flex area in between.

Tolerances in production

Very great precision tolerances must be maintained in manufacture, so that the ZIF contact is properly seated in the connector. In this way, the correct insertion without stress ensures for the best connection to flexible and flex-rigid PCBs by respecting the tight tolerance range of ±0.1 mm, is created through routing. However, enhanced tolerances such as ±50µm can only be realized through the use of camera controlled routing or laser cutting technology.

For flex-rigid boards, there are a number of options here:

1) If the customer agrees to extend the contact stiffener into the flex area, stable tabs can be set in different ways to attain the required thickness.

2) If an extension of the stiffened area is not suitable, the tabs in the flex area must be set in the stiffened area (FR4 depth milling).

3) Intermediate tabs: Here, the entire PCB's material thickness remains unchanged, offering enhanced flexibility compared to standard solutions. For example, in cases where the flex PCB is micro-circuit board with active layer, the stiffener must overlap with the flex flexible layer. Conventional milling (see PCB in the background) removes this extra support, and the assembly panel becomes less stable.

For flex PCBs, a stiffener is affixed to the contact area, resulting in a higher spring force upon flex-rigid FPCs. Würth Elektronik utilizes cost-effective precision depth milling to obtain the required thickness.

In Figure 5, a combination of precision depth cutting and extra support is visible in a stable assembly support at the attachment of the PCB. Uniformly reliable gap WR-FPC in the design also ensures for the rigid area's stability, the extra support, and the assembly panel becomes less stable.

For further options with a stable intermediat tab, please refer to the technical data sheet of the ZIF connector taken from the underside of the PCB. Conventional milling can be applied for flex PCBs too. Given normal conditions, the stiffener must overlap with the flex area. The stiffener must have a length of the stiffener. The stiffener must overlap with the flex flexible layer. Some additional method (for example, the method of high precision routing) is needed for the attached thickness.

For flex-rigid boards, the following conditions apply:

1) In the case of internal flexible layer, the ZIF contact is usually also located on the inside of the PCB. For flex-rigid PCBs with a hybrid structure, the contact can be manufactured without much effort as long as the rigid part is in contact with the connector. This solution is mainly used for the rigid area's stability.

Recent developments in technology

Würth Elektronik eiSos' designers of the new ZIF connector paid particular attention to the production panelisation for cost reduction purposes. For example, the contact arrangement is created between the ZIF connector, which is soldered onto the PCB, and the contact position: For flex PCBs, a stiffener is affixed to the contact area; which means that high-precision milling to obtain the required thickness can be omitted.

The contact can be easily inserted into the connector by holding it at these "ears". An idea originating from PCB technology: "Ears" behind the ZIF contact improves handling: the contact can be easily inserted into the connector by holding it at these "ears".

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For flex-rigid boards, there are a number of options here:

1) If the customer agrees to extend the contact stiffener into the flex area, stable tabs can be set in different ways to attain the required thickness.

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3) Intermediate tabs: Here, the entire PCB's material thickness remains unchanged, offering enhanced flexibility compared to standard solutions. For example, in cases where the flex PCB is micro-circuit board with active layer, the stiffener must overlap with the flex flexible layer. Conventional milling (see PCB in the background) removes this extra support, and the assembly panel becomes less stable.

For flex PCBs, a stiffener is affixed to the contact area, resulting in a higher spring force upon flex-rigid FPCs. Würth Elektronik utilizes cost-effective precision depth milling to obtain the required thickness.

In Figure 5, a combination of precision depth cutting and extra support is visible in a stable assembly support at the attachment of the PCB. Uniformly reliable gap WR-FPC in the design also ensures for the rigid area's stability, the extra support, and the assembly panel becomes less stable.

For further options with a stable intermediat tab, please refer to the technical data sheet of the ZIF connector taken from the underside of the PCB. Conventional milling can be applied for flex PCBs too. Given normal conditions, the stiffener must overlap with the flex flexible layer. Some additional method (for example, the method of high precision routing) is needed for the attached thickness.

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Flex-rigid PCBs and ZIF connectors

Flexible and flex-rigid PCBs are being designed more and more with the prevalent ZIF interconnection concepts. Würth Elektronik has recognized this trend and is offering a ZIF connector design-kit, particularly created to meet the challenges of flex-rigid PCBs. ZIF connectors are well suited for high-speed applications due to their high mechanical stability and low contact resistance. They can be easily inserted into the connector by holding them at the “ears” which highlights the flex-rigid PCB specialist Andreas Schilpp, “an essential prerequisite is as much as expressiveness as possible”. Hence, making quality manufacturable and cost effective is Würth Elektronik’s top priority, high-speed data is being transmitted double side by double side on the flex-rigid PCB, which allows the customer to design two independent boards in one. Therefore, the flex-rigid PCB specialist Andreas Schilpp, “an essential prerequisite is as much as expressiveness as possible”, which also must be contained in the manufacturing drawing according to the data sheets of the connector manufacturer. Without the corresponding specifications in the drawing, the contact side could become necessary. Such a change is made possible by via holes in the flex-rigid PCB, which would require some complex special operation steps during the production process.

Various options for ZIF connections

The contact can be easily inserted into the connector by holding it at these “ears”. Figure 5: A combination of precision laser cutting and depth milling leaves a stable assembly support at the underside of the PCB. Conventional milling (see PCB in the background) removes this stable assembly support at the underside of the PCB. A combination of precise laser cutting and depth milling leaves a stable assembly support at the underside of the PCB.

Tolerances in projection

There are many ways to not connecting tube in flex-rigid boards. In order to make the insertion tube of the ZIF connector not visible in the cut away side, any take out of the tubes and making the contact side invisible is possible. Figure 6: Can be cut in various ways. The upper variant had the tube directly beside the contact. The lower variant had the tube upside down. The connection area of the PCB footprint offers many advantages (see option three).

Further options with a stable intermediate tab

In order to allow the insertion of the contact into the ZIF connector, the specified contact area must be made visible in any take out of the tubes and making the contact side invisible. This ZIF connector is soldered onto the PCB. The contact side could be necessary. Such a change is made possible by via holes in the flex-rigid PCB.

Drawing specifications in the manufacturing documents

Without the corresponding specifications in the drawing, the contact side could become necessary. Such a change is made possible by via holes in the flex-rigid PCB. Usually, the customer can not necessarily be recognised by customers at the early stage of design. Therefore, the flexibility should be simplified in the manufacturing drawing according to the data sheets of the connector manufacturer:

1) If the customer agrees to extend the contact stiffener into the flexible area, stable tabs can be set in various ways: The upper variant has tabs in the flexible area directly beside the contact side. This solution is only possible for laser-cut flexible out-sides. Laser-cut micro tabs in the flexible area: Micro tabs can be applied for laser-cut flex flexible out-sides. 2) If an extension of the stiffened area is not suitable, the tabs in the flexible area must be set closer to the connection area. There are a number of options here: For fl exible PCBs, the stiffeners (see option two). The method shown at the bottom leaves material in the original original. 3) If the customer agrees to extend the contact stiffener into the flexible area, stable tabs can be set in various ways: The upper variant has tabs in the flexible area directly beside the contact side. This solution is only possible for laser-cut flexible out-sides. Laser-cut micro tabs in the flexible area: Micro tabs can be applied for laser-cut flex flexible out-sides.
Various options for ZIF connections

Suitable connections between displays and PCBs for smaller ZIFs are often critical. Flex-rigid PCB specialists, for example, use flexible printed circuit boards, while mobile devices are increasingly using flexible substrate circuits for medical equipment. The key is to find the right method for flexible and rigid PCBs. Today, this can be determined by extracting the technical surface finishes and the surface finishes of the PCBs, which means that each PCB is different. We should always pay attention to the very thin finishing tolerances due to the excessive and high requirement of the finishing production process. In contrast, for very thin flex-rigid PCBs, Würth Elektronik offers system solutions that can be effectively designed using highly precise methods with tolerances ranging from ±0.05 mm down to ±0.001 mm.

Tolerances in production

Very small geometrical tolerances must be maintained in manufacture, so that the ZIF connector’s male and female parts can be mated without any damage on either side. Standard is 0.3 mm ± 0.05 mm, but it can only be maintained in the case of a zero 45 degree tolerance. Therefore, attention should be paid to the assembly assurance only if the ZIF connector is designed as a tool in rigid and flex-rigid PCB manufacturing. The assembly assurance of 0.3 mm ± 0.05 mm is achieved by the assembly force which is designed using highly precise methods with tolerances ranging from ±0.05 mm down to ±0.001 mm.

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Further options with a stable intermediate tab

Flex-rigid PCBs in practice

“Making quality manufacturable and cost effective is Würth Elektronik’s top priority”, highlights the ZIF connector specialist Andreas Schilpp. “As it’s also the case in many other areas: the earlier customers involve their suppliers in the design and development stages, the higher the chances of benefiting from system solutions become. Namely, this is because we are able to communicate more efficiently and therefore significantly reduce the associated expenditure. There is a common thread of process”

Faithful to Würth Elektronik’s tradition of close customer ties and proximity, difficult and complex customised solutions can be worked out as well. “We are not only service providers, but also consultants and trouble-shooters in the entire range of flexible and flex-rigid matters,” explains Schilpp.

There are many ways to connect a flexible PCB to a rigid PCB.
The right technology was also espoused in the ex-voto of an AR-V device inside data entry, created in a monitor administration in an urban area. With ZIF conductors meets the display to an updated controls and security. Additionally, by using the flexible ZIF contacts in a contact between ZIF first, then a 0.6 mm solder-free contact was achieved and an improved packaging pro-
vided a stable assembly process. In the flexible region, the PCBs could be removed by hand, without the need for tools or special processing.

**Figure 7:** ZIF contact replaces wiring in a motor control unit for roller shutters and awnings.

Further advantages were that cable wiring to the motherboard was no longer necessary, the use of rigid boards. Flex-rigid technology is well-proven, reliable and particularly good in meeting the requirements of components, mainly CPU’s. In a ZIF socket, contacts are opened prior to placement of the device, and it is possible to increase the complexity of mechanical designs, whilst also improving the degree of freedom for optimised housing and space requirements can be minimised by applying 3D circuitry.

**Figure 8:** Bend-Flexible PCBs for contact applications as connector with an optical module in a ser-
vice for monitoring or security.

Würth Elektronik offers the best contact between flexible PCBs and ZIF connectors

About Würth Elektronik Circuit Board Technology (CBT)

Nürnberg, July 2010 – PCB specialist Würth Elektronik once again demonstrates their competence in system solutions and customer support; now offering one-stop flex-rigid PCB solutions with ZIF contacts and custom-designed ZIF connectors. Customers from diverse fields such as industry, automo-
tive, medical care and digital image processing benefit from Würth Elektronik’s particular problem-solving approach. Most notably in the two key product qualities of reliability and cost. This makes flex-rigid and ZIF connectors an affordable and effective choice for maximum use of complex circuit technologies in the intermediate space, in particular with respect to system costs.

**About the Würth Elektronik Group**

Würth Elektronik is a leading global electronics manufacturer and service provider. Würth Elektronik Group is an internationally operating, independent subsidiary of the Würth Group with more than 5,900 employees and a turnover of 374 million Euros. Würth Elektronik Group consists of four business units: Würth Elektronik CBT, Würth Elektronik eiSos, Würth Solar and Würth Electronics. The Group is headquartered in Noida, India, and has production plants in Niedernhall, Rot am See and Schopfheim. In addition, Würth Elektronik Group is represented in more than 35 countries throughout the world with direct subsidiaries, a sales and service network, and through production partnerships. A further 70 countries are served via Würth Group’s network.

Würth Elektronik is the leading PCB manufacturer in Europe, producing a wide spectrum of PCBs: from standard to technically demanding PCBs such as HDI, flex-rigid and ZIF technologies. The extensive PCB portfolio ranges from double sided PCBs and multilayers in all technologies and is a driving force behind new techni-
cal innovations, for example, in the field of embedded active and passive components. Würth Elektronik is a founding member of GloveNet, a platform for research communities, e.g. GloveNet or TIPS. In 2009 Würth Elektronik employed 5,900 personnel and generated a turnover of 374 million Euros.

In 2009, the Würth Elektronik Group includes: Würth Elektronik CBT (flex-rigid PCBs and ZIF connectors), Würth Elektronik eiSos (passive and electromechanical components), Würth Solar (photovoltaic modules and solar power systems) – a division of the Würth Elektronik Group, an internationally operating, independent subsidiary of the Würth Group with more than 5,900 employees and a turnover of 374 million Euros. Würth Elektronik CBT is – alongside Würth Elektronik ICS (electromechanical and electronics system solutions), Würth Elektronik eiSos (passive and electromechanical components) and Würth Solar (photovoltaic modules and solar power systems) – a division of the Würth Elektronik Group, an internationally operating, independent subsidiary of the Würth Group with more than 5,900 employees and a turnover of 374 million Euros. Würth Elektronik CBT is an internationally operating subsidiary of the Würth Group with more than 5,900 employees and a turnover of 374 million Euros.

For another application a special design and implementation was created using a semi-flexible PCB with a ZIF connector for use in standard ZIF connections. This applica-
tion case in a module for the optical display of temperature and air quality in a sen-
tal, internal resistors and heaters were also used. Here all the typical demands are met:

- **Increased efficiency:** Less solder joints assure higher reliability.
- **Improved assembly:** Flex-rigid technology allows a simpler assembly process.
- **Improved product quality:** Precision contact tolerances are achieved.
- **Reduced installation size:** Space requirements can be minimised by applying 3D circuitry.
- **Reduced assembly costs:** Logistical and assembly costs are significantly reduced with flex-rigid boards.
- **Improved system weight:** System weight can be brought down.

**Flex-rigid technology** offers a number of benefits:

- **Space requirements can be minimised by applying 3D circuitry.**
- **Logistical and assembly costs are significantly reduced with flex-
  rigid boards.**
- **Improved system weight:** System weight can be brought down.

**Using flex-rigid technology to create ZIF contacts in be-
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- **Improved system weight:** System weight can be brought down.

**More information**

**www.wg-online.com/flexible-rigid**
The flexible multilayer boards are already proving their value in daily applications. For example, as reasons for controlling roller shutters, awnings and front doors in this context, internal rotations and positions were also used. Here, all the typical demands are met.

High positional stability and variability, simple assembly, resistance against UV, pressure and humidity and aggressive environmental conditions are all accepted, ready-made contact connections which allow for a low level of stress. The wiring and assembly processes were realized using high-quality connection methods, and an assembly process for the handling was avoided.

The flexible technology was also utilized in the en opens the way for MEMS devices inside data centers, in the monitors administered in valuable buildings. The ZIF contact conducted the signals to the updated environment and security, additionally, by being the flexible PCB. The contact position between the contact was achieved and an integrated provision permitted a stable assembly process. In the flexible region, the PCB could be removed to insert, without the need for tools or special processing.

Flex-rigid multilayer boards are already proving their value in daily applications. For example, in the field of roller shutters, awnings and Venetian blinds, as sensors for controlling motors. In this case environment, internal resistors and heaters were also used. Here, all the typical demands are met.

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Flex-rigid technology is beneficial for various application areas, such as mobile communication, automotive, medical care and digital image processing benefit from Würth Elektronik's particular problem solving approach. Most notably in the two key points: quality and cost. This makes flex-rigid and ZIF connectors an affordable and effective choice for maximum use of complex circuit technologies in the minimum space, in particular with respect to system costs.

In order to achieve large bending radii, the single-sided PCB already had a thickness of 0.3 mm in the contact area, which means that it could be directly plugged into the ZIF connector without the need for additional stiffeners or extra milling. Wiring and solder joints were replaced, otherwise difficult connections can be created, thereby simplifying the assembly process.

Using flex-rigid technology to create ZIF contacts is becoming more and more widespread, as it offers a number of benefits:

- Improved reliability
- Cost savings in purchasing and logistics
- Reduced form factor
- Less complexity and expense in design and development

Particular advantages of flex-rigid PCBs

- Flex-rigid technology is beneficial for various application areas, such as mobile communication, automotive, medical care and digital image processing.
- In order to achieve large bending radii, the single-sided PCB already had a thickness of 0.3 mm in the contact area, which means that it could be directly plugged into the ZIF connector without the need for additional stiffeners or extra milling.
- Wiring and solder joints were replaced.
- It is possible to increase the complexity of mechanical design, while also improving the degree of freedom for improved housing solutions.
- Using flex-rigid technology to create ZIF contacts is becoming more and more widespread, as it offers a number of benefits:

- Reduced form factor
- Less complexity and expense in design and development

About the Würth Elektronik Group

Würth Elektronik is the leading PCB manufacturer in Europe, producing a wide range of Flex-rigid circuit boards through a comprehensive range of PCB, cable and connector systems. The Würth Elektronik Group employs more than 5,000 people at its 13 factories in six countries. The Group's strong market position is based on a tradition of innovation, for example, in the field of embedded active and passive components. Würth Elektronik is able to offer a complete range of products, from miniaturized components and systems to complete systems, including complete system solutions and customer support, now offering one-stop solutions with ZIF connectors and cable designs to customers in the automotive, medical technology, medical care, and digital image processing. Würth Elektronik enables customers to address the specific needs of their system, whether in high-tech, use of complex circuit technologies in the minimum space, in particular with respect to system costs.

More information

www.we-online.com/fl ex-rigid