A short history of the PV connector

With over 15 years’ experience in the field, Multi-Contact is a leading provider of dependable connector systems for photovoltaic installations. The company’s pre-assembled connectors, cables, and junction boxes allow for quick and easy connection on-site, while the cable couplers are fully touch-protected and designed for high voltage and high current-carrying capacity. It’s safe to say that there are few companies out there more qualified to give us the lowdown on the evolution of the technology...

While the first connectors for photovoltaic (PV) installations were primarily designed for functionality, today they meet a variety of application-specific requirements. By now, there are complete connection solutions, including junction boxes, connectors and cables. In any case, safe and efficient electrical contacts are the beginning and end of the story.

In the early 1990s, photovoltaic cables were connected using screw terminals or splice connectors. With the increasing number of installed systems, the need arose for a fast, safe, and easy-to-handle connection solution – a plug-in connector.

From splice to plug connectors

The specific requirements of PV installations did not allow the use of standard industrial connectors. Exposed to wind, sun and rain as well as often extreme temperature variations, the connectors have to be suitable for harsh environments. They should not only be watertight and resistant to temperature, UV and ozone, but also touch-protected, with high current carrying capacity as well as efficient, with low contact resistance – all this throughout the entire lifecycle of the installation, at least 20 years.

Based on these requirements, Multi-Contact developed the MC3, one of the world’s first PV connectors, in 1996. The connector with MC Multilam became widely accepted by the rapidly evolving market, defining the international standard for PV connectors.

Efficiency is the key in a growing market

Political conditions stimulated the growth of both number and size of installed photovoltaic systems. In addition to small, building-integrated installations and rooftop arrays, off-grid and rural installations were set up throughout Europe. Module technology was continuously refined, increasing the performance of the modules. Photovoltaics went from a niche to a mass market. Experience gained in the early years and the expanding range of applications lead to new requirements and regulatory changes. Today, eco-friendliness alone is by far not enough for investing into PV installations – they are expected to pay off as well. In fact, the economic pressure can be tremendous, in particular with large installations but small investors also want to maximise their profit. The efficiency of a photovoltaic installation not only depends on the modules used, but on the overall performance of components such as inverters, cables and connectors as well as on professional handling.
MC4 – the Original

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- wireless - for easy handling
- compact - for lower cost of materials
- safe - original Multi-Contact technology

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Safety aspects become more important

As photovoltaics gained importance, the industry was facing new demands. With large-scale installations, cable cross sections increase as well as the required ampacity. At the same time, the globalisation of the PV market asks for international standards. Safety aspects in particular have come into focus over the past few years. After all, disconnection under load may cause fatal electric arcs. Therefore, only lockable connectors with standardised retention force may currently obtain TÜV approval. According to the National Electric Code (NEC) 2008, connectors for the North American market even require a special tool for disconnection.

Figure 2. Cost-effective PV connector for automated assembly

Second-generation PV connectors such as the MC4, which Multi-Contact introduced to the market in 2002, meet these requirements and are protected against polarity reversal. The installer is given acoustic feedback by the integrated locking system. This is particularly important for correct installation under difficult conditions. Just like the MC3 did before, the MC4 quickly set a new standard for PV connectors. Many manufacturers started copying the MC4’s mating face; however, these third-party connectors are not compatible with the MC4 system despite their similar design.

Thanks to the MC Multilam Technology, the MC3 and MC4 connectors ensure efficient power transmission. Low contact resistance provides for little power loss and high efficiency. Due to the constant high contact force, these connectors are reliable and long-lasting. In contrast, lower-quality connectors with high contact resistance can heat up considerably, increasing the risk of smouldering fires and premature deterioration of the material.

The right balance between price and quality

As a consequence of the dynamic market development, the number of providers, and thus the price pressure, has been increasing. However, the high demand placed on quality and safety remains unchanged. Accordingly, the industry requires solutions which allow lower costs without affecting the quality. In order to fulfil this task, numerous approaches have been developed along the entire production chain – from the raw materials to the installation of the facility. For instance, the automated production of solar panels helps reduce manufacturing costs while increasing process reliability. Component manufacturers support this development by providing automatable components, e.g. junction boxes. Another attempt is the production of the components themselves. Multi-Contact, for example, has started the automated assembly of MC4 connectors, providing a cost-effective solution particularly for module manufacturers, while maintaining the high quality standard of the product.

Application-specific designs may also help accelerate the on-site installation process. For instance, the MC4QUICK can quickly and easily be connected to the inverter or to extension cables. Pre-assembled branch cable leads with defined branches, specifically designed for a certain PV installation, simplify the process as well. All this makes production and installation more efficient, particularly in large installations.

The trend continues

Today many manufacturers offer complete connection solutions with connectors, junction boxes and solar cables. Considering the continued growth of the PV market, the increasing price pressure as well as safety requirements, the coming years are likely to see increasingly diversified solutions. Installations will be optimised for their specific operating location. It is estimated that approximately 40 per cent of new installations could be equipped with module-integrated electronics. In addition to safety features such as system shutdown in case of failure, possible functions include MPP tracking for optimised energy output as well as system monitoring. The great potential of building integrated photovoltaics points towards another innovation boost. All these projects will require efficient, safe and reliable electrical contacts.

For more information, please visit: www.multi-contact.com

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