

# TECHNICAL PAPER

## KYOCERA AVX Connectors for Medical Device PCBs

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### **Abstract**

The term “medical device” covers a broad spectrum of electrical equipment, ranging from small implantable stimulators to room sized MRI machines. This equipment is typically broken down into three classes based on the safety implications of possible failure modes. Class I devices present minimal potential for harm to the user and are often simpler in design. 47% of medical devices fall into this class, and 95% of these are exempt from any special regulatory oversight. Once appreciable safety concerns come into play, the device is elevated to Class II status. Class III devices require the utmost scrutiny and are subject to intense regulatory oversight, putting them into a category of their own when it comes to the suitability of electronic components. While KYOCERA AVX manufactures other products for use in Class III devices, Class I and II devices, can be designed using traditional electronic supply chain components, as long as a focus is maintained on reliability and environmental compatibility. KYOCERA AVX produces a wide variety of contacts and connectors that are well-suited to Class I and II medical applications, particularly at the PCB level for connecting wires to boards, boards to boards, and battery packs to boards.



# KYOCERA AVX CONNECTORS FOR MEDICAL DEVICE PCBS

## INTRODUCTION

The term “medical device” covers a broad spectrum of electrical equipment, ranging from small implantable stimulators to room sized MRI machines. This equipment is typically broken down into three classes based on the safety implications of possible failure modes. Class I devices present minimal potential for harm to the user and are often simpler in design. 47% of medical devices fall into this class, and 95% of these are exempt from any special regulatory oversight.

Once appreciable safety concerns come into play, the device is elevated to Class II status. This class represents 43% of all medical devices and includes items like powered wheelchairs and pregnancy test kits. At the highest level of safety concern are Class III devices. These devices usually sustain or support life, are implanted, or present potential unreasonable risk of illness or injury. Examples

include implantable pacemakers and breast implants, and only 10% of all medical devices fall under this category.

Class III devices require the utmost scrutiny and are subject to intense regulatory oversight, putting them into a category of their own when it comes to the suitability of electronic components. While KYOCERA AVX manufactures other products for use in Class III devices, Class I and II devices, can be designed using traditional electronic supply chain components, as long as a focus is maintained on reliability and environmental compatibility. KYOCERA AVX produces a wide variety of contacts and connectors that are well-suited to Class I and II medical applications, particularly at the PCB level for connecting wires to boards, boards to boards, and battery packs to boards.

## FINDING SUITABLE CONNECTORS FOR MEDICAL APPLICATIONS

At the simplest level, a connector is a coupling device that joins electrical terminations to create a circuit. Electro-mechanical connectors make a quality connection that can replace soldering and even outperform it electrically. When choosing a connector for a medical application, one must consider not only the typical ratings for voltage and current, but also the constraints on physical size, temperature, and durability. For medical devices (where reliability is always a key factor), connection methods are limited to insulation displacement (IDC), poke home, and traditional compression contacts.

In an IDC connector, the joining mechanism of the wire and the contact is cold welding. To achieve this phenomenon in open air, the gas between the two pieces of metal must be completely forced out. A wedge-shaped slot is forced through the insulation of a solid or multi-stranded wire in such a way as to guide the metal strands into the slot. The wedge shape exerts a tremendous force on the wire bundle, forcing all the gasses out and creating the cold weld. A simplified illustration of

the mechanism is shown below. IDC connectors are easy to install, very reliable, and repeatable in a production environment.

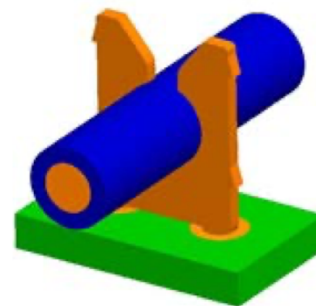


Figure 1 - IDC connector mating an insulated wire to a PCB

For situations when stripped wire is acceptable, the poke-home connector was introduced as a highly reliable solution for connecting a small number of discrete wires to a printed circuit board assembly. The wire is inserted into the connector and proper positioning is ensured using integrated wire guides and an end stop. Dual beam high-force contacts

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## FINDING SUITABLE CONNECTORS FOR MEDICAL APPLICATIONS

(typically beryllium copper) grip the exposed metal of the wire and provide an extremely low electrical resistance connection with excellent wire retention.

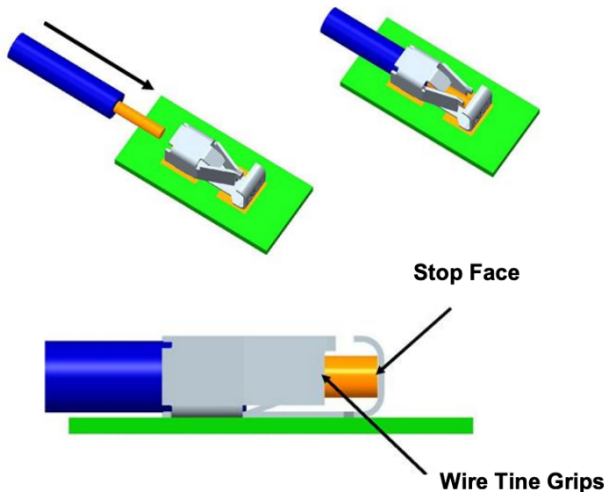


Figure 2 - Poke home connector retains and contacts at the same time

When the end goal is to create a connection between two PCBs (or a battery pack and a PCB), traditional spring force contacts can be used. To ensure reliability and environmental suitability for medical applications, special design techniques can be leveraged. For example, using gold-plated beryllium copper contacts guarantees fatigue resistance and low electrical resistance. Similarly, specialized contact shapes are used to maximize spring force, absorbing assembly tolerances while maximizing contact force even in harsh environments. An example is shown below for a surface mount connector designed for mating a battery pack to a PCB in a medical handheld product.

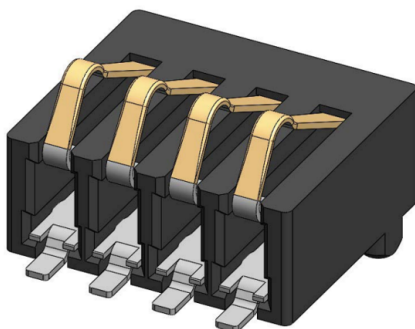


Figure 3 - Compression contacts for battery pack connector

In board-to-board applications where a large number of pins may be required, compression contacts can also be used as shown below. Two rows of contacts are situated with extremely fine pitch, as low as 0.35mm, in a low profile surface mount component. PCBs can be stacked and retained mechanically in such a way that these compression contacts create a high reliability connection to a set of exposed pads.

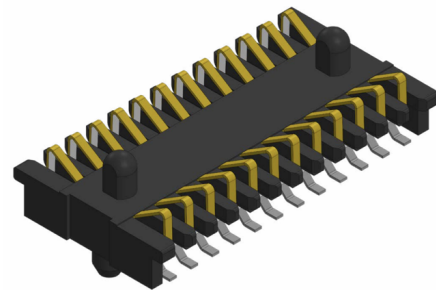


Figure 4 - Compression contacts for board-to-board connector

When right angle connections are required, the exact same compression spring contact mechanism can be used within the confines of a card edge connector. Shown below, the contacts are arranged vertically within a low profile plastic housing, allowing a PCB to be inserted into the slot and contacts to be made with exposed pads on its edge.

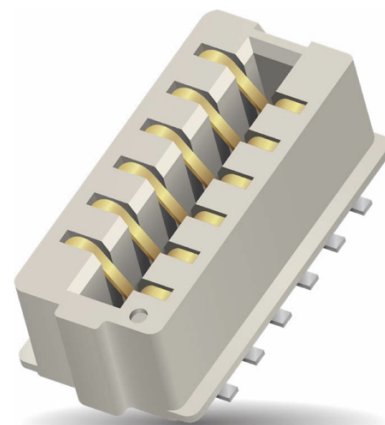


Figure 5 - Compression contacts for card edge

# KYOCERA AVX CONNECTORS FOR MEDICAL DEVICE PCBS

## KYOCERA AVX SOLUTIONS FOR MEDICAL DEVICES

KYOCERA AVX is a world leader in developing high performance connectors where reliability and durability are mission critical. For wire-to-board applications, a broad family of IDC and Poke-home connectors are offered: <https://www.kyocera-avx.com/products/connectors/medical/wire-to-board/>.

These connectors are available in numerous orientations, wire gauge ranges, and board mounting styles. Most importantly, both the IDC and the poke-home contacts are engineered for the highest reliability and optimal electrical performance.

For internal board-to-board connectors, a variety of options are available including one and two piece stacking solutions as well as co-planar end-to-end

styles: <https://www.kyocera-avx.com/products/connectors/medical/board-to-board/>.

Two-piece connectors and individual contacts provide multiple packaging solutions for perpendicular, parallel and coplanar applications. Features include ultra small pitch, low stacking heights and a broad range of pin counts.

For external mating contacts in robust battery connectors and docking/charging cradle integration, miniaturized connectors offer high reliability over 5000 mating cycles. These include multiple interface orientations and extremely fine pitch down to 1.27mm. <https://www.kyocera-avx.com/products/connectors/battery/>.

## SUSTAINABLE, RELIABLE MEDICAL-GRADE CONNECTORS

When designing connector solutions for battery packs or for inter-PCB stackups within Class I and Class II medical devices, attention must be expanded beyond form-factor and cost to also focus heavily upon reliability, electrical performance, and environmental suitability. Premium contacts like those used in KYOCERA AVX's Poke-home and IDC connectors are an excellent choice for wire-to-board applications. Compression contacts, like those found in KYOCERA AVX's battery and fine-pitch board stack offering, are an excellent alternative when permanent retention is not an option.

In addition to the aforementioned connectors, KYOCERA AVX designs, develops, manufactures, and supplies advanced capacitors, antennas, connectors, circuit protection and timing devices, sensors, controls, filters, fuses, diodes, resistors, couplers, and inductors optimized for employment in the international 5G, IoT, aerospace, automotive, consumer electronics, industrial, medical, and military markets. To learn more, visit: <https://www.kyocera-avx.com/kyocera-avx-components-corporation/>.



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