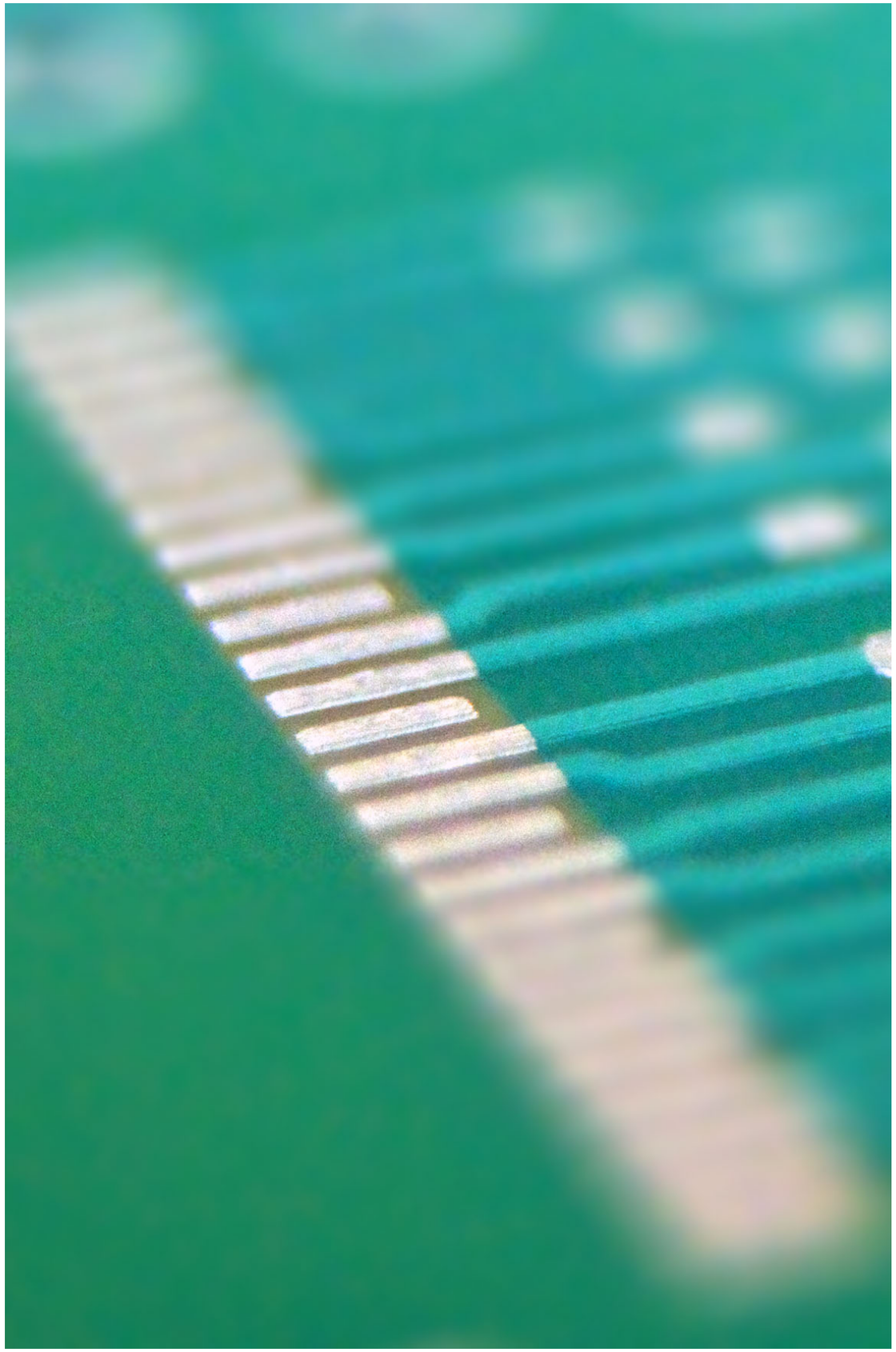
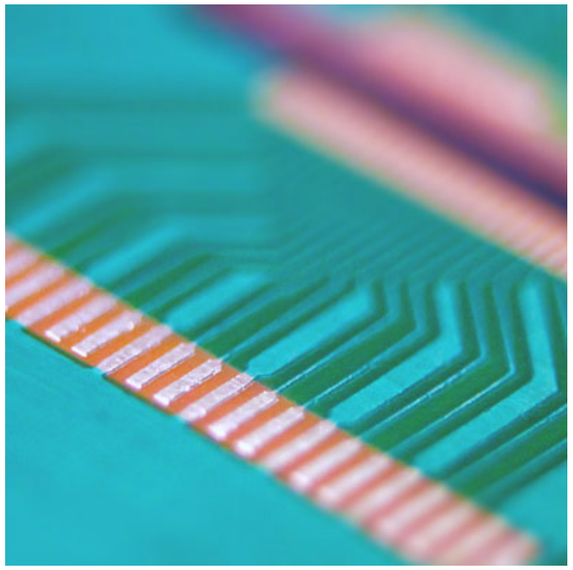
Aluminum Trace Printed Circuit Board: Case Study

The research team at D-Wave Systems needed a PCB that could operate in cryogenic environments at 500 mK above absolute zero while retaining superconductivity.

Omni Circuit Boards provided the solution.





Aluminium Trace PCB

Information courtesy of Omni Circuit Boards.

Summary

D-Wave Systems, a British Columbia-based leader in the field of quantum computing, approached Omni Printed Circuit Boards for a collaborative project. The research team at D-Wave Systems needed a PCB that could operate in cryogenic environments between absolute zero and 500 milliKelvin while retaining superconductivity. Through a process of ongoing testing, refinement, and design modifications, Omni produced the world's first aluminium / copper bimetal trace, etched PCB, opening the door for future applications combining cryogenics, superconducting PCB traces and chip interconnection using superconducting wirebonds – especially for high-tech research and development departments around the globe.

The Challenge

D-Wave Systems, a British Columbia-based technology firm, is an industry leader in the development of quantum computing hardware and applications. Their systems, which consist of engineered artificial atoms, uniquely use quantum mechanics to revolutionize the way information is processed to enable organizations to solve their most complex computational problems.

However, in order to utilize quantum processing, researchers required a dependable printed circuit board that could operate in cryogenic environments of 500 milliKelvin above absolute zero while retaining electrical superconductivity and thermal conductivity qualities and allowing for elements to be aluminium wedge bonded directly to the PCB. A survey of PCB designers and manufacturers around the world yielded no viable solution. D-Wave System's research team determined that milling boards internally would not be an option, and set out to search for a PCB firm that would be willing to experiment with different ideas, materials, and processes.

The research team at D-Wave Systems reached out to Omni Printed Circuit Boards, another British Columbia firm specializing in the development of custom PCB platforms. Through a collaborative design, development, and testing process, the two teams were able to agree on parameters for a prototype and begin manufacturing.

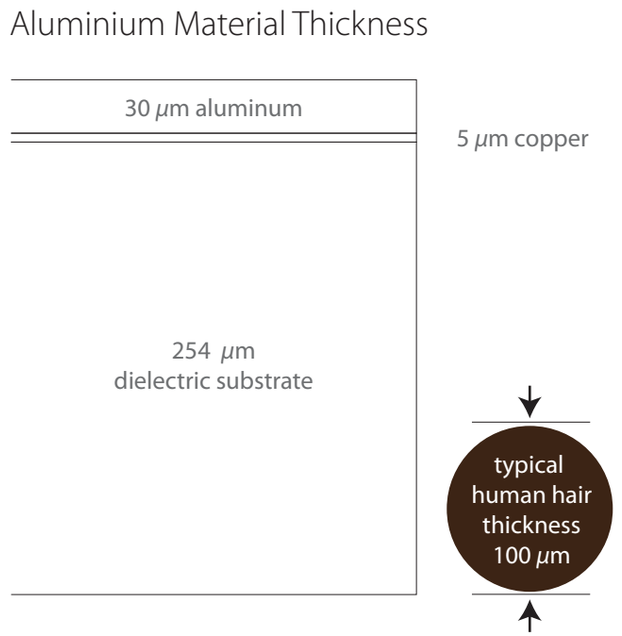
By focusing on the client's needs, and ongoing feedback from live tests, Omni Circuit Boards was able to determine aluminium trace etching offered superconductivity, reliability, and a far superior aluminum-to-aluminum bond than prior technologies (including gold or silver-to-aluminum). The resulting PCBs were further tested and refined to ensure that wire bonding would be reliable, and the boards would be able to stand up to repeated cryogenic cycling.

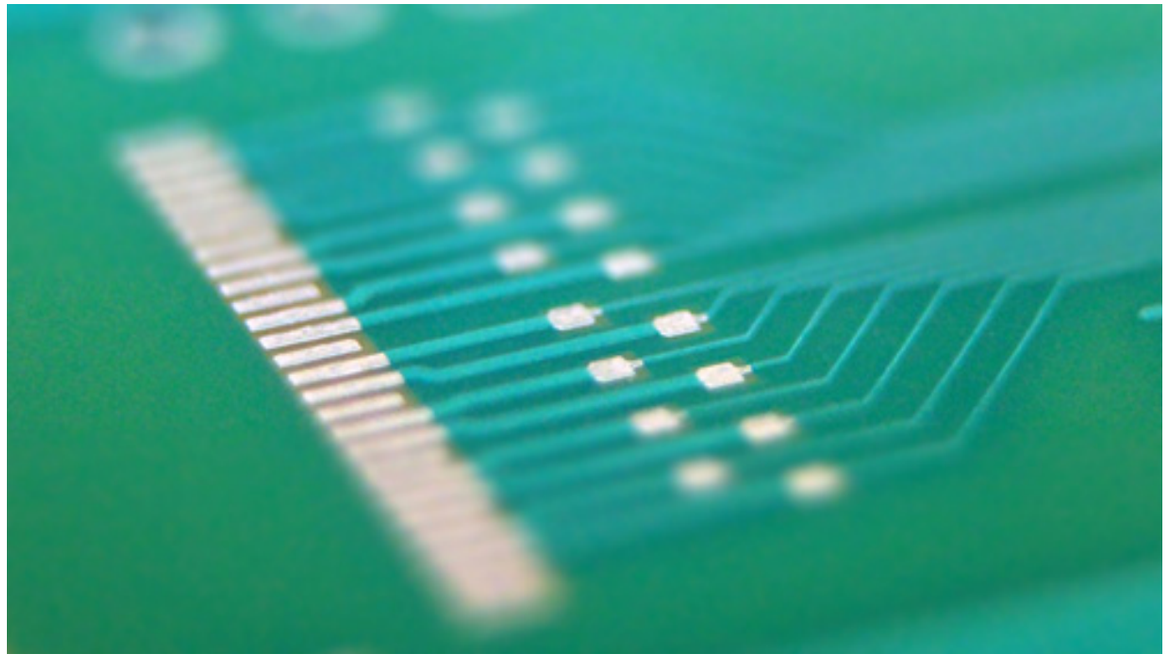
The Result

The resulting aluminium trace PCB is a custom product that perfectly fits the requirements and capabilities laid out by D-Wave Systems in their initial consultations. The monometal wirebond interface is at least 10 times stronger/more reliable than our current technology minimizing the amount of time needed for re-installation and maintenance. Additionally, they excel at superconductivity in low-temperature quantum computing environments.

Just as importantly, the solderable aluminium trace PCBs developed by Omni allow for aluminium-to-aluminium wire bonding, and have design parameters specifically configured for the D-Wave Systems chipset.

The finished product serves as a testament to Omni's innovative approach to PCB production. Our mix of cutting-edge products and technology, a committed research and engineering staff, and a desire to find unorthodox solutions to advanced technology challenges, makes us the ideal partner for research projects. We are not afraid to find new answers or re-envision the PCB manufacturing process, which allows us to create products that other firms cannot duplicate.

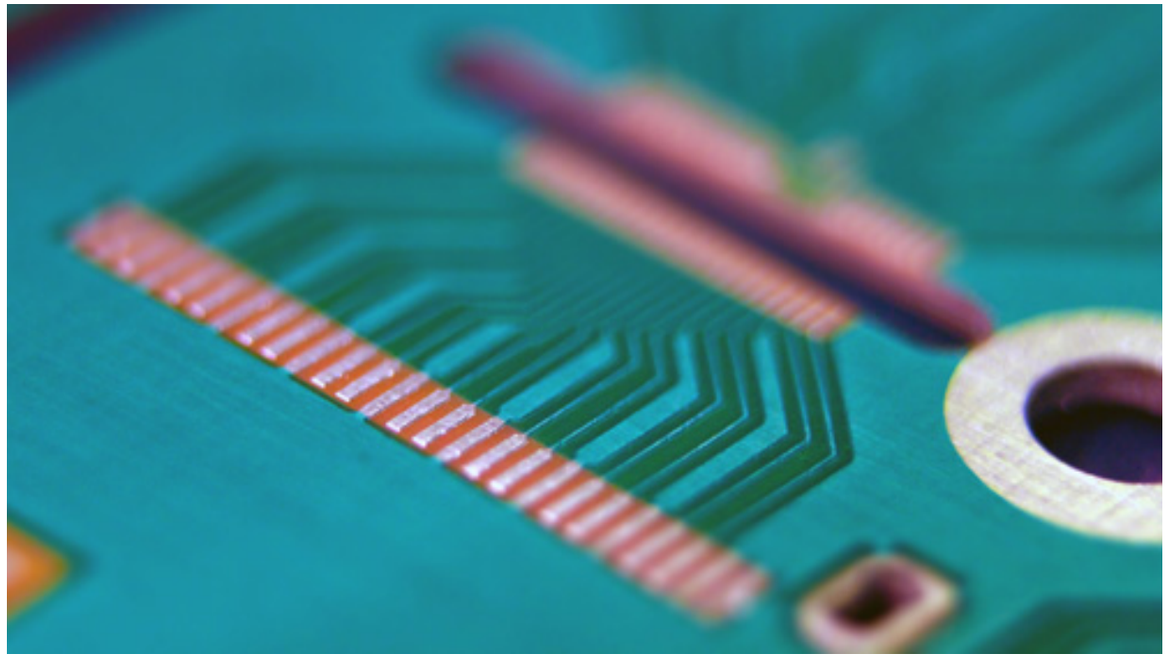




Future Applications

An initial assessment of the aluminium trace PCB product shows new opportunities for applications and cryogenics, quantum computing, and other leading-edge processing projects that call for unpackaged chips to be mounted to custom PCB layouts. Omni anticipates that this technology will be particularly intriguing to universities, physicists, and technology research departments.

Because the Omni Printed Circuit Board philosophy is to bend the spectrum of PCB design possibilities to meet new testing and manufacturing challenges for our clients, the best uses may remain uncovered at the present moment. By working closely with the organizations that need new answers – especially in cryogenic and superconductive environments – we look forward to finding new applications.



How to Get More Information

Organizations interested in exploring aluminium trace PCBs and other custom circuit board products and solutions are encouraged to contact Omni directly through our convenient online "quote request" generator, which can be found at: http://www.omnicircuitboards.com/art/.

For the most accurate and complete quote possible, please include your first and last name, relevant contact information, and any available Gerber or NC files for our design team to examine. In addition, please provide details regarding the quantity and delivery schedule associated with your request.

Or, to find out more about the technical specifications and applications of our aluminium-on-aluminium PCB, contact a member of the Omni team directly at **1-855-798-9717**.

About Omni Printed Circuit Boards

Omni Printed Circuit boards is a PCB design and manufacturing firm located in Richmond, British Columbia. Our mission is to develop custom, innovative, and cutting-edge products for our clients, delivering solutions that can not be found anywhere else in the market. We treat every project as a collaborative process, working closely with designers, engineers, and researchers to produce results within even the most challenging performance environments.

You can learn more about us, our team, and our PCB design and manufacturing process at Omni Circuit Boards (omnicircuitboards.com).