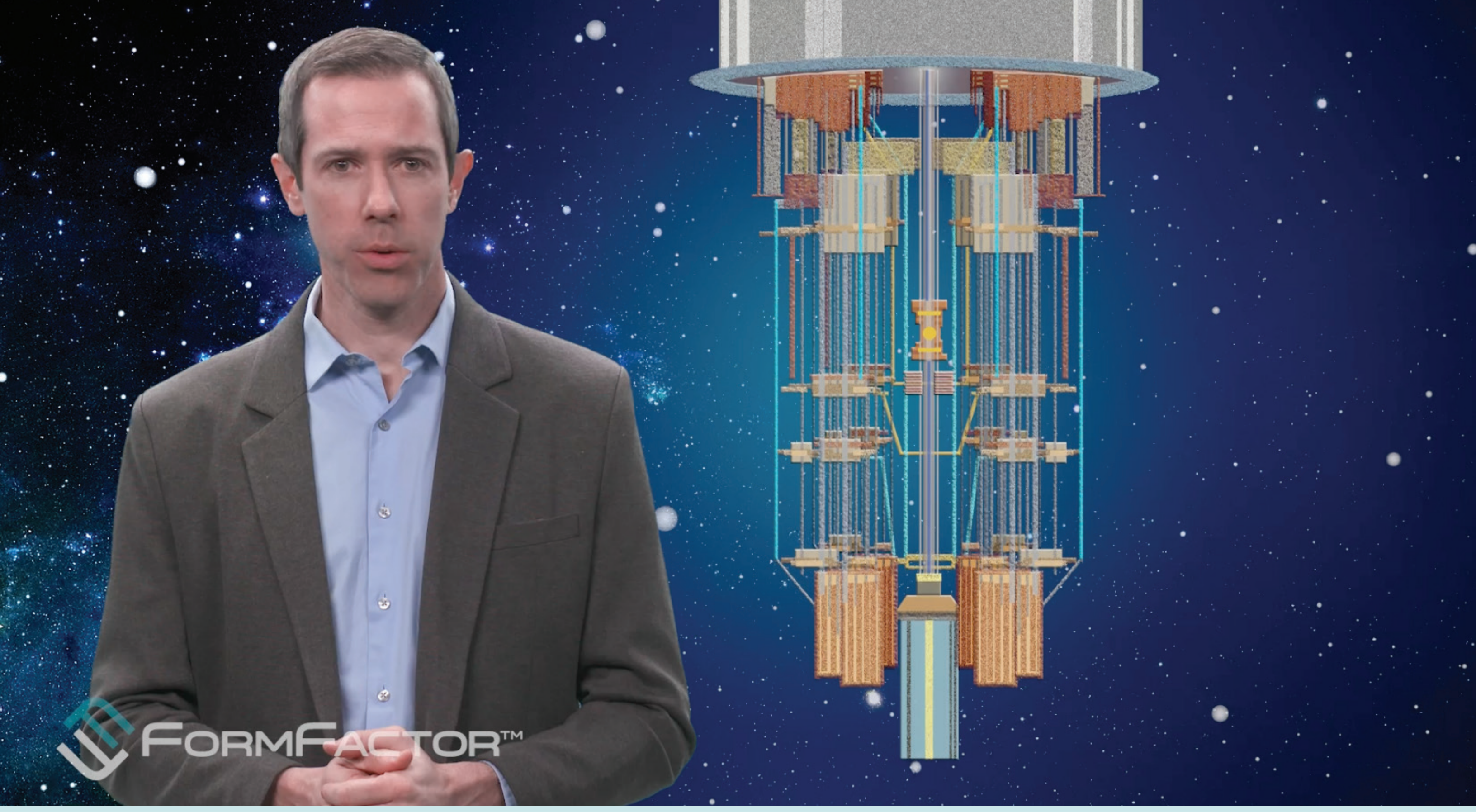


Quantum Computing, Superconductors and the Cold Hard Truth

Quantum computers stand poised to deliver dramatic breakthroughs in any number of scientific and engineering fields. Personalized drugs, pinpoint weather predictions, better batteries and super-secure encryption all fall within the realm of possibility, along with many other applications.

In parallel, another category of machines called superconducting computers promises to elevate conventional computing to the so-called exascale level, where they will deliver a formidable 1018 FLOPS of processing speed at only one tenth the power of present technology.

However, both share a common attribute that must be accommodated on their journey from lab to fab: They can only function at ultra-low temperatures approaching absolute zero.

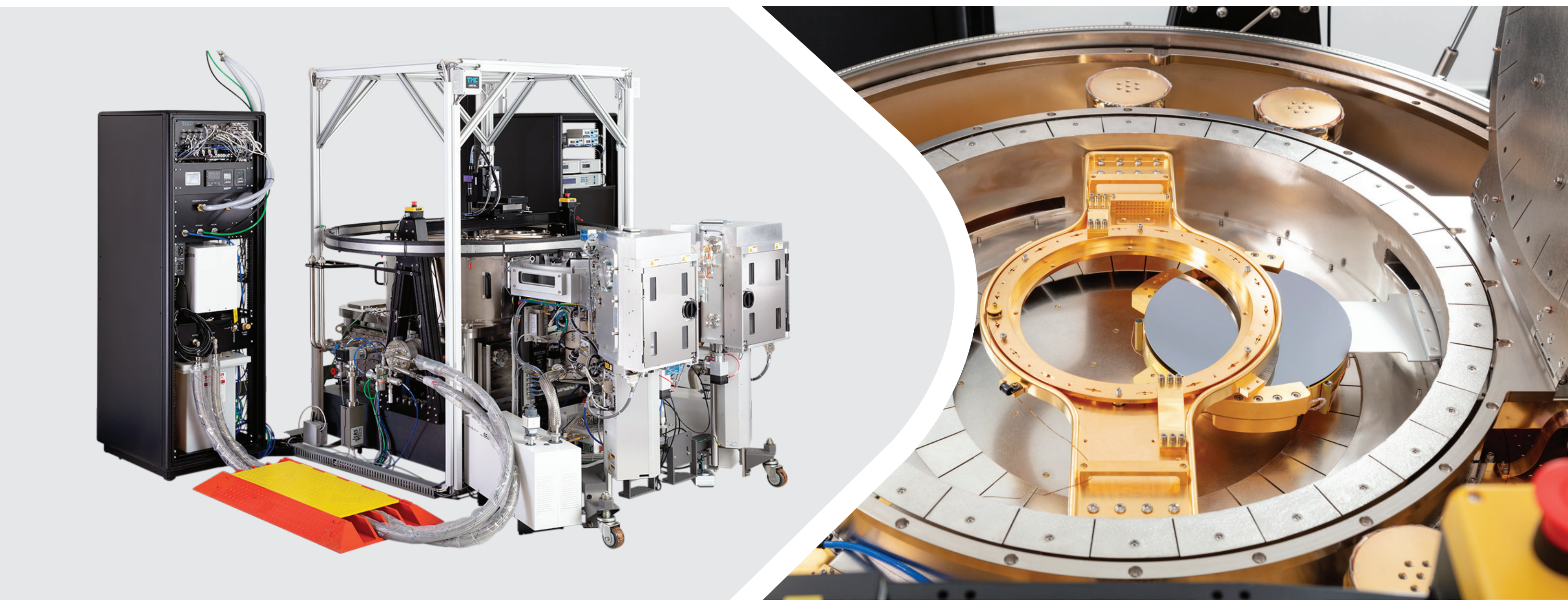
The Deepest of Freezes

Quantum computing machines are constructed of “quantum bits” called qubits, which leverage a phenomenon called superposition; unlike traditional data bits, qubits can simultaneously hold both one and zero values. Multiple qubits can also demonstrate marvelous interactions called entanglement. Using these quantum behaviors in concert, qubit-based systems can evaluate, in parallel, enormous numbers of potential solutions to complex problems. However, qubits are extremely sensitive to small amounts of thermal noise, so to maintain a stable state long enough to complete their calculation (“coherence”) they are kept at temperatures approaching absolute zero. For further efficiency, designers often leverage superconducting connections to build qubits into computing systems.

Classical supercomputers will still be needed for many computing tasks, but today these computers consume very high amounts of power – from megawatts to gigawatts. New types of logic families, such as RQL (reciprocal quantum logic) and RSFQ (rapid single flux quantum) and others, leverage quantum effects and superconducting connections to perform the same classical computing functions but with extraordinary speed and efficiency. Here again, the key is to create an operating environment close to absolute zero. It’s projected that a conventional supercomputer consuming a megawatt could be replaced by a superconducting machine consuming only 10 kilowatts.

Wafer Probing Goes Cryogenic

An intense effort is underway in research facilities around the world to develop the components that will move these new computing technologies out of the lab and into commercial production. One major challenge is to create test and measurement environments that mirror the extremely low temperatures at which these components will eventually operate. Wafer- and chip-level probing must be conducted to evaluate the new devices and circuits, verify operating parameters, and validate volume fabrication processes. Many of the test and measurement operations are similar to those for traditional semiconductors, only now these procedures must be executed at extremely low temperatures.



Exploring the lower limits

At FormFactor, we have already moved aggressively to develop wafer probing systems to meet this challenge. With our recent acquisition of High Precision Devices (HPD), we’ve extended our semiconductor probing capabilities into cryogenic testing environments as low as 30 millikelvin. FormFactor’s HPD 4 K cryogenic probe stations and Adiabatic Demagnetization Refrigeration (ADR) cryostats are part of FormFactor’s suite of cryogenic products to give our customers the broadest range of test and measurement options.

To learn more about our cryogenic test solutions please visit formfactor.com/go/quantum

FormFactor™
Test insight from lab to fab.

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