



# QUANTUM TECHNOLOGIES

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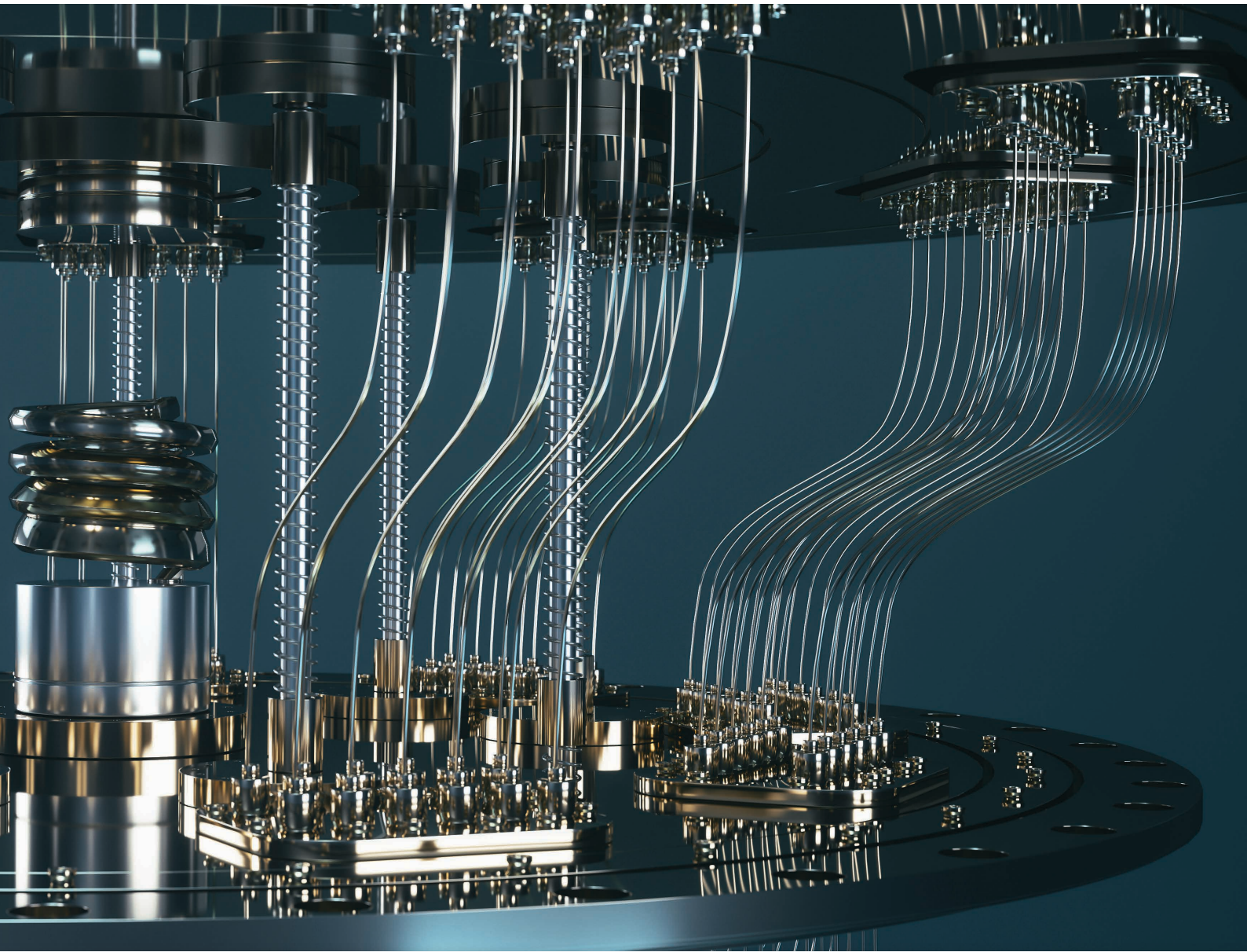
**SIMPLIFICATION IS OUR INNOVATION**

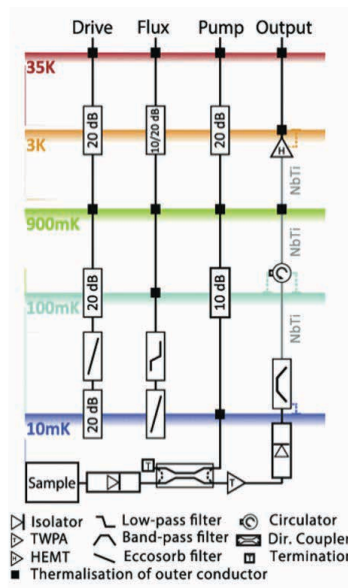
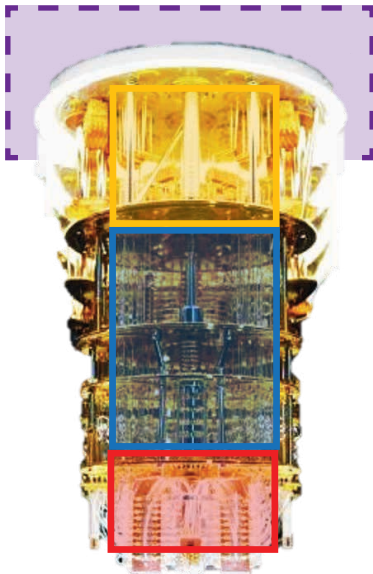
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**Radiall** 

*Quantum computers are accelerating the transformation of various industries like aeronautic conception and design, health care and life science, financial services and manufacturing efficiency and productivity. To support the growing quantum technologies, Radiall is working with R&D, laboratories, start-ups and others to create new interconnect solutions that are tested in-house and qualified in accredited labs. Radiall's interconnect offering brings together a solution of RF cable assemblies, connectors, attenuators, switches and fiber optics to emerging technology to solve application challenges like densification, thermalisation to some tens of milliKelvin, networking and integration, miniaturization and non-magnetism.*





Radiall semi-rigid cables assemblies use proprietary/specific technologies to withstand the lower temperatures up to tens of millikelvin. These technologies have been proven in laboratory and in field. With cables in .047" (and .033" - .013" under development), we have SMA, SMPM and multiport coax connector solutions. Stage interface could use Radiall attenuators (0-30 dB on request):

- Room temperature long semi-rigid, precise bending shape
- 4°K: Cable with good thermal isolation, CuproNickel CuN semi-rigid cables
- 1°K: Cable with superior thermal isolation, superconducting semi-rigid cables in Niobium Titanium (NbTi)
- 10°mK: Highly conductive, close to qubit, lower temperature, amagnetic, hand formable cable assembly in Copper Silver (CuPro)

### Dilution Refrigerator (DR)

#### Room Temperature Long Semi-rigid

> 4°K: **Good Thermal Isolation**

1°K - 4°K: **Superior Thermal Isolation**

< 1°K: **Highly Conductive**

Source: Krinner, S., Storz, S., Kurpiers, P., Magnard, P., Heinsoo, J., Keller, R., Luetolf, J., Eichler, C. and Wallraff, A., 2019. Engineering cryogenic setups for 100-qubit scale superconducting circuit systems. EPJ Quantum Technology, 6(1), p.2.

## RF CABLES, CONNECTORS & ASSEMBLY SOLUTIONS

Radiall's RF cables, connectors and assemblies are able to satisfy quantum technologies' specific requirements, including:

- Densification: Miniature connectors, multi coaxial harness (bundle), small diameter semi-rigid cables, multi-pin coax connectors
- Thermalization: Through panel, thermal conductivity insulator
- Solution: A-magnetism, seamless/solderless connectors, HF and material expertise, (cryo)switches and (cryo)attenuators

With testing during the R&D stage, Radiall determined that SMA, 2.92, SMP and SMPM connectors remain stable at low temperatures. VSWR, insertion loss and mechanical properties remain stable down to 10 mK.

To meet market demands, Radiall is continuously developing more modular, miniaturization and cryogenic evaluation on cryogenic representative environments.



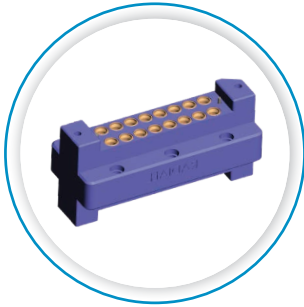
**SMPM-LOCK**



**SMPW**



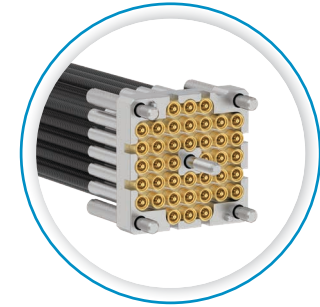
**IMP (LP-SR-HD)**



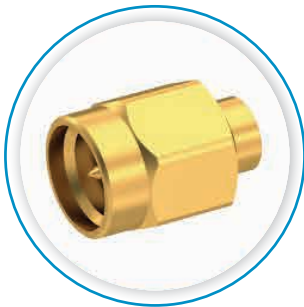
**ATTENUATOR**



**SEMIRIGID 3D BENDING**



**F2C-40**



**SMA**



**2.92**



**SMP**

## RF CABLE ASSEMBLIES

Our range of coaxial connector solutions are suitable for cryogenic applications such as quantum computing.

PART NUMBER	DESCRIPTION
R294C2312002	2 SMA Straight Plugs Semi-Rigid .085" Tinned Copper 500 mm
R294C2312005	2 SMA Straight Plugs Semi-Rigid .085" Tinned Copper 2000 mm
R294C2312008	2 SMA Straight Plugs Semi Rigid .034" Niobium-Titanium Inner/Outer conductor 100 mm
R294C2312009	2 SMA Straight Plugs Semi Rigid .034" Niobium-Titanium Inner/Outer conductor 200 mm
R294C2312010	2 SMA Straight Plugs Semi Rigid .034" Niobium-Titanium Inner/Outer conductor 450 mm
R294C2312012	2 SMA Straight Plugs Semi Rigid .034" Niobium-Titanium Inner/Outer conductor 200 mm
R294C2312015	2 SMA Straight Plugs Semi Rigid .034" Silver Plated CuproNickel Inner/Outer conductor 200 mm
R294C2312017	2 SMA Straight Plugs Semi Rigid .034" Silver Plated CuproNickel Inner/Outer conductor 100 mm
R294C2312018	2 SMA Straight Plugs Semi Rigid .034" Silver Plated CuproNickel Inner/Outer conductor 200 mm
R294C2312019	2 SMA Straight Plugs Semi Rigid .034" Silver Plated CuproNickel Inner/Outer conductor 450 mm
R294C2312020	2 SMA-COM Straight Plugs Hand-Formable Cable Unjacketed .085" 250 mm
R294C2312021	2 SMA-COM Straight Plugs Hand-Formable Cable Unjacketed .085" 500 mm
R294C2312022	2 SMA-COM Straight Plugs Hand-Formable Cable Unjacketed .085" 1000 mm

### Notes

There are more cable assemblies available as well as custom cable assemblies.

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## RF ATTENUATORS

In quantum computing, cryogenic microwave attenuators are used in different stages of the thermal dilution refrigerator to reduce the thermal noise in the signal. The RF lines within each layer increases the signal-to-noise ratio (SNR), requiring the attenuator for the thermalized layer to protect the signal level.

PART NUMBER	DESCRIPTION
R429800000	SMA Attenuator 0 dB 18 GHz 2W
R429820000	SMA Attenuator 20 dB 18 GHz 2W



## RF SWITCHES

With cryogenic switches, Radiall provides a solution to meet emerging market demands. These switches function at extremely low temperatures (0 Kelvin/-273 °C) and actuate at very low power. They can be easily integrated into equipment and are a perfect solution for a variety of laboratory applications.

PART NUMBER	DESCRIPTION
R583423141	Specific SP6T Ramses SMA 18 GHz Latching 28 Vdc D-SUB Male Connector Bipolar Actuator Command for Cryogenic Application
R571433141	Specific SPDT Ramses SMA 18 GHz Latching 28 Vdc Pins Terminals Bipolar Actuator Command for Cryogenic Application
R5927B2141	Specific SP6T Ramses Sub-Miniature SMA 26.5 GHz Latching 12 Vdc Pins Terminals Bipolar Actuator Command for Cryogenic Application



# SIMPLIFICATION is our INNOVATION

*We advance the design and engineering process for innovators, groundbreakers and pioneers of technology. We reduce weight, improve durability and streamline installation to provide leading-edge connectors that drive product performance.*

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