Delft Circuits

Hardware for quantum engineers.

# Cri/oFlex®

## Flex cabling for cryogenic systems

Includes

CF1

CF2

CF3

# Cri/oFlex®

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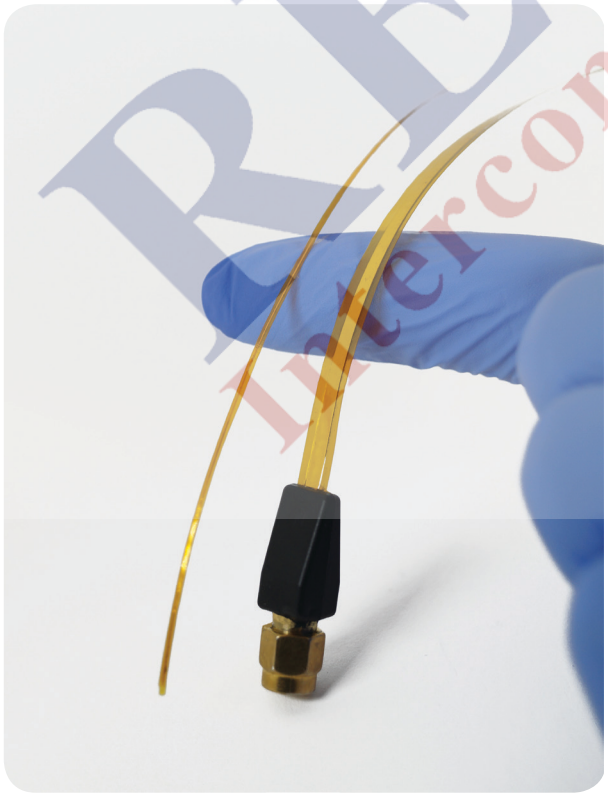
## Unique ultra-thin, vibration isolated i/o

Cri/oFlex® CF1 cable series is specially dedicated to low mechanical coupling applications. Thanks to its intrinsic high flexibility, it is naturally well suited for SPM applications. In comparison to the standard Cri/oFlex® cables, during its development process we paid particular attention to increase flexibility and ensure UHV compatibility. To optimize vibration isolation we can fabricate microwave transmission lines as thin as 100 um (4 mil), and as narrow as 1 mm (~40 mils).

- High flexibility
- Specified working temperatures 4-400K
- Made of UHV compatible compounds

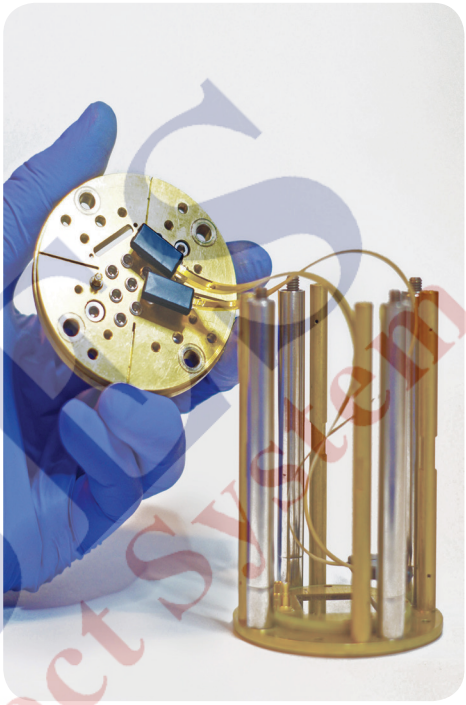


This high flexibility, which is comparable to a sheet of paper, in conjunction with its insensitivity of the insertion loss upon bending is extremely useful for cabling in high density environments like the probe stage of an SPM. We offer a large variety of connector options such as SMA, SMP and SMPM to adapt the cabling to any system. To further adjust Cri/oFlex® cables to your needs, we offer the possibility of selecting the operating frequency bandwidth from 0 to 26.5 GHz. Operating frequencies up to 40 GHz are currently under development.

- Selectable frequency bandwidth
- Standard connector types
- Ulta-flexibility option

## Standerdized Flex Cryogenic Cabling

Cri/oFlex® CF2 series is specifically designed for cryogenic environments where thermal load, microwave performance, small form factor and phase stability are critically important. Our standardized CF2 series is ideally suited to solve space constraints in crowded setups, such as table-top cryo systems or densely populated mixing chambers of dilution refrigerators.



- Extremely flexible
- Excellent phase stability
- Small form factor
- Optional filtering & signal conditioning
- Countless bending and straightening cycles
- Low thermal load

| General Properties | |
|---|---|
| Connector | |
| Connector Type | SMA, SMP, SMPM (all male) |
| Connector Configuration | Straight and Right-angle |
| Flex | |
| Length | 10 to 1200 mm |
| Width | 4 mm |
| Thickness | 0.3 mm |
| Materials | Polyimide & Silver (Ag) |
| Transmission-line type | Stripline |

| Thermal Properties | |
|---|---|
| Operating Temperature | $10^{-3}$ K → 400 K |
| Heat Load @ 4k (ΔT: 4 - 40 K), L = 0.4m | < 18 µW |
| Expected Heat Load @ 10 mK (ΔT: 10 - 350 mK), L = 0.2m | ~ 5 nW |
| Thermal Cycles | > 50 |

| (Static) Mechanical Properties | |
|---|---|
| Min. Bending Radius | 1 mm |
| Required Length for Longitudinal Rotation | 2.5 cm / rotation |
| Max. Tensile Force | 50 N |

| Electrical Properties | |
|---|---|
| Impedance | 50 Ω (± 2 Ω ) (Customizable on Request) |
| Operating Frequency | DC to 18 GHz |
| Isolation | -60 dB, flex to flex, for connector data contact us |

# Cri/oFlex® CF2

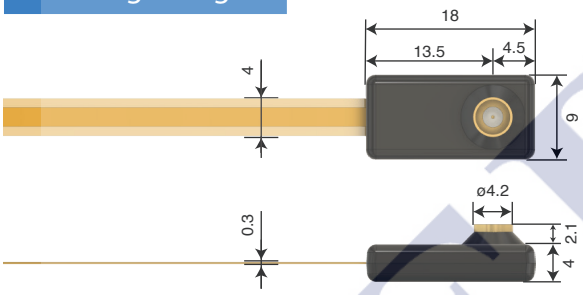
## Customization options

| Connector Type | 0-2 GHz | 0-6 GHz | 0-12 GHz | 0-18 GHz |
|---|---|---|---|---|
| SMP right-angle | ✓ | ✓ | ✓ | ✓ |
| SMA straight | ✓ | ✓ | ✓ | ✗ |
| SMP straight | ✓ | ✓ | ✓ | ✓ |

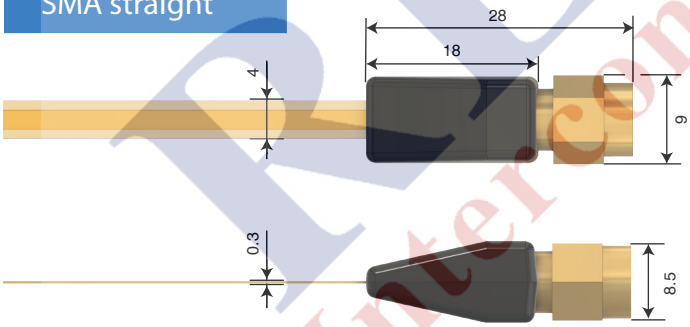
✓ readily available
✓ available upon request
✗ under development

## Connector Dimensions

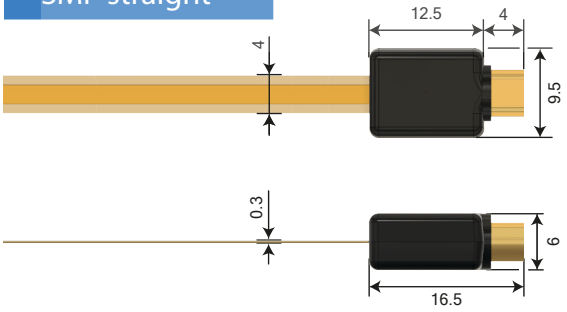
### SMP right angle




### SMA straight

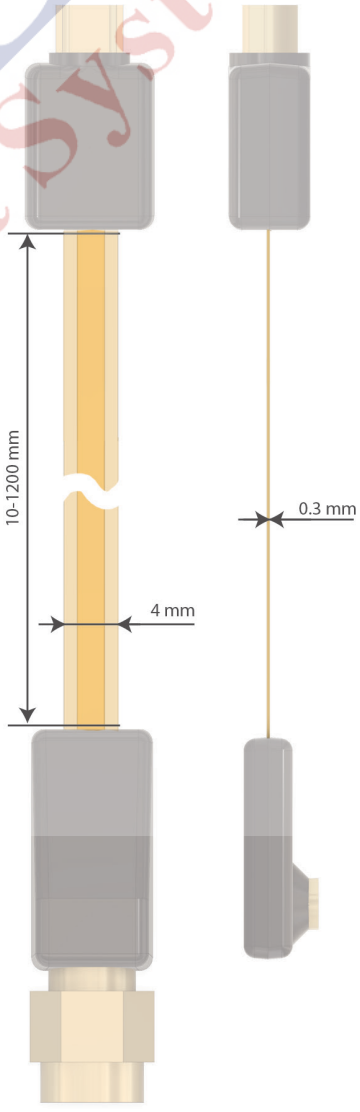



### SMP straight



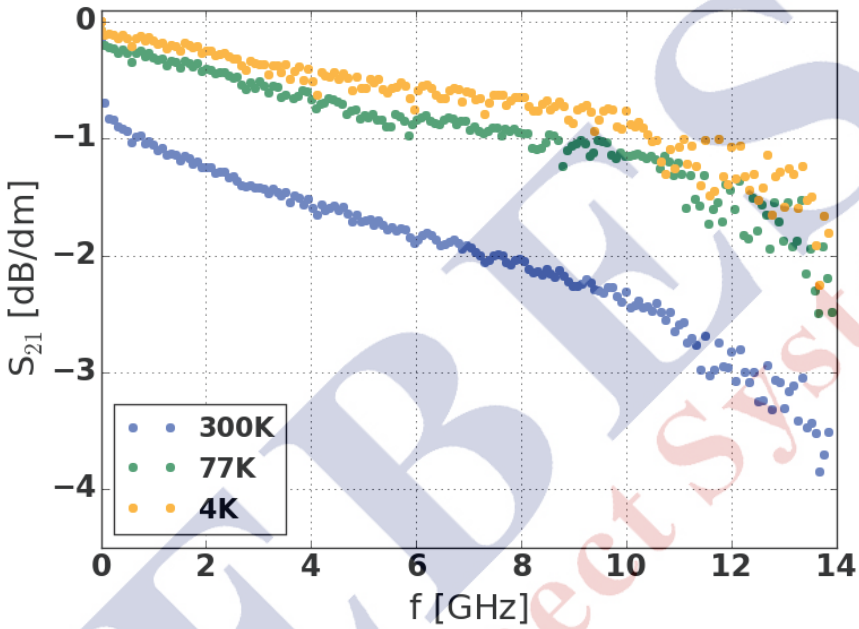

All dimensions are in mm

## Flex Dimensions



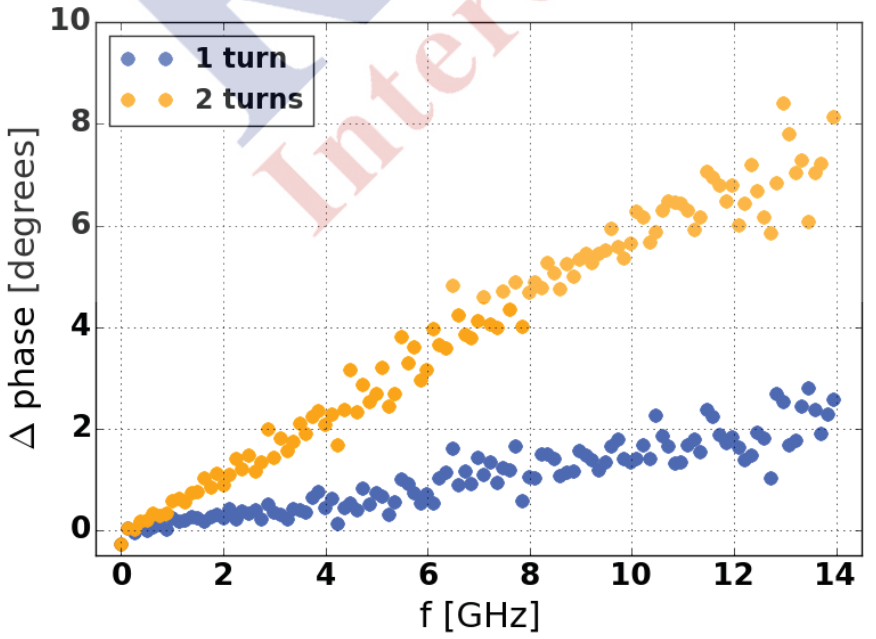
## Insertion loss, S21

The figure below shows the roll-off (S21) of a typical DC-10 GHz bandwidth flex cable. The cable length is 30cm and is fitted with SMP right angle connectors on both ends.

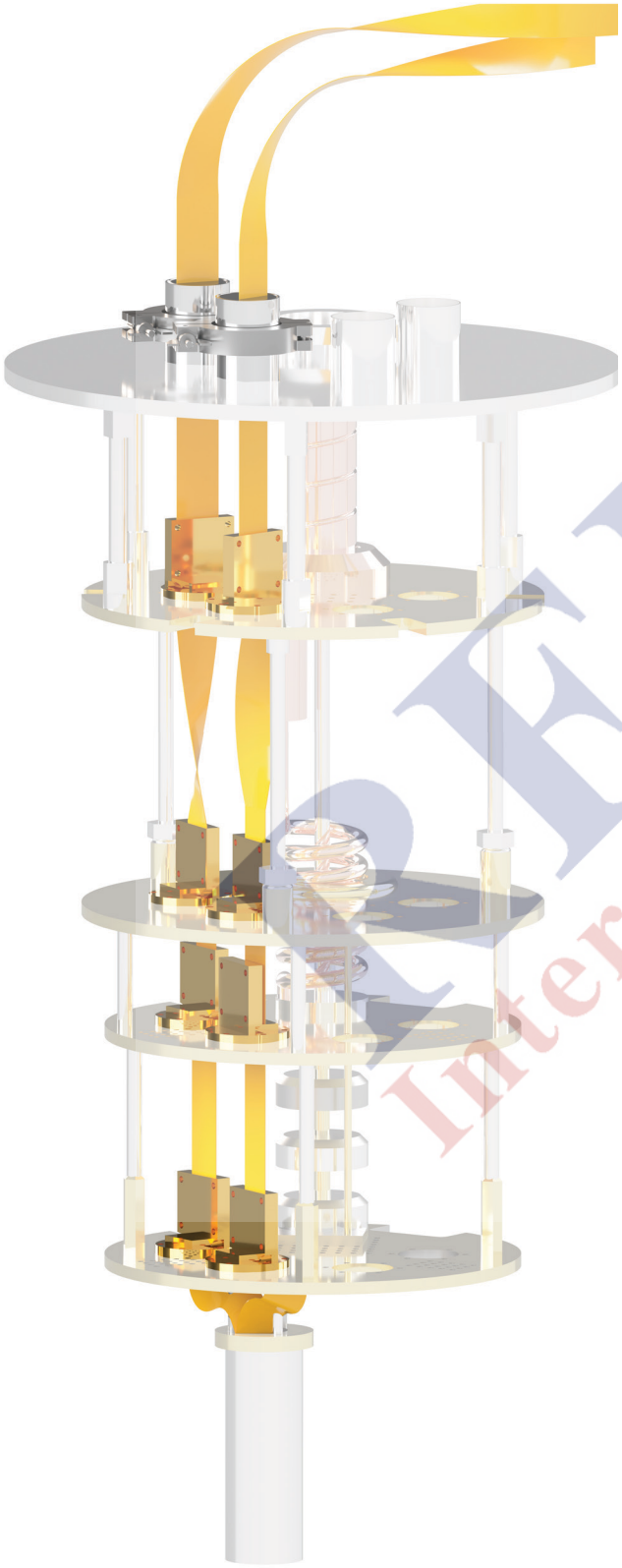



## Phase stability

The figure below shows the difference in phase of a typical DC-10 GHz bandwidth flex cable, upon winding once or twice around a cilindrical object with a diameter of 8 mm. The used cable is 20cm long and is fitted with SMP right angle connectors on both ends.




## Filtered multi-channel i/o



Our Cri/oFlex® CF3 product line provides multi-channel i/o. It is specifically designed to supply i/o-chains in dilution refrigerators from room-temperature to 10 mK. Routing your signal, with the right conditioning and noise properties, to your cold stage while achieving the lowest possible temperatures, requires careful balancing between the thermal and electrical characteristics. Cri/oFlex® is specifically designed for such environments where thermal load, microwave performance, noise characteristics, small form factor and phase stability are critical.

Cryogenic quantum computing architectures create stringent requirements on i/o for Qubit control. Superconducting, spin-donor and topological Qubits all require at least one control line per Qubit. As the number of Qubits increases rapidly, highly scalable i/o with low thermal load and small volume becomes a key enabling technology for the continuous growth of Quantum Computers. Based on Cri/oFlex® CF3 we are developing a scalable i/o platform which is optimized for the needs of the Quantum Computing industry and has the potential to increase the number of signal lines inside a dilution refrigerator to a few thousand.

# Cri/oFlex®

# Delft Circuits

Delft Circuits is a young company dedicated to supply the best hardware for the quantum engineer and industry. Together with our customers we make quantum technologies a reality.

Quantum technologies offer revolutionary new capabilities, the industry is booming, but is still in its infancy. With Quantum computing, a landscape of new possibilities will be added to the thriving eco-system of high-performance computing, machine learning and artificial intelligence. Quantum-communication and -internet bring new capabilities in (information) security and distributed (quantum) computing. Finally, quantum sensing will bring a whole new dimension to a host of industries and sciences.

The past two decades we witnessed an explosion in academic research and results. Now this development is transitioning into the first steps of the quantum industry, of which we are proudly part. With our team we are devoted to supply the quantum engineers in industry, academia and national labs, the best available tools, technology and services, such that they can focus on their real task.

As an independent quantum hardware supplier we support our customers in making quantum technologies a reality.