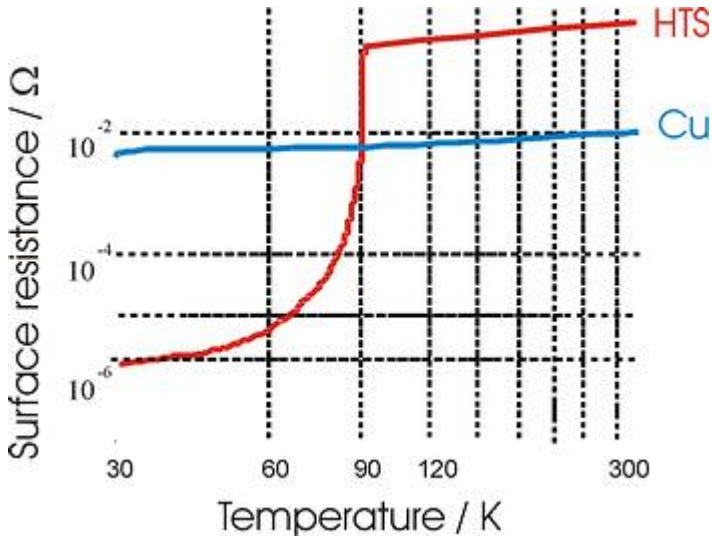
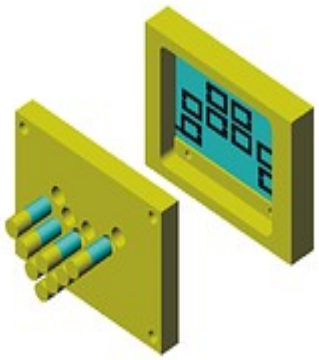
The Emerging Device Technology (EDT) Research group has extensive work in the area of superconducting microwave circuits. The use of superconductors allows unparalleled performance improvements as compared with normal metal conductors.

The group has designed superconducting microwave circuits for mobile communication base stations radio astronomy recievers and satellite communications systems. Examples include mobile communications base station and satellite filters, superconducting beam formers for antenna arrays, and duplexers for splitting and filtering microwave signals.

The surface resistance of a conducting material can be used to give an indication of the performance of a microwave circuit. The surface resistance of a superconductor decreases rapidly as temperature is decreased and is much less than copper at low temperatures. The graph below shows the surface resistance of $YBa_2Cu_3O_7$ high temperature superconductor (HTS) at 2GHz.



The diagram below is of a packaged superconducting microwave circuit showing the superconducting resonators in black and the single crystal magnesium oxide substrate in green. The yellow is the gold plated titanium box used to house the microwave circuit The circuit is only 5cm by 4cm in size



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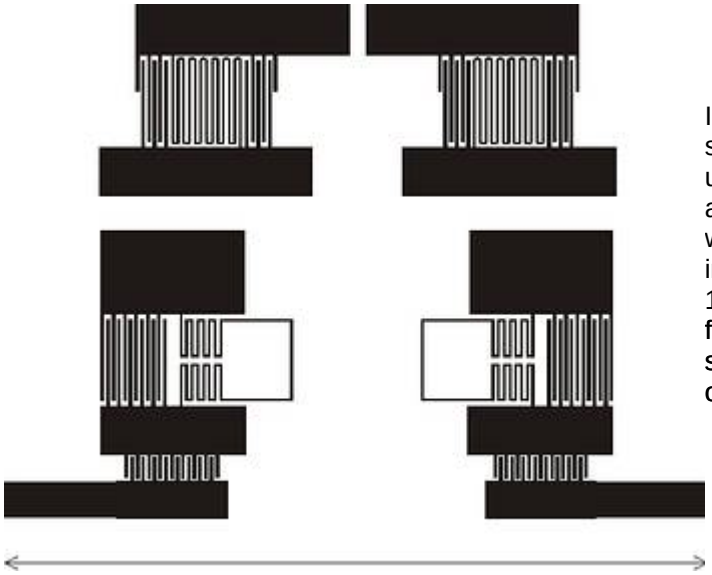
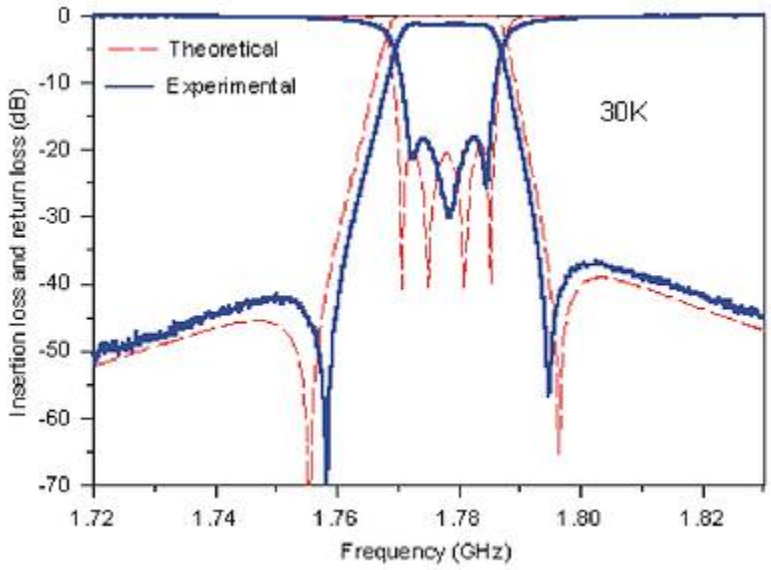


In the diagram to the left, the black lines show the superconducting circuit of an ultra miniature microwave filter developed at Birmingham. This is the smallest filter, with this performance operating at 2GHz, in the world It occupies an area of only 1cm square and has a quasi-elliptic frequency response giving extremely sharp filter skirts. The frequency response of the filter is shown as a graph below.



The EDT group not only makes, designs and test filters but also works with industry to evaluate the performance in systems. A project together with European industry has developed a superconducting receiver for a mobile communications base stations. It contains six filters and three duplexers, a cooler and associated electronics. The system has been tested with great success by TMN, a Portuguese telecommunications company.

The photograph to the left shows a unit which holds six filters and low noise amplifiers. Only one section has a filter in the picture which is shown in black with the amplifier above it. Another three filters and amplifier can be located on the other side of the box.

The picture below shows the entire superconducting receiver. The cylinders in black are the size of thermos flasks and hold the superconducting components and the cooler. This system is many times smaller than a conventional receiver system and can be mounted on the mast of the mobile base station.

Two books have been written by members of the EDT centre which relate to the work described above the references are:

- Hong J.-S. and Lancaster M. J. 'Microstrip filters for RF/microwave applications' John Wiley and Sons Inc. 2001 ISBN 0-471-38877-7
- Lancaster M. J. 'Passive microwave device applications of high temperature superconductors' Cambridge University Press, Cambridge UK 1997. ISBN 0-521-48032-9