

## Zuse's relay calculator Z4 used for Swiss fighter jet P-16

Zuse's legendary relay calculator Z4 was the first computer used at a university in continental Europe, and P-16 was the first airworthy jet fighter developed in Switzerland. The Zuse Z4 was in operation at the main building of the Swiss Federal Institute of Technology Zurich (ETH Zurich) from 1950 to 1955. The war plane P-16 was designed by the Flug- und Fahrzeugwerke Altenrhein (FFA) on Lake Constance (Eastern Switzerland). The Z4 was utilized for top secret flutter calculations. With 920 hours of machine time FFA was the most important client of Z4. The professors responsible for the flutter calculations were Urs Hochstrasser (ETH Zurich and Berne University) and Hans-Rudolf Schwarz (ETH Zurich and Zurich University).

Herbert Bruderer

The changeful history of the first airworthy Swiss jet fighter P-16 was very dramatic. The airplane was designed and built for Swiss Air Force by the private aircraft company Flug- und Fahrzeugwerke Altenrhein (FFA) on Lake Constance near the Austrian and the German border. The senior population living in the region recalls the exciting events of that time: flights with sonic boom, crash into Lake Constance, rescue of the pilot thanks to the ejection seat, and finally the annulation of the purchase order of the P-16 by Swiss parliament, which was indeed a serious mistake.

### The legendary relay calculator Zuse Z4 computes the Swiss jet fighter P-16

Only very few historians of computing know that the legendary Zuse machine Z4, in operation at the main building of the Swiss Federal Institute of Technology Zurich (ETH Zurich) from 1950 to 1955, was involved in the flutter calculations for the jet fighter P-16. This fact was, as Professor Hans-Rudolf Schwarz of Zurich University tells, top secret: He says that at the beginning the fighter jet was not able to fly with supersonic speed. The wings had been all right, but the elevator had fluttered at 0.8 Mach. The engineers did not trust his calculations but the test pilot confirmed Schwarz's results. In order to solve this problem, they have integrated plumb into the leading edge of the elevator. This allowed a speed of 1.4 Mach. The fuel had been distributed in the wing tanks to three chambers. To avoid fluttering they first consumed the fuel of the rear chamber, then of the middle chamber and at last of the front chamber.



*Konrad Zuse,  
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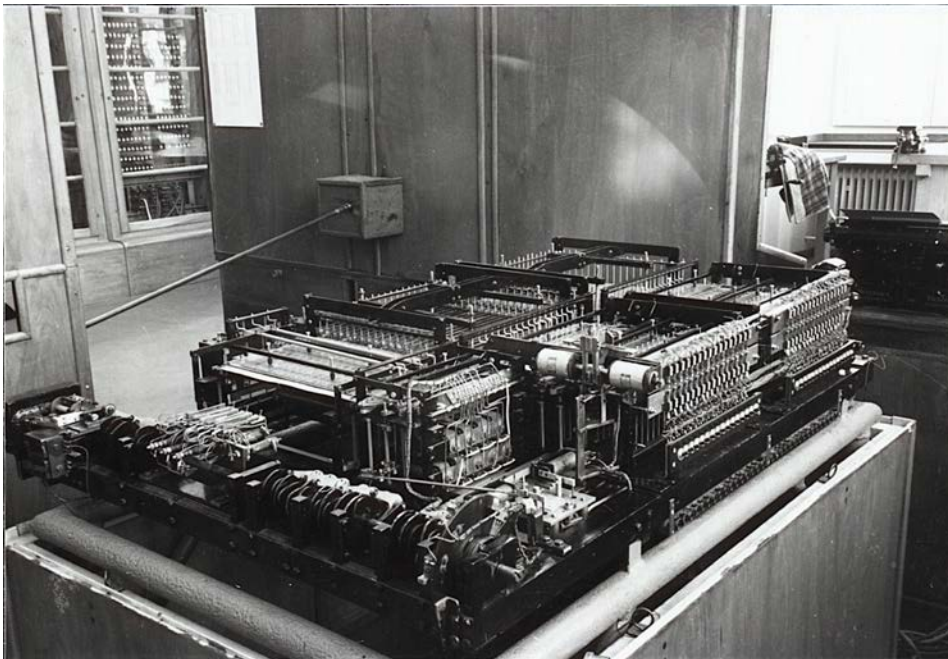


*Swiss jet fighter P-16 at Altenrhein on Lake Constance, © by Staatsarchiv, St. Gallen*

## Flutter calculations for P-16: largest duty for Zuse's Z4 computer

The sequence-controlled Z4, invented by the German computer pioneer Konrad Zuse, served for about 100 tasks in Zurich. We have got details about 55 principal jobs and mathematical investigations. With 920 hours machine time Z4, the work done for FFA was the biggest job carried out with the Z4 in Zurich. The calculations for the P-16 took place from 1952 to 1955 with the aid of the Z4. They were continued with its successor, the electronic digital computer ERMETH, until 1957. The main contributor was Professor Urs Hochstrasser (ETH Zurich and Berne University), later on secretary of state for education and science (Swiss Government). In his very detailed eyewitness report (published in Herbert Bruderer: Konrad Zuse und die Schweiz) he corrects the legend, which is often cited throughout the world, that the Z4 had been so reliable that it had computed at night without supervision.

By the way, the Z4 also calculated some 500 hours for another Swiss jet, the revolutionary N-20 with delta wings, developed by the Eidgenössische Flugzeugwerke Emmen, a federal enterprise.



*Mechanical memory of Zuse's relay calculator Z4 (in operation at the Swiss Federal Institute of Technology, Zurich from 1950 to 1955), © by ETH Library, Zurich*

## Conclusions

Switzerland's history of computing begins with Zuse's relay calculator Z4. Almost all early Swiss computer pioneers worked with this programmable sequence-controlled computer, among them Eduard Stiefel (founder and director of the Institute of Applied Mathematics of ETH Zurich), Heinz Rutishauser (a father of the compiler and leading designer of the programming language Algol) and Ambros Speiser (founding director of IBM Research, Zurich). The know-how acquired with Z4 facilitated the development of the first Swiss stored-program computer called ERMETH.

A P-16 jet is exhibited at the Fliegermuseum Dübendorf (near Zurich), the Zuse Z4 is conserved at the Deutsches Museum in Munich and the ERMETH at the Museum für Kommunikation, Berne.

## Reference

Herbert Bruderer: Konrad Zuse und die Schweiz. Wer hat den Computer erfunden? Oldenbourg-Verlag, München 2012, XXVI, 224 pages



This book contains a worldwide survey of the first computers (USA, England, Germany, and Switzerland) and an international bibliography with more than 500 publications. It deals with the controversial question „Who invented the computer?“ Other significant topics are Alan Turing, John von Neumann and their respective machines.

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