

# IBM 350 RAMAC

The RAMAC (Random Access Method of Accounting and Control) was announced in 1956. It included the first rotating magnetic disk drive for mass data storage. It was the first storage device to provide direct access in less than a second to 5 million characters. This capacity and the short access time capability it provided marked the beginning of a revolution in computing by introducing real-time transaction processing and replacing the sequential data processing procedures required with data stored on punched cards or magnetic tape.

## Features

The RAMAC's disk drive consisted of a stack of 50 magnetic disks that were 2 feet in diameter. This disk drive could store 5 million characters using a 6-bit character code plus a parity and space bit per character. The characters were organized into 50,000 100-character records. The maximum access time was 0.8 seconds to any record in the disk stack, which rotated at 1,200 rpm. Data was recorded on each disk side in circumferential tracks.

The RAMAC disk drive introduced several radically new innovations to devices for magnetic digital data recording. Those innovations in storing digital data included the following.

- 1. A stack of closely spaced magnetic disks rotating at high speed.
- 2. An access mechanism for positioning two read/write heads to tracks, one for each side of a disk, and for inserting and withdrawing the heads to move up and down the stack to quickly access any specific disk track.
- 3. A pressurized air-bearing head (which required compressed air) to maintain a small non-contact spacing.
- 4. A miniature read/write head to fit within the small spacing between the disks that included a wide erase head to deal with positioning tolerances.
- 5. The development of spin coating to achieve a uniform coating of magnetic iron oxide paint on the aluminum disk

## Background

In 1952, IBM established a small research laboratory in a one-story building at 99 Notre Dame Avenue in downtown San Jose, California. Rey Johnson was the director, and the laboratory's size was originally limited to 50 people. At the time, IBM's product development labs were located back East, in New York. However, particularly after World War II, the West Coast had become the center of technological innovation and talent. IBM was finding it difficult to recruit talent to

its east coast labs, so it established this lab in order to begin attracting the growing engineering talent that was on the West Coast.

Rey Johnson, an inventive genius, was given free rein to focus on projects that it was hoped would benefit IBM in the next 4 to 5 years. This freedom, and the exploratory environment he inspired in the lab, led to the creation of a radically new random access storage device and a new system for data processing.

Prior to the RAMAC, business data was stored on punched cards and tape. To minimize extensive re-punching of fixed data, it was necessary to manually select cards with standardized information from a card "tub file." This data would be merged with the newly keypunched data before processing. To improve processing efficiency, Rey Johnson initially looked for a way to mechanize such a tub file. However, he quickly realized that a solution to improving access to specific data required a way to randomly select data. He began to envision the creation of a magnetic recording mass storage device with a large storage capacity and a short access time that could provide direct access to the data to write, read or modify their content. This would provide the capability to process specific transactions as they occurred.

The lab undertook to design and develop a high capacity disk drive with a short access time to any record. Rey Johnson's brilliance was to envision the use of a stack of disks to store data instead of the magnetic drums that were being used. The volumetric storage efficiency (i.e. recording surface area) of a stack of disks is far superior to that of a drum. Under Rey Johnson, Lou Stevens led the team that designed the IBM 350 disk drive while John Haanstra led the team that designed the companion IBM 305 data processing system, the first transaction processing system with direct access. The IBM Model 305 data processing system and the Model 350 disk drive became identified as the RAMAC.

In September 1956, IBM announced the RAMAC (which consisted of the 350 disk drive and the 305 data processing system). Later, the 350 disk drive was announced as available for use with other systems.

The RAMAC demonstrated the value of magnetic disk storage for accounting and control applications. Today, magnetic disk storage is pervasive in all computing applications and has become the way essentially all on-line digital data is stored and shared worldwide over the Internet.

However, the RAMAC disk drive was a one-of-a-kind product. The RAMAC established a rotating stack of magnetic disks as the optimum design to maximize recording surface area in a given volume. However, the costs and

complexity of the pressurized air bearing head required a radically different approach for head spacing. Rey Johnson was assigned in 1955 to come up with a radically new design for future disk drives, a new “species,” not just a next generation drive. He took on this challenge while the RAMAC was still under product development. This radically new drive became the IBM 1301.

Rey Johnson is universally recognized as the creator, inventor and father of the RAMAC disk drive. He received the National Medal of Technology for his contributions to data storage in 1986. In 2007 and 2008, three individuals on the RAMAC project were recognized by the U.S. National Inventors Hall of Fame. Lou Stevens was recognized for the rotating magnetic disk stacks. William Goddard and John Lynott were recognized for the air-bearing head.

## **Selected References**

### **Early product development activities**

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### **Patents**

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William Goddard and John Lynott (Patent 3,134,097)

National Inventors Hall of Fame

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## **AWARDS**

ASME (American Society of Mechanical Engineers) designated the RAMAC an international historical landmark in 1984.

The City of San Jose, California, designated 99 Notre Dame Avenue—birthplace of RAMAC—as an historical City landmark in 2002.

IEEE (Institute of Electrical and Electronics Engineers) designated the RAMAC an IEEE Milestone in 2005.

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