

PROJECT RAMAC - UPDATE

Goal

**Restore a RAMAC disk drive
to an operational state for public display.**

Magnetic Disk Heritage Center (MDHC)

Mission:

To preserve the story and historical legacy of

Magnetic Disk Storage

at 99 Notre Dame, San Jose, California, where it all began.



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Why the Restoration?

- To generate local interest in the creation of a Magnetic Disk Storage Museum at 99 Notre Dame, San Jose, California, the birthplace of the magnetic disk drive, in the original building where it all began.
- Demonstrate a working RAMAC disk drive, a unit that clearly illustrates the fundamental mechanical nature of the “random” access features of magnetic disk storage and the design and capabilities of the original disk drive, announced 50 years ago.
- Provides a dramatic example of the technical progress in magnetic disk drive performance in terms of where we started and where we are now.
- Only four RAMAC disk drives still exist and the one MDHC has is the only one currently available for public display.
- Magnetic disk storage indispensable to advances in computing systems and applications with huge consequences on society but largely overlooked.

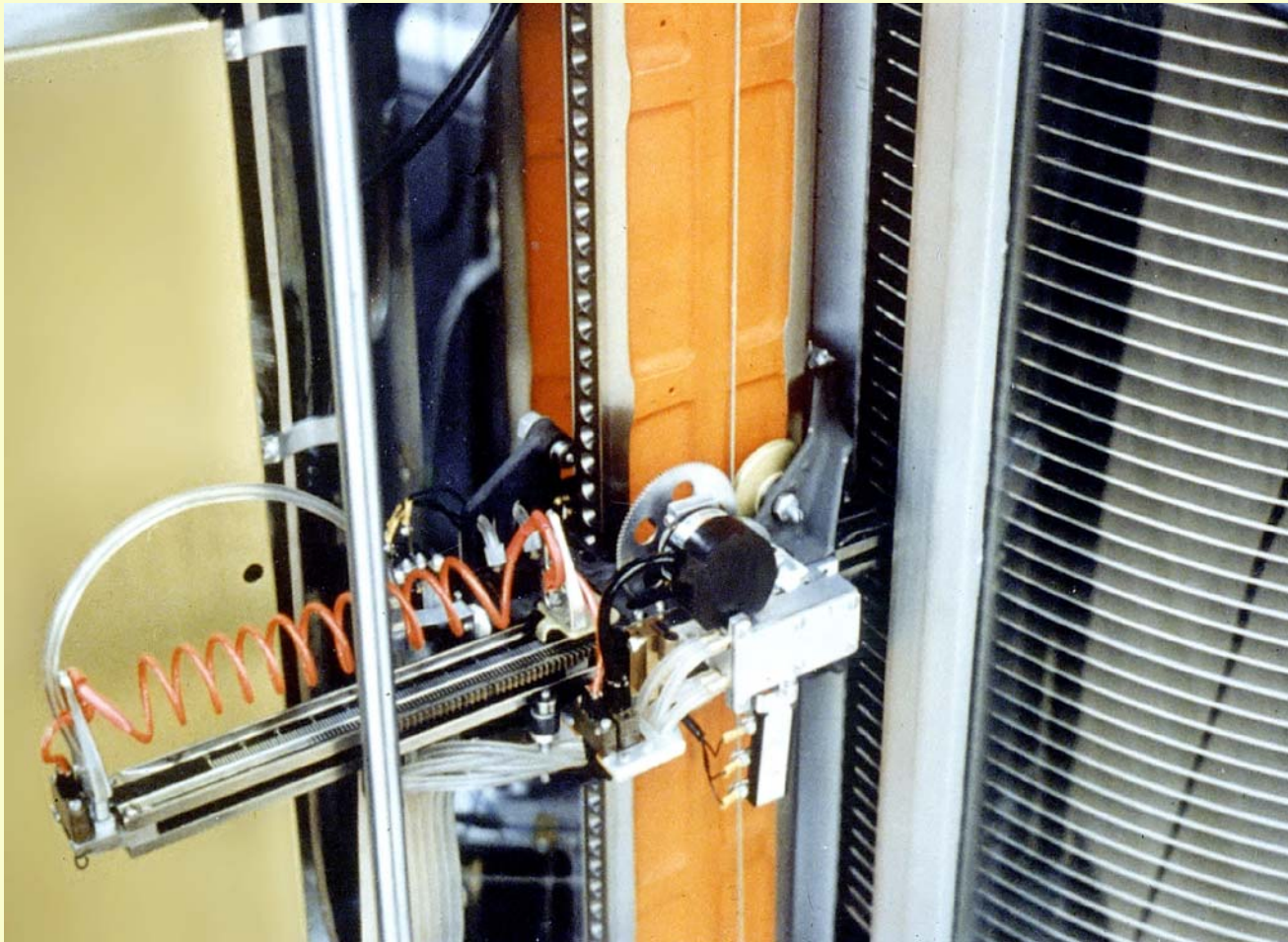
RAMAC Restoration Approach

- Restore the original mechanics and mechanisms (including read/write performance. to their original state.
 - *These aspects represent the key technical innovations of the product!*
- Replace the original vacuum tube and relay control unit with a new controller using current microprocessor technology and computer control

Feasibility studies at Santa Clara University

- **Academic years 2003-2004 and 2004-2005**
- **Project pursued as educational and design engineering experience for senior students**
- **First year focus was demonstrating mechanical access functions (disk, track and record addressing) as well as testing and refurbishing of disk drive hardware. Required design of new “solid-state” controller.**
- **Second year focus on the reading and writing of signals on disks.**
- **This period established:**
 - **Successful established feasibility of restoring the disk drive to an operational state and showed there were no “show stoppers”.**

IBM RAMAC 350 disk drive (Announced 1956)



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Disk Drive received (cabling added)



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SCU disk drive controller developed



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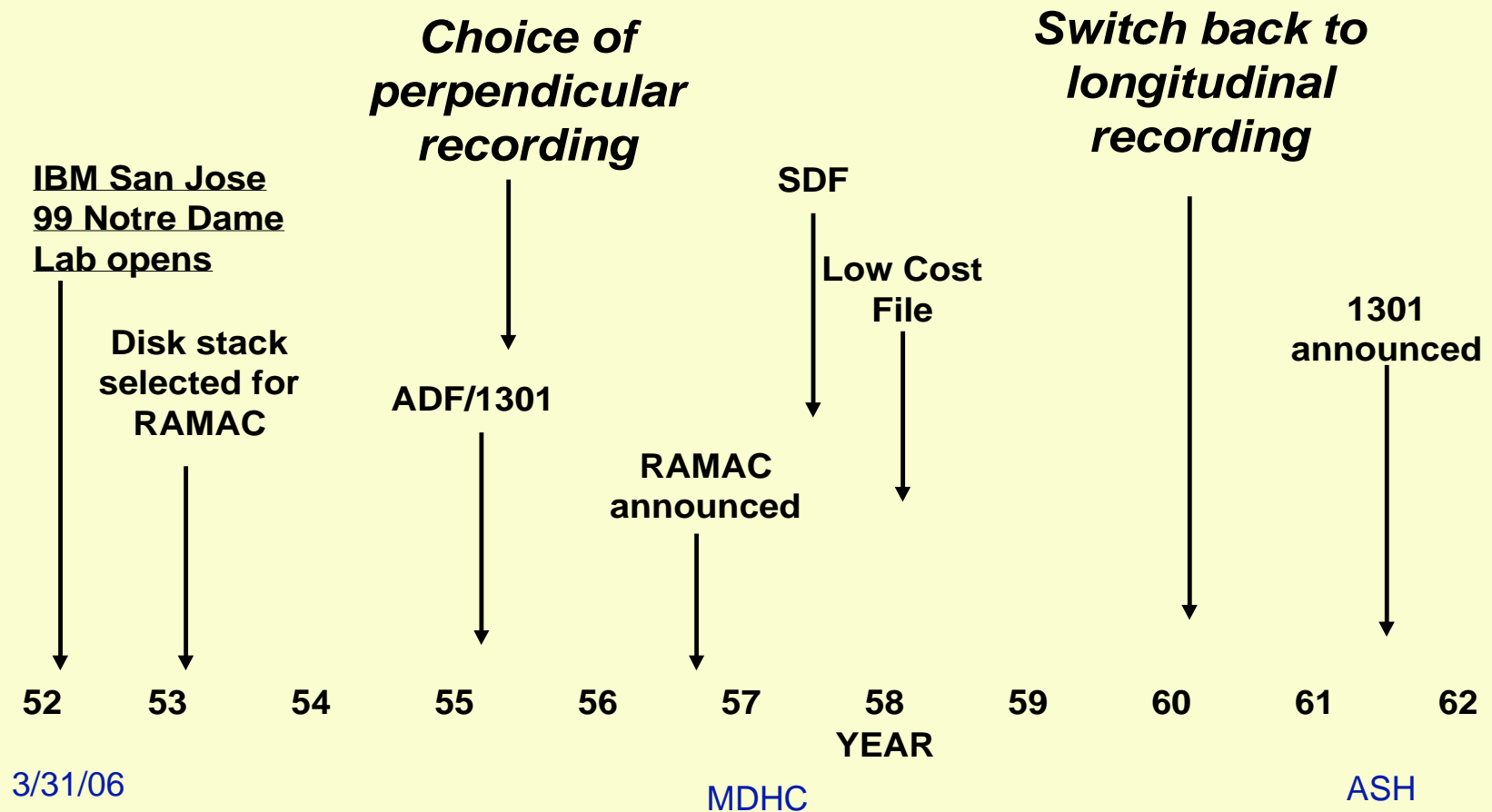
RANDOM ACCESS METHOD OF ACCONTING AND CONTROL (RAMAC)

Original targets and those implemented

Features	Proposed targets set <u>2/53</u> Served as basis for choice of disk stack	RAMAC (<u>announced 9/56</u>)
Disk diameter	16 inches	24 inches
Number of disks	50	50
Bits per inch	200	100
Tracks per inch	20	20
Capacity	4 MB	5 MB
Rpm	960	1200
Data rates	2 (inner and outer band)	1 (constant data rate)
Maximum seek time	Less than one second	0.8 seconds

The Early Years

Magnetic Disk Time Line



RAMAC Access Mechanism

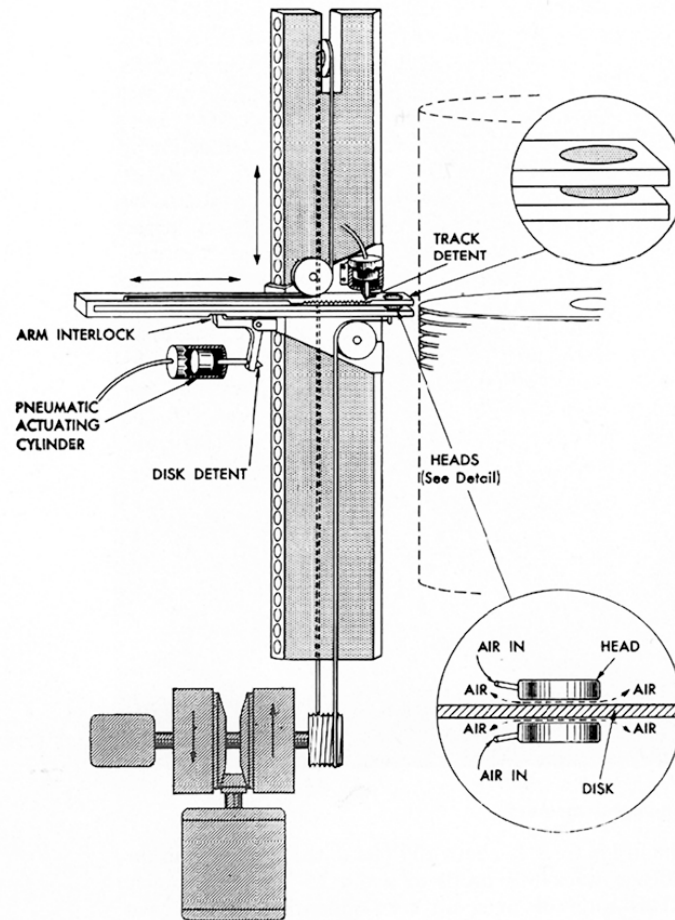


Figure 2

RAMAC Access positioning Method

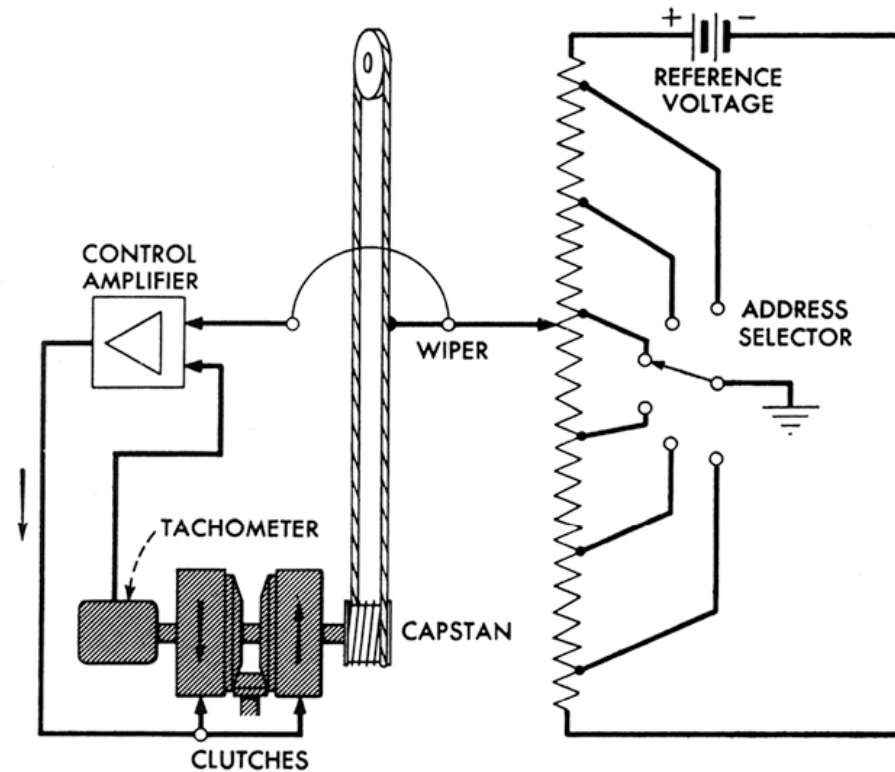
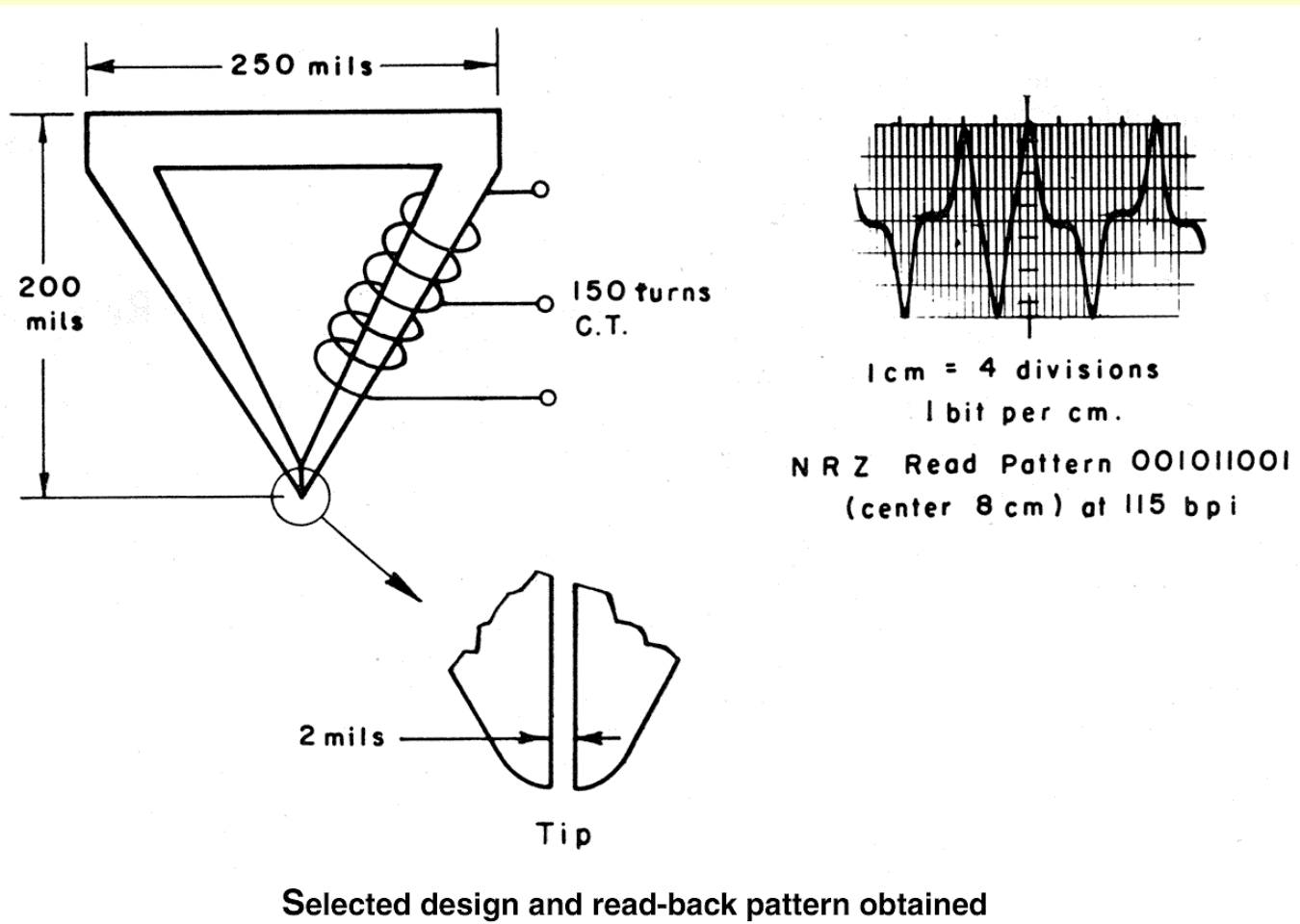


Figure 3
Functional schematic for either horizontal or vertical positioning by access mechanism.

Miniaturized Magnetic Head Design ---- (needed for 0.4 inch disk stack spacing and 1 mil head/disk separation)



99 Notre Dame, A City Landmark
2002 picture → on 50th anniversary



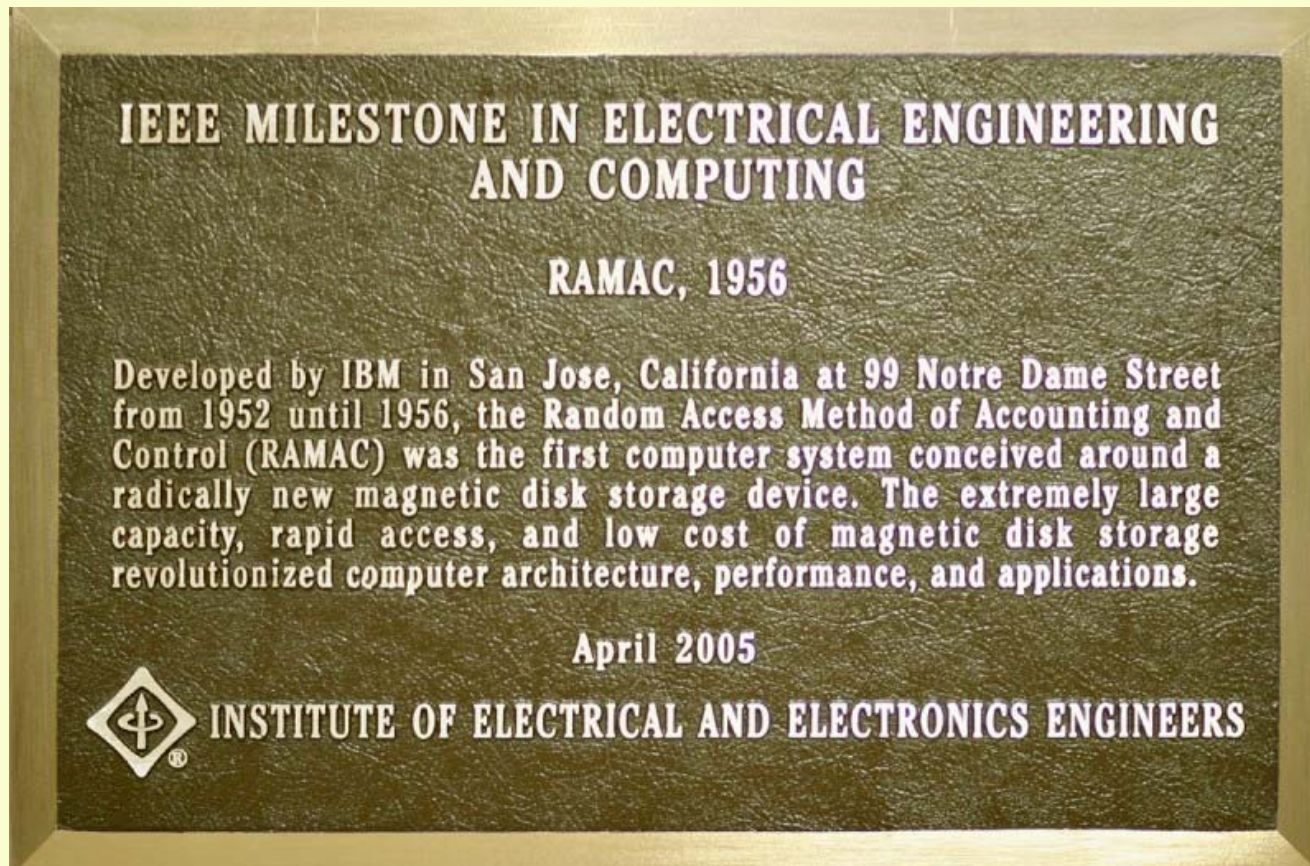
The original building!

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IEEE Milestone Plaque



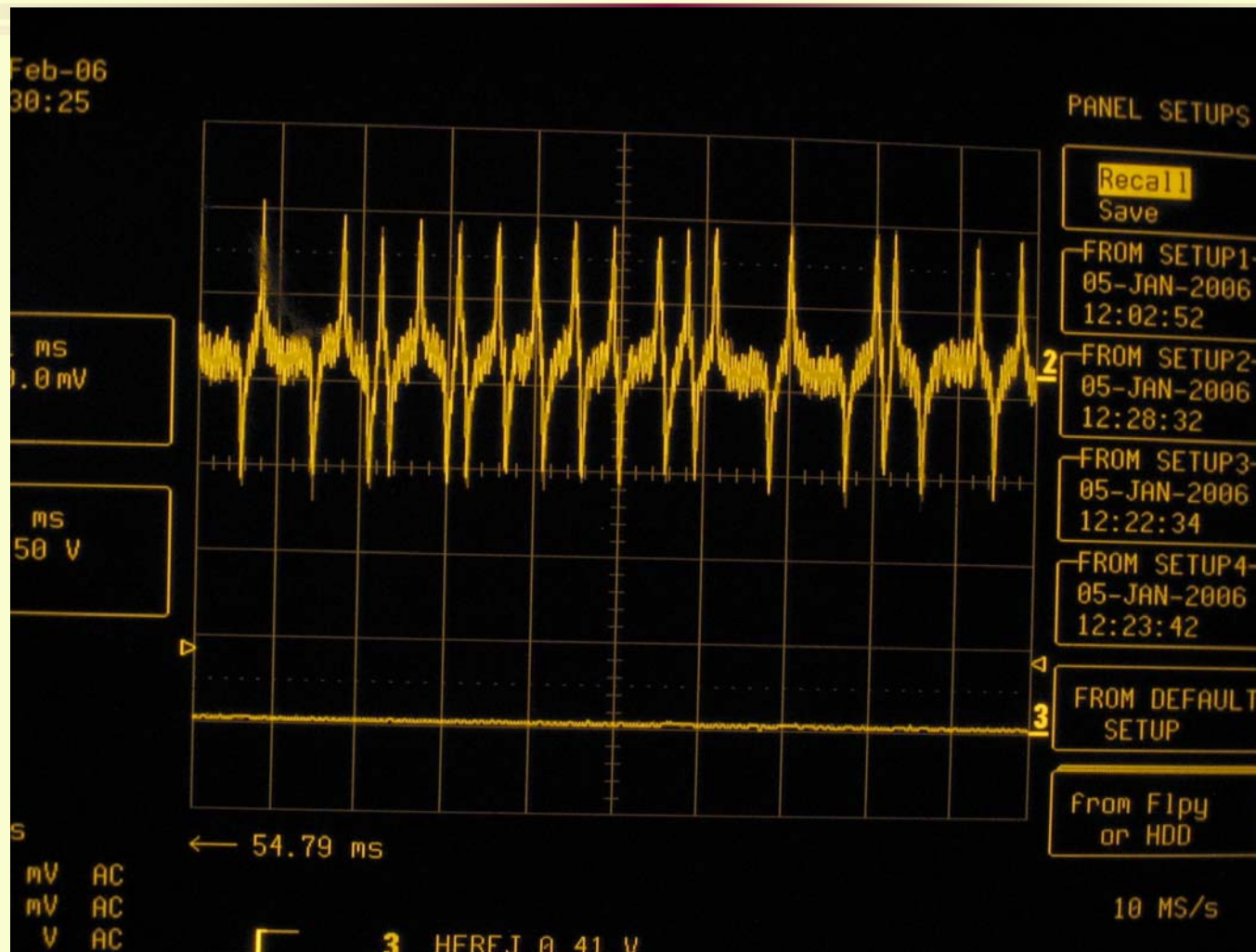
ASME International Landmark Plaque



RAMAC Restoration, progress to date

- Project regarded as great educational and engineering design project for senior students. (2003-2004 and 2004-2005 academic years)
- First year: focus on mechanical access functions; disk, track and record addressing.
- Second year. focus on the reading and writing of data on disks.
- **Result:** Successful established feasibility of restoring the disk drive to an “operational” state (no show stoppers)..
- Summer of 2005, Relocated project to Computer History Museum for final engineering design phase for public display of a functional unit.
- This continuing effort led by the Magnetic Disk Heritage Center (spun off from SCU at time of move and created as a non-profit C-3 organization)

Readback waveform (2/28/06)



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RAMAC Restoration

Current Status

- **Redesign of servo positioning system being undertaken with support of Pat Connolly, graduating from SCU in June with a MS degree in Mechanical Engineering, who played a key role in the restoration from the beginning as a part-time student. The senior design report of the student group pursuing the access controller design is available on the MDHC website (www.magneticdiskheritagecenter.org).**
- **By “popular demand” now pursuing reading information currently on the disks. Joe Feng is heading this effort. Write driver redesign will be carried forward following this.**
- **Hope to have a special display of the RAMAC disk drive in September, 2006, the month the disk drive was announced 50 years ago in 1956 as part of 50th anniversary celebration at CHM.**