CDC 9760 (SMD)
1973
The first significant departure from IBM standards for disk storage media and technology in the OEM market.

Why it's important
Prior to Control Data Corporation's (CDC's) SMD (Storage Module Drive), the Plug Compatible Manufacturer's (PCMs) and Original Equipment Manufacturers (OEMs) generally used IBM compatible or very near IBM compatible media, with a comparable level of technology in their disk drives.

Rather than follow the rumored IBM "Winchester" technology, which resulted in the complex and expensive IBM 3348 removable head disk assembly in a IBM 3340 dual disk drive configuration (Figure 1), CDC developed a rack-mountable disk drive with a non-IBM removable disk pack at a higher level of recording density and performance (6000 BPI and 10Mb/s) than IBM (Figure 2).


Figure 1 - IBM 3340 Winchester Disk Drive

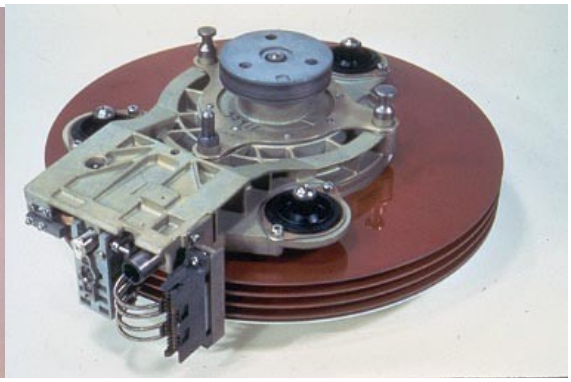
IBM 3348 35-MB data module without covers
Source: IBM Corp


Figure 2 - CDC 9762 SMD and two packs

CDC 877 80-MB Pack mounted in drive
Source: Seagate - photos by Gary Sorenson

CDC's first SMD, the 9760 removable pack disk drive, was announced in 1973 and the easy-to-attach SMD interface established a family of both removable and fixed media drives that became the preferred choice for almost all system OEMs in the late 1970s and through the 1980s.

The success of the SMD interface products made CDC the largest OEM disk drive supplier in the world by 1980. By the time the SMD interface became an ANSI disk drive standard in 1982, it was available from all the mid- and high-end OEM drive suppliers.

Discussion

In 1970, CDC disk drive development and manufacturing were located principally in Edina, Minnesota, in a facility called Normandale [20, 26]. CDC was already a leading supplier of disk drives for their own systems, as well as for many other system OEMs. In December of 1970, a group of engineers, led by Tom Murnan, started conceptual design of a fixed media disk drive, called the Memory Module, which could be rack mounted with up to 4 independent HDAs (head disk assemblies) sharing a common set of electronics [1, 2]. This was in response to the rumored IBM "30-30" (Winchester) fixed media technology. Several people, including Bill Morgan, an ex- IBM consultant to Tom Kamp, President of CDC's Peripherals Division, felt that CDC should follow IBM with fixed media but ultimately everyone lined up behind a removable pack design instead [4, 5, 6, 20]

By August 1972, the decision had been made to develop a 5-disk removable disk pack drive that would fit in a standard 10.5 inch rack, since CDC did not have contact / start stop heads but did have a unique ramp-loaded head, capable of 6000BPI at a flying height of less than 30 microinches at 3600 RPM [3, 4, 5, 14, 17, 20, 25]. The final decision was made by Lloyd Thorndyke, VP/GM of Normandale, with considerable input from engineering, marketing and sales, led by Larry Matthews, Tom Murnan, Phil Arneson, Tom Dugdale, and Gordon Brown [14, 17, 18, 26]. Phil Arneson then presented a $4.5M funding proposal to Tom Kamp that was approved [18].

Tom Murnan became the project manager of the Storage Module Drive and held the first design review on August 30, 1972 [6]. He released the first SMD spec on September 19, 1972 [7].

The first product was the 40MB 9760, which was announced and shown at the National Computer Conference (NCC) in June 1973 in New York City. A double track density (384 TPI) version, the 80MB 9762, was announced in June 1974 [11, 17, 18]. These were followed by 150MB 9764 and 300MB 9766 drives, which used the same head, disk, channel, and interface technology but on CDC's HPD (3330-1 and 3330-11 equivalent) mechanical platforms [11,17,18]. The 300MB 9766 was for many years the largest capacity removable pack disk drive on the market.

Nixdorf was the first SMD customer, receiving the first 9760 unit in December 1973. This was followed by Systems Industries and several others but sales did not begin to really build until 1977, when the 5,000th unit was shipped [11, 13]. Much of this was due to the lack of 10Mb/s interface adapters. Once independent adapter suppliers, like Microcomputer Systems, started to supply these adapters, however, virtually all of the other minicomputer OEMs bought the SMD. By 1979, the 50,000th SMD unit was shipped and in July, 1981 the 100,000th unit was shipped [13, 16].

Century Data, Ampex, and several others copied the SMD, which was advantageous to CDC because customers were wary of having only one supplier. By 1983, at least 25 manufacturers were supplying SMD compatible disk drives [19].

A steady stream of SMD-interface compatible products from CDC followed the 9760, creating the broadest range of OEM products in the market in that timeframe (see Table 1):

Table 1 - CDC SMD-interface Drives listed by Year of Introduction

Date	Model	Capacity	Disk Size	Project	Product Type
1973	9760	40 MB	14"	SMD	removable media drive
1974	9762	80 MB	14"	SMD	removable media drive
1975	9764	150 MB	14"	SMD	removable media drive
1975	9766	300 MB	14"	SMD	removable media drive
1976	9730	80 MB	14"	MMD	fixed media drive
1977	9427	5/5 MB	14"	CMD	cartridge drive (Hawk)
1978	9730	160 MB	14"	MMD	fixed media drive
1978	9448	16/16 MB	14"	CMD	cartridge drive (Phoenix)
1978	9448	48/16 MB	14"	CMD	cartridge drive (Phoenix)
1978	9448	80/16 MB	14"	CMD	cartridge drive (Phoenix)
1979	9775	675 MB	14"	FMD	fixed media drive
1980	9410	24 MB	8"	-	fixed media drive (Finch)
1980	9455	8/8 MB	8"	LSD	Cartridge/fixed media drive(Lark)
1982	9410	40 MB	8"	-	fixed media drive (Finch)
1982	9457	25/25 MB	8"	LSD	Cartridge/fixes media drive(Lark)
1982	9710	80 MB	9"	RSD	removable media drive
1982	9715	160 MB	9"	FSD	fixed media drive
1983	9715	340 MB	9"	FSD	fixed media drive
1983	9715	515 MB	9"	FSD	fixed media drive
1983	9771	800 MB	14"	XMD	fixed media drive
1985	9715	315 MB	9"	FSD	fixed media drive
1985	9720	368 MB	8"	EMD	fixed media drive (Sabre)
1985	9772	850 MB	14"	XMD	fixed media drive
1987	9720	500 MB	8"	EMD	fixed media drive (Sabre)
1987	9720	736 MB	8"	EMD	fixed media drive (Sabre)
1987	9720	850 MB	8"	EMD	fixed media drive (Sabre)
1988	9720	1230 MB	8"	EMD	fixed media drive (Sabre)
1988	9773	1360 MB	14"	XMD	fixed media drive
1989	9720	2500 MB	8"	EMD	fixed media drive (Sabre)

Source: http://bitsavers.trailing-edge.com/pdf/cdc/discs/CDC_Drive_Models.txt

The original 9760 / 9762 SMD drives, which initiated such a broad range of products, included several technical innovations.

1. A lightweight mechanics set that allowed a self-contained removable pack disk drive to fit into a 10.5-inch height.
2. The SMD unipad head, with spoiler holes, in order to get the stability needed for close flying height without head crashes [20, 25, 26]
3. A 5-disk removable pack with a single servo track surface and 5 recording surfaces.
4. The 10Mb/s SMD dual-port interface, with an internal data separator and phase lock loop, direct track addressing, and differential transmitters and receivers.

Noel Allen designed the deck, spindle, and actuator of the mechanics set and received 7 patents [17, 20]. The deck itself only weighed 7.5 pounds and had a flexural frequency of 356 Hz.

Harold Beecroft designed the SMD head and received 3 patents, while Doug Hennenfent developed the SMD head manufacturing process [20, 26]. A side-by-side comparison of the 3330 and SMD heads is shown in Figure 3 [25]:

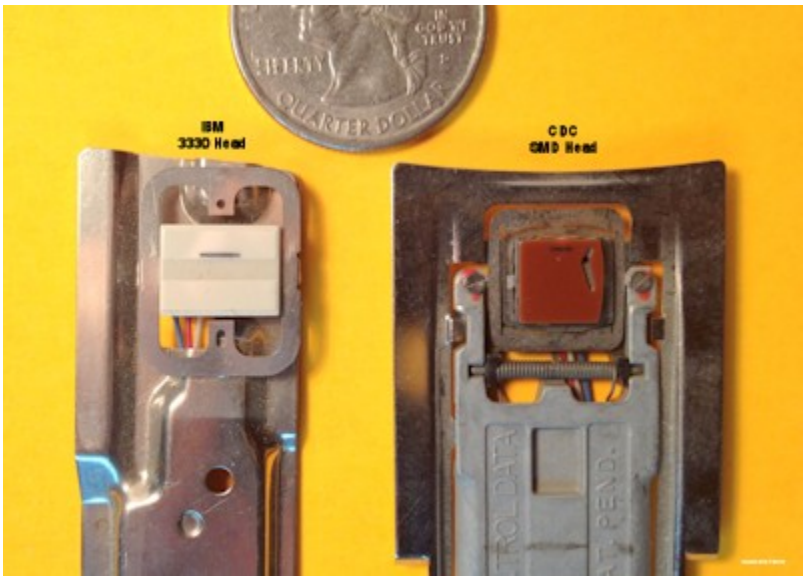

Figure 3 –IBM 3330 head (left) and CDC SMD head (right)
Source: Wetpaint - Photoshop scaled image copyright by Tom Gardner

The SMD disk pack was developed in Normandale and produced in Omaha but was also second-sourced from other media suppliers. Gary Warmka was the lead engineer and Norm Talsoe helped tweak the formulation for better S/N [17, 18, 20]. MPI had a unique capability in Normandale to develop the necessary production equipment, such as servo track writers and disk pack testers. This effort was led by Dick Yonke [17, 20].

Bruce Johnson was the lead designer of the SMD Interface, which became the first ANSI disk drive standard (X3.91M) in 1982 [17, 20]. The significance of this was that customers could easily mix and match a variety of SMD-compatible interface drives from multiple suppliers in a system. This was a key enabler of the minicomputer industry's explosive growth during the late 1970s and early 1980s. As a result, "SMD drive" initially meant a removable pack drive but it subsequently became the term to define any drive built with an SMD interface.

In summary, CDC's initial success with the SMD was based on having a 6000 BPI removable disk pack at a much lower cost than IBM's 3348 Data Module. Ultimately, however, it was the standardization of the SMD interface that enabled an extensive interface-compatible family of removable and fixed media products to be produced by over 25 suppliers, giving system OEMs the flexibility, capacity, and performance they needed to address new applications [15, 20].

Note: In 1975, CDC's disk drive operations were merged with Honeywell's disk drive operations into a jointly-held subsidiary, called Magnetic Peripherals Inc (MPI), with CDC having 70 percent ownership and all OEM sales revenue [21]. MPI was subsequently renamed Imprimis in 1988 and was acquired by Seagate in 1989 [20].

Timeline:

December 1970	Memory Module Project Kickoff
January 1971	Memory Module Proposal Generated
Jan – Dec 1971	Engineering Feasibility Studies and Technology Development
April 1972	Fixed versus Removable Media Study Initiated
Summer 1972	SMD Program Plan & $4.5M funding request approved by Tom Kamp
September 1972	SMD Specification Created
June 1973	9760 SMD announced at NCC
August 1973	First SMD 9760 Demonstration Units Shipped to Customers
November 1973	SMD 9760 Manufacturing Plan Authorized @ 200 units/month
December 1973	First SMD Preproduction Unit Shipped to Nixdorf
March 1974	Manufacturing Plan Modified to Include the SMD 9762 [80 Mbytes]
April 1974	Initiated Development of the SMD 9764/66 Drives [150/ 300 Mbytes]
June 1974	Announced 9762 at NCC
May 1975	Announced the SMD 9764 and 9766 Products at NCC
1976	Announced MMD
1977	Announced CMD (Phoenix) at Munich System 77 Show
May 1977	Delivered the 5,000th SMD to Systems Industries
1979	Announced the 675MB 9775 FMD (double capacity 3350 equivalent)
December 1979	Delivered the 50,000th SMD to Philips
August 1981	Delivered the 100,000th SMD to Datapoint
1982	SMD interface approved by ANSI as industry standard X3.91M
1983	Delivered the 100,000th CMD Drive

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