CADO 20/20 Systems
Small Business Computers

MANAGEMENT SUMMARY

CADO Systems Corporation designs, develops, manufactures, and markets microprocessor-based small business computer systems for use in data processing, word processing, and message processing applications. The company was founded in 1973 under the name Cado Computer Associates, and changed its name to CADO Systems Corporation in 1976. The first shipment of computer systems began in May 1976, and over 4500 CADO systems have been delivered to date.

The company sells most of its systems to small businesses or professional firms with $0.5-$10.0 million in annual sales. CADO markets its computer systems exclusively through distributors worldwide. The company's distributors offer complete "turnkey" service to users of CADO products. The services include application analysis, customized programming, systems installation, and training. Hardware maintenance is typically provided by the distributor under contracts with the end-user.

In 1976, CADO first entered the data processing field with the Database 40 System. The Database 40 was an 8080 microprocessor-based system marketed as a data entry device. The system supported a single terminal, the Teletype Dataspeed 40. The system was later upgraded to accept more generalized business processing applications. The upgraded Database 40 system was followed by the System 20/IV and 40/IV for multiple-terminal business processing applications and augmented communications facilities.

The CADO 20/20 Systems family consists of the single-station, multi-tasking 20/21 or C.A.T. terminal, the 20/22, and the multi-station, multi-tasking 20/24 and the 20/28. These systems can be used for data processing, word processing, and message processing applications. Remote communications capabilities are available with the 20/24 and 20/28 models. Each system employs an Intel 8085A microprocessor.

MAIN MEMORY: 32K to 96K bytes RAM

DISK CAPACITY: Up to 76 megabytes

WORKSTATIONS: Up to 8

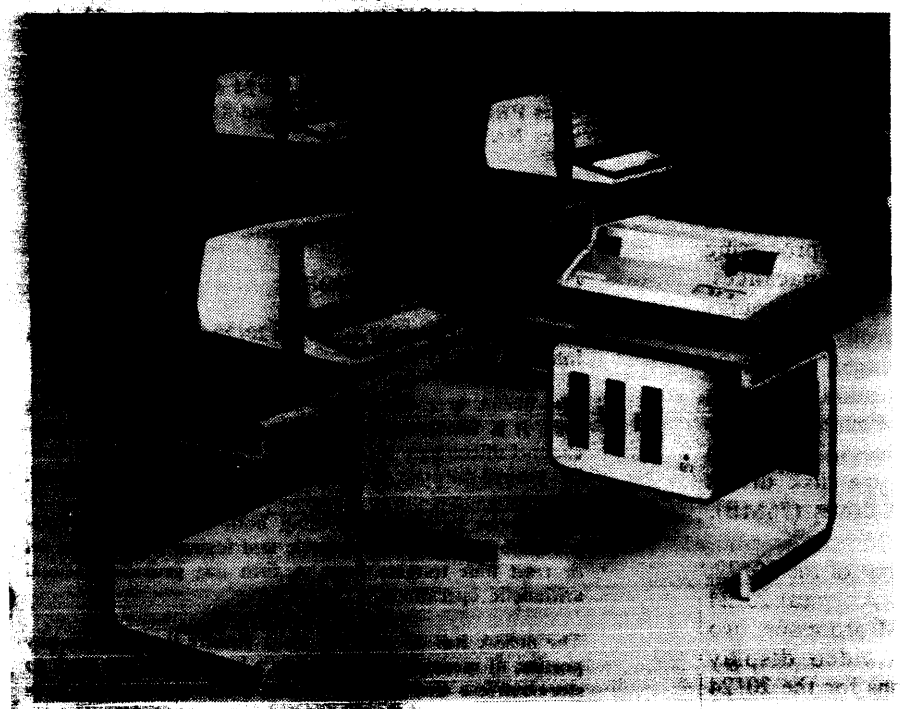
PRINTERS: Up to 300 lpm

OTHER I/O: RS-232-C devices

CHARACTERISTICS

MANUFACTURER: CADO Systems Corporation, 2771 Toledo Street, Torrance, California 90503. Telephone (213) 320-9660.

DISTRIBUTORS: All CADO hardware and software is available for purchase or lease-purchase from more than 160 authorized agents throughout the U.S. and the world. In addition to the hardware, each distributor has access to a library of over 150 various application programs. Lease-purchase agreements, based on the current money market,



The 20/24 represents one of the multi-station, multi-tasking systems of the 20/20 Systems family. One of many possible configurations (shown here) includes three terminals, a 100-cps printer, and a cabinet housing three floppy disk drives and the 8085A microprocessor.

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In May 1980, CADO introduced its latest addition to the CADO family, the 20/20 Systems. The 20/20 Systems include the CADO C.A.T. (20/21), the 20/22, the 20/24, and the 20/28. The 20/21 and the 20/28 represent the newest members of the CADO family of small business computers. The 20/22 and the 20/24 differ from the 20/II and the 20/IV systems only in cabinet design, which the vendor refers to as the "Office of the Future" look.

The CADO C.A.T. (Computer-Aided Tutor) (20/21) is a single-user, multi-tasking system designed for small businesses and first-time computer users. The 20/21 contains an Intel 8085A microprocessor with 32K bytes of RAM (random-access memory). The basic 20/21 configuration includes an integrated display with a keyboard, a printer, two diskette drives, five financial accounting software packages, a document-oriented word processing program, the Just Ask II inquiry and report generation system, and seven tutorial diskettes with manuals.

Tutorial programs, available for all of the 20/20 Systems, display fundamental information on the terminal's CRT screen, step-by-step instructions, and questions used to teach the operator, which must be answered correctly for the tutorial program to continue. C.A.T. tutorial programs include General Ledger, Accounts Payable, Direct Billing/Accounts Receivable, Payroll, Inventory Management, Word Processing, and the Just Ask II Inquiry/Report System.

Just Ask II is a high-speed English language management/inquiry system which enables the user to create his own management reports. The system provides information from the user's data files, sorts and totals information as requested, inserts specific information from data files into word processing correspondents, and creates bar charts that specifically display information from the user's data base.

In addition to having what the vendor refers to as the "Office of the Future" look, the 20/22 has an increased minimum memory configuration of 32K bytes, 16K bytes more that its predecessor, the 20/II. The 20/22 is a two-port, multi-tasking system supporting a terminal and a printer. It also supports Just Ask II, the word processing packages, and nine financial accounting packages, including Sales Accounting, Accounts Payable, Accounts Receivable, Inventory Management, Payroll, Purchasing, Direct Billing, Job Cost, and General Ledger. The 20/22 can employ data storage medium for additional data storage capacities. The 20/22 can be configured with two or three single- or dual-sided diskette drives (a maximum of 3.6MB), up to four Winchester-type disk drives (52MB), and up to four cartridge disk drives (76MB).

The 20/24 configuration is similar to that of the 20/22, but with four I/O ports instead of two. A typical 20/24 configuration includes a 32K-byte RAM processor, two dual-sided floppy disk drives, two video display terminals, and a 100-cps printer. Options for the 20/24 include a 48K-byte RAM processor, a Winchester-type are arranged through a third-party lending institution. CADO distributors also provide all hardware and software support for the 20/20 Systems.

MODELS: System 20/21 (C.A.T.), System 20/22, System 20/24, and System 20/28.

DATE OF ANNOUNCEMENT: The CADO C.A.T. (20/21) and the 20/28 were introduced in May 1980. The 20/22 and the 20/24 are enhancements of the 20/II and 20/IV systems which were first announced in 1978.

DATE OF FIRST DELIVERY: July 1980 for the entire line of 20/20 systems.

NUMBER INSTALLED TO DATE: 4500 (all models).

DATA FORMATS

BASIC UNIT: 8-bit byte.

FIXED-POINT OPERANDS: All arithmetic functions are in fixed-point, binary integer form with 6-byte (47 bits plus sign) precision.

FLOATING-POINT OPERANDS: None.

INSTRUCTIONS: Program instructions are one, two or three bytes (8, 16 or 24 bits) in length. Multiple-byte instructions must be stored in successive locations; the address of the first byte is always used as the address of the instruction. The exact instruction format depends on the particular operation to be executed.

INTERNAL CODE: Binary.

MAIN STORAGE

TYPE: NMOS.

CYCLE TIME: 1.3 microseconds for each 20/20 System.

CAPACITY: The minimum main storage capacity for the 20/21, the 20/22, and the 20/24 is 4K bytes of PROM and 32K bytes of RAM. The minimum capacity of the 20/28 is 8K bytes of PROM and 64K bytes of RAM (two 32K-byte RAM processors). Although the memory capacities of the 20/21 and the 20/22 are not expandable, the maximum main storage capacities of the 20/24 and the 20/28 are 4K bytes PROM/48K bytes RAM and 8K bytes PROM/96K bytes RAM, respectively.

PARITY CHECKING: None.

STORAGE PROTECTION: None.

CENTRAL PROCESSOR

GENERAL: The entire line of the 20/20 Systems employs an Intel 8085A CPU.

The 8085A is a complete 8-bit parallel central processing unit. It is fabricated on a single LSI chip using Intel's n-channel silicon gate MOS process. The 8085A contains six 8-bit general-purpose working registers and an accumulator. The six general-purpose registers may be addressed individually or in pairs, providing both single- and double-precision operators. Arithmetic and logical instructions set or reset four testable flags. A fifth flag provides decimal arithmetic operations.

The 8085A has an external stack feature that enables any portion of memory to be used as a last-in/first-out stack to store/retrieve the contents of the accumulator, flags, program counter, and the six general-purpose registers. The 16-

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION/SPEED	MANUFACTURER
TERMINALS		
DM10	CRT/keyboard, 96-character ASCII, 32 control characters, 8 x 8 dot matrix, 24 lines, 80 characters per line, transmission rates from 110 to 19,200 bps	Beehive International
DM1A	Same as DM10 with the addition of an auxiliary port for a buffered bidirectional printer, 12 programmable function keys, and full cursor control	Beehive International
OWL-1200	CRT/keyboard only, 96-character ASCII, 32 control characters, 9 x 12 dot matrix, 24 lines, 80 characters per line, transmission rates from 75 to 9600 bps	Perkin-Elmer
4030-5GFO	CRT/keyboard, 96-character ASCII, 32 control characters, 7 x 9 dot matrix, 24 lines, 80 characters per line	Teletype 40/2 GFO
—	CRT/keyboard, 96-character ASCII, 32 control characters, 7 x 9 dot matrix, 24 lines, 80 characters per line	CADO
PRINTERS		
5515	Line printer, 96-character ASCII (128-character optional), 136 columns, 55 characters per second	NEC Information Systems
810	Serial printer, 64-character ASCII (96-character optional), 132 columns, 150 characters per second	Texas Instruments
5221	Line printer, 96-character ASCII, 136 columns (68 columns in boldface), 150 characters per second	Dataroyal Incorporated
40P202/AG	Line printer, 64-character ASCII (96-character optional), 80 columns (132 columns optional), 300 lines per minute (220 lines per minute with 132 columns)	Teletype 40

disk drive (with one dual-sided floppy disk drive for backup operations), three terminals, and a choice of a 200-lpm, a 150-cps, or a letter-quality character printer. Included with the 48K-byte RAM option is the Word Processing II package and a complete communications package.

The 20/24 is suitable for small- to medium-sized businesses with fairly heavy data processing, word processing, and/or data communications requirements. It also offers virtually unlimited potential in distributed processing: with the CADO 3270 bisynchronous protocol, up to 32 CADO systems with a minimum of 48K bytes of RAM can have access to a remote mainframe's processing power and data base.

The 20/28 is essentially two 20/24 systems that share a common data base. A typical 20/28 system configuration includes one 32K-byte RAM processor and one optional 48K-byte RAM processor, an optional Winchester-type disk drive (with one floppy disk drive for backup operations), four terminals, and a 150-cps matrix printer. This configuration includes Just Ask II, Word Processing II, and the communications packages.

A second 20/28 configuration can include two 48K-byte RAM processors, six terminals, one or two line printers, and a letter-quality character printer. The 20/28 can provide large businesses with a total information processing capability consisting of simultaneous data processing, word processing, and data communications operations.

CADO Systems Corporation, with the introduction of the 20/20 Systems, has provided businesses of all sizes the opportunity to delve into or enhance existing data processing, word processing, and message processing

bit stack pointer controls the addressing of this external stack. The stack gives the 8085A the ability to handle multiple-level priority interrupts by rapidly storing and restoring processor status. It also provides almost unlimited subroutine nesting.

Separate 16-line address and 8-line bidirectional data buses are used to facilitate interfacing to memory and I/O. Signals to control the interface to memory and I/O are provided directly by the 8085A. Ultimate control of the address and data buses resides with the "Hold" signal. It provides the ability to suspend processor operation and to force the address and data buses into a high impedance state. This permits OR-tying these buses with other controlling devices for direct memory access (DMA) or multiprocessor operations.

CONTROL STORAGE: Systems 20/21 (C.A.T.), 20/22, and 20/24 each contain 4K bytes of PROM control storage, while the 20/28 features 8K bytes of PROM.

REGISTER: There are no registers directly available to the user.

ADDRESSING: The 8085A has four different modes for addressing data stored in memory or in registers. In the direct mode, bytes 2 and 3 of the instruction contain the exact memory location of the data item. Register mode specifies the register or register-pair in which the data is located. Register-indirect mode specifies a register pair that contains the memory address where the data is located. In the immediate mode, the instruction contains the data itself, either 8- or 16-bit.

INSTRUCTION REPERTOIRE: For the 8085A, the accumulator group instructions include arithmetic and logical operators with direct, indirect, and immediate addressing modes. Move, load, and store instruction groups provide the ability to move either 8 or 16 bits of data between memory, the six working registers, and accumulator using direct, indirect, and immediate addressing modes.

The ability to branch to different portions of the program is provided with jump, jump conditional, and computed jumps. Also, the ability to call to and return from subroutines is provided both conditionally and unconditionally.

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facilities. A library of over 150 applications software packages is available from the CADO network of distributors. The tutorial programs, available with all of the 20/20 Systems, alleviate the installation fears of some companies by providing tutorial instructions for accounting applications. The 20/24 and the 20/28 provide the processing and communications capabilities required by larger businesses. The 20/20 Systems, at a relatively low cost, provide the equipment and the software that can be utilized by a wide range of users.

USER REACTION

Datapro conducted interviews with 10 CADO System 20/24 (20/IV) users randomly selected from a list of current users supplied by the vendor. The list consists of various types of businesses located throughout the United States. The interviewed users included a food store chain, an industrial shipping and supply company, a rubber company, a radio station, among others. The average length of time that the systems had been installed was approximately 13 months.

The principal application utilized by the users on their systems is the general accounting package which includes Accounts Payable, Accounts Receivable, General Ledger, Inventory, Payroll, etc. Other applications implemented within the systems are order entry, time reporting, distribution, and traffic and billing.

Among the 10 users, a total of 17 systems have been installed. Each system was reported to employ a printer, and the mass storage devices used among the 17 systems included nine Winchester-type disk drives, four floppy disk drives, and one Pertec cartridge disk drive.

The following table illustrates the ratings of the CADO System 20/24 (20/IV) issued by the contacted users:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	9	1	0	0	3.9
Reliability of mainframe	10	0	0	0	4.0
Reliability of peripherals	9	1	0	0	3.9
Maintenance service:					
Responsiveness	5	1	0	0	3.8
Effectiveness	5	1	0	0	3.8
Technical support:					
Trouble-shooting	4	2	0	0	3.7
Education	3	1	3	0	3.0
Documentation	3	3	1	1	3.0
Manufacturer's software:					
Operating system	6	4	0	0	3.6
Compilers and assemblers	4	1	1	0	3.5
Application programs	7	2	0	0	3.8
Ease of programming	3	3	2	0	3.1
Ease of conversion	3	2	0	0	3.6
Overall satisfaction	10	0	0	0	4.0

*Weighted Average on a scale of 4.0 for Excellent.

Of the 10 users interviewed by Datapro, not one could site any significant problems or disadvantages with the system. A few of the vendors did mention a few "bugs" when their systems were first installed, but they were

The Restart (or single-byte call) instruction is useful for interrupt vector operation.

Double-precision operators such as stack manipulation and double add instructions extend both the arithmetic and interrupt handling capability. The ability to increment and decrement memory, the six general registers, and the accumulator is provided, as well as extended increment and decrement instructions to operate on the register pairs and stack pointer. Further capability is provided by the ability to rotate the accumulator left or right through or around the carry bit.

Input and output may be accomplished using memory addresses as I/O ports or the directly addressed I/O provided for in the instruction set.

The following special instruction group completes the 8085A instruction set: HALT, stops processor execution; RIM, for read interrupt mask; SIM, for set interrupt mask; and DAA instructions, which provide decimal arithmetic capabilities. STC allows the carry flag to be directly set, and the CMC instruction allows it to be complemented. CMA complements the contents of the accumulator, and XCHG exchanges the contents of two 16-bit register pairs directly.

INSTRUCTION TIMINGS: The basic machine instruction time for the 20/20 Systems is 1.3 microseconds.

INTERRUPTS: The 8085A has five interrupt inputs: INTR, RST 5.5, RST 6.5, RST 7.5, and TRAP. INTR is asynchronous; therefore, a request can be generated at any time during any instruction cycle. Each of the RESTART inputs (5.5, 6.5, 7.5) has a programmable mask. TRAP is also a RESTART interrupt, except it is non-maskable.

PHYSICAL SPECIFICATIONS: The 8085A microprocessor is installed within the same cabinet as the floppy disk drives, or cartridge disk drives, or Winchester disk/floppy disk drives, depending upon the storage capacity required by the user. With the 20/20 Systems employing the floppy disk drives only, the cabinet can be mounted on the underside of the workstation's desktop surface. The mountable cabinet measures 22 inches wide, 14½ inches high, 22¾ inches deep, and weighs 120 pounds. For cartridge or Winchester disk configurations, the 8085A is housed in a stand-alone system cabinet. The stand-alone cabinet weighs 350 pounds, and measures 25¼ inches wide, 27¼ inches high, and 32 inches deep. Power requirements are 115/230 VAC, at 50/60-Hz. The ambient operating temperature is 10°C to 38°C, with a relative humidity of 20 to 80 percent.

INPUT/OUTPUT CONTROL

I/O CHANNELS: Printers and CRTs operate through programmed I/O up to a maximum of 960 bytes per second. A DMA channel transfers data to and from disk at the rate of 1 million bytes per second.

SIMULTANEOUS OPERATIONS: The multi-port models of the 20/20 Systems are the 20/22, the 20/24, and the 20/28, which include 2, 4, and 8 ports, respectively. All peripheral devices interfaced to the respective number of ports of the 20/20 Systems can be active simultaneously providing multi-tasking operations.

CONFIGURATION RULES

Maximum configuration parameters for the 20/20 Systems are as follows (specifically the 20/28):

- Up to 96K bytes of main memory,
- Up to 52 megabytes (net usable storage to customers) of Winchester-type disk storage,

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The basic configuration of the CADO C.A.T. (20/21) consists of an integrated CRT display with two floppy disk drives and a keyboard, and a printer. The CADO C.A.T., with 32K bytes of RAM, is priced at $13,990.

either expected or nothing significant according to the users. The users were generally quite pleased with their systems. Some of the descriptions of the system used by the users included "fast," "accurate," "reliable," and "very responsive." Many of the users noted that they were quite satisfied with both the hardware and software of the system. "It will do anything we want it to do," one user commented. "It's a tremendous piece of equipment for the price we payed for it."

Datapro appreciates the cooperation of these 10 CADO customers, and that of the vendor for supplying us with the list of current users.□

- Up to eight serial devices,
- Up to three floppy disk drive units,
- Up to four cartridge disk devices,
- Up to four Winchester-type disk drives, and
- Up to two line printers in simultaneous operations.

WORKSTATIONS: The 20/20 Systems models are also differentiated by the number of terminal workstations permitted within their configuration. The 20/21 (C.A.T.) features a single integrated workstation with a CRT display, a keyboard, a microprocessor (the 8085A), and two floppy disk drives. The remaining models of the 20/20 Systems employ a CADO-manufactured terminal, a Beehive International Micro Bee DM10 or DM1A (CADO Models C-101 or C-111), a Perkin-Elmer OWL-1200 (CADO Model 1210), or a Bell Systems Dataspeed 40/2 (CADO Model C-5010), which are available from CADO distributors. All of these terminals can be connected to any processor port via RS-232-C interfaces. Excluding the Bell Systems' Dataspeed 40/2 terminals, all terminals on a given system can be interconnected through the same CPU. The maximum number of ports to be used for workstation terminals for the 20/22, the 20/24, and the 20/28 is 1 port, 4 ports, and 8 ports, respectively.

Although not directly available from CADO distributors, inquiry terminals such as dumb CRTs, a KSR terminal (any hardcopy printing terminal with a keyboard), or Bell System's VuSet can be used for simple inquiries and transactions. However, special programs must be written to use these terminals.

DISK STORAGE: CADO offers four basic disk drive configurations for its 20/20 Systems. These include drives for single-sided floppy diskettes, dual-sided floppy diskettes, Winchester-type disks, and cartridge disks. The 20/21 features two integrated single-sided or dual-sided diskettes for 616K bytes to 1.2 megabytes of data storage capacity. The 20/22, 20/24, and 20/28 systems can be configured with 2 or 3 single- or dual-sided diskette drives, or up to 4 cartridge or Winchester-type disk drives for a data storage capacity ranging from 1.2 megabytes to 76 megabytes. Further details can be found under the MASS STORAGE heading.

MAGNETIC TAPE UNITS: None.

PRINTERS: As with the workstation terminals, a series of line printers, character printers, and matrix printers can be employed by the 20/20 Systems. The following printers provide the 20/20 Systems various feature options such as print speeds, print quality, character sets, and line lengths: the NEC Information Systems SPINWRITER Model 5515 Character Printer (CADO P-1000, used primarily for word processing applications), the Texas Instruments Model 810 Matrix Printer (CADO P-811), the Dataroyal Incorporated Model 5221 Matrix Printer (CADO P-150), and the Bell Systems Dataspeed 40 (CADO P-4202 or P-4212). Printer specifications are available in the PERIPHERALS/TERMINALS chart on M11-117-103. The above printers can be connected as slaves to CRTs in the following combinations:

- Bell Systems Dataspeed 40 printer to a Bell Systems Dataspeed 40/2 CRT,
- Texas Instruments 810 printer to a Perkin-Elmer OWL-1200 CRT,
- NEC 5515 printer to a Perkin-Elmer OWL 1200 CRT,
- Texas Instruments 810 Printer to a Beehive DM10 or DM1A CRT,
- NEC 5515 printer to a Beehive DM10 or DM1A CRT.

MASS STORAGE

SHUGART SA800-1: A single-sided, dual-density floppy disk unit which provides a capacity of 631,000 bytes of storage. The format is 77 tracks per surface, 32 sections per track, and 256 data bytes per sector. The average access time is 260 milliseconds, the track-to-track seek time is 8 milliseconds, and the average rotational delay is 83 milliseconds. A system containing two or three single-sided floppy disk units provides 1.2 megabytes or 1.8 megabytes of storage, respectively. The drives and their necessary controller electronics mount within the systems cabinet.

SHUGART SA850-2: The dual-sided, dual-density floppy disk unit provides a capacity of 1,261,568 bytes of storage. The format is 77 tracks per surface, 32 sectors per track, and 256 data bytes per sector. The average access time is 91 milliseconds, the track-to-track seek time is 3 milliseconds, and the average rotational delay is 83 milliseconds. A maximum configuration of three dual-sided floppy disk drives contains 3.6 megabytes of data storage.

CENTURY DATA SYSTEMS 76220-101: Up to four Winchester-type disk drives are available as an option with the 20/22, 20/24, and 20/28 systems. The Winchester-type disk drives provide from 20 megabytes gross or 13 megabytes net-storage to user (one drive) to 52 megabytes (net storage for four drives) of data storage. A single disk drive consists of a 14-inch disk platter with two recording surfaces. Four read/write heads are mounted on a single seek arm with two heads on each side of the disk platter. The average access time is 60 milliseconds, the track-to-track seek time including head settling time is 20 milliseconds, and the

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average rotational delay is 12.5 milliseconds. Since the Winchester-type disk is totally sealed and fixed, the system requires a single- or dual-sided floppy diskette for data base back-up operations. The Winchester-type and floppy disk drives, with their associated electronics, are mounted in a stand-alone system cabinet.

PERTEC D-3482: The moving-head, front-loading, cartridge disk drive, with three fixed disks and one removable cartridge, provides a total of 19 megabytes of storage. The maximum data storage capacity for a four-cartridge system is 76 megabytes. The average access time is 52 milliseconds, the track-to-track seek time including head settling time is 10 milliseconds, and the average rotational delay is 12.5 milliseconds. Cartridge disk systems require a separate electronics cabinet for mounting the drives, power supplies, and the controller.

INPUT/OUTPUT UNITS

See the PERIPHERALS/TERMINALS table on M11-117-103.

COMMUNICATIONS CONTROL

Two of the CADO 20/20 Systems are capable of supporting bisynchronous and asynchronous protocols. The 20/24 and the 20/28, with minimum main storage capacities of 48K bytes of RAM, can support both IBM-compatible communications protocols and message processing protocols. The systems are provided with an RS-232-C interface for both local and remote data communications.

The IBM-compatible CADO protocols provide either batch mode or real-time data communications capabilities. The CADO batch mode protocols can be configured to emulate an IBM 2770, 2780, 3780, or 3741. Transmission of data is conducted via Bell Systems modems (201C, 208, 209, etc.) and common carrier switched or non-switched facilities or by direct connection. Connection in a switched environment is made manually or by an auto-answer device. Half-duplex, non-transparent, point-to-point operation is supported at speeds up to 9600 bits per second. The CADO bisynchronous protocols provide the interface between a CADOL application program and the communications line. They perform the blocking and unblocking of the data, the transmission and reception, the timing, error checking, retries, line turnaround, and acknowledgement.

The CADO 3270 protocol, which emulates the IBM 3270, allows the 20/24 and 20/28 systems to interactively communicate with an IBM System/3, /360, or /370 via an IBM 3270 BSC line discipline. Up to 32 CADO 20/24 or 20/28 systems can be attached to one line. According to the vendor, the CADO 3270 does not emulate IBM's 3270 screen or buffer handling features, and is best suited for the development of new inquiry/response applications. The remaining specifications of the 3270, including the maximum data transmission rate of 9600 bps, are the same as the batch mode protocols.

The message processing (asynchronous) protocols supported by the 20/24 and 20/28 include DDD (Teletype's Direct Distance Dialing), TWX, Telex, and 8A1. DDD is a general-purpose asynchronous protocol used with the standard dial-up telephone exchange service which enables the user to communicate with a remote computer, terminal, or printer through a modem. DDD is a full-duplex, ASCII, point-to-point, primary-channel device operating at speeds up to 9600 bps. Auto-answer and reverse channel operations are supported. TWX and Telex are also asynchronous protocols used for message processing. Telex is a worldwide switched, public teleprinter system and TWX is a Western Union service similar to Telex but operated only in the United States. The CADO 8A1 protocol allows multiple terminals to communicate to the same computer over a single pair of communications lines. Maximum data transmission rates for the DDD, Telex, TWX, and 8A1 are 9600, 50, 150, and 1200 bps, respectively.

SOFTWARE

The CADO 20/20 Systems are fully programmable. The use of disk storage in conjunction with the resident operating system allows the execution of segmented application programs. The operating system is PROM-resident: CADO provides a diskette library of system programs, including those for program generation, system administration, and data communications.

CADO systems software consists of a CADOL II source editor; a CADOL II compiler; a CADOL II language interpreter; indexed, random-access, multi-file data base management systems; proprietary operating systems; and sets of utilities for program generation, program debugging, and system set-up and maintenance.

OPERATING SYSTEMS: The CADO operating systems are designed to support up to eight (20/28) independent user programs operating in a real-time operator environment. Each user program is provided with an independent 2K-byte memory partition, which contains the registers, buffers, pointers, and file set definitions allocated to a single program task. The 20/21 contains one memory partition. The 20/22, the 20/24, and the 20/28 contain two, four, and eight partitions, respectively. Program overlays selected by each of the program tasks are loaded into a program pool that is shared by all users and managed by the system. Each user program can be executed from separate program segments, or multiple user programs can be executed from a single program segment in the program pool.

Primary entry stations (CRTs) are permanently assigned to one partition each, starting at system turn-on. Other I/O devices, such as readers or printers, are connected to I/O ports but are not assigned to partitions. These devices are then available to be assigned upon program request for specific tasks.

Memory partitions that do not have CRTs assigned to them are available to accept background processing tasks. The system provides the capability for any program to initiate a background task executing without a CRT in a free partition.

All CADO systems execute user programs in an interpretive mode from function commands produced by the source language compiler. The run-time interpretive mode of the systems provides a degree of independence between user source language and individual system configuration. The function command produced by the compiler occupy one byte of program space each, and several commands also require one or more bytes of control or modification parameters. The compact command structure allows for a relatively large amount of program functionality in a small amount of program space. It also allows for a compact and efficient interpreter, since syntax errors are detected at compile time rather than at run time.

Arithmetic functions of add, subtract, multiply, and divide are performed on an eight-byte-wide arithmetic stack. Numeric variables are supported as two's-complement, fixed-point, binary integers with a maximum precision of six bytes. The use of an eight-byte arithmetic stack helps to prevent overflow conditions from occurring on intermediate results in expression evaluation.

Variable relationship conditions of less than, less than or equal, equal, not equal, greater than or equal, and greater

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than are supported between either numeric or alphanumeric variables. Mixed-mode relationships are not supported.

Data entry and printout functions are controlled by the terminal monitor, which includes the following instructions:

- Position the cursor,
- Set and clear tab stops,
- Define field characteristics,
- Display fixed or variable information,
- Accept and display keyboard input with field content and format control.

The terminal monitor also provides field editing and program control.

The entry of numeric fields is controlled by field size and decimal point format. The system allows up to 14 digits in a numeric field, with up to 7 digits to the right of the decimal point. The system automatically zero-fills to the specified decimal format if the operator terminates a numeric entry prior to completing the format. Alphanumeric field entry is controlled only by field length. Alphanumeric variables are automatically terminated by flagging the last character with a "Field End" bit. Alphanumeric variables that contain no characters are carried as a single "Null" byte.

The CADO systems are designed to operate interactively with a random-access data base stored on disk. The data base system converts the physical disk space addressing of drives, tracks, and sectors into a logical information addressing structure of files, records, and fields.

LANGUAGES: The program language for the CADO 20/20 Systems is CADOL II (Computer-Aided Document Origination Language), a high-level English-text type language combining the coding form and arithmetic functions of BASIC and the CADO-designed I/O and format control for the systems' terminals, printers, and disk drives. The I/O operations allow complete access to the data base facilities of the system, and the formatting and data entry statements are specifically designed for the data entry environment.

COMMUNICATIONS SOFTWARE: Data communications control procedures are performed under the direction of the CADO Binary Synchronous Communications package, a turnkey set of parameterized programs that provide transmission and software compatibility with IBM 2770, 2780, and 3780 terminals. The CADO BSC package is table-driven via diskette-resident tables. Multiple sets of option tables and operational sequences can be user-defined to execute a variety of similar functions for different applications.

CADO BSC operates in batch mode only in a point-to-point, half-duplex arrangement and executes data transfers between disk and line, with automatic BSC generation and checking of the transferred data in the on-line mode. All other functions, such as multiple record packing, code translation (internal CADO code is ASCII), and space compression, are performed off-line. CADO BSC assumes that all data to be transmitted is stored in communications format, just as CADO BSC stores received data.

CADO BSC maintains three files on disk: the Comm Data File, the Trace Data File, and the System Control File. The Comm File is essentially a communications buffer reserved for formatted data to be transmitted, or for received data. The Trace Data File, a user-selectable option, contains trace information for each message (transmission and reply). The System Control File contains all file information, table parameters, and control information required to operate CADO BSC. The diskette location and extent of each of these files are user-defined.

UTILITIES: CADO offers a comprehensive set of system utility programs via diskettes for the 20/20 Systems, including program generation, program debug, system set-up and maintenance, system support, and runtime diagnostics.

The program generation package includes an editor (CADOL II Source Editor) to enter and modify programs in "source" (e.g., the untranslated text that makes up the program), a directory of other source management programs, and a compiler to translate source into "object," which is in the form of an intermediate language (IL). IL can be subsequently "run" in the computer through the use of an interpreter program. The program debug utility is provided to aid in the process of getting a program to run correctly. The system set-up and maintenance program provides the following utilities: disk copy, platter (for cartridge systems only), label, data file, text file, installation, diagnostics, and system configuration. The system support program provides utilities for sort routines and a library of system utilities.

DATA BASE MANAGEMENT SYSTEM: The CADO Data Base Management System operates interactively with an indexed, random-access, multi-file data base stored on disk. It supports any number of file definitions and is allowed by the operating system to have one set of 10 files (0 through 9) open at a given time.

The CADO 20/20 Systems support both data and text files. Each data file within a CADO data base occupies an independent, contiguous storage area on disk. This storage area contains both a fixed-length search-key portion and a variable-length data portion of each record stored in the file.

Files within the data portion are defined by the File Definition utility, which provides the computation logic necessary for allocation of file size and distribution of key space versus data space on tracks used for a given file. All tracks within the storage area for a given file have the same space allocation to key storage and data storage.

The key portion of each record contains a single alphanumeric record identifier variable, a data length variable, and a data record address. The maximum length of the record identifier variable is specified at the time a file is defined and can range in length from 0 to 20 bytes. The File Definition utility adds three bytes to this specification for record length and address storage. All records within a file carry the same length record identifier. (A file with no record identifier can only be accessed sequentially.)

The CADO 20/20 Systems support two types of fields within data records: alphanumeric and numeric. Alphanumeric fields in records, or string variables in the system, are made up of ASCII-coded characters which occupy one byte per character. The alphanumeric field length is controlled by the system to restrict the amount of storage space used to one byte per character contained in the field, independent of the maximum field length. This control is effected by flagging the last character of the field with a Field End bit. There is no logical limit to the number of fields contained within a data record; however, there is a physical record length limit of 255 bytes.

Numeric fields are stored as fixed-length binary integers. Negative variables are stored in two's-complement form. Field-length is fixed and format is controlled by the programmer. As opposed to the fixed six-byte precision of numeric variables within the processor, numeric fields within data records can be controlled to have any precision from one to six bytes.

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The CADO data file can be accessed directly by the record number, randomly by the record identifier search key, and sequentially. The direct access by record number uses the file's start address and number of records per track to calculate the exact storage position on the disk for the specified record. This type of record accessing is normally used for reinsertion of a record into the data base after it has been modified or updated. The random-access method uses a random disk address generation technique based on the key to be inserted into or retrieved from the data base. The disk address generated is used as the starting address to begin a sequential search for a record. This type of record access is most commonly used for storage or retrieval of specific records in master files. Sequential processing of all records in a file is obtained by overriding the random-address generation and suppressing the compare-for-equal in the sequential search. This type of access is used for retrieval of an entire file for report generation, transaction posting, or data transmission.

Text files, which are used for word processing and message processing, are grouped into volumes. A volume can range in size from a portion of one diskette to any number of diskettes. Besides a contiguous storage area to contain the files, a volume also includes a Space Allocation Map (SAM) and a Directory. SAM keeps a record of which storage areas have been used and which are still available. The Directory lists the name of each text file and the location of the file in the data storage area. Once a volume has been created, individual text files within the volume can be accessed sequentially by name, and can be created, manipulated and deleted as needed.

APPLICATIONS SOFTWARE: Each CADO distributor has access to a library of over 150 various applications programs maintained by the vast CADO distributor network. Customized programs have been written by CADO for retailers, wholesalers, distributors, manufacturers, professional practitioners, health services, and manufacturers' representatives.

Standard application packages available from CADO include billing, accounts payable and receivable, inventory, payroll, general ledger, sales accounting, job management, purchase order writing, client write-up, dental, time reporting, and independent insurance agency management. Also included as standard or optional features for the CADO 20/20 Systems are the Just Ask II inquiry and report writing program and a word processing program.

Just Ask II is a report writer language that allows the user to create a program that will produce a customized report from a file that the user also creates. This report writer language executes on all 20/20 Systems.

The CADO Word Processing System is fully interactive. Messages are displayed on the CRT screen of the workstation terminal which prompt the operator to enter the required information. In one interactive session, the operator can create, edit, save, and print a document. Two word processing systems have been created to date. Word Processing I contains standard functions such as automatic screen scrolling, automatic line end, automatic paging, full text editing, automatic page numbering, among others. Word Processing II also includes several enhancements such as boldface type, superscript and subscript, overstrike (for accents, intended crossing out of letters, etc.), character set shift, control character display, among others.

PRICING

POLICY: All CADO hardware and software is available for purchase or lease-purchase from more than 160 authorized agents throughout the U.S. and the world. Lease-purchase agreements are arranged through a third-party lending institution. CADO distributors also provide all hardware and software support for the 20/20 Systems; however, in some areas, service is provided through special arrangements with the Teletype Corporation for the CADO equipment as well as for the Bell Systems' Dataspeed devices.

EQUIPMENT: The following are typical system prices. Final pricing of all CADO hardware and software is quoted by CADO's independent distributors.

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PACKAGED SYSTEMS			
System 20/21 (C.A.T.)	Multi-tasking processor with 32K bytes RAM; two diskette drives (1.2MB); Dataroyal 5221 matrix printer (CADO P-150); keyboard and video display; CADO C.A.T. tutorials and supplies; CADO C.A.T. financial applications software; CADO word processing features; Just Ask II report writer	$13,990	$140
System 20/22	Intel 8085A 20/22 processor with 32K bytes RAM; 3 dual-sided diskette drives (3.6MB); system console and printer stand; 1 workstation terminal with CRT; TI Model 810 matrix printer (CADO P-811)	17,330	170
System 20/24	Intel 8085A 20/24 processor with 48K bytes RAM; 3 dual-sided diskette drives (3.6MB); system console and printer stand; 2 CADO workstations; 2 CRTs; TI Model 810 matrix printer (CADO P-811); CADO word processing features; Just Ask II report writer	24,725	240
System 20/24	Same as above except with 1 dual-sided diskette drive and a 13.2MB Winchester-type disk drive	27,740	260
System 20/28	2 Intel 8085A processors featuring 96K bytes RAM; 1 dual-sided diskette drive; one 13.2MB Winchester-type disk drive; system console; 4 CADO workstations; 4 CRTs; 2 printer stands; NEC Information Systems SPINWRITER Model 5515 character printer (CADO P-1000); TI Model 810 matrix printer (CADO P-811)	45,410	435
MASS STORAGE			
SA800-1	Shugart single-sided, dual-density floppy disk drive (631,000 bytes)	1,495	NA
SA850-2	Shugart dual-sided, dual-density floppy disk drive (1.2MB)	1,995	NA
76220-101	Century Data Systems Winchester-type disk drive (13.2MB)	5,995	NA
D-3482	Pertec cartridge disk drive (19MB)	11,150	NA

*All systems include operating system software and a Just Ask II report writer.
**The 48K- and 96K-byte systems include data communications features and a word processing package.
***These prices are typical equipment prices. All final prices are distributor-dependent.