

DEC Datasystem 500 Series

MANAGEMENT SUMMARY

The DEC Datasystems are sold as enhanced, packaged configurations of standard DEC minicomputer equipment plus an operating system and appropriate program development aids such as language processors, debug tools, utilities, edit-programs, etc. These systems are designed primarily for sale either to sophisticated end users or to "systems houses." A primary characteristic of both of these marketplaces is the ability to develop their own applications software, thus reducing the amount of hand-holding support needed directly from DEC. The DEC Datasystems are not turnkey systems dedicated to specific problem solutions with pre-programmed applications. Rather, applications programs must either be developed directly by the end user or prepared for him by a systems house.

A significant streamlining of the Datasystem 500 family occurred in July 1973 when the original Model 520 (based upon the earlier PDP-11/20 minicomputer) was replaced by the new Model 530 (based upon the newer, more powerful PDP-11/40) for batch or time-shared operations. Also, the original DS-700 and 800 systems, based on the PDP-11/20 and PDP-15 systems, respectively, were replaced by Models 540 (also built on a PDP-11/40), 550, and 560. The larger DS-550 and -560 models are based on the top-of-the-line PDP-11/45. As originally announced in February 1972, the DEC Datasystem family included the DS-500 Series (Model 520) ➤

One of the most flexible small-to-medium-scale business computer families available today, the DS-500 line includes four current models based upon DEC's two most powerful 16-bit minicomputers and any of three operating systems designed for interactive time-sharing or medium-scale data base processing environments.

CHARACTERISTICS

MANUFACTURER: Digital Equipment Corporation, 146 Main Street, Maynard, Massachusetts 01754. Telephone (617) 897-5111.

MODELS: DEC Datasystem 500 Models 530 and 540 (based on PDP-11/40), and Models 550 and 560 (based on PDP-11/45).

DATA FORMATS

BASIC UNIT: 16-bit word plus 1 parity bit. The DS-500 systems can also handle 8-bit bytes and are capable of bit manipulation.

FIXED-POINT OPERANDS: 16-bit words or 8-bit bytes are used as operands in both single- and double-operand instructions. Bit manipulation is provided through Boolean AND/OR instructions. ➤



A typical single-user, interactive Datasystem 530 configuration is shown here. Based on DEC's powerful PDP-11/40, this system adapts well to small-business EDP environments. This particular configuration includes, from left to right, a 45-ips TU10D magnetic tape unit, 4.8 million bytes of storage provided by 2 RK05 disk drives, a PDP-11/40 central processor with 16,384 words of 1-microsecond main memory, a VT05 CRT display terminal, and a 132-position LS-11 dot matrix printer.

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▷ for batch operations, the DS-700 Series for 16- or 32-user time-sharing, and the DS-800 Series for processing data bases with up to 10 million bytes.

Thus, the current DEC Datasystem 500 lineup includes the Model 530 batch or time-shared system for small-scale users, and the 540, 550, and 560 systems that can be used for heftier batch operations, for time-sharing with as many as 32 users, and for data base processing of 320-million-byte (or smaller) data bases.

What distinguishes the DEC Datasystems from configurations that are otherwise available from DEC on a piecemeal basis is that the components in the DEC Datasystems are physically packaged into special consoles, desks, and other functional office furniture, and that several modifications to the basic PDP-11 CPU and its configuration rules have been made.

The new 16K-word core stack memory for the DS-500's has a 1.0-microsecond cycle time, parity is standard (instead of optional), no bipolar semiconductor memory is available, and the RS64 disk is not available, nor are the DC08, DN11, and DR11 communication systems.

Human engineering features and additional customer support services are also included in the DEC Datasystems package, such as delivery, installation, and shake-down of operations under the user's choice of operating system. On as nearly a direct comparison basis as possible, packaged DS-500's tend to cost more than the separately purchased DEC components, but this increase is generally well worth the price for low-volume systems houses or for sophisticated end users (considering both the system packaging and the higher throughput via faster core memory).

The basic marketing strategy for DEC's DS-500 line is to promote the systems as alternatives to centralized computing facilities in large or geographically dispersed companies that have remote sites with either localized time-sharing requirements, numerous small-to-medium-scale data bases, or medium-sized batch processing requirements. A DS-500 system can also be considered as a centralized computing facility on its own merit for medium-sized companies or for divisions of larger companies.

Although the DS-500's are not marketed directly against installed IBM equipment, the DEC RPG language is largely compatible with RPG II on the IBM 1130, 360/20, and System/3. Whether planned or not, DEC often does encounter competition from these systems, as well as from the Burroughs B 1700, the Honeywell Model 58, 2020, or 62/60, the Singer System Ten, and the NCR Century 50 or 100. In this highly competitive market area, the relatively low cost and high performance of the DS-500's have earned DEC a modest ▷

▶ **FLOATING-POINT OPERANDS:** Optional 32-bit single-precision operands with an 8-bit exponent and signed 24-bit fraction on the 530 and 540; and 64-bit double-precision operands with an 8-bit exponent and signed 56-bit fraction on the 550 and 560. Single-precision hardware is available on the 530 and 540, while single- and double-precision hardware is available for Models 550 and 560. Floating-point software subroutines are also available for all models.

INSTRUCTIONS: One-, two-, or three-word instructions. Seventy-five standard instructions and four optional instructions are provided on Models 530 and 540; 80 instructions are standard on Models 550 and 560. Decimal instructions are available with the CTS/E 500 operating system.

Addressing is done to the byte level through 16-bit internal registers, allowing addressing of up to 64KB. (The upper 8KB is reserved for I/O registers.) A memory management option is required to address larger main storage.

Eight address modes are provided with each operand address, consisting of three bits to specify address mode and three bits to specify the register used to calculate the address. The modes consist of "Register" (operand in register), "Register Indirect" (operand address in register), "Auto Increment/Decrement Indirect" (self-incrementing/decrementing register which points to an address in memory), "Indexed", and "Indexed Indirect".

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: Magnetic core or MOS, depending on model (see CAPACITY, below).

CYCLE TIME: 1.0 microsecond per word for core, and 450 nanoseconds per word for MOS.

CAPACITY: 32K to 56K bytes of core memory for Model 530 and up to 224K bytes for Models 540 and larger in increments of 32KB (the highest 8KB of address space is reserved for I/O device registers). For Models 550 and 560, a combination of core and MOS memory is available up to 256K bytes. The Model 560 has all semiconductor (MOS) memory for the basic 32KB, with up to 224KB being available with the addition of extra core.

Note that 8KB of main memory in all systems is typically reserved for I/O device registers.

CHECKING: Parity bit is standard with each word.

STORAGE PROTECTION: Hardware memory protection is standard in systems larger than 56K words.

CENTRAL PROCESSORS

GENERAL: The DS-530 and 540 systems offer TTL logic to optimize performance with core memory. The top-of-the-line Models 550 and 560 use Shottky logic, multilayer PC boards, an additional bus, etc., to optimize performance with fast semiconductor memory.

REGISTERS: DS-500's have eight user-accessible 16-bit registers (six general-purpose, one stack pointer, and one program counter), and one 16-bit processor status register. The general-purpose registers can be used as ▶

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▷ but growing share of the small business computer marketplace, with about 300 systems installed as of July 1974.

The steadily increasing number of systems houses using DS-500's (as well as equipment from other vendors) in applications-oriented turnkey systems presents an interesting and attractive alternative to the do-it-yourself programming approach for end users. Prospective small business computer users can expect to find the DS-500's sold under a wide variety of third-party names as time goes on, and users are well advised to give serious consideration not only to the DS-500 basic packages as available directly from DEC, but also to the availability of turnkey packages from non-DEC sources. □

► index registers, hardware stack pointers, or accumulators. In Models 530 and 540, there are two stack pointers (kernel and user modes), while Models 550 and 560 have three stack pointers (kernel, user, and supervisor modes), plus a full duplicate set of general-purpose registers.

INDIRECT ADDRESSING: Standard for all models.

INSTRUCTION REPERTOIRE: All DS-500 processors have 16 arithmetic, 21 branch, 7 trap and interrupt, 19 data manipulation, and 7 logic instructions. Optional floating-point instructions are also available.

INSTRUCTION TIMINGS: All times are for full-word, fixed-point operands, in microseconds.

Instruction	Models 530, 540		Models 550, 560	
			Core	MOS
Load/Store:	2.42/2.24	1.84	1.01	
Add/Subtract:	2.66/2.80	1.84	1.01	
Multiply/Divide:	9.66/11.30	4.68/8.58	3.86/7.76	
Compare and Branch:	2.75	2.03	1.35	

INTERRUPTS: Four-level automatic priority interrupt system, plus seven additional software-supported levels of interrupts for all models. Each of the interrupt levels can attach multiple, independently prioritized peripheral devices.

VIRTUAL ADDRESSING: The DS-500's can access up to 256KB of main memory in 64KB segments through one or two sets of eight address translation registers (150 nanoseconds per address translation) and an 18-bit Unibus interface. Two or more sets of length registers are used to delineate the bounds of addressability for individual programs, and these, together with associated status registers, give memory protection for multiprogramming.

PROCESSOR MODES: With memory management, Models 530 and 540 operate in either a "kernel" or a "user" mode, where the user mode restricts programs from modifying key machine states relating to memory mapping and protection. Models 550 and 560 with memory management have three modes: kernel, user, or supervisor. The supervisor mode is intended to facilitate multiprogramming by providing a control program state for more efficient system management.

STACK ORGANIZATION: All models have an instruction stack capability to facilitate the implementation of

shareable (re-entrant) routines. The size of the pushdown stacks is limited only by the size of available memory.

INPUT/OUTPUT CONTROL

UNIBUS: The DS-500 Models 530 and 540 have a single-column Unibus that treats all components or modules of a system as equal-level devices for data access/transfers, including the processor, memory modules, and peripherals. Models 550 and 560 have two of these plus a special dedicated bus. The priority of any device connected to the busses is determined by its physical position, and the processor is normally attached so that it has the highest priority.

There is no logical limit to the number of device attachments that can be made to the Unibus, with bus access and control handled by the interrupt system. The maximum Unibus data transfer rate is 2.5 million words/second, and it always operates in a master/slave manner. On Models 550 and 560, a high-speed memory bus is provided to permit the execution of programs from high-speed semiconductor memory at up to eight million words per second without overloading the Unibus capacity.

CONFIGURATION RULES: In general, each device that ties into the Unibus imposes a single "bus load," although the CPU and the multi-device bulk storage bootstrap loader impose two bus loads each. The Unibus can support 19 bus loads before a Bus Repeater must be added.

All DS-500 models are supplied with sufficient cabinets, mounting chassis, power supplies, and Bus Repeaters to enable the maximum configuration to be implemented without difficulty. The DS-530 processor is in one cabinet and will support up to 56KB of core, any of six peripheral device combinations, and up to four communications lines.

Models 540, 550, and 560 processors include an expander cabinet and will accommodate up to 224KB of main memory, any of six peripheral device combinations, and up to four communications lines.

In DS-500 systems requiring 5 to 32 lines for communications, a separate cabinet is supplied for this purpose.

SIMULTANEOUS OPERATIONS: Overlapped instruction execution and memory access is provided. Individual blocks of 16KB can be independently interleaved on Models 550 and 560.

MASS STORAGE

RS11 FIXED-HEAD DISK: Stores up to 512KB per drive with an average access time of 16.9 milliseconds and a data transfer rate of 125KB/second. Up to eight RS11's can be attached to the controller.

RK05 DECPACK REMOVABLE DISK CARTRIDGE SYSTEM: This removable disk cartridge system stores up to 2.4 million bytes per drive with an average access time (including head movement) of 70 milliseconds and a data transfer rate of 180.5KB/second. Up to eight RK05's can be attached to the controller.

RP03 MOVING-HEAD DISK: Stores up to 40 million bytes per drive with an average access time (including head movement) of 29 milliseconds and a data transfer

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► rate of 266.6KB/second. Up to eight RP03's can be attached to the controller. Each drive has its own free-standing cabinet.

INPUT/OUTPUT UNITS

TU10D MAGNETIC TAPE SYSTEM: Available in 7- and 9-track industry-compatible NRZI versions, which record on 1/2-inch tape. The transport is single-capstan with vacuum columns; the read/write heads are the dual-gap, read-after-write type. Tape speed is 45 ips, and maximum data transfer rate is 36,000 characters per second. Program-selectable recording densities of 200, 556, and 800 bpi are available with the 7-track model, while a standard 800 bpi is offered in the 9-track model.

PC05 PAPER TAPE READER/PUNCH: Reads ASCII-formatted, 8-channel, uncoiled, fan-fold paper tape at the rate of 300 characters per second, and punches 5-, 6-, 7-, or 8-channel paper tape at 50 characters per second. The reader and punch can be independently operated under direct program control.

CR11 CARD READER: Reads 80-column, Hollerith-coded cards at a maximum speed of 300 cards per minute under program control. The input and output hoppers have a capacity of 500 cards of 0.007-inch thickness. The reader is a table-top unit and has a vacuum card pick mechanism.

LS11 LINE PRINTER: Prints 132 positions at the rate of 165 characters per second or 60 lines per minute. Characters are formed by a 5-by-7 dot matrix with capabilities for printing expanded (oversized) characters. Character and line spacings are 10 characters per inch and 6 lines per inch, respectively. Additional features include vertical forms control, pinfeed forms handling, multiple copies (up to five parts with single-shot carbon), and accommodation for variable paper widths up to 14-7/8 inches by using adjustable tractors.

LP11-VA LINE PRINTER: Prints 132 positions at the rate of 300 lines per minute. The printer is a buffered, impact-type unit with a revolving character drum and hammer for each column. It prints from a 64-character set using the IBM 1403 print font and ASCII code format. The pin-feed tractors are adjustable for handling fan-fold paper from 4 to 9-7/8 inches in width.

LP11-WA LINE PRINTER: Same as the LP11-VA, above, except it uses a 96-character set and prints both upper and lower case characters at 230 lines per minute.

LA30 DECWRITER: The DECwriter I/O terminal provides asynchronous electromechanical impact printing at a rate of up to 30 characters per second from a 64-character print set. Each character is formed in a 5-by-7 dot matrix by a vertical row of 7 spring-loaded pins in a movable head. A standard 9-7/8-inch continuous forms tractor advances 1- or 2-part paper for printing at 6 lines per inch. Characters are printed at a horizontal pitch of 10 characters per inch, and 80 print positions are provided. As a data entry device, the DECwriter has either a 96- or 128-character keyboard for ASCII code.

VT05 ALPHANUMERIC DISPLAY TERMINAL: This solid-state CRT terminal, built by DEC, provides a buffered 10-1/8" by 7-5/8" display of twenty 72-character lines, for a total of 1,440 characters per display. Displayable uppercase ASCII characters are generated in a 2240-bit read-only memory. Each character is represented

with a 5-by-7 dot matrix. The 9816-bit refresh buffer regenerates the display 60 times per second. The 64-character-set keyboard is supported by a non-destructive, blinking cursor and erase controls. The alphanumeric character set can be superimposed on a background video image derived from a closed-circuit TV or video player. The VT05 is Teletype-compatible and communicates in half- or full-duplex mode over standard telephone lines, using data sets, at rates up to 2400 bps.

COMMUNICATIONS CONTROL

TYPE I SUBSYSTEM: Allows 1 to 4 asynchronous communications lines (DS5C3, -4, -5) to be added to the processor cabinet.

TYPE II SUBSYSTEM: A programmable multiplexor that allows 1 to 32 asynchronous communications lines.

DS5C3 SINGLE LINE UNIT: Single, asynchronous line, with speed and code set by switches: 10, 30, and 240 bps available; for local device connection.

DS5C4 SINGLE LINE UNIT: Single-line, asynchronous, with EIA interface for modem connection to remote terminal. Speed and code set by switches: 110, 150, and 300 bps available.

DS5C5 PROGRAMMABLE LINE UNIT: Asynchronous single-line unit with EIA interface for modem connection to remote terminals. Speed and code are set under software control to adapt to incoming calls from terminals at different speeds: 110, 150, or 300 bps.

SOFTWARE

OPERATING SYSTEMS: Three different operating systems are available for any of the DS-500 models. Each is provided with an appropriate level of program development and utility system support.

COMMERCIAL OPERATING SYSTEM: COS-500 is a disk-based, batch-oriented system that offers program development support for RPG II (compatible with IBM System/3 and Burroughs B 700 and B 1700), a Macro Assembler, and FORTRAN IV (compatible with IBM 1130), as well as program development aids for on-line debugging (ODT), RPG trace, general-purpose editing (EDIT-II), and non-DEC RPG conversion aids.

COS-500 runs on a 64KB system with two disk drives, a card reader, operator console, and line printer. COS-500 systems were first delivered in July 1972.

COMMERCIAL DATA MANAGEMENT SYSTEM: CDMS-500 is a data management system based upon MUMPS-11 (Massachusetts General Hospital Multi-Programming System) and is designed to support 1 to 32 active users with a data base of up to 320 million bytes. CDMS-500 supports variable-length data strings stored without preformatting in a hierarchical storage structure where frequently used data is optimally placed. Program development support for the MUMPS high-level Interpretive language is also provided. A powerful sort program (System/3-compatible) is also provided.

The minimum DS-500 system required for CDMS-500 is a 32KB processor with one disk drive. An 8-user configuration requires a 64KB main memory, two or more disk drives, an industry-compatible magnetic tape drive, and a line printer. CDMS-500 systems were first delivered in August 1973. ►

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► **COMMERCIAL TIME-SHARING SYSTEM:** CTS/E-500 is an outgrowth of DEC's Resource Time Sharing System (RSTS) and its extended (RSTS-E) version. CTS/E-500 can support up to 32 concurrent users (depending upon processing demands) on a Model 540, 550, or 560 system, or 8 concurrent users on a Model 540, 550, or 560 system, or 8 concurrent users on a Model 530 system (up to about 6 if heavy usage is expected). Program development support for BASIC-PLUS is provided by CTS/E-500. The minimum configuration consists of a 96KB DS-500 system, two disks, and a line printer. A powerful sort program (System/3-compatible) is also provided. CTS/E-500 systems were first delivered in February 1972.

PROGRAMMING: Under COS-500, RPG II is the most popular language. Under CDMS-500, the MUMPS interpretive language is used, and with CTS/E-500, BASIC-PLUS is used.

APPLICATIONS: All applications must be developed either by the user or by a systems house. DEC does not directly provide applications such as payroll, etc.

PRICING

EQUIPMENT: The following typical purchase prices include controllers, adapters, and software.

FOUR-USER TIME-SHARING DEC DATASYSTEM 540: Consists of a 96KB PDP-11/40 CPU operating under CTS/E, LA30 DECwriter, a 4.8MB DECpack disk storage, 60-lpm printer, four CRT's, and four-line data communications interface. Purchase price is \$86,453.

TWELVE-USER TIME-SHARING DEC DATASYSTEM 540: Consists of a 128KB PDP-11/40 CPU operating under CTS/E, LA30 DECwriter, 512KB swapping disk, 7.2MB DECpack disk storage, 9-track magnetic tape unit, four CRT's, teletype, and 10-line data communications interface. Purchase price is \$142,424.

FOUR-USER DATA MANAGEMENT DATASYSTEM 540: Consists of 56KB PDP-11/40 CPU operating under CDMS, LA30 DECwriter, 40MB DECpack disk storage, 9-track magnetic tape unit, 300-lpm printer, four CRT's, and four-line data communications interface. Purchase price is \$108,179.

SOFTWARE: One operating system is provided with each DS-500 at no additional charge. COS-500 is available separately for \$6,500, CDMS-500 for \$10,000, and CTS/E-500 for \$6,500.

SUPPORT: Separately priced hardware maintenance by DEC is available through a field support force of more than 1,000 personnel. Purchase of a DS-500 includes full installation/setup of the hardware and desired operating system.

CONTRACT TERMS: The DS-500 models are available for purchase or on third-party full-payout leases for one-, three-, and five-year terms (arranged by DEC through Digital Leasing, a subsidiary of U.S. Leasing Corporation). Five-year terms, for instance, are available for a monthly payment of 2.2% of the purchase price. ■

EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
DATASYSTEM 500 BASIC SYSTEMS			
DS53	DS 530, includes PDP-11/40 processor, 16K words, LA 30 console	\$22,380	\$175
DS54	DS 540, includes PDP-11/40 processor, 16K words, extended instruction set, LA 30 console	28,000	224
DS55	DS 550, includes PDP-11/45 processor, 16K words, LA 30 console	38,395	303
DS56	DS 560, includes PDP-11/45 processor, 16K words, LA 30 console	47,195	507
MEMORY/PROCESSOR OPTIONS			
DS5-C	56KB Total Memory	6,160	35
DS5-D	64KB Total Memory	8,888	35
DS5-F	96KB Total Memory	15,818	70
DS5-H	128KB Total Memory	21,978	105
DS5-K	160KB Total Memory	28,908	140
DS5-M	144KB Total Memory	35,068	175
KS5-P	224KB Total Memory	41,998	210
FP11-B	Floating Point Processor for DDS 550, DDS 560	5,290	59
MASS STORAGE (TAPE AND DISK)			
RS11	Disk Drive, 512KB/disk	9,900	56
RK05	DECpack Disk Cartridge, 2.4MB/disk	5,335	84
RP03	Disk Drive, 40MB/disk	20,000	210
RK05-K	Cartridge for RK05	99	0
30-09589-02	Cartridge for RP03	295	0

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		<u>Purchase Price</u>	<u>Monthly Maint.</u>
MASS STORAGE (TAPE AND DISK) (Cont.)			
DS5X1	Controller for 8 RK05's	\$ 6,490	\$ 56
DS5X2	Controller for 8 RK05's and 8 TU10's	10,055	91
DS5X3	Controller for 8 RS11's and 8 RK05's	12,430	91
DS5X4	Controller for 8 RP03's and 8 TU10's	16,630	133
DS5X5	Controller for 8 RS11's and 8 TU10's	22,570	168
DS5X6	Controller for 8 RS11's, 8 RK05's and 8 TU10's	15,995	126
TU10D	Industry-compatible Magnetic Tape Drive, 45 ips, 36 KBS	8,250	98
LINE PRINTERS			
LS11	Printer, 64-character, 60 lpm	5,915	67
LP11-VA	Printer, 64-character, 300 lpm	9,900	165
LP11-WA	Printer, 96-character, 230 lpm	11,900	112
CARD EQUIPMENT			
CR11	Reader, 30 cpm	4,860	70
TERMINALS			
LA30	DECwriter, 30 cps	3,195	42
LT33	Keyboard Printer	1,275	35
VT05B-A	CRT (Local), 1440 characters	2,795	31
VT05B-B	CRT (Remote), 1440 characters	2,870	31
COMMUNICATIONS			
DS5C1	Communications Subsystem Type I	204	0
DS5C3-AA	Local asynchronous line unit for LT33	470	8
DS5C3-AE	Line unit for local 30-cps LA30 or VT05	470	8
DS5C3-AN	Line unit for local 240-cps VT05	470	8
DS5C4-AA	EIA line unit for 110-baud, 11-unit terminal	495	8
DS5C4-AD	EIA line unit for 150-baud, 10-unit terminal	495	8
DS5C4-AE	EIA line unit for remote 30 cps LA30, or VT05, or equal 300-baud, 10-unit code	495	8
DS5C5-AA	EIA remote; 4-line modem control; expandable to 8 lines	2,370	32
DS5C5-AB	EIA remote; 8-line modem control; expandable to 12 lines	3,316	39
DS5C5-AC	EIA remote; 12-line modem control; expandable to 16 lines	4,262	46
DS5C5-AD	EIA remote; 16-line modem control	5,208	53
DS5C5-AE	Line adapter; 4 lines EIA	533	14
DS5C5-AF	Line adapter; 4 lines, 2 mA (current loop), TTY, LA30, VT05	187	7
DS5C5-AG	Line adapter; 4 lines, EIA/CCITT with control; used for expansion of DS5C5-AA, -AB, and -AC	946	7
DS5C6	Communications Subsystem Type II; includes 16-line multiplexor, expandable to 32 lines	6,715	56
DS5C7	16-line multiplexor expander	6,620	63

SOFTWARE PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
DS5X-XJ	CTS/E	\$ 6,500	\$ 0
DS5X-XL	CDMS	10,000	0
DS5X-XT	COS and CDMS	13,500	0
DS5X-XY	COS and CTS/E	10,250	0