

DEC Datasystem 320 and 350 Series

MANAGEMENT SUMMARY

With the November 1976 announcement of the new DEC Datasystem Models 322 and 324, due for delivery in March 1977, Digital has closed the gaps that existed in the earlier Datasystem family. Unlike the DS-354 and 357, which use the PDP-11/34 processor, the new DS-322 and 324 are built around the LSI-11 microprocessor.

The LSI-11 technology enables Digital to put an N-channel MOS processor, 4096-word random-access memory, vectored automatic priority interrupt logic, real-time clock input, power failure/auto-restart logic, and buffered parallel 16-bit I/O port on one 8.5-by-10-inch circuit board. The PDP-11/34 offers more power by allowing users to address up to 253,952 bytes of MOS memory, and, with the CTS-300 operating system, to support up to eight terminals.

Here's a quick look at the current Datasystem 300 family members (other than the single-user Datasystem 310, which is separately covered in Report M11-385-101):

- Model 322—supports up to 4 terminals, using the LSI-11 processor with up to 56K bytes of MOS memory. Up to 4 floppy disk drives or up to 8 disk cartridge drives can be added to provide a maximum of 19 million bytes of disk cartridge storage. One dual floppy disk drive is standard. ➤

Unlike the single-user-oriented Datasystem 310, the DS-320 and DS-350 systems support up to 4 or 8 terminals in a time-sharing environment. These disk-oriented computers provide the bridge between the smaller DS-310 and the larger DS-500 family in Digital's product line. These packaged configurations are attractive to users who want to develop their own application programs using Digital's DIBOL-11 language, or to obtain software through sources other than DEC.

CHARACTERISTICS

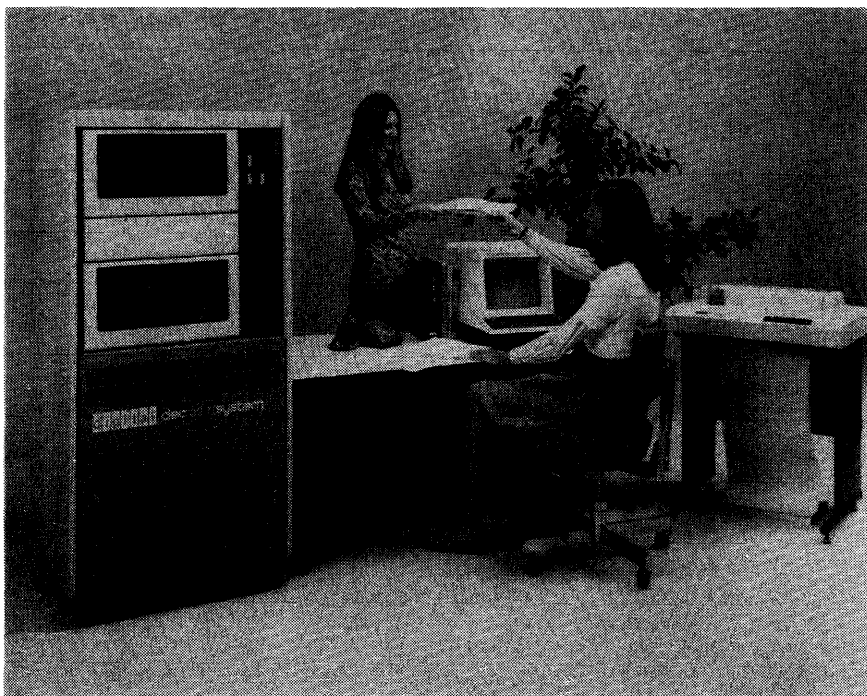
MANUFACTURER: Digital Equipment Corporation, Business Products Group, 146 Main Street, Maynard, Massachusetts 01754. Telephone (617) 897-5111.

VENDORS: Manufacturer and OEM suppliers. Contact DEC's Business Products Group to find the OEM supplier in your locale.

MODELS: DEC Datasystems 322, 324, 354, and 357. The Datasystems 322 and 324 are LSI-11-based, while the Datasystems 354 and 357 are PDP-11/34-based.

DATA FORMATS

BASIC UNIT: 16-bit word plus 2 parity bits. The processor can also handle 8-bit bytes, and is capable of bit manipulation. ➤



This typical DEC Datasystem 324 configuration consists of an LSI-11 processor with 32K bytes of MOS memory, a cabinet holding one RK-05F fixed disk on top and one RK05J removable disk on the bottom for a total of 7.2 megabytes of on-line storage, a VTS2 DECscope console, and an LA180 printer rated at 180 cps. It's all yours for \$34,000, including the CTS-300 operating system and DIBOL compiler.

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DEC DATASYSTEM 300 FAMILY

MODEL	322	324	354	357
Processor	LSI-11	LSI-11	PDP-11/34	PDP-11/34
Maximum number of terminals	4	4	8	8
Recommended number of terminals	1 to 3	1 to 3	2 to 6	2 to 6
Standard disk model	RX11 floppy	RK05	RK05	RK06
Standard disk capacity	512K bytes	7.2 million bytes	7.2 million bytes	28 million bytes
MOS memory capacity, bytes:				
Minimum	32K	32K	32K	64K
Maximum	56K	56K	248K	248K

NOTE: All models include one VT52 DECscope console, CTS-300 Operating System, DIBOL-11, and DECform software. Printers are optional and range from 30 cps to 300 lpm.

- ● Model 324—supports up to 4 terminals, using the LSI-11 processor with up to 56K bytes of MOS memory. Although 7.2 million bytes of disk storage is standard, the system can have up to 4 floppy disk drives and a maximum of 19 million bytes of disk cartridge storage.
- Model 354—supports up to 8 terminals, using the PDP-11/34 processor with a maximum of 248K bytes of MOS memory. Up to 8 disk drives can be configured for a total of 19 million bytes, although 7.2 million bytes are standard.
- Model 357—supports up to 8 terminals, using the PDP-11/34 processor with a maximum of 248K bytes of MOS memory. Up to 8 disk drives can be configured for a total of 112 million bytes, although 2 RK06 drives are standard for a total of 28 million bytes.

The DS-354 and 357 models have been around since July 1975, and at least 1200 have been installed to date. Deliveries of the DS-322 and 324 models are scheduled to start in mid-March of 1977, and there are already 100 or so on order, according to DEC.

Growth has been cited as the main advantage in the DEC Datasystem product line. These computers are directed toward "Fortune 1000" companies that can effectively utilize small, multi-user computer systems at multiple remote installations to implement distributed data processing, as well as toward "turnkey" operations that might be looking for packaged configurations.

DIBOL-11, DEC's own COBOL-like programming language, provides the compatibility throughout the Datasystem product line. A DIBOL-11 program running on a DS-322 could be run on a 324 without recompiling, and on a DS-354 or 357 with recompilation. DEC can now boast of DIBOL-11 compatibility from the DS-310 through the DS-573 through the use of DITRAN, which translates DIBOL-8 (used on the DS-310) to DIBOL-11. ➤

➤ **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.

FLOATING POINT OPERANDS: None provided.

INSTRUCTIONS: The programmer sees the system in terms of the DIBOL language syntax, which is a COBOL-like programming language. The internal arrangement of the system is the PDP-11/34 (Datatypes 354 and 357) or LSI-11 (Datatypes 322 and 324) instruction set and architecture.

INTERNAL CODE: ASCII.

MAIN STORAGE

TYPE: MOS (metal oxide semiconductor).

CYCLE TIME: 1200 nanoseconds per word on the Datatypes 322 and 324, and 725 nanoseconds per word on the Datatypes 354 and 357.

CAPACITY: Datatypes 322 and 324: minimum of 32K bytes with a maximum of 56K bytes in 8K-byte increments. Datatypes 354 and 357: minimum of 32K bytes with a maximum of 248K bytes in 32K-byte increments.

CHECKING: Parity checking is standard on the Datatypes 354 and 357. None on the Datatypes 322 and 324.

STORAGE PROTECTION: None

RESERVED STORAGE: Uppermost 8K bytes of memory reserved for I/O registers.

CENTRAL PROCESSORS

Please refer to Report M11-384-301, *DEC PDP-11 Family*, for details on the LSI-11 and PDP-11/34 processors.

INPUT/OUTPUT CONTROL

Please refer to Report M11-384-301 for a discussion of the LSI-11 and PDP-11/34 I/O architecture.

MASS STORAGE

RX11 FLOPPY DISK DRIVES: A Datasystem 322 floppy disk subsystem consists of a controller and two ➤

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
MAGNETIC TAPE	(DS-357 or 354 only)	
TS03	Industry-compatible; 12.5-ips, 9-track, 800 bpi; 10,000 cps transfer rate, 7-inch reel	DEC
TU16	Industry-compatible; 45-ips, 9-track, 800/1600 bpi; 72,000 cps transfer rate, 12-inch reel	DEC
PRINTERS		
LA35	132 positions, 96 characters, 7 x 7 matrix; 30 cps	DEC
LA180	132 positions, 96 characters, 7 x 7 matrix; 180 cps	DEC
LP11-WA	132 positions, 96 characters, drum; 240 lpm	Dataproducts
LP11-VA	132 positions, 64 characters, drum; 300 lpm	Dataproducts
CARD UNITS	(DS-357 or 354 only)	
CR11	Card reader, 80-column; 300 cpm	Documation
TERMINALS*		
VT52	DECscope; CRT/keyboard, 1920 characters, 80 characters by 24 lines, numeric keypad, direct cursor addressing, 64 character set; 9600 bps	DEC
LA36	DECwriter II; printer/keyboard, 132 positions, 96 characters, 7 x 7 dot matrix; 300 bps; asynchronous; 30 cps print speed, 50 cps positioning speed	DEC

*Terminals can be intermixed since each one transmits a self-identifying code so that the software can identify the features of each model.

➤ CTS-300 is the operating system for all members of the Datasystem 300 family. This updated version of COS-350 now addresses up to 56K bytes of memory, and will be able to address 248K bytes by May 1977. CTS-300 supports up to eight concurrent jobs, printer spooling, three methods of file access, numerous utilities, a DIBOL-11 compiler, and DECFORM, a new utility for data entry, file maintenance, and inquiry.

“Big block send and receive” is available on all Data-systems in the 300 family. This novel feature allows information to be passed between programs, thus enabling the sharing of programming resources. Although six jobs might be running simultaneously, they can all share the same screen formatting program or disk accessing programs, thereby saving memory and programming efforts.

DEC does not offer any application programs for the DECsystems at the present time, but numerous systems houses offer turnkey systems that are based upon the DECsystem hardware and oriented toward specific applications.

Disk drives and processor types determine the differences among the Datasystem models. The standard DS-322 comes with 2 RX11 floppy disk drives with a capacity of 256,256 bytes each. A maximum of four drives is allowed, for just over one million bytes of on-line storage.

Although not standard equipment, RKO5 disk cartridges can be added to the DS-322. The RKO5 comes in two versions, each having a limit of eight drives. The ➤

➤ drives; one additional subsystem is permitted for a total of four disk drives, or a capacity of 1 million characters of on-line storage. Data is recorded in 77 tracks on one side of the diskette. Each track is formatted into 26 sectors of 128 bytes each. Head movement time is 10 milliseconds per track plus 20 milliseconds head settling time. Rotational speed is 360 rpm, giving an average rotational delay of 83 milliseconds. Average access time is 357 milliseconds. The data transfer rate is 55,600 bytes per second. Track capacity is 3328 bytes, and the total capacity of one diskette is 256,256 bytes. The subsystem is manufactured by DEC.

RK05 CARTRIDGE DISK DRIVES: There are two versions currently available: the RK05J and the RK05F. The RK05J is a removable-disk drive with a capacity of 2.4 million bytes of data, while the RK05F is a fixed disk offering 4.8 million bytes. (The RK05F looks like 2 disks to the processor.)

The standard DS-324 system includes a single cabinet with one RK05J and one RK05F disk, for a total of 7.2 million bytes. From there, the user can add either type to a maximum of eight drives, counting each RK05F as two drives. At least one removable-disk (RK05J) unit is required.

Data is recorded on both sides of a single disk contained in an IBM 2315-style, front-loading cartridge. There are 203 tracks (RK05J), or 406 tracks (RK05F), with data recorded in 12 sectors of 512 bytes each. Head movement time is 10 milliseconds for a single-track move, 85 milliseconds for a 200-track move, and 50 milliseconds average. Rotational delay averages 20 milliseconds. Data transfer rate is 180,000 bytes per second. The RK05 subsystem is manufactured by DEC.

RK06 CARTRIDGE DISK DRIVES: The basic DS-357 system includes a disk controller and two RK06 drives; up to six drives can be added for a total of eight. Data is recorded on two disks contained in an IBM 5440-style, ➤

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MASS STORAGE DEVICES

MODEL	DESCRIPTION	CAPACITY/DRIVE	AVERAGE ACCESS TIME
RX11	Floppy disk drive; 55,600 bytes/second transfer rate	256,256 bytes	357 milliseconds
RK05J	Disk cartridge drive (removable single disk); 180,000 bytes/second transfer rate	2.4 million bytes	70 milliseconds
RK05F	Disk cartridge drive (fixed single disk); 180,000 bytes/second transfer rate. Each drive is counted as two drives for configuring	4.8 million bytes	70 milliseconds
RK06	Disk cartridge drive (removable double disks); 538,000 bytes/second transfer rate	14 million bytes	50.5 milliseconds

NOTE: All disk subsystems are manufactured by DEC.

▷ RK05J is a removable cartridge drive with a capacity of 2.4 million bytes per drive, offering a total of 19 million bytes with eight drives. The RK05F is a fixed-disk version with a "double density" capacity of 4.8 million bytes per drive. Each RK05F is counted as two drives, so a maximum configuration would consist of three RK05F's and two RK05J's, for a total of 19 million bytes of disk storage.

The standard DS-324 has one RK05J and one RK05F for a total of 7.2 million bytes of storage.

Although the operating system will support up to four jobs on the DS-322 and 324, DEC recommends a limit of three terminals, or even two, in situations where unusually complex tasks are being performed. Furthermore, although the DS-354 and 357 can support up to eight terminals, DEC recommends a practical limit of six in certain situations.

All Datasystems include one VT52 DECscope terminal as an operator console and data entry device. The VT52 is an improved version of the VT50, offering twice the capacity of the earlier model. A numeric keypad functions as a numeric data entry device and can also be used with user software to provide a distinction between numeric and alphanumeric keystrokes.

An alternate terminal is the LA36 DECwriter, which provides hard-copy printing at 30 cps, using a 7-by-7 dot matrix printer. The LA36 features 96 upper and lower case letters, numbers, and symbols, and a paper adjustment that allows up to six-part forms.

Users can intermix terminal types, since each one transmits a self-identifying code that tells the software the individual characteristics of that terminal.

Four printers are offered as optional equipment: the 30-cps LA35, the 180-cps LA180, and the 240-lpm LP11-WA, all of which utilize the full 96-character set, and the LP11-VA, which uses a 64-character set and is rated at 300 lpm.

▶ top-loading cartridge. There are 200 tracks per inch, with 22 sectors/track and 512 bytes/sector. Each drive has a capacity of 14 million bytes, with expansion capabilities ranging to a maximum of 112 million bytes for an 8-drive subsystem. Average head positioning time is 38 milliseconds, with average rotational delay taking 12.5 milliseconds, for an average access time of 50.5 milliseconds. The data transfer rate is 538,000 bytes per second. The RK06 subsystem is manufactured by DEC.

INPUT/OUTPUT UNITS

See PERIPHERALS/TERMINALS table.

COMMUNICATIONS CONTROL

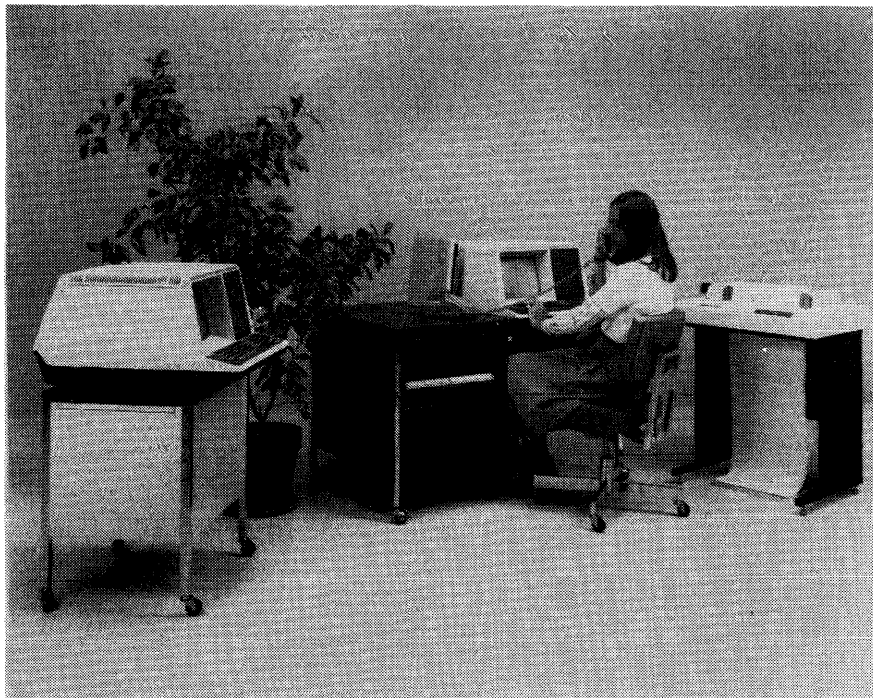
The CTS-300 2780 communications package is a hardware/software combination that permits telephone transmission of data to remote systems using a protocol similar to that of the IBM 2780. The remote systems can include all Datasystems, PDP-8's, PDP-11's, DECsystem-10's and 20's, or certain IBM 360's and 370's. Transmission rates can range up to 4800 bits per second, with conversion of file formats to EBCDIC for transmission. DICAM (Datasystem Interactive Communication Access Method) is available for interactive communications with IBM 360 or 370 host computers. The 2780 communications package is available for all DS-300 series computers.

SOFTWARE

OPERATING SYSTEM: CTS-300 (*Commercial Transaction System*) supports up to eight jobs on a DS-350 and up to four jobs on a DS-320. This disk-resident operating system is an enhanced version of COS-300, which was available on the DS-340. Included with CTS-300 is a DIBOL (Digital's version of COBOL) compiler, utilities that include sort/merge, and DECFORM. CTS-300 supports either interactive or batch processing, and offers sequential, indexed sequential, or random file access. According to DEC, CTS-300 supports multiple terminals running independent tasks on unique or shared files.

CTS-300 includes the following features: text editor, printer spooling, DIBOL debugging techniques, cross references, sorting and merging utilities, Peripheral Interchange Program (PIP) for file maintenance, SYSGEN, and PATCH for updating the operating system. CTS-300 requires 20K bytes of memory in a multi-user environment. Although the maximum memory capacity of a DS-350 is currently 248K bytes, CTS-300 will be limited to handling a maximum of 56K bytes until the second quarter of 1977.

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The DEC Datasystem 322 is the floppy-disk-oriented member of the Datasystem family. Shown here are two VT52 DECscopes, the LSI-11 processor housed in a desk along with two floppy disk drives, and an LA36 printer rated at 30 cps. Prices start as low as \$19,315 for a configuration that includes 32K bytes of memory, two floppy drives, one VT-52, and full software support. Printer speeds can range from 30 cps to 300 lpm. A 2780 communications package permits data communications with other Datasystem and larger host computers.

▷ DS-357 and 354 users have a choice of two 9-track magnetic tape units. The TS03 drive uses a 7-inch reel and records 800 bits per inch at 12.5 inches per second. The TU16 drive uses a 12-inch reel and records 800 or 1600 bits per inch at 45 inches per second. DS-357 and 354 users can also add the CR11 80-column card reader, which is rated at 300 cards per minute.

USER SURVEY

Five users of DEC Datasystem 354's were among the total of 11 Datasystem 300 users whose ratings are shown in Datapro's November 1976 feature report, *User Ratings of Minicomputers and Small Business Computers* (M07-100-401). The ratings assigned by these five users are reflected in the following table.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	3	2	0	0	3.6
Reliability of mainframe	5	0	0	0	4.0
Reliability of peripherals	5	0	0	0	4.0
Maintenance service:					
Responsiveness	3	2	0	0	3.6
Effectiveness	4	1	0	0	3.8
Technical support	1	3	0	1	2.8
Manufacturer's software:					
Operating system	2	3	0	0	3.4
Compilers and assemblers	3	2	0	0	3.6
Ease of programming	4	1	0	0	3.8
Ease of conversion	3	1	1	0	3.4
Overall satisfaction	3	2	0	0	3.6

* Weighted Average on a scale of 4.0 for Excellent.

The users seemed to agree on the principal strengths of the DEC Datasystems; "low cost" and "high throughput" were typical advantages they cited. Only one respondent mentioned a disadvantage: "Limited to 4 ▷

▶ "Big block send and receive" is a noteworthy feature of CTS-300. A maximum of 252 bytes of information can be transferred between various programs. This feature allows various jobs to share specialized programs that might handle one specific function, such as screen I/O or disk I/O. By sharing resources, six jobs would use the same disk accessing program, etc., thereby eliminating repetitious programming and saving memory at the same time.

LANGUAGE: *DIBOL-11* is an enhanced version of the *DIBOL* language that was available for use on the Datasystem 340 and other DEC computers. *DIBOL-11* provides software compatibility throughout the Datasystem family, from the 322 through the 573. The Datasystem 310 can be included in this compatible family through the use of *DITRAN*, which translates *DIBOL-8* into *DIBOL-11* and provides multi-user programming elements that allow several application programs to run simultaneously.

DIBOL-11 is a compatible extension of the language first used on the PDP-8. The language was designed to permit writing business-oriented programs for a minicomputer. It is structured into data definition and procedures sections, similar to *COBOL*.

Records and numeric integer or alphanumeric fields are defined in the data definition section. Variable names of up to six characters are supported. Files are associated with record/file definition through *OPEN* statements in the procedures section. Printed output formatting is accomplished through an edit mask facility much like that of *COBOL*. In arithmetic operations, a precision of 18 digits is maintained. The language includes complete facilities for handling the display during program execution and for calling external subroutines.

DIBOL programs can be written interactively using the *EDIT* program. The source module is stored on disk and submitted to the *DICOMP* language translator when translation is desired. *DIBOL* programs are executed through a run-time interpreter. A dynamic snapshot facility, called *DDT* for *DIBOL* Debugging Technique, permits stopping a program with display of variable values; the values can be modified and a new checkpoint established. ▶

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▷ terminals." (This user was undoubtedly pleased to learn that CTS-300 will support eight terminals on a DS-354 as of June 1977.)

The ratings are largely self-explanatory. DEC has enjoyed a good reputation for reliable equipment throughout its product line, and is clearly maintaining that reputation in the DECsystems. What's more, the users assigned high marks to every other rating category, with the sole exception of one user who was displeased with DEC's technical support.

Fewer than half of the Datasystems now being manufactured are delivered directly to end users to do their own programming, although DEC feels that, in a few years, the majority of its Datasystems will be sold to end users. At present, more than half of the systems are sold on an OEM basis to software firms that customize software and resell the DEC equipment with packaged programs. Thus, overall user satisfaction (or lack thereof) with a particular system will tend to reflect both the hardware and the application software, whatever its source. □

▶ The principal differences between DIBOL-8 and DIBOL-11 are cosmetic changes, to make DIBOL-11 look a little more like COBOL, and differences in the handling of file devices. DIBOL-11 makes use of a directory structure. DEC provides a translator that accounts for the cosmetic changes and flags the I/O syntax changes required.

DECFORM is a new generative programming aid that allows a customer to tailor screen formatting and editing procedures. According to DEC, DECFORM is capable of screen formatting, checking, prompting, and inquiring; is easy to use; and is compatible with both CTS-300 and CTS-500, thereby making DECFORM available on all Datasystems except the 310.

Five basic tasks can be performed: 1) Add—for basic data entry; 2) Inquiry—for examination without change; 3) Change—for file maintenance; 4) Verify—for re-keying pre-selected fields; and 5) Delete (not available for sequential files).

Screen formatting is simply a matter of building a table of field size, field name, horizontal position, and vertical position for each desired field on the screen. This table is passed over to the DECFORM compiler along with the name of the file to be accessed; the DECFORM compiler then generates a DIBOL-11 program. Formats may be divided into multiple screens to allow for more logical layouts and to eliminate crowding. Provisions are also made for passwords and other security procedures. Once the format is displayed, the operator may begin keying in data, and will receive prompting and error messages as they are needed.

The following edits are incorporated into DECFORM: display leading zeros; stop after every field is entered; retain previous screen when starting a new record; override checks through special characters; automatic duplication of fields; automatic incrementing of fields; establish initial values for fields; check digits; perform arithmetic functions (extensions, taxes, etc.); hide a field; and list running totals.

The following checks are available: alphanumeric, numeric, field required, field must be filled, constant insertion,

range checks on numeric fields, table look-up, cross-field comparisons, field protection (unalterable), subfield checking to individual characters, and data retrieval from other files.

According to DEC, it is possible to use the DECFORM procedures to extend, discount, and tax an invoice, while pulling alphabetic descriptions from a table.

DITRAN is a translator that converts DIBOL-8 into DIBOL-11. This enables Datasystem 310 users to convert to any other Datasystem with a minimum of effort. This actually entitles the Datasystem 310 to be included in the 300 and 500 family through DIBOL-11 compatibility. However, since DITRAN was developed through the Digital Equipment Computer Users Society (DECUS) rather than by DEC itself, the company offers no guarantees, and may not officially support DITRAN.

The memory requirements for DITRAN and DECFORM are dependent upon the configuration in use.

APPLICATION PROGRAMS: DEC does not furnish any application programs for the DS-300 family at this time.

PRICING

POLICY: The DEC Datasystems 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 joint venture with U.S. Leasing Corp).

The CTS-300 operating system is available only as a part of a Datasystem configuration, not separately.

SUPPORT: Separately priced hardware maintenance by DEC is available through a field support force of over 2,500 personnel. Purchase prices include full on-site installation/setup of hardware and software. A 90-day on-site warranty is included. The maintenance prices quoted below are for eight hours per day, five days per week. Extended-period maintenance is available at extra cost.

EQUIPMENT: The prices for the following typical systems include all required controllers, adapters, cables, and software.

DS-322 including an LSI-11 processor, 32K bytes of MOS memory, 2 floppy disk drives, 1 VT52 console, and the CTS-300 operating system: \$19,315.

DS-322 including an LSI-11 processor, 32K bytes of MOS memory, 1 floppy disk drive (512,000 characters), 1 VT52 console, 1 LA180 dot matrix printer, and the CTS-300 operating system: \$20,900.

DS-324 including an LSI-11 processor, 32K bytes of MOS memory, 2 RK05 disks, 1 VT52 console, and the CTS-300 operating system: \$32,615.

DS-324 including an LSI-11 processor, 32K bytes of MOS memory, 1 RK05F and 1 RK05J in 1 cabinet for 7.2 million bytes of disk storage, 1 VT52 console, 1 LA180 printer, and the CTS-300 operating system: \$34,000.

DS-354 including a PDP-11/34 processor, 32K bytes of MOS memory, 2 RK05 disks, 1 VT52 console, and the CTS-300 operating system: \$37,950 (or \$38,955 with 64K bytes of MOS memory).

DS-357 including a PDP-11/34 processor, 64K bytes of MOS memory, 2 RK06 disk drives, 1 VT52 console, and the CTS-300 operating system: \$51,170. ■

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EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
BASIC SYSTEMS			
DS-322	LSI-11 processor, 32K bytes of MOS memory, 2 RX11 floppy disk drives, VT52 console, CTS-300 operating system	19,315	120
DS-324	LSI-11 processor, 32K bytes of MOS memory, 2 RK05 disks (7.2 megabytes total), VT52 console, CTS-300 operating system	32,615	210
DS-354	PDP-11/34 processor, 32K bytes of MOS memory, 2 RK05 disks (7.2 megabytes total), VT52 console, CTS-300 operating system	37,950	211
DS-357	PDP-11/34 processor, 64K bytes of MOS memory, 2 RK06 disks (28 megabytes total), VT52 console, CTS-300 operating system	51,170	302
MSV11-B	8K bytes of MOS memory for LSI-11	625	25
MS11-JP	32K bytes of MOS memory for PDP-11/34	2,550	25
MASS STORAGE			
RX11	Floppy disk drive; 256,256 bytes of storage; 10K bytes/second transfer rate; 357 msec. average access time	3,350	25
RK05J	2.4-megabyte removable disk cartridge drive; 180K bytes/second transfer rate; 70 msec. average access time	5,600	39
RK05F	4.8-megabyte non-removable disk drive; 180K bytes/second transfer rate; 76 msec. average access time	6,200	54
RK06-EA	Single-access 14-megabyte disk cartridge drive; 538K bytes/second transfer rate; 50.5 msec. average access time	10,450	78
RK06-FA	Dual-access 14-megabyte disk cartridge drive; 538K bytes/second transfer rate; 50.5 msec. average access time	13,200	88
MAGNETIC TAPE EQUIPMENT (DS-357 or 354 only)			
TS03	Industry-compatible tape drive; 12.5 inches/second; 9-track; 800 bpi; 10,000 cps transfer rate; 7-inch reel	3,850	50
TU16	Industry-compatible tape drive; 45 inches/second; 9-track; 800/1600 bpi; 72,000 cps transfer rate; 12-inch reel	10,300	60
CARD UNITS (DS-357 or 354 only)			
CR11	Card reader, 80 column; 300 cpm	6,170	53
PRINTERS			
LA35	132 positions; 96 char.; 7 x 7 matrix; 30 cps	2,260	19
LA180	132 positions; 96 char.; 7 x 7 matrix; 180 cps	3,770	55
LP11-WA	132 positions; 96 char.; drum; 240 lpm	14,050	72
LP11-VA	132 positions; 64 char.; drum; 300 lpm	11,800	72
TERMINALS			
VT52	DECscope, CRT/keyboard; 1920 characters; numeric keypad; direct cursor addressing; 64-char. set; 9600 bps	2,200	20
LA36	DECwriter II; printer/keyboard; 132 positions; 96-char. set; 7 x 7 dot matrix; 300 bps	2,470	19
COMMUNICATIONS			
	2780 Hardware/Software Data Communications Package	4,400	11