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To The Potential Computer User:

PDP-8/E is a major step forward in Digital Equipment Corporation's small computer product line. It is the all new, lower cost successor to the popular PDP-8/I and PDP-8/L and is the outgrowth of the largest concentration of minicomputer engineering, programming and user expertise in the world.

More than 7500 PDP-8, 8/S, 8/I and 8/L systems are installed throughout the world, making this the largest family in the mini-computer industry. In these installations, 8-Family users have developed new areas of expertise: in education; the life sciences; process control; numerical control; research; shipboard navigation; computerized typesetting; and many more demanding applications.

Add to all this the fact that Digital has more than 1000 people in the field to provide fast and efficient local service anywhere at anytime, and you have a powerful sales message. Most people would be happy to stop right there.

We at Digital, however, have never been complacent about our products. We felt PDP-8/E should be much much more, and it is! We could describe it in glowing terms like one-of-a-kind and advanced and state-of-the-art, but doesn't everybody say this about everything these days?

Suffice it to say, we feel PDP-8/E is a truly unique computer. Unique in price: the lowest cost ever for a general purpose computer. Unique in hardware architecture: allowing it to be used in applications previously considered the domain of larger, more costly systems. Unique in system flexibility: drawing on a broad line of Digital designed and manufactured options, peripheral devices and interfacing components. And, unique in depth of software: the result of seven years of experience in developing the most efficient and comprehensive minicomputer programming systems available in the industry.

Among the most significant of these features is an internal bus system we call OMNIBUS™, the printed circuit successor to back panel wiring. OMNIBUS means greater reliability by doing away with the possibility of broken wires. OMNIBUS means versatility by permitting options and peripherals to be plugged into the processor at any location. The expansion capability and flexibility of such a design are obvious.

Also of importance to system designers is PDP-8/E's space saving packaging arrangement which provides room for up to 32K of memory and several peripheral interfaces in the basic 10½ inch by 19 inch by 24 inch cabinet. The design saves you the expense of extra cabinets, extra space and extra cabling.

The modularity of PDP-8/E's design lets you buy only as much computer as you need. From minimal control systems for the OEM to fully expanded dedicated general purpose tools for the end user, there is a PDP-8/E configuration that is just right for the job.

In the near future we will be making PDP-8/E available with our existing Computerpacks, Digital's integrated, computer based systems with software, interfaces and peripherals built in. We will also be announcing significant new products in this area, in addition to continuing our long term commitment to the development of easier to use and more powerful Family-of-Eight software and less expensive options and peripherals.

PDP-8/E is a giant step in this continued development. It's a new machine with a successful past and an even more promising future. We are just as excited and just as committed to this future now as when we introduced the PDP-8 in 1964. We hope you will be too.

Sincerely,

Nick J. Mazzarese

Nick J. Mazzarese
Vice President/Group Manager
Small Computers

digital pdp8e

MEMORY ADDRESS

EMA

OFF POWER PANEL LOCK

SW

F	D	E									
LINK	GT	INT BUS	NO INT	ION	UM	MD DIR	DAT CONT	SW	PAUSE	BRK PROG	BRK
			IR0	IR1	IR2	IF0	IF1	IF2	DF0	DF1	DF2
											STATE
0	1	2	3	4	5	6	7	8	9	10	11

STATUS

BUS MQ MD AC

SWITCH REGISTER

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

ADDR LOAD   EXTD ADDR LOAD

CLEAR   CONT   EXAM   HALT   SING STEP

DEP

RUN

Digital's all new PDP-8/E is the most powerful, most expandable and most versatile 12-bit computer available today. Its low price and high performance make it the ideal system for a variety of uses. Extending all the way from minimal control units to fully expanded general-purpose systems. It is fast, compact and easy to interface.
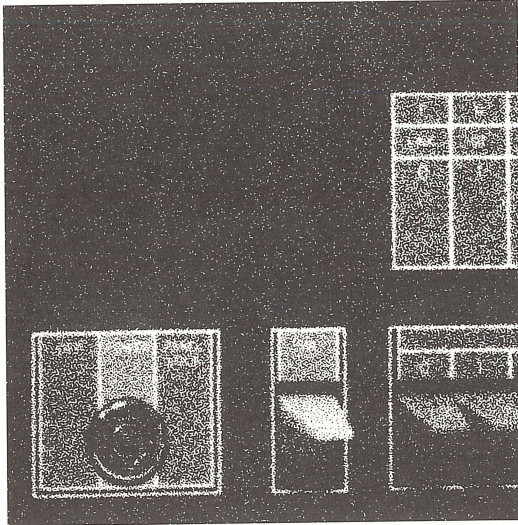
PDP-8/E FEATURES

PDP-8/E offers features such as: a unique internal bus system called OMNIBUS™, which allows you to plug memory and processor options into any available slot location; the availability of 256 words of Read/Only or Read/Write memory; a 1.2 microsecond memory cycle time; the use of TTL integrated circuitry with MSI technology; expansion to 32,768 12-bit words of core storage; low cost mass storage expansion with DECdisk or DECtape; and a space and money saving packaging design.

In addition PDP-8/E provides a standard, general-purpose hardware register; an optional program priority interrupt which greatly reduces the response time to service I/O interrupts; a two module interface for up to 4 Teletypes; a more powerful instruction set which includes an expanded EAE; a customer-proven software package which includes BASIC, FOCAL®, Digital's own conversational computer language; and DIBOL, our new COBOL-like business oriented language; and many other new processor options and peripherals.

PDP-8/E features at a glance:

☐ Increased speed — memory cycle time of 1.2 microseconds.

☐ A unique internal bus design called OMNIBUS which eliminates the need for back panel wiring. Processor options can be inserted in any available slot.

☐ A full line of over 60 options and peripherals immediately available.

☐ Availability of 256 word increments of Read-Only Memory and/or Read/Write memory.

☐ A new packaging scheme which makes PDP-8/E physically smaller than its predecessor, PDP-8/I. And, with no predetermined locations needed for options, there is no wasted space in the logic panel.

☐ A standard General Purpose register in the basic machine which becomes the MQ Register when the EAE option is implemented.

☐ An optionally available advanced program priority interrupt which greatly reduces the response time to an interrupt request.

☐ A six bit byte swap instruction allowing faster and more convenient character handling.

☐ Six additional Processor IOT instructions which make flag manipulation and interrogation faster and easier.

☐ A two module interface for up to 4 Teletypes.

☐ TTL integrated circuit modules utilizing MSI technology.

☐ Over 7500 compatible PDP-8 Family computers in use for sharing programs through Digital's users group DECUS.

☐ Low-cost core memory expansion to 32,768 words and low-cost mass storage expansion with DECdisk, DECtape and IBM-compatible magnetic tape.

☐ Worldwide, dependable service.

☐ Program and maintenance training included.

☐ Fully parallel processor.

☐ Link feature to facilitate multiple precision arithmetic.

☐ Two's complement arithmetic.

☐ Full range of turn-key and applications oriented systems available.

☐ Over seven years of software development by Digital.

☐ Expanded hardware multiply/divide.

☐ Eight auto-index registers.

☐ Hardware Bootstrap Loader option.

☐ Pushdown List option.

The PDP-8/E instruction set is carefully designed to allow the programmer to carry out sophisticated tasks in a simple straight-forward manner. It features 192 I/O transfer codes for servicing from 64 to 192 input/output devices plus a unique microprogramming technique for saving memory and time. The power and flexibility of the PDP-8/E instruction set has been proven in over 7500 Family-of-Eight installations. It is easy to learn, simple to use, and facilitates maintenance of software.

BASIC INSTRUCTIONS

AND	0000	logical AND
TAD	1000	2's complement add
ISZ	2000	increment and skip if zero
DCA	3000	deposit and clear AC
JMS	4000	jump to subroutine
JMP	5000	jump
IOT	6000	in/out transfer
OPR	7000	operate

PROCESSOR IOT INSTRUCTIONS

*SKON	6000	skip if interrupt on and turn interrupt off
ION	6001	turn interrupt on
IOF	6002	turn interrupt off
*SRQ	6003	skip if interrupt request
*GTF	6004	get interrupt flags
*RTF	6005	restore interrupt flags
*SGT	6006	skip if greater than flag
*CAF	6007	clear all flags

*New instructions on basic PDP-8/E

GROUP 1 OPERATE MICROINSTRUCTIONS

NOP	7000	no operation
CLA	7200	clear AC
CLL	7100	clear link
CMA	7040	complement AC
CML	7020	complement link
RAR	7010	rotate AC and link right one
RAL	7004	rotate AC and link left one
RTR	7012	rotate AC and link right two
RTL	7006	rotate AC and link left two
IAC	7001	increment AC
*BSW	7002	swap bytes in AC

*New instruction in basic PDP-8/E

GROUP 2 OPERATE MICROINSTRUCTIONS

SMA	7500	skip on minus AC
SZA	7440	skip on zero AC
SPA	7510	skip on plus AC
SNA	7450	skip on non-zero AC
SNL	7420	skip on non-zero link
SZL	7430	skip on zero link
SKP	7410	skip unconditionally
OSR	7404	inclusive OR, switch register with AC
HLT	7402	halts the program
CLA	7600	clear AC

MQ MICROINSTRUCTIONS

*NOP	7401	no operation
*CLA	7601	clear AC
*MQL	7421	load MQ from AC then clear AC
*MQA	7501	inclusive OR, MQ with AC

*New instructions in basic PDP-8/E

EAE INSTRUCTIONS

ACS	7403	load step count from accumulator
MUY	7405	multiply
DVI	7407	divide
NMI	7411	signed normalize
SHL	7413	shift left
ASR	7415	arithmetic right shift
LSR	7417	logical right shift
SCA	7441	load AC from step counter
*DAD	7563	double precision add
*DST	7565	double precision store
*DCM	7567	double precision two's complement
*NMU	7451	absolute normalize
*SAM	7453	subtract AC from MQ

*New instructions in PDP-8/E EAE option

COMBINED OPERATE MICROINSTRUCTIONS

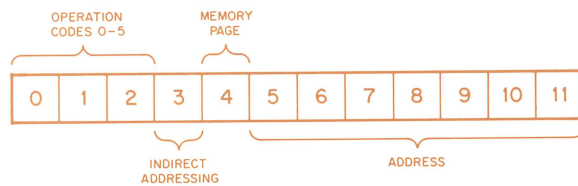|			
CIA		7041	complement and increment AC
LAS		7604	load AC with switch register
STL		7120	set link (to 1)
GLK		7204	get link (put link in AC bit 11)
CLA	CLL	7300	clear AC and link
CLA	IAC	7201	set AC = 1
CLA	CMA	7240	set AC = −1
CLL	RAR	7110	shift positive number 1 right
CLL	RAL	7104	shift positive number 1 left
CLL	RTL	7106	clear link, rotate 2 left
CLL	RTR	7112	clear link, rotate 2 right
SZA	CLA	7640	skip if AC = 0, then clear AC
SZA	SNL	7460	skip if AC = 0 or link is 1 or both
SNA	CLA	7650	skip if AC ≠ 0, then clear AC
SMA	CLA	7700	skip if AC < 0, then clear AC
SMA	SZA	7540	skip if AC ≤ 0
SMA	SNL	7520	skip if AC < 0 or link is 1, or both
SPA	SNA	7550	skip if AC > 0
SPA	SZL	7530	skip if AC ≥ 0, and if the link is 0, or both
SPA	CLA	7710	skip if AC ≥ 0, then clear AC
SNA		7470	skip if AC < 0 and link = 0, or both
*CAM		7621	clear AC and MQ
*SWP		7521	swap AC and MQ
*ACL		7701	load MQ into AC
*CLA	SWP	7721	load AC from MQ, clear MQ

*New instructions on basic PDP-8/E

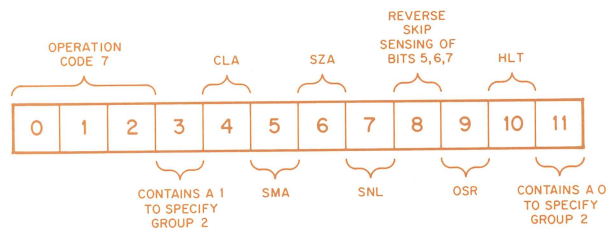## PDP-8/E INSTRUCTION SET

INSTRUCTION FORMATS

0	1	2	3	4	5	6	7	8	9	10	11

INDIRECT
ADDRESSING   ADDRESS

MEMORY REFERENCE INSTRUCTION BIT ASSIGNMENTS

OPERATION
CODE 7   CLA   CMA   ROTATE
AC AND L
RIGHT   ROTATE 1
POSITION IF A 0,
2 POSITIONS
IF A 1

0	1	2	3	4	5	6	7	8	9	10	11

CONTAINS
A 0 TO
SPECIFY
GROUP 1   CLL   CML
AC AND L
LEFT   ROTATE BSW   IAC
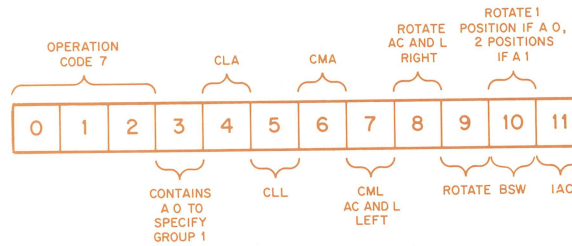
Logical Sequences:
1—CLA, CLL
2—CMA, CML
3—IAC
4—RAR, RAL, RTR, RTL or BSW

GROUP 1 OPERATE INSTRUCTION BIT ASSIGNMENTS

OPERATION
CODE 7   CLA   SZA   REVERSE
SKIP
SENSING OF
BITS 5,6,7   HLT

0	1	2	3	4	5	6	7	8	9	10	11

CONTAINS A 1
TO SPECIFY
GROUP 2   SMA   SNL   OSR   CONTAINS A 0
TO SPECIFY
GROUP 2

Logical Sequences:
1 (Bit 8 is Zero)—Either SMA or SZA or SNL
1 (Bit 8 is One)—Both SPA and SNA and SZL
2—CLA
3—OSR, HLT

GROUP 2 OPERATE INSTRUCTION BIT ASSIGNMENTS

OPERATION
CODE 6   GENERATES
AN IOP 4
PULSE AT
EVENT TIME 3
IF A 1   GENERATES
AN IOP 1
PULSE AT
EVENT TIME 1
IF A 1

0	1	2	3	4	5	6	7	8	9	10	11

DEVICE
SELECTION   GENERATES
AN IOP 2
PULSE AT
EVENT TIME 2
IF A 1

IOT INSTRUCTION BIT ASSIGNMENTS

OPERATION
CODE 7   CLA   0=INSTRUCTION
CLASS 0
1=INSTRUCTION
CLASS 1   INSTRUCTION
CODE #

0	1	2	3	4	5	6	7	8	9	10	11

CONTAINS
A1 TO
SPECIFY
EAE GROUP   MQA   MQL   CONTAINS
A1 TO
SPECIFY
EAE GROUP
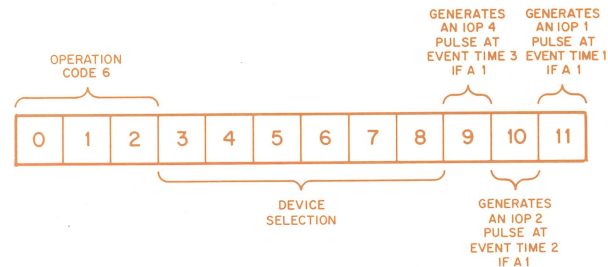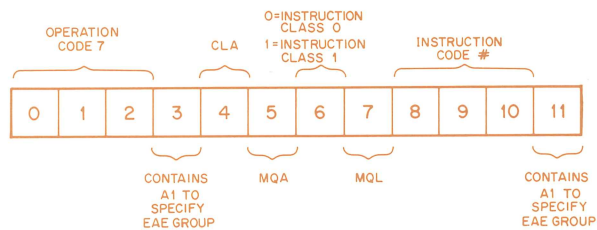
	#	Command	
	0	NOP	
	1	ACS	Load Step count
	2	MUY	Multiply
Instruction Class 0	3	DVI	Divide
	4	NMI	Signed Normalize
	5	SHL	Shift Left
	6	ASR	Arithmetic Right Shift
	7	LSR	Ligical Right Shift

	#	Command	
	0	SCA	Read step count
	1	DAD	Double Precision Add
	2	DST	Double Precision Store
Instruction Class 1	3	DCM	Double Precision Two's Complement
	4	NMU	Absolute Normalize
	5	SAM	Subtract
	6	NOP	
	7	NOP	Reserved

Logical Sequence

1 CLA
2 MQA, MQL
3 All others

EAE MICROINSTRUCTION BIT ASSIGNMENTS

In science, Digital computers have cut the researcher's experiment time with direct, on-line data reduction. PDP computers control and monitor powerful nuclear reactors, control X-ray diffractometers, and analyze nuclear spectroscopy data. They are used extensively in environmental pollution research. They monitor medical data, automatically analyze electro-cardiograms, and study the effects of drugs on the nervous system. They assisted in the analysis of samples brought back from the moon by the first U.S. astronauts, guided the S.S. MANHATTAN as she sailed the Northwest Passage and are used in testing the Boeing 747 giant jet and the Anglo-French Concorde supersonic airplane.

Digital's computers provide engineers with a powerful control and testing tool. They control blast furnaces and open hearths, monitor slab mills and finishing mills in steel plants. The chemical industry uses PDP computers for complete process control systems, while power utilities use them in systems to control plant startup, power generation, and power network distribution.

The PDP computer's flexibility is also attractive in the education field. It provides a classroom computer to teach students about computer programming and hardware design. Many students use them for homework problems and research projects.

The Digital product line has emerged after more than a decade of careful planning and development, a decade in which Digital learned that no single size or type of computer offers a universal solution. A computer manufacturer must provide a customer with more than a basic computer mainframe: It must offer a range of interfacing and peripheral equipment; easy-to-use and efficient software packages; and reliable, worldwide service, and support.

Markets also must be viewed in two ways. While one segment is concerned with computer specifications, another seeks packaged solutions. The latter does not ask about mainframe, memory size, bytes, or bits. They ask about price/performance for their particular solution, and they want the answers in a language they understand. Digital products are built to reflect this two-pronged approach.
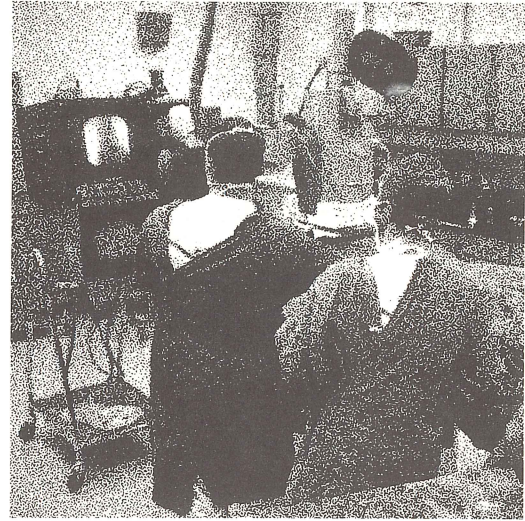
ABOUT DIGITAL APPLICATIONS
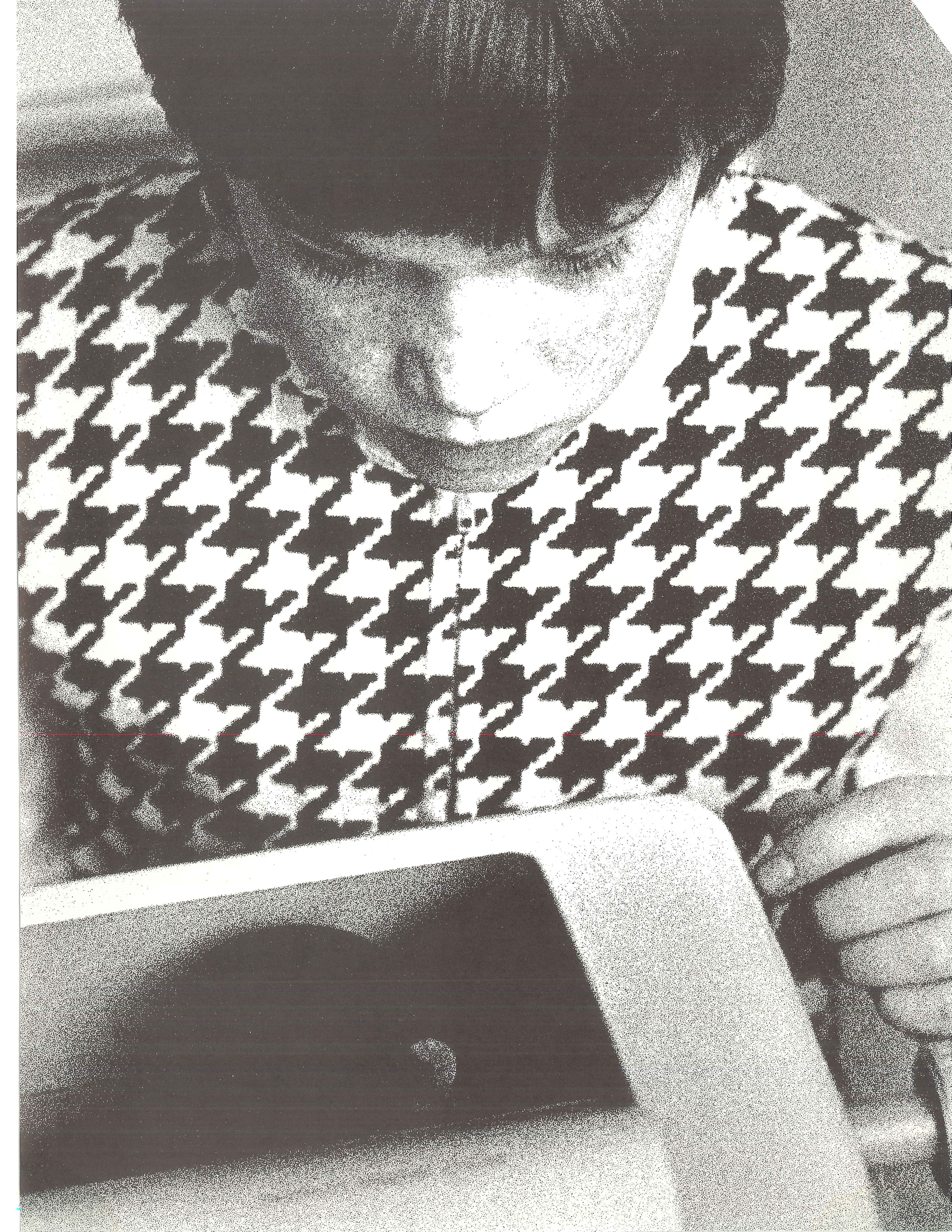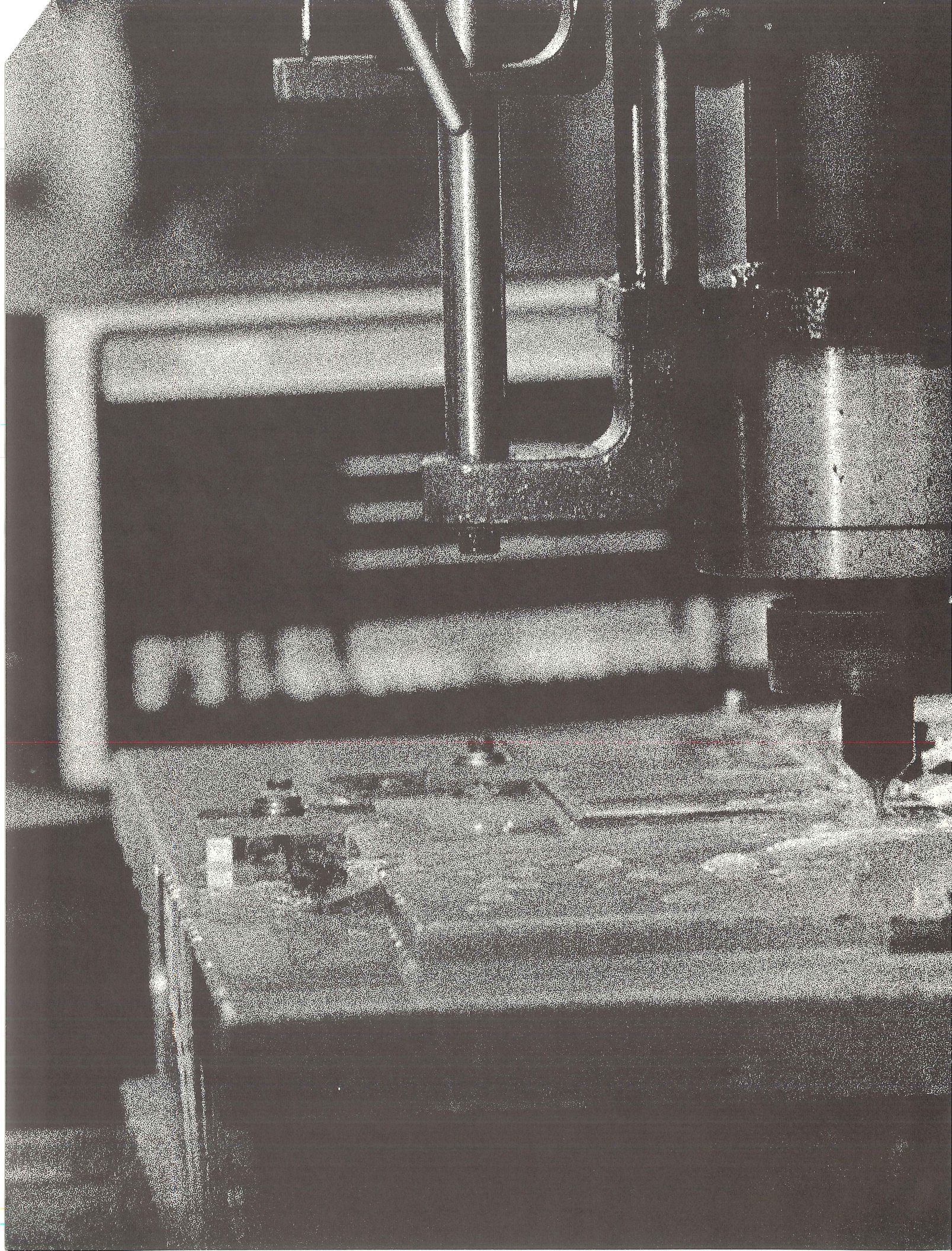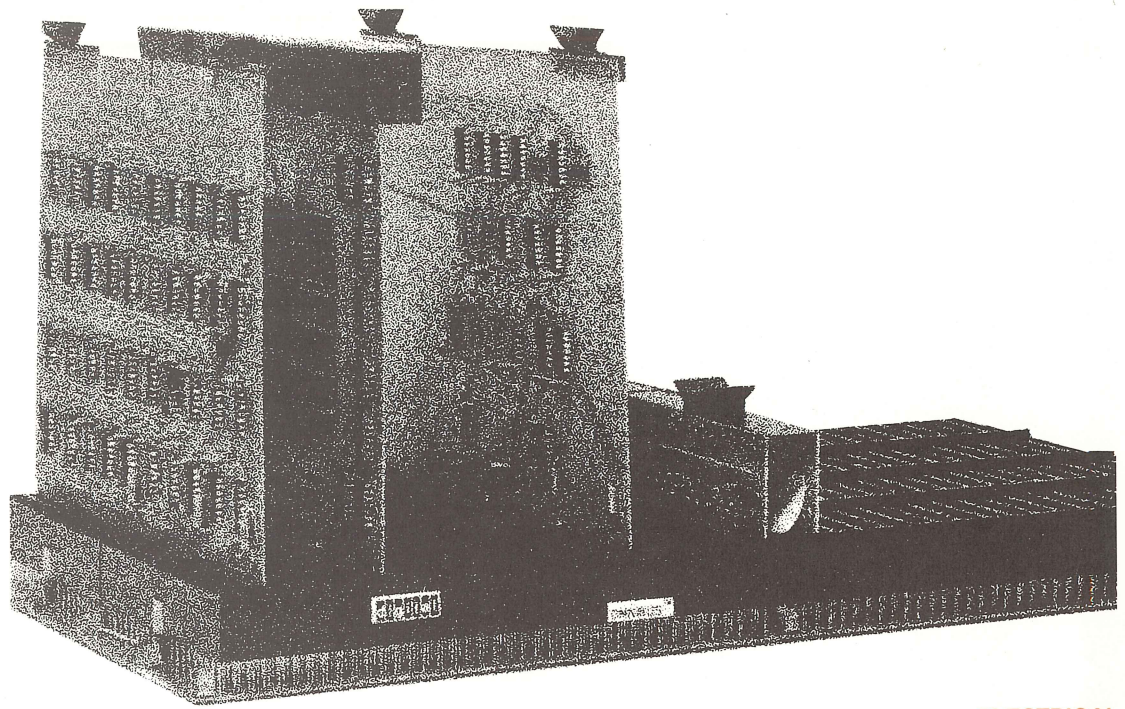
PHYSICAL

Table Top Model—Dimensions: 10½ inches high, 19 inches wide, and 24 inches deep. Weight: 100 pounds.

Rack Mountable Model—Dimensions: 10½ inches high, 19 inches wide, and 23¼ inches deep; can be mounted in any standard 19 inch commercial cabinet (standard cabinets supplied by Digital are 71²/₁₆ inches high, 21¹¹/₁₆ inches wide with end panels, and 30 inches deep). Weight: 90 pounds.

ASR-33 Teletype—Dimensions: 33 inches high to top of console, 45 inches high to top of copyholder, 23 inches wide, 18 inches deep. Weight: 70 pounds (on stand).

PDP-8/E SPECIFICATIONS

ELECTRICAL

Processor—Power Requirements: 95-130V, 47-63 Hz, approx. 6 amperes, single phase. 185-250V, 47-63 Hz, approx. 3 amperes, single phase. Power Dissipation: 450 Watts.

Teletype—Input Voltage: 115 V AC ± 10%, 60 Hz ± 0.45 Hz; 230 V AC ± 10%, 50 Hz ± 0.50 Hz. Line Current Drain: 2 amperes. Power Dissipation: 150 watts.

FUNCTIONAL

Memory Cycle Time: 1.2 microseconds. Word Length: 12-bits. Core Memory Size: 4,096 words, expandable to 32,768 words (also available with 256 word increments of ROM and/or R/W memory).

ENVIRONMENTAL

PDP-8/E is designed to operate from +0 to +55°C and with a relative humidity of from 10 to 95% (without condensation).

CABLE REQUIREMENTS

The PDP-8/E I/O cable is a combination shield and ribbon or coaxial cable. The maximum length of the data break I/O bus cable is 30 ft. using coaxial or 25 ft. using ribbon cable. Maximum length on the programmed I/O bus is 50 ft. using coaxial or 45 ft. using ribbon cable.

INSTALLATION PROCEDURE

PDP-8/E installation is performed by Digital personnel at the customer site. Customers also may send personnel to instruction courses on computer operation, programming, and maintenance conducted regularly in Maynard, Massachusetts; Palo Alto, California; and Reading, England.

PDP-8/E provides the most extensive software packages ever developed for a small-scale general-purpose computer. It includes FORTRAN, ALGOL, BASIC, TSE Time Sharing System, MACRO-8, SABR, PAL III and PAL-D assemblers, PS-8, on-line tape editing and debugging programs, linking loader, and a floating point package. Also part of this package is FOCAL®, a conversational calculator language developed by Digital to make it possible for computer novices to start writing programs and solving problems their first day on the computer and learn the ins and outs of programming at the same time. PDP-8/E also comes with DIBOL, Digitals new COBOL-like business-oriented language.

Experienced programmers will find that PDP-8/E software incorporates many advanced features previously unavailable on any small machine. The system makes immediately available to each user the full data processing capability of the PDP-8/E and serves as the operating nucleus for a growing library of programs and routines. New techniques, routines and programs are constantly being developed, field tested, documented and distributed through the Digital Program Library and the Digital Equipment Computer Users Society (DECUS).

Extensive documentation makes PDP-8/E software easy to learn and use. Two new handbooks, "Introduction to Programming" and "Programming Languages" are handy textbooks for beginners or experts.

Most of the programs operate within the basic 4,096-word core memory. Some of the programs are especially designed to take advantage and make use of additional core and/or mass memory devices.

SYMBOLIC EDITOR

The Symbolic Editor can substantially ease the labor of writing and editing source (symbolic) programs. It reduces the number of assembly or compilation passes necessary to successfully execute programs and allows the programmer to write, edit, correct, and update his source programs on-line from the Teletype keyboard. Using Editor, the programmer merely types his source program into core from the keyboard, or he may enter a previously generated source program (tape) into core using either the Teletype or high-speed paper tape reader. By issuing certain commands, he can edit his program, list one or more lines or the entire program, insert additional lines, alter existing portions of his program, move one or more lines from one place to another, delete one or more lines or the entire program. When altering existing portions of his program, the programmer can search for and change a single character or group of characters in any line without having to retype the entire line. Editor enables the programmer to create and modify source programs rapidly and efficiently.

SYMBOLIC ASSEMBLERS

Symbolic assemblers translate symbolic source programs into binary code which can be loaded into and run on the computer. Digital presently offers four assemblers for PDP-8/E: two are available for systems with 4K words of core, another for 8K to 32K words of core, and still another for use with a DECdisk.

PAL III ASSEMBLER (4K)

The PAL III Symbolic Assembler is a two-pass assembler which translates symbolic programs written in the PAL III language into binary-coded programs. The assembler offers an optional third pass which produces an octal/symbolic printout and/or punchout of the assembled program. PAL III permits symbolic origins, expressions, and references. Its output is in binary code for use with DEC's standard Binary Loader.

MACRO-8 ASSEMBLER (4K)

The MACRO-8 Symbolic Assembler accepts symbolic programs written in the MACRO-8 symbolic language (very similar to PAL III) and translates them into binary-coded programs in two passes. An optional third pass is available for an octal/symbolic assembly program listing. MACRO-8 is compatible with PAL III and has the following additional features: user-defined macros, double-precision integers, floating-point constants, arithmetic and Boolean operators, literals, text facilities, and automatic off-page linkage generation.
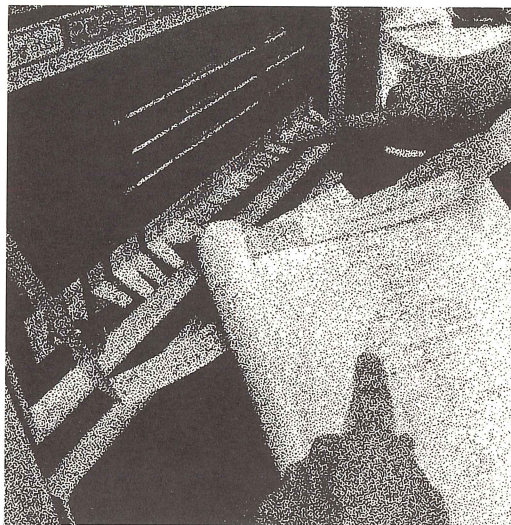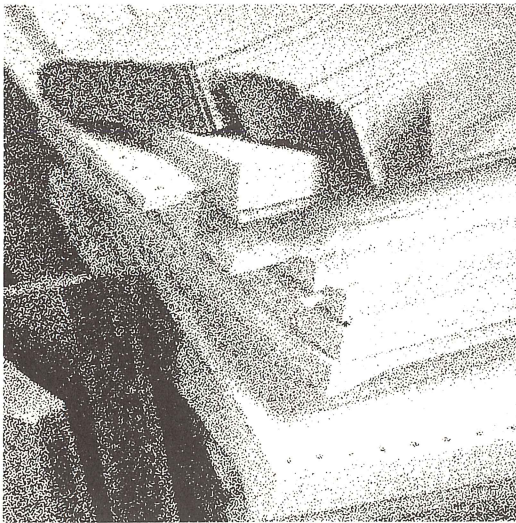

SOFTWARE

PAL-D ASSEMBLER (4K with DECdisk)

PAL-D (Program Assembly Language for the DECdisk Monitor System) is the symbolic assembly program designed primarily for PDP-8/E equipped with a DECdisk. PAL-D incorporates virtually all the features of both PAL III and MACRO-8.

8K SABR ASSEMBLER

SABR (Symbolic Assembler for Binary Relocatable programs) is an advanced one-pass symbolic assembler for 8K to 32K PDP-8 Family computers. SABR programs are core page independent, allowing programs to be written without regard for the 128-word core page of the computer. SABR automatically generates off-page and off-field references for direct and indirect statements. It also automatically connects instructions on one page to those that overflow onto the next. The list of available pseudo-ops is extensive, including external subroutine calling, argument passing, and conditional assembly. SABR offers an optional second pass to produce a side-by-side octal/symbolic listing of the assembled program.

The relocatable binary tapes produced by SABR are loaded into any field of core memory and executed with the 8K Linking Loader, as is the comprehensive library of subprograms (also used with 8K FORTRAN). These subprograms may be called by any SABR program. SABR also acts as the second pass of the 8K FORTRAN system.

Several other PDP-8 assemblers (some of which can run on larger computers) are available from DECUS.

4K FORTRAN

The 4K FORTRAN Compiler lets the user express problems in a mixture of English words and mathematical statements. It reduces the time needed for program preparation and enables users with little or no knowledge of the computer's organization and operating language to write effective programs. The 4K FORTRAN language consists of four general types of statements: arithmetic, logic, control, and input/output. FORTRAN functions include addition, subtraction, multiplication, division, sine, cosine, arctangent, square root, natural logarithm, and exponentiation.

8K FORTRAN

The 8K FORTRAN system translates a source program into relocatable binary code. The relocatable binary code is output on paper tape and then loaded into the computer for program execution. The 8K FORTRAN system features USA Standard FORTRAN syntax; subroutines; two levels of subscripting; function subprograms; input/output supervisors; relocatable output loaded by the 8K Linking Loader; COMMON statements; I, F, E, A, X, and H format specifications; and arithmetic and trigonometric library subroutines.

The 8K FORTRAN system consists of a one-pass compiler, the 8K SABR assembler, 8K Linking Loader, and a comprehensive library of subprograms. The system requires a PDP-8/E with at least 8K words of core memory, an ASR 33 Teletype, and a high-speed paper tape reader and punch. 8K FORTRAN utilizes all available core to 32K. 8K FORTRAN is a modified version of USASI Basic FORTRAN.

FOCAL® -8

FOCAL-8 (FOrmula CALculator for the PDP-8 Family computers) is an on-line, conversational interpretive language, used as a tool by students, engineers, and scientists in solving a wide variety of numerical problems. The language consists of short imperative English statements and mathematical expressions in standard notation. FOCAL puts the full calculating power and speed of the computer at the user's fingertips without having him master the intricacies of assembly language programming; in fact, the user need not know anything about computers.

Using FOCAL-8, programs can be entered from the Teletype keyboard and immediately executed, with the interpretive features of editing, compiling, and executing the stored program. FOCAL is available with additional segments (overlay tapes) which provide increased calculating accuracy, more core for large programs by utilizing two fields of core, or graphic display capabilities. Of special mention is the system segment that gives each of seven FOCAL users the power and flexibility of FOCAL from one computer. This time-sharing system permits one FOCAL program to serve several users so that each feels he has the whole system all to himself.

FLOATING POINT PACKAGE

The floating point package permits the PDP-8/E to perform arithmetic operations that could not otherwise be done without the addition of costly optional hardware. With the floating point package, the programmer need not concern himself with writing and repeatedly calling complicated arithmetic subroutines. He merely has to specify in one instruction the desired arithmetic operation (operator) and an argument (operand), and the operation will be performed automatically. In addition to increasing accuracy, floating point operations relieve the programmer of scaling problems common in fixed-point arithmetic. The floating point subroutines and interpreter permit the programmer to encode arithmetic operations to either 6 or 10 decimal digits of precision as easily as though the machine had floating point hardware.

ALGOL-8

ALGOL-8 is one of the most widely used international programming languages. The language emphasizes formal, well-defined procedures for solving problems with computers and is the standard publication language of the Association for Computing Machinery (ACM). Digital's ALGOL compiler conforms to SUBSET ALGOL 60 as approved by the International Federation of Information Processing Societies (IFIPS), with some restrictions. ALGOL is available through DECUS.

BASIC*-8

BASIC-8 is Digital's implementation of this widely available problem-solving language for scientific, business and educational applications. For persons with little or no computer experience, BASIC-8 can be used to write computer programs for solving a variety of numerical problems. For the more advanced computer user, BASIC-8 contains a number of features that make it suitable for programming complex problems.

DECDISK KEYBOARD MONITOR

The DECdisk Keyboard Monitor system consists of a keyboard-oriented Monitor, and a comprehensive package of software programs, which includes a FORTRAN Compiler, Program Assembly Language (PAL-D), Edit program (Editor), and Dynamic Debugging Technique (DDT-8) program. Also provided is a system builder for generating a customized monitor according to the user's particular machine configuration (amount of core, number of disks, etc.).

The system is modular and open-ended, permitting the user to construct the software required in his environment, and allows the user full access to his disk for storage and retrieval of his programs. By typing appropriate commands to the Monitor, the user can load a program, save it, and later call it for execution. The Monitor system is also usable with DECtape.

ON-LINE DYNAMIC DEBUGGING PROGRAMS

Dynamic debugging programs are service programs that allow the programmer to run his binary program on the computer. From the Teletype keyboard, the programmer can control program execution, examine registers and change their contents, make alterations to the program, and much more. DDT-8 and ODT-8 are the two dynamic debugging programs included in the system software package.

*BASIC is the trademark of Dartmouth College.

DDT-8 (Dynamic Debugging Technique) allows the programmer to do all the things mentioned in the preceding paragraph by communication with his object program using either the mnemonic coding of the symbolic program or the octal coding of the binary program.

ODT-8 (Octal Debugging Technique) allows the programmer to do all the things mentioned above by communicating with his object program using the octal representation of his binary program. ODT-8 occupies less core storage than DDT-8 and can be loaded in upper or lower memory, depending on where the binary program resides.

Additional debugging programs are available from DECUS.

PS/8 PROGRAMMING SYSTEM

PS/8, an 8K programming system, represents a significant advance in software development for small computers by providing capabilities previously available only on large machines. It is a program development system for a PDP-8/E with a minimum 8K of core and either DECtape, or a RK8 Disk Pack.

SOFTWARE

PS/8 allows the user device independent access to up to 15 I/O devices including up to eight DECtapes, up to four Disk Units, Teletype, high speed paper tape reader and punch, card reader, line printer, and any other device for which it is possible to write a device handler in one, or in some cases two pages.

The user program may call upon the monitor for several services, including loading device handlers for which the user may assign a name, looking up input files on these devices, creating and closing variable and fixed length output files on these devices, and getting and decoding a line of input from the console Teletype which identifies input and output files and options.

PS/8 gives the user, in addition to the language processors (8K FOCAL, 8K FORTRAN, 8K PAL-D and SABR), absolute and relocatable loaders, a Symbolic Editor, CONVERT (a program to provide file compatibility with the present Disk Monitor System); PIP (Peripheral Interchange Program); and an invisible ODT (Octal Debugging Technique) which allows the programmer to debug programs without giving up valuable core space.
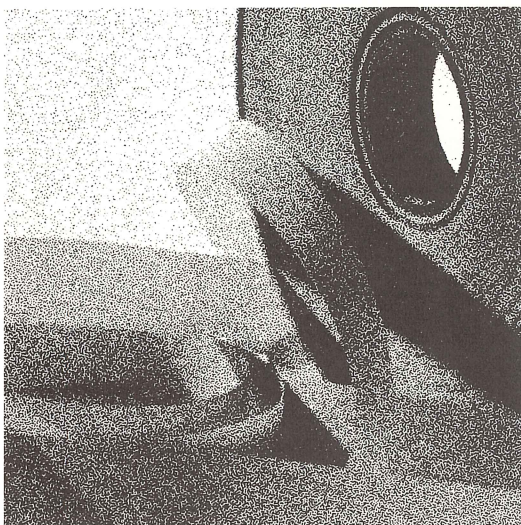
TSE TIME SHARING SYSTEM

TSE Time Sharing System is a general purpose, stand alone time sharing system. TSE can accommodate up to 13 users simultaneously with a PDP-8/E configuration. A minimum of 12K of core memory and a disk is required for a comprehensive library of system programs which provide facilities for compiling, assembling, editing, loading, saving, calling, debugging, and running user programs on-line.

The center of a TSE system is a complex of programs called Monitor. Monitor coordinates the operations of the various units, allocates the time and services of the computer to users, and controls their access to the system. The computer works on user programs simultaneously by segregating the central processor operations from the time-consuming activities of the human users. Execution of various programs are interspersed without interfering with one another and without detectable delays in the responses to the individual user.

DIBOL

DIBOL (Digital Equipment Business-Oriented Language) is a complete business-oriented software system for the PDP-8/E. It allows, for the first time, a relatively inexperienced programmer to produce complete business applications on a small computer. The DIBOL software system is directed toward the small business that can *write its own* in-house EDP management/accounting programs. They can now use the power of the PDP-8/E computer to efficiently and economically construct programs for billing, accounts receivable, inventory control, payroll, general ledger and other operations.

DIBOL contains a simple business-oriented language, a data management system to provide automatic input, sorting and file maintenance and a monitor to tie the various subsystems together.

DIBOL combines the best features of COBOL and FORTRAN into an easy-to-learn business language. COBOL is organized into two principal sections, i.e., a file set up section and a data manipulation section. DIBOL follows this same organization. DIBOL, like COBOL, performs all necessary file/data manipulation commands, converts Alphanumeric elements to Decimal and converts Decimal elements to Alphanumeric, GO-TO statements and subroutine calls. Unlike COBOL, DIBOL commands are in simple algebraic expressions similar to FORTRAN.

DIBOL is easy to learn with only a minimum amount of training.

Digital offers a complete line of options and peripherals for the PDP-8/E. Through use of the unique OMNIBUS, back panel wiring is eliminated. In its place a printed circuit panel and mounting blocks provide 20 electrically identical slots that permit you to plug in memory and processor options in any available position. An additional 20 slots can be added to the basic configuration either at the factory or in the field.

EXTENDED ARITHMETIC, KE8-E

This option allows the PDP-8/E to perform parallel arithmetic operations on positive binary numbers much faster than by programmed subroutine. The option multiplies two 12-bit, unsigned numbers to obtain a 24-bit product in an average of 6.0 microseconds (including operand access) and divides a 24-bit, unsigned number by a 12-bit number in 6.5 microseconds. A group of microinstructions is added to the instruction repertoire to permit double precision addition, automatic multiplication and division, and 24-bit shifting to normalize and scale arguments. The KE8-E is mounted on a single quad module that plugs into the OMNIBUS.

POWER FAILURE AND AUTOMATIC RESTART OPTION, KP8-E

This option protects an operating program in the event of primary power failure. If a power failure occurs, this option causes a program interrupt, allowing time to store the contents of active registers in core. When power is restored an interrupt routine restores the contents of the active registers and continues the program.

PUSHDOWN LIST CONTROL, KH8-E

This option implements a Pushdown List in memory. Full words may be inserted or removed from this list. The address of the top item is kept in a list pointer and the program can keep a count in the list counter. The control is mounted on a single quad module that plugs into the OMNIBUS.

AUTOMATIC PRIORITY INTERRUPT (API), KF8-E

The Priority Interrupt option will be available in the near future and will include the circuitry to control a push/pop list. The A.P.I. control will mount on a single quad module that plugs into the OMNIBUS.

CORE MEMORY(4K), MM8-E

A 4K memory block consists of three quad modules that plug into the OMNIBUS. The MM8-E is offered in 12-bit, 4096 word configurations.

MEMORY PARITY CONTROL, MP8-E

The Memory Parity Option adds all the circuitry and core memory necessary to read and test the parity for up to 32K of core. Three quad modules are required. The MP8-E plugs into the OMNIBUS.

256 WORD ROM, MR8-EA

This option is a 256 word Read-Only memory that mounts on a single quad module that plugs into the OMNIBUS.

256 WORD R/W MEMORY, MW8-E

This option is a 256 word Read/Write memory which can be write protected by means of an easily accessible switch. The control and memory are mounted on a single quad module that plugs into the OMNIBUS.

BOOTSTRAP LOADER, MI8-E

This option is a hardware Bootstrap Loader. The control is mounted on a single quad module that plugs into the OMNIBUS.

REAL-TIME CLOCK, DK8-EP

The DK8-EP is used with the PDP-8/E to count intervals or events in a large variety of ways. The DK8-EP consists of two quad modules that plug into the OMNIBUS. The major features include: a 12-bit counter and overflow utilizing MSI integrated circuitry; a 12-bit buffer register; five program
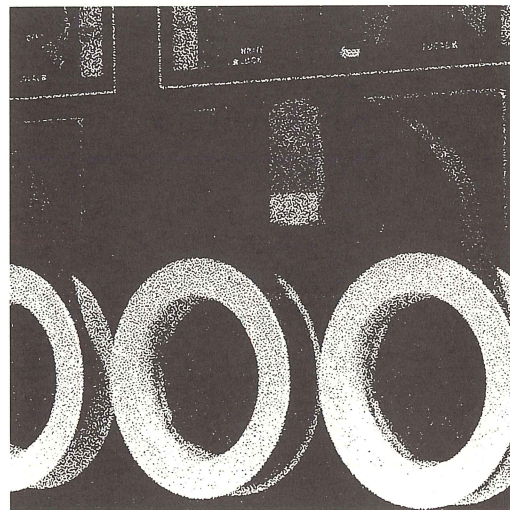
PDP-8/E OPTIONS AND PERIPHERALS

selectable count rates plus an input for an internal clock source; a crystal controlled clock for accuracy and stability; and three external inputs to the three Schmidt triggers which have adjustable thresholds.

LINE FREQUENCY CLOCK, DK8-EA AND CRYSTAL CLOCK, DK8-EC

The DK8-EA Line Frequency Clock and the DK8-EC 50 Hz Crystal Clock are used whenever periodic interrupts are required. Either option mounts on a single quad module that plugs into the OMNIBUS.

HIGH SPEED PERFORATED TAPE READER AND PUNCH, PC8-E

The PC8-E includes the PR8-E high-speed reader and PP8-E paper tape punch. The control plugs directly into the OMNIBUS. The PR8-E photo-electrically senses eight-channel, fanfold, perforated tape at 300 characters per second. The companion paper tape punch operates at 50 characters per second. Both include hoppers for handling fanfold tape. Reader and punch are available separately.
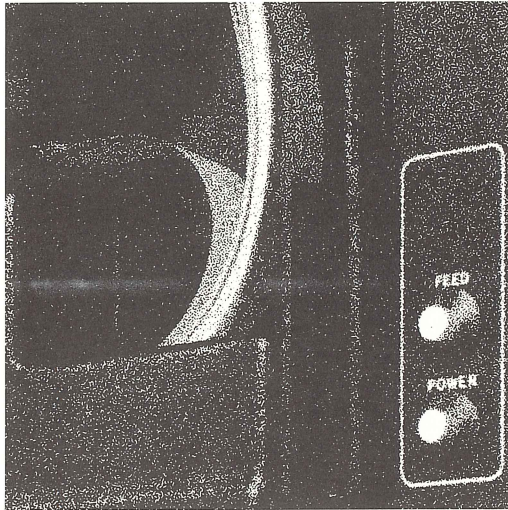
OPTICAL MARK CARD READER & CONTROL, CM8-E

The Optical Mark Reader and Control reads marked or punched Hollerith data cards with pre-printed timing marks at a nominal rate of 200 cards per minute. No special pen or pencil is needed to mark the standard 12-row, 40-column mark sense card. The control circuit for the card reader is mounted on a single quad module that plugs in the OMNIBUS.

CARD READER AND CONTROL, CR8-E

The control circuit for this device is located on a single quad board that plugs into the OMNIBUS. It reads standard 12-row, 80-column punched cards at a maximum rate of 200 cards per minute.

LINE PRINTER & CONTROL, LE8

The LE8 is an interface to several models of Line Printers offered by Digital. The interface and control is mounted on one single quad module that plugs into the OMNIBUS. Line Printers include 80 and 132 column with 64 or 96 character sets.

INCREMENTAL PLOTTER CONTROL, XY8-E

Enabling direct digital plotting, the incremental plotter control XY8-E operates most models of CalComp and Houston Instrument plotters. The complete control and interface is contained in one quad module that plugs into the OMNIBUS.

DATA BREAK INTERFACE, KD8-E

This option adds the hardware and cables to implement one standard Family-of-8 Data Break Channel. As many as 12 may be added, provided no internal options use the break system. The KD8-E is mounted on a single quad module that plugs into the OMNIBUS. Multiplexing of Data Break devices is handled within the PDP-8/E, making the addition of a data break multiplexer unnecessary.

EXTERNAL BUS INTERFACE FOR POSITIVE I/O DEVICES, KA8-E

This option provides conversion from the OMNIBUS to a PDP-8 Family positive external programmed I/O bus. A maximum of one KA8-E may be used per machine. The KA8-E consists of one quad module that plugs into the OMNIBUS.

12-CHANNEL BUFFERED DIGITAL I/O, DR8-EA

The DR8-EA provides for 12 digital outputs and 12 digital inputs. Both signals are of TTL levels. These signals are the means to drive and/or receive AC or DC switches, relays, converters, or signal conditioners. The entire option is contained on one quad module that plugs into the OMNIBUS.

DIGITAL OUTPUT SYSTEMS, DR01/06

In order to provide drive signals for digital control equipment such as indicators, relays, latching relays, solenoids, and stepper motors, Digital provides six

varieties of digital output channels. Each unit accepts parallel computer words under program control. The different types of digital output systems convert output bits to indicator or relay drive current, form A contact closures, positive or negative logic levels, set/reset pulses for latching relays, or medium-power pulse outputs. The KA8-E is a prerequisite for the DR01/06.

DECDISK RANDOM ACCESS DISK FILE, DF32D

The DECdisk type DF32D is a low-cost, random-access, bulk storage device and control with a capacity of 32,768 13-bit words (12-bits plus parity) of storage. Transfer rate is 32 microseconds per word. The DF32D can economically expand the memory capacity of the PDP-8/E by providing up to 131,072 words of additional storage using three expander DS32D disks. The KA8-E and KD8-E are prerequisites for the DF32D.

DISK CARTRIDGE SYSTEM, RK8

The RK8 consists of one Disk File and Control and will handle up to three additional RK01 Expander Disk Files. Each RK01 Expander Disk File will store up to 831,488 12-bit words. The maximum configuration of the system is one RK8 and three RK01's providing 3.3 million words of disk storage. The RK01-K is the Disk Cartridge.

DECTAPE TRANSPORT, TU56, AND AUTOMATIC CONTROL, TC08

The TU56 is a TTL logic, dual DECtape transport. A maximum of four dual transports can be driven by the TC08 DECtape control. Each dual unit allows for the mounting of two tape transports in just 10½ inches of standard 19 inch equipment rack. The TC08 control also uses TTL logic. A maximum DECtape configuration with 4 TU56 dual transports, each carrying a 200,000 word tape reel, can provide over 1.6 million words of storage. Binary information is transferred between the tape and the computer at a rate of a 12-bit word every 133 microseconds. The KA8-E and KD8-E are prerequisites for the TC08.

INDUSTRY COMPATIBLE MAGNETIC TAPE

An announcement concerning the availability of industry compatible magnetic tape for the PDP-8/E will be made shortly.

POINT PLOT DISPLAY & CONTROL, VC8-E

The VC8-E is a two axis Digital-to-Analog Converter and intensifying circuit which provides the deflection and intensity signals needed to plot data. Oscilloscopes available for Point Plotting are the VR03A and the VR12, and provisions are made for servicing the 374A Light Pen. Points can be plotted at approximately a 30 KHz rate. The control circuit for this device is located on a single quad module that plugs into the OMNIBUS.

CHARACTER GENERATOR, VA8-E

The VA8-E is a basic 64 character ASCII coded Character Generator and is offered as an option to the VC8-E. It consists of a single quad module that plugs into the OMNIBUS.

GRAPHIC SYSTEM, KV8-E

The KV8-E Graphic System consists of the Storage Tube Display Control, VS8-E; the Storage Oscilloscope Display, VT01; and the Joy Stick Cursor Control, H306. The VS8-E is the control for the VT01 (a modified Tektronix 611 scope) storage display. The VS8-E can draw linear or circular stroke vectors and plot points. The VT01 has a display surface of 16.3 horizontal by 21 vertical centimeters. It offers a compact storage tube display at low cost. The VS8-E plugs into the OMNIBUS.

The H306 Joy Stick is a self-contained unit which connects to the VT01, which in turn connects to the VS8-E control. The H306 Joy Stick is a controlled pointer, incorporating a write-through cursor.
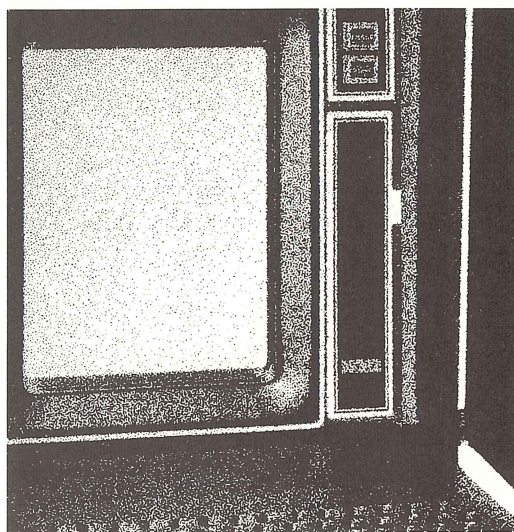
PDP-8/E OPTIONS AND PERIPHERALS

10-BIT ANALOG-TO-DIGITAL CONVERTER, AD8-EA

The AD8-EA is a 10-bit successive approximation Analog-to-Digital converter with sample and hold amplifier packaged on a single quad module that plugs into the OMNIBUS. The A/D Converter converts an analog input signal (0 to +10V) to a 10-bit binary number.

EIGHT-CHANNEL MULTIPLEXER & CONTROL, AM8-EA

The AM8-EA has a 64-channel multiplexer control, eight preamplifiers and eight-channel multiplexer switches. It is used with the AD8-EA Analog-to-Digital Converter. It is packaged on a single quad module that plugs into the OMNIBUS.

EIGHT-CHANNEL MULTIPLEXER EXPANDER, AM8-EB

The AM8-EB is an eight-channel multiplexer expander for the AM8-EA option. Up to seven expanders, 56_{10} channels maximum, may be added to the basic system. Eight FET switches and eight amplifiers are supplied on a single quad module that plugs into the OMNIBUS.
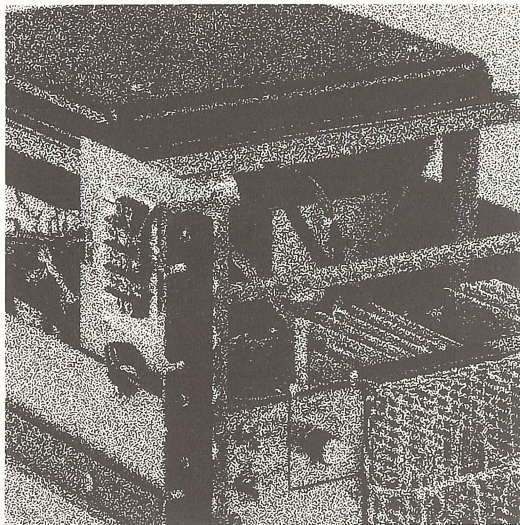
GENERAL-PURPOSE ANALOG-TO-DIGITAL CONVERTER SYSTEM, AD01-AP

The AD01-AP is a low-cost, successive approximation converter that converts an analog input signal to a ten-bit straight binary number. Input voltage range is 0 to +10 volts, and input impedance is 1000 ohms. Conversion rate is 100 KHz, and conversion time is 10 microseconds. The AD01-B is an AD01-AP with a multiplexer control for up to 16 channels of analog input. Maximum conversion rate with the AD01-B is 50 KHz. Sample and hold plus other input amplifiers are available as options.

GUARDED SCANNING DIGITAL VOLTMETER, AF04-A

The AF04-A is a guarded scanning integrating digital voltmeter system with automatic ranging from ±10 mV to ±300 volts. It features a usable 5-microvolts resolution and full expansion to 1000 channels. Guarded input construction and active integration provide an effective common mode rejection of greater than 140 dB at all frequencies. Operated under program control, it is capable of either random or sequential channel selection. The KA8-E and DW08-A are prerequisites for the AF04-A.

MULTIPLEXER CONTROL, AM08

The AM08 is an analog multiplexer control for up to 1,024 channels. The analog switches, which the AM08 controls, are mounted in either AM02 or AM03 mounting hardware, depending on whether the signals are signal-ended or differential. The analog output can be converted to digital form for computer input by an AD01-AP.

DIGITAL-TO-ANALOG CONVERTER, AA50-AP

The AA50-AP D/A converter is used to convert 12-bit binary numbers to analog voltages. The unit contains one, two, or three converters with three separate digital buffer registers. Register updating is done through one 12-bit input channel. The KA8-E is a prerequisite for the AA50-AP.

DIGITAL-TO-ANALOG CONTROL, AA05/7

The AA05/7 controls up to 64 digital-to-analog converter channels. Each channel can contain a 10-bit D/A converter module (type A608/11) to handle single and double buffering plus various output voltages. The D/A converter address and digital word to be converted are both program-controlled. The double-buffered D/A converter's new data can be stored and not affect the previous data, thereby permitting fast updating of all channels with a single command. The AA05/7 includes housing for up to 24 digital-to-analog channels. Up to 40 additional

channels, all of which are controlled by the AA05/7, can be housed in the AA07 expansion option. The KA8-E is a prerequisite for the AA05/7.

DIGITAL INPUT SYSTEMS, DS01/04

Prepackaged multichannel digital input subsystems are easily connected to the PDP-8/E computer. Contact closures and sustained logic levels are buffered until they can be sampled. When many input lines are in use, they are scanned in groups of 12. The KA8-E is a prerequisite for the DS01/04.

CONSOLE TELEPRINTER CONTROL, KL8-E

The KL8-E provides the standard control for the Console Teleprinter. Control operations run at speeds up to and including 600 baud. Teleprinters used with the KL8-E may utilize 8-bit code with either one or two stop elements. The control plugs into the OMNIBUS.

SYNCHRONOUS MODEM INTERFACE, DP8-EA

The DP8-EA is an interface between the computer and a full- or half-duplex serial synchronous modem having interface characteristics compatible with EIA RS-232-B standards. The DP8-EA consists of two quad modules, a level converter, and a synchronous interface that plugs into the OMNIBUS.

ASYNCHRONOUS DATA, DT8-EA

The DT8-EA Asynchronous Data control will control up to four Teleprinter stations, transmit and receive. This option consists of a single quad module with all the necessary drivers and IOT decoders. A maximum of three DT8-EA's may be used on the PDP-8/E for a total of 12 Teletypes maximum. The DT8-EA plugs into the OMNIBUS.

MODEM CONTROL, DT8-EB

This asynchronous option is used for remote operations to interface a Bell series 100 or equivalent modem to the DT8-EA multiple Teletype control. This unit will interface four modems on one quad board, and up to three DT8-EB's can be used with the corresponding DT8-EA's. The DT8-EB plugs into the OMNIBUS.

HIGH-SPEED INTERFACE, DT8-EC

The DT8-EC is a high-speed clock which may be used with alphanumeric display terminals, where a clock rate greater than 300 Baud is necessary, or when the transmit and receive clock rates differ. One DT8-EA is needed with each DT8-EC. The DT8-EC will handle four CRT terminals and is a single quad module which plugs into the OMNIBUS.

TELETYPES

An LT33-DC (Automatic Send/Receive) Teletype with paper tape reader and punch is available with the PDP-8/E. Also available as options are the LT35-DC, LT33-CC and LT35-CC.

INTERFACE MODULES

Digital is the world's largest supplier of logic modules. A complete line of modules, mounting hardware and accessories is availabie to those who want to build interfaces to special peripherals. More information is available in Digital's Logic Handbook and Small Computer Handbook.

To The Potential Computer User

ABOUT DIGITAL EQUIPMENT CORPORATION

In a little over a decade, Digital Equipment Corporation has grown from three employees and one floor of production space to a major international corporation, which in 1969 grossed more than $87 million in sales. Digital now employs over 5,500 people around the world. Its products are manufactured in several plants, and are sold and serviced from customer support offices worldwide.

The company produces a wide variety of computer and control products, ranging from logic modules to large time-sharing systems. The product spectrum includes 12-, 16-, 18-, and 36-bit computers, various peripherals, special systems, accessories, and a variety of software packages.

Digital first began manufacturing computer-related equipment in 1957, with a line of logic circuit modules. This product line has continually been broadened, and the company now ranks as the world's leading manufacturing supplier of modules, producing more than three million per year.

Digital's first computer, the PDP-1, was introduced 10 years ago. It sold for $120,000 while competitive machines were priced at over $1 million. Ever since the PDP-1, Digital has been a leading force in the on-line, real-time computer field. With close to 9,000 computers installed, the company ranks as the world's third largest manufacturer in terms of number of systems installed.

The PDP-5, introduced in 1963, was the first truly small computer. Its successor, the PDP-8 series, begun in 1964, is one of the most successful families of computers ever produced.

Digital is a leading force in small computers, but it also has been a pacesetter in other parts of the industry. For example, one of the first time-sharing systems ever built incorporated a PDP computer. And, Digital introduced the first large-scale, commercially available time-sharing system in 1965 — the PDP-6. Its successor, the PDP-10, is the price/performance leader in its field.