CONTROL DATA® 160-A COMPUTER

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The CONTROL DATA 160-A is a desk-size computer with the speed capability, and flexibility of many large-scale computers. Internal and external interrupt, buffered input/output, expansible magnetic core memory (optional), external multiply/divide unit (optional), storage cycle time of 6.4 microseconds—these and other outstanding features discussed on the following pages have won a place for the 160-A in applications that run the gamut from commercial data processing to highly sophisticated engineering-scientific research. A careful review of 160-A capabilities related to cost, not only initially but also for actual processing, will give you a good idea of the reason for this acceptance. In addition, the low initial cost of this equipment combined with its upwards compatibility to the CONTROL DATA 160G Computer System makes it an ideal choice, where budgets and immediate processing requirements are limited but allowances must be made for future growth.

SUMMARY OF 160-A FEATURES

- Stored program, general purpose digital computer
- Parallel mode of operation
- 12-bit word length
- Single address logic:
  function code (F) . . . . 6 bits
  execution code (E) . . . . 6 bits
- Low cost
- 8192 words of magnetic core storage (expansible to 16,384; 24,576; or 32,768 words):
  6.4 microseconds . . . . memory cycle time
  12.8 microseconds . . . . basic add time
  15.0 microseconds . . . . average execution time
- Buffered input/output
- Internal and external interrupt
- External multiply and divide unit (optional)
- Binary arithmetic (one's complement)
- Flexible repertoire of 130 instructions
- Completely solid state
- Low-power consumption
- High reliability

160-A APPLICATIONS

A general-purpose, digital computer, the 160-A can be used in numerous applications . . . including:

Real-Time Applications

The 160-A exchanges data with input/output devices at any rate up to 70,000 words per second. This transfer rate, an average instruction execution time of 15 microseconds, and the capability of buffering data while computing or while the operator manually enters data (whether the computer program is running or stopped) make the 160-A ideal for real-time applications.

Off-Line Conversion

The 160-A is able to control a wide selection of peripheral devices, and thus to operate as an efficient off-line system for larger computers. Of special note is the Control Data Bin Pak program which allows direct binary output of large-scale binary machines to be processed by the 160-A. Additional service routines include:

- Card-to-magnetic tape
- Magnetic tape-to-printer
- Paper tape-to-card
- Magnetic tape-to-paper tape
- Card-to-printer
- Plotter output operations

General Data Processing

With the capability of fully buffering information to input/output devices, the 160-A Computer System includes the capability to read up to 1600 cards per minute, print 1000 lines per minute, or file up to 60,000 characters per second.

Data Acquisition and Reduction

The input/output design of the 160-A permits direct and high-speed communication with analog-to-digital conversion equipment. After transmission of data, information can be converted, reduced or formatted by means of a stored program and then written on magnetic tape for later analysis if desired.

Peripheral Processing

Because of the high cost involved in operating peripheral devices from large-scale computer systems, the 160-A offers the user a low cost peripheral processor which can operate magnetic tape units, high-speed printers and card reader or card punch units.

The 160-A will operate up to four 1000 line-per-minute line printers at a maximum of 4000 lines per minute while simultaneously performing card-to-tape operations at the maximum rate of the card reader.

A typical maximum 160-A configuration employing the auxiliary memory and an additional buffered I/O channel, will handle up to 8 simultaneous card/tape/printer operations at full speed.

Scientific Computing with FORTRAN

A low-cost arithmetic unit especially designed for high-speed FORTRAN execution and a powerful set of logic commands which enable the fastest compilation times of any machine in its class, combine to make the 160-A system exceptionally useful for both engineering and scientific problems. Using the field-proven 160-A FORTRAN (a complete FORTRAN II computer), scientific applications are quickly programmed, checked out, and in production. A complete subroutine library (sine, cosine, etc.), and comprehensive diagnostics are included with the system.

Civil Engineering Problems

Using CEPS (the Civil Engineering Programming System), the 160-A applies high-speed solving power to geometric calculations in highway design, right-of-way, bridge geometry, subdivision and parcel work, structures, construction layout, photogrammetry, hydraulics and many more.

Biomedical Experimentation and Analysis

Today's Biomedical Researcher is confronted with the need for a small, real-time, inexpensive, powerful,

"hands-on", data acquisition and data processing system. The 160-A meets these needs and more. By adding a high-speed analog-to-digital and/or a digital-to-analog converter system to an impressive array of standard peripheral devices, the 160-A can accomplish these typical tasks:

1. On-line processing of ECG, PCG, and EEG data for analysis and diagnosis.

2. Averaging of evoked response physiologic signals.

3. Closed-loop hybrid computational analysis of physiologic systems such as in cardiovascular, respiratory control and renal control studies. Hybrid computer systems employ an analog computer interfaced to the 160-A.

4. General statistical analysis of biomedical data.

5. Real-time on off-line display and plotting in conjunction with X-Y plotters, digital plotters (such as the CONTROL DATA 165-2) and oscilloscopes.

6. Surveillance storage and logging of vital sign physiologic data in patient monitoring applications. Here, an analog-to-digital converter would scan signals from medical electronic instrumentation and transducers available from reputable manufacturers.

Communications and Telemetry

A high-speed, parallel processor with decision-making powers, the 160-A can be used as the principal element in communication and control networks.

Proven reliability of the 160-A is a prerequisite for such applications. In addition, the 160-A can be used to communicate via microwave link with the large-scale CONTROL DATA 1604 Computer at transmission rates of approximately 1,000,000 bits per second.

160-A OPERATION

Operation of the 160-A Computer is sequenced by an internally stored program. Along with the data being processed, this program is stored in the random-access memory. All peripheral equipments on the buffer channel have direct access to this memory . . . thus permitting input/output operations to proceed during computation.

Buffered Input/Output

Input/output operations in the 160-A are carried out independently of the main computer program. When transmission of data is required, the main computer program is used only to initiate an automatic cycle which buffers data to or from the computer memory. The main computer program then continues while the

3

actual buffering of data is carried out independently and automatically.

Communication with on-line peripheral equipments is completely buffered and completely automatic. This buffering includes addressing capabilities for selecting the peripheral device, and registers for transferring the data. Thus, input/output operations are carried out in parallel and simultaneously with the execution of the main program.

While these are routine capabilities for the very large computer systems, Control Data has accomplished a real breakthrough in designing this level of sophistication in a low cost, desk-size computer . . . the 160-A.

Magnetic Core Memory

The basic 160-A memory consists of 8192 words of magnetic core storage, divided into two banks of storage—each with a capacity of 4096 12-bit words and a storage cycle time of 6.4 microseconds.

The basic memory can be expanded in external modules of 8192 words up to a maximum of 32,768 words. These external memory modules—including control circuitry and an additional input/output buffer channel—are housed in a single cabinet. Any module in this external cabinet may be time-shared by two 160-A Computers, as shown in the following diagram.
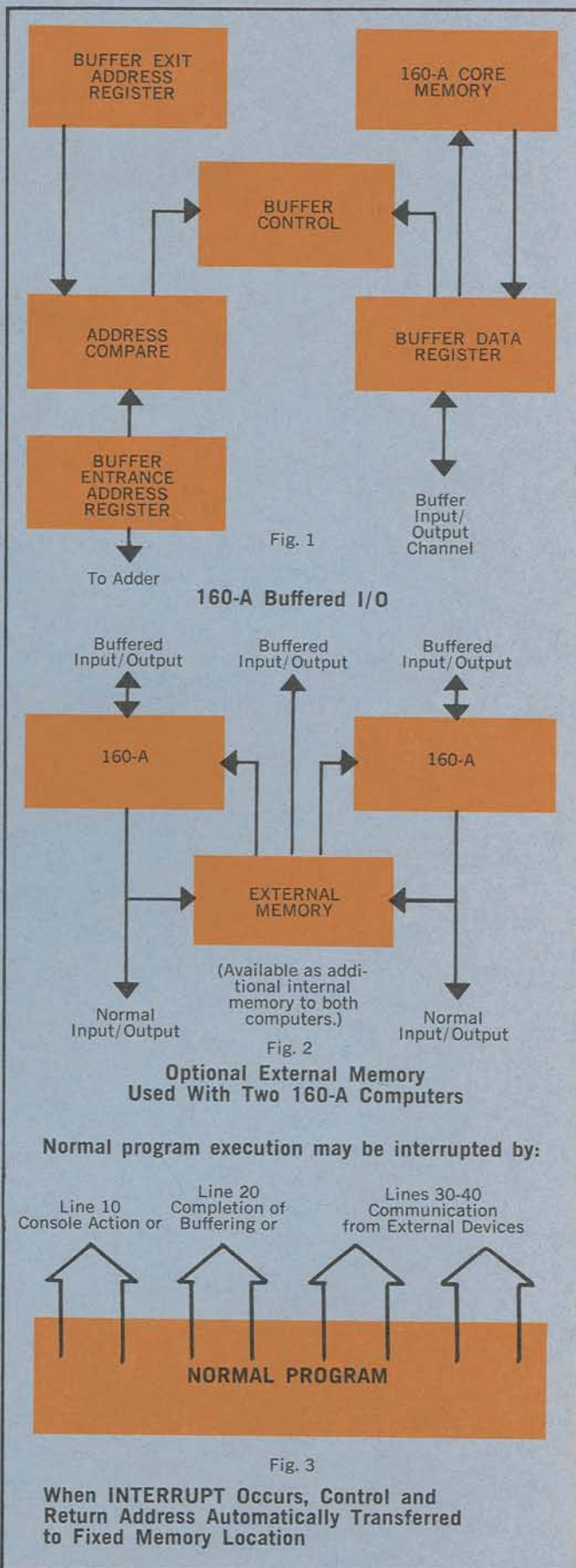
External Multiply-Divide Unit

An external arithmetic unit is available as an optional input/output device for use with the 160-A Computer. It performs the following operations with positive operands sent to it from the computer: Divide, multiply, add, subtract, shift left, shift right and normalize and count. All multiply-divide calculations are carried out in fixed point. Single and double precision numbers are represented in one's complement form. Once computation begins within the unit, the computer is free to perform other tasks.

Manual controls include on-off switches with an indicator light to signal a timing fault. Sixteen computer external-function codes select and direct the unit, with five status responses to indicate processing flow: Unit Ready, Overflow, Unload not Completed, Busy Computing and Divide Fault (occurs when divisor is equal to or smaller than the most significant 27 bits of the dividend.) Upon completion of computation, results are read back into the computer.

Interrupt

Program interrupt is one of many standard features that provides the CONTROL DATA 160-A with capability

Fig. 1

160-A Buffered I/O

Fig. 2

**Optional External Memory
Used With Two 160-A Computers**

Normal program execution may be interrupted by:

Fig. 3

**When INTERRUPT Occurs, Control and
Return Address Automatically Transferred
to Fixed Memory Location**

4

and flexibility usually associated with large-scale computers. Certain internal and external conditions arise which make it necessary for the main computer program to be interrupted. This interrupt results in the transfer of computer control to some fixed location in memory without losing the information needed to return to the main program.

The 160-A has four interrupt lines: two internal and two external. When an interrupt signal occurs on one of these lines, the computer executes a Return Jump instruction to one of four fixed memory locations, depending upon the line which generated the interrupt.

Interrupt signals are recognized in a priority sequence, the lower numbered being recognized first. Thus, where an interrupt occurs simultaneously on Lines 10 and 20, Line 10 will be recognized first. Once a internal interrupt signal is placed on a line, it remains until it is recognized or until a console Master Clear is executed. External interrupt signals are cleared by an external equipment clear or a console master clear.

CONTROL PANEL

A display panel and a switch panel, together constituting the operating console or control panel, contain all switches and indicators necessary to operate the 160-A Computer. The display panel contains three windows in which the contents of nine registers may be displayed in octal, using Arabic numerals. Buttons are provided beneath these windows for clearing and entering data into the P, A, and Z registers. Centered beneath each register window is a three-position lever switch which determines the particular register contents to be displayed. A fourth window contains a status indicator and an MCS mode display; the latter indicates the storage bank currently being used. The display panel also holds the power switches for the punch and reader.

The switch panel contains the computer power and mode switches. The Margin switch is used for maintenance checkout. Enter-Sweep permits the entering of data into core storage or the examination of storage contents. Load-Clear is used to load a program from paper tape, or to master clear the computer. Run-Step determines the operating mode: in RUN the 160-A operates at high speed; in STEP one storage reference cycle is executed each time the switch is pressed.

Three Selective Jump and three Selective Stop switches increase the programming capabilities of the computer. Any combination of a Selective Jump switch and the step switch activates the Slow Speed Run (about 10 memory cycles per second.)
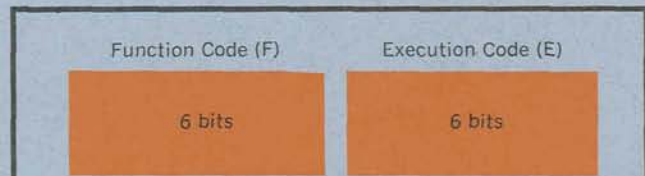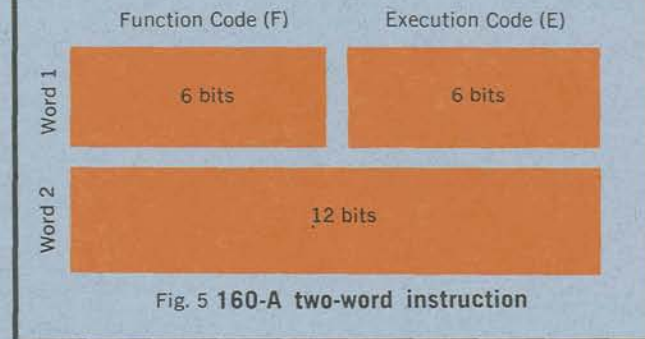

Fig. 4 **160-A one-word instruction**

Fig. 5 **160-A two-word instruction**

160-A INSTRUCTION WORD FORMAT

A 160-A instruction word is divided into a 6-bit function code (F) and a 6-bit execution address (E). Shown in Fig. 4.

The function code (F), and in some cases the execution code (E), determines which instruction in the 160-A repertoire will be executed. Because E contains only 6 bits, it is not possible for E to specify a complete storage address in all cases. Therefore, depending upon F, the computer selects for each instruction one of several addressing modes.

Most instructions require only one word of storage, but certain expanded instructions are available which occupy two words of storage. The format of 2-word instructions has the first word containing a 6-bit function code and a 6-bit execution address. (See Fig. 5.) The execution address in two-word numbers is usually equal to zero. The second word contains a 12-bit address or operand (G), depending on the instruction. Words 1 and 2 are then located in sequential storage addresses of the same bank.

ADDRESSING MODES

No Address Mode—N

In the NO ADDRESS MODE, E is the lower 6 bits of an implied 12-bit operand, the higher order 6 bits of which are always zero. Thus, the E portion of the instruction word becomes the operand.

Direct Address Mode—D

With the DIRECT ADDRESS MODE, E selects one of the first 100 octal locations in the direct storage bank (d).

Indirect Address Mode—I

In the INDIRECT ADDRESS MODE, E references one of the last 77 octal of the first 100 octal locations in the direct storage bank (d) for an operand address to be referenced in the indirect storage bank (i).

Relative Forward Address Mode—F

In the RELATIVE FORWARD ADDRESS MODE, E is added to the contents of the P register. This sum then becomes the effective operand address in the relative storage bank,(r).

Relative Backward Address Mode—B

The RELATIVE BACKWARD ADDRESS MODE functions in a manner similar to the RELATIVE FORWARD (F) mode, except that E is subtracted from the contents of the P register to form an effective address in the relative storage bank.

Specific Address Mode—S

In the SPECIFIC ADDRESS MODE, the effective address is always storage location 7777 in storage bank zero. The E portion of the instruction word is always equal to zero.

Memory Address Mode—M

All MEMORY ADDRESS MODE commands occupy two sequential storage locations where the G portion of the 24-bit instruction word contains the address of the operand to be referenced in the indirect storage bank (i). The E portion of the instruction word is always equal to zero.

Constant Address Mode—C

All CONSTANT ADDRESS MODE commands occupy two sequential storage locations where the G portion of the 24-bit instruction word contains the operand. The E portion of the instruction word is always equal to zero.

DESCRIPTION OF REGISTERS

The CONTROL DATA 160-A Computer uses three operational and seven transient registers. Operational registers are referred to implicitly in the individual program steps, and may be modified by manually inserting quantities into them. The transient registers are important only to the internal operation of the computer and are not available for modification from the control panel.

Operational Registers

A Register—A is the principal arithmetic register; for most arithmetic operations, A operates as a subtractive accumulator. The quantity zero is represented by all zeros.

Z Register—As a buffer register Z receives the word read out of storage and holds the word to be written into storage. For addition and subtraction operations, the contents of Z are added to or subtracted from the contents of A.

P Register—P, the Program Control Register, contains the address of the current instruction. At the beginning of each instruction, the contents of P are increased by one to provide the address of the instruction. If a jump is called for, a jump address is entered in P. For certain instructions, the contents of P are advanced by two.

Transient Registers

BFR—During a buffer operation the Buffer Data Register holds the word of information being transferred to or from storage.

BER—During a buffer operation the Buffer Entrance Register holds the address to, or from, which information is being transferred. It is advanced by one with each data-word transfer.

BXR—The Buffer Exit Register contains the terminating address plus one for the current buffer operation. After each data-word transfer, a comparison is made between BER and BXR to determine whether another word should be transferred.

A' Register—A' is an auxiliary arithmetic register. The results of arithmetic operations are first formed in A' and then transmitted to the A, Z, S, or BER registers.

S Register—S functions as the Storage Address Register. Prior to any storage reference, the address word is entered in S. The contents of S are used to select the storage location involved in the reference.

F Register—F holds the upper 6 bits of an instruction word (the function code) throughout the execution of the instruction. The execution of an instruction is under the control of the quantity in F.

PSR—The Punch Storage Register is used on output operations involving the paper-tape punch. During such operations data normally held in Z is transferred to PSR, thereby releasing Z and enabling the computer to resume high-speed computation while the output word is recorded by the punch.

All but the PSR register may be indicated on the display panel.

PROGRAMMING SYSTEMS

The computing power, flexibility, and speed of the 160-A Computer are enhanced by the programming systems developed by Control Data for the 160-A Computer. These programming systems include symbolic assemblers, compilers, and interpretive systems with languages suited for general-purpose calculational tasks.

OSAS-A

A symbolic assembler, the OSAS-A provides fully symbolic coding, automatic address correspondence, code-error checking, and listing of source and object program. The object code may be in fixed or relocatable format. Full machine language of the 160-A is available in symbolic operation codes. Pseudo operations control the assembler and its translation of the source program.

SICOM

SICOM for the Control Data 160-A Computer is a general-purpose interpretive system utilizing floating point arithmetic. It effectively converts the 160-A from a binary, fixed point machine with a 12-bit word length, into a decimal, floating point machine with a 10-decimal digit, plus exponent, word length. SICOM provides for full arithmetic, indexing, and logical capabilities . . . as well as additional features which provide functions and SICOM or machine language subroutines.

AUTOCOMM

Commercial data processing problems can be handled effectively on the 160-A by using AUTOCOMM. English language statements are used to describe each operation to be performed. These include BCD arithmetic of up through 12 decimal digits, powerful output editing, indexing and BCD comparing. Virtually any 160-A peripheral device may be used on an input/output unit. OSAS-A Assembly Language coding may be included with the source code, providing the full application of the 160-A, when highly sophisticated operations are to be performed.

INTERFOR

INTERFOR is an interpretive programming system for the 160-A Computer. It contains a symbolic assembler (FLAP), a binary program loader (FLOADER), a library of subroutines, and an interpreter. The system provides symbolic and numeric programming capabilities, six index registers, and 33-bit floating point arithmetic. The commands of the system are derived from a subset of the CONTROL DATA 1604 Computer commands. Programs may be written for this system which will also run on the 1604 Computer.

160-A FORTRAN

The 160-A FORTRAN includes a compiler, a subroutine library, and an interpreter. Programs are written in an algebraic-like notation using symbolic indentifiers. The language of the 160-A FORTRAN SYSTEM is the FORTRAN II language. The system contains all input/output routines necessary to use 160-A peripheral equipment. Provision is made to allow addition of routines to handle non-standard equipment.

CONTROL DATA Buffered Line Printers

The 166-2 Line Printer has a 120-character-wide print drum with a 64-character circumference around the drum. It can be operated on-line as well as off-line in five different modes. The CONTROL DATA 166-2 has a 150 lpm speed. The CONTROL DATA 1612 Printer, which is a high-speed peripheral device, provides a maximum output of 1000 lpm.

CONTROL DATA 169 Auxiliary Memory Unit

The CONTROL DATA 169 provides the option of operating two CONTROL DATA 160-A Computers together, sharing a common memory and a buffer channel. Available as an optional device, the 169 provides expansibility in modules of 8192 12-bit words up to a maximum of 24,576 words, providing a total system of 32,768 words.
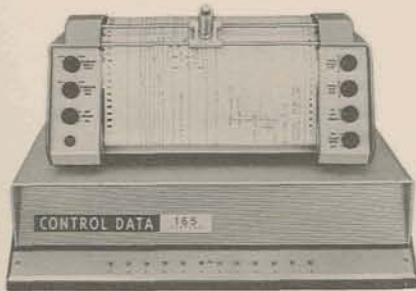
CONTROL DATA Plotters

The incremental plotter permits direct on-line communication from the 160-A. The CONTROL DATA 165-2 is a high-speed, two-axis recorder for plotting one variable against another. The 165-2 has a drum and carriage speed of 300 steps per second, and a pen speed of 10 operations (5 up and 5 down) per second maximum.

CONTROL DATA 405 Card Reader

The 405 Card Reader reads punched cards photoelectrically at the rate of 1200 (80-column) and 1600 (51-column) per minute. With an optional feature added, it can input either columnar data or Hollerith data (converted to BCD) directly to the CONTROL DATA 166 Line Printer for off-line card-to-printer or card-to-tape conversion.

CONTROL DATA 168-2 Arithmetic Unit

Provides the option of expanding the inherent flexibility of the 160-A Computer. Addition, subtraction, multiply, and divide are performed in 27-bit precision. The 168-2 performs operations in the following speeds: Addition and subtraction—205 usec; multiplication—280 usec; division—350 to 420 usec. Times include obtaining operands from memory and storing the results in memory.
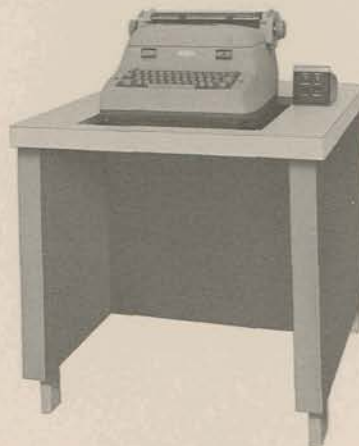
CONTROL DATA 161 Typewriter

The 161 accepts input information at normal typing speeds and prints output data from the computer at a rate of 10 to 12 characters per second. The 161 has a standard keyboard and a control panel containing two lever switches (Operating Mode and Input Disconnect) and two lights (Ready and Input Request).
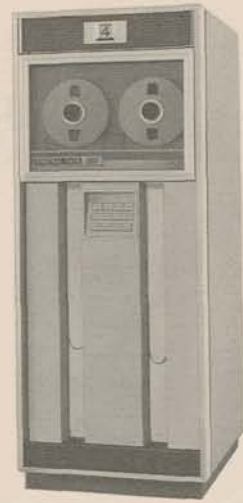
CONTROL DATA 601, 603, 604, 606 Tape Transports

The 600 Series Tape Transports provide fast, reliable storage and manipulation of digital information in computing and data processing systems.

CONTROL DATA 601: 37.5" per second, 200 or 556 bits per inch, 7.3 or 20.85 KC transfer rate.

CONTROL DATA 603: 75" per second, 200 or 556 bits per inch, 15 or 41.7 kc transfer rate.

CONTROL DATA 604: 75" per second, 200 or 556 bits per inch, 15,41.7 or 60 kc transfer rate.

CONTROL DATA 606: 150" per second, 200 or 556 bits per inch, 30 or 83.4 kc transfer rate.

CONTROL DATA 415 Card Punch

The CONTROL DATA 415 punches 80 column cards at the rate of 250 cards per minute. A post-punch read station is included to facilitate complete card checking.

F	E	G	MNE-Monic	Name	Timing
				STOP COMMANDS	
00	00		ERR	Error Stop	1
77	00		HLT	Halt	1
77	77		HLT	Halt	1
				DATA TRANSMISSION COMMANDS	
01	00	XXXX	BLS	Block Store (no jump)	1
				(jump)	2
01	01		PTA	Transfer P to A	1
01	05	XXXX	ATE	A to Buffer Entrance Register	
				(no jump)	1
				(jump)	2
01	06	XXXX	ATX	A to Buffer Exit Register	
				(no jump)	1
				(jump)	2
01	07		ETA	Buffer Entrance Register to A	1
01	30		CTA	Bank Controls to A	1
01	5X		STP	Store P at Location 5X	3
01	6X		STE	Store Buffer Entrance Register at Location 6X and Transfer A to Buffer Entrance Register	3
04	XX		LDN	Load No Address	1
20	XX		LDD	Load Direct	2
21	00	XXXX	LDM	Load Memory	3
21	XX		LDI	Load Indirect	3
22	00	XXXX	LDC	Load Constant	2
22	XX		LDF	Load Forward	2
23	00		LDS	Load Specific	2
23	XX		LDB	Load Backward	2
05	XX		LCN	Load Complement No Address	1
24	XX		LCD	Load Complement Direct	2
25	00	XXXX	LCM	Load Complement Memory	3
25	XX		LCI	Load Complement Indirect	3
26	00	XXXX	LCC	Load Complement Constant	2
26	XX		LCF	Load Complement Forward	2
27	00		LCS	Load Complement Specific	2
27	XX		LCB	Load Complement Backward	2
40	XX		STD	Store Direct	3
41	00	XXXX	STM	Store Memory	4
41	XX		STI	Store Indirect	4
42	00	XXXX	STC	Store Constant	3
42	XX		STF	Store Forward	3
43	00		STS	Store Specific	3
43	XX		STB	Store Backward	3

F	E	G	MNE-Monic	Name	Timing
				DATA TRANSMISSION COMMANDS (Cont.)	
76	XX		HWI	Half Write Indirect	4
				ARITHMETIC COMMANDS	
01	12		MUT	Multiply A by 10	1
01	13		MUH	Multiply A by One Hundred	1
07	XX		SBN	Subtract No Address	1
34	XX		SBD	Subtract Direct	2
35	00	XXXX	SBM	Subtract Memory	3
35	XX		SBI	Subtract Indirect	3
36	00	XXXX	SBC	Subtract Constant	2
36	XX		SBF	Subtract Forward	2
37	00		SBS	Subtract Specific	2
37	XX		SBB	Subtract Backward	2
06	XX		ADN	Add No Address	1
30	XX		ADD	Add Direct	2
31	00	XXXX	ADM	Add Memory	3
31	XX		ADI	Add Indirect	3
32	00	XXXX	ADC	Add Constant	2
32	XX		ADF	Add Forward	2
33	00		ADS	Add Specific	2
33	XX		ADB	Add Backward	2
50	XX		RAD	Replace Add Direct	3
51	00	XXXX	RAM	Replace Add Memory	4
51	XX		RAI	Replace Add Indirect	4
52	00	XXXX	RAC	Replace Add Constant	3
52	XX		RAF	Replace Add Forward	3
53	00		RAS	Replace Add Specific	3
53	XX		RAB	Replace Add Backward	3
54	XX		AOD	Replace Add One Direct	3
55	00	XXXX	AOM	Replace Add One Memory	4
55	XX		AOI	Replace Add One Indirect	4
56	00	XXXX	AOC	Replace Add One Constant	3
56	XX		AOF	Replace Add One Forward	3
57	00		AOS	Replace Add One Specific	3
57	XX		AOB	Replace Add One Backward	3
				SHIFT COMMANDS	
01	02		LS1	Left Shift One	1
01	03		LS2	Left Shift Two	1
01	10		LS3	Left Shift Three	1
01	11		LS6	Left Shift Six	1

F	E	G	MNE-Monic	Name	Timing
				SHIFT COMMANDS (Cont.)	
01	14		RS1	Right Shift One	1
01	15		RS2	Right Shift Two	1
44	XX		SRD	Shift Replace Direct	3
45	00	XXXX	SRM	Shift Replace Memory	4
45	XX		SRI	Shift Replace Indirect	4
46	00	XXXX	SRC	Shift Replace Constant	3
46	XX		SRF	Shift Replace Forward	3
47	00		SRS	Shift Replace Specific	3
47	XX		SRB	Shift Replace Backward	3
				LOGICAL COMMANDS	
02	XX		LPN	Logical Product No Address	1
10	XX		LPD	Logical Product Direct	2
11	00	XXXX	LPM	Logical Product Memory	3
11	XX		LPI	Logical Product Indirect	3
12	00	XXXX	LPC	Logical Product Constant	2
12	XX		LPF	Logical Product Forward	2
13	00		LPS	Logical Product Specific	2
13	XX		LPB	Logical Product Backward	2
03	XX		SCN	Selective Complement No Address	1
14	XX		SCD	Selective Complement Direct	2
15	00	XXXX	SCM	Selective Complement Memory	3
15	XX		SCI	Selective Complement Indirect	3
16	00	XXXX	SCC	Selective Complement Constant	2
16	XX		SCF	Selective Complement Forward	2
17	00		SCS	Selective Complement Specific	2
17	XX		SCB	Selective Complement Backward	2
				STORAGE BANK CONTROL COMMANDS	
00	1X		SRJ	Set Relative Bank Control and Jump	1
00	2X	SIC	Set	Indirect Bank Control	1
00	3X		IRJ	Set Indirect and Relative Bank Control and Jump	1
00	4X		SDC	Set Direct Bank Control	1
00	5X		DRJ	Set Direct and Relative Bank Control and Jump	1
00	6X		SID	Set Indirect and Direct Bank Control	1
00	7X		ACJ	Set Direct, Indirect, and Relative Bank Control and Jump	1

F	E	G	MNE-Monic	Name	Timing
				STORAGE BANK CONTROL COMMANDS (Cont.)	
01	4X		SBU	Set Buffer Bank Control	1
				JUMP COMMANDS	
60	XX		ZJF	Zero Jump Forward	1
61	XX		NZF	Non-Zero Jump Forward	1
62	XX		PJF	Positive Jump Forward	1
63	XX		NJF	Negative Jump Forward	1
64	XX		ZJB	Zero Jump Backward	1
65	XX		NZB	Non-Zero Jump Backward	1
66	XX		PJB	Positive Jump Backward	1
67	XX		NJB	Negative Jump Backward	1
70	XX		JPI	Jump Indirect	2
71	00	XXXX	JPR	Return Jump	3
71	XX		JFI	Jump Forward Indirect	2
				INPUT-OUTPUT COMMANDS	
01	04		CBC	Clear Buffer Controls	1
01	20		CIL	Clear Interrupt Lockout	1
72	00	XXXX	IBI	Initiate Buffer Input (no jump)	1
				(jump)	2
73	00	XXXX	IBO	Initiate Buffer Output (no jump)	1
				(jump)	2
72	XX	YYYY	INP	Normal Input	*
73	XX	YYYY	OUT	Normal Output	*
74	XX		OTN	Output No Address	*
76	00		INA	Input to A	*
76	77		OTA	Output from A	*
75	00	XXXX	EXC	External Function Constant	2
75	XX		EXF	External Function Forward	2
				MISCELLANEOUS COMMANDS	
00	0X		NOP	No Operation	1
77	0X		SLS	Selective Stop	1
77	X0	YYYY	SLJ	Selective Jump (no jump)	1
				(jump)	2
77	XX	YYYY	SJS	Selective Stop and Jump (no jump)	1
				(jump)	

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