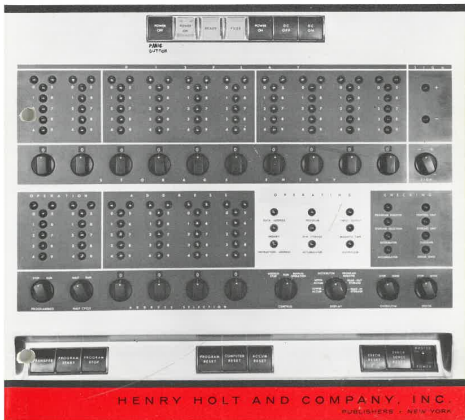


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*Programming the*

# IBM 650 MAGNETIC DRUM COMPUTER AND DATA- PROCESSING MACHINE



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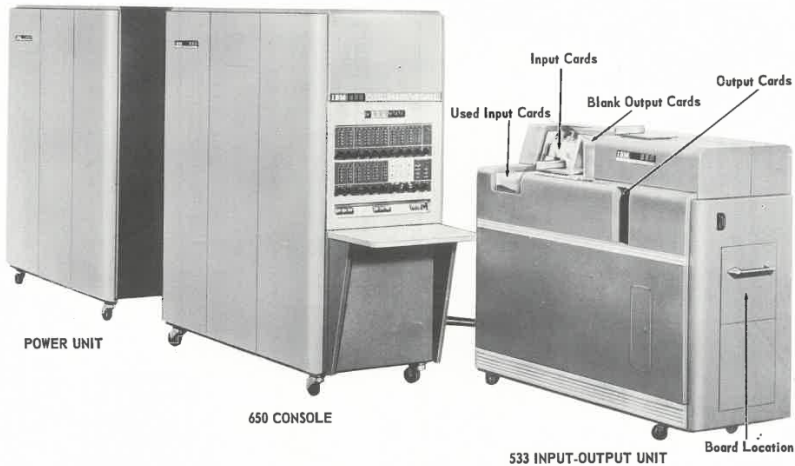


FIGURE 1-1  
MAGNETIC DRUM DATA-PROCESSING MACHINE  
TYPE 650



## 1-7. ACCUMULATOR.

The arithmetical unit is a 20-digit accumulator (like a 20-digit desk calculator). For convenience, it is thought of as divided into three parts, the upper half of the accumulator (10 digits), the lower half of the accumulator (10 digits), and a sign. In some operations it is



FIGURE 1-4  
ACCUMULATOR

desirable to use only the upper half of the accumulator; in some, to use only the lower half; and, in some, to use both parts. However, the machine *always* behaves as if the entire 20-digit accumulator were used, with zeros usually being placed on the unused section. A result that is in the accumulator will remain there until it is erased by a "reset" operation, or altered by an arithmetical operation, or until the power is shut off. (Capacitor storage which is used in the accumulator does *not* "hold"—i.e., remain indefinitely in the absence of regenerative power—as does the magnetic storage of the drum.)

1-6. DRUM.

The storage (formerly called "memory") unit of the 650 is a cobalt-nickel-plated cylinder about 4 inches in diameter and 16 inches long called a *Magnetic Drum* or just *Drum*. The drum revolves at about 19,500 rpm. Information is stored on the drum in the form of magnetized spots. The drum is divided into 2000 word locations, each word containing 10 digits and a sign. It is convenient to think of the surface of the drum as divided into 2000 rectangles, each containing 10 digits and a sign. Each rectangle is then a "drum location." Figure 1.3 shows a layout of a portion of the drum. Each location is given a "street address" or "drum location address" which is a 4-digit number running from 0000 to 1999. Words may be thought of as stored in 40 bands of 50 words each, running around the drum. Since the drum rotates at

	0000	0050	0100	0150	0200	0250	0300	0350	0400	0450	0500	0550	0600
BANDING	00	01	02	03	04	05	06	07	08	09	10	11	12
	13	14	15	16	17	18	19	20	21	22	23	24	25
	26	27	28	29	30	31	32	33	34	35	36	37	38
	39	40	41	42	43	44	45	46	47	48	49	50	51
	52	53	54	55	56	57	58	59	60	61	62	63	64
	65	66	67	68	69	70	71	72	73	74	75	76	77
	78	79	80	81	82	83	84	85	86	87	88	89	90
	91	92	93	94	95	96	97	98	99	00	01	02	03
	04	05	06	07	08	09	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24	25	26	27	28	29
SIGNATURES	30	31	32	33	34	35	36	37	38	39	40	41	42
	43	44	45	46	47	48	49	50	51	52	53	54	55
	56	57	58	59	60	61	62	63	64	65	66	67	68
	69	70	71	72	73	74	75	76	77	78	79	80	81
	82	83	84	85	86	87	88	89	90	91	92	93	94
	95	96	97	98	99	00	01	02	03	04	05	06	07
	08	09	10	11	12	13	14	15	16	17	18	19	20
	21	22	23	24	25	26	27	28	29	30	31	32	33
	34	35	36	37	38	39	40	41	42	43	44	45	46
	47	48	49	50	51	52	53	54	55	56	57	58	59
NO. OF WORDS	60	61	62	63	64	65	66	67	68	69	70	71	72
	73	74	75	76	77	78	79	80	81	82	83	84	85
	86	87	88	89	90	91	92	93	94	95	96	97	98
	99	00	01	02	03	04	05	06	07	08	09	10	11
	12	13	14	15	16	17	18	19	20	21	22	23	24
	25	26	27	28	29	30	31	32	33	34	35	36	37
	38	39	40	41	42	43	44	45	46	47	48	49	50
	51	52	53	54	55	56	57	58	59	60	61	62	63
	64	65	66	67	68	69	70	71	72	73	74	75	76
	77	78	79	80	81	82	83	84	85	86	87	88	89

FIGURE 1-3  
MAGNETIC DRUM LAYOUT

ARITHMETIC CODES		
Add Upper	10	AUP
Add Lower	15	ALO
Subtract Upper	11	SUP
Subtract Lower	16	SLO
Multiply	19	MPY
Divide	14	DIV
Divide Reset Upper	64	DVR
Reset Add Upper	60	RAU
Reset Add Lower	65	RAL
Reset Subtract Upper	61	RSU
Reset Subtract Lower	66	RSL
Add Absolute (Magnitude) to Lower	17	AML
Subtract Absolute (Magnitude) from Lower	18	SML
Reset Add Absolute (Magnitude) to Lower	67	RAM
Reset Subtract Absolute (Magnitude) from Lower	68	RSM

INDEXING REGISTER CODES		
<b>REGISTER "A"</b>		
Add	50	AXA
Subtract	51	SXA
Reset Add	80	RAA
Reset Subtract	81	RSA
Branch Non-Zero	40	NZA
Branch Minus	41	BMA
<b>REGISTER "B"</b>		
Add	52	AXB
Subtract	53	SXB
Reset Add	82	RAB
Reset Subtract	83	RSB
Branch Non-Zero	42	NZB
Branch Minus	43	BMB
<b>REGISTER "C"</b>		
Add	58	AXC
Subtract	59	SXC
Reset Add	88	RAC
Reset Subtract	89	RSC
Branch Non-Zero	48	NZC
Branch Minus	49	BMC

BRANCHING CODES		
<b>ACCUMULATOR</b>		
Branch Non-Zero Upper	44	NZU
Branch Non-Zero	45	NZE

BRANCHING CODES CONT'D		
Branch Minus	46	BMI
Branch on Overflow	47	BOV
<b>DISTRIBUTOR</b>		
Branch on 8 in Position 10	90	BDO
Branch on 8 in Position 1	91	BD1
Branch on 8 in Positions 2-8	92-98	BD2-8
Branch on 8 in Position 9	99	BD9
<b>INDEXING REGISTER "A"</b>		
Branch Non-Zero	40	NZA
Branch Minus	41	BMA
<b>INDEXING REGISTER "B"</b>		
Branch Non-Zero	42	NZB
Branch Minus	43	BMB
<b>INDEXING REGISTER "C"</b>		
Branch Non-Zero	48	NZC
Branch Minus	49	BMC

TAPE—RAMAC		
Branch No Tape Signal	25	NTS
Branch No End of File	54	NEF
Branch on Inquiry	26	BIN

INPUT—OUTPUT CODES		
<b>SYNCHRONIZER 1</b>		
Read	70	RD1
Write	71	WR1
Read Conditional	72	RC1
<b>SYNCHRONIZER 2</b>		
Read	73	RD2
Write	74	WR2
Read Conditional	75	RC2
<b>SYNCHRONIZER 3</b>		
Read	76	RD3
Write	77	WR3
Read Conditional	78	RC3

IMMEDIATE ACCESS STORAGE		
Load IAS Block	08	LIB
Load IAS	09	LDI
Store IAS Block	28	SIB
Store IAS	29	STI
Set IAS Timing Ring	27	SET

MISC. OPERATION CODES		
<b>STORE</b>		
Store Lower Accumulator	20	STL
Store Upper Accumulator	21	STU
Store "D" Address of Lower Accumulator	22	SDA
Store "I" Address of Lower Accumulator	23	SIA
Store Distributor	24	STD
<b>SHIFT</b>		
Shift Right	30	SRT
Shift Right and Round	31	SRD
Shift Left	35	SLT
Shift Left and Count	36	SCT
<b>MISC.</b>		
No Operation	00	NOP
Stop (Halt)	01	HLT
Load Distributor	69	LDD
Table Look-Up	84	TLU

TAPE		
Read Tape Numeric	04	RTN
Read Tape Alphameric	05	RTA
Write Tape Numeric	06	WTN
Write Tape Alphameric	07	WTA
Read Tape for Checking	03	RTC
Branch No Tape Signal	25	NTS
Branch No End of File	54	NEF
Rewind Tape	55	RWD
Write Tape Mark	56	WTM
Backspace Tape	57	BST

RAMAC—DISK STORAGE		
Seek Disk Storage	85	SDS
Read Disk Storage	86	RDS
Write Disk Storage	87	WDS
Branch on Inquiry	26	BIN
Reply to Inquiry	79	RPY

FLOATING DECIMAL ARITH.		
Floating Add	32	FAD
Floating Subtract	33	FSD
Floating Multiply	39	FMP
Floating Divide	34	FDV
Unnormalized Floating Add	30	FUA
Floating Add Absolute (Magnitude)	37	FAM
Floating Subtract Absolute (Magnitude)	38	FSM

## 1-9. INSTRUCTIONS.

The IBM 650 is a stored-program machine. The instructions are stored on the drum in the same form as data. Since the only thing which the drum can store is a set of 10-digit signed numbers, the instructions to the machine are coded as 10-digit numbers. The 10 digits of an instruction are sectioned into three groups as shown:

