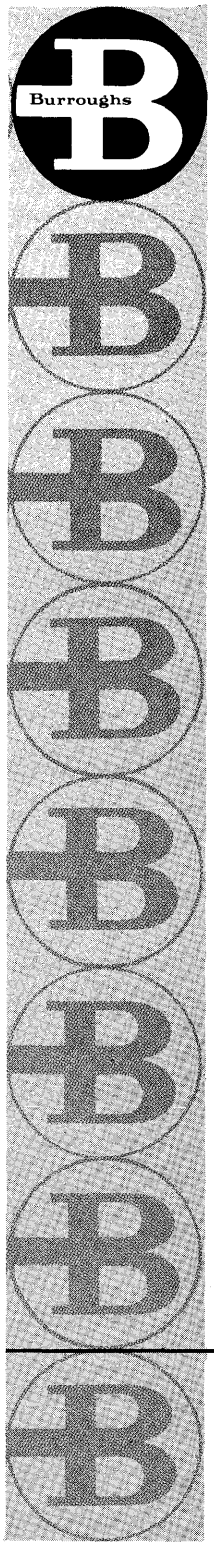
DS684
1 OCTOBER 1965

BURROUGHS D84 MODULAR INTEGRATED CIRCUIT MILITARY COMPUTER

Burroughs Corporation

DS684
1 OCTOBER 1965



BURROUGHS D84 MODULAR INTEGRATED CIRCUIT MILITARY COMPUTER

Burroughs Corporation

1. FUNCTIONAL MODULARITY -MATRIX ORGANIZATION

D825 - 1962

D830 - 1964

B8500-1966

2. ADVANCED MICROCIRCUIT TECHNIQUES*, AND

3. ADVANCED MAULER COMPUTER DESIGN**

* FEB. '64 COMPLETION OF 12-BIT ARITHMETIC UNIT (700 I.C.'s) — LIFE-TEST CONTINUING.

** TO IMPROVE T.E.C. (REDUCE IN SIZE, INCREASE MTBF)

COMBINED TO PRODUCE D84*

FEATURING

- PHYSICALLY INDEPENDENT FUNCTIONAL MODULES
- ALL LOGIC IMPLEMENTED WITH MONOLITHIC INTEGRATED CIRCUITS

FOR

- FLEXIBILITY IN SYSTEMS CONFIGURATIONS
- GROWTH POTENTIAL BUILT-IN
- COMPACT
- RELIABILITY
- LIGHT-WEIGHT
- LOW POWER CONSUMPTION

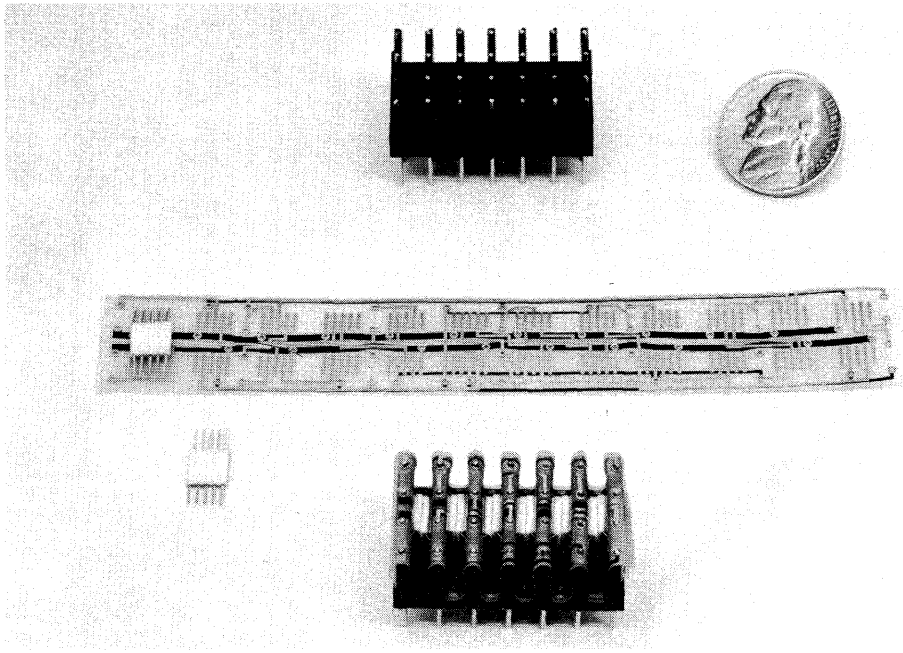
PROTOTYPE (OPERATIONAL JANUARY '65) DIFFERS FROM PRODUCTION D84

(1) PACKAGING MORE COMPACT - 100% FLATPACK UTILIZATION/LOGISTICAL DISADVANTAGE, AND

(2) INSTRUCTION REPERTOIRE — 35 BASIC COMMANDS VS. 47

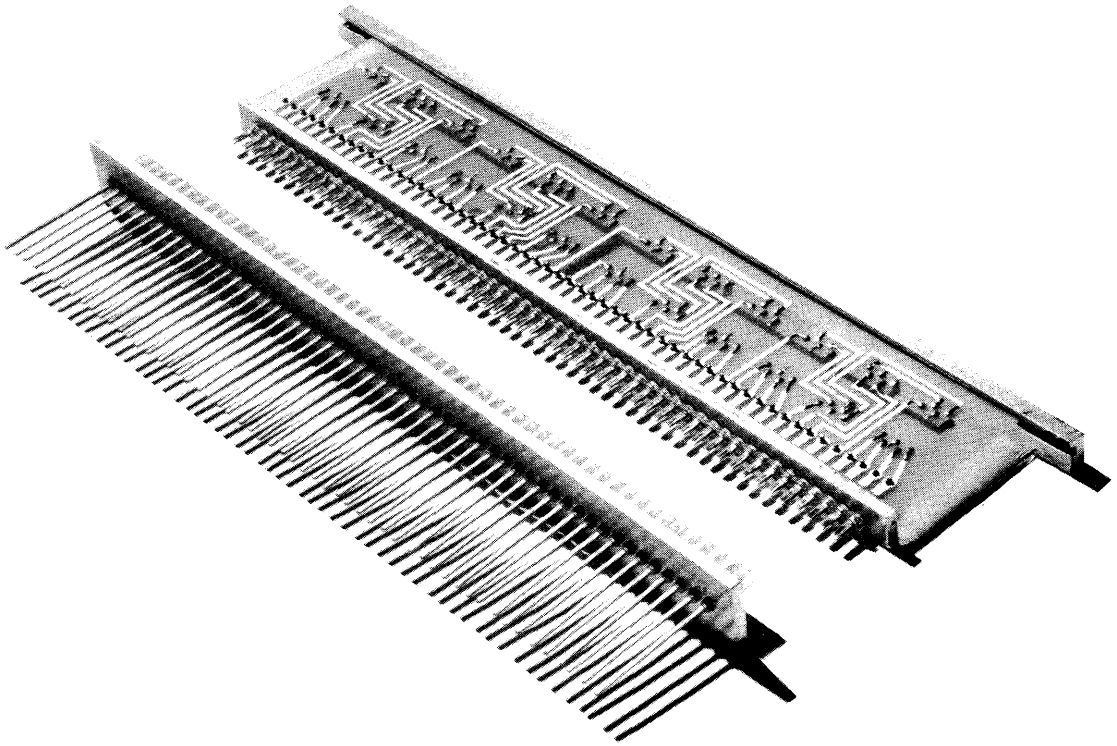
* NOV. '63 START-UP.

T & D C.N.M. - "3-D"



OVER 100 TYPES -- ALL FLATPACKS USED: LINE MAINTENANCE AT FUNCTIONAL MODULE LEVEL

D84 C.N.M. -"2-D"



35 MAX. TYPES (ONLY 23 IN LOGIC*) : AVERAGE FLATPACK UTILIZATION 10 TO 11 PER CNM : LINE. MAINTENANCE AT CNM (THROWAWAY) LEVEL— MADE PRACTICAL VIA DIAGNOSTICS PROGRAM

* i.e. EXCLUDING MEMORY AND SPECIAL I/O CIRCUITS

MAJOR ADVANTAGES

1. LOW COST

   - DEVELOPMENT COMPLETE
   - ONE TIME CHARGES RESTRICTED TO DESIGN OF SPECIAL INTERFACES IN THE I/O MODULE.

2. MODULAR EXPANSIBILITY THROUGH TO MULTIPROCESSING FOR MORE THROUGHPUT AND/OR GRACEFUL DEGRADATION.

3. MULTIPLE INDEXING

   - MULTI-LEVEL INDIRECT ADDRESSING
   - VERSATILE INSTRUCTION REPERTOIRE
   - LEADING TO REDUCED MEMORY REQUIREMENTS

     AND / OR REDUCED RUNNING TIME.

MAJOR ADVANTAGES CONTINUED

4. AGGRESSIVE INTERRUPT SYSTEM

- PROGRAMMABLE PRIORITIES
- INTERRUPTS MAY BE IGNORED OR STORED
  FOR DEFERRED ACTION – 24 MAX. INTERRUPTS

5. FLEXIBILITY OF I/O

- CHANNEL TYPE AND NUMBER TAILORED TO APPLICATION
- PACKAGING FLEXIBILITY TO MAINTAIN LOWEST PRACTICAL
  SIZE FOR SPECIFIED I/O DESIGN – 3 STANDARD PACKAGES

6. EXTENDED PRODUCT LIFE

- MODULAR GROWTH – IN MEMORY, I/O, & CENTRAL DATA PROCESSORS (MULTI-PROCESSING)
- HIGHER SPEED CIRCUITS FOR SYSTEM SPEED-UP WHEN USED WITH THIN-FILM MEMORIES (8:1 BY LAST QUARTER '67 DELIVERIES) — PROGRAM COMPATIBLE WITH PRESENT SYSTEM.

MAJOR ADVANTAGES CONTINUED

7. MAINTENANCE

- NO PREVENTIVE MAINTENANCE
- EMERGENCY MAINTENANCE PHILOSOPHY SELECTED BY CUSTOMER
    1. ON-LINE, WHILE SYSTEM IS OPERATIVE (MULTI-PROCESSING) — NO DOWNTIME
    2. AT FUNCTIONAL MODULE LEVEL - < 5 MIN. DOWNTIME
    3. AT CIRCUIT NETWORK MODULE LEVEL - 30 MIN. DOWNTIME
    4. AT FLATPACK LEVEL

D84 - AVERAGE INSTRUCTION EXECUTE TIME

1. "COMMAND AND CONTROL MIX" – COMMUNICATIONS OF THE ACM – MAY '64

   A) WITH 4μS CYCLE TIME MEMORY - 10μS

   B) WITH 3μS CYCLE TIME MEMORY - 8μS

   VS. 360/40 - 14μS

   360/50 - 5μS

2. "GIBSON MIX" - SCIENTIFIC CALCULATIONS

   A) WITH 4μS CYCLE TIME MEMORY - 19μS

   B) WITH 3μS CYCLE TIME MEMORY - 15μS

   VS. 360/40 - 30μS

   360/50 - $7\frac{1}{2}\mu$S

SOFTWARE - INITIAL DELIVERIES (LATE '65 THRU 1st. HALF OF '66)

1. ASSEMBLER PROGRAM - FORTRAN IV FOR 7044 AND 7094

- SYMBOLIC MNEMONICS SPECIFY OPERATIONS
- SYMBOLIC TAGS SPECIFY MEMORY REFERENCES
- OBJECT PROGRAM PRODUCED (CARD DECK) FOR D84
- PROGRAM DECK PRODUCED FOR INPUT TO SIMULATOR

2. SIMULATOR PROGRAM - FORTRAN IV FOR 7044 AND 7094

- DEBUG OBJECT PROGRAM
- MEASURES PROGRAM RUNNING TIME

SOFTWARE- INITIAL DELIVERIES (LATE '65 THRU 1st. HALF OF '66) CONTINUED

3. SUBROUTINES (FOR CALL-UP BY THE ASSEMBLER)

- SQUARE ROOT
- TRIGONOMETRIC FUNCTIONS
- INVERSE TRIGONOMETRIC FUNCTIONS
- POLYNOMIAL OF DEGREE n
- ASCII TO BINARY CONVERSION
- DOUBLE PRECISION MULTIPLY, DIVIDE

4. DIAGNOSTIC PROGRAM

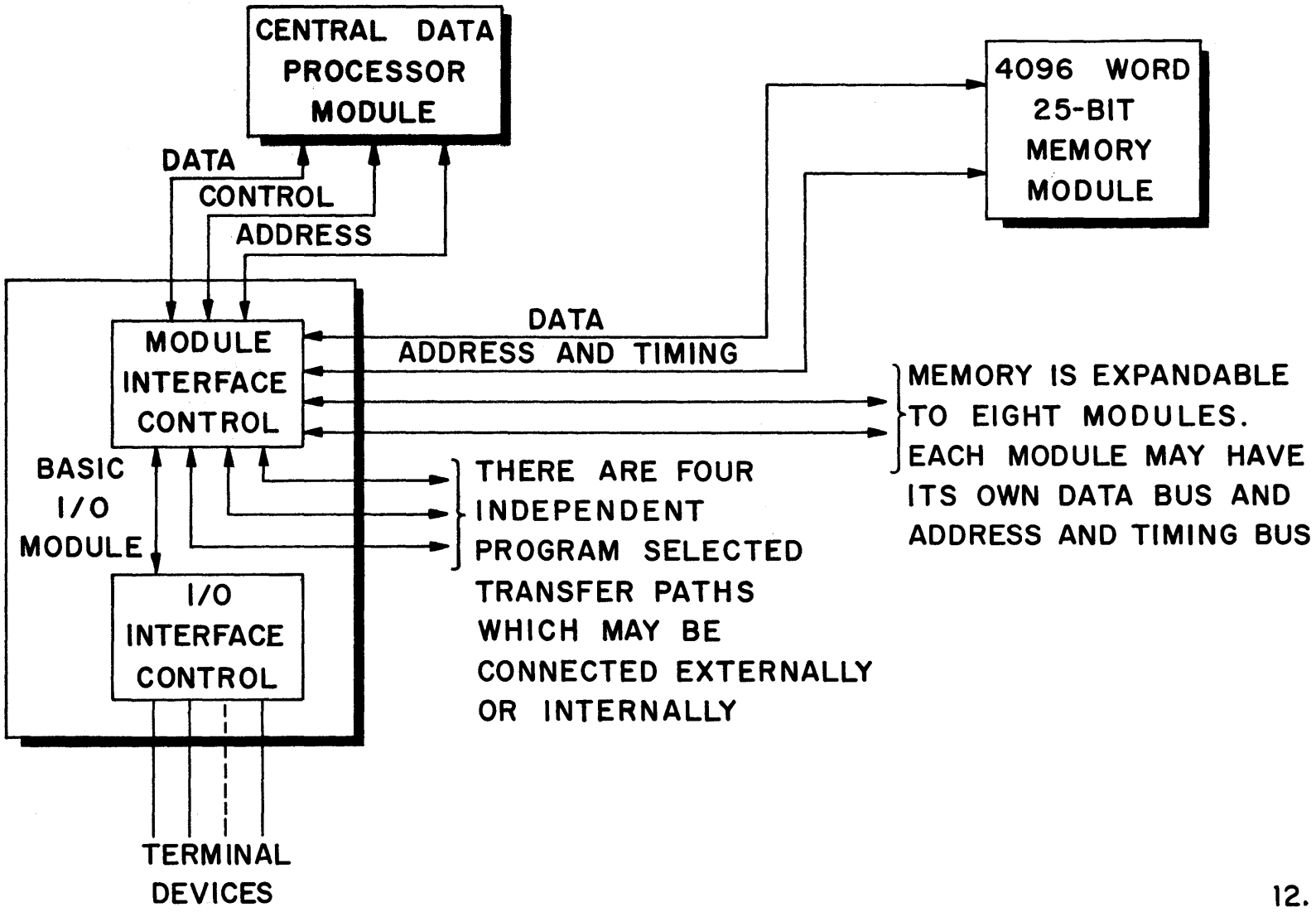
- MINIMUM OPERATOR INTERVENTION
- LOCATES FAULT TO THROW-AWAY MODULES* - 9 MIN. MEAN TIME.

* TO A MAX. OF 5 CNM's, 90% OF THE TIME — TO AN ABSOLUTE MAX. OF 10 CNM's

SUBROUTINES

MNEMONIC	DESCRIPTION	REQUIRED STORAGE	EXECUTION TIME (MS)
SIN	SINGLE-PRECISION SIN	93	0.75
COS	SINGLE-PRECISION COS	93	0.75
INTAN	SINGLE-PRECISION TAN^{-1}	154	1.52
INSIN	SINGLE-PRECISION SIN^{-1}	123	2.35
INCOS	SINGLE-PRECISION CON^{-1}	123	2.35
SINCO	DOUBLE-PRECISION SIN OR COS	100	2.856
ARCTAN	DOUBLE-PRECISION TAN^{-1}	167	5.850
ASICO	DOUBLE-PRECISION SIN^{-1} OR COS^{-1}	130	7.990
DPDIV	DOUBLE-PRECISION DIVIDE	37	0.416
DPMUL	DOUBLE-PRECISION MULTIPLY	33	0.248
SQRT	DOUBLE-PRECISION SQUARE-ROOT	52	1.762
POLNOM	DOUBLE-PRECISION POLYNOMIAL OF DEGREE n	47	(0.188+0.318n) where n = number of terms less one

BASIC D84M COMPUTER SYSTEM CONCEPT



MODULE FUNCTIONS

CENTRAL DATA PROCESSOR:

- ARITHMETIC UNIT
- INSTRUCTION EXECUTION
- INDEXING
- PROGRAM SEQUENCING
- MEMORY ADDRESSING

MODULE INTERFACE CONTROL:

- MEMORY ACCESS CONTROL
- DATA ROUTING
- PROGRAM INTERRUPTS
- START/STOP CONTROLS
- BOOTSTRAP CONTROLS
- CONSOLE INTERFACE

I/O INTERFACE CONTROL:

- TERMINAL DEVICE SELECTION
- DATA TRANSFER TIMING
- WORD BUFFER
- SPECIAL FUNCTIONS

MEMORY:

- PROGRAM STORE
- DATA STORE
- I/O BUFFER

FUNCTIONAL CHARACTERISTICS

OPERATION:

SYNCHRONOUS, PARALLEL

ARITHMETIC:

FRACTIONAL BINARY, FIXED POINT

SIGN PLUS 23 BITS MAGNITUDE

OPERATING SPEEDS:

ONE MEGACYCLE CLOCK

EXECUTION OF UP TO 333,000 INSTRUCTIONS/SEC.

COMMAND REPERTOIRE:

47 BASIC COMMANDS

OVER 300 USEFUL VARIATIONS

ADDRESSING:

SINGLE ADDRESS, DIRECT

MULTILEVEL INDIRECT

FUNCTIONAL CHARACTERISTICS (CONTINUED)

INDEXING:

INDEX REGISTERS IN MEMORY
NUMBER OF INDEX REGISTERS AND LOCATION PROGRAM DETERMINED

MEMORY:

MODULAR, 4096 WORD BASIC MODULE
EXPANDABLE TO 32768 WORDS (EIGHT MODULES)
ONE MICROSECOND ACCESS TIME
CYCLE TIME DETERMINED BY TYPE OF MEMORY

INPUT / OUTPUT:

MASKABLE INTERRUPTS
BUFFERED AND UNBUFFERED I/O CHANNELS
PROVISIONS FOR SPECIAL I/O FUNCTIONS

EXECUTION TIMES

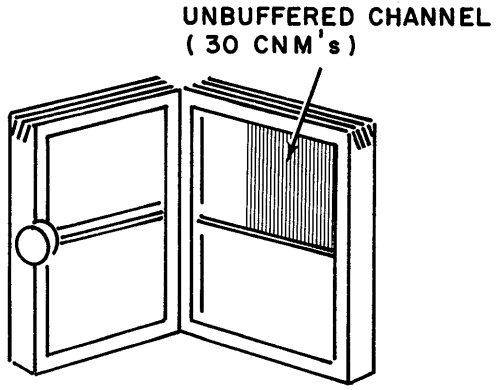
COMMAND	EXECUTION TIME FOR 4μsec.R/R MEMORY	3μsec.R/R MEMORY	2μsec.R/R MEMORY
ADD	8	6	4
ADD LITERAL	4	4	3
ADD DOUBLE PRECISION	12	9	6
MULTIPLY	28	27	25
DIVIDE	51	50	50
STORE SINGLE WORD	8	6	4
STORE DOUBLE WORD	12	9	6
BRANCH	4	4	3
TEST (EQUAL, GREATER, LESS)	8	6	4
TEST (EQUAL, GREATER, LESS) LITERAL	4	4	3
TEST (EQUAL, GREATER, LESS) BLOCK OF BLOCK SIZE m	16+8(m-1)	12+7(m-1)	10+5(m-1)

TYPES OF STANDARD I/O

UNBUFFERED CHANNEL :

ADDRESSABLE TERMINAL DEVICES : 127
MAXIMUM DATA RATE :

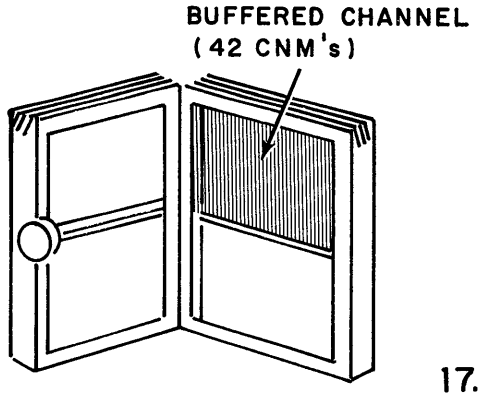
4μ SEC MEMORY : 35 700 WORDS/SEC.
2μ SEC MEMORY : 50 000 WORDS/SEC



BUFFERED CHANNEL :

ADDRESSABLE TERMINAL DEVICES : 64
BUFFERED CHANNELS PER CDP : 16
MAXIMUM DATA RATE :

4μ SEC MEMORY : 250 000 WORDS/SEC.
2μ SEC MEMORY : 500000 WORDS/SEC



TYPES OF STANDARD I/O CONTINUED

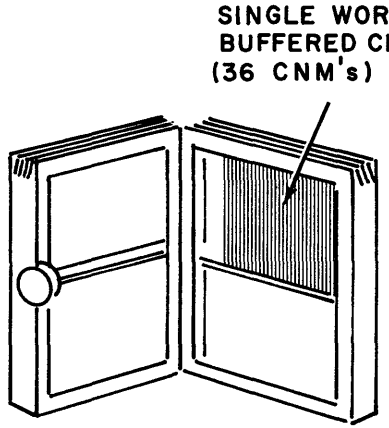
CIRCULATING BUFFERED CHANNEL:

MODIFIED BUFFERED CHANNEL FOR USE WITH DISPLAY

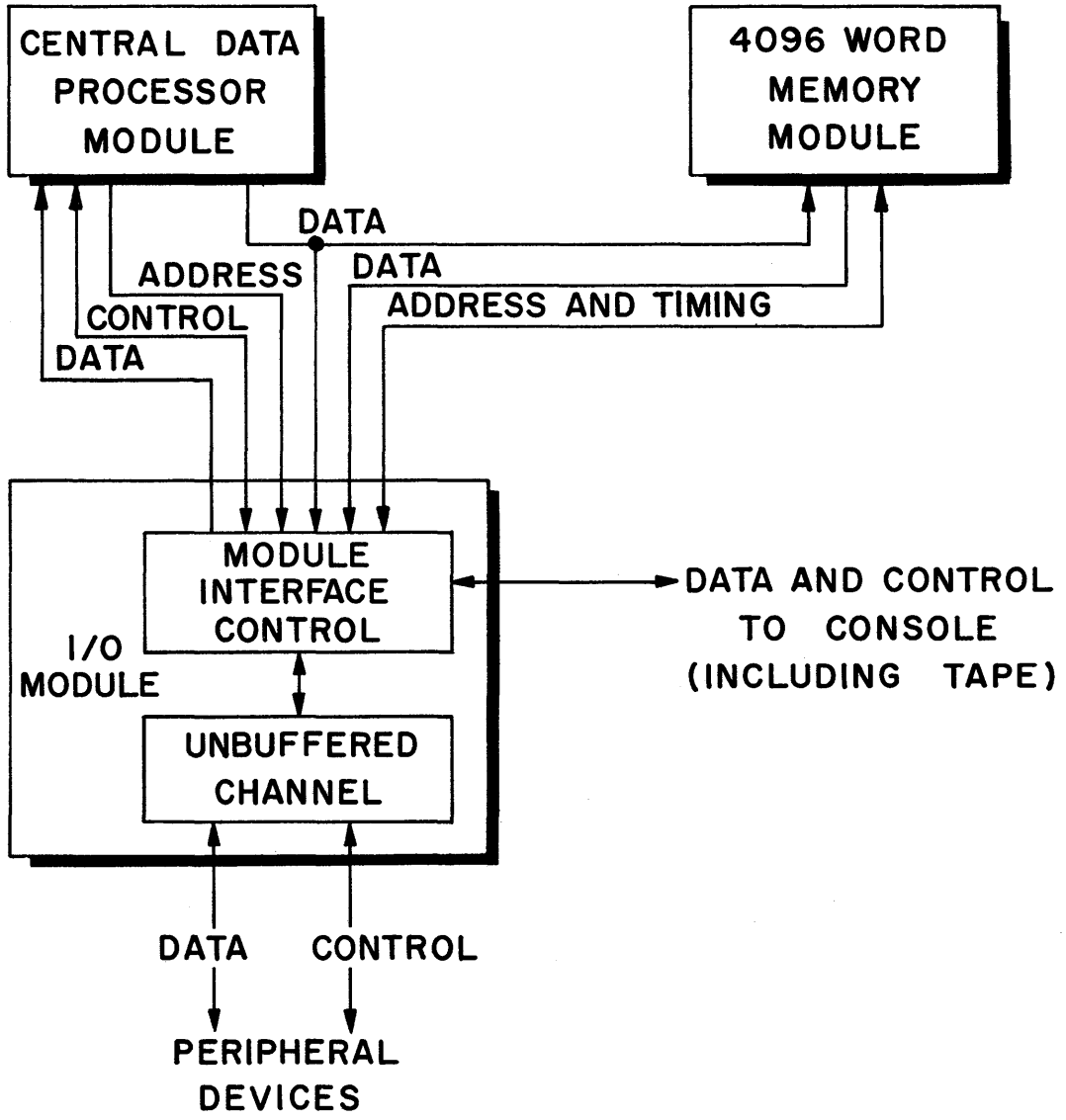
SINGLE WORD BUFFERED CHANNEL

ADDRESSABLE TERMINAL DEVICES 64
CHANNELS PER CDP 4
MAXIMUM DATA RATE:

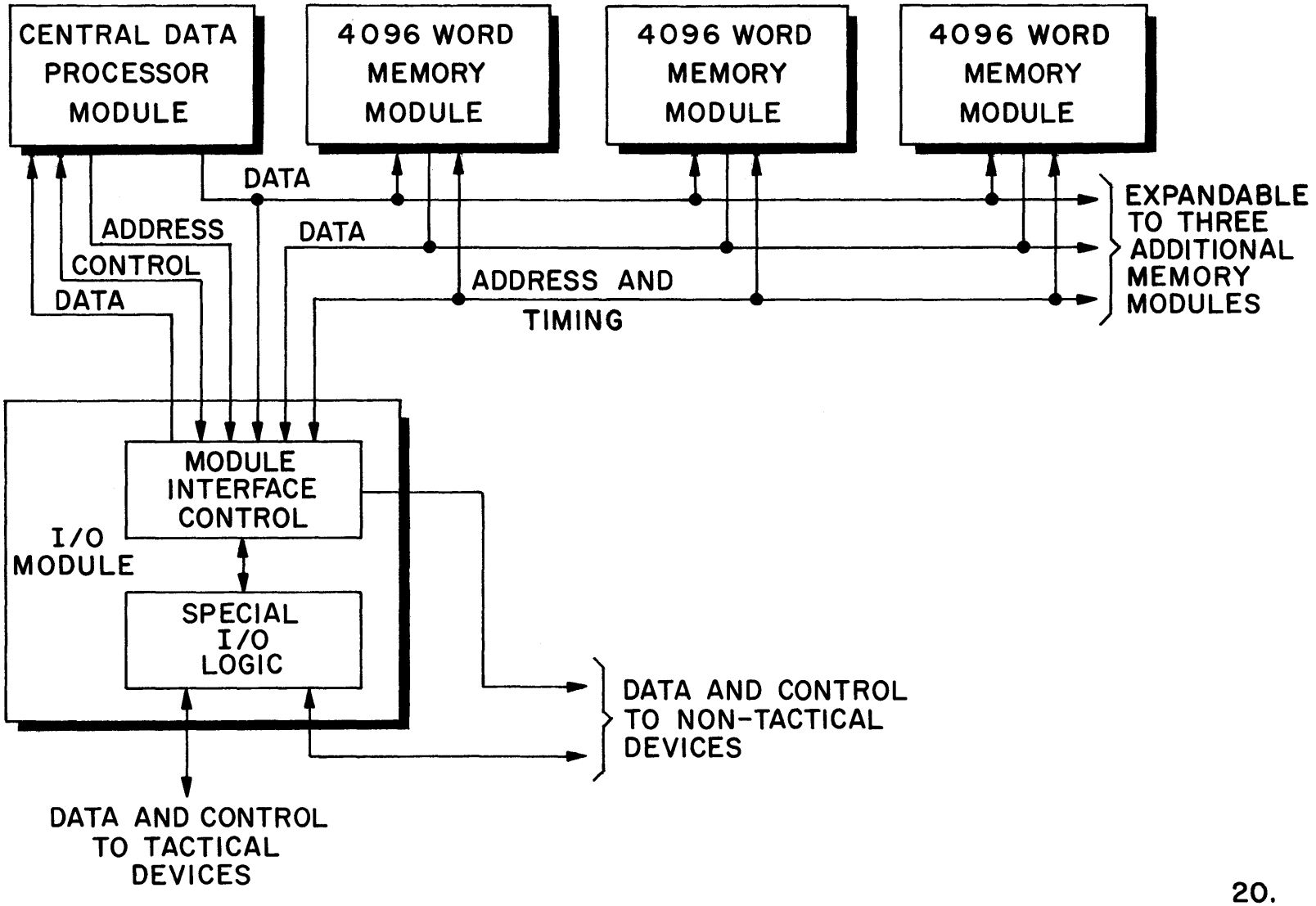
4μ SEC MEMORY: 27 500 WORDS / SEC.
2μ SEC MEMORY: 41 600 WORDS / SEC.



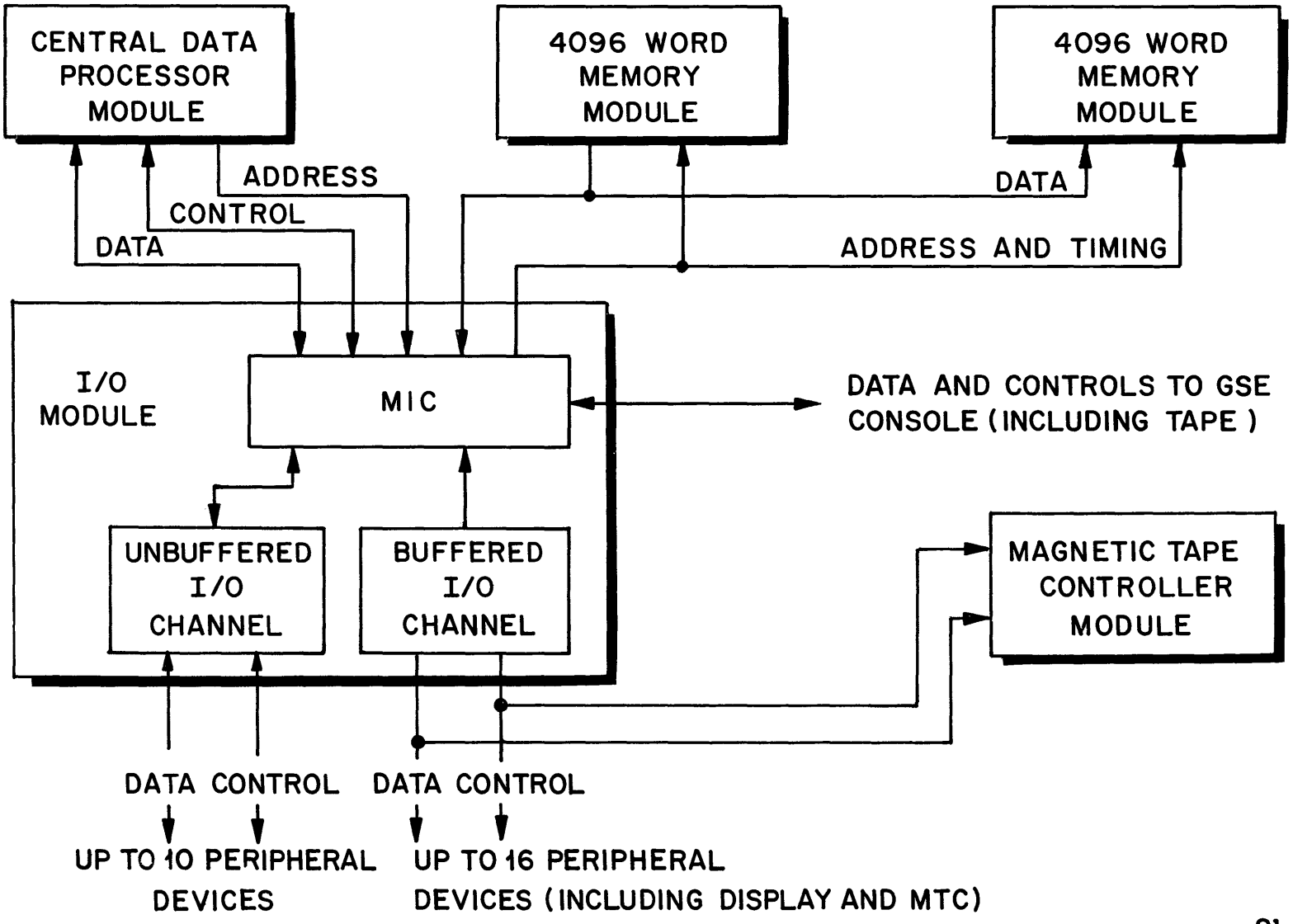
MINIMUM D84M COMPUTER SYSTEM



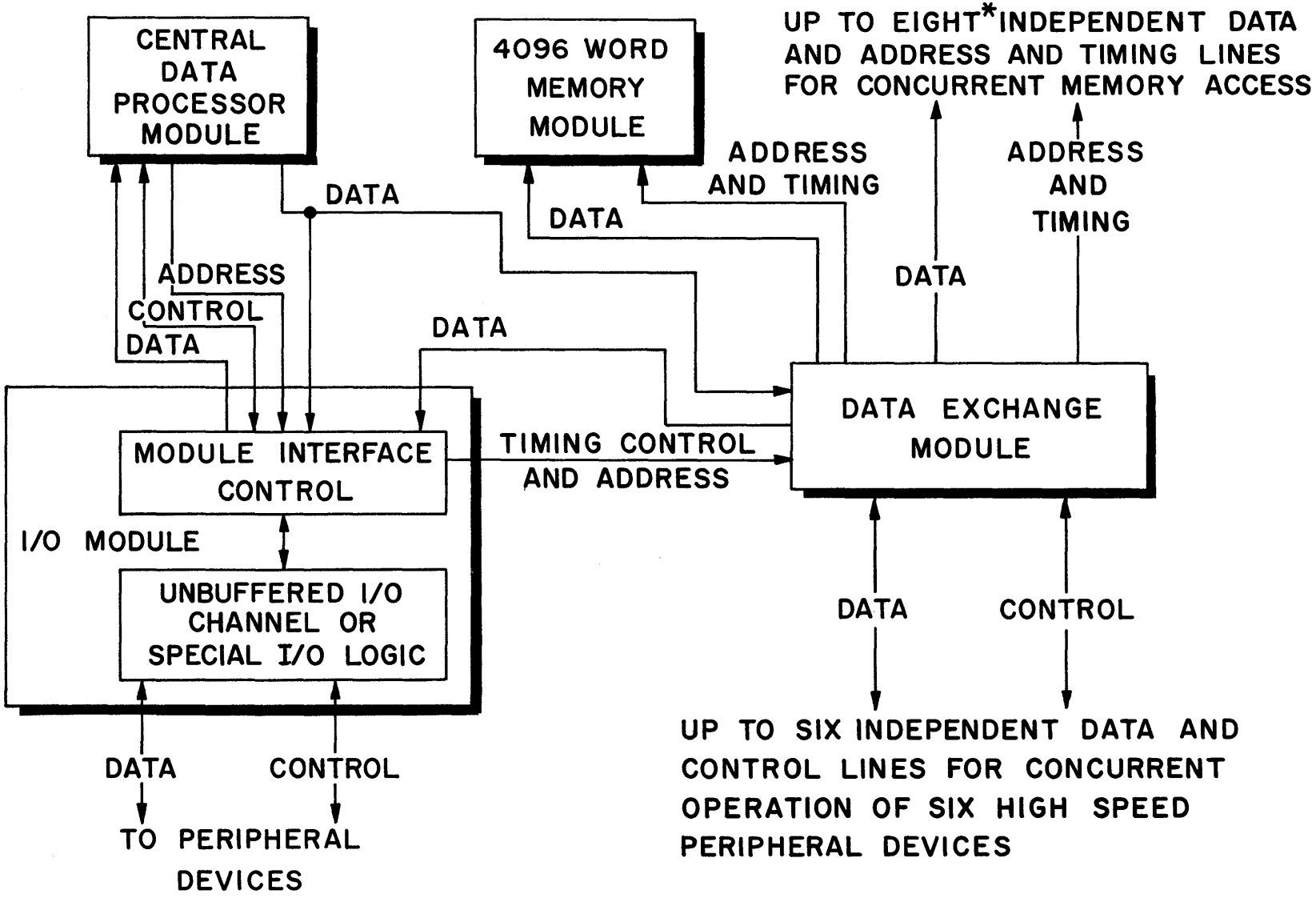
D84M COMPUTER FOR PERSHING IPTS



D84M COMPUTER FOR CLASSIFIED AIRBORNE APPLICATION



D84M COMPUTER WITH CONCURRENT MEMORY ACCESS



* EIGHT MAX. PER CDP

D84M ASSEMBLER PROGRAM

LANGUAGE: FORTRAN IV (COMPATIBLE WITH IBM 7044, 7094, 360, GE 625)

FEATURES:

- 47 BASIC INSTRUCTIONS
- OVER 300 MNUMONICS
- SOFTWARE LITERALS
- LIBRARY SUBROUTINES
- 27 PSEUDO OPERATIONS

INPUT: CARD DECK

OUTPUTS:

- HARD COPY
- PAPER TAPE FOR LOADING PROGRAMS INTO D84
  - A) MAGNETIC TAPE TO PREPARE PAPER TAPE
  - B) CARD DECK TO PREPARE PAPER TAPE
- SIMULATOR INPUT PROGRAM
  - A) MAGNETIC TAPE
  - B) CARD DECK
- SUBROUTINE LIBRARY ON MAGNETIC TAPE

STORAGE REQUIREMENTS: 12,000 WORDS

RUNNING TIME: 6-7 MINUTES (AVERAGE)

D84M SIMULATOR PROGRAM

LANGUAGE: FORTRAN IV (COMPATIBLE WITH IBM 7044, 7094, 360, & GE 625)

FEATURES:

SIMULATION OF CDP AND I/O

SPECIFIABLE MEMORY CONFIGURATION & CYCLE TIME

DEBUGGING AIDS:

- FULL OR PARTIAL TRACE OF PROGRAM
- FULL OR PARTIAL LISTING OF MEMORY
- LOADING OF PORTIONS OF SIMULATED MEMORY DURING SIMULATION

MONITORING OF ERRORS DURING SIMULATION

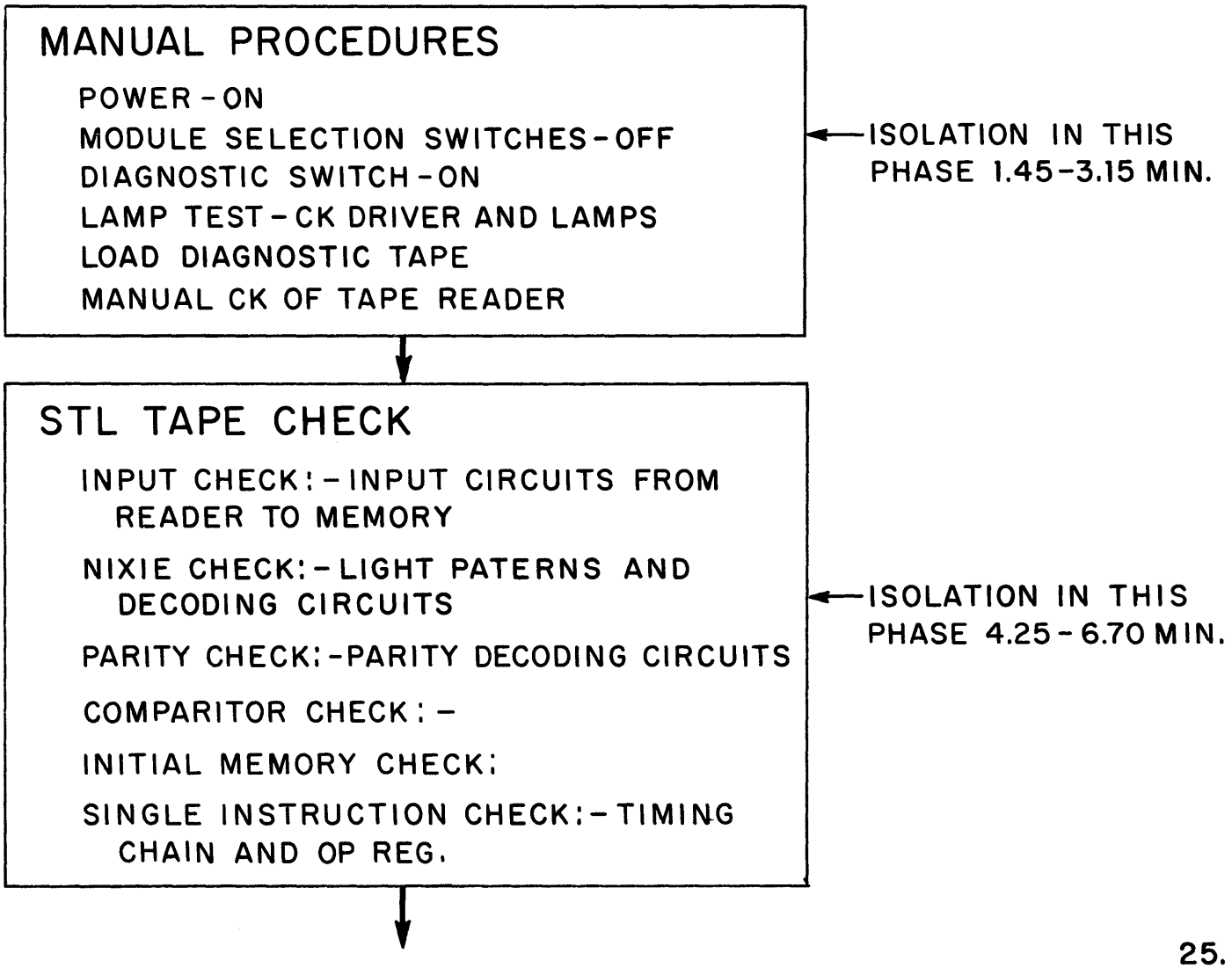
RUNNING MORE THAN ONE SIMULATION*

SIMULATION OF REAL TIME

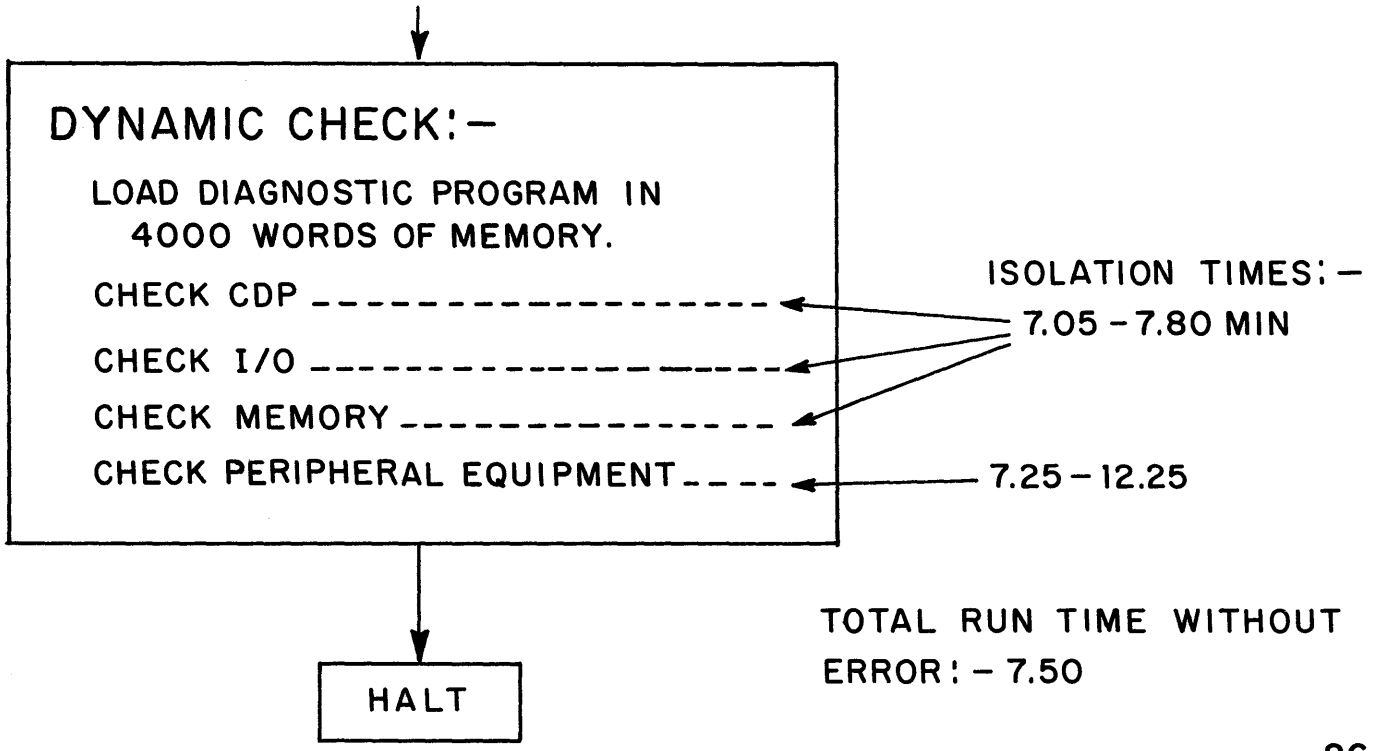
SIMULATION OF INTERRUPTS UNDER OPERATOR CONTROL

* i.e. SIMULATING 2 PROGRAMS IN ONE RUN.

D84M DIAGNOSTIC PROGRAM

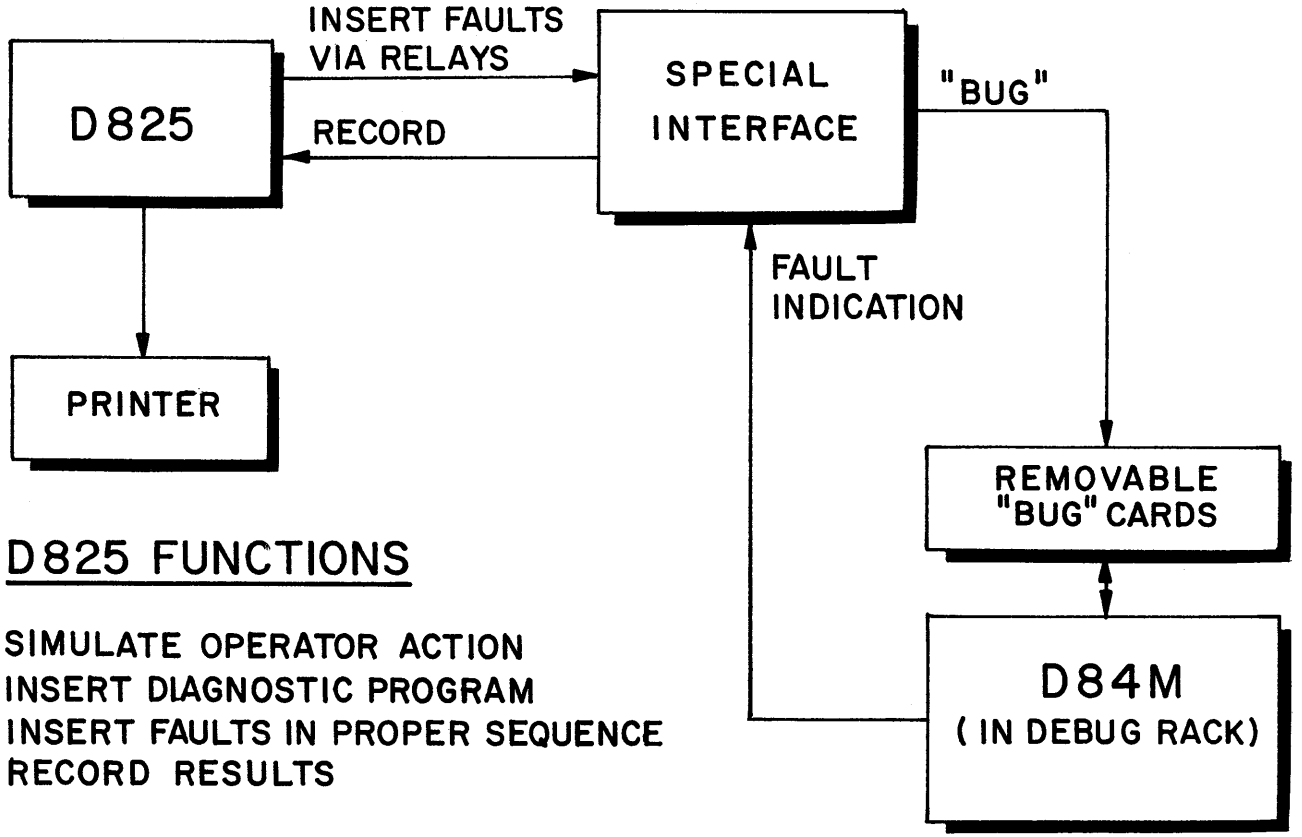


D84M DIAGNOSTIC PROGRAM - CONTINUED



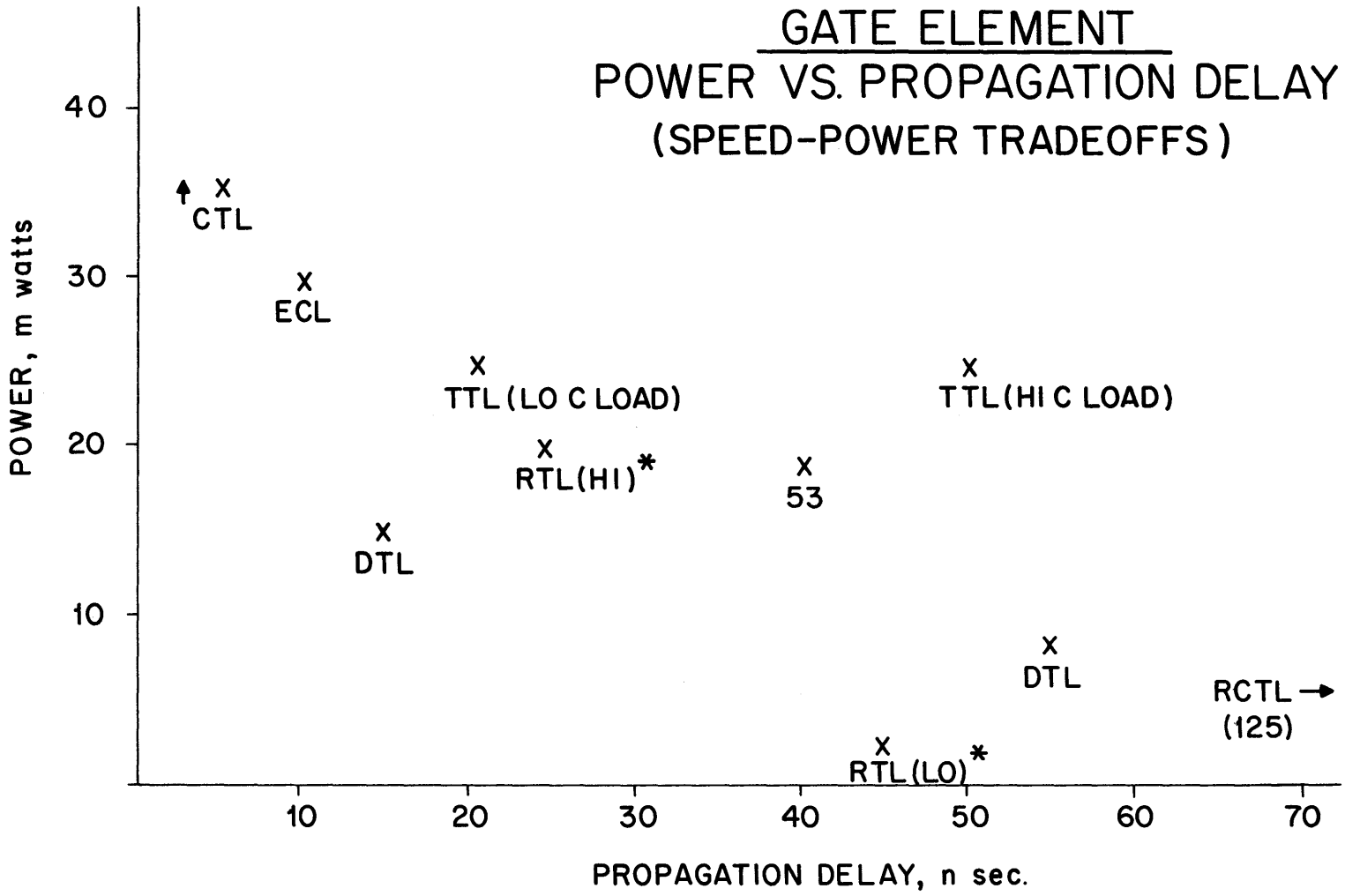
TOTAL RUN TIME WITHOUT ERROR: - 7.50

D84 DIAGNOSTIC PROGRAM VALIDATION

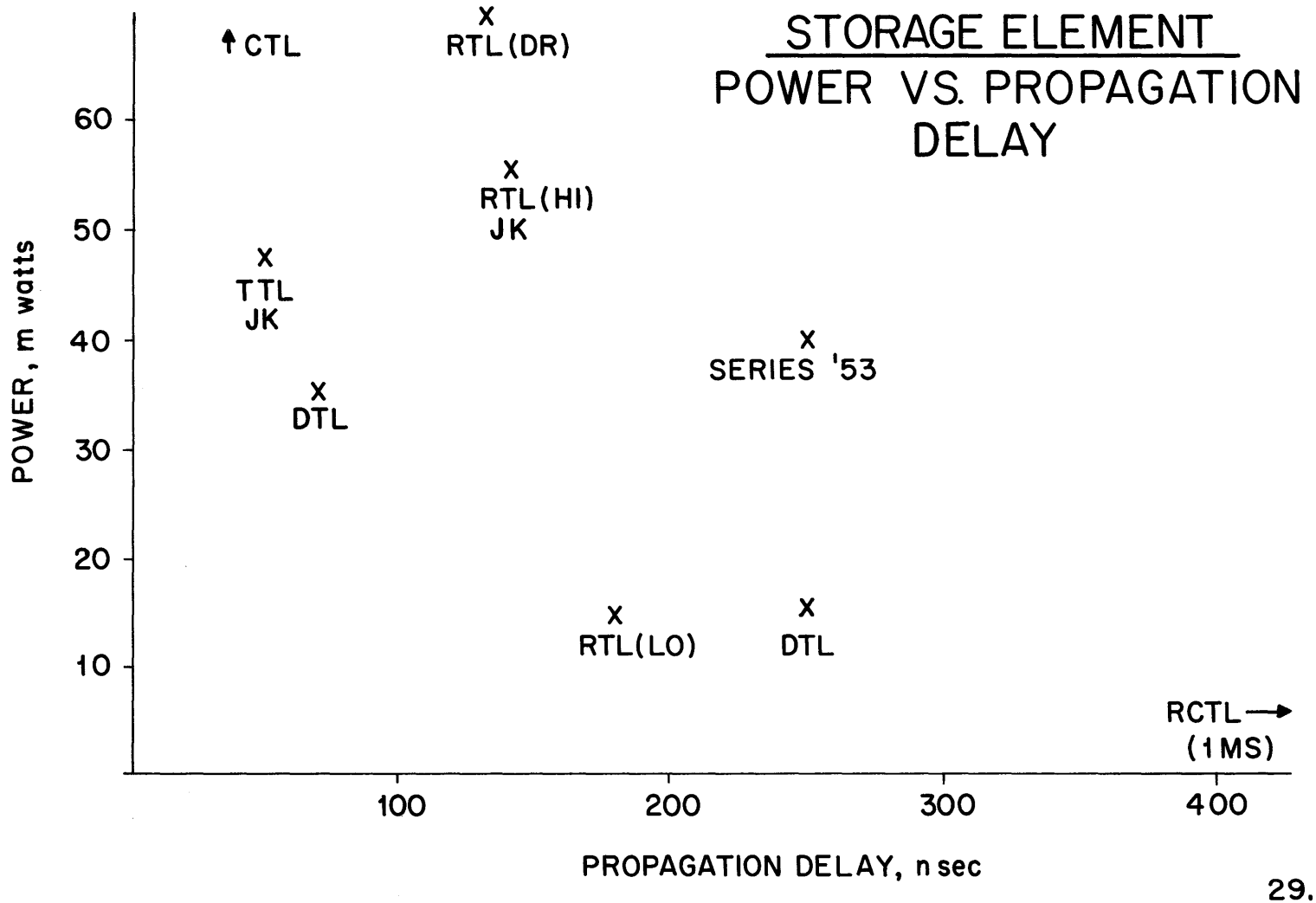


D825 FUNCTIONS

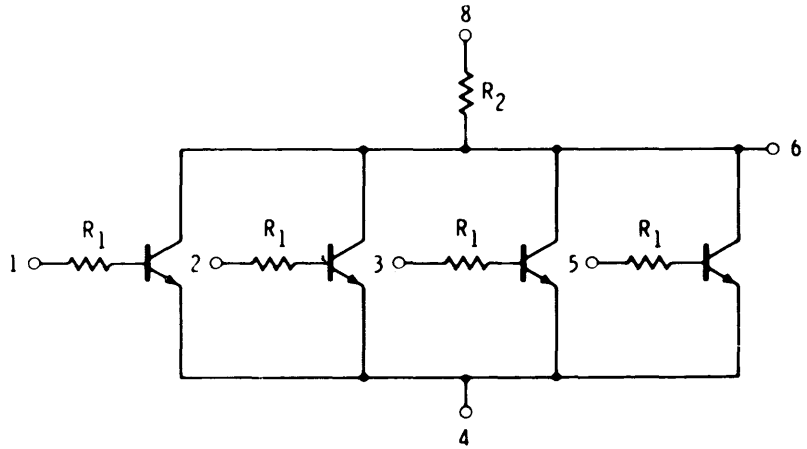
SIMULATE OPERATOR ACTION
INSERT DIAGNOSTIC PROGRAM
INSERT FAULTS IN PROPER SEQUENCE
RECORD RESULTS



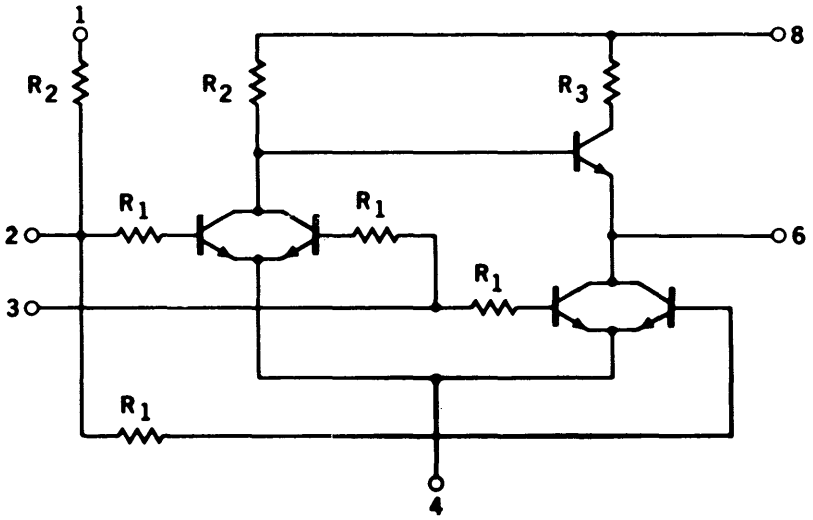
* D84 LOGIC USES >85% LOW-POWER, < 15% HIGH-POWER GATES.


STORAGE ELEMENT
POWER VS. PROPAGATION DELAY
CTL
RTL(DR)
RTL(HI)
JK
TTL
JK
DTL
SERIES '53
RTL(LO)
DTL
RCTL
(1 MS)
60
50
40
30
20
10
100
200
300
400
POWER, m watts
PROPAGATION DELAY, n sec

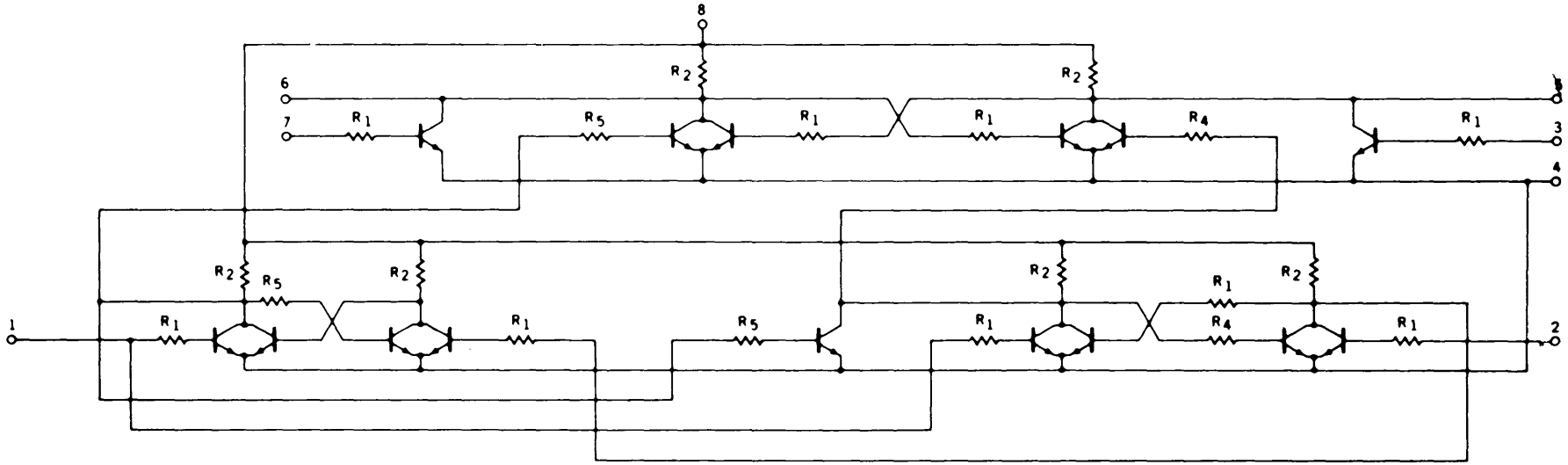
RTL GATE



RTL BUFFER

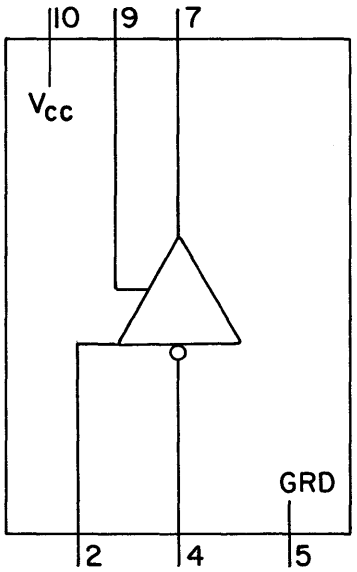


RTL FLIP-FLOP

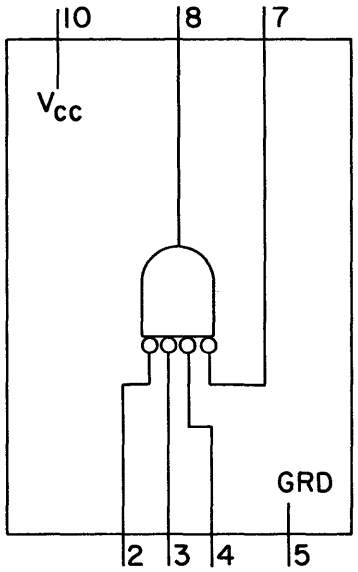


NEGATIVE LOGIC SYMBOLS USED IN D84 FOR FLAT PACKS

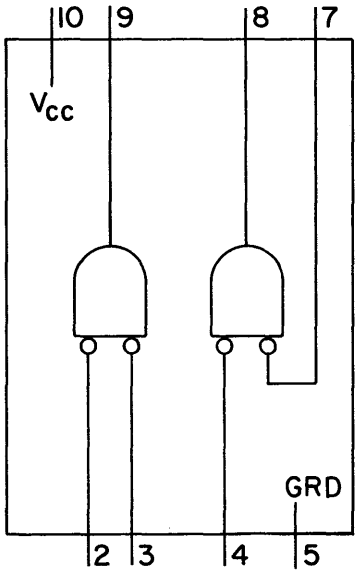
HIGH POWER LOGIC



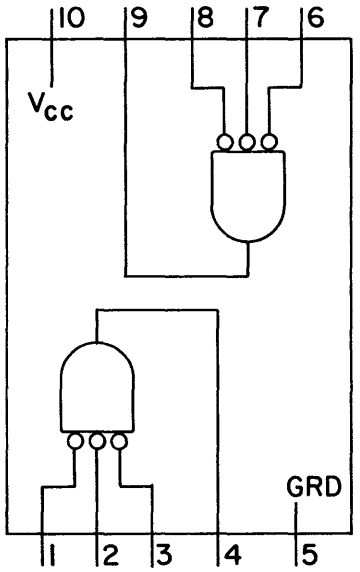
HIGH POWER BUFFER
11040622



4 INPUT-HIGH
POWER GATE
11040625



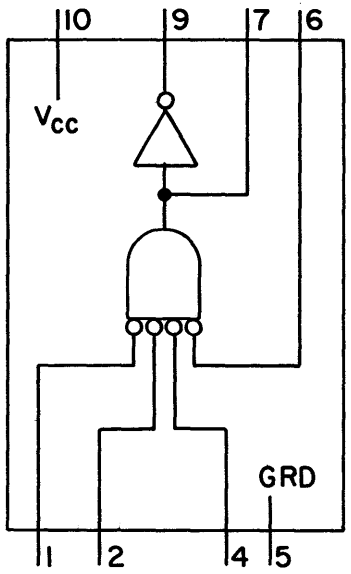
DUAL-2 INPUT-HIGH
POWER GATE
11040624



DUAL-3 INPUT-HIGH
POWER GATE
11040623

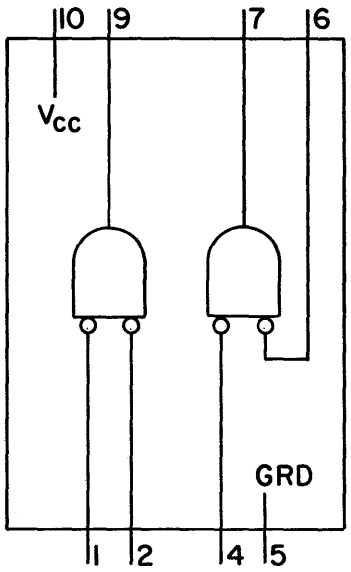
NEGATIVE LOGIC SYMBOLS USED IN D84 FOR FLAT PACKS

LOW POWER LOGIC



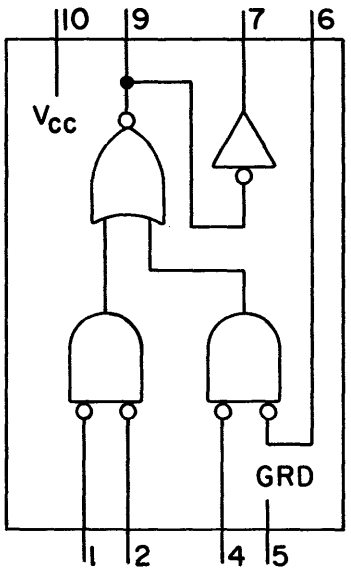
4 INPUT-LOW POWER GATE-WITH INVERTER

1104062l



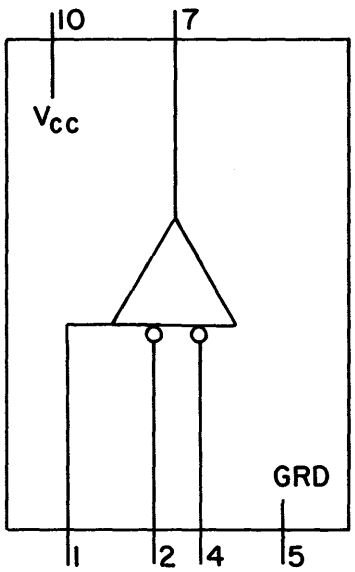
DUAL-2 INPUT-LOW POWER GATE

1104062O



LOW POWER HALF ADDER-WITH INVERTER

1104061 7

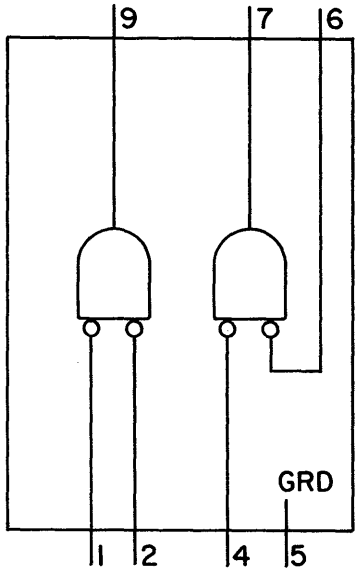


GATED LOW POWER BUFFER-B_L

1104061 8

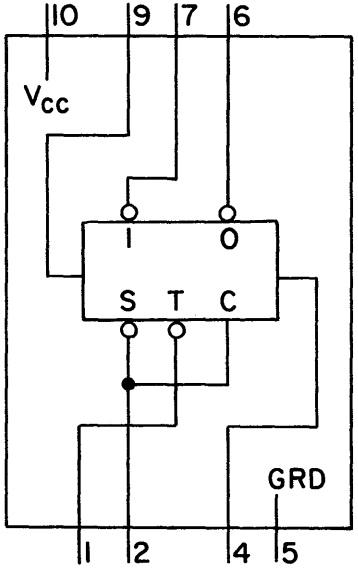
NEGATIVE LOGIC SYMBOLS USED IN D84 FOR FLAT PACKS

LOW POWER LOGIC (CONTINUED)



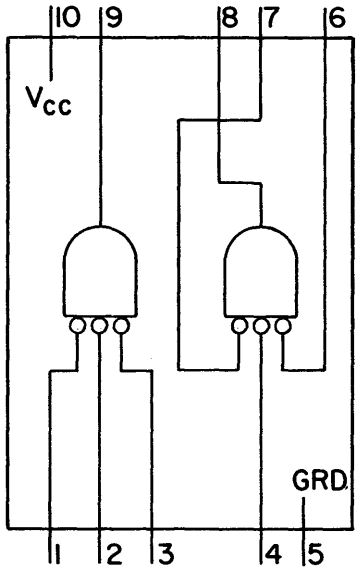
LOW POWER
EXPANDER* - E_L

11040615



LOW POWER
FLIP-FLOP-FF

11040616

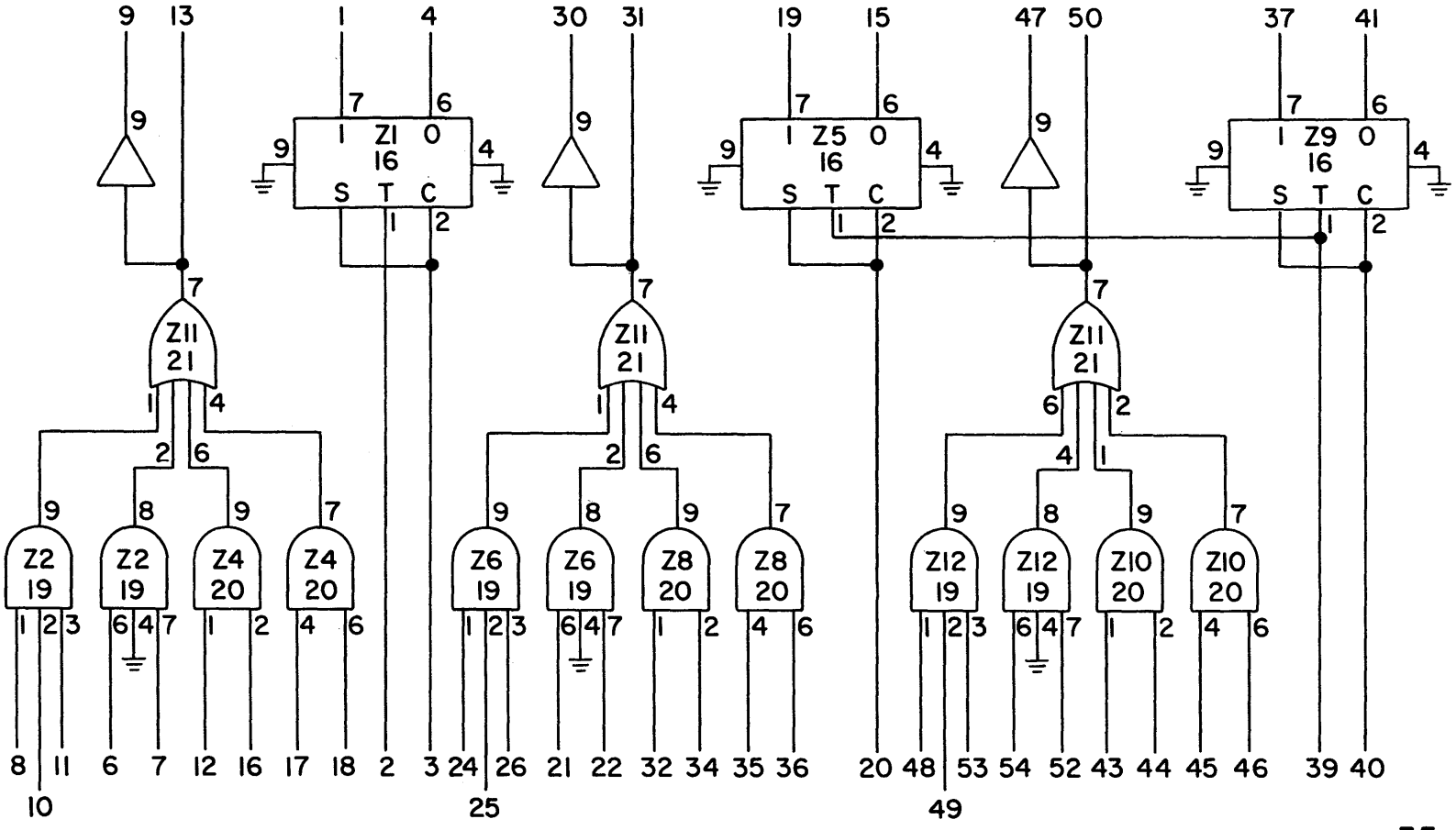


DUAL-3 INPUT-LOW
POWER GATE

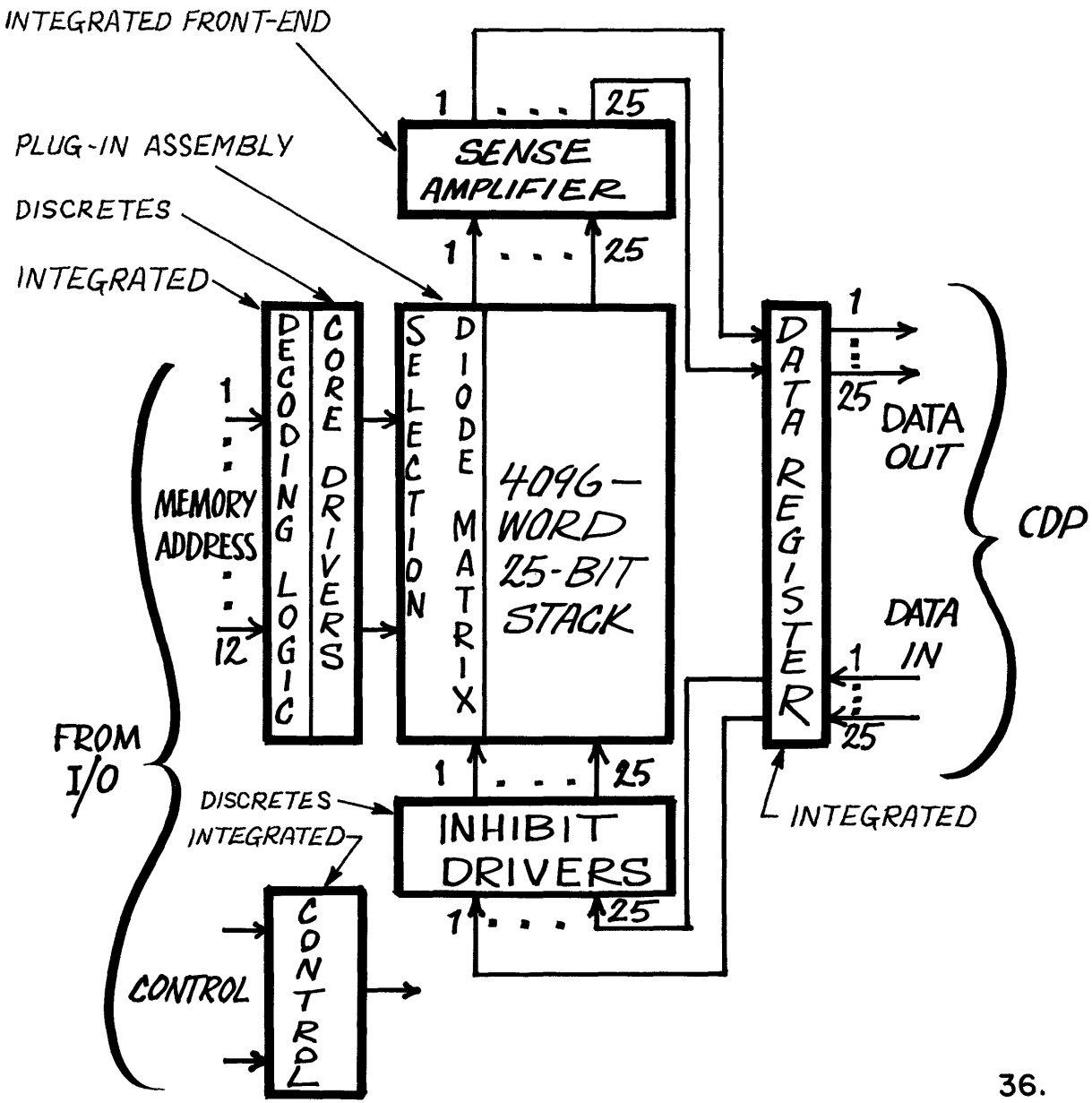
11040619

* USED ON GATE INPUTS, FOR INCREASED FAN-IN WHEN NECESSARY.

REGISTER CIRCUIT NETWORK MODULE



MEMORY SYSTEM BLOCK DIAGRAM



RELIABILITY - D84*

MODULE	FAILURE RATE (FAILURES/10^6 HOURS)	MTBF (HOURS) (APPROXIMATE)
POWER SUPPLY	56.58	17,600
CDP	74.49	13,400
I/O	77.0 (MIC & 1 CHANNEL)	13,000
MEMORY	269.27	3,700
SYSTEM	477	2,100 HRS.

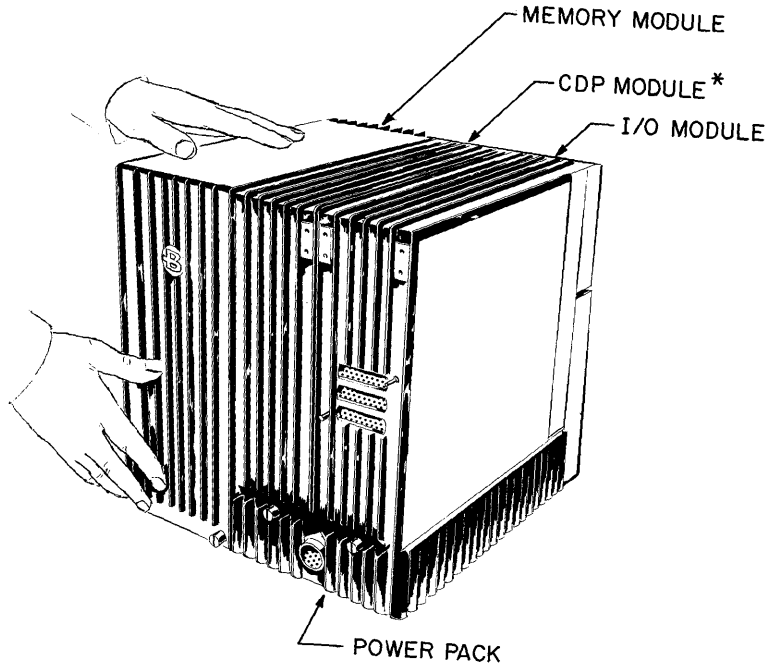
ESTIMATED IMPROVEMENT VIA MINUTEMAN SELECTION CRITERIA FOR DISCRETE COMPONENTS - 2 TO $2\frac{1}{2}$ TIMES.

* FOR BASIC SYSTEM DEFINED BY "GREEN SHEETS", WITH 4K MEMORY.

90% CONFIDENCE LEVEL.

.003% PER 1000 HRS. I.C. FAILURE RATE ($0.03/10^6$ HOURS)

D84 PREPRODUCTION PROTOTYPE



CONTAINS:

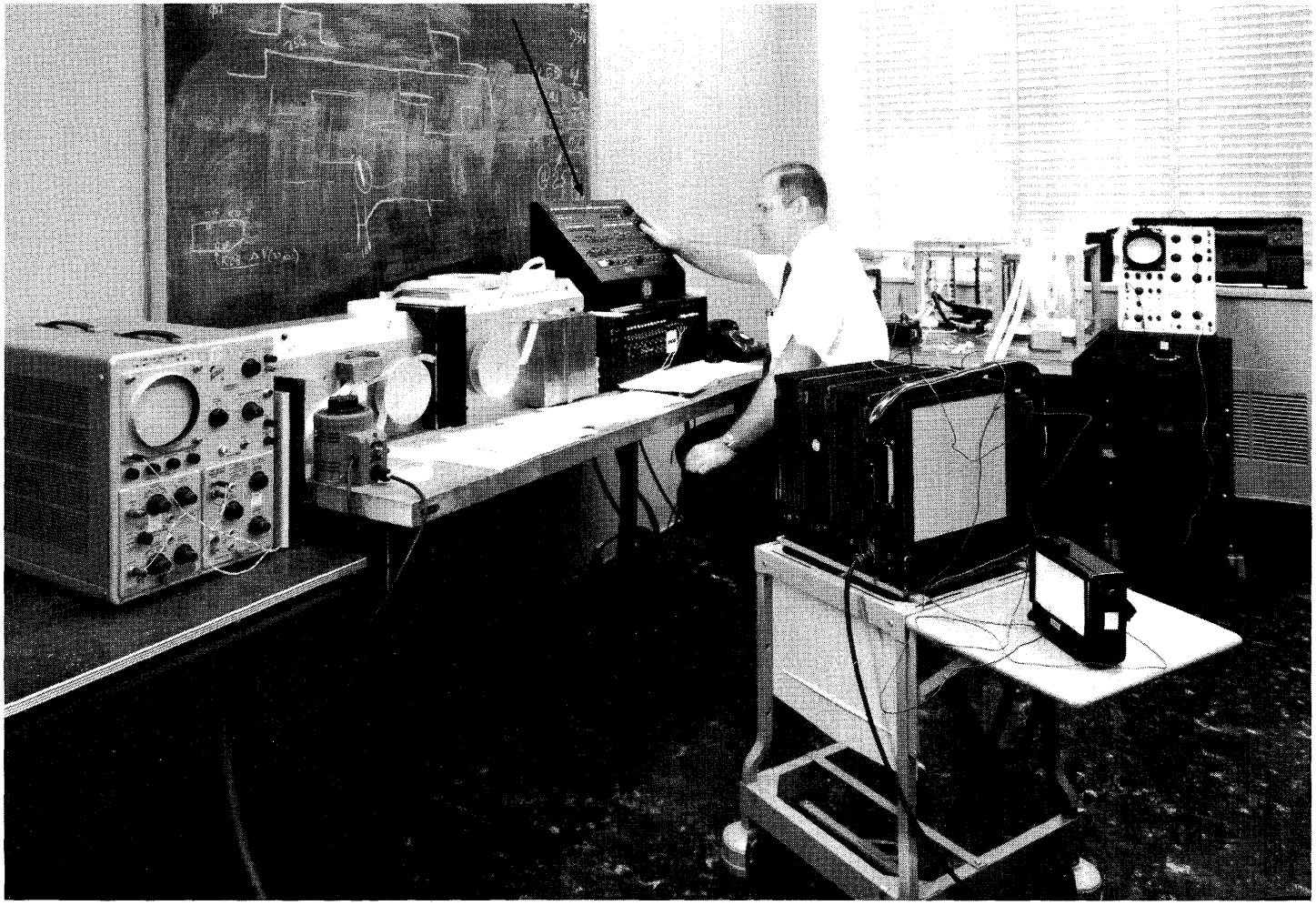
1	CDP MODULE
1	I/O MODULE
1	4096x25 BIT CORE MEMORY MODULE
1	POWER PACK (NOT PLUGGABLE)

HEIGHT:	13.7 IN.
WIDTH:	12.5 IN.
DEPTH:	15.0 IN.
VOLUME:	1.4 CU. FT.
WEIGHT:	100 LB.
POWER:	110 WATTS
COOLING:	NONE

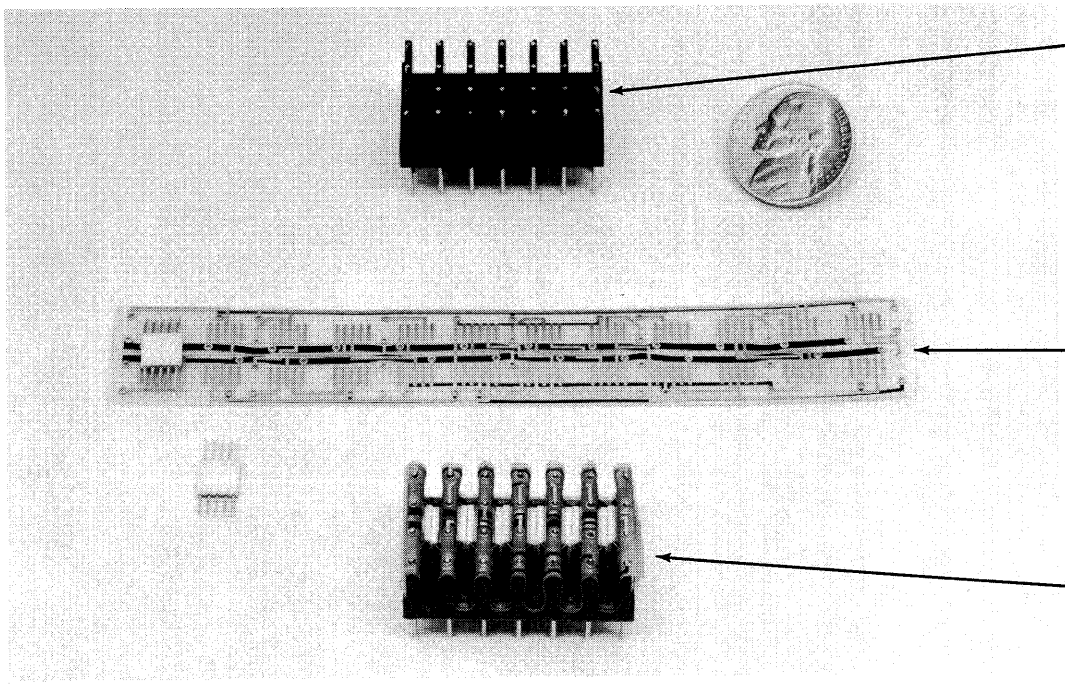
* CONTAINS 4 PLUGGABLE "CARDS", EACH A SANDWICH OF TWO PRINTED CIRCUIT (MOTHER) BOARDS CONTAINING UP TO 48 ("3-D") CIRCUIT NETWORK MODULES.

D84 PROTOTYPE TEST STATION

PROGRAMMER'S
PANEL



CIRCUIT NETWORK MODULE
FOR
D84 PREPRODUCTION PROTOTYPE



HEIGHT : 0.43 IN.

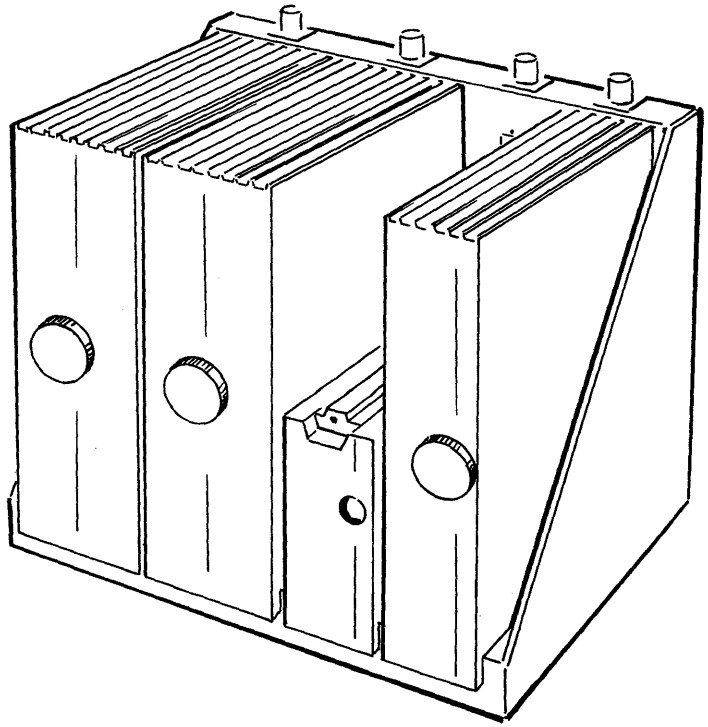
DEPTH : 0.8 IN.

WIDTH : 1.3 IN.

VOLUME : 0.45 CU. IN.

WEIGHT : 30 GRAMS

D84M COMPUTER*



HEIGHT : 18.0 IN.

DEPTH : 16.5 IN.

WIDTH : 21.0 IN.

WEIGHT : 150 LB.

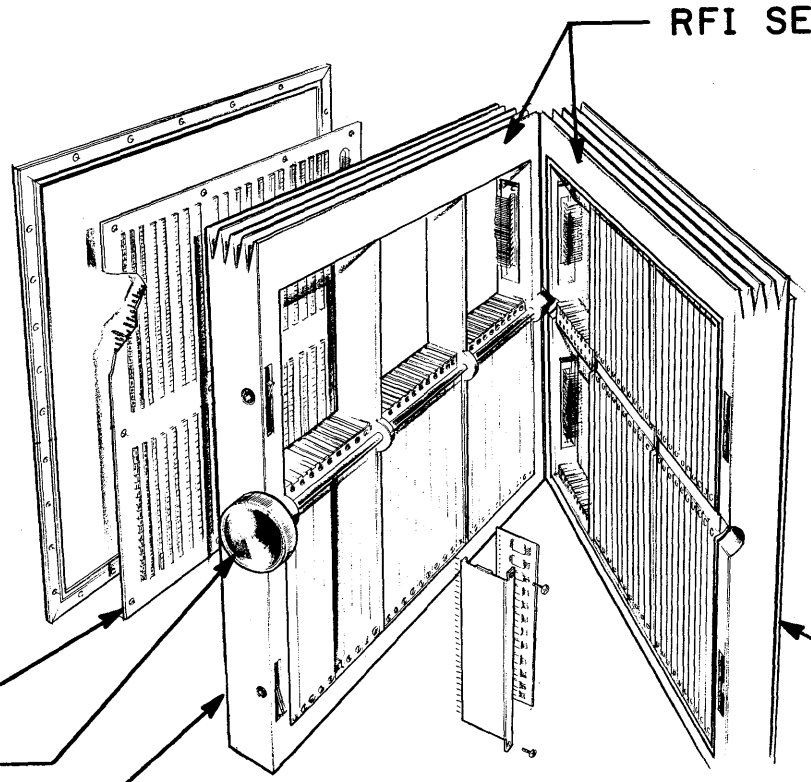
VOLUME : 3.9 CU. FT.

POWER : 160 WATTS

COOLING : NONE

* MINIMUM ("GREEN SHEET") SYSTEM

I/O AND CDP MODULES

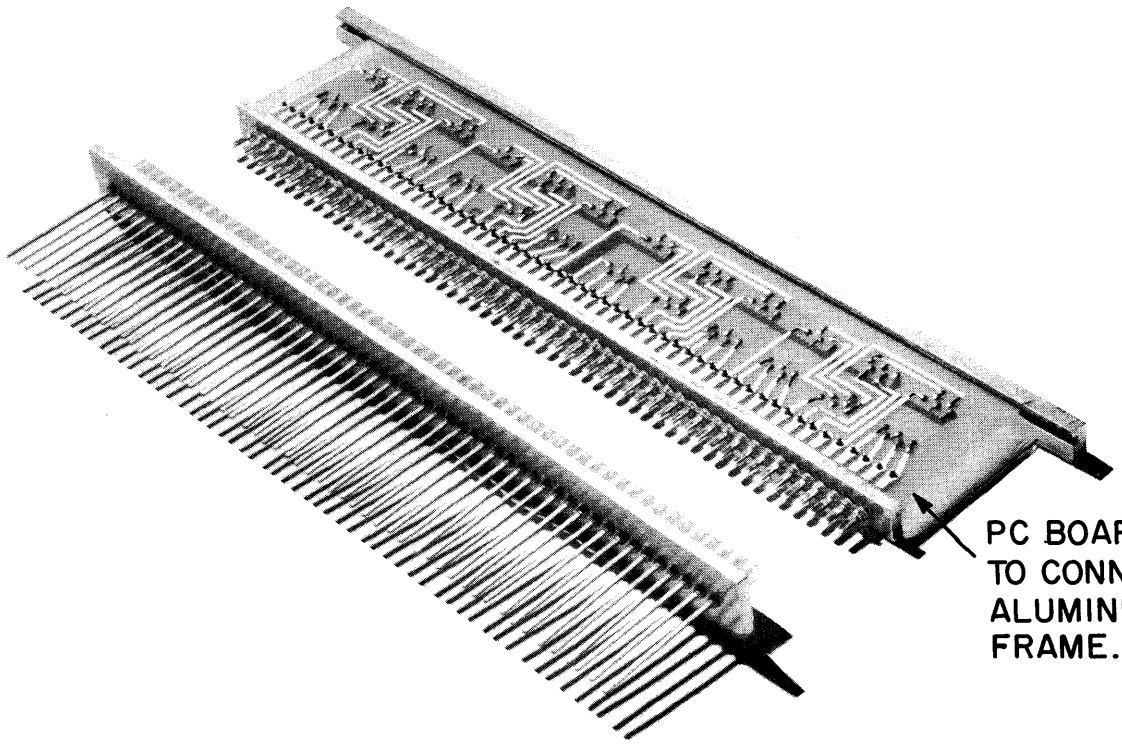


	I/O	CDP
HEIGHT :	16.0 IN.	16.0 IN.
WIDTH :	6.0 IN.	6.0 IN.
DEPTH :	14.5 IN.	14.5 IN.
VOLUME :	0.78 CU. FT.	0.78 CU. FT.
WEIGHT :	APPLICATION DEPENDENT	50 LB.
POWER :	APPLICATION DEPENDENT	43 WATTS

* MOVES MODULE TO MATE WITH SHEAR PINS, AND GUIDE TO FLOATING CONNECTORS.

** MAX. OF 3 WIRES / PIN — SOLDERED OR WIRE-WRAPPED AT CUSTOMER'S OPTION.

D84M CIRCUIT NETWORK MODULE (CNM)



HEIGHT : 0.25 IN.

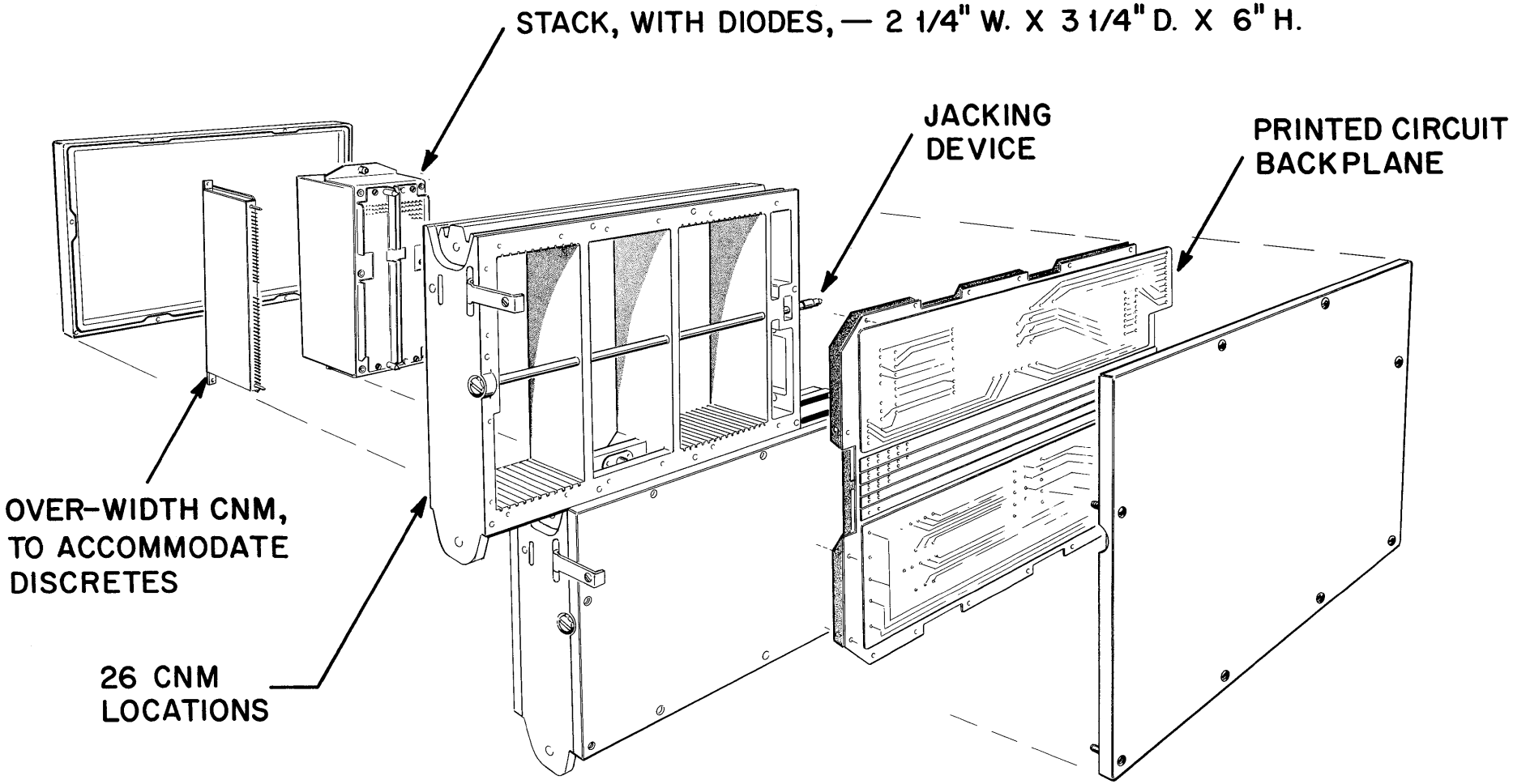
DEPTH : 6.5 IN.

WIDTH : 1.5 IN.

VOLUME : 2.5 CU. IN.

WEIGHT : 26 GRAMS

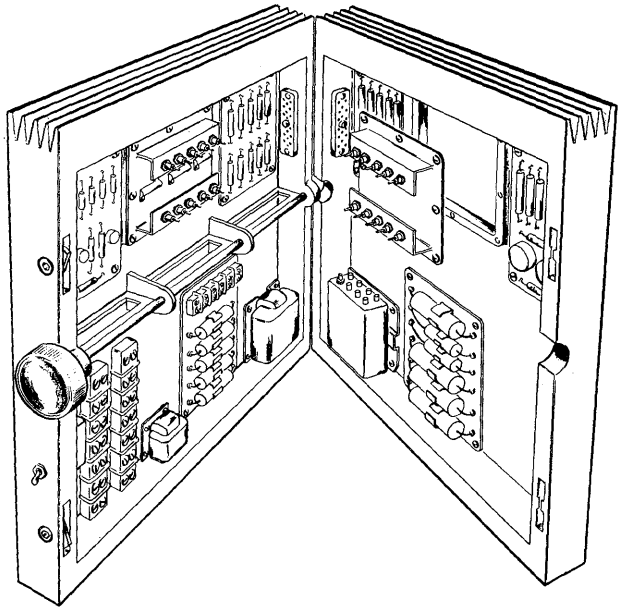
MEMORY MODULE



HEIGHT :	8.0 IN.	WEIGHT :	13 LB.
DEPTH :	14.5 IN.	VOLUME :	0.26 CU. FT.
WIDTH :	3.9 IN.	POWER :	75 WATTS ACTIVE* 12 WATTS STANDBY

* WORST-CASE, WHEN WRITING ALL 0's EACH MEMORY CYCLE.

POWER PACK



HEIGHT : 16.0 IN.

DEPTH : 14.5 IN.

WIDTH : 4.5 IN.

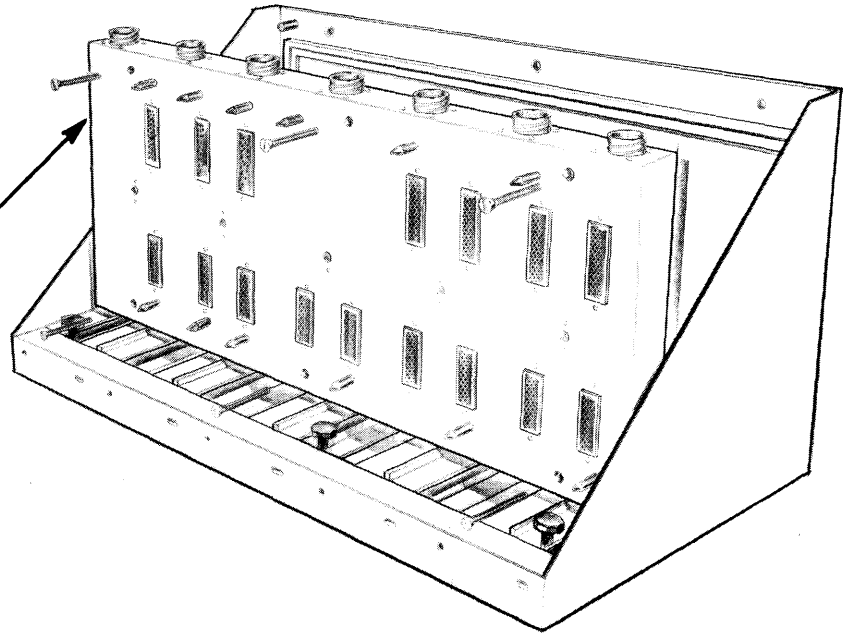
WEIGHT : 35 LB.

VOLUME: 0.52 CU. FT.

POWER CAPACITY: 300 WATTS

DISCRETE COMPONENTS, ALL ON REMOVABLE SUB-ASSEMBLIES

MOUNTING BASE ASSEMBLY



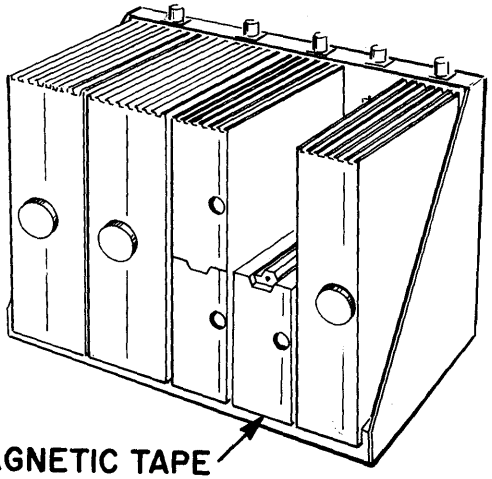
HEIGHT :	18.0 IN.	WIDTH*:	30.0 IN.
DEPTH :	16.5 IN.	WEIGHT*:	41 LB.

* THIS ASSEMBLY PROVIDES FOR 24K MEMORY

TYPICAL D84M CONFIGURATIONS

CONTAINS: ①

- 1 CDP MODULE
- 1 I/O MODULE
- 2 4096 x 25 BIT MEMORY MODULES
- 1 MAGNETIC TAPE CONTROLLER
- 1 POWER PACK

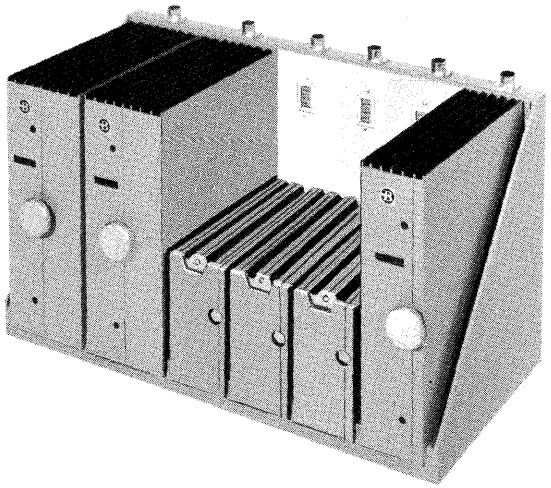


MAGNETIC TAPE CONTROLLER, IN 1/4" SIZE I/O MODULE

HEIGHT: 18.0 IN.
WIDTH: 25.0 IN.
DEPTH: 16.5 IN.
VOLUME: 4.5 CU. FT.
WEIGHT: 210 LB.
POWER: 230 WATTS *

CONTAINS: ②

- 1 CDP MODULE
- 1 I/O MODULE
- 3 4096 x 25 BIT MEMORY MODULES
- 1 POWER PACK PROVISIONS FOR EXPANSION TO 24K MEMORY

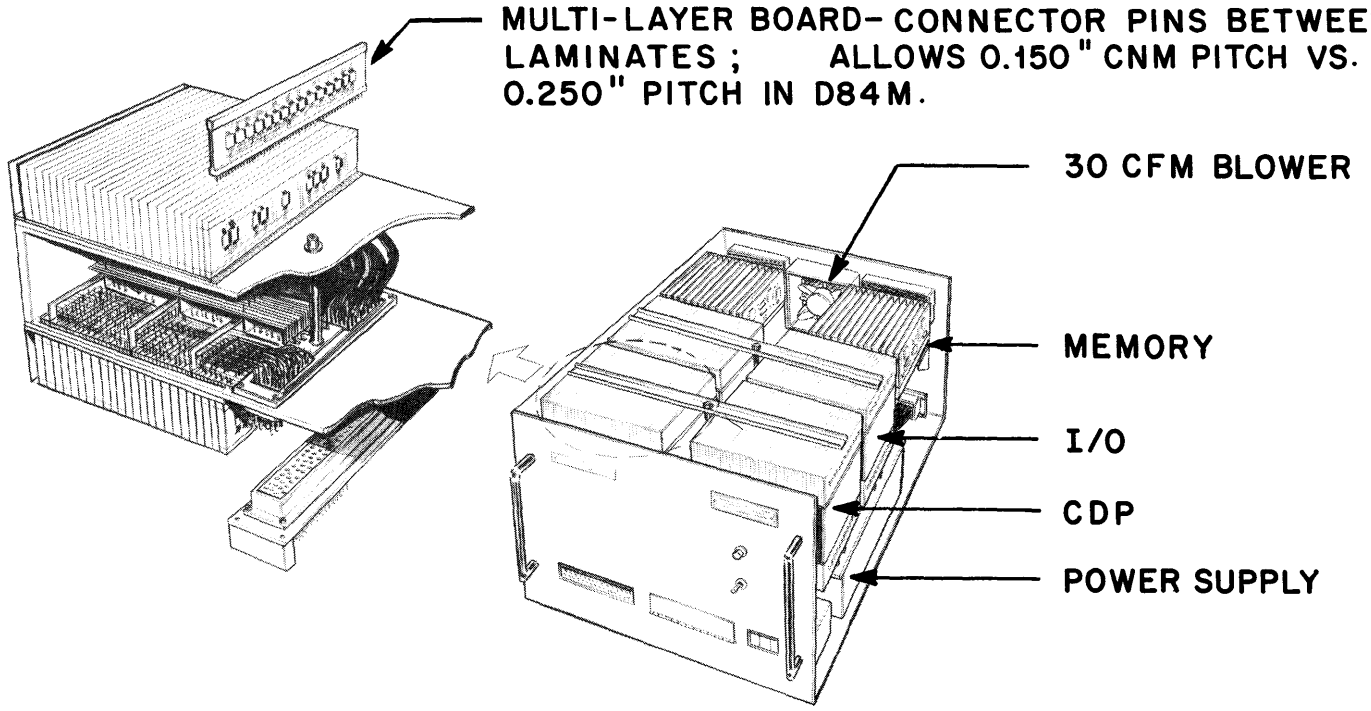


HEIGHT: 18.0 IN.
WIDTH: 30.0 IN.
DEPTH: 16.5 IN.
VOLUME: 5.25 CU. FT.
WEIGHT: 218 LB.
POWER: 230 WATTS *

* ONE 4096-WORD MEMORY ACTIVE, BALANCE ON STANDBY— WORST CASE

① SYSTEM BLOCK DIAGRAM ON CHART 21.
② SYSTEM BLOCK DIAGRAM ON CHART 20.

D84A AIRBORNE COMPUTER



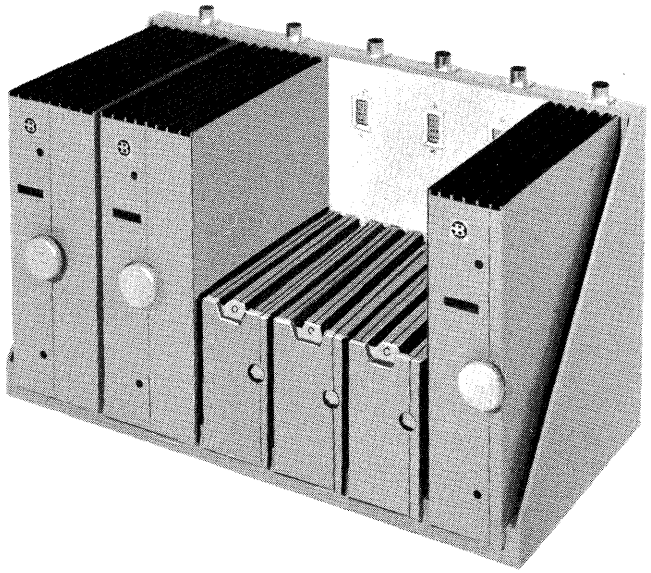
CONTAINS :

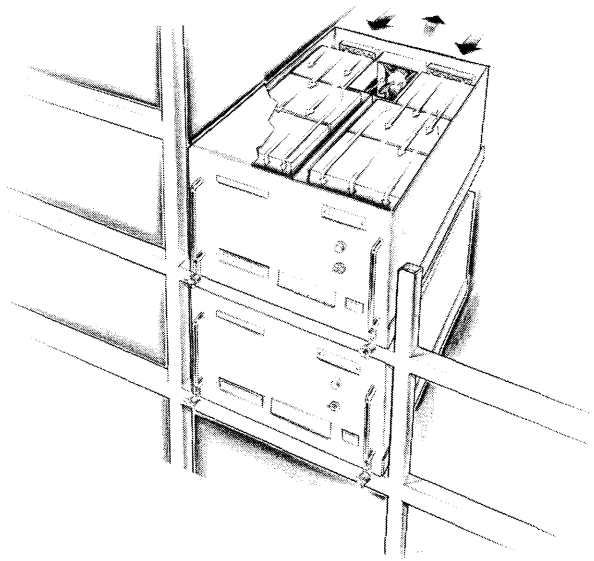
1	CDP MODULE
1	I/O MODULE
1	4096 x 25 BIT CORE MEMORY MODULE
1	POWER PACK

HEIGHT :	$7\frac{5}{8}$	IN.	STANDARD ATR CASE MS 91403-CID
WIDTH :	$15\frac{3}{8}$	IN.	
DEPTH :	$19\frac{9}{16}$	IN.	
WEIGHT :	60	LB.	
POWER :	170	WATTS	
COOLING :	30	CFM (AT SEA LEVEL)	

D84A AND D84M CNM's ARE LOGICALLY IDENTICAL, TYPE FOR TYPE.

D84M vs. D84A





CONTAINS:

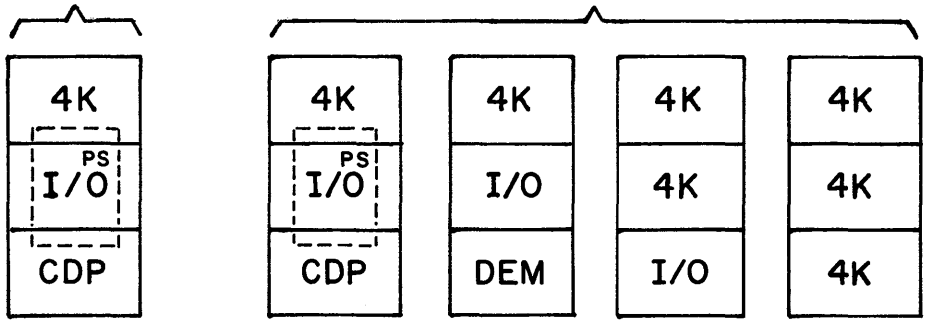
- 1 CDP MODULE
- 1 I/O MODULE
- 1 POWER PACK
- 3 4096-WORD MEMORY MODULES

	D84M	D84A
HEIGHT:	18.0 IN.	15 1/4 IN.
WIDTH:	30.0 IN.	15 3/8 IN.
DEPTH:	16.5 IN.	19 9/16 IN.
WEIGHT:	218 LB.	88 LB.
VOLUME:	5.25 CU.FT.	2.66 CU.FT.
POWER	230 WATTS	194 WATTS
	IN SAME VOLUME, 3 MORE 4096-WORD MEMORIES ACCOMMODATED (FOR 24 K TOTAL)	IN SAME VOLUME, 1 MORE 4096-WORD MEMORY ACCOMMODATED (FOR 16 K TOTAL)

D84A SYSTEM EXPANSION

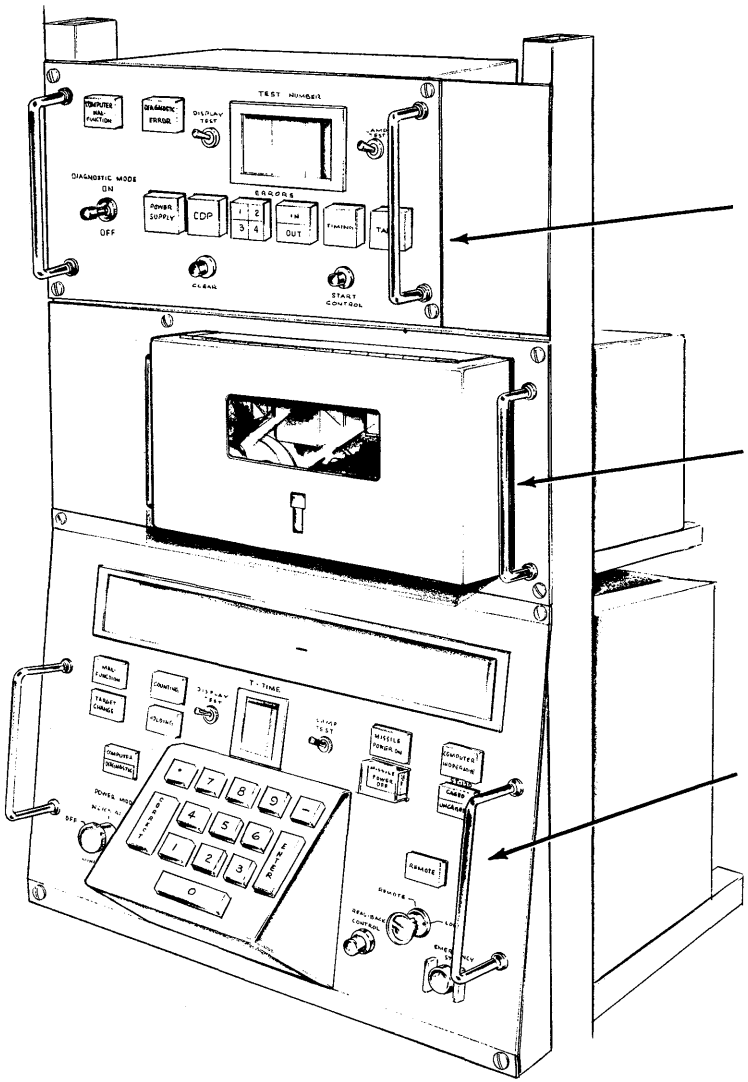
BASIC COMPUTER

EXAMPLES OF MODULE MIXES FOR SYSTEM EXPANSION



	WT. EA.	60 LB.	60 LB.	47 LB.	41 LB.	34 LB.
P. S.	13 LB.	13	13			
4K MEM.	6 LB.	6	6	6	12	18
I/O (FULL)	13 LB.	13	13	13	13	
CDP	12 LB.	12	12			
ATR	16 LB.	16	16	16	16	16
DEM	12 LB.			12		

TYPICAL CONTROL AND MAINTENANCE EQUIPMENT



SOFTWARE-LATER DELIVERIES
(2nd. HALF -'66)

1. ON-LINE ASSEMBLER
    - 2 PASS ON MINIMUM SYSTEM
    - RELOCATABLE SUBROUTINES
2. COMPILER
    - FORTRAN IV
3. EXECUTIVE PROGRAM
    - LOADER, ON MINIMUM SYSTEM
    - MULTIPROCESSING

NEW SPECIFICATION SHEETS TO BE RELEASED:

	DELIVERY CAPABILITY
DATA EXCHANGE MODULES — 3 TYPES	2nd QUARTER '66
1— TO ADDRESS 65K HOMOGENEOUSLY	
2— TO BUFFER WITH CONCURRENT ACCESS TO MEMORY BY I/O AND CDP (AND INCLUDE (1))	
3— TO MULTI—PROCESS (AND INCLUDE 1AND 2)	
BUFFERING OPTIONS	1st & 2nd QUARTER '66
D 84A PACKAGING OPTION	3rd QUARTER '66
CONTROLLER LOGIC FOR COMMONLY USED PERIPHERALS	1st QUARTER '66
I/O EXCHANGE OPTION ON EACH CONTROLLER TYPE	2nd QUARTER '66
NDRO THIN FILM	1st QUARTER '67
CHARACTER MANIPULATION	2nd QUARTER '66
BINARY←→BCD CONVERSION HARDWARE	2nd QUARTER '66

BUDGETARY PRICES

"GREEN SHEET MACHINE" – D84M OR D84A
PACKAGING – WITH 4K MEMORY

1 – $96K ($74K)

10 – $70K ($55K)

100 – $57K ($52K)

500 – $48K ($48K)

ADDITIONAL MEMORY MODULES

1 – $19K ($17K)

10 – $15K ($14K)

100 – $12K ($12K)

500 – $10K ($10K)

PRICES IN PARENTHESIS ARE FOR LIMITED ENVIRONMENT— FROM +15°C TO +55°C

Burroughs Corporation

DEFENSE AND SPACE GROUP

Paoli, Pennsylvania 19301