HP 2116A COMPUTER
VOLUME THREE

INTERFACE KIT 12543A
DIGITAL VOLTMETER
DATA INPUT (3440A)

OPERATING AND SERVICE MANUAL

HEWLETT PACKARD DYMEC DIVISION

PRELIMINARY MANUAL

for

HP 2116A COMPUTER
VOLUME THREE

INTERFACE KIT 12543A
DIGITAL VOLTMETER
DATA INPUT (3440A)

JULY 1967

INTERFACE KIT 12543A

DIGITAL VOLTMETER DATA INPUT (3440A)

1-1. INTRODUCTION

1-2. Interface Kit 12543A for the Hewlett-Packard HP 2116A Computer System provides the interface for input of data to the Computer from the HP 3440A Digital Voltmeter. The interface kit consists of the following:

a. Data Source Interface Card (HP Part No. 02116-6004).
b. Interconnecting Cable (HP Part No. 02116-6154).
c. BCS Data Source Interface Driver Tape (HP Accessory No. 20008A).

1-3. DESCRIPTION

1-4. The Data Source Interface Card and interconnecting cable provide signal and data transfer between the HP 2116A Computer and the HP 3440A Digital Voltmeter. The card contains many of the HP 562 Digital Recorder circuits and appears as a 562 Recorder to the 3440A Voltmeter. The interface card contains control and interrupt logic, and the logic necessary for entering data into the computer from the voltmeter. The interface card does not contain storage for information; all storage is performed in the voltmeter. The card plugs into any of the interface card Input/Output slots of the computer and assumes the lower Select Code of the slot it is plugged into.

1-5. The BCS (Basic Control System) Data Source Interface Driver Tape is a flexible Input/Output routine which permits transfer of data between the Computer and the Voltmeter. The driver is accessed through the BCS I/O Control subroutine (.IOC.) by a 5-word calling sequence. The driver is made part of the Basic Control System through the use of the Prepare Control System routine which is furnished with each Computer.

Refer to Chapter 1 of the HP 2116A Computer Basic Control System manual for information on Input/Output programming and to Chapter 4 for information on the processing of the BCS Data Source Interface Driver Tape.

1-6. INSTALLATION

1-7. Refer to the HP 3440A Digital Voltmeter Operating and Service manual and its associated plug-in unit manuals for installation, operation and maintenance information on the voltmeter. Connect the voltmeter to the data source interface card using the interconnecting cable listed in step "b" of Paragraph 1-2, as follows:

a. Facing the back of the 3440A Voltmeter, plug the connector labeled "02116-6154" into connector J2 of the voltmeter. Connector J2 is labeled "DIGITAL RECORDER".

b. Pull open the front panel of the computer.

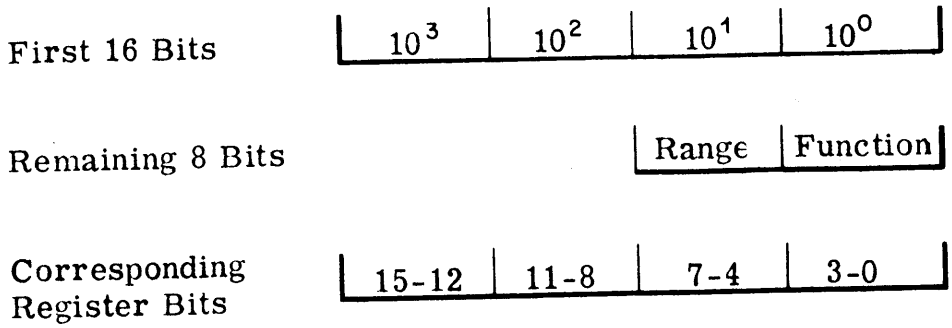
c. Plug the data source interface card into the Input/Output slot assigned for the particular computer system.

d. Pass the other connector of the interconnecting cable through the slot at the bottom-rear of the computer and up to the front. Slide the connector onto the data source interface card. Close the computer's front panel.

1-8. GENERAL THEORY OF OPERATION.

1-9. GENERAL.

1-10. The voltmeter presents 24 data bits in BCD code to the interface card. These 24 bits are transferred to the computer in two steps, the least significant 16 bits transferred first. Two Load Into A (LIA) or Load Into B (LIB) instructions are required to load the A- or B-register with the 24 bits of information. The A- or B-register can contain only 16 data bits. If only one register is used to input the 24 bits of data, the first 16 bits must be stored in memory before the remaining 8 bits are loaded into the register. Refer to Table 1-1 for a list of the pin connections of the interconnecting cable and the signals applied to the individual pins. The following provides the standard data transfer formats:



10^0 - 10^3: Data Bits corresponding to the 4 digits of the Voltmeter display.

Range: Decimal 10^{-n} Multiplier

Function: A number indicating the state of the voltmeter, as follows:

NO. (BCD)	FUNCTION
0	+ Volts
1	- Volts
7	Overrange (1-2-4-8 Code)
9	Overrange (1-2-2'-4 Code)

1-11. INPUT OPERATIONS

1-12. Refer to Figure 1-1. A Set Control (STC), Clear Flag (CLF) instruction initiates the input of data from the voltmeter. The STC portion of the instruction resets the Input Control FF which will enable the first 16 bits of data to the computer. It also sets the Control FF to remove the input to the Print Command FF. This allows removal of the Hold signals to the voltmeter. The CLF portion of the instruction resets the Print Command FF which actually removes the Hold signal to the voltmeter, allowing it to make a voltage measurement. The CLF portion of the instruction also resets the Flag FF to prevent an interrupt signal from being sent to the computer before data has been received by the interface card.

Table 1-1. Interconnecting Cable Leadwire Connections

INTERFACE CARD CONNECTOR PIN	DIGITAL VOLTMETER CONNECTOR PIN	DATA BIT	DIGITAL VOLTMETER SIGNAL
4	1	0	10^0
B	2	1	
J	26	2	
L	27	3	
T	3	4	10^1
V	4	5	
6	28	6	
8	29	7	
2	5	8	10^2
D	6	9	
F	30	10	
N	31	11	
R	7	12	10^3
X	8	13	
Z	32	14	
10	33	15	
5	9	16	Function
C	10	17	
K	34	18	
M	35	19	
U	11	20	Range
W	12	21	
7	36	22	
9	37	23	
14	25		+ Reference
13	22		+ Hold
17	48		- Record Command
16	23		+ Record Command
*24, BB	50		Gnd
** 20	24		-Reference
15	47		-Hold
*1, A			
**3, E, H, P, S, Y, AA, 11			

NOTES: * Pins 1 & A and 24 & BB are connected on interface card connector.

** Pins 3, E, H, P, S, Y, AA and 11 are connected to pin 20 on interface card connector.

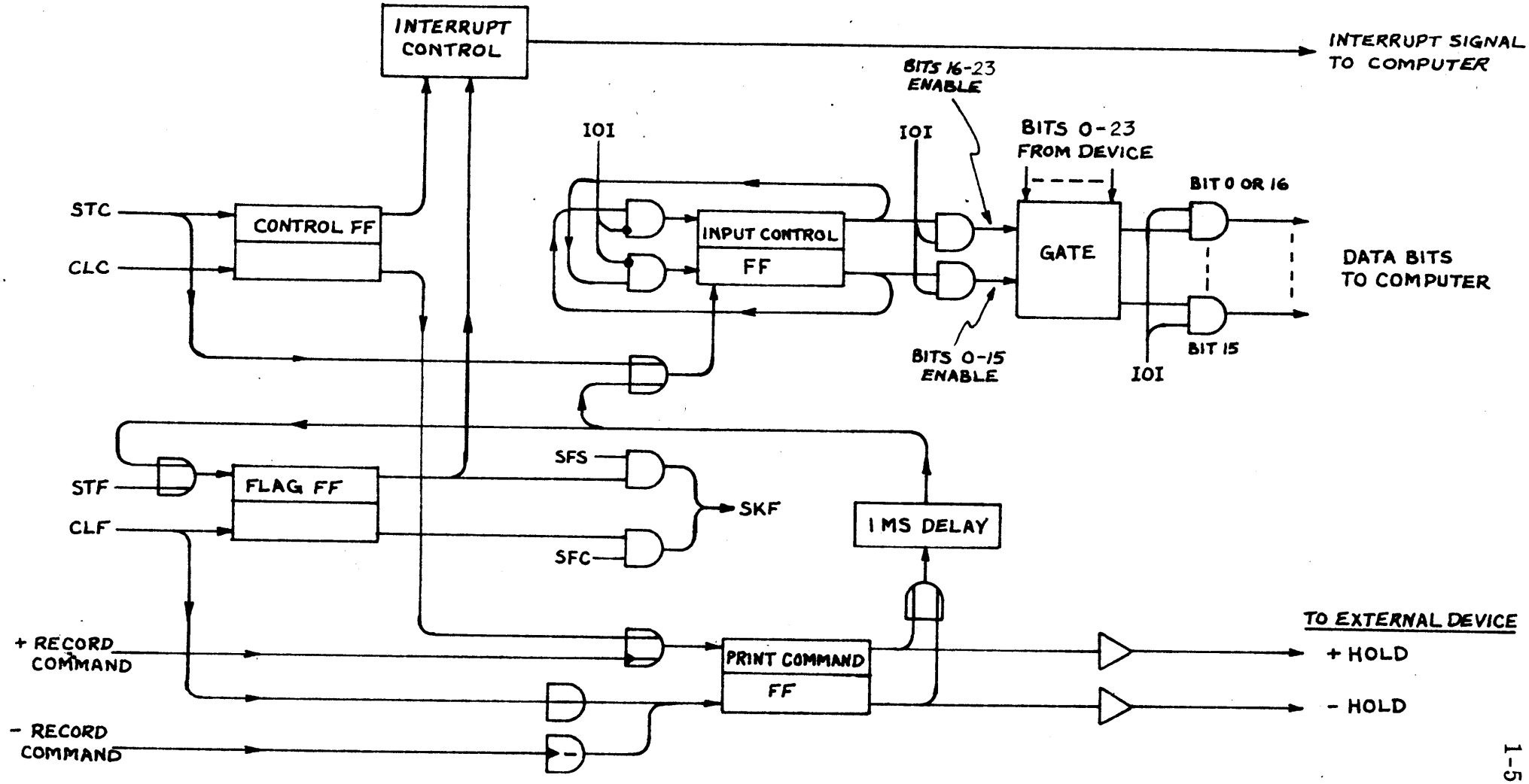


Figure 1-1. Simplified Logic Diagram for Data Source Interface Card

1-13. When the voltmeter has made a reading, it sends a Record Command signal to the interface card. This causes the Print Command FF to restore the Hold signal to the voltmeter, preventing it from making another voltage reading. After a one millisecond delay, the Print Command FF output ensures that the Input Control FF is reset (to enable the first 16 bits to the computer). It also sets the Flag FF to initiate an interrupt signal to the computer, indicating that data is available on the interface card.

1-14. The first programmed LIA/B instruction provides an IOI signal to the interface card at times T4 and T5. With the Input Control FF reset, bits 0 through 15 (10^0 through 10^3 digits) are enabled to the A- or B-register of the computer. When the IOI signal drops (at the end of time T5), the Input Control FF sets. The second LIA/B instruction provides another IOI signal to the interface card which, with the Input Control FF set, enables bits 16 through 23 (Function and Range) to the A- or B-register of the computer.

1-15. A CLF instruction is required to initiate another voltage reading by removing the Hold signal to the voltmeter. At the completion of the voltmeter operations, a Clear Control (CLC) instruction should be programmed to reset the Control FF and remove the voltmeter from the Input/Output system. For a detailed logic diagram of the data source interface card, refer to the logic diagram at the end of this section.

1-16. TIMING

1-17. The repetition rate on pairs of LIA/B instructions is limited to a maximum of 4kHz, with a minimum delay of 250 microseconds between pairs of instructions, by high impedance circuitry in the voltmeter.

NOTE

Table 1-2 lists the part numbers of the Microcircuit Packages, identified in the logic diagram at the end of this section, by reference designations preceded by MC. Figure A-1 in Appendix A contains logic diagrams of the Microcircuit Packages according to part number.

1-18. REPLACEABLE PARTS

1-19. Refer to Table 1-2 for a list of replaceable parts in alpha-numerical order of their reference designations, with a description and HP part number for each part.

1-20. To order a replacement part, address the order or inquiry to your local Hewlett-Packard field office. See the list at the rear of this manual for field-office addresses.

1-21. Specify the following information for each part when ordering:

a. Hewlett-Packard part number.
b. Circuit reference designation.
c. Description.

1-22. To order a part not listed in Table 1-2, give a complete description of the part and include its function and location.

Table 1-2. Data Source Interface Card - Replaceable Parts

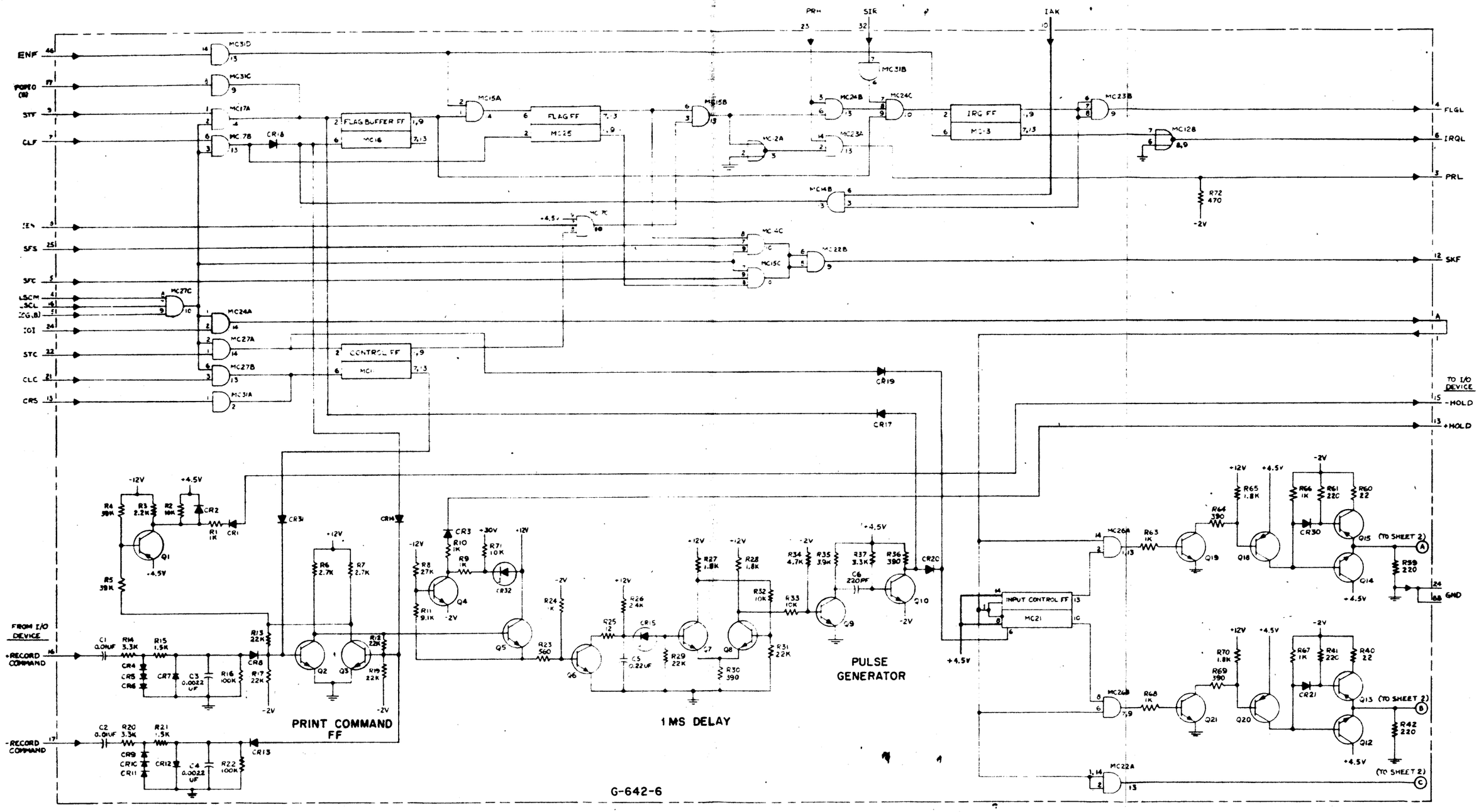
REFERENCE DESIGNATION	DESCRIPTION	HP PART NO.
C1, C2	Capacitor, fixed, Ceramic, 0.01 μf	0150-0093
C3, C4	Capacitor, fixed, Mylar, 0.0022 μf	0160-0154
C5, C7	Capacitor, fixed, Mylar, 0.22 μf	0160-0380
C6	Capacitor, 220 pf ± 1%	0140-0221
C8 thru C13, C108 thru C113, C208 thru C213, C308 thru C313, C408 thru C413, C508 thru C513, C608 thru C613, C708 thru C713	Capacitor, fixed, 0.001 μf	0150-0050
C16 thru C18, C20, C21	Capacitor, fixed, Tant, 2.2 μf	0180-0155
C19	Capacitor, fixed, Tant, 1.0 μf	0180-0291
CR1 thru CR14, CR21 thru CR31, CR122 thru CR129, CR222 thru CR229, CR322 thru CR329, CR422 thru CR429, CR522 thru CR529, CR622 thru CR629, CR722 thru CR729	Diode, Silicon	1901-0040
CR15	Diode (6.2V Breakdown)	1902-0036
CR17 thru CR20	Diode	1910-0022
CR32	Diode (4.1V Breakdown)	1902-0188
Q1, Q13, Q15, Q18, Q20	Transistor, Silicon, PNP(2N3640)	1853-0015
Q2 thru Q10, Q12, Q14, Q16, Q17, Q19, Q21, Q116, Q117, Q216, Q217, Q316, Q317, Q416, Q417, Q516, Q517, Q616, Q617, Q716, Q717	Transistor, Silicon, NPN(2N3646)	1854-0094
MC11 thru MC13, MC16, MC25	Microcircuit Package	1820-0952
MC14, MC15, MC17, MC24, MC27	Microcircuit Package	1820-0953
MC21	Microcircuit Package	1820-0967
MC22, MC23, MC26, MC28, MC128, MC228, MC328, MC428, MC528, MC628, MC728	Microcircuit Package	1820-0956

Table 1-2. Data Source Interface Card - Replaceable Parts (Cont'd.)

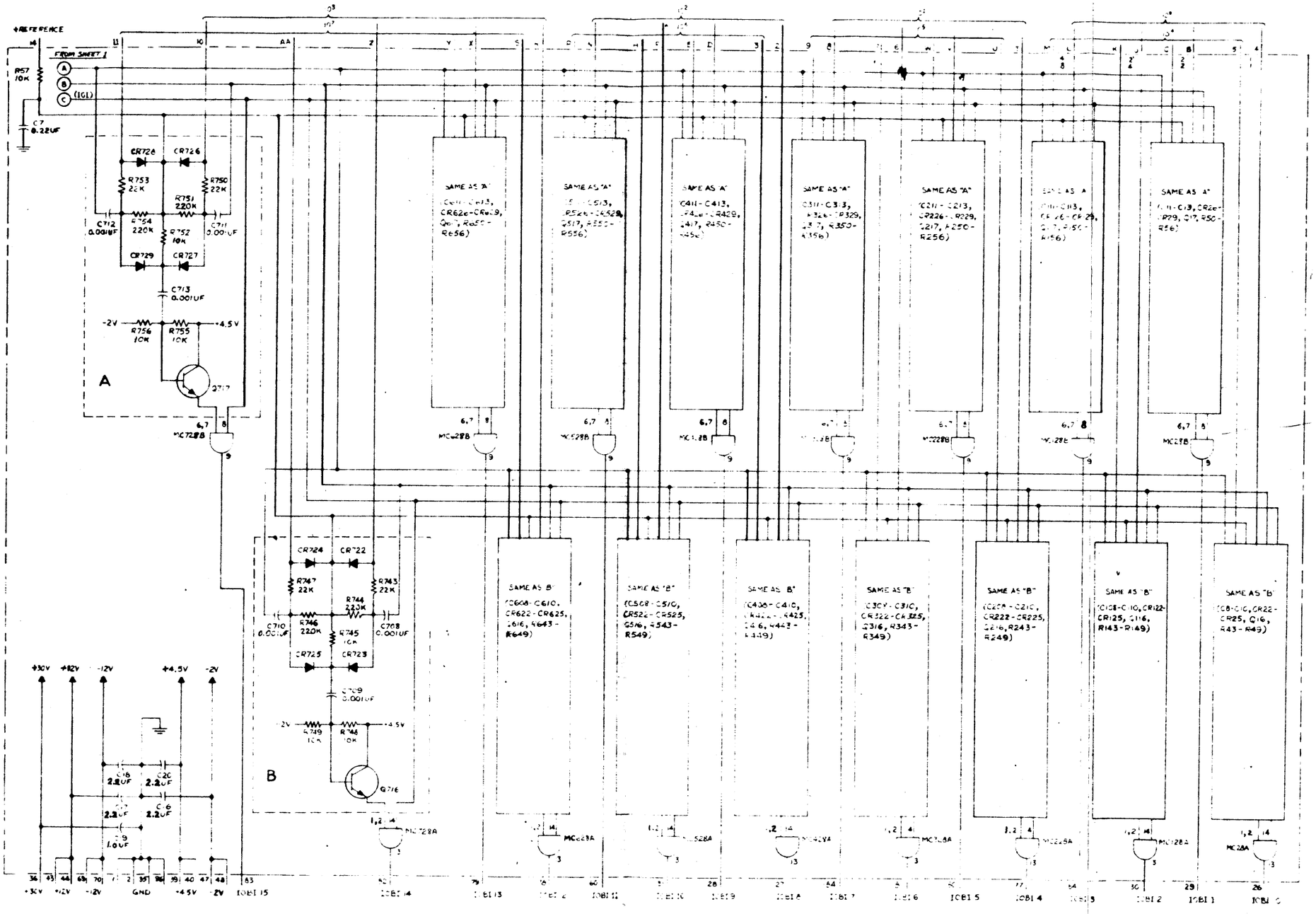
REFERENCE DESIGNATION	DESCRIPTION	HP PART NO.
MC31	Microcircuit Package	1820-0965
R1, R9, R10, R24, R63, R66 thru R68	Resistor, fixed, 1K ±5%, 1/4 w	0683-1025
R2, R33, R45, R48, R49, R52, R55 thru R57, R145, R148, R149, R152, R155, R156, R245, R248, R249, R252, R256, R345, R348, R349, R352, R355, R356, R445, R448, R449, R452, R455, R456, R545, R548, R549, R552, R555, R556, R645, R648, R649, R652, R655, R656, R745, R748, R749, R752, R755, R756	Resistor, fixed, 10K ±5%, 1/4 w	0683-1035
R3	Resistor, fixed, 2.2K ±5%, 1/4 w	0683-2225
R4	Resistor, fixed, 39K ±5%, 1/4 w	0683-3935
R5, R35	Resistor, fixed, 3.9K ±5%, 1/4 w	0683-3925
R6, R7	Resistor, fixed, 2.7K ±5%, 1/4 w	0683-2725
R8	Resistor, fixed, 27K ±5%, 1/4 w	0683-2735
R11	Resistor, fixed, 9.1K ±5%, 1/4 w	0683-9125
R12, R13, R17, R19, R29, R31, R37, R43, R50, R53, R143, R147, R150, R153, R243, R247, R250, R253, R343, R347, R350, R353, R443, R447, R450, R453, R543, R547, R550, R553, R643, R647, R650, R653, R743, R747, R750, R753	Resistor, fixed, 22K ±5%, 1/4 w	0683-2235
R14, R20, R37	Resistor, fixed, 3.3K ±5%, 1/4 w	0683-3325
R15, R21	Resistor, fixed, 1.5K ±5%, 1/4 w	0683-1525
R16, R22	Resistor, fixed, 100K ±5%, 1/4 w	0683-1045
R23	Resistor, fixed, 560 ohms ±5%, 1/4w	0683-5615

Table 1-2. Data Source Interface Card - Replaceable Parts (Cont'd.)

REFERENCE DESIGNATION	DESCRIPTION	HP PART NO.
R25	Resistor, fixed, 12 ohms ±5%, 1/4 w	0683-1205
R26	Resistor, fixed, film, 2.4K ±2%	0757-0933
R27, R28, R65, R70	Resistor, fixed, 1.8K ±5%, 1/4 w	0683-1825
R30, R36, R64, R69	Resistor, fixed, 390 ohms ±5%, 1/4w	0683-3915
R32	Resistor, fixed, 10 ohms ±5%, 1/4 w	0683-1005
R34	Resistor, fixed, 4.7K ±5%, 1/4 w	0683-4725
R40, R60	Resistor, fixed, 22 ohms ±5%, 1/4w	0683-2205
R41, R42, R59, R61	Resistor, fixed, 220 ohms ±5%, 1/4w	0683-2215
R44, R46, R51, R54, R144, R146, R151, R154, R244, R246, R251, R254, R344, R346, R351, R354, R444, R446, R451, R454, R544, R546, R551, R554, R644, R646, R651, R654, R744, R746, R751, R754	Resistor, fixed, 220K ±5%, 1/4 w	0683-2245
R71	Resistor, fixed, 680 ohms ±5%, 1/4w	0683-6815
R72	Resistor, fixed, 470 ohms ±5%, 1/4w	0683-4715



DATA SOURCE INTERFACE CARD
LOGIC DIAGRAM (SHEET 1 OF 2)



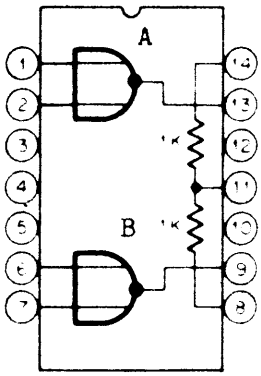
DATA SOURCE INTERFACE CARD
LOGIC DIAGRAM (SHEET 2 OF 2)

APPENDIX A

CTμL PIN DIAGRAMS

TOP VIEW

1820-0952



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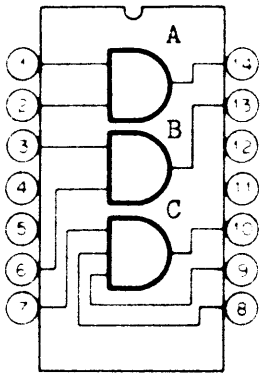

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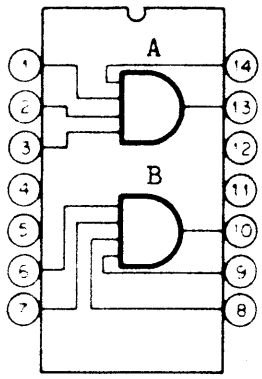

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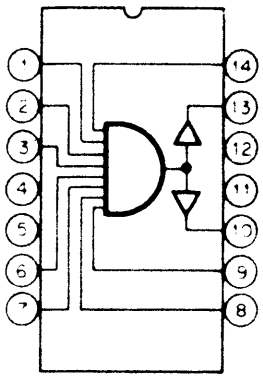

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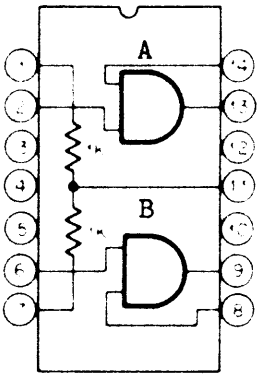

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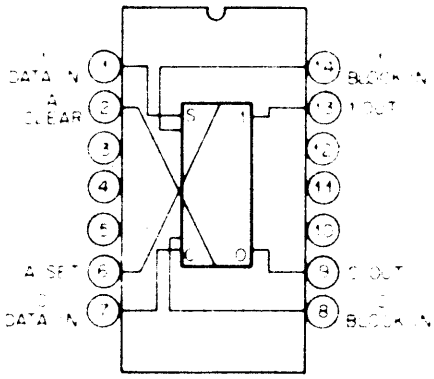

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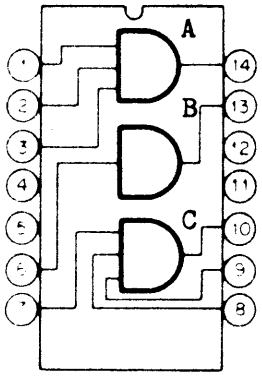

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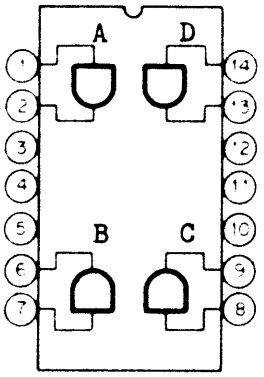
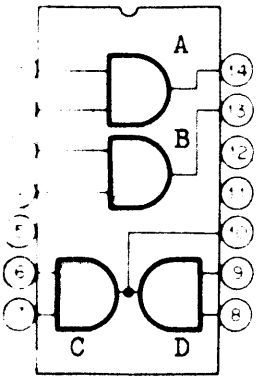


SEE FIGURE A-2

1820-0966



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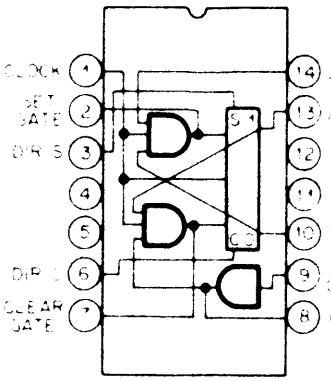

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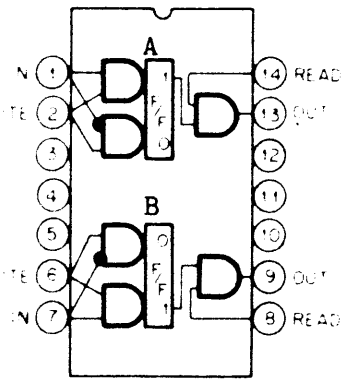
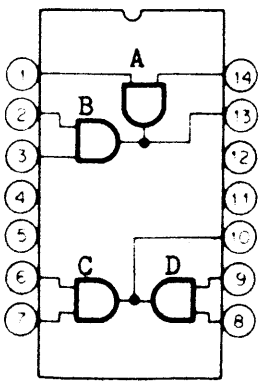


1820-0971



SEE FIGURE A-3

PIN 5 ON ALL PACKS IS GROUND
PIN 11 ON ALL PACKS IS V_{BB} = -2V ± 10%
PIN 12 ON ALL PACKS IS V_{CC} = +4.5V ± 10%

* **Pins 8 and 14 of 1820-0968 are** connected to 4.5 volts unless otherwise specified on a logic diagram using the Microcircuit Package.

Figure A-1. Logic Diagrams for Microcircuit Packages, Top View

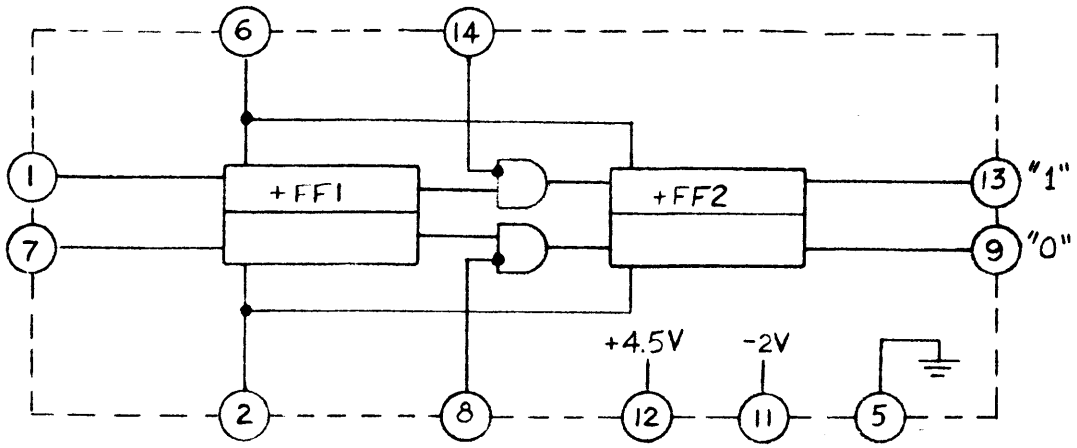
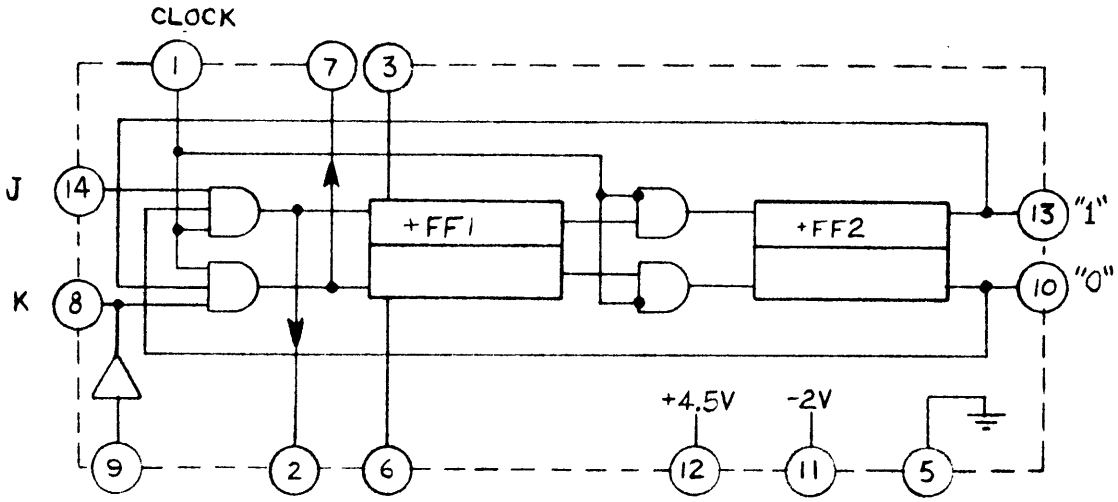
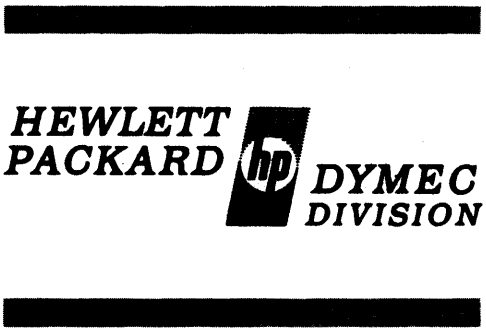


Figure A-2. 1820-0957 - Simplified Logic Diagram



IF, DURING CLOCK PULSE ⎍, INPUTS ARE		AND OUTPUTS ARE		NEW OUTPUTS AFTER PULSE DROPS WILL BE:	
"J"	"K"	SET	RESET	SET	RESET
1	1	1	0	0	1
1	1	0	1	1	0

Figure A-3. 1820-0967 - Simplified Logic Diagram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DIVISION