MODEL 2116A COMPUTER
VOLUME THREE

INTERFACE KIT 12544A
COUNTER/THERMOMETER
DATA INPUT (8 DIGITS)

OPERATING AND SERVICE MANUAL

HEWLETT
PACKARD **hp** DYMEC
DIVISION

PRELIMINARY MANUAL

for

MODEL 2116A COMPUTER
VOLUME THREE

INTERFACE KIT 12544A
COUNTER/THERMOMETER
DATA INPUT (8 DIGITS)

02116 - 90468

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INTERFACE KIT 12544A

COUNTER/THERMOMETER DATA INPUT (8 DIGITS)

1-1.   INTRODUCTION

1-2.   Interface Kit 12544A for the HP 2116A Computer System consists of the following:

a.   Data Source Interface Card (HP Part No. 02116-6004).

b.   Interconnecting Cable (HP Part No. 02116-6153).

1-3.   The Data Source Interface Card and interconnecting cable provide signal and data transfer between the HP 2116A Computer and the HP 5245L Electronic Counter, the HP 2801A Quartz Thermometer, or similar digital output devices. The card contains many of the HP 562 Digital Recorder circuits and will appear as a 562 Recorder to the measuring device. The interface card contains control and interrupt logic, and the logic necessary for entering up to 32 bits of data into the computer. The interface card does not contain storage for information; all storage must be performed in the measuring device. 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.

1-4.   INSTALLATION

1-5.   INSTALLATION OF HP 5245L ELECTRONIC COUNTER

1-6.   Refer to the 5245L Electronic Counter Operating and Service Manual for unpacking and installation information on the counter. Connect the counter 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 counter, plug the connector labeled "02116-6153" into connector J11 of the counter. Connector J11 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.

e.   Gently close the front panel of the computer.

1-7.   INSTALLATION OF HP 2801A QUARTZ THERMOMETER.

1-8.   Refer to the Handbook for Model DY-2801A Quartz Thermometer for unpacking and installation information on the quartz thermometer. Connect the quartz thermometer to the data source interface card using the interconnecting cable. Observe the instructions of steps "a" through "e" of **Paragraph 1-6** except plug the connector labeled "02116-6153" into connector J7 of the quartz thermometer. Connector J7 is labeled "RECORDER".

1-9.   INSTALLATION OF OTHER DEVICES.

1-10.   If other devices are to be connected to the data source interface card, appropriate data voltage levels, + Reference and - Reference voltages, and Record Commands must be provided to the data source interface card. Table 1-1 lists the pin connections of the interconnecting cable and the signals applied to the individual pins. Figure 1-1 **illustrates**

Table 1-1.   Interconnecting Cable Leadwire Connections

INTERFACE CARD CONNECTOR PIN	COUNTER/THERMOMETER CONNECTOR PIN	DATA BIT	COUNTER/THERMO-METER SIGNAL
4	1	0	
B	2	1	10^0
J	26	2	
L	27	3	
T	3	4	
V	4	5	10^1
6	28	6	
8	29	7	
2	5	8	
D	6	9	10^2
F	30	10	
N	31	11	
R	7	12	
X	8	13	10^3
Z	32	14	
10	33	15	
5	9	16	
C	10	17	10^4
K	34	18	
M	35	19	
U	11	20	
W	12	21	10^5
7	36	22	
9	37	23	
3	13	24	10^6 (Counter)
E	14	25	Mode Readout
H	38	26	(Thermometer)
P	39	27	
S	15	28	10^7 (Counter)
Y	16	29	Polarity Readout
AA	40	30	(Thermometer)
11	41	31	
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			

NOTE: * PINS 1 & A and 24 & BB are connected on interface card connector.

the relationship between the + and - Reference voltage levels and the logic "one" and logic "zero" data input requirements. The voltage-level input requirements may be summarized as follows:

a.   The negative voltage level for a logic "zero" input to the computer must be at least 4 volts negative with respect to the + Reference voltage to the interface card.

b.   The positive voltage level for a logic "one" input to the computer must be more positive than the + Reference voltage to the interface card.

c.   If a positive input voltage level is used to represent a false or logic "zero" condition to the computer, the input data must be placed in a computer register and complemented before being placed in memory.

1-11.   The Record Command input to the interface card from the external device may be a positive or a negative pulse (see Table 1-1). The pulse must be 6 to 40 volts in amplitude and 20 microseconds or more in width.

1-12.   Figure 1-2 illustrates a typical application where inputs to the data source interface card are provided by contact closures. Any unused data input leadwires in the interconnecting cable (see Table 1-1) must be connected to pin 20, - Reference, of the interface card connector. If unused pins are not connected to pin 20, computer software must mask the unused bits to prevent the possibility of erroneous input data.

1-13.   SIMPLIFIED THEORY OF OPERATION

1-14.   GENERAL
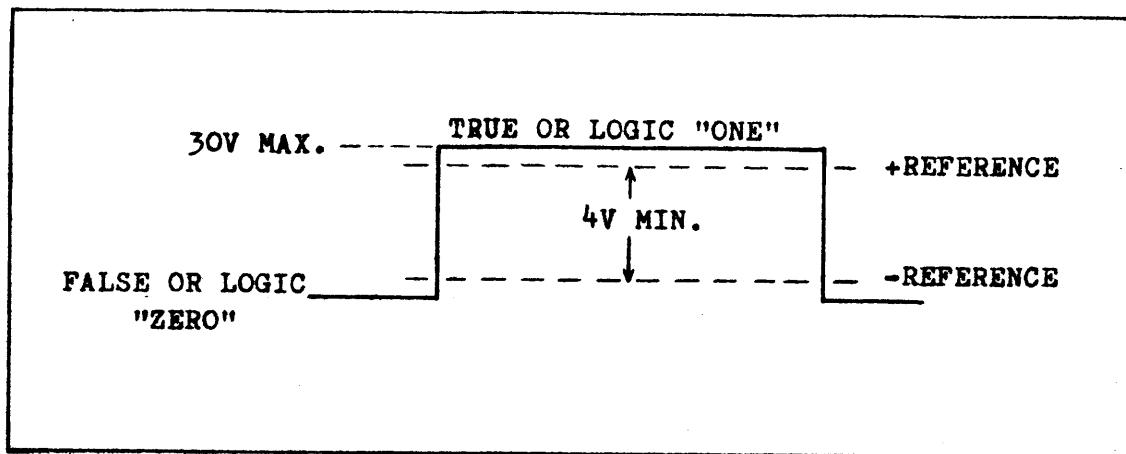
Figure 1-1. Data Input and Reference Voltage Levels
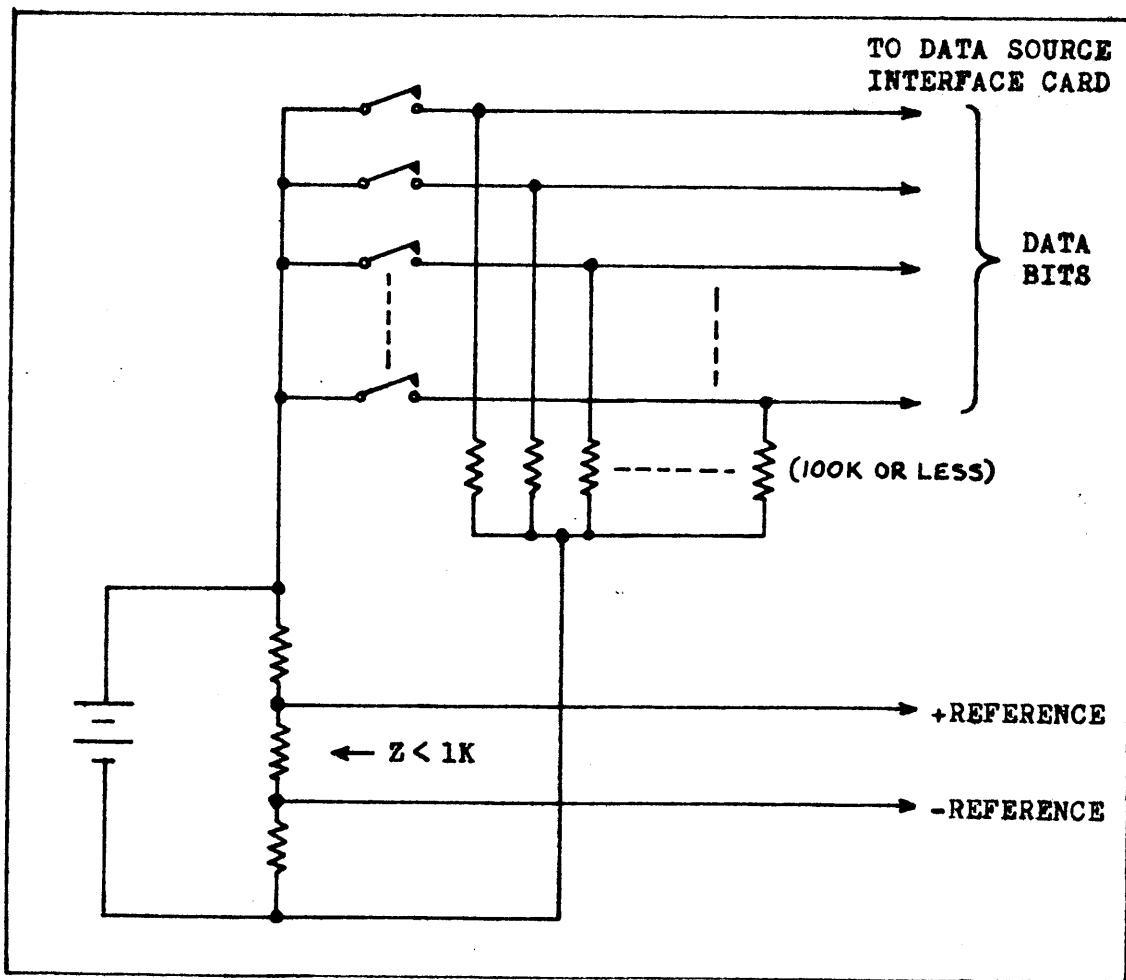
Figure 1-2. Typical Application Using Contact Closures

1-15.   The interconnecting cable of the interface kit allows the parallel transfer of up to 32 bits of data from a digital output device to the data source interface card. The input data is transferred from the interface card to the computer by two Load Into A (LIA) or Load Into B (LIB) instructions. The first LIA/B instruction transfers bits 0 through 15 (see Table 1-1) and the second LIA/B instruction transfers bits 16 through 31 to the A- or B-register of the computer. (The A- or B-register can contain only 16 data bits. If only one register is used to input the 32 bits of data, the first 16 bits must be stored in memory before the second 16 bits are loaded into the register.)

1-16.   INPUT OPERATIONS

1-17.   Refer to Figure 1-3. A Set Control, Clear Flag (STC, CLF) instruction initiates the input of 32 bits of data from the external device. 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 external device. The CLF portion of the instruction resets the Print Command FF which actually removes the Hold signals to the device, allowing it to perform its input function. 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.

1-18.   When the device has completed its input function, it sends a Record Command signal (+ or -) to the interface card. This causes the Print Command FF to restore the Hold signal to the device, preventing it from performing another input operation. After a one millisecond delay, the
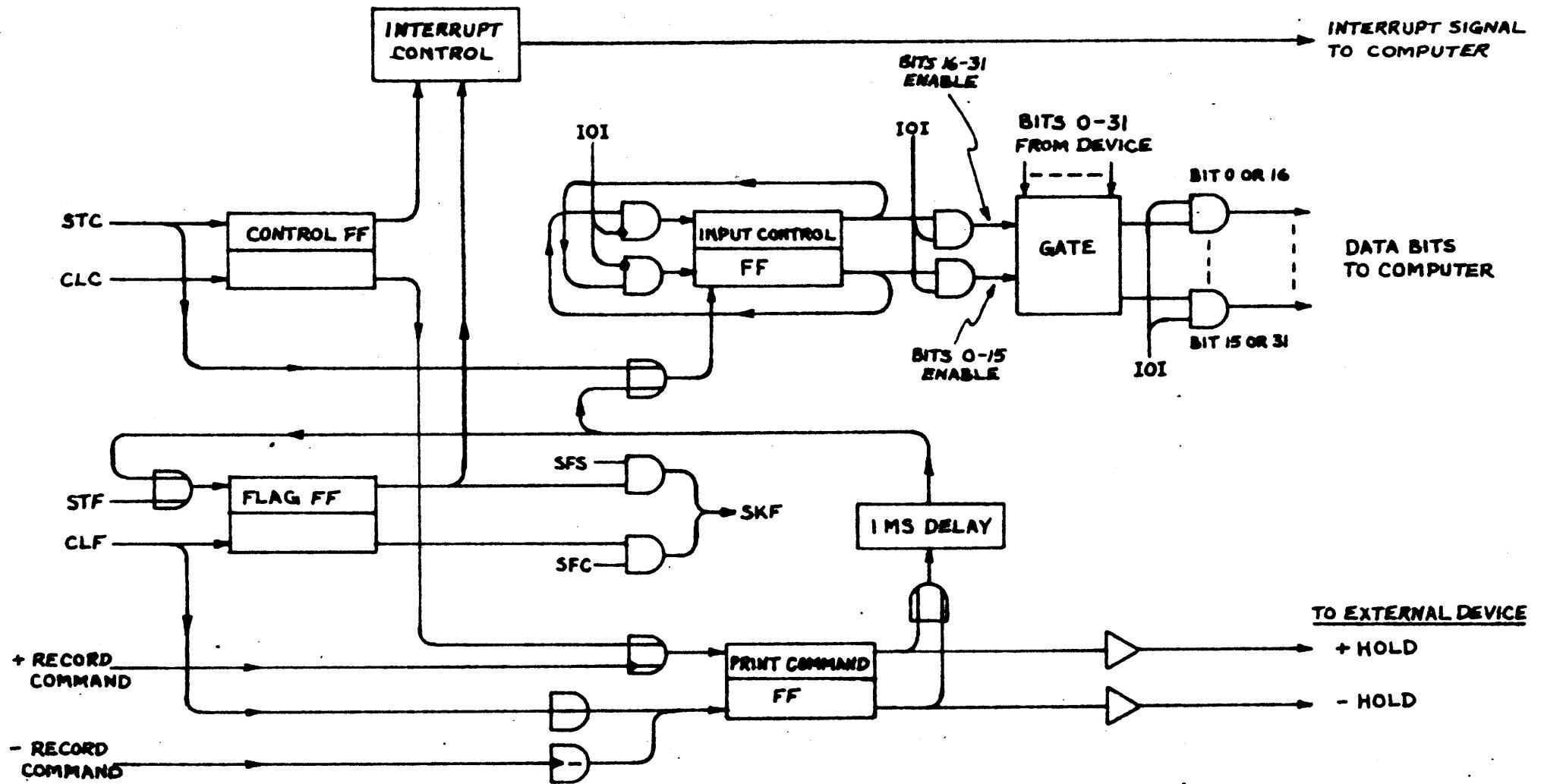
Figure 1-3. Simplified Logic Diagram for Data Source Interface Card

Print Command FF output ensures that the Input Control FF is reset
(to enable the first 16 bits to the computer) and sets the Flag FF to
initiate an interrupt signal to the computer, indicating that 32 bits of
data are available on the interface card.

1-19.   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 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 31 to the A- or B- register of the computer.

1-20.   A CLF instruction is required to initiate another input of 32
bits by removing the Hold signal to the external device. At the completion
of the input operations, a CLC instruction should be programmed to reset
the Control FF and remove the external device from the Input/Output sys-
tem. For a detailed logic diagram of the data source interface card,
refer to the logic diagram at the end of this section.

1-21.   TIMING.

1-22.   The repetition rate on pairs of LIA/B instructions is limited
to a maximum of 4KC, with a minimum delay of 250 microseconds between
pairs of LIA/B instructions, by high impedance circuitry.

1-23.   REPLACEABLE PARTS

1-24.   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.

1-25.   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.

1-26.   Specify the following information for each part when ordering:
  a.   Hewlett-Packard part number.
  b.   Circuit reference designation.
  c.   Description.

1-27.   To order a part not listed in Table 1-2, give a complete
description of the part and include its function and location.

NOTE

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

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

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. Replaceable Parts for Data Source Interface Card (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. Replaceable Parts for Data Source Interface Card (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)

G-642-6
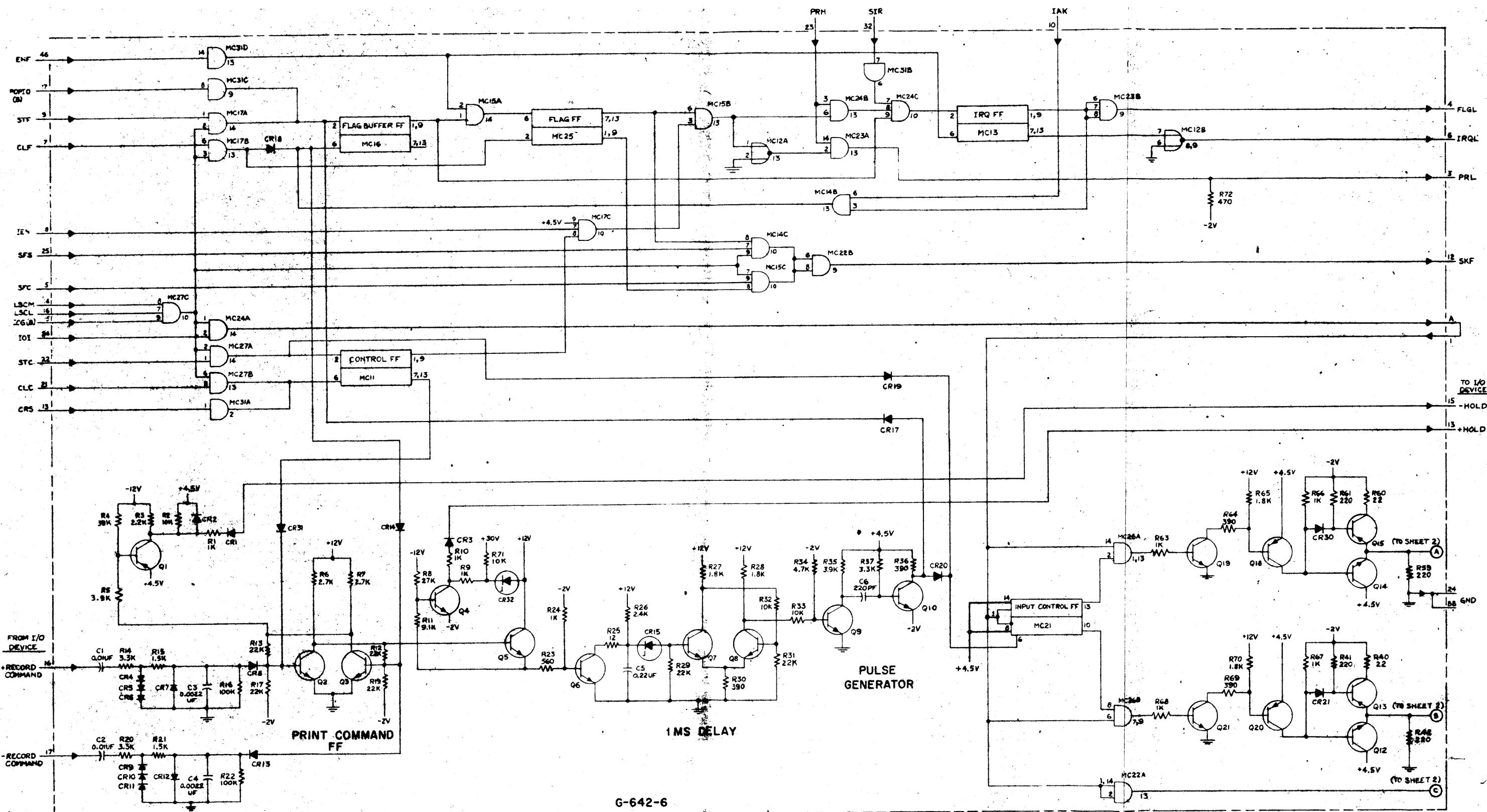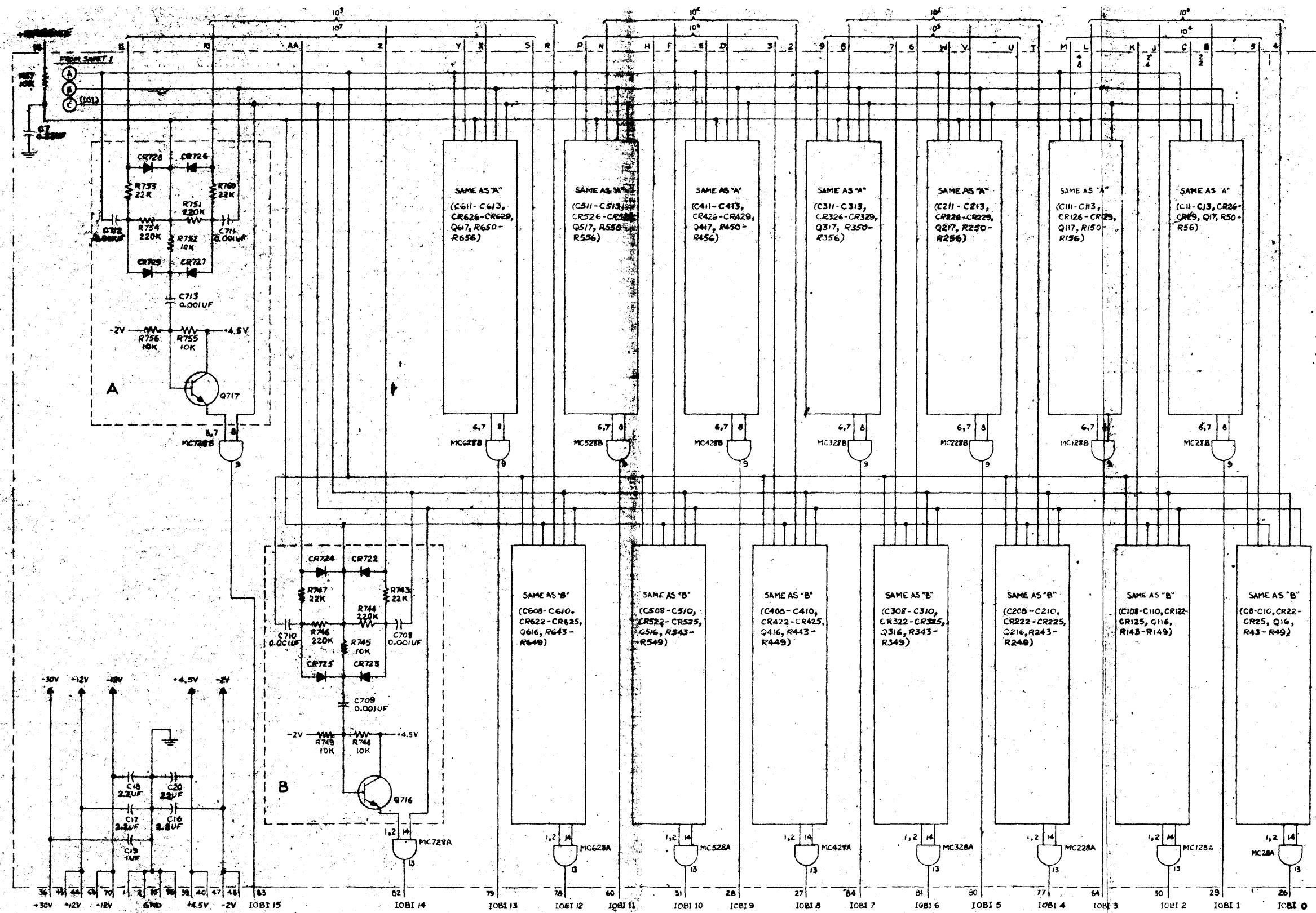
DATA SOURCE INTERFACE CARD
LOGIC DIAGRAM   (SHEET 2 OF 2)

APPENDIX A

CTµL PIN DIAGRAMS
TOP VIEW
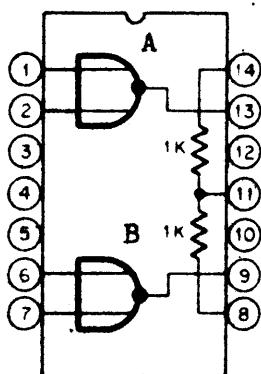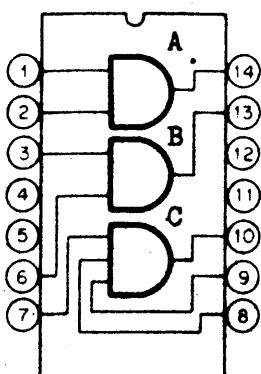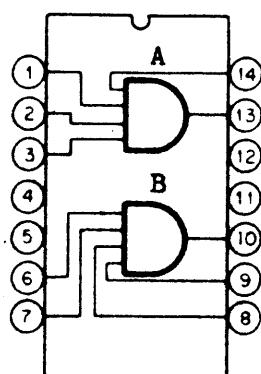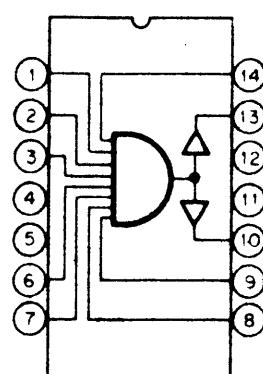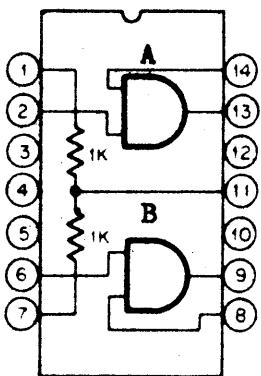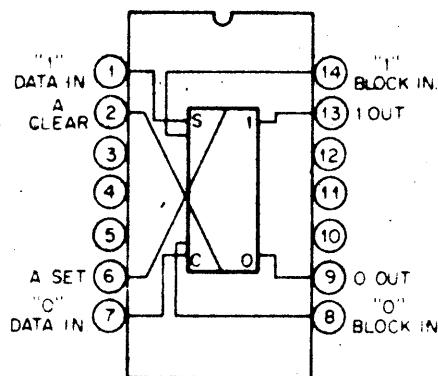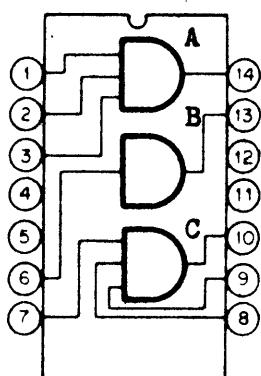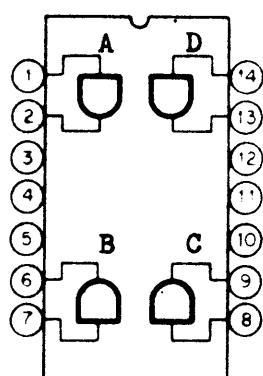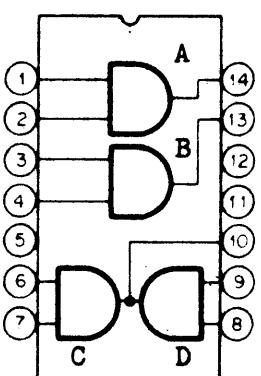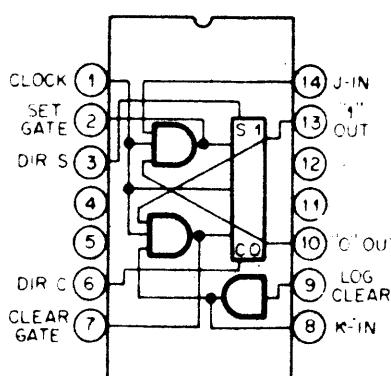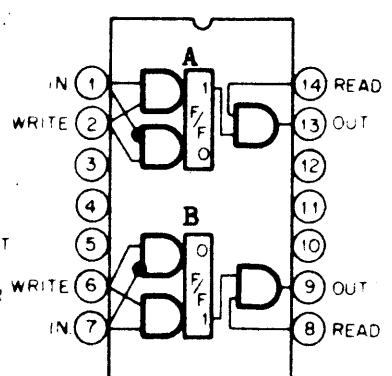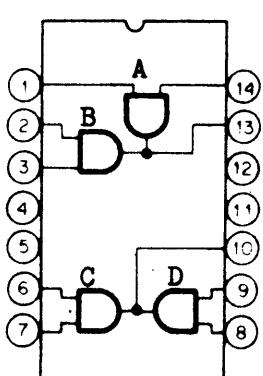
SEE FIGURE A-2

SEE FIGURE A-3

PIN 5 ON ALL PACKS IS GROUND
PIN 11 ON ALL PACKS IS $V_{EE} = -2V \pm 10\%$
PIN 12 ON ALL PACKS IS $V_{CC} = +4.5V \pm 10\%$

* **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**
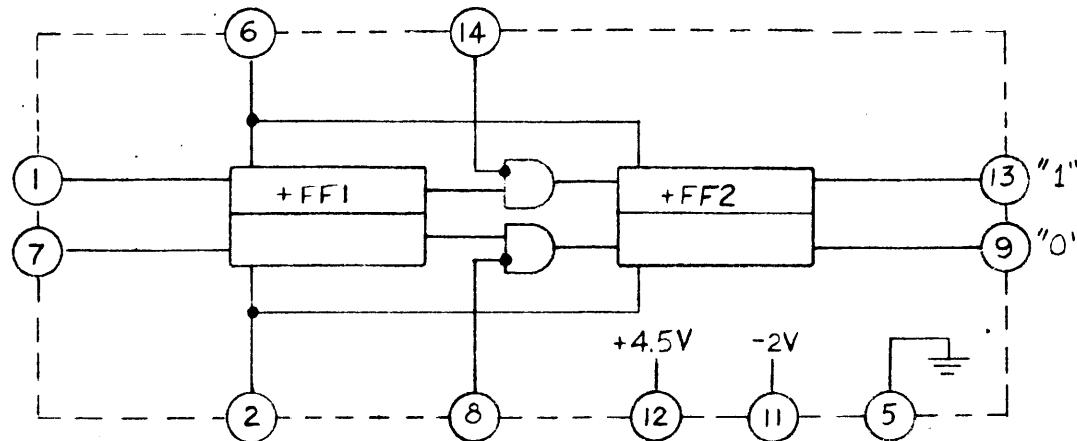
Figure A-2. 1820-0957 - Simplified Logic Diagram
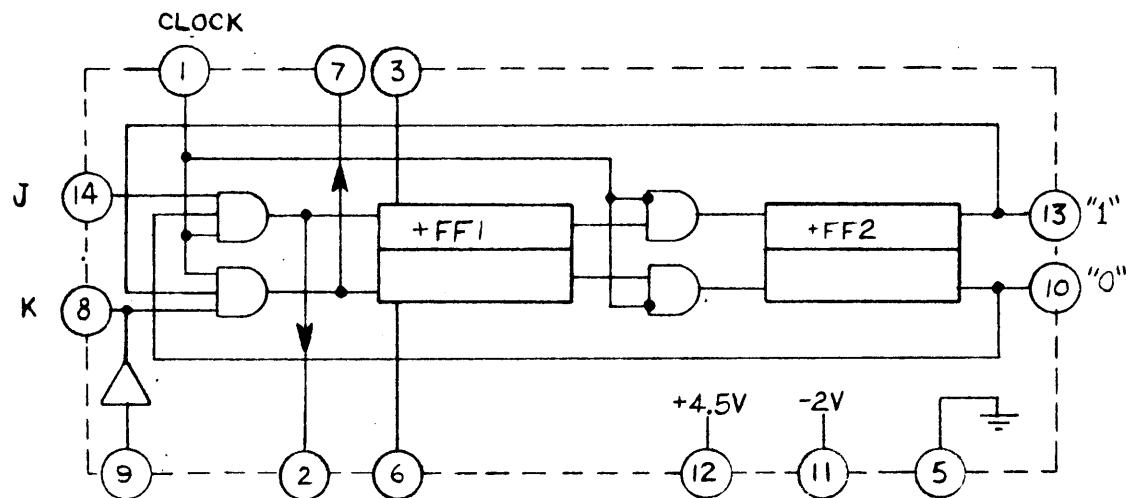
IF, DURING CLOCK PULSE ⊓				NEW OUTPUTS AFTER PULSE DROPS WILL BE:	
INPUTS ARE		AND OUTPUTS ARE			
"J"	"K"	SET	RESET	SET	RESET
1	1	1	0	0	1
1	1	0	1	1	0

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

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