NATIONAL RADIO ASTRONOMY OBSERVATORY
GREEN BANK, WEST VIRGINIA

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ANALOG INPUT TO 140-FT H316

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ANALOG INPUT TO 140-FT H316

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1. INTRODUCTION

This report describes the interface necessary for the 316 computer to input analog data to the 140-ft telescope.

2. PROGRAMMING

OCP 40 — Resets the input system to channel zero.

INA 1140 — Inputs analog data and steps the input system to read the next channel. There are sixteen channels of data (CH 0 - CH 15). It takes about 45 milliseconds between each INA. At this time some of these channels are not used. The data format for temperature (CH 0) is listed below.

Bit	
1	Sign 1 = +
2	0
3	0
4	100's of degrees C
5	
6	10's of degrees C
7	
8	
9	
10	Units of degrees C
11	
12	
13	
14	Tenths of degrees C
15	
16	

Three channels (CH 4, CH 5, and CH 6) contain weather data from the interferometer. Channel 4 is dew point, CH 5 is temperature, and CH 6 is barometric pressure.

3. ANALOG INPUT SYSTEM

The analog input system has two sections (see Figure 1).

One section located in the 316 interface chassis (H316 analog input card) contains an address decoder, 16-bit shift register, and necessary gating to apply the data to the computer input bus.

The other section (DVM multiplexer control) located in the operator's console contains a digital voltmeter, logic to control the DVM, shift register storage, 16-channel analog multiplexer, and analog buffer cards.

4. H316 ANALOG INPUT CARD

This card decodes the address bus and generates the following signals:

OCP 40	This signal is used to reset a binary counter and ready flip-flop. This signal is also used by the DVM multiplexer control card located in the operator's console.
INA 140	This signal resets a binary counter (÷ 16) and ready flip-flop. It is also used by the DVM multiplexer control card.
AD 140+A/+B	These signals are used to gate the data on the input bus.

This card, in addition to the address decode, contains a 16-bit shift register that receives its data from the DVM control card. A binary counter and ready flip-flop are reset by an OCP 40 or an INA 140. These two signals also cause the DVM to take a reading. When the reading is finished, the data is clocked into the shift register. The clock pulses are counted and on the sixteenth clock the ready flip-flop is set. This enables the 316 to do an INA 140 which starts the cycle again.

5. DVM MULTIPLEXER CONTROL

This card located in A chassis in the operator's console controls a DVM and analog multiplexer (see Figure 2).

The computer can reset a ÷ 16 counter by an OCP 40. When the computer does an INA 140 the counter is incremented by one. The DVM control logic will start a conversion on a time share basis with the local readout. This conversion will be started by an OCP 40 or an INA 140.

The local readout conversion is initiated 20 times a second. The address for the local readout is selected by a digi switch.

When a reading was taken for the computer, the data is loaded into a shift register and shifted to the "316 Analog Input Card" at a 20 kHz rate.

6. ANALOG BUFFER CARDS

One "Douglas Card" has space for two analog channels. The analog buffer cards can contain circuitry necessary for interfacing any analog signals. The output of the analog multiplexer is divided by 50. The range of the DVM is ± 199.9 millivolts. The input to the multiplexer should be limited to ± 7.5 volts.

7. TEMPERATURE INPUT

"Temperature sensitive resistors" are used to sense temperature. These resistors have a nominal resistance of 1K ohm at 25°C. These resistors have a positive temperature coefficient.

Each analog circuit has to be calibrated for each resistor. There are two adjustments, one for the resistance value at 0°F (-17.8°C) and one for 100°F (37.8°C). To calibrate the circuit, set in the 0°F value in place of the "TSR" and adjust the -17.8 pot for a -17.8 meter reading on the appropriate channel. Then set in the 100°F value and adjust the 37.8 pot for a meter reading of 37.8. These adjustments will have to be made several times as one adjustment affects the other.

We have purchased 25 of these resistors and measured their resistance at 0°F and 100°F for calibration.

Corning Glass Works has discontinued production of these "temperature sensitive resistors".

7. BUFFER CARDS FOR INTERFEROMETER WEATHER DATA

Three lines were run from the interferometer to indicate dew point, temperature, and pressure.

No adjustment is required on these signals. The DVM display can be converted to a meaningful reading by the approximate formulas listed below:

Reading -60 = dew point.

Reading -60 = temperature.

Air Pressure = .1375 reading + 61.25.

8. CREDITS

Credit should be given to Ron Weimer and Jerry Turner for interfacing the interferometer weather data. Credit should also be given to Doreen Morris, R. Skaggs and the Green Bank Machine Shop for their help in constructing this system.

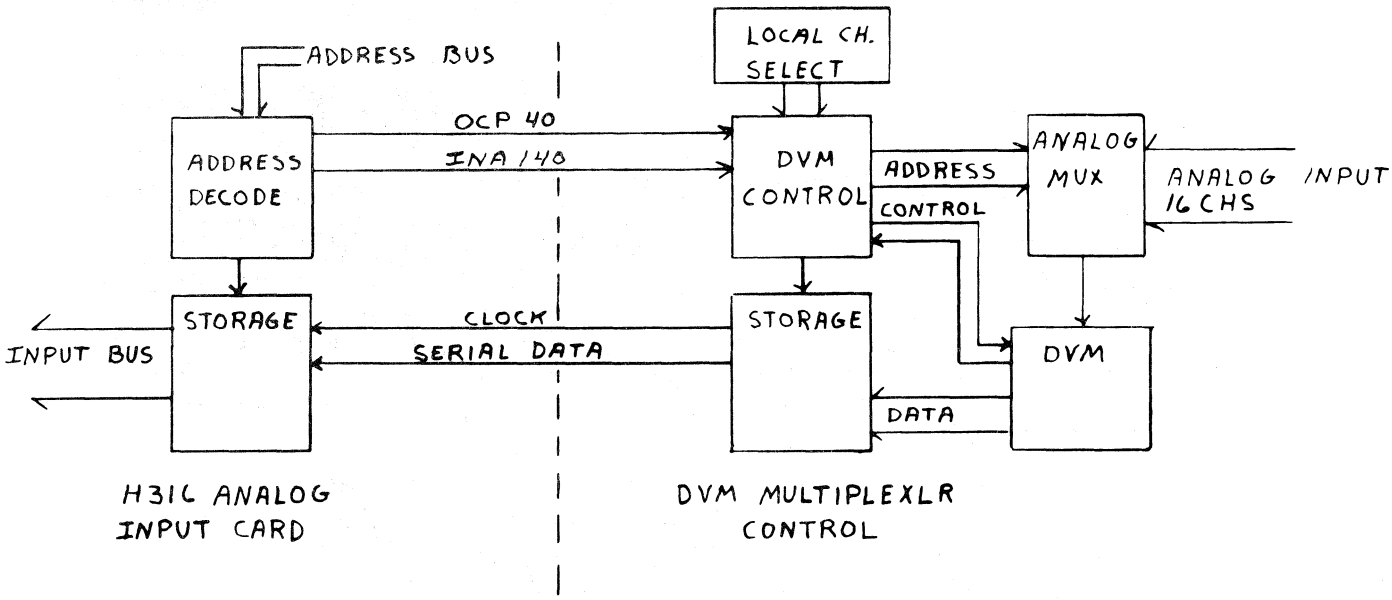

ADDRESS BUS
LOCAL CH. SELECT
OCP 40
INA 140
ADDRESS DECODE
DVM CONTROL
ADDRESS
CONTROL
ANALOG MUX
ANALOG INPUT 16 CHS
STORAGE
CLOCK
SERIAL DATA
INPUT BUS
STORAGE
DVM
DATA
H316 ANALOG INPUT CARD
DVM MULTIPLEXLR CONTROL

FIG 1

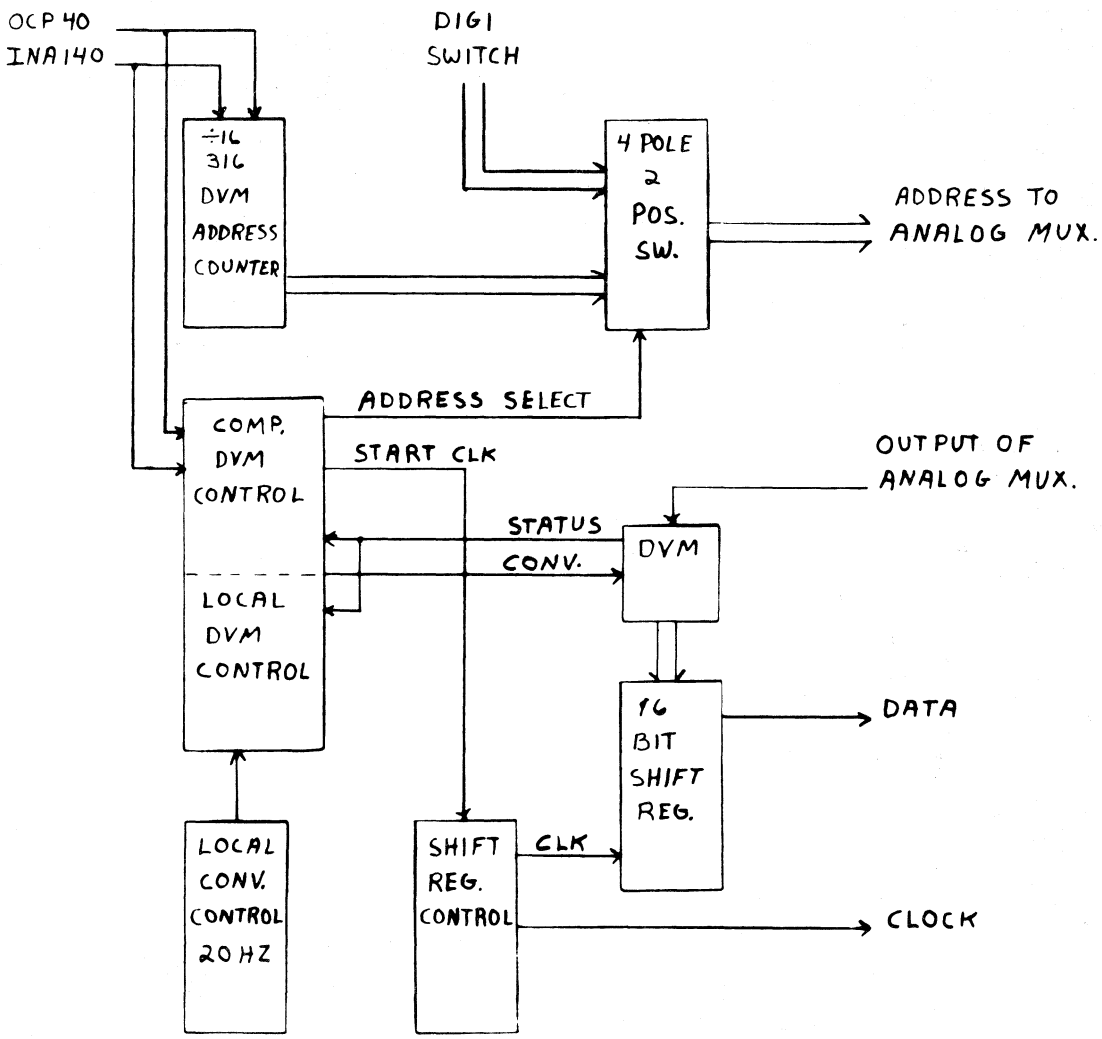

OCP 40
INA 140
DIGI SWITCH
÷16
316 DVM ADDRESS COUNTER
4 POLE 2 POS. SW.
ADDRESS TO ANALOG MUX.
ADDRESS SELECT
COMP. DVM CONTROL
START CLK
OUTPUT OF ANALOG MUX.
STATUS
CONV.
DVM
LOCAL DVM CONTROL
16 BIT SHIFT REG.
DATA
LOCAL CONV. CONTROL 20 HZ
SHIFT REG. CONTROL
CLK
CLOCK

FIG 2

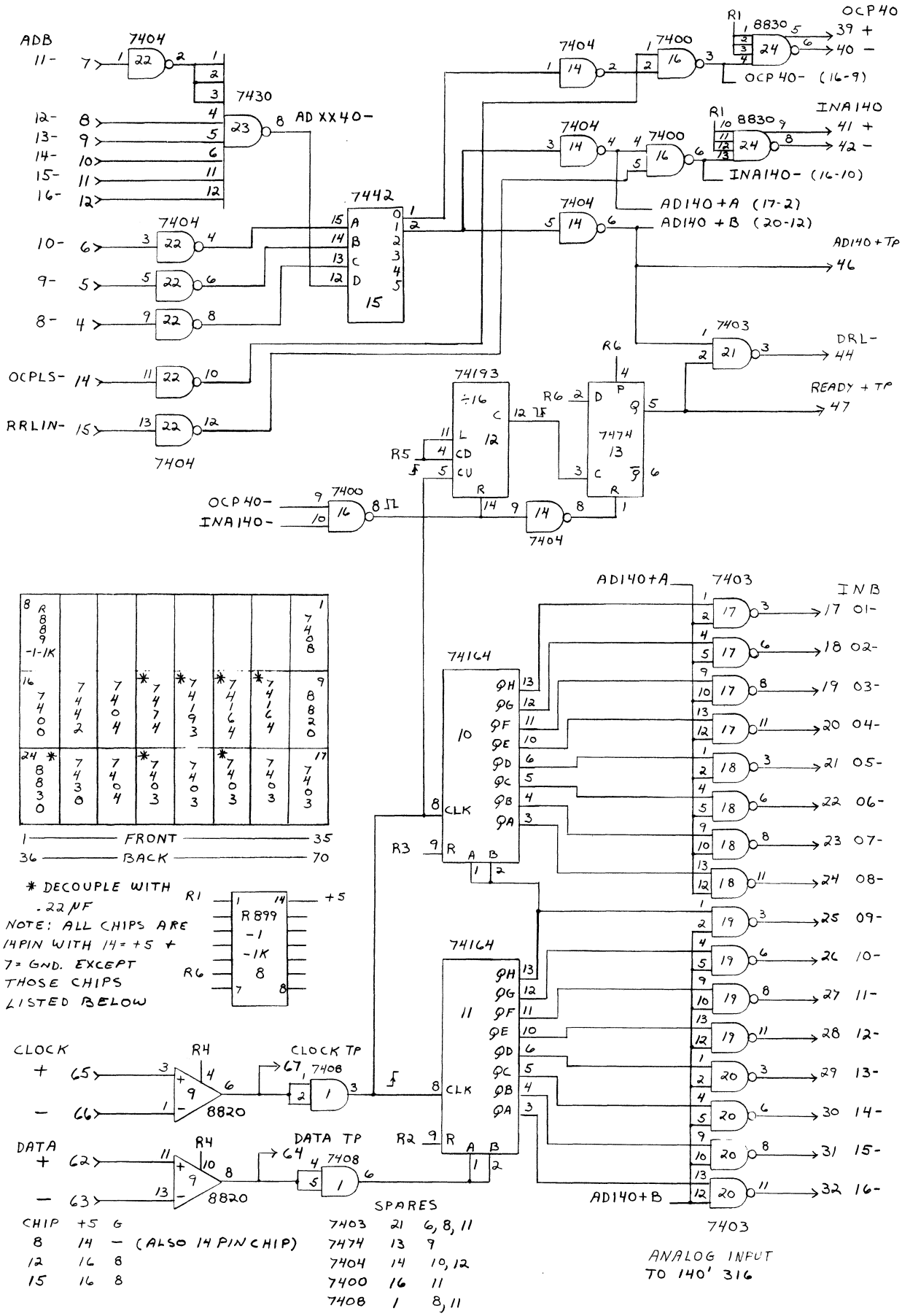
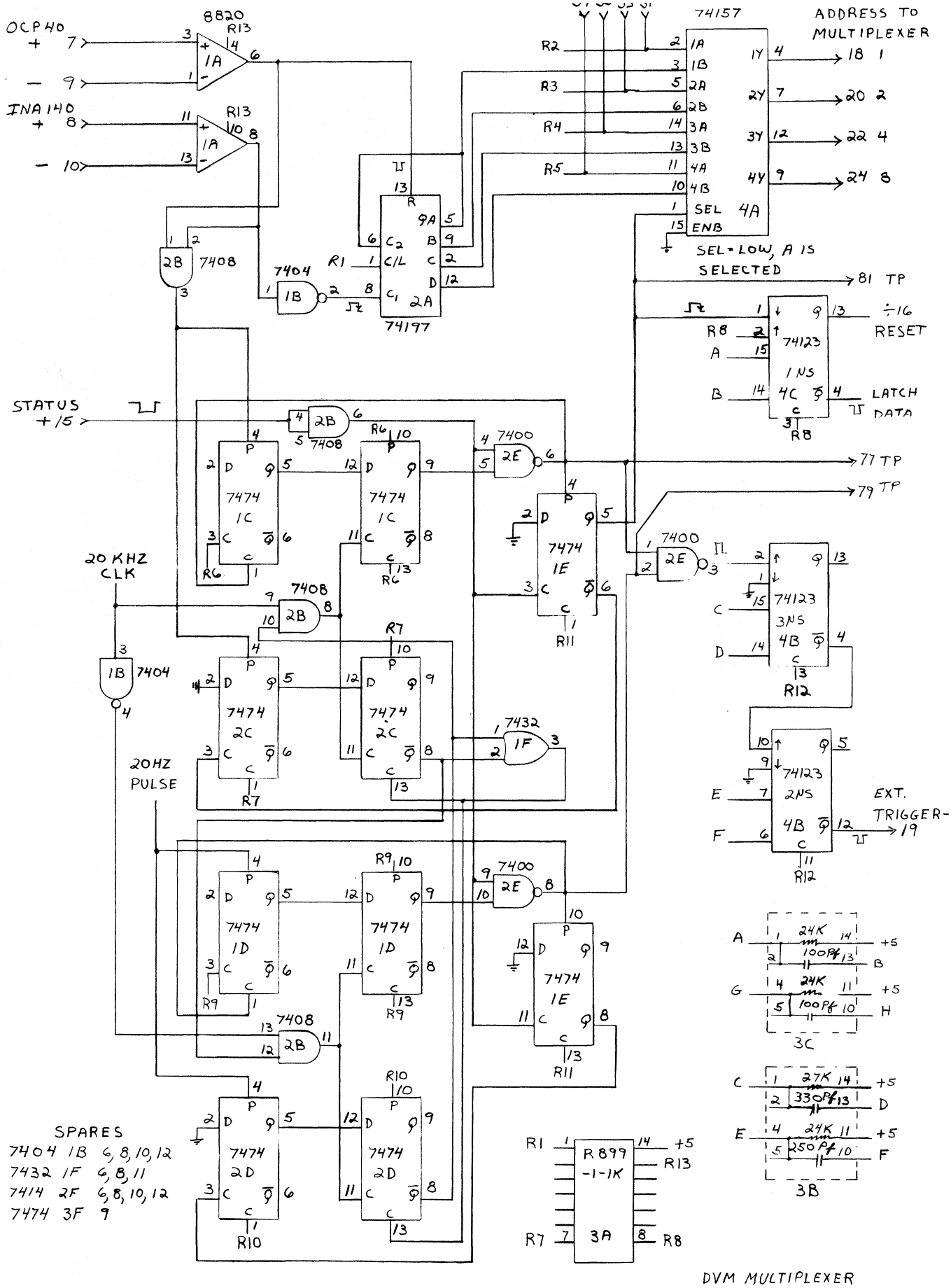
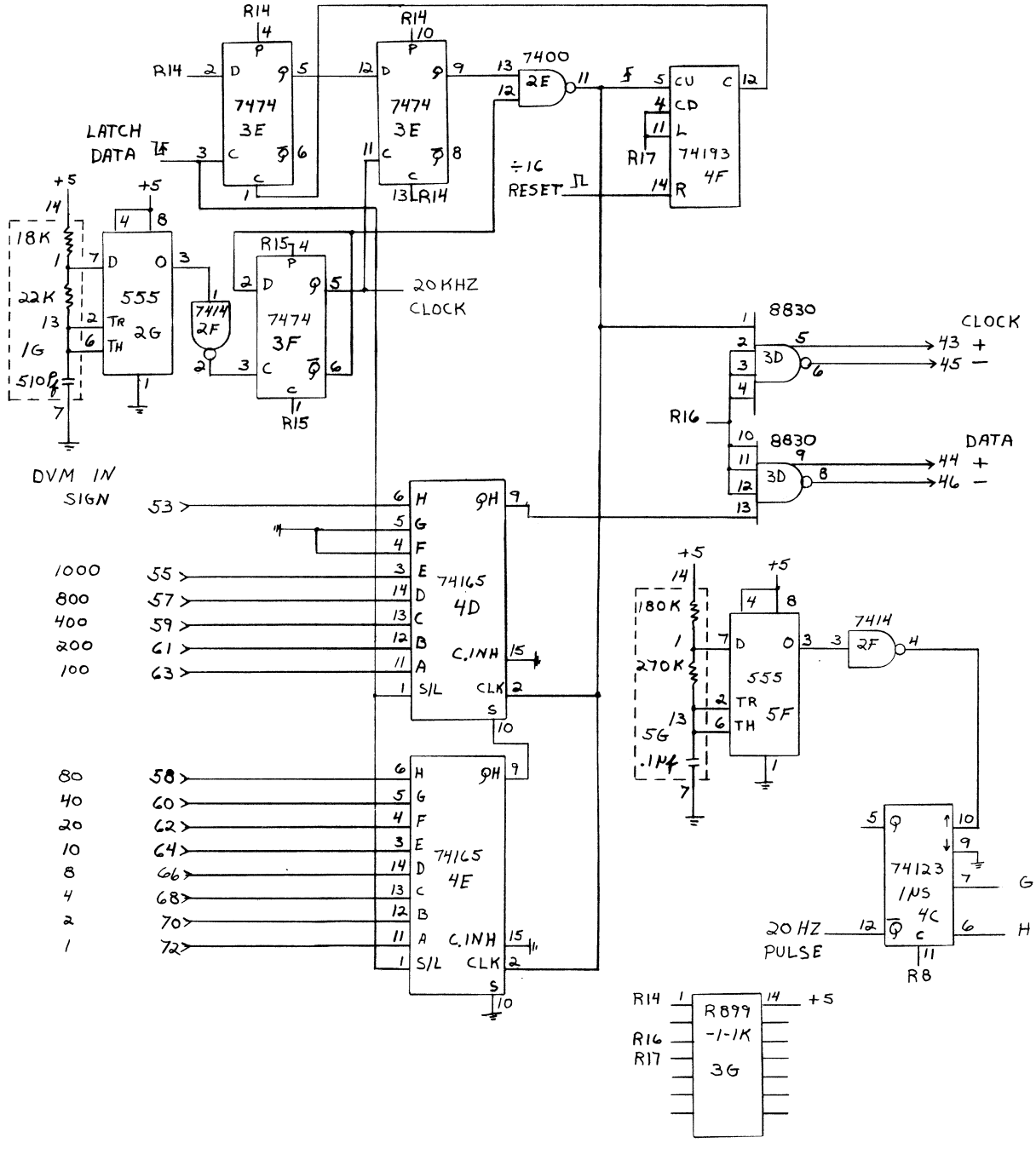
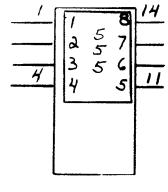

ADB
11-
12-
13-
14-
15-
16-
10-
9-
8-
OCPLS-
RRLIN-
7404
7430
7442
AD XX40-
OCP40
39 +
40 -
OCP40- (16-9)
INA140
41 +
42 -
INA140- (16-10)
AD140+A (17-2)
AD140+B (20-12)
AD140+TP
46
7403
DRL-
44
READY+TP
47
74193
÷16
R5
R6
7474
OCP40-
INA140-
7400
74164
74H03
INB
01-
02-
03-
04-
05-
06-
07-
08-
09-
10-
11-
12-
13-
14-
15-
16-
FRONT
BACK
* DECOUPLE WITH .22 MF
NOTE: ALL CHIPS ARE 14 PIN WITH 14 = +5 + 7 = GND. EXCEPT THOSE CHIPS LISTED BELOW
R899
-1
-1K
CLOCK
DATA
R4
CLOCK TP
DATA TP
8820
7408
R3
R2
SPARES
7403 21 6, 8, 11
7474 13 9
7404 14 10, 12
7400 16 11
7408 1 8, 11
CHIP +5 G
8 14 - (ALSO 14 PIN CHIP)
12 16 8
15 16 8
ANALOG INPUT TO 140' 316

FIG 3

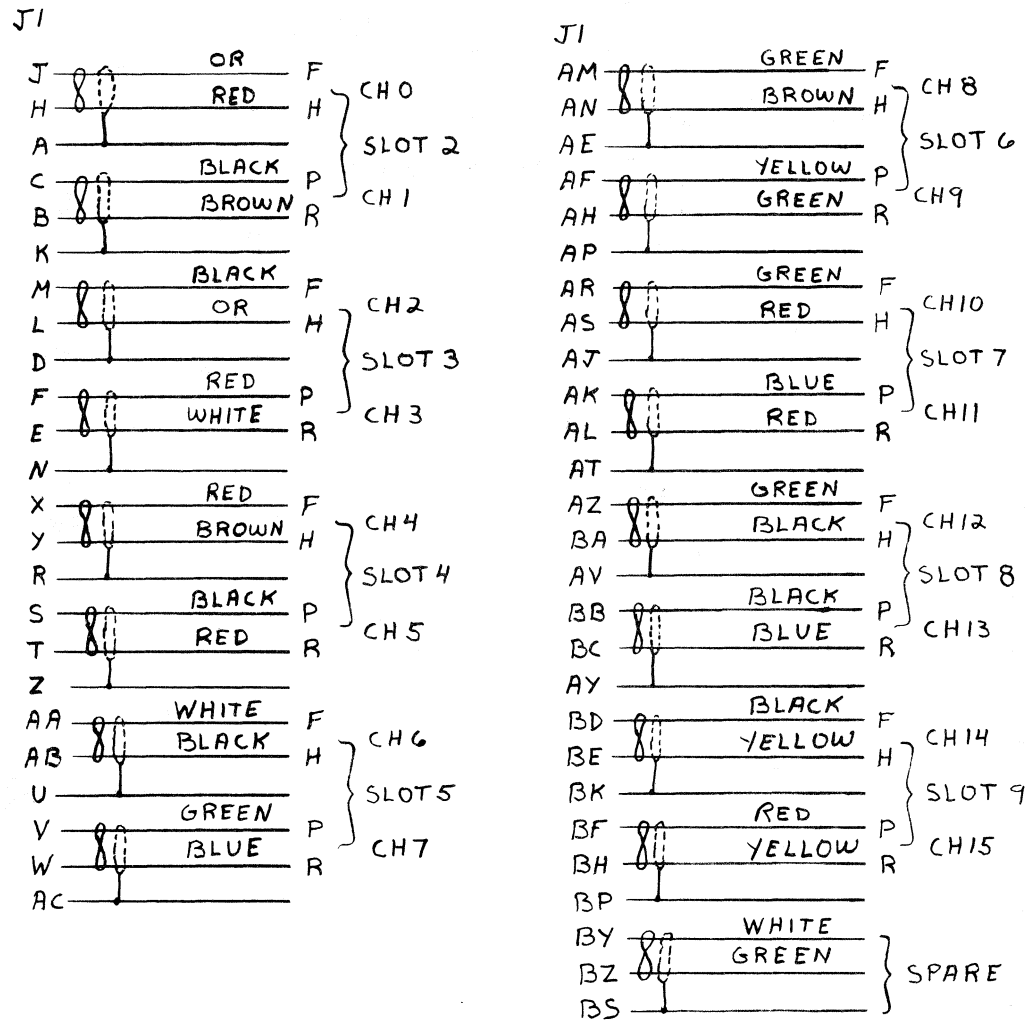

OCP 40
8820
R13
1A
INA 140
R13
1A
74157
ADDRESS TO MULTIPLEXER
R2
R3
R4
R5
1Y
2Y
3Y
4Y
SEL 4A
ENB
SEL = LOW, A IS SELECTED
81 TP
74197
7404
7408
74123
÷16
RESET
LATCH DATA
STATUS
7400
77 TP
79 TP
7474
20 KHZ CLK
20HZ PULSE
7432
74123
EXT. TRIGGER-19
SPARES
7404 1B 6, 8, 10, 12
7432 1F 6, 8, 11
7414 2F 6, 8, 10, 12
7474 3F 9
R899
-1-1K
3A
3C
3B
DVM MULTIPLEXER CONTROL
PAGE 1 OF 2



555 CONVERSION TO A 14 PIN CHIP



DVM MULTIPLEXER CONTROL


J1
J
H
A
C
B
K
M
L
D
F
E
N
X
Y
R
S
T
Z
AA
AB
U
V
W
AC
OR
RED
BLACK
BROWN
BLACK
OR
RED
WHITE
RED
BROWN
BLACK
RED
WHITE
BLACK
GREEN
BLUE
F
H
P
R
CH 0
SLOT 2
CH 1
CH 2
SLOT 3
CH 3
CH 4
SLOT 4
CH 5
CH 6
SLOT 5
CH 7
J1
AM
AN
AE
AF
AH
AP
AR
AS
AJ
AK
AL
AT
AZ
BA
AV
BB
BC
AY
BD
BE
BK
BF
BH
BP
BY
BZ
BS
GREEN
BROWN
YELLOW
GREEN
GREEN
RED
BLUE
RED
GREEN
BLACK
BLACK
BLUE
BLACK
YELLOW
RED
YELLOW
WHITE
GREEN
CH 8
SLOT 6
CH 9
CH 10
SLOT 7
CH 11
CH 12
SLOT 8
CH 13
CH 14
SLOT 9
CH 15
SPARE
INPUT CABLE

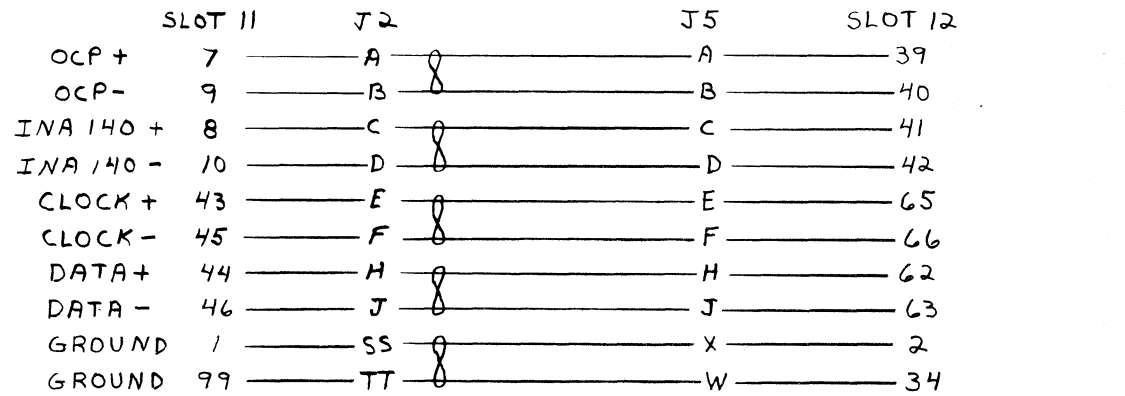
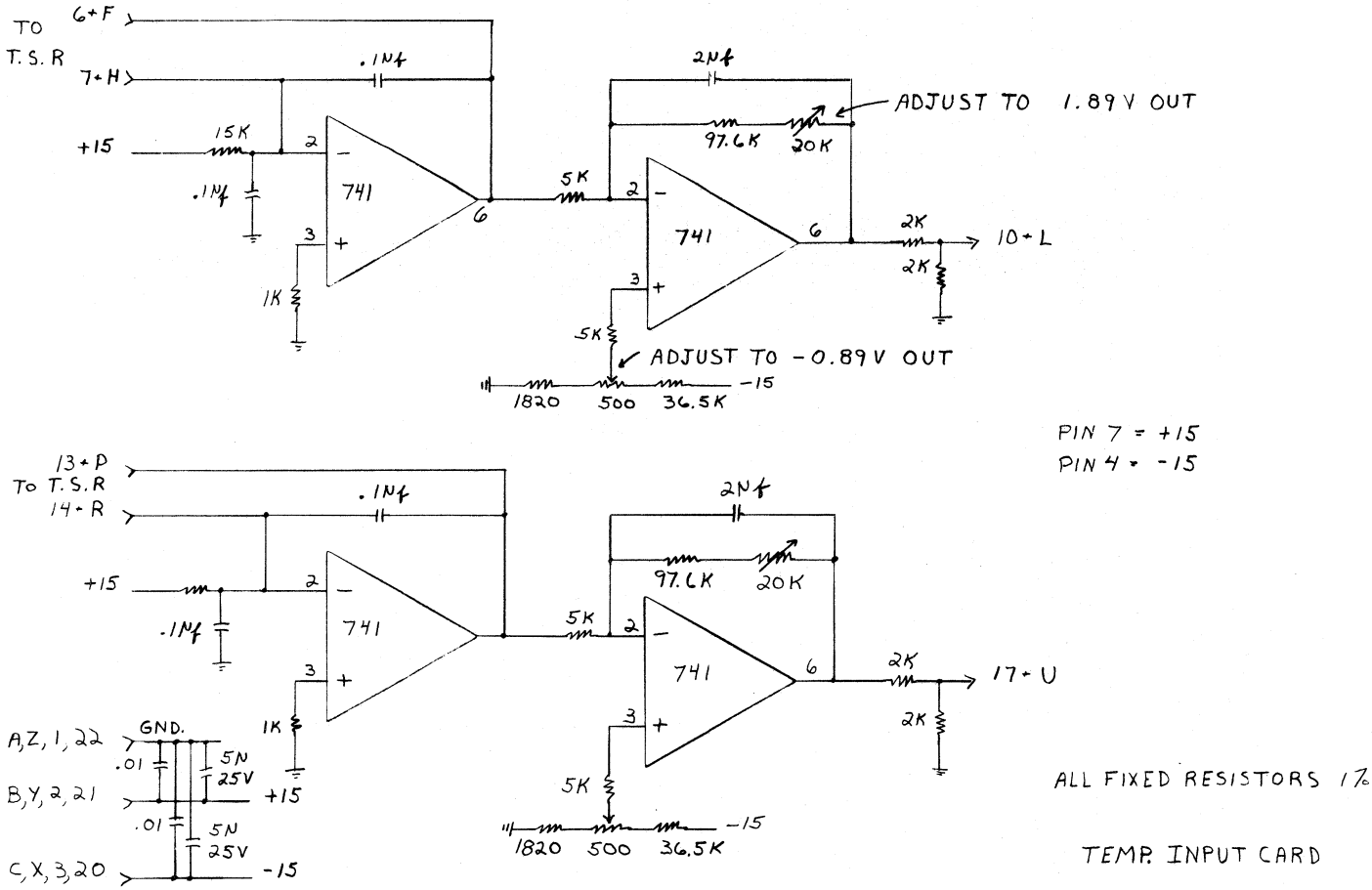

ANALOG INPUT CHASSIS
SLOT 11
J2
H 316
J5
SLOT 12
OCP +
OCP-
INA 140 +
INA 140 -
CLOCK +
CLOCK -
DATA +
DATA -
GROUND
GROUND
7
9
8
10
43
45
44
46
1
99
A
B
C
D
E
F
H
J
SS
TT
A
B
C
D
E
F
H
J
X
W
39
40
41
42
65
66
62
63
2
34
DATA CABLE

FIG. 5


TO T.S.R
6←F
7←H
.1Mf
2Mf
ADJUST TO 1.89 V OUT
+15
15K
97.6K
20K
.1Mf
741
5K
741
2K
10←L
2K
1K
5K
ADJUST TO -0.89 V OUT
-15
1820
500
36.5K
PIN 7 = +15
PIN 4 = -15
13←P
TO T.S.R
14←R
.1Mf
2Mf
97.6K
20K
+15
741
5K
741
2K
17←U
2K
1K
A,Z,1,22
GND.
.01
5N
25V
B,Y,2,21
+15
.01
5N
25V
C,X,3,20
-15
5K
-15
1820
500
36.5K
ALL FIXED RESISTORS 1%
TEMP. INPUT CARD

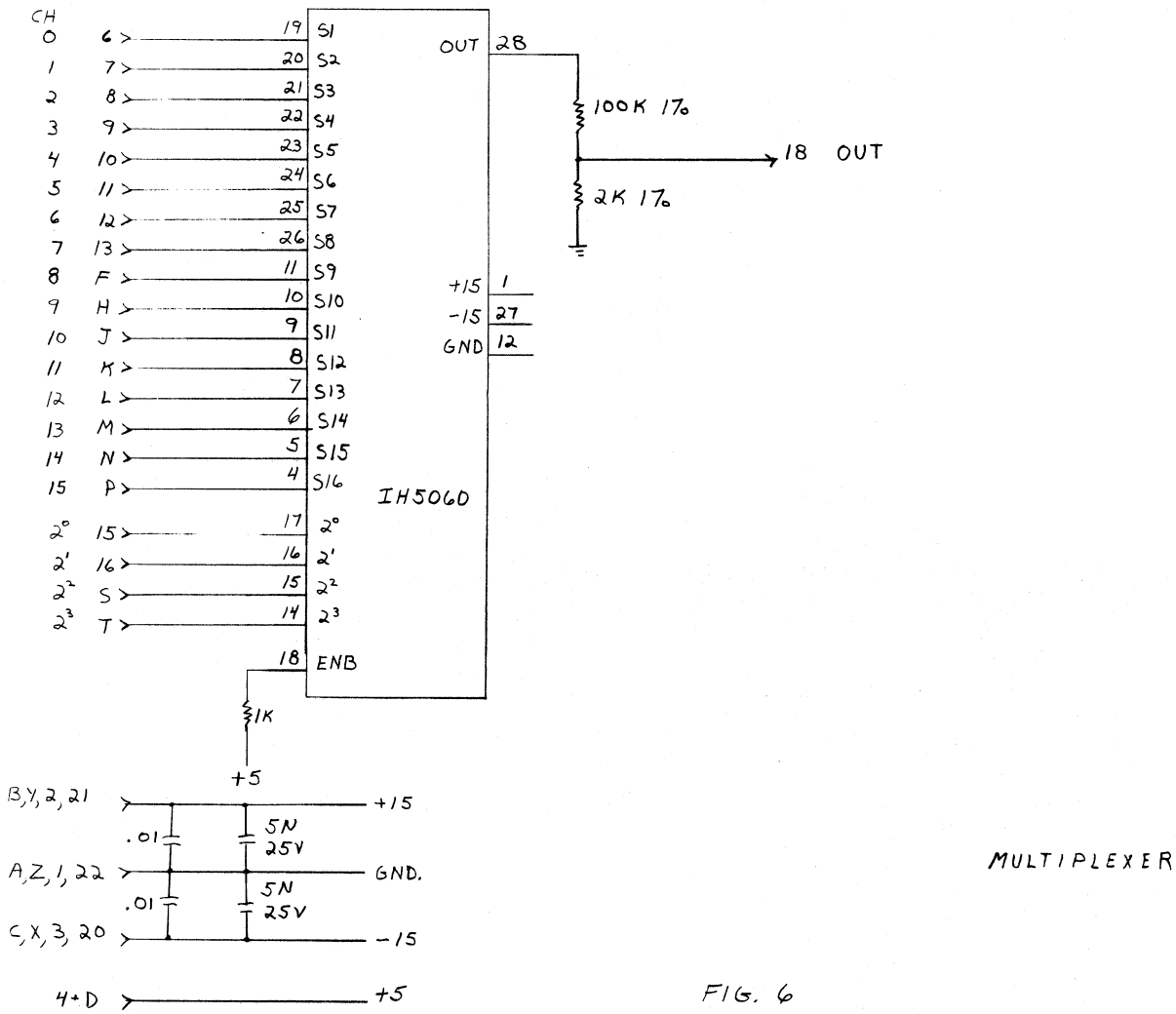
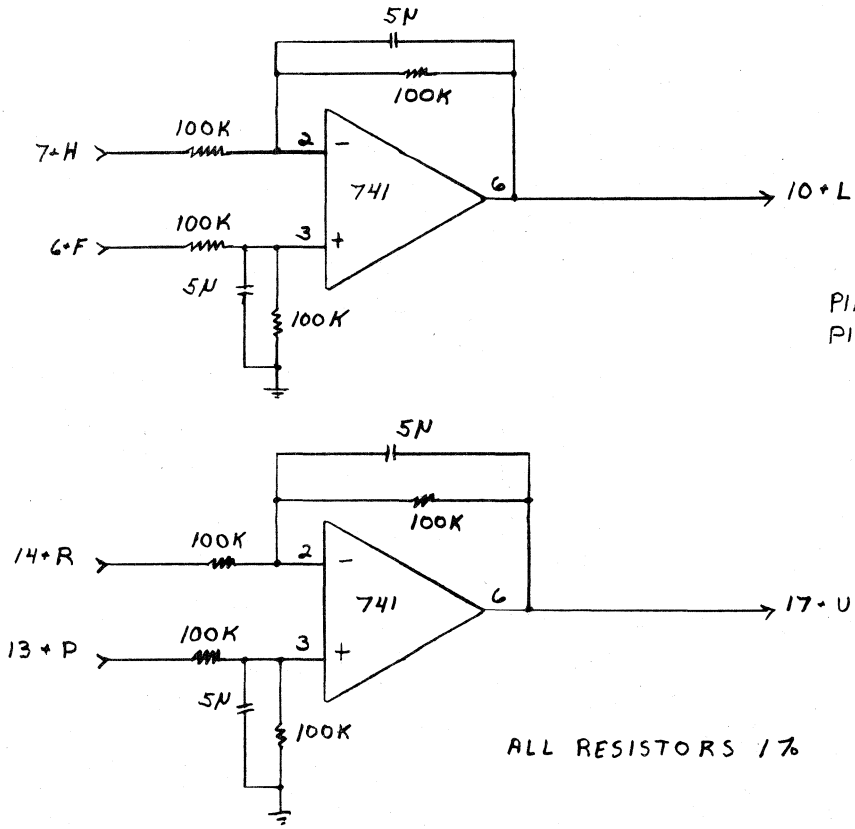
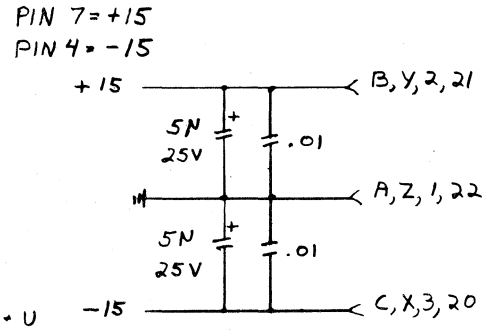
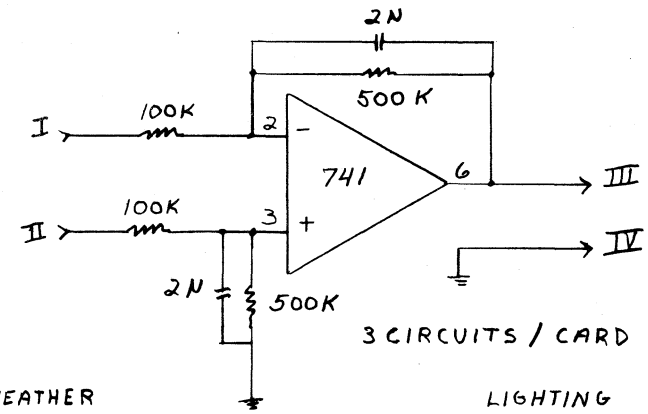

CH
0 6
1 7
2 8
3 9
4 10
5 11
6 12
7 13
8 F
9 H
10 J
11 K
12 L
13 M
14 N
15 P
2⁰ 15
2¹ 16
2² S
2³ T
19 S1
20 S2
21 S3
22 S4
23 S5
24 S6
25 S7
26 S8
11 S9
10 S10
9 S11
8 S12
7 S13
6 S14
5 S15
4 S16
IH5060
17 2⁰
16 2¹
15 2²
14 2³
18 ENB
OUT 28
100K 1%
18 OUT
2K 1%
+15 1
-15 27
GND 12
1K
+5
B,Y,2,21
+15
.01
5N
25V
A,Z,1,22
GND.
.01
5N
25V
C,X,3,20
-15
4←D
+5
MULTIPLEXER

FIG. 6





BUFFER CARD FOR
INTERFEROMETER
DATA SIGNALS
LOCATED AT 140'



CIRCUIT	PINS 1	2	3	
	19	12	6	I
	17	13	8	II
	21	15	10	III
	A,1	A,1	A,1	IV

ALL RESISTORS 1%

C-3 +15
D,4 -15

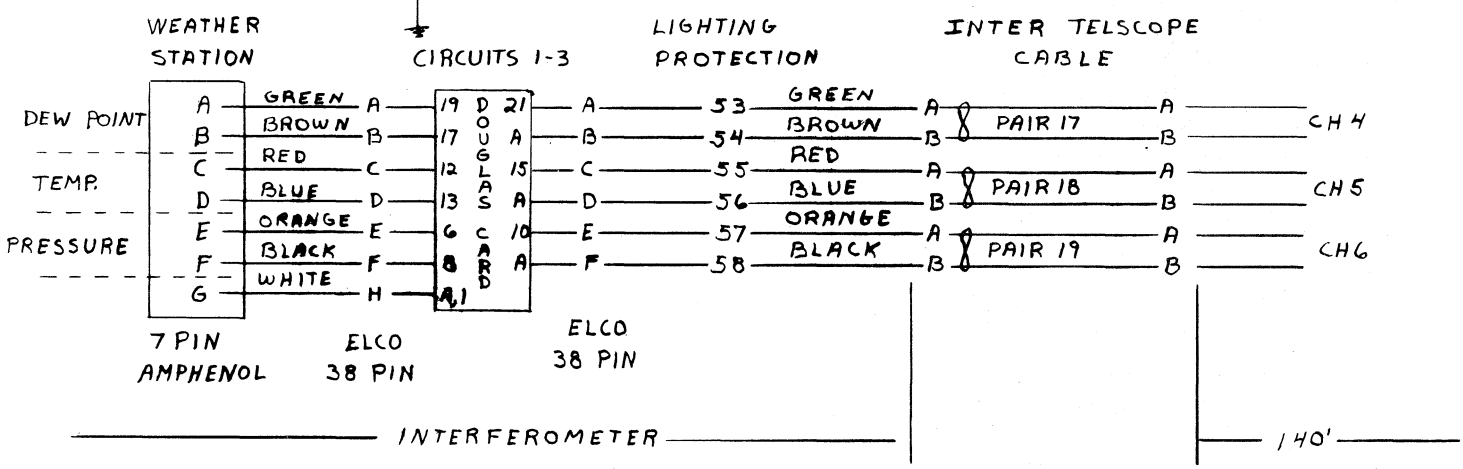


FIG 7