

COM-TRAN TEN LOGIC DIAGRAMS

FOR

COMBAT SYSTEMS ADVANCED DIGITAL

A-100-0142

(VOLUME 4)

Prepared by

Service School Command
Great Lakes, IL, 60088-5400

Prepared for

Chief of Naval Education and Training
Naval Air Station Pensacola
Pensacola, FL 32559-5000

September 1995

STUDENT GUIDE

FOR

DATA SYSTEMS TECHNICIAN CLASS A

PHASE TWO

A-150-0025

VOLUME II

(PART 3)

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TABLE OF CONTENTS

Forward	iii
Safety Notice	iv
Training Time Out	v
Phase Two Schedule	vi
Instruction Timing Charts	I
System Block Diagram	II
Key to Logic Diagrams	III
A Register	1
ALU Module	2
B Register / Two's Comp. / Selector	3
C Register	4
D Register	5
Q Register	6
Clock	7
Memory Module	8
Lamp Module 1	9
I Register	10
M Register	11
P Register	12
S Register	13

TABLE OF CONTENTS

X Register / X Adder	14
Switch Logic	15
Lamp Module 2	16
Control 1	17
Control 2	18
Control 3	19
Control 4	20
Control 5	21
Control 6	22
Control 7	23
Control 8	24
Switch 1	25
Switch 2	26
TTY Interface Read	27
TTY Interface Write	28
TTY Interface Control	29
Signal Distribution	A
Power Distribution	B
Computer Board 'A' Assy. Drawing	C
Computer Board 'B' Assy. Drawing	D
Integrated Circuit Board Drawing	E

FORWARD

1. THIS STUDENT GUIDE IS INTENDED FOR USE IN THE DATA SYSTEMS TECHNICIAN CLASS A - PHASE TWO COURSE.
2. THIS PUBLICATION SUPERCEDES THE APPLICABLE PORTION OF ANY PREVIOUSLY DEVELOPED STUDENT GUIDE FOR THIS COURSE AND IS EFFECTIVE UPON RECEIPT.
3. COMMANDS ARE INVITED TO SUBMIT COMMENTS AND RECOMMENDATIONS ON THE CONTENTS OF THIS COURSE TO THE CHIEF OF NAVAL TECHNICAL TRAINING, NAVAL AIR STATION, MEMPHIS, TENNESSEE 38054.

SAFETY NOTICE

THOUGH THE CIRCUITS IN THIS TEXT ARE PAPER REPRESENTATIONS, STUDENTS SHOULD OBSERVE AND REMAIN AWARE OF THE SAFETY PRECAUTIONS AS PRESCRIBED IN OPNAV 5100 SERIES FOR ENERGIZED EQUIPMENT. ALL PERSONNEL AND EQUIPMENT SAFETY PRECAUTIONS WILL BE PRACTICED AT ALL TIMES.

FURTHER PRECAUTIONS AND PROCEDURES CAN BE FOUND IN CHAPTERS 9600 AND 9670 OF THE NAVAL SHIPS TECHNICAL MANUAL, AND IN THE EIMB GENERAL HANDBOOK NAVSHIPS 0967-000-0100 CHAPTER 30.

NOTES

- A. INTENTIONAL SHOCKS ARE STRICTLY FORBIDDEN.
- B. NEVER WORK ALONE- WHILE WORKING ON ENERGIZED EQUIPMENT, IT IS NECESSARY TO HAVE ANOTHER PERSON QUALIFIED IN FIRST AID STANDING BY.
- C. ALL REPAIR AND MAINTENANCE WORK SHALL BE DONE BY AUTHORIZED PERSONNEL ONLY.
- D. TAG OUT EQUIPMENT AND LOG PROPERLY.
- E. IN GENERAL, USE ONE HAND ONLY WHEN SERVICING LIVE EQUIPMENT.
- F. HIGH VOLTAGES MAY BE PRESENT ACROSS TERMINALS THAT ARE NORMALLY LOW VOLTAGE, DUE TO EQUIPMENT BREAKDOWN.
- G. HIGH VOLTAGE, HIGH CAPACITY CAPACITORS SHOULD BE DISCHARGED WITH THE GROUNDING STICK WITH APPROXIMATELY 10 OHMS IN SERIES WITH THE GROUNDED LINE.
- H. DO NOT USE TEST EQUIPMENT KNOWN TO BE IN POOR CONDITION.
- I. MAKE CERTAIN YOU ARE NOT GROUNDED WHENEVER YOU ARE ADJUSTING EQUIPMENT OR USING MEASURING EQUIPMENT.

TRAINING TIME OUT

THE FOLLOWING IS THE COMBAT SYSTEMS TECHNICAL SCHOOLS COMMAND "TRAINING TIME OUT" POLICY FOR SITUATIONS WHERE A POTENTIAL FOR PERSONAL RISK EXISTS:

- A. ANY TIME A STUDENT OR INSTRUCTOR HAS APPREHENSION CONCERNING HIS OR HER PERSONAL SAFETY OR THAT OF ANOTHER, HE OR SHE SHALL SIGNAL FOR A "TRAINING TIME OUT" TO CLARIFY THE SITUATION AND RECEIVE OR PROVIDE ADDITIONAL INSTRUCTION AS APPROPRIATE. A "TRAINING TIME OUT" SHALL BE PLACED IN EFFECT BY CALLING OUT "TRAINING TIME OUT" IN A LOUD, CLEAR VOICE. UPON HEARING THIS SIGNAL, ALL TRAINING SHALL CEASE UNTIL THE SITUATION IS RESOLVED.
- B. IN THOSE CASES WHERE A STUDENT REFUSES TO PARTICIPATE IN THE TRAINING EXERCISE AFTER "TRAINING TIME OUT" INSTRUCTION HAS OCCURRED, HE OR SHE WILL BE REMOVED FROM TRAINING AND REFERRED TO HIGHER AUTHORITY FOR APPROPRIATE ADMINISTRATIVE PROCESSING.
- C. ANY TIME A STUDENT DEMONSTRATES SIGNS OF PANIC, FEAR, EXTREME FATIGUE, OR LACK OF CONFIDENCE, INSTRUCTORS SHALL STOP THE TRAINING, IDENTIFY THE PROBLEM AND MAKE A DETERMINATION TO CONTINUE OR DISCONTINUE TRAINING. INSTRUCTORS SHALL BE CONSTANTLY ALERT TO ANY UNUSUAL BEHAVIOR WHICH MAY INDICATE A STUDENT IS EXPERIENCING DIFFICULTY AND SHALL IMMEDIATELY TAKE APPROPRIATE ACTION TO ENSURE THE STUDENT'S SAFETY.
- D. ALL STUDENTS SHALL BE BRIEFED ON THIS "TRAINING TIME OUT" POLICY PRIOR TO COMMENCEMENT OF TRAINING AND REMINDED OF THIS PROCEDURE PRIOR TO ANY LABORATORY SESSION WHERE THE POTENTIAL FOR PERSONAL INJURY EXISTS.

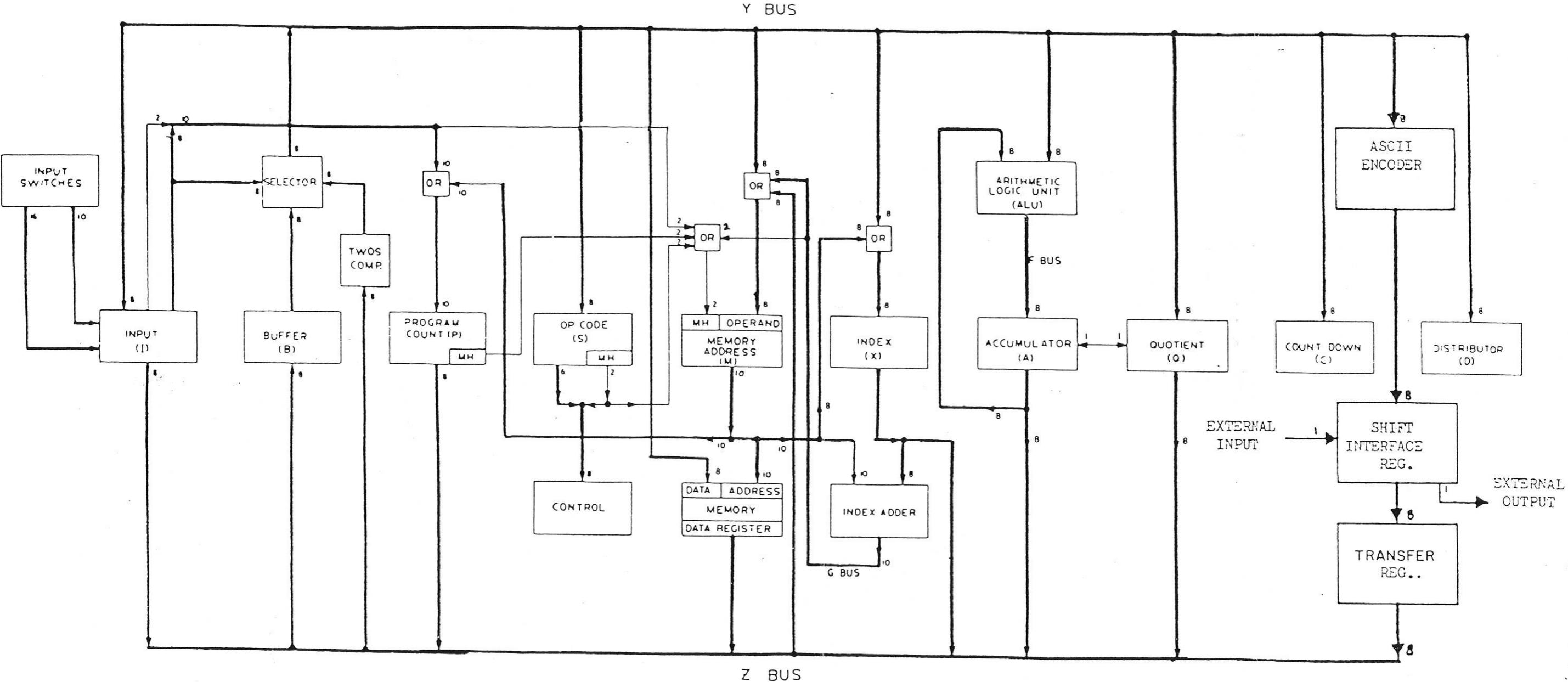
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SYM	HEX																	
AQ		ACQUISITION	TPM, TPB CLEAR INST ERR	ISB	TBS NOTE 2	IF ERROR SERI, IF NOT INST ERR BY- PASS, STOP	INCM	ISB	INCM	IF NOT IN RPT WITH AE OR INS MODE, TMP	TBM	IF S2=1 AXM	SDP15				CLEAR ARITH ERROR, CKE	
		EXECUTION	DPO	DP1	DP2	DP3	DP4	DP5	DP6	DP7	DP8	DP9	DP10	DP11	DP12	DP13	DP15	
LCI	01	LOAD C IMM.	TBC ^{P922} 25LA pin 2		SDP15												A	
LDA	20	LOAD A	ISB ^{P923} 3KA	TBA ^{P923} 29EC pin 11		SDP15												
LAI	02	LOAD A IMM.		TBA ^{P923} 29EC pin 70		SDP15												
LXI	12	LOAD X IMM.	TBX ^{P922} 25LD pin 9		SDP15													
LCC	30	LOAD CONSEC.	ISB	INCM	IBS ^{P924} 26DA	SDP15												
LAN	38	LOAD A NEG.	ISB	TBA	2's COMP A	SDP15												
LDQ	40	LOAD Q	ISB		TBQ ^{P922} 28FD pin 2	SDP15												
STA	48	STORE A	TAB	IBS	SDP15												SET COND. CODE,- CKE	
STX	50	STORE X	TXB	IBS	SDP15													
STQ	58	STORE Q	TQB	IBS	SDP15													
ADD	60	ADD	CL CARRY ISB	INA IF OVFL SAOV, IF EC, SCARY	IF ADD OVFL, AND NOT BYPASS STOP	SDP15												
SUB	68	SUBTRACT	CL CARRY ISB	INS IF OVFL SAOV, IF EC, SCARY	IF ADD OVFL, AND NOT BYPASS STOP	SDP15												
MPY	70	MULTIPLY	ISB SC=8	TBQ IF B7=0 SDP4	2's COMP A	2's COMP Q	TAB	CLA	IF Q0=0 SDP9	INA	SET SIGN =B7	SAQR SIGN→A7 AO →Q7	DEC	IF C≠0 SDP6				
DIV	78	DIVIDE	ISB SC=8	IF B=0 SERD&STOP IF A7≠B7 SET SIGN	IF A7=0 SDP6	IF Q=0 2's COMP A IF Q≠0 1's COMP A	2's COMP Q	IF A7=1 SERD&STOP	IF C=0 SDP11	DEC	IF B7=1 INA, IF B7=0 JNS (NOTE 3) SAL Q7→AO	SQL F7→Q0	SDP6, IF F7=0 F BUS→A	IF Q7 SET & SIGN CL OR 06-00 ≠0	IF B7 ≠ SIGN F/F 2's COMP A	IF SIGN F/F SET 2's COMP Q		
RAO	80	REPLACE & ADD ONE	CL CARRY ISB	TBA	INCA IF EC SET CARRY		TAB	IBS		SDP15				SERD&STOP				
RSO	88	REPLACE & SUBTRACT ONE	CL CARRY ISB	TBA	DECA IF EC SET CARRY		TAB	IBS		SDP15								

LOGIC TIMING CHART

- DPA14 & DP14 can be generated but are never used.
- Bits S1 & S0 will not be visible on the front panel until completion of the TBM signal at DPA8.
- During the DIVIDE the ALU is enabled from DP8-DP11 to make F bus data available for use at DP10.
- DPL of all instructions clears the condition codes.

		DESCRIPTION	DPO	DP1	DP2	DP3	DP4	DP5	DP6	DP7	DP8	DP9	DP10	DP11	DP12	DP13	DP15
SYM	HEX																
INX	03	INCREASE INDEX		TBM	AXM	TMX			SDP15								
SLA	0B	SHIFT LEFT ARITHMETIC	TBC	IF C=0 SDP15	SAQL	DEC SDP1											
SRA	10	SHIFT RIGHT ARITHMETIC	TBC	IF C=0 SDP15	SAQR	DEC SDP1											
SLL	13	SHIFT LEFT LOGICAL	TBC	IF C=0 SDP15	SAL	DEC SDP1											
SRL	18	SHIFT RIGHT LOGICAL	TBC	IF C=0 SDP15	SAR	DEC SDP1											
AND	19	AND	IAND		SDP15												
IOR	1A	INCLUSIVE OR	IORI		SDP15												
XOR	1B	EXCLUSIVE OR	IEX		SDP15												
BUN	90	BRANCH UNCONDITIONAL	TMP	SDP15													
BST	98	BRANCH AND STOP	TMP STOP	SDP15													
BSB	A0	BRANCH TO SUBROUTINE	TPHB	IBS	INCM	TPLB	IBS	INCM	TMP	SDP15							
BPS	A8	BRANCH ON POSITIVE	IF CC>0 TMP	SDP15													
BZE	B0	BRANCH ON ZERO	IF CC=0 TMP	SDP15													
BNG	B8	BRANCH ON NEGATIVE	IF CC<0 TMP	SDP15													
BNC	C0	BRANCH ON NO CARRY	IF CARRY IS NOT SET TMP	SDP15													
BXZ	C8	BRANCH ON INDEX=0	IF X=0 TMP	SDP15													
SKI	08	SKIP ON INTERRUPT	IF INT=0 SDP15	CLINT	TBC	TPM	IF C=0 SDP15	INCM DEC	INCM	TMP SDP4							
SKS	09	SKIP ON SENSE SWITCH	IF SENSE CLR SDP15		TBC	TPM	IF C=0 SDP15	INCM DEC	INCM	TMP SDP4							
SKF	0A	SKIP ON FLAG	IF FLAG CLR SDP15		TBC	TPM	IF C=0 SDP15	INCM DEC	INCM	TMP SDP4							

CODE		DESCRIPTION	DPO	DP1	DP2	DP3	DP4	DP5	DP6	DP7	DP8	DP9	DP10	DP11	DP12	DP13	DP14	See note 1 on page 1A	DP15
SYM	HEX																		
FLS	F8	SET FLAG	STF		SDP15														
FLC	28	CLEAR FLAG	CLF		SDP15														
MNI	F0	MANUAL INPUT		WAIT	TIB	IBS	IF C=0 SDP15		INCM DEC SDP1										
MNO	D8	MANUAL OUTPUT		ISB	TBI WAIT		IF C=0 SDP15		INCM DEC SDP1									SET COND. CODE, CKE	
SST	00	SENSE STATUS	INSS	TEB	TBA	SDP15													
OCD	11	OUTPUT COMMAND	INOC		SDP15														
WDB	D0	WRITE DATA BLOCK	INW	ISB		INWD WAIT	IF C=0 SDP15		INCM DEC SDP1										
RDB	E0	READ DATA BLOCK	INR WAIT	INRD WAIT	TEB	IBS	IF C=0 SDP15		INCM DEC SDP1										
RDI	E8	READ UNTIL INTERRUPT	INR WAIT	INRD WAIT	TEB IF INT=1 SDP15	IBS			INCM SDP1										

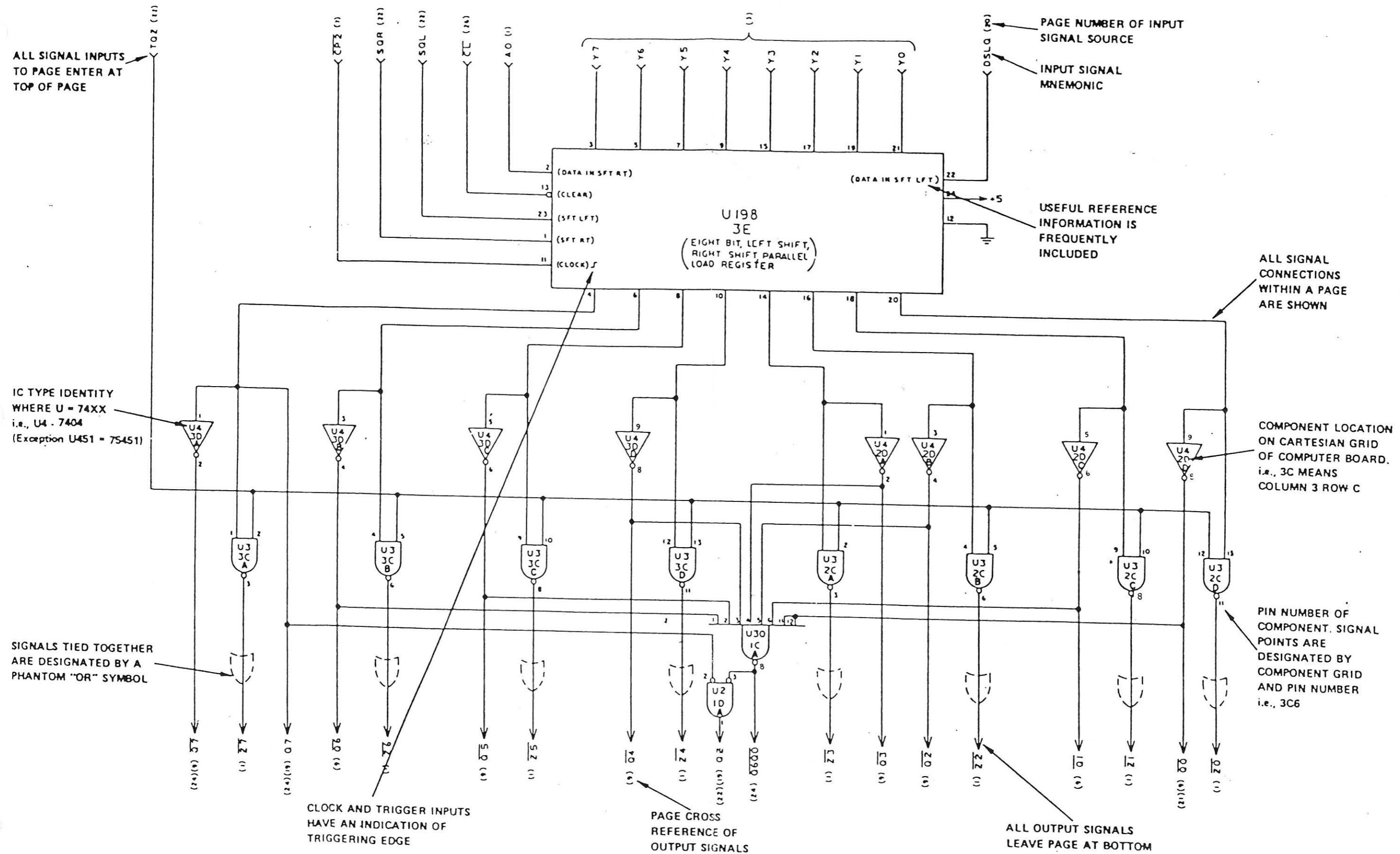


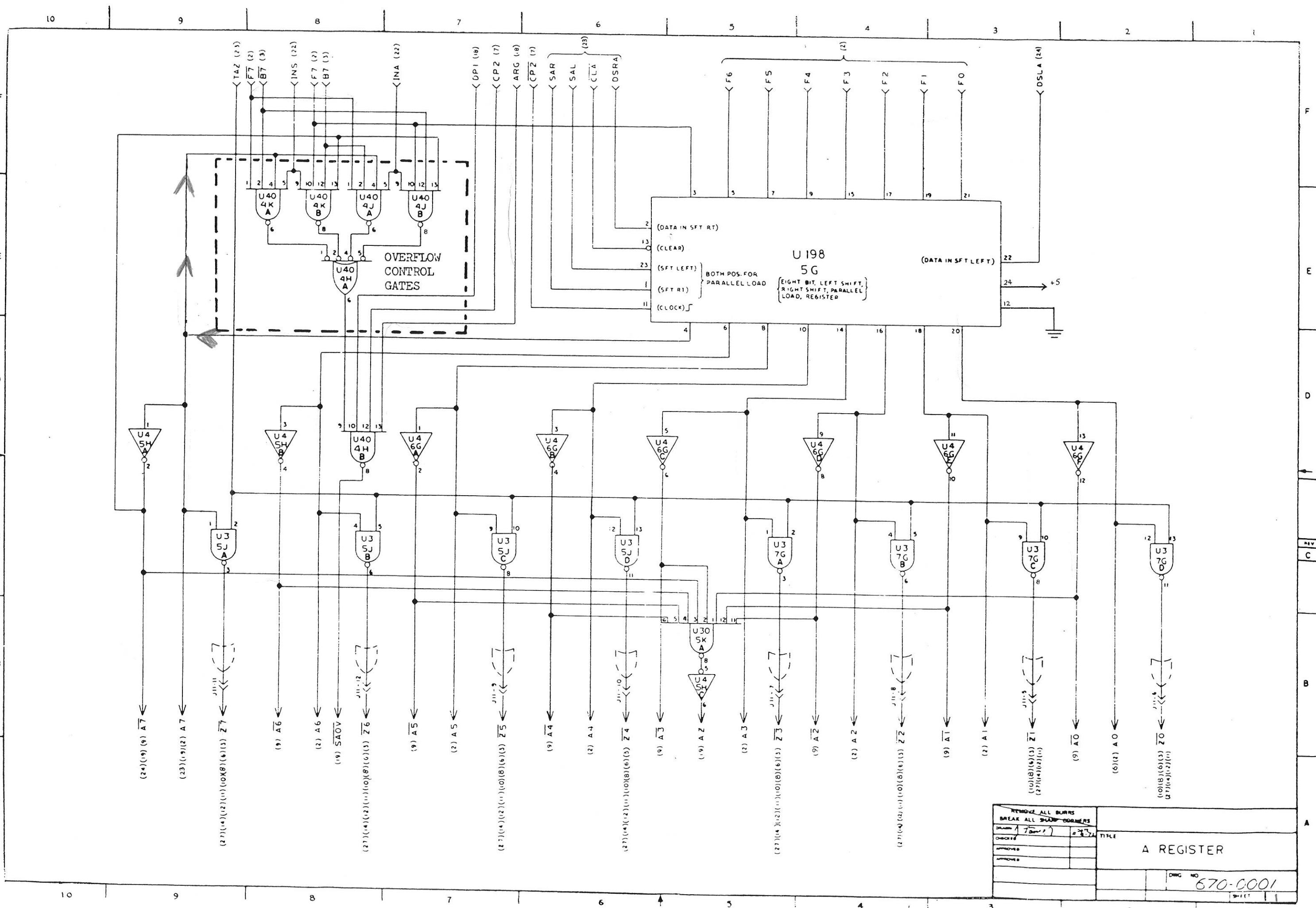
THREE OR MORE DATA LINES PER BUS

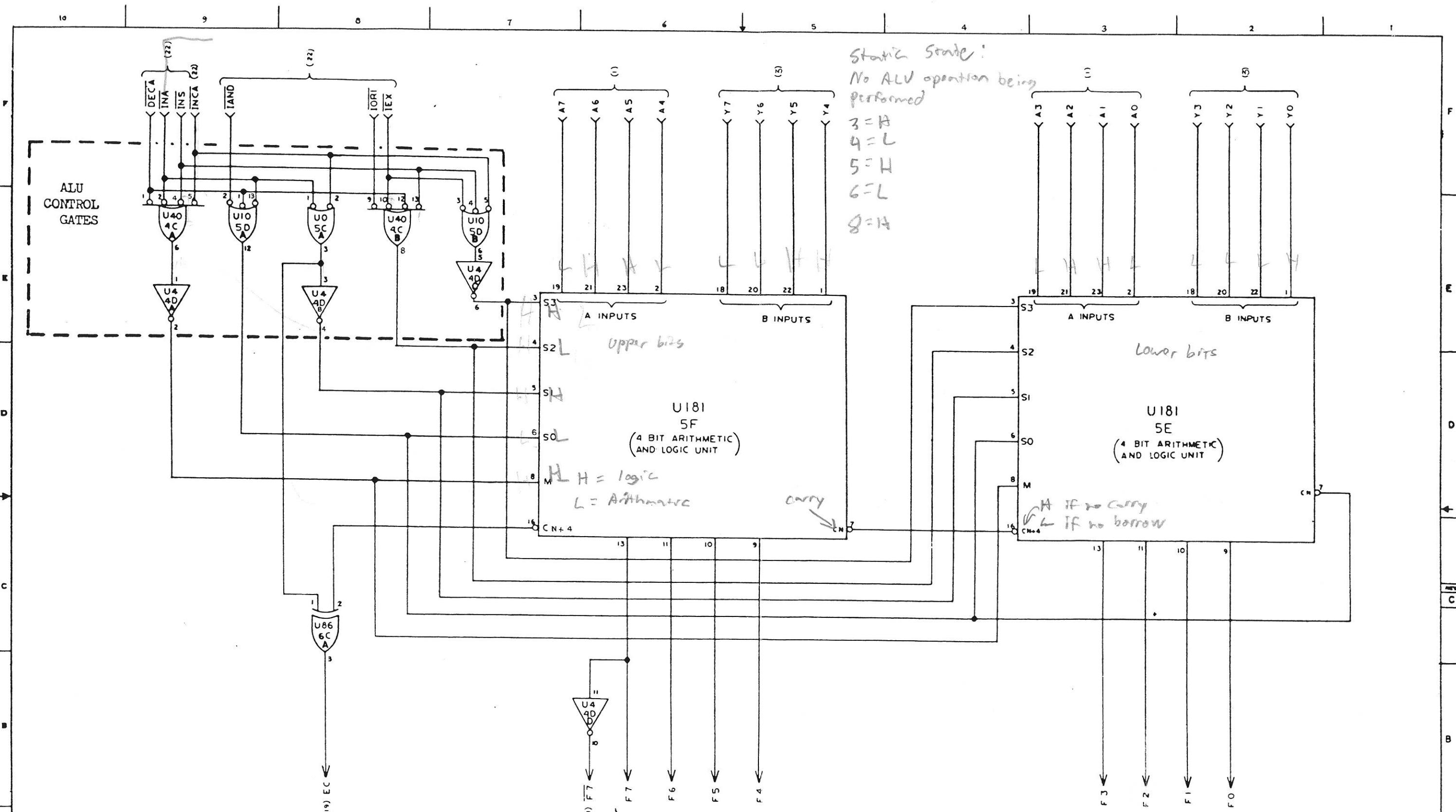
ONE OR TWO DATA LINE(S) PER BUS

REMOVE ALL BURRS BREAK ALL SHARP CORNERS		
<i>Block Diagram</i>		<i>10-11</i>
		TITLE
		BLOCK DIAGRAM
		Date NO
		REMARKS

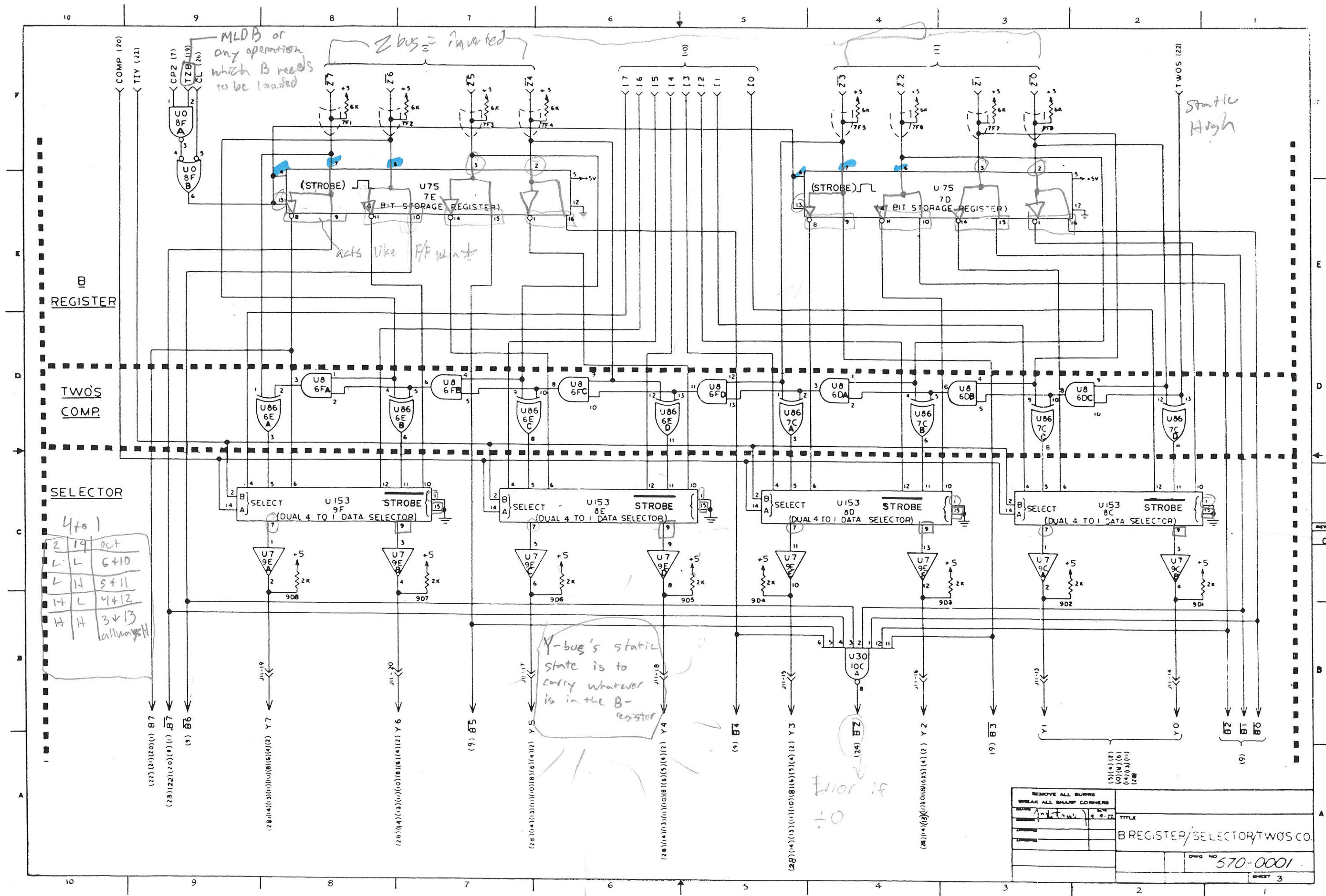
KEY TO LOGIC DIAGRAMS

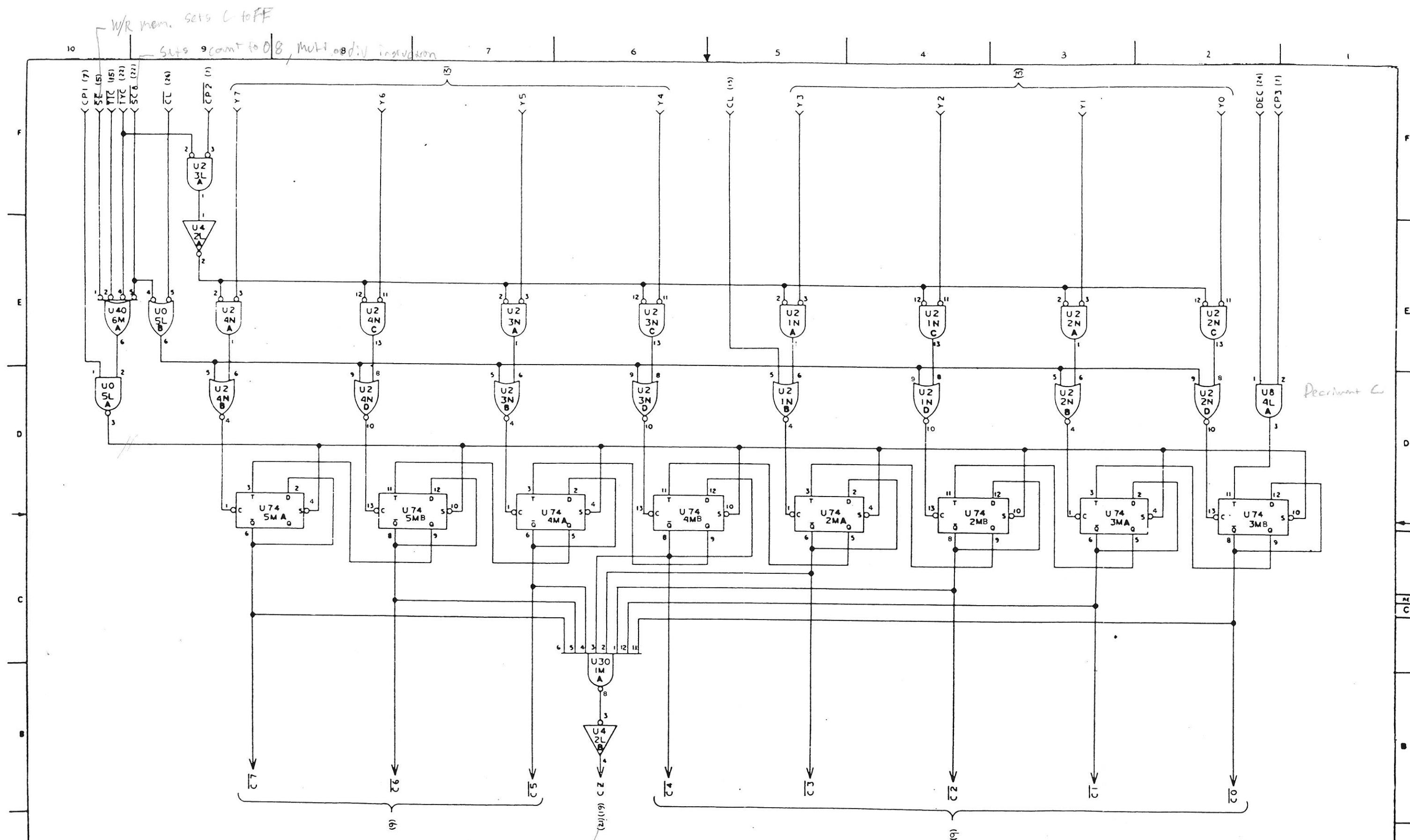




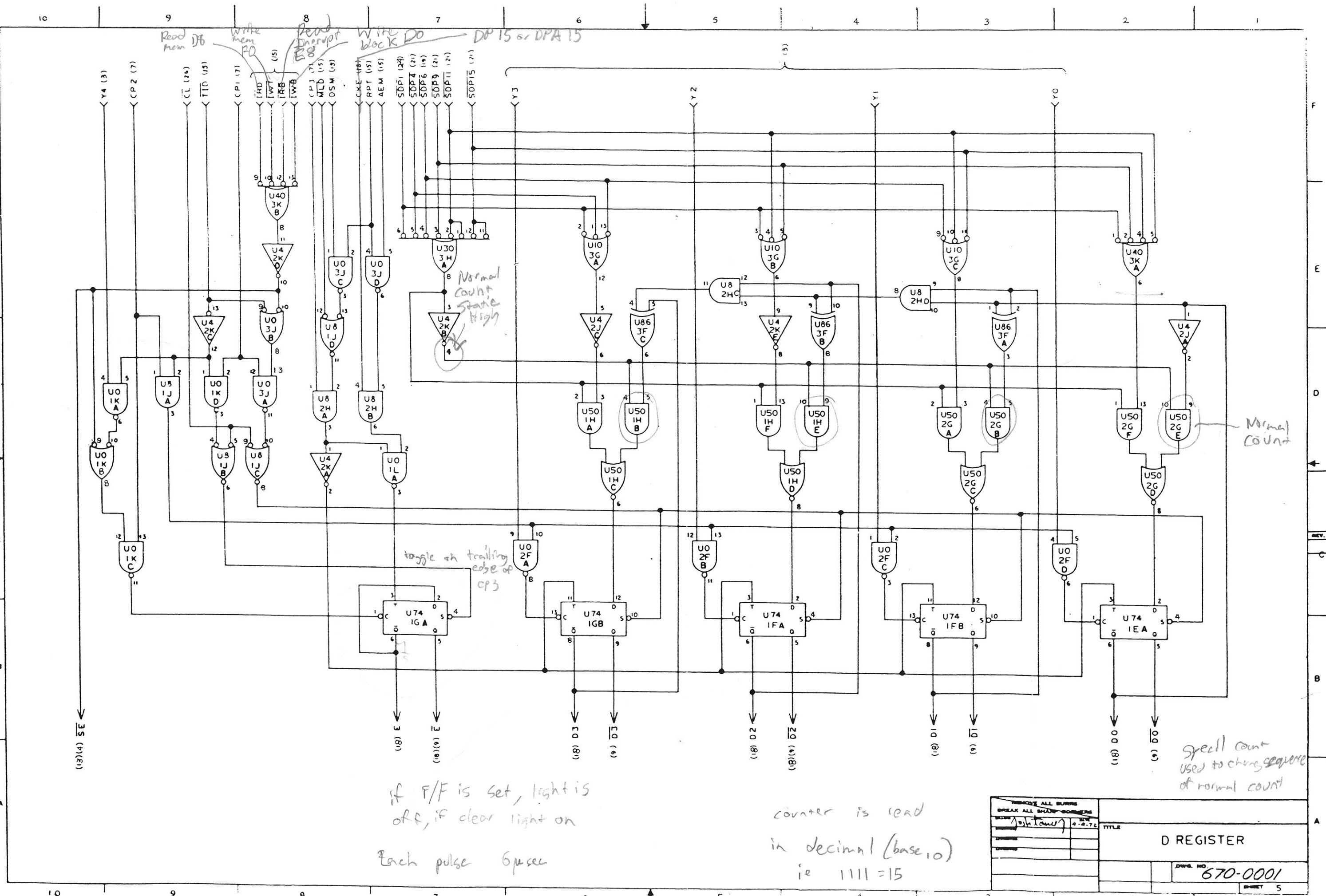


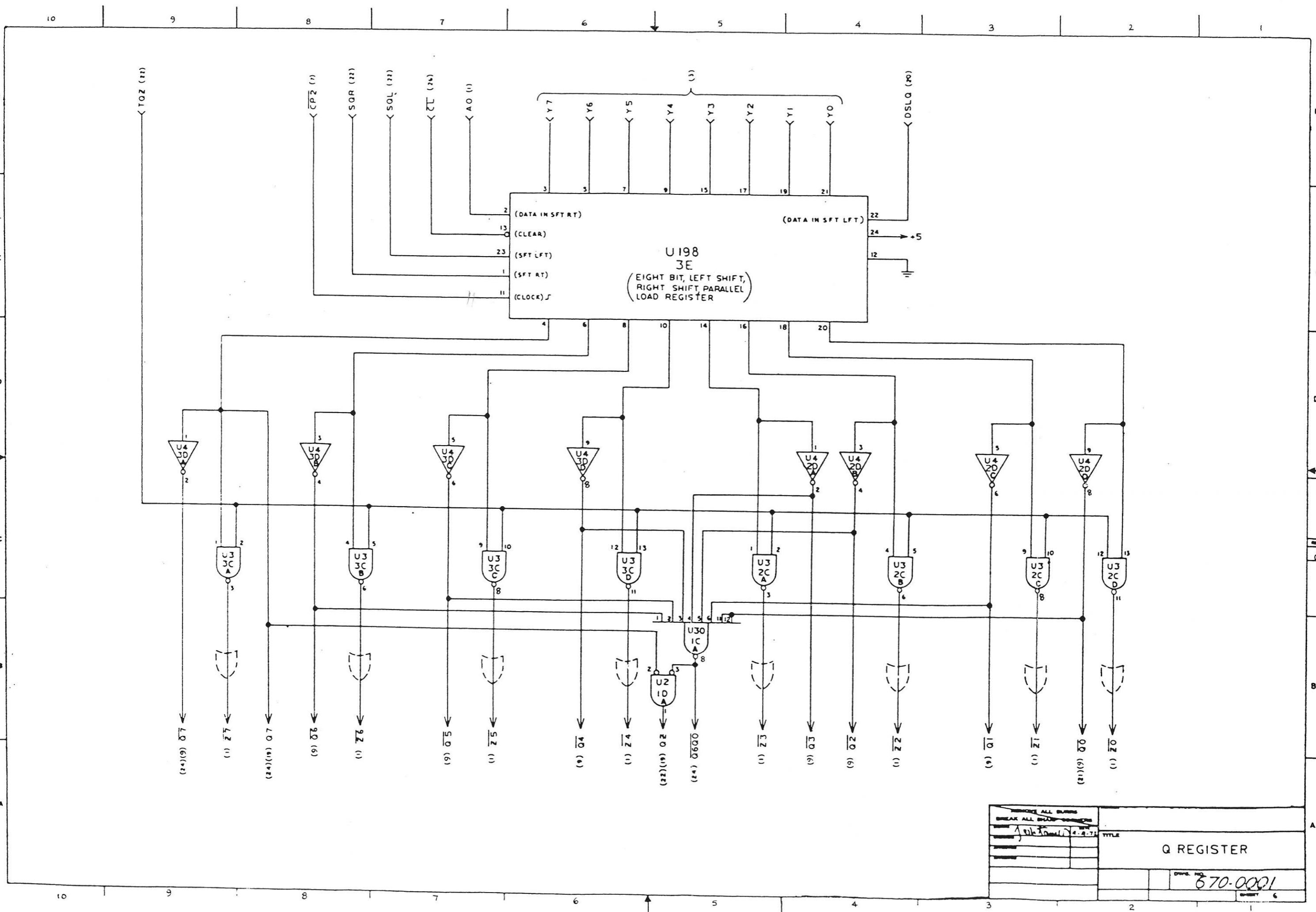
U181 capable of 48 operations. CT-10 is only wired for 8 of them but a fault could set any of them

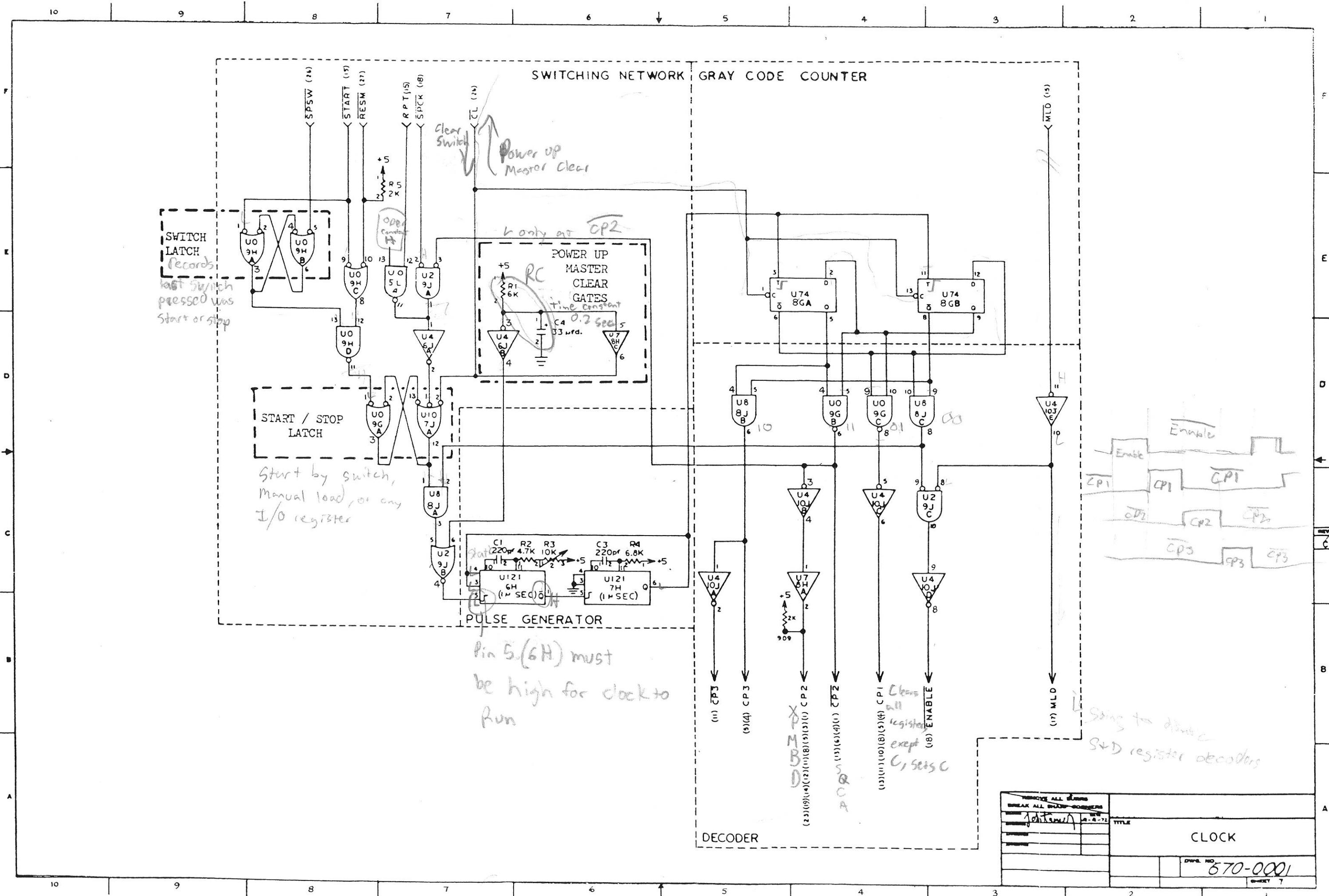


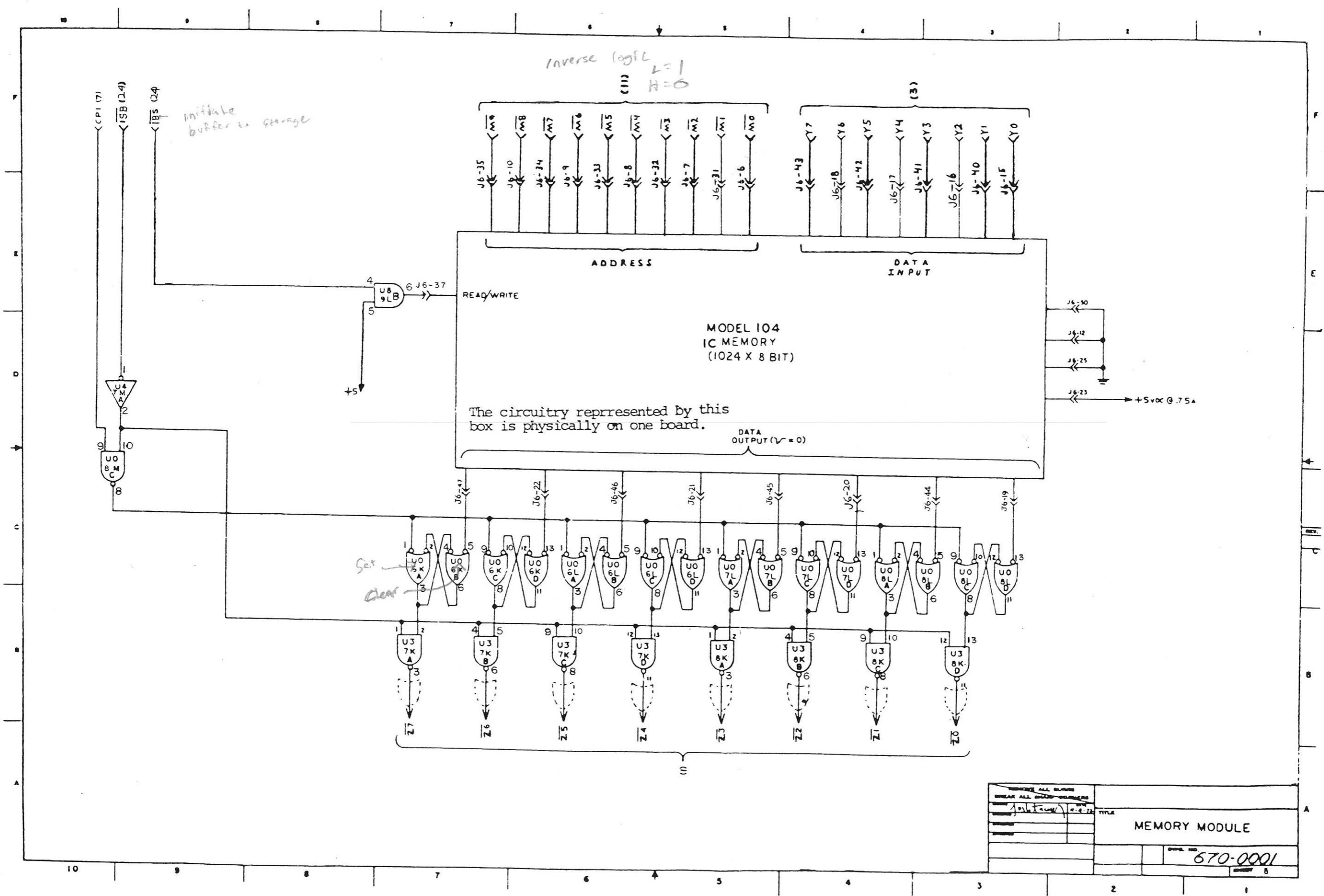


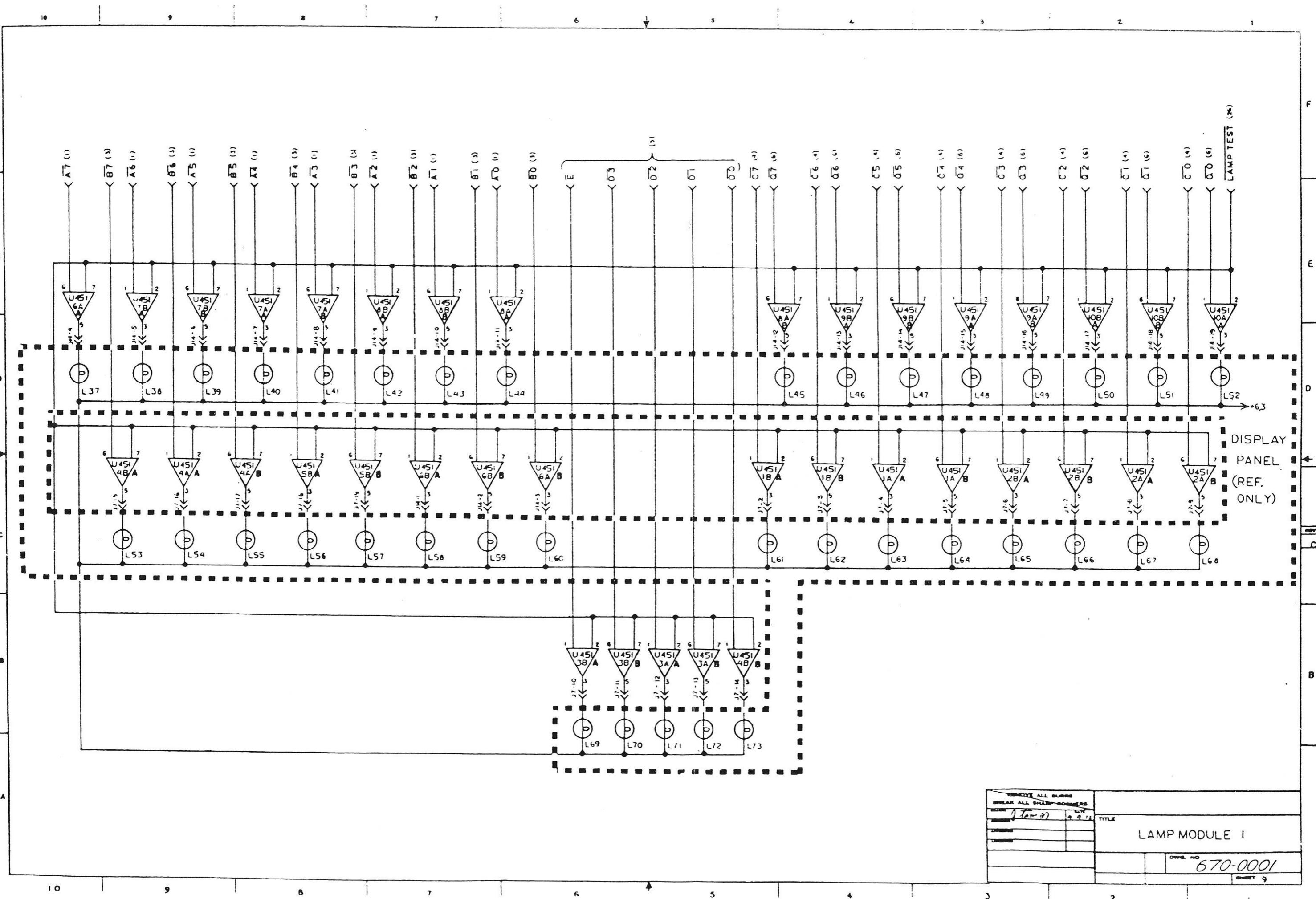
REMOVE ALL BURRS BREAK ALL SHARP CORNERS		TITLE	
DATE	JUN 1971	4-787	
CHECKED			
APPROVED			
SUPERVISED			
		DRAWING NO.	670-0001
		REVISION	4

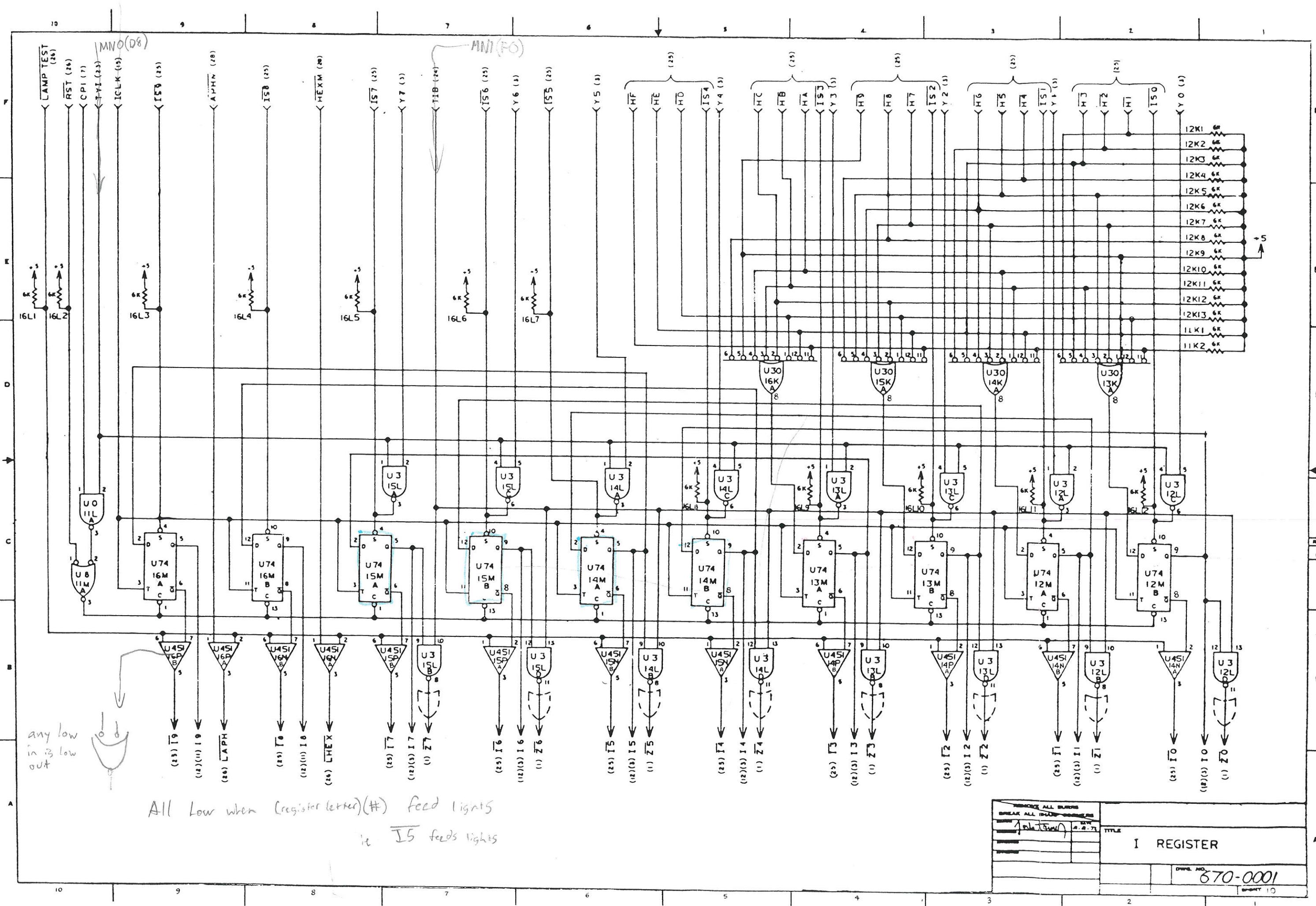


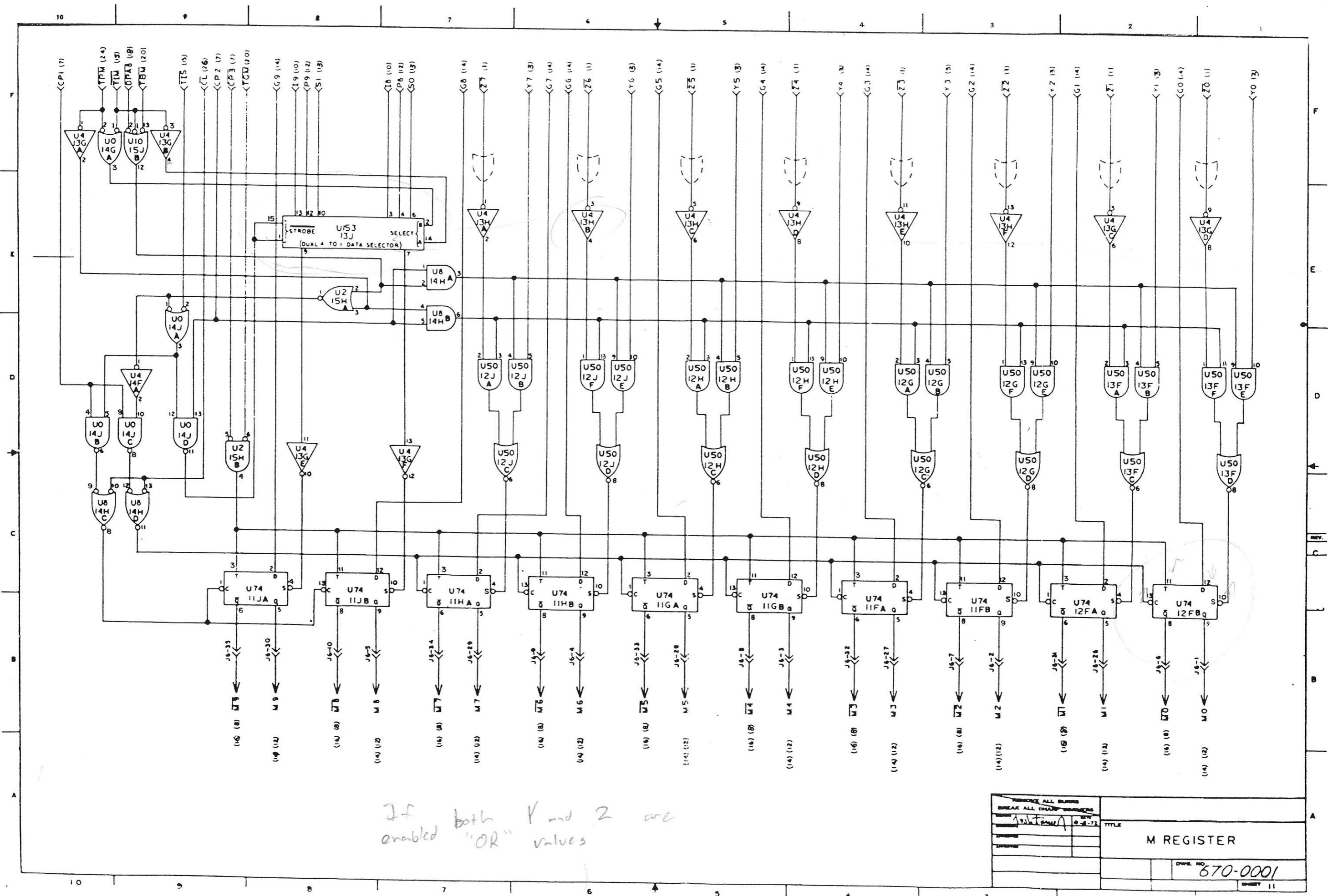


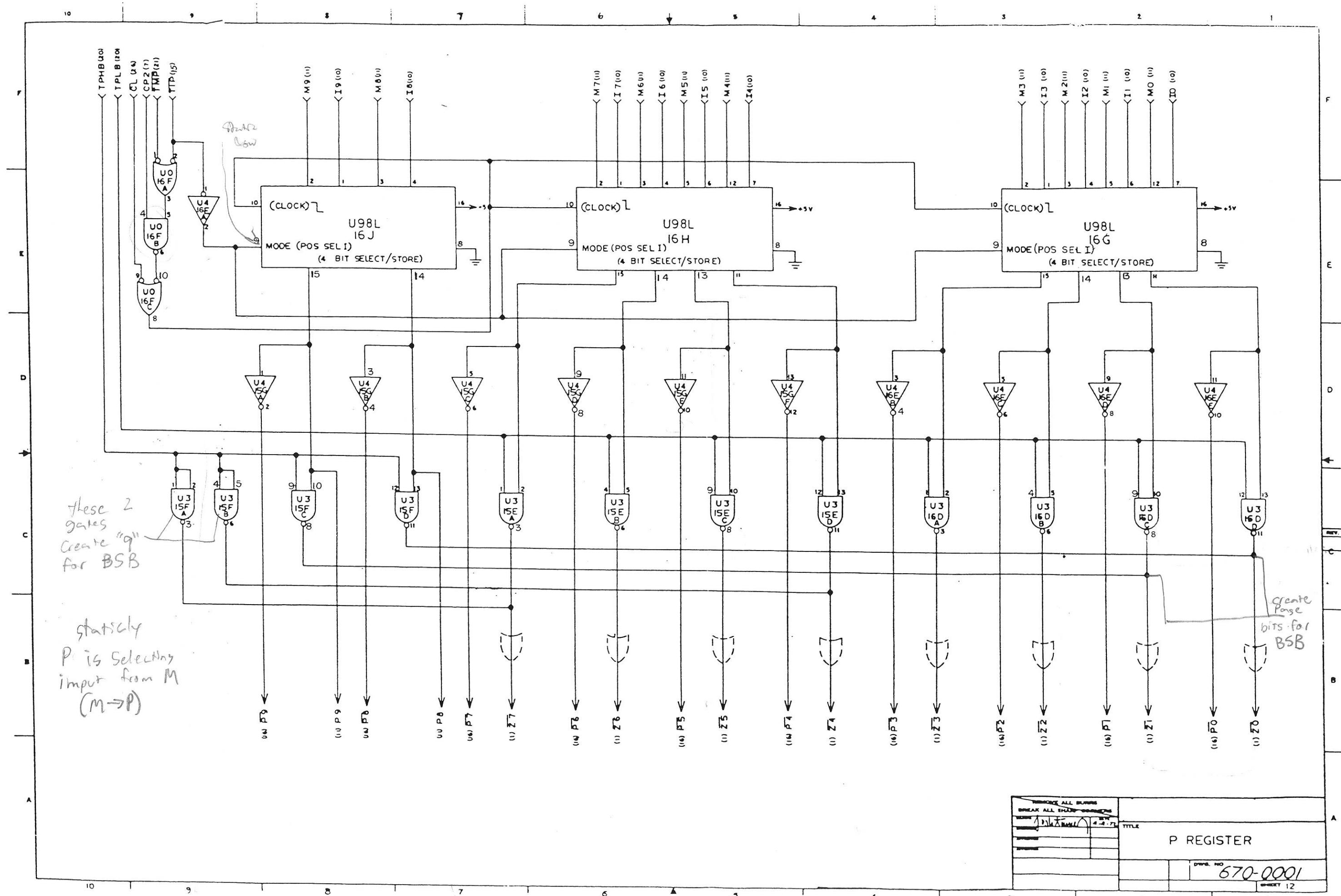


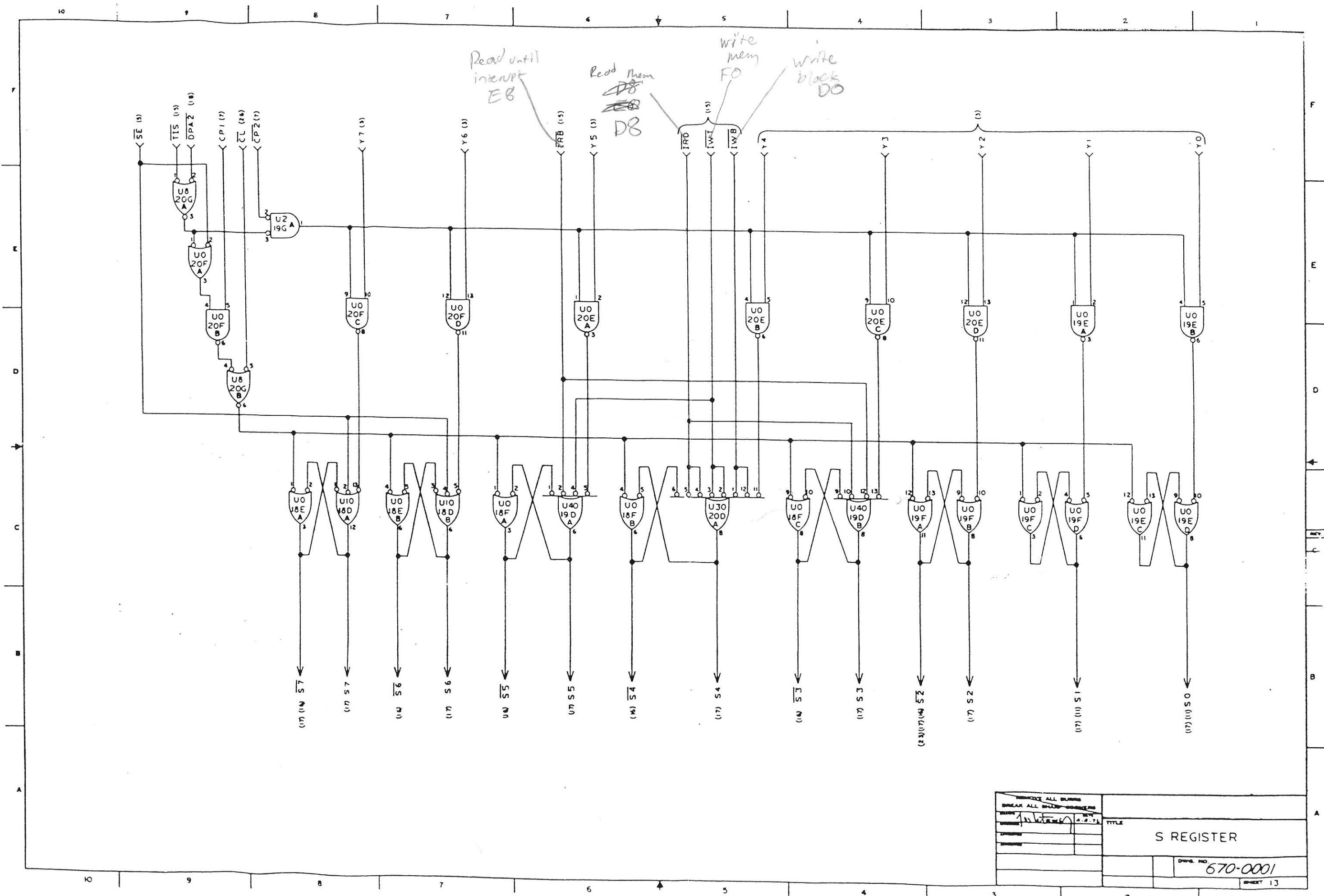


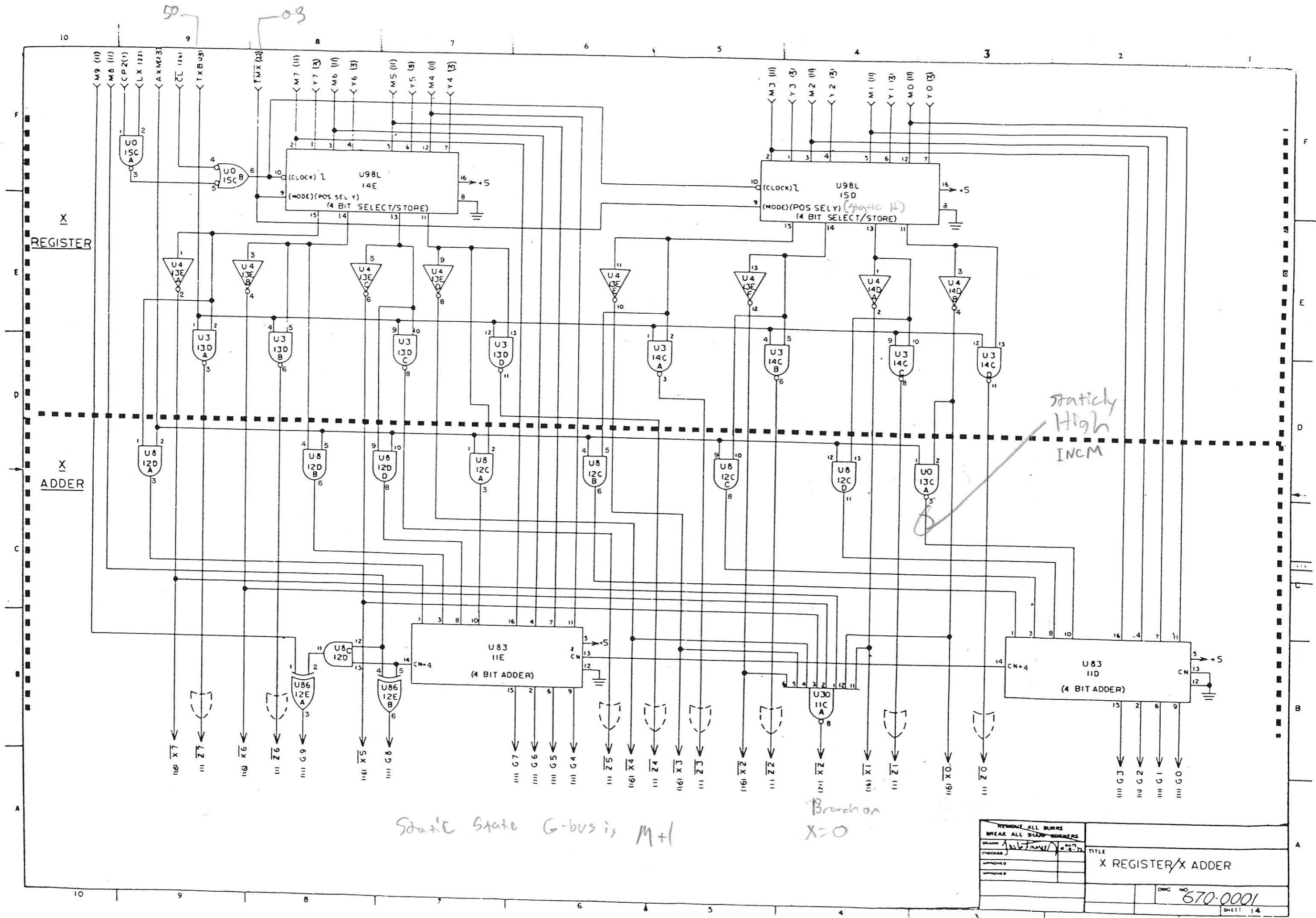


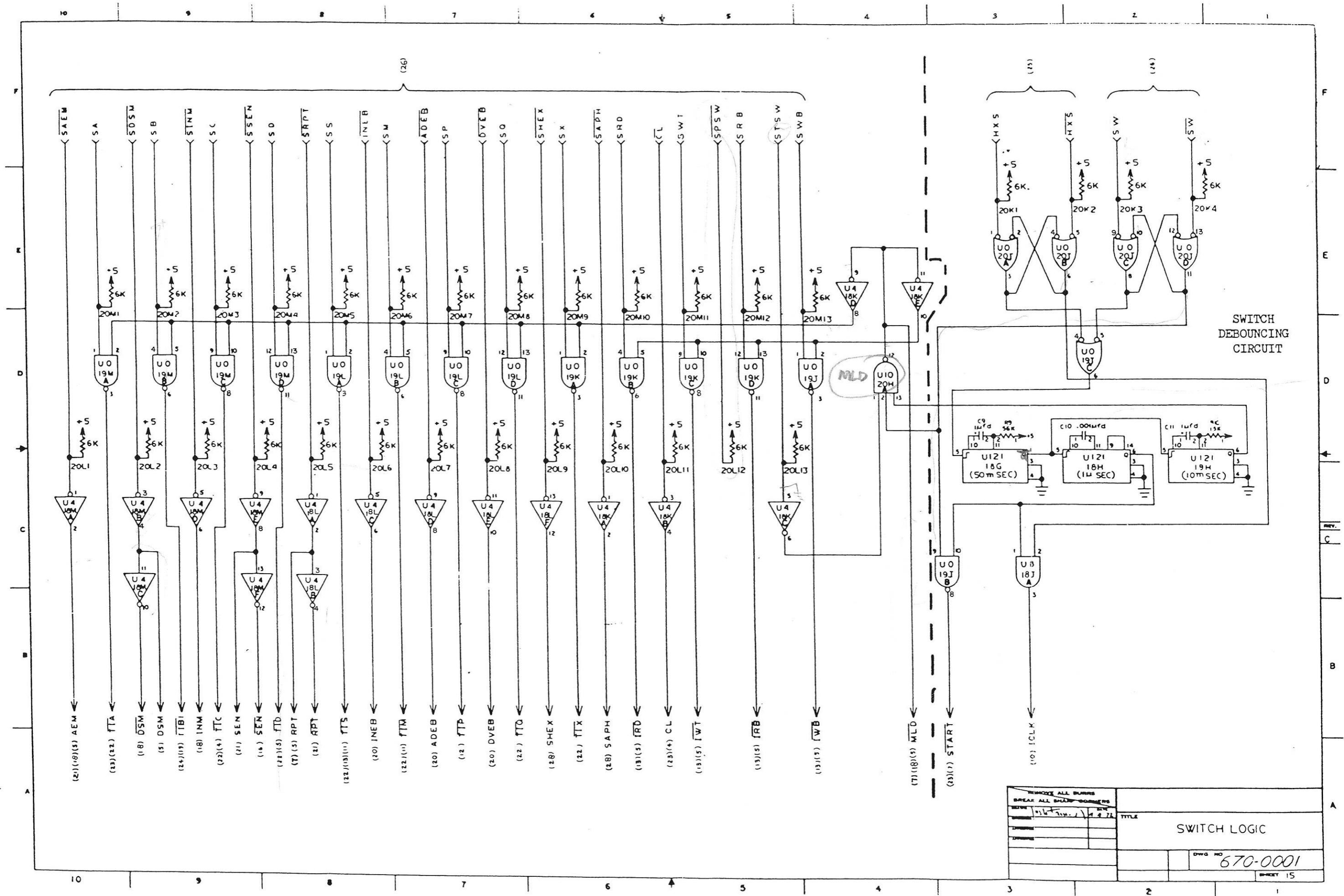


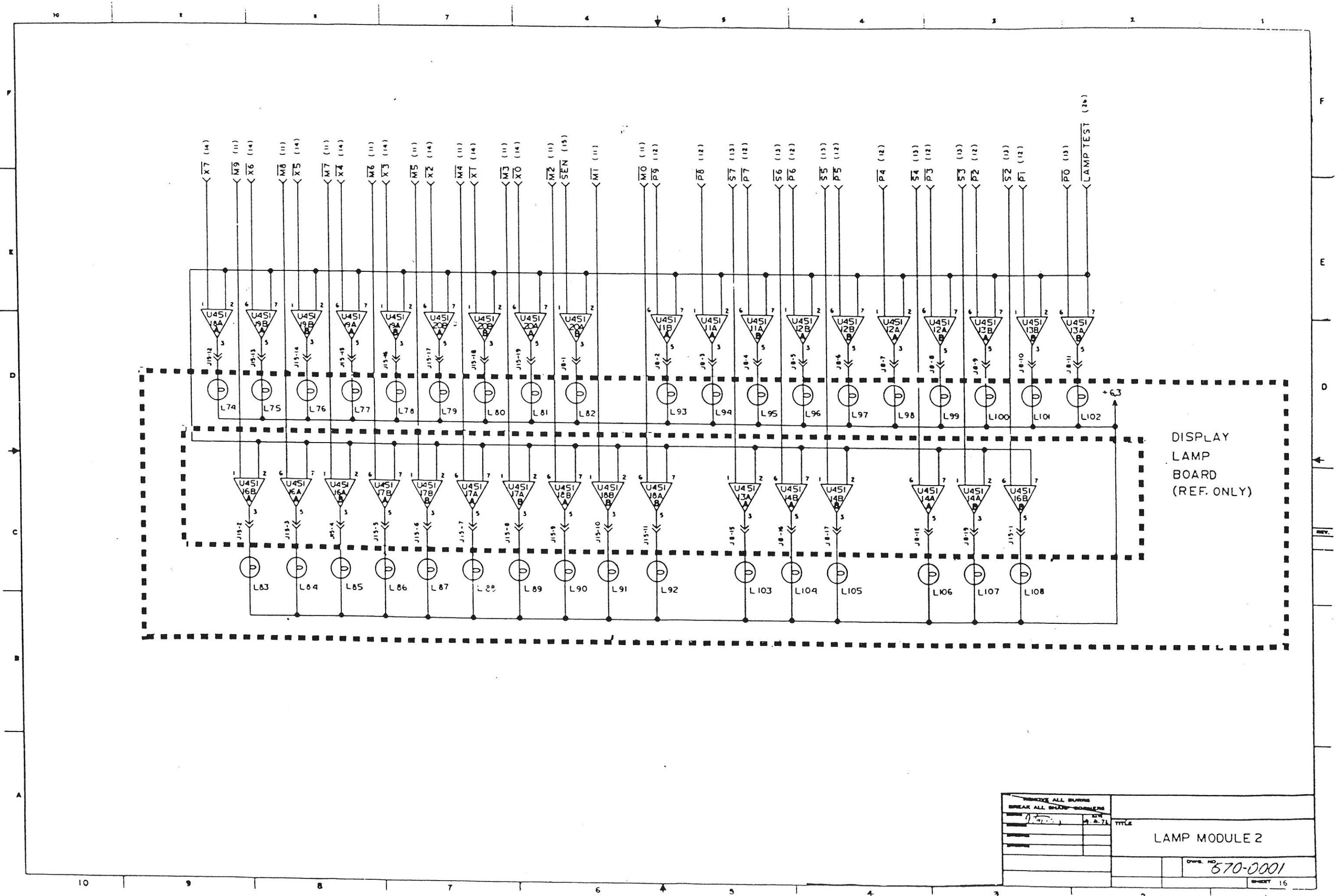


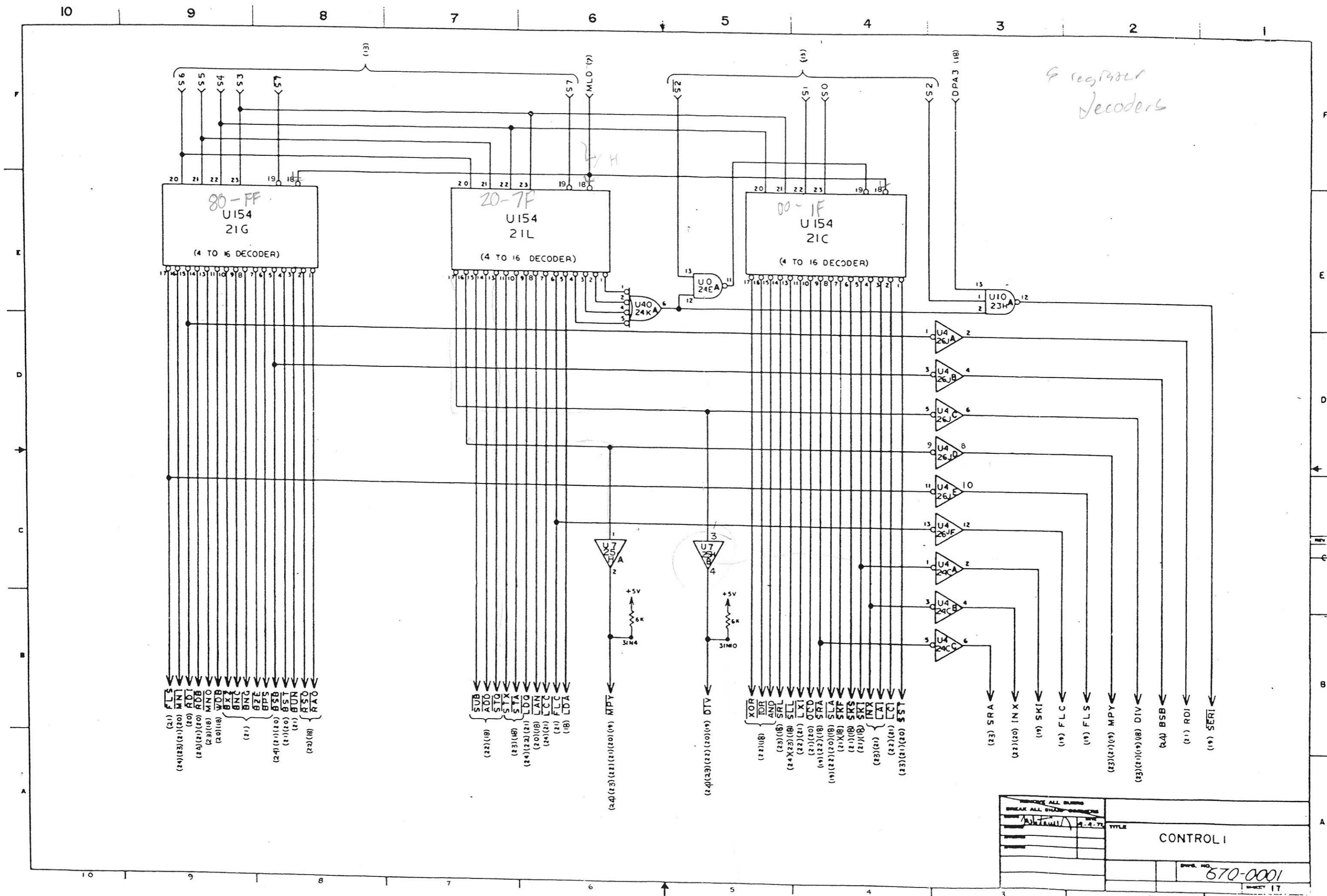


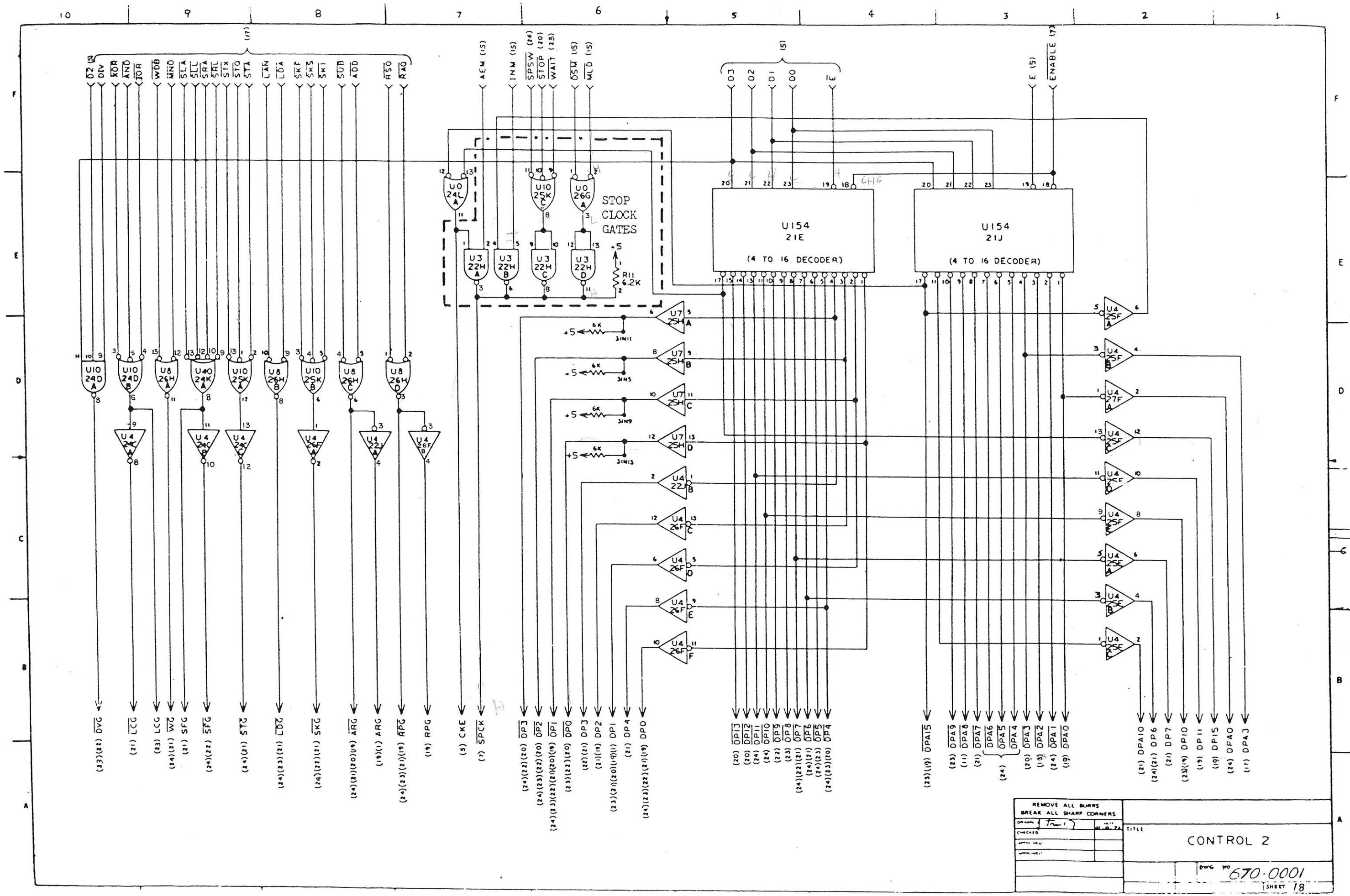


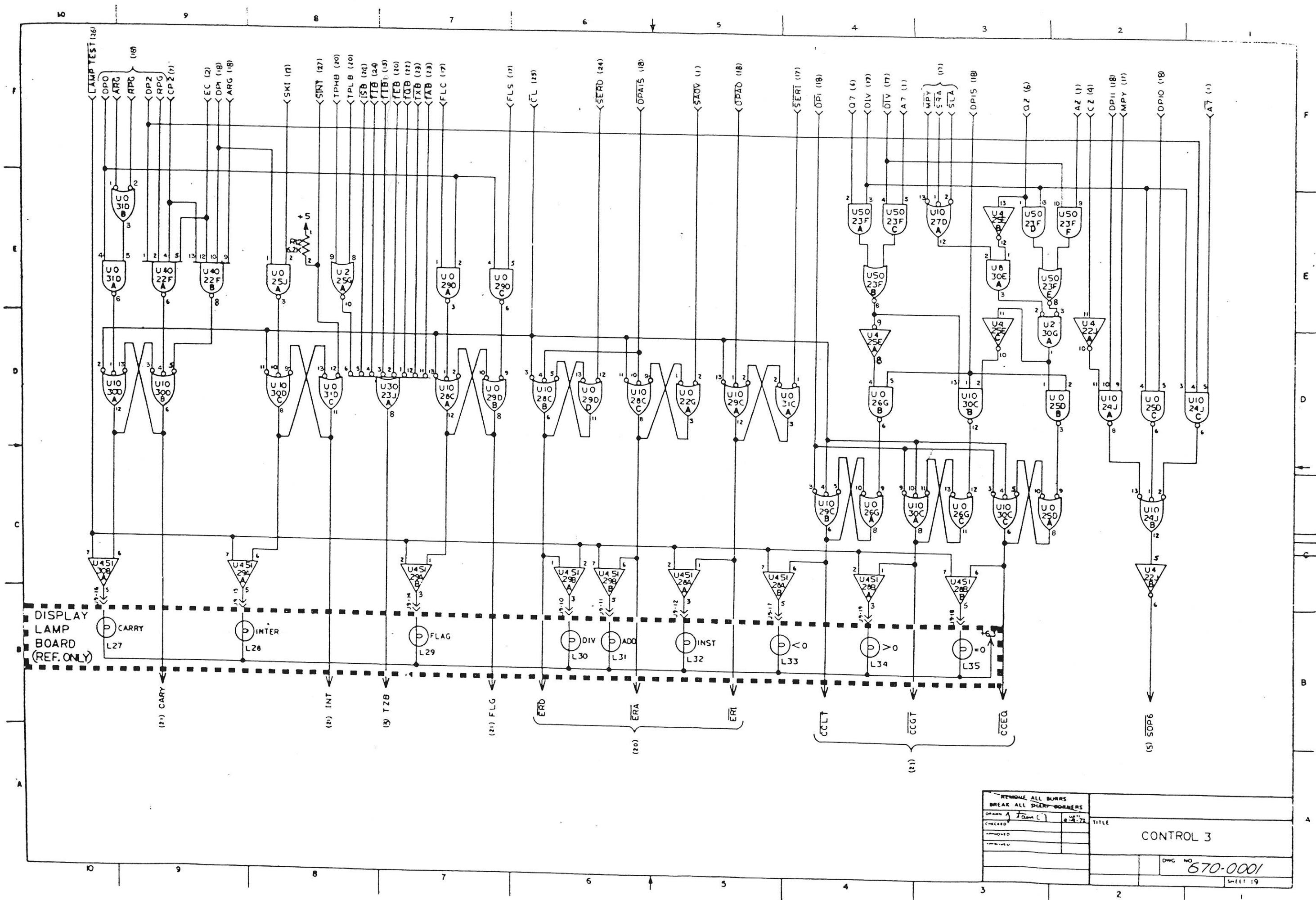


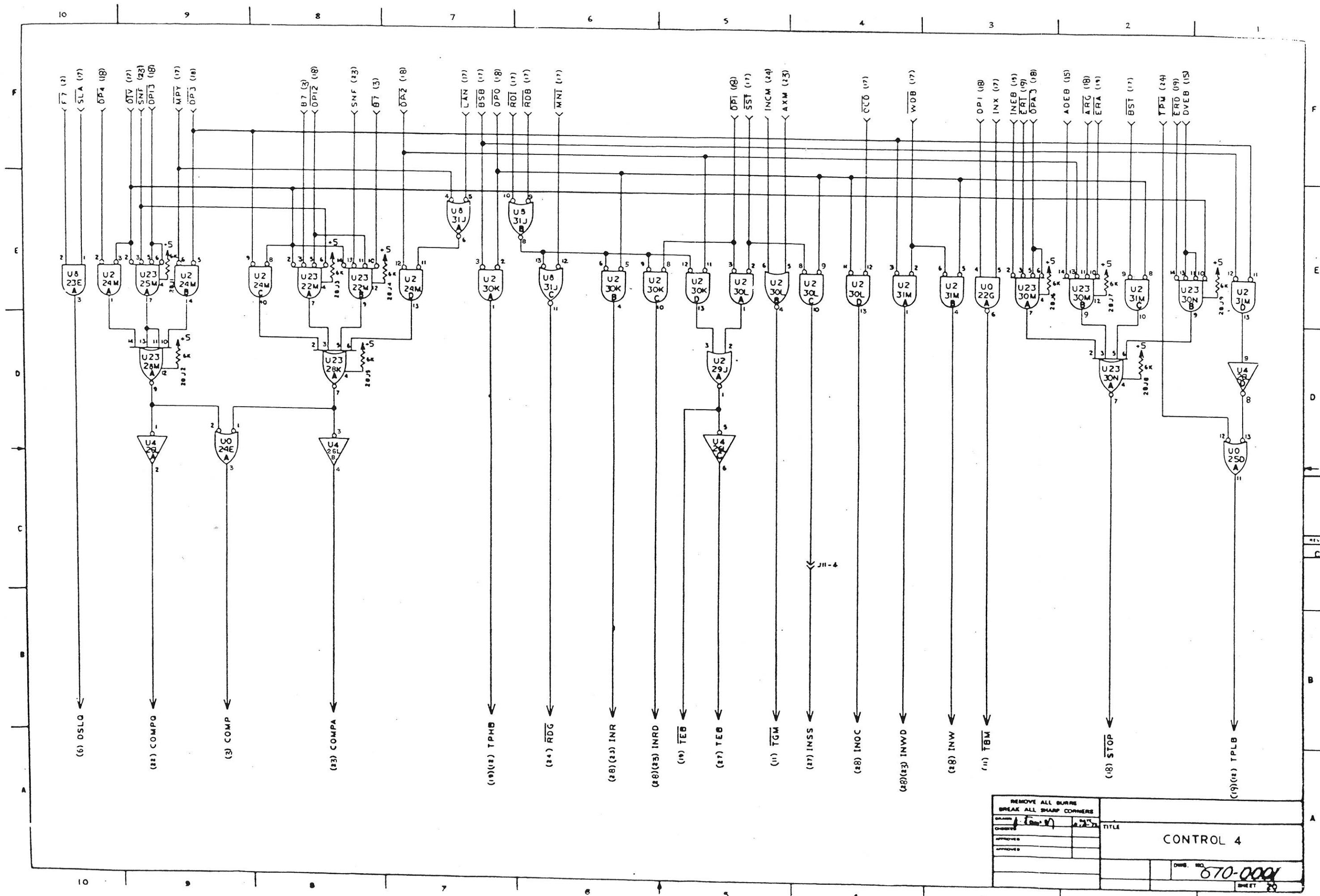


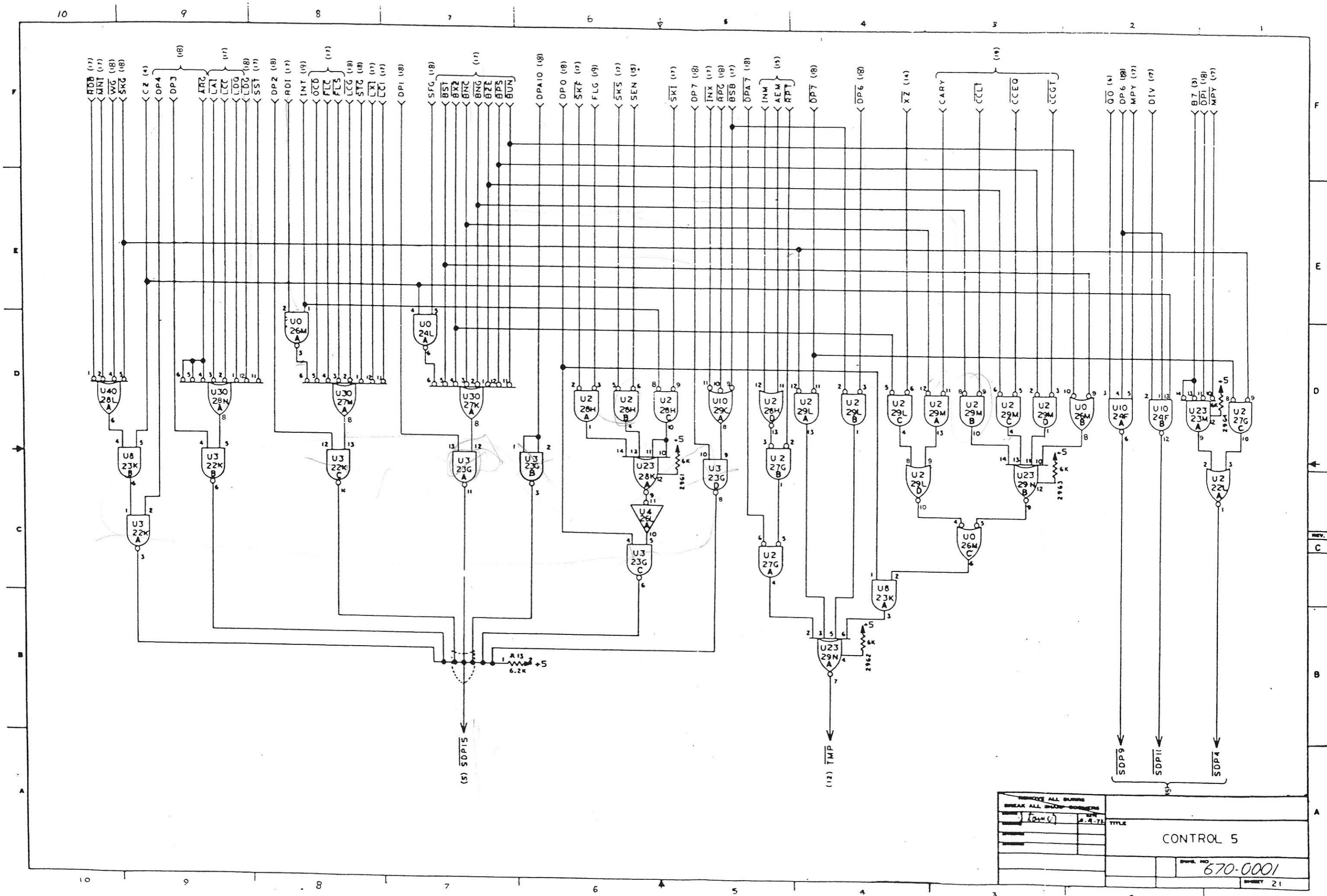


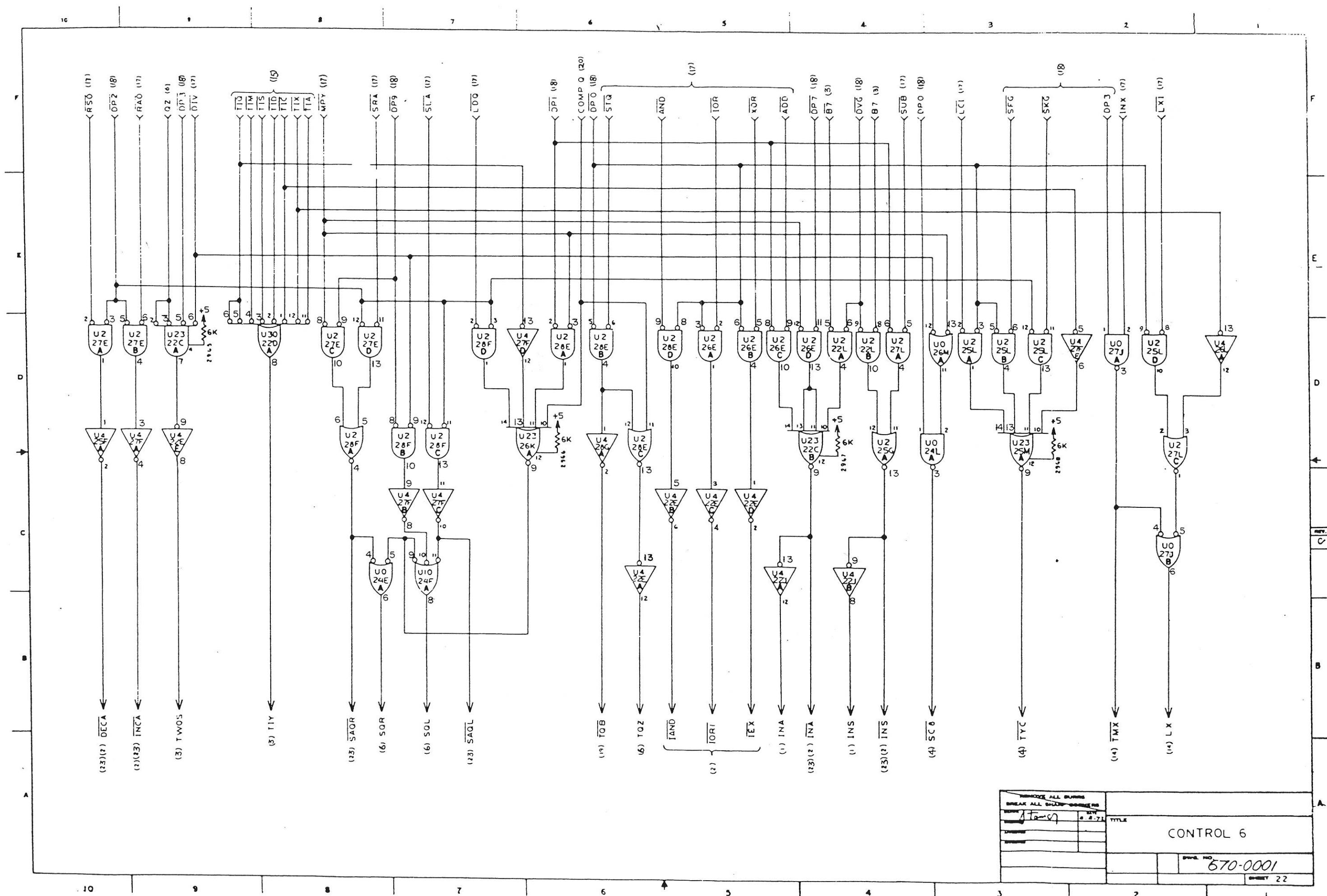


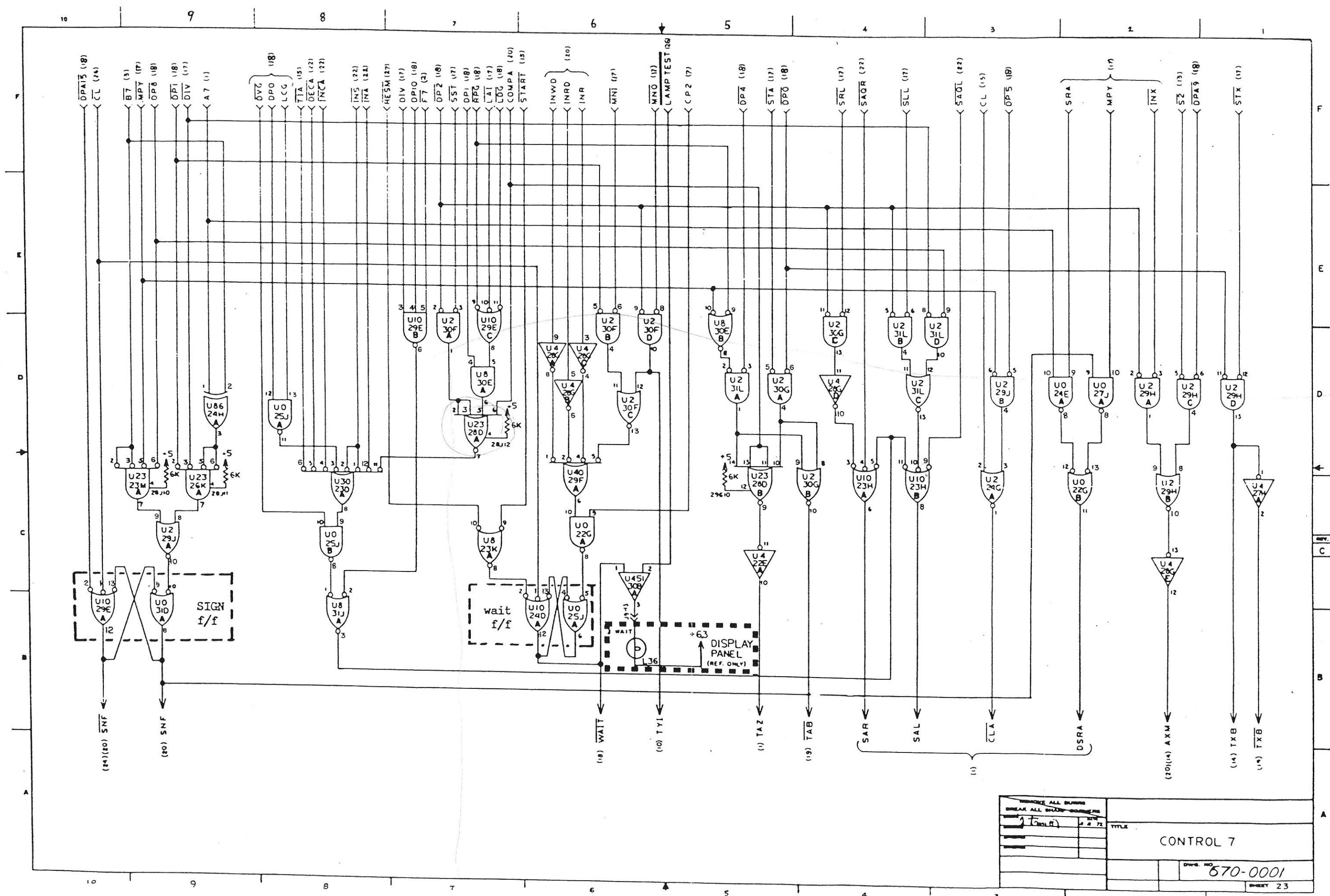


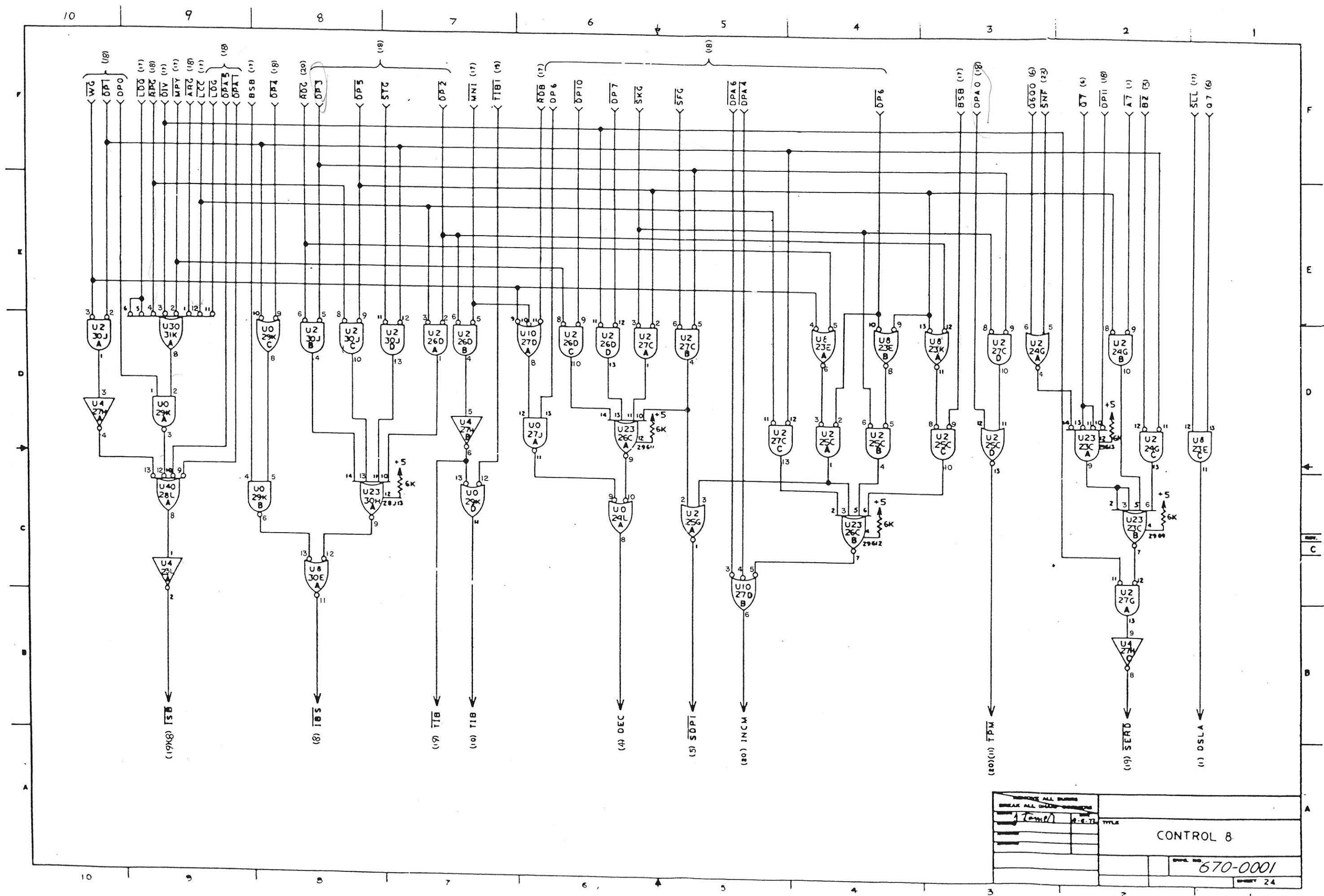










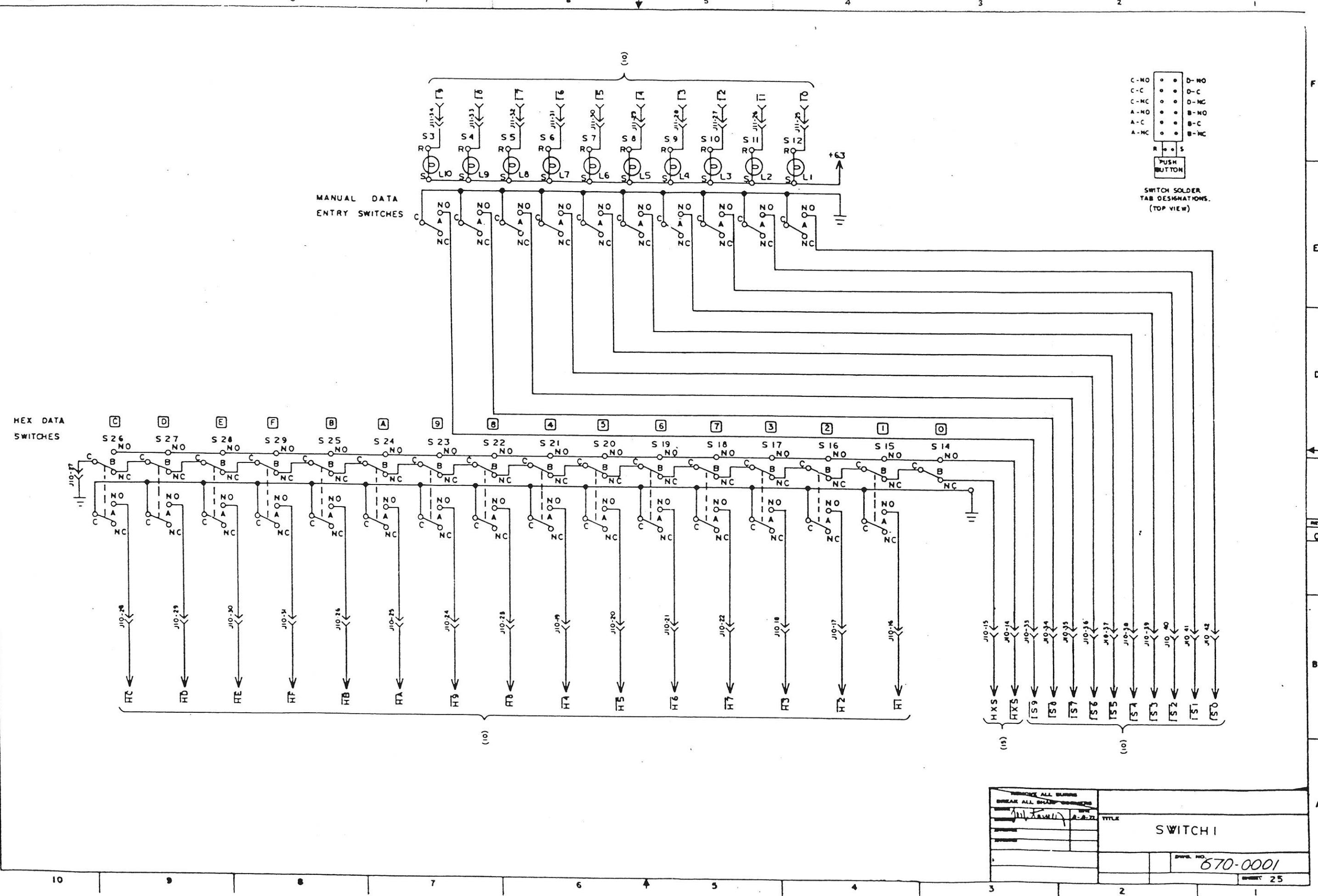
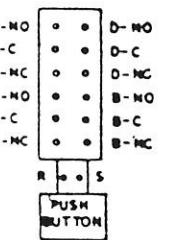


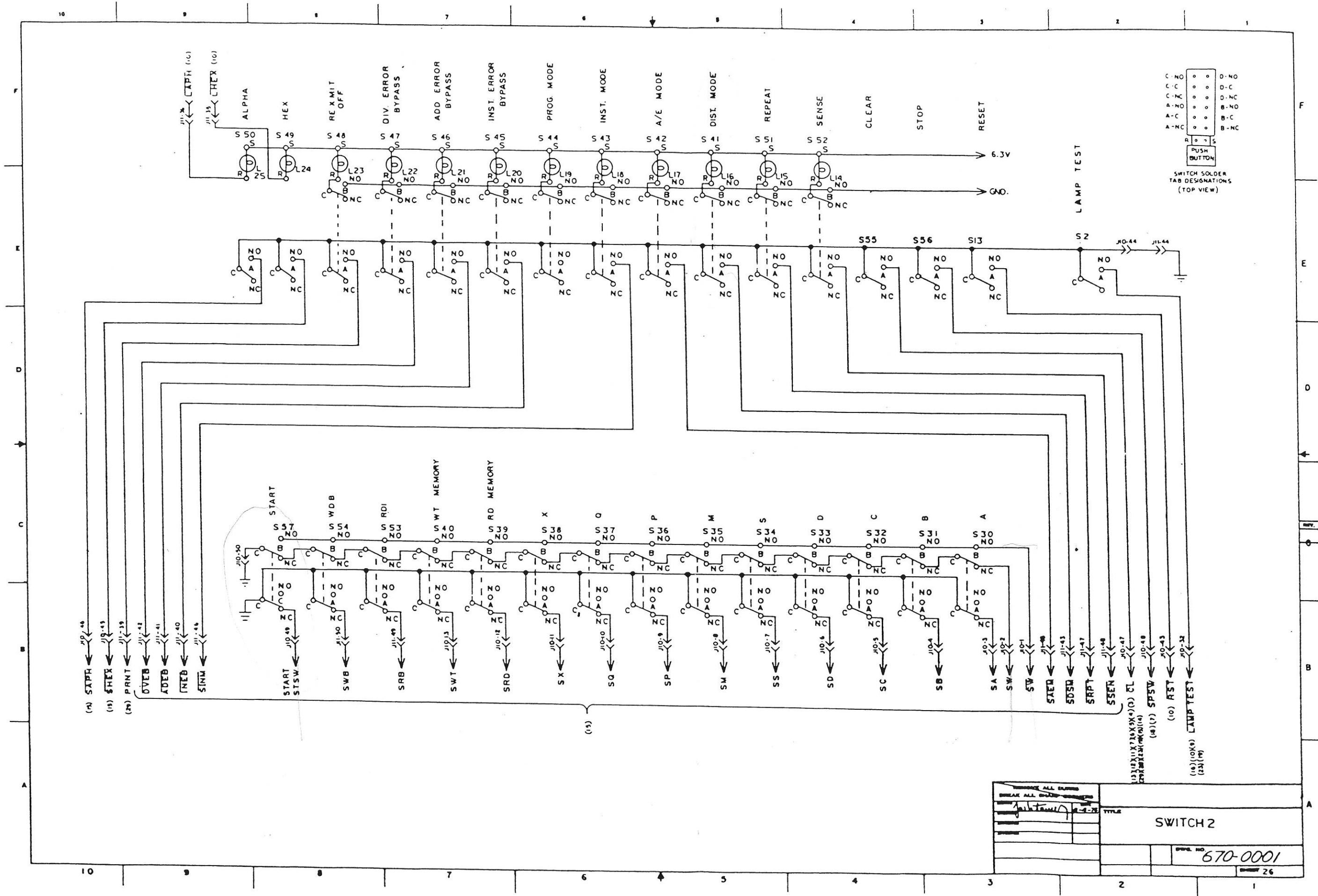
ALL DUE BREAK ALL DUE		Temp		DATE	
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36
37	38	39	40	41	42
43	44	45	46	47	48
49	50	51	52	53	54
55	56	57	58	59	60
61	62	63	64	65	66
67	68	69	70	71	72
73	74	75	76	77	78
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85	86	87	88	89	90
91	92	93	94	95	96
97	98	99	100	101	102

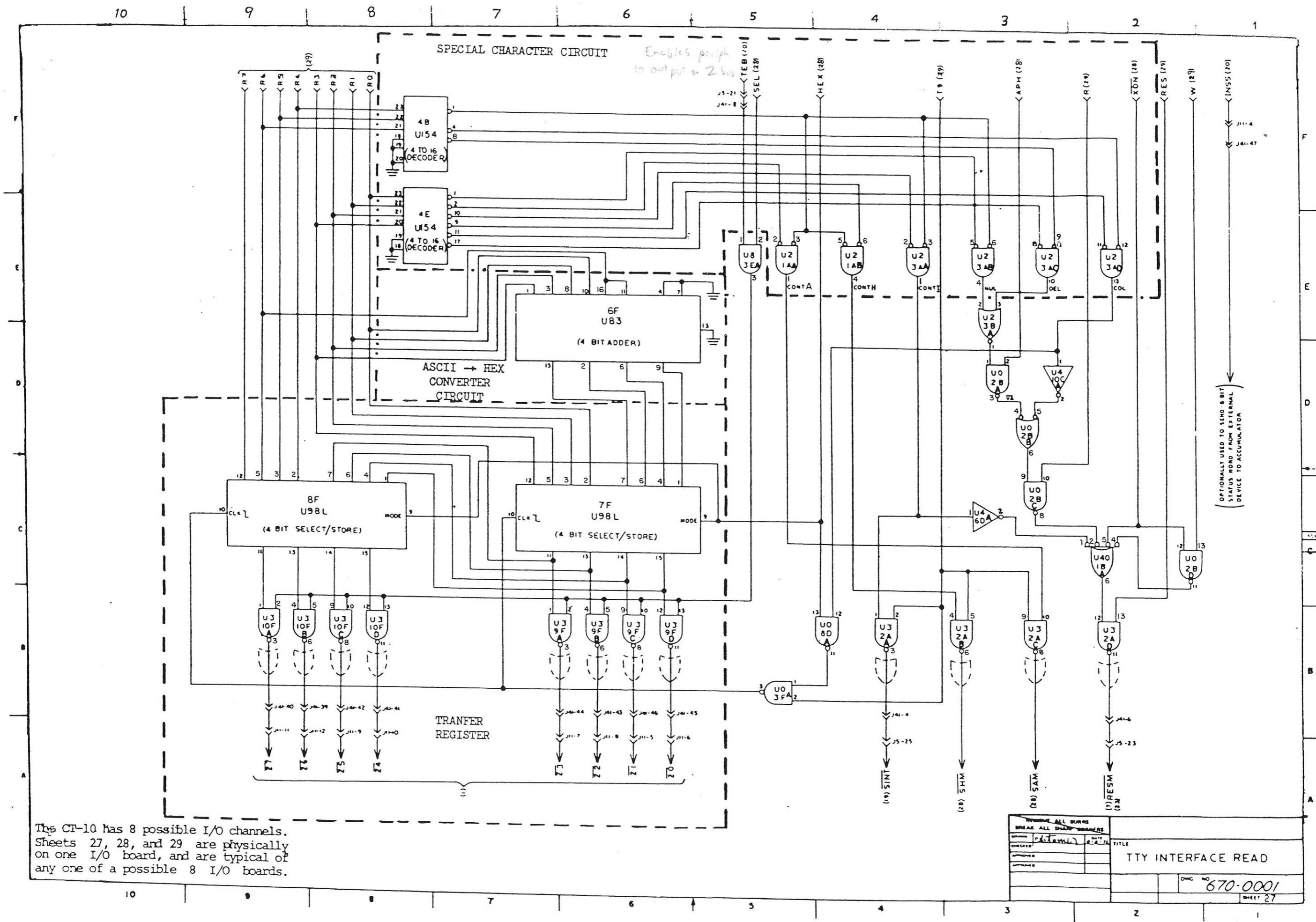
670-0001

CONTROL 8

24

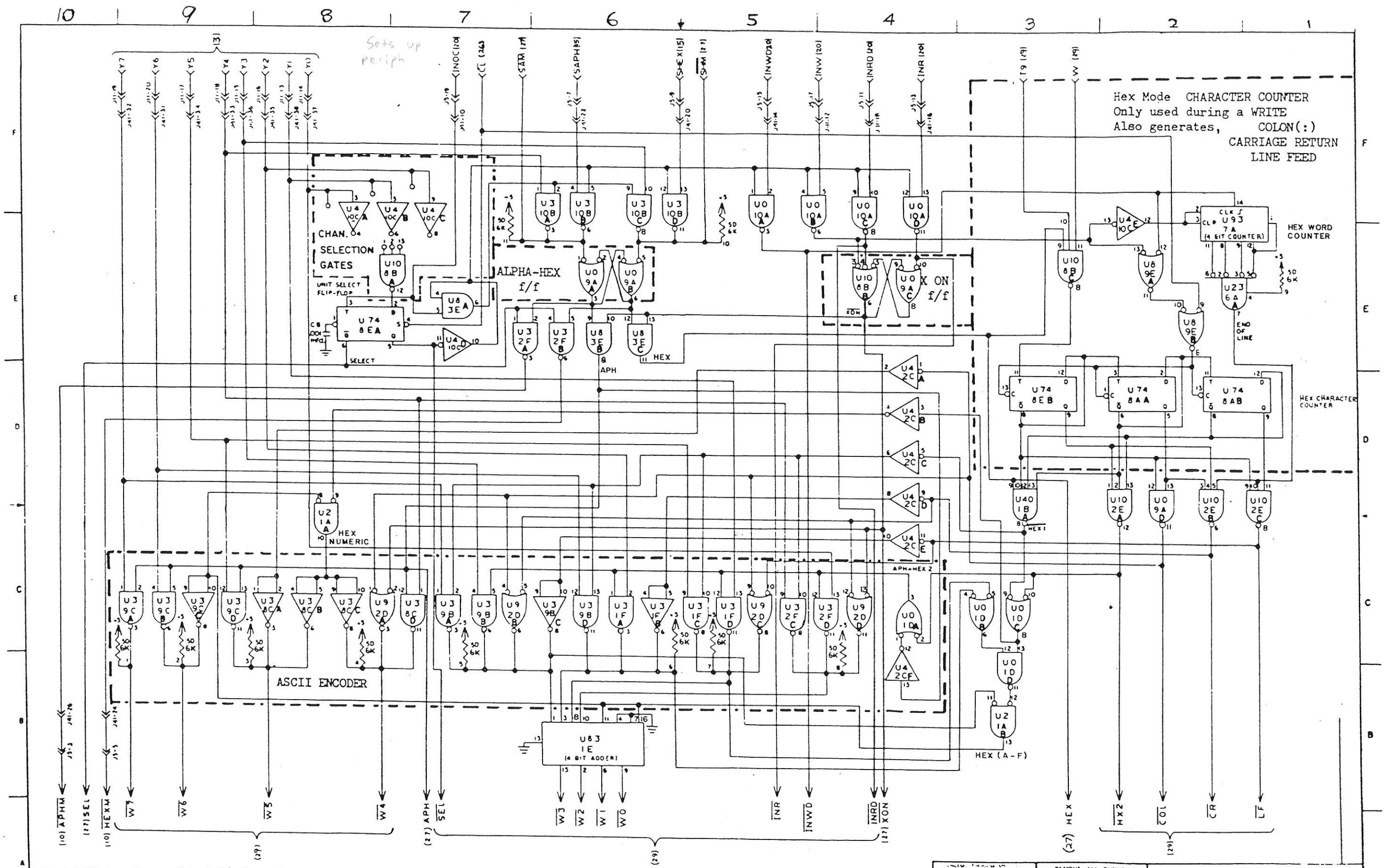






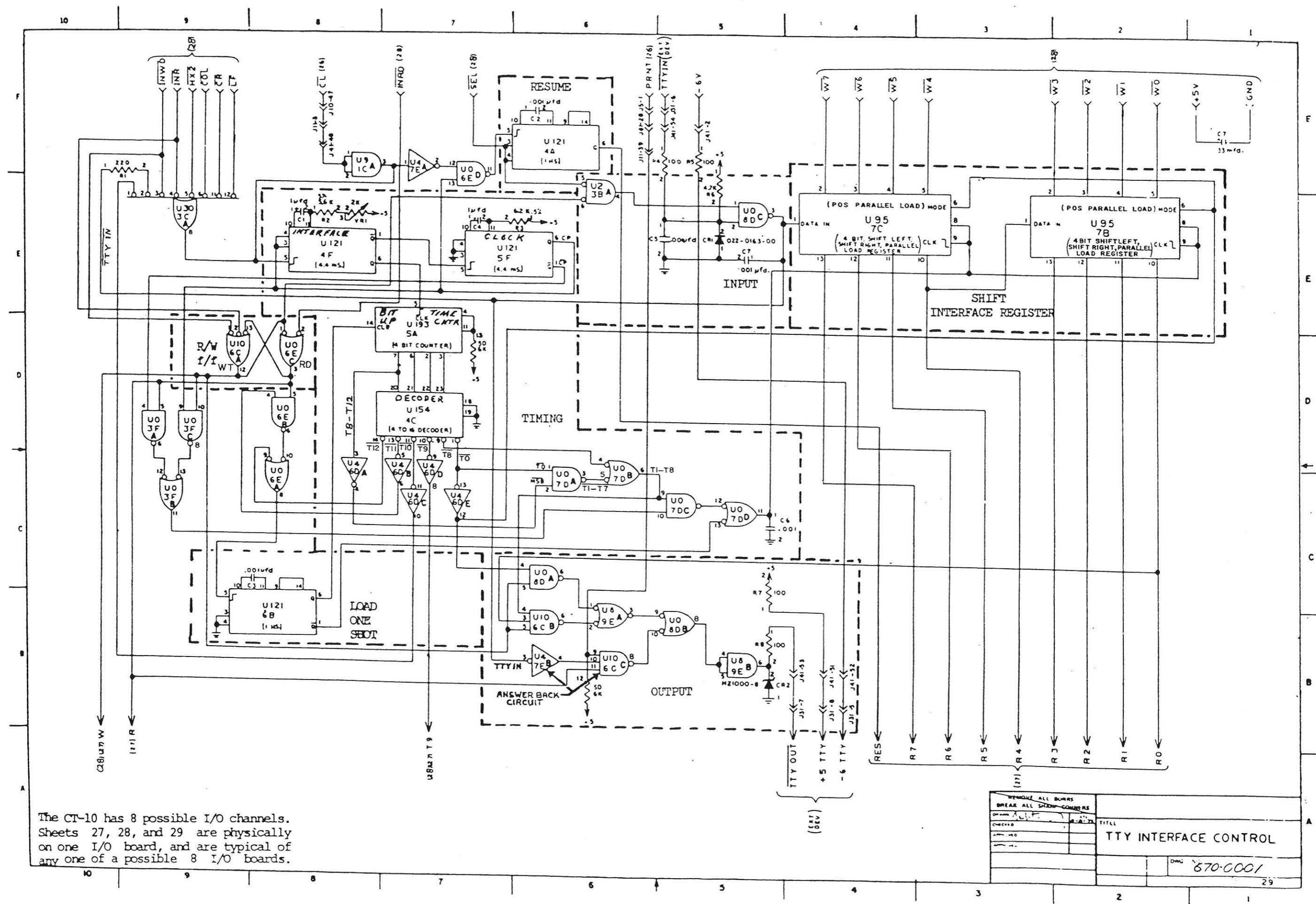
The CT-10 has 8 possible I/O channels.
Sheets 27, 28, and 29 are physically
on one I/O board, and are typical of
any one of a possible 8 I/O boards.

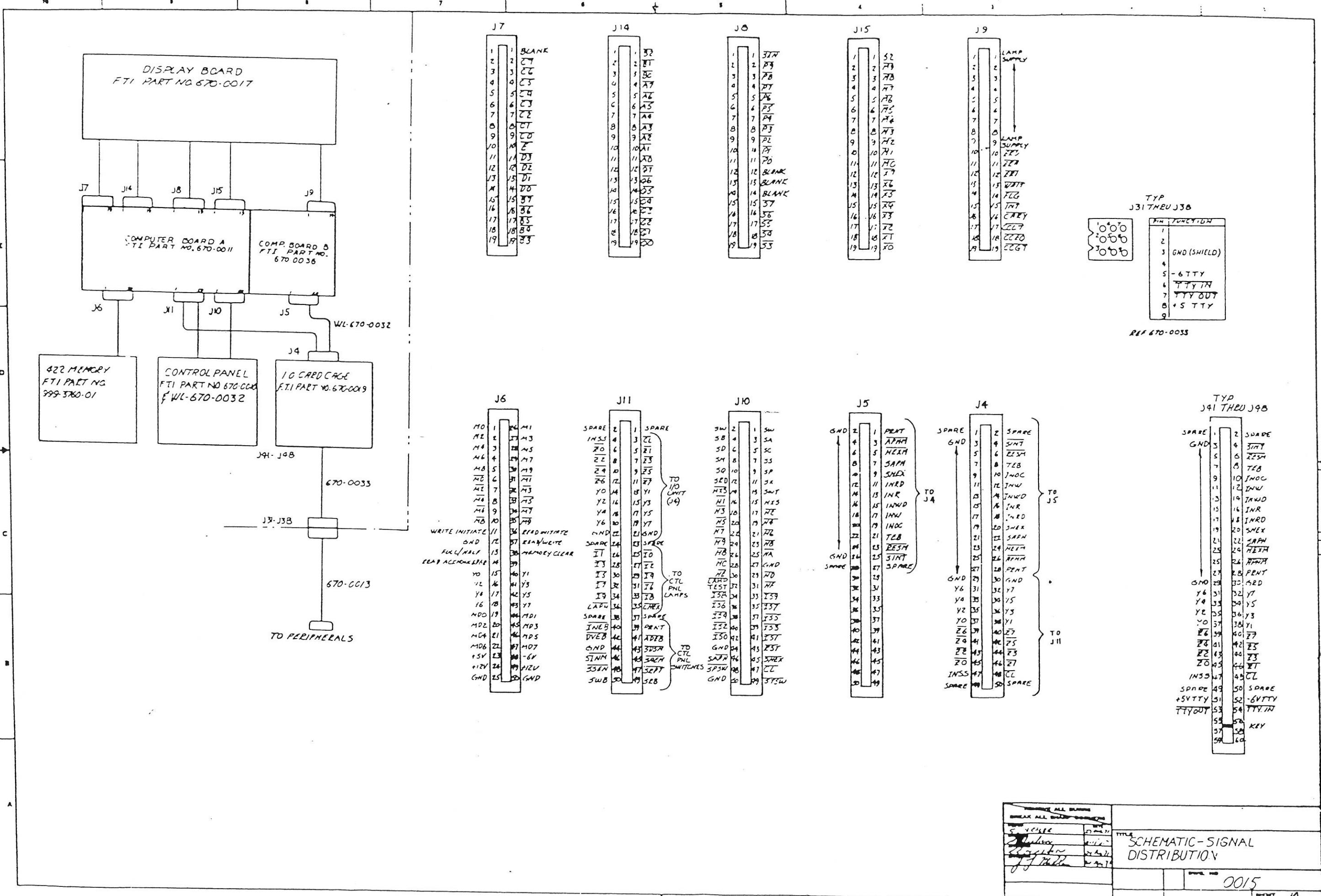
RENAME ALL BUSES	BREAK ALL SHUNT BRANCHES	
CASE NUMBER	DATE	TITLE
SEARCHED	INDEXED	
SERIALIZED	FILED	
670-0001		
SHEET 27		

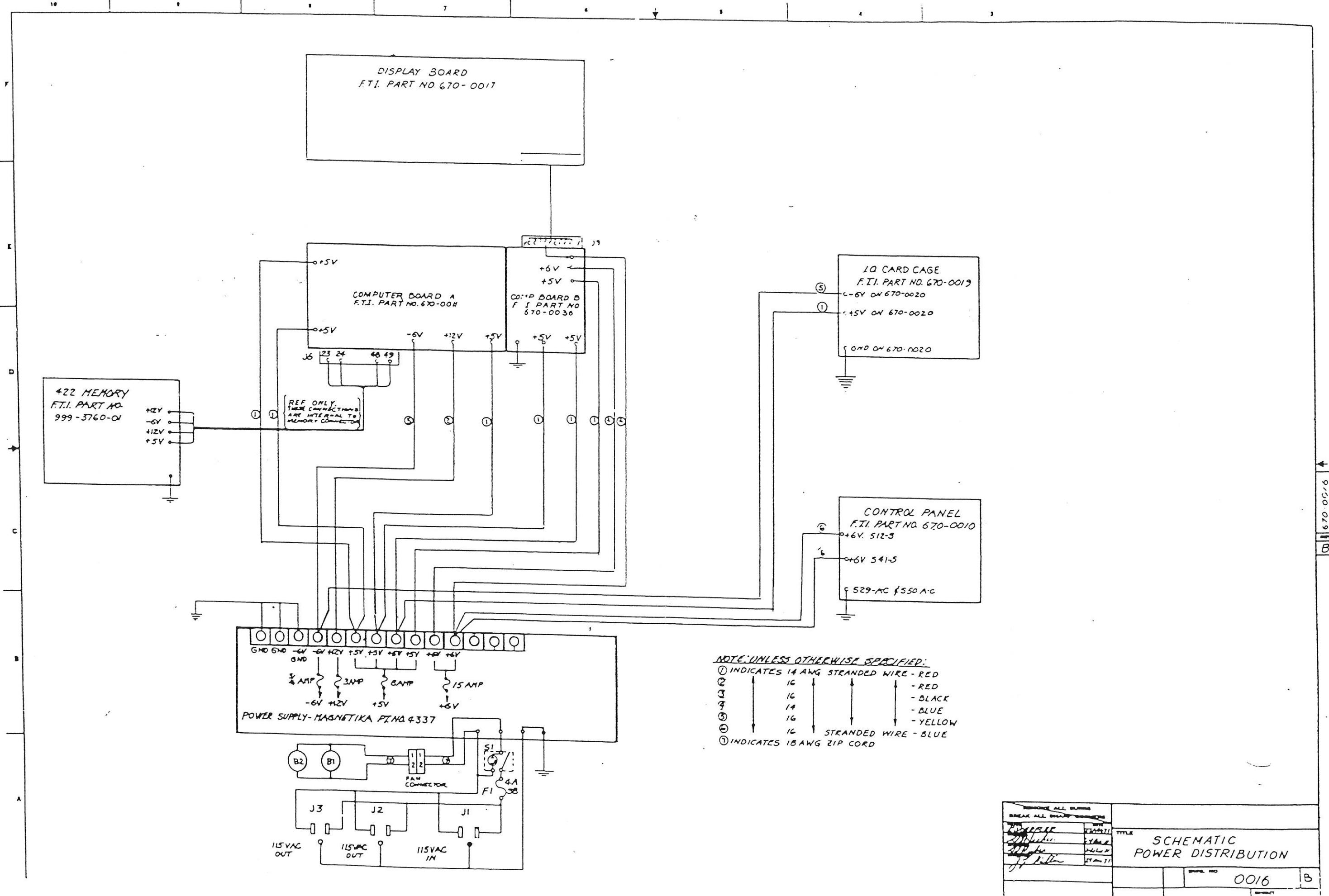


The CT-10 has 8 possible I/O channels. Sheets 27, 28, and 29 are physically on one I/O board, and are typical of any one of a possible 8 I/O boards.

REMOVED ALL BURNS BREAK ALL SHARP LINES AND ANGLES IN THIS DRAWING. DO NOT USE DECIMAL POINT IN NUMBER.		TITLE: TTY INTERFACE WRITE	
MATERIAL:		DWG NO. 670-0001	
SPEC:		APPLIC.	
FINISH:		SPEC	
NEXT ASSET	USED ON		

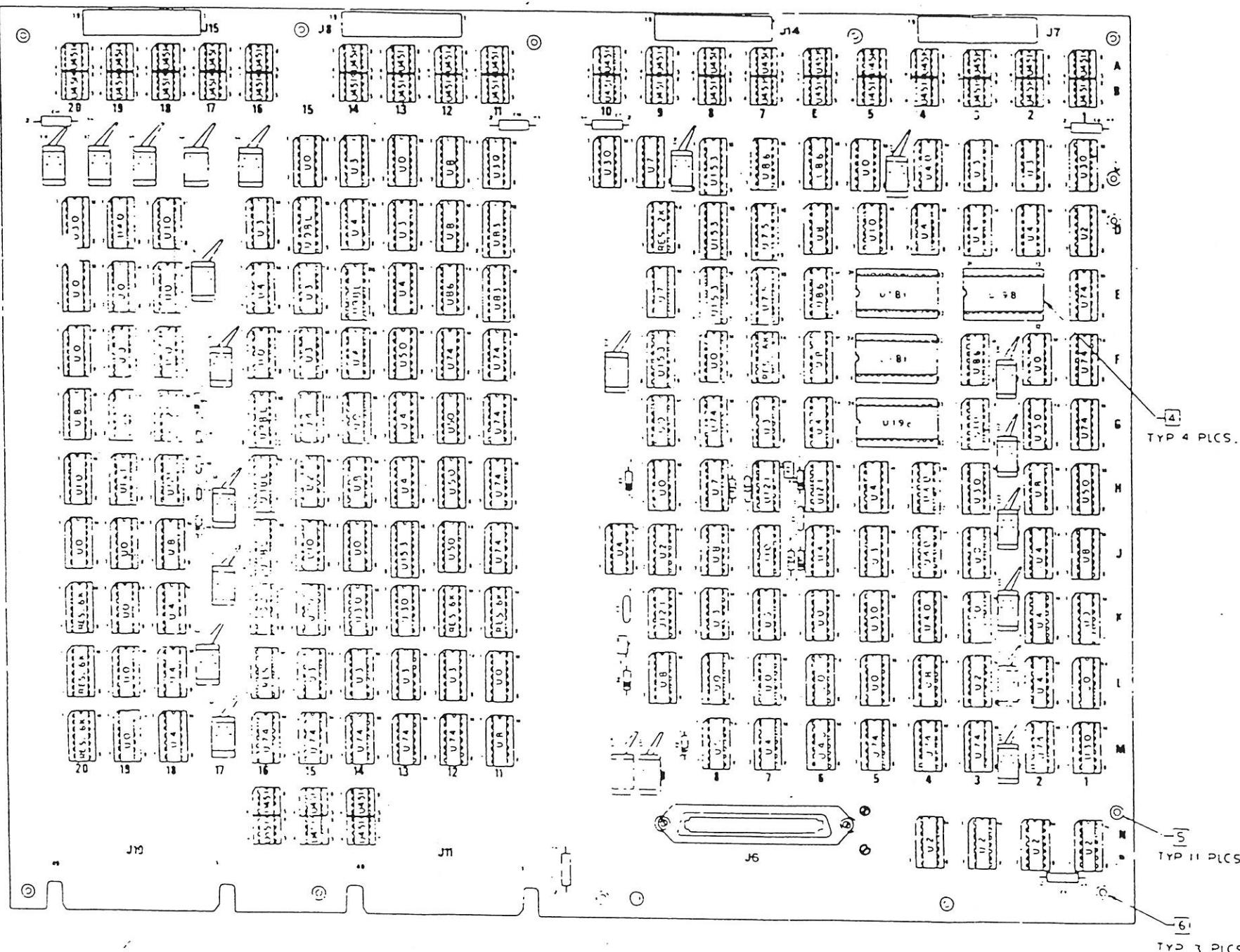






SHADE ALL BREAKERS	BREAK ALL SHADDED BREAKERS
DISCHARGE	DISCHARGE
200A	200A
300A	300A
400A	400A
500A	500A
600A	600A
700A	700A
800A	800A
900A	900A
1000A	1000A
1100A	1100A
1200A	1200A
1300A	1300A
1400A	1400A
1500A	1500A
1600A	1600A
1700A	1700A
1800A	1800A
1900A	1900A
2000A	2000A
2100A	2100A
2200A	2200A
2300A	2300A
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2500A	2500A
2600A	2600A
2700A	2700A
2800A	2800A
2900A	2900A
3000A	3000A
3100A	3100A
3200A	3200A
3300A	3300A
3400A	3400A
3500A	3500A
3600A	3600A
3700A	3700A
3800A	3800A
3900A	3900A
4000A	4000A
4100A	4100A
4200A	4200A
4300A	4300A
4400A	4400A
4500A	4500A
4600A	4600A
4700A	4700A
4800A	4800A
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6600A	6600A
6700A	6700A
6800A	6800A
6900A	6900A
7000A	7000A
7100A	7100A
7200A	7200A
7300A	7300A
7400A	7400A
7500A	7500A
7600A	7600A
7700A	7700A
7800A	7800A
7900A	7900A
8000A	8000A
8100A	8100A
8200A	8200A
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26000A	26000A
26100A	26100A
26200A	26200A
26300A	

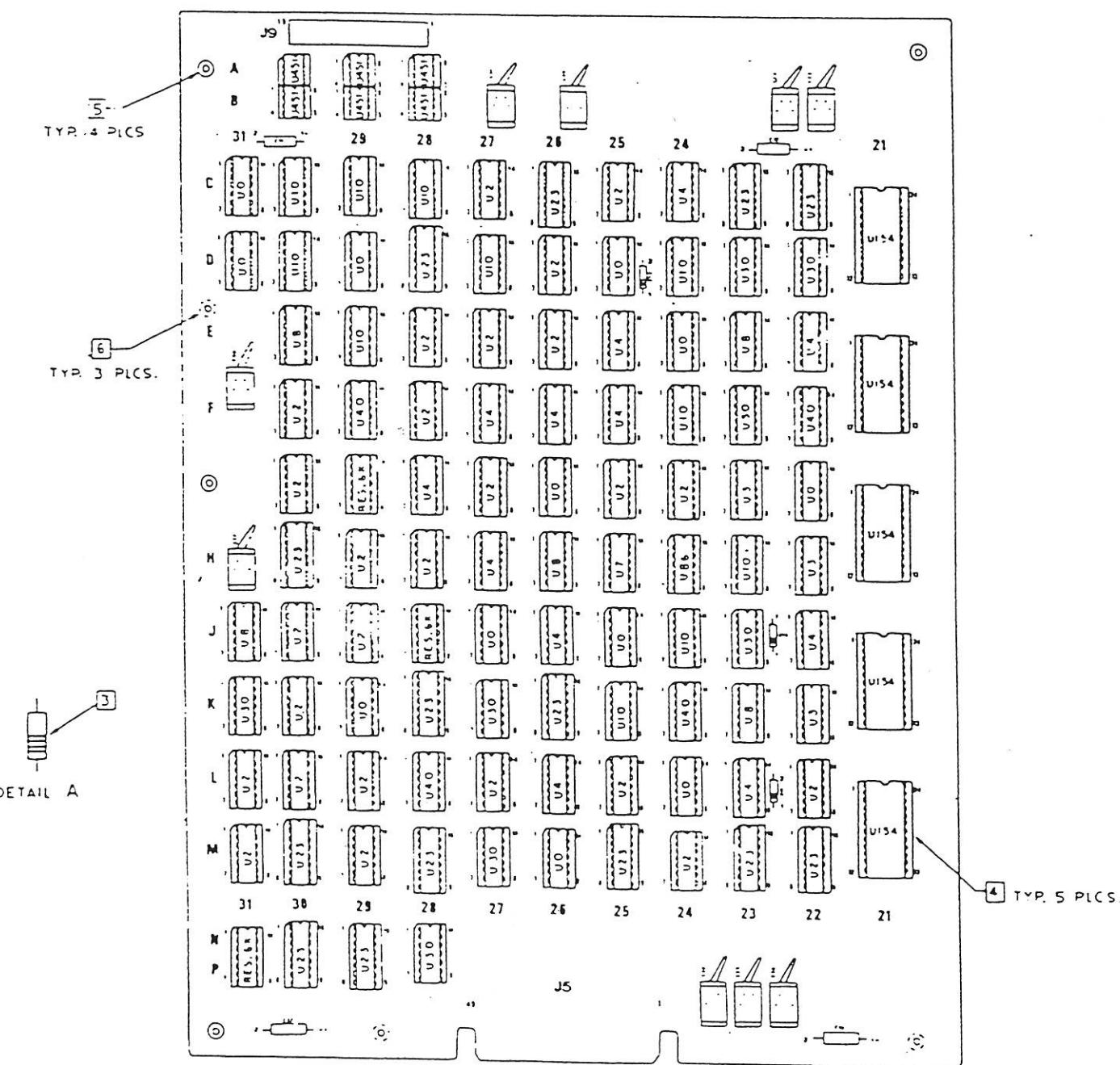
REVISIONS		DESCRIPTION	DATE APPROVED
REV D	000		



NOTES:

1. ORIENT MARKED SIDE OF IC'S AND IC SOCKETS WITH RESPECT TO REFERENCE MARK ON BOARD.
2. INSTALL CAPACITORS ACCORDING TO POLARITY MARKED ON BOARD.
3. INSTALL RESISTORS WITH TOLERANCE BAND IN DIRECTION SHOWN IN DATA.
4. INSTALL 100L x .28" x 16" PHENOLIC SPACER.
5. INSTALL FROM COMPONENT SIDE OF BOARD SWAGE AND THEN SOLDER.
6. INSTALL EACH SIDE OF BOARD SWAGE AND THEN SOLDER.

REF ID	QTY	PART DESCRIPTION	PART NAME	COORDINATES	NOTE / KEY
<i>ALL OTHER UNLISTED PARTS ARE ASSEMBLED AND LOCATED AS INDICATED ON THIS DRAWING. FRACTIONAL DIMENSIONS ARE IN INCHES. V INDICATES SURFACE MOUNT. MATERIAL SPECIFICATION</i>					
<i>REMOVE ALL BURRS. BREAK ALL SHARP CORNERS.</i>					
<i>PRINTED ON ONE SIDE ONLY. REVERSE FOR OTHER SIDE.</i>					
10	1	STAND OFF			AMATONE
39	2	EL. CAPACITOR 1MFD 10V 10Z	C9C11		
26	1	DISC CAPACITOR 100uF	C9		
37	3	CER. CAPACITOR 220pF 32	C1/C3		
36	1	ELECTROLYTIC CAPACITOR 33uF 10V 20Z	C5/C6/C7/C8/C4/C5		
35	1	CONNECTOR J6			AMPHENOL
34	1	HEADER J14			AMPHENOL
33	1	RESISTOR 1K 1/4W. 5%	R6		
32	1	RESISTOR 1K 1/4W. 5%	R4		
31	1	RESISTOR 47K 1/4W. 5%	R2		
30	2	VARIABLE RESISTOR 10K 1/4W. 5%	R3,R7		
29	1	RESISTOR 15K 1/4W. 5%	R10		
28	1	RESISTOR 56K 1/4W. 5%	R9		
27	3	RESISTOR 62K 1/4W. 5%	R1, R5, R8		
26	1	SWITCH T-8001	22		
25	24	AC231 4 IC SOCKET 24 PIN			AUGAT INC.
24	1	VIC 16 36 IC SOCKET 16 PIN			VIRGIN
23	1	VIC 4 1591 IC SOCKET 14 PIN			VIRGIN
22	1	DP PULL UP RESISTOR NETWORK	R2A	9C	BECKMAN
21	1	DP PULL UP RESISTOR NETWORK	R6K	7F HU12K 16-20420L 204	BECKMAN
20	1	SN74431 4:4 TTL-DIP-IC	U451	7A7B2A,BB9A,9B104J,01A1B12A32B3A13B34A,HB14K,14E19H5P,16A36B,H4J5P,17A17B1B18B19A,HB20A20B	TEXAS INST.
19	1	SN7474B 2 TTL-DIP-IC	U19B	2L46 4E,4F	TEXAS INST.
18	1	SN74181 2 TTL-DIP-IC	U18	BC808E 9F13	TEXAS INST.
17	1	SN74153 5 TTL-DIP-IC	U153	6+7H,9A15G,1B9H	TEXAS INST.
16	1	SN74121 6 TTL-DIP-IC	U121	14E15D,6G,6H,6J	TEXAS INST.
15	1	SN7474B 1:5 TTL-DIP-IC	U9B1	3F,6E,7C,12E	TEXAS INST.
14	1	SN74861 2 TTL-DIP-IC	U86	H01E	TEXAS INST.
12	1	SN7475 2 TTL-DIP-IC	U75	10,1E	TEXAS INST.
11	1	SN7472 1:8 TTL-DIP-IC	U74	IE,1F,1G,2M, SH4M,3H,8G,11I,12F,12G,13H,14H,15H,16H	TEXAS INST.
0	1	SN7450 6 TTL-DIP-IC	U50	1-2L,2G,2H,2J,13F	TEXAS INST.
9	1	SN7440 7 TTL-DIP-IC	U40	3H,AC4,4AK,5H,19D	TEXAS INST.
8	1	SN7430 11 TTL-DIP-IC	U30	1C,1H,3H,5H,10C,HC3K,14K,5H,6C,20C	TEXAS INST.
7	1	SN7410 6 TTL-DIP-IC	U10	3G,5G,7G,15L,18D,20H	TEXAS INST.
6	1	SN7408 13 TTL-DIP-IC	U8	1J,2H,4,6,6F,8J,9L,11M,12D,14M,18J,20G	TEXAS INST.
5	1	SN7407 3 TTL-DIP-IC	U7	8H,9C,9E	TEXAS INST.
4	1	SN7405 21 TTL-DIP-IC	U4	202J,2K,2M,30,4D, SH66,6J,7M,10J,15G,13G,13H,14F,15C,18L,18M	TEXAS INST.
3	1	SN7403 15 TTL-DIP-IC	U3	2C,3C,5J,7G,7H,12L,13J,13L,14C,15E,15F,15G,15H,15D	TEXAS INST.
2	1	SN7402 9 TTL-DIP-IC	U2	1C,1D,1E,1F,1G,1H,1I,1J,1K,1L,1M,1N,1O,1P,1Q,1R,1S,1T,1U,1V,1W,1X,1Y,1Z	TEXAS INST.
1	1	SN7400 31 TTL-DIP-IC	U0	1K,1L,2F,3J,5C,5L,6A,6L,7L,8F,1B,1M,9H,9M,10H,20L,20J,20I,20J	TEXAS INST.
<i>PRINT AREA UNDERSIDE</i>					
<i>CODE IDENT NO. DATE APPROVED</i>					
<i>670-0011</i>					
<i>COMPUTER BOARD A</i>					



NOTES:

1. ORIENT MARKED SIDE OF IC'S AND IC SOCKETS WITH RESPECT TO REFERENCE MARK ON BOARD.
 2. INSTALL CAPACITORS ACCORDING TO POLARITY MARKED ON BOARD.
 3. INSTALL RESISTORS WITH TOLERANCE BAND IN DIRECTION SHOWN IN DETAIL A.
 4. INSTALL 100 U. 2.8W ± 16% PHENOLIC SPACER.
 5. INSTALL FROM COMPONENT SIDE OF BOARD SIGHT AND THEN SOLDER.
 6. INSTALL FROM NON-COMPONENT SIDE OF BOARD SIGHT AND THEN SOLDER.

LEGEND

1
7430 - Type of gate -J30-
8-6 Page in prints
C Output pin number

Multiple Output pins on a Single Gate

21

3
7545
3-HD
5-HD Gate's output pins
 3 & 5 Not Used thus
 not found in prints

2 / 2

11
7483
MOBC
14 Page number in prints

C BOARD