

3.1 INTRODUCTION.

3.1.1 This section contains operating information for the DMM. The information contains illustrations of all front and rear panel controls, indicators and connectors along with tabular listing of the function and purpose for each. Operating instructions for manual or bench operation are presented in two ways; a description of each operating feature followed where necessary, with a step-by-step operating example. Some operating features or functions are simple one or two step operations and thus no operating examples are included.

3.1.2 Remote operation via the IEEE-STD-488-1978 General Purpose Interface Bus is one of the principal features of the DMM. This section presents bus address selection information and a tabular listing of the device-dependent messages used to program the instrument. Also included is a GPIB program, measurement and data transfer example.

3.2 OPERATION.

3.2.1 Before operating the instrument, it is strongly recommended that the operator read this entire section in order to avoid damage to the unit. After reading the operating instructions, refer to the installation section, then check the position of the line voltage selector through the viewing window on the rear panel.

CAUTION

This instrument may be damaged if operated on line voltage other than that called for by the line voltage selection card, P2.

WARNING

Removal of covers exposes potentially lethal voltages. Avoid contact with internal electrical connections while unit is connected to AC power source.

3.2.2 After ensuring that the line voltage selector is in the proper position and the cover on the instrument replaced, connect the power cord to the AC outlet and depress the POWER switch to power-up to DMM. The DMM will display 5005 or 5006 upon applying power and the LED annunciators and AUTO are ON.

3.3 CONTROLS AND INDICATORS.

3.3.1 The front panel keyboard switches execute all the functions and modes of operation when the DMM local function is selected.

3.3.2 The panel designators, keyboard switches (refer to as key) and locations for all controls, indicators, and connectors are illustrated on Figure 3.1 and Figure 3.2. The description for each are itemized in Table 3.1 and Table 3.2.

3.4 BASIC MEASUREMENTS.

3.4.1 Digital Zero Command.

3.4.1.1 This procedure should be employed after turn-on and at other selected intervals to verify the DMM's zero accuracy in the DC function.

3.4.1.2 To check the DMM's zero accuracy, short the HI-LO INPUT terminals together and verify a display read-out of zero ± 3 digits in each DC range. If the reading exceeds this limit in any range, perform a digital zero command as described below:

- a) Short the HI-LO INPUT terminals.
- b) Select the DC function, .1 range.
- c) Depress and hold the .1 Range Key until the display reads "CAL 0", verifying that the zero command was enabled. Release the .1 range key.
- d) REMOTE OPERATION: The GPIB command K2, the digital zero command program instruction is described in paragraph 3.5.18.

3.4.2 Range Control.

3.4.2.1 Upon initialization, the DMM goes to its home state; autorange and continuous readings. With a signal applied to the input HI-LO terminals, the autorange will set the range to match whatever signal the DMM sees at the input terminals. For example, if a 6 volt battery is connected to the input terminals and the DMM is initialized by power turn-on, the DMM goes through the auto-test routine and the autorange will select the 10 volt range.

3.4.2.2 To manually disable autorange, depress one of the range keys. This action extinguishes the autorange annunciator and the DMM will now respond to the selected range.

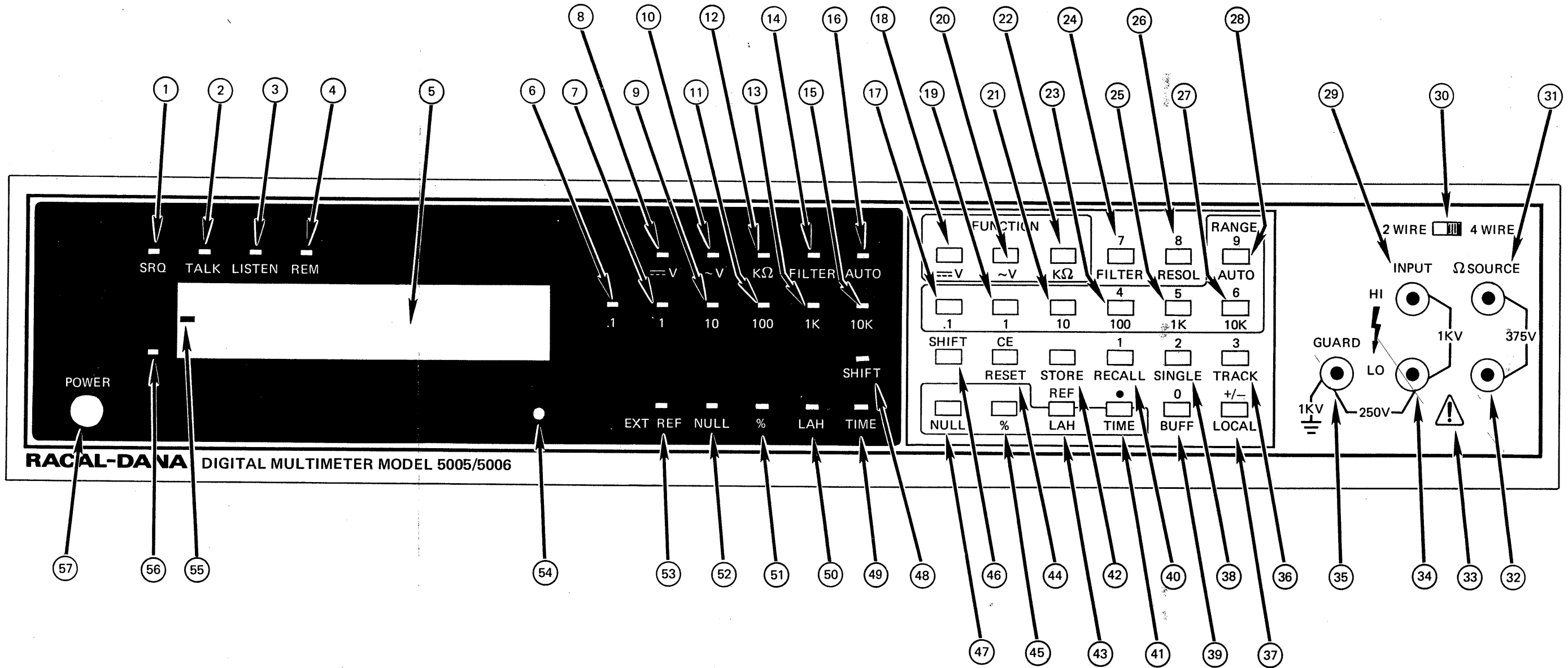


Figure 3.1 - Front Panel Location Guide

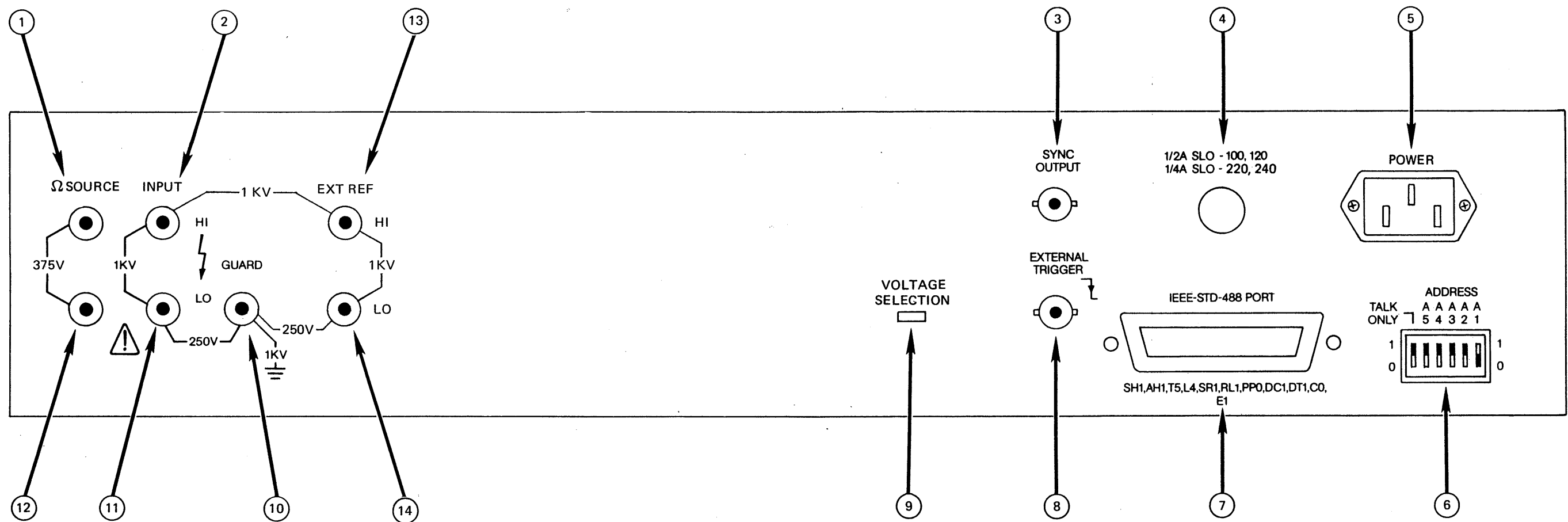


Figure 3.2 - Rear Panel

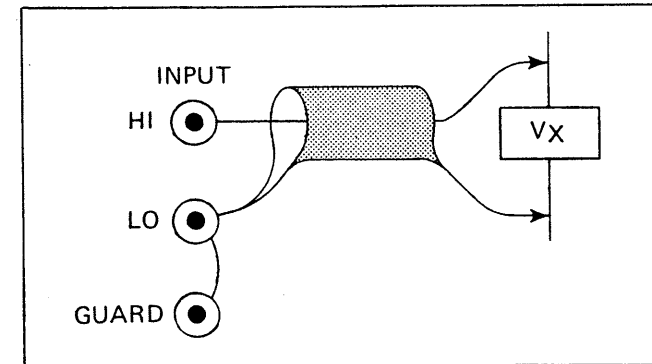


Figure 3.3 - DC, AC Measurement Connections Using Coaxial Cable

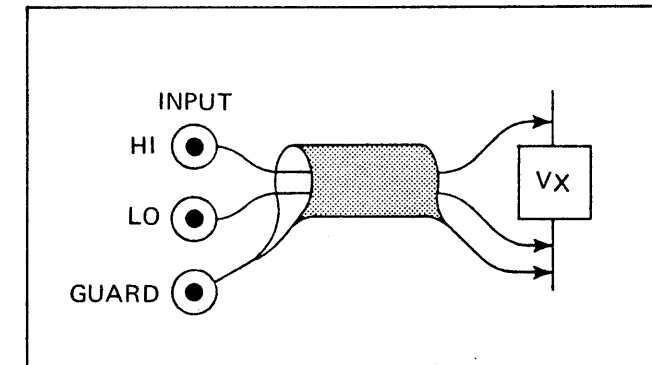


Figure 3.4 - DC, AC Measurement Connection Using Two Conductor Shielded Cable

3.4.3 DC Volts Measurements.

3.4.3.1 The basic instrument is capable of measuring DC volts in 5 ranges: 0.1V, 1V, 10V, 100V, 1000V. To measure DC voltage proceed as follows:

3.4.3.2 Complete the DMM turn-on procedure as described in paragraph 3.2.2, then check the zero accuracy of the instrument as described in paragraph 3.4.1.

3.4.3.3 Connect the DC voltage to the INPUT HI-LO terminals, refer to Figure 3.3 and Figure 3.4, and read the value from the display and range annunciators.

3.4.4 AC Volts Measurements.

3.4.4.1 The DMM is capable of measuring AC volts in 4 ranges: 1V, 10V, 100V, 1000V. To measure AC voltage proceed as follows:

3.4.4.2 Complete the DMM turn-on procedure as described in paragraph 3.2.2.

3.4.4.3 Select the AC volts function by pressing the AC key, then verify that the AC annunciator LED is on.

3.4.4.4 Connect the AC voltage to the INPUT HI-LO terminals, refer to Figure 3.3 and Figure 3.4, and read the value from the display and range annunciators.

3.4.4.5 AC Voltage measurements for the Model 5005 Averaging AC to DC Converter are always AC coupled (DC component of input is blocked). For the Model 5006 True RMS to DC Converter, AC Voltage Measurements can be made either as AC coupled or DC coupled.

3.4.4.6 To select DC coupled operating (AC + DC mode) for the 5006 AC converter, proceed as follows:

- a) Set DMM power switch to off.

WARNING

These instructions are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

- b) Unplug power cord.
- c) Remove top cover (see 2.5.1.2).

WARNING

Removal of covers exposes potentially lethal voltages. Avoid contact with internal electrical connections while unit is connected to AC power source.

- d) Extract RMS Converter and remove top guard shield on converter board.
- e) Set S1 and S2 switches to DC (toward center of board).
- f) Replace guard shield and reinstall RMS Converter in unit.
- g) Install top cover (see 2.5.1.5).
- h) Set connect power cord and set AC power switch to ON. To select AC coupled operation, perform steps (a) through (h) above, but in step (e), set S1 and S2 switches to AC (away from center of board).

3.4.5 Resistance Measurements.

3.4.5.1 The DMM is capable of measuring resistance values in six ranges, starting at 100 ohms full scale to 10,000,000 ohms full scale. The correlation between the front panel keyboard and resistance selection is best described by the chart that compares range designators and resistance scales, as follows:

- a) When the $K\Omega$ function is selected, the range keys carry a scaled factor of 1000 or range key "1" equals one thousand ohms full scale.
- b) Range keys and resistance measurement comparison:

Range Key	Ohms - Full Scale
.1	100 Ohms
1	1000 Ohms
10	10,000 Ohms
100	100,000 Ohms
1K	1,000,000 Ohms
10K	10,000,000 Ohms

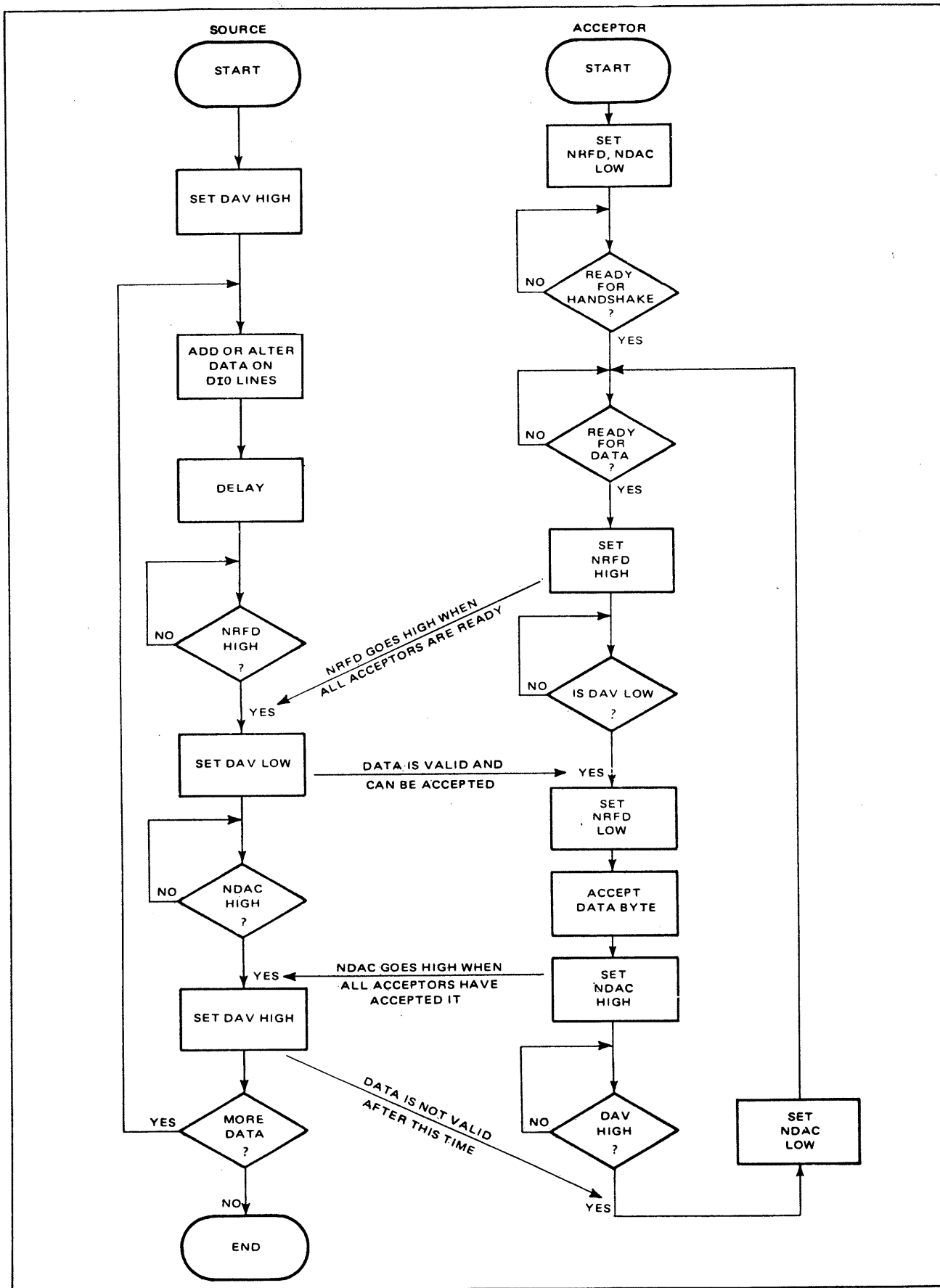


Figure 3.18 - Handshake Flow Chart

Table 3.8 - Instrument Address Selector

ASCII CHARACTERS		DATA LINES							ADDRESS SWITCH SETTING	DECIMAL ADDRESS
		D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁		
TALK	LISTEN	TALK	LISTEN	ADDRESS					TALK ONLY	
				16	8	4	2	1		
@	SP	0	1	0	0	0	0	0		00
A	!	0	1	0	0	0	0	1		01
B	"	0	1	0	0	0	1	0		02
C	#	0	1	0	0	0	1	1		03
D	\$	0	1	0	0	1	0	0		04
E	%	0	1	0	0	1	0	1		05
F	&	0	1	0	0	1	1	0		06
G	' (APOSTROPHE)	0	1	0	0	1	1	1		07
H	(	0	1	0	1	0	0	0		08
I	)	0	1	0	1	0	0	1		09
J	*	0	1	0	1	0	1	0		10
K	+	0	1	0	1	0	1	1		11
L	,	0	1	0	1	1	0	0		12
M	-	0	1	0	1	1	0	1		13
N	.	0	1	0	1	1	1	0		14
O	/	0	1	0	1	1	1	1		15

ASCII CHARACTERS		DATA LINES							ADDRESS SWITCH SETTING	DECIMAL ADDRESS
		D ₇	D ₆	D ₅	D ₄	D ₃	D ₂	D ₁		
TALK	LISTEN	TALK	LISTEN	ADDRESS					TALK ONLY	
				16	8	4	2	1		
P	∅	0	1	1	0	0	0	0		16
Q	1	0	1	1	0	0	0	1		17
R	2	0	1	1	0	0	1	0		18
S	3	0	1	1	0	0	1	1		19
T	4	0	1	1	0	1	0	0		20
U	5	0	1	1	0	1	0	1		21
V	6	0	1	1	0	1	1	0		22
W	7	0	1	1	0	1	1	1		23
X	8	0	1	1	1	0	0	0		24
Y	9	0	1	1	1	0	0	1		25
Z	:	0	1	1	1	0	1	0		26
[	;	0	1	1	1	0	1	1		27
\	<	0	1	1	1	1	0	0		28
]	=	0	1	1	1	1	0	1		29
^	>	0	1	1	1	1	1	0		30
NONE		ILLEGAL							NONE	31

Table 3.9 - Bus Operation Sequence

	HANDSHAKE LINES	BUS LINES	DATA LINES	MEANING OR FUNCTION
1		REN Lo		Arms bus peripherals to go to remote mode.
2		IFC		Stops activity on the bus.
3		ATN Lo		Signifies that data byte will be a "Bus Message".
4	NRFD Hi			DMM says ready for data.
5			?	UNL (Unlisten) message (ASCII character ?) on data bus by controller means "all bus peripherals unlisten".
6	DAV Lo			Controller says data on bus is valid.
7	NRFD Lo			DMM says its not ready for new data; do not change data lines while DMM is accepting data.
8				DMM reads data lines.
9	NDAC Hi		↓	DMM says it has read data.
10	DAV Hi		?	Controller says data no longer valid.
11	NDAC Lo			DMM removes data accepted flag.
12	NRFD Hi			DMM says it's ready for next data byte.
13				Controller removes or changes data on bus.
14			U	"I talk", controller becomes talker (HP9825 talker address).
15			"	"You listen", addressed peripheral becomes listener (In this case it is the DMM set to decimal address 02; see table 3.9).
16		ATN Hi		Signifies that data byte will be a "Device Dependent Message" as opposed to an "Interface Message".
17			F	Function
18			1	DC Volts
19			R	Range
20			5	10 Volts
21			T	Trigger
22			1	Continuous
23			CR	End of transmission by HP9825.
24			LF	
25		ATN Lo		Byte to follow is a Bus Message.
26			?	UNL (unlisten) bus message.
27			B	"You talk", DMM talk address (02).
28			5	"I listen", HP9825 listen address.
29		ATN Hi		Message to be transmitted by DVM is Data.
30			+	Measurement data transmitted by DMM
31			1	
32			.	
33			0	
34			2	
35			5	
36			4	
37			6	
38			E	Exponent Indicator means X 10 ⁰¹
39			+	Sign of exponent.
40			0	Exponent. Here it indicates 10 ¹⁰
41			1	
42			CR	End of data message.
43			LF	

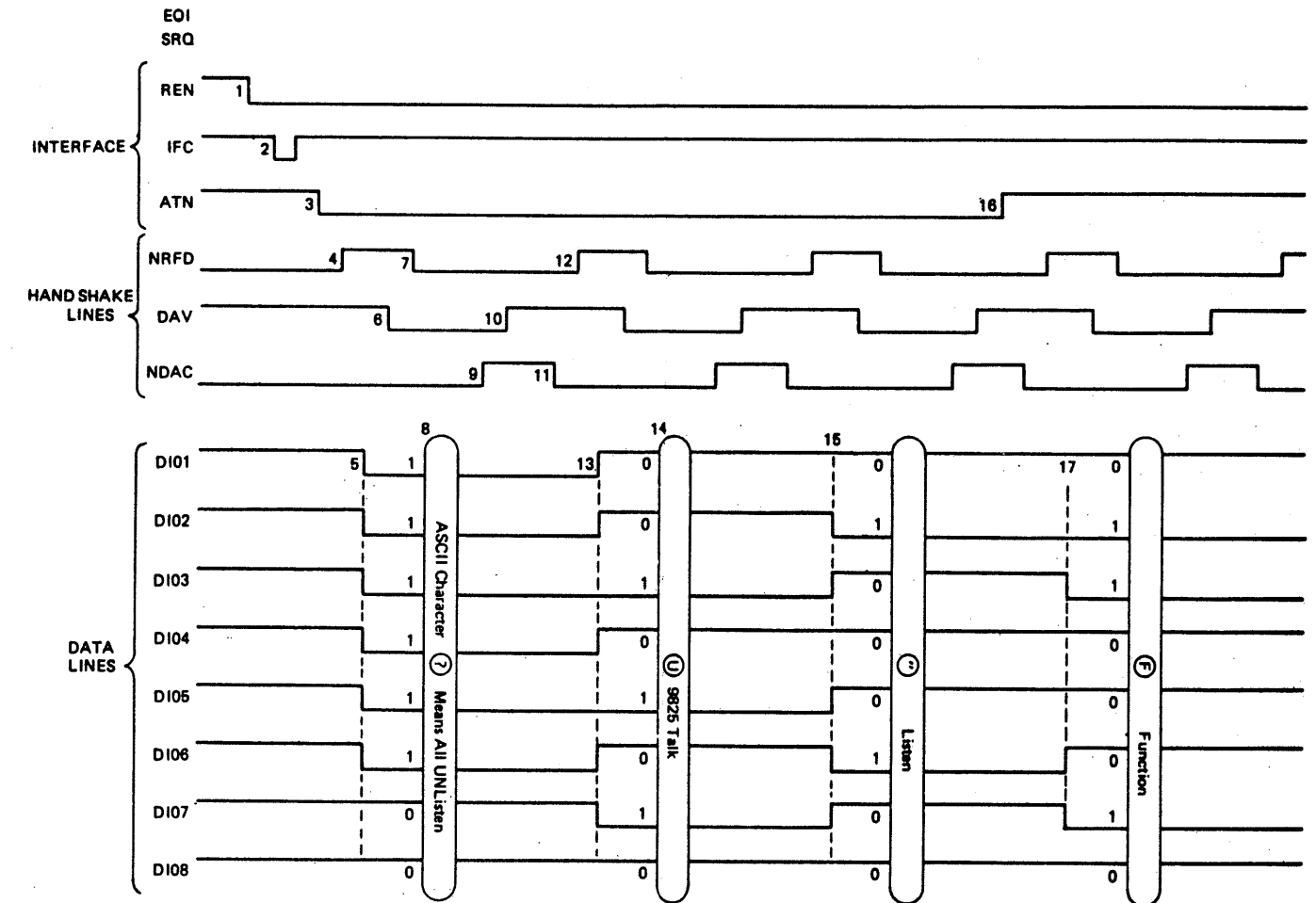


Figure 3.19 - Interface Timing

3.5.6.11 Having transmitted the program string of device dependent messages to the DMM, the controller then sets the ATN line low which indicates that the characters to follow in lines 26 through 28 are bus messages. These bus messages change the talker/listener relationship of the controller and DMM; the DMM is made a talker and the controller becomes a listener.

3.5.6.12 Lines 30 through 43 illustrate the sequence of the transmission of data by the DMM. The handshake sequence is the same when the DMM is transmitting data as that outlined in lines 1 through 13 of the table, except that the DMM is controlling the handshake lines.

3.5.6.13 Upon completion of the data transmission, the DMM transmits a carriage return (CR) and line feed (LF) to indicate the end of the data transmission. Refer to Table 3.10 for the GPIB programming requirements.

Table 3.10 - GPIB Programming Requirements

- | | |
|----|--|
| 1. | Character Code: 7 bit ASCII, upper or lower case. |
| 2. | All program strings transmitted to the DMM should end in a terminating character. Acceptable terminators are: <ul style="list-style-type: none"> A. CR - Carriage Return B. LF - Line Feed C. EOI - This GPIB message EOI, true during transfer of the last byte of a string. D. X - ASCII letter. |
| 3. | Programming numerical constant over the GPIB
The following units are assumed when programming numerical constants over the GPIB:
Volts
Kohms,
Hours . Minutes Seconds |

3.5.7 Interface Message Repertoire.

3.5.7.1 The DMM is equipped with a standard GPIB interface which conforms to the specifications contained in IEEE-488-1978. The specification includes the definition of multi-line interface messages and this definition divides the messages into two groups; the primary command group and the secondary command group. The DMM includes none of the secondary command group in its interface message repertoire.

3.5.7.2 The primary command group of interface messages is further broken down into four lower categories: (1) the listen address group, (2) the talk address group, (3) the universal command group and (4) the addressed command

group. The DMM is designed to include in its interface message repertoire 31 listen addresses and 31 talk addresses. The listen and talk addresses to which the DMM may be set are listed in Table 3.8.

3.5.7.3 The interface messages to which the DMM is designed to respond are listed in Table 3.11 along with their decimal equivalents, hex equivalents, meanings and data line codes. The function of the DMM in response to each of these commands is described in the following paragraphs.

3.5.7.4 GO TO LOCAL (GTL).

3.5.7.4.1 As shown in Table 3.11, the GTL command means go to local and the decimal and hex equivalent are both 01. Upon receipt of this interface message, the DMM, if previously programmed for remote, will return to its local operational state. This means that the instrument will then perform the function according to the settings of the front panel controls on the instrument until such time as it returns to remote control.

3.5.7.5 SELECTED DEVICE CLEAR (SDC).

3.5.7.5.1 Upon receipt of the SDC command, the DMM will go to the home state. The decimal and hex equivalent are both 04. The SDC message has the same effect as transmitting the GPIB program code 'Z' to the DMM.

3.5.7.6 GROUP EXECUTE TRIGGER (GET).

3.5.7.6.1 As shown in Table 3.11, the decimal and hex equivalents of the GET command are both 08. Upon receipt of the GET interface message, the DMM will trigger a reading if it had previously been placed in the HOLD mode. The group execute trigger command is used to trigger the simultaneous execution of a number of functions by a number of bus members at the same time. To use this command, one or more bus members are programmed to perform a function on receiving the GET interface message. Subsequently, the controller will transmit the GET command and all bus members previously programmed will begin execution on receipt of the command.

3.5.7.7 LOCAL LOCK OUT (LLO).

3.5.7.7.1 The DMM may be brought back into local control by pressing the "Local" key on the keyboard. If, however, the DMM receives an LLO (Hex 11 or decimal 17) command while in remote operation, it may not be brought back into local control through keyboard operation.

LEGEND

1. POWER SUPPLY
2. DC,AC,3-POLE FILTER
- 2A. AC CONVERTER
3. OHMS
4. RELAY DRIVE
5. A/D CONVERTER
6. μ P CONTROL & NON-VOL
7. OCI-1,2,3
8. GPIB
9. LED DISPLAY

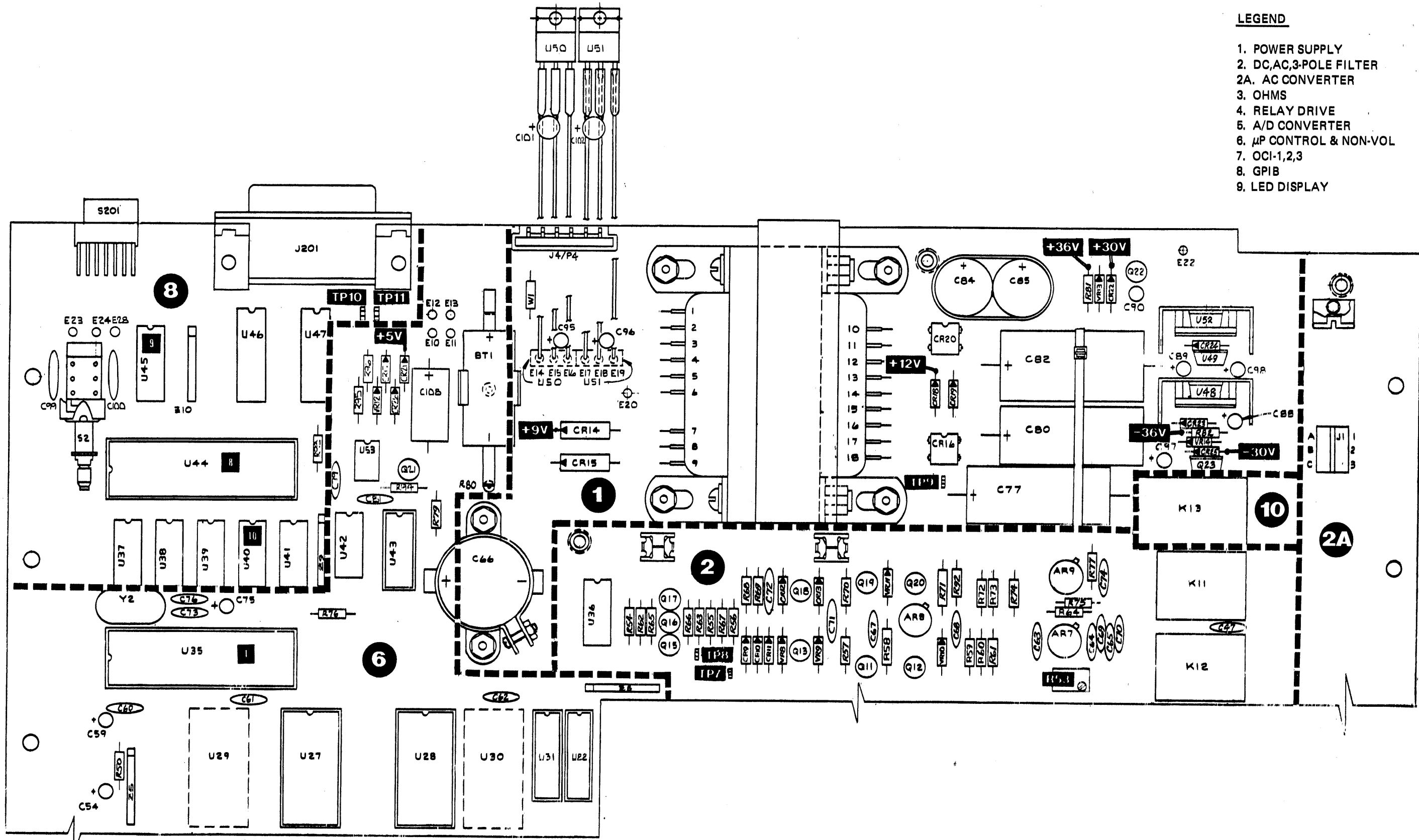


Figure 5.8 - Test Point Location

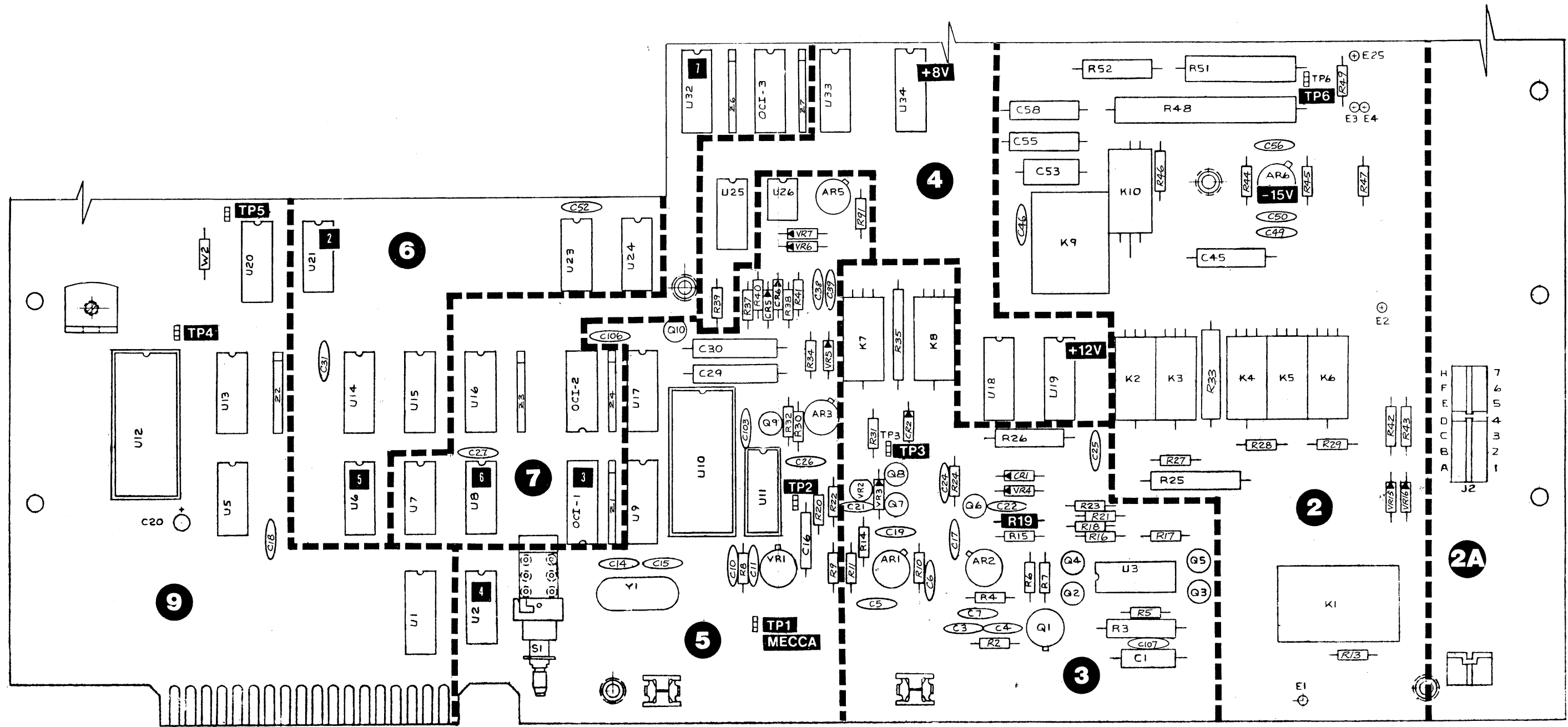
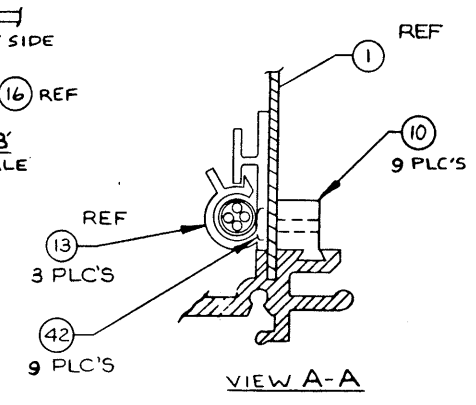
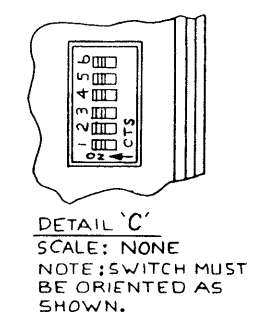
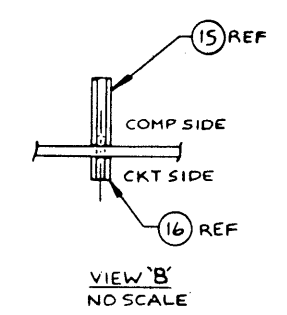
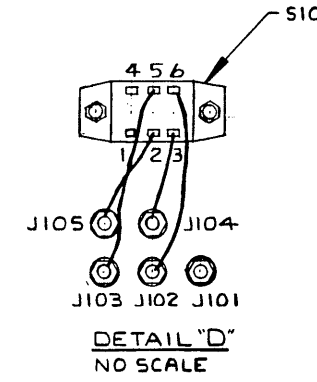
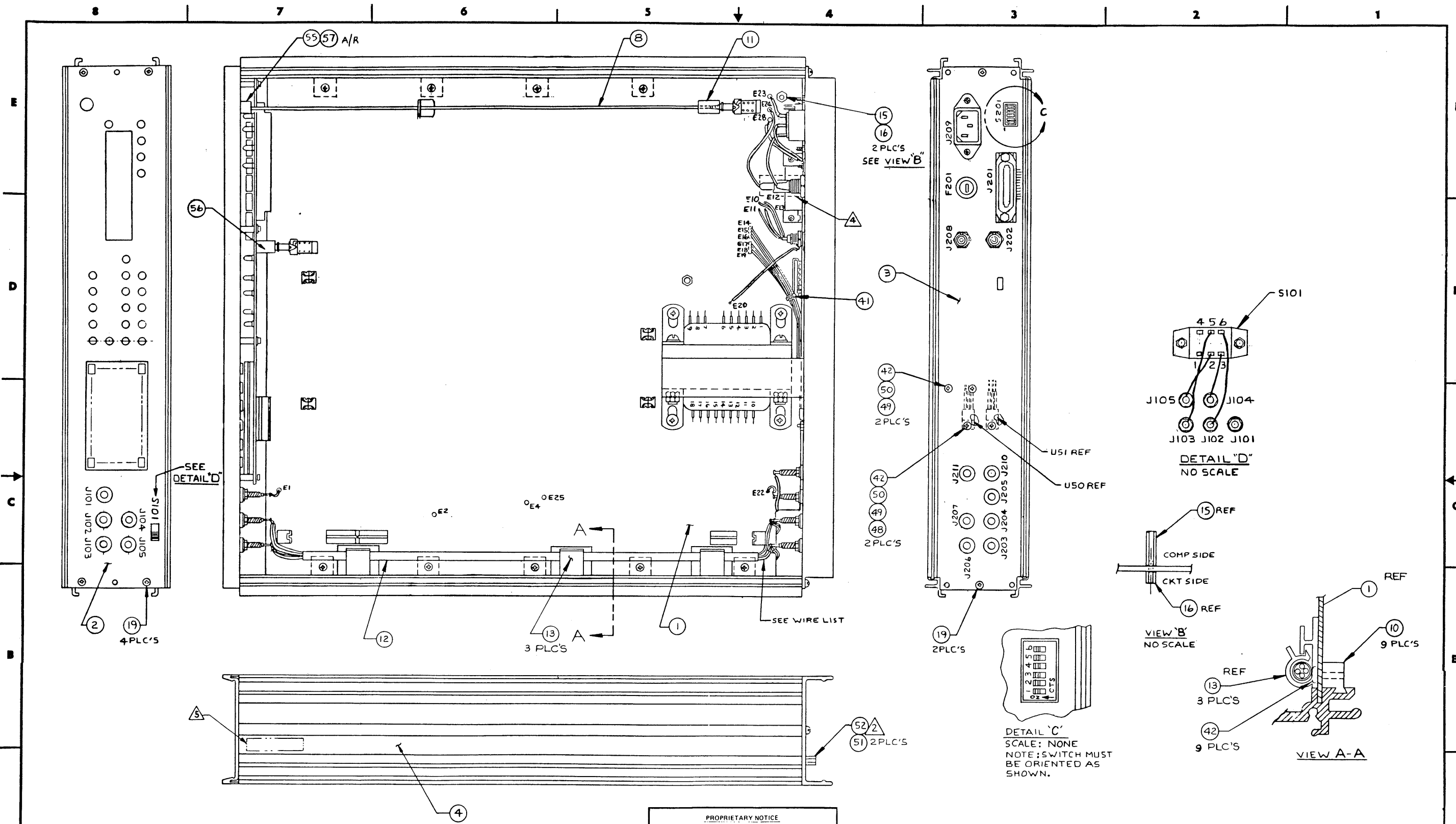


Figure 5.8 - Test Point Location continued

SECTION 6

DRAWINGS

Chassis (404136, 404200)	6-2
PCB Assy., Motherboard (401659)	6-3
Schematic, Motherboard (431659)	6-5
PCB Assy., Display (401651)	6-16
Schematic, Display (431651)	6-17
PCB Assy., AC Converter (404107)	6-18
Schematic, AC Converter (432131)	6-19
PCB Assy., RMS Converter (404106)	6-20
Schematic, RMS Converter (432130)	6-21



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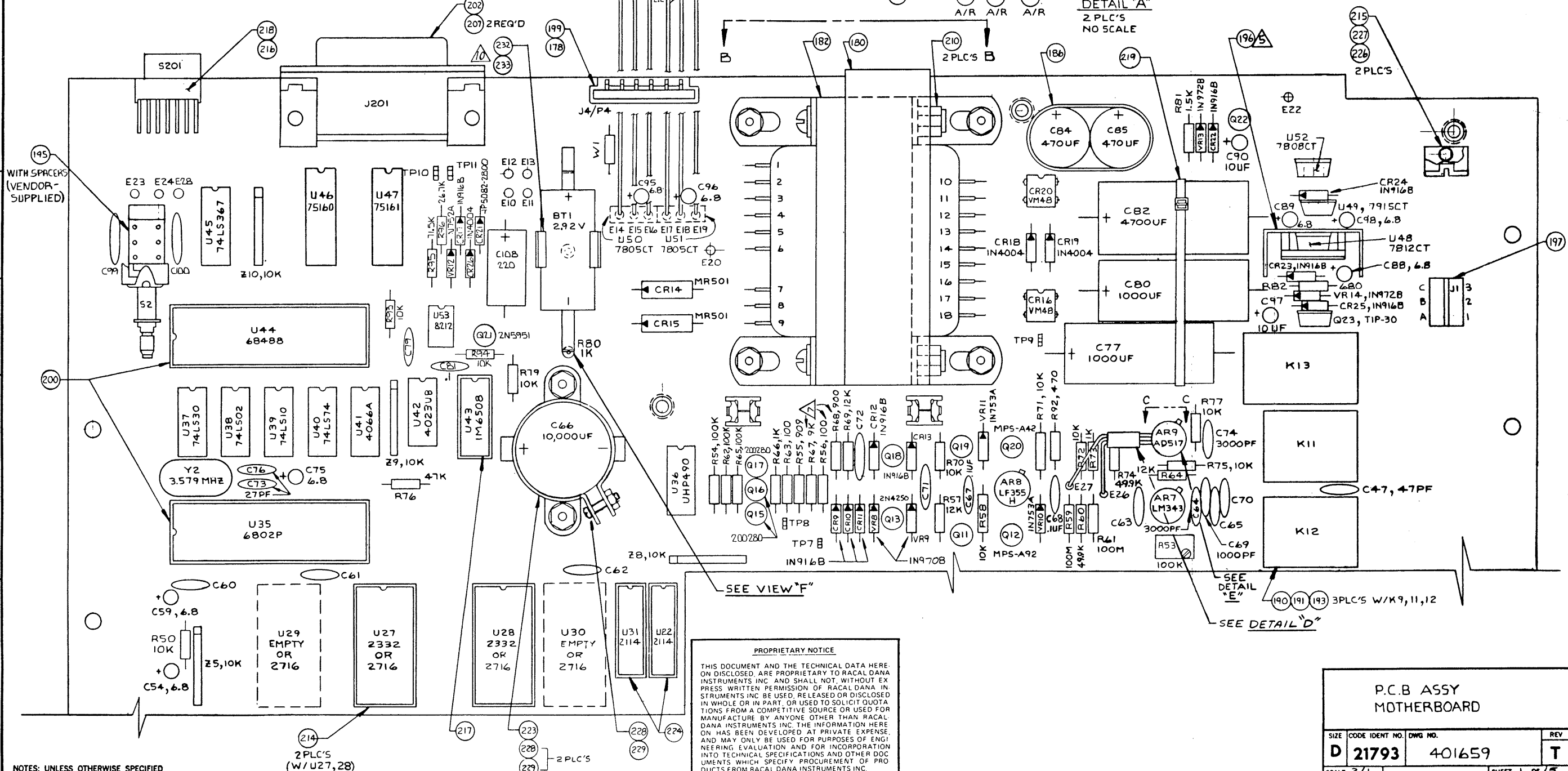
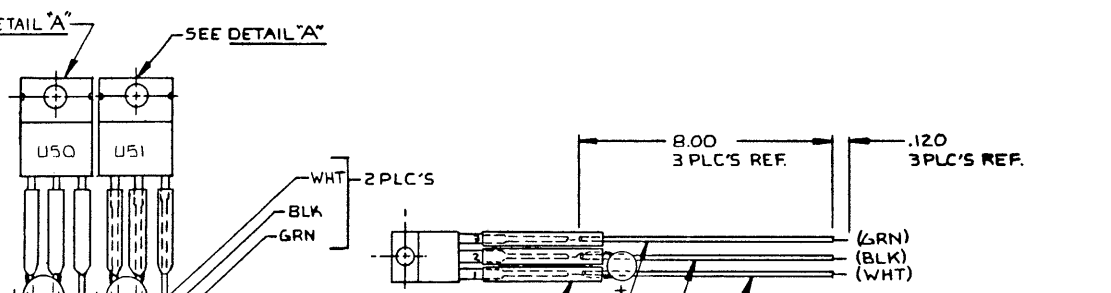
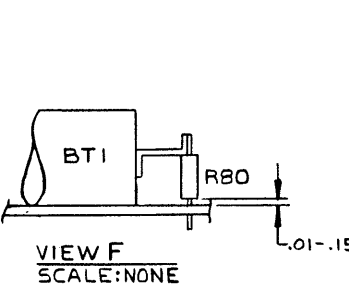
- 5 FOR PROPER SIDE PANEL ORIENTATION RACAL-DANA P/N MUST APPEAR AT FRONT END OF INSTRUMENT.
 - 4 INSTALL SHRINK TUBING OVER FUSEHOLDER AFTER WIRES ARE SOLDERED TO TERMINALS
 - 3. SEE WIRE LIST FOR INDIVIDUAL WIRE LENGTHS & TERMINATION POINTS; USE SHRINK TUBING AS REQUIRED.
 - DISCARD LOCKWASHERS & WASHERS SUPPLIED WITH ITEM 52.
 - 1. ASSEMBLY PROCESSES & PROCEDURES TO CONFORM TO RACAL-DANA STANDARD.
- NOTES: UNLESS OTHERWISE SPECIFIED

CHASSIS ASSEMBLY		
SIZE	CODE IDENT NO.	DWG NO.
D	21793	404136
SCALE: NONE	SHEET 1 OF 7	

NOTE UNLESS OTHERWISE SPECIFIED

1. ASSEMBLY PROCESSES + PROCEDURES TO CONFORM TO RACAL-DANA WORKMANSHIP STANDARDS.
2. REFERENCE SCHEMATIC NO. 431659
3. RESISTORS ARE IN OHMS.
4. CAPACITORS ARE IN UF, .01.

- ⚠ BEND TABS 90° ON FAR SIDE OF PCB.
- ⚠ PART OF RESISTOR SET 012045.
- ⚠ PART OF RESISTOR SET 012043.
- ⚠ PART OF RESISTOR SET 012044.
- ⚠ TRANSISTORS ARE 200200.
- ⚠ INSTALL RIVET HEAD FROM THE FAR SIDE.
- ⚠ RESISTORS R6 & R7 ARE MATCHED PAIR.



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P.C.B ASSY MOTHERBOARD			
SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	401659	T
SCALE 2/1	SHEET 1 OF 5		6-3

NOTES: UNLESS OTHERWISE SPECIFIED

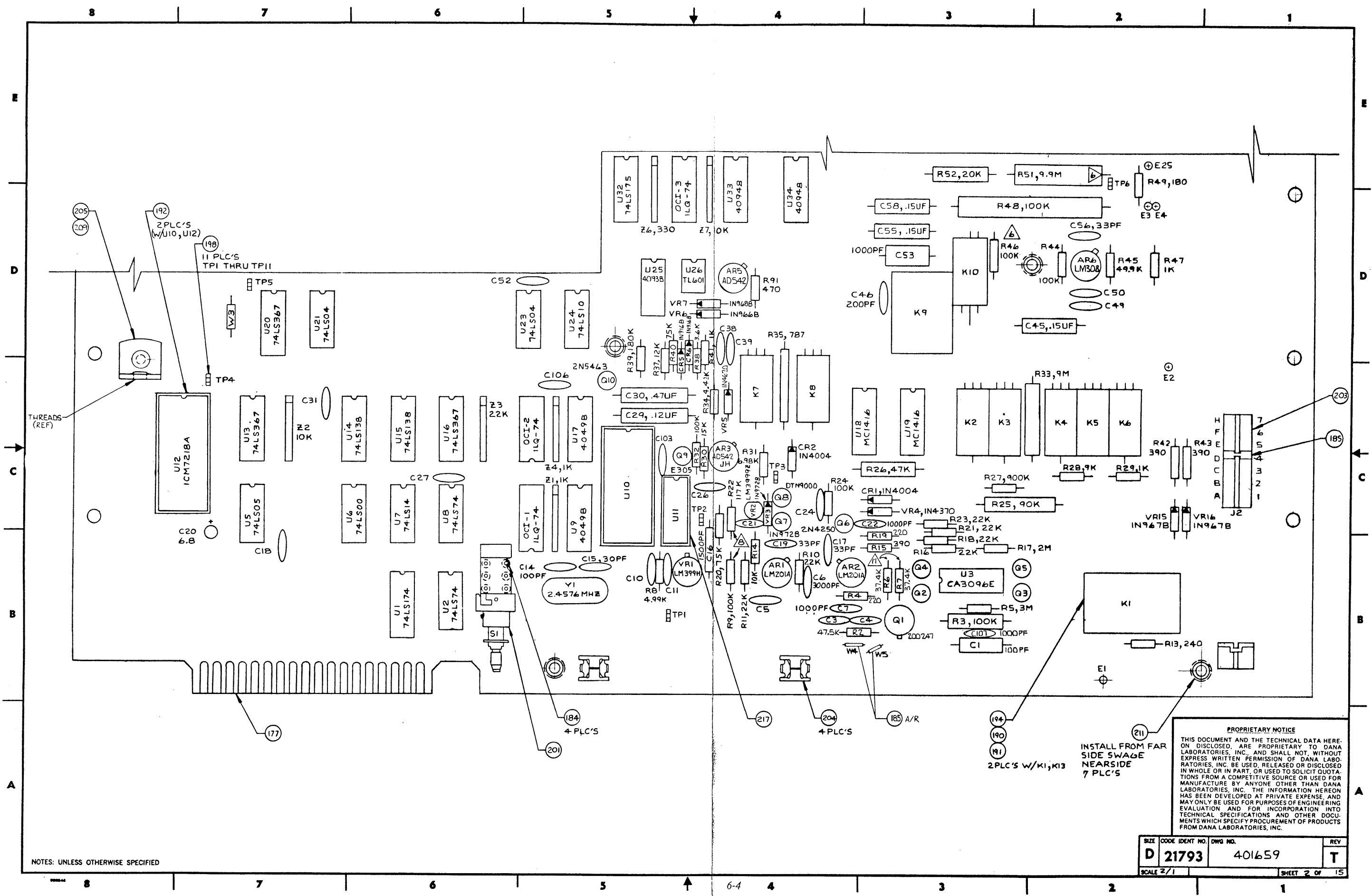
2PLC'S (W/U27,28)

2PLC'S

SEE VIEW 'E'

SEE DETAIL 'E'

SEE VIEW 'F'

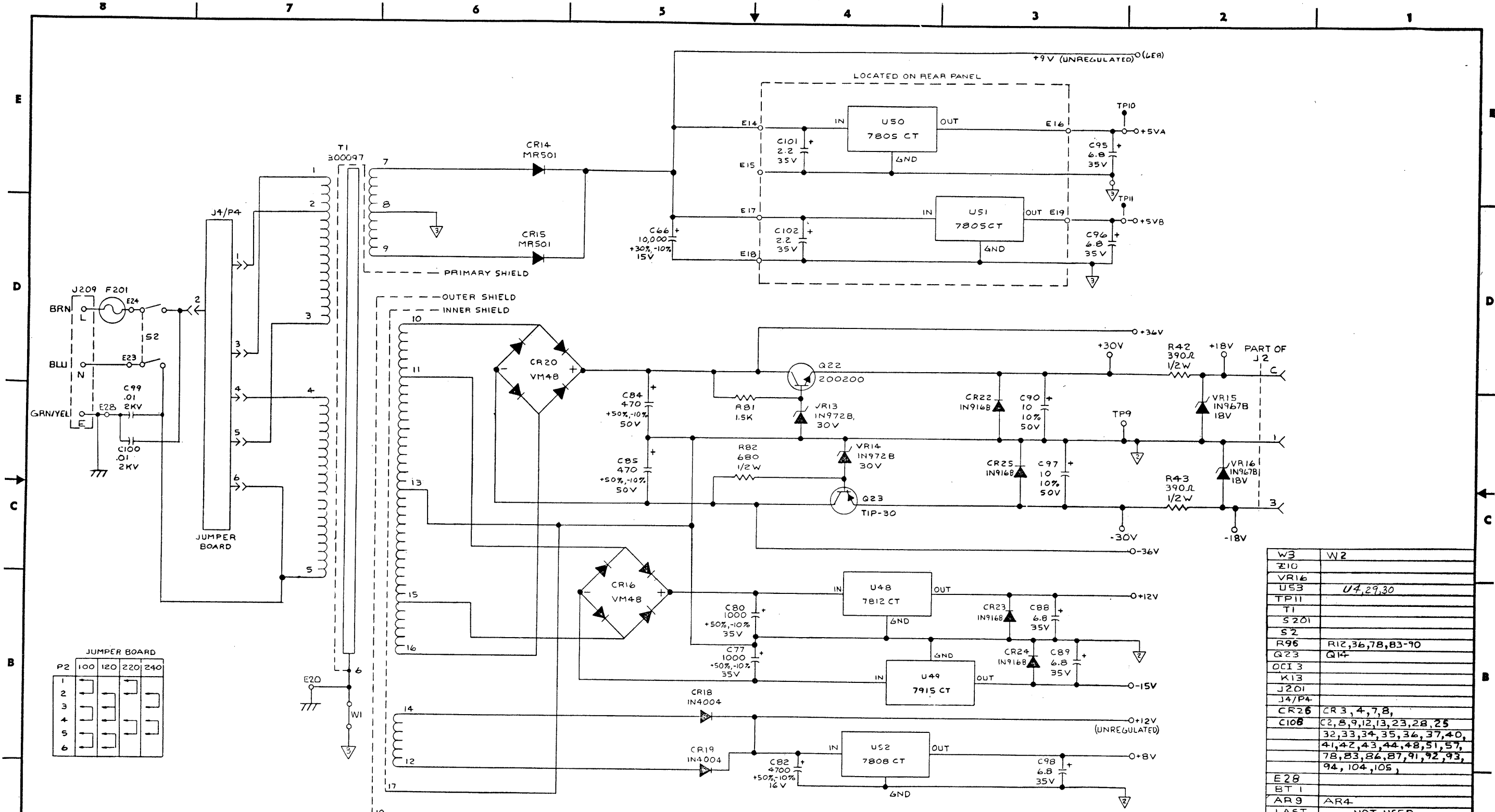


NOTES: UNLESS OTHERWISE SPECIFIED

INSTALL FROM FAR
SIDE SWAGE
NEARSIDE
7 PLC'S

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SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	401659	T
SCALE 2/1	SHEET 2 OF 15		



JUMPER BOARD

P2	100	120	220	240
1	←	←	←	←
2	←	←	←	←
3	←	←	←	←
4	←	←	←	←
5	←	←	←	←
6	←	←	←	←

W3	W2
E10	
VR16	
U53	U4, 29, 30
TP11	
T1	
S201	
S2	
R96	R12, 36, 78, 83-90
Q23	Q14
OCI3	
K13	
J201	
J4/P4	
CR26	CR3, 4, 7, 8,
C108	C2, 8, 9, 12, 13, 23, 28, 25,
	32, 33, 34, 35, 36, 37, 40,
	41, 42, 43, 44, 48, 51, 57,
	78, 83, 86, 87, 91, 92, 93,
	94, 104, 105,
E28	
BT1	
AR9	AR4
LAST	NOT USED
	DESIGNATORS

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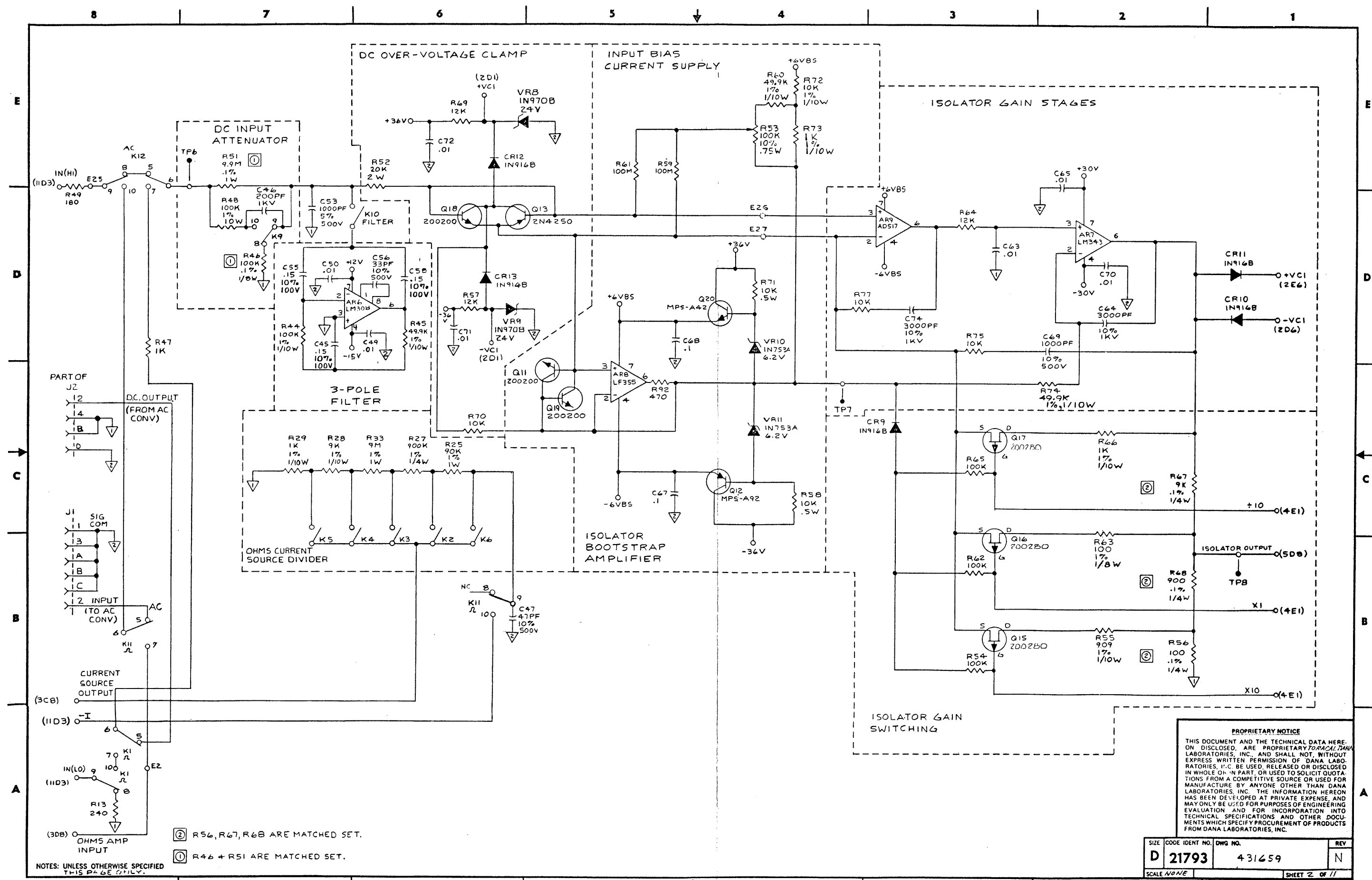
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SCHEMATIC - MOTHERBOARD

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	431659	N

SCALE NONE SHEET 1 OF 11

- ⏏ CHASSIS GROUND
 - ⏏ DIGITAL GROUND
 - ⏏ ANALOG COMMON
 - ⏏ REFERENCE COMMON (MECCA)
3. RESISTOR NETWORKS ± 2%
 2. CAPACITORS ARE IN MF, ± 20%, 100V
 1. RESISTORS ARE IN OHMS, ± 5%, 1/4W
- NOTES: UNLESS OTHERWISE SPECIFIED FOR PAGES I-II.

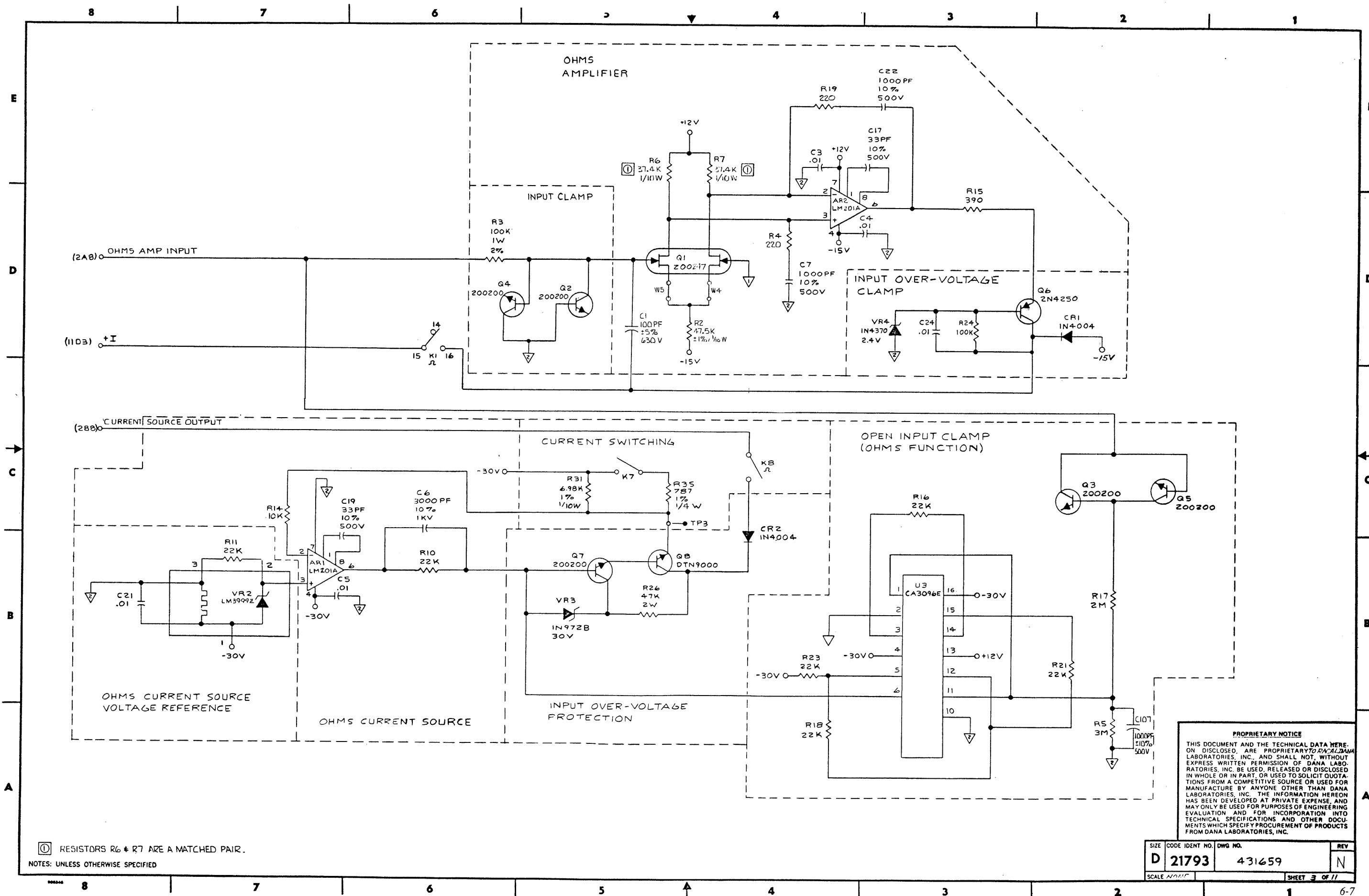


② R56, R67, R68 ARE MATCHED SET.
 ① R46 + R51 ARE MATCHED SET.

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SIZE	CODE IDENT NO.	DWG NO.	REV
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SCALE NONE			SHEET 2 OF 11

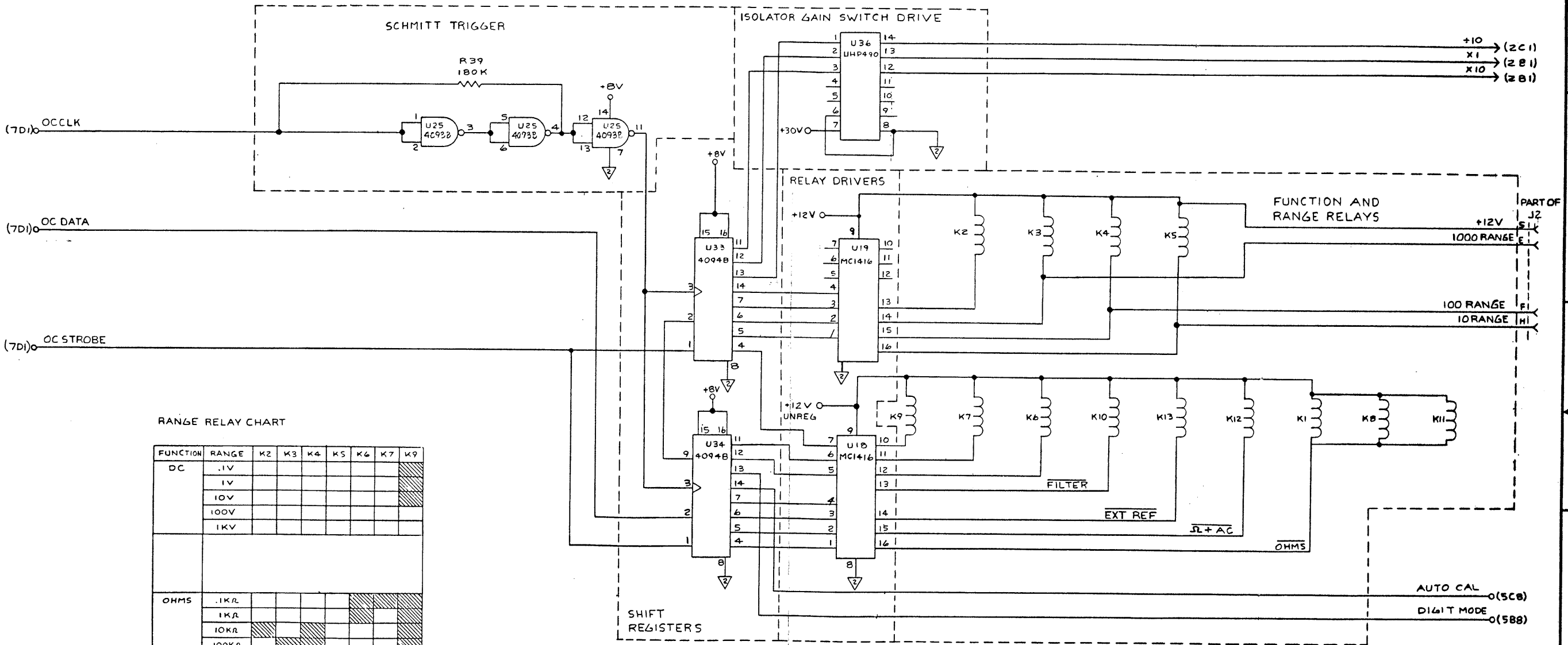


Ⓛ RESISTORS R6 & R7 ARE A MATCHED PAIR.
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SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	431659	N
SCALE	SHEET 3 OF 11		

8 7 6 5 4 3 2 1



RANGE RELAY CHART

FUNCTION	RANGE	K2	K3	K4	K5	K6	K7	K9
DC	.1V							
	1V							
	10V							
	100V							
	1KV							
OHMS	.1KΩ							
	1KΩ							
	10KΩ							
	100KΩ							
	1000KΩ							

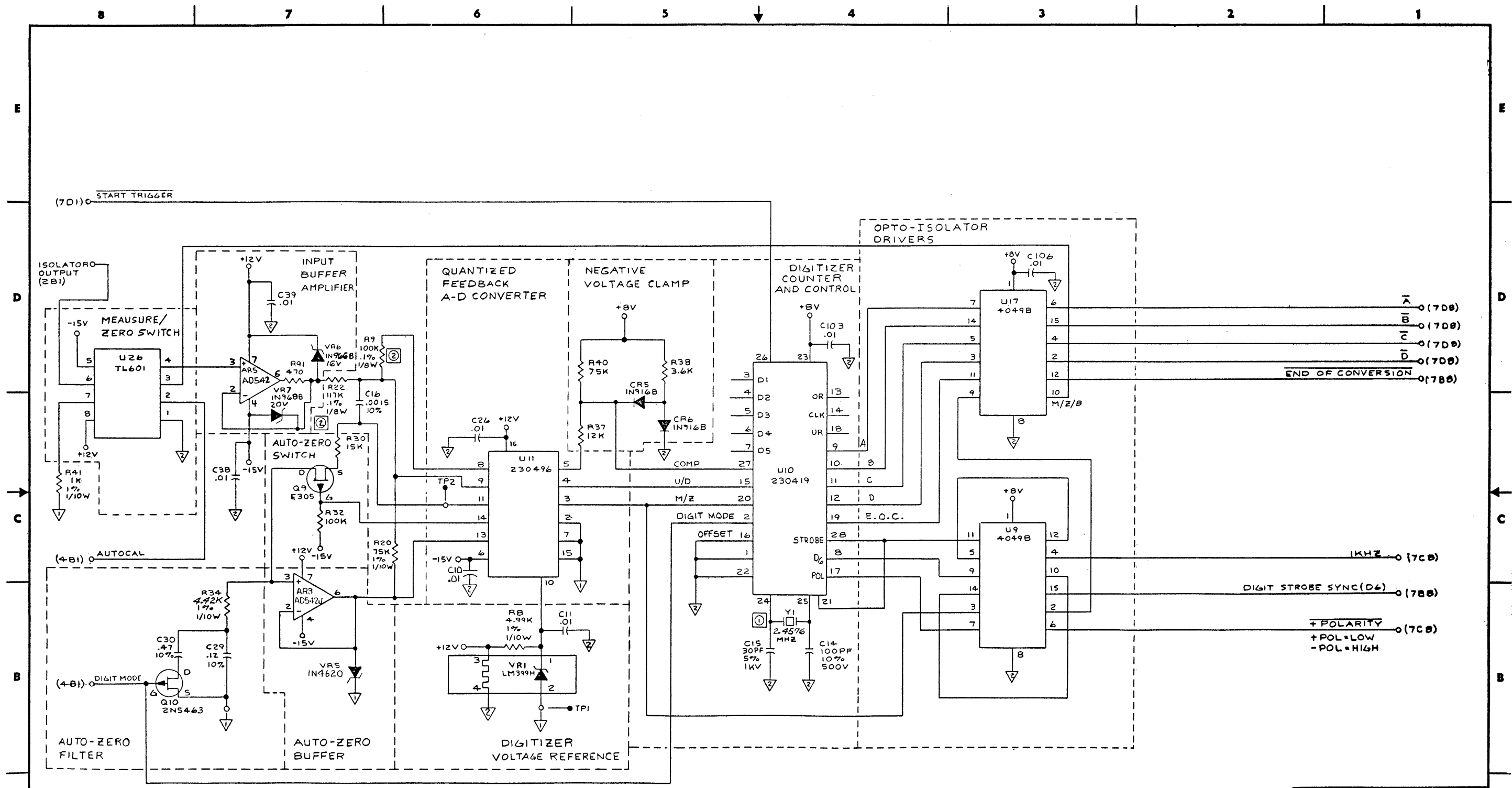
ENERGIZED

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D	21793	431659	N
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8 7 6 5 4 3 2 1



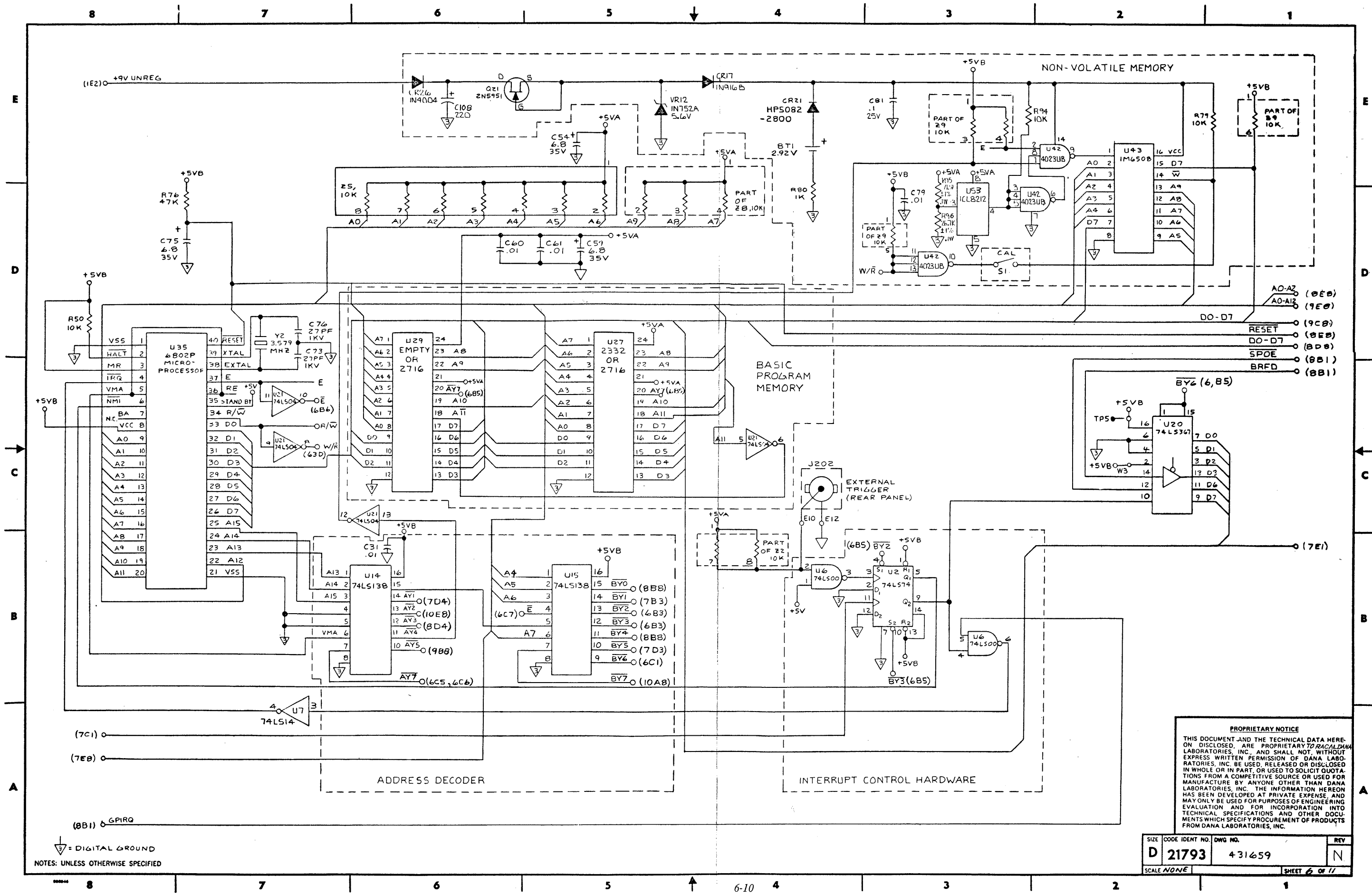
Ⓢ R9 AND R22 IS MATCHED RESISTOR SET.

Ⓣ 2 + 576 MHZ FOR 60HZ.
2 048 MHZ FOR 50HZ.

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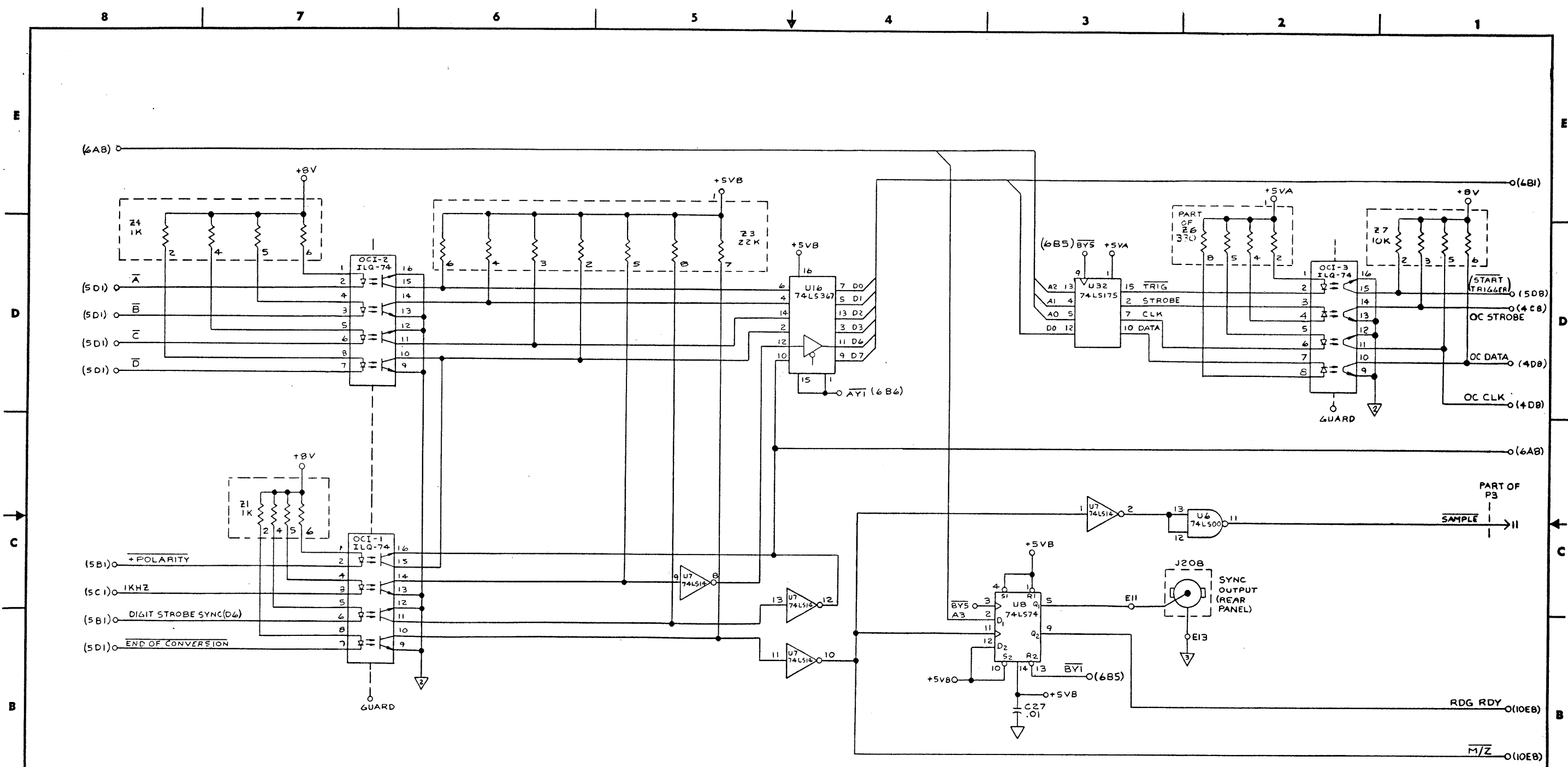
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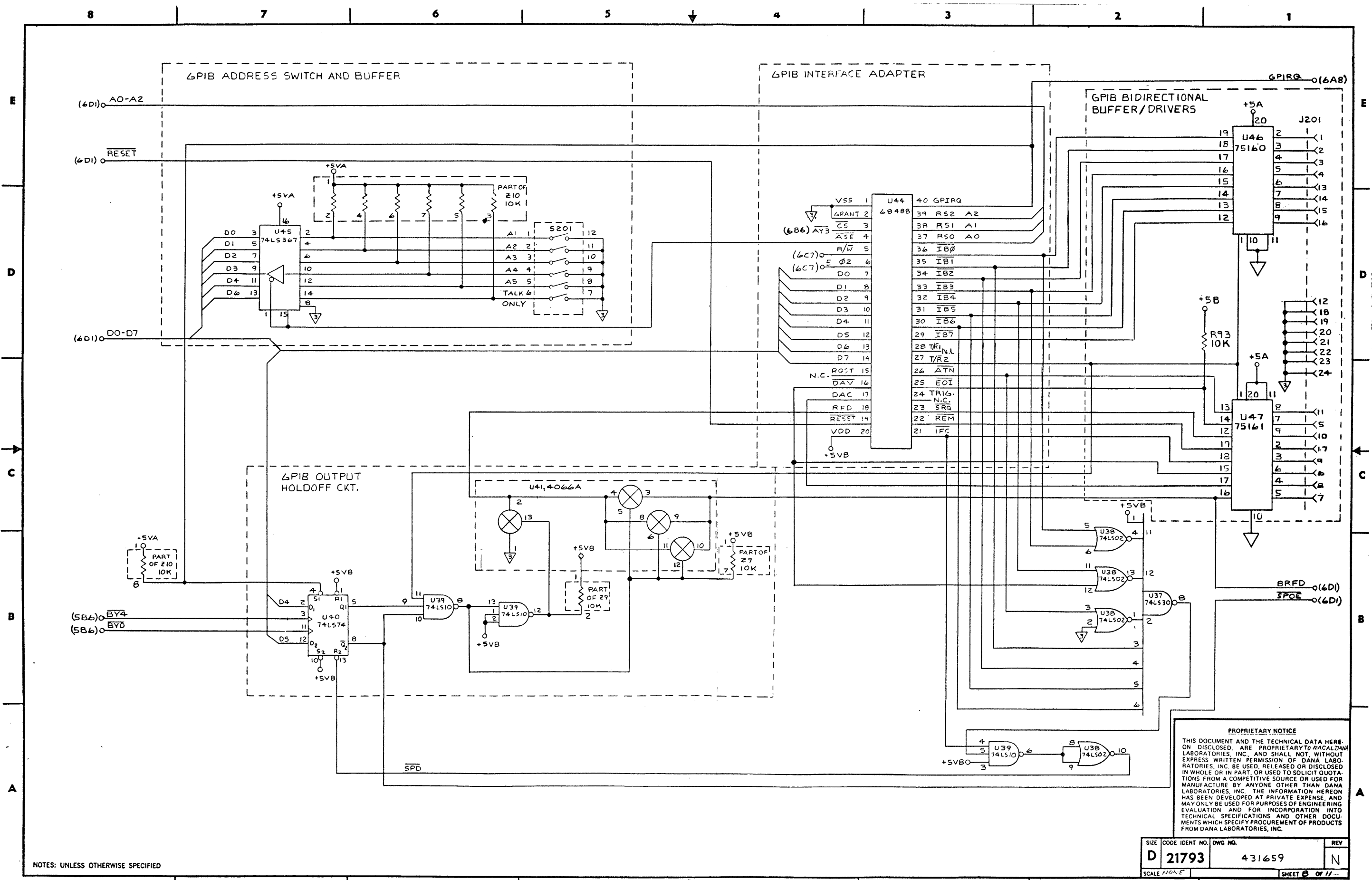
⏏ = DIGITAL GROUND
 NOTES: UNLESS OTHERWISE SPECIFIED



NOTES: UNLESS OTHERWISE SPECIFIED

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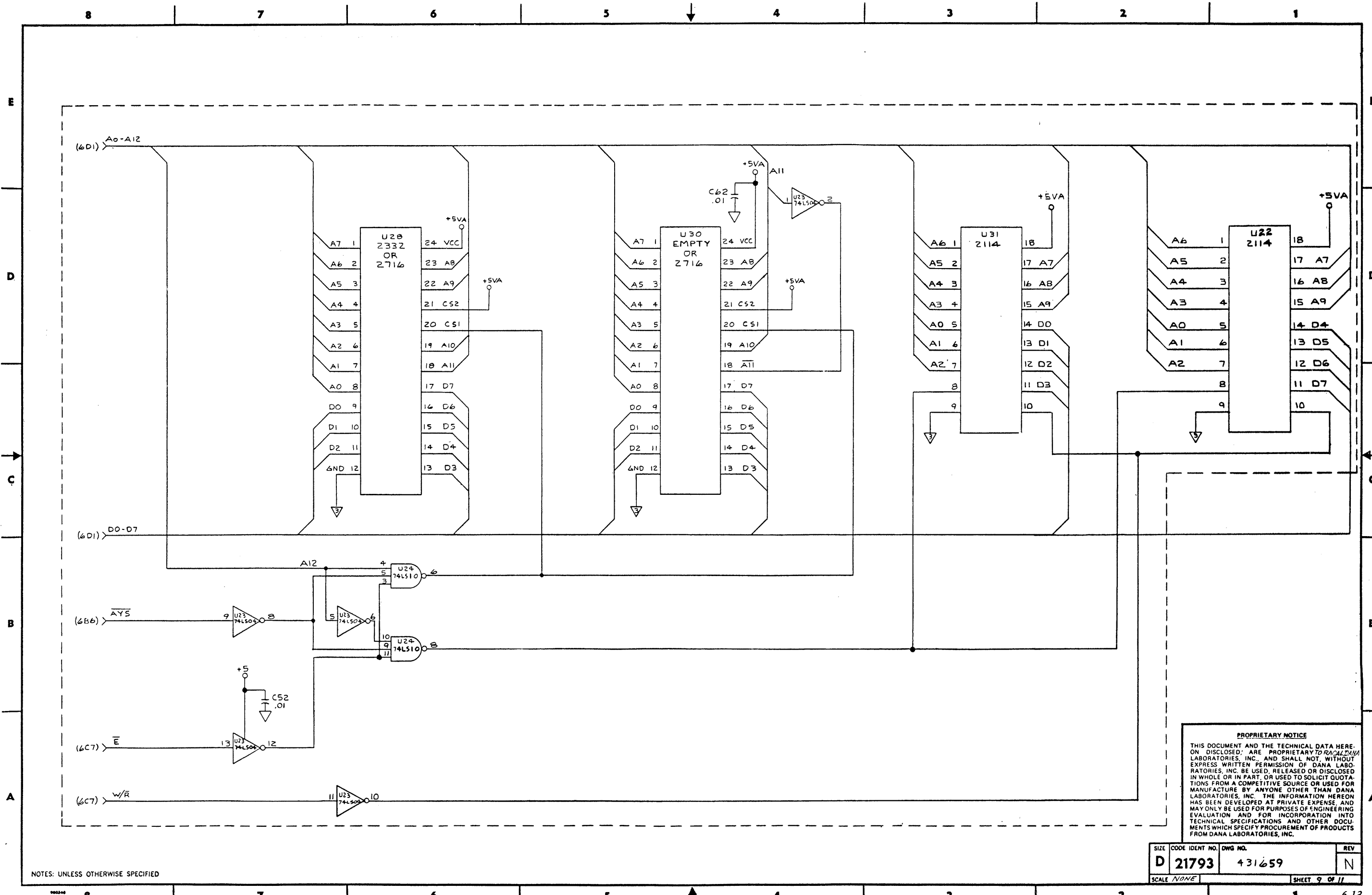
SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	431659	N
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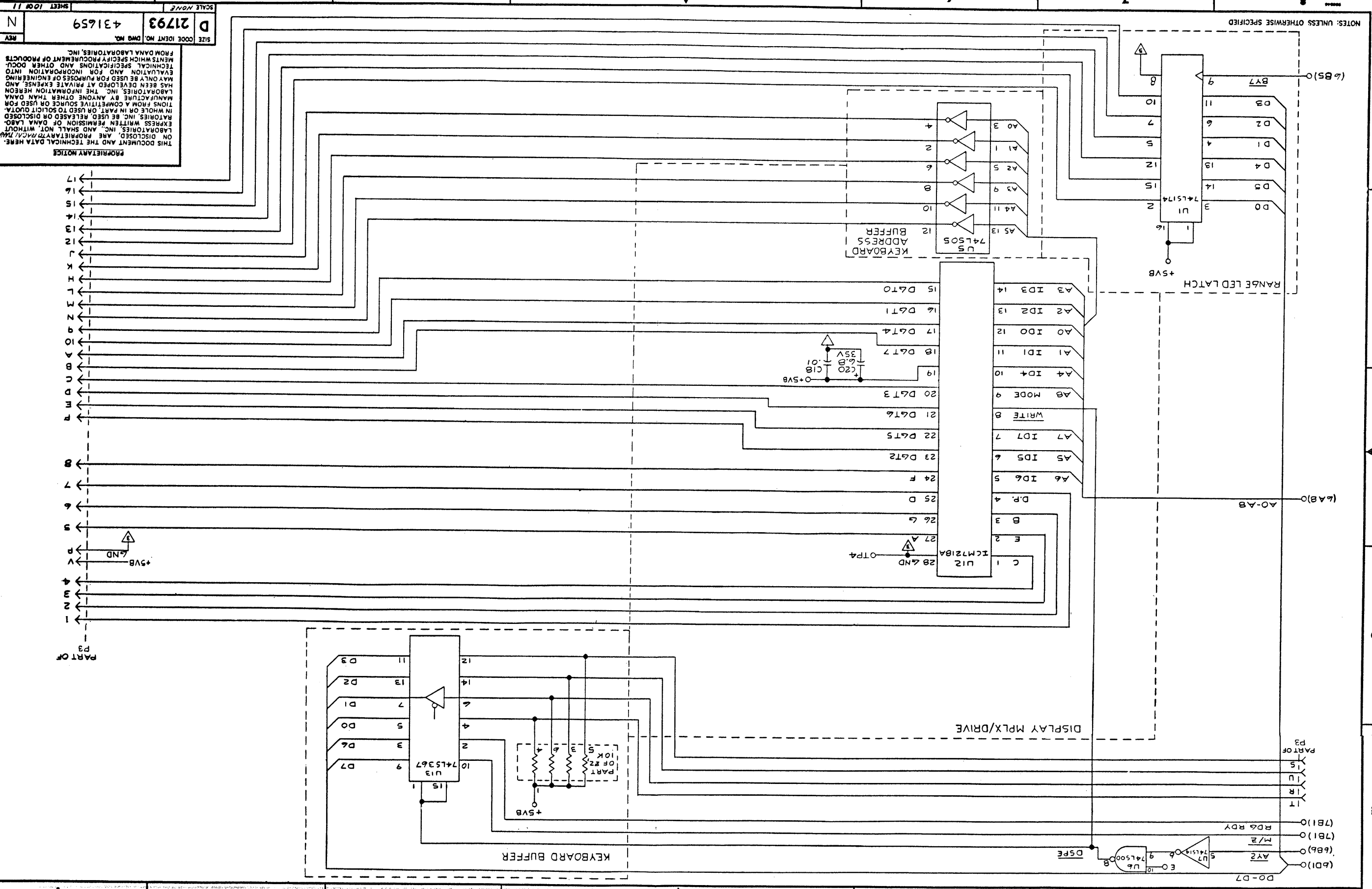
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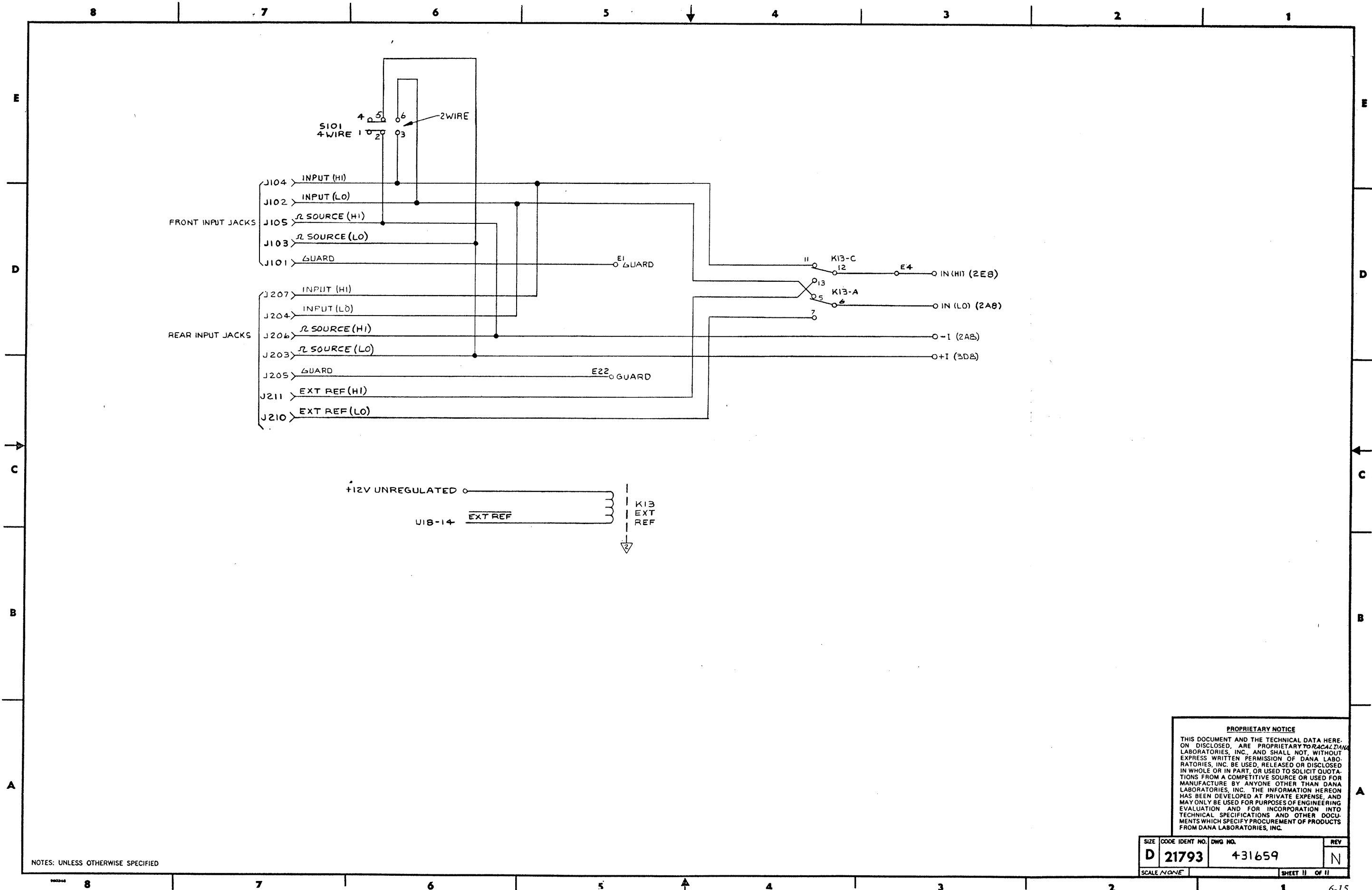
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