

WINCHESTER DISK ADAPTER
SPECIFICATIONS

Title WDA SPECIFICATION	Design T.W.	Date 9-8-83	Sheet 1 of _____	No. ZA10012	Rev
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WINCHESTER DISK ADAPTER SPECIFICATIONS

The Winchester Disk Adapter (WDA) allows attachment of up to eight CDC 9715-160 or 9715-80 Small Disk Drives on each of two ports. The larger -160 Drive is treated as if it were two logical drives of the same capacity as the smaller -80 Drive. Therefore, there are 16 logical addresses available on each port. The smaller drives are selected only by even logical addresses; the larger drives by both even and odd address, each accessing one-half of the drive storage capacity.

The Drives are formatted with 28 sectors per track. There are 4115 tracks per logical drive; 63 are reserved for use as alternates. Head selection has been made transparent to the user by assuming that each logical drive has 4115 tracks. Cylinder addresses 0000H through OFD3H access the non-reserved tracks; addresses 1000H through 103EH access the reserved tracks. The alternate tracks are spaced one in every thirteen physical cylinder so that the seek time can, in most cases, be less than the rotational latency time.

Each track is formatted with the logical sectors interleaved to allow for head switching between logical cylinders thus any group of tracks may be transferred at the rate of 28 sectors per 50 milliseconds, providing no physical seek is required by the drive.

Burst error detection and correction facilities provided for correction of up to 7 bit errors.

The sectors as recorded on the disk pack will always contain 320 data words, not counting the sector address. A larger or smaller number of words, however, may be transferred with the WDA accessing additional sectors or making up the difference. When it is desired to transfer more than a single sector's worth of data, it is only necessary to provide the sector address for the beginning sector and the total word count desired. The WDA will compute successive sector addresses and will cause new head selects and seeks to occur when necessary.

The WDA incorporates a significantly different I/O protocol which requires programming concepts new to the 2130 system. There is only one XIO command. That command is a function control which provides a memory address to the WDA. The WDA then begins cycle stealing command words from successive memory locations beginning at that address. Completion of the operation specified by the command word will be flagged by an interrupt. All operations, including transfer of status information, will be terminated in this fashion. There are several special cases of the single XIO that do not result in cycle stealing command words. These special cases are flagged by modifier bits in the XIO.

These modifier bits are involved with the following immediate operations: unmask interrupt; mask interrupt; reset interrupt; and halt controller.

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A sequence of operations may be begun with a single XIO and there will be only one interrupt at the end of the last operation as long as each operation in the sequence completes normally. This is done by chaining command words. When command words are chained, an interrupt will not occur at the end of the operation specified by each command word, but instead the WDA will go to the next command word in the command buffer. Multiple non-contiguous command word buffers may be used by linking between buffers with the "alternate command buffer" command word. If any operation associated with chain commands does not complete in a normal manner, then the rest of the command chain will not be executed but an interrupt will be presented.

All special function read and write commands require a seek command prior to execution; the seek operation which is normally executed prior to the read/write operation is suppressed. Other attributes of the special commands are:

1. Initialize Track The same data field of 320 words or less is written to all 28 sectors. The sector ID's are constructed by the controller.
2. Initialize ID Field The data in the ID field specified by the Write Command is written from the first two words in the data field. CW + 3 is accessed, but ignored. (1st data word is the track address; 2nd, flag and sector.)
3. Write ID Field, Diagnostic As in Initialize ID Field, except that the CRC bytes will be written from data in the third word of the data field.
4. Diagnostic Sector Write The ECC bytes of the record are written from words 321, 322 and 323 of the host data field. CW + 3 is accessed and a word count of 323 must be used to write a valid record.
5. Diagnostic Read The ECC bytes of the record are written to words 321, 322 and 323 of the host data field. CW + 3 is accessed and word count of 323 is required to read all data and ECC bytes.
6. Read ID Diagnostic The ID field and CRC bytes at the sector specified are written to the first four words of the host data field. As many words of the following data field will be written to host as allowed in the remaining word count. CW + 3 is accessed and must be at least 4; a word count of 327 will read both ID and data diagnostically. The high byte of the first ID word contains no valid data; the other is always zero.

Except for Initialize Track, all special functions are executed for only one sector per command.

Title

Design

Date

Sheet

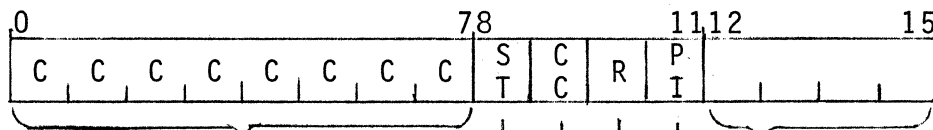
3

of

No.

Rev

BASIC COMMAND WORD
(CONTENTS OF COMMAND ADDRESS)



RESERVED FOR SPECIAL
DIAGNOSTIC READ FUNCTIONS

OPERATION FLAGS

PROGRAMMED INTERRUPT

RESERVED (DO NOT USE)

CHAIN TO NEXT COMMAND

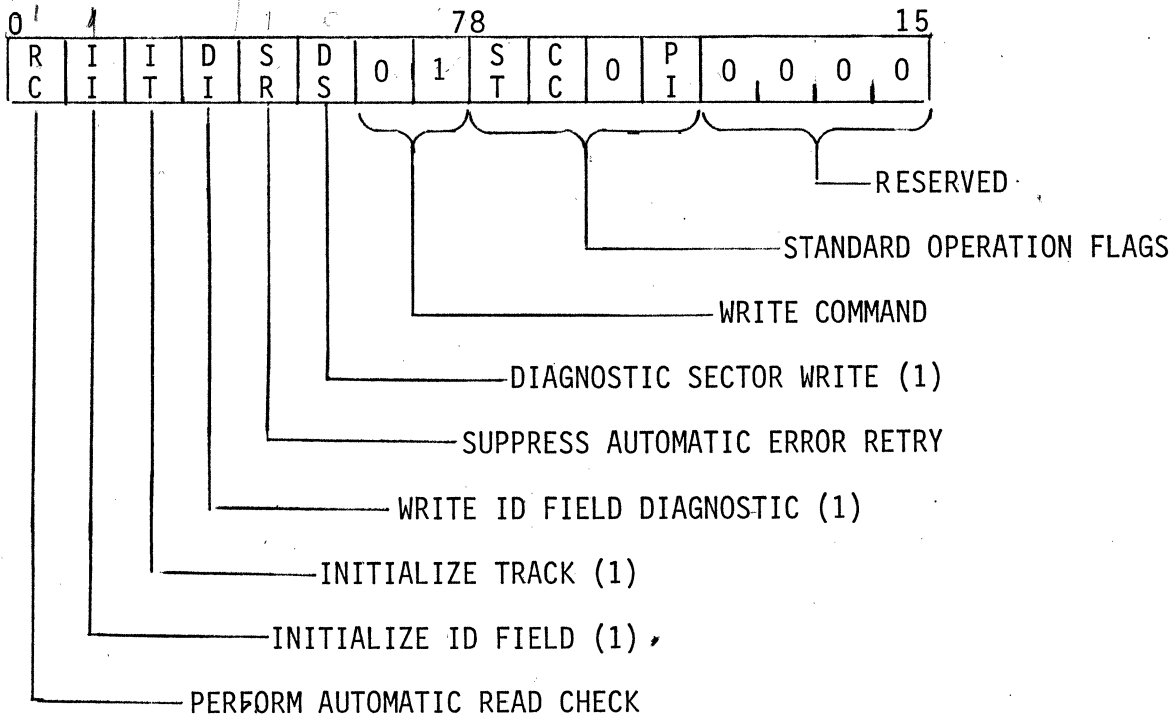
SUPPRESS DATA TRANSFER

X	X	X	X	0	0	0	0	RESERVED (INVALID)
M	M	M	M	M	M	0	1	WRITE
M	M	M	M	M	M	1	0	READ
M	M	M	M	M	M	1	1	CONTROL
M	M	M	M	0	1	0	0	SENSE
X	X	X	X	1	1	0	0	RESERVED (INVALID)
X	X	X	X	1	0	0	0	ALTERNATE COMMAND BUFFER

X = UNASSIGNED
M = MODIFIER
SEE SPECIFIC
COMMANDS

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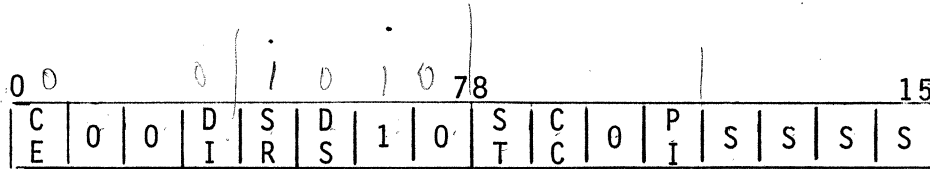
WRITE COMMAND



1. SPECIAL WRITE COMMAND; REQUIRES SEEK COMMAND PRIOR TO WRITE COMMAND. AUTOMATIC RETRY IS NOT ALLOWED.

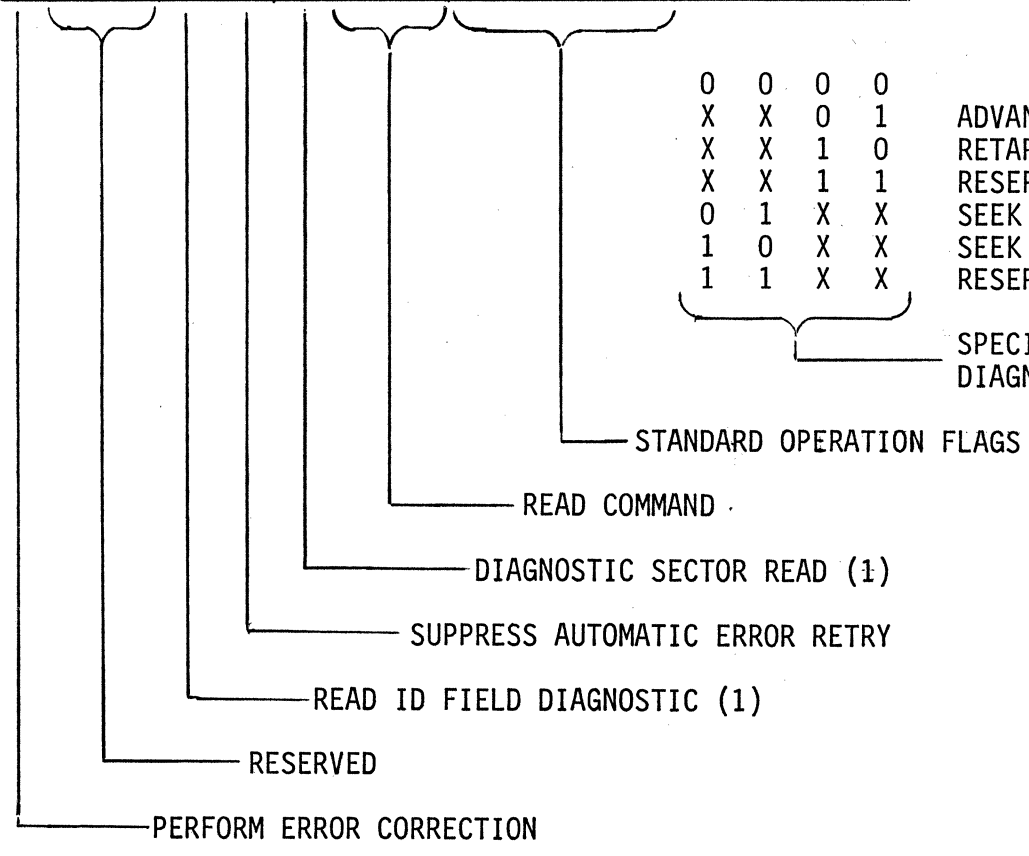
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READ COMMAND



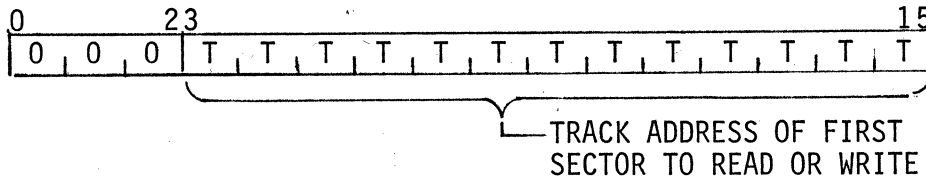
0	0	0	0	ADVANCE DATA WINDOW
X	X	0	1	RETARD DATA WINDOW
X	X	1	0	RESERVED (INVALID)
X	X	1	1	RESERVED (INVALID)
0	1	X	X	SEEK OFFSET FORWARD
1	0	X	X	SEEK OFFSET REVERSE
1	1	X	X	RESERVED (INVALID)

SPECIAL READ
DIAGNOSTIC FUNCTIONS (1)

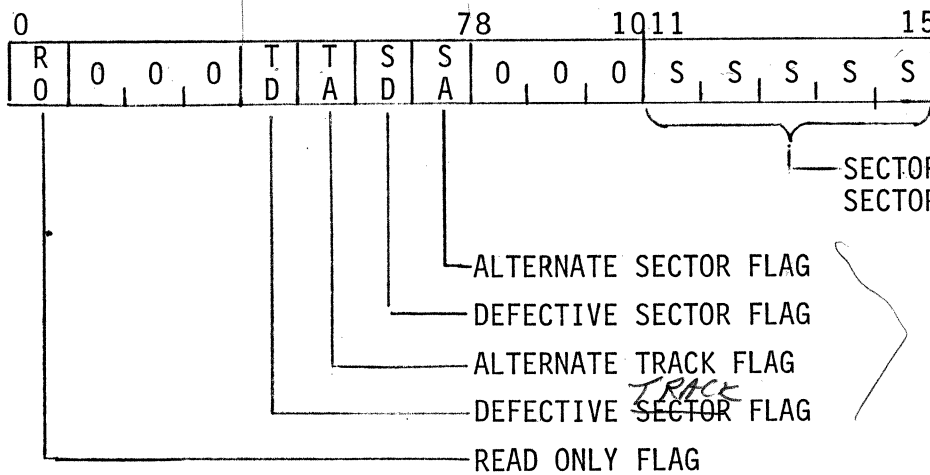


(1) SPECIAL READ COMMAND: REQUIRES SEEK COMMAND PRIOR TO READ COMMAND. AUTOMATIC RETRY IS NOT ALLOWED.

READ OR WRITE
COMMAND WORDS CW+1, CW+2, CW+3 AND CW+4

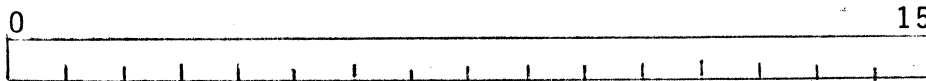


CW+1



CW+2

ALTERNATE SECTOR OR TRACK FLAGS ARE INCLUDED IN THE COMMAND WORD ONLY WHEN ALTERNATE MEDIA MANAGEMENT BY THE CONTROLLER IS NOT PROVIDED. ALL OTHER FLAGS ARE WRITTEN TO THE ID FIELD DURING ID INITIALIZE FROM DATA IN THE HOST DATA FIELD.



CW+3

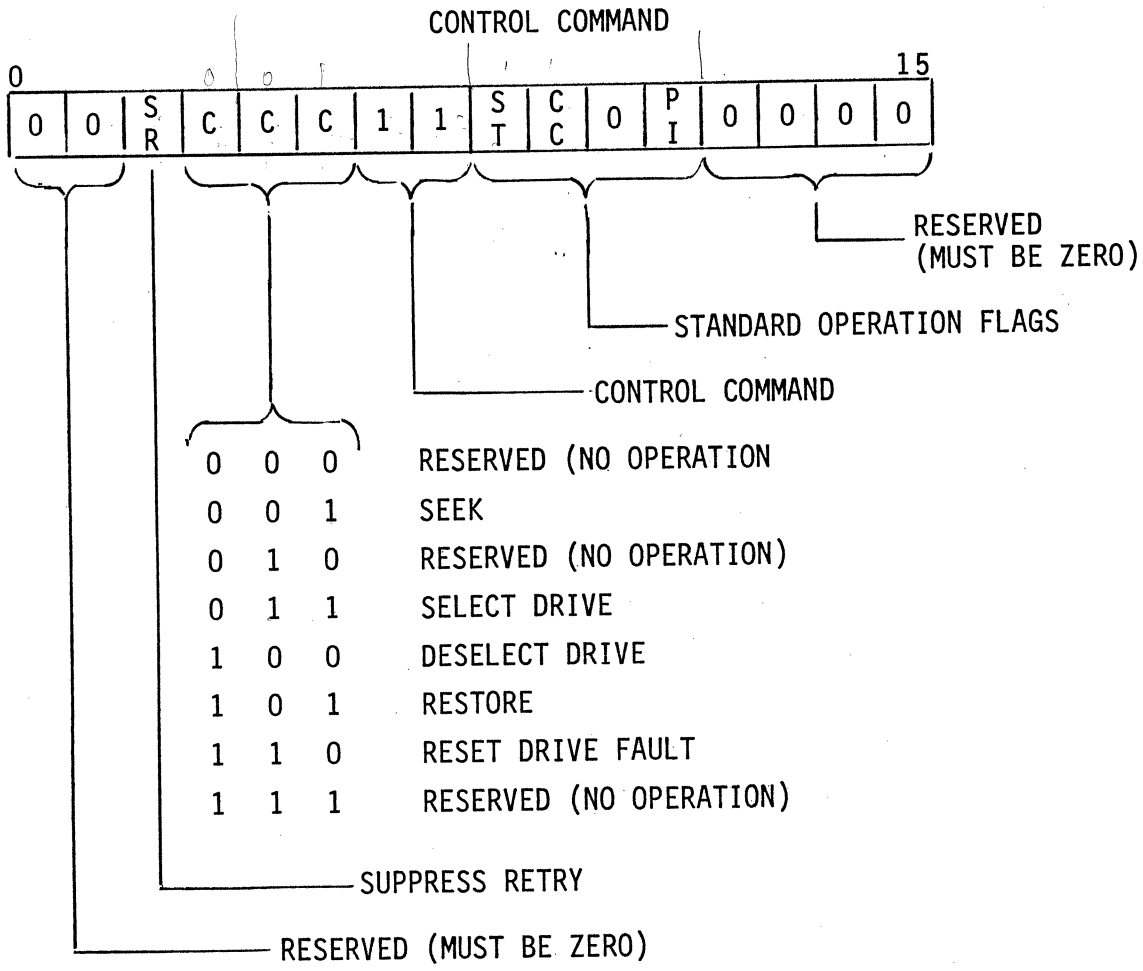
NUMBER OF 16 BIT WORDS TO TRANSFER



CW+4

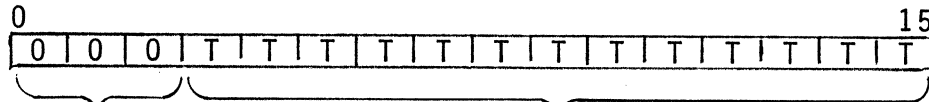
ADDRESS OF HOST DATA BUFFER

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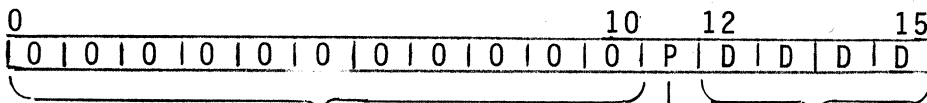
CONTROL COMMAND WORD CW + 1



SEEK
COMMAND

TRACK ADDRESS
RANGE OF DECIMAL VALUES
TRACK ADDRESSES 0 - 4051
ALTERNATE TRACKS 4096 - 4159

RESERVED (MUST BE ZERO)



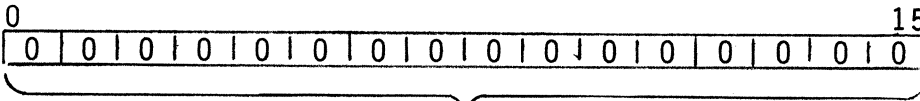
SELECT
COMMAND

RESERVED
(MUST BE ZERO)

0 = PORT A
1 = PORT B

LOGICAL DRIVE NUMBER
(DECIMAL RANGE 0 - 15)

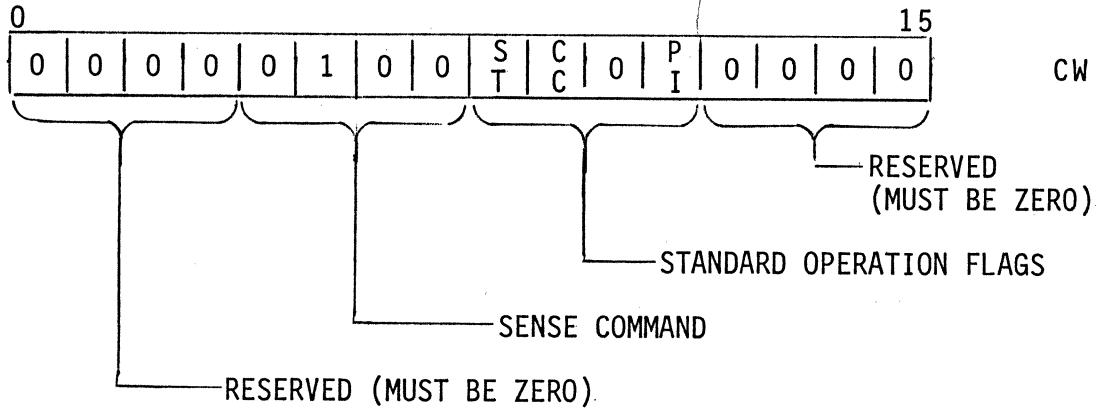
BITS 12, 13 AND 14 REPRESENT PHYSICAL DRIVES 0 THROUGH 7. ODD NUMBERED LOGICAL DRIVES (1, 3, 5, ETC.) ARE AVAILABLE ONLY WHEN THE PHYSICAL DRIVE IS A FIXED STORAGE DRIVE.



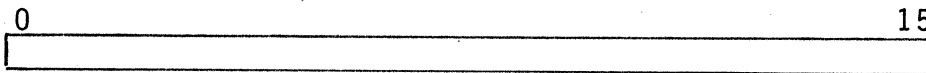
ALL OTHER
CONTROL COMMANDS

RESERVED
(MUST BE ZERO)

SENSE COMMAND

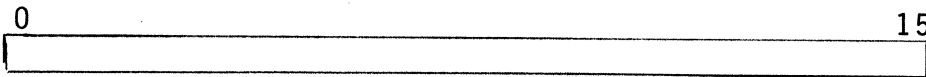


CW



WORD COUNT

CW + 1



HOST BUFFER ADDRESS

CW + 2

THE MAXIMUM ALLOWABLE WORD COUNT IS 128. *SCRATCH PAD*

STATUS WORD #1 IS ALWAYS ZERO UNTIL THE LAST OPERATION IS COMPLETED OR ABORTED. IT IS RESET AT THE COMPLETION OF THE SENSE OPERATION. ALL OTHER SENSE STATUS WORDS ARE UPDATED AS REQUIRED.

IF AN INVALID COMMAND OR HOST MEMORY ERROR IS ENCOUNTERED, THE APPROPRIATE BIT IS SET IN STATUS WORD #1 AND OPERATION IS TERMINATED.

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WDA STATUS WORDS

- WORD 1: Operation status; see Table of Bit Functions
 - WORD 2: Drive status; see Table of Bit Functions
 - WORD 3: Last command address; this is the address of last command fetched, other than a sense or alternate buffer command. In case of error, it will be the address of command in which the error occurs if not corrected by retrying execution.
 - WORD 4: Internal status registers; see Table of Bit Functions
 - WORD 5: Host starting address of last data field used. In case of error, it will be the address of the first data in the sector where the data occurred.
 - WORD 6: Track address of last operation
 - WORD 7: Flags, if any, and sector of last operation. This is the sector ID required of the last operation.
 - WORD 8: Track address read from last operation.
 - WORD 9: Flags and sector read from last operation.
This is the sector ID read from the last operation
 - WORD 10, Bits 0 - 7: Number of times ID error recovery tried
 - WORD 10, Bits 8 - 15: Number of times data error recovery tried by re-read
 - WORD 11, Bits 0 - 7: Number of times overrun error recovery tried
 - WORD 11, Bits 8 - 15: Number of times disk error recovery tried
- These counts are number of errors that invoked an error recovery attempt and are not multiplied by the number of tries to recover a particular error.
- WORD 12, Bits 0 - 7: Number of times data error recovered by ECC
 - WORD 12, Bits 8 - 15: Number of times alternate media area used
 - WORD 13: A Port Drive configuration
 - WORD 14: B Port Drive configuration

Bit 15 represents logical drive #0; bit 0 represents logical drive #15. A zero indicates attachment has been configured for that drive number.

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WORD 15: Version and modification of control code

WORD 16 - 18: Syndrome word from burst error processor - If ECC has not been invoked, these words will contain the six syndrome bytes as read from the burst error processor. If correction has been attempted, the order of bits in each byte will have been reversed.

WORD 19: Address of first word in host with bits in error

WORD 20, Bits 12 - 15: Bit pointer to start of error in host memory word. These bits represent position of the first bit in the word to which the error correction byte is to be applied. If the value is zero, the correction starts with the host word bit 0; other starting points may be found by subtracting the value from 16. Correction then proceeds from most significant bit to least across host word boundaries.

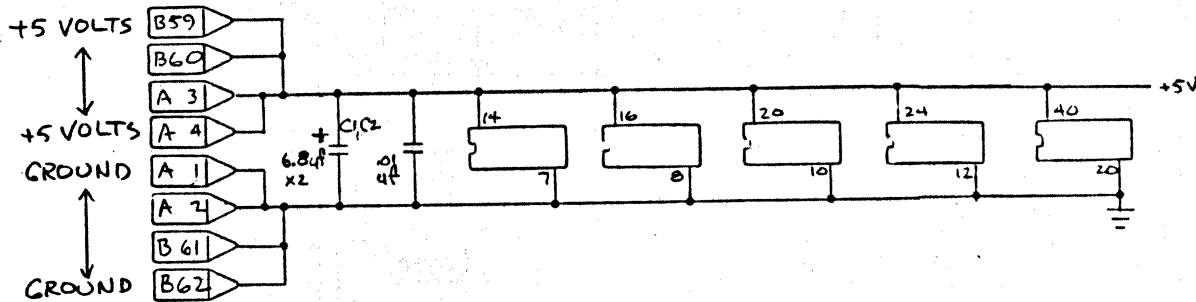
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STATUS WORD 1

<u>Bit #</u>	<u>Significance</u>
0	Error, operation aborted
1	Operation completed
2	Accessed drive not ready.
3	Invalid command or command sequence
4	Host memory error on command or sense word
5	Read error occured in data field -
6	Read error occured in ID field
7	Host memory error on disk data transfer
8	Data overrun during disk data transfer
9	ID does not compare
10	Time-out during seek or loss of sector pulse
11	Drive or sector is write protected; set only if write op.
12	Seek error indicated by drive
13	Unavailáble track address
14	Unavailable sector address
15	Fault condition indicated by drive

Bit 0 is set when any one of the conditions indicated by bits 2 through 15 has prevented the completion of a command to the drive and/or attachment. If automatic error correction is permitted, one or more of bits 5, 6, 7, 8 and 12 may be set without bit 0 indicating that an error has occured during the last command chain executed. If automatic alternate track and sector operation is suppressed, bit 13 or 14 will be set in conjunction with bit 9.

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UNLESS OTHERWISE NOTED
1. RESISTOR VALUES IN OHMS, 1/4W, 5%

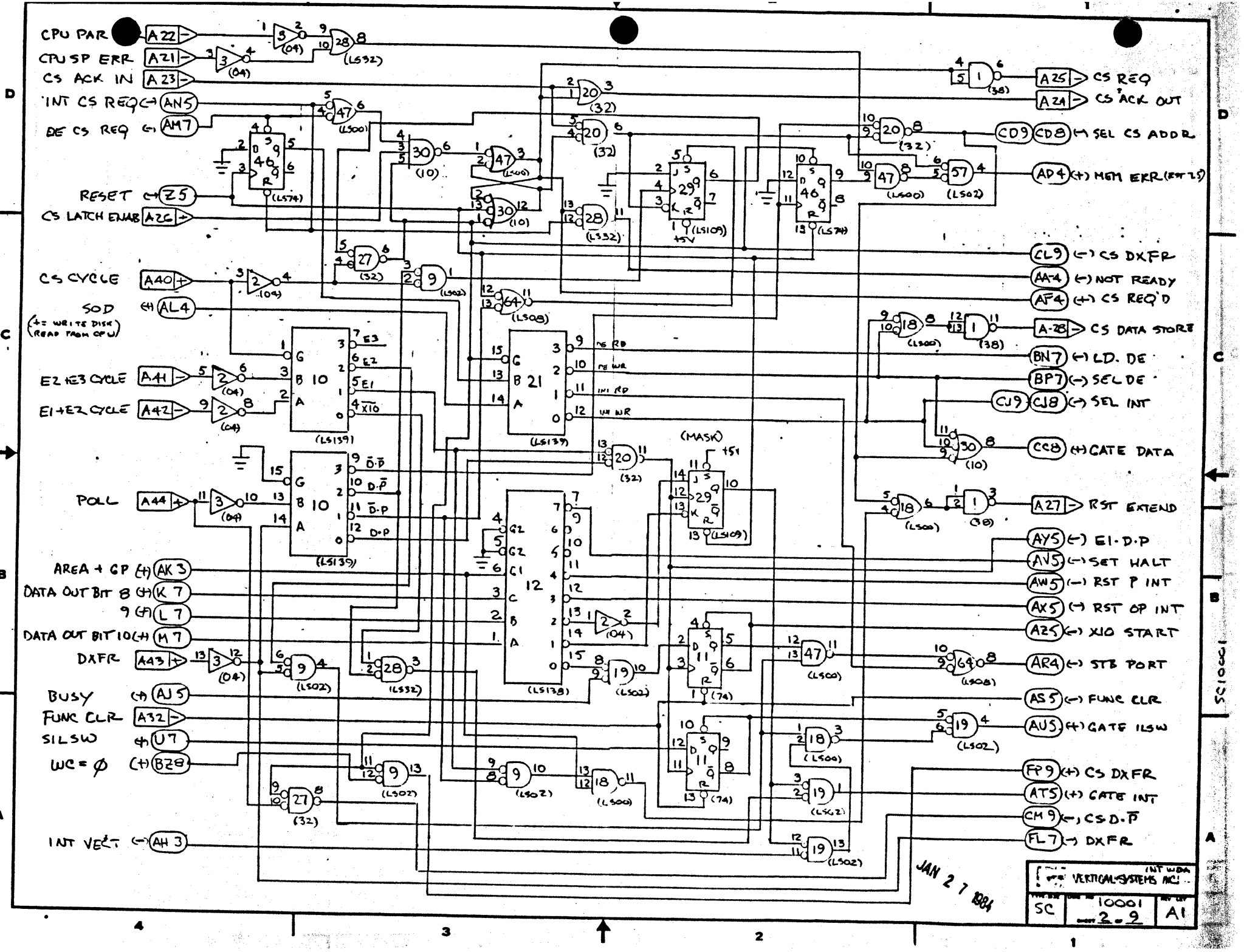
JAN 27 1984

AC10068

LAST SIGNAL EN FR

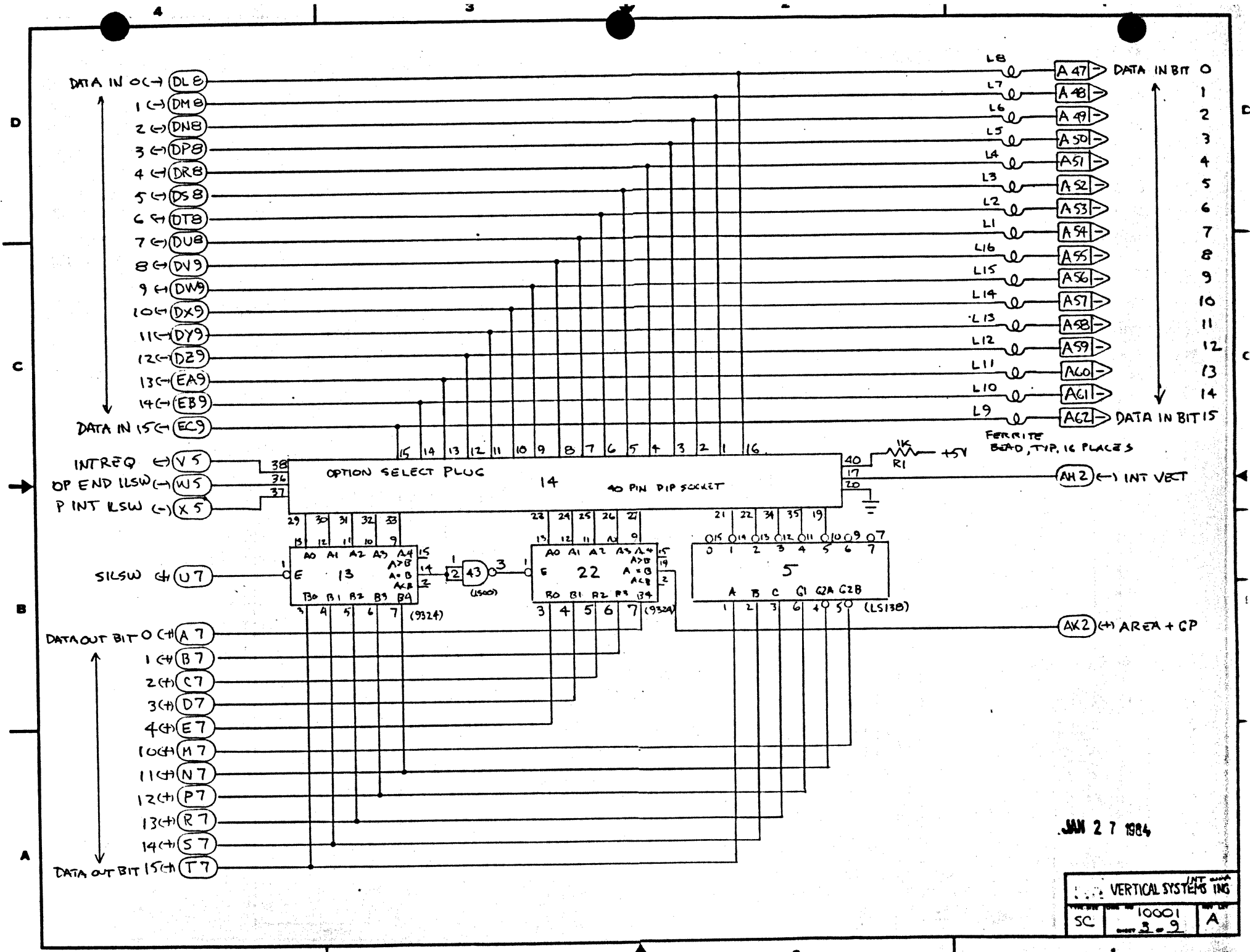
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LIST OF MATERIALS						
FILE NUMBER		THIS PRINT CONTAINS PROPRIETARY INFORMATION REPRODUCTION OF THIS PRINT OR ANY INFORMATION CONTAINED HEREIN OR MANUFACTURE OF ANY ARTICLE HEREFROM FOR DISCLOSE TO OTHERS IS FORBIDDEN EXCEPT BY SPECIFIC WRITTEN PERMISSION FROM VERTICAL SYSTEMS, INC.		TITLE INTERPRETER, WDA		
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DIMENSION TOLERANCES ANGULAR DIMENSION ± 1/2° DECIMAL 1 PLACE ± .005 DECIMAL 2 PLACE ± .010		VERTICAL SYSTEMS, INC.		
		BREAK SHARP EDGES MAX INSIDE CORNERS MAX		DRAWN		
		ALL MACHINE SURFACES ✓		CHECKED		
LETTER		DRW	CHK	DATE	DESIGN	TWJ
CHARGE RECORD NO		DO NOT SCALE THIS PRINT		SCALE	TYPE SIZE	NO LETTERS
					SC	NO 10001
					1-9	AI

SC10001



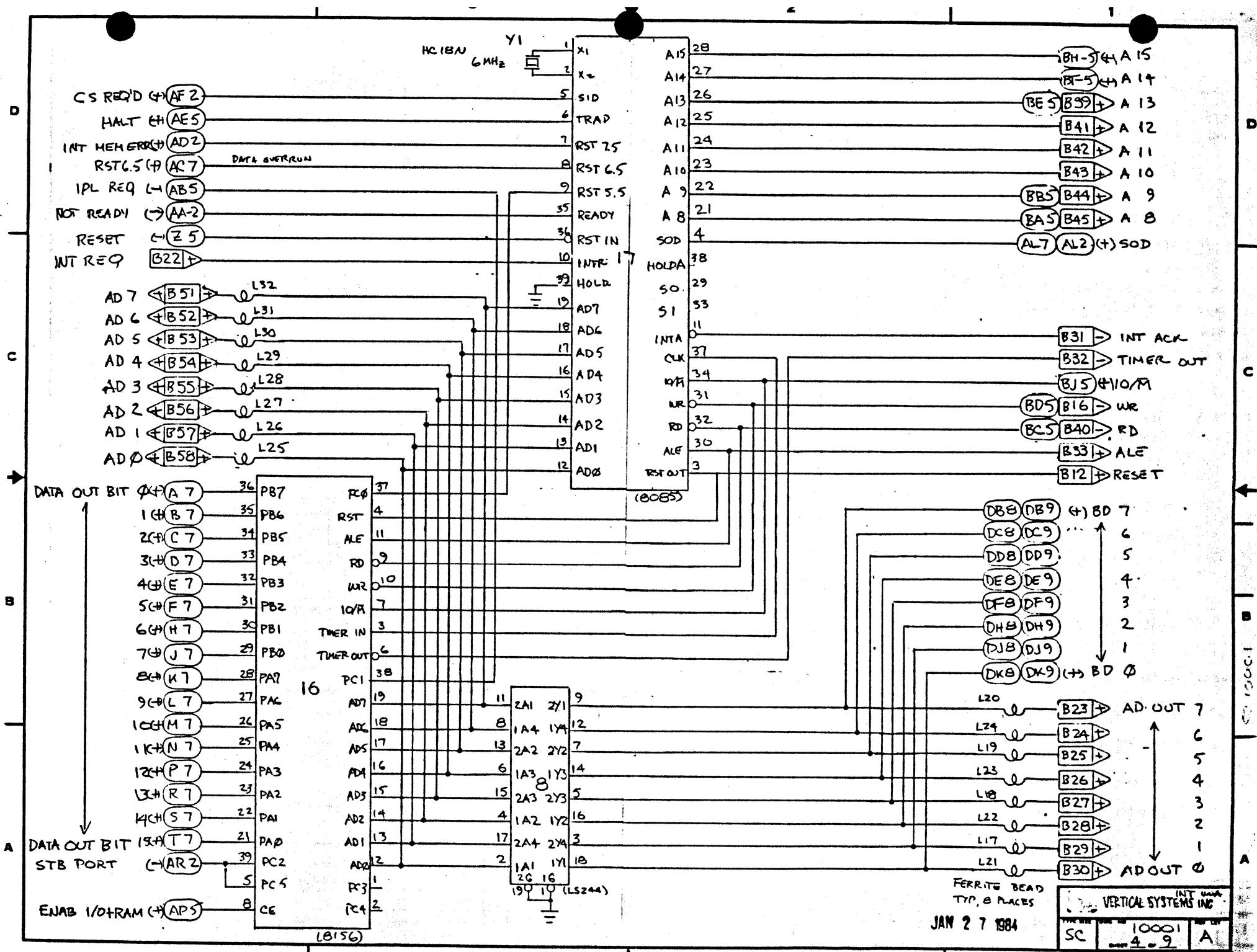
JAN 27 1984

INT WDA		SC 10001		A1	
VERTICAL SYSTEMS INC.		10001		A1	
SC		2-9		A1	



JAN 27 1984

VERTICAL SYSTEMS INC		
SC	10001	A
	3-9	



JAN 27 1984

FERRITE BEAD
TOP, 8 PLACES

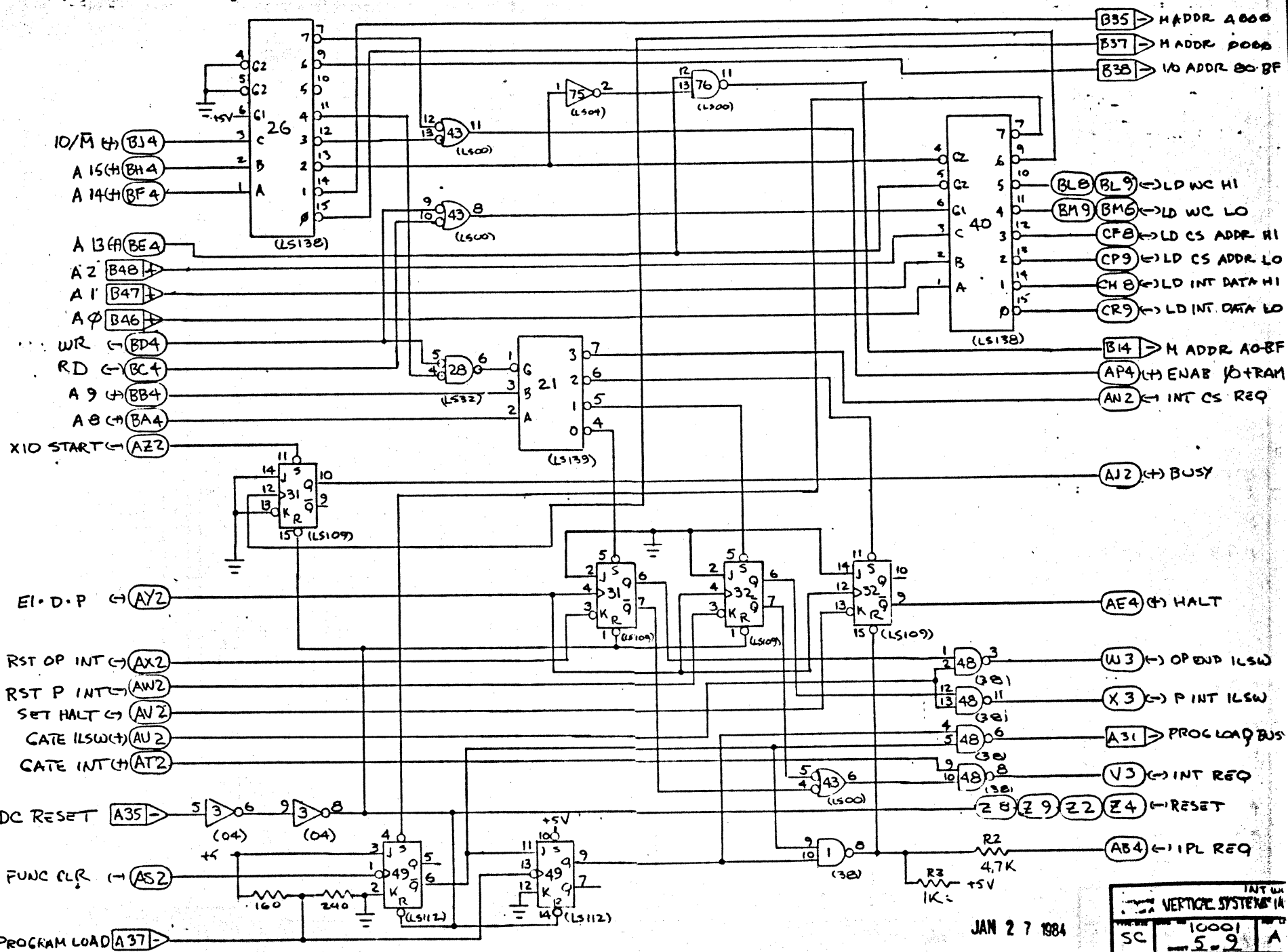
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INT. NO. 10001
SC 4-9 A

D

C

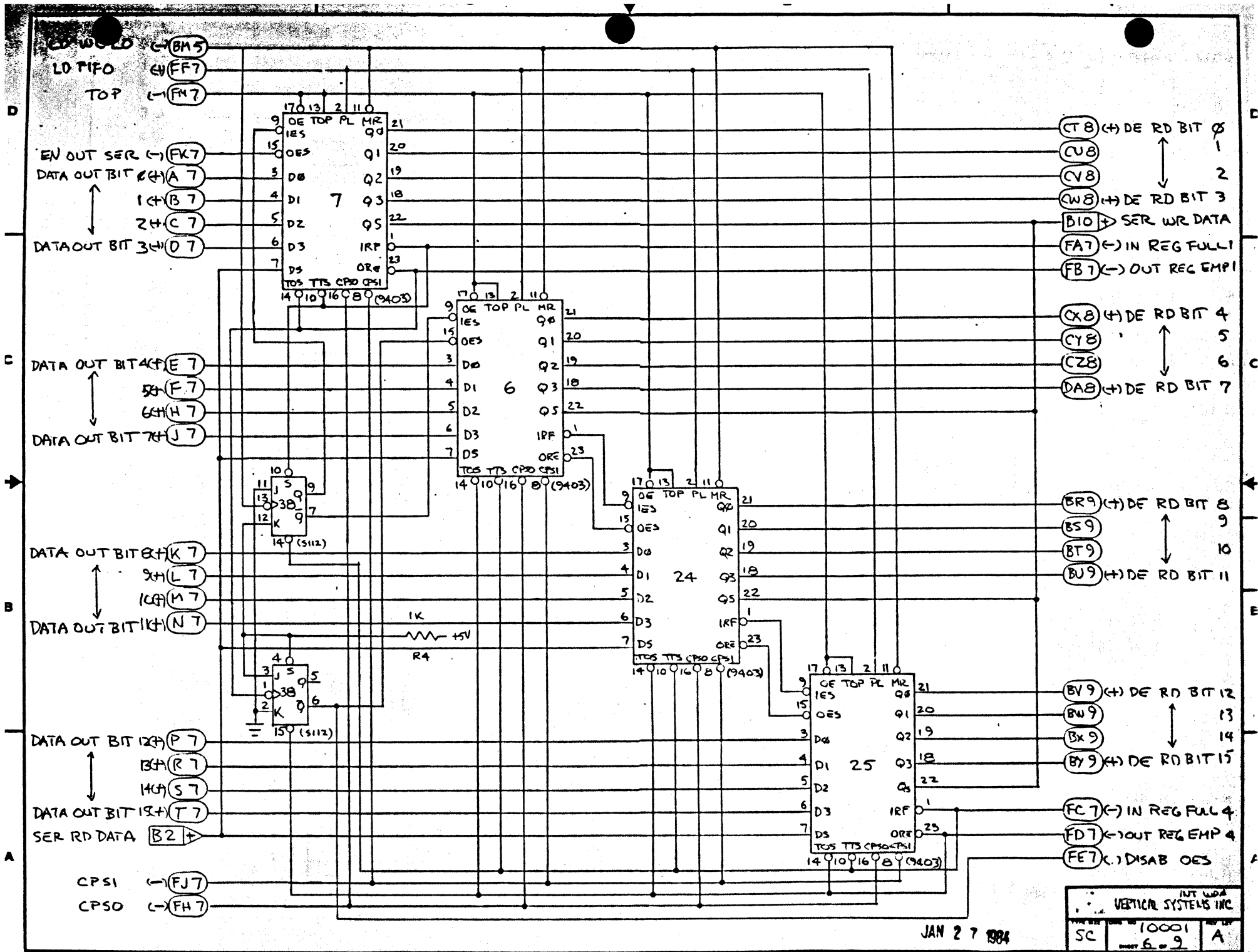
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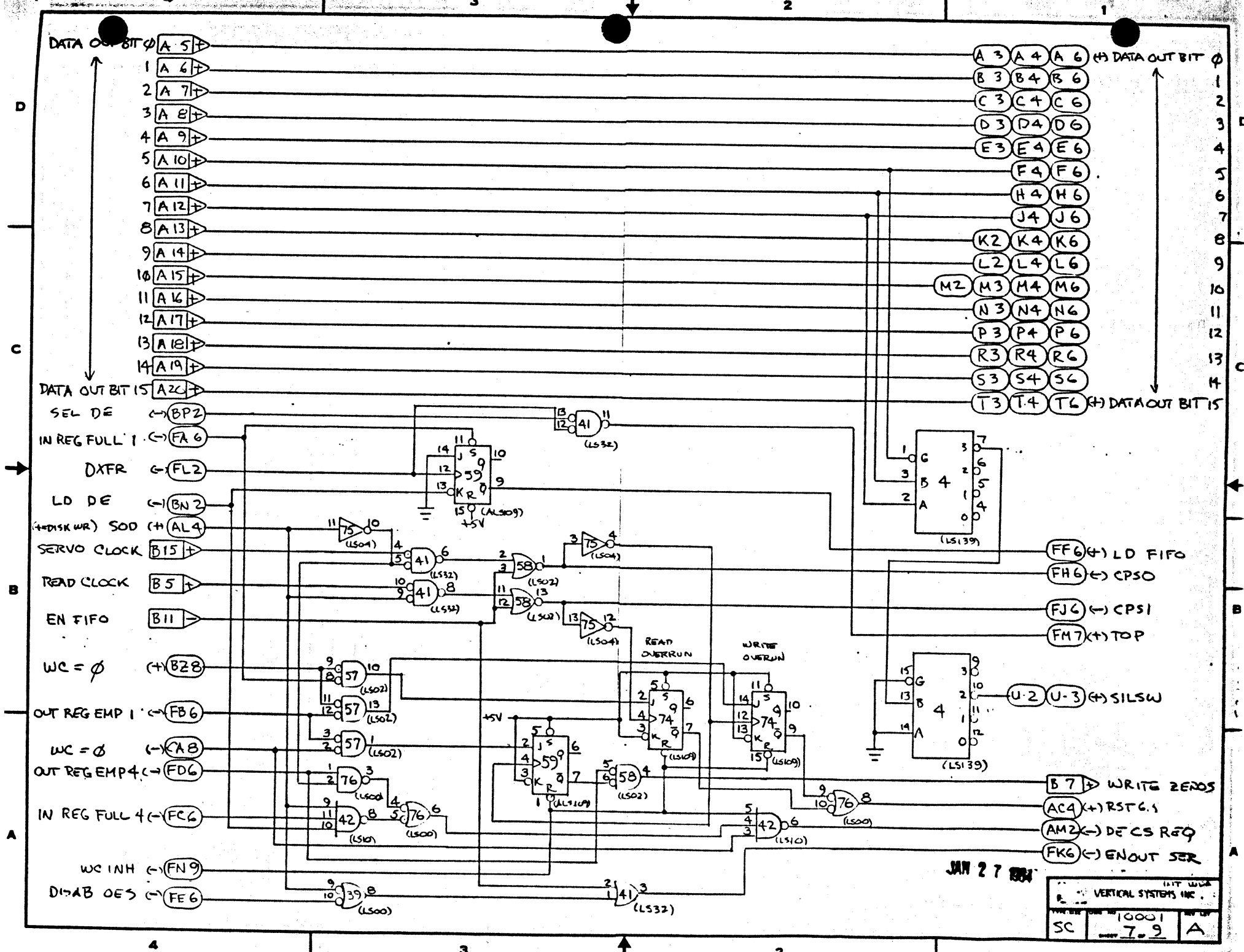
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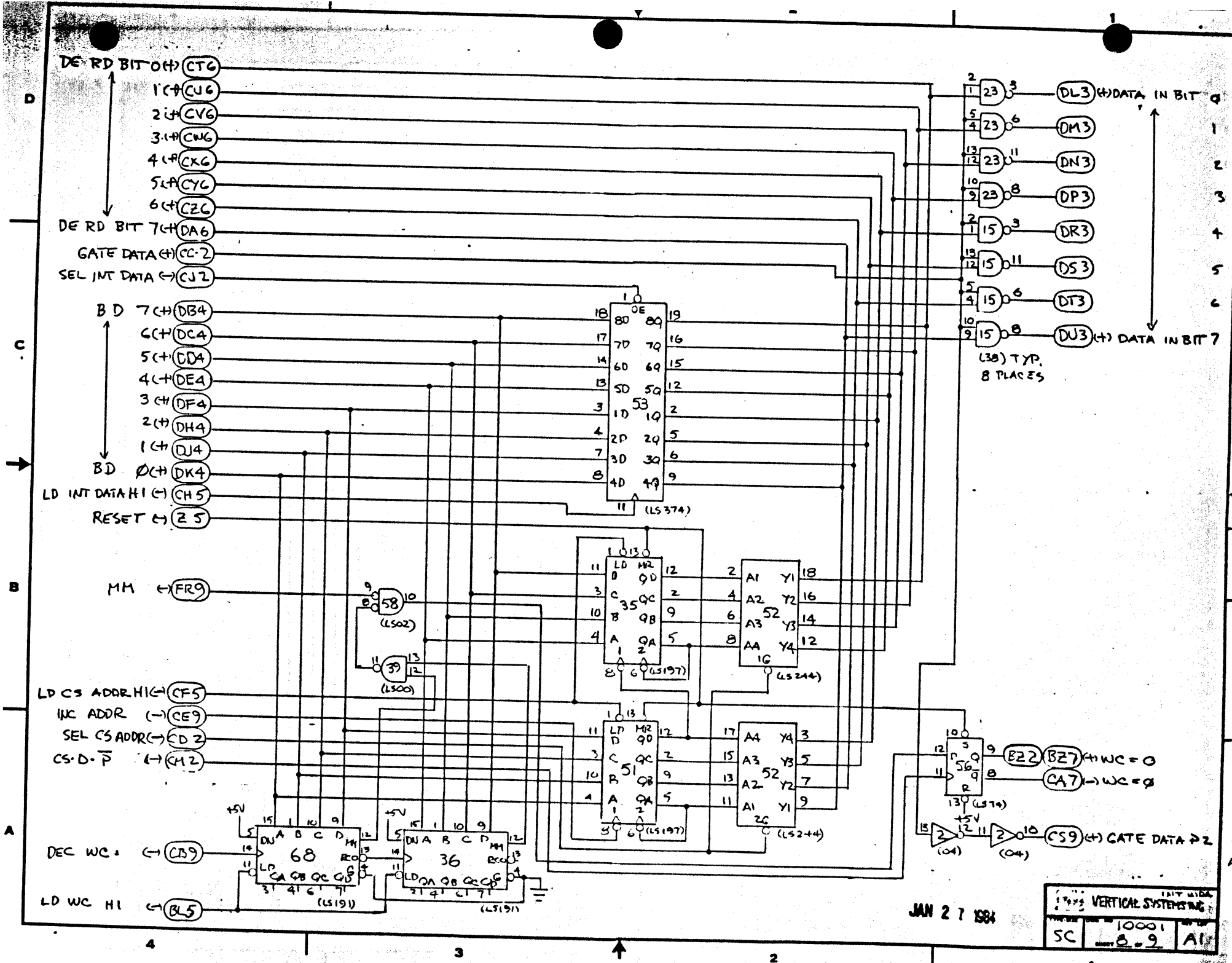
INT IN		
VERTICE SYSTEMS INC		
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	509	





JAN 27 1984

VERTICAL SYSTEMS INC.		
PART NO.	10001	REV. UP
SC	7.9	A

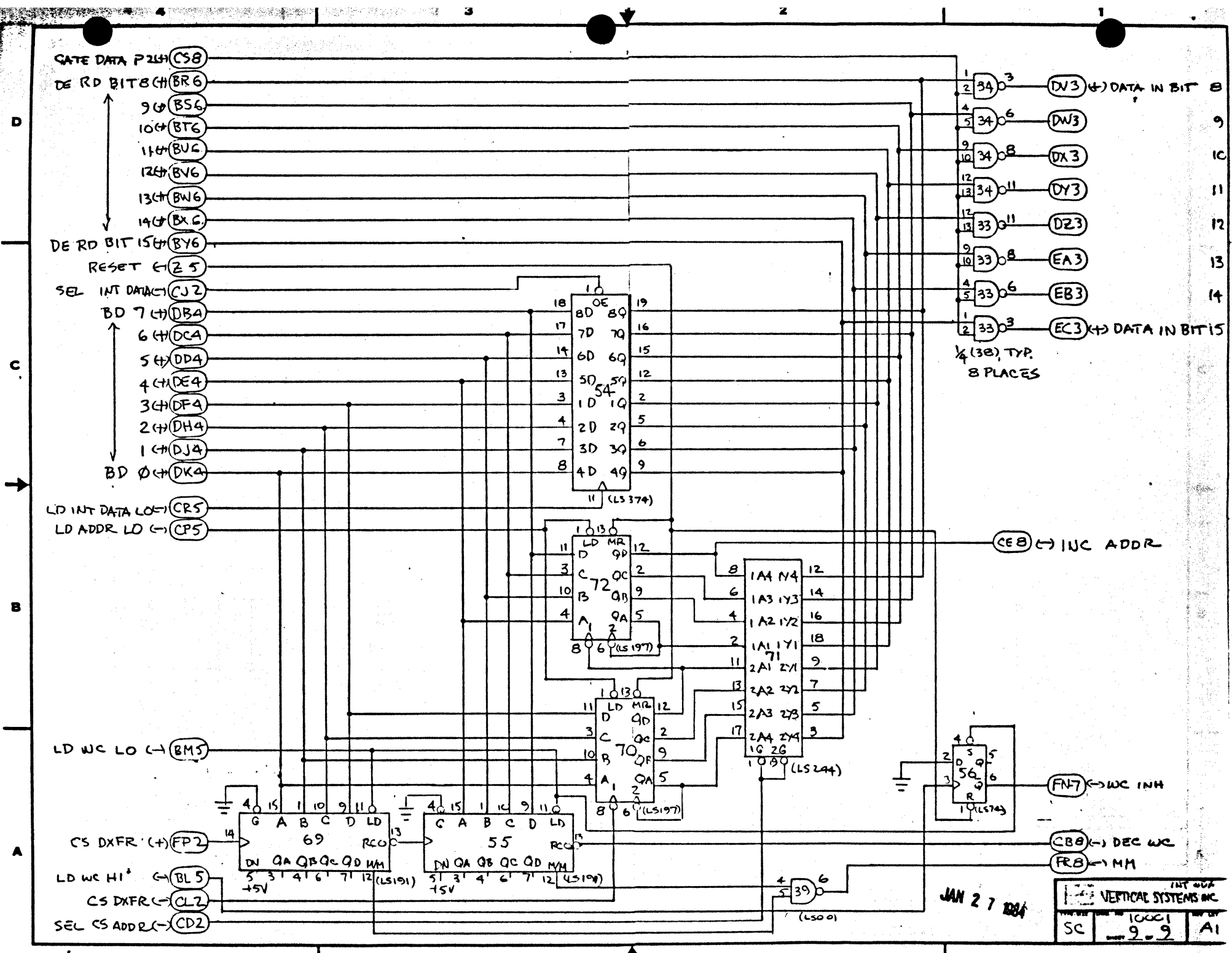


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VERTICAL SYSTEMS INC.

10001

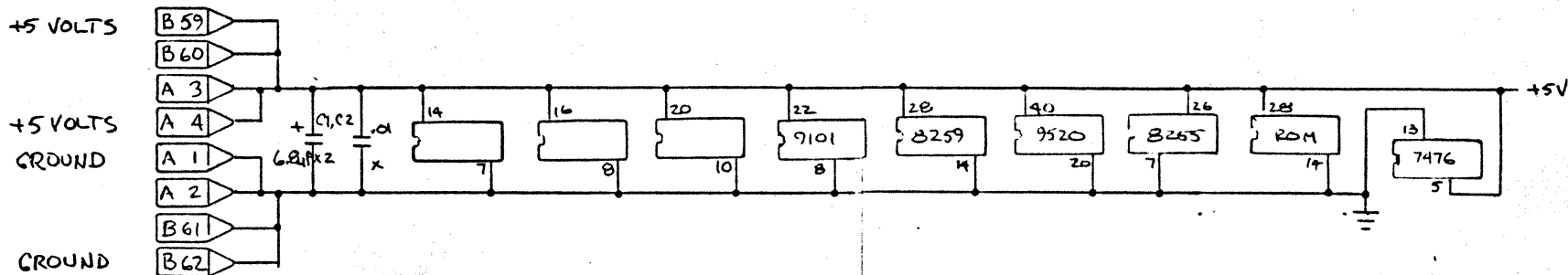
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JAN 27 1984

VERTICAL SYSTEMS INC		
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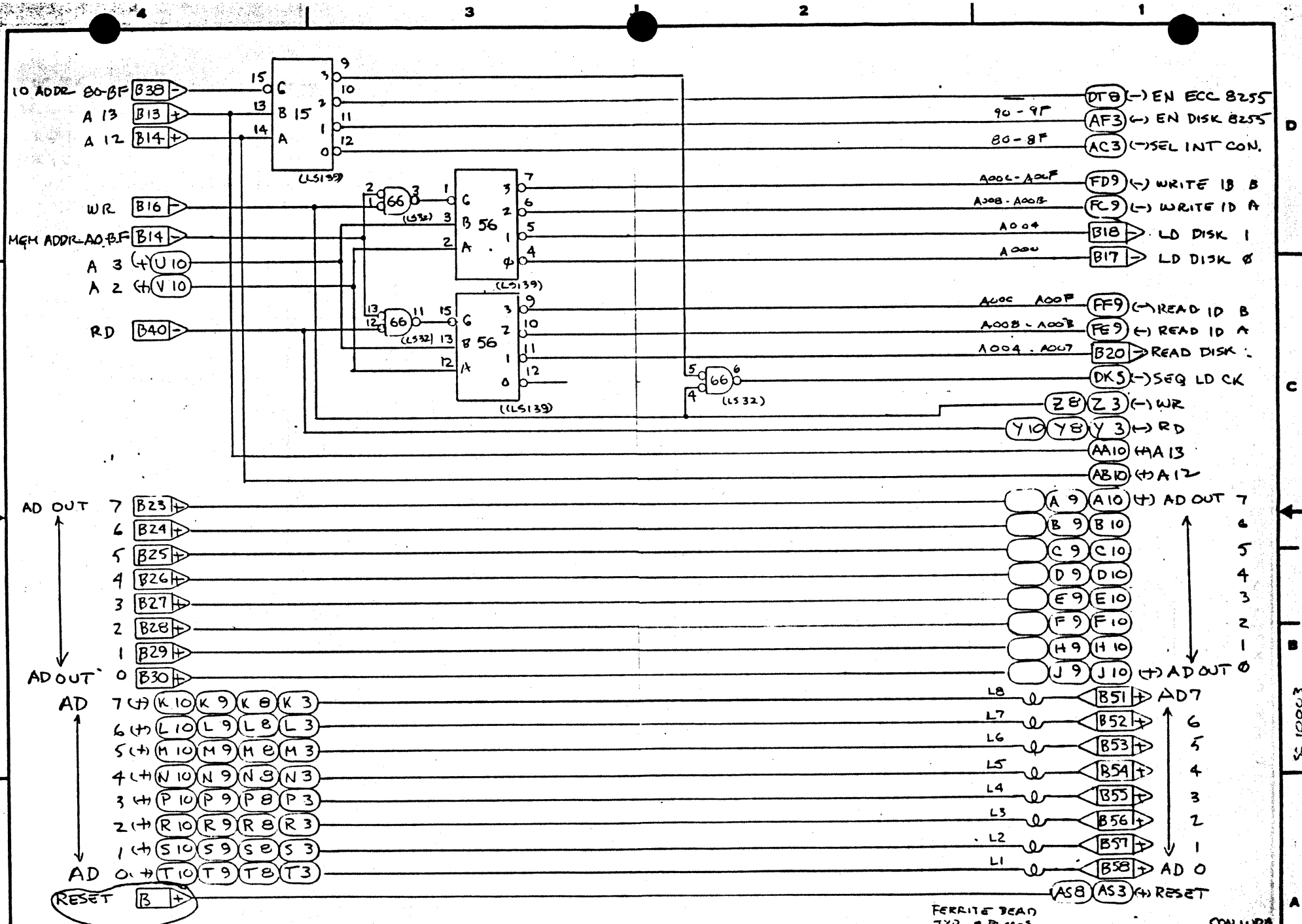
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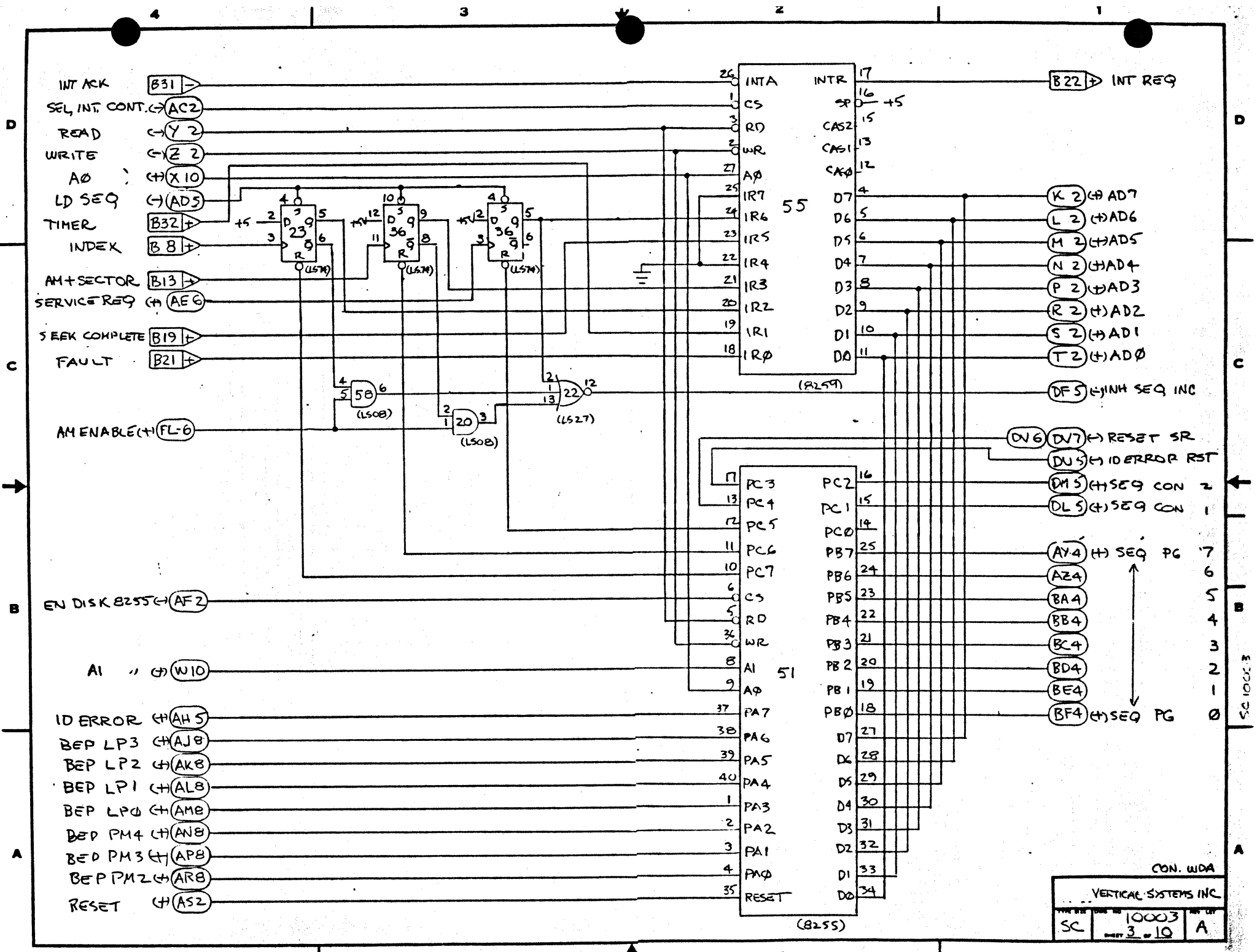
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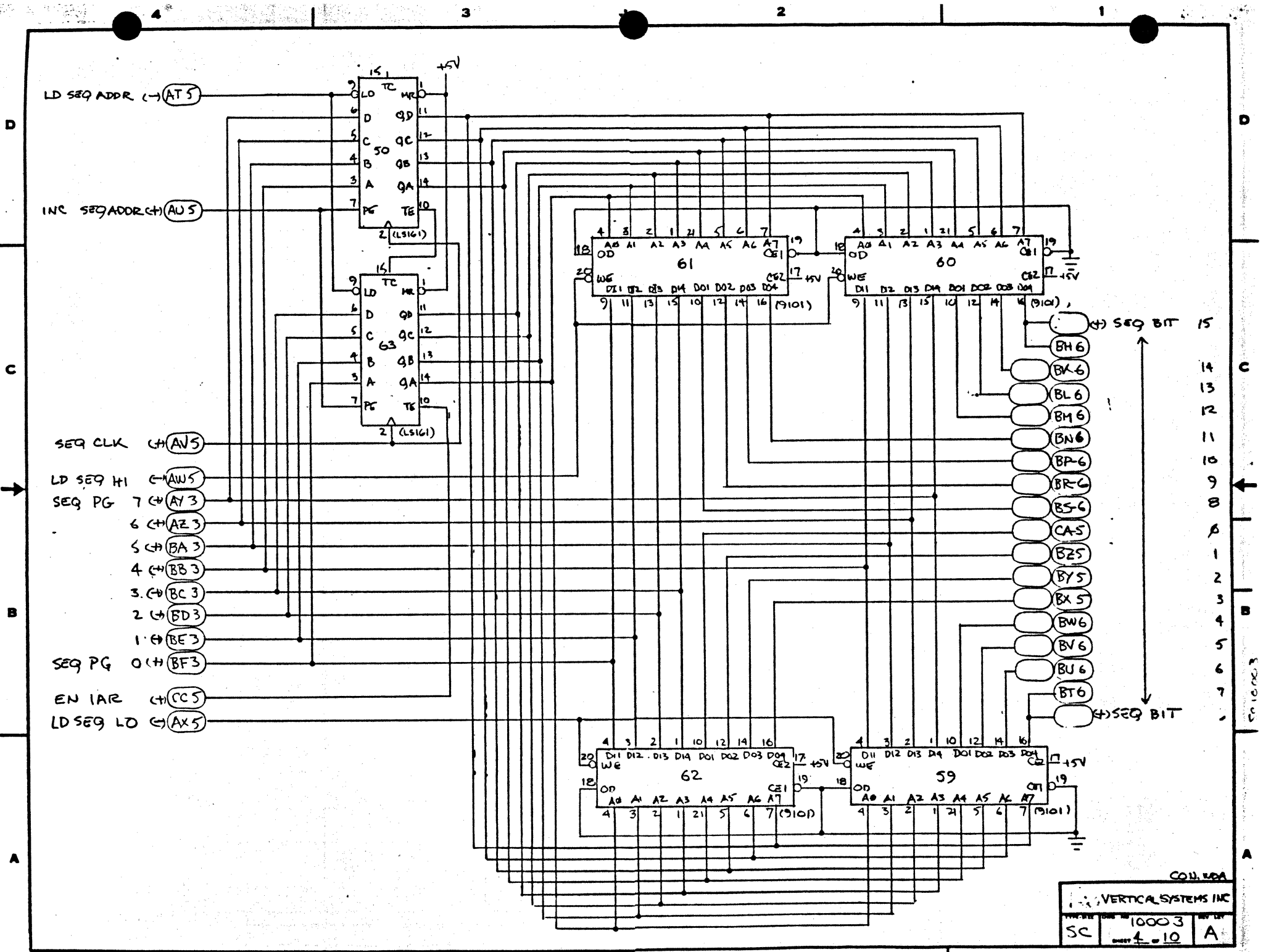
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	THIS PRINT CONTAINS PROPRIETARY INFORMATION. REPRODUCTION OF THIS PRINT OR ANY INFORMATION CONTAINED HEREIN OR MANUFACTURE OF ANY ARTICLE THEREFROM FOR DISCLOSURE TO OTHERS IS FORBIDDEN EXCEPT BY SPECIFIC WRITTEN PERMISSION FROM SECTIA SYSTEMS INC.				UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DIMENSION TOLERANCES: ANGULAR DIMENSION ± 1° DECIMAL 1 PLACE ± .005 DECIMAL 2 PLACE ± .010	
			TITLE	CONTROLLER, WDA		
				VERTICAL SYSTEMS INC.		
			ALL MACHINE SURFACES	✓	DRAWN	CHECKED
			CHAMFER ALL THREADS (5° X 1 FULL THREAD (MINIMUM))	DESIGN	TEW	TYPE SIZE SC
			CHANGE RECORD NO.	DATE	SCALE	DWG NO 10003 SHEET 1 of 10
						REV LET NO A

SC 10003



SC 10003





LD SEQ ADDR (-) (AT 5)

INC SEQ ADDR (+) (AU 5)

SEQ CLK (+) (AV 5)

LD SEQ HI (-) (AW 5)

SEQ PG 7 (+) (AY 3)

6 (+) (AZ 3)

5 (+) (BA 3)

4 (+) (BB 3)

3 (+) (BC 3)

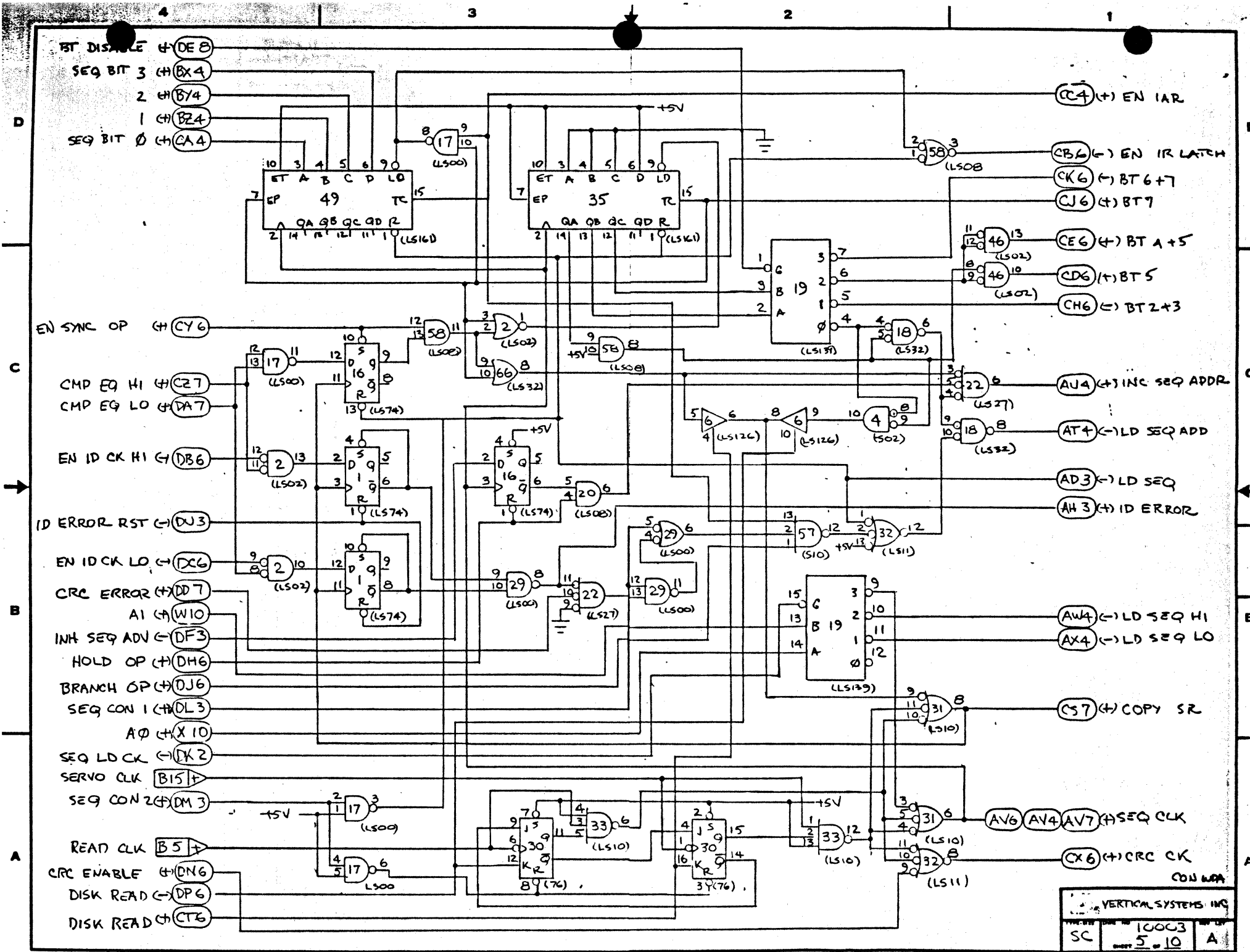
2 (+) (BD 3)

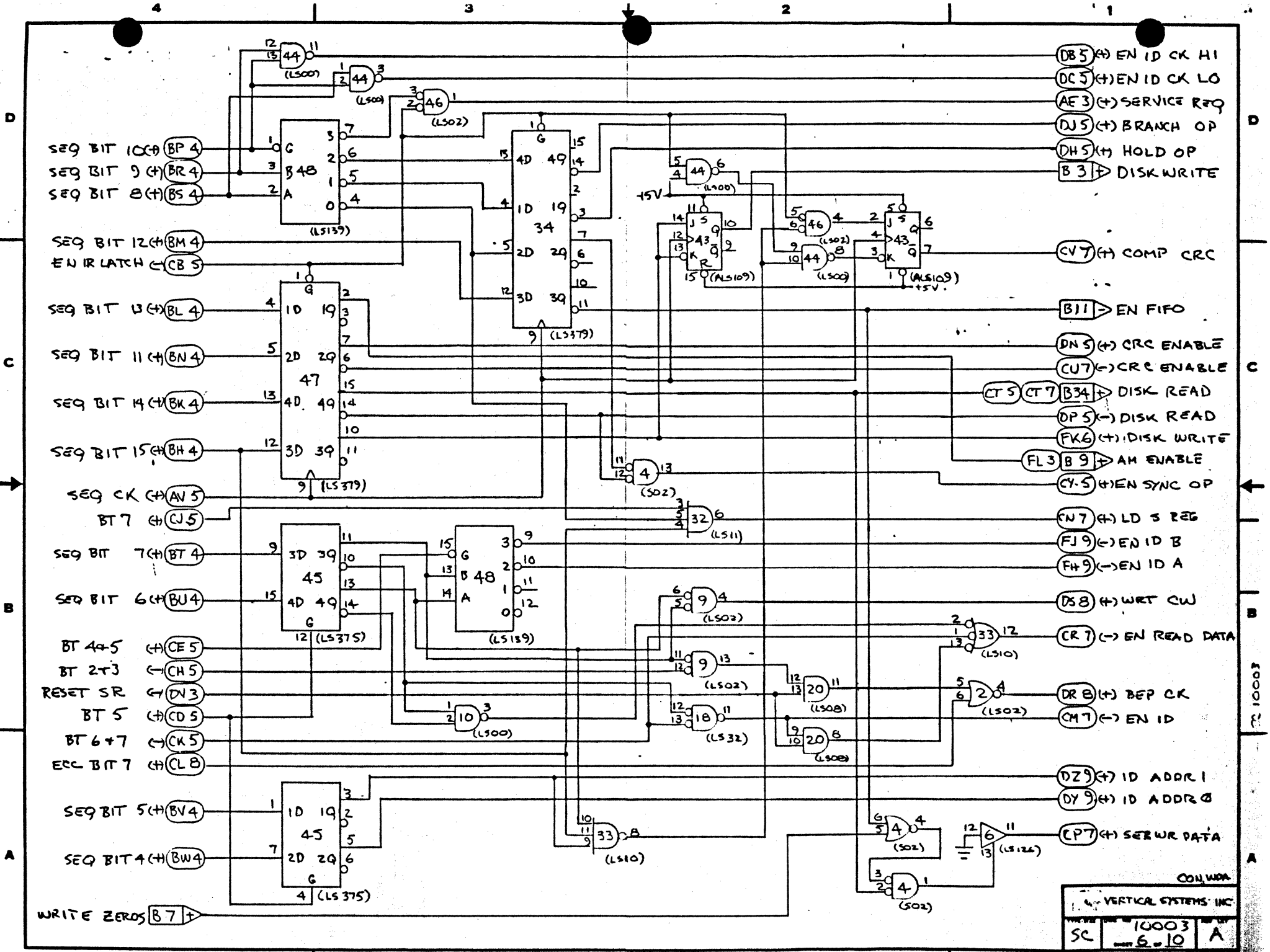
1 (+) (BE 3)

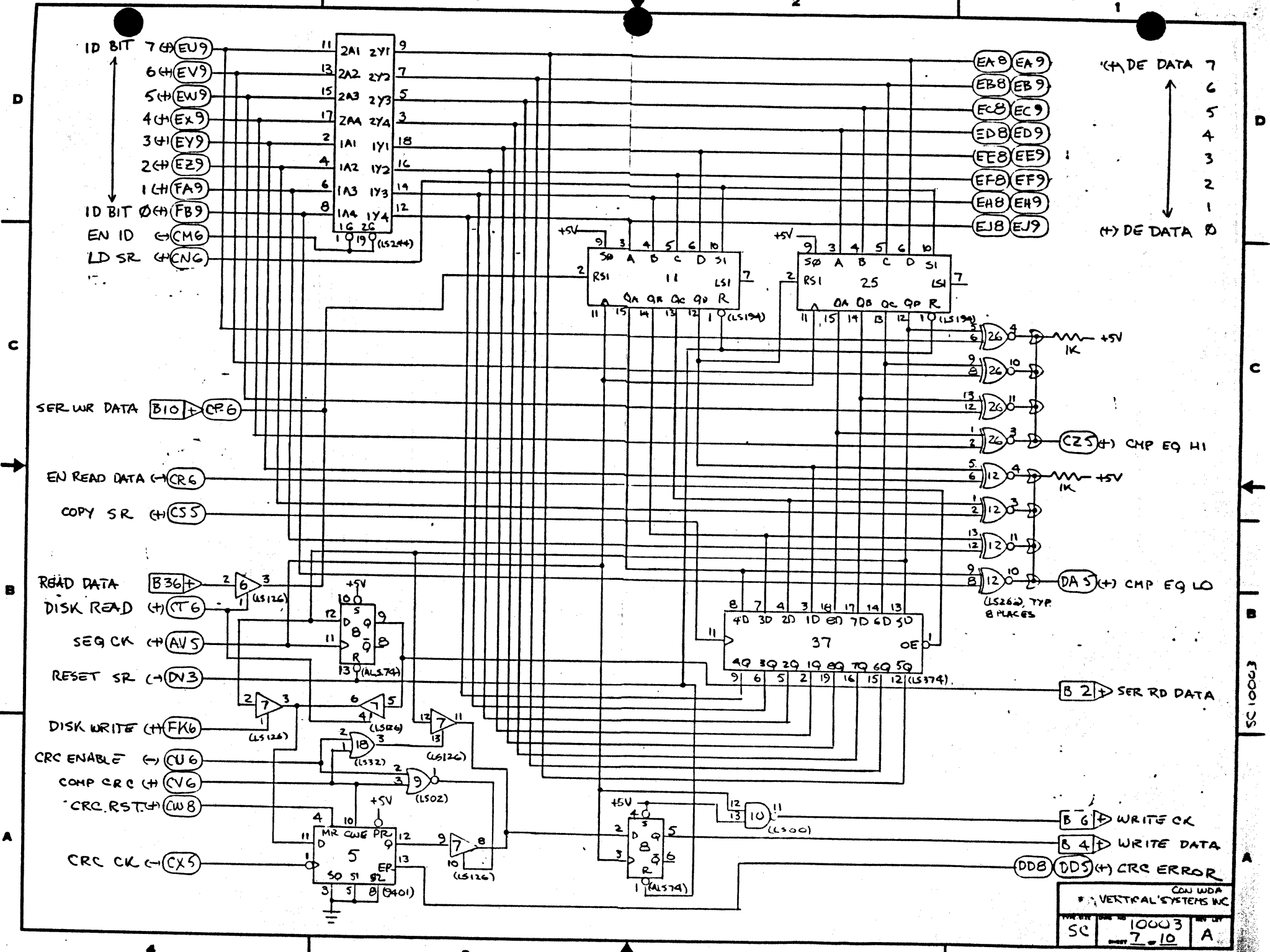
SEQ PG 0 (+) (BF 3)

EN IAR (+) (CC 5)

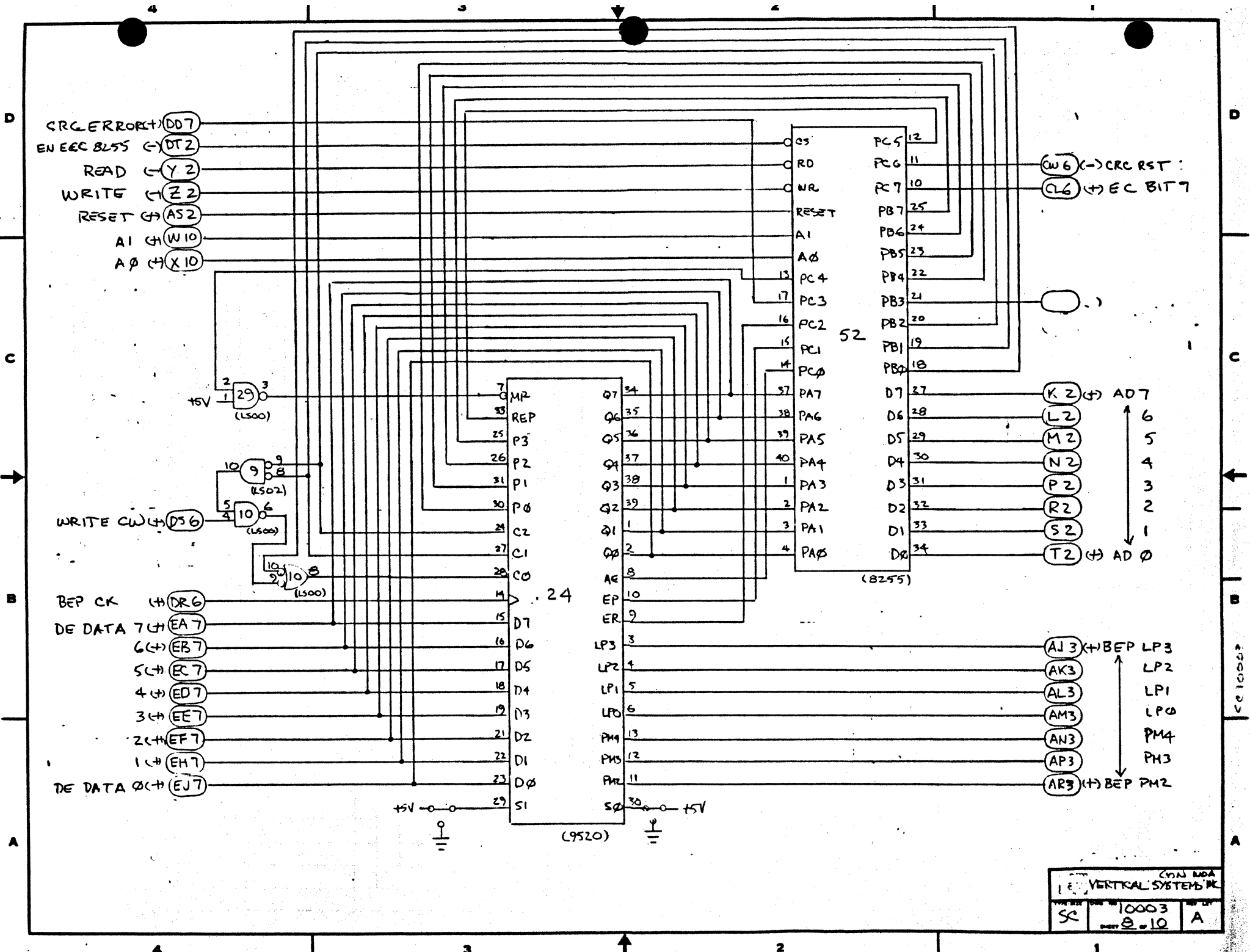
LD SEQ LD (-) (AX 5)



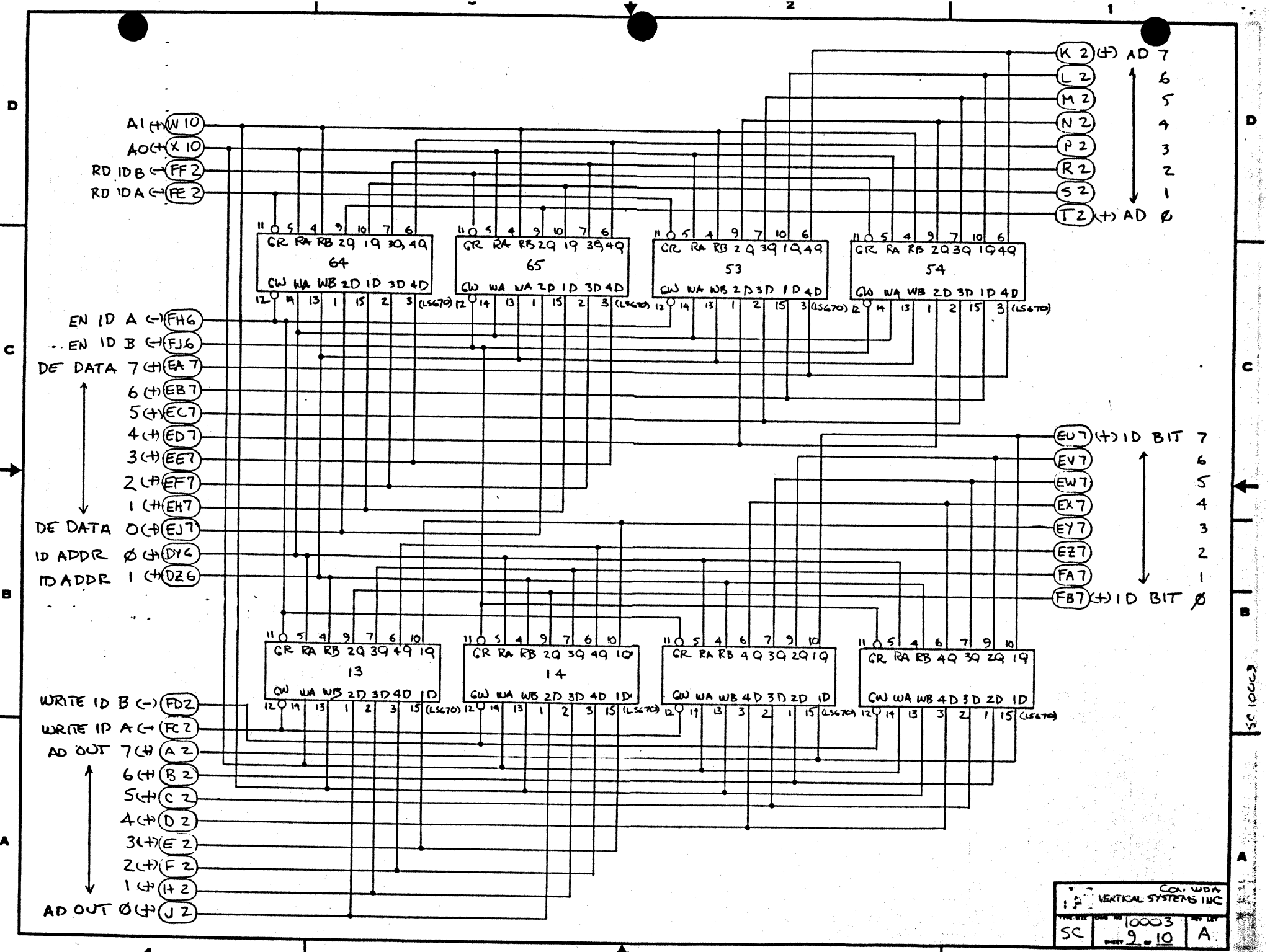




CON WDA		
F. VERTICAL SYSTEMS INC		
DATE	10003	REV
SC	7-10	A



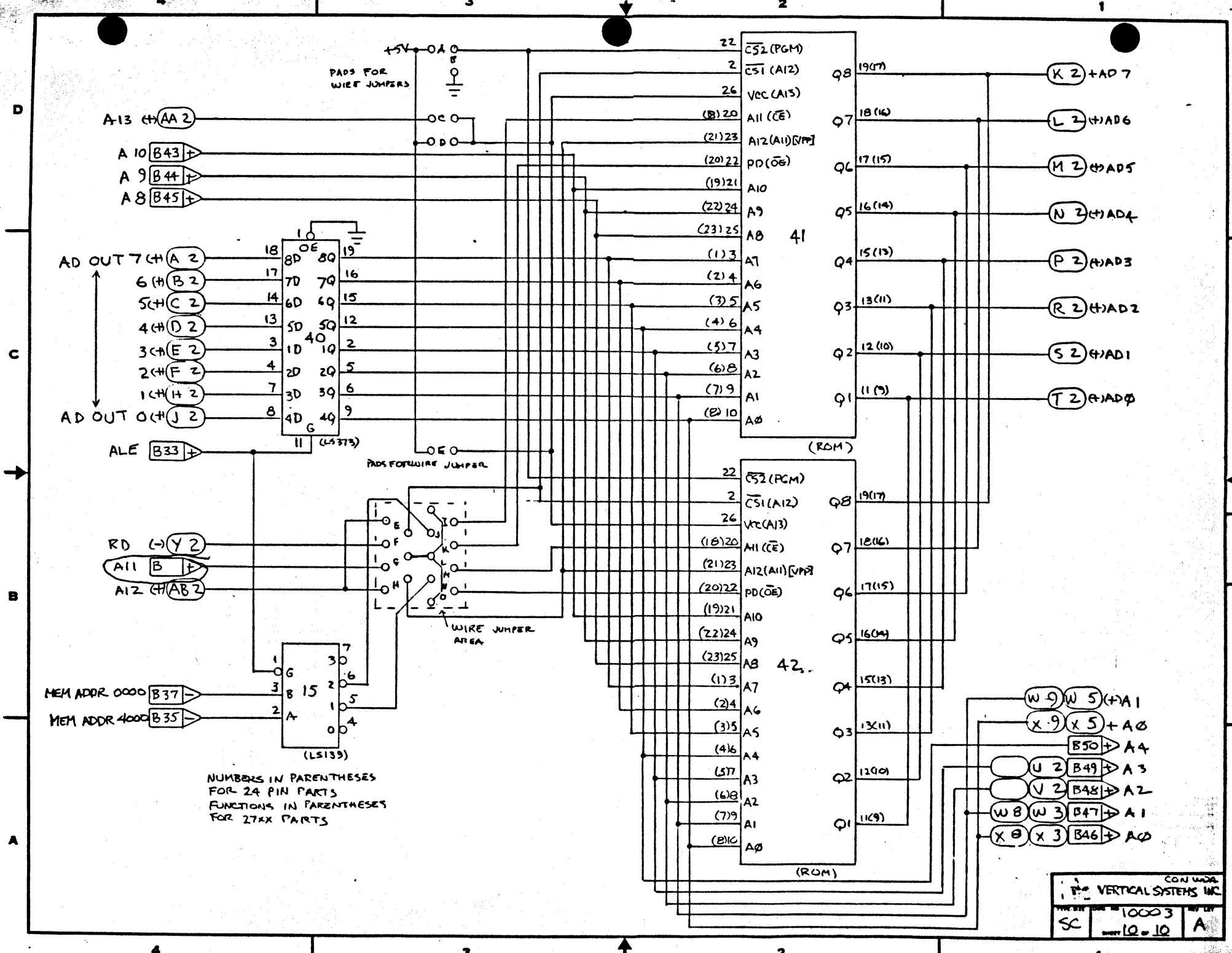
(C) 1984 NDA
 LE VERTICAL SYSTEMS INC
 SC 10003 8-10 A



CON. WOV
 VERTICAL SYSTEMS INC.
 SC 10003
 9-10
 A

SC 10003

A



A-13 (A 2)
 A 10 (B 43)
 A 9 (B 44)
 A 8 (B 45)

AD OUT 7 (A 2)
 6 (B 2)
 5 (C 2)
 4 (D 2)
 3 (E 2)
 2 (F 2)
 1 (H 2)
 AD OUT 0 (J 2)

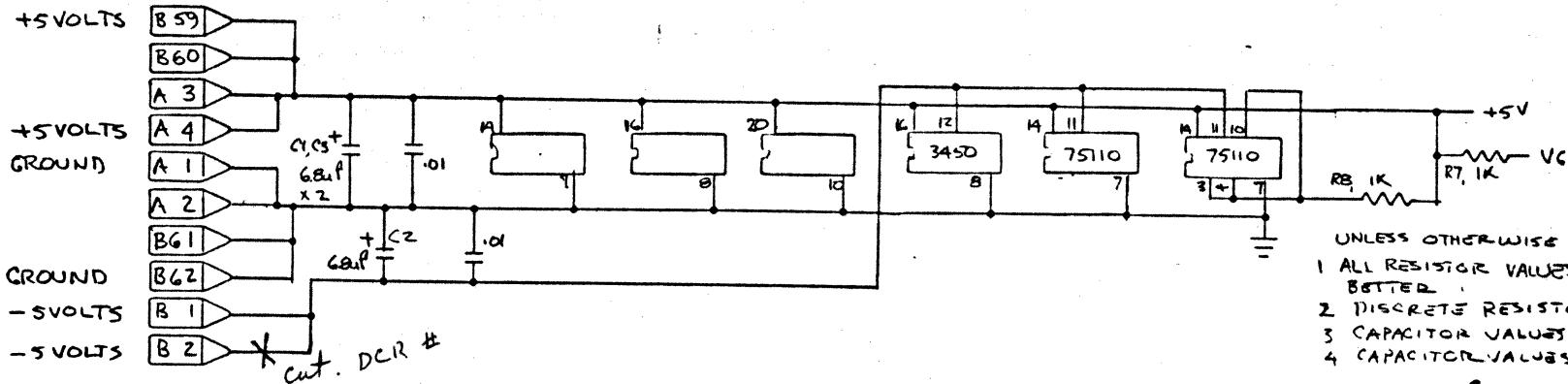
ALE (B 33)

RD (Y 2)
 A11 (B 1)
 A12 (AB 2)

MEM ADDR 0000 (B 37)
 MEM ADDR 4000 (B 35)

NUMBERS IN PARENTHESES
 FOR 24 PIN PARTS
 FUNCTIONS IN PARENTHESES
 FOR 27XX PARTS

CON WDR
 VERTICAL SYSTEMS INC
 10003
 10-10
 A

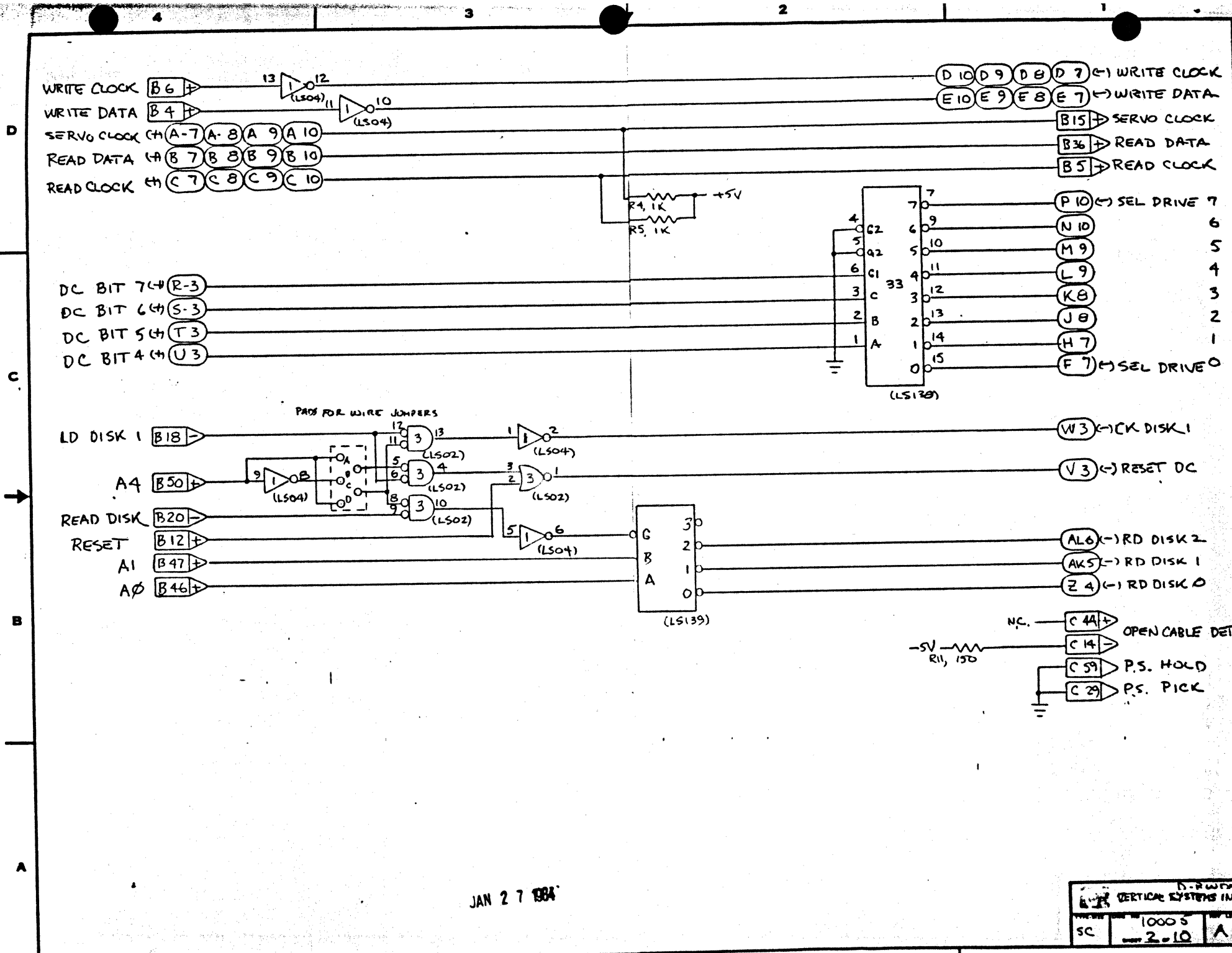


- UNLESS OTHERWISE NOTED:
- 1 ALL RESISTOR VALUES IN OHMS, 5% OR BETTER
 - 2 DISCRETE RESISTORS, 1/4W
 - 3 CAPACITOR VALUES < 1 IN uf
 - 4 CAPACITOR VALUES > 1 IN pf

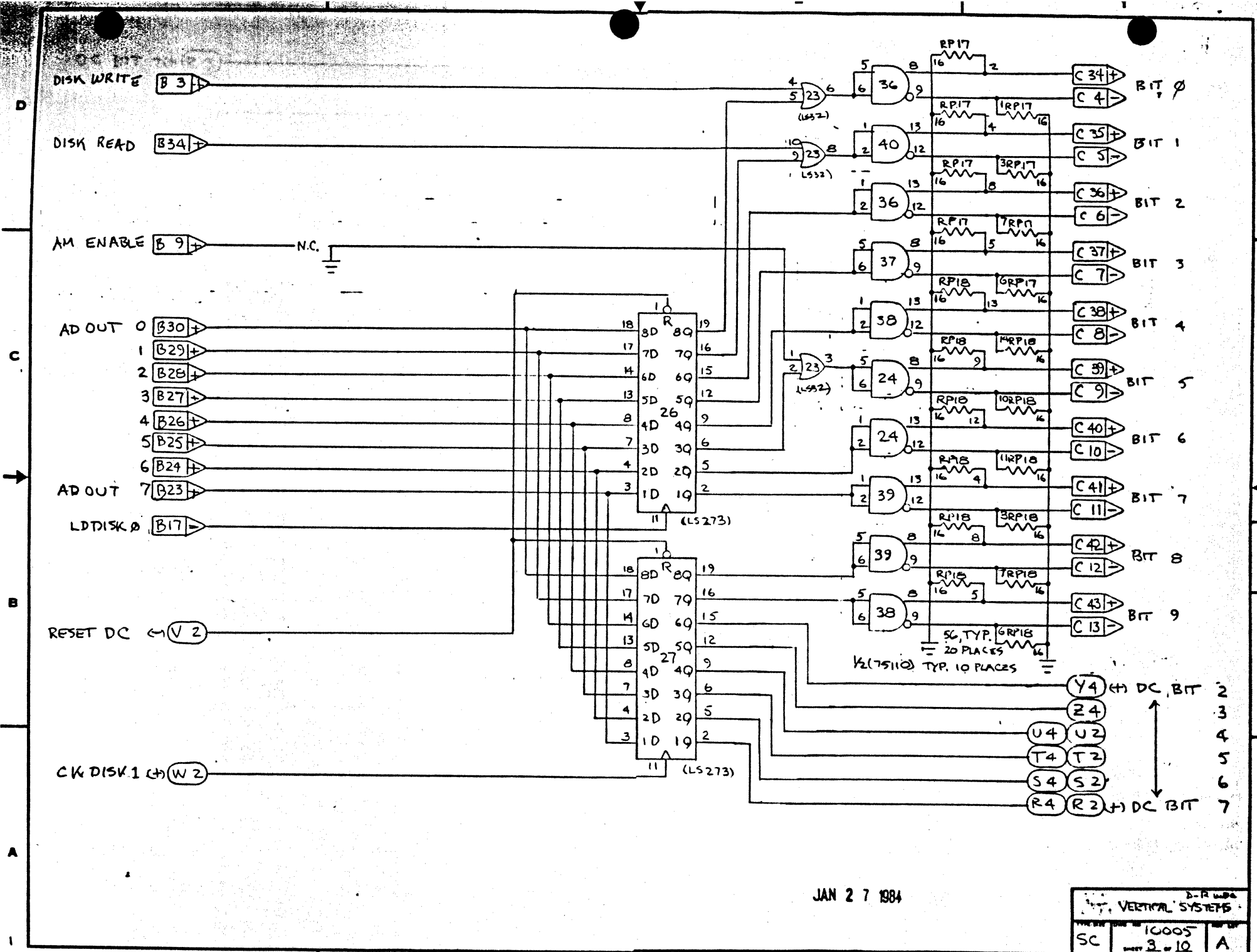
AC 10069

JAN 26 1984

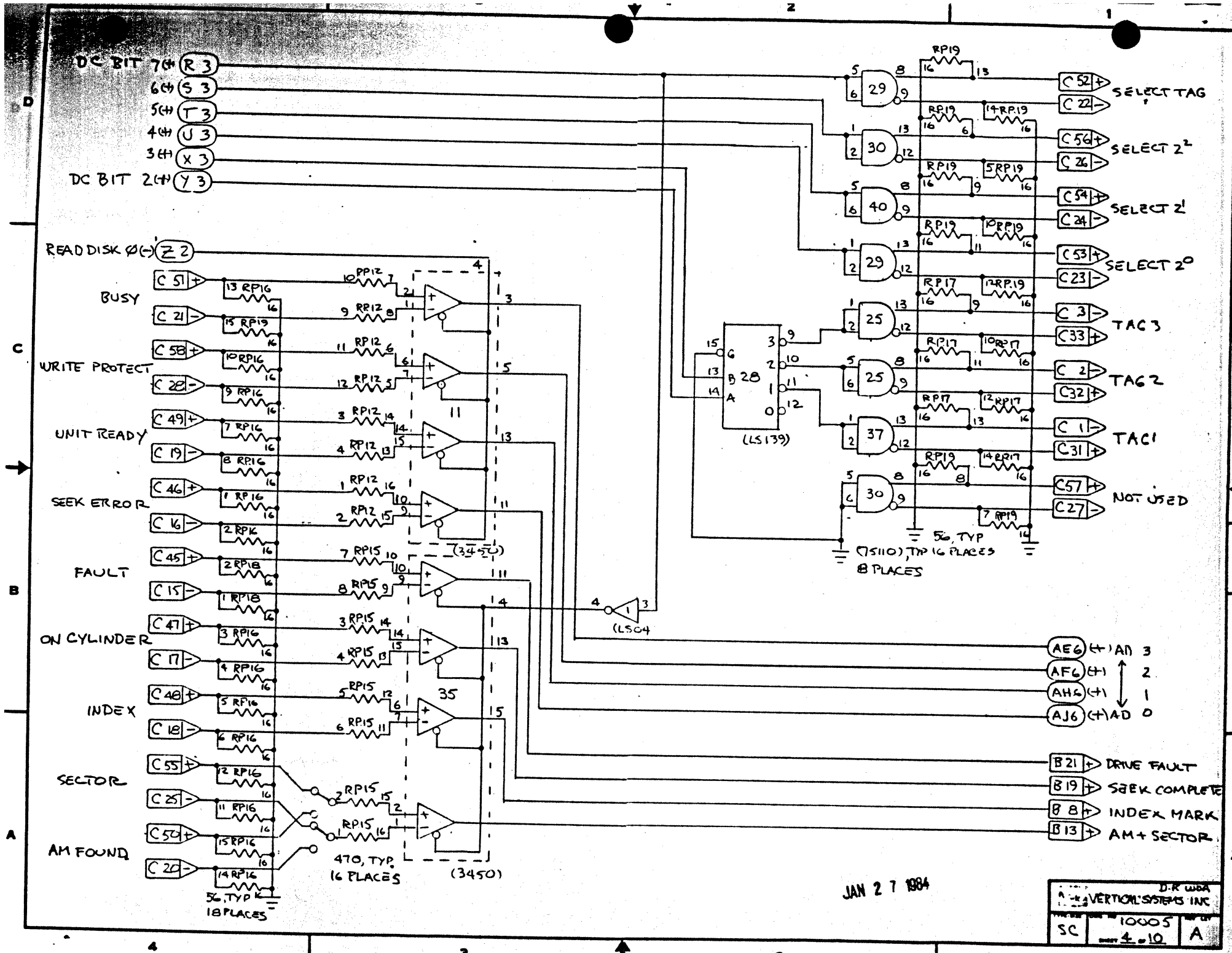
FILE NUMBER	QTY REQD	PART OR FILE NUMBER	NOMENCLATURE	MFG PART NO OR MATERIAL	MFG NAME OR SPECIFICATION	ITEM NO
	THIS PRINT CONTAINS PROPRIETARY INFORMATION REPRODUCTION OF THIS PRINT OR ANY INFORMATION CONTAINED HEREIN OR MANUFACTURE OF ANY ARTICLES HEREFROM FOR DISCLOSURE TO OTHERS IS FORBIDDEN EXCEPT BY SPECIFIC WRITTEN PERMISSION FROM VERTICAL SYSTEMS INC					UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DIMENSION TOLERANCES ANGULAR DIMENSION 1 1/2° DECIMAL 3 PLACE ± .005 DECIMAL 2 PLACE ± .010
	ALL MACHINE SURFACES ✓ Y CHAMFER ALL THREADS #2 X 1 FULL THREAD (INT/EXT)					DO NOT SCALE THIS PRINT
TITLE		DRIVER-RECEIVER, WDA				
DRAWN		VERTICAL SYSTEMS INC				
LETTER	DRW	CHK	DATE	DESIGN	SCALE	CHECKED
				TW	SC	DATE
CHANGE RECORD NO						NO. 10005
						1 OF 10
						A



JAN 27 1984



JAN 27 1984



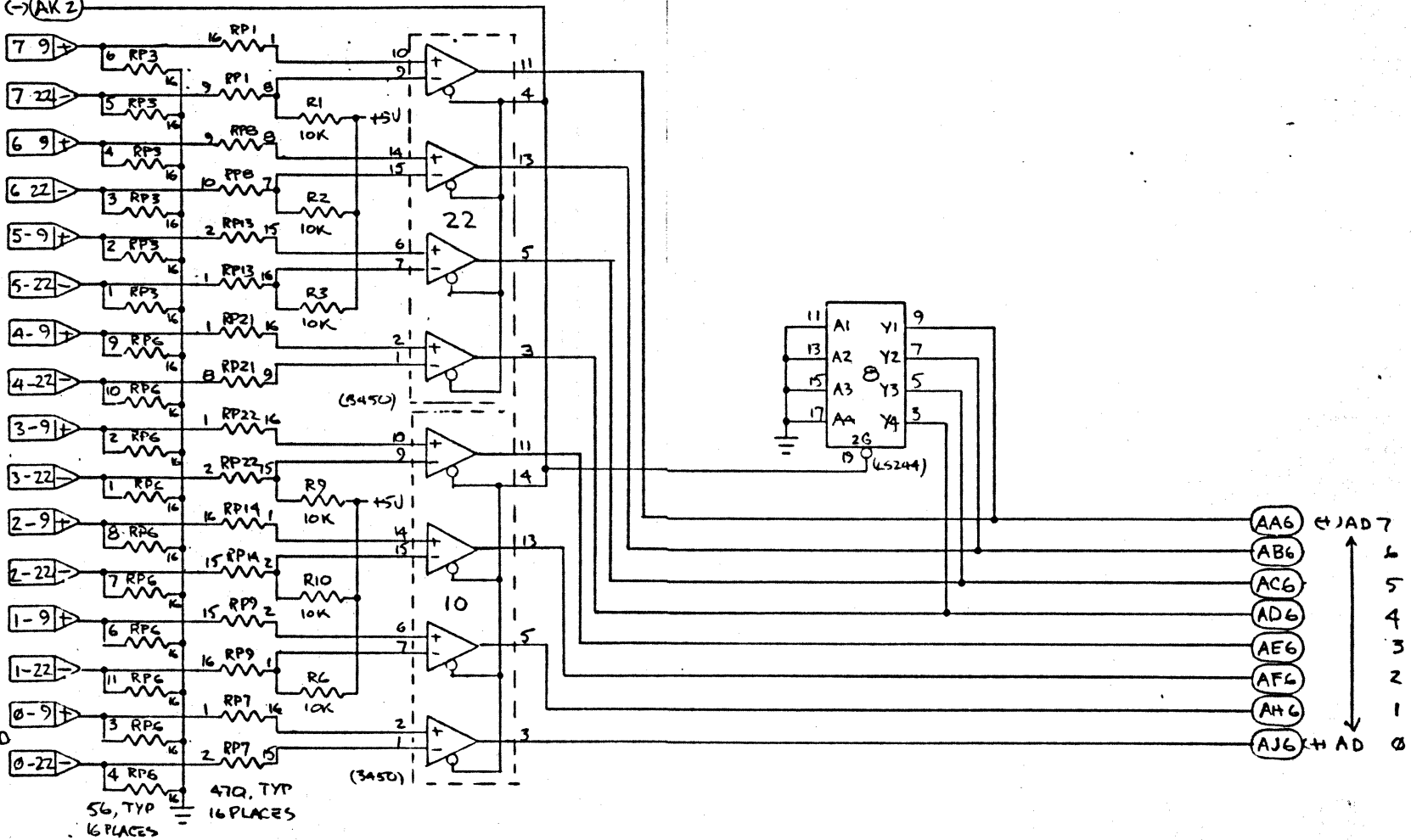
JAN 27 1984

D-R WDA		
A-2 VERTON SYSTEMS INC		
SC	10005	A
	4 of 10	

READ DISK 1 (→) AK 2

UNIT SELECTED

UNIT SELECTED



JAN 27 1964

RD DISK 2 → (AL 2)

SEEK END

SEEK END

56, TYP
16 PLACES

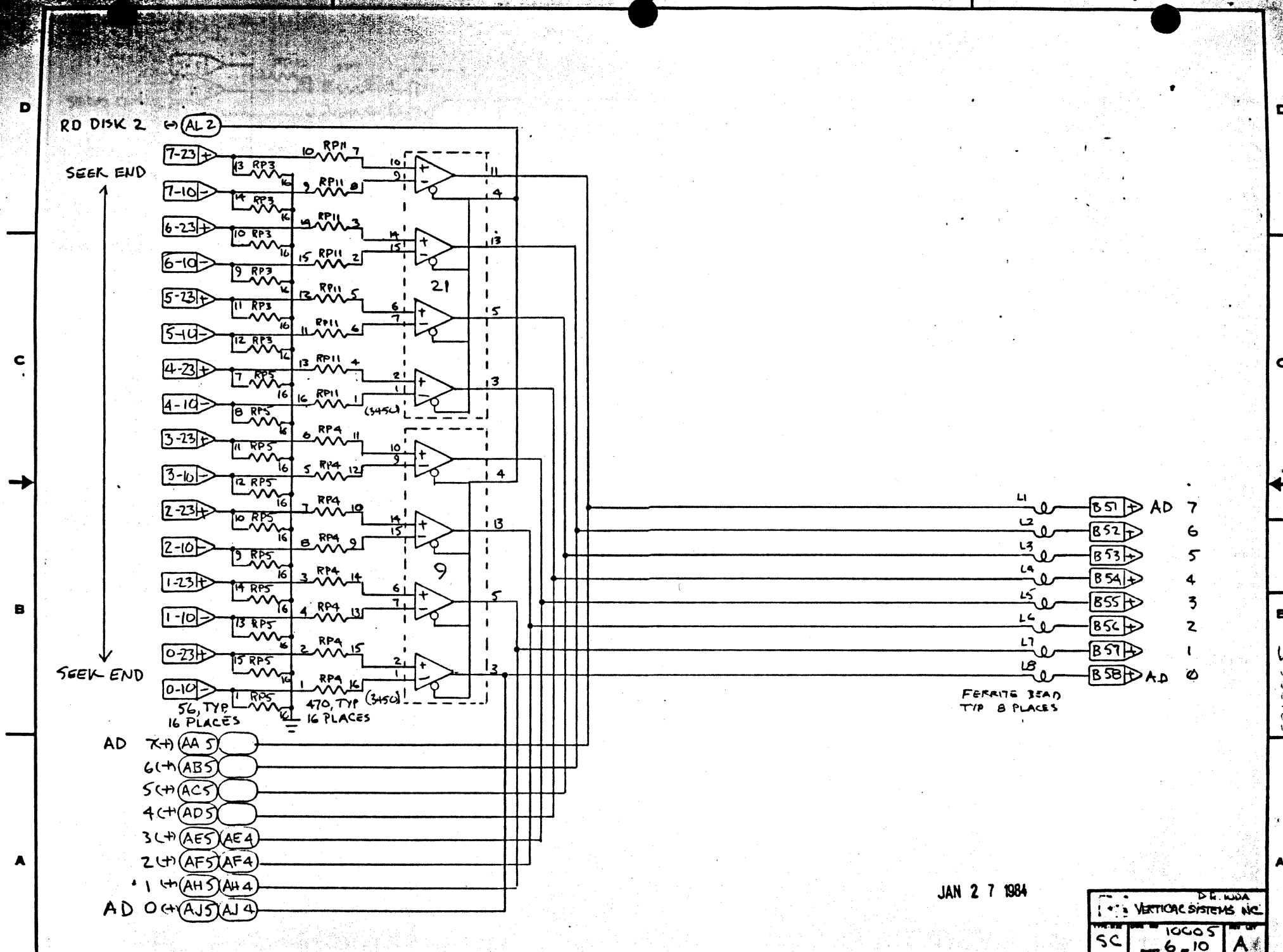
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16 PLACES

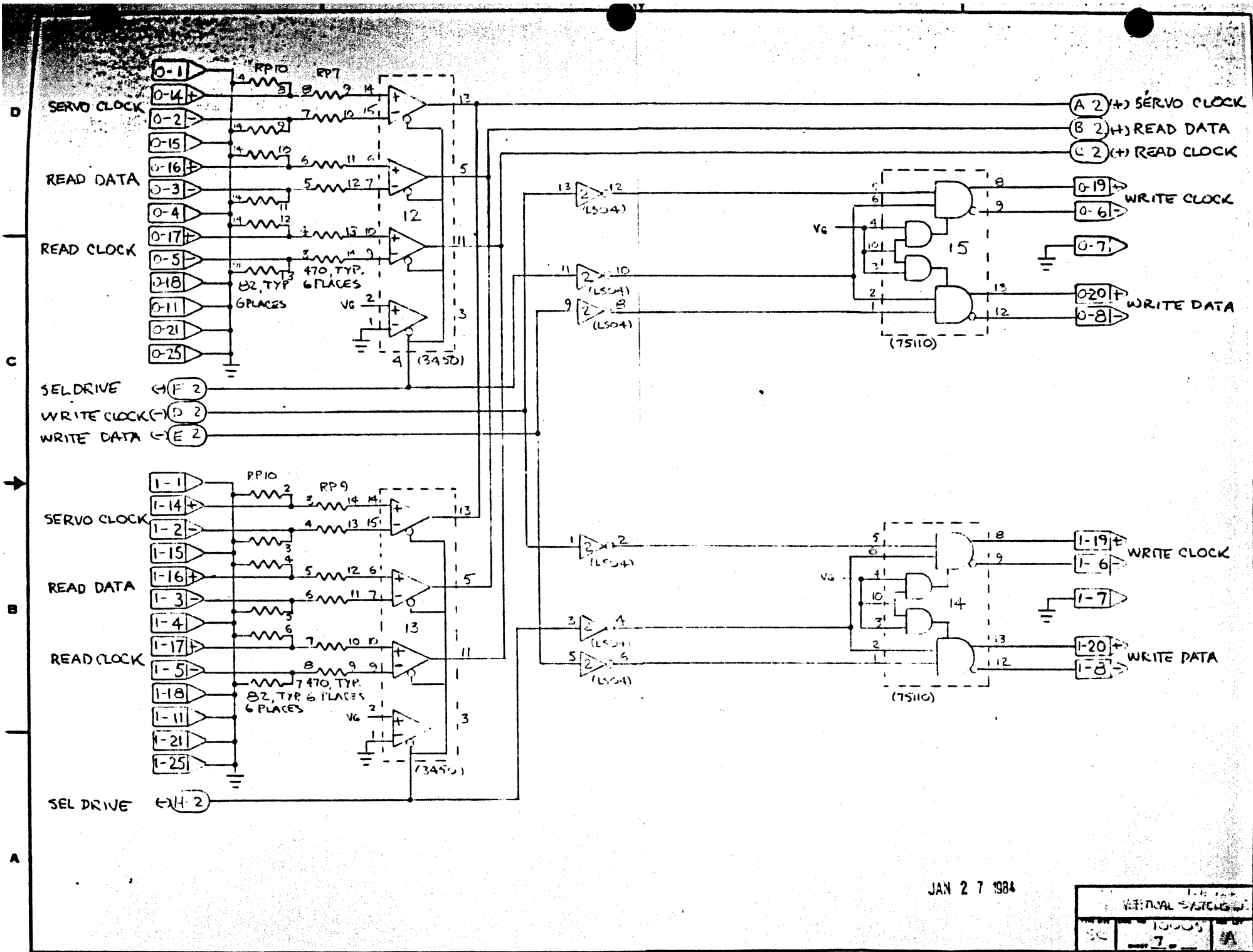
- AD 7 → (AA 5)
- 6 → (AB 5)
- 5 → (AC 5)
- 4 → (AD 5)
- 3 → (AE 5) (AE 4)
- 2 → (AF 5) (AF 4)
- 1 → (AH 5) (AH 4)
- AD 0 → (AJ 5) (AJ 4)

FERRITE BEAD
TYP 8 PLACES

JAN 27 1984

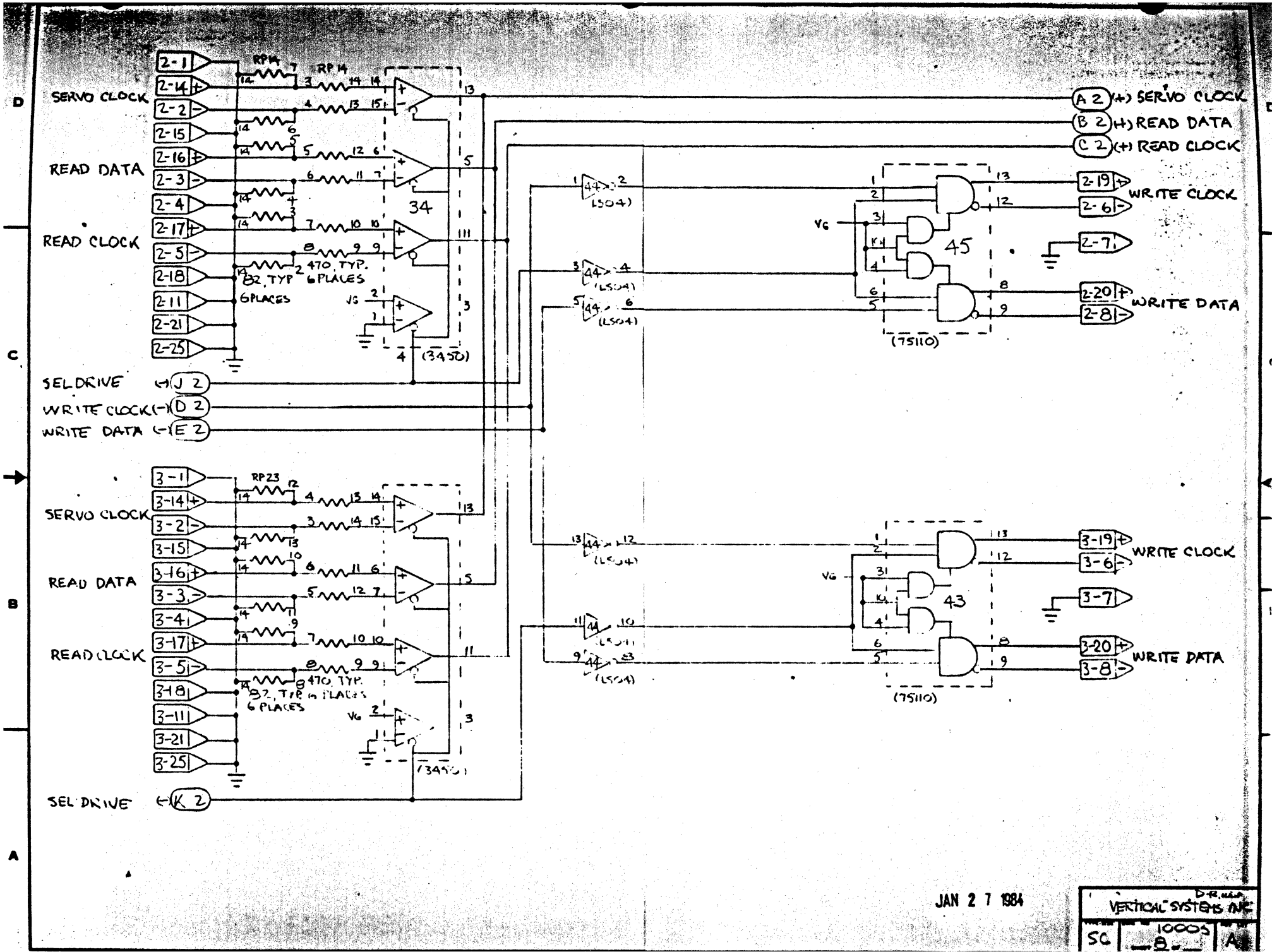
DR. WDA
VERTICAL SYSTEMS INC.
SC 10005
6-10 A





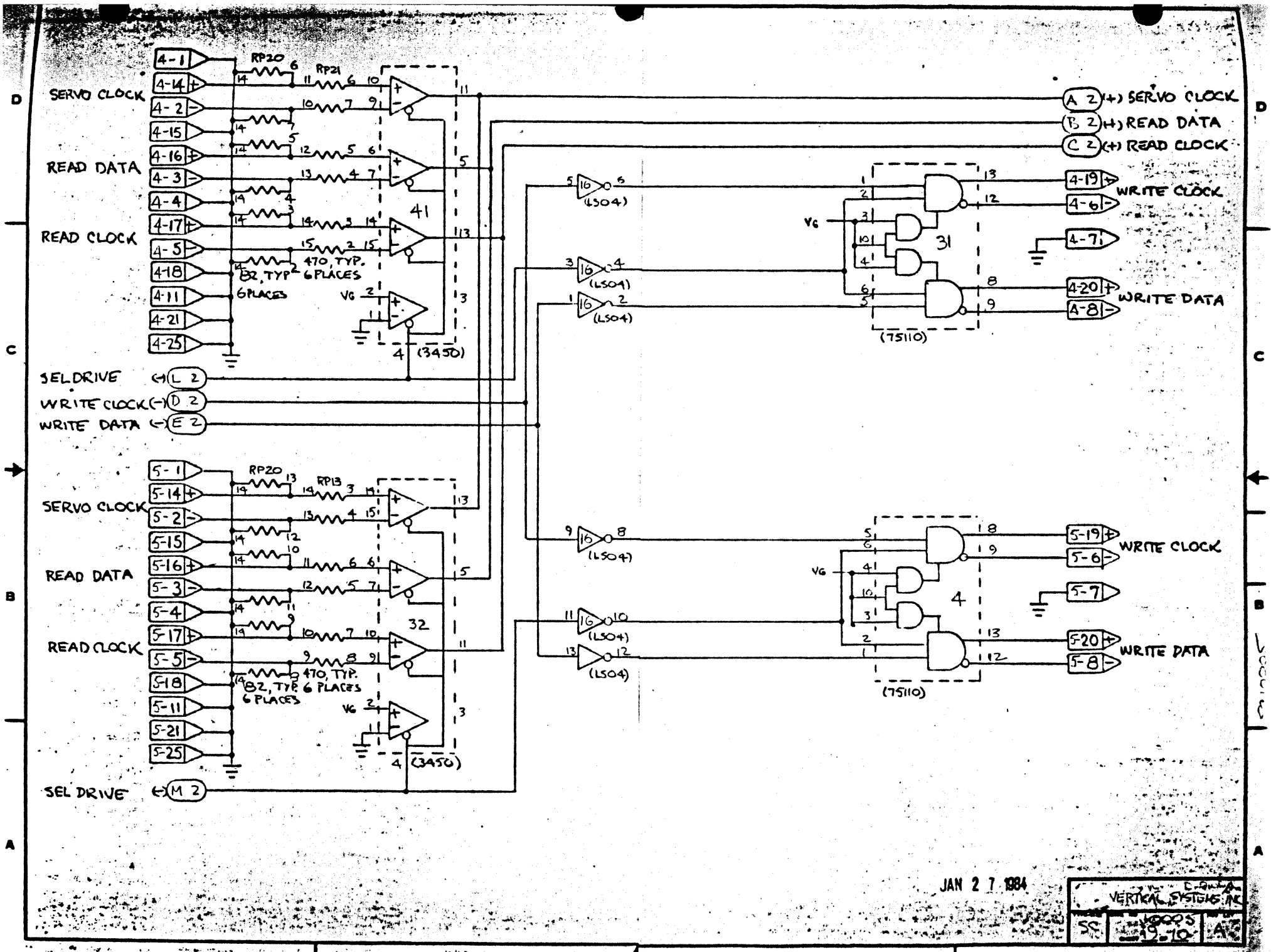
JAN 27 1984

REF ID: A66666		
SC	10005	A
	7	



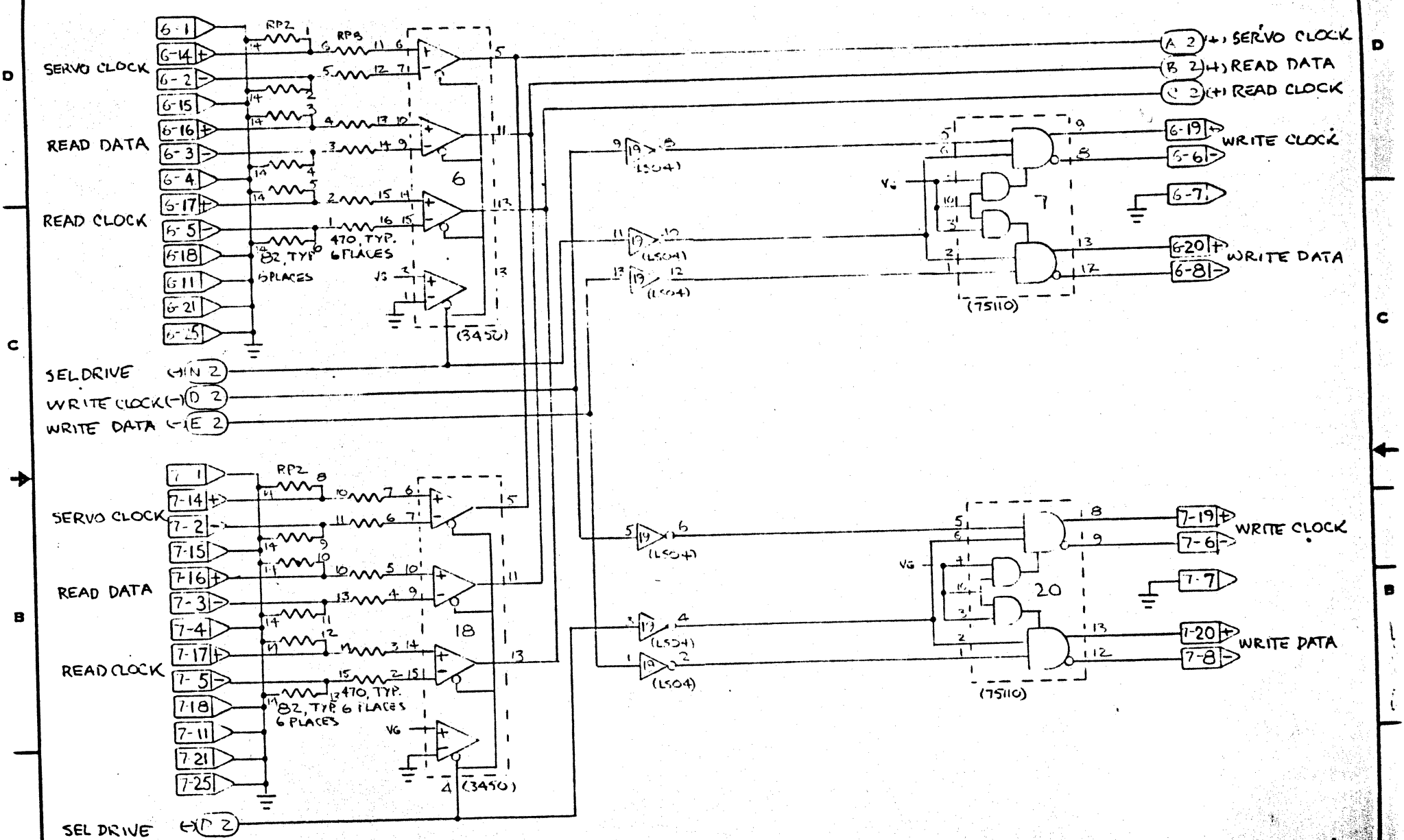
JAN 27 1984

D.R. 10005
 VERTICAL SYSTEMS INC
 SC - B - A



JAN 27 1984

VERTICAL SYSTEMS, INC.
 SS 1000S
 19-10



JAN 27 1984

VERTICAL SYSTEMS INC.		
SC	1005	A
	10/10	