Cromemco

STDC

Disk Controller

Instruction Manual

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Chapter 1

THE STDC HARD DISK CONTROLLER

INTRODUCTION

The Cromemco STDC board is an intelligent hard-disk controller, using the ST-506 standard interface to support a wide variety of 5-1/4" Winchester drives. An STDC-controlled drive can have up to 16 heads and 1024 cylinders.

As an intelligent disk controller, the STDC needs little attention from the host operating system. With its own Z80A microprocessor, 64K bytes of RAM, and direct access to main memory (DMA), the STDC allows the host CPU to continue executing instructions during disk read/write operations, relieving the disk I/O "bottleneck" afflicting many multi-user systems.

System performance is further enhanced by the STDC's four full-track data buffers. On each disk read, an entire track is read into one of the data buffers. When subsequent sector requests are on the same track (as is likely), the data is immediately available. If all the buffers are full when a new read request appears, the STDC either discards or writes back to disk the least-used of the four buffers (based on frequency of access and time since last use).

In addition, the STDC can divide a single disk drive into as many as 32 logical units. Thus, a separate "drive" can be assigned to each user, or the apparent disk size can be matched to a back-up medium.

The STDC board is supported by the following operating systems: Cromix-Plus, 68000 Cromix version 20.63 or higher, and Z80 Cromix version 11.27 or higher. To run the STDC and WDI-II boards concurrently in the same system, the WDI-II must be modified (refer to appendix C).

Table 1-1 lists the STDC's technical specifications.

Table 1-1: STDC TECHNICAL SPECIFICATIONS

Disk Interface:	ST-506
Drives supported:	2
Disk Transfer Rate:	5 megabits/second
Storage per Track:	10K bytes
Buffers:	4 data and 1 verify (10K bytes each)
S-100 Interrupts:	Vectored interrupt w/priority controller
S-100 I/O Ports:	1 (input and output)
Processor Type:	Z80A
Instruction Set:	158 instructions, including the 78 instructions of the 8080 processor
Memory:	64K bytes RAM, 8K bytes ROM
Clock Frequency:	4.000 MHz
Bus	S-100/IEEE-696
Power Requirements:	+8 VDC @ 1.5 amps +18 VDC @ .050 amps -18 VDC @ .050 amps
Operating Environment:	0 - 55 degrees C

INSTALLING THE STDC BOARD

Switch Settings

None.

Jumper-Selectable Options

CPU Selection - When shipped separately, the STDC is configured for use with a DPU or XPU central processor board. To use the STDC with a ZPU, change the jumpers on the solder side of the STDC as shown in figure 1-1.

Port Address - The STDC port address is factory set at F8h. If necessary, the address can be changed to FAh by changing the A1 address bit as shown in figure 1-1.

ZPU Select

Add 2
Jumpers

Cut Trace
and Add
Jumper

A1

Cut and Jump
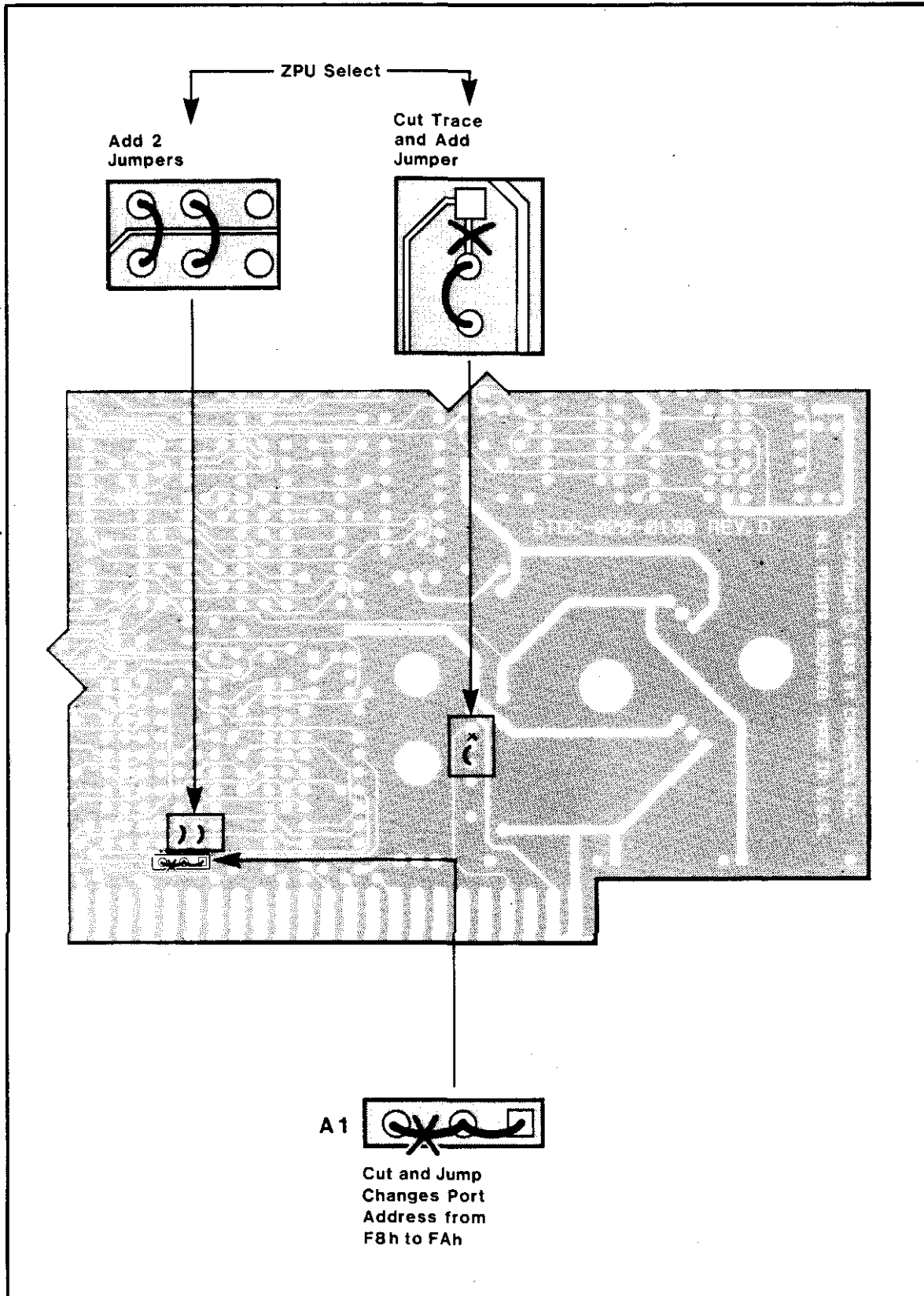Changes Port
Address from
F8h to FAh

Figure 1-1: STDC (SOLDER SIDE)

Cables

After inserting the STDC in any S-100 bus slot, as described in your system manual, install the cables listed below. The data and control cables are supplied with the hard disk drive.

Control Cable – Attach the control cable (Cromemco part number 519-0195) to the 34-pin connector at J1 (figure 1-2), with the red cable stripe (pin 1) to the left. On the drive, the cable stripe must be closest to the edge connector's key slot. If you have two hard disks, install a dual-drive control cable (Cromemco part number 519-0225).

Data Cable – Attach the data cable (Cromemco part number 519-0194) to the 20-pin connector at J5, with the cable stripe to the left. On the drive, the cable stripe must be closest to the edge connector's key slot. If you have two hard disks, install another data cable from J4 on the STDC to the second drive.

Priority Interrupt Cable – The 6-connector priority interrupt cable (part number 519-0029) determines the order in which the host processor services conflicting interrupt requests. Attach the first connector to J1 on the 64FDC/16FDC board by aligning the blue dot on the connector with the blue dot on the plug (see figure 1-3). Aligning the yellow dots on the remaining plugs and connectors, attach the second connector to the next highest priority board, the third connector to the next highest, and so on. The STDC should be the last board in the chain, with the priority cable connected to the right-hand (revision D and higher) IN pin of J2 (see figure 1-2). The OUT pin of J2 is not connected, nor is the IN pin of J1 on the 64FDC/16FDC.

The order of the boards between the 64FDC/16FDC and the STDC is not critical, as long as no boards or connectors are skipped. The suggested order of board priorities is: 64FDC/16FDC, OCTART, TU-ART, IOP, BIART, GPIB, CTI, PRI, and STDC. Any unused connectors must be at the end of the cable farthest from the 64FDC/16FDC. Never connect the priority interrupt cable to the Maximizer, because it could erase all data from the hard disk(s).

If the priority connectors are not color coded, install the cable so that the OUT pin of the higher priority board is linked to the IN pin of the next highest board (the IN pin is on the right on all boards except 64FDC/16FDC, STDC revision C, and CTI).
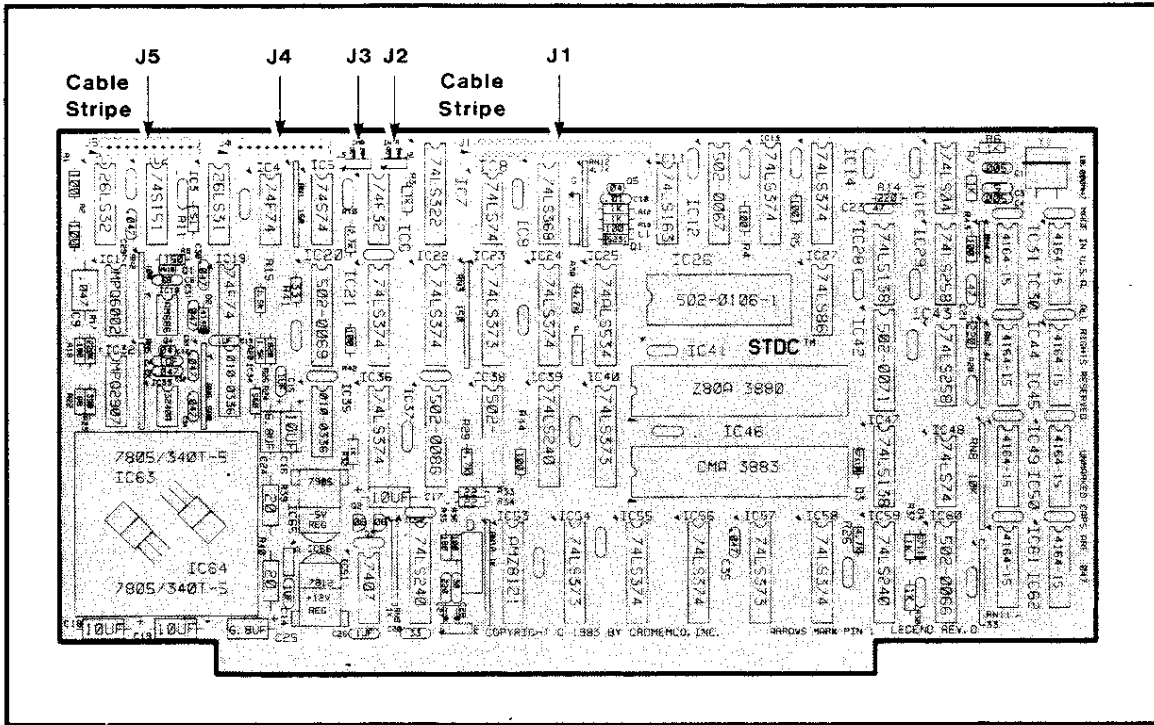
Figure 1-2: STDC (COMPONENT SIDE)
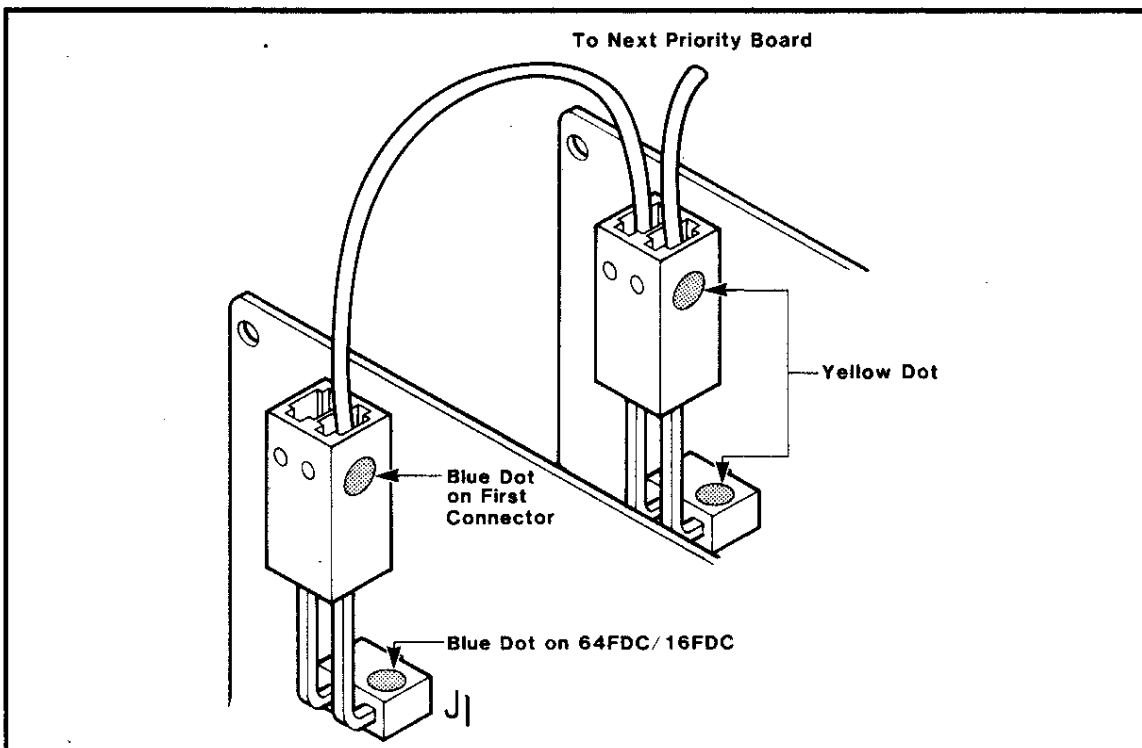
Figure 1-3: INSTALLING THE PRIORITY CABLE

SOFTWARE SET-UP

The procedure for initializing the hard disk drive varies with the version of the operating system. For Cromix-Plus systems, refer to the Cromix-Plus System Administrator's Manual (part number 023-5020); for 68000 Cromix version 20.63, refer to the Release 7 SUDS note (part number 023-9598); and on Z80 Cromix version 11.27, refer to the Release 10 SUDS note (part number 023-9597).

Note that the number of STDC's and hard disk drives that can be installed in a system depends on the operating system, as shown below:

	Cromix-Plus	UNIX	Total Hardware
Number of STDC's	1*	1*	8
Number of drives/STDC	2	1*	2

*Custom software required to add more.

Appendix A

DISK FORMAT

The STDC formats the hard disk by track, not by sector. Each track is formatted to store 10K bytes of data, as follows:

	Bytes	Value
Preamble	64	all zeros
Sync byte	1	04
Start alignment	5	00,AA,AA,AA,00
Header	3	low cylinder, high cylinder, surface #
Data	10,240	
End alignment	4	00,AA,AA,00
End header	3	low cylinder, high cylinder, surface #
CRC	2	varies
Syndrome	2	0000 (if no errors)
Postamble	2	0000

Appendix B

ERROR MESSAGES

In the event of a hard disk error, the Cromix Operating System displays an error message to aid in the diagnosis and correction of the problem.

HARD-DISK ERROR MESSAGES

If the Cromix Operating System encounters an error when accessing a hard disk drive, it displays the error in the following format:

STDC **mode** error: Unit=**uu**, Block=**d**, Head=**h**, Cyl=**cc**, Stat=**xx**, Error=**ffss**

where:

mode	is either Read, Write, Verify, Home, or Seek.
uu	is the minor device number.
d	is the block number in (decimal).
cc	is the cylinder number (hexadecimal).
h	is the head number (hexadecimal).
xx	in the status byte (indicates type or error)
ffss	is the error number. The first two digits give the fatal disk error and the last two give the system disk error.

If bit 0 of the status byte is set to 1, the error numbers refer to the following error codes. If bit 1 is set to 1, the fatal error number (ff) refers to the Cromix errors in the **/equ/jsysequ.asm** file (refer to appendix A of the Cromix-Plus Programmer's Reference Manual, part number 023-5014).

Hard-Disk Fatal Errors

The following error codes are displayed when a fatal disk error occurs:

00   Failed to Seek & Read Header during R/W

An error occurred during an attempt to seek & read the header preceding a read/write operation.

01   Failed to Seek - Timeout

The seek did not complete within a specified time. Check the drive electronics.

02   Fault Occurred during Seek

During the seek, a fault error occurred within the drive, as reported by the drive. This may be any of several errors.

03   Failed to Seek to Correct Track

The sector header as read off the disk is not what the drivers expected, thus the current disk location is incorrect.

04   Failed to Read CRC of Header

The CRC for the header as read from the disk is incorrect; it is different than what was expected. Most likely, the current disk location is incorrect or the media surface is damaged.

05   Failed to Rezero - Timeout

A rezero command did not complete within a specified time. Check the drive electronics.

06   Fault Occurred after Rezeroing

A fault error occurred within the drive after a rezero command was executed. This may be any of several errors.

07   Drive not Ready

The ready signal from the drive is not active. Make sure the drive is connected properly.

08   Failed to Write - Fault Error

During the write, a fault error occurred within the drive, as reported by the drive. This may be any of several errors.

09   Failed to Verify after Write

After data is written to the disk, it is read back and verified. This error occurs if the data cannot be properly verified.

0A   Failed to Read - Fault Error

During the read, a fault error occurred within the drive, as reported by the drive. This may be any of several errors.

0B   Failed to Read - CRC Error

The CRC read from the disk is incorrect; it is different than the expected CRC. This error usually means that the data just read is incorrect.

0C   Failed to Read - Cannot Locate Sector

The sector cannot be found on the current track. This error occurs if the media surface is damaged or if the controller electronics are not functioning properly.

0D   Surface is Write Protected

The surface selected for the current write command is write protected and cannot be written to.

0E   Failed to Select Unit

There was an attempt to select a drive that was not present, or the controller or drive malfunctioned.

0F   Failed to Select Head

The drive has returned a fault error on attempting to select a non-existent head.

10   Index Pulse Timeout

Index pulses were not being received properly.

11   Seek Range Error

There was an attempt to access a non-existent track.

12   Buffer not Available

Error occurred while trying to flush write buffers.

Hard Disk System Errors

The following error codes are displayed when a system disk error occurs:

00   No Acknowledge Received from Drive

The drive did not acknowledge a command sent to it. Make sure the drive is connected properly.

01   Drive Remains BUSY - Acknowledge Stuck Low

The acknowledge signal from the drive did not go high again after the command strobe went inactive.

02   Timeout Occurred during Rezeroing

A rezero command did not complete within a specified time. Check the drive electronics.

03   Fault Condition Reported by Drive

A fault condition occurred within the drive, as reported by the drive. This may be any of several errors.

04   Failed to Read - CRC Error

The CRC just read from the disk is incorrect; it is different than the expected CRC. This error usually means the data just read is incorrect.

05   Header Off the Disk Does Not Compare with Expected Header

The sector header as read from the disk is not what the drivers expected. Thus, the current disk location is incorrect.

06   Failed to Verify after Write Operation

After data is written to the disk, it is read back and verified. This error occurs if the data cannot be properly verified.

07   Header or Trailer Error

The format of the sector header or trailer just read is incorrect.

Appendix C

USING THE STDC WITH A WDI-II

To operate the STDC and WDI-II boards concurrently in the same system, the WDI-II must be modified as described in this appendix. This procedure applies to revisions C and D of the STDC, and revision D of the WDI-II.

Note: The following modification should be done only by your local authorized Cromemco dealer, distributor or service facility.

1. Position the WDI-II board with the solder side up and the edge connector towards you.

2. Solder together pins 32 and 33 of IC42. Solder a 5-inch insulated jumper to IC42 pin 33, and run it through the feed-through hole just above pin 33 (figure C-1).

3. Turn the board over so the component side is up and the edge connector is towards you.

4. Cut the traces from pins 32 and 33 of IC42 (figure C-2).

5. At the feed-through hole to the right of IC1 Pin 7, cut the trace going to IC43 pin 13 (figure C-2).

6. Solder the 5-inch jumper from the solder side to the feed-through hole at the right of IC1 pin 7 (figure C-2).

7. Install a 2-pin connector (Cromemco part number 017-0009) at J3, to the left of IC1 (figure C-2).

8. On the STDC board, install a 2-pin connector at J3 if it is not already in place (figure 1-2).

9. Install the WDI-II and STDC boards, and connect the DMA priority cable from the right-hand OUT pin of J3 on the WDI-II to the right-hand IN pin of J3 on the STDC (figures C-2 and 1-2).

This completes the modification. Follow normal checkout procedures to verify proper operation.
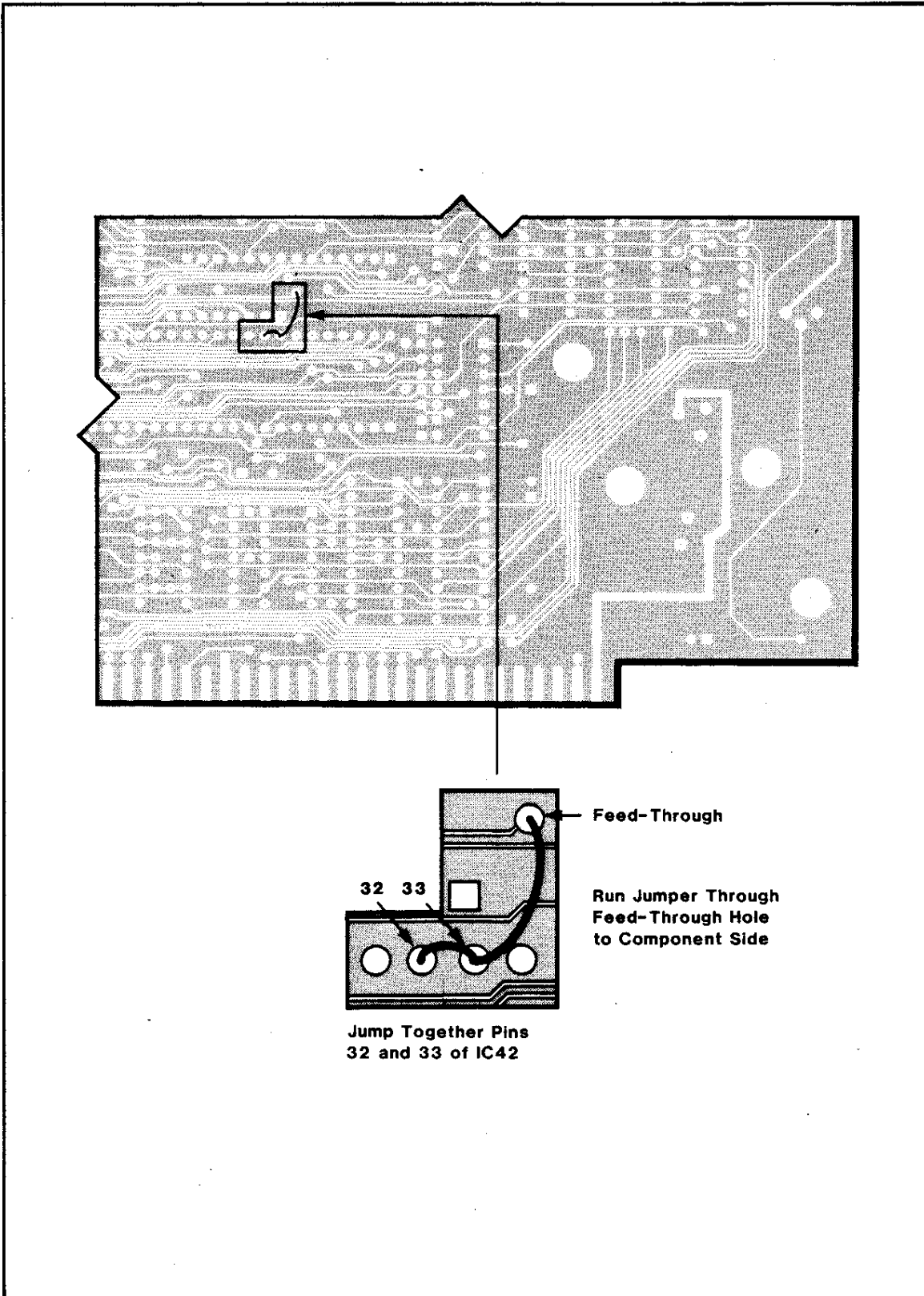
Feed-Through

**Run Jumper Through
Feed-Through Hole
to Component Side**

32   33

**Jump Together Pins
32 and 33 of IC42**

Figure C-1: WDI-II MODIFICATIONS (SOLDER SIDE)

14

Cut Trace to
IC43 Pin 13

Jumper from
Solder Side

Install 2 Pin
Connector
at J3

Out

Feed-Through

33   32
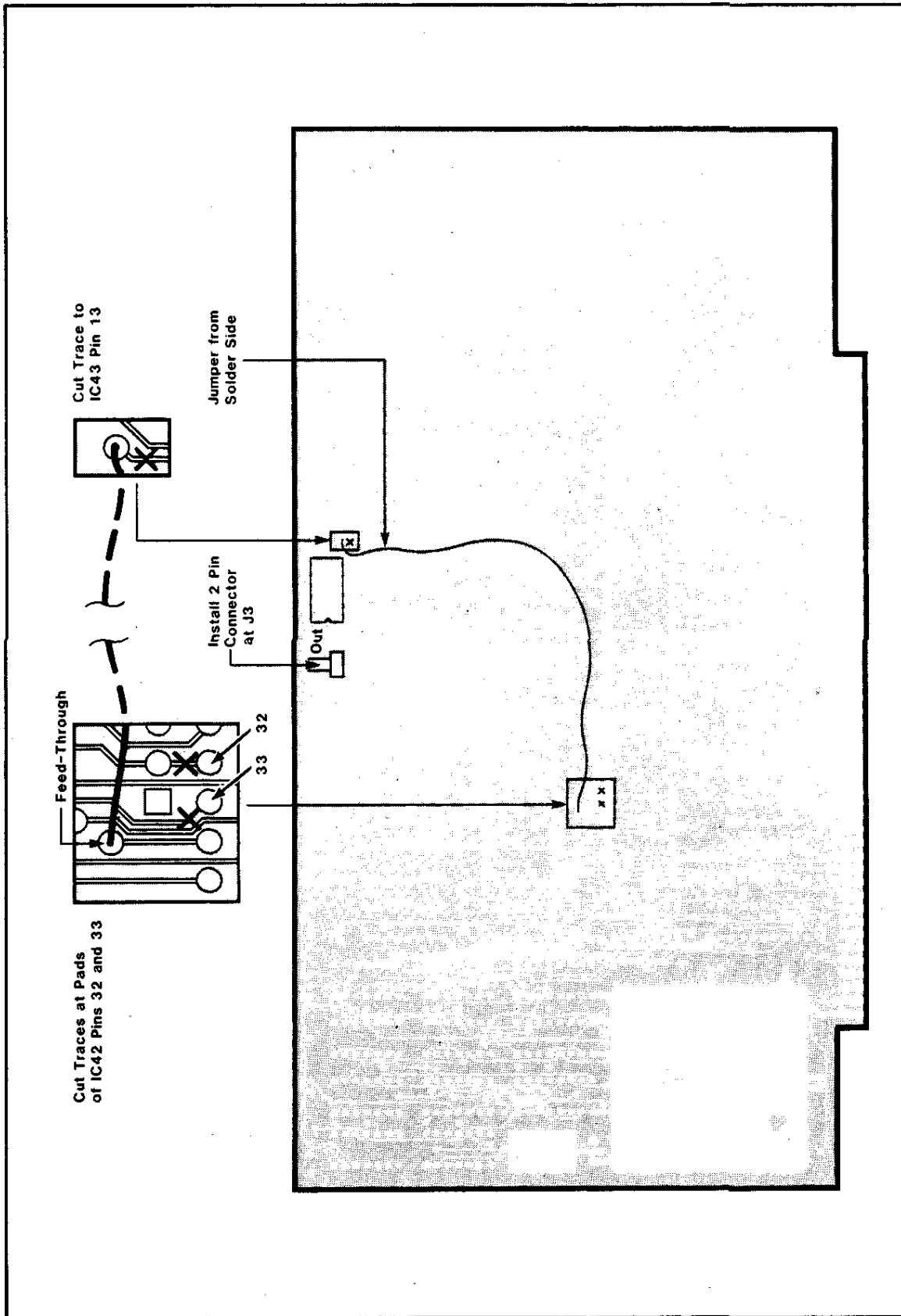
Cut Traces at Pads
of IC42 Pins 32 and 33

Figure C-2: WDI-II MODIFICATIONS (COMPONENT SIDE)

Appendix D

STDC PARTS LIST

Integrated
Circuits

Designation	Cromemco Description	Part No.
IC1	26LS32	010-0360
IC2	74S151	010-0156
IC3	26LS31	010-0361
IC4	74F74	010-0337
IC5	74S74	010-0142
IC6	74F32	010-0377
IC7	74LS322/AM25LS22	010-0362
IC8	74LS74	010-0055
IC9	74LS368	010-0153
IC11	74LS163	010-0128
IC12	Sckt 20 pin	017-0004
	Pal STDC Disk Formatter	502-0067
IC13-14	74LS374	010-0133
IC16	74LS04	010-0066
IC17	MPQ6002	012-0070
IC18	AM686 CNI	011-0108
IC19	74F74	010-0337
IC20	Sckt 20 pin	017-0004
	Pal STDC NRZ-MFM Precom	502-0069
IC21-22	74LS374	010-0133
IC23	74LS373	010-0102
IC24	74LS374	010-0133
IC25	74ALS354	010-0397
IC26	Sckt 28 pin	017-0071
	ROM Code STDC	502-0106-3
IC27	74LS86	010-0052
IC28	74LS138	010-0096
IC29	74LS258	010-0101
IC30-31	64K RAM 128 Cycle	011-0107
IC32	MPQ2907	012-0071
IC33	CA3240A RCA	012-0028
IC34-35	Delay Line	010-0336
IC36	74LS374	010-0133
IC37	Sckt 20 pin	017-0004
	Pal STDC	502-0086

**Integrated
Circuits** (Continued)

Designation	Cromemco Description	Part No.
IC38	Sckt 20 pin	017-0004
	Pal STDC Inter Control	502-0123
IC39	74LS240	010-0038
IC40	74LS373	010-0102
IC41	Z80A/MOSTEK 3880P-44	011-0010
	Sckt 40 pin	017-0006
IC42	Sckt 20 pin	017-0004
	Pal STDC Addr Compar	502-0071
IC43	74LS258	010-0101
IC44-45	64K RAM 128 Cycle	011-0107
IC46	Z80A-DMAAPS	011-0041
	Sckt 40 pin	017-0006
IC47	74LS138	010-0096
IC48	74LS74	010-0055
IC49-50	64K RAM 128 Cycle	011-0107
IC51	7407	010-0104
IC52	74LS240	010-0038
IC53	AMZ8121/AM25LS2521	010-0328
IC54	74LS373	010-0102
IC55-56	74LS374	010-0133
IC57	74LS373	010-0102
IC58	74LS374	010-0133
IC59	74LS240	010-0038
IC60	Sckt 20 pin	017-0004
	Pal STDC Memory Control	502-0066
IC61-62	64K RAM 128 Cycle	011-0107
IC63-64	Reg. 7805/340T-5	012-0001
	Sil-pad reg.	021-0109
IC65	Reg. 7905/320T-5	012-0000
IC66	Reg. 7812	012-0002
IC65-66	Heatsink mounts	021-0164

**Diodes/
Transistors**

Designation	Cromemco Description	Part No.
D1	1N5231B	008-0006
D2	1N4148	008-0002
D3	1N5711/5082-2800 HP	008-0033
Q1	VN10KM VFET	009-0026
Q2-3	2N3906	009-0002
Q4-5	2N3904	009-0001

Capacitors

Designation	Cromemco Description	Part No.
C1	.005 uf crdc 100V	004-0142
C2	.001 uf crdc 50V	004-0141
C3	5 pf crdc 1000V	004-0145
C4	.005 uf crdc 100V	004-0142
C6	68 pf mica 100V	004-0121
C7,8	5 pf crdc	004-0145
C9	.047 uf poly 50V	004-0151
C10	.01 uf crdc 25V	004-0153
C12-15	1 uf mono 50V	004-0147
C16-19	10 uf tant 20V	004-0032
C20	75 pf crdc 50V	004-0007
C21,23	47 pf crdc 1000V	004-0152
C24-25	6.8 uf tant 35V	004-0034
C26	1 uf mono 50V	004-0147
C27	220 pf crdc 1000V	004-0013
C28	30 pf crdc 1000V	004-0003
C29-35	.047/50V	004-0061
-o-	.047/50V	004-0061

Resistors

Designation	Cromemco Description	Part No.
R1-2	100 ohm 1/4	001-0007
R3	1 kohm 1/4	001-0018
R4-5	100 ohm 1/4	001-0007
R6-7	1 kohm 1/4	001-0018
R8	150 ohm 1/4	001-0008
R10	2.7 kohm 1/4	001-0023
R11	51 ohm 1/4	001-0004
R12,13	1 kohm 1/4	001-0018
R14	220 ohm 1/4	001-0010
R15	1.5 kohm 1/4	001-0020
R17	220 kohm 1/4	001-0078
R18	180 ohm 1/4	001-0009
R20	1.5 kohm 1/4	001-0020
R22	68 ohm 1/4	001-0005
R23	390 ohm 1/4	001-0013
R24	560 ohm 1/4	001-0015

Resistors (Continued)

Designation	Cromemco Description	Part No.
R25	1 kohm 1/4	001-0018
R26	4.7 kohm 1/4	001-0024
R28	220 ohm 1/4	001-0010
R29	4.7 kohm 1/4	001-0024
R31	1 kohm 1/4	001-0018
R32	330 ohm 1/4	001-0012
R33-34	22 ohm 1/4	001-0001
R35	180 ohm 1/4	001-0009
R36	100 ohm 1/4	001-0007
R38	1 kohm 1/4	001-0018
R39-40	20 ohm 3W	001-0046

Resistor Networks

Designation	Cromemco Description	Part No.
RN1	150 ohm 7R 8P	003-0010
RN3	150 ohm 9R 10P	003-0083
RN4	47 ohm 4R 8P	003-0047
RN5	2 kohm 4R 8P	003-0029
RN6	680 ohm 4R 8P	003-0087
RN7	47 ohm 4R 8P	003-0047
RN8	10 kohm 9R 10P	003-0024
RN9	1 kohm 7R 8P	003-0007
RN10	1 kohm 9R 10P	003-0011
RN11	33 ohm 4R 8P	003-0000

Miscellaneous

Designation	Cromemco Description	Part No.
L1	Inductor 100 uH	007-0023
J1	Sckt 34 pin connector	017-0091
J2,J3	Sckt wafer 2 pin	017-0009
J5	Sckt 20 pin connector	017-0364
Y1	Crystal 10 MHz	026-0035
	Rivet .125 x .382	015-0188
	Spacer 1/4 hex 6-32	015-0169
	Standoff 1/4 hex 4-40	015-0173
	STDC PC board	020-0138
	Heatsink	021-0017
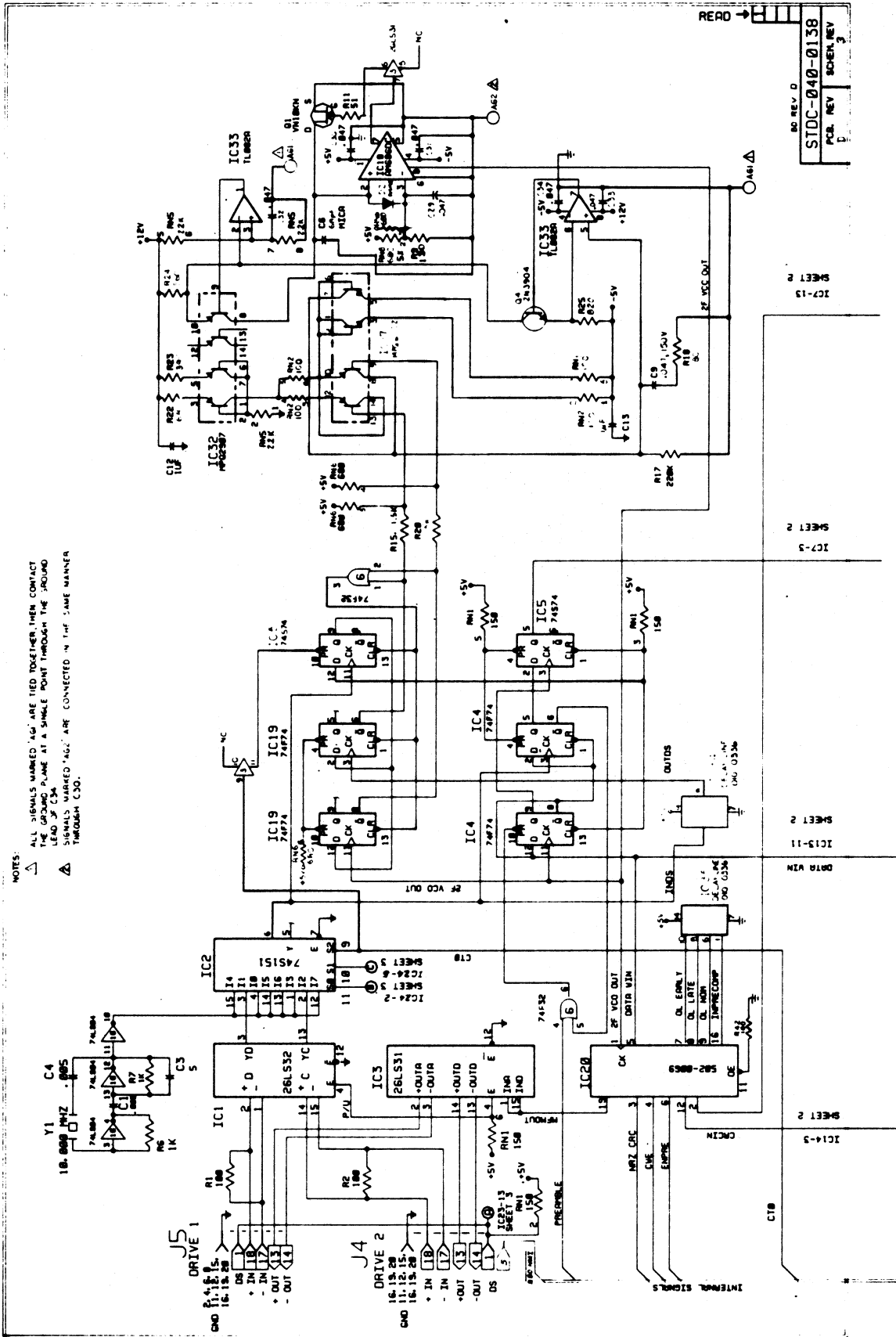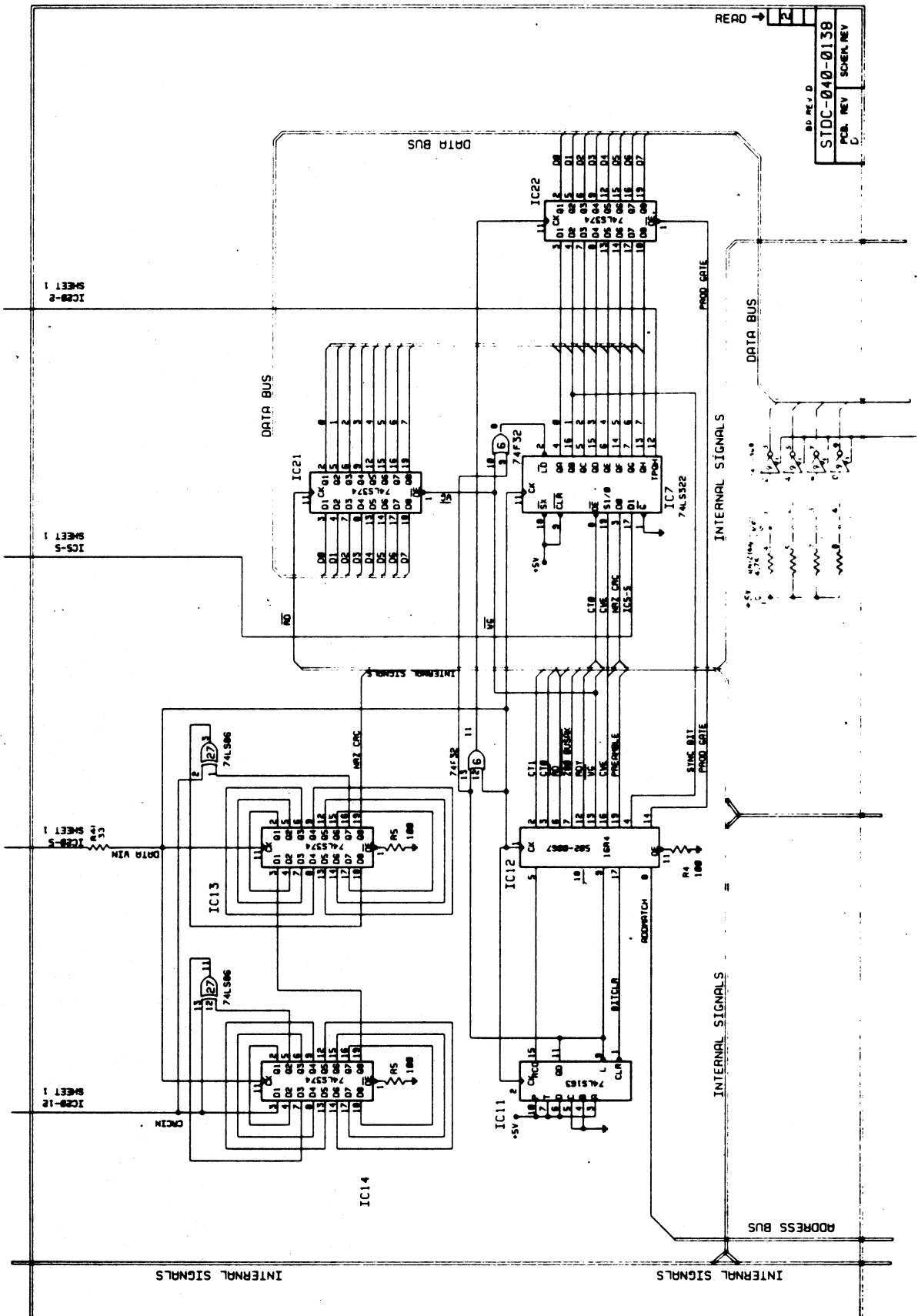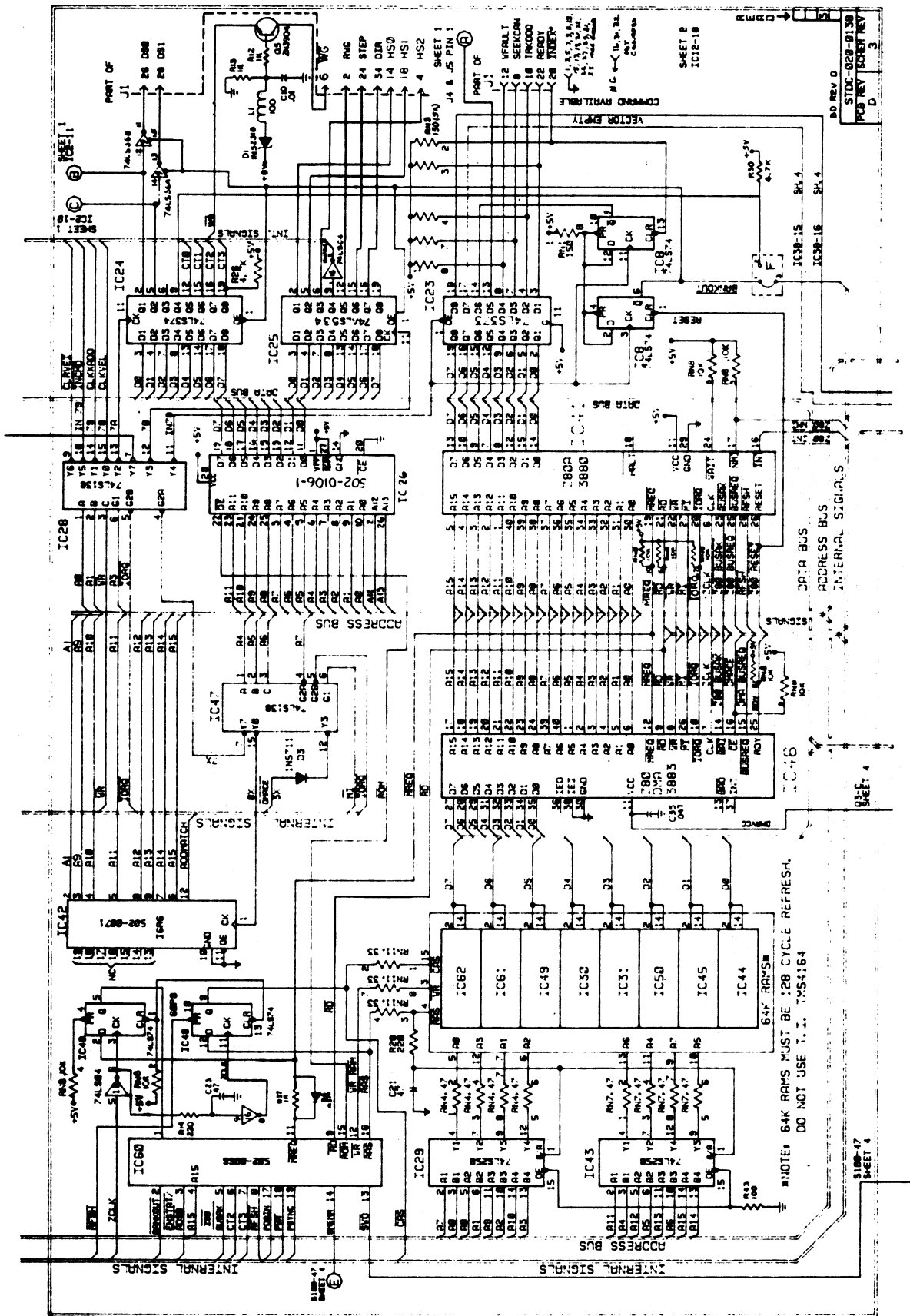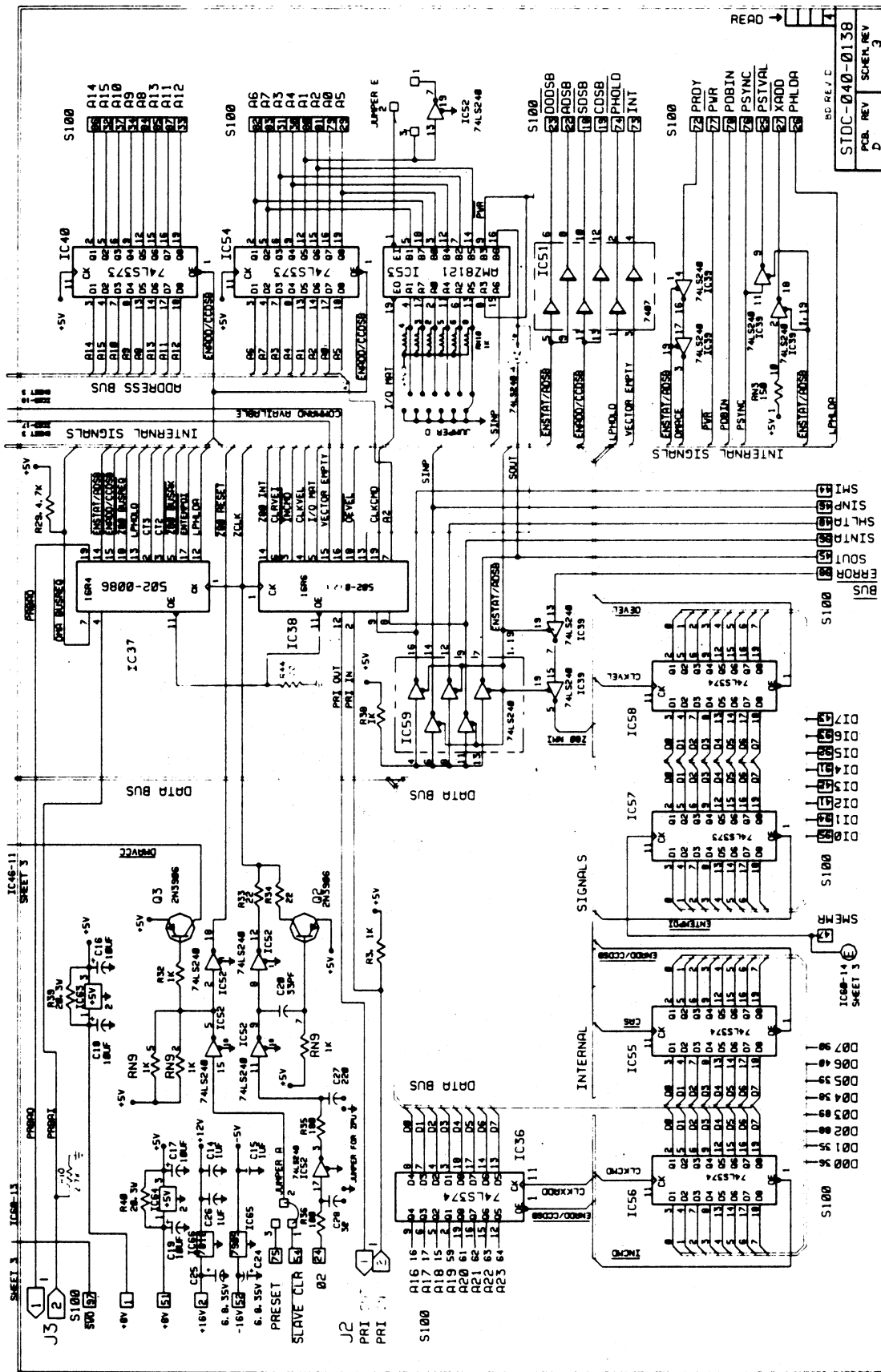
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2. the return authorization number
3. a description of the problem, and
4. proof of the date of retail purchase

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