



NABU Computer Diagnostics

Version 1.7.5

Created in March 2023

Created by Rudy's Retro Intel

<https://www.youtube.com/@RudysRetroIntel>

Please email me (retrointeldiy@gmail.com) if you would like to add to this document. Future versions will be available as more information is collected, tested and verified.

Additional support provided by:

- Geek With Social Skills (<https://www.youtube.com/@geekwithsocialskills>)
- The technical manual and schematics for the NABU PC were done by MJP while reverse engineering the NABU PC. MJP are his initials and on the original PDF (NABU_Computer_Technical_Manual_by_MJP.pdf)
- NABU Personal Computer User's Manual
- Data sheets found at <https://www.datasheets.com> , <https://datasheetspdf.com/> and https://archive.org/details/ic_datasheets?and%5B%5D=subject%3A%22office+box%22&sort=date
- IC pinouts, visit <https://www.futurlec.com/IntegratedCircuits.shtml>
- Joe's Computer Museum (<https://www.youtube.com/@JoesComputerMuseum>)

For the latest version of this document and other NABU related information, use the links below.

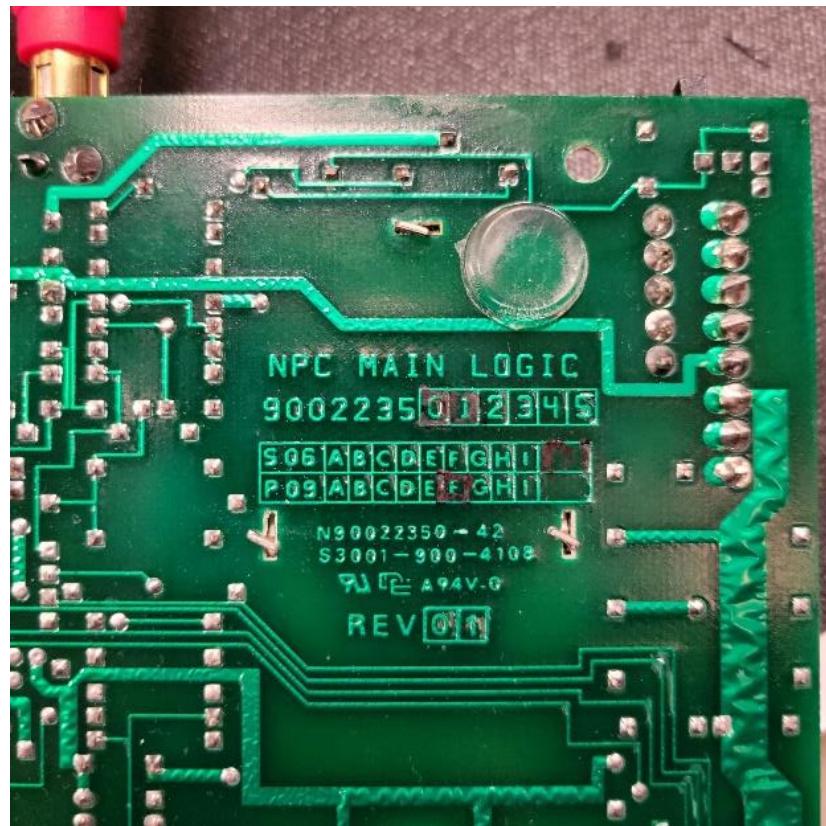
<https://www.nabunetwork.com>
<https://github.com/RudyRetroIntel/Vintage-Computer-Diagnostics>

"Thank you to everyone who helped with this documentation. With this knowledge we can ensure that the NABU computer can be repaired and enjoyed now and into the future.

Rudy's Retro Intel"

***** This document is based on the work I have performed on my NABU computer and is provided "as is". I\we do not take any responsibility for errors and\or damages that may occur when repairing your NABU computer. This is information is provided freely to all NABU computer owners. Please ensure you know how to perform electronics\electrical work. If not, please contact someone who has these skills before starting. *****

This NABU computer diagnostics document was created to help diagnose issues with a NABU computer. My diagnostics and recommendations are based on the motherboard revision 01. Image below.



**Check your board revision as these diagnostics may differ.*

Index

<i>The NABU Computer Configuration</i>	- Page 4
<i>Location of ICs</i>	- Page 5
<i>Pictorial Diagnostics</i>	- Page 6
<i>Complete System Failure</i>	- Page 7
<i>Network Adapter Failures</i>	- Page 8
<i>Keyboard Failures</i>	- Page 9
<i>Sound Failure</i>	- Page 11
<i>Serial Failure</i>	- Page 11
<i>LED Display Failures</i>	- Page 12
<i>System RAM Failures</i>	- Page 13
<i>Video RAM Failures</i>	- Page 15
<i>Card Slot Failure</i>	- Page 19
<i>Parallel Port Failure</i>	- Page 20
<i>NABU Computer Schematics</i>	- Page 21
<i>IC location and Part Numbers</i>	- Page 27
<i>NABU Connector Pinouts</i>	- Page 28
<i>Keyboard Encoding Chart</i>	- Page 29
<i>NABU Memory Map</i>	- Page 30
<i>Bodge Wires Connection</i>	- Page 31
<i>IC Pinouts</i>	- Page 44
<i>NABU Adapter Cable Connection</i>	- Page 51

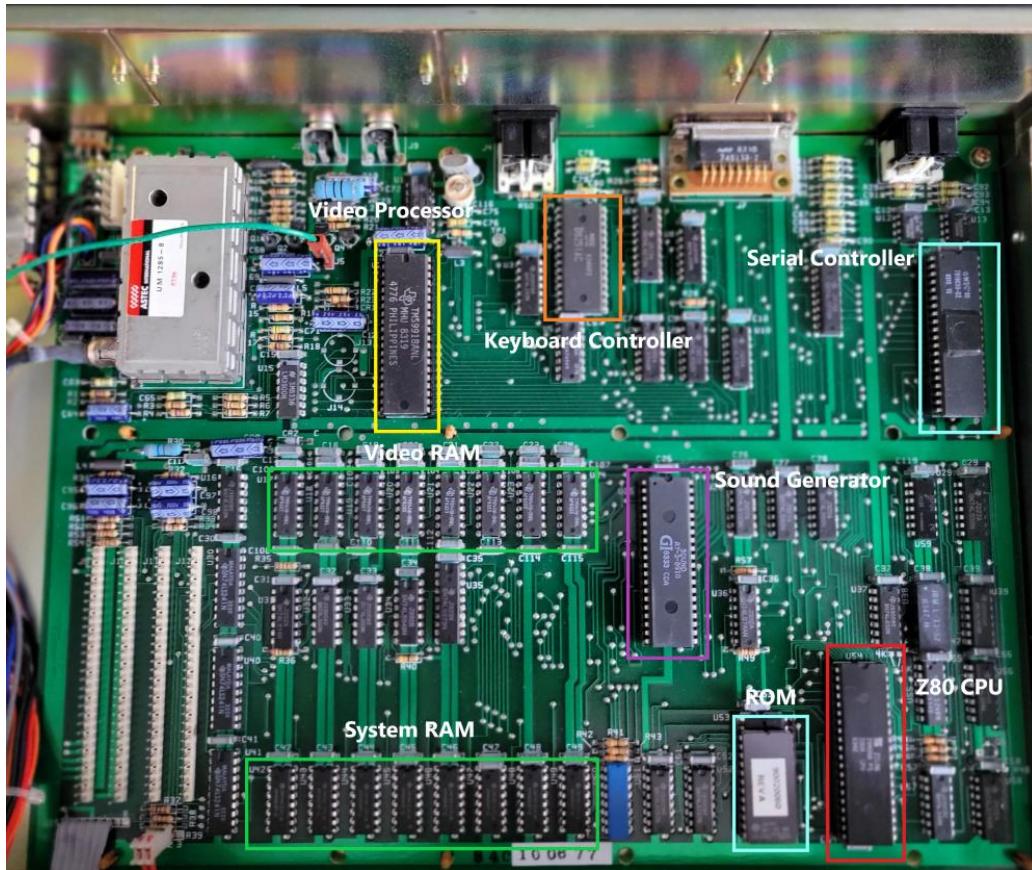
The NABU Computer Configuration

- Processor (CPU) is a Zilog Z80A microprocessor running at 3.58Mhz
- Total of 80K of memory and is configured to use 64K for the Z80A processor and dedicated 16K for video memory
- Frequency comes from a 10.735635Mhz crystal which is divided down to 3.579545 (3.58) Mhz
- Four slots are available to add additional cards
- ROM is a 4K byte which contains the bootstrap software. Other boards have an 8K ROM
- Outputs to composite or a NTSC frequency via the RF modulator. Text mode = 24, 40-character rows in 2 colors. Graphic mode = 32 x 24. Total screen resolution is 256 x 192 pixels, 15 colors plus transparent capabilities, sprite-oriented, hardware-supported animation
- Keyboard uses an unregulated +10VDC to power the unit and receives\sends via an EIA RS422 over twisted pair cable with shield at 6992 BAUD rate
- Printer port uses a DB-15 (female D-Type) Centronics parallel printer standard connection with handshake
- Audio output is 10K ohm output impedance, 1.5V p-p signal for driving separate audio amplifier or input to a monitor
- Adapter port provides a full duplex, 111 Kbit per second serial interface

** Any software troubleshooting is beyond the scope of this document. Here we will only cover hardware related issues. **

Location of ICs

The image below shows the location of all major ICs. Use this as a reference.



Video IC: TMS9918ANL – Video Display Controller by Texas Instruments

Keyboard IC: D8251AC – Programmable Communication Interface by Rochester

Serial\Network IC: TR1863-B-02 – Universal Asynchronous Receiver/Transmitter by Western Digital

CPU IC: Z80A – Microprocessor by Zilog

Sound IC: AY-3-8910 – Programmer Sound Generator by ETC

ROM: 2732G EPROM

Video Memory ICs: TMS 4116-15NL by Texas Instruments

System Memory IC: HM4864P-2- 65536 x 1 Bit DRAM by Hitachi

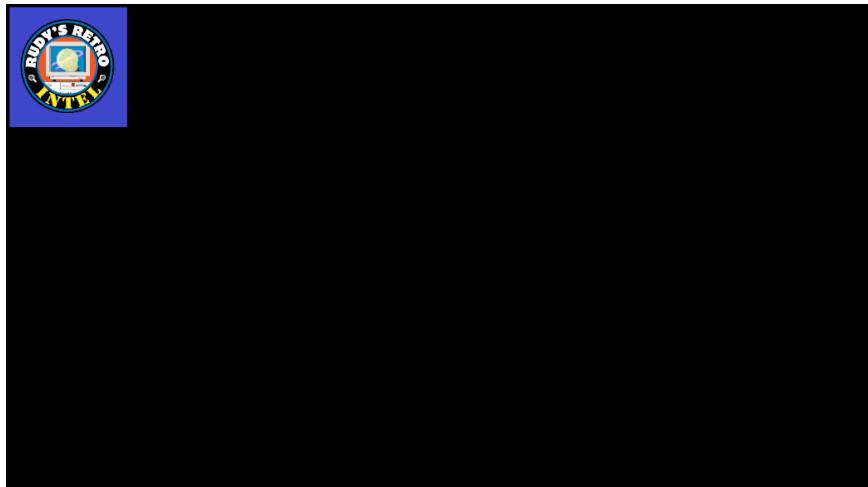
* When placing the lid on the NABU computer, ensure that the side with the holes is on the side closest to the motherboard. If you place the lid on the opposite way, the system can\will over heat. These holes allow for cooler air to pass over the motherboard and into the power supply. From there, the hot air is expelled out the back of the power supply via the built in fan *

Pictorial Diagnostics

With your NABU computer turned on, view the following images and find the one that closely matches what you are viewing on your screen. Next look at the corresponding diagnostic information.

- Where possible, links to vendors where parts can be purchased will be shown. No affiliation with any vendors. Check your favorite vendor for replacement parts
- IC pinouts are included where available. See “*IC Pinouts*” in the index
- **NOTE: Your background color may be different. My background is blue however the video capture device changed it. This doesn't matter as the images will be the same.**

Complete System Failure

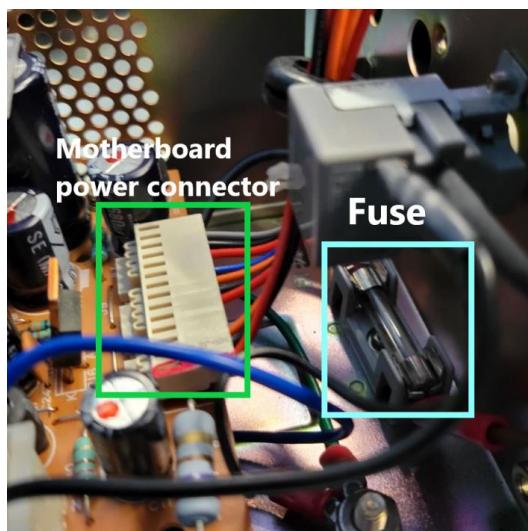


Symptom: Black screen, no sound. The Alert LED located on the front panel may be ON.

Diagnoses: This is a major fault and the following needs to be tested\replaced.

Test\Replace Power supply

- Check power plug is connected and power is available from wall socket
- Check fuse located inside power supply. See image below
- Ensure motherboard connection to the power supply is connected and secure. See image below
- Press down all ICs in sockets, as they can have poor contact(s) due to heat
- Ensure that the lid side with the holes is on the side closest to the motherboard
- Other possible issues could be related to the power supply electronics. Future versions of this documentation may cover power supply repairs
- Inside power supply. Note the motherboard connector and fuse locations.



Test\Replace video cables and\or monitor\TV used.

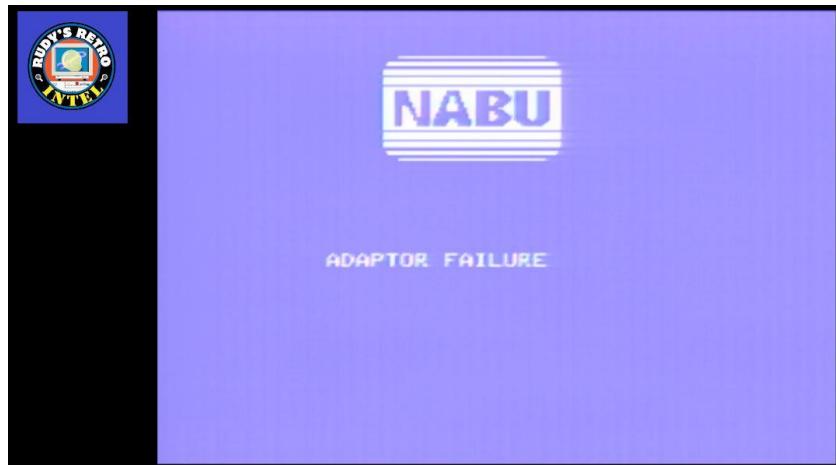
Test\Replace ROM – **U53** - 2732G EPROM: Burn new EPROM and replace

Test\Replace Video processor – **U2** - TMS9919ANL. See pinout diagram on next page

Test\Replace CPU – **U54** - Zilog Z80 processor. See pinout diagram on next page

Test\Replace Transistors 2N3904

Network Adapter Failures



Symptom: Failure to connect to the NABU network.

Diagnoses: This is normal if you do not have a connection to the NABU server\network. If connecting to the network and are getting this error, check connections and network status.

If errors are still present test\replace **U14** - TR1863P-02, **U29** - 74LS32, **U12** UA9637ACP and\or **U13** - UA9638ACP, **U32** - 74LS00

Keyboard Failures



Symptom: Keyboard not working.

Diagnoses: Check that the keyboard is connected to the NABU computer.

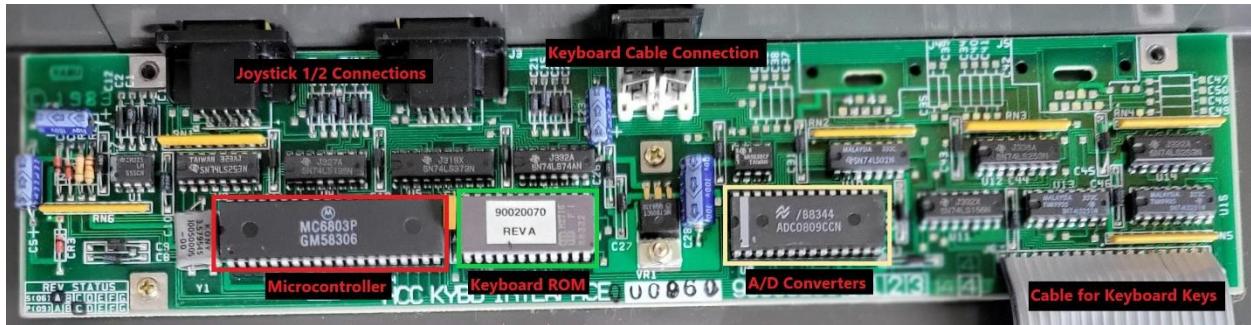


Symptom: Keyboard connected properly however; Alert LED is ON.

Diagnoses: Replace **U4** - D8251AC, **U8** - 74LS32 *within the NABU PC.*

Keyboard Internals

Logic board inside the keyboard itself.



With continued keyboard issues, the following should be tested\replace as needed.

Diagnoses:

MC7805T - 7805 5V 1A Positive Regulator – Ensure proper voltage is present

Ribbon Cable – Cable to connect logic board to physical keys – Check for damage and verify continuity

MC6803P - 8-Bit A/D Converter with 8-Channel Multiplexer – Use datasheet and oscilloscope

ADC0809CCN - Converters with 8-ChannelMultiplexer – Use datasheet and oscilloscope

ROM – Custom NABU PC keyboard ROM – Use datasheet and oscilloscope

555 – Timer IC – Use datasheet and oscilloscope

All support ICs – Review each IC's logic with datasheet and oscilloscope

Sound Failure



Symptom: Sound Failure message, no sound heard, Alert LED on.

Diagnoses: Replace **U25** - AY-3-8910 sound generation IC. **U15** - LM3900, **U35** - 74LS373, **U54** - Z80 processor, **U26** - 74LS153, **U27** - 74LS32, **U39** - 74LS00, **U36** - 74LS74, **U28** - 74LS38, **U34** - 74LS348, **U32** and **U33** - 74LS00, **U1** - 74LS14

Serial Failure



Symptom: NABU logo and no other characters.

Diagnoses: Replace **U14** - TR1863-B-02 – Universal Asynchronous Receiver/Transmitter

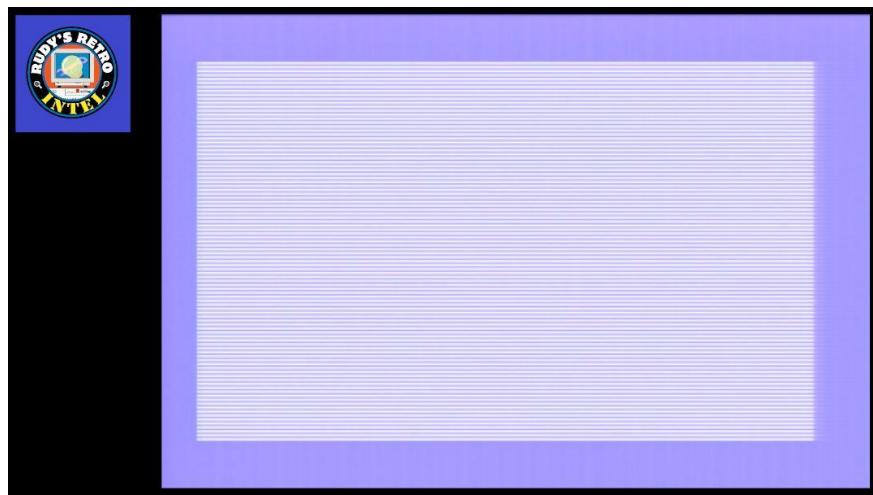
LED Display Failures



Symptom: NABU computer LEDs not displaying or have some not working

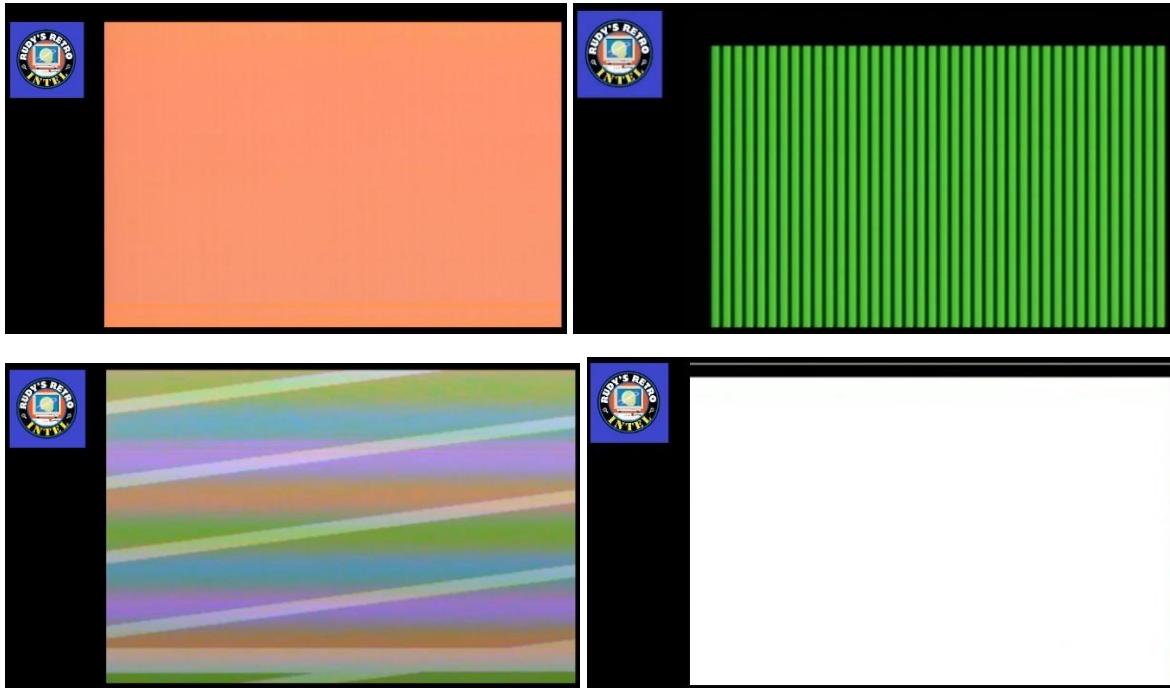
Diagnoses: Replace **U5** - SN7406, **U6** - 74LS273, replace LED(s), Check +5VDC, **U8** and **U27** - 74LS32

System RAM Failures



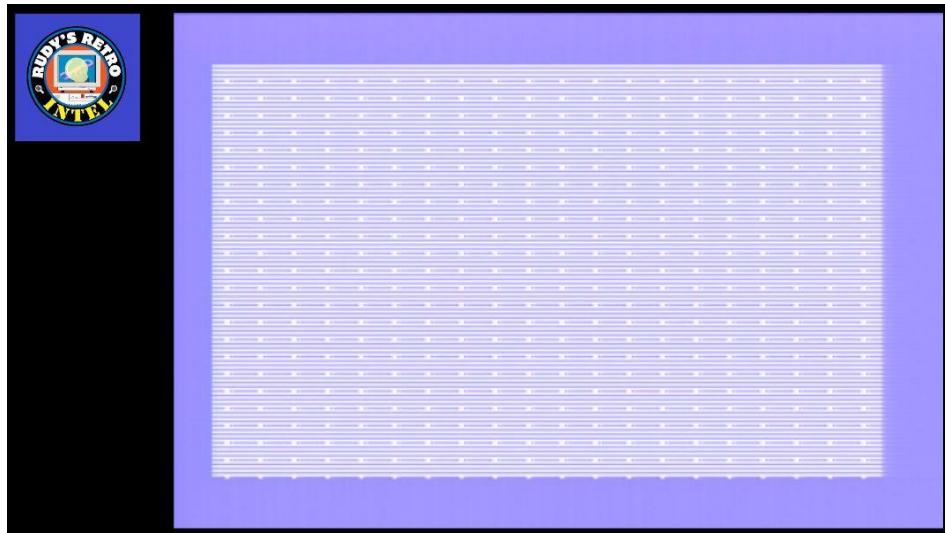
Symptom: No text, small\fine vertical bars.

Diagnoses: Replace **U42, U43, U45, and\or U49** - HM4864P DRAM, **U51 and U52** – 74LS157, **U54** -Z80 CPU, **U37, U9, U57** – 74LS32, **U39** – 74LS00, **U56** – 74LS04, **U36** – LP76-57, **U55** – 74LS260, **U28** – 74LS38



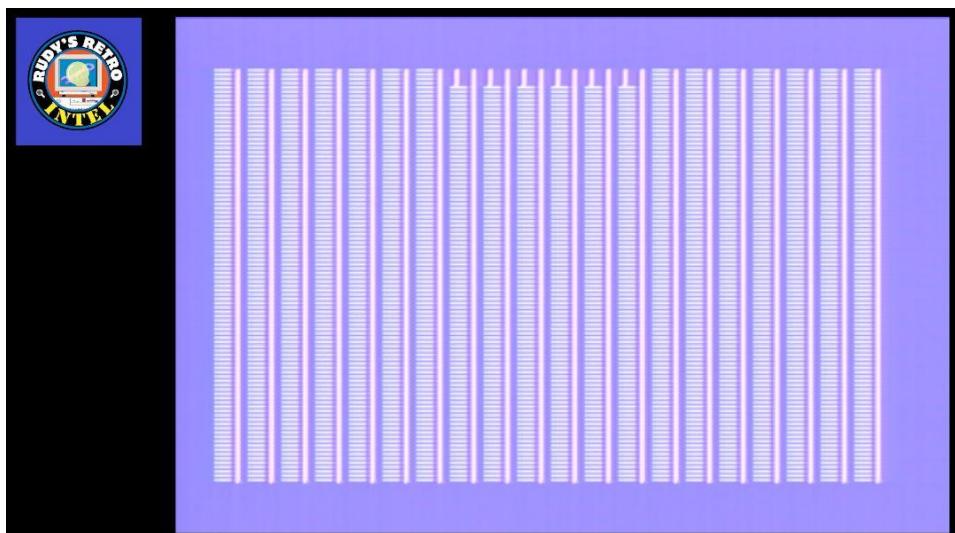
Symptom: Solid color, vertical green bars, scrambled colors and\or white screen.

Diagnoses: Replace **U44** with HM4864P – DRAM Chip DRAM 64Kbit 64Kx1 5V.



Symptom: Fine stripes with dots aligned vertically and horizontally.

Diagnoses: Replace **U46** - HM4864P – DRAM Chip DRAM 64Kbit 64Kx1 5V.



Symptom: Vertical bars (solid and non-solid bars), NABU logo tries to display.

Diagnoses: Replace **U47** - HM4864P – DRAM Chip DRAM 64Kbit 64Kx1 5V.



Symptom: NABU logo tries to display, Error: “RE-TYPE CHANNEL CODE” appears. This screen may disappear and reappear, flashing message.

Diagnoses: Replace **U48** - HM4864P – DRAM Chip DRAM 64Kbit 64Kx1 5V.

Video RAM Failures



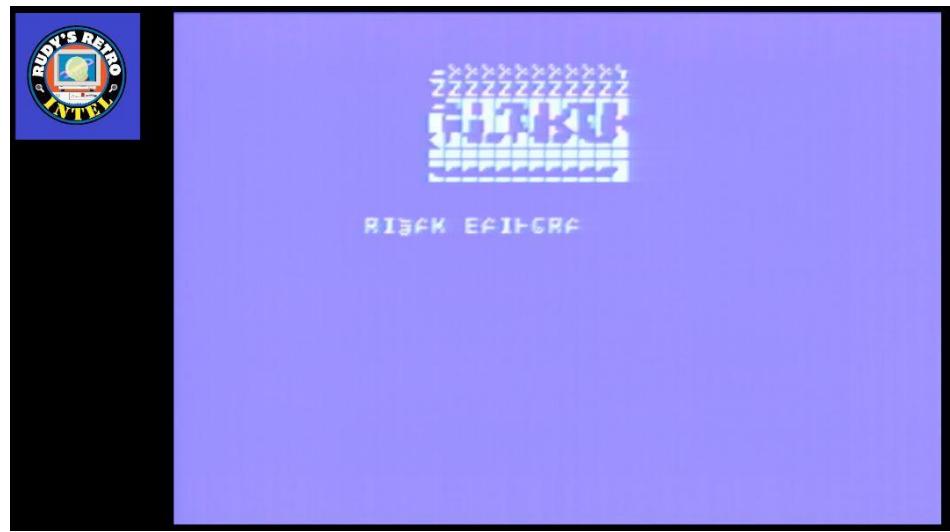
Symptom: NABU logo and text characters not shown correctly.

Diagnoses: Replace **U17** - TMS4116-15NL – DRAM, **U3** – 74LS32, **U1** – 74LS74, **U59** – 74F04, **U56** – 74LS04, **U7** – 74LS74, **U31** – 74LS14



Symptom: NABU logo and text characters not shown correctly.

Diagnoses: Replace **U18** - TMS4116-15NL - DRAM 16,384-Bit (16Kx1) 150ns 5V.



Symptom: NABU logo and text characters not shown correctly.

Diagnoses: Replace **U19** - TMS4116-15NL - DRAM 16,384-Bit (16Kx1) 150ns 5V.



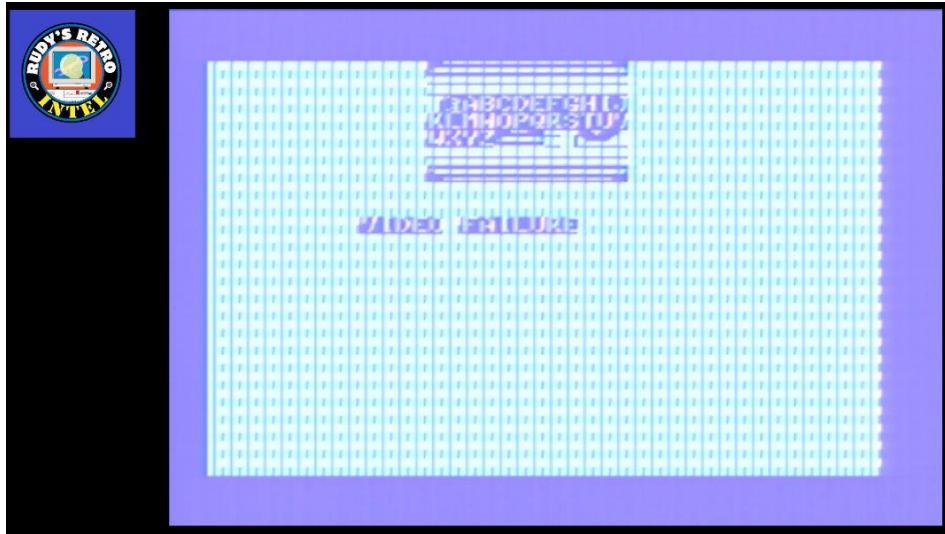
Symptom: NABU logo and text characters not shown correctly.

Diagnoses: Replace **U20** - TMS4116-15NL - DRAM 16,384-Bit (16Kx1) 150ns 5V.



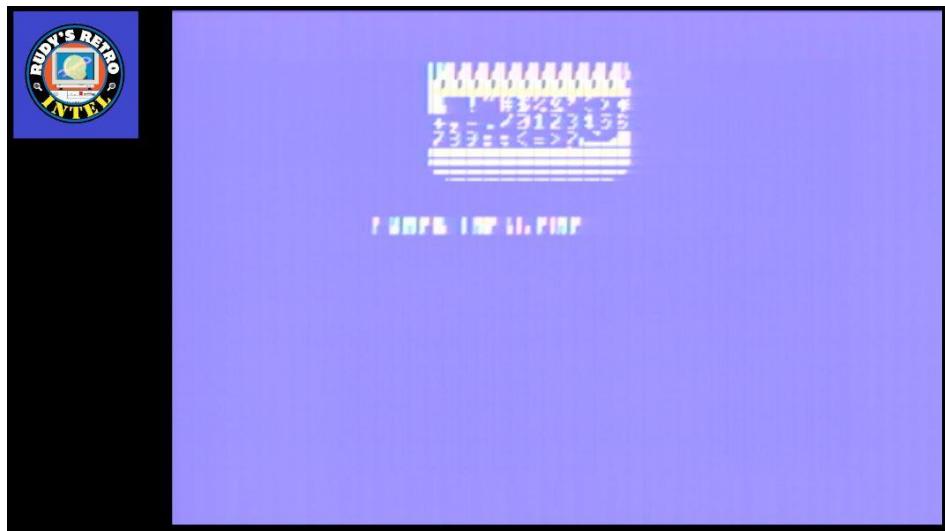
Symptom: NABU logo and text characters not shown correctly.

Diagnoses: Replace **U21** - TMS4116-15NL - DRAM 16,384-Bit (16Kx1) 150ns 5V.



Symptom: NABU logo and text characters not shown correctly, inverse vertical bars displayed.

Diagnoses: Replace **U22** - TMS4116-15NL - DRAM 16,384-Bit (16Kx1) 150ns 5V.



Symptom: NABU logo and text characters not shown correctly and\or blurred.

Diagnoses: Replace **U23** - TMS4116-15NL - DRAM 16,384-Bit (16Kx1) 150ns 5V.



Symptom: NABU logo and text characters not shown correctly, displays video failure message correctly.

Diagnoses: Replace **U24** - TMS4116-15NL - DRAM 16,384-Bit (16Kx1) 150ns 5V.

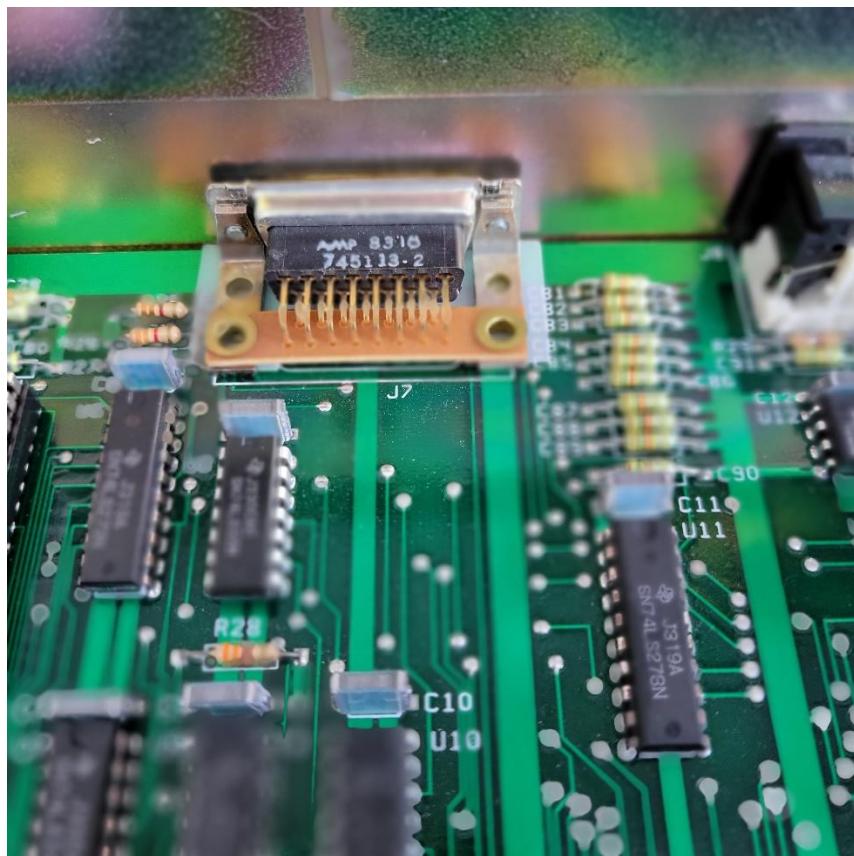
Card Slot Failure



Symptom: Optional cards not working properly, not working, not recognized in slot J9-J12.

Diagnoses: Replace **U30, U40** and\or **U41** - 74LS241. **U9, U29** and\or **U37** - 74LS32. Check optional card and perform additional troubleshooting.

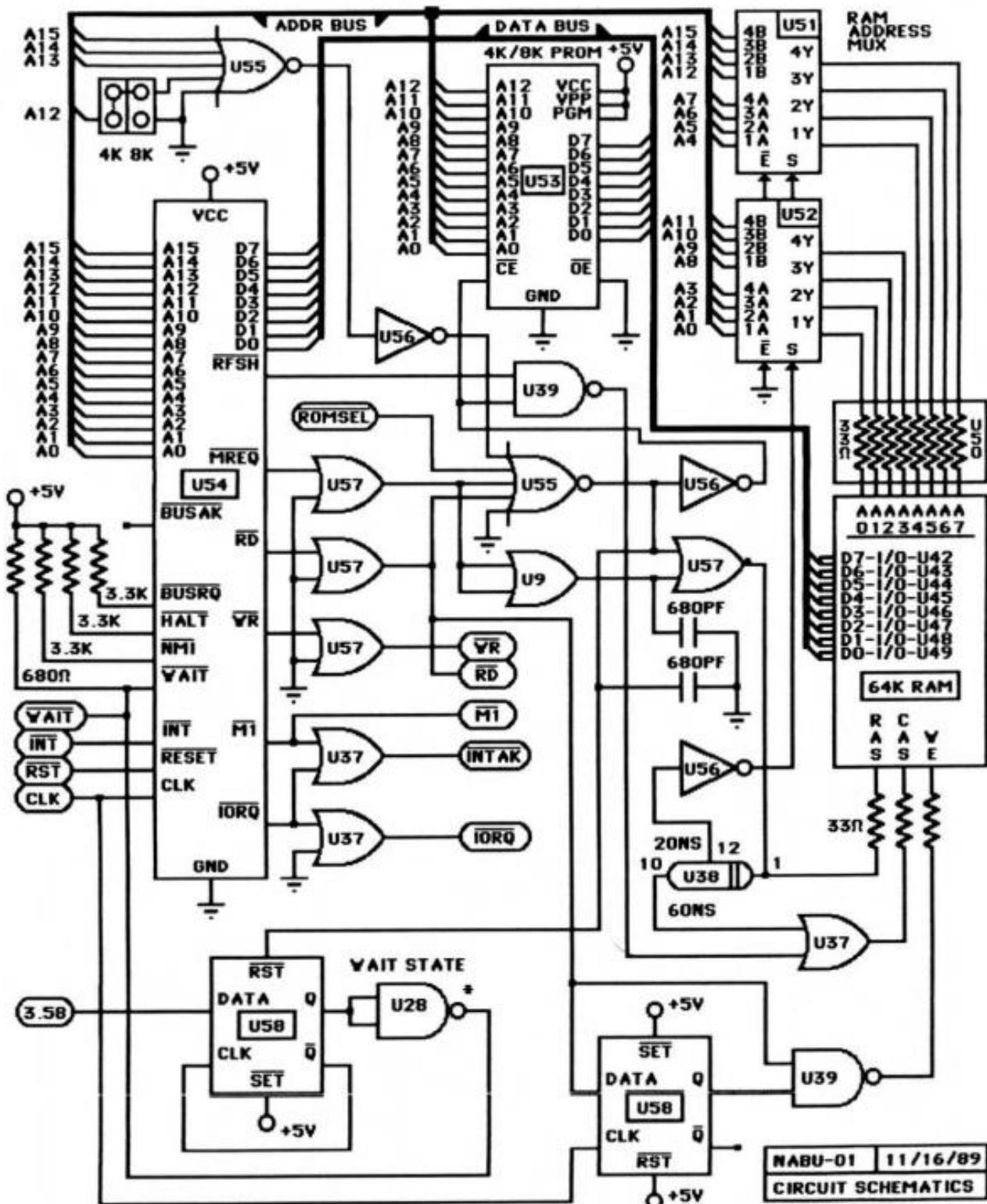
Parallel Port Failure

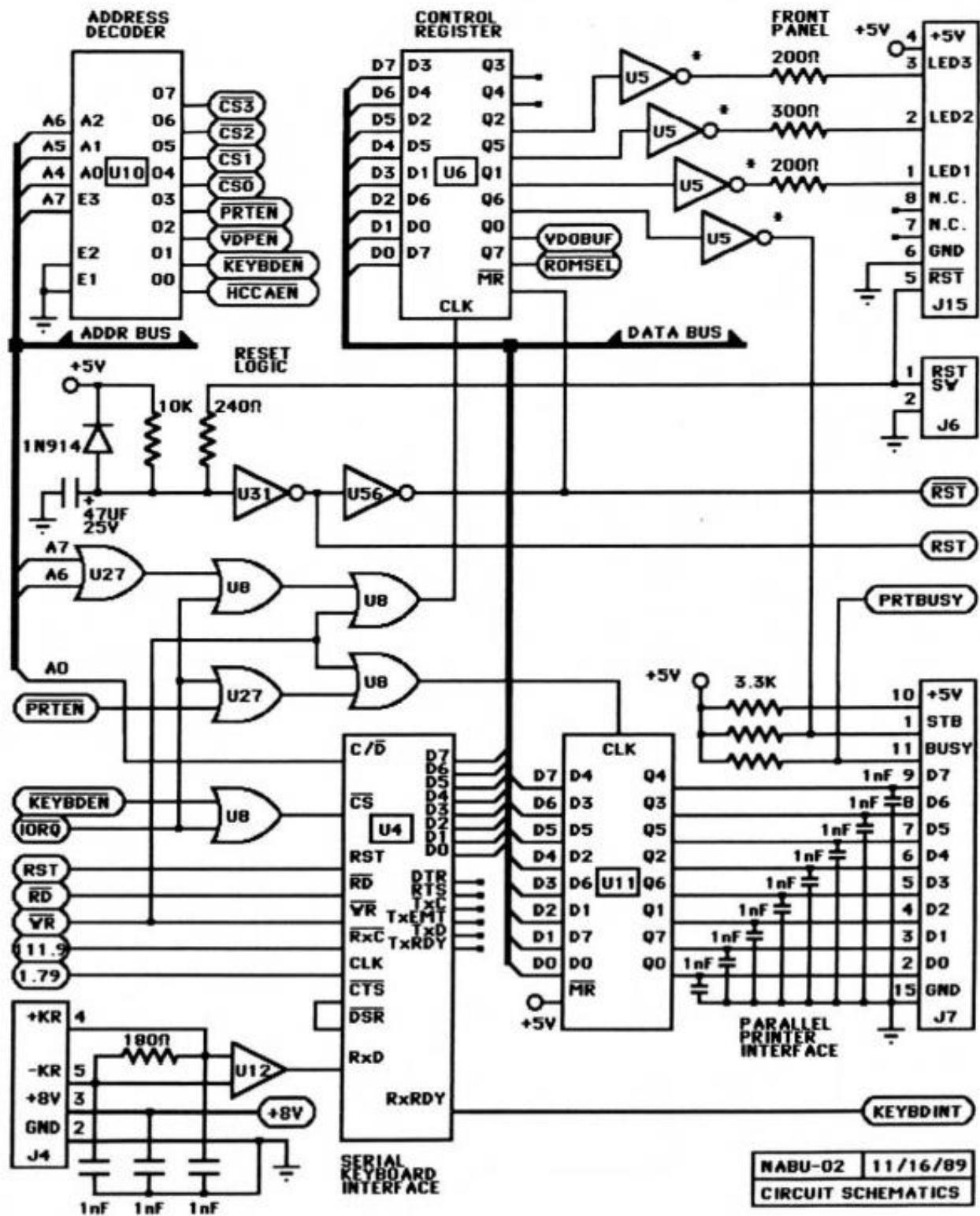


Symptom: Parallel port or device not working properly, not working, not recognized.

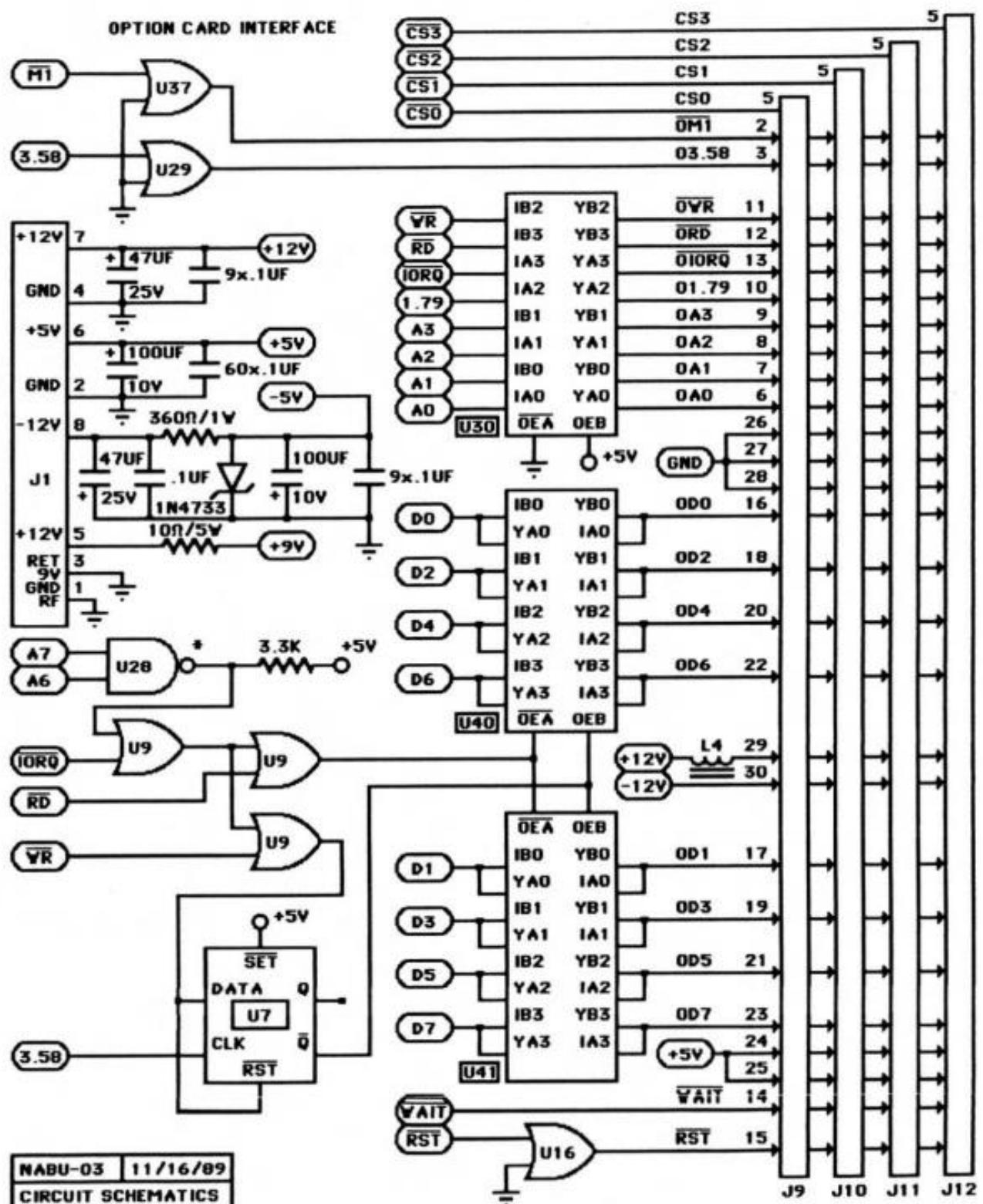
Diagnoses: Replace **U11**, **U6** - 74LS273, **U8**, **U27** – 74LS32, **U12** - UA9637ACP.

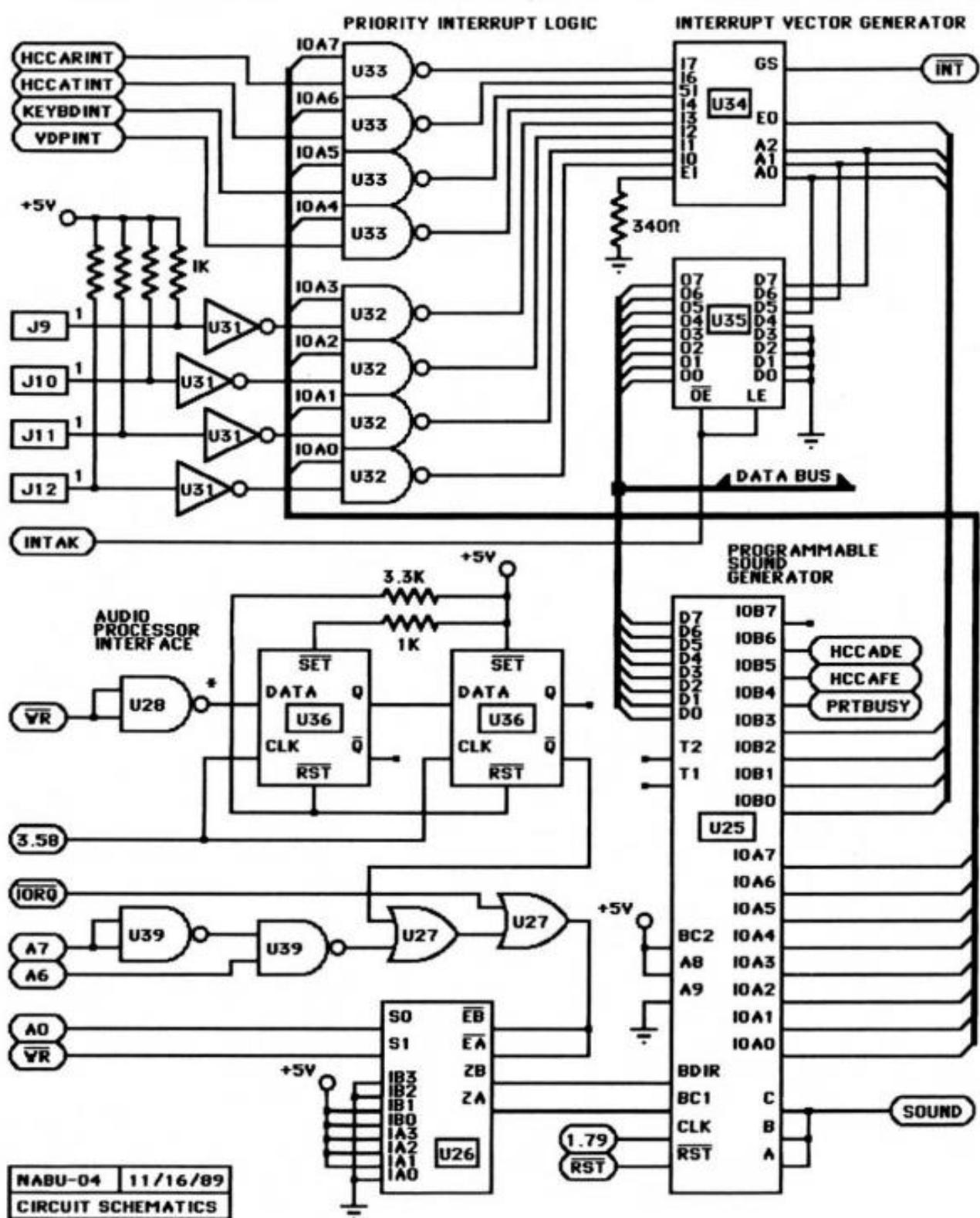
NABU Computer Schematics

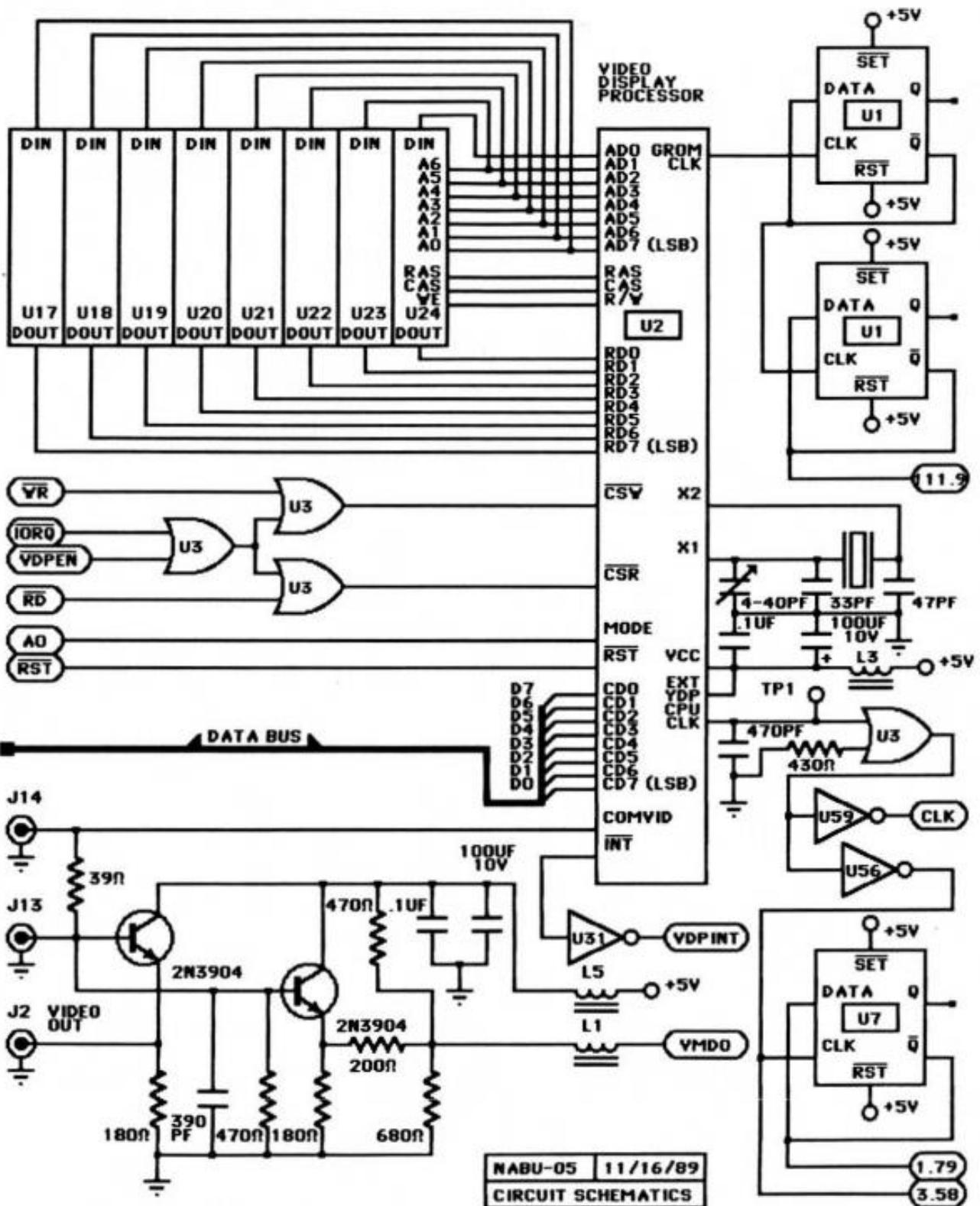


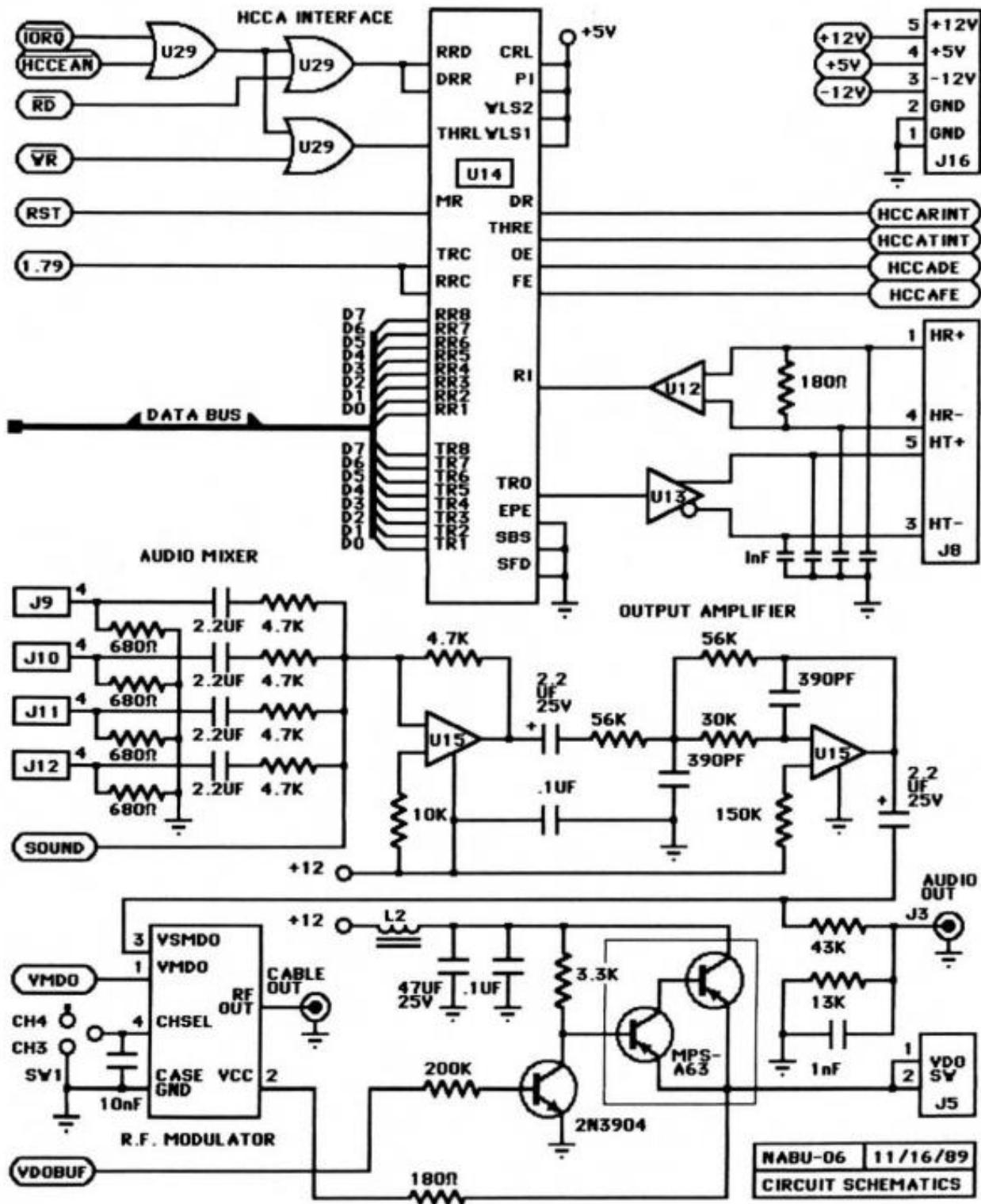


NABU-02 | 11/16/89
CIRCUIT SCHEMATICS









IC location and Part Numbers

CHIP NO.	I.C. REF.
U1 ,U7 ,U36 ,U58	LS74
U2	TMS9918
U3 ,U8 ,U9 ,U16 ,U27 ,U29 ,U37 ,U57	LS32
U4	8251A
U5	7406
U6 ,U11	LS273
U10	LS138
U12	9637
U13	9638
U14	TR1863P
U15	LM3900
U17.... 24	TMS4116
U25	AY-3-8910
U26	LS153
U28	LS38
U30 ,U40 ,41	LS241
U31	LS14
U32 ,U33 ,U39	LS00
U34	LS348
U35	LS373
U38	LP76-57
U42.... 49	HM4864-2
U50	33Ω PACK
U51 ,U52	LS157
U53 4K EPROM	2732
U53 8K EPROM	2764
U54	Z80A
U55	LS260
U56	LS04
U59	74F04

* Corrections: U14 is TR1863B-02 *

NABU Connector Pinouts

Listed below are the pin outs and description for the connectors on the NABU computer.

LED display connection is an 8-pin header

Pin 1 = Power On indicator and is GREEN

Pin 2 = Pause indicator and is YELLOW

Pin 3 = Alert indicator and is RED

Pin 4 = Check indicator and is GREEN

Pin 5 = Reset Switch

Pin 6 = Ground\logical ground

Adapter connection is a 5 pin DIN connector and uses the following configurations

Pin 1 = Receive + (positive)

Pint 2 = **Not used**

Pint 3 = Transmit – (negative)

Pint 4 = Receive – (negative)

Pint 5 = Transmit + (positive)

Power supply unit

Power supply which is an ASTEC (AC8152) or a TDK (MRM146U) which outputs 40 WATTS

Voltage Output DC

Pin 1 = -12VDC (negative) with a maximum current of 0.5 Amps

Pin 2 = +12VDC (positive) with a maximum current of 2.5 Amps

Pin 3 = Common connection

Pin 4 = +5VDC (positive) with a maximum current of 5 Amps

Game controller connection

Pin 1 = Contact for UP movement

Pin 2 = Contact for DOWN movement

Pin 3 = Contact for LEFT movement

Pin 4 = Contact for RIGHT movement

Pin 5 = **Not used**

Pin 6 = Contact for FIRE control

Pin 7 = **Not used**

Pin 8 = Ground

Pin 9 = **Not used**

Keyboard connection is a 6 pin DIN

The keyboard uses a MC6801 micro processor

Pin 1 = Not used – use as shield ground

Pin 2 = +9VDC

Pin 3 = +9VDC

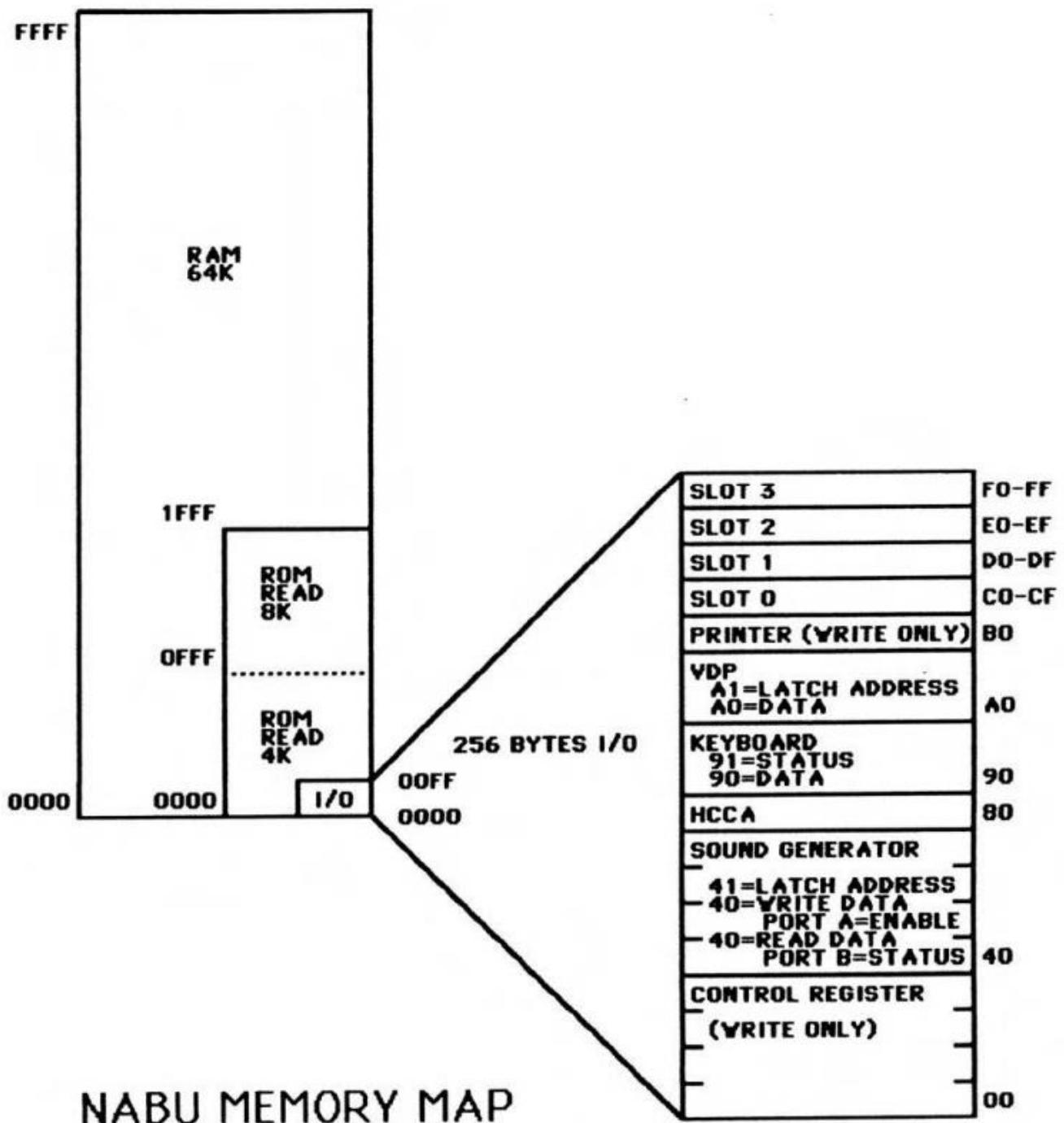
Pin 4 = Transmit +(positive)

Pin 5 = Transmit – (negative)

Pin 6 = Not used

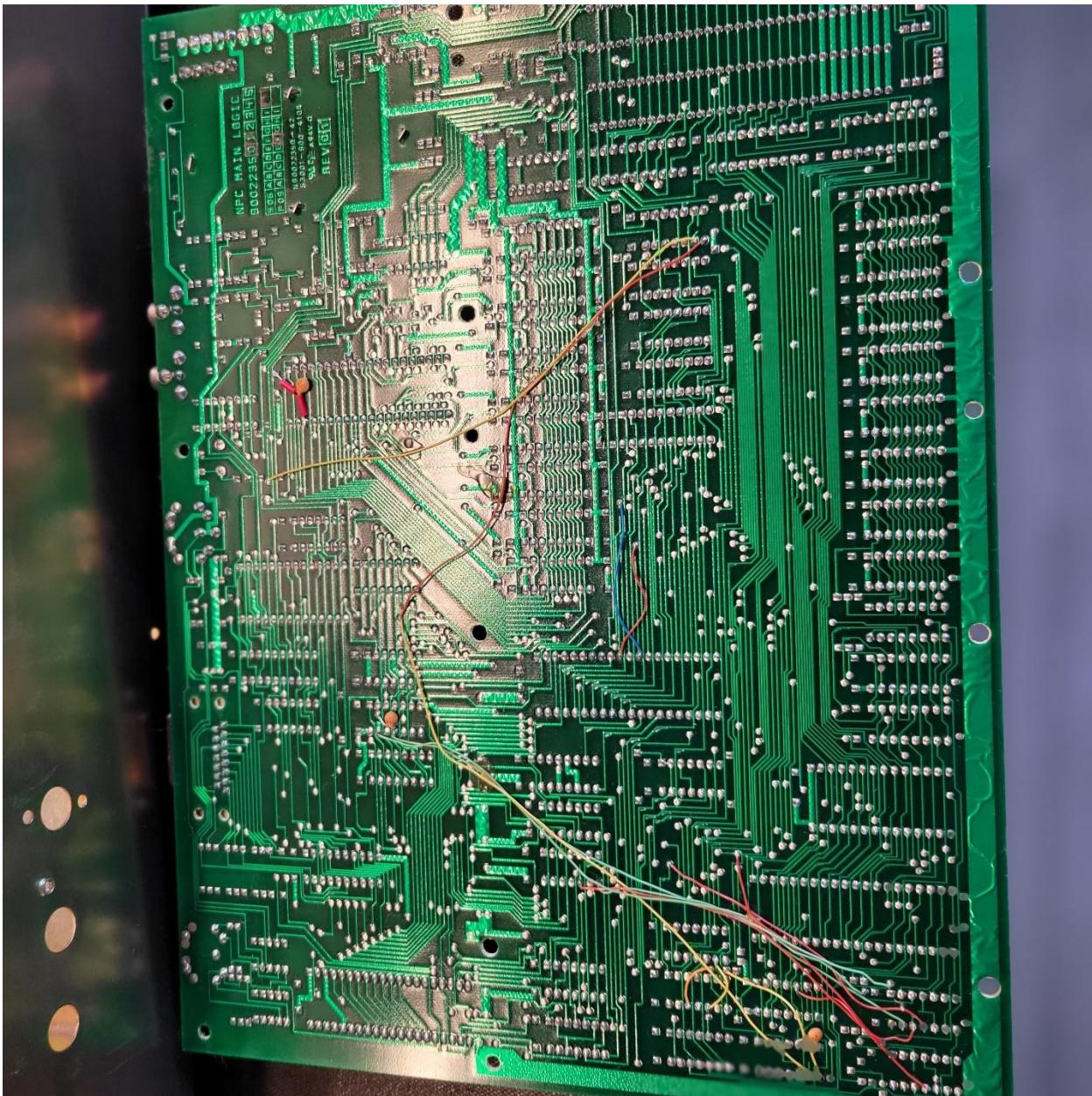
Keyboard Encoding Chart

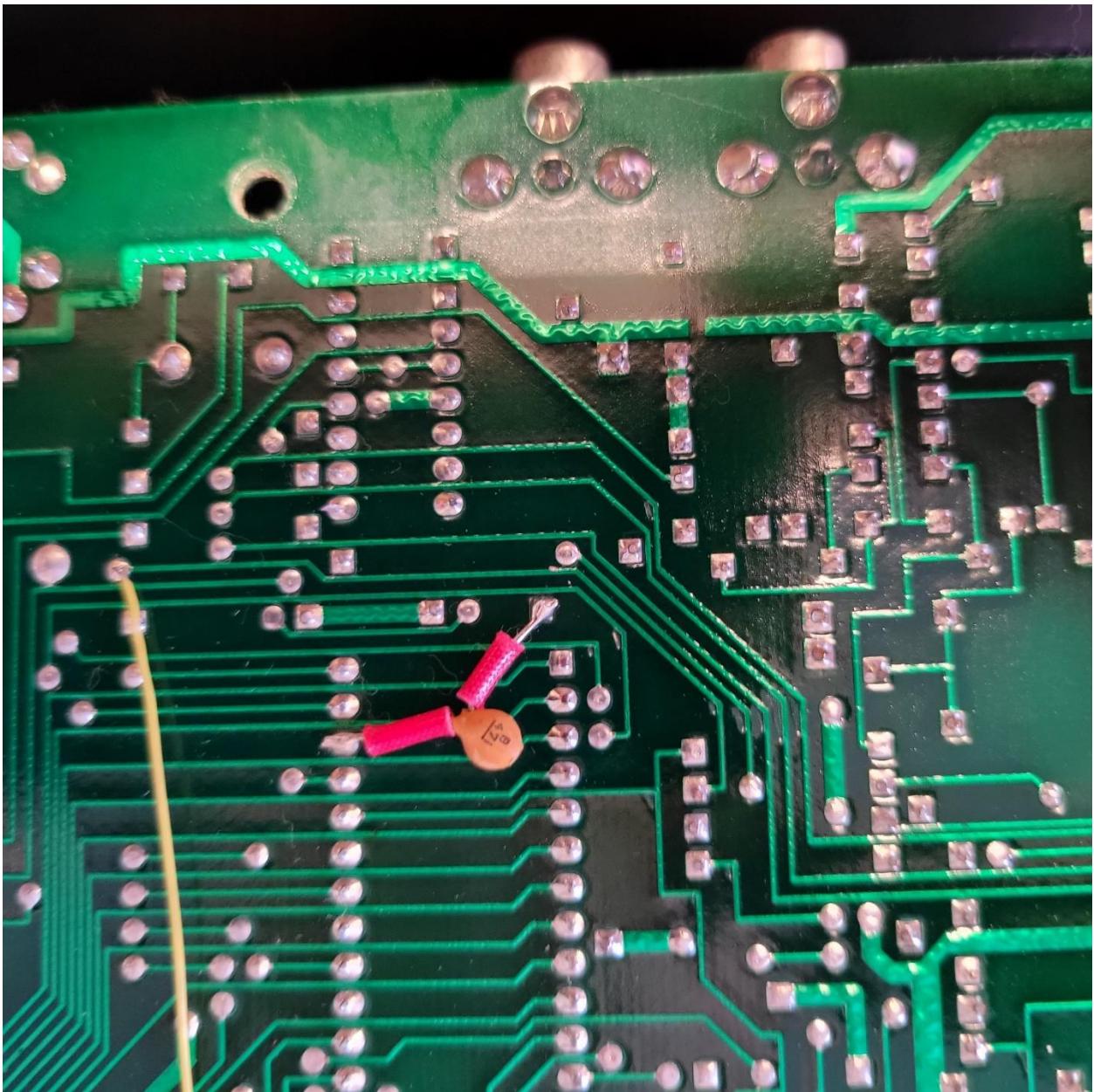
00 ctrl @	20 (SP)	40 @	60 (na)	80 'JS1'	A0 'JS'	C0 (na)	E0 -> (dn)
01 ctrl A	21 !	41 A	61 a	81 'JS2'	A1 'JS'	C1 (na)	E1 <- (dn)
02 ctrl B	22 "	42 B	62 b	82 (na)	A2 'JS'	C2 (na)	E2 I (dn)
03 ctrl C	23 #	43 C	63 c	83 (na)	A3 'JS'	C3 (na)	E3 I (dn)
04 ctrl D	24 \$	44 D	64 d	84 (na)	A4 'JS'	C4 (na)	E4 III> (dn)
05 ctrl E	25 %	45 E	65 e	85 (na)	A5 'JS'	C5 (na)	E5 <III (dn)
06 ctrl F	26 &	46 F	66 f	86 (na)	A6 'JS'	C6 (na)	E6 NO (dn)
07 ctrl G	27 '	47 G	67 g	87 (na)	A7 'JS'	C7 (na)	E7 YES (dn)
08 ctrl H	28 (48 H	68 h	88 (na)	A8 'JS'	C8 (na)	E8 SYM (dn)
09 ctrl I	29)	49 I	69 i	89 (na)	A9 'JS'	C9 (na)	E9 PAUSE (dn)
0A ctrl J	2A *	4A J	6A j	8A (na)	AA 'JS'	CA (na)	EA TV/NABU (dn)
0B ctrl K	2B +	4B K	6B k	8B (na)	AB 'JS'	CB (na)	EB (na)
0C ctrl L	2C ,	4C L	6C l	8C (na)	AC 'JS'	CC (na)	EC (na)
0D ctrl M	2D -	4D M	6D m	8D (na)	AD 'JS'	CD (na)	ED (na)
0E ctrl N	2E .	4E N	6E n	8E (na)	AE 'JS'	CE (na)	EE (na)
0F ctrl O	2F /	4F O	6F o	8F (na)	AF 'JS'	CF (na)	EF (na)
10 ctrl P	30 0	50 P	70 p	90 'E1'	B0 'JS'	D0 (na)	F0 -> (up)
11 ctrl Q	31 1	51 Q	71 q	91 'E2'	B1 'JS'	D1 (na)	F1 <- (up)
12 ctrl R	32 2	52 R	72 r	92 'E3'	B2 'JS'	D2 (na)	F2 I (up)
13 ctrl S	33 3	53 S	73 s	93 'E4'	B3 'JS'	D3 (na)	F3 I (up)
14 ctrl T	34 4	54 T	74 t	94 'E5'	B4 'JS'	D4 (na)	F4 III> (up)
15 ctrl U	35 5	55 U	75 u	95 'E6'	B5 'JS'	D5 (na)	F5 <III (up)
16 ctrl V	36 6	56 V	76 v	96 (na)	B6 'JS'	D6 (na)	F6 NO (up)
17 ctrl W	37 7	57 W	77 w	97 (na)	B7 'JS'	D7 (na)	F7 YES (up)
18 ctrl X	38 8	58 X	78 x	98 (na)	B8 'JS'	D8 (na)	F8 SYM (up)
19 ctrl Y	39 9	59 Y	79 y	99 (na)	B9 'JS'	D9 (na)	F9 PAUSE (up)
1A ctrl Z	3A :	5A Z	7A z	9A (na)	BA 'JS'	DA (na)	FA TV/NABU (up)
1B ctrl [3B ;	5B [7B {	9B (na)	BB 'JS'	DB (na)	FB (na)
1C ctrl <	3C <	5C (na)	7C (na)	9C (na)	BC 'JS'	DC (na)	FC (na)
1D ctrl]	3D -	5D]	7D }	9D (na)	BD 'JS'	DD (na)	FD (na)
1E ctrl ^	3E >	5E ^	7E (na)	9E (na)	BE 'JS'	DE (na)	FE (na)
1F ctrl -	3F ?	5F -	7F DEL	9F (na)	BF 'JS'	DF (na)	FF (na)

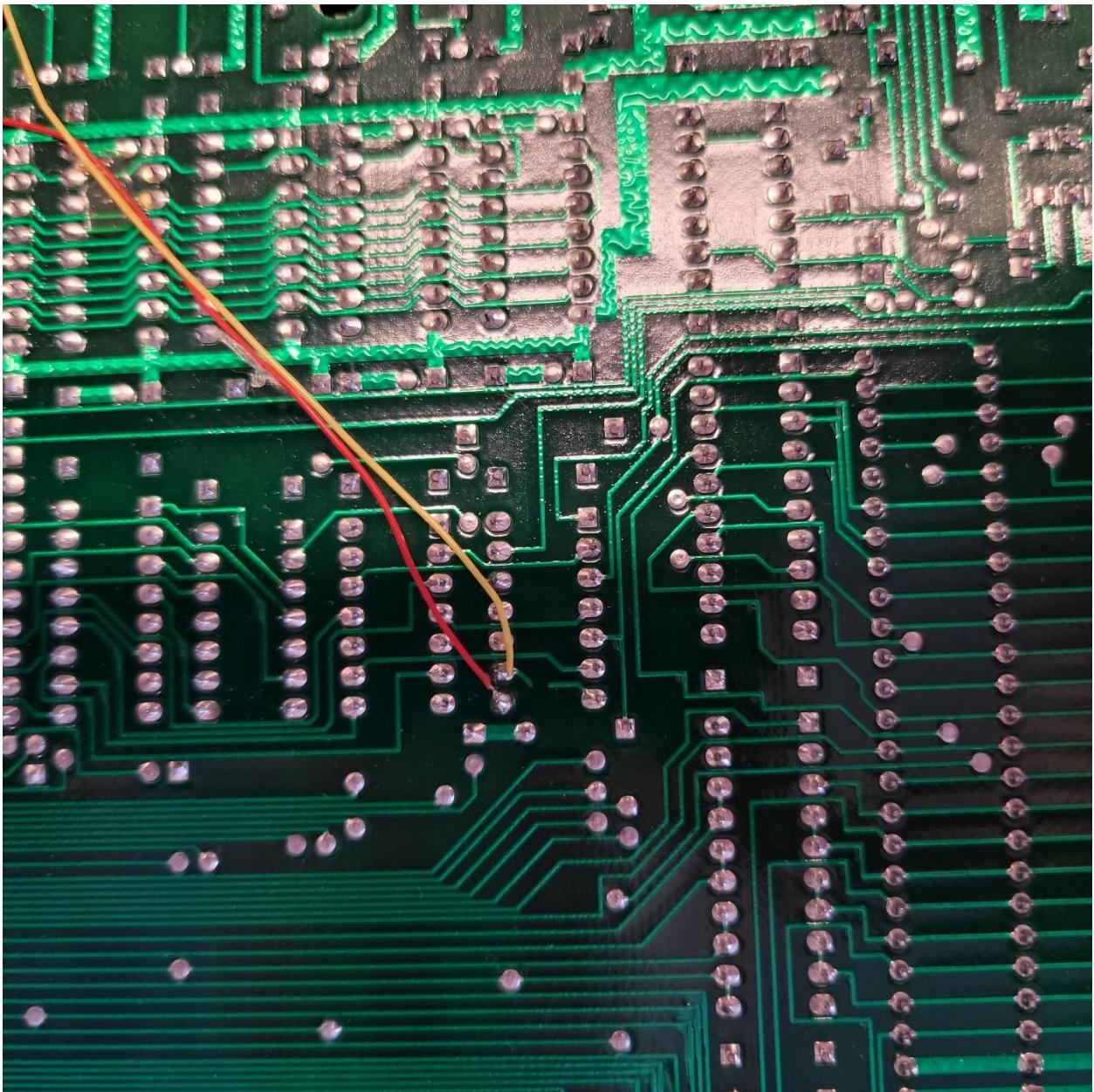


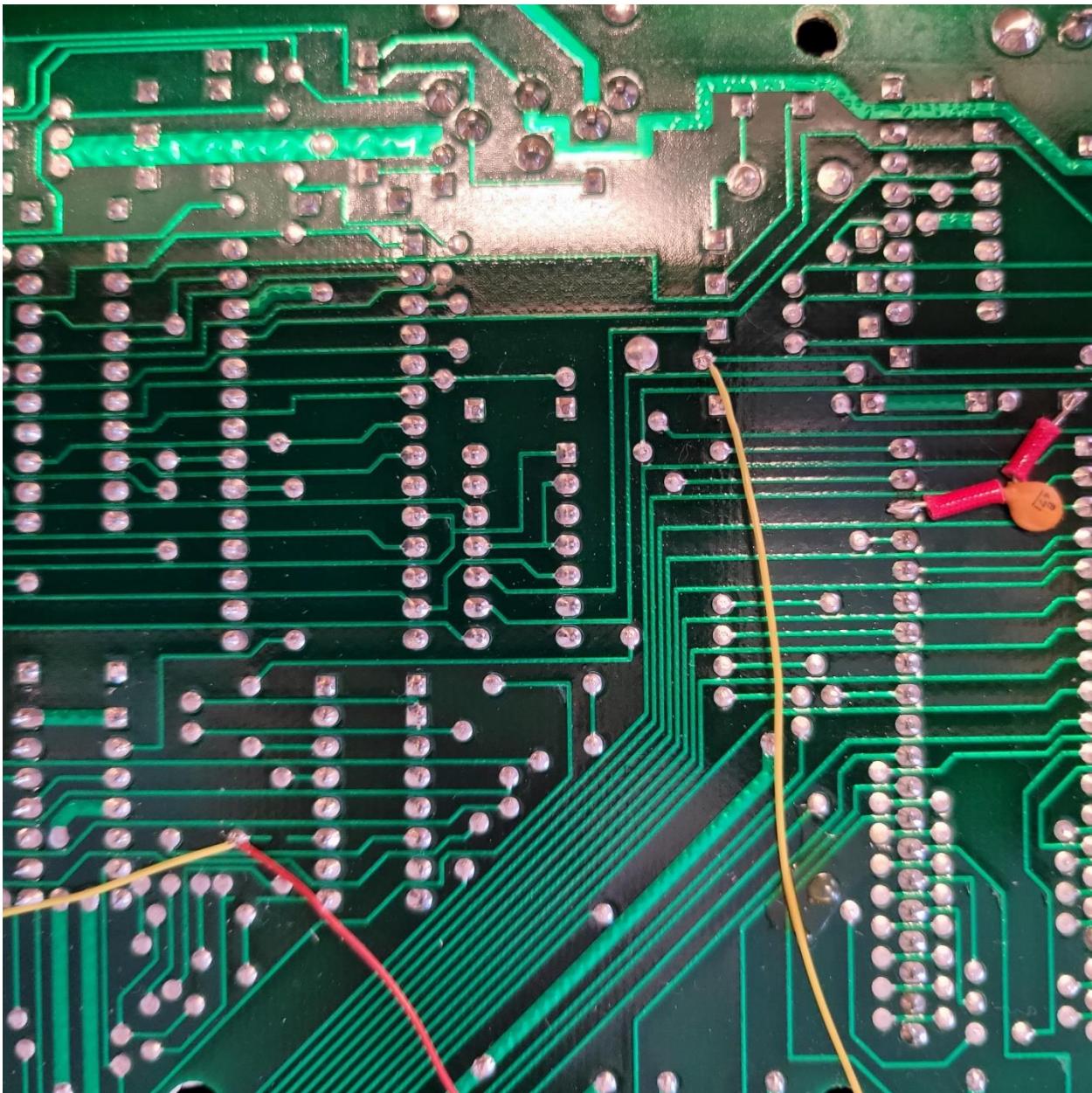
Bodge Wires Connection

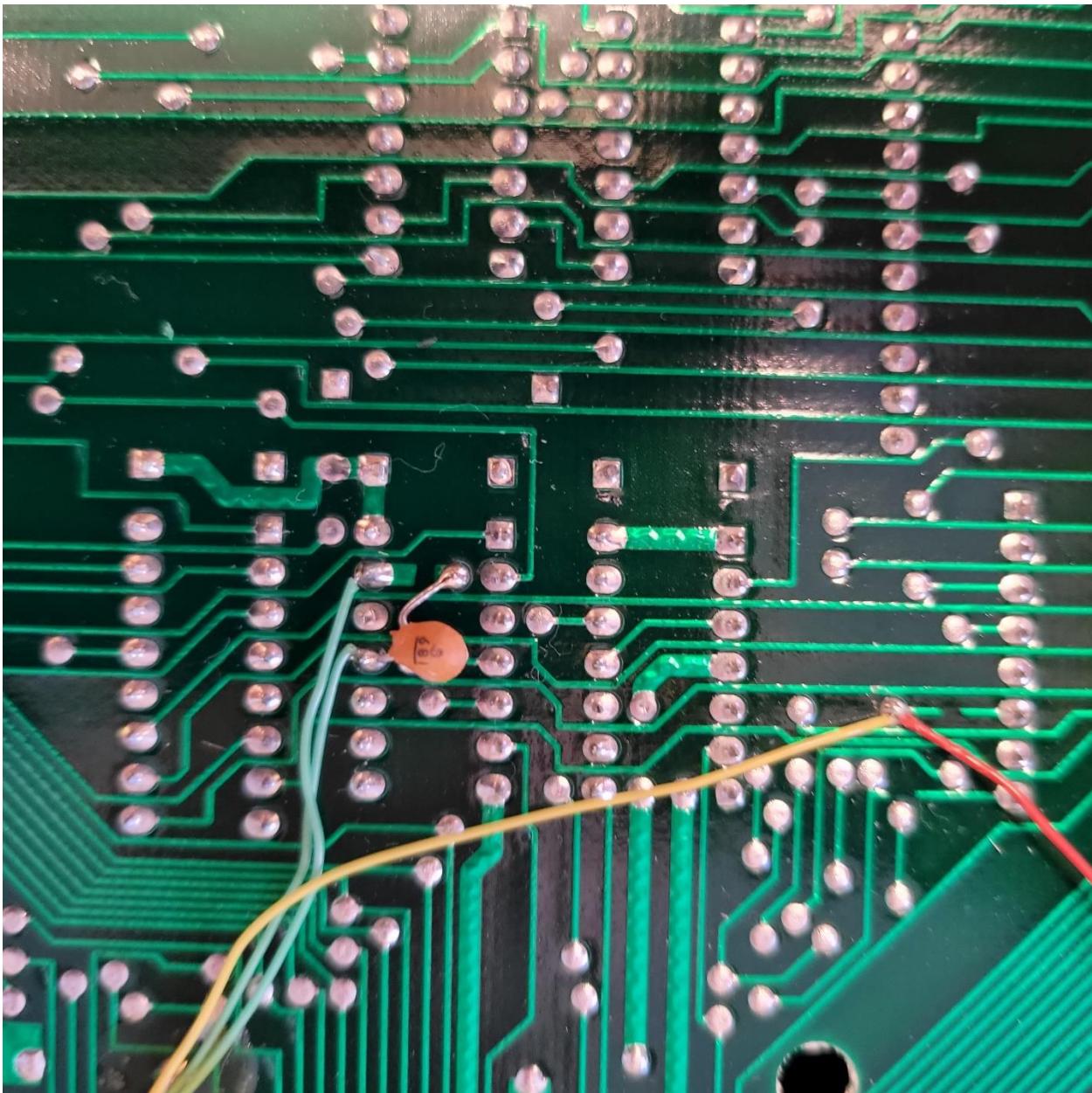
On the back of the motherboard there are several bodge wire connections. Below are the images that show these connections. If some are missing or you need to remove them to perform repairs, these images could be used to help with the reattachments. Take pictures before removing wires.

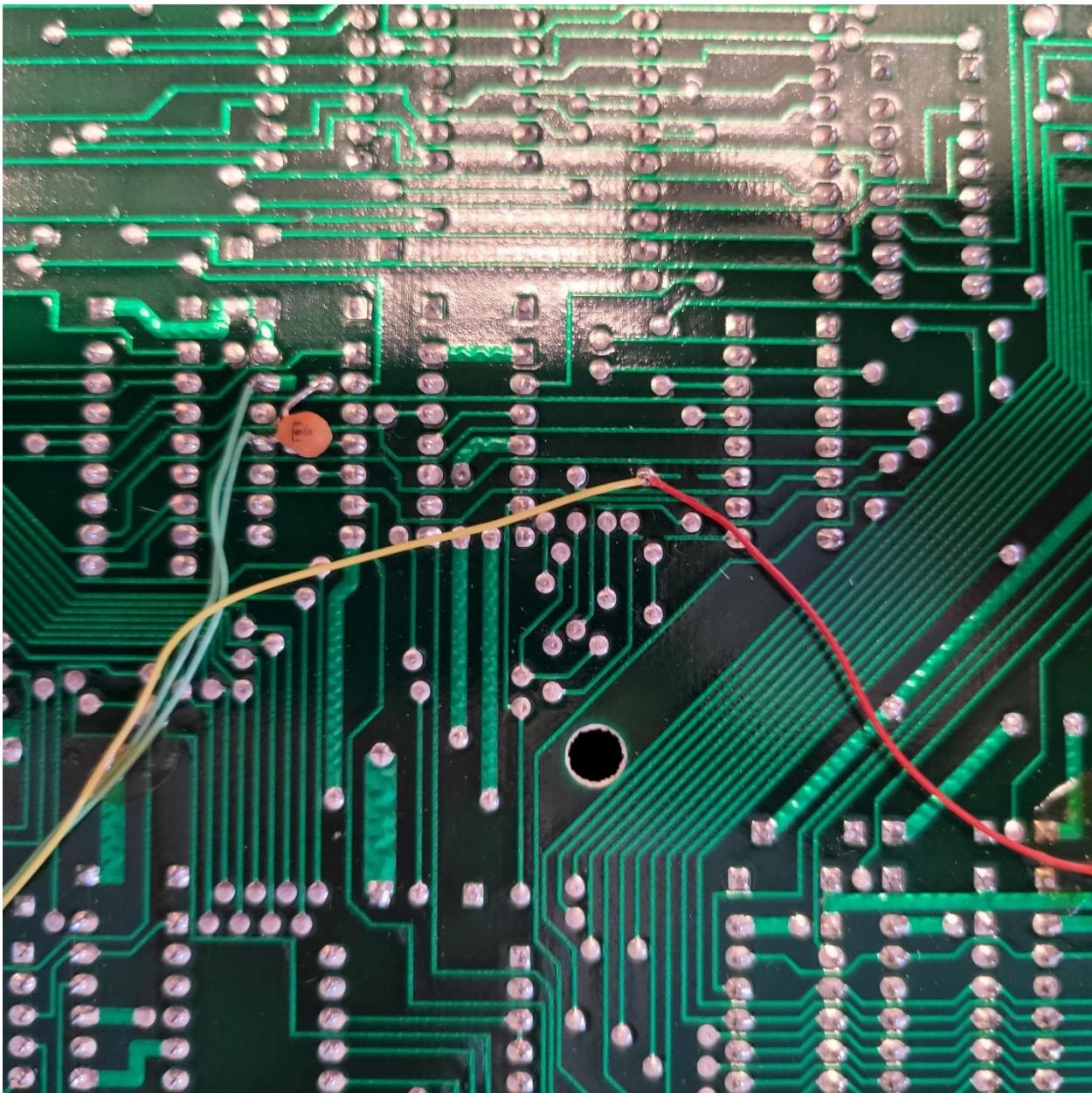


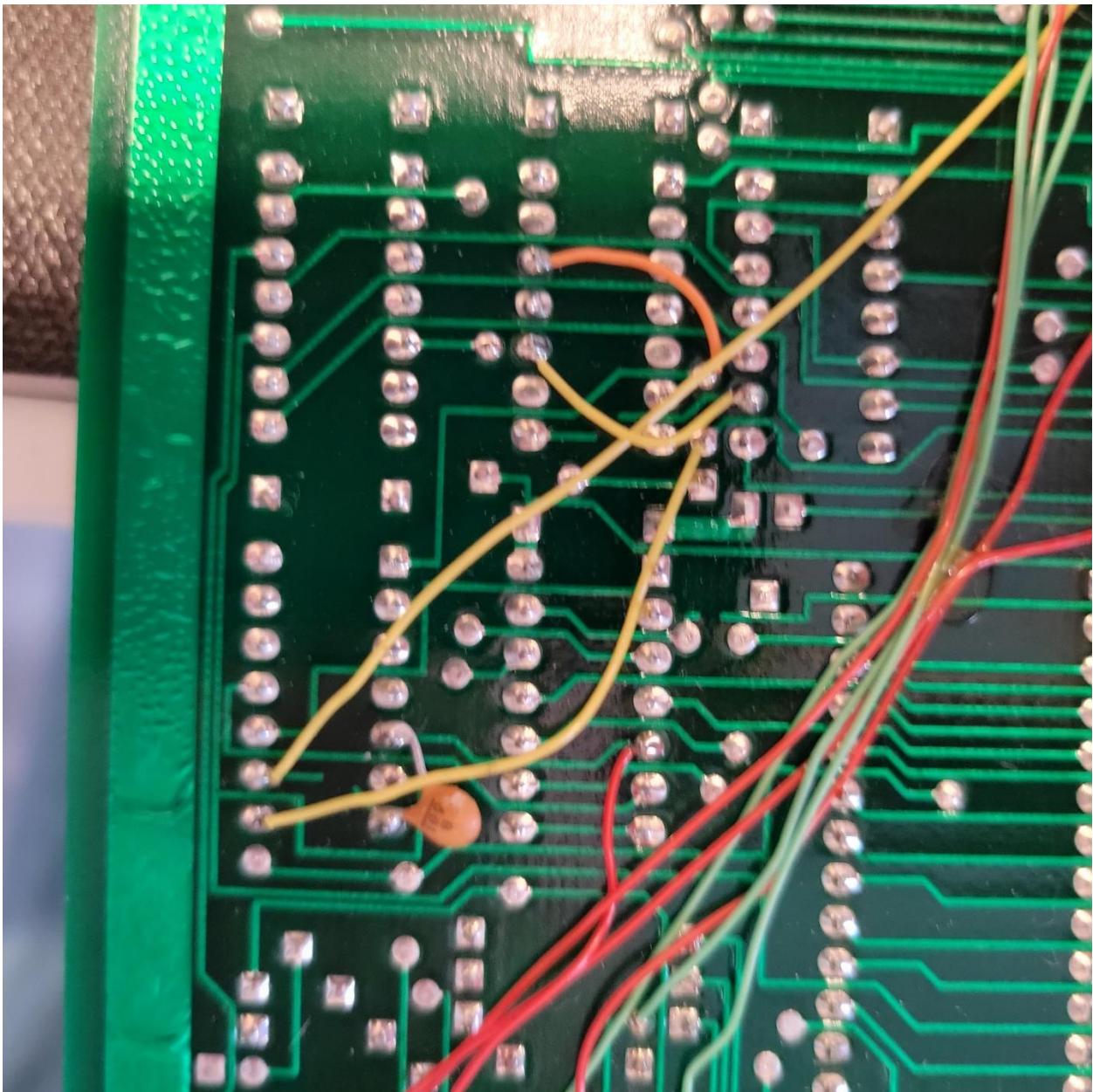


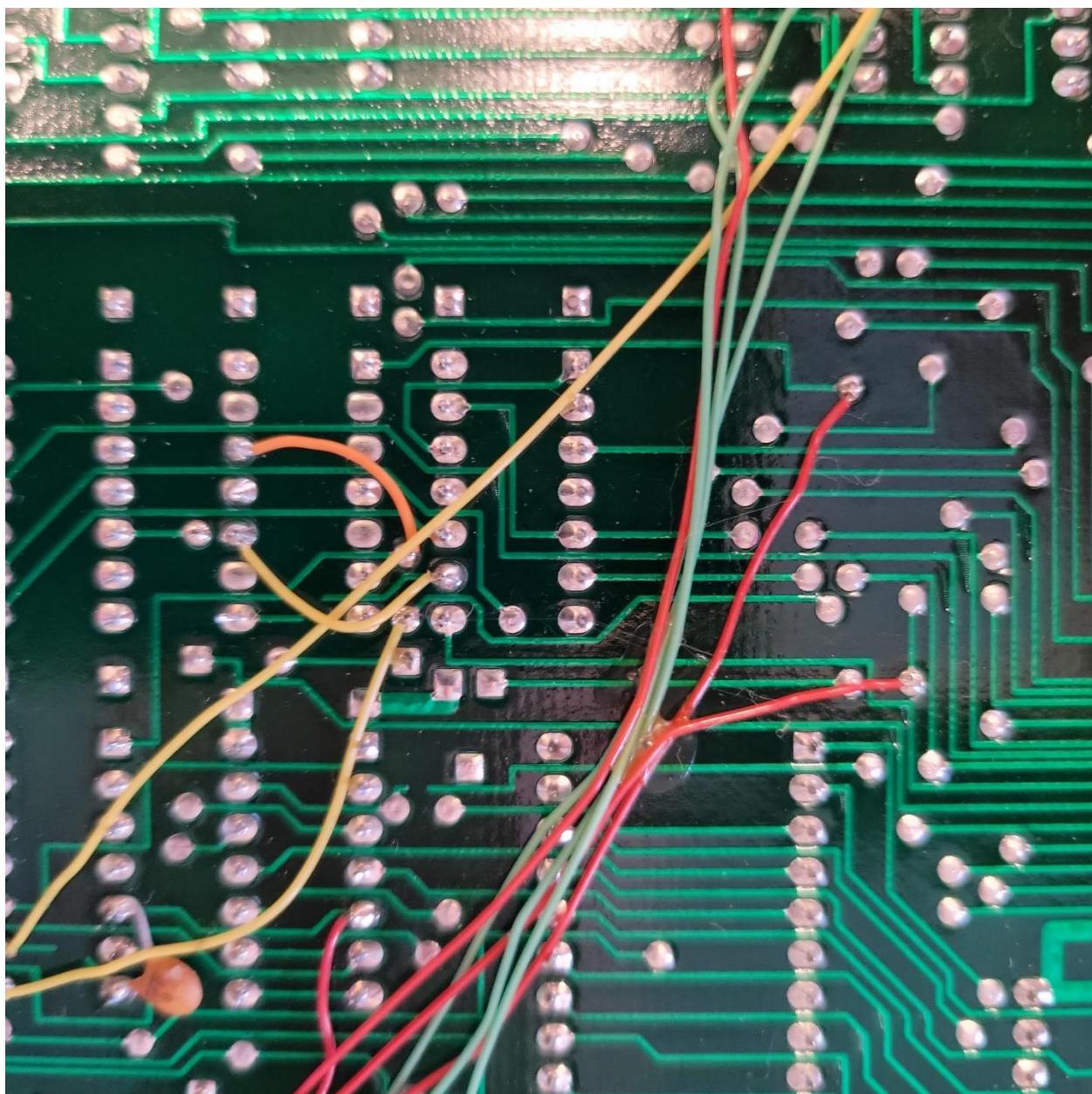


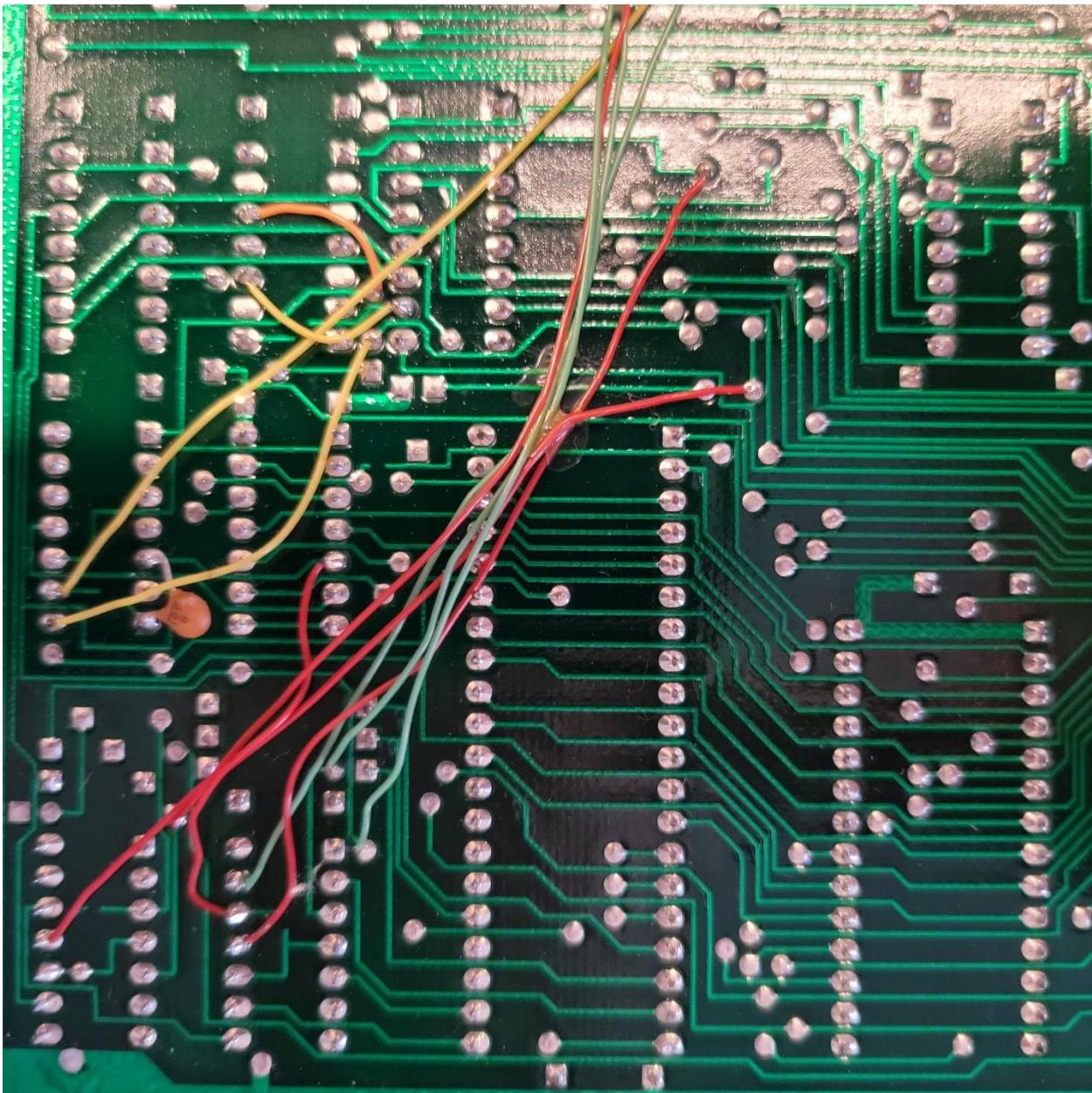


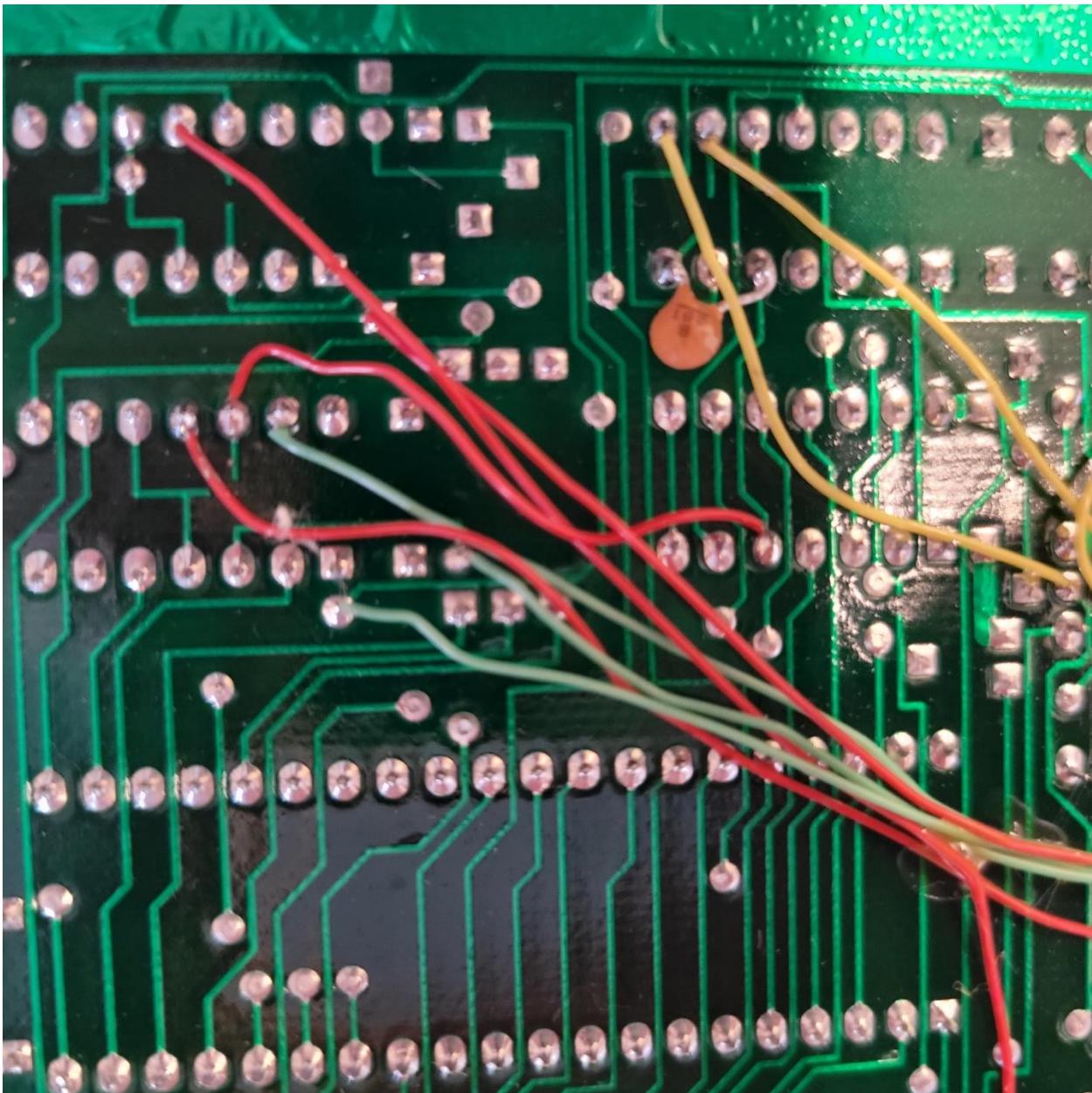


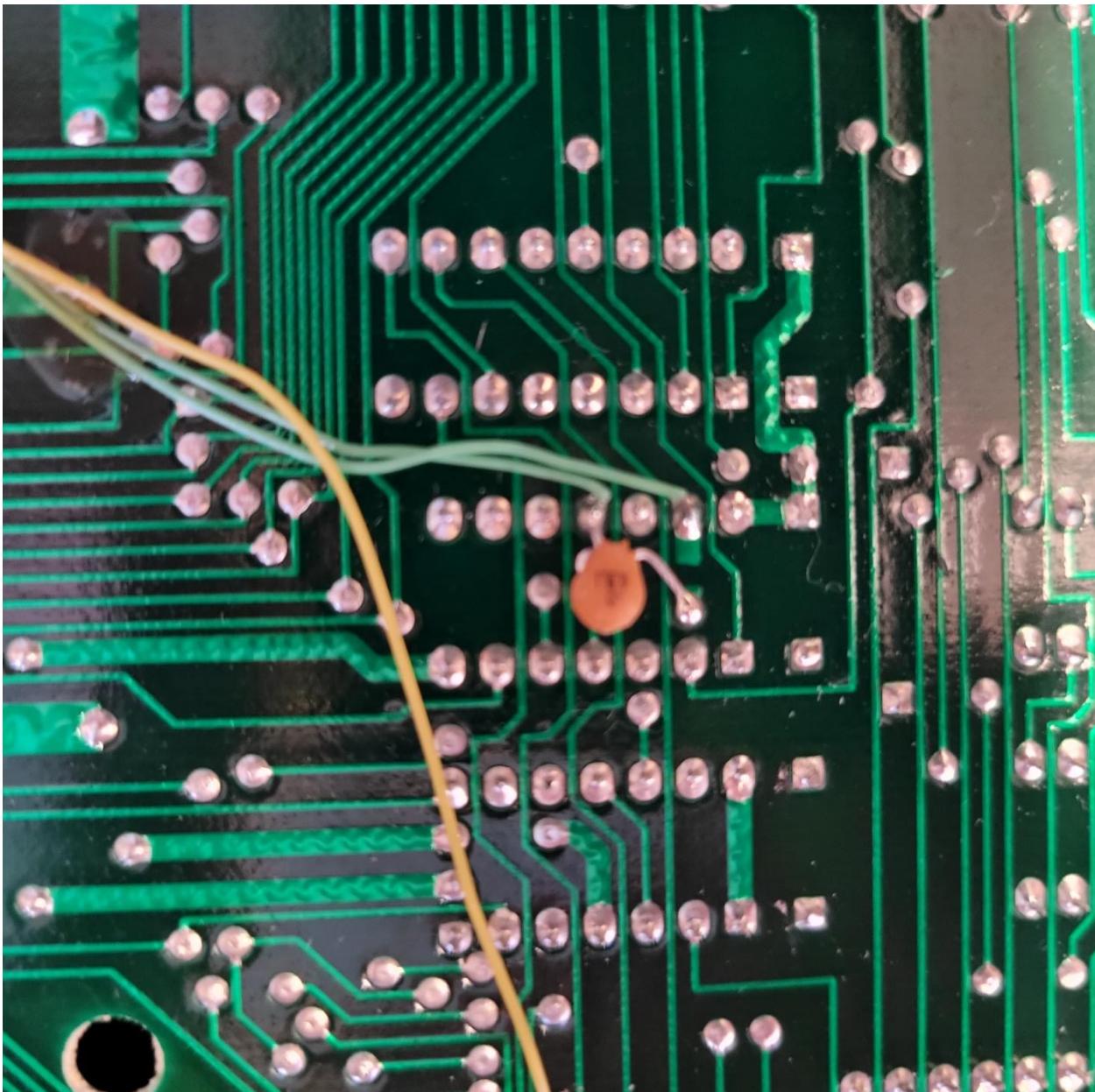


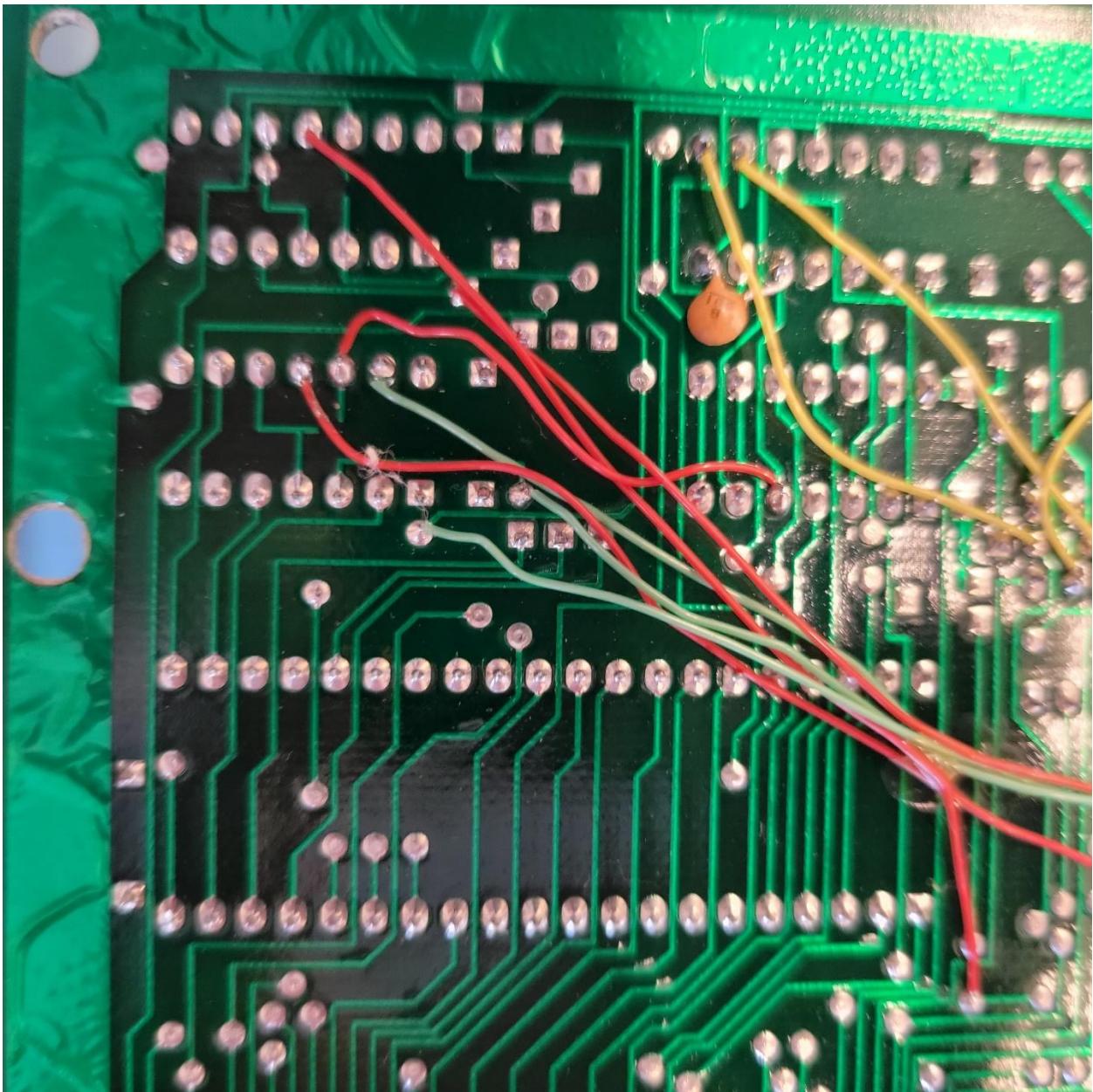


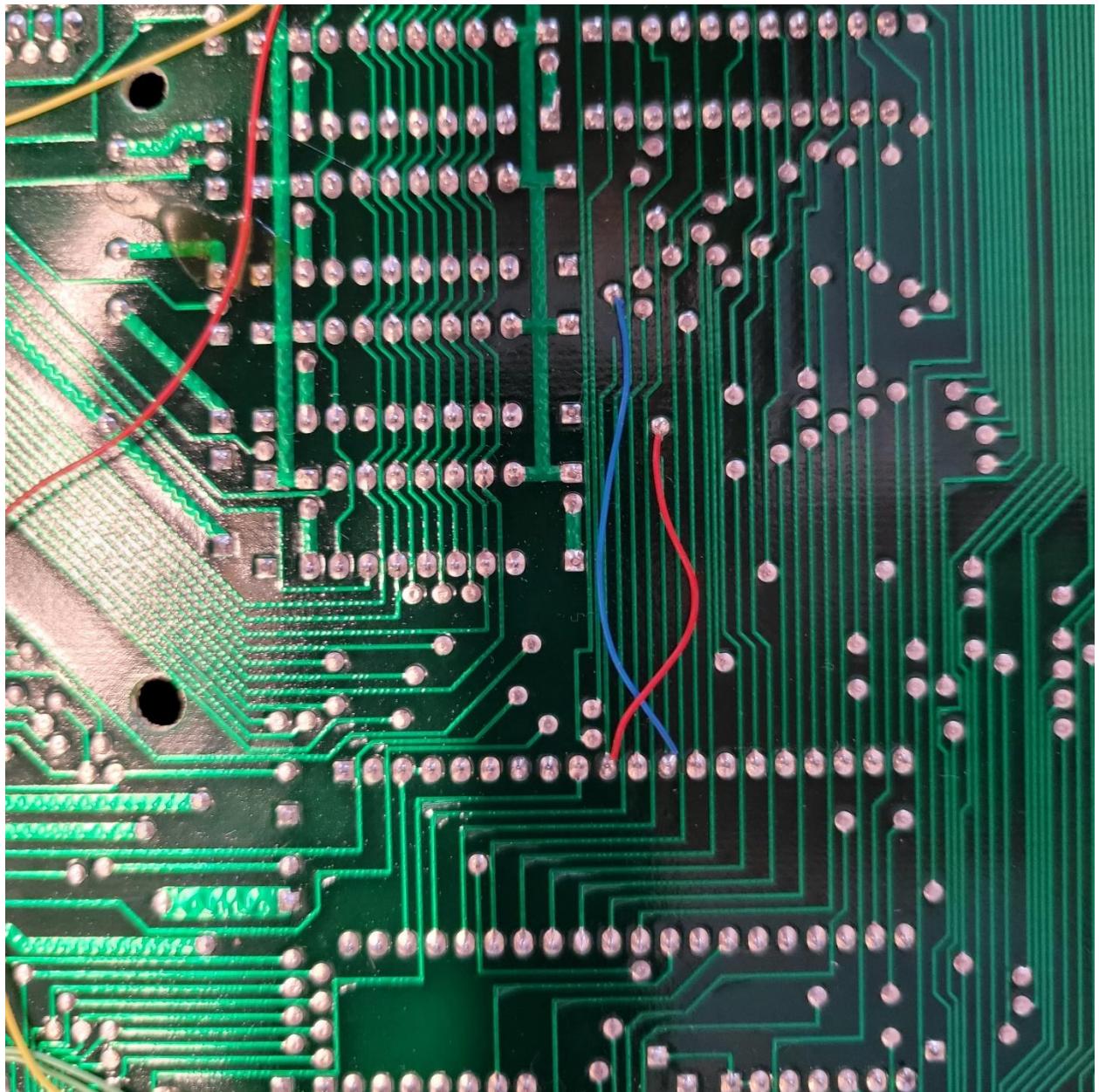






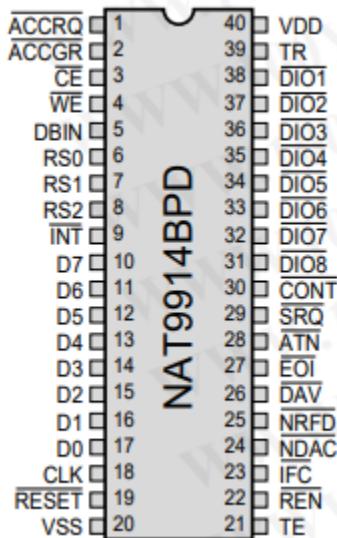




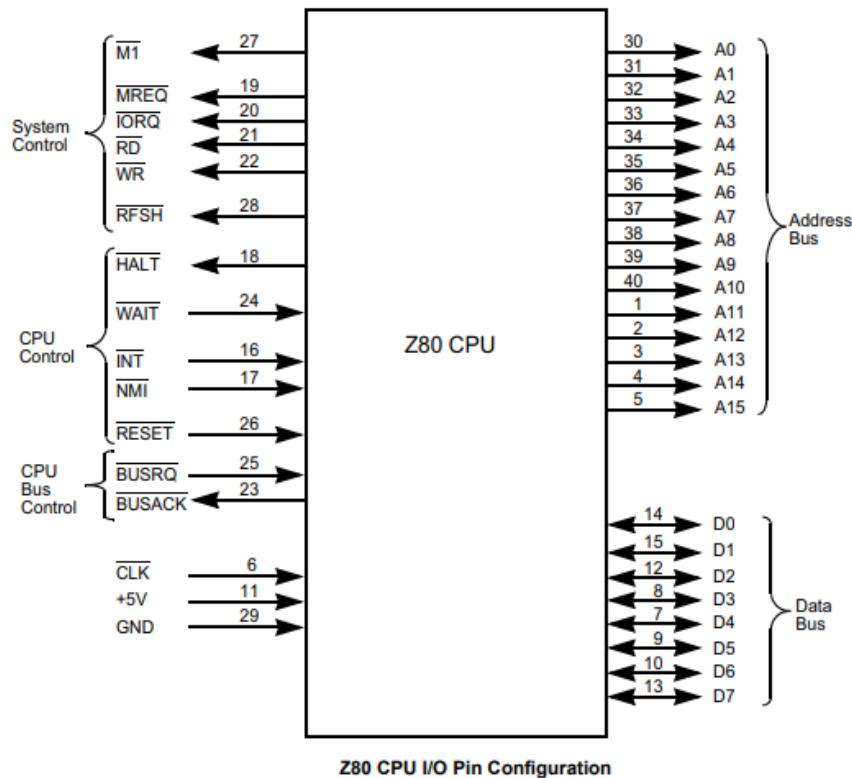


IC Pinouts

Video processor – TMS9919ANL pinout. TMS9919ANL is pin compatible with NAT9914BPD



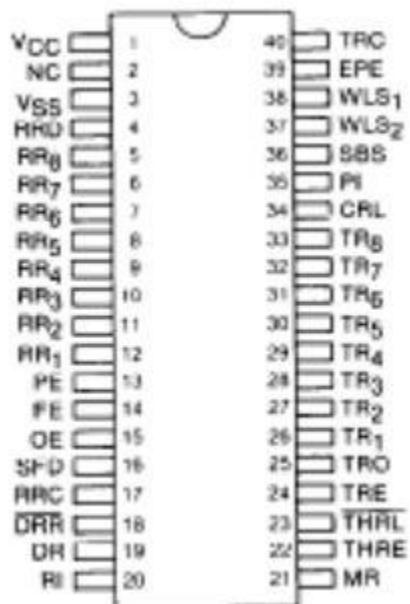
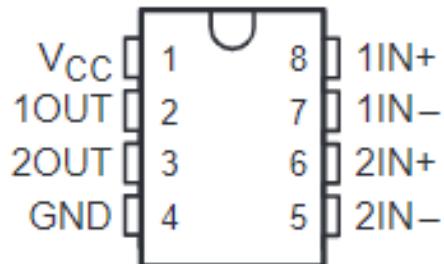
Z80 Processor pinout.



Z80 CPU I/O Pin Configuration

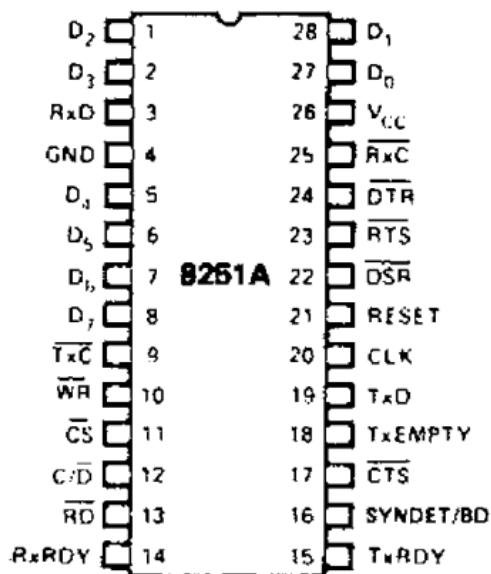
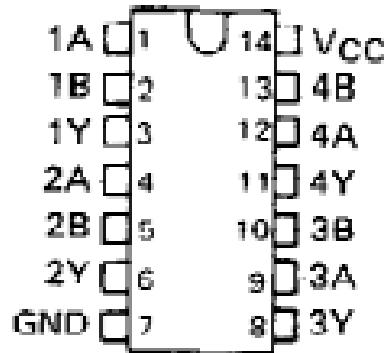
https://www.jameco.com/z/Z80A-CPU-Major-Brands-IC-Z80A-4-8-16bit-CPU-N-Channel-Silicon-Gate_35596.html

**uA9637AC . . . D OR P PACKAGE
(TOP VIEW)**



TR1863B

SN5432, SN54LS32, SN54S32 . . . J OR W PACKAGE
SN7432 . . . N PACKAGE
SN74LS32, SN74S32 . . . D OR N PACKAGE
(TOP VIEW)



- https://www.jameco.com/z/D8251AC-NEC-Corporation-IC-USART-8251-Dip-28_52644.html

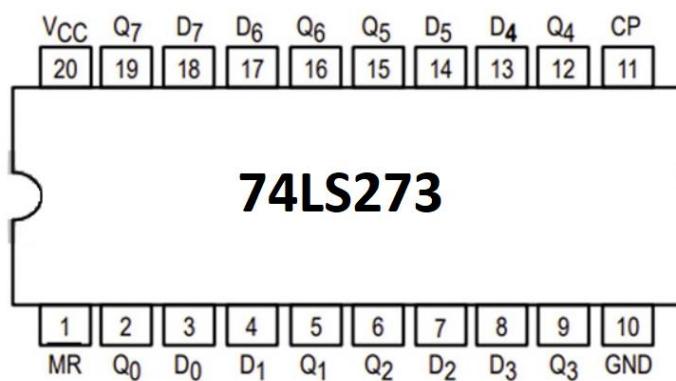
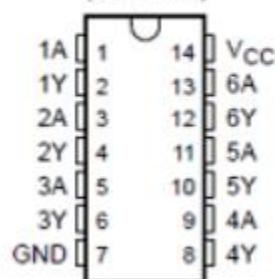
AY-3-8910 PIN ASSIGNMENTS

Top View	
V _{ss} (GND)	•1
N.C.	2
ANALOG CHANNEL B	3
ANALOG CHANNEL A	4
N.C.	5
IOB7	6
IOB6	7
IOB5	8
IOB4	9
IOB3	10
IOB2	11
IOB1	12
IOB0	13
IOA7	14
IOA6	15
IOA5	16
IOA4	17
IOA3	18
IOA2	19
IOA1	20
	40
	39
	38
	37
	36
	35
	34
	33
	32
	31
	30
	29
	28
	27
	26
	25
	24
	23
	22
	21
	V _{cc} (+5V)
	TEST 1
	ANALOG CHANNE
	DA0
	DA1
	DA2
	DA3
	DA4
	DA5
	DA6
	DA7
	BC1
	BC2
	BDIR
	TEST 2
	A8
	A9
	RESET
	CLOCK
	IOA0

TR1863-B-02 – Universal Asynchronous Receiver/Transmitter

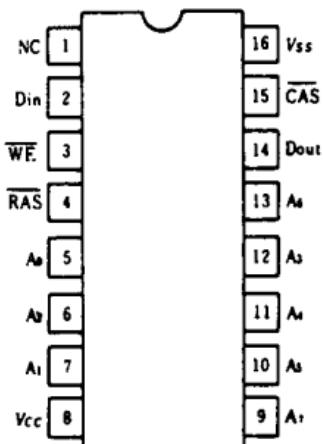
V _{DC}	1	40	TRC
NC	2	39	EPE
V _{SS}	3	38	WLS1
RHD	4	37	WLS2
RR ₈	5	36	SBS
RR ₇	6	35	PI
RR ₆	7	34	CRL
RR ₅	8	33	TR ₈
RR ₄	9	32	TR ₇
RR ₃	10	31	TR ₆
RR ₂	11	30	TR ₅
RR ₁	12	29	TR ₄
PE	13	28	TR ₃
FE	14	27	TR ₂
OE	15	26	TR ₁
SFD	16	25	TRO
RRC	17	24	TRE
DRR	18	23	THRL
DR	19	22	THRE
RI	20	21	MR

SN5406, SN5416 . . . J OR W PACKAGE
 SN7406 . . . D, N, OR NS PACKAGE
 SN7416 . . . D OR N PACKAGE
 (TOP VIEW)



HM4864P – DRAM Chip DRAM 64Kbit 64Kx1 5VDC

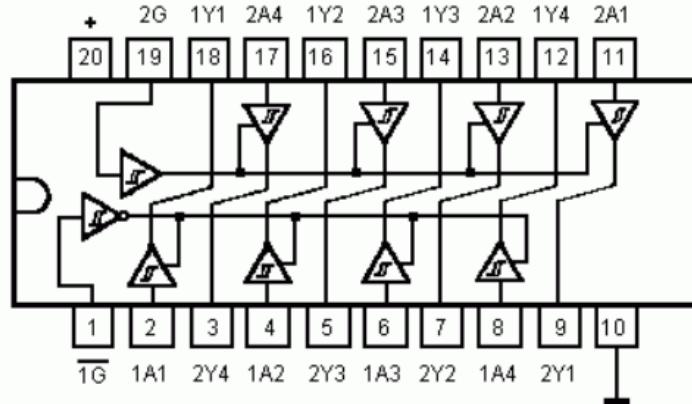
■ PIN ARRANGEMENT



(Top View)

A₀-A₇	Address Inputs
CAS	Column Address Strobe
Din	Data In
Dout	Data Out
RAS	Row Address Strobe
WE	Read/Write Input
V_{cc}	Power (+5V)
V_{ss}	Ground
A₀-A₄	Refresh Address Input

<https://www.datasheets.com/en/part-details/hm4864p-2-hitachi-62627550#datasheet>

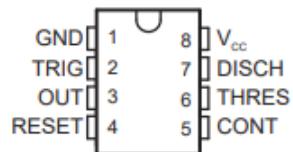


74LS241

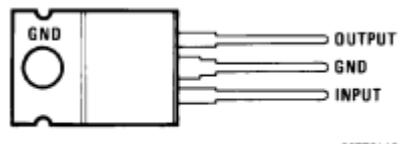
For addition IC pinouts, visit <https://www.futurlec.com/IntegratedCircuits.shtml>

Pin Configuration and Functions

NA555...D OR P PACKAGE
 NE555...D, P, PS, OR PW PACKAGE
 SA555...D OR P PACKAGE
 SE555...D, JG, OR P PACKAGE
 (TOP VIEW)

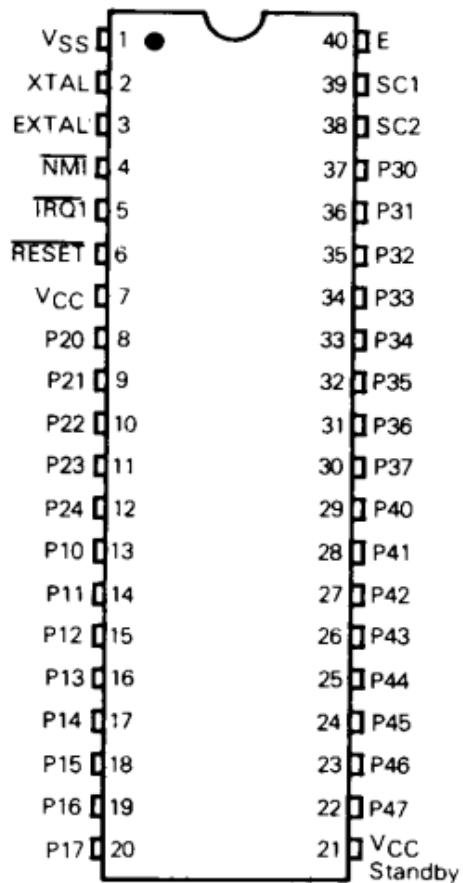


555 Timer

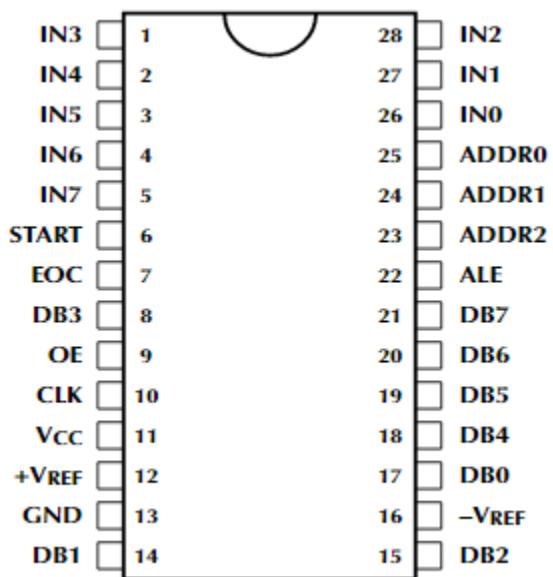


Top View

7805T



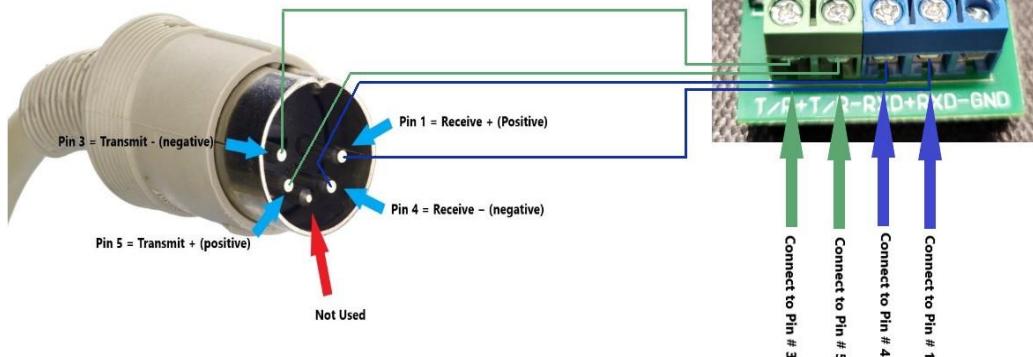
MC6801



ADC0809CCN



NABU Adapter Connections



For additional documentation on the adapter, please visit

<https://www.nabunetwork.com>

<https://github.com/RudyRetroIntel/Vintage-Computer-Diagnostics>