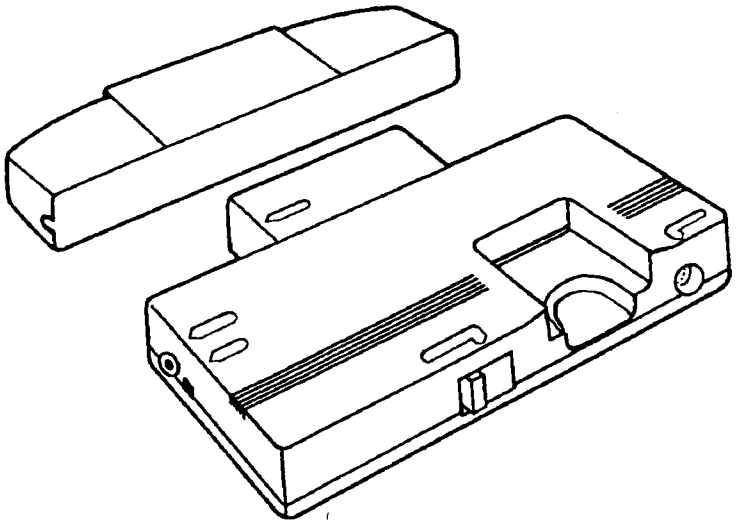
NEC

HES-TGX-01 SYSTEM

TURBOGRAFX-16 UNIT

SERVICE MANUAL

Better Service
Better Reputation
Better Profit



SPECIFICATIONS

Power Ratings

Supply ..... 10.5 V DC
Consumption ..... approx. 4 W

CPU and Memory

Processor ..... 6280 at 7.2 MHz
RAM ..... 8 Kbytes
VRAM ..... 64 Kbytes (16 bit)

Graphics

Output ..... composite video (NTSC) on RF channel 3 or 4
Maximum Resolution ..... 256 x 216
Color Palette ..... 512 colors
Colors/Card 16

Sprites

Number/Screen 64
Colors/Sprite 16
Maximun Number/Scanline 16

Stereo Audio

RF Output ..... L + R composite mono
Expansion Bus ..... L + R separate, 2 channels

Accessories

TurboPad Controller, TurboChip Game Card, AC Adapter, RF Switch

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SAFETY PRECAUTIONS

1. Before returning an instrument to the customer, always make a safety check of the entire instrument, including, but not limited to the following items:
a. Be sure that no built-in protective devices are defective and/or have been defeated during servicing.
(1) Protective shields are provided on this chassis to protect both the technician and the customer. Correctly replace all missing protective shields, including any removed for servicing convenience.
(2) When reinstalling the chassis and/or other assembly in the cabinet, be sure to put back in place all protective devices, including, but not limited to, nonmetallic control knobs, insulating fishpapers, adjustment and compartment covers/shields, and isolation resistor/capacitor networks. Do not operate this instrument or permit it to be operated without all protective devices correctly installed and functioning.
b. Be sure that there are no cabinet openings through which an adult or child might be able to insert their fingers and contact a hazardous voltage. Such openings include, but are not limited to, excessively wide cabinet ventilation slots, and/or an improperly fitted and/or incorrectly secured cabinet back cover.
c. Leakage Current Hot Check - With the instrument completely reassembled, plug the AC line cord directly into a 120 V AC outlet. (Do not use an isolation transformer during this test.) Use a leakage current tester or metering system that complies with American National Standards Institute (ANSI) C101.1 Leakage Current for Appliances, and Underwriters Laboratories (UL) 1410, (50.7). With the instrument AC switch first in the on position and then in the off position, measure from a known earth ground (metal waterpipe, conduit, etc.) to all exposed metal parts of the instrument (antennas, handle bracket, metal cabinet, screw heads, metallic overlays, control shafts, etc.), especially any exposed metal parts that offer an electrical return path to the chassis. Any current measured must not exceed 0.5 milliamp. Reverse the instrument power cord plug in the outlet and repeat test.

ANY MEASUREMENTS NOT WITHIN THE LIMITS SPECIFIED HEREIN INDICATE A POTENTIAL SHOCK HAZARD THAT MUST BE ELIMINATED BEFORE RETURNING THE INSTRUMENT TO THE CUSTOMER.

2. Read and comply with all caution and safety-related notes on or inside the cabinet, or on the chassis.

3. Design Alteration Warning - Do not alter or add to the mechanical or electrical design of this unit. Design alterations and additions, including, but not limited to , circuit modifications, and the addition of items such as auxiliary audio and/or video output connections might alter the safety characteristics of this unit and create a hazard to the user. Any design alterations or additions will void the manufacturers warranty and will make you, the servicer, responsible for personal injury of property damage resulting therefrom.

4. Observe original lead dress. Take extra care to assure correct lead dress in the following areas: near sharp edges, near thermally hot parts - be sure that leads and components do not touch thermally hot parts, the AC supply, high voltage, and antenna wiring. Always inspect in all areas for pinched, out-of-place, or frayed wiring. Do not change spacing between components, and between components and the printed circuit board. Check AC power cord for damage.

5. Components, parts, and/or wiring that appear to have overheated or are otherwise damaged should be replaced with components, parts, or wiring that meet original specifications. Additionally, determine the cause of overheating and/or damage, and, if necessary, take corrective action to remove any potential safety hazard.

6. SAFETY PRODUCT NOTICE - some electrical and mechanical parts have special safety-related characteristics which are often not evident from visual inspection, nor can the protection they give necessarily be obtained by replacing them with components rated for higher voltage, wattage, etc. Parts that have special safety characteristics are identified by and asterisk or an exclamation point inscribed in a triangle on the schematics and parts list. Use of a substitute replacement that does not have the same safety characteristics as the recommended replacement part might create shock, fire, and/or other hazards. Product Safety is under review continuously and new instructions are issued whenever appropriate.

DESIGN INFORMATION

General

Processor: The TurboGrafx-16 contains a heavily modified 65C02 processor running at 7.2 MHz. In addition to the standard 65C02 modifications, other extensions made to the chip's instruction set enable the CPU to run routines even faster than equivalent 65C02 routines in some cases. For example, in block moves of memory data the CPU block move instructions take a minimum of 50% fewer cycles than an equivalent 65C02 routine. These instructions also save program space.

Program RAM: This is random access (modifiable) memory contained within the base unit that is available to the program. The amount of RAM is an indication of the possible complexity of the games. With 8K of RAM, the TurboGrafx-16 is capable of very deep and complex play.

Video RAM: This is an indication of how complex the graphics can be. The TurboGrafx-16, with 64K VRAM and one ROM address space, downloads only the characters it needs into VRAM so it doesn't have copies of certain characters (like alphanumeric characters) in each bank of ROM. In addition, because the character set is in RAM, it can be modified on the fly. With more than enough VRAM in the system to provide a unique character for every location on the screen, a bit map screen can be simulated. This is essential in certain types of games like flight simulators.

The VRAM on the NEC machine is 16 bits wide. This can be easily understood with the use of an analogy. Compare the basic process of video display to a highway. One needs to get from one place (memory) to another (the display). To increase the amount of traffic (data rate) you can move from place to place, you can increase the speed (clock rate) or you can increase the number of lanes (the bus width). The TurboGrafx-16 uses both techniques with a 16 bit transfer path and a 7.2 MHz processor.

Timer: The NEC machine contains a hardware timer, providing greatly increased capabilities in such areas as sound effects.

Background

Resolution: This represents the practical maximum that can be displayed on a television set without interleaving. (Interleaving could double the vertical resolution but at the expense of noticeable flicker). The TurboGrafx-16 can be programmed to a higher resolution, approximately 320 dots across, but color distortions may be introduced, especially on the sprites. With proper color choice on certain games, this effect is minimized.

Color Palette: The TurboGrafx- 16 has 512 colors. The human eye is very color oriented and a large number of colors is better received than increased resolution. As mentioned in the RESOLUTION discussion, this machine has pretty much the practical limit when it comes to resolution, a limit set by normal TV broadcasts. Why do broadcasts look superior to computer images? This is due to a large number of colors which produce a smoothing effect (anti-aliasing). While the TurboGrafx-16, with its cost constraints, cannot approach broadcast quality, it is close. The large number of colors is perhaps the biggest advantage of the TurboGrafx-16.

Card Size: All background graphics are made up of 8 pixel (dot) x 8 pixel characters.

Color/Card: The TurboGrafx-16 has 16 colors per card, making its characters complex and realistic.

Scroll Registers: The machine can move its background display (scroll) in the horizontal and vertical direction. The TurboGrafx-16 has two independent scroll registers. This makes it marginally easier to program than a machine with one scroll register (which must be written to twice), especially for games that only scroll in one direction.

Virtual Playfield: The virtual playfield is a background larger than the screen can display. The screen display is simply a window to the virtual playfield, and shows only a portion of it. This capability makes scrolling on the TurboGrafx-16 even easier to program.

Raster Interrupts: Raster interrupts tell the processor that a certain scan line has just been displayed. This information can be used to get timing information and/or to divide a screen into bands. Additional uses include changing the color palette for a certain portion of the screen, and establishing different scroll rates in different areas of the screen.

Sprites

Sprites, also called motion objects, can be visualized as characters that can be positioned on a pixel (dot) boundary over the background, thus loaning themselves to easy movement. Games involving animation and motion are easier to program on systems with sprites than on systems without sprites.

Number/Screen: The TurboGrafx-16 has 64 sprites, many more than most other home video systems. This enables the machine to play games with lots of moving objects, like R-Type, without multiplexing. (Multiplexing, a technique used in systems with a limited number of objects, uses an object for one thing on one screen and then for another thing on the next screen. It causes very noticeable flicker. An example would be Pacman on the Atari VCS.)

Color/Sprite: This is similar to the color per card noted above, 16 colors/sprite, and allows the TurboGrafx-16 to have very detailed and complex sprites.

Size: When large moving objects are required for a game, it is easiest to program if large sprites are available. Otherwise, smaller sprites must be grouped together to construct these larger objects. This increases the probability of exceeding the maximum number of sprites per scanline as mentioned below. The TurboGrafx-16, with its programmable sprite size (16x16 or 32x64 pixels), offers two approaches to sizing objects for display.

Number/Scanline: The game system draws on the display in a series of horizontal lines (scanlines). The process starts offscreen. The next line to be displayed is drawn, background first, then each sprite that is partially displayed on that scanline is drawn in sequence. There is a finite amount of time that is available to do this until the line has to be displayed. As a result, if the scanline is unfinished, some of the sprite data for that scan line may be lost. This would cause a portion of the sprite to disappear from the screen or flicker. In fact, multiplexing may have to be employed to allow more than X number of sprites on a scanline. With a 16 sprite per scanline limit, however, the possibility of multiplexing or showing visible flicker in a TurboGrafx-16 game is much less than the possibility in other popular systems.

Sound

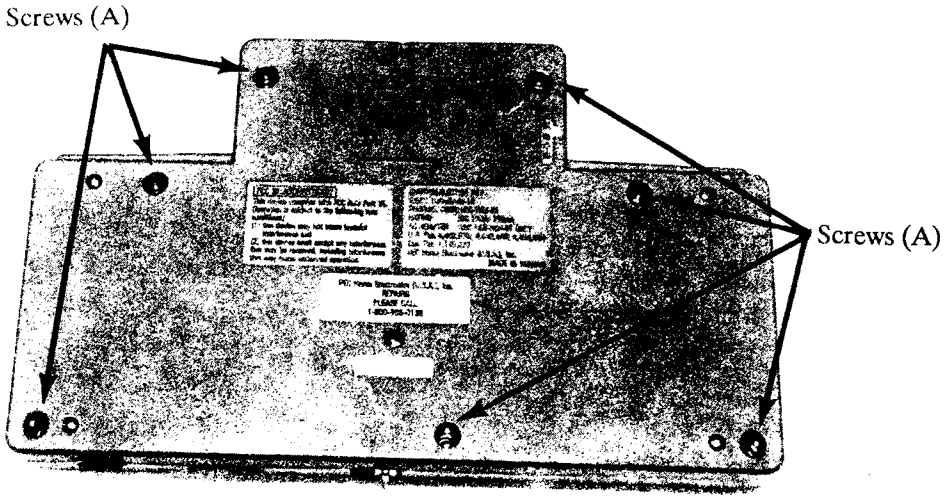
Stereo: The TurboGrafx-16 has stereo capabilities apart from the CD ROM interface. It also has 6 programmable waveform generators. Square, sine, sawtooth, triangle and other waveforms can be easily programmed into any generator. In addition, additional noise may be mixed into generators 5 and 6.

LFO: This stands for Low Frequency Oscillator, a device used to modify sound for effects like Vibrato or Tremolo.

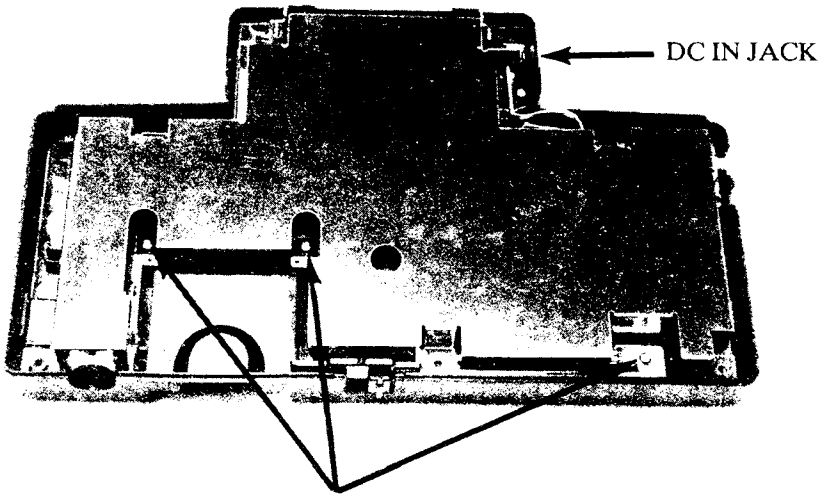
DISASSEMBLY/ASSEMBLY

NOTE: The following steps are for dissambly. They will also help you reassemble the unit if you follow them backwards.

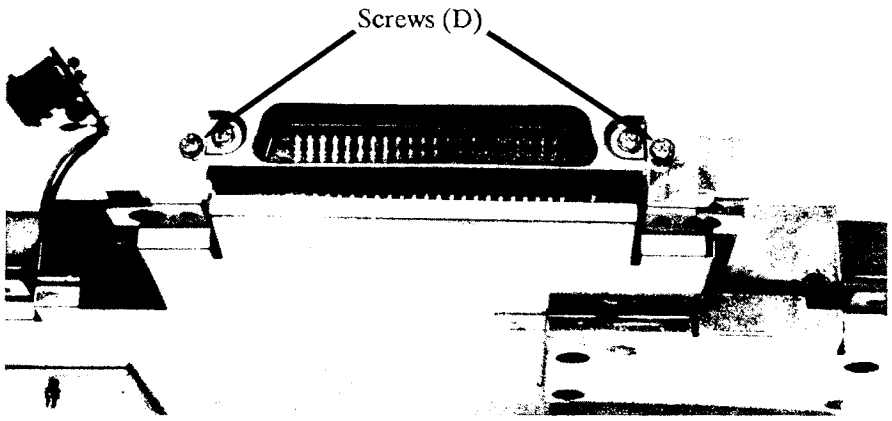
1. Turn the unit upside down and remove the 7 screws (A).



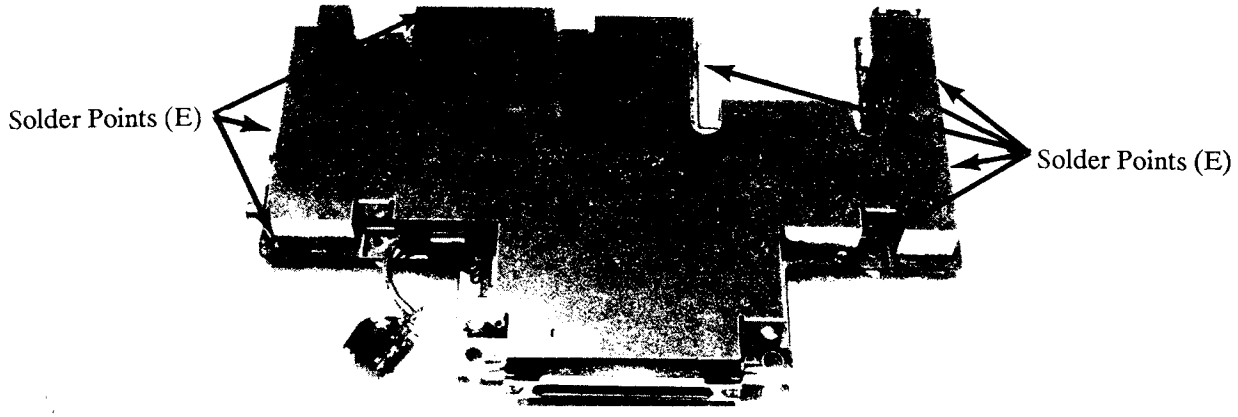
2. Lift off the bottom plastic cover. Then remove the 3 machine screws (B).
3. First, lift out the DC IN JACK (C). Then lift the entire board and shield assembly out of the top plastic cover.



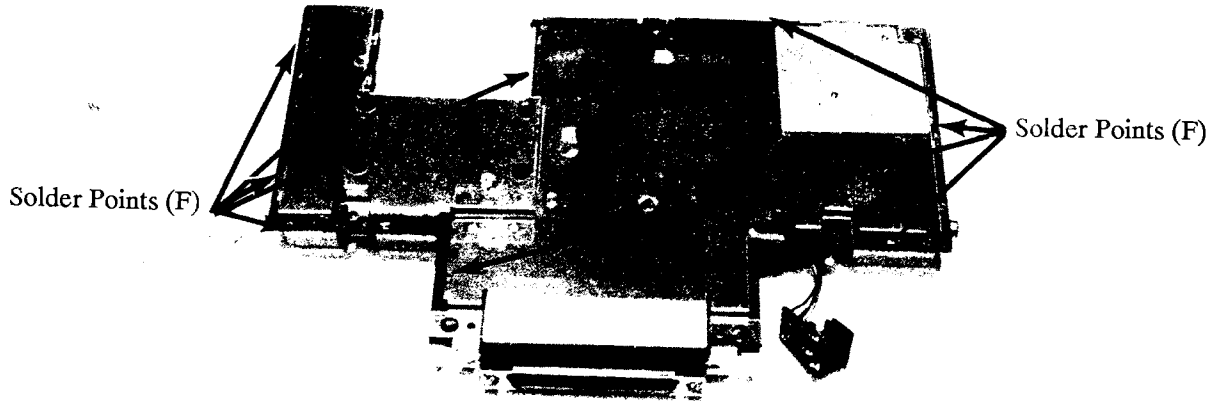
4. Remove the two outside screws (D) to either side of the expansion bus cover (they hold the two shields together).



5. Desolder the 8 points (E) where the bottom shield is soldered to the board. It is easiest if you start by the controller port and work your way around the unit spot by spot.



6. Turn the board over and repeat, desoldering the 9 points (G) where the top shield is soldered to the board.



NOTE: When replacing the shields, make sure the flanges from the top shield (the shallow one) overlap the flanges from the bottom shield on either side of the expansion bus port.

TROUBLESHOOTING

REQUIRED TOOLS

Digital Multimeter

Oscilliscope (100 MHz preferred)

TurboGrafx-16 Service Manual

Solder iron

Test jig

Cabinet screwdriver

#1 Phillips screwdriver

There are two ways to troubleshoot this machine -- through software and hardware. If the unit powers up, run the test jig and troubleshoot it with the software program. If the unit doesn't power up, you must physically test the machine yourself.

GENERAL TROUBLESHOOTING

1. Check for bad solder connections. A bad solder connection will be more grey or black than silver. Also check for solder bridges, or solder connections that overlap extra pins or short parts they were not designed to connect. Resolder any bad connections.Also check for solder flux on all components.

2. Look at the connector pins for both the TurboPad and the Expansion Bus, making sure the pins are not bent, broken, and do not have open or shorted traces. Repair or replace as necessary.

3. Make sure the pins on each of the ICs are centered from the IC to the board. Also make sure none of the pins are shorted to any shield or to any other pin.

4. Measure both the input and the output for the 5V Regulator (IC 113). The input should be 13.5 V DC, while the output should be 5V DC. Replace if needed.

5. Check the RF Modulator -- test the three input pins to see if a correct signal reaches the part. Replace as necessary. See schematics for pin assignments.

6. Also check and repair/replace the following: FS101; open or shorted traces from CN101 to IC101; open traces on oscillator (OSC101); and connections to/from IC 102, IC101, and/or CN102.

8/4 Pirate Ron a Ken 4332

USING THE TEST JIG

1. First, attach the test jig to the expansion bus on the rear of the TurboGrafx-16 unit. Be sure this connection is firm.

2. Plug the AC cord from the test jig into a wall socket. Then plug the power cord into the TurboGrafx unit.

3. Connect the RF modulator to the TurboGrafx unit. Turn the TV to channel 3 or 4.

4. Insert the diagnostic card into the game card slot. Insert loopback plug into TurboPad connector. Turn on the power switch for both the TurboGrafx unit and the test jig.

The test jig performs a series of 17 tests on the unit. Each test is dependent on the last -- if test 2 fails the unit never goes to test 3. The first four tests will give an audio signal if they fail, but no video image. The remaining test will give an error code. The chart on the following page explains each error code and its respective test. Skip ahead if there is a video image/error code displayed. If there isn't an image, follow the steps below:

Is there power?

NO: Check for a short between Vcc and ground.

Check FS101.

YES: Check for sound output:

Is there sound?

NO: Check IC101.

Check pin 11 (RESET) and pin 10 (OSC).

Check IC101, pins 17 and 18.

Check IC101 to CN102.

YES (long beeping sound): IC102 may be bad

If so, check traces between IC101 and IC102.

If check proves negative, try replacing IC102.

If not (short beeping sound), IC110/IC114 may be bad

Check trace of IC101 to IC111, IC111 to IC110/114.

If there is no short beeping sound either, IC112 may be defective **(long continous sound):**

If so, check traces between IC101 and IC112.

If not, IC101 functions under following conditions:

Pin 45, IC101 is shorted, or

IC101, pins 1-6 are shorted, or

IC101, pins 77-80 are shorted, or

IC101, pins 64-74 are shorted.

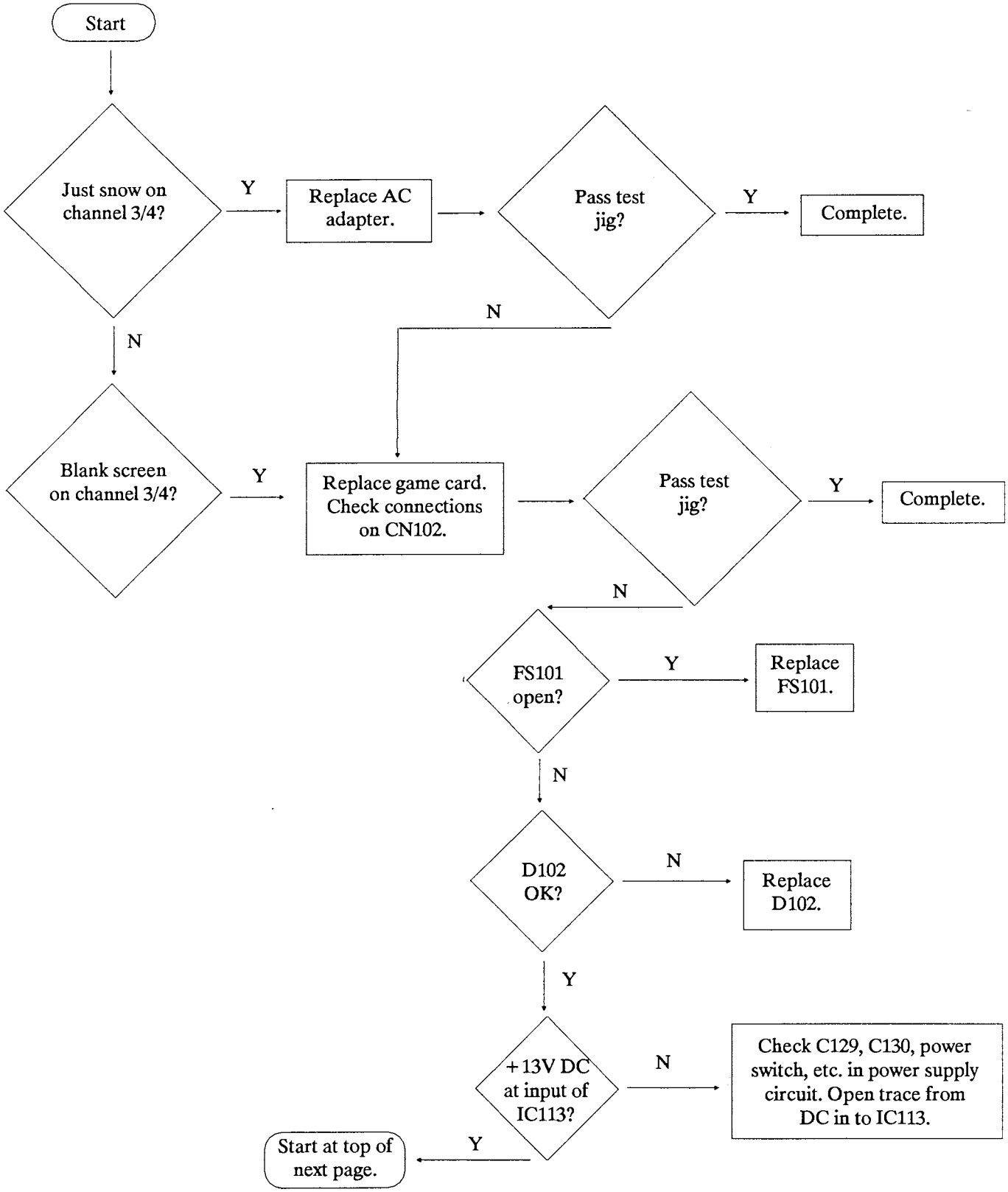
ERROR CODE EXPLANATIONS

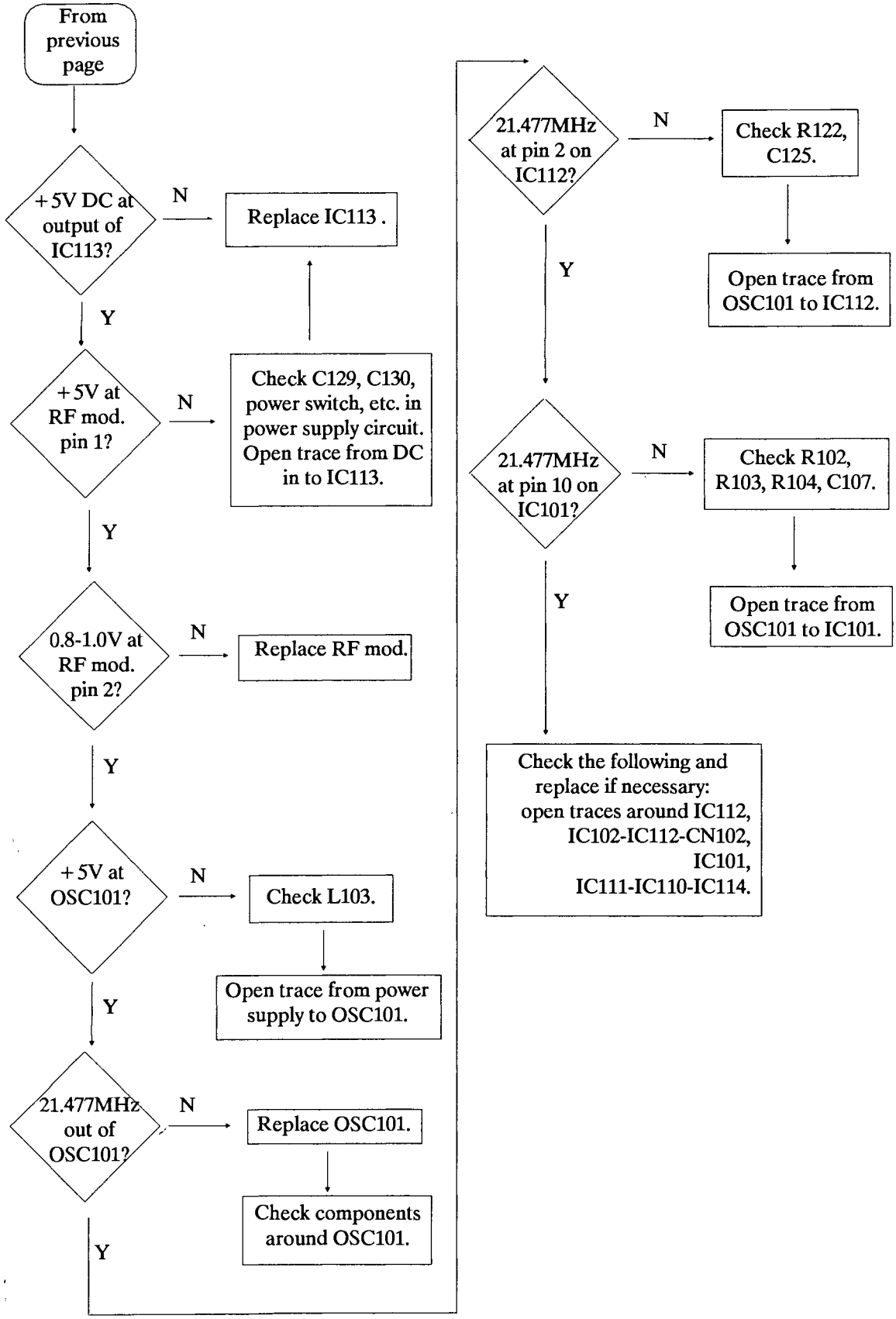
Test Item	Error Code	Check
IC111 Interrupt	No Display	Busy signal line (IC101 to IC111) NMI signal line (CN103 to IC101) A8-A20 lines
	02-1, 2 **	IRQ1 line (IC101 to IC111)
Mapping Register	03-1, 2 **	Signal lines of IC101, or IC101
IC111DMA	04-0 **	DMA Signal lines of IC111, or IC111
IC111 speed and internal interrupts	05-1 **	Signal lines of IC101, or IC101 Signal lines of IC111, or IC111
	05-2 **	HSM line (CN102 to CN103, IC101) XWR, A16-A20 lines (CN102 to CN103, IC112, IC111, IC101, IC102)
	05-3 **	Signal lines of IC101, or IC101 Signal lines of IC111, or IC111
	05-4 **	HSM line (CN102 to CN103, IC101) XWR, A16-A20 lines (CN102 to CN103, IC112, IC111, IC101, IC102)
Address Bus	06-2 ## 06-3 ## 06-0 ##	A0-A7 (CN102-CN103, ICs 101, 102, 111, 112) A8-A15 (CN102-CN103, ICs 101, 102, 111, 112) XRD (CN102-CN103, ICs 101, 102, 111, 112)
	"##" means the data of address bus when the error occurs. The test program writes "55" or "AA" on address bus.	
Controller Port	07-1, 2 **	XCARD line (CN102 to CN103) XB line (CN103 to IC 101)
	07-3, 4, 5, 6, 7 **	Controller signal lines (IC101 to CN101)
Audio Output Line	08-1, 2 **	Sound output lines (IC101 to OpAmp, RF mod)
CRT Signals	09-1 **	SYNC line (IC112 to CN103)
	09-2 **	COMPV line (CN103 to IC112, RF mod)
	09-3/4 **	HSYNC/VSYNC line (CN103 to IC112, IC111)
Video Data Line	10-1, 2 **	VD lines (CN103 to IC112, IC 111)
IC112 External Sync	11-1, 2 **	CSEL line (CN103 to IC112)
Analog RGB Level	12-1, 2, 3 **	RGB lines (CN103 to IC112)
CRT Signals	No Display	VD lines (CN103 to IC112, IC111) RF output line (IC112 to RF mod)
Sound Check	No Sound	Sound output lines (IC101 to OpAmp, RF mod)
	Two short sounds	Voltage of AGND (IC101)

"**" = ⓞ (shown on screen) means test has passed

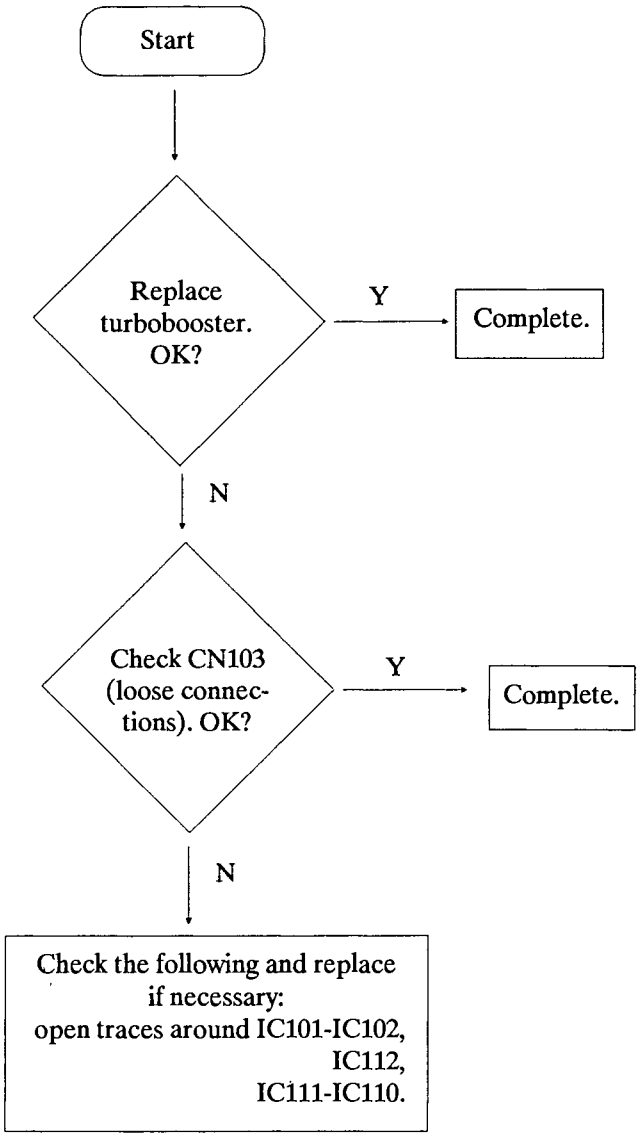
FLOWCHARTS

No Picture On Channel 3 Or 4

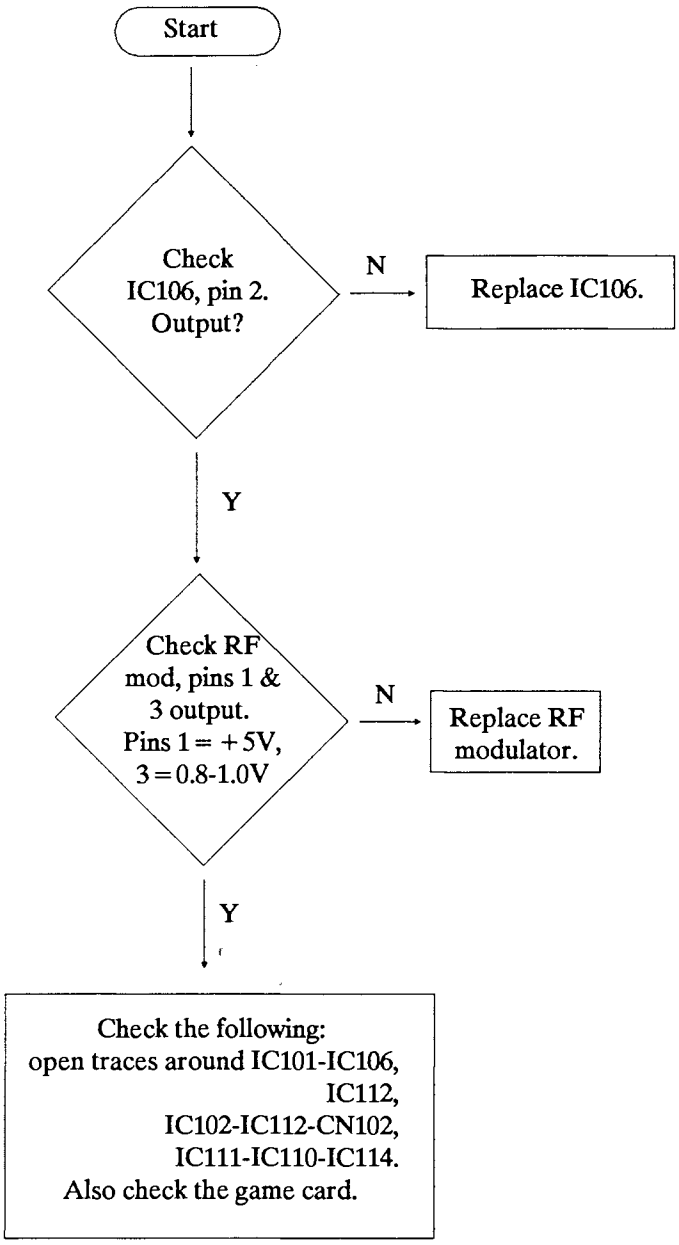



From previous page
+5V DC at output of IC113?
N
Replace IC113 .
Y
+5V at RF mod. pin 1?
N
Check C129, C130, power switch, etc. in power supply circuit. Open trace from DC in to IC113.
Y
0.8-1.0V at RF mod. pin 2?
N
Replace RF mod.
Y
+5V at OSC101?
N
Check L103.
Open trace from power supply to OSC101.
Y
21.477MHz out of OSC101?
N
Replace OSC101.
Check components around OSC101.
Y
21.477MHz at pin 2 on IC112?
N
Check R122, C125.
Open trace from OSC101 to IC112.
Y
21.477MHz at pin 10 on IC101?
N
Check R102, R103, R104, C107.
Open trace from OSC101 to IC101.
Y
Check the following and replace if necessary:
open traces around IC112,
IC102-IC112-CN102,
IC101,
IC111-IC110-IC114.

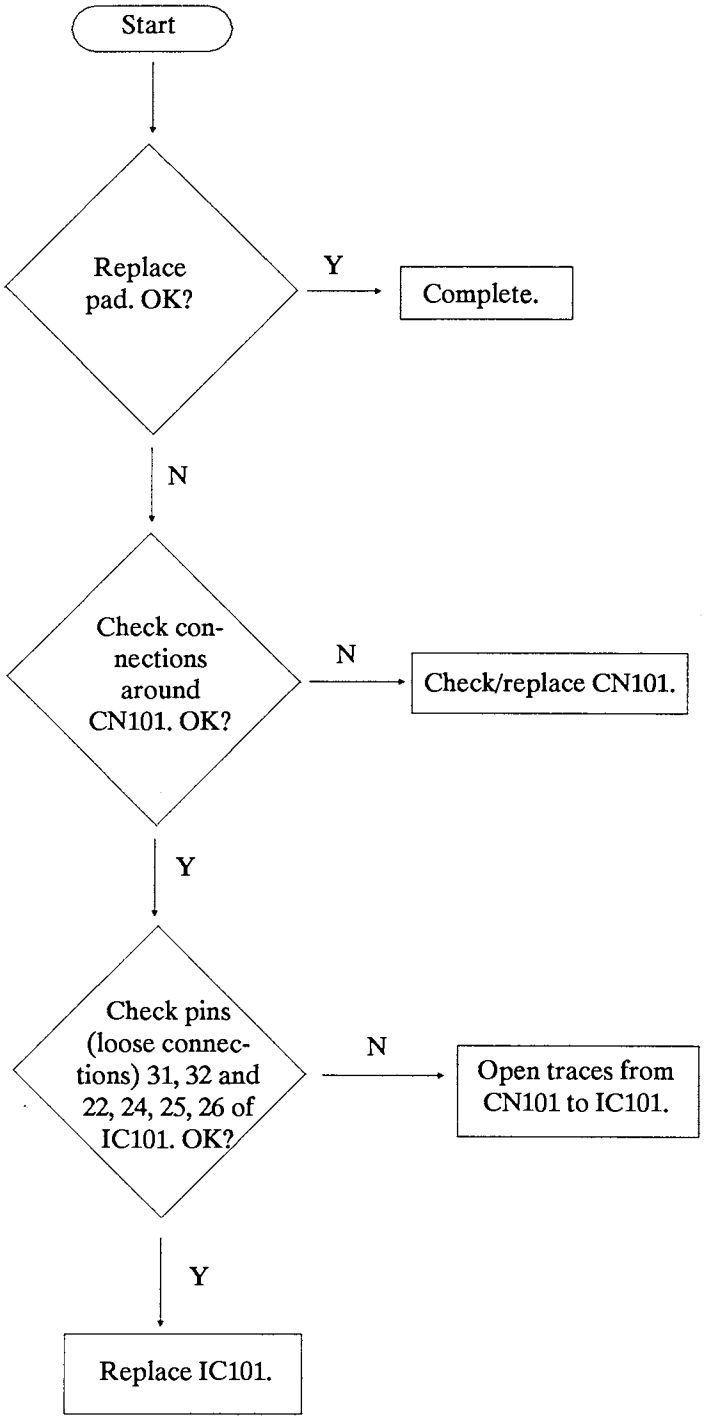
No Picture, Using Turbobooster



No Audio

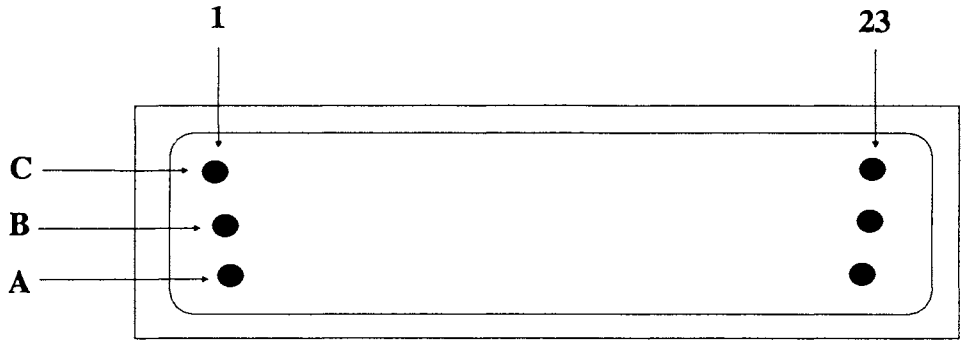

Start
Check IC106, pin 2. Output?
N
Replace IC106.
Y
Check RF mod, pins 1 & 3 output. Pins 1 = +5V, 3 = 0.8-1.0V
N
Replace RF modulator.
Y
Check the following:
open traces around IC101-IC106,
IC112,
IC102-IC112-CN102,
IC111-IC110-IC114.
Also check the game card.

Controller Malfunctions



PIN ASSIGNMENTS

EXPANSION BUS Interface

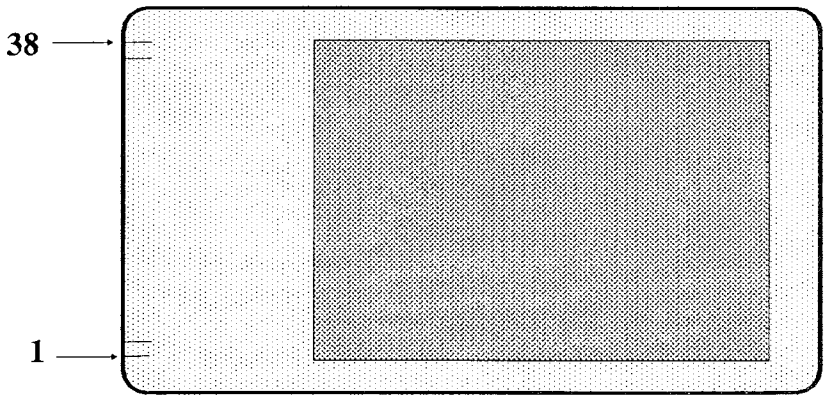


PIN NO.	NAME	I/O	FUNCTION
A01	Audio L	O	Audio Output (L channel)
A02	+5A	O	Power Supply +5V
A03	CESEL	I	Chip Select 6260
A04	A18	O	System Address Bus 18
A05	A14	O	System Address Bus 14
A06	A9	O	System Address Bus 9
A07	A10	O	System Address Bus 10
A08	D6	IO	System Data Bus 6
A09	DCK	I	Dot Clock
A10	X V SYNC	I	Vertical Sync
A11	EXTPOW	I	External Power Supply +10.5V
A12	SPBG	O	Sprite Data/Background Data
A13	VD7	O	Video Data Bus 7
A14	EXTPOW	I	External Power Supply +10.5V
A15	VD5	O	Video Data Bus 5
A16	VD4	O	Video Data Bus 4
A17	VD3	O	Video Data Bus 3
A18	VD2	O	Video Data Bus 2
A19	VD1	O	Video Data Bus 1
A20	VD0	O	Video Data Bus 0
A21	OVAG	IO	GND for Analog Circuit
A22	COMPV	O	Composite Video
A23	VIDEOR	O	Analog Video Output (Red)

PIN NO.	NAME	I/O	FUNCTION
B01	AUDIOC	O	Audio Output from Game Card
B02	XB	I	bit 7 of K port
B03	HSM	O	High Speed Mode
B04	XWR	O	Write from CPU
B05	XNMI	I	Non Maskable Interrupt to CPU
B06	A8	O	System Data Bus 8
B07	XRD	O	Read from CPU
B08	D7	IO	System Data Bus 7
B09	D4	IO	System Data Bus 4
B10	D2	IO	System Data Bus 2
B11	XHSYNC	I	Horizontal Sync
B12	A0	O	System Address Bus 0
B13	A2	O	System Address Bus 2
B14	VD6	O	Video Data Bus 6
B15	A5	O	System Address Bus 5
B16	A7	O	System Address Bus 7
B17	A12	O	System Address Bus 12
B18	A16	O	System Address Bus 16
B19	A20	O	System Address Bus 20
B20	RDY	I	Wait Request to CPU
B21	XIRQ2	I	Interrupt Request 2
B22	XRESET	IO	Reset
B23	VIDEOG	O	Analog Video Output (Green)

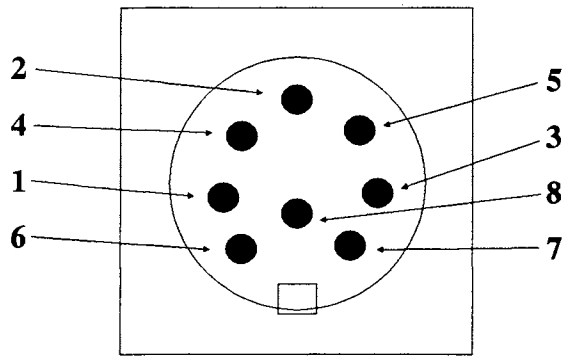
PIN NO.	NAME	I/O	FUNCTION
C01	AUDIOR	O	Audio Output (R channel)
C02	OVAG	IO	GND for Analog Circuit
C03	XCARD	O	H w/o Game Card, L w/Game Card
C04	XCEK	O	Chip Enable 6260
C05	A17	O	System Address Bus 17
C06	A13	O	System Address Bus 13
C07	A11	O	System Address Bus 11
C08	GND	IO	GND for Digital Circuit
C09	D5	IO	System Data Bus 5
C10	D3	IO	System Data Bus 3
C11	D1	IO	System Data Bus 1
C12	D0	IO	System Data Bus 0
C13	A1	O	System Address Bus 1
C14	A3	O	System Address Bus 3
C15	A4	O	System Address Bus 4
C16	A6	O	System Address Bus 6
C17	GND	IO	GND for Digital Circuits
C18	A15	O	System Address Bus 15
C19	A19	O	System Address Bus 19
C20	GND	IO	GND for Digital Circuits
C21	+5A	O	Power Supply +5V
C22	SYNCV	O	Composite Sync
C23	VIDEOB	O	Analog Video Output (Blue)

GAME CARD Connector Pin Assignments



PIN NO.	NAME	I/O	FUNCTION
1	XCHECK	I	L level w/Game Card, H w/o GC
2	AUDIO	I	Audio In
3	A19	O	System Address Bus 19
4	A16	O	System Address Bus 16
5	A15	O	System Address Bus 15
6	A12	O	System Address Bus 12
7	A7	O	System Address Bus 7
8	A6	O	System Address Bus 6
9	A5	O	System Address Bus 5
10	A4	O	System Address Bus 4
11	A3	O	System Address Bus 3
12	A2	O	System Address Bus 2
13	A1	O	System Address Bus 1
14	A0	O	System Address Bus 0
15	D7	IO	System Data Bus 7
16	D6	IO	System Data Bus 6
17	D5	IO	System Data Bus 5
18	Vss	-	GND
19	D4	IO	System Data Bus 4
20	D3	IO	System Data Bus 3
21	D2	IO	System Data Bus 2
22	D1	IO	System Data Bus 1
23	D0	IO	System Data Bus 0
24	XCE	O	Chip Enable
25	A10	O	System Address Bus 10
26	XOE	O	Output Enable
27	A11	O	System Address Bus 11
28	A9	O	System Address Bus 9
29	A8	O	System Address Bus 8
30	A13	O	System Address Bus 13
31	A14	O	System Address Bus 14
32	A17	O	System Address Bus 17
33	A18	O	System Address Bus 18
34	XWR	O	Write Strobe
35	HSM	O	High Speed Mode
36	XRESET	I	Reset
37	XIRQ2	I	Interrupt Request 2 to CPU
38	VccPower (+5V)	-	Power (+5V) +Vcc

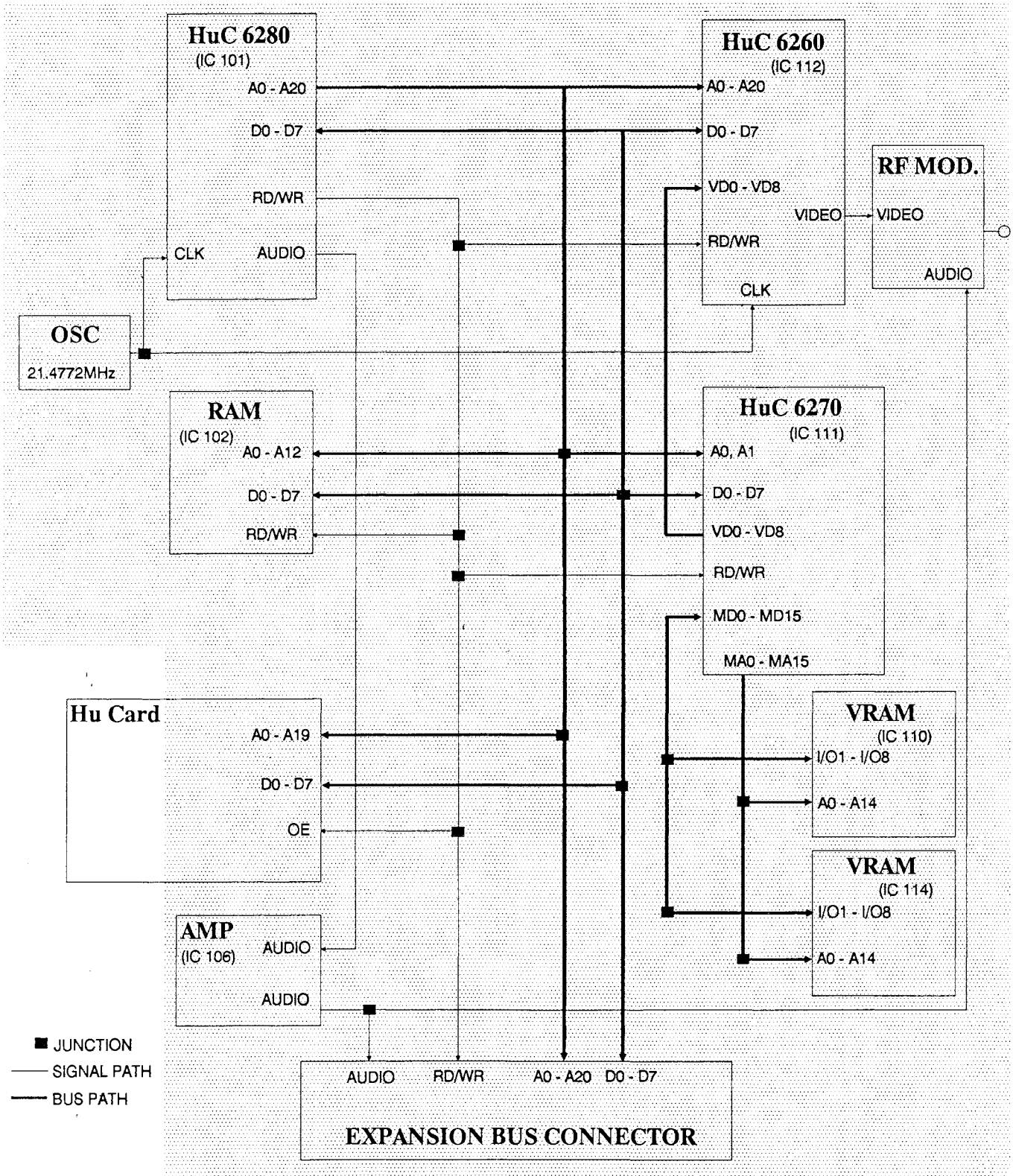
PAD Connector Pin Assignments



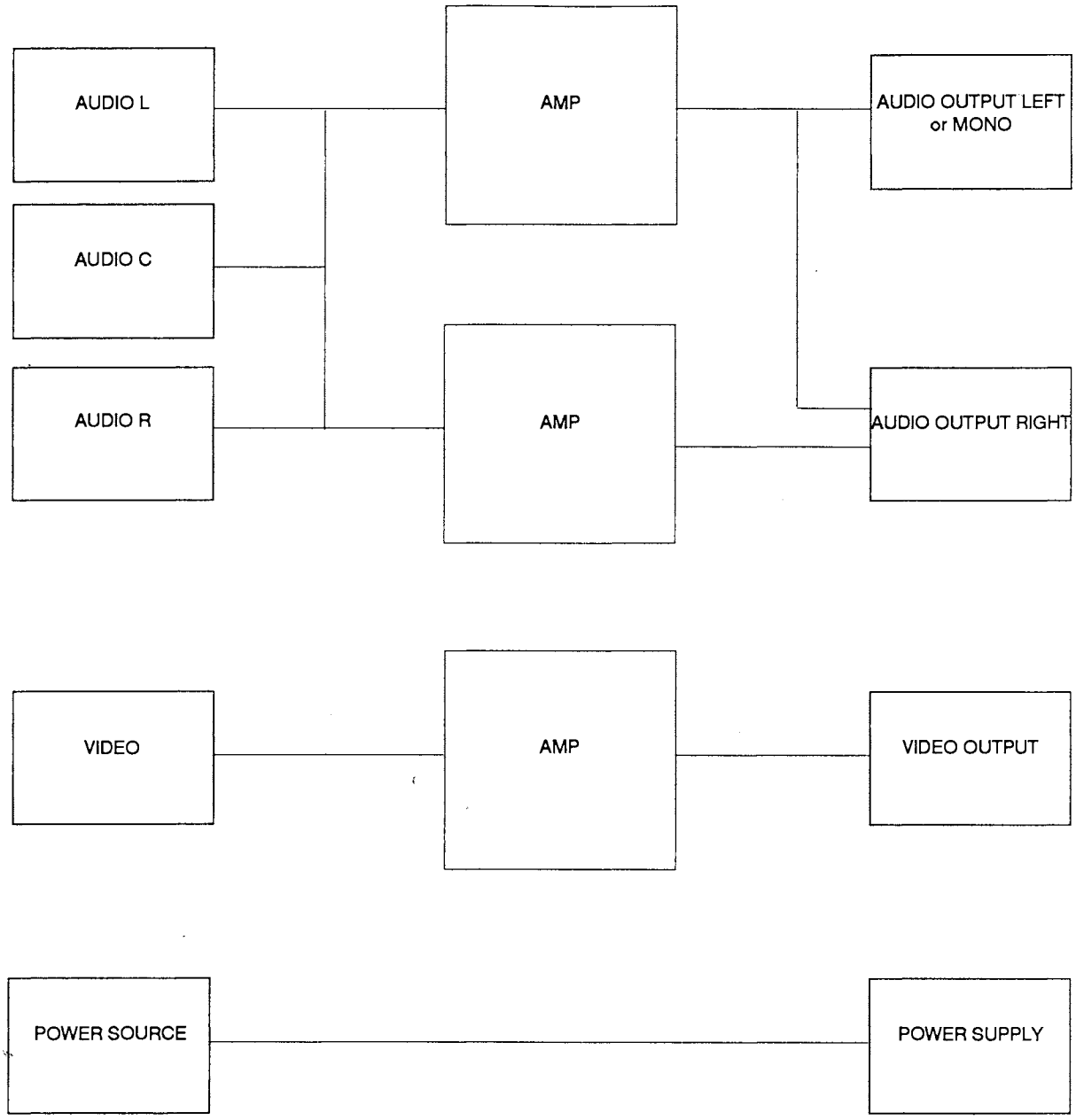
PIN NO.	NAME	DIR	FUNCTION
1	VDD	-	Power Supply
2	DI0	I	Data 0
3	DI1	I	Data 1
4	DI2	I	Data 2
5	DI3	I	Data 3
6	SEL	O	Select
7	CLR	O	Clear
8	GND	-	Signal GND

BLOCK DIAGRAMS

TurboGrafx-16 Base Unit



TurboBooster



PARTS LIST

SYMBOL	PART NO	DESCRIPTION	REMARKS
R101	79060515	33K 1/6W	
R102	79060516	56K 1/6W	
R103	79060516	56K 1/6W	
R104	79060568	470 1/6W	
R105	79060506	4.7K 1/6W	
R106	79060508	5.6K 1/6W	
R107	79060506	4.7K 1/6W	
R108	79060506	4.7K 1/6W	
R109	79060506	4.7K 1/6W	
R111	79060506	4.7K 1/6W	
R112	79060506	4.7K 1/6W	
R113	79060511	9.1K 1/6W	
R114	79060511	9.1K 1/6W	
R115	79060511	9.1K 1/6W	
R116	79060506	4.7K 1/6W	
R117	79060507	5.1K 1/6W	
R118	79060513	15K 1/6W	
R119	79060501	1K 1/6W	
R121	79060580	220 1/6W	
R122	79060568	470 1/6W	
R123	79060516	56K 1/6W	
R124	79060516	56K 1/6W	
R125	79060504	2.7K 1/6W	
R126	79060570	680 1/6W	
R127	79060499	20 1/6W	
R128	79060500	100 1/6W	
R129	79060503	1.5K 1/6W	
R130	79060506	4.7K 1/6W	
R131	79060509	6.2W 1/6W	
R132	79060510	8.2K 1/6W	
R133	79060501	1K 1/6W	
R134	79060514	27K 1/6W	
R135	79060503	1.5K 1/6W	
R136	79060508	5.6K 1/6W	
R137	79060512	13K 1/6W	
R138	79060498	0K 1/6W	
R140	79060577	330 1/6W	

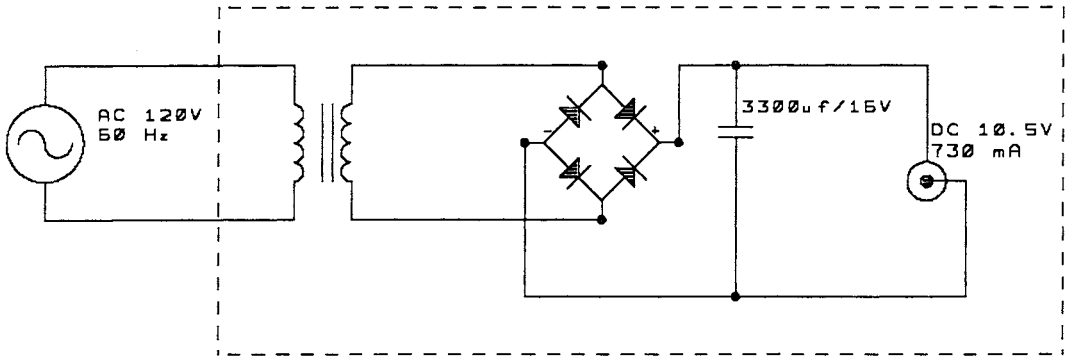
SYMBOL	PARTS NO.	DESCRIPTION	REMARKS
C101	79060528	C, ELEC 22u/16V	
C102	79060522	C, CERA 0.1u/25V	
C103	79060522	C, CERA 0.1u/25V	
C104	79060522	C, CERA 0.1u/25V	
C105	79060522	C, CERA 0.1u/25V	
C106	79060522	C, CERA 0.1u/25V	
C107	79060524	C, CERA 220p/50V	
C109	79060522	C, CERA 0.1u/25V	
C112	79060524	C, CERA 220p/50V	
C113	79060527	C, ELEC 10u/16V	
C114	79060525	C, CERA 15000p/50V	
C115	79060522	C, CERA 0.1u/25V	
C117	79060522	C, CERA 0.1u/25V	
C118	79060522	C, CERA 0.1u/25V	
C121	79060522	C, CERA 0.1u/25V	
C122	79060523	C, CERA 33p/50V	
C123	79060522	C, CERA 0.1u/25V	
C124	79060522	C, CERA 0.1u/25V	
C125	79060524	C, CERA 220p/50V	
C126	79060522	C, CERA 0.1u/25V	
C127	79060522	C, CERA 0.1u/25V	
C128	79060522	C, CERA 0.1u/25V	
C129	79060531	C, ELEC 100u/25V	
C130	79060522	C, CERA 0.1u/25V	
C131	79060522	C, CERA 0.1u/25V	
C132	79060530	C, ELEC 100u/16V	
C133	79060522	C, CERA 0.1u/25V	
C134	79060522	C, CERA 0.1u/25V	
C135	79060522	C, CERA 0.1u/25V	
C136	79060527	C, ELEC 10u/16V	
C137	79060522	C, CERA 0.1u/25V	
C138	79060522	C, CERA 0.1u/25V	
C139	79060522	C, CERA 0.1u/25V	
C140	79060529	C, ELEC 47u/16V	
C141	79060526	C, ELEC 1u/10V	
C142	79060527	C, ELEC 10u/16V	
C143	79060526	C, ELEC 1u/10V	
C144	79060526	C, ELEC 1u/10V	
C145	79060526	C, ELEC 1u/10V	
C146	79060526	C, ELEC 1u/10V	
C147	79060526	C, ELEC 1u/10V	
C148	79060526	C, ELEC 1u/10V	
C149	79060526	C, ELEC 1u/10V	

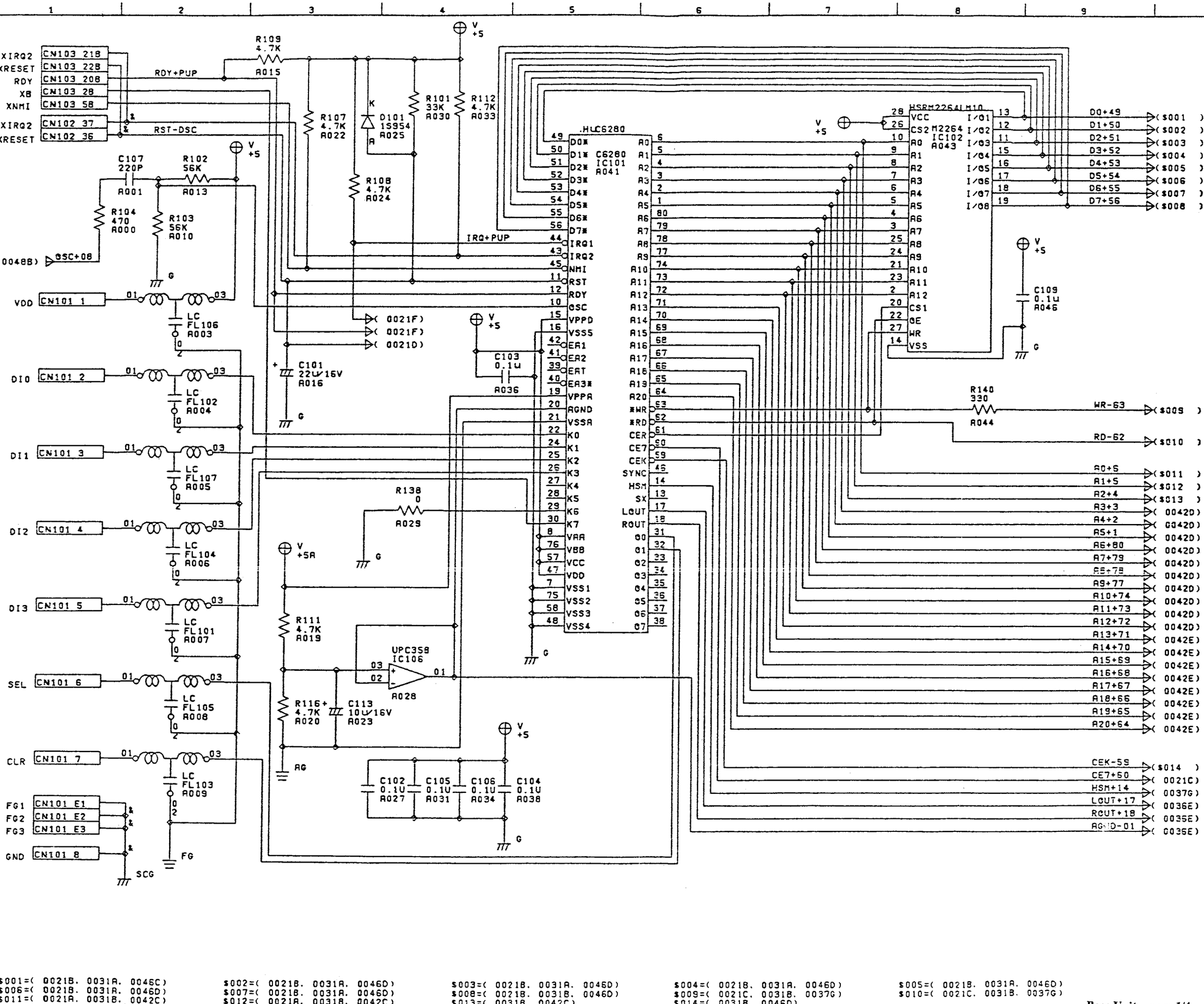
SYMBOL	PARTS NO.	DESCRIPTION	REMARKS
C1	79060591	C, ELEC 22u/25V	
C2	79060522	C, CERA 0.1u/25V	
TR101/TR103	79060497	2SC945 (Q)	
TR102	79060496	2SA733 (Q)	
MR1	79060517	4.7Kx8 1/6W	
FS101	79060518	1.25V/125A	FUSE
CN101	79060519	TCS5040-18-4151	DIN 8 PIN
CN102	70056285	L-38-N	GAMECARD CONNECTOR
CN103	70556517	CRAB69P-3	EXP CONNECTOR
CN104	79060520	HEC0749-01-010	DC JACK
SW101	79060521	SSSB122XB1-SX	SLIDE SWITCH
FL101 - FL107	79060532	ZJSR5101-221	
FL108	79060533	COM. MODE FLTR	
FL112	61606916	NOISE FILTER 1H102M (DS306)	DS306-55B102M50
L106	79060569	COIL	
D101	79060536	1S954	
D102	79060537	20D1	
OSC101	79060538	CXO-046B	
RF	79060539	RF MODULATOR	
	79060585	MAIN PCB ASSY	W/O SHIELD CASE
	79060586	MAIN PCB ASSY	WITH SHIELD CASE
	2E411771	BASE UNIT TOP CABINET	
	2E411781	MAIN UNIT BOTTOM CABINET	
	2E411791	BUS COVER	
	2E525081	BOT. SHIELD CASE	
	2E453271	PWR SWITCH KNOB	
	2E525091	HEAT SINK	
	2E850941	SCREW FOR CAB.	
	2E851271	SCREW FOR CARD CONNECTOR	
	2E851281	SCREW FOR EXP CON./HEAT SINK	
	79060552	DC ~~CODE~~ CORD W/CORE	WITH CN104
	2E818441	GIFT BOX	
	79060559	OPERATOR MAN.	
	79060560	SOFTWARE TITLE POSTER	
	79060562	PERIPHERALS PAMPHLET	
	2E818471	WELCOME CARD	

SYMBOL	PARTS NO.	DESCRIPTION	REMARKS
	79060564	PAD CONTROLLER	TurboPad
	79060565	AC ADAPTER	HES-ACA-01
	79060566	ANTENNA SWITCH	
	79060567	75-300 OHM ADAPTER	
IC106	79060491	uPC358	
IC113	79060492	uPC7805	
IC110	37054758	MOS HSRM20256LM12	
IC114	37054758	MOS HSRM20256LM12	
IC102	37054759	MOS HSRM2264LM10	
IC101	37056661	MOS HUC6280	
IC111	37056662	MOS HUC6270	
IC112	37056663	MOS HUC6260	
	78650061	GAME CARD (KEITH COURAGE)	TurboChip
L107	79060569	COIL B-8	
L103	79060535	COIL BLO2RN-R62	
	2E702861	NAME PLATE	
	79060573	DC FERRITE CORE	
	79060583	DC CODE (RED)	
	79060582	DC CODE (BLUE)	
	79060581	DC CODE (BLACK)	
	2E526181	T. SHLD CASE ASSY	
	2E607991	BARRIER	INSULATION PLATE
	2E818431	FILLER A, CARTON	
	2E818461	FILLER B, CARTON	
	2E282391	CLAMPER, WIRE	
	2E608001	PLATE, SHIELDING	ABOVE IC102
	79060572	UL TUBE (FUSE)	
	79060571	COMIC BOOK	
	79060578	TGX-16 MAGAZINE	
	79060579	SELL SHEET	
	79060561	WARRANTY CARD	

SCHEMATICS

AC Adapter





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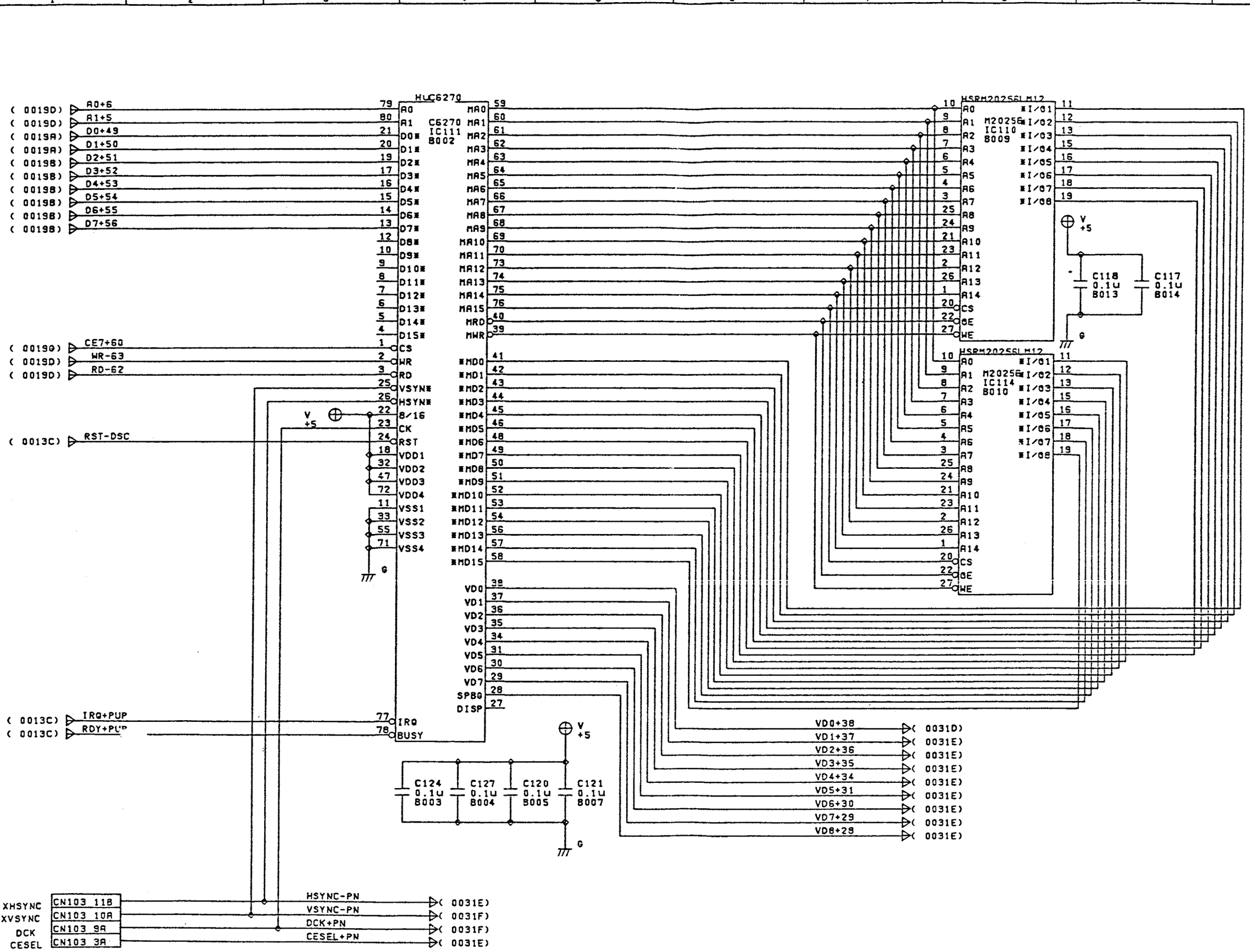
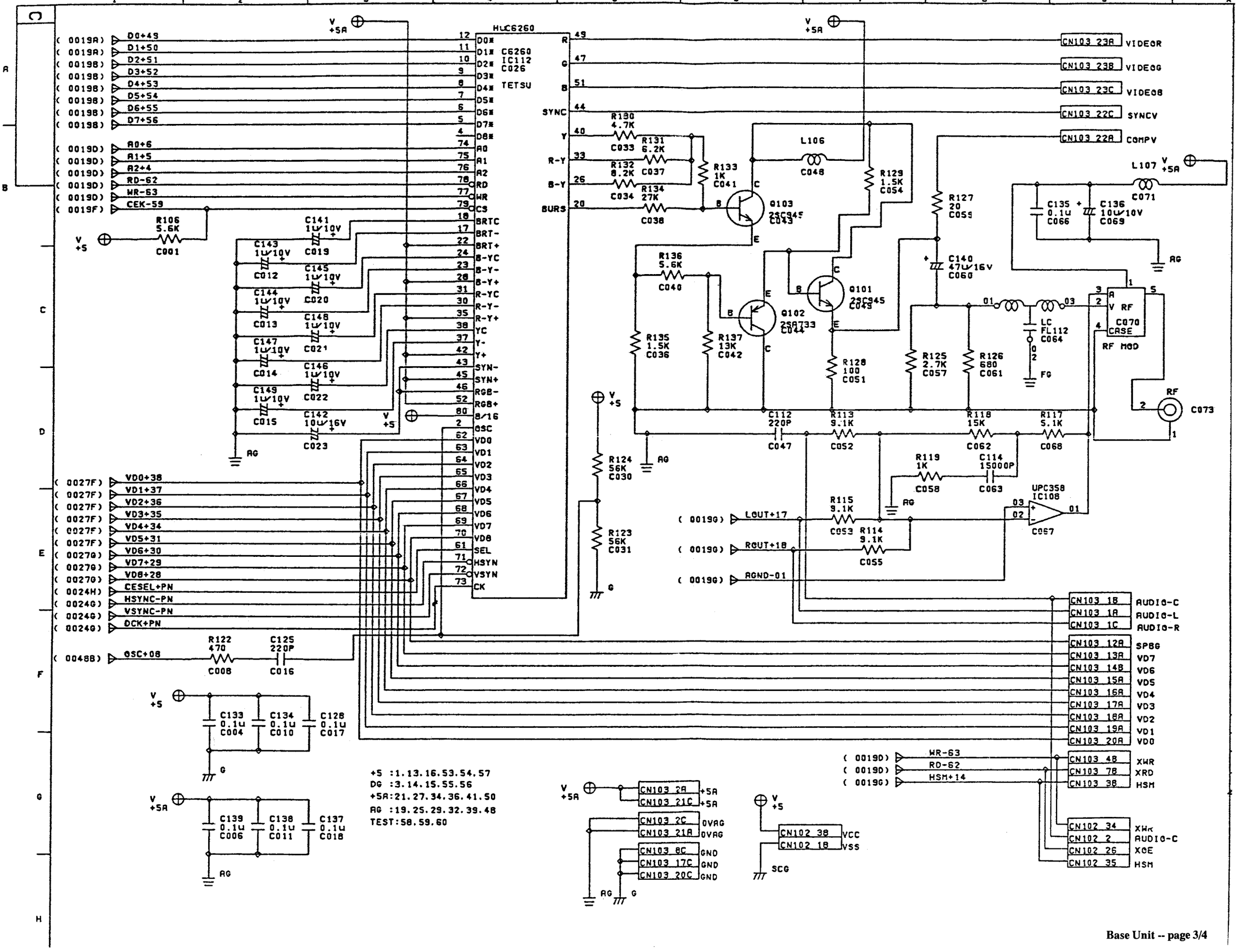

HUC6270
C6270 IC111 B002
HSRM2025SLM12
M20256 IC110 B009
M20256 IC114 B010
C118 0.1u B013
C117 0.1u B014
C124 0.1u B003
C127 0.1u B004
C120 0.1u B005
C121 0.1u B007
V +5
G
(0019D) A0+6
(0019D) A1+5
(0019A) D0+49
(0019A) D1+50
(0019B) D2+51
(0019B) D3+52
(0019B) D4+53
(0019B) D5+54
(0019B) D6+55
(0019B) D7+56
(0019D) CE7+60
(0019D) WR-63
(0019D) RD-62
(0013C) RST-DSC
(0013C) IRQ+PUP
(0013C) RDY+PUP
VD0+38 (0031D)
VD1+37 (0031E)
VD2+36 (0031E)
VD3+35 (0031E)
VD4+34 (0031E)
VD5+31 (0031E)
VD6+30 (0031E)
VD7+29 (0031E)
VD8+28 (0031E)
XHSYNC CN103 11B
XVSYNC CN103 10A
DCK CN103 9A
CESEL CN103 3A
HSYNC-PN (0031E)
VSYNC-PN (0031F)
DCK+PN (0031F)
CESEL+PN (0031E)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IC112
C026
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D2+51
D3+52
D4+53
D5+54
D6+55
D7+56
A0+6
A1+5
A2+4
RD-62
WR-63
CEK-59
R106 5.6K C001
C141 C019
C143 C012
C145 C020
C144 C013
C148 C021
C147 C014
C146 C022
C149 C015
C142 C023
VD0+38
VD1+37
VD2+36
VD3+35
VD4+34
VD5+31
VD6+30
VD7+29
VD8+28
CESEL+PN
HSYNC-PN
VSYNC-PN
DCK+PN
OSC+08
R122 470 C008
C125 220P C016
C133 0.1u C004
C134 0.1u C010
C128 0.1u C017
C139 0.1u C006
C138 0.1u C011
C137 0.1u C018
+5 :1.13.16.53.54.57
DG :3.14.15.55.56
+5A:21.27.34.36.41.50
AG :19.25.29.32.39.48
TEST:58.59.60
R130 4.7K C033
R131 6.2K C037
R132 8.2K C034
R134 27K C038
R133 1K C041
L106 C048
Q103 2SC945 C043
R129 1.5K C054
R136 5.6K C040
Q102 2SA733 C044
Q101 2SC945 C045
R135 1.5K C036
R137 13K C042
R128 100 C051
R124 56K C030
R123 56K C031
R127 20 C059
C140 47u 16V C060
C135 0.1u C066
C136 10u 10V C069
L107 C071
LC FL112 C064
C070 CASE
RF MOD
RF C073
C112 220P C047
R113 9.1K C052
R118 15K C062
R117 5.1K C068
R125 2.7K C057
R126 680 C061
R119 1K C058
C114 15000P C063
UPC358 IC108
R115 9.1K C053
R114 9.1K C055
C067
LOUT+17
ROUT+18
AGND-01
CN103 23A VIDEOR
CN103 23B VIDEOG
CN103 23C VIDEOB
CN103 22C SYNCV
CN103 22A COMPV
CN103 1B AUDIO-C
CN103 1A AUDIO-L
CN103 1C AUDIO-R
CN103 12A SPBG
CN103 13A VD7
CN103 14B VD6
CN103 15A VD5
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CN103 3B HSM
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CN102 2 AUDIO-C
CN102 26 XOE
CN102 35 HSM
CN103 2A +5A
CN103 21C +5A
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CN103 20C GND
CN102 38 VCC
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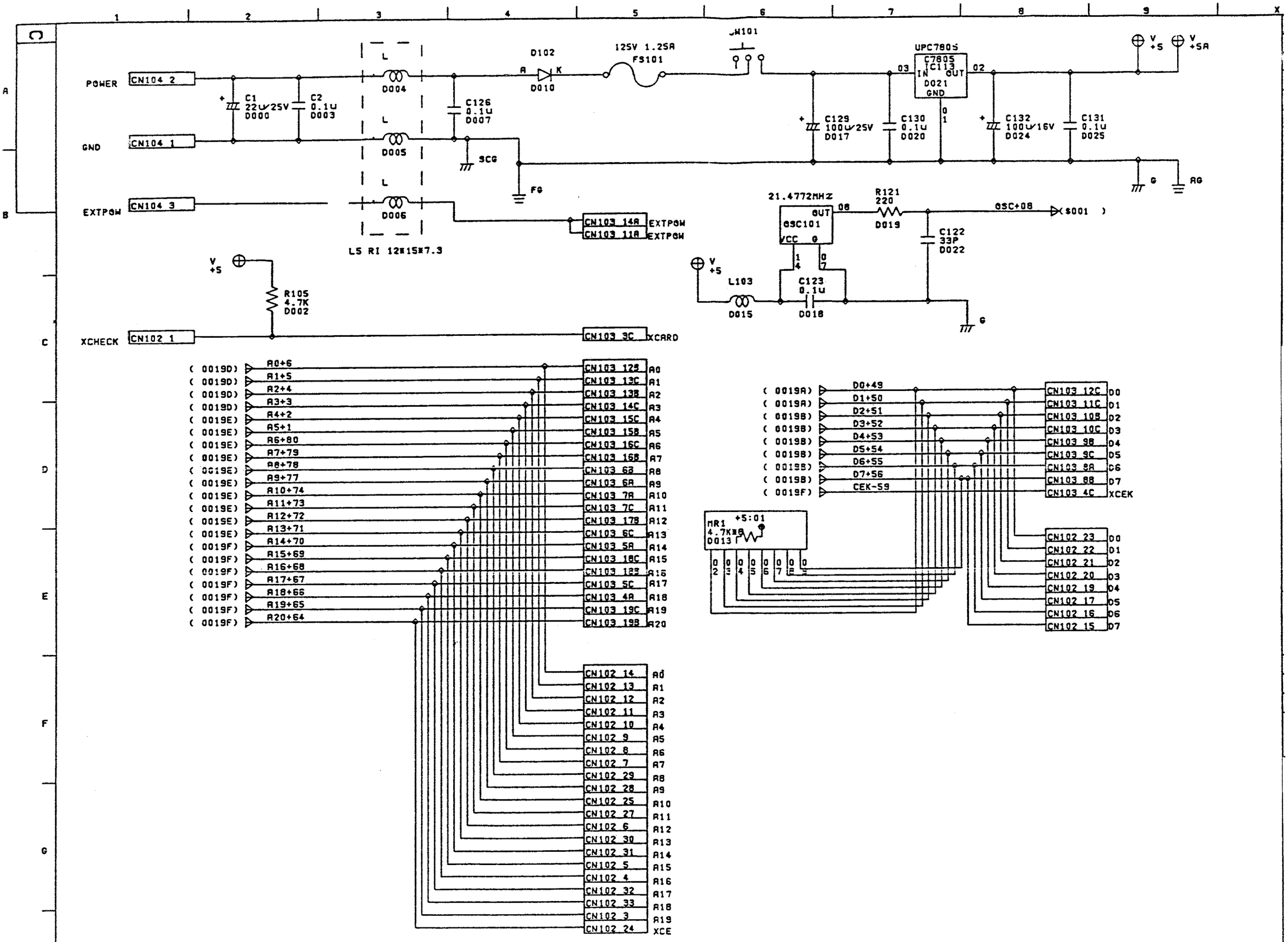

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