DeskJet 500

Martin Hepperle, January 2024

DeskJet Family History

DeskJet	2276A	
DeskJet PLUS	2277A	
DeskJet 500	C2106A	
Deskwriter	2278A	for Apple Systems
Deskwriter	2279A	for Apple Systems

HP No.	Printer	Emulation		Processor	RAM Extension	Notes
		Epson FX-80	IBM Proprinter III			
2276A	DeskJet	22707E	n.a.	initial development	up to 2 × 128 KB	22727K cartridge for landscape print reqd.
2277A	DeskJet PLUS	22707F	22707P	same as 500, faster than DeskJet	up to 2 × 128 KB or 2 × 256 KB	
C2106A	DeskJet 500	22707F	22707P	same as PLUS, faster than DeskJet	up to 2 × 128 KB or 2 × 256 KB	
2278A	Deskwriter			for Apple Systems		
2279A	Deskwriter			for Apple Systems		

Ink Cartridges for DeskJet 500

51626AE black, (short form name: No. 26)

51608A black

Softfont Format

The character format 5 was used only for the DeskJets and provides a mild compression of the character bitmaps. These bitmaps are “sparse” with typically every other column used. The compression allows suppressing the bytes which are “empty” at the cost of a small “directory” bitmap of the actually used bytes. Softfonts for the DeskJet 500 can have a size of up to 36 pt, the earlier models can store characters of up to 14 pt height.

It is remarkable that the character definition is actually using a 600 × 300 resolution with every second dot printable. This is similar to the semi-bit shift algorithm used in HP terminals, refining the resolution of character edges. This resolution is higher than contemporary standard LaserJet printers which provided 300 × 300 dpi.

Besides the User and Service Manuals a “DeskJet Developers Manual” seems to exist, but is not freely available. This should also include the Softfont format description.

DeskJet 500 Built-In Fonts

Portrait Courier, CG Times, Letter Gothic, several sizes

Landscape Courier, several sizes

22707L Cartridge Fonts

Landscape Font Cartridge Letter Gothic 12pt, 9.5pt italic; Courier 12pt

Compared to basic printer: larger Courier and additional Letter Gothic sizes

Repairs

When I received the printer it had several defects:

- The transformer block with center tapped output windings of 2×12V was missing one of the two required voltages. This transformer is also used for PaintJet printer and the ColorPro plotter.
  This block is not intended to be serviced by the end user and a special tool, which I did not have, is required to remove the four screws.
  Alternatively, it can be cracked open by applying a chisel-shaped wood carving tool at several places along the joint line between upper and lower case parts. After some careful taps with a hammer onto the chisel, moving around the separation line, the tool can be inserted into the opening gap and used for levering both case halves apart. As expected, the four standoffs connecting both halves broke during this brute force process, but the exterior of the case remains intact. After repairs, the standoffs can be glued together and/or the screws be replaced.
  There is a glass fuse for each of the two output windings mounted directly at the transformer (5 mm × 20 mm, 125 V / 4 A). In my case, one of them was burnt out, probably due to a short on the power supply board of the printer. In order to minimize costs, no fuse holders are used. Instead, short wires are soldered directly to the glass fuses.
- The power connector could not be inserted into the plug on the printer power supply board. An inspection of the PSU board showed that one pin was bent and all four soldering points were broken. Probably the previous owner tried to force the power supply plug onto the misaligned connector. This seems to be a common fault with these parts.
  Reflowing with a powerful soldering iron while the connector was plugged onto the pins re-aligned the four pins properly.
- A visual inspection showed that at least one of the electrolytic capacitors on the PSU board had leaked.
  All output voltages were present and in their designated range, as long as the PSU board was not connected to the Logic PCA. However, the voltages broke down, as soon as the PSU board was connected to the logic PCA. Replacing all electrolytic capacitors on the PSU board fixed this issue.

Elektrolytic Capacitors HP DeskJet 500 PSU

Count	Position	Type	RM	Dimensions
2	C98, C99	2700 µF/35V	8mm	Dia 18mm×Height 35mm
3	C4, C5, C6	1200 µF/35V	5mm	Dia 13mm×Height 35mm
7	C13, C17, C21, C67, C62, C64, C83	180 µF/25V	5mm	Dia 10mm×Height 17mm
1	C76	12 µF/100V	5mm	Dia 6mm×Height 13mm

all radial types, upright, 105°C.

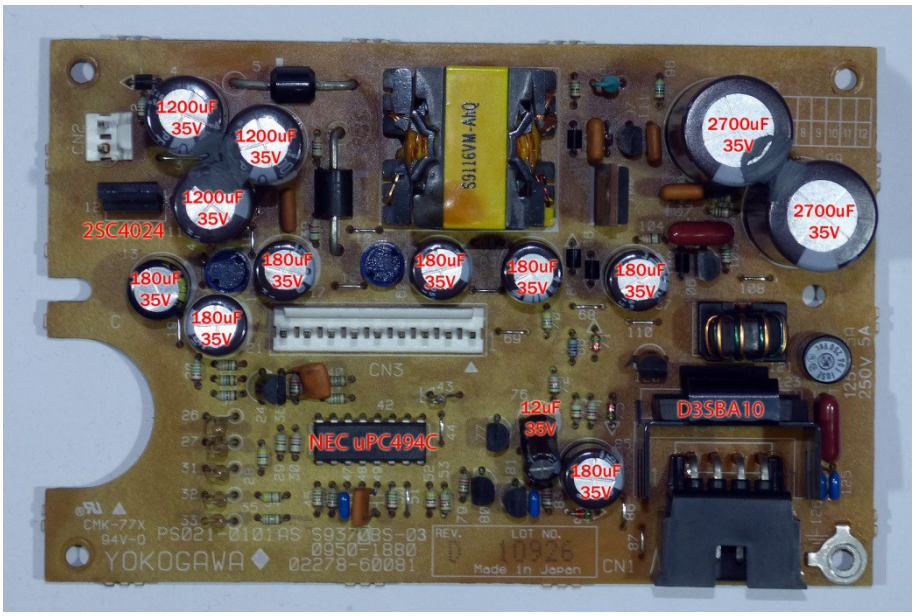

Figure 1: **DeskJet 500 power supply board with capacitors and main parts labeled.**

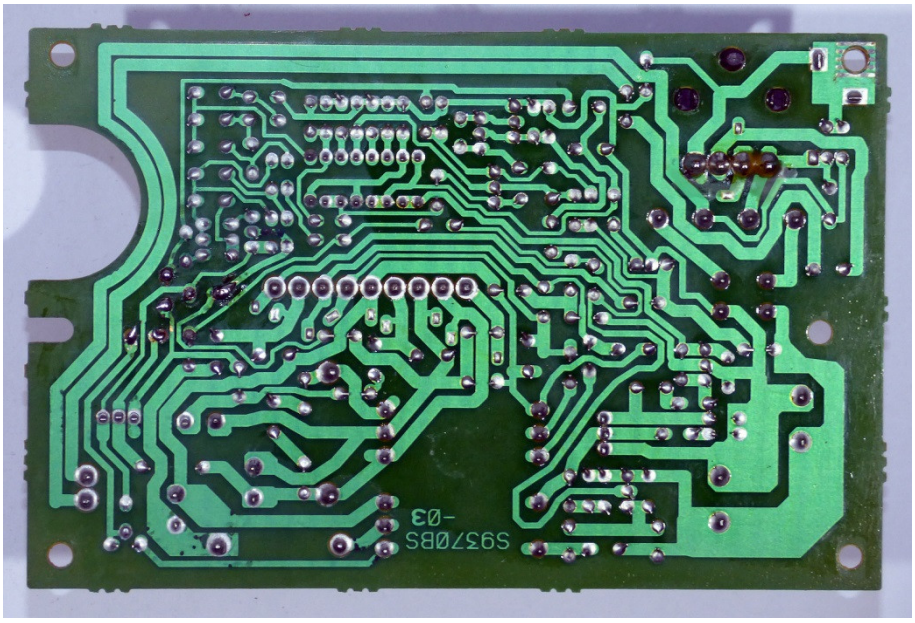

Figure 2: **Lower side of DeskJet 500 power supply board, connector pins reflowed.**

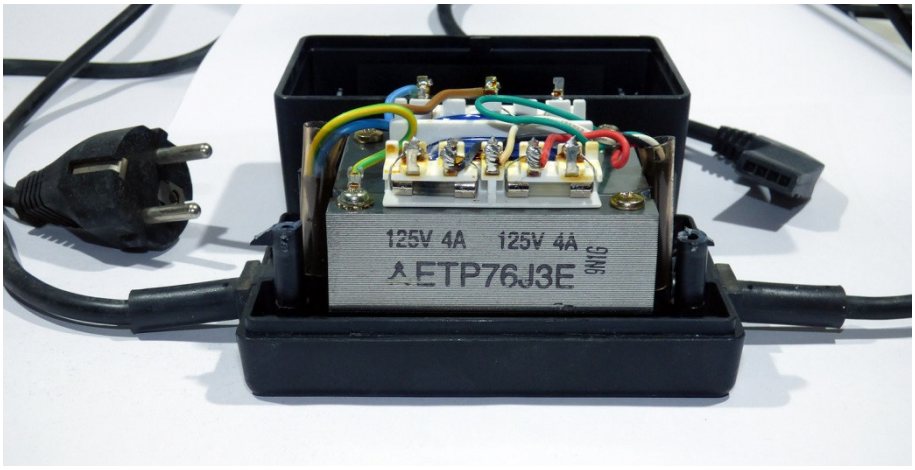

Figure 3: **DeskJet 500 Transformer with two 125V/4A glass fuses.**

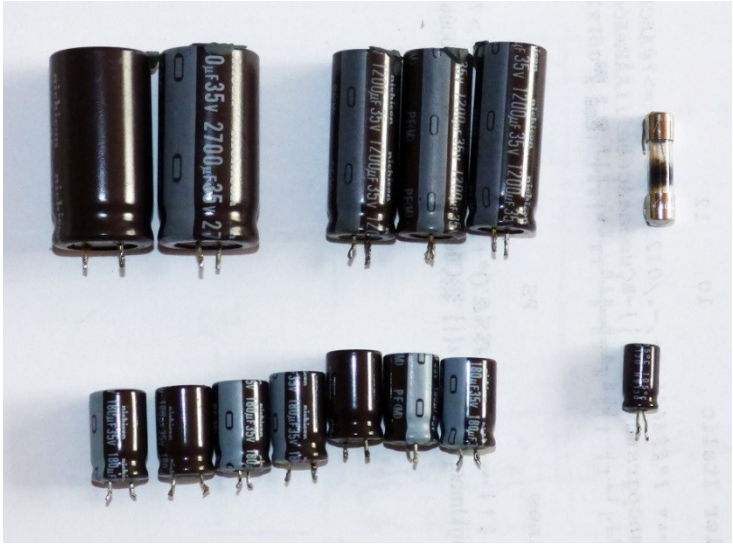

Figure 4: Replaced leaking capacitors and burned out fuse.

Other Parts of the HP DeskJet 500 PSU

Power Supply Board: YOKOGAWA PS021-0101AS 0950-1880 HP 02278-60081 or HP 02277-60087

Power regulator IC	NEC µPC 494C, DIP-16
Power transistor	C4024
Full bridge rectifier	D3SBA10

Connector from PSU to Logic PCA

Pin	Voltage	Current	Power	Load
1	GND	-	-	-
2	22 V	0.35 A	8 W	63 Ω
3	GND	-	-	-
4	19.4 V	0.245 A	5 W	80 Ω
5	GND	-		-
6	–12 V	0.02 A	¼ W	600 Ω
7	+12 V	0.04 A	½ W	300 Ω
8	5 V	1 A	5 W	1 Ω
9	25 V	-	-	-

Note: pin 9 is an unregulated DC voltage, fed directly from the bridge rectifier, filtered through a ferrite ring coil and smoothed by two parallel 2700 µF / 35 V capacitors.

Some Desirable Cartridges

HP offered a large number of font cartridges, RAM expansion for Softfonts, as well as two emulation cartridges to support software for which no DeskJet driver was available.

22706B	Prestige Elite (with Math and PI Font)
22707F	Epson FX-80 Emulation
22707P	IBM Proprinter III Emulation
22707A	128 KB RAM
22707B	256 KB RAM

Examination of a HP DeskJet 500 Font Cartridge

Martin Hepperle, July 2024

The HP DeskJet, DeskJet Plus and DeskJet 500 were the successor of the HP ThinkJet. They offered a much higher resolution of 300 dpi and crisp output on normal, uncoated office paper. The print quality was close to the more expensive LaserJets of the time, at the cost of lower speed.

These printers could be enhanced by plugging font, RAM or emulation cartridges into one of the two expansion slots.

Unfortunately, not much is known today about these plug-in cartridges and their internal structure.

The unobtainable “DeskJet Developers Manual” may contain this information.

Figure 5: The font cartridge 22707L offers additional fonts in landscape orientation.

Opening Considered Harmful

First I tried to pry the top and bottom halves apart with steel prying tools. This did not work and I feared to break the case.

Next I found that there were two indentations under the label on the top. So I tried to pull that label off. When I lifted one corner with a knife, only the transparent cover sheet came off and the printed part stayed on the case. So I stopped at that first corner. In a second attempt I heated the label carefully with a heat gun and was able to lift it together with the printed text. The glue stayed nicely on the label. Two holes became visible. I did not see any steel rivets or screws in the two holes, so I drilled them to a larger diameter. This did not help to open the case.

Finally I tried again a bit harder with the prying tools. Suddenly one corner close to the connector snapped open and then I saw how the latches worked. Unfortunately, they are close to the bottom of the case so that they do not open easily when prying from above.

These cartridges are composed of two shells which are snapped together by four relatively strong hooks. The shells are quite stiff and require a lot of force to open (as you can see from the scratches).

The ABS material is rather sturdy, but also stiff. The good news is that there is no glue or ultrasonic welding.

The two cylindrical bosses in the middle of the case are only for alignment and retention of the PCB. Thus it is NOT necessary to remove the sticker and to drill them out as I did.

The PCB has two positions for installing ROMs. The first has a DIP-28 pinout, the second one is for a DIP-32 part. The address and data lines connections are connected in parallel.

Besides the ROM there is a 74ALS00 chip for controlling the output enable pin of the ROM.

The internal structure of these ROMs is not known.

As they can contain pure character bitmap data as well as code (e.g. for the FX-80 emulation) they must have a header with the data/code information and a sort of font directory.

Some Pictures

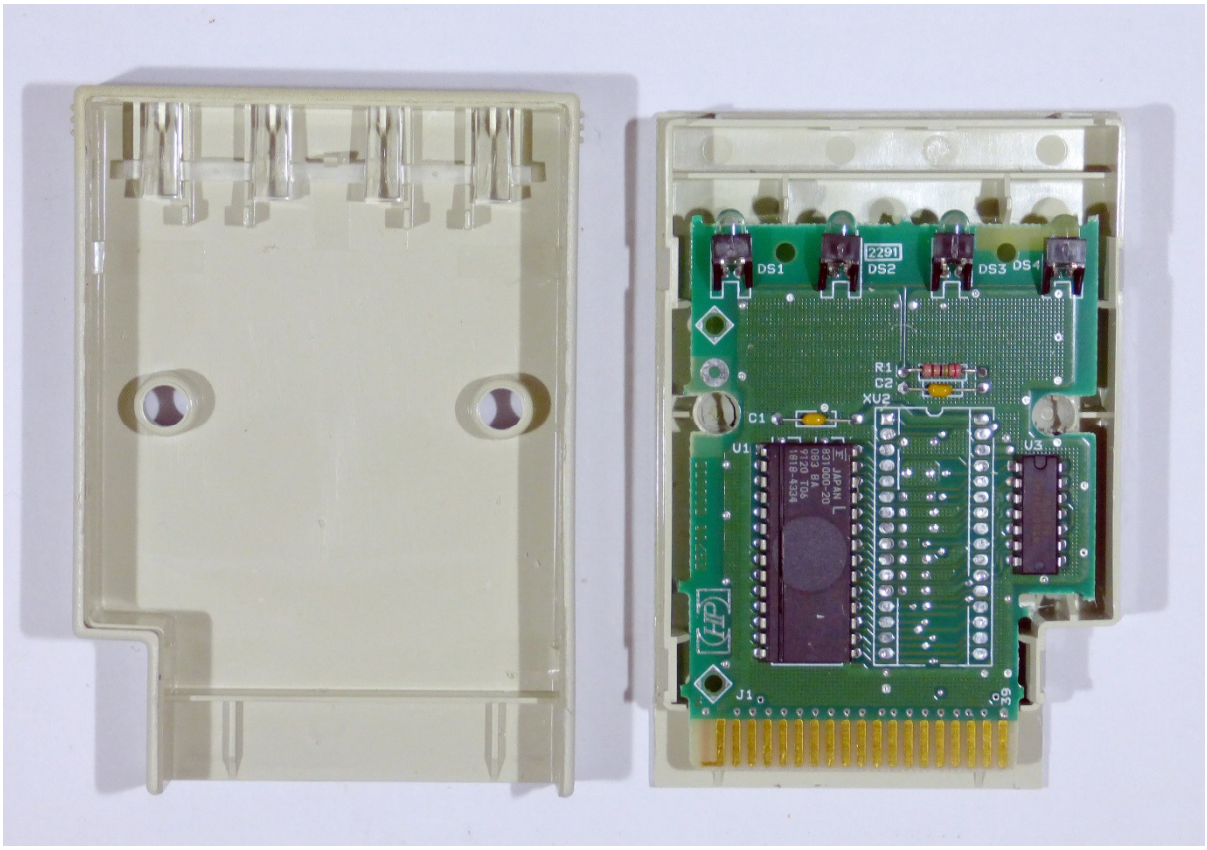

Figure 6: Opened cartridge, top view.

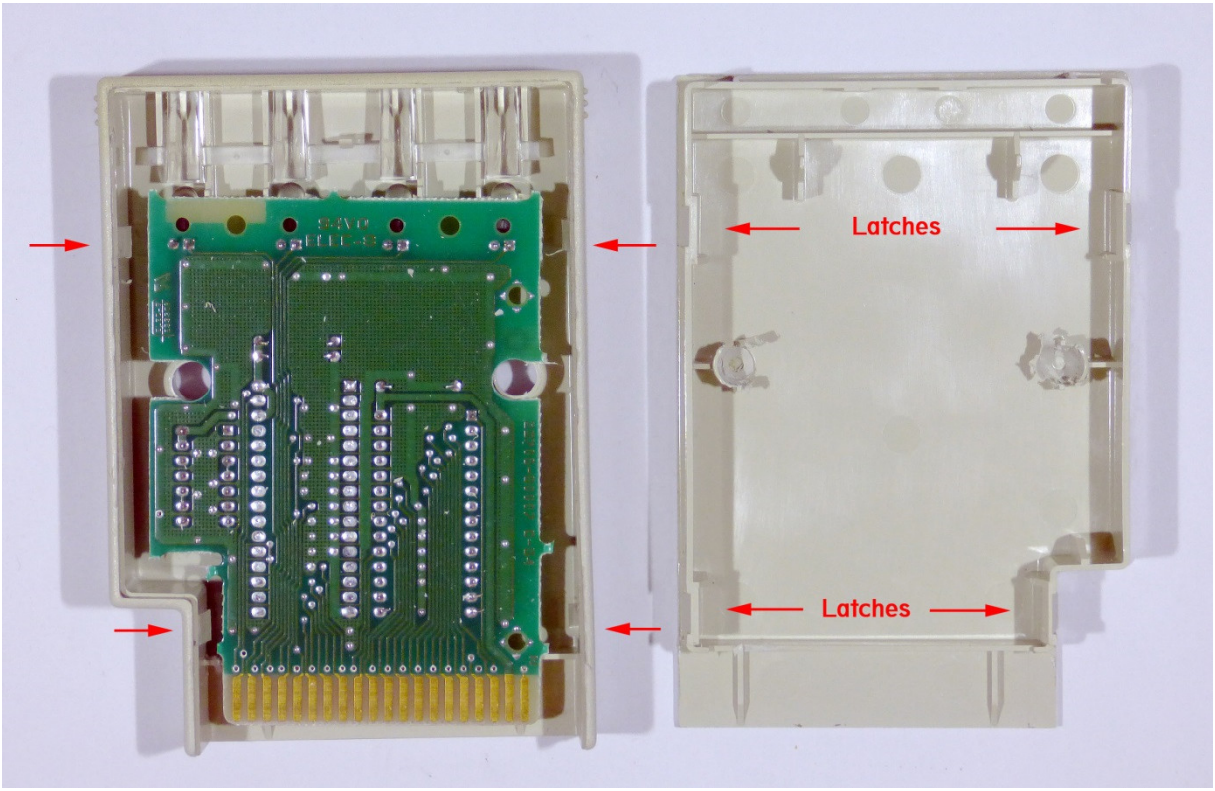

Figure 7: Opened cartridge, bottom view.

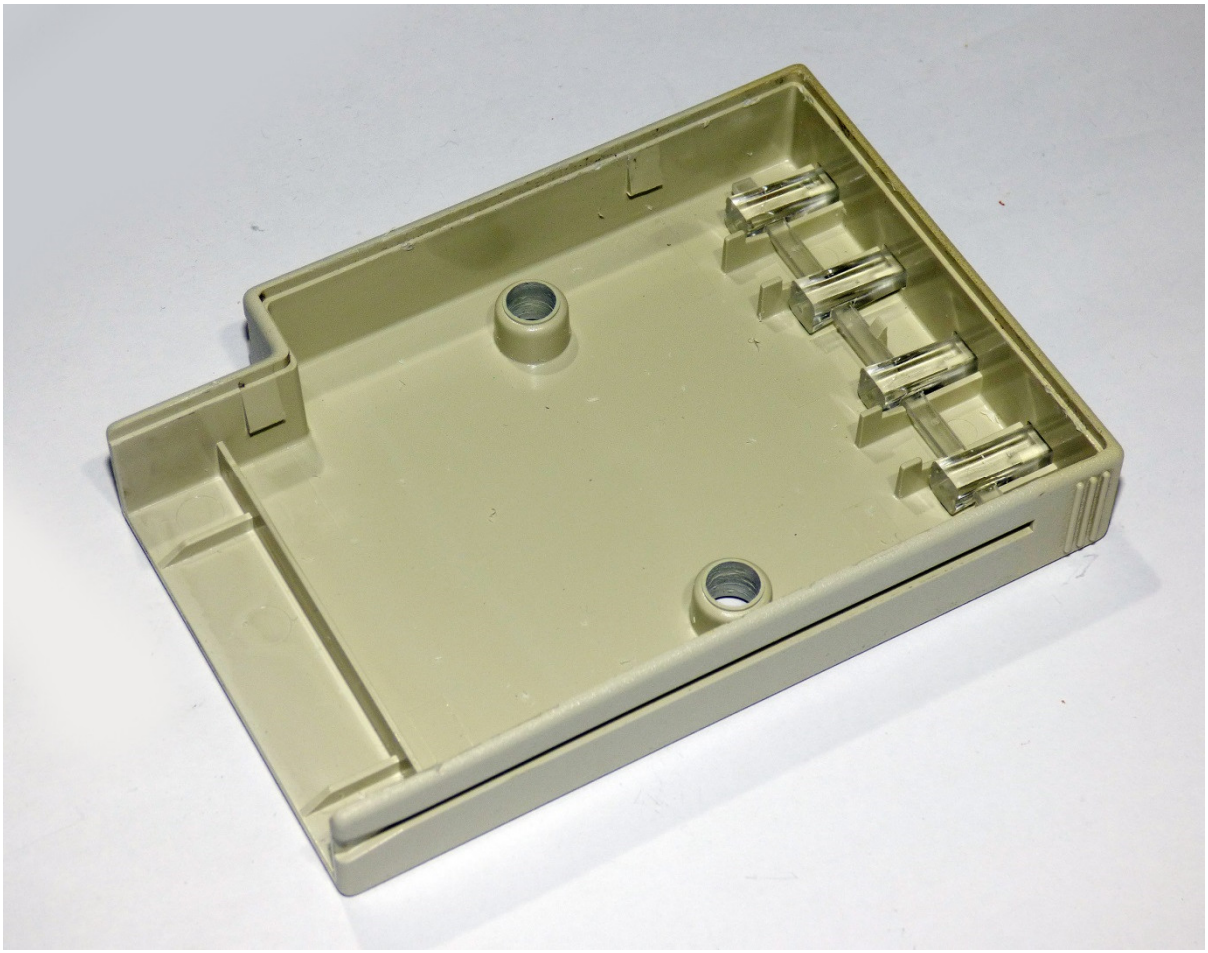

Figure 8: Top shell with LED light path insert.

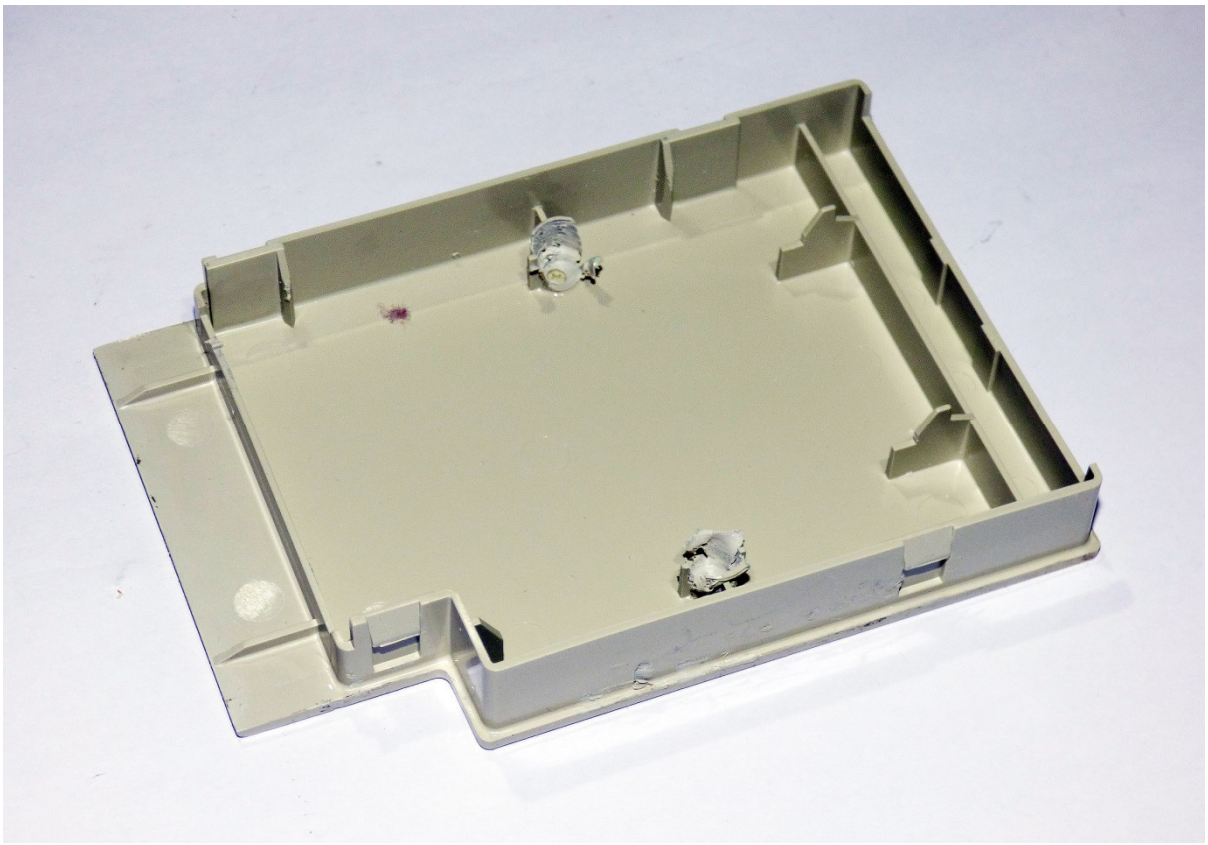

Figure 9: Bottom shell with enlarged centering posts.

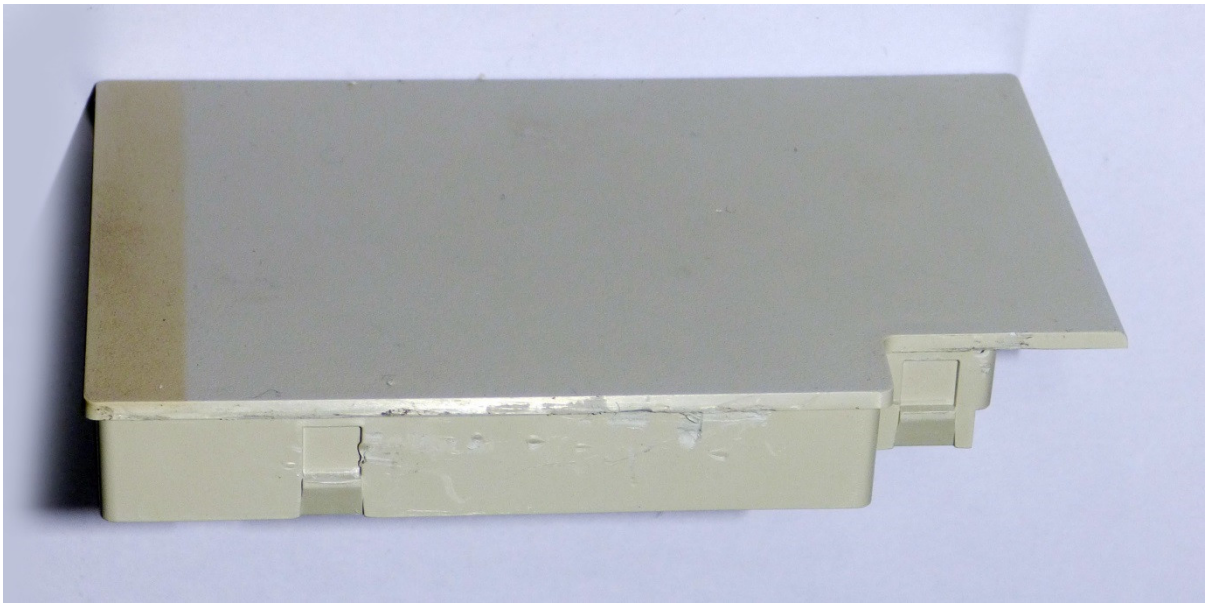

Figure 10: Detail view of edge with latch hook.

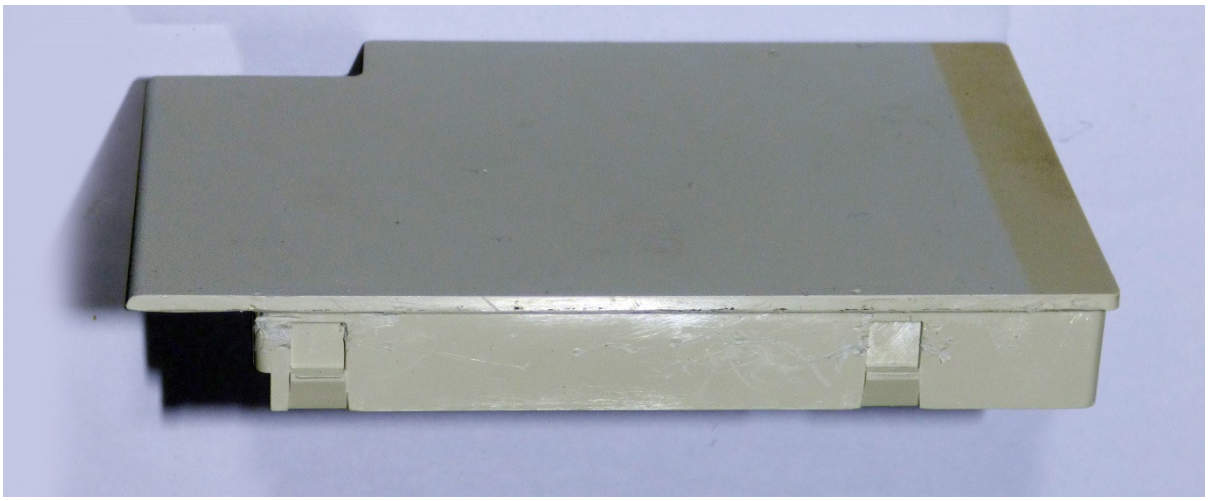

Figure 11: Detail view of edge with latch hook.

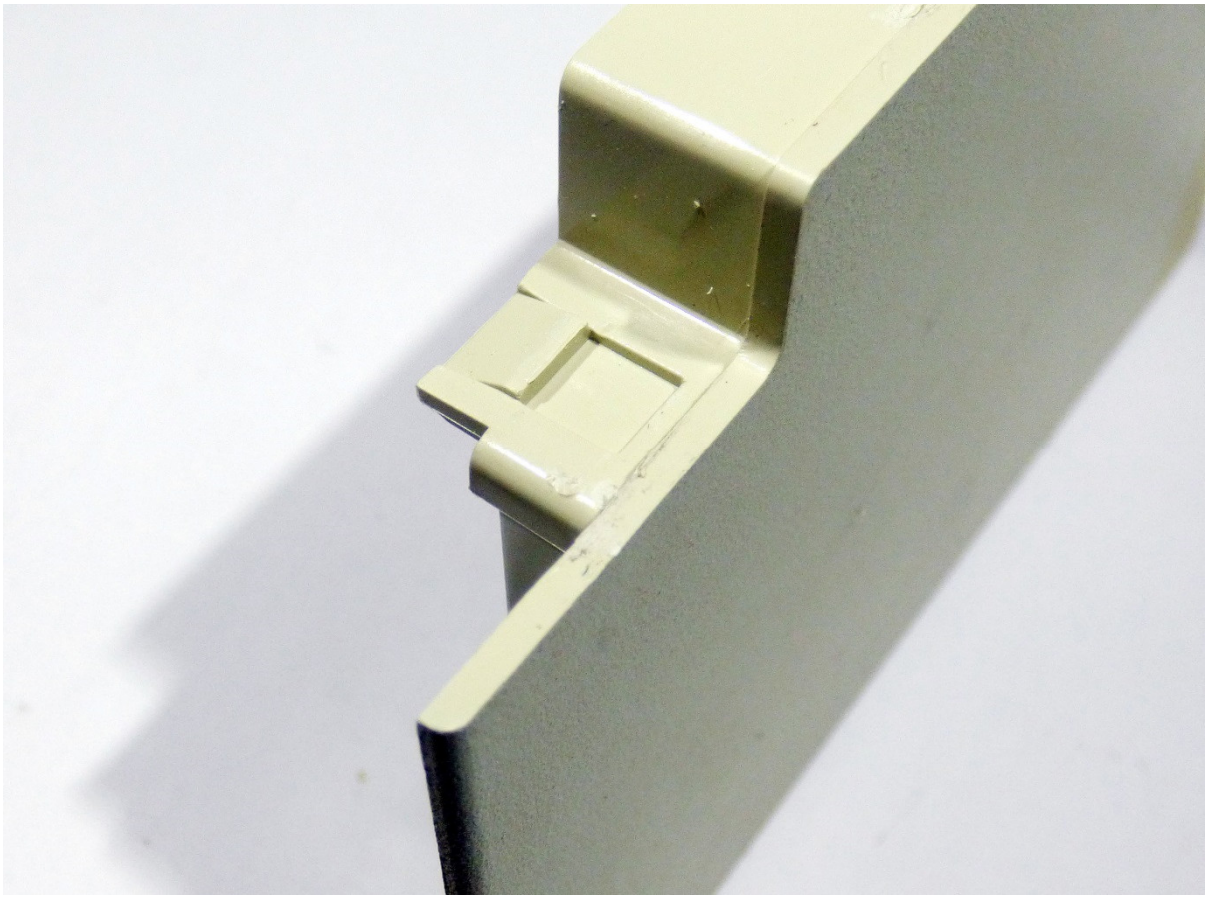

Figure 12: Detail view of edge with triangular latch hook.

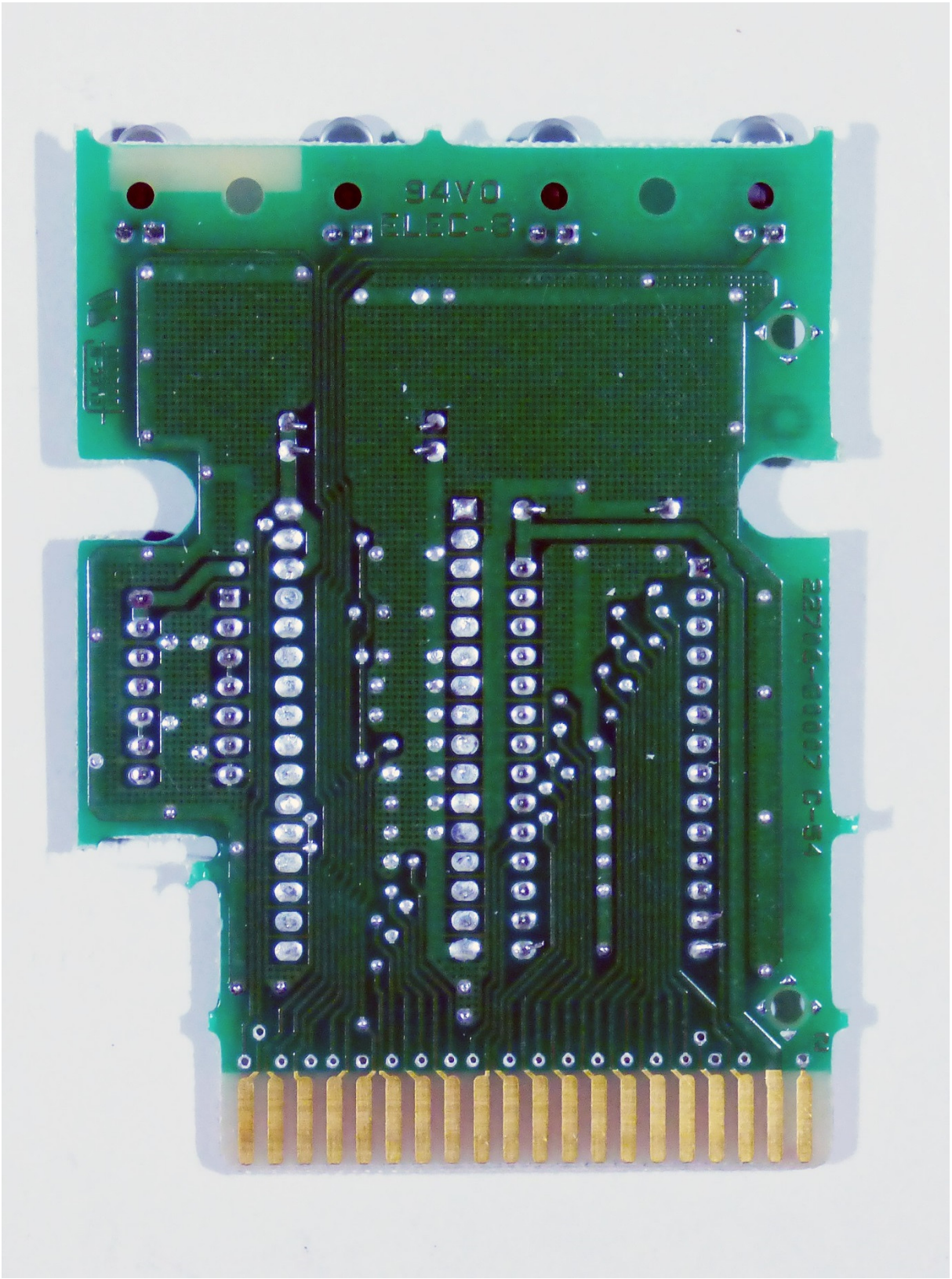

Figure 13: Bottom view of PCB.

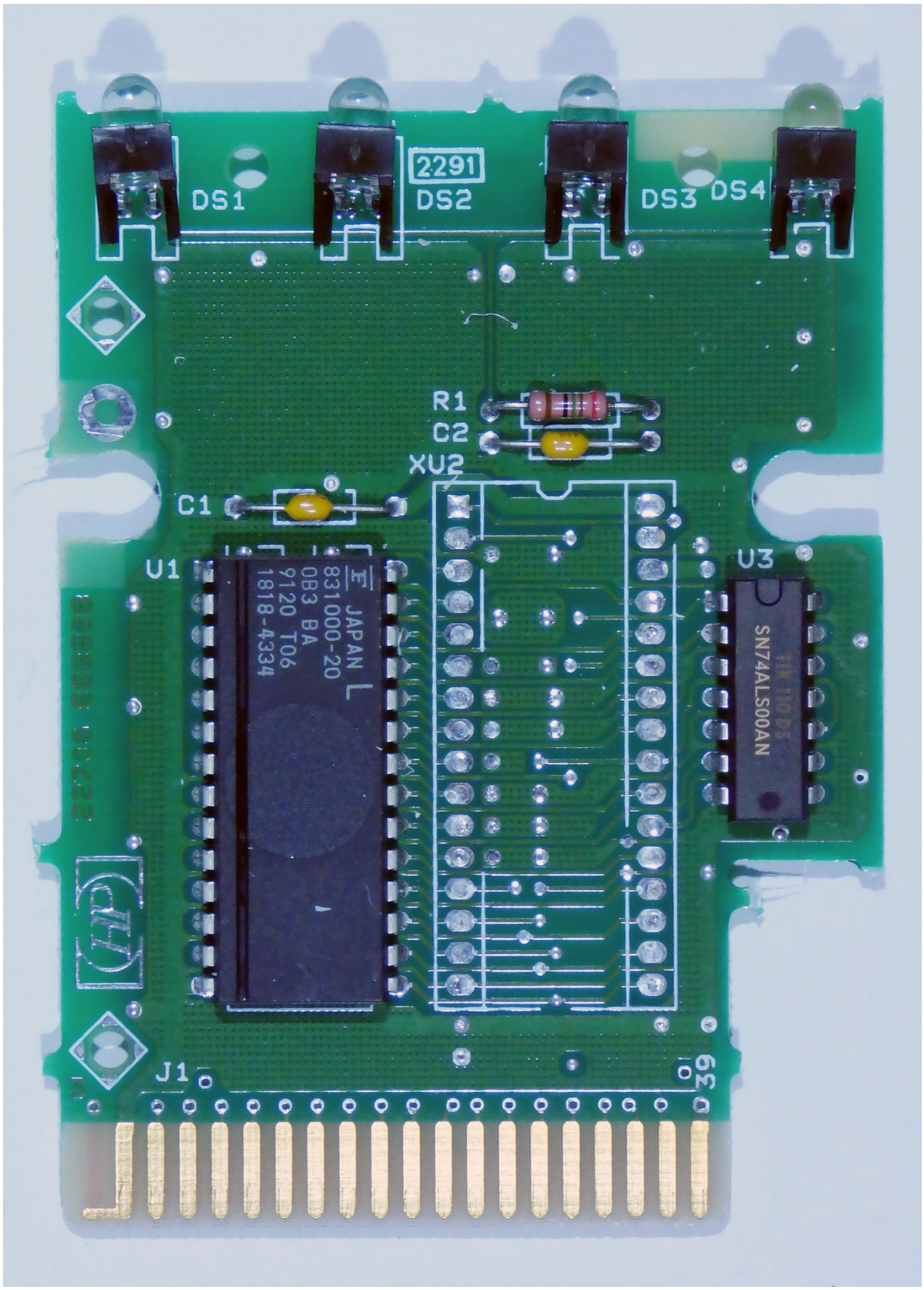

Figure 14: Top view of PCB.

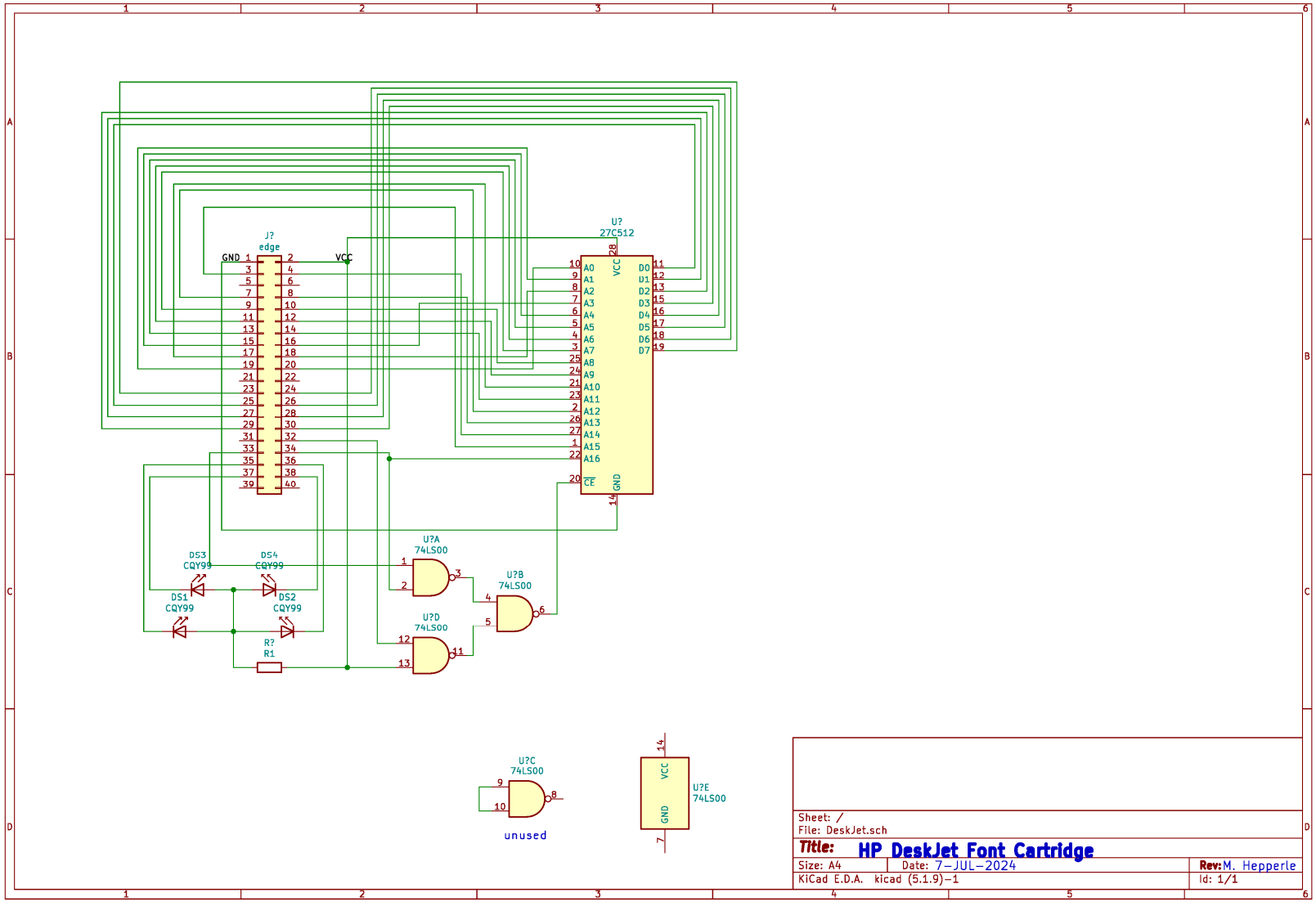

Figure 15: Redrawn schematics (may contain errors).

Individual Connections

Odd edge Fingers are 1...39 on top and even contacts 2...40 on bottom

The first finger (-2) on the bottom is not used. There is no corresponding finger on the top side.

Main connections

Edge top	**Function**	**ROM DIP-28**		**Edge bottom**	**Function**
39				**40**	
37	LED3	DS3	DS4	**38**	LED4
35	LED1	DS1	DS2	**36**	LED2
33	LS00-1A			**34**	LS00-1B
31				**32**	LS00-4A
29	D2	13	15	**30**	D3
27	D1	12	16	**28**	D4
25	D0	11	17	**26**	D5
23	D7	19	18	**24**	D6
21				**22**	
19	A1	9	10	**20**	A0
17	A10	21	8	**18**	A2
15	A4	6	7	**16**	A3
13	A5	5	23	**14**	A11
11	A6	4	24	**12**	A9
9	A7	3	25	**10**	A8
7	A12	2	26	**8**	A13
5				**6**	
3	A15	1	27	**4**	A14
1	GND	14	28	**2**	VCC

Chip Enable is controlled by U3 /74ALS00N)

The four LEDs are connected via R1 to VCC and sink to ground through the contacts 35-38:

```
DS1: 35 --|<]--+---[ R1 ]-VCC
DS2: 36 --|<]--+
DS3: 37 --|<]--+
DS4: 38 --|<]--+
```

DeskJet Cartridge						
27C1000	MB831000				MB831000	27C1000
VPP	n.c.				to VCC	*VCC*
OE/	n.c.					*PGM*
A15	A15	1		28	VCC	N.C.
A12	A12	2		27	A14	A14
A7	A7	3		26	A13	A13
A6	A6	4		25	A8	A8
A5	A5	5		24	A9	A9
A4	A4	6		23	A11	A11
A3	A3	7		22	A16	A16
A2	A2	8		21	A10	A10
A1	A1	9		20	CE/	CE/
A0	A0	10		19	D8	D8
D1	D1	11		18	D7	D7
D2	D2	12		17	D6	D6
D3	D3	13		16	D5	D5
VSS	VSS	14		15	D4	D4
			128 kByte			

Figure 16: ROM MB831000 pinout in comparison to 27C1000 EPROM of equal capacity. Reading the ROM as a 27C1000 EPROM requires feeding the VCC pin from the DIP-32 pinout.

In this particular font cartridge (HP 22707L) one DIP-28 ROM Fujitsu MB831000-20 is installed. This ROM has a capacity of 128 kB and the pinout is very similar to a DIP-32 EPROM.

Therefore I read it as a 27C1000 after adding one additional connection to the EPROM reader socket. The pinout has to be aligned so that the footprint of the “virtual” DIP-32 part aligns with the bottom pins (pin 14 of DIP-28 equals pin 16 of the DIP-32 part). The additional connection is then feeding VCC from virtual pin 32 to pin 28 for reading the DIP-28 part as a DIP-32 EPROM. All other pins are JEDEC compatible and the EPROM specific programming or output enable pins are not needed.

```
-OFFSET- -------------- BYTES -------------- ---- ASCII -----
00000000 620020DF 02FFFF20 20202020 20202020 b. ....
00000010 20203238 30383232 3730374C 20202020   280822707L
00000020 20202020 20202A00 40005600 1C011C02       *.@.V.....
00000030 1E040000 00000000 00000000 0101FFFF ................
00000040 AA001E05 1E062008 00000000 00000000 ......  .........
00000050 00000200 FFFF5110 00000000 B004B004 ......Q.........
00000060 00000000 5802C800 002C0100 00000000 ....X....,......
00000070 00000001 00019600 8A021C00 8C010000 ................
00000080 4C657474 65722047 6F746869 63202020 Letter Gothic
00000090 00002020 20313220 20203132 20202032 ..   12   12   2
000000A0 34202020 31320000 FFFF5110 00000000 4   12....Q.....
000000B0 B004B004 64000000 5802C800 002C0100 ....d...X....,..
000000C0 00000000 00000001 00019600 8A021C00 ................
000000D0 8C010000 4C657474 65722047 6F746869 ....Letter Gothi
000000E0 63202020 00002020 20313220 20203132 c   ..   12   12
000000F0 20202032 34202020 31320000 FFFF434F    24   12....CO
00000100 50595249 47485420 4845574C 4554542D PYRIGHT HEWLETT-
00000110 5041434B 41524420 31393837 00451B45 PACKARD 1987.E.E
00000120 4F43431D 57572531 1D050D57 43434343 OCC.WW%1...WCCCC
00000130 43434343 43432F3B 33133343 45434343 CCCCCC/;3.3CECCC
00000140 43434343 43434343 43434343 43514343 CCCCCCCCCCCCCQCC
00000150 43434343 43434355 57552305 1D334531 CCCCCCCUWU#..3E1
00000160 45314543 45435445 45313131 43433131 E1ECECTEE111CC11
00000170 41333131 31413153 63530D37 0B0B0B07 A3111A1ScS.7....
00000180 092D6211 45432D45 4351574B 4B43493D .-b.EC-ECQWKKCI=
00000190 31434345 4B3D4357 1341574F 054F4F23 1CCEK=CW.AWO.OO#
000001A0 23212721 39150D0D 0D07092F 31313333 #!'!9....../1133
000001B0 3333312D 313B3B3B 3D292525 450D3D35 331-1;;;=)%%E.=5
000001C0 351D1D0D 25256343 0D0D6363 63636363 5...%%cC..cccccc
000001D0 63353D63 633D3B33 3B353333 35636363 c5=cc=;3;5335ccc
000001E0 3B3D3B3D 6315633B 333D3533 3B3D3533 ;=;=c.c;3=53;=53
000001F0 35316363 31315543 31433131 43434343 51cc11UC1C11CCCC
00000200 21413135 212F2F5F 61251D09 57412B19 !A15!//_a%..WA+.
00000210 4347412B 092F2F2B 0D571DFF 20092009 CGA+.//+.W.. . .
00000220 8409C909 5A0A010B AA0B4E0C 7A0C140D ....Z.....N.z...
00000230 A80D050E 550E870E 950EA90E 340FC50F ....U.......4...
00000240 3610BD10 5711EF11 7A120F13 A5134214 6...W...z.....B.
00000250 E4142115 7515EF15 14169216 0717B217 ..!.u...........
```

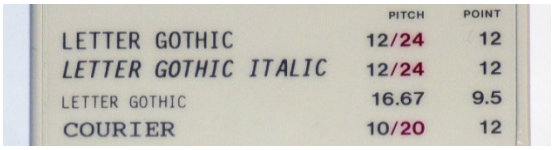

Figure 17: Start of the ROM content with Letter Gothic 12 pt bitmaps.

```
-OFFSET- -------------- BYTES -------------- ---- ASCII -----
00010000 62002069 02FFFF20 20202020 20202020 b. i...
00010010 20203238 30383232 3730374C 20202020   280822707L
00010020 20202020 20202A00 40005600 1C011C02       *.@.V.....
00010030 1E040000 00000000 00000000 0300FFFF ................
00010040 AA001E05 1E062008 00000000 00000000 ...... .........
00010050 00000400 FFFF5110 00000000 8306B603 ......Q.........
00010060 00000000 5802C800 00D80000 00000000 ....X...........
00010070 01000001 00019600 F401C000 CC000000 ................
00010080 4C657474 65722047 6F746869 63202020 Letter Gothic
00010090 B65E3136 2E363720 20392E35 20202020 .^16.67  9.5
000100A0 20202020 20200000 FFFF5110 00000000       ....Q.....
000100B0 E803B004 00000000 2C01C800 00680100 ........,....h..
000100C0 00000000 00000001 00019600 58020007 ............X...
000100D0 600C0000 436F7572 69657220 20202020 `...Courier
000100E0 20202020 FD872020 20313020 20203132     ..   10   12
000100F0 20202032 30202020 31320000 FFFF434F    20   12....CO
00010100 50595249 47485420 4845574C 4554542D PYRIGHT HEWLETT-
00010110 5041434B 41524420 31393837 002F0F31 PACKARD 1987./.1
00010120 3D332F0F 3F3F191F 0F030739 2F2F2F2F =3/.??.....9////
00010130 2F2F2F2F 2F2F1F27 190F192F 2F2F2F2F //////.'.../////
00010140 2F2F2F2F 2F2F2F2F 2F2F2F2F 2F392F2F ////////////9//
00010150 2F2F2F2F 2F2F2F3F 393F0903 0F213121 ///////?9?...!1!
00010160 3121312D 312F3931 31212121 2F2F2121 1!1-1/911!!!//!!
00010170 2D212121 212D2141 4D410729 09090705 -!!!!-!AMA.)....
00010180 071F030D 2F2F2331 2F353B35 2F2F2F27 ....//#1/5;5///'
00010190 23312F2D 3A2F2F3F 112D3D39 03393917 #1/-://?.-=9.99.
000101A0 171B1B1B 230F0909 09050721 1F1F292D ....#......!..)-
000101B0 2B292B1F 2321272F 3D231D1D 2D112F2F +)+.#!'/=#..-.//
000101C0 2F13130D 1D1D4B31 0D0D4B4B 4B4B4B4B /.....K1..KKKKKK
000101D0 4B272B4B 4B2B2B27 2B272727 274B4B4B K'+KK++'+''''KKK
000101E0 2B2B2B2B 4B0B4B2B 272B2727 2B2B2727 ++++K.K+'+''++''
000101F0 27254B4B 2521392F 212F2121 2F2F2F2F '%KK%!9/!/!!////
00010200 192B2321 1723234F 551F1707 3B2B1911 .+#!.##OU...;+..
00010210 2F2F2F19 07232319 0D3D19FF 20092009 ///..##..=.. . .
00010220 6F098E09 EC09710A D40A480B 640BC90B o.....q...H.d...
00010230 300C620C 950CAF0C B60CC30C 1C0D870D 0.b.............
00010240 E60D430E A40EFC0E 580FBF0F 0B108E10 ..C.....X.......
00010250 F5102011 58118E11 A511DB11 3812A412 .. .X.......8...
```

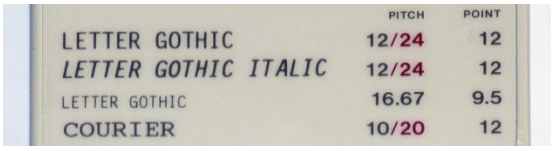

Figure 18: The second half of the ROM with Letter Gothic 9.5 and Courier 12 bitmaps.

Literature

[1] "DeskJet", HP Journal, October 1988.

[2] "DeskJet 500C", HP Journal, August 1992.

[3] "DeskJet – Owner's Manual", 02276-90018, May 1988.

[4] "2276 DeskJet – Service Manual", 02276-90021, May 1988.

[5] "DeskJet 500 – Owner's Manual", C2106-90015, October 1991.

[6] "DeskJet Family – Service Manual", C2106-90021, August 1990.

[7] "DeskJet PLUS –User's Manual", French, German, Italian, Spanish, 02277-90005, December 1988.

[8] Cummings, Steve, "DeskJet Unlimited", Peachpit Press, 2nd Edition, 1991.

[9] "DeskJet Developers Manual" – not available in 2024.