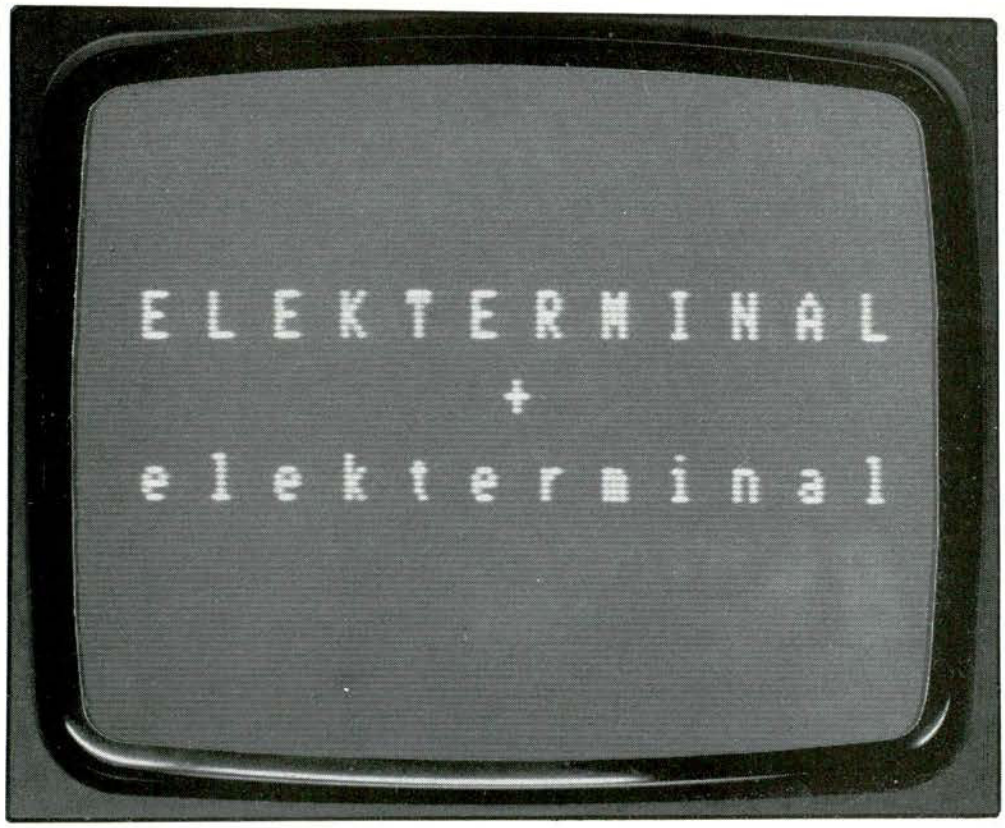

D. Paulsen

Page extension for the Elekterminal
Elekterminal width extender
High-speed readout for the Elekterminal
These are some of the extensions that were added to the Elekterminal since its introduction (1978). Now the ELEKTERMINAL becomes an elekterminal. Continuing with the series of extensions, this article presents lower-case, special characters and as a matter of interest, the umlauts for German and other languages (ä, ö, ü).

lower-case and special characters on the Elekterminal

The Elekterminal was originally developed as a refinement for the '78 BASIC computer. This SC/MP BASIC system has a Tiny BASIC interpreter which can only handle upper-case and is relatively slow. Recent computer systems, such as the Junior System with BASIC Version 3.3 make greater demands of a terminal.

Change of IC

The character set of the Elekterminal is located in ROM IC11 = RO-3-2513 CGR-001. A total of 64 ASCII characters can be displayed in a 5 x 7 matrix with this character generator. So far these 64 characters have only been upper-case, with a few ASCII special characters.
Conversion to upper-case and lower-case is mainly achieved by replacing IC11 by a type 2716 EPROM. This IC must be programmed according to the hex dump in table 3 in order to contain the codes for displaying a total of 96 ASCII characters.

+ 1 bit

In order to display 64 ASCII characters the screen memory merely requires a width of 6 bits ($2^6 = 64$). For 96 characters, however, an additional bit is needed. Since this bit must also be stored, another 1024 x 1-bit memory IC must somehow be accommodated on the printed circuit board. Moreover, after readout from the RAM area, this seventh bit must be buffered. Since IC9 only has space for 6 bits, a TTL IC is required in order to solve the problem.
Thus three new ICs are needed to display 96 characters: a 2716 instead of the old IC11, an additional RAM IC of type 2102A4 and a flip-flop from a 74LS74.

Lack of space?

Where can the three ICs be accommodated? For the 2102 the answer is simple: this IC is simply soldered onto IC4 in piggy-back fashion, except for pins 11 and 12. Before soldering, these two pins are spread and later wired to the other ICs.
The best solution for the 2716 and the 7474 is to place them on a small perforated board. This additional board is soldered to the main board instead of the former IC11, using stiff wire.
Pin 12 of the additional RAM IC is connected to pin 2 of the 7474; pin 11 is connected to point B5 on the board (see circuit diagram in figure 1).

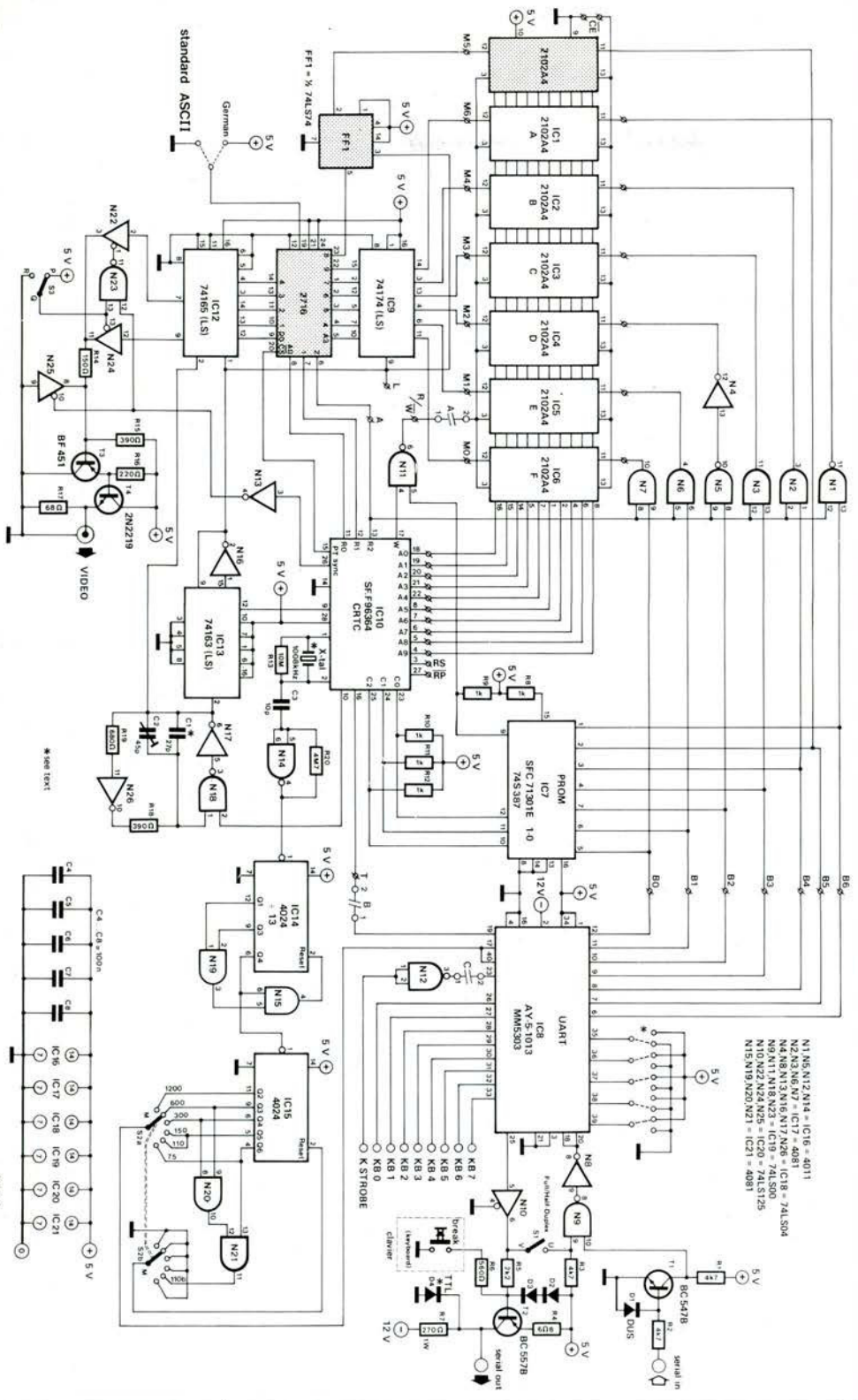

Figure 1. The extended Elekterminal. We have added RAM IC 2102, the flip-flop (1/2 7474) and a type 2716 EPROM. This replaces IC11.

Software

The EPROM contains two complete character sets: one is the German-English set and the other is the standard ASCII character set.
This is necessary because if the German set is used it means that some special ASCII characters must be omitted. Some computers need these special characters. For this reason, pin 19 of the EPROM can be used to switch to the international character set.
Table 1 shows the relationship between the ASCII code, internal Elekterminal code, absolute EPROM address and the corresponding characters.
Table 2 shows the locations for the German characters, just in case you need them.

Keyboard

There are no problems in connecting a standard ASCII keyboard or an ASCII keyboard with German characters to the extended Elekterminal.
The situation is somewhat different, however, when using the Elektor ASCII

2

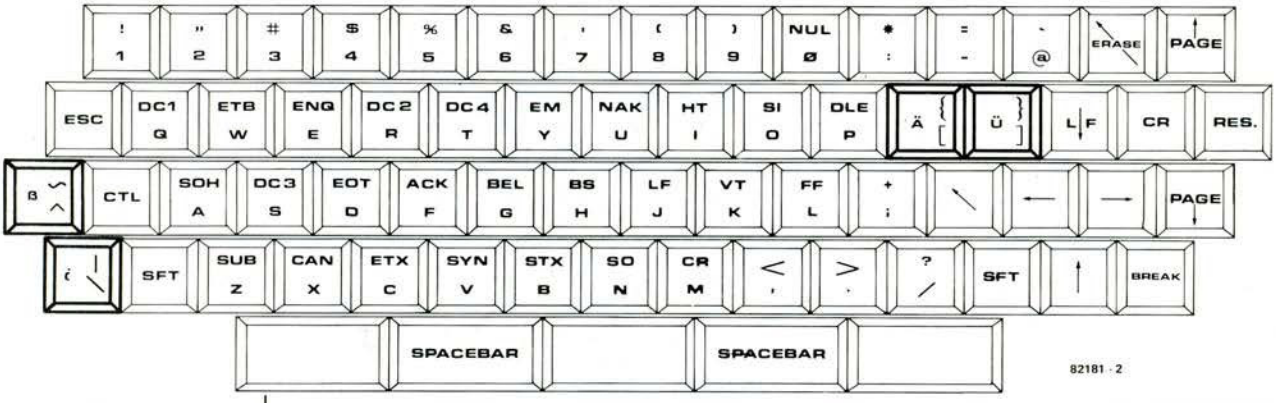

Figure 2. The ASCII keyboard of the Elekterminal. Two keys must be added here.

3

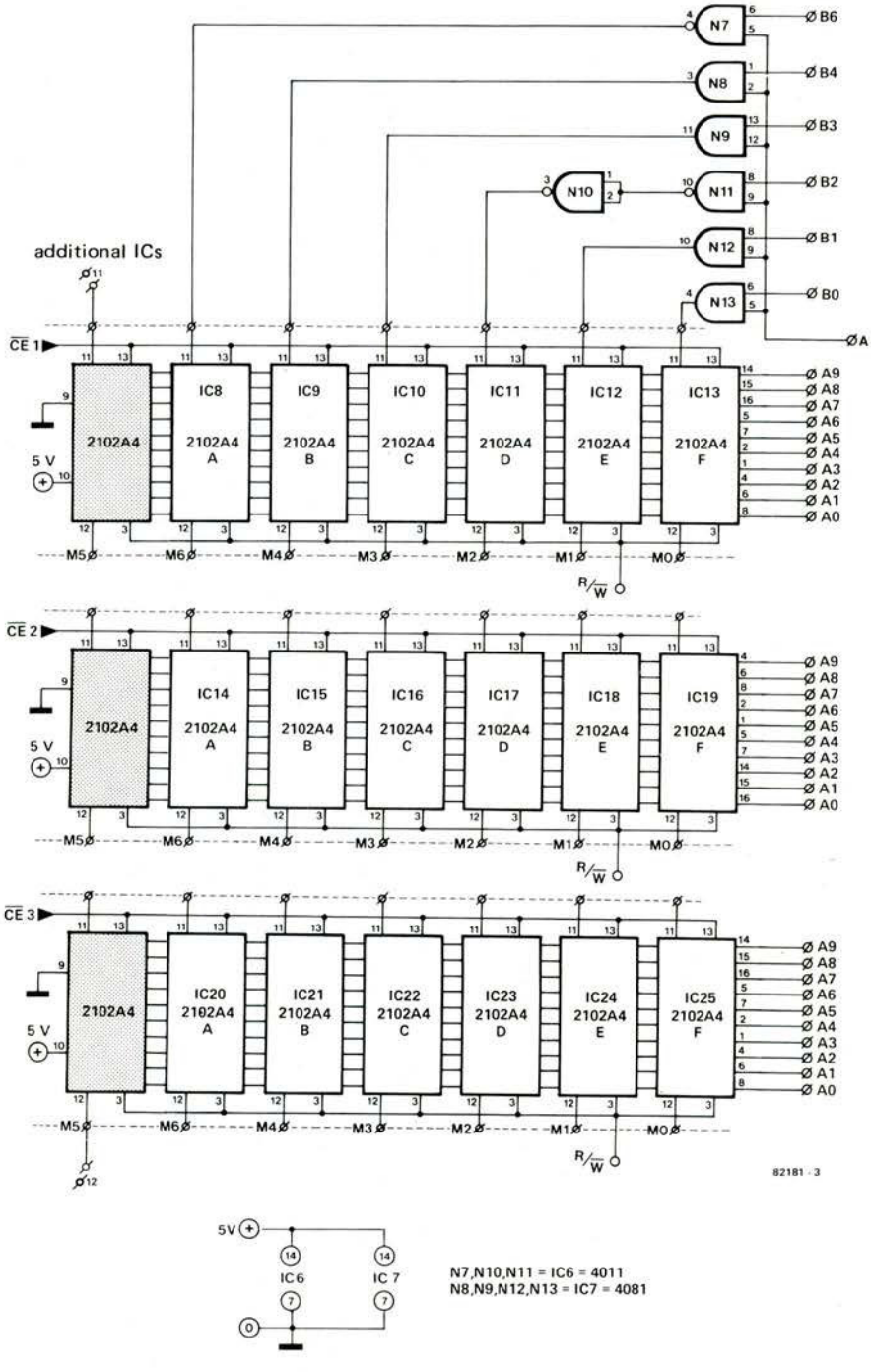

Figure 3. The circuit of the page extension with RAMs for the seventh bit.

Table 1

ASCII-Code	Internal Code	EPROM address	ASCII character
00 – 0F	40 – 4F	200 – 27F	ASCII 01 = Blank, rest free
10 – 1F	50 – 5F	280 – 2FF	free
20 – 2F	60 – 6F	300 – 37F	! to /
30 – 3F	70 – 7F	380 – 3FF	0 to ?
40 – 4F	00 – 0F	000 – 07F	@ to 0
50 – 5F	10 – 1F	080 – 0FF	P to –
60 – 6F	20 – 2F	100 – 17F	`to 0
70 – 7F	30 – 3F	180 – 1FF	p to DEL

Table 1. This table shows the relationship between ASCII codes, internal ASCII code (bit 6 inverted), the absolute EPROM address and the character displayed.

keyboard intended for the Elekterminal. Two keys are missing from this keyboard, which are needed to supply the ASCII codes for all characters. The two keys can be added to the circuit board for the keyboard as shown in figure 2. The Öö/| key is connected to pins 21 and 32 of the keyboard encoder IC and the ß/~ key is connected to pins 22 and 32.
The letters Ä and Ü can now be selected with the keys for braces and square brackets.
To be able to switch conveniently between the German and internal character sets, the lead from pin 19 of the 2716 on the video interface PCB can be connected to an additional changeover switch or pushbutton with changeover contact on the keyboard.

Table 2

ASCII Code	ASCII character	German version
7B	{	ä
5B	[	Ä
7C	|	ö
5C	\	Ö
7D	}	ü
5D	]	Ü
7E	~	ß
5E	^	^

Table 2. By switching between the international and German ASCII character set, either special characters or the German characters are selected for some ASCII codes.

7 bits for several pages

With the Elekterminal with the 4-page screen memory ('Page extension for the Elekterminal') memory space must also be provided for the seventh bit in the additional 3-page screen memory. In this case three more type 2102A4 ICs are needed.
As was the case on the video interface PCB, these ICs must be soldered onto ICs 8, 14 and 20 on the page extension in piggy-back fashion, except for pins 11 and 12.
The three pin 11s are interconnected with insulated hookup wire and this lead is then connected to pin 11 of the additional 2102 on the video interface PCB.
The same applies to the pin 12s: the three pin 12s are interconnected and then connected to pin 12 of the additional memory on the video interface PCB.
This terminates all modifications, extensions and improvements to the Elekterminal. ◀

Literature:

Elektor 11/78
Elekterminal:
ASCII keyboard
Elektor 12/78
Elekterminal:
video interface
Elektor 7/79
Shift-lock for the
ASCII keyboard
Elektor 9/79
Upper-case only with
the ASCII keyboard
Elektor 9/79
Page extension for the
Elekterminal
Elektor 3/80
Increased screen width
with the Elekterminal
Elektor 7/80
'High-speed' readout
for the Elekterminal

Table 3

```
      0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
D000  00 0E 11 17 15 17 10 0F 00 04 0A 11 11 1F 11 11
D010  00 1E 11 11 1E 11 11 1E 00 0E 11 10 10 10 11 0E
D020  00 1E 11 11 11 11 11 1E 00 1F 10 10 1E 10 10 1F
D030  00 1F 10 10 1E 10 10 10 00 0E 11 10 10 13 11 0F
D040  00 11 11 11 1F 11 11 11 00 0E 04 04 04 04 04 0E
D050  00 01 01 01 01 01 11 0E 00 11 12 14 18 14 12 11
D060  00 10 10 10 10 10 10 1F 00 11 1B 15 15 15 11 11
D070  00 11 11 19 15 13 11 11 00 0E 11 11 11 11 11 0E
D080  00 1E 11 11 1E 10 10 10 00 0E 11 11 11 15 12 0D
D090  00 1E 11 11 1E 14 12 11 00 0E 11 10 0E 01 11 0E
D0A0  00 1F 15 04 04 04 04 04 00 11 11 11 11 11 11 0E
D0B0  00 11 11 11 0A 0A 04 04 00 11 11 15 15 15 0A
D0C0  00 11 11 0A 04 0A 11 11 00 11 11 0A 04 04 04 04
D0D0  00 1F 01 02 04 08 10 1F 00 1F 18 18 18 18 18 1F
D0E0  00 00 10 08 04 02 01 00 00 1F 03 03 03 03 03 1F
D0F0  00 04 0E 15 04 04 04 04 00 00 00 00 00 00 00 1F
D100  00 08 04 02 00 00 00 00 00 00 00 0E 01 0F 11 0F
D110  00 10 10 1E 11 11 11 1E 00 00 00 0F 10 10 10 0F
D120  00 01 01 0F 11 11 11 0F 00 00 00 0E 11 1F 10 0E
D130  00 02 04 04 0E 04 04 04 00 00 0F 11 11 0F 01 06
D140  00 10 10 1E 11 11 11 11 00 04 00 0C 04 04 04 0E
D150  00 04 00 04 04 04 14 08 00 08 08 09 0A 0C 0A 09
D160  00 0C 04 04 04 04 04 0E 00 00 00 1A 15 15 15 15
D170  00 00 00 1E 11 11 11 11 00 00 00 0E 11 11 11 0E
D180  00 00 1E 11 11 1E 10 10 00 00 0F 11 11 0F 01 01
D190  00 00 00 0B 0C 08 08 08 00 00 00 0F 10 0E 01 1E
D1A0  00 00 04 0E 04 04 04 02 00 00 00 11 11 11 11 0F
D1B0  00 00 00 11 11 0A 0A 04 00 00 00 11 11 11 15 0A
D1C0  00 00 00 11 0A 04 0A 11 00 00 11 11 11 0F 01 06
D1D0  00 00 00 1F 02 04 08 1F 00 06 08 08 10 08 08 06
D1E0  00 16 19 11 1E 11 1E 10 00 0C 02 02 01 02 02 0C
D1F0  00 01 0E 10 00 00 00 00 00 00 00 00 00 00 00 00
D200  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D210  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D220  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D230  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D240  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D250  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D260  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D270  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D280  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D290  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D2A0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D2B0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D2C0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D2D0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D2E0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D2F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D300  00 00 00 00 00 00 00 00 00 04 04 04 04 04 00 04
D310  00 0A 0A 0A 00 00 00 00 00 0A 0A 1F 0A 1F 0A 0A
D320  00 04 0F 14 0E 05 1E 04 00 18 19 02 04 08 13 03
D330  00 08 14 14 08 15 12 0D 00 04 04 04 00 00 00 00
D340  00 04 08 10 10 10 08 04 00 04 02 01 01 01 02 04
D350  00 04 15 0E 04 0E 15 04 00 00 04 04 1F 04 04 00
D360  00 00 00 00 00 04 04 08 00 00 00 00 1F 00 00 00
D370  00 00 00 00 00 00 00 04 00 00 01 02 04 08 10 00
D380  00 0E 11 13 15 19 11 0E 00 04 0C 04 04 04 04 0E
D390  00 0E 11 01 0E 10 10 1F 00 1F 01 02 06 01 11 0E
D3A0  00 02 06 0A 12 1F 02 02 00 1F 10 1E 01 01 11 0E
D3B0  00 07 08 10 1E 11 11 0E 00 1F 01 01 02 04 08 10
D3C0  00 0E 11 11 0E 11 11 0E 00 0E 11 11 0F 01 02 1C
D3D0  00 00 00 04 00 04 00 00 00 00 00 04 00 04 04 08
D3E0  00 02 04 08 10 08 04 02 00 00 00 1F 00 1F 00 00
D3F0  00 08 04 02 01 02 04 08 00 0E 11 01 06 04 00 04
D400  00 0E 11 17 15 17 10 0F 00 04 0A 11 11 1F 11 11
D410  00 1E 11 11 1E 11 11 1E 00 0E 11 10 10 10 11 0E
D420  00 1E 11 11 11 11 11 1E 00 1F 10 10 1E 10 10 1F
D430  00 1F 10 10 1E 10 10 10 00 0E 11 10 10 13 11 0F
D440  00 11 11 11 1F 11 11 11 00 0E 04 04 04 04 04 0E
D450  00 01 01 01 01 01 11 0E 00 11 12 14 18 14 12 11
D460  00 10 10 10 10 10 10 1F 00 11 1B 15 15 15 11 11
D470  00 11 11 19 15 13 11 11 00 0E 11 11 11 11 11 0E
D480  00 1E 11 11 1E 10 10 10 00 0E 11 11 11 15 12 0D
D490  00 1E 11 11 1E 14 12 11 00 0E 11 10 0E 01 11 0E
D4A0  00 1F 15 04 04 04 04 04 00 11 11 11 11 11 11 0E
D4B0  00 11 11 11 0A 0A 04 04 00 11 11 11 15 15 15 0A
D4C0  00 11 11 0A 04 0A 11 11 00 11 11 0A 04 04 04 04
D4D0  00 1F 01 02 04 08 10 1F 00 0A 00 0E 11 11 1F 11
D4E0  00 0A 00 0E 11 11 11 0E 00 0A 00 11 11 11 11 0E
D4F0  00 04 0E 15 04 04 04 04 00 00 00 00 00 00 00 1F
D500  00 08 04 02 00 00 00 00 00 00 00 0E 01 0F 11 0F
D510  00 10 10 1E 11 11 11 1E 00 00 00 0F 10 10 10 0F
D520  00 01 01 0F 11 11 11 0F 00 00 00 0E 11 1F 10 0E
D530  00 02 04 04 0E 04 04 04 00 00 0F 11 11 0F 01 06
D540  00 10 10 1E 11 11 11 11 00 04 00 0C 04 04 04 0E
D550  00 04 00 04 04 04 14 08 00 08 08 09 0A 0C 0A 09
D560  00 0C 04 04 04 04 04 0E 00 00 00 1A 15 15 15 15
D570  00 00 00 1E 11 11 11 11 00 00 00 0E 11 11 11 0E
D580  00 00 1E 11 11 1E 10 10 00 00 0F 11 11 0F 01 01
D590  00 00 00 0B 0C 08 08 08 00 00 00 0F 10 0E 01 1E
D5A0  00 00 04 0E 04 04 04 02 00 00 00 11 11 11 11 0F
D5B0  00 00 00 11 11 0A 0A 04 00 00 00 11 11 11 15 0A
D5C0  00 00 00 11 0A 04 0A 11 00 00 11 11 11 0F 01 06
D5D0  00 00 00 1F 02 04 08 1F 00 0A 00 0E 01 0F 11 0F
D5E0  00 00 0A 00 0E 11 11 0E 00 00 0A 00 11 11 11 0E
D5F0  00 0E 11 16 11 11 16 10 00 00 00 00 00 00 00 00
D600  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D610  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D620  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D630  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D640  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D650  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D660  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D670  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D680  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D690  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D6A0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D6B0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D6C0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D6D0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D6E0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D6F0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
D700  00 00 00 00 00 00 00 00 00 04 04 04 04 04 00 04
D710  00 0A 0A 0A 00 00 00 00 00 0A 0A 1F 0A 1F 0A 0A
D720  00 04 0F 14 0E 05 1E 04 00 18 19 02 04 08 13 03
D730  00 08 14 14 08 15 12 0D 00 04 04 04 00 00 00 00
D740  00 04 08 10 10 10 08 04 00 04 02 01 01 01 02 04
D750  00 04 15 0E 04 0E 15 04 00 00 04 04 1F 04 04 00
D760  00 00 00 00 00 04 04 08 00 00 00 00 1F 00 00 00
D770  00 00 00 00 00 00 00 04 00 00 01 02 04 08 10 00
D780  00 0E 11 13 15 19 11 0E 00 04 0C 04 04 04 04 0E
D790  00 0E 11 01 0E 10 10 1F 00 1F 01 02 06 01 11 0E
D7A0  00 02 06 0A 12 1F 02 02 00 1F 10 1E 01 01 11 0E
D7B0  00 07 08 10 1E 11 11 0E 00 1F 01 01 02 04 08 10
D7C0  00 0E 11 11 0E 11 11 0E 00 0E 11 11 0F 01 02 1C
D7D0  00 00 00 04 00 04 00 00 00 00 00 04 00 04 04 08
D7E0  00 02 04 08 10 08 04 02 00 00 00 1F 00 1F 00 00
D7F0  00 08 04 02 01 02 04 08 00 0E 11 01 06 04 00 04
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