

Update: METAFONT mode_def Settings for Various T_EX Output Devices

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An earlier article by this title appeared in TUGboat Vol. 8, No. 1, page 33. Almost immediately, corrections and new information started arriving. The present iteration attempts to correct the errors of the previous article and present additional information now available. If interest warrants, this may become an "annual" column.

As Neenie Billawala has explained (TUGboat Vol. 8, No. 1, pages 29–32), the marking characteristics of different print engines must be taken into account in order to assure legible, attractive output. For the Computer Modern family, this is done by tuning several parameters built into the METAFONT design. The settings for all printers used at Stanford appear in the file WAITS.MF. Other settings are frequently requested and (less frequently) communicated in T_EXhax or Laser-Lovers.

Here is a typical `mode_def` setting, adapted from PLAIN.MF (*The METAFONTbook*, page 270) for 200 dpi devices (such as the Xerox XGP, the original T_EX output device); it has been augmented by the parameter *aspect_ratio* (required for non-square rasters; the default value is given).

```
mode_def lowres =
proofing:=0;          % not making proofs
fontmaking:=1;       % we are making a font
tracingtitles:=0;    % don't show titles
pixels_per_inch:=200;
blacker=.65;         % make pens a bit blacker
fillin=.2;           % adjust for diagonal fillin
o_correction=.4;     % less overshoot
aspect_ratio:=1/1;   % vertical/horizontal
enddef;
```

For all font "production", typical settings are *proofing* = 0 and *fontmaking* = 1. *tracingtitles* is usually set to 0 for low-resolution fonts (400 dpi or less) and to 1 for higher-resolution fonts, to reassure one that the computer is still in operation and to indicate how far it has progressed during a long job. The standard proof settings can be found in PLAIN.MF as already noted.

For more guidance, see *Adapting to local conditions*, *The METAFONTbook*, page 278.

Stan Osborne has observed in T_EXhax that "Anyone interested in understanding these parameters should read *The METAFONTbook* and experiment by setting sentences and paragraphs with many sizes of their new fonts. The look, blackness, readability, feel, taste, etc., of the variations of new fonts should be compared with the samples found in the cmr book." This excellent advice should not be ignored.

The table on the next page contains a summary of the relevant settings gleaned from available sources. Most of the print engines cited in the table are listed below, along with an indication of whether they are write-black (wb) or write-white (ww), if known, and the names of some of the output devices into which they have been built.

Canon CX (wb)	Apple LaserWriter, Cordata, HP LaserJet, Imagen 8/300, QMS and Talaris 8 ppm printers
Canon LBP-10	Imagen 10/240
Canon (wb)	Imagen 3320, Imagen 7320
Ricoh 4080 (ww)	DEC LN03; TI OmniLaser 2115
Ricoh LP4120 (ww)	HP 2688A, Imagen 12/300
Ricoh 4150 (ww)	Talaris 1500
Xerox XP-12 (ww)	DEC LN01, QMS 1200, Talaris 1200, Xerox 2700
Xerox XP-24 (ww)	Imagen 24/300, QMS 2400, Talaris 2400, Xerox 3700

As always, additions and corrections to this list are solicited.

A late note from John Lavagnino of Brandeis University warns against assuming that "improved" models of printers, or even printers from different manufacturers based on the same print engine, will produce equivalent output:

We have discovered that the LN03 and the LN03-Plus don't print the same way: a font that looks fine on the LN03 will look lighter on the LN03-Plus. In fact it isn't necessary to download fonts to observe this: even the internal fonts look different.

We've been badgering DEC about this for some time, and they have finally agreed that this is the case. The current story is that they "made the pixels smaller" on the LN03-Plus, "to make it look more like a typewriter."

Be aware, then, that a good `mode_def` for one will only be a poor approximation for the other.

Consider yourselves warned.

Typical `mode_def` parameter settings for CM fonts

Source of information		<i>pixels_per_inch</i>	<i>blacker</i>	<i>fillin</i>	<i>o_correction</i>	<i>aspect_ratio</i>
PLAIN.MF						
proof		2601.72	0	0	1	
lowres		200	.65	.2	.4	
WAITS.MF						
dover	(Xerox Dover)	384	1.2	0	.6	
imagen	(Canon CX)	300	0	.2	.6	
qms	(Xerox XP-12E)	300	.75*	0*	.5*	
aps	(APS-Micro5)	722.909	.2	.2	1	
crs	(Alphatype CRS)	4000+4000/3	.4	0	1	
boise	(HP 2680A)	180	.55	.1	.3	
DD	(DataDisc terminal)	70	0	0	.2	
canon	(Canon LBP-10)	240	.2	.2	.4	
newDD	(DataDisc terminal)	70	0	0	.2	4/3
cg	(Compugraphic 8600)	1301.5	.2	.2	1	1569/1301.5
epson		240	0	0	.2	9/10
Charles Karney, T _E Xhax 86#4, Oct 86 [Note 1]						
qms	(Xerox XP-12E)	300	.8	.2	.4	
John Gourlay, May 87 [Note 2; page 128]						
xerxxxvii	(Xerox XP-12)	300	.6	-.3	.6	
Charles LaBrec, T _E Xhax 86#6, Oct 86 [Note 3]						
decln	(Ricoh 4080)	300	.9	-.2	.5	
Stan Osborne, Apr 87 [Note 4]						
decln	(Ricoh 4080)	300	.2	-.4	.5	
Janene Winter, May 87 [Note 5; page 178]						
ibm	(IBM 3820) (ww)	240	.65	-.2	.45	
ibm-a	(IBM 3812) (ww)	240	.4	-.2	.4	
ibm-b	(IBM 3800) (ww)	240	.2	-.1	.6	
ibm-c	(IBM 4250) (ww)	600	.05	0	.6	
sherpa	(IBM 6670) (wb)	240	1	1	.6	
Matthias Feyerabend, GSI, Darmstadt, May 87 [Note 6]						
ibmlaser	(IBM 3820)	240	.3	-1	.4	
bensmall	(Benson 9211)	200	-.5	0	.4	
bensmall	[alternate settings for problem fonts]	200	0	0	.4	
benbig	(Benson 9436)	254	-.8	0	.4	
benbig	[alternate settings for problem fonts]	254	-.1	0	.4	

* A note in WAITS.MF states that these settings are conjectural.

Notes:

1. Charles Karney states, "...I haven't fully explored the parameter space. If anyone knows of a better (or 'authorized') solution, I'd appreciate hearing about it."

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2. John Gourlay has diagnosed an unexpected modification to the pen path as *blacker* increases, causing the diameter of such letters as "o" to decrease; the details are discussed in his article on page 128. The parameter values given here are a compromise, allowing most characters to keep their original sizes, although the value of *blacker* "is not quite enough to compensate for the thinning inherent in the printer." There is still "an inconsistency in the weights of characters. Nevertheless, [Gourlay] feel[s] that this set of parameters is considerably better than the ones that result from the 'conjectural' parameters, and also better than the 'am' fonts they replace."

Gourlay.Ohio-State@csnet-relay

3. Charles LaBrec's comments: "I have twiddled the parameters a bit, and this seems to produce good 12 point cm fonts. I am a bit unsure because changing *blacker*, *fillin*, or *o_correction* seem to make no difference for quite a large range of values. I can't remember exactly, but you will get the same results as [these] for $.4 < \textit{blacker} < .9$, $-.8 < \textit{fillin} < -.1$, and $0 < \textit{o_correction} < .7$. But this probably makes a good starting point."

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[Editor's note: The value given in TUGboat 8#1 for decln *fillin* should have been $-.2$, not $+.2$.]

4. Stan Osborne: "The decln mode [Mr. LaBrec] suggested did not *fillin* correctly and was too black for the smaller point sizes. His choice of settings produces small sized fonts that are much blacker than the small cmr's found in the cmr book (Vol E). ... I found the [above] values of *blacker* and *fillin* to produce readable small fonts for an LN03... These values were not carefully tested for larger point sizes. (I stopped experimenting when I got something I liked and I had verified that larger sizes were also usable.) [...!ucbvax!dual!dbi!stan]
5. Janene Winter has found these settings "to be optimal for the IBM printers". This information was transmitted by Dean Guenther along with his site report (page 178).
6. Matthias Feyerabend: "Fonts tested are CMR5, CMR10, CMR12 and CMSSI17 for a full range of settings for *blacker* and *fillin*."